ELECTRICAL SAFETY

Introduction

Electricity is our most valuable energy resource. Though we use it everyday, few people really understand what electricity is and how it works. Even more important, most people do not have a respect or complete understanding of its potential hazards.

Electricity is the number one cause of fires in the work place.

More than 800 people are electrocuted each year. Thousands more suffer disabling injuries from accidental contact with electricity. More than half of these accidents involve the same common low voltage you use in your home.

Because of these alarming statistics, federal regulations have been established to train you on the hazards of electricity and safe work practices you can use when working with or near electricity.

In this training program you will learn . . .

- The fundamentals of electricity
- Its associated hazards
- Safe work practices to ensure your safety and that of your co-workers.

The information you learn will have valuable applications both on and off the job. With a knowledge of how electricity works and a respect for the potential hazards, you can prevent electrical accidents from occurring in your facility.

Electrical Hazards

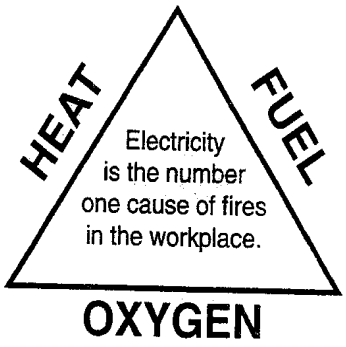
There are three basic types of electrical hazards:

- Fire
- Shock
- Burns

Fires

Electricity is the number one cause of fires in the work place. Three ingredients are necessary for a fire to exist:

- Oxygen
- Fuel
- Heat



Electricity generates heat. Engineering controls, such as fuses, circuit breakers, ground fault circuit interrupters and insulators, are designed to prevent electricity from becoming the heat source for fires.

What safe work practices can be used to prevent electrically related fires?

Electrical Hazards

(continued)

Electric Shock

Electrical shock occurs when the body comes in contact with the flow of electricity. You do not have to have direct contact with an exposed live wire for this to happen. If a conductive material such as the boom of a truck or mobile crane comes in contact with an overhead power line and you touch the vehicle while on the ground, you could be shocked. Accidental contact with electricity can cause a variety of health consequences varying from minor tingling to internal organ damage, burns, and even death.

Factors that affect the seriousness of the injury include:

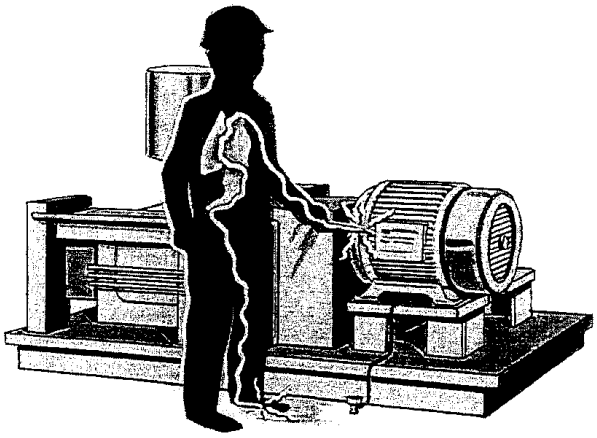
- The type of circuit and its voltage
- Resistance and Amperage
- The path the current takes through the body
- The length of contact with the energized source.

Contact with overhead power lines is the number one cause of electric shock in industry and the main cause of electrocutions.

Four other common causes of electrical shock in the work place include:

- Failure to lockout electrical systems for maintenance and repairs
- Failure to ground
- Defective equipment and lines
- Wet electrical equipment.

Below are the effects of contact with common 60 hertz AC current.



1 milliamp (ma)	Usually harmless, but the slight tingling or involuntary movement to the shock could cause you to lose your balance and be injured in a fall.
5-15 ma	May result in a loss of muscle control. This may cause you to not be able to let go of the source of shock and could potentially increase the degree of injury.
75-300 ma	Strong enough to cause death.
2.5+ amps	Can cause internal organ damage and internal and external burns. Cardiac arrest and respiratory failure may occur.

Personal Protective Equipment

Since the body is a conductor of electricity, the proper selection and use of non-conductive personal protective equipment is very important when working with or near electricity.

Which of the following personal protective equipment is required at your facility?

_____ **LEATHER GAUNTLET GLOVES OVER RUBBER INSULATED GLOVES** -- rubber is a non-conductive material. The leather protects the rubber from tears and other damage.

_____ **HARD HATS** -- Non-metal hard hats should be worn whenever there is the potential of a bump hazard or your head coming in accidental contact with an energized source.

_____ **EYE PROTECTION** -- Safety glasses should be worn at all times in the work environment. Side shields are strongly recommended. Filtered eye protection must be worn when working with electrical arcs such as welding.

_____ **RUBBER OR NON-CONDUCTIVE CLOTHING** -- Metal belt buckles, buttons, and certain synthetic fibers will conduct electricity. Natural fibers such as cotton should be worn. Additional protection, such as rubber sleeves, should be worn when working near exposed energized parts.

_____ **RUBBER-SOLED SHOES OR BOOTS**

WARNING! Metal jewelry such as watches, rings, key chains and earrings should never be worn when working around exposed energized parts. The metal objects could cause serious burns to the skin if accidental contact is made with an energized electrical source.

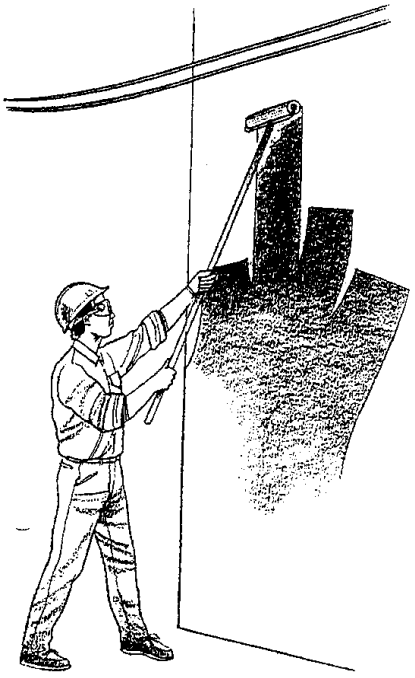
While wearing the proper personal protective equipment is an important and necessary preventive measure, it does not make you immune from electrical hazards. That's why safe work practices are essential to ensure your safety.

Safe Work Practices

The most effective way to avoid accidental contact with electricity is to de-energize the system you are working on or maintain a safe distance from energized parts.

Overhead Power Lines

Federal regulations require you to keep minimum distances from unguarded, energized, overhead power lines. The distance requirements are based on the nominal voltage.



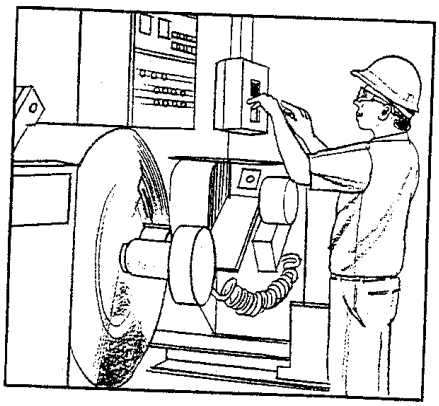
Unqualified persons working near overhead power lines, either on the ground or in an elevated position, must keep a minimum 10-foot clearance from overhead power lines of 50kV or less. This distance includes any conductive object the person may contact. For voltages to ground over 50 kV, the distance increases 4 inches for every 10kV over 50kV. So if a power line is 60kV, you would need to keep a distance of 10 ft. 4 in.

The clearance distance for vehicles and mechanical equipment is also a minimum of 10 feet.

Other safe work practices you can follow include:

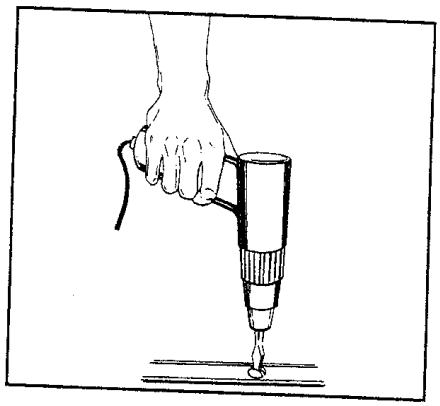
When Working with or Around Electrical Equipment

- Make sure all guards are properly in place.
- Make sure all electrical equipment and systems are grounded.
- Keep the equipment lubricated and well maintained.
- Never bypass built-in safety features.
- Practice good housekeeping procedures.
- Report any malfunctions immediately.



When Using Electrically Powered Tools

- Inspect the tool before use.
- Check the cord for signs of defect.
- Use permanent wiring whenever possible.
- Avoid using electrical tools in wet conditions.
- Use only spark proof tools in highly combustible areas.

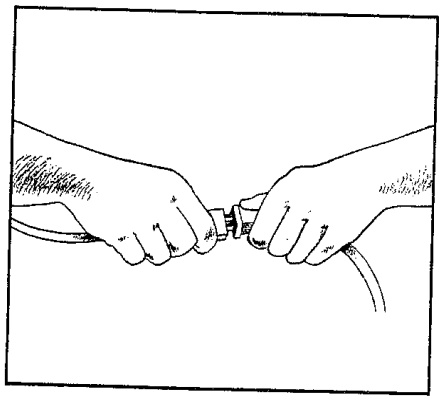


Safe Work Practices

(continued)

When Using Extension Cords

- Make sure the cord is rated for the load it will carry.
- Inspect the cord for signs of defects such as fraying.
- Ground fault interrupts should be used when possible.
- Never drape the cord over metal ductwork or piping.
- Never alter a cord to perform a task.
- Never remove the grounding prong to fit the plug into a two-pronged receptacle.



Other Safe Work Practices

- Using non-conductive ladders around electrical equipment.
- Never exceed the capacity by overloading circuits.
- Never reach blindly into an electrical cabinet.
- Use illumination when needed.
- Secure doors or openings that could bump you into an energized part.
- Be aware of all energized electrical parts in your area.
- Use the proper tools.
- Always make sure your hands are dry when plugging and unplugging energized plugs and receptacles.
- Know and use lockout and tagout procedures.
- Respect the potential electric hazards.

Basic Electrical

WAC 296-800-280

Rule

WAC 296-800-28030 (Continued)

- Make sure flexible cords and cables are approved and suitable for:
  - The way they will be used.
  - The location where they will be used.
- Not fasten or hang cords and equipment in any way that could cause damage to the outer jacket or insulation of the cord.
- Make sure insulation on flexible cords and cables is intact.
- Make sure flexible cords and electrical cords are:
  - Connected to devices and fittings so that any pulling force on the cord is prevented from being directly transmitted to joints or terminal screws on the plug
  - Used only in continuous lengths without splice or tap.
- Prohibit your employees from using wet hands to plug or unplug equipment or extension cords if the equipment is energized.

Note:

Hard service flexible cords No. 12 or larger may be repaired or spliced if the insulation, outer sheath properties, and use characteristics of the cord are retained.

-Continued-

WAC 296-800-28030 (Continued)

You must

(3) Provide the following for temporary use.

- Make sure temporary electrical power and lighting installations that operate at 600 volts or less are used only:
  - During and for remodeling, maintenance, repair or demolition of buildings and similar activities.
  - Experimental or developmental work.
  - For no more than 90 days for:
    - Christmas decorative lighting
    - Carnivals
    - Other similar purposes
- Make sure flexible cords and electrical cords used on a temporary basis are protected from accidental damage.
  - By avoiding sharp corners and projections.
  - If they pass through doorways or other pinchpoints.

Basic Electrical

WAC 296-800-280

Rule

WAC 296-800-28035

Guard electrical equipment to prevent your employees from electrical hazards

You must

(1) Guard live parts of electric equipment operating at 50 volts or more against accidental contact by any of the following means:

- By approved cabinets or other forms of approved enclosures.
- By location in a room, vault, or similar enclosure that is accessible only to employees qualified to work on the equipment. Entrances to rooms and other guarded locations containing exposed live parts must be marked with conspicuous warning signs forbidding unqualified persons to enter.
- By permanent, substantial partitions or screens so that only employees qualified to work on the equipment will have access within reach of the live parts. Any openings must prevent accidental contact with live parts by employees or objects employees carry.
- By location on a balcony, gallery, or platform that will exclude unqualified persons.
- By being located 8 feet or more above the floor or other working surface.

(2) Make sure all electrical appliances, fixtures, lampholders, lamps, rosettes, and receptacles don't have live parts normally exposed to employee contact.

- Rosettes and cleat type lampholders at least 8 feet above the ground may have exposed parts.

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Basic Electrical

WAC 296-800-280

Rule

WAC 296-800-28040

Make sure electrical equipment is effectively grounded

You must

- Make sure the path to ground from circuits, equipment, and enclosures is permanent and continuous.
- Make sure equipment connected by cord and plug is grounded under these conditions:
  - Equipment with exposed noncurrent carrying metal parts
  - Cord and plug connected equipment which may become energized
  - Equipment that operates at over 150 volts to ground
  - Equipment in hazardous locations. (WAC 296-24-95613)

Exemption:

This doesn't apply to guarded motors and metal frames of electrically heated appliances, if the appliance frames are permanently and effectively insulated from ground.

You must

- Ground the following type of equipment:
  - Hand-held motor-operated tools
  - Refrigerators
  - Freezers
  - Air conditioners
  - Clothes washers and dryers
  - Dishwashers
  - Electrical aquarium equipment
  - Hedge clippers
  - Electric lawn mowers

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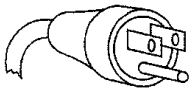
WAC 296-800-28040 (Continued)

- Electric snow blowers
- Wet scrubbers
- Tools likely to be used in damp or wet locations
- Appliances used by employees standing on the ground, on metal floors or working inside of metal tanks or boilers
- Portable hand lamps.

Note:

Grounding can be achieved by: Using tools and appliances equipped with an equipment grounding conductor (3-prong plug and grounded electrical system).

Grounded Plug	Double Insulated
	**Double Insulated** 
Hand held tools and some other types of equipment must use a 3-wire plug or the tool label must show the tool as insulated by words or symbol.	

You must

- Make sure exposed metal parts of fixed equipment that don't conduct electricity, but may become energized, are grounded if the equipment is in a wet or damp location and isn't isolated.
- Make sure ground wires are identified and look different than the other conductors (wires).

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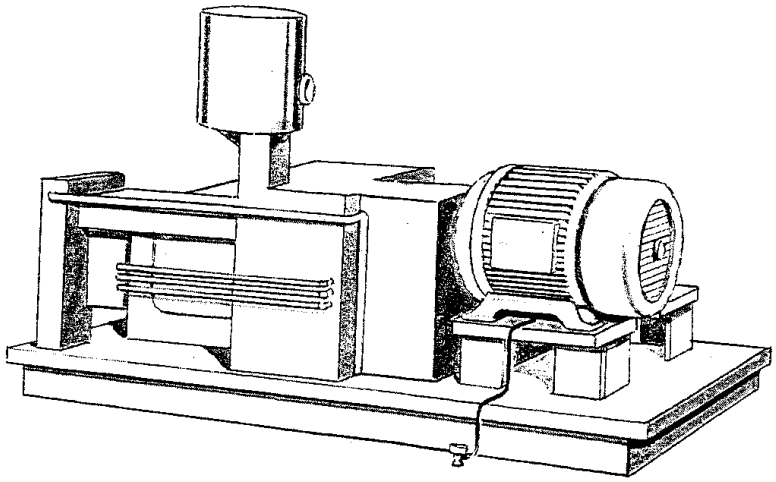
Grounding

Grounding is another protective measure to prevent accidental contact with electricity. It is normally considered a secondary form of protection. Grounding ensures there is a path of low resistance to ground if there is an electrical equipment failure.

How Does Grounding Work?

Grounding is done by connecting all the non-current carrying metal parts together and then connecting them to the ground. It is important that the grounding conductor is firmly attached.



If equipment fails, the electricity will take the path of least resistance. In equipment that is grounded, the current would take a path through the ground wire rather than through the person touching the failed equipment because the human body is more resistant to electricity than the ground wire.

When inspecting your equipment, make sure it is properly grounded. Without proper grounding, a person could become the path to ground if he or she touches the equipment.

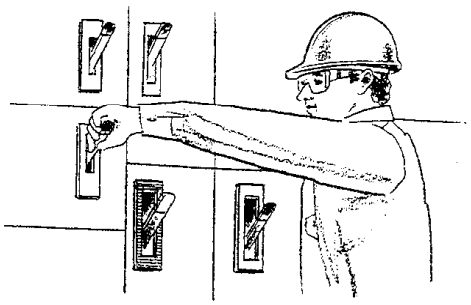
A ground wire will not protect you if you come in contact with an exposed energized part.

Lockout and Tagout Procedures

By de-energizing a system and then locking and tagging it out before beginning work, you can avoid accidental contact with energized parts. Proper lockout and tagout procedures include:

• Identify all sources of energy to the circuit or equipment and properly disconnecting them.

• Release stored electrical energy which might endanger personnel.



• Release or block all stored non-electrical energy that could accidentally energize the system.

• Apply a lock and tag on each disconnecting means to prevent accidental release or startup. The tags used will warn against unauthorized operation of the disconnect means and removal of the tag.

If a tag is used without a lock, use additional safety measures such as removing an isolating circuit element, blocking a controlling switch, or opening an extra disconnecting device.

• Verify that all energy sources have been isolated and the proper equipment is locked out.