GADSDEN TECHNICAL INSTITUTE
CONTINUAL EDUCATION
COVID-19 EMERGENCY LESSONS

Teacher Name:	Mr. Alfred Suber
Dates of Instruction:	March 30 – April 13, 2020
Lesson Title:	Basic Safety (Construction) Site Safety Orientation
Grade Levels:	10 – 12; Adult
Subject Area:	Carpentry

Assignment: After reading the material on carpentry shop safety, the student will be able to: maintain a clean, orderly and safe work area; transport, handle and store materials safely; operate a fire extinguisher; qualify in basic first-aid procedures; identify and report safety hazards; demonstrate the inspection, use and care of personal protective equipment (PPE); describe "Right-to-Know" Law as recorded in (29 CFR-1910.1200); explain the purpose of the Occupational Safety and Health Administration (OSHA); identify health-related problems that may result from exposure to hazardous materials; describe the proper precautions for handling hazardous materials, explain eligibility and the procedures for obtain worker's compensation; explain the importance of complying with the Americans with Disabilities Act (ADA) requirements..

Lesson Instructions:
Week of March 30 – April 3, 2020, read sections 1, 2 and 3 pages 1-48. Study and Learn Trade Terms Definitions on pages 97-98.

Week of April 6 – 15, 2020, read sections 4, 5, and 6 pages 50-87. Study and Learn Trade Terms Definitions on pages 97-98.

Practice Activities:
Week of March 30 – April 3, 2020, answer section review questions on pages 15, 39 and 49.

Week of April 6 – 15, 2020, answer section review questions on pages 57, 66 and 87. Answer review questions pages 88, 89, and 90. Answer trade terms quiz questions on pages 91-92.

Instructional Materials:
1. Carpentry Introduction to Site Safety Module 1 reading packet
2. Carpentry Introduction to Site Safety Module 1 questions packet.

Special Notes from Instructor:
ALL paper work should be kept in your folder, signed and dated to reflect completion date(s) prior to bringing them to class with you on April 16, 2020. If there are any questions, I can be reached at (850) 875-8324; ext. 5121 or email suberj@gcpsmail.com.

Mission Statement

The mission of Gadsden Technical Institute is to recognize the worth and potential of each student. We are committed to providing opportunities for basic and advanced instruction in a conducive learning environment. The Center encourages academic and technical curiosity, innovation and creativity by integrating applied academic skills in all occupational areas. We strive to instill the attitudes and skills necessary to produce motivated, self-sufficient individuals who are able to function effectively in our ever-changing, complex society.

SECTION ONE

1.0.0 SAFETY AND HAZARD RECOGNITION

Objectives

Describe the importance of safety, the causes of workplace incidents and accidents, and the process of hazard recognition and control.

a. Define incidents and accidents and the significant costs associated with them.
b. Identify the common causes of incidents and accidents and their related consequences.
c. Describe the processes related to hazard recognition and control, including the Hazard Communication (HAZCOM) Standard and the provisions of a Safety Data Sheet (SDS).

Trade Terms

Accident: According to the US Occupational Safety and Health Administration (OSHA), an unplanned event that results in personal injury and/or property damage.

Combustible: Capable of easily igniting and rapidly burning; used to describe a fuel with a flash point at, or above, 100°F (38°C).

Competent person: A person who is capable of identifying existing and predictable hazards in the surroundings or working conditions that are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

Confined space: A work area large enough for a person to work, but arranged in such a way that an employee must physically enter the space to perform work. A confined space has a limited or restricted means of entry and exit. It is not designed for continuous work. Tanks, vessels, silos, pits, vaults, and hoppers are examples of confined spaces. Also see *permit-required confined space*.

Flammable: Capable of easily igniting and rapidly burning; used to describe a fuel with a flash point below 100°F (38°C).

Ground fault: Incidental grounding of a conducting electrical wire.

Hazard Communication (HAZCOM) Standard: The Occupational Safety and Health Administration standard that requires contractors to educate employees about hazardous chemicals on the job site and how to work with them safely.

Hydraulic: Powered by fluid under pressure.

Incident: Per the US Occupational Safety and Health Administration (OSHA), an unplanned event that does not result in personal injury but may result in property damage or is worthy of recording.

Management system: The organization of a company's management, including reporting procedures, supervisory responsibility, and administration.

Occupational Safety and Health Administration (OSHA): An agency of the US Department of Labor. Also refers to the Occupational Safety and Health Act of 1970, a law that applies to more than 111 million workers and 7 million job sites in the United States.

Personal protective equipment (PPE): Equipment or clothing designed to prevent or reduce injuries.

Pneumatic: Powered by air pressure, such as a pneumatic tool.

Respirator: A device that provides clean, filtered air for breathing, no matter what is in the surrounding air.

Safety culture: The culture created when the whole company sees the value of a safe work environment.

Safety data sheet (SDS): A document that must accompany any hazardous substance. The SDS identifies the substance and gives the exposure limits, the physical and chemical characteristics, the kind of hazard it presents, precautions for safe handling and use, and specific control measures.

Trench: A narrow excavation made below the surface of the ground that is generally deeper than it is wide, with a maximum width of 15 feet (4.6m). Also see *excavation*.

When you take a job, you have an obligation to your employer, co-workers, family, and yourself to work safely. You also have an obligation to make sure anyone you work with is working safely. Your employer is likewise obliged to maintain a safe workplace for all employees. The ultimate responsibility for on-the-job safety, however, rests with you; safety is part of everyone's job. In this module, you will learn to ensure your safety, and that of the people you work with, by obeying the following rules:

- Follow safe work practices and procedures, both regulatory and corporate.
- Inspect safety equipment before use.
- Use safety equipment properly.

To take full advantage of the wide variety of training, job, and career opportunities the construction industry offers, you must first understand the importance of safety. Successful completion of this module will be your first step toward achieving this goal. Later modules offer more detailed explanations of safety procedures, along with opportunities to practice them.

On a typical job site, there are often many workers from many trades in one place. These workers are all performing different tasks and operations. As a result, the job site is constantly changing and hazards are continually emerging. These hazards can jeopardize your safety. Your employer should make every effort to plan safety into each job and to provide a safe and healthful job site. Ultimately, however, your safety is in your own hands.

Safety training is provided to make you aware that hazards exist all around you every day. The time you spend learning and practicing safety procedures can save your life and the lives of others.

Safety is a learned behavior and attitude. It is a way of working that must be incorporated into the company as a culture. A **safety culture** is created when all the workers at a job site or in an organization see the value of a safe work environment and support it through their actions. Creating and maintaining a safety culture is an ongoing process that includes a sound safety structure and attitude, and relates to organizations as well as individuals. Everyone in the company, from management to laborers, must be responsible for safety every day they come to work.

There are many benefits to having a safety culture. Companies with strong safety cultures usually have the following characteristics:

- Fewer at-risk behaviors
- Lower **incident** and **accident** rates
- Less turnover
- Lower absenteeism
- Higher productivity

Did You Know?

Safety First

Safety training is required for all activities. Never operate tools, machinery, or equipment without prior training. Always refer to the manufacturer's instructions.

A strong safety culture can also improve a company's safety record, which leads to winning more bids and keeping workers employed. Contractors with poor safety records are sometimes excluded from bidding, so good safety performance is essential. Factors that contribute to a strong safety culture include the following:

- Embracing safety as a core value
- Strong leadership
- Establishing and enforcing high standards of performance
- The commitment and involvement of all employees
- Effective communication and commonly understood and agreed-upon goals
- Using the workplace as a learning environment
- Encouraging workers to have a questioning attitude and empowering them to stop work when faced with potential hazards.
- Good organizational learning and responsiveness to change
- Providing timely response to safety issues and concerns
- Continually monitoring performance
- Positive reinforcement when proper safety practices are demonstrated by employees

Around the World

GOST

While OSHA serves to protect workers by setting safety standards in the United States, other systems are used internationally. One such set of technical standards used on a regional basis is known as GOST. GOST standards are more far-reaching than OSHA standards, as they cover a much broader range of topics than worker safety alone. The first set of GOST standards were published in 1968 as state standards for the former Soviet Union. After the Soviet Union was dismantled, GOST became a regional standard used by many previous members of the Soviet Union. Although countries may also have some standards of their own, countries such as Belarus, Moldova, Armenia, and Ukraine continue to use GOST standards as well. The standards are no longer administered by Russia, however. Today, the standards are administered by the Euro-Asian Council for Standardization, Metrology and Certification (EASC).

1.1.0 Incidents and Accidents

Incidents and accidents can occur at any job site. Both at-risk behavior and poor working conditions can cause these undesirable events. You can help prevent such events by using safe work habits, understanding what causes them, and learning how to prevent them.

The terms *incident* and *accident* are often used interchangeably. However, according to the US **Occupational Safety and Health Administration (OSHA)**, an incident is an unplanned event that may or may not result in property damage. However, an incident is worthy of being documented so that steps can be taken to prevent it from recurring. When an incident occurs, no personal injury has occurred.

An accident is defined as an unplanned event that results in personal injury and/or property damage. Therefore, an event that results in property damage alone could be considered an incident or an accident. If personal injury or a fatality has occurred, the event is definitely an accident.

There are varying opinions on the use of these two terms, however. The US National Safety Council defines an incident as an unplanned, undesired event that adversely affects the completion of a task. In this definition, there is no mention of injury or property damage. Other safety organizations across the globe are likely to have their own definitions of these terms as well, or may use completely different terms.

The most important thing to understand is that both incidents and accidents are undesirable events that have a negative effect on both projects and workers. Do not be surprised when you hear the terms used interchangeably by other workers. The definitions provided by OSHA are used here to provide context for these terms as they are used throughout this module.

The lessons you will learn in this module will help you work safely. You will be able to spot and avoid hazardous conditions on the job site. By following safety procedures, you will help keep your workplace free from incidents and accidents, and protect yourself and others from injury or even death.

1.1.1 Incident and Accident Categories

Incidents and accidents are often categorized by their severity and impact, as follows:

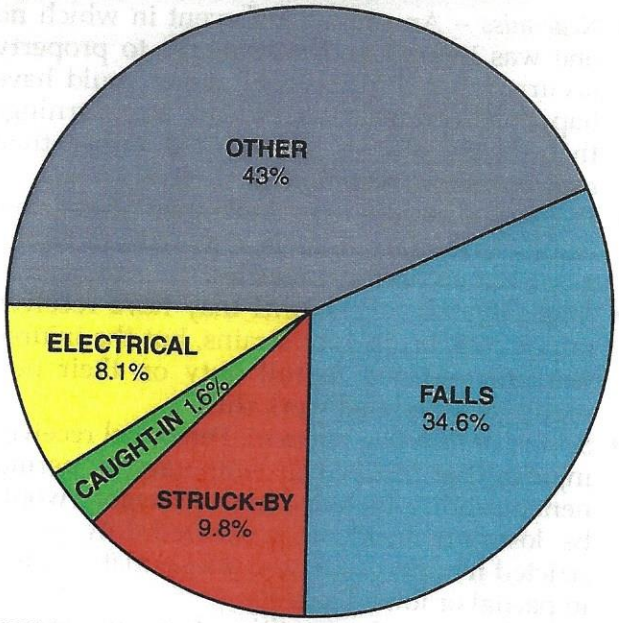
- *Near-miss* – An unplanned event in which no one was injured and no damage to property occurred, but during which either could have happened. Near-miss incidents are warnings that should always be reported rather than overlooked or taken lightly.
- *Property damage* – An unplanned event that results in damage to tools, materials, or equipment, but no personal injuries.
- *Minor injuries* – Personnel may have received minor cuts, bruises, or strains, but the injured workers returned to full duty on their next regularly scheduled work shift.
- *Serious or disabling injuries* – Personnel received injuries that resulted in temporary or permanent disability. Included in this category would be lost-time incidents, restricted-duty or restricted-motion cases, and those that resulted in partial or total disability.
- *Fatalities* – Deaths resulting from unplanned events.

Studies have shown that for every serious or disabling injury, there were 10 injuries of a less serious nature and 30 property damage incidents. A further study showed that 600 near-miss incidents occurred for every serious or disabling injury.

There are four leading causes of death in construction work. These are often referred to as the "big four", the "fatal four", or the "focus four". They include falls; struck-by hazards; caught-in or caught-between hazards; and electrical hazards (*Figure 1*). Deaths from falls far exceed all other causes.

Here are explanations of the four leading hazard groups:

- Falls from elevation are incidents involving failure of, failure to provide, or failure to use appropriate fall protection.
- Struck-by accidents involve unsafe operation of equipment, machinery, and vehicles, as well as improper handling of materials, such as through unsafe rigging operations.
- Caught-in or caught-between accidents involve unsafe operation of equipment, machinery, and vehicles, as well as improper safety procedures at **trench** sites and in other **confined spaces**.
- Electrical shock accidents involve contact with overhead wires; use of defective tools; failure to disconnect power source before repairs; or improper **ground fault** protection.



SOURCE: US OSHA, 2013

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Figure 1 The four high-hazard areas.

1.1.2 Costs

Incidents and accidents cost billions of dollars each year and cause much needless suffering. The National Safety Council estimates that the organized safety movement has saved more than 4.2 million lives since it began in 1913. This section examines why incidents and accidents happen and how you can help prevent them.

Accidents that result in injury or death can have a lasting effect not only on the victims, but on their families, co-workers, and employers. An injured worker who is disabled by an accident faces potentially huge medical bills. On top of those expenses, the worker's family faces loss of the income they rely on. It's convenient to think that insurance will take care of the costs, but it may not. Workers who are injured because they violated established safety rules may have their insurance claims denied and may be dismissed from the company because of the violation. A worker who is injured in a fall because he or she was not using fall protection could be refused compensation. How these issues are handled varies dramatically among companies and countries.

Employers and co-workers can be affected because many contract awards are based, in part, on a company's safety record. Therefore, incidents and accidents can also result in the loss of future jobs, which affects the company's financial position. This can mean layoffs, hiring freezes, or inability to purchase new equipment or tools. In this way, these events affect not only injured employees and their families, but everyone on the job site.

1.2.0 Incident and Accident Causes

When an incident or accident occurs on the job site, it can often be attributed to one of the following causes:

- Failure to communicate
- At-risk work habits
- Alcohol or drug abuse
- Lack of skill
- Intentional acts
- Unsafe acts
- Rationalizing risks
- Unsafe conditions
- Housekeeping
- **Management system** failure

Each of these causes is discussed further in the sections that follow.

1.2.1 Failure to Communicate

Many incidents happen because of a lack of communication. For example, you may learn how to do things one way on one job, but what happens when you go to a new job site? You need to communicate with the people at the new job site to find out whether they do things the way you have learned to do them. If you do not communicate clearly, incidents can happen. Remember that different people, companies, and job sites do things in different ways.

Making assumptions about what other workers know and what they will do can cause incidents.

The Fatal Four

Out of 3,945 worker fatalities in US private industry during the 2012 calendar year, 775, or 19.6 percent, were in construction. The leading causes of worker deaths on construction sites were falls, followed by struck-by-object, electrocution, and caught-in/between. These fatal four were responsible for nearly three out of five (56 percent) construction worker deaths in 2012 reports, as reported by the US Bureau of Labor Statistics. Eliminating the fatal four would save the lives of 435 workers in America every year.

Half-Measures

Most workers who die from falls are wearing harnesses but failed to tie off properly. Always follow the manufacturer's instructions when wearing a harness. Know and follow your company's safety procedures when working on roofs, ladders, and other elevated locations and make sure you have an adequate anchor point at all times.

Don't assume, for example, that all workers understand what you are saying; some workers have limited language skills, especially outside of their native language. Also, don't use terms or jargon that other people may not understand.

CAUTION

Never assume anything. It never hurts to ask questions, but disaster can result if you don't ask. For example, do not assume that an electrical power source is turned off. First ask whether the power is turned off, then check it yourself to be completely safe.

All work sites have specific markings and signs to identify hazards and provide emergency information (*Figure 2*). Learn to recognize these types of signs:

- Informational
- Safety
- Caution
- Danger
- Temporary warnings

Informational markings or signs provide general information. These signs are blue. The following are considered informational signs:

- No Admittance
- No Trespassing
- For Employees Only

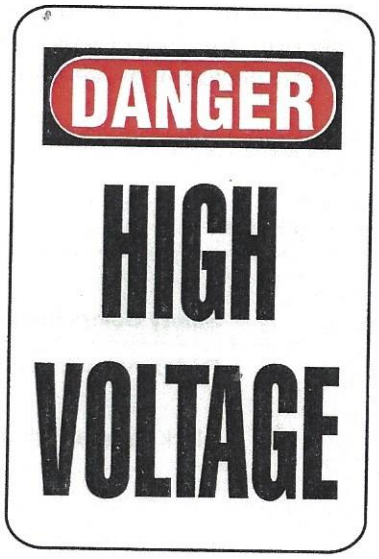
Toolbox Talks

Toolbox talks are one way to effectively keep all workers aware and informed of safety issues and guidelines. Toolbox talks are 5- to 10-minute meetings that review specific health and safety topics. These are very common at construction sites of all types.

INFORMATION SIGN

SAFETY SIGN

CAUTION SIGN



DANGER SIGN

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Figure 2 Communication tags and signs.

Safety signs give general instructions and suggestions about safety measures. The background on these signs is white; most have a green panel with white letters. These signs tell you where to find such important areas as the following:

- First-aid stations
- Emergency eye-wash stations
- Evacuation routes
- **Safety Data Sheet (SDS)** stations
- Exits (usually have white letters on a red field)

Caution markings or signs tell you about potential hazards or warn against unsafe acts. When you see a caution sign, protect yourself against a possible hazard. Caution signs are yellow and have a black panel with yellow letters. They may give you the following information:

- Hearing and eye protection are required
- **Respirators** are required
- Smoking is not allowed

Danger markings or signs tell you that an immediate hazard exists and that you must take certain precautions to avoid an incident. Danger signs are red, black, and white. They may indicate the presence of the following:

- Defective equipment
- **Flammable** liquids and compressed gases
- Safety barriers and barricades
- Emergency stop button
- High voltage

Safety tags are temporary warnings of immediate and potential hazards. They are not designed to replace signs or to serve as permanent means of protection. Learn to recognize the standard incident and accident prevention signs and tags (*Table 1*).

1.2.2 At-Risk Work Habits

Some examples of at-risk work habits are procrastination, carelessness, and horseplay. Procrastination (putting things off) is a common cause of incidents. For example, delaying the repair, inspection, or cleaning of equipment and tools can cause incidents and even accidents. If you try to push machines and equipment beyond their operating capacities, you risk injuring yourself and your co-workers.

Machines, power tools, and even a pair of pliers can hurt you if you don't use them safely. It is your responsibility to be careful; tools and machines don't know the difference between wood or steel, and flesh and bone.

Work habits and work attitudes are closely related. If you resist taking orders, you may also resist listening to warnings. If you let yourself be easily distracted, you won't be able to concentrate. If you aren't concentrating, you could cause a significant problem.

Your safety is affected not only by how you do your work, but also by how you act on the job site. This is why most companies have strict policies for employee behavior. Horseplay and other inappropriate behavior are forbidden. Workers who engage in such behavior on the job site may be fired.

These strict policies are provided for the worker's protection. There are many hazards on construction sites. Each person's behavior—at work, on a break, or at lunch—must follow the principles of safety.

A person pulling a practical joke on a co-worker could consider it just having fun, but in fact, it could cause the co-worker serious, even fatal, injury. If you horse around on the job, play pranks, or don't concentrate on what you are doing, you are showing a poor work attitude that can lead to a serious incident.

Table 1 Tags and Signs

Basic Stock (background)	Safety Colors (ink)	Message(s)
White	Red panel with white or gray letters	Do Not Operate Do Not Start
White	Black square with a red oval and white letters	Danger Unsafe Do Not Use
Yellow	Black square with yellow letters	Caution
White	Black square with white letters	Out of Order Do Not Use
Yellow	Red/magenta (purple) panel with black letters and a radiation symbol	Radiation Hazard
White	Fluorescent orange square with black letters and a biohazard symbol	Biological Hazard

1.2.3 Alcohol and Drug Abuse

Alcohol and drug abuse costs the construction industry millions of dollars a year in incidents, accidents, lost time, and lost productivity. The true cost of alcohol and drug abuse is much more than just money, of course. Substance abuse can cost lives. Just as drunk driving kills thousands of people on our highways every year, alcohol and drug abuse kills on the construction site.

Using alcohol or drugs creates a risk of injury for everyone on a job site. Many states have laws that prevent workers from collecting insurance benefits if they are injured while under the influence of alcohol or illegal drugs.

Would you trust your life to a crane operator who was under the influence of drugs? Would you bet your life on the responses of a co-worker under the influence of alcohol or drugs? Alcohol and drug abuse have no place in the workplace. A person on a job site who is under the influence of alcohol or drugs is an incident or accident waiting to happen—possibly a fatal accident.

People who work while using alcohol or drugs are at risk of incident or injury; their co-workers are at risk as well. That's why most employers have a formal substance abuse policy that you should be aware of and follow. Avoid any substances that can affect your job performance; the life you save could be your own.

You do not have to be abusing drugs such as marijuana, cocaine, or heroin to create a job hazard. Many prescription and over-the-counter drugs, taken for legitimate reasons, can affect your ability to work safely. Amphetamines, barbiturates, and antihistamines are only a few of the prescription-controlled legal drugs that can affect the ability to work or operate machinery safely. The main thing is to understand and follow your company's substance abuse policy.

CAUTION

If your doctor prescribes any medication that you think might affect your job performance, ask about its effects. Your safety and the safety of your co-workers depend on everyone being alert on the job.

1.2.4 Lack of Skill

Every worker needs to learn and practice new skills under careful supervision. Never perform new tasks alone until you have been checked out by a supervisor. Lack of skill can cause incidents and accidents quickly. For example, suppose you are told to cut some boards with a circular saw, but you aren't skilled with that tool. A basic rule of circular saw operation is never to cut without a properly functioning guard. Because you haven't been trained, you don't know this. You find that the guard on the saw is slowing you down, so you jam the guard open. The result could be a serious accident. Proper training can prevent this from happening.

Never operate a power tool or machine until you have been trained to use it. Some power tools require that a worker be trained and certified in their use. You can greatly reduce the chances of incidents and accidents by learning the safety rules for each task you perform.

1.2.5 Intentional Acts

When someone purposely causes property damage or injury, it is called an intentional act. An angry or dissatisfied employee may purposely create a situation that leads to an incident or accident. If someone you are working with threatens to get even or pay back someone, let your supervisor know at once.

Did You Know?

Stress Effects

Stress creates a chemical change in your body. Although stress may heighten your hearing, vision, energy, and strength, long-term stress can harm your health. Not all stress is job-related; some stress develops from the pressures of dealing with family and friends and daily living. In the end, your ability to handle and manage your stress determines whether stress hurts or helps you. Use common sense when you are dealing with stressful situations. For example, consider the following:

- Keep daily occurrences in perspective. Not everything is worth getting upset, angry, or anxious about.
- When you have a particularly difficult workday scheduled, get plenty of rest the night before.
- Manage your time. The feeling of always being behind creates a lot of stress. Waiting until the last minute to finish an important task adds unnecessary stress.
- Talk to your supervisor. Your supervisor may understand what is causing your stress and may be able to suggest ways to manage it better.

Unfortunately, terrorism must also be a consideration on the job site. The level of concern is typically dependent on the site itself and the nature of the structure. Pipelines, for example, may represent a significant target due to their size, importance, location (sections of pipeline are in remote areas), and potential for destruction. Controversial sites also tend to attract attention, perhaps from terrorist groups operating within a country that oppose the construction or what the structure represents.

As an individual worker, the most important thing you can do is to pay attention. Become familiar with people on the job site and look for strangers that do not seem to fit. A terrorist attack can come from any direction and be delivered in many different ways. It can begin with a single individual gaining access to the job site.

1.2.6 Unsafe Acts

An unsafe act is a change from an accepted, normal, or correct procedure that can cause an incident or accident. It can be any conduct that causes unnecessary exposure to a job-site hazard or that makes an activity less safe than usual. Here are examples of unsafe acts:

- Failing to use required **personal protective equipment (PPE)**
- Failing to warn co-workers of hazards
- Lifting improperly
- Loading or placing equipment or supplies improperly
- Making safety devices (such as saw guards) inoperable
- Operating equipment at improper speeds
- Operating equipment without authority
- Servicing equipment in motion
- Taking an improper working position
- Using defective equipment
- Using equipment improperly

1.2.7 Rationalizing Risk

Everybody takes risks every day. When you get in your car to drive to work, you know there is a risk of being involved in an accident. Yet when you drive using all the safety practices you have learned, you know that there is a very good chance you will arrive at your destination safely. Driving is an acceptable risk because you have some control over your own safety and that of others.

Some risks are not acceptable. On the job, you must never take risks that endanger yourself or others just because you think you can justify doing so. This is called rationalizing risk which means ignoring safety warnings and practices. For example, because you are late for work, you might decide to run a red light. Perhaps you feel the risk is worth the time saved. This is not only a dangerous driving habit, but this kind of thinking is unacceptable on the job site.

The following are common examples of rationalized risks on the job:

- Crossing barricades or boundaries because there is no apparent activity
- Not wearing gloves because it's easier to do the job with bare hands
- Removing your hard hat because you are hot and you cannot see anyone working overhead
- Not tying off your fall protection because you only have to lean over by about a foot

Think about the job before you do it. If you think that it is unsafe, then it is unsafe. Stop working until the job can be done safely. Bring your concerns to the attention of your supervisor. Your health and safety, and that of your co-workers, make it worth taking extra care.

1.2.8 Unsafe Conditions

An unsafe condition is a physical state that is different from the acceptable, normal, or correct condition found on the job site. It usually results in an incident or accident. An unsafe condition can be anything that reduces the degree of safety normally present. The following are some examples of unsafe conditions:

- Congested workplace
- Defective tools, equipment, or supplies
- Excessive noise
- Fire and explosive hazards
- Hazardous atmospheric conditions (such as gases, dusts, fumes, and vapors)
- Inadequate supports or guards
- Inadequate warning systems
- Cluttered work area
- Poor lighting
- Poor ventilation
- Radiation exposure
- Unguarded moving parts such as pulleys, drive chains, and belts

All employees should be given the authority to stop work when an unsafe condition is observed.

1.2.9 Poor Housekeeping

Housekeeping means keeping your work area clean and free of scraps, clutter, or spills. It also means being orderly and organized. Store your materials and supplies safely and label them properly. Arranging your tools and equipment

to permit safe, efficient work practices, and easy cleaning is also important.

If the work site is indoors, make sure it is well-lit and ventilated. Don't allow aisles and exits to be blocked by materials and equipment. Make sure that flammable liquids are stored in safety cans. Oily rags must be placed only in approved, self-closing metal containers (*Figure 3*).

Remember that the major goal of housekeeping is to prevent incidents. Good housekeeping reduces the chances for slips, fires, explosions, and falling objects. Here are some good housekeeping rules:

- Remove from work areas all scrap material and lumber with nails protruding.
- Clean up spills to prevent falls.
- Remove all **combustible** scrap materials regularly.
- Make sure you have containers for the collection and separation of refuse. Containers for flammable or harmful refuse must have covers.
- Dispose of wastes often.
- Store all tools and equipment in the proper location and condition when you are finished with them.
- Keep all aisles and walkways clear of materials and tools.

Another term for good housekeeping is pride of workmanship. If you take pride in what you are doing, you won't let trash build up around you. The saying, "a place for everything and everything in its place" is the right attitude on the job site.

1.2.10 Management System Failure

Sometimes the cause of an incident or accident is failure of the management system. The management system should be designed to prevent or correct the acts and conditions that can create safety hazards. If the safety management system is not functioning properly, problems are likely to occur.

Tool Blades

Dull blades cause more accidents than sharp ones. If you do not keep your cutting tools sharpened, they won't cut very easily. When you have a hard time cutting, you exert more force on the tool. When that happens, something is bound to slip. And when something slips, you can be injured.

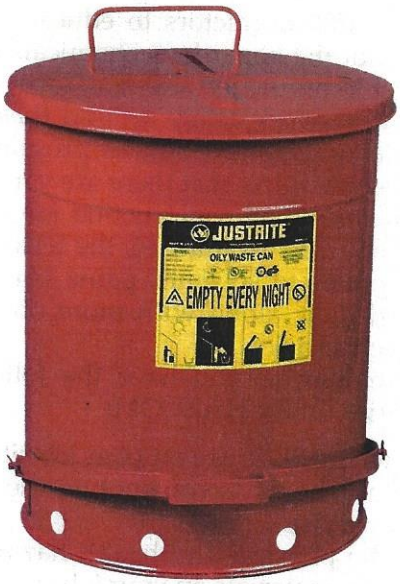

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Figure 3 Container for oily rags and waste.

What traits could mean the difference between a management system that fails and one that succeeds? A company implementing a good management system will do the following:

- Put safety policies and procedures in writing
- Distribute written safety policies and procedures to each employee
- Review safety policies and procedures periodically
- Enforce all safety policies and procedures fairly and consistently
- Evaluate supplies, equipment, and services to see whether they are safe
- Provide regular, periodic safety training for employees

1.3.0 Hazard Recognition, Evaluation, and Control

The process of hazard recognition, evaluation, and control is the foundation of an effective safety program. When hazards are identified and assessed, they can be addressed quickly, reducing the hazard potential. Simply put, the more aware you are of your surroundings and the dangers in them, the less likely you are to be involved in an incident.

There is a standard rule in the United States that affects every worker in most industries. It is often referred to as HAZCOM, which is short for **Hazard Communication Standard**. The US HAZCOM also aligns with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS). HAZCOM may also be called the Right-To-Know requirement. It

requires all US contractors to educate their employees about the hazardous chemicals they may be exposed to on the job site. Employees must be taught how to work safely around these materials. Other countries have similar programs.

Many people think that there are very few hazardous chemicals on construction job sites. That is simply not true. In practice, the term *hazardous chemical* applies to solvents, paint, concrete, and even wood dust, along with more obvious substances such as acids.

As an employee, you have the following responsibilities under HAZCOM:

- Know where SDSs are on your job site.
- Report any hazards you spot on the job site to your supervisor.
- Know the physical and health hazards of any hazardous materials on your job site, and know and practice the precautions needed to protect yourself from these hazards.
- Know what to do in an emergency.
- Know the location and content of your employer's written hazard communication program.

The final responsibility for your safety rests with you. Your employer must provide you with information about hazards, but you must know this information and follow safety rules.

1.3.1 Hazard Recognition

There are many potential hazard indicators. The best approach in determining if a situation or equipment is potentially hazardous is to ask these questions:

- How can this situation or equipment cause harm?
- What types of energy sources are present that can cause an incident?
- What is the magnitude of the energy?
- What could go wrong to release the energy?
- How can the energy be eliminated or controlled?
- Will I be exposed to any hazardous materials?

Before you can fully answer these questions, you need to know the different types of incidents and accidents that can happen and the energy sources behind them. Some of the different types of events that can cause injuries include the following:

- Falls on the same elevations or falls from elevations
- Being caught in, on, or between equipment
- Being struck by falling objects
- Contact with acid, electricity, heat, cold, radiation, pressurized liquid, gas, or toxic substances
- Being cut by tools or equipment
- Exposure to high noise levels
- Repetitive motion or excessive vibration

You might recognize the first four high-hazard conditions as the so-called fatal four previously discussed. Remember, these four types of accidents cause more than half of all construction fatalities.

When equipment is the cause of an incident or accident, it is usually because there was an uncontrolled release of energy. The different types of energy sources that can be released include the following:

- Mechanical
- **Pneumatic**
- **Hydraulic**
- Electrical
- Chemical
- Thermal (heat or cold)
- Radioactive
- Gravitational
- Stored energy

There are a number of ways to recognize hazards and potential hazards on a job site. Some techniques are more complicated than others. In order to be effective, they all must answer this question: What could go wrong with this situation or operation? No matter what hazard recognition technique you use, answering that question in advance will save lives and prevent equipment damage.

1.3.2 Job Safety Analysis (JSA) and Task Safety Analysis (TSA)

Performing a job safety analysis (JSA), also known as job hazard analysis (JHA), is one approach to hazard recognition. Another common technique is performing a task safety analysis (TSA), also called a task hazard analysis (THA).

In a JSA, the task at hand is broken down into its individual parts or steps and then each step is analyzed for its potential hazards. Once a hazard is identified, certain actions or procedures are recommended that will correct that hazard. For example, during a JSA, it is determined that using a chain hoist to install a pump motor in a tight space would be safer than having a worker do it manually. By using the chain hoist, the chance that the worker's hand would get crushed during installation is reduced. Using the JSA process saved the worker from injury. *Figure 4* shows an example of a form used to conduct a JSA.

Figure 4 Job safety analysis form.

JOB SAFETY ANALYSIS

TITLE OF JOB OR TASK

TASK	START	END	HAZARDS	CONTROLS
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				

Required Training:

Required Personal Protective Equipment (PPE):

Job Name: _____

Job Number: _____

Supervisor: _____

Date: _____

Weekly Vehicle Check List:

_____ **Tire Pressure**
_____ **Oil**
_____ **Air Filter**
_____ **Transmission Fluid**
_____ **Lights**
_____ **Wkly Mileage**

Names of Employees:

PRINT NAME	SIGN NAME	TOTAL HOURS

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JSAs can also be used as pre-planning tools. This helps to ensure that safety is planned into the job. You may be asked to take part in a JSA during job planning. When JSAs are used as pre-planning tools, they contain the following information:

- Tools, materials, and equipment needs
- Staffing or manpower requirements
- Duration of the job
- Quality concerns

Task safety analysis is similar to job safety analysis in that both require workers to identify potential hazards and needed safeguards associated with a job they are about to do. The difference is the form used to report the hazards. During a TSA, a pre-printed, fill-in-the-blank checklist is often used to document any hazard found during analysis. Before work begins, the first-line supervisor or team leader should discuss the conclusions found during the TSA with the crew. Some companies require workers to sign the completed TSA forms or checklists before they start work. This helps companies document the hazards and ensure that workers have been told of the potential hazards and safety procedures.

1.3.3 Risk Assessment

Whether an action is considered safe is often a matter of evaluating risk. Risk is a measure of the probability, consequences, and exposure related to an event. Probability is the chance that a given event will occur. Consequences are the results of an action, condition, or event. Exposure is the amount of time and/or the degree to which someone or something is exposed to an unsafe condition, material, or environment.

A safe operation is one in which there is an acceptable level of risk. This means there is a low probability of an incident and that the consequences and exposure risk are all acceptable. For example, climbing a ladder has risk that is considered to be acceptable if the proper ladder is being used as intended, if it is set up correctly, and if it is in good condition. The probability of exposure to a hazard and its potential consequences are all low. If any one of these conditions were different, climbing the ladder would have an unacceptable level of risk.

1.3.4 Reporting Injuries, Incidents, and Near-Misses

All on-the-job incidents and accidents, no matter how minor, must be reported to your supervisor. Some workers think they will get in trouble if they report minor injuries, but that is not the case. Small injuries, like cuts and scrapes, can later become big problems because of infection and other complications.

US employers with more than 10 employees are required to maintain a log of significant work-related injuries and illnesses using specific OSHA forms and documents. Employee names can be kept confidential in certain circumstances. A summary of these injuries must be posted at certain intervals, although employers do not need to submit it to OSHA unless requested. Employers can calculate the total number of injuries and illnesses and compare the result with the average national rates for similar companies. By analyzing incidents and accidents, companies and OSHA can improve safety policies and procedures. By reporting an incident, you can help keep similar events from happening in the future. For details on the operation of OSHA and its important mission, refer to the *Appendix*.

1.3.5 Safety Data Sheets

SDSs are fact sheets prepared by the chemical manufacturer or importer. Each product used on a construction site must have an SDS. An SDS describes the substance, along with its hazards, safe handling, first aid, and emergency spill procedures. The HAZCOM standard requires new SDSs (formerly known as material safety data sheets or MSDSs) to be in a standardized format. The sections of the form include the following:

- *Section 1, Product identification, manufacturer contact information, recommended uses and restrictions*
- *Section 2, Hazard identification*
- *Section 3, Composition/information on ingredients*
- *Section 4, First aid measures*
- *Section 5, Firefighting information*
- *Section 6, Incidental release measures*
- *Section 7, Handling and storage*
- *Section 8, Exposure controls/personal protection*
- *Section 9, Physical and chemical properties*
- *Section 10, Stability and reactivity*
- *Section 11, Toxicological properties*
- *Section 12, Ecological properties*
- *Section 13, Disposal considerations*
- *Section 14, Transport information*
- *Section 15, Regulatory information*
- *Section 16, Other information*

Figure 5 shows a sample SDS for a PVC solvent-cement. The most important things to look for on an SDS are the specific hazards, personal protection, handling procedures, and first aid

WELD-ON®

GHS SAFETY DATA SHEET

WELD-ON® 705™ Low VOC Cements for PVC Plastic Pipe

Date Revised: **DEC 2011**
Supersedes: **FEB 2010**

SECTION 1 - PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: **WELD-ON® 705™ Low VOC Cements for PVC Plastic Pipe**

PRODUCT USE: Low VOC Solvent Cement for PVC Plastic Pipe

SUPPLIER:

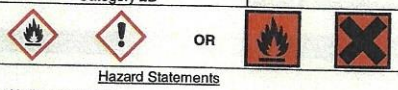
MANUFACTURER: IPS Corporation
17109 South Main Street, Carson, CA 90248-3127
P.O. Box 379, Gardena, CA 90247-0379
Tel. 1-310-898-3300

EMERGENCY: Transportation: CHEMTEL Tel. 800.255-3924, 813-248-0585 (International) **Medical:** Tel. 800.451.8346, 760.602.8703 3E Company (International)

SECTION 2 - HAZARDS IDENTIFICATION

GHS CLASSIFICATION:

Health		Environmental		Physical	
Acute Toxicity:	Category 4	Acute Toxicity:	None Known	Flammable Liquid	Category 2
Skin Irritation:	Category 3	Chronic Toxicity:	None Known		
Skin Sensitization:	NO				
Eye:	Category 2B				

GHS LABEL:  OR

Signal Word: **Danger**

WHMIS CLASSIFICATION: CLASS B, DIVISION 2

Hazard Statements	Precautionary Statements
H225: Highly flammable liquid and vapor	P210: Keep away from heat/sparks/open flames/hot surfaces – No smoking
H319: Causes serious eye irritation	P261: Avoid breathing dust/fume/gas/mist/vapors/spray
H332: Harmful if inhaled	P280: Wear protective gloves/protective clothing/eye protection/face protection
H335: May cause respiratory irritation	P304+P340: IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
H336: May cause drowsiness or dizziness	P403+P233: Store in a well ventilated place. Keep container tightly closed
EUH019: May form explosive peroxides	P501: Dispose of contents/container in accordance with local regulation

SECTION 3 - COMPOSITION/INFORMATION ON INGREDIENTS

	CAS#	EINECS #	REACH Pre-registration Number	CONCENTRATION % by Weight
Tetrahydrofuran (THF)	109-99-9	203-726-8	05-2116297729-22-0000	25 - 50
Methyl Ethyl Ketone (MEK)	78-93-3	201-159-0	05-2116297728-24-0000	5 - 36
Cyclohexanone	108-94-1	203-631-1	05-2116297718-25-0000	15 - 30

All of the constituents of this adhesive product are listed on the TSCA inventory of chemical substances maintained by the US EPA, or are exempt from that listing.
* Indicates this chemical is subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 (40CFR372).
# indicates that this chemical is found on Proposition 65's List of chemicals known to the State of California to cause cancer or reproductive toxicity.

SECTION 4 - FIRST AID MEASURES

Contact with eyes: Flush eyes immediately with plenty of water for 15 minutes and seek medical advice immediately.
Skin contact: Remove contaminated clothing and shoes. Wash skin thoroughly with soap and water. If irritation develops, seek medical advice.
Inhalation: Remove to fresh air. If breathing is stopped, give artificial respiration. If breathing is difficult, give oxygen. Seek medical advice.
Ingestion: Rinse mouth with water. Give 1 or 2 glasses of water or milk to dilute. Do not induce vomiting. Seek medical advice immediately.

SECTION 5 - FIREFIGHTING MEASURES

Suitable Extinguishing Media: Dry chemical powder, carbon dioxide gas, foam, Halon, water fog.
Unsuitable Extinguishing Media: Water spray or stream.
Exposure Hazards: Inhalation and dermal contact
Combustion Products: Oxides of carbon, hydrogen chloride and smoke
Protection for Firefighters: Self-contained breathing apparatus or full-face positive pressure airline masks.

	HMIS	NFPA	
Health	2	2	0-Minimal
Flammability	3	3	1-Slight
Reactivity	0	0	2-Moderate
PPE	B		3-Serious
			4-Severe

SECTION 6 - ACCIDENTAL RELEASE MEASURES

Personal precautions: Keep away from heat, sparks and open flame.
Provide sufficient ventilation, use explosion-proof exhaust ventilation equipment or wear suitable respiratory protective equipment.
Prevent contact with skin or eyes (see section 8).
Environmental Precautions: Prevent product or liquids contaminated with product from entering sewers, drains, soil or open water course.
Methods for Cleaning up: Clean up with sand or other inert absorbent material. Transfer to a closable steel vessel.
Materials not to be used for clean up: Aluminum or plastic containers

SECTION 7 - HANDLING AND STORAGE

Handling: Avoid breathing of vapor, avoid contact with eyes, skin and clothing.
Keep away from ignition sources, use only electrically grounded handling equipment and ensure adequate ventilation/fume exhaust hoods.
Do not eat, drink or smoke while handling.
Storage: Store in ventilated room or shade below 44°C (110°F) and away from direct sunlight.
Keep away from ignition sources and incompatible materials: caustics, ammonia, inorganic acids, chlorinated compounds, strong oxidizers and isocyanates.
Follow all precautionary information on container label, product bulletins and solvent cementing literature.

SECTION 8 - PRECAUTIONS TO CONTROL EXPOSURE / PERSONAL PROTECTION

EXPOSURE LIMITS:

Component	ACGIH TLV	ACGIH STEL	OSHA PEL	OSHA STEL:
Tetrahydrofuran (THF)	50 ppm	100 ppm	200 ppm	
Methyl Ethyl Ketone (MEK)	200 ppm	300 ppm	200 ppm	
Cyclohexanone	20 ppm	50 ppm	50 ppm	

Engineering Controls: Use local exhaust as needed.
Monitoring: Maintain breathing zone airborne concentrations below exposure limits.
Personal Protective Equipment (PPE):
Eye Protection: Avoid contact with eyes, wear splash-proof chemical goggles, face shield, safety glasses (spectacles) with brow guards and side shields, etc. as may be appropriate for the exposure.
Skin Protection: Prevent contact with the skin as much as possible. Butyl rubber gloves should be used for frequent immersion.
Use of solvent-resistant gloves or solvent-resistant barrier cream should provide adequate protection when normal adhesive application practices and procedures are used for making structural bonds.
Respiratory Protection: Prevent inhalation of the solvents. Use in a well-ventilated room. Open doors and/or windows to ensure airflow and air changes. Use local exhaust ventilation to remove airborne contaminants from employee breathing zone and to keep contaminants below levels listed above. With normal use, the Exposure Limit Value will not usually be reached. When limits approached, use respiratory protection equipment.

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Figure 5A Solvent cement SDS. (1 of 2)

WELD-ON

GHS SAFETY DATA SHEET

Date Revised: DEC 2011

WELD-ON® 705™ Low VOC Cements for PVC Plastic Pipe

Supersedes: FEB 2010

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Clear or gray, medium syrupy liquid		
Odor:	Ketone	**Odor Threshold:**	0.88 ppm (Cyclohexanone)
pH:	Not Applicable		
Melting/Freezing Point:	-108.5°C (-163.3°F) Based on first melting component: THF	**Boiling Range:**	66°C (151°F) to 156°C (313°F)
Boiling Point:	66°C (151°F) Based on first boiling component: THF	**Evaporation Rate:**	> 1.0 (BUAC = 1)
Flash Point:	-20°C (-4°F) TCC based on THF	**Flammability:**	Category 2
Specific Gravity:	0.9611 @23°C (73°F)	**Flammability Limits:**	**LEL:** 1.1% based on Cyclohexanone
Solubility:	Solvent portion soluble in water. Resin portion separates out.		**UEL:** 11.8% based on THF
Partition Coefficient n-octanol/water:	Not Available	**Vapor Pressure:**	129 mm Hg @ 20°C (68°F)based on THF
Auto-ignition Temperature:	321°C (610°F) based on THF	**Vapor Density:**	>2 (Air = 1)
Decomposition Temperature:	Not Applicable	**Other Data: Viscosity:**	Medium bodied
VOC Content:	When applied as directed, per SCAQMD Rule 1168, Test Method 316A,VOC content is: ≤ 510 g/l.		

SECTION 10 - STABILITY AND REACTIVITY

Stability:	Stable
Hazardous decomposition products:	None in normal use. When forced to burn, this product gives off oxides of carbon, hydrogen chloride and smoke.
Conditions to avoid:	Keep away from heat, sparks, open flame and other ignition sources.
Incompatible Materials:	Oxidizers, strong acids and bases, amines, ammonia

SECTION 11 - TOXICOLOGICAL INFORMATION

Likely Routes of Exposure: Inhalation, Eye and Skin Contact

Acute symptoms and effects:

Inhalation:	Severe overexposure may result in nausea, dizziness, headache. Can cause drowsiness, irritation of eyes and nasal passages.
Eye Contact:	Vapors slightly uncomfortable. Overexposure may result in severe eye injury with corneal or conjunctival inflammation on contact with the liquid.
Skin Contact:	Liquid contact may remove natural skin oils resulting in skin irritation. Dermatitis may occur with prolonged contact.
Ingestion:	May cause nausea, vomiting, diarrhea and mental sluggishness.

Chronic (long-term) effects: None known to humans

Toxicity:	LD_{50}	LC_{50}
Tetrahydrofuran (THF)	Oral: 2842 mg/kg (rat)	Inhalation 3 hrs. 21,000 mg/m^3 (rat)
Methyl Ethyl Ketone (MEK)	Oral: 2737 mg/kg (rat), Dermal: 6480 mg/kg (rabbit)	Inhalation 8 hrs. 23,500 mg/m^3 (rat)
Cyclohexanone	Oral: 1535 mg/kg (rat), Dermal: 948 mg/kg (rabbit)	Inhalation 4 hrs. 8,000 PPM (rat)

Reproductive Effects	Teratogenicity	Mutagenicity	Embryotoxicity	Sensitization to Product	Synergistic Products
Not Established	Not Established	Not Established	Not Established	Not Established	Not Established

SECTION 12 - ECOLOGICAL INFORMATION

Ecotoxicity:	None Known
Mobility:	In normal use, emission of volatile organic compounds (VOC's) to the air takes place, typically at a rate of ≤ 510 g/l.
Degradability:	Biodegradable
Bioaccumulation:	Minimal to none.

SECTION 13 - WASTE DISPOSAL CONSIDERATIONS

Follow local and national regulations. Consult disposal expert.

SECTION 14 - TRANSPORT INFORMATION

Proper Shipping Name:	Adhesives
Hazard Class:	3
Secondary Risk:	None
Identification Number:	UN 1133
Packing Group:	PG II
Label Required:	Class 3 Flammable Liquid
Marine Pollutant:	NO

EXCEPTION for Ground Shipping
DOT Limited Quantity: Up to 5L per inner packaging, 30 kg gross weight per package.
Consumer Commodity: Depending on packaging, these quantities may qualify under DOT as "ORM-D" .

TDG INFORMATION	
TDG CLASS:	FLAMMABLE LIQUID 3
SHIPPING NAME:	ADHESIVES
UN NUMBER/PACKING GROUP:	UN 1133, PG II

SECTION 15 - REGULATORY INFORMATION

Precautionary Label Information:	Highly Flammable, Irritant	Ingredient Listings: USA TSCA, Europe EINECS, Canada DSL, Australia AICS, Korea ECL/TCCL, Japan MITI (ENCS)	
Symbols:	F, Xi		
Risk Phrases:	R11: Highly flammable.		
	R20: Harmful by inhalation.		R66: Repeated exposure may cause skin dryness or cracking
	R36/37: Irritating to eyes and respiratory system.		R67: Vapors may cause drowsiness and dizziness
Safety Phrases:	S9: Keep container in a well-ventilated place.	S26: In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.	
	S16: Keep away from sources of ignition - No smoking.	S33: Take precautionary measures against static discharges.	
	S25: Avoid contact with eyes.	S46: If swallowed, seek medical advise immediately and show this container or label.	

SECTION 16 - OTHER INFORMATION

Specification Information:		
Department issuing data sheet:	IPS, Safety Health & Environmental Affairs	All ingredients are compliant with the requirements of the European Directive on RoHS (Restriction of Hazardous Substances).
E-mail address:	<EHSinfo@ipscorp.com>	
Training necessary:	Yes, training in practices and procedures contained in product literature.	
Reissue date / reason for reissue:	12/14/2011 / Updated GHS Standard Format	
Intended Use of Product:	Solvent Cement for PVC Plastic Pipe	

This product is intended for use by skilled individuals at their own risk. The information contained herein is based on data considered accurate based on current state of knowledge and experience. However, no warranty is expressed or implied regarding the accuracy of this data or the results to be obtained from the use thereof.

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Figure 5B Solvent cement SDS. (2 of 2)

information. Most SDSs have a 24-hour emergency-response number.

Using *Figure 5*, try to find the information you would need to use the cement described on the sample SDS. First locate the hazards; section 2 of the SDS shows that the adhesive is flammable, and also an eye and skin irritant that can cause respiratory irritation, dizziness, and drowsiness.

Next, find out how to minimize these hazards. Section 7 gives general handling and storage information. It indicates that ventilation is needed to reduce hazardous vapors, which can be a fan in an open window. If ventilation is not enough, respiratory protection is needed. Section 8 tells you how to protect your eyes and skin.

Section 4 lists the first aid measures for eye contact, skin contact, or inhalation. Section 5 explains fire hazards and firefighting measures. Now you have the information you need in case of an emergency.

The SDSs must be kept in the work area and be readily accessible to all workers. The company's safety officer or **competent person** should review the SDS before a hazardous material is used. Ask your supervisor to point out where the SDSs are located if you are not sure. Have him or her point out the sections that relate to your job; the health and safety of you and your co-workers may depend on it.

Additional Resources

US Occupational Safety and Health Administration. Numerous safety videos are available on line at **www.osha.gov/video**.

Construction Safety, Jimmie W. Hinze. 2006. Upper Saddle River, NJ: Pearson Education, Inc.

DeWalt Construction Safety/OSHA Professional Reference, Paul Rosenberg; American Contractors Educational Services. 2006. DEWALT

Basic Construction Safety and Health, Fred Fanning. 2014. CreateSpace Independent Publishing Platform.

1.0.0 Section Review

1. The person primarily responsible for your safety is _____.
   a. your foreman
   b. your instructor
   c. yourself
   d. your employer

2. The color commonly used for informational signs is _____.
   a. green
   b. red
   c. yellow
   d. blue

3. The SDS for any chemical used at a job site must be available _____.
   a. at the job site
   b. on line
   c. at the contractor's office
   d. at the nearest hospital

SECTION TWO

2.0.0 ELEVATED WORK AND FALL PROTECTION

Objectives

Describe the safe work requirements for elevated work, including fall protection guidelines.

a. Identify and describe various fall hazards.
b. Identify and describe equipment and methods used in fall prevention and fall arrest.
c. Identify and describe the safe use of ladders and stairs.
d. Identify and describe the safe use of scaffolds.

Performance Tasks

1. Properly set up and climb/descend an extension ladder, demonstrating proper three-point contact.
2. Inspect the following PPE items and determine if they are safe to use:
   - Fall arrest harnesses
   - Lanyards
   - Connecting devices
3. Properly don, fit, and remove the following PPE:
   - Fall arrest harness

Trade Terms

Cross-bracing: Braces (metal or wood) placed diagonally from the bottom of one rail to the top of another rail that add support to a structure.

Excavation: Any man-made cut, cavity, trench, or depression in an earth surface, formed by removing earth. It can be made for anything from basements to highways. Also see *trench*.

Guarded: Enclosed, fenced, covered, or otherwise protected by barriers, rails, covers, or platforms to prevent dangerous contact.

Hand line: A line attached to a tool or object so a worker can pull it up after climbing a ladder or scaffold.

Lanyard: A short section of rope or strap, one end of which is attached to a worker's safety harness and the other to a strong anchor point above the work area.

Maximum intended load: The total weight of all people, equipment, tools, materials, and loads that a ladder can hold at one time.

Midrail: Mid-level, horizontal board required on all open sides of scaffolds and platforms that are more than 14 inches (35 cm) from the face of the structure and more than 10 feet (3 m) above the ground. It is placed halfway between the toeboard and the top rail.

Planked: Having pieces of material 2 inches (5 cm) thick or greater and 6 inches (15 cm) wide or greater used as flooring, decking, or scaffold decks.

Scaffold: An elevated platform for workers and materials.

Six-foot rule: A rule stating that platforms or work surfaces with unprotected sides or edges that are 6 feet (≈2 m) or higher than the ground or level below it require fall protection.

Toeboard: A vertical barrier at floor level attached along exposed edges of a platform, runway, or ramp to prevent materials and people from falling.

Top rail: A top-level, horizontal board required on all open sides of scaffolds and platforms that are more than 14 inches (36 cm) from the face of the structure and more than 10 feet (3 m) above the ground.

Falls from elevated areas are the leading cause of fatalities in the workplace. Falls from elevated heights account for about one-third of all deaths in the construction trade. Approximately 85 percent of the injured workers lose time from work; approximately 33 percent require hospitalization; some never return to the job.

While the risk of falls is high in construction and some other trades, there are many things that workers can do to safeguard themselves. Using the appropriate PPE; following proper safety procedures; practicing good housekeeping habits; and staying alert at all times will help you stay safe when working at an elevation. Employers are required to provide for both fall prevention and fall arrest, and to make sure workers are trained and certified in the use of fall protection equipment. Fall prevention consists of covered floor openings, climbing aids, barricades, and guardrails that are designed to protect against falls. Fall arrest consists of equipment such as body harnesses, **lanyards**, connection devices, lifelines, and safety nets that are intended to protect a worker in case a fall occurs. All these topics are covered in this section.

2.1.0 Fall Hazards

Falls are classified into two groups: falls from an elevation and falls from the same level. Falls from an elevation can happen during work from **scaffolds**, work platforms, decking, concrete forms, ladders, stairs, and work near **excavations**. Falls from elevation often result in death unless the fall is arrested. Falls on the same level are usually caused by tripping or slipping. Sharp edges and pointed objects, such as exposed concrete reinforcing bars (rebar), could cut and otherwise harm a worker. Other bodily injuries are also common results of tripping or slipping.

In the United States, fall protection is required for platforms or work surfaces with unprotected sides or edges that are 6 feet (≈2 meters) or above the ground or the level below. This is commonly referred to as the **six-foot rule**. However, some international regulations and company policies may require fall protection for heights less than 6 feet.

2.1.1 Walking and Working Surfaces

Slips, trips, and falls on walking and working surfaces cause 15 percent of all incidental deaths in the construction industry. Some incidents occur due to environmental conditions, such as snow, ice, or wet surfaces. Others happen because of poor housekeeping and careless behavior, such as leaving tools, materials, and equipment out and unattended. You can avoid slips, trips, and falls by being aware of your surroundings and following the rules on your site. Remember these general walking and working surface guidelines to avoid incidents:

- Keep all walking and working areas clean and dry. If you see a spill or ice patch, clean it up, or barricade the area until it can be properly attended to.
- Keep all walking and working surfaces clear of clutter and debris.
- Run cables, extension cords, and hoses overhead or through crossover plates so that they will not become tripping hazards.
- Do not run on scaffolds, work platforms, decking, roofs, or other elevated work areas.

2.1.2 Unprotected Sides, Wall Openings, and Floor Holes

Any opening in a wall or floor is a safety hazard. There are two types of protection for these openings: (1) they can be **guarded** or (2) they can be covered. Cover any hole in the floor when possible. Hole covers must be clearly marked. When it is not practical to cover the hole, use barricades. If the bottom edge of a wall opening is less than 39 inches (1 m) above the floor and would allow someone to fall 6 feet (≈2m) or more, then place guards around the opening.

The types of barriers and barricades used vary from one job site to another. There may also be different procedures for when and how barricades are put up. Learn and follow the policies at your job site. Several different types of guards are commonly used:

- Railings are used across wall openings or as a barrier around floor openings to prevent falls (*Figure 6A*).
- Warning barricades alert workers to hazards but provide no real protection (*Figure 6B*). Warning barricades can be made of plastic tape or rope strung from wire or between posts. The tape or rope is color-coded as follows:
  - *Red means danger.* No one may enter an area with a red warning barricade. A red barricade is used when there is danger from falling objects or when a load is suspended over an area.
  - *Yellow means caution.* You may enter an area with a yellow barricade, but be sure you know what the hazard is, and be careful. Yellow barricades are used around wet areas or areas containing loose dust. Yellow with black lettering warns of physical hazards such as bumping into something, stumbling, or falling.
  - *Yellow and purple together mean radiation warning.* No one may pass a yellow and purple barricade without authorization, training, and the appropriate PPE. These barricades are often used where piping welds are being X-rayed.
- Protective barricades give both a visual warning and protection from injury (*Figure 6C*). They can be wooden posts and rails, posts and chain, or steel cable. People should not be able to get past protective barricades.
- Blinking lights are placed on barricades so they can be seen at night (*Figure 6D*).
- Hole covers are used to cover open holes in a floor or in the ground (*Figure 6E*).

WARNING! Never remove a barricade unless you have been authorized to do so. Follow your employer's procedures for putting up and removing barricades.

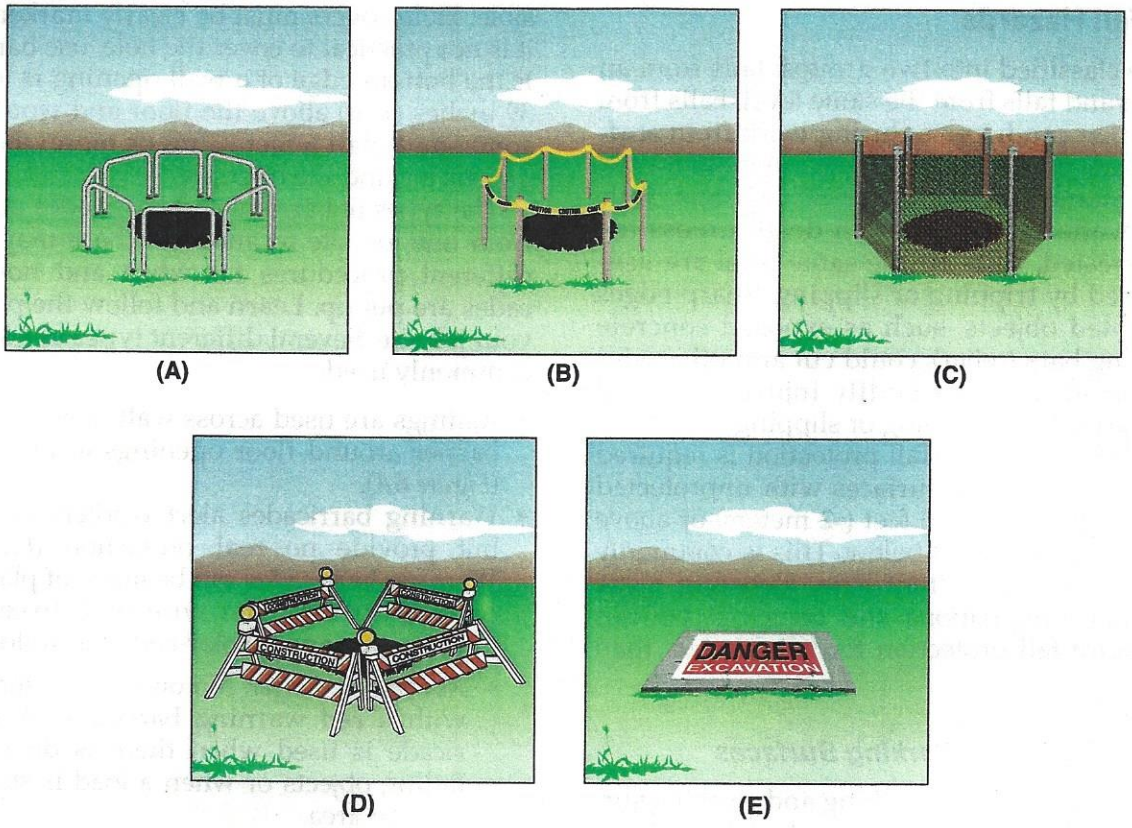


Figure 6 Common types of barriers and barricades.

Follow these guidelines when working near unprotected sides, floor holes, and wall openings:

- Hole covers must be cleated, wired, or otherwise secured to prevent them from slipping sideways or horizontally beyond the hole.
- Covers must extend adequately beyond the edge of the hole.
- Hole covers must be strong enough to support twice the weight of anything that may be placed on top of them. They must also be clearly marked. Use ¾-inch (2 cm) plywood as a hole cover, provided that one dimension of the opening is less than 18 inches (46 cm); otherwise, 2-inch (5-cm) lumber is required.
- Never store material or equipment on a hole cover.
- Guard all stairway floor openings, with the exception of the entrance, with standard railing and **toeboards**.
- Guard all wall openings from which there is a drop of more than 6 feet (≈2m) and for which the bottom of the opening is less than 39 inches (1 m) above the working surface.
- Guard all open-sided floors and platforms 6 feet (≈2m) or more above adjacent floor or ground level, using a standard railing or the equivalent.

2.2.0 Fall Arrest

The key to preventing serious injury or death should a fall occur is the personal fall arrest system (PFAS). A complete PFAS (*Figure 7*) consists of anchor points, a body harness, and connecting devices. Anchor points are related to the structure, and the type and availability of anchor points help determine what other equipment should be chosen. The body harness comprises the system of belts, rings, or hooks worn by the worker. Connecting devices and lanyards are used to maintain attachment between anchor points and the PFAS, and include lanyards and various pieces of hardware.

NOTE

This training alone does not provide any level of certification in the use of fall arrest or fall restraint equipment. Trainees should not assume that the knowledge gained in this module is sufficient to certify them to use fall arrest equipment in the field.

2.2.1 Anchor Points

There are both permanent anchor points and temporary, reusable anchor points (*Figure 8*). Anchor points must be rated at or equal to 5,000 pounds (2,267 kg) breaking or tensile strength, or twice the intended load.

Figure 7 Personal fall-arrest system.

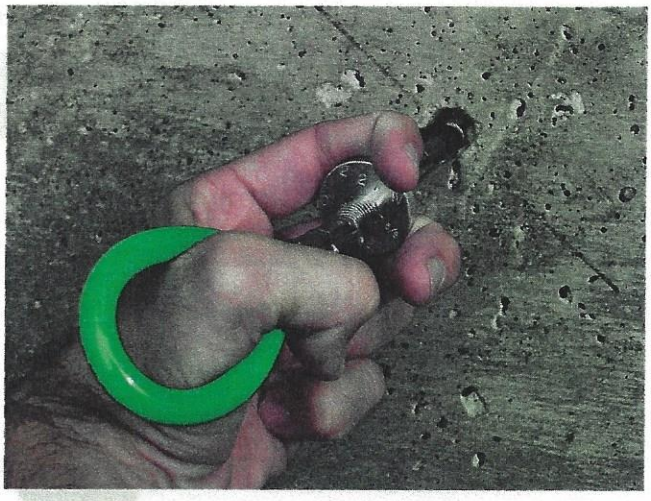
Ideally, the fall arrest anchor point will be located directly above the back D-ring (*Figure 9*), in order to minimize any swing-zone hazards, as well as the free-fall distance. The maximum free-fall distance is 6 feet (≈2 m). To understand swing zones, picture a tied-off worker standing three feet (1 m) away from a point directly under the anchor point. If the worker falls, gravity will cause his body to swing toward the anchor point axis and momentum will cause the body to swing past that point. If there is a wall or other solid object close by, he may strike it and be injured. Swing zones are minimized when the anchor point is directly above the worker when he falls. Serious injury and damage can occur when a human body strikes an immoveable object while swinging as a pendulum. Although the PFAS may do its job by preventing the worker from falling a great distance, serious injury or death can still occur by striking an object in the swing zone.

Case Histories

Here are some examples of fatal incidents that resulted from failure to provide the proper fall protection:

- A worker taking measurements was killed when he fell backward from an unguarded balcony to the concrete below.
- A roofer handling a piece of fiberboard backed up and tripped over a 7½-inch (19 cm) parapet. He fell more than 50 feet (15 m) to the ground level and died of severe head injuries.

(A) PERMANENT ANCHOR



(B) CONCRETE ANCHOR

(C) BEAM ANCHOR

(D) TIE-BACK LANYARD

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Figure 8 Anchor points.

Anchor points are often needed to secure the position of the worker, leaving the hands free to accomplish a task. Ideally, workers will select anchor points to maintain a potential fall distance of no more than 2 feet (61 cm). For example, a worker placing reinforcing bars in a concrete wall form may use two short positioning lanyards connected to the hip rings on the harness. The fall protection lanyard would be connected to the rear D-ring.

Positioning connections cannot be considered the primary anchor. Positioning anchor points are required to be rated at a 3,000 pound (1,360 kg) strength instead of the 5,000 pound (2,268 kg) rating for primary fall arrest. Remember that positioning lanyards, connected to D-rings on the harness other than the back or front chest D-ring, are fall restraints rather than fall arresting connections. A positioning lanyard does not take the place of a fall arrest lanyard or anchor point.

2.2.2 Harnesses

Full body harnesses, like the one shown in *Figure 10*, are available in sizes that are based on the height and weight of the user. The back D-ring is the only one used to connect the harness to the anchor point for primary fall arrest purposes unless you are climbing a ladder. When climbing a ladder, the front chest D-ring is the likely choice for connecting the fall arrest harness. D-rings located at the hips are used for positioning and fall restraint only. D-rings mounted to shoulders are often used for rescue situations. All of them can be used for fall restraint, but the back D-ring is the primary connection for fall arrest.

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Figure 9 Back D-ring.

A body harness must fit correctly to ensure that it will provide proper protection. Do not place additional holes or openings in harness components under any circumstances. No field modifications to a body harness or lanyard should be attempted. Installation, maintenance, and inspection instructions are provided for every harness, and it is the responsibility of the worker to read and understand the details regarding his or her personal equipment. Workers must inspect their body harness each day that is in use.

Harness straps are generally designed with some stretch to help absorb some of the potential force of a fall. This means good, taut installation on the body is essential so that the worker cannot fall out of the harness in the event of a fall.

Figure 11 shows the proper procedure for donning a common full body harness. The most important adjustments to be made include the chest straps, the groin straps, and the final position of the back D-ring. The related details that follow must be considered during the fitting and wearing of a full body harness:

NOTE

These guidelines are general in nature and the instructions provided for specific equipment by the manufacturer must always take precedence. It is the worker's responsibility to be intimately familiar with the duty of each and every ring and strap on a given harness.

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Figure 10 Full body harness.

- The back D-ring location is vital to proper fall arrest. Position this ring between the shoulder blades. If it is too low, it will tend to cause the body to hang in a more horizontal position during fall arrest, increasing pressure on the diaphragm and affecting breathing. If it is positioned too high or with too much slack, the D-ring may strike the worker's head at the base of the fall, and the shoulder straps may be pulled too tightly into the neck and restrict blood flow. The impact at the base of the fall arrest can be dramatic, so the force must be spread all around the body to prevent injury to any one portion.
- Chest straps generally form either an "H" pattern or an "X" pattern. Adjust "H" pattern straps to land between the bottom of the sternum and the belly button. This helps ensure the horizontal portion of the "H" does not contact the throat during a fall, choking the worker. Some harness designs may not allow

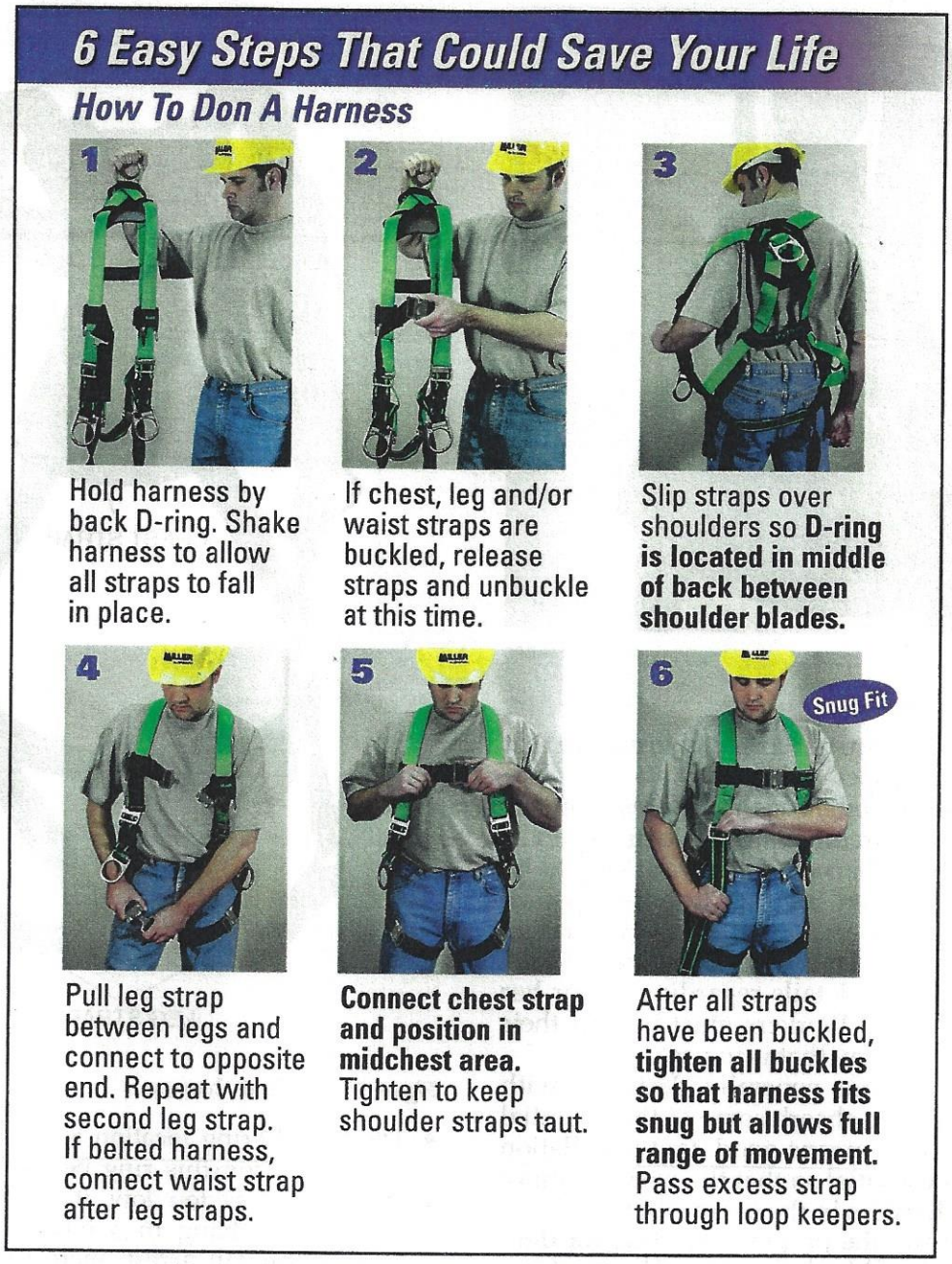

Figure 11 Installing the body harness.

for this adjustment, with the final position of the "H" being based solely on a properly sized harness.

- The position of the chest straps is also crucial for "X" pattern harnesses. Position the "X" at or just below the sternum.
- Leg straps are an integral and required part of a PFAS. Adjust the groin straps for a good, snug fit. Too much slack here will cause extreme discomfort in a fall, when the impact snatches them up tight and you are left suspended this way.
- A suspension trauma strap (*Figure 12*) is recommended as part of the PFAS gear. The suspension trauma strap is stored in a pouch connected to the harness within easy reach. This is done by either one end of the strap being permanently sewn to the harness (by the manufacturer); one end of the strap attached to the harness with a carabiner (*Figure 13*); or by choking the pouch around a harness strap or hip D-ring. The strap can then be quickly removed and used without any possibility of the user dropping it. Once connected, the strap allows

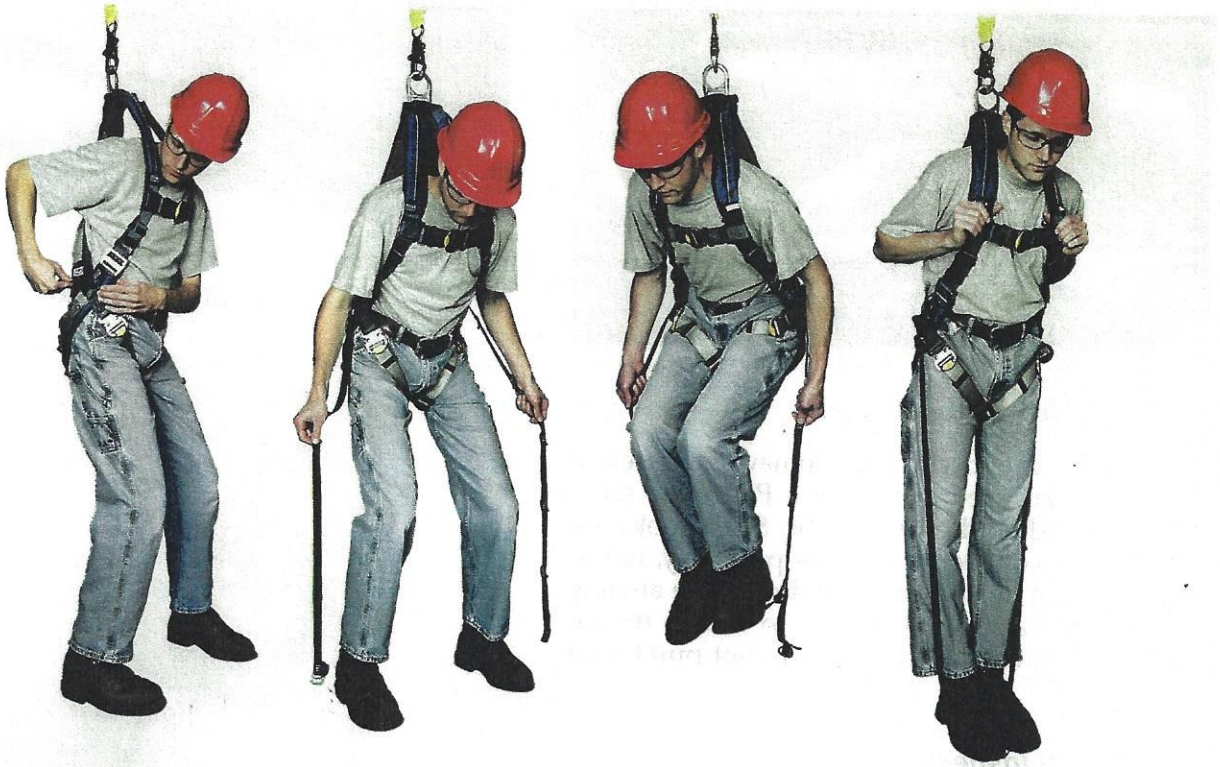

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Figure 12 Suspension trauma strap use.

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Figure 13 A carabiner.

the worker to stand up in the harness, relieving suspended weight and pressure from the hips and groin. This helps open the path for blood flow from the legs back to the heart, preventing blood from pooling in the lower extremities.

- A separate waist or tool belt, while not considered a necessary component of the fall-arrest system, must be fitted properly. It is best used for body positioning with the D-rings precisely located at the hips, rather than in the front or rear. Do not adjust it in a way that could apply pressure to the kidneys or lower back. If the waist belt is not an integral part of the harness, it must not be worn on the outside of the harness—put it on first, then add the harness over it. This is also true of any added tool belts.
- Saddles, like waist belts, are also not considered an integral or required part of the PFAS. They are optional and often detachable. They are generally used by workers to allow a seated, suspended position when the task may require long periods in the same location.

It is important to note that not all hardware will qualify as a component of a PFAS. Some hardware is to be used only for attaching tools and equipment to the worker or to structures. Hardware used as connecting devices as part of the PFAS must be drop-forged steel, and have a corrosion-resistant finish resistant to salt spray per ANSI standards. Any type of hook or carabiner must be equipped with safety gates or keepers to prevent the hooked object from being disconnected incidentally. In most cases, these safety gates will be required to be two-step, also called double action. Designs for these features vary, but those designed so that both movements required to open the gate can be done with a single hand are generally better. Using both hands to manipulate a single connector can be a hazard in itself.

Double-locking snap hooks (*Figure 14*) are usually curved and have an opening to allow connection to a line that can then be securely closed. They are usually not as consistent in appearance

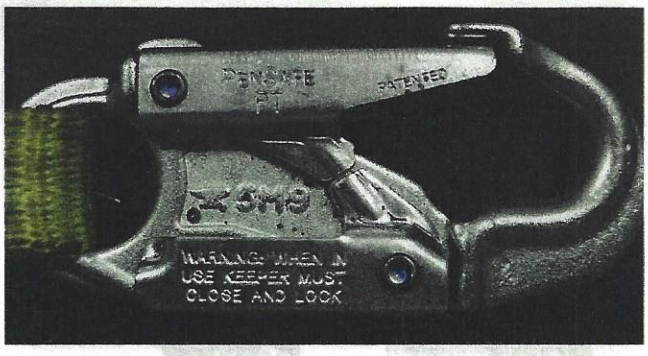

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Figure 14 Double-locking snap hook.

as carabiners, and come in somewhat different shapes. When used as part of a PFAS, the security closure should be automatic. Snap hooks are designed to connect to D-rings primarily, not to each other. In most cases, snap hooks are already connected to a lanyard or rope to ensure the integrity of the connection, and are not purchased separately.

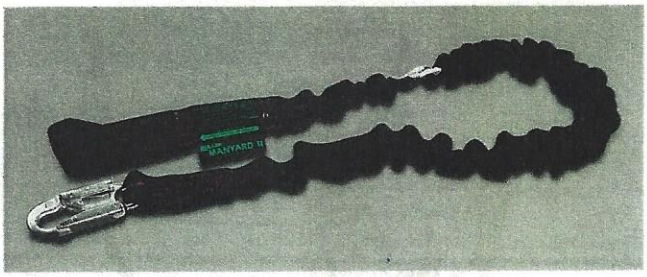
2.2.3 PFAS Inspection

Always inspect your lanyard, harness, and any other fall protection gear prior to use. Never use damaged equipment. Treat a safety harness as if your life depends on it, because it does! To maintain their service life and high performance, all belts and harnesses should be inspected frequently. Damage to fall arrest systems includes burns, hardening due to chemical contact, and excessive wear. When inspecting a harness, check that the buckles and D-ring are not bent or deeply scratched. Check the harness for any cuts or rough spots.

The PFAS should be inspected monthly by a competent person. This requirement should be established through your company's safety program. The competent person has the authority to impose prompt corrective measures to eliminate any hazards. If there is any question about a defect, no matter how small it may seem to be, err on the side of caution. Take the fall arrest component(s) out of service for testing or replacement.

2.2.4 Lanyards

Lanyards consist of some primary material of construction (rope, webbing, aircraft cable, etc.) with a connecting device attached to the ends. Lanyards used for fall arrest are either shock absorbing or self-retracting (*Figure 15*). Non-shock absorbing lanyards, such as the one shown in *Figure 16*, are used for positioning and fall restraint. Lanyards used for positioning are not considered part of the



(A) SHOCK-ABSORBING

(B) RETRACTABLE

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Figure 15 Fall arrest lanyards.

fall-arrest system; they are fall restraints and will be attached to D-rings on the harness other than the back D-ring. Since fall restraint is all about preventing a fall from happening, lanyards used for positioning should not allow a fall or movement greater than 2 feet (0.61 m). Two such lanyards are usually required to permit movement from one place to another.

The retractable fall arrest lanyard shown in *Figure 15* is rapidly becoming the preferred device. Since it automatically retracts or feeds lanyard as the worker moves about, there is never a great deal of slack that can pose a risk in itself. In addition, the potential fall distance is significantly reduced.

Lanyards for fall restraint or arrest must never be field-fabricated, and must never be connected together to increase their length. Depending on the use, padding may be added during fabrication or added in the field to protect against sharp edges. Never tie a knot in a lanyard, as knots

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Figure 16 Non-shock absorbing lanyard.

can severely reduce the load limit. Never wrap a lanyard around a structure and then choke it back into itself unless it is designed for this use. A special large D-ring is usually attached to the lanyard for this purpose. It is important to remember that whenever you are wearing a PFAS, 100 percent tie-off is required. A PFAS is absolutely useless unless you are tied off.

The D-ring used on the PFAS for fall arrest may only be connected to one live connection at a time. This can be challenging when trying to move from one point to another, especially horizontally. The user must be able to reach back and disconnect a lanyard, while maintaining one lanyard connected at all times. A Y-configured lanyard (*Figure 17*) can be used for this purpose. A Y-configured lanyard has a single point of attachment at the D-ring that is used to accommodate two lanyards. They are also referred to as double-leg or tieback lanyards.

Before using a shock absorbing or self-retracting lanyard, the potential fall distance is determined. Then the proper equipment is selected to meet available fall clearance (*Figure 18*). Note in the figure that the fall distance with the self-retracting lanyard is significantly shorter than it is with a shock absorbing lanyard; hence its increasing popularity. Failure to select proper equipment and calculate fall distance may result in serious personal injury or death. These calculations must be done by experienced and qualified personnel on the job site. If a personal fall arrest system is actuated due to a fall, it must be inspected by a competent person before it can be used again. In most cases, replacement will be necessary.

2.2.5 Lifelines

A lifeline is a flexible line such as a cable or rope connected vertically to an anchorage at one end (vertical lifeline), or horizontally to an anchorage at both ends (horizontal lifeline). It serves as a means for connecting other components of a personal fall-arrest system to the available anchorage.

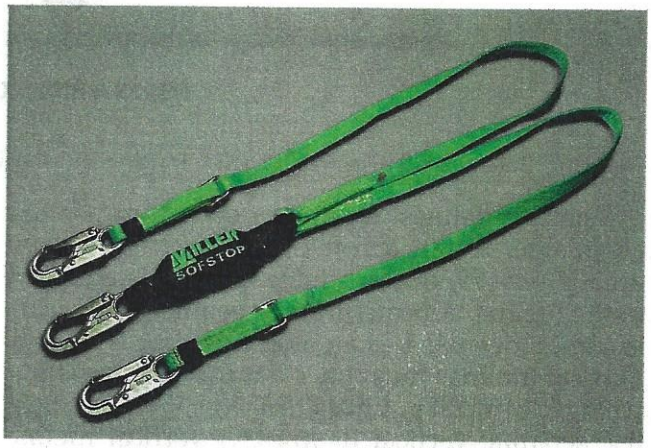

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Figure 17 Y-configured shock absorbing lanyard.

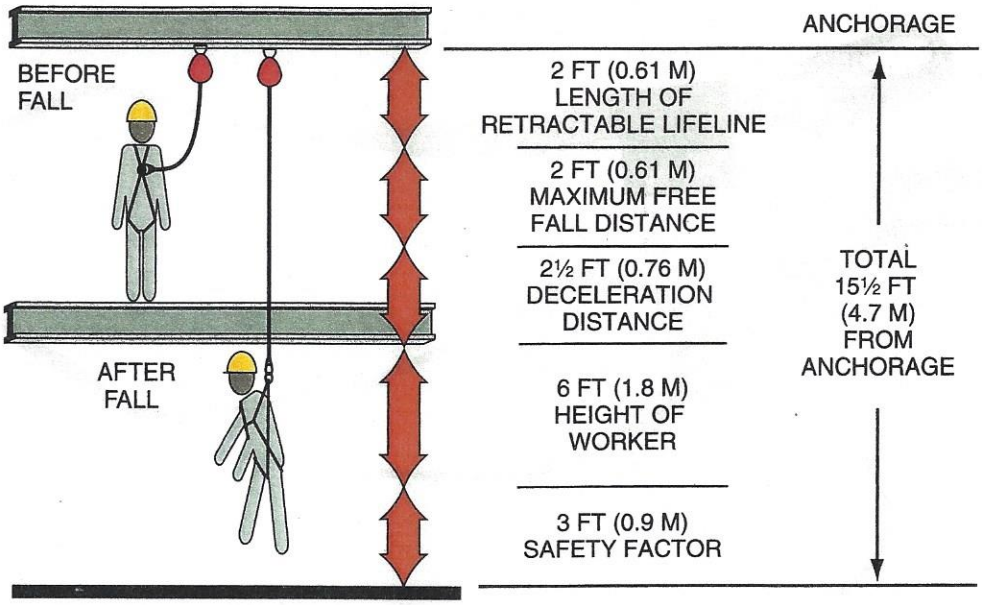

Figure 18 Potential fall distances for self-retracting and shock absorbing lanyards.

Vertical lifelines are suspended from a fixed anchorage. A fall arrest device such as a rope grab (*Figure 19*) or retractable lanyard is attached to the lifeline. A beam grab, or beamer (*Figure 20*), is sometimes used as an anchorage for a lifeline. Vertical lifelines must have a minimum breaking strength of 5,000 pounds (2,267 kg). Workers must use separate vertical lifelines. A vertical lifeline must have a termination on the end unless it extends to the ground or to the next lower level of the structure.

Horizontal lifelines (*Figure 21*) are connected between two fixed anchorages. A lanyard is attached to the lifeline. Horizontal lifelines must be designed, installed, and used under the supervision of a competent person. The required breaking strength of any horizontal lifeline is determined by the number of workers that will be attached to it.

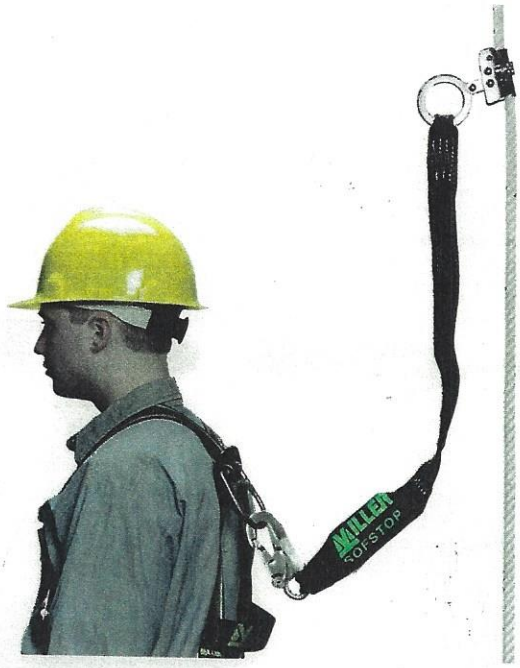

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Figure 19 Rope grab.

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Figure 20 Beam grab.

WARNING!

Keep in mind that horizontal lifelines are rated for a maximum number of connected workers. Check with your supervisor or the manufacturer before connecting to a lifeline that is being used by other workers.

2.2.6 Guardrails

Guardrails (*Figure 22*) are a common type of fall prevention. They protect workers by providing a barrier between the work area and the ground or lower work areas. They may be made of wood, pipe, steel, or wire rope and must be able to support 200 pounds (90 kg) of force applied in any direction to the top rail and 150 pounds (68 kg) for the **midrail**. A guardrail must be 42" ±3" (106 ±8 cm) high to the top rail and have a toeboard that is a minimum of 4" (10 cm) high. This helps to prevent the inadvertent loss of tools or material through the bottom rail. The toeboard must be securely fastened with not more than ¼" (5 mm) clearance above the floor level.

2.2.7 Safety Nets

Safety nets are used for fall protection on bridges and similar projects. They must be installed not more than 30 feet (9 m) beneath the work area. There must be enough clearance under a safety net to prevent a worker who falls into it from hitting the surface below it. There must also be no obstruction between the work area and the net.

Depending on the actual vertical distance between the net and the work area, the net must extend 8 to 13 feet (2 to 4 m) beyond the edge of the work area. Mesh openings in the net must be limited to 36 square inches (232 sq cm) and 6 inches (15 cm) from the side. The border rope must have a 5,000-pound (2,267 kg) minimum breaking strength, and connections between net panels must be as strong as the nets themselves. Safety nets must be inspected at least once a week and after any event that might have damaged or weakened them. Worn or damaged nets must be removed from service.

2.3.0 Ladders and Stairs

Ladders are used daily to perform work in elevated locations. Any time work is performed above ground level, there is a risk of incidents. You can reduce this risk by carefully inspecting ladders before you use them and by using them properly.

Overloading means exceeding the **maximum intended load** of a ladder. Overloading can cause ladder failure, which means that the ladder could buckle, break, or topple. The maximum intended load is the total weight of all people, equipment, tools, materials, loads that are being carried, and other loads that the ladder can hold at any one time. Check the manufacturer's specifications to determine the maximum intended load. Ladders are usually given a duty rating that indicates their load capacity, as shown in *Table 2*. Note that ladders designed for the metric market are not usually direct equivalents to ladders built for the American market. Capacity ratings of 130 kg (286 lbs) and 150 kg (330 pounds) are the most common for the trades. Ladder heights will also be stated in metric units and may not be exactly the same size as those designed for the American market.

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Figure 21 Horizontal lifeline.

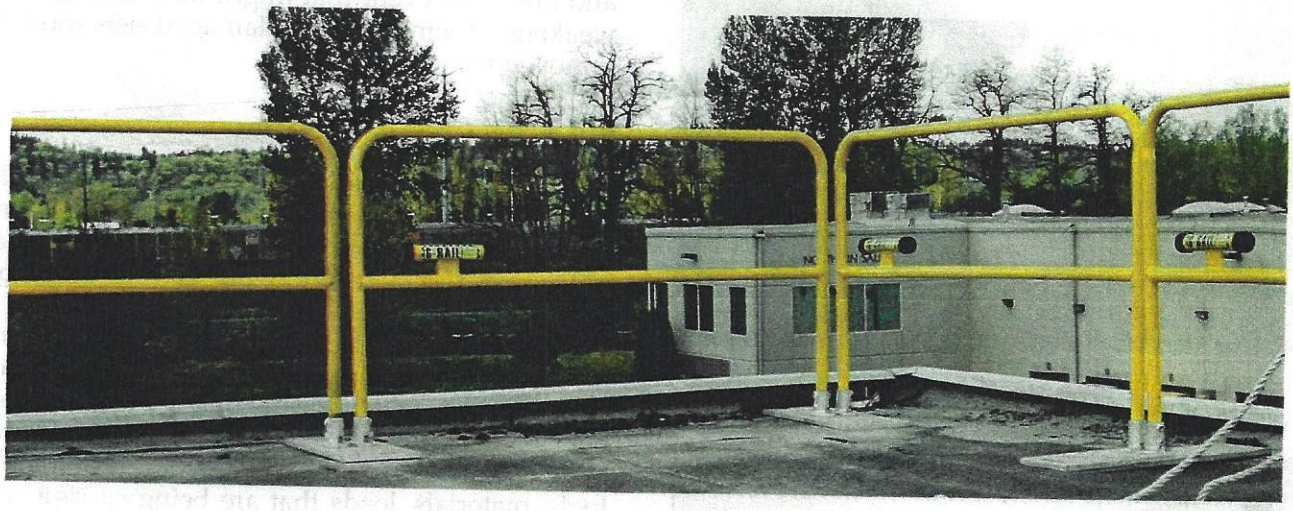

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Figure 22 Guardrails.

Drop-Testing Safety Nets

Safety nets should be drop-tested at the job site after the initial installation, whenever relocated, after a repair, and at least every six months if left in one place. The drop test consists of a 400-pound (181 kg) bag of sand of 29" to 31" (74 to 79 cm) in diameter that is dropped into the net from at least 42" (107 cm) above the highest walking/working surface at which workers are exposed to fall hazards. If the net is still intact after the bag of sand is dropped, it passed the test.

Table 2 Ladder Duty Ratings and Load Capacities

Duty Rating	Load Capacities
Type IAA	375 lbs., extra-heavy duty/ professional use
Type IA	300 lbs., extra-heavy duty/ professional use
Type I	250 lbs., heavy duty/industrial use
Type II	225 lbs., medium duty/commercial use
Type III	200 lbs., light duty/household use

There are different types of ladders to use for different jobs (*Figure 23*). Selecting the right ladder for the job at hand is important to complete a job as safely and efficiently as possible. Ladder types include portable straight ladders, extension ladders, and stepladders.

WARNING!

Use ladders only for their intended purposes. Ladders are not interchangeable; incorrect use of a ladder can result in injury or damage.

When using a ladder, be sure to maintain three-point contact with the ladder while ascending or descending. Three-point contact means that either two feet and one hand or one foot and two hands are always touching the ladder.

2.3.1 Straight Ladders

Straight ladders consist of two rails, rungs between the rails, and safety feet on the bottom of the rails (*Figure 24*). Straight ladders are generally made of aluminum, wood, or fiberglass.

Metal ladders conduct electricity and should never be used around electrical equipment. Any portable metal ladder must have "Danger! Do Not Use Around Electrical Installations" stenciled on the rails in two-inch red letters. Ladders made of dry wood or fiberglass, neither of which conducts electricity, should be used around electrical equipment. Check that any ladder, especially a wooden ladder, is completely dry before using it; even a small amount of water will conduct electricity.

Case History

A worker was climbing a 10-foot (3.05 m) ladder to access a landing, which was 9 feet (2.74 m) above the adjacent floor. The ladder slid down, and the worker fell to the floor, sustaining fatal injuries. Although the ladder had slip-resistant feet, it was not secured, and the railings did not extend 3 feet (0.91 m) above the landing.

Different types of ladders are intended for use in specific situations. Aluminum ladders are corrosion-resistant and can be used where they might be exposed to the elements. They are also lightweight and can be used where they must often be lifted and moved. Fiberglass ladders are very durable, so they are useful where some amount of rough treatment is unavoidable. Wooden ladders, which are heavier and sturdier than fiberglass or aluminum ladders, can be used where heavy loads must be moved up and down. However, wooden ladders are subject to more rapid deterioration as the wood swells and shrinks. Both fiberglass and aluminum are easier to clean than wood.

Wooden ladders should never be painted. The paint could hide cracks in the rungs or rails. Clear varnish, shellac, or a preservative oil finish will protect the wood without hiding defects.

Figure 25 shows the safety feet attached to a straight ladder. Make sure the feet are securely attached and that they are not damaged or worn down. Do not use a ladder if its safety feet are not in good working order.

It is very important to place a straight ladder at the proper angle before using it. A ladder placed at an improper angle will be unstable and could cause a fall. *Figure 26* shows a properly positioned straight ladder.

The distance between the foot of a ladder and the base of the structure it is leaning against must be one-fourth of the distance between the ground and the point where the ladder touches the structure. Stated another way, there should be a 4-to-1 ratio between the distances. For example, if the height of the wall shown in *Figure 26* is 16 feet (4.9 m), the base of the ladder should be 4 feet (1.2 m) from the base of the wall. If you are going to step off a ladder onto a platform or roof, the top of the ladder should extend at least 3 feet (0.9 m) above the point where the ladder touches the platform, roof, side rails, etc.

Ladders should be used only on stable and level surfaces unless they are secured at both the bottom and the top to prevent any incidental movement (*Figure 27*). Never try to move a ladder while you are on it. If a ladder must be placed in front of a door that opens toward the ladder, the door should be locked or blocked open. Otherwise, the door could be opened into the ladder.

Ladders are made for vertical use only. Never use a ladder as a work platform by placing it horizontally. Make sure the ladder you are about to climb or descend is properly secure before you do so. Check to make sure the ladder's feet are solidly positioned on firm, level ground. Also check

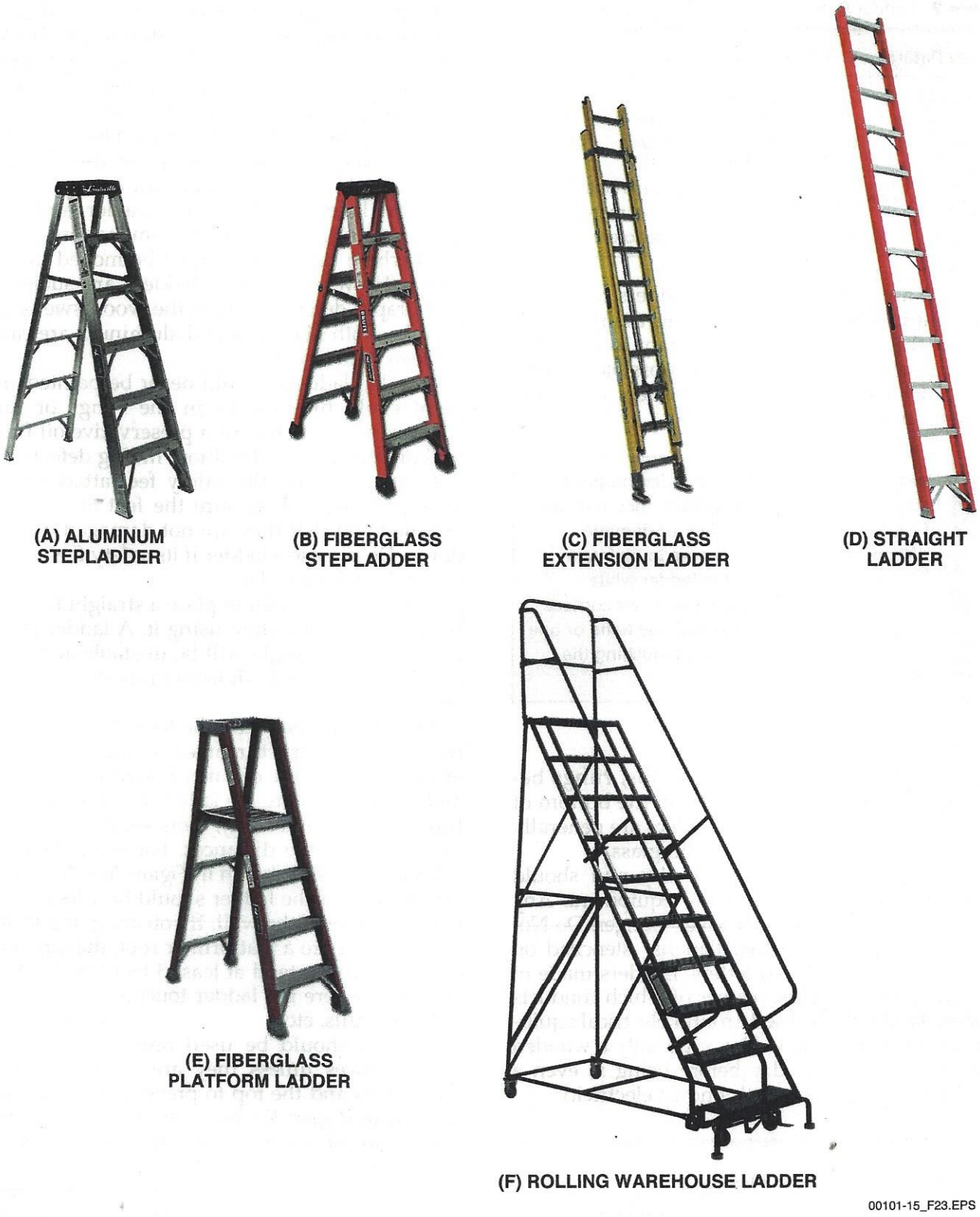

Figure 23 Different types of ladders.

to make sure the top of the ladder is firmly positioned and in no danger of shifting once you begin your climb. Remember that your own weight will affect the ladder's steadiness once you mount it. It is important to test the ladder first by putting some of your weight on it without actually beginning to climb. This way, you can be sure that the ladder will remain steady as you climb.

When climbing a straight ladder, keep both hands on the rails or rungs (*Figure 28*). Maintain

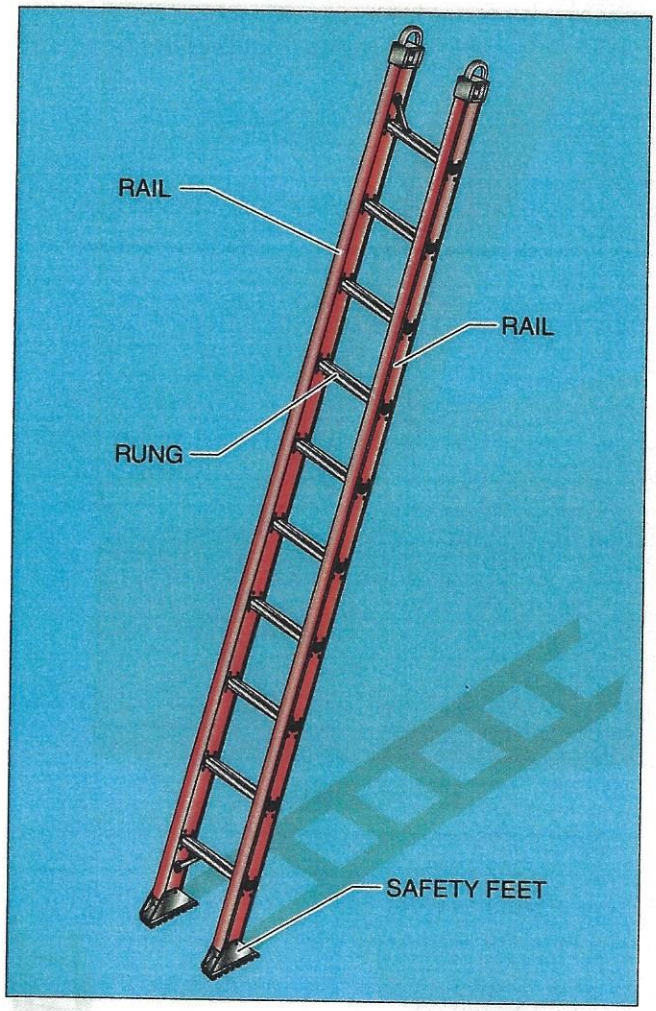

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Figure 24 Portable straight ladder.

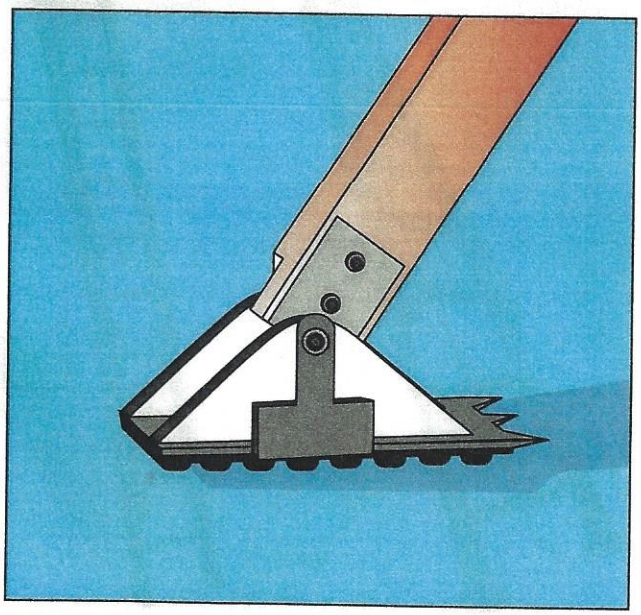

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Figure 25 Ladder safety feet.

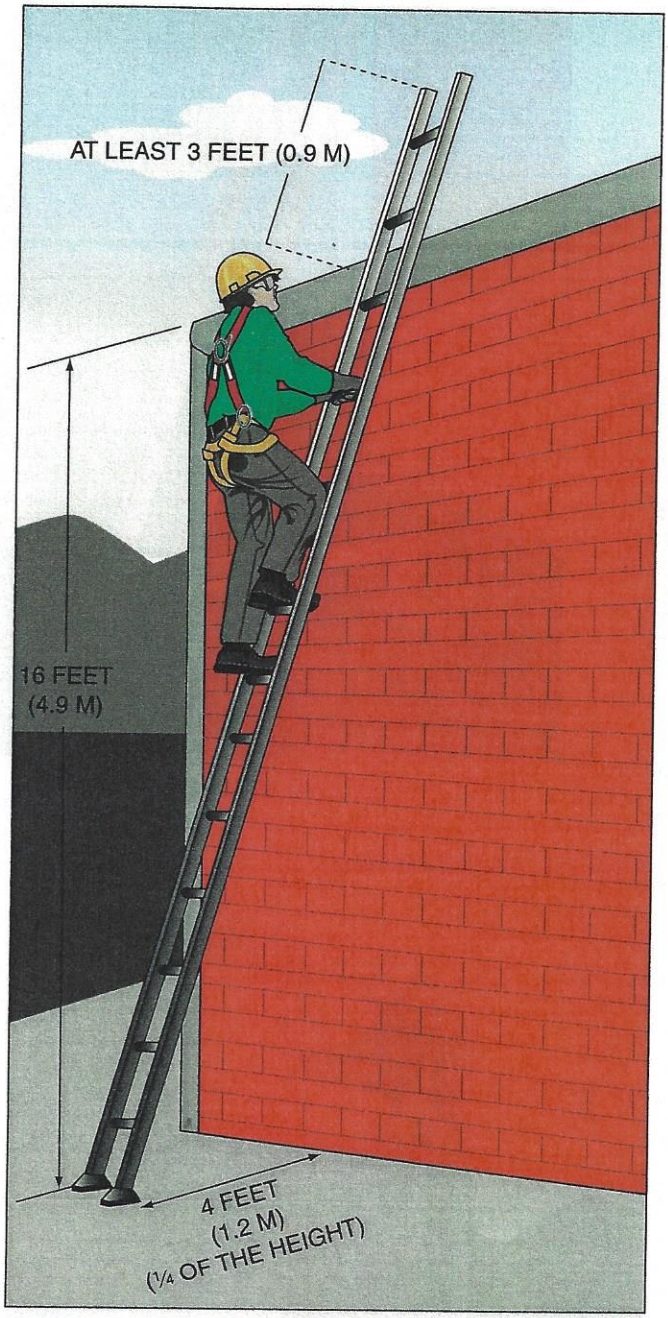

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Figure 26 Proper positioning of a straight ladder.

three points of contact at all times, as shown in the figure. This can be two feet and one hand, or one foot and two hands. Always keep your body's weight in the center of the ladder between the rails. Face the ladder at all times. Never go up or down a ladder while facing away from it.

To carry a tool while you are on the ladder, use a **hand line** or tagline attached to the tool. Climb the ladder and then pull up the tool. Don't carry tools in your hands while you are climbing a ladder.

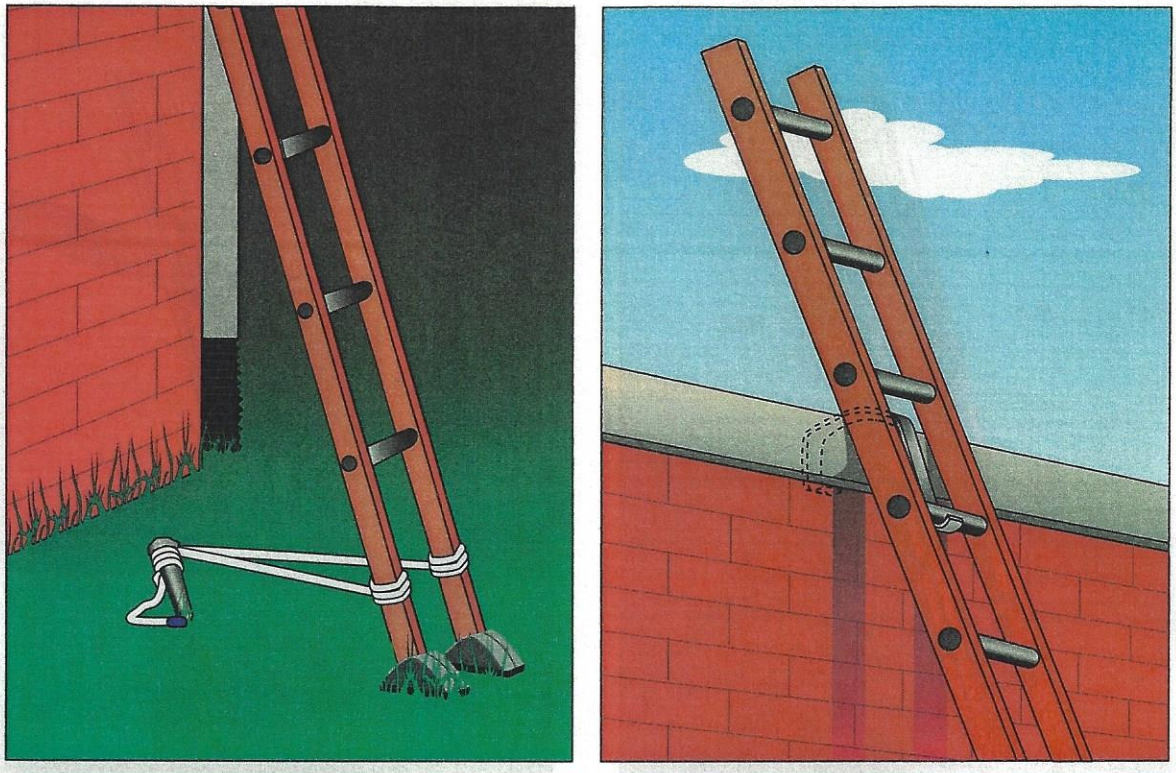

Figure 27 Securing a ladder.

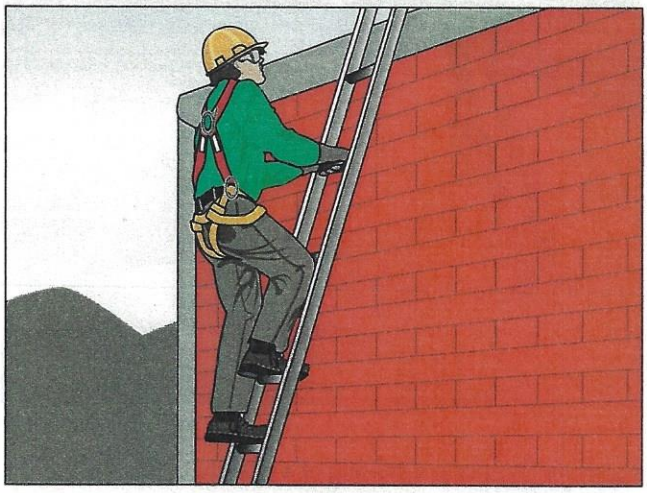

Figure 28 Moving up or down a ladder.

2.3.2 Extension Ladders

An extension ladder is actually two straight ladders connected so that the overlap between them can be altered to increase or decrease the length of the ladder (*Figure 29*).

Extension ladders are positioned and secured following the same rules as straight ladders. When adjusting the length of an extension ladder, always reposition the movable section from the bottom, not the top, to ensure that the rung locks

Figure 29 Examples of extension ladders.

(*Figure 30*) are properly engaged after you make the adjustment. Check to make sure the section locking mechanisms are fully hooked over the desired rung. Also check to make sure that all ropes used for raising and lowering the extension are clear and untangled.

Extension ladders are positioned and secured following the same rules as straight ladders. There are, however, some safety rules that are unique to extension ladders:

WARNING!

Extension ladders have a built-in extension stop mechanism. Do not remove this mechanism. If the mechanism is removed, it could cause the ladder to collapse under a load.

Haul materials up on a line rather than hand carrying them up an extension ladder.

- Make sure the extension ladder overlaps between the two sections (*Figure 31*). For ladders up to 36' (10.5 m) long, the overlap must be at least 3' (0.9 m). For ladders 36' to 48' (10.8 to 14.6 m) long, the overlap must be at least 4' (1.2 m). For ladders 48' to 60' (14.6 to 18.3 m) long, the overlap must be at least 5' (1.5 m).

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Figure 30 Rung locks.

- Never stand above the highest safe standing level on a ladder. On an extension ladder, this is the fourth rung from the top. If you stand higher, you may lose your balance and fall. Some ladders have colored rungs to show where you should not stand.
- Avoid carrying anything on a ladder, because it will affect your balance and may cause you to fall. Haul materials up on a line instead.
- Keep yourself centered on the ladder. Do not over-reach, lean to one side, or try to move a ladder while standing on it.

2.3.3 Stepladders

Stepladders are self-supporting ladders made of two sections hinged at the top (*Figure 32*). The section of a stepladder used for climbing consists of rails and rungs like those on straight ladders. The other section consists of rails and braces. Spreaders are hinged arms between the sections that keep the ladder stable and keep it from folding while in use.

When positioning a stepladder, be sure that all four feet are on a hard, even surface. Otherwise, the ladder can rock from side to side or corner to corner when you climb it. With the ladder in position, be sure the spreaders are locked in the fully open position. The following safety precautions must be followed when using a stepladder:

- Never stand on the top step or the top of a stepladder. Putting your weight this high will make the ladder unstable. The top of the ladder is made to support the hinges, not to be used as a step.
- Although the rear braces may look like rungs, they are not designed to support your weight. Never use the braces for climbing or climb the back of a stepladder. However, there are specially designed two-person ladders available with steps on both sides.
- Check the load capacity of the ladder and do not exceed it.

WARNING!

Never stand on a step with your knees higher than the top of a stepladder. You need to be able to hold on to the ladder with your hand. Keep your body centered between the side rails.

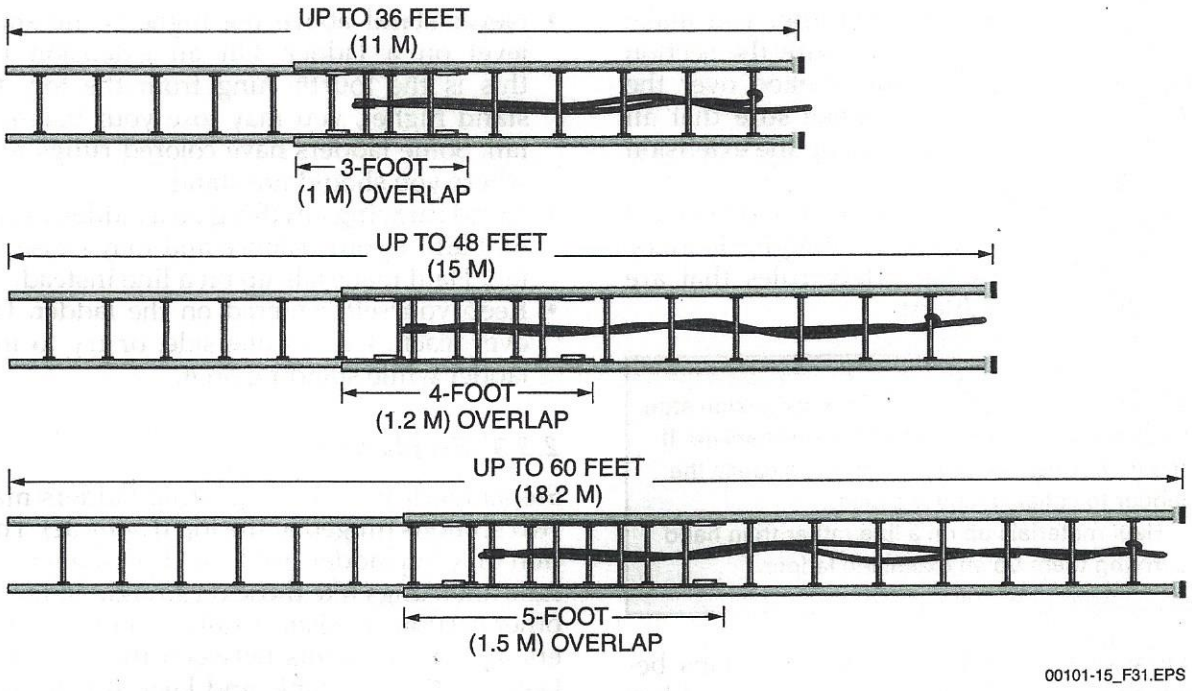


Figure 31 Overlap lengths for extension ladders.

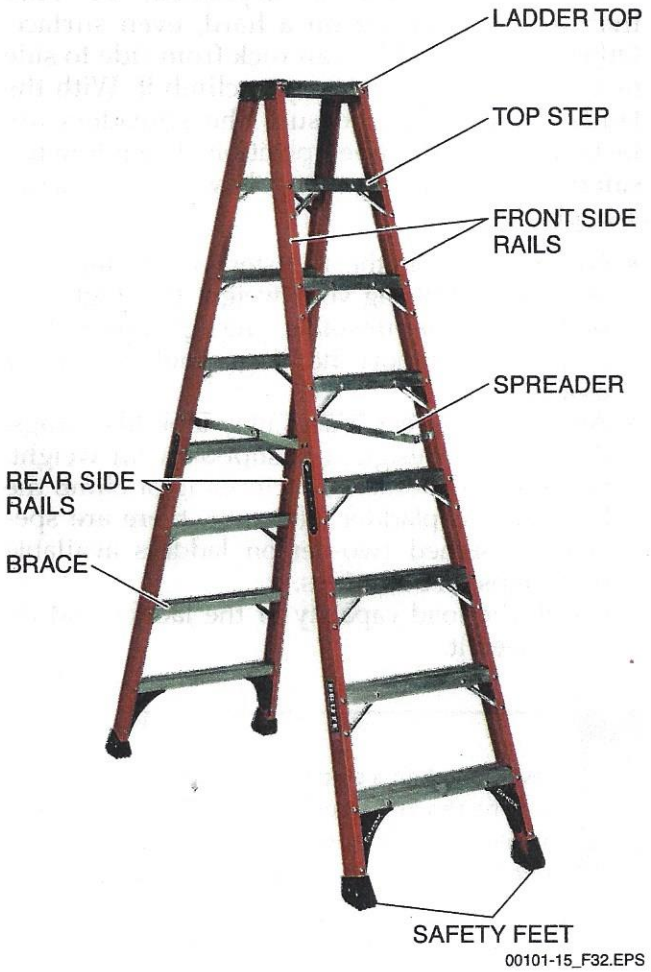


Figure 32 Typical fiberglass stepladder.

2.3.4 Inspecting Ladders

Always inspect a ladder before you use it. Check the rails and rungs for cracks or other damage. Also, check for loose rungs. If you find any damage, do not use the ladder. Check the entire ladder for loose nails, screws, brackets, or other hardware. If you find any hardware problems, tighten the loose parts or have the ladder repaired before you use it. OSHA requires regular inspections of all ladders and an inspection just before each use.

CAUTION

Wooden ladders should never be painted. The paint could hide cracks in the rungs or rails. Clear varnish, shellac, or a preservative oil finish will protect the wood without hiding defects.

The same rules for inspecting straight ladders apply to extension ladders. In addition, the rope that is used to raise and lower the movable section of the ladder should be inspected. If the rope is frayed or has worn spots, it should be replaced before the ladder is used.

The rung locks support the entire weight of the movable section and the person climbing the ladder. Inspect them for damage before each use. If they are damaged, they should be repaired or replaced before the ladder is used.

Inspect stepladders the way you inspect straight and extension ladders. Pay special attention to the hinges and spreaders to be sure they are in good repair. Also, be sure the rungs are clean. The rungs of a stepladder are usually flat, so oil, grease, or dirt can build up on them and make them slippery.

2.3.5 Stairways

Stairways are also routinely used on construction sites where there is a break in elevation of 19 inches (46 cm) or more, and no ramp, runway, sloped embankment, or personnel hoist is provided. Observe the following regulations, based on OSHA standards, when using stairways on a job site:

- Stairways having four or more risers or rising more than 30 inches (76 cm), whichever is less, must be equipped with at least one handrail and one stair railing system along each unprotected side.
- Winding and spiral stairways must be equipped with a handrail offset sufficiently to prevent walking on those portions of the stairways where the tread width is less than 6 inches (15 cm).
- Stair railings must be not less than 36 inches (91 cm) from the upper surface of the stair railing system to the surface of the tread, in line with the face of the riser at the forward edge of the tread.

To reduce the likelihood of slips, trips, or falls, keep stairways clean and clear of debris. Do not store any tools or materials on stairways, and clean up liquid spills, rain water, or mud immediately.

Stairways must have adequate lighting. This can sometimes be a problem because permanent lighting is usually installed after stairway construction is completed. If the lighting is inadequate, temporary lighting should be installed in the stairway. Each bulb should be equipped with a protective cover and the string should be inspected daily for burned out or broken bulbs.

Whenever possible, avoid using stairways to transport materials between floors. Carrying small materials and tools is fine, as long as the materials do not block your vision. Going up or down a stairway while carrying large items is physically demanding and increases the chance of injuries and falls. Use the building elevator or crane service to transport large materials from one floor to another.

2.4.0 Scaffolds

Scaffolds provide safe elevated work platforms for people and materials. They are designed and built to comply with high safety standards, but normal wear and tear or incidentally putting too much weight on them can weaken them and make them unsafe. That's why it is important to inspect every part of a scaffold before each use. Personnel who assemble scaffolds must be certified to do so.

CAUTION

Only a competent person has the authority to supervise setting up, moving, and taking down scaffolds. Only a competent person can approve the use of scaffolds on the job site after inspecting the scaffolds.

2.4.1 Types of Scaffolds

Two basic types of scaffolds—self-supporting scaffolds and suspended scaffolds—are used in the construction industry. The rules for safe use apply to both of them. Self-supporting scaffolds can be manufactured units or can be assembled at the site.

Manufactured scaffolds (*Figure 33*) are made of painted steel, stainless steel, or aluminum. They are stronger and more fire-resistant than wooden scaffolds. They are supplied in ready-made, individual units, which are assembled on site. A rolling scaffold has wheels on its legs so that it can be easily moved. The scaffold wheels have brakes so the scaffold will not move while workers are standing on it.

WARNING!

Never unlock the wheel brakes of a rolling scaffold while anyone is on it. People on a moving scaffold can lose their balance and fall.

Built-up scaffolds (*Figure 34*) are built from the ground up at a job site using steel framework sections and lumber. Swing (suspended) scaffolds (*Figure 35A*) are suspended by ropes or cables in a manner that allows it to be raised or lowered as needed. Another type of suspended scaffolding is a work cage (*Figure 35B*). A work cage is typically suspended with rigging devices that attach to I-beams with various sizes of clamps and rollers.

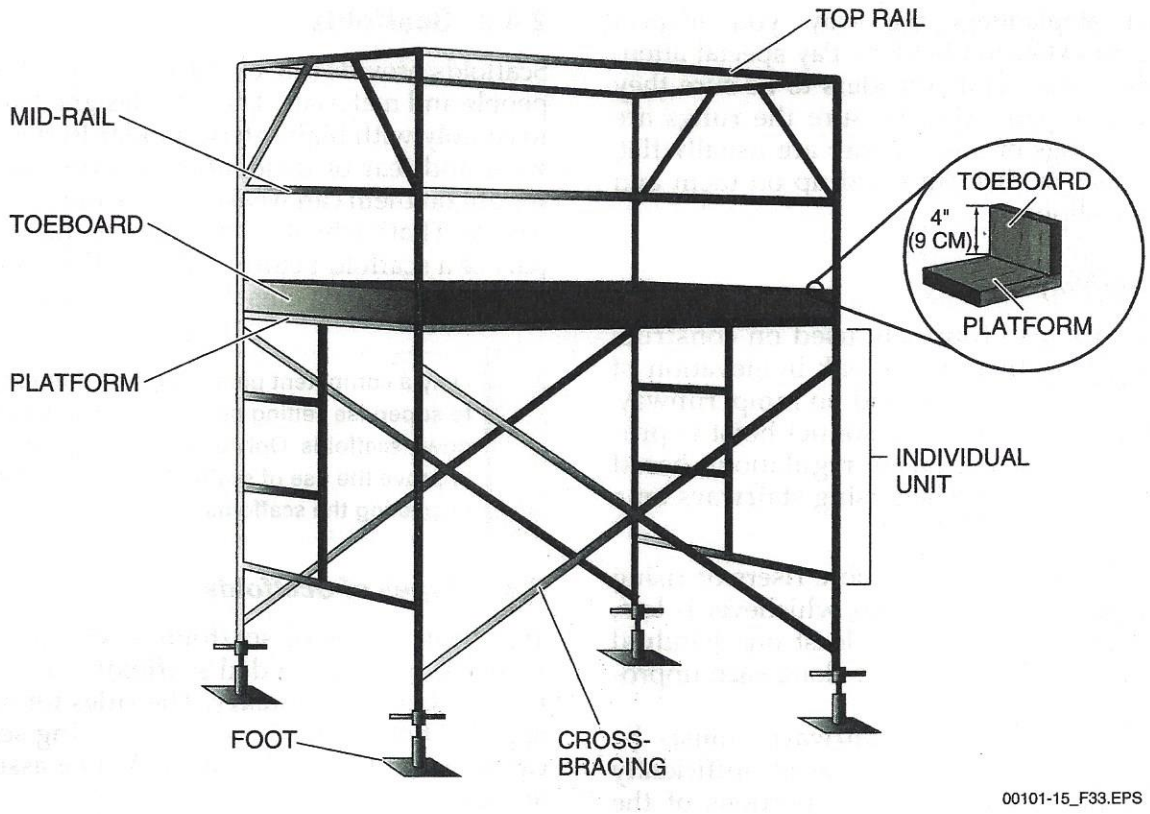


Figure 33 Typical manufactured scaffold.

2.4.2 Inspecting Scaffolds

Any scaffold that is assembled on the job site must be tagged to indicate whether the scaffold meets OSHA standards and is safe to use. Three colors of tags are used: green, yellow, and red (*Figure 36*).

- A green tag means the scaffold meets all OSHA standards and is safe to use.
- A yellow tag means the scaffold does not meet all OSHA standards. An example is a scaffold on which a railing cannot be installed because of equipment interference. To use a yellow-tagged scaffold, you must wear a safety harness attached to a lanyard. You may have to take other safety measures as well.
- A red tag means a scaffold is being put up or taken down. Never use a red-tagged scaffold.

Don't rely on the tags alone; inspect all scaffolds before you use them. Check for bent, broken, or badly rusted tubes. Also check for loose joints where the tubes are connected. Any of these problems must be corrected before the scaffold is used.

Make sure you know the weight limit of any scaffold you will be using. Compare this weight limit to the total weight of the people, tools, equipment, and material you expect to put on the scaffold. Scaffold weight limits must never be exceeded.

If a scaffold is more than 10 feet (3.1 m) high, check to see that it is equipped with **top rails**, midrails, and toeboards; otherwise, use a PFAS. All connections must be pinned. That means they must have a piece of metal inserted through a hole to prevent connections from slipping. **Cross-bracing** must be used. A handrail is not the same as cross-bracing. The walking area must be completely **planked**.

If it is possible for people to walk under a scaffold, the space between the toeboard and the top rail must be screened. This prevents objects from falling off the work platform and injuring those below.

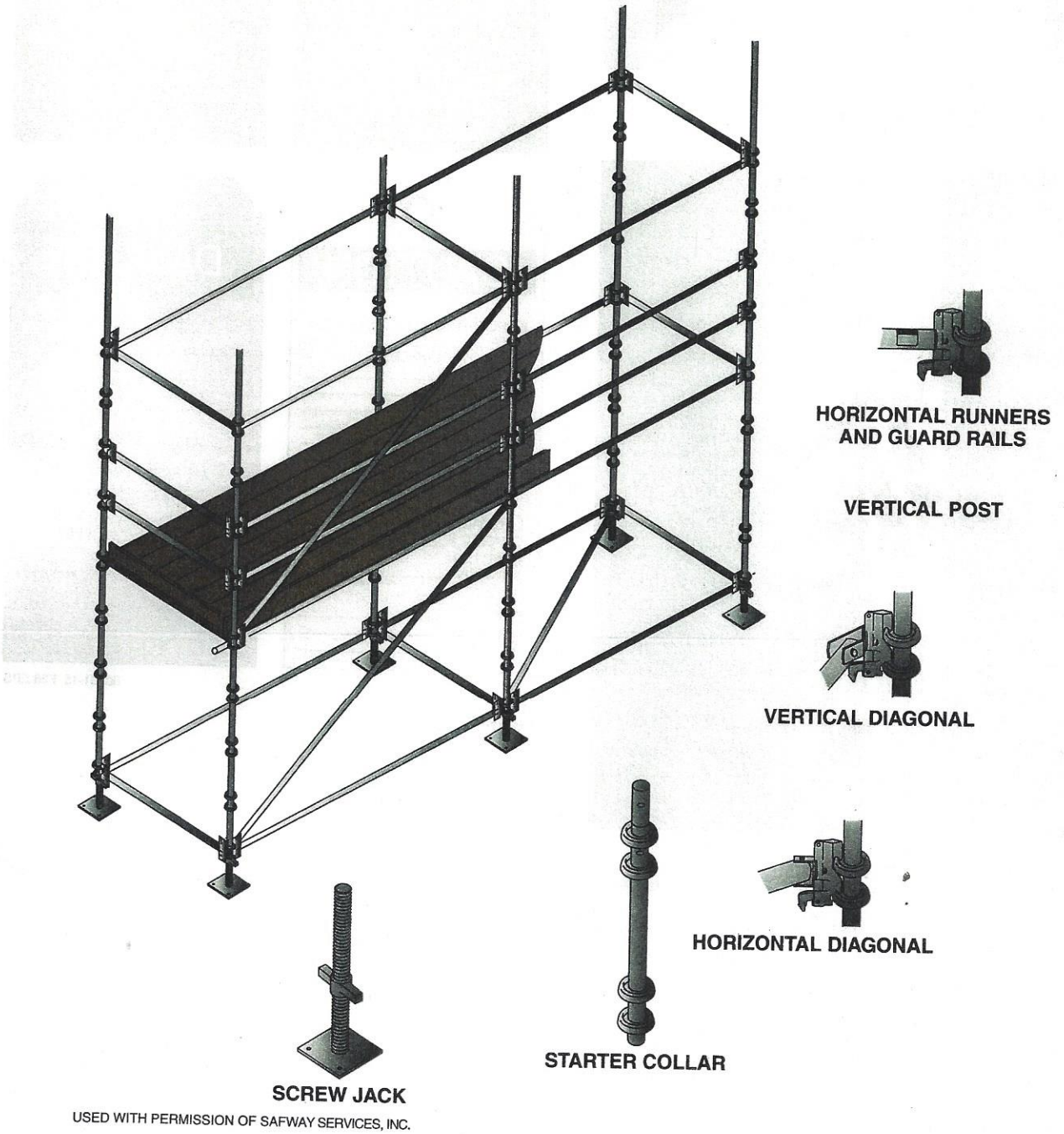
When you examine a rolling scaffold, check the condition of the wheels and brakes. Be sure the brakes are working properly and can stop the scaffold from moving while work is in progress. Be sure all brakes are locked before you use the scaffold.

2.4.3 Using Scaffolds

Be sure that a competent person inspects the scaffold before you use it. There should be firm footing under each leg of a scaffold before putting any weight on it. If you are working on loose or soft soil, you can put planks or matting under the scaffold's legs or wheels, as shown in *Figure 34*. When moving a rolling scaffold, first unlock the brakes and then move the scaffold. Once the scaffold is repositioned, don't forget to relock the brakes.

WARNING!

Keep scaffolds a minimum of 3 feet (91 cm) from power lines up to 300 volts and a minimum of 10 feet (3.1 m) from power lines above 300 volts. Never move a scaffold while someone is on it.



USED WITH PERMISSION OF SAFWAY SERVICES, INC.

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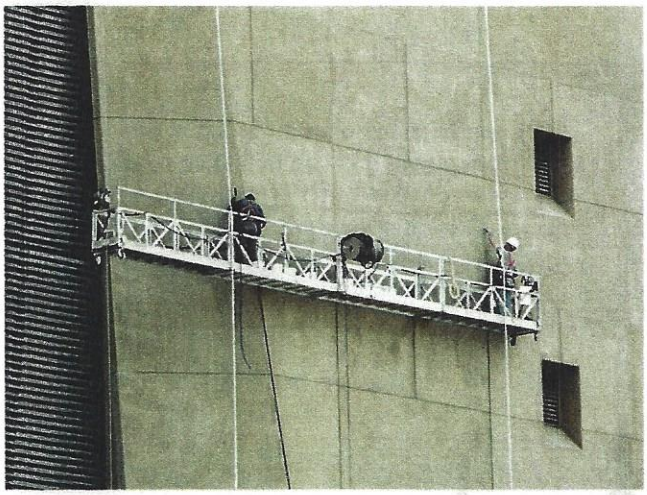
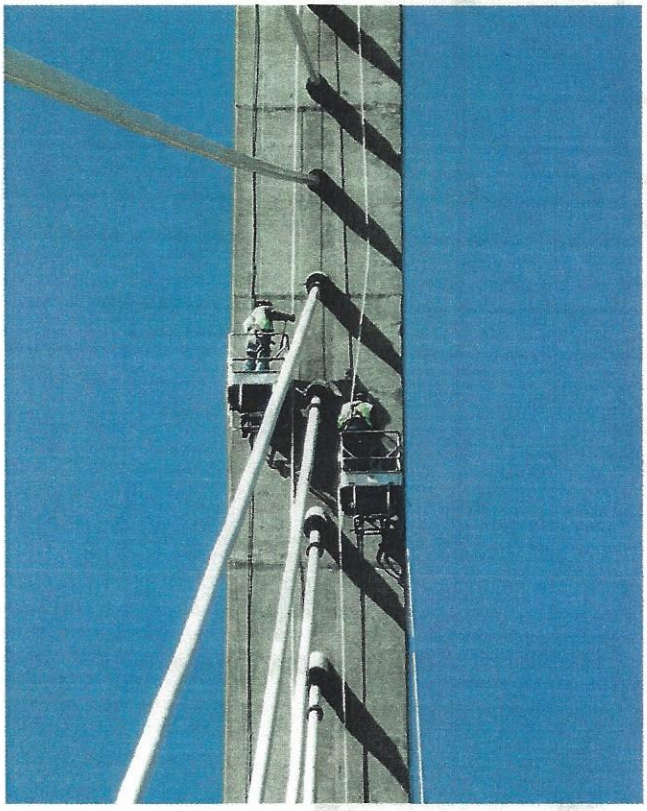
Figure 34 Built-up scaffold.



(A) SUSPENDED SCAFFOLD



(B) WORK CAGE

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Figure 35 Suspended scaffold and work cage.

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Figure 36 Typical scaffold tags.

Additional Resources

US Occupational Safety and Health Administration. Numerous safety videos are available on line at **www.osha.gov/video**.

Construction Safety, Jimmie W. Hinze. 2006. Upper Saddle River, NJ: Pearson Education, Inc.

DeWalt Construction Safety/OSHA Professional Reference. Paul Rosenberg; American Contractors Educational Services. 2006. DEWALT.

Basic Construction Safety and Health, Fred Fanning. 2014. CreateSpace Independent Publishing Platform.

2.0.0 Section Review

1. A barrier with yellow and purple markings indicates a _____.
   a. fire hazard
   b. fall hazard
   c. radiation hazard
   d. confined space hazard

2. Positioning lanyards are used only as fall restraint devices and may *not* be used as fall arrest devices.
   a. True
   b. False

3. When positioning a straight ladder against a wall, how far from the wall should the base of the ladder be?
   a. Four feet (1.2 m)
   b. One-fourth the distance from the ground to the point where the ladder touches the wall
   c. The height of the wall minus 4 feet (1.2 m)
   d. One-half the distance from the ground to the point where the ladder touches the wall

4. If a scaffold has a yellow tag, it means _____.
   a. the scaffold may only be used by one person at a time
   b. the scaffold is condemned and cannot be used
   c. a safety harness must be worn when using it
   d. the scaffold is under assembly and cannot be used

SECTION THREE

3.0.0 STRUCK-BY AND CAUGHT-IN-BETWEEN HAZARDS

Objectives

Identify and explain how to avoid struck-by and caught-in-between hazards.

a. Identify and explain how to avoid struck-by hazards.
b. Identify and explain how to avoid caught-in and caught-between hazards.

Trade Terms

Shielding: A structure used to protect workers in trenches.

Shoring: A support system designed to prevent a trench or excavation cave-in.

Signaler: A person who is responsible for directing a vehicle when the driver's vision is blocked in any way.

Spoil: Material such as earth removed while digging a trench or excavation.

There is an apparent overlap in struck-by and caught-in-between hazards that needs to be clarified, as they can involve the same kinds of equipment. *Struck-by* means being hit by a moving object, while *caught-in-between* means being trapped between a moving object and a solid surface. Assume a worker is working near a crane that is swinging a load and the load hits the worker. That is an example of a struck-by incident. However, if the worker is behind the crane and the crane backs up, pinning the worker against a wall, it becomes a caught-in-between incident.

3.1.0 Struck-By Hazards

On any job site, there is a risk of being struck by falling objects, such as tools dropped from above. Flying objects such as debris from grinding and chipping metal are another struck-by hazard. On any site where there is moving equipment, or where workers are near roadways, there is a also the danger of being struck by a vehicle.

3.1.1 Falling Objects

Workers are at risk from falling objects when they are beneath machinery and equipment such as cranes and scaffolds; where overhead work is being performed; or when working around stacked materials. To protect against struck-by injuries from falling objects, always wear an approved hard hat. Employers generally require workers to wear hard hats at all times on construction sites.

When working near machinery and equipment such as cranes, never stand or work beneath the load or in the fall zone. Barricade hazard areas where rigging equipment is in use, and post warning signs to inform other workers of falling object hazards. Inspect cranes and rigging components before use and do not exceed the rated load capacity.

When performing overhead work, be sure all tools, materials, and equipment are secured to prevent them from falling on people below. Use protective measures such as toeboards, debris nets, catch platforms, or canopies to catch or deflect falling objects. Use tool lanyards to prevent tools from falling.

Many workers are hurt or killed by falling stacks of material. Do not stack materials higher than 4:1 height-to-base ratio. Secure all loads by blocking and interlocking them. Interlocking means placing alternate layers at right angles to each other. Be aware of changing weather conditions, such as wind, that may lift and shift loads.

3.1.2 Flying Objects

There is a danger from flying objects when power tools or activities such as pushing, pulling, or prying causes objects to become airborne. Chipping, grinding, brushing, or hammering are all examples of job tasks that may cause flying objects. Tools that move at very high speed, like pneumatic and powder-actuated tools, can be very dangerous. Injuries from flying objects can range from minor abrasions to concussions, blindness, or death. The workers shown in *Figure 37* are using a pneumatic chipping hammer and a pneumatic grinder, and are properly using protective face shields.

To protect against flying object hazards, follow these guidelines:

- Use eye protection, such as safety glasses, goggles, or face shields where machines or tools may cause flying particles.
- Inspect tools and machines to ensure that protective guards are in place and in good condition.
- Make sure you are trained in the proper operation of pneumatic and powder-actuated tools.
- Use shielding devices such as welding screen or similar equipment to block flying debris.

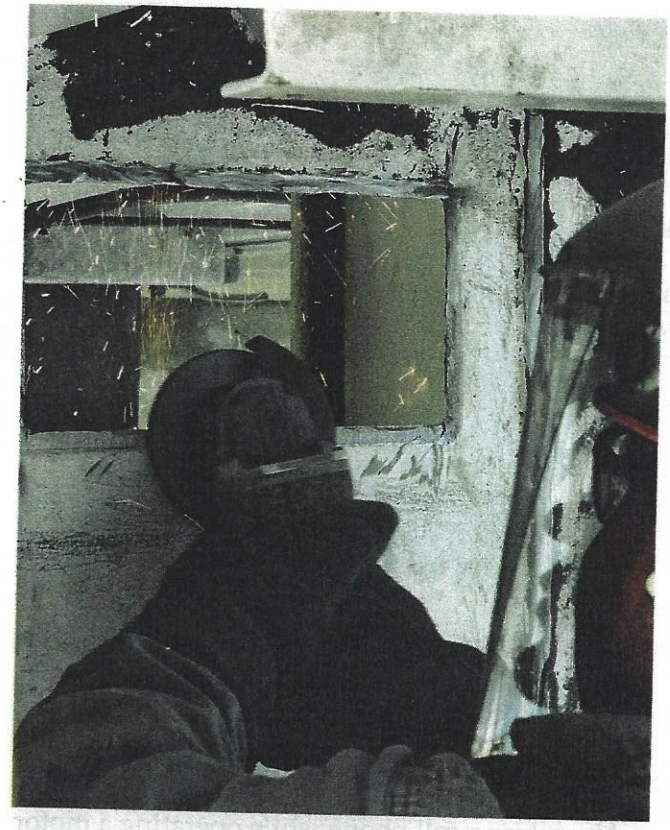

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Figure 37 Protection from flying particles.

3.1.3 Vehicle and Roadway Hazards

A common cause of incidents for workers on large job sites and highway projects are vehicle-related hazards such as being run over by vehicles or equipment (especially backing equipment) or by equipment tip-over. The most common cause of death for equipment operators is equipment roll-over. If vehicle safety practices are not observed at your site, you risk being struck by swinging backhoes, moving vehicles, or swinging crane loads. If you work near public roadways (*Figure 38*), you risk being struck by passenger or commercial vehicles. When working near moving vehicles and equipment, follow these guidelines:

- Stay alert at all times and keep a safe distance from vehicles and equipment.
- Maintain eye contact with vehicle or equipment operators to ensure that they see you.
- Never get into blind spots of equipment operators.
- Keep off equipment unless authorized.
- Wear reflective or high-visibility vests or other suitable garments.
- Never stand between pieces of equipment unless they are secured.
- Never stand under loads handled by lifting or digging equipment, or near vehicles being loaded or unloaded.

Operators must also use caution when driving vehicles. The operator of any vehicle is responsible for the safety of passengers and the protection of the load. Follow these safety guidelines when you operate a vehicle on a job site:

- Always wear a seat belt.
- Be sure that each person in the vehicle has a firmly secured seat and seat belt.
- Obey all speed limits. Reduce speed in crowded areas.
- Look to the rear and sound the horn before backing up. If your rear vision is blocked, get a **signaler** to direct you.

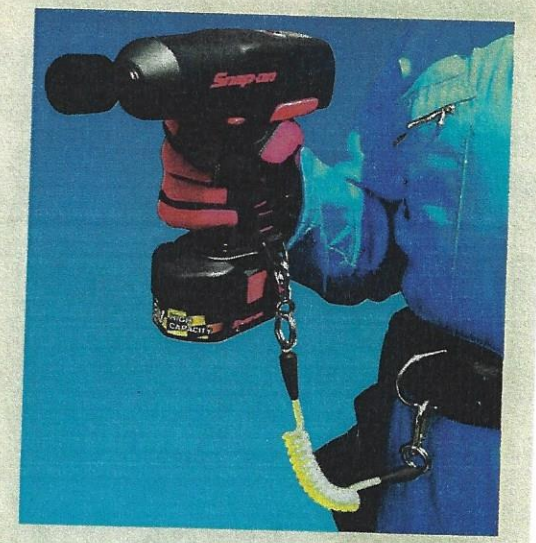
Case Histories

- A worker was standing under a suspended scaffold that was hoisting a workman and three sections of ladder. Sections of that ladder became unlatched and fell 50 feet (≈15m), striking the worker in the skull. The worker was not wearing any head protection and died from his injuries.
- A carpenter was using a powder-actuated tool to anchor a plywood form in preparation for pouring a concrete wall. The nail passed through the hollow wall, traveled 72 feet (≈22m), and struck an apprentice in the head, killing him. The tool operator had never been trained in the proper use of the tool, and none of the employees in the area, including the victim, was wearing PPE.

Tool Lanyards

When working at elevations, a dropped tool can become a serious hazard. If the tool has moving parts, like battery-powered drills, the fall will likely destroy it.

Tool lanyards specifically designed for work in the elevated environment have been introduced by Snap-on®. Tethering tools to the tool belt or wrist can prevent injuries, save tools, prevent component damage, and prevent lost time in retrieval.



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- Every vehicle must have a backup alarm. Make sure the backup alarm works.
- Always turn off the engine when fueling.
- Turn off the engine and set the brakes before leaving the vehicle.
- Never stay on or in a truck that is being loaded by excavating equipment.
- Keep windshields, rearview mirrors, and lights clean and functional.
- Carry road flares, fire extinguishers, and other standard safety equipment at all times.
- Never use a cell phone while operating a motor vehicle.

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Figure 38 A busy job site.

WARNING!

When a vehicle is operated indoors, the carbon monoxide in its exhaust can kill or sicken anyone in the vicinity unless there is good ventilation. Carbon monoxide is especially dangerous because you cannot see, smell, or taste it. It is never a good idea to operate a vehicle, a generator, or any other machine with an internal combustion engine indoors. Make sure there is good ventilation before you operate a motorized vehicle or equipment such as a generator indoors.

3.2.0 Caught-In and Caught-Between Hazards

Congested work sites, heavy equipment, and the presence of multiple trades can contribute to caught-in-between hazards. The primary causes of caught-in-between fatalities include trench/excavation collapse, rotating equipment, and unguarded parts.

One of the most disastrous caught-in hazards on a construction job site is being trapped by a cave-in of the walls of a trench or excavation. Other caught-in or caught-between hazards involve protective guards on power tools and machines, as well as the risk of being crushed by heavy equipment.

3.2.1 Trenches and Excavation

Trenches and excavations are common hazards, especially in construction and pipeline work. Anyone working in or around a trench or excavation must know and follow safety procedures aimed at protecting workers from cave-ins.

An excavation is any man-made cut, cavity, trench, or depression formed by removal of earth or soil. Sometimes the terms *excavation* and *trench* are used interchangeably, but there is a difference. A trench is an excavation that is deeper than it is wide, and usually not wider than 15 feet (4.6 m). Nearly all trenches are dangerous if not protected. Because trenches are narrow, workers can easily become trapped.

Did You Know?

Struck-by Fatalities

Nearly one in four struck-by vehicle deaths involve construction workers – more than any other occupation.

Hazards involved with trench and excavation work include the following:

- Cave-ins
- Water accumulation
- Falling objects
- Collapse of nearby structures
- Hazardous atmospheres produced by toxic gases in the soil

WARNING!

Just 2 to 3 feet (0.61 to 0.91 m) of soil can put enough pressure on your lungs to prevent you from breathing. In as little as 4 to 6 minutes without oxygen, you can sustain considerable brain damage.

Cave-ins are the most common and deadly hazard in excavation work. When dirt is removed from an excavation, the surrounding soil becomes unstable and gravity can force it to collapse. Cave-ins occur when soil or rock falls, or slides, into an excavation. Most cave-ins occur in trenches 5 to 15 feet (1.53 to 4.6 m) deep, and happen suddenly with little or no warning. On average, about 1,000 trench collapses occur each year in the United States.

Soil conditions can change, so they must be constantly evaluated. There are certain factors that could change the surroundings of the site, making a cave-in more likely. These factors include the following:

- Changes in weather conditions, such as freezing, thawing, or sudden heavy rain
- An excavation dug in unstable or previously disturbed soil
- Excessive vibration around the excavation
- Water accumulation in an excavation

Sometimes there are visible warning signs around the excavation that can be spotted before a cave-in occurs. Being aware of the warning signs increases your chances of getting out before a collapse occurs. Visible warning signs of a potential cave-in include the following:

- Ground settlement or narrow cracks in the sidewalls, slopes, or surface next to the excavation

Did You Know?

Excavation Fatalities

The fatality rate for excavation work is 112 percent higher than the rate for general construction.

- Flakes, pebbles, or clumps of soil separating and falling into the excavation
- Changes or bulges in the wall slope

If you notice any of these signs, get out of the excavation immediately and alert your co-workers as well.

Soil type is a key factor in determining the type of protective system needed to ensure that the trench will be safe. Solid rock is the most stable, while sandy soil is the least stable. The four types of soil are shown in *Table 3*.

To be safe, treat soil as if it is Type C soil, per *Table 3*, unless proven otherwise. It is better to over-prepare for a stronger soil than to not prepare enough for a weaker one.

A competent person must inspect excavations daily and decide whether cave-ins or failures of protective systems could occur, and whether there are any other hazardous conditions present. The competent person must conduct inspections before any work begins, as needed throughout the shift, and after every rainstorm or other hazard-increasing incident.

If the inspection reveals indications of protective system failure, hazardous atmospheres, or a possible cave-in, workers must be removed from the hazardous area and may not return until corrective action has been taken. Always ask the competent person on site or your immediate supervisor if you have questions about proper safety practices.

Once visual and manual tests are performed and the soil type is determined, a protective system must be chosen. Protective systems are required in nearly all excavations. There are various types of trench protective systems to meet each type of soil condition. Selecting a protective system for an excavation depends on soil conditions, the depth of the trench, and the environmental conditions surrounding the site.

Regardless of what type of system is used, if the excavation is more than 20 feet (6.1 m) deep, the entire excavation protective system has to be designed by a registered professional engineer. There are two basic systems of trench protection: sloping and benching systems and support systems. The method to be used is determined by the engineer and is based on the types of soil and the site conditions.

Table 3 Soil Types

Name	Type/Characteristics
Solid Rock	Excavation walls stay vertical as long as the excavation is open.
Type A Soil	Fine-grained, cohesive: clay, hardpan, and caliche. Particles too small to see with the naked eye.
Type B Soil	Angular rock, silt, and similar soil.
Type C Soil	Coarse-grained, granular: sand, gravel, and loamy sand. Particles are visible to the naked eye.

Did You Know?

Heavy Soil

One cubic yard of earth weighs approximately 2,700 pounds (1,225 kg)—that's the weight of a small car. Since the meter is longer than a yard, a cubic meter of soil weighs more — about 3,527 pounds (1,600 kg).

Sloping and benching are forms of trench protection that cut away and slant the excavation face. A sloping system is a method in which the sides of an excavation are cut back to a safe angle using relatively smooth inclines (*Figure 39*, top). A benching system is similar to a sloping system, but instead of smooth inclines, the sides of the trench wall are cut back using a series of steps (*Figure 39*, bottom). Benching systems cannot be used with Type C soil.

Trenches are often located in narrow places, so sloping and benching are not options. In these situations, support systems like **shoring** or **shielding** must be used. Shoring structures are typically made of metal or wood and are used to support the sides of a trench and prevent soil from caving in. They consist of plating held firmly in place with expandable braces (*Figure 40*). There are many types of shoring systems. Some of them are easy to install, and others require experience and engineering.

Shielding structures, also known as trench boxes, are placed inside trenches or excavations, and are strong enough to protect workers in the event of a cave-in, so long as the workers are within the confines of the box (*Figure 41*). Trench shields are used only to provide a protected space for workers. Shoring not only protects workers, but also prevents the trench walls from collapsing.

Did You Know?

Cave-In Fatalities

Each year in the United States, more than 100 people are killed and many more are seriously injured in cave-in incidents. The chances of a trapped worker being killed can be as high as 50 percent.

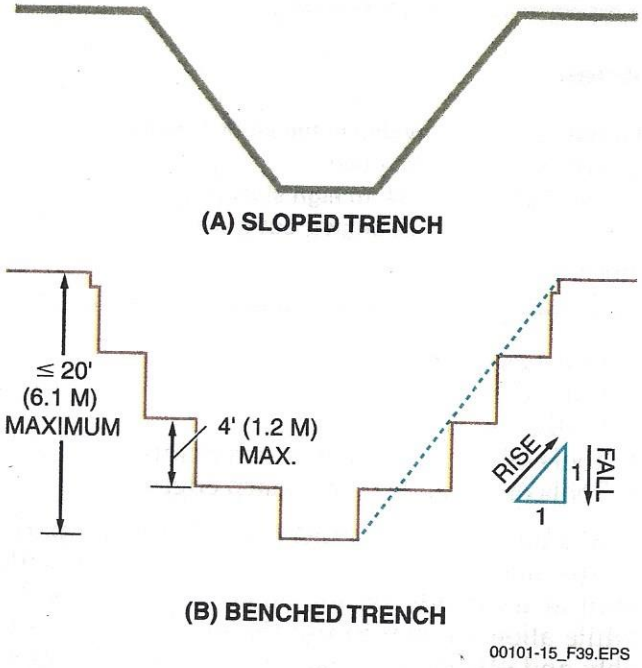

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Figure 39 Sloped and benched trenches for Type B soil.

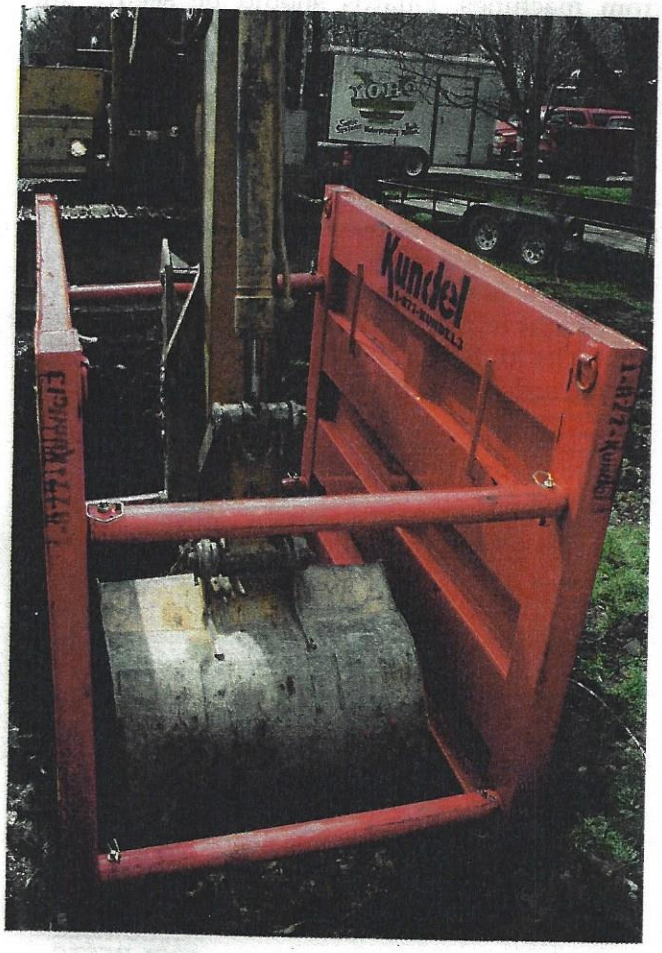

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Figure 40 Shoring structure.

Case History

A worker was in a trench installing forms for concrete footers when it caved in, causing fatal injuries. The trench, which was 7½ feet (2.29 m) deep, was in loose, sandy (Type C) soil, and no inspection was conducted before the start of the shift.

Spoil piles, comprised of the material removed from an excavation, and other materials represent a hazard if not handled properly. Loose rock, soil, materials, and equipment on the face or near the excavation can fall or roll into the excavation, or overload and possibly collapse excavation walls. Keep all spoil, materials, and heavy equipment at least 2 feet (0.6 m) away from the edge of an excavation, or set up barricades to contain falling material. Scale the excavation face to remove loose material, and place spoil so that rainwater runs away from the excavation. Use a retaining device strong enough and high enough to resist expected loads. If the spoil cannot be safely stored on site, remove it to a temporary site.

When working in a trench, there must be a safe means of entry and exit for workers, such as a stairway, ladder, or ramp. There must be an exit every 25 feet (7.6 m) for every trench over 4 feet (1.2 m) deep. Lifting equipment such as loader buckets and backhoe shovels are not safe means for entering or exiting a trench. Once you are in the trench and before you begin work, take a moment to look around and find the nearest ladder so that you can plan your exit, if necessary.

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Figure 41 Shielding structure.

Case Histories

- Two workers were installing pipe in a trench. No means of protection was provided in the vertical wall trench. A cave-in occurred, fatally injuring one worker and causing serious injury to the other.
- Four workers were in an excavation, boring a hole under a road. Eight-foot (2.44 m) high steel plates used as shoring were placed against the side walls of the excavation at about 30-degree angles, but were not supported by horizontal bracing. One of the plates tipped over, crushing one worker.

Your company is required to have an emergency action plan that must be communicated to every worker. If you are not sure what the emergency action plan is for your site, don't be afraid to ask questions. Your knowledge could help prevent serious injury or even death, and your supervisor wants you and everybody working with you to be as safe as possible.

Most importantly, try to prevent emergencies before they happen. When in doubt, get out! If you notice potentially dangerous conditions while working in an excavation, get yourself and your co-workers out of danger immediately, and inform your supervisor or the competent person of your concerns.

3.2.2 Tool, Machine, and Equipment Guards

Almost all tools and machines used in construction and industrial work are equipped with guards that protect workers from rotating parts. *Figure 42* show the guards on a grinding machine. All tools and machines that could harm workers must have a guard shielding the hazard. The following types of tools and machines must have guards:

- Grinding tools
- Shearing tools
- Presses
- Punches
- Cutting tools
- Rolling machines
- Tools or machines with pinch points
- Tools or machines with sharp edges

Machine guards should prevent moving parts of the machine from coming into contact with your arms, hands, or any other part of the body, while allowing you to use the machine comfortably and efficiently. Some workers find machine guards to be aggravating and try to remove them from machines. Guards should be secure and should not be easily removed. They should be maintained in good condition, made of durable material, and bolted or screwed to the machine so that tools are needed for their removal. *Figure 43* shows a coupling guard installed over the coupling that connects a motor shaft to a pump shaft. The guard is bolted in place and should only be removed when the motor is not running. The guard is there to prevent someone from being caught in the coupling, which rotates at high speed. Its highly visible markings indicate that it is a hazardous location.

Case History

A spoil pile had been placed on top of a curb, which formed the west face of a trench. A backhoe was working on top of the spoil pile. The west face of the trench collapsed on two workers who were installing sewer pipe. One worker was killed; the other received back injuries. The trench was 8 feet (2.4 m) deep with vertical walls. No cave-in protection was provided. The superimposed loads of the spoil pile and backhoe may have caused the collapse.

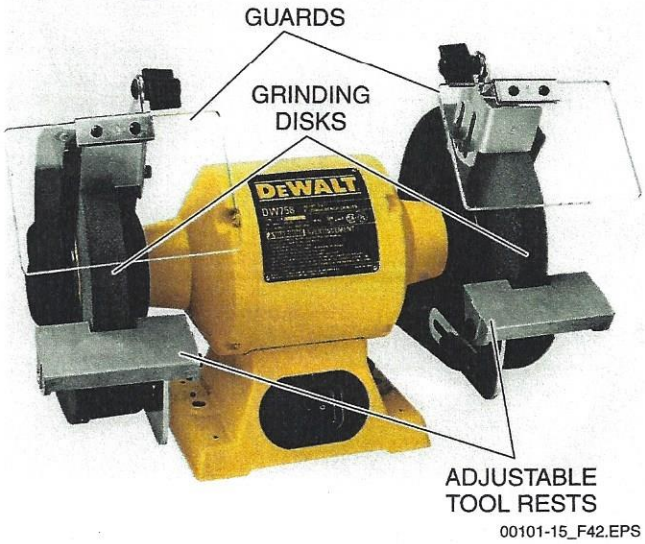

Figure 42 Bench grinder with guards.

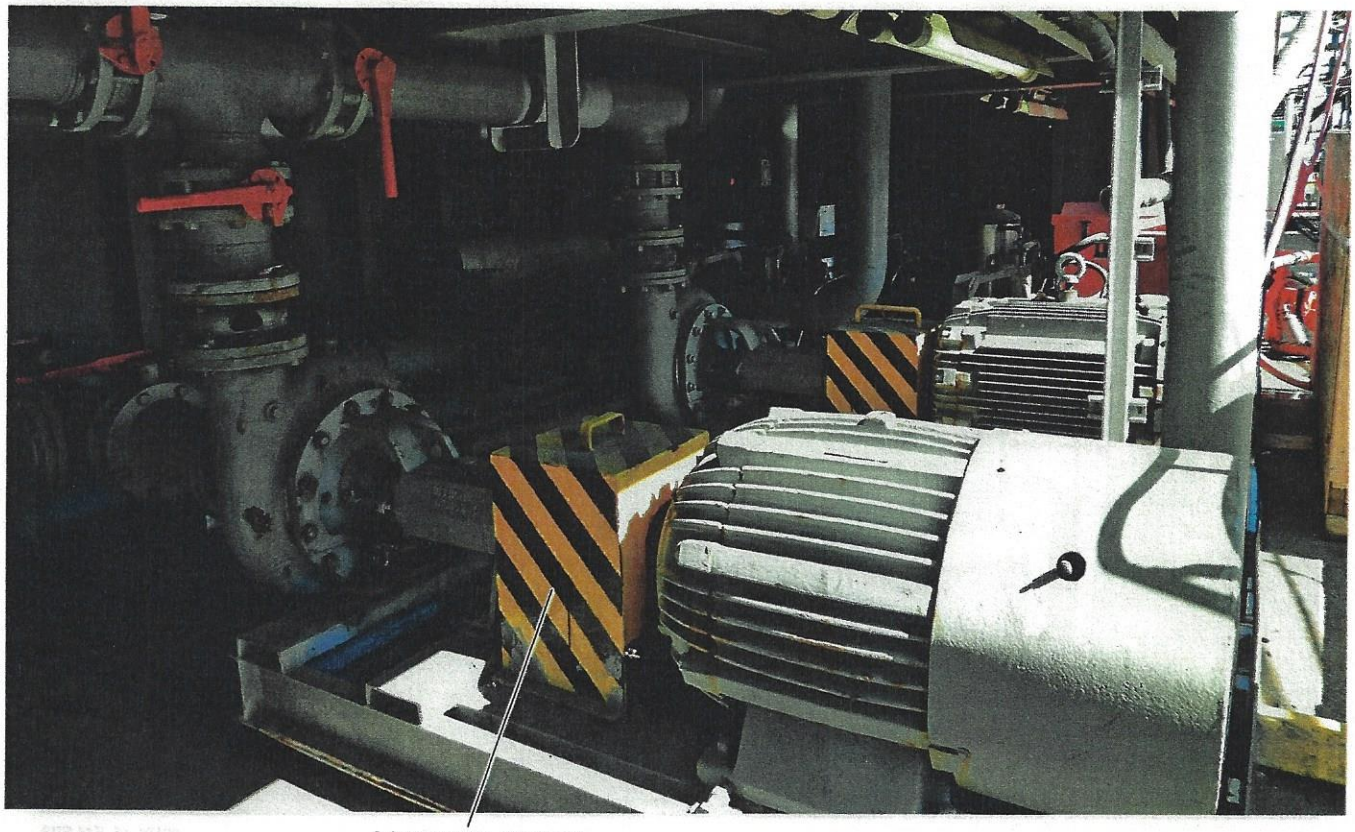

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Figure 43 Coupling guard.

Follow these guidelines for using and caring for tool and machine guards:

- Do not remove a guard from a tool or machine except for cleaning purposes or to change a blade or perform other service. Make sure the machine is turned off and tagged out.
- When you are finished with cleaning or maintenance, replace the guard immediately.
- Do not use any material to wedge a guard open.
- Guards and attachments are designed for the specific tool or machine you are using. Use only attachments that are specifically designed for that tool or machine.

3.2.3 Cranes and Heavy Equipment

Motorized equipment is used in many different jobs including construction, mining, plant maintenance and operations, road maintenance, equipment transportation, and snow removal. Working with motorized equipment can be dangerous. Workers can be crushed by falling loads, fall from equipment, be electrocuted by power lines, or be struck or trapped by vehicles. The swing radius of equipment can also be a hazard if the job is not carefully planned and properly barricaded. Most heavy equipment has pinch points. *Figure 44* shows some of the pinch point hazards on an excavator.

Dangers exist for both equipment operators and other workers on the site. In one example, a contractor was operating a backhoe when another employee attempted to walk between the swinging back end of the backhoe and a concrete wall. As the employee approached the backhoe from the operator's blind side, the back end hit the victim, crushing him against the wall. A similar problem can occur with a crane or excavator, as shown in *Figure 45*. As the cab swings, the rear end extends beyond the base of the machine. For that reason, barricades must be placed around the working perimeter of the machine.

Because working with or near motorized equipment is dangerous, you must understand that your first responsibility on a job is safety. This includes your own safety, the safety of others on the site, and the safe use of equipment on the site. You must know the hazards and safety procedures of every job you are on, regardless of the work you are doing.

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Figure 44 Pinch and crush points.

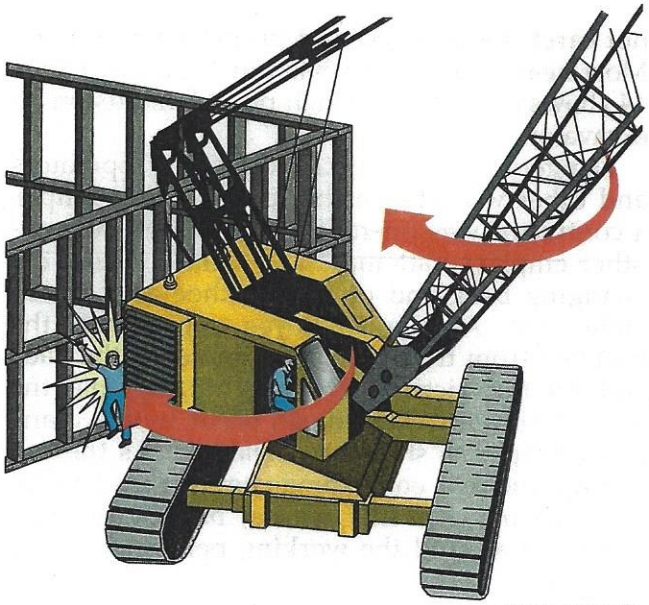

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Figure 45 Example of a caught-between hazard.

Case History

Two employees were attempting to adjust the brakes on a backhoe. The victim told the backhoe operator to raise the wheels off the ground with the front bucket and the outriggers so that he could get to the brakes. The victim then crawled under the machine and began to adjust the brakes. He did this without considering that there was only a 36" (0.9 m) space from the ground to the drive shaft. While adjusting the brakes, the hood of his rain jacket wrapped around the drive shaft and broke his neck. He died instantly.

The Bottom Line: Loose clothing can be caught in moving parts of machinery. You must consider all possible dangers when working on equipment.

Source: The Occupational Safety and Health Administration (OSHA)

Additional Resources

US Occupational Safety and Health Administration. Numerous safety videos are available on line at **www.osha.gov/video**.

Construction Safety Jimmie W. Hinze. 2006. Upper Saddle River, NJ: Pearson Education, Inc.

DeWalt Construction Safety/OSHA Professional Reference. Paul Rosenberg; American Contractors Educational Services. 2006. DEWALT.

Basic Construction Safety and Health, Fred Fanning. 2014. CreateSpace Independent Publishing Platform.

3.0.0 Section Review

1. Which of these activities is most likely to produce flying objects?
   a. Using a chipping hammer
   b. Using a screwdriver
   c. Painting a wall
   d. Climbing a ladder

2. The type of soil most likely to result in a trench cave-in is _____.
   a. solid rock
   b. Type A
   c. Type B
   d. Type C

SECTION FOUR

4.0.0 ENERGY RELEASE HAZARDS

Objectives

Identify common energy-related hazards and explain how to avoid them.

a. Describe basic job-site electrical safety guidelines.
b. Explain the importance of lockout/tagout and describe basic procedures.

Performance Task

4. Inspect a typical power cord and GFCI to ensure their serviceability.

Trade Terms

Ground: The conducting connection between electrical equipment or an electrical circuit and the earth.

Ground fault circuit interrupter (GFCI): A device that interrupts and de-energizes an electrical circuit to protect a person from electrocution.

Lockout/tagout (LOTO): A formal procedure for taking equipment out of service and ensuring that it cannot be operated until an authorized person has removed the lock and/or warning tag.

Proximity work: Work done near a hazard but not actually in contact with it.

Whenever possible, you will de-energize equipment before you begin working on it. Your employer will have written guidelines that you must follow to de-energize the equipment. It is important to follow all guidelines because some circuits receive power from multiple sources. To place equipment in a safe work condition, all energy sources must be removed. Once equipment is de-energized, **lockout/tagout (LOTO)** devices must be attached to all sources to prevent someone from unknowingly restoring the energy before the work has been completed.

4.1.0 Electrical Safety Guidelines

Electrical safety is a concern for all workers, not just for electricians. On many jobs, no matter what your trade, you will use or work around electrical equipment. Extension cords, power tools, portable lights, and many other pieces of equipment use electricity.

Not all electrical incidents result in death. There are different types of electrical incidents. Any of the following can happen:

- Burns
- Electric shock
- Explosions
- Falls caused by electric shock
- Fires

If the human body comes in contact with an electrically energized conductor and is also in contact with a **ground** at the same time, the body becomes an additional path of resistance for the electrical currect to flow through. The electricity flows through the body in less than the blink of an eye without warning. That's why safety precautions are so important when working with and around electrical circuits. When a body conducts electrical current, and the current is high enough, the person can be electrocuted (killed by electric shock). *Table 4* shows the effects of different amounts of electrical current on the human body and lists some common tools that operate using those currents.

Here's an example: A craft worker is operating a portable power drill while standing on damp ground. The power cord inside the drill has become frayed, and the electric wire inside the cord touches the metal drill frame. Three amps of current pass from the wire through the frame, then through the worker's body and into the ground. *Table 4* shows that this worker will probably die.

There are specific policies and procedures to keep the workplace safe from electrical hazards. You can do many things to reduce the chance of an electrical incident. If you ever have any questions about electrical safety on the job site, ask your supervisor.

WARNING!

Less than one amp of electrical current can kill. Always take precautions when working around electricity.

Did You Know?

Electrocution

Electric shocks or burns are a major cause of incidents in the construction industry. According to the Bureau of Labor Statistics, electrocution is the fourth leading cause of death among construction workers.

Table 4 Effects of Electrical Current on the Human Body

Current	Common Item/Tool	Reaction to Current
0.001 amps	Watch battery	Faint tingle.
0.005 amps	9-volt battery	Slight shock.
0.006 – 0.025 amps (women) 0.009 – 0.030 amps (men)	Christmas tree bulb	Painful shock. Muscular control is lost.
0.050 – 0.9 amps	Small electric radio	Extreme pain. Breathing stops; severe muscular contractions occur. Death may result.
1.0 – 9.9 amps	Jigsaw (4 amps); Sawsall® or Port-a-Band® saw (6 amps); portable drill (3 – 8 amps)	Ventricular fibrillation and nerve damage occur. Death may result.
10 amps and above	ShopVac® (15-gallon); circular saw	Heart stops beating; severe burns occur. Death may result.

4.1.1 Grounding

Grounding is a method of protecting humans from electric shock; however, it is normally a secondary protective measure. The term *ground* refers to a conductive body, usually the earth. A ground is a conductive connection, whether intentional or incidental, by which an electric circuit or equipment is connected to earth or to an engineered grounding system. By grounding a tool or electrical system, a low-resistance path to the earth is intentionally created. When properly done, this path offers low resistance and has enough current-carrying capacity to prevent the buildup of voltages that could create a personnel hazard. This does not guarantee that no one will receive a shock. It will, however, greatly reduce the possibility of such incidents, especially when used in combination with your company's safety program.

Use three-wire extension cords for portable power tools and make sure they are properly connected (*Figure 46*, top). The three-wire system is one of the most common safety grounding systems used to protect you from incidental electrical shock. The third wire is connected to a ground system. If the insulation in a tool fails, the current will pass to ground through the third wire—not through your body. Double-insulated tools (*Figure 46*, bottom) are also very effective in preventing shocks. In fact, it has become more common to use double-insulated tools because they are safer than relying on a three-wire cord alone. *Figure 46* also shows the double-insulated symbol that can be found on double-insulated tools. Double-insulated tools use a two-wire power cord with no ground pin. One prong of the plug is larger than the other so it can only be connected to a polarized receptacle.

4.1.2 Ground Fault Circuit Interrupters

A **ground fault circuit interrupter (GFCI)** is a fast-acting circuit breaker that senses small imbalances in the circuit caused by current leakage to ground. A GFCI continually matches the amount of current going to an electrical device against the amount of current returning from the device. Whenever the two values differ by more than 5 milliamps, the GFCI interrupts the electric power within ¼₀th of a second. *Figure 47* shows an extension cord with a GFCI.

A GFCI must be used on all receptacles that are not part of the building's permanent wiring, such as temporary power and extension cords. A GFCI provides protection against a ground fault, which is the most common form of electrical shock. It also provides protection from fires, overheating, and wiring insulation deterioration.

Tripping of GFCIs—interruption of circuit flow—is sometimes caused by wet connectors and tools. Limit the amount of water that tools and connectors come into contact with by using watertight or sealable connectors. Tripping may also be caused by cumulative leakage from several tools or from extremely long circuits. GFCIs should be periodically inspected in accordance with the manufacturer's recommendations or site safety practices. GFCIs have a TEST button that can be pressed to verify that the GFCI is working. The GFCI should be tested before any use.

CAUTION

Do not plug a GFCI-protected device into a GFCI-protected circuit.

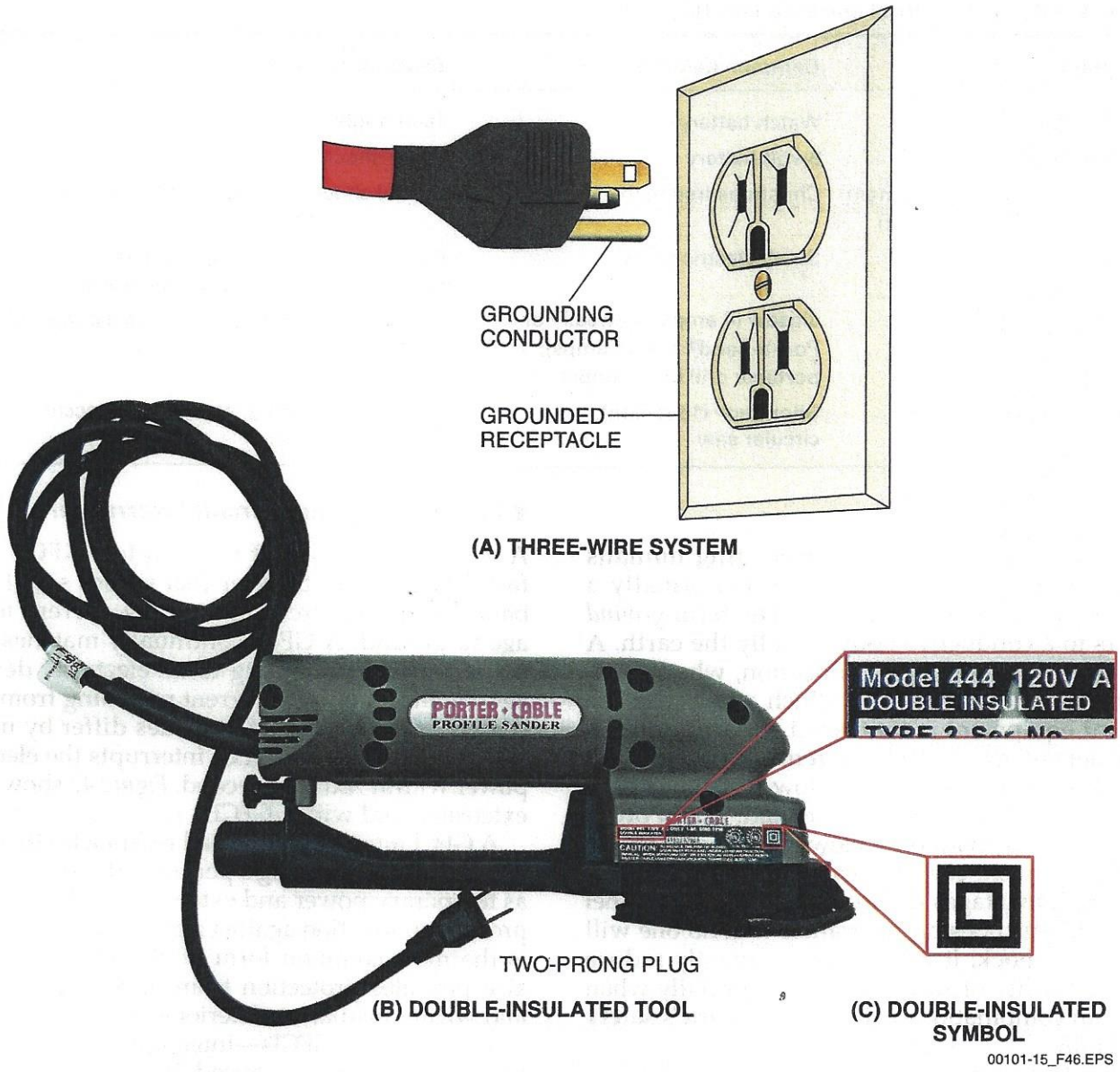

Figure 46 Three-wire system, double-insulated tool, and double insulated symbol.

Figure 47 Extension cord with a GFCI.

Case History

A self-employed builder was using a metal cutting tool on a metal carport roof and was not using GFCI protection. The male and female plugs of his extension cord partially separated, and the active pin touched the metal roofing. When the builder grounded himself on the gutter of an adjacent roof, he received a fatal shock.

The Bottom Line: Always use GFCI protection and be aware of potential hazards.

Source: The Occupational Safety and Health Association (OSHA)

4.1.3 Summary of Electrical Safety Guidelines

Here are some basic job-site electrical safety guidelines:

- All power tools used in construction should be ground-fault protected.
- Make sure that panels, switches, outlets, and plugs are grounded.
- Never use bare electrical wire.
- Never use metal ladders near any source of electricity.
- Inspect electrical power tools before you use them.
- Never operate any piece of electrical equipment that has a danger tag or lockout device attached to it.

WARNING!

All work on electrical equipment should be done with circuits de-energized, locked out, and confirmed. All conductors, buses, and connections should be considered energized unless proven otherwise.

- Never use worn or frayed cables (*Figure 48*). If the cord is frayed or worn, disconnect the power and dispose of the cord.
- Make sure light bulbs have protective guards to prevent incidental contact (*Figure 49*).

4.1.4 Working Near Energized Electrical Equipment

No matter what your trade, your job may include working near exposed electrical equipment or conductors. This is one example of **proximity work**. Often, electrical distribution panels, switch enclosures, and other equipment must be left open during construction. This leaves the wires and components in them exposed. Some or all of the wires and components may be energized. Working near exposed electrical equipment can be safe, but only if you keep a safe working distance.

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Figure 49 Work light with protective guard.

Regulations and company policies tell you the minimum safe working distances from exposed conductors. The safe working distance can be very small or span a significant distance, depending on the voltage. The higher the voltage, the greater the required safe working distance.

You must learn the safe working distance for each situation. Make sure you never get any part of your body or any tool you are using closer to exposed conductors than that distance. You can get information on safe working distances from your instructor, your supervisor, company safety policies, and regulatory documents. This subject is also covered in greater detail in other craft curricula where it is relevant.

One of the common causes of electrical shock is coming into contact with overhead wires with metal ladders, cranes, or excavating equipment.

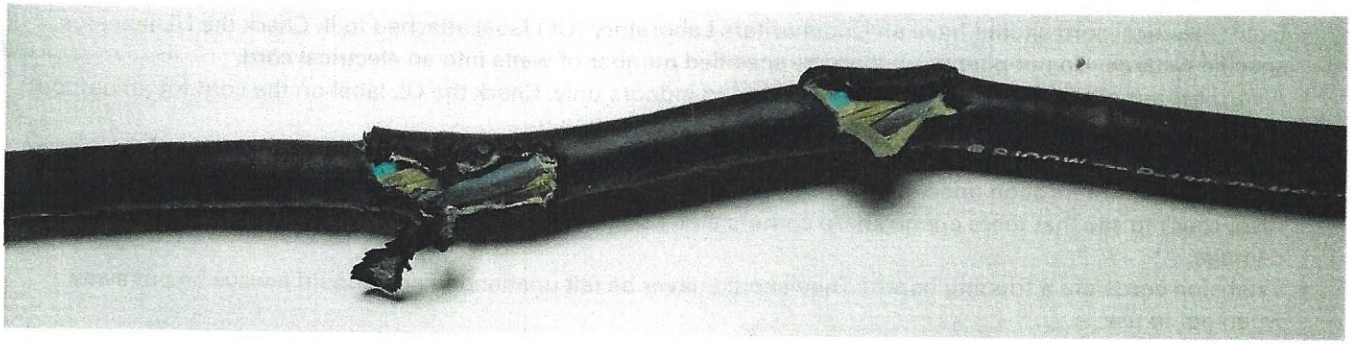

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Figure 48 Never use damaged cords.

Case History

A fan connected to a 120-volt electrical system with an extension cord provided ventilation for a worker performing a chipping operation from an aluminum stepladder. The insulation on the extension cord was cut through, exposing bare wire, which made contact with the ladder. The ground wire was not attached on the male end of the cord's plug. When the energized conductor made contact with the ladder, the path to the ground included the worker's body, resulting in death.

A distance of at least 10 feet (3 meters) must be maintained from any conductor carrying 50,000 volts or less. Greater distances are required for higher voltages.

4.1.5 If Someone Is Shocked

If you are there when someone gets an electrical shock, you can save a life by taking immediate action. The best thing to do is to immediately shut off the power to the circuit. Do not touch the victim while he or she remains in contact with the power source. Once the circuit is disconnected, call an ambulance or the emergency number at your job site. Render first aid only if you are trained to do so.

WARNING! Do not touch the victim or the electrical source with your hand, foot, or any other part of your body or with any object or material. You could become part of the circuit—and another victim.

4.2.0 Lockout/Tagout Requirements

Failure to disable machinery before working on it is a major cause of injury and death on job sites. Lockout/tagout procedures safeguard workers against unexpected releases from various energy sources. An energy source can be electrical, mechanical, hydraulic, pneumatic, chemical, or thermal. After the power has been turned off, energy can still be stored in a device or component. For example, even when a hydraulic system has been turned off, hydraulic pressure may remain in all or part of the system. This high-pressure energy can be released if the system is opened during service or repairs, creating an extremely hazardous situation. Additional dangers exist if the device or system contains chemicals, flammable liquids, high-temperature liquids, or gases.

When anyone is working on or around active systems, all equipment that could release energy must be shut down, drained, de-energized, or otherwise rendered harmless whenever possible. Switches, circuit breakers, valves and other components are switched off or closed, and then locks or tags (*Figure 50*) are applied so they cannot be re-energized while work is ongoing.

Generally, each lock has its own key, and the individual who applies the lock keeps the key. A variety of tags are used, depending on the circumstances and the organization. Tags (*Figure 51*) typically have the word *DANGER* on them, along with other printed information, writing space for comments, and a line for the installer's signature and date. The authorized person who applied the lock must be the one to remove it. In an emergency, a supervisor or other person authorized by the employer may remove a lockout/tagout.

Electrical Cord Safety

Electrical cords are frequently seen on construction sites, yet they are often overlooked. Use the following safety guidelines to ensure your safety and the safety of other workers.

- Every electrical cord should have an Underwriters Laboratory (UL) label attached to it. Check the UL label for specific wattage. Do not plug more than the specified number of watts into an electrical cord.
- A cord set not marked for outdoor use is to be used indoors only. Check the UL label on the cord for an outdoor marking.
- Do not remove, bend, or modify any metal prongs or pins of an electrical cord.
- Do not run a cord through doorways or through holes in ceilings, walls, and floors that might pinch the cord. Also, check to see that there are no sharp corners along the cord's path. Any of these situations will lead to cord damage.
- Extension cords are a tripping hazard. They should never be left unattended and should always be put away when not in use.

(A) ELECTRICAL LOCKOUT

(B) VALVE LOCK

(C) PNEUMATIC LOCKOUT

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Figure 50 Lockout/tagout devices.

In a lockout, an energy-isolating device such as a disconnect switch or circuit breaker is placed in the Off position and a lock is applied. Padlocks are popular and versatile, but other styles (*Figure 52*) are often specifically suited for the equipment being serviced. Multiple lockout devices (*Figure 53*) are used when more than one person is accessing the equipment. When a worker needs to service a system and sees that another person's lock has been applied, it is tempting to accept this as a safe situation. However, the lock may be removed by the first worker and the circuit re-energized while the second worker is still vulnerable. In these cases, the multiple lockout devices allow several workers to apply locks, and each is ensured that the system cannot be restored until theirs is removed.

Figure 51 Typical safety tags.

In a tagout, components that control power to equipment and machinery are set to a safe position and a written warning is attached. This method may be more appropriate for valves and other energy-controlling devices that are difficult or impossible to lock, since tags alone cannot prevent a control device or switch from being repositioned.

It is important to emphasize that LOTO procedures are not solely related to electrical energy sources. Technicians cannot forget that other forms of energy may need to be rendered safe as well.

The exact procedures for LOTO will vary by organization and site. Check with your instructor or site supervisor regarding the detailed LOTO procedure at your site and be sure you are familiar with the proper steps.

4.2.1 Pressurized or High-Temperature Systems

Many jobs require that workers be close to tanks, piping systems, and pumps that contain pressurized or high-temperature fluids. Be aware that touching a container of high-temperature fluid can cause burns. Many industrial processes involve fluids that are as hot as several thousand degrees. Also, if a container holding pressurized fluids is damaged, it may leak and spray dangerous fluids. Any work around pressurized or high-temperature systems is considered proximity work. Barricades, a monitor, or both may be needed to ensure the safety of those working nearby.

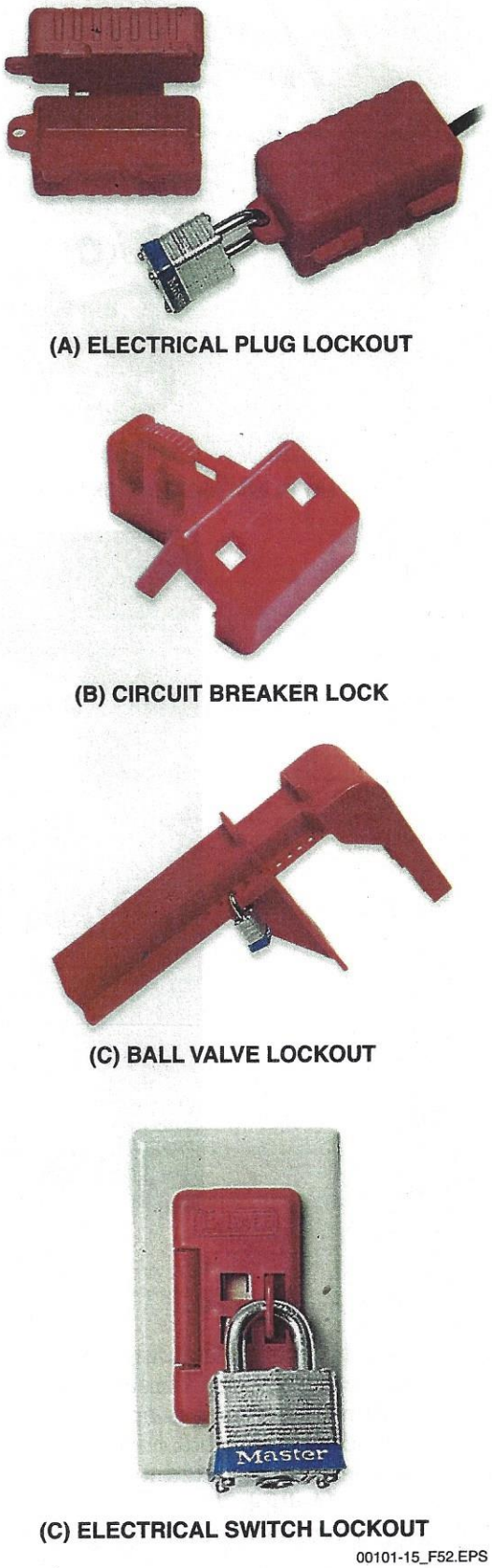

Figure 52 Lockout devices.

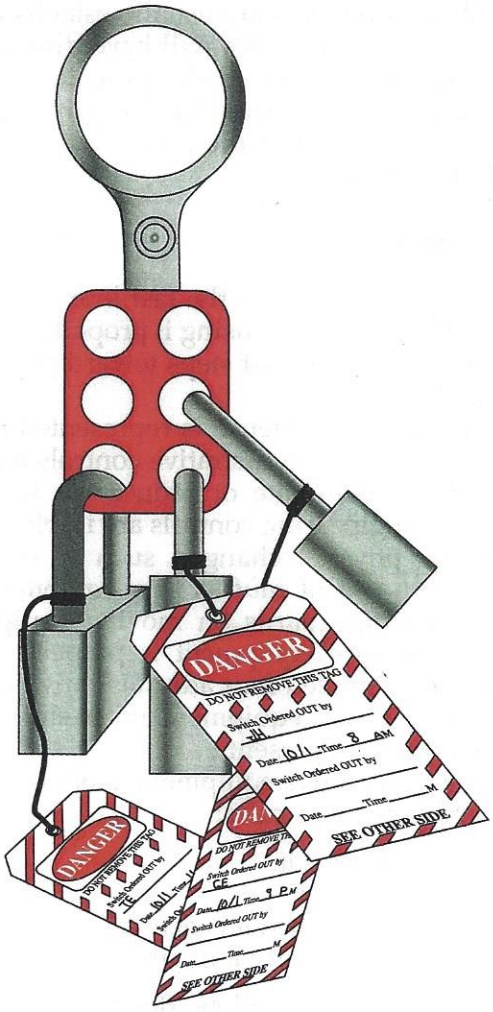

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Figure 53 Multiple lockout/tagout device.

Additional Resources

US Occupational Safety and Health Administration. Numerous safety videos are available on line at **www.osha.gov/video.**

DeWalt Construction Safety/OSHA Professional Reference, Paul Rosenberg; American Contractors Educational Services. 2006. DEWALT.

Basic Construction Safety and Health, Fred Fanning. 2014. CreateSpace Independent Publishing Platform.

4.0.0 Section Review

1. The purpose of double-insulating an electrically powered tool is to _____.
   a. prevent the tool from overheating
   b. protect users from electrical shock
   c. keep the tool from getting too cold
   d. allow it to use a three-prong receptacle

2. When a lockout is performed, the key to the lock is _____.
   a. left in the lock
   b. kept by the person who applied the tag
   c. given to the foreman for safekeeping
   d. hidden in a convenient place

SECTION FIVE

5.0.0 PERSONAL PROTECTIVE EQUIPMENT

Objectives

Identify and describe the proper use of personal protective equipment.

a. Identify and describe the PPE used to protect workers from bodily injury.
b. Identify potential respiratory hazards and the basic respirators used to protect workers against those hazards.

Performance Tasks

2. Inspect the following PPE items and determine if they are safe to use:
   - Eye protection
   - Hearing protection
   - Hard hat
   - Gloves
   - Approved footwear

3. Properly don, fit, and remove the following PPE items:
   - Eye protection
   - Hearing protection
   - Hard hat
   - Gloves

Trade Terms

Arc welding: The joining of metal parts by fusion, in which the necessary heat is produced by means of an electric arc.

Every worker is responsible for wearing appropriate PPE on the job. When worn correctly, PPE is designed to protect you from injury. You must keep it in good condition and use it when you need to. When workers are injured on the job, it is often because they are not using required PPE.

You will not see all the potentially dangerous conditions just by looking around a job site. It is important to stop and consider what type of incidents could happen on any job that you are about to do. Knowing how to use PPE will greatly reduce your chance of getting hurt. Keep in mind that PPE requirements are usually established by the job site. Some job sites will have different requirements than others, so always make sure you check. For example, some sites require high-top safety boots instead of the more common standard 6-inch tops.

5.1.0 PPE Items

Remember, while PPE is the last line of defense against personal injury, using it properly and taking care of it are the first steps toward protecting yourself on the job.

The first line of defense is represented by the engineering and administrative controls used by employers to eliminate or reduce the need for some PPE. Engineering controls are implemented by making physical changes, such as reducing noise by the use of mufflers on equipment engines; installing guards on moving equipment; and making sure equipment is properly maintained. An example of an administrative control is operating noisy equipment on a shift when fewer workers are present.

The best protective equipment is of no use unless you follow these rules:

- Regularly inspect it.
- Properly care for it.
- Use it properly when it is needed.
- Never alter or modify it in any way.

The sections that follow describe protective equipment commonly used on construction sites, and tell how to use and care for each piece of equipment. Be sure to wear the equipment according to the manufacturer's specifications.

WARNING! Your clothing must comply with good general work and safety practices. Do not wear clothing or jewelry that could get caught in machinery or otherwise cause an incident, such as loose clothing, baggy shirts, or dragging pants. You must wear a shirt at all times; some tasks will require long-sleeved shirts. Your shirt should always be tucked in unless you are performing welding.

Protective equipment commonly worn by craft workers on any job site usually includes the following:

- Hard hats
- Eye protection
- Gloves

Sharing PPE

It is not a good idea for workers to share PPE. If one person has an infection, it can be passed to another through the shared equipment.

- Safety footwear
- Hearing protection
- Respiratory protection
- High-visibility clothing

5.1.1 Hard Hats

Figure 54 shows a typical hard hat. The outer shell of the hat can protect your head from a hard blow. The webbing inside the hat keeps space between the shell and your head. Adjust the headband so that the webbing fits your head and there is at least one inch of space between your head and the shell.

Do not alter your hard hat in any way. Inspect your hard hat every time you use it. If there are any cracks or dents in the shell, or if the webbing straps are worn or torn, get a new hard hat. Wash the webbing and headband with soapy water as often as needed to keep them clean. Wear the hard hat only as the manufacturer recommends. Never wear anything but approved clothing under your hard hat.

WARNING!

No articles should be worn under the hard hat that could interfere with fit and visibility. That includes ball caps or hoodies that obscure peripheral vision. Only employer-approved gear is to be worn under the hard hat.

00101-15_F54.EPS

Figure 54 Typical hard hat.

5.1.2 Eye and Face Protection

Wear eye protection (*Figure 55*) wherever there is even the slightest chance of an eye injury. In general, eye protection is required any time you are on a job site. Face shields (*Figure 56*) are added over safety glasses for certain tasks, such as grinding. Appropriate eye or face protection is required when there is a possibility of exposure to hazards from flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, or potentially injurious light radiation. The following are examples of tasks requiring eye protection:

- Grinding and chipping metal
- Using power saws and other tools/equipment that can throw out solid material

Did You Know?

Hard Hats

Hard hats were once made of metal. However, metal conducts electricity, so most hard hats are now made of reinforced plastic or fiberglass.

Case History

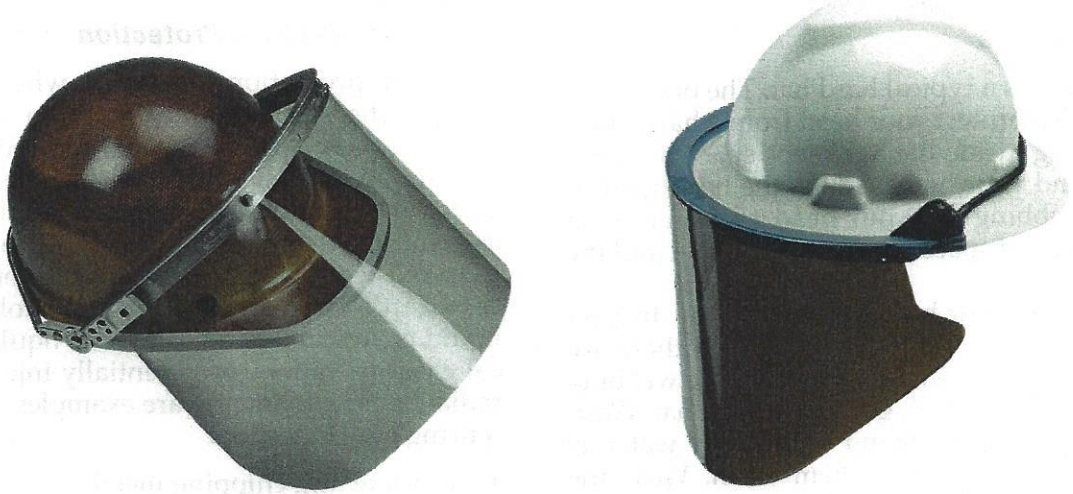
A training specialist traveled nearly three hours to reach a remote job site in order to observe and photograph the installation of high-voltage transmission lines. On arriving, he parked his car, put on his work boots, hard hat, reflective vest and safety glasses and walked over to the location where the work was being done. He was introduced to the project manager who shocked him by saying: "Sir, I have to ask you to leave my job site because you are not wearing electrically insulated boots". Given no choice, the training specialist headed toward his car for the long trip home. Fortunately, the project manager needed to go back to the office for a meeting and offered the loan of his boots, thus preventing six hours of wasted time, as well as the loss of a rare opportunity.

The Bottom Line: Project managers and superintendents in construction and industrial work are serious about safety. If you are not fully prepared, you may find yourself sitting on the sidelines. A worker who shows up at a job site without the required PPE could lose a day's pay and possibly face disciplinary action.

(A) SAFETY GLASSES (B) TINTED SAFETY GLASSES (C) SAFETY GOGGLES

00101-15_F55.EPS

Figure 55 Typical safety glasses and goggles.



(A) CLEAR FACE SHIELD (B) TINTED FACE SHIELD

00101-15_F56.EPS

Figure 56 Full-face shields.

- Working with molten lead, tar pots, and other molten materials
- Working with chemicals, acids, and corrosive liquids
- **Arc welding**

On the job site, potential eye hazard areas are usually identified, but always be on the lookout for possible hazards.

> **CAUTION**
>
> Standard eyeglasses are not adequate protection in high-hazard work zones. Shatterproof lenses and side shields are required for eye protection in those areas.

Regular safety glasses will protect you from falling objects or from objects flying toward your face. Side shields provide added protection and are required whenever there is risk of flying debris. Safety goggles provide the best protection from all directions. A face shield is required, in addition to safety glasses or goggles, when there is likely to be flying debris. Grinding and chipping activities are good examples of such activities.

Handle your safety glasses and goggles with care. If they get scratched, replace them; the scratches will interfere with your vision. Clean the lenses regularly with lens tissues or a soft cloth.

Welders must use tinted goggles or welding hoods. The tinted lenses protect the eyes from the bright welding arc or flame. Welders must use filter lenses as specified by job site requirements. Welder's helpers and all employees working in the vicinity of arc welding should not look directly at the welding process and are also required to use eye protection with the prescribed level of shading. Oxyacetylene welding and burning also require the use of a filter lens.

Follow these general precautions for eye care:

- Always report all eye injuries and suspected foreign material in your eye to your supervisor immediately. Do not try to remove foreign matter yourself.
- Keep your hands away from your eyes.

- Keep materials out of your eyes by regularly clearing debris from your hard hat brim, the top of your goggles, and your face shield. When removing a cap, hard hat, or face shield, be careful to remove it in a way that prevents accumulated dirt and debris from falling into your eyes.
- Flood your eyes with water if you feel something in them. Never rub them, as this can make the problem worse.
- Know the location of eyewash stations and how to use them.

5.1.3 Hand Protection

On many construction jobs, you must wear heavy-duty gloves to protect your hands (*Figure 57*). Construction work gloves are usually made of cloth, canvas, or leather. Make sure your work gloves are a good fit. Wearing gloves that are too big for your hands can lead to injury. Never wear gloves around rotating or moving equipment. They can easily get caught in the equipment. Replace gloves when they become worn, torn, or soaked with oil or chemicals.

Gloves help prevent cuts and scrapes when you handle sharp or rough materials. Heat-resistant gloves are needed for handling hot materials. Craftworkers should be familiar with standards governing hand protection, such as ANSI/SEA Standard 105-2011, *Hand Protection Selection Criteria* and European Standard EN388, *Protective Gloves Against Mechanical Risks*. These standards establish a rating system for gloves tested for their resistance to various hazards, including chemical burns, abrasions, cuts, punctures, resistance to heat and flame, and resistance to cold. Additional European standards govern protection from chemicals and microorganisms (EN374); thermal hazards (EN407 and EN511); and ionizing radiation and radioactive contamination (EN421).

Electricians use special rubber-insulated gloves when they work on or around live circuits. When working with solvents or other chemicals, it may be necessary to wear chemical-resistant gloves.

WARNING!

Only specially trained employees are allowed to use dielectrically tested rubber gloves to work on energized equipment. Never attempt this work without proper training and authorization.

5.1.4 Foot and Leg Protection

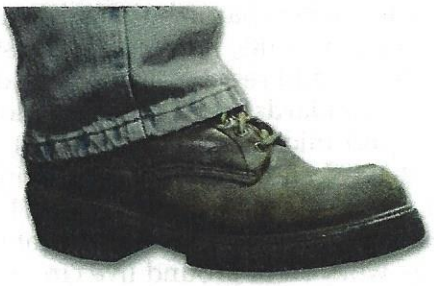
Approved safety footwear must be worn on all job sites. The best shoes to wear on a construction site are shoes with a safety toe to protect toes from falling objects (*Figure 58*). This type of shoe is generally required on every construction-related job site.

Some specialized work will require different footwear or gear. For example, safety-toed rubber boots are needed on job sites that are subject to chemically hazardous conditions or standing water. When climbing a ladder, your shoes or boots must have a well-defined heel to prevent your feet from slipping off the rungs. You will

(A) FITTED WORK GLOVES (B) GLOVES WITH CUFFS (C) RUBBERIZED COTTON

00101-15_F57.EPS

Figure 57 Work gloves.



00101-15_F58.EPS

Figure 58 Safety shoe.

need foot guards when using jackhammers and similar equipment.

Never wear canvas shoes or sandals on a construction site. They do not provide adequate protection. Always replace boots or shoes when the sole tread becomes worn or the shoes have holes, even if the holes are on top. Because of the risk of fire, do not wear oil-soaked shoes when you are welding or cutting metal.

Remember these general guidelines relating to leg protection:

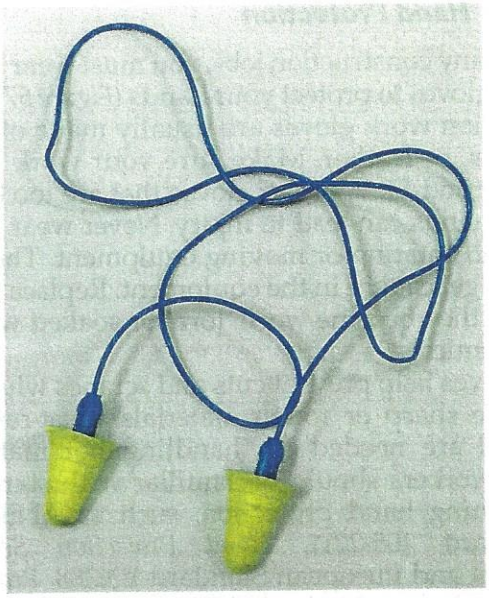
- Never carry pointed tools, such as scissors or screwdrivers, in your pants pockets. Use a canvas or leather tool sheath with all sharp ends pointing down.
- When using certain special equipment, such as chainsaws and brush hooks, use shin guards.
- Consider stability when stepping into or onto locations where materials are stored. Materials may shift and pinch your legs and/or feet.

5.1.5 Hearing Protection

Unlike damage to most parts of the body, ear damage does not always cause pain. Exposure to loud noise over a long period of time can cause hearing loss, even if the noise is not loud enough to cause pain. Vibrations caused by sound waves enter the ear and are received by the cochlea, which consists of tiny hair cells inside the ear that convert the vibrations into sound signals. Exposure to intense sound waves over time can damage the cochlea and reduce the ability to hear. Damage to the cochlea can also cause tinnitus, which is a permanent condition characterized by ringing or buzzing in the ears that never stops. Hearing loss reduces your quality of life and makes simple, daily tasks more complicated. Save your hearing by using hearing protection whenever you are working in a noisy environment.

Here is a good rule to follow: If the noise level is so great that you have to raise your voice to be heard by someone who is less than 2 feet (61 cm) away, you need to wear hearing protection.

Most construction companies follow rules defined in official safety standards in deciding when hearing protection must be used. One type of hearing protection is specially designed earplugs that fit into your ears and filter out noise (*Figure 59*, top). Another type of hearing protection is earmuffs, which are large padded covers for the entire ear (*Figure 59*, bottom). The headband on earmuffs must be adjusted for a snug fit. If the noise level is very high, you may need to wear both earplugs and earmuffs.



(A) EAR PLUGS

(B) EAR MUFFS

00101-15_F59.EPS

Figure 59 Hearing protection.

Noise-induced hearing loss can be prevented by using noise control measures and personal protective devices. *Table 5* shows the recommended maximum length of exposure to sound levels rated 90 decibels and higher. When noise levels exceed those outlined in *Table 5*, an effective hearing conservation program is required. A company-appointed program administrator will oversee this program. If you have questions about the hearing conservation program on your site, see your supervisor or the program administrator.

5.2.0 Respiratory Hazards and Protection

Wherever there is danger of an inhalation hazard, you must use a respirator. There are a number of job-site conditions that require workers to wear respirators, including the following:

- Dust from metal grinding
- Toxic fumes from welding or flame cutting of some metals
- Working with cleaning solvents
- Working in low-oxygen environments such as confined spaces
- Spray painting
- Sand blasting
- Drilling concrete
- Working with chemicals such as chlorine or ammonia

Silica is a mineral found in concrete, masonry, and rock. During construction, silica may be found in a dust form. Prolonged exposure to silica dust could cause silicosis and lung cancer. Silicosis is an incurable, and sometimes fatal, lung disease. The time it takes for silicosis to develop varies depending on how long the exposure lasted and how much silica the person was exposed to. When you are working in an area where silica dust is present, you must use the appropriate respiratory protection. Never work around silica dust without proper training, authorization, and PPE.

Asbestos is another hazardous material that can be harmful to your lungs. Prolonged exposure can cause lung cancer, asbestosis (scarring of the lung tissue), and a cancer called mesothelioma. It may take more than 20 years for these diseases to develop. Smoking significantly increases the risk of lung disease. If you smoke, tar from cigarettes will stick to the asbestos fibers in the lungs, making it more difficult for your body to get rid of the asbestos.

Sources of asbestos include older insulation and other building materials, such as floor tiles, pipe insulation drywall compounds, and reinforced plaster, along with some roofing and siding materials. The United States banned production of most asbestos products in the 1970s, meaning that asbestos-containing materials (ACMs) are generally found in structures built before 1980. During renovation or maintenance operations, asbestos may be dislodged and the fibers become airborne. Asbestos fibers are particularly hazardous and must not be disturbed unless special techniques and procedures are used to remove it safely. Although you will not feel the effects immediately, this exposure can be a serious health hazard. Never handle asbestos without proper training, authorization, and PPE.

Table 5 Maximum Noise Levels

Sound Level (decibels)	Maximum Hours of Continuous Exposure per Day	Examples
90	8	Power lawn mower
92	6	Belt sander
95	4	Tractor
97	3	Hand drill
100	2	Chain saw
102	1.5	Impact wrench
105	1	Spray painter
110	0.5	Power shovel
115	0.25 or less	Hammer drill

Around the World

Asbestos Use

Asbestos was identified as a health risk many years ago. However, countries have reacted to the hazard in different ways. While some countries banned its use in products and construction decades ago, other countries, such as India, continue to use asbestos without regulation of any form. Indeed, asbestos use in India has risen over 80 percent in the last decade.

The World Health Organization (WHO) estimates that 125 million people worldwide are exposed to asbestos each year in the workplace. Even in the United States, asbestos may still be encountered in old buildings, flooring, and insulation components. Be aware of the regulations concerning the use of asbestos In your region and stay alert to sources that might do you harm if not avoided.

Only workers who have been trained and licensed are authorized to perform work related to asbestos including, but not limited to, the following tasks:

- Demolition
- Removal
- Alteration
- Repair
- Maintenance
- Installation
- Cleanup
- Transportation
- Disposal
- Storage

If asbestos is encountered or suspected on the job site, a supervisor must be notified and all work must stop until the asbestos is either sealed off or removed by licensed professionals.

5.2.1 Types of Respirators

Federal law specifies which type of respirator to use for different types of hazards. There are four general types of respirators (*Figure 60*):

- Self-contained breathing apparatus (SCBA)
- Supplied air mask
- Full facepiece mask with chemical canister (gas mask)
- Half mask or mouthpiece with mechanical filter

A SCBA carries its own air supply in a compressed air tank. It is used where there is not enough oxygen or where there are dangerous gases or fumes in the air.

A supplied-air mask uses a remote compressor or air tank to provide breathable air in oxygen-deficient atmospheres. Supplied-air masks can generally be used under the same conditions as SCBAs.

A full-facepiece mask with chemical canisters is used to protect against brief exposure to dangerous gases or fumes. A half mask or mouthpiece with a mechanical filter is used in areas where you might inhale dust or other solid particles.

5.2.2 Wearing a Respirator

If you need to use a respirator, your employer must provide you with the appropriate training to select, test, wear, and maintain this equipment. Your employer is also responsible for having you medically evaluated to ensure you are fit enough to wear respiratory protection equipment without being harmed. You must also be tested to ensure a proper fit and a good seal.

Wearing a respirator generally places a burden on the employee. A self-contained breathing apparatus is heavy and may be difficult for some workers to carry; negative-pressure respirators restrict breathing; and other respirators may cause claustrophobia. For these and other reasons, workers must be medically evaluated by a physician or other licensed health care professional to determine under what conditions they may safely wear respirators.

Respirators are ineffective unless properly fit-tested to the user. To obtain the best protection from a respirator, perform positive (breathing out) and negative (breathing in) fit checks each time it is worn. These fit checks must be repeated until a good face seal is obtained. A respirator must be clean, in good condition, and all of its components must be in place in order to provide adequate protection.

When a respirator is required, a personal monitoring device is usually also required. This device samples the air to measure the concentration of hazardous chemicals.

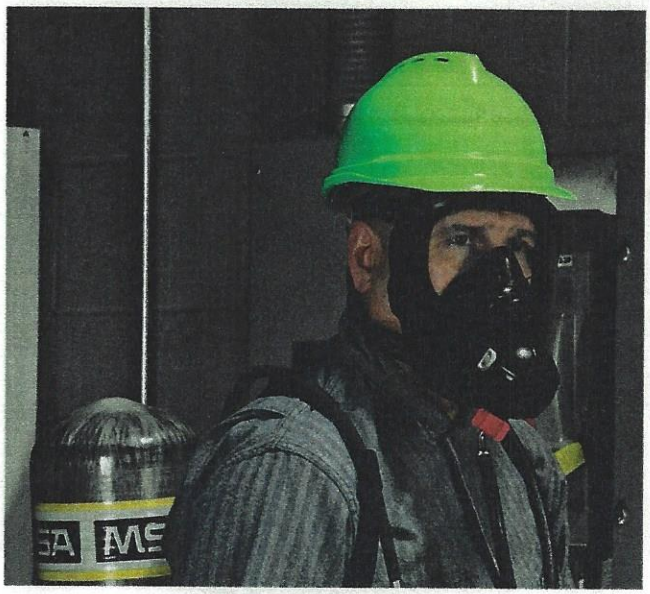
5.2.3 Selecting a Respirator

Follow company and government procedures when choosing the type of respirator for a particular job. Also be sure that it is safe for you to wear a respirator. Under current regulations, workers must fill out a questionnaire to identify potential problems in wearing a respirator. Depending on the answers, a medical exam may be required. When a respirator is not required, workers may voluntarily use a dust or particle mask for general protection. These masks do not require fit testing or a medical examination.

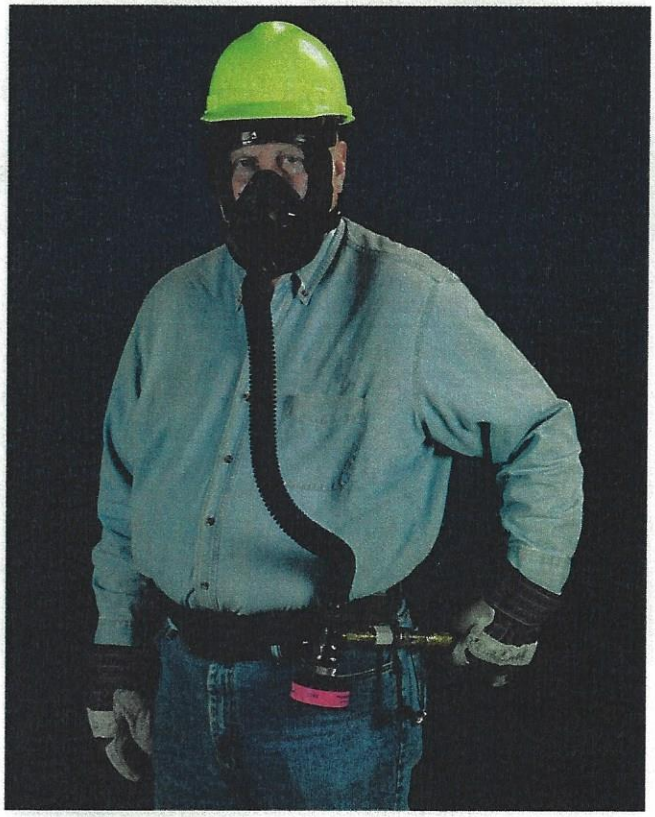
Always use the appropriate respiratory protective device for the hazardous material involved and the extent and nature of the work to be performed. Before using a respirator, you must determine the type and concentration level of the contaminant, and whether the respirator can be properly fitted on your face. If you wear contact lenses, practice wearing a respirator with your contact lenses to see whether you have any problems. That way, you will identify any problems before you use the respirator under hazardous conditions.

CAUTION

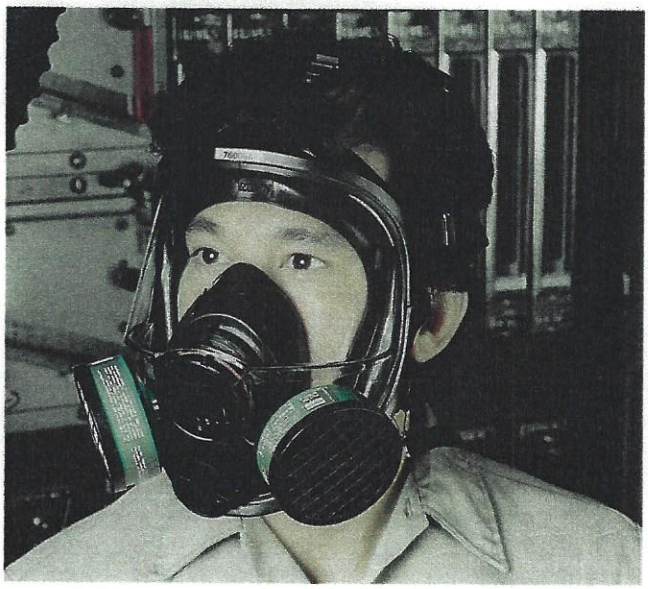
All respirator instructions, warnings, and use limitations contained on each package must be read and understood by the wearer before use.



(A) SELF-CONTAINED BREATHING APPARATUS (SCBA)



(B) SUPPLIED AIR MASK



(C) FULL FACEPIECE MASK

(D) HALF MASK

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Figure 60 Examples of respirators.

Additional Resources

US Occupational Safety and Health Administration. Numerous safety videos are available on line at **www.osha.gov/video.**

Construction Safety, Jimmie W. Hinze. 2006. Upper Saddle River, NJ: Pearson Education, Inc.

DeWalt Construction Safety/OSHA Professional Reference. Paul Rosenberg; American Contractors Educational Services. 2006. DEWALT.

Basic Construction Safety and Health, Fred Fanning. 2014. CreateSpace Independent Publishing Platform.

5.0.0 Section Review

1. Personnel working in the vicinity of arc welding work must wear eye protection with tinted lenses.
   a. True
   b. False

2. Drilling concrete requires use of a respirator because it produces _____.
   a. asbestos
   b. lead
   c. toxic fumes
   d. silica dust

SECTION SIX

6.0.0 JOB-SITE HAZARDS

Objectives

Identify and describe specific job-site safety hazards.

a. Identify various exposure hazards commonly found on job sites.
b. Identify hazards associated with environmental extremes.
c. Identify hazards associated with hot work.
d. Identify fire hazards and describe basic firefighting procedures.
e. Identify confined spaces and describe the related safety considerations.

Trade Terms

Brazing: A process using heat in excess of 800°F (427°C) to melt a filler metal that is drawn into a connection. Brazing is commonly used to join copper pipe.

Flash burn: The damage that can be done to eyes after even brief exposure to ultraviolet light from arc welding. A flash burn requires medical attention.

Flash point: The temperature at which fuel gives off enough gases (vapors) to burn.

Permit-required confined space: A confined space that has been evaluated and found to have actual or potential hazards, such as a toxic atmosphere or other serious safety or health hazard. Workers need written authorization to enter a permit-required confined space. Also see *confined space*.

Qualified person: A person who, by possession of a recognized degree, certificate, or professional standing, or by extensive knowledge, training, and experience, has demonstrated the ability to solve or prevent problems relating to a certain subject, work, or project.

Welding curtain: A protective screen set up around a welding operation designed to safeguard workers not directly involved in that operation.

Wind sock: A cloth cone open at both ends mounted in a high place to show which direction the wind is blowing.

It is impossible to list all the hazards that can exist on a construction or industrial job site. This section describes some of the more common hazards and explains how to deal with them. For your safety, you must know the specific hazards where you are working and how to prevent incidents and injuries. If you have questions specific to a job site, ask your supervisor.

6.1.0 Job-Site Exposure Hazards

The term *exposure* refers to contact with a chemical, biological, or physical hazard. Exposure can be chronic or acute. Chronic exposure is long-term and repeated, and may be mild or severe. Acute exposure is short-term and intense.

According to the HAZCOM standard, your employer must inform you of any hazards to which you might be exposed. In order to better protect you, your employer may require pre-employment and periodic medical examinations to ensure that your health is not being negatively affected by chemical exposure during work. Exams are usually conducted annually, and generally involve targeted organ testing. Because most medical tests cannot directly check for specific chemical exposure, blood tests are used to check the status of the particular organs (called target organs) known to be most affected by the chemicals to which a person has been exposed.

The results of these tests are compared to pre-employment test results and any other annual or periodic exams you may have had. Employers also frequently request a final screening when a worker leaves the company.

Workers can be exposed to chemicals and other hazardous materials in a variety of ways. Routes of exposure include breathing (inhalation), eating or drinking (ingestion), and skin contact (absorption). Chemical exposure is subject to permissible exposure limits (PELs). In other words, some level of exposure to certain chemicals and fumes is considered acceptable and does not represent a hazard. A PEL is the maximum concentration of a substance that a worker can be exposed to in an eight-hour shift. When a worker approaches or reaches the PEL, he or she must be removed from that environment.

There are various types of hazardous materials you may come in contact with during various types of construction work, including the following:

- Lead
- Bloodborne pathogens
- Chemicals

Taking the time to understand each of these hazards will help you stay healthy and safe. Working around these hazards requires special training and PPE. Never handle any of these materials without proper training, authorization, and PPE.

6.1.1 Lead

Lead occurs naturally in the Earth's crust and is spread through human activities, such as mining and the burning of fossil fuels. As an element, lead is indestructible—it does not break down. Once it is released into the environment, it can move from one medium to another. For example, lead in dust can be carried long distances, dissolve in slightly acidic water, and find its way into soil where it can remain for years. Lead is difficult to detect because it has no distinctive taste or smell.

Lead has many useful properties. It is soft and easily shaped, durable, resistant to some chemicals, and fairly common. Because lead is so versatile, it is used in the production of piping, batteries, and casting metals. However, lead is a toxic metal that can cause serious health problems. You can be exposed to lead by breathing air, drinking water, eating food, and swallowing or touching dust or dirt that contains lead.

You may encounter lead-based paints during demolition or renovation of structures built before 1978, when lead-based paint was banned. Dust created from sanding lead-based paints is hazardous. Protective clothing and equipment must always be used when lead levels are above the PEL. If you are unsure whether lead is present, consult your supervisor.

All waste contaminated with lead is considered hazardous. Those who handle hazardous waste must have special training. Never handle hazardous materials or waste without proper training, authorization, and PPE.

6.1.2 Bloodborne Pathogens

Bloodborne pathogens are another health hazard you may encounter on the job site. Sometimes you will hear them referred to as bloodborne infectious diseases. They are diseases that can be transmitted by contact with an infectious person's blood or other bodily fluids, the most common being HIV (the virus that causes AIDS) and hepatitis B and C.

You could be exposed to another person's blood on the job site when administering first aid to an injured person or being involved in a multi-victim incident. In order to safeguard yourself, you must know the universal precautions to prevent exposure and follow them closely:

- Always use appropriate gloves, eye protection, and a mask when administering first aid.
- If you come in contact with someone's blood, immediately wash the affected areas with soap and water. Otherwise, use antiseptic hand cleanser or antiseptic towelettes until washing with soap and running water is possible.
- Notify your supervisor of the contact right away.

You may need to seek medical attention for precautionary screening, particularly if that person has any bloodborne infectious diseases. Your employer should have a written exposure control plan and procedure for such occurrences.

6.1.3 Chemical Splashes

Chemicals such as acids and solvents can pose physical hazards, including acid reactions or burns. Acids can create toxic vapors or react violently when mixed with other chemicals. Other chemicals are flammable, combustible, or explosive. For example, solvents and compressed gases are often flammable. These materials can catch fire in their liquid or gaseous state. Some materials, such as blasting caps, are dangerous solids. These items should be kept away from open flames, sparks, intense heat, or other ignition sources to prevent fires or explosions. Know the physical hazards of the chemicals being used in order to prevent fires and chemical reactions.

Workers should always check the SDS for a chemical before working with or around it. That way, you will be prepared to take appropriate corrective action if you or another worker is exposed.

WARNING! Chemical splashes can become medical emergencies. Before working with any chemicals, ensure that you know where the nearest shower and eyewash station are, and verify that they are functioning properly.

Remember to wear prescribed clothing and PPE on the job site at all times. This will help guard against your skin and eyes being splashed with chemicals. If you are not sure of the PPE needed on your job site or for a certain task, consult your supervisor before beginning work.

WARNING

Never handle any chemicals without proper training and PPE. Review the SDS for each chemical, and strictly follow SDS first aid instructions if you suspect exposure.

6.1.4 Container Labeling

On a construction site, any material in a container must have a label. Labels describe what is in a container and warn of chemical hazards. The HAZCOM Standard states that hazardous material containers must be labeled, tagged, or marked. The label must include the name of the material, the appropriate hazard warnings, and the name and address of the manufacturer. On December 1, 2015, OSHA will require that all shipments be labeled as outlined by the Global Harmonization System (GHS), which has been adopted as a worldwide standard to enhance awareness and improve the safety and health of workers exposed to these substances.

In today's global marketplace, chemicals and similar hazardous materials are in constant movement between countries. With many countries having their own hazardous material labeling system, products must often be labeled multiple times to support the systems of both the shipping and receiving countries. The GHS will solve this problem by providing some standardized labeling for various materials. There are nine pictograms that workers must become familiar with are shown here. Those that are related to flammable, combustible, and explosive materials are shown in *Figure 61*, and those that represent other hazards are shown in *Figure 62*.

Pictograms have been in use for a number of years to depict a variety of hazards or to communicate information. The advantage of pictograms is that they cross any language barrier. Regardless of language, pictograms such as those used in the GHS tell the user what type of hazard to be concerned about. Although other systems of container labeling will be encountered for years to come, the pictograms all share common features and visually represent the hazard of concern.

If a material is transferred from a labeled container to a new container, the new container must be labeled with all of the information from the original label. Make sure that any materials being worked with are labeled. Be sure that you understand your company's labels.

WARNING!

Never use chemicals from an unlabeled container.

Process Safety Management

One way to avoid the hazards associated with chemical spills is to evaluate those hazards and plan ahead for dealing with unwanted releases. Forward-thinking companies adopt a method known as process safety management for this purpose. Process safety management involves training employees and contractors; making information available; establishing formal procedures; analyzing potential hazards; and taking steps to mitigate the hazards.

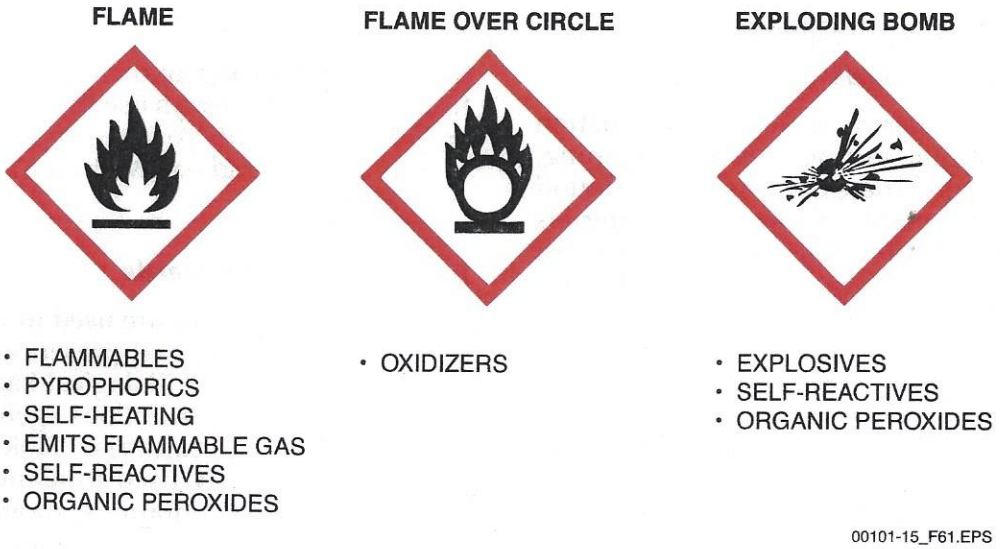

Figure 61 GHS labels for flammable, combustible, and explosive materials.

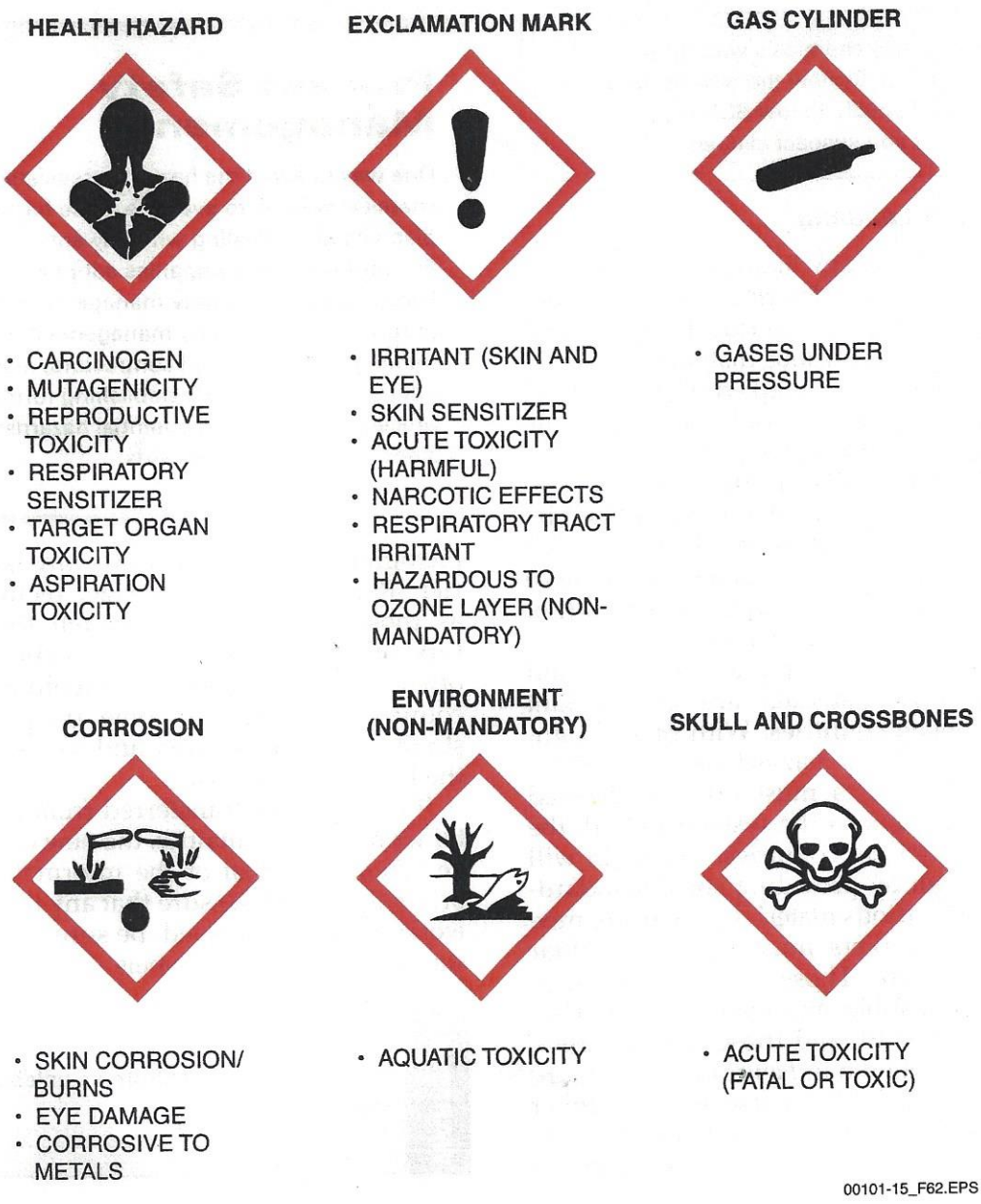

Figure 62 GHS labels for various materials.

6.1.5 Radiation Hazards

Radioactive materials are used in construction during radiographic testing of welds in piping, vessels, and pumps. These hazards are also found at nuclear power plants. Radioactive materials must be properly labeled and warning signs must be posted in the work area. Only trained workers are allowed in these areas. If you see signs containing symbols like those shown in *Figure 63*, stay away from that area unless properly trained.

Radioactive materials are a special type of physical hazard. Excessive radiation exposure can cause skin burns, nausea, vomiting, infertility, and cancer. Employees can minimize radiation exposure by limiting the amount of time they are exposed and/or increasing their distance from the source. Always use the proper shielding or PPE. Check with your supervisor to find out if there are any radioactive hazards and how to avoid them.

6.1.6 Biological Hazards

Biological hazard signs are used to warn workers of the actual or potential presence of a biological hazard (*Figure 64*). Biological hazards, or biohazards, can be any infectious agents that create a real or potential health risk. Biological hazard signs are commonly used to identify contaminated equipment, containers, rooms, materials, and areas housing experimental animals.

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Figure 63 Radioactivity warning symbols.

Background colors on signs may vary, but must contrast enough for the symbol to be easily identified. Wording is used on the sign to indicate the nature of the hazard or to identify the specific hazard.

6.1.7 Evacuation

In many work environments, specific evacuation procedures are needed. These procedures go into effect when dangerous situations arise, such as fires, chemical spills, and gas leaks. In an emergency, you must know the evacuation procedures. You must also know the signal (usually a horn or siren) that tells workers to evacuate.

When the evacuation signal sounds, follow the evacuation procedures precisely. That usually means taking a certain route to a designated assembly area and telling the person in charge that you are there. If hazardous materials are released into the air, you may have to determine which way the wind is blowing. Some sites may have a **wind sock** that indicates the wind direction. Different evacuation routes are planned for different wind directions. Taking the right route will keep you from being exposed to the hazardous material.

00101-15_F64.EPS

Figure 64 Biological hazard symbol.

6.2.0 Environmental Extremes

Workers on construction and industrial sites are often required to work outdoors in extremes of heat and cold. It is important to know how to protect yourself in such environments and to recognize the symptoms of conditions that could be caused by environmental extremes.

6.2.1 Heat Stress

Heat stress occurs when abnormally hot air and/or high humidity, or extremely heavy exertion, prevents your body from cooling itself fast enough. When this happens, you may suffer heat cramps, heat exhaustion, or a heat stroke. To prevent heat stress, take the following precautions:

- Drink plenty of water.
- Avoid alcoholic or caffeinated drinks.
- When possible, perform the most strenuous work during cooler parts of the day.
- Wear lightweight, light-colored clothing.
- Wear loose-fitting cotton clothing if it does not create a hazard.
- Keep your head covered and your face shaded.
- Take frequent, short breaks.
- Rest in the shade whenever possible.

Workers are encouraged to drink 4 cups (≈1 liter) of water per hour when the heat index is 103°F (39.5°C) or higher when working in hot conditions. Start by having one or two glasses of water before beginning work, and then drink one cup (237 milliliters) every 15 to 20 minutes when working in hot conditions. It is possible to drink too much water as well. Water intake should not

exceed 6 cups (1.4 l) per hour or 3 gallons (11.4 l) per day. Drinking water should be cool but not cold.

6.2.2 Heat Cramps

Heat cramps are muscular pains and spasms caused by heavy exertion. Any muscles can be affected, but most often it is the muscles that have been used the most. Loss of water and electrolytes from heavy sweating causes these cramps. Symptoms of heat cramps include the following:

- Painful muscle spasms and cramping
- Pale, sweaty skin
- Normal body temperature
- Abdominal pain
- Nausea

As noted above, body temperature is not normally elevated during the onset of heat cramps. An increase in body temperature usually indicates that the problem is escalating to a more serious stage. If you experience heat cramps, take the following steps: move to a cool area, drink some water, and gently stretch and massage cramped muscles.

6.2.3 Heat Exhaustion

Heat exhaustion typically occurs when people exercise heavily or work in a warm, humid place where body fluids are lost through heavy sweating. When it is humid, sweat does not evaporate fast enough to cool the body properly.

Symptoms of heat exhaustion include the following:

- Cool, pale, and moist skin
- Heavy sweating
- Headache, nausea, vomiting
- Dilated pupils
- Dizziness
- Possible fainting
- Fast, weak pulse
- Slight elevation in body temperature

If someone is showing the symptoms of heat exhaustion, get the victim to a shaded area and have him or her lie down. Try to cool the victim by applying cold wet cloths, fanning, removing heavy clothing, and giving small amounts of cool water if the victim is conscious. If the victim's condition does not improve within a few minutes, call emergency medical services.

6.2.4 Heat Stroke

Heat stroke is life threatening. The body's temperature-control system, which produces sweat to cool the body, stops working. Body temperature can rise so high that brain damage and death may result if the body is not cooled quickly.

WARNING! If you suspect someone has heat stroke, call emergency medical services immediately.

The symptoms of heat stroke include the following:

- Hot, dry, or spotted skin
- Extremely high body temperature
- Very small pupils
- Mental confusion
- Headache
- Vision impairment
- Convulsions
- Loss of consciousness

While waiting for help to arrive, try to cool the victim using the methods described for heat exhaustion. Ice packs placed in the armpits and the groin should be used, if possible.

6.2.5 Cold Stress

When your body temperature drops even a few degrees below normal, which is about 98.6°F (37°C), you can begin to shiver uncontrollably and become weak, drowsy, disoriented, unconscious, or even fatally ill. This loss of body heat is known as cold stress, or hypothermia.

People who work outdoors during the winter need to learn how to protect against loss of body heat. The following guidelines can help you keep your body warm and avoid the dangerous consequences of hypothermia, frostbite, and overexposure to the cold.

WARNING! Always seek immediate medical attention if you suspect hypothermia or frostbite.

Outdoors, indoors, in mild weather, or in cold, it is a good idea to dress in layers. Layering your clothes allows you to adjust what you are wearing to suit changing temperature conditions. In cold weather, wear cotton, polypropylene, or lightweight wool next to your skin, and wool layers over your undergarments. For outdoor activities, choose clothing made of waterproof, wind-resistant fabrics such as nylon. Since a great deal of body heat is lost through the head, always wear a hat for added protection.

Water chills the body far more rapidly than air or wind. Always take along an extra set of clothing whenever working outdoors. If clothes become damp, change to dry clothes to prevent your body temperature from dropping in cold weather. Wear waterproof boots in damp or snowy weather, and always pack raingear even if the forecast calls for sunny skies.

6.2.6 Frostbite

Frostbite is a dangerous condition that can have lifelong effects on your body. It usually affects the hands, fingers, feet, toes, ears, and nose. Symptoms of frostbite include a pale, waxy-white skin color and hard, numb skin.

Remember the following when providing first aid for frostbite:

- Never rub the affected area. This can damage the skin and tissue.
- After the affected area has been warmed, it may become puffy and blister.
- The affected area(s) may have a burning feeling or numbness. When normal feeling, movement, and skin color have returned, the affected area(s) should be dried and wrapped to keep it warm.
- If there is a chance the affected area may get cold again, do not warm the skin. If the skin is warmed and then becomes cold again, it will cause severe tissue damage. Seek medical attention as soon as possible. First aid for frostbite includes moving the victim to a warm area, removing wet clothing, and applying warm water of about 105°F (41°C) to the affected area. Do not pour the warm water directly onto the area, however.

6.2.7 Hypothermia

Hypothermia is a serious, potentially fatal condition caused by loss of body heat. You do not have to be in below-freezing temperatures to be at risk for hypothermia. Hypothermia can happen on land or in water.

The effects of hypothermia can be gradual and often go unnoticed until it is too late. If you know you'll be working outdoors for an extended period of time, work with a buddy. At the very least, let someone know where you'll be and what time you expect to return. Ask your buddy to check you for overexposure to the cold, and do the same for your buddy. Check for shivering, slurred speech, mental confusion, drowsiness, and weakness. If anyone shows any of these signs, call for emergency medical assistance and see that the victim is moved indoors as soon as possible to warm up.

WARNING! If a co-worker exhibits uncontrolled shivering, slurred speech, clumsy movements, fatigue, and confused behavior, immediately call for medical assistance.

Symptoms of hypothermia include the following:

- A drop in body temperature
- Fatigue or drowsiness
- Uncontrollable shivering
- Slurred speech
- Clumsy movements
- Irritable, irrational, confused behavior

If a person is showing symptoms of hypothermia from exposure to cold air, immediately call for medical assistance. The victim should be moved to a warm, dry area. Any wet clothing should be removed and replaced with dry

Around the World

Temperature Extremes

Some places in the world reach incredibly hot and cold temperatures. Although work may come to a halt in the worst conditions, the job goes on between the extremes. In Chita, Russia for example, the average low temperature in January is roughly –30°C (≈–22°F). The average high during this period is around –17°C (≈1°F). Since these are average temperatures, people in Chita must adapt and continue working. The admiration of the world's workers should go to those who must work in temperature extremes like this without hesitation.

clothing or blankets. If possible, give the victim warm sweet drinks; avoid drinks with caffeine, as well as alcohol. Have the victim move his arms and legs to create muscle heat. If he is unable to do this, place warm bottles or hot packs around the armpits, groin, neck, and head. Do not rub the victim's body or place him in a warm bath. This could cause additional harm.

Body heat is lost up to 25 times faster in water than on land and the methods used to help victims while waiting for medical help to arrive is different. If you are a victim, first of all, do not remove any clothing. Close up and tighten all clothing to create a layer of trapped water close to the body. This provides insulation that slows heat loss. Keep your head out of the water and put on a hat or hood if possible. Get out of the water as quickly as possible, or climb onto a floating object. Do not attempt to swim unless you can reach a floating object or another person. Swimming or other physical activity uses the body's heat and reduces survival time by about 50 percent.

If it is not possible to get out of the water, wait quietly, and conserve your body heat by folding your arms across your chest, keeping your thighs together, bending your knees and crossing your ankles. If another person is in the water, huddle together with your chests pressed tightly together.

6.3.0 Hot Work Hazards

Welding and torch cutting of metals is done using heat that is high enough to melt steel. In addition, most flame cutting and some welding processes are done with flammable gases. For those reasons, such processes are classified as hot work and are subject to special safety precautions. Grinding with a pneumatic or electric grinding machine (*Figure 65*) is also classified as hot work, as it gives off sparks that could cause a fire or explosion in an environment containing flammable gases or concentrated dust. Hot work always carries a risk of severe burns as well as fire hazards. Being aware of these risks is of great importance and will help keep you safe.

6.3.1 Arc Welding Hazards

Arc welding is a process in which metals are joined using a high-intensity electric arc (*Figure 66*) at temperatures in the range of 1,500 to 3,000°F (815 to 1,648°C). The arc melts and fuses the base metals. In most cases, a filler metal is melted along with the base metal to strengthen the joint. Welders are required to wear specialized PPE

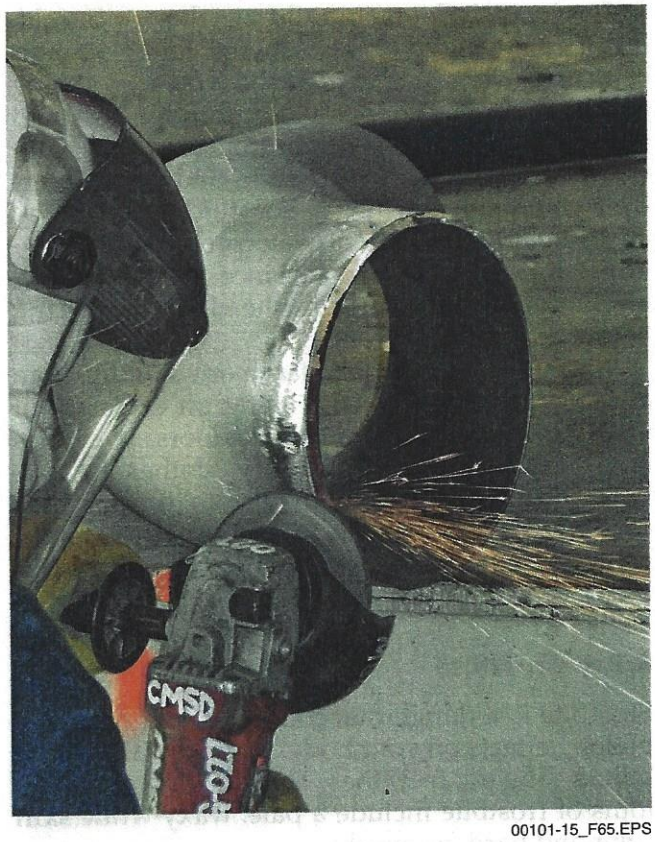

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Figure 65 Grinding creates sparks.

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Figure 66 Arc welding.

that protects their eyes from damage and protects their bodies from burns caused by sparks and molten metal. Such eye protection includes tinted goggles as well as a full face shield with a tinted viewing window. Anyone working in the vicinity of arc welding must also be protected, especially from damage to their eyes caused by looking at the welding arc. Never look at an arc welding operation without wearing the proper tinted eye protection, because the ultraviolet light from the

arc will burn your eyes. Even a reflected arc can harm your eyes. It is extremely important to follow proper safety procedures at and around all welding operations. Serious eye injury or even blindness, as well as burns, can result from unsafe conditions.

When people are working near a welding operation, **welding curtains** (*Figure 67*) must be set up and everyone in the vicinity must wear tinted protective eyewear.

Even a brief exposure to the ultraviolet light from arc welding can cause a **flash burn** and damage your eyes badly. You may not notice the symptoms until sometime after the exposure. Here are some symptoms of flash burns to the eye:

- Headache
- Feeling of sand in your eyes
- Red or weeping eyes
- Trouble opening your eyes
- Impaired vision
- Swollen eyes

Welded material is dangerously hot. Mark it with a sign and stay clear for a while after the welding has been completed.

6.3.2 Oxyfuel Cutting, Welding, and Brazing

Oxygen and acetylene (oxyfuel) gases are combined to produce a flame with a temperature high enough to melt steel. So-called oxyfuel is commonly used to cut and weld steel and to join copper pipe by **brazing**.

Figure 68 shows a worker using an oxyfuel torch to cut steel. Persons working with or around welding, brazing, or metal cutting equipment can be severely burned from the intense heat and flames generated in these processes. In addition, the gases used in these processes pose an additional danger because they are stored under pressure in metal cylinders (*Figure 69*).

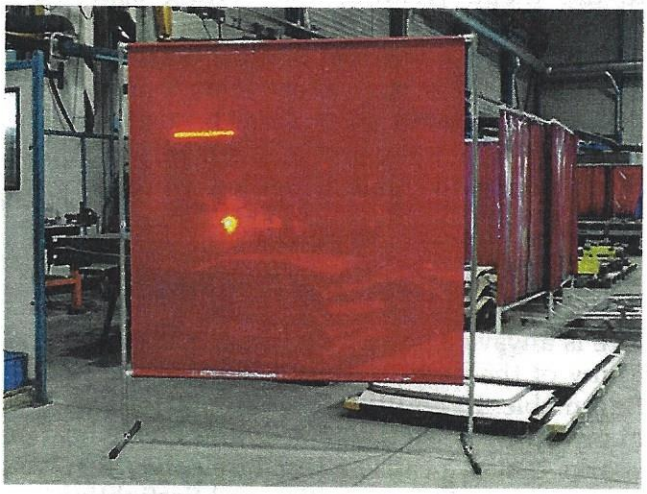

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Figure 67 Welding curtain.

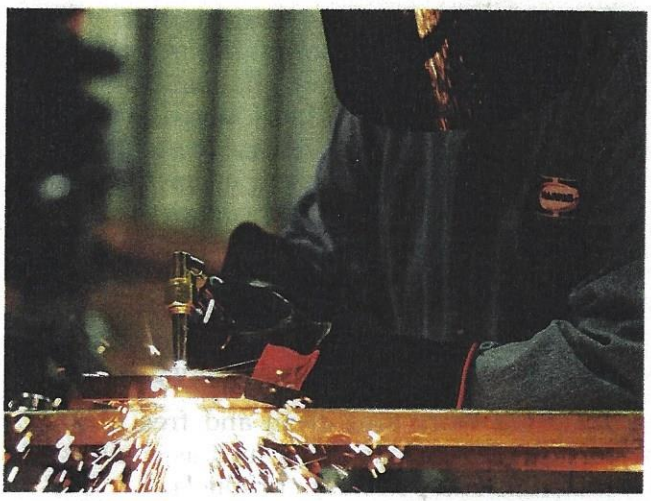

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Figure 68 Oxyfuel cutting.

Many hazards are involved in the handling, storage, and use of compressed gases. It takes energy to compress and confine the gas. That energy is stored until purposely released to perform useful work or until incidentally released by container failure or other causes.

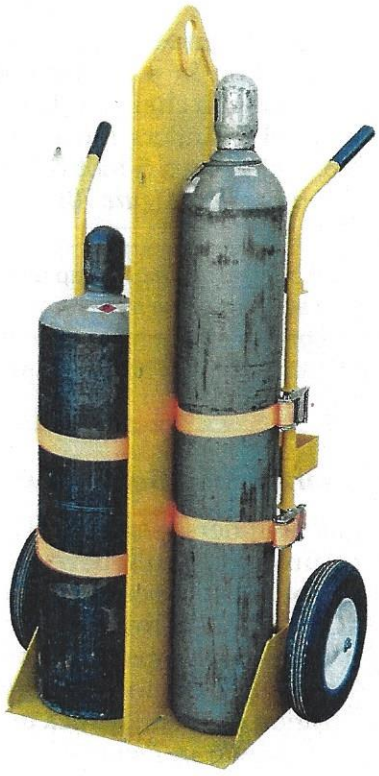

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Figure 69 Compressed-gas cylinders used for oxyfuel cutting.

Some gases, such as acetylene, are highly flammable. Oxygen is an explosion hazard if it comes into contact with grease or oil. Flammable compressed gases have additional stored energy besides simple compression-released energy. In case of a fire, for example, escaping oxygen will make the fire more intense. Other compressed gases, such as nitrogen, can cause asphyxiation simply because they displace oxygen.

The cylinders containing oxygen and acetylene must be transported, stored, and handled very carefully. Always follow these safety guidelines:

- Keep the work area clean and free from potentially hazardous items such as combustible materials and petroleum products.

WARNING!

Keep oxygen away from sources of flame and combustible materials, especially substances containing oil, grease, or other petroleum products. Compressed oxygen mixed with oil or grease will explode. Never use petroleum-based products around fittings that serve compressed oxygen lines.

- Use great caution when you handle compressed gas cylinders.
- Store cylinders in an upright position where they will not be struck, where they will be away from corrosives, and where they cannot tip over or fall. Cylinders must be stored in the upright position in a secure container or secured to a wall with chains. When in storage, oxygen and fuel cylinders must be separated by 20 feet (6.1 m) or by a 5-foot (1.5 m) high ½-hour fire-rated barrier (*Figure 70*).

WARNING!

Do not remove the protective cap unless a cylinder is secured. If the cylinder falls over and the nozzle breaks off, the cylinder could shoot off like a rocket, injuring or killing anyone in its path.

6.3.3 Transporting and Securing Cylinders

Always handle cylinders with care. They are under high pressure and should never be dropped, knocked over, rolled, or exposed to heat in excess of 140°F (60°C). When moving cylinders, always be certain that the valve caps are in place. Cylinders must be transported to the workstation in the upright position on a hand truck or bottle cart such as the one shown in *Figure 69*. Oxygen and cutting gases should not be transported on the same cart unless the cart has a divider, as shown. Be aware that some job sites will not permit oxygen and cutting gases to be transported on the same cart under any circumstances.

Never attempt to lift a cylinder using the holes in a safety cap; use an approved lifting cage (*Figure 71*). Make sure that the cylinder is secured in the cage. Cages of various sizes are available for high-pressure cylinders and cylinders containing liquids.

6.3.4 Hot Work Permits

A hot work permit (*Figure 72*) is an official authorization from the site manager to perform work that may pose a fire hazard. The permit includes information such as the time, location, and type of work being done. The hot work permit system promotes the development of standard fire safety guidelines. Permits also help managers keep records of who is working where and at what time. This information is essential in the event of an emergency at times when personnel need to be evacuated.

Most sites require the use of hot work permits and fire watches. When these requirements are violated, severe penalties may be imposed because of the risk it represents. Before a hot work permit is issued, a competent person must inspect the work area to ensure that no flammable or combustible materials are present. This inspection includes the areas above and below where the work will be performed, as well as the surrounding area.

A fire watch is posted when welding or cutting work is being done in many areas. One person other than the welding or cutting operator must constantly scan the work area for fires. Fire watch personnel should have ready access to fire extinguishers and alarms and know how to use them. Welding and cutting operations should never be performed without a fire watch. The area where welding is done must be monitored afterwards until there is no longer a risk of fire. The person on fire watch must be dedicated to that activity and may not perform other work during the time when hot work is being performed.

6.4.0 Fire Hazards and Firefighting

Fire is always a hazard on construction job sites. Many of the materials used in construction are flammable. In addition, welding, grinding, and many other construction activities create heat or sparks that can cause a fire. Fire safety involves two elements: fire prevention and firefighting.

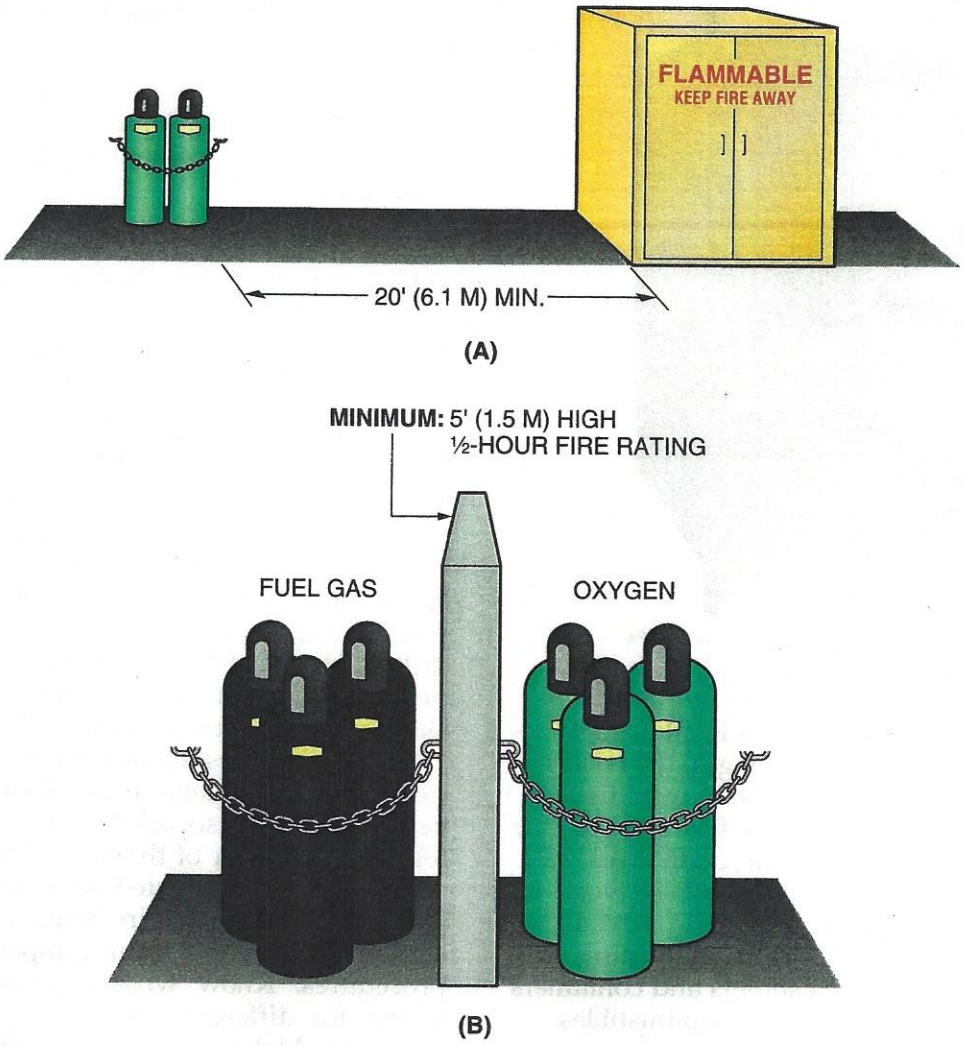

Figure 70 Cylinder storage.

6.4.1 How Fires Start

For a fire to start, three things are needed in the same place at the same time: fuel, heat, and oxygen. If one of these three is missing, a fire will not start.

Fuel is anything that will combine with oxygen and heat to burn. Oxygen is always present in the air. When pure oxygen is present, such as near a leaking oxygen hose or fitting, material that would not normally be considered fuel (including some metals) will burn.

Heat refers to a source of ignition. It may be as simple as a single spark. Heat is anything that will raise a fuel's temperature to the **flash point**. The flash point is the temperature at which a fuel is encouraged to burn. The flash points of some fuels are quite low—room temperature or less. When the burning gases raise the temperature of a fuel to the point at which it ignites, the fuel itself will burn—and keep burning—even if the original source of heat is removed.

What is needed for a fire to start can be shown as a fire triangle (*Figure 73*). If one element of the triangle is missing, a fire cannot start. If a fire has started, removing any one element from the triangle will put it out.

6.4.2 Combustibles

Combustibles are categorized as liquid, gas, or ordinary combustibles. The term *ordinary combustibles* means paper, wood, cloth, and similar fuels. Liquids can be flammable or combustible. Flammable liquids have a flash point below 100°F (38°C). Combustible liquids have a flash point at or above 100°F (38°C). Flammable gases used on construction sites include acetylene, hydrogen, ethane, and propane. To save space, these gases are compressed so that a large amount is stored in a small cylinder or bottle. As long as the gas is kept in the cylinder, oxygen cannot get to it and start a fire. The cylinders should be stored away

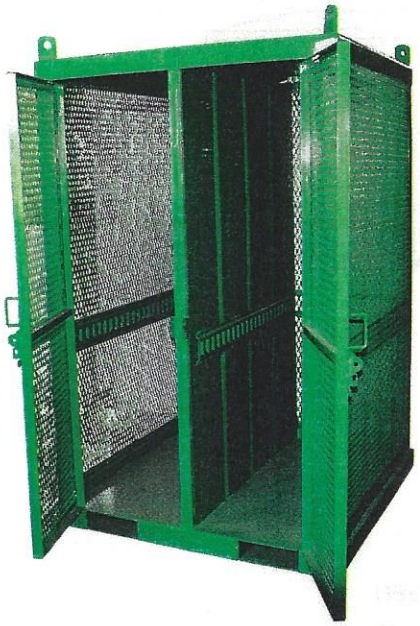

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Figure 71 Cylinder lifting cage.

from sources of heat. If oxygen is allowed to escape and mix with a flammable gas, the resulting mixture will explode under certain conditions.

The easiest way to prevent fire in ordinary combustibles is to keep a neat, clean work area. If there are no scraps of paper, cloth, or wood lying around, there will be no fuel to start a fire. Establish and maintain good housekeeping habits. Use approved storage cabinets and containers for all waste and other ordinary combustibles.

6.4.3 Fire Prevention

The best way to ensure fire safety is to prevent a fire from starting. Fire can be prevented by the following actions:

- *Removing the fuel* – Liquid does not usually burn. What generally burns are the gases (vapors) given off as the liquid evaporates. Keeping liquids in an approved, sealed container prevents evaporation. If there is no evaporation, there is no fuel to burn.
- *Removing the heat* – If the liquid is stored or used away from a heat source, it will not be able to ignite.
- *Removing the oxygen* – The vapor from a liquid will not burn if oxygen is not present. Keeping safety containers tightly sealed prevents oxygen from coming into contact with the fuel.

The best way to prevent a fire is to make sure that fuel, oxygen, and heat are never present in the same place at the same time.

The following are some basic safety guidelines for fire prevention:

- Always work in a well-ventilated area, especially when using flammable materials such as shellac, lacquer, paint stripper, or construction adhesives.
- Never smoke or light matches when working with or near flammable materials.
- Keep oily rags in approved, self-closing metal containers.
- Store combustible materials only in approved containers.

6.4.4 Basic Firefighting

You are not expected to be an expert firefighter, but you may have to deal with a fire to protect your safety and the safety of others. You need to know the locations of firefighting equipment on your job site as well as which equipment to use on different types of fires. However, only a **qualified person** is placed in a position where firefighting skills are a required activity.

Most companies tell new employees where fire extinguishers are kept. If you have not been told, be sure to ask. Also, ask how to report fires. The telephone number of the nearest fire department should be clearly posted in your work area. If your company has a fire brigade, learn how to contact them. Learn your company's fire safety procedures. Know what type of extinguisher to use for different kinds of fires and how to use them. Make sure all extinguishers are fully charged. Never remove the tag from an extinguisher—it shows the date the extinguisher was last serviced and inspected.

A fire watch is required to have a fire extinguisher while on duty. A portable extinguisher such as the one shown in *Figure 74* is commonly provided for that purpose.

The function of a fire extinguisher is to remove one of the three elements (oxygen, heat, fuel) needed to sustain a fire. A fire extinguisher cannot remove fuel, so it is designed to remove either heat or oxygen. Heat is removed by using a coolant such as water; oxygen is removed by smothering the fire with dry chemicals or CO_2.

Fire extinguishers are rated for specific types of fires. Class A extinguishers, for example, are intended for fires involving ordinary combustibles such as paper, wood, and fabric. An extinguisher that is rated only for Class A fires might contain water, which could not be used on electrical or grease fires. Using water on a Class B fire (flammable liquids, grease, or gases) could spread the fire or splash burning fuel. Using water on a

HOT WORK PERMIT

For Cutting, Welding, or Soldering with Portable Gas or ARC Equipment

(References: 1997 Uniform Fire Code Article 49 & National Fire Protection Association Standard NFPA 51B.)

Job Date_____ Start Time_____ Expiration_____ WO #_____

Name of Applicant_____ Company_____ Phone_____

Supervisor_____ Phone_____

Location / Description of work _____

IS FIRE WATCH REQUIRED?

1. _____ (yes or no) Are combustible materials in building construction closer than 35 feet to the point of operation?
2. _____ (yes or no) Are combustibles more than 35 feet away but would be easily ignited by sparks?
3. _____ (yes or no) Are wall or floor openings within a 35 foot radius exposing combustible material in adjacent areas, including concealed spaces in floors or walls?
4. _____ (yes or no) Are combustible materials adjacent to the other side of metal partitions, walls, ceilings, or roofs which could be ignited by conduction or radiation?
5. _____ (yes or no) Does the work necessitate disabling a fire detection, suppression, or alarm system component?

YES to any of the above indicates that a qualified fire watch is required.

Fire Watcher Name(s) _____ Phone_____

NOTIFICATIONS

Notify the following groups at least 72 hours prior to work and 30 minutes after work is completed.
Write in names of persons contacted.

Notify in person OR by phone ONLY if question #5 above is answered "yes":

- Facilities Management Fire Alarm Supervisor

Notify by phone or in person: (If by phone, write down name of person and send them a completed copy of this permit.)

- Facilities Management Fire Protection Group
- Environmental Health & Safety Industrial Hygiene Group

SIGNATURES REQUIRED

University Project Manager_____ Date _____ Phone_____

I understand and will abide by the conditions described in this permit. I will implement the necessary precautions which are outlined on both sides of this permit form. Thirty minutes after each hot work session, I will reinspect work areas and adjacent areas to which spark and heat might have spread to verify that they are fire safe, and contact Facilities Management Alarm Technicians to have any disabled fire protection systems reactivated.

_____ _____ Date _____ Phone_____
Permit Applicant Company or Department

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Figure 72 Hot work permit.

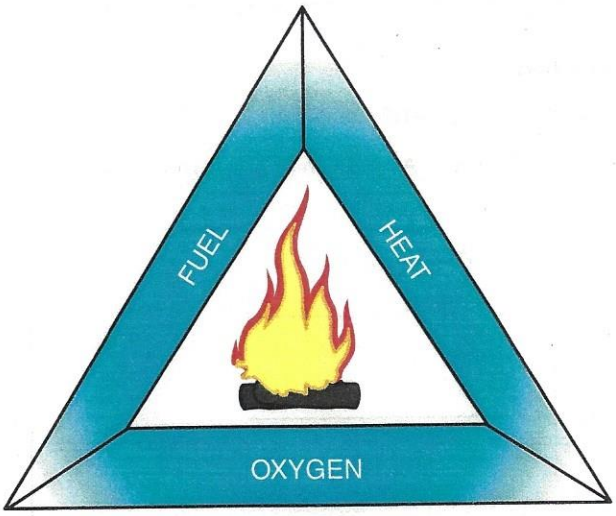

Figure 73 The fire triangle.

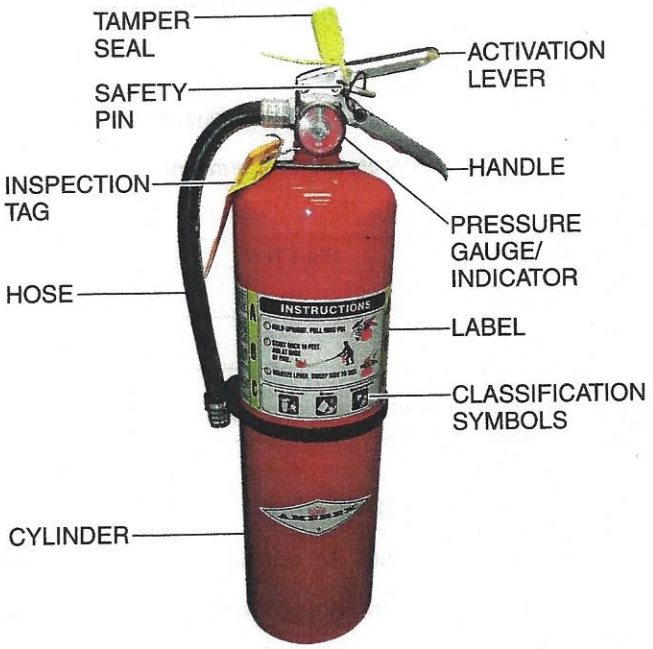

Figure 74 A portable fire extinguisher.

Class C (electrical) fire could cause you to be electrocuted because water conducts electricity. Class D fire extinguishers are required for fires involving reactive metals such as sodium, potassium, magnesium, titanium, zirconium, and the metal hydrides. A Class D fire extinguisher contains a powder designed to coat the metal to either smother the fire or keep oxygen from reaching the fire. If the powder coat fails to extinguish the fire, the best solution is to reapply the powder to keep the fire from spreading.

A pictogram label (*Figure 75*) on the extinguisher denotes the type(s) of fire for which the extinguisher is intended. The extinguisher shown in the figure is a dry-chemical extinguisher, which can be used on a Class A, B, or C fire. This type is the most common because it can be used to fight most fires. Some CO_2 extinguishers can also be used on Class A, B, or C fires, but others are designed for use on only class B and C fires. This can be seen in *Figure 76*.

CO_2 is heavier than oxygen, so it smothers the fire by displacing the available oxygen. It also cools as it expands, so it can serve as a coolant. Some companies permit only CO_2 extinguishers to be used because the dry chemical in a dry-chemical extinguisher is a corrosive that can damage electrical systems. In addition, the fine powder emitted by the material in a dry-chemical extinguisher can cause eye and respiratory irritation when it becomes airborne. One advantage of the dry-chemical extinguisher is that its working range is 10 to 20 feet (3.1 to 6.1 m), while the range of the CO_2 extinguisher is 3 to 8 feet (0.9 to 2.4 m). A pressurized-water extinguisher, which is used only for Class A fires, has a range of about 50 feet (15 m).

Prevention and Preparation Are the Keys to Fire Safety

Any fire in the workplace can cause serious injury or property damage. When chemicals are involved, the risks are even greater. Prevention is the key to eliminating the hazards of fire in the workplace. Preparation is the key to controlling any fires that do start. Take the following precautions to ensure safety from fire in the workplace:

- Keep work areas clean and clutter-free.
- Know how to handle and store chemicals.
- Know what you are expected to do in case of a fire emergency.
- Should a fire start, call for professional help immediately. Don't let a fire get out of control.
- Know what chemicals you work with. You might have to tell firefighters at a chemical fire what kinds of hazardous substances are involved.
- Make sure you are familiar with your company's emergency action plan for fires.
- Use caution when using power tools near flammable substances.

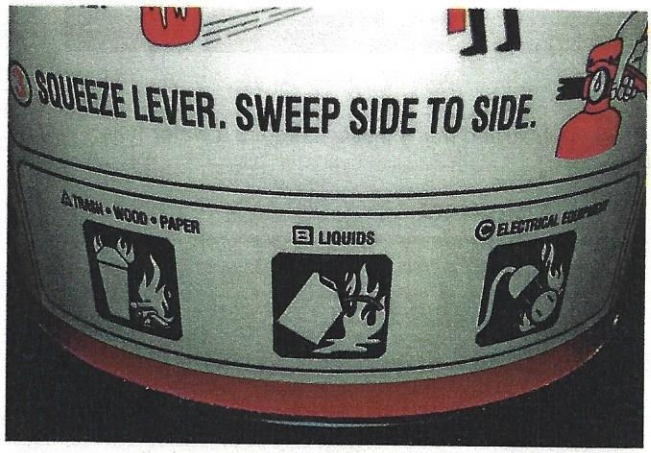

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Figure 75 Fire extinguisher pictograms.

WARNING!

Do not use a CO_2 extinguisher on a Class D fire, as it can cause the fire to spread. Also note that CO_2 is heavier than air, so it will concentrate in low areas, displacing oxygen. For that reason, a CO_2 extinguisher must never be taken into, or used in, a confined space. Before it can be used in a confined space, all personnel in the space must first be evacuated. After the extinguisher has been used in the confined space, the space must be cleared by a competent person before it can be re-entered.

Finally, CO_2 is discharged from the extinguishers at a temperature of –109°F (–78°C), so it can cause frostbite if it contacts the skin. Never discharge it while it is pointed at someone and do not hold it by the activation lever unless the activation lever is insulated.

WARNING!

When using a CO_2 extinguisher do not hold the activation lever with your bare hand, as it will become extremely cold.

Fire extinguishers must be periodically inspected to make sure they are properly charged. The needle on the extinguisher's pressure gauge must register in the green area (*Figure 77*). The inspection must be documented on the tag attached to the extinguisher. Whenever you check out an extinguisher, make sure its inspection tag (*Figure 78*) is up to date and that the pressure gauge registers the correct charge. Not all extinguishers have gauges, however. Extinguishers without gauges must be weighed to determine if they are fully charged.

6.4.5 Using a Fire Extinguisher

Use the PASS method (*Figure 79*) when attacking a fire:

- Pull the pin from the handle, breaking the tamper seal in the process (*Figure 80*).
- Aim the nozzle at the base of the fire while 8 to 10 feet away.
- Squeeze the discharge handle.
- Sweep the nozzle back and forth at the base of the fire.

Note that the method of attacking the fire can vary from one extinguisher to another. The instructions for a specific fire extinguisher are printed on the label, as shown in *Figure 81*. Be sure you are familiar with the type of extinguishers that are commonly provided on your current job site.

As the fire is extinguished, move in closer until it is completely out. Stop shooting every three or four sweeps to check progress. Try not to use all of the contents on the initial attack, in case the fire flares up. Once the extinguisher has been used, it must be re-charged.

EXTINGUISHER TYPE	TYPE OF FIRE
	**Ordinary Combustibles** Fires in paper, cloth, wood, rubber, and many plastics require a water-type extinguisher labeled A. 
 CO_2 OR  Dry Chemical	**Flammable Liquids** Fires in oils, gasoline, some paints, lacquers, grease, solvents, and other flammable liquids require an extinguisher labeled B.  **Electrical Equipment** Fires in liquids, fuse boxes, energized electrical equipment, computers, and other electrical sources require an extinguisher labeled C. 
	**Ordinary Combustibles, Flammable Liquids, or Electrical Equipment** Multi-purpose dry chemical extinguishers are suitable for use on Class A, B, and C fires. 
	**Metals** Combustible metals such as magnesium and sodium require special extinguishers labeled D. 

00101-15_F76.EPS

Figure 76 Fire extinguisher applications.

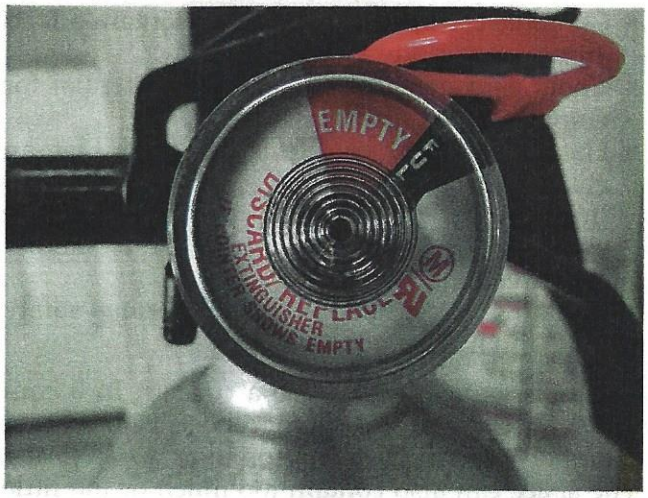

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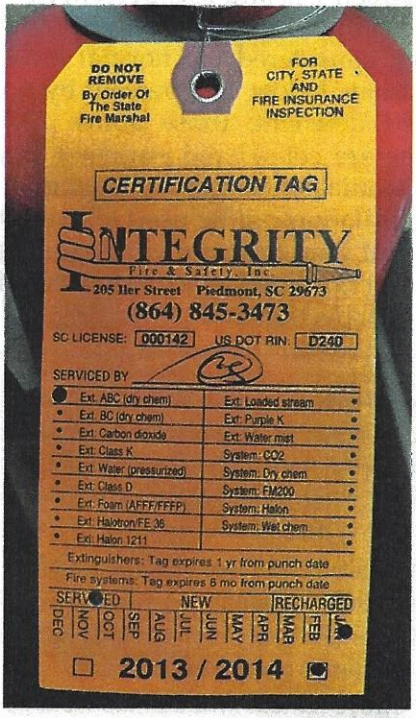
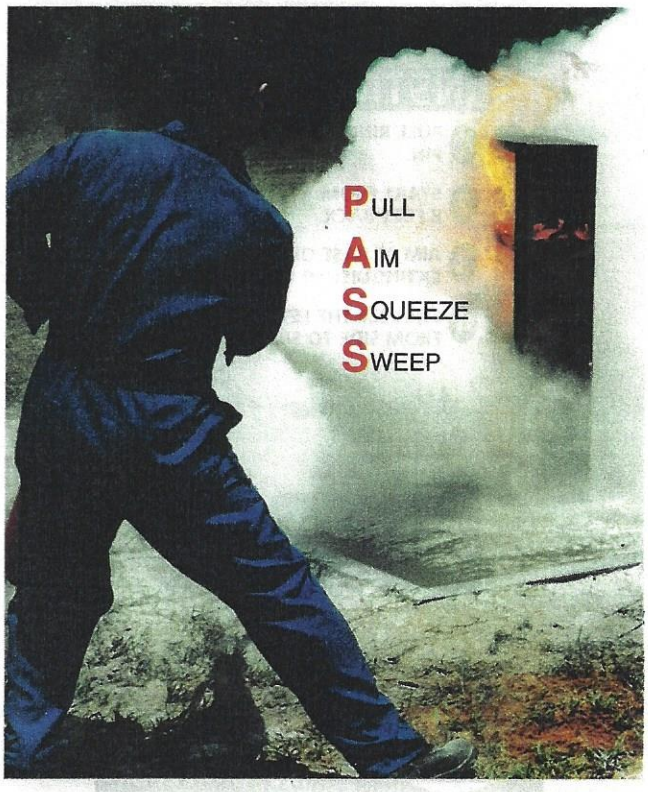
Figure 77 Fire extinguisher pressure gauge.



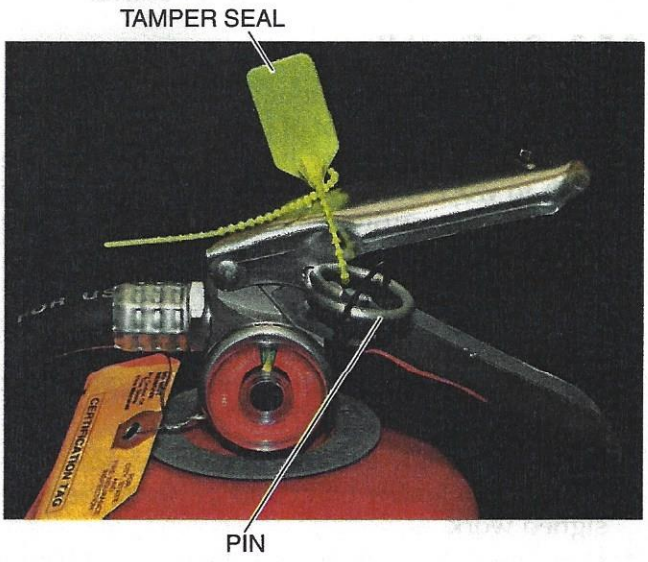
00101-15_F78.EPS

Figure 78 Fire extinguisher inspection tag.



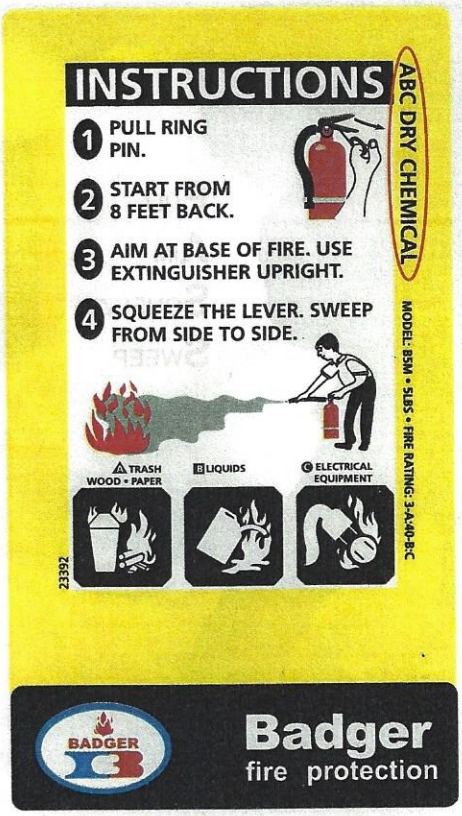
00101-15_F79.EPS

Figure 79 PASS Method.



00104-15_F80.EPS

Figure 80 Pin and tamper seal.



00101-15_F81.EPS

Figure 81 Example of fire extinguisher instructions.

6.5.0 Confined Spaces

Construction and maintenance work is not always done outdoors; a lot of it is done in confined spaces. A confined space is a space that is large enough to work in but that has limited means of entry or exit. A confined space is not designed for human occupancy and it has limited ventilation. Examples of confined spaces are tanks, vessels, silos, storage bins, hoppers, vaults, pits, and certain compartments on ships and barges (*Figure 82*).

OSHA defines a confined space as a space that has the following characteristics:

- Is large enough and so configured that employees can bodily enter and perform their assigned work.
- Has a limited or restricted means of entry or exit.
- Is not designed for continuous employee occupancy.

OSHA further defines a **permit-required confined space** as a space that has one or more of the following characteristics:

- Contains or has the potential to contain a hazardous atmosphere.
- Contains a material that has the potential for engulfing an entrant.
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross-section.
- Contains any other recognized serious safety or health hazard.

Atmospheric hazards are a concern in a confined space. The air in the space can contain flammable or explosive vapors or toxic gases. The space can also contain too much or too little oxygen. For safe working conditions, the oxygen level in a confined space atmosphere must range between 19.5 and 23.5 percent by volume as measured with an oxygen analyzer, with 21 percent being considered the normal level. Oxygen concentrations below 19.5 percent by volume are considered deficient; those above 23.5 percent by volume are considered enriched. Special meters are available to test atmospheric hazards. Forced ventilation can be used to overcome these hazards, but that does not eliminate the need to satisfy other confined space safety requirements, including inspection and permitting.

WARNING!

If too much oxygen is introduced into a confined space, it can be absorbed by a worker's clothing and ignite. If too little oxygen is present, it can lead to death in minutes. For this reason, the following precautions apply:

- Make sure confined spaces are ventilated properly for cutting or welding purposes.
- Never use oxygen in confined spaces for ventilation purposes.
- Always remain aware of the work going on around you, as conditions can change.

A permit-required confined space is a type of confined space that has been evaluated by a qualified person and found to have actual or potential hazards. Written authorization, commonly known as an entry permit, is required in order to enter a permit-required confined space. Once the entry permit is issued, it must be posted at the entry to the confined space.

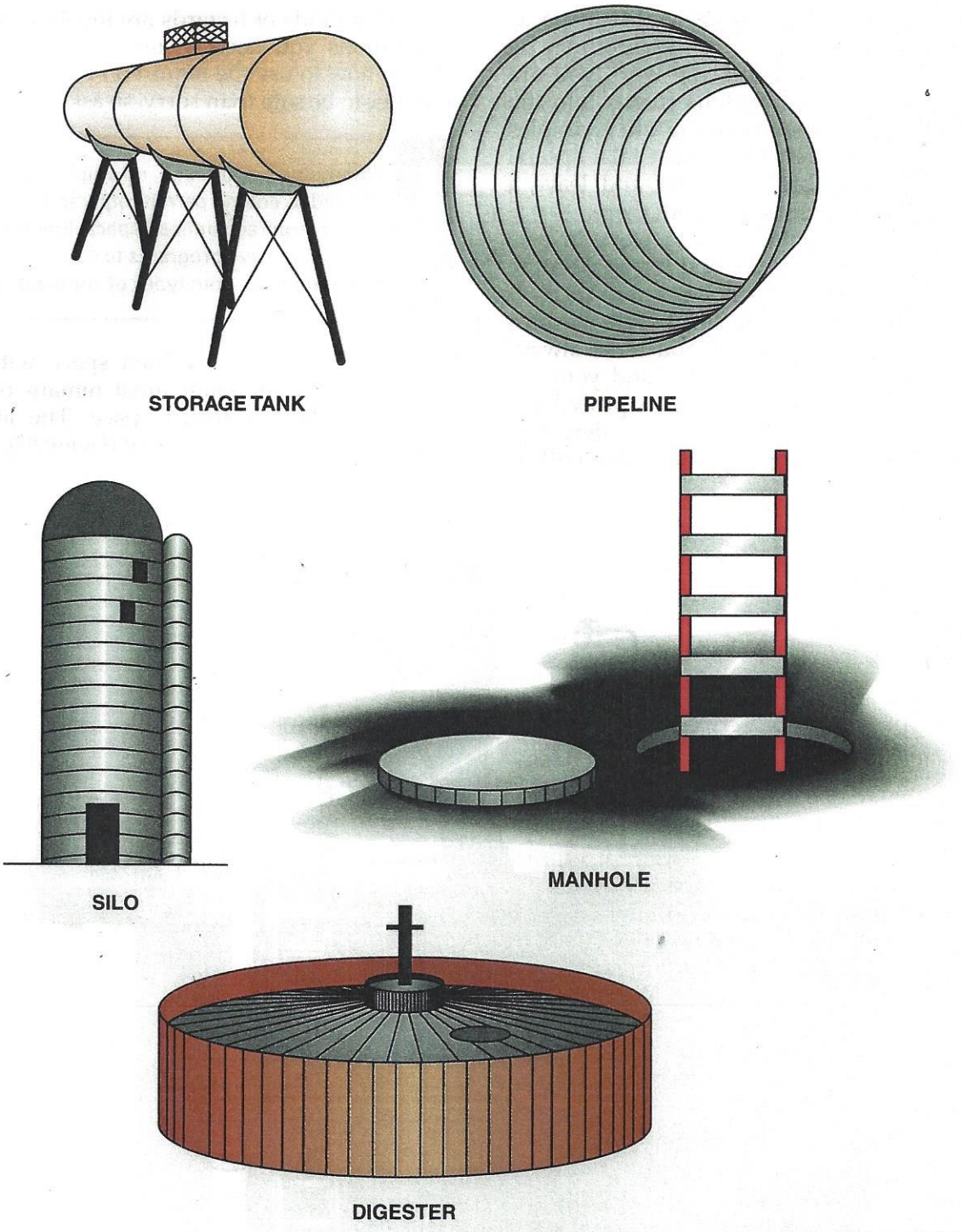


Figure 82 Examples of confined spaces.

When equipment is operating, confined spaces may contain hazardous gases or fluids, or may be oxygen-deficient. In addition, the work you are doing may introduce hazardous fumes into the space. Welding and metal cutting are examples of such work. For safety, you must take special precautions both before you enter and leave a confined space, and while you work there.

Until you have been trained to work in permit-required confined spaces and have taken the needed precautions, you must stay out of them. If you are not sure whether a confined space requires a permit, ask your supervisor. You must always follow your employer's procedures and your supervisor's instructions. Confined space procedures may include getting clearance from a safety representative before starting the work. You will be told what kinds of hazards are involved and what precautions you need to take. You will also be shown how to use the required PPE. Remember, it is better to be safe than sorry, so ask!

WARNING!

Without proper training, no employee is allowed to enter a permit-required or non-permit-required confined space. Employers are required to have programs to control entry to, and hazards in, both types of confined spaces.

Never work in a confined space without an attendant. An attendant must remain outside a permit-required confined space. The attendant monitors entry, work, and exit (*Figure 83*).

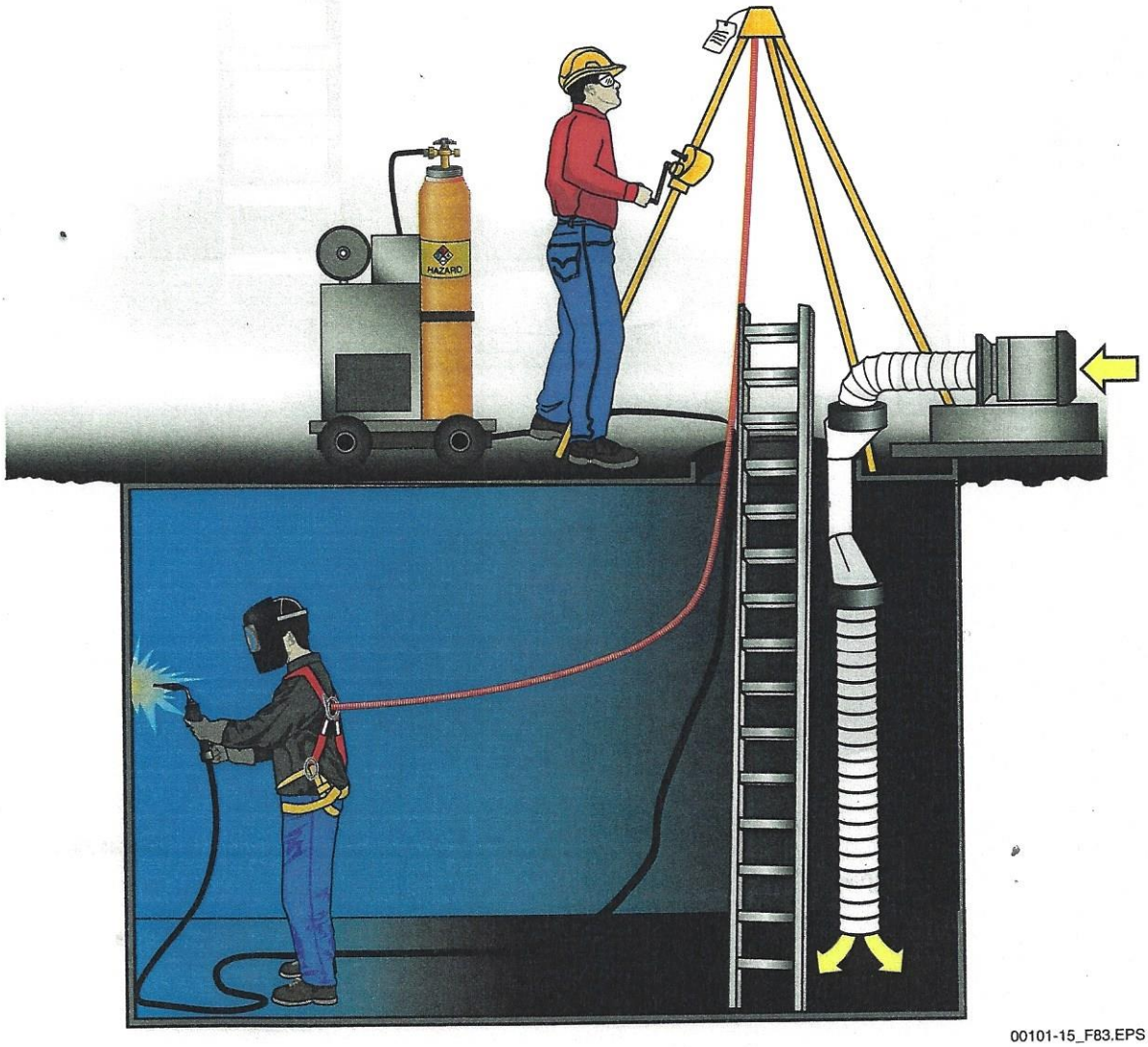


Figure 83 Permit-required confined space.

Additional Resources

US Occupational Safety and Health Administration. Numerous safety videos are available on line at **www.osha.gov/video.**

Construction Safety, 2006. Jimmie W. Hinze. Upper Saddle River, NJ: Pearson Education, Inc.

DeWalt Construction Safety/OSHA Professional Reference, Paul Rosenberg; American Contractors Educational Services. 2006. DEWALT.

Basic Construction Safety and Health, Fred Fanning. 2014. CreateSpace Independent Publishing Platform.

6.0.0 Section Review

1. The term PEL refers to a worker's _____.
   a. personal energy level
   b. maximum exposure limit
   c. the amount of lead in the bloodstream
   d. product efficiency level

2. A condition in which body temperature drops a few degrees below normal is known as _____.
   a. heat stress
   b. cold stroke
   c. cold stress
   d. heat exhaustion

3. Swollen eyes and a sandy feeling in the eyes are symptoms of _____.
   a. a flash burn
   b. heat stroke
   c. asbestos exposure
   d. frostbite

4. The three elements needed for a fire to start are fuel, combustible liquid, and oxygen.
   a. True
   b. False

5. A confined space is an enclosed space that has _____.
   a. only one door
   b. limited access
   c. hazardous gases
   d. locked doors

SUMMARY

Although the typical job site has many hazards, it does not have to be a dangerous place to work. Your employer has programs to deal with potential hazards. Basic rules and regulations help protect you and your co-workers from unnecessary risks.

This module has presented many of the basic guidelines you must follow to ensure your safety and the safety of your co-workers. These guidelines fall into the following categories:

- Following safe work practices and procedures
- Inspecting safety equipment before use
- Using safety equipment properly

The basic approach to safety is to eliminate hazards in the equipment and the workplace; to learn the rules and procedures for working safely with and around the remaining hazards; and to apply those rules and procedures. The information covered here provides the foundation for a safe, productive, and rewarding career.

Review Questions

1. The four leading causes of death in the construction industry include electrical incidents, struck-by incidents, caught-in or caught-between incidents, and _____.
   a. vehicular incidents
   b. falls
   c. radiation exposure
   d. chemical burns

2. A sign that has a white background with a green panel with white lettering is a _____.
   a. general information sign
   b. safety instruction sign
   c. caution sign
   d. danger sign

3. To properly dispose of oily rags, they must be _____.
   a. stored in a container designed for the purpose
   b. washed thoroughly and returned to use
   c. taken outdoors and thrown into a dumpster
   d. burned at the end of the shift

4. Keeping your work area clean and free of scraps or spills is referred to as _____.
   a. managing
   b. organizing
   c. housekeeping
   d. stacking and storing

5. HAZCOM classifies all paint, concrete, and wood dust as _____.
   a. hazardous materials
   b. common materials
   c. inexpensive materials
   d. nonhazardous materials

6. Under HAZCOM, if you spot a hazard on your job site you must _____.
   a. report it to your supervisor
   b. leave immediately
   c. notify your co-workers
   d. correct the problem

7. Which of the following must be reported to your supervisor?
   a. Only major injuries
   b. Only incidents and major injuries
   c. All injuries, incidents, and accidents
   d. Only incidents in which a death occurred

8. Metal ladders should *not* be used near _____.
   a. stairways
   b. scaffolds
   c. electrical equipment
   d. windows

9. If you lean a straight ladder against the top of a 16-foot (4.8 m) wall, the base of the ladder should be _____.
   a. 3 feet (0.9 m) from the base of the wall
   b. 4 feet (1.2 m) from the base of the wall
   c. 5 feet (1.5 m) from the base of the wall
   d. 6 feet (1.8 m) from the base of the wall

10. The two basic types of scaffolds are _____.
    a. self-supporting and suspended scaffolds
    b. fixed and portable scaffolds
    c. metal and wooden scaffolds
    d. assembled and deliverable scaffolds

11. Interlocking stacked material is done by _____.
    a. applying a chain and padlock to it
    b. driving stakes around the stack
    c. securing the objects with rope
    d. placing the objects at right angles

12. To reduce the risk of workers being hurt or killed by falling materials, the maximum height-to-base ratio of a stack of materials should be _____.
    a. 2:1
    b. 4:1
    c. 8:1
    d. 10:1

13. The most common cause of death for equipment operators is _____.
    a. hit and run
    b. equipment rollover
    c. brake malfunction
    d. head-on collisions

14. Most cave-ins happen suddenly with little or no warning and occur in trenches 5 feet (1.5 m) to _____.
    a. 10 feet (3.4 m) deep
    b. 15 feet (4.6 m) deep
    c. 20 feet (6.1 m) deep
    d. 25 feet (7.6 m) deep

15. In every trench over 4 feet (1.2 m) deep, there must be an exit every _____.
    a. 10 feet (3.4 m)
    b. 12 feet (3.7 m)
    c. 18 feet (5.5 m)
    d. 25 feet (7.6 m)

16. The minimum distance that a spoil pile must be located from the edge of an excavation is _____.
    a. 6 inches (15 cm)
    b. 2 feet (61 cm)
    c. 5 feet (1.5 m)
    d. 100 yards (91.4 m)

17. The type of trench protection designed to prevent trench wall cave-ins is _____.
    a. trench shield
    b. trench box
    c. spoil pile
    d. shoring

18. Protective guards are provided on power tools and machines in order to keep _____.
    a. dirt out of the tool or machine
    b. workers from being caught in rotating or moving parts
    c. the tool or machine from being struck by moving equipment
    d. unauthorized personnel from using the tool or machine

19. The minimum safe working distance from exposed electrical conductors _____.
    a. depends on the voltage
    b. is 6 inches (15 cm)
    c. is one foot (30 cm)
    d. is unlimited

20. Work that is performed near a hazard but not in direct contact with it is called _____.
    a. close call work
    b. near miss work
    c. proximity work
    d. barricade work

21. Circuit breakers and disconnect switches are examples of _____.
    a. energy-isolating devices
    b. energy-removal devices
    c. lockout/tagout devices
    d. multiple lockout devices

22. Which of the following provide the best eye protection?
    a. Welding hoods
    b. Face shields
    c. Safety goggles
    d. Strap-on glasses

23. The type of respirator that has its own clean air supply is the _____.
    a. half mask
    b. mouthpiece with mechanical filter
    c. self-contained breathing apparatus
    d. full facepiece mask

24. A worker can be exposed to hazardous materials by inhalation, ingestion, and _____.
    a. osmosis
    b. absorption
    c. radiation
    d. proximity

25. Hypothermia is a condition brought on by _____.
    a. excessive alcohol consumption
    b. prolonged exposure to cold
    c. excessive sweating
    d. prolonged exposure to heat

26. When in storage, oxygen and fuel cylinders used in oxyfuel cutting must be separated by _____.
    a. 20 feet (6.1 m)
    b. a metal barrier
    c. a 20-foot (6.1 m) wall
    d. 10 feet (3.4 m)

27. Grease and oil must be kept away from oxygen tanks because _____.
    a. grease or oil will contaminate the oxygen
    b. oxygen causes oil to freeze
    c. grease or oil can cause oxygen to explode
    d. oxygen will contaminate the oil or grease

28. Which of these must be present in the same place at the same time for a fire to occur?
    a. Oxygen, carbon dioxide, and heat
    b. Oxygen, heat, and fuel
    c. Hydrogen, oxygen, and wood
    d. Grease, liquid, and heat

29. A fire extinguisher labeled C would be used to fight a(n) _____.
    a. electrical fire
    b. magnesium fire
    c. paper fire
    d. gasoline fire

30. Which of the following characteristics is typical of a confined space?
    a. It has a limited amount of ventilation.
    b. There is no means of escape.
    c. It is too small to work in.
    d. It may be entered by untrained employees.

Trade Terms Quiz

Fill in the blank with the correct term that you learned from your study of this module.

1. The formal procedure for taking equipment out of service and ensuring it cannot be operated until an authorized person has returned it to service is _____.
2. A(n) _____ is any man-made cut, cavity, trench, or depression in an earth surface, formed by removing earth.
3. A(n) _____ identifies unsanitary, hazardous, or dangerous working conditions and has the authority to correct or eliminate them.
4. A(n) _____ is large enough to work in but has limited means of entry or exit.
5. Liquids that are _____ must be stored in safety cans to avoid the risk of fire.
6. To save lives, prevent injuries, and protect the health of America's workers, _____ publishes rules and regulations that employees and employers must follow.
7. Even a brief exposure to the ultraviolet light from arc welding can damage the eyes, causing a(n) _____.
8. _____ is an OSHA rule requiring all contractors to educate their employees about the hazardous chemicals they may be exposed to on the job site.
9. The temperature at which a fuel gives off enough gases to burn is called the _____.
10. A(n) _____ is the conducting connection between electrical equipment or an electrical circuit and the earth.
11. When climbing a ladder or scaffold, a tagline or _____ should be used to pull up tools.
12. If a work area is _____, that means it has pieces of material at least 2 inches (5 cm) thick and 6 inches (15 cm) wide used as flooring, decking, or scaffolds.
13. When doing work more than 6 feet (≈2 m) above the ground, a worker must wear a safety harness with a(n) _____ that is attached to a strong anchor point.
14. A structure that prevents trench walls from collapsing is known as _____.
15. Information on how to handle hazardous substances is located in the _____.
16. Overloading, which means exceeding the _____ of a ladder, can cause ladder failure.
17. If you are operating a vehicle on a job site and cannot see to your rear, get a(n) _____ to direct you.
18. Before working in a(n) _____ you must be trained, obtain written authorization, and take the necessary precautions.
19. A(n) _____ is a narrow excavation made below the surface of the ground that is generally deeper than it is wide.
20. The _____ on a scaffold is placed halfway between the toeboard and the top rail.
21. _____ for welding includes a face shield, ear plugs, and gloves.
22. A(n) _____ has proven his or her extensive knowledge, training, and experience and has successfully demonstrated the ability to solve problems relating to the work.
23. A(n) _____ provides clean air for breathing.
24. A(n) _____ is an elevated working platform for workers and material.
25. Working near a hazard, but not actually in contact with it is known as _____.
26. A vertical barrier called a(n) _____ is used at floor level on scaffolds to prevent materials from falling.
27. A(n) _____ shows which way the wind is blowing.
28. A horizontal board called a(n) _____ is used at top-level on all open sides of scaffolds and platforms.

29. The _____ is a general construction rule that states that fall protection is required any time you are working 6 feet (≈2 m) above a lower level.
30. _____ is the company organization that includes reporting procedures and supervisory responsibility.
31. The process of joining metal parts using an electric arc is known as _____.
32. An equipment or process powered by compressed air is _____.
33. Wood or metal braces placed diagonally from the bottom of one rail to the top of another rail in order to provide support are referred to as _____.
34. When a whole company sees the value of safety it is said to have a(n) _____.
35. Material such as soil removed from a trench or excavation is known as _____.
36. An area that is enclosed, fenced, covered, or otherwise protected by barriers, rails, covers, or platforms to prevent dangerous contact is said to be _____.
37. A(n) _____ is an unintentional, electrically conducting connection between an ungrounded conductor of an electrical circuit and the normally noncurrent-carrying conductors, metal objects, or the earth.
38. A(n) _____ is a device that interrupts and de-energizes an electrical circuit to protect a person from electrocution.
39. The type of equipment that is powered by fluid pressure is _____.
40. An unplanned event that results in personal injury is referred to as a(n) _____.
41. A protective screen set up around a welding operation designed to safeguard workers not directly involved in that operation is a(n) _____.
42. A process using heat in excess of 800°F (427°C) to melt base metal, along with a filler metal in order to join copper pipe is called _____.
43. A material that is capable of easily igniting and rapidly burning with a flash point at or above 100°F (38°C) is considered _____.
44. A structure used to protect workers in trenches, but lacking the ability to prevent cave-ins is _____.
45. A near miss that occurs but does not result in personal injury is considered to be a(n) _____.

Trade Terms

Accident
Arc welding
Brazing
Combustible
Competent person
Confined space
Cross-bracing
Excavation
Flammable
Flash burn
Flash point
Ground
Ground fault
Ground fault circuit interrupter (GFCI)
Guarded
Hand line
Hazard communication Standard (HAZCOM)
Hydraulic
Incident
Lanyard
Lockout/tagout (LOTO)
Management system
Maximum intended load
Midrail
Occupational Safety and Health Administration (OSHA)
Permit-required confined space
Personal protective equipment (PPE)
Planked
Pneumatic
Proximity work
Qualified person
Respirator
Safety culture
Safety data sheet (SDS)
Scaffold
Shielding
Shoring
Signaler
Six-foot rule
Spoil
Toeboard
Top rail
Trench
Welding curtain
Wind sock

Cornerstone of Craftsmanship

Bob Fitzgerald

Southern Company
Manager – Project Safety and Health

How did you choose a career in the Safety and Health field?
After many years working as an emergency medical technician (EMT) in the public and private sectors, I was hired as a medic on a construction site. What sparked my interest in safety and health was the notion of not just treating the injured, but actually being able to do something to prevent the incident from happening in the first place. When working in the medical field, you have to really care and have compassion for people. I think that is one of the major attributes of a successful safety professional.

What types of training have you been through?
I have taken all sorts of safety and health classes through the years, including trenching, shoring, electrical, fall protection, respiratory protection, and more. I was privileged to attend the NCCER Safety Academy at Clemson University early in my safety career and I think that was a turning point in my philosophy and thinking about safety management. Since then I have earned my Bachelor's of Science and a Master's degree in Safety and Health. I also hold the Certified Safety Professional and Construction Health and Safety Technician designation.

What kinds of work have you done in your career?
I have had two jobs in my professional career: EMT and Safety Professional.

Tell us about your present job.
I serve as the Manager for Project Safety & Health for Southern Company Operations Engineering and Construction Services, presently based in Birmingham, Alabama. Southern Company is the premier energy company serving the Southeast through its subsidiaries. Our firm provides engineering and project management services for most major capital work at Southern Company Electric Generating facilities as well as new generation projects.

What do you enjoy most about your job?
I enjoy helping people and making a difference in their lives. I feel very gratified to know that something I may say or some influence I may have could impact a person getting home safely to their families. That truly humbles me and is my motivation.

What factors have contributed most to your success?
You really have to care about people. Safety is a people business! My early experiences in the medical field helped me to have empathy for people and to see the pain and suffering that could happen if things go wrong.

What advice would you give to those new to Safety and Health field?
Realize that the value for safety and health is fundamental in all crafts or whatever role you perform in construction or industrial work. Watch out for each other and don't be afraid to speak up if you see an at-risk situation or action. Take the risk of intervening to help someone. Learn all you can about safety and put it to use.

Interesting career-related fact or accomplishment:
In 1995, I had the privilege to work with a wonderful team of construction professionals and craftworkers to earn the OSHA Voluntary Protection Program (VPP) STAR designation at a site in Stevenson, Alabama. This particular construction site was the first in the state of Alabama to earn the OSHA STAR. The effort that went into achieving OSHA STAR still echoes today in folks that I meet that worked on that site. They have instilled a culture of safety and a lifelong safety commitment. It was, and is, great!

Appendix

OSHA Mission and Standards

The mission of the Occupational Safety and Health Administration (OSHA) is to save lives, prevent injuries, and protect the health of America's workers. To accomplish this, federal and state governments work in partnership with millions of working men and women who are covered by the Occupational Safety and Health Act (OSH Act) of 1970.

Nearly every worker in the US comes under OSHA's jurisdiction. There are some exceptions, such as miners, transportation workers, many public employees, and the self-employed. These specific groups are not covered by OSHA standards, but most are covered by standards developed by the specific industry.

The Code of Federal Regulations

The *Code of Federal Regulations (CFR)* Part 1910 covers the OSHA standards for general industry. *CFR* Part 1926 covers the OSHA standards for the construction industry. Either or both may apply to you, depending on where you are working and what you are doing. If a job-site condition is covered in the CFR book, then that standard must be used. However, if a more stringent requirement is listed in *CFR* 1910, it should also be met. Check with your supervisor to find out which standards apply to your job.

29 *CFR* 1926 is divided into subparts A through Z. As you progress in task-specific training, you will learn about all the subparts applicable to your work. *Subpart C of* 29 *CFR* 1926 applies to all construction and maintenance work. It outlines the general safety and health provisions for the construction industry. It covers the following topics:

- Safety training and education
- Injury reporting and recording
- First aid and medical attention
- Housekeeping
- Illumination
- Sanitation
- PPE
- Standards incorporated by reference
- Definitions
- Access to employee exposure and medical records
- Means of egress
- Employee emergency action plans

For assistance in identifying parts, sections, paragraphs, and subparagraphs of an OSHA standard, refer to Appendix *Figure 1.*

All of OSHA's safety requirements in the Code of Federal Regulations apply to residential as well as commercial construction. In the past, OSHA enforced safety only at commercial sites. The increasing rate of incidents at residential sites led OSHA to enforce safety guidelines for the building of houses and townhomes. Today, however, OSHA still focuses its enforcement efforts on commercial construction.

The General Duty Clause

If a standard does not specifically address a hazard, the general duty clause must be invoked. Failing to adhere to the general duty clause can result in heavy fines for your employer. The general duty clause reads as follows:

> In practice, OSHA, court precedent, and the review commission have established that if the following elements are present, a general duty clause citation may be issued:
>
> - The employers failed to keep the workplace free of a hazard to which employees of that employer were exposed.
> - The hazard was recognized. (Examples might include: through your safety personnel, employees, organization, trade organization, or industry customs.)
> - The hazard was causing or was likely to cause death or serious physical harm.
> - There was a feasible and useful method to correct the hazard.

Employee Rights and Responsibilities

While it is the employer's responsibility to keep workers safe by complying with the General Duty Clause and all other OSHA regulations, workers have certain rights and responsibilities on the job site as well. First and foremost, workers must follow their employers' safety rules. While workers cannot be cited or fined by OSHA, they can be disciplined for violating their employer's safety rules. Workers must also wear the provided personal protective equipment. Workers should also inform their foreman about health and safety concerns on the job.

An OSHA Standard reference may look like this:

29 CFR 1926.501 (a)(1)(i)(A)

and breaks down like this:

29	=	Title (Labor)
CFR	=	Code of Federal Regulations
1926	=	Part (Construction)
.501	=	Section
(a)	=	Paragraph
(1)	=	Subparagraph
(i)	=	Subparagraph
(A)	=	Subparagraph

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Figure 1 Reading OSHA standards.

Section 11(c) of the OSH Act prohibits employers from disciplining or discriminating against any worker for practicing their rights under OSHA, including filing a complaint. You have the right to file a complaint if you do not think that your employer is protecting your health and safety at work. You may submit a written request to OSHA asking for an inspection of your worksite. Workers who file a complaint have the right to have their names withheld from their employers, and OSHA will not reveal this information.

Workers who would like an on-site inspection must submit a written request. You have the following rights when job site inspection is conducted:

- You must be informed of imminent dangers. An OSHA inspector must tell you if you are exposed to an imminent danger. An imminent danger is one that could cause death or serious injury now or in the near future. The inspector will also ask your employer to stop any dangerous activity.
- You have the right to accompany the OSHA inspector in the walk-around inspection. Walk-around activities include all opening and closing conferences related to the conduct of the inspection.
- You have the right to be told about citations issued at your workplace. Notices of OSHA citations must be posted in the workplace near the site where the violation occurred and must remain posted for three days or until the hazard is corrected, whichever is longer.

After an inspection has been performed, OSHA will give the employer a date by which any hazards cited must be fixed. Employers can appeal these dates, and appeals must be filed within 15 days of the citation. Workers have the right to meet privately with the OSHA inspector to discuss the results of the inspection.

If you have been discriminated against for asserting your OSHA rights, you have the right to file a complaint with the OSHA area office within 30 days of the incident. Make sure you file your complaint as soon as possible, as the time limit is strictly enforced.

You also have the right to see and copy any medical records about you that the employer has obtained. Your employer is required by OSHA 29 *CFR* 1926.33 and OSHA 29 *CFR* 1910.1020 to maintain your medical records for 30 years after you leave employment. If you are employed for less than one year, the employer can maintain your records or give them to you when you leave the job.

Inspections

OSHA conducts six types of inspections to determine if employers are in compliance with standards:

- *Imminent danger inspections* – OSHA's top priority for inspection, conducted when workers face an immediate risk of death or serious physical harm.
- *Catastrophe inspections* – Performed after an incident that requires hospitalization of three or more workers. Employers are required to report fatalities and catastrophes to OSHA within eight hours.
- *Worker complaint and referral inspections* – Conducted due to complaints by workers or a worker representative, or a referral from a recognized professional.
- *Programmed inspection* – Aimed at high-risk areas based on OSHA's targeting and priority methods.
- *Follow-up inspection* – Completed after citations to assure employer has corrected violations.
- *Monitoring inspection* – Used for long-term abatement follow-up or to assure compliance with variances.

Before beginning an inspection, OSHA staff must be able to determine from the complaint that there are reasonable grounds to believe that a violation of an OSHA standard or a safety or

health hazard exists. If OSHA has information indicating the employer is aware of the hazard and is correcting it, the agency may not conduct an inspection after obtaining the necessary documentation from the employer.

Complaint inspections are typically limited to the hazards listed in the complaint, although other violations in plain sight may be cited as well. The inspector may decide to expand the inspection based on professional judgment or conversations with workers.

Complaints are not necessarily inspected in first-come, first-served order. OSHA ranks complaints based on the severity of the alleged hazard and the number of workers exposed. That is why lower-priority complaints can often be handled more quickly using the phone/fax method than through on-site inspections.

Inspections are typically performed by conducting a walk-around. During a walk-around inspection, the inspector typically does the following:

- Observes conditions of the job site.
- Talks to workers.
- Inspects records.
- Examines posted hazard warnings and signs.
- Points out hazards and suggests ways to reduce or eliminate them.

After the walk-around inspection, there is typically a closing conference held between the inspector and the site contractor or company managers. During this conference, inspectors discuss their findings, citing specific violations and suggested abatement methods. Inspectors may also conduct interviews with the employers, workers, and representatives at this point.

Violations

Employers who violate OSHA regulations can be fined. The fines are not always high, but they can harm a company's reputation for safety. Fines for serious safety violations can cost up to $7,000. Fines for each violation that was done willfully can cost up to $70,000. In 2012, roughly $260,000,000 in fines were issued against employers. In the decade prior to 2012, annual fines averaged approximately $150,000,000. Significant increases and decreases in annual fines tend to be dependent on the current federal administration and OSHAs budget provided by federal lawmakers.

Compliance

Just as employers are responsible to OSHA for compliance, employees must comply with their company's safety policies and rules. Employers are required to identify hazards and potential hazards within the workplace and eliminate them, control them, or provide protection from them. This can only be done through the combined efforts of the employer and employees. Employers must provide written programs and training on hazards, and employees must follow the procedures. You, as the employee, must read and understand the OSHA poster at your job site explaining your rights and responsibilities. If you are unsure where the OSHA poster is, ask your supervisor.

To help employers provide a safe workplace, OSHA requires companies to provide a competent person to ensure the safety of the employees. In *OSHA 29 CFR 1926*, OSHA defines a competent person as follows:

> Competent person means one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which employees, and who has authorization to take prompt corrective measures to eliminate them.

In comparison, *OSHA 29 CFR 1926* defines a qualified person as follows:

> Someone who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated his ability to solve or resolve problems relating to the subject matter, work, or the project.

In other words, a competent person is experienced and knowledgeable about the specific operation and has the authority from the employer to correct the problem or shut down the operation until it is safe. A qualified person has the knowledge and experience to handle problems. A competent person is not necessarily a qualified person.

These terms will be an important part of your career. It is important for you to know who the competent person is on your job site. OSHA requires a competent person for many of the tasks you may be assigned to perform, such as confined space entry, ladder use, and trenching. Different individuals may be assigned as a competent person for different tasks, according to their expertise. To ensure safety for you and your co-workers, work closely with your competent person and supervisor.

Trade Terms Introduced in This Module

Accident: Per the US Occupational Safety and Health Administration (OSHA), an unplanned event that results in personal injury or property damage.

Arc welding: The joining of metal parts by fusion, in which the necessary heat is produced by means of an electric arc.

Brazing: A process using heat in excess of 800°F (427°C) to melt a filler metal that is drawn into a connection. Brazing is commonly used to join copper pipe.

Combustible: Capable of easily igniting and rapidly burning; used to describe a fuel with a flash point at or above 100°F (38°C).

Competent person: A person who is capable of identifying existing and predictable hazards in the surroundings or working conditions that are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

Confined space: A work area large enough for a person to work in, but with limited means of entry and exit and not designed for continuous occupancy. Tanks, vessels, silos, pits, vaults, and hoppers are examples of confined spaces. Also see *permit-required confined space.*

Cross-bracing: Braces (metal or wood) placed diagonally from the bottom of one rail to the top of another rail to add support to a structure.

Excavation: Any man-made cut, cavity, trench, or depression in an earth surface, formed by removing earth. It can be made for anything from basements to highways. Also see *trench.*

Flammable: Capable of easily igniting and rapidly burning; used to describe a fuel with a flash point below 100°F (38°C).

Flash burn: The damage that can be done to eyes after even brief exposure to ultraviolet light from arc welding. A flash burn requires medical attention.

Flash point: The temperature at which fuel gives off enough gases (vapors) to burn.

Ground: The conducting connection between electrical equipment or an electrical circuit and the earth.

Ground fault: An unintentional, electrically conducting connection between an ungrounded conductor of an electrical circuit and the normally noncurrent-carrying conductors, metal objects, or the earth.

Ground fault circuit interrupter (GFCI): A device that interrupts and de-energizes an electrical circuit to protect a person from electrocution.

Guarded: Enclosed, fenced, covered, or otherwise protected by barriers, rails, covers, or platforms to prevent dangerous contact.

Hand line: A line attached to a tool or object so a worker can pull it up after climbing a ladder or scaffold.

Hazard Communication Standard (HAZCOM): The standard that requires contractors to educate employees about hazardous chemicals on the job site and how to work with them safely.

Hydraulic: Powered by fluid under pressure.

Incident: Per the US Occupational Safety and Health Administration (OSHA), an unplanned event that does not result in personal injury but may result in property damage or is worthy of recording.

Lanyard: A short section of rope or strap, one end of which is attached to a worker's safety harness and the other to a strong anchor point above the work area.

Lockout/tagout: A formal procedure for taking equipment out of service and ensuring that it cannot be operated until a qualified person has removed the lock and/or warning tag.

Management system: The organization of a company's management, including reporting procedures, supervisory responsibility, and administration.

Maximum intended load: The total weight of all people, equipment, tools, materials, and loads that a ladder can hold at one time.

Midrail: Mid-level, horizontal board required on all open sides of scaffolds and platforms that are more than 14 inches (35 cm) from the face of the structure and more than 10 feet (3.05 m) above the ground. It is placed halfway between the toeboard and the top rail.

Occupational Safety and Health Administration (OSHA): An agency of the US Department of Labor. Also refers to the Occupational Safety and Health Act of 1970, a law that applies to more than more than 111 million workers and 7 million job sites in the country.

Permit-required confined space: A confined space that has been evaluated and found to have actual or potential hazards, such as a toxic atmosphere or other serious safety or health hazard. Workers need written authorization to enter a permit-required confined space. Also see *confined space.*

Personal protective equipment (PPE): Equipment or clothing designed to prevent or reduce injuries.

Planked: Having pieces of material 2 inches (5 cm) thick or greater and 6 inches (15 cm) wide or greater used as flooring, decking, or scaffold decks.

Pneumatic: Powered by air pressure, such as a pneumatic tool.

Proximity work: Work done near a hazard but not actually in contact with it.

Qualified person: A person who, by possession of a recognized degree, certificate, or professional standing, or by extensive knowledge, training, and experience, has demonstrated the ability to solve or prevent problems relating to a certain subject, work, or project.

Respirator: A device that provides clean, filtered air for breathing, no matter what is in the surrounding air.

Safety culture: The culture created when the whole company sees the value of a safe work environment.

Safety data sheet (SDS): A document that must accompany any hazardous substance. The SDS identifies the substance and gives the exposure limits, the physical and chemical characteristics, the kind of hazard it presents, precautions for safe handling and use, and specific control measures.

Scaffold: An elevated platform for workers and materials.

Shielding: A structure used to protect workers in trenches but lacking the ability to prevent cave-ins.

Shoring: Using pieces of timber, usually in a diagonal position, to hold a wall in place temporarily.

Signaler: A person who is responsible for directing a vehicle when the driver's vision is blocked in any way.

Six-foot rule: A rule stating that platforms or work surfaces with unprotected sides or edges that are 6 feet (≈2 m) or higher than the ground or level below it require fall protection.

Spoil: Material such as earth removed while digging a trench or excavation.

Toeboard: A vertical barrier at floor level attached along exposed edges of a platform, runway, or ramp to prevent materials and people from falling.

Top rail: A top-level, horizontal board required on all open sides of scaffolds and platforms that are more than 14 inches (36 cm) from the face of the structure and more than 10 feet (3 m) above the ground.

Trench: A narrow excavation made below the surface of the ground that is generally deeper than it is wide, with a maximum width of 15 feet (4.6 m). Also see *excavation.*

Welding curtain: A protective screen set up around a welding operation designed to safeguard workers not directly involved in that operation.

Wind sock: A cloth cone open at both ends mounted in a high place to show which direction the wind is blowing.

Additional Resources

This module presents thorough resources for task training. The following reference material is suggested for further study.

US Occupational Safety and Health Administration. Numerous safety videos are available on line at **www.osha.gov/video**.

Construction Safety, Jimmie W. Hinze. 2006. Upper Saddle River, NJ: Pearson Education, Inc.

DeWalt Construction Safety/OSHA Professional Reference, Paul Rosenberg; American Contractors Educational Services. 2006. DEWALT.

Basic Construction Safety and Health, Fred Fanning. 2014. CreateSpace Independent Publishing Platform.

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