10-Hour OSHA General Industry Safety & Health Outreach Course

2018
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Preface

This manual covers the topics that OSHA prescribes for 10-hour courses under the OSHA General Industry Outreach Safety and Health Training Program. This course may only be taught by authorized instructors who have successfully completed the OSHA General Industry Trainer Course, OSHA 501.

This manual was prepared by the Worker Training Program of the International Brotherhood of Teamsters - the Teamsters Union - with funds from the National Institute of Environmental Health Sciences.

OSHA Outreach Training Program Guidelines

The requirements of the OSHA Outreach Training Program for General Industry are outlined on the following page. You may download a complete copy of OSHA’s Guidelines for this program at www.osha.gov (Click on “Training”).

Course Requirements

This is a basic, introductory safety and health course, and there is no prerequisite for taking it. There is also no required refresher for this course, although employers and employees might benefit if workers took this course again from time to time.

This course may be taught over a period of time, no longer than six months, with each session lasting at least one hour.

Although OSHA prescribes the topics that must be included in this course, the specific content of each topic should be chosen to best meet the needs of the workers involved, taking into account their job tasks the hazards that they encounter.
The International Brotherhood of Teamsters, with 1.4 million members, is one of the largest labor unions in the world. It is also the most diverse union in the United States. The Teamsters represent all types of workers - from airline pilots to zookeepers. One out of every ten union members is a Teamster.

There are hundreds of Teamsters Local Unions across North America. The local unions and their members are the heart and backbone of the union.

Unlike other labor unions, the Teamsters Union is structured to promote strong local unions, and strong local leaders. Since the locals negotiate most Teamsters contracts and provide most of the services to the members, they keep most of the dues money. Locals retain their own expert labor lawyers, certified public accountants, full-time business agents, organizers, and clerical staff.

The Members of each local elect their own officers, devise their own structure, and vote on their own bylaws, compatible with the International Constitution and Bylaws. While enjoying their independence, the locals benefit from the expertise and assistance of the International Union, and of the various conferences and councils in the union’s structure.

Teamsters Joint Councils are set up in areas with three or more local unions. Joint Councils help coordinate Teamsters activities in those areas. They also help solve problems and decide some jurisdictional and judicial matters.

Teamster Trade Divisions and Conferences aid Teamsters leaders throughout the country who share common interests and problems. They provide an informational clearinghouse for locals that negotiate in the same industry or bargain with the same employer.
The Teamsters were one of the first unions to establish a Safety and Health Department. The Safety and Health Department is committed to protecting the health and well-being of Teamster members, their families and their communities from chemical, microbiological, and physical health and safety hazards.

The IBT Safety and Health Department includes professionals in safety, industrial hygiene and adult education.

The Safety and Health Department provides many educational resources on line. Visit www.teamster.org and click on “Resources”, and then “Safety & Health.”

The Teamsters offer safety and health training throughout the United States for:

- Construction Workers
- Hazardous Waste Workers
- Industrial workers
- Hazardous Materials Transportation Workers
- Port Workers
- Emergency Responders
- Radiological Workers
Teamster instructors use effective adult education, real equipment, and realistic hands-on activities.

Teamster instructors have experience doing the same types of jobs that trainees perform, including hazmat transportation, warehousing, construction and remediation. Instructors use participatory adult teaching techniques and hands-on activities. Instructors have completed the OSHA 500 and 501 Construction and General Industry Trainer Courses. Teamster instructors complete a period of supervised teaching and evaluation. Each instructor attends an annual Instructor Development Program that includes new regulations and work procedures, and practice teaching. Each Instructor is certified in first aid / CPR.

Teamster Training Centers have classrooms and outdoor areas for realistic hands-on activities. The Training Centers also have mobile units that can transport instructors and equipment to hold courses at hazardous waste sites, construction projects, company locations and union halls ... anywhere.

For more information, or to schedule a course, contact:

IBT Worker Training Program
25 Louisiana Avenue, N.W.
Washington, DC 20001
(202) 624-6963
(202) 624-8125 (fax)
ibt_niehsgrant@teamster.org
www.teamster.org
Learning objectives

This Chapter introduces the OSHA standards that apply to general industry, and the rights and responsibilities of workers and employers with regard to occupational safety and health.

After completing this Chapter you will be able to demonstrate your ability to:

1. DESCRIBE briefly the history and purpose of OSHA and the OSH Act.

2. IDENTIFY the safety and health rights and responsibilities of employers and employees.

4. IDENTIFY the rights of whistle-blowers.

5. DESCRIBE what to do if you feel that it is unsafe to do an assigned task.

6 IDENTIFY the basic OSHA record keeping requirements.

7. EXPLAIN the General Duty Clause.

9. RECOGNIZE that there are resources available from OSHA through its web site and 800 number.
OSHA stands for the Occupational Safety and Health Administration. It is the federal agency that enforces safety and health standards to protect workers.

In 26 states there are state safety and health agencies that do this job instead of federal OSHA.

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* The programs in CT, NJ, NY and VI only apply to public employees.

In 1970 Congress passed a law called the Occupational Safety and Health Act, or OSH Act. This law created OSHA, and gave OSHA the power to write safety and health standards.

In addition to creating OSHA, the OSH Act also created NIOSH, the National Institute for Occupational Safety and Health. This federal agency studies safety and health problems, recommends standards, and gives advice to workers and employers.
### Purpose of the OSH Act

The OSH Act says::

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

Section 5 of the OSH Act declares the responsibilities of employers with regard to safety and health:

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.

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.

### General Duty Clause

The first of these employer responsibilities is called the General Duty Clause. 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.
Section 5 of the OSH Act also describes the duty of employees:

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.

OSHA does not issue orders to workers. It does not fine workers. 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 required by OSHA. If you fail to follow your supervisor’s instructions you might be disciplined or terminated.

OSHA writes rules, called OSHA Standards, to protect workers on the job. 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 inspects work sites. OSHA can issue correction orders and assess penalties against the employer. You have the right to talk to the OSHA inspector, to point out hazards, and to see a copy of the inspection report.
OSHA requires your employer to:

- Provide a safe and healthy workplace.
- Comply with OSHA standards.

As an employee, you have legal rights, 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.
   C. Respirator training (if applicable).
   D. Confined space training (if applicable).

3. The right to information.
   A. Safety data sheets (SDS’s).
   B. Your employer’s Log of Work-Related Injuries and Illnesses (the “OSHA 300 Log”).
   C. Results of workplace monitoring and surveys.
   D. Your own medical records.
   E. Your employer’s written safety and health plans.
   F. 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 that would expose you to imminent danger of death or serious injury.
   (See the next page for more detail about this right.)

8. Protection from retaliation or discrimination because of your safety and health activities.
   File a discrimination complaint with OSHA if you have been discriminated against for discussing safety and health, pointing out hazards, filing an OSHA complaint, or refusing dangerous work.

   If you file a complaint with OSHA, put it in writing, be specific, and cite the exact standard that’s being violated. Keep a copy for your records. Be sure to also contact your union representative.
Whistle-blower Rights

You have the right to file a complaint with OSHA because of safety and health hazards at your work site.

Section 11(c) of the OSH Act makes it illegal for the employer to discipline you for using your OSHA rights:

No person shall discharge or in any manner discriminate against any employee because such employee has filed a complaint or ... because of the exercise ... of any right afforded by this Act.

The Right to Refuse Dangerous Work

What if a situation arises where you believe it is unsafe to do a task? For example, if you are assigned a truck with faulty brakes. The union contract and the law give you rights if you feel that you must refuse to do dangerous work. To preserve your rights, be sure to:

1. Don’t act alone. Talk with your fellow workers. If you are a union member, contact your shop steward or union representative.

2. Point out the danger. Explain the hazard to the supervisor and to your fellow workers.

3. Be clear that you are not insubordinate. Explain that you will do the job if it can be done safely.

4. Offer to do other work.

5. Don’t walk off the job. Don’t leave the site unless ordered to do so by the supervisor.

Usually you, or your union steward will be able to resolve the problem by discussing it with the supervisor.

If you are disciplined, your union representative can help you to file a grievance. You should also consider filing a complaint about your discipline with OSHA and with the National Labor Relations Board.
OSHA requires your employer to keep records of the OSHA recordables - injuries and illnesses that result in:

- Death.
- One or more days away from work after the day on which the injury happened.
- Restricted work or transfer to another job.
- Medical treatment beyond first aid.
- Loss of consciousness.
- A significant injury or illness diagnosed by a doctor or other licensed health care professional.

You have a right to see any records about your own injury or illness. You also have the right to see the employer’s OSHA 300 Log, which is a list of all the recordable accidents and injuries that occur in your workplace each year. The employer must post the OSHA 300 Log for each year in a conspicuous place from February 1 to April 30 of the year following the year that the log describes.
Here is part of the OSHA Electrical Standard:

All 125-volt, single phase, 15- and 20-ampere receptacles installed in bathrooms or on rooftops shall have ground-fault circuit interrupter protection for personnel.

This paragraph has a number called a citation. The citation is 29 CFR 1910.304(b)(3)(i). Every paragraph has its own citation.

- CFR stands for Code of Federal Regulations. This is a set of law books containing all the regulations of all the federal agencies.
- 29 is the number for the US Department of Labor. OSHA is part of the Department of Labor, so it’s citations start with 29.
- 1910 is the Part of the OSHA standards that apply to General Industry.
- 304 is the Section of the General Industry Standards titled Wiring design and protection.
- b is the second topic in Section 404. In this case, b is called branch circuits.
- 3 is the third subtopic in b. It is called Ground-fault circuit interrupter protection for personnel.
- (i) is the first item in part 3. It is the actual text that requires GFCI’s in bathrooms and on rooftops.

Part 1910, General Industry Standards, is divided into several Subparts. Each Subpart has a different general topic and a different letter. For example: “Subpart S, Electrical”, “Subpart Q, Welding, Cutting and Brazing”, etc. Section 304 in the example above is in Subpart S. However, the Subpart letter, “S”, is not generally used in the citation.
U.S. Federal Regulations are published in a set of books called the Code of Federal Regulations or CFR.


§ 304 Wiring design and protection.

(a) Use and identification of grounded and grounding conductors—
   (1) Identification of conductors
   (2) Polarity of connections....
   (3) Using grounded terminals
(b) Branch circuits—
   (1) Branch Circuits—
   (2) Receptacles and cord connectors—
   (3) Ground-fault circuit interrupter protection for personnel—
      (i) All 125-volt, single phase, 15- and 20-ampere receptacles installed in bathrooms or on rooftops shall have ground-fault circuit interrupter protection for personnel.
If there is an emergency or if a hazard is immediately life-threatening, call your local OSHA Regional Office or 1-800-321-OSHA.

If you are in a state that has its own state program, and you do not know the phone number, call 1-800-321-OSHA, and they will direct you to your state office.

For More Information about Health and Safety

The IBT Safety and Health Department has many fact sheets about safety and health. Go to the Teamsters website www.teamster.org and click on “Resources” and then “On Safety and Health.” Or call (202) 624-6963.

There are hundreds of internet sites with health and safety information. Here are just a few sites to help you get started. All have links to other useful sites.

- U.S. Occupational Safety and Health Administration (OSHA):
  www.osha.gov

- National Institute of Occupational Safety and Health (NIOSH):
  www.cdc.gov/niosh

- U.S. Department of Transportation (DOT):
  www.hazmat.dot.gov

- New Jersey Department of Health:
  www.state.nj.us/health/eho/rtkweb
If you work at a Department of Energy Facility, DOE Order 440.1A says that workers at DOE facilities can “decline to perform an assigned task because of a reasonable belief that, under the circumstances, the task poses an imminent risk of death or serious bodily harm to that individual, coupled with a reasonable belief that there is insufficient time to seek effective redress through the normal hazard reporting and abatement procedures.”

Section 405 of the Surface Transportation Assistance Act protects drivers, mechanics, and freight handlers from discrimination or discharge for:

- Refusing to operate a vehicle if to do so would violate a safety regulation.
- Refusing to operate a vehicle if the employee has a reasonable apprehension of serious injury, or injury to the public, because of the unsafe condition of the equipment.
- Complaining or testifying about violations of vehicle safety requirements.

If you feel that you must refuse to operate the vehicle, make sure that you first ask your supervisor to correct the problem, or give you another, safe vehicle to use.

If you believe that you have been penalized for refusing to drive an unsafe vehicle, you can file a Section 405 complaint with OSHA. Any complaint must be filed within 180 days.

If you belong to a union, you should talk to your shop steward or union representative.
Chapter 2

Walking and Working Surfaces

Learning objectives

This Chapter reviews the OSHA Standards that apply to working and walking surfaces, including ladders.

After completing this Chapter you will be able to demonstrate your ability to:

1. IDENTIFY the OSHA safety requirements for protecting workers from falling through holes and openings in floors, working surfaces and walls.

2. DESCRIBE the requirements for a standard guard rail.

3. EXPLAIN the danger of shock or electrocution when using portable ladders.

4. DESCRIBE how to safely use portable ladders.
The OSHA standard, Walking and Working Surfaces is 29 CFR 1910, Subpart D. The purpose of the OSHA standard is to prevent slips, trips, and falls, which constitute a majority of all accidents in general industry.

Slips, trips and falls are responsible for 15% accidental deaths. The OSHA standard applies to all permanent places of employment.

The OSHA standard contains ten sections, which are listed in the box below. These sections deal with floors, scaffolds, ladders and other surfaces on which employees work. They also include requirements for housekeeping and for guards and railings to keep employees from falling off raised surfaces or falling through holes in walls and floors.

1910.21 - Definitions.
1910.22 - General requirements.
1910.23 - Guarding floor and wall openings and holes.
1910.24 - Fixed industrial stairs.
1910.25 - Portable wood ladders.
1910.26 - Portable metal ladders.
1910.27 - Fixed ladders.
1910.28 - Safety requirements for scaffolding.
1910.29 - Manually propelled mobile ladder stands and scaffolds (towers).
1910.30 - Other working surfaces.
The OSHA Standard defines railings, holes, openings, etc. in terms of their measurements. These measurements control the regulatory requirements for safety and health. For example, we will see that floor openings greater than a certain size need to be covered or have guard rails.

Standard Railing. This is a barrier along the edge of a platform, ramp or floor opening to prevent people from falling over the edge, or through a hole.

A standard guardrail must includes a top rail, intermediate rail and support posts. Any of these components can be made of wood if it is at least as two inches by four inches. Rails and posts can also be made of steel pipe that is at least 1 ½ inches in diameter.

Another possible material is structural steel angle, which must be at least 2 inches on each side and 3/8 inches thick. The ends of rails must extend no more than three inches beyond the end or corner post, unless the protrusion does not cause any hazard of getting caught.

A guardrail must be strong enough to resist a 200 pound load applied in any direction, at any point on the top rail.

- **Top Rail.** The top surface of the top rail must be approximately 42 inches above the floor level. The top rail must be smooth and free of nails and splinters.
- **Intermediate Rail.** The intermediate rail is about midway between the floor and the top rail.
- **Posts.** Wood posts must be no more than six feet apart. Steel posts can up to eight feet apart.
Stair Rail or Stair Railing. A stair rail is a rail along an open side of a stairs. The height of a stair rail is measured up from the top surface of a stair tread. The top of the stair rail must be between 30 and 34 inches above the tread.

Handrail or Hand Railing. A hand rail is a rail along a closed side of a stairs.

Standard Toe board. The purpose of a toe board is to prevent tools or other materials from falling over the edge of a work platform. Falling objects can injure workers below or cause property damage.

A standard toe board is at least 4 inches high. The bottom surface of the toe board must be no more than ¼ inch above the top surface of the floor or platform.

Openings and Holes. The OSHA definitions specify the size of openings and holes that must be guarded to prevent workers from falling through. OSHA assumes that an opening smaller than the definition is too small for a person or large object to fall through.

- Wall Hole. A hole in a wall that is at between 1 and 30 inches high, and any width.
- Wall Opening. An opening in a wall that is at least 30 inches high and 18 inches wide.
- Floor Opening. Any opening in a floor, platform, pavement, or other work surface that is more than 12 inches wide, and through which a person might fall. Examples include hatchways, stair and ladder openings, pits and manholes.
- Floor Hole. Any opening in a floor that is at least one inch wide in its smallest dimension, and no more than 12 inches wide in its greatest dimension. If it’s more than 12 inches across, then it’s an opening, not a hole.
Housekeeping

[29CFR 1910.22(a)]

A messy work area creates dangerous opportunities for slips trips and falls. All work areas, including aisles, storerooms and passageways must be kept in a clean, orderly and sanitary condition.

Floors. Keep floors clean, clear and dry. Where wet processes are used, there must be a drainage system and slip resistant platforms or mats for workers to stand and walk on. Floor must not have protruding nails, loose boards or holes.

Aisles. Keep aisles and passageways clear, and free of tripping hazards. If there are forklifts or other mechanical equipment, then the aisles must have sufficient clearance for these machines. Don’t run an extension cords across an aisle. Mark all permanent aisles. This is usually done with stripes of yellow paint. Don’t store materials within the marked area.

Pits, Tanks, Vats and Ditches. There should be covers or guardrails to protect workers from falling into open pits, vats, tanks and ditches.

Floor Load Ratings. There must be conspicuous signs that state the floors load rating, usually in pounds per square foot. The actual weight of material and equipment must not be greater than the load rating. Load ratings are determined by an engineer and approved by the local building official.
Stairway and Ladder Openings. The opening in a floor where a stairway goes down must have a standing guardrail on three sides.

An opening for a fixed ladder must have guardrails on all open sides, except the side where the ladder goes down. That side must have a swinging gate, or must be offset so that a person cannot walk directly into the hole.

Hatches and Chutes. Hinged floor openings and trapdoors must have guardrails so that there is only one exposed side. The door (or doors) must be closed when the opening is not in use.

Open chutes and hatches must have covers in place when not in use. When they are opened, then must have guardrails on all sides. Up to two of these guardrails may be removed, if necessary to load material through the opening.

If the job requires continuous dumping or feeding material through an opening, there must be protection to keep a person from falling through the opening.

Skylights. Skylights must be guarded by a skylight screen or by a standard railing.

Man Holes. Man holes require a cover. This cover does not have to be hinged. When the man hole is open, someone must stand guard, or there must be a temporary railing in place.

Temporary Floor Openings. Guarding is required for temporary floor opening also. A temporary floor opening must have a cover, or guardrail, or there must be a person guarding the opening.
Guards for Holes Openings

(Continued)

[29 CFR 1910.23]

Floor Holes. There must be a cover or guardrail for every floor hole. If the cover or guardrail needs to be temporarily removed, then there must be a person to continuously guard the hole.

Stairway Doors. If a door opens onto the top of a stairway, there must be a platform that allows at least 20 inches beyond the swing of the door.

Wall Openings. A wall opening must be guarded if the fall from the other side is four feet or more. Use a gate, rail or half door.

Open-Sided Floors. There must be a guardrail on all open sides of floors and platforms if the drop is four feet or more. This is not required where there is a ramp or stairs. There must also be toe boards if people walk underneath, or if there is moving machinery, or if there is any equipment that could be damaged by falling objects.

Stacked Material. If boxes or other material is stacked close to a railing, a sheet of plywood or similar material should be used to prevent the material from falling through, or over the top of the railing.
If a stairway has four or more risers, then it must have a handrail or a stair rail. In order to determine where to place guardrails or railings, OSHA considers stairways in three categories based on how wide they are:

1. Less than 44 inches wide:
   - Closed on both sides. A handrail on at least one side, preferably on the right-hand side when descending. A handrail on the other side offers additional safety, but is not required.
   - Open on one side. A stair rail on the open side. A handrail on the closed side offers extra safety, but is not required.
   - Open on both sides. A stair rail on both sides.

2. Between 44 and 88 inches wide. A handrail on each closed side, and a stair railing on each open side.

3. 88 inches or wider. A handrail on each enclosed side, plus a stair rail on each open side, plus a stair rail in the middle.
Fixed Stairways

[29 CRF 1910.24]

Width. Fixed stairs must be at least 22 inches wide.

Angle. The angle of the stairs must be between 30 and 50 degrees.

Treads. The treads must all be within ¼ inch of the same depth.

Risers. The risers must all be within ¼ inch of the same height.

Stairway Platforms. Platforms must be at least as wide as the stairway, and must extend at least 30 inches in the direction of travel.

Vertical Clearance. There must be at least 7 feet of clearance above a stairway.

Strength. A fixed stairway must be strong enough to hold at least five times the anticipated load. In any case, it must be able to hold at least 1,000 pounds.

Spiral Stairs. On spiral stairs there must be handrail or stair rail on the outside of the stairs, and a handrail on the inside located so that a person cannot step on the part of the tread that is less than 6 inches deep. Spiral stairs are much less safe than regular straight stairs, especially if workers have to carry tools or other materials up or down the stairs. OSHA says that spiral stairs are only for special circumstances and for secondary access. A winding stairway can be used on the outside of circular tank, if the tank is at least five feet in diameter.
The American National Standards Institute (ANSI) has established a rating system for the strength of portable ladders. The ANSI rating number will be on a label on the ladder. If the label isn’t there, you don’t know how strong the ladder is. OSHA uses the ANSI system. The four ANSI ratings are:

- Type I. Industrial. 250 lbs. capacity for trades, construction, maintenance and industry.
- Type IA. Heavy Duty Industrial. 300 lbs. capacity.
- Type II. Commercial. 225 lbs. capacity for light maintenance work.
- Type III. Household. 200 lbs. capacity for household use.

Quality and Condition of Parts. All wooden parts must be in good condition, without cracks, splinters or sharp edges. They must be made of high density wood like hard pine.

OSHA requires that portable wooden ladders be inspected frequently. We suggest inspection the first time the ladder is used each shift. Check the condition of the wood. Make sure that the rungs or steps fit tightly into the side rails. Check all metal parts.

If the ladder is defective, it must be marked, “Dangerous, Do Not Use.” A common safe practice is to saw the ladder so that it cannot be used again.

All wooden parts should be kept clean and finished with a clear varnish - not paint. Paint can hide defects in the wood.
Portable Metal Ladders

[29 CRF 1910.26]

The use of portable metal ladders is similar to that of portable wooden ladders. However, a metal ladder will conduct electricity. Metal ladders should not be used where there is any chance of electrical shock. Electricity can cause shock or electrocution. Even if the electricity itself doesn’t hurt you, it might cause you to fall and suffer serious injury.

Portable Fiber Glass Ladders

The OSHA Standard was written many years ago, and does not address ladders with fiberglass side rails. These ladders are light and strong, and, most importantly, the side rails do not conduct electricity. These are the ladders of choice for electricians, and should be used in any situation where there is the possibility of contact with electric circuits.

Fixed Ladders

[29 CRF 1910.27]

In factories and buildings there are often fixed ladders used to reach upper levels and platforms. Fixed ladders should be designed by an engineer to assure that they are strong, stable, and able to bear the weight of the workers who use them.

There must be sufficient clearance on the climbing side of the ladder: At least 30 inches if the ladder is straight up-and-down; at least 36 inches if the ladder is on a 76 degree angle. There must also be clearance on the other side of the latter for the climber’s feet to extend over the rungs. OSHA requires at least 7 inches here, unless there is an unavoidable obstruction.
Inspect all ladders for visible defects on a regular basis and after any incident that could affect their safe use. Keep ladders free of slipping hazards like oil or grease.

If you use a ladder near energized electrical equipment, it must have wood or fiberglass side rails.

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.

Face the ladder when ascending or descending.

Don’t load a ladder beyond the manufacturer’s rated capacity. Don’t carry anything on a ladder that might cause you to lose your balance.

Never use the top or top step of a stepladder as a step.

If you use a portable ladder for access to an upper landing, the side rails must extend at least 3 feet above the 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.

If you use a ladder where it might be displaced by activities or traffic, then it must be secured to prevent accidental movement or protected by a barricade.

Keep the area at the top and bottom of the ladder clear.

Never move a ladder while someone is on it.

Using Straight and Extension Ladders

\[
\frac{1}{4}L
\]

At Least 3 feet

\[
\frac{1}{4}L
\]
Learning objectives

This Chapter reviews the OSHA requirements for exit routes, emergency action plans, fire prevention plans and fire protection equipment.

After completing this Chapter you will be able to demonstrate your ability to:

1. DESCRIBE the basic requirements that assure that a workplace will have adequate exits and exit routes in case of an emergency.

2. IDENTIFY the contents of a proper emergency action plan.

3. IDENTIFY the contents of a proper fire prevention plan.

4. DESCRIBE several general fire safety requirements.

5. IDENTIFY four types of fire extinguishers, and the kinds of fire that each should be used for.

6. DESCRIBE the OSHA requirements for fire brigades.
OSHA addresses exit routes, emergency action plans and fire prevention plans in Subpart E, and fire protection in Subpart L of the General Industry Standards.

**Subpart E: Exit routes, emergency action plans, and fire prevention plans**

- 1910.33 - Table of contents.
- 1910.34 - Coverage and definitions.
- 1910.36 - Design and construction requirements.
- 1910.37 - Maintenance, safeguards and operational features of exit routes.
- 1910.38 - Emergency action plans.
- 1910.39 - Fire prevention plans.

**Appendix - Exit routes, emergency action plans, and fire prevention plans.**

**Subpart L: Fire Protection**

- 1910.155 - Scope, application and definitions.
- 1910.156 - Fire brigades.
- 1910.157 - Portable fire extinguishers.
- 1910.158 - Standpipe and hose systems.
- 1910.159 - Automatic sprinkler systems.
- 1910.160 - Fixed extinguishing systems, general.
- 1910.161 - Fixed extinguishing systems, dry chemical.
- 1910.162 - Fire extinguishing systems, gaseous agent.
- 1910.163 - Fixed extinguishing systems, water spray/foam.
- 1910.164 - Fire detection systems.
- 1910.165 - Employee alarm systems.

**Appendix A - Fire protection.**

**Appendix B - National consensus standards.**

**Appendix C - Fire protection references.**

**Appendix D - Publications incorporated by reference.**

**Appendix E - Test methods for protective clothing.**
The OSHA requirements for exit routes, emergency action plans and fire prevention plans are based on the Life Safety Code developed by the National Fire Protection Association (NFPA). The Life Safety Code is a longer and more detailed document than the OSHA standard. Many workplaces that admit members of the public, such as hospitals, are required by other laws to comply with the life safety code, and to have regular inspections to assure compliance. OSHA says that compliance with the Life Safety Code is deemed to be compliance with the corresponding sections of the OSHA standard.

Exit routes must be designed and maintained so that employees can find and follow the route – and get out safely and quickly.

- Exit routes must be a permanent part of the workplace.
- An exit must be separated from the rest of the structure by fire retardant materials.
- Exits must have self-closing doors.
- There must be enough exits.
- There must be at least two exit routes in every work place, as far apart as possible.
- There must be more than two exit routes if this is necessary to make sure that all employees can evacuate safely and quickly.
- The exit discharge must lead directly to a street, walkway or refuge area with outside access.
- Exit doors must unlocked from the inside.
- Exit doors must be side-hinged and open outward.
When an emergency occurs, it is essential that emergency systems function properly and that exits are not blocked.

- Keep exits and exit route free of furnishings or decorations that could burn or explode.
- Plan exit routes so that employees travel away from – not toward – hazards as they evacuate.
- Keep exit routes free and clear of materials or equipment that would make it harder to get out.
- Do not route exits through any room or space that could be locked.
- Lighting must be adequate so that an employee with normal vision can see along the exit route.
- Each exit must have a sign: EXIT.
- Keep exit doors free of other signs, posters or decorations that might make it less visible.
- Post direction signs (with arrows) along the exit routes.
- Post enough exit and direction signs so that they can be seen from all areas of the work place.
- Post a NOT AN EXIT sign on any door or passage that employees might confuse with an exit.
- Regularly inspect and maintain all emergency systems such as sprinkler systems, alarms, self-closing doors, emergency lights and exit lights.
- Make sure that exit routes, exits, and their required signs are maintained during repair, construction and remodeling operations.
Emergency Action Plans
[29 CFR 1910.38]

The employer must have a written Emergency Action Plan that includes these elements:

- How to report fires and other emergencies.
- Procedures for emergency evacuation.
- Procedures for performing critical plant operations before evacuation.
- Procedures to account for all employees.
- Personnel responsibilities.
- Alarm systems.
- Training for each employee about alarms, exit routes and evacuation procedures; and additional training for employees who will assist in evacuating other employees.

Fire Prevention Plans
[29 CFR 1910.39]

The employer must have a written fire prevention plan that includes these elements:

- List of all major fire hazards.
- Handling and storage procedures for hazardous materials.
- Potential ignition sources and their control.
- Fire protection equipment needed to control each major fire hazard.
- Control of waste flammable and combustible materials.
- Regular maintenance of hot equipment.
- Personnel responsibilities.
- Employee Training about fire hazards in the workplace, and about the Fire Prevention Plan.
Ignition Hazards: All wiring and electrical equipment must be installed in accordance with the Electrical Standard (Subpart S), and the National Electrical Code, in order to prevent ignition sources that could start a fire.

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 Extinguishers: There must be adequate fire extinguishers of the right kind for the classes of fire that might occur.

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.
A material that can act as a fuel (that can burn) is called a combustible or a flammable material. Later we will explain the difference between these two terms. A material that doesn’t burn is called non-combustible.

Four things are necessary for fire:

1. Fuel.
2. Oxygen.
3. Ignition source (heat) to start the process.
4. Chain reaction to keep the fire going.

We call this the fire pyramid. If any component is missing, the fire can’t happen. If a fire starts, we have to remove at least one component in order to put it out.
There are many different flammable and combustible liquids on construction sites: fuels, lubricants, 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.

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.
<table>
<thead>
<tr>
<th>Extinguishing Agents</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Agent</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water H2O</td>
<td></td>
<td>Conducts electricity. May spread class B fires. Cries in cold climates.</td>
</tr>
<tr>
<td>Carbon Dioxide CO2</td>
<td></td>
<td>Dissipates rapidly - smoldering materials may ignite again. 1.5 times heavier as air - can collect in low areas. Need more than 35% by volume in air in a total flooding system - more than 4% in air is toxic. Chilling effect may damage equipment.</td>
</tr>
<tr>
<td>Dry Chemical (Sodium Bicarbonate)</td>
<td></td>
<td>Often not very effective on class A fires. Absorbs moisture and may harden in the container. Irritating to some people. Nozzle pressure may cause burning liquids to splash.</td>
</tr>
<tr>
<td><strong>How it Works</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>Removes HEAT from the fire pyramid. Makes the fire too cold to burn.</td>
<td>Conducts electricity. May spread class B fires. Cries in cold climates.</td>
</tr>
<tr>
<td>B-C</td>
<td>Removes OXYGEN from the fire pyramid.</td>
<td>Dissipates rapidly - smoldering materials may ignite again. 1.5 times heavier as air - can collect in low areas. Need more than 35% by volume in air in a total flooding system - more than 4% in air is toxic. Chilling effect may damage equipment.</td>
</tr>
<tr>
<td>B-C</td>
<td>Breaks the CHAIN REACTION in the fire pyramid.</td>
<td>Often not very effective on class A fires. Absorbs moisture and may harden in the container. Irritating to some people. Nozzle pressure may cause burning liquids to splash.</td>
</tr>
<tr>
<td><strong>Use On</strong></td>
<td>A</td>
<td>B-C</td>
</tr>
<tr>
<td></td>
<td>B-C</td>
<td>B-C</td>
</tr>
<tr>
<td>Agent</td>
<td>Use On</td>
<td>How it Works</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>--------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>Halon 1211 (Bromochlorodifluoromethane)</td>
<td>A-B-C</td>
<td>Breaks the CHAIN REACTION in the fire pyramid</td>
</tr>
<tr>
<td>Halon 1301 (Bromo trifluoromethane)</td>
<td>A-B-C</td>
<td>Breaks the CHAIN REACTION in the fire pyramid</td>
</tr>
</tbody>
</table>
• Approved containers used for the storing and handling flammable and combustible liquids.

• All flammable liquids stored in closed containers.

• Rigid separators between stacked containers of combustibles or flammables - to assure support and stability.

• Fuel gas cylinders and oxygen cylinders separated by distance, or 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.

• All combustible waste such as oily rags must be stored in covered metal receptacles.
• 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 areas.

• Extinguishers free from obstructions or blockage.

• All extinguishers serviced and tagged at least once a 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 where flammable or combustible materials are used or stored.

• “NO SMOKING” rules enforced.
An employer may organize a fire brigade, made up of employees, to be trained, equipped and available to fight structural fires that might occur at the work place.

Written Plan. The employer who has a fire brigade must have a written plan that provides the organizational structure of the brigade, training requirements and brigade member functions.

Physical fitness. The employer must assure that the members of the fire brigade are physically fit to perform this emergency work. OSHA specifically lists heart disease, epilepsy and emphysema as disqualifying medical conditions.

Training. The employer must assure that fire brigade member receive adequate training and practice that is sufficient for the duties that they will perform. Fire brigade leaders must have additional training. Training must occur as often as necessary, and at least annually. The quality of the training must be similar to that which students would receive at nationally recognized fire training schools.

Information about hazards. In addition to training about how to do fire brigade duties safely, the employer must make sure that fire brigade members know the nature and location of hazards in the work place, such flammable and combustible materials, toxic substances, radioactive materials and water-reactive materials.

Protective Clothing Equipment. The employer must provide fire brigade members with all necessary personal protective equipment and protective clothing. This includes structural fire fighting clothing (bunker gear) and self-contained breathing apparatus (SCBA).
Learning objectives

This module describes the hazards created by electric installations, wiring and equipment at construction sites, and reviews the safe work practices that will reduce the risk of electrocution and other injuries or damage.

After completing this Chapter you will be able to demonstrate your ability to:

1. EXPLAIN why electricity can be deadly.
2. EXPLAIN the importance of maintaining correct polarity and continuity of grounding wires in all electrical circuits.
3. EXPLAIN what GFCI’s do and why they are important.
4. IDENTIFY at least five safe work practices related to electrical equipment and wiring.
The OSHA Electrical Standard applies electrical installations and equipment in or on buildings and structures, and elsewhere on the premises. The standard applies to all general industry work sites including, for example: buildings, factories, yards, carnivals, parking lots and parking structures, mobile homes and recreational vehicles used as an employer’s workplace, and industrial substations.

**Applicability of the Standard**

[29 CFR1910.302]
Electricity creates two main hazards at construction sites.

(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.

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. The purpose is 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.

(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 fire and explosion, OSHA has requirements for special wiring and equipment in areas where flammable materials may be present in the air.
We measure current in Amps. If a current of \(\frac{1}{10}\) Amp passes through your heart, it can cause ventricular fibrillation. This means that your heart muscles start to vibrate rapidly, and don’t pump blood. You will die within minutes.

A typical 120 volt circuit can supply 15 or 20 Amps.

This is many times what it takes to kill you.

Anytime that you are working with 120 volt electrically powered tools, lighting and equipment, there is more than enough electricity to kill you.

Obviously, higher voltages like 220 and 440 are also deadly.

<table>
<thead>
<tr>
<th>Current (mA)</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 mA</td>
<td>You can feel a tingle</td>
</tr>
<tr>
<td>10 mA</td>
<td>You can’t let go</td>
</tr>
<tr>
<td>50 mA</td>
<td>Possibly fatal</td>
</tr>
<tr>
<td>100 mA</td>
<td>Definitely FATAL!</td>
</tr>
<tr>
<td>15,000 mA or 20,000 mA</td>
<td>Available from a typical outlet</td>
</tr>
</tbody>
</table>

Note:

1 Amp = 1,000 mA
15 Amp = 15,000 mA
20 Amp = 20,000 mA
The employer must 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. Is the insulation on tool and extension cords in good condition?

- Heating Effects. Can the equipment cause overheating?

- Arcing and sparks. Can arcing and sparks occur where flammable materials are present?

- Classification. Right size? Correct voltage, current capacity, etc.?

- Other factors. Any other factors that affect workers’ safety.

All electrical conductors and equipment must be approved by a nationally recognized testing organization such as UL. Approved equipment must have a label that tells the manufacturer and the electrical rating (voltage, amps and watts).
All disconnecting switches must 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.

Locks. All disconnecting switches must be capable of accepting a lock for lock-out purposes, as explained in Chapter 17 of this Manual.

There must be sufficient clearance around electrical panels and equipment for safe operation and maintenance of the equipment.

The minimum clearance in front of electrical panels is 30 inches. However, the clearance must be at least as great as the width of the equipment, and must be sufficient to permit the door(s) to open to a right angle.

Live parts of electrical equipment operating at 50 volts or greater shall be guarded so that workers cannot accidentally 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.
Identification of Grounded and Grounding Conductors
[29 CFR1910.304(a)]

In all electrical wiring, cables and connectors it must be obvious which is the “hot” wire, the “neutral or grounded” wire and the “grounding” wire.

- Hot: wire: black;
  metal connections, brass colored.
- Neutral (grounded): wire: white;
  metal connections, silver colored.
- Grounding: wire: green or bare copper; metal connections, green.

Never reverse the polarity by connecting a black wire to a white wire, for example. Most plugs and sockets are polarized, meaning that the connectors, because of their size and location, can only be connected one way.

Never break off the grounding connector in order to fit a three-prong plug into a two-hole receptacle.

Over current Protection
[29 CFR1910.304(f)]

Protect circuits from over current. Too much current can cause wires and equipment to overheat. Protection from over current 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.
Exposed metal parts of cord and plug connected tools and equipment must 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 its 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.

This requirement applies to:

- Hand-held motor operated tools.
- Equipment used in damp or wet locations.
- Equipment used by workers standing on the bare ground, or on metal floors, or inside a metal tank.
- Portable x-ray equipment.
- Portable hand lamps.

Exception: A double insulated tool doesn’t have to be grounded.

Circuit breakers and fuses. A wire can only handle a certain amount of electricity. If too many tools are connected (or too big a tool), then too much electricity will try to flow. The wire will overheat, possibly starting a fire. A circuit breaker (or fuse) disconnects the circuit if more than a specific current tries to pass. This protects equipment and property, but does not necessarily protect you from shock or electrocution.

Breakers and fuses protect equipment and property, but do not necessarily protect you from shock or electrocution.
Grounded Circuits

Double insulated tools. Some hand tools don’t have a third wire ground, but they do have a plastic case that doesn’t conduct electricity. The plastic case is intended to prevent injury, as long as it’s not broken.

Grounded circuits (third wire). If the wiring inside a tool becomes frayed, and touches the tool’s metal case, then electricity can pass into the hand of the person holding the tool. If the person is also in contact with something that conducts electricity (like damp ground), then some electricity will pass through the person’s body.

The green ground wire in a tool’s cord is attached to the tool’s metal case. This wire is supposed to be connected, via the third prong, to a wire that returns to the service box. The idea is for the ground wire to provide such a good path that the electricity will take this route, rather than through the body. This easy path should also allow so much current to flow that the circuit breaker or fuse trips. This only works if the ground wire is in good condition and properly connected all the way back to the service box.

You have heard that “electricity takes the path of least resistance.” This isn’t exactly correct. Faced with two possible paths, most, but not all, takes the easy path. Most current will return via the ground wire, but a little might still pass through the person’s body. If the ground circuit is not in good condition, then even more electricity will pass through the person. It might be enough to kill!

Double Insulated Tools

Most of the current will take the path of least resistance, but a little bit might still pass through your body.
Ground fault circuit interrupter (GFCI). Electricity moves in a circle, down the black wire, through the tool, and back on the white wire. The tool does not use up the current. The same amount of current leaves the tool as enters it. Under normal conditions, the same current flows through each of the two wires. If there is damage, then some current might return via the green ground wire – or through your body.

A ground fault circuit interrupter senses flow in the black and white wires. If it’s not the same, the GFCI shuts off the circuit. If some current is flowing through your body, the GFCI will sense less current in the white wire. The GFCI will trip before your heart does. A GFCI can sense a difference as small as 5 milliampere, and can shut off in a fraction of a second, before there’s enough current to cause ventricular fibrillation.

OSHA requires construction sites to have either an assured grounding program or use GFCI’s. An “assured grounding program” means that the ground wires are checked at least daily. [29 CFR 1926.404(b)(1)(iii)]

However, something could happen between checks. So, GFCI’s provide better protection against electrocution.

The best protection is a combination of all three:

1. a circuit breaker (or fuse) to protect against fire caused by overheated circuits,
2. a grounded third-wire to provide additional fire protection and some protection against electrocution, and
3. a GFCI to for the best protection against current that is enough to kill but too small to blow the breaker.
Testing Grounding Circuits

The grounding 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 to go to ground.

This only works if the ground conductors have continuity, which means that the ground connection has to be complete through all cords, plugs, receptacles and wiring — all the way back to the service panel.

To make sure that the equipment grounding conductors are connected properly:

- Inspect and test the ground connections regularly and make records of the tests.
- No damaged or defective equipment should be used.
- Visual inspections every day. Visually inspect cords, plugs, and tools for defects and damage before each day’s use.
- Continuity Test. Test the continuity of the ground conductor on cord sets, grounded tools and equipment, and receptacles. Use a lamp and battery, ohmmeter or a receptacle tester.
- Proper terminal test. Use a receptacle tester to assure that the ground at each receptacle is connected to the correct terminal.

GFCI Required
[29 CFR 1910.304(b)(3)]

Ground fault circuit interrupters (GFCI) are required in all bathrooms and rooftops. Also, temporary receptacle outlets used during maintenance and repair activities must have GFCI protection.
Aerial lifts, cranes and other equipment must maintain a sufficient clearance from overhead power lines.

The minimum distance is from any power line is 10 feet. A greater distance is required for lines carrying more than 50 kilovolts.

A Teamster operating a boom truck is focused on picking and placing the load, and can lose track of how close the boom is getting to a power line. Use a spotter when working near power lines. The spotter can make the difference between a safe job and a potential fatality.

Always assume that any overhead line is energized, unless the owner or the utility has certified that it is not energized – and you can see that it’s grounded.

Before any digging or excavation takes place, the contractor must locate all underground power lines, gas lines, communications cables, pipe lines and sewers. Contact utility companies for information. All lines should be marked, and, if possible, disconnected.
Environmental Considerations

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.

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.

Locations with Fire and Explosion Hazards

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 Chapter.
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.

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.
Learning objectives

This Chapter reviews the OSHA requirements for the safe and effective use of personal protective equipment, including work boots, hard hats, face shields and respirators.

After completing this Chapter you will be able to demonstrate your ability to:

1. DESCRIBE how to inspect your hard hat.
2. IDENTIFY the two main types of respirators.
3. EXPLAIN the importance making sure that your respirator fits correctly.
4. IDENTIFY the factors to consider in order to select the correct type of respirator and the correct cartridges or filters for that respirator.
5. EXPLAIN the importance of using the correct shade lens when welding or cutting.
6. EXPLAIN who pays for personal protective equipment that is necessary to work safely at your job site.
Personal protective equipment or PPE includes glasses, face shields and goggles for eye and face protection, hard hats, gloves, boots, protective clothing and respirators. OSHA requires that you use personal protective equipment whenever it is necessary to protect you from injury including overexposure to contaminants.

There are design standards that the manufacturers of PPE must follow to make sure that the PPE works, and works safely. OSHA does not write the design standards, but it does require that PPE comply with design standards from other organizations such as ANSI and ASTM. Respirators must not only meet the NIOSH design standards, they must be submitted to a NIOSH approved laboratory for testing and certification.

There are many different kinds of safety shoes and safety boots. Most have a steel cup in the toe end to protect your toes from being crushed. They also usually have a steel shank in the sole to prevent punctures from nails. Some boots have an additional metatarsal protector further up to prevent the middle part of the foot from being crushed. There are also chemical resistant boots, electrically non-conductive boots, and other specialty footwear.

OSHA requires that safety shoes and boots comply with industry design standards written by ANSI or ASTM. Look at the label inside the tongue. It must say which standard it complies with.

(Note, the OSHA standard just mentions ANSI, but, in fact ASTM has taken over the design standards for shoes and boots.)
Hard Hats
[29 CFR 1910.135]

OSHA requires workers to wear hard hats wherever there is a possible danger of head injury from impact or flying objects, or if there is the possibility of electrical shocks and burns.

All hard hats must comply with ANSI standards. ANSI has standards for two types of hard hats:

- Type I - Protects against impact on the top.
- Type II - Protects against top and side impact.

Each type of hard hat is available in three different electrical conductivity classes:

- Class G - General (for most work.)
- Class E - Electrical (for work around exposed electrical conductors and equipment.)
- Class C - Conductive (for areas where it is critical to prevent static charges from building up.)

Bump caps, motorcycle helmets and bicycle helmets do not meet ANSI standards for hard hats, and may not be used at work for head protection.
Eye and face protective equipment include safety glasses, goggles, and face shields. There are many types, and you must use the type that is appropriate for the work that you are doing.

OSHA requires workers to wear eye and face protection whenever there is the possibility of eye or face injury from flying objects (including dust, shaving and splinters), chemical splashes or radiation.

All eye and face protective equipment must comply with ANSI standards. Read the label to make sure that it does.

If you need corrective lenses, then you can use safety glasses that have your prescription ground in, or safety goggles that fit over your regular glasses. However, you must never wear regular glasses with a respirator, because the arms of the glasses will prevent the respirator from sealing against your face.

Welding and cutting produce both heat and intensely bright light that can quickly damage your eyes. Sometimes the damage is permanent. Some of this light you can’t see (infra red and ultra violet) but it can still severely damage your eyes.

You must make sure that you have lenses that are dark enough to block out the dangerous rays - including the ones that you can’t see.

Lenses come in different shade numbers. The higher the number, the darker the lens - and the more harmful rays it blocks out. The correct shade number depends on the type of welding or cutting, and in the case of electric arc welding, the amperage.
Air Contaminants

For something to be an air contaminant, it must be small enough to stay in the air and small enough to be inhaled. There are two ways that this can happen:

1. Gases and Vapors. These are individual molecules that become part of the air itself.

2. Particulates. These are tiny pieces that float in the air. Solid particulates: dust, fiber and fume. Liquid particulates: mist and spray.

Oxygen Deficiency

Oxygen deficiency can occur in confined spaces where the oxygen has been used up, and there is poor ventilation so it doesn’t get replaced. In fact, oxygen deficiency is the leading cause of confined space deaths.

19½ % Oxygen is the lowest level OSHA allows.

Below 19½ % you must have a respirator that supplies breathing air.

### Oxygen and Health

| Too Much | 23½% | Oxygen enriched  
| Fire danger |
| Just Right | 21% | Normal oxygen level |
| Too Little | 19½% | OSHA minimum for safe entry |
| 16% | Dizzy  
| Confused |
| 14% | Hard to breathe |
| 6% | Death in a few minutes |
OSHA requires workers to wear respirators when there is no other way to prevent harmful exposure to air contaminants. The OSHA respirator standard for construction is identical to the general industry standard.

These are three hazardous conditions in the air that require workers to use respirators:

1. Gas and vapor contaminants. These are individual molecules that become part of the air itself.

2. Particulate contaminants. These are tiny pieces that float in the air. Solid particulates: dust, fiber and fume. Liquid particulates: mist and spray.

3. Oxygen deficiency. The lowest level you are allowed to breathe is 19½%.

You may have all three conditions at the same time.

There are two basic types of respirators:

1. Air Purifying Respirators (APR’s). You breath the dirty air around you. The respirator has filters or cartridges that try to clean that air before you inhale it. APR’s do not supply oxygen.

2. Atmosphere supplying respirators. These have a separate, clean air supply from a cylinder on your back (SCBA), or an air line.

In an oxygen deficient atmosphere you must have an atmosphere supplying respirator.
Use the Correct Respirator

Respirators are serious equipment. There are different kinds of respirators - for different situations. You need to know how to select and use the proper respirator.

If you use the wrong respirator, you could be exposed to toxic chemicals or oxygen deficiency. It could even be fatal!

NIOSH Approval

NIOSH has standards for approving respirators.

- Never use a respirator or cartridge unless it has the NIOSH TC number and the NIOSH symbol.
- Never try to use filters, valves or parts from one make of respirator on another make.

Air Purifying Respirators (APRs)

With an air purifying respirator or APR, the air you breathe is the air around you. It starts out contaminated, and you depend on the filters or cartridges to catch the contaminants before you breath them in.

There are many chemicals for which there is no filter or cartridge that works.

Air purifying respirators do not supply oxygen.

Fit Testing

If the respirator doesn’t fit your face almost perfectly, dirty air will get in around the edge of the respirator.

Before wearing any respirator that requires a tight seal against your face, you must have a fit test to make sure that the respirator fits you correctly.
The word dust mask can refer to two different things. One is a NIOSH approved respirator, and the other is not. You need to know the difference. A dust mask that is not NIOSH approved provides no protection against air contaminants. You are just fooling yourself if you think that it does.

Dust mask type respirators that are NIOSH approved have a technical name: filtering face piece respirator. The material the mask is made of acts as the filter.

Dust mask type respirators are filters. They only work for particulates in the air. Dust masks provide no protection against gas or vapor contaminants.

Some dust masks have an exhalation valve. This helps prevent the mask from soaking up moisture from the air you breathe out.

NIOSH approved dust masks have a rating of 95. This means that mask will clean at least 95% of the particles out of the air as it passes through the mask.

All NIOSH approved dust mask type respirators have two separate straps. This helps to make the mask fit against your face. Never use the kind that has only one rubber band; it won’t seal well against your face - and it’s not NIOSH approved.

Remember that a dust mask that is not NIOSH approved provides no protection against air contaminants. The material it’s made of doesn’t collect enough of the contaminants, and if it only has one strap, it won’t seal well against your face. It may be cheap, but you are just fooling yourself if you think that it makes your work safer.
Respirators with Replaceable Filters and Cartridges

Some air purifying respirators use filters or cartridges:

- Filters are for particulates.

  Particulates are small solid or liquid pieces floating in the air. A filter traps these particulates.

  Filters do not trap gases and vapors.

- Chemical cartridges are for gases and vapors.

  Gases and vapors are individual molecules in the air. Chemical cartridges catch some kinds of gases and vapors, but there are many gases and vapors for which there is no cartridge that works.

  Chemical cartridges do not protect against particulates.

One of the most common mistakes that people make is to not understand the difference between a filter and a chemical cartridge. If you are exposed to particulates, use a filter. If you are exposed to gases or vapors, use a chemical cartridge.

If you are exposed to particulates and gases/vapors at the same time, then you need to use a combination filter-chemical cartridge.
Filters. OSHA says that for filters, you can use them until you sense increased breathing resistance, which means that the filters are getting clogged.

Chemical cartridges. Breathing resistance does not increase when a chemical cartridge gets used up.

For chemical cartridges, OSHA requires the employer to use a change-out schedule that is based on the concentration of contaminant in the air and on how hard you are working. This has to be determined by a person with technical expertise.

OSHA also allows you to use a chemical cartridge that has an end of service life indicator (ESLI). This is something that changes color when the cartridge is full. However, there are very few of this kind of cartridge available.

IDLH means immediately dangerous to life and health. If you are exposed to an IDLH concentration (or greater) for thirty minutes or more, you will likely:

- Die, or
- Suffer permanent damage to your health, or
- Become unconscious or otherwise unable to leave the area (after which you might die, or suffer permanent damage to your health.)

You must never use an APR in an IDLH situation. If the APR stops working, for example if the filter or cartridge gets used up, then you will risk death or permanent damage to your health.
Assigned Protection Factors

The protection factor means how much cleaner the air in the respirator is assumed to be if you pass qualitative fit test. (In the qualitative test we don’t actually measure the air – that’s why we use an assigned protection factor to assume how much cleaner it is inside the mask.)

For example, a PF of 10 means the air in the respirator is supposed to be ten times cleaner than the outside air. If the contaminated air has 1000 ppm, then the air in the respirator – what you breathe – ought to be 100 ppm.

If you pass a qualitative fit test, you assume that the respirator has at least the protection indicated by the PF.

OSHA Assigned Protection Factors (PF)  

- Quarter-face APR: 5
- Half-face APR: 10
- Full-face APR: 50
- Full-face PAPR: 1,000
- SCBA: 10,000
- Air line with escape cylinder: 1,000
- Air line without escape cylinder: 1,000
It is important that you understand when you can – and cannot – use an air purifying respirator.

APR’s can only be used when:

- There is at least 19½% oxygen.

- There will be no confined space entry (unless it is established by air monitoring before and during entry that contaminant levels cannot rise above the range of the available APR filters or cartridges).

- You know the identity of the contaminants – so you can pick the right cartridge or filter.

- You know the concentration of the contaminants – so you can know if the respirator is rated for this concentration.

- There are no IDLH concentrations.

- There is a correct APR filter or cartridge available.

If there is a possibility that the situation might change for the worse – a leak might occur or a fire might start – then you won’t know what the contaminants or concentrations are. Don’t rely on an APR.

Look at the NIOSH Pocket Guide and at the manufacturer’s selection chart to see what type of respirator you need to use.
Inspecting and Checking Your Respirator

Every time before you use a respirator you should inspect it. When you put it on you should perform a couple of quick seal checks.

User inspection.

- Make sure that you have the correct respirator and the correct filters or cartridges.

- Inspect the face piece, straps and visor.

- Inspect the inhalation and exhalation valves.

Negative pressure check.

- With your hands, cover the inlets to the filters or cartridges.

- Inhale. If the respirator is working properly, then you should be able to feel the face piece being sucked toward your face.

- Hold your breath for 10 seconds. The face piece should remain sucked in.

Positive pressure check.

- Cover the exhalation valve with your hand.

- Exhale. You should be able to feel the respirator expanding away from your face.

- Again, hold it for 10 seconds.
Your employer is required by the OSH Act to provide a safe and healthy workplace. If the only way to make the work site safe and healthy is to use personal protective equipment, such as respirators, face shields, hard hats, and chemical protective clothing, then the employer must pay for it.

In the past there was uncertainty about which types of personal protective equipment the employer was required to pay for. A new OSHA standard, which went into effect May 15, 2008, makes this requirement clear.

Your employer must pay for all necessary personal protective equipment except:

- Everyday clothing like long-sleeve shirts, pants, street shoes and normal work boots.

- Items used solely for protection from the weather, such as winter coats, gloves, parkas, rubber boots, hats, raincoats, sunscreen, and sun glasses.

- Non-specialty work shoes and boots - even if they have steel toes - if the employer permits you to wear these shoes and boots off the job.

- If the employer provides separate metatarsal guards, then the employer does not have to pay for special boots with the guards built in.

- If the worker is responsible for loosing or damaging an item of personal protective equipment, then the employer can require the worker to pay for the replacement item.
Learning objectives

This Chapter reviews the health hazards caused by chemicals that you might use or be exposed to on a construction site.

This Chapter also reviews the OSHA Hazard Communication Standard - known as HAZCOM - that requires you to receive training and information about the hazardous chemicals at your work site.

After completing this Chapter you will be able to demonstrate your ability to:

1. IDENTIFY examples of adverse health effects from occupational exposure to chemicals.

2. IDENTIFY the proper definition of these terms:
   
   a. Cancer  
   b. Acute Effect  
   c. Chronic Effect  
   d. Latency Period  
   e. Target Organ  
   f. Local Effect  
   g. Systemic Effect
3. IDENTIFY five routes of entry: five ways that chemicals get into or on your body.

4. IDENTIFY two examples of chronic effects of chemical exposure.

5. IDENTIFY two examples of acute effects of chemical exposure.

6. IDENTIFY the five major requirements of the OSHA HAZCOM Standard.

7. IDENTIFY the kinds of information about a chemical that you can find on its SDS.

8. LIST six types of information which must be on a chemical label.
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, how much you absorb, and your own state of health.

We divide hazardous chemicals into several categories:

- Asphyxiants (lack of oxygen).
- Corrosives.
- Irritants.
- Sensitizers.
- Toxins (poisons).

A single chemical might fit into more than one category. For example, an acid might be corrosive (burn your skin) and be a poison (if it gets inside you).
Lack of oxygen – asphyxia. There are two ways that chemicals can cause a lack of oxygen:

- Displacing the oxygen in the air.
- Interfering with how the body uses oxygen.

The normal amount of oxygen in the air is 21%.

OSHA says that you may not work in an area with less than 19½ oxygen.

<table>
<thead>
<tr>
<th>Lack of Oxygen (Asphyxia)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any gas or vapor can be a simple asphyxiant if enough is released to displace oxygen in the air.</td>
</tr>
</tbody>
</table>

Any gas or vapor can be a simple asphyxiant if enough is released to displace oxygen in the air.

Corrosives burn any tissue they contact: skin, eyes, mouth, nose, esophagus, stomach, and lungs. (Examples: acids like sulfuric acid or hydrofluoric acid; and bases like ammonia and lye.)

<table>
<thead>
<tr>
<th>Corrosives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irritants</td>
</tr>
<tr>
<td>Sensitizers</td>
</tr>
</tbody>
</table>

Corrosives

Irritants

Sensitizers cause some people to become “sensitized”, and react to even a very small exposure. They suffer asthma-like symptoms, or skin irritation. (Examples: formaldehyde, nickel, and toluene-di-isocyanide.)

Irritants cause redness, swelling, itching or burning of the eyes and skin. If inhaled, they cause coughing, or difficulty breathing. (Examples: solvents, weak solutions of ammonia, weak solutions of acids.)

<table>
<thead>
<tr>
<th>Sensitizers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrosives</td>
</tr>
<tr>
<td>Irritants</td>
</tr>
</tbody>
</table>
There are many kinds of toxins (poisons) – depending on what organs or parts of the body they damage.

Liver toxins (hepatotoxins) can cause hepatitis, cirrhosis, or liver failure. (Examples: ethyl alcohol, PCB’s, carbon tetra-chloride, vinyl chloride.)

Neurotoxins affect nerves. Some affect the brain (central nervous system) causing dizziness, nausea, headaches, poor coordination, or behavior changes. Other neurotoxins affect the nerves that go to other parts of the body (peripheral nervous system) causing numbness, tingling, weakness or tremors. (Examples: lead, mercury, organic solvents.)

Kidney toxins (nephrotoxins) damage the kidneys, and may cause kidney failure. (Examples: lead, cadmium, mercury, methyl alcohol, carbon tetrachloride.)

Respiratory toxins damage the lungs and airways. Ozone and phosgene gas cause fluid to collect in the lungs (edema). Asbestos and silica cause lung scarring. Asbestos and tobacco smoke can cause lung cancer.

Blood toxins (hematopoietic toxins) affect the blood, or the organs that make blood cells. (Example: benzene.)

Reproductive toxins affect your ability to conceive, or give birth to normal, healthy children. Possible effects include low sperm count, deformed sperm, impotence, menstrual irregularities, infertility, miscarriage, low birth weight and birth defects. (Example: ethyl alcohol.)
Cancer is the uncontrolled growth of abnormal cells. Cancer is what happens when some cells begin to “misbehave”, and enough of these “cancer” cells grow so that they cause a problem.

For example, the cells in your lungs form a structure which expands and contracts as you breathe. Some cells form the air passages, others let oxygen pass into your blood. If some cells grow into a mass that interferes with the passage of air or the normal expansion and contraction, then this mass of cells is called lung cancer.

Because there are different kinds of cells, there are different kinds of cancer: liver cancer, lung cancer, leukemia (blood cancer), skin cancer and so forth.

Chemicals that increase your risk of cancer are called carcinogens. Just because you are exposed to a carcinogen doesn’t mean you’ll get cancer.

Not all chemicals cause cancer. We need to identify the ones that do, and keep our exposure as low as possible. Very few chemicals have actually been studied to see if they are carcinogens.

### Some Examples of Chemical Carcinogens

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Type of Cancer</th>
<th>Chemical Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asbestos</td>
<td>Lung cancer, mesothelioma</td>
<td>Insulation, brake linings</td>
</tr>
<tr>
<td>Arsenic</td>
<td>Lung cancer</td>
<td>Pesticides, pigments, smelter residue</td>
</tr>
<tr>
<td>Benzene</td>
<td>Leukemia</td>
<td>Chemical manufacture, solvents</td>
</tr>
<tr>
<td>Benzidine</td>
<td>Bladder cancer</td>
<td>Manufacture of dyes, plastics, chemicals</td>
</tr>
<tr>
<td>Chromium</td>
<td>Lung cancer</td>
<td>Welding fume, plating fume and residue</td>
</tr>
<tr>
<td>Coal tar</td>
<td>Skin and scrotal cancer</td>
<td>Fly ash, roofing and sealing compounds</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>Bladder cancer</td>
<td>Manufacture of dyes, rubber, chemicals</td>
</tr>
<tr>
<td>Vinyl chloride</td>
<td>Liver cancer</td>
<td>Manufacture of polyvinyl chloride (PVC)</td>
</tr>
</tbody>
</table>
Air Contaminants

Air contaminants are hazardous chemicals in the air.

In order to be small enough to stay in the air and be inhaled, the chemical must either be in the form of a gas or a particulate. All air contaminants are either:

- Gases and vapors
- Particulates

Gases and vapors are the same thing: individual molecules in the air. Particulates include dusts, fibers, fumes, mists and sprays.

Chemical Forms and Health Effects

The form of a chemical has a lot to do with how it affects our health, and with how we protect ourselves.

Very small particulates, like welding fumes, penetrate deep into the lungs when we inhale – and stay there. A larger particulate, like sawdust, might be caught in the nose, and we can blow it out. Fibers, like asbestos, because of their long, thin shape, also penetrate deep into the lungs.

Small particulates are also harder to trap in a respirator filter than larger particulates. For fumes, fibers and very small dusts we need a much better filter than we would need for sawdust.

Vapors and gases, because they are individual molecules, can penetrate deep into the lungs – where they can be absorbed into the blood.

Vapors and gases are difficult to capture in a respirator cartridge. For many gases and vapors there is no cartridge that works – we have to use a respirator with its own air supply.
### Gases and Vapors

**Gas:** individual molecules – flying around in the air.

**Vapor:** a gas that evaporates from a liquid or solid.

### Particulates

**Dust:** Tiny solid particles – floating in the air.

**Fibers:** Tiny solid particles – much longer than wide – floating in the air.

**Fume:** Very tiny solid particles – from hot processes – floating in the air.

**Mist and Spray:** Tiny liquid pieces – floating in the air.
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.

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.
If a chemical causes damage 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 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.

Local and Systemic Effects

Local effect: Occurs where the chemical contacts your body.

Systemic Effect: Occurs in some other organ after the chemical has circulated through your system.

Local effect, systemic effect and target organ have to do with where the chemical affects you.

Acute effect, chronic effect and latency period have to do with when the chemical affects you.
Short Term and Long Term Effects

Some chemicals cause effects that occur right away. If acid gets in your eye, it causes a painful burn immediately. If you inhale ammonia vapor, you cough and feel irritation in your nose and airways right away. This is called a short-term effect or acute effect.

If you breathe small amounts of asbestos fibers you won’t even notice them. There are no acute effects. 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.

The same chemical can cause both kinds of effects. For example, toluene is a chemical used in paints and solvents, and in the cement for plastic models. Inhale toluene and you can get dizzy or “high”, and feel respiratory irritation. Toluene can also dry and irritate the skin. These are acute effects. However, if you are exposed again and again, toluene will damage your liver and destroy brain cells. These are chronic effects.

We usually notice acute effects. For example, acid burns and we feel it almost immediately. Just one whiff of ammonia vapor can make you cough. These effects can warn us to take precautions.

Unfortunately, you usually won’t notice chronic effects until it’s too late, because they happen slowly and it takes a long time to develop symptoms. You have to learn the possible chronic effects of the chemicals you work with. Then you will know that you must be careful, and what precautions to take, even if the materials don’t cause any immediate effects.

Acute = short term
Chronic = long term

Latency Periods:
Average Years After Exposure for Cancer to Appear

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asbestos</td>
<td>33</td>
</tr>
<tr>
<td>Arsenic</td>
<td>25</td>
</tr>
<tr>
<td>Benzene</td>
<td>10</td>
</tr>
<tr>
<td>Benzidine</td>
<td>16</td>
</tr>
<tr>
<td>Chromates</td>
<td>21</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>22</td>
</tr>
<tr>
<td>Vinyl chloride</td>
<td>15</td>
</tr>
</tbody>
</table>
The OSHA Hazard Communication Standard, or HAZCOM requires employers to have: [29 CFR 1910.1200 and 1926.59]

1. Written HAZCOM program to inform workers of chemical hazards.

2. Safety Data Sheets (SDSs) for each hazardous chemical in the workplace, and make these SDSs available to workers.

3. Labels on all containers of hazardous chemicals.

4. List of hazardous chemicals in the workplace, and make this list available to workers.

5. Training to workers about:
   - The employer’s HAZCOM program.
   - The operations or locations in the workplace where hazardous chemicals are present.
   - What hazardous chemicals are present.
   - How to use SDSs.
   - How to interpret chemical labels.
   - How to detect the presence of chemicals.
   - The health and safety hazards of the chemicals.
   - Safe work practices, protective equipment and emergency procedures for the chemicals.

HAZCOM requires your employer to tell you the “what, where and how” of the hazardous chemicals in your work place.

Training on HAZCOM must be provided at the beginning of each new assignment involving hazardous chemicals or whenever a new physical or health hazard is introduced.
Chemical Labels

See the next page for the OSHA Pictograms

Under the new HAZCOM Standard, all chemical labels must include a pictogram describing the hazards presented by the product. See page 87 for a list of the pictograms.

There is an exception: If the secondary container is only used by one worker for only one shift, then it doesn’t have to be labeled.

Labels on chemical containers must include:

1. The name of the product.

2. Name, address and phone number of the manufacturer or importer.

3. The hazards of the product, including:
   • A signal word - either DANGER or WARNING.
   • The physical hazards of the product.
   • The health hazards of the product.
   • The target organs which the product may affect.
   • Precautions and protective equipment.
   • Emergency first aid information.

4. Pictogram: Under the new HAZCOM Standard, all labels will be required to display a pictogram describing the nature of the hazard presented by the product. See page 87 for the approved pictograms.

The label may include a CAS number, which is a unique “social security” number for each chemical. This is helpful because most chemicals have more than one name. If you look in another information source you can be sure that you are getting information about the right chemical if you verify the CAS number.

The label might also include a UN/NA identification number, which is the DOT number for the chemical, or for the group of chemicals it belongs to.

If you transfer a chemical to a secondary container, HAZCOM requires the secondary container to be labeled also. For example, if you fill a one-quart can and take it to the repair shop, this secondary container also needs a label.
### HAZCOM Pictograms

<table>
<thead>
<tr>
<th>Health Hazard</th>
<th>Flame</th>
<th>Exclamation Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Carcinogen</td>
<td>• Flammables</td>
<td>• Irritant</td>
</tr>
<tr>
<td>• Respiratory Sensitizer</td>
<td>• Self-Reactives</td>
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Your employer is required to have a **Safety Data Sheet** (SDS) for every hazardous chemical used in the workplace.

The SDS must provide the following information in the order listed below:

1. Identification;
2. Hazard identification;
3. Composition/information on ingredients;
4. First-aid measures;
5. Fire-fighting measures;
6. Accidental release measures;
7. Handling and storage;
8. Exposure controls/personal protection;
9. Physical and chemical properties;
10. Stability and reactivity;
11. Toxicological information;
12. Ecological information;
13. Disposal considerations;
14. Transport information;
15. Regulatory information; and
16. Other information including date and preparation or last revision.
The NFPA Hazard Identification System provides information to fire fighters in an emergency. You will find the diamond shaped NFPA labels on containers, storage tanks, doors and walls.

“0” means no hazard. “4” means the most severe hazard. The bottom diamond is for special information, such as “radioactive”, or “water reactive”.

The higher the number, the greater the hazard. “4” is the most extreme hazard.

The NFPA label does not identify the chemical. It does not give specific health effects. It also does not identify the manufacturer. These are all things which OSHA requires on product labels.

The NFPA Hazard Identification System is intended to provide information to fire fighters during an emergency.

The NFPA label does not identify the chemical, the specific health effects, or the manufacturer.
DOT Placards, Labels and Markings

The US Department of Transportation (DOT) has requirements for placards, labels and other markings on hazardous materials in transportation. These can help you identify the chemical hazards in your workplace.

DOT divides hazardous materials into nine hazard classes. See the next page for a list of these DOE hazard classes. Below are examples of placards from each class.
# DOT Hazard Classes and Divisions

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<td>ORM-D</td>
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<td>Other regulated material</td>
</tr>
</tbody>
</table>
Learning objectives

This Chapter reviews safe work practices and OSHA requirements for handling hazardous materials, including flammable and combustible liquids.

After completing this Chapter you will be able to demonstrate your ability to:

1. DESCRIBE safe handling practices for compressed gas cylinders.
2. EXPLAIN the terms flash point, flammable and combustible.
3. EXPLAIN the purpose of bonding and grounding containers of flammable materials.
4. IDENTIFY four incompatible chemical combinations.
The OSHA Hazardous Materials Standard addresses flammable and combustible liquids, compressed gasses, explosives, and operations involving spraying and dipping with hazardous materials.

This subpart also includes two standards that we do not address in this manual because they each have extensive training requirements that are beyond the scope of the General Industry Outreach Course: Process Safety Management Standard and the Hazardous Waste Operations and Emergency Response (HAZWOPER).

Subpart H: Hazardous Materials

1910.101 - Table of contents.
1910.102 - Coverage and definitions.
1910.104 - Oxygen.
1910.105 - Nitrous oxide.
1910.106 - Flammable and Combustible Liquids.
1910.107 - Spray finishing.
1910.108 - Dip Tanks.
1910.110 - Storage and handling of LPG.
1910.111 - Storage and handling: anhydrous ammonia.
1910.119 - Process safety management.
1910.120 - HAZWOPER.
1910.122-126 - Dipping and coating.
Compressed Gases
[29 CFR 1910.101]

Compressed gases are used in many general industry operations. For example, welding gases like acetylene, oxygen, argon and helium are stored and used as compressed gasses in steel cylinders.

All compressed gases are hazardous simply because they are under extremely high pressure. The pressure alone can cause injury and property damage. If the valve is broken off of a compressed gas cylinder, the cylinder can take off like a rocket.

Many compressed gasses are also hazardous because of the properties of the substance, for example, toxic or flammable gases.

Visual inspection. The employer must make sure that all compressed gas cylinders are in a safe condition to the extent that this can be determine by visual inspection.

Handling Compressed Gas Cylinders
[29 CFR 1910.253]

The following safe work practices are from the OSHA Welding and Cutting Standard, but they apply to all situations where workers handle gas cylinders.

- Keep the valve cap in place when the cylinder is not in use.
- Put the valve cap on whenever you move a cylinder, unless it is in a special cart or dolly.
- If you must move a cylinder by hand, tilt and roll it on the bottom edge.
- When cylinders are transported by forklift or truck, they must be secured in a vertical position.
- When cylinders are hoisted, they must be secured on a cradle, sling board, or pallet.
• Never hoist a cylinder with a choker sling. Never use a magnet. Never hoist it by the valve cap.

• At all times a cylinder must be held securely – in an upright position – with a chain, in a cylinder holder, or on a special cart or dolly.

• Make sure to close the cylinder valve whenever the cylinder is not in use.

• Keep cylinders far enough away from the welding or cutting operation so that sparks, slag, or flame can’t reach them. If this is impractical, shield the cylinders with fire resistant material.

• Don’t take fuel or oxygen cylinders into a confined space. Leave the cylinders outside the space, and drag the hoses into the place where you need to weld.

• Never use a cylinder, whether full or empty, as a roller or support.

• Store cylinders where they will not be knocked over or damaged by passing vehicles or by falling objects.

• Store oxygen cylinders and fuel cylinders apart. There must be at least 20 feet between them when they are not in use, or they must be separated by a noncombustible barrier at least 5 feet high.
Flammable Vapor Explosions

To have an explosion of flammable vapors in the air, there has to be the right mixture of vapor (fuel) and oxygen. If there is too little vapor, it won’t burn. If there is too much vapor, it won’t burn either.

The lower explosive limit (LEL) is the smallest concentration of vapor in the air that will sustain a chain reaction and burn in the air, creating a vapor explosion.

The LEL is different for different chemicals. For gasoline it’s 1.4%. At least 1.4% of the molecules in the air have to be gasoline in order to start a fire or explosion.

If there’s a release of flammable vapor into the air, we want to be certain that the concentration is far below the LEL. This is because conditions could change. More fuel could evaporate, or the concentration could be greater as we move deeper into a confined space or closer to the source of the fuel. Also, the instrument we use to measure the concentration might not be accurate.

OSHA requires the concentration to be less than 10% of the LEL.

OSHA requires the concentration to be less than 10% of the LEL in order for workers to remain in the area. [29 CFR 1910.146(b)]

A prudent safety and health program might establish an even lower action level (the point at which you have to leave the area). We can use ventilation to lower the concentration below the action level.
Liquids evaporate more easily as they get warmer, and they evaporate less if they are colder.

The flash point is the lowest temperature of a liquid at which it gives off enough vapor so that a spark will set off a fire or explosion.

A low flash point tells you a material is dangerous. Consider gasoline. It’s flash point is minus 45°F. Anytime 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.

Consider diesel fuel. It’s flash point is around 130°. Diesel fuel is not as easy to start burning as gasoline.

A flammable liquid is one that has a low flash point so that under normal conditions there’s enough vapor that a spark will set off a fire or explosion.

A combustible liquid is one that 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 set off a fire or explosion.
What’s normal temperature? The NFPA (National Fire Protection Association) says that if the flash point is below 100° F, the material is considered flammable. If the flash point is 100° or above, it’s combustible. The idea is that most of the time the temperature doesn’t get above 100°, so it isn’t hot enough for the liquid to give off enough vapor to burn or explode.

The Department of Transportation (DOT) calls a liquid flammable if the flash point is 140° or less. [49 CFR 173.120(a)]

DOT calls a liquid combustible if it has a flash point above 140°. [49 CFR 173.120(b)]

DOT recognizes that sometimes liquids do get hotter than 100°. This could happen in a tanker on a sunny day, in drums in a sealed trailer in the sun, or on a warm day in Tucson.

The idea behind both the NFPA and DOT systems is that we need to be even more careful with flammable liquids because even a little spark could cause a fire.
Because a tiny spark can ignite the vapors, it is essential to prevent all sparks when handling flammable liquids.

Static electricity is produced when dissimilar materials rub together. Friction transfers electrons from one object to the other. If the extra electrons have no way to leave, they just sit there. That’s what “static” means.

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 body. When your are about to touch a door knob, the electrons jump to the knob.

When liquid flows through a hose, or pours out of a container, friction causes electrons to transfer from the liquid to the container. When the spout touches another container, there could be a spark which ignites the vapors coming from the liquid.

Bonding is connecting a good conductor (such as a copper wire) between two containers so that any extra electrons on one container can flow easily to the other container without causing a spark.

Grounding is connecting a good conductor (such as a copper wire) 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.
Incompatible chemicals are combinations of chemicals that undergo dangerous reactions if they mix with each other. The effects of these reactions are:

- Production of heat and pressure;
- Fire and explosion;
- Formation of toxic gases and vapors; or
- Formation of flammable gases and vapors.

Some chemicals are dangerous if they simply contact water, air, or common substances like wood and paper.

Because of the extreme danger which incompatible chemicals create, a great deal of effort must be put into analyzing hazardous substances and keeping them separate. This includes the creation of segregated staging areas for chemical storage. It is also why the DOT has special rules about chemical segregation during transportation.

While you are not expected to be a chemist, there are some deadly combinations you can remember:

- Never mix acids and bases. They react violently.
- Never mix cyanide compounds with acids. This creates deadly hydrogen cyanide gas.
- Never let strong oxidizers contact flammables or combustibles. Fire or explosion could follow.
- Never put water on materials that react violently with water, like magnesium or sodium metal.
Oxidizers are chemicals that release oxygen when they react with other chemicals. This can cause the other chemical to burn or to explode. Examples are chlorine gas, swimming pool chlorine, ozone, nitrates, concentrated hydrogen peroxide, and sulfuric and nitric acids. Keep oxidizers away from flammables and combustibles, including oils and greases.

Corrosives are chemicals that corrode (eat into) other substances. They can cause serious, painful burns to skin, and permanent eye damage. Many corrosives react with metals, so they can’t be put in standard drums. A corrosive can eat through the metal of another container, releasing the contents and possibly causing a dangerous chemical reaction.

Acids and bases are two general kinds of corrosives. While they are similar in that they both corrode many other substances, they react violently together. Never let acids and bases mix.

The pH scale is a way of measuring the strength of an acid or base solution in water. The scale runs from “0” to “14”, with “7” in the middle. “7” is neutral, neither acid nor base. “7” is the pH of pure water.

If the pH is less than “7”, it’s an acid. If the pH is more than “7”, it’s a base. The further the number gets from “7”, the stronger (more corrosive) the solution is.
Learning objectives

This Chapter reviews the proper methods to move materials, including the safe use of slings. This also includes a brief review of safety procedures for powered industrial trucks (fork lifts.). However, this Chapter does not substitute for the equipment-specific training that you are required to receive if you are a fork lift operator.

After completing this Chapter you will be able to demonstrate your ability to:

1. IDENTIFY four safe work practices for storing materials.
2. DESCRIBE how to determine the rated capacity of a sling.
3. IDENTIFY six things to consider before rigging a load with slings.
4. IDENTIFY five safe work practices when lifting a load with slings.
Materials Handling and Storage is Subpart N of the OSHA General Industry Standards. It has eight sections as shown in the box below.

In this Chapter we will discuss the standards for material handling in general, cranes and derricks, and the proper use of slings.

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 and Storage 29 CFR 1910, Subpart N

Powered Industrial Trucks: 29 CFR 1910.178
Overhead and Gantry Cranes: 29 CFR1910.179
Crawler Locomotive and Truck Cranes: 29 CFR 1910.180
Derricks: 29 CFR 1910.181
Helicopters: 29 CFR 1910.183
Slings: 29 CFR 1910.184

(Note: There is no OSHA section .182.)
General Requirements
[29 CFR 1910.176]

Use of Mechanical Equipment. There must be sufficiently wide aisles, loading docks, and doorways in order to use mechanical handling equipment safely. Mark permanent aisles and passageways, and keep them clear.

Clearance Signs. Post signs that state clearance levels.

Housekeeping. Don’t let things accumulate and become a hazard. Keep storage areas free of tripping hazards, fire hazards or explosion hazards. Don’t provide places for rats or other pests to live or hide.

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 onto the blocks.

Gloves and Boots. Wear work gloves and steel-toed boots when handling heavy materials.
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 are 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.
Here we review a few basic principles of crane safety. If you work where a crane is in operation, you need to be aware of its presence, and make sure that you do not walk or work under the load.

Crane operation is beyond the scope of this course. A crane operator requires special training on the safe operation of the particular type of crane that he or she operates.

- 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.
Check all of these things before rigging the load:

- **Inspection.** Inspect the sling prior to use.

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

- **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

Follow these safe practices when lifting the load:

- Make sure that you have selected the proper sling for the job.
- Make sure that you have rigged the load correctly.
- 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.

Sling Materials

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.
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.

Lay is a term used to describe both fiber rope and wire rope. The word Lay can have more than one meaning:

- One complete wrap of strands around the core.
- 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.
Selecting the Proper Wire Rope Sling

For example: a new wire rope sling with a strength of 10,000 pounds would have a rated working load of 2,000 pounds.

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.

There are four characteristics to consider with wire rope: 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.

As the sling gets used, its ultimate strength declines because of wear and stretching. This makes it important to rigorously inspect wire rope slings, especially old 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 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 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.
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 cageing, 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.

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.

Storing Wire Rope Slings

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.

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.
Synthetic slings are made of nylon, dacron or kevlar. 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.

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.)
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.
**Capacity.** Each forklift or other industrial truck must be marked with it’s rated capacity. Don’t overload it.

**Modifications.** Don’t make any modifications without the manufacturer’s prior written approval.

**Attachments.** 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 Chapter on electrical hazards we discuss safe battery charging.

If you operate a powered industrial truck, you must have special training that includes hands-on practice with each type of truck that you will operate.
Learning objectives

This Chapter reviews the guards, devices and safe work practices that can prevent injury when workers use tools, especially power tools and machinery. The material on pages 121-127 is based on OSHA’s eTool, “Machine Guarding.”

After completing this Chapter you will be able to demonstrate your ability to:

1. IDENTIFY examples of guards and devices.
2. EXPLAIN the importance and proper use of guards and devices.
3. IDENTIFY three types of switches used on power tools.
4. IDENTIFY the hazards of electric tools.
5. IDENTIFY the hazards of abrasive tools
6. IDENTIFY the hazards of pneumatic tools.
7. IDENTIFY the hazards of powder-actuated tools.
8. IDENTIFY four types of points of operation that may present safety hazards for the worker operating a tool or machine.
Machine Guarding is Subpart O of the OSHA General Industry Standards. It has five sections. Power tools are the subject of Subpart P; it has four sections.

According to OSHA, workers who operate or maintain machinery suffer 18,000 amputations, lacerations, crushing injuries, and abrasions each year, and over 800 deaths.

Power tools and machinery are fitted with guards and devices designed to keep you from being injured. It is important to understand how these guards and devices work, and how to use them properly. It is also essential to realize that it very dangerous to disable or remove a guard – even if you think that removal makes it easier to use the machine.

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Subpart O: Machine Guarding

1910.211 - Definitions.
1910.212 - General requirements for all machines.
1910.213 - Woodworking machinery.
1910.117 - Mechanical power presses.
1910.118 - Forging machines.
1910.119 - Mechanical power transmission apparatus.

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Subpart P: Hand and Portable Power Tools

1910.216 - Definitions.
1910.217 - Hand and portable power tools, general.
1910.218 - Guarding of portable power tools.
1910.219 - Other portable tools and equipment.
There are three main areas of any machine to consider when discussing machine guarding:

**Point of operation.** The point or place that the machine does the work that it’s designed for. For example, where a drill press drills the hole, or where a power saw cuts.

**Power transmission apparatus.** This includes flywheels, pulleys, belts, drive-shafts, couplings, cans, gears, chains, etc. that transmit power to the part of the machine that does the work.

**In-running nip points.** This means a place where two moving parts come together, such as where gears mesh, or a belt passes over a pulley.

**Other moving parts.** This means all the other parts of the machine that move or rotate – include feed mechanisms and auxiliary parts of the machine.

Some other terms that we use to describe machine guarding include:

**Device.** A control or attachment that restrains the operator from reaching the point of operation, or prevents operation if the operator’s hands are within the point of operation, or automatically pulls the operator’s hands away from the point of operation, or senses the presence of the operators hands and prevents the operation.

**Guard.** A barrier (like a screen or door) that prevents the operator from putting hands or fingers into the point of operation or other dangerous part of the machine.

**Prime mover.** The source of power of a machine. For example, an electric motor, a hydraulic pump, or an air compressor.
The purpose of machine guarding is to protect the machine operator and other employees from hazards created by in-running nip points, rotating parts, blades, cutters and other hazardous parts of machines and equipment. Guarding is also used to protect workers from flying chips & sparks. Some examples of this are barrier guards, light curtains, two-hand operating devices etc.

- The machine’s construction and its guards must prevent the operator, or any part of the operator’s body from getting into the danger zone of the machine during its operation.
- Guards must not create additional hazards.
- Guards must be attached to the machine, if possible.

Guards on a cut-off saw
Guarding the Point of Operation

[29 CFR 1910.212(a)(3)]

The point of operation is the area on a machine where the work is performed.

- The guards are must be designed so that they keep the operator’s hands and other parts of his or her body away from the point of operation.

- Push sticks and other tools used for placing material in the point of operation must be designed so that they keep the worker’s hands out of the danger zone.

- Push sticks and other material handling tools are additional safety aides; they are not replacements for proper machine guards.

Examples of machines that usually require point of operation guarding include:

- Power presses
- Power saws
- Jointers
- Rollers and calenders
- Shears
- Portable power tools
- Milling machines

This distance guard keeps the operator’s hands away from the point of operation.
Rotating parts can be dangerous; even smooth, slowly rotating shafts can grip hair and clothing, and can force the hand and arm into a dangerous position. Injuries due to contact with rotating parts can be severe.

Collars, couplings, cams, clutches, flywheels, shaft ends, spindles, meshing gears, and horizontal or vertical shafting are some examples of common rotating mechanisms that can be hazardous.

The danger increases when projections such as set screws, bolts, nicks, abrasions, and projecting keys or set screws are exposed on rotating parts.

Rotating parts that can catch clothing and hair
In-running nip points are places where moving parts come together, such as two gears meshing, or a belt passing over a pulley. A nip point can also exist where a moving part is close to a fixed part. For example, the small space between a grinding wheel and the tool rest.

Moving parts of machinery, tools and equipment can make other hazardous motions that need to be guarded:

- Reciprocating. Parts that move back-and-forth, or up-and-down, can crush a worker’s hand or pin their body against another object.

- Cutting. Saws, shears, drills, boring machinery and other pieces of equipment can cut or amputate.
The drive shafts, belts, gears and other power transmission apparatus that drive a machine must be guarded. Otherwise this apparatus can present a hazard because it rotates and or has in-running nip points.
Guards must be strong and effective, and must not make it harder for you to do your job.

- **Prevent contact.** The safeguard must prevent hands, arms, and any other part of a worker’s body from making contact with dangerous moving parts.

- **Be secure.** A safeguard that can easily be made ineffective is no safeguard at all. Guards and safety devices should be made of durable material that will withstand the conditions of normal use. They must be firmly attached to the machine.

- **Protect from falling objects.** The safeguard should ensure that no objects can fall into moving parts. A small tool which is dropped into a cycling machine could easily become a projectile that could strike and injure someone.

- **Create no new hazards.** A safeguard defeats its own purpose if it creates another hazard such as a shear point, or a jagged edge. The edges of guards, for instance, should be rolled or bolted in such a way that they eliminate sharp edges.

- **Create no interference.** A safeguard that impedes a worker from performing the job quickly and comfortably might soon be overridden or disregarded. Proper safeguarding can actually enhance efficiency as it can relieve the worker’s apprehensions about injury.

- **Allow safe lubrication.** If possible, one should be able to lubricate the machine without removing the safeguards. For example, locate oil reservoirs outside the guard.
Even the most elaborate safeguarding system cannot offer effective protection unless the worker knows how to use it and why. Specific and detailed training is therefore a crucial part of any effort to provide safeguarding against machine-related hazards. Thorough operator training should involve instruction or hands-on training in the following:

- A description and identification of the hazards associated with the particular machines and tools that the worker will operate.

- The safeguards themselves, how they provide protection, and the hazards for which they are intended.

- How to use the safeguards properly.

- How and under what circumstances safeguards can be removed, and by whom (in most cases, repair or maintenance personnel only).

- When a lock-out/tag-out program is required.

- What to do (for example, contact the supervisor) if a safeguard is damaged, missing, or unable to provide adequate protection.

This kind of safety training is necessary for new operators and maintenance or setup personnel, when any new or altered safeguards are put in service, or when workers are assigned to a new machine or operation.
Power Tools: Safe Work Practices

Guards on Power tools

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.

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.
- 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.
- 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 – including tools that workers furnish themselves. [29 CFR 1910.243]
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.

Grounding: 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.
Electric Power Tools
[29 CFR 1910.243(a)]
(Continued)

Follow these safe work practices for 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.

The safest electrical supply system relies on one or both of the following:

- Ground Fault Circuit Interrupters (GFCI).
- An assured equipment grounding conductor program that assures that there is proper grounding of every circuit.

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 Chapter 4, “Electrical Safety,” for more information on GFCI’s and assured equipment grounding conductor programs.
There are three types of switches that are used on power tools:

- Momentary (Only “ON” while pressure is applied.)
- Momentary with a LOCK-ON that releases with a single touch.
- Positive ON-OFF switch. (Stays “ON” until turned “OFF”.)

<table>
<thead>
<tr>
<th>Safe Switches for Power Tools</th>
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<tr>
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<tr>
<td>Circular Saw</td>
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<td>Chain Saw</td>
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<td>Percussion Tool</td>
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<td>Drill</td>
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<td>Fastener Driver</td>
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<tr>
<td>Belt Sander</td>
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<tr>
<td>Reciprocating Saw</td>
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<tr>
<td>Jig, Saber or Scroll Saw</td>
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<tr>
<td>(blade bigger than ¼”)</td>
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<tr>
<td>Disk Sander</td>
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<tr>
<td>(disk bigger than 2”)</td>
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<tr>
<td>Grinder</td>
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<tr>
<td>(wheel bigger than 2”)</td>
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<tr>
<td>Router</td>
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<tr>
<td>Planer</td>
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<tr>
<td>Laminate Trimmer</td>
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<td>Nibbler</td>
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<td>Shears</td>
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<tr>
<td>Jig, Saber or Scroll Saw</td>
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<td>(blade ¼” or less)</td>
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<tr>
<td>Disk Sander</td>
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<td>(disk 2” or less)</td>
</tr>
<tr>
<td>Grinder</td>
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<td>(wheel 2” or less)</td>
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</table>
Abrasive Wheel Tools

[29 CFR 1910.215 and 1910.243(c)]

Abrasive wheel tools — like grinders and cutting wheels — create two special safety hazards:

- Pieces of the work being cut or ground can fly out.
- The abrasive wheel itself can shatter.

**Guards:** To protect 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. Do not remove the guard. If you can’t do the work with the guard in place, then you might be using the wrong tool.

**Sound Test:** Before mounting an abrasive wheel, check it for cracks. Tap it 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 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.

Safe working procedures:

- 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 can create these special hazards:

- Getting hit by an attachment or fastener.
- Loud noise.
- Getting injured by air pressure.
- Muscle and joint injury (ergonomic injury).

**Hose:** Inspect the hose. Check that the hose and tool are securely connected. 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.

**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 and staples:** A tool that drives nail, rivets or staples, 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 hand hold.

**Noise:** Many pneumatic tools make a very loud noise. Repeated exposure to loud noise will cause hearing loss. Hearing loss is irreversible.

Safe working procedures:

- Always wear safety glasses or a face shield.
- Never point an air gun toward anyone.
- Wear ear protection (ear plugs or ear muffs).
Liquid Fuel Tools

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 flash point. 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.

Confined Spaces: Do not use liquid fuel tools in a confined space, or in any area with poor ventilation. These tools give off carbon monoxide, an odorless colorless gas that is deadly. Remember, that air-purifying respirators do not supply oxygen, and do not protect against carbon monoxide.

Safe working procedures:

- 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 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.

Safe working procedures:

- 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.
Learning objectives

This Chapter reviews the topic of Industrial Hygiene, which has to do with identifying and controlling chemical health hazards in the work place.

After completing this Chapter you will be able to demonstrate your ability to:

1. EXPLAIN what industrial hygiene is, and why it is important for controlling worker exposures to harmful chemicals.

2. IDENTIFY the different physical forms of chemicals.

3. DESCRIBE the occupational exposure limits used to control workers’ exposures to harmful chemicals.

4. DESCRIBE the limitations and uncertainties related to chemical exposure limits.
Industrial hygiene is the art and science of anticipating, recognizing, evaluating, and controlling workplace hazards that may cause worker injuries and illnesses.

Specialists trained in industrial hygiene are called industrial hygienists.

A certified industrial hygienist is one who has at least five years of professional experience in occupational safety and health, has passed a rigorous certification examination, and participates in a program of continuing education. Most certified industrial hygienist also have a masters degree in occupational or environmental health, chemistry, engineering or a related field. There are currently about 6,500 certified industrial hygienists in the United States.

Although industrial hygienists often deal with all types of workplace hazards, they have traditionally focused on identifying, evaluating and controlling chemical exposures. Sometimes this work includes taking samples or measurements of contaminants in order to measure workers’ exposures, or to tell whether control equipment and work practices are effective.

Many of the professional employees of OSHA, including many compliance officers, are industrial hygienists.

OSHA has standards for exposure to chemical substances in the work place. These standards are based partly on the work of industrial hygienists who have evaluated workplace exposures to various chemicals.
Chemical Forms

Chemicals are made of molecules. For example, water is made of water molecules, toluene is made of toluene molecules. Depending on how the molecules are “stuck” together, the chemical may be in the form of a solid, a liquid or a gas.

Solids keep their size and shape, unless they’re broken into smaller pieces. That’s because the molecules are tightly stuck together. Solids are things like a stone, a piece of wood, or ice.

Liquids flow, like water. That’s because the molecules are loosely stuck together and can attach and detach from each other. Liquids keep the same size (volume), but change shape to fit their container.

Gases have no definite size or shape. That’s because the molecules are all separate – free to fly around. A gas expands to fill the space available. If a gas leaks, it disperses in all directions. Gases are individual molecules – flying around.

Many chemicals can exist in different forms, depending on the conditions.

Vapors are chemicals that evaporate.

In terms of air monitoring and respirator selection, gases and vapors are the same thing.

Chemicals can change form, depending on the conditions. For example, if it’s cold enough, water is a solid called ice. With heat, it melts and becomes liquid. Water can evaporate to become a gas (water vapor).

Vapor is the word for a gas that evaporates from a liquid or solid. For example, paint thinner is a liquid. We smell it because some of the liquid evaporates to form solvent vapor, which gets into our noses. When a vapor cools, it can condense back into a liquid.

A gas is something that’s normally in the form of a gas. A vapor is something that is usually liquid or solid, but has evaporated to form a gas. Vapors behave like the other gases in the air. They diffuse (spread out) into the space available.
Dust is a solid material that has been ground into small pieces. You can see dust in the beam of a movie projector, or when you shine a flash light in a dark room. Because dust floats in the air, it can be inhaled.

Fibers are also small solid pieces that float in the air. Fibers are like dusts, except that the individual pieces are much longer than they are wide. For some chemicals, this arrow-like shape makes it easier for them to get deep into the lungs. An example is asbestos, which breaks up into thousands of tiny, microscopic fibers that penetrate deep into the lungs.

Fumes are extremely small solid particles formed in hot processes like fire, welding, and diesel engines. Fumes are like dusts, except that they are even smaller.

Fume is not vapor, although many people say “fume” when they mean “vapor”. You smell gasoline vapor, not gasoline fumes.

This distinction is important because we use a different kind of filter to trap solid particles like fume than to trap gases and vapors. Respirator labels use these words to mean different things. If you don’t know the difference, you may pick the wrong respirator and not be protected.

Mists and Sprays are tiny droplets that float in the air, and can settle on clothing or bare skin, or be inhaled.

Particulate means any liquid or solid in a form small enough to float in the air. Dust, fiber, fume, mist and spray are all particulates.

Smoke from burning is a usually a mixture of chemicals including gases, vapors and particulates.
Chemical Forms and Health Effects

The form of a chemical has a lot to do with how it affects our health, and with how we protect ourselves.

The smaller a particulate is, the more hazardous it is. Very small particulates, like welding fumes, penetrate deep into the lungs when we inhale – and stay there. A larger particulate, like sawdust, might be caught in the nose, and we can blow it out. Fibers, because of their long, thin shape, also penetrate deep into the lungs.

Small particulates are also harder to trap in a respirator filter than larger particulates. For fumes, fibers and very small dusts we need a much better filter than we would need for sawdust.

Vapors and gases, because they are individual molecules, can penetrate deep into the lungs – where they can be absorbed into the blood.

Vapors and gases are difficult to capture in a respirator cartridge. For many gases and vapors there is no cartridge works – we have to use a respirator with its own air supply.

Air Contaminants

Air contaminants are hazardous chemicals in the air.

In order to be small enough to stay in the air and be inhaled, the chemical must either be in the form of a gas or a particulate. All air contaminants are either:

- Gases and vapors.
- Particulates.

Remember that the gases and vapors are the same thing: individual molecules in the air. “Particulate” includes dusts, fibers, fumes, mists and sprays.
Gases and Vapors

Gas: individual molecules – flying around in the air.

Vapor: a gas that evaporates from a liquid or solid.

Particulates

Dust: Tiny solid particles – floating in the air.

Fibers: Tiny solid particles – much longer than wide – floating in the air.

Fume: Very tiny solid particles – from hot processes – floating in the air.

Mist and Spray: Tiny liquid pieces – floating in the air.
Exposure Limits

The best policy is to keep any exposure as low as possible.

How much exposure is too much? This depends on the chemical. However, the best policy is to keep any exposure as low as possible.

Several organizations and government agencies set limits for common chemicals. The idea is that most people will not be harmed if their exposure is kept below the limit. For example, the OSHA limit for toluene is 100 ppm. OSHA assumes that for most people, this amount in the air at work will not cause health problems.

An exposure limit is based on information from animal experiments and on information about the effects that workers experience in industries that use the chemical. Exposure limits are listed on SDSs (Safety Data Sheets).

We use exposure limits to decide what type of personal protective equipment to use. If you suffer health effects, the limits might be used to decide whether the effects were caused by the chemicals you worked with.

Most limits are for the amount of a chemical in the air. They only deal with the inhalation route of entry.

At work, the amount of a chemical in the air changes during the day, depending on what’s going on. For example, if someone is painting, there will be a higher level of solvent vapor than when the paint cans are closed and the products are dry.

Most exposure limits are based on the average exposure. The actual concentration will sometimes be above the average, sometimes less. The average is called the Time-Weighted-Average or TWA. “Time-weighted” just means that it’s the average over a period of time. Usually it’s an 8-hour TWA.

8-hour TWA = The average exposure to a chemical over an 8 hour work day.
A few chemicals have a Short Term Exposure Limit, or STEL. These chemicals are so irritating that even if the average concentration were low, the times when the concentration goes above the average would cause problems. A STEL is a limit you should only be exposed to for fifteen minutes or less, and for no more than four fifteen minute periods a shift, at least one hour apart.

Some chemicals have a Ceiling Limit or C. This means that the concentration in the air must never go above this limit, even for a few minutes.

Some limits say the word Skin. This reminds you that the liquid or solid form of the chemical can be absorbed through the skin. This is not an exposure limit for the skin. It’s just a warning to avoid skin exposure by wearing the proper gloves and protective clothing.

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<thead>
<tr>
<th>Exposure Limits for Air Contaminants</th>
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<tr>
<td><strong>Time-weighted average</strong> TWA</td>
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<tr>
<td><strong>Short Term Exposure Limit STEL</strong></td>
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<tr>
<td><strong>Ceiling Limit C</strong></td>
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<tr>
<td><strong>Skin</strong></td>
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Parts Per Million ppm

Parts per million (ppm) means how many of one kind of molecule are in a mixture of one million molecules.

Air is a mixture of individual molecules of nitrogen (78%), oxygen (21%) and other gases and vapors (1%). Each breath contains many millions of molecules.

Suppose we could count the molecules as we inhaled them. By the time we got to one million, we would have counted about 210,000 oxygen molecules, about 780,000 nitrogen molecules, and about 10,000 molecules of other gases and vapors. Out of one million molecules we have 210,000 oxygen molecules. One way to say this is that we have 210,000 parts per million (ppm) of oxygen. With a big numbers like these it’s easier to just say 21%.

However, for hazardous chemicals, a much smaller concentration can be harmful. Consider benzene. The OSHA PEL is 1 ppm. This means that OSHA has determined that even if only one out of every million molecules we breathe is a benzene molecule, we may be absorbing enough benzene to damage our health.

We can use ppm to describe the concentration of a gas or vapor in the air. We never use ppm for particulates.

Percent and ppm

One percent is equal to ten thousand ppm. 1% = 10,000 ppm.

The exposure limit – to prevent health effects – for benzene vapor in the air is 1 ppm. The lower explosive limit (LEL) – the least concentration required for benzene vapor to burn – is about one percent.

If you do the math, you can show that one percent (1%) is equal to ten thousand (10,000) ppm.

Because these levels are so different, we use different instruments to measure benzene concentrations for fire protection and benzene levels for health protection.
Milligrams per meter cubed (mg/m³) is another way to describe the concentration of a contaminant in the air.

A cubic meter (m³) is a measure of volume. Think of a square box with each edge a little longer than a yard. If you haul redi-mix, then you are familiar with cubic yards. A cubic meter is a little bit more.

A milligram (mg) is a very small weight. For example, a vitamin pill might contain 60 mg of vitamin C.

Suppose the air is contaminated with silica dust from dumping crushed rock. Suppose also that we collect a one cubic meter box full of this air. Then we carefully separate out the dust, and weigh it on a sensitive scale.

If the scale reads 6 milligrams, we would describe the air as having 6 milligrams of silica dust in one cubic meter of air: 6 milligrams per meter cubed or 6 mg/m³.

For particulates we use mg/m³ to describe the concentration in the air – never ppm.

Suppose we did the same thing with a cubic meter of air that contained benzene vapor. If we separated out the benzene molecules and weighed them, the scale might read, for example, 3 mg. We would then say that the concentration of benzene vapor was 3 mg/m³.

We can use either mg/m³ or ppm to describe the concentration of a gas or vapor in the air.
The American Conference of Governmental Industrial Hygienists (ACGIH) is an association of industrial hygienists. They prepare a list of recommended limits called Threshold Limit Values (TLV). They are only recommendations, and are not legally binding.

The federal Occupational Safety and Health Administration (OSHA), or in some states, the state safety and health agency, sets legally binding limits called Permissible Exposure Limits (PEL).  

[29 CFR 1910.100]

The National Institute for Occupational Safety and Health (NIOSH) makes recommendations called Recommended Exposure Limits (REL).

The TLV, PEL and REL are often the same. For example, xylene has an 8-hr TWA of 100 ppm in all three systems.

Sometimes they are different. For example, for carbon disulfide the TLV is 10 ppm, the PEL is 4 ppm, and the REL is 1 ppm.

For formaldehyde, the OSHA PEL is 1 ppm TWA with a STEL of 2 ppm. NIOSH and ACGIH, have not set a REL or TLV. Formaldehyde is a carcinogen. NIOSH and ACGIH believe that you can’t set a limit since any exposure increases your cancer risk somewhat.

The PEL is the legally required limit. However, the fact that ACGIH or NIOSH has a lower limit indicates that there are health professionals who believe greater protection is required. You or your union representative should ask for control measures that keep the exposure below the lowest recommended limit. You should argue that there is evidence for the lower limit, and that it is better to err on the side of caution. The best policy is to always keep exposures as low as possible.

**Who Sets the Limits?**

<table>
<thead>
<tr>
<th>Exposure Limits</th>
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<tbody>
<tr>
<td>ACGIH TLV</td>
<td>Recommendation of a private organization.</td>
</tr>
<tr>
<td>OSHA PEL</td>
<td>Legally binding standard of a government agency.</td>
</tr>
<tr>
<td>NIOSH REL</td>
<td>Recommendation of a government agency.</td>
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</table>

**Which Limit to Use?**

Always keep exposures as low as possible.
The limits are not perfect. Many have been lowered over the years as we discover that even smaller amounts of a chemical are harmful. Here are some reasons why a limit might not be valid (might not be low enough):

- The limit might be based on insufficient information.

- A chemical might cause more than one effect, but have a limit based on only one effect.

- Some of us may be more affected than other people. ACGIH says that its TLV’s are believed to protect “nearly all workers” – but not all.

- Limits don’t take into account the effects of other chemicals a worker is exposed to. The combined effect may be more than the individual effects.

- Most limits are based on the amount of chemical in the air. This ignores other routes of entry. Many chemicals are absorbed through the skin.

- There are over one hundred thousand chemicals used in the United States. There are limits for only about 600. Most chemicals have no exposure limit.

For example:

The OSHA PEL for formaldehyde (1 ppm) will protect most workers from respiratory irritation, but these limits don’t necessarily prevent an excess risk of nasal cancer.

The combined effect of exposure to two or more different chemicals might be greater than the effects of each one separately.
Direct Reading Instruments
Electronic Instruments

“Direct reading” means that the instrument tells us information when we use it. This is different than taking a sample of a contaminant and sending it to a laboratory to find out what it is and how much of it there is.

Taking Samples

If you’ve ever watched “Star Trek” then you’ve seen the ultimate direct reading instrument, the tri-corder. It’s a device that identifies and measures just about everything. Unfortunately, it’s only imaginary. The real instruments available to us are much less sophisticated.

There are direct reading instruments that can measure:

- Oxygen.
- Combustible and flammable gases and vapors.
- Certain (but not all) toxic contaminants
- Ionizing radiation.
- Noise.

Some instruments measure more than one thing. For example, an oxygen meter is often part of an instrument that also measures flammable gases and vapors.

Each instrument has a sensor that reacts to the presence of a particular condition, and a display which tells what the measurement is.

For many contaminants it is possible to take a sample in the workplace and then analyze it in an industrial hygiene laboratory. The instruments and equipment in the laboratory are usually more sophisticated and more accurate than direct reading instruments. The laboratory might be able to identify and measure chemicals that direct reading instruments cannot.

As part of a workplace evaluation, you might be asked to wear a small sample collecting device. An industrial hygienist or technician will explain to you how it works. If you do not understand, ask questions. You have a right to know what’s going on.
Sampling and measuring contaminants can be very important, but results are never 100% accurate. You need to know how much faith you can put in the results: what they mean – and what they don’t mean.

- Conditions change. Sampling and measuring only tell you what’s happening at a specific time and place. They don’t tell you what the situation will be later, or what it will be somewhere else. This is why repeated or continuous monitoring may be required, especially during confined space entry.

- We only measure or sample some things. There may be other contaminants. Because you measure for one thing, and don’t find it, doesn’t mean that there aren’t other contaminants that may be even more harmful. The type of monitoring or sampling must be appropriate for the contaminants or conditions that may be present.

- The equipment is inaccurate. There are many reasons that monitoring equipment may give inaccurate results. For example:
  - If an instrument is not calibrated correctly, then the results will be inaccurate.
  - Electronic devices rely on batteries, which can wear down. They have sensors and other components that may work less well over time, or be damaged by careless handling.
Are You Exposed to Chemicals?

How do you know what chemicals you are exposed to? How do you know how much you’re exposed to? How do you know if your exposure is below than the limit?

There are instruments for monitoring some chemicals in the air. For some chemicals there are tests to see how much is in your body.

There are also clues to indicate exposure even if you don’t have special instruments. You may be able to smell a chemical or feel an acute effect like itching skin or watery eyes. There may also be clues in your work environment to indicate exposure.

**Odor.** If you can smell it, you are inhaling it.

However, many chemicals don’t have a smell, or the amount needed for smell is higher than the exposure limit. Others have no smell, like carbon monoxide, or they numb your sense of smell, like hydrogen sulfide.

**Taste.** Never taste something that might be a hazardous chemical. However, if you inhale a chemical or accidentally get some in your mouth, it may have a particular taste that warns you you’re being exposed.

**Particles in your respiratory system.** Your nose and airways have mucous that traps particulates and removes them when you cough or blow your nose. If your mucous is an unusual color or has visible particles in it, then you have inhaled particulates. 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.** Leaking drums or pools of liquid indicate a hazard. Chemicals may be evaporating into the air. Don’t walk through spilled material, or get it on your bare skin.

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This is why for particulate contamination, like asbestos fibers, people say, “It’s what you can’t see that hurts you.”
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.

Acute symptoms. Many chemicals cause irritation. One whiff of ammonia warns you it’s there.

Settled dust. If there is dust on the ground or on other surfaces, it probably got there by settling out of the air. This means that there are particulates in the air that you could inhale. It is likely that if you walk through the area, or use equipment, you will send more of the settled dust back into the air, increasing the inhalation hazard. If dust settles on the ground, it can also settle on your clothes, on your hair, and on your food.

Dead vegetation or dead animals. If they’re dead, think about what chemical might have killed them.

It’s important to recognize the warning signs of chemical exposure, like odor, or acute symptoms. But what if there are no signs? Can you forget about exposures? Many chemicals have no smell, taste, or acute symptoms. Some people can’t smell certain chemicals. Some chemicals numb your sense of smell. Many air contaminants are invisible. There may be contamination on the things you handle, without there being enough to see or feel.

Use the common sense clues we’ve discussed as warning signs. But never assume you’re not exposed just because you don’t see or feel any warning signs.

Are You Exposed?

Acute symptoms like dizziness, nausea or headache may also warn you of exposure. But it’s easy to ignore these, or assume that you’re just getting a cold or the flu.

What If There Are No Signs or Symptoms of Exposure?
Biological Hazards

Biological hazards include acute and chronic infections, parasites, toxic shock and allergic reactions to plants and animals. This includes:

- Bacteria
- Viruses
- Fungus
- Pollens
- Insects
- Snakes
- Rodents

Biological hazards may be found at any hazardous waste site. These hazards may result from infections agents that were disposed of (such as medical wastes), or they may be natural inhabitants of the area.

**Infectious waste.** The most common form of waste that might contain biological hazards in infectious medical and laboratory waste. This can include syringes and other “sharps”, as well as bandages and materials contaminated with infected body fluids.

Infectious waste is required to be packed in red plastic bags. Needles, syringes, scalpels and other sharps are required to be packed in hard red plastic containers. These red bags and plastic containers must be printed with the biohazard warning symbol.

Infectious waste may only be legally disposed of at sites specifically authorized to accept infections waste. However, it has frequently been disposed of improperly, so you might encounter infectious waste at any waste site.
Hantavirus is transmitted to humans from the dried droppings, urine, or saliva of mice and rats.

Molds and fungus release millions of small spores small into the air. Some cause allergic or asthma-like reactions as well as other respiratory symptoms.

Bloodborne pathogens include human immunodeficiency virus (HIV), hepatitis B, and hepatitis C.

These hazards might be found in waste from hospitals and clinics, especially if the waste contains used needles. Used needles abandoned by drug users are also a potential hazard.

You might also be exposed to bloodborne pathogens from a worker who is injured.

If you are stuck by a needle or other sharp or get blood in your eyes, nose, mouth, or on broken skin:

- Immediately flood the exposed area with water and clean any wound with soap and water or a skin disinfectant if available.

- Report this immediately to your supervisor.

- Seek immediate medical attention.
Learning objectives

This Chapter reviews the hazards associated with exposure to blood or other potentially infectious materials, and discusses the requirements of the OSHA Bloodborne Pathogens Standard

After completing this Chapter you will be able to demonstrate your ability to:

1. EXPLAIN meaning and importance of universal precautions.

2. DESCRIBE the requirements of a good exposure control plan.

3. DESCRIBE control measures for preventing or minimizing exposure to blood or other potentially infectious materials.

4. EXPLAIN your right to receive – and to decline to receive – hepatitis B vaccination.

5. EXPLAIN why frequent, thorough hand washing is important to protect yourself and others from the spread of infectious disease.
The purpose of the OSHA Bloodborne Pathogens Standard is to minimize the possibility that workers will become infected with HIV (human immunodeficiency virus - the cause of AIDS) or HBV (hepatitis B virus.)

The Standard emphasizes the use of engineering controls to prevent accidental injury from contaminated sharp objects such as needles. The Standard also requires a written program, good housekeeping practices and worker training. Employers must make vaccinations available to workers who may be exposed to HBV, although a worker has the right to decline being vaccinated.

The Standard has nine sub-sections and one appendix.

Bloodborne Pathogens [29 CFR 1910.1030]
1910.1030 (a) - Scope and Application.
1910.1030 (b) - Definitions.
1910.1030 (c) - Exposure Control.
1910.1030 (d) - Methods of Compliance.
1910.1030 (e) - Research and Production Facilities.
1910.1030 (f) - Hepatitis B Vaccination.
1910.1030 (g) - Communication of Hazards.
1910.1030 (h) - Record Keeping.
1910.1030 (i) - Effective Dates.
Appendix A - HBV Vaccine Declination.
The OSHA Bloodborne Pathogens Standard applies to all occupational exposure to blood or other potentially infectious materials.

The possibility of exposure and infection is a of great concern to workers in hospitals, clinics, nursing homes, dental offices; and also home health care workers. These are all situations where the work is directly involved with caring for people, and where there is an obvious possibility of contact with other people’s blood or bodily fluids.

It is important to realize, however, that bloodborne pathogen risks can occur in many other types of workplace. For example, there is a risk of contamination in any situation that involves cleaning and housekeeping: someone may have cut themselves, or may have thrown away a syringe in the trash. Other workers who may be at risk include bus drivers, teachers and other workers who deal regularly with groups of people.

In another standard, 29 CFR 1910.151, Medical Services and First Aid, OSHA requires that unless there is a nearby hospital or clinic to immediately treat all injured workers, the employer must have one or more workers trained to give first aid. First aid workers usually take courses and get certified through the American Heart Association or the American Red Cross.

The first aid trained workers in any workplace are at risk of contact with blood and other potentially infectious materials.
Some Important Definitions

[29CFR 1910.1030(b)]

**Occupational exposure.** Reasonably anticipated skin, eye, mucous membrane, or parenteral contact with blood or other potentially infectious materials that may result from the performance of an employee’s duties.

If you are first aid certified, and expected to respond if a fellow worker gets injured, then you have a reasonable expectation of contact with blood or other potentially infectious materials.

**Other potentially infectious materials.** Semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, saliva in dental procedures, any body fluid that is visibly contaminated with blood, and all body fluids where it is difficult or impossible to tell which it is.

**Universal precautions.** All human blood and certain human body fluids are treated as if known to be infectious for HIV, HBV, and other bloodborne pathogens.

Basically, you treat every situation in which you might contact other people’s blood or other fluids as if these were contaminated.

**Exposure incident.** Any time that you have direct contact with blood or other potentially infectious materials. This means direct contact via your eye, mouth, other mucous membranes, or via any cut or damaged skin.

If blood or other potentially infectious materials contact your intact skin, this is not considered an exposure incident.
Exposure Control Plan

[29CFR 1910.1030(c)]

If workers might have exposure to blood or other potentially infectious materials, then the employer must have an exposure control plan. The plan must include:

**Exposure determination.** A list of job classifications in which some or all workers have occupational exposure to blood or other potentially infectious materials.

**Methods of Compliance.** First: universal precautions. Also, the employer must use engineering controls and good work practices to eliminate or minimize potential exposures. Employees must be trained and encourage to wash their hands thoroughly and frequently.

**Vaccinations.** Free hepatitis B vaccinations, unless the worker declines to be vaccinated.

**Evaluation of exposure incidents.** Evaluating and documenting what happened if an employee is exposed, and providing medical follow-up.

**Input from non-managerial employees.** The employer must include regular workers in the process of designing and implementing the exposure control plan.

**Communicating hazards to employees.** Providing training and information to workers.

**Record keeping.** Keeping records of workers’ training, exposures, and follow-up; and preserving the records for 30 years after the worker’s last day of work.

**Plan must be available to affected employees.** The employer must make the exposure control plan available, and must train employees about how it works.

**Reviewed and updated at least annually.** Review and update the exposure control plan every year.

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Engineering Controls means things like retractable needle syringes and special boxes to dispose of sharp objects.
The OSHA Standard lists several control methods that the employer must use:

- Universal precautions.
- Engineering controls.
- Hand washing.
- Sharps protection.
- Eating, food and drink control.
- Safe work practices.
- Specimen containers.
- Proper handling of contaminated equipment.
- Personal protective equipment.
- Housekeeping.
- Regulated waste.
- Laundry.

Personal hygiene, including frequent, thorough hand washing is essential to preventing the spread of infection. Your health and life may depend on how careful you are, and how well you wash your hands.

The employer must provide hand washing facilities readily accessible to all employees. In off-site and other situations in which it is not possible to install a sink, the employer may have workers use antiseptic hand cleaners and clean antiseptic towels. Workers should still wash with soap and running water as soon afterwards as they can.

Wash your hands, arms, any part that has contact with blood or other potentially infectious materials as soon as possible.
Masks, Gloves and Protective Clothing

When there is potential occupational exposure to blood or other potentially infectious materials, the employer must provide – at not cost to the worker – appropriate personal protective equipment (PPE). Depending on the situation, this might include gloves, gowns, lab coats, face shields, safety glasses, mouth pieces, and masks.

OSHA says that PPE is “appropriate,” only if it actually prevents blood or other potentially infectious materials from passing through and getting on the worker’s cloths, skin, mouth, eyes or other mucous membranes.

The employer must make sure that the correct PPE is available, in the right size for each employee.

The employer must provide laundering for reusable PPE, such as gowns and lab coats. There must be proper disposal of single use PPE and of reusable PPE that is damaged or that can no longer be laundered properly.

**Masks.** Masks are respirators. There purpose is to keep you from inhaling airborne particles that might be contaminated with HIV, HBV or other infectious materials. As discussed in Chapter 5 of this manual, you may only use respirators that are approved by NIOSH.

The most common mask (respirator) for infection protection is the NIOSH-approved N-95 respirator.

**Gloves.** If there is a danger of hand contact with blood or other potentially infectious materials, then the worker must wear protective gloves. The most common type are single-use disposable gloves. Single-use means just that: once you take them off, you throw them away.

Formerly most single-use gloves for infection control were made of natural latex. Many people are allergic to latex. Other non allergenic gloves are readily available.
OSHA requires that all tools, equipment, and work surfaces be that become contaminated must be cleaned and disinfected. The disinfectant product used must say on the label that it has been registered with the EPA as a disinfectant that is effective against HIV and HBV.

Be sure to read the label, and pay special attention to the section titled “Special Instructions for Cleaning and Decontamination Against HIV-1 and HBV of Surfaces/Objects Soiled with Blood/Bodily Fluids.”

- Workers who clean-up and disinfect equipment and work surfaces must wear personal protective equipment (gloves and face mask.)
- Clean up blood and other contaminants before applying the disinfectant.
- Dispose of infectious waste properly.
- Make sure to apply enough disinfectant so that the surface stays wet for at least 30 seconds of HIV contaminants, and 10 minutes for HBV.
Hepatitis B Vaccinations
[29CFR 1910.1030(f)]

The employer must provide hepatitis B vaccination to employees who may have exposure to blood or other potentially infectious materials – within 10 days of initial work assignment. The vaccination is free, and must be available at a reasonable time and place.

If an employee has already received the complete hepatitis B vaccine series, then he or she does not need to be vaccinated again.

The employee may decline to be vaccinated. The employer may not discipline a worker for declining to be vaccinated. If a worker declines, and later decides to be vaccinated, the employer must provide for the vaccination at that time.

The employer must make sure that an employee who declines the hepatitis B vaccination signs the statement contained in Appendix A of the Standard. The statement includes, “I understand that by declining this vaccine, I continue to be at risk of acquiring hepatitis B, a serious disease.”

Biohazard Labels and Signs
[29CFR 1910.1030(g)]

Labels. Any container, refrigerator or bag that contains materials contaminated with blood or other potentially infectious material must be labeled with the biohazard warning symbol:

OSHA says that it is OK to use red disposal bags that are not labeled. However, most employers buy bags made for this purpose; they are red and have the label.

Signs. OSHA requires the biohazard sign at the door to laboratories that do research on HIV or HBV.
Training. The employer must provide bloodborne pathogen training to all employees who may be exposed to blood or other potentially infected materials:

- At the time of initial assignment.
- At least once a year thereafter.
- When conditions or job assignments change in a way that affects the employee’s exposure.

Training language and level. The training materials must be appropriate in content and vocabulary to the educational level, literacy, and language of employees.

Training Content. The training must include:

- An accessible copy of the standard.
- An explanation of “epidemiology.” This is the study of how disease spreads in a population.
- An explanation of how bloodborne diseases are transferred from person to person.
- How to recognize symptoms of disease.
- How the employer’s Exposure Control Plan works.
- How to recognize bloodborne pathogen hazards.
- How to use control measures. How they work, what are their limitations.
Post-Exposure Follow-up
[29CFR 1910.1030(f)(3)]

Exposure incident means direct contact with blood or other potentially infectious materials via your eye, mouth, other mucous membranes, or non-intact skin.

Keeping Records
[29CFR 1910.1030(h)]

If an exposure incident occurs, then the employer must provide you with medical evaluation and follow-up. This must include:

- Documentation of what happened, including the route(s) of exposure.
- Identification the source (person) of the blood or other potentially infectious material.
- The source person’s blood must be tested as soon as feasible for HIV and HBV, unless the source person does not consent to be tested.
- Medical evaluation, advice and counseling.

The employer must keep records for each employee who may have occupational exposure to blood or other potentially infected materials. These records can be very important later if the worker does become ill from his or her exposure. The records for each employee must include:

- Name.
- Social security number.
- Dates of hepatitis B vaccination.
- Results of medical tests and exams related to exposure.

The employee must keep each worker’s medical records confidential. Nothing in the medical records may be disclosed without the employee’s written consent.

The employer must safely and confidentially maintain records for 30 years after the employee’s last day of work.
Learning objectives

This Chapter discusses the prevention of injuries to your muscles and joints caused by improper lifting and repetitive motion.

After completing this Chapter you will be able to demonstrate your ability to:

1. DESCRIBE what ergonomics means and why it is important to eliminate ergonomic hazards.

2. DESCRIBE the proper way to lift.
Ergonomic hazards can cause injuries to muscles, tendons, ligaments, joints, cartilage, and nerves. These injuries most often involve the back, shoulders, neck, legs, arms, wrists and hands.

There are many different names used for ergonomic injuries:

- Musculoskeletal disorder (MSD).
- Repetitive stress injury.
- Cumulative trauma disorders.
- Carpal tunnel syndrome.
- Lower back pain.
- Disk injury.
- Tendonitis.
- Sciatica.

These are painful and often disabling conditions that often develop over a long period of time. They are very difficult to cure, so prevention is always important.

MSDs can cause pain, numbness, tingling, stiff joints, difficulty moving, muscle loss, and paralysis. This can result in lost time or even the inability to work at all.

You might have a musculoskeletal disorder if you have any of these symptoms:

- Numbness in your fingers.
- Numbness in your thighs.
- Stiff joints.
- Back pain.
The Back

The back is made up of a series of bones and discs stacked atop one another. Each of the bones is called a vertebra. There are nerves that run down through the back. These nerves together make up the spinal chord in the spinal canal. Individual nerves leave the spinal chord and lead out between the discs and vertebrae to go to different parts of the body.

Common Back Disorders

Muscle Guarding (Spasm):

When you feel pain, one of your body’s reactions is muscle guarding. The muscles contract in order to “splint” or immobilize the painful area.

Prolonged muscle guarding causes muscle spasm. Muscle spasm can be very painful, but it does not necessarily mean that there is a serious problem.

Ice packs, muscle relaxant medication or relaxation are useful treatments. However, the only way to prevent this from happening again is to correct the underlying reason for the muscle guarding. This may mean changing the way that you do a job.
Disc strain or bulge:

The two most common causes of a bulging disc are sitting or standing in a forward slumped position and forward bending and lifting. It is almost never the result of one injury and usually takes months or years to develop. Poor physical fitness and loss of flexibility are almost always related causes.

You must regain flexibility in backward bending and maintain balanced posture until the disc has had a chance to heal. Use safe lifting techniques to minimize damage and prevent recurrence.

Herniated Disc:

Slumped sitting, bending forward and improper lifting can lead to a herniated disc. Medical attention and physical therapy is often necessary. In severe cases, surgery may be required. Recognition of the problem at an early stage can help prevent the need for surgery.

Acute Muscle strain:

Improper lifting, twisting, falls or other injuries such as whiplash can cause acute muscle strain. If the injury is minor then only a few days of rest may be required. Otherwise, seek medical treatment.

Chronic muscle strain:

This is the result of long-term stress from poor posture. For example, sitting at work or in a car in a slumped position, standing with the stomach muscles relaxed and the back in a swayed position for hours, or holding the head in a forward position too much of the time. The best prevention is to eliminate the cause: try to do you work in a posture that does not cause muscle strain.
Lifting is one of the most common ergonomic hazards. Improper lifting can cause serious back injury.

Construction workers and hazardous waste workers move materials. They put drums in overpacks, move materials and equipment, load and unload trucks. These activities often require lifting heavy objects by hand. If not done correctly, lifting can injure your back.

**Proper Lifting Technique.** 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.

Lifting puts a tremendous strain on the muscles and discs in the lower back. Even a worker using proper technique has a force of several hundred pounds on the lower back.

If the load is too heavy, or if the worker reaches out too far, or twists while lifting, the force can be many times greater, even if the weight of the object is not very great.

The job should be planned to minimize the amount of manual lifting. There should be enough workers to lift safely. Use drum grapplers, fork trucks and boom trucks whenever possible.
Immediate care:

- Ice the injury for 15 minutes every other hour.
- Refrain from postures or activities that can aggravate the pain.
- Seek medical help if the pain or spasm persists or if radiating pain occurs down the arms or legs.

As improvement takes place:

- Begin moving. Exercise, but do so cautiously, with medical advice.
- Strive to improve your overall physical condition and regain flexibility.
- Examine what you did and how you could have prevented the injury.

Sleeping:

Find sleeping positions that are right for you. There is no “best sleeping position.”

- Sleep on a mattress that is firm, but not too hard.
- A larger bed allows you to change position more easily.
- When getting out of bed, roll to one side and sit up. Then use your arms to help you stand up.
- Don’t sleep on a mattress that is too soft or sagging.

Care of Back Injuries

Be cautious about self-treatment with exercises you find in books or magazines. These may be good exercises for conditioning, but harmful if you have an active back problem. They might actually make the problem worse. It is always best to get expert medical advice.
Eliminate the Cause of the Problem:

Correct poor posture and faulty work habits. If your work environment is at fault, it may be necessary to ergonomically modify some of your job tasks. Work in the safest manner possible. Use good posture and safe lifting techniques.

Ice, Heat, Ultrasound, Etc.:

Ice, heat, ultrasound and electrical stimulation can reduce pain and spasms, and increase flexibility. These treatments do not correct the problem; they only allow you to begin exercises that can correct the problem.

Medications:

Your doctor may prescribe drugs to reduce inflammation, tension and pain. Medication doesn’t cure the problem, but make it possible to begin exercise.

Rest:

Bed rest used to be considered a must for back pain sufferers, but it is seldom used today for treatment of back pain. It is much more important to correct bad posture and work habits that cause the pain.

Physical Therapy and Exercise:

Strength and stretching exercises are essential to prevent back pain and to rehabilitate after injury. Exercises can even correct a slightly bulging disc. However, you must use the correct exercises in the correct way. The wrong exercises, or too much exercise can make the problem worse. If you have an active back problem, seek medical help so that you get an exercise program designed specifically for you.
Ergonomics means designing jobs to fit the worker, rather than forcing the worker’s body to fit the job.

Ergonomics means adapting job tasks, work stations, tools, vehicles and equipment to fit the worker in order to reduce physical stress on the worker’s body and to eliminate potentially serious, disabling injuries like musculoskeletal disorders (MSD).

Examples of ergonomic solutions include fully adjustable driver’s seats, preventive maintenance to reduce vibration, and good job planning to minimize manual lifting.

The National Institute for Occupational Safety and Health (NIOSH) has studied workers who do lifting. NIOSH found that workers wearing back supports are just as likely to be injured as those who don’t use them.

In a press release on December 05, 2000, NIOSH said:

NO EVIDENCE
THAT BACK BELTS REDUCE INJURY

Even for employees in the most strenuous types of jobs, comparisons of back injury claims and self-reported back pain failed to show any differences in rates or incidence associated with back belt use.

Manufacturers of back supports, and also some scientists and workers, disagree with NIOSH. Many people believe supports help because they remind you to use proper technique. One thing is certain: a back support won’t make you stronger. Don’t assume that you can lift more just because you have one.
Learning objectives

This Chapter reviews the hazards of heat stress and noise exposure, and describes safe work practices and control measures to reduce injury and illness caused by these hazards.

After completing this Chapter you will be able to demonstrate your ability to:

1. IDENTIFY the four types of heat stress.
2. IDENTIFY the conditions that cause heat stress.
3. IDENTIFY ways to prevent heat stress.
4. IDENTIFY the hazard caused by exposure to loud noise.
Heat stress can be a serious, life-threatening hazard, especially for workers wearing impermeable protective clothing. Heat stress means that your body is having trouble keeping its temperature at the normal level – about 99°F. It means that your body is overheating.

Heat in your body comes from two sources:

- Heat your muscles make as they work.
- Heat from the environment around you.

If your body gets too hot it means that:

- You are working too hard, and/or
- The environment is too hot, and/or
- Something is keeping your body’s cooling system from working effectively.

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

Heat stress is possible if you are working in a hot environment.

Heat stress is also possible if you are wearing protective clothing – even when it isn’t very hot.

Protective clothing can keep chemicals out. But these garments also trap sweat inside, and keep it from evaporating. Sweating only cools if the sweat evaporates. If sweat can’t evaporate, it can’t cool.

If you wear heavier or more protective clothing than you need, you may be create a new hazard: heat stress.

Even in moderate weather, it’s possible to suffer heat stress if you’re in protective clothing that interferes with your body’s cooling.

It’s important to recognize the signs and symptoms of heat stress so you can take preventive action before heat stress causes serious problems. Preventive action means adequate rest breaks, drinking plenty of water, and not working harder than your fitness allows.
There are four types of adverse health effects caused by heat stress:

**Heat Rash.** Itchy rash that occurs when the skin becomes swollen and plugs the sweat glands. This is not a life-threatening condition, but 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 have heavy sweating. 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! Symptoms include:

- Hot, red, dry skin with little or no sweating.
- Very rapid pulse.
- Temperature above 105°F.
- Dizziness, nausea, delirium or possible coma.

One half of all heat stroke victims die. Get help immediately if you think that a coworker is experiencing heat stroke!
Monitoring for Heat Stress

You should monitor yourself for heat stress whenever you work in a hot environment. You should also monitor yourself whenever you wear impermeable protective clothing, even if it’s not hot out. Here’s how:

- **Check your pulse.** 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. Touch your arm lightly just above the wrist. Count the beats for 15 seconds. Multiply by 4 to get beats per minute.

- **Take Your Temperature.** Take your temperature at the beginning of a break, before drinking. Keep the thermometer under your tongue for at least 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.** Weigh yourself at the beginning and end of the day. If you’ve lost more than a pound in one day, this is probably water loss. You need to drink more.

Becoming Acclimated

If you are healthy and are not wearing protective clothing that interferes with sweat evaporation, then you may become used to the heat. This takes several days, so take it easy at first. If you are wearing protective clothing, your sweat may not be able to evaporate. It’s possible to suffer heat stress no matter how fit you are, no matter how “used to it” you are.
There are several ways to help prevent heat stress:

- **Recognize the signs of heat stress in yourself and in your fellow workers.** Often we don’t notice what’s happening to ourselves. If your buddy looks like they’re having a hard time, getting too red, sweating too much, or acting dizzy and uncoordinated, don’t be afraid to say something. You might be saving their life.

- **Adjust Schedules.** Take breaks. Heavy work in protective clothing or in a hot environment may require more time resting than working. Schedule heavy work in the coolest part of the day, or at night.

- **Provide Rest Shelters.** Have shaded rest shelters with chairs or benches. Air conditioning is even better.

- **Drink fluids.** Sweating cools the body, but it also robs the body of fluid. Drink enough to replace what you lose. You may not feel thirsty until you’ve become dehydrated. Drink regularly 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 conditions that cause heat stress. Your muscles work more efficiently and your body is better able to transfer heat to your skin surface where sweating can dissipate this heat.
Noise Exposure

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 in order to prevent hearing loss later.

Controlling Noise Exposure

OSHA has two different standards for noise exposures. One is for workers in general industry [29 CFR 1910.95].

The other standard is for workers in the construction industry. [29 CFR 1926.52]

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).

If, despite using engineering and administrative controls, your average daily exposure is 90 dBA or above, OSHA requires hearing protection (plugs or muffs) to be worn.
The general industry standard also requires a hearing conservation program if average sound 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 if your work site is “construction industry,” it’s still a good idea to have a hearing conservation program, including training and annual exams.

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).

[29 CFR 1910.95(b)(1) and 29 CFR 1926.52(b)]
Noise Limits

The sound level you experience from a piece of equipment depends on what it is, how well it is maintained, whether it has sound insulation, how close you are, and whether you wear 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.

<table>
<thead>
<tr>
<th>OSHA PEL for NOISE</th>
<th>Typical Sound Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>90 dBA 8 hours</td>
<td>170 dBA Space shuttle takeoff</td>
</tr>
<tr>
<td>95 dBA 4 hours</td>
<td>160 dBA</td>
</tr>
<tr>
<td>100 dBA 2 hours</td>
<td>150 dBA Jet engine</td>
</tr>
<tr>
<td>105 dBA 1 hour</td>
<td>140 dBA Threshold of pain</td>
</tr>
<tr>
<td>110 dBA 30 minutes</td>
<td>130 dBA</td>
</tr>
<tr>
<td>115 dBA 15 minutes</td>
<td>120 dBA Pneumatic chipper</td>
</tr>
<tr>
<td>Above 115 dBA</td>
<td>Not allowed</td>
</tr>
<tr>
<td></td>
<td>110 dBA Bulldozer</td>
</tr>
<tr>
<td></td>
<td>100 dBA Diesel truck passing by</td>
</tr>
<tr>
<td></td>
<td>90 dBA Plugs or muffs required</td>
</tr>
<tr>
<td></td>
<td>80 dBA Noisy office</td>
</tr>
<tr>
<td></td>
<td>70 dBA Vacuum cleaner</td>
</tr>
<tr>
<td></td>
<td>60 dBA Conversation</td>
</tr>
<tr>
<td></td>
<td>50 dBA Quiet office</td>
</tr>
<tr>
<td></td>
<td>40 dBA Quiet home</td>
</tr>
<tr>
<td></td>
<td>30 dBA Recording studio</td>
</tr>
<tr>
<td></td>
<td>20 dBA Whisper</td>
</tr>
<tr>
<td></td>
<td>10 dBA Quietest sound a healthy ear can hear</td>
</tr>
</tbody>
</table>

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.
Learning objectives

This Chapter reviews the content and implementation of an effective safety and health program that will reduce to the greatest extent possible the occurrence of occupational injuries and illnesses.

After completing this Chapter you will be able to demonstrate your ability to:

1. IDENTIFY the components of an effective safety and health program.

2. DESCRIBE the importance of management commitment and worker involvement in a safety and health program.
Companies that have good safety and health programs also have:

- Fewer work-related injuries and illnesses.
- Injuries, when they do happen, are less severe.
- Better employee morale.
- Higher productivity.
- Lower workers’ compensation costs.

The four characteristics of effective safety and health programs are:

- Management commitment and employee involvement. This means that there are clear assignments of responsibilities for safety and health to managers, supervisors, and workers.

- Regular, meaningful inspections to identify hazards.

- Effective, prompt steps to correct problems and control hazards.

- Effective employee training and orientation for the recognition and avoidance of hazards.
Management Commitment to Safety and Health

If management is truly committed to safety and health, then it will demonstrate that commitment by:

- A clear statement of its safety and health policy.
- A clear statement of safety and health program goals and objectives.
- Open and obvious involvement in the safety and health program from top management to frontline supervisors.
- Giving supervisors the authority to correct safety and health hazards.
- Holding supervisors and other management personnel accountable for safety and health.
- Demonstrating leadership in identifying and correcting safety and health hazards.
- Actively seeking employee involvement in identifying and correcting safety and health hazards.
- Encouraging worker participation in planning, presenting and evaluating safety and health training.
Workers know their own jobs, and they know the hazards associated with their jobs. Workers have valuable experience and knowledge that is key to identifying and correcting safety and health hazards.

Safety and health is not just a topic for professionals and supervisors. It takes all three to solve problems: worker experience and knowledge, professional expertise, and supervisory authority.

Workers can play a valuable and effective role in:

- Inspecting the work place.
- Identifying and analyzing hazards.
- Creating effective solutions to problems.
- Developing good work practices and formalizing these in standard operating procedures.
- Training other workers.

OSHA does not require all employers to have a joint labor-management safety and health committee. However, several state OSHA programs do require these committees. Whether or not it’s required, a safety and health committee that includes both workers and supervisors is one of the most effective parts of a safety and health program.

It is through a strong safety and health committee that workers and management can effectively do the tasks listed in the two previous sections of this Chapter.
The purpose of hazard analysis is to identify safety hazards so that they can be corrected. This means looking for both obvious existing hazards, as well as potential hazards that may not be so apparent.

Hazard analysis looks at:

- Facilities. Building, structures, yards, and other work areas where jobs are done.

- Processes. How is work being done? How do different tasks or steps in the process affect each other?

- Materials. What materials are used on the job? What are the hazardous properties of these materials? How can each materials react with other materials?

- Equipment. What equipment, machines and tools are used on the job? What are the hazards associated with these?

An important aspect of hazard analysis is look at each job that workers do, to break it down into its steps, and look at what are the hazards, and what are the safe ways to do the job.

Often the hazards associated with a job task are more than just the most obvious ones. For example, it will be obvious to most people that an important risk associated with gas cutting is the risk of starting a fire. But also consider the ergonomic risks to the welder’s health if he or she has to move heavy equipment, or work in an awkward, stressful position.
Learning objectives

This Chapter reviews the proper procedures and equipment for working safely at heights - in order to prevent falls. In Chapter 2, Walking and Working Surfaces, we discussed the railings and guards required to prevent falls through holes and openings in walls and floors. We also discussed safety requirements for ladders and stairs. In this Chapter we deal with safe work on scaffolds and personnel lifts, and we discuss the proper use of fall protection equipment.

After completing this Chapter you will be able to demonstrate your ability to:

1. IDENTIFY safe work practices for mobile scaffolds.

2. EXPLAIN the main components of a personal fall arrest system.

5. DESCRIBE safe work practices for aerial lifts.
OSHA does not have a specific fall protection section in the General Industry Standards. It does address fall protection in the section on aerial lifts, and it mentions fall protection in other sections such as the welding standard.

OSHA does address fall protection in detail in the Construction Industry Standards. Much of work at heights that takes place in a general industry location is actually construction work, such as remodeling and renovation. It is sometimes hard to define the difference between maintenance (general industry) and renovation (construction). The important point, however, is to work safely. In general industry it is often a good idea to follow the safe work practices that OSHA specifies for similar work in construction.

There are almost 10,000 accidents each year involving scaffolds, aerial lifts and elevated work platforms, and approximately 80 worker deaths.

Most of these accidents result 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.

Two out of three scaffolds where an accident occurred were missing a guard rail.
Personal Fall Arrest Systems

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.

Snap hooks 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.
Many buildings have platforms or scaffolds that are permanently installed, can move under power, and are used for maintenance work such as cleaning windows. This equipment must be designed by an engineer to meet certain strength and stability criteria. The building owner must certify in writing to the employer whose employees will use the equipment, that it meets the safety criteria.

Guardrails. The work platform must have guard rails on all sides. The guard rail must include a top rail at least 36 inches high, a mid rail, and a toe board.

Roofs. If employees need to do maintenance work on a roof, or use the roof to get to a work platform, then the roof perimeter must have a guardrail or parapet.

Emergency Plan. The employer must have a written emergency action plan in order to be prepared for emergencies such as a power outage that could trap workers on the platform, and how to rescue an injured worker from a platform.

Over-speed arrest. The hoist machinery that moves the platform up and down must have an arrest system that stops the platform if it moves too fast.
Manually Propelled Mobile Scaffolds

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

The planks must not deflect more than $\frac{1}{60}$ 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.

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.
Vehicle
Mounted
Elevated Work
Platforms

[29 CFR 1910.67]

OSHA has safety requirements for aerial lifts, including articulated boom platforms and other vehicle mounted personnel platforms. This equipment is sometimes called a “cherry picker.”

ANSI Standards. Aerial lifts must be designed and constructed to confirm to specifications of the American National Standards Institute (ANSI.)

Modifications. No modifications, extensions or attachments may be made to an aerial lift without the written certification of the manufacturer or of a nationally recognized testing laboratory.

Road travel. The equipment must be lowered before the vehicle travels on a road or highway.

Trained operator. Only an operator with training in the particular piece of equipment may operate an aerial lift.

No Climbing. Workers must stand on the work platform of floor of the aerial lift. Do not climb on the guard rail or reach so far out that your feet are not flat on the floor.

Load limits. Never try to exceed the load limits specified by the manufacturer.

Body Harness. Workers in the platform must wear a safety harness with a lanyard attached to a designed anchor point on the aerial lift. Do not attach the lanyard to the building or other structure outside of the aerial lift.

Welding leads. If workers are welding while standing in an aerial lift, they may not attach the ground lead to the aerial lift.
Height: A freestanding mobile scaffold should be no more than four times as high as it is long. Otherwise it is too unstable and could easily fall.

Casters: These must be strong enough to support four times the load on them. Each caster 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
Protection from Falling Objects

Hard hats: Employees who work on or around elevated work platforms, aerial lifts or scaffolds must wear hard hats to protect them from the possibility of falling objects.

Toe boards: Scaffolds, aerial lifts and elevated work platforms must have toe boards or some other means to prevent tools, materials and debris from falling on workers below.

Barricades: The employer can put up barricades to keep workers and visitors from areas where falling objects might land.
Learning objectives

This Chapter reviews the safe work practices required to prevent injury or illness related to welding, cutting and brazing.

After completing this Chapter you will be able to demonstrate your ability to:

1. IDENTIFY the hazards created by gas welding and cutting, and the procedures and equipment used to protect against these hazards.

2. IDENTIFY the hazards created by arc welding, and the procedures and equipment used to protect against these hazards.

3. EXPLAIN why it is important to keep all oxygen equipment and fitting free of grease or oil.

4. IDENTIFY the OSHA requirements for the safe use and storage of welding gases.
Welding can start a fire. Welding and cutting make heat, and heat can start fires. Whenever possible, move all objects to be welded or cut to the welding shop or other designated safe location. If these objects cannot be moved, then move all combustible or flammable materials away from the welding operation.

Fire shields and guards. If combustible and flammable hazards cannot be removed, then you must use fireproof shields or guards to confine the heat, flame, sparks, and slag so that they cannot ignite nearby materials.

Fire extinguishers. Make sure that the correct fire extinguishing equipment is immediately available in the work area. Check this equipment to make sure that it has been properly inspected and tagged, and is ready for use.

Fire Watch. There must be a fire watcher, an additional worker, present when the welding, cutting, or heating operations take place near flammable or combustible materials, or in any area where a fire might start.

The fire watch must continue for at least 30 minutes after the welding or cutting is complete.

The fire watcher needs to know the possible fire hazards, and also, how to use the fire extinguisher.

Containers and tanks. Never weld or cut on any drum or container that has contained toxic, combustible or flammable unless it has been cleaned, purged and tested.

Fire Safety
[29 CFR 1910.252(a)]
Welding and cutting can damage your eyes. Welding and cutting produce heat and light that can burn your eyes. Arc welding produces intense blue light, as well as invisible ultra-violet radiation. These can burn the cornea of the eye and cause painful welder’s flash (also known as arc flash and keratitis.)

Gas welding and cutting flames can produce an intense yellow light that should also be filtered.

Eye shields. Always wear the correct type of shield or goggles for the type of welding you are doing. The shield or goggles must have a dark enough shade to filter out the harmful light and ultra-violet radiation.

OSHA suggests that you start with a shade that is too dark to see the weld zone. Then go to a lighter shade which gives sufficient view of the weld zone without going below the minimum shade number in the chart.

Welding and cutting can create poisonous (toxic) gases and fumes. These can come from the metal you are welding or cutting, or the welding rod or wire you are using. They may also come from paints and coatings.

You might be exposed to lead, cadmium, zinc, chromium, mercury or other toxic metal fumes.

The best protection is to use the correct respirator. In order to know which respirator to use, and experienced person must determine what toxic gases or fumes might be generated, and how much of them there are in the air.

Look back to the Chapter 5, Personal Protective Equipment, which describes how to select the correct respirator.
### Electric Arc Welding and Cutting

<table>
<thead>
<tr>
<th>Operation</th>
<th>Minimum Protective Shade</th>
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<tbody>
<tr>
<td></td>
<td>Minimum Protective Shade</td>
</tr>
<tr>
<td>Arc Operation Current</td>
<td>(Amperes)</td>
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<tr>
<td>Shielded less than 60</td>
<td>7</td>
</tr>
<tr>
<td>metal arc 60 to 160</td>
<td>8</td>
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<tr>
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<td>&amp; Flux cored 160 to 250</td>
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<td>arc cutting 300 to 400</td>
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<td>400 to 800</td>
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### Gas Flame Welding and Cutting

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<tr>
<th>Operation</th>
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</tr>
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<tbody>
<tr>
<td></td>
<td>Plate Thickness (Inches)</td>
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<td>Soldering</td>
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<td>Brazing</td>
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<td></td>
<td>over 1/2</td>
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<tr>
<td>Oxygen</td>
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</tr>
<tr>
<td>cutting</td>
<td>1 to 6</td>
</tr>
<tr>
<td></td>
<td>over 6</td>
</tr>
</tbody>
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**Filter Lenses for Protection Against Radiant Energy**

[29 CFR 1910.133(a)(5)]
Handling Compressed Gas Cylinders

Compressed gas cylinders can be under extreme pressure. If the valve is damaged or broken off, they can take off like a rocket.

- Keep the valve cap in place when the cylinder is not in use.
- Also put the valve cap on whenever you move a cylinder, unless it is in a special cart or dolly.
- If you must move a cylinder by hand, tilt and roll it on the bottom edge.
- When cylinders are transported by forklift or truck, they must be secured in a vertical position.
- When cylinders are hoisted, they must be secured on a cradle, sling board, or pallet.
- Never hoist a cylinder with a choker sling. Never use a magnet. Never hoist it by the valve cap.
- At all times a cylinder must be held securely – in an upright position – with a chain, or in a cylinder holder, or on a special cart or dolly.
- Make sure to close the cylinder valve whenever the cylinder is not in use.
- Keep cylinders far enough away from the welding or cutting operation so that sparks, slag, or flame can’t reach them. If this is impractical, shield the cylinders with fire resistant material.
- Don’t take fuel or oxygen cylinders into a confined space. Leave the cylinders outside the space, and drag the hoses into the place where you need to weld.
- Never use a cylinder, whether full or empty, as a roller or support.
Store oxygen cylinders and fuel cylinders apart. There must be at least 20 feet between them when they are not in use, or they must be separated by a noncombustible barrier at least 5 feet high and having a fire-resistance rating of at least one-half hour. Store cylinders where they will not be knocked over or damaged by passing vehicles or by falling objects.

Use safe work practices with gas cylinders:

- Cracking the Valve. Before connecting the regulator to a cylinder, open the valve slightly and then close it. This will clear the valve of dust or dirt that might otherwise enter the regulator.

- Opening the valve for use. Open the valve slowly to prevent damage to the regulator. One or two turns is sufficient.

- Removing the regulator. Always close the cylinder valve first. Then release the gas from the regulator before removing it.

- Different colors. The fuel gas hose and the oxygen hose must be easily distinguishable from each other. Usually they are different colors.

- Taping. If the hoses are taped together, be sure not more than 4 out of every 12 inches is covered.

- Tripping hazards. Don't run hoses across passageways, ladders or stairs where they can create a tripping hazard.

- Inspection. Inspect the torch, hoses and fittings before use. Make sure that they do not leak.

- Oxygen cylinders. Make sure that no oil or grease gets on the valve, cap or fittings of an oxygen cylinder.

Oxygen makes things burn much more easily. Even a small amount of oil or grease can be a fire hazard.
Cables. Arc welding and cutting cables must be rated for the maximum current to be used. Inspect cables to make sure that they are in good condition, flexible, and that the insulation is not damaged.

Don’t use cable that are damaged or have cuts in the insulation.

Ground cable. The ground return cable must be big enough handle the largest current that the arc welding operation might use.

Ground connection. Make sure that the ground cable is firmly attached to a good ground. Never ground to a pipe that carries fuel or other flammable or combustible material.

Third wire ground. The frame of the arc welder must be grounded through a third wire in the power cable. Inspect all ground connections to ensure that they are mechanically strong and electrically adequate.

Electrode holders. When not in use, remove the electrode and place the holder so that it cannot accidently contact any conducting object.

Turn of the machine. If you leave your work, even temporarily, turn off the arc welder. Turn it off also when you move it.

Faulty or defective equipment. If any welding or cutting equipment is defective, place it out of service, tag it, and notify your supervisor.

Shielding. Use screens or shields to protect other persons nearby from the direct rays of the arc.
Learning objectives

This Chapter reviews the safety precautions that you need to follow to safely lock-out and tag-out machinery and equipment in order to prevent the release of hazardous energy that could injure or kill you, or other workers who perform maintenance and repair operations.

After completing this Chapter you will be able to demonstrate your ability to:

1. EXPLAIN the difference between lock-out procedures and tag-out procedures.

2. IDENTIFY the appropriate means to lock-out different forms of energy such as electrical energy, mechanical energy, and pressurized fluids.
The OSHA Lock-Out / Tag-Out Standard is called Control of Hazardous Energy, 29 CFR 1910.147. The purpose of this standard is to protect workers who service and maintain machines and equipment where unexpected startup or energizing could cause injury or death.

The Standard requires practices and procedures to shut down equipment, isolate it from its energy source(s), and prevent the release of potentially hazardous energy. Employers must establish an energy control program, consisting of energy control procedures, employee training, and periodic inspections to ensure that before service and maintenance is performed, machines and equipment are isolated from their energy source(s) and rendered safe.

The standard gives minimum performance requirements. Employers have the flexibility to develop lock-out/tag-out programs that are suitable for their respective facilities.

During normal operations, workers do not need to, and are not supposed to remove guards or bypass safety devices. It’s usually the maintenance and service workers who have to do this in order to fix or adjust something. However, if a worker during regular operations needs to remove a guard or disable a safety device, then the requirements of this standard apply to that worker.

The standard makes and exception for minor tool changes and adjustments that are part the routine use of the equipment – but only if this is done in a safe manner.
Some Important Definitions

[29 CFR1910.147(b)]

Energy Source means a source of electrical, mechanical, hydraulic, pneumatic, chemical, heat, cold or other energy.

Energy Isolating Device means a mechanical device that physically prevents the transmission or release of energy. Some examples are:

- Circuit breakers.
- Disconnect switches;
- Valves
- Blocks used to isolate mechanical energy

Note that the on-off switches used to operate a machine is not an energy isolating device. The circuit breaker is – provided that it completely isolates the machine from electrical energy.

Lock-Out Device means a lock, blank flange, bolt, chain or other positive device that hold an energy-isolating device in a safe position and prevent a machine or equipment from starting.

Tag-Out Device means a tag or sign that can be securely attached to an energy-isolating device and which says that the equipment is not supposed to be operated until the worker who placed the tag-out device removes it.

Lock-out means placement of a lock-out device on an energy-isolating device to assure that the equipment cannot be operated until the lock-out device is removed. If the machine has more than one energy source, then each energy source must be locked out.

Tag-out means placement of a tag-out device on an energy-isolating device to tell others that the equipment is not supposed to be operated until the worker who placed the tag-out device removes it.
The employer must have an energy control program that has these three core components:

1. Energy Control Procedures. This is a written procedure for a specific machine, that explains in detail what employees must do to accomplish lock-out / tag-out.

2. Regular Inspections. This means that the employer must verify, by periodic inspection, that employees are following the lock-out / tag-out procedures specified in the written program.

3. Employee Training. The employer must assure that employees receive training – and retraining, as necessary – to make sure that they have the skills and knowledge necessary to follow the lock-out / tag-out procedures specified in the written program.

The material in this manual is awareness training only. You also need to be trained in the specific procedures in your employer’s Lock-Out / Tag-Out Program.

The Lock-out / Tag-Out Standard specifies good lock-out procedures, but also gives employers the option of using less rigorous procedures. We don’t think that either of these exceptions is a good idea:

1. Tag-out. An employer can use tag-out, instead of lock-out, if the employer can show that the tag-out procedure provides sufficient protection.

2. No written procedures. The employer doesn’t have to have a written lock-out procedure for a machine that’s simple to lock out.
Lock-Out or Tag-Out?

[29 CFR1910.147(b)]

Lock-out is the preferred procedure. Lock-out is the best procedure. You should always use lock-out unless the machine or equipment is not capable of being locked out. If it can’t be locked out, then you must use a tag-out procedure.

[29 CFR1910.147(c)(1) and (2)]

Hopefully, it will be rare that a machine is not capable of being locked out. All new machines and equipment must be installed with energy-isolating devices so that they can be locked out.

[29 CFR1910.147(c)(2)(iii)]

Exception: Despite the fact that lock-out is the best procedure, OSHA allows an employer to use tag-out instead, even if the machine is capable of lock-out, if the employer can demonstrate that the tag-out procedure provides full worker protection.

[29 CFR1910.147(c)(3)]

This exception is legal – the OSHA Standard says so – but we don’t think it’s a good idea. If a machine can be locked out, then do it. Lock-out is the safest procedure.

Tag-Out Procedure

[29 CFR1910.147(b)]

If the employer is going to use a tag-out procedure instead of lock-out, this is what must happen:

1. Attach Tags. Attach lock-out devices (tags) to all the energy-isolating devices, that is, to all the places where you would attach a lock-out device.

2. Work Practices. The employer must be able to show that the work practices used with tag-out provide protection that is as effective as lock-out would be. Examples of these practices include removing a handle on a valve, turning off switches or removing circuit elements.
Except as explained below, the employer must have a written energy control procedure for each machine or piece of equipment. The written procedure includes:

1. Outline. An outline of the scope, purpose, authorization, rules and techniques used.

2. Use. A statement of the intended use of the procedure. Which machine(s)? When is it necessary to use the procedure?

3. Procedural Steps. The specific steps to shut down, isolate, block and secure the machine to control its hazardous energy.

4. Placing lock-out devices. The specific steps for attaching, removing or transferring lock-out devices for each employee involved.

The employer may skip the written procedure if all of the following are true:

- The machine does not store residual energy, and does not reaccumulate energy after shut down.
- The machine has a single energy source that can be readily identified and isolated, completely de-energizing the machine.
- A single lock-out device will lock it out.
- The authorized employee performing servicing or maintenance controls the lock-out device.
- The servicing or maintenance does not create hazards for other employees.
- The employer has had no accidents involving the unexpected activation or re-energizing machines or equipment during servicing or maintenance.
The employer must provide locks, hardware and tags necessary for each employee who is part of a lock-out procedure. This might include locks, tags, chains, wedges, key blocks, adapter pins, self-locking fasteners, or other hardware. All lock-out devices must be:

- Durable. Able to withstand the environment in which they will be used.

- Substantial. Lock-out devices must be strong enough that they cannot be removed without excessive force, for example, with a bolt cutter.

Tag-out devices must be strong enough to prevent accidental removal. They must be attached with single-use ties that require at least 50 pounds of force to pull apart. It is common to use nylon cable ties to attach tags.

- Individually identified. Lock-out and tag-out devices must identify the person who attached the device.

- Must not be used for other purposes. Lock-out and tag-out devices must only be used for locking out or tagging out equipment that is being serviced or maintained. For example, don’t use the lock on your clothes locker.

- Must be standardized. Within the facility, the lock-out devices must be standardized with respect to shape, size or color.
OSHA requires that a series of steps, in a specific order, to apply lock-out devices:

1. Prepare for Shutdown. The employee who is going to shut down and lock out the machine must have knowledge about the type of energy involved, how much there is, what hazards the energy presents, and how to control this energy. For example, the employee who locks out a milling machine must know that it is operated by electricity, what the voltage is, that the available electricity is sufficient to kill a person, and that the energy can be controlled by locking-out the circuit breaker. He or she must know where the circuit breaker is, and must also know that there is no other circuit feeding this machine. If there is a second feed, then the employee must know how to lock out that feed also.

2. Isolate. Locate all energy-isolating devices (switches, valves, etc.) that control the machine and turn them off.

3. Lock-Out. Attach lock-out devices to each energy-isolating device. Each employee involved in the repair or maintenance work must attach his or her own lock-out device.

4. Relieve Stored Energy. Even though the machine is off and locked-out, it might still have stored energy. This must be relieved, disconnected or restrained.

5. Verify. Before maintenance or repair work begins, an authorized employee must verify that the machine is properly locked-out and that any stored energy has been relieved.
Group Lock-Out

[29 CFR1910.147(f)(3)]

Often more than one person will do maintenance or repair on the same machine. Each individual worker must place his or her personal lockout device when the work begins, and remove it when the work is completed. [29 CFR1910.147(f)(3)(ii)(D)]

However, most switches, valves, etc. do not have room for more than one lock. There are group locking devices that can attach to the energy-isolating device and provide spaces for multiple locks.

With group lock-out, there must be an employee or supervisor who is responsible for the group lock-out device and for making sure that all workers involved in the operation attach their locks. [29 CFR1910.147(f)(3)(ii)(A) & (B)]

Changing Shifts and Workers

[29 CFR1910.147(f)(4)]

The lock-out / tag-out program must include specific procedures to make sure that when a shift or personnel change occurs, there is an orderly transfer of lock-out / tag-out device protection. For example, this means that workers leaving the job remove their locks and the new workers taking over immediately place their locks.
You may have to turn on a machine that has been locked-out in order to test it. This can be done, if all of the following are also done:

1. Clear all tools and materials from the machine.
2. Remove all workers from the machine area.
3. Remove lock-out devices.
4. Energize and test the machine.
5. Turn off the machine
6. Replace the lock-out devices.

If the test is positive, and the machine is to be restored to service, then all guards and safety devices must be restored and the release procedure completed before regular operation begins.

When the machine is to be put back into normal operation, the following procedures must be followed:

1. Inspect the machine. Make sure that all tools and materials are removed, and that the machine parts are intact and ready for operation. This includes restoring all guards and safety devices.
2. Remove all workers from the machine area.
3. Notify other affected workers that the machine is going back into operation.
4. Remove lock-out devices. Each device must be removed by the worker who attached it.
Employees involved in lock-out and tag-out procedures must be trained to understand the importance of energy control, and to know who to follow the correct procedures.

In addition to the workers who actually participate in lock-out and tag-out procedures, all other employees in the area must be trained to recognize lock-out and tag-out devices and to know that they must not tamper with or remove these devices.

The OSHA standard specifies three types of training for three different categories of workers:

- **Authorized Employees.** These are the employees who participate directly in a lock-out or tag-out procedure. They are the ones who attach their locks and tags. Authorized employees must be trained to recognize sources of hazardous energy, the types and strengths of energy, and the procedures for control.

- **Affected employees.** These are employees who normally use the machine or equipment that is being locked or tagged out, or who perform other work in the area where the locked out or tagged out machine is located. These employees must be trained on the purpose and use of energy control procedures. They need to know not to try to use the machine while it is being serviced.

- **Other employees.** These are other employees in the general area who are not directly involved, and do not normally use the machine or equipment that is being locked or tagged out. They need to know the general procedure, and they must understand that they must not try to operate the equipment or machine, or tamper with any lock-out or tag-out devices.

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Training
[29 CFR1910.147(c)(7)]

The material in this manual is awareness training only. You also need to be trained in the specific procedures in your employer’s Lock-Out / Tag-Out Program.
- notes -
Learning objectives

This Chapter reviews awareness training about the hazards of confined spaces so that you will be able to recognize and avoid them.

This Chapter is awareness training only. If your job requires that you enter a confined space, be a standby attendant or be a member of a rescue team, then you must first receive more detailed training including site specific information about your employer’s confined space entry and rescue procedures.

After completing this Chapter you will be able to demonstrate your ability to:

1. IDENTIFY five characteristics that make a confined space hazardous.
2. IDENTIFY three hazardous atmospheres found in confined spaces.
3. IDENTIFY two reasons why a confined space permit is important.
Many confined spaces are easy to recognize: tanks, tank trucks, tank cars, boilers, pipelines, septic tanks, manholes, utility vaults, sewers and ventilation ducts.

In some cases, it might be less obvious that a work area is a confined space. For example, sumps and pits can be confined spaces even though they are open to the air.

Any type of health or safety hazard might be present in a confined space. However, if an accident or hazardous exposure occurs, the consequences are often worse because they occur in a confined space.

For example, using a chipping hammer to remove slag or corrosion is a noisy operation. Inside a steel tank the noise is even louder. When using a solvent to remove grease, toxic vapors may be released. In a sump pit the concentration of vapors will be greater because there is less air to dilute them. Also, if an accident occurs, it is more difficult to escape or to be rescued from a confined space.
OSHA requires a Confined Space Program that includes:

- Identifying and labelling confined spaces.
- A Confined Space Permit System.
- Evaluation of the hazards before anyone enters.
- Air monitoring before and during the entry.
- Specific safe work practices.
- All necessary safety equipment.
- Standby personnel to monitor workers inside and summon the rescue team if an accident occurs.
- Training for all workers and supervisors involved.
- Close-out procedures to make sure that all workers have left safely and it is OK to return the space to its intended purpose.
- A rescue plan.
- Procedures for sharing information about confined spaces if there are multiple contractors.

The OSHA Standard for confined spaces in general industry is:

29 CFR 1910.146
OSHA requires your employer to determine if there are any confined spaces in the workplace. Each confined space must be posted with a sign. This is an example:

**DANGER**
PERMIT-REQUIRED
CONFINED SPACE
DO NOT ENTER
WITHOUT PERMIT
THIS SPACE CONTAINS MOVING PARTS
AND POTENTIAL OXYGEN DEFICIENCY

Although not specifically required by OSHA, a confined space sign might also include specific work practices such as what type of respirator to wear. The sign might also include an emergency phone number.

Entry means putting any part of your body into the confined space. If you stick your head through the opening to get a quick look or to sniff the air inside, you have just entered the confined space. These are unsafe work practices unless all safe entry procedures have been followed, including, if necessary, wearing the proper respirator.

What Does “Entry” Mean?

Never stick your head inside to get a quick look or sniff the air. One breath could be fatal.
What Makes Confined Spaces Dangerous?

Several characteristics make confined spaces dangerous:

- Restricted entry and exit
  It’s hard to get in or out, and difficult for rescue personnel to respond quickly.

- Not designed for continuous work
  The space was made for some other purpose, not for people to work there.

- Poor ventilation
  It’s hard for fresh air to get in or for contaminants to get out.

- May contain a hazardous atmosphere.
  - Oxygen deficiency.
  - Toxic air contaminants.
  - Flammable.

- May contain other hazards.
  - Electrical hazards.
  - Sparks.
  - Moving machinery.
  - Process liquids.
  - Engulfment hazards.
  - Extreme temperatures.
  - Noise.
  - Falling objects.

Three types of air hazard:
1. Oxygen deficiency
2. Flammables
3. Toxic contaminants
Never enter a confined space unless proper monitoring is being done. Stay out, or get out, if there is:

- Less than 19½% oxygen. Unless you are wearing an SCBA or an airline respirator with escape bottle.

- More than 10% of the LEL of a flammable material.

- More than 50% of the PEL of an air contaminant. Unless you are wearing the proper respirator.

- More than the IDLH of a toxic air contaminant. Unless you are wearing an SCBA or an airline respirator with escape bottle.

Do not enter to do the initial testing. Use equipment with a hose or remote capability.

Continue monitoring while workers are inside. Conditions may change!

All monitoring must be done by a properly trained person using the appropriate, calibrated equipment.
The Confined Space Permit authorizes the work to be done and certifies that all necessary safety procedures are in place. The Permit must include:

- The location of the confined space.
- The purpose of the entry.
- The date and duration of the entry.
- Names of all workers who will enter.
- Names of standby personnel.
- Supervisor’s name and signature.
- Identification of all present or potential hazards.
- Specific procedures such as lock-out, ventilation and purging.
- Air testing to be done before and during entry.
- How to summon the Rescue Team.
- Communication procedures.
- List of all required PPE, including respirators.
- If “hot work” such as welding is to be done, an additional Hot Work Permit must be issued.

A Confined Space Permit takes time to fill out properly.

Don’t cut corners. Failure to carefully complete the permit could cost lives.

If the work will be continued by a different crew, or by the same crew on a different shift, then a new permit should be issued.
The permit is not just a piece of paper. It serves two very important purposes:

- Assures that time is taken to identify all hazards and to take all necessary precautions to protect the lives of workers. It’s like the checklist that a pilot goes through before taking off.

- Requires the supervisor to take responsibility, in writing, for assuring that safe work practices are followed. It holds the supervisor accountable.

If monitoring reveals oxygen deficiency, toxic contaminants, or flammables then the space must be ventilated and tested again before workers enter.

Ventilation works best if clean air flows into the space at one end and exits at the other end. If the spaces has only one opening, blow or suck air through a hose located as far into the space as possible. Fresh air will travel through the space on its way out.

Use clean air. Make certain the blower’s intake is not near a source of contaminants such as vehicle exhaust.
Lock-Out
Tag-Out

It is essential to isolate a confined space from sources of hazardous energy. The best method is lock-out:

- Lock-out electrical circuits by removing circuit breakers and putting locks on the switches.
- Lock-out pipes by removing a section of pipe and sealing both exposed ends with solid plates. This is called “double blank and block.”
- Lock-out mechanical equipment by removing gears, drive shafts or chain drives.

Also tag-out the equipment with a sign to alert others that the equipment must remain out of service. Remember that tag-out by itself – without lock-out – does not prevent an accidental start-up.

Standby
Attendant

A trained attendant (standby person) must be assigned to remain outside the confined space while workers are inside. The attendant should not have any other duties that prevent giving his or her full attention to the workers inside the confined space.

The attendant is responsible for starting the rescue procedure as described in the employer’s Safety and Health Plan. Usually this means calling the rescue team.

The attendant should only enter the confined space if he or she is part of the rescue team and is properly trained and equipped.

Each worker should have their own lock. Equipment can only be turned on after each worker has remove their own lock.

More than 50% of all the workers who die in confined space accidents are would-be rescuers who enter without the proper equipment and training.
More than one half of all the workers who die in confined space accidents are would-be rescuers.

They die because they do not have the training or equipment to perform a safe rescue. It is normal to want to help your fellow worker. However, you are not helping if you only add to the list of fatalities.

The only effective way to protect confined space workers is to have a Rescue Plan and specially trained and equipped rescue personnel.

In many cases it is best to provide for non-entry rescue. This means that the workers entering the confined space are equipped with harnesses which will allow them to be extracted without anyone else actually entering.

OSHA allows the employer to rely on an off-site rescue team such as a fire department. However, these rescuers might arrive too late.

You have the best protection if your employer maintains a properly trained and equipped on-site rescue team.