# TEAMSTERS Construction Safety & Health Training

## For Use in the OSHA Construction Safety and Health Outreach Course

International Brotherhood of Teamsters — NIEHS Worker Training Grants

**Teamsters Construction**
**Safety and Health Training**

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National Institute of Environmental Health Sciences
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Some of the text of this manual, and many of the illustrations, are based on material in various publications of the United States Occupational Safety and Health Administration.


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# Contents

# INTRODUCTION

## Teamsters

## Construction Safety and Health Training

This manual is designed to be used in 10-hour Construction Safety and Health Training courses which meet the requirements of the OSHA Construction Safety and Health Outreach Program.

In order for the training to fulfill the expectations of the OSHA Outreach Program, and for workers to receive cards from OSHA indicating that they have successfully completed the training, the course must cover ten topics as shown below. Each topic lasts one hour.

1. ■ Introduction to the OSHA Standards
2. ■ Electrical Safety
3. ■ Fall Protection
4. One of the following:
   - ■ Materials Handling
   - ■ Cranes, Derricks and Hoists
   - ■ Motor Vehicles
5. One of the following:
   - ■ Scaffolding
   - ■ Excavations
   - ■ Stairways and Ladders
6. Any five other OSHA Construction Standards or relevant safety
7. and health topics. These may include:
8. Any topics under 4 and 5, above, not already covered, and/or
9. Any of the following Modules in this manual:
10. 
    - ■ Toxic and Hazardous Substances
    - ■ Personal Protective Equipment
    - ■ Confined Spaces
    - ■ Fire Protection and Prevention
    - ■ Tools - Hand and Power
    - ■ Heat, Cold, Noise and Vibration

# The Teamsters

The International Brotherhood of Teamsters was founded in 1903. We now represent 1.4 million workers in the construction industry, the transportation industry, and in almost every other type of employment.

In 1973 the Teamsters established a Safety and Health Department. It was one of the first unions to do so. The Safety and Health Staff includes professionals in safety, industrial hygiene and adult education. You can reach the Safety and Health Department at:

IBT Safety and Health Department
25 Louisiana Avenue, N.W.
Washington, DC 20001
(202) 624-6960

The Teamsters have courses that meet federal and state requirements for:

- **Basic Hazardous Waste Worker Training**
- **Hazardous Waste Worker Refresher Training**
- **Emergency Responder Training**
- **Radiological Worker Training**
- **Hazardous Materials Transportation Awareness Training**
- **Construction Safety and Health Training**

Teamster training is provided by certified, experienced instructors using effective adult education methods, real equipment, and realistic hands-on activities.

Teamster Training Centers have mobile units that can travel to local union halls, construction and remediation sites, government facilities or other locations to train workers. For more information, or to schedule a course, please contact:

IBT NIEHS Worker Training Grants Office
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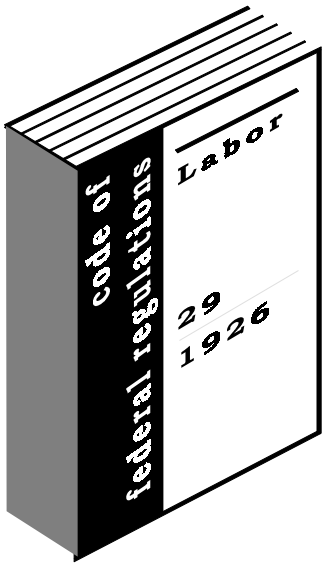
Washington, DC 20001
(202) 624-6963

- Notes -

# TEAMSTERS Construction Safety & Health Training

## *Module 1*

# THE OSHA STANDARDS



**LEARNING OBJECTIVES**

✔ **IDENTIFY EMPLOYER AND EMPLOYEE SAFETY AND HEALTH RIGHTS AND RESPONSIBILITIES.**

**a**. Identify the agency responsible for enforcing safety and health standards.

**b**. Identify the safety and health rights and responsibilities of employees.

**c**. Identify the safety and health responsibilities of employers.

**d**. State what to do if you feel that it is unsafe to do a task which you have been assigned.

**e**. Identify the qualifications of a "competent person."

## What is OSHA?

**OSHA** is the common name for the **U.S. Occupational Safety and Health Administration**. This is the federal agency which enforces safety and health standards to protect workers. In 23 states there are state safety and health agencies which do this job instead of federal OSHA.

**States with their own Occupational Safety and Health Program**

| | | | |
|---|---|---|---|
| Alaska | Iowa | New Mexico | Utah |
| Arizona | Kentucky | New York* | Vermont |
| California | Maryland | North Carolina | Virginia |
| Connecticut* | Michigan | Oregon | Washington |
| Hawaii | Minnesota | South Carolina | Wyoming |
| Indiana | Nevada | Tennessee | * Only public employees. |

## The Occupational Safety and Health Act of 1970

In 1970 Congress passed a law called the Occupational Safety and Health Act (OSH Act). This law created OSHA, and gave OSHA the power to write safety and health standards. On the next two pages we outline the sections of the law which are most important for you as a worker.

## Purpose: ... to assure ... every working man and woman ... safe and healthful working conditions ...

Section 2 of the OSH Act lists Congressional Findings and Purpose:

> ***The Congress finds that personal injuries and illnesses arising out of work situations impose a substantial burden upon, and are a hinderance to, interstate commerce in terms of lost production, wage loss, medical expenses, and disability compensation payments.***
>
> ***The Congress declares its purpose and policy...to assure so far as possible every working man and woman in the Nation safe and healthful working conditions and to preserve our human resources...***

## Responsibilities of Employers and Employees

Section 5 of the OSH Act tells the duties of employers and employees :

> ***(a) Each Employer - (1) shall furnish to each of his 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 his employees; (2) shall comply with the occupational safety and health standards promulgated under this Act.***
>
> ***(b) Each employee shall comply with occupational safety and health standards and all rules, regulations, and orders issued pursuant to this Act which are applicable to his own actions and conduct.***

You have the responsibility to comply with OSHA standards.

Your employer has two responsibilities: (1) to provide you with safe and healthy work and a safe and healthy work place, and (2) to comply with OSHA standards.

The first of these employer responsibilities is called the "**General Duty Clause**." It is often referred to as "**Section 5(a)(1)**." The General Duty Clause means that even if there is no OSHA Standard about a particular safety or health problem, the employer still has to make sure that your workplace is safe, healthy and free of recognized hazards.

## OSHA Makes Rules

Section 6 of the OSH Act gives OSHA authority to write safety and health rules.

The safety and health rules which OSHA writes to protect workers are called **OSHA Standards**. There are many OSHA standards that may apply to your job. For example: standards which limit the concentration of toxic substances in workplace air, standards for the safe operation of forklifts, or standards for electrical safety. OSHA standards have the force of law.

## OSHA Enforces Rules

Section 8 of the OSH Act gives OSHA authority to inspect work sites. OSHA can issue correction orders and assess penalties against the employer. You have the right to file a complaint with OSHA because of safety and health hazards at your work site. You have the right to talk to the OSHA inspector, to point out hazards, and to see a copy of the inspection report.

OSHA cannot impose any legal sanctions — such as fines — on workers who violate OSHA standards. When Congress wrote the OSH Act it gave employers the full legal responsibility for safety and health in the workplace.

As an employee you are expected to comply with the instructions issued by your employer. These include following safe work practices and wearing personal protective equipment. If you fail to follow your supervisor's instructions you might be disciplined or terminated.

## No Discrimination for Safety and Health Activities

Section 11(c) of the OSH Act makes it illegal for an employer to punish a worker for exercising his or her OSHA rights:

> ***(1) No person shall discharge or in any manner discriminate against any employee because such employee has filed a complaint or ... has testified or is about to testify in any such proceeding or because of the exercise by such employee on behalf of himself or others of any right afforded by this Act.***

# Can You Refuse Dangerous Work?

What if your job requires you to do something that you think is too dangerous? This is a difficult situation. You want to work. You don't want to be discharged. But you don't want to risk you life or your health.

Under Section 11(c) of the OSHA Act, and also under rulings of the National Labor Relations Board, you might be protected against discipline or discharge for refusing to do dangerous work, but only if you can prove that all the following conditions were met:

**(1)** You had a reasonable belief, based on what you knew at the time, that there was a real, imminent danger of death or serious injury, and

**(2)** You asked the employer to eliminate the danger, and

**(3)** You had no reasonable alternative, and

**(4)** There wasn't time to get OSHA involved, and

**(5)** You contacted OSHA within 30 days of when you were disciplined or discharged for this incident.

## If You Feel You Must Refuse, Take All of These Steps:

**(1)** **Don't act alone. Talk to your fellow workers. Talk to your shop steward or union representative. Let your union act with you. This is why you have a union.**

**(2)** Make it clear that you are not being insubordinate. Point out the danger. Explain that you are willing to do the job if it can be done safely.

**(3)** Offer to do other work.

**(4)** Don't walk off the job. Don't leave the site unless ordered to do so by the supervisor.

**(5)** Call OSHA at the first opportunity.

# Your OSHA Rights

OSHA requires your employer to provide a safe and healthy workplace, and comply with OSHA standards.

As an employee, you have legal rights provided by OSHA and other federal laws, and you also have the responsibility to work in a safe manner in compliance with OSHA standards. Your OSHA rights include:

1. **The right to a safe and healthy workplace**.

2. **The right to receive safety and health training**.

   A. Hazard communication training.

   B. HAZWOPER emergency response training (if applicable).

   C. Respirator training (if applicable).

   D. Confined space training (if applicable).

3. **The right to information**.

   A. Material Safety Data Sheets (MSDS's).

   B. Copies of OSHA standards related to your work site.

   C. Your employer's Log and Summary of Occupational Injuries (the "OSHA 200 Log").

   D. Results of workplace monitoring and surveys.

   E. Your own medical records.

   F. Written safety and health programs, including the *emergency response*, *hazard communication*, and any other applicable safety and health programs.

   G. Copies of any OSHA citations.

4. **The right to take part in safety and health activities**.

   A. Point out hazards and suggest corrections.

   B. Discuss safety and health concerns with your fellow workers and your union representative.

5. **The right to participate in OSHA inspections**.

   A. You or your union representative participate in the opening and closing conferences.

   B. You or your union representative accompany the OSHA inspector during the inspection.

   C. Respond to questions from the OSHA inspector.

6. **The right to file an OSHA complaint if a hazard exists**.

   A. Have your name kept confidential by OSHA.

   B. Be told by OSHA of actions on your complaint.

   C. Be notified if your employer contests a citation.

   D. Object to an abatement period proposed by OSHA.

7. **The right to refuse to do work which would expose you to imminent danger of death or serious injury.**

   (We discuss this right in more detail on the next page.)

8. **The right to protection from retaliation or discrimination because of safety and health activities**.

   A. File a complaint with OSHA if you believe you have been discriminated against for discussing safety and health, pointing out hazards, filing an OSHA complaint, or refusing dangerous work.

# The Numbering System for OSHA Standards

Here is an example of a paragraph from the OSHA Electrical Standard:

> ***Ground-fault circuit interrupters***. All 120-volt, single phase, 15- and 20-ampere receptacle outlets on construction sites, which are not part of the permanent wiring of the building or structure and which are in use by employees, shall have approved ground-fault circuit interrupters for personnel protection.

This paragraph has a number called a citation. The citation is **29 CFR 1926.404(b)(1)(ii)**. Every paragraph has its own citation. This helps you find it in a law book, and it makes it easy to refer to a particular requirement.

- "**CFR**" stands for "**Code of Federal Regulations**." This is a set of law books containing the regulations of all the federal agencies. The citations for all federal regulations include the letters "CFR."

- "**29**" is the number for the US Department of Labor. The citations for all Department of Labor regulations begin with the number "29." OSHA is part of the Department of Labor, so it's citations start with "29."

- "**1926**" is a **Part** of the Department of Labor Regulations. Part 1926 contains the OSHA standards for the Construction Industry.

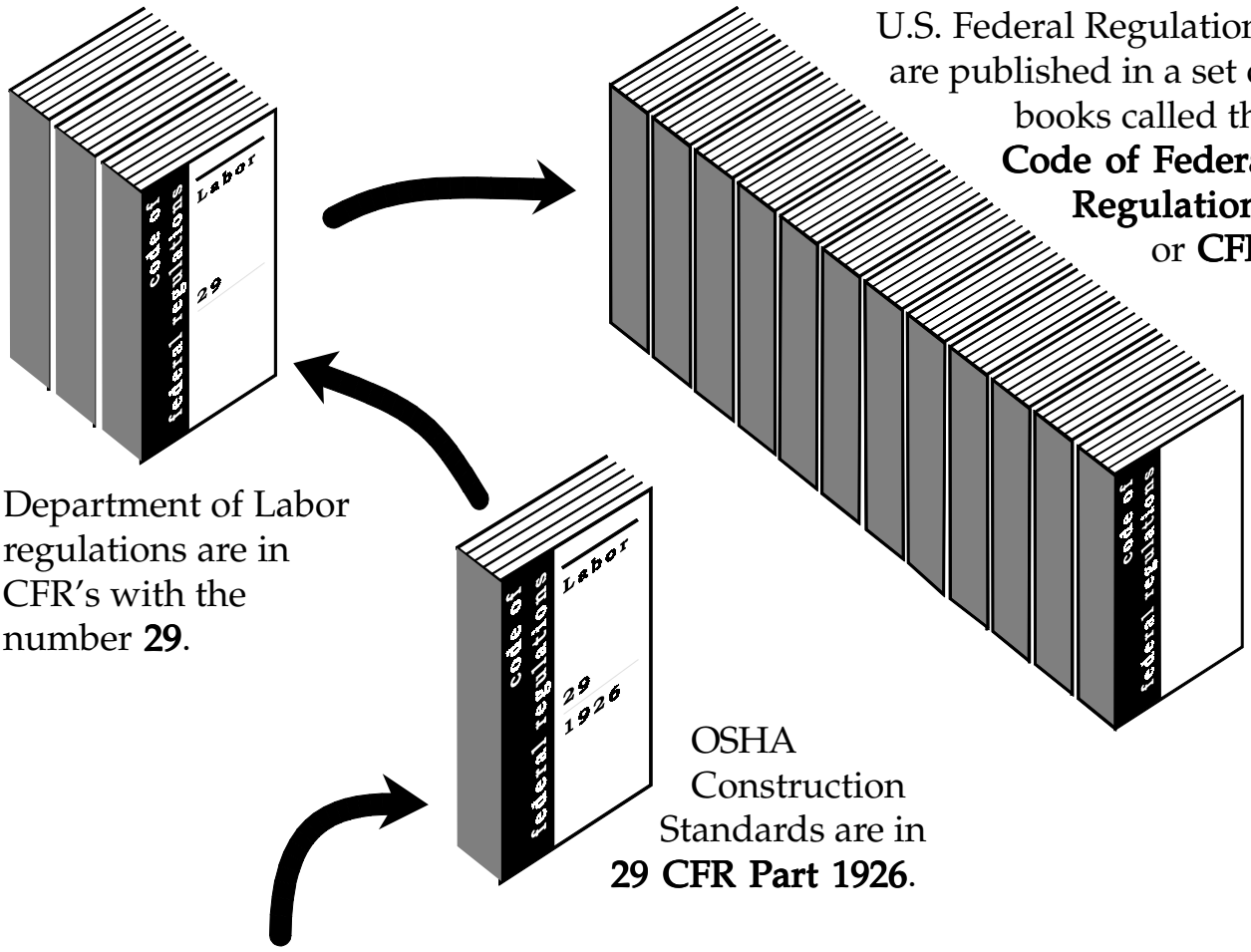
- "**404**" is the **Section** of the Construction Industry Standards titled "Wiring design and protection."

- "**b**" is the second topic in Section **404**. "**b**" is called "branch circuits."

- "**1**" is the first subtopic in "**b**." It is called "Ground fault protection."

- "***ii***" is the second item that is part of "**1**." It is called "Ground fault circuit interrupters."

Part 1926, Construction Industry Standards, is divided into several **Subparts**. Each Subpart has a different general topic and a different letter. For example: "Subpart K, Electrical", "Subpart L, Scaffolding", etc. Section 404 in the example above is in Subpart K. However, the Subpart letter, "K", is not used in the citation.




U.S. Federal Regulations are published in a set of books called the **Code of Federal Regulations** or **CFR**.

Department of Labor regulations are in CFR's with the number **29**.

OSHA Construction Standards are in **29 CFR Part 1926**.

**§ 404 Wiring design and protection.**

**(a)** Use and identification of grounded and grounding conductors–

**(1)** Identification of conductors ....

**(2)** Polarity ....

**(3)** Use of grounding ....

**(b)** Branch circuits–

**(1)** Ground-fault protection–

**(i)** General. The employer shall use either ground fault circuit interrupters as specified in paragraph (b)(1)(ii) of this section or an assured equipment grounding conductor program as specified in paragraph (b)(1)(iii) of this section to protect employees ....

**(ii)** Ground-fault circuit interrupters. All 120-volt, single-phase, 15- and 20- Ampere receptacle outlets on construction sites, which are not a part of the permanent wiring of the building or structure and which are in use by employees, shall have approved ground-fault circuit interrupters for personnel protection. Receptacles on a two-wire, single-phase portable or vehicle-mounted generator rated not more than 5kW, where the circuit conductors of the generator are insulated from the generator frame and all other grounded surfaces, need not be protected with ground-fault circuit interrupters.

**(iii)** Assured equipment grounding conductor program. ....

# General Safety and Health Provisions

## Contractor Requirements [29 CFR 1926.20]

A construction contractor shall not require an employee to work in conditions that are unsanitary, hazardous or dangerous.

## Accident Prevention [29 CFR 1926.20]

The employer shall have a competent person make frequent, regular inspections of the job site, materials and equipment to look for safety and health hazards.

All machinery and tools must comply with OSHA standards. If it's not safe, it can't be used. Defective equipment and tools left on the job site shall be tagged or locked so that they can't be used.

Only properly trained or experienced workers shall operate machinery.

## Safety Training [29 CFR 1926.21]

The employer shall instruct each employee to recognize and avoid unsafe conditions and how to avoid hazards.

Employees required to handle hazardous substances shall receive instruction regarding safe use, potential hazards, and personal protective equipment.

Employees required to enter confined spaces shall receive instruction on the nature of the hazards involved, precautions to take, protective equipment and emergency procedures. A confined space is any space having limited means of getting out and which may have an accumulation of toxic or flammable contaminants or oxygen deficiency.

There is a detailed standard for confined space work in general industry, but it does not apply to construction work.

# General Safety and Health Provisions
**(continued)**

## First Aid [29 CFR 1926.23]

The employer shall provide first aid services for every employee.

## Fire Protection and Prevention [29 CFR 1926.24]

The employer shall develop and maintain an effective program for fire protection and prevention throughout all phases of the project. This includes making sure that fire extinguishing equipment is available.

## Housekeeping [29 CFR 1926.25]

The employer shall remove combustible scrap and debris. Scrap and forms with protruding nails shall be kept clear of work areas and passageways. There shall be proper waste containers.

## Illumination [29 CFR 1926.26]

The employer shall provide sufficient natural or artificial illumination for work areas, ramps, stairs, offices, shops and storage areas on the construction site.

## Sanitation [29 CFR 1926.27]

The OSHA standards include requirements for adequate drinking water and sanitary facilities at construction sites.

## Personal Protective Equipment [29 CFR 1926.28]

The employer shall provide necessary respirators and other protective equipment and require that it be worn when necessary.

# General Safety and Health Provisions
**(continued)**

## Competent Person [29 CFR 1926.32(f)]

Many OSHA regulations require there to be a **competent person** who takes responsibility for inspecting or approving work or equipment. In 29 CFR 1926.32(f) OSHA defines a competent person as:

> ***...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.***

**A competent person is someone who understands the work and its hazards, and has the authority to correct unsafe conditions**.

## Access to Employee Medical Records [29 CFR 1926.33]

As an employee you have a right to see and copy any medical records about you that your employer has. You also have the right to see and copy any records of exposures, such as air sampling results, that indicate the exposure that you might have experienced on the job.

You can authorize another person, such as your union representative or attorney to get these records for you.

## Escape Exits [29 CFR 1926.34]

The building or structure under construction must have exits that allow escape from all areas at all times in case of emergency. (In the case of work at an occupied prison or mental hospital, doors can be locked provided supervisory personnel is continually on duty to facilitate emergency escape.)

**A**. What federal agency is responsible for enforcing standards for safety and health on the job?

_____

**B**. In some states, a state agency enforces safety and health standards. Is your state one of the states with its own safety and health enforcement agency?

_____

**C**. List eight categories of safety and health rights which you have as an employee.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

**D**. What are the qualifications of a competent person?

_____

_____

REVIEW THIS MODULE: THE OSHA STANDARDS



**E**. List seven types of safety and health information that you have a right to obtain.

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

**F**. Describe the steps that you should take if you believe that a task which you have been instructed to perform is so unsafe that you need to refuse to do it.

_____

_____

_____

_____

_____

# TEAMSTERS Construction Safety & Health Training

*Module 2*

# ELECTRICAL SAFETY

International Brotherhood of Teamsters — NIEHS Worker Training Grants

**LEARNING OBJECTIVES**

✔ **IDENTIFY THE MAIN REQUIREMENTS OF THE OSHA ELECTRICAL STANDARD**.

- **a**. Identify four main topics in the Electrical Standard.
- **b**. Identify five safety requirements for electrical installations that supply power and lighting at construction sites.
- **c**. Identify five requirements of an assured equipment grounding conductor program if the employer chooses this option.
- **d**. Identify where GFCI's shall be used if the employer chooses the GFCI option.
- **e**. Identify five safe work practices to protect construction workers from electrical hazards.
- **f**. Describe four safety requirements for areas where batteries are stored.

## The OSHA Electrical Standard

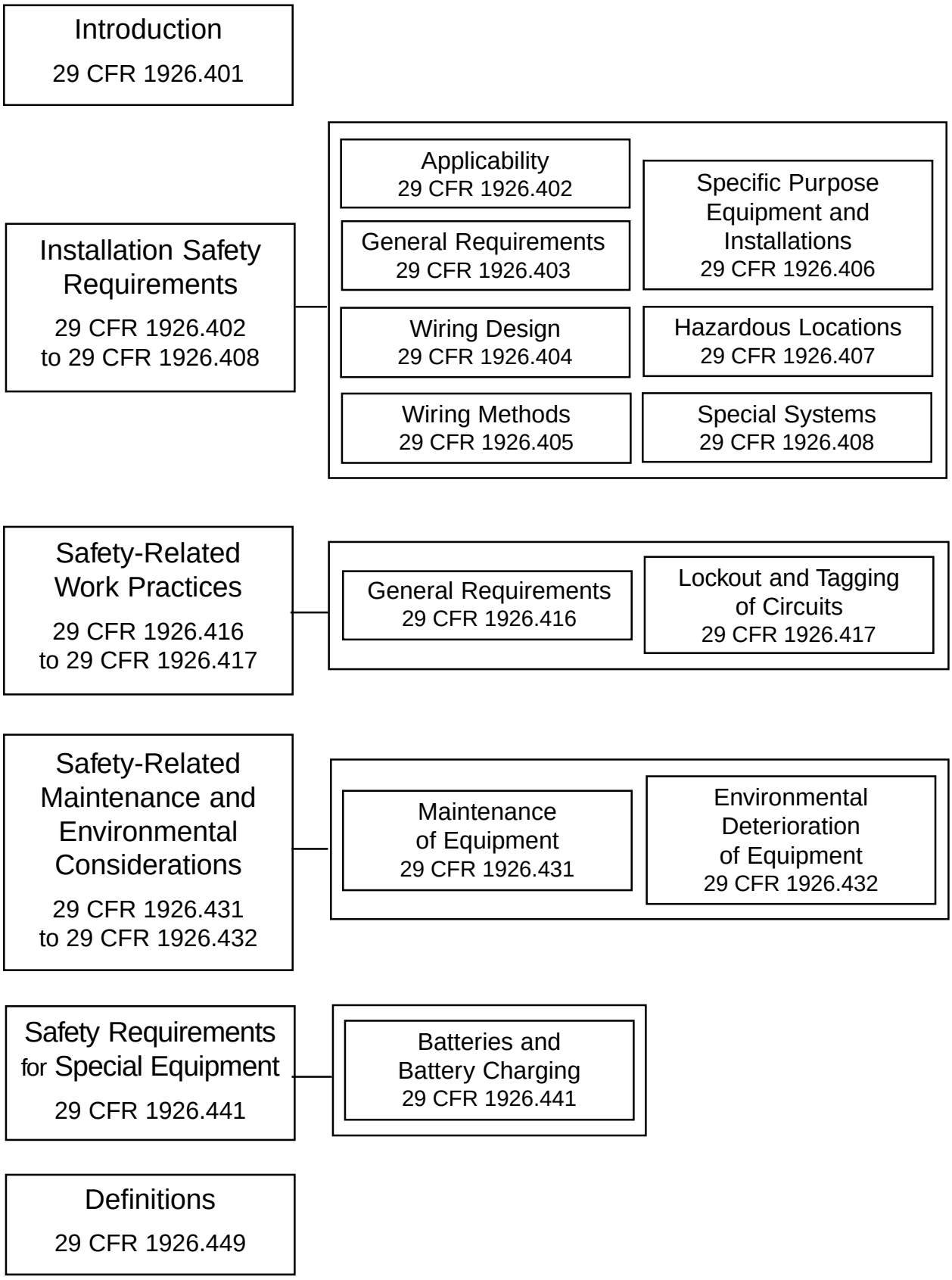
"**Electrical**" is Subpart K of the OSHA Construction Standards. It covers four main topics:

- **Installations Safety Requirements.**
- **Safety-Related Work Practices**.
- **Safety-Related Maintenance and Environmental Considerations**.
- **Special Equipment**.

There is also an **Introduction** and a list of **Definitions**.

Note: This module is for construction workers who are not electricians. You use electrically operated equipment and lighting on the job, but you do not install or maintain electrical panels, circuits and installations. We will not cover every detail of the Standard. We will discuss the topics which directly affect your safety as a construction worker who is not an electrician.

# The Electrical Standard 29 CFR 1926 Subpart K



# Electrical Hazards

Electricity creates two main hazards on a construction site:

**(1) Shock or electrocution**.

If you come in contact with a live circuit you may be shocked, burned or killed. Even if the shock itself doesn't cause injury, it might make you have an accident like falling from a ladder.

**(2) Fire or explosion**.

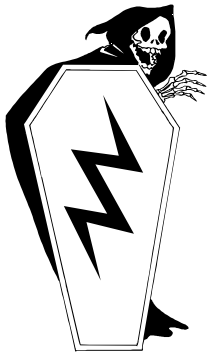
If too much current flows through a wire or a piece of equipment it might get hot enough to start a fire.

When you turn a switch on or off, or connect or disconnect a cord, there might be a spark which could ignite flammable gasses, vapors or dust in the air. Equipment such as a motor creates sparks as it operates.

In order to prevent shock or electrocution, OSHA has requirements for electrical installations, maintenance of equipment and safe work practices. These are intended to keep workers from accidently contacting live wires or parts. There is also a provision for ground fault circuit interrupters (GFCI) which in many situations can save your life even if you do come in contact with a live circuit.

In order to prevent fire and explosion, OSHA has requirements for special wiring and equipment in areas where flammable materials may be present in the air.

# How Much Juice Does It Take to Kill?



We measure current in Amps. If a current of $^1/_{10}$ Amp passes through your heart, it can cause ventricular fibrillation. This means that your heart muscles are vibrating rapidly, but are not pumping blood. You will die within minutes.

A typical 120 volt circuit can supply 20 Amps.

This is 100 times what it takes to kill.

# Installation Safety Requirements
**[29 CFR 1926.402-408]**

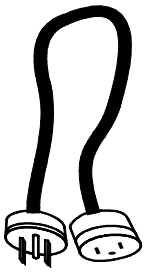
## Applicability [29 CFR 1926.402]

**These sections apply to temporary and permanent installations on the jobsite**. They don't apply to permanent installations in place before the job began.

## Approval [29 CFR 1926.403(a)]

**All electrical conductors and equipment shall be approved**. Extension cords, service panels, switches, breakers, etc. must have a UL or approval label.

**What about extension cords made by electricians on the job?**



...[They are] acceptable provided the...cord sets are constructed in a manner equivalent to those that are factory-assembled and approved... All components must be approved.....[and] must be compatible...with the other components... Boxes intended for use in a permanent installation may not be used... The cord set must be assembled by a qualified person... The wiring...must be checked before the cord set is first used... Grounding conductors shall be tested for continuity... [OSHA *Letter of Interpretation* 3/3/1992]

## Examination, Installation and Use of Equipment [29 CFR 1926.403(b)]

**The employer shall make sure that electrical equipment is free from recognized hazards**. To assure safety the employer shall consider:

- **Suitability**. Is this the right equipment for this purpose?
- **Strength and durability**. Will it provide protection? Will it last?
- **Insulation**. Never use a cord whose insulation is damaged.
- **Heating Effects**. Can the equipment cause overheating?.
- **Arcing and sparks**. Can arcing and sparks occur where flammable materials are present?
- **Classification**. Right size, voltage, current capacity, etc.?
- **Other factors**. Any other factors that affect workers' safety.

## Identification of Disconnecting Means [29 CFR 1926.403(h)]

**All disconnecting switches shall be clearly identified**. You need to know how to turn it off in an emergency. The "OFF" switch on a machine, or the circuit disconnect shall have a label, unless it's location makes it obvious.

## Guarding of Live Parts [29 CFR 1926.403(i)(2)]

**Live parts of electrical equipment operating at 50 volts or greater shall be guarded so that workers cannot accidently come in contact**. Here are some ways to achieve safe guarding:

- **Cabinet, room or vault.** Only accessible to qualified persons.
- **Partitions**. Strong, permanent partitions to exclude unqualified persons.
- **Platform**. On a balcony or platform that excludes unqualified persons.
- **Elevate**. Place on a pole or elevated location at least 8 feet up.

## Overcurrent Protection [29 CFR 1926.404(e)]

**Protect circuits from overcurrent**. Too much current can cause wires and equipment to overheat. Protection from overcurrent means:

- **Large enough conductors.** Wires must be large enough to handle the load that they are expected to carry.
- **Each circuit shall have a proper fuse or circuit breaker**.
- **No fuse on the grounded conductor**. The grounded (green) wire must stay connected. It should not have a fuse or circuit breaker.
- **Locate fuses and circuit breakers properly**. Fuses or circuit breakers shall be in a location that is easy and safe to get at, and where there are no flammable or combustible materials stored.

## Grounding Equipment Connected by Cord & Plug [29 CFR 1926.404(f)(7)(iv)]

**Exposed metal parts of cord and plug connected tools and equipment shall be grounded**. This means metal parts, like the case, that are not normally supposed to carry electricity. If the metal part becomes energized (because of damage to the tool or it's insulation) then you could get shocked. Grounding the metal part provides an easy path for the current so that it is less likely to go through your body. Grounding uses the green ground wire in the cord.

The requirement for grounding applies to plug and cord connected equipment and tools in the following situations:

- **In hazardous locations:** Where there are flammable or combustible materials.
- **If the tool or equipment operates at over 150 volts**.
- **Any of the following**:

  **(1) Hand-held motor operated tools**.

  **(2) Equipment used in damp or wet locations**.

  **(3) Equipment used by workers standing on the bare ground, or on metal floors, or inside a metal tank**.

  **(4) Portable x-ray equipment**.

  **(5) Portable hand lamps**.

  **(6) Exception**: A **double insulated tool** doesn't have to be grounded.

## Marking [29 CFR 1926.403(g)]

**Electrical equipment shall be marked**. This means it has a label which tells the manufacturer, and the electrical rating (voltage, amps and watts). Remember that this requirement applies to extension cords made on the job.

# Ground Fault Protection
**[29 CFR 1926.404(b)(1)]**

## Ground Fault Currents

Electricity travels in a **circuit**. An electric cord has two current-carrying wires. Electricity flows from the service panel through the black wire to a power tool. It runs the motor in the tool, and returns to the service panel via the white wire.

For reasons that have to do with how the electric company's system works, the white wire at the service panel is connected to the earth.

Suppose the metal case of a power tool — such as a drill — becomes energized. This could happen if the insulation is frayed where the cord enters the handle, or if there is damage inside the tool. Suppose that you are standing on the ground, or touching a pipe that goes into the ground, while you use the drill. Because the white wire is connected to the earth at the service panel, it's possible that some current that would normally go back through the white wire will return to the service panel by travelling through your body and then through the earth back to the panel. This is called a **ground-fault current**. Remember, it only takes $1/10$ Amp passing through your heart to kill you!

## Two Ways to Protect Against Ground Fault Currents

There are two ways to protect against the shock hazard of ground fault currents:

- **Grounding the tool.** The green wire in the cord — which is connected to the tool's case — provides an easy path for fault current to return to the service panel. This means less of it will go through your body.

- **Ground Fault Circuit Interrupter (GFCI)**. This device can tell if the same amount of current is passing through the white wire as through the black wire. If there is less in the white wire, then the extra must be going somewhere — maybe through your body. As soon as the GFCI sees a difference in the current in the two wires, it shuts off the circuit.

OSHA tells your employer to use either an **assured equipment grounding conductor program,** or **GFCI's**. GFCI's provide the best available protection.

## Assured Equipment Grounding Conductor Program [29 CFR 1926.404(b)(1)(iii)]

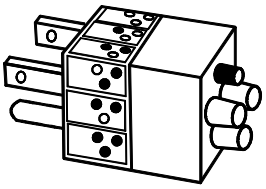
The ground conductor — the green wire — normally doesn't carry current. However, if there is a ground fault, then the ground wire is supposed to provide an easy path for the fault current so that less of it will go through your body.

This only works if the ground conductors have **continuity** and are **connected to the proper terminal**. The ground connection has to be complete through all cords, plugs, receptacles and wiring — all the way back to the service panel.

**An assured equipment grounding conductor program, it must include**:

- **A written description of the program**. This shall be kept at the jobsite. The description includes all procedures, tests and the test schedule.
- **One or more competent persons**. These workers inspect and test the ground connections and make records of the tests.
- **Visual inspections every day**. Visually inspect cords, plugs, and tools for defects and damage before each day's use.
- **Two kinds of tests**:

  (1) **Continuity Test**. Test the continuity of the ground conductor on cord sets, grounded tools and equipment, and receptacles that are not part of the permanent wiring of the building. Use a lamp and battery, ohmmeter or a receptacle tester.



  (2) **Proper terminal test**. Use a receptacle tester to assure that the ground at each receptacle is connected to the correct terminal.

- **Test Schedule**:

  (1) **Before each piece of equipment is used the first time**.

  (2) **At least once every three months**. (Cords and receptacles that are fixed in place and not damaged can be tested every 6 months.)

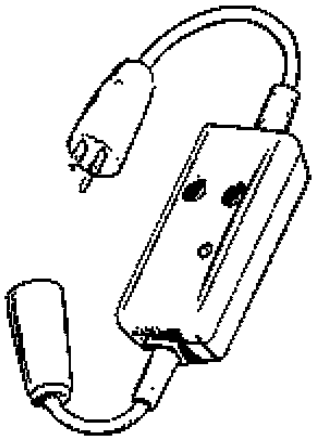
- **No damaged or defective equipment shall be used**.

- **Written program description, inspection and test results shall be available at the jobsite to all affected employees and to OSHA**.

## **Ground Fault Circuit Interrupters** [29 CFR 1926.404(b)(1)(ii)]

A **GFCI** will turn off the circuit if it senses that the **difference** between the current "going" through the black wire and the current "returning" through the white wire is more than $5/1000$ of an Amp. That's a tiny difference. $5/1000$ Amp is 20 times **less** than the current that can kill. If this little bit of fault current is getting lost — and maybe entering your body — the GFCI will cut the circuit and protect you. It can do this in $1/40$ of a second, which is less time than it would take to cause your heart to fibrillate. The GFCI provides two protection factors: (1) It acts when there is a fault current that is less than the amount that kills and (2) it acts faster than the current can affect you.

You can be exposed to a ground fault current if the metal case of a power tool becomes energized and you touch the tool. This can happen with the metal case of any electrical equipment, switch box, etc. You can be exposed to a ground fault current if you touch a cord with damaged insulation, or if you handle a wet cord or plug. Your body provides the best path to ground when you are touching a grounded metal object such as a pipe, or when you are standing on a wet surface. A properly working GFCI should protect you.



**If your employer chooses to use GFCI's, then there must be a GFCI protecting each 120-volt, single phase, 15- and 20-Amp receptacle outlet** on the site that is not part of the permanent wiring of the building. **A receptacle at the end of an extension cord** is not part of the permanent wiring, so it **must be protected by a GFCI even if the extension cord is plugged into the permanent wiring**.

A GFCI has a test button. This fools the GFCI into sensing a fault current and tests whether it cuts out the circuit. The OSHA standard does not mention these tests. It's a good idea to test each GFCI regularly, at least once a day. **Better yet: test a GFCI everytime you use it: it only takes a second, and it could save your life**.

A GFCI only protects you against ground fault currents. It will not protect you if you touch both the black wire and the white wire. In that case the current can flow through you body from black to white as if you were a power tool. The GFCI won't know the difference.

# Safety-Related Work Practices
**[29 CFR 1926.416-418]**

## Protection of Employees [29 CFR 1926.416(a)]

**No work near live circuits**: Don't work near a live circuit that you might contact unless you are protected against shock by de-energizing the circuit and grounding it, or by insulation or guarding.

**Unknown underground power lines**. If you use a jack hammer or other tools that might hit underground lines — and you don't know the exact location of those lines — then you shall wear insulated gloves.

**Before work begins**: The employer shall determine where exposed or concealed electric power lines are located.

**Post and maintain warning signs**. There shall be signs telling where circuits are. The employer shall advise employees of the location, the hazards involved, and the protective measures to be taken.

## Passages and Work Spaces [29 CFR 1926.416(b)]

**Barriers**. Guarding shall be provided to ensure that workspace for electrical equipment will not be used as a passageway.

**Tripping Hazards**. Working spaces and walkways shall be kept clear of cords so as not to create tripping hazards.

## Load Ratings [29 CFR 1926.416(c)]

**Don't exceed load ratings**. Never put in a larger fuse or circuit breaker than the capacity of the circuit wires protected by the fuse or circuit breaker.

## Fuses [29 CFR 1926.416(d)]

**Don't pull fuses with your bare hands**. Use an insulated tool with the correct voltage rating to install or remove a fuse with one or both terminals energized.

## Cords and Cables [29 CFR 1926.416(e)]

**No worn or frayed cords and cables**. Cords which are lightly damaged may be repaired with electrical tape as long as it can be done in a way that provides the same insulation as the undamaged cord.

**Don't hang extension cords with nails, staples or wire**. These can strain, cut or tear the cord.

## Lockout and Tagging of Circuits Being Worked On [29 CFR 1926.417]

**Tagging controls**. If a circuit is turned off so that someone can work on the circuit, then the control switch for that circuit must be tagged.

**Circuits and Equipment**. Before working on a circuit or electrical equipment, turn it off, and tag every switch or other point where it could be turned on.

# Hazardous Locations
### [29 CFR 1926.407]

## Special Requirements for Locations with Fire and Explosion Hazards [29 CFR 1926.407]

OSHA has special requirements intended to assure that wiring and equipment cannot cause gases, vapors, dusts, or fibers in the air to ignite or explode.

Some of the methods discussed in the OSHA Standard include:

- Thermal insulation so that hot equipment doesn't start a fire.
- Gaskets to prevent gases and vapors from contacting sparks.
- "Flame paths" designed into equipment so that if gases and vapors do get inside and cause an explosion, it will be contained in the device the combustion products will cool before they escape.

We will not go into the details of hazardous locations in this module.

# Maintenance and Environmental Considerations
**[29 CFR 1926.431-432]**

## Maintenance of Equipment [29 CFR 1926.431]

**Maintain equipment in hazardous locations**: The employer shall assure that electrical equipment in hazardous locations is maintained in a dust-tight, dust-ignition-proof or explosion-proof condition without missing screws, gaskets, or other untight conditions.

## Environmental Deterioration of Equipment [29 CFR 1926.432(a)(1)]

**Special equipment and wiring for certain conditions**: Some environmental conditions can damage wires and equipment. In the following situations, only use wire and equipment that is approved for that situation:

- **Wet or damp locations.**
- **Where gases, vapors, fumes, liquids or there agents might cause deterioration of conductors or other equipment**.
- **High temperatures**.

## Weather Protection [29 CFR 1926.432(a)(2)]

**Protect equipment during construction**: Equipment and wiring that is approved only for dry locations — and will be protected when the building is finished — shall be protected from the weather during construction.

## Corrosion Prevention [29 CFR 1926.432(b)]

**Use the proper equipment and wiring to prevent corrosion**: Metal raceways, cable armor, boxes, sheathing, cabinets, fittings, and supports shall be of materials appropriate for the environment in which they are to be installed.

# Requirements for Special Equipment
## [29 CFR 1926.441]

### Batteries [29 CFR 1926.441(a)]

**Safety requirements where unsealed batteries are used**: There are special requirements for locations where unsealed batteries — for example, lead-acid type batteries — are used. The purpose of these requirements is to prevent the accumulation of explosive gas released from batteries, and to protect workers and equipment from exposure to the corrosive electrolyte in batteries.

- **Locate batteries where gases, fumes and electrolyte cannot contaminate other areas or equipment.**
- **Ventilate so that gas does not accumulate into an explosive mixture**.
- **Use racks and trays that are acid resistant**.
- **Provide acid resistant floors**.
- **Provide face shields, aprons and rubber gloves to workers who handle batteries**.
- **Provide an emergency shower and eyewash station**.
- **Provide facilities for washing and neutralizing spilled electrolyte and for fire protection**.

### Battery Charging [29 CFR 1926.441(b)]

**Safety requirements for charging batteries**:

- **Only charge batteries in a location designed for that purpose.**
- **Protect charging equipment from damage by trucks**.
- **Keep vent caps in place during charging**.

**A**. What are the four main topics in the Electrical Standard?

1. _____

2. _____

3. _____

4. _____

**B**. What are five safety requirements for electrical installations that supply power and lighting at construction sites?

1. _____

2. _____

3. _____

4. _____

5. _____

**C**. What are five requirements of an assured equipment grounding conductor program if the employer chooses this option?

1. _____

2. _____

3. _____

4. _____

5. _____

REVIEW THIS MODULE: ELECTRICAL SAFETY

**D**. Where must GFCI's be used if the employer chooses this option?

_____

_____

_____

_____

**E**. What are five safe work practices to protect construction workers from electrical hazards?

1. _____
2. _____
3. _____
4. _____
5. _____

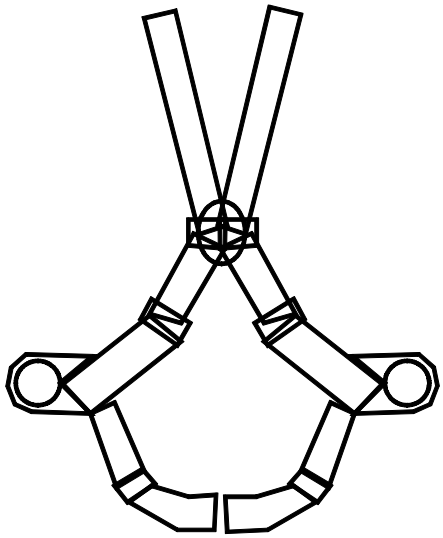
**F**. What are four safety requirements for areas where batteries are stored?

1. _____
2. _____
3. _____
4. _____

# TEAMSTERS Construction Safety & Health Training

*Module 3*

# FALL PROTECTION



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**LEARNING OBJECTIVES**

✔ **IDENTIFY THE MAIN REQUIREMENTS OF THE OSHA ELECTRICAL STANDARD.**

**a**. Identify the threshold height for fall protection.
**b**. Identify the main components of a guardrail system.
**c**. Identify the main components of a safety net system.
**d**. Identify the main components of a personal fall arrest system.
**e**. Identify the requirements of a Fall Protection Training Program.

## Construction Workers Die in Falls

Falls are the leading cause of construction worker fatalities. Each year, between 150 to 200 workers die and more than 100,000 are injured in falls.

## The Fall Protection Standard

Fall Protection is Subpart M of the OSHA Construction Standards. It has four sections and five non-mandatory appendices:

- **Scope and Application and Definitions**
- **Duty to Have Fall Protection**
- **Fall Protection Systems, Criteria and Practices**
- **Training Requirements**
- **Five Non-Mandatory Appendices**

The appendices show ways to comply with the Standard. Each appendix is "non-mandatory" (the employer doesn't have to do exactly what the appendix says). The employer can use other methods as long as they get the same result.

# Fall Protection Standard 29 CFR 1926 Subpart M

**Scope, Application and Definitions**
29 CFR 1926.500

**Duty to Have Fall Protection**
29 CFR 1926.501

- (a) General
- (b) (1) Unprotected Sides & Edges
- (2) Leading Edges
- (3) Hoist Areas
- (4) Holes
- (5) Form Work & Reinforcing
- (6) Ramps, Runways, Walkways
- (7) Excavations
- (8) Dangerous Equipment
- (9) Overhand Bricklaying
- (10) Roofing & Low-sloped Roofs
- (11) Steep Roofs
- (12) Precast Concrete Erection
- (13) Residential Construction
- (14) Wall Openings
- (15) Walking/working Surfaces
- (c) Protection from Falling Objects

**Fall Protection Systems, Criteria and Practices**
29 CFR 1926.502

- (a) General
- (b) Guardrail Systems
- (c) Safety Net Systems
- (d) Personal Fall Arrest Systems
- (e) Positioning Device Systems
- (f) Warning Line Systems
- (g) Controlled Access Zones
- (h) Safety Monitoring Systems
- (i) Covers
- (j) Protection from Falling Objects
- (k) Fall Protection Plan

**Training Requirements**
29 CFR 1926.503

- (a) Training Program
- (b) Certification of Training
- (c) Retraining

**Five Non-Mandatory Appendices**

- A Determining Roof Widths
- B Guardrail Systems
- C Personal Fall Arrest Systems
- D Positioning Device Systems
- E Sample Fall Protection Plan

## Scope and Application

The OSHA Standard covers most construction workers except those inspecting workplace conditions prior to the start of work or after it's completed.

- Areas that require fall protection:
  - Ramps
  - Excavations
  - Holes
  - Wall openings
  - Walkways
  - Hoist areas
  - Form Work and rebar
  - Unprotected sides and edges
- Activities that require fall protection:
  - Leading edge work
  - Precast concrete erection
  - Residential construction
  - Roofing work
  - Overhand bricklaying

Fall protection for workers on scaffolds is covered in Subpart L, Scaffolding.

## Whenever You Are 6 Feet Up (Or More)

Construction employers must protect their employees from fall hazards when an affected employee is 6 feet or more above a lower level.

## The Employer Chooses How to Do It

The standard allows the employer to select the fall protection measures that are right for the type of work being done. These can include:

- Guardrail Systems
- Safety Net Systems
- Personal Fall Arrest Systems
- Positioning Device Systems
- Warning Line Systems
- Safety Monitoring Systems

# Fall Protection Systems
## [29 CFR 1926.502]

### Guardrail Systems [29 CFR 1926.501(502)(b)]

If the employer chooses to use guardrail systems to protect workers from falls, the systems must meet the following criteria:

The top rails and midrails may be made of wire or rope which is at least one-quarter inch to prevent cuts and lacerations. If wire rope is used for top rails, it must be flagged at least every 6 feet with high-visibility material. If manila, or synthetic rope is used, it must be inspected frequently to ensure strength and stability. Steel and plastic banding cannot be used as top rails or midrails.

The top edge height of top rails must be between 39 inches and 45 inches above the walking level. If workers are using stilts, the top edge height must be increased an amount equal to the height of the stilts.

Screens or mesh can be used in place of midrails. No opening in the guardrail system may be more than 19 inches across.

The guardrail system must be capable of withstanding a force of at least 200 pounds.

Guardrail components must be free of damage that could cause lacerations.

When guardrail systems are used at hoisting areas, a chain, gate or removable guardrail section must be placed across the access opening when hoisting operations are not taking place.

If guardrails are used on ramps and runways, they must be erected on each unprotected side or edge.

## Safety Net Systems [29 CFR1926.502(c)]

Safety nets must be installed close under the walking/working surface they protect and never more than 30 feet below that surface.

Safety nets must be inspected at least once a week for damage. Defective nets must not be used.

No opening in the net can be more than 36 inches square and no more than 6 inches on any side. The openings, measured center-to-center, of mesh ropes or webbing, must not be more than 6 inches.

Safety nets must have sufficient clearance underneath to prevent contact with the surface or structure below.

The potential fall area from the walking/working surface to the net shall be unobstructed.

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

**How Far Out Nets Must Extend**

| Vertical distance from working level to the net | Minimum horizontal distance from the working surface to the outside of the net |
|---|---|
| Up to 5 feet | 8 feet |
| More than 5 feet up to 10 feet | 10 feet |
| More than 10 feet | 13 feet |

Safety nets shall be capable of absorbing an impact force of a 400-pound bag of sand 30 inches in diameter dropped from 42 inches above the highest surface on which employees work or walk.

Items that have fallen into safety nets must be removed as soon as possible and at least before the next work shift.

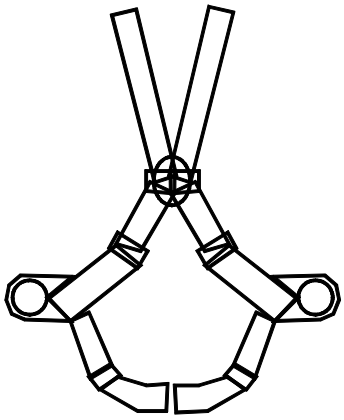
## Personal Fall Arrest Systems [29 CFR1926.502(d)]

These consist of an anchorage, connectors, lifeline, lanyard, and a body harness. They may also include a deceleration device.

If a personal fall arrest system is used for fall protection, it must do the following:

- Limit maximum stopping force on an employee to 1,800 pounds.
- Not allow the employee to free fall more than 6 feet or hit a lower level.
- Bring an employee to a complete stop and limit maximum deceleration distance an employee travels to 3½ feet.
- Strong enough to withstand twice the impact of an employee free falling 6 feet or the free fall distance of the system, whichever is less.

The fall arrest system must include a body harness. Body belts were prohibited as of January 1, 1998. (However, a body belt may still be used in a positioning device system.)



Inspect the personal fall arrest system before each use for damage and deterioration. Remove defective components from service immediately.

Ropes and lanyard must be of synthetic fibers (like nylon and kevlar), not manila.

Snaphooks must be the locking kind, and must be designed for the object to which they are attached.

A competent person must supervise the design and installation of lifelines and anchorages.

## Positioning Device Systems [29 CFR1926.502(e)]

A positioning device system uses a body belt or body harness which is set so that a worker can free fall no more than 2 feet.

## Warning Line Systems [29 CFR1926.502(f)]

A warning line system consist of ropes, wires, or chains, and supporting stanchions. The purpose of this system is not to physically prevent workers from falling, but to alert them to danger so they do not get too close to a fall hazard area. A warning line must be:

- Flagged at least once every 6 feet with high visibility material.
- All points must be between 34 and 39 inches above the walking surface.
- The stanchions that hold up the warning line must resist tipping by a moderate force of 16 pounds.
- The line must be rigged so that pulling on one section does not take up the slack in an adjacent section before the stanchion tips over.

Compare these requirements to the control line used in a controlled access zone. (See the next paragraph.)

## Controlled Access Zones [29 CFR1926.502(g)]

A **controlled access zone** is an area where certain work (such as overhand bricklaying and leading edge work) may take place without the use of conventional fall protection systems. This is allowed because a fall protection system may interfere with the work and create a greater hazard.

**Control Line**: There must be a **control line** that defines the controlled access limits so that other workers don't enter. Control lines can be ropes, wires, or tapes with supporting stanchions. The control line must be:

- Flagged at least once every 6 feet with high visibility material.
- All points must be between 39 and 45 inches above the walking surface. It may be as high as 50 inches if overhand bricklaying is being done.
- Strong enough to sustain force of at least 200 pounds.
- Connected at each end to a wall or guardrail.
- A control line for a leading edge must be roughly parallel to the edge.

The Standard includes minimum and maximum distances for locating the control line from various activities.

## Safety Monitoring Systems [29 CFR1926.502(h)]

When no other alternative fall protection can be implemented, the employer can appoint a competent person to monitor the safety of workers. This safety monitor must:

- Be competent to detect unsafe work practices and recognize fall hazards.
- Be located on the same walking/working surfaces of the workers and able to see them and communicate orally to warn them of fall hazards.
- Have no other duties to distract from the monitoring function.

## Covers [29 CFR1926.502(i)]

A cover for a hole must be strong enough to support at least twice the weight of anybody or anything that might rest on it. For example, if the cover is on a hole in a roadway, then it must be able to support twice the axle load of the heaviest vehicle that might drive over it.

## Protection from Falling Objects [29 CFR1926.502(j)]

When guardrail systems are used to prevent materials from falling from one level to another, any openings must be small enough to prevent the passage of potential falling objects.

No materials or equipment except masonry and mortar shall be stored within 4 feet of working edges.

## Toeboards [29 CFR1926.502(j)(2), (3), and (4)]

When toeboards are used as protection from falling objects, they must be erected along the edges of the overhead working surface for a distance sufficient to protect persons working below. Toeboards must:

- Be capable of withstanding a force of at least 50 pounds.
- Be at least 3½ inches tall.
- Have no more than ¼ clearance above the working surface and no gap or space greater than 1 inch along their length.

If tools or materials are piled higher than the top edge of a toeboard, paneling or screening must be erected to protect employees below.

## Canopies [29 CFR1926.502(j)(8)]

When used as protection from falling objects, canopies must be strong enough to prevent collapse and to prevent penetration by any objects that fall on them.

# Fall Protection in Specific Work Activities
**[29 CFR 1926.501]**

## Leading Edges [29 CFR1926.501(b)(2)]

Each employee who is constructing a leading edge 6 feet or more above a lower level must be protected by a guardrail system, safety net system, or personal fall arrest system.

If the employer can demonstrate that it is infeasible or creates a greater hazard to implement these systems, the employer must implement a fall protection plan that will protect these workers.

## Hoist Areas [29 CFR1926.501(b)(3)]

Each employee in a hoist area must be protected from falling 6 feet or more by a guardrail system or personal fall arrest system.

If the guardrail (or part of it) must be removed to facilitate hoisting operations, as during the landing of materials, and a worker must lean through the access opening or over the edge of the opening to receive or guide materials, that employee must be protected by a personal fall arrest system.

## Holes [29 CFR1926.501(b)(4)]

If a hole is more than 6 feet deep, it must have a guardrail or a cover. However, if the work requires the hole to be open or the guardrail removed, then workers near the hole must use a personal fall arrest system.

A hole may not have more than two sides with removable guardrail sections.

## Form Work and Reinforcing Steel [29 CFR1926.501(b)(5)]

Fall protection is not required for employees while moving on the vertical face of rebar assemblies built in place.

OSHA considers the multiple hand holds and foot holds on rebar assemblies as providing similar protection as that provided by a fixed ladder. However, an employee must have fall protection when moving at a height more than 24 feet, the same as for fixed ladders.

## Ramps, Runways, and Other Walkways [29 CFR1926.501(b)(6)]

If a ramp, runway or walkway is more than 6 feet above the level below, it must have guardrails.

## Excavations [29 CFR1926.501(b)(7)]

If an excavation is 6 feet deep, or more, then employees working near the excavation must be protected by a guardrail system, fence, barricade, or cover.

If there is a walkway to cross over the excavation, it must have a guardrail if the it is 6 feet or more from the walkway to the lower level.

## Overhand Bricklaying and Related Work [29 CFR1926.501(b)(9)]

Each employee performing overhand bricklaying or related work 6 feet or more above lower levels must be protected by a guardrail system, safety net system, or personal fall arrest system, or shall work in a controlled access zone.

If the job requires the employee to reach more than 10 inches below the level of the surface on which they are working, then the employee must be protected by a guardrail system, safety net system, or personal fall arrest system.

## Roofs [29 CFR 1926.501(b)(10) and (11)]

Sides and edges 6 feet or more above lower levels must have a guardrail system, safety net system, or personal fall arrest system.

On a low slope roof there can be a combination of a warning line system and guardrails, safety nets, personal fall arrest, or safety monitoring system. On low-slope roofs 50 feet or less in width, the use of a safety monitoring system without a warning line system is permitted.

## Precast Concrete Erection [29 CFR 1926.501(b)(12)]

Each employee who is erecting precast concrete members and related operations such as grouting 6 feet or more above a lower level must be protected by a guardrail system, safety net system, or personal fall arrest system.

If the employer can demonstrate that it is infeasible or creates a greater hazard to implement these systems, the employer must implement a fall protection plan that will protect these workers.

## Residential Construction [29 CFR 1926.501(b)(13)]

If the employer can demonstrate that it is infeasible or creates a greater hazard to implement a guardrail system, safety net system or personal fall arrest system, the employer must implement a fall protection plan that will protect these workers. Appendix M has alternative fall protection plans that may be used.

## Wall Openings [29 CFR 1926.501(b)(14)]

If a wall opening is less than 39 inches above a work surface on the inside of the opening and 6 feet or more above the lower level on the outside of the opening, then it must be guarded with a guardrail system, safety net system or personal fall arrest system.

## **Training** [29 CFR 1926.503]

Employers must provide a training program for employees who might be exposed to fall hazards. The Fall Protection Training Program must include:

**(a)** The nature of fall hazards in the work area.

**(b)** The correct procedures for erecting, maintaining, disassembling, and inspecting fall protection systems.

**(c)** The use and operation of controlled access zones and guardrail, personal fall arrest, safety net, warning line, and safety monitoring systems.

**(d)** The role of each employee in the safety monitoring system when the system is in use.

**(e)** The limitations on the use of mechanical equipment during the performance of roofing work on low-slope roofs.

**(f)** The correct procedures for equipment and materials handling and storage and the erection of overhead protection.

**(g)** Employees' role in fall protection plans

**(h)** The standards in this Subpart M.

Employers must prepare a written certification that identifies the employee trained and the date of the training. The employer or trainer must sign the certification record. Retraining also must be provided when necessary.

**A**. What is the threshold height for OSHA fall protection requirements?

_____

**B**. What are the main components of a guardrail system?

_____

_____

_____

_____

_____

_____

_____

**C**. What are the main components of a safety net system?

_____

_____

_____

_____

_____

_____

_____

REVIEW THIS MODULE: FALL PROTECTION

**D**. What are the main components of a personal fall arrest system?

_____

_____

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_____

_____

_____

**E**. What are thr requirements of a Fall Protection Training Program?

_____

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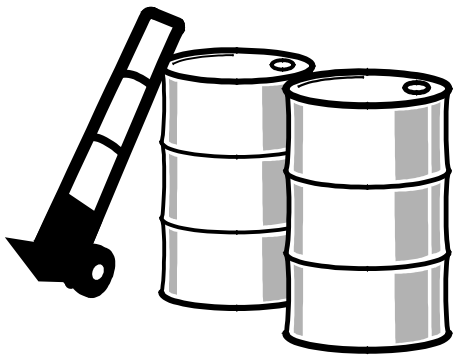
# TEAMSTERS
# Construction
# Safety & Health Training

## *Module 4*
# MATERIALS HANDLING



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**LEARNING OBJECTIVES**

✔ **IDENTIFY THE SAFE WORK PRACTICES FOR HANDLING MATERIALS AND USING SLINGS.**

- **a**. Identify four safe work practices for storing materials.
- **b**. Identify five safe work practices for using powered industrial trucks.
- **c**. Describe how to lift a load safely by hand.
- **d**. Identify how to determine the rated capacity of a sling.
- **e**. Identify six things to consider before rigging a load with slings.
- **f**. Identify five safe work practices when lifting a load with slings.

# Materials Handling

"**Materials Handling, Storage, Use, and Disposal**" is Subpart H of the OSHA Construction Standards. It has three sections as shown on the next page.

Handling and storing materials involves many different operations. For example: hoisting tons of steel with a crane, driving a truck loaded with concrete blocks, carrying bags of cement by hand, and stacking drums, lumber, or loose bricks.

The improper handling and storing of materials can cause serious injuries. Often the weight and bulkiness of an object is a major factor in injuries. Back injury is the most common and most costly workplace injury. Almost one-half million workers injure their backs every year. Moving materials by hand can also cause sprains and strains to other muscles and joints.

Fractures, lacerations and bruises result from being struck by moving or falling objects, by getting pinched between objects, or by incorrectly cutting strapping.

# Materials Handling, Storage, Use, and Disposal
# 29 CFR 1926 Subpart H

General Requirements for Storage
29 CFR 1926.250

Rigging Equipment for Material Handling
29 CFR 1926.251

Disposal of Waste Materials
29 CFR 1926.252

## General Requirements

**Don't Try to Do More Than You Can**. If a load is so bulky that you cannot properly grasp or lift it, or if it's so big that you cannot see past it, get help.

**Placing Blocks**. If you place blocks under a load, make sure that your hands are completely removed before the load is lowered unto the blocks.

**Gloves and Boots**. Wear work gloves and steel-toed boots when handling heavy materials.

**Moving Equipment**. When using forklifts or other equipment to move materials:

- Know the rated capacity of the equipment. Don't overload it.
- Center the load.
- Keep the load in the lowest possible position while traveling.

# Storage Areas

Keep storage areas free from accumulated materials that may cause tripping, fires, or that may contribute to the harboring of rats and other pests.

**Stacking**. When stacking materials, be aware of such factors as the materials' height and weight, how accessible the stored materials are to the user, and the condition of the containers.

Know the load limits of the floor or rack. Don't overload it. Load limits should be posted in all storage areas.

Don't stack materials too high; they could fall. Know the proper maximum height for different materials and containers.

Stack bags in interlocking rows to remain secure. Step the layers back and cross-key the bags at least every ten layers. To remove bags from the stack, start from the top row first.

**Sprinkler Heads**. If there are fire sprinkler heads, don't stack materials so high that the heads would be blocked.

**Drums and Barrels**. If drums and barrels are stacked on their ends, place planks or plywood between the tiers for added security. If stacked on their sides, make sure that the bottom tier is securely blocked to prevent rolling.

# Cranes and Derricks

We discuss the safe use of cranes in another module. Here we will only review a few basic principles:

- Only a qualified person can operate a crane or derrick.
- Know the load rating. Never try to lift more than the rated capacity.
- No workers should ever be under the load.
- Inspect the crane before each work shift.
- Follow maintenance and major inspection schedules.

# Slings

**Visual Inspection**. Look the sling over before each use. Look for kinks, bird caging, and broken wires. If the sling is damaged or defective, remove it from service.

**Modifications**. Never shorten a sling with knots, bolts or other makeshift devices.

**Capacity**. Never load a sling beyond its rated capacity

We will look more closely at slings later in this module.

# Powered Industrial Trucks

Here we present a brief discussion of the safe operation of powered industrial trucks (forklifts, etc.). OSHA recently adopted a new standard which requires special training for workers who operate powered industrial trucks. The new standard is 29 CFR 1910.178(l). This module by itself does not fulfill the OSHA training requirements. In order to meet the requirements, operators must have hands-on training on the specific types of industrial trucks they will operate.

**Capacity**. Never exceed the rated capacity of an industrial truck. Each truck should be marked with it's rated capacity. Don't overload it.

**Modifications**. Don't make any modifications to the truck without the manufacturer's prior written approval.

**Attachements**. Only use attachments that are designed to work with the particular truck.

**Fire and Explosion**. Internal combustion engines are very hot. Electric motors create sparks. In either case, the engine or motor could start a fire or explosion if there are flammable vapors, gases or particulates in the air. There are specially designed industrial trucks for use in dangerous atmospheres. These have enclosed electrical systems, guarded exhausts, and temperature limitation features.

**Toxic Exhaust**. Gasoline and diesel engines emit toxic substances in the exhaust, including carbon monoxide (CO). CO is an odorless, tasteless gas that is extremely deadly. A very small amount can make you feel dizzy and tired, and can affect your coordination. A little bit more can put you to sleep or kill you. Do not use gasoline or diesel powered industrial trucks indoors unless there is good ventilation. It's always better to use propane or electric powered trucks indoors.

**Charging Batteries**. Batteries can emit explosive hydrogen gas when they are charged. Battery electrolyte is extremely corrosive and can burn your skin or blind you. In the module on electrical hazards we discuss safe battery charging.

**Training**. As we mentioned previously, workers who operate powered industrial trucks must now have special training that includes hands-on practice with each type of truck that they will operate.

## Ergonomics

Ergonomics is a branch of science that studies the relationship between workers and their tasks. The basic principle of ergonomics is that the job should be adapted to fit the person, rather than forcing the person to fit the job. This means that tools and equipment should be easy to operate, without excessive force or awkward postures. Otherwise, injury can occur to the worker's muscles, joints and bones.

Ergonomics focuses on the work environment and items such as design and function of workstations, controls, displays, safety devices, tools, and lighting to fit the workers' physical requirements and to ensure their health and safety.

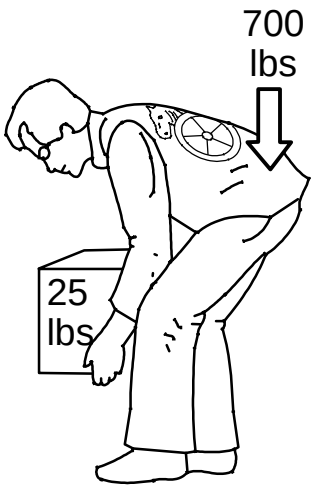
Ergonomics includes restructuring or changing workplace conditions to make the job easier and reducing stressors that cause cumulative trauma disorders and repetitive motion injuries.

In the area of materials handling and storing, ergonomic principles may require controls such as reducing the size or weight of the objects lifted, installing a mechanical lifting aid, or changing the height of a shelf.

# Heavy Lifting

Workers move materials. Trucks are unloaded. Supplies are moved to warehousing areas. Waste materials are collected and loaded for disposal. These activities often require lifting heavy objects by hand. To prevent painful, possibly permanent injury, use the proper technique.

- Don't overestimate your strength:
  if it's too bulky or too heavy, get assistance.
- Keep the back straight and lift with the legs.
- Lift slowly and carefully.
- Keep the load as close to your body as possible.
- Don't turn or twist while you are lifting.
- Be just as careful putting the load down.




This worker is using proper technique and is lifting a box that only weighs 25 pounds. Even so, he has a force of 750 pounds on his lower back.

Imagine what can happen to your back if the load is too heavy, or you doesn't use good technique. The force on the lower back can be as much as 2000 pounds!

The job should be planned to minimize the amount of lifting. There should be enough workers to lift safely. Use fork lifts and boom trucks whenever possible.

## Do back supports work?

The National Institute for Occupational Safety and Health (NIOSH) studied workers who do lifting. They found that workers wearing supports are just as likely to be injured as those who don't use them. Supports can actually make your muscles weaker. Consider what would happen to your biceps if you kept your arm in a sling. A back support won't make you stronger, and it could make your back weaker.

# Sling Safety

Slings are the most commonly used piece of materials-handling apparatus. They are used to suspend loads from cranes, derricks and hoists.

## Sling Materials

Slings can be made of different materials. These include chain, wire rope, wire mesh, natural fiber rope, synthetic fiber rope, and synthetic webbing.

## Chains

Chains are used because of their great strength and their ability to adapt to the shape of the load. However, chain slings are subject to damage by sudden shocks. Misuse of chain slings can damage the sling, resulting in sling failure and possible injury to a worker.

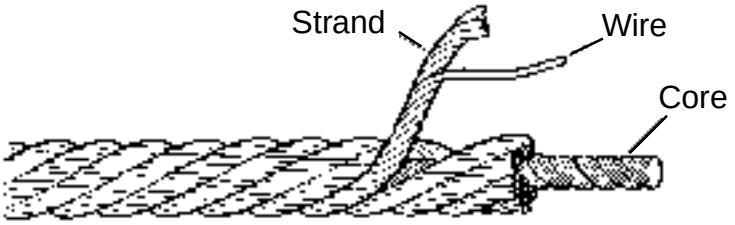
Chain slings are also the best choice for lifting materials that are very hot. They can be heated to temperatures of up to several hundred degrees.

All sling types must be visually inspected prior to use. When you inspect an alloy steel chain sling, pay special attention to any stretching, excess wear, nicks and gouges. These are all indications that the sling may be unsafe and must be removed from service.

## Wire Rope

Wire rope is composed of individual wires that have been twisted to form strands. The strands are then twisted to form a rope.

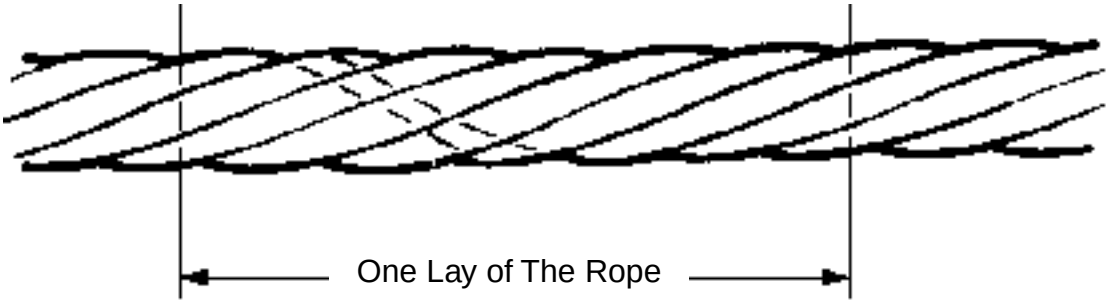
Some wire rope has a fiber core. This makes it more flexible, but also more easily damaged. Wire rope with a wire core is stronger and more resistant to heat damage, but it is less flexible.



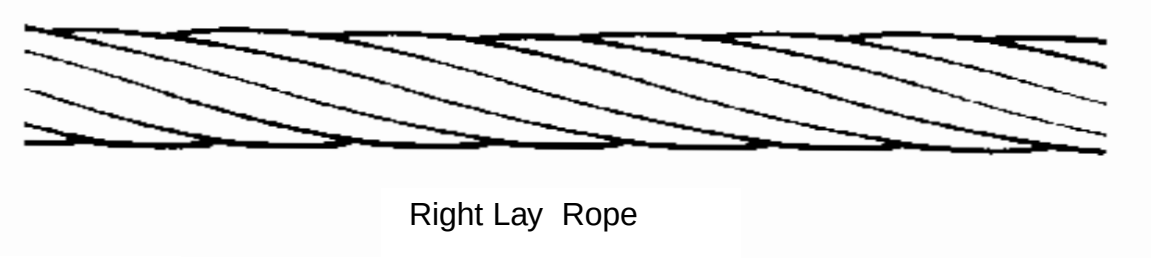
## Rope Lay

"Lay" is a term used to describe both fiber and wire rope. "Lay" can refer to three different things:

1. One complete wrap of the strands around the core is called a lay.




2. The direction the strands are wound around the core. Wire rope is referred to as right lay or left lay. A right lay rope is one in which the strands are wound in a right-hand direction like a screw thread. A left lay rope is just the opposite.




3. The direction the wires are wound in the strands in relation to the direction of the strands around the core: In regular lay rope, the wires in the strands are laid in one direction while the strands in the rope are laid in the opposite direction. In lang lay rope, the wires are twisted in the same direction as the strands.

## Wire Rope Sling Selection

When selecting a wire rope sling to give the best service, there are four characteristics to consider: strength, ability to bend without distortion, ability to withstand abrasion, and ability to withstand abuse.

**Strength**. The maximum load limit is determined by dividing the ultimate strength of the rope by a safety factor. New wire rope has a safety factor of 5 to 1. For example: a new wire rope sling with a strength of 10,000 pounds would have a rated working load of 2,000 pounds

As the sling gets used, its ultimate strength declines because of wear and stretching. In the example above, if the strength decreases to 8000 pounds over time, but the rated load is still considered to be 2000 pounds, then there is only a 4 to 1 safety factor.

This means that it is important to rigorously inspect wire rope slings, especially older ones, to ensure that they are still safe to use.

**Fatigue**. A wire rope has to withstand repeated bending without the wires breaking from fatigue. Fatigue failure results from small cracks that develop after repeated bending. Sharp bends cause more fatigue. Use rounded blocks or pads to increase the radius where the sling bends around a load.

**Abrasion**. The ability of a wire rope to withstand abrasion depends on the size, number of wires, and construction of the rope. Smaller wires are more flexible but are less able to withstand abrasion. Larger wires make the rope less flexible, but they are better able to withstand abrasion .

**Abuse**. Abusing a wire rope sling can cause serious structural damage to the wire rope, such as kinking or bird caging. This reduces the rope's strength. Bird caging is when the wire rope strands are forcibly untwisted and spread outward.

## Wire Rope Sling Inspection

Wire rope slings must be visually inspected before each use.

The operator should 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, the sling must not be used.

Also inspect the end fittings and other components for any damage that could make the sling unsafe.

All workers who use slings should know how to recognize damage to slings, not just the foreman or the crane operator.

## Lubrication

Lubrication makes a wire rope sling last longer. The wire rope stretches as it takes up a load. This means that all the wires in the rope move little bit. Lubrication allows them to slip along each other without excessive wear.

The manufacturer provides the initial lubrication. The wire rope should also be lubricated from time to time as it is used. There is no set rule on how much or how often this should be done. It depends on the conditions under which the sling is used. The heavier the loads, the greater the number of bends, or the more adverse the conditions under which the sling operates, the more frequently lubrication will be required.

## Storage

Wire rope slings should be stored in a ventilated, dry building. Never store them on the ground or allow them to be continuously exposed to the elements because this can cause corrosion and rust. If it is necessary to store a wire rope sling outside, make sure that it is set off the ground and protected.

Using the sling several times a week, even at a light load, is a good practice. Records show that slings that are used frequently or continuously give useful service longer than those that are idle.

## Discarding Wire Rope Slings

Discard a wire sling under the following conditions:

- Severe corrosion.
- Localized wear (shiny worn spots) on the outside.
- A one-third reduction in outer wire diameter.
- Damage to end fittings.
- Distortion, kinking, bird caging, or other damage to the rope structure.
- Excessive broken wires. If ten randomly distributed wires in one lay are broken, or five wires in one strand of a rope lay are damaged, the sling must not be used.

## Fiber Rope Slings

Fiber rope slings are pliant, they grip the load well and they don't mar the surface of the load. However, they are less strong than wire rope slings or synthetic web slings. Use fiber rope slings only for light loads. Don't use them to lift objects with sharp edges unless you can carefully pad the edges to protect the rope. Also, don't use fiber rope slings if they will be exposed to high temperatures, to corrosive materials or to abrasion.

Fiber rope deteriorates much more quickly than other sling materials. You should carefully inspect the sling before each load. First look at the outside for dry, brittle, scorched, or discolored fibers. Scratch the fibers with your finger nail. If they come apart easily, the fiber sling has suffered some kind of chemical damage.

Then carefully untwist a portion of the rope to look at the interior. It should be as clean as when the rope was new. A buildup of dust on the inside of the fiber rope indicates excessive internal wear.

If any of these conditions are found, the sling is unsafe. It must be discarded.

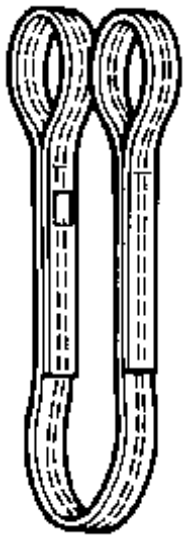
## Synthetic Web Slings

These slings are made of synthetic fibers such as nylon, dacron or kevlar. The threads are woven into a flat web. Synthetic web slings have these properties:

- Strength. Some larger slings can handle loads of up to 300,000 pounds.
- Flexible. They can conform easily to the shape of the load.
- Safety. Because they fit the shape of the load, they are less likely to slip.
- Load protection. They are less likely to scratch the surface of the load.
- Long life. They don't rot or mildew. They have good abrasion resistance.
- Shock absorbance. Synthetics, especially nylon stretch to absorb shocks.

## Discarding Synthetic Web Slings

Discard synthetic web slings if any of the following defects exist:



- Chemical burns, including burns from acids and caustics.
- Melting or charring from excessive heat or friction.
- Snags, punctures, tears, or cuts.
- Broken or worn stitches.
- Damage from excessive exposure to sunlight.
- Distortion of fittings.
- Elongation. (Check the manufacturer's specifications.)

## Before You Rig

Check all of these things before rigging the load:

- Inspection. Inspect the sling prior to use.
- Weight. Determine the weight of the load and how it will be distributed if there is more than one sling.
- Center of Gravity. Determine the center of gravity of the load. Make sure that the load can be rigged with the hook directly above the center of gravity. Otherwise the load will tilt when it is raised.
- Sling Angle. The more vertical the legs of the sling are, the less strain there is on them. The closer they are to horizontal, the more strain they experience. Strain is the same as more weight. As the sling angle gets closer to horizontal, the sling can support less weight.
- Number of Legs. Determine the number of legs the sling or slings will have when the load is rigged.
- Hitches. Determine the type of hitch to use to secure the sling to the load and the sling to the hook.
- Rated Capacity. The manufacturer should supply a chart with the rated capacity of the sling at different angles and with different types of hitches. Use an extra margin of safety with older slings.

## Safe Lifting with Slings

- Slowly take up the load a few inches. Check the balance and load tension.
- Keep other workers clear. Never let anyone go under the load.
- Have only one person in charge and giving signals.
- Don't raise the load higher, or leave it up longer than necessary.
- After the maneuver, check the slings for damage.

**A**. What are four safe work practices for storing materials?

**1**. _____

**2**. _____

**3**. _____

**4**. _____

**B**. What are five safe work practices for using powered industrial trucks?

**1**. _____

**2**. _____

**3**. _____

**4**. _____

**5**. _____

**C**. What is the safe way to lift a load by hand?

_____

_____

_____

_____

_____

_____

REVIEW THIS MODULE: MATERIALS HANDLING



**D**. How do you determine the rated capacity of a sling?

_____

_____

_____

_____

**E**. What are six things to consider before rigging a load with slings?

**1**. _____

**2**. _____

**3**. _____

**4**. _____

**5**. _____

**6**. _____

**F**. What are five safe work practices for lifting a load with slings?

**1**. _____

**2**. _____

**3**. _____

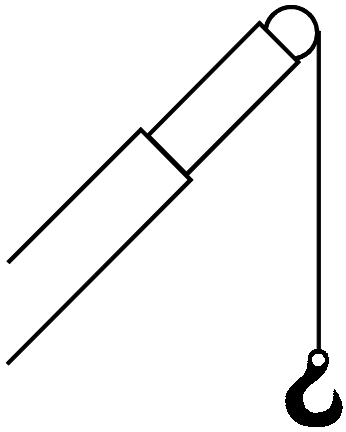
**4**. _____

**5**. _____

# TEAMSTERS Construction Safety & Health Training

*Module 5*

# CRANES, DERRICKS and HOISTS



International Brotherhood of Teamsters — NIEHS Worker Training Grants

## LEARNING OBJECTIVES

✔ **IDENTIFY THE HAZARDS AND THE SAFE WORK PRACTICES FOR CONSTRUCTION CRANES.**

**a**. Identify how to determine the safe capacity of a crane or derrick.

**b**. Identify when cranes and hoists must be inspected and tested.

**c**. Identify when wire rope must be taken out of service on a crane or hoist.

**d**. Identify the conditions in which a personnel platform suspended from a crane or derrick may be used.

**e**. Identify the safe work practices for using a personnel platform suspended from a crane or derrick.

**f**. Identify when a pre-lift meeting is required.

# The OSHA Crane Standard

**"Cranes, Derricks, Hoists, Elevators and Conveyors"** is Subpart N of the OSHA Construction Standards. It has seven sections listed on the next page. In this module we focus on cranes, derricks and hoists.

There are more than 125,000 cranes used in construction in the United States. Approximately 80 workers die in crane related accidents each year. According to OSHA, the major causes of crane accidents include:

- Contact with power lines.
- Overturning.
- Dropped loads.
- Boom collapse.
- Crushed by counterweights.
- Rigging failure.
- Improper use of outriggers.
- Improper use of lifting devices.

Often cranes are not properly maintained and inspected. Many cranes are operated by workers who do not have the necessary qualifications.

# Cranes, Derricks, Hoists, Elevators and Conveyors Subpart N

Cranes and Derricks
29 CFR 1926.550

Overhead Hoists
29 CFR 1926.554

Helicopters
29 CFR 1926.551

Conveyors
29 CFR 1926.555

Material Hoists, Personnel Hoists and Elevators
29 CFR 1926.552

Aerial Lifts
29 CFR 1926.556

Base Mounted Drum Hoists
29 CFR 1926.553

# CRANES AND DERRICKS
## [29 CFR 1926.550]

## General Requirements [29 CFR 1926.550(a)]

**Specifications and Limitations**. Equipment must be operated according to the manufacturer's specifications and limitations. If this information is not available, then an engineer competent in this area must determine the limitations and specifications and record these in writing. Attachments must not exceed the rated load capacity.

**Signals**. Workers must use the appropriate hand signals. A copy of the signals must be posted on the site.

**Pre-Shift Inspections**. A competent person must inspect all machinery and equipment prior to each use to make sure it is in safe operating condition. Any deficiencies must be repaired, or defective parts replaced, before continued use.

**Annual Inspections**. At least once a year a competent person must conduct a thorough inspection of the hoisting machinery. The employer must keep a record of the dates and results of inspections.

**Defective Wire Running Rope**. Wire rope must be taken out of service if any of the following conditions exist in running ropes:

- Six randomly distributed broken wires in one lay.
- Three broken wires in one strand in one lay.
- Wear of one-third the original diameter of outside individual wires.
- Kinking, crushing, bird caging, or distortion of the rope structure.
- Heat damage.
- Reduction in the nominal diameter.

**Defective Wire Standing Rope**. Wire rope must be taken out of service if any of the following conditions exist in standing ropes:

- More than two broken wires in one lay beyond the end connections.
- More than one broken wire at an end connection.

**Modifications**. No modifications or additions which affect the capacity or safe operation of the equipment shall be made without the manufacturer's written approval. If modifications are made, the capacity, operation, and maintenance instruction plates, tags, or decals, shall be changed accordingly. In no case shall the original safety factor of the equipment be reduced.

**Guarding**. Belts, gears, shafts, pulleys, drums, fly wheels, chains, or other moving parts or equipment must be guarded to protect employees from contact.

Accessible areas within the swing radius of the rear of the rotating superstructure of the crane must be barricaded to prevent an employee from being struck or crushed by the crane.

Exhaust pipes must be guarded or insulated in areas where workers might contact them.

**Enclosed Spaces**. If an internal combustion engine exhausts in an enclosed space, then the air must be tested to assure that employees are not exposed to unsafe concentrations of toxic gases or oxygen deficiency. The employer must keep a record of these test results.

**Safety Glass**. Cab windows must be made of safety glass, or equivalent, that introduces no visible distortion that would interfere with the safe operation of the machine.

**Walking Surfaces**. Platforms and walkways shall have anti-skid surfaces.

**Fire Extinguisher**. There must be a fire extinguisher accessible to the cab or operating station. This must be a 5BC rating, or higher.

**Nearby Workers**. Employees must keep clear of loads about to be lifted and clear of suspended loads.

**Electric Power Lines**. Operate cranes near a power line only if:

- The power line is deenergized and visibly grounded; or
- Insulated barriers are in place to prevent contact; or
- Sufficient clearance is maintained as shown in the box below.

| **Required clearance while working**: | |
|---|---|
| 50,000 volts (50kV) or less | 10 feet |
| More than 50,000 volts (50kV) | 10 feet plus 0.4 inch for each 1 kV over 50 kV |
| **Required clearance while moving from one place to another without a load and with the boom lowered** | |
| 50,000 volts (50kV) or less | 4 feet |
| More than 50kV but less than 345 kV | 10 feet |
| More than 345 kV up to 750 kV | 16 feet |

If it is difficult for the operator to see the power line, then there must be a person designated to watch the clearance and to warn the operator.

Any overhead wire shall be considered to be an energized line until the person owning the line or the electrical utility authorities state that it is not energized line and it has been visibly grounded

## Hammerhead Tower Cranes [29 CFR 1926.550(c)]

**Clearance for Employees**. There must be clearance between the moving or rotating parts and fixed objects to allow the passage of employees without harm.

**Work On the Boom**. If an employee must work on the horizontal boom of a tower crane, then the boom must have a guardrails or a personal fall arrest system. This equipment is described more fully in the Fall Protection module.

# Personnel Platforms
## [29 CFR 1926.550(g)]

Using cranes or derricks to hoist personnel can be very dangerous.

**No Safe Alternative. The** OSHA standard prohibits hoisting personnel by crane or derrick except when no safe alternative is possible. Using a crane or derrick to hoist people is only allowed if conventional means of transporting employees (for example, ladders or personnel hoists) are not feasible or unless they present greater hazards.

**On the Level**. A crane or derrick used to lift people must rest on a horizontal surface that is within 1 percent of a level grade.

**Operation**. The operator must always be at the controls when the crane engine is running and the personnel platform is occupied.

Any movement of the personnel platform must be performed slowly and cautiously without any sudden jerking.

When the platform is in a stationary position, all brakes and locking devices on the crane or derrick must be set.

**Wire Rope**. The wire rope used for personnel lifting must have a safety factor of at least seven. This means that it can support seven times the maximum intended load. If rotation resistant rope is used, it must have a safety factor of at least ten.

**Crane Capacity**. The combined weight of the loaded personnel platform and its rigging must not exceed 50 percent of the rated capacity of the crane or derrick for the radius and configuration.

**Instruments and Components**. If there is a variable angle boom, then there must be a boom angle indicator that is visible to the operator. Cranes with telescoping booms must have a device to clearly indicate the boom's extended length, or an accurate determination of the load radius to be used during the lift must be made prior to hoisting personnel.

Cranes and derricks also must be equipped with an anti-two-block device.

**Personnel Platforms**. A platform used for lifting personnel must be designed by a qualified engineer or a qualified person competent in structural design. The platform must have a safety factor of at least five. The suspension system must be designed to minimize tipping due to personnel movement on the platform.

The platform must have a standard guardrail system that is enclosed from the toeboard to the mid-rail to keep tools, materials, and equipment from falling on employees below.

The platform also must have an inside grab rail, adequate headroom for employees, and a plate or other permanent marking that clearly indicates the platform's weight and rated load capacity.

If personnel might be exposed to falling objects, overhead protection on the platform and the use of hard hats are required.

The access gate must have a restraining device to prevent accidental opening.

All welding on the personnel platform and its components must be performed by a qualified welder who is familiar with weld grades, types, and materials specified in the platform design.

**Loading**. The personnel platform must not be loaded in excess of its rated load capacity or its maximum intended load.

Only personnel instructed in the requirements of this standard and the task to be performed — along with their tools, equipment, and materials needed for the job — are allowed on the platform.

Materials and tools must be secured and evenly distributed to balance the load while the platform is in motion.

**Rigging**. Bridles and associated rigging for attaching the personnel platform to the hoist line must not be used for any other purpose.

Hooks must be closed and locked, or a shackle with bolt, nut, and retaining pin may be used. "Mousing" (wrapping wire around a hook to cover the hook opening) is not permitted in place of a locking hook.

**Inspecting and Testing**. A trial lift of the unoccupied personnel platform must be made before any employees are hoisted. During the trial lift, the personnel platform must be loaded at least to its anticipated lift weight.

The lift must start at ground level or at the location where employees will enter the platform and proceed to each location where the personnel platform is to be hoisted and positioned. The trial lift must be performed immediately prior to placing personnel on the platform.

The operator must check all systems, controls, and safety devices to ensure the following:

- They are functioning properly.
- There are no interferences.
- All boom or hoisting configurations necessary to reach work locations will allow the operator to remain within the 50 percent load limit of the hoist's rated capacity.

If a crane or derrick is moved to a new location or returned to a previously used one, the trial lift must be repeated before hoisting personnel.

After the trial lift, the personnel platform must be hoisted a few inches and inspected to ensure that it remains secured and is properly balanced. A thorough visual inspection of the crane, the personnel platform, and the base support or ground must be conducted by a competent person to determine if the trial lift exposed any defects or produced any adverse effects. Any defects found during inspections must be corrected before hoisting personnel.

Before employees are hoisted, a check must be made to ensure the following:

- Hoist ropes are free of kinks.
- Multiple part lines are not twisted around each other.
- The primary attachment is centered over the platform.
- There is no slack in the wire rope.
- All ropes are properly seated on drums and in sheaves.

**Pre-Lift Meeting**. The employer must hold a pre-lift meeting with all workers involved (operator, signal person(s), foreman, and the workers to be lifted) to review the procedures. This meeting must be held before the trial lift at each new work site and must be repeated for any new employees in the operation.

**Safe Work Practices**. Employees must follow these safe work practices:

- Use tag lines unless their use creates an unsafe condition.
- Keep all parts of the body inside the platform.
- Make sure a platform is secured to the structure where work is to be performed before entering or exiting.
- Wear a body harness with a lanyard. Attach the lanyard to the lower load block or overhaul ball, or to a structural part of the platform.
- Stay in view, or in direct communication with the operator or signal person.

Crane and derrick operators must follow these safe work practices:

- Never leave the controls with the engine running or the platform occupied.
- Don't operate if there are indications of dangerous weather conditions.
- Do not make any lifts on another load line of a crane or derrick that is being used to hoist personnel.

**Moving the Crane**. Personnel hoisting is prohibited while the crane is traveling except when the employer demonstrates that this is the least hazardous way to accomplish the task, or when portal, tower, or locomotive cranes are used.

- Travel must be restricted to a fixed track or runway.
- Travel must be limited to the radius of the boom during the lift.
- The boom must be parallel to the direction of travel.
- There must be a complete trial run before workers occupy the platform.
- If the crane has rubber tires, the condition and air pressure tires must be checked.

# Hoists
## [29 CFR 1926.552]

## General Requirements

**Limitations and Capacities**: The employer must comply with the manufacturer's specifications and limitations. If these are not available, then a professional engineer, competent in the field, must determine the limitations and specifications in writing.

The rated load capacities, operating speeds and special hazard warnings must be posted on cars and platforms.

**Wire Rope**. Wire rope must be taken out of service if any of the following conditions exist in hoisting ropes:

- Six randomly distributed broken wires in one lay.
- Three broken wires in one strand in one lay.
- Wear of one-third the original diameter of outside individual wires.
- Kinking, crushing, bird caging, or distortion of the rope structure.
- Heat damage (for example from contact with a cutting torch or arc).
- Reduction in the nominal diameter.

### Material Hoists

**Postings**. Operating rules, including signals and line speeds must be posted at the operator's station.

**Not for Personnel**. No person shall be allowed to ride on material hoists except for the purposes of inspection and maintenance.

**Entrances**. The entrances to the hoistways must have substantial gates or bars across the full width of the entrance. Bars and gates must be painted with diagonal contrasting colors, such as black and yellow stripes.

The entrance bars must be at least 2- by 4-inch wooden bars or the equivalent, located 2 feet from the hoistway line. They must be located between 36 inches and 42 inches above the floor.

Gates or bars at entrances must have a latching device.

**Overhead Protective Covering**. There must be 2-inch planking, ¾-inch plywood, or other solid material on the top of a material hoist cage or platform.

The operator's station must have overhead protection equivalent to tight planking at least 2 inches thick.

**Hoist Towers**. The tower may be enclosed, or not enclosed, as follows:

An enclosed tower must be enclosed on all sides for its entire height with a screen enclosure of ½-inch mesh wire, except for landing access.

When a hoist tower is not enclosed, the hoist platform or car must be totally enclosed (caged) on all sides for the full height between the floor and the overhead protective covering with ½-inch mesh wire or equivalent.

**Car Arresting Devices. There** must be car arresting devices in case the rope fails.

**Design**. Material hoist towers must be designed by a licensed professional engineer.

**Booms**. The installation of live booms on hoists is prohibited.

## Personnel Hoists

**Endless Belt Hoists**. The use of endless belt manlifts is prohibited.

**Enclosure**. Hoist towers outside the structure must be enclosed for the full height on the side or sides used for entrance and exit.

At the lowest landing, the sides not used for exit or entrance must also be enclosed to height of at least 10 feet. Other sides of the tower adjacent to floors or scaffold platforms must be enclosed to a height of 10 feet above the level of such floors or scaffolds.

Towers inside of structures must be enclosed on all four sides throughout the full height.

**Anchoring**. Towers must be anchored to the structure at least once every 25 feet. In addition, there must be a system of guy wires of at least one-half inch in diameter wire rope.

**Doors and Gates**. Doors and gates must be at least 6 feet 6 inches high and must have mechanical locks which cannot be operated from the landing side.

Doors or gates must have electric contacts which prevent movement of the hoist when door or gate is open.

**Cars**. Cars must be permanently enclosed on all sides and the top, except for the entrance and exit which have gates or doors.

The car must have a data plate in a conspicuous place showing its capacity.

**Overhead Protective Covering**. There must be 2-inch planking, ¾-inch plywood or other solid material on the top of every personnel hoist.

**Car Arresting Devices**. There must be car arresting devices capable of stopping and holding the car at the rated load.

**Emergency Stop Switch**. There must be an emergency stop switch in the car.

**Hoisting Ropes**. There must be at least three hoisting ropes for traction hoists and two for drum-type hoists. The minimum diameter of hoisting and counterweight wire ropes is ½-inch wire rope.

**Inspections and Tests**. After assembly of the hoist, and before being put in service, there must be an inspection and test of all functions and safety devices under the supervision of a competent person. A similar inspection and test is required following major alteration of an existing installation.

Personnel hoists must be inspected and tested at least once every 3 months. The employer must prepare a written certificate showing who did the test, and when. The most recent certification record must be kept on file.

# Aerial Lifts
## [29 CFR 1926.556]

**Lift controls**. Test lift controls each day prior to use.

**Authorized Operators**. Only authorized persons can operate an aerial lift.

**Body Belts**. A worker in an aerial lift must have a body belt or harness with a lanyard attached to the boom or basket. Never belt off to an adjacent pole or structure.

**Stance**. Stand firmly on the floor of the basket. Never sit or climb on the edge of the basket or use planks, ladders, or other devices for a work position.

**Load Limits**. Never exceed the boom and basket load limits specified by the manufacturer .

**Brakes and Chocks**. Set the brakes and place wheel chocks.

If outriggers are used, position them on pads or on a solid surface.

**Movement**. Never move an aerial lift truck with the boom elevated and a worker in the basket, except when the equipment is specifically designed for this type of operation.

**Controls**. There must be a lower set of controls (at the truck body) and an upper set (at the platform or basket). Lower controls must provide for overriding the upper controls. Controls must be plainly marked as to their function.

Never operate the lower level controls without permission from the employee in the lift, except in case of emergency.

**Insulation**. The insulated portion of an aerial lift shall not be altered in any manner that might reduce its insulating value.

**A**. How do you determine the safe capacity of a crane or derrick?

**B**. When must cranes and derricks be inspected and tested?

**C**. When must wire rope be taken out of service?

REVIEW THIS MODULE: CRANES, DERRICKS & HOISTS

**D**. Under what conditions may workers be lifted in a personnel platform suspended from a crane or derrick?

**E**. What are five safe work practices for using a personnel platform suspended from a crane or derrick?

**F**. When is a pre-lift meeting required?

# TEAMSTERS Construction Safety & Health Training

## *Module 6*

# MOTOR VEHICLES

International Brotherhood of Teamsters — NIEHS Worker Training Grants

## LEARNING OBJECTIVES

✔ **IDENTIFY THE SAFE OPERATING PRACTICES FOR VEHICLES AND HEAVY EQUIPMENT USED ON A CONSTRUCTION SITE.**

- **a**. Identify when rollover protective structures (ROPS) are required.
- **b**. Identify when a back-up alarm is required.
- **c**. Identify the safety precautions required when working on split rim tires.
- **d**. Identify the safety requirements for working under raised equipment.
- **e**. Identify the parts and systems that must be inspected during a pre-shift safety check.
- **f**. Identify three types of braking systems required on construction vehicles.

# Motor Vehicles

"**Motor Vehicles, Mechanized Equipment and Marine Operations**" is Subpart O of the OSHA Construction Standards. It has seven sections as shown on the next page.

In this module we will discuss the requirements of sections 600, 601, 602 and 604 with respect to motor vehicles and mechanized equipment that are used at construction sites on land.

**Powered Industrial Trucks**: This module includes a brief discussion of the safe operation of powered industrial trucks (forklifts, etc.). OSHA recently adopted a new standard which requires special training for workers who operate powered industrial trucks. The new standard is 29 CFR 1910.178(l). This module by itself does not fulfill the new OSHA training requirements. In order to meet the new requirements, operators must have hands-on training on the specific types of industrial trucks they will operate.

# Motor Vehicles, Mechanized Equipment and Marine Operations 29 CFR 1926 Subpart O

Equipment
29 CFR 1926.600

Site Clearing
29 CFR 1926.604

Motor Vehicles
29 CFR 1926.601

Marine Operations and Equipment
29 CFR 1926.605

Material Handling Equipment
29 CFR 1926.602

Definitions Applicable to this Subpart
29 CFR 1926.606

Pile Driving Equipment
29 CFR 1926.603

# Equipment — General Requirements
## [29 CFR 1926.600]

**Parking**. If heavy equipment is left at night adjacent to a highway that is in normal use, then there must be lights or reflectors on the equipment or on a barricade.

Whenever equipment is parked, set the parking brake shall be set. If it's on a hill, you must also use chock blocks.

**Split Rims**. If you work on split tires that mount on split rims, you must use a safety cage. This includes inflating, mounting, or dismounting tires installed on split rims.

**Raised Equipment**. If a piece of heavy machinery is jacked up, or suspended by slings, it must also have blocks or cribbing before anyone works underneath.

If repair work is done on bulldozer or scraper blades, end-loader buckets, dump bodies, or similar equipment, fully lower the equipment, or support it with blocks. Set all controls in neutral.

**Charging Batteries**. Be careful when charging batteries. The hydrogen gas which they make when charging can explode. Also, the electrolyte can burn you or cause blindness. Follow the safe work practices specified in the OSHA Electrical Standard. [See 29 CFR 1926.441.]

**Windows**. All glass used in the windows of cabs must be safety glass.

**Power Lines**. If there are power lines near where you are using mechanized equipment, you must maintain a safe clearance distance. The OSHA Crane Standard lists the required safe distances, which depend on the voltage of the power line. [See 29 CFR 1926.550(a)(15).]

**Railroad Cars**. If there is a railroad track on the site, use derailers or bumper blocks to assure that railroad cars cannot accidently roll.

# Motor Vehicles
## [29 CFR 1926.601]

This section applies to motor vehicles that operate on an off-highway jobsite, not open to public traffic.

**Brakes**. All vehicles must have three properly working brake systems. These systems may use common components. The three braking systems are:

- Service brake system.
- Emergency brake system.
- Parking brake system.

**Lights**. Vehicles that operate at night, or where there is diminished light, must have at least two headlights and two taillights in good working order.

All vehicles must have brake lights in operable condition regardless of light conditions.

**Horn**. All vehicles must be equipped with an audible warning device (horn).

**Backing**. No employer shall use any motor vehicle having an obstructed view to the rear unless the vehicle:

- Has a reverse signal alarm audible above the surrounding noise; or
- Is backed up only when an observer signals that it is safe to do so.

**Windshields**. Vehicle cabs must have windshields and powered wipers. Cracked or broken glass must be replaced promptly. Except in dry areas where condensation does not occur, windshields must also have defrosters.

**Falling Materials**. If a vehicle is loaded by crane, powered shovel or loader, then there must be a canopy or shield that is strong enough to protect the operator from shifting or falling materials.

**Carrying Passengers**. Vehicles used to transport employees must have a firmly secured seat for each passenger. They must also have seatbelts.

**Dump Bodies**. Trucks with dump bodies must have a positive means of support, permanently attached, and capable of being locked in position to prevent accidental lowering of the body while maintenance or inspection work is being done. The levers controlling the dump body must have a latch to prevent accidental starting or tripping. The trip handle must be placed so that the operator is in the clear.

**Fenders**. Vehicles with rubber tires must have fenders. Mud flaps may be used in lieu of fenders if the vehicle is not designed for fenders.

**Pre-Shift Safety Checks**. All vehicles in use must be checked at the beginning of each shift to assure that the following parts are in safe operating condition and free of apparent damage that could cause failure while in use:

- Service brakes and connections
- Parking brakes
- Emergency brakes
- Tires
- Horn
- Steering
- Coupling devices
- Seat belts
- Operating Controls
- Safety devices

All defects must be corrected before the vehicle is placed in service.

## Site Clearing
### [29 CFR 1926.604]

Workers engaged in site clearing must be protected from irritant and toxic plants and instructed in the available first aid treatment.

Vehicles used in site clearing must have rollover protective structures (ROPS).

# Material handling equipment
## [29 CFR 1926.602]

This section applies to earth moving equipment, including earthmoving equipment: scrapers, loaders, crawler or wheel tractors, bulldozers, off-highway trucks, graders, agricultural and industrial tractors, and similar equipment.

**Seat belts**. All equipment covered by this section must have seat belts. *Exception*: If the equipment is designed only for standup operation, seat belts are not required.

**Brakes**. All earthmoving equipment must have a service braking system capable of stopping and holding the equipment fully loaded.

**Fenders**. Earthmoving equipment that can go 15 mph and that has pneumatic tires, must have fenders.

**Rollover protective structures (ROPS)**. Many types of earth moving equipment must have rollover protection. This is covered specifically in Subpart W of the OSHA Construction Standards.

**Audible alarms**. Bidirectional machines, such as rollers, compactors, front-end loaders, and bulldozers must have a horn, loader than the surrounding noise.

**Backing**. No employer shall permit equipment to be backed unless it:

- Has a reverse signal alarm audible above the surrounding noise; or
- Is backed up only when an observer signals that it is safe to do so.

**Scissor points**. Scissor points on front-end loaders that create a hazard to the operator during normal operation must have a guard.

# Powered Industrial Trucks
## [29 CFR 1926.602(c)]

**Rated Capacity**. Lift trucks, stackers, etc., must have the rated capacity clearly posted on the vehicle  These ratings shall not be exceeded.

No modifications or additions that affect the capacity or safe operation of the equipment shall be made without the manufacturer's written approval. In no case shall the original safety factor of the equipment be reduced.

If a load is lifted by two or more trucks working together, the proportion of the total load carried by any one truck shall not exceed its capacity.

**Spinner Knobs**.  Steering or spinner must  not be used unless the steering mechanism is designed to safely use a knob. Check with the manufacturer to make sure.

**Passengers**. No unauthorized personnel may ride on powered industrial trucks. A safe place to ride shall be provided where riding of trucks is authorized.

**Lifting Personnel**. If a truck is equipped with a platform for lifting personnel then the platform must have:

- Controls that allow the workers on the platform to shut off the truck.
- Protection from falling objects.

**Training**. OSHA recently adopted a new standard which requires special training for workers who operate powered industrial trucks. The new standard is 29 CFR 1910.178(l). This module by itself does not fulfill the new OSHA training requirements. In order to meet those new requirements, operators must have hands-on training on the specific types of industrial trucks they will operate. This module, by itself, does not satisfy the new training requirements.

# Vehicle Decontamination

Vehicles that are contaminated with hazardous chemicals (for example, trucks used at hazardous waste cleanup sites) must be decontaminated before leaving the site. Here are some basic principles of vehicle decontamination:

- Keep vehicles and heavy equipment from getting contaminated in the first place. Don't drive through spills or contaminated areas.
- If vehicles must be used near contaminated areas, consider covering the wheels, and other exposed parts with tape and plastic sheeting.
- Have sturdy platforms or other means to safely get at all parts without having to climb on the vehicle.
- Decon workers must have the right protective clothing, respirators and eye protection.
- Be careful when using pressurized sprayers.
- Use decon solutions that are compatible with the chemicals involved, and with the vehicle's paint.
- Provide a means to collect runoff water.
- Usually start at the top and work down.
- Use long handled brushes to get at all parts .
- Pay special attention to the under carriage and other parts where contamination might not be noticed.
- Plan a method to determine that decon is complete. This may include taking surface wipe samples.
- Properly treat and dispose of all waste water.

# A Review of Vehicle Safety

- Inspect all equipment before use.
- Do regular inspection and maintenance as scheduled.
- Follow the site's traffic management plan.
- Stay on equipment until it stops.
- Use roll over protection (roll bars, etc.).
- Use cab shields or protective canopies on equipment loaded by crane, power shovel or loader.
- Use extreme caution on slopes or near excavations.
- Use a safety tire rack to work on tires with split or locking-ring rims.
- Block wheels and set brakes on parked vehicles.
- Beware of rotating equipment — watch for loose clothing.
- Listen for backup alarms.
- Be seen — wear an orange vest.

**A**. When are rollover protective structures (ROPS) are required?

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**B**. When are back-up alarms required?

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**C**. What are the safety precautions required when working on split rim tires?

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**D**. What are the three types of braking systems required on construction vehicles?

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REVIEW THIS MODULE: MOTOR VEHICLES



**E**. What are the safety requirements for working under raised equipment?

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**F**. List the parts and systems that must be inspected during a pre-shift vehicle safety check.

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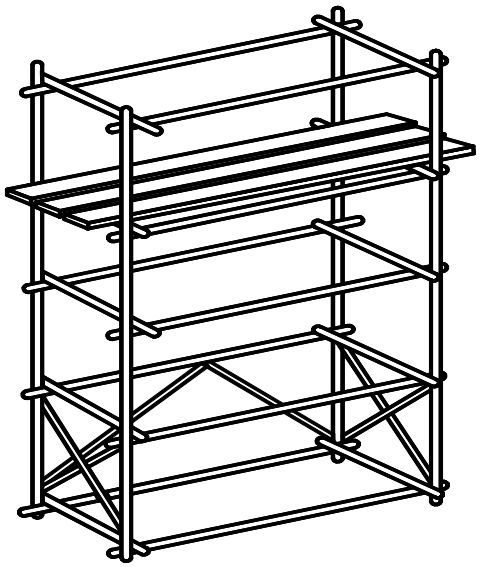
# TEAMSTERS
# Construction
# Safety & Health Training

## *Module 7*
# SCAFFOLDING



International Brotherhood of Teamsters — NIEHS Worker Training Grants

**LEARNING OBJECTIVES**

✔ **IDENTIFY THE PROPER SAFE WORK PRACTICES FOR USING SCAFFOLDS.**

**a**. Identify the work activities to which the OSHA Scaffolding Standard applies.

**b**. Identify the general requirements for scaffold capacity, platforms, access and use.

**c**. Identify the requirements for fall protection from scaffolds.

**d**. Identify the requirements for protection from objects falling from scaffolds.

## The OSHA Scaffolding Standard

Scaffolding is Subpart L of the OSHA Construction Standards. It contains five sections and five appendices:

- **Scope, Application and Definition.**
- **General Requirements**.
- **Additional Requirements for Specific Types of Scaffold**.
- **Aerial Lift.**
- **Training Requirement**.
- **Five Appendices**.

Each appendix contains information to assist employers and employees to comply with the Standard. The information in each appendix is "non-mandatory." This means that the employer is not required to do exactly what's in the appendix. The appendix has methods that work, but the employer can use other methods as long as they comply with the standard.

# The Scaffolding Standard 29 CFR 1926 Subpart L

**Scope, Application and Definitions**
29 CFR 1926.450

- (a) Scope and Application
- (b) Definitions

**General Requirements**
29 CFR 1926.451

- (a) Capacity
- (b) Platform Construction
- (c) Supported Scaffolds
- (d) Suspended Scaffolds
- (e) Access
- (f) Use
- (g) Fall Protection
- (h) Falling Object Protection

**Additional Requirements for Specific Types of Scaffolds**
29 CFR 1926.452

- (a) Pole scaffolds
- (b) Tube and coupler scaffolds
- (c) Fabricated frame scaffolds (welded)
- (d) Plasterers' scaffolds
- (e) Bricklayers' scaffolds
- (f) Horse scaffolds
- (g) Form scaffolds and carpenters' brackets
- (h) Roof bracket scaffolds
- (i) Outrigger scaffolds
- (j) Pump jack scaffolds
- (k) Ladder jack scaffolds
- (l) Window jack scaffolds
- (m) Crawling boards (chicken ladders)
- (n) Step, platform, and trestle ladder scaffolds
- (o) Single-point adjustable suspension scaffolds.
- (p) Two-point adjustable suspension scaffolds
- (q) Multi-point adjustable suspension scaffolds
- (r) Catenary scaffolds
- (s) Float (ship) scaffolds
- (t) Interior hung scaffolds
- (u) Needle beam scaffolds
- (v) Multi-level suspended
- (w) Mobile scaffolds
- (x) Repair bracket scaffolds
- (y) Stilts

**Aerial Lifts**
29 CFR 1926.453

- (a) General Requirements
- (b) Specific Requirements

**Training Requirements**
29 CFR 1926.454

- (a) Employees who work on scaffolds
- (b) Employees who assemble, maintain or dismantle scaffolds.
- (c) Retraining

**Five Appendices**

- A Scaffold Specifications
- B Guardrail Systems
- C Determining the Feasibility of Providing Safe Access and Fall Protection for Scaffold Erectors and Dismantlers
- D Training Topics for Scaffold Erectors and Dismantlers
- E Drawings and Illustrations


# Scaffold Are Hazardous

OSHA estimates that there are almost 10,000 accidents each year involving scaffolds, and approximately 80 worker deaths.

The Federal Bureau of Labor Statistics studied reports of scaffold accidents and found out that:

- Most scaffold injuries resulted from:
  - the employee slipping.
  - the employee getting hit by a falling object.
  - the planking or support giving way.
- One out of four injured workers had no training about scaffold safety. Most of the rest only had informal on-the-job safety training.
- Only one out of three scaffolds where an accident occurred had a guard rail.

# In This Module...

The Standard provides detailed requirements for 25 different types of scaffold. (Look back at items **a** through **y** in the middle of the previous page.) In this module we will discuss the following items:

- General requirements.
- Common types of supported scaffolds:
  - Wooden pole scaffolds.
  - Tube and coupler scaffolds.
  - Tubular welded frame scaffolds.
  - Manually propelled mobile scaffolds.
  - Pump jack scaffolds.
  - Form scaffolds.
- Training requirements.

# Scope, Application and Definitions
**[29 CFR 1026.450]**

## Scope and Application [29 CFR 1026.450(a)]

The OSHA Scaffolding Standard applies to all scaffolds used in

- Construction
- Demolition
- Alteration
- Repair (Includes Painting and Decorating)

***Exception:*** Personnel platforms that hang from a crane or derrick are covered under the OSHA Crane and Derrick Standard.)

## Definitions [29 CFR 1026.450(b)]

OSHA lists definitions for all important terms used in the Standard. Especially important are the definitions of each type of scaffold. The definitions specify whether a particular scaffold is a "supported" or a "suspension scaffold." This distinction is important since there are special safety rules for each type. In this Module we discuss some common types of supported scaffold.

# General Requirements
**[29 CFR 1026.451]**

## Capacity [29 CFR 1026.451(a)]

A qualified person shall design every scaffold.

A scaffold shall be constructed and loaded to comply with its design.

Every scaffold and scaffold component must be able to support, without failure, its own weight and at least 4 times the maximum intended load.

## Scaffold Platform Construction [29 CFR 1026.451(b)]

All platforms shall be fully decked or planked.

***Exceptions:*** (1) Walkways only have to be two planks wide (18 inches).

(2) Platforms that are only used by workers to erect or dismantle a scaffold only have to be as wide as the employer determines is necessary to provide safe working conditions.

The planks or units that make up the platform shall be close together: There shall be no more than 1 inch between the planks.

***Exception:*** There can be a greater space only if it's necessary. For example, if side brackets are used, then the scaffold uprights (which are bigger than 1 inch) are between the main part of the platform and the plank on the side brackets.

If the platform consists of separate planks, each plank shall be at least a nominal 2 inches thick by 10 inches wide. (This is about 1½ by 9½ inches.)

There shall be no more than 9½ inches between the platform units and the uprights. If there is more than this space, then put in another plank.

Platforms must be at least 12 inches wide on ladder scaffolds, pump jack scaffolds and top plate bracket scaffolds.

There shall be no more than 14 inches between the platform edge and the face of the structure, unless there is a guard rail system or personal fall arrest system.

The front edge of an outrigger scaffold shall be no more than 3 inches from the face of the structure. The front edge of a scaffold used for plastering and lathing shall be no more than 18 inches from the face of the structure.

If the platform unit is 10 feet long or less, it must stick out past its support at least 6 inches, but not more than 12 inches.

If the platform unit is more than 10 feet long, it must stick out past its support at least 6 inches, but not more than 18 inches.

Planks do not have to overhang if they are securely fastened to their support.

If platforms are abutted, the butt shall rest on a separate support surface.

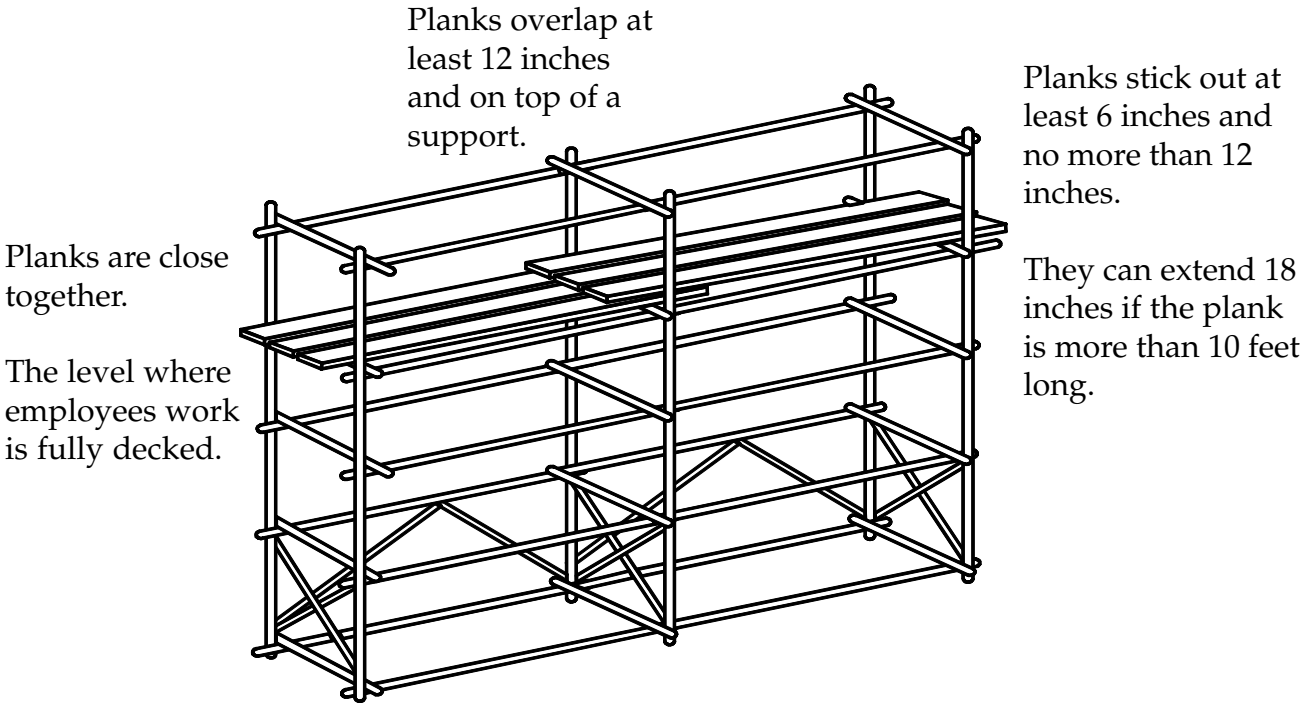
Overlap platforms only on a support. There shall be at least 12 inches of overlap.

Where a scaffold turns a corner, lay the planks that are on an angle first. Then lay the lengthwise planks on top.

Never paint the top and bottom surface of a wood platform. The idea is to be able to see cracks and defects in the wood. The surface may be treated with a clear preservative and the ends may be painted.

Never mix components manufactured by different manufacturers unless the parts fit together without force.

Only modify parts to fit if a competent person determines that the change is structually sound.



## Criteria for Supported Scaffolds [29 CFR 1026.451(c)]

Make sure that the scaffold can't tip over: If its more than 4 times taller than it is wide (at the base), then the scaffold must be tied to the structure, or braced, or have guy wires so that it can't tip.

If the work platform sticks out in a way that makes the scaffold unbalanced, then there must also be ties, braces or guy wires.

The poles or legs must be plumb, and must rest on base plates or some other firm foundation that is level, rigid and strong enough to support the scaffold, workers and equipment.

Forklifts are not generally designed to support scaffolds. However, a forklift can be used to support a work platform if the platform is attached to the forks (not just resting on them) and the fork truck is not moved sideways while the platform is occupied.

## Access [29 CFR 1026.451(e)]

How do you get to the work platform? There must be a ladder, stairs or ramp if the platform is more than 2 feet above (or below) the access point. "Access point" means the place where you are before you go to the work platform. The access point might be the ground, or it could be another work platform.

Cross braces don't count as a ladder and must not be used for access.

The ladder, stairs or ramp must be strong and secure. It may be an integral part of the scaffold. It should not cause the scaffold to tip.

If a ramp has a rise to run ratio greater than 1 to 8, then it must have cleats to help prevent workers from slipping. No ramp shall be steeper than 1 to 3.

How do you get up and down a scaffold while you are erecting it or taking it down? OSHA says that a competent person shall determine how workers who are erecting or dismantling a scaffold will gain access.

## **Use** [29 CFR 1026.451(f)]

A competent person shall supervise the erection, moving, dismantling or altering of any scaffold. The competent person shall select experienced and trained employees to do this work.

A competent person must inspect each scaffold prior to each work shift.

The competent person must also inspect the scaffold after any occurrence that might have affected the scaffold's structural integrity.

A scaffold shall not be loaded in excess of its capacity.

Never move a scaffold with workers on it, unless the scaffold has been designed by a registered professional engineer specifically to be moved while occupied.

Keep the scaffold clear of electric power lines:

- At least 3 feet away from an insulated line under 300 volts.
- At least 10 feet away from an insulated line over 300 volts.
- At least 10 feet away from any un-insulated line.

No work is allowed on a scaffold covered with snow or ice until it is removed.

No work is allowed on a scaffold during high winds unless a competent person determines that it is safe to work.

Never stand on a box or other makeshift item to reach higher from the platform.

The planks must not deflect more than $1/60$ of their length. This means that the greatest deflection allowed in a 10 foot long plank is 2 inches. If it bends more than this, replace it with a stronger plank.

You are not allowed to use a "shore" or "lean-to" scaffold. This is a scaffold which is placed against a building or structure and held in place with props.


## Fall Protection [29 CFR 1026.451(g)]

**The 10 Foot Threshold**: There must be fall protection for workers on a scaffold where the work platform is more than 10 feet up. **This is different than the 6 foot requirement for other walking and working surfaces in the OSHA Fall Protection Standard**. OSHA says that this is because:

> *Scaffolds are temporary structures.... The same features that make scaffolds appropriate for short-term use in construction, (such as ease of erection and dismantling) also make them less amenable to the use of fall protection at the time the first level is being erected.*

**Guardrails**: Wood pole scaffolds, tube & connector scaffolds, and welded frame scaffolds shall all have guardrails on all sides. Guardrails shall be made of 2x4's or an equivalent material, and shall be approximately 42 inches above the work platform (38 to 45 inches).

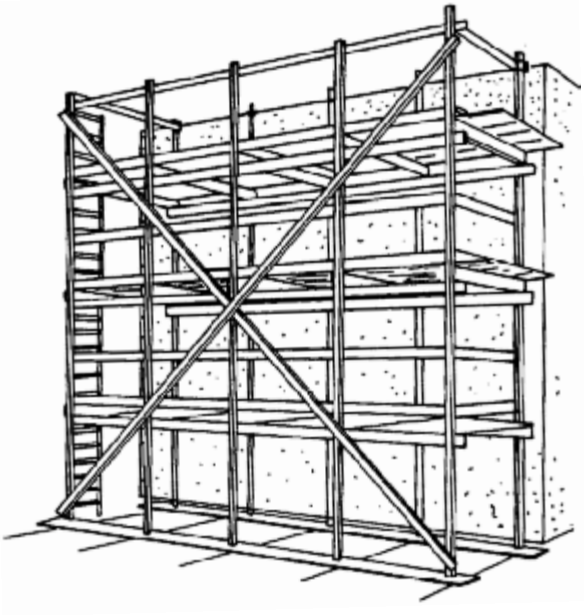
***Exceptions:*** For employees doing overhand bricklaying, it is not required to have a guardrail on the side facing the work.

A walkway that is used to get from one scaffold platform to another (and is not used for working) only needs a guardrail on one side.

Guardrails must not have splinters, nails or other hazards.

**Erecting and dismantling**: It might be hard to figure out how to have fall protection for workers who erect or dismantle scaffolding. Often a personal fall arrest system (for example, a life line and lanyard) will work.

OSHA says that the employer must figure out how to provide fall protection for workers who erect or dismantle a scaffold, if possible. There must be a valid reason if the employer decides not provide fall protection to these workers.



**Wood Pole Scaffold**

## Falling Object Protection [29 CFR 1026.451(h)]

**Hardhats**: Employees who work on or around scaffolds shall wear hard hats.

**Toeboards**: The scaffold must have toeboards or some other means to prevent tools, materials and debris from falling on workers below. Alternatives to toeboards include screens, debris nets, catch platforms and canopies.

Toeboards shall be at least 3½ inches tall and allow no more than a ¼ inch space between the toeboard and the work surface.

If an object on the scaffold is too big or heavy for the toe board to keep it from falling off, then it must be kept away from the edge and secured if possible.

**Barricades**: The employer can put up barricades to keep workers from areas where falling objects might land.

# Specific Types of Scaffolds
### [29 CFR 1026.452]

## Wood Pole Scaffolds [29 CFR 1026.452(a)]

The general requirements discussed earlier apply to these scaffolds.

The poles which hold up the scaffold shall be plumb and shall rest on a firm foundation or base plate.

If the poles are spliced, they shall be cut square and the upper section shall rest directly on the lower section. There shall be splice plates on at least two adjacent sides. The plates shall extend at least 2 feet in either direction from the splice.

There shall be adequate diagonal and cross bracing.

Never splice ledgers (the long, horizontal pieces) between poles.

A wood pole scaffold taller than 60 feet must be designed only by a registered professional engineer.

## Tube and Coupler Scaffolds [29 CFR 1026.452(b)]

**Tubing**: Posts, bearers, runners and bracing must be 2 inch O.D. steel tubing.

**Maximum Post Spacing**:

| | Light Duty | Medium Duty | Heavy Duty |
|---|---|---|---|
| **Front to Back**: | 6 feet | 5 feet * | 6 feet |
| **Along the Length**: | 10 feet | 8 feet | 6 feet six inches |
| (*May be 6 feet front to back if bearers are 2½ O.D.) | | | |

**Posts**: Posts must be accurately spaced, plumb, and rest on suitable bases.

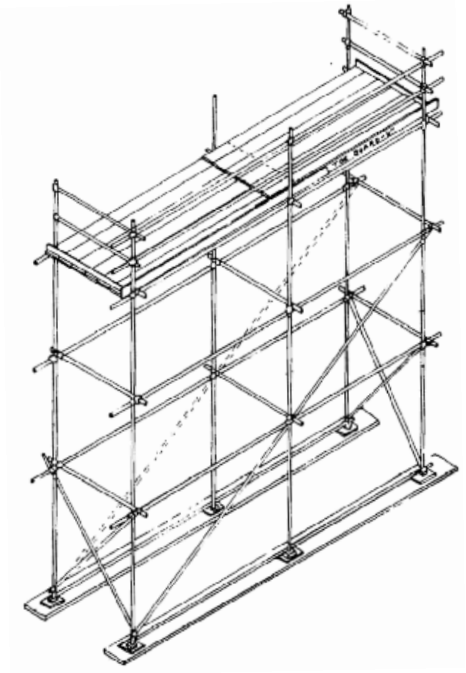
**Runners**: Runners must be coupled to each post. Bottom runners must be as close to the base as possible.

**Bearers**: Bearers must be coupled to the posts, or to the runners as close as possible to the posts. Bearers must be between 4 inches and 12 inches longer than the post spacing or runner spacing.

**Cross Bracing**: Place across the width of the scaffold at least every third set of posts horizontally and every fourth runner vertically.

**Longitudinal Diagonal Bracing**: Place on approximately a 45 degree angle . Run from the base to the extreme top. Brace both the inner and outer rows of posts in both directions. Repeat every fifth set of posts. (The illustration only shows the longitudinal diagonal bracing in one direction.)

**Attachment to the Building**: Brace and tie the scaffold securely to the building at least every 30 feet horizontally and 26 feet vertically.



**Tube and Coupler Scaffold**

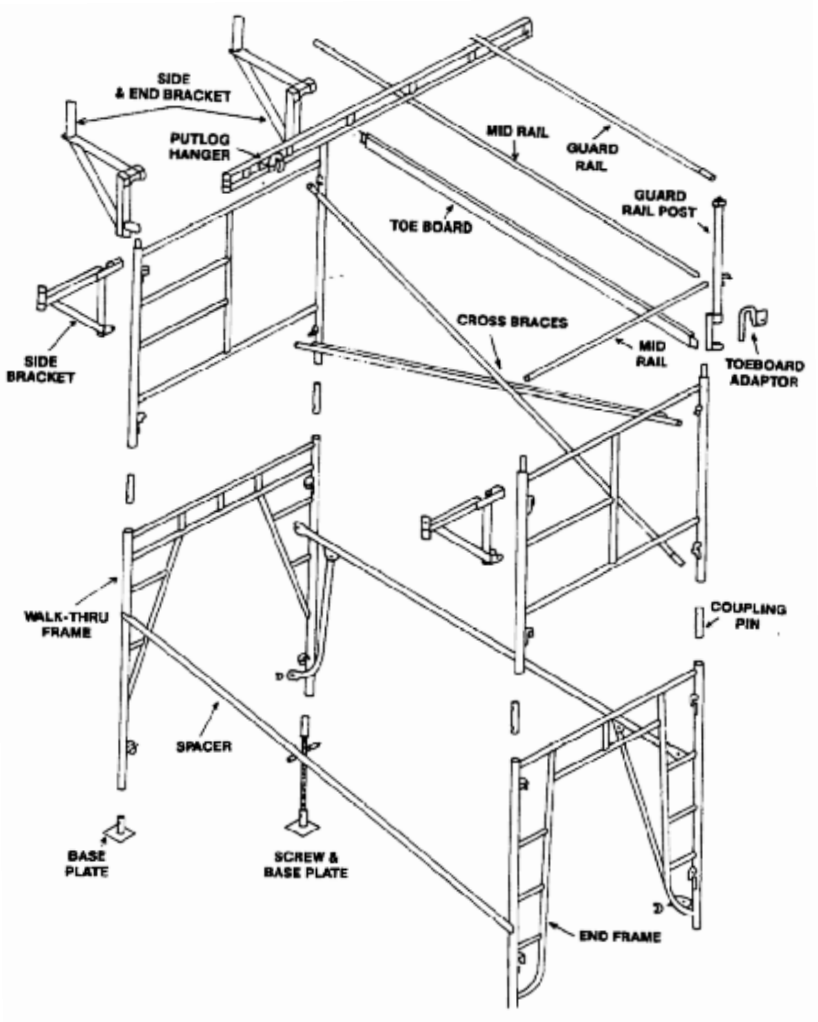
## Tubular Welded Frame Scaffolds [29 CFR 1026.452(c)]

**Bases**: Scaffold legs must rest on adjustable or plain bases that are placed on a foundation that can support the maximum load on the scaffold.

**Attachment to the Building**: Brace and tie the scaffold securely to the building at least every 30 feet horizontally and 26 feet vertically.

**Cross and Diagonal Bracing**: The bracing must be attached so that it squares and aligns the vertical members so that the scaffold is plumb, square and rigid.

**Uplift Protection**: If part of the scaffold might be accidently lifted, then the vertical members must have pins to lock them together so they can't separate.




**Tubular Welded Frame Scaffold**

## Manually Propelled Mobile Scaffolds [29 CFR 1026.452(w)]

**Height**: A freestanding mobile scaffold must be no more than four times as high as it is long.

**Casters**: These must be strong enough to support four times the load on them. Each castor must have a positive locking device.

**Ladder or Stair**: A ladder or stair must be built into the scaffold or firmly attached. The ladder or stair must be located so that when workers climb it they do not tip the scaffold.

**Moving**: Move the scaffold only on level surfaces free of holes or obstructions. Apply force as low as possible so the scaffold won't tip.

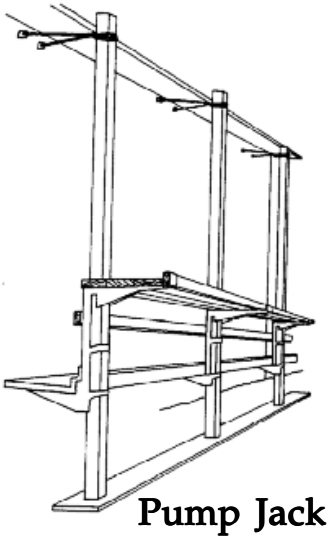
**Riding**: Workers may be on the scaffold when it is moved only if all of the following conditions exist:

- The floor is within 3 degrees of level and free from pits, holes or obstructions.
- The minimum dimension of the base is at least one half the height.
- All tools and materials are removed or firmly secured.

**Plumb and Secure**: Before workers ascend the scaffold, it must be on a suitable footing. It must be plumb, and the casters must be locked.

**Manually propelled mobile scaffolds**

## Pump Jack Scaffolds [29 CFR 1026.452(j)]



Pump Jack

**Maximum Load**: 500 lbs. total weight of workers, tools and materials between any two poles. No more than two workers between any two poles.

**Prevent slipping**: Each jack bracket must have **two** positive gripping mechanisms to prevent slipping.

**Poles**: Poles must be two 2 inch by 4 inch pieces of clear, straight grained wood. Poles must not be more than 30 feet high and not more than 10 feet apart.

**Planking**: Planks must be secured. Connect or overlap planks only on a bracket.

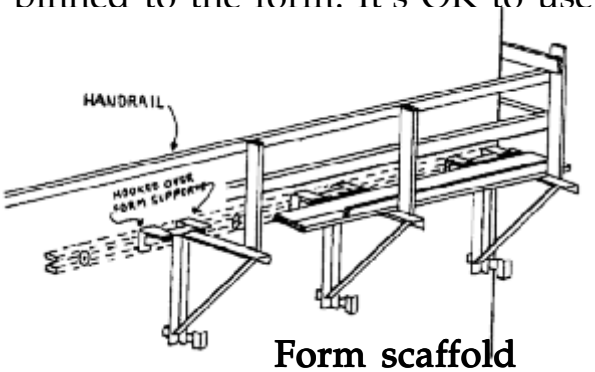
## Form Scaffolds [29 CFR 1026.452(g)]

**Planking**: Planks must be secured to the brackets, or they must overlap by at least six inches. Only join or overlap planks at a bracket.

**Span**: The span between brackets must not be more than 8 feet.

**Figure-Four Form Scaffolds**: The outrigger ledger must be made of two pieces of 1 inch by 6 inch (or heavier) wood nailed on both sides of the vertical form support. The ledger can be no more than 42 inches long. There must be a 45 degree angle brace that intersects the ledger at least 3 feet from the form.

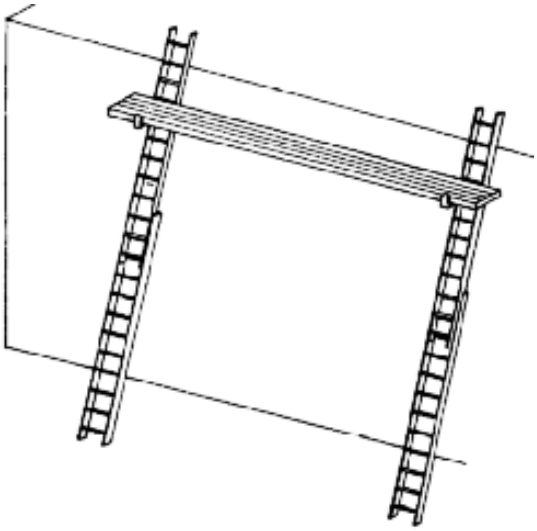
**Metal Bracket Form Scaffolds**: The brackets must be an integral part of the form, or they must be securely bolted or pinned to the form. It's OK to use "hook-over" brackets if they hang from form walers, and if the walers are securely anchored to the form or secured to the shea bolts.




Form scaffold

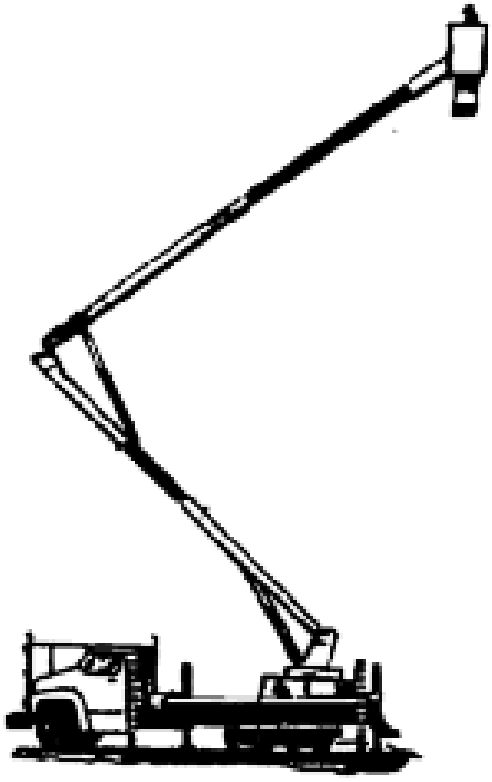
**Wooden Bracket Form Scaffolds**: The brackets must be an integral part of the form panels.

## Other Scaffold Types



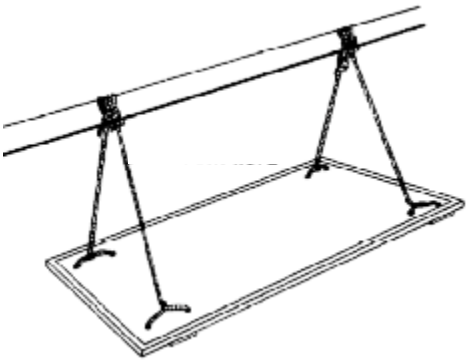
Ladder Jack Scaffold

Plasterer's Scaffold

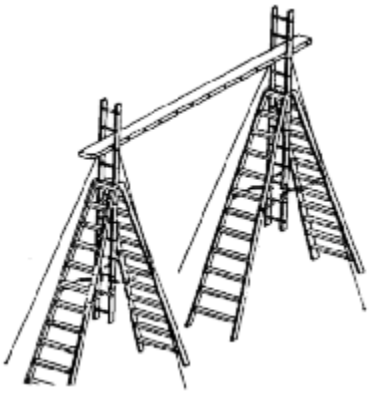


Aerial Lifts

## Other Scaffold Types

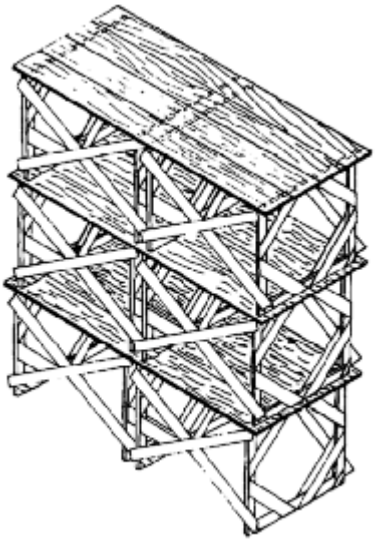


Float Scaffold

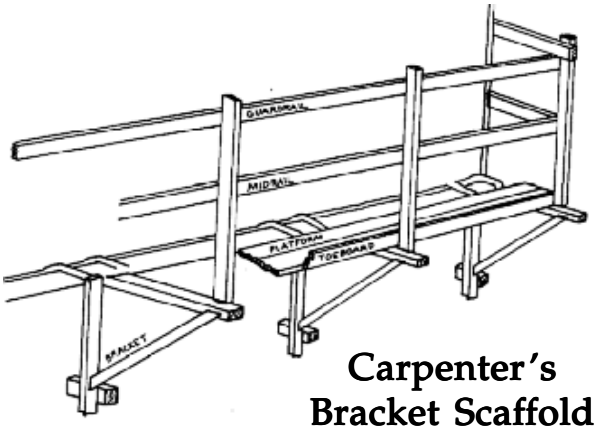


Extension
Trestle Scaffold

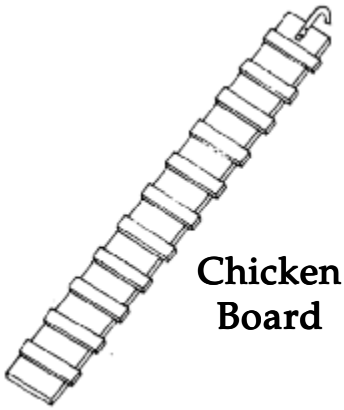
Horse Scaffold



Bricklayer's
Square Scaffold

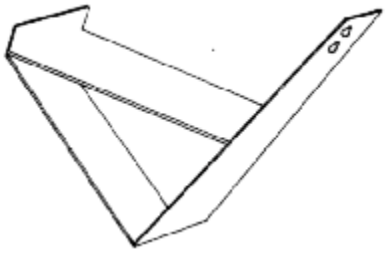



Carpenter's
Bracket Scaffold



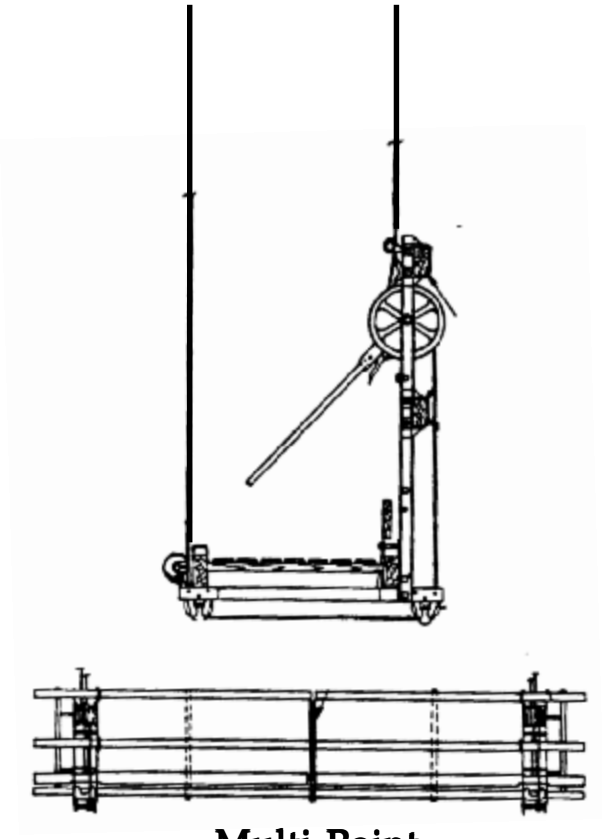
Chicken
Board

## Other Scaffold Types

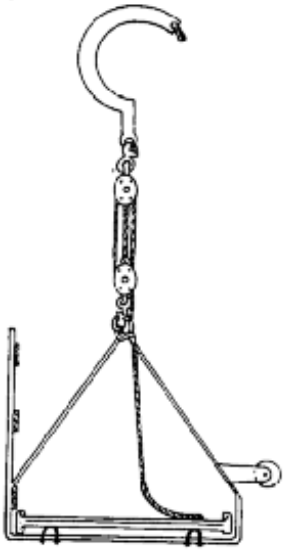


Roofing Bracket

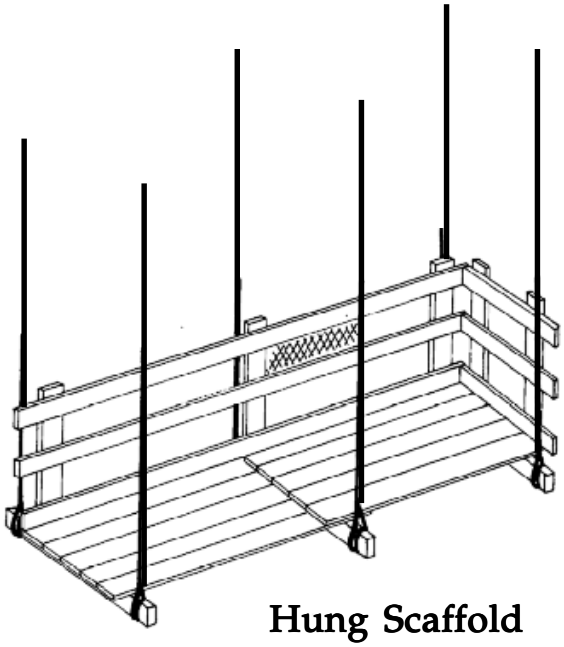
Boatswain's Chair



Multi-Point
Suspension Scaffold



Swinging
Scaffold



Hung Scaffold

**A**. The OSHA Scaffolding Standard applies to:

_____

_____

**B**. What are the general requirements for the capacity of scaffolds?

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**C**. What are the general requirements for scaffold platforms?

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**D**. What are the general requirements for scaffold access?

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REVIEW THIS MODULE: SCAFFOLDING

**F**. What are the general requirements for scaffold use?

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**F**. What are the requirements for fall protection from scaffolds?

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**G**. What are the requirements for protection from falling objects?

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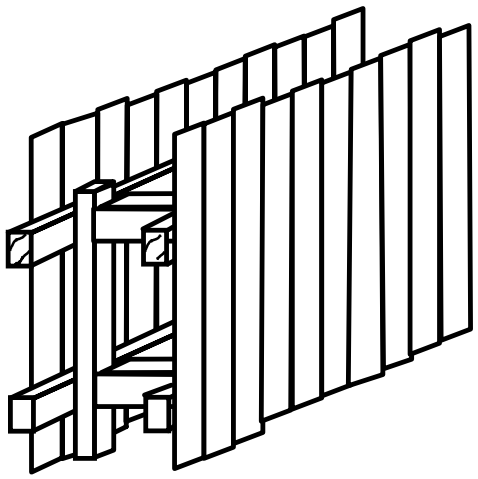
# TEAMSTERS Construction Safety & Health Training

## *Module 8*

# EXCAVATIONS



International Brotherhood of Teamsters — NIEHS Worker Training Grants

**LEARNING OBJECTIVES**

✔ **IDENTIFY SAFE WORK PRACTICES FOR EXCAVATIONS AND TRENCHES.**

**a**. Identify the steps that must be taken before excavation work begins.

**b**. Identify the general safety requirements for excavation work.

**c**. Identify the four soil types.

**d**. Identify the two main types of protective systems for excavations and trenches.

**e**. Identify the depth of an excavation that requires a protective system.

f. Identify the responsibilities of a competent person with regard to excavation and trenching work.

# Excavations

**Excavations** is Subpart P of the OSHA Construction Standards. It has three sections and six appendices that are listed on the next page.

**Scope and Application** [29 CFR 1926.650]

This subpart applies to all open excavations made in the earth's surface, including trenches.

**Excavation** means any man-made cut, cavity, trench, or depression in an earth surface, formed by earth removal.

**Trench** means an excavation that is 15 feet or less wide, and is longer than it is wide.

# Excavations: 29 CFR 1926 Subpart K

Scope, Application and Definitions

29 CFR 1926.650

Soil Classification

Appendix A

Specific Excavation Requirements

29 CFR 1926.651

Sloping and Benching

Appendix B

Requirements for Protective Systems

29 CFR 1926.652

Timber Shoring For Trenches

Appendix C

Aluminum Hydraulic Shoring For Trenches

Appendix D

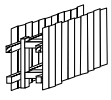
Alternatives to Timber Shoring

Appendix E

Selection of Protective Systems

Appendix F





# Specific Excavation Requirements
**[29 CFR 1926.651]**

## Plan Before You Dig

Many excavation accidents result from a failure to plan the excavation work correctly. Proper investigation and preparation of the site takes time. The contractor should build safety into the pre-bid plan.

It is important, **before digging starts**, to:

- Remove or support objects and structures near the excavation.
- Determine the exact location of underground utilities that might be in the area of the proposed excavation. This includes sewer, telephone, fuel, electric, water lines, or any other underground installations. Contact the local utility companies so they can identify where their lines are.
- Identify nearby underground storage tanks, pipe lines or sewers that could leak toxic or flammable materials into the excavation.
- Identify overhead structures and utilities that might be a hazard during excavation work.
- Determine the types of soil that the excavation will encounter.
- Determine whether traffic near the excavation will cause a hazard.
- Locate nearby sources of surface water that might run into the excavation.
- Determine the depth of the water table. Will underground water cause flooding?
- Consider the weather that might occur while the work takes place.

# General Safety Requirements

## Getting In and Out

In any trench that is 4 feet or more deep, there must be a stairway, ladder, ramp or other safe means of egress so that a worker never has to go more than 25 feet along the trench to get out. In other words, ladders and ramps can be no more than 50 feet apart.

Ramps used in any excavation must be designed by a competent person.

## Falling Loads

No employee shall be permitted underneath loads handled by lifting or digging equipment. Employees must stand away from a vehicle being loaded or unloaded to avoid being struck by falling materials. (An operator may remain in the cab, if the vehicle is equipped to provide protection during loading and unloading.)

## Warning System to Alert Vehicles Near the Excavation

When mobile equipment is operated near an excavation, or when such equipment needs to approach the edge of an excavation, and the operator does not have a clear and direct view of the edge, then there must be a warning system. This can be barricades, hand or mechanical signals, or stop logs. If possible, the grade should be away from the excavation.

## Hazardous Atmospheres

If the excavation is 4 feet or more deep, and there is the possibility of hazardous gases or vapor entering, or the possibility of oxygen deficiency, then OSHA requires the air in the excavation to be monitored. This might include measuring the oxygen level, determining the concentration of toxic gases and vapors, and measuring whether the level of flammable gases and vapors is well below the flammable range.

This kind of monitoring is a good idea, even if the excavation is less than 4 feet deep.

## Emergency Rescue Equipment.

Emergency rescue equipment, such as breathing apparatus, a safety harness and line, or a basket stretcher, must be available nearby if there is a possibility of toxic materials getting into the excavation.

## Water Accumulation

Employees must not work where water is accumulating, unless precautions are taken. These precautions depend on the situation, but could include special shield systems to prevent cave-ins, water pumps, or safety harnesses and lifelines. If pumps are used, a competent person must monitor their operation.

If the work interrupts the natural flow of a stream, then the contractor must construct a diversion ditch or a dike to prevent the excavation from flooding.

If there has been heavy rainfall or runoff in the area, then a competent person must inspect to make sure that the excavation and its supports are still safe.

## Adjacent Structures

If there is a structure adjacent to the excavation, it must be supported to prevent a cave in. A registered professional engineer must determine that the structure is adequately supported either by existing rock or a foundation under the structure, or by supports added in preparing for the excavation.

## Inspection By a Competent Person

Before the start of work each day, a competent person must inspect the excavation, the adjacent areas, and protective systems for evidence of a situation that could result in possible cave-ins, failure of protective systems, hazardous atmospheres, or other hazardous conditions. Additional inspections must take place as needed throughout the shift. Inspections shall also be made after every rainstorm or other event that might have increased hazards at the excavation.

If the inspection reveals a hazardous condition, it must be corrected before workers are allowed in the excavation.

## Fall Protection.

The OSHA Standard does not specifically require guardrails around an excavation, since these might interfere with the work. However, it's a good idea if they can be used.

The Standard does require guardrails on any walkway that workers use to cross over a trench or other excavation if it is 6 feet or more from the walkway to the surface below.

If workers are on a scaffold in an excavation, then they need fall protection as required in the Fall Protection Standard and the Scaffolding Standard.

# Protective Systems
### [29 CFR 1926.652]

The Standard describes two types of protective systems to prevent cave ins:

- Benching and sloping systems.
- Support Systems (shoring and shielding).

An excavation must have one or the other (or a combination) of these protective systems.

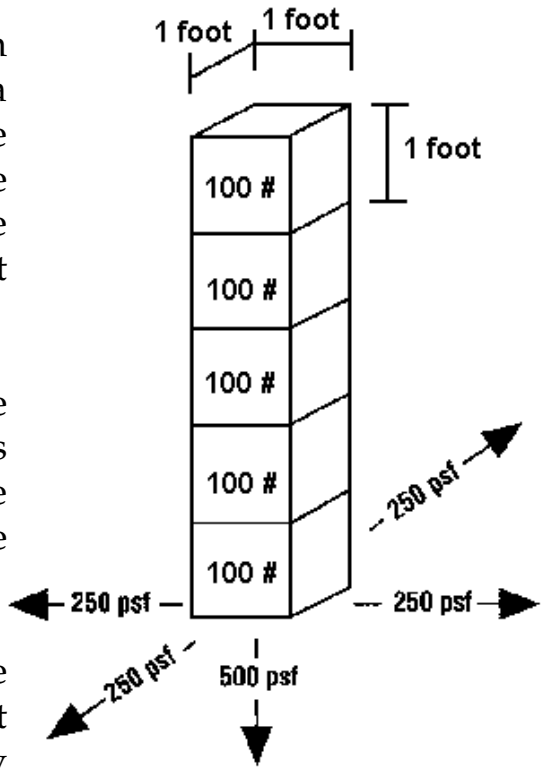
**Exceptions**. A protective system is not required if:

- The entire excavation is in stable rock, or
- The excavation is less than five feet deep and a competent person has examined the ground and determined that there is no indication of a potential cave-in.

Many workers have died in trenching accidents because adequate shoring was not in place. Every trench that is 5 feet or more deep must have shoring or shields — or have benching or sloping. Otherwise, no oner may enter the trench.

# Trench and Excavation Failure

Soil is heavy. One cubic foot weighs more than 100 pounds. If you go one foot down, there is a downward pressure of 100 pounds per square foot (psi). At a depth of two feet it's 200 psi. Five feet down it's 500 psi. There is also pressure pushing outwards. This lateral pressure is about half of the downward pressure




Think of the ground as made up of a lot of these columns stacked next to each other. The sideways pressure from each column is supported by the pressure from the columns around it. They are all supporting each other.

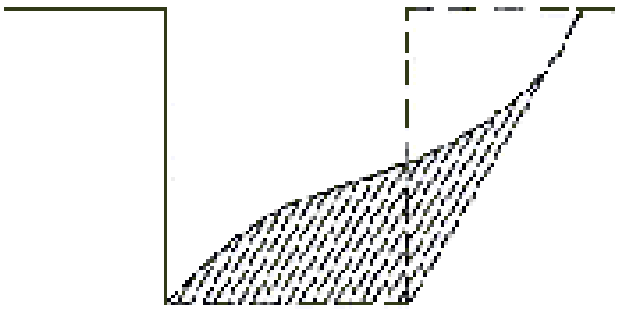
When we cut an excavation, we take away the support from one side. The pressure pushes out with nothing to support it. Unless the soil is very cohesive (sticks to itself), it will give way.

## Tension Cracks

Tension cracks usually form at a distance of about ½ to ¾ the depth of the trench away from the opening.

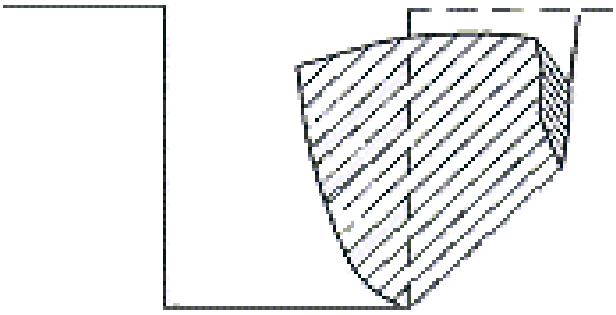
## Sliding or Sluffing

Sliding or sluffing may occur as a result of tension cracks.



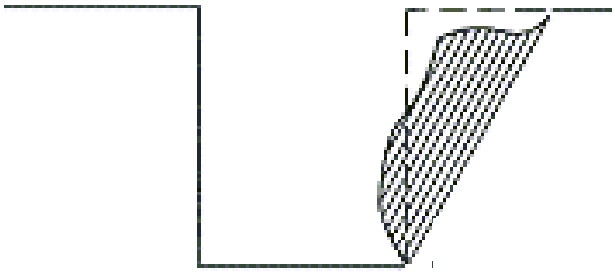
## Toppling

Tension cracks can also cause toppling.



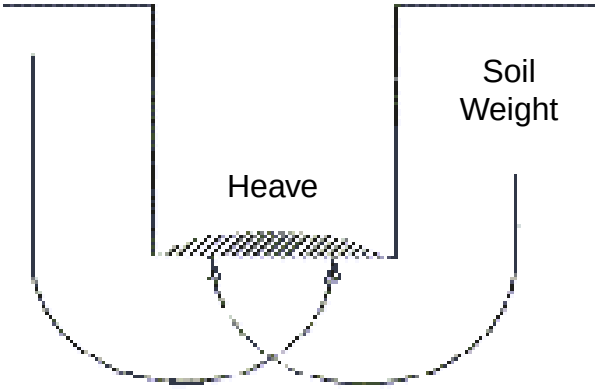
## Subsidence and Bulging

An unsupported excavation can cause subsidence at the surface and bulging of the vertical face of the trench. The trench may collapse.



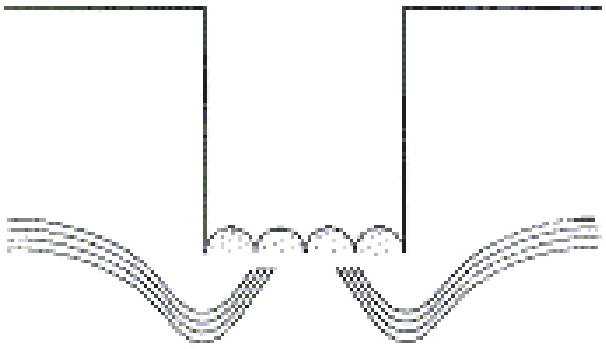
## Heaving or Squeezing

Bottom heaving or squeezing is caused by the downward pressure created by the weight of adjoining soil. This pressure causes a bulge in the bottom of the cut. Heaving and squeezing can occur even when shoring or shielding has been properly installed.




## Boiling

Boiling is an upward water flow into the bottom of the cut. A high water table is one of the causes of boiling. Boiling produces a "quick" condition in the bottom of the cut, and can occur even when shoring or trench boxes are used.



# Types of Soil

A competent person must determine what type of soil the excavation is in. Some soils are more stable than others. At one extreme is rock, which might be so stable that it requires no shoring or other protective system. At the other extreme is sand, which is very unstable. OSHA divides soils into four types:

## Stable Rock

Natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed. It usually has a rock name such as granite or sandstone.

## Type A Soil

Very cohesive soils. "Cohesive" means that the soil particles stick to each other so that the soil is less likely to crumble apart. Examples of Type A soils include clay, silty clay, sandy clay, and clay loam.

## Type B Soil

Soils which are fairly cohesive, but less so than Type A. Examples of Type B soils include angular gravel; silt; silt loam; previously disturbed soils unless otherwise classified as Type C.

## Type C Soil

The least cohesive soils. Examples of Type C soils include granular gravel, sand, loamy sand, submerged soil, soil from which water is freely seeping, and submerged rock that is not stable.

## But...

If a soil has cracks, has been disturbed (dug or moved before), is in a slanting layer, has seeping water, or is subject to vibration, then it is considered to be in a less cohesive type. For example, clay that has been disturbed is Type B, not A.

If there are layers of different soil types, then use the soil classification of the weakest layer. Each layer may be classified individually if a more stable layer lies below a less stable layer, i.e., where a Type C soil rests on top of stable rock.

# Testing the Soil

Here are some of the ways that a competent person can determine the soil type:

## Pocket Penetrometer

This instrument measures how cohesive the soil is. Push it into the soil and the indicator displays the reading.

## Shearvane or Torvane

This instrument has blades which you press into the soil. Then you turn the knob slowly and read the indicator when the soil breaks apart.

## Thumb Penetration Test

Press your thumb firmly into the soil. If it's very difficult to make an indentation, the soil is probably Type A. If your thumb penetrates no further than the length of the thumb nail, it is probably Type B soil. If it penetrates the full length of the thumb, it is Type C soil. This is the least accurate test method.

## Dry Strength Test

With experience one might be able to recognize different soil types by how easily the soil crumbles in your hand, how big the pieces are and whether the pieces break into smaller pieces. This test also is not very accurate.

## Plasticity or Wet Thread Test

Moisten some soil and mold it into a ball. Roll it into a $1/8$ inch thread. Break off 2 inches. Hold by one end. If it doesn't break, it's probably Type A or Type B.

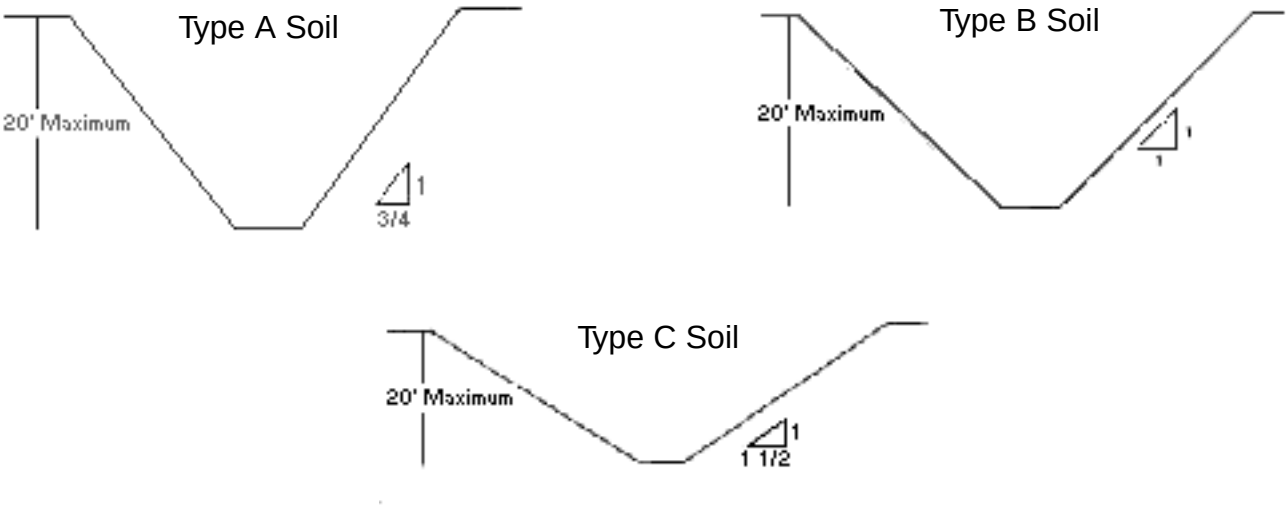
## Visual Inspection

Look at the soil being excavated. If it remains in clumps, it is cohesive; if it looks like sand or gravel, it's not very cohesive. Check for cracks and fissures developing near the excavation. Look at the open sides of the excavation to see if there are layers of different types of soil. Look for signs of bulging, or sliding. Look for water running in from the surface or seeping in underground.

# Sloping and Benching

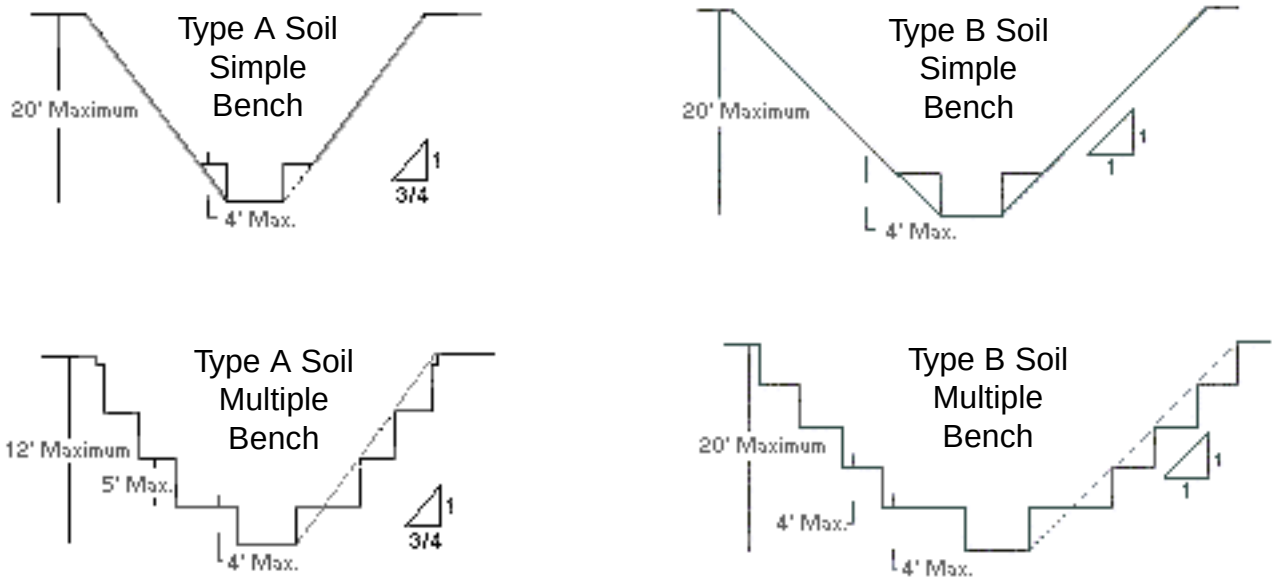
## Sloping

**Sloping** is one way to protect workers in a trench or other excavation. The sides of the excavation are cut at an angle so that they won't collapse. The angle has to be more gradual if the soil is less cohesive. In other words, for Type B it's less steep than for Type A. For Type C it's even less steep.



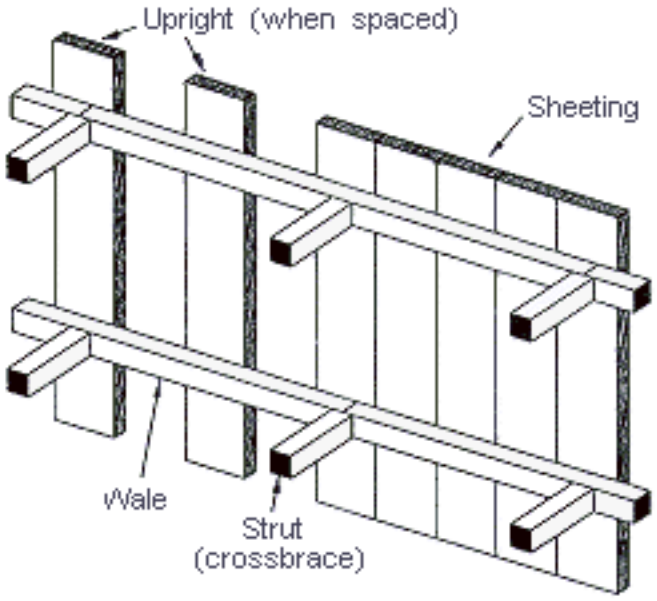

## Benching

In Type A or Type B soil it is possible to cut steps to prevent collapse. This is called **benching**.



# SHORING

There are two types of shoring: timber shoring and mechanical jack shoring. Install all shoring from the top down and remove it from the bottom up. A competent person must supervise the installation and removal, and inspect the shoring before each work shift.

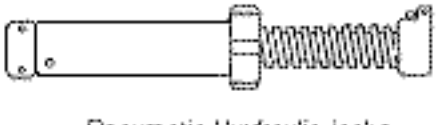



## Timber Shoring

Timber shoring is a system of wooden posts, wales, struts, and sheeting. Workers have to enter the trench in order to install or remove it. During part of this time they are not completely protected since the shoring is not installed.

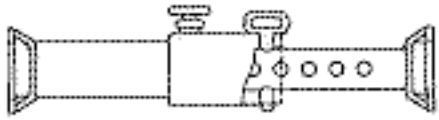
## Mechanical Shoring

Mechanical shoring uses hydraulic, pneumatic or screw jacks as cross braces or struts. There are systems where the wales and sheeting are made of aluminum or steel and are designed to fit the jacks.

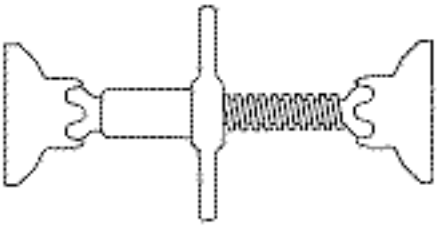


Pneumatic / hydraulic jacks

Some types of hydraulic and pneumatic shoring can be installed and removed without a worker having to enter the trench. Some aluminum systems are so light that a single person can install it.



Screw jack



Hydraulic and pneumatic shoring should be checked at least once per shift for leaking hoses and/or cylinders, broken connections, cracked nipples, bent bases, and any other damaged or defective parts.

# Shielding

**Shields or trench boxes** are different from shoring. They are not designed to support the sides of the excavation. Rather they are intended to protect workers inside of the shield if the excavation caves in. Shields are designed to safely handle certain loads. Do not use a shield or trench box in a situation that it was not designed for. Again, a competent person must assure that the shield or trench box is used properly.

The excavated area between the outside of the trench box and the face of the trench should be as small as possible. This space is usually backfilled to prevent the box from moving.

Trench boxes may be used in combination with sloping and benching. The box should extend at least 18 inches above the surrounding area if there is a sloping toward excavation. This can be accomplished by providing a benched area adjacent to the box.

Earth excavation to a depth of 2 feet below the shield is permitted, but only if the shield is designed to resist the forces calculated for the full depth of the trench and there are no indications that soil is slipping from behind or below the box's supports.

A competent person must regularly inspect the trench box for signs of bulging, heaving, boiling and vibration

**A**. What steps must be taken before excavation work begins?

**B**. What are the general safety requirements for excavations?

REVIEW THIS MODULE: EXCAVATIONS

**C**. What are the four types of soil?

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**D**. What are the two main types of protective systems?

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**F**. What excavation depth requires the use of a protective system?

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**G**. What are the responsibilities of a competent person with regard to excavation and trenching work?

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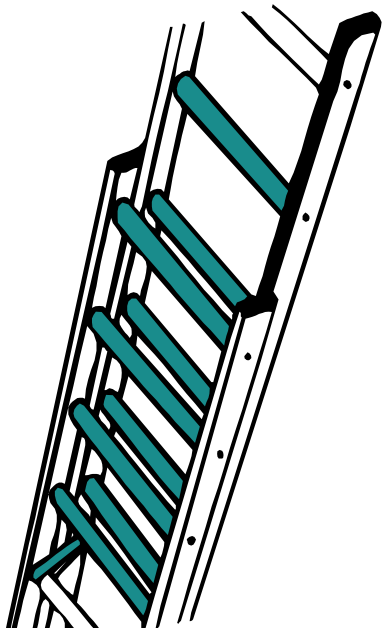
# TEAMSTERS Construction Safety & Health Training

## *Module 9*

# STAIRWAYS and LADDERS



International Brotherhood of Teamsters — NIEHS Worker Training Grants

## LEARNING OBJECTIVES

✔ **IDENTIFY THE MAIN REQUIREMENTS OF THE STANDARD FOR STAIRWAYS AND LADDERS.**

- **a**. Identify when a ladder or stairs is required.
- **b**. Identify the general requirements for safe use of stairs.
- **c**. Identify the general requirements for safe use of ladders.
- **d**. Identify when fall protection is required for a fixed ladder.
- **e**. Identify when a ladder with nonconductive side rails is required.
- **f**. Identify the proper procedures for dealing with defective ladders.

# Stairways and Ladders

**"Stairways and Ladders"** is Subpart X of the OSHA Construction Standards. This subpart has five sections and one non-mandatory appendix, as shown on the next page.

Stairways and ladders are a major source of injuries and fatalities among construction workers. OSHA estimates that there are 24,882 injuries and as many as 36 fatalities per year due to falls from stairways and ladders used in construction. Nearly half of these injuries are serious enough to require time off the job.

Work on and around ladders and stairways is hazardous.

# Stairways and Ladders 29 CFR 1926 Subpart X

| | |
|---|---|
| Scope, Application and Definitions<br>29 CFR 1926.1050 | Ladders<br>29 CFR 1926.1053 |
| General Requirements<br>29 CFR 1926.1051 | Training Requirements<br>29 CFR 1926.1060 |
| Stairways<br>29 CFR 1926.1052 | Appendix A Ladders<br>29 CFR 1926.305 |

# Scope and Application
**[29 CFR 1926.1050]**

This standard applies to all stairways and ladders used in construction. This includes ladders and stairways made on the job. However, ladders and stairways that are specifically manufactured for scaffolds are covered by Subpart L, Scaffolds (29 CFR 1926.451).

# General Requirements
**[29 CFR 1926.1051]**

There must be a ladder any place where workers are expected to go up or down more than 19 inches, unless there is a ramp, slope or hoist. At least one point of access between levels must be kept clear at all times.

Before any worker uses a stairway or ladder, the employer must make sure that the stairway or ladder complies with this Subpart. This includes fall protection systems which are required for some ladders and stairways.

# Stairways
**[29 CFR 1926.1052]**

## Landings

Stairways that will not be a permanent part of the structure must have landings at every 12 feet of vertical rise. Each landing must be at least 30 inches deep and 22 inches wide.

## Angle

Stairways must be installed at least 30 degrees — and no more than 50 degrees — from the horizontal.

## Treads and Risers

The risers should all be the same height, and the treads should all be the same depth. No more than ¼ inch of variation is allowed.

## Doors and Gates

If a door or gate opens directly onto a stairway, there must be a platform that extends at least 20 inches beyond the swing of the door.

## Metal Pan Stairways

Landings and treads of metal pan stairways must be secured in place before they are filled. Before workers can use a metal pan stairway, it must be permanently filled with concrete, or temporarily filled with wood. *Exception*: Workers involved in the actual assembly or construction of the stairway may use it while they are working on it, even if it hasn't been filled.

## Slippery Conditions

Keep stairways free of ice, snow, oil or other slippery conditions.

## Handrails and Stair Rails

Note: "Handrail" means rail used to provide a hand hold for support. "Stair rail" means a barrier to keep you from falling off. A stair rail can serve as a handrail, or they may be two separate parts of the same stairs.

Stairways with four or more risers, or rising more than 30 inches in height — whichever is less — must have at least one handrail. The handrail must be between 30 and 37 inches above the steps. Handrails must be strong enough to take a force of at least 200 pounds. Temporary handrails must have a minimum clearance of 3 inches between the handrail and wall.

Each unprotected side or edge of a stairway must also have a stair rail. A stair rail must be at least 36 inches high. If it also serves as the handrail, then it must not be more than 37 inches high. A stair rail must have screen, mesh, or balusters between the top rail and the steps.

# Ladders
## [29 CFR 1926.1053]

### Ladder Traffic

If the only way to enter or leave the work area is by ladder, and there are 25 or more workers in the area, then there must be at least two ladders, or a double-cleated ladder.

Two ladders, or a double-cleated ladder are also required if there is up and down use at the same time.

### Rungs Cleats and Steps

Rungs, cleats, and steps must be parallel, level, and uniformly spaced when the ladder is in position for use.

Rungs, cleats, and steps of portable and fixed ladders must be spaced between 10 inches and 14 inches apart.

### Connecting Ladders Together

Never tie or fasten ladders together to create a longer ladder unless they are specifically designed for this purpose.

When splicing side rails, the resulting side rail must be equivalent in strength to a one-piece side rail made of the same material.

Two or more separate ladders used to reach an elevated work area must be offset with a landing between the ladders, except when portable ladders are used to gain access to fixed ladders.

### Wood Ladders

Wood ladders must not be painted with an opaque covering, except for identification or warning labels which may be placed only on one face of a side rail. This is so cracks or other defects can be seen.

## Portable Ladders

Portable ladders must be strong enough to support at least four times the maximum intended load.

The side rails of portable ladders must be at least 11½ inches apart.

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

## Fixed Ladders

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

Each step or rung of a fixed ladder must be able to support a load of at least 250 pounds applied in the middle of the step or rung.

A fixed ladder must extend at least 42 inches above an access level or landing platform. Either: (1) Continue the rung spacing with horizontal grab bars; or (2) Use vertical grab bars with the same lateral spacing as the ladder rails.

The side rails of a fixed ladder must be at least 16 inches apart.

If a fixed ladder is made up of separate rungs attached to the structure without side rails, then the rungs must be shaped to prevent slipping off the ends.

There must be at least 7 inches of clearance between the rungs of a fixed ladder and the structure to which it is attached. *Exception*: In an elevator pit, this clearance may be as little as 4½ inches.

There must be at least 30 inches of clearance on the climbing side of a fixed ladder. *Exception*: If obstructions are unavoidable, the clearance may be reduced to 24 inches if a deflection device is installed.

The step-across distance between rungs of fixed ladders and the nearest edge of a landing must be at least 7 inches and no more than 12 inches.

## Fall Protection for Fixed Ladders

If the total length of climb is 24 feet or more, then a fixed ladder must have some kind of fall protection. This can be any of the following:

- Ladder safety devices.
- Self-retracting lifelines and rest platforms at least every 150 feet.
- A cage or well. If the total length of climb is more than 50 feet, the ladder must be in multiple sections, with each section not to exceed 50 feet (long. Each section must be offset from adjacent sections with a landing platforms.

If the length of climb is less than 24 feet, but the top of the ladder is more than 24 feet above a lower level, then there must also be a cage, well, ladder safety device, or self-retracting lifeline.

## Ladder Safety Devices for Fixed Ladders

All safety devices must be able to withstand a drop test consisting of a 500 pound weight dropping 18 inches.

All safety devices must permit the worker to ascend or descend without continually having to hold, push, or pull any part of the device, leaving both hands free for climbing.

All safety devices must be activated within 2 feet after a fall occurs.

The connection between the carrier or lifeline and the point of attachment to the body harness must not be longer than 9 inches.

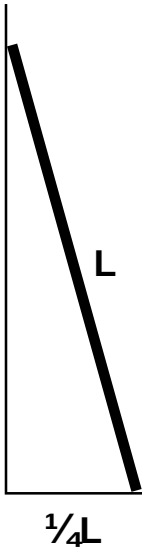
## Using Ladders

If you use a portable ladder for access to an upper landing, the side rails must extend at least 3 feet above the upper landing surface. If this is not possible, then the ladder must be secured, and a grab rail must be provided to assist workers in getting on and off the ladder at the landing.

Maintain ladders free of oil, grease, and other slipping hazards.

Never load a ladder beyond the manufacturer's rated capacity.

A ladder leaning against a structure must be at an angle so that the horizontal distance from the top support to the foot of the ladder is approximately one-quarter of the working length of the ladder.




Make sure that the ladder is on a stable and level surface, or is secured to prevent accidental movement.

If you use a ladder in a passageway or driveway where it might be displaced by workplace activities or traffic, then it must be secured to prevent accidental movement or protected by a barricade.

Keep the area around the top and bottom of the ladders clear.

Never move a ladder while some one is on it.

If a you use a ladder near energized electrical equipment, it must have nonconductive side rails.

Never use the top or top step of a stepladder as a step.

A competent person must inspect all ladders for visible defects on a regular basis and after any incident that could affect their safe use.

Face the ladder when ascending or descending.

Don’t carry anything on a ladder that might cause you to lose your balance.

## Structural Defects

If a ladder has any structural defect (such as broken or missing rungs, split rails, corroded components, or other defects) immediately tag or mark it "Do Not Use" and withdraw it from use. To withdraw a fixed ladder from use either: (1) tag it or mark it “Defective”, or (2) block the rungs with plywood so it cannot be used.

Ladder repairs must restore the ladder to a condition meeting its original design criteria before the ladder is returned to use.

# Training Requirements
### [29 CFR 1926.1060]

Your employer must provide a training program for each employee using ladders and stairways. For example, employers must ensure that each employee is trained by a competent person in the following areas, as applicable:

- The nature of fall hazards in the work area.
- The proper use of any fall protection systems used with ladders.
- The proper construction, use, placement, and care of stairs and ladders.
- The maximum intended load-carrying capacities of ladders used.

In addition, employers must retrain each employee as necessary to maintain their understanding and knowledge .

**A**. When is a ladder or stairs required?

**B**. What are the general requirements for the safe use of stairs?

**C**. What are the general requirements for the safe use of ladders?

REVIEW THIS MODULE: STAIRWAYS & LADDERS

**D**. When is fall protection required for a fixed ladder?

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_____

**E**. What must be done with a defective ladder?

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**F**. When is ladder with nonconductive side rails required?

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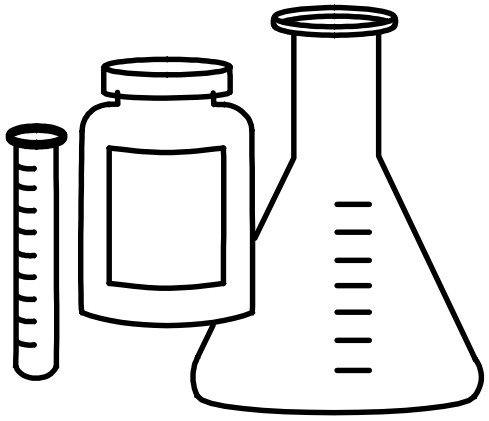
# TEAMSTERS Construction Safety & Health Training

*Module 10*

# TOXIC & HAZARDOUS SUBSTANCES



International Brotherhood of Teamsters — NIEHS Worker Training Grants

## LEARNING OBJECTIVES

✔ **IDENTIFY THE WAYS THAT CHEMICALS CAN AFFECT YOUR HEALTH.**

**a**. Identify five routes of entry by which chemicals can get into or on your body.

**b**. Define "acute" and "chronic" health effects.

**c**. Define "local" and "systemic" health effects.

**d**. Define "target organ" and "latency period".

**e**. Identify the five major provisions of the OSHA Hazard Communication Standard (HAZCOM).

**f**. Identify the three types of information required by OSHA on chemical labels.

**g**. Know how to find information on a Material Safety Data Sheet (MSDS).

**h**. Identify five common warning signs of chemical exposure.

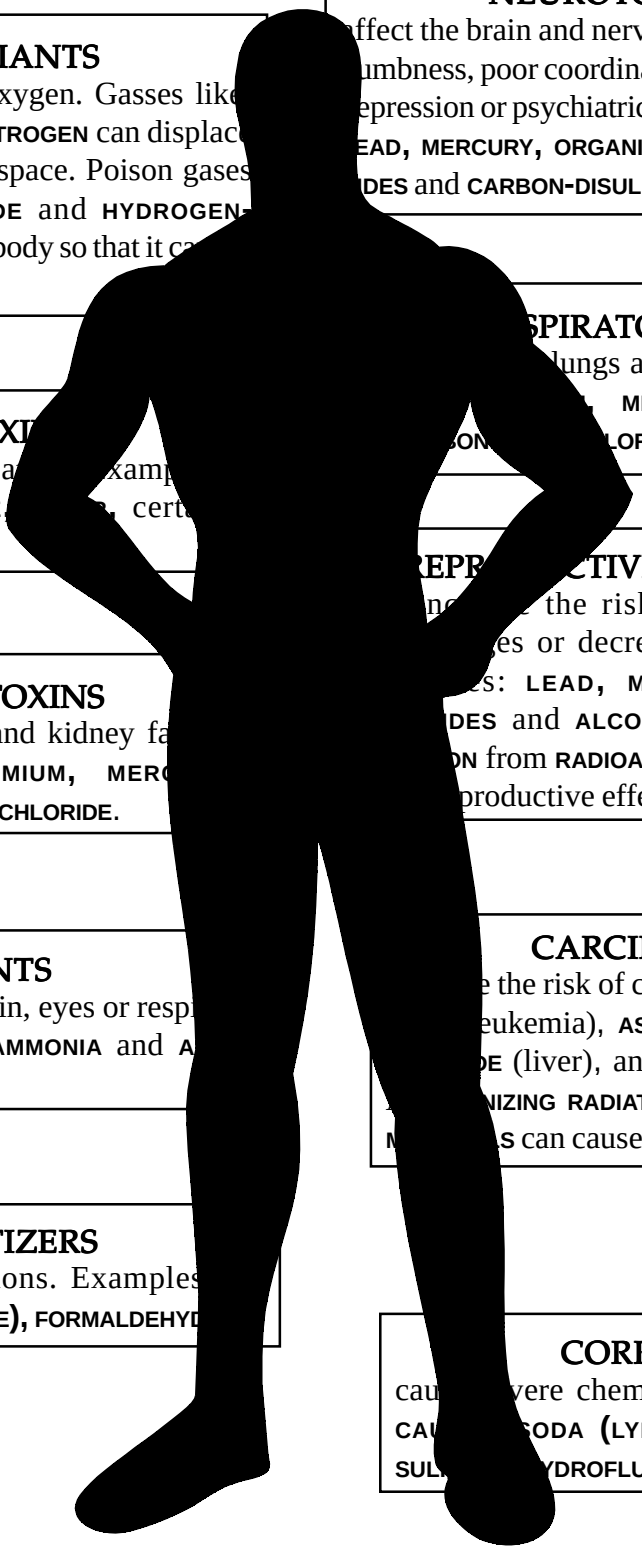
# Chemicals Can Affect You In Many Ways

There are many ways hazardous chemicals can affect you. You might get a rash, feel sick or become dizzy. Your liver, lungs or other organs might be damaged. Your ability to have children might be affected. You might get cancer. The effect depends on:

- **The chemical**. (Different chemicals produce different effects.)
- **The dose**. (How much you absorb.)
- **Your own state of health**. (Some people may be affected more.)

We will discuss how chemicals affect your health. We will also look at the **OSHA Hazard Communication Standard** which says that your employer shall give you information about the hazardous substances on the job site.

# Health Effects of Hazardous Chemicals



## NEUROTOXINS

affect the brain and nerves. They can cause umbness, poor coordination, memory loss, epression or psychiatric effects. Examples: EAD, MERCURY, ORGANIC SOLVENTS, PESTI-IDES and CARBON-DISULFIDE.

## ASPHYXIANTS

deprive the body of oxygen. Gasses like CARBON-DIOXIDE and NITROGEN can displac the air in an enclosed space. Poison gases like CARBON-MONOXIDE and HYDROGEN-SULFIDE can poison the body so that it ca use oxygen.

## SPIRATORY TOXINS

lungs and airways. Examples: MERCURY, ALCOHOL, and LORIDE.

## LIVER TOXI

cause cirrhosis and hepa xamp CARBON-TETRACHLORIDE, cert PESTICIDES and ALCOHOL.

## REPR CTIVE HAZARDS

nc the risk of birth defects, es or decreased sperm count. s: LEAD, MERCURY, CERTAIN IDES and ALCOHOL. Also IONIZING ON from RADIOACTIVE MATERIALS can productive effects.

## KIDNEY TOXINS

cause kidney damage and kidney fa Examples: LEAD, CADMIUM, MERC ALCOHOL, CARBON-TETRACHLORIDE.

## IRRITANTS

cause irritation of the skin, eyes or respi tory tract. Examples: AMMONIA and A GASES like CHLORINE.

## CARCINOGENS

e the risk of cancer. Examples: BEN- eukemia), ASBESTOS (lung), VINYL- DE (liver), and BENZIDINE (bladder). NIZING RADIATION from RADIOACTIVE LS can cause many types of cancer.

## SENSITIZERS

cause allergic reactions. Examples (TOLUENE-DIISOCYANATE), FORMALDEHYD

## CORROSIVES

cau vere chemical burns. Examples: CA SODA (LYE) and ACIDS such as SUL YDROFLUORIC and NITRIC.

# Routes of Entry

In order for a hazardous material to affect your health, it has to get into or on your body. The different ways that chemicals do this are called ***routes of entry.***

1. ***Inhalation*** is breathing-in a hazardous material. It may damage the lungs, and it may be absorbed in the blood and carried to other parts of your body.

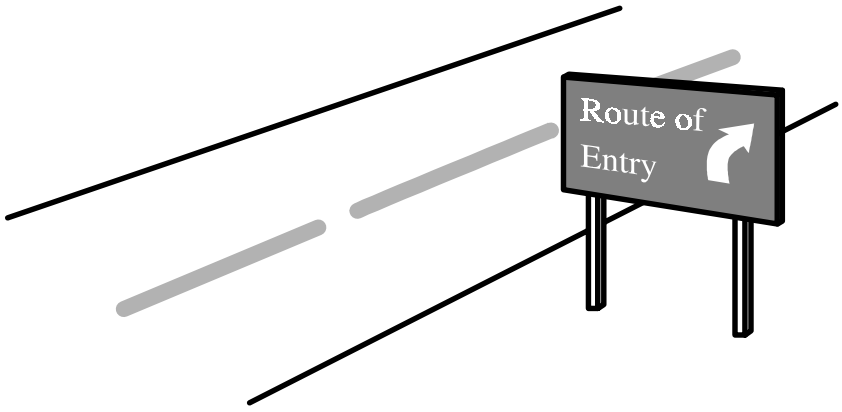
2. ***Skin or eye contact*** is when a hazardous material gets on your skin or in your eye.

3. ***Skin absorption*** is when a hazardous material gets on your skin and soaks through. It then enters the blood and is carried to other parts of your body.

4. ***Ingestion*** is when you accidentally swallow a material. This might happen if the material gets on your hands, and then on the sandwich you eat for lunch.

5. ***Injection*** is when a sharp object punctures the skin, allowing a chemical or infectious agent to enter.

Chemicals can use more than one route of entry. For example, if you handle a leaking container of solvent, you may get some on your hands. It can irritate your skin. It can also soak through, into your blood, and reach your liver or other organs. It can also evaporate and you will inhale it. The solvent affects you by skin contact, skin absorption, and inhalation.



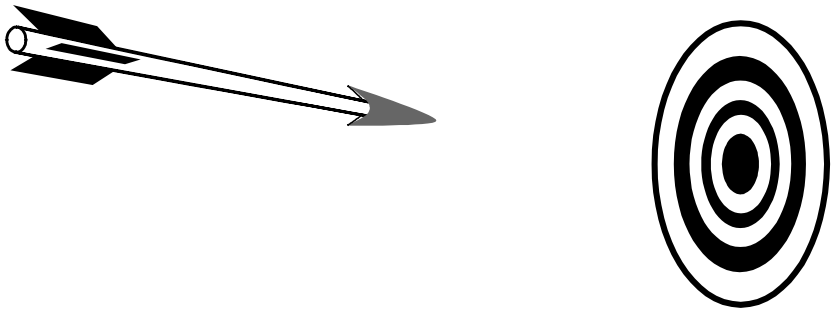
# Where a Chemical Affects You

If a chemical causes damage at the place where it comes in contact with your body, this is called a ***local effect***. For example, if acid spills on your hand, the skin burn is a local effect. When you inhale ammonia, the irritation in your nose, throat and airways is a local effect.

If a chemical is absorbed — by whatever route of entry — and travels through your system to damage another organ, this is called a ***systemic effect***. For example, suppose that you inhale solvent vapors and start to feel dizzy. The solvent has been absorbed through the lungs, traveled in the bloodstream and caused an effect in your brain. Another example might be a chemical that soaks through your skin and then causes damage to your liver.

Many chemicals produce both local and systemic effects. For example, inhaling a solvent might irritate the nose and lungs. This is a local effect: it happens where the chemical comes in contact with your body. But the solvent will also be absorbed in the lungs and carried by the blood to the liver, kidneys and brain. Damage to these other organs is a systemic effect.

In any case, the organs that a chemical affects are called ***target organs***.



**The words "local effect", "systemic effect" and "target organ" all have to do with where the chemical affects you.**

# When a Chemical Affects You

## Short-term Effects

Some chemicals cause effects that occur right away. If acid gets in your eye, it causes a painful burn immediately. This is called a ***short-term effect*** or ***acute effect***.

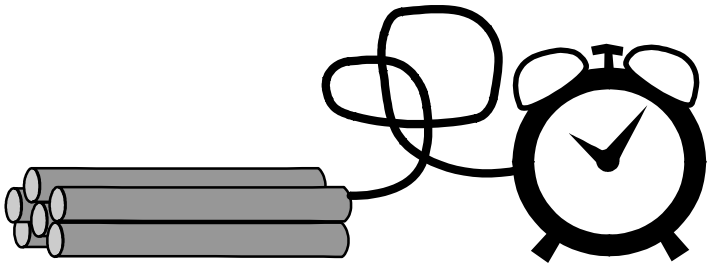
## Long-term Effects

If you breathe small amounts of asbestos fibers you won't even notice them. But if you inhale asbestos month after month, year after year, you greatly increase your chances of getting lung cancer. This is a ***long-term effect*** or ***chronic effect***.

It may take many years between the time you were exposed and when symptoms begin to appear. This is called the ***latency period***. For some diseases, like cancer, the latency period can be twenty, thirty or more years.

One chemical can have both effects. For example, If you inhale toluene, you can get dizzy. This is an acute effect. If you are exposed again and again, toluene can damage your liver and destroy brain cells. These are chronic effects.

Unfortunately, you usually won't notice a chronic effect until it's too late, because it happens slowly and it takes a long time to develop symptoms. You have to *learn* the chronic effects of the chemicals you work with. Then you will know what precautions to take, even if the chemicals don't cause immediate effects.



**The words "acute effect", "chronic effect" and "latency period" all have to do with when the chemical affects you.**

# Hazard Communication

## You have a right to know about hazardous chemicals at work.

As a construction worker you come in contact with many chemical substances. Some of are relatively safe. Others pose serious health and safety risks.

Many workers have been injured, made sick or even died because they did not know the hazards of the chemicals they worked with, and did not know what precautions to take. There is an OSHA standard called the **Hazard Communication Standard**, or **HAZCOM**, which guarantees your **right to know** about the chemicals you work with.

The **OSHA HAZCOM Standard (29 CFR 1926.59)** requires employers to:

1. Have a written HAZCOM program to inform workers of hazards.
2. Have a Material Safety Data Sheet (MSDS) for each hazardous chemical in the workplace, and make these MSDS's available to workers.
3. Make certain that all containers of hazardous chemicals are clearly labeled.
4. Maintain an up-to-date list of hazardous chemicals in the workplace and make this list available to workers.
5. Provide training to workers about:
   - A. The Hazard Communication Standard.
   - B. The employer's HAZCOM program.
   - C. Where hazardous chemicals are present.
   - D. What hazardous chemicals are present.
   - E. How to use MSDS's.
   - F. How to interpret chemical labels.
   - G. How to detect the presence of chemicals.
   - H. The health and safety hazards of the chemicals.
   - I. Safe work practices, protective equipment and emergency procedures for the chemicals.

# HAZCOM LABELS

The HAZCOM Standard requires manufacturers and importers of hazardous chemicals to put labels on the containers in which the chemicals are packaged. These HAZCOM labels must include:

1. Identity of the chemical.
2. Name, address and phone number of the manufacturer or importer.
3. Appropriate hazard warnings, such as:
   - A precautionary word, such as DANGER, CAUTION or WARNING.
   - The physical hazards of the product.
   - The health hazards of the chemical.
   - The target organs which the chemical may affect.
   - Precautions and protective equipment.
   - Emergency first aid information.

ACME

ACME CHEMICAL CO.
32 Grandville Rd.
Cincinnati, OH 45223
(513) 555-1212

UN # 1294
CAS # 108-88-3

ACME SPECIAL SOLVENT

TOLUENE

WARNING ! FLAMMABLE. HARMFUL IF SWALLOWED. VAPORS HARMFUL IF INHALED. MAY CAUSE IRRITATION to SKIN, EYES and RESPIRATORY SYSTEM. MAY CAUSE DROWSINESS or UNCONSCIOUSNESS.
TARGET ORGANS: Nervous system, respiratory system, skin, eyes.
PRECAUTIONS: Keep container closed when not in use. Keep away from heat, sparks, fire or flame. Use only with adequate ventilation or with proper respirator.
FIRST AID: Inhalation, remove victim from exposure.
Swallowing: do not induce vomiting. Call a physician immediately.

# Material Safety Data Sheet (MSDS)

A **Material Safety Data Sheet (MSDS)** is prepared by the chemical manufacturer or importer for each hazardous substance. It contains detailed information about the substance, its hazards, and precautions.

Your employer is required to have a MSDS for every hazardous chemical *used* at your workplace. It is not required to have MSDS's for substances that are only *in transportation* in the workplace, but are not being *used*. MSDS's must be available to all workers on all shifts.

Twelve types of information must be on the MSDS:

1. **The identity of the chemical**.
2. **Physical and chemical characteristics**.
3. **Physical hazards** (fire, explosion, reactivity).
4. **Health hazards** (signs and symptoms of exposure, medical conditions aggravated by exposure).
5. **Routes of entry**.
6. **Exposure limits** (OSHA PEL, ACGIH TLV, etc.).
7. **Whether the chemical is a carcinogen**.
8. **Precautions for safe handling**.
9. **Control measures** (engineering controls, work practices and personal protective equipment).
10. **Emergency and first aid procedures**.
11. **Date the MSDS was prepared**.
12. **Name, address and phone number of the manufacturer or importer**.

# MATERIAL SAFETY DATA SHEET

PRODUCT NAME:
ABC Solvent

SECTION I MANUFACTURER INFORMATION

ABC Chemical Products, Inc.
2 Canary Street
Somewhere, MA 12345

Emergency Telephone Number:
1 - 800 123 - 1234
Date Prepared: April 10, 1999

SECTION II HAZARDOUS INGREDIENTS

| Common name | OSHA PEL (STEL) | ACGIH | NIOSH | % |
|---|---|---|---|---|
| Acetone | 750 ppm (1000) | Same | Same | 20 |
| Ethylene Glycol | 50 ppm ceiling | Same | Same | 3 |
| Methyl Ethyl Ketone | 200 ppm (300) | Same | Same | 2½ |
| Xylene | 100 ppm (150) | Same | Same | 6 |
| Inert Ingredients (Non-Hazardous) | | | | 68½ |

SECTION III PHYSICAL CHARACTERISTICS

| | | | |
|---|---|---|---|
| Boiling Point: | 125ºF | Specific Gravity (water = 1): | 0.78 |
| Vapor Pressure: | 135 mmHg | Melting Point: | -150ºF |
| Vapor Density (air = 1): | 1.1 | Evaporation Rate | |
| Solubility in water: | 20% | (Butyl Alcohol = 1): | 4.5 |
| Appearance and odor: | Clear liquid, solvent like odor. | | |

SECTION IV FIRE AND EXPLOSION HAZARD DATA

Flash Point: 5ºF (open cup)
Flammable Range: LEL 1.5% UEL 9.5%
Extinguishing Media: NFPA Class B Extinguisher
Special Fire-Fighting Procedures: Water spray may be ineffective. Use NFPA Class B extinguisher ($CO_2$, dry chemical).
Explosion Hazards: Closed container may explode if heated.

SECTION V REACTIVITY DATA

Explosive
Avoid heat, open flame, electrical equipment.
Incompatibility: Oxidizers
Hazardous Decomposition Products: Carbon Monoxide, Carbon Dioxide
Hazardous Polymerization: Will not occur

## MATERIAL SAFETY DATA SHEET (page 2)

SECTION VI HEALTH HAZARD DATA

Routes of Entry: X Inhalation X Skin contact X Skin absorption X Ingestion

Acute Health Effects: Eye, nose and throat irritation.
Central nervous system (dizziness).
Skin irritation.

Chronic Health Effects: No chronic effects reported.

Target Organs: CNS, Respiratory system, Eyes, Skin.

| Carcinogenicity: | NTP | IARC | OSHA |
|---|---|---|---|
| | Not reported | Not reported | Not Reported |

Signs and Symptoms of Exposure:
Eye, nose, throat, lung, skin irritation. Dizziness.

Medical Conditions Aggravated By: Asthma

Emergency & First Aid: Vapors inhalation: Remove to fresh air. Call physician.
Eyes: Flush with running water for at least 15 minutes.
Skin: Wash with water.
Ingestion: Do not induce vomiting. Call physician.

SECTION VII PRECAUTIONS FOR SAFE HANDLING AND USE

In case of material release or spill:
Remove all sources of ignition. Avoid breathing vapors.
Ventilate.

Waste Disposal: Dispose in accordance with state and federal regulations.

Handling and Storage: Do not store over 110°F.
Store as NFPA Class 1A flammable liquid.

Other Precautions: Bond containers when pouring. Use with adequate ventilation.

SECTION VIII CONTROL MEASURES

Respiratory Protection: NIOSH Approved Pressure Demand SCBA or Airline.

Ventilation: Use local exhaust ventilation.
Ventilate and test confined space before entry.
All ventilation equipment must be explosion proof.

Protective Gloves: Butyl rubber.

Eye Protection: Chemical splash goggles.

Protective Clothing: Splash apron.

# Are You Exposed?

How do you know if you are exposed to a hazardous chemical? Here are some clues that warn you. Pay attention to them.

**Odor**. If you can smell it, you are inhaling it. However, many toxic chemicals (for example, carbon monoxide) have no odor.

**Taste**. If you inhale a chemical or accidentally get some in your mouth, it may have a particular taste that warns you are being exposed.

**Particles in your respiratory system**. If your mucous is an unusual color or has visible particles in it, then you have inhaled chemical dust. What you see are particles that were large enough to be trapped. There may be smaller ones that made it deep into your lungs. Particulates this small are too small to see.

**Spills or leaks**. Spilled chemicals may be evaporating into the air. Don't walk through spilled material, or get it on your bare skin.

**Visible material in the air**. If you see visible clouds of vapor or particulates, there is probably a serious exposure problem. Remember, however, that most gases and vapors are invisible, and that often the most dangerous particulates are too small to see. This is why for particulate contamination, like asbestos fibers, people say, "It's what you can't see that hurts you."

**Acute symptoms**. Many chemicals cause irritation. One whiff of ammonia warns you it's there. If you experience irritation in your respiratory system, or skin irritation, or if you have a headache or nausea, think about whether this is being caused by chemical exposure.

**Settled dust**. If there is chemical dust on the ground or other surfaces, it got there by settling out of the air. This means that there is dust in the air you are breathing. If dust settles on the ground, it can also settle on your clothes, on your hair, and on your food.

**Dead vegetation**. If plants are dead or dying, think about what chemical might have killed them.

**A**. Give two examples of acute health effects.

**1**. _____

**2**. _____

**B**. Give two examples of chronic health effects.

**1**. _____

**2**. _____

**C**. Identify five **routes of entry** by which chemicals can get into or on your body.

**1**. _____

**2**. _____

**3**. _____

**4**. _____

**5**. _____

**D**. What is a "target organ"?

_____

_____

**E**. What is a "latency period"?

_____

_____

REVIEW: TOXIC & HAZARDOUS SUBSTANCES

**F**. What are the five major requirements of HAZCOM?

1. _____
2. _____
3. _____
4. _____
5. _____

**G**. What three types of information are required by OSHA on a chemical label?

1. _____
2. _____
3. _____

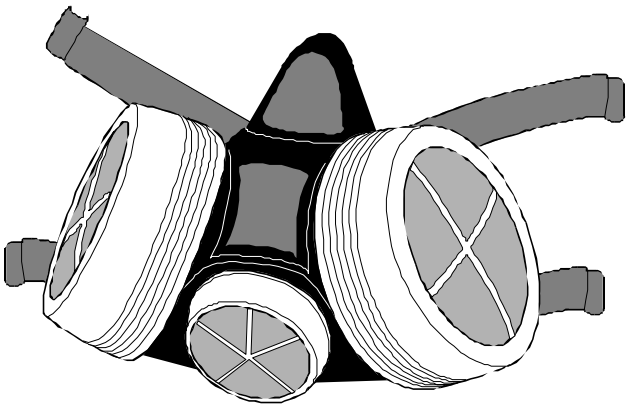
**H** What are seven warning signs that you might be exposed to hazardous chemicals?

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

# TEAMSTERS Construction Safety & Health Training

*Module 11*

# PERSONAL PROTECTIVE EQUIPMENT



International Brotherhood of Teamsters — NIEHS Worker Training Grants

**LEARNING OBJECTIVES**

✔ **IDENTIFY THE PROPER USE OF PERSONAL PROTECTIVE EQUIPMENT.**

- **a**. Identify when hard hats, safety glasses and safety boots must be worm.
- **b**. Identify when hearing protection is required.
- **c**. Identify the limitations of air purifying respirators.
- **d**. Identify the limitations of air supplying respirators.
- **e**. Explain what a protection factor is.
- **f**. Explain the proper methods for inspecting, maintaining and storing protective clothing.

# Personal Protective Equipment

Subpart E of the OSHA Construction Standards is Personal **Protective and Life Saving Equipment**. It has ten sections listed on the following page.

**Personal Protective Equipment (PPE) means** safety and health items that you wear in order to protect you from hazards on the job.

- Respirators
- Protective Clothing
- Gloves
- Safety Glasses, Goggles and Face Shields
- Hard Hats
- Ear Plugs and Ear Muffs
- Boots

**Life Saving Equipment** refers to safety nets, life lines and lanyards. In this module we will focus on PPE. We discuss life saving equipment in "Fall Protection."

# Personal Protective and Life Saving Equipment
# 29 CFR 1926 Subpart E

| | |
|---|---|
| Criteria for Personal Protective Equipment<br>29 CFR 1926.95 | Respiratory Protection<br>29 CFR 1926.103 |
| Occupational Foot Protection<br>29 CFR 1926.96 | Safety Belts, Lifelines and Lanyards<br>29 CFR 1926.104 |
| Head Protection<br>29 CFR 1926.100 | Safety Nets<br>29 CFR 1926.105 |
| Hearing Protection<br>29 CFR 1926.101 | Working Over or Near Water<br>29 CFR 1926.106 |
| Eye and Face Protection<br>29 CFR 1926.102 | Definitions Applicable to This Subpart<br>29 CFR 1926.107 |

What happened to sections .97, .98 and .99? These sections are listed in the CFR as "Reserved". This means that there is nothing in these sections, but OSHA could use them later to add new standards.



# Criteria for Personal Protective Equipment
**[29 CFR 1926.95]**

This section states that whenever personal protective equipment (PPE) is necessary, because of hazards in the workplace (chemical hazards, radiological hazards, or mechanical irritants) the PPE "...**Shall be provided, used and maintained in a sanitary and reliable condition**..."

In a situation where the employees provide their own PPE, for example, workboots, the employer is still responsible to make sure that the PPE is adequate, properly maintained and sanitary.

# Occupational Foot Protection
**[29 CFR 1926.96]**

This section is very brief. It merely says that safety-toe boots and shoes must meet ANSI Standard Z41.1. The ANSI Standard has specifications for different amounts of protection that footwear must provide, depending on the type of work the person is doing. When you buy work shoes or boots, look at the label. It should say that they meet the ANSI Standard. If not, don't buy them.

# Head Protection
**[29 CFR 1926.100]**

You must wear a hard hat in a work area where there is the possibility of:

- Injury from impact.
- Injury from falling or flying objects.
- Injury from electrical shock or burn.

Helmets for impact protection and falling/flying object protection must meet ANSI Standard Z 89.1. If you are working near live electrical circuits, then the helmet must be non-conductive and meet ANSI Standard Z 89.2. Read the label. If it doesn't meet the ANSI Standard, don't use it.

# Hearing Protection
**[29 CFR 1926.101]**

This section says that if the noise level that a worker experiences is greater than the levels in Table 1926.52 D-2, and it is not feasible to reduce the noise level, then "**ear protective devices shall be provided and used**."

We measure noise levels with an instrument called a sound level meter. It reads out in sound units called dBA's.

If you don't have a sound level meter, here's a rule of thumb: If you have to shout to be understood by a person a few feet away, then the sound level is probably above 90 dBA.

Use real ear plugs or muffs. Plain cotton is **not** an acceptable protective device.

**Table D-2**
**Permissible**
**Noise Exposures**

| Duration Per Day (Hours) | Sound Level (dBA) |
|---|---|
| 8 | 90 |
| 6 | 92 |
| 4 | 95 |
| 3 | 97 |
| 2 | 100 |
| 1 ½ | 102 |
| 1 | 105 |
| ½ | 110 |
| ¼ or less | 115 |

# Eye and Face Protection
**[29 CFR 1926.102]**

You must where eye protection if there is the possibility of:

- Eye injury from flying objects.
- Injury from hazardous chemicals.
- Injury from radiant energy such as welding arcs.

Safety glasses and goggles must meet ANSI Standard Z 87.1. Check the label.

What if you also wear prescription glasses? Usually you can wear safety goggles or a face shield over your glasses. You can also get safety glasses with your prescription ground in, but these are expensive.

If you are welding , make sure that your lenses have the correct shade number.


# When Do You Need A Respirator?

These are **three** hazardous conditions of the air that require respiratory protection:

- **Toxic Particulates**. These are tiny pieces that float in the air. There are solid particulates: dusts, powders, fibers and fumes. There are also liquid particulates: mists, sprays and fogs.

- **Toxic Gases and Vapors**. These are individual molecules of toxic chemicals that evaporate into the air. They become part of the air itself.

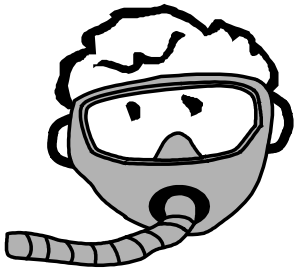
- **Oxygen Deficiency**. Too little oxygen can cause serious adverse effects, including death. The lowest level you are allowed to breathe is 19½%.

You might encounter a **combination** of two, or all three, of these conditions.

# Types of Respirators

There are two basic types of respirators:

1. **Air Purifying Respirators (APR's)**. With these you breath the dirty air around you. The respirator has filters or cartridges that try to clean the air before you inhale it.



2. **Atmosphere Supplying Respirators**. These provide a separate, clean air supply from a cylinder on your back **(SCBA)**, or through an **airline** from a cylinder or from a compressor located in a clean area.

# Air Purifying Respirators

With an **APR**, the air you breathe is the contaminated air around you. You depend on the filters or cartridges to clean the air before you inhale it. The air comes in because your breathing sucks it in. We call this suction **negative pressure**. If the respirator doesn't fit your face almost perfectly, some dirty air will get sucked in around the edge of the respirator.

There are three styles of APR that are used by construction workers:

- **Half-face APR**. Covers the chin, mouth and nose, but not the eyes.
- **Full-face APR**. Covers the chin, mouth, nose and eyes.
- **Powered air purifying respirator (PAPR)**. Has a fan that blows air through the filters or cartridges.

# Using an APR

**To safely use an air purifying respirator, all of the following must be true**:

- ✔ **You are not making a confined space entry.**
- ✔ **You know there's at least 19½% oxygen**. (APR's don't supply oxygen.)
- ✔ **You know the identity of the contaminants**. (Otherwise you can't pick the right cartridge or filter.)
- ✔ **You know the concentration of the contaminants**. (Otherwise you don't know if the respirator is rated for this concentration.)
- ✔ **You have approved filters or cartridges for these contaminants at these concentrations**.
- ✔ **You know that the concentration of contaminants is not above the IDLH level (immediately dangerous to life or health)**. (If the filters or cartridges stop working, you will be exposed to an IDLH level.)
- ✔ **The contaminants have good warning properties**. (See the next page.)


### Good Warning Properties

Filters and cartridges only last so long. After that the contaminants can pass through. The only way you'll know before it's to late is if you can smell or taste the chemical at very low concentrations, when it first starts to get through. If you can, we say the chemical has good warning properties. Many chemicals have no smell or taste, or they numb your nose, or you can only smell them after the concentration has become dangerously high. These chemicals do not have good warning properties.


## When is An Air Supplying Respirator Required?

Air supplying respirators give you a clean source of air. You don't breathe the dirty air around you. **You must use an air supplying respirator for**:

- ✔ **Confined space entry**.
- ✔ **Less than 19½% oxygen in the air**.
- ✔ **You don't know the identity of the contaminants**.
- ✔ **You don't know the concentration of the contaminants**.
- ✔ **There are no filters or cartridges approved for these contaminants at these concentrations**.
- ✔ **Levels above IDLH (immediately dangerous to life or health)**.
- ✔ **The contaminants don't have good warning properties**.

Air supplying respirators provide much greater protection than APR's, and you can use then in oxygen deficient atmospheres. However:

- SCBA's are heavy. Cylinders can weigh 25-35 pounds.
- Air line respirator hoses may limit your movement. The hose is awkward to handle, and can get caught or damaged.

# Air Supplying Respirators

There are two styles of air supplying respirators:

- **Self contained breathing apparatus (SCBA)**. The air comes from a cylinder on your back. There are half-hour and one-hour cylinders. These usually last less than the stated time.

- **Air line respirator (also called a supplied air respirator or SAR)**. The air comes through a hose from a storage cylinder or air compressor. There's a danger that the air hose could be cut or kinked, stopping the air. For this reason, you should always have a 5-minute escape cylinder which you can turn on if the hose fails.

SCBA's, and SAR's with escape cylinder, provide the best protection available.

# How Much Protection Does A Respirator Provide?

No respirator is perfect, but some types provide more protection than others. NIOSH assigns **protection factors** to different respirators. The protection factor tells how much cleaner the air inside the respirator is than the air outside.

**NIOSH Protection Factor (PF)**

| | |
|---|---|
| **Quarter-face APR** | **5** |
| **Half-face APR** | **10** |
| **Full-face APR** | **50** |
| **PAPR** | **50** |
| **Air line without escape cylinder** | **2,000** |
| **SCBA** | **10,000** |
| **Air line with escape cylinder** | **10,000** |

Here's an example: If the PF is 10, this means the air inside the respirator should be ten times cleaner than the air outside the respirator. If the air outside the respirator has 1000 ppm of a contaminant, then the air inside — the air you actually breathe — ought to be 100 ppm.

# Protective Clothing

There are many types of protective clothing. These include hard hats to protect the head from bumps and from small, falling objects. Safety glasses to protect the eyes from flying pieces. Chemical goggles and face shields to protect the eyes from chemical splashes. Safety shoes and boots to protect the feet from cuts and punctures, and from being crushed. Stainless steel mesh gloves to protect the hands from cuts. Leather gloves to protect the hands from abrasion. And many others.

# Chemical Protective Clothing

You may think that you have pretty tough skin, but it's not designed for the chemical and physical abuse that it's exposed to in the workplace, like sunburn, cuts, scrapes, burns and chemical exposures. Skin is the site of three routes of entry for chemical exposures: skin contact, skin absorption and injection.

The type of protective clothing that is intended to protect you from **skin contact** and **skin absorption** is called **chemical protective clothing**, or **CPC**.

It's often easy to ignore skin exposures. We think, "I'll just wash it off later". However, in addition to damaging the skin itself, chemicals that are absorbed through the skin go to every part of the body where they might damage other organs, affect the nerves, cause cancer or cause reproductive effects.

There are many types of CPC. They cover different parts of the body; they have different kinds of closures (zippers, etc.); and they may or may not have room inside for other protective equipment. Here are some examples:

- Two piece chemical splash suits.
- One piece chemical splash suits.
- Encapsulating chemical suits.
- Vapor resistant totally encapsulating suits.
- Chemical resistant gloves.
- Chemical resistant boots.

# Choosing the Right Protective Clothing

There are several things to consider in selecting the right CPC:

- **Chemical resistance**. You need to know how well it resists chemicals.
- **Strength**. Will it tear easily? Will the seams split? Will the zipper break?
- **Heat, cold** and **sun**. Will it deteriorate in heat,cold, or sunlight?
- **Use with respirators**. Is it designed to allow you to wear a respirator?
- **Cleaning**. Can it be decontaminated?
- **Fit**. Does the it fit you comfortably? Does it allow full range of motion?
- **Cost**. Cheap CPC may cost more in the long run. Inadequate CPC doesn't last as long, and may increase injuries and illness.

You select CPC on the basis of manufacturers' specifications and selection charts, and information in reference books. Here are the most common CPC materials:

| Material | Protects Against | Limitations |
|---|---|---|
| **Natural rubber** | Bases, some alcohols and dilute acids. Inexpensive. | Dries out with age. Poor for organic chemicals. Some people allergic to it. |
| **Neoprene** | Many organic chemicals, and dilute acids and bases. | Less acid resistant than PVC. Poor for chlorinated solvents. |
| **Nitrile** | Petroleum products, alcohols, dilute acids and bases, PCP's. | Poor for organic chemicals, gets stiff in cold weather. |
| **Polyurethane** | Alcohols, petroleum products. | Poor for acids and bases. |
| **Polyvinyl chloride (PVC)** | Many acids, bases, peroxides and some organic chemicals. | Poor for chlorinated solvents and many organics. |


# Taking Care Of CPC

Inspect your chemical protective clothing *before* you wear it. Check it for:

- Tears, holes and cuts.
- Evidence of contamination.
- Damaged zippers, seals or valves.

**Do not use CPC that is damaged or contaminated**.

After CPC is used, it must be either:

- Thoroughly decontaminated before it is stored; ***or***
- Disposed of. Contaminated CPC is considered a hazardous waste.

It is difficult to thoroughly decontaminate CPC. You might not be able to see or feel chemicals that have soaked into the CPC material.

After decontamination, make sure that the CPC is dry. Store it in a cool, dry place according to the maker's directions.

REVIEW: PERSONAL PROTECTIVE EQUIPMENT

**A**. List the three hazardous conditions of the air that might require the use of a respirator.

**1**. _____

**2**. _____

**3**. _____

**B**. What are the two basic types of respirators?

**1**. _____

**2**. _____

**C**. With an air purifying respirator (APR), the air you breathe comes from:

_____

**D**. What does it mean if a chemical does not have *good warning properties*?

_____

_____

_____

_____

_____

_____



**E**. List nine conditions that must all be true in order to wear an air purifying respirator:

_____

_____

_____

_____

_____

_____

_____

**F**. When should you inspect your chemical protective clothing?

_____

_____

**G**. What is a protection factor?

_____

_____

**H**. When must you wear hearing protection?

_____

_____

# TEAMSTERS Construction Safety & Health Training

*Module 12*

# CONFINED SPACES

International Brotherhood of Teamsters — NIEHS Worker Training Grants

## LEARNING OBJECTIVES

✔ **IDENTIFY THE PROPER PROCEDURES FOR WORKING SAFELY IN CONFINED SPACES.**

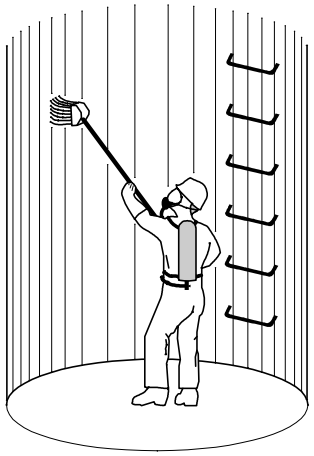
- **a**. Identify a confined space.
- **b**. Identify five reasons why entering and working in a confined space can be very dangerous.
- **c**. Identify safe entry procedures and work practices for confined spaces
- **d**. Explain why air monitoring is important before entering a confined space.

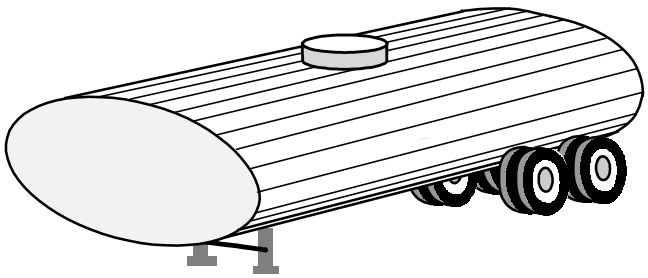
# Confined spaces can be deadly places.

If you are required to work in a confined space, or if you are the standby person while others are inside a confined space, then you and your co-workers need to know the proper procedures for safe entry.

You also have to know how to initiate the rescue procedure if an emergency arises. Only a properly trained and equipped rescue team should attempt a confined space rescue.

**More than half of the workers killed in confined space accidents each year are would-be rescuers who die when they attempt to help their fellow workers, but who do not have the proper training and equipment**.





# Some True Stories

The following descriptions are taken from official reports of the National Institute of Occupational Safety and Health (NIOSH).

## Case No. 1

A 20-year-old construction worker died while attempting to refuel a gasoline engine powered pump used to remove waste water from a 66 inch diameter sewer line that was under construction. The pump was approximately 3,000 feet from where the worker had entered the line. The worker was overcome by carbon monoxide. A co-worker, who had also entered the sewer line, escaped. A 28-year-old state inspector entered from another point along the sewer line and died in a rescue attempt. Both deaths were due to carbon monoxide intoxication. In addition to the fatalities, 30 firefighters and 8 construction workers were treated for carbon monoxide exposure.

## Case No. 2

A 27-year-old sewer worker entered an underground pumping station (8' x 8' x 7') via a fixed ladder in a three foot diameter shaft. Because the crew was unaware of procedures to isolate the work area and ensure that the pump had been bypassed, the transfer line was still under pressure. When the workers removed the bolts from an inspection plate that covered a check valve, the force of the waste water blew the inspection plate off, allowing sewage to flood the chamber, and trapping one of the workers. A co-worker, a supervisor, and a policeman attempted a rescue and died. The first two deaths appeared to be due to drowning and the latter two appeared to be due to inhalation of "sewer gas."

## Case No. 3

A 22-year-old worker died inside a toluene storage tank that was 10 feet in diameter and 20 feet high while attempting to clean the tank. The worker entered the tank through the 16 inch diameter top opening using a 1/2 inch rope for descent. Although a self-contained breathing apparatus was present, the worker was not wearing it when he entered the tank. The worker was overcome and collapsed onto the floor of the tank. In an attempt to rescue the worker, fire department personnel began cutting an opening into the side of the tank. The tank exploded, killing a 32-year-old firefighter and injuring 15 others.

# OSHA Standards for Confined Spaces

OSHA has a Confined Space Standard which is part of the Standards for General Industry. It contains detailed requirements for confined space work. The standard requires warning signs, air monitoring, entry permits, worker training, standby attendants, rescue plans and a written confined space program. This standard does **not** apply to the Construction Industry.

The OSHA Standards for the Construction Industry do include this general requirement for confined space work:

> **29 CFR 1926.21(b)(6)(i) Safety training and education**
> All employees required to enter into confined or enclosed spaces shall be instructed as to the nature of the hazards involved, the necessary precautions to be taken, and in the use of protective and emergency equipment required. The employer shall comply with any specific regulations that apply to work in dangerous or potentially dangerous areas.
>
> **(ii)** For the purposes of paragraph (b)(6)(i) of this section, "confined or enclosed space" means any space having a limited means of egress, which is subject to the accumulation of toxic or flammable contaminants or has an oxygen deficient atmosphere. Confined or enclosed spaces include, but are not limited to, storage tanks, process vessels, bins, boilers, ventilation or exhaust ducts, sewers, underground utility vaults, tunnels, pipelines, and open top spaces more than 4 feet in depth such as pits, tubs, vaults, and vessels.

# What Makes Confined Spaces Dangerous?

Any hazard could exist in a confined space. But because it's in a confined space, it's probably more dangerous. Even worse, if an injury or over-exposure occurs, it's hard to get out, or to be rescued.

A*ny one* of these conditions can create a hazardous confined space situation:

## 1. Not designed for normal, continuous occupancy

It's not designed for people. There may not be enough room to stand up. There may be obstructions on the floor. There may not be enough light. In other words, the space was meant for something else, like storing liquids, or collecting run-off, not for people to work in.

## 2. Hard to get in and out

There probably isn't a big, easy to open and walk-through door. Instead, there's a manhole or other small opening that you have to crawl through, or be lowered into. You may need a special harness and hoist in order to be pulled out quickly in an emergency.

## 3. Poor natural ventilation

There probably aren't windows. There might not be any means of natural ventilation. Without ventilation, toxic or flammable gases can accumulate, or the oxygen we need to breath could be used up.

## 4. May contain a hazardous atmosphere

A minor spill or a small amount of residue might give off enough vapor to create a toxic or explosive condition. Fumes from welding, or vapors from paints and cleaning solvents can accumulate quickly. Chemical reactions, or the presence of microbes may use up oxygen. Toxic or flammable vapors may seep into manholes, sewer lines and trenches from adjacent contaminated soil.

## 5. May contain other safety hazards

Some confined spaces contain augurs, mixing blades or other moving machinery. Some have pipes through which acids, corrosives or other liquids can enter. There may be hazardous electrical equipment. There may be extreme (high or low) temperatures.

# Is It a Confined Space?

Here is an exercise is to help you to recognize what is a confined space. There are many different kinds of confined spaces. Sometimes it's not obvious at first whether you're dealing with a confined space or not.

Here are four different situations. Decide whether each one is a confined space. If it is, write down the hazardous conditions which make it so.

| Description | Confined Space Yes or No? | What makes it hazardous? |
|---|---|---|
| A vertical chemical storage tank (diameter 20 feet, height 30 feet) with an 18 inch hatch in the top. The tank has been drained. | | |
| A 24 inch diameter sewer line with manholes located approximately every 50 yards. | | |
| A 30 foot by 20 foot basement room containing several drums of unidentified materials. There is a single door providing access. | | |
| A trench five feet deep and 60 yards long located at a site where various liquid chemicals have been improperly dumped. | | |

## Before You Enter a Confined Space

- Make sure that you know what the hazards are so that you can be prepared.
- Make sure that your co-workers and your foreman know that you are going to be working in a confined space.
- If there is any possibility of **toxic gas, vapor** or **dust**, make sure that the air is monitored so that you know that it is safe, or you know what kind of respirator to wear.
- If there is any possibility that there are **flammable gases** or **vapors**, make sure that the air is monitored. Don't enter if it's above 10% of the level that could cause an explosion.
- All **safety equipment** such as ventilation systems, respirators and safety harnesses must be ready.
- You must have the proper **training**.
- There should be a **rescue plan** so you know what to do in an emergency.

## While Someone is Inside

- It is safest if there is a **standby person** who is in contact with the people inside the space, and who is trained to start the rescue process.
- If there is a possibility of a toxic or flammable atmosphere then there should be air monitoring to make sure that conditions don't get worse.

## Rescue

More than half the workers who die in confined space accidents are would-be rescuers. They don't have the proper training or equipment, but they enter a confined space anyway to try to save their fellow worker. After they collapse, someone else enters, and also dies. You must follow the rescue plan. Only the properly trained and equipped rescue team should attempt a rescue.

# Monitoring the Air

The most common cause of death in confined space accidents is that workers are asphyxiated or poisoned because the air is not safe to breathe. There may be a toxic contaminant such as carbon monoxide. There may be a lack of oxygen.

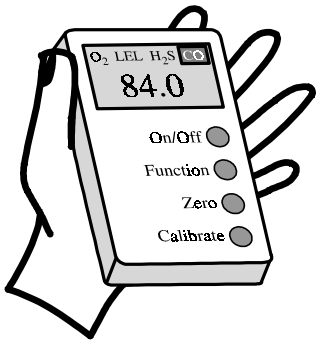
Another common cause of death is fire or explosion caused by flammable contaminants in the air.

Because a confined space is "confined" it's hard for fresh air to get in. The level of contaminants can easily rise to a dangerous level. This is why it is so important to monitor the air **before you enter a confined space** if there is any possibility of a hazardous or oxygen deficient atmosphere.

There are small, portable instruments that can be used to measure the air in a confined space. Each instrument can be connected to a flexible tube so that the air can be checked without a worker actually going into the confined space.

There are instruments that will measure the following air problems:

- Toxic Substances such as
  - Carbon Monoxide
  - Hydrogen Sulfide
- Oxygen Deficiency
- Flammability




Your life or health may depend on the accuracy of monitoring equipment. Instruments are worthless unless you know that they are functioning properly. This means regular inspection and servicing, proper storage, and being calibrated to the contaminant or condition they will measure.

There should be a designated person trained to inspect and calibrate the equipment regularly, and to assure that it is stored properly. Internal adjustments or other specialized service should be done by a qualified technician.

**A**. What are five reasons why entering or working in a confined space can be very dangerous?

1. _____

2. _____

3. _____

4. _____

5. _____

**B**. More than half of the workers killed each year in confined space accidents are:

_____

_____

**C**. Give six examples of confined spaces that might be on a construction site.

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

REVIEW THIS MODULE: CONFINED SPACES



**D**. What are seven safe work practices for confined spaces?

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

**E**. Why is it important to monitor the air in a confined space before entering?

_____

_____

_____

_____

# TEAMSTERS
# Construction
# Safety & Health Training

## *Module 13*
# FIRE PROTECTION and PREVENTION

International Brotherhood of Teamsters — NIEHS Worker Training Grants

## LEARNING OBJECTIVES

✔ **IDENTIFY THE MAIN REQUIREMENTS FOR FIRE SAFETY AT CONSTRUCTION SITES.**

- **a**. Define "Flammable" and "Combustible."
- **b**. Identify the four components of the fire pyramid.
- **c**. Identify the four classes of fire extinguishers and the class of fire each is used for.
- **d**. Identify the purpose of bonding containers of flammable materials.
- **e**. Identify the purpose of grounding containers of flammable materials.
- **f**. Identify five general fire safety requirements for construction sites.

# The OSHA Fire Protection & Prevention Standard

Fire Protection and Prevention is Subpart F of the OSHA Construction Standards. This standard has ten sections that are shown on the following page.

Fire is a serious danger at construction sites. Many building materials, such as wood, are combustible. Also, there are often many flammable and combustible materials in use, including gasoline, and diesel fuel, cleaning solvents, and paints. Kerosene and liquefied petroleum gas are often used for temporary heating. Waste materials can also accumulate on the site and create a fire hazard.

Construction work often includes activities, such as welding and cutting, that can ignite flammable and combustible materials. Electrical equipment, power tools, and motor vehicle exhaust can also be sources of ignition.

It is essential that the employer have a practical, comprehensive fire protection and prevention plan that include the necessary equipment and safe work practices to prevent, as far as possible, the risk of fire. The plan must also include how workers and management will respond in the event a fire does break out.

# The Fire Protection and Prevention Standard
# 29 CFR 1926 Subpart F

| | |
|---|---|
| Fire Protection 29 CFR 1926.150 | Definitions for This Subpart 29 CFR 1926.155 |
| Fire Prevention 29 CFR 1926.151 | Fixed Extinguishing Systems, General 29 CFR 1926.156 |
| Flammable and Combustible Liquids 29 CFR 1926.152 | Fixed Extinguishing Systems, Gaseous Agent 29 CFR 1926.157 |
| Liquified Petroleum Gas (LPG) 29 CFR 1926.153 | Fire Detection Systems 29 CFR 1926.158 |
| Temporary Heating Devices 29 CFR 1926.154 | Employer Alarm Systems 29 CFR 1926.159 |

# Fire Protection
## [29 CFR 1926.150]

**Fire Protection Program**: The employer shall have a comprehensive Fire Protection Program in place throughout all phases of the construction project.

**Fire Extinguishers**: There must be adequate fire extinguishers of the right kind for the classes of fire that might occur.

**Fixed Firefighting Systems**: If the facility that is being constructed includes an automatic sprinkler system, then the installation of the sprinkler system shall closely follow the building construction. The sprinkler system shall be placed in service as each floor is completed (subject to applicable local inspection and permitting).

**Fire Alarms**: An alarm system, which may be a telephone, must be provided to allow employees to alert the local fire department in case of emergency.

**Fire Cutoffs**: If the project includes fire doors with automatic closing devices, emergency stairs or fire walls, these shall be installed as soon as practicable.

# Fire Prevention
## [29 CFR 1926.151]

**Ignition Hazards**: All wiring and electrical equipment shall be installed in accordance with the Electrical Standard (Subpart K).

**Internal Combustion Engines**: Locate equipment powered by internal combustion engines so that the exhaust is not directed toward combustible materials.

**No Smoking**: Smoking shall be prohibited around any operation, equipment or material that poses a fire hazard. Post "NO SMOKING or OPEN FLAME."

**Housekeeping**: The entire site shall be kept free from the accumulation of unnecessary combustible materials.

**Storage**: Storage shall not obstruct the path of travel to emergency exits.

# Fire

## Combustion

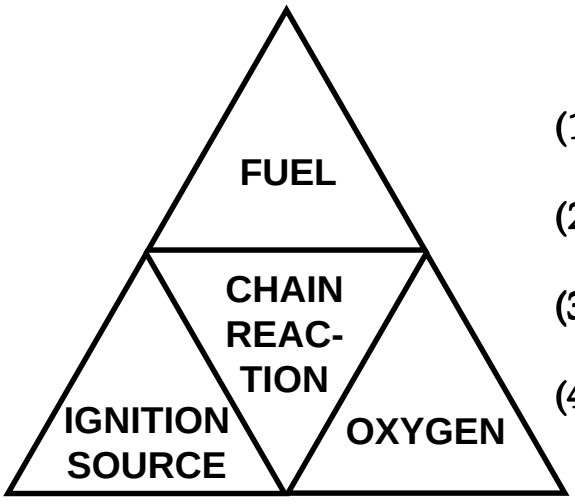
Many materials are hazardous because they can burn. **Combustion** is the technical name for burning. It is the chemical reaction between fuel and oxygen which gives off heat and light. **Fire** is one form of combustion. Some fires produce flames. Others may just smolder.

A material which can act as a fuel (that is, can burn) is called **combustible**. If a material won't burn under normal conditions, it's called **noncombustible**.

Some materials burn so fast that we call it an **explosion.** An explosion is a form of combustion that happens very quickly, releasing heat and pressure in a fraction of a second. This kind of explosion is a super fast fire.

## The Fire Pyramid

Four things are necessary for fire to happen. We call this the **fire pyramid**:




**(1) Fuel.**

**(2) Oxygen.**

**(3) Ignition Source** (heat) to start the process.

**(4) Chain Reaction** to keep the fire going.

If any component is missing, the fire can't start.

To put a fire out, we remove at least one component of the pyramid.

An **ignition source** is anything hot enough to start the fuel burning. Some examples of ignition sources are: a match, a spark of static electricity, an electric current, lightning, a welding torch, and friction.

The lowest temperature that the ignition source can be and still start a particular fuel burning is called the **ignition temperature** of the fuel. It's different for different fuels.

In order for the fire to continue, the heat created by the part of the fuel which starts burning first has to spread to more of the fuel, causing it to burn. This produces more heat, which starts more fuel burning, which creates more heat, and so on. This is the **chain reaction**.

Try to start a "2x4" on fire using a match. You have fuel, oxygen, and an ignition source. You won't be able to keep a fire going because the heat from the initial reaction (where the match flame touches the wood) is absorbed by the wood and dissipated. There isn't enough heat to keep a chain reaction going.

## Flammable Materials

Some liquids that burn have a different name: **flammable**. A flammable liquid is one which gives off enough vapors **under normal conditions** that a small ignition source (like a spark) can ignite the vapors.

For example, gasoline is a flammable liquid. It evaporates easily. This means that lots of molecules of gasoline go up into the air where they mix with oxygen. A tiny spark provides enough heat to burn the gasoline molecules near the spark. This creates more heat which burns the surrounding molecules, which makes more heat, which starts more molecules burning, and so on. This chain reaction happens so fast that it seems like all the vapor ignited at once. The heat also makes more liquid evaporate so there is more fuel in the air, which causes more liquid to evaporate and burn. This continues until all the liquid has vaporized and burned, or until the fire is put out.

Now consider diesel fuel. Under normal conditions diesel won't ignite with a spark. It gives off vapor — that's why you can smell it. However, it doesn't give off enough to create a mixture in the air that can sustain a chain reaction. The molecules are too few, too far apart. (No chain reaction: no fire pyramid.)

## Flash Point

Liquids evaporate more easily as they get warmer, and they evaporate less if they are colder. The **flash point** is the l**owest temperature** of a **liquid** at which it evaporates enough vapor so that a spark will ignite the vapor.

A low flash point tells you a material is dangerous. Consider gasoline. It's flash point is about minus 45 degrees. If gasoline is warmer than minus 45, there will be enough vapor to have a fire or explosion. This means that in any situation (except maybe at the South Pole) liquid gasoline creates enough vapor to burn.

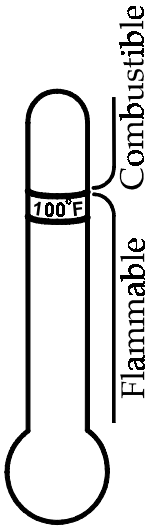
Diesel fuel has a flash point around 130 degrees Fahrenheit. Usually it's not that hot, so it doesn't give off enough vapor to ignite with a spark. If it does get that hot, then there would be enough vapor to ignite with a spark.

A **flammable liquid** is one which has a flash point low enough so that under normal conditions there's enough vapor that a spark will ignite it.

A **combustible liquid** is one which has a flash point higher than the temperatures we consider normal. This means that under normal conditions there won't be enough vapor for a spark to ignite it.

What's normal temperature? We use 100 degrees Fahrenheit as the cutoff:

- If the flash point is below 100°F, the material is considered flammable.
- If the flash point is 100°F or above (up to 200°F), it's combustible.




The idea is that most of the time the temperature doesn't get above 100 degrees, so it isn't hot enough for a combustible liquid to give off enough vapor to ignite. But it's often hot enough for a flammable liquid to reach its flash point and create a fire or explosion hazard. We need to be more careful with flammable liquids because an ignition source such as a spark could cause a fire or explosion.

Remember also that it's possible for a combustible liquid to get hotter than 100 degrees. This could happen in a tank on a sunny day, in drums in a sealed trailer in the sun, or on a warm day in Tucson.

# Bonding and Grounding of Containers

## Sparks can ignite flammable materials.

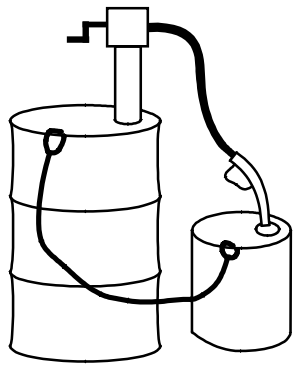
It is essential to prevent sparks when handling flammable liquids because a spark can ignite the vapors. **Static electricity** is one thing that causes sparks.

**Static electricity** is created when two different materials rub together. Friction moves electrons from one object to the other. If the extra electrons have no way to leave their new home, they just sit there. That's why it's called static electricity.

A spark occurs when the object with the extra electrons gets close to another object that can conduct electricity. The electrons jump through the air to the conductor. When you walk across a nylon carpet wearing rubber soles, electrons transfer from the carpet to your shoes. When your are about to touch a metal door knob, the electrons rush through your body and jump to the knob.

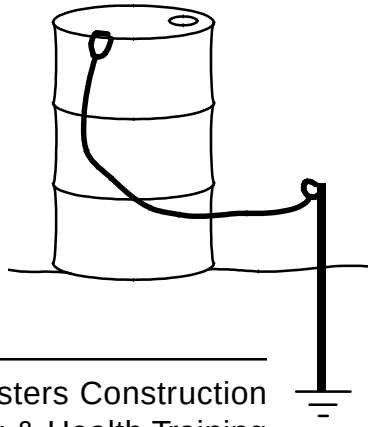
When liquid flows through a hose, friction causes electrons to transfer from the liquid to the hose. When the spout touches another container, there could be a spark which ignites the vapors coming from the liquid.

## Bonding and Grounding Prevent Sparks.



**Bonding** is connecting a good conductor between two containers so that extra electrons on one container can flow easily to the other container without sparking.

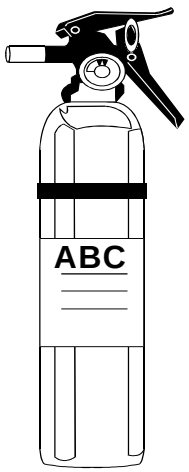
**Grounding** is connecting a good conductor between a container and the earth. This prevents a spark from jumping between the container and a metal object that is in contact with the earth.



Not just any old wire will do. Use heavy gauge copper wire with special connectors that are designed for this purpose. These connectors are either clamps with sharp pointed screws, or special heavy duty clips. The connector has to make a good contact with the container, piercing through the rust or paint.

# Fire Extinguishers

There are often many different many flammable and combustible liquids on a construction site: fuel and lubricants for vehicles, paints, solvents, etc. There are also combustible solids such as wood and paper. If a fire starts, the first line of defense is often the portable fire extinguisher.




There are different types of extinguishers for different types of fires. Using the wrong type of extinguisher could be ineffective, or even dangerous. For example, using water on an oil fire will spread the fire because the burning oil can float on top of the water. The heat could also cause the water to boil with explosive force, blowing burning oil in all directions. Also, using water on a fire around electrical equipment may cause electrical short circuits that damage equipment or cause an electrocution hazard.

If you might be expected to use a fire extinguisher, then you should have hands-on training on how to use it properly.

**The NFPA Classification of Fires and Fire Extinguishers**

**A** For cellulose fuels like wood and paper. These extinguishers may contain water, multipurpose dry chemical or halon.

**B** For flammable or combustible liquids. These extinguishers may contain dry chemical, carbon dioxide or halon.

**C** For fires around electrical equipment. These use an agent that does not conduct electricity (carbon dioxide, dry chemicals or halon). These agents are effective against other types of fire, so a type C extinguisher also has an A or a B rating, or all three (ABC).

**D** Fires of combustible metals such as magnesium or sodium. Water and some common extinguishing agents react with these metals making the fire worse. The agent used depends on the metal for which the extinguisher was designed.

| Extinguishing Agents | | | | |
|---|---|---|---|---|
| **Extinquishing Agent** | **Use on** | **How it Works** | **Advantages** | **Disadvantages** |
| **Water ($H_20$)** | **A** | Removes "heat" from the fire pyramid. Makes the fuel too cold to burn. | Very effective on class A fires.<br>Inexpensive.<br>Readily available and plentiful.<br>Non--toxic. | Conducts electricity.<br>May spread class B fires.<br>Freezes in cold climates.<br>May carry pollutants in run-off water. |
| **Carbon Dioxide ($CO_2$)** | **B-C** | Removes "oxygen" from the fire pyramid. | Effective on class B & C fires.<br>Does not conduct electricity.<br>Does not react with most other chemicals.<br>Does not leave a residue. | Dissipates rapidly — smoldering. materials may re-ignite.<br>1½ times heavier than air — can collect in low areas.<br>Need more than 35% by volume in air in a total flooding system.<br>More than 4% in air is toxic.<br>Chilling may damage equipment. |
| **Dry Chemical (Sodium Bicarbonate)** | **B-C** | Breaks the "chain reaction" in the fire pyramid. | Very effective on class B & C fires.<br>Does not conduct electricity.<br>Generally considered to be non-toxic. (Sodium bicarbonate is the same thing as baking soda.) | Leaves a residue.<br>Obscures vision.<br>Not effective on deep-seated classs A fires.<br>Absorbs moisture and may "cake" in the container.<br>Irritating to some people.<br>Nozzle pressure may cause burning liquids to splash. |

## Extinguishing Agents (continued)

| Extinquishing Agent | Use on | How it Works | Advantages | Disadvantages |
|---|---|---|---|---|
| **Multi-Purpose Dry Chemical (Ammonium Phosphate)** | **A-B-C** | Breaks the "chain reaction" in the fire pyramid. | Effective on class A, B & C fires.<br>Does not conduct electricity. | Obscures vision.<br>More irritating than regular. dry chemical agent.<br>Nozzle pressure may cause burning liquids to splash. |
| **Halon 1211** (Bromochloro-difluoromethane) | **A-B-C** | Breaks the "chain reaction" in the fire pyramid. | Effective on class A, B & C fires.<br>Does not leave a residue.<br>It's a liquid at room temperature, so it can be sprayed from a portable fire extinguisher. | Acutely toxic — 4% in air causes dizziness and heart arrythmia<br>Need more than 5% to work.<br>Toxic decomposition products.<br>Much heavier than air — collects in low areas.<br>Depletes the ozone layer.<br>Chilling may damage equipment. |
| **Halon 1301** (Bromo tri-fluoromethane) | **A-B-C** | Breaks the "chain reaction" in the fire pyramid. | Effective on class A, B & C fires.<br>Not considered toxic at less than 10% by volume in air. Generally used at less than 7% by volume.<br>Does not leave a residue.<br>Does not cause chilling. | Acutely toxic — More than 10% by volume in air can cause dizziness, disorientation and heart arrythmia.<br>Toxic decomposition products.<br>5 times heavier than air — collects in low areas.<br>Depletes the ozone layer. |
| **Carbon Tetrachloride** | Very toxic. Can damage the liver, kidneys and nervous system. Carbontetrachloride is no longer used as an extinguishing agent. If you have an old carbon tetrachloride extinguisher, dispose of it as hazardous waste. | | | |

## Construction Site Fire Safety Checklist

- ✔ Approved containers used for the storing and handling flammable and combustible liquids.
- ✔ All flammable liquids kept in closed containers when not in use (for example, parts-cleaning tanks, pans, etc.).
- ✔ Rigid separators between containers of combustibles or flammables, when stacked one upon another, to assure their support and stability.
- ✔ Fuel gas cylinders and oxygen cylinders separated by distance, and fire-resistant barriers, while in storage.
- ✔ Storage tanks adequately vented to prevent the development of excessive vacuum or pressure.
- ✔ Storage rooms for flammable and combustible liquids have explosion-proof lights.
- ✔ Storage rooms for flammable and combustible liquids have adequate ventilation.
- ✔ Bulk drums of flammable liquids grounded and bonded to containers during dispensing.
- ✔ Safety cans used for dispensing flammable or combustible liquids at a point of use.
- ✔ All spills of flammable or combustible liquids cleaned up promptly.
- ✔ Combustible scrap, debris, and waste (oily rags, etc.) stored in covered metal receptacles and removed from the work site promptly.

- ✔ Flammable and combustible liquid wastes kept in fire-resistant, covered containers until they are removed from the worksite.
- ✔ Proper fire extinguishers provided for the types of materials in areas where they are to be used.
- ✔ Proper fire extinguishers mounted within 75 feet of outside areas containing flammable liquids, and within 10 feet of inside storage area for such materials.
- ✔ All extinguishers free from obstructions or blockage.
- ✔ All extinguishers serviced and tagged at intervals not to exceed 1 year.
- ✔ All extinguishers fully charged and in their designated places.
- ✔ If sprinkler systems are permanently installed, the nozzle heads are directed so that water will not spray into operating electrical equipment.
- ✔ LPG (propane) stored, handled, and used in accordance with safe practices and standards.
- ✔ LPG tanks guarded to prevent damage from vehicles.
- ✔ "NO SMOKING" signs posted on LPG tanks.
- ✔ "NO SMOKING" signs posted in areas where flammable or combustible materials are used or stored.
- ✔ "NO SMOKING" rules enforced.

(Adapted from OSHA *Self Inspection Checklist*, May, 1997)

**A**. Define these terms:

Combustible: _____

_____

Flammable: _____

_____

**B**. What are the four parts of the fire pyramid?

**1**. _____ 3. _____

**2**. _____ 4. _____

**C**. What's burning in each of these classes of fire?

**Class A** _____

**Class B** _____

**Class C** _____

**Class D** _____

**D**. What is the purpose of:

**Bonding containers of flammable liquids?** _____

_____

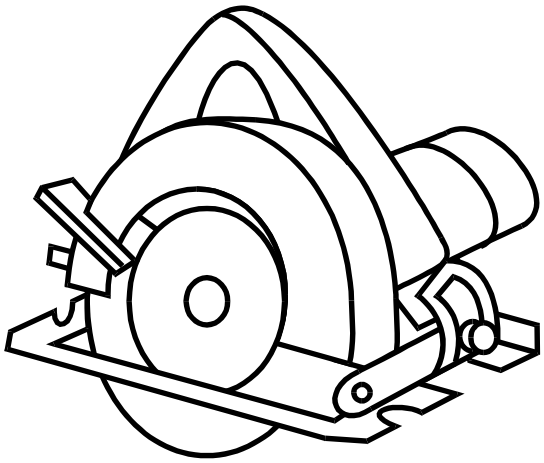
**Grounding containers of flammable liquids?** _____

_____

REVIEW: FIRE PROTECTION & PREVENTION

# TEAMSTERS
# Construction
# Safety & Health Training

## *Module 14*
# TOOLS —
# HAND & POWER



International Brotherhood of Teamsters — NIEHS Worker Training Grants

## LEARNING OBJECTIVES

✔ **IDENTIFY THE HAZARDS AND SAFE WORK PRACTICES OF HAND AND POWER TOOLS.**

**a**. Identify seven basic safe work practices for tools.

**b**. Identify importance and proper use of guards.

**c**. Identify three types of switches used on power tools.

**d**. Identify the hazards of electric tools.

**e**. Identify the hazards of abrasive wheel tools.

**f**. Identify the hazards of pneumatic tools.

**g**. Identify the hazards of liquid fuel tools.

**h**. Identify the hazards of powder-actuated tools.

# Tools — Hand and Power

**"Tools — Hand and Power"** is Subpart I of the OSHA Construction Standards. It has eight sections which are listed on the facing page.

We often forget that tools are dangerous. We forget to use safe work practices. Unfortunately, thousands of injuries occur because of the improper use of tools.

Tools cause many kinds of injuries, including eye injuries, lacerations, punctures, amputations, electrocutions, and burns. Using a tool the wrong way can also cause muscle and joint problems that we call "ergonomic injuries."

When we use tools we might make a hazardous situation even more risky. For example, if a tool jams or kicks back, a worker on a scaffold might lose his or her balance and fall. A worker using an electric tool near flammable liquids might ignite the vapors in the air and cause a fire or explosion.

In this module we will review tool hazards and the appropriate safe work practices and protective equipment required by the OSHA Standard.

# The Tools Standard 29 CFR 1926 Subpart I

| | |
|---|---|
| General Requirements<br>29 CFR 1926.300 | Woodworking Tools<br>29 CFR 1926.304 |
| Hand Tools<br>29 CFR 1926.301 | Jacks - Lever and Rachet, Screw and Hydraulic<br>29 CFR 1926.305 |
| Power-Operated Hand Tools<br>29 CFR 1926.302 | Air Receivers<br>29 CFR 1926.306 |
| Abrasive Wheels and Tools<br>29 CFR 1926.303 | Mechanical Power-Transmission Apparatus<br>29 CFR 1926.307 |

# Basic Safety Rule for Tools

- Use the right tool for the job.
- Examine the tool before use. Don't use a damaged tool.
- Operate tools according to the manufacturers' instructions.
- If a guard is required, use it.
- Use a ground fault circuit interrupter (GFCI) with electric tools.
- Wear the right personal protective equipment.
- Keep tools in good condition with regular inspection and maintenance.

# Hand Tools
## [29 CFR 1926.301]

"**Hand Tools**" are tools that are powered manually. They don't have motors. Examples are axes, screw drivers, hammers, chisels, scrapers, wrenches, etc.

**Impact Tools**: Wear safety glasses when using impact tools like drift pins and chisels with steel heads. A piece of the head can break off and strike your eye.

**Wrenches**: Wear work gloves if there is a possibility that a wrench might slip and injure your hand. Usually it's safer to pull a wrench rather than push it.

**Wooden Handles**: If the handle is cracked or lose, the head of the tool might fly off and strike you or another worker.

**Sharpening**: Remember that dull tools cause more injuries than sharp ones.

**Sparks**: Iron or steel hand tools may produce sparks. Use spark-resistant tools made of nonferrous materials where flammable liquids and gases are present.

**Vises and clamps**: Use a vise or clamp if necessary to hold the work securely. An insecure piece can cause the tool to slip, or cause you to loose your balance.

# Power- Operated Hand Tools
## [29 CFR 1926.302]

There are several types of power tools, based on the source of power:

- Electric
- Pneumatic (Air)
- Liquid Fuel (Gasoline)
- Hydraulic
- Powder

These safe work practices will reduce the dangers of using power tools:

- Never carry a tool by the cord or hose.
- Never yank the cord or the hose to disconnect the tool.
- Keep cords and hoses away from heat, oil, and sharp edges.
- Wear safety glasses.
- Disconnect the tool when changing blades, bits, and cutters.
- Keep and use guards and safety switches that are part of the tool.
- Hold work with clamps or a vise to free both hands to operate the tool.
- Maintain good footing and good balance.
- Dress for safety. Loose clothing or jewelry can catch in moving parts.
- Keep people not involved in the work at a safe distance.
- Disconnect tools when not using them.
- Keep tools in good condition.
- Remove damaged tools from use and tag them: "DO NOT USE."

*The employer is responsible for the safe condition of tools and equipment used by employees. Employers shall not issue or permit the use of unsafe hand tools.*

# Guards
## [29 CFR 1926.300(b)]

Hazardous moving parts of tools need guards in order to prevent accidental contact with blades, belts, gears, shafts, and pulleys. These parts should be guarded to the extent possible without preventing the proper use of the tool.

Most power tools come equipped with the proper guards. The tool is designed to be used with the guard in place. Don't decide that you know better than the engineer who designed the tool. Never remove a guard. If the tool can't do the job with the supplied guard in place, it may not be the right tool for the job.

Never remove or disable the retractable guard on a hand-held electric saw.

# Electric Tools
## [29 CFR 1926.302(a)]

The most serious hazards of electric tools are **shocks** and **electrical burns**.

**Shocks**: Shock can cause injury and even heart failure. Under certain conditions, even a small amount of electric current can result in fibrillation of the heart and death. An electric shock also can cause the user to fall off of a ladder or elevated work surface and be injured due to the fall.

**Burns:** If an electric current arcs to your body it can also cause a severe burn. Remember that an electric arc is hot enough to weld steel.

**Protection**: To protect the user from shock and burns, electric tools must have one of the following arrangements:

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

**Ground**: If you use an adapter in a two-hole receptacle, you must attach the adapter wire to a known ground. Never break off the third prong.

**Double Insulation**: 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.

Follow these safe work practices when using electric tools:

- Operate electric tools within their design limitations.
- Use gloves and appropriate safety footwear when using electric tools.
- Store electric tools in a dry place when not in use.
- Do not use electric tools in damp or wet locations unless they are approved for that purpose.
- Keep work areas well lighted when operating electric tools.
- Ensure that cords from electric tools do not present a tripping hazard.

At a construction site the employer must provide one or the other of these systems to further protect workers from shock:

- **Ground fault circuit interrupters (GFCI)** for every circuit that is not part of the permanent wiring of the building.
- An **assured equipment grounding conductor program** that assures proper grounding of every circuit that is not part of the permanent wiring of the building.

A **GFCI** will turn off the circuit if it senses a difference between the current "going" to a tool through the black wire and the current "returning" through the white wire. If the current is different, it might mean that some electricity is going through your body. The GFCI will cut the circuit and protect you.

See Module 2, "Electrical Safety," for more information of GFCI's and assured equipment grounding conductor programs.

# Safe Switches
## [29 CFR 1926.300(d)]

There are three types of switches that are used on power tools:

- Momentary ON-OFF switch. (Only "ON" while pressure is applied.)
- Momentary ON-OFF switch with a LOCK-ON that releases with a single touch of the ON-OFF switch.
- Positive ON-OFF switch. (Stays "ON" until turned "OFF".)

The following chart shows which tools can have which type of switch.

| Safe Switches for Power Tools | | | |
|---|---|---|---|
| | **Momentary ON-OFF** | **Momentary w/ LOCK-ON** | **Positive ON-OFF** |
| Circular Saw<br>Chain Saw<br>Percussion Tool | **Required** | **No** | **No** |
| Drill<br>Fastener Driver<br>Belt Sander<br>Reciprocating Saw<br>Jig, Saber or Scroll Saw (blade bigger than¼")<br>Disk Sander (disk bigger than 2")<br>Grinder (wheel bigger than 2") | **OK** | **OK** | **No** |
| Platen Sander<br>Router<br>Planer<br>Laminate Trimmer<br>Nibbler<br>Shears<br>Jig, Saber or Scroll Saw (blade ¼" or less)<br>Disk Sander (disk 2" or less)<br>Grinder (wheel 2" or less) | **OK** | **OK** | **OK** |

# Abrasive Wheel Tools
## [29 CFR 1926.303]

Abrasive wheel tools — like grinders and cutting wheels — create two special safety hazards:

- Pieces of the material being cut or ground can fly out.
- The abrasive wheel itself can shatter.

**Guards**: To protect the worker from flying pieces or a shattered wheel, there must be a guard that covers the spindle nut and at least one-half of the wheel. The fastenings must be strong enough that the guard will stay aligned with the wheel and will not come off during use. Abrasive wheel tools are manufactured with this kind of guard. Do not remove the guard. If you can't do the work with the guard in place, then you might be trying to use the wrong tool.

**Sound Test**: Before mounting an abrasive wheel, check it for cracks. To test, tap gently with a piece of hard wood. An undamaged wheel will give a clear metallic "ring. "If the wheel sounds cracked or dead, discard it.

**Wheels**: Tighten the spindle nut enough to hold the wheel in place without distorting the flange. Follow the manufacturer's recommendations. Check to make sure that the operating speed of the tool is not faster than the maximum speed that the manufacturer specified for the wheel.

Allow the tool to reach operating speed before you start to grind or cut. Don't stand directly in front of the wheel as it comes up to speed. A defective wheel can shatter when it is first turned on.

When you use an abrasive wheel tool:

- Always wear safety glasses or a face shield.
- Never clamp a hand-held grinder in a vise.
- Turn off the power when not in use.

# Pneumatic Tools
## [29 CFR 1926.302(b)]

Pneumatic tools can create these special hazards:

- Getting hit by an attachment or fastener.
- Loud noise.
- Getting injured by the pressure of the compressed air.
- Muscle and joint injury (ergonomic injury).

**Hose**: Inspect the hose. Make sure that the hose will not get damaged during use by rubbing against a sharp object, being burned or damaged by chemicals. Also make sure that it does not create a tripping hazard. Check that the tool is securely connected to the hose. There should be a clip or locking device to keep the tool from popping off. If the hose is more than ½ inch in diameter, there must be a safety valve at the compressor. This is a good idea for smaller air hoses too.

**Attachments**: Use a safety clip to secure an attachment — such as a chisel or chipping hammer — so that it cannot be ejected from the tool.

**Nails, rivets and staples**: A tool that drives nail, rivets or staples, and has pressure greater than 100 psi, must have a special device to keep fasteners from being ejected, unless the muzzle is pressed against the work surface.

**Ergonomics**: Vibrating tools, like jackhammers, can strain muscles and damage joints. Heavy rubber grips reduce these effects and provide a secure handhold.

**Noise**: Many pneumatic tools make a very loud noise. Repeated exposure to loud noise will cause hearing loss. Hearing loss is irreversible.

When you use a pneumatic tool:

- Always wear safety glasses or a face shield.
- Never point an air gun toward anyone.
- Wear ear protection (ear plug or ear muffs).

# Liquid Fuel Tools
## [29 CFR 1926.302(c)]

Fuel-powered tools, like chain saws, usually operate on gasoline. The special hazards with these tools are:

- Fire caused by flammable gasoline vapor.
- Toxic exhaust (carbon monoxide).
- Loud noise.

**Gasoline**: Gasoline is flammable: it has a very low flashpoint. This means that it gives off a lot of vapor. A spark, flame or other heat source can ignite the vapor. Keep gasoline in an approved container. When you transfer fuel from a larger tank or drum to a smaller container, bond the two containers together to prevent sparks that might ignite the vapor. Shut off the engine before refilling.

**Ventilation**: If you have to use a gasoline powered tool inside, make sure that there is sufficient ventilation to remove toxic exhaust.

**Respirator**: In an enclosed or confined space the only safe procedure is to wear an air supplying respirator to protect against carbon monoxide. A regular cartridge type respirator does not stop carbon monoxide. At this point, however, it would probably be better to use an electric or pneumatic tool instead of a gasoline powered tool.

When you use a gasoline powered tool:

- Always wear safety glasses or a face shield.
- Have fire extinguisher nearby. (Class B, BC, or ABC — not Class A).
- Wear ear protection (ear plug or ear muffs).

# Powder-Actuated Tools
## [29 CFR 1926.302(e)]

Powder-actuated tools operate like a loaded gun. Only specially trained employees should use them.

**Powder**: Select a powder level — high or low velocity — that is appropriate for the tool and the job and does not create excessive force.

**Muzzle**: The muzzle of the tool must have a protective shield to catch fragments that are projected when the tool is fired.

**Safety:** The tool must not be able to operate until it is pressed against the work surface with a force of at least 5 pounds greater than the total weight of the tool.

**Misfire**: If a powder-actuated tool misfires, hold the tool in the operating position for at least 30 seconds before trying to fire it again. If it still will not fire, hold the tool in the operating position for another 30 seconds and then carefully remove the load in accordance with the manufacturer's instructions. This will make the faulty cartridge less likely to explode. Put the bad cartridge in water immediately.

When you use a powder-actuated tool:

- Always wear safety glasses or a face shield.
- Inspect the tool before use.
- Only load the tool immediately before using.
- Never point the tool at anyone; this is no joke.
- Never leave a loaded tool unattended.
- Wear ear protection (ear plug or ear muffs).
- If the tool is damaged or defective, take it out of service immediately and tag it.

**A**. What are seven basic safe work practices for tools?

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**B**. Why are guards important? Give examples of guards on different types of tools.

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**C**. What are the three types of switch used on power tools? Give examples of tools that use each kind.

_____

_____

_____

REVIEW THIS MODULE: Tools — Hand & Power



**D**. What are the hazards of electric tools?

**E**. What are the hazards of abrasive wheel tools?

**F**. What are the hazards of pneumatic tools?

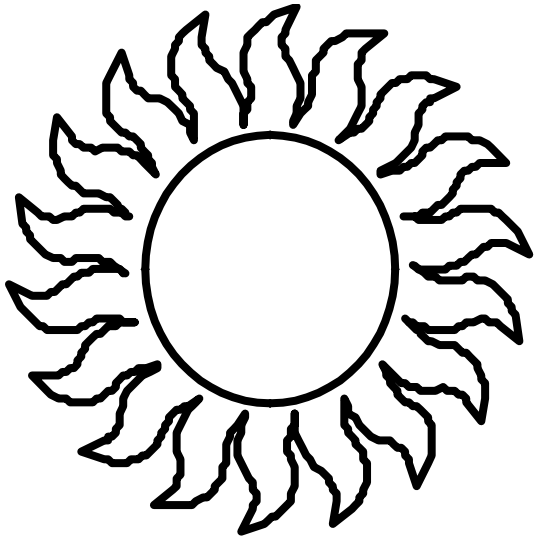
**G**. What are the hazards of liquid fuel tools?

**H**. What are the hazards of powder-actuated tools?

# TEAMSTERS
# Construction
# Safety & Health Training

*Module 15*

# HEAT, COLD, NOISE AND VIBRATION



International Brotherhood of Teamsters — NIEHS Worker Training Grants

## LEARNING OBJECTIVES

✔ **IDENTIFY THE HAZARDS OF, AND PRECAUTIONS FOR HEAT, COLD, NOISE & VIBRATION**.

- **a**. Identify the four types of heat stress.
- **b**. Identify the conditions that cause heat stress.
- **c**. Identify the steps to prevent heat stress.
- **d**. Identify the hazard caused by exposure to loud noise.
- **e**. State the ways to prevent overexposure to loud noise.
- **f**. Identify five types of cold stress.
- **g**. Identify steps to prevent cold stress.
- h. Identify what parts of the body are affected by exposure to vibration.

# Heat, Cold, Noise and Vibration

In this module we discuss four hazards that are caused by the environment in which you work. These are heat stress, cold stress, loud noise and vibration.

OSHA does not have a specific construction standard for heat stress, cold stress or vibration. It does have a construction standard for noise. The standard is called Occupational Noise Exposure 29 CFR 1926.52. It is in Subpart D.

# Heat Stress

Heat in your body comes from two sources. One is the heat your muscles make as they work. The other is heat from the environment around you.

Your body has a cooling system. As the body gets hotter, it sends more blood to the skin where heat in the blood dissipates into the air. This is like the way hot water from an engine goes to the radiator where it gives off heat. Your body also sweats. As the sweat evaporates, it takes even more heat with it.

Heat stress means that your body is having trouble keeping its temperature at the normal level — about 99°F. Your body is **overheating**:

- You are working too hard, and/or
- The environment is too hot, and/or
- Something is keeping your cooling system from working effectively.

Heat stress is possible if you are working in a hot environment. Heat stress is also possible if you are wearing protective clothing even if your work environment isn't very hot. This is because protective clothing can prevent your sweat from evaporating — which means the sweat isn't taking heat away from you body.

It's important to recognize the signs and symptoms of heat stress so that preventive action can be taken *before* heat stress causes serious problems. Preventive action means adequate rest breaks, drinking plenty of water, and not working harder than your fitness allows.

# Heat Stress Can Kill

**Heat stress** is one of the most serious hazards you might encounter in construction work. There are many possible effects of heat stress. The most dangerous effect is called **heat stroke**. Heat stroke is a serious medical condition. Almost one half of all people who experience heat stroke die as a result.

# The Four Types of Heat Stress

## Heat Rash

This is an itchy rash that occurs when the skin becomes swollen and plugs the sweat glands. This is not a life-threatening condition, but it indicates that heat stress conditions may be present.

## Heat Cramps

These are painful cramps caused when sweating diminishes water and electrolytes so that not enough are available for your working muscles. This is not life threatening, but it indicates you are working under heat stress conditions. Stop work; rest in a cool, shaded area; and drink fluids.

## Heat Exhaustion

You feel warn-out, nauseous, dizzy or faint. You are sweating a lot. You may have rapid, shallow breathing. Stop work: rest in a cool place. Drink fluids. Get medical assistance: heat exhaustion can develop into deadly heat stroke.

## Heat Stroke

This is a serious medical emergency. Call emergency medical help now! The symptoms are hot, red, dry skin; little or no sweating; very rapid pulse; dizziness; nausea; body temperature above 105 °F; delirium or possible coma. One half of all heat stroke victims die. **Get help immediately!**

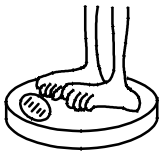
# The Danger of Protective Clothing

On some construction projects you may be required to wear impermeable protective clothing because of chemical contamination on the site. Unfortunately, these garments also trap sweat *inside*, and keep it from evaporating. Sweating only cools the body if the sweat *evaporates*. If it can't evaporate, it can't cool. Even under moderate or cool working conditions, it's possible to suffer heat stress if you're inside protective clothing that interferes with your body's cooling.

# Monitoring for Heat Stress

Take your pulse when you begin a break. If your heart rate is more than 110 beats per minute, then you should shorten your next work period, or work less vigorously. Count the beats for 15 seconds. Multiply by 4 to get beats per minute.

Take your temperature at the beginning of a break, before drinking. Keep the thermometer under your tongue for two minutes. Normal body temperature is about 99 °F. If your temperature is above 100 °F, shorten your next work period, or work less vigorously.



Weigh yourself before and after work. If you've lost more than a pound in one day, this is probably water loss. You need to drink more.

# Preventing Heat Stress

## Recognize Heat Stress In Yourself and Others

If your buddy is getting too red, sweating too much, or acting uncoordinated, don't be afraid to say something. You might be saving his life.

## Adjust the Work Schedule

Schedule heavy work in the coolest part of the day, or at night. Take breaks.

## Provide Rest Shelters

Have shaded rest shelters with chairs or benches. Air conditioning is even better.

## Drink fluids

Drink throughout the day. Don't wait until you're thirsty.Your employer is required to provide clean running water, or sanitary, insulated water jugs.

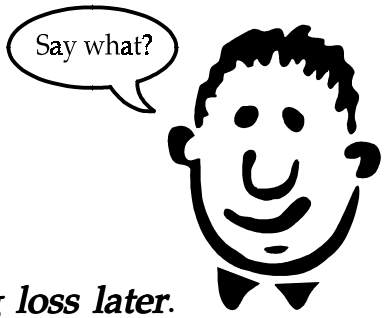
## Keep Fit

The healthier you are, the more resistant your body is to heat stress.

# Noise Exposure Can Damage Your Hearing.

Long term (chronic) exposure to loud noise levels at work can harm your hearing by damaging or destroying nerve cells in your inner ear. This kind of hearing damage is called **industrial hearing loss**.

This is a ***permanent condition***. Because it develops slowly, over several years of noise exposure, you won't notice it until it's too late, until one day when you realize that you can't understand your grandchildren, or that music just doesn't sound right anymore.




***You need to protect yourself now to prevent hearing loss later***.

## Noise Sources at Work

1. List the sources of loud noise in your work:

| Noise Source<br>(Compressor, truck engine, pneumatic chipper, etc.) | How loud is it?<br>(Very loud, can't understand someone talking, painful, etc.) | How often is it?<br>(Occasionally, several hours per day, all the time, etc.) |
|---|---|---|
| | | |
| | | |

2. What do you think could be done to make these noise sources more quiet? (Better maintenance, different model of equipment, sound insulation, etc.)

3. Do you use hearing protection? What kind? Does using hearing protection cause you any problems?

4. Is there a hearing conservation program at your job? If so, what's it like?

# Controlling Noise Exposure

OSHA has two different standards for noise exposures. One is for workers in general industry. The other standard applies to workers in construction industry.

Both standards require the employer to control noise exposure with **engineering controls** (which includes good maintenance) and **administrative controls** (like limiting the amount of time a worker is exposed) wherever possible. If, despite using engineering and administrative controls, your average exposure is 90 dBA or above, OSHA requires **hearing protection** (plugs or muffs).

# Hearing Conservation Programs

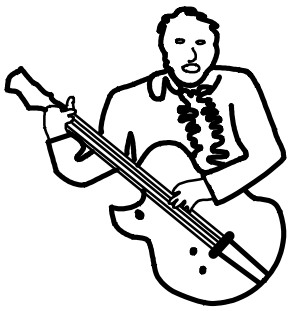
The general industry standard also requires a **hearing conservation program** if average levels are 85 dbA or above. The program must include:

- Training and information about risks and how to control them;
- Measuring noise levels at work;
- Annual hearing exams;
- Engineering and administrative controls, where feasible;
- Protective equipment; and
- Keeping records.

Even though your job is considered "construction industry," it's still a good idea to have a hearing conservation program, including training and annual exams.

## What's the difference between noise and sound?

It's like the difference between a weed and a flower. Noise is sound that's not wanted. Whether you call it sound or noise depends on your point of view. Whether it can harm your hearing depends on how loud it is and how long you are exposed. Many an aging rock star knows the hearing damage caused by exposure to loud sound.



# Measuring Noise

Noise is measured with a sound level meter which reads in "decibels". We use the abbreviation "dBA" for decibels. The "A" means that OSHA requires a certain type of sound level meter, an "A scale" meter. A conversation in a quiet room makes about 60 dBA. A jet engine can create 150 dBA.

Decibels are different than ordinary numbers. According to OSHA, every time the sound level goes up 5 dBA, **it's twice as loud!** So, 95 dBA is twice as loud as 90 dBA. 100 dBA is four times as loud as 90 dBA.

**If your average daily exposure is 90 dBA or above, OSHA requires hearing protection (plugs or muffs) to be worn.**

## How Loud Is It?

In the box at the right are some examples of typical sound levels. The actual sound level you experience from a piece of equipment depends on what it is, how well it is maintained, whether it has any sound insulation, how close you are to it and whether you are wearing hearing protection.

How the sound level affects you depends on how loud it is and on **how long you are exposed**. OSHA says that an average of 90 dBA for eight hours is the most you are supposed to receive. This is the same as just four hours at 95 dBA, 2 hours at 100 dBA, 1 hour at 105 dBA, ½ hour at 110 dbA or ¼ hour at 115 dBA

| | |
|---|---|
| **170 dBA** | Space shuttle takeoff |
| **160 dBA** | |
| **150 dBA** | Jet engine |
| **140 dBA** | Threshold of pain |
| **130 dBA** | |
| **120 dBA** | Pneumatic chipper |
| **110 dBA** | Bulldozer |
| **100 dBA** | Diesel truck passing by |
| **90 dBA** | Plugs or muffs required |
| **80 dBA** | Noisy office |
| **70 dBA** | Vacuum cleaner |
| **60 dBA** | Conversation |
| **50 dBA** | Quiet office |
| **40 dBA** | Quiet home |
| **30 dBA** | Recording studio |
| **20 dBA** | Whisper |
| **10 dBA** | The quietest sound a healthy ear can hear |

# Cold Stress

Cold stress means that your body is having trouble keeping its temperature at the normal level — about 99°F. Your temperature is falling.

Your body tries to save heat for the brain and major organs. Blood circulation to the skin, arms and legs drops to keep from losing heat. This is like the way a closed thermostat keeps coolant from circulating through the radiator if a truck engine is cold. It's the opposite of what happens when the body is too hot.

## The Five Types of Cold Stress

### Decreased Coordination

If less blood flows to your hands and feet, your nerves get numb and there is a loss of coordination. This can cause accidents in using tools and equipment.

### Frostbite

This is when part of your body actually freezes such as the nose, fingers or toes. First there is a sharp stinging sensation. However, numbness may allow frostbite to occur without you realizing it. Frostbite can result in permanent nerve damage, or in the actual loss of the part affected.

### Hypothermia

This is a severe drop in the body's temperature (below 96°F). Effects include drowsiness, irregular heartbeat, unconsciousness and death.

### Immersion Foot

Itching, swelling, and sores from wearing wet boots or gloves in the cold.

### White Finger

Vibration from jack hammers or chain saws, combined with the cold, can cause lasting nerve damage without freezing

# Preventing Cold Stress

Cold stress can occur when you work outside in the winter. It can also occur in damp, windy conditions, even when it's well above freezing.

- Wear several layers of dry clothes so that you can vary the amount of clothing to match the conditions. If there is wind, wear a windbreaker, since wind increases the effects of cold air and chills you even faster.
- Don't get overheated. Sweat can dampen clothing and lead to over-cooling.
- Keep hands, feet, ears and face warm. This is where frostbite strikes first.
- Heart disease, sedatives or excessive alcohol make you more susceptible.
- Chilled? Sleepy? Pain in your extremities? Go to a warm shelter.

# Vibration

Vibration from power tools and vehicles can damage nerves, joints and organs. Vibration can affect the whole body, as when you're seated in a vibrating vehicle cab. It can also affect specific parts of the body like the hands or wrists, as when you use vibrating tools.

Repeated exposure to **whole body vibration** can cause digestive disturbances, fatigue, loss of appetite, blurred vision, hearing loss, and damage to the kidneys.

Repeated vibration of the hands, especially when cold, can lead to an injury called Raynaud's phenomenon, or **white finger**. The symptoms include loss of color, numbness and insensitivity to pain or temperature, poor coordination, and sores on the fingertips. Chronic exposure can cause permanent disability.

Use vibrating tools only when there is no other practical method. Use tools that are designed to minimize vibration. Make sure that tools are properly maintained and adjusted. Wear warm gloves when using vibrating equipment in a cold environment. Properly maintain vehicles and cab suspension systems.

**A**. What are the four types of heat stress?

**1**. _____

**2**. _____

**3**. _____

**4**. _____

**B**. What are three conditioins that can cause heat stress?

**1**. _____

**2**. _____

**3**. _____

**C**. What are five ways to prevent heat stress?

**1**. _____

**2**. _____

**3**. _____

**4**. _____

**5**. _____

**D**. What is the hazard cause by exposure to loud noise?

_____

_____

REVIEW: HEAT, COLD, NOISE & VIBRATION

**E**. How can you prevent overexposure to loud noise?

_____

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_____

**F**. What are the five types of cold stress?

**1**. _____

**2**. _____

**3**. _____

**4**. _____

**5**. _____

**G**. What are the ways to prevent cold stress?

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**H**. What parts of the body can be injured by vibration?

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