ELECTRICAL SAFETY

Electricity is such an integral part of our lives at home and in the workplace that we can tend to take its power for granted. But it's a sobering fact that hundreds of workers are electrocuted each year.

Electrical accidents in the workplace can, for the most part, be avoided if you use safe electrical equipment and work practices.

WHERE ARE THE REGULATIONS?

The Occupational Safety and Health Administration (OSHA) have devoted an entire section (Subpart S) of its regulations to rules governing electrical work. These regulations can be found in 29 CFR 1910.301-.399. In addition, you may find regulations relating to personal protective equipment, found in Subpart I of the General Industry regulations. While the City of Oviedo is not subject to OSHA regulations and reporting, the information within the above mentioned sections can be very valuable.

Supervisors and/or Directors will train you in safe work practices for working with electrical equipment as it specifically relates to your job. The training rules distinguish between workers who work on or near exposed energized parts and those who do not. Even if you are not qualified to work on exposed energized equipment, you must know the specific safety practices which apply to your job.

ARE YOU QUALIFIED TO WORK WITH ELECTRICITY?

There are two categories of workers who face a risk of electric shock that is not reduced to a safe level by using electrical protective devices. These categories identify workers who are:

1. Unqualified, that is, those workers who face a risk of electric shock, but are not trained to work on or near exposed live parts. Unqualified employees must be trained in and familiar with safety-related work practices required by their respective departments.

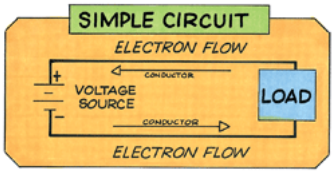
2. Qualified, that is, those workers trained on avoiding the hazards of working on or near exposed live parts, in addition to the training required for unqualified workers.

Qualified workers are trained: to distinguish exposed live parts from other parts of electric equipment, in methods to determine nominal voltage of exposed live parts, and to know the proper clearance distances.

This chapter focuses on information needed by workers who are unqualified.

HOW DOES ELECTRICITY WORK?

To handle electricity safely, including working with electrical equipment, you need to understand how electricity acts, the hazards it presents, and how those hazards can be controlled.



Electricity is the flow of electrons through a conductor. An electron is a tiny particle of matter that orbits around the nucleus of an atom. Electrons of some atoms are easily moved out of their orbits. This ability of electrons to move or flow is the basis of electrical current.

When you activate a switch to turn on an electric machine or tool, you allow current to flow from the generating source through conductors (wires) to the area of demand (motor).

A complete circuit is necessary for the controlled flow of electrons along a conductor. A complete circuit is made up of a source of electricity, a conductor, and a consuming device (load).

VOLTS = CURRENT X RESISTANCE (OR V=IR)

The equation, Volts = Current x Resistance, is known as Ohm's Law. The factors discussed below relate to one another as described by this equation. This relationship makes it possible to change the qualities of an electrical current but keep an equivalent amount of power.

A force or pressure must be present before water will flow through a pipeline. Similarly, electrons flow through a conductor because electromotive force (EMF) is exerted. The unit of measure for EMF is the volt.

For electrons to move in a particular direction, a potential difference must exist between two points of the EMF source. For example, a battery has positive and negative poles.

The continuous movement of electrons past a given point is known as current. It is measured in amperes. The movement of electrons along a conductor meets with some opposition. This opposition is known as resistance. Resistance to the flow of electricity is measured in ohms. The amount of resistance provided by different materials varies widely.

For example, most metals offer little resistance to the passage of electric current. However, porcelain, wood, pottery, and some other substances have a very high resistance to the flow of electricity. In fact, these substances can be used as insulators against the passage of electric current.

WHAT ARE THE HAZARDS OF ELECTRICITY?

The primary hazards of electricity are:

- Shock
- Burns
- Arc-blast
- Explosions
- Fires

SHOCK

Electric currents travel in closed circuits through some kind of conducting material. You get a shock when some part of your body becomes part of an electric circuit. An electric current enters the body at one point and exits the body at another location. High-voltage shocks can cause serious injury (especially burns) or death.

You will get a shock if you touch:

- Both wires of an electric circuit.
- One wire of an energized circuit and ground.
- Part of a machine which is "hot" because it is contacting an energized wire and the ground.

The severity of the shock a person receives depends on several factors:

- How much electric current flows through the body?
- What path the electric current takes through the body.
- How much time elapses while the body is part of the electric circuit?

What happens to the body?

A current as small as 60/1000 of an ampere can kill you if it passes through your chest. The typical household current operates at 15 amperes.

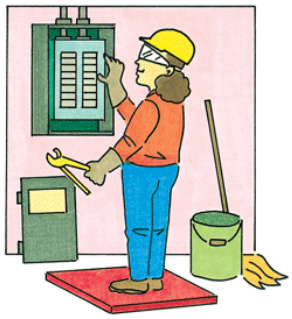
The effects of an electric shock on the body can range from a tingle in the part touching the circuit to immediate cardiac arrest. A severe shock can cause more damage to the body than is readily visible.

Relatively small burn marks may be all that are visible on the outside. However, a severely shocked person can suffer internal bleeding and severe destruction of tissues, muscles, and nerves. Finally, a person receiving an electric shock may suffer broken bones or other injuries that occur from falling after receiving a shock.

The case of water

In its pure state, water is a poor conductor of electricity. However, if even small amounts of impurities are present in the water (salt in perspiration, for example), it becomes a ready electrical conductor.

Therefore, if water is present anywhere in the work environment or on your skin, be extra careful around any source of electricity.



BURNS

Burns can result when a person touches electrical wiring or equipment that is improperly used or maintained. Typically, such burn injuries occur on the hands.

ARC-BLAST

Arc-blasts occur when high-amperage currents jump from one conductor to another through air, generally during opening or closing circuits, or when static electricity is discharged. Fire may occur if the arcing takes place in an atmosphere that contains an explosive mixture.

EXPLOSIONS

Explosions occur when electricity provides a source of ignition for an explosive mixture in the atmosphere. Ignition can be due to overheated conductors or equipment, or normal arcing (sparking) at switch contacts. OSHA standards, the National Electrical Code, and related safety standards have precise requirements for electrical systems and equipment used in hazardous atmospheres.

FIRES

Electricity is one of the most common causes of fire both in the home and workplace. Defective or misused electrical equipment is a major cause, with high resistance connections being one of the primary sources of ignition. High resistance connections occur where wires are improperly spliced or connected to other components such as receptacle outlets and switches.

High resistance connections cause heat to build up. In some cases, enough heat can build up to start a fire.

CAUSES OF ELECTRICAL ACCIDENTS

It is important for you to understand how to avoid electrical hazards when you work with electrical power tools, maintain electrical equipment, or install equipment for electrical operation.

Accidents and injuries in working with electricity are caused by one or a combination of the following factors:

- Unsafe equipment and/or installation.
- Unsafe workplaces caused by environmental factors.
- Unsafe work practices.

PREVENTING ELECTRICAL ACCIDENTS

Protective methods to control electrical hazards include:

- Insulation.
- Electrical protective devices.
- Guarding.
- Grounding.
- PPE.

INSULATION

Insulators of glass, mica, rubber, or plastic are put on electrical conductors to protect you from electrical hazards. Before you begin to work on any piece of electrical equipment, take a look at the insulation (on electrical cords, for example) to be sure there are no exposed electrical wires.

ELECTRICAL PROTECTIVE DEVICES

Electrical protective devices, including fuses, circuit breakers, and ground-fault circuit-interrupters (GFCIs), are critically important to electrical safety. These devices interrupt current flow when it exceeds the capacity of the conductor and should be installed where necessary.

Current can exceed the capacity of the conductor when a motor is overloaded, for example, when you ask a 10 horsepower motor to do the work of a 12 horsepower motor, or when a fault occurs, as when insulation fails in a circuit.

When a circuit is overloaded, the insulation becomes brittle over time. Eventually, it may crack and the circuit fails, or faults.

Fault occurs in two ways. Most of the time a fault will occur between a conductor and an enclosure. This is called a ground fault. Infrequently, a fault will occur between two conductors. This is called a short circuit.

A device which prevents current from exceeding the conductor's capacity creates a weak link in the circuit. In the case of a fuse, the fuse is destroyed before another part of the system is destroyed. In the case of a circuit breaker, a set of contacts opens the circuit. Unlike a fuse, a circuit breaker can be reused by reclosing the contacts. Fuses and circuit breakers are designed to protect equipment and facilities, and in so doing, they also provide considerable protection against shock.

However, the only electrical protective device whose sole purpose is to protect people is the ground-fault circuit-interrupter. The GFCI is not an overcurrent device. It senses an imbalance in current flow over the normal path and opens the circuit. GFCIs are usually installed on circuits that are operated near water.

GUARDING

Any live parts of electrical equipment operating at 50 volts or more must be guarded to avoid accidental contact. This protection can be accomplished in several different ways. The machinery or equipment can be located:

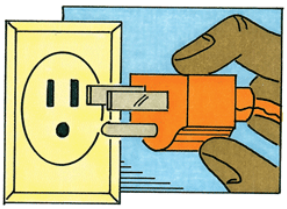
- In a room, enclosure, or vault accessible only to qualified personnel.
- Behind substantial covers, panels, or partitions which prevent easy access.
- On a balcony, platform, or gallery area which is elevated and not accessible to unqualified/unauthorized persons.
- At least eight feet above the floor of the work area.

Any entrance to an area containing exposed live parts of electrical equipment must be marked with conspicuous warning signs. These signs should forbid entrance except by qualified persons.

GROUNDING

Grounding is necessary to protect you from electrical shock, safeguard against fire, and protect against damage to electrical equipment. There are two kinds of grounding:

- Electrical circuit or system grounding, accomplished when one conductor of the circuit is intentionally connected to earth and protects the circuit should lightning strike or other high voltage contact occur.



  Grounding a system also stabilizes the voltage in the system so expected voltage levels are not exceeded under normal conditions.

- Electrical equipment grounding occurs when the equipment grounding conductor provides a path for dangerous fault current to return to the system ground at the supply source of the circuit should the insulation fail.

When a tool or other piece of electrical equipment is grounded, a low-resistance path is intentionally created to the earth. This path has enough current-carrying capacity to prevent any buildup of voltages in the equipment which could pose a hazard to an employee using the equipment. Therefore, never remove the ground prong from a plug because the equipment no longer protects you from short circuits. If you're touching an ungrounded tool, you will become the path of least resistance to the ground.

Grounding does not guarantee that an employee will never receive a shock or be injured or killed by electricity in the workplace. However, this simple procedure will substantially reduce the likelihood of such accidents. Be sure any equipment you work on is properly grounded.

SAFE WORK PRACTICES FOR HANDLING ELECTRICITY

If your job requires you to work on or near exposed energized parts, you should be sure that any tools you use are in good repair, that you use good judgment when working near electrical lines, and that you use appropriate protective equipment.

PERSONAL PROTECTIVE EQUIPMENT

If you work on or near exposed energized parts, you must be trained as a qualified person. The City will provide you with protective equipment. You must use electrical protective equipment appropriate for the body parts that need protection and for the work to be done. Electrical protective equipment includes insulating blankets, matting, gloves, sleeves, overshoes, face protection, and hard hats among other equipment specially made to protect you from electricity.

LOCKOUT/TAGOUT

Before any repair work or inspection of a piece of electrical equipment is begun by a qualified person, the current must be turned off at the switch box, and the switch padlocked in the OFF position.

The other step in this procedure is the tagging of the switch or controls of the machine or other equipment which is currently locked out of service. The tag indicates which circuits or pieces of equipment are out of service.

WORK AT WORKING SAFELY

Safety should be foremost in your mind when working with electrical equipment. You face hazards from the tools themselves and the electricity that powers them. It's up to you to wear protective equipment when it's specified, use all safety procedures, and work with tools correctly. The following general rules apply to each piece of electrical equipment you use:

- Be sure your electrical equipment is maintained properly. Regularly inspect tools, cords, grounds, and accessories. Make repairs only if you are authorized to do so. Otherwise, arrange to have equipment repaired or replaced immediately.
- Be sure you use safety features like three-prong plugs, double-insulated tools, and safety switches. Be sure electrical covers and panels are in place and that you always follow proper procedures.
- Install or repair equipment only if you're qualified and authorized to do so. A faulty job may cause a fire or seriously injure you or other workers.
- Keep electric cables and cords clean and free from kinks. Never carry equipment by its cords.
- Use extension cords only when flexibility is necessary:
    - **Never** use them as substitutes for fixed wiring.
    - **Never** run them through holes in walls, ceilings, floors, doorways, or windows.
    - **Never** use them where they are concealed behind walls, ceilings, or floors.
- Don't touch water, damp surfaces, ungrounded metal, or any bare wires if you are not protected. Qualified employees must wear approved rubber gloves when working with live wires or ungrounded surfaces, and wear electrically-insulated shoes or boots.
- Don't wear metal objects (rings, watches, etc.) when working with electricity. They might cause arcing.
- If you are working near overhead power lines of 50 kilovolts (kV) or less, you or any equipment you are using must not come any closer than 10 ft. from the lines. Add 4 inches of distance for every 10 kV over 50 kV.

Good work habits soon become second nature. Treat electricity with the respect it deserves, and it will serve you efficiently and safely.