



## **Course SS101**

# **Safety Fundamentals**

## Note:

This manual contains the 5S tag system that is designed to make you aware of the hazards that may be present during the course of the task. Safety is our first priority. You will see 5S tags throughout the book indicating any safety information and equipment required. The purpose of the 5S system is to make you aware of any hazards that are present and that may cause injury. With the information presented prior to the task, you will develop good quality job habits that will ensure safety is followed. With proper safety equipment and awareness of the hazards you will complete your task safely and efficiently.



### **Safety Tags**

Information regarding the subject will appear in red text, boxed in, with safety information, hazards, and safety equipment. The 5S safety tags will give you the information you need to use safe practices in that task. As you continue the training you will learn the proper practice for safety at each level of the job.

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## 1. Personal Safety Safety Equipment Required

Working on HVAC equipment demands several skills. A technician must be able to work with electricity, hand tools, and test equipment. Air conditioners also present the following hazards.

- High-pressures
- High temperatures
- Extremely low temperatures
- High voltage
- High electrical current
- Moving parts

### Safety Equipment Required

Awareness of all electrical components and connections and moving parts. Lock out tags, safety glasses, thermal gloves, Volt meter, refrigerant gauges and several hand tools needed to complete these jobs.

#### Safety rules for employees

Provide the following tips to your employees to help them avoid injury and protect you bottom line:

- Wear the right clothing for the job. Winter cold and summer heat can present problems on the job. Shirts should be worn at all times.
- Wear appropriate safety shoes for the job.
- Use the right personal protective gear, including safety glasses, hard hats, and safety shoes.
- Never wear rings, necklaces, and other jewelry if it can pose a hazard.
- Be aware that open flames or sparks can ignite combustible materials. Portable heating and welding equipment, along with discarded cigarette butts, pose the greatest dangers.
- Participating in horseplay is dangerous and counterproductive. Avoid it!

### 1.1. Common Sense Is a Very Important Part of Safety

Awareness is also a key ingredient. A good technician will always pay close attention to his surroundings. Many accidents are caused by carelessness, which may result from:

- Rushing through the job
- Working when tired
- Not following basic safety rules
- Improper training

Most accidents can be prevented if safety is taken seriously at all times.

## **1.2. Personal Attitude toward Safety**

Statistics tell us that accidents happening in or around the workplace cause approximately 10,000 deaths per year. Always remember that you can prevent an accident by thinking ahead. You must make safety a standard that you follow every moment of the workday. While all of us enjoy having fun while we work, there is no room for horseplay in the workplace.

## **1.3. Personal Protection**

Everyone in the technical field knows that wearing protective gear will prevent injuries. In spite of that, many people have chosen not to wear protective equipment. This results in many injuries and even deaths every year!

Take a moment to think about some of the consequences of an accident or injury.

- Lost time at work
- Lost income
- Higher insurance premiums

Not only do the employees suffer, but their families do as well.

By using the methods described in the following pages, the technician can minimize accidents and injuries and enjoy a rewarding career.

## 1.4. Eye Protection

### **S** Proper Safety Equipment

Certainly one of the most important safety concerns a technician should have is protecting the eyes against impact from debris and chemicals. While working on equipment, whether balancing a refrigerant charge, adjusting gas pressure, drilling, or brazing, always wear the safety glasses that are approved for the specific task you are performing.

OSHA (the Occupational Safety & Health Administration) requires the use of the following safety glasses.

- Chemical Protective Goggles must be worn when working with refrigerants. The goggles must be splash proof.
- Wrap-around safety glasses must be worn when servicing equipment and using tools.
- Both types must meet ANSI (the American National Standards Institute) standard Z87.1.



While regular eyeglasses with safety lenses can be worn, you must use side shields to protect against debris impact. It is still better to wear safety glasses over regular eyeglasses to avoid damaging expensive prescription eyewear. Both safety goggles and wrap around glasses are inexpensive and available at most supply houses.

### **S** Proper Safety Equipment

Wear proper protection equipment for each task that calls for it. Safety glasses are an important piece when your eyes may be in danger of flying debris or chemicals. Safety glasses protect your eyes while working in a safety hazard job task. Safety glasses are made of shatter-resistant plastic side shield will protect your eyes from splashing and flying debris. Regular glasses cannot function as safety glasses.

## 1.5. Back Protection Proper Lifting Technique

The leading injury in the work place usually has to do with injuries to the back. While most back injuries are minor, there can be severe damage that can result in permanent injury.

Here are some tips that can help reduce the possibility of back injury.

- While working on a system that causes your body to be arched, crouched or stooped, it is best to take frequent breaks. Stand up and stretch your body forward and backwards and side to side.
- Never lift or carry anything that is beyond your limits. Get someone to help.



### Proper Lifting Technique

Bend to lift an object – don't stoop. Keep your back straight by tucking in your chin. Lift with the strong leg muscles, not the weaker back muscles.

#### 1.5.1. Lifting Materials

To lift materials properly:

- 1) Bend at the knees.
- 2) Keep your back straight.
- 3) Keep your body square with the object and your legs apart with one foot positioned slightly forward.
- 4) Get as close to the object as possible.
- 5) Concentrate on tightening the stomach muscles.
- 6) Let your leg muscles do the work of lifting the object.



#### 1.5.2. Handing the Load

Now that you are standing up straight, here are a few things to remember about handling the load.

- 1) When turning, pivot your body by using your feet, keeping the back straight.



- 2) Carry the load as close to the body as possible.
- 3) Walk at a slower pace.

Once you have made it to the destination, remain as straight as possible and reverse the procedure for lifting.

Back support belts have been used successfully in the industry for several years. It has been proven that wearing these belts has reduced the number of back injuries dramatically. It is recommended anytime you are lifting material in excess of 10-15 pounds, you should wear a back support belt.

## 1.6. Head Protection Proper Safety Equipment

When working in an environment where falling objects are a possibility, you should wear a hard hat. Head injuries can be life threatening! While many residential technicians, as well as parts personnel, have the opinion that only commercial sites present a hazard, this should be reconsidered. It is definitely better to be safe than sorry.

Hard hats come in many types depending on the work environment. Plastic, composite, and metal are among the materials used. The wearing of a hard hat is strictly to prevent all types of head injuries.



***Note: Never wear a metal hard hat when working on electrical components.***

- Drilling holes or otherwise modifying a hard hat can make it unsafe!
- Do not attempt to modify a piece of protective equipment!

### Proper Safety Equipment

You must protect the head if you are in a hazard of objects falling from above and striking you on the head. That you might bump your head against a fixed object such as exposed pipes or beams. They are designed to resist penetration by objects, absorb shocks and blows, water resistant and slow burning.

## 1.7. Hearing Protection Proper Safety Equipment

Have you ever wondered what it would be like to lose your hearing or eyesight? It would be difficult, if not impossible, to continue doing your job. Using protective equipment will help assure this won't happen.

Some of the situations requiring hearing protection include:

- Using a skill saw, reciprocating saw, or high speed drill.
- Using high-pressure air tools.
- Being exposed to moderate levels of noise for an extended period of time.

The two types of protection generally used are earplugs and earmuffs. Headphones designed for use with a radio are not suitable for hearing protection.



### Proper Safety Equipment

Hearing protection is important because your ears are composed of very delicate structures. Whenever a sound produces air is set into motion as sound waves. If the wave enters the ear with high pressure damage to the structure of the ear can result.

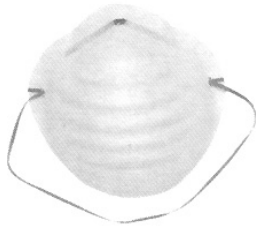
## 1.8. Lung Protection Proper Safety Equipment

The purpose of our lungs is to deliver the proper amount of oxygen to the blood stream. Without the correct oxygen level, bodily systems will begin to fail.

The lack of oxygen can be caused by the inhalation of contaminants such as:

- Toxic gases or fumes (for instance, phosgene gas, which is produced when a flame or extreme heat comes in contact with refrigerant and causes it to burn)
- Toxic chemicals (coil cleaners or brazing flux)
- Gas supplies to heat systems

When working in an enclosed space, take extra care to provide fresh air to the room. Several styles of respirator type masks are available from supply houses.



disposable face mask



respirator mask

### **S Proper Safety Equipment**

All safety respiratory are design for specific air and fume hazards it is important to know all the types of hazards and what you equipment is designed for. Until the 1970's, many types of building products and insulation materials used in homes contained asbestos. Most products today do not contain asbestos, however, those that do require a label if the asbestos containing material could be inhaled. Asbestos is a mineral fiber. It can be positively identified only with a special type of microscope. There are several types of asbestos fibers. In the past, asbestos was added to a variety of products to strengthen them and to provide heat insulation and fire resistance. It is not uncommon for homes built between 1930 and 1950 to have asbestos insulation. Hot water and steam pipes in older houses may be coated with an asbestos material or covered with an asbestos blanket or tape. Oil and gas furnace insulation and door gaskets sometimes contain asbestos, as do protective paper and board materials that are sometimes installed around wood burning stoves. Most people exposed to small amounts of asbestos, as we all are in our daily lives, do not develop these health problems. However, if disturbed, asbestos material may release asbestos fibers, which can be inhaled into the lungs. The fibers can remain there for a long time, increasing the risk of illness. Asbestos material that would crumble easily if handled, or that has been sawed, scraped, or sanded into a powder, is more likely to release fibers and create a health hazard. Although private homes are usually not covered by the asbestos regulations that apply to schools and public buildings, asbestos professionals should still use procedures described during federal or state-approved training. State and local health departments or regional offices of the Environmental Protection Agency (EPA) can help you with a more detailed understanding of this and may have listings of licensed professionals in your area.

## 1.9. Hand and Foot Protection

### 1.9.1. Gloves

#### Proper Safety Equipment

In our industry we deal with a lot of sheet metal and materials with sharp edges. Studies indicate that up to 30% of all work-related injuries have to do with injured fingers, hands, and arms. The majority of these could have been avoided if the use of gloves was a common practice.



As always, you must choose the proper type of glove for the application. Here are a few recommendations:

- When working with lumber or steel, use leather gloves.
- When working with chemicals, use rubber gloves.
- When welding, use long gauntlet leather gloves.
- Working with hot or cold substances, use thermally insulated gloves.
- Electrical work requires the use of rubber (OSHA approved) gloves.



#### Proper Safety Equipment

Thin gauge sheet metal has a smaller burr when stamped or punctured as compared to thick gauge. Bigger burrs or rougher edges require thicker gloves.

The glove thickness will help prevent the burr from Penetrating the glove. Gloves with higher tension combined with coatings for abrasion resistance should be considered better protection.

### 1.9.2. Safety Shoes

## **S** Proper Safety Equipment

Below are a few recommendations that are important when choosing the right pair of shoes for non-office employees.

- Steel toe - when handling materials.
- Rubber soles - when working on any part of an electrical system.
- Electric shock resistant - when working on live high power devices.
- Ankle support - when climbing ladders.



*Note: When wearing lace up boots, make sure the laces are fed through all the eyelets or clasps for maximum support.*

## **S** Proper Safety Equipment

Your safety boots are on your feet all day. In many different environments it is important to not only be safe but comfortable throughout the day. Make sure they meet all safety requirements for oils slip resistant. Steel toe where required

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## 2. Review Questions – Personal Safety

- 1) Most accidents can be prevented by:
  - a) Proper training
  - b) Paying attention to your surroundings
  - c) Taking safety seriously
  - d) All of the above
- 2) Accidents and injuries affect families and co- workers as well as the employee.
  - a) True
  - b) False
- 3) When carrying a load, it is important to:
  - a) Move as quickly as possible to prevent carrying it too long.
  - b) Carry the load as far away from the body as possible to avoid contact.
  - c) Keep the back straight.
  - d) Bend at the knees.
- 4) Never wear a metal hard hat in an atmosphere where \_\_\_\_\_ is present.
  - a) Water
  - b) Corrosive chemicals
  - c) Electricity
  - d) A composite material
- 5) It is okay to modify protective equipment if it makes it more comfortable.
  - a) True
  - b) False
- 6) Two types of OSHA approved hearing protection are earplugs and:
  - a) Earmuffs
  - b) Headphones

- c) Shock resistant
  - d) None of the above
- 7) The most dangerous consequence of a lack of oxygen is:
- a) Heavy sweating
  - b) Rapid pulse
  - c) Lack of concentration
  - d) Body functions may shut down
- 8) When working with hot metals or cold substances you should wear:
- a) Rubber gloves
  - b) Leather gloves
  - c) Thermally insulated gloves
  - d) A/C gloves

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## 3. Emergency Medical First Aid

### 3.1. Eyes

### Emergency Procedures

Chemical contact with the skin requires flushing the affected area with water. Chemical burns to the eyes must be taken very seriously. Damage to the eye can occur within 1 to 5 minutes, so speed is of the utmost importance in treatment.

- Flush the eye with water continuously for a minimum of 10 minutes.
- After the eye has been flushed out thoroughly, cover with sterile gauze and tape the eye shut.
- Seek medical attention immediately.

Blows to the eye:

- Any injury resulting in a direct hard blow to the eye needs to be seen by a physician.
- If contact lenses are in place, DO NOT try to remove them. A physician needs to be responsible for their removal.
- Immediately after the incident, the person should lie down and an ice pack placed over the eye. Keep the eye closed as much as possible.

Cuts to the eye require the following steps be taken:

- Immediately cover the cut eye with an ice pack.
- Cover the other eye that has not been injured to limit eye movement (when one eye moves, so does the other).
- Seek medical treatment immediately. There are no minor eye injuries.
- If anything becomes embedded in the eye, DO NOT TRY to remove it. Cover both eyes with an ice pack and seek immediate medical assistance.



## Emergency Procedures

**50%** of workers injured while wearing eye protection thought the eyewear had minimized their injuries. But nearly half the workers also felt that another type of protection could have better prevented or reduced the injuries they suffered. **It is estimated that 90% of eye injuries can be prevented through the use of proper protective eyewear.** No matter where we work, flying particles, dusts, fumes, vapors or harmful rays are apt to expose us to potential eye injury. Fortunately, we can protect against these hazards by using the appropriate protective eyewear for our jobs and by following our companies' established safety guidelines.

### 3.2. Cuts

## Emergency Procedures

When a person has been cut, the blood that is seen could be coming from a vein or an artery. Blood from a vein is usually dark red in color, while blood from an artery is a brighter red in color. While the procedure for handling a cut is the same, arterial bleeding is considered a much more serious threat.

First aid for cuts consists of the following steps:

- Place a thick pad of sterile gauze over the cut.
- Tape or tie the dressing in place.
- Raise the cut area above heart level if possible.
- Apply continuous direct pressure to the wound.
- Seek medical attention.

There are some blood-borne diseases that you need to be careful not to contract. The following steps need to be taken to help eliminate the risk of exposure:

- When blood is present, always wear medical grade gloves and a facial guard.
- When administering CPR, always use a protective mouthpiece.
- Washing hands with an antibacterial soap is a must.
- If you come in contact with blood, you should see your physician and be tested.

## **S** Emergency Procedures

Severe cuts and lacerations can result in amputations of fingers, toes, hands, and feet. Such acute injuries also might lead to permanent disability — or even death. Cuts and lacerations occur most often when workers are using power tools. Wear appropriate clothing and protective gear including pants, long sleeves, steel-toed boots, goggles or a face shield, and gloves. No matter the task, keep people not involved with the work at a safe distance. Keep good footing and maintain balance when operating power tools. Sturdy work boots can help with this since they provide a wide base of support.

### **3.3. Heat Exhaustion** **S Prevention and Awareness**

Heat exhaustion can occur quicker than most people realize. It occurs after prolonged exposure to high temperatures and humidity. Here are some symptoms that can warn of a potential episode:

- Heavy sweating (with sudden chills)
- Stops sweating altogether, even though the surrounding temperature hasn't changed
- Muscle cramps
- Headache
- Dizziness
- Nausea
- Pale and clammy skin
- Rapid heart rate
- Vomiting
- Fainting

If you find yourself having or observe someone having these symptoms, you need to follow these procedures:

- 1) Move to a cooler location out of the sun (preferably in air conditioning).
- 2) Lie down, keeping your legs elevated 8 to 12 inches above the floor or ground.
- 3) Make sure all clothing is loose.

- 4) Sports drinks or 1/4 to 1/2 teaspoon of salt in 4 cups of water should be administered.
- 5) Place cool wet cloths on the body and forehead to cool the body temperature.
- 6) Seek medical attention.



### **Prevention and Awareness**

The body cools off during sweating; evaporation of sweat off skin cools the skin's surface. When the body cannot dispose of excess heat, it stores it. The body core temperature rises and heart rate increases. Heat stroke is the most serious heat stress condition! Sweating stops in about 50% of individuals. The body can no longer get rid of excess heat. Victims will die unless treated promptly. Behavior changes are a good indicator of possible heat stress. To prevent heat stress, take action when behavior change occurs. Team members must look out for each other. If you are unsure if a person is suffering from heat stress, remove them from hot environment.

Hydrate with water 45 to 50 degrees; avoid iced beverages. 1 cup (5 to 10 ounces) every 15- 20 min.

## **3.4. CPR and the Handling of Choking Victims**

This is a subject that requires extensive hands-on training by people skilled in this specific area. We do recommend that all employees register with the Red Cross and take these courses. It is critical for someone that is in need of this type of assistance to get help as quickly as possible.

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## 4. Review Questions - Emergency Medical First Aid

- 1) When a chemical has come in contact with the eye, you must flush the eye for a minimum of:
  - a) 30 minutes
  - b) 20 minutes
  - c) 15 minutes
  - d) 10 minutes
- 2) When an eye has suffered a cut, you should cover both eyes to avoid:
  - a) Eye movement
  - b) Cross contamination
  - c) Shock
  - d) Loss of fluid
- 3) If a person is wearing contact lenses and suffers an eye injury, you should immediately remove them.
  - a) True
  - b) False
- 4) Which type of bleeding is considered the most dangerous?
  - a) Arterial
  - b) Venous
- 5) After applying a sterile dressing to a wound, you should continuously apply:
  - a) An antiseptic
  - b) Fresh bandages
  - c) Pressure
  - d) Clean water
- 6) Heat exhaustion occurs after prolonged exposure to:
  - a) High temperatures
  - b) High humidity

- c) Heavy lifting
  - d) High temperatures and high humidity
- 7) If a person suddenly stops sweating while working in a hot attic, it may be a symptom of:
- a) Hypothermia
  - b) Heat exhaustion
  - c) A lack of oxygen
  - d) Evaporation
- 8) The organization that provides CPR training for the general public is:
- a) The Red Cross
  - b) The American Medical Association (AMA)
  - c) The Heimlich Institute
  - d) The Insurance Underwriters Association (IUA)
- 9) When assisting a victim who is bleeding, you should always wear:
- a) Medical grade gloves
  - b) A facial mask
  - c) Both a and b
  - d) None of the above
- 10) Muscle cramps and nausea may be an indication of:
- a) Trauma
  - b) Heat exhaustion
  - c) Dizziness
  - d) Deprivation

## 5. Electrical Safety



### Electrical Safety

Many accidents are the result of carelessness. It is easy for a person to focus on the work and forget about safety. Therefore, you must train yourself to always do things in a safe manner. Look for the hazards around you and understand the safe work practices required to do the job properly.

Prior to working on electrical equipment, you must:

- De-energize the equipment by unplugging it and shutting off the circuit breaker or the disconnect switch.
- Lock out the breaker or disconnect so no one else can restore power while you are working. This can be accomplished with a lock system at the power panel or taping the panel shut.
- Verify with a voltmeter that the power has been disconnected.
- Ground the equipment or make sure the ground wire is connected to a good earth ground.
- Look for wires that are frayed, worn, or brittle and replace them.
- Use tools that have insulated handles.

When you must work in a damp or wet location, work from a dry, insulated mat or platform. If you must work near energized equipment, wear dry shoes with good rubber soles and approved rubber gloves.

Most fatal electrical shocks happen to people who should know how to prevent them. Moreover, as some people become more experienced with electrical equipment, they become careless and don't follow all the safety precautions. This leads to an accidental, sometimes fatal, electrical shock.



### Electrical Safety

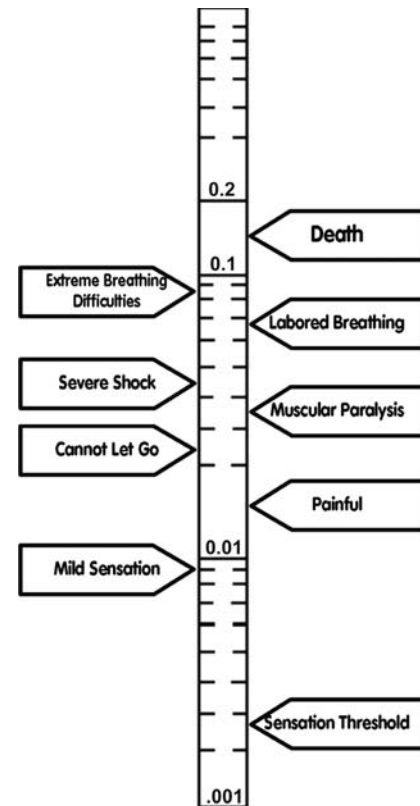
Whenever you work with electrical circuits there is a risk of electrical hazards, especially electrical shock. Anyone exposed to these hazards at home or at work. Workers are exposed to more hazards because job sites can be cluttered with tools, materials, fast paced and open to the weather. We must pay special attention to electrical hazards because we work on electrical circuits. Coming in to contact with electrical voltage can cause current to flow through the body, resulting in electrical shock and burn. How is electrical shock received? An electrical shock is received when electrical current passes through the body.

## 5.1. Voltage

### **S** Electrical Safety

It would seem that a shock from a very high voltage source (such as power lines) would be more deadly than regular household current. However, this is not always the case. People have been electrocuted by household equipment of 120 volts, and in industrial situations by as little as 42 volts. The intensity of an electrical shock lies not in the amount of voltage, but the amount of electrical current forced through the body. Electrical current is the flow of electricity and is measured in AMPS. Any current flow through the body in excess of 10 milliamps can deliver a painful to severe shock. A milliamp is 1/1000th of an amp, so you can see it takes very little current to pose a danger. An ordinary kitchen toaster can draw as much as 10-15 amps of current.

The heartbeat is triggered by electrical impulses from the brain. An electrical shock is enough to disrupt the normal signals and cause heart failure.



### **S** Electrical Safety

It has been researched that over a hundred people die each year because machines that are being repaired, set up, or serviced have not been properly locked out. Lockout Tagout was specifically created to make sure that a particular machine's energy is neutralized before it is serviced on. This electrical safety procedure keeps employees from accidentally starting up a machine without them knowing that the machine is under maintenance and that people are currently working on it.

## 5.2. First Response for Electrical Shock Victims **S** Electrical Safety

- 1) De-energize the circuit and remove the victim from contact as quickly as possible.
- 2) If you cannot de-energize the circuit, use an insulated material such as a length of dry rope, dry wood, or a leather belt to remove the victim from contact with the energized circuit.

- 3) If the victim is not breathing and unconscious, call for help and start CPR immediately (if you have been trained).
- 4) Continue resuscitation until professional help arrives.

### **S Electrical Safety**

Always test a circuit to make sure it is de-energized before trying to help a shock victim. You will receive electrical shock if a part of your body completes the electrical circuit by touching a live wire and an electrical ground. The shock victim is part of the electrical circuit.

## **5.3. Seven Rules for Safe Practice and to Avoid Electric Shock**

### **S Electrical Safety**

- 1) Be sure of the condition of the equipment and the dangers present BEFORE working on the equipment. Supposedly "unloaded" guns kill many sportsmen; supposedly "disconnected" circuits kill many people.
- 2) Never rely on safety devices such as fuses, relays, and interlock systems to protect you. They may not be working and may fail to protect when needed most.
- 3) NEVER remove the grounding prong of a three-wire wall plug. This eliminates the safety-grounding feature of the equipment and makes it a potential shock hazard.
- 4) Do not work on a cluttered bench. A disorganized mess of parts and tools leads to shocks and accidents. Develop organized work procedures.
- 5) Do not work on wet floors. Your resistance to electrical shock is substantially reduced. Work from a rubber mat or on an insulated floor.
- 6) Don't talk when working on electrical systems. Don't let yourself be distracted.
- 7) Always move slowly when working around electrical circuits. Rapid movements may lead to accidental shocks.

### **S Electrical Safety**

Use the three-stage safety model: recognize, evaluate, and control hazards. Evaluate the situation you are in and assess your risks. Control the hazards by creating a safe work environment and by using safe work practices.



## 5.4. Working with Energized Circuits Electrical Safety

The following items are required when working with live circuits. These regulations are requirements of OSHA and should be followed to ensure the safety of the technician.

- Only qualified workers can work around energized equipment.
- De-energize circuits, lockout, and tagout before working on them (lockouts prevent someone else from re-energizing the circuit without your knowledge).
- Stay away from overhead power lines.
  - Unqualified workers must stay at least 10 feet away, including any conducting tools.
  - Qualified workers must use the right insulated tools.
  - Vehicles must stay at least 10 feet away, or have proper insulated barriers.
  - Workers on the ground should not contact vehicles or equipment unless properly protected.
- Use insulated tools
  - Nonmetal hard hats, earmuffs, goggles, and shields.
  - Equipment must be used properly and be in good condition.
- Follow safety rules with portable electric tools.
- Obey all warning signs.
- Ladders should be non-conducting (non-metallic).
- Don't wear metal objects (watches, belt buckles, rings, or jewelry). If you must wear a ring, always wrap it with electrical tape to insulate it from electricity.

### Electrical Safety

Identify electrical hazards, evaluate hazards, and control hazards.

## 5.5. Tools

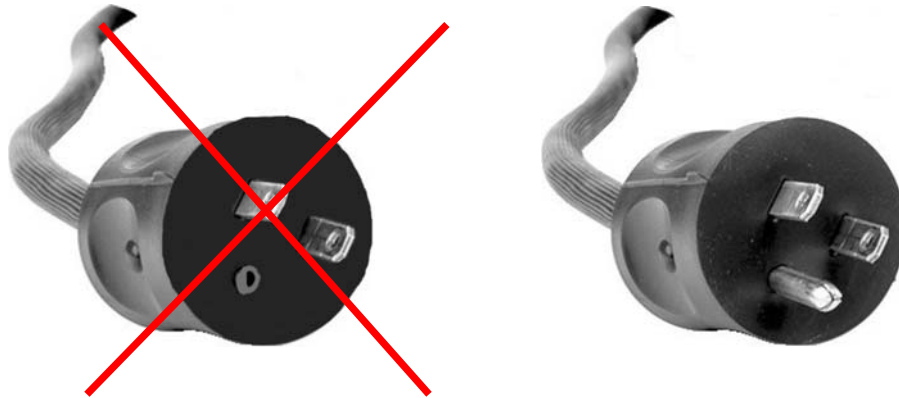
### **S** Electrical Safety

#### **S** Electrical Safety

Inspect tools before using them. Check for cracked casings, dents, missing or broken parts, and contamination (oil, moisture, dirt, corrosion). Damaged tools must be removed from service and properly tagged. These tools should not be used until they are repaired and tested.

Manufacturers are now making power tools that are double insulated to protect against electrical shock. There are still some older tools in the workplace that do not have this feature. Do not use these older tools near live (energized) circuits.

Never use a power tool that has a bad plug or one that has been modified. Never cut the ground terminal off a plug to make it fit a 2 wire wall outlet. If you find a damaged power cord, replace it immediately.



*Courtesy of OSHA*

OSHA requires certain guards or devices to keep hands, arms, and other body parts away from moving machine parts.

Types of machine guards include:

- Fixed guards or barriers between you and the machine's power train or point of operation.
- Interlocked guards, which disengage the power source if opened or removed.
- Adjustable or self-adjusting guards which can be moved to fit specific operations (such as a blade guard on a saw).

Remember:

- Never remove or disable a machine guard.

- Never reach around or under a machine guard.
- Never use a machine with guards that are missing or disabled.

## 5.6. Extension Cords **Electrical Safety**

The sizing of extension cords should follow the guidelines that would normally be used when installing equipment. The following wire sizing example includes wire that is designed for motor (inductive loads) usage.

- 14 gauge wire - 15 amps
- 12 gauge wire - 20 amps
- 10 gauge wire - 30 amps



Always refer to the data plate on the power tool to determine what the amp draw is. When using multiple tools, be cautious of overloading the capacity of the extension cord.

Inspect the cord before use for nicks and damage.

### **Electrical Safety**

Keep extension cords in prime condition. Store cords properly to keep from damaging or breaking the wires. Do not bend sharply or twist. Never place in areas of heavy foot traffic. Never run extension cords through doorways where they may be pinched by a closing door.

## 5.7. Lockout Tags



*Courtesy of OSHA*

Before working on any piece of equipment that requires electricity, always check to see if voltage is present. NEVER assume electricity is not present until you have checked for voltage with a meter and proved there is no voltage.

There have been many debates about when a technician should use a lockout tag. The following points should clarify the rulings.

While working on a system, the power must be de-energized by turning OFF a breaker, removing a fuse, or moving or pulling a disconnect switch to the OFF position. The only time a lockout tag is required is when the switch is in the OFF position and out of your visual sight while working on the equipment.

### Electrical Safety

You must find where circuit breakers, fuses, and switches are located. Make certain all energy sources are locked out and tagged out before performing any work on an electrical circuit or electrical device. Then test the circuit to see if it is completely de-energized. Lock out and tag out eliminates stored hazardous energy so that it is not accidentally released to injure or impair the worker (forms of hazardous energy that we might be exposed to in course of the task).

### 5.7.1. Locks



#### Electrical Safety

A lock that is placed on an energy isolating device in order to prevent its operation.

Locks must be:

- Standardized throughout the workplace - you cannot use any old lock for lockout.
- Durable enough to withstand heat, cold, and corrosion.
- Strong enough that they can't be removed without heavy force or special tools.
- Identified by the names of the authorized employees who install and remove them.

### 5.7.2. Tags



Tags must be:

- Standardized in terms of size, color, print, and format.
- Clearly readable and contain clear warning information.
- Strong enough so they can't be accidentally removed.
- Identified by the name of the authorized employees who install and remove them.
- Tags are for warning purposes and should be used only if lockout is impossible.

#### **Electrical Safety**

Tags are prominent warning tag attached to the device to communicate the reason why, when, and who locked out the device.

#### SEVEN BASIC STEPS TO LOCKOUT:

- 1) Perform “Personal Risk Assessment” prior to job.
- 2) Shut down the equipment.
- 3) Check the moving parts to see if they've stopped.
- 4) Shut off and put on the correct lock at each place where you isolate the energy source. Fill out and attach a tag to each lock so that it identifies who locked it out, the date, and the reasons why.
- 5) Check it. Test circuits for electricity. Check that switches and valves are turned off and locked. Check gauges for zero pressure. Turn the operating controls on to see if the main energy is still getting through. Turn them off again.
- 6) Neutralize the stored energy — release or block off all parts under tension or pressure, wait for temperatures to go down, disconnect, drain or vent whatever it needs to clean out the system.
- 7) Check it. Pressure gauges should be zero. Look for movement in the system. Listen for release of air or liquid.

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## 6. Review Questions - Electrical Safety

- 1) The severity of an electrical shock lies mostly in the amount of \_\_\_\_\_ through the body
  - a) Current
  - b) Voltage
  - c) Resistance
  - d) Differential
- 2) The third (round) prong of a three wire plug is there to:
  - a) Maintain a steady voltage
  - b) Increase product efficiency
  - c) Provide a test point for troubleshooting
  - d) Provide safety
- 3) Ladders used around electricity must be:
  - a) Conductive
  - b) Metallic
  - c) Non-conductive
  - d) Extendable
- 4) A 12-gauge extension cord can safely handle \_\_\_\_\_ amps.
  - a) 12 amps
  - b) 15 amps
  - c) 20 amps
  - d) 10 amps

- 5) Always make sure a circuit is de-energized by checking with:
- a) A helper
  - b) The home owner
  - c) An ohmmeter
  - d) A voltmeter
- 6) A lockout tag must be used when:
- a) The breaker is out of the technician's sight
  - b) The breaker size is more than 10 amps
  - c) You must leave the circuit disabled
  - d) A helper is not available
- 7) It is okay to use a machine with a missing guard provided the operator is both skilled in its use and the machine is double insulated
- a) True
  - b) False
- 8) Circuit breakers are used to protect the user from electrical shock.
- a) True
  - b) False
- 9) When troubleshooting a live electrical circuit, you should not wear:
- a) Steel toe shoes
  - b) Any type of hard hat
  - c) Rings or jewelry
  - d) Safety glasses

10) Unqualified workers must stay at least \_\_\_\_ feet from energized equipment, power lines, and tools that conduct electricity.

- a) 10
- b) 20
- c) 25
- d) 5



## 7. Equipment Safety

### 7.1. Ladders



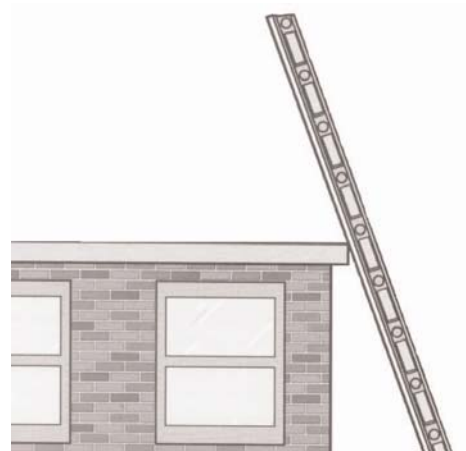
*Courtesy of OSHA*

Even simple stepladders can be dangerous if not used properly. Follow these basic rules:

- Never use a ladder that is damaged in any way and always inspect it before use.
- Always use safety features (safety feet, spreaders, locking devices) and do not use if they are missing or damaged.
- Don't exceed the weight limit - there should be a label showing the maximum weight.
- Face the ladder when going up or down.
- Never try and move the ladder while you are on it.
- Do not use a metal ladder when working on live electrical wires.

When using extension ladders:

- Use the "4-to-1" rule: the base of the ladder should be one foot from the wall for every 4 feet of height.
- The top of the ladder should extend at least three feet above the support point.
- Never place a ladder against a door, window, or other support point. Don't work from a ladder if it's very windy.
- 



#### Safety Tag

Be aware of overhead wires and live electrical circuits. Metal extension ladders conduct electricity and create hazards of electrocution. Wood and Fiberglass do not if they are dry. Don't take ladder safety for granted; they are a major source of accidents at job sites. Ladders must also be capable of supporting their load without failing and free of slipping hazards.

## 7.2. Material Safety Data Sheets (MSDS) Safety Tag

### Safety Tag

The material safety data sheet is a detailed information bulletin prepared by the manufacturer or importer of the chemical that describes the following information for a given chemical:

Material safety data sheets contain basic information needed to ensure the safety and health of the user at stages of the material's manufacture, storage, use, and disposal. Here are a few important facts that you will find in MSDS sheets.

- Flash points
- Freezing points
- Reactivity data for fire fighters
- Health hazard data
- Time Weighted Averages (TWA)
- First aid section
- Special protection requirements in response to particular hazards
- Hand protection
- Respiratory protection
- Eye protection
- Full body protection

There are many chemicals that are stocked on a service truck for which we would recommend you request a copy of the MSDS sheets.

## 7.3. Welding, Cutting, and Brazing Safety Tag

*Courtesy of OSHA*

### 7.3.1. The "Three Fs" of Welding

**Fire** (from flame, sparks, and hot slag)

- Remove combustible materials from the area.
- Clean all flammable substances from the work surface.
- Keep a sand bucket and fire extinguisher nearby.
- Wear fire resistant clothing.

**Fumes** (from heated metal)

- Work area should be well ventilated.
- Wear approved respirator if required.
- Stop working if you feel ill.

**Face** (prevent injuries to the face and eyes)

- Wear a face shield to protect against sparks and flying particles.
- Goggles may also be needed when chipping or cutting metal.

### 7.3.2. Other Welding Dangers

Watch out for these other welding dangers:

**Electric shock** (when arc welding):

- Make sure equipment is in good condition and properly grounded.
- Don't work in wet areas.
- Don't wear metal items such as jewelry or watches.
- Wear insulated gloves.

**Explosions** (when gas welding):

- Check the material safety data sheets for handling of the gas you are using.
- Handle compressed gas cylinders very carefully.

- Always turn off the gas when not lit.

**The leading cause of welding accidents is carelessness. Take safety seriously!**

**Never take chances.** This is for your own personal information as well as a record that can be kept on the service truck for law enforcement that may request it.

## **S Safety Tag**

When welding, cutting, and brazing, your contact with hot and sharp metal surfaces is increased. Proper safety equipment will help protect you from hazards that are present during this phase of the job task.

Fumes and gases are hazardous. Welding and brazing produces fumes and gases. Breathing these fumes and gases is very hazardous to your health.

Keep your head out of fumes. Do not breathe fumes. If inside, ventilate the area. Some gases like natural gas and acetylene are lighter than air and will collect in areas. Hot Parts can burn. Doesn't touch parts bare handed. Allow a cooling period before working on equipment. To handle hot parts, use proper tools and wear heavy, insulated gloves and clothing to prevent burns.

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## 8. Review Questions - Equipment Safety

- 1) Never use a ladder that:
  - a) Is taller than necessary
  - b) Has been damaged
  - c) Has a neoprene base
  - d) Is made of composite materials
- 2) An extension ladder should extend at least \_\_\_\_\_ feet past the point of support.
  - a) 1
  - b) 3
  - c) 5
  - d) 7
- 3) The basic rule for setting up an extension ladder is to have the base of the ladder one foot away from the structure for every \_\_\_\_\_ feet of height.
  - a) 10
  - b) 8
  - c) 6
  - d) 4
- 4) You should never place a ladder against a(n):
  - a) Door or window
  - b) Overhang
  - c) Fascia
  - d) Metallic substance
- 5) Information concerning health hazards, first aid, protection and hazard response, is found on (in):
  - a) The UL tag
  - b) The ARI label

- c) The ANSI spec sheet
  - d) The MSDS sheet
- 6) Fumes from heated metal, or phosgene gas from refrigerant coming in contact with a torch flame may require the use of a \_\_\_\_\_ when brazing.
- a) Respirator
  - b) Desiccant
  - c) Thermistor
  - d) Ozonator
- 7) Compressed gases can be:
- a) Flammable
  - b) Explosive
  - c) Toxic
  - d) All of the above
- 8) If the valve on a gas container is stuck, you must use the proper tool to free the valve.
- a) True
  - b) False
- 9) You should never move a compressed gas cylinder by:
- a) Carrying it on your back
  - b) Using a hand truck
  - c) Carrying it over your shoulder
  - d) Rolling or dragging it
- 10) You must follow \_\_\_\_\_ rules for the storage of compressed gas cylinders in the workplace.
- a) OSHA
  - b) NADA
  - c) American Gas Association
  - d) ARI

## 9. Fire Safety



Fire needs three specific items in order to exist:

- Fuel (source could be wood, paper, plastics, chemicals, etc.)
- Oxygen (there is 21% oxygen in the air that we breathe)
- Heat

If you are able to eliminate any one of these items, the fire will be suppressed.

Fires primarily get started in our industry by:

- Soldering or brazing copper piping
- Welding
- Electrical shorts
- Natural or LP (Liquid Petroleum) gas leaks

Most of these fires could be prevented by using common sense.

- While soldering, brazing, or welding keep flammable substances clear from work area. If working in a confined space where combustible materials are close by and cannot be removed, cover it with a damp cloth. However, during the course of your work it is necessary to check the cloth to ensure it is still damp.
- When working with electrical wire be careful not to drive a staple through the wire's insulation. Double check wiring terminals that you have crimped on or wire nuts used to tie wire together.
- Gas pipe connections - double check each connection to ensure that pipe fitting sealer was used and the joint is good and tight.

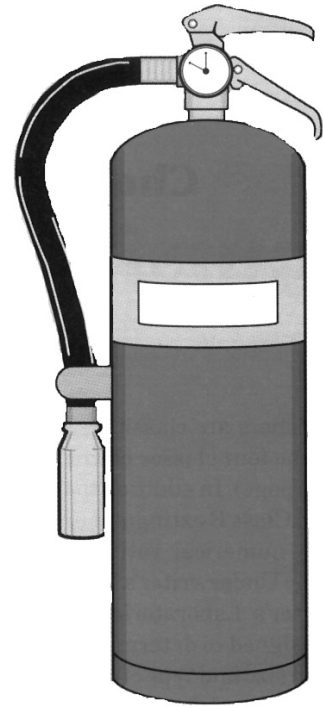
If for one reason or the other a fire does get started, here are some simple procedures to follow.

- 1) If possible remove the fuel. Example: A natural gas fire can be extinguished by turning off the fuel supply.
- 2) Smother the fire by something that would not allow oxygen to get to the fire.
- 3) Use a fire extinguisher. If a fire extinguisher is being used, here are some important facts about fire extinguishers that you need to know.

## 9.1. Fire Extinguisher Classifications

- **Class A** is used on fires involving ordinary combustable materials, such as wood, cloth, or paper.
- **Class B** is used on fires involving flammable liquids, greases, and gases.
- **Class C** is used on fires involving energized electrical equipment. The media inside the fire extinguisher does not conduct electricity.
- **Class D** is used in fires involving combustable metals, such as magnesium, titanium, zirconium, sodium, and potassium.

Fire extinguishers need to be checked at least once quarterly. Most extinguishers have a gauge to let you know what the status of the charge is. Those that do not have a gauge have an expiration date stamped on them. Recharge or replace as necessary.



## 9.2. Using a Fire Extinguisher to Put Out a Fire

- 1) Pull the safety pin out
- 2) Aim at the base of the fire
- 3) Pull the handle

Note: Most small fire extinguishers that are kept on service trucks can only be used once, meaning you literally can only pull the handle once. There is no second chance.

**Even if you feel very good about extinguishing the fire, it is always recommended to call the fire department to ensure there are no hidden hot spots.**





### Safety Tag

Types of fire extinguishers are water and foam, carbon dioxide, dry chemical, wet chemical, clean agent, dry powder, water mist, and cartridge operated dry chemical.

Water extinguishers are for class A fires only, and Foam extinguishers are for class A and B fires only. It is important to know the locations and types of extinguishers in your work area prior to actually using one. Like any mechanical device, fire extinguishers must be maintained on a regular basis to insure proper operations. Fire Extinguishers must be inspected or given a quick check every 30 days.

Ask yourself the following questions for the quick check:

- Is it in the correct location?
- Is it visible and accessible?
- Does the gauge and pressure indicator the correct pressure?

Fire extinguishers must be maintained annually in accordance with local, state, and national codes and regulations.

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## 10. Review Questions – Fire Safety

- 1) Fire needs a source of fuel, oxygen, and \_\_\_\_\_ to exist.
  - a) Heat
  - b) Material
  - c) Gas
  - d) Combustibles
- 2) Where should you aim the fire extinguisher to effectively put out a fire?
  - a) At the tips of the flames
  - b) At the base of the flames
  - c) At the center of the flames
  - d) All over the flames
- 3) Class A fire extinguishers are used on \_\_\_\_\_ fires.
  - a) Flammable liquid
  - b) Electrical
  - c) Wood, cloth, or paper
  - d) Combustible metal
- 4) Class B fire extinguishers are used on \_\_\_\_\_ fires.
  - a) Flammable liquid
  - b) Electrical
  - c) Wood, cloth, or paper
  - d) Combustible metal
- 5) Class C fire extinguishers are used on \_\_\_\_\_ fires.
  - a) Flammable liquid
  - b) Electrical
  - c) Wood, cloth, or paper

- d) Combustible metal
- 6) Even if you feel the fire is totally under control, you should contact the fire department.
  - a) True
  - b) False

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## 11. Conclusion

Taking the time to review and use these safety practices will prevent accidents. Here are a few points to remember:

- Be aware of the surroundings.
- Double-check electrical switches to make sure power is off.
- Use all approved safety equipment.
- Learn to use tools properly.
- Report all accidents to your supervisor.