Welcome! **Thank you for purchasing this course either as part of the 60-Hour program or for Continuing Competency. Many of the courses are available in both Video and/or Text. It is not necessary to complete both versions. We offer both versions to ensure your learning style is addressed. You can choose whether you want to watch the video, or read the text, but you DO NOT have to do both. You can use either version for study purposes- just be sure to take the all quizzes in one version OR the other.**

This course is a review of the safety codes needed for residential construction. By studying these codes and providing visuals when necessary, the students will gain a greater understanding of how to comply with the safety standards of Michigan. A copy of the Michigan Construction Safety Codes that apply to Residential Building is included with the course at no additional cost (Attached as a PDF to the Introduction). This course will help the student become better acquainted with the safety codes.

If you are taking this course as part of the 60-Hour Prelicense Program, please read the information below:

The 60-Hour program is made up of 8 separate courses listed below. Five of the courses are available in both Video and Text/Online. It is not necessary to complete both versions. You can choose whether you want to watch the video version or read the text version. As the videos for the other four courses are completed, they will be added to your registration at no additional charge.

COURSES

1. Business of Building (Video or text)

2. Contracts, Liabilities and Risk Management (Video or text)
3. Project Management for Contractors (Video or text)
4. Marketing for Building Contractors (Video or text)
5. Building Green (Video or text)
6. Residential Code Review (Video coming soon)
7. Michigan Construction Safety (Video or text)
8. Overview of Building Trades (Video or text)

PLEASE CONTINUE READING:

FREE WITH PURCHASE

These are all optional and not required in order to complete the 60-Hour program, but the math tutorial and exam prep are extremely helpful in studying for the State exam.

--3-Hour Math Tutorial video for State exam prep
--Michigan Exam Prep (sample questions for State exam prep)

You will be sent the following via U.S. Postal Service and should receive them within 3-5 business days:

-- Applications to the state of Michigan
-- PSI Testing Information booklet
-- MIOSHA Test Review sheet

-- Books (if ordered)

We have included the actual Construction Safety Standards for you in pdf format above. You are welcome to print them for your own personal use.

CONSTRUCTION SAFETY STANDARDS

Introduction

MIOSHA Office of Training & Education

The federal laws concerning the Occupational Safety and Health (OSHA) of employees are administered in Michigan by (MIOSHA), which falls under the authority of the Michigan Department of Licensing and Regulatory Affairs (LARA). MIOSHA is responsible for worker safety and health protection. States have the option of taking over the enforcement of these rules. The rules that each state create must be at least as strict as those of the federal standards.

Is there a need for MIOSHA?

EACH YEAR...

* Nearly **6,000** workplace fatalities occur
* **50,000** deaths from workplace-related illnesses
* **5.7 million** non-fatal workplace injuries
* Injuries alone cost US businesses over **$125 billion**

Has MIOSHA made a difference?

YES!!

Since 1970 MIOSHA has:

- Helped cut the work-related fatality rate in half
- Worked with employers and employees to reduce workplace injuries and illnesses by 40%
- Virtually eliminated brown lung disease in the textile industry, and
- Reduced trenching and excavation fatalities by 35%

What does MIOSHA do?

- Encourages employers and employees to reduce workplace hazards and implement new or improve existing safety and health programs
- Develops and enforces mandatory job safety and health standards
- Maintains a reporting and record keeping system to monitor job-related injuries and illnesses
- Provides assistance, training and other support programs to help employers and workers.

Who is covered by MIOSHA?

- Most private sector employees

- Does not cover the self-employed or immediate members of farm families that do not employ outside workers

MIOSHA STANDARDS

- MIOSHA develops and enforces standards that employers must follow
- Where MIOSHA does not have standards, employers are responsible for following the OSH Act's General Duty Clause
- Each employer shall furnish to each of his/her employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to employees..

What does MIOSHA require?

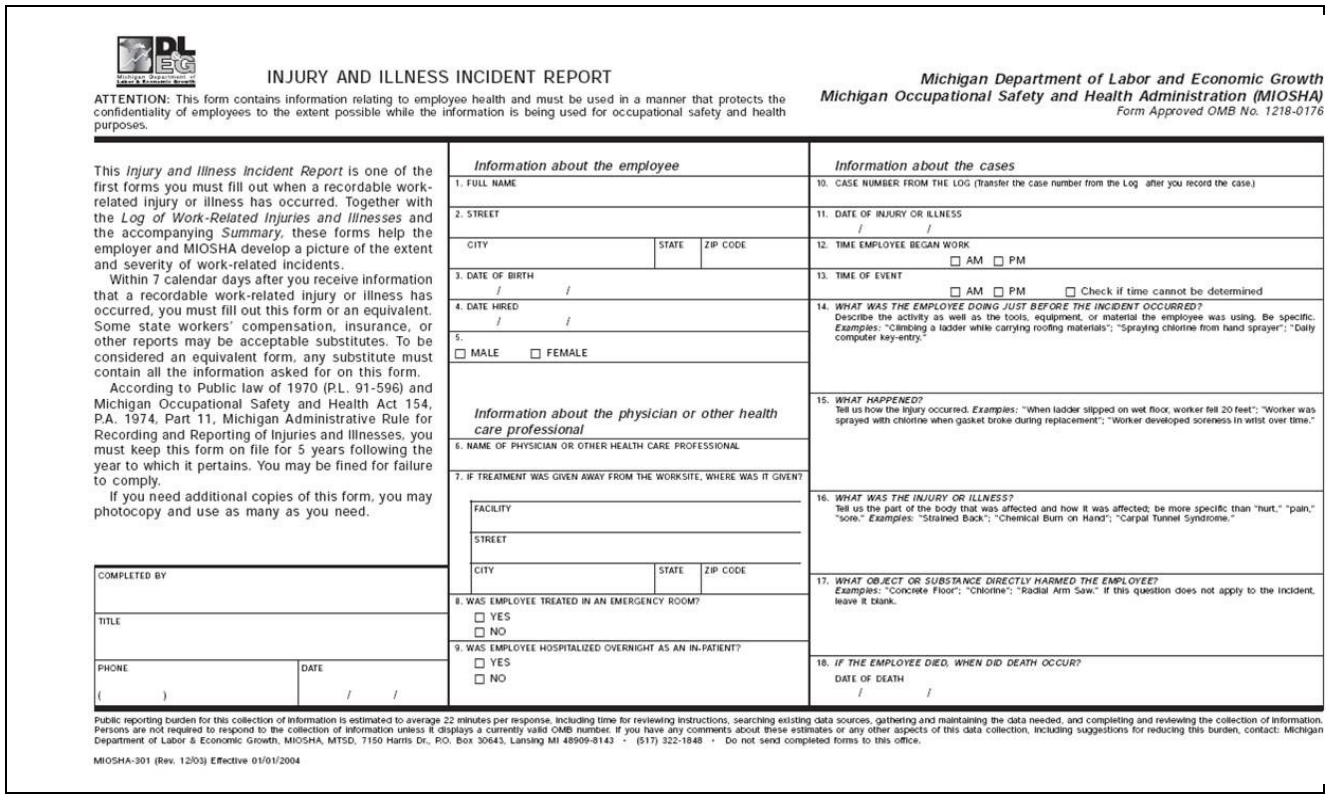
- Determine which standards apply to your workplace
- Follow the MIOSHA standards and requirements.

RECORDKEEPING AND REPORTING

- Employers of **11 or more employees** must maintain records of occupational injuries and illnesses
- All employers must display the MIOSHA poster, and report to OSHA within 8 hours any accident that results in a fatality or in-patient hospitalization of 3 or more employees
- All forms must be maintained on a calendar year basis
- A summary of records for the previous year must be posted from February through April

MIOSHA FORM 301

(must be filled out within 7 days or a recordable event)



INJURY AND ILLNESS INCIDENT REPORT

Michigan Department of Labor and Economic Growth
Michigan Occupational Safety and Health Administration (MIOSHA)
Form Approved OMB No. 1218-0176

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

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

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

According to Public law of 1970 (P.L. 91-596) and Michigan Occupational Safety and Health Act 154, P.A. 1974, Part 11, Michigan Administrative Rule for Recording and Reporting of Injuries and Illnesses, you must keep this form on file for 5 years following the year to which it pertains. You may be fined for failure to comply.

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

COMPLETED BY

TITLE

PHONE ( )

DATE / /

Information about the employee

1. FULL NAME
2. STREET
CITY | STATE | ZIP CODE
3. DATE OF BIRTH / /
4. DATE HIRED / /
5. ☐ MALE ☐ FEMALE

Information about the physician or other health care professional

6. NAME OF PHYSICIAN OR OTHER HEALTH CARE PROFESSIONAL
7. IF TREATMENT WAS GIVEN AWAY FROM THE WORKSITE, WHERE WAS IT GIVEN?
FACILITY
STREET
CITY | STATE | ZIP CODE
8. WAS EMPLOYEE TREATED IN AN EMERGENCY ROOM? ☐ YES ☐ NO
9. WAS EMPLOYEE HOSPITALIZED OVERNIGHT AS AN IN-PATIENT? ☐ YES ☐ NO

Information about the cases

10. CASE NUMBER FROM THE LOG (Transfer the case number from the Log after you record the case.)
11. DATE OF INJURY OR ILLNESS / /
12. TIME EMPLOYEE BEGAN WORK ☐ AM ☐ PM
13. TIME OF EVENT ☐ AM ☐ PM ☐ Check if time cannot be determined
14. *WHAT WAS THE EMPLOYEE DOING JUST BEFORE THE INCIDENT OCCURRED?* Describe the activity as well as the tools, equipment, or material the employee was using. Be specific. *Examples:* "Climbing a ladder while carrying roofing materials"; "Spraying chlorine from hand sprayer"; "Daily computer key-entry."
15. *WHAT HAPPENED?* Tell us how the injury occurred. *Examples:* "When ladder slipped on wet floor, worker fell 20 feet"; "Worker was sprayed with chlorine when gasket broke during replacement"; "Worker developed soreness in wrist over time."
16. *WHAT WAS THE INJURY OR ILLNESS?* Tell us the part of the body that was affected and how it was affected; be more specific than "hurt," "pain," "sore." *Examples:* "Strained Back"; "Chemical Burn on Hand"; "Carpal Tunnel Syndrome."
17. *WHAT OBJECT OR SUBSTANCE DIRECTLY HARMED THE EMPLOYEE?* *Examples:* "Concrete Floor"; "Chlorine"; "Radial Arm Saw." If this question does not apply to the incident, leave it blank.
18. *IF THE EMPLOYEE DIED, WHEN DID DEATH OCCUR?* DATE OF DEATH / /

Public reporting burden for this collection of information is estimated to average 22 minutes per response, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Persons are not required to respond to the collection of information unless it displays a currently valid OMB number. If you have any comments about these estimates or any other aspects of this data collection, including suggestions for reducing this burden, contact: Michigan Department of Labor & Economic Growth, MIOSHA, MTSD, 7150 Harris Dr., P.O. Box 30643, Lansing MI 48909-8143 • (517) 322-1848 • Do not send completed forms to this office.

MIOSHA-301 (Rev. 12/03) Effective 01/01/2004

Recordable injuries include death, days away from work, restricted work or transfer to another job, medical treatment beyond first aid and loss of consciousness.

MIOSHA FORM 300

LOG OF WORK RELATED INJURIES AND ILLNESSES

Year 20 ____ ____

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

Michigan Department of Labor and Economic Growth
Michigan Occupational Safety and Health Administration (MIOSHA)
Form Approved OMB No. 1218-0176

You must record information about every work-related death and about every work-related injury or illness that involves loss of consciousness, restricted work activity or job transfer, days away from work, or medical treatment beyond first aid. You must also record significant work-related injuries and illnesses that are diagnosed by a physician or licensed health care professional. You must also record work-related injuries and illnesses that meet any of the specific recording criteria listed in Public Law of 1970 (P.L. 91-596) and Michigan Occupational Safety and Health Act 154 P.A. 1974, Part 11, Michigan Administrative Rule for Recording and Reporting of Injuries and Illnesses. Feel free to use two lines for a single case if you need to. You must complete an injury and illness Incident Report (MIOSHA Form 301) or equivalent form for each injury or illness recorded on this form. If you're not sure whether a case is recordable, call your local MIOSHA office for help. You may be fined for failure to comply.

ESTABLISHMENT NAME

CITY | STATE

IDENTIFY THE PERSON			DESCRIBE THE CASE			CLASSIFY THE CASE											
						Using these four categories, check ONLY the one most serious result for each case:				Enter the number of days the injured or ill worker was:		Check the "Injury" column or choose one type of illness: (M)					
(A) Case no.	(B) Employee's name	(C) Job title (e.g. Welder)	(D) Date of injury or onset of illness	(E) Where event occurred (e.g., Loading dock north end)	(F) Describe injury or illness, parts of body affected, and object / substance that directly injured or made person ill (e.g., Second degree burns on right forearm from acetylene torch)	Death	Days away from work	Remained at work: Job transfer or restriction	Remained at work: Other recordable cases	Away from work	On job transfer or restriction	Injury	Skin disorder	Respiratory condition	Poisoning	Hearing loss	All other illnesses
						(G)	(H)	(I)	(J)	(K)	(L)	(1)	(2)	(3)	(4)	(5)	(6)
			Month / Day /			☐	☐	☐	☐	____Days	____Days	☐	☐	☐	☐	☐	☐
			Month / Day /			☐	☐	☐	☐	____Days	____Days	☐	☐	☐	☐	☐	☐
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					Page Totals ➧	____	____	____	____	____	____	____	____	____	____	____	____
												Injury (1)	Skin disorder (2)	Respiratory condition (3)	Poisoning (4)	Hearing loss (5)	All other illnesses (6)

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

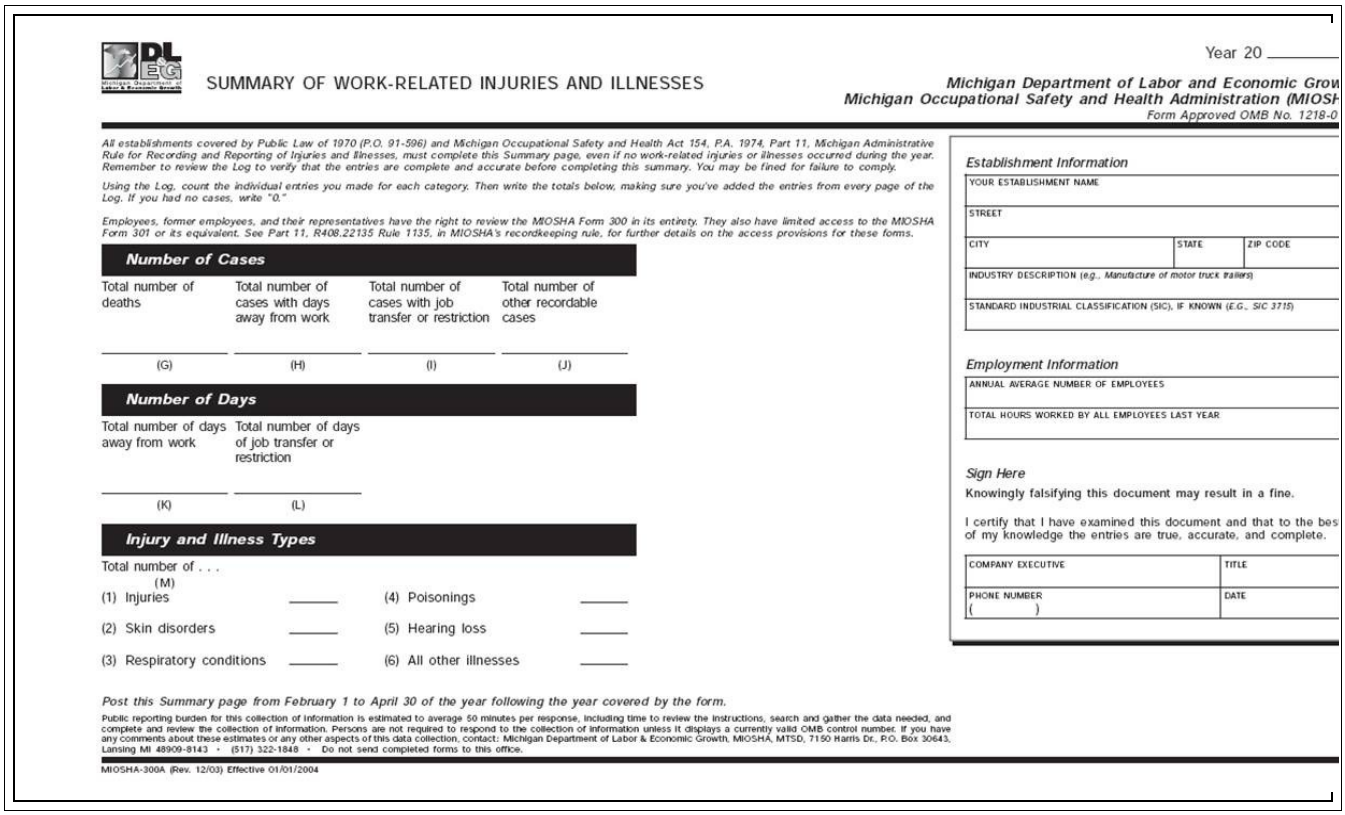
Hearing Standard Threshold Shifts must be recorded under Column 5

Public reporting burden for this collection of information is estimated to average 14 minutes per response, including time to review the instructions, search and gather the data needed, and complete and review the collection of information. Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number. If you have any comments about these estimates for any other aspects of this data collection, contact:
Michigan Department of Labor & Economic Growth, MIOSHA, MTSD
7150 Harris Dr., P.O. Box 30643, Lansing, MI 48909-8143 • (517) 322-1848 • Do not send completed forms to this office.

MIOSHA-300 (Rev. 11/03) Effective 01/01/2004

Page____ of _____

MIOSHA FORM 300A



SUMMARY OF WORK-RELATED INJURIES AND ILLNESSES

Year 20 _____

Michigan Department of Labor and Economic Grow
Michigan Occupational Safety and Health Administration (MIOSH
Form Approved OMB No. 1218-0

All establishments covered by Public Law of 1970 (P.O. 91-596) and Michigan Occupational Safety and Health Act 154, P.A. 1974, Part 11, Michigan Administrative Rule for Recording and Reporting of Injuries and Illnesses, must complete this Summary page, even if no work-related injuries or illnesses occurred during the year. Remember to review the Log to verify that the entries are complete and accurate before completing this summary. You may be fined for failure to comply.

Using the Log, count the individual entries you made for each category. Then write the totals below, making sure you've added the entries from every page of the Log. If you had no cases, write "0."

Employees, former employees, and their representatives have the right to review the MIOSHA Form 300 in its entirety. They also have limited access to the MIOSHA Form 301 or its equivalent. See Part 11, R408.22135 Rule 1135, in MIOSHA's recordkeeping rule, for further details on the access provisions for these forms.

Number of Cases

Total number of deaths	Total number of cases with days away from work	Total number of cases with job transfer or restriction	Total number of other recordable cases
(G)	(H)	(I)	(J)

Number of Days

Total number of days away from work	Total number of days of job transfer or restriction
(K)	(L)

Injury and Illness Types

Total number of . . . (M)

(1) Injuries _____
(2) Skin disorders _____
(3) Respiratory conditions _____
(4) Poisonings _____
(5) Hearing loss _____
(6) All other illnesses _____

Establishment Information

YOUR ESTABLISHMENT NAME
STREET
CITY | STATE | ZIP CODE
INDUSTRY DESCRIPTION (*e.g., Manufacture of motor truck trailers*)
STANDARD INDUSTRIAL CLASSIFICATION (SIC), IF KNOWN (*E.G., SIC 3715*)

Employment Information

ANNUAL AVERAGE NUMBER OF EMPLOYEES
TOTAL HOURS WORKED BY ALL EMPLOYEES LAST YEAR

Sign Here

Knowingly falsifying this document may result in a fine.

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

COMPANY EXECUTIVE | TITLE
PHONE NUMBER ( ) | DATE

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

Public reporting burden for this collection of information is estimated to average 50 minutes per response, including time to review the instructions, search and gather the data needed, and complete and review the collection of information. Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number. If you have any comments about these estimates or any other aspects of this data collection, contact: Michigan Department of Labor & Economic Growth, MIOSHA, MTSD, 7150 Harris Dr., P.O. Box 30643, Lansing MI 48909-8143 · (517) 322-1848 · Do not send completed forms to this office.

MIOSHA-300A (Rev. 12/03) Effective 01/01/2004

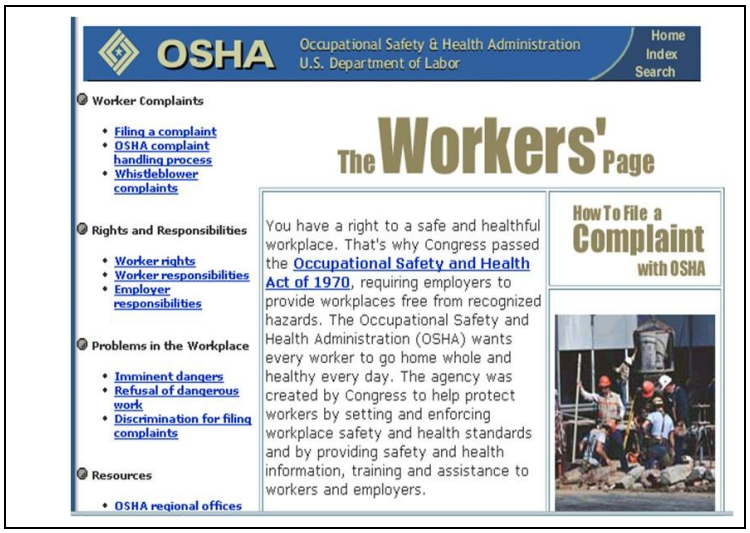
EMPLOYEE RIGHTS & RESPONSIBILITIES

What are workers' responsibilities?

- Read the MIOSHA poster.
- Follow the employer's safety and health rules and wear or use all required gear and equipment.
- Follow safe work practices for your job, as directed by your employer.
- Report hazardous conditions to a supervisor or safety committee.
- Report hazardous conditions to MIOSHA, if employers do not fix them.
- Cooperate with MIOSHA inspectors (see MIOSHA Workers' web page for more information).

What are workers' rights?

- Identify and correct problems in their workplaces, working with their employers whenever possible.
- Complain to MIOSHA about workplace conditions threatening their health or safety in person, by telephone, by fax, by mail or electronically through MIOSHA's web site.



- Section 11(c) of the MIOSH Act gives workers the right to week safe and healthful conditions on the job without being disciplined or fired (see OSHA Workers' web page for more information).

EMPLOYER RIGHTS & RESPONSIBILITIES

What are employers' rights and responsibilities?

- Employers must provide a safe and healthful workplace free of recognized hazards and follow the MIOSHA standards.
- Every jobsite is required to provide and have a written Construction Safety or Accident Prevention Program.
- The MIOSH Act grants employers important rights, particularly during and after an OSHA inspection.
- Employers must provide training, medical examinations and recordkeeping.

EMPLOYERS MUST APPOINT A COMPETENT PERSON (SAFETY OFFICER)

A person who:

- Knows the right standard
- Can identify hazards in the operation
- Is designated by the employer, and has the authority to take appropriate action
- "competent person" is found in many standards
- Some standards set specific requirements for the competent person

WORKPLACE INSPECTIONS

- Establishments covered by the MIOSH Act are subject to inspection by MIOSHA compliance safety and health officers (CHSO's).

- Most inspections are conducted without advance notice.

What Types of Hazards are Addressed in Standards?

- Electrical
- Cranes
- Falls
- Excavation
- Scaffolding
- Machines
- Stairways & Ladders
- Chemical
- Tools
- Personal Protection Equipment

Does an inspector have the right to enter your place of employment without permission?

According to MIOSHA Act 154, an inspector does have the right to conduct an inspection or investigation without unreasonably disrupting the employer's operations. If permission is denied, the department may apply to the proper judicial official for a warrant commanding the sheriff or a peace officer to aid the department in the inspection to determine if there is a safety or health violation.

EMPLOYER MAY QUALIFY FOR "FOCUSED INSPECTION"

- Has to meet certain conditions
- The inspector will "focus" on these four hazard areas
  - Falls
  - Struck by
  - Caught in/between
  - Electrical
- The Inspection process looks like this:
  - CSHO displays their official credentials
  - There will be an opening conference
  - Next a walk-around inspection
  - Ending with a closing conference
- Conducting the walk-around inspection:
  - CHSO and accompanying representatives (employer and employee) inspect the establishment for potentially hazardous working conditions
  - CHSO discusses possible corrective actions with the employer
  - CHSO may consult, at times privately, with employees
- What happens after the inspection?
  - MIOSHA may or may not issue citations
  - Citations inform the employer and employees of the regulations and standards allegedly violated and of the proposed time for abatement

- The employer must post a copy of each citation at or near the place where the violation occurred, for 3 days or until the violation is corrected, whichever is longer

SOURCES OF ASSISTANCE

- MIOSHA web site (www.michigan.gov/miosha)
- Consultation assistance
- Federal and State area offices
  - Speakers, publication, a/v aids, technical advice
- Training and education
  - MIOSHA Training Institute (OTI) and the OTI Education Centers
  - MIOSHA Outreach Training Program
- MIOSHA Office of State Programs
- Voluntary Protection Programs

--Where to get MIOSHA Standards

- MIOSHA website (wwwmichigan.gov/miosha)

CONSULTATION ASSISTANCE

- Provided at no cost.
- Developed for smaller employers with more hazardous operations.
- Delivered by state government agencies or universities employing professional safety and health consultants.
- No penalties are proposed or citations issued.
- Possible violations of MIOSHA standards are not reported to MIOSHA enforcement staff unless the employer fails to eliminate or control any serious hazard or imminent danger.

MIOSHA EMERGENCY HOT-LINE

1-800-858-0397

- Report workplace safety or health fatalities or the hospitalization of 3 or more employees.
- Report a workplace hazard.
- File a complaint about a workplace hazard.
- Request information on MIOSHA.
- Request an MIOSHA publication.

SUMMARY

- MIOSHA helps save lives and prevent injuries.
- MIOSHA balances a cooperative approach with traditional enforcement.
- MIOSHA standards are the enforceable requirements for worker safety and health.
- Inspections are MIOSHA's way to ensure compliance.
- MIOSHA offers various means of assistance.

Personal Protective Equipment

OSHA Office of Training & Education

STANDARDS	HEAD	EYE/HEARING	FOOT/HAND	BODY

Learning Objectives

Describe the causes of the most commmon workplace injuries.

Name the Personal Protective Equipment (PPE) most often used to protect workers.

All employees should be provided with, or have their own Personal Protective Equipment. Use Engineering Controls to change, remove, or enclose hazards. Implement Work Practice Controls to change the way work is done to reduce the hazard.

Personal protective equipment, commonly referred to as "PPE", is equipment worn to minimize exposure to a variety of hazards. Examples of PPE include such items as gloves, foot and eye protection, protective hearing devices (earplugs, muffs), hard hats, respirators and full body suits.
To ensure the greatest possible protection for employees in the workplace, the cooperative efforts of both employers and employees will help in establishing and maintaining a safe and healthful work environment.
http://www.osha.gov/SLTC/personalprotectiveequipment/index.html

Protecting Employees from Workplace Hazards

- Employers must protect employees from hazards such as falling objects, harmful substances, and noise exposures that can cause injury
- Employers must:
  - Use all feasible engineering and work practice controls to eliminate and reduce hazards
  - Use personal protective equipment (PPE) if the controls don't eliminate the hazards
- Personal Protective Equipment is the **last** level of control--meaning that engineering and work practice controls should be implemented before assigning Personal Protective Equipment to the particular job. Employers should try to physically remove potential dangers-- for example, by isolating a particular hazard or danger from the general workplace environment prior to starting the project. Another level of control that can be tried first is to modify the way worker performs the job itself to make it safer-- using wet methods to control harmful dust/airborne particles.

How do I identify potential hazards in my workplace?

Begin with a survey. Observe the work environment. Ask employees how they perform their tasks. Look for sources of potential injury such as:

- Objects that might fall from above.
- Exposed pipes or beams at work level.
- Exposed liquid chemicals.
- Sources of heat, intense light, noise, or dust.
- Equipment or materials that could produce flying particles.

ENGINEERING CONTROLS

If the work environment can be **physically changed** to prevent employee exposure to the potential hazard, then the hazard can be eliminated with an engineering control.
Examples...

- Initial design specifications
- Substitute less harmful material
- Change the process
- Enclose the process
- Isolate the process

WORK PRACTICE CONTROLS

If employees can change the way they do their jobs and the exposure to the potential hazard is removed, then the hazard can be eliminated with a **work practice control**. This is a type of administrative control where the employer **modifies the manner in which the employee performs assigned work.** The modification may result in a reduction of exposure through such methods as changing work habits, improving sanitation and hygiene practices, or making other changes in the way the employee performs the job.

Examples:

- **Job Rotation**--only reduces exposure--it does **NOT** eliminate the hazard.
- **Wet methods** suppress dust.
- **Personal Hygiene** is very important when working in areas where toxic substances such as lead or asbestos are present. Good hygiene practices can prevent the spread of toxic materials to your family.
- **Housekeeping and Maintenance** are essential tools in eliminating hazards such as slips, trips and falls.

EMPLOYER RESPONSIBILITIES:

- Assess workplace for hazards
- Determine when to use Personal Protective Equipment
- Provide PPE training for employees and instruction in proper use

♦ **Employers must provide PPE for employees if:**

- Their work environment presents a hazard or is likely to present a hazard to any part of their bodies; **OR**
- Their work processes present a hazard or are likely to present a hazard to any part of their bodies; **OR**
- During their work, they might come into contact with hazardous chemicals, radiation, or mechanical irritants; **AND**

- You are unable to eliminate employee exposure or potential exposure to the hazard by engineering, work practice, or administrative controls.

♦ **Employers must provide:**

a. **Hard Hat--**Class A rated when there is a risk of bumping their head, falling objects, and flying objects. Class B helmets are worn by electricians.

b. **Safety Glasses**—these are almost ALWAYS necessary in any given construction environment.

c. **Life Jackets** and a **Rescue Boat** if working on or near water.

♦ **Employers are required to train** each employee who must use PPE.
Employees must be trained to know at least the following:
a. When and what PPE is necessary.
b. How to properly put on, take off, adjust and wear the PPE.
c. The limitations of the PPE.
d. Proper care, maintenance, useful life and disposal of PPE.

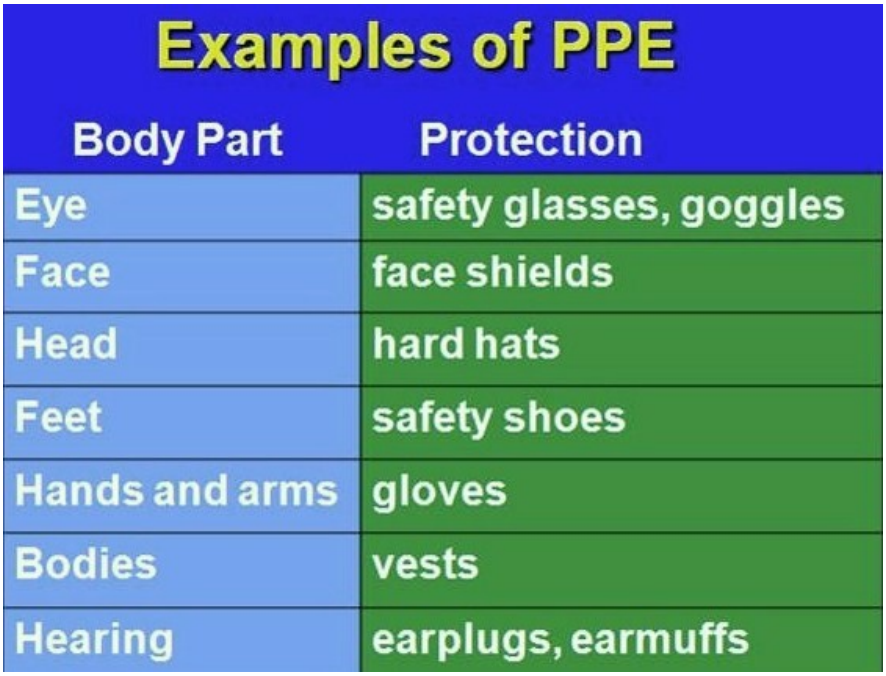
EMPLOYEE RESPONSIBILITIES:

- Use PPE in accordance with training received and other instructions.
- Inspect daily and maintain in a clean and reliable condition.

♦ **Employees must provide:**

a. **Safety boots:** employees are responsible for ordinary, general purpose work boots. If special protective boots are necessary, the employer shall provide them.

b. **Gloves:** employees are responsible for general purpose gloves. If special protective gloves are necessary—it is the responsibility of the employer to provide them.



Examples of PPE	
Body Part	Protection
Eye	safety glasses, goggles
Face	face shields
Head	hard hats
Feet	safety shoes
Hands and arms	gloves
Bodies	vests
Hearing	earplugs, earmuffs

↑**TOP OF PAGE**

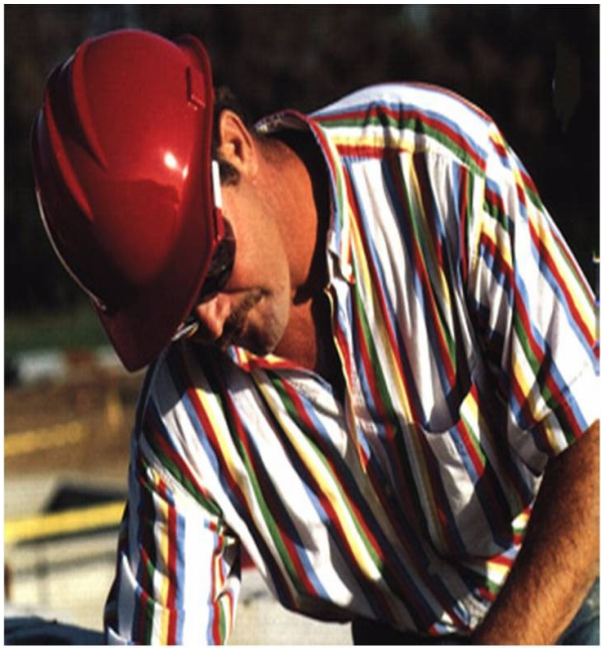
HEAD INJURIES

Hard hats were worn by only **16%** of workers sustaining head injuries, although two-fifths were required to wear them for certain tasks at specific locations. *
A majority of these workers were injured while performing their normal jobs at regular worksites.
Cuts or bruises to the scalp and forehead occurred in **85%** of the cases, concussions in **26%.** Over a third of the cases resulted from falling objects striking the head. *

** U.S. Department of Labor, Bureau of Labor Statistics, Accidents Involving Head Injuries, Report 605*

♦ **Causes of Head Injuries**

- Falling objects such as tools
- Bumping head against objects, such as pipes or beams
- Contact with exposed electrical wiring or components



♦ **Selecting the Right Hard Hat**

Hard hats require a hard outer shell and a shock-absorbing lining. The lining should incorporate a head band and straps that suspend the shell 1 to 1-1/4 inches away from the user's head to provide shock absorption during impact and ventilation during wear.
Remove hard hats from service if the suspension system shows signs of deterioration or no longer holds the shell away from the employee's head. Also make sure the brim or shell is not cracked, perforated or deformed or shows signs of exposure to heat, chemicals, or ultraviolet light. Stickers, or custom painting is unacceptable.

Class A:

- General service (building construction, shipbuilding, lumbering)
- Good impact protection but limited voltage protection

Class B:

- Electrical/Utility work
- Protects against falling objects and high-voltage shock and burns

Class C:

- Designed for comfort, offers limited protection
- Protects against bumps from fixed objects, but does not protect against falling objects or electrical shock.

Case Reports

The following Case Reports of accidents investigated by OSHA illustrate how seemingly innocent workplace activities can have deadly consequences.

- *An employee was standing under a suspended scaffold that was hoisting a workman and three sections of ladder. Sections of the ladder became unlashed and fell 50 feet, striking the employee in the skull. The employee was not wearing any head protection and died from injuries received.*
- *Two employees were using a wire rope to winch a wooden tool shed onto a flat bed trailer. The wire rope broke, snapped back, and struck one of the employees in the top of the head, killing him. The employee was not wearing a hard hat.*
- *Workers were using a winch to pull a 10-foot section of a 600 lb. grain spout through a vent hole, when the spout became wedged. Using pry bars, they attempted to free the spout, which was still under tension from the winch. When it popped free, the release of tension caused it to strike one of the workers in the head, who had no head protection.*

- *A carpenter was attempting to anchor a plywood form in preparation for pouring a concrete wall, using a powder actuated tool. The nail passed through the hollow wall, traveled some 27 feet, and struck an apprentice in the head, killing him. The tool operator had never been trained in the proper use of the tool, and none of the employees in the area, including the victim, were wearing personal protective equipment.*

Progress Check

- List at least five examples of PPEs.
- Name three causes of head injuries.

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EYE PROTECTION

Eye protection must be provided when any of these hazards are present:

- Dust and other flying particles, such as metal shavings or sawdust--almost **70%** of the accidents studied resulted from flying or falling objects, or sparks striking the eye.
- Corrosive gases, vapors, and liquids--contact with chemicals caused one-fifth of the injuries. Battery charging, installing fiberglass insulation, and compressed air or gas operations are areas of concern.
- Molten metal that may splash.
- Potentially infectious materials such as blood or hazardous liquid chemicals that may splash.
- Intense light from welding and lasers.

Where do accidents happen most often?*
-- More than 40% of injuries occurred among craft workers, like carpenters and plumbers. Over a third of the injured workers were operatives, such as assemblers, sanders, and grinding machine operators. More than 20% of the injured workers were employed in construction.

** U.S. Department of Labor, Bureau of Labor Statistics, Accidents Involving Eye Injuries, Report 597*

Solvent in the Eye: Could Have Been Worse • by Kenny

About 25 years ago, I spent a morning with an insurance agent looking at business insurance plans. When we got to the topic of workmen's compensation, the agent pointed out that plumbers had a high incidence of eye injuries.

Later that afternoon, I stopped by a job site to check on the progress of my men. I walked up to my head plumber, who was working off a ladder at the time, looked up at his work — and bam! A drop of PVC glue splashed into my right eye. The insurance guy was right.

As soon as that glue hit, it felt as if someone had stuck something sharp in my eye. Thanks to the pain and the tears now streaming from both eyes, I ran into a wall on my dash to flush out my eye at the nearest sink. Later, the ophthalmologist did a more t job of flushing out the eye and gave me drop fully, there was no permanent damage.

At the time, our company was small, with n safety policy. But ever since that incident, I ke of safety goggles on hand, and so do my em Better yet, we use them whenever we think th possibility of getting an eyeful.

Kenny Hart and his father operate Hart's Plum Heating in Virginia Beach, Va.

Courtesy of/Permission Granted by the Journal of Light Construction

♦ Criteria for Selection

- Protects against specific hazards
- Comfortable to wear
- Does not restrict vision or movement
- Durable and easy to clean and disinfect
- Does not interfere with the function of other required PPE

♦ Eye Protection for Employees Who Wear Eyeglasses

Ordinary glasses do NOT provide the required protection. Proper choices include:

- Prescription glasses with side shields and protective lenses
- Goggles that fit comfortably over corrective glasses without disturbing the glasses

- Goggles that incorporate corrective lenses mounted behind protective lenses

1. SAFETY GLASSES

- Made with metal/plastic safety frames
- Most operations require side shields
- Used for moderate impact from particles produced by jobs such as carpentry, woodworking, grinding, and scaling

2. GOGGLES

- Protect eyes and the area around the eyes from impact, dust, and splashes
- Some goggles fit over corrective lenses
- Laser (welding) safety goggles protect eyes from intense concentration of light produced by lasers

3. FACE SHIELDS

According to the Dept. of Labor, only 1% of approximately 770 workers suffering face injuries were wearing face protection. The majority of these workers were injured while performing their normal job duties.

- Full face protection
- Protect face from dust and splashes or spray of hazardous liquid
- Does NOT protect from impact hazards

- Wear safety glasses or goggles underneath

4. WELDING SHIELDS

- Protects eyes against burns from radiant light
- Protects face and eyes from flying sparks, metal spatter, and slag chips produced during welding, brazing, soldering, and cutting

Beware Flying Nails • by John Isaksen

George was about 20 years old when he hired on to help us with a colonial we were building. He impressed us from the beginning with his carpentry skills and great attitude toward the trade, so we offered him a full-time job.

But before he could start, he had a small job of his own to finish. While working on his project, he was pulling an 8d common nail out of some framing lumber, using his cat's paw — the kind of thing carpenters do every day without thinking about it. But instead of easing out slowly, the nail catapulted from the wood at high speed, flipped around, and stuck right in his eye. Four operations and a contact lens later, George could see "okay," but with nowhere near the 20/20 vision he had before the accident.

In our state, business owners aren't required to cover themselves with workmen's comp, and, like most small contractors, George hadn't done wife had health insurance through her work covered some of the cost, but because she w nant, she had planned to quit and stay a However, with the accident, she had to c working to keep the insurance in force — unfortunate side effect of the injury.

Since that time, we require everyone on our to wear safety glasses at all times. We supply ou ers with the model of their choice, and w anyone complains he gets to hear me tell the story again. The moral of the story is that ev knows to be careful when the danger is obvi wearing safety glasses *all* the time will prot from the unexpected stuff.

John Isaksen is a remodeler in Bellevue, Wash.

****Courtesy of/Permission Granted by the Journal of Light Construction**

Progress Check

- What hazards require the need for eye protection?
- What is the difference between safety glasses and goggles, and when would you use one instead of the other?

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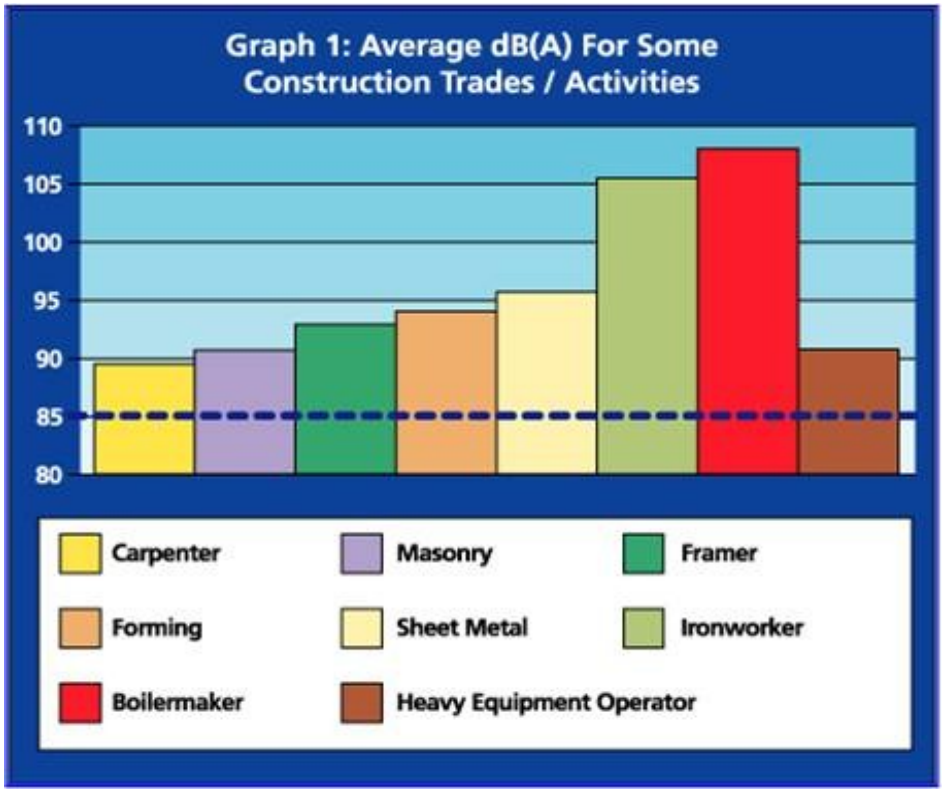
HEARING PROTECTION

Use ear protective devices when it is not feasible to reduce or eliminate noise or its duration. All ear protection devices should be fitted to the wearer. Hearing protection must be provided:
-After implementing engineering and work practice controls
-When an employee's noise exposure exceeds an 8-hour time-weighted average (TWA) sound level of 90 dBA.

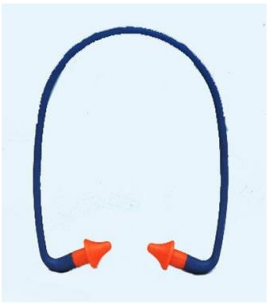
-



	DECIBEL - dB(A)	EQUIPMENT
Double protection recommended above 105 dB(A)	112	Pile driver
	110	Air arcing gouging
	108	Impact wrench
	107	Bulldozer - no muffle
	102-104	Air grinder
	102	Crane - uninsulated cab
	101-103	Bulldozer - no cab
	97	Chipping concrete
	96	Circular saw and hammering
	96	Jack hammer
	96	Quick-cut saw
	95	Masonry saw
	94	Compactor - no cab
Hearing protection recommended above 85 dB(A)	90	Crane - insulated cab
	87	Loader/backhoe - insulated cab
	86	Grinder
	85-90	Welding machine
	85	Bulldozer - insulated cab
	60-70	Speaking voice

Table 1: Some typical noise levels found on construction sites

Earmuffs ***Earplugs*** ***Canal Caps***



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FOOT PROTECTION

Foot protection must be provided when any of these factors are present.

- Heavy objects such as barrels or tools that might roll onto or fall on employees' feet
- Sharp objects such as nails or spikes that might pierce ordinary shoes
- Molten metal that might splash on feet
- Hot or wet surfaces
- Slippery surfaces

Safety Shoes

- Impact-resistant toes and heat-resistant soles protect against hot surfaces common in roofing and paving
- Some have metal insoles to protect against puncture wounds
- May be electrically conductive for use in explosive atmospheres, or non-conductive to protect from workplace

electrical hazards. Conductive shoes must **never** be worn if an employee is exposed to electrical hazards.

Progress Check

- When must hearing protection be provided?
- What is the benefit of wearing safety shoes?

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HAND PROTECTION

The nature of the hazard(s), the activity, and the length of the activity determines your glove selection. The variety of potential hand injuries may make selecting the appropriate pair of gloves more difficult than choosing other protective equipment. Take care to choose gloves designed for the particular circumstances of you workplace. Hand protection must be provided when any of these risks are present:

- Burns
- Bruises
- Abrasions
- Cuts
- Punctures
- Fractures
- Amputations
- Chemical Exposures

--What Kinds of Protective Gloves are Available?

- Durable gloves made of metal mesh, leather, or canvas: protect from cuts, burns, and heat
    - Kevlar protects against cuts, slashes and abrasions
    - Stainless steel mesh protects against cuts and lacerations
- Fabric and coated fabric gloves: protect from dirt and abrasion
- Chemical and liquid resistant gloves: protect from burns, irritation, and dermatitis
- Rubber gloves: protect from cuts, lacerations, and abrasions
    - Nitrile protects against solvents, harsh chemicals, fats and petroleum products and also provides excellent resistance to cuts and abrasion.
    - Butyl provides the highest permeation resistance to gas or water vapors

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BODY PROTECTION

Major Causes of Bodily Injuries:

- Intense heat
- Splashes of hot metals and other hot liquids
- Impacts from tools, machinery, and materials

- Cuts
- Hazardous chemicals
- Radiation

♦ Criteria for Selection

Different materials will protect against different chemical and physical hazards. When chemical or physical hazards are present, check with the clothing manufacturer to make sure that the material selected will provide protection from the specific chemical or physical hazards in your workplace. To provide protective clothing for parts of the body exposed to possible injury, there are several types of body protection:

- Vests
- Aprons
- Jackets
- Coveralls
- Full body suits

Progress Check

- Name four kinds of protective gloves.
- What are the major causes of bodily injury?

SUMMARY

Employers must implement a PPE program where they:

- Assess the workplace for hazards.
- Use engineering and work practice controls to eliminate or reduce hazards before using PPE.
- Select appropriate PPE to protect employees from hazards that cannot be eliminated.

- Inform employees why the PPE is necessary, how and when it must be worn.
- Train employees how to use and care for their PPE including how to recognize deterioration and failure.
- Require employees to wear selected PPE.

Falls in Construction

MIOSHA Office of Training & Education

FALL PROTECTION	WALKWAYS & RAMPS	GOOD PRACTICES	SUMMARY

Learning Objectives

Describe methods of fall protection available to workers.

State the main criteria that prompts use of fall protection for construction.

The issues of how to provide fall protection for employees at construction sites are difficult ones. There are so many different types of work and so many different kinds of fall hazards that it is not possible to organize fall protection into a neat set of rules that

fit all situations. MIOSHA reflects this difficulty when it places its rules for fall protection in several different subparts in the Construction Standards, depending primarily on the nature of the work being undertaken. There are separate locations, for example, for fall protection during work on scaffolds, during work on certain cranes and derricks, during work in tunnels, during work on stairways and ladders, during steel erection etc.

- **Falls are the leading cause of death in the construction industry**.
- Most fatalities occur when employees fall from open-sided floors and through floor openings.
- Falls from as little as 4 to 6 feet can cause serious lost-time accidents and sometimes death.
- Open-sided floors and platforms 6 feet or more in height **must** be guarded.

Fall Protection Options

The general rule is if an employee can fall six feet or more onto a lower level, fall protection must be provided.

In most cases, a guardrail system, a safety net system, or a personal fall arrest system must be used. In some cases, fences, barriers, covers, equipment guards, or a controlled access zone may be used. Employees must be protected not just from falling off a surface, but from falling through holes and from having objects fall on them from above.

Fall Protection Planning

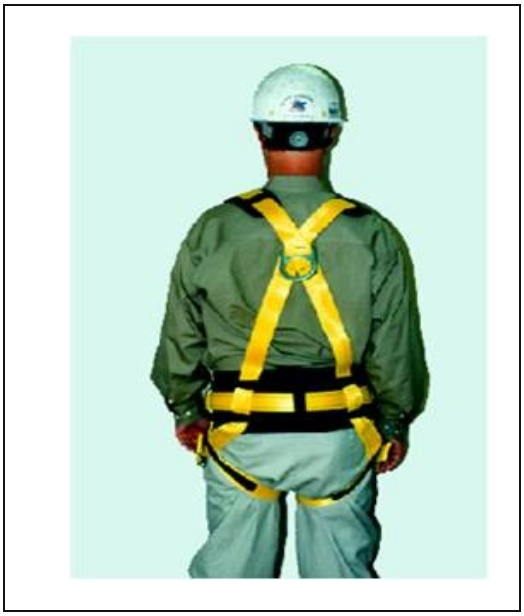
An employer may use a variety of fall protection systems to protect employees. These systems must meet MIOSHA requirements. The competent person must make frequent and regular inspections, as required, to determine if these systems meet MIOSHA requirements

before employees rely on these systems. More details may be found in 29 CFR 1926.502

Employers engaged in leading edge work, precast concrete erection work, or residential construction work, who can demonstrate that it is infeasible or it creates a greater hazard to use conventional fall protection equipment may develop a **fall protection plan** that provides other measures to be taken to reduce or eliminate fall hazards for workers. Fall protection plans must conform to MIOSHA provisions and be prepared by a qualified person. Although a fall protection plan is required, it does not have to be written, nor does it have to be site specific. Fall protection plans must identify locations where conventional fall protection methods cannot be used, and set up controlled access zones and any necessary safety monitoring systems.

Personal Fall Arrest Systems

A personal fall arrest system places the employee into a body harness that is fastened to a secure anchorage so that he/she cannot fall. Body belts are not acceptable as personal fall arrest systems. A few key requirements:



- There should be no free fall more than 6 feet.
- There should be prompt rescue after a fall.
- PFAS's must be inspected prior to each use.
- PFAS's must not be used after a fall incident until they have been inspected by a competent person.

NOTE: Body belts can be used as a positioning device when a free fall is only 2 feet.

Safety Line Anchorages

Must be independent of any platform anchorage and capable of supporting at least 5,000 lbs. per worker.

Guardrails

Guardrail systems provide a barrier to protect the employee from falling:

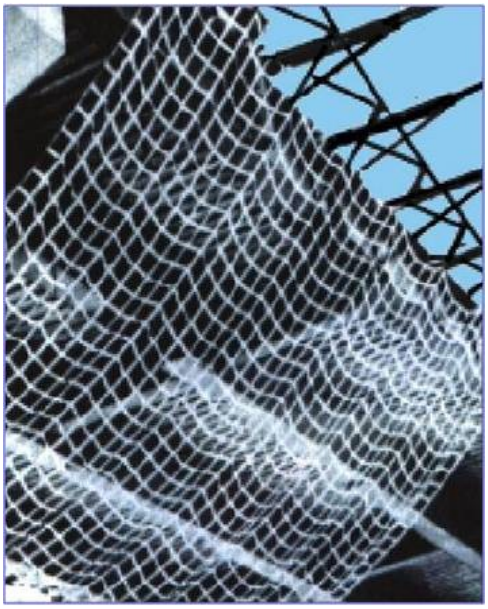
- Top edge of the guardrail must be **42"± 3"** inches above the walking/working level and must be able to support 200 lbs--down and side to side.
- There must also be protection from falling between the top rail and the walking/working surface. Midrails, screens, mesh, or intermediate vertical members may be used for this protection. There are specific requirements for their installation.
- Toe boards must be at least 3½" above the walking surface.
- The protective barriers must be strong enough to support a falling employee. Wood, chain and wire rope may be used for top rails and midrails.
- Overall, there should be no opening greater than 19" in the railing system.

Safety Nets

Safety net systems catch the employee if he/she does fall. The safety nets:

- Must be strong enough to support a falling employee.

- Must have sufficiently small mesh openings so the employee cannot fall through the net.
- Must be close enough to the surface of the walking/working surface that the fall into the safety net will not injure the employee (never more than 30 feet below the walking/working level).
- Must be close enough to the edge of the working surface (the **outer edge** of the net between 8-13 feet from the edge of the walking/working surface, depending on the distance to the walking/working surface) so that the falling employee will not slip past the net.



Safety nets must extend outward from the outermost projection of the work surface as follows:

Vertical distance from working level to horizontal plane of net	Minimum required horizontal distance of outer edge of net from the edge of the working surface
Up to 5 feet	8 feet
5 to 10 feet	10 feet
More than 10 feet	13 feet

- Any items in the net that could pose a hazard must be removed.

- All safety nets must be inspected every week for damage, for example small holes or wear and tear.

SOURCE: Construction Safety & Health Fall Hazards, Central New York COSH, 2007, OSHA grant product

When Fall Protection is Needed

- When an employee is on a walking/working surface that has an unprotected edge.
- When an employee is constructing on a leading edge.
- When an employee may fall through a hole in the walking/working surface.
- When an employee is working on the face of formwork or reinforcing steel.
- When employees are on ramps, runways and other walkways.
- When employees are working at the edge of an excavation, well, pit or shaft.
- When employees are working above dangerous equipment (even employees working **less** than six feet over dangerous equipment must be protected).
- When an employee is performing overhand bricklaying** and related work.
- When an employee is performing roofing work.
- When an employee is engaging in precast concrete erection (with certain exceptions).
- When an employee is engaged in residential construction (with certain exceptions).

**Overhand bricklaying: The process of laying bricks and masonry units such that the surface of the wall to be jointed is on the opposite side of the wall from the mason, requiring the mason to lean over the wall to complete the work. It includes mason tending and electrical installation incorporated into the brick wall during the overhand bricklaying process.

Progress Check

- What are the key requirements for a Personal Fall Arrest System?
- What types of barriers are acceptable as protection from falling between a top rail and the walkway?

Taking Care of the Injured • by Bill Robinson

Before becoming a building contractor, I worked offshore for nearly 15 years, a truly dangerous working environment where safety is taken seriously. One day, one of my co-workers on the drilling platform where we were based fell about 8 feet onto steel grating. We rushed to his aid, moving him to a more comfortable position out of the way so work could continue while we waited for the medevac helicopter to arrive. Fortunately, he was okay, and returned to work the next day, but I was written up for moving a fall victim before medical assistance arrived, which could have seriously complicated his condition.

Later, I was working for a land-based contractor doing remodeling. About half the crew were Spanish-speaking laborers, so communication was tricky on this site. And, compared with my experience offshore, there seemed to be considerable complacency about working safely. We had just removed a second-story balcony rail for demo when one of the Latino workers went up on the balcony; because we couldn't speak any Spanish, we couldn't warn him about the missing railing. I didn't see him fall, but I did hear a sickening thud followed by a muffled groan as he landed on the concrete floor below the balcony. When I around, he was lying on the ground, eyes roll and his tongue curled back in his throat.

Having learned my lesson from the a offshore, I didn't try to move the man, but concentrated on getting him stabilized by clea breathing passage and keeping him from movi then calling the EMTs. Fortunately, he too reco

Because of the lax safety guidelines on this and the difficulty we had in communicating v co-workers, a person was nearly killed or perm disabled. But, by not moving the victim, I making any injuries that he had worse.

When I was younger, I worried too muc keeping the job moving. Now, I realize that it important to work safely, and if there is an in take care of the injured worker first.

Bill Robinson is a general contractor and consu Arroyo Grande, Calif.

Courtesy of/Permission Granted by the Journal of Light Construction

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Walkways and Ramps

Ramps, runways, and other walkways must be protected by guardrail systems when employees can fall 6 feet or more.

The walking/working surface must be strong enough to support employees safely. If not, employees may not work on the surface. This knowledge will be gained during frequent and regular inspections made, as required, by competent persons designated by the employer.

Residential Construction

In residential construction, you must be protected if you can fall more than 6 feet.

Unprotected Sides and Edges

Unprotected sides and edges must have guardrails or the equivalent. **This 1/4" nylon rope is not a proper way to guard this open floor. There is no midrail, no toeboards...and sagging is not allowed.**

Sky Lights and Other Openings

Covers must be:

- able to support at least twice the weight of employees, equipment, and materials that may be imposed on them at one time
- secured to prevent accidental displacement from wind, equipment, or workers' activities
- color coded or bear the markings "HOLE" or "COVER"

Personal fall arrest systems, covers, or guardrail systems shall be erected around holes (including skylights) that are more than 6 feet above lower levels. Note--all floor holes must be protected against slips/trips--even if a fall would be less than 6 feet.

This opening could be made safe by using a guardrail, or strong cover.

Floor Holes

Floor holes should be covered completely and securely. If no cover is available, a guard rail is acceptable.

Case Reports

The following Case Reports of falls investigated by OSHA illustrate

how seemingly innocent workplace activities can have deadly consequences.

- *An employee pulling a concrete hose along a form fell two stories and hit his head on steel rebars which punctured his brain.*
- *A laborer fell through a roof opening about 8 feet to a patio foundation that had about 20 half-inch rebars protruding straight up. The laborer was impaled by one of the bars and died.*

Source: U.S. Department of Labor | Occupational Safety & Health Administration

Excavations

Employees at the edge of an excavation 6 feet or more deep shall be protected from falling by guardrail systems, fences, barricades, or covers. If walkways are used to permit workers to cross over excavations, guardrails are required on the walkway if the fall would be 6 feet or more.

This excavation is not properly shored, and needs to be guarded.

Roofs

If workers are working on low sloped roofs (4 in 12 and under), or steep roofs (over 4 in 12), with unprotected sides and edges 6 feet or more above lower levels, they shall be protected from falling by:

- guardrail systems with toe boards
- safety net systems
- personal fall arrest systems

When other fall protection methods are infeasible, **Controlled Access Zones** (CAZ) may be employed. This method is used for leading edge, or fixed edge work where a minimum distance from the edge of 6' is used to protect employees from falling objects when there is work being performed on unprotected leading edges. Control lines consist of ropes, wires, tapes, or equivalent materials clearly marked at not more than 6 foot intervals with high-visibility materials. Only authorized employees should be allowed in an area where an employee is being protected by this type of safety monitoring system.

Wall Openings

Employees working on, at, above, or near wall openings (including those with chutes attached) where the outside bottom edge of the wall opening is 6 feet or more above lower levels and the inside bottom edge of the wall opening is less than 39 inches above the walking/working surface must be protected from falling by the use of either a guardrail system, a safety net system, or a personal fall arrest system.

Progress Check

- List 2 requirements regarding skylight covers.
- What do walkways higher than 6 feet require?

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Good Work Practices

- Perform work at ground level if possible. For example, build prefab roofs on the ground and lift into place with a crane.
- Tether or restrain workers so they can't reach the edge.
- Designate and use safety monitors (this is the least desirable of all the systems).
- Use conventional fall protection.

Training

Training must be provided to each employee who might be exposed to fall hazards. In construction, this will involve most employees. The training by a competent person must enable each employee to recognize the hazards of falling and train employees in the procedures to be followed to minimize these hazards.

The training must include:

- The nature of fall hazards in the work area
- The correct procedures for erecting, maintaining, disassembling, and inspecting the fall protection systems to be used
- The use and operation of guardrail systems, personal fall arrest systems, safety net systems, warning line systems, safety monitoring systems, controlled access zones, and other protection
- The role of each employee in the safety monitoring system when this system is used

- The limitations on the use of mechanical equipment during the performance of roofing work on low-sloped roofs
- The correct procedures for the handling and storage of equipment and materials and the erection of overhead protection
- The role of employees in fall protection plans
- The standards of subpart M

The employer must verify compliance with the training requirements by preparing a written certification record.

The employer must retrain any employee when the employer has reason to believe that the trained employee does not have the understanding and skill required.

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Summary

MIOSHA requires employers to provide fall protections systems that must meet certain criteria:

- Walking and working surfaces must have sufficient strength and structural integrity to support employees safely.
- Employers must provide protection to employees working in areas with unprotected sides or edges 6 feet or more above a lower level.
- Specific types of protection are required in work areas with leading edges, in hoist areas, in work areas with holes, ramps, runways, and other walkways, in areas where excavations are being conducted, where dangerous equipment is being used, during overhand bricklaying, in roofing, in precast concrete erection, in residential construction, and in work areas with wall openings.

Hard hats are required when workers may be exposed to falling objects.

Other requirements include either:

- the use of toeboards, screens, or guardrail systems
- the use of a canopy structure
- barricading area to which objects could fall and prohibiting employees from entrance

Progress Check

- Describe what Fall Hazard Training looks like.
- What is the purpose of a written certification record?

Stairways and Ladders

MIOSHA Office of Training & Education

STAIRS	LADDERS	SUMMARY

Learning Objectives

Describe safety guidelines and requirements for stairways used at a construction site.

List safe practices and requirements for ladders used at a construction site.

Stairways and ladders cause many injuries and fatalities among construction workers. About half the injuries caused by slips, trips and falls from ladders and stairways require time off the job.

There must be a stairway or ladder at points of access where there is an elevation break of **19 inches** or more. At least one point of

access must be kept clear. Points of access are those areas used by employees for work-related movement from one area or level to another.

This is true unless a ramp, runway, embankment, or personnel hoist is provided.

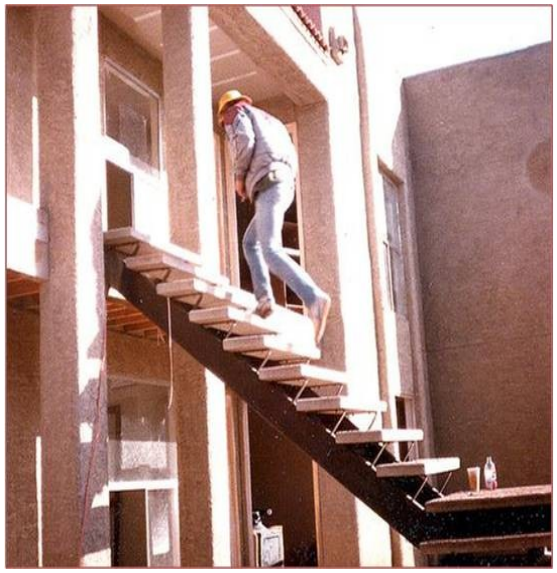
STAIRS

The rules covering stairways and their components generally depend on how and when stairs are used. Specifically, there are rules for stairs used during construction and stairs used temporarily during construction, as well as rules governing stair rails and handrails.

Stairs should be installed between a 30 and 50 degree angle. They must have a uniform riser height and tread depth, with less than ¼ inch variation. Stairways must have at least 7' of vertical clearance above the line of the tread. Fixtures between 5' and 7' are permissible if guarded and marked.

Handrails

Stairways with four or more risers, or are higher than 30 inches, must be equipped with at least one handrail. Handrails and top rails must be able to withstand a force of 200 pounds of weight applied within 2 inches of the top edge in any downward or outward direction, at any point along the top edge. The railing cannot be less than 36" or more than 37" above the line of the tread nosing.



This is an unacceptable stairway!

Handrails must provide an adequate handhold for employees to grasp to prevent falls. Temporary handrails must have a minimum clearance of 3” between the handrail and walls, stair rail system and other objects. OSHA has specific height requirements for handrails. Check the standard to ensure these are met during installation of handrails, stair rails and guardrails

Stair Rails

Stairways with four or more risers or are more than 30 inches high must have a stair rail along each unprotected side or edge, or a hand rail on protected edges.

If there is a fall hazard of 6 feet or more on an exposed side of the stairs, then a stair rail system must be provided to prevent workers from falling off the side.

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Temporary Stairways

A temporary stairway is one where permanent treads and/or landings are to be filled in at a later date. Metal stair pans are are just “concrete forms” that are filled with concrete after the stairs have been set in place.

Stairways that will not be a permanent part of the building under construction must have landings at least 30" in the direction of travel and be 22" in width, at every 12' of vertical rise.

Secure metal pan landings and metal pan treads in place before filling.

Replace all treads and landings when worn below the top edge of the pan.

Workers may not use spiral stairways that will not be a permanent part of the structure.

Only use pan stairs if they are filled with filler material at least to the top edge of each pan.

Stairway Landings

Stairway landings must be at least 30 inches deep and 22 inches wide at every 12 feet or less of vertical rise. Unprotected sides of landings must have standard 42 inch guardrail systems.

Platforms and Swing Doors

Where doors or gates open directly on a stairway, provide a platform that extends at least 20 inches beyond the swing of the door.

Dangerous Conditions

Fix dangerous conditions before using. Stairway parts must be free of projections which may cause injuries or snag clothing. It is important to address other potentially dangerous conditions such as slippery stairs, rails or landings due to weather conditions or the composition of the stair material (e.g. smooth, metal surfaces).

Progress Check

- What are the standard MIOSHA requirements for stairway landings?
- List 3 potentially dangerous stairwell conditions that can pose a risk for workers.

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LADDERS

Ladders are one of the most commonly used pieces of equipment in the building industry. Ladders are a major source of injuries and fatalities among construction workers, and many of the injuries are serious enough to require time off the job. MIOSHA rules apply to all ladders used in construction, alteration, repair, painting, decorating, and demolition of worksites that are covered by construction safety and health standards.

General ladder requirements:

- Ladders must be kept in a safe condition
- should be able to support 4 times the rated working load

DO--

- Keep the area around the top and bottom of a ladder clear
- Ensure rungs, cleats, and steps are level and uniformly spaced
- Ensure rungs are spaced 10 to 14 inches apart
- Keep ladders free from slipping hazards
- Use ladders only for their designated purpose

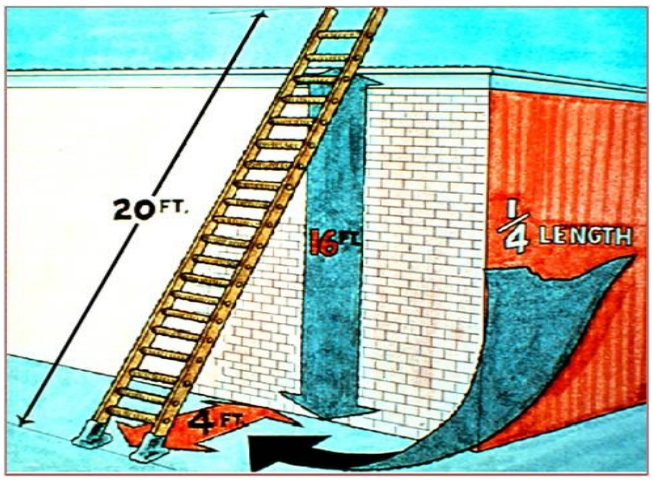
DON'T--

- Tie ladders together to make longer sections, unless designated for such use
- Use single rail ladders
- Load ladders beyond the maximum load for which they were built, nor beyond the manufacturer's rated capacity
- Use the top or top step of a stepladder as a step!

- Use cross bracing on the rear of a stepladder for climbing--unless the ladder is designed for that
- Ladders must not be placed in a passageway, doorway, hallway, or driveway unless protected by barricades to prevent displacement

Securing Ladders:

- Secure ladders to prevent accidental movement due to workplace activity
- Only use ladders on stable and level surfaces, unless secured
- Do not use ladders on slippery surfaces unless secured or provided with slip resistant feet
- When using a portable ladder for access to an upper landing surface, the side rails must extend at least 3 feet above the upper landing surface
- The maximum height of an extension ladder is 60'
- If using ladders where the employee or the ladder could contact exposed energized electrical equipment, they must have nonconductive side rails such as wood or fiberglass.
- Non-self-supporting ladders (which lean against a wall or other support) should be positioned at an angle where the horizontal distance from the top support to the foot of the ladder is ¼ the working length of the ladder. If the supporting height of the ladder is 16', then the base needs to be 4' away from the supporting wall.



Portable Ladders

Portable Ladder: a ladder that can be readily moved or carried.

Ladder rungs, cleats, and steps must be parallel, level and uniformly spaced.

The rungs and steps of portable metal ladders must be corrugated, knurled, dimpled, coated with skid-resistant material or treated to minimize slipping.

When portable ladders are used for access to an upper landing surface, the side rails must extend at least 3 feet above the upper landing surface. When such an extension is not possible, the ladder must be secured, and a grasping device such as a grab rail must be provided to assist workers in mounting and dismounting the ladder. A ladder extension must not deflect under a load that would cause the ladder to slip off its support.

Inspect before use for cracks, dents and missing rungs. Design or treat rungs to minimize slipping. Side rails should be at least eleven and a half inches apart. The ladder must be able to support four times the maximum load.

A metal ladder shall not be used or moved unless a minimum of 20 feet is maintained between power transmission or distribution lines. For non-metal ladders 10 feet is required.

Case Report

The following Case Reports of falls investigated by OSHA illustrate how seemingly innocent workplace activities can have deadly consequences.

- *An employee was climbing a 10 foot ladder to access a landing which was 9 feet above the adjacent floor. The ladder slid down, and the employee fell to the floor, sustaining fatal injuries. Although the ladder had slip-resistant feet, it was not secured, and the railings did not extend 3 feet above the landing.*

Source: U.S. Department of Labor | Occupational Safety & Health Administration

Double-Cleated Ladders

Use a double-cleated ladder (with a center rail), or two or more ladders when ladders are the only way to enter or exit a working area with 25 or more employees. Also use a double-cleated ladder when a ladder will serve simultaneous two-way traffic.

Wooden Ladders

Never paint a wooden ladder!. Never use any kind or variation of opaque covering. Use a suitable transparent protective material.

Tall Fixed Ladders

Fixed Ladder: a ladder that cannot be readily moved or carried because it is an integral part of a building or structure.

In using a cage or well, ladder sections must be offset from adjacent sections, and landing platforms must be provided at maximum intervals of 50 feet

Use a fixed ladder at a pitch no greater than 90 degrees horizontal measurement from the back of the ladder.

A fixed ladder must be able to support at least 2 loads of 250 pounds each, concentrated between any two consecutive attachments. It must also support added anticipated loads caused by ice buildup, winds, rigging and impact loads resulting from using ladder safety devices.

Equip a fixed ladder 24 feet or longer with either a:

- Ladder safety device
- Self-retracting lifelines with rest platforms every 150 feet or less
- Cage or well, and multiple ladder sections, each section not exceeding 50 feet

Damaged or Defective Ladders

A competent person must inspect ladders for visible defects, like broken or missing rungs. If a defective ladder is found, immediately mark it defective or tag it. Withdraw defective ladders from service until repaired.

Climbing the Ladder

Face the ladder when going up or down. Use at least one hand to grab the ladder when going up or down. Do not carry any object or load that could cause you to lose your balance.

Training

A competent person must train each employee in the following areas, as applicable:

- The nature of fall hazards in the work area
- The correct procedures for erecting, maintaining, and disassembling the fall protection systems to be used
- The proper construction, use, placement, and care in handling of all stairways and ladders
- The maximum intended load-carrying capacities of ladder

Progress Check

- What is the proper way to position non-self-supporting ladders?

- When should a double-cleated ladder be used?

Summary

Key Components of Stairway Safety

- Proper measurements of treads
- Use of handrails, stair rails and guardrails
- Correct placement of landings and platforms

Key Components of Ladder Safety

- A competent person must inspect
- Use the correct ladder for the job
- Use the correct angle, supports, treads, cross braces and rail
- Never overload
- Your employer must train you in proper use of a ladder

Scaffolds

MIOSHA Office of Training & Education

FALL PROTECTION	SAFE CONSTRUCTION	TYPES	INSPECTIONS	SUMMARY

Learning Objectives

Recognize the hazards associated with different types of scaffolds.

Understand the procedures to control and minimize those hazards.

A scaffold is an elevated, temporary work platform. There are three basic types:

- **Supported Scaffold**--platforms supported by rigid, load bearing members, such as poles, legs, frames and outriggers.
- **Suspended Scaffolds**--platforms suspended by roped or other non-rigid, overhead support
- **Aerial Lifts**--vehicle-mounted devices used to get worker to an elevated position--referred to as "cherry pickers" or "boom trucks"

Employees working on scaffolds are exposed to these hazards:

- Falls from elevation--caused by slipping, unsafe access, and the lack of fall protection
- Struck by falling tools/debris
- Electrocution--from overhead power lines
- Scaffold collapse--caused by instability or overloading
- Bad planking giving away

Falls may occur:

- While climbing on or off the scaffold
- Working on unguarded scaffold platforms
- When scaffold platforms or planks fall

About two out of every three construction workers (2.3 million) work on scaffolds regularly. There are general standards that are designed to protect workers from falling, falling objects, and other related hazards. Protecting these workers from scaffold-related accidents would prevent 4,500 injuries and 50 deaths every year.

If a worker on a scaffold can fall more than 10 feet, protect them by guardrails, and/or Personal Fall Arrest Systems. (PFAS) PFASs consist of an anchorage, connectors, a body belt or body harness and may include a lanyard, deceleration device, lifeline, or combinations of these. The type of fall protection required depends on the kind of scaffold being used.

Fall Protection

Guardrails

Top rails must be 42"± 3"above the walking surface.

A cross brace may be used as part of the guardrail system as follows:

If the pivot point occurs from 36” to 48” above the platform, then a mid-rail shall be added midway between the platform and the brace pivot point.

If the pivot point occurs from 18” above the platform, then a top rail shall be added.

If the pivot point occurs less than 18” or more than 48” above the platform, then both a top rail and mid rail shall be provided.

Toe boards must be at least **3½"** high.

Guardrails are not required:

- when the front end of all platforms is less than 14 inches from the face of the work
- when the outrigger scaffolds are three inches or less from the front edge
- when employees are plastering and lathing 18 inches or less from the front edge

Case Reports

The following Case Reports of falls investigated by OSHA illustrate how seemingly innocent workplace activities can have deadly consequences.

- *An employee preparing masonry fascia for removal from a building fell from the third level of a tubular welded-frame scaffold. No guarding system was provided for the scaffold. Further, the platform was coated with ice, creating a slippery condition.*
- *A contract employee was taking measurements from an unguarded scaffold inside a reactor vessel when he either lost his balance or stepped backwards and fell 14½ feet, sustaining fatal injuries.*
- *An employee was installing overhead boards from a scaffold platform consisting of two 2" x 10" boards with no guardrails. He lost his balance, fell 7½ feet to the floor, and was fatally injured.*
- *A laborer was working on the third level of a tubular welded-frame scaffold which was covered with ice and snow. Planking on the scaffold was inadequate, there was no guardrail, and no access ladder for the various scaffold levels. The worker slipped and fell head first approximately 20 feet to the pavement below.*

Source: U.S. Department of Labor | Occupational Safety & Health Administration

Personal Fall Arrest Systems (PFAS)

A personal fall arrest system places the employee into a body harness that is fastened to a secure anchorage so that he/she cannot fall. Body belts are not acceptable as personal fall arrest systems. A few key requirements:

- There should be no free fall more than 6 feet.
- There should be prompt rescue after a fall.
- Inspect PFAS's prior to each use.
- Don't use PFAS's until they have been inspected by a competent person.
- A competent person must determine the feasibility and safety of providing fall protection for employees erecting or dismantling supported scaffolds.

Fall Protection Requirements

- Boatswains' chair, catenary scaffold, float scaffold, needle beam scaffold, ladder jack scaffold require a Personal Fall Arrest System.
- Single-point or two-point adjustable scaffolds require both a PFAS and a guardrail system.
- Crawling board (chicken ladder) needs a PFAS, a guardrail system or a three-fourth inch diameter grab line or equivalent handhold securely fastened beside each crawling board.
- **The ends of this scaffold are not properly guarded!**
- On a walkway within a scaffold a guardrail system installed within 9½ inches of and along at least one side of the walkway is required.
- On a supported scaffold when performing overhand bricklaying operations--PFASs or guardrail systems on all open sides and ends of the scaffold are required.
- For all other scaffolds, a PFAS or a guardrail system is necessary.

Falling Object Protection

The number one protection is a hard hat. In addition, when there is the danger of falling hand tools, debris or other small objects, the employer must install toe boards, screens or guardrail systems above the worker on a scaffold. Debris nets, catch platforms, or canopy structures that contain or deflect the falling objects can also be installed.

When the potential falling objects are too large to be held by toe boards, screens or guardrail systems, the employer must place such objects away from the edge of the surface from which they could fall and must secure those materials as necessary to prevent their falling.

Workers on scaffolds must be aware of employees working below them, who are in danger from objects falling from the scaffold. Where this danger exists, the employer must erect a barricade to keep employees from working below the scaffold, or must place a toe board or an edging along the edge of the platform.

Overhead Power Lines

The possibility of electrocution is a serious consideration when working near overhead power lines. Check the clearance distances listed in the standard.

Scaffolds may be closer to power lines than specified where the clearance is necessary to perform work, but only after the utility company, or electrical system operator, is notified of the need to work closer, and they deenergize or relocate the lines, or install protective coverings to prevent contact with the lines.

Scaffold clearance requirements are:

-3 feet for insulated power lines of less than 300 volts

-10 feet for insulated power lines of 300 volts or more and for all uninsulated power lines.

Progress Check

- Name the 3 basic types of scaffolds.
- Under what conditions are NO guardrails required?
- What is the number one protection from falling objects?

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Essential Elements of Safe Scaffold Construction

Platforms:

Platforms must be fully planked or decked with no more than 1 inch gaps where practicable. It must be able to support its own weight plus 4 times its maximum load, and be at least 18 inches wide. Spaces between the platform and the uprights shall not be more than 9½ inches. Planking should be graded and marked as scaffold planking. There should be:

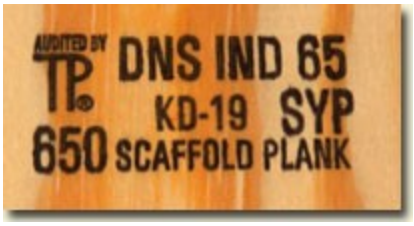
- no large gaps in the front edge of platforms
- each abutted end of a plank must rest on a separate support surface
- overlap platforms at least 12 inches over supports, unless restrained to prevent movement

The front edge of all platforms:

- no more than 14" from the face of the work
- 3" from the face for outrigger scaffolds
- 18" from the face for plastering and lathing operations

There should be no paint on wood platforms. Scaffold grade is the only wood to be used. Scaffold platforms must be fully planked between front upright and guardrail supports. Each component part must match and be of the same type. Platforms must be erected on stable and level ground with wheel locks and braces.

The height of the scaffold should not be more than 4 times its minimum base dimension unless guys, ties, or braces are used.



***Platform Ends**:*

Each end of a platform, unless cleated or otherwise restrained by hooks, must extend over its support by at least 6 inches but not more than 12 inches, unless the platform is designed and installed

so that the cantilevered portion of the platform is able to support employees and/or materials without tipping. Guardrails which block employee access to the cantilevered end are also an option.

Access requirements for employees erecting and dismantling supported scaffolds are: a safe means of access must be provided when a competent person has determined the feasibility and analyzed the site conditions. Direct access to or from another surface shall only be used when the scaffold is not more than 14 inches horizontally and 24 inches vertically from the other surface. Cross braces shall not be used as a means of access.

Portable, Hook-on and Attachable Ladders--must be positioned so as not to tip the scaffold

Ramps and Walkways--must have guardrails which comply with code if more than 6 feet above the lower levels

Stairway-type Ladders and Stair Towers--bottom step cannot be more than 24 inches above the level on which the scaffold is supported

Built-in Scaffold Ladders--must be specifically designed and constructed for use as ladder rungs.

Using Scaffolds

- Don't work on snow or ice covered platforms or during storms or high winds
- Use tag lines on swinging loads
- Protect suspension ropes from heat and acid

Progress Check

- Describe how scaffold planking should be laid.
- What is the purpose for using guys, ties or braces?

Types of Scaffolds

***Supported Scaffolds*:**

Supported scaffolds are framed squares made of metal or wood, usually assembled on site. Supported scaffolds with a height to base ratio of more than 4:1 must be restrained by guying, tying, bracing, or an equivalent means.

The platforms are supported by legs, outrigger beams, brackets, poles, uprights, posts and frames. Guys, ties and braces keep the scaffolds from tipping. Scaffold poles, legs, posts, frames and uprights must be on base plates and mud sills or other firm foundations.

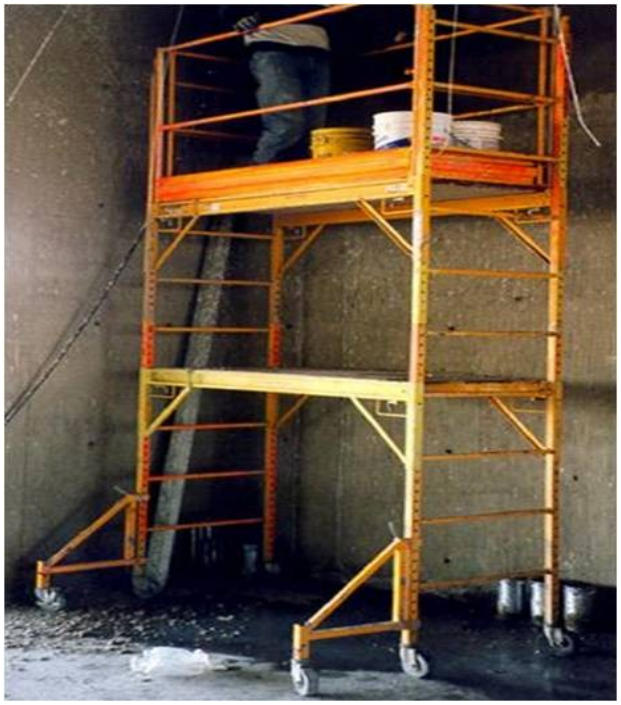
Either the manufacturers' recommendations or the following placements must be utilized for guys, ties and braces to prevent a scaffold from tipping:

- Install guys, ties or braces at the closest horizontal member to the 4:1 height and repeat vertically with the top restraint no further than the 4:1 height from the top
- Vertically--every 20 feet or less for scaffolds less than three feet wide: every 26 feet or less for scaffolds more than three feet wide
- Horizontally--at each end, at intervals not to exceed 30 feet from one end.

Suspension Scaffolds:

- Platforms suspended by ropes or wires. Rope must be capable of supporting 6 times the load.
- Train employees to recognize hazards.
- Secure/tie to prevent swaying.
- Support devices must rest on surfaces that can support four times the load.
- A competent person must evaluate connections to ensure the supporting surfaces can support the load, and inspect ropes for defects before every shift.
- PFASs must have anchors independent of the scaffold support system.

Moving Scaffolds:



- Scaffolds shall not be moved horizontally while employees are on them, unless they have been designed by a registered professional engineer specifically for such movement.
- Employees cannot ride on scaffolds unless:

-The surface on which the scaffold is being moved is within 3 degrees of level, and free of pits, holes, and obstructions

-The height of base/width ratio of the scaffold during movement is two to one or less, unless the scaffold is designed and constructed to meet or exceed nationally recognized stability test requirements.

-Outrigger frames, when used, are installed on both sides of the scaffold.

-When power systems are used, the propelling force is applied directly to the wheels, and does not produce a speed in excess of 1 foot per second.

-No employee should be on any part of the scaffold which extends outward beyond the wheels, casters or other supports.

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Scaffold Inspection

A competent person must inspect scaffolds and scaffold components for visible defects before each work shift, and after any occurrence which could affect a scaffold's structural integrity.

Any part of a scaffold damaged or weakened such that its strength is less than that required shall be immediately repaired or replaced, braced to meet those provisions, or removed from service until repaired.

Scaffold Erection

Scaffolds can only be erected, moved, dismantled or altered under the supervision of a competent person.

A competent person selects and directs workers and determines the feasibility of fall protection.

Scaffolds over 125 feet high above the base plates must be designed by a registered professional engineer and constructed and loaded per the design.

Training Requirements

Employees who work on a scaffold must be trained by a person qualified to recognize the hazards associated with the type of scaffold used and to understand the procedures to control and minimize those hazards. The training must include fall hazards, falling object hazards, electrical hazards, proper use of the scaffold, and handling of materials.

A competent person must train all employees who erect, disassemble, move, operate, repair, maintain, or inspect scaffolds. Training must cover the hazards, the correct procedures for

erecting, disassembling, moving, operating, repairing, inspecting, and maintaining the type of scaffold in use.

The training shall also include the design criteria, maximum intended load-carrying capacity and intended use of the scaffold. Retraining should occur when:

- Changes at the worksite present a new hazard
- Changes in the types of scaffolds, fall protection, falling object protection, or other equipment present a new hazard
- An employee's work with scaffolds indicate the need

Progress Check

- What are the requirements for employees erecting and dismantling supported scaffolds?
- How often should scaffolds be inspected?
- What are the key areas to be covered when training employees who erect, move, and operate scaffolds?

Summary

Remember to:

- Use appropriate scaffold construction methods
  - Erect, move, or alter scaffold properly
  - Protect from falling objects or tools
- Ensure stable access
- Use a competent person
  - Train on scaffold construction and the hazards involved with scaffolds

- Inspect the scaffold before each shift and after alterations
- Determine fall protection requirements

Excavations

MIOSHA Office of Training & Education

HAZARDS	SITE PLANNING	PROTECTION	INSPECTIONS	SUMMARY

Learning Objectives

State the greatest risk that is present at an excavation.

Briefly describe the three main methods for protecting employees from cave-ins.

Name at least three factors that pose a hazard to employees working in excavations, and at least one way to reduce those hazards.

Describe the role of a competent person at an excavation site.

Excavation and trenching activities tend to be the most hazardous in the construction industry. OSHA defines an excavation as any man-made cut, cavity, trench, or depression in the earth's surface formed by earth removal. A trench is defined as a narrow underground excavation that is deeper than it is wide, and is no wider than 15 feet (4.5 meters).

Excavation projects vary considerably, each with its own set of unique problems. Cave-ins pose the greatest risk and are much more likely than other excavation related accidents to result in worker fatalities. Other potential hazards include falls, falling loads, hazardous atmospheres, and incidents involving mobile equipment. Trench collapses cause dozens of fatalities and hundreds of injuries each year. U.S. Bureau of Labor Statistics (BLS) data show that 271 workers died in trenching or excavation cave-ins from 2000 through 2006.

Despite the efforts by regulatory agencies, accidents continue to occur at a high rate. Observation of OSHA Excavation Standards can greatly reduce the risk of injury.

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Excavation Hazards

Cave-ins pose the greatest risk and are much more likely than any other excavation-related accident to result in worker fatalities. Excavating is one of the most hazardous construction operations. Most accidents occur in trenches 5-15 feet deep. There is usually no warning before a cave-in.

Five minutes after this photo was taken, the trench on the left collapsed with virtually no warning.

Cave-in hazards are increased by machinery which get too close. Even normal vehicular traffic, such as that along an adjacent interstate or road through an industrial part may impact an excavation. The vibrations from continuous or heavy traffic may undermine the soil and cause a cave-in.

Other hazards include:

- Asphyxiation due to lack of oxygen
- Inhalation of toxic materials
- Fire
- Moving machinery near the edge of the excavation can cause a collapse
- Accidental severing of underground utility lines
- Water accumulation
- Access/Egress

Water is hazardous!

Employees shall not work in excavations in which there is accumulated water, or in excavation in which water is accumulating, unless adequate precautions have been taken to protect employees against the hazards posed by water accumulation. The precautions necessary to protect employees adequately vary with each situation, but could include special support or shield systems to protect from cave-ins, water removal to control the level of accumulating water, or use of a safety harness and lifeline. **Note that these workers are not wearing hardhats to protect them from materials falling into the trench.**

If water is controlled or prevented from accumulating by the use of water removal equipment, the water removal equipment and operations shall be monitored by a competent person to ensure proper operation.

If excavation work interrupts the natural drainage of surface water (such as streams), diversion ditches, dikes, or other suitable means shall be used to prevent surface water from entering the excavation, and to provide adequate drainage of the area adjacent to the excavation.

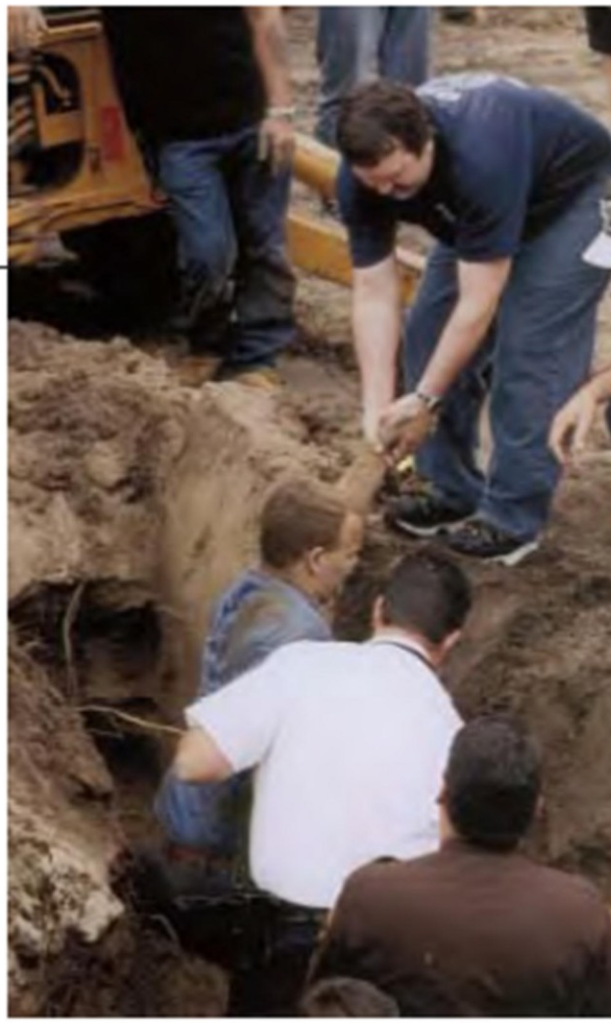
Buried Alive • by John Vastyan

Aaron Wentz is one of the lucky ones. Though buried twice by tons of soil during a trenching accident, he managed to survive an ordeal that kills more than 100 construction workers each year. And he emerged with few physical or mental scars; frequently those who survive a trench collapse have to deal with a lifetime of disabilities caused by the accident. When you consider that the weight of a cubic yard of soil is comparable to that of a midsize automobile, and that a typical trench-wall collapse involves 3 to 5 cubic yards, it's not hard to see why trench work can be so dangerous.

A 29-year-old plumber in Kearney, Neb., at the time of the accident, Wentz was working 13 feet below grade while tapping into a main sewer line. Dug by a skilled backhoe operator, the work area at the bottom of the trench measured 6 feet by 6 feet, and the trench sidewalls were sloped back per OSHA guidelines so that the top of the trench was nearly 21 feet wide. But, shortly after being inspected and approved by a city building inspector who was on the job site that day, the trench walls collapsed, burying Wentz and covering his head with more than 20 inches of soil. Hearing the rumbling of the soil as it began to move, he had just enough time to lean against the opposite side of the trench and throw an arm up over his head, forming an air pocket that probably saved his life.

Wentz's father, Orlin, was working on the job that day, and with help from co-workers and onlookers he was able to uncover Wentz's neck and shoulders after about eight minutes, pulling the soil away with bare hands and shovels. But as rescuers uncovered Wentz's chest and were attempting to remove him from the trench, a second avalanche of soil — a common hazard for rescue workers that often causes multiple fatalities in a trench collapse — buried Wentz again.

No other workers were buried, but this time more than 2 feet of soil covered Wentz's head, and with one hand pinned behind his back and the other fractured from soil pressure, he was able to create only a small air pocket near his mouth with his hand. Though it took



from the trench, and he managed to walk to the amb
lance under his own power (photo, above).

OSHA declined to conduct a safety hearing into t
accident, but a subsequent review by safety consu
tants identified few obvious flaws in the trench's co
struction. Instead, unpredictable soil conditio
caused by an unstable mix of sand and clay, t
vestiges of an ancient river, would have probab
caused a collapse even under ideal conditions. Went
company went back to finish the job a week later, a
had to widen the trench to nearly 40 feet to reach s
that hadn't been disturbed by the accident. They
longer take on any work in that area of the city.

Does Wentz still get down in the trenches? Ye
though he admits that some days are easier tha
others. It's harder on his father, who can no long
comfortably go near a trench. But, as Wentz note
sometimes accidents just happen, regardless of ho
safely you work or what precautions you take.

Hazardous Atmosphere

This is when hazardous conditions exist such as excavation in areas where hazardous substances are stored. Excavations must be tested to a depth of at least 4 feet before an employee enters the excavation for:

- oxygen deficiency
- high combustible gas concentration
- high levels of other hazardous substances

Employers must test where oxygen deficiency or a hazardous atmosphere could reasonably be expected to exist, before an employee enters the excavation.

If hazardous conditions exist, controls such as proper respiratory protection or ventilation must be provided. Also, controls used to reduce atmospheric contaminants to acceptable levels must be tested regularly.

Where adverse atmospheric conditions may exist or develop in an excavation, the employer must also provide and ensure that emergency rescue equipment, (e.g., breathing apparatus, a safety harness and line, basket stretcher, etc.) is readily available. This equipment must be attended when used.

Employees shall not be permitted to work in hazardous and/or toxic atmospheres. Such atmospheres include those with:

-- less than 19.5% oxygen,

-- a combustible gas concentration greater than 20% of the lower flammable limit, and,

-- concentrations of hazardous substances that exceed those specified in the Threshold Limit Values for airborne contaminants established by the ACGIH.

Progress Check

- Name 5 cave-in hazards.
- What protective measures must an employer provide when atmospheric conditions exist?

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METHODS OF CREATING SAFE WORKING CONDITIONS

Designing a protective system can be complex because you must consider many factors: soil classification, depth of cut, water content of soil, changes due to weather or climate, surcharge loads (eg., spoil, other materials to be used in the trench) and other operations in the vicinity.

Shield--a structure able to withstand a cave-in and protect employees. Shields can be permanent structures, or can be designed to be portable and moved along as work progresses. Also known as a trench box or trench shield.

Shoring--a structure such a metal hydraulic, mechanical or timber shoring system that supports the sides of an excavation and protects against cave-ins.

Sloping--a technique that employs a specific angle of incline on the sides of the excavation. The angle varies based on assessment of impacting site factors such as solid type, environmental conditions or exposure, and application of surplus loads.

Benching-- is a variation on sloping and consists of cutting the sides of the excavation to form one or more horizontal levels or steps.

LOCATING UTILITY LINES (MISS DIG)

Contractors cannot excavate until they have ascertained the location of all underground utilities. Phone "811" or 1-800-482-7171 three full working days prior to the date you plan to dig.

Site Evaluation Planning

- Evaluate soil conditions and select appropriate protective systems
- Construct protective systems in accordance with the standard requirements
- Test for low oxygen, hazardous fumes and toxic gases, especially when gasoline engine-driven equipment is running, or the dirt has been contaminated by leaking lines or storage tanks. Insure adequate ventilation or respiratory protection if necessary.
- Provide safe in and out access
- Contact utilities to locate underground lines
- Determine the safety equipment needed
- Inspect the site daily at the start of each shift, following a rainstorm, or after any other hazard-increasing event
- Keep excavations open the minimum amount of time needed to complete operations. Surface crossing of

trenches should not be made unless absolutely necessary. If necessary, they are only permitted under the following conditions:

- vehicle crossing--must be designed by and installed under the supervision of a registered professional engineer
- walkways or bridges--must have a minimum clearance width of 20 inches, be fitted with standard rails, and extend a minimum or 24 inches past the surface edge of the trench.

Spoils (excavated materials):

- Don't place spoils within 2 feet from the edge of the excavation
- Measure from the nearest part of the spoils to the excavation edge
- Place spoils so rainwater runs away from the excavation
- Place spoils well away from the excavation site

Progress Check

- Under what conditions are surface crossings of trenches allowed?

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Protection of Employees

Employees should be protected from cave-ins by using an adequately designed protective system. A protective system is a method of protecting employees from cave-ins , from material that could fall or roll from an excavation face or into an excavation, or from the collapse of adjacent structures. A well-designed protective system includes:

- Correct design of sloping and benching systems
- Correct design of support systems, shield systems, and other protective systems

PLUS--appropriate handling of materials and equipment

PLUS--attention to correct installation and removal

EQUALS--protection of employees at excavations

Case Reports

The following Case Reports of trenching accidents investigated by OSHA illustrate how seemingly innocent workplace activities can have deadly consequences.

- *Two employees were installing 6" PVC pipe in a trench 40' long x 9' deep x 2' wide. No means of protection was provided in the vertical wall trench. A cave-in occurred, fatally injuring one employee and causing serious facial injuries to the other.*
- *An inadequately protected trench wall collapsed, killing one employee who had just gotten into the trench to check grade for installation of an 8" sewer line. The trench was 20-25 feet deep and had been benched about one bucket-width (4 feet) on each side. At the time of the collapse a backhoe was still extracting soil from the trench.*
- *Four employees were in an excavation 32' long x 7' deep x 9' wide boring a hole under a road. Eight-foot steel plates used as shoring were placed against the side walls of the excavation at about 30-degree angles. No horizontal bracing was used. One of the plates tipped over, crushing an employee.*

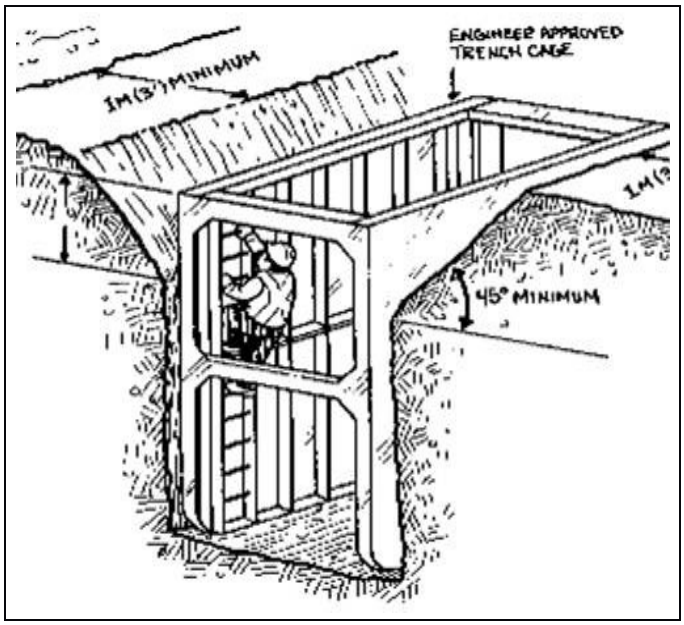
Source: U.S. Department of Labor | Occupational Safety & Health Administration

Factors Involved in Designing a Protective System

- Soil classification
- Depth of cut
- Water content
- Changes due to weather amd climate
- Other operations in the vicinity

Protection from Falls, Falling Loads and Mobile Equipment:

- Install barricades
- Use hand/mechanical signals
- Grade soil away from the site
- Fence or barricade trenches left overnight
- Use a flagger when sign, signals and barricades are not enough protection

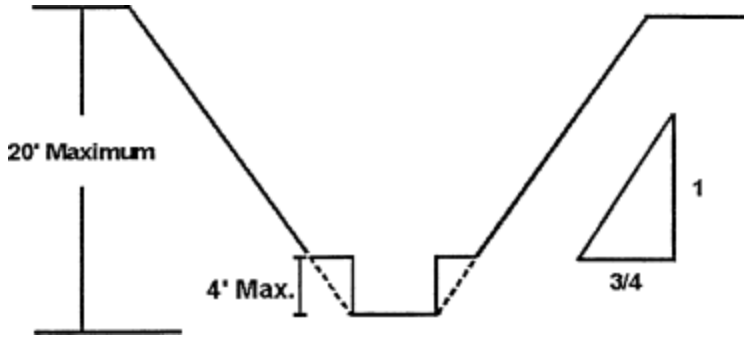


- Prohibit employees under loads that are handled by lifting or digging equipment. To avoid being struck by any spillage or falling materials, require employees to stand away from vehicles being loaded or unloaded. If cabs or vehicles provide adequate protection from falling loads during loading and unloading operations, the operators may remain in them.

The employer shall select and construct:

- slopes and configurations of sloping and benching systems
- support systems, shield systems, and other protective systems

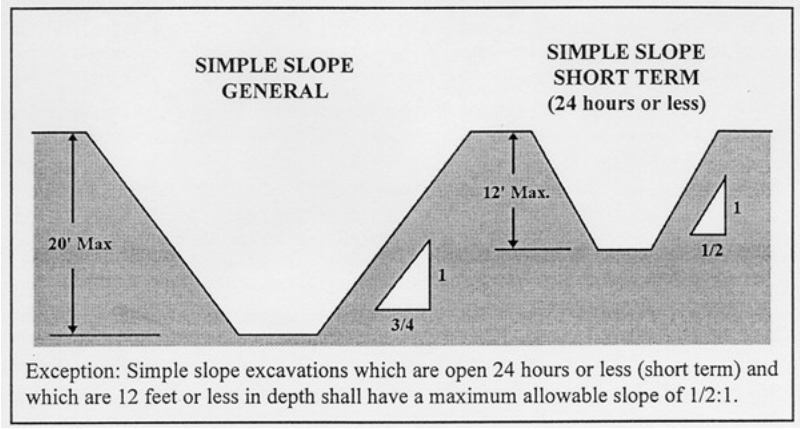
Benching--excavating the sides of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.



Shoring--is used when the location or depth of the cut makes sloping back to the maximum allowable slope impractical. There are two basic types of shoring: timber and aluminum hydraulic.

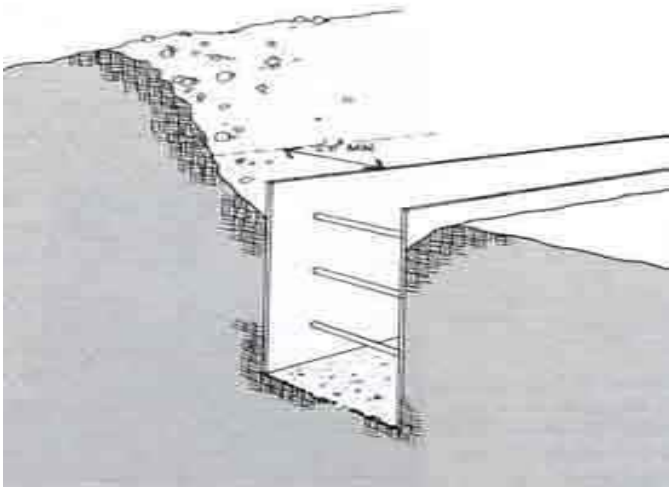
- Provides a framework to work in
- Uses wales, cross braces and uprights
- Supports excavation walls

Sloping--involves cutting back the trench wall at an angle inclined away from the excavation.



Trench boxes (shielding)-- different from shoring because instead of supporting the trench face, they are mostly serving to protect the workers from cave-ins. The excavated area between the outside of the trench box and the face of the trench should be as small as possible. The space between the trench box and the excavation side may be backfilled (or other means may be used) to prevent lateral movement of the box. Shields may not be subjected to loads exceeding those which the system was designed to withstand.

Trench boxes may be used in combination with sloping and benching.



Hydraulic Trench Support

- Using hydraulic jacks the operator can easily drop the system into the hole
- Once in place, hydraulic pressure is increased to keep the forms in place
- Trench pins are installed in case of hydraulic failure

Means of Egress and Access

A stairway, ladder, or ramp must be present in excavations that are 4 or more feet deep, and within 25 feet of the employees.

Structural Ramps: are used solely by employees as a means of access or egress from excavations. Structural ramps used for access or egress of equipment shall be designed by a competent person qualified in structural design, and shall be constructed in accordance with the design**. This ladder does not meet the requirements of the standard. It should extend 3 feet above the excavation.** Ramps and runways constructed of two or more structural members shall have the structural members connected together to prevent displacement. Structural members used for ramps and runways shall be of uniform

thickness. Cleats or other appropriate means used to connect runway structural members shall be attached to the bottom of the runway or shall be attached in a manner to prevent tripping. Structural ramps used in lieu of steps shall be provided with cleats or other surface treatments on the top surface to prevent slipping. **These two ladders lashed together are not an adequate means of egress. The ladder should also extend 3 feet above the top of the excavation.**

Progress Check

- Name at least 5 protective measures to guard against falls and falling loads or equipment.
- What is benching?

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Inspections of Excavations

Competent Person

Must have had specific training in and be knowledgeable about

- Soil classification
- The use of protective systems
- The requirements of the standard

The competent person must be capable of identifying hazards, and authorized to immediately eliminate hazards.

A competent person must make daily inspections of excavations, areas around them and protective systems:

Before work starts and as needed

- After rainstorms, high winds or other occurrences which may increase hazards
- When you can reasonably anticipate an employee will be exposed to hazards.

If the competent person finds evidence of a possible cave-in, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions:

- Exposed employees must be removed from the hazardous area
- Employees may not return until the necessary precautions have been taken

Progress Check

- What is the role of the competent person at an excavation site?

Summary

- The greatest risk in an excavation is a cave-in.
- Employees can be protected through sloping, shielding, and shoring the excavation.

- A competent person is responsible to inspect the excavation.
- Other excavation hazards include water accumulation, oxygen deficiency, toxic fumes, falls, and mobile equipment.

Cranes

MIOSHA Office of Training & Education

TYPES | ACCIDENTS | PREPARATION | INSPECTIONS | SUMMARY

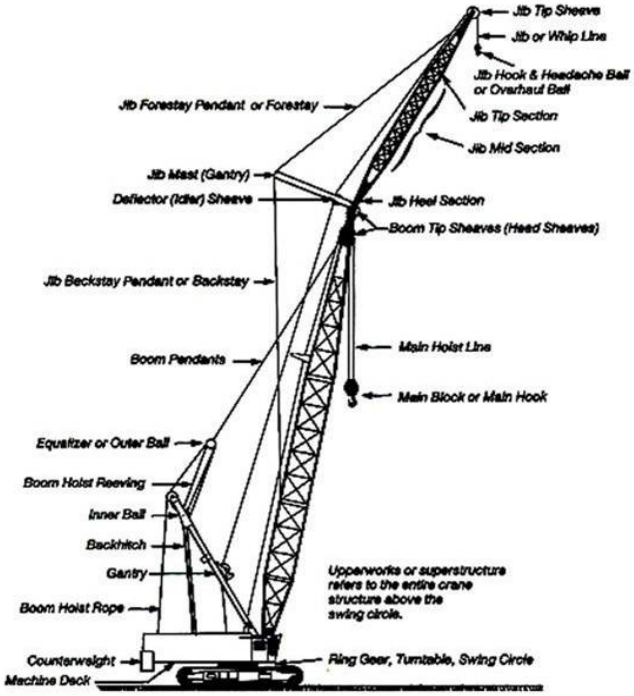
Learning Objective

Explain the risks and precautions associated with the use of cranes.

Discuss the steps involved in preparation for start-up at a job site.

Moving large, heavy loads is crucial to today's manufacturing and construction industries. Much technology has been developed for these operations, including careful training and extensive workplace precautions. There are significant safety issues to be considered, both for the operators of the diverse "lifting" devices, and for workers in proximity to them. Fatalities and serious injuries can occur if cranes are not inspected and used properly. Many fatalities can occur when the crane boom, load line or load contacts power lines. Other incidents happen when workers are struck by the load,

are caught inside the swing radius or fail to assemble/ disassemble the crane properly.
http://www.osha.gov/SLTC/cranehoistsafety/index.html



Types of Cranes:

1. Mobile
2. Hydraulic
3. Overhead
4. Gantry
5. Tower

Commonly Used Cranes:

- Hydraulic rough terrain crane
- Crawler lattice boom friction crane

There are several significant differences between these cranes, primarily in boom hoist and load line controls. The somewhat smooth operation of the boom control adjustments on the **hydraulic cranes** may falsely suggest that it is simple to operate.

The **lattice boom friction cranes'** movement in its boom or its adjustment in load position tend to be a little jerky requiring more skill and experience to operate smoothly.

Another difference is their load charts. Due to the fixed boom lengths, the lattice boom friction crane has a more simplified load chart. This requires extensive motion control and anticipation of boom movement to accurately lift or place loads.

The hydraulic crane's load charts are more extensive making them complicated due to variations in boom length, so more training in multiple charts is required.

The differences between these cranes are significant enough to require specific training on each type of crane. Crane operators cannot expect to be totally knowledgeable and proficient in the operation of the many diverse types of cranes available today. They cannot be expected to move from one type of crane to another without adequate education and training on specifics of each piece of equipment.

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Crane Accidents

1. Boom or crane contact with energized power lines
2. Impediment under the hook lifting device
3. Overturned cranes
4. Dropped loads
5. Boom collapse
6. Crushing by the counter weight
7. Outrigger use
8. Falls
9. Rigging failures
10. Improper maintenance and inspection of cranes

Power lines - stay at least 10 feet from power lines to avoid potential dangers.

How Do Accidents Occur?

There are three main causes of crane accidents. These include:

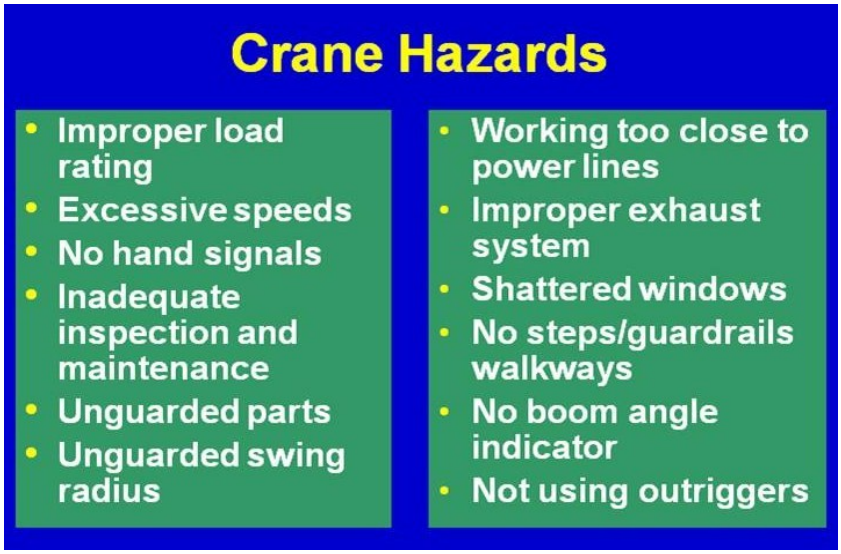
- **Instability** - unsecured load, load capacity exceeded or unlevel or too soft ground.
- **Lack of Communication** - the point of operation is a distance from the crane operator or not in full view of the operator, requiring team communication.
- **Lack of training**
- **Improper Loads/speeds -** can result in the tipping of the crane.

In addition to instability factors, communication, and training, some cranes are not maintained properly nor inspected regularly to ensure safe operation.

Although mechanical failures represent only 11% of causes of crane accidents, they usually result in the major accidents involving injuries, fatalities, substantial material costs, and usually spectacular media coverage. Studies and analyses of crane accidents involving mechanical failure show they are frequently due to a lack of preventive maintenance or adequate training and/or experience on the part of the personnel involved. It is important that not only crane operators but also personnel working with cranes receive training in crane operations. Cranes and associated rigging equipment must be inspected regularly to identify any existing or potentially unsafe conditions. In addition, preventive maintenance must be performed as required by the crane manufacturer and/or supplier to ensure safe crane operation.

Who is at Risk?

The most obvious persons at risk include the operators and persons at the crane site.



Competent Person

A **competent person** is one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.
The employer shall designate a competent person who shall inspect all machinery and equipment prior to each use, and during use, to make sure it is in safe operating condition. Any deficiencies shall be repaired, or defective parts replaced, before continued use.

A thorough, annual inspection of the hoisting machinery shall be made by a competent person, or by a government or private agency recognized by the U.S. Department of Labor. The employer shall maintain a record of the dates and results of inspections for each hoisting machine and piece of equipment.

Progress Check

- List the 5 common types of cranes.
- What are the most common differences?
- What are the 3 main causes of crane accidents?

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Preparation

Planning Before Start Up

1. Level the crane and ensure support surface is firm and able to support the load.
2. Contact power line owners and determine precautions. Know the location and voltage of overhead power lines.
3. Know the basic crane capacities, limitations, and job site restrictions, such as the location of power lines, unstable soil or high winds.
4. Make other personnel aware of hoisting activities.
5. Barricade areas within swing radius.
6. Ensure proper maintenance and inspections.
7. Determine safe areas to store materials and place machinery.

Know the Weight of the Load

1. Refer to shipping ticket or other documentation
2. Ensure lift calculations are correct
3. Ensure load is within load chart rating for boom length and load radius of the crane.

The crane is rated by the maximum weight it will lift at a minimum radius and minimum boom length - the further from its center point, the less it will lift.

Know the Load and Speed Capacity

Make sure the crane operator can see the:

- rated load capacities
- operating speeds
- special hazard warning or instruction

Rated load capacities, and recommended operating speeds, special hazard warnings, or instructions, shall be conspicuously posted on all equipment. Instructions or warnings shall be visible to the operator while he is at his control station.

Load Limiting Factors

- Unlevel ground
- Wind
- Side loads
- On its wheels
- Lifting over the side
- Use of extensions, jibs and other attachments
- Limits of wire rope, sling and lifting devices

Mobile Cranes

Four basic lifting principles that govern a crane's mobility and safety during lifting operations:

1.**Center of Gravity** -Point in the object where its weight can be assumed to be concentrated or, stated in another way, it is the point in the object around which its weight is evenly distributed. The location of the center of gravity of a mobile crane depends primarily on the weight and location of its heaviest components (boom, carrier, upper works and counterweight).

2. **Leverage** - Cranes use leverage to lift loads. Rotation of the upper works (cab, boom, counterweight, load) changes the location of the center of gravity, its leverage point or fulcrum.

3. **Stability** - Relationship of the load weight, angle of the boom and its radius (distance from the cranes center of rotation to the center of load) to the center of gravity of the load. Stability could also be affected by the support on which the crane is resting. A crane's load rating is generally developed for operations under ideal conditions, i.e., a level firm surface. Unlevel surfaces or soft ground therefore must be avoided. In areas where soft ground poses a support problem, mats and or blocking should be used to distribute a crane's load and maintain a level stable condition.

4. **Structural Integrity** - The crane's main frame, crawler track and/or outrigger supports, boom sections, and attachments are all

considered part of the structural integrity of lifting. In addition, all wire ropes, including stationary supports or attachment points, help determine lifting capacity and are part of the overall structural integrity of a crane's lifting capacity.
These elements may also affect structural integrity:

- The load chart capacity in relationship to stability;
- The boom angle limitations which affect stability and capacity; and
- The knowledge of the length of boom and radius in determining capacity.

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Safety Precautions

Hand Signals - An illustration of the signals must be posted at the job site.

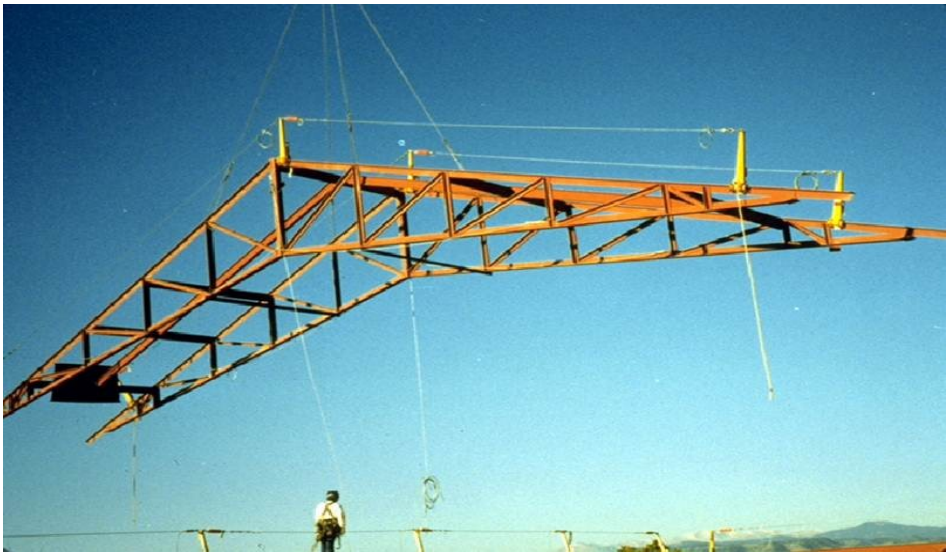
Guard Moving Parts - Belts, gears, shafts, pulleys, sprockets, spindles, drums, fly wheels, chains, or other reciprocating, rotating, or other moving parts or equipment shall be guarded if such parts are exposed to contact by employees, or otherwise create a hazard.

Designated Swing Radius- Stay out of the swing radius of the crane and make sure there are barrier guards showing the swing radius. Accessible areas within the swing radius of the rear of the rotating superstructure of the crane, either permanently or temporarily mounted, shall be barricaded in such a manner as to prevent an employee from being struck or crushed by the crane.

Clear Operating Visibility - Make sure broken windows or other obstructions do not prevent the operator from seeing. All windows in cabs shall be of safety glass, or equivalent, that introduce no visible distortion that will interfere with the safe operation of the machine.

Ladders - Use ladders to get to the upper portion of the cab. Where necessary for rigging or service requirements, a ladder, or steps, shall be provided to give access to a cab roof.

Guardrails - Runways and steps need to have guardrails, handholds and slip resistant surfaces.



Boom Angle Indicator- The boom angle indicator is an accessory device that measures the angle of the boom base section centerline to horizontal. Cranes with variable angle booms shall be equipped with a boom angle indicator, readily visible to the operator.

Suspended Loads - Keep the load as close as possible to the ground when picking and carrying a load. All employees shall be kept clear of loads about to be lifted, and of suspended loads.

Supporting Surface- The crane shall be uniformly level within one percent of level grade and located on firm footing. Cranes equipped with outriggers shall have them all fully deployed following the manufacturer's specifications when hoisting employees. Operators should be mindful of asphalt which easily becomes a shifting, soft surface under a concentrated load.

Sheaves -

a) Sheave grooves shall be smooth and free from surface defects which could cause rope damage. The cross sectional radius at the bottom of the groove should be such as to form a close fitting saddle for the size rope used and the sides of the groove should be tapered outwardly to facilitate entrance of the rope into the groove. Flange corners should be rounded and the rims should run true about the axis of the rotation.

b) Sheaves carrying ropes which can be momentarily unloaded shall be provided with close fitting guards or other suitable devices to guide the rope back into the groove when the load is applied again.

c) The sheaves in the lower load block shall be equipped with close-fitting guards that will prevent the load from becoming fouled when the block is lying on the ground with ropes loose.

d) Means should be provided, if necessary, to proven the chafing of the ropes.

e) All sheave bearings shall be provided with means for lubrication. Permanently lubricated bearings are acceptable.

Rigging Equipment Slings

Types of slings include alloy steel chain, wire rope, metal mesh, natural or synthetic fiber rope, and synthetic web.

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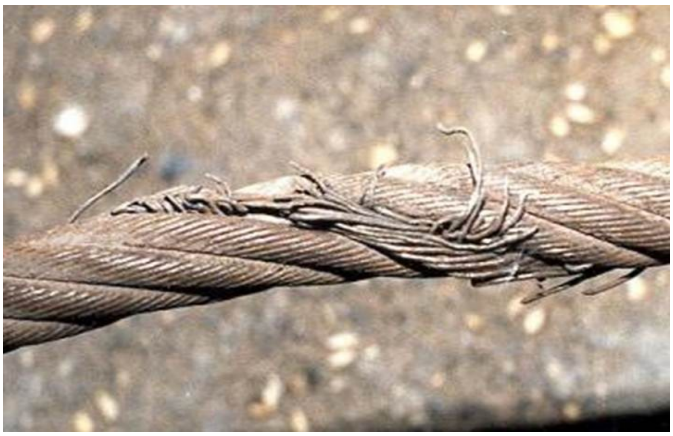
Inspections

Inspections of the hoisting machinery must be made by a competent person. The employer must maintain a record of these inspections.



What to Inspect?

- Correct air pressure and no leaks
- Tires properly inflated
- Clearance for tail swing
- Wire rope wear
- Physical damage to crane
- Loose or missing hardware, nuts, or bolts
- Fluid leaks

These are only some of the items to be inspected on a regular basis and for a complete inspection criteria contact the crane manufacturer and/or supplier. Any equipment that is damaged or defective should be immediately removed from service.

Training

Operators

a. Cranes shall be operated only by the following personnel:
    1. Designated operators
    2. Learners under the direct supervision of a designated operator
    3. Maintenance and test personnel, when it is necessary in the performance of their duties
    4. Inspectors
b. No one other than personnel specified in Paragraph 5-3.1a shall enter a crane cab, with the exception of persons such as oilers and supervisors, whose duties require them to do so, and then only in the performance of their duties and with the knowledge of the operator of other appointed person.

Qualifications for Operators

a. Operators shall be required to pass practical operating examination. Examination shall be limited to the specific type equipment he/she will operate
b. Operators shall meet the following physical qualifications
    1. Have vision of at least 20/30 Snellen in one eye, and 20/50 in the other, with or without glasses
    2. Be able to distinguish red, green, and yellow, regardless of position of colors, if color differentiation is required for operation

3. Hearing with or without hearing aid, must be adequate for the specific operation.
4. A history of epilepsy or of a disabling heart condition shall be sufficient reason for disqualification.

Progress Check

- What are the 4 primary steps to prepare for using a crane at a construction site?
- What constitutes the "structural integrity" of a crane?
- List 4 types of rigging equipment slings.

Definitions:

Crane – Consists of a rotating structure for lifting and lowering horizontally on rubber tires or crawler treads.

Hoist - Used to lift and lower the load.

Boom – An inclined spar, strut, or other long member supporting the hoisting tackle.

Boom stops – A device used to limit the angle of the boom at its highest position.

Brake – To slow or stop motion by friction or power.

Block – Sheaves or grooved pulleys in a frame with hook, eye and strap.

Jib – Extension attached to the boom point to provide added boom length for lifting specified loads.

Boom angle indicator – An accessory device that measures the angle of the boom base section centerline to horizontal.

Load – The weight of the object being lifted including:

- Load block and hook
- Wire rope
- Rigging
- Boom attachments
- Ancillary attachment

Outrigger – Support members attached to the crane's carrier frame which are used to level the crane.

Pendants – Stationary wire ropes used to support the boom.

Radius – The horizontal distance from the axis of the rotation of the crane's superstructure to the center of the suspended load.

Superstructure – The rotating frame, gantry and boom or other operating equipment.

Counter weight – Weights used for balancing loads and the weight of the crane in providing stability.

Deck – The revolving superstructure or turntable bed.

Drum – The spool or cylindrical member around which cables are wound for raising and lowering loads.

Summary

An unstable load, lack of communication, lack of training, and inadequate maintenance or inspection are major contributors to crane accidents.

Operators or others working in the area can be victims of "struck by" and "caught in" injuries.

Contact with power lines causes many accidents.

A competent person must inspect a crane regularly to ensure it is in proper order.

Planning and training reduces accidents.

Electrical Safety

MIOSHA Office of Training & Education

Learning Objectives

Describe the basics of electricity and the injuries that can be caused by improper contact.

Identify the hazards of electricity on a construction site and the best way to prevent those hazards from occurring.

Electricity --The Dangers

Whenever you work with power tools or electrical circuits there is a risk of electrical hazards, especially electrical shock. Risks are increased at construction sites because many jobs involve electric power tools.

Electrical trade workers must pay special attention to electrical hazards because they work on electrical circuits. Coming in contact with an electrical voltage can cause current to flow through the body, resulting in electrical shock and burns. Serious injury or even death may occur.

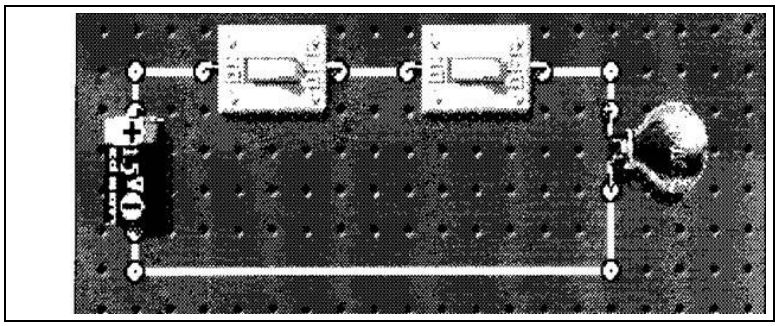
Electricity has long been recognized as a serious workplace hazard, exposing employees to electric shock, electrocution, burns, fires, and explosions. In 1999, for example, 278 workers died from electrocutions at work, accounting for almost 5 percent of all on-the-job fatalities that year, according to the Bureau of Labor Statistics. What makes these statistics more tragic is that most of these fatalities could have been easily avoided.

- About 5 workers are electrocuted every week
- Causes 12% of young worker workplace deaths
- Takes very little electricity to cause harm
- Significant risk of causing fires

Electricity--How it Works

Electricity is the flow of energy from one place to another. In an electrical circuit, **amperage** or **current** (electrons in motion) is measured in **amps**. This current is pushed through the circuit by its

voltage--which is measured in **volts**. A **generator** provides the pressure (voltage) for the electrical current to travel through electrical conductors (wires). The fundamentals are:



- electricity is the flow of energy from one place to another
- it requires a source of power--usually a generating station
- a flow of electrons (current) travels through a conductor
- it travels in a closed circuit

Electrical Terms

Current--electrical movement (measured in amps)

Circuit--complete path of the current. Includes electricity source, a conductor, and the output device or lead (such as a lamp, tool, or header).

Resistance--restriction to electrical flow. Resistance is measured in ohms. Four factors determine the resistance of a material to the flow of electricity:

- What it is made of (silver is best, copper is most common)
- Its diameter (smaller diameter=more resistance)
- Its temperature (higher temperature=higher resistance)
- Its length (longer=higher resistance)

Conductors--substances, like metals, with little resistance to electricity that allow electricity to flow

Grounding--a conductive connection to the earth which acts as a protective measure.

Insulators--substances with high resistance to electricity like glass, porcelain, plastic, and dry wood that prevent electricity from getting to unwanted areas.

ELECTRICAL INJURIES

When an electrical shock enters the body it may produce different types of injuries. Electrocution results in internal and external injury to body parts or the entire body--often resulting in death. After receiving a "jolt" of electricity all or part of the body may be temporarily paralyzed and this may cause loss of grip or stability. A person may also involuntarily move as a result of receiving an electrical shock, resulting in a fall. Internal or external burns may result from contact with electricity.

There are four main types of electrical injuries

- Direct:
  - Electrocution or death due to electrical shock
  - Electrical shock
  - Burns
- Indirect:
  - Falls

Electrical Shock

An electrical shock is received when an electrical current passes through the body. You will get an electrical shock if a part of your body completes an electrical circuit by:

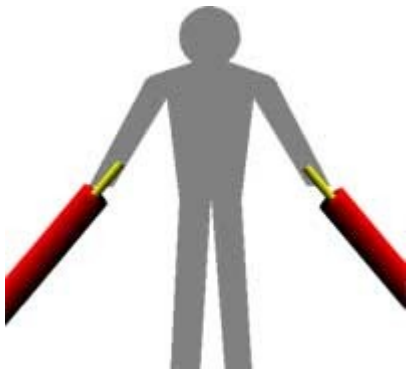
-Touching a live wire and an electrical ground.

-Touching a live wire and another wire at a different voltage.

The metal parts of electric tools and machines may become energized if there is a break in the insulation of the tool or machine wiring. A worker using these tools and machines is made less vulnerable to electric shock when there is a low-resistance path from the metalllic case of the tool machine to the ground. This is done through the use of an equipment grounding conductor--a low-resistance wire that causes the unwanted current to pass directly to the ground, thereby greatly reducing the amount of current passing through the body of the person in contact with the tool or machine.

How Shocks Occur

Electricity travels in closed circuits, normally through a conductor. Shock results when the body becomes part of the electrical circuit; current enters the body at one point and leaves at another. Typically, shock occurs when a person contacts:

		
Both wires of an energized circuit.	One wire of an energized circuit and the ground.	A metallic part in contact with an energized wire while the person is also in contact with the ground.

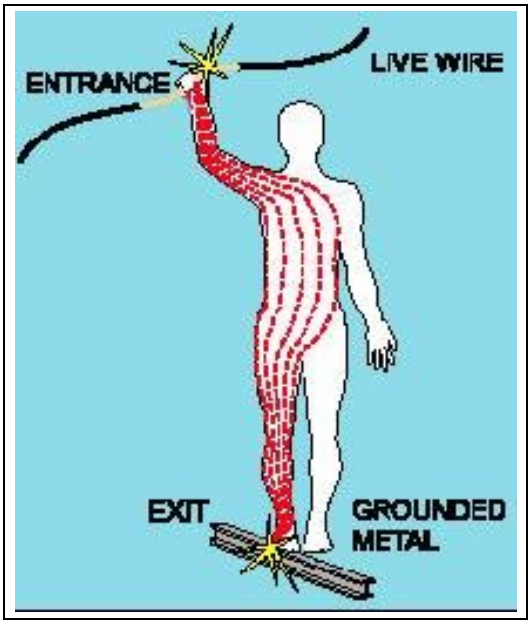
Metallic parts of electric tools and machines can become energized if there is a break in the insulation of their wiring. A low-resistance wire between the metallic case of the tool/machine and the ground – an equipment grounding conductor – provides a path for the

unwanted current to pass directly to the ground. This greatly reduces the amount of current passing through the body of the person in contact with the tool or machine. Properly installed, the grounding conductor provides protection from electric shock.

Source: U.S. Department of Labor | Occupational Safety & Health Administration

Shock Severity

Severity of the shock depends on:



- Path of current through the body
- Amount of current flowing through the body (amps)
- Duration of the current through the body

LOW VOLTAGE DOES NOT MEAN LOW HAZARD!

Other factors that may affect the severity of the shock are:

- The voltage of the current.

- The presence of moisture

- The general health of the person prior to the shock.

Low voltages can be extremely dangerous because, all other factors being equal, the degree of injury increases the longer the body is in contact with the circuit.

The resistance of the body varies based on:

• The amount of moisture on the skin (less moisture = more resistance)
• The size of the area of contact (smaller area = more resistance)
• The pressure applied to the contact point (less pressure = more resistance)
• Muscular structure (less muscle = less resistance)

Dangers of Electrical Shock

- Currents above 10 mA* can paralyze or "freeze" muscles
- Currents more than 75 mA can cause a rapid, ineffective heartbeat--death will occur in a few minutes unless a defibrillator is used
- 75 mA is not much current--a small power drill uses 30 times as much

*mA=milliampere=1/1,000 of an ampere

For example, 1/10 of an ampere (amp) of electricity going through the body for just 2 seconds is enough to cause death.

Currents above 10 mA can paralyze or “freeze” muscles. When this “freezing” happens, a person is no longer able to release a tool, wire, or other object. In fact, the electrified object may be held even more tightly, resulting in longer exposure to the shocking current. For this reason, hand-held tools that give a shock can be very dangerous. If you can’t let go of the tool, the current continues through your body for a longer time, which can lead to

respiratory paralysis (the muscles that control breathing cannot move). You stop breathing for a period of time. People have stopped breathing when shocked with currents from voltages as low as 49 volts. Usually, it takes about 30 mA of current to cause respiratory paralysis.

Current level (Milliamperes)	Probable Effect on Human Body
1 mA	Perception level. Slight tingling sensation. Still dangerous under certain conditions.
5mA	Slight shock felt; not painful but disturbing. Average individual can let go. However, strong involuntary reactions to shocks in this range may lead to injuries.
6mA - 16mA	Painful shock, begin to lose muscular control. Commonly referred to as the freezing current or "let-go" range.
17mA - 99mA	Extreme pain, respiratory arrest, severe muscular contractions. Individual cannot let go. Death is possible.
100mA - 2000mA	Ventricular fibrillation (uneven, uncoordinated pumping of the heart.) Muscular contraction and nerve damage begins to occur. Death is likely.
> 2,000mA	Cardiac arrest, internal organ damage, and severe burns. Death is probable.

References

NIOSH [1998]. Worker Deaths by Electrocution; A Summary of NIOSH Surveillance and Investigative Findings. Ohio: US Health and Human Services.

Greenwald EK [1991]. Electrical Hazards and Accidents - Their Cause and Prevention. New York: Van Nostrand Reinhold.

Burns

- Most common shock-related injury
- Occurs when you touch electrical wiring or equipment that is improperly used or maintained
- Typically occurs on hands
- Very serious injury that needs immediate attention

Shock-related injuries include burns, internal injuries, and injuries due to involuntary muscle contractions. The most common shock-related injury is a burn. Burns suffered in electrical incidents may be one or more of the following three types:

1. **Electrical burns** cause tissue damage, and are the result of heat generated by the flow of electrical current through the body. These are one of the most serious injuries you can receive and require immediate attention.

2. **Arc or Flash burns** are caused by high temperatures near the body produced by an electrical arc or explosion. Attend to them immediately.

3. **Thermal contact burns** occur when skin comes in contact with overheated electric equipment, or when clothing is ignited by an electrical incident.

Progress Check

- Name and describe the 3 most common electrical burns.
- What factors affect the way the human body

responds to electrical voltages?

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Electrical Hazards and How to Control Them

Electrical accidents are caused by a combination of three factors:

- Unsafe equipment and/or installation
- Workplace made unsafe by the environment
- Unsafe work practices

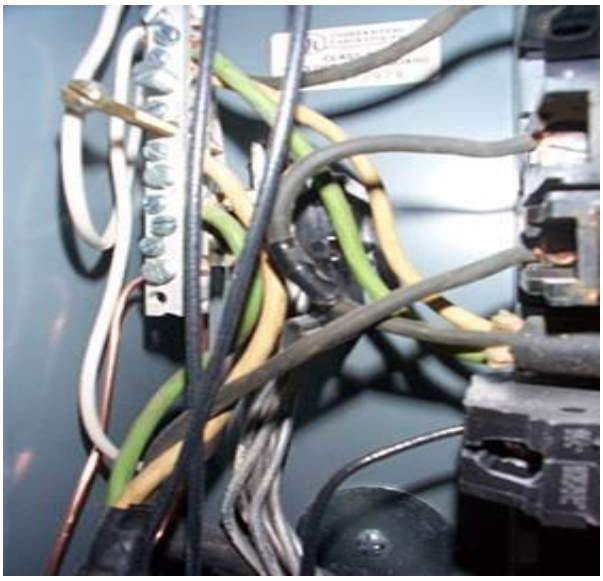
Exposed electrical parts	***Overhead power lines***
Inadequate wiring	***Defective insulation***
Improper grounding	***Overloaded circuits***
Wet conditions	***Damaged tools & equipment***
Improper PPE	

Hazard--Exposed Electrical Parts

Live parts of electric equipment operating at **50 volts** or more should be guarded against accidental contact by cabinets or other forms of enclosures, or by isolating wiring by any of the following means:

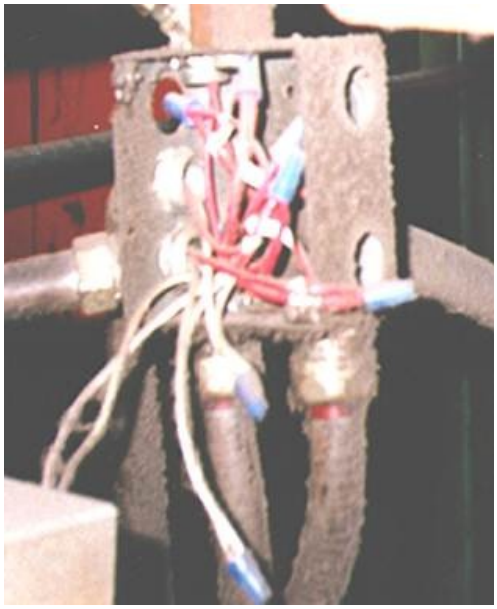
- By location in a room, vault, or similar enclosure that is accessible only to qualified persons. The area should be guarded and signed with **DANGER** and the voltage of the equipment.
- By partitions or screens so arranged that only qualified persons will have access to the space within reach of the live parts. Any openings in such partitions or screens shall be so sized and located that persons are not likely to come into accidental contact with the live parts or to bring conducting objects into contact with them.
- By location on a balcony, gallery, or platform so elevated and arranged as to exclude unqualified persons.
- By elevation of 8 feet or more above the floor or other working surface and so installed as to exclude unqualified persons.

Use guards or barriers and replace covers. Always guard live parts of equipment operating at 50 volts or more against accidental contact.



Conductors entering boxes, cabinets, or fittings should be protected from abrasion, and openings through which conductors enter should be effectively closed. Unused openings in cabinets, boxes, and fittings should also be effectively closed.

All pull boxes, junction boxes, and fittings should be provided with covers. If metal covers are used, they should be grounded. In energized installations each outlet box should have a cover, faceplate, or fixture canopy. Covers of outlet boxes having holes through which flexible cord pendants pass should be provided with bushings designed for the purpose or have smooth, well-rounded surfaces on which the cords may bear.



Isolate electrical parts by using guards and barriers.

Junction boxes, pull boxes and fittings must have approved covers.

Unused openings in cabinets, boxes and fittings must be closed (no missing knockouts).

This photo shows violations of these requirements.

Hazard--Overhead Power Lines

Overhead and buried power lines are especially hazardous because they carry extremely high voltage. Fatal electrocution is the main risk, but burns and falls from elevation are also hazardous. Using tools and equipment that can contact power lines increases the risk.

More than half of all electrocutions are caused by direct worker contact with energized power lines. Power line workers must be especially aware of the dangers of overhead lines. In the past, 80% of all lineman deaths were caused by contacting a live wire with a bare hand. Due to such incidents, all linemen now wear special rubber gloves that protect them up to 34,500 volts. Today, most electrocutions involving overhead power lines are caused by failure to maintain proper work distances. Some examples of equipment that can contact power lines are:

Cranes	***Ladders***
Scaffolds	***Backhoes***
Scissor Lifts	***Raised dump truck bed***
Aluminum paint roller	

Overhead power lines must be deenergized and grounded by the owner or operator of the lines, or other protective measures must be provided before work is started. Protective measures (such as guarding or insulating the lines) must be designed to prevent contact with the lines.

PPE may consist of rubber insulating gloves, hoods, sleeves, matting, blankets, line hose, and industrial protective helmets.

Other safety measures include:

- Look for overhead power lines and buried power line indicators.
- Post warning signs.
- Contact utilities for buried power line locations.
- Stay at least 10 feet away from overhead power lines.
- Unless you know otherwise, assume that overhead lines are energized.
- Get the owner or operator of the lines to de-energize and ground lines when working near them.
- Other protective measures include guarding or insulating the lines.
- Use non-conductive wood or fiberglass ladders when working near power lines.

- Power line workers need special training and PPE.

Case Reports

Too Close To Power Line

Seven employees of a masonry company were erecting a brick wall from a tubular, welded-frame scaffold approximately 24 feet high. The scaffold had been constructed only 21 horizontal inches across from a 7,620-volt power line. A laborer carried a piece of wire reinforcement (10 feet long by 8 inches wide) along the top section of the scaffold and contacted the power line with it. The laborer, who was wearing leather gloves, received an electric shock and dropped the wire reinforcement, which fell across the power line and simultaneously contacted the metal rail of the scaffold, energizing the entire scaffold. A 20-year-old bricklayer standing on the work platform in contact with the main scaffold was electrocuted.

Crane Boom Too Close To Power Line

A 56-year-old construction laborer was removing forms from a concrete wall poured several days earlier. As he removed the forms, he wrapped them with a length of cable called a choker, which was to be attached to a crane. The victim signaled the operator of the crane to extend the boom and lower the hoist cable. Both the operator and the victim failed to notice that the boom had contacted a 2,400-volt overhead power line. When the victim reached down to connect the choker to the hoist cable, he suddenly collapsed. Co-workers provided CPR, but were unable to revive the victim. Only after a rescue squad arrived about 4 minutes later did anyone realize that the crane was in contact with a power line -- all those present had assumed that the victim had suffered a heart attack.

Crane Boom Swung Into Power Line

A 29-year-old worker was electrocuted when he pushed a crane cable into a 7,200-volt power line. The victim was part of a crew that was constructing a concrete wall. Before work began, the company safety director made sure that insulated line hoses were placed over sections of the the power line near the jobsite and that a safety clearance zone was marked off for arriving cement trucks. After the wall was poured, one driver cleaned the loading chute of his cement truck with a water hose mounted on the truck. As he began to pull away, the crew supervisor yelled to him, asking if the crew could use his water hose to wash out their cement bucket suspended from the crane. The driver stopped the truck under the power line, and the victim, not realizing that the truck had moved, swung the boom to position the bucket behind the truck. When he grasped the handle of the bucket to pull it down, the crane cable came into contact with the overhead line. The victim provided a path to ground and was electrocuted.

Source: U.S. Department of Labor | Occupational Safety & Health Administration

Hazard--Inadequate Wiring

An electrical hazard exists when the wire is too small a gauge for the current it will carry. Normally, the circuit breaker in a circuit is matched to the wire size. However, in older wiring, branch lines to permanent ceiling light fixtures could be wired with a smaller gauge than the supply cable.

Note that wire-gauge size is inversely related to the diameter of the wire. For example, a No. 12 flexible cord has a larger diameter wire than a No. 14 flexible cord.

Choose a wire size that can handle the total current. Remember: The larger the gauge number, the smaller the wire!

American Wire Gauge

Wire size--Handles up to:

#10 AWG 30 amps

#12 AWG 25 amps

#14 AWG 18 amps

#16 AWG 13 amps

***For example--a portable tool will draw more current than the cord can handle, causing overheating and a possible fire without tripping the circuit breaker.**

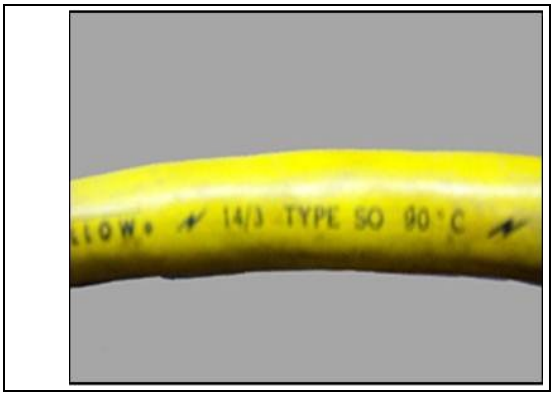
The circuit breaker could be the right size for the circuit but not for the smaller-wire extension cord.

Use the Correct Wire

The MIOSHA standard requires flexible cords to be rated for hard or extra-hard usage. These ratings are to be indelibly marked approximately every foot of the cord. Since deterioration occurs more rapidly in cords which are not rugged enough for construction conditions, the National Electric Code and MIOSHA have specified the types of cords to use in a construction environment. This rule designates the types of cords that must be used for various applications including portable tools, appliances, temporary and portable lights. The cords are designated HARD and EXTRA HARD SERVICE.

Examples of HARD SERVICE designation types include S, ST, SO, STO, SJ, SJO, SJT, & SJTO. Extension cords must be durably marked as per 1926.405(g)(2)(ii) with one of the HARD or EXTRA HARD SERVICE designation letters, size and number of conductors.

- Wire used depends on operation, building materials, electrical load, and environmental factors.
- Used fixed cords rather than flexible cords
- Use the correct extension cord



This example must be 3-wire type and designed for hard or extra hard use.

Hazard--Defective Cords and Wires

Extension cords may have damaged insulation. Sometimes the insulation inside an electrical tool or appliance is damaged. When insulation is damaged, exposed metal parts may become energized if a live wire inside touches them. Electric hand tools that are old, damaged, or misused may have damaged insulation inside. If you touch damaged power tools or other equipment, you will receive a shock. You are more likely to receive a shock if the tool is not grounded or double-insulated.

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Hazard--Damaged Cords

The normal wear and tear on extension and flexible cords at your site can loosen or expose wires, creating hazardous conditions. Cords that are not 3-wire type, not designed for hard-usage, or that have been modified, increase your risk of contacting electrical current.

Cords can be damaged by:

- Aging
- Door or window edges
- Staples or fastenings
- Abrasion from adjacent material
- Activity in the area

Improper use can cause shocks, burns or fire.

Ways to prevent damage:

- Insulate live wires
- Check before use
- Use only cords that are 3-wire type
- Use only cords marked for hard or extra-hard usage
- Use only cords, connection devices, and fittings equipped with strain relief
- Remove cords by pulling on the plugs, not the cords
- Cords not marked for hard or extra-hard use, or which have been modified, must be taken out of service immediately.

Improper Use of Extension and Flexible Cords

Case Reports

Flexible Cord Not 3-Wire, Hard Service Variety

A worker received a fatal shock when he was cutting drywall with a metal casing router. The router's 3-wire power cord was spliced to a 2-wire cord and plug set which was not rated for hard service. A fault occurred, and with no grounding and no GFCI protection, the worker was electrocuted.

No Strain Relief

A worker was operating a ¾" electric chisel when an electrical fault occurred in the casing of the tool, causing him to be fatally electrocuted. An OSHA inspection revealed that the tool's original power cord had been replaced with a flat cord, which was not designated for hard service, and that strain relief was not provided at the point where the cord entered the tool. Additionally, the ground prong was missing and there was no GFCI protection.

Source: U.S. Department of Labor | Occupational Safety & Health Administration

Grounding

Grounding is a secondary method of preventing electrical shock. Grounded electrical systems are usually connected to a grounding rod that is placed 6-8 feet deep in the earth.

Grounding creates a low-resistance path from a tool to the earth to disperse unwanted current. When a short or lightning occurs, energy flows to the ground, protecting you from electrical shock, injury and death.

Grounded - connected to earth or to some conducting body that serves in place of the earth.

Grounded, effectively (Over 600 volts, nominal.) Permanently connected to earth through a ground connection of sufficiently low impedance and having sufficient ampacity that ground fault current which may occur cannot build up to voltages dangerous to personnel.

Grounded conductor- A system or circuit conductor that is intentionally grounded.

Grounding conductor- A conductor used to connect equipment or the grounded circuit of a wiring system to a grounding electrode or electrodes.

Hazard--Improper Grounding

The most frequently violated MIOSHA electrical regulation is improper grounding of equipment and circuitry. The metal parts of an electrical wiring system that we touch (switch plates, ceiling light fixtures, conduit, etc.) should be grounded and at 0 volts. If the system is not grounded properly, these parts may become energized. Metal parts of motors, appliances, or electronics that are plugged into improperly grounded circuits may be energized. When a circuit is not grounded properly, a hazard exists because unwanted voltage cannot be safely eliminated. If there is no safe path to ground for fault currents, exposed metal parts in damaged appliances can become energized.

Extension cords may not provide a continuous path to ground because of a broken ground wire or plug.

Electrical systems are often grounded to metal water pipes that serve as a continuous path to ground. If plumbing is used as a path to ground for fault current, all pipes must be made of conductive material (a type of metal). Many electrocutions and fires occur because (during renovation or repair) parts of metal plumbing are replaced with plastic pipe, which does not conduct electricity.

A typical extension cord grounding system has four components:

- a third wire in the cord, called a ground wire;
- a three-prong plug with a grounding prong on one end of the cord;
- a three-wire, grounding-type receptacle at the other end of the cord;
- a properly grounded outlet.

Two kinds of grounds are required by the standard:

1. **Service or system ground.** In this instance, one wire, called the neutral conductor or grounded conductor, is grounded. In an ordinary low-voltage circuit, the white (or gray) wire is grounded at the generator or transformer and again at the service entrance of the building. This type of ground is primarily designed to protect machines, tools, and insulation against damage.

2. For enhanced worker protection, an additional ground, called the **equipment ground**, must be furnished by providing another path from the tool or machine through which the current can flow to the ground. This additional ground safeguards the electric equipment operator if a malfunction causes the metal frame of the tool to become energized.

Precautions:

- Ground power supply systems, electrical circuits, and electrical equipment
- Frequently inspect electrical systems to insure path to ground is continuous
- Inspect electrical equipment before use
- Don't remove ground prongs from tools or extension cords
- Ground exposed metal parts of equipment

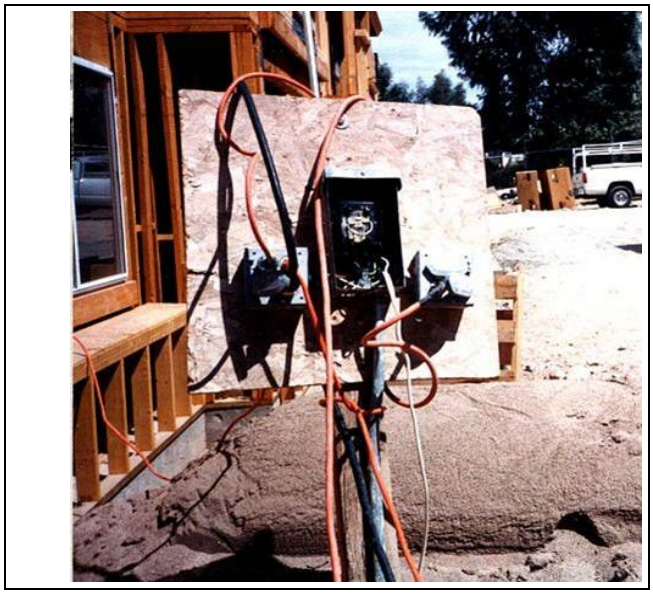
Use GFCI (ground-fault circuit interrupter)

• Matches the amount of current going to an electrical device against the amount of current returning from the device.
• Interrupts the electric power within as little as 1/40 of a second when the amount of current going differs from the amount returning by about 5 mA
• Must be tested to ensure it is working correctly.
• NEC requires GFCI's be used in these high-risk situations:
• Electricity is used near water.
• The user of electrical equipment is grounded (by touching grounded material).
• Circuits are providing power to portable tools or outdoor receptacles.
• Temporary wiring or extension cords are used.

There is one disadvantage to grounding: a break in the grounding system may occur without the user's knowledge. Using a ground-fault circuit interrupter (GFCI) is one way of overcoming grounding deficiencies.

Hazard--Overloaded Circuits

Hazards may result from:



- Too many devices plugged into a circuit, causing heated wires and possibly a fire
- Damaged tools overheating
- Lack of over current protection
- Wire insulation melting, which may cause arcing and a fire in the area where the overload exists, even inside a wall.

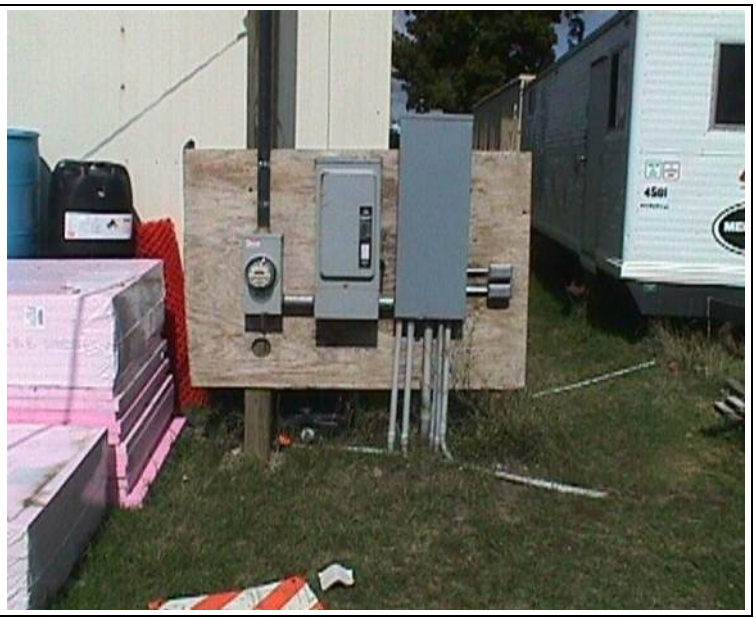
If the circuit breakers or fuses are too big (high current rating) for the wires they are supposed to protect, an overload in the circuit will not be detected and the current will not be shut off. A circuit with improper over current protection devices – or one with no over current protection devices at all – is a hazard.

<u>Prevention</u>

To prevent too much current in a circuit, a circuit breaker or fuse is placed in the circuit. If there is too much current in the circuit, the breaker "trips" and opens like a switch. If an overloaded circuit is equipped with a fuse, an internal part of the fuse melts, opening the circuit. Both breakers and fuses do the same thing: open the circuit to shut off the electrical current

The basic idea of an over current device is to make a weak link in the circuit. In the case of a fuse, the fuse is destroyed before another part of the system is destroyed. In the case of a circuit breaker, a set of contacts opens the circuit. Unlike a fuse, a circuit breaker can be re-used by re-closing the contacts. Fuses and circuit breakers are designed to protect equipment and facilities, and in so

doing, they also provide considerable protection against shock in most situations. However, the only electrical protective device whose sole purpose is to protect people is the ground-fault circuit-interrupter.



Protective Devices--automatically open the circuit if excess current from an overload or ground-fault is detected--shutting off electricity.

Fuses and circuit breakers are over current devices. When too much current is detected, fuses melt and circuit breakers trip.

Progress Check

- List at least 6 electrical hazards.
- What are the 4 components of a typical extension cord grounding system?
- Describe safety measures that must be observed when working on/near overhead power lines.

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Power Tool Requirements

- Have a three-wire cord with ground plugged into a grounded receptacle
- Be double insulated
- Be powered by a low-voltage isolation transformer

Common Examples of Misused Equipment = MIOSHA Violations

- Using multi-receptacle boxes designed to be mounted by fitting them with a power cord and placing them on the floor.
- Fabricating extension cords with ROMEX® wire.
- Using equipment outdoors that is labeled for use only in dry, indoor locations.
- Attaching ungrounded, two-prong adapter plugs to three-prong cords and tools.
- Using circuit breakers or fuses with the wrong rating for over-current protection, e.g. using a 30-amp breaker in a system with 15- or 20-amp receptacles. Protection is lost because it will not trip when the system's load has been exceeded.
- Using modified cords or tools, e.g., removing ground prongs, face plates, insulation, etc.
- Using cords or tools with worn insulation or exposed wires.

Tool Safety Tips

- Use gloves and appropriate footwear
- Store in a dry place when not using
- Don't use in wet/damp conditions
- Keep working areas well lit
- Ensure no tripping hazards are present
- Don't carry a tool by the cord

- Don't yank the cord to disconnect it
- Keep cords away from heat, oil, and sharp edges
- Disconnect when not in use and when changing accessories such as blades and bits
- Remove damaged tools from use

Progress Check

- List several common examples of equipment misuse according to MIOSHA standards.

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Safety Related Work Practices

There are "clues" that electrical hazards exist. For example, if a GFCI keeps tripping while you are using a power tool, there is a problem. Don't keep resetting the GFCI and continue to work. You must evaluate the "clue" and decide what action should be taken to control the hazard.

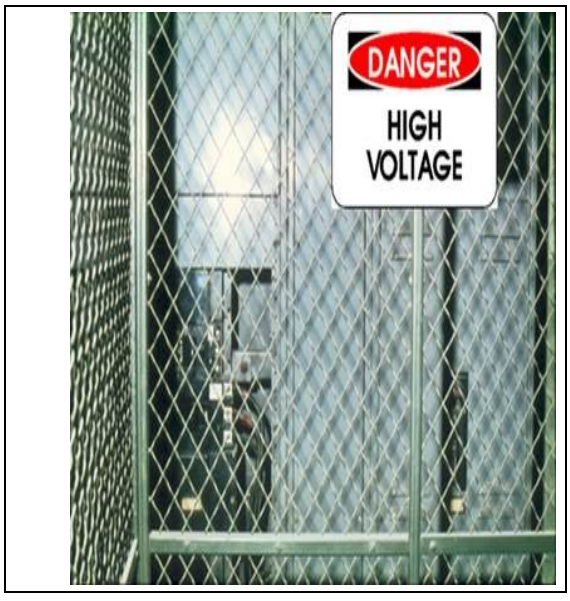
There are a number of other conditions that indicate a hazard.

- Tripped circuit breakers and blown fuses show that too much current is flowing in a circuit. This could be due to several factors, such as malfunctioning equipment or a short between conductors. You need to determine the cause in order to control the hazard.
- An electrical tool, appliance, wire, or connection that feels warm may indicate too much current in the circuit or equipment. You need to evaluate the situation and determine your risk.

- An extension cord that feels warm may indicate too much current for the wire size of the cord. You must decide when action needs to be taken.
- A cable, fuse box, or junction box that feels warm may indicate too much current in the circuits.
- A burning odor may indicate overheated insulation.
- Worn, frayed, or damaged insulation around any wire or other conductor is an electrical hazard because the conductors could be exposed. Contact with an exposed wire could cause a shock. Damaged insulation could cause a short, leading to arcing or a fire. Inspect all insulation for scrapes and breaks. You need to evaluate the seriousness of any damage you find and decide how to deal with the hazard.
- A GFCI that trips indicates there is current leakage from the circuit First, you must decide the probable cause of the leakage by recognizing any contributing hazards. Then, you must decide what action needs to be taken.

To protect workers from electrical shock:

- Use barriers and guards to prevent passage through areas of exposed energized equipment
- Pre-plan work, post hazard warnings and use protective measures
- Keep working spaces and walkways clear of cords



Lockout and Tagging of Circuits

- Apply locks to power source after de-energizing
- Tag deactivated controls

- Tag de-energized equipment and circuits at all points where they can be energized
- Tags must identify equipment or circuits being worked on

(a) **Controls**. Controls that are to be deactivated during the course of work on energized or de-energized equipment or circuits should be tagged.

(b) **Equipment and circuits**. Equipment or circuits that are deenergized should be rendered inoperative and should have tags attached at all points where such equipment or circuits can be energized.

(c) **Tags**. Tags should be placed to identify plainly the equipment or circuits being worked on.

(d) **Lockout and tagging**. While any employee is exposed to contact with parts of fixed electric equipment or circuits which have been de-energized, the circuits energizing the parts should be locked out or both.

Progress Check

- What clues or conditions indicate an electrical hazard?
- What does a tripped GFCI indicate?

Summary

Electrical equipment must be:

- Listed and labeled
- Free from hazards
- Used in the proper manner

If you use electrical tools you must be:

- Protected from electrical shock
- Provided necessary safety equipment

Egress/Fire Protection

MIOSHA Office of Training & Education

ACTION PLANS	FIRE PREVENTION	SUMMARY

Learning Objectives

Describe MIOSHA requirements for proper fire prevention, egress, and equipment.
Be able to create a working emergency action and fire prevention plan.

Fire safety becomes everyone's job at a worksite. Employers should train workers about fire hazards in the workplace and about what to do in a fire emergency. This plan should outline the assignments of key personnel in the event of a fire and provide an evacuation plan for workers on the site. In the construction industry, a "fire plan" should be set up prior to beginning any demolition job.
http://www.osha.gov/SLTC/firesafety/

- Fires and explosions kill more than 200 and injure more than 5000 workers each year.

- There is a long and tragic history of workplace fires in this country caused by problems with fire exits and extinguishing systems.
- MIOSHA requires employers to provide proper exits, firefighting equipment and employee training to prevent fire deaths and injuries in the workplace.

Emergency Action Plan

The emergency action plan must be in writing, except for firms with 10 or fewer employees. These businesses can communicate the plan orally to employees. The plan covers reasonably expected emergencies, such as fires, explosions, toxic chemical releases, hurricanes, tornadoes, blizzards and floods.

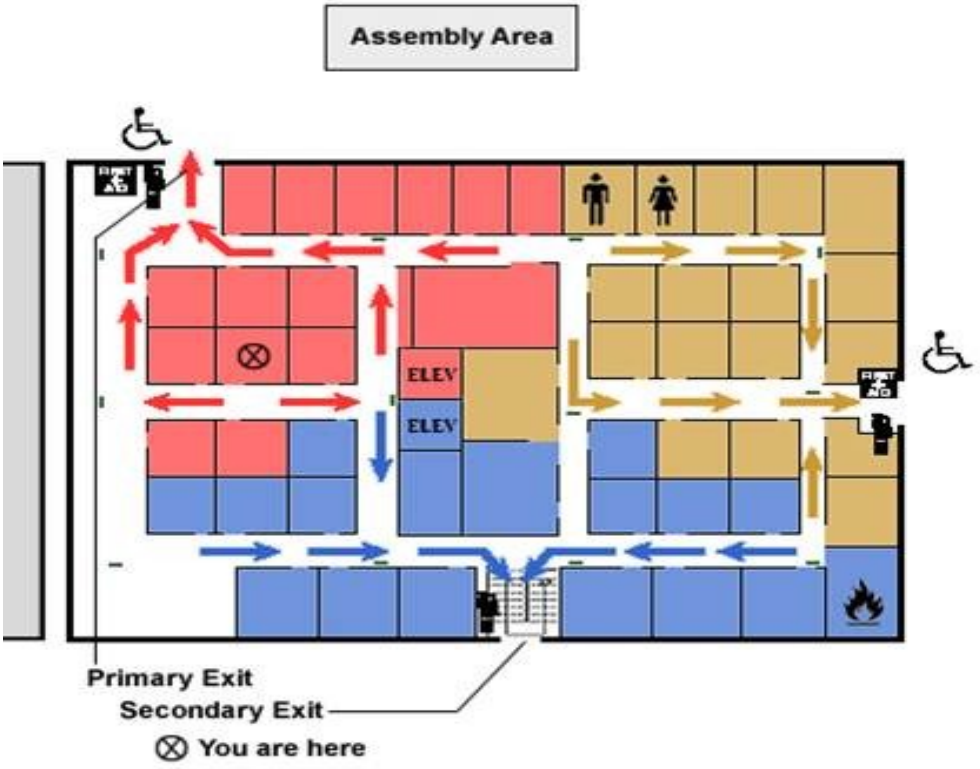
The emergency action plan describes the actions that must be taken to ensure employee safety in emergencies. It should include floor plans or maps which show emergency escape routes and tells employees what actions to take in an emergency situation. An alarm system must be in place which has a distinctive signal. Emergency plans include, as a minimum:

- Escape procedures and escape route assignments
- Critical plant operations shutdown procedure
- Procedure to account for all personnel
- Assignment of rescue and medical duties
- Means for reporting emergencies
- Identification of responsible persons to contact for further information
-Employee training is necessary

Exit Route

An **exit route** is a continuous and unobstructed path of exit travel from any point within a workplace to a place of safety. It consists of three parts:

1. **Exit access** - part of an exit route that leads to an exit
2. **Exit** - part of an exit route that is generally separated from other areas to provide a protected way of travel to the exit discharge.
3. **Exit discharge** - part of an exit route that leads directly outside or to a street, walkway, refuge area, public way, or open space with access to the outside.



Basic Requirements

Exit routes must be free and unobstructed.

Keep the exit routes free of explosive or highly flammable materials.

Arrange exit routes so that employees will not have to travel toward a high hazard area, unless it is effectively shielded.

Emergency safeguards such as sprinkler systems, alarm systems, fire doors and exit lighting, must be in proper working order at all times.

Each exit route must be adequately lighted so that an employee with normal vision can see along the exit route.

The exit routes must be permanent and there must be enough exits in the proper arrangement for quick escape.

Exits must be separated by fire resistant materials.

An opening into an exit must be protected by an approved self-closing fire door that remains closed or automatically closes in an emergency.

Exit routes must be maintained during construction, repairs or alterations.

Exit Discharge

Each exit discharge must lead directly outside or to a street, walkway, refuge area, public way, or open space with access to the

outside that is large enough to accommodate all building occupants likely to use the exit route.

Exit stairs that continue beyond the level on which the exit discharge is located must be interrupted on that level by doors, partitions or other effective means that clearly indicate the direction of travel to the exit discharge.

Exit Doors Must Be Unlocked

Persons must be able to open from the inside at all times without keys, tools or special knowledge.

Devices, such as a panic bar that locks only from the outside, is permitted.

Must be free of any device or alarm that could restrict emergency use if the device or alarm fails.

May be locked from the inside only mental, penal, or correctional facillities where there is constant supervision.

Side-Hinged Doors

- Must be used to connect any room to an exit route
- A door that connects any room to an exit route must swing out in the direction of exit travel if the room is designed to be occupied by more than 50 people or contains high hazard contents.
    - High hazard contents are those which are liable to burn with extreme rapidity or which may produce poisonous fumes or explosions in a fire. Examples include flammable chemicals and grain.

Exit Route Capacity and Dimensions

The exit route must support the maximum permitted occupant load for each floor served.

The capacity must not decrease in the direction of exit route travel to the exit discharge.

Ceiling must be at least 7-1/2 feet high with no projection reaching a point less than 6 ft. 8 in. from floor.

An exit access must be at least 28 in. wide at all points.

Objects that project into the exit route must not reduce the width of the exit route to less than the minimum width requirements for exit routes.

Exit Marking

Each exit must be clearly visible and marked with an "Exit" sign.

Each exit route door must be free of decorations or signs that obscure the visibility of the door.

If the direction of travel to the exit or exit discharge is not immediately apparent, signs must be posted along the exit access indicating direction to the nearest exit.
The line of sight to an exit sign must be visible at all times.

Each doorway or passage along an exit access that could be mistaken for an exit must be marked "Not an Exit" or similar designation, or be identified by a sign indicating its actual use (e.g. "closet").

Progress Check

- What are the proper ways to mark exits?
- Define "exit discharge".
- List the minimum components of an emergency action plan.

↑**TOP OF PAGE**

Fire Prevention Plan

The plan must include

- A list of the major fire hazards and handling, storage, and control procedures.
- Names or job titles of persons responsible for maintenance of equipment and systems to prevent or control ignitions or fires.
- Names or job titles of persons responsible for control of fuel source hazards.
- Training for all employees who have responsibilities in the plan.

Accumulations of flammable and combustible waste materials and residues must be controlled so they do not contribute to a fire emergency.

Portable Fire Extinguishers

If portable fire extinguishers are provided for employee use, the employer must mount, locate and identify them so workers can access them without subjecting themselves to possible injury.

Extinguisher Classification

Letter classification given to an extinguisher to designate the class or classes of fire on which it will be effective.

- **Class A** - ordinary combustibles (wood, cloth, paper).
- **Class B** - flammable liquids, gasses or greases.
- **Class C** - energized electrical equipment.
- **Class D** - combustible metals.

The class of extinguisher should be on the extinguisher shell. The picture-symbol labeling system now in use is designed to make the operation of fire extinguishers more effective and safe to use through the use of less confusing pictorial labels. The system also emphasizes when not to use an extinguisher on certain types of fires.

Because of recent information outlining the difficulties inherent in the extinguishment of fires in cooking appliances that involve combustible cooking media (vegetable or animal oils and fats), a new classification (Class K) has been established. This classification is not listed in MIOSHA standards. NFPA 10 specifies that listed and labeled Class K fire extinguishers are to be provided in these cases.

Extinguisher Rating

Numerical rating given to Class A and B extinguishers which indicate how large a fire an experienced person can put out with an extinguisher.

Ratings are based on tests conducted at Underwriters' Laboratories, Inc.

- Class A: 1-A, 2-A...40-A
- Class B: 1-B, 2-B...640-B

A 4-A extinguisher, for example, should extinguish about twice as much fire as a 2-A extinguisher.

Class C extinguishers have only a letter rating because there is no readily measurable quantity for Class C fires which are essentially

Class A or B fires involving energized electrical equipment. Class D extinguishers likewise do not have a numerical rating. Their effectiveness is described on the faceplate.

Maintaining Portable Fire Extinguishers

- Must be maintained in a fully charged and operable condition.
- Must be kept in their designated places at all times except during use.
- Must conduct an annual maintenance check.
- Must record the annual maintenance date and retain this record for one year after the last entry or the life of the shell, whichever is less.

Portable Fire Extinguisher Training and Education

Where portable fire extinguishers have been provided for employee use in the workplace, employees must be provided with an educational program on the:

- General principles of fire extinguisher use
- Hazards of incipient (beginning) stage fire fighting.

Employees designated to use extinguishers must recieve instruction and hands on practice in the operation of the equipment.

Progress Check

- What are the 4 classifications of fire extinguishers?
- How must extinguishers be maintained?

Summary

There must be enough exits in the proper arrangement for quick escape.

Exit routes must be marked, lighted, free of obstructions and locks must not be used to impede or prevent escape.

An emergency action plan and a fire prevention plan must be in place.

Fire extinguisher classes and numerical rating help a user understand its capabilities.

Fire extinguishers must be inspected, maintained and employees must be trained to use them.

Hazard Communication

MIOSHA Office of Training & Education

STANDARDS	CONTAINER LABELING	MATERIAL SAFETY DATA SHEETS	TRAINING	SUMMARY

Learning Objectives

Identify employer responsibilities towards reducing workplace hazards.

Be familiar with the information provided in Material Safety Data Sheets.

About 32 million workers work with and are potentially exposed to one or more chemical hazards. There are approximately 650,000 existing chemical products, and hundreds of new ones being introduced annually.

Chemical exposure may cause or contribute to many serious health effects such as heart ailments, central nervous system damage, kidney and lung damage, sterility, cancer, burns, and rashes.

Some chemicals may also be safety hazards and have the potential to cause fires and explosions and other serious accidents.

OSHA's Hazard Communication Standard

Hazard Communication Program

Container Labeling

Material Safety Data Sheet

The Hazard Communication (HazCom) standard establishes uniform requirements to make sure that the hazards of all chemicals imported into, produced, or used in U.S. workplaces are evaluated, and that this hazard information is transmitted to affected employers and exposed employees.

The HazCom standard is different from other OSHA health rules because it covers all hazardous chemicals. The rule also incorporates a "downstream flow of information," which means that producers of chemicals have the primary responsibility for generating and disseminating information, whereas users of chemicals must obtain the information and transmit it to their employees.

1. **OSHA's Hazard Communication (HazCom)** standard applies to general industry, shipyard, marine terminals, long shoring, and construction employment and covers chemical manufacturers, importers, employers and employees exposed to chemical hazards.

Office workers who encounter hazardous chemicals only in isolated instances are not covered by the rule. OSHA considers most office products (such as pens, pencils, adhesive tape) to be exempt under the provisions of the rule. OSHA has stated that intermittent or occasional use of a copying machine does not result in coverage under the rule. However, if an employee handles the chemicals to service the machine, or operates it for long periods of time, then the standard would apply.

Employer Responsibilities

- Identify and list hazardous chemicals in their workplaces.
- Obtain Material Safety Data Sheets (MSDSs) and labels for each hazardous chemical, if not provided by the manufacturer, importer, or distributor
- Implement a written HazCom program, including labels, MSDSs, and employee training.
- Communicate hazard information to employees through labels, MSDSs, and formal training programs.

Minimize Workplace Hazards

The first step in minimizing workplace hazards is to perform a thorough hazard assessment. Chemical manufacturers and importers must review scientific evidence on the hazards of chemicals they produce or import and report findings. Employers can rely on the evaluations performed by the manufacturers or importers to establish the hazards of the chemicals they use.

Written HazCom Program

Ensures that all employers receive the information they need to inform and train their employees. It provides necessary hazard information to their employees. The requirements for the written program are:

-Describe container labeling, MSDSs, and employee training for each workplace

-List the hazardous chemicals

-Make information regarding hazards and protective measures available to other employers on-site

Progress Check

- What and to whom does OSHA's Hazard Communication Standard apply?

↑**TOP OF PAGE**

2. Container Labeling

Chemical manufacturers and importers must convey the hazard information to downstream employers by means of labels on containers and Material Safety Data Sheets (MSDSs). Language used on the warning label does not have to be identical to that on the MSDS.

Chemical manufacturers, importers,

and distributors must be sure that containers of hazardous chemicals leaving the workplace are labeled, tagged, or marked with:

- the identity of the chemical,

- appropriate hazard warnings, and

- the name and address of the chemical manufacturer, importer, or other responsible party

Consumer products having labels meeting requirements of the Consumer Product Safety Act do not have to have additional labeling under the HazCom Standard.

Various other chemical products (for example, pesticides, foods, drugs, cosmetics, beverage alcohols) that are subject to labeling laws administered by other Federal agencies are also exempt from the labeling requirements of the HazCom Standard.

- The hazard warning can be any type of message, picture or symbol that provides information on the hazards of the chemical(s) and the targeted organs affected, if applicable.
- Labels must be legible, in English (plus other languages, if desired), and prominently displayed

Exemptions to the requirement for container labeling:

It is acceptable to:

-Post signs/placards that convey hazard information if there are a number of stationary containers within a work area with similar contents and hazards

-Substitute various types of standard operating procedures, process sheets, and similar written materials for container labels on stationary process equipment if they contain the same information and are readily accessible to employees in the work area

-Portable containers into which hazardous chemicals are transferred from labeled containers and are intended only for the immediate use of the employee who makes the transfer are not required to be labeled.

- Pipes or piping systems, and engines, fuel tanks, or other operating systems in a vehicle, are not considered to be containers.

Progress Check

- What information must be included on hazardous chemical labels?
- Which products are exempt form the HazCom Standard?

↑**TOP OF PAGE**

3. Material Safety Data Sheets

Chemical manufacturers and importers must develop an MSDS for each hazardous chemical they produce or import, and must provide the MSDS at the time of the initial shipment to a downstream

distributor or user. Distributors also must ensure that downstream employers are similarly provided an MSDS.

The MSDSs must be updated by the chemical manufacturer or importer within three months of learning of "new or significant information" regarding the chemical's hazard potential.

OSHA does not require that MSDSs be provided to purchasers of household consumer products (such as "windex" and "white-out") when the products are used in the workplace in the same manner that a consumer would use them, i.e.; where the duration and frequency of use (and therefore exposure) is not greater than what the typical consumer would experience. Employees who are required to work with hazardous chemicals in a greater duration and frequency of exposure than a normal consumer have a right to know about the properties of those hazardous chemicals.

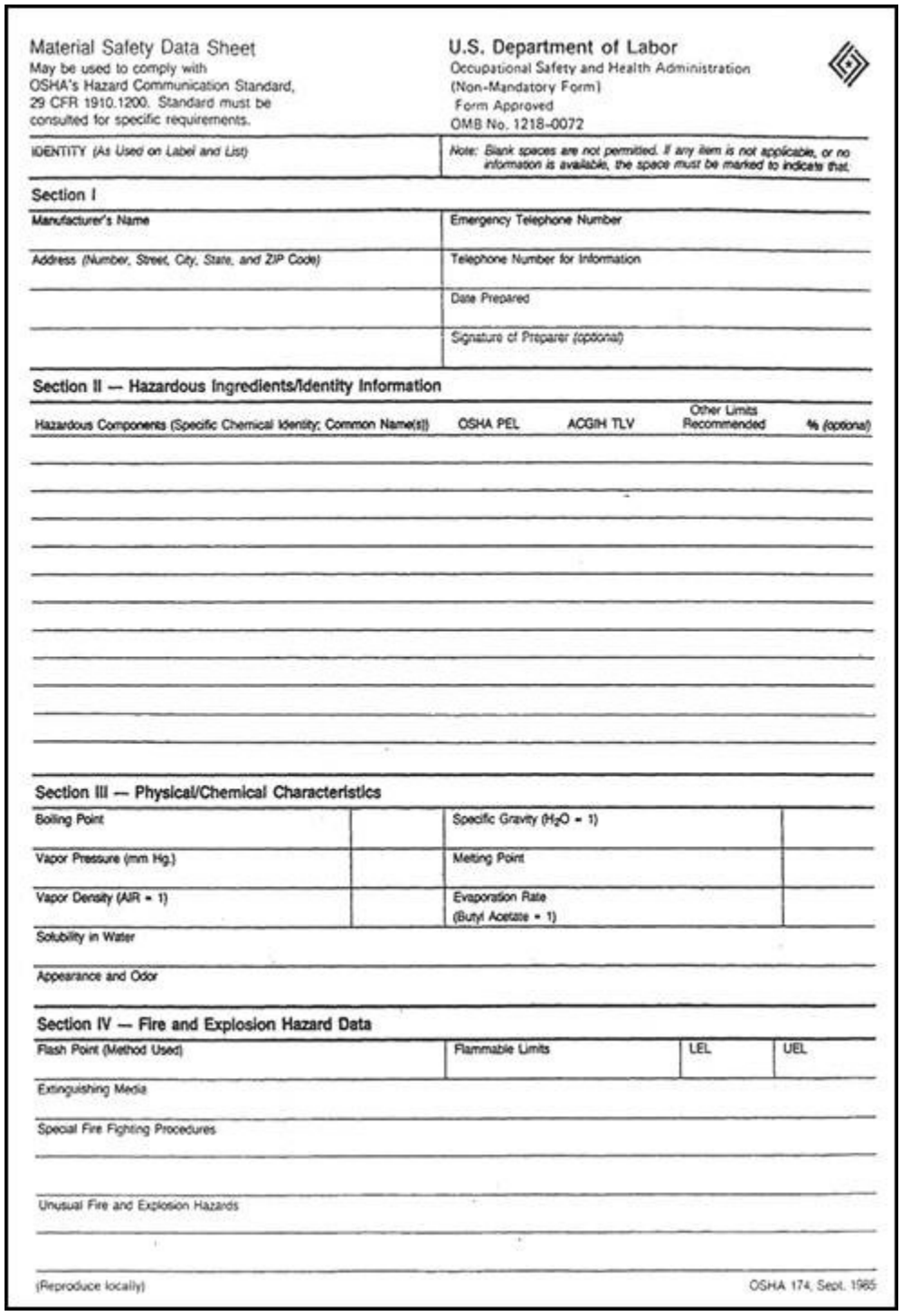
MSDSs describe:

- Physical hazards, such a fire and explosion risk
- Health hazards, such as signs of exposure
- Routes of exposure
- Precautions for safe handling and use
- Emergency and first-aid procedures
- Control measures

MSDSs must be in English and include information regarding the specific chemical identity and common names. They must also provide information about the:

- Physical and chemical characteristics
- Health effects
- Exposure limits
- Carcinogenicity (cancer causing)
- Identification (name, address, and telephone number) of the organization responsible for preparing the sheet

They must be readily accessible to employees in their work area.



Material Safety Data Sheet
May be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910.1200. Standard must be consulted for specific requirements.

U.S. Department of Labor
Occupational Safety and Health Administration
(Non-Mandatory Form)
Form Approved
OMB No. 1218-0072

IDENTITY (As Used on Label and List)

Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.

Section I

Manufacturer's Name	Emergency Telephone Number
Address (Number, Street, City, State, and ZIP Code)	Telephone Number for Information
	Date Prepared
	Signature of Preparer (optional)

Section II — Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity; Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	% (optional)

Section III — Physical/Chemical Characteristics

Boiling Point		Specific Gravity (H_2O = 1)	
Vapor Pressure (mm Hg.)		Melting Point	
Vapor Density (AIR = 1)		Evaporation Rate (Butyl Acetate = 1)	

Solubility in Water

Appearance and Odor

Section IV — Fire and Explosion Hazard Data

Flash Point (Method Used)	Flammable Limits	LEL	UEL

Extinguishing Media

Special Fire Fighting Procedures

Unusual Fire and Explosion Hazards

(Reproduce locally)

OSHA 174, Sept. 1985

Progress Check

- List at least 5 items that must be described on a MSDS.

↑ **TOP OF PAGE**

Training

Training is not satisfied solely by giving the employee the data sheets to read. An employer's training program is to be a forum for explaining to employees not only the hazards of the chemicals in their work area, but also how to use the information generated in the hazard communication program. This can be accomplished in many ways (audiovisuals, classroom instruction, interactive video), and should include an opportunity for employees to ask questions to ensure that they understand the information presented to them. Training must be carried out in a language that is comprehensible to the employees.

Training need not be conducted on each specific chemical found in the workplace, but may be conducted by categories of hazard (e.g., carcinogens, sensitizers, acutely toxic agents, irritants, flammables) that are or may be encountered by an employee during the course of his duties.

Employees who have been previously trained by another employer, union, or other entity, do not have to be retrained if the previous training is sufficient to meet the standard’s training requirements for the current work being performed. However, employees must have information about where to find MSDSs in the workplace, who in the company is responsible for the HazCom program, and where to get copies.

Training is required for employees who are exposed to hazardous chemicals in their work area:

- At the time of initial assignment
- Whenever a new hazard is introduced into their work area

They must be trained on:

- The HazCom program, including information on labels, MSDSs, and how to obtain and use available hazard information
- Hazards of chemicals
- Protective measures such as engineering controls, work practices, and the use of PPE
- How to detect the presence or release of a hazardous chemical (using monitoring devices, and observation)
- Operations in their work areas where hazardous chemicals are present
- Location and availability

Progress Check

- When is training for employees exposed to hazardous chemicals is required?

Summary

OSHA's Hazard Communication Standard is based on a simple concept--that employees have both a need and a right to know the hazards and identities of the chemicals they are exposed to when

working. Employees also need to know what protective measures are available to prevent adverse effects from occurring.

Tool Safety

MIOSHA Office of Training & Education

Learning Objective

Describe the hazards surrounding the use of hand and power tools.

List the important safety tips associated with Powder-Actuated Tools.

Explain the basic procedures for safe jack handling.

Hazards

Hand and power tools are a part of our everyday lives. These tools help us to perform tasks that otherwise would be difficult or impossible. However, even simple tools can be hazardous, and

have the potential for causing severe injuries when used or maintained improperly. Special attention toward hand and power tool safety is necessary in order to reduce or eliminate these hazards. Employers must ensure that employees are trained in the proper use of tools before authorizing their use.

Workers using hand and power tools may be exposed to these hazards:

- objects that fall, fly, are abrasive or splash.
- harmful dusts, fumes, mists, vapors and gasses.
- frayed or damaged electrical cords, hazardous connections and improper grounding.

Run-In With a Biscuit-Joiner • by Richard Hark

About a year ago, when a friend and fellow stair-builder left a message on my voice mail telling me he'd just cut off his index finger in a router accident, I thought to myself, "That could happen to any one of us." Ironically, it was only one month later that I cut one of my own fingers off at the first knuckle. My tool of choice, however, was the seemingly innocuous hand-held biscuit joiner.

I was making a series of large newel-post caps, which were about 13 inches square with a "hip-roof" configuration. Each side of the hip was made from an individual piece of mahogany, and I was assembling the segments — 72 in all — with biscuits and yellow glue. I knew, of course, that a repetitive job of this size really required a jig to hold the workpieces firmly, but I was impatient to get the job done. I'd spread a sheet of slippery plastic over the bench to keep it clean of glue and was simply holding the segments with my left hand while cutting the slots. Even worse, I was using the tool with the fence flipped up out of the way; I was controlling the slot location with a block of wood under the workpiece.

I'd fallen into a rhythm and gotten quite a few pieces slotted when suddenly the bit grabbed the workpiece and threw it to the right. That left my hand in the way, and the blade grabbed my ring finger and chopped it, pulling it right into the aluminum blade housing and blowing it apart. Never have I been more angry with myself than I was at that moment, looking at that last finger joint hanging by a scrap of skin. I knew I'd been stupid not to make a simple jig, which would have taken all of five minutes. It hurt in more ways than one.

The doctor said that he could reattach the joint, but it would be rigid and useless and get in my way. He advised removal and I reluctantly agreed. With only nine fingers left whole (photo, above), I've gone back to work with a renewed respect for the power of simple hand tools. And I don't mind spending a few extra minutes to make the jigs that keep my hands out of harm's way.

Richard Hark is a custom stair builder in Harwich, Mass.

Courtesy of/Permission Granted by the Journal of Light Construction

Basic Tool Safety Rules

1. Maintain tools regularly
2. Use the appropriate tool for the job
3. Inspect tools before use
4. Operate according to manufacturers' instructions
5. Use the right personal protective equipment (PPE)
6. Use guards

Hand Tools

Hazards

Hazards are usually caused by misuse and improper maintenance.

• If a screwdriver is used as a chisel, the tip of the chisel may break and fly off, hitting 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 fly off and strike the user or other employees.

• If the jaws of a wrench are sprung, the wrench might slip.

• If impact tools, such as chisels, wedges, or drift pins have mushroomed heads, the heads might shatter on impact, sending sharp fragments flying toward the user or other employees.

Protection

Use PPE, such as safety goggles and gloves.

Keep the floor surface where working free from debris and tripping or slipping hazards.

Keep cutting tools sharp.

Power Tools

Tools must be fitted with guards and safety switches.

They are extremely hazardous when used improperly.

There are many different types determined by their power source:

- Electric
- Pneumatic
- Liquid Fuel
- Hydraulic
- Powder-actuated

Switches

Hand-held power tools must be equipped with one of the following:

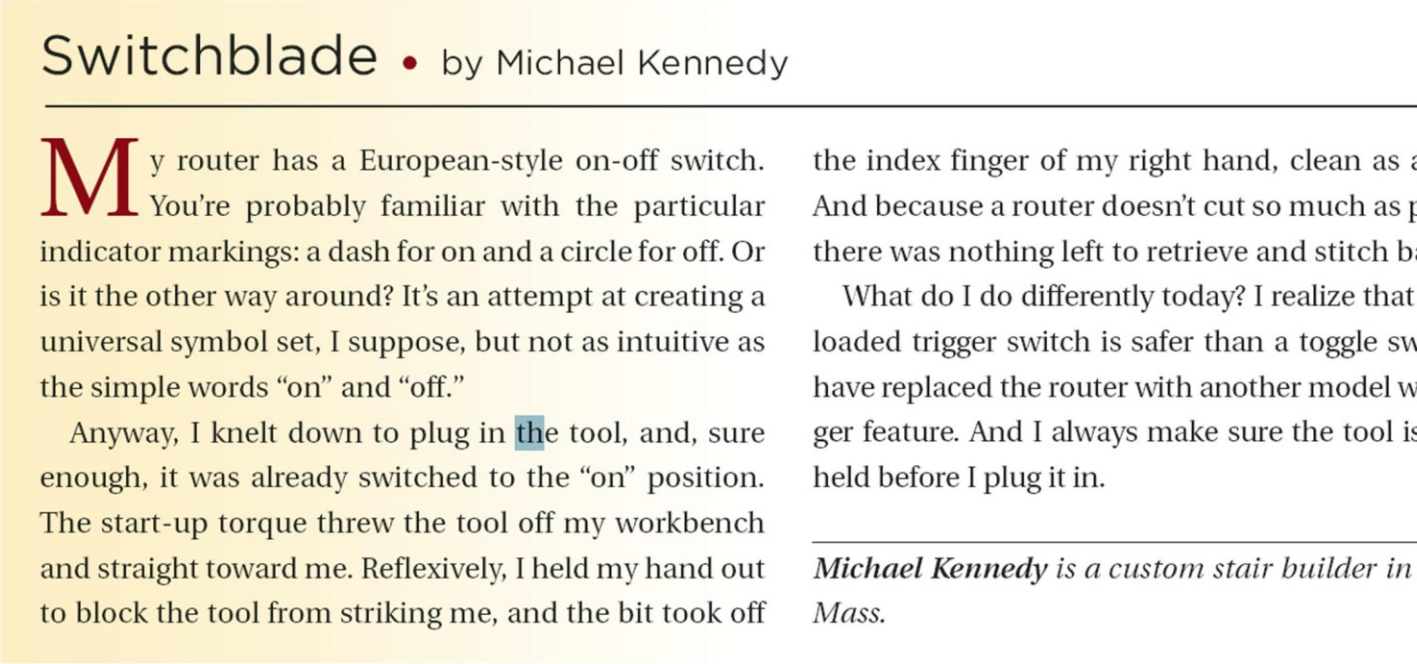
Constant pressure switch

Shuts off power upon release.

Examples: circular saw, chain saw, grinder, hand-held power drill.

On-Off Switch

Examples: routers, planers, laminate trimmers, shears, jig saws, nibblers, scroll saws.



Switchblade • by Michael Kennedy

My router has a European-style on-off switch. You're probably familiar with the particular indicator markings: a dash for on and a circle for off. Or is it the other way around? It's an attempt at creating a universal symbol set, I suppose, but not as intuitive as the simple words "on" and "off."

Anyway, I knelt down to plug in the tool, and, sure enough, it was already switched to the "on" position. The start-up torque threw the tool off my workbench and straight toward me. Reflexively, I held my hand out to block the tool from striking me, and the bit took off the index finger of my right hand, clean as a

And because a router doesn't cut so much as p

there was nothing left to retrieve and stitch ba

What do I do differently today? I realize that loaded trigger switch is safer than a toggle sw have replaced the router with another model w ger feature. And I always make sure the tool is held before I plug it in.

Michael Kennedy is a custom stair builder in Mass.

Courtesy of/Permission Granted by the Journal of Light Construction

Precautions

Disconnect tools when not in use, before servicing and cleaning and when changing accessories.

Keep people not involved with the work away from the work.

Secure work with clamps or a vise, freeing both hands to operate the tool.

Do not hold the switch button while carrying a plugged in tool.

Keep tools sharp and clean.

Consider what you wear - loose clothing and jewelry can get caught in moving parts.

Remove damaged electric tools and tag them: "Do Not Use".

Electric Cords

Do not carry portable tools by the cord.

Do not use electric cords to hoist or lower tools.

Do not yank cord or hose in order to disconnect it.

Keep cords and hoses away from heat, oil and sharp edges.

Electric Power Tools

In order to protect a worker from shock, electric power tools must:

- have a three wire cord plugged into a grounded receptacle
- be double insulated
- be powered by a low voltage isolation transformer

Three-wire cords contain two current-carrying conductors and a grounding conductor. Any time an adapter is used to accommodate a two-hole receptacle, the adapter wire must be attached to a known ground. The third prong must never be removed from the plug.

Double-insulated tools are available that provide protection against electrical shock without third-wire grounding. On double-insulated tools, an internal layer of protective insulation completely isolates the external housing of the tool.

Good Practices

Operate tools within design limits.

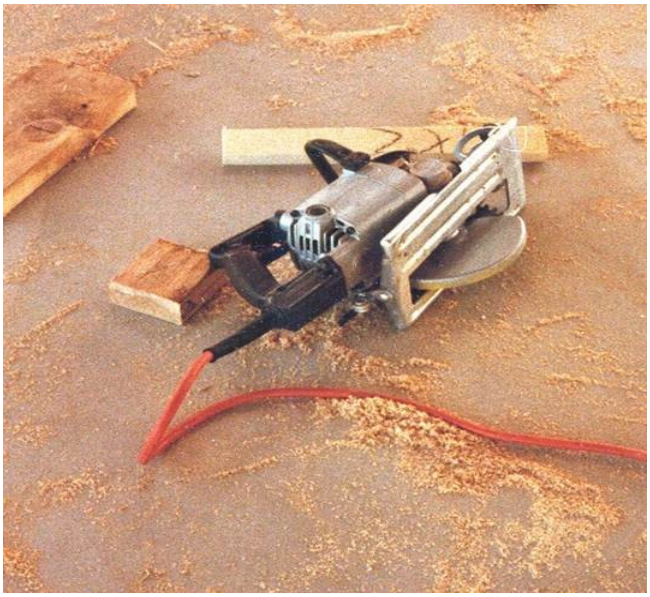
Use gloves and safety shoes.

Store tools in a dry place.

Do not use in wet locations unless the tool is approved for that kind of use.

Keep work areas well lit.

Ensure cords do not present a tripping hazard.



When using gloves, make sure they will not cause an amputation hazard by becoming loose clothing.

Progress Check

- List the 6 basic tool safety rules.
- Give some examples of tools that must be equipped with a constant pressure switch.

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Abrasive Wheels and Tools

These tools may throw off flying fragments.

Inspecting Abrasive Wheels

Before mounting

- inspect closely for damage
- perform sound or ring test to ensure the tool is free from cracks or defects

To test:

- tap wheel gently with a light, non metallic instrument.
- if wheel sounds cracked or dead, do not use it because it could fly apart.

Abrasive Wheel Use

To prevent cracking:

- fit the wheel on the spindle freely.
- tighten the spindle nut enough to hold the wheel in place without distorting the flange.

Let the tool come up to speed prior to cutting or grinding.

Do not stand in front of the wheel as it comes up to full speed.

Use eye and/or face protection.

Ensure the spindle speed does not exceed the maximum speed marked on the wheel.

Abrasive Wheel Work Rests

Floor and bench-mounted grinders shall be provided with work rests which are rigidly supported and readily adjustable. Keep work rests

not more than 1/8th inch from wheel surface. This prevents jamming the work between the wheel and the rest, which may cause the wheel to break.

On offhand grinding machines, use work rests to support the work. They are to be equipped with adjustable work rests to compensate for wheel wear. The work rest shall be securely clamped after each adjustment. The adjustment shall not be made with the wheel in motion.

Guarding

Always make sure to guard exposed moving parts of power tools such as belts, gears, shafts, pulleys, sprockets, spindles, flywheels, chains or other moving parts.

NEVER remove a guard when tool is in use.

Point of Operation - where the work is actually preformed on the materials - it must be guarded.

The guarding device shall be designed and constructed to prevent the operator from having any part of his body in the danger zone during the operating cycle. **Below is a radial arm saw with proper point of operation guards.**

Protection

Machine guards must protect the operator and others from:

- point of operation
- in-running nip points
- rotating parts
- flying chips and sparks

Examples of guarding methods are - barrier guards, two-hand tripping devices, electronic safety devices, etc.

Belt sanding machines must be provided with guards at each nip point where the sanding belt runs onto a pulley.

Counting to 9½ • by Ed Williams

I was building a mahogany library for a client and was trying to keep on schedule. One of our carpenters couldn't come in that day, so I was attempting to make up for lost help. Doing repetitive work with a dangerous tool early on a Monday morning is not the time to be absent-minded, but I was. I reached around the back of the table-saw blade (as I'd foolishly done a thousand times before) to remove the drop piece from the left of the blade after it fell off the cut, but the waste piece caught the back of the blade, kicked back, and dragged my left hand over the spinning saw blade. Faster than my mind could work, my thumb — no match for a 10-inch carbide blade spinning at 3,450 rpm — was gone from the first knuckle up.

There are many advantages to working with other people, one being that there is always someone available to take you to the hospital. So, after my initial outcry, my hand was shoved into a bag of ice (another good reason to have a refrigerator in your shop) and I was driven to the closest hospital.

When you're in shock, you really don't feel any pain; 45 minutes later, though, you're thanking God for nurses and morphine. The hospital staff cleaned and covered my wound with bandages (I still didn't look), put an IV in my arm, took me up to X-ray, and then brought me back down again to wait seven hours for surgery. Afterward, they sent me home with my wife, my hand in a cast. As the morphine wore off, the pain became almost unbearable. No amount of pain pills can numb severed nerve endings in one's thumb.

A few weeks later, the cast came off and the stitches came out, and I got to see what I had left to work with. It was pretty depressing. While the cast was on I could swear I could feel the top of my thumb moving, like playing "Where is Thumbkin?" with the kids. But Thumbkin was gone. The medical phenomenon is known as "phantom pain": The feeling is real, but the body part just ain't there.

Ordered to attend physical therapy for six weeks, I scoffed. Thumb therapy? But, boy, am I glad I went. Encouraging and supportive, the therapists had seen it all and knew to tell me that it looked good when it didn't and to use it when I didn't want to. For weeks afterward, my wife had to tie my shoes, zip my pants, help me put on my shirt (I still have a hard time with buttons), cut my food, and tie my arm up between sofa pillows at night to keep my hand elevated while I slept. When I did get back to work, I was helpless there as well. I couldn't carry plywood or hold just about anything with my left hand. Thankfully, I own the company.

It's been a year now since my accident, and what's left of my thumb is still very sore to the touch. I bump it just a little and I climb the walls. A cabinetmaker I know lost the top of his ring finger 20 years ago and his finger is still sore, a discouraging thought. I did start playing the guitar again after about six months, which is great therapy, but not a day goes by that I'm not aware of my left hand's "shortcomings," especially when even a simple thing like holding a screw or a nail between my left thumb and forefinger is just a dream.

I can't stress enough how important it is to be careful in our business at all times, no matter how much experience you have. Next time you think you can get your hand a little closer to the blade just for that one cut, I hope you'll remember this story like a slap on the back of the head.

Believe me, you don't want to be writing your own safety story.

Ed Williams is a finish carpenter and cabinetmaker in Dallas.

Progress Check

- What is the "point of operation"?
- Describe the basic procedure for abrasive wheel use.

↑TOP OF PAGE

Radial Saws

The upper hood should completely enclose the upper portion of the blade down to a point that will include the end of the saw arbor. Construct the upper hood in a manner and of material that will protect the operator from flying splinters, broken saw teeth, etc., and will deflect sawdust.

Guard the sides of the lower exposed portion of the blade to the full diameter of the blade by a device that will automatically adjust itself to the thickness of the stock and remain in contact with stock being cut to give maximum protection possible for the operation being performed.

The photo shows a radial arm saw equipped with an upper and lower blade guard. This must be guarded to prevent the operator from coming in contact with the rotating blade.

Portable Circular Saws

Guard these saws above and below the base plate or shoe. The lower guard must cover the saw to the depth of the teeth.

The upper guard should cover the saw to the depth of the teeth, except for the minimum arc required to permit the base to be tilted for bevel cuts. The lower guard should cover the saw to the depth of the teeth, except for the minimum arc required to allow proper retraction and contact with the work.

When the tool is withdrawn from the work, the lower guard should automatically and instantly return to the covering position.

The worker is holding the bottom guard up to demonstrate how it slides up as the blade comes in contact with the material being cut.

Table Saws

Hand-fed crosscut table saws should always be guarded by a hood.

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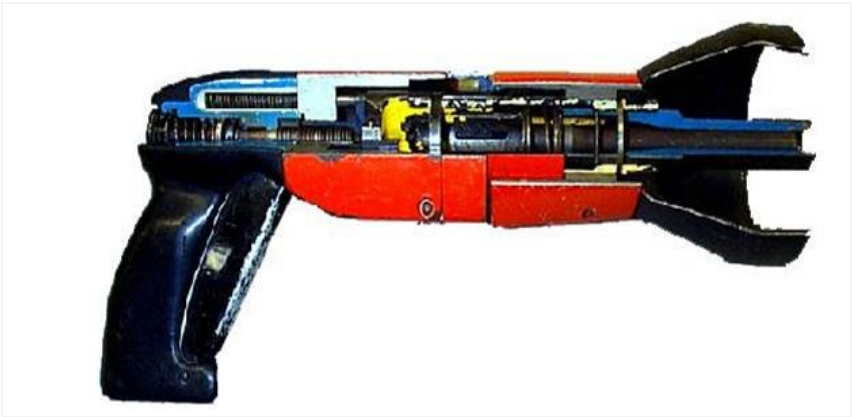
Pneumatic Tools

Pneumatic tools are powered by compressed air. They include nailers, staplers, chippers, drills and sanders. The primary hazard posed by pneumatic tools is the risk of being hit by a tool attachment or by a fastener from the tool. Remember to take the same precautions with an air hose that you take with electric cords.



Nail Gun--Cut-away View

Ensure the tool is fastened securely to the air hose to prevent a

disconnection. Use a short wire or positive locking device attaching the iar hose to the tool.

Secure pneumatic power tools to the hose by some positive means to prevent the tool from becoming accidentally disconnected.

Safety clips or retainers shall be securely installed and maintained on pneumatic impact tools to prevent attachments from being accidentally expelled.

Place a safety device on the muzzle to prevent the tool from ejecting fasteners, unless the muzzle is in contact with the work surface.

Install a safety clip or retainer to prevent attachments, such as chisels on a chipping hammer, from being ejected.

Wear eye protection. Wear hearing protection with jackhammers.

Muzzle in contact with work surface

Do not use compressed air for cleaning. The only exception would be when the psi is reduced to less than 30, and an effective chip guard and PPE are in use.

Nailed by My Own Gun • by John Wilder

As a fencing contractor, I drive hundreds, even thousands, of nails in a day's work, so I depend on my nail guns. On one particular job, I was face-nailing stringers to 4x4 posts when I got a little careless. While holding the stringer with my left hand a bit too close to where I was nailing, my nail gun double-fired and kicked back, sending the second 16d ring-shank nail through the fleshy part of my left hand between the thumb and index finger. I was fortunate I didn't nail my hand to the post, because I was working alone at the time and freeing myself would have been tricky.

Since it was a ring-shank nail, I couldn't just pull it out of my hand, so I called my wife and asked her to meet me at the urgent-care clinic. There wasn't much blood, apparently because the hot-melt glue on the Bostitch nails I was using cauterized the wound. And, except for the shotlike sensation when the nail went in, there wasn't a lot of pain. Still, I was careful not to snag the nail on anything as I drove the five miles to the urgent-care facility.

I arrived before my wife and showed the receptionist my hand with the nail protruding from both sides. Fascinated, she called the other nurses and docto to see it before sending me to an exam room to w the attending physician. In the meantime, my arrived, and while the receptionist couldn't identi by name, she quickly remembered me when my asked for "the guy with the nail in his hand." Late doctor deadened my hand with a shot of Novo unscrewed the nail, and sent me home with a dre antibiotics, and some painkillers.

Usually, the result of a nail-gun misfire in my l work is a hole in nearby vinyl siding. It's easy careless and complacent when you're shooting l nails day after day. Now, whenever my left hand too close to the line of fire, I quickly remind myse a pneumatic nailer is a serious weapon as well indispensable tool.

John Wilder is a fencing contractor near Da Beach, Fla.

****Courtesy of/Permission Granted by the Journal of Light Construction**

Liquid Fuel Tools

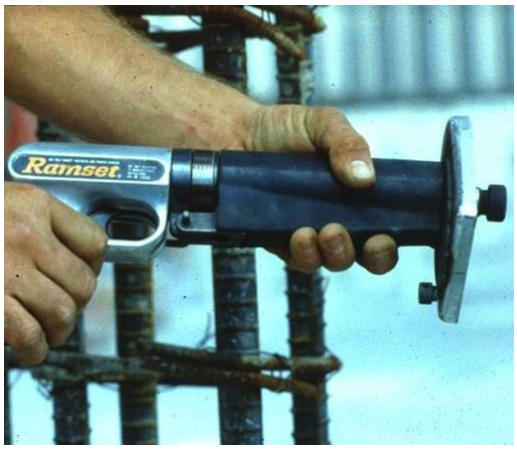
If using a fuel powered tool in an enclosed area such as a trench, be aware that carbon monoxide generated can displace or deplete oxygen. Mechanical ventilation and testing needs to be done.

- Usually gas powered

- Main hazard--fuel vapors
- Use only approved flammable liquid containers
- Before refilling a fuel-powered tool tank, shut down the engine and allow it to cool

Powder-Actuated Tools

Users of powder-actuated tools must be trained and licensed to operate. Each tool should be tested each day before loading to ensure the safety devices are working properly. The operator must wear suitable ear, eye and face protection. Be sure to select a powder level that will do the work without excessive force.



Avoid driving into materials easily penetrated unless materials are backed by a substance that will prevent the pin or fastener from passing through. Also, do not drive fasteners into very hard or brittle material that might chip or splatter, or cause the fastener to ricochet. Other safety tips are:

- Don't use in an explosive or flammable atmosphere
- If a powder-actuated tool misfires, the operator shall hold the tool in position for at least 30 seconds.
- Inspect tool before use to ensure--
    - it is clean
    - that moving parts operate freely

    - the barrel is free from obstructions and has the proper shield, guard and attachments
- Don't load the tool unless using immediately
- Don't leave a loaded tool unattended
- Keep hands clear of the barrel end
- Never point the tool at anyone
- Store unloaded in a locked box

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Jacks

To set up a jack, ensure that:

- The base is on a firm, level surface
- It's centered
- The jack head is placed against a level surface
- You apply the lift force evenly

Lubricate and inspect jacks regularly, according to this schedule:

(1) for jacks used continuously or intermittently at one site - at least once every 6 months,

(2) for jacks sent out of the shop for special work - inspect when sent out and inspect when returned

(3) for jacks subjected to abnormal loads or shock - inspect before use and immediately thereafter.

Blocking

Immediately block the load after it is lifted. Put a block under the base of the jack when the foundation is not firm, and place a block between the jack cap and load if the cap might slip.

Photo-handyman jack is providing a firm base by using the railroad tie. The load is cribbed to prevent it from falling.

Progress Check

- What are the hazards associated with using a fuel powered tool in an enclosed area?
- What is the ONLY exception for using compressed air when cleaning power tools?
- Describe the basic inspection/lubrication schedule for jacks?

Summary

Hazards are usually the result of improper tool use or not following one or more of these protection techniques:

- Inspecting the tool before use
- Using PPE (Personal Protective Equipment)
- Using guards
- Properly storing the tool
- Using safe handling techniques

Materials Handling

MIOSHA Office of Training & Education

| HAZARDS | HANDLING | STORAGE | DISPOSAL | SUMMARY |

Learning Objectives

Identify, avoid and control hazardous materials through proper handling, storage, use and disposal.

Overview

The efficient handling and storing of materials is vital to industry. These operations provide continuous flow of raw materials, parts, and assemblies through the workplace, and ensure that materials are available when needed. Yet, the improper handling and storing of materials can cause costly injuries. Handling and storing of materials involves diverse operations:

Manual material handling

- Carrying bags or material
- Unpacking material

Material handling via machine

- Forklift
- Crane
- Rigging

Stacking or storing drums, barrels, kegs, lumber, loose bricks or other materials

Hazards

Employers and employees can and should examine their workplaces to detect any unsafe or unhealthful conditions, practices, or equipment and take the necessary steps to correct them.

General safety principles can help reduce workplace accidents. These include work practices, ergonomic principles, and training and education. Whether moving materials manually or mechanically, employees should be aware of the potential hazards associated with the task at hand and know how to control their workplaces to minimize the danger. Some commons hazards are:

- Improper manual lifting or carrying loads that are too large or heavy
- Being struck by materials or being caught in pinch points
- Crushed by machines, falling materials or improperly stored materials
- Incorrectly cutting ties or securing devices

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Manual Handling

Manual materials handling is the principal source of compensable injuries in the American work force, and four out of five of these injuries will affect the lower back.

Material handling tasks should be designed to minimize the weight, range of motion, and frequency of the activity.

Work methods and stations should be designed to minimize the distance between the person and the object being handled.

Repetitive or sustained twisting, stretching, or leaning to one side are undesirable. Corrections could include repositioning bins and moving employees closer to parts and conveyors.

Store heavy objects at waist level.

Provide lift-assist devices, and lift tables.

When placing blocks under a load:

- Ensure the load is not released until hands are removed from under the load.

- Blocking materials should be large and strong enough to support the load safely.

Seek help:

- When a load is too bulky to properly grasp or lift
- When you can't see around or over the load
- When you can't safely handle the load

Attach handles to loads to reduce the chances of getting fingers smashed.

Safe Lifting Training:

Training should include general principles of ergonomics, recognition of hazards and injuries, procedures for reporting hazardous conditions, and methods and procedures for early reporting of injuries.

Safe lifting training should also include:

• Health risks related to improper lifting

• The basic anatomy of the spine, the muscles, and the joints of the trunk, and the contributions of intra-abdominal pressure while lifting.

• Awareness of individual body strengths and weaknesses—determining one's own lifting capacity.

• Recognition of physical factors that might contribute to an accident and how to avoid the unexpected.

• Knowledge of body responses—warning signals—to be aware of when lifting.

As well as…

-How to lift safely

-How to avoid unnecessary physical stress and strain

-What you can comfortably handle without undue strain

-Proper use of equipment

-Recognizing potential hazards and how to prevent /correct them

Rigging Equipment Slings

The types of slings covered are those made from alloy steel chain, wire rope, metal mesh, natural or synthetic fiber rope (conventional three strand construction), and synthetic web (nylon, polyester, and polypropylene).

Three types of slings are discussed in detail in this presentation: alloy steel chain, wire rope and synthetic web.




Sling Inspection

Each day before being used, the sling and all fastenings and attachments should be inspected for damage or defects by a competent person designated by the employer. Additional inspections should be performed during sling use, where service conditions warrant. Damaged or defective slings should be immediately removed from service.

Alloy Steel Chains

Alloy steel chains adapt to the shape of the load, and are the best choice for hoisting very hot materials. Welded alloy steel chains must have an affixed tag stating size, grade, rated capacity, and sling manufacturer.

Hooks, rings, oblong links, or other attachments, when used with alloy steel chains, must have a rated capacity at least equal to that of the chain.

Unsuitable Alloy Steel Chain Attachments

Job or shop hooks and links, or makeshift fasteners, formed from bolts, rods, etc. or other such attachments, cannot be used. When a chain shows excessive wear, or is cracked or pitted, remove it from service. Non-alloy repair links cannot be used.

The attachment on the left is correct, the one on the right is incorrect.

Wire Rope Slings

Strength — Function of size, grade, and construction. It must be sufficient to accommodate the maximum load that will be applied. The maximum load limit is determined by means of a multiplier. This multiplier is the number by which the ultimate strength of a wire rope is divided to determine the working load limit. Thus a wire rope sling with a strength of 10,000 pounds and a total working load of 2,000 pounds has a design factor (multiplier) of 5. New wire rope slings have a design factor of 5. As a sling suffers from the rigors of continued service, the design factor and the sling's ultimate strength are proportionately reduced.

Fatigue — A wire rope must have the ability to withstand repeated bending without the failure of the wires from fatigue. Failure is the result of the development of small cracks under repeated applications of bending loads. It occurs when ropes make small radius bends. The best way to prevent this is to use blocking or padding to increase the radius of the bend.

Abrasive Wear — The ability to withstand abrasion is determined by the size, number of wires, and construction of the rope. Smaller wires bend more readily and therefore offer greater flexibility but are less able to withstand abrasive wear. Conversely, larger wires of less flexible ropes are better able to withstand abrasion.

Abuse — Abuse will cause a wire rope sling to become unsafe long before any other factor. Abusing a wire rope sling can cause serious structural damage to the wire rope, such as kinking or bird caging which reduces the strength of the wire rope. (In bird caging, the wire rope strands are forcibly untwisted and become spread outward.) Therefore, in order to prolong the life of the sling and protect the lives of employees, the manufacturer's suggestion for safe and proper use of wire rope slings must be strictly adhered to.

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Selection Considerations

- Strength
- ability to bend without cracking
- ability to withstand abrasive wear
- ability to withstand abuse

These limitations apply to the use of wire rope:

- An eye splice made in any wire rope should have not less than three full tucks. However, this requirement should not operate to preclude the use of another form of splice or connection which can be shown to be as efficient and which is not otherwise prohibited.

- Except for eye splices in the ends of wires and for endless rope slings, each wire rope used in hoisting or lowering, or in pulling loads, must consist of one continuous piece without knot or splice.

- Eyes in wire rope bridles, slings, or bull wires should not be formed by wire rope clips or knots.

- Wire rope should not be used if, in any length of eight diameters, the total number of visible broken wires exceeds 10 percent of the total number of wires, or if the rope shows other signs of excessive wear, corrosion, or defect.

-When U-bolt wire rope clips are used to form eyes, Table H-20 should be used to determine the number and spacing of clips. (see 1926.251, c,4,5,6)

-Slings should not be shortened with knots or bolts or other makeshift devices. Eye splices made in any wire rope must have at least three full tucks.

-Protruding ends of wire ropes should be covered or blunted.

-When using U-bolt wire rope clips to form eyes, ensure the "U" section is in contact with the dead end of the rope.

Only use for non-lifting purposes.

This is the correct method.

When to Remove From Service

Visually inspect before each use. Check the twists or lay of the sling. If ten randomly distributed wires in one lay are broken, or five wires in one strand of a rope lay are damaged, do not use the

sling. End fittings and other components should also be inspected for any damage that could make the sling unsafe.

Bird cage -- Wire rope strands are untwisted and become spread outward. Caused by sudden release of tension and the rebound of the rope from the overloaded condition. These strands and wires will not return to their original positions.

Synthetic Web Sling

Synthetic webbing (nylon, polyester, and polypropylene).

Synthetic webbing should be of uniform thickness and width and selvage edges shall not be split from the webbing's width.

Mark or code to show:

- Name or trademark of manufacturer
- Rated capacities for the type of hitch
- Type of material

Fittings must be:

- At least as strong as that of the sling
- Free of sharp edges that could damage the webbing

Stitching:

The thread shall be in an even pattern and contain a sufficient number of stitches to develop the full breaking strength of the sling.

When using synthetic web slings, take the following precautions:

- Nylon web slings shall not be used where fumes, vapors, sprays, mists or liquids of acids or phenolics are present.

- Polyester and polypropylene web slings shall not be used where fumes, vapors, sprays, mists or liquids of caustics are present.

- Web slings with aluminum fittings shall not be used where fumes, vapors, sprays, mists or liquids of caustics are present.

Do not use synthetic web slings of polyester and nylon at temperatures in excess of 180 deg. F (82 deg. C). Polypropylene web slings shall not be used at temperatures in excess of 200 deg. F

Remove from service if any of these are present:

- Acid or caustic burns
- Melting or charring of any part
- Snags, punctures, tears or cuts
- Broken or worn stitches
- Distortion of fittings

Progress Check

- What requirements should be observed when placing blocks under a load?
- What type of chain is best for lifting very hot materials?
- When should wire ropes be removed from service?

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Storing Materials

Keep storage areas free from accumulated materials that may cause tripping, fires, or explosions, or that may contribute to harboring rats and pests.

Maximum safe load limits of floors within buildings and structures, in pounds per square foot, shall be conspicuously posted in all storage areas, except for floor or slab on grade.

Aisles and passageways shall be kept clear to provide for the free and safe movement of material handling equipment or employees.

When a difference in road or working levels exist, means such as ramps, blocking, or grading shall be used to ensure the safe movement of vehicles between the two levels.

Bags and bundles must be stacked in interlocking rows to remain secure. Bagged material must be stacked by stepping back the layers and cross-keying the bags at least every ten layers. Manually stacked piles of bagged material weighing 30 pounds per bag shall not be stacked higher than 5'. To remove bags from the stack, start from the top row first.

Boxed materials must be banded or held in place using cross-ties or shrink plastic fiber.

Drums, barrels, and kegs must be stacked symmetrically. If stored on their sides, the bottom tiers must be blocked to keep them from rolling. When stacked on end, put planks, sheets of plywood dunnage, or pallets between each tier to make a firm, flat, stacking surface. When stacking materials two or more tiers high, the bottom tier must be chocked on each side to prevent shifting in either direction.

When stacking, consider the need for availability of the material. Material that can't be stacked due to size, shape, or fragility can be safely stored on shelves or in bins. Structural steel, bar stock, poles, and other cylindrical materials, unless in racks, must be stacked and blocked to prevent spreading or tilting. Pipes and bars should not be stored in racks that face main aisles; this could create a hazard to passers-by when removing supplies**.**

Brick Storage

-Stack bricks in a manner that will keep them from falling.

- Do not stack them more than 7 feet high

-Taper back a loose brick stack after it is 4 feet high.

Lumber Storage

-Manually stacked piles cannot exceed 6'**.**

-Remove protruding nails before stacking.

-Stack lumber on sills.

-Stack lumber so that it is stable and self supporting.

-Base of stack should not be less that 1/2/ of the height.

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Disposal of Waste Materials

Use an enclosed chute when you drop material more than **20 feet** outside of a building. If you drop debris through holes in the floor without chutes, enclose the drop area with barricades. Warning signs for falling material must be posted at each site.

When debris is dropped through holes in the floor without chutes, enclose the drop area with barricades at least 36 inches tall and no more than 42 inches high, and at least 6 feet back from the edge of the opening. If mechanical equipment or a wheelbarrow is used to dump material, a 4" thick by 6" tall bumper must be secured to the floor at the chute openings.

Remove all scrap lumber, waste material, and rubbish from the immediate work area as work progresses. Keep all solvent waste, oily rags, and flammable liquids in fire resistant covered containers until removed from the worksite.

Openings cut in a floor for disposal of materials should be less than 25 percent of the aggregate floor area, unless the lateral supports of the removed flooring remain in place. Floors weakened or made unsafe by demolition must be shored so they can safely carry the demolition load.

Progress Check

- What is the best way to store material that cannot be stacked?
- What are some precautions to take when disposing

of materials through a chute?

Summary

Manually handling materials

- When lifting objects, lift with your legs, keep your back straight, do not twist, and use handling aids

Using cranes, forklifts, and slings to move materials

- Watch for potential struck by/crushed by dangers
- For slings, check their load capacity, inspect them, and remove them from service when they display signs of stress or wear

Also

- Keep work areas free from debris and materials
- Store materials safely to avoid struck by /crushed by hazards.