UNIVERSITY OF CALIFORNIA

Shop Safety Manual

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Introduction

INTRODUCTION

Welcome to the University of California Shop Safety Manual – a resource to help you get in gear with safety. This handbook contains essential safety information that you need for working in a shop.

Why is Safety Important?

Following safety procedures is one of the most effective ways to prevent workplace injuries. Working safely also protects the tools that you use and your facility from damage. Safe operations foster a productive and healthy working environment.

Environment, Health and Safety's (EH&S) Role

EH&S recognizes that you are an expert at your job and our role is to ensure that you have what you need to do your job safely. Hazards are not always obvious and serious injuries and accidents can happen from not working safely.

Your Safety Toolbox

EH&S partners with shops to develop and recommend preventive solutions to help everyone work safely. Think of this collection of safety measures as tools that go into your safety toolbox. Your tools include safety controls, good work practices, and training. Fill your toolbox with the safety precautions, job aids, and training resources discussed in this manual.

Maintain your safety skill set to protect yourself and your coworkers. Know the safety rules and procedures (Appendix L), obtain the necessary training, and understand the inherent risks found in machine shops. In short, keep your personal safety toolbox fully stocked.

This manual covers shop safety specifics, such as guarding requirements for machines and proper lifting techniques. Always ask your supervisor or an EH&S Specialist for clarification if you do not understand something, because understanding safety concepts is necessary for putting them into practice. Safety begins with you and is everyone's responsibility.

Access EH&S contact information via your local campus website if you have any safety concerns.

SECTION 1

Responsibilities

SECTION 1: RESPONSIBILITIES

This section provides an overview of the responsibilities associated with the home department, each shop worker and EH&S support staff.

Department

The shop's home department must ensure that the resources required for proper shop oversight are provided to each shop in their department. The department is responsible for:

1. Ensuring that areas under their control comply with internal and external regulations and guidelines;
2. Providing supervisors under their management with the authority to develop and implement safe work practices;
3. Maintaining an up-to-date Injury and Illness Prevention Program that covers the department and all shops within that department; and
4. Providing the shop with the resources necessary to comply with health and safety policies and guidelines.

Shop Supervisor

The Shop Supervisor plays a key role in the implementation of the shop's safety program. They are responsible for:

1. Encouraging and promoting a healthy safety culture within the shop;
2. Modeling and enforcing safe work policies;
3. Ensuring that all employees receive the appropriate training before beginning work;
4. Ensuring that periodic inspections are done (semi-annual inspections required in addition to EH&S annual inspections);
5. Stopping unsafe work;
6. Developing safe work procedures such as Job Safety Analyses (JSAs);
7. Providing proper personal protective equipment (PPE) to employees under their supervision;
8. Encouraging employees to report health and safety issues (including injuries) without the fear of reprisal; and
9. Maintaining the necessary documentation for the shop, including training records.

Shop Employees

Employees are critical to the safety culture of the shop. All employees must comply with health and safety regulations, policies and work practices. This includes, but is not limited to:

1. Using proper PPE (when required);
2. Attending and actively participating in all training;
3. Notifying supervisors when potential hazards are present in the shop or when additional training is needed;
4. Reporting all work-related injuries to the supervisor; and
5. Participating in and being aware of periodic safety inspections.

EH&S SPECIALISTS

EH&S Specialists are responsible for assisting machine shops with health and safety concerns. This includes, but is not limited to:

1. Performing periodic and/or unscheduled safety inspections and following up on the action items set forth in those inspections;
2. Notifying all shops when new safety programs, initiatives, processes, etc. are rolled out;
3. Being a point of contact and conduit of information for shops with safety concerns; and
4. Assistance with the implementation of the Shop Safety Program and all related programs.

SECTION 2

Your Injury and Illness Prevention Program

SECTION 2: YOUR INJURY AND ILLNESS PREVENTION PROGRAM (IIPP)

Overview

The Injury and Illness Prevention Program (IIPP) is a documented safety plan to protect employees from injuries and illnesses in the workplace. It complies with the California Code of Regulations Title 8, Section 3203 by establishing a framework for identifying and correcting workplace hazards, ensuring employee training and compliance, and communicating information relating to employee safety and health issues. The information is reviewed and updated on a regular basis to reflect any changes in regulations, personnel, or procedures.

Responsibilities

Management

Management must ensure that an IIPP is implemented in all areas under their scope of responsibility, including shops. They must establish a process, such as a Safety Committee or Safety Coordinator, to maintain, update, and implement this safety program.

Supervisors

Supervisors play a key role in the implementation of the IIPP. They are responsible for the following:

1. Encouraging a safe work culture by modeling and enforcing safe work practices;
2. Completing periodic (quarterly as best practice, semi-annual at a minimum), inspections of shops under their direction;
3. Stopping work that poses an imminent hazard;
4. Implementing measures to eliminate or control workplace hazards;
5. Developing safe work procedures such as standard operating procedures (SOPs) and job safety analyses (JSAs);
6. Providing appropriate safety training and personal protective equipment to employees under their supervision;
7. Documenting employee training and departmental safety activities;
8. Reporting work related injuries and illnesses;
9. Encouraging employees to report health and safety issues without fear of reprisal;
10. Disciplining employees who do not comply with safe work practices; and
11. Communicating all health and safety issues.

Employees

All employees must comply with applicable health and safety regulations, policies, and work practices. This includes, but is not limited to:

1. Using personal protective equipment where required;
2. Actively participating in all required safety and health training;
3. Requesting information relating to job safety whenever needed;
4. Learning about the potential hazards of assigned tasks and work areas;

5. Observing health- and safety-related signs, posters, warnings, and directions;
6. Warning co-workers about defective equipment and other hazards;
7. Reporting any unsafe or unhealthy conditions immediately to a supervisor, and stopping work if it poses an imminent hazard;
8. Reporting all work-related injuries and illnesses promptly to a supervisor;
9. Cooperating with incident investigations to determine the root cause; and
10. Participating in shop safety inspections.

The Office of Environment, Health & Safety (EH&S)
EH&S provides consultation and support services to shop supervisors and employees to assist them in meeting their duties and responsibilities.

EH&S responsibilities include, but are not limited to:

1. Performing periodic and/or unscheduled safety inspections (Appendix G) and following up on the action items set forth in those inspections;
2. Notifying all shops when new safety programs, initiatives, processes, etc. are rolled out;
3. Being a point of contact and conduit of information for shops with safety concerns; and
4. Assisting with the implementation of the Shop Safety Program and all related programs.

The EH&S Specialists are also available to assist with the development and maintenance of training materials. These materials and support can include but are not limited to:

1. Shop Safety Manual;
2. Resources for monthly safety meetings; and
3. Assistance with inspections and incident investigations as requested or indicated by frequency and/or severity of incidents.

Identifying and Correcting Workplace Hazards

Inspection Program Overview
The purpose of the University of California Shop Safety Inspection Program is to identify and eliminate/reduce unsafe conditions that could result in injuries, illnesses, or property damage. Principal responsibility for the identification of hazards in the workplace lies with the Shop Supervisor. The supervisor is responsible for completion of periodic inspections to assess, record, and correct hazardous and potentially hazardous conditions that may exist.

Scheduled Safety Inspections
Shops must complete regularly scheduled workplace safety inspections. Annual self-inspections (in addition to EH&S inspections) shall be completed to detect and eliminate any hazardous conditions that may exist using the Shop Safety Self-Inspection Checklist (Appendix K). Targeted self-inspections, using documents such as the Flooring Inspection Checklist (Appendix E), can also be used to support hazard identification of higher frequency conditions such as those that can lead to trips and falls. The inspections must be documented with abatement of any hazards detected.

Unscheduled Safety Inspections
Supervisors must conduct unscheduled safety inspections whenever new substances, processes, procedures, or equipment are introduced into the workplace and present new safety or health hazards. Inspections must also be conducted when previously unrecognized hazards are identified.

Report of Unsafe Conditions
Employees are encouraged to report existing or potentially hazardous conditions or unsafe work practices to their shop supervisor so that corrective action (e.g., training, purchase of appropriate equipment, etc.) can be taken in a timely manner. A Hazard Notification/Safety Recommendation form can be used to report unsafe conditions.

Employees can also submit health or safety concerns through notifying and informing their supervisor or by contacting EH&S. Employees who report unsafe conditions cannot be disciplined, nor suffer any reprisals. Complaints can be made anonymously, if desired.

Safety Inspection Records
The shop supervisor is responsible for maintaining safety inspection records and reports. Records must include:

- Name of the inspector
- Date of the inspection
- All identified unsafe work conditions or work practices
- Corrective actions

Records should be filed in the Shop Safety Manual (or electronically) and kept for a minimum of five years.

Report Hazards Promptly

You can report hazards by using any of the following methods:

1. Contact
2. Call EH&S
3. Submit a Hazard Alert Form

Correcting Workplace Hazards
Identified hazards must be promptly investigated by shop supervisors. Corrective actions or plans with deadlines for completion must be developed and implemented based on the frequency and/or severity of the hazard. If an imminent hazard exists, work in the area should cease, and the appropriate supervisor notified. If the hazard can be corrected immediately without endangering employees or property, all personnel must be removed from the area, except those individuals who are necessary to correct the hazard. These individuals must have protective equipment and other necessary safeguards before addressing the situation.

Serious hazards that threaten life or property should be corrected as soon as practicable. Non-serious hazards should be assigned a correction date with a supporting correction plan completed and approved by EH&S. EH&S consultation is available to determine appropriate abatement actions.

Specific procedures that can be used to correct hazards include, but are not limited to, the following:

1. Lockout/Tagout (LOTO) of unsafe equipment;
2. Stopping unsafe work practices and providing retraining on proper procedures before work resumes;
3. Reinforcing use of and providing personal protective equipment;
4. Isolating or barricading areas that have chemical spills or other hazards to deny access until the appropriate correction is made; and
5. Reporting problems or hazardous conditions to a supervisor or EH&S.

Hazard Correction Report
A Hazard Notification/Safety Recommendation form can be used to document corrective actions, including projected and actual completion dates. The Self-Inspection Checklist can also be used for this purpose, if the hazard was identified during a regular self-inspection. If necessary, supervisors can seek assistance in developing appropriate corrective actions by contacting the EH&S Shop Safety Coordinator/Inspector. Hazard Correction Reports must be kept in the Shop Safety Manual (or electronically) for five years.

Communicating Workplace Hazards

Supervisors
Supervisors are the first point of contact and are responsible for communicating all safety and health issues to employees. All employees are encouraged to communicate safety concerns to their supervisor without fear of reprisal.

Safety Committee
Departmental Safety Committees can serve as another resource for communicating health and safety issues to employees. Shop personnel should be represented on the committee. Safety Committee minutes should be posted or made available at a convenient location for access by all shop employees. E-mail, distribution of written memoranda, or articles in internal departmental newsletters (if applicable) can also be used to communicate safety committee information.

Resources
While supervisors must provide employees with hazard information pertinent to their work assignments, information concerning safety hazards is available from a number of other sources. These sources include, but are not limited to, Job Safety Analyses (JSAs) (Appendix H), Standard Operating Procedures (SOPs), Safety Data Sheets (SDSs), container labels, equipment manuals, this Shop Safety Manual, EH&S newsletters and websites, and work area postings.

Emergency Response Plan/Emergency Action Plan
Shops must have an emergency response plan. Departmental Emergency Response Plans (ERPs) address life and safety issues during or after an earthquake, fire or flood, loss of critical infrastructure, a terrorist attack, civil unrest, or other calamity. Area Emergency Action Plans (EAPs) outline what to do during a catastrophic event to minimize damage to life and property. The EH&S Office or Office of Emergency Management can provide guidance and direction on the development of an ERP and EAP. Risk Management can provide guidance to departments in developing business continuity plans.

Incident, Injury, & Illness Reporting And Investigations

An incident is an unplanned event that results in injury, illness, or property damage. A near miss is an unplanned event that did not result in injury, illness, or damage, but had the potential to do so. Both incidents and near misses should be investigated to determine the root cause and to reduce or eliminate the hazards that contributed to the incident.

Reporting and Treatment
Employees who are injured or become ill at work must report the injury or illness immediately to their supervisor and personnel department. Employees will be provided with the appropriate level of medical care required for the injury or illness. Employees referred for treatment may be provided with a location-specific medical treatment referral form. If the injury requires more than first aid treatment, the Workers' Compensation Claim form should be given to the employee as well. These forms can be obtained from Risk Management.

All injuries must be reported to Risk Management within 24 hours. You can report injuries to Risk Management by:

- Calling the UC Injury reporting line
- Faxing a report to the Risk Management Office
- Emailing the Risk Management Office

Serious injuries must be reported to EH&S within 8 hours. Report serious injuries by calling EH&S. Serious injuries include death, amputations, concussions, crush injuries, fractures, burns, lacerations with significant bleeding or requiring stitches, or hospitalization (other than for observation) for greater than 24 hours. ***If in doubt, you should contact EH&S with any available information so they can determine whether reporting is necessary.*** EH&S must contact the California Occupational Safety and Health Administration (Cal/OSHA) to report the serious injury within 8 hours of knowledge to avoid a citation. An incident investigation will be conducted by EH&S for serious accidents, in conjunction with a representative from the injured employee's department.

Investigations

When incidents occur on the job, supervisors, in conjunction with EH&S Specialists must investigate them to identify the root cause or hazards that contributed to the incident. Supervisors must complete any repairs and implement any procedural changes to correct conditions contributing to the incident.

EH&S Specialists conduct incident investigations for workplace injuries, when it is evident that safety procedures need to be reviewed and improved, or as requested.

Incident investigations and near misses should be reviewed at your departmental safety meetings. EH&S Specialists are available to attend these meetings and help develop safety procedures to avoid future injuries.

Specific procedures that may be used to investigate workplace injuries (Appendix C) and hazardous substance exposures include:

1. Interviewing injured employee, supervisor, and/or witnesses;
2. Examining the injured employee's workstation for causative factors;
3. Reviewing established procedures to ensure they are adequate and implemented accordingly;
4. Reviewing training records of affected employees;
5. Determining potential contributing factors to the incident;
6. Taking corrective actions to prevent the incident/exposure from reoccurring; and
7. Documenting all findings and actions taken.

Training

Effective dissemination of safety information is essential for a successful safety program. All employees must be trained in general safe work practices including specific instructions on hazards unique to their job assignment. Training must be completed before the use of any dangerous equipment, exposure to any known hazardous conditions, or when new hazards are identified.

Supervisors are responsible for ensuring their employees receive appropriate safety training and for documenting that this training has been provided. Section 2 of this manual provides more information on training, including an

outline of required trainings for shop personnel. Attendance at training classes and safety meetings is required. Documentation of individual safety training and safety meetings (Appendix M) must be kept by the supervisor in the Shop Safety Manual for five years.

Recordkeeping

Records of occupational injuries and illnesses, medical surveillance, exposure monitoring, inspections, trainings, and other safety activities must be maintained for specific periods of time. Records must be kept in either the Shop Safety Manual or employee personnel files following university guidelines. Department personnel representatives must present them to Cal/OSHA or other regulatory agency representatives if requested. EH&S may review these records during routine compliance inspections.

The following are examples of documents that must be kept on file in the department for the minimum times indicated below:

1. Copies of safety inspection forms = one year
2. Copies of all hazard identification forms = one year
3. Copies of all incident investigations = three years
4. Copies of all safety postings and safety meeting agendas = one year
5. Copies of all employee training checklists and related training documents = three years
6. Copies of employee exposure records, or other employee medical records = 30 years or for the duration of each individual's employment if > 30 years. Access to employee medical records will be limited in accordance with university policies, state, and federal guidelines.

Compliance

Compliance is critical for an effective IIPP. Managers and supervisors must serve as role models for working safely and provide resources necessary to ensure a safe work environment for their employees. All employees are required to follow safety policies and operating procedures. Employees will be provided with safety training and information to complete all assigned duties safely. When needed, employees will be provided with additional training and information, or retraining to maintain their knowledge of campus safety policies and procedures.

Employees who demonstrate safe work practices should be rewarded through the use of performance evaluations or incentive programs. Any employee who demonstrates repeated unsafe, unhealthy work practices will be subject to corrective action and/or disciplinary action. Disciplinary action must conform to UC policies and/or corrective bargaining agreements. If the offense is egregious or willful, the action may result in immediate disciplinary action. The Employee Labor Relations Department must be consulted on any disciplinary matter as it relates to compliance with this program.

SECTION 3

Safety Training

SECTION 3: SAFETY TRAINING

This section helps you comply with California Occupational Safety and Health Administration (Cal/OSHA) training regulations and provides guidance on training requirements. It will help you create, maintain, and reinforce a safe work environment.

Why is Training Important?

Training plays a role in developing a strong safety culture in which employees promote safe procedures in the workplace. Another important benefit of regularly-scheduled safety training is to serve as a reminder of job-related hazards and how to prevent injuries.

Who is Responsible For Safety Training in My Shop?

All shop employees play important roles in safety training. Outside resources are available, such as Environment, Health & Safety (EH&S) and Risk Management, to provide training expertise not available within the shop itself. Supervisors are responsible for developing and implementing a shop training plan which identifies the training needs of new hires, job-specific training requirements, and the training demands imposed by changing conditions or job duties. Additionally, supervisors must maintain proper documentation of training records for shop employees. Specific responsibilities of supervisors include:

1. Encouraging a safe work culture by modeling and enforcing safe work practices;
2. Completing periodic (quarterly as best practice, semi-annual at a minimum), inspections of shops under their direction, in conjunction with EH&S;
3. Developing safe work procedures, including standard operating procedures (SOPs) and job safety analyses (JSAs). (SOPs/JSAs are essential training tools that communicate hazards and corresponding safe work practices);
4. Providing appropriate safety training and personal protective equipment to employees under their supervision; and
5. Documenting employee training and departmental safety activities.

Employees must be aware of training requirements, attend and participate in the trainings, and follow the safety rules. This includes asking questions when a concept is not understood and implementing the safe work practices learned from training. Specific responsibilities of employees include:

1. Actively participating in all required safety and health training;
2. Asking questions and requesting information relating to job safety whenever needed;
3. Learning about the potential hazards of assigned tasks and work areas; and
4. Observing health- and safety-related signs, posters, warnings, and directions.

EH&S Specialists provide guidance and resources for the overall implementation of training. This includes helping shop supervisors assemble annual training plans, providing resources such as training videos and guides, and conducting certain training sessions. The EH&S Shop Safety Coordinator conducts annual safety inspections and assists shops in meeting all safety codes and regulations required by law.

What Type of Training is Required?

Effective dissemination of safety information is essential for a successful safety program. Supervisors are

responsible for ensuring their employees receive appropriate safety training and for documenting that this training has been provided. Training can be provided through group presentations or by one on one coaching. Group training can be done during existing staff meetings, or by having specific safety meetings, or brief meetings such as "tailgates" at the beginning of the work shift. Attendance at safety training classes and meetings is mandatory.

All shop employees must receive training in general safe work practices as outlined in the Shop Safety Training Matrix in Table 3.1 (Appendix Y). The general safety training that all shop employees must receive includes the following:

1. Emergency Preparedness/Earthquake Safety Training Guide (Appendix N)
2. Fire Safety Training Guide (Appendix O)
3. Hand Tool Safety Training Guide (Appendix P)
4. Hazard Communication Training Guide (Appendix Q)
5. Hearing Conservation Training Guide (Appendix R)
6. Housekeeping Practices Training Guide (Appendix S)
7. Injury and Illness Prevention Program Training Guide (Appendix T)
8. Lockout/Tagout
9. Personal Protective Equipment (PPE) Training Guide (Appendix W)
10. Portable Power Tool Safety Training Guide (Appendix V)
11. Safe Lifting/Back Injury Prevention Training Guide (Appendix X)

Table 3.1 – Shop Safety Training Matrix

Topic	Frequency Required		
	Upon Hire	As Hazards Change	Annual
General Safety Training Required by all Shop Employees			
Hand Tool Safety	x	x	
Hazard Communication	x	x	
Housekeeping Practices	x	x	
Illness & Injury Preparedness Program (IIPP)	x	x	x
Lockout/Tagout	x		
Personal Protective Equipment	x		
Portable Power Tool Safety	x	x	
Safe Lifting/ Back Injury Prevention	x		
Job-Specific Training			
Asbestos Awareness	x		x
Asbestos Abatement	x		x
Biosafety: Bloodborne Pathogens	x		x
Chemical Fumehood	x	x	
Confined Space Entry	x	x	every two yrs*
Fall Protection	x	x*	every two yrs*
Forklift Operator	x		every three yrs*
Hazardous Waste	x		x
Heat Illness Prevention for Outdoor Workers	x		x*

Topic	Frequency Required		
	Upon Hire	As Hazards Change	Annual
Lab Awareness	x		
Ladder Safety (Appendix U)	x	x	x
Lead Abatement	x		
Power Tool Safety	x	x*	x*
Respirator Training & Fit Test	x		x
Sewage Clean-Up Procedure	x		
Shop Safety and Hazard Awareness	x	x	

Note: Additional trainings may be required by your department.

**As best practice, or per EH&S policy*

Job-specific training requirements may differ depending upon job duties. The Shop Safety Training Matrix (Table 3.1) summarizes shop training topics and frequency requirements. Depending on your Campus and Department, the availability and source of training information may vary. Please consult with your EH&S Office to review the availability of training materials and resources.

Shop supervisors must determine the job-specific training required for each shop employee. Additionally, hazard assessments are necessary to determine supplemental training for safety and health hazards not included in the general shop safety training curriculum. Job-specific training also includes complete understanding of operator manuals and/or SOP/JSA for machines and tools used on the job. Additional job-specific training is also required whenever new substances, processes, procedures or equipment are introduced to the workplace, and when new or previously unrecognized hazards become known.

What Type of Training Records Must Be Kept?

The IIPP specifies that all training must be documented. Use the Training Documentation Form (Appendix M) or equivalent to document group training sessions, such as monthly safety training meetings and "tailgate meetings". This form includes all the information that safety inspectors and regulatory agencies such as Cal/OSHA will request during an investigation. Use the Employee Safety Training Matrix and Record or equivalent to document training for individual employees (Appendix Y).

Keep a copy of all safety trainings and records for at least the last five years in your Shop Safety Manual or electronically. If required by your department, send a copy to your human resources specialist or Safety Coordinator.

What Training Resources Are Available?

EH&S provides training resources to simplify the implementation of safety training. Consult with your EH&S Office to access available on-line safety training, videos, job safety analysis information, and to get an update on available instructor led training.

Video Lending Library

Videos or DVDs can be issued to supplement monthly safety talks, and may be available from EH&S. Contact the Campus EH&S Office for more information.

Job Safety Analysis (JSA) Website

JSAs are used to describe how to perform a task step-by-step, any hazards associated with a task, and controls

to mitigate these hazards. JSAs can be used to educate employees on safe practices prior to utilizing equipment. Contact your Campus EH&S Office to discuss developing JSA's or accessing currently available JSA's for your operations.

Training Guides

Training guides are available for general training topics. The guides include a step-by-step presentation guide and specific discussion items. The guides can be found on pages 116-149.

How Do I Establish A Shop Training Program?

Using the Shop Safety Training Matrix (Table 3.1) as a reference, supervisors should take the following steps to establish and implement a shop training plan:

1. Create a training matrix specific for your shop with the EH&S Shop Safety Coordinator.
2. Establish an annual training plan based on your required training matrix.
3. Reference the available materials from EH&S for training topics to be facilitated by the shop.
4. Contact the EH&S Shop Safety Coordinator to schedule training sessions conducted by either EH&S staff or an outside vendor.
5. Use the Training Documentation Form or equivalent in (Appendix M) to record employee completion of training.
6. At least annually, review the training matrix to be sure it accurately reflects the needs of shop employees.

SECTION 4

Ergonomics & Materials Handling

SECTION 4: ERGONOMICS & MATERIALS HANDLING

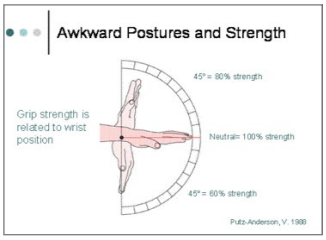
This section provides information about designing your work area and completing tasks in a way that makes your job more efficient and comfortable. Ergonomics and proper materials handling techniques make your job safer and help to prevent injuries.

Ergonomics

Ergonomics focuses on how your work affects your physical well-being. It is the science of matching the job to the worker to improve efficiency and to reduce the risk of discomfort or injury. Ergonomic changes can include restructuring or changing the work environment or modifying a task by using different tools or procedures. In the area of materials handling, ergonomic interventions can include training in back safety, reducing the weight of objects lifted, using mechanical lifting devices, or changing the height of a pallet or shelf. The goal of ergonomics is to reduce your exposure to work hazards. A hazard is defined as a physical factor within your work environment that can harm your body. Ergonomic hazards include working in awkward or uncomfortable postures and using excessive force or high repetition.

Work Smarter, Not Harder

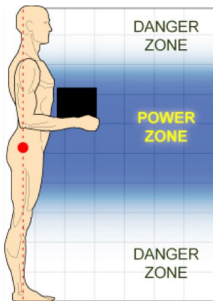
Many jobs require you to work in awkward postures or to use repetitive or prolonged force. The risk of injury increases with exposure to hazards, combined with longer exposure times and insufficient rest or recovery time.



Posture is Important

An awkward posture occurs when a joint is held in a “non-neutral” position at the extreme ends of its range of motion. A joint becomes weaker as it is moved away from its mid-point. Awkward postures place the muscles out of balance, make tasks more physically demanding, and add stress to the body.

An example of an awkward posture is when the wrist is bent up and down at the extreme ends of its range of motion.



Awkward postures can occur in shops when doing bench work, especially if tools and materials are placed outside of the “power zone”. The power zone is close to the body, between mid-thigh and mid-chest height. This zone is where the arms and back can lift the most with the least amount of effort. The risks associated with lifting and carrying are magnified when items must be retrieved or placed outside of the power zone. Examples of specific high-risk postures can be found in Table 4.1.

Table 4.1 – High-Risk Postures

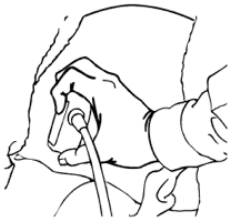
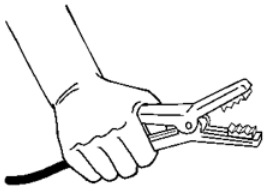
	Working with hands above the head, or with the elbows above the shoulders for prolonged periods without frequent breaks

	Working with the neck bent more than 45° without support or frequent posture changes for prolonged periods
	Working with the back bent forward without support or frequent posture changes
	Squatting or kneeling to work repetitively or for prolonged periods
	Working outside of the power zone

Avoid Forceful Exertions

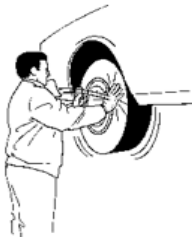
Force is defined as exerting effort to accomplish something. Shop work involves various types of force, including high hand forces, contact pressure, and high force associated with lifting and carrying tasks. Table 4.2 depicts examples of high hand force that occur when using tools.

Table 4.2 – High Hand Forces

	Holding and operating a hand tool weighing two pounds or more, or pinching with a force of four pounds or more (comparable to using a pair of pliers or hammer) for more than three hours per day. Risk is increased when using the following awkward wrist postures
	Working with the neck bent more than 45° without support or frequent posture changes for prolonged periods

Another type of force that can cause injury is contact pressure. Contact pressure occurs when a body part that is not protected by muscle or padding is compressed against a hard surface or sharp edge. Prolonged compression on a padded surface can also result in contact pressure. An example of this activity is kneeling to work using knee pads or a floor mat. Examples of contact pressure are in Table 4.3.

Table 4.3 – Contact Pressure

	Using the hand (heel/base of palm) as a hammer more than once per minute
	Using the knee as a hammer more than once per minute or kneeling for prolonged periods on knee pads or a mat

More is Not Always Better

Doing too much will not only make you tired, but it can also wear your body out! Highly repetitive tasks can put you at high risk of discomfort or injury. The risk of injury is even greater when you work in awkward postures. High repetition tasks commonly seen in shops include:

- Use of hand tools such as saws, hammers, screwdrivers, and wrenches
- Hand sanding or grinding

Too little movement can also be as harmful as too much movement. Prolonged or sustained postures occur when we do not move. Discomfort and fatigue can result from holding tensed muscles in fixed positions for long periods. The risk of injury increases if you hold fixed positions in awkward postures. An example of an awkward and prolonged posture is bending over to caulk or drill without changing tasks for long periods of time.

Lifting and Carrying

Many lifting injuries can be prevented by reducing the weight and number of lifts as much as possible, and by learning how to use appropriate lifting techniques when it is necessary to lift and carry objects.

Using proper lifting techniques can reduce or eliminate the potential for injury when you must lift or move objects by hand. Use forklifts, hoists, carts, dollies, and other types of lifting equipment when you have to lift or move heavy or bulky objects.

Before lifting an object, assess the situation by asking yourself the following questions:

- Can you lift this load safely, or is it a two-person lift?
- How far will you have to carry the load?
- Is the path clear of clutter, cords, slippery areas, overhangs, stairs, curbs or uneven surfaces?
- Will you encounter closed doors that need to be opened?
- Once the load is lifted, will it block your view?
- Can the load be broken down into smaller parts?
- Would gloves improve your grip or protect your hands?

Size up the load:

- Test the weight by lifting one of the corners. Stop lifting if it is too heavy or difficult to handle.
- Consider asking for help from fellow workers.
- Break down the load into smaller parts.
- Use a mechanical lift or a hand truck.

The Art of Lifting

There is really no single “right way” to lift. However, there are more and less demanding ways to lift. The key to working safely is to figure out how to lift in the least demanding way possible.

Here are some guidelines to reduce risk of injury when lifting.

Staggered Stance. Lifting with the feet close together and in line with each other makes it more difficult for you to use your legs to help with the lift. Staggering your stance encourages the legs to become involved and reduces the demands on your back. Simply stepping toward a load (with a staggered stance) moves the center of gravity closer to the load and minimizes the demands of the lift. If you feel your weight shifting forward onto your forward leg, you know you have successfully transferred this weight demand from your back to your stronger legs.

Keep It Close and Keep the Curves! The closer a load is kept to your power zone, the easier it is to keep the natural curves of your back. The vertebra, discs, ligaments and muscles are in their strongest and most supportive position when the natural curvature of the spine is maintained.

Build a Bridge. In most cases, the demands of any lift are determined by the position of a person's upper body during the lift. Many people lift by bending over at the waist and leaving their upper body hanging like a "one-sided bridge". This places all the demands of the lift onto the lower back and increases the risk of injury. This can be avoided by "building a bridge" to support the weight of the upper body. To do this, place an arm on your leg or a nearby stationary object. If you need both of your arms to manage the object you are lifting, step forward toward the load with one leg and create a "bridge" with your legs to reduce the workload on your back.

Feet First. Moving your feet first gets you closer to the load and reduces the amount you have to reach. The farther you reach, the more you have to lift your upper body as well as the load. Moving your feet first also helps reduce the risk of twisting while you lift.

Prepare and Compensate

Let Your Body Breathe. Lifting and carrying loads can be hard work. Like athletes, workers can avoid injuries or discomfort by preparing the body for work. Muscles are more flexible and less prone to injury when they are warm and full of oxygen. Stretching and moving around prior to work helps pump blood into your muscles. Blood warms up muscles and brings in oxygen, allowing your muscles to "breathe". This can be particularly effective at the beginning of the workday, after breaks, or if you work in cold environments.

Compensating for work demands simply means letting the body recover from work in an efficient manner. Performing periodic stretches can minimize accumulation of fatigue throughout the day. Stretches can "apologize" to the body for working it so hard.

Use Mechanical Lifting Devices Whenever Possible

The best way to avoid a back injury is to reduce the number of lifts you carry out as much as possible. Hand trucks, push carts, and forklifts are great engineering controls that reduce your exposure to lifting hazards. If you use a forklift, make sure you have received the appropriate training and are authorized to operate one.

Tips for Using Hand Trucks and Carts:

1. Push rather than pull. It is easier and safer to push than to pull. You can use your body weight to assist when pushing, and you can see where you are going. You are also less likely to twist when pushing.
2. Keep close and lock your arms. Stay close to the load, try not to lean over, and maintain the curves of your back when pushing or pulling.
3. Use both hands. Carts are easier to push and control using both hands.
4. If necessary, use tie-downs to secure the load.
5. Use powered carts when available.

Setting Up A Safe Work Environment

Avoiding exposure to work hazards such as awkward postures, repetition and high forces is the best way to avoid discomfort and injury. Here are some ways that you can set up a safe work environment.

Tool Design

Shop workers use many different tools. The design of the tool can affect your working posture and the force and repetition you are exposed to while working. To reduce your risk exposure, use Table 4.4 to match your tool selection to the task you must complete.

Table 4.4 – Tool Selection

For tasks requiring a POWER GRIP	
SINGLE-HANDLE TOOLS	DOUBLE-HANDLE TOOLS
	
Handle Diameter= 1¼” to 2”	Open Grip Span = <3 ½” Closed Grip Span = >2”
For tasks requiring PRECISION	
SINGLE-HANDLE TOOLS	DOUBLE-HANDLE TOOLS
	
Handle Diameter= ¼” to ½”	Open Grip Span = <3” Closed Grip Span = >1”

Guidelines for Tool Selection

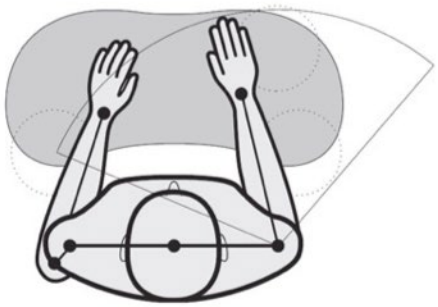
Keep the following guidelines in mind when selecting tools:

- Select tools with smooth, non-slippery, padded handles. Avoid tools with finger grooves, hard plastic handles, sharp edges, small or large diameter handles.
- Use grips or tape to build up small diameter tools, especially if you need to use them with a power grip. Better still, select tools with larger diameter handles (1¼”-2”) and soft grips.
- Use longer handle tools (screwdrivers, wrenches) for better leverage.
- Use vises, clamps, or jigs to stabilize objects to avoid prolonged forceful gripping with the hand.
- Avoid gripping or pinching with your wrist in awkward positions. Take frequent breaks to stretch and rest hands.
- Alternate activities frequently throughout the day. Rotate heavy and/or repetitive tasks with lighter, less repetitive tasks.

Task Modification

The way you complete your work tasks can influence your level of fatigue and your exposure to risk. The following suggestions can help you work more efficiently and comfortably:

The Neutral Reach Zone



- Use two hands to lift rather than one, even with light objects and tasks.
- Slide or push and pull objects instead of lifting.
- Avoid jerky movements when lifting objects.
- Use power devices when available.
- Keep reaching to a minimum. Position objects close to the body within easy reach (the “neutral reach zone”).
- Use a step stool or ladder when necessary to reach above shoulder level, or to lift objects overhead.
- Alternate tasks throughout the day. Rotate heavy and/or repetitive task with lighter, less repetitive tasks.

SECTION 5

Mechanical Materials Handling

SECTION 5: MECHANICAL MATERIALS HANDLING

Often times, individual workers benefit from using specialized materials handling equipment to complete tasks which otherwise require many workers. Powered industrial trucks and cranes are examples of these types of equipment. Operators should be trained and certain precautions should be taken as outlined in the section below.

Powered Industrial Trucks

A powered industrial truck, or (PIT) is defined as "an industrial vehicle used to carry, push, pull, lift or stack material that is powered by an electric motor or an internal combustion engine. Included are vehicles that are commonly referred to as forklift trucks, rider-trucks, motorized or powered hand trucks, pallet trucks and tugs." Cal/OSHA Title 8 CCR 3668 requires that every operator be trained and certified to operate powered industrial trucks in the workplace, and that the operator's performance be evaluated every three years (Note: Not all PITs are considered forklifts but all forklifts are PITs). Contact the Campus EH&S Office to discuss options for receiving powered industrial truck training.

As best practice, electric PITs should be used anytime work is being performed indoors, as gas powered vehicles/ equipment produce exhaust and toxic gases that present indoor air quality hazards. An example of a dangerous by-product produced by an internal combustion engine is carbon monoxide gas, which can be detrimental to safety and health at certain levels of exposure. See the "Gas Powered Equipment" subsection below for more details.

Forklifts

When driving a forklift, it is imperative to keep the combined center of gravity (CG) inside the stability triangle (the area inside the two front wheels and the pivot point of the rear axle). If the combined center of gravity moves outside the stability triangle, the forklift tends to tip sideways. Factors that can cause a forklift to tip include excessive speed while turning and driving on uneven surfaces. Special care should also be taken when ascending or descending an incline or decline plane to maintain center of gravity and prevent tipping of the vehicle.

Other potential dangers may include but are not limited to the following:

- lift trucks being inadvertently driven off loading docks;
- lifts falling between docks and unsecured trailers;
- workers being struck by a lift truck; or
- workers falling while on elevated pallets and tines.

The following excerpts are some applicable rules and regulations from the California Code of Regulations pertaining to Industrial Trucks:

- Loads shall be so balanced, braced, or secured as to prevent tipping and falling. Only stable or safely arranged loads shall be handled.
- Employees shall not ride on the forks of lift trucks.
- The forks on a forklift shall always be carried as low as possible, consistent with safe operations.
- A loaded vehicle shall not be moved until the load is safe and secure.
- When provided by the industrial truck manufacturer, an operator restraint system such as a seat belt shall be used.

Drivers shall check the vehicle at the beginning of each shift using the Forklift Pre-Shift Inspection Checklist (Appendix F) or equivalent form. If it is found to be unsafe, the matter shall be reported immediately to a supervisor, and the vehicle shall not be put in service again until it has been made safe. Attention shall be given to the proper functioning of tires, horn, lights, battery, controller, brakes, steering mechanism, cooling system, and the lift system for fork lifts (forks, chains, cable, and limit switches).

Cranes, Hoists And Slings

There are two classes of cranes/hoists defined according to rated load capacities: "Three Tons and Under (≤3 Ton)" and "Over Three Tons (>3 Ton)". The larger cranes are subject to more stringent inspections, load tests and scheduled maintenance. Smaller cranes/hoists must have initial load tests, documented inspections and routine maintenance. Inspection requirements are outlined under Cal/OSHA Title 8 CCR 5021 and 5031.

Each shop in possession of cranes or hoists shall:

- Identify all cranes, hoists and rigging owned by the shop
- Identify cranes rated over three tons and manage load testing every four years
- Identify cranes rated three tons or less and manage their annual inspections
- Designate one or more "Qualified Person(s)" to operate the crane or hoist
- Provide for and document each Qualified Person's "operator training" prior to allowing them to inspect, maintain and/or operate specific department crane equipment (Retain all training records)
- Conduct documented quarterly inspections of all crane and hoist equipment
- Coordinate the completion of annual inspections of cranes/hoists/lift gear over three tons by a certificating agency, and a documented quadrennial load test conducted by a certificating agency
- Use of mobile vehicle cranes should be cleared with the appropriate campus department before work begins. You may contact the Campus EH&S Office for further information

Load Test Requirements

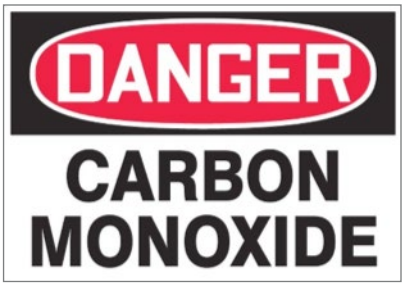
Upon initial equipment installation, or when conducting load tests every four years, the shop's designated responsible person must:

- Assure that all crane and hoist components and their attachments to a structure are engineered to support 125% of maximum load capacity of the equipment component with the lowest load rating
- Arrange for an initial load test of 125% rated capacity and performed by a certificating agency
- Arrange for initial testing of rigging at 110% - 125% maximum load capacity (to be determined by the certificating agency based upon type and use of crane)
- Ensure rigging is tagged or otherwise marked with load capacities
- Work with the appropriate department on campus and certificating agency to coordinate timing, space required, and access to the site. You may contact the Campus EH&S Office for further information

Gas-Powered Equipment

Using gas-powered tools such as high-pressure washers, concrete cutting saws, welders, compressors, and generators inside buildings or in semi-enclosed spaces can lead to a potentially dangerous concentration of Carbon Monoxide (CO) in the air. CO can rapidly accumulate, even in areas that appear to be well ventilated, and build up to dangerous or fatal concentrations within minutes.

Carbon Monoxide incidents can be avoided by following the recommendations below:



- Do not allow the use or operation of gas-powered engines or tools inside buildings or in partially enclosed areas
- Learn to recognize the symptoms and signs of CO exposure: headache, nausea, weakness, dizziness, visual disturbances, changes in personality, and loss of consciousness. Any of these symptoms and signs can occur within minutes of exposure
- Always place the pump/power unit of high-pressure washers and other tools outdoors and away from air intakes so that engine exhaust is not drawn indoors where the work is being done
- Consider the use of tools powered by electricity or compressed air if they are available and can be used safely
- Use personal CO monitors where potential sources of CO exist. These monitors should be equipped with audible alarms to warn workers when CO concentrations are too high

Contact EH&S with any concerns regarding gas-powered equipment or Carbon Monoxide.

SECTION 6

Machine & Tool Safety

SECTION 6: MACHINE AND TOOL SAFETY

Overview

Drill presses, table saws, band saws, grinders, milling machines, and a variety of small tools are used in many campus shops. This section presents safety procedures and guidelines, including the use of guards and personal protective equipment. Information about machinery repair and routine maintenance is also included.

General Safety Tips

Safe work practices in shops are critical to preventing work-related injuries. Crushed hands and arms, amputations, and other injuries can occur when shop work is done without proper care. Machine parts, functions, or processes that may cause injury must always be controlled or eliminated whenever possible.

Never use machinery without proper training or appropriate guards. Ask your supervisor for training if you do not know how to use a piece of machinery or a power tool.

Stay alert when working, and keep others at a safe distance when using a machine. If you see a co-worker having difficulty working (e.g., from being over-medicated, ill, or excessively tired), let your supervisor know so they can take care of the situation.

Machinery Safety Guidelines

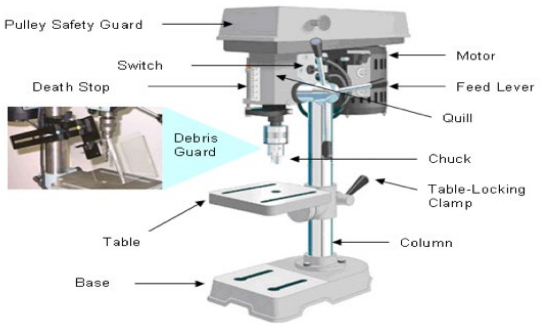
1. Get trained on each machine before using.
2. Follow instruction manuals.
3. Select the appropriate machine/tool for the job.
4. Use required PPE and guards.
5. Set up before starting. Change dull blades, clamp work, secure bits, and remove chuck keys.
6. Make sure operating controls are clearly labeled and easy to reach.
7. Turn off machinery when unattended.

Always use lockout/tagout procedures when inspecting or repairing machines. And make sure you report any equipment that is unsafe or needs repair.

Drill Press

A drill press is a machine that is used to drill holes of various sizes in wood, metal, and other materials. Usually mounted or bolted to the floor or work bench, it consists of a base, column, table, spindle, and drill head, which is usually driven by an electric motor. The head has a set of turning handles that move the spindle and chuck vertically. The table can also be adjusted vertically and is usually moved by a rack and pinion. See Figure 6.1.

Figure 6.1 – Drill Press



Drill Press Requirements and Safeguards

State regulations require that all drill presses be guarded at all times when in use, secured to the floor or bench, and be in good working condition.

Guards are required for all moving parts, including the point of operation where the work is performed, at all power transmission components, and at all other moving parts of the machine. The adjustable debris guard must always be adjusted and in place before attempting any type of cut.

Drill Press Training and PPE

You must receive specific training and PPE before working with a drill press. Training must include instruction from an experienced user on how to operate a drill press, review of the SOP, and the proper use of guards and PPE.

At a minimum, you must always wear safety glasses when operating a drill press. Face shields are recommended for added protection whenever feasible.

Drill Press Safety Tips

1. Select round, hex, or triangular shank bits.
2. Secure bits and remove chuck before turning on machine.
3. Work at speed appropriate for bit size and material.
4. Position work to avoid drilling into table.
5. Clamp work to table.
6. Feed bit evenly into work piece.
7. Back out of deep holes.
8. Clear off chips with brush after turning off machine.
9. Never hold work piece by hand.

Table Saw

A table saw consists of a circular saw blade that is driven by an electric motor. The blade protrudes through the surface of a table, which provides support for the material being cut. The height of the blade determines the depth of the cut that is made in the material, and the angle of the cut is controlled by adjusting the angle of the blade. See Figure 6.2.

Figure 6.2 – Table Saw

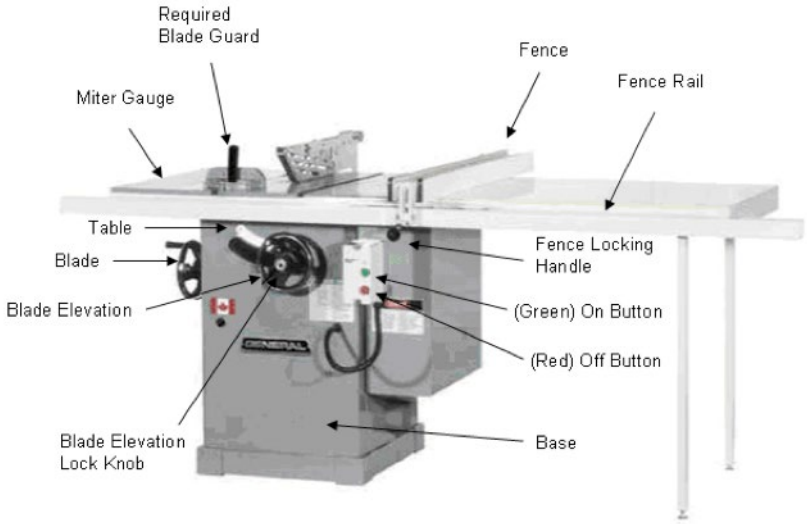


Table Saw Requirements and Safeguards

All table saws used in shops must be in good operating condition and be securely mounted. All rotating or moving parts must be guarded. Portions of table saws that extend beyond or behind a table must be covered with a guard, such as a crown guard, or with an exhaust hood if an exhaust system is required. Anti-kickback devices, hood guards, and spreaders are required. Push sticks are highly recommended to keep hands away from blades. All moving parts (belts and gears) and the point of operation must be guarded. Circular table saws must have a hood (crown guard) that completely covers the blade projecting above the table. The guard must ride the thickness of the stock being cut, adjusting to the thickness of the stock.

Keep the blades' guards, spreaders, and anti-kickback devices in place. Align the spreader with the blade. Check their action to make sure they operate properly before cutting.

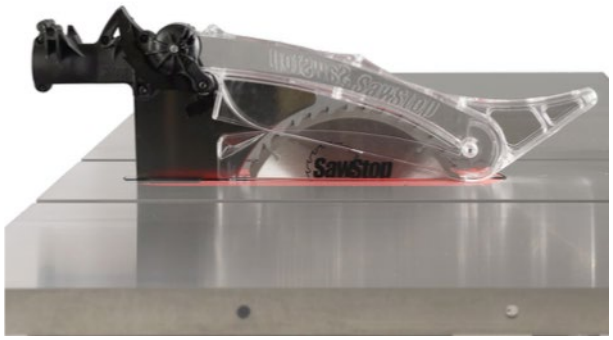


Table Saw Training and PPE

You must receive specific training and personal protective equipment (PPE) before working with a table saw. Training must include instruction from an experienced user on how to operate a table saw, review of the SOP, and the proper use of guards and PPE.

You must wear safety glasses, goggles, or face shields when operating a table saw. If the cutting operation is dusty, wear a dust mask. Do not wear gloves, ties, dangling jewelry, long sleeves, or any other loose-fitting clothing that could get caught in the blade. Slip-resistant footwear is also essential.

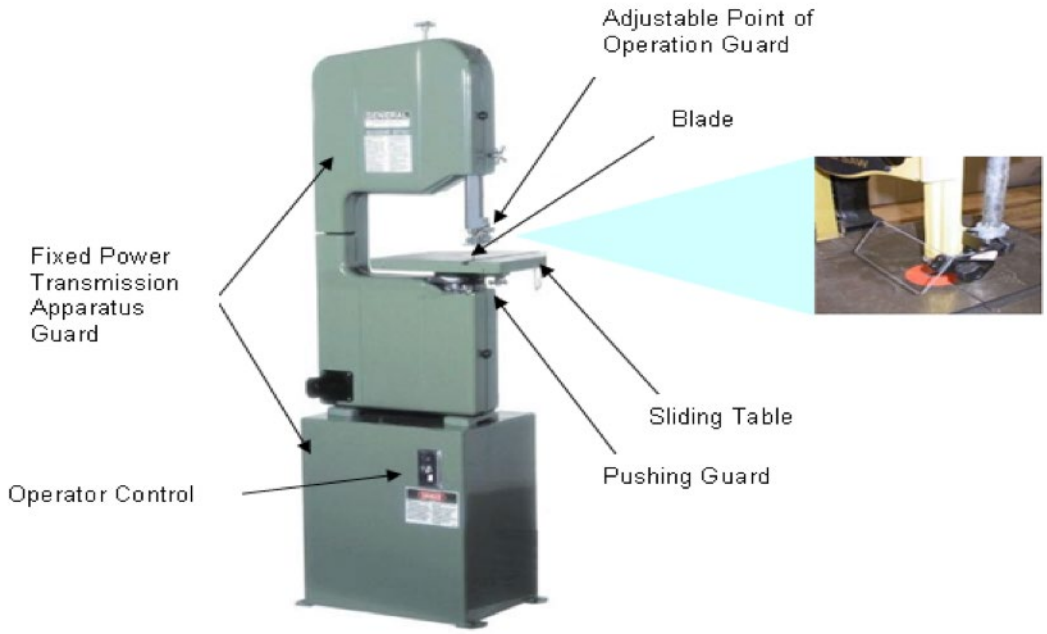
Table Saw Safety Tips

1. Set blade height maximum ¼" (6mm) above stock. This ensures that if your hand slips, you will get a slight cut rather than lose a limb.
2. Position guides.
3. Make sure tabletop is smooth and polished. Dirty, rough tables require extra force to push the stock through the blade. This can increase your chance of slipping or losing your balance.
4. Stand balanced and avoid awkward movements to prevent falling into the blade.
5. Select seasoned, dry, flat wood for cutting.
6. Check stock for nails, knots screw, stones, etc. These items can become projectiles and cause injury.
7. Release work only after it has gone past the blade.
8. Use a push stick to cut stock that less than 6" (150 mm) wide.
9. Make sure that the blade has stopped turning before you adjust the table.
10. Do not leave the saw until the blade has come to a complete stop.

Band Saw

Band saws have blades made of continuous bands of metal with teeth along one edge, and are used to cut a variety of materials, including wood and metal. Work pieces are fed into the cutting edge of the blade on vertical machines powered by electric motors. The metal band blade rides on two wheels rotating in the same plane. Band sawing produces uniform cutting as a result of an evenly distributed tooth load. Band saws can be used to produce straight cuts and are also particularly useful for cutting irregular or curved shapes. See Figure 6.3.

Figure 6.3 – Band Saw



Requirements and Safeguards

All band saws must be secured to the floor or bench, and have blade tension control devices with indicators.

As with other machinery, all moving parts and the point of operation must be guarded. The entire saw blade must be enclosed or guarded, except for the working portion of the blade between the bottom of the guide rolls and the table. Adjust the blade guard as close as possible to the table without interfering with movement of the stock. An adjustable secondary debris guard must also be in place.

Push sticks or push shoes are recommended to keep fingers and hands away from moving blades.

Band Saw Training and PPE

You must receive specific training and personal protective equipment (PPE) before working with a band saw. Training must include instruction from an experienced user on how to operate a band saw, review of the SOP, and the proper use of guards and PPE.

Operators must wear safety glasses. If the material being sawed chips severely, use a face shield in addition to safety glasses. Slip-resistant footwear is also essential.

As with any power saw, do not wear gloves, ties, dangling jewelry, long sleeves, or loose-fitting clothing.

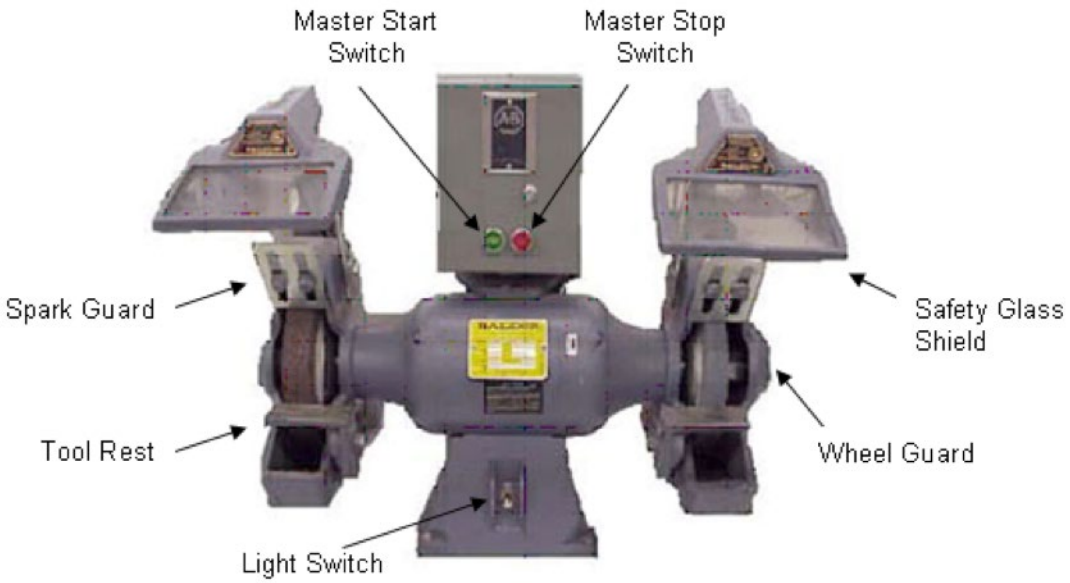
Band Saw Safety Tips

1. Clear tools, debris, and unnecessary materials off table.
2. Verify location of on/off switch and emergency power disconnect.
3. Check blade for tightness.
4. Adjust the blade guard as close as possible to the table without interfering with movement of the stock.
5. Adjust the travel guard down so that the blade will travel within the angle or channel.
6. Operate at manufacturer's recommended speed.
7. Cut only those materials recommended for use with the machine.
8. Do not force material into the blade.
9. Unplug power cord before changing blade or servicing.
10. Lock power disconnect in "off" position when changing the blade or servicing the saw.
11. Test the saw after disconnecting power and before beginning service.

Bench or Pedestal Grinder

A grinder uses an abrasive wheel to grind objects that need to be shaped or repaired. It is often used to remove metal from a work piece, sharpen tools, and clean parts. It consists of a power driven grinding wheel and a tool rest used to guide and feed work-pieces onto the wheel. See Figure 6.4.

Figure 6.4 – Bench Grinder



Grinder Requirements and Safeguards

All grinders must be mounted to floors or benches. The tool rest must be adjusted within one-eighth inch of the grinding wheel. Adjustable tongue (spark) guards should be within one-fourth inch from the wheel. Side guards must cover the spindle, nut and flange, and at least 75% of the wheel. Safety glass shields must be clear to allow the user to see the wheel.

As with all other machinery, guards are required for all moving parts and at the point of operation. Side guards must cover the spindle, nut, flange, and 75% of the wheel. In addition, each stone or wire brush must have an adjustable, clear debris shield (also known as an eye shield).

If metal grinding operations are going to take place, a hot work permit must be obtained.

Grinder Training and PPE

You must receive specific training and personal protective equipment (PPE) before working with a band saw. Training must include instruction from an experienced user on how to operate a grinder, review of the SOP, and the proper use of guards and PPE.

Operators should wear full-face protection and ear protection, and should wear leather gloves and a leather apron.

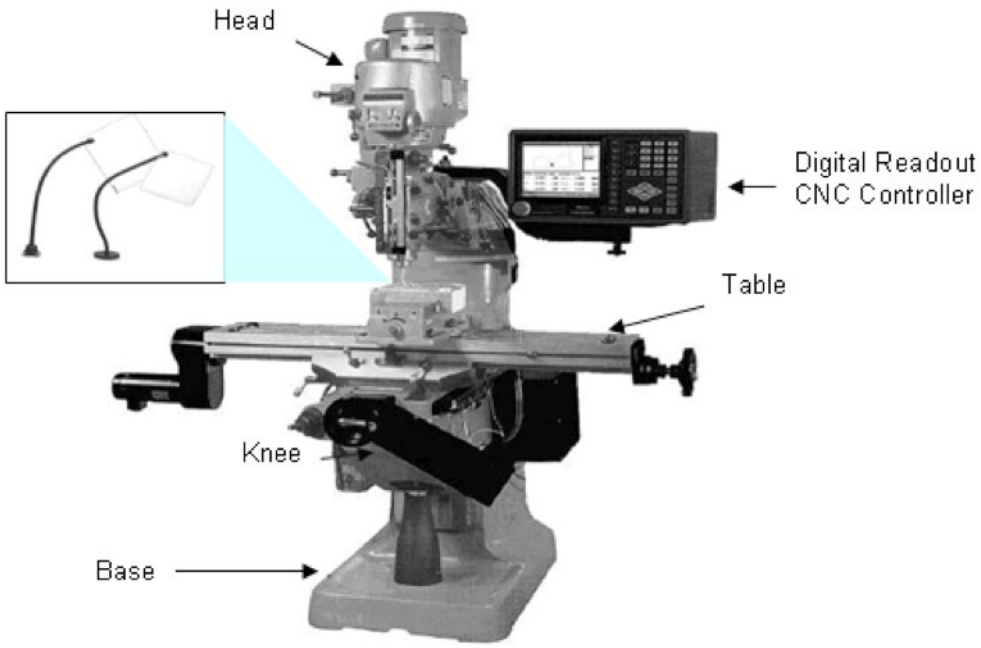
Bench and Pedestal Grinder Safety Tips

1. Stand to the side of the grinder when starting the electric motor.
2. Use the correct wheel for the material you are grinding, polishing, or buffing.
3. Adjust the tool rest as close as possible to the grinding wheel without touching it. It must have a gap of between one-sixtinth and one-eighth inches.
4. Keep the face of the abrasive wheel square. Use a dressing tool to remove some of the abrasive compound to square the wheel.
5. Never grind on the side of the wheel. This can cause the wheel to shatter.
6. Avoid overheating metal when grinding. If the metal becomes too hot and is allowed to cool too slowly, it may become soft. If it is cooled too quickly (quenched), it may become brittle.
7. Dip the metal into the water pot attached to the bottom of the grinder as you shape it to keep it from getting too hot.
8. If your grinder does not have a water pot, place a container of water near the grinder to cool the piece you are grinding.

Milling Machine

Milling machines shape metal and other solid materials. A cutter rotates about the spindle axis and table to which the work-piece is affixed. In contrast to drilling, where the drill is moved exclusively along its axis, milling involves movement of the rotating cutter sideways as well as 'in and out'. The cutter and work-piece move relative to each other, generating a tool path along which material is removed. Milling machines may be manually operated, mechanically automated, or digitally automated via computer numerical control. See Figure 6.5.

Figure 6.5 – Milling Machine



Milling Machine Requirements and Safeguards

Milling machines must be in good condition and properly lubricated with all moving chains and gears guarded at all times.

As with all other machinery, guards are required for all moving parts and the point of operation. An adjustable chip shield must be in place whenever cutting is taking place.

Milling Machine Training and PPE

You must receive specific training and personal protective equipment (PPE) before working with a milling machine. Training must include instruction from an experienced user on how to operate a band saw, review of the SOP, and the proper use of guards and PPE.

Operators must always wear safety glasses and slip-resistant shoes. Never wear loose clothing or other articles that dangle and could catch on the cutter.

Milling Machine Safety Tips

1. Keep area around machine clear of debris; wipe up any oil on the floor.
2. Clean and dry the table before setting up.
3. Secure any holding devices (e.g., vise, angle plate, dividing head, or tail stock).
4. Select the right kind of cutter for the job.
5. Check to make sure that the machine is turned off before inserting the cutter.
6. Make sure that the arbor, cutter, and collars are clean before mounting them in the spindle.
7. Handle sharp cutters with a rag.
8. Securely set the work piece in the vise with a rubber hammer or mallet.
9. Be certain that the holding device clears the arbor and the over-arm supports.
10. Select the proper cutting speed, rpm, and rate of feed for the job.
11. Disengage the control handles when using automatic feeds.
12. Keep hands away from the revolving cutter at all times.
13. Never touch the metal chips with your fingers. Clear chips away from the cutter with a brush. After cutting is finished, vacuum or sweep debris rather than blowing with an air hose.
14. Release any automatic feeds after the job is complete.
15. Clean and wipe the machine when finished.

Hand & Power Tools

Shop workers often take hand and power tools for granted since they are used so frequently. This can make it easy to forget the potential danger they may pose. Nevertheless, many tool-related accidents occur due to improper maintenance or misuse of hand and power tools. Pay close attention to the condition of your tools and know how to use them properly.

Hand Tools

Hand tools are manually powered tools such as pliers, screwdrivers, hammers, hand saws, and wrenches. While not powered by an external source, hand tools can be dangerous if improperly handled or used to perform the wrong task.

Never use a tool for something other than for what it was intended. Common examples of misuse include using a wrench for a hammer or using a screwdriver as a crowbar. Don't use extender or "cheater" bars to increase leverage or force on wrenches.

Keep hand tools in good working condition and always inspect them before using.

Hand Tool Safety Tips

1. Keep knife and saw blades sharpened.
2. Direct blades away from other workers in the work area.
3. Replace wrenches when jaws are worn and begin to slip.
4. Replace tools with splintered handles, cracked blades, or any other defect.
5. Use tools for their intended use only.

Power Tools

Power tools are classified by their power source and include electrical, pneumatic, liquid fuel, hydraulic, and powder actuated tools. Potential hazards include electric shock and injury from moving parts.

Power Tools That Require Guards

1. Tools with non-flush projections on revolving or reciprocating edges.
2. Tools with wheels.
3. Tools with blades.
4. Tools with sanding and grinding parts.

Most power tools are designed with safety in mind. Manufacturers must follow Occupational Safety and Health Administration (OSHA) guidelines that require all power tools to have guards, switches and controls, electrical grounding, and maintenance guidelines. These features are important for your safety. Do not use any tools that have broken or missing guards, switches, or grounding conductors. Never remove safety guards.

Electrical Tools

Examples of electrical power tools include power drills, power saws, and power grinders. Electrical tools introduce the risk of shock, which can potentially lead to serious injury. To help avoid electrical shock, it is required that all exposed non-current carrying metal parts of tools that may become energized be grounded.

Safety Guidelines for Electrical Tools

1. Inspect cords for defects such as cracks, frays, and other signs of wear or faults in the cord insulation.
2. Use properly grounded tools with three-prong plugs and double insulation.
3. Inspect the plug for cracks and for missing, loose, or faulty prongs.
4. Use manufacturer recommended guards and shields.
5. Switch off tools before connecting them to a power supply.
6. Disconnect the power supply before making adjustments or changing accessories.
7. During use, keep power cords clear of tools and away from the path that the tool will take.
8. Use approved extension cords that have the proper wire size (gauge) for the length of cord and power requirements of the electric tool that you are using.
9. Use appropriate PPE for the work you are doing. This may include items such as safety glasses or goggles, hearing protection, dust mask, gloves, safety boots or shoes, or rubber boots.

Pneumatic Tools

Pneumatic tools are powered by compressed air. Common types of these air-powered hand tools include nail guns, stapling guns, grinders, drills, riveting guns, and jackhammers. These tools can cause injuries due to flying parts or loose attachments. Before you begin a job, make sure that pneumatic tools are fastened securely to their air hoses to prevent them from becoming disconnected while in use.

Safety Guidelines for Pneumatic Tools

1. Review the manufacturer's instructions before using a tool.
2. Wear safety glasses or a face shield and, where necessary, safety shoes or boots and hearing protection.
3. Make sure air hoses do not present a tripping hazard.
4. Never point a compressed air gun at another person.
5. Use the recommended air pressure for the task.
6. Post warning signs where pneumatic tools are used. Set up screens or shields in areas where nearby workers may be exposed to flying fragments, chips, dust, and excessive noise.
7. Ensure that the compressed air supplied to the tool is clean and dry. Dust, moisture, and corrosive fumes can damage a tool. An in-line regulator filter and lubricator increases tool life.
8. Keep tools clean and lubricated, and maintain them according to the manufacturers' instructions.
9. Do not attempt to catch falling machinery or power tools.
10. Support heavy tools with a counter-balance when possible

Liquid Fuel Tools

Liquid fuel-powered tools are usually powered by gasoline. Examples of liquid fuel tools include chain saws, lawn mowers, concrete saws, and pressure washers. When used properly and according to the manufacturer's instructions, these types of tools are very dependable and safe. Like any other kind of tool, there can be some serious hazards involved if they are used improperly. The most serious hazards presented by these tools are dangerous exhaust fumes and vapors that can burn or explode. Proper ventilation, careful handling of fuel, and attention to fire safety can help reduce these hazards.

Safety Guidelines for Liquid Fuel Tools

1. Shut and cool down the engine before refilling a fuel tank.
2. Always transport fuel in approved flammable liquid containers.
3. Have fire extinguishers available when working.
4. Always wear foot, eye, face, head, and ear protection when required.

Hydraulic Tools

Hydraulic tools are powered by a hydraulic pump which can be hand, foot, or engine powered, or even built into the tool itself. Hydraulic tools generate, control, and transmit power by the use of pressurized liquids. Examples of hydraulic tools include jacks, presses, and impact wrenches. Hydraulic power tools present various hazards, including trip hazards or slipping hazards from oil leaks.

Safety Guidelines for Hydraulic Tools

1. Never exceed the load limit marked on the tool.
2. Always use a hydraulic jack on a firm and level surface.
3. Visually inspect all hydraulic tools at least once every six months.
4. Visually inspect all jacks used outside the shop before they go out and when they return.
5. Immediately inspect any hydraulic tool when subjected to an abnormal load, pressure, or shock.
6. Always use leather gloves, safety shoes, and face, eye and ear protection.
7. Consider using impact-resistant gloves.

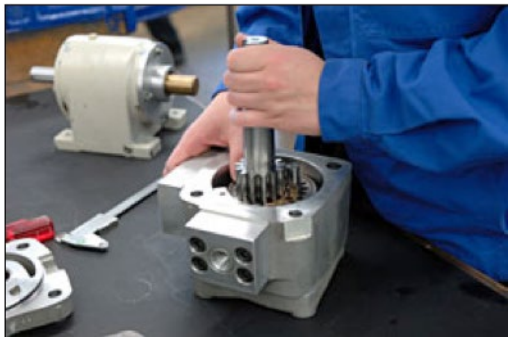
Powder Actuated Tools

A powder-actuated tool is a nail gun used in construction and fabrication to join materials to hard substrates such as steel and concrete. This technology relies on a controlled explosion created by a small chemical propellant. An example of a powder-actuated tool is a concrete fastener.

Powder-actuated tools come in both low and high velocity types. Either design can be dangerous to operate. In low velocity tools, the propellant acts on a piston in the chamber, which drives the fastener into the substrate. In high velocity tools, the propellant acts directly on the fastener, similar to a firearm.

Safety Guidelines for Powder Actuated Tools

1. Never point a powder-actuated tool at another person.
2. Use an alignment guide when shooting a fastener into an existing hole.
3. Do not fire fasteners into materials that would let them pass through to the other side.
4. Stay at least three inches away from the edges or corners of materials like brick or concrete.
5. Stay one-half inch away from a steel corner or edge. In steel, the fastener must not come any closer than one-half inch from a corner or an edge.
6. Do not drive fasteners into hard or brittle materials that might chip or splatter, or make the fastener ricochet.
7. Always wear hand, eye, ear, and face protection.



Machine Maintenance: Repairs and Inspection

Who can repair machinery?

Only authorized individuals, such as the shop supervisor, manager, designee, or approved vendor can repair machinery. User manuals or Standard Operating Procedures (SOPs) must be consulted and followed when maintaining or repairing equipment. Any piece of machinery that undergoes repair, whether it is repaired in-house or sent out, must have documentation which clearly outlines the extent of the repairs. Records of machinery repair must be maintained in the shop.

What type of machinery must have routine inspections?

All heavy machinery that is continuously in use must have routine safety or maintenance inspections. Inspections must be documented using machine-specific checklists or general maintenance logs that demonstrate routine review and inspection of machine parts and performance.

How do I report a machine in need of maintenance or repairs?

You must immediately notify a supervisor, manager, or their designee of needed maintenance or repairs. Lockout/Tagout (LOTO) procedures must be implemented if any machine guard is removed or before any maintenance or repairs are conducted. Refer to Section 7 of this manual for more information on LOTO procedures.

SECTION 7

Lockout/Tagout

SECTION 7: LOCKOUT/TAGOUT

This section contains information about Lockout/Tagout (LOTO) in compliance with Cal/OSHA Title 8 Section 3314. LOTO is a process used to shut down machinery and equipment for repairs, service, maintenance, and other operations.

What is Lockout/Tagout?

Lockout/Tagout (LOTO) establishes a means of positive control to prevent the accidental starting or activating of machinery or systems while they are being repaired, cleaned and/or serviced. By physically locking out and tagging out each energy source associated with a machine, accidents can be prevented.

What is the UC LOTO Program?

The UC Lockout/Tagout (LOTO) Program provides an overview of LOTO for campus (and off-campus) operations, and details UC procedures for using LOTO as follows:

1. Establish a safe and positive means of shutting down machinery, equipment and systems.
2. Prohibit unauthorized personnel or remote control systems from starting machinery or equipment while it is being serviced.
3. Provide a secondary control system (tagout) in addition to, and/or when it is impossible to, positively lockout the machinery or equipment by traditional means.
4. Establish responsibility for implementing and controlling lockout/tagout (LOTO) procedures.
5. Ensure that only approved locks, standardized tags and fastening devices will be utilized in the LOTO procedures.
6. Develop risk assessment procedures to implement alternative methods when traditional LOTO cannot be utilized.

Lockout is a physical process that stops the energy of a piece of equipment at its source, creating a “Zero Energy State”. A typical scenario is that a power switch, circuit breaker, or valve is turned off, and a locking device is attached to prevent the power from being turned back on.

Tagout is a written warning on a tag that describes the tag out procedure. The tag displays the name of the service person and the duration of time that the machine will be locked and tagged out.

Locks and tags must have a similar format and be readily recognizable by shop users. They must be easy to read and durable enough to withstand 50 pounds of pulling force.

Who Can Perform LOTO Procedures?

Only employees who have attended the LOTO training and have received authorization from EH&S can create and carry out LOTO procedures. Training covers how to identify and shut down all live parts of machines and ensure effectiveness of lockout devices and procedures. Trained workers are provided with locks and tags that must be used to clearly indicate who has locked and tagged the machine. Under normal operating procedures, the only person(s) allowed to undo a LOTO procedure is the person(s) that implemented it.

Which Types of Machines Require LOTO?

All machines that are powered by electrical, mechanical, chemical, or other type of energy or have the potential to store or re-accumulate energy may require LOTO.

When Should LOTO Procedures Be Used?

Any machine that is being serviced, repaired or maintained may be required to be locked and tagged out. This includes lubricating, cleaning, un-jamming, removing guards, and/or when the body comes close to machinery parts.

What Steps Must Be Taken When Implementing LOTO?

1. Notify all affected employees before beginning LOTO and verify that they are a safe distance from the machine. Identify any potential hazards and the primary and any secondary energy sources used in the machine.
2. Shut down and terminate the flow of energy into the machine at the local and main power source. There may be more than one local source.
3. Isolate the energy sources and prevent unexpected movement. Bleeding, blocking, venting, etc. may also be needed.
4. Connect the designated lock or tag to the energy control(s). Each user must have their own lock, tag, and key. Place the locks and/or tags so that they are clearly visible.
5. Test the machine to ensure that no energy is flowing. Turn "on" the local switch control(s) to make sure that zero energy is reached. Be sure to turn them "off" before moving to the next step.
6. Perform maintenance, service, or repair.
7. When service or maintenance is complete, remove all tools and keep the energy switches in the "off" position.
8. Remove the lock and/or tag. The individual(s) who placed the lock or tag is the only person(s) authorized to remove it.
9. Make sure affected employees are a safe distance from the machine. Turn on the energy in the reverse order that the energy sources were taken off-line and test the machine for proper operation. Notify other workers that the machine is operational again.

Employees and contractors must follow LOTO procedures (Appendix J) and must not take short cuts. EH&S requires an initial LOTO training for all shop supervisors who perform servicing or maintenance. A LOTO audit will typically be part of the annual Shop Safety Inspection in order to maintain or correct the LOTO procedures and help keep workers safe.

Refer to your campus-specific Lockout/Tagout Program for specific policies. Contact EH&S for help in developing or completing LOTO procedures and training employees.

SECTION 8

Fire Safety

SECTION 8: FIRE SAFETY

This section contains information about fire prevention, fire extinguishers, obtaining emergency response placards, and procedures for what to do in the event of a fire. All shop employees must be familiar with these fire safety fundamentals.

Facility Requirements

Maintaining your facility is an important fire prevention measure.

Egress

Walkways and exits are not designed for storage and must be kept clear. At minimum, 3 feet of clearance must be maintained at all times so that people can exit safely and quickly. Remove any tripping hazards immediately and make sure that exit routes are unobstructed and clearly identifiable. Refer to the building evacuation plan to identify exit routes for your building and to your campus evacuation map, to see where your shop should go during a catastrophic event.

Storage

Avoid storage of excess combustible materials (e.g., cardboard, paper, and rags) in the shop. Do not store items closer than 18 inches below sprinkler heads, in order to allow the free flow of water from fire sprinklers, or 24 inches below the ceiling level if there are not any sprinklers.

Storage of flammables and combustibles must fall within the “maximum allowable quantity” specified for the control area as designated under the California Fire Code (CFC). Furthermore, no more than 10 gallons of flammable chemicals (cumulative) may be stored outside of a flammable storage cabinet at any time. Keep oily rags in a separate, flash proof metal container.

Always keep flammable and combustible materials away from all sources of ignition (e.g., welding operations, electrical equipment, etc.).

Electrical Equipment

All electrical equipment must be properly grounded and bonded. Grounding ensures that electricity is directed correctly and bonding prevents the buildup of static electricity, which can lead to sparks. Ensure that extension cords and electrical circuits are never overloaded.

Housekeeping

Clean up debris from machines and work areas frequently, as certain shop materials can pose a significant fire hazard. For example, dust explosions can occur from high levels of airborne wood dust or from accumulation inside the switchgear. Always make sure there is adequate ventilation when conducting work.

Fire Safety Equipment

Know the location of fire safety equipment (extinguishers, smoke detectors, fire alarm pull stations, etc.). Fire safety equipment should have a designated location and be visible.

Fire Extinguishers

Be familiar with the different types of fire extinguishers and the types of fires that they are used for.

Fire Extinguisher Type

Fire extinguishers are classified into four classes depending on the type of fire they extinguish:

Class A: Combustible materials
Class B: Flammable liquids
Class C: Electrical
Class D: Combustible metals (magnesium, sodium, lithium, and potassium)
Class K: Cooking media

Fire extinguishers may be used for a specific class of fire or a combination thereof. A common combination is the ABC fire extinguisher. Check the shop to ensure that the correct types of extinguishers are available. Extinguishers are inspected annually and are refurbished and hydrostatically tested every six years. Fire extinguishers must be properly mounted and accessible along exit paths. Never store items on or around them and make sure they are visible and accessible at all times.

Using a Fire Extinguisher

Remember the "PASS" acronym when operating an extinguisher:
P – Pull the pin
A – Aim at the base of the fire
S – Squeeze the trigger
S – Sweep from side to side

Contact EH&S to get further information on signing up for fire extinguisher training.

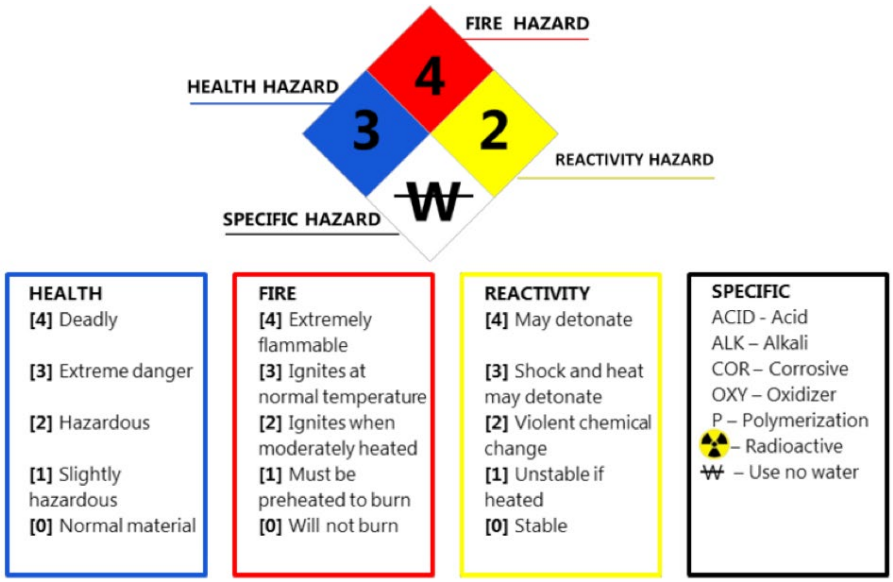
Emergency Response Placards

These placards inform emergency response personnel about a number of hazards present in a particular area. All shops that use or store chemicals are required to have an emergency response placard posted on the exterior entrance door. The placard includes information such as health, fire, and reactivity hazards listed on the NFPA fire diamond, emergency contacts, and an occupant list.

Figure 8.1 depicts how the blue, red, and yellow sections of a fire diamond are numbered 0-4, depending on the severity of the hazard. The white section of the placard is used to identify specific hazards, such as whether a chemical is corrosive, water reactive, or radioactive.

Contact EH&S to find out further information on Emergency Response Placards, how to access them and where they should be posted.

Figure 8.1 – Emergency Response Placard



Preparing for and Knowing What to Do in Case of a Fire

Having a plan for what to do in the event of fire is an essential fire safety measure.

In order to prepare for a fire, you must:

- Know the evacuation routes from your shop/office, floor, and building. Study these in advance. It is easy to become disoriented during an actual emergency.
- Know the location of the nearest fire extinguisher. Report missing fire extinguishers immediately to Facilities Management.
- Always keep fire rated doors closed.
- Post emergency numbers and your own room number on your telephone.
- Report any unsafe conditions to the EH&S Office and/or Campus Fire.

During a fire, you must:

- Remain calm and get out of the immediate area.
- Activate the fire alarm, exit via the stairs and DO NOT USE THE ELEVATOR.
- Close the door behind you as you leave and all other doors as you exit, after ensuring that all other occupants have exited—doors are built to withstand fire for a period of time.
- If you see smoke coming from your exit route, find another way out, if possible.
- Feel the door with the back of your hand before you open it. If it is hot, find another way out.
- Drop to the floor to avoid smoke and fumes. Crawl to safety.
- If your clothes catch on fire, STOP where you are, DROP to the ground and ROLL over and over to smother the flames.
- Call 9-1-1 from a safe location.

- If you are trapped in a burning building, stay near a window and close to the floor. If possible, signal for help.
- Meet with the emergency responders upon arrival and report what you saw—DO NOT LEAVE THE AREA. The information you have may save lives and valuable time.

Important Fire Safety Reminders

If your clothing catches on fire, you can use the nearest emergency shower ONLY if you are within a few seconds of the shower. If you are not near a shower, then stop, drop, and roll. Report any burn injuries to the supervisor immediately and seek medical treatment.

Anytime a fire extinguisher is used or discharged, it must be reported immediately to Police Dispatch.

All fires, regardless of size, must be reported immediately (911); this is a California State Fire Marshal's requirement.

SECTION 9

Seismic Safety

SECTION 9: SEISMIC SAFETY

Overview

This section provides information to prepare your shop for an earthquake and what to do in the event of an earthquake. Education and advance preparation are key to earthquake preparedness and safety. Each office area/shop/lab is responsible for developing an Emergency Action Plan (EAP), which outlines emergency procedures for that specific area. The Office of Emergency Management should be contacted for assistance in preparing a Departmental Emergency Action Plan.

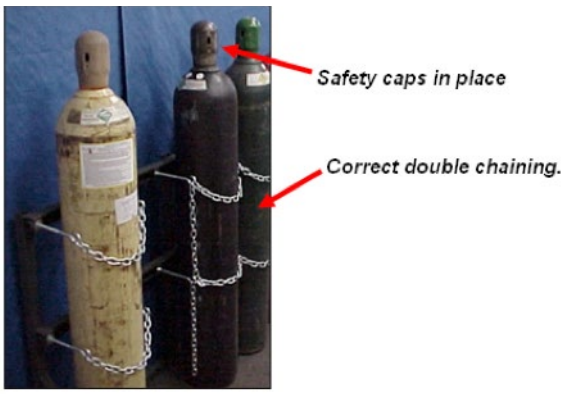
Prepare the Shop for an Earthquake

Hazardous materials and heavy items are of great concern to shops during an earthquake. Bolting, restraining, and proper storage are vital to keeping these items secure during an earthquake.

Compressed Gas Cylinders

Store compressed gas cylinders in a frame casing or by double-chaining them to a cylinder rack or wall. Racks must be bolted to a secure structure, such as a wall. The chains must be located one-third from the top and one-third from the bottom of the cylinder (see Figure 9.1). When a gas cylinder is not in use, remove the valve and replace it with a safety cap. Refer to Section 14 on Compressed Gas Cylinders for more detailed information about storage requirements.

Figure 9.1–Gas Cylinders Stored Correctly



Heavy Equipment

Bolt large equipment, such as a drill press or a table saw, to the floor. Heavy equipment stored on a worktable or bench must be bolted to the supporting structure.

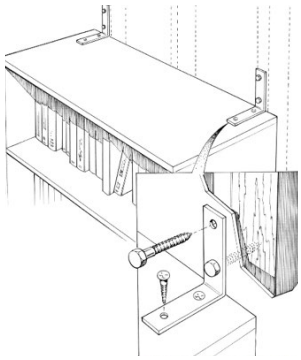
Ladders

The safest way to store ladders is to hang them horizontally using wall brackets or on flat racks. If this is not possible, ladders may be stored vertically and secured to a wall using a chain or wall bracket. The restraint should be placed around the upper section of the ladder. Never hang a ladder vertically from one of its rungs.

Cabinets and Shelving

Furniture over five feet tall should be secured to the floor or to a wall. When that is not possible, rows of cabinets or shelving should be secured to one another.

Cabinets should latch shut. Shelving above five feet should have internal restraints to prevent items from falling (never store unrestrained items above five feet). Restraints include lips, bars, netting, and bungee cords.



Do not place heavy items on top of a cabinet or shelf. Large pieces of wood or metal stock should be secured and stored horizontally on a lower shelf, instead of vertically.

Facilities carpenters can determine the best method to secure equipment and furniture. Contact them directly for an evaluation and assistance in bolting and restraining items in your shop.

Hazardous Materials
Hazardous materials must be securely stored to prevent spillage. If these materials are placed in a cabinet or on a shelf, ensure that they are restrained by a cabinet door that latches shut or by a lip, bar, bungee cord, or netting on shelves. They must be segregated according to hazard class, be tightly sealed, and be placed in secondary containment that is compatible with the chemicals they are holding. Flammable materials must be stored in a separate flammable storage cabinet. Refer to Section 7 on Chemical Safety for additional detailed information on chemical storage.

Exits and Walkways
Post all exit signs and do not store or place heavy items around exits as they could block egress if an earthquake occurs. Maintain a minimum of three feet of clearance in all walkways.

Prepare An Earthquake Plan

Advance preparation and practice will help you to remain calm and safe during an actual emergency. Prepare for an earthquake by conducting earthquake drills, knowing evacuation routes, and being familiar with your area's Emergency Action Plan.

Practice Drop, Cover, and Hold On
Practice taking cover so that it becomes second nature to you in the event of an earthquake. Always take cover quickly during an earthquake, because you face the greatest risk of injury from loose items falling.

Locate Fire Extinguishers
Know where the fire extinguishers are located in your shop and how to properly use them. Refer to Section 5 on Fire Safety for more information. Contact EH&S to schedule fire extinguisher training.

Know Your Exit Routes
Evacuation is the last resort during or after an earthquake. However, in the event of a gas leak or fire, it may be required. Refer to the building evacuation plan to identify exit routes for your building and to the campus evacuation map to see where your shop should go during a catastrophic event.

Locate Utility Shut-off Valves
Shutting off utilities will generally be the responsibility of the building coordinator or Facilities Management, but it is a good practice to know their location should you need to direct someone to where they are located.

What To Do When An Earthquake Hits

If you are indoors when the shaking starts:

- Drop, cover, and hold on. Get under a strong desk or table, if one is nearby. If you are not near a strong table or desk, drop to the floor against an interior wall and cover your head and neck with your arms.
- Avoid windows, hanging objects, mirrors, tall furniture (filing cabinets and bookshelves), large appliances and cabinets filled with heavy objects.
- If you are on campus, it is safer to remain inside a building after an earthquake unless there is a fire or gas leak.

- Glass from high-rise buildings does not always fall straight down; it can catch a wind current and travel great distances.
- Do not try to run out of your building during strong shaking—you can be killed or injured by falling debris (glass, roof tiles, concrete, etc.).
- Do not use elevators.
- If you use a wheelchair, lock the wheels and cover your head.
- If you are outdoors when shaking starts:
    - Move to a clear area if you can safely walk. There are no overhead power lines on the campus, but you should avoid buildings and trees.
    - If you're driving, pull to the side of the road and stop. Avoid stopping under overhead hazards or near buildings.

Once the earthquake shaking stops:

- Be prepared for aftershocks—they may be frequent and could exceed the first quake in severity.
- Check the people around you for injuries; provide first aid. Do not move seriously injured persons unless they are in immediate danger of a gas leak, hazardous material spill, fire or falling debris.
- Check around you for dangerous conditions such as fires, downed power lines and structure damage.
- If you have fire extinguishers and are trained to use them, put out small fires immediately.
- Check your phones to be sure they have not shaken off the hook and are tying up a line.
- Inspect your residence and work areas for damage.
- If you are trapped in debris:
    - Move as little as possible so that you don't kick up dust. Cover your nose and mouth with a handkerchief or clothing.
    - Tap on a pipe or wall so that rescuers can hear where you are. Use a whistle if one is available. Shout only as a last resort. Keep a whistle in your emergency kit.

SECTION 10

Hazard Communication and Chemical Safety

SECTION 10: HAZARD COMMUNICATION AND CHEMICAL SAFETY

Overview

This section provides you with information about the proper identification, use, storage, and disposal of chemicals.

Chemical Use

Before working with any chemical, you must be aware of the hazards associated with it, how to use and handle it with appropriate safety controls, and the proper storage and disposal of it. This can be accomplished through attending training and reviewing references such as **Safety Data Sheets (SDS)** and written procedures. Always ask questions if you are unsure of how to handle a chemical.

Know About the Chemicals that You Use

Individuals working with chemicals should take Hazard Communication training provided by EH&S. You may contact the EH&S Office to get more details on the availability of the training. The HazCom training equips you with the tools to understand the manufacturer's hazard labeling information and the SDS.

All shops that contain chemicals must have an SDS binder in their work area or have the ability to access SDS information electronically and in a timely manner. The first section should include a chemical inventory (preferred format located in (Appendix D), and the SDSs should follow. If you do not have a SDS for a chemical, you can get it from the manufacturer, EH&S, or look for it online. Review the SDS before chemical use and cleanup.

Knowing some basic information about the chemicals that you use and the type of PPE that is required is essential to using chemicals safely.

Contact EH&S for a hazard evaluation if you have additional concerns or questions after taking the HazCom online training and reviewing the manufacturer's SDS or hazard warnings on the label.

How do I find information on a SDS?

The following information will be listed on the SDS (in this order) for every chemical that you use:

- **Section 1, Identification** includes product identifier; manufacturer or distributor name, address, phone number; emergency phone number; recommended use; restrictions on use.
- **Section 2, Hazard(s) identification** includes all hazards regarding the chemical; required label elements.
- **Section 3, Composition/information on ingredients** includes information on chemical ingredients; trade secret claims.
- **Section 4, First-aid measures** includes important symptoms/effects, acute, delayed; required treatment.
- **Section 5, Fire-fighting measures** lists suitable extinguishing techniques, equipment; chemical hazards from fire.
- **Section 6, Accidental release measures** lists emergency procedures; protective equipment; proper methods of containment and cleanup.

- **Section 7, Handling and storage** lists precautions for safe handling and storage, including incompatibilities.
- **Section 8, Exposure controls/personal protection** lists OSHA's Permissible Exposure Limits (PELs); ACGIH Threshold Limit Values (TLVs); and any other exposure limit used or recommended by the chemical manufacturer, importer, or employer preparing the SDS where available as well as appropriate engineering controls; personal protective equipment (PPE).
- **Section 9, Physical and chemical properties** lists the chemical's characteristics.
- **Section 10, Stability and reactivity** lists chemical stability and possibility of hazardous reactions.
- **Section 11, Toxicological information** includes routes of exposure; related symptoms, acute and chronic effects; numerical measures of toxicity.
- **Section 12, Ecological information** lists ecotoxicity persistence and degradability; bioaccumulative potential, mobility in the soil.
- **Section 13, Disposal considerations***
- **Section 14, Transport information** lists UN number, UN proper shipping name, transport hazard class(es), packing group, if applicable, environmental hazards.
- **Section 15, Regulatory information** includes safety, health and environmental regulations specific for the product in question.
- **Section 16, Other information**, includes the date of preparation or last revision.

Handling Chemicals Safely

Be aware of your surroundings and keep the following items in mind:

General Safe Handling Practices

- If you are using flammable chemicals, make sure any ignition sources have been extinguished and heat is kept away.
- If you are using more than one chemical, make sure they will not react dangerously with one another.
- If you notice any fumes, vapors, bubbling, or unusual odors, stop what you are doing, vacate the area and request assistance.

Minimize Your Exposure

Proper chemical handling includes selecting the right kind of personal protective equipment (PPE) for the specific chemical hazard. In particular, you must select a glove that provides adequate protection against the individual chemical you are using (check the SDS for details), if necessary. When pouring or handling liquid chemicals, make sure you don proper splash protection (including gloves, aprons, and goggles).

A functional workplace ventilation system can prevent unnecessary inhalation exposures and reduce or eliminate the need for respiratory protection. Proper ventilation can also reduce the potential for fire hazards. Examples of workplace ventilation systems include:

- Dust collection systems on woodworking equipment.
- Using spray hoods when painting.
- Snorkel vents over chemical and welding operations.

Contact EH&S for a hazard evaluation if you are unsure if the chemical you are handling requires special PPE, ventilation, or respiratory protection.

Housekeeping and Personal Hygiene

- Do not use or store chemicals in non-work areas such as eating areas or in locker rooms. Eating and drinking is prohibited in work areas and must be assigned to a specific area or room.
- Always wash your hands after working with chemicals. Prolonged exposure to certain chemicals may have delayed effects.
- Always clean up equipment and work surfaces if they come into contact with chemicals and avoid placing chemical containers on the floor or at the end of a bench or table to prevent a spill.
- Keep containers closed when not in use.

Know What To Do in Case Of A Spill

Personal safety is the highest priority when a spill occurs. Depending on the scope of the spill and your training in spill clean-up procedures, you may be able to clean up a spill yourself or with the help of coworkers who are also trained in spill clean-up. EH&S is available to clean up spills if you are not trained in these procedures or if the spill is large.

In case of a small spill that does not present a significant hazard:

- Cordon off the affected area.
- Don the proper PPE for the chemical that has spilled (according to the SDS).
- Surround the spill using paper towels or the absorbent material from your spill kit.
- Proceed to clean up the spill using the same materials.
- Dispose of all clean-up materials as hazardous waste.

In the case of a large spill, call police dispatch at 911.

Chemical Storage

Chemicals must be physically segregated according to hazard class to prevent adverse chemical reactions. The segregation rules apply to all chemicals, regardless of their physical state (solid, liquid, or gas). If space is limited, incompatible chemicals can be placed in separate secondary containments in the same cabinet. Proper chemical segregation can be accomplished by designating storage cabinets, tubs, bins, or specific areas for a specific hazard class. Hazardous classes include:

- **Flammable:** fuel, welding gases, solvents, paint thinner, acetone, spray aerosols
- **Combustible:** flux, paint, wood dust, stain, cutting fluid, some adhesives, oil
- **Oxidizers:** oxygen, hydrogen peroxide, bleach, certain cleaners
- **Toxics:** mercury, lead, alloys containing cadmium or beryllium, chlorinated solvents or degreasers, solders, pesticides
- **Acids:** etching solutions, battery acid
- **Bases:** caustic or alkaline materials, ammonia based cleaners and some chemical strippers
- **Reactives:** polymer kits, epoxy resin

Chemicals must be stored in secondary containment, such as plastic tubs, and should not be scattered around the shop. Ensure that these materials are properly restrained when they are stored in cabinets or on shelving. Avoid storing chemicals near sources of heat or combustion.

Chemical containers must be compatible with the chemicals they are holding. For example, corrosive chemicals, such as strong acids and bases, will corrode metal containers.

All chemical containers must also be clearly labeled with the manufacturer's original label. If you transfer any chemicals to another container, you are required to provide your own label. Containers must be clearly labeled with the product identifier (from the SDS), and general information about the hazards of the chemical.

No more than 10 gallons of flammable chemicals may be stored outside of a flammable storage cabinet at any time. Keep oily rags in a separate, flash proof metal container.

When chemicals are not in use, they must be tightly sealed. If containers are damaged, leaking, or corroded, the contents must be transferred to a new properly labeled container or disposed of as hazardous waste.
Refer to the EH&S Safety Website for details on chemical hygiene and segregation.

Hazardous Chemical Waste

When a chemical product is discarded or is no longer useable, it typically becomes a hazardous waste, which requires special disposal procedures. Old or expired chemicals that cannot or will not ever be used should be disposed of as hazardous waste. Remember that waste can be decreased by purchasing only the amount of a chemical that you need or by substituting non-hazardous products for hazardous chemicals.

What is hazardous waste?
A waste meets the definition of hazardous waste if it has one or more of the following hazardous characteristic(s): it is flammable, corrosive, reactive, or toxic. These are referred to as characteristic wastes. Hazardous wastes that could be generated in the shops include oil, oily rags, used solvent, paint, aerosol cans, etc.

What do I do with hazardous waste?

1. Identify and Label with a Hazardous Waste Tag.

A Hazardous Waste Tag must be placed on each hazardous waste container upon start of accumulation and must be kept on the container at all times. The EH&S Office can assist the shop in creating hazardous waste tags and using available software to support the proper labeling and pick-up of hazardous waste.

See Figure 10.1 for an example of a completed tag.

Figure 10.1 – Sample Hazardous Waste Tag


Tracking #: 2177757
Accumulation Start Date: 2017-02-02
Must Be Given to EH&S By: 2017-05-03
Contents: Chemical Name | Amount
lead foil | 90 %
sodium chloride | 10 %
1.0 gal | Solid | Bag
Flammable | Corrosive Acid (pH≤ 2) | Reactive | Extremely Hazardous
Toxic | Corrosive Base (pH≥ 12.5) | Oxidizer
2177757
University of California, Los Angeles UCLA - Main Campus
405 Hilgard Avenue Los Angeles, CA 90024
HAZARDOUS WASTE
Generator Account Name:
Your Name:
Phone #: Not Available
Location:
Comments:

2. Follow the container requirements.

- Liquid container requirements:
  - Containers must be free of exterior contamination.
  - Containers must be chemically compatible and the size should be suitable for the material stored.
  - Containers must be in good condition with screw tops or sealed lids.
  - Containers must not be leaking, rusting, or have any other defects.
  - Containers must not be filled to the top (only fill 90% full, leaving 10% air space)

- Dry container requirements:
    - Dry waste must be double bagged in transparent, sturdy bags and cannot have sharp or protruding edges.

3. Store the waste safely in the shop:

- Collect and store hazardous waste in the same or adjacent room where it is generated before it is transported.
- Keep the containers closed and inspect them for signs of leaks, corrosion, or deterioration regularly.
- Report damaged containers to EH&S. EH&S will help with the transfer of contents to an appropriate container.
- Segregate chemical wastes to prevent incompatible mixtures. For example, do not mix acids with bases, acids with cyanide compounds, or oxidizers with organic materials.
- Label storage areas according to the types of chemicals kept there (e.g., “Corrosive”, “Flammable”, etc.).
- Storage of hazardous waste under the sink is prohibited.

Dispose of waste within 90 days from the first point of generation. Coordinate waste pick-up with the EH&S Office prior to reaching the 90 day limit.

What about special wastes?
Contact EH&S if you think you may have a special waste, such as an unknown chemical or a container that is damaged or corroded.

How can I decrease hazardous waste?
Some hazardous chemicals can be substituted with non-hazardous products, like using aqueous parts washers instead of solvent based ones. Other wastes can be decreased by not purchasing large quantities of chemicals when only a small quantity is necessary for a job. If a certain chemical has an expiration date, use the older containers first. If possible, use substances that can be neutralized or stabilized either physically or chemically. Use less hazardous substitutes when feasible.

What do I do with empty chemical containers?
Containers that held chemicals or hazardous waste are only considered empty when material cannot be poured or scraped from them. Most empty containers do not need to be managed as hazardous waste, but there are some exceptions. You will need to dispose of a container as hazardous waste if it contains waste residue or if its capacity is greater than five gallons.

What else do I need to know?

- Don’t dispose of chemicals down the drain or in regular trash receptacles.
- Unknown chemicals may require special analysis. Contact the EH&S Office for further details on proper handling of unknown chemicals.

SECTION 11

Electrical Safety

SECTION 11: ELECTRICAL SAFETY

Overview

Unsafe equipment, unsafe acts, and working with electricity in hazardous environments can lead to electrical accidents and injuries. In this section, you will learn about electrical safety fundamentals and safe work practices to help keep you and your co-workers safe.

Why Worry About Electricity?

Electricity can be deadly. Electrocution is one of the leading causes of workplace fatalities. Thousands of electrical contact injuries occur every year in the United States, many resulting in permanent disabilities.

Surprisingly, most of these accidents involve low voltage (600 volts or less).

What Type of Electrical Equipment is Safe to Use?

You put yourself at risk when you use unsafe equipment. Equipment with faulty insulation, improper grounding, defective parts, and loose connections is dangerous. While extension cords can be used on a temporary basis, they must meet specific criteria to be safe.

All electrical equipment used by shop employees must be Underwriters Laboratory (UL) approved and be properly grounded and bonded. Grounding ensures that electricity is directed correctly, and bonding prevents the build-up of static electricity, which can lead to sparks. All electrical plug points must have a three-pronged plug. Portable power tools must be double insulated or have a three-pronged plug.

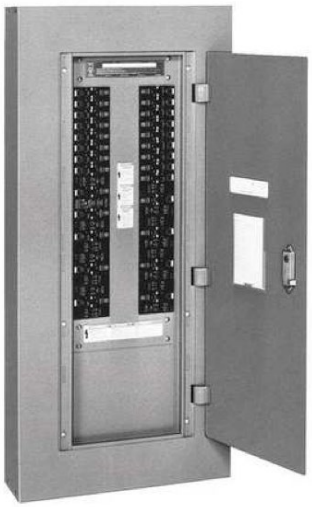
Extension cords are meant for temporary use and not as permanent installations. If you have to use one, select a UL approved #16 gauge heavy-duty extension cord.

Extension cords or long equipment cords can be mounted overhead or secured on the floor with a non-conducting bridge. They must not run along walkways, through walls, or above ceilings. Protect power strips from water or chemical spills and splashes by mounting them above ground level.

Do not daisy chain circuits. Electricity creates resistance in the form of heat. Longer wiring has greater amounts of electricity streaming through it, resulting in more resistance and heat.

Do not overload or use single to multiple outlet adapters. Overloading circuits produces excess heat. If additional electrical outlets are needed to power the equipment in your shop, contact Facilities Management to install them. Any live parts on electrically powered equipment must be guarded. Bare conductors, exposed terminals, and energized metal parts can store up to 55% of line voltage and shock you if you touch them with your bare hands or work tools.

If you use electrically powered machines, a clearly identified power or kill switch must be within arm's reach so you can quickly turn off the machine if there is an emergency. All power sources must be secured, easily accessible, and free from obstruction.



Working Safely Around Electricity

It is important to understand how electricity can potentially harm you and your coworkers. Electrical current will not flow unless it has a complete path or circuit that returns to its source (battery, transformer). Your body can serve as a path in the same way as other conductors like metals, earth, and concrete. When current flows through your body, it can cause harmful electric shock, resulting in burns, muscle damage, and heart damage. Physical injuries, such as broken bones, can result from falls that occur after being shocked.

Insulators resist the flow of electricity. Insulating materials are used to coat copper conducting wires and are used to make electrical work gloves. Insulators help protect you from coming into contact with electricity flowing through conductors.

The best way to avoid shock is to eliminate the electrical current itself. Know the location of electrical panels in your shop. This knowledge is important if an emergency power shut off is required. Label the circuit breakers with the corresponding outlets on the interior of the panel door. Do not use tape to secure any breaker in either an on or off position.

Make sure that electrical panels are visible. Do not mount posters or labels on them. The only exception to this is the use of labels to distinguish between multiple panels in a single location. Keep at least 3 feet buffer of clearance around the panel.

Keep cover plates on all electrical outlets, junction boxes, and switches. Remove or replace frayed or damaged cords and never use electrical wires as supports. There should be no exposed wiring anywhere in your shop. If there is, report it to your supervisor for repair or replacement.

Turn off all electrical equipment when not in use. Never leave electrically powered equipment unsupervised. Turn it off if you have to take a break or perform another task, even for a minute.

Always switch off the power before unplugging a piece of equipment. Be sure to report any electrical failure or excessive heating of equipment to your supervisor as soon as it occurs.

Before conducting maintenance or repair of any electrical equipment, ensure that all energy is released, power sources are disconnected, and lockout/tagout procedures are followed. Refer to Section 7 and the LOTO Program for details.

Are Some Work Environments More Dangerous Than Others?

Certain environmental conditions can increase your exposure to potential hazards when working with electricity. You must take special precautions when working around wet or damp areas. Ground fault circuit interrupters (GFCI) must be used if working around areas that have a potential for water pooling. Electric shock can result from frayed wires or cords.

Special care is also needed when working in potentially hazardous environments. An accidental static discharge can cause a fire or explosion when flammable chemicals or combustible dusts are present.

Who Can Complete Electrical Work?

Facilities electricians must approve all maintenance, repair, and modification of existing electrical systems within campus buildings or structures prior to implementation. Installation, maintenance, and repairs of existing machinery or buildings may only be conducted by **qualified personnel** (e.g., mechanics, electricians, or specially trained individuals). All electrical work must adhere to the standards of the National Electric Code.

Required PPE and Training

Employees who work directly with electricity should use the personal protective equipment required for the jobs they perform. This equipment may include rubber insulating gloves, hoods, sleeves, matting, blankets, line hose, and industrial protective helmets designed to reduce electric shock hazard.

Anyone who operates, services, or maintains electrical equipment must be appropriately trained. All employees should be trained to be thoroughly familiar with the safety procedures for their particular jobs. At a minimum, training must include instruction in power tool safety, lockout/tagout procedures, and personal protective equipment. Training records must be kept for five years.

SECTION 12

Hot Work

SECTION 12: HOT WORK

OVERVIEW

Welding, soldering, brazing, and other activities that require open flames or produce heat are commonly known as "hot work." Hot work presents increased potential for fire and explosion, especially when performed in confined or other enclosed spaces. You must be aware of these hazards to work safely and avoid accidents and injuries. Contact the EH&S Office regarding the Campus Hot Work Program and for further specifics on any of the information below.

WHO CAN DO HOT WORK ON CAMPUS?

All welding, brazing, soldering, and other hot work operators (including third party contractors) must be trained on each piece of equipment they use. You must be trained by your supervisor or other qualified person before conducting any type of hot work. All training must be documented and kept on file.

You must have a designated hot work area or pull a hot work permit before conducting any type of hot work on campus. Contact the EH&S Office to discuss designating a hot work area, or contact your permit authorizing individual to issue a permit. Table 12.1 provides a summary of hot work safety requirements.

Employees performing hot work at off-campus facilities shall obtain necessary training, permits and/or designated area approvals accordingly.

COMMON HAZARDS

Air Contaminants

Hot work produces air contaminants. The most common contaminants include metal fumes and gases. Hazardous fumes may be produced from heating toxic metals found in common alloys. Some examples are beryllium, cadmium and nickel. The particles created are small and can deposit deep in the lungs.

Toxic gases, including ozone, carbon monoxide, and nitrogen oxides, can result from fluxing and degreasing operations.

Be aware of hazardous materials that may be present in solder (e.g., lead). Fluxes may also produce hazardous gases. Always work with the proper ventilation and substitute less hazardous fluxes and solders when possible. The adverse health effects of exposure to welding fumes and gases can range from respiratory tract irritations to systemic poisoning. These effects can be short or long term, depending on the level of exposure. Setting up an appropriate work environment and using the appropriate goggles, face shields, and/or respirators will protect you from contaminants.

Radiation

Both visible ultraviolet (UV) and infrared (IR) radiation are produced when welding and cutting. These types of radiation can cause skin damage (sunburn and cancer) and eye damage (welder's flash, cataracts, and burns). You may not be aware of these injuries until after they occur since UV and IR radiation is not detectable by the senses. Appropriate clothing and filter lenses will protect you from radiation damage.

Burns and Fires

Hot work can be a fire hazard. Burns, fires, or explosions can result from flames, arcs, molten metals, heated

surfaces, or metal splatters. Sparks from welding operations have been known to travel as far as 35 feet horizontally from the welding sight.

Be aware of fire hazards when welding and remember that you can cause fires or be burned when working. Unplug and place soldering irons or guns in holders or stands when not in use. Always assume that a soldering iron or gun is hot. Give equipment time to cool down before touching tongs and tips.

Electrical Shocks

Every year welders die from electric shock. Electric shocks can occur when proper precautions are not taken. Equipment must meet Underwriters Laboratories (UL) code and be checked and serviced regularly. Servicing and installation must only be undertaken by a qualified licensed electrician.

Never tamper with electrical supply circuits or systems. Welders are only responsible for making connections in the welding circuit and for setting external welding machine controls.

Be aware of your work environment. Do not work in wet conditions or on non-insulated surfaces. Use wooden platforms and rubber mats for protection, especially in confined spaces.

Always use fully insulated electrode holders and never touch an energized electrode when in contact with the work circuit. Remember, hot work poses the risk of electrocution. If you sweat profusely, stop working – this will increase the risk of electrocution. Do not touch electrodes or welding wire with your bare hands, and never place holders or welding guns under your armpits.

HOT WORK SAFE PRACTICES

For your protection, make sure all work areas are well-ventilated. Use hoods or local exhaust ventilation (LEV) to minimize exposure to hazardous fumes, gases, and heat.

Consider the safety of other workers around you. Use light filters and welding **screens**, and always have fire extinguishers readily available.

Do not work around sources of ignition. Keep flammable chemicals in approved storage cabinets. Keep combustible material at least 35 feet (11 meters) away from hot work operations. If this is not possible, then make sure these items are properly shielded. Remember that walls, ceilings, and floors are also combustible. Shield these areas as necessary. Seal or guard any cracks and holes where hot sparks might fall.

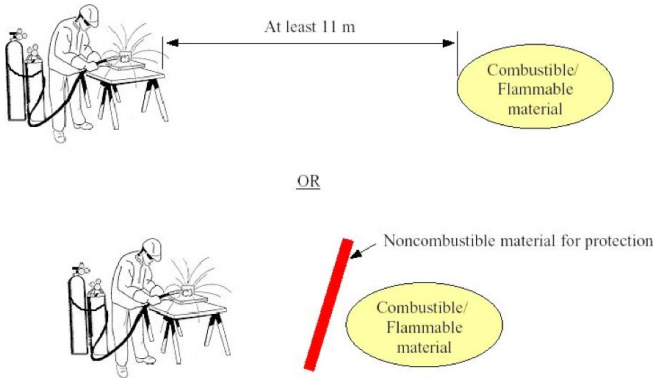


Table 12.1 – Hot Work Fire Safety Precautions

Before the Work– *All* of the following precautions must be taken:

- ☐ All cutting and/or welding equipment inspected and free of damage or defects.
- ☐ A fully charged, multi-purpose, dry chemical portable fire extinguisher in the work area.
- ☐ Accessible fire alarm pull station or means of contacting the fire department (e.g., site telephone) is available.
- ☐ Floor areas under and at least 35 feet around the cutting/welding operation free of combustible and flammable materials OR proper shielding in place.

Where applicable, the following precautions must be taken before the work begins:

- ☐ Fire resistant shields (fire retardant plywood, flameproof tarpaulin etc.), covering combustible floors.
- ☐ Spark/slag catchers (fire retardant plywood, flameproof tarpaulins etc.) suspended below any elevated cutting/welding operation.
- ☐ All floor and wall openings covered to prevent sparks/slag from traveling to other, unprotected areas.
- ☐ Containers in or on which cutting/welding will take place purged of flammable vapors.

During/After the Work – *All* of the following precautions must be taken:

- ☐ Person(s) assigned to a fire watch during and for at least 30 minutes after all cutting/welding ceases.
- ☐ Fire watch person(s) supplied with multi-purpose dry chemical, portable fire extinguisher and trained in its use.
- ☐ A fire alarm pull station or means of contacting the fire department (e.g., site telephone) available and accessible to fire watch person(s).

Always use appropriate guards when welding. Do not put fingers between tongs or linkages when spot-welding. Make sure that guards are always in place, and follow Lockout/Tagout procedures when welding energized or powered equipment.

Gas welding and cutting tasks pose a high level of fire and explosion hazards due to the flammability of the gas cylinders. Always use appropriate pressure and backflow prevention devices when using gas systems. Ignite torches with approved friction devices. Remember to close gas valves before removing regulators.

Protect cylinders from hot metal and sparks by positioning them away from your point of operation. When not in use, store welding and cutting gases away from oxygen cylinders in approved cylinder racks with the valves turned off.

Required PPE

Welding, soldering, or brazing without the proper personal protective (PPE) equipment can be dangerous. Because hot work involves an open electric arc or flame, the risk of burns is significant. To prevent burns, you must wear the proper PPE, such as heavy leather gloves and protective long sleeve jackets.

Additionally, the brightness of the weld area can lead to a condition called arc eye, in which ultraviolet light causes inflammation of the cornea and can burn the retinas of the eyes. Goggles and welding helmets with dark faceplates prevent this exposure.

There are newer helmet models with a faceplate that self-darkens upon exposure to high amounts of UV light. If using a standard faceplate, be sure to use the appropriate shade scale to protect against radiation.

To protect bystanders, translucent welding screens can be placed around the welding area. These curtains, made of a polyvinyl chloride plastic film, shield nearby workers from exposure to the UV light from the electric arc.

Required PPE

1. Thermal fire resistant gloves
2. Fire-resistant long sleeve shirt/jacket or cover based on operation
3. Fire resistant cuff-free long pants
4. Protective goggles or face shield
5. Work shoes or boots
6. Hearing protection where applicable
7. Respirator where applicable

SECTION 13

Ventilation and Certification Considerations

SECTION 13: VENTILATION AND CERTIFICATION CONSIDERATIONS

When performing certain shop-related activities, it is important to keep adequate ventilation and circulation of air. These activities may include, but are not limited to:

- Welding
- Brazing
- Soldering
- Carpentry activities that produce significant dust
- Cutting certain metals
- Using certain hazardous chemicals

Types of Ventilation

Dust Collection
A dust collection system is required when performing carpentry activities that may produce significant amounts of dust. A dust collector is attached to each dust-producing machine, and transports the dust to a central collection system, where the dust is filtered from the air and the air is exhausted from the system. This reduces the likelihood that workers will breathe in small wood particles in the air.

Hand-Held Power Tool Dust Extraction
Certain powered hand tools, including sanders and grinders, can produce large quantities of dust. Many hand-held power tools are now available with dust extraction and capture technologies designed into the tool. These local exhaust collection methods can be very effective in capturing and decreasing the amount of dust in and around the work area. They also have the advantage of being mobile and can be used in the wide variety of areas where hand-held powered tools are commonly needed. If possible, purchase and use hand-held power tools that are engineered and designed with local exhaust capabilities.

Fume Hoods
Fume hoods are one of the most common methods of ventilation. Working with chemicals inside a fume hood can significantly decrease hazardous fumes in the breathing zone of the worker. Their application, however, may be limited due to the fact that they are stationary and space is limited.

Snorkel Arms
Snorkel arms are movable, flexible ventilation tools that can be placed directly over the work where it's happening on the bench. Snorkel arms are the ideal method of ventilation when a traditional fume hood can't be used (due to the size/weight of the work, location of the hood, etc.).

Spray Booths
Spray booths are a form of ventilation used when spray painting, coating, or glazing. Spray booths are available in different sizes for different applications, which range from fume hood-sized booths to large walk-in booths.

Testing and Certification

All fume hoods, snorkel arms and spray booths must be tested annually to ensure that their airflow is adequate. EH&S or Facilities Services perform these tests annually with an anemometer. Once the fume hood, snorkel arm

or spray booth is determined to have adequate airflow, a certification is issued. Where applicable, operate hoods at the designated sash height to ensure maximum protection and ventilation efficiency. If the airflow is not adequate, the fume hood, snorkel arm or spray booth must be taken out of service until repairs can be made.

Gas-Powered Equipment

Gas-powered equipment should not be used indoors at any time due to ventilation concerns and the potential for exposure to carbon monoxide, an odorless and tasteless toxic gas. Contact EH&S if gas-powered equipment must be used in or near indoor areas.

SECTION 14

Compressed Air and Gas Safety

SECTION 14: COMPRESSED AIR AND GAS SAFETY

Compressed Air

Compressed air is air kept under high pressure that is used on its own and to power mechanical devices. This section provides information about the hazards involved with compressed air and the associated safe work practices. It also contains information about pneumatic impact tools and compressed air systems.

What Hazards Are Associated With Compressed Air?

Compressed air is a focused stream of air driven at a high velocity, which can cause serious injury or death to its operator or persons in the immediate area if used improperly.

Compressed air is extremely forceful

Air pressure of 40 pounds per square inch (psi) can dislodge chips and other particles and drive them into your eyes and face with the force of shrapnel. Flying particles can also cause cuts and bruises to other parts of the body. Damage depends on the size, weight, shape, composition, and speed of the particles.

Compressed air itself can be a serious hazard

Compressed air, even at relatively low pressures (as low as five psi) can cause serious injuries to the eyes, ears, or any other body part. Compressed air can even enter the bloodstream through a break in the skin or through a body opening and cause air bubbles in the blood that lead to serious medical problems.

Compressed air is noisy. Hearing damage can result from the sound of compressed air, which can reach 120-130 decibels (dB) - well above Cal OSHA's 90 dB permissible exposure limit.

Safe Work Practices

Can compressed air be used for cleaning?

No - because compressed air is so powerful, it must NEVER be used for cleaning. Using compressed air to clean debris off clothes is hazardous. Injuries can be caused by the stream of air or by flying dust or debris. Use a brush or vacuum cleaner to clean equipment and remove debris.

Training

You must receive the appropriate training for using compressed air during your site orientation in the shop. This training will help you to understand the limits of the equipment you are using and know how to shut it off when necessary. Know the maximum allowable pressure of the compressor, and make sure that all pipes, hoses, and fittings match the pressure rating. Locate air supply shutoff valves as close as possible to the point of operation.

PPE

Wear the appropriate personal protective equipment (PPE) for the task. Safety glasses are always required when using compressed air or pneumatic tools, and face guards or shields and hearing protection are required with some impact tools. Gloves and steel-toed shoes may also be required. Never wear loose clothing while working with compressed air and tie long hair back or secure under a cap.

Inspections

All components of compressed air systems should be visually inspected regularly. This includes the air receivers or tanks, air distribution lines, pressure regulation devices, and air compressors.

Pneumatic Impact Tools

Pneumatic tools include air compressors and a variety of tool attachments. Wrenches, nail guns, and blow guns are common attachments. Although they require some special handing, they can save a great deal of time and effort and are relatively easy to use.

Always visually inspect the tool, air hose, and fittings for damage, wear and tear, or missing parts before using. Make sure air hoses and fittings are securely tightened. If a tool fails the pre-use inspection, notify your supervisor and tag it out of service by attaching a red tag that states “DO NOT OPERATE – EQUIPMENT TAGGED OUT.”

Never point pneumatic impact tools toward a person. Turn off the air supply at the control valve and tool blade before disconnecting a pneumatic tool (unless it has quick disconnect plugs). Be especially careful when using pneumatic tools around fuel, flammable vapors, or explosive atmospheres. They can generate static electricity and must be grounded or bonded when these chemical hazards are present.

Compressed Air System

A compressed air system is comprised of an air receiver, air distribution lines, and a pressure regulatory device.

Air Receivers

Testing air receivers. Only hydrostatically tested and approved tanks may be used as air receivers. The only time the maximum allowable pressure of an air receiver can be exceeded is when testing it.

Be prepared to inspect air tanks and install them so that the entire outside surface can be easily inspected. Do not bury them or place them in hard to reach locations. The intake and exhaust pipes of small tanks must be removable for interior inspections. Tanks over 36 inches in diameter must have manholes. Inspection openings are sufficient for smaller tanks. Tanks with volumes of 5 cubic feet or less can have pipe lug openings.

Air Distribution Lines

Select air lines made of high quality materials with standard fittings and secure connections. Check hoses before use to make sure they are free of defects and properly connected to pipe outlets. Repair or replace defective equipment immediately.

Identify the maximum allowable pressures (psi) by tagging or marking pipeline outlets.

Air hoses are subject to damage and can become hazards. Avoid bending or kinking air hoses. Hose reels can help with this. Keep air hoses free of grease and oil to prevent deterioration. Secure hose ends to prevent whipping if an accidental cut or break occurs. Whenever possible, suspend hoses overhead for more efficient access and protection against damage, and to reduce tripping hazards.

Pressure Regulation Devices

Use ASME approved cast iron seat or disk safety valves that are stamped for the intended service application.

Air Compressor Safety Guidelines

1. Make sure air intake is from a clean outside source.
2. Use filters or screens to maintain clean air intake.
3. Do not operate gasoline or diesel powered compressors indoors.
4. When using equipment outside buildings, position exhausts so they are directed away from doors, windows, and air intakes.
5. Ground all exposed, non-current carrying, metal parts of a compressor.
6. Operate at manufacturer's recommended speeds.
7. Keep equipment from overheating.
8. Use guards on all moving parts, such as compressor flywheels, pulleys, and belts.
9. LO/TO the switches of electrically operated compressors during maintenance to prevent accidental starting.
10. Disconnect portable electric compressors from the power supply before performing maintenance.
11. Use Cal/OSHA compliant air nozzles with pressure-relieving valve.

Valves, gauges, and other regulating devices should be installed such that they cannot be made inoperative. Never set the valve higher than the maximum allowable working pressure of the receiver. The safety valves should be set to blow at pressures slightly above those necessary to pop the receiver safety valves. Settings must be less than 15 psi or 10% above the standard operating pressure of the compressor. Shield blow-off valves to prevent personal injury and equipment damage from sudden blow-offs.

Do not position stop valves on air lines running between the compressor and the receiver.

If the design of a safety or a relief valve allows liquid to collect on the discharge side of the disk, equip the valve with a drain at the lowest point where liquid can collect.

Maintaining Compressed Air Equipment

Keep equipment appropriately lubricated, while avoiding over lubricating. Do not use flammable lubricants on compressors, because they often operate at high temperatures that could cause a fire or explosion.

Frequent cleaning with soapy water (e.g., lye solutions) is recommended to keep carbon deposits off of compressor parts. Do not use kerosene or other flammable substances to clean compressed air equipment. Be sure to purge air systems after each cleaning.

Compressed Gas Cylinders

Compressed gas cylinders are specifically designed to contain gases under pressure and to safely dispense the gas through a control valve. This section provides information about compressed gas cylinders and their associated hazards and safe handling guidelines.

What Kinds of Compressed Gases Are Stored in Cylinders?

There are three major categories of compressed gases stored in cylinders: liquefied, non-liquefied, and dissolved gases.

Liquefied Gases

Liquefied gases can become liquids at normal temperatures when they are inside cylinders under pressure. They exist inside the cylinder in a liquid-vapor balance or equilibrium. When the cylinder is new, it primarily contains liquid gas with vapors filling the space above the liquid. As the gas is removed from the cylinder, liquid evaporates to replace it, keeping the pressure in the cylinder constant. Anhydrous ammonia, chlorine, propane, nitrous oxide, and carbon dioxide are examples of liquefied gases.

Non-Liquefied Gases

Non-liquefied gases are also known as compressed, pressurized, or permanent gases. These gases do not become liquid when they are compressed, unless they are exposed to extremely high temperatures. Common examples of these are oxygen, nitrogen, helium, and argon.

Dissolved Gases

Dissolved gases are dissolved in a volatile solvent in order to stabilize them. Acetylene is the only common dissolved gas used on campus. It is an unstable chemical and can explode at atmospheric pressure. Nevertheless, acetylene is routinely stored and used safely in cylinders at high pressures (up to 250 psi at 21°C), because the cylinders are filled with an inert, porous filler. The filler is saturated with acetone or another suitable solvent. When acetylene gas is added to the cylinder, the gas dissolves in the filler, resulting in a stable solution.

Hazards

Compressed gases present unique hazards. Depending on the particular gas, there is a potential for simultaneous exposure to both mechanical and chemical hazards.

Mechanical hazards

All compressed gas cylinders are hazardous because of the high pressures inside the cylinders. Gas can be released deliberately by opening the cylinder valve, or it can be released accidentally from a broken valve, leaking valve, or from a broken safety device. Even at relatively low pressure, gas can flow rapidly from an open or leaking cylinder. The large amount of potential energy resulting from the compression of the gas makes the cylinder a potential rocket or fragmentation bomb. Exposing the cylinders to extreme temperatures or physically damaging them in any way can pose serious threats to life and property.

Chemical hazards

Gases stored in cylinders range from inert and harmless, to toxic, and explosive. The range includes the following:

- Flammable or combustible
- Explosive
- Corrosive
- Toxic or poisonous
- Inert
- A combination of hazards

Flammable gases, such as acetylene, butane, ethylene, hydrogen, methylamine, and vinyl chloride, can burn or explode under certain conditions. A gas can ignite at temperatures between its lower flammable limit (LFL) and upper flammable limit (UFL), called the flammable range. The flammability range of any gas is widened in the presence of oxidizing gases such as oxygen or chlorine and by higher temperatures or pressures.

An ignition source must be present for a flammable gas to ignite. There are many possible ignition sources in most workplaces, including open flames, sparks (either resulting from work being done in the shop or from static electricity), and hot surfaces.

Flash-back can occur with flammable gases. If a cylinder leaks in a poorly ventilated area, these gases can settle and collect in sewers, pits, trenches, basements or other low areas. The gas trail can spread far from the cylinder. If the gas trail contacts an ignition source, the fire produced can flash back to the cylinder.

Some pure compressed gases are chemically unstable. If exposed to slight temperature or pressure increases, or mechanical shock, they can readily undergo certain types of chemical reactions such as polymerization or decomposition. These reactions may be violent, resulting in fire or explosion.

Some compressed gases are **corrosive**. They can burn and destroy body tissues on contact. Corrosive gases can also corrode metals. Common corrosive gases include ammonia, hydrogen chloride, chlorine, and methylamine.

Many compressed gases are **toxic**. Health problems can result from exposure depending on the specific gas, its concentration, length of exposure, and the route of exposure (that is, inhalation, eye, or skin contact).

Even though inert gases, such as argon, helium, and nitrogen, are not toxic and do not burn or explode, they can cause injury or death if present in high concentrations. Large quantities can displace enough air to reduce oxygen levels. If oxygen levels are low enough, people entering the area can lose consciousness or die from asphyxiation. Low oxygen levels can particularly be a problem in poorly ventilated areas, such as confined spaces.

Who Can Handle Gas Cylinders?

You must be trained before handling compressed gas cylinders. Training must include how to read and interpret the cylinder label and the Safety Data Sheet (SDS) for the gas in the cylinder. You also need to understand the hazards that cylinders present and how to handle, transport, and dispose of cylinders. If you are required to use PPE, you must be provided with it and trained in its use and wear.

Hard copies of SDSs for all compressed gases that you handle must be kept in your Shop Safety Manual/SDS binder for easy access. SDSs can be found online on the manufacturer's website or at https://ehs.ucop.edu/sds/#/.

How Do I Know What is in a Compressed Gas Cylinder?

The contents of all compressed gas cylinders must be clearly identified. The manufacturer or shipper must label or tag each cylinder with the name of its contents.

Do not accept any compressed gas cylinder without an identifying label or tag. If the labeling on a cylinder becomes unclear or a tag is defaced to the point where the contents cannot be identified, mark the cylinder as

"contents unknown" and return directly to the shipper or manufacturer.

What other identifying information is required?
Rooms with compressed gases must have a National Fire Protection Association (NFPA) fire diamond posted at the entry of the room with the hazard classifications and the types of gases stored.

All gas lines leading from a compressed gas supply should be clearly labeled to identify the gas, the shop or area served, and the relevant emergency telephone numbers.

Safe Handling Guidelines

Careful procedures are necessary for handling compressed gases. This includes the cylinders containing the compressed gases, regulators or valves used to control the gas flow, and the piping used to confine the gases during flow.

Users and installers must know the type of gas contained in cylinders before installation and use. The cylinder must be returned to the supplier if its content is not identified, if the hydrostatic test date is past due, or if it is damaged. An inventory must be kept of all gas cylinders used and stored in your shop. The inventory must be kept in the shop's SDS binder.

Never modify, tamper with, paint, deface, obstruct, remove, or repair any part of the cylinder, including the pressure relief device, the container valve, or the valve protection device. This can turn a cylinder into a potential rocket or fragmentation bomb and result in serious injury. Never strike an electric arc on the cylinder. This can cause an explosion and fire.

What PPE is required?
Steel-toed, slip-resistant shoes and gloves are required when transporting cylinders. Eye-protection, face shields, and protective aprons may be required when working with the gas, depending on the gas in the cylinder.

When are regulators and caps required?
Regulators and caps are always required. Never use a cylinder without attaching the correct pressure regulator. After attaching the regulator, check the adjusting screw of the regulator to see that it is released before opening the cylinder. Never permit the gas to enter the regulator suddenly.

Before using a cylinder, slowly "crack" the valve to clear dust or dirt. Do not stand in front of the regulator gauge glass when opening the valve and make sure that the opening is not pointed toward anyone. Additional precautions must be taken with toxic or flammable gas cylinders.

If there is a leak between the cylinder and regulator, always close the valve before attempting to tighten the union nut. Regulators must be removed from the cylinders when not in use and replaced with caps. Never force the regulator or cap when removing or replacing them. In addition, the cap should only be hand tightened.

How do I handle leaking cylinders?
If you discover a leaking cylinder, first evaluate the size of the leak and hazards of the gas. For minor leaks, immediately evacuate the room or area. If it is safe to do so, wear the appropriate PPE to match the hazard, and

move the cylinder to a safe place such as a fume hood. Immediately contact both Environment Health & Safety and the cylinder vendor to inform them of the leaking cylinder.

If you find a major and uncontrollable leak, immediately evacuate the room or area. Call 911 and initiate the emergency response procedures outlined in your emergency response/action plan or chemical release procedures.

Storage

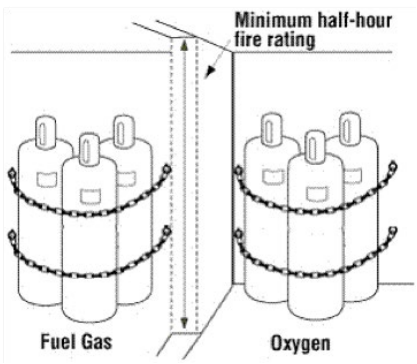
Chaining

Compressed gas cylinders must be double chained to a stable structure, such as a wall. Install one chain one-third from the bottom of the cylinder and a second chain one-third from the top of the cylinder. Do not use straps or bench clamps for securing cylinders. If chains are needed, submit a request to Facilities Management or contact EH&S for guidance on having restraints installed.

A maximum of three cylinders may be clustered together. Secure cylinders of equal sizes together to avoid chaining problems.

Casings

Whenever feasible, use cylindrical "clam shell" casings or frame casings to secure cylinders next to workbenches. Clam shell casings are safer than chains for larger sized cylinders, and frame casings can be used to secure cylinders of various sizes. Both types of casings allow cylinders to be securely bolted to the floor and secured adjacent to the working area, away from walls and without the need for chaining.



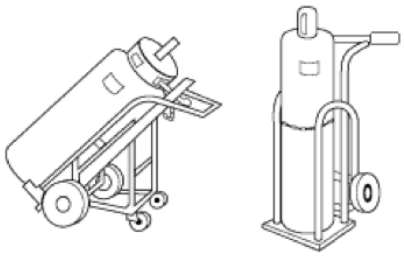
How do I store cylinders that contain different types of gases?

You must store oxygen cylinders at least 20 feet away from fuel-gas cylinders or combustible materials (especially oil or grease). If this is not possible, you can separate them by a noncombustible barrier that is at least five feet high with a fire resistance rating of least one-half hour. The barrier must be at least 18 inches above the tallest cylinder. Some shops have affixed five-foot sheet metal partitions between cylinders to meet regulations.

Additional Storage Requirements

As a general rule, never store cylinders on transportation carts. The only exception to this rule involves the use of welding cylinders (oxygen and fuel cylinders). When used for portable service or for intermittent use, welding cylinders may remain on carts.

Always store cylinders in upright positions on their base unless they are designed for use in a horizontal position. If used horizontally, they must be secured horizontally.



Cylinder Trolleys

Transporting Cylinders

Unless cylinders are secured on a special cart, remove the regulators, close the valves, and replace with the protective valve caps before moving them. Do not lift the cylinder by the protective valve caps. Transport cylinders weighing more than 40 pounds on a cart and secure them with a chain.

Always handle cylinders with care. Cylinders must never be dragged, pushed, or pulled across the floor. Never drop a cylinder, or permit cylinders to strike each other violently when moving. Load cylinders to allow as little movement as possible and secure them to prevent violent contact or upsetting.

Disposal

When cylinders are empty or no longer needed, you must dispose of them. Empty cylinders must be marked "Empty" and stored apart from other cylinders. Whenever possible, return empty cylinders to the supplier. If the supplier is unknown, dispose of the cylinder as hazardous chemical waste through EH&S.

Never discard pressurized cylinders in the trash.

SECTION 15

Ladders

SECTION 15: LADDERS

Overview

Ladders are one of the most commonly used pieces of equipment in industry. They are easy to carry, versatile and can be used in a variety of jobs. While they can make many tasks easier, they can also be a safety hazard. You can take steps to protect yourself and others from ladder-related injuries. This section provides you with information about selecting the appropriate ladder for a job and how to use it safely. It also contains information about inspecting, maintaining, and storing ladders.

What Type Of Training Do I Need Before Using A Ladder?

You must receive ladder safety training before using ladders, and refresher training as necessary. Training must be provided by your supervisor or someone with specialized knowledge in ladder safety.

Training must cover the proper selection, use, placement, and care of portable stepladders and extension ladders. This must include the maximum load capacities of ladders and information about fall hazards in your work area.

Selecting The Right Ladder For The Job

There are two basic types of portable ladders: self-supporting stepladders, and non-self-supporting straight and extension ladders. Either type can be made of metal, wood, or fiberglass. All ladders have weight limits which must be considered by the user. You must consider both the type and weight limitation of a ladder when making a selection.

Portable Ladder Duty Ratings

Type IAA – Special duty, up to 375 pounds
Type IA – Extra heavy duty, up to 300 pounds
Type I – Heavy duty, up to 250 pounds

Manufacturers give ladders duty ratings based on the maximum weight they can safely support. The ladder rating must be affixed to the side of the ladder. Only Type IAA, Type IA, and Type I heavy duty ladders can be used for commercial purposes or on a construction job site.

The duty rating must exceed your weight plus the weight of any tools and materials you carry with you. Ladders must not be subjected to loads greater than their duty rating.

There are specific applications for wooden, aluminum, and fiberglass ladders. Table 15.1 provides a summary of the advantages and disadvantages of each type of ladder. Keep these in mind when selecting one to use.

Table 15.1 – Ladder Selection Guide

Type of Ladder	Pros	Cons
Wood	• Good insulation against heat and cold	• Require protective coating of varnish to keep wood from drying and splitting • Heavy

Type of Ladder	Pros	Cons
Aluminum	• Lightweight • Corrosion-resistant • Will not crack or chip with rough handling	• Does not insulate well against heat • Conducts electricity (never use aluminum ladders near energized electrical lines)
Fiberglass	• Durable and weather resistant • Nonconductive when clean and dry • Will not dry out or split • Provides better insulation against heat than aluminum	• Heavier than comparable aluminum or wood • Can chip or crack with improper handling

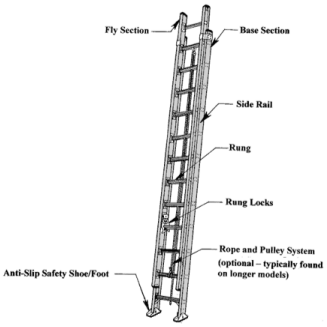
What are the differences between stepladders and extension ladders?
The standard stepladder has flat steps and a hinged back. They must have metal spreaders or locking arms.

Stepladders are self-supporting, nonadjustable, and intended for use by only one worker at a time. They cannot be longer than 20 feet as measured along the front edge of the side rails. If you need a longer ladder, select an extension ladder.

Only use stepladders on surfaces that have a firm, level footing such as floors, platforms, and slabs. Never stand on the top step or top cap when using a stepladder.

Extension ladders offer the greatest length in a general-purpose ladder. They are considered non-self-supporting because they must be leaned against a stable surface such as a wall for support.

Extension ladders consist of two or more sections that travel in guides or brackets, allowing adjustable lengths. The sliding upper section must be on top of the lower section. Each section must overlap its adjacent section a minimum distance, based on the ladder's overall length. The overall length is determined by the lengths of the individual sections, measured along the side rails.



Determining The Correct Length

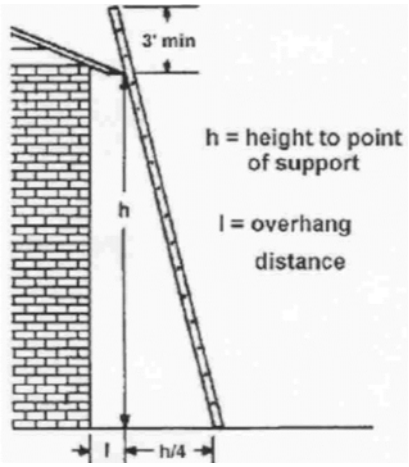
Stepladders

When working on a stepladder, you should be able to reach about four feet above the top of the ladder while standing two steps down from the top. For example, most workers should be able to reach an eight-foot ceiling on a four-foot ladder. Never use the top cap of a stepladder as a step.

Extension ladders

Select a ladder that is seven-10 feet longer than the vertical distance to the upper contact point on the support structure (e.g., a wall or roofline). The ladder must extend at least three feet (minimum of three rungs) above the roof. Never stand on the ladder rungs that extend above a roofline.

Erect the ladder so that the bottom section “faces” a wall or other supporting surface. Place the ladder feet so that the horizontal distance between the feet and the top support is one-quarter of the working length of the ladder.



How do I set up an extension ladder?
You must use proper methods to set up an extension ladder. Unless done correctly, the ladder can be damaged, and you can be injured.

Begin by laying the ladder on the ground with the base resting against the bottom of the wall and the top pointing away from the wall.

Next, starting at the top of the ladder, lift the end over your head and walk under the ladder to the wall, moving your hands from rung to rung as you go.

When the ladder is vertical, and the top touches the wall, pull out the base so that the distance away from the wall is about one-fourth of the height to the point of support.

Reverse this process to take down the ladder. Remember that you will be walking backwards, so check for obstacles in your path before starting. Lower the ladder slowly to keep it under control and keep it from falling.

Ladder Safety Procedures

Always place ladders on stable bases. Never use boxes, barrels, or other unstable surfaces to obtain additional height. When necessary, ask a co-worker to hold the base of the ladder to help stabilize it. If no one is available, securely fasten the ladder at the top and bottom to prevent it from slipping.

Falls frequently result from slipping on the rungs of ladders. Metal rungs can be especially slippery in certain conditions. To minimize slipping, rungs of metal ladders must be corrugated, knurled, dimpled, or coated with skid-resistant material.

No matter what type of ladder you use, always wear shoes with slip-resistant soles that are free of mud or grease to avoid slips and falls.

Never stand higher than the third highest rung from the top when using an extension ladder. When using a step ladder, do not stand on the top step or top cap of the ladder. Climbing above these levels makes the ladder unsteady and leaves climbers without a handhold.

Inspecting, Maintaining, And Storing Ladders

Ladders must be regularly inspected by a supervisor or designee for visible defects on a regular basis. They must also be inspected after any incident that could affect their safe use. Use the Ladder Inspection Checklist located in (Appendix I) for inspections. Copies of ladder inspections must be filed in this manual or electronically and kept for five years.

Portable ladders with structural defects, such as corroded, broken faulty or missing rungs, cleats, steps, or rails must immediately be marked defective and tagged out with a “Do Not Use” tag. Any tagged ladders must be removed from service until repaired.

Ladder Care and Storage

1. Maintain ladders in good condition.
2. Keep all ladder accessories, especially feet, in good condition.
3. Lubricate metal bearings and pulleys of extension ladders on a regular basis. Check before use to see if additional lubrication is necessary.
4. Check ropes on extension ladders on a regular basis as well as before use. Replace worn or frayed ropes.
5. Wooden ladders to be used outside should be treated to prevent weather damage. A clear finish or transparent penetrating preservative should be used.
6. Never paint a wooden ladder. This will cover dangerous cracks or fill and hide them.
7. Never sit on ladder side rails.
8. Never use a metal or fiberglass ladder which has been exposed to fire or strong chemicals; it should be discarded.
9. Be sure that ladders are properly supported and secured when in transit. Vibration and bumping against other objects can damage them.
10. Never store materials on a ladder.
11. Store wooden ladders where they will not be exposed to excessive heat or dampness. Store fiberglass ladders where they will not be exposed to sunlight or other ultraviolet light sources.
12. Store ladders on flat racks or wall brackets, which give them proper support when not in use. Secure ladders to keep them from tipping.
13. Whenever possible, hang extension ladders horizontally.
14. Store stepladders vertically, in a closed position, to reduce the risk of sagging or twisting.

Immediately destroy any ladder that cannot be repaired.

Anyone who uses a ladder can complete minor maintenance such as lubricating hinges and tightening hardware. More extensive ladder repair must be completed by a qualified person or the manufacturer.

Refer to the Ladder Safety Manual for more information.

SECTION 16

Hearing Protection

SECTION 16: HEARING PROTECTION

Overview

Hearing loss can result from exposure to loud noises over a long period of time and is not typically the result of one single event. Since we don't notice gradual hearing loss, we are often not aware it is occurring. This is why exposure to harmful noise in a shop environment is often overlooked.

Workplace hearing loss can be prevented. You must understand how much exposure to hazardous noise it takes to cause temporary or permanent hearing loss so you can take the right precautions and adjust noise levels appropriately. By recognizing when noise hazards are present, you and your supervisor can implement methods to protect your hearing.

What Is The Difference Between Sound And Noise?

Sounds are vibrations transmitted through the air that are detectable by the human ear. Every day we experience sound in our environment, such as the sounds from television and radio, household appliances, traffic, leisure activities, tools and equipment.

Noise is a loud, disagreeable, or unwanted sound. When we are exposed to harmful noise – sounds that are too loud or loud sounds that last too long – sensitive structures in our inner ear can be damaged, causing noise-induced hearing loss (NIHL). NIHL is preventable.

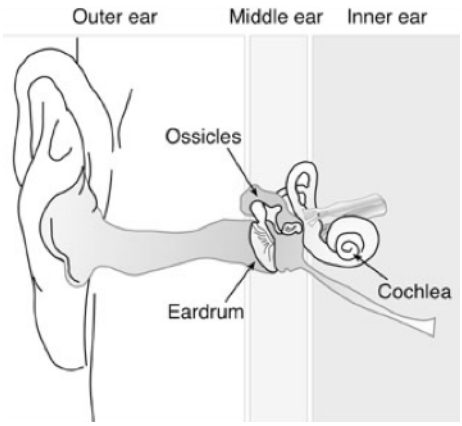


Figure 16.1 - Structure of Ear

How Do We Hear?

The outer ear collects sound waves in the air, and channels them via the ear canal to the eardrum causing it to vibrate. Three tiny bones called ossicles in the middle ear vibrate in response to the ear drum. These vibrations are sent to the cochlea, a snail-shaped structure in the inner ear filled with fluid. Hair cells in the cochlea bend with the vibrations transforming them into electrical impulses sent by the auditory nerve to the brain, which interprets them as sound. Healthy hair cells are the key to good hearing. They are fragile, and can be lost when ears are not protected from harmful noise. They can also be lost or damaged by head injuries, infection, and strong medication. Some naturally die off with age.

How is Sound Measured?

The intensity or loudness of sound is measured in decibels (dB) and weighted by frequencies, where the range that a human ear can hear is measured in dB(A). Since the range of intensities that the human ear can detect is so large, the scale used to measure sound intensity is based on multiples of 10. For example, the sound of normal conversation is measured at 60dBA. A rise of 10dBA from 60dB to 70dBA produces a sound that is 10 times stronger than the original sound. An example of a 70dBA sound is busy street traffic. An increase of another 10dBA produces a sound that measures 80dBA, but is 100 times stronger than the original 60dBA sound. A vacuum cleaner produces an 80dBA sound. See Figure 16.2 for examples of activities and their corresponding sound intensities.

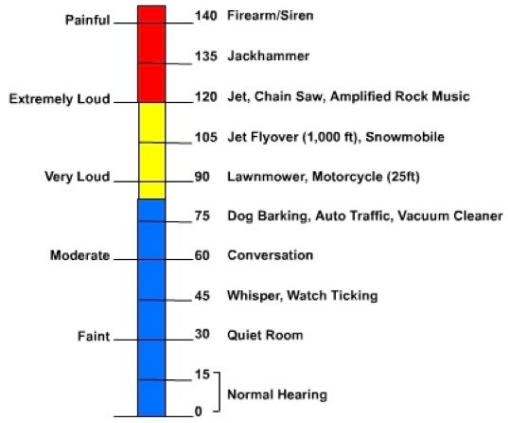


Figure 16.2 - Sound Intensity

Sounds in the workplace vary by intensity. Low intensity sounds are harmless, but excessive exposure to noise above 85dB is dangerous. If the level of noise is high enough, or if you are exposed to loud sounds over a long period of time, you can damage your hearing.

The amount of noise it takes to cause hearing loss depends not only on the intensity of the noise, but also on the length of time that you are exposed to it. Other factors such as sound frequency and your health also affect how much damage noise can inflict on your ears.

Hearing Loss

Effects of Hearing Loss

When you have hearing loss, sounds have to be louder in order for you to hear them. You may also have trouble hearing higher frequencies. Over time, sounds may become distorted or muffled, and it may be difficult to understand human speech.

Different Types of Hearing Loss

If you have work-related hearing loss, it usually results from exposure to noise. This type of hearing loss may be temporary or permanent. However, hearing loss also occurs as part of the aging process.

Temporary Hearing Loss

Exposure to harmful noise may cause only a temporary hearing loss. This type of hearing loss is often accompanied by a ringing, buzzing or humming in the ears or head known as tinnitus. If a person regains hearing, the temporary hearing loss is called a temporary threshold shift. This shift usually disappears 16 to 48 hours after exposure to loud noise.

Permanent Hearing Loss

Unfortunately, exposure to harmful noise may cause permanent hearing loss. The hearing loss may be gradual from noise exposure over an extended period of time, or immediate after a single exposure (painful acoustic trauma). If a person does not regain normal hearing, it is referred to as a permanent threshold shift. Tinnitus often accompanies permanent hearing loss.

Hearing Loss Due to Aging

As we age, the hair cells inside the inner ear begin to die off naturally resulting in a type of hearing loss called presbycusis. Age related hearing loss usually involves high frequency sounds, like a watch ticking or certain consonant sounds in normal speech.

Age-related hearing loss tends to run in families. Repeated exposure to loud noises, smoking, and certain medical conditions and medications also contribute to age-related hearing loss. About half of all people over age 75 have some amount of age-related hearing loss.

How do I determine if my shop is too noisy or if I have hearing loss?

A Hearing Conservation Program includes sampling of the workplace and all employees exposed to hazardous

noise. Noise sampling determines which areas of the workplace have hazardous levels of noise. Hearing tests are given to employees to determine if noise exposure is causing hearing loss.

Noise sampling is done with a sound level meter or with a clip-on dosimeter that indicates how much noise an individual employee is exposed to. Sometimes, noise exposure can be reduced by engineering or administrative controls. If it cannot be reduced, personal protective equipment (PPE), such as hearing protectors may be required.

Hearing tests measure how loud a sound has to be before you begin to hear it. An audiometer sends a series of tones through a set of headphones to each of your ears. You indicate when you hear each tone. Your test results are documented on an audiogram which plots hearing levels in decibels against sound frequency (pitch) in hertz. (Try to avoid high levels of noise for 14 hours before the test. If that's not possible, wear hearing protection.)

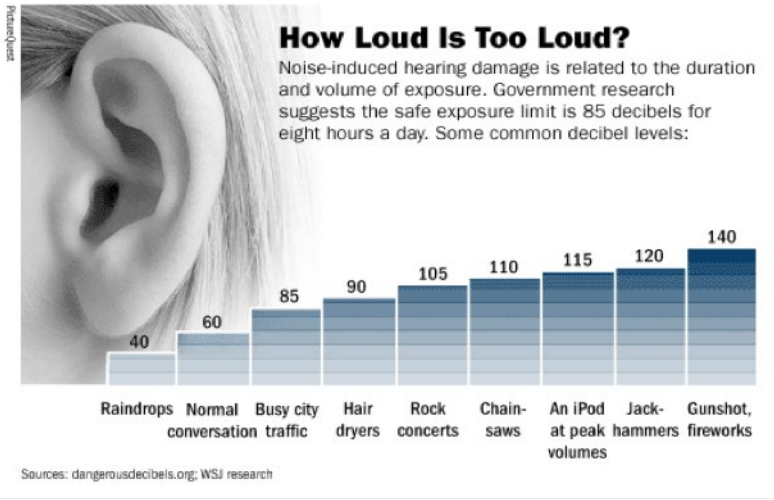


Figure 16.3 - Common Sound Levels

Your baseline test shows your normal hearing level and how much hearing loss you may have. It is also a reference for future tests.

Your annual test results are ongoing checks of your hearing. They are the best way to make sure that your hearing protection program is working.

Retesting and referral to a specialist may be necessary if your annual test shows a significant change in your hearing. A professional medical evaluation determines if your hearing loss is potentially serious and if further action is needed.

Hearing Protection

When you must work in an area exceeding Cal/OSHA permissible noise exposure limits, administrative or engineering controls must be implemented to reduce your exposure. If these interventions do not reduce sound levels below required levels, you must use PPE.

Engineering controls reduce or remove the noise hazard itself. They include changes to equipment or to the work environment. Loud machinery or tools can be modified to reduce the sound levels they produce. Sound barriers or enclosures can reduce noise pollution caused by machinery or tools that cannot be modified.

Administrative controls are used to remove the worker from the hazard. Job rotation can help reduce the time you are exposed to harmful noise. By arranging your work schedule so that you split the operation of loud machinery or tools with coworkers, you can protect your hearing.

The last defense in a hearing protection program is the use of PPE. You must be provided with a selection of suitable hearing protection at no cost whenever necessary.

You must select the appropriate hearing protector and it must fit in order to work properly.

Hearing protection's ability to reduce noise is measured as its Noise Reduction Rating (NRR). Greater NRRs provide better noise attenuation. The NRR is usually listed on the hearing protector's box. EH&S can help determine appropriate types of hearing protectors for specific situations, and can provide training on the proper use of hearing protectors.

How much will noise be reduced by hearing protection?
Use the following formula to estimate the attenuation afforded to a noise-exposed employee when selecting ear protectors:

1. Identify the Noise Reduction Rating (NRR) of the hearing protection device listed on the packaging.
2. Subtract 7 dB from the NRR. (7dB is the standard correction factor.) Then subtract the resulting value from the estimated workplace noise level (i.e., TWA) as follows:

   Estimated Exposure = TWA - (NRR - 7)
   Example:
   TWA=90 dB, muff NRR=19 dB
   Estimated Exposure = 90 - (19-7) = 78 dB

The noise reduction rating of 19 means the protector will reduce the noise level by 12 decibels (i.e., the difference between 19 and 12) – often a crucial difference for your ears. This brings the estimated noise exposure down to 78 dB in this example.

Information on hearing protection is presented in Table 16.1.

Table 16.1 – Common Types of Hearing Protection

Type	Description	Fit	Care
 Disposable ear plugs	Disposable foam plugs that expand after placed inside ear canal to block noise. Single size.	Roll and compress the plug lengthwise between your fingertips. Reach one hand around the back of your head and pull up on the outer ear to straighten the ear canal. Insert until you feel it plugging, then hold it in place for a moment until it begins to expand.	Use clean hands to insert. Inspect before re-insertion. If damaged or dirty, replace them. Periodically, check to be sure the fit is still snug.

Type	Description	Fit	Care
 Reusable plugs	Usually made of flexible rubber or silicon and are pre-formed to fit the ear. May be flanged or cone-shaped, and joined by a cord to reduce loss.	Reach one hand around the back of your head and pull up on the outer ear to straighten the ear canal. Insert the plug until you feel it sealing and the fit is comfortable. Select plugs that are the right size for your ears.	Can be worn safely for one to six months depending on the type. Replace when hard, torn, or deformed. Inspect and clean them often with warm soapy water. Rinse well. Store them in the case supplied by the manufacturer.
 Ear Muffs	Resemble stereo headphones with soft plastic cushions, filled with foam or liquid. If exposed to very loud noise, wear earmuffs and plugs together.	Check to see that the cushions are flexible and fit tightly around your ears so no sound can penetrate. Keep your hair from underneath the cushions. Don't defeat their purpose by wearing radio earphones under them.	Wipe the cushions clean with a damp rag when soiled. Check the cushions often, and replace them if they're stiff, worn, cut, or torn. Don't modify your muffs in any way.

Appendices

APPENDIX A: EARTHQUAKE PREPAREDNESS

Why should I prepare?

Earthquakes represent the greatest natural disaster threat to people living in Southern California. Every California resident should have a disaster preparedness plan and know what to do before, during and after an earthquake.

How do I prepare for an earthquake?

People need to be prepared at home, in the office and while commuting:

- Keep personal disaster supply kits where you spend most of your time, so they can be reached even If your building is badly damaged. The kits will be useful for many emergencies, and should include items such as water and snacks; emergency contact phone numbers, a prescription list, sturdy shoes, etc. (See the websites below for more extensive guidance.)
- Create a disaster preparedness plan for your home and review the plan for your work environment.
- Identify potential hazards in your home and begin to fix them.

Be Prepared with a Disaster Supply Kit

1. Prepare your kit based in how it will be used (personal/family survival, food and water, search & rescue, etc.)

2. Check kits at least annually. Kits stored in a car trunk degrade quickly under extreme heat conditions.

3. Use a backpack or small bag so you can take them with you if you evacuate.

Don't forget a kit for home, work and your vehicle!

What should I do in an earthquake?

Wherever you are, protect yourself! If you cannot find shelter beneath furniture, then crouch low against a wall, with your arms covering your head and neck.

1. Immediately **DROP** to the ground where you are
2. Take **COVER** by getting under a sturdy desk or table
3. **HOLD ON** to something sturdy and ride out the earthquake until the shaking stops

What do I need to remember?

- **Don't run.** You can trip or fall, or there could be broken glass. You can injure yourself or others by running.
- **Remain Indoors.** NEVER try to exit a building; you could be killed by falling debris.
- **If you are driving, slow down and pull to the side of the road until the shaking stops.** Don't park under trees, overhead power lines, or freeway overpasses.

What websites can help me prepare?

To improve your readiness and assemble a preparedness kit	[WEBSITE]
Discover Drop, Cover, and Hold On!	[WEBSITE]
Learn about [CAMPUS] Emergency Management Programs	[WEBSITE]
Review [CAMPUS] Employee Safety Handbook	[WEBSITE]
Review the [CAMPUS] Shop Safety Manual	[WEBSITE]

APPENDIX B: EMERGENCY NUMBERS

The following list contains important emergency telephone numbers and related information.

Type of Emergency	Who to Call	Phone Number
General (includes fire, police, emergency medical treatment, and off-hour chemical spills)	**UCPD Dispatch**	**911** from an on-campus phone or cell phone within campus boundaries or **[PHONE NUMBER]** from a cell phone outside of campus boundaries
Emergency Repairs and Maintenance	**Facilities Management 24-hour Trouble Call**	**[PHONE NUMBER]**
Report Serious Injury, Biological Exposure, Chemical or Radiological Spill	**EH&S Hotline**	**[PHONE NUMBER]**
Other Numbers		
[PHONE NUMBER]		**800-222-1222**
Occupational Health Facility (OHF)		**[PHONE NUMBER]**
EH&S Office of Emergency Management		**[PHONE NUMBER]**
Insurance and Risk Management		**[PHONE NUMBER]**

APPENDIX C: REPORTING WORKPLACE INJURIES

Why do I need to report my workplace injuries?

Employees injured on the job are covered by workers' compensation insurance. Workplace injuries must be reported to Insurance & Risk Management (IRM) to initiate a claim. In addition, serious injuries must be reported to EH&S as soon as they occur to ensure reporting to Cal/OSHA within eight hours of occurrence (CCR Title 8, Section 342).

How to Report an Injury

1. Notify your supervisor and/or personnel department immediately after the injury occurs.
2. Complete the Incident Report and Referral for Medical Treatment Form and take it with you to the treatment facility.
   During business hours, go to the Occupational Health Facility
   After business hours or on weekends, go to the Emergency Room.
3. Your supervisor and/or personnel department must report the injury and submit proper forms **to IRM within 24 hours.**

How to Report a Serious Injury

UC defines a serious injury as death, amputation, concussion, crushing, fracture, laceration with significant bleeding and requiring significant stitches, severe burn, and/or injuries requiring overnight hospitalization.

1. Immediately get first aid and/or call 911.
2. Report the injury to your supervisor and/or personnel department.
3. Your supervisor and/or personnel department must contact and inform EH&S of the injury details.
4. Your supervisor and/or personnel department must report the injury to IRM within 24 hours (see procedures above).

*Field employees must follow the above injury reporting procedures. Seek treatment at the medical treatment facility assigned to your work location.

Should I call the serious injury hotline?

NO	YES
I sprained my ankle and will need a brace.	I fractured my knee and will need surgery.
I cut my arm on a file cabinet.	I cut my arm on a table saw.
I closed my finger in my desk drawer.	I crushed my finger in the gears of a drill press.
I burned my mouth while eating lunch.	I burned myself with acid in the lab.

APPENDIX D: CHEMICAL INVENTORY FORM

Common Name	**Physical State** [Solid, Liquid, or Gas]	**Average Daily Storage Units**	**Units** [Gallons, Cubic feet, Pounds, tons, kg, mg, L, mL]	**Container** (steel drum, can, carboy, fiber drum, cylinder glass bottle, plastic bottle, tote, other)

Department: _____

Prepared by: _____ Date: _____

APPENDIX E: FLOOR INSPECTION CHECKLIST

Inspected by/Department: _____ **Date:** _____

	Yes	No	Comments
Floor and Walkway Condition			**If NO, describe what will be done to correct the hazard.**
Are walkways free from slippery conditions that pose potential slip/fall hazards?			
Is proper signage indicating wet and/or slippery floors available where needed (i.e. immediately following mopping/clean up procedures)?			
Are drain covers present where needed?			
Are transitions between uneven floor surfaces that may cause a trip/fall hazard clearly marked?			
Are floors free from cracks, holes or missing tile?			
Are existing handrails in good condition?			
Floor Mats			
Are entrance mats present?			
Do mats have adequate grip to the floor surface?			
Are mats in good condition?			
Are mats missing where needed? (i.e. by sinks, walk-in freezers, etc.)			
Housekeeping			
Are aisles and walkways kept clear from boxes/clutter?			
Are electrical cords kept clear from walkways?			
Any spills or debris observed in walkways?			
Are cleaning equipment properly stored?			
Are there protruding objects posing trip/fall hazards?			
Material Handling/Employee Behavior			
Are employees following safe mopping/cleaning procedures?			
Do employees verbally warn pedestrians to be cautious of wet floors?			
Are employees carrying large loads while walking and limiting view of walkway?			
Do employees ask for assistance when carrying large or awkward loads?			
Training			
Are employees informed on the proper clean-up procedures to follow when there is a spill?			
When necessary, do employees know to contact Environment, Health & Safety for slip meter assessments?			
Are employees trained on the proper utilization of equipment?			
Are routine trainings conducted addressing potential safety hazards (i.e. back safety, slip/fall, etc.)?			
Tally Responses:			**Total "No" Responses** (indicates number of corrective items needed)

APPENDIX F: FORKLIFT PRE-SHIFT INSPECTION CHECKLIST

SAFETY AND OPERATIONAL CHECKS (PRIOR TO EACH SHIFT)
Have a qualified mechanic correct all problems

Motor Off Checks	OK	Needs Maintenance
Leaks – Hydraulic Oil, Battery		
Tires – Condition and Pressure		
Forks, Top Clip Retaining Pin and Heel – Condition		
Hydraulic Hoses, Mast Chains, Cables & Stops – Check Visually		
Overhead Guard – Attached		
Battery – Water/Electrolyte Level and Charge		
Hydraulic Fluid Level – Dipstick		
Transmission Fluid Level – Dipstick		
Operator's Manual in Container		
Capacity Plate Attached – Information Matches Model, Serial Number and Attachments		
Battery Restraint System – Adjust and Fasten		
Sitdown Truck - Seat Belt – Functioning Smoothly		
Brake Fluid – Check level		

Motor On Checks (Unusual Noises Must Be Investigated Immediately)	OK	Needs Maintenance
Accelerator Linkage – Functioning Smoothly		
Parking Brake – Functioning Smoothly		
Service Brake – Functioning Smoothly		
Steering Operation – Functioning Smoothly		
Drive Control – Forward/Reverse – Functioning Smoothly		
Tilt Control – Forward and Back – Functioning Smoothly		
Hoist and Lowering Control – Functioning Smoothly		
Attachment Control – Operation		
Horn – Functioning		
Lights & Alarms (where present) – Functioning		
Hour Meter – Functioning		
Battery Discharge Indicator – Functioning		
Instrument Monitors – Functioning		
Other		

APPENDIX G: INSPECTION CHECKLIST

EH&S Inspector:	**Time:**	**Date:**
Department/Location:		
Shop Manager:		
Phone:		
Personal Office:		

1.0 Policies & General Safety				
Question	**Yes**	**No**	**N/A**	**Evaluation Notes**
1.1 Does the department have a Shop Safety Manual?				
1.2 Is the department conducting semi-annual Inspections?				
1.3 Is there an "Authorized User" list?				
1.4 Is there a list of machine/tool trainings with signatures?				
1.5 Are First Aid Kits available and stocked?				
1.6 Area is neat, clean, and free from debris (i.e. no accumulation of dirt, dust, other materials)?				
1.7 Adequate (visible) signage and/or warning devices to keep employees aware of area hazards?				
1.8 Work area is clear of slip, trip, or fall hazards?				
1.9 Working surfaces are dry, otherwise slip resistant? In areas that stay wet, greasy, or slippery, floor mats or other anti-slip materials are used?				
1.10 Illumination/lighting is adequate for the task to be performed?				
1.11 Stairways are in good condition with handrails in place and treads in good condition?				
1.12 Plumbing systems are working properly and there are no leaks?				

1.0 Policies & General Safety				
Question	**Yes**	**No**	**N/A**	**Evaluation Notes**
1.13 Eating, drinking, & smoking are prohibited in areas where chemicals are present?				
1.14 Is a student safety orientation done where students are present?				
1.15 Are students supervised while working?				
1.16 Does the shop have a copy of or know how to access the departmental IIPP?				
1.17 Does the shop have a copy of the Hazard Communication Program?				
1.18 Does the shop have a LOTO Program?				
1.19 If applicable, does the shop have a copy of the Heat Illness Prevention Plan?				

2.0 Aisles & Walkways				
Question	**Yes**	**No**	**N/A**	**Evaluation Notes**
2.1 Aisles and walkways are clearly marked?				
2.2 Aisles and walkways are maintained free of debris and open for use?				
2.3 Cabinets five ft. or greater secured?				
2.4 Emergency egress routes are clearly marked and illuminated?				

3.0 Electrical Safety				
Question	**Yes**	**No**	**N/A**	**Evaluation Notes**
3.1 Power strips/surge protectors are used properly: one per single duplex electrical outlet, surge protectors/power strips are not being "daisy chained"?				
3.2 Extension cords are properly grounded, free of damage, used properly, and placed in a manner to prevent tripping? Temporary wiring is not used for permanent installations. Extension cords are used only for temporary supply of power?				
3.3 There are no frayed cords, wires, torn or frayed insulation, loose or broken conduit, and/or exposed wires?				

3.0 Electrical Safety				
Question	**Yes**	**No**	**N/A**	**Evaluation Notes**
3.4 Ground Fault Circuit Interrupters (GFCI) are used around water?				
3.5 Junction boxes, outlets, switches, fittings, etc. are covered and in good condition?				
3.6 Breaker boxes and electrical panels are properly labeled, doors close properly, and 36" clearance in front of all electrical panels?				

4.0 Fire Safety & Emergency Preparedness				
Question	**Yes**	**No**	**N/A**	**Evaluation Notes**
4.1 Are exits marked, illuminated, and free from obstructions?				
4.2 Are fire extinguishers present, accessible, within annual service date, and fully charged?				
4.3 Fire doors appear in good condition and not propped open?				
4.4 Sprinkler valves and FDCs are visibly unobstructed with 36" clearance?				
4.5 Are all stairwells clear of any obstructions/combustibles?				
4.6 Emergency lights operational?				
4.7 Are phones available?				
4.8 Are emergency phone numbers & EH&S numbers posted?				

5.0 Installed Fire Suppression Systems				
Question	**Yes**	**No**	**N/A**	**Evaluation Notes**
5.1 Nothing is hanging or supported by the sprinkler piping or heads?				
5.2 Pull Stations identified and accessible?				
5.3 A minimum of 18" threshold maintained below sprinkler heads?				

6.0 Chemical Hygiene				
Question	**Yes**	**No**	**N/A**	**Evaluation Notes**
6.1 SDSs for the chemicals used or stored in the work area are readily available and kept in an SDS binder or digital equivalent?				
6.2 Is a chemical inventory present and inclusive of all shop chemicals?				
6.3 Adequate storage is provided for the chemicals utilized in the work area?				
6.4 Are flammable liquids stored in closed containers when not in use?				
6.5 Flammable liquids are stored in designated flammable storage cabinets?				
6.6 Combustibles are not being stored in the flammable cabinets?				
6.7 Are all chemical containers labeled with the name of the material and immediate hazard warning?				
6.8 Eyewash stations tested monthly and kept clear of obstructions?				
6.9 Are spill kits available?				
6.10 Compressed gas cylinders are adequately secured (double chained, wall bracket or clamp)?				
6.11 Compressed gases are stored with the protective cap in place?				
6.12 Incompatible gases are stored in separate locations or have appropriate engineering controls?				
6.13 Is hazardous waste being stored in proper containers and in a designated area?				
6.14 Is hazardous waste being disposed of properly?				

7.0 PPE				
Question	**Yes**	**No**	**N/A**	**Evaluation Notes**
7.1 The Hazard Assessment Tool for Shops (HATS) has been completed within the last 12 months?				
7.2 The appropriate type and size of PPE is available for each job task?				

7.0 PPE				
Question	**Yes**	**No**	**N/A**	**Evaluation Notes**
7.3 Employees are using the correct PPE for the job task?				
7.4 PPE is clean and in good condition?				
7.5 Are respirators being used and if so, have the employees been trained, fit tested, and medically cleared?				

8.0 Equipment				
Question	**Yes**	**No**	**N/A**	**Evaluation Notes**
8.1 Adequate storage space is provided for tools and equipment?				
8.2 Adequate space is provided around & between equipment to allow for safe passage, servicing, stocking, and waste removal?				
8.3 Portable tools are effectively grounded (GFCIs) or are provided with double insulation?				
8.4 Tools are inspected prior to each use and damaged tools/equipment are removed from service?				
8.5 All permanent equipment is bolted to wall/floor?				
8.6 Machine guards are provided for all potential nip/pinch points & cutting/ rotating parts to protect operators?				
8.7 Are employees conducting and documenting daily forklift inspections?				
8.8 Material handling equipment (cranes, hoists, slings, etc.) are routinely inspected prior to use and removed from service, if defects are noted?				
8.9 Are JSAs present and up-to-date for appropriate equipment?				
8.10 Is compressed air being used only as directed by the manufacturer?				

9.0 High Risk Operations				
Question	**Yes**	**No**	**N/A**	**Evaluation Notes**
9.1 Are fall protection devices used for work at elevated heights and inspected regularly?				
9.2 Ladders are inspected, and single ladders secured, tied off, and extend three feet over the landing platform?				
9.3 For areas with confined spaces: Are confined spaces identified and labeled in the work area? Are established procedures (permits) being used for entry?				
9.4 Are LOTO supplies available for use?				
9.5 LOTO is being utilized to control hazardous energy?				
9.6 Are machine-specific LOTO procedures available for all equipment in the area?				
9.7 Are periodic LOTO inspections being done by authorized users?				

10.0 Industrial Hygiene				
Question	**Yes**	**No**	**N/A**	**Evaluation Notes**
10.1 Are noise levels in the shop within the permissible exposure level? If above the action level, is hearing protection utilized?				
10.2 Is the shop free of airborne contaminants that would require respiratory protection beyond a dust mask? If not, specify required IH monitoring and/or fit-testing.				
10.3 Local Exhaust Ventilation (LEV) adequate for the machines in the area?				
10.4 Are fume hoods properly tested/certified?				
10.5 Are snorkel hoods/fume extraction arms properly tested certified?				

11.0 Training				
Question	**Yes**	**No**	**N/A**	**Evaluation Notes**
11.1 Has training on LOTO Program and equipment specific procedures been completed?				
11.2 Has Hot Work training been completed? If so, has Fire Safety training been completed?				
11.3 Has Fall Protection training been completed?				
11.4 Has Hazard Communication training been completed?				
11.5 Has Forklift training been completed?				
11.6 Has Aerial Lift training been completed?				
11.7 Has Confined Space training been completed?				
11.8 Has Ladder Safety training been completed?				
11.9 Has Heat Illness training been completed?				
11.10 Has emergency preparedness and earthquake safety been completed?				
11.11 Has Safe Lifting/Back Injury Prevention training been completed?				
11.12 Have all other required safety trainings being completed? Specify which trainings are required and which of those have been completed.				

APPENDIX H: JOB SAFETY ANALYSIS FORM

Picture of task/Equipment		
	Task:	
	Shop/Dept Name:	
	Job Title(s):	
	Analyzed by:	
	Date:	

Required PPE:

Required/Recommended Trainings:

Task	Hazards	Controls

APPENDIX I: LADDER INSPECTION CHECKLIST

Date	
Person Conducting Inspection	
Ladder Type & I.D. #	

Items to be checked	Condition OK	Needs Repair
General		
Loose steps or rungs (consider loose if they can be moved by hand)		
Loose nails, screws, bolts, or other metal parts		
Cracked, split, or broken uprights, braces, steps, or rungs		
Slivers on uprights, rungs, or steps		
Damaged or worn non-slip bases		
Stepladders		
Wobbly (from side strain)		
Loose or bent hinge spreaders		
Broken stop on hinge spreaders		
Loose hinges		
Extension ladders		
Loose, broken, or missing extension locks		
Defective locks that do not seat properly when the ladder is extended		
Deterioration of rope		
Trolley ladders		
Worn or missing tires		
Wheels that bind		
Floor wheel brackets missing		
Ladders binding in guides		
Ladders and rail stops broken, loose, or missing		
Rail supports broken or section of rail missing		
Trolley wheels out of adjustment		
Trestle Ladders		
Loose hinges		
Wobbly		
Loose or bent hinge spreaders		
Stop on hinge spreader broken		
Center section guide for extension out of alignment		
Defective locks for extension		

APPENDIX J: LOTO INSPECTION CHECKLIST

Date:	**Area/Dept:**
Equip/Process:	**Inspector(s):**
Task:	

Type of Lockout/Tagout Procedures Utilized (Check all that apply):			
	Electrical-Flexible Cord-Exclusive Control		Hydraulic-Stored Energy-Lock
	Electrical-Flexible Cord-Plug Lockout		Hydraulic-Ball Valve-Locking Cap
	Electrical-Disconnect-Lock		Process-Gate Valve-Locking Cap
	Electrical-Breaker Switch-Switch Device		Process-Line-Break in Line
	Electrical Fuse Block-Block Device		Process-Line-Cable or Chain
	Electrical-PLC-Lock		Mechanical-Block-Pin
	Pneumatic-Quick Disconnect-Locking Cap		Mechanical-Mobile Equipment-Block
	Pneumatic-Ball Valve-Locking Cap		Mobile Equipment-Ignition-Key Control
	Other (please explain):		

Authorize Workers:	**Craft/Title:**
1.	
2.	
3.	
4.	
5.	

#	Questions:	Yes	No	N/A
1.	Were the affected personnel notified of the work to be performed?			
2.	Is a written procedure available for the task?			
3.	If Yes to #2, was it followed?			
4.	If Yes to #2, is the procedure adequate?			
5.	If No to #2, is a procedure needed?			
6.	Did each authorized employee know what energy sources to isolate?			
7.	Are the proper energy control devices being used?			
8.	Did authorized employee(s) verify equipment is safe after lockout?			
9.	Was the on/off switch returned to "off" position following verification?			
10.	Did each authorized employee on the job have his or her personal lock and tag attached to all isolation points on the equipment or device?			
11.	Is the tag properly filled out (User clearly identified)?			
12.	Does the authorized employee have sole control of his/her key?			
13.	Have authorized employees responsibilities been reviewed with them?			
14.	Did authorized employees understand their responsibilities under the energy control procedure being inspected?			
15.	Was the procedure found to be correct/without deficiency? If not, what was corrected?			

APPENDIX K: SELF-INSPECTION CHECKLIST

This checklist should be used on an annual basis by the Shop Supervisor or designee to conduct shop self-inspections. Conducting self-inspections helps eliminate workplace hazards, maintain safety requirements, and prepare the shop for annual inspections by the Shop Safety Specialist.

This checklist is not all-inclusive and should be modified to reflect the unique hazards that are present in different shops. Supervisors and employees should identify hazards that are not included and supplement the list in the Additional Hazards section (at the end of the Checklist) to safety controls are in place for your specific work.

Department/Shop Name	
Shop Location	
Inspection performed by/ Contact Information	
Shop Manager/ Contact Information	

	Yes	No	N/A	Comments
Emergency & Fires				
Are emergency phone numbers (including EH&S serious injury hotline) posted near a phone?				
Do employees know where to gather in case of an evacuation?				
Do employees know workplace injury reporting procedures?				
Is safety equipment (safety shower, eyewash, fire extinguisher) inspected and accessible/ unobstructed?				
Are employees trained on emergency procedures/ protocols and locations of emergency equipment?				
Are all exits and walkways free of obstruction?				
Are first aid kits fully stocked?				
Are fire extinguishers present and inspected within the past year?				
Are oily rags kept in a closed metal bin and removed from the shop regularly?				
Training and Documentation				
Is an authorized user list kept for the shop?				
Have all employees received general safety training: Hazard Communication, Injury & Illness Prevention Program (IIPP), personal protective equipment (PPE), fire safety, back safety, etc.?				

Have all employees been trained on the equipment that they operate?				
Are all employees current on specialized training (where applicable): Ladders Fall Protection First Aid Lockout/Tagout Forklift Materials Handling Respirators				
Are all safety trainings documented and filed/ stored?				
Do all employees have access to the Shop Safety Manual?				
Has the Hazard Assessment Tool for Shops (HATS) been completed?				
Is the Hazard Communication Program available?				
Is the Safety Data Sheet (SDS) binder available and indexed?				
Personal Protection				
Do employees wear appropriate attire in the shop?				
Is proper PPE (hearing protection, respiratory protection) provided where required?				
Do employees use proper PPE with handling hazardous materials?				
Is a spill kit present and stocked with appropriate PPE (safety glasses, gloves)?				
Are materials 50 lbs. or more handling with assistive devices, such as pallet jacks, hand trucks, etc.				
Housekeeping and Ventilation				
Are all worksites free of excess clutter?				
Is food/eating area kept away from chemical storage?				
Are all cabinets above five feet secured or anchored?				
Are all machines anchored appropriately?				
Are floors free of slip, trip and fall hazards?				
Do all work areas have adequate ventilation and task-specific ventilation where applicable?				

Electrical Safety				
Are all cords in good condition?				
Do all cord plugs have grounding conductors (third prong)?				
Is the breaker panel accessible with clearance of three feet on each side?				
Is all facility wiring properly shielded or enclosed?				
Are ground fault interrupters (GFCI) available for use in wet areas?				
Mechanical Safety				
Do all machines have guards to protect against points of operation, nip points, rotating parts, moving parts, flying chips, sparks, etc.?				
Are written standard operating procedures (SOPs) or Job Safety Analyses (JSAs) available for each machine and utilized by all employees?				
Are machines regularly cleaned and maintained?				
Are maintenance records, calibrations, certifications of each machine kept on file?				
Do only authorized employees perform maintenance?				
Are Lockout/Tagout procedures followed and locks/tags available?				
Portable Tools				
Are all power tools in good operating condition?				
Are ladders in good operating condition?				
Are cylinders and hoses free from cracks or dents?				
Are cylinders secured upright with a double chain and valve protector caps?				
Is a “hot work” procedure in place for welding?				
Storage, Hazardous Materials and Waste				
Are all hazardous materials labeled legibly and properly?				
Are chemicals stored neatly and in cabinets?				
Is chemical waste properly stored and labeled with EH&S Hazardous Waste Tags?				
Is stored waste in secondary containment?				
Does EH&S pick up the hazardous waste at least every 90 days?				

Are flammables in excess of 10 gallons stored in appropriate flammables cabinets?				
Are hazardous materials stored appropriately (i.e. not on counter or floors)?				
Are flammables/combustibles stored away from ignition sources?				
Are flammable gas cylinders kept at least 20 feet from compressed oxygen cylinders?				
TOTALS ➔ *Total "No" Responses indicates number of corrective items needed				

Additional Hazards

Write any hazards in the spaces provided (if any exist).	
Hazard	**Comments**

Supervisor's Signature	
Date	

APPENDIX L: STUDENT, FACULTY AND STAFF SHOP SAFETY RULES

Responsibilities

Shop Supervisors shall have authority over shop operations and safety. This includes but is not limited to the responsibility, authority, and obligation to authorize or prohibit access for the safety of an individual.

Students, faculty and staff working in shops must comply with all applicable health and safety regulations, policies, and work practices.

Approval to operate machinery, power tools and/or hand tools must be obtained prior to use. Authorized users shall be designated/approved by the Shop Supervisor. A signed authorization form certifies this level of qualification and must be on file with the Shop Supervisor.

Safe Work Practices

- Authorized users shall be familiar with operator safety manual and/or Job Safety Analysis (JSA) prior to use of any piece of equipment.
- Authorized users shall not deviate from safety protocol as outlined by the manufacturer.
- Equipment shall be used only as intended and within the specifications set forth by the manufacturer.
- Safety glasses must be worn at all times in the shop. Contact your shop supervisor for specific PPE requirements.
- Work safely and methodically. Resist rushing and ask for help when you need it.
- Aisles, exits, and access to emergency equipment must be kept clear at all times.
- Immediately report any problems or concerns to the Supervisor. Report unsafe work when witnessed.
- Damaged equipment or equipment that does not appear to be operating normally must not be used. Report the problem equipment to the Supervisor to be locked out of service.
- All guards and shields must be secured and in place prior to operating equipment.
- Compressed air must not be used to clean skin or clothing. Never use compressed air for cleaning work area surfaces.
- Housekeeping is everyone's duty and includes cleaning up debris from machines and work areas frequently, maintaining proper equipment storage, and keeping walkways and doorways clear.
- Electrically energized shop equipment must be used in a safe manner as intended by the manufacturer. Equipment must be de-energized and locked out/tagged out during maintenance or repair.

Personal Safety

- Cell phones, headphones, and other personal electronic devices must not be used when working at any machine. Loud music is prohibited.

- Do not leave machines running unattended.
- Full-length pants must be worn at all times. Sleeveless shirts or tank tops are prohibited.
- Remove loose jewelry before beginning work.
- Long hair must be pulled back, secured and contained; long beards must also be contained.
- No loose clothing may be worn in the shop.
- Keep hands and other body parts a safe distance away from moving machine parts. Use a tool to remove swarf and debris.
- No open-toed shoes, flip-flops or sandals are permitted.
- Food and drink are permitted in designated areas only.

Stop Work Policy

- The Campus has established a Stop Work Policy when unsafe work or conditions are observed. It is the responsibility of everyone to exercise this policy when observing unsafe work conditions or practices. If you see unsafe behavior or activities, don't hesitate to use the Stop Work Policy and immediately report the unsafe work to the Shop Supervisor and/or EH&S.

Emergencies

Safety Data Sheets (SDSs) contain information about chemicals used in the shop. Become familiar with SDSs to understand chemical hazards in the shop. Know the locations of the nearest eye wash station and first aid kit before using shop equipment.

IF AN EMERGENCY OCCURS:

1. **CALL 911**
2. **Notify your Supervisor**
3. **Call EH&S ASAP following any serious injury**

SHOP USE AUTHORIZATION FORM

Shop Name: _____

Location/Department:_____

I have read, had an opportunity to ask questions about, understand and been given a copy of the Shop Safety Rules. I pledge to only conduct work according to the shop safety rules, procedures and practices outlined within the contents of the document. I understand that failure to follow rules, procedures and practices outlined within the document may result in immediate expulsion and possibly permanent revocation of privileges to work in the shop noted above. In addition, other disciplinary action may be brought by the department for failure to follow these rules, procedures and practices.

Authorized Shop User

Print Name: _____

Signature: X _____

Date: _____

Shop Supervisor

Print Name: _____

Signature: X _____

Date: _____

Instructions to the Shop Supervisor: *Please separate the 2-page "Student, Faculty, and Staff Machine Shop Safety Rules" document and provide it as a copy to every authorized person who will be working in your shop. Have each person sign/date this third page of the "Student, Faculty, and Staff Shop Safety Rules" document and keep their signed page in your file as evidence of basic safety training/orientation to your shop. Provide additional training as you may determine is needed based upon assessment of your shop's hazards, equipment and operations. Include a checklist of training subjects and materials covered as evidence of your training efforts (template attached).*

MACHINE/EQUIPMENT-SPECIFIC TRAINING

Shop Name: _____

Shop Supervisor: _____

Shop User Name: _____

Machine/Equipment	Date of Training	User Signature	Supervisor Signature

APPENDIX M: TRAINING GUIDE - TRAINING DOCUMENTATION FORM

Use this document to record any site-specific training sessions, and place a copy in the *Shop Safety Manual*. Attach a summary of training materials

Training Topic: _____ **Presenter:** _____

Location: _____ **Date:** _____ **Duration:** _____

Name	Signature

APPENDIX N: TRAINING GUIDE - EMERGENCY PREPAREDNESS/ EARTHQUAKE SAFETY

Effective dissemination of safety information is an integral part of the Injury and Illness Prevention Program (IIPP). This document was created to facilitate worker safety training. Training must be completed before the use of any tool or piece of equipment, exposure to any hazardous condition, or when new hazards are identified.

Prepare the following items for this meeting:

- Training Documentation Form
- Campus Evacuation Map
- Departmental Emergency Response Plan
- Workplace Emergency Action Plan
- Campus Emergency Management Website

Planning for Emergencies

Immediately after an emergency, essential services may be cut off and local disaster relief and government responders may not be able to reach you right away. One of the most important steps you can take to prepare for emergencies is to develop/review your Emergency Action Plan (EAP).

Creating Emergency Action Plans and Department Emergency Response Plans

- Obtain the EAP template and complete with information specific to your workspace(s). Consult the Office of Emergency Management with any questions
- Review the Campus Evacuation Map with the employees. Identify the evacuation areas for your department.
- Draw, display, and discuss a floor plan of your building with all exits, hazards and evacuation routes.
- Discuss a plan for evacuating people with special needs or with disabilities.
- Ensure employees know where emergency telephone numbers and emergency broadcast stations are posted (preferably by telephones).
- If you have one, review your departmental emergency response plan with the employees. If you don't have one, develop a plan with your department.
- Discuss and plan how your employees would stay in contact if you were separated. Identify two meeting places: the first should be near your building and the second should be away from building, in case you cannot return.
- Encourage employees to take a first aid and CPR class (to be coordinated by your department). Develop a plan for shutting off electricity, gas and water supplies at main switches and valves in your building. Have the tools you would need to do this (usually adjustable pipe and crescent wrenches).

Disaster Supply Kits

Review the items that your workplace might need in the event of an emergency (e.g., water, food, essential medication). Make sure employees are aware of the resources and information on the Emergency Management website.

If you have a disaster supply kit, review its contents and update if necessary.

Earthquake Safety Recommendation

There are actions you can take before or even while an earthquake is happening that will reduce your chances of being hurt. Lights may be out or hallways, stairs, and room exits may become blocked by fallen furniture, ceiling tiles, and other debris. Planning for these situations will help you to take action quickly. Train employees in the following:

- Duck, cover, and hold; move only as far as necessary to reach a safe place.
- If indoors, stay there until shaking stops. Many fatalities occur when people run outside, only to be killed by falling debris from collapsing walls and windows.
- If outdoors, find a spot away from buildings, trees, streetlights, power lines, and overpasses.
- If in a vehicle, pull over when safe to do so and remain until shaking stops.
- Make sure furniture is seismically restrained.
- Secure materials stored on shelves.
- Store heavy and breakable objects on low shelves.
- If in a high-rise building, expect the fire alarms and sprinklers to go off during an earthquake. Do not use the elevators.
- What other preventive actions can you take to ensure the safety of yourself or your coworkers?

Key Takeaway Points

- Knowing the evacuation routes and meeting location for employees in your department found in the Emergency Action Plan.
- Familiarity with the departmental Emergency Response Plan.
- Awareness of disaster supply kit resources.
- Preparing for and knowing what to do during an earthquake.

APPENDIX O: TRAINING GUIDE - FIRE SAFETY

Effective dissemination of safety information is an integral part of the Injury and Illness Prevention Program. This document was created to facilitate worker safety training. Training must be completed before the use of any tool or piece of equipment, exposure to any hazardous conditions, and/or when new hazards are identified.

In Preparation for this meeting (items needed):

- Training Documentation Form
- Campus Evacuation Map

Be Prepared

Fire safety is everyone's responsibility. Fire safety training is required annually to prepare all employees for a fire emergency. The following measures can help to be better prepared to handle a fire:

- Know the exit routes from your shop, floor, and building. Study these in advance. It is easy to become disoriented during an actual emergency.
- Know the locations of fire extinguishers and know how to use them via the PASS method. Take the time to read the instructions. Report any missing extinguishers immediately.
- Make sure that emergency numbers are posted on your telephone. Include your room number.
- Report any unsafe conditions to the Campus EH&S Office immediately.

Discussion Topic: What has your workplace done in preparation for a fire?

Fire Do's and Don'ts

Most fires start out small, but after a few minutes they can be out of control. It's important to act fast to sound the alarm and just as important to know what to do. Here are a few do's and don'ts that will help you stay safe during a fire:

- **DO:** Close all doors on your way out of the shop. This will slow the spread of fire and smoke. Activate the nearest fire alarm pull station.
- **DO:** Report the fire; don't assume someone else will do it. Call the campus police at 911.
- **DO:** Use stairs to vacate the building. Assemble outside.
- **DON'T:** Use an elevator. Elevators can be very dangerous in a fire, even when they appear to be safe.
- **DON'T:** Arbitrarily break windows. Falling glass is a serious threat to pedestrians and fire fighters or rescue personnel below.
- **DON'T:** Exit until you have felt the top of exit door. If the door is hot, or if excessive smoke prevents your exit, keep the door closed.
- **DON'T:** Go back for your personal belongings if ordered to leave the building.

Types of Fires and Extinguishers
Fire extinguishers can be classified into four classes depending on the type of fire they extinguish.

Class A-Ordinary combustibles fires such as paper, rags, wood
Class B-Flammable liquid fires such as oil, solvents, gasoline, grease
Class C-Electrical fires
Class D-Combustible metals

Here are the **most common types of fire extinguishers:**

- **Pressurized water extinguisher** - Use only on Class A fires. Do not use on Class B or C fires. (This could cause fire spread or electrical shock.)
- **Carbon Dioxide** - Use on Class B or C fires
- **Dry chemical/Combination A, B, C**-Use on Class A, Class B and Class C fires.

Discussion Topic: What types of fire extinguishers are used in your workplace?

How to use a *Fire Extinguisher*
If a fire extinguisher is used, remember the **"PASS" acronym**:

Pull ring from extinguisher handle
Aim nozzle at base of fire
Squeeze Handle
Sweep nozzle back and forth as you advance

Fire extinguisher training is available. Contact the EH&S Office for further information.

Discussion Topic: Does everyone understand the PASS method?

Fire Prevention

- Do not store items in corridors, aisles, exit routes, stairwells, fan rooms, equipment rooms, or electrical rooms. Keep these areas clear.
- Try to avoid using extension cords for various small appliances. Do not use ungrounded plugs or multiple outlet adapters. These are not permitted and tend to overload electrical circuits, causing fires to occur.
- Always keep fire rated doors closed. These doors are designed to slow the spread of fire and protect egress routes.
- Store and handle chemicals and flammable liquids properly. Flammable liquids must be stored in limited quantities and be kept in approved flammable liquids storage cabinets.

Discussion Topic: What other fire prevention measures have been instituted in your workplace?

In the Event of a Fire
Use the nearest emergency shower or stop, drop, and roll! If it is safe to do so, attempt to extinguish the fire using a fire extinguisher.

Discussion Topic: Identify the nearest emergency showers and practice stop, drop, and roll.

Key Takeaway Points

- Know the evacuation routes and meeting location for the shop.
- Prepare for and know what to do in the event of a fire.
- Know how to use a fire extinguisher.
- Know fire prevention measures.

See Also

- Fire Extinguisher Training – contact the EH&S Office for further information.

APPENDIX P: TRAINING GUIDE - HAND TOOL SAFETY

Effective dissemination of safety information is an integral part of the Injury and Illness Prevention Program. This document was created to facilitate worker safety training. Training must be completed before the use of any tool or piece of equipment, exposure to any hazardous conditions, and/or when new hazards are identified.

In Preparation for this meeting (items needed):

- Training Documentation Form
- Gather some hand tools that are commonly used in the shop to demonstrate proper condition and use.

Introduction

Hand tools are non-powered tools, and they include anything from axes to wrenches. The greatest hazards posed by hand tools result from misuse and improper maintenance.

Some examples:

- Using a screwdriver as a chisel may cause the tip of the screwdriver to break and injure the user or other employees.
- If a wooden handle on a tool such as a hammer or an axe is loose, splintered, or cracked, the head of the tool may detach and strike the user or another worker.
- A wrench must not be used if its jaws are sprung, because it might slip.

Hazard Recognition

- Tools are such a common part of our work that it is difficult to remember that they may pose hazards. All tools are manufactured with safety in mind but a serious accident can occur before steps are taken to search out and avoid or eliminate tool-related hazards.
- In the process of removing or avoiding the hazards, workers must learn to recognize the hazards associated with the different types of tools and the safety precautions necessary to prevent those hazards.

Responsibilities

- Supervisors are responsible for the safe condition of tools and equipment used by employees, and employees are responsible for properly using and maintaining tools. Supervisors should caution employees that saw blades, knives, or other tools be directed away from other employees working in close proximity. Knives and scissors must be sharp. Dull tools can be more hazardous than sharp ones.
- Floors must be kept as clean and dry as possible to prevent accidental slips with or around dangerous hand tools.
- When working around flammable substances, sparks produced by iron and steel hand tools can be a dangerous ignition source. Therefore, spark-resistant tools made from brass, plastic, aluminum, or wood should be used when working around flammable substances.

- Although hand tools look simple to use, they are not always harmless. Take the extra time to choose the right tool for the job and use it safely.

Safety Guidelines

- Careless or improper hand tool use can result in serious injuries. Follow these simple guidelines for a safer hand tool experience:
  - It is important to take the time to match the correct tool to the job.
  - Inspect the hand tool to ensure safe operation.
  - Think about how to carry your tools so that they don't get damaged.
  - Use appropriate personal protective equipment (PPE) such as safety glasses, safety shoes, or leather gloves.
  - Use the tool correctly.
  - Store tools securely in a dry area.

Points of Discussion

- Take this time to inspect the current state of all hand tools.
- What hand tools does your shop use?
- Which tools in your shop require routine inspection?
- What do you look for when inspecting your tools?
  - Are the blades sharp?
  - Are the handles free from splinters?
  - Does the tool have a tight fitting head?
- What precautions must the employees take when working with hand tools?
- What types of personal protective equipment must employees wear when working with hand tools?

Key Takeaway Points

- Recognition of hand tool hazards.
- Knowing how to use hand tools properly.
- Awareness of the importance of keeping hand tools in good condition.

APPENDIX Q: TRAINING GUIDE - HAZARD COMMUNICATION AND AWARENESS

Effective dissemination of safety information is an integral part of the Injury and Illness Prevention Program. This document was created to facilitate worker safety training. Training must be completed before the use of any tool or piece of equipment, exposure to any hazardous conditions, and/or when new hazards are identified.

In Preparation for this meeting (items needed):

- Training Documentation Form
- Your chemical inventory
- Printed copies of SDSs for two or three chemicals used in your department
- Chemical container with label
- Examples of PPE used to protect workers from chemicals (e.g., goggles, gloves, respirators)

Introduction

Many chemicals used in campus shops and labs are considered hazardous. All employees who work with these materials must understand the health hazards involved and how to protect themselves. Cal/OSHA regulations require employers to communicate the hazards of these chemicals to employees through the use of chemical labels and Safety Data Sheets (SDS).

Physical & Health Hazards

Hazardous chemicals pose a physical or health danger. Chemicals are classified as being physically hazardous when they are flammable, combustible, corrosive, or reactive. Chemicals presenting health hazards include carcinogens, toxics, irritants, and sensitizers. The health effects of chemicals can be either acute (short-term), or chronic (long-term). Acute effects can show up immediately or soon after the exposure. Chronic effects may take years to show up.

Chemical substances can be in the form of solids, liquids, dusts, vapors, gases, fibers, mists, and fumes. Solids and liquids are easier to recognize since they can be seen. Fumes, vapors and gases are usually invisible. The physical state of a substance has a lot to do with how it gets into your body and what harm it can cause.

Chemicals get into the body via three main routes of exposure: breathing (inhalation), skin (dermal) or eye contact, or swallowing (ingestion). Once chemicals have entered your body, some can move into your bloodstream and reach internal “target” organs, such as the lungs, liver, kidneys, or nervous system and damage them.

Discussion Topics:

- What chemicals or chemical products are used in your work area?
- Where do you store your chemicals or chemical products?
- How can you identify the chemicals used in your department?
- What are some physical and health hazards associated with common chemicals in your workplace?
- How can chemicals enter the body?

Safety Data Sheets/Labels and Warnings

Labels on chemical containers can provide basic safety information concerning the contents of that container. All containers must have labels. These labels are required to have the following six components (in no particular order);

1. Product identifier
2. Signal word
3. Hazard statement
4. Pictograms
5. Precautionary statement
6. Supplier information

Safety Data Sheets (SDSs) are data sheets that contain information about the health and safety properties of workplace chemical products. They are usually written by the supplier or manufacturer of the product. All employees must have access to SDSs for the chemicals they use.

An SDS is required to have certain information. The form is divided into 16 sections that provide different types of information about the chemical product. These sections are the same on every SDS. Under Cal/OSHA's Hazard Communication standard, an SDS must contain the following information:

1. Product identification
2. Hazard identification
3. Composition/Information on ingredients
4. First-aid measures
5. Fire-fighting measures
6. Accidental release measures
7. Handling and storage
8. Exposure controls/personal protection
9. Physical and chemical properties
10. Stability and reactivity
11. Toxicological information
12. Ecological information
13. Disposal considerations
14. Transport information
15. Regulatory information
16. Other information

Exposure/Exposure Limits

When reading Safety Data Sheets (SDS), you will frequently encounter abbreviations such as PEL, TWA, STEL, and IDLH. These provide workers with important information on how long they can be exposed to a chemical before harm may occur, as follows:

- Permissible Exposure Limit (PEL): The maximum amount of a chemical a worker can be exposed to over an eight-hour period.
- Time-Weighted Average (TWA): The PEL is usually shown as a time-weighted average (TWA) to calculate exposure for an eight-hour workday and 40-hour work week.
- Short-term exposure limit (STEL): The amount of a chemical the worker should not be exposed to over a 15 minute period.
- Immediately Dangerous to Life and Health (IDLH): Indicator that the chemical poses an immediate threat to your health.

Protection – Hierarchy of Controls

The three accepted strategies for controlling exposure to hazardous materials are engineering controls, administrative controls, and personal protective equipment (PPE). Engineering controls remove the hazard from the worker. An example of an engineering control is use of local exhaust ventilation or a fume hood. Administrative controls reduce worker exposure to hazardous materials. Examples include work practice changes, such as working with small quantities of chemicals or limiting exposure times. PPE is the least desirable control and should be used as last resort. The use of PPE does not reduce or eliminate the hazard at the source, but it does protect the worker from exposure. Sometimes, PPE is the only solution available.

Discussion Topics:

- What are the two primary methods of communicating chemical hazards to employees? Where are the SDSs kept in your facility?
- What type of information can be found on an SDS?
- What engineering and administrative controls are in place at your facility?
- What job tasks in your workplace involve chemical use that could expose an individual to the permissible exposure limit?
- What type of PPE is required to work with chemicals in your facility?

Summary

- Hazardous chemicals can pose health and/or physical hazards.
- Physical hazards refer to a chemical's potential fire and/or explosive properties, and the chemical's stability and reactivity to air, water, light, sparks, or heat.
- Health hazards affect the body in some negative way. Effects may be acute or chronic in nature.
- Chemicals get into the body through three main routes of exposure: breathing (inhalation), skin (dermal) or eye contact, or swallowing (ingestion).

- Information relating to chemicals and their hazards can be found on labels and SDSs provided by the manufacturer.
- SDSs are referenced in your IIPP Manual and made accessible for all employees to use.
- The permissible exposure limit (PEL) is the maximum amount of a chemical a worker can be exposed to over an eight-hour period.
- Workers can be protected by implementing engineering and administrative controls and PPE, or a combination of the three.
- Refer to the SDS for the required PPE if you work with or are in an area where chemicals are used.

Resources:
Campus EH&S Hazard Communication Program
SDS Websites

APPENDIX R: TRAINING GUIDE - HEARING CONSERVATION

Effective dissemination of safety information is an integral part of the Injury and Illness Prevention Program. This document was created to facilitate worker safety training. Training must be completed before the use of any tool or piece of equipment, exposure to any hazardous conditions, and/or when new hazards are identified.

In Preparation for this meeting (items needed):

- Training Documentation Form
- Shop Safety Manual
- Examples of hearing protection

Introduction

Many chemicals used in campus shops and labs are considered hazardous. All employees who work with these materials must understand the health hazards involved and how to protect themselves. Cal/OSHA regulations require employers to communicate the hazards of these chemicals to employees through the use of chemical labels and Safety Data Sheets (SDS). Every year, millions of workers in the United States are exposed to hazardous noise. Prolonged exposure to noise over years can cause permanent damage to the ear that can't be repaired. Noise Induced Hearing Loss (NIHL) is usually gradual, and impairment isn't noticed until a substantial degree of hearing loss has already occurred. Fortunately, the incidence of NIHL can be reduced or eliminated with the use of engineering controls and hearing conservation programs.

Sound and Hearing

Sound stimulates tiny hair-like cells in your inner ear. These vibrate and send auditory messages to your brain. Too much noise for too long can damage the cells until they no longer send signals to the brain. When this happens, hearing is lost. Most of the workplace sounds that cause permanent damage occur over a number of years (e.g., about eight hours per workday over 10 years or more). This slowly progressing damage may go unobserved until it's too late.

Noise

Exposure to normal noise levels doesn't cause hearing loss. Hearing loss occurs because of overexposure to high noise levels. Sound is measured in decibels (dB) and is defined by strength, frequency (pitch), and duration. To help you see the difference in the decibel scale, look at these examples of various noise levels:

- 20 dB-soft whisper
- 30 dB-leaves rustling, very soft music
- 60 dB-normal speech, background music
- 85 dB-heavy machinery with soundproof cab
- 90 dB-lawnmower, shop tools
- 100 dB-heavy machinery without soundproof cab
- 115 dB-loud music, sand blasting
- 140 dB-jet engine, shotgun

A noise level of 85 dB over an eight-hour workday is loud enough to damage hearing. In the workplace, hearing protection must be used to reduce noise exposure for anyone who is exposed to 90 dB or more over the course of their workday. Sounds above 120 dB can cause hearing damage after only a brief exposure and should be avoided unless the proper hearing protection is worn.

Discussion Topics:

- What are ways that your shop ensures that employees are not exposed to noise levels that can affect hearing ability?
- What noise levels are loud enough to damage your hearing?

Prevention

Employers must assess noise exposures and provide appropriate hearing protection as needed for everyone in the workplace. Workers must use the protection consistently and correctly. Both equipment operators and others who are working nearby may need protection. If you work in a noisy area, be aware of the hazard and use protection even if you are not the one making the noise.

Noise exposure can be successfully reduced with the use of properly fitting hearing protection. Hearing protection works by blocking the sound waves from entering your inner ear. Hearing protection devices are labeled with a Noise Reduction Rating (NRR) that is measured in decibels. The manufacturer determines the NRR by testing under the best conditions.

When choosing the correct hearing protection, consider the following:

- Does it provide the adequate NRR?
- Does the protection interfere with your work?
- Does the device fit properly?

There are two main types of hearing protection: ear plugs and ear muffs. The following table lists the advantages and disadvantages of each.

EAR PLUGS	
Advantages	**Disadvantages**
Small	May cause irritation
Lightweight	Easy to lose
Inexpensive	Must wash hands before inserting
Comfortable	Only protect up to 105 dB
May be worn with other PPE	Must be inserted properly

EAR MUFFS	
Advantages	**Disadvantages**
Easy to use	Heavier than plugs
Designed to fit anyone	Uncomfortable
Wont Irritate the ear	Bulky
Reusable	Must keep seal to be effective

Discussion Topics:

- When do employees need to wear hearing protection in your shop?
- What type of hearing protection is available for employees to wear when working?
- What are the advantages and disadvantages of ear plugs and ear muffs? Which type of protection is most appropriate for the tasks your workers complete?
- Do your employees know how to insert ear plugs?

Key Takeaway Points

- Occupational hearing loss can occur slowly over a long period of time and be unnoticeable until damage is permanent.
- Once hearing loss occurs, it cannot be repaired.
- Hearing loss occurs because of overexposure to high noise levels.
- When noise levels exceed 85 dB over an eight-hour workday, hearing protection is required.
- Supervisors are responsible for assuring that hearing protection provided to employees provides adequate Noise Rating Reduction (NRR).
- Employers are required to administer a hearing conservation program for employees in environments where they are exposed to noise levels at or above 85 dB.
- If sounds in your shop are louder than conversational levels for prolonged periods of time, you must conduct a sound survey.
- Ringing in the ears after leaving a shop is normal sign of possible hearing damage.
- If your ears ring or sounds are muffled after leaving a shop, you should be using ear protection when working.

APPENDIX S: TRAINING GUIDE - GENERAL SAFETY AND HOUSEKEEPING

Effective dissemination of safety information is an integral part of the Injury and Illness Prevention Program. This document was created to facilitate worker safety training. Training must be completed before the use of any tool or piece of equipment, exposure to any hazardous conditions, and/or when new hazards are identified.

In Preparation for this meeting (items needed):

- Training Documentation Form
- Self-Inspection Checklist (Appendix K)
- Hazardous Chemical Waste guidelines (Section 10)

Introduction

Good housekeeping is an effective way to eliminate potential hazards in the workplace. Good housekeeping practices involve material management and storage throughout your entire workplace. It also includes a material flow plan to ensure minimal handling. Employee training is a key component that will ensure good housekeeping practices. Employees should be encouraged to report any unusual hazards or conditions to their supervisor. Lastly, semi-annual shop inspections are essential tools that are used to find, recognize, and mitigate hazards that arise in the workplace.

Point of Discussion: Review the findings on the last inspection checklist with employees or take this time to conduct an overall inspection of your shop and ask employees what items of housekeeping must be routinely checked.

Light Fixtures

All buildings need adequate lighting. Light fixtures with non-working light tubes need to be replaced. Storage areas that contain combustible materials should have explosion proof light fixtures installed. Lighting must be distributed evenly to eliminate shadows or dark spots in the workplace.

Point of Discussion: Are there any light fixtures that are non-functional or can you find an area in your workplace that could use more lighting?

Floors

Keeping floors dry and clear of trash and debris will eliminate slip, trip, and fall accidents. All spills should be cleaned up immediately. All sawdust, shavings, or clippings should be swept up or vacuumed once the cutting has ceased. Areas that cannot be cleaned continuously, such as entranceways, should have anti-slip flooring. Replace flooring that has been worn, ripped, or damaged, as this poses a tripping hazard. Portable power tools or hand tools should be removed from the work area and placed in storage if they are not in use. All floor openings must be guarded to prevent serious falls.

Point of Discussion: Are your floors kept free of trash and debris?

Chemical Spill Clean-up

Routine cleaning and maintenance of machines and equipment is a good way of eliminating spills. Another is to use drip pans and guards where possible spills might occur. If a chemical spill does occur, it is important to follow your workplace spill cleanup procedures. Part of the procedure should involve using the Safety Data Sheet for advice on how to clean the spill and protect yourself from the chemical hazard. Absorbent material is useful for wiping up greasy, oily or other liquid spills. Used absorbents must be disposed of properly and safely.

Point of Discussion

- Do employees know of the chemical spill-clean-up procedures and how to clean up a chemical spill?
- Review chemical spill clean-up procedure.

Aisles and Stairways

Aisles and stairways must be kept clear of all objects that can cause trips and falls. Aisles should have three feet of clearance and any items that protrude into the aisle should be removed immediately. Warning signs and mirrors can prevent collisions by improving sight lines at blind corners. Stairways and aisles also require adequate lighting.

Point of Discussion: Are your aisles and stairways clear of all objects?

Tools and Equipment

Keeping tools and equipment neat and orderly will improve efficiency as well as safety in the workplace. Tools that are not in use should be returned to their storage areas promptly to reduce the chance of them being lost or misplaced. Workers should be trained to regularly inspect, clean and store all of their tools. Any tool or piece of equipment that is in need of maintenance or repair should be removed from service until repairs can be made.

Point of Discussion: Do your tools have a designated area of storage? If not, assign an area. If yes, are your tools stored in their assigned area? If not, why not?

Maintenance

A good maintenance program provides for the inspection, maintenance, upkeep and repair of tools, equipment, machines and processes. Routine maintenance of equipment and machinery must be conducted and recorded in your workplace maintenance log. Building maintenance should also be conducted as this involves painting and cleaning walls, maintaining windows, damaged doors, leaky plumbing, and broken tile or floor surfaces.

Point of Discussion: Are employees recording all routine maintenance and repairs in the maintenance log?

Waste Disposal

Disposal of trash, dust, clippings, and miscellaneous material is essential to good housekeeping practices. Waste should not be allowed to build up on the floor as this poses a slip, trip, and fall hazard. Scrap containers should be placed near where the waste is produced as this makes waste collection and disposal much easier. Waste receptacles should be clearly labeled with their contents and should be emptied out regularly.

Point of Discussion

- Discuss waste collection and disposal strategies.
- If you produce hazardous waste in your shop, review the hazardous waste storage and disposal guidelines.

Material Storage

Safe storage practices are essential for good housekeeping. Heavy items stored above six feet, should have restraints in place to prevent them from falling. Workers should not store items on top of personal lockers, cabinets, or machinery that are taller than six feet, as they were not meant for storage. Stored materials should allow at least 18 inches of clearance under sprinkler heads, or two feet of clearance under the ceiling where there are no sprinklers present. Stored materials should not obstruct aisles, stairs, doorways, fire equipment, emergency shower or eyewash stations, first aid stations, machinery shut-offs and electrical panels. Designated storage areas should be clearly marked.

Point of Discussion: Are elevated storage requirements in effect in your workplace? If not, why not.

Fire Prevention

Flammable, combustible, toxic and other hazardous materials should be kept in approved containers and stored in designated areas. Flammable or combustible material above ten gallons must be kept in a flammable storage cabinet. Flammable storage cabinets are required to be self-closing. Chemical storage inside of flammables cabinets should be labeled, free of rust or corrosion, not stacked, and free of any cardboard or other combustibles. Lastly, oily or greasy rags should be placed in a metal container and disposed of as hazardous waste regularly.

Point of Discussion: If you have a flammable storage cabinet, do you take the time to dispose of any unwanted chemicals?

Key Takeaway Points

- Importance of good housekeeping practices.
- Awareness of what good housekeeping involves.
- Chemical spill clean-up procedures.
- Maintain clear egress.
- Hazardous waste guidelines (if hazardous waste is produced in the shop).
- Storage of materials in the shop.
- Fire prevention.

APPENDIX T: TRAINING GUIDE - IIPP

Effective dissemination of safety information is an integral part of the Injury and Illness Prevention Program (IIPP). This document was created to facilitate worker safety training. Training must be completed before the use of any tool or piece of equipment, exposure to any hazardous condition, or when new hazards are identified.

Prepare the following items for this meeting:

- Training Documentation Form
- Departmental IIPP Binder

Objectives of the IIPP

The Injury and Illness Prevention Program (IIPP) is state-mandated program under Cal/OSHA (Title 8, CCR Section 3203), and provides a summary of the safety protocols and procedures specific to your workplace. The IIPP acts as your department's "umbrella" safety program that references any other safety programs that you may have in place that are geared towards specific work tasks/exposures (e.g. Shop Safety Manual, Lab Safety Manual, Biosafety Manual, etc.). Below are summaries of the required components that are written into an IIPP.

Supervisor & Employee Responsibility

Supervisors are responsible for implementing and enforcing the IIPP in the areas they supervise. Supervisors are expected to be able to identify and correct/report any hazards in the workplace. Supervisors must ensure that employees are provided with general and job specific safety training, and with the appropriate personal protective equipment (PPE) required for the job. They are also responsible for taking disciplinary action against any employee that does not follow safety policies and procedures when working.

Individual employees are responsible for following work procedures and safety guidelines for any task they complete. This includes the use of required PPE. If employees do not know how to safely complete a job, they must ask for instruction and/or training. If they get hurt on the job, they are responsible for reporting it to their supervisor immediately. They must also report any safety issues to a supervisor as soon as possible.

Identification and Correction of Workplace Hazards

Employees must report injuries to their supervisor immediately and are covered under workers' compensation insurance. Workplace injuries must be reported to Risk Management within 24 hours. In addition, serious injuries must be reported to EH&S as soon as they occur to ensure reporting to Cal/OSHA within eight hours of occurrence (CCR Title 8, Section 342). Refer to your departmental IIPP for specific instructions on injury reporting and medical treatment.

As a follow up to injuries that occur, the Office of Environment, Health and Safety collaborates with departments on conducting incident investigations as appropriate. The purpose of completing an investigation is to determine the cause of the incident and make any necessary repairs or procedural changes to avoid future illnesses and injuries. An incident investigation guide and report template is located in the IIPP for reference.

Training

In order to maintain a safe work environment, employees must be trained on the hazards and safety procedures associated with their jobs. These trainings must be documented (using a sign-in sheet) and are to include topics on general safe work practices as well as exposures/hazard specific topics unique to each employee's job assignment. Training can be completed in a group or through one-on-one sessions with supervisors or their designees. If employees feel they do not have the training required to complete a job safely, they must inform their supervisors so they can be trained before beginning work.

Compliance

Supervisors must set positive examples for working safely and require safe work practices from their staff. If any employee fails to follow safe work practices, supervisors must follow the University's Disciplinary Action Policy and any applicable union contract agreements to discipline employees for non-compliance.

Discussion Points:

- If you get hurt on the job, what should you do?
- What is the purpose of an incident investigation?
- If you do not know how to safely perform a job when asked to do it, what should you do?
- What are the methods used in your department to communicate safety information?

Summary

- The IIPP is designed to make sure employees are safe from injury and illness when working.
- Supervisors are responsible for providing employees with general and job specific safety training and documenting completion.
- Supervisors must provide all employees with appropriate PPE for the jobs they complete.
- Supervisors are responsible for correcting and/or reporting unsafe conditions in the workplace.
- Any hazards identified during an inspection must have an action plan developed with timeline to eliminate or reduce the hazard.
- Staff meetings, tailgates, newsletter, bulletin boards and e-mails are effective methods for communicating safety information.
- Incident Investigations are done to determine cause, implement procedures and issue corrective recommendations accordingly.
- Employees cannot be reprimanded for reporting safety issues.
- Employees must be disciplined if they do not follow safety procedures written into the IIPP.

APPENDIX U: TRAINING GUIDE - LADDER SAFETY

Effective dissemination of safety information is an integral part of the Injury and Illness Prevention Program. This document was created to facilitate worker safety training. Training must be completed before the use of any tool or piece of equipment, exposure to any hazardous conditions, and/or when new hazards are identified.

In Preparation for this meeting (items needed):

- Training Documentation Form
- Ladder Inspection Checklist

Introduction

Ladders are tools commonly used in shops. When maintained properly and used according to safety guidelines, they are a simple and effective tool. However, every year thousands of workers are injured or killed due to ladder-related accidents. Cal/OSHA requires employers to provide safety guidelines for working with ladders and requires that ladders be in good condition and free of damage. This helps to prevent ladder-related accidents. It is the responsibility of the employee to follow safety guidelines and to report any damaged or unsafe ladders in the workplace. A fall from a ladder can be serious, but this can be avoided by working safely on or around ladders.

Types of Ladders

Ladders can be constructed from a variety of materials such as wood, metal, and reinforced plastic. They usually consist of two side rails that are joined at regular intervals called rungs or steps. Generally, ladders do not have moving parts, except for extension ladders which have ropes, pulleys, and ladder locks. Some ladders have additional safety features, such as roof hooks or adjustable feet that make the ladder more stable. Generally there are four types of ladders:

4 Types of Ladders	Portable	Adjustable	Self-Supporting
1) Step Ladder	YES	NO	YES
2) Straight Ladder	YES	NO	NO
3) Extension Ladder	YES	YES	NO
4) Fixed Ladder	NO	NO	YES

Discussion Topics:

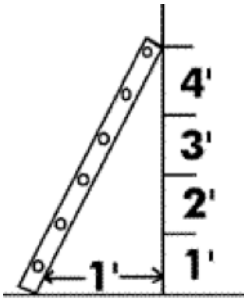
- Each type of ladder has unique features that ensure safety in the workplace.
- Talk about the various job tasks that are performed in your workplace using ladders.
- What types of ladders are in the shop?

Ladder Selection

Selecting the appropriate ladder for the job can greatly reduce your chances of being involved in an accident. The following four things must be considered when selecting a ladder:

1) Height Requirement

The average worker can work comfortably at shoulder level, which is about five feet above where he/she stands. Since the worker must stand at least two feet down from the top of a ladder, the maximum working height would be about three feet above the top of the ladder. For example, a five-foot stepladder would give an effective working height of eight feet.



Ladder Safety 1:4 Rule

When using straight or extension ladders, the worker must follow the one quarter rule to calculate the height of the ladder needed. This is also referred to as the 1:4 rule for ladder safety. The rule states that the base of the ladder must be one foot away from the structure for every four feet of height to where the ladder rests against the structure. The length of the ladder can then be calculated with the formula $A^2 + B^2 = C^2$, where A and B are the length of the structure and base, and C is the length of the ladder. Keep in mind an additional three feet must be added to the length of the ladder to ensure adequate overlap.

2) Weight Capacity

Weight capacity is also a key element to consider when selecting a ladder. Ladders can break or give way under excessive weight stress. When evaluating the stress to be placed on a ladder, remember to factor in additional equipment, such as tools and personal protective equipment. If a person's body weight plus tools and equipment exceed the weight capacity of the ladder, then use a ladder with a higher weight capacity or use an alternative means of transporting the tools and equipment, such as a rope or tow line. Ladders are usually classified into classes called duty rating as follows:

Class	Duty Rating & Recommended Use
IAA	375 pounds; extra heavy-duty industrial use
IA	300 pounds; extra heavy-duty industrial use
I	250 pounds; heavy-duty use
II	225 pounds; medium-duty use
III	200 pounds; light-duty use

3) Surface Conditions

Various surface conditions can lead to falls when using ladders. If the surface is uneven, use optional foot attachments that are designed to level the feet of the ladder. If the surface is hard or smooth, choose a ladder with non-skid feet and take extra precautions, such as asking a coworker to hold the ladder in place.

4) Hazardous Environment

When selecting a ladder, be sure to check for hazards, such as exposed electrical equipment or power lines. If electrical hazards exist in the working area, choose a non-conductive ladder such as a wood or reinforced plastic ladder. Also, maintain a distance of at least 10 feet from the electrical equipment or power lines.

Discussion Topics:

- Discuss how height, weight, floor surface, and the environment can lead to dangerous work conditions.
- Are all employees aware of how to choose the appropriate ladder?
- What would be the height of the ladder needed for a 12-foot building using the one quarter rule?

Ladder Inspection

Once you have selected the right ladder for the job, it is important to conduct a visual and operational inspection. Ask yourself: are the steps free of oil, grease, and dirt? If ropes are attached, are they in good condition? Are there any signs of structural damage such as cracked side rails or broken parts? Are the support braces intact? If for any reason the ladder does not pass the inspection, make sure to tag it and remove it from service immediately.

Discussion Topics:

- What are employees looking for during the ladder inspection?
- Is the ladder inspection checklist utilized for documentation?
- Take the time now to complete the ladder inspection checklist for each of the ladders in your workplace.

Ladder Set up and Use Rules

Place ladder feet firmly and evenly on the ground or floor. Make sure the ladder is sitting straight and secure before climbing it. If one foot sits in a low spot make sure to readjust or use feet leveling attachments. Do not try to make a ladder reach farther by setting it on boxes, blocks or other unstable bases. If there is danger of slippage, ask a coworker to hold the ladder steady. Never set up or use a ladder in a high wind, especially a lightweight metal or fiberglass type. Never set up a ladder in front of a door unless the door is locked or a guard is posted.

Always follow these rules when using a ladder:

- Always face the ladder when climbing up or down.
- Never climb the backside of a step ladder.
- Never use the top two rungs on a step ladder.
- Never use the top three rungs on straight or extension ladders.
- Never use a ladder for scaffolding.
- Never attempt to reposition a ladder while in use.
- Do not reach beyond your arm's normal extension.
- Never hurry up a ladder and keep three points of contact at all times.

Discussion Topics:

- What techniques are your employees using to set up ladders in your workplace?
- What other rules are followed in your workplace to ensure safety?

Ladder Storage and Maintenance DOs & DON'Ts

Do's	Don'ts
Maintain ladders in good condition.	Never paint a wooden ladder as this will cover dangerous cracks or fill and hide them.
Keep all ladder accessories, especially safety shoes, in good condition.	Never use a metal or fiberglass ladder which has been exposed to fire or strong chemicals, it should be discarded.

Do's	Don'ts
Store fiberglass ladders where they will not be exposed to sunlight or other ultraviolet light sources.	Never store materials on top of a ladder. Vibration and bumping against other objects can damage them.
Be sure that ladders are properly supported and secured when in transit.	Never use a damaged ladder. Damaged ladders must be removed from service.
Restrain/store ladders on racks to prevent them from falling over when not in use.	Never store ladders near entrances or exits as they may fall and block emergency pathways.

Discussion Topics:

- How are your ladders stored in your workplace?
- What type of maintenance is needed for the ladders in your workplace?

Key Takeaway Points

- Know about the different types of ladders and their intended use.
- Know ladder height requirements.
- Know duty ratings and labeling.
- Know how to conduct a ladder inspection to ensure that ladders are safe to use.

APPENDIX V: TRAINING GUIDE - PORTABLE POWER TOOL SAFETY

Effective dissemination of safety information is an integral part of the Injury and Illness Prevention Program. This document was created to facilitate worker safety training. Training must be completed before the use of any tool or piece of equipment, exposure to any hazardous conditions, and/or when new hazards are identified.

In Preparation for this meeting (items needed):

- Training Documentation Form
- Two Portable Power tools
- Operator's Manuals or Job Safety Analyses for the tools
- List of Personal Protective Equipment (PPE) assigned

Introduction

Employees who use portable power tools may potentially be exposed to the hazards of falling, flying, abrasive, and splashing objects, and to harmful dusts, fumes, mists, vapors, or gases. They must be provided with the appropriate personal protective equipment. All electrical connections for these tools must be suitable for the type of tool and the working conditions (e.g., wet, dusty, flammable vapors). When a temporary power source is used for construction, a ground-fault circuit interrupter should be used.

Employees should be trained on the proper use of all tools. Workers should be able to recognize the hazards associated with the different types of tools and the necessary safety precautions.

Discussion Topics:

- Does your workplace have records showing that all employees received training on the operations of each power tool that is in use? If not, then take the time to go through and provide training on at least two power tools that the employees use in your workplace. (A separate training must be held to cover all of your portable power tools. Training for each power tool must be documented and include the information stated above.)

Types of Power Tools

Power tools are classified by their power source and include: electrical, pneumatic, liquid fuel, hydraulic, and powder actuated tools. Some of the potential hazards of power tools include electric shock, which is specific to electric powered tools, while other hazards such as moving parts are general to all power tools.

Fortunately, most tools are designed with safety in mind. Manufacturers are careful to address safety issues in regard to their tools and usually provide users' manuals with specific instructions on the use of tools in the manner that they were designed. To ensure that the tools are designed and manufactured properly, Cal/OSHA requires that all power tools include guards, switches and controls, an electrical grounding plug, be double insulated, and have maintenance guidelines. If the tool you are using has broken or missing guards, switches, or grounding conductors, then do not use the tool. Remember the following when using power tools with guards:

- Safety guards must never be removed when a tool is being used.

- All projections on revolving or reciprocating edges must be flush or guarded.
- Tools with wheels, blades, sanding, and grinding parts must be guarded.

Discussion Topics:

- What are the different types of power tools in use at your facility?
- Do all of your portable power tools meet the guidelines required by OSHA? (i.e., guards, switches and controls, grounding plug or double insulated, maintenance guidelines)

General Safety Precautions

Employees who use hand and power tools and who are exposed to the hazards of falling, flying, abrasive and splashing objects, or exposed to harmful dusts, fumes, mists, vapors, or gases, must be provided with the proper personal protective equipment necessary to protect them from the hazard.

All hazards involved in the use of power tools can be prevented by following five basic safety rules:

1. Keep all tools in good condition with regular maintenance.
2. Use the right tool for the job.
3. Examine each tool for damage before use.
4. Operate tools according to the manufacturer's instructions.
5. Provide and use the proper protective equipment.

Employees and employers have a responsibility to work together to establish safe working procedures. If a hazardous situation is encountered, work should be stopped as soon as possible and the situation should be brought to the attention of the supervisor immediately.

Discussion Topics:

- What hazards are you exposed to when using portable power tools and what PPE do you wear to protect you against these hazards?
- Are portable power tools being inspected before each use? If not, why not? If yes, remember to document the maintenance or repair of all power tools in your machinery maintenance log.

Key Takeaway Points

- Effective written procedures and training are essential in portable power tool safety.
- Always check the tool before use for any visible damage or alteration.
- Never use a tool that is damaged or has been altered.
- Always use adequate personal protective equipment that will both protect the worker and allow for a firm grip or hold during use.

APPENDIX W: TRAINING GUIDE - PERSONAL PROTECTIVE EQUIPMENT (PPE)

Effective dissemination of safety information is an integral part of the Injury and Illness Prevention Program. This document was created to facilitate worker safety training. Training must be completed before the use of any tool or piece of equipment, exposure to any hazardous conditions, and/or when new hazards are identified.

In Preparation for this meeting (items needed):

- Training Documentation Form
- Examples of PPE used in your shop

Introduction

Hazards exist in every workplace in many different forms: sharp edges, falling objects, flying sparks, chemicals, noise and many other potentially dangerous situations. Cal/OSHA requires that supervisors protect their employees from workplace hazards that can cause injury. Controlling a hazard at its source is the best way to protect employees. Depending on the hazard or workplace conditions, Cal/OSHA recommends the use of engineering or administrative controls to manage or eliminate hazards. However, when engineering and administrative controls are not feasible or do not provide sufficient protection, supervisors must provide personal protective equipment (PPE) to their employees and ensure its use. PPE is equipment worn to minimize exposure to a variety of hazards.

Discussion Topics:

- What tasks in your workplace cannot be controlled by engineering or workplace controls and require the use of PPE?
- What types of PPE are used in your workplace?

PPE Requirements

To ensure the greatest possible protection for employees in the workplace, cooperative effort between supervisors and employees is needed in establishing and maintaining a safe and healthful work environment. Responsibilities are as follows:

Supervisors:

- Perform a hazard assessment of the workplace to identify and control physical and health hazards
- Identify and provide ANSI approved PPE for employees at no cost to the employee
- Train employees in the use and care of PPE
- Maintain PPE, including replacing worn or damaged PPE
- Periodically review, update, and evaluate the effectiveness of the PPE program

Employees:

- Properly wear PPE
- Attend training sessions on PPE

- Care for, clean and maintain PPE
- Inform a supervisor of the need to repair or replace PPE

Discussion Topics:

- Take the time to evaluate your PPE program and receive feedback from your employees on whether the PPE used is adequate.
- Are all of the PPE requirements met in your workplace?

Training Requirements

Supervisors are required to train each employee who will need to use PPE. Employees must be trained on at least the following:

- When PPE is necessary
- What PPE is necessary
- How to properly put on, take off, adjust and wear the PPE
- The limitations of PPE
- Proper care, maintenance, useful life, and disposal of PPE

Supervisors should make sure that each employee demonstrates an understanding of the PPE training before they are allowed to perform work requiring the use of PPE. This includes the ability to properly wear and use PPE. If a supervisor believes that a previously trained employee is not demonstrating the proper understanding and skill level in the use of PPE, that employee should receive retraining. Additionally, training or retraining is also required when there are changes in the workplace or in the type of required PPE. The supervisor must document employee trainings with a sign-in sheet indicating the employee name, signature, date, and type(s) of PPE discussed.

Discussion Topics:

- Does your workplace have records showing that employees received training on PPE (in the form of the Hazard Assessment Tool for Shops or otherwise) as stated above? If not, take the time to go through and provide training on each item of PPE that you provide in your workplace (per the training requirements above).

Types of PPE

- **Head Protection**
  Hard hats provide protection from the impact of falling objects and other struck-by injuries and may help to provide protection against electrical shock. Hard hats must be replaced when damaged and/or every five years. When choosing a hard hat, ensure that the one you choose provides the level of protection needed for your working environment.
- **Eye and Face Protection**
  When selecting the most suitable eye and face protection for employees, the following elements should be taken into consideration:
  - Ability to protect against specific workplace hazards
  - Should fit properly and be reasonably comfortable to wear
  - Should provide unrestricted vision and movement

- Should be durable and cleanable
- Should allow unrestricted functioning of any other required PPE

Some common examples of eye and face protection include: safety glasses, goggles, welding shields, laser safety goggles, and face shields.

- **Hand Protection**
  Hand injuries are one of the most common types of injuries. It is critical that you protect your hands with gloves. Not all gloves are created the same. The following are common examples of gloves and their uses:
  - Leather: better grip
  - Cotton: general use
  - Stainless steel mesh: cut resistance
  - Kevlar: sharp edges
  - Welder's: welding
  - Rubber or Nitrile: chemical
  - Disposable: biohazards
  - Neoprene: handling propane
  - Specific use: chemical dependent

- **Foot and Leg Protection**
  Employees who face possible foot or leg injuries from falling or rolling objects or from crushing or penetrating materials should wear protective footwear. Also, employees whose work involves exposure to hot substances or corrosive or poisonous materials must have protective gear to cover exposed body parts, including legs and feet. If an employee's feet may be exposed to electrical hazards, non-conductive footwear should be worn.

  The following are common examples of foot and leg protection: metatarsal guards, toe guards, shin guards, steel-toe boots, and safety shoes.

- **Respiratory Protection**
  Certain shop tasks may require the use of a respirator. If you must wear a respirator, you must attain medical clearance, be fit-tested once a year, and remain clean shaven.

  Most employees are not required to wear respiratory protection. However, for many tasks, a dust mask is strongly recommended. When using a dust mask, remember that they must be worn properly to do the job. Dispose of them after use or store them properly. Never leave masks hanging on equipment.

- **Hearing Protection**
  Many factors are involved in determining the need to provide hearing protection for employees. This can depend on:
  - Loudness of the noise as measured in decibels (dB)
  - Duration of each employee's exposure to the noise
  - Whether or not employees move between work areas with different noise levels
  - Whether or not noise is generated from one or multiple sources

Some types of hearing protection include: single use earplugs, molded earplugs, and earmuffs.

Discussion Topics:

- From the items of PPE just discussed, have you identified the need for PPE that is not currently provided? If yes, state what type of PPE is needed and why.

Key Takeaway Points

- Familiarity with different types of PPE
- Knowledge of tasks that require PPE
- Knowledge of PPE training requirements
- Knowledge of personal responsibility for wearing PPE

APPENDIX X: TRAINING GUIDE - SAFE LIFTING/BACK INJURY PREVENTION

Effective dissemination of safety information is an integral part of the Injury and Illness Prevention Program. This document was created to facilitate worker safety training. Training must be completed before the use of any tool or piece of equipment, exposure to any hazardous conditions, and/or when new hazards are identified.

In Preparation for this meeting (items needed):

- Training Documentation Form
- Prepare to demonstrate proper lifting techniques.
- Consider the lifts workers must complete. Be prepared to review lifts requiring two workers or mechanical lifting devices.
- Prepare to demonstrate stretches that employees should perform to prepare for and compensate for work they have to do.

Introduction

Many lifting injuries can be prevented by reducing the weight and number of lifts as much as possible, and by learning how to use appropriate lifting techniques when it is necessary to lift and carry objects.

Use forklifts, hoists, carts, dollies, and other types of lifting equipment when you have to lift or move heavy or bulky objects. If you must lift or move objects by hand, use of proper lifting techniques can save you a great deal of discomfort.

Before lifting an object, assess the situation by asking yourself the following questions:

- Can you lift this load safely, or is it a two-person lift?
- How far will you have to carry the load?
- Is the path clear of clutter, cords, slippery areas, overhangs, stairs, curbs and uneven surfaces?
- Will you encounter closed doors that need to be opened?
- Once the load is lifted, will it block your view?
- Can the load be broken down into smaller parts?
- Would gloves improve your grip or protect your hands?

Size up the load

- Test the weight by lifting one of the corners. If it is too heavy or is shaped awkwardly, stop.
- Consider asking for help from fellow workers, or break down the load into smaller parts.
- Try to use a mechanical lift or a hand truck.

Discussion Topic: What objects do you often carry at your workplace? Can these objects be carried in a safer manner?

The Art of Lifting

There is really no “right way” to lift. However, there are more and less demanding ways to lift. The key to working safely is to figure out how to lift in the least demanding way possible when you have to move materials or tools. Here are some guidelines to reduce your risk exposure when lifting:

Keep It Close and Keep the Curves! The closer a load is kept to your power zone, the easier it is to keep the natural curves of your back. When the spine is in its natural curves, the vertebra, discs, ligaments and muscles are in their strongest and most supportive position.

Staggered Stance: Lifting with the feet close together and in line with each other makes it more difficult for you to use your legs to help with the lift. Staggering your stance encourages the legs to become involved and reduces the demands on your back. Simply stepping toward a load (with a staggered stance) moves the center of gravity closer to the load and minimizes the demands of the lift. If you feel your weight shifting forward onto your forward leg, you have successfully transferred this weight demand from your back to your stronger legs.

Build a Bridge: In most cases, the demands of any lift are determined by the position of the lifter’s upper body during the lift. Many people lift by bending over at the waist, leaving their upper body hanging like a “one-sided bridge”. This places all the demands of the lift onto the lower back. This load can be reduced by “building a bridge” to support the weight of the upper body. To do this, place an arm on your leg or a nearby stationary object. If you need both of your arms to manage the object you are lifting, step forward toward the load with one leg and create a “bridge” with your legs to reduce the workload on your back.

Feet First: Moving your feet first gets you closer to the load and reduces the amount you have to reach. The farther you reach, the more you have to lift your upper body as well as the load. Turning with your feet first (pivoting) also helps reduce the risk of twisting while you lift.

Discussion Topic: Ask for volunteers to demonstrate the concepts of “Keep it Close and Keep the Curves”, “Staggered Stance”, “Build a Bridge”, and “Feet First”.

Prepare and Compensate

Lifting and carrying loads can be hard work. Like athletes, workers can avoid injuries or discomfort by preparing the body for work. Muscles generate more force when warm and full of oxygen. Stretching and moving around prior to work helps pump blood into your muscles. Blood warms up muscles and brings in oxygen, allowing your muscles “to breathe”. This can be particularly effective at the beginning of the workday and after breaks.

Compensating for work demands simply means letting the body recover from work in an efficient manner. Performing periodic stretches can minimize accumulation of fatigue throughout the day. Stretches can "apologize" to the body for working it so hard.

Discussion

- Do you prepare and compensate before and after lifting and carrying heavy loads? Demonstrate some simple stretches that can help the employees prepare and compensate before and after a lift.

Use Mechanical Lifting Devices Whenever Possible

The best way to avoid a back injury is to reduce the number of lifts you have to do as much as possible. Hand trucks, pushcarts and forklifts are great engineering controls that reduce your exposure to lifting hazards. If you use a forklift, make sure you have training and are authorized to operate one.

Using hand trucks and pushcarts

- Push rather than pull. It is easier and safer to push than to pull. You can use your body weight to assist when pushing.
- Use powered carts when available.
- Keep close and lock your arms. Stay close to the load, try not to lean over and keep the curves of your back when pushing or pulling.
- Use both hands. Carts are easier to push and control using both hands.
- Use tie-downs, if necessary, to secure the load.

Discussion

- What devices are available to you in your workplace to reduce your exposure to lifting hazards? Are these devices enough or is there a need for additional devices?

Key Takeaway Points

- Evaluate the lifts you must do and determine if they can be safety done alone. If not, ask for help or get a mechanical lifting device.
- Remember there is no "right" or "wrong" way to lift. There are less or more demanding ways.
- Follow these four guidelines to reduce the demands of the lifts you must complete:
  - Keep it close and keep the curves
  - Staggered stance
  - Build a bridge
  - Feet first
- When using carts, push rather than pull whenever possible. Use both hands and stay close to the load.

APPENDIX Y: TRAINING GUIDE - EMPLOYEE SAFETY TRAINING MATRIX AND RECORD

Employee Name: _____

Topic	Frequency Required			Trainer
	Upon Hire	As Hazards Change	Annual	Trainer
General Safety Training Required by all Shop Employees				
Emergency Preparedness/ Earthquake Safety	x	x		Office of Emergency Management or Shop
Fire Safety	x	x		Shop
Hand Tool Safety	x	x		Shop
Hazard Communication	x	x		EHS or Shop
Housekeeping Practices	x	x		Shop
Illness & Injury Preparedness Program (IIPP)	x	x	x	Shop
Lockout/Tagout	x			EHS
Personal Protective Equipment	x			Shop
Portable Power Tool Safety	x	x		Shop
Safe Lifting/Back Injury Prevention	x			Shop
Job-Specific Training				
Asbestos Awareness	x		x	EHS
Asbestos Abatement	x		x	Contact EHS for Out-Sourced Vendor
Biosafety: Bloodborne Pathogens	x		x	EHS
Chemical Fumehood	x	x		Shop
Confined Space Entry	x	x	every 2 yrs*	Contact EHS for Out-Sourced Vendor
Fall Protection	x	x*	every 2 yrs*	Contact EHS for Out-Sourced Vendor
Forklift Operator	x		every 3 yrs*	Contact EHS for Out-Sourced Vendor
Hazardous Waste	x		x	EHS
Heat Illness Prevention for Outdoor Workers	x		x*	EHS or Shop
Lab Awareness	x			EHS
Ladder Safety	x	x	x	EHS or Shop
Lead Abatement	x		x	Contact EHS for Out-Sourced Vendor
Power Tool Safety	x	x*	x*	Shop
Respirator Training & Fit Test	x		x	EHS
Sewage Clean-Up Procedure	x			EHS
Shop Safety and Hazard Awareness	x	x		Shop

Note: Additional trainings may be required by your department. **As best practice, or per EH&S policy.*