

SEESL Safety training manual

Revision History

Revision No.	Date	Description	Approver Initials
0	June 2009	Original	TMA
1	September 2010	Incorporated updated OSHA regulations	TMA
2	Jaunary 2017	Updated header, table of contents and formatting	SAW
3	November 2018	Reformatted	NDH

Forward

Portions of Modules in this Training Manual were revised and updated, with this issue date, to incorporate updated and/or revised OSHA procedures and regulations as required. The source for these revisions was Mr. Richard Aitken, of Risk Consultants Inc., based on an audit and assessment of the UB-NEES Safety Plan, implemented by NEESInc.

This Safety Training Manual is developed for the training of:

- (i) Students and personnel of the Department of Civil, Structural and Environmental Engineering (CSEE).
- (ii) Personnel and visitors of the UB node of the Network for Earthquake Engineering Simulation (NEES).
- (iii) Personnel and visitors of the Structural Engineering and Earthquake Simulation Laboratory (SEESL).

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1 Introduction

1.1 University at Buffalo – Campus Commitment To Safety

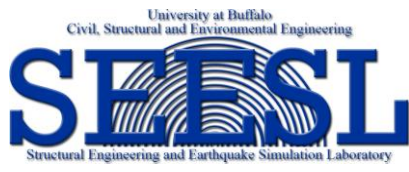
The University policy intimated by Provost’s Memo dated 04/03/2001, requires all university personnel including faculty, staff, students and visitors to follow safe working procedures. Excerpts from the provost memo are reproduced below:

“The University at Buffalo is committed to the safety, health and well-being of its students, faculty, staff and public. Faculty and staff have the responsibility to promote health and safety in their environment and operations. All members of the University community are expected to support this commitment.

The Department of Occupational and Environmental Safety (OES), in consultation with stakeholders, shall develop safety and environmental compliance standards, policies and procedures to guide the University community in meeting this commitment to safety.

Such standards, policies and procedures, once adopted, shall be binding upon all the members of the university community. Any individual who knowingly and willfully, or in a highly negligent manner, violates a safety or environmental law, regulation, or OES policy may be subject to University, civil or criminal action.”

The Safety Training Manual will be reviewed annually to ensure compliance with current regulatory guidelines. The appropriate signatures will appear on the Acknowledgement page and be dated to reflect a timely review.



1.2 Safety commitments and responsibilities defined

1.2.1 Administrators, managers and supervisors:

All management and supervisory staff are responsible for safety performance in their areas and for ensuring that departments and other units under their supervision have effective programs to meet their safety obligations. This includes reviewing matters such as space allocation and employee health and safety programs as they relate to research involving biohazards, chemical hazards, radiation safety and fire and life safety issues. This also includes providing appropriate safety equipment and personal protective equipment to employees and students to do the work safely. The Administrative Official may designate a departmental safety coordinator or departmental safety committee to carry out the departmental health and safety responsibilities, but still remains accountable for providing effective health and safety programs.

1.2.2 Occupational and environmental safety (OES) services

OES staff will function as consultants to unit heads, faculty/staff members and students in all areas of environmental compliance, safety and radiological health. OES will make routine, as well as special health and risk appraisals or investigations when necessary or requested, will assist departmental safety committees in the development of intra-departmental safety programs and participate in health and safety training and education projects.

OES will maintain reference materials from local, state, and federal agencies in regard to safety rules and regulations affecting campus operations and will assist in the technical interpretation of these rules and regulations. In addition, unless a policy or requirement of a local, state, or federal agency supercedes, campus operations will be conducted in accordance with the best available recognized standards such as those promulgated by the National Fire Protection Association (NFPA), the American National Standards Institute (ANSI), the National Institute for Occupational Safety and Health (NIOSH), etc.

OES will develop, for appropriate review and approval, environmental health and safety standards and policies, which shall be binding once adopted.

OES will assist in the identification and assessment of actual or potential health and safety hazards and will identify applicable regulations, standards or similar requirements. OES will inspect campus operations and facilities to identify problems, will provide code interpretations and consult with departments to assist in correcting problems. Inspections may be conducted routinely, or at the request of any member of the University community, or in response to accidents or other known problems.

OES has the responsibility and authority to intervene to control, reduce or eliminate any condition or activity which poses a direct or immediate safety threat to any individual or illegal discharge to the air, ground or water. The University Police may assist OES in meeting this responsibility. Long term resolution or correction of problems, should this occur, is the responsibility of the appropriate dean, director or departmental head. OES will maintain reference materials in support of health and safety training. OES will assist the University community in providing appropriate and necessary health and safety training to all staff and students. This assistance will include direct training, train the trainer support and assistance in developing customized or special training programs.

1.2.3 Principal investigators

Principal investigators have responsibility for the health and safety of the individuals they supervise, for safe management of the laboratories or facilities they operate and for the impacts of their activities on the environment, health and safety of the public.

Responsibilities include:

- i. Informing new employees about safety and health procedures, rules and regulations and their specific responsibilities.
- ii. Assuring that required equipment and personal protective devices are provided, maintained and used.
- iii. Taking prompt action when unsafe acts or conditions are reported or observed.
- iv. Insuring that individuals receive safety training as required by their responsibilities.
- v. Promptly investigating and reporting all on-the-job accidents, and/or work related health problems, and requesting medical treatment if required.
- vi. Coordinating or conducting internal inspections, reviews or audits to assure safe and healthful conditions and compliance with applicable safety and environmental regulations.
- vii. Providing or acquiring necessary resources for necessary health and safety equipment, materials and facilities.

1.2.4 All employees and students

All employees and students have the responsibility to comply with health and safety rules, regulations, policies and procedures.

Responsibilities include:

- i. Following safety, health, and environmental standards, rules, policies, regulations, procedures and orders.
- ii. Reporting hazardous conditions to their supervisor and/or OES.
- iii. Wearing prescribed protective equipment.
- iv. Reporting job-related injuries or illnesses to the supervisor and seeking prompt and appropriate medical treatment.
- v. Refraining from operating equipment or apparatus, or conducting any procedure, without proper training and authorization.

1.3 Willful noncompliance

Any individual, who knowingly and willfully, or in a highly negligent manner, violates a safety or environmental law, regulation, or OES policy may be subject to University, civil or criminal action. Such individuals may be denied legal representation pursuant to the Public Officer Law. The university will not accept ignorance of applicable laws, regulations or policies as an excuse.

1.4 Accident characteristics

An accident is an unintended, unplanned, single or multiple event sequence that is caused by unsafe acts, unsafe conditions or both, and may result in immediate and/or delayed undesirable effects.

The ultimate goal in accident prevention is “zero” disabling injuries and no lost work-time. However, there are many barriers to achieving this goal, the most important of which is the human attitude. Most people feel that “it won’t happen to me” or “it won’t happen here”.

A study of industrial accidents in US industry, by H.W. Heinrich, concluded that work related accidents are contributed to by the following factors.

Factors	Percent Contribution
Unsafe Conditions	10%
Unsafe Acts	88%
Acts of God	2%

As the above data indicates, unsafe acts which are performed by workers (in our situation, all the students and laboratory personnel) contribute to 88% of the work accidents. It is, therefore very important that all of those involved in the university activities; in the laboratories, in classrooms and/or in the hallways, perform safely at all times.

While the CSEE Department management is responsible for providing safety education and safe workplaces, the users are expected to follow the guidelines provided in this training manual.

All employees and students are responsible for working in a safe manner, adhering to applicable safety regulations, and University policies and procedures. Safety is everybody's responsibility.

Any unsafe conditions, at the workplace; and any unsafe acts and behaviors by co-workers should be reported immediately to:

Chair, CSEE Department

212 D Ketter Hall,

University at Buffalo,

Amherst, NY 14260

Tel. (716) 645-4364

1.5 Unsafe Conditions and Behaviors

Figure 1.1 shows a safety pyramid.

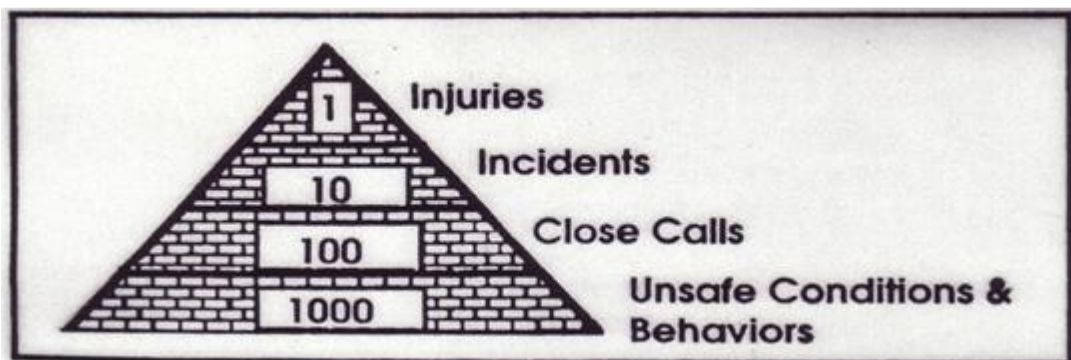


FIGURE 1.1: The Injury Pyramid

A research has shown that 1000 unsafe conditions and behaviors give rise to 100 close calls which in turn create 10 incidents.

Every 10 incidents cause 1 injury. To control injuries, therefore, the effort has to be focused on reducing and eliminating unsafe conditions and behaviors.

This training manual contains current regulations and some practical safety guidelines, a knowledge of which will help you achieve a safer attitude and create a safer work environment for yourself and for your co-workers. This training manual has been organized into 17 modules and is targeted to the CSEE Department students and laboratory personnel. The training requirements of each of these two groups are distributed in the Table 1.1 below.

TABLE 1.1: Training Requirements of CSEE Department Personnel

Module	CSEE Students and Visitors	Laboratory Personnel
1. Introduction	X	X
2. General Safety and Health Provisions	X	X
3. Hazard Communication Standard (Right to Know Law)	X	X
4. House keeping	X	X
5. First-aid	X	X
6. Fire Protection	X	X
7. Emergency Procedures	X	X

8. Personal Protective Equipment (PPE)	X	X
9. Electrical Hazards	X	X
10. Lockout / Tagout Procedures	X	X
11. Overhead / Gantry Cranes Safety	X	X
12. Ladder Safety	X	X
13. Fork Lift Safety		X
14. Fall Protection	X	X
15. Confined Spaces		X
16. Welding, Cutting and Brazing	X	X
17. Accident Recording and Reporting		X

2 General Safety & Health Provisions

- Injuries occur every 20 seconds;
- Approximately, 6,300 Americans die each year while at work;
- 33,150 people receive disabling injuries from falling on stairs every year;
- 645 people are killed from falls every year;
- 2,490 eye injuries occur daily;
- Cumulative trauma disorders (CTDs) account for half of reported occupational illnesses.

The above statistics show that a workplace can be hazardous. This is unfortunately, true, but does not have to be. Several companies and institutions have achieved zero injuries in their workplaces by setting up safety programs that included raising the safety awareness in their employees mostly by training and education. Our Department of CSEE has the same goal.

2.1 CSEE department intends to provide you with

- i. Safety Training Manual;
- ii. Personal Protective Equipment (PPE);
- iii. Material Safety Data Sheets (MSDS), to describe chemical hazards;
- iv. Emergency and first-aid plans.

However, it is your responsibility to learn the safety guidelines and acquire necessary safety skills, before starting any job or before taking part in any laboratory based assignments.

2.2 What are your responsibilities as an employee or as a student?

To help prevent exposure to workplace safety and health hazards, you must comply with all OSHA requirements that apply to your actions and conduct.

2.2.1 Your rights as an employee

You have the right, among other actions, to do the following:

- i. Review employer-provided OSHA standards, regulations and requirements;
- ii. Receive adequate safety and health training via this Safety Training Manual;

- iii. Ask the Public Employee Safety & Health Bureau (PESH) located at 65 Court Street, Buffalo, NY 14202 Tel. (716) 847-7133 Fax (716) 847-7108 to investigate hazardous conditions or violations of standards in your workplace;
- iv. Have your name withheld from your employer of your filing a complaint with PESH;
- v. Be advised of PESH actions regarding your complaint, and have an informal review of any decision not to inspect or issue a citation;
- vi. Have your representative accompany the PESH compliance officer on inspections;
- vii. Observe any monitoring or measuring of toxic substances or harmful physical agents in your workplace and review any related monitoring or medical records;
- viii. Review at a reasonable time the Log of Work-Related Injuries and Illnesses (OSHA 300A);
- ix. Request a closing discussion following an inspection;
- x. Object to the abatement period set in a citation issued to the CSEE Department;
- xi. Seek safe and healthful work conditions without CSEE Department retaliating on you.

2.2.2 Your rights as a student

- i. Review employer-provided OSHA standards, regulations and requirements;
- ii. Receive adequate safety and health training via this Safety Training Manual;
- iii. Observe any monitoring or measuring of toxic substances or harmful physical agents in your workplace and review any related monitoring or medical records;
- iv. Report any unsafe acts and unsafe conditions to your Principal Investigator or CSEE Department Chair;
- v. Seek safe and healthful work conditions without CSEE Department retaliating on you.

2.3 Imminent dangers

2.3.1 What is an imminent danger?

An imminent danger is a workplace hazard that puts you at immediate serious risk of death or serious physical harm. It may be a safety hazard such as a heavy object loosely hanging over you or exposed electrical wire that could cause a serious or fatal accident under present conditions. It also may be a health hazard such as toxic substances or dangerous fumes, dusts, or gases that could cause death or irreversible physical harm, shorten life, or reduce physical or mental performance.

2.3.2 What should you do if you encounter an imminent danger?

If a safety or health hazard puts you in imminent danger of death or serious injury or illness, notify your principal investigator and CSEE Department Chair immediately and request corrective action. Also ask him/her to provide protection to you and your co-workers until the hazard is eliminated or controlled.

2.3.3 What if CSEE Department does not act?

If CSEE Department does not promptly take steps to remove or control the hazard, you can contact Environment, Health & Safety (EHS) Services of University at Buffalo at 829-2401. If EHS does not respond, you can contact the nearest PESH office, listed in your phone book under “NY State Department of Labor,” at (716) 847-7133.

When you call, provide the name and address of CSEE Department and describe the hazard in detail and how long it has existed. Also provide your name, address, and a telephone number where you can be contacted. If you request, PESH will not reveal your name to CSEE Department.

2.3.4 What protections do you have for refusing dangerous work or reporting an imminent danger?

PESH and the NY State Department of Labor work together to protect employees who are punished for refusing to work in imminently dangerous situations involving serious safety or health hazards. Contact either agency to discuss your case. In addition, PESH can protect you if you are discharged or disciplined for refusing to do work that would expose you to imminent danger, provided that you have notified your principal investigator or department chair of the hazard, the hazard has not been corrected, and there is not enough time for you to seek relief through PESH’s standard complaint process.

In addition, it is illegal for your employer to punish you for reporting a safety or health hazard. The Occupational Safety and Health Act (OSH Act) protects you from being discriminated against, fired, demoted, or otherwise penalized for any of the following:

- Complaining to your employer about a hazard;
- Requesting a PESH inspection;
- Participating in union safety and health activities; or
- Otherwise exercising your rights under the OSH Act.

If you believe your rights have been violated, you must file your complaint with OSHA within 30 days. OSHA can take action, including going to court if necessary, to force the CSEE Department to restore your job, earnings, and benefits. You will not have to pay any legal fees.

2.4 General safety rules

- i. Immediately wipe out wet or greasy spots and oil spills on the floor;
- ii. Use proper lifting methods, i.e. bend the knees not the back;
- iii. Be cautious around corners and stairway/elevator exits as well as when opening doors into hallways;
- iv. Promptly report to your principal investigator or the CSEE Department Chair any items that need to be repaired to prevent accidents from occurring;
- v. Stairs, exits and connecting tunnels need to be lighted. Report burned out bulbs to the CSEE Department maintenance personnel;
- vi. No smoking or consumption of alcoholic beverages, or any other prohibited substances is allowed inside the Ketter Hall;
- vii. Laboratory facilities such as refrigerators should not be used for storing food;
- viii. Everyone must rinse all the instruments and non-disposable materials that have been in contact with toxic, caustic or radioactive materials before leaving them to be washed by others;
- ix. No tool should be placed in such a way that it would create a falling object hazard,
- x. Chairs and stools should not be used as a ladder. Ladders are available in all areas. If not, request one for your area;
- xi. You must return all the hand-tools and power tools at the designated place and should not leave them on floor unattended, at any time which creates trip hazards;
- xii. The PPE is provided to be worn in the laboratory. No hard hats, gloves or any other PPE is allowed to be taken out of the laboratory;
- xiii. Do not place equipment in hallways. In case of fire or other emergencies, hallway must be clear for emergency rescue personnel;
- xiv. Ensure that doors are either completely closed or completely opened against the wall in the hallway. Fire code specifies laboratory and office doors should remain closed except during immediate use.

2.5 General work habits

- Report to work physically and mentally rested and be prepared to perform your job safely and properly.
- Report unsafe acts and conditions to your principal investigator or Department Chair.
- Keep your mind at work. Always keep your temper and thoughts under control.
- Report injuries to the principal investigator as soon as possible.
- If you are taking a prescribed drug which may have a side effect, inform your principal investigator or CSEE Department Chair before beginning the day's work.

2.6 Safety guidelines for machine shop

Working with machine tools can be hazardous even for experienced machine operators. Therefore, great care must be observed while using the machine tools. It must be noted that, no one is allowed to use the machine tools unless prior approval is sought from the Department Chair or Principal Investigator. The user must demonstrate that, he/she has completely understood all the operations of a particular machine, before he/she starts using it.

Following safety guidelines must be strictly adhered to:

- Appropriate PPE must be worn;
- The machine should not be left unattended;
- The operator should not communicate with anyone when the machine is running;
- Before starting the machine, the operator should check for proper functioning of guards and other safety devices;
- Before making any adjustments, the machine should be turned off and should be allowed to come to a standstill;
- Do not attempt to slow down a machine by touching it;
- No machine should be operated if you do not have at least one person as an attendant;
- If in doubt, Mr. Duane Kozlowski of SEEEL in Ketter Hall should be consulted.

2.7 Substance Abuse Policy

Use of illegal drugs, alcohol or other prohibited substances while in CSEE Department facilities or reporting to the laboratory under the influence of the above mentioned substances is a cause for future denial of the CSEE Department facilities. No exceptions or excuses shall be entertained.

The following Substance Abuse policy shall be enforced by the Department of CSEE.

- i. First time offenders shall be given a written notice and a record shall be maintained on his/her file. The employee offender shall be sent on an unpaid leave for one week and he/she shall not be permitted to use or operate any of the CSEE Department facilities.
- ii. On the second offense, the employee shall be dismissed from his/her job. The student offender shall be expelled from the department. A report of this action shall be forwarded to the Department of Public Safety (University Police) and the Dean of Engineering for further action.
- iii. The Safety and Health Committee of the CSEE Department shall have the sole authority to decide on the above two actions.
- iv. All of the employees and students must immediately report to the CSEE Department Chair, if they see any of their colleagues or students under the influence of any prohibited substance or alcohol. They must also report if they observe or suspect any alcohol or prohibited substance in any of the CSEE Department facilities including bathrooms, hallways, student lounges, trailers and RA/TA offices.
- v. The CSEE Department facilities must be absolutely free of the presence of any alcohol and/or any prohibited drug/substance, at all times.

2.8 Working in Ketter Hall laboratories after regular hours

Unless special written authorization is obtained from the CSEE Department Chair, some of the Ketter Hall Laboratories namely Structural Engineering and Earthquake Simulation (SEES) Laboratory and Geotechnical Laboratory can not be used after regular hours. Such authorization is valid only if the Principal Investigator of the particular project is present with his/her research assistants and laboratory technicians at all times during the period of the authorization.

3 Hazard Communication Standard

Chemicals have many valuable uses but they can cause serious health and safety hazards. Chemicals are known to be hazardous if they cause acute health problems, chronic health problems, suddenly release pressure, catch fire easily or if they are reactive.

The Hazard Communication Standard (HCS), sometimes called the Right to Know Law or HazCom, is a set of regulations first promulgated in 1988 by the Office of Occupational Safety and Health Administration (OSHA). It has been adopted by and is enforced by New York State OSHA. The Standard requires that every effected employer establish a program to tell employees of the hazards associated with the materials in their workplace. The program must have five main components as follows:

1. Written Hazard Communication Program documentation;
2. Identifying and keeping an inventory of hazardous chemicals;
3. Obtaining and keeping material safety data sheets on the identified hazards;
4. Ensuring that the hazardous materials are labeled with name and hazard; and
5. Training employees on the standard, safety information, labeling and protective measures.

3.1 Written program

Under the HazCom standard, CSEE Department must complete and keep a written Hazard Communication Program. The written program describes how the requirements for labels and other forms of warning, material safety data sheets (MSDSs), and employee information and training, are implemented in the workplace. It indicates who is responsible for MSDSs, labels, warning signs and training, as well as the location of the inventory, MSDSs, and other information and resources pertaining to hazardous chemicals and safety measures. An inventory list of hazardous chemicals is required to be maintained as part of the written program.

3.2 Chemicals inventory

An employee must know the potential hazards, in order to know how to protect himself/herself. If a person has chemicals under his/her control, or he/she is a designated individual, he/she must make an inventory of the hazardous chemicals. It is his/her duty to identify chemicals in containers, including pipes, and also chemicals generated in the work operations. (for example, welding fumes, dusts, and exhaust fumes are all sources of chemical exposures), read labels provided by suppliers for hazard information and, make a list of all chemicals in the workplace that are potentially hazardous. He/she has to note the typical maximum quantity, its location within the workplace, and where the MSDS for the material will be kept.

The HazCom Inventory is to be updated as new chemicals are brought into the workplace and a copy is to be provided annually to be provided to CSEE Department Chair at least annually.

An initial inventory of all chemicals and materials will be made of all new work areas and facilities. An annual audit, the HazCom Inventory, shall be conducted thereafter. All hazardous chemicals and materials will be identified and listed. A copy of the HazCom Inventory for each work area will be kept with the MSDSs for that area (or in a secure location if the MSDSs are in the public areas) and the updated inventory lists shall be provided to the CSEE Department Chair at least annually.

Each listing will note at least the following information:

- Name & contact information for persons responsible for the area or chemicals;
- Date the list was compiled or updated;
- Building & room/area location of the work or storage area;
- Name and hazard(s) of the chemical or product;
- Typical maximum quantity of the chemical or material;
- General location within the work area where material is kept;
- Name of the manufacturer or supplier.(must match the MSDS).

A system shall be maintained to add any newly introduced hazardous chemicals or materials to the inventory. Typically the person responsible for material shall update the list for the specific work area and ensure that the master list is updated. The CSEE Department Chair will ensure that the list is updated.

3.3 Material safety data sheets (MSDS)

The role of the MSDS is to provide detailed information on each hazardous chemical, including its potential hazardous effects, its physical and chemical characteristics, and recommendations for appropriate protective measures. This information is useful for designing protective programs, as well as informing the chemical user of the hazards. MSDSs must be readily accessible to users when they are in their work areas.

CSEE Department must have an MSDS for each hazardous chemical in use. The MSDS must be in English. CSEE Department is entitled to receive a data sheet from the supplier, which includes all of the information required under the rule. The MSDS sheet must be completed with adequate information. Employees and students should not use or be exposed to any chemicals for which the safety data have not

been reviewed and appropriate safety measures implemented. Employees may contact CSEE Department Chair for assistance in such matters.

3.3.1 MSDSs may be obtained by way of the following

1. In the shipment from manufacturer as part of the purchase requirements;
2. From the manufacturers hotline/fax/webpage;
3. From a web search of online databases;

The manufactures are required by OSHA to provide MSDSs but sometimes it is difficult to obtain information for old chemicals, from small companies and consumer products. In general, the preferred source for MSDS is the chemical manufacturer, because these files are actively updated to reflect all that is known about the hazardous material in question. Most major chemical suppliers provide a toll-free number and will fax the latest MSDS to purchasers. Material Safety Data Sheets are also often available via the manufactures home web page.

As part of the purchase agreement, CSEE Department also receives MSDSs for chemicals purchased. These are filed by substance and copies can be made. Requested MSDS can be retrieved during the normal work hours.

Other sources of chemical safety information include online searches and published safety references.

3.3.2 Information on MSDS

A Typical MSDS is attached at the end of this chapter. The following information is normally provided on a MSDS:

- **Product name and identification**
 1. Name of the chemical as it appears on the label;
 2. Manufacturer's name and address;
 3. Emergency telephone numbers: used to obtain further information about a chemical in the event of an emergency
 4. Chemical name of synonyms
 5. C.A.S #: refers to the Chemical Abstract Service registry number that identifies the chemical;
 6. Date of preparation: the most current date that the MSDS was prepared
- **Hazardous ingredients**

1. Hazardous ingredients: substances that, in sufficient concentration, can produce physical or acute or chronic health hazards to persons exposed to the product;
 - i. Physical hazards include fire, explosions, corrosion, and projectiles.
 - ii. Health hazards include any health effect, even including irritation or development of allergies;
 2. TLV: refers to the Threshold Limit Value. A TLV is the highest airborne concentration of a substance to which nearly all adults can be repeatedly exposed, day after day, without experiencing adverse effects. These are usually based on an eight-hour time weighted average;
 3. PEL: refers to the Permissible Exposure Limit. The PEL is an exposure limit established by OSHA, normally for an eight hour exposure;
 4. STEL: refers to the Short Term Exposure Limit. The STEL is a 15-minute time-weighted average exposure that should not be exceeded at any time during a workday. A STEL exposure should not occur more than four times per day and there should be at least 60 minutes between exposures;
 5. LD50 (lethal dose 50): lethal single dose (usually oral) in mg/kg (milligrams of chemical per kilogram of animal body weight) of a chemical that results in the death of 50% of a test animal population;
 6. LC50 (lethal concentration 50): concentration dose expressed in ppm for gases or micrograms of material per liter of air for dusts or mists that results in the death of 50% of a test animal population administered in one exposure;
- **Physical/chemical characteristics**
 1. Boiling point, vapor pressure, vapor density, specific gravity, melting point, appearance, and odor; all provide useful information about the chemical;
 2. Boiling point and vapor pressure provide a good indication of the volatility of a material;
 3. Vapor density indicates whether vapors will sink, rise, or disperse throughout the area. The further the values are from one (the value assigned to atmospheric air), the faster the vapors will sink or rise.
 - **Fire and explosion hazard data**
 1. Flashpoint: refers to the lowest temperature at which a liquid gives off enough vapor to form an ignitable mixture with air;
 2. Flammable or Explosive Limits: the range of concentrations over which a flammable vapor mixed with air will flash or explode if an ignition source is present;

3. Extinguishing Media: the fire fighting substance that is suitable for use on the substance that is burning;
4. Unusual Fire and Explosive Hazards: hazards that might occur as the result of overheating or burning of the specific material.

- **Reactivity data**

1. Stability: indicates whether the material is stable or unstable under normal conditions of storage, handling, and use;
2. Incompatibility: lists any materials that would, upon contact with the chemical, cause the release of large amounts of energy, flammable vapor or gas, or toxic vapor or gas;
3. Hazardous Decomposition Products: any materials that may be produced in dangerous amounts if the specific material is exposed to burning, oxidation, or heating, or allowed to react with other chemicals;
4. Hazardous Polymerization: a reaction with an extremely high or uncontrolled release of energy, caused by the material reacting with itself.

- **Health hazard data**

1. Routes of entry:

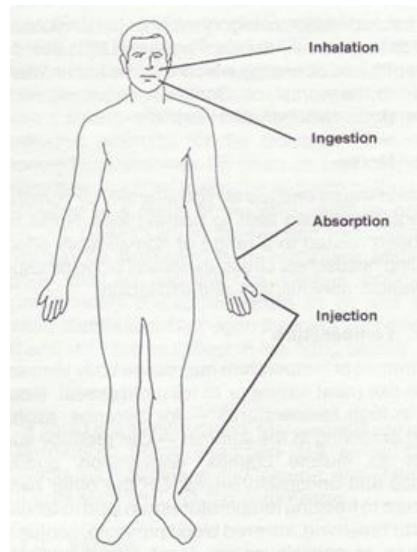


Figure 3.1: Routes of entry for toxic substances

- i. Inhalation – The respiratory system is considered the most important route of entry for most chemical and biological hazards. It consists of mouth, nose, windpipe, and lungs. Possible dangers include breathing of a gas, vapor, fume, mist, or dust.
 - ii. Skin absorption - A possible significant contribution to overall chemical exposure by way of absorption through the skin, mucous membranes, and eyes by direct or airborne contact.
 - iii. Ingestion – Toxic substances may enter body by ingestion. This is rare but may occur by accident or by eating and smoking with contaminated hands in a contaminated environment.
 - iv. Injection – In rare circumstances, a chemical may enter the body by injection. For example, the skin can be punctured by oil leaking from a hydraulic hose.
 2. Health hazards (acute and chronic):
 - i. Acute – an adverse effect with symptoms developing rapidly.
 - ii. Chronic – an adverse effect that can be the same as an acute effect, except that the symptoms develop slowly over a long period of time or with recurrent exposures;
 3. Carcinogen – a substance that is determined to be cancer producing or potentially cancer producing;
 4. Signs and symptoms of overexposure: the most common symptoms or sensations a person could expect to experience from overexposure to a specific material. It is important to remember that only some symptoms will occur with exposures in most people;
 5. Emergency and first aid procedures: instructions for treatment of a victim of acute inhalation, ingestion, and skin or eye contact with a specific hazardous substance. The victim should be examined by a physician as soon as possible.
- **Precautions for safe handling and use**
 1. Spill Clean up: includes methods to be used to control and clean up spills. Also includes precautions such as to avoid breathing the vapors, avoiding contact with liquids and solids, removing sources of ignition, and other important considerations. May also include special equipment used for the clean up;
 2. Waste Disposal Methods: acceptable and prohibited methods for disposal as well as dangers to the environment;

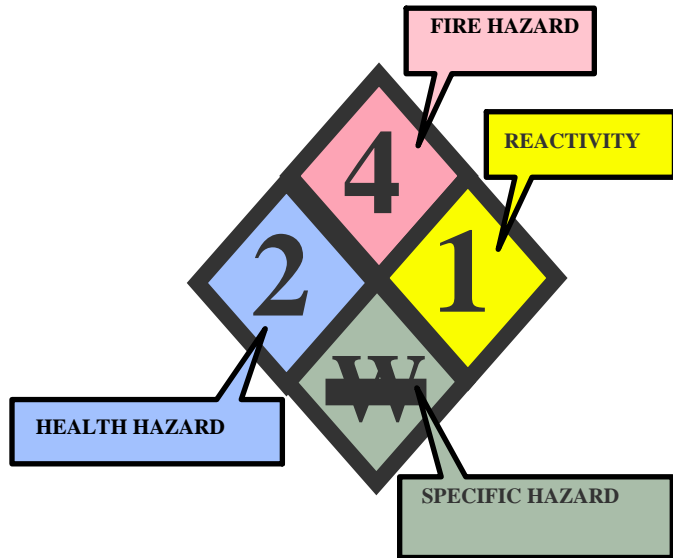
Note: The methods recommended by the chemical manufacturer do not necessarily comply with federal, state, or local regulations. Contact CSEE Department Chair for disposal information.

3. Other Precautions: any other precautionary measures not mentioned elsewhere in the MSDS.
- **Control measures**
 1. Respiratory Protection: whenever respiratory protection is needed, the type required and special conditions or limitations should be listed;
 2. Ventilation: if required, the type will be listed as well as applicable conditions of use and limitations;
 3. Protective Gloves: when gloves are necessary to handle the specific material, the construction, design, and material requirements should be listed;
 4. Eye Protection: when special eye protection is required, the type will be listed along with any conditions of use and limitations;
 5. Other Protective Equipment or Clothing: lists items, such as aprons, not discussed elsewhere in the MSDS.

3.4 Labels

Containers of hazardous chemicals must be labeled, tagged, or marked with the identity of the material and appropriate hazard warnings. The original label must include the identity of the material, appropriate hazard warnings, and the manufacture name and address. The identity used by the supplier may be a common or trade name ("Magic Formula"), or a chemical name (1,1,1, -trichloroethane). The hazard warning is a brief statement of the hazardous effects of the chemical ("flammable," "causes lung damage"). Labels frequently contain other information, such as precautionary measures ("do not use near open flame"). Labels must be legible and prominent.

HEALTH	<input type="checkbox"/>
FLAMMABILITY	<input type="checkbox"/>
REACTIVITY	<input type="checkbox"/>
PERSONAL PROTECTION	<input type="checkbox"/>



FIVE NFPA HAZARD LEVELS

- 4 EXTREME
- 3 HIGH
- 2 MODERATE
- 1 SLIGHT
- 0 INSIGNIFICANT

FIVE HMIS HAZARD LEVELS

- 4 SEVERE
- 3 SERIOUS
- 2 MODERATE
- 1 SLIGHT
- 0 MINIMAL

The degrees of hazard in each of these categories are given as follows:

Health - The degree of health hazard of a chemical or material is based on the form or condition of the material, as well as its inherent properties. The degree of health hazard of a material should indicate the degree of personal protective equipment required for working safety with the material:

- A rating of 1 is for slightly hazardous (toxic) material which require only minimal protection (for example, safety glasses and gloves) in addition to normal work clothing to work with safely
- A rating of 2 is for moderately toxic or hazardous material which require additional PPE or equipment (e.g. chemical goggles, lab/work smock, local ventilation) in addition to that required for less toxic material. Consult the MSDS for specific health hazard and proper PPE to use with this material.
- A rating of 3 or 4 is for highly to extremely toxic (deadly) material (and any carcinogen, mutagen, or teratogen). These materials will require specialized equipment (e.g. respirator (or exhaust hood), full face shield, rubber apron, specialized glove, handling tongs, etc).beyond that required for moderately toxic material. You must consult the MSDS and/or other safety information to determine the hazard (acute or chronic) and the proper PPE and engineering controls to safely use of this material.

Flammability - The flammability hazards deal with the degree of susceptibility of the material to ignite and burn. The form or condition of the materials, as well as their properties, affects the extent of the hazard. Many hazardous materials such as acetone and gasoline have a flash point (ignition temperature) far below freezing and will readily ignite with a spark if the vapor concentration is sufficient. A low rating of 1 is for material with a flash point above 200F while more hazardous ratings of 2, 3, and 4 are for materials with respective flash point below 200, 100 and 73 F.

Reactivity - The reactivity hazards deal with the potential of a material or chemical to release energy. Some materials are capable of rapid release of energy without any catalyst, while others can undergo violent eruptive or explosive reactions if they come in contact with water or other materials. Generally this rating is used to indicate the potential to be reactive if the material is heated, jarred, or shocked.. A low rating of 1 indicates a material that is normally stable but may be reactive if heated. The more hazardous ratings of 2, 3, and 4 indicate a material is capable of violent reaction, shock/rapid heating and detonation respectively.

Other Hazard Information - An open space at the bottom of the NFPA diagram can be used to indicate additional information about the chemical or material. This information may include the chemical or material's radioactivity, proper fire extinguishing agent, skin hazard, and its use in pressurized containers, protective equipment required, or unusual reactivity with water. For example, the usual signal to indicate unusual reactivity with water is the letter "W" with a long line through the center. Similarly the words ACID, COR (corrosive), RAD (radiation), OXY (oxidizer) and other abbreviations may be used.

3.4.1 Secondary containers' labels and signs

If materials are transferred from the original container into other containers, these must be labeled as well. Large containers or storage units containing hazardous chemicals or mixtures must also be labeled or have warning signs. It is recommended that other warning or caution signs be placed in the work areas to remind individuals of the hazards and of the protective equipment that may be necessary in the area.

[Exception: A single use container used immediately after transfer and maintained by the original transferor does not need to be labeled. Container should be appropriately discarded after use.]

3.5 Exposure

Each employee or student who may be "exposed" to hazardous chemicals when working must be provided information and trained prior to initial assignment to work with a hazardous chemical, and whenever the hazard changes. "Exposure" or "exposed" under the rule means "an employee or student is subjected to a hazardous chemical in the course of employment through any route of entry (inhalation, ingestion, skin contact or absorption, etc.) and includes potential (e.g., accidental or possible) exposure."

3.6 Employee and student information and training

An employee or student working with hazardous chemicals must receive training and information on the hazard communication standard, on MSDS and labels, and protective measures.

Information and training may be done either by individual chemical, or by categories of hazards (such as flammability or carcinogenicity). If there are only a few chemicals in the workplace, then preferably, each one should be individually discussed. Where there are large numbers of chemicals, or the chemicals change frequently, employees should be trained based on the hazard categories (e.g., flammable liquids, corrosive materials, carcinogens). Employees must have access to the substance-specific information on the labels and MSDSs.

The most important aspects of training are to ensure employees are aware that they are exposed to hazardous chemicals, that they know how to read and use labels and material safety data sheets, and that, as a consequence of learning this information, they are following the appropriate protective measures (e.g. personal protective equipment, safe procedures, and engineering controls).

In addition to the elements of the Hazard Communication Standard, each effected employees shall be trained on:

- Any operation or location in the work area where hazardous chemicals are present;
- Definitions and information provided on MSDSs as well as the availability of other sources of information on hazardous materials;
- The physical and health hazard of the chemical, including protective measures used to protect the employee from exposure.

3.7 Responsibilities of the employees and students

To maintain a safe workplace, all the employees should do the following:

- Read the OSHA poster outside the work area;
- Follow all lawful safety and health rules and regulations of CSEE Department and wear or use appropriate PPE while working;
- Report hazardous conditions to the Principal Investigator or Department Chair;
- Report any job-related injury or illness to CSEE Department, and seek treatment promptly.

3.8 Sample MSDS Sheet

The following MSDS sheet for Sulfuric Acid is attached as a sample. It should not be relied upon for its accuracy or completeness. Obtained from <http://ccins.camosun.bc.ca/~humphreb/msdsexample.htm> on [08/21/2003](#).

SULFURIC ACID, 52 - 100 %

MSDS Number: S8234 --- Effective Date: 09/14/00

1. Product Identification

Synonyms: Oil of vitriol; Babcock acid; sulphuric acid

CAS No.: 7664-93-9

Molecular Weight: 98.08

Chemical Formula: H₂SO₄ in H₂O

Product Codes:

J.T. Baker: 5030, 5137, 5374, 5802, 5815, 5889, 5960, 5961, 5971, 6902, 9673, 9674, 9675, 9676, 9679, 9680, 9681, 9682, 9684, 9687, 9691, 9693, 9694

Mallinckrodt: 2468, 2876, 2878, 2900, 2904, 3780, 4222, 5524, 5557, H644, H976, H996, V344, V651

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Sulfuric Acid	7664-93-9	52 - 100%	Yes
Water	7732-18-5	0 - 48%	No

3. Hazards Identification

Emergency Overview

POISON! DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR CONTACTED WITH SKIN. HARMFUL IF INHALED. AFFECTS TEETH. WATER REACTIVE. CANCER HAZARD. STRONG INORGANIC ACID MISTS CONTAINING SULFURIC ACID CAN CAUSE CANCER. Risk of cancer depends on duration and level of exposure.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)

Flammability Rating: 0 - None

Reactivity Rating: 3 - Severe (Water Reactive)

Contact Rating: 4 - Extreme (Corrosive)

Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES

Storage Color Code: White (Corrosive)

Potential Health Effects

Inhalation:

Inhalation produces damaging effects on the mucous membranes and upper respiratory tract. Symptoms may include irritation of the nose and throat, and labored breathing. May cause lung edema, a medical emergency.

Ingestion:

Corrosive. Swallowing can cause severe burns of the mouth, throat, and stomach, leading to death. Can cause sore throat, vomiting, diarrhea. Circulatory collapse with clammy skin, weak and rapid pulse, shallow respirations, and scanty urine may follow ingestion or skin contact. Circulatory shock is often the immediate cause of death.

Skin Contact:

Corrosive. Symptoms of redness, pain, and severe burn can occur. Circulatory collapse with clammy skin, weak and rapid pulse, shallow respirations, and scanty urine may follow skin contact or ingestion. Circulatory shock is often the immediate cause of death.

Eye Contact:

Corrosive. Contact can cause blurred vision, redness, pain and severe tissue burns. Can cause blindness.

Chronic Exposure:

Long-term exposure to mist or vapors may cause damage to teeth. Chronic exposure to mists containing sulfuric acid is a cancer hazard.

Aggravation of Pre-existing Conditions:

Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance.

4. First Aid Measures

Inhalation:

Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician immediately.

Ingestion:

DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Call a physician immediately.

Skin Contact:

In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Excess acid on skin can be neutralized with a 2% solution of bicarbonate of soda. Call a physician immediately.

Eye Contact:

Immediately flush eyes with gentle but large stream of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Call a physician immediately.

5. Fire Fighting Measures

Fire:

Concentrated material is a strong dehydrating agent. Reacts with organic materials and may cause ignition of finely divided materials on contact.

Explosion:

Contact with most metals causes formation of flammable and explosive hydrogen gas.

Fire Extinguishing Media:

Dry chemical, foam or carbon dioxide. Do not use water on material. However, water spray may be used to keep fire exposed containers cool.

Special Information:

In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full face piece operated in the pressure demand or other positive pressure mode. Structural firefighter's protective clothing is ineffective for fires involving this material. Stay away from sealed containers.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Neutralize with alkaline material (soda ash, lime), then absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker NEUTRASORB(R) or TEAM(R) 'Low Na+' acid neutralizers are recommended for spills of this product.

7. Handling and Storage

Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Protect from physical damage. Keep out of direct sunlight and away from heat, water, and incompatible materials. Do not wash out container and use it for other purposes. When diluting, always add the acid to water; never add water to the acid. When opening metal containers, use non-sparking tools because of the possibility of hydrogen gas being present. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:

For Sulfuric Acid:

- OSHA Permissible Exposure Limit (PEL) -

1 mg/m³ (TWA)

- ACGIH Threshold Limit Value (TLV) -

1 mg/m³(TWA), 3 mg/m³ (STEL), A2 - suspected human carcinogen for sulfuric acid contained in strong inorganic acid mists.

Ventilation System:

A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, Industrial Ventilation, A Manual of Recommended Practices, most recent edition, for details.

Personal Respirators (NIOSH Approved):

If the exposure limit is exceeded and engineering controls are not feasible, a full face piece respirator with an acid gas cartridge and particulate filter (NIOSH type N100 filter) may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. If oil particles (e.g. lubricants, cutting fluids, glycerin, etc.) are present, use a NIOSH type R or P particulate filter. For emergencies or instances where the exposure levels are not known, use a full-face piece positive-pressure, air-supplied respirator. **WARNING:** Air purifying respirators do not protect workers in oxygen-deficient atmospheres. Where respirators are required, you must have a written program covering the basic requirements in the OSHA respirator standard. These include training, fit testing, medical approval, cleaning, maintenance, cartridge change schedules, etc. See 29CFR1910.134 for details.

Skin Protection:

Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:

Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance: Clear oily liquid.

Odor: Odorless.

Solubility: Miscible with water, liberates much heat.

Specific Gravity: 1.84 (98%), 1.40 (50%), 1.07 (10%)

pH: 1 N solution (ca. 5% w/w) = 0.3; 0.1 N solution (ca. 0.5% w/w) = 1.2; 0.01 N solution (ca. 0.05% w/w) = 2.1.

% Volatiles by volume @ 21C (70F): No information found.

Boiling Point: ca. 290C (ca. 554F) (decomposes at 340C)

Melting Point: 3C (100%), -32C (93%), -38C (78%), -64C (65%).

Vapor Density (Air=1): 3.4

Vapor Pressure (mm Hg): 1 @ 145.8C (295F)

Evaporation Rate (BuAc=1): No information found.

10. Stability and Reactivity

Stability:

Stable under ordinary conditions of use and storage. Concentrated solutions react violently with water, spattering and liberating heat.

Hazardous Decomposition Products:

Toxic fumes of oxides of sulfur when heated to decomposition. Will react with water or steam to produce toxic and corrosive fumes. Reacts with carbonates to generate carbon dioxide gas, and with cyanides and sulfides to form poisonous hydrogen cyanide and hydrogen sulfide respectively.

Hazardous Polymerization:

Will not occur.

Incompatibilities:

Water, potassium chlorate, potassium perchlorate, potassium permanganate, sodium, lithium, bases, organic material, halogens, metal acetylides, oxides and hydrides, metals (yields hydrogen gas), strong oxidizing and reducing agents and many other reactive substances.

Conditions to Avoid:

Heat, moisture, incompatibles.

11. Toxicological Information

Toxicological Data:

Oral rat LD50: 2140 mg/kg; inhalation rat LC50: 510 mg/m³/2H; standard Draize, eye rabbit, 250 ug (severe); investigated as a tumorigen, mutagen, reproductive effector.

Carcinogenicity:

Cancer Status: The International Agency for Research on Cancer (IARC) has classified "strong inorganic acid mists containing sulfuric acid" as a known human carcinogen, (IARC category 1). This classification applies only to mists containing sulfuric acid and not to sulfuric acid or sulfuric acid solutions.

-----\Cancer Lists\-----

---NTP Carcinogen---

Ingredient	Known	Anticipated	IARC Category
------------	-------	-------------	---------------

Sulfuric Acid (7664-93-9)	No	No	None
---------------------------	----	----	------

Water (7732-18-5) No No None

12. Ecological Information

Environmental Fate:

When released into the soil, this material may leach into groundwater. When released into the air, this material may be removed from the atmosphere to a moderate extent by wet deposition. When released into the air, this material may be removed from the atmosphere to a moderate extent by dry deposition.

Environmental Toxicity:

LC50 Flounder 100 to 330 mg/l/48 hr aerated water/Conditions of bioassay not specified; LC50 Shrimp 80 to 90 mg/l/48 hr aerated water /Conditions of bioassay not specified; LC50 Prawn 42.5 ppm/48 hr salt water /Conditions of bioassay not specified.

This material may be toxic to aquatic life.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)



Proper Shipping Name: SULFURIC ACID (WITH MORE THAN 51% ACID)

Hazard Class: 8

UN/NA: UN1830

Packing Group: II

Information reported for product/size: 440LB

International (Water, I.M.O.)

Proper Shipping Name: SULPHURIC ACID (WITH MORE THAN 51% ACID)

Hazard Class: 8

UN/NA: UN1830

Packing Group: II

Information reported for product/size: 440LB

15. Regulatory Information

-----\Chemical Inventory Status - Part 1\-----

Ingredient		TSCA	EC	Japan	Australia
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Sulfuric Acid (7664-93-9)		Yes	Yes	Yes	Yes
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Water (7732-18-5)		Yes	Yes	Yes	Yes
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-----\Chemical Inventory Status - Part 2\-----

--Canada--

Ingredient Korea DSL NDSL Phil.

Sulfuric Acid (7664-93-9) Yes Yes No Yes

Water (7732-18-5) Yes Yes No Yes

-----\Federal, State & International Regulations - Part 1\-----

-SARA 302- -----SARA 313-----

Ingredient RQ TPQ List Chemical Catg.

Sulfuric Acid (7664-93-9) 1000 1000 Yes No

Water (7732-18-5) No No No No

-----\Federal, State & International Regulations - Part 2\-----

-RCRA- -TSCA-

Ingredient CERCLA 261.33 8(d)

Sulfuric Acid (7664-93-9) 1000 No No

Water (7732-18-5) No No No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: Yes

SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No

Reactivity: Yes (Pure / Liquid)

Australian Hazchem Code: 2P

Poison Schedule: No information found.

WHMIS:

This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: 3 Flammability: 0 Reactivity: 2 Other: Water reactive

Label Hazard Warning:

POISON! DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR CONTACTED WITH SKIN. HARMFUL IF INHALED. AFFECTS TEETH. WATER REACTIVE. CANCER HAZARD. STRONG INORGANIC ACID MISTS CONTAINING SULFURIC ACID CAN CAUSE CANCER. Risk of cancer depends on duration and level of exposure.

Label Precautions:

Do not get in eyes, on skin, or on clothing.



Do not breathe mist.

Keep container closed.

Use only with adequate ventilation.

Wash thoroughly after handling.

Do not contact with water.

Label First Aid:

In all cases call a physician immediately. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before re-use. Excess acid on skin can be neutralized with a 2% bicarbonate of soda solution. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.

Product Use:

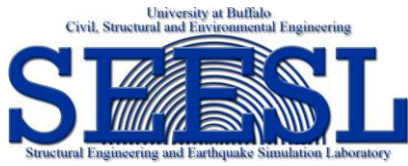
Laboratory Reagent.

Revision Information:

MSDS Section(s) changed since last revision of document include: 8.

Disclaimer:

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Prepared by: Strategic Services Division

Phone Number: (314) 539-1600 (U.S.A.)

4 Housekeeping

Good housekeeping is known to eliminate some workplace hazards and it also helps in getting the job done safely. Untidy workplace hides the hazards and thus makes the workplace unsafe to work in.

Housekeeping does not mean the workplace has to be spotless and neither it is an occasional cleanup operation. It is rather a continuous procedure and one should understand that occasional cleanups are no good for reducing accidents.

Everyone has to consider his/her daily routine and come up with a strategy to keep the workplace tidy as he/she is working. It does take some time to get accustomed to this habit but once you are into it, you would like your work area better and moreover, you would be reducing dangers to other occupants which would have been caused otherwise.

OSHA Regulations state: “All places of employment, passageways, storerooms and service rooms should be kept clean and orderly and in a sanitary condition.”

OSHA 1910.22 (a)

4.1 Examples of untidy workplace

It doesn't take much effort to make the workplace untidy and thereby potentially hazardous. Some common examples of untidy workplace are:

- i. Stringing extension cords across on floor in aisles and walkways without taping them down – potential trip hazard;
- ii. Leaving tools and other objects on racks without stacking them neatly;
- iii. Blocking fire exit routes, walkways, aisles etc.;
- iv. Letting saw dust, oil spills, wood chips accumulate – potential fire hazard.

4.2 Common accidents caused by untidy workplace

Untidy workplace causes many serious accidents and injuries which may sometimes result in fatalities. Following are some examples of common accidents:

- i. Slipping on oily, greasy or wet surfaces;
- ii. Getting hit by falling objects;
- iii. Tripping over objects on floors and stairways;

- iv. Striking against projecting material;
- v. Cutting or puncturing the skin on projecting objects.

4.3 Benefits of effective housekeeping program

The housekeeping program has numerous benefits. Besides the few listed below, it improves your attitude towards better working conditions and safety, and in turn increases the productivity.

- i. Less number of slipping and tripping accidents;
- ii. Reduced fire hazards;
- iii. Reduction in workers exposure to hazardous situations;
- iv. Efficient equipment cleanup and maintenance;
- v. Effective use of available space;
- vi. Better hygienic conditions;
- vii. Improved morale.

4.4 Planning a housekeeping program

One has to remember that housekeeping means maintaining the workplace in a tidy and safe condition and not just accomplishing it at once, it has to be a continuous process and part of everybody's routine.

A good housekeeping program manages storage and movement of material in a safe and cost effective manner. It might increase the inventory adding few more trash cans but eventually it proves to be cost effective.

- i. Process of Housekeeping Program:
- ii. Removal of tripping/slipping hazards during the work-hours;
- iii. Cleanup after the work-hours;
- iv. Daily or weekly waste disposal;
- v. Removal of unused material;
- vi. Inspection to ascertain expected tidiness is achieved.

4.5 Elements of a housekeeping program

4.5.1 Dust and dirt removal

Various fabrication activities such as drilling, tapping, grinding, sanding, arc welding, and torching create metal pieces and dirt. Never use compressed air to blow off such kind of dirt. Vacuum cleaners are known to be the best solution for cleaning the workplace of such materials. However, some metal pieces formed by drills and dirt in confined spaces can not be picked up by vacuum cleaners. In such conditions, manual cleanup is required which should be carried out carefully using appropriate PPE.

(i.e. Gloves, goggles, and if necessary, apron)

4.5.2 Walking and working surfaces

Aisles and stairways should be maintained free of materials. It should be noted that an aisle is not a place for stacking material which can not be accommodated in the designated storage area.

A poor floor condition is the main cause of slipping/tripping accidents. Therefore, the floor should be maintained free of such hazards. Spilled oil or other lubricants should be wiped cleaned immediately. Straps used for lifting material by crane should always be replaced on the racks. Packing material should always be disposed off immediately. Care should be taken while using gas-torch that the gas-hoses will not form a trip hazard. Cables and other hydraulic hoses should be covered with metal plates so as to minimize the trip hazard. Metal shavings produced by drill machines should be promptly cleaned. Caution signs such as, work area or slippery floor should always be used where applicable.

4.5.3 Tools

The CSEE Department has a variety of power tools and equipment in the laboratory. Some hand held power tools are drills, band saws, grinders, sanders, hammers, files etc. The machinery consists of lathe machines, milling machines, shaping machine, and bench grinder. You must make sure that the tools and machinery used by you are clean before you leave, otherwise you could be denied future use of laboratory facilities. If something was found defective during the course of the work, it must be reported to Mr. Duane Kozlowski at the earliest, leaving the fault unattended could lead to a serious accident. Never use faulty equipment. Your safety is more important than the job schedule.

All hand tools must always be returned to the designated storage area after working. Even while working, they should never be placed in aisles or walkways as, it could create serious tripping hazards.

All power tools must be unplugged whenever not in use e.g. during the lunch break and the power cords and extension cords should be wound. The power tools can accidentally start and cause an accident.

4.5.4 Waste disposal

The CSEE Department follows the recycling policy. Every occupant of the laboratory must make sure that he/she is not mixing the steel or wood trash with general trash. There are separate trash cans for steel, wood and general trash. If in doubt, the occupant should clarify where he/she should dispose the waste.

4.5.5 Storage

All material must be stored away from the walkways and aisles. Fire exits must be kept clear of all stored material and projecting material. Preferably, material should be stored in such locations which would require less re-handling.

Stored material must allow at least three (3) feet of clear space under the fire sprinkler heads.

Flammable material such as lubricating oil, propane cylinders should be stored only in the designated areas. These areas shall be clearly marked with hazard warning signs.

Material Safety Data Sheets (MSDS) must be accessible for each hazardous stored material.

4.6 General housekeeping tips

- Never leave tool drawers open;
- Stack all items only in the designated areas;
- Move the items away from stairways and aisles where they can create a trip hazard;
- Have only the tools and material in the work area that are necessary for the job;
- After working with a tool, put it in its place. If using personal tools create a safe place for them;
- Clean up the spills and dirt immediately;
- Place trash in the right containers;
- After gas-torching, clean up the slag when it is cool enough to handle;
- Cleanup your machinery before you leave – it's a part of your job;
- Report any burnt bulbs to laboratory personnel;
- Store all hazardous materials with proper labels.

5 First Aid

Every year about 140,000 deaths occur as a result of injuries. Many of these injuries did not have to end in death if someone; a co-worker, a nurse or any other person, who witnessed the injury had been able to make a fast decision to provide first aid to the injured, and organize to get an ambulance as soon as possible. When severe injuries occur, minutes count. Quick, calm, and educated decisions can keep an injury from getting worse, or save a life.

There are some minor injuries or first-aid injuries that need some care and in-house treatment by the injured person himself or by a co-worker. Minor cuts, bruises, and ‘grit in the eye’ fall in this category.

First aid is known to have been practiced ever since the beginning of humanity. Every citizen is expected to learn first aid as a civic responsibility. This module will familiarize you with some of the above situations, and provide some guidelines to take care of minor injuries, and first-aid in case of some injuries until the ambulance arrives or the injured person is rushed to the nearest hospital.

5.1 Wounds

A wound is caused when a tissue in our body is torn or cut.

Types of wounds:

- **Incised wounds** caused by sharp instruments. These wounds bleed extensively.
- **Contused wounds** caused by crushing. These wounds look bruised.
- **Lacerated wounds** caused by rough surfaces. These wounds bleed less.

Wounds pose two dangers namely bleeding and infection.

5.1.1 Treating bleeding

- i. Press the sides of wound together to bring them together
- ii. Raise the injured part of body (only if fracture is not suspected)
- iii. With your palm, gently press a pad bigger than wound on the wound until bleeding lessens and finally stops.
- iv. If bleeding continues, add new pads without removing original pad(s).
- v. Bandage firmly but not too tightly.

5.1.2 Measures to avoid infection

- i. The first aid provider must wash own hands thoroughly with soap and water;
- ii. The external wound should be cleaned thoroughly with potable water and should be dried with sterile gauze;
- iii. Wound should be covered with sterile or dry sterile gauze;
- iv. Cotton should not be allowed to be in direct contact with the wound;
- v. If antiseptic cream is intended to be used, it should not be mixed with water;
- vi. The wound should be bandaged.

5.2 Burns and scalds

Burns are caused when the skin comes in contact with dry heat like fire/flames, hot metal, live wires etc.

Scalds are caused by moist heat like boiling water, steam, oil, tar etc.

Chemical burns are caused by strong acids and strong alkalis.

5.2.1 Degrees of burns

The degree of burn indicates the degree of damage to the tissues. Following are the degrees of a burn:

- First Degree Burns: The skin appears reddened
- Second Degree Burns: Blisters are seen on the skin
- Third Degree Burns: There is destruction of deeper tissues with scarring

5.2.2 Danger of burns

- They could lead to excessive loss of body fluids;
- They produce severe pain;
- They could lead to infection in affected area;
- After healing they could leave scars and could restrict movements.

5.2.3 Treating extensive burns

- i. Try to keep the patient calm;
- ii. Do not remove adhering particles of charred skin;
- iii. Cover the burnt area with a clean dressing and bandage;
- iv. If hands are burnt, they should be placed above the level of victim's heart;
- v. If feet or legs are burnt, they should be elevated;

- vi. If face is burnt, sit up the patient and observe for breathing difficulty. Maintain an open airway if respiratory problems develop;
- vii. Do not open the blisters on victim's skin;
- viii. Try and remove all rings, bangles, belt and boots from the victim's body immediately as it may be difficult later if the limbs begin to swell;
- ix. If medical help can not be reached for an hour, and if the victim is conscious and not vomiting, try to feed a weak solution of salt and soda [one teaspoon of salt and half teaspoon of baking soda per quart of water].

5.2.4 Treating minor burns

- i. Clean the affected area gently with water;
- ii. Immerse the burnt area in cold water;
- iii. Never apply cotton wool directly over the burnt area;
- iv. No greasy substance should be used over the affected area.

5.2.5 Treating chemical burns

- i. The burn should be washed with a large quantity of water by using hose or shower as quickly as possible – this washes away much of the irritants;
- ii. Contaminated clothing should be cut out;
- iii. Burnt area should not be touched;
- iv. The area should be treated as for burns depending on the severity of the burn.

5.3 Fractures

Fracture is defined as complete or partial breakage of a bone.

5.3.1 Types of fractures

- Simple – Broken ends of the bone do not cut open the skin
- Compound – Broken end of the bone may be in contact with open air
- Complicated – An internal organ is broken in addition to the fractured bone

5.3.2 Signs of fractures

- i. Severe pain at and/or around place of fracture
- ii. Swelling and tenderness over the area with partial discoloration
- iii. Inability to perform normal movements of the affected part

- iv. Deformity of the limb. The limb may also appear shorter.
- v. Crackling sound or unnatural movements may be felt in the area of fracture (this should never be tampered with by the first aid provider)

5.3.3 Aims of first-aid for fractures

- Prevention of further damage
- Reduction in pain
- Making the patient feel comfortable
- Getting medical aid as soon as possible

5.3.4 Treating fractures

- i. Fractures generally occur with other injuries like wounds. Symptoms like heavy bleeding must receive priority for first-aid over a fracture
- ii. Patient should be handled gently avoiding all unnecessary movements
- iii. If broken ends of the bone are seen above the skin, the wound should not neither be washed nor should be treated with any antiseptics.
- iv. The fractured area should not be handled unnecessarily
- v. No attempt should be made to reduce the fracture or to bring the bones to normal position
- vi. Effort should be made to stabilize and support the injured area so that no movement is possible. This helps in reducing further injury and controls bleeding.
- vii. The fracture area and joints on both sides of fracture should be immobilized by using bandages. It is essential that rescuer be familiar with the use of bandages.

5.4 Electrical injuries

When a part of body comes in contact with a live electric wire or cable from which current is leaking, the person gets an electric shock. The electric shock could be produced only when the electric current passes through human body, which is in contact with the earth. It passes more quickly if the contacting part is wet or moist. In wet conditions, even lower voltages could be dangerous.

5.4.1 Effects of electrical shock

Depending on the voltage and duration of contact, one or all of the following may occur.

- Fatal Stoppage of the heart
- Sudden stoppage of breathing due to sudden paralyses of breathing muscles

- Superficial or deep burns

5.4.2 Treating victims effected by electric shock

The rescuer must behave responsibly and intelligently. If not, the rescuer may become a victim himself/herself and receive an electric shock or die along with the initial victim.

- i. The source of current should be switched off if the victim is in contact with the current. This must be done with rescuer standing on a dry piece of wooden board. Where possible, rubber gloves should be worn.
- ii. Never use a knife or scissors to cut the current carrying wire.
- iii. If the current is of very high voltage, the rescuer is at greater danger as arcing can occur. The victim should be dragged using non-conductive material like wooden stick, wooden plank or a dry nylon rope.
- iv. If the victim is not breathing properly, artificial respiration should be given.
- v. If required, victim should be treated for burns.
- vi. The victim should be transferred to professional medical facilities providers as soon as possible.
- vii. The victim has to be examined by a medical practitioner as mild electrical injuries produce effects only after a while.

5.5 Foreign bodies

5.5.1 Foreign body under the skin

The skin may be pierced by metal, wooden or glass pieces.

Unless very easy to deal with, the victim should be administered with professional medical aid after dressing the wound.

5.5.2 Foreign body in the eye

Insects, dust, metal particles from lathes and other machine tools, wood particles etc. are common objects that a foreign body in the eye. They cause irritation and reddening of the eye if not removed promptly. Penetrating foreign bodies are a serious danger to eye.

Treating Victim Having a Foreign Body In The Eye

- i. The victim should be instructed to not to rub the eye.

- ii. The victim should be taken to sufficiently illuminated area. The lower eyelid should be pulled down and the foreign body should be taken out with a moist swab provided the foreign body is floating and not penetrated.
- iii. If the foreign body is not visible, it could be under the upper eyelid. The victim should be instructed to hold clean water in his hands and blink several times, immersing the eye in water.
- iv. If the foreign body is penetrated in the eye, do not touch it. Those are for the doctors to handle. Apply a soft pad and instruct the victim to not rub the eye take him/her quickly to hospital.
- v. If the injury is suspected to be from chemicals or plant oils, blinking eyelids several times under water is the best first-aid. Thereafter, apply a soft pad and take the victim to the hospital.

5.5.3 Foreign body in the ear

- If the foreign body is an insect, the ear should be filled with glycerin or warm salt water. If the insect floats up, it can be removed easily.
- If nothing floats up, take the patient to the doctor as soon as possible.

5.5.4 Foreign body in the nose

Instruct the patient to breath through the mouth. Take the patient to the doctor. Do not try to remove the foreign body.

5.6 Managing an unconscious patient

A person could become unconscious due to various reasons. Following are the general principles of providing first-aid to an unconscious person.

- i. Person should be moved an area having free supply of fresh air.
- ii. Dentures should be removed as they pose a chocking hazard.
- iii. Clothing at neck, chest and waist should be loosened.
- iv. If breathing has stopped or about to stop, turn the patient into required posture and start artificial respiration.
- v. Do not give food or drinks to the patient.
- vi. If you know specific cause of unconsciousness and particular remedial measures, do apply them.
- vii. Try to observe the patient continuously; do not leave the patient unattended at any time.
- viii. Move the patient to a hospital.

5.7 Contents of first-aid box

The following basic items must be present in the first-aid box at all times. If they are used up it should be reported to the Department Chair for re-ordering.



- Two pairs of Latex, or other sterile gloves;
- Sterile dressings to stop bleeding;
- Cleansing agent/soap and antibiotic towelettes to disinfect;
- Antibiotic ointment to prevent infection;
- Burn ointment to prevent infection;
- Adhesive bandages in a variety of sizes;
- Eye wash solution to flush the eyes or as general decontaminant;
- Thermometer.

5.8 Bloodborne pathogens exposure control plan

Program Purpose

The purpose of this program is to ensure worksite safety and promote a healthy environment for all persons.

Bloodborne pathogens are disease-causing germs carried by blood. If there is an accident or situations involving blood or other body fluids that may be mixed with blood, serious diseases can be transmitted. Two of the most dangerous diseases are caused by the Hepatitis B Virus (HBV) and the Human Immunodeficiency Virus (HIV). Other bloodborne diseases include syphilis, malaria and hepatitis C. Hepatitis B is one of the most common bloodborne viruses that could be present in blood or bodily fluids. This disease can cause severe damage to the liver, and can even lead to death. Vaccines are in existence to help prevent HBV. Although HIV is not likely to be spread in the workplace, it could happen anywhere that blood / bodily fluids are present. The HIV virus decreases the body's ability to fight infection. HIV is known to cause acquired immune deficiency syndrome (AIDS), which leads to death. There is presently no known vaccine for HIV.

All persons must be trained on the information in this plan. Any site-specific information that may apply to persons using our facilities should be included in this training.

Statement of Policy – Bloodborne Pathogen Exposure Control

The University is committed to providing a safe and healthful work environment for all employees. In pursuit of this endeavor, the following exposure control plan is provided to eliminate or minimize occupational exposure to bloodborne pathogens in accordance with OSHA standard 29 CRP 1910.1030, “Occupational Exposure to Bloodborne Pathogens.”

The Exposure Control Plan is a key document to assist the lab in implementing and ensuring compliance with the standard, thereby protecting all concerned. The Exposure Control Plan includes:

Program Administration

Employee Exposure Determination

Methods of Exposure Implementation and Control

Hepatitis B vaccination

Post-Exposure Evaluation and Follow-Up

Administration of Post-Exposure Evaluation and Follow-Up

Procedures for Evaluating the Circumstances Surrounding an Exposure Incident

Training

Recordkeeping

Procedures for Evaluation of Circumstances Surrounding an Exposure Incident

Specific Procedures for Facility Users to Avoid or Minimize Exposure

Program Administration

The Department Chair is responsible for the implementation of the Facility Exposure Control Plan.

The Department Chair will maintain, review and update the Exposure Control Plan at least annually and whenever necessary to include new or modified tasks and procedures.

Those workers who are determined to have occupational exposure to blood or other potentially infectious materials must comply with the procedures and work practices outlined in this Exposure Control Plan.

The Site Safety Officer will maintain and provide all necessary personal protective equipment (PPE), labels, red biohazard bags and sharps disposable biohazard containers as required by the standard.

The Site Safety Officer will ensure that all medical actions required are performed and that appropriate employee health and OSHA records are maintained.

The Site Safety Officer will be responsible for training, documentation of training, and maintaining the written Exposure Control Plan available to workers, OSHA and NIOSH representatives.

Programs are in place for each category of employees concerning:

What to do when there is a blood spill

Personal Protection

Clean-up and Disposal

Disinfection

What to do with contaminated surfaces, objects and laundry

Notification to all workers that there are special procedures necessary when anyone in any work area feels he / she has been exposed to a bloodborne pathogen. This shall also be part of the continuing education through safety programs.

Informing all persons of the location of the Exposure Control Plan.

Procedure to follow for person filing a Report of Possible Exposure to Bloodborne Pathogens.

Exposure Determination

Methods of Implementation and Control

Standard Precautions

Understanding the purpose of the Bloodborne Pathogens Program begins with knowing that "Standard Precautions" means "Treating all Blood and Body Fluid as if Infectious". All workers will utilize universal precautions.

Exposure Control Plan

Persons covered by the bloodborne pathogens standard shall receive an explanation of this plan during initial orientation. It will also be reviewed in annual refresher training during a safety meeting.

The Site Safety Officer is responsible for reviewing and updating the Exposure Control Plan annually or more frequently if necessary to reflect:

new or modified tasks and procedures which affect occupational exposure

new or revised positions with occupational exposure

changes in technology that eliminate or reduce exposure to bloodborne pathogens

Work Practice Controls

Work practice controls will be used to prevent or minimize exposure to bloodborne pathogens. The specific work practice controls in the form of procedures are detailed at the end of the Exposure Control Plan.

The University evaluates new procedures or needs for changes in workplace practices by:

Direct involvement by operations management

Student feedback and recommendations

Biohazard Waste Guidelines

Any soiled wound dressing or other material that is saturated to the point of dripping and releasing blood or bloody body fluids if compacted in a waste receptacle should be then deposited into a designated biohazard collection unit. Unsaturated soiled would dressings and other materials should be disposed of in such a manner as to confine and contain any blood or bloody fluids that may be present. For example,

small dressings or materials can be enclosed in the disposable glove used to remove them by pulling the glove off inside out containing the material inside of it. This glove with the material inside can then be discarded into the regular trash receptacle for disposal. Larger dressings and materials should be removed using gloved hands and placed inside a plastic bag. This bag can then be deposited into the regular trash receptacle.

Items that may contain urine and feces should be handled with Standard Precautions. Urine and feces should be flushed down the toilet. Toilets should be kept clean and free of gross contamination inside and out. Large or un-flushable items that may contain urine or feces can be bagged and placed into the regular trash. If gross contamination is present on any of these items, they should be bagged and placed in designated biohazard collection units.

Personal Protective Equipment (PPE)

PPE is provided at no cost to. Training is provided by the Site Safety Officer or designated trainer in the use of appropriate PPE for the tasks or procedures to be performed.

The types of PPE available are as follows:

Gloves

Safety Glasses

Masks

Aprons

Safety Tongs

All persons using PPE must observe the following precautions:

Wash hands immediately or as soon as feasible after removal of gloves or other PPE.

Remove PPE after it becomes contaminated and before leaving the work area.

PPE may be decontaminated by using a solution of 1 part bleach and 4 parts water.

Utility gloves may be decontaminated for reuse if their integrity is not compromised. Discard utility gloves if they show signs of cracking, peeling, tearing, puncturing or deterioration.

Never wash or decontaminate disposable gloves for reuse.

Wear appropriate gloves when it can be reasonably anticipated that there may be hand contact with blood or other potentially infectious material and when handling or touching contaminated items or surfaces.

Replace gloves if torn, punctured, contaminated or if their ability to function as a barrier is compromised.

Remove immediately or as soon as feasible any garment contaminated by blood or other potentially infectious material, in such a way as to avoid contact with the outer surface. Dispose of in red biohazard bag.

6 Module 6: Fire Protection

Fire safety is important business. According to National Safety Council (NSC) figures, losses due to fires in 2001 totaled \$4.1 billion, and 3900 persons lost their lives. Fires and burns accounted for 4.9 percent of all unintentional injury deaths in 2001, in the U.S.A.

There is a long and tragic history of workplace fires in our country. One of the most notable was the fire at the Triangle Shirtwaist Factory in New York City in 1911 in which nearly 150 women and young girls died because of locked fire exits and inadequate fire extinguishing systems.

History repeated itself several years ago in the fire in Hamlet, North Carolina, where 25 workers died in a fire in a poultry processing plant. It appears that here, too, there were problems with fire exits and extinguishing systems.

Most victim of fires die from smoke or toxic gases and not from burns (Hall 2001).

6.1 Most common causes of workplace fire

- Improperly used or maintained electrical equipment
- Smoking
- Blocking heater vents
- Poor housekeeping

6.2 Types of fires

- "Class A fire" involves ordinary combustible materials such as paper, wood, cloth, and some rubber and plastic materials.
- "Class B fire" involves flammable or combustible liquids, flammable gases, greases and similar materials, and some rubber and plastic materials. Some examples are, gasoline, oil, some paints, and solvents.
- "Class C fire" involves energized electrical equipment such as power tools, wiring, and fuse boxes, .
- "Class D fire" involves combustible metals such as magnesium, titanium, zirconium, sodium, lithium and potassium.

6.3 Types of fire extinguishers



Water: These extinguishers contain water and compressed gas and should only be used on Class A (ordinary combustible) fires, that include wood and paper etc. **It is dangerous to use water or an extinguisher labeled only for Class A fires on fires involving flammable liquids or energized electrical equipment.**

(a) Water Type Fire Extinguisher for Class A Fires



Carbon Dioxide (CO₂) extinguishers are most effective on Class B and C (combustible liquids and electrical) fires. Since the gas disperses quickly, these extinguishers are only effective from 3 to 8 feet. The carbon dioxide is stored as a compressed liquid in the extinguisher; as it expands, it cools the surrounding air. The cooling will often cause ice to form around the “horn” where the gas is expelled from the extinguisher. Since the fire could re-ignite, continue to apply the agent even after the fire appears to be out.

(b) Carbon Dioxide Type Fire Extinguisher for Class B & C Fires



Dry Chemical extinguishers are usually rated for multiple purpose use. They contain an extinguishing agent and use a compressed, non-flammable gas as a propellant.

(c) Dry Chemical Type Fire Extinguishers for Class A, B, C and D fires

Table 6.1 classifies 4 types of fires against 4 types of portable fire extinguishers. It is necessary for every occupant to have the knowledge of the applicability of each of the extinguishers.

Types of Fires	Water Type	Carbon Dioxide	Dry Chemical
Class A Fires (Wood, paper, trash)	YES	NO	YES
Class B Fires (Flammable liquids, gasoline, oil, paints, grease)	NO	YES	YES
Class C Fires (Electrical equipment)	NO	YES	YES
Class D Fires (Combustible metals)	Special extinguishing agent required	-	-
Method of Operation	Pull pin, squeeze handle	Pull pin, squeeze lever	Pull pin, squeeze handle
Range	30'-40'	3'-8'	5'-30'
Maintenance	Check air pressure gauge monthly	Weigh semi annually	Check gas pressure gauge and condition of dry chemical annually

Table 6.1: Selection of fire extinguishers

6.4 Fire detection and alarm

When you discover a fire, smell or see smoke, or detect any other emergency that endangers building occupants, Pull the Fire Alarm. Figure 6.2 below, shows a typical fire alarm.



WARNING: Malicious False Alarms are a criminal code offense with up to a \$5,000 fine, and/or two year jail term, and a criminal record for life.

Figure 6.2: Typical fire alarm pull station

The locations of fire alarm pull stations and portable fire extinguishers in CSEE Department facilities are given in Figures 6.4, 6.5, 6.6. Please walk through CSEE Department facilities and familiarize yourself with these Fire Alarm Pull Stations. Learning the location of fire extinguishing equipment and fire alarm pull stations in your work area is important.

6.5 Using fire extinguishers

The University provides portable fire extinguishers of various types throughout all University buildings. **These quick fire suppression devices are designed to be used in the early stages of fire development by persons trained in their use.** If you have not received training in the use of portable fire extinguishers, do not attempt to use them, simply follow the RACE Action Plan and exit the building.

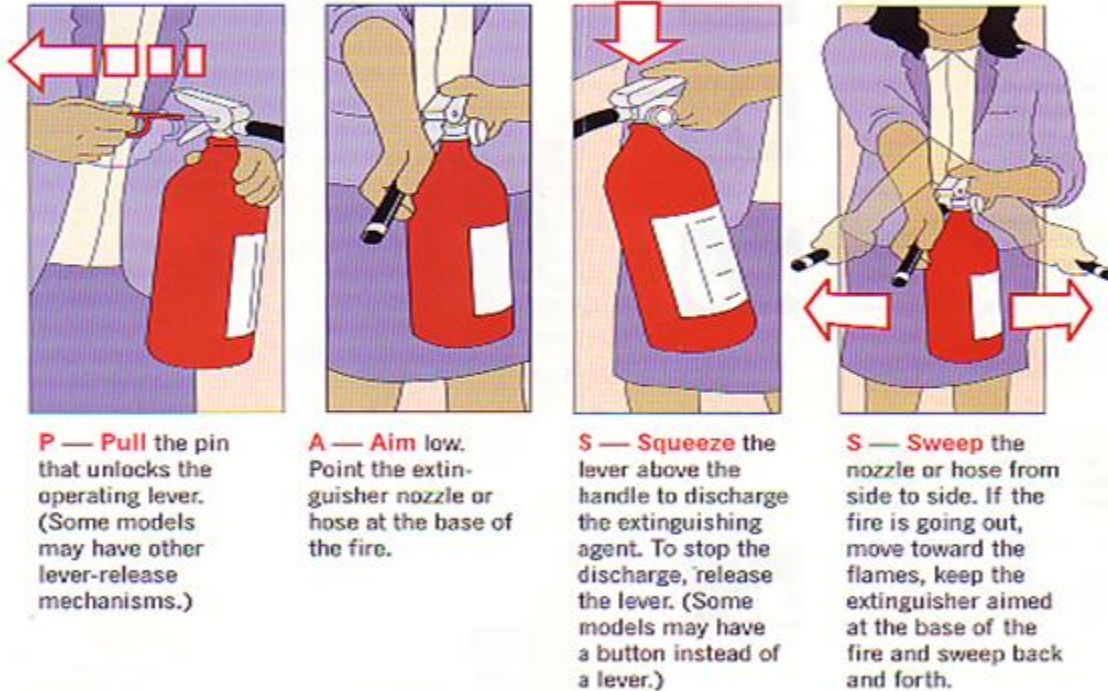
SPECIAL NOTE: Fire hose lines are located in cabinets in specific locations throughout University buildings. Use of these hose lines is restricted to professional fire fighters who are properly trained and equipped. No one else should attempt to use the hose lines to extinguish or control a fire, simply follow the RACE Action Plan.

The process of opening and using fire extinguishers is illustrated in Figure 6.3.

PASS: fighting a small fire

Keep your back to a clear exit and stand six to eight feet (two to three meters) away from the fire. If the fire does not go out, leave the area.

To operate your extinguisher, remember the word PASS.



Once the fire goes out, watch the fire area and be prepared to repeat the process if the fire re-ignites.

Figure 6.3: Using fire extinguishers

The following CSEE Department employees are trained in fighting small fires, using portable fire extinguishers. These employees are updated annually and include:

- Mark C. Pitman
- Todd Snyder
- Duane A. Kozlowski
- Scot A. Weinreber

6.6 Building occupant action plan in the event of a fire (RACE)

Employees discovering or becoming aware of a fire should immediately take the following actions.

1. **Rescue** yourself first, if you are able without placing yourself at risk, assist others from the fire area who may need assistance. Do not endanger your well being but notify emergency responders of persons who may require rescue.
2. **Announce** to everyone in the fire area of the emergency and activate the nearest fire alarm pull station. Call Campus Police from a safe area at 645 2222 and inform them of the exact location of the fire. The caller should give the Campus Police as much information about the emergency as possible, i.e. type of emergency, exact location and services needed.
3. **Contain** the fire and hot toxic smoke being produced by closing the door (do not lock the door) of the fire room as you leave. This simple action will hold the fire back and keep smoke from entering the corridors allowing time for everyone to escape.
4. **Escape** the fire building by following the exit signs to the nearest exit and proceed to the outside. Go to the nearest fire-free and smoke-free stairwell. Do not use the elevators. The electrical power to the elevators may be cut off and you may be caught between floors. After leaving the building, proceed to a distance of 50 feet and assemble with your group. Do not re-enter the building for any reason until an “all clear” is given by the fire department.

When the fire alarm sounds, STOP what you are doing and leave the building immediately



Remember: When fire strikes, get out & stay out

SPECIAL NOTE: If you are in a room other than the fire room when the fire alarm is activated use caution before entering into the corridor to escape. First check your door for heat, if it is hot to the touch do not open it, use another escape route or simply stay where you are and phone Campus Police at 645-

2222 to inform them of your location. If there is no phone in the room, go to the window and alert emergency responders of your location.

An easy way to remember this Action Plan is to use the acronym

RACE - Rescue Announce Contain Escape

Emergency Guidelines for Trapped Individuals:

- Stay calm and take steps to protect yourself
- Go to a room with an outside window, and telephone for help if possible
- Stay where rescuers can see you and wave a light-colored cloth to attract attention
- Open windows if possible, but be ready to shut them if smoke rushes in
- Stuff clothing, towels, or newspapers around the cracks in doors to prevent smoke from entering your room.

Clothing fire:

For a clothing fire, “stop, drop, and roll”. Immediately drop to the floor and roll over repeatedly to extinguish the flames, holding your hands over your face to protect it from flames.

6.7 Emergency evacuation routes

Figures 6.4, 6.5, and 6.6 show the fire exit doors. These doors have emergency exit push bars. You are required to study the shortest route to the nearest exit door from your place of work.

The emergency exits are shown to provide a general guideline to escaping from the building. However, the occupants are required to examine the severity for themselves and then decide on whether or not to use the emergency exits and which exit to be used [if safe].

6.8 Fire safety procedures

All students, staff, faculty and laboratory employees of CSEE Department should know the following:

- Be familiar with the CSEE Department facilities emergency evacuation routes, see figures 6.4, 6.5, and 6.6.
- Know the pathway to at least two alternative exits from every room/area at the workplace;
- Recognize the sound/signaling method of the fire/evacuation alarms

- Know who to contact in an emergency and how to contact them
- Know how many desks or cubicles are between your workstation and two of the nearest exits so you can escape in the dark if necessary
- Know where the fire/evacuation alarms are located and how to use them
- Report damaged or malfunctioning safety systems and back-up systems

6.9 DO's and DON'Ts of fire safety

Avoid fire risk by following these do's and don'ts:

DOs:

- Have wires replaced when insulation becomes frayed or worn;
- Ensure use of correct cables for the job;
- Use extension cords that are in good condition and adequate for the task;
- Check to see whether the ground connections are sound;
- Keep spontaneously combustible material away from light and machinery;
- All gas cylinders should be chained to a cart or wall;
- Maintain electric arc equipment;
- Store spare oxygen and fuel gas cylinders in separate areas;
- Place flashback arrestors on all oxygen and fuel gas connections;
- Always obey the "NO SMOKING" sign.

DON'Ts:

- Do not use temporary wiring;
- Do not overload machinery, circuits and power outlets;
- Do not leave equipment or machinery running unattended;
- Do not keep spare cylinders near the work area;
- Do not block fire exit doors;
- Do not block access routes to fire exit doors (including hallways and stairs);
- Do not place furniture, file cabinets, or garbage cans in the Ketter Hall hallways;
- Do not take the fire extinguishers out of their hooks or use them for other purposes such as door-stops;

- Do not cover or hide the fire extinguishers, fire hose lines, or fire alarm pull stations;
- Do not use or store sources of ignition, such as cigarettes, matches, portable heating equipment, unguarded light bulbs etc., in areas where explosives, flammable liquids, gases or any other combustibles exist.

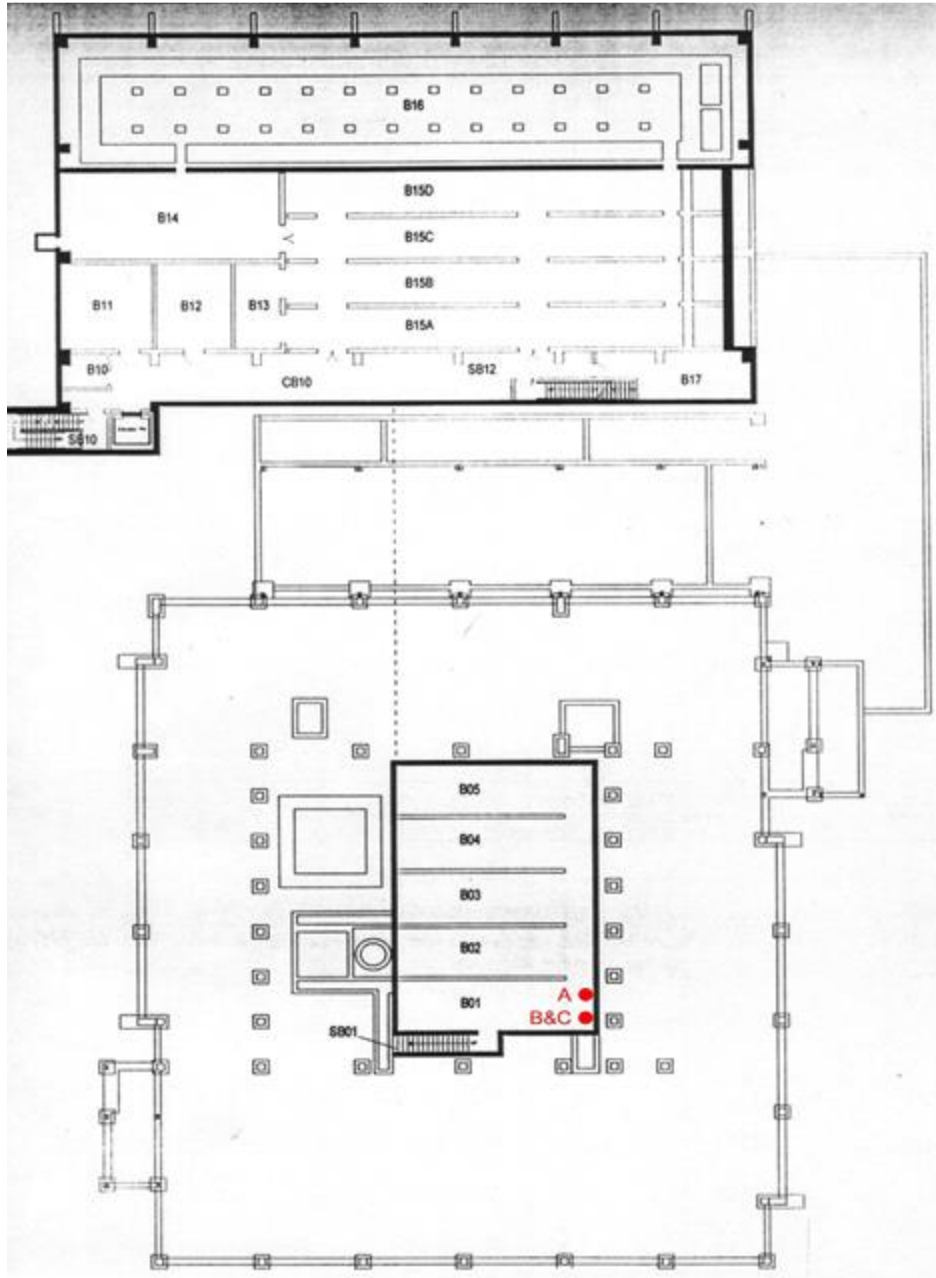


Figure 6.4: Ketter Hall basement floor plan

- **A** **Class A type fire extinguisher**
- **B&C** **Class B & C type fire extinguisher**
- **P** **Fire alarm pull station**

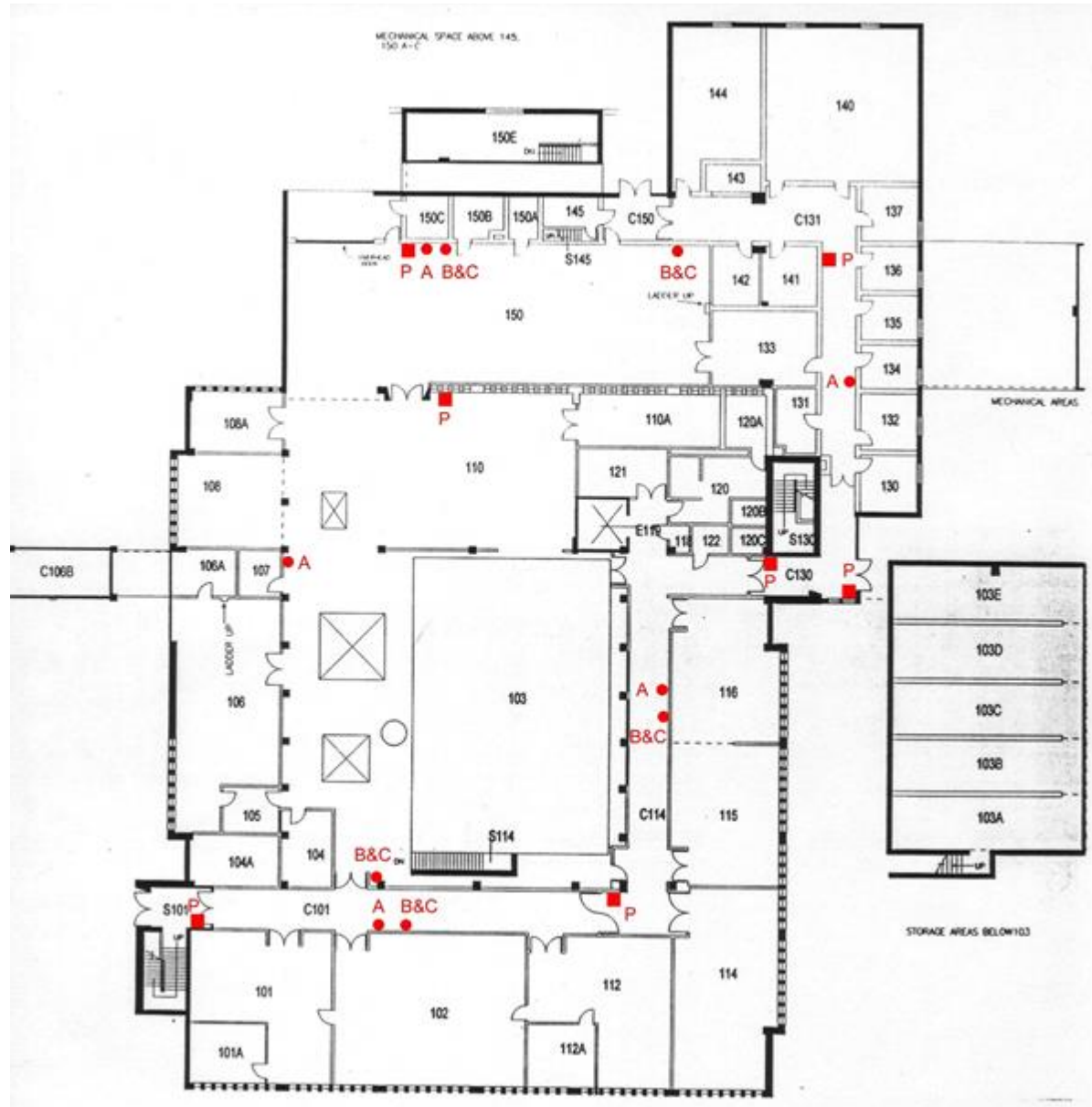


Figure 6.5: Ketter Hall first floor plan

- A Class A type fire extinguisher
- B&C Class B & C type fire extinguisher
- P Fire alarm pull station

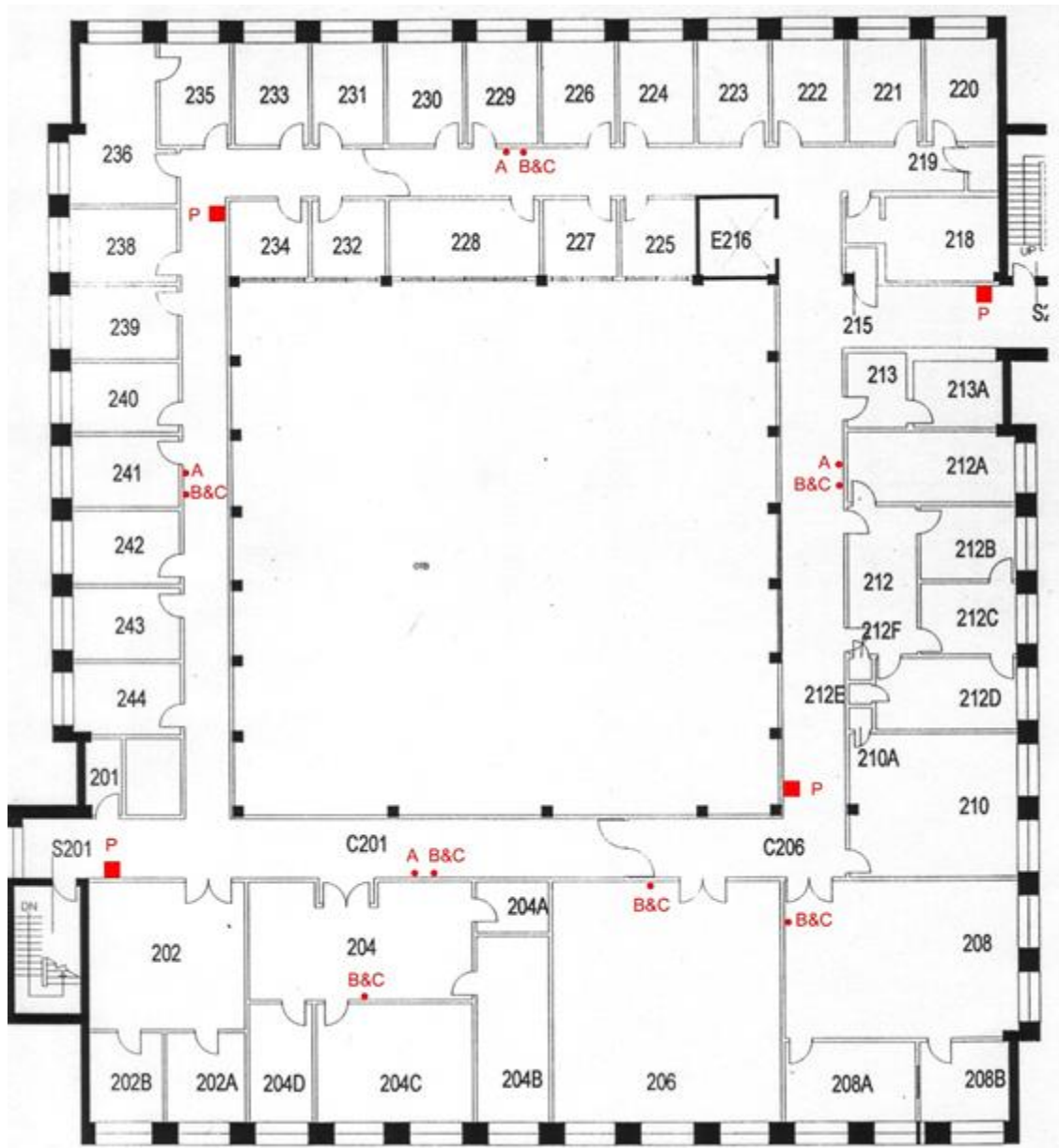


Figure 6.6: Ketter Hall second floor plan

- A Class A type fire extinguisher
- B&C Class B & C type fire extinguisher
- P Fire alarm pull station

KETTER HALL BUILDING EVACUATION PROCEDURES

General Procedures:

It is the personal responsibility of all University buildings occupants to immediately exit the building when the fire alarm is activated. Remaining in the building is unacceptable, regardless of the reason. Occupants should exit from the closest stairway/exterior door to their area. Elevators are not to be used. Regardless of which exit is used, building occupants should proceed to their designated assembly area for check in with their floor fire safety warden. Persons shall not enter the building until advised that it is safe to do so by authorized personnel after the building has been declared safe by the fire department on location.

Evacuation Assembly Area:

The designated areas for assembly are the sidewalks to the east of Ketter Hall (between Ketter and Jarvis Hall). Occupants from Ketter Hall should gather as follows:

- Floor 1 should assemble on the south side of the sidewalk (closest to Bonner)
- Floor 2 should assemble on the path between Ketter and Jarvis Halls
- SEESL/NEES staff should assemble on the sidewalk immediately outside the exterior door closest to Ketter 140.

In the event of inclement weather, the assembly area will be the overhang on Furnas Hall. Occupants are asked to assemble by floor, with Floor 1 assembling closest to the Student Union, Floor 2 in the middle of the area, and SEESL closest to Ketter Hall.

Fire Safety Wardens:

The Ketter Hall Fire Safety Wardens and their respective area responsibilities are:

- First Floor Ketter: Don Goralski/Traci Meagley
- Second Floor Ketter: Margie Poniatowski/Kirsten Brown
- SEESL Laboratory: Scot Weinreber/Duane Kozlowski

Role of the Floor Area Fire Safety Wardens:

Each Floor of Ketter Hall has a fire safety warden who is assigned to coordinate exit from the building and to facilitate communication between the Ketter Hall Building Evacuation Coordinator, emergency personnel, and occupants from their floor of Ketter Hall. Occupants from Ketter Hall are required to check in with their floor fire safety warden at their designated assembly area. During a building evacuation, the Floor Fire Safety Wardens will:

- Walk down the hallway of their floor, knocking on doors and telling occupants to leave immediately
- Note anyone who appears to remain in the area
- Report this information to the Ketter Hall Building Evacuation Coordinator (who will be wearing the "green vest") on the way to the assembly area
- Gather occupant info at their assembly area

- And will report to "green vest" if either (a) the alarm was activated on their floor, or (b) the occupant information has changed since preliminary report.

Responsibilities of All Building Occupants:

It is the responsibility of all building occupants to

- Leave the building as quickly as possible
- Check in with their floor safety warden at the designated assembly area to ensure that their whereabouts has been accounted for
- Follow all instructions given by emergency personnel, the Ketter Hall building coordinator, and their floor fire safety warden
- Re-enter the building only after receiving permission to do so

It is the responsibility of faculty members/principal investigators to provide these instructions to all persons who enter their lab space – their students, staff, visitors, etc. – so they will know the proper procedures for emergency evacuation and will be familiar with the location of stairwells. Ketter 202 is used by student clubs as a meeting room, so student club faculty advisors should provide these evacuation instructions to the members of these clubs.

Important Information and Reminders:

Leave the building immediately.

Remain calm.

Quickly but safely stop your work.

Gather personal belongings if it is safe to do so. Remember to take keys and any prescription medications possible, since it may be hours before occupants will be allowed back in the building.

If safe, close office or lab doors but do not lock them.

Use the closest safe stairway and proceed to the nearest exit. Do NOT use the elevators.

Proceed to the designated assembly area and report to the floor fire safety warden.

Re-enter the building only after receiving permission from authorized personnel to do so.

Submitted by:

Andrew Whittaker
Professor and Chair
Department of Civil, Structural and Environmental Engineering
August 12, 2010

7 Module 7: Emergency Procedures

Emergency Preparedness at the University at Buffalo

Emergencies caused by disasters, accidents, injuries, and crime can occur at any time without warning. Being physically and psychologically prepared to handle unexpected situations is an individual as well as an organizational responsibility.

Read and keep these 'Emergency Procedures' in an accessible place in your office for immediate reference and do not file it. When you are familiar with the information, you will be better prepared to protect yourself and your co-workers.

What You Can Do to Prepare Yourself for an Emergency?

- Keep enough emergency supplies in your office or car (medication, flashlight, comfortable shoes, bottled water, food, batteries, portable radio) for up to seventy-two (72) hours in case of a serious emergency;
- Become familiar with the quickest exit routes from your office/building;
- Locate the nearest fire extinguisher and pull station, and register for a fire-extinguisher training course;
- Register for cardiopulmonary resuscitation (CPR), first-aid, crime prevention, or other safety training courses; and
- Prepare a plan for yourself and your co-workers specifying what to do, where to go, and how to cope until you are all able to get home.

7.1 Power outage emergency

The inherent danger during a major power outage is panic. Try to remain calm. In the event of a major, campus wide outage, the University has emergency generators that will immediately provide emergency power to selected areas of the campus.

Keep flashlights and batteries in key locations throughout your work areas.

7.1.1 In case of a power outage

- i. Remain calm;
- ii. Follow directions from the Department of Public Safety for immediate action;

- iii. If evacuation of a building is required, seek out people with special needs and provide assistance, call 645-2222 for assistance;
- iv. Laboratory personnel should secure all experiments, and unplug electrical equipment before evacuating. All chemicals should be stored in their original locations. Provide natural ventilation by opening all windows and doors. If this is not possible or natural ventilation is inadequate, evacuate the laboratory until power is returned;
- v. Do not use candles or other types of open flame for lighting;
- vi. Unplug all electrical equipment including computers and turn off light switches;
- vii. Do not use elevators; and
- viii. Emergency lighting for exit pathways will function for fifteen to thirty minutes following a power outage. In areas with poor natural light, evacuate promptly.

7.1.2 If people are trapped in an elevator

- i. Tell passengers to stay calm and that you are getting help;
- ii. Call 645-2222 and provide information;
- iii. Stay near passengers until police or other assistance arrives, provided it is safe to stay in the building.

7.2 Severe weather emergency

Severe weather conditions can occur suddenly or be predicted ahead of time. Severe weather likely to occur in this area includes: snow and ice storms, heavy rains, and high winds.

Campus Closure

The decision to close campus or discontinue normal campus operations is made by the University President, who may notify campus via electronic mail. Local media is also notified and provides updates.

Personal Safety

Snow and Ice: To the greatest extent possible, walk only on paths that have been cleared or sanded. Stay clear of sagging or downed power lines. Heavy snow and ice may cause tree limbs to fall; avoid areas with the heaviest concentration of trees. Exercise extreme caution when driving.

Heavy Rains and Flooding: In the case of extensive roof or window leaks or imminent flooding of ground areas, unplug electrical devices and secure all equipment by moving or covering it.

Tornado - High Winds: If possible, remain inside the building, away from windows. Report to a designated Tornado Shelter. When outside, avoid areas with the heaviest concentration of trees. Stay clear of sagging or downed power lines.

Securing Records and Equipment

Power outages may occur as a result of severe weather conditions. Equipment and office and laboratory materials could be damaged by flooding or conditions occurring as a result of broken windows or other damage to a building. Take appropriate action to secure vital records, equipment, and chemicals.

7.3 Threatening and violent behavior emergency

Threats may be statements of intent or expressions of strong emotion. They can be indirect or direct, verbal or nonverbal. Shaking a fist or pounding the desk, throwing things, and showing a weapon are all examples of nonverbal threats. Verbal threats may be indirect expressions of frustration or anger directed toward a person or office or they may be direct statements of the intention to harm. These situations are complex, and it is not expected that individuals will be able to assess whether the threat is serious and might actually lead to harm. However, it is expected that university employees consider any threat or display of hate as potentially serious.

Most people who commit violent acts exhibit warning signs. It is important to take seriously any behaviors or words that imply threat, and consult your colleagues to assess the risk. Any such situation should be reported to the CSEE Department Chair, Tel. (716)645-2114 Ext. 2446. If the threat or violent behavior poses an immediate danger, then it shall also be reported to Department of Public Safety at 645-2222.

Steps to Follow

1. If the threat is immediate, leave the situation if possible and call the Department of Public Safety, 645-2222. If threats or bizarre behavior indicate potential danger, personal safety is the top priority.

For an angry or hostile co-worker or student

- Stay calm;
- Listen attentively;
- Maintain eye contact;
- Be courteous, Be patient, Be respectful;

- Keep the situation in your control.

If shouting, swearing, and threatening continues:

- Signal a co-worker or supervisor, that you need help;
- Do not make any calls yourself;
- Have someone call the Department of Public Safety or police.

If someone is threatening you with a gun, knife, or other weapon

- Stay calm. Quietly signal for help;
 - Maintain eye contact;
 - Stall for time;
 - Keep talking--but follow instructions from the person who has the weapon;
 - Don't risk harm to yourself or others;
 - Never try to grab the weapon;
 - Watch for a possible chance to escape to a safe area.
2. If the threat isn't immediate, consult appropriate resources for help in assessing the level of danger, determining an appropriate intervention, and choosing appropriate safety measures.

7.4 Civil disturbance emergency

Civil disturbances include riots, property damage, threatening individuals, or assemblies that have become significantly disruptive. Demonstrations are visible actions designed to advocate a position on a particular issue. Most are peaceful but they become problematic when they obstruct university business.

In Case of Civil Disturbance or Demonstration

- i. Avoid provoking or obstructing demonstrators,
- ii. Secure your area (lock doors and safes; remove files, vital records, and expensive equipment),
- iii. Avoid area of disturbance,
- iv. Continue with normal routines as much as possible,
- v. If the disturbance is outside, stay away from doors or windows. Stay inside, and
- vi. If officers are not already present, call the Department of Public safety, 645-2222 to alert them to the situation.

7.5 Explosion emergency

In the event of explosion in the building, employees should take the following actions:

- i. Immediately take cover under tables, desks, or anything else that provides protection against flying glass and debris;
- ii. After the immediate effects of the explosion have subsided, call the Department of Public Safety, 645-2222;
- iii. If necessary, activate the building fire alarm system;
- iv. Evacuate the immediate area of the explosion;
- v. Seek out and assist injured and disabled persons in evacuating the building. Exit via the stairway. Do not use the elevator;
- vi. Once outside, move at least 150 away from the building. Keep roadways and walkways clear for emergency vehicles;
- vii. Wait for instructions from public safety officers or other emergency personnel. Do not reenter the building until instructed to do so.

7.6 Flooding emergency

In Case of Imminent Flooding

- i. Secure vital equipment, records, and chemicals (move to higher, safer ground). Shut off all electrical equipment. Secure all laboratory experiments;
- ii. Wait for instructions from the Department of Public Safety for immediate action;
- iii. Do not return to your building unless you have been instructed to do so by someone from the Department of Public Safety.

7.7 Earthquake emergency

If a major earthquake were to occur, the University at Buffalo needs to be prepared to provide its own resources for an unlimited period of time.

Biggest Dangers Posed By Earthquakes

- Falling objects (pictures, items in cupboards and on shelves, ceiling tiles and fixtures, furniture, file cabinets, and bookshelves);
- Swinging doors and broken windows;

- Fires (from broken natural gas lines or electrical short circuits).

7.7.1 Inside a building

- Stay inside;
- Take cover underneath a desk or table or against an inside wall, protecting your head and neck;
- Stay away from windows where glass can shatter and from objects that could fall on you;
- Do not use elevators.

7.7.2 Outdoors

- Stay in an open area away from trees, buildings, walls, and power lines. Do not enter building;
- Drop to your knees and get into a fetal position, close your eyes and cross your arms over the back of your neck for protection;
- Stay in fetal position until the shaking stops;
- In a moving vehicle, stop quickly and stay in the vehicle. Once the shaking has stopped, proceed with caution. Avoid bridges or ramps that may have been damaged by the quake.

7.7.3 After shaking stops

- Be prepared to evacuate if instructed to do so. The decision to evacuate campus will be based on the severity of the earthquake and the damage to the buildings;
- Do not use regular or cellular phones except to report serious injuries;
- Assist in the building evacuation of people with special needs;
- The Department of Public Safety will provide instructions for immediate action by means of door-to-door alert, police-vehicle loud speakers, and fire alarms;
- Do not enter any building that is deemed to be or appears unsafe. Leave the area if you smell gas or fumes from other chemicals;
- Be prepared for after shocks;
- Help injured or trapped people. Give first aid where appropriate. Do not move the seriously injured unless they are in immediate danger of further injury. Call for help.

7.8 Suspicious package or object emergency

If you receive or discover a suspicious package or foreign device, **do not touch it, tamper with it, or move it**. Dial 645-2222 immediately and report it to the Department of Public Safety.

Detecting Suspicious Packages or Letters

Suspicious packages are not limited to those delivered by a commercial or U.S. postal carrier. The following characteristics have been designated by the U.S. Post Office and the Department of Alcohol, Tobacco, and Firearms as indicators of suspicious packages:

- i. Lumps, bulges, or protrusions on package;
- ii. A lopsided or heavy-sided package or excessive masking tape;
- iii. Handwritten addresses or labels from companies (check to see if the company exists and if they sent a package or letter);
- iv. Packages wrapped in string;
- v. Excess postage on small packages or letters;
- vi. No postage or uncanceled postage;
- vii. Handwritten notes, such as, "To Be Opened in the Privacy of," "Confidential," "Your Lucky Day Is Here," "Prize Enclosed";
- viii. Restrictive markings such as "confidential" or "personal";
- ix. Improper spelling of common names, places, or titles;
- x. Generic or incorrect titles. Titles with no name attached;
- xi. Leaks, stains, or protruding wires, string, tape, etc.;
- xii. Hand delivered or "dropped off for a friend" packages or letters;
- xiii. No return address or nonsensical return address;
- xiv. Foreign mail, air mail, and special-delivery packages;
- xv. Any letter or packages arriving before or after a phone call from an unknown person asking if the item was received.

If you have a suspicious letter or package, call 645-2222.

Move people away. **Do not move or open** the package. **Do not investigate** too closely. **Do not cover** the package.

7.9 Evacuation procedure

Before an emergency, determine the nearest exit to your location, the safest route to follow, and alternate exits.

Exit Routes

Keep all exit routes free and unobstructed. Do not place any material or equipment temporarily or permanently, within the exit routes.

The CSEE Department facilities has safeguards designed to protect the students and staff during an emergency, e.g. sprinkler systems, alarm systems, fire doors, and exit lighting. They must be in proper working order at all times. If you notice that any of the emergency protection devices are not functioning, report the same immediately to CSEE Department Chair, Tel. (716) 645-2114 Ext. 2446.

Emergency escape routes for all offices and labs for CSEE Department facilities are shown on the floor plans in Figures 7.1, 7.2 and, 7.3 attached. Study them, and practice walking along the emergency exit route from your office to the nearest exit door.

Emergency evacuation plans are reviewed and / or updated annually.

Evacuation of a Building

- i. Walk – Do not run;
- ii. Do not use elevators;
- iii. Leave immediate area, but remain available to emergency personnel;
- iv. If time permits during an evacuation, secure your workplace and take personal items such as keys, purse, medication, and glasses. In fire or other dangerous conditions, evacuate immediately leaving personal items behind;
- v. Seek out people with special needs and provide assistance (the Department of Public Safety will provide assistance, 645-2222);
- vi. If you cannot return to your building, wait for instructions from the Department of Public Safety, your building manager, or other individual in-charge.

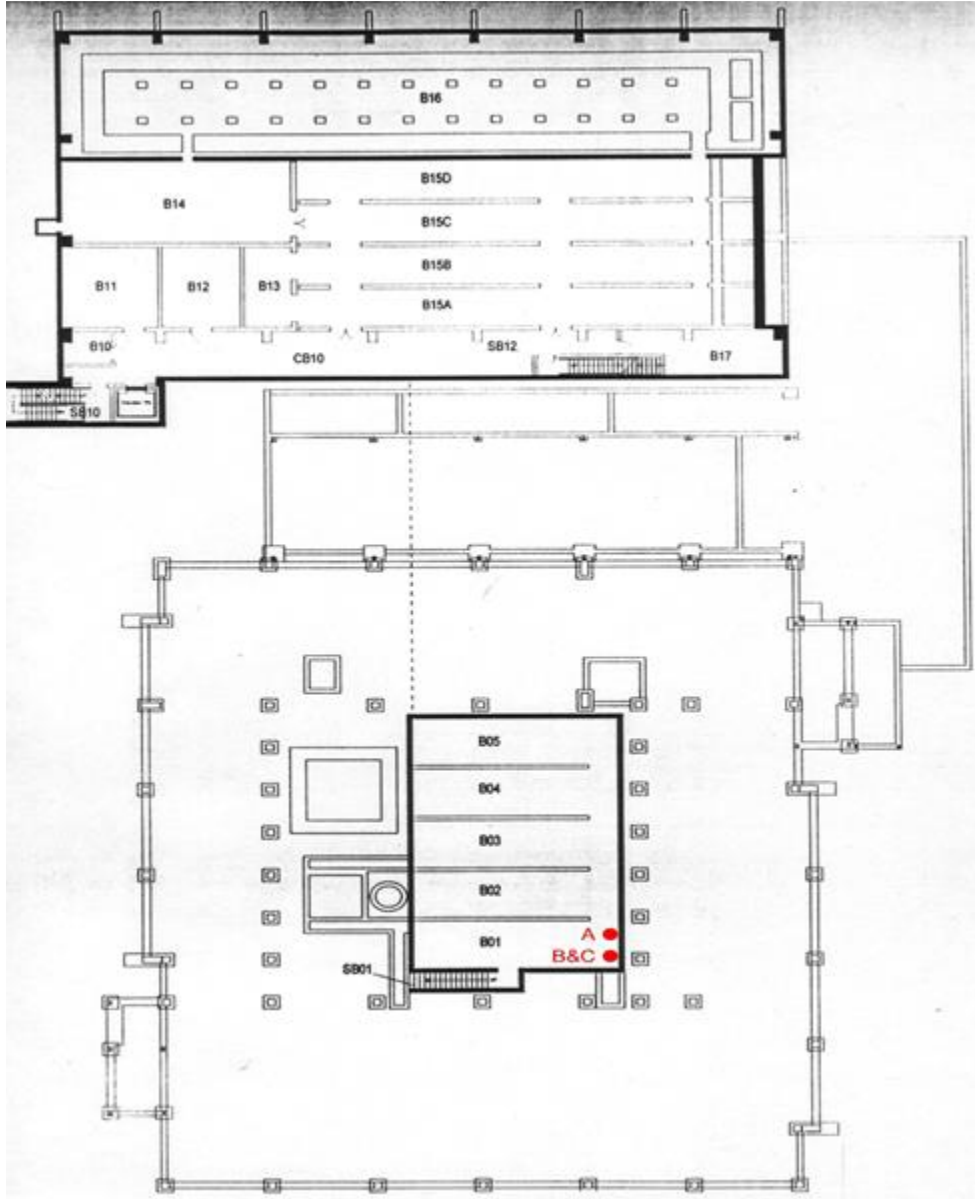


Figure 7.1: Ketter Hall basement floor evacuation plan

- Evacuation route
- A Class A type fire extinguisher
- B&C Class B & C type fire extinguisher
- P Fire alarm pull station

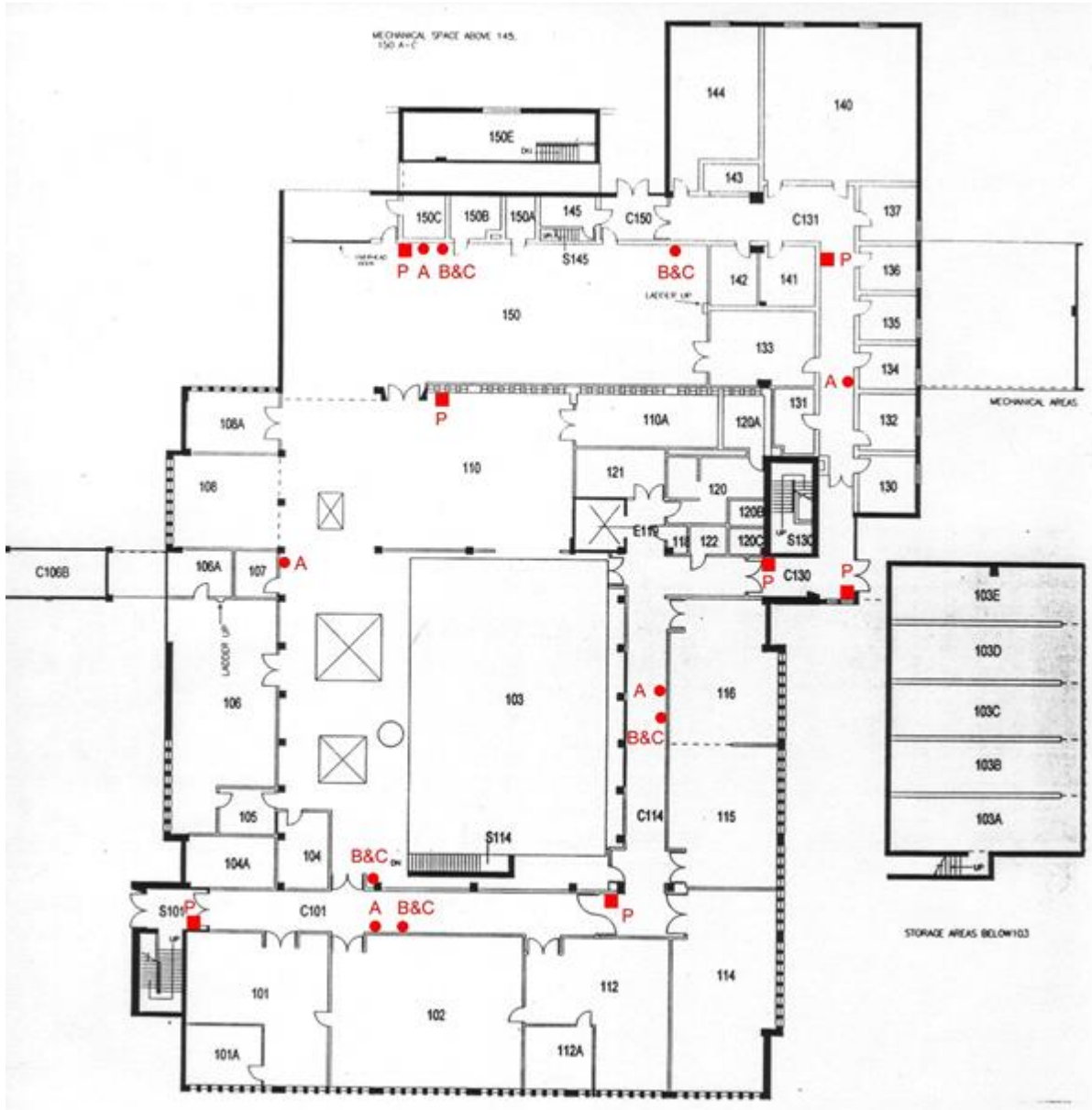


Figure 7.2: Ketter Hall first floor evacuation plan

- Evacuation route
- A Class A type fire extinguisher
- B&C Class B & C type fire extinguisher
- P Fire alarm pull station

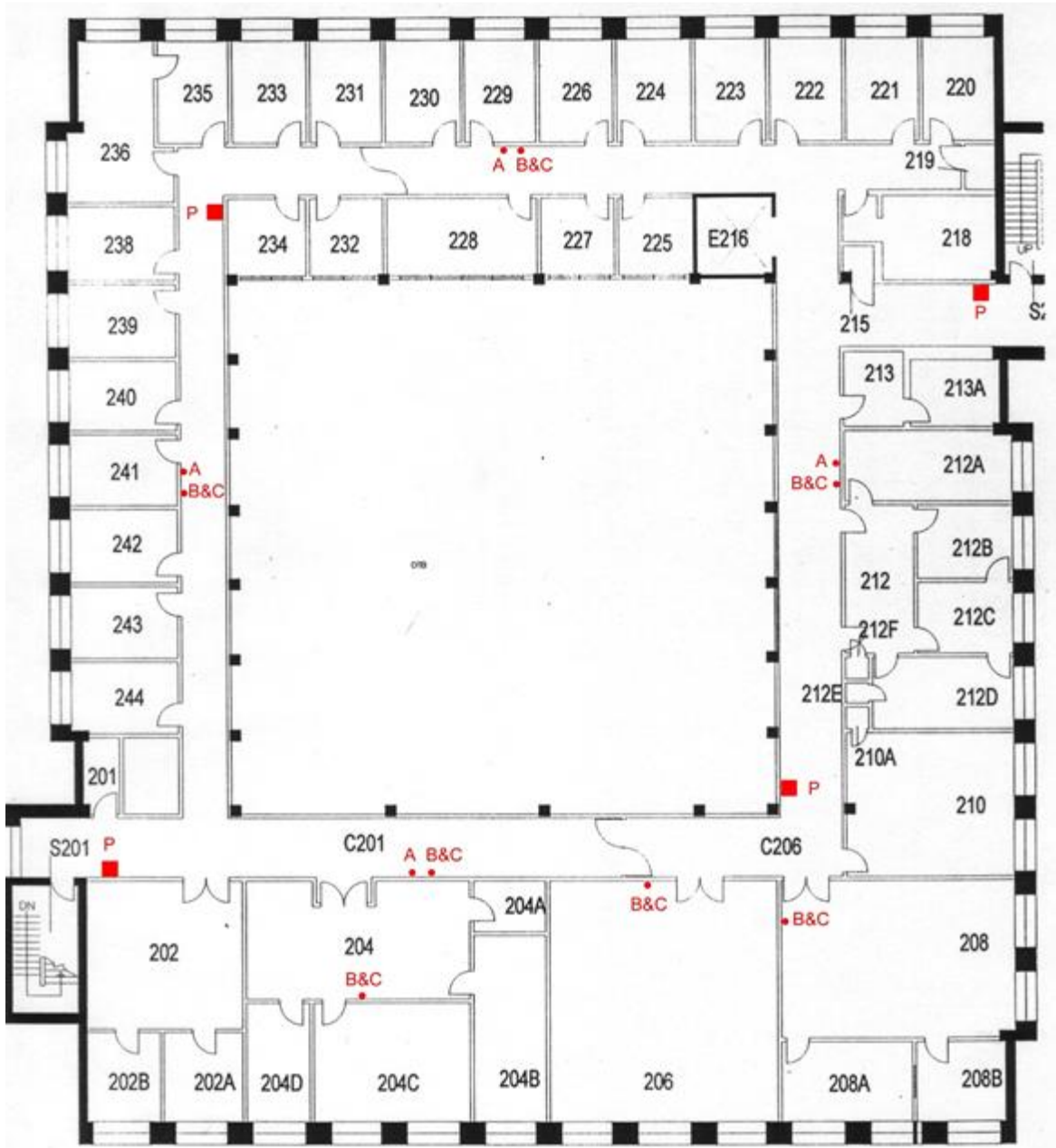


Figure 7.3: Ketter Hall second floor evacuation plan

- Evacuation route
- A Class A type fire extinguisher
- B & C Class B & C type fire extinguisher
- P Fire alarm pull station

8 Module 8: Personal Protective Equipment (PPE)

The Occupational Health and Safety Act (OSHAct 1970) requires that every worker shall wear or use such personal protective clothing, equipment or device as is necessary for his/her protection from the particular hazards to which he/she is exposed.

PPE is equipment or clothing one can wear to minimize his/her exposure to specific hazards. PPE includes items such as gloves, safety boots, ear muffs, respirators, protective eyewear, hard hats, and safety harnesses. It is easy to take it for granted but PPE is there for a reason and therefore, it is worth the effort to put it on. Some typical PPE examples are shown in Figure 8.1

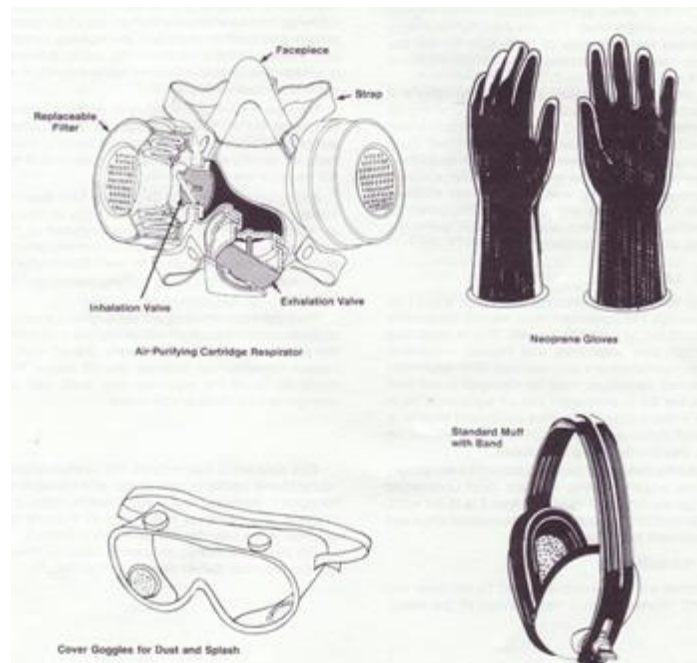


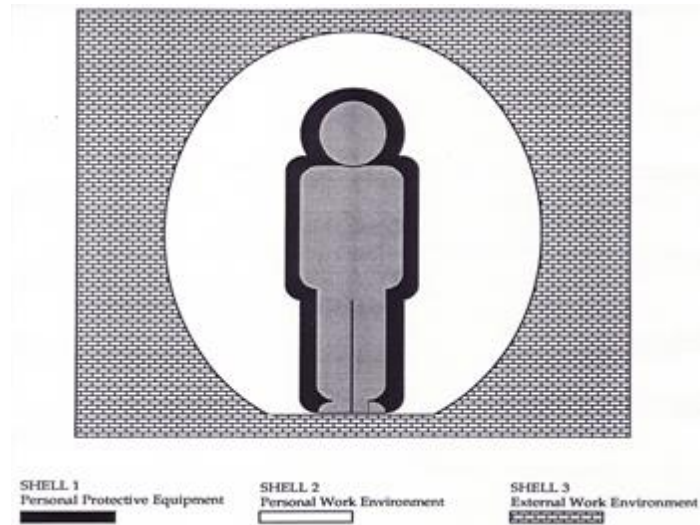
Figure 8.1: Examples of personal protective equipment

We should know how to assess the risks in the workplace and choose the most effective PPE to reduce those risks; we should also know the correct use of PPE, different types, and their maintenance and storage procedures. Every concerned person must demonstrate an understanding and the ability to use PPE properly, before he/she will be allowed to perform the work requiring the use of PPE.

Your head, eyes, hand, hands and feet are not a match for chemicals, falling loads or sharp objects. If PPE can help minimize the danger, then wear it.

If you are in a designated area, then be sure to wear the appropriate PPE. These areas have been designated for a reason. Hazards exist and you must wear the appropriate protective equipment at all times. Depending on the particular task or industrial environment, wearing PPE may also be prescribed by legislation. e.g. noise regulations require hearing protection to be worn if daily sound level exceeds the action level of 85 dBA.

8.1 PPE – last resort



It is important to remember that wearing PPE does not remove or even control the hazard. The hazard still exists – the exposure to it is being limited. When looking at the ways to reduce the risk levels at your workplace, PPE should be regarded as the last resort risk reduction measure.

Figure 8.2: Worker's safety shells

During a normal workday in the laboratory, employees and students are vulnerable to a multitude and variety of potential accidents. The working environment could be broken down into three safety shells. The first shell is the area which immediately surrounds the worker, usually referred to as PPE. The second shell refers to the space within the worker's arm reach called the personal work environment. The third shell refers to the environment beyond the worker's reach, in this case the laboratory itself.

There is a hierarchy of risk reduction measures which should be looked at before resorting to PPE.

1. Eliminate or substitute hazardous procedures
2. Engineering and administrative controls
3. PPE

Ideally, the hazard should be eliminated or substituted by a less hazardous alternative. Engineering and administrative controls should be introduced e.g. the use of localized or central exhaust fan system can reduce the need of respirators. PPE protects only the person wearing it, where as controlling the risk at its source protects everyone in the workplace. When risk reduction measures are not practical or fully effective, suitable PPE should be required and should be readily available.

Effective protection is only achieved by continuous use of suitable PPE. PPE may also restrict the user to some extent by limiting mobility, visibility or by requiring additional weight to be carried. The use of PPE may increase the possibility of other types of accidents occurring and can give the worker a false sense of security, causing him/her to face even more risks than normal. It is therefore necessary to follow all control and safety measures and not simply rely on PPE for protection.

8.2 Choosing the right PPE

When choosing a PPE, the first task is to identify the hazard present and assess the degree of risk. e.g. working around an earthquake simulating shake table, the person's head, eyes, hands and feet and body are in danger. Assessment of degree of risk in this case, would involve looking at the height of the test object, person's proximity to shake table, length of time person is present near the shake table, and so on.

Once the potential hazards are established, compare the hazards with the capability of PPE and select PPE which has necessary protective features. Check to see that the equipment fits properly and does not create secondary health or safety risks.

Comfort, fit, and style should also be taken into account when selecting PPE. Protective items which are uncomfortable or which do not fit properly are the most commonly cited reasons for not wearing the PPE when an accident occurred. Where possible, personnel should be involved in selection and trial of PPE.

In situations, where more than one PPE is required to be used, it is important to choose the items of equipment which are compatible. If the respirator is shifting the ear muffs, the effectiveness of ear muffs may be reduced. The combination of PPE chosen must work together effectively to control all the risks. Also make a point to choose quality PPE which meets appropriate OSHA standards.

Having chosen the appropriate PPE for a particular hazard, the next step is to ensure that the equipment be used effectively. Make a point to check the manufacturer's instructions for details on fitting procedures and general use. Proper fitting PPE is essential if it is to perform effectively. Ill-fitting equipment can in itself cause an accident or lead to additional health problem. Each item of PPE should be personal to each

employee. This reduces the risk of infection and it also means one can choose a piece of equipment which fits well.

8.3 Types of PPE

There are six (6) basic types of PPE.

- Head Protection
- Hand Protection
- Foot Protection
- Eye Protection
- Ear Protection
- Respiratory Protection

8.3.1 Head protection



Persons working in areas where there is a possible danger of head injury from impact, or from falling or flying objects, or from electrical shock and burns, shall be protected by protective helmets. [29 CFR 1926.100(a)]

Hard hats shall be worn in all designated areas, marked by yellow tape. Visitors are included in this requirement.

Safety helmets or hard hats protect against falling objects. Bump caps provide protection against striking fixed objects, scalping, and entanglement. When choosing head protection, make sure you choose appropriate shell size for your head. Additional neck protection could also be obtained, if considered necessary. There is a wide range of hard hat attachments which should be considered if the job requires combination of PPEs, such as ear muffs and safety glasses with hard hats.



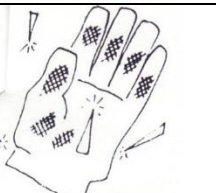

Long hair (longer than four inches) can be drawn into machine parts such as chains, belts, rotating devices, suction devices, and blowers. Long hair must be covered and protected with hair nets, soft caps, or the like. These items however, must not themselves present a hazard. There are three types of hard hats.

Types of Hard Hats:

- **Class A helmets** are for general service. They provide good impact protection but limited voltage protection. They are used mainly in mining, construction, shipbuilding, lumbering, and manufacturing.
- **Class B helmets** are used when there is a significant exposure to electrical hazards. They protect against falling objects and high-voltage shock and burns.
- **Class C helmets** are designed for comfort, these light weight helmets offer only limited protection. They protect the person from bumping against fixed objects but do not protect against falling objects or electric shock.

8.3.2 Hand protection

When working with sharp objects, safety gloves should be worn. Gloves are the most common protectors for the hands. PVC, rubber, nitro or neoprene gloves are sufficient when working with most chemicals. When working with sharp objects, wear metal reinforced gloves. Depending on the nature of your tasks, wrist-cuffs or armllets may also be required. Avoid using gloves while working on moving machinery. Moving parts can easily pull your gloves, arm and hand into machinery.

	<p>Leather Gloves: protect against sparks, moderate heat, blows, chips, and rough objects. Welders in particular need the durability of higher quality leather gloves.</p>
	<p>Aluminized Gloves: used for welding, furnace, and foundry work because they provide reflective and insulating protection against the heat. Aluminized gloves require an insert made of synthetic materials that protect against heat and cold.</p>
	<p>Metal Mesh Gloves: These gloves have a metal mesh built-in the material and thus they provide protection from cuts, rough materials, and blows from sharp objects.</p>
	<p>Chemical and Liquid Resistant Gloves: rubber (latex, nitrile, or butyl), plastic, or synthetic rubber-like material such as neoprene, protect workers from burns, irritation, and dermatitis caused by contact with oils, greases, solvents, and other chemicals. The use of rubber gloves also reduces the risk of exposure to blood and other potentially</p>

	<p>infectious substances. Some common gloves used for chemical protection are butyl rubber gloves, natural latex or rubber gloves, neoprene gloves, nitrile rubber gloves.</p>
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8.3.3 Foot protection

The most common form of foot injury occurs when heavy objects fall on one's foot, a weight rolls over the foot or an object pierces through the sole of the shoe. Make sure the shoes or boots are of steel reinforced toe and puncture resistant soles. If you work around exposed electrical cables then wear metal free footwear with rubber sole. Rubber or synthetic footwear is more appropriate when working around chemicals as chemicals can eat through leather boots. Figure 8.3 illustrates a typical safety shoe.

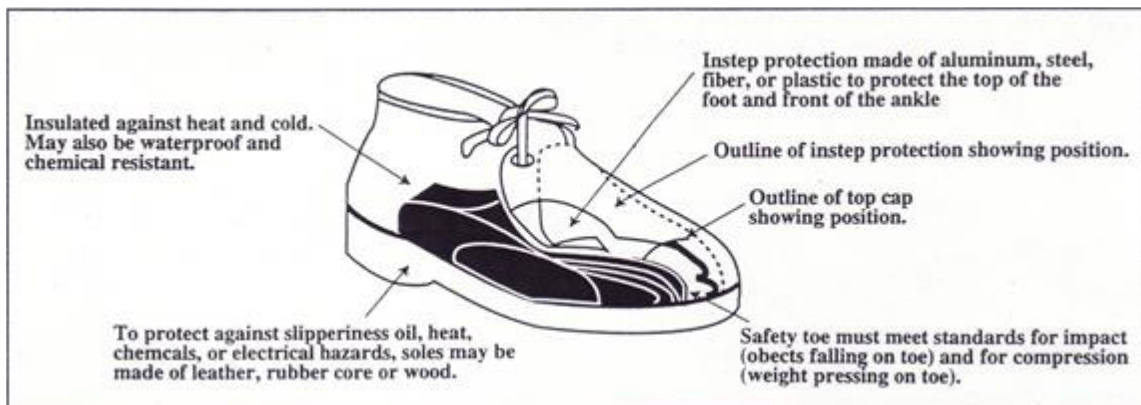


Figure 8.3: A typical safety shoe

Source: Construction Safety Association of Ontario

8.3.4 Eye protection

Safety glasses or goggles should be worn when one is chipping, sanding, welding, cutting, drilling or using power-actuated tools. They should actually be worn at all times as the eyes must last for a lifetime.

Make sure you have sufficient eye protection for the particular hazard. When working with chemicals, you should wear goggles and a face shield. Never wear a face shield or welding helmet without wearing safety glasses for added protection.

Types of Eye and Face Protection:

Figure 8.4 and Table 8.1 describe various types of eye and face protection along with their applications.

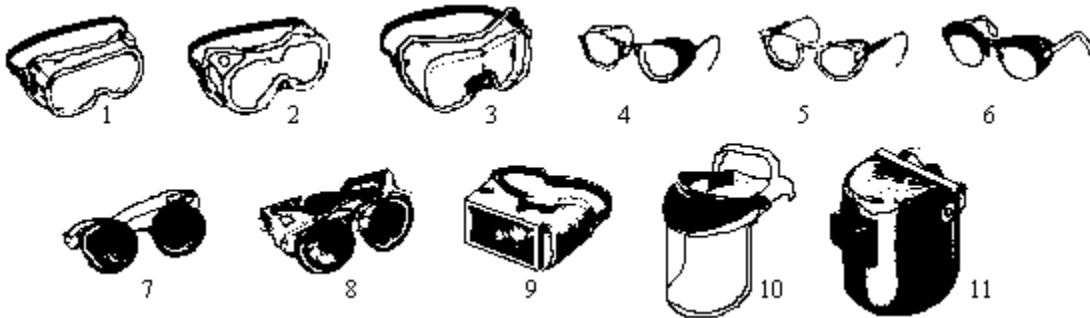


Figure 8.4: Various types of eye and face protection available

- | | |
|---|--|
| 1. GOGGLES | Flexible Fitting - Regular Ventilation |
| 2. GOGGLES | Flexible Fitting - Hooded Ventilation |
| 3. GOGGLES | Cushioned Fitting - Rigid Body |
| 4. SPECTACLES | Metal Frame, with Sideshields |
| 5. SPECTACLES | Plastic Frame - with Sideshields |
| 6. SPECTACLES | Metal-Plastic Frame - with Sideshields |
| 7. WELDING GOGGLES | Eyecup Type - Tinted Lenses |
| 8. CHIPPING GOGGLES | Eyecup Type - Clear Safety Lenses |
| 9. WELDING GOGGLES | Coverspec Type - Tinted Lenses |
| 10. CHIPPING GOGGLES | Coverspec Type - Clear Safety Lenses |
| 11. WELDING GOGGLES | Coverspec Type - Tinted Plate Lens |
| 12. FACE SHIELD (Available with Plastic or Mesh Window) | |
| 13. WELDING HELMETS | |

Table 8.1: Application of various types of eye and face protection

Operation	Hazards	Recommended Protectors
Acetylene-Burning, Acetylene-Cutting, Acetylene-Welding	Sparks, harmful rays, molten metal, flying particles	7, 8, 9
Chemical Handling	Splash, acid burns, fumes	2,10 (For severe exposure wear 10 over 2)
Chipping	Flying particles	1, 3, 4, 5, 6, 7A, 8A
Electric (arc) welding	Sparks, intense rays, molten metal	9, 11, (11 in combination with 4, 5, 6, in tinted lenses advisable)
Grinding-Light	Flying particles	7, 8, 9 (For severe exposure add 10)
Grinding-Heavy	Flying particles	1, 3, 7A, 8A (For severe exposure add 10)
Laboratory	Chemical splash, glass breakage	2 (10 when in combination with 4, 5, 6)
Machining	Flying particles	1, 3, 4, 5, 6, 10
Spot welding	Flying particles, sparks	1, 3, 4, 5, 6, 10

Source: 29CFR 1926 Subpart E

8.3.5 Ear protection

There are two types of hearing protection available.

1. Ear plugs
2. Ear muffs

If you work in a area where the noise level is above 80 dBA, then you must wear suitable hearing protection at all times. Ear plugs may be pre-shaped or individually molded to suit the particular shape of the ear. There are also disposable plugs which could be compressed and placed in the ear. Whether you use ear plugs or ear muffs, make sure they fit properly and they reduce noise to a safe level.



Disposable Ear Plugs: These are made of waxed cotton, foam or fiberglass wool. These ear plugs are self-forming and, when properly inserted, work as well as most molded earplugs.



Reusable Ear Plugs: These plugs must be individually fitted by a professional. These plugs should be cleaned after each use.



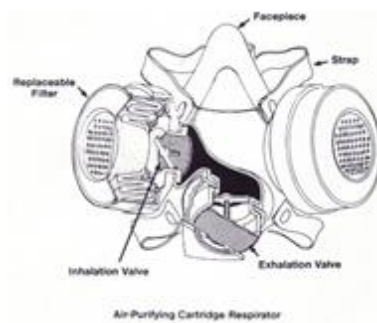
Ear Muffs: Earmuffs require a perfect seal around the ear. Glasses, long sideburns, long hair and facial movements such as chewing may reduce the protective value of earmuffs. Special earmuffs designed for use with eyeglasses or beards may have to be purchased.

8.3.6 Respiratory protection

Respiratory protectors prevent lung pollution due to harmful dust, fumes, mist, gas or smoke. Protection for lungs ranges from simple dust masks to a full face respirator. There are three (3) types of respirators.

Air Purifying Respirators

The most common type of air purifying filter is the common “dust mask”. To achieve the minimum level of protection the use of an N-95 or N-99 mask is required. These are available from the Site Safety Manager.



Other types of air purifying respirators utilize filters or chemical cartridges to remove impurities from the air.

Supplied Air Respirators

These need the air to be supplied from an outside source to the mask, hood or entire suit.

Self-contained Breathing Devices

These use cylinders of compressed air.

Recognize the particular airborne hazard of each task and choose the respirator air purifying cartridge which will be effective. The cartridges and canisters only have a limited life so replace them according to manufacturer's instructions. Where there is oxygen deficiency or any danger of losing consciousness due to high levels of harmful fumes, use an approved supplied air breathing apparatus. Never use a cartridge air purifier and respirator.

Dust Masks

Dust masks should be used in dusty environments. OSHA requires masks to be 95% efficient against particulate aerosols and free from oil, these are termed as N95 masks.

Several brands of such masks are available; a few of them are shown below.



HandyStrap™, with buckle, allows mask to hang around neck when not in use. Stretch cloth HandyStrap™ feels cool and comfortable. Soft foam nose flange for added comfort and no pressure points. Dura-Mesh shell resists collapsing in heat and humidity. Softspun™ lining for increased comfort and durability



Added absorbent helps filter out nuisance levels of ozone and organic vapors (less than OSHA PEL). Ventex™ valve lets the hot air out faster so workers stay cooler.



Added carbon layer to help filter out nuisance levels of ozone and organic vapors (less than OSHA PEL). Soft, foam nose flange gives added comfort. Exhale valve reduces hot air build-up for added comfort. 95% efficient against particulate aerosols free of oil.

8.4 PPE maintenance and storage

An effective system of maintenance and storage of PPE is essential to make sure that the equipment continues to provide the degree of protection for which it was designed.

Store the PPE away from heat, dust, and moisture. Also make a point of cleaning and if necessary disinfecting the PPE at the end of shift.

PPE should be examined before it is put on and should not be worn if found defective or has not been cleaned.

Replacement PPE and replacement parts should be readily available.

More comprehensive inspections should be carried out at regular intervals in accordance with the manufacturer's instructions.

An effective system of storage and maintenance of PPE should address the following issues for each PPE:

- Who is responsible;
- Personnel designation;
- Cleaning procedures;
- Storage;
- Inspection procedures;
- PPE life expectancy;
- PPE replacement.

Maintenance Procedure for Protective Eyewear

- Disassemble goggles or spectacles;
- Thoroughly clean all parts with soap and warm water after each use;
- Carefully rinse off all traces of soap;
- Replace all defective parts.

Disinfection Procedure for Protective Eyewear

- Immerse and swab all parts for 10 minutes in a germicidal solution;
- Remove all parts from the solution and hang in a clean place to air dry at room temperature or with heated air;
- Do not rinse the parts after submerging them in the disinfectant as rinsing will remove the germicidal residue that remains after drying.

8.5 Checklist

Head Protection

- Hard hats shall be worn with bill facing forward;
- Hard hats should never be altered;
- Hard hats must match the hazard;
- Hard hats should be kept clean;
- Hard hats should never be dropped;
- Hard hats should be inspected daily;
- Hard hats should not be left in sunlight;
- There should be sufficient gap between shell and safety harness.

Hand Protection

- Gloves should fit correctly, loose gloves could snag on the machinery or make handling difficult, tight could cause hand fatigue;
- Gloves should allow for quick removal;
- Machine guards should be checked;
- Gloves should be correct for the type of hazard;

- Insulated gloves should be used for electrical work;
- Check for wear and tear;
- Avoid using gloves while using moving machinery.

Foot Protection

- Use steel reinforced toes;
- Use puncture resistant sole;
- Check for correct rating for the hazards;
- Chemical and electrical hazards require special footwear;
- Use leg and feet guards if necessary.

Eye & Face Protection

- Know the hazards;
- Good fit is critical;
- Side shields add protection;
- Should be cleaned every day;
- Wear glasses or goggles under face shields.

Hearing Protection

- A must if sound level is 80 dBA in work area;
- Choose correct attenuation;
- Must fit well;
- Must be compatible with other PPE;
- Inspect regularly;
- Must be personal to the user.

Respiratory Protection

- Choose correct filter;
- Study manufacturer's instructions;
- Check fit before using;
- Clean it after use;

- Store it in cool, dry container;
- Inspect regularly.

8.6 Summary

PPE is an important and necessary consideration in the development of an institution's health and safety program. However, PPE should not be relied on solely for protection from hazards. Wearing PPE does not reduce hazards. The hazards still exist and it is vital that everyone exercises care even while using PPE. Assess workplace hazards before commencing a task and always make sure that, you are wearing a correct PPE to reduce your exposure to those hazards.

If you are given PPE at work, make sure you wear it.

It has been given to you for a reason and your safety could depend on it.

9 Module 9: Electrical Hazards

Whenever you work with power tools or on electrical circuits there is a risk of electrical shock. Electricity is often used without much thought about the hazards it can cause, as it is a familiar part of our lives, but serious injury or even death can occur as a result of an electrical shock.

There are four main types of electrical injuries: electrocution (death due to electrical shock), electrical shock, burns, and falls. In this module, various electrical hazards will be described. You will also learn how to recognize, evaluate, and control electrical hazards.

9.1 How is an electrical shock received?

An electrical shock is received when electrical current passes through the body. If your body happens to be a conductor for the two wires or two surfaces having voltage difference, current will pass through your body, resulting in an electric shock. If you are in contact with a live wire or any live component of an energized electrical circuit and also in contact with any grounded object, you will receive a shock. Wet clothing, high humidity, and perspiration also increase your chances of getting an electric shock.

You can also receive a shock from electrical components that are not grounded. Contact with another person who is receiving an electrical shock may cause you to be shocked.

9.2 Dangers of an electric shock

The severity of injury from electrical shock depends on the amount of electrical current and the length of time current passes through the body. The amount of internal current a person can withstand and still be able to control the muscles of the arm and hand can be less than 10 milliamperes (mA). Currents above 10 mA can paralyze or ‘freeze’ the muscles. When this ‘freezing’ happens, a person is no longer able to release a tool, wire, or other object. Instead, the electrified object may be held even more tightly, resulting in longer exposure to electric current.

Table 9.1 shows what usually happens for a range of currents (lasting one second) at typical household voltages. However, longer exposures are known to cause more severe injuries than those indicated in the table.

Table 9.1: Effects on Electrical Current on a Body

Current	Reaction
1 milliamp	Just a faint tingle.
5milliamps	Slight shock felt. Disturbing, but not painful.
6-25 milliamps (women) 9-30 milliamps (men) *Differences in the muscle and fat content affect the severity of the shock	Painful shock. Muscular control is lost. This is the range where ‘freezing’ starts.
50-150 milliamps	Extremely painful shock, respiratory arrests, severe muscle contractions.
1,000-4,300 milliamps (1-4.3 amps)	Heart pumping action becomes irregular. Muscles contract, nerve damage occurs. Death is likely.
10,000 milliamps (10 amps)	Cardiac arrest and severe burns occur. Death is probable.
15,000 milliamps (15 amps)	Lower overcurrent at which a typical fuse or circuit breaker opens a circuit.

Source: NIOSH Electrical Safety Manual, 2002

A severe shock can cause much more damage to the body than is visible. A person may suffer internal bleeding and destruction of tissues, nerves and muscles. Sometimes the hidden injuries caused by an electrical shock result in a delayed death. Shock is often only the beginning of chain events. Even if electrical current is too small to cause injury, your reaction to the shock may cause you to fall, resulting in bruises, broken bones, burns as illustrated in Figure 9.1, or even death. The length of time of the shock greatly affects the amount of injury. If the shock is short in duration, it may only be painful. A longer shock (lasting a few seconds) could be fatal if the level of current is high enough to cause the heart to go into irregular pumping.

Wet working conditions or broken skin drastically increases probability of receiving a shock. The low resistance of wet skin allows current to pass into the body more easily and gives a greater shock.



Figure 9.1: Burns Caused by Electric Shock

The most common shock-related nonfatal injury is a burn. Burns caused by electricity may be of three types:

- **Electrical Burns:** Electrical burns can result when a person touches electrical wiring or equipment that is energized. As illustrated in Figure 9.1, electrical burns are one of the most serious injuries, and need to be given immediate attention. Additionally, clothing may catch fire and a thermal burn may result from the heat of fire.
- **Arc Burns:** Arc-blasts occur when high-ampere currents arc through the air. Arcing is the luminous electrical discharge that occurs when high voltages exist across a gap between conductors and current travels through the air. This situation is often caused by equipment failure due to abuse or fatigue. Temperatures as high as 35,000 degrees F have reached in arc-blasts. Arcing gives off thermal radiation (heat) and intense light, which can cause burns.

Several factors affect the degree of injury, including skin color, area of skin exposed, and type of clothing worn. Proper clothing, distance between the worker and the arc, and overcurrent protection can reduce the risk of such a burn. Sometimes the pressure wave caused by arcing throws the victims away from the arc-blast. While this may reduce further exposure to the thermal energy, serious physical injury may also result.

- **Thermal Burns:** Thermal burns may result if an explosion occurs when electricity ignites an explosive mixture of material in the air. This ignition can result from the buildup of combustible vapors, gases, or dusts. Ignition can also be caused by overheated conductors or equipment, or by normal arcing at switch contacts or in circuit breakers.

9.3 Electrical fires

Electricity is one of the most common causes of fires and thermal burns in homes and workplaces. Defective or misused electrical equipment is a major cause of electrical fires. If there is a small electrical fire, be sure to use only a Class C or multi-purpose (ABC) fire extinguisher, or you might make the problem worse. All fire extinguishers are marked with letter(s) that tell you the kinds of fires they can put out. Some extinguishers contain symbols, too.

9.4 First aid for electric shock

Shut off the electrical current if the victim is still in contact with the energized circuit. While you do this, have someone else call for help. If you cannot get to the switchgear quickly, pry the victim from the circuit with something that does not conduct electricity such as dry wood. Do not touch the victim yourself if he or she is still in contact with an electrical circuit. You do not want to be a victim, too.

Do not leave the victim unless there is absolutely no other option. You should stay with the victim while Emergency Medical Services (EMS) is contacted. The caller should come back to you afterwards to verify that the call was made. If the victim is not breathing, does not have a heartbeat, or is badly injured, quick response by a team of emergency medical technicians (EMT's) or paramedics gives the best chance for survival.

9.5 Electrical safety guidelines

One must use the three-stage safety model for hazards:

- Recognize
- Evaluate, and

- Control

To avoid injury or death, you must understand and recognize hazards. You need to evaluate the situation you are in and assess your risks. You need to control hazards by creating a safe work environment, by using safe work practices, and by reporting hazards to a supervisor or principal investigator.

9.5.1 Recognizing electrical hazards

The first step in protecting yourself is recognizing the hazards present in your work area. To do this, you should know the situations which can put you in danger. The following are some examples:

- **Inadequate Wiring:** An electrical hazard exists when the wire gauge is too small for the current it will carry. When you use an extension cord, the size of the wire you are placing into the circuit may be too small for the equipment. The circuit breaker may not be right for the smaller-gauge extension cord. A tool plugged into the extension cord may use more current than the cord can handle without tripping the circuit breaker, the wire will overheat and could cause a fire.
- **Exposed Electrical Parts:** Electrical hazards exist when wires or other electrical parts are exposed. Wires and parts can be exposed if a cover is removed from a wiring or breaker box. Electrical terminals in motors, appliances, and electronic equipment may be exposed. Older equipment may have exposed electrical parts. If you contact exposed live electrical parts, you will be shocked. You need to recognize that an exposed electrical component is a hazard.
- **Defective Insulation Hazards:** Insulation that is defective or inadequate is an electrical hazard. Usually, a plastic or rubber covering insulates wires. Insulation prevents conductors from coming in contact with each other. Insulation also prevents conductors from coming in contact with people. Extension cords may have damaged insulation. Sometimes the insulation inside an electrical tool or appliance is damaged. When insulation is damaged, exposed metal parts may become energized if a live wire inside touches them. Electric hand tools that are old, damaged, or misused may have damaged insulation inside. If you touch damaged power tools or other equipment, you will receive a shock. You need to recognize that defective insulation is a hazard.
- **Improper Grounding Hazards:** When an electrical system is not grounded properly, a hazard exists. The most common OSHA electrical violation is improper grounding of equipment and circuitry. The metal parts of an electrical wiring system that we touch (switch plates, ceiling light fixtures, conduit, etc.) should be grounded and should be tested to confirm that it is at 0 volts. If the system is not grounded properly, these parts may become energized. Metal parts of motors,

appliances, or electronics that are plugged into improperly grounded circuits may be energized and can cause a shock.

- **Overload Hazards:** Overloads in an electrical system are hazardous because they can produce heat, and/or arcing. Wires and other components in an electrical system or circuit have a maximum amount of current they can carry safely. If too many devices are plugged into a circuit, the electrical current will heat the wires to very high temperatures. If any one tool uses too much current, the wires will heat up. The temperature of the wires can be high enough to cause a fire. If their insulation melts, arcing may occur. Arcing can cause a fire in the area where the overload exists, even inside a wall. You need to recognize that a circuit with improper overcurrent protection devices—or one with no overcurrent protection devices at all is a hazard.



Overloads are a major cause of fires.

- **Wet Conditions Hazards:** Working in wet conditions is hazardous because you may become an easy path for electrical current. If you touch a live wire or other electrical component—and you are well-grounded because you are standing in even a small puddle of water—you will receive a shock.

9.5.2 Evaluating electrical hazards

After you recognize a hazard, your next step is to evaluate your risk from the hazard. Obviously, exposed wires should be recognized as a hazard. If the exposed wires are 15 feet off the ground, your risk is low. However, if you are going to be working on a roof near those same wires, your risk is high. The risk of shock is greater if you will be carrying metal conduit that could touch the exposed wires. You must constantly evaluate your risk. Combinations of hazards increase your risk. Improper grounding and a damaged tool greatly increase your risk. Wet conditions combined with other hazards also increase your risk.

9.5.3 Controlling electrical hazards

Lockout and Tag out Circuits and Equipment:

Create a safe work environment by locking out and tagging out circuits and machines. Before working on a circuit, you must turn off the power supply. Once the circuit has been shut off and de-energized, lock out the switchgear to the circuit so the power cannot be turned back on inadvertently. Then, tag out the circuit with an easy-to-see sign or label that lets everyone know that you are working on the circuit. If you are working on or near machinery, you must lock out and tag out the machinery to prevent startup. Before you begin work, you must test the circuit to make sure it is de-energized.



Use the following checklist for Lockout and Tag out:

- Identify all sources of electrical energy for the equipment or circuits in question.
- Disable backup energy sources such as generators and batteries.
- Identify all shut-offs for each energy source.
- Notify all personnel that equipment and circuitry must be shut off, locked out, and tagged out. (Simply turning a switch off is NOT enough.)
- Shut off energy sources and lock switchgear in the OFF position. Each worker should apply his or her individual lock. Do not give your key to anyone.
- Test equipment and circuitry to make sure they are de-energized. This must be done by a qualified person.
- Deplete stored energy by bleeding, blocking, grounding, etc.

- Apply a tag to alert other workers that an energy source or piece of equipment has been locked out.
- Make sure everyone is safe and accounted for before equipment and circuits are unlocked and turned back on. Note that only a qualified person may determine when it is safe to re-energize circuits.

Control Inadequate Wiring Hazards

Electrical hazards result from using the wrong size or type of wire. You must choose the right size wire for the amount of current expected in a circuit. The wire's insulation must be appropriate for the voltage and tough enough for the environment. Connections need to be reliable and protected.

Control Hazards of Flexible Wiring

Electrical cords supplement fixed wiring by providing the flexibility required for maintenance, portability, isolation from vibration, and emergency and temporary power needs. Flexible wiring can be used for extension cords or power supply cords. Power supply cords can be removable or permanently attached to the appliance. Do not use flexible wiring in situations where frequent inspection would be difficult, where damage would be likely, or where long-term electrical supply is needed. Flexible cords cannot be used as a substitute for the fixed wiring. **Some Guidelines for using Flexible Cords are as follows:**

- Do not run flexible cords through holes in walls, ceilings, or floors;
- Do not run flexible cords through doorways, windows, or similar openings (unless physically protected);
- Do not conceal flexible cords in walls, ceilings, floors, conduits or other raceways.

Use the right Extension Cord. The size of wire in an extension cord must be compatible with the amount of current the cord will be expected to carry. The amount of current depends on the equipment plugged into the extension cord. Current ratings (how much current a device needs to operate) are often printed on the nameplate. Table 10.2 shows current carrying capacity of different wire gauges. Remember, larger the gauge number, the thinner is the wire.

Table 9.2: American Wiring Gauge (AWG)

Wire Size	Current Carrying Capacity
#10 AWG	30 amps
#12 AWG	25 amps
#14 AWG	18 amps
#16 AWG	13 amps

The length of the extension cord also needs to be considered when selecting the wire size. Voltage drops over the length of a cord. If a cord is too long, the voltage drop can be enough to damage equipment.

Control Hazards of Exposed Live Electrical Parts

Electrical hazards exist when wires or other electrical parts are exposed. These hazards need to be controlled to create a safe work environment. Isolation of energized electrical parts makes them inaccessible unless tools and special effort are used. **Some Precautions to Prevent Injuries from Contact With Live Parts are as follows:**

- Immediately report exposed live parts to a supervisor or principle investigator. As a student, you should never attempt to correct the condition yourself without supervision.
- Provide guards or barriers if live parts cannot be enclosed completely.
- Use covers, screens, or partitions for guarding that require tools to remove them.
- Replace covers that have been removed from panels, motors, or fuse boxes.
- Even when live parts are elevated to the required height (8 feet), care should be taken when using objects (like metal rods or pipes) that can contact these parts.
- Close unused conduit openings in boxes so that foreign objects (pencils, metal chips, conductive debris, etc.) cannot get inside and damage the circuit.

Control Hazards of Exposure to Live Electrical Wires With No or Defective Insulation

Insulation is made of material that does not conduct electricity (usually plastic, rubber, or fiber). Insulation covers wires and prevents conductors from coming in contact with each other or any other conductor. If conductors are allowed to make contact, a short circuit is created, current passes through the shorting material without passing through a load in the circuit, and the wire becomes overheated.

Insulation helps protect wires from physical damage and conditions in the environment. Insulation is used on almost all electrical wires, except some ground wires and some high-voltage transmission lines. Insulation is used internally in tools, switches, plugs, and other electrical and electronic devices.

In all situations, you must be careful not to damage insulation while installing it. Do not allow staples or other supports to damage the insulation.

Bends in a cable must have an inside radius of at least 5 times the diameter of the cable so that insulation at a bend is not damaged.

Control Hazards of Shocking Currents – Ground Circuits and Equipment

When an electrical system is not grounded properly, a hazard exists. This is because the parts of an electrical wiring system that a person normally touches may be energized, or live, relative to ground. Parts like switch plates, wiring boxes, conduit, cabinets, and lights need to be at zero volts relative to ground. If the system is grounded improperly, these parts may be energized. The metal housings of equipment plugged into an outlet need to be grounded through the plug.

Grounding is connecting an electrical system to the earth with a wire. Excess or stray current travels through this wire to a grounding device (commonly called a “ground”) deep in the earth. Grounding prevents unwanted voltage on electrical components. Grounding does not guarantee that you will not be shocked, injured, or killed from defective equipment. However, it greatly reduces the possibility.



Control Overload Current Hazards

When a current exceeds the current rating of equipment or wiring, a hazard exists. The wiring in the circuit, equipment, or tool cannot handle the current without heating up or even melting. Not only will the wiring or tool be damaged, but the high temperature of the conductor can also cause a fire. To prevent this from happening, an overcurrent protection device (circuit breaker or fuse) is used in a circuit. These devices shut-off a circuit automatically if they detect current in excess of the current rating of equipment or wiring. This excess current can be caused by an overload, short circuit, or high-level ground fault.



10 Module 10: Lockout/Tag out Procedures

Many industrial accidents are known to be caused by accidental release of energy. OSHA estimates that adherence to lockout/tagout can eliminate nearly 2% of all worker deaths in the private industry. This module will familiarize you with CSEE Department's Lockout/Tagout procedure, importance of energy control and how to apply energy isolation and lockout/tagout.

CSEE Department requires that every person who may be required to work on electrical or mechanical equipment, must strictly adhere to the lockout/tag out requirements and directions. Lock out devices and tags are intended to protect the employees who may be working on the systems that are being shut down

or are already shut down. It should be noted that, the lockout/tag out devices are not supposed to be used for discouraging tampering, preventing unauthorized operation, or for any other purposes.

10.1 What is lockout/tag out?

Lockout is putting a lock on the part of the machine that controls the energy, e.g. circuit breaker, switch, controls, valves etc. It is a system of setting up positive restrictions on release of electrical, pneumatic or any other form of energy that could endanger life and/or property. These restrictions are generally required during maintenance of equipment.

Lockout is accomplished in three steps:

- A switch, a circuit breaker or a pneumatic valve that supplies energy to equipment is turned off;
- A lockout device is placed on the such switch or valve to hold it in off position;
- A padlock is attached to the lockout device, so that the lockout device cannot be removed.

Lockout/tag out devices are to be removed only by the person(s), who set them up and by no other person. Removal of lockout/tag out by unauthorized person is a cause of instant expulsion from CSEE facilities.

10.2 Applying lockout/tag out for maintenance of equipment

Before lockout/tagout is applied, all personnel in the work area must be notified. Lockout/tagout should be applied only by the authorized employees, trained to perform maintenance and service operations. The OSHA standards mandate that the following six step procedure be followed.

10.2.1 Preparation for shutdown

First step in lockout/tagout is shutting down the equipment. Before turning off the equipment to lockout or tag out the authorized person must know the following things:

- The type(s) and amount of energy being supplied to the equipment;
- Hazards posed by each type of energy;
- Measures to control the energy.

10.2.2 Equipment shutdown

The equipment should be shut down by using its operating controls. Shutdown procedure provided by the manufacturer should be followed so as not to endanger life and property.

10.2.3 Isolation of Equipment

After operating the controls on the equipment, the authorized person should completely isolate the incoming power to the equipment. He/she should make sure that all the incoming energy sources namely electrical, pneumatic, hydraulic etc. are isolated. Electrical switches should be operated only when the equipment is turned off and fuses should not be removed as an alternative to disconnecting.

10.2.4 Application of lockout/tag out devices

All the energy isolating devices operated to shut off the energy supply to the equipment, should be locked to prevent accidental startup.

- Lockout devices supplied by CSEE should only be used;
- Lockout devices should not be used for any other purpose;
- If required, more than one employee should lockout one energy source, with his/her personal lock using multiple-lock hasp;
- The label on the lockout device should be completely filled in by the person applying the lockout device;
- The tag should then be applied on the operating control of the equipment, describing the person responsible for shutting down the power-supply and date of such shut-down.



Figure 10.1: A typical lockout device (both sides)



Figure 10.2: Switch lockout device



Figure 10.3: Plug lockout device



Figure 10.4: Valve lockout device



Figure 10.5: A typical tag

10.2.5 Control of stored energy

Before starting the maintenance operation, the authorized person must inspect the equipment to make sure that all parts have stopped moving. It should be ensured that, the energy left in the equipment after isolating is drained safely. The following guidelines should be followed where applicable:

- Ground wires should be installed;
- Trapped pressure should be removed from pneumatic lines;
- Hydraulic oil should be drained and plugs should be installed to prevent egress of particulate matter in the hydraulic lines;
- Tension in the springs should be released;
- Parts that could fall because of gravity should be blocked or braced;
- If isolated energy can reaccumulate, ensure that it stays below hazardous level.

10.2.6 Isolation verification

Finally, it should be ensured that energy is not being supplied to the equipment. This should be accomplished by following guidelines:

- Check that main isolation switch can not be turned to 'ON' position;
- Check that all pneumatic and hydraulic lines are disconnected and plugged [if applicable];
- Press all control switches to turn the equipment on, and it should turn on;

- Remember to bring all control switches to off position after this checking.

10.2.7 Tag out

Tag out is the placement of a tag out device. A tag out device is a tag and means of attachment. Tags are warning devices attached to energy isolation devices, and do not provide the physical restraint on those devices that is provided by a lock.

- Only the tags provided by CSEE Department should be used;
- Tags should be easy to read and understand, even if they are used in damp or corrosive areas;
- Tags should be tough enough, so they cannot be removed accidentally;
- A nylon cable should only be used for attaching a tag. Such a cable should be self locking, single use and should be able to withstand at least 50 pounds.

A typical example of tag is shown in [Figure 10.5](#).

10.3 Removing lockout/tag out

Before removing the lockout/tag out, ensure that the equipment is safe to operate by all the workers. The following guidelines should be followed:

- It should be ensured that, the equipment is completely assembled and all tools are removed from the equipment;
- Everyone working in the area should be notified that, the lockout/ tag out s being removed, and it should be ensured that every person is standing clear of the energy sources and equipment;
- Remove the lockout and tag out devices and store them in their designated place;
- Reenergize the equipment sequentially, checking for errors at each and every step.

In special situations, where outside contractors are working in CSEE facilities, all of the persons should be made aware of outside contractor's lockout/tag out devices and authorized persons. The outside contractor must be made aware of the CSEE Department personnel authorized to carry out lockout/tag out operations.

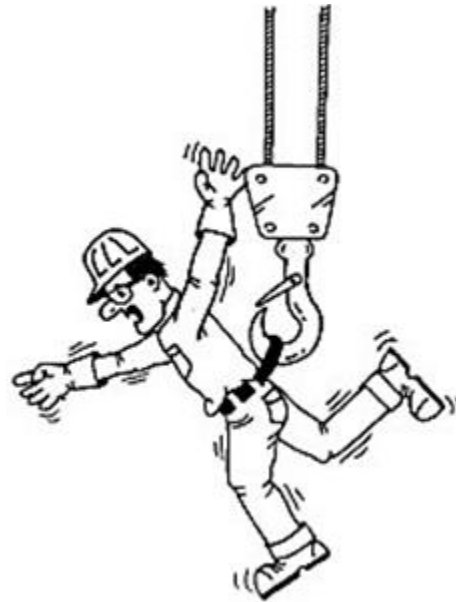
10.4 Safety guidelines

- Notify all affected employees must be notified, before beginning lockout/ tag out;
- Lockout/tagout the energy sources prior to maintenance or repair;
- Never tamper or remove with locks or tags found on the machinery, every person should take care that the tags are not accidentally removed by him/her or any co-workers;
- Never attempt to start, energize or use the equipment, which is locked out to perform service or maintenance;
- If in doubt, the person whose name appears on the lockout/tag out device should be contacted.

11 Module 11: Overhead/Gantry Cranes Safety

11.1 Introduction

Approximately 160 crane-related accidents occur every year, of which 3% are due to gantry cranes. Several types of cranes, hoists and rigging devices may be used in the Ketter Hall and Jarvis Hall Laboratories for lifting and moving materials. CSEE's policy is to maintain a safe workplace for its students, faculty, staff, and visitors. The safety rules and guidelines in this module apply to all operations at Ketter Hall Laboratories that involves use of overhead cranes installed in or attached to buildings; and to all CSEE students, faculty, staff, and visitors.



This module identifies, what can go wrong if the crane is improperly used, how to work safely in the vicinity of the crane, how to identify hazards, how to control risks, pre-operational checks, hooks and slings used to lift the load, and communication signals used during crane operation.

The CSEE Department laboratory currently has gantry cranes. These are the cranes with a movable bridge carrying a hoisting mechanism and traveling on an overhead fixed runway which is supported at more than two places. These cranes do not have booms. They move loads using the wheels rolling along rails.

11.1.1 Causes of accidents

- Rigging faults
- Overloading the crane
- Lack of communication

11.2 Operator qualifications

Only those persons who are designated by the employer should be permitted to operate the crane. 29CFR 1910.179(b)(8)

- The minimum qualifications for a person operating a crane in the Ketter Hall Laboratories are as follows:
- The operator has corrected vision that meets the requirements as vision for a valid driver's license;
- The operator has effective use of all 4 limbs;
- The operator is of sufficient height to operate the controls and to have an unobstructed view over the controls into the work area;
- The operator has coordination between eyes, hands and feet;
- The operator is free of known convulsive disorders and episodes of unconsciousness.
- The operator must also have the ability to understand signs, labels, and instructions.
- The operator must be examined for these qualifications at least once every 3 years.
- The documentation of each "licensed operator" is maintained in the Site Safety Managers office.

11.3 Training program

Any person, before he/she operates the Gantry Crane should be trained and must demonstrate proper use. Graduate research assistants, if required to use the overhead cranes, must take the crane operator's training and pass it. Training of all operators shall include the following.

- Maximum rated capacity of the crane;
- Capacities of equipment and attachments;
- Purpose use and limitation of controls;
- How to make daily checks;
- Energizing sequences, including pneumatic, hydraulic, and electrical sequences;
- Start-up and shutdown procedures;
- Emergency shutdown procedures;
- General operating procedures;
- Rigging procedures;
- All basic signaling procedures, including hand, radio, or telephone signals, where required;
- Practice in operating the assigned equipment through the mechanical functions necessary to perform the task.

The operator, after proper training, should be issued a permit, which he/she is required to carry at all times while on duty. A certificate to this effect should be on file before any one is permitted to use the various Overhead Cranes in the CSEE Department Laboratories. The documentation of each “licensed operator” is maintained in the Site Safety Managers office.

11.4 Safe operation

11.4.1 Operational checks to be performed prior to use

Always assess the risk and safety concerns at the work area before commencing a lift job. Start by inspecting the work area. Check overhead to ensure no work is going on that could contribute to a dangerous or hazardous situation. Look around to ensure that other workers are aware that you are lifting and they are not too close to the lift area. Other laboratory occupants must be kept away from the vicinity of a lifted load, as consequences of an unsecured load could be fatal. If you are a pedestrian, choose an alternate route. Do not get too close, especially when the load is raised. Be cautious and patient.

The general rule of safety is, load should never be lifted over people, mobile equipment, dangerous materials and structures where people are present.

At the beginning of each shift during which a crane is used, a visual inspection must be made in accordance with **Table 11.1**. A visual inspection is limited to that which can be made from a catwalk or other safe observation point. Any defects must be reported to a supervisor.

- The usual procedure is to operate the winders to check it can raise and lower. Operate each button to check they do not stick and that they function;
- The main function of hoist upper limit switch is to prevent the hook from hitting the carriage-way, causing the hoist rope to over stress;
- The lower limit switch is to ensure that, there is at least two turns of rope on the drum. This prevents the line from going slack;
- Listen for any unusual noises or shuddering;
- If you see or smell smoke from the motors, there is something wrong;
- Inspect the slings before every use, if the sling is worn out i.e. when the red fibers/cords are seen, it should be discarded and cut in two pieces immediately.

Table 11.1: Operator Inspection Checks

Inspection Item	Description of Inspection / Check Points
Tagged Crane	Check that crane is not tagged with an out-of-order sign
Control Devices	Test run that all motions agree with control device markings
Brakes	Check that all motions do not have excessive drift and that stopping distances are normal
Hook	Check for damage, cracks, deformations of the throat opening, wear on the load bearing point, and twist
Hook Latch	Check proper operation of the hook latch
Wire rope	Check for broken wires, broken strands, kinks, and any deformation or damage to the rope structure
Reeving	Check that wire rope is properly reeved and rope parts are not twisted about each other
Limit Switches	Check that the upper limit device stops lifting motion of the hoist load block before striking any part of the hoist or crane
Oil Leakage	Check for any sign of oil leakage on the crane and the floor area beneath the crane
Unusual Sounds	Check for any unusual sounds from the crane while operating the crane (Report This To The Supervisor Immediately)
Warning and Safety Labels	Check that warning and other safety labels are not missing and that they are legible
Housekeeping and lighting	Check area for accumulation of material, trip or slip hazards, and poor lighting

11.4.2 Attaching the load

When attaching or moving a load, the operator, rigger, or hooker must make sure of all of the following:

- The hoisting rope or chain is free of kinks or twist and not wrapped around the load;
- The load is attached to the load block hook by means of a sling or other approved device;
- The sling and load will clear all obstacles or obstructions;
- The load is balanced and secured before lifting the load more than a few inches;
- Multiple lines are not twisted around each other;
- The hook is brought over the load in a manner to prevent swinging;
- There is no sudden acceleration or deceleration of the moving load.

11.4.3 Moving the load

- The person responsible for directing the lift shall make sure that the load is properly secured, balanced and positioned in the sling or other lifting device;
- The person responsible for directing the lift shall make another visual inspection of the hoist chain or rope to make sure there are no kinks or twists;
- The hook shall be brought over the load in a manner that will prevent swinging when lifting the load;
- The chain or rope shall be inspected to ensure that it is properly seated in the chain sprocket or drum groove;
- Lift equipment shall not be used for side pulls;
- The operator shall not lift, travel or lower a load while someone is on the load or hook;
- The operator shall not lift the load over people;
- Always have a block to rest the load on so that the sling can be easily removed;
- Avoid setting up jerky movements;
- To take out the slack in slings, raise the load just off the ground smoothly and gradually. If you notice the load is slightly off center, stop and lower the load to re-rig;
- When the load is stable, continue to lift slowly and gently until it is clear of all the objects in its path;
- When traveling with a suspended load, break and accelerate slowly to minimize the swing;
- Slowly lower the load, decreasing the speed while resting;
- Stop the hoist when it is low enough to unhook the sling.

11.4.4 Parking the load

- The operator shall not leave a suspended load unattended;

- The hook should be raised above the head level when not in use.

11.5 Annual inspections

All overhead cranes should be inspected at least annually by an authorized person. A certificate to this effect should be kept on record, and should be made available to the safety committee during their inspections. [1910.179]

The crane shall be inspected for the items covered in the periodic inspection, as well as the following:

- i. Deformed, cracked, or corroded members;
- ii. Loose bolts or rivets;
- iii. Cracked or worn sheaves and drums;
- iv. Worn, cracked, or distorted parts such as pins, bearings, shafts, gears, rollers, locking, and clamping devices;
- v. Excessive wear on the brake system parts, linings, pawls, and ratchets;
- vi. Load indicators for any significant inaccuracies;
- vii. Excessive wear of chain drive sprockets and excessive chain stretch;
- viii. Electrical apparatus for signs of pitting or any deterioration of controller contractors, limit switches, and push button stations.

Written documentation of the annual inspections is required to be maintained. The documentation must include the date of the inspection, the name and signature of the person who performed the inspection, and equipment and accessories that were inspected need to be specifically mentioned.

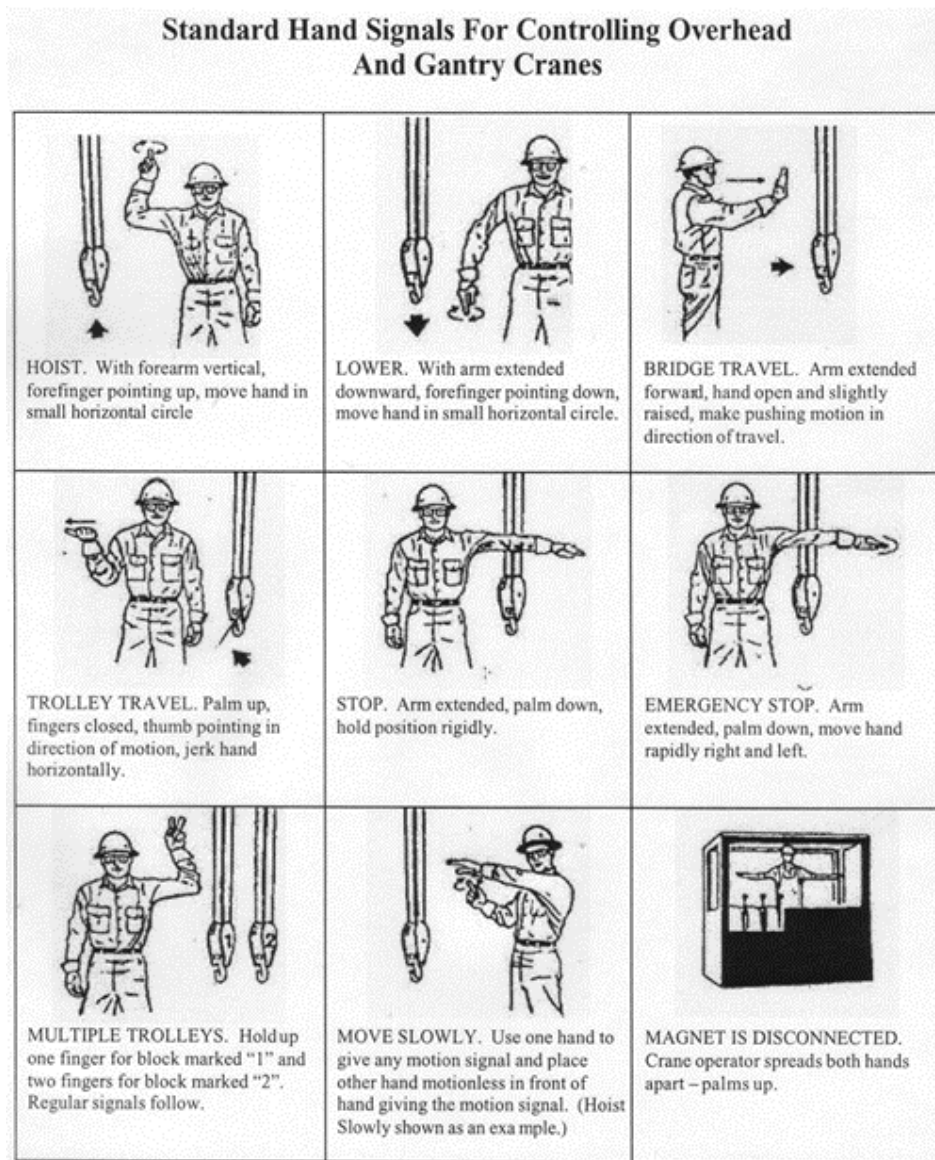
11.6 General safety guidelines

- i. Never load beyond the rated capacity;
- ii. Don't allow personnel to ride the on the load or hook;
- iii. Stand clear of all loads. Never allow yourself or someone else to come underneath the load;
- iv. Slowly inch the hoist into the load;
- v. Center the hoist over the load before lifting;
- vi. Never leave a suspended load unattended;
- vii. Review the hand signals used when operating hoists;
- viii. Make sure all loads are hooked safely, with the safety latch closed;

- ix. Test all controls, brakes, and limit switches to assure the hoist is operating properly prior to using it;
- x. Avoid swinging or jerking the load or load hook when traveling;
- xi. Do not use limit devices/switches as a normal means of stopping the hoist. These are for emergency use only.

11.7 Hand signals

Hand signals shall be used unless the participants of the lift are equipped with telephones, radios or other equivalent means of communication.



The operator must respond to hand signals from person directing the lift, except for emergency stop signal, which must be obeyed when given by any employee.

12 Module 12: Ladder safety

Falls are the leading cause of deaths in the work environment. According to the National Safety Council, over 6,000 people suffer disabling injuries from fall injuries. The accidents include falling from ladders. Most of these accidents occur because the victims violate the basic rules of ladder safety.

12.1 Training

The training should cover the following areas:

- Recognizing hazards related to ladders;
- Procedures to minimize the hazards;
- Correct procedures for erecting, maintaining and disassembling the fall protection system to be used in connection with use of ladders;
- Proper construction, use, placement and care in handling all ladders; and
- Maximum intended load carrying capacity of ladders.

12.1.1 Roles and responsibilities

CSEE Department

- Provide applicable types of portable ladders;
- Provide specific training for ladder users;
- Establish ladder inspection guidelines.

Principal Investigators / Supervisors

- Ensure ladders are inspected at specified intervals and maintain the record of such inspection; and
- Ensure ladder safety requirements are strictly adhered to.




Ladder Users

- Read this module carefully and seek clarifications if required; and
- Follow ladder safety requirements.

12.2 Common causes of ladder accidents

- Failure to secure (tie) the ladder firmly;
- Over-reaching from ladders on sides, rather than moving them;
- Standing ladders on unstable objects such as boxes to gain additional height;
- Climbing with single hand while carrying something in the other hand;
- Throwing tools to a fellow worker, standing on a ladder;
- Placing the ladder at an improper angle;
- Using metal ladders where potential electrical hazard exists; and
- Using damaged ladders.

12.3 Types of portable ladders

TYPE	DESCRIPTION	
Stepladder	A self-supporting portable ladder, non-adjustable in length, having flat steps and hinged back.	
Single Ladder	A non self-supporting portable ladder, nonadjustable in length, consisting of one section. The size of the single ladder is designated by the overall length of the side rail.	
Extension Ladder	A non self-supporting portable ladder adjustable in length.	

12.4 Ladder selection

There are different types of ladders available, each intended for different use. They may be made of wood, aluminum or fiberglass and designed for light or industrial use. The user must make sure that the ladder is long enough to work and sturdy enough to withstand repeated use. Aluminum is generally preferred over other materials as it is light-weight and is not affected by weather as much as wood. However, if the work involves possible contact with sources of electric current, an aluminum ladder is not suitable as it conducts electricity.

Always make sure that the ladder to be used has the adequate duty rating to carry the combined weight of the user and the material to be raised.

There are four (4) types of Ladders based on Load Carrying Capacity

- **Type 1A:** These ladders have a duty rating of 300 pounds and are recommended for extra-heavy-duty industrial use.
- **Type 1:** These ladders have a duty rating of 250 pounds and are manufactured for heavy-duty use.
- **Type 2:** These ladders have a duty rating of 225 pounds and are intended for medium-duty use.
- **Type 3:** These ladders have a duty rating of 200 pounds and are rated for light-duty use.

Only Type 1A and Type 1 ladders should be used in the CSEE Department Laboratories.

Only Straight Ladders should be used if the work task is 20 feet above the ladder placement surface; and Step Ladders should not be used in such conditions. Single ladders longer than 30 feet should not be used. Extension ladders longer than 60 feet should not be used.

12.5 Safe operations

Before setting up any type of ladder, double-check overhead for obstructions. Never use the metal ladders around electrical equipment or power lines.

12.5.1 Ladder inspection

The ladders can develop problems rendering them unsafe. Therefore, every time one uses the ladder, it should be thoroughly inspected. The step ladders should be checked for proper working of the locking system and spreader, which provide stability. Check for the following points. If the ladder is found to be

defective, report it to Mr. Duane Kozlowski or Mr. Todd Snyder and have it tagged-out. Do not use the ladder unless it is repaired and, if the ladder cannot be repaired, it must be destroyed.

Checklist for Ladder Inspection:

- Make sure that steps, rails or braces are not damaged, and are not loose.
- Are all the steps in good condition?
- Are the side rails intact without any cracks?
- Are the steps fitting snugly into the side rails?
- Is the ladder free of corrosion?
- Are the side rails and steps free of grease or other slippery substance?
- Are the movable parts operating smoothly?
- Are the ropes on extension ladders intact?

12.5.2 Setting up ladders

If the ladder is placed in a dangerous location or setup improperly, an accident is bound to happen, no matter how safe the ladder is. If you must setup the ladder in a walkway or aisle, always erect barricade or guard to prevent collisions.

- Place the ladder firmly on the ground. If one of the feet is imbalanced causing the ladder to stand inclined, level it up by using firm packing. Make sure there is enough skid resistance between the packing material and the ground and foot of the ladder;
- Brace the foot of the ladder, preferably tie it down to a permanent structure if there is any danger of slipping;
- Stepladders should be fully opened with spreaders locked;
- Never setup a ladder in front of a door unless the door is locked or someone is guarding it at all times;
- The ladders should be projecting at least three (3) feet above the top point of the structure which is to be climbed;
- Ladders must be placed by adhering to the 1:4 rule, as illustrated in **Figure 12.1**. Which essentially means, ladder should be 1 foot away from the structure for every 4 feet to be climbed.

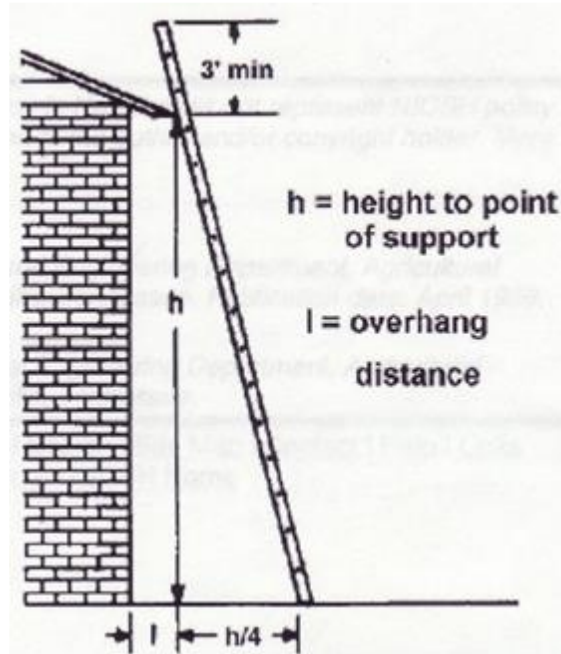


Figure 12.1: Ladder placed in accordance with 1:4 rule

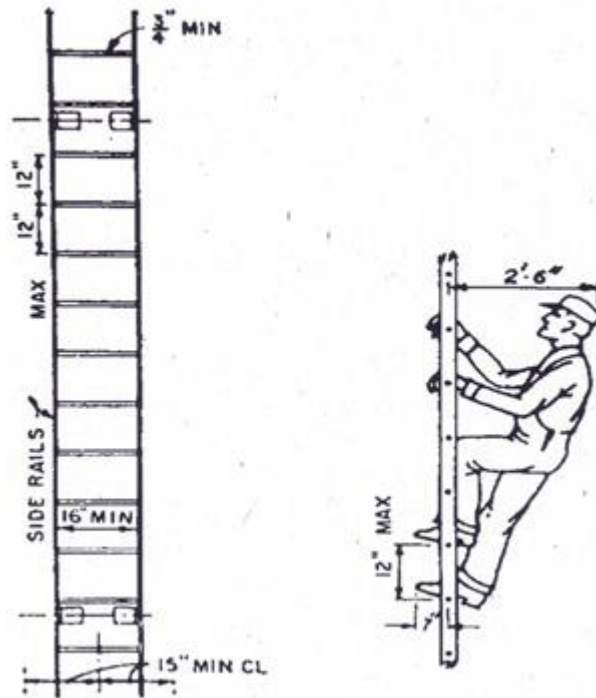


Figure 12.2: Technical requirements of ladders & climbing

Setting up short ladders (which can be raised by one person):

- Place the base of ladder against solid surface;
- Lift the top edge of ladder and walk it down step by step, moving it towards the base until the ladder is upright;
- Rest the top of the ladder against the wall or other firm surface, then lift or slide the base out to its final position



Setting up long ladders (which need two or more people to setup):

- Lay the ladder on the ground with the base at the spot where it is intended to stand;
- Heaviest person amongst the group should stand at the base and should put his/her foot on the bottom step;
- Remaining person(s) should then start to raise the ladder while heavy partner reaches forward from the base and grasps the side rails. (Care should be taken by the heavy person not too exert to much pressure as this can cause serious back injury);
- Once the ladder is upright, rest the top against the structure to be climbed.



12.5.3 Ladder climbing

- Clean all debris from shoes before climbing the ladder;
- Ensure that the steps have sufficient skid resistance on the surface;
- Whether climbing up or down, always face the ladder. Use both hands and maintain a secure grip;
- Do not carry loads while climbing the ladder. Climb yourself first and then use rope to raise the loads, tools;

- Always stand on the ladder with feet in the center of the steps;
- Never reach too far on the sides or to the rear from ladder, move the ladder to a new position whenever necessary;
- Always keep holding the ladder with one hand;
- Never climb on to ladder from side;
- Never switch from one ladder to another. Climb Down;
- Never slide down a ladder

12.6 Storage of ladders

- Always store ladders in covered, ventilated area, protected from weather;
- Ladders can fall if stored vertically. Secure the top of ladder with a bracket if possible;
- Never hang a ladder from a step;
- When storing the ladders horizontally, install wall brackets and hang the side rail on the brackets, make sure the side rail is sufficiently supported and won't sag by self weight;
- Never sit on a side rail of a stored ladder;

12.7 Maintenance of ladders

- Ladders should be inspected once every three (3) months by a competent person and a record of said inspections must be maintained;
- Check all ladder hardware, nuts, bolts etc. for tightness;
- Examine and replace [if required] damaged ropes on extension ladders;
- Never attempt to straighten a bent ladder, remove it from service.

12.8 Safety guidelines

- Use only fiberglass ladders for work near electric cables;
- Never use a spiral stairway, that is not a permanent part of a structure;
- Short ladders should not be spliced together to make long ladders;
- Ladders should never be used in the horizontal position as scaffolds or work platforms;
- The top of regular step ladder should not be used as a step;
- Use a ladder which is long enough;
- Never carry equipment or tools while climbing a ladder;
- Do not leave tools or materials on top of the ladders;

- Always face the ladder while climbing up or down;
- Never move a ladder while standing on it;
- Keep your weight evenly distributed on the ladder step; and
- Read and follow the warning stickers for highest standing levels.

13 Module 13:Forklift Safety

Every year, an alarming number of forklift operators are involved in the accidents. Latest data from OSHA indicates that about 90,000 workers are injured and approximately 100 killed every year in forklift related accidents.

Accident statistics of serious forklift accidents:

Accident	Percentage
Tip-over	25.3%
Contact with other forklift	18.8%
Falling Load	14.4%
Riding on Forks	12.2%
Fall off dock	7.0%
Maintenance	6.1%
Breakdown	4.4%
Other	11.8%
Total	100.0%

13.1 Causes of forklift accidents

Tip-over is the main cause of forklift accidents, as in the above table. Proper training and care during the use is known to avoid such accidents. Three primary causes of forklift accidents are:

- Unbalanced, raised load;
- Striking an overloaded object;
- Excessive speed while turning forklift.

13.2 Pre-qualifications for selecting forklift operators for training

Forklift operation is treated to be one of the high risk jobs as the injury rate of the accidents caused by forklifts is very high. All of the forklift operators must meet the following requirements to be able to receive the training:

- Must not have any vision problems which cannot be corrected with glasses or contact lenses;
- Must not have adverse hearing loss which cannot be corrected with hearing aids;
- No physical impairment that would restrict safe operation;
- No neurological disorders that affect balance or consciousness; and
- Must not be on medication that affects vision or other physical or mental abilities.

13.3 Training topics

Training shall be carried out by an experienced operator chosen by the CSEE department, and the training shall include the following:

1. Forklift (Vehicle) Related Topics

It is expected that the trainee receives complete knowledge of the forklift as a machine. This will enable him/her to adjust with the changing work-place and terrain conditions safely.

- i. Operating instructions, warning and precautions;
- ii. Controls and instrumentation; location and purpose;
- iii. Starting up the forklift;
- iv. Steering;
- v. Visibility (criticalities when loaded);
- vi. Seat belts(s);
- vii. Fork attachments;
- viii. Forklift capacity;
- ix. Refueling;
- x. Operating limitations.

2. Work-place Related Topics

This forms the most important part of training program as this is the area where risk is involved towards others working in the same area, causing injuries and fatalities.

- i. Surface conditions of vehicle operation;
- ii. Load stability while in motion;
- iii. Loading and unloading (stacking techniques);
- iv. Restrictions due to pedestrian traffic;
- v. Narrow aisles;
- vi. Restricted (hazardous) locations where the forklift will be operated;
- vii. Effect of ramps and sloped surfaces on stability;
- viii. Other unique and dangerous situations that could affect safe operation.

13.4 Pre-operation checklist

Pre-operation checks are a must for all the machines that could create potential danger. The forklift shall be inspected for proper working of the following items:

- Seat-belt
- Headlights
- Horn
- Brakes
- Leaks [if any]
- Backup warning alarm
- Fire extinguisher

13.5 Safety guidelines for loading

Loading is the first operation where imminent danger of tipping exists. Operators should never overload the forklift and should never jerk the loads.

- Only stable and arranged loads shall be handled. Care should be taken while handling asymmetrically balanced loads;
- Multiple tiered loads shall be split in batches so as not to exceed the rated capacity of the forklift;
- The forks should be placed under the load as far as possible, the forks shall be immediately tilted backwards to stabilize the load;
- Elevated load shall never be tilted forward except when the load is in deposit position.

13.6 Safety guidelines for forklifts in motion

- Forklifts in motion cause danger to the surrounding objects and people. Utmost care should be observed while the forklift is in motion;
- The forklift shall not be driven faster than 5 mph;
- Loads should never be carried more than 6 inches above the surface level, where the forklift is operating;
- Operator must sound horn and use extreme care when meeting pedestrians, making turns and cornering;
- Forklift shall not be driven up to anyone standing in front of a fixed object;
- No person shall be allowed to stand or pass under the elevated part of truck irrespective of whether it is loaded or empty;
- Nobody but the operator should be on the forklift;
- Arms or legs shall not be placed outside the running lines of forklift or above the body shield fitted on the forklift;
- Enough headroom shall be maintained under overhead installations; lights, pipes, sprinkler systems etc.;
- All traffic regulations shall be observed and right of way shall be yielded to emergency vehicles;
- Safe distance from the vehicle in front should be maintained which is at least three times the forklift length;
- Operator must slow down and sound the horn at intersections and other locations where vision is obstructed;
- Grades shall be ascended and descended slowly. Grades in excess of 10% should be traveled with the load upgrade;
- At all times, the forklift should be operated at such speed which shall bring it to stop in a safe manner;
- Driving over loose objects should be avoided;
- When the truck is to be left unattended; the forks shall be fully lowered, power shall be shut off, and brakes set. Wheels shall be blocked if parking on an inclined surface;
- The overhead guard must always be in place. It is provided to offer protection from crushing if forklift tips over;

13.7 Safety guidelines for forklift parking

- Forklift should always be parked on a flat surface. However in unavoidable circumstances, if the forklift is parked on slope, the wheels must be blocked;
- Forklift shall never be parked so as to block fire aisles, access to stairways, or fire equipment;
- The forks should be lowered and should be resting flat on ground;
- The controls should be in idle condition, engine should be turned off and brakes should be set;
- The key must always be removed.

13.8 Fueling safety

The forklift in the CSEE department works on Propane. Propane, being a spontaneously combustible fuel, must receive proper care while handling, and during storage. Following safety measures shall be observed:

- The engine shall be shut off before replacing the propane cylinder;
- The proper PPE shall be work while performing any maintenance on the forklift.
- The valve on the empty cylinder should be closed tightly;
- The empty cylinder should be moved in the place designated for empty cylinders;
- New cylinder shall be placed on the forklift and should be securely clamped;
- Fuel pipe shall be attached firmly;
- Valve should be opened and it should be checked that no gas is smelled.

13.9 Forklift maintenance

Forklift, if not maintained in order to be working safely can pose serious safety hazards. The following guidelines must be strictly adhered to:

- The forklift shall be examined for any defects or unsafe conditions before putting to use everyday. When defects are found, they shall be immediately reported and corrected;
- The forklift shall be removed from service if it is suspected to be not in safe operating condition;
- The repairs shall be carried out by authorized personnel only;
- Battery shall be disconnected before carrying out electrical repairs;
- The forklift shall not be altered in any way, even if spare parts are not available. The same shall be reported to the manufacturer;
- The forklift shall not be added with additional counter weight unless written approval from the manufacturer is sought;

- The forklift shall be kept in clean condition, free of lint, excess oil and grease;
- The fire extinguisher on the forklift shall be checked periodically for rated pressure in the tank.

14 Module 14: Fall Protection

Falls result in lost production time, medical costs, paper work and suffering.

In the year 2001, 808 workers died due to falls, accounting 13.7% of total deaths in the US industry. **Figure 14.1** illustrates injury statistics of fall accidents.

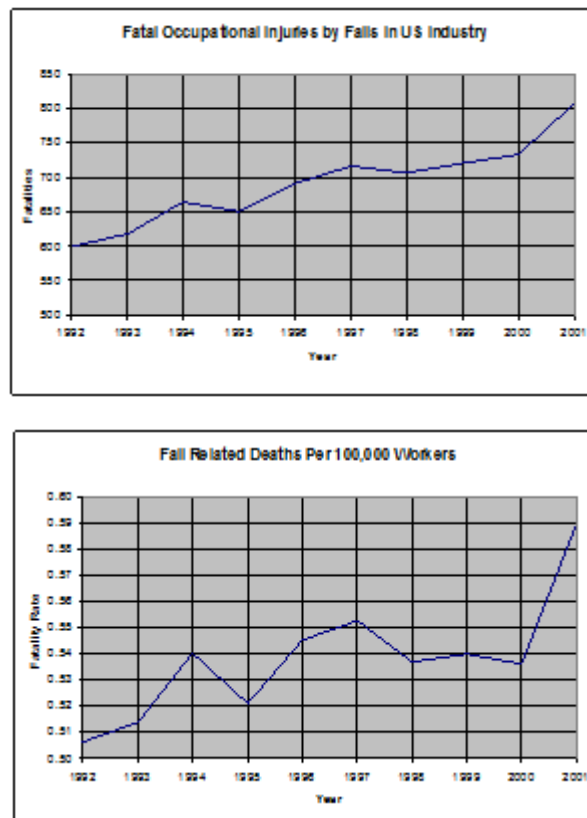


Figure 14.1: Injury statistics of fall accidents

Fall prevention and fall protection are two terms, frequently used to explain the means to control fall hazards. However, fall prevention and fall protection are different and should be considered separately. Proper fall prevention eliminates a hazardous situation and therefore removes the chance of exposure to a fall. Fall protection follows recognition that a hazardous situation exists which cannot be fully or adequately eliminated, and therefore fall arrest equipment and procedures are required to be provided to exposed persons.

14.1 When is fall protection required?

Whenever a person in CSEE Department engaged in laboratory or any other maintenance activities is exposed to a potential fall of 6 feet or greater from an unprotected side or edge, the OSHA fall protection standard for Construction (29 CFR 1926.501 [Duty to have fall protection]) applies. If a fall hazard exists, we should select either a guardrail system, safety net system or personal fall arrest system or a combination of two or more to protect the worker from a fall.

14.2 Fall protection training

14.2.1 Description of roles and responsibilities

CSEE Department

- Classify the areas and activities specifically, where fall protection is required, this shall be made known to all laboratory personnel and students via training;
- Obtain suitable fall protection systems; and
- Ensure all exposed personnel is trained.

Principle Investigators / Supervisors

- Know when fall protection is necessary;
- Provide personnel with fall protection equipment; and
- Ensure workers use fall protection devices.

Exposed persons

- Read this module carefully;
- Recognize fall hazards before engaging into a work activity that would cause fall hazards;
- Demand fall protection devices when necessary; and
- Use fall protection devices.

14.2.2 Training program

The training must include the following:

- The nature of fall hazards in the work area;
- The correct procedures for erecting, maintaining, disassembling, and inspecting the fall protection systems to be used;

- The use and operation of applicable protection to be used;
- The role of each employee in the safety monitoring system when this system is used;
- The correct procedures for the handling and storage of equipment and materials and the erection of overhead protection;
- The role of employees in fall protection plans; and
- Certification of training.

14.2.3 Retraining

When the competent authority from CSEE Department has reason to believe that an employee who has already been trained does not have the understanding and skill required as regards fall protection and prevention, CSEE Department shall retrain each such employee.

Circumstances when Retraining is generally required are:

- Changes in the workplace which renders previous training obsolete;
- Changes in the types of fall protection systems or equipment to be used render previous training obsolete; and
- Inadequacies in an affected employee's knowledge or use of fall protection systems or equipment which indicates that the employee has not retained the requisite understanding or skill.

14.3 Types of falls

- Falls on same level (Slips and Trips)
- Falls from elevation

It is documented that the majority (60 percent) of falls happen on the same level resulting from slips and trips. The remaining 40 percent are falls from a height.

14.4 Falls on same level

14.4.1 Slips

Slips occur when there is not enough friction or traction between the footwear and walking surface.

Common causes of Slips are:

- Wet or greasy surfaces;
- Spills;

- Unanchored carpets or mats; and
- Walking surfaces which do not have same degree of traction in all areas.

14.4.2 Trips

Trips occur when the foot strikes or hits against some object causing us to lose balance.

Common causes of Trips are:

- Uncovered cables;
- Unattended tools;
- Insufficient lighting and obstructed view;
- Uneven walking surfaces; and
- Loose carpet ends and floor mats.

14.4.3 Prevention of slips and trips

Slips and trips occur from an unanticipated change in the contact between the feet and the walking surface. Proper housekeeping, quality of walking surfaces, and selection of proper footwear are the important considerations for preventing fall accidents. Some of the major safety areas are explained below:

Housekeeping

Refer to **Module 5** of this safety manual for detailed guidelines about housekeeping.

Without proper housekeeping, no other preventive measures such as installation of fall-preventive flooring or wearing specialty footwear can be effective. Some important housekeeping techniques are listed below:

- Always clean up spills immediately;
- Remove obstacles and clutter from the walkways and your work area;
- Cover the electric cables that are on the walking surfaces;
- Maintain your work area always well-lit; and
- Report any unsafe condition that is beyond your control to correct.

Footwear

No footwear is designed to be slip resistant against every type of potential slip hazard. Therefore, every hazardous area should be analyzed and manufacturer of the footwear should be contacted for ensuring the

suitability of a specially required type of footwear. However, as a general guideline, only safety boots shall be worn in the laboratory.

Safety is everybody's responsibility. Therefore, every individual must take precautionary measures to avoid slips and falls.

Tips for avoiding Slipping:

- Watch your step;
- Adjust your speed of walking according to the skid resistance of the walking surface; and
- Try to make wide turns at corners.

Tips for avoiding Tripping

- Keep the tools drawers closed;
- Always make sure that you are walking in well lit conditions;
- Use a flash light if the light is insufficient for you to walk; and
- Ensure that things you are carrying do not obstruct your view.

14.5 Falls from elevation

OSHA Fall Protection Standard mandates that, whenever a person is exposed to a potential fall of 6 feet or greater from an unprotected side or edge, some suitable fall protection has to be provided.

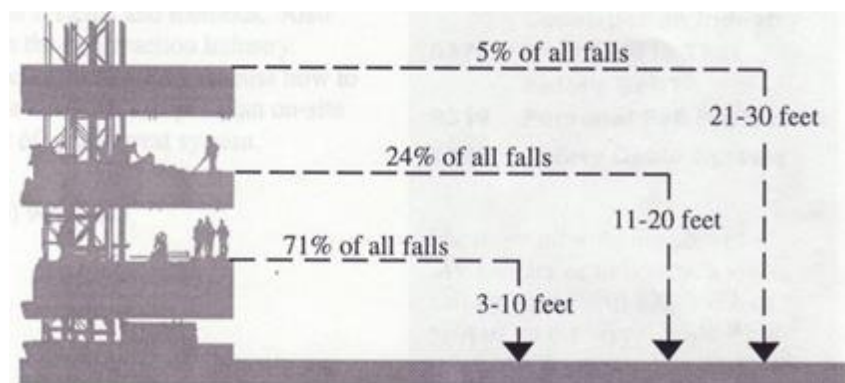


Figure 14.2: Statistics of falls from heights

One does not have to reach very high heights in order to receive disabling injuries from falls. As illustrated in [Figure 14.2](#), statistics show that about 71% falls take place from 3-10 feet height, falls from

11-20 feet account for the next 24% and only 5% falls take place in the height range of 21-30 feet. It could be inferred that, bravado, carelessness and negligence towards the required fall protection equipment are the primary causes of falls.

CSEE Department shall be adhering to effective fall protection policy, elements of which shall be as follows:

- Strictly enforcing safe work procedures;
- Requiring students and lab personnel to report potential fall hazards;
- Training students and all employees to recognize fall hazards and to use fall-protection equipment; and
- Reviewing fall-protection procedures periodically to ensure they are effective and comply with the current OSHA standards.

14.6 Types of fall protection systems

14.6.1 Fall arrest system



Figure 14.3: Fall arrest system

A fall arrest system is required if the risk of falling from an elevated level exists. It is designed to be passive, activated only if a fall occurs.

The essential components of an effective Fall Arrest System are:

1. Personal Protective Gear – Full Body Harness;
2. Connecting Device – Shock-Absorbing Lanyard;
3. Anchorage Point – Eye Bolt/Beam.

The fall arrest system should be used anytime a working height of six feet or more is reached. Working height is the distance from the walking/working surface to a grade or lower level. A fall arrest system will only come into service should a fall occur. A full-body harness with a shock-absorbing lanyard or a retractable lifeline is the only product recommended by OSHA. Full Body Harnesses are designed to arrest the most severe free falls. A full-body harness distributes the forces throughout the body, and the shock-absorbing lanyard decreases the total fall arresting forces.



Figure 14.4: Full body harness

A full body harness, as illustrated in **Figure 14.4**, is a belt system designed to distribute the impact energy of a fall over the shoulders, thighs, and buttocks. A well designed harness will be snug-fitting, yet comfortable. Harnesses should feature adjustable thigh straps, a waist strap, a chest strap, sliding D-ring midway up the back, and a strap across the buttocks. A properly designed harness provides prolonged suspension after a fall without restricting blood flow, which could result in internal injuries. Full body harness also helps in rescue as the worker is positioned upright.

In addition to the full body harness, lanyards should be used to arrest the fall. The lanyards must be securely anchored to a non-deflecting point. Self-retracting lanyard slowly lets out a length of lanyard under slight tension. At the onset of a fall, the device locks to arrest the fall.

An anchorage is generally an essential part of the structure itself – a beam, girder, or column – that will ultimately have to withstand the forces of arresting a fall.

The Fall Arrest System:

- Must be rigged so that an employee can neither free fall more than 6 feet nor contact any lower level;

- Must bring an employee to a complete stop and limit maximum deceleration distance an employee travels to 3.5 feet;
- Must have sufficient strength to withstand twice the potential impact energy of an employee free falling a distance of 6 feet or the free fall distance permitted by the system, whichever is less.



X

Figure 14.5: Adverse effect of body belts

Prior to January 1, 1998, body belts which fitted around waist were considered an approved fall arrest system. However, after January 1, 1998 OSHA has prohibited the use of such body belts as they were known to cause damage to internal organs AS ILLUSTRATED IN **Figure 14.5.**

14.6.2 Positioning system

The personal positioning system allows workers to hold themselves in place, keeping their hands free to accomplish a task. Whenever the worker leans back, the system is activated, making it an active system.

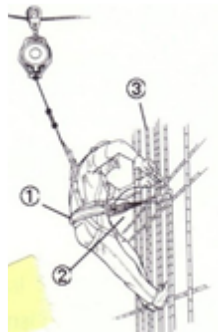


Figure 14.6: Positioning system

The essential components of an effective Positioning System are:

1. Personal Protective Gear – Full Body Harness;
2. Connecting Device – Shock-Absorbing Lanyard;
3. Anchorage Point – Eye Bolt/Beam.

14.6.3 Retrieval system

The personal retrieval system is mostly used in confined spaces. This system is primarily used where workers enter tanks, manholes, etc. and may require retrieval from the same if emergency occurs.



Figure 14.7: Retrieval system

The essential components of an effective Retrieval System are:

1. Tripod and suitable winch equipment;
2. Personal Protective Gear – Full Body Harness;
3. Connecting Device – Shock-Absorbing Lanyard;
4. Anchorage Point – Eye Bolt/Beam.

14.6.4 Suspension system

The personal suspension system is used widely in the window washing and painting industries, and is designed to lower and support a worker while allowing hands-free work environment.

The essential components of an effective Suspension System are:

1. Personal Protective Gear – Chair and Full Body Harness;
2. Connecting Device – Workline;
3. Anchorage Point – Anchor Bolt.



Figure 14.8: Suspension system

14.7 Inspection and maintenance of fall protection equipment

To maintain the service life and high performance, all belts and harnesses should be inspected frequently. Visual inspection before each use should become routine, and also a routine inspection by a competent person at certain definite intervals shall be required. If any of the conditions listed below are found the equipment should be replaced before being used.

14.7.1 Harness inspection

1. **Belts and rings:** For harness inspections begin at one end, hold the body side of the belt toward you, grasping the belt with your hands six to eight inches apart. Bend the belt in an inverted "U." Watch for frayed edges, broken fibers, pulled stitches, cuts or chemical damage. Check D-rings and D-ring metal wear pads for distortion, cracks, breaks, and rough or sharp edges. The D-ring bar should be at a 90 degree angle with the long axis of the belt and should pivot freely.



Figure 14.9: D-Ring

Attachments of buckles and D-rings should be given special attention. Note any unusual wear, frayed or cut fibers, or distortion of the buckles. Rivets should be tight and unremovable with fingers. Body side rivet base and outside rivets should be flat against the material. Bent rivets will fail under stress.

Inspect frayed or broken strands. Broken webbing strands generally appear as tufts on the webbing surface. Any broken, cut or burnt stitches will be readily seen.

2. **Tongue buckle:** Buckle tongues should be free of distortion in shape and motion. They should overlap the buckle frame and move freely back and forth in their socket. Rollers should turn freely on the frame. Check for distortion or sharp edges.



Figure 14.10: Tongue buckle

3. **Friction buckle:** Inspect the buckle for distortion. The outer bar or center bars must be straight. Pay special attention to corners and attachment points of the center bar.



Figure 14.11: Friction buckle

14.7.2 Lanyard inspection

When inspecting lanyards, begin at one end and work to the opposite end. Slowly rotate the lanyard so that the entire circumference is checked. Spliced ends require particular attention. Hardware should be examined under procedures detailed below.



Figure 14.12: Lanyards

Hardware

- **Snaps:** Inspect closely for hook and eye distortion, cracks, corrosion, or pitted surfaces. The keeper or latch should seat into the nose without binding and should not be distorted or obstructed. The keeper spring should exert sufficient force to firmly close the keeper. Keeper locks must provide the keeper from opening when the keeper closes.
- **Thimbles:** The thimble (protective plastic sleeve) must be firmly seated in the eye of the splice, and the splice should have no loose or cut strands. The edges of the thimble should be free of sharp edges, distortion, or cracks.

Lanyards

- **Steel lanyards:** While rotating a steel lanyard, watch for cuts, frayed areas, or unusual wear patterns on the wire. The use of steel lanyards for fall protection without a shock-absorbing device is not recommended.
- **Web lanyards:** While bending webbing over a piece of pipe, observe each side of the webbed lanyard. This will reveal any cuts or breaks. Due to the limited elasticity of the web lanyard, fall protection without the use of a shock absorber is not recommended.
- **Rope lanyards:** Rotation of the rope lanyard while inspecting from end to end will bring to light any fuzzy, worn, broken or cut fibers. Weakened areas from extreme loads will appear as a noticeable change in original diameter. The rope diameter should be uniform throughout, following a short break-in period. When a rope lanyard is used for fall protection, a shock-absorbing system should be included.

Shock-absorbing packs

The outer portion of the shock-absorbing pack should be examined for burn holes and tears. Stitching on areas where the pack is sewn to the D-ring, belt or lanyard should be examined for loose strands, rips and deterioration.

14.7.3 Visual indication of damage to webbing and rope lanyards

- **Heat:** In excessive heat, nylon becomes brittle and has a shriveled brownish appearance. Fibers will break when flexed and should not be used above 180 degrees Fahrenheit.

- **Chemical:** Change in color usually appears as a brownish smear or smudge. Transverse cracks appear in a belt damaged by chemicals, when belt is bent over tight. This causes a loss of elasticity in the belt.
- **Molten metal or flame:** Webbing and rope strands may be fused together by molten metal or flame. Watch for hard, shiny spots or a hard and brittle feel. Webbing will not support combustion, nylon will.
- **Paint and solvents:** Paint will penetrate and dry, restricting movements of fibers. Drying agents and solvents in some paints will appear as chemical damage.

14.8 Cleaning of fall protection equipment

Basic care for fall protection safety equipment will prolong the life of the equipment and contribute toward the performance of its vital safety function. Proper storage and maintenance after use is as important as cleaning the equipment of dirt, corrosives or contaminants. The storage area should be clean, dry and free of exposure to fumes or corrosive elements. Do not store webbing and rope lanyards in direct sunlight, because ultraviolet rays can reduce the strength of some material.

Nylon and Polyester

Wipe off all surface dirt with a sponge dampened in plain water. Squeeze the sponge dry. Dip the sponge in a mild solution of water and commercial soap or detergent. Work up a thick lather with a vigorous back and forth motion. Then wipe the belt dry with a clean cloth. Hang freely to dry but away from excessive heat.

Drying

Harness, belts and other equipment should be dried thoroughly without exposure to heat, steam or long periods of sunlight.

14.9 Guidelines for using fall protection equipment

- Exposed personnel must use the fall protection systems whenever the need dictates;
- The user must read and follow manufacturer's instructions carefully;
- The user must adjust the fit of the body harness, as improperly adjusted harness could result in injury or death in the event of a fall;
- Inspect the anchorage to be sure it will withstand the force of arresting a fall;

- Ensure all connectors are in good conditions;
- When connecting to lifeline or lanyard, user must make sure that the connector is securely locked;
- Eliminate knots or kinks, which can reduce the strength of the lanyard;
- Avoid running the lanyard over sharp edges, the cutting action reduces the strength of lanyard.

15 Module 15: Confined Spaces

Work in confined spaces presents unusual and severe hazards to a sizable portion of the maintenance work force. Common tasks, such as welding, use of solvents and adhesives, live electrical work, or painting can quickly become lethal in a confined space. The National Institute for Occupational Safety and Health (NIOSH) reports that about 63 occupational fatalities per year in the United States are caused by improper confined space entries. The Occupational Safety and Health Administration (OSHA) reports that over 60 percent of the fatalities were would-be rescuers.

Confined space is a space that:

1. is large enough and so configured that an employee can bodily enter and perform work;
2. has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry.); and
3. are not designed for continuous occupancy.

There are two types of confined spaces:

- **Non-permit-required confined space:** A space that meets the definition of a confined space but, which after evaluation, does not contain or have potential to contain any hazard capable of causing death or serious physical harm.
- **Permit-required confined space:** A confined space that has one or more of the following characteristics:
 - Potential to contain a hazardous atmosphere.
 - Material that has potential for engulfing an entrant.
 - An internal configuration that could trap or asphyxiate an entrant such as inwardly converging walls or a floor that slopes downward and tapers to a smaller cross-section.
 - Any other recognized serious safety or health hazard

Many fatalities occur because victims do not fully understand the threat of airborne hazards that they cannot see, smell, or feel. Additional fatalities occur when untrained persons enter unknown atmospheres to rescue fallen co-workers.

15.1 Common causes of accidents in confined spaces

The causes can be divided in two categories:

- Unsafe Acts and Omissions
- Unsafe Conditions

15.1.1 Unsafe acts and omissions

- Failure to test the atmosphere in a confined space before entry;
- Failure to continuously monitor the atmosphere in a permit-required confined space;
- Failure to lock out hazardous fluids, mechanical equipment, and electrical power to equipment inside the confined space;
- Failure to follow approved entry procedures;
- Lack of training;
- Failure to preplan rescue and retrieval efforts;
- Failure to use adequate respirators;
- Lack of a communication system when entrants are out of sight.

15.1.2 Unsafe conditions

- Fall hazards;
- Oxygen deficient atmosphere;
- Oxygen enriched atmosphere;
- Poor lighting;
- Flammable atmosphere;
- Toxic atmosphere;
- Electrical shock hazards;
- Presence of an engulfing or drowning medium;
- Entrapping mechanisms e.g. jaws for holding workpieces;
- Contact with hazardous chemicals.

15.2 Hazards in confined spaces

15.2.1 Hazardous atmosphere

A hazardous atmosphere means an atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to self-rescue (that is to escape unaided from a confined space), injury, or acute illness from one or more of the following causes:

- Oxygen deficient atmosphere. When the oxygen content is below 19.5 percent, it is too low to provide enough oxygen for a working person;
- Oxygen enriched atmosphere. Oxygen content above 23.5 percent causes combustible substances to burn more vigorously than in normal atmosphere. For example, in an oxygen enriched atmosphere, a person's hair, clothing, and even skin will burn rapidly if ignited;
- Flammable explosive atmosphere. Flammable gases, vapors, or dusts are dangerous in concentrations above 10 percent of the lower flammable explosive limit;
- Toxic atmosphere. Dangerous air contamination caused by a toxic substance is the concentration immediately dangerous to life and health. This definition does not preclude the requirement to control the concentrations to below the permissible exposure limit for persons working without respiratory protection;
- Airborne combustible dust at a concentration that exceeds its LFL (Lower Flammability Limit – The lowest percentage of a substance in the air that leads to fire or explosion). In a concentration above LFL, dust obscures vision at a distance of 5 feet or less;
- Any other atmospheric condition that is immediately dangerous to life or health is considered a hazardous atmosphere.

15.2.2 Electrical/mechanical hazards

Electrical power that could shock workers or move mechanical equipment must be locked or tagged out prior to entry into a confined space. Machinery that could move under the influence of gravity, spring loads, or other forces must be mechanically blocked or immobilized before work is started in a confined space.

15.2.3 Engulfment/drowning

Grain, dusts, powders, liquids, or slurries pose serious hazards to persons entering confined spaces. Persons engulfed in sawdust cannot breathe and become asphyxiated in a very short time. Lifelines

attached to an approved harness, mechanical lifting aids, and an alert safety attendant are needed to prevent deaths in this work environment.

15.2.4 Fall hazards

Fall hazards are serious because it is difficult to retrieve an injured person in confined space. Free-fall distance must be limited to 2 feet (0.61 meters) before the fall is arrested.

15.3 Protective devices and controls

15.3.1 Air testing equipment

All air-testing equipment should be calibrated in accordance with the manufacturer's instruction.

Oxygen Meters and Monitors

The oxygen content of the air in a confined space is the first and most important constituent to measure before entry is made. The acceptable range of oxygen is between 19.5 and 23.5 percent. This content is measured before flammability is tested because rich mixtures of flammable gases or vapors give erroneous measurement results. For example, a mixture of 90 percent methane and 10 percent air will test nonflammable because there is not enough oxygen to support the combustion process in the flammability meters. This mixture will not support life and will soon become explosive if ventilation is not provided to the space. Before entry, spaces must be ventilated until both oxygen content and flammability are acceptable.

Flammability Meters

Flammability meters are used to measure the amount of flammable vapors or gases in the atmosphere as a percent of the LFL. The oxygen content must be near 21 percent for results to be meaningful.

Toxic Air Contamination Testers

Tests for toxic contaminants must be specific for the target toxin. The instrument manufacturer should be consulted for interferences. Therefore, it is important to know the history of the confined space so proper tests can be performed. Part of hazard assessment is to identify all possible contaminants that could be in the confined space.

15.3.2 Protective devices

Fall-Protection Equipment

Fall-protection equipment for confined spaces should be the full body harness type to minimize injuries from uncontrolled movements when it arrests a worker's fall. This type of harness also permits easier retrieval from a confined space than a waist belt. Adjustable lanyards should be used to limit free fall to two feet before arrest.

Respirators

An industrial hygienist should select respirators on the basis of his or her evaluation of possible confined-space hazards. NIOSH-approved respirators should be identified in the approved procedure required by the confined-space entry permit. It is important to note that air-purifying respirators cannot be used in an oxygen deficient atmosphere.

Lockout/Tag out Devices

Lockout/tag out devices permit employees to work safely on de-energized equipment without fear that the devices will be accidentally removed. Lock and tag devices are required to withstand a 50-pound pull without failure. Devices used to block or restrain stored mechanical energy devices must be engineered for safety.

Safety Barriers

Safety barriers separate workers from hazards that cannot reasonably be eliminated by other engineering controls. Required barriers will be identified in the approved confined-space entry procedure.

Ground Fault Circuit Interrupters

Ground fault circuit interrupter must be used for all portable electrical tools and equipment in confined spaces because most workers will be in contact with grounded surroundings.

15.3.3 Emergency response equipment

Fire Extinguishers

"Hot work" inside a confined space requires that an approved fire extinguisher and a person trained in its use be stationed in the confined space or in a suitable vantage point where he or she could effectively suppress any fire that might result from the work.

First Aid Equipment

Blankets, first-aid kit, Stokes stretchers, and any other equipment that may be needed for first-response treatment must be available just outside the confined space. Medical and safety professionals should select equipment on the basis of their evaluations of the potential hazards in the confined space.

Retrieval Equipment

A tripod or another suitable anchorage, hoisting device, harnesses, wristlets, ropes, and any other equipment that may be needed to make a rescue must be identified in the confined-space safe-entry procedures. It is important that this equipment be available for immediate use. Harnesses and retrieval ropes must be worn by entrants unless they would increase hazards to the entrants or impede their rescue.



The essential components of an effective Retrieval System are:

1. Tripod and suitable winch equipment;
2. Personal Protective Gear – Full Body Harness;
3. Connecting Device – Shock-Absorbing Lanyard;
4. Anchorage Point – Eye Bolt/Beam.

15.4 Confined space operations

15.4.1 Protective equipment

Appropriate NIOSH-approved respiratory protection and other protective equipment must be provided and worn in confined space areas when required.

15.4.2 Top entry

Confined spaces with top and side openings should be entered from the side whenever practicable. When entry must be made into a confined space through a top opening, the following requirements apply: (1) A harness-type safety belt that supports a person in an upright position must be used, and (2) A hoisting device with a minimum mechanical advantage of 4 to 1 must be provided for lifting workers out of the confined space.

15.4.3 Hot work

Work using flames, arcs, sparks, or other sources of ignition is prohibited within a confined space unless hot work permit is obtained. It is also prohibited in a space having a common surface with a confined space that contains or is likely to develop dangerous air contamination due to the presence of flammable or explosive substances.

15.4.4 Inert atmospheres

Whenever inert gases such as nitrogen are used to create an inert atmosphere to prevent ignition of flammable gases or vapors, no ignition source is permitted unless the atmosphere is kept below 10% of LFL. Ventilation is required before entry to ensure the atmosphere is acceptable before an entry permit is issued by OES of University of Buffalo. Testing the oxygen content must be done every 20 minutes, and written records of test results must be kept at the job site for the duration of the job.

15.4.5 Electrical equipment

Only Underwriters Laboratories or equivalent approved lighting and electrical equipment should be used in confined spaces that are subject to dangerous air contamination from flammable or explosive substances. Portable electric tools used in a confined space must be protected by a ground fault circuit interrupter.

15.4.6 Corrosives

Employees working in confined spaces that have last contained substances corrosive to the skin or substances that can be absorbed by the skin, are required to wear appropriate protective clothing and equipment, unless the space has been decontaminated prior to entry.

15.4.7 Communications

An effective means of communications between employees inside a confined space and the safety attendant must be used whenever conditions in the space require use of respirators or whenever entrants

are out of sight of the safety attendant at any time. It is important that the communication system be tested before each use, and frequently thereafter, to ensure that it is working properly.

15.4.8 Rescue operations

An approved harness and an attached line must be used. The free end must be secured outside the confined space. The line should be at least 0.5 inches in diameter and able to withstand a 2,000 pound test. Exception: A line may be eliminated in situations where it would further endanger the worker or not contribute to rescue. At least one other employee who may have other duties must be within calling distance to assist the safety attendant in an emergency. If required by the entry procedure, the safety attendant must have an appropriate, NIOSH-approved, SCBA (Self Contained Breathing Apparatus) respirator available for immediate use. The safety attendant may enter the confined space, but only in case of emergency and after notifying another employee. This employee will then become the safety attendant and assume all duties outside of the confined space. The safety attendant must wear appropriate protective equipment, including self-contained breathing apparatus, during the emergency entry.

15.5 Accident prevention guidelines

Following are the suggested measures to reduce the accidents in confined spaces:

- The management and workers should be able to identify confined spaces;
- Official procedures such as obtaining permit, and testing air quality should always be followed;
- The confined space ambient air testing should be conducted by trained Industrial Hygiene (IH) personnel before entering;
- Atmosphere in the confined space should be continuously monitored;
- Appropriate PPE must always be worn;
- A co-worker (attendant) to watch when working in confined spaces should always be present;
- If the worker feels light-headed or disoriented, he/she should attempt to come out of confined space immediately;
- One should never attempt a rescue unless he/she is trained to do so and have a qualified attendant to watch.

16 Module 16: Welding and Cutting

Welding is a task which is hazardous in many more ways than other tasks performed in the CSEE Department laboratories. The hazards include electric shock, fire, compressed gases, and toxic fumes etc. This module will familiarize you with the hazards, guidelines to avoid them, and suggested remedial measures in case of exposure to the hazard.

The welding and cutting operations include, electricity in arc welding and compressed gases in flame cutting. These operations can cause:

- Electrical Hazards;
- Fire and Burns;
- Hazards due to Compressed Gases;
- Exposure to Fumes.

These hazards are described in the following sections.

16.1 Electrical hazards

The entire work piece is electrically energized when the arc is present. The power supply circuit is also energized when power is on. Thus the operation involves a potential fire hazard. Electric shock from welding could be fatal, cause burns and could cause serious injuries if falling takes place as a result of the shock.

16.1.1 Guidelines to avoid electrical shock

- Always read the instruction manual provided by the manufacturer before operating any welding transformers;
- Never try to repair the welding machine even if you know what is wrong, report the fault to Mr. Duane Kozlowski;
- Always learn to install the welding machine and follow the sequence of operations;
- Always wear flame resistant insulating gloves, and safety shoes;
- Never dip an electric holder in water to cool it, keep water and dampness away from the work-area where welding is to be performed;
- Never use any worn or damaged cables for power input or for welding gun;
- Keep all covers and panels in place.

16.1.2 Remedial measures in case electric shock occurs

- Turn the power off;
- Use non-conductive material e.g. wood, to pull the victim away from live wires;
- If the victim is not breathing, call the physician and start administering cardiopulmonary resuscitation (CPR);
- Always treat an electric burn as a thermal burn, apply cold compresses and cover it with clean, dry dressing.

Refer Module 5 – First Aid for detailed procedures.

16.2 Fire hazards

Welding produces sparks, molten metal and hot surfaces. All of these can cause fire if the user is not careful.

16.2.1 Causes of fires in welding & cutting

The main cause of fires in welding and cutting is flying sparks which are known to travel up to 35 feet in a horizontal direction from the point where they are produced.

Sparks can become lodged in clothing, confined spaces, foundation holes in strong floor or even pass through to the basement of the SEES Laboratory if the foundation holes are not covered.

Concrete gets damaged by molten metal and slag, therefore the concrete should be covered with a piece of steel sheet to prevent such damage.

Poor housekeeping can also increase the risk of fire due sparks as saw dust or clothing becomes more combustible when it is mixed with oil.

For the reasons noted above, a Hot Work Permit will be issued for any operation that will generate heat through cutting, grinding, or welding. This will include requirements for a fire watch and clearance of the site. Site clearance will be conducted 30 minutes after the hot work has been completed. The permit will then be signed as completed and filed in the operations office.

16.2.2 Guidelines for preventing fires due to welding or cutting

- Always make efforts to remove all the combustible matter from your work area;

- Never let the sparks shoot at any combustible materials, if it is not avoidable, cover all such materials with fire resistant shield;
- The hydraulic actuators in the lab, though not combustible are susceptible to severe damage due to sparks; therefore, extreme care should be observed while working around those;
- Immediately stop welding or cutting operation if you smell any gas around you;
- CSEE Department mandates that one person has to act as a fire watch whenever any welding or cutting is in progress. Such fire watch should stand near to the work area with a fire extinguisher. The fire watch must wear all the appropriate PPE.
- After welding or cutting is completed, the welder must go to the basement to ensure that there is no evidence of fire. One must understand that easily visible smoke or flame may not be present for some time after the fire has generated.

16.3 Safe use of compressed gases

Extreme care should be taken while using oxygen and acetylene for welding and cutting. Oxygen-Acetylene mixture produces a higher flame temperature than any other gas used commercially. Therefore, if burns occur, they are of very severe nature. Acetylene is only slightly lighter than the air, thereby it does not disperse rapidly.

- The cylinder(s) should be marked with the chemical gas name. The cylinders should be stored upright and should be tied to the wall or any other firm support. During use, the cylinders must be tied to the cart with chain.
- Valve should always be covered the valve cap when the cylinders are not in use, and even when they are empty as the empty cylinders have enough pressure to cause accidents if the stem of the valve is accidentally broken.
- Broken or malfunctioning gauges or regulators should not be used under any circumstances.
- While replacing the cylinder, the valve of the empty cylinder should be closed and capped. Empty cylinder should be tagged 'empty' and stored in designated storage area. New cylinder should then be taken from the storage area and connected to the torch. It must be ensured that gas is not leaking. If gas is smelled, valves of both the cylinders should be closed immediately.

16.4 Personal protective equipment (PPE)

As discussed in Module 8 PPE, welding and cutting are the activities, where PPE has to be resorted to. Use of flame resistant gloves, face shield, protective eye wear, safety boots is a must.



- Radiation is electromagnetic energy given off by the arc or flame that can injure eyes and burn skin. Ultraviolet radiation is invisible but causes serious damage. The effects of radiation depend on intensity and length of time one is exposed to radiant energy. The most common forms of injuries are skin burns and eye damage.
- The welder must use a welding helmet with correct shade of filter plate as described in Module 8 PPE.
- The skin must be protected by using appropriate gloves and clothing, one must wear full-sleeves shirt.
- The reflections from the welding arcs are also dangerous. Therefore, persons working around the work area where welding is in progress, should be careful about accidental exposure and should wear safety glasses with UV protective side shields at all times when danger of such exposure exists.
- Before starting the welding, a Hot Work Permit should be obtained from the Site Operations Manager and the persons present in that area must make sure that they are not carrying any spontaneously combustible articles such as butane lighters or matchsticks.
- To prevent burns, one must wear fire resistant insulating gloves and should not touch hot objects without allowing sufficient time to cool down.
- The persons in the welding work-area should not wear pants with cuffs or shirts/jackets with open pockets that can catch and hold molten metal and sparks.

- When welding or cutting in confined spaces the exposed persons must wear flame-resistant ear plugs or ear muffs to keep sparks out of ears.

16.5 Fumes and gases

Welding and cutting processes generally produce fumes and gases which are harmful to health. Fumes are solid particles which originate from welding consumables, base materials(s) and the coatings present on them [if any].

Depending on the materials the effects of fumes may vary from irritation of eyes to damage to respiratory system. They could occur immediately or after prolonged exposure. Zinc Oxide fumes, can cause a serious disease like metal fume fever. The symptoms of which include headache, fever, muscle aches, thirst, nausea, vomiting, fatigue etc.

In confined spaces, fumes and gases might displace breathing air and then use of respirators becomes a must.

16.5.1 Guidelines for avoiding overexposure to fumes

- Never breathe the fumes;
- Keep your head out of way of fumes;
- If you find it uncomfortable to perform, obtain a mechanical ventilation device;
- Always wear air-supplying respirator while working in confined spaces.

17 Module 17: Accident Recording and Reporting

17.1 Basic requirement

CSEE Department is mandated to maintain injury and illness records using the OSHA forms. Recording or reporting a work-related injury, illness, or fatality does not mean that the CSEE Department or the injured employee was at fault, or that the employee is eligible for workers' compensation or any other benefits. All injuries that require medical attention (beyond first aid) should be reported on an incident report form and submitted to the Safety Officer within 24 hours.

CSEE Department must record on the OSHA 300 Log the recordable injuries and illnesses of all employees on the payroll, whether they are labor, executive, hourly, salary, part-time, seasonal, or migrant workers. CSEE Department must also record the recordable injuries and illnesses that occur to employees who are

not on CSEE Department payroll if the CSEE Department supervises these employees on a day-to-day basis.

17.2 Work-relatedness of an injury

Work Environment - The establishment and other locations where one or more employees are working or are present as a condition of their employment. The work environment includes not only physical locations, but also the equipment or materials used by the employee during the course of his or her work.

An injury or illness is considered to be work-related if an event or exposure in the work environment either caused or contributed to the resulting condition or significantly aggravated a pre-existing injury or illness. Work-relatedness is presumed for injuries and illnesses resulting from events or exposures occurring in the work environment, unless any one of the following exception applies:

- At the time of the injury or illness, the employee was present in the work environment as a member of the general public rather than as an employee;
- The injury or illness involves signs or symptoms that surface at work but result solely from a non-work-related event or exposure that occurs outside the work environment;
- The injury or illness results solely from voluntary participation in a wellness program or in a medical, fitness, or recreational activity such as blood donation, physical examination, flu shot, exercise class, racquetball, or baseball;
- The injury or illness is solely the result of an employee eating, drinking, or preparing food or drink for personal consumption (whether bought on the employer's premises or brought in). For example, if the employee is injured by choking on a sandwich while in the employer's establishment, the case would not be considered work-related.
- Note: If the employee is made ill by ingesting food contaminated by workplace contaminants (such as lead), or gets food poisoning from food supplied by the employer, the case would be considered work-related
- The injury or illness is solely the result of an employee doing personal tasks (unrelated to their employment) at the establishment outside of the employee's assigned working hours;
- The injury or illness is solely the result of personal grooming, self-medication for a non-work-related condition, or is intentionally self-inflicted;
- The injury or illness is caused by a motor vehicle accident and occurs on a company parking lot or company access road while the employee is commuting to or from work;

- The illness is the common cold or flu (Note: contagious diseases such as tuberculosis, brucellosis, hepatitis A, or plague are considered work-related if the employee is infected at work);
- The illness is a mental illness. Mental illness will not be considered work-related unless the employee voluntarily provides the employer with an opinion from a physician or other licensed health care professional with appropriate training and experience (psychiatrist, psychologist, psychiatric nurse practitioner, etc.) stating that the employee has a mental illness that is work-related.

17.3 Determination of new cases

An injury or illness will be considered to be a "new case" if:

- The employee has not previously experienced a recorded injury or illness of the same type that affects the same part of the body, or
- The employee previously experienced a recorded injury or illness of the same type that affected the same part of the body but had recovered completely (all signs and symptoms had disappeared) from the previous injury or illness and an event or exposure in the work environment caused the signs or symptoms to reappear.

17.4 Recording criteria

17.4.1 Recording criteria for needle stick and sharp injuries

CSEE Department must record all work-related needle stick injuries and cuts from sharp objects that are contaminated with another person's blood or other potentially infectious material such as, human bodily fluids, tissues and organs, and other materials infected with the HIV or hepatitis B (HBV) virus. CSEE Department must enter the case on the OSHA 300 Log as an injury. To protect the employee's privacy, you may not enter the employee's name on the OSHA 300 Log.

17.4.2 Recording criteria for cases involving medical removal under OSHA standards

If an employee is medically removed under the medical surveillance requirements of an OSHA standard, you must record the case on the OSHA 300 Log.

17.4.3 Recording criteria for cases involving occupational hearing loss

A Standard Threshold Shift, or STS, is defined as a change in hearing threshold, relative to the baseline audiogram for that employee, of an average of 10 decibels (dB) or more at 2000, 3000, and 4000 hertz (Hz) in one or both ears.

If an employee's hearing test (audiogram) reveals that the employee has experienced a work-related Standard Threshold Shift (STS) in hearing in one or both ears, and the employee's total hearing level is 25 decibels (dB) or more above audiometric zero (averaged at 2000, 3000, and 4000 Hz) in the same ear(s) as the STS, CSEE Department must record the case on the OSHA 300 Log.

17.4.4 Recording criteria for work-related tuberculosis cases

If any of the CSEE Department employees has been occupationally exposed to anyone with a known case of active tuberculosis (TB), and that employee subsequently develops a tuberculosis infection, as evidenced by a positive skin test or diagnosis by a physician or other licensed health care professional, CSEE Department must record the case on the OSHA 300 Log by checking the "respiratory condition" column.

17.5 Annual summary, retention and updating

At the end of each calendar year, CSEE Department must:

- Review the OSHA 300 Log to verify that the entries are complete and accurate, and correct any deficiencies identified;
- Create an annual summary of injuries and illnesses recorded on the OSHA 300 Log; and
- Certify the annual summary; and post the same on prominently visible locations.

CSEE Department will save the OSHA 300 Log, the privacy case list (if one exists), the annual summary, on OSHA 300A and the OSHA 301 Incident Report forms for five (5) years following the end of the calendar year that these records cover.

17.6 Disclosing injury data to government agencies

17.6.1 Providing records to government representatives

The government representatives authorized to receive the records are:

- A representative of the Secretary of Labor conducting an inspection or investigation under the OSH Act;
- A representative of the Secretary of Health and Human Services (including the National Institute for Occupational Safety and Health -- NIOSH) conducting an investigation under section 20(b) of the OSH Act, or

- A representative of a State agency responsible for administering a State plan approved under section 18 of the OSH Act.

17.6.2 Annual OSHA injury and illness survey of ten or more employers

If CSEE Department receives an annual survey form from OSHA, it must be filled out and sent to OSHA or OSHA's designee, as stated on the survey form. CSEE Department must report the following information for the year described on the form:

- The number of workers employed by CSEE Department;
- The number of hours worked by the employees; and
- The requested information from the records that CSEE Department keeps under 29 CFR 1904.

17.6.3 Requests from the bureau of labor statistics for data

If CSEE Department receives a Survey of Occupational Injuries and Illnesses Form from the Bureau of Labor Statistics (BLS), or a BLS designee, it must be promptly completed and returned following the instructions contained on the survey form.

17.7 Sample of OSHA form

OSHA Form 300, 300A, and 301 are provided on following pages for ready reference.

Year
U.S. Department of Labor
Occupational Safety and Health Administration
Form approved OMB no. 1218-0170

Attention: This form contains information relating to the confidentially of employers to the extent possible while the information is being used for occupational safety and health purposes.

Establishment name _____
City _____ State _____

OSHA's Form 300
Log of Work-Related Injuries and Illnesses

You must record information about every work-related injury or illness that involves loss of consciousness, restricted work activity or job transfer, days away from work, or medical treatment beyond first aid.
You must also record significant work-related injuries and illnesses that are diagnosed by a physician or licensed health care professional. You must also record work-related injuries and illnesses that meet any of the specific recording criteria listed in 29 CFR 1904.8 through 1904.12. Feel free to use two lines for a single case if you need to. You must complete an injury and illness incident report (OSHA Form 301) for equipment loss for each injury or illness recorded on this form. If you're not sure whether a case is recordable, call your local OSHA office for help.

Identify the person		Describe the case		Classify the case			Enter the number of days lost or restricted work activity or other job transfer			Check the "injury" column or choose one type of illness					
(A) Case No.	(B) Employee's name	(C) Job Title (e.g., Welder)	(D) Date of injury or illness (month/year)	(E) Where the event occurred (e.g., Loading dock north end)	(F) Describe injury or illness, parts of body affected, and object/substance that directly injured or made person ill (e.g., Second degree burns on right forearm from scald/steam touch)	(G) Days away from work	(H) Job transfer or restriction	(I) On-job injury or restriction (days)	(J) Days away from work or restriction (days)	(K) On job injury	(L) Respiratory	(M) Skin Disorder	(N) Poisoning	(O) Other illnesses	

Page totals _____
Be sure to transfer these totals to the Summary page (Form 300A) before you post it.

Public reporting burden for this collection of information is estimated to average 14 minutes per response, including time to review the instructions, search and gather the data needed, and complete and review the collection of information. Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number. If you estimate this burden to be significantly lower than the average, you should contact the Office of Management and Budget, Paperwork Reduction Project (1218-0170), Washington, DC 20503. Do not send this comment form to this office.

OSHA's Form 300A Summary of Work-Related Injuries and Illnesses

All establishments covered by Part 1904 must complete this Summary page, even if no injuries or illnesses occurred during the year. Remember to review the Log to verify that the entries are complete. Using the Log, count the individual entries you made for each category. Then write the totals below, making sure you've added the entries from every page of the log. If you had no cases write "0".

Employees, former employees, and their representatives have the right to review the OSHA Form 300 in its entirety. They also have limited access to the OSHA Form 301 or its equivalent. See 29 CFR 1904.35, in OSHA's Recordkeeping rule, for further details on the access provisions for these forms.

Number of Cases

Total number of deaths	(G)	0	Total number of cases with days away from work	(H)	0	Total number of other recordable cases	(I)	0
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Number of Days

Total number of days of job transfer or restriction	(K)	0	Total number of days away from work	(L)	0
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Injury and Illness Types

Total number of...	(M)	0	(4) Poisoning	0
(1) Injury	0	(5) All other illnesses	0	0
(2) Skin Disorder	0			
(3) Respiratory Condition	0			

Post this Summary page from February 1 to April 30 of the year following the year covered by the form

Public reporting burden for the collection of information is estimated to average 50 minutes per response, including time to review the instruction, search and gather the data needed, and complete and review the collection of information. Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number. If you have any comments about these estimates or any aspects of this data collection, contact: US Department of Labor, OSHA, Office of Statistics, Room N-3644, 200 Constitution Ave, NW, Washington, DC 20210. Do not send the completed forms to this office.



Year _____
U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1718-0178

Establishment Information

Your establishment name _____
Street _____
City _____ State _____ Zip _____
Industry description (e.g., Manufacture of motor truck trailers) _____
Standard Industrial Classification (SIC), if known (e.g., SIC 3715) _____

Employment Information

Annual average number of employees _____
Total hours worked by all employees last year _____

Sign here

Knowledge falsifying this document may result in a fine.

I certify that I have examined this document and that to the best of my knowledge the entries are true, accurate, and complete.

Company executive _____ Title _____
Phone _____ Date _____


OSHA's Form 301 Injuries and Illnesses Incident Report

This Injury and Illness Incident Report is one of the first forms you must fill out when a recordable work-related injury or illness has occurred. Together with the Log of Work-Related Injuries and Illnesses and the accompanying Summary, these forms help the employer and OSHA develop a picture of the extent and severity of work-related incidents.

Within 7 calendar days after you receive information that a recordable work-related injury or illness has occurred, you must fill out this form or an equivalent. Some state workers' compensation, insurance, or other reports may be acceptable substitutes. To be considered an equivalent form, any substitute must contain all the information asked for on this form.

According to Public Law 91-506 and 29 CFR 1904, OSHA's recordkeeping rule, you must keep this form on file for 5 years following the year to which it pertains.

If you need additional copies of this form, you may photocopy and use as many as you need.



U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB No. 1218-0176

Attention: This form contains information relating to employee health and must be used in a manner that protects the confidentiality of employees to the extent possible while the information is being used for occupational safety and health purposes.

Information about the employee

1) Full Name _____

2) Street _____

City _____ State _____ Zip _____

3) Date of birth _____

4) Date hired _____

5) Male Female

Information about the physician or other health care professional

6) Name of physician or other health care professional _____

7) If treatment was given away from the worksite, where was it given?
 Facility _____
 Street _____
 City _____ State _____ Zip _____

8) Was employee treated in an emergency room?
 Yes No

9) Was employee hospitalized overnight as an in-patient?
 Yes No

Information about the case

10) Case number from the Log _____ (Transfer the case number from the Log after you record the case.)

11) Date of injury or illness _____

12) Time employee began work _____ AM/PM

13) Time of event _____ AM/PM Check if time cannot be determined

14) **What was the employee doing just before the incident occurred?** Describe the activity, as well as the tools, equipment or material the employee was using. Be specific. Examples: "climbing a ladder while carrying roofing materials"; "spraying chlorine from hand sprayer"; "daily computer key entry."

15) **What happened?** Tell us how the injury occurred. Examples: "When ladder slipped on wet floor, worker fell 20 feet"; "Worker was sprayed with chlorine when gasket broke during replacement"; "Worker developed soreness in wrist over time."

16) **What was the injury or illness?** Tell us the part of the body that was affected and how it was affected; be more specific than "hurt", "pain", or "sore". Examples: "strained back"; "chemical burn, hand"; "carpal tunnel syndrome."

17) **What object or substance directly harmed the employee?** Examples: "concrete floor"; "chlorine"; "radial arm saw." If this question does not apply to the incident, leave it blank.

18) **If the employee died, when did death occur?** Date of death _____

Completed by _____

Title _____

Phone _____ Date _____

Public reporting burden for this collection of information is estimated to average 22 minutes per response, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this data collection, including suggestions for reducing the burden, to the collection information manager, Paperwork Project, Washington, DC 20503. Do not send the completed form to this office.

