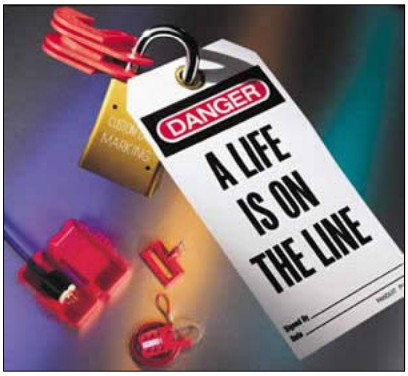
# Basic Electrical Safety Awareness




## General Electrical Safety

- Electricity has long been recognized as a serious workplace hazard, exposing employees to such dangers as electrical shock, electrocution, fires, and explosions
- For example, anywhere from 250 to 350 workers die from electrocutions at work, accounting for almost 3-5% of all on-the-job fatalities, according to the Bureau of Labor Statistics

## Regulations

- OSHA standards are designed to cover many electrical hazards in many different industries.
- Most of OSHA's electrical standards are based on the National Electric Code and National Fire Protection Association Standards.
- Although OSHA operates a federal occupational safety and health program, 26 states and 2 territories operate their own OSHA-approved programs.

## Regulations

- OSHA standards focus on the design and use of electrical equipment and systems.
- The standards covers the exposed or operating elements of an electrical installation such as lighting, equipment, motors, machines, appliances, switches, controls, and enclosures, requiring that they be constructed and installed to minimize workplace electrical dangers.

# Regulations

- Recent changes to the standards, now require specific procedures, if workers are going to work on energized circuits or equipment
- Know as the NFPA 70E standard it set the requirements for the procedures and PPE to be used anytime system is energized

# Employer Responsibilities

- Develop Electrical Safety program for their locations
- Make sure all equipment is properly maintain
- Make sure employees have proper training
- Control unauthorized access to electric utility rooms

## Employer Responsibilities

- Keep access to electrical panels and controls panels clear
- Do not store any equipment or materials in electric utility rooms or closets.

## Employees Responsibilities

- Follow all rules and procedures
- Use only approved electrical equipment and tools.
- Make sure all covers & guards are over electrical circuits
- Immediately report any exposed wires, missing covers or broken plates equipment.

## Employee Responsibilities

- When necessary use only electrically rated PPE
- Never use water around electrical
- Use proper lighting

## Employee Responsibilities

- Avoid loose clothing and jewelry
- Follow all lockout/tagout procedures

# Employee Responsibilities

- Other responsibilities include but are not limited to:
  - Avoiding overload on circuits
  - Inspecting all equipment, cords, switches and components prior to each use
  - Read and follow all safety signs, symbols, and barriers

# Electrical Basics

- Electricity flows more easily through some materials than others. Some substances such as metals generally offer very little resistance to the flow of electric current and are called “conductors.” A common but perhaps overlooked conductor is the surface or subsurface of the earth.
- Glass, plastic, porcelain, clay, pottery, dry wood, and similar substances generally slow or stop the flow of electricity. They are called “insulators.”

# Shocks Causes

- Normally electricity travels in closed circuits, through a conductor. But sometimes a person's body — an efficient conductor of electricity — mistakenly becomes part of the electric circuit.
- This can cause an electrical shock. Shocks occur when a person's body completes the current path with:
  - both wires of an electric circuit;
  - one wire of an energized circuit and the ground;
  - a metal part that accidentally becomes energized due, for example, to a break in its insulation; or
  - another "conductor" that is carrying a current.

# Effects of Shocks

- An electric shock can result in anything from a slight tingling sensation to immediate cardiac arrest. The severity depends on the following:
  - The amount of current flowing through the body,
  - The current's path through the body,
  - The length of time the body remains in the circuit, and
  - The current's frequency.
- The following chart shows the effects vs. ampere

# Effects of Shocks

| | |
|---|---|
| 3 ma | painful shock |
| 10 ma | muscle contraction “no-let-go” danger |
| 30 ma | lung paralysis- usually temporary |
| 50 ma | possible ventricular fibrillation. (heart dysfunction, usually fatal) |
| 100 ma to 4 amps | certain ventricular fibrillation, fatal heart paralysis; |
| Over 4 amps | severe burns, death. |

# Reaction to Electricity

- Caution - Low voltage doesn’t always mean low hazards
- Any amount of electricity can cause additional injuries, such as:
  - falls
  - internal bleeding
  - destruction of tissue, nerves and muscles

## Protection Against Electrical Hazards

- What is the best way to protect yourself against electrical hazards?
- Most electrical accidents result from one of the following three factors:
  - unsafe equipment or installation,
  - unsafe environment, or
  - unsafe work practices
- Some ways to prevent these accidents are through the use of insulation, guarding, grounding, electrical protective devices, and safe work practices.

## Protection Against Electrical Hazards

### What protection does insulation provide?

- Insulators such as glass, mica, rubber, or plastic used to coat metals and other conductors help stop or reduce the flow of electrical current.
- To be effective, the insulation must be suitable for the voltage used and conditions where it is being used.
- And must not be damaged

## Protection Against Electrical Hazards

### How do you identify different types of insulation?

- Insulation on conductors is often color coded. Insulated equipment grounding conductors usually are either solid green or green with yellow stripes
- Insulation covering grounded conductors is generally white or gray.
- Ungrounded conductors, or “hot wires,” often are black or red, although they may be any color other than green, white, or gray.

## Protection Against Electrical Hazards

### What is grounding and what protection does it offer?

- “Grounding” a tool or electrical system means intentionally creating a low-resistance path that connects to the earth. This prevents the buildup of voltages that could cause an electrical accident.
- Grounding is normally a secondary protective measure to protect against electric shock.
- It does not guarantee that you won’t get a shock or be injured or killed by an electrical current.

# Protection Against Electrical Hazards

**What are circuit protection devices and how do they work?**

- Circuit protection devices limit or stop the flow of current automatically in the event of a ground fault, overload, or short circuit in the wiring system
- Examples of these devices are fuses, circuit breakers, ground-fault circuit interrupters

# Protection Against Electrical Hazards

- Fuses and circuit breakers open or break the circuit automatically when too much current flows through them.
- Fuses and circuit breakers are designed to protect conductors and equipment.
- Ground-fault circuit interrupters, or GFCIs, are used in wet locations, construction sites, and other high-risk areas.

## Protection Against Electrical Hazards

Ground Fault Circuit Interrupter's

- Are devices that can interrupt the flow of electricity within as little as 1/40 of a second to prevent electrocution.
- GFCIs compare the amount of current going into electric equipment with the amount of current returning from it along the circuit conductors

## Protection Against Electrical Hazards

- If the difference exceeds 5 milliampere, the device automatically shuts off the electric power
- GFCI's are designed to protect you from shock

## Protection Against Electrical Hazards

**What work practices help protect you against electrical hazards?**

Electrical accidents are largely preventable through safe work practices. Examples of these practices include the following:

- de-energizing electric equipment before inspection or repair,
- keeping electric tools properly maintained,
- exercising caution when working near energized lines, and using appropriate protective equipment.

## Protection Against Electrical Hazards

**How can you protect yourself against metal parts that become energized?**

- A break in an electric tool's or machine's insulation can cause its metal parts to become "hot" or energized, meaning that they conduct electricity.
- Touching these energized parts can result in an electrical shock, burn, or electrocution.

## Protection Against Electrical Hazards

- The best way to protect yourself when using electrical tools or machines is to establish a low-resistance path from the device's metallic case to the ground. This requires an equipment grounding conductor, a low-resistance wire that directs unwanted current directly to the ground.
- Cord and plug equipment with a three-prong plug is a common example of equipment incorporating this ground conductor.

## Protection Against Electrical Hazards

- Another form of protection is to use listed or labeled portable tools and appliances protected by an approved system of double insulation or its equivalent.
- The tool must be marked distinctively to indicate that the tool or appliance uses an approved double insulation system.

# Portable Electric Tools

- Inspect your electrical tools:
  - Check insulated grips and casings for cracks, tears and worn spots
  - Discard or replace home-made insulation
  - Never use if prongs or guards are cracked or missing
  - Never use near water

# Portable Extension Cords

- Inspect portable extension cords:
  - Is the cord rated for the tools you're using?
  - Does the cord have a working ground-fault circuit interrupter (GFCI)?

## Care in use of flexible electric cords

- Inspect for damage
- Switches, components and wiring won't stand up to rough handling
- Raising or lowering equipment by its flexible cord or stapling a cord damages insulation.

## Portable Extension Cords

- Does the cord have loose parts, deformed and missing pins or damage to its outer jacket or insulation?
- Are the cord's plug and receptacle designed to be used together?

# Protection Against Electrical Hazards

**What protection does personal equipment offer?**

- Employees who work directly with electricity should use the personal protective equipment required for the jobs they perform.
- This equipment may include rubber insulating gloves, hoods, sleeves, matting, blankets, line hose, and industrial protective helmets designed to reduce electric shock hazard

# Work Practices

**Authorized Employees**

- Only qualified employees are permitted to work on or repair electrical systems or equipment.

**Non-authorized Employees:**

- Are not permitted to work on or repair electrical systems, cords or equipment.

## Work Practices

- Beware of overload
- Safe outlets are always grounded
- Never overload any outlet, more than two plugs per double outlet may be an overload

## Work Practices

- No “Daisy Chaining”
- No using temporary cords for small appliances
- Don’t hang cords over cubicles!
- Don’t jam furniture against cords/plugs.

# Work Practices

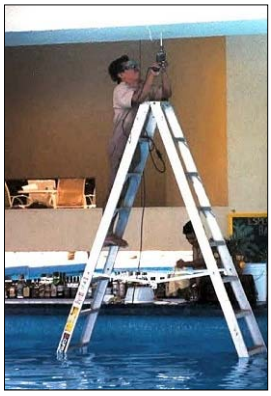
- Read and follow safety signs, symbols and barriers.




# Work Practices

Avoid working with electricity if you or the work area has been exposed to wet weather

- If your work site is at all moist, locking connectors provides safety



# Lockout/Tagout

**How can you prevent an accidental or unexpected equipment startup?**

- Proper lockout/tagout procedures protect you from the dangers of the accidental or unexpected startup of electrical equipment and are required by OSHA. These procedures ensure that electrical equipment is de-energized before it is repaired or inspected and protects you against electrocution or shock.

# What Is Lockout/Tagout?

- Referred to as LOTO or LOBO
- Blocks flow of energy from power source to the equipment
- Provides means of warning (tag)
- A method of protecting workers

## When should LOTO be performed?

***Standard must be followed if:***

- an employee is required to remove or bypass a guard or other safety device
- an employee is required to place any part of his/her body into machine's point of operation or a danger zone associated with a machine's operating cycle.

## When do you use Lockout/Blockout Procedures?

Workplace activities such as:

- Installing
- Setting up
- Adjusting
- Inspecting
- Modifying
- Maintaining and/or servicing machines or equipment.

# LOTO

- Who uses LOTO procedures
  - Only properly trained and authorizes workers may use their employer LOTO procedures
  - Under the procedures the authorizes workers does the isolation of the circuits or equipment
  - All affected workers must be informed of the LOTO

# Lockout/Blockout Program

## Lockout/Block Program should contain:

- A survey of the equipment by responsible persons who are thoroughly familiar with its operation and associated hazards, in order to identify which machinery should be locked and blocked out.
- Identification and labeling of lockout devices.
- Selection and purchase of locks, tags and blocks.
- A standard operating procedure that is written and followed.

## Equipment Survey

- Survey the plant or operation to identify all energy sources.
  - Requires physical inspection, possibly in combination with a study of drawings and equipment manuals.
- Locate and mark the disconnecting function.
  - Categorize the identification details as to equipment supplied and energy type and magnitude, from material worked out beforehand in this lockout/blockout program planning study.

## Labeling the Energy Disconnecting Means

- A sign or sticker—**"LOCKOUT HERE"**—placed at the disconnecting means will help direct workers to correct lockout devices.
- In complicated operations, schematics of just the disconnecting means may need to be drawn up by the plant's engineering department.


## Methods of Locking Out Controls

There are many different ways to lock out a piece of equipment. Commonly, one of two methods can be used LOCKS or TAGS

## Methods of Locking Out Controls

- Locks are the preferred method because they give you a physical barrier that has to be removed to operate the equipment.
- Tags are less efficient but as long as everyone understands what they are for they can also provide protection

## Lockout/Blockout Procedures

## Typical Shutdown Procedure

- Notify affected employees
- Shut down equipment
- Shut off energy source(s) to affected equipment
- Affix lock(s) and tag(s) to each energy source controlling device

## Shutdown Procedures *(continued)*

- Relieve all stored energy from capacitor banks, springs, compressed air, hydraulics, steam, etc.
- Verify isolation of energy has occurred by trying equipment

*Note: Do Not attempt any work until process is completed.*

## Restoring Equipment to Service

- Remove all non-essential items.
- Check equipment components, including guards and safety devices.
- Repair or replace defective guards before removing lockouts.
- Remove each lockout device using the correct removal sequence.
- Make a visual check before restoring energy to ensure that everyone is physically clear of the equipment.

## Unusual Conditions

# Group Lockout/Blockout Procedures

- Authorized employee must apply own lock to multiple lockout device
- Assign one authorized employee as lead primary authority of group
- Primary authority tracks exposure status during job
- Each authorized employee is responsible for removal of lockout/Blockout device


# Maintaining Lockout/Blockout During Shift or Personnel Changes

Ensure continuous lockout/Blockout status:

1. *Off-going* authorized employee removes his/her lockout device.
2. *On-coming* authorized employee applies his/her own lockout device

## Testing Equipment During Lockout

***Authorized employees must:***

- Clear machine of tools and materials.
- Remove employees from machine.
- Remove LOTO devices and notify affected employees of removal.
- Energize and proceed with testing/positioning.
- De-energize all systems, notify affected employees and re-apply LOTO devices.
- Continue with servicing/maintenance work.

## In Summary

- Electricity will try to reach ground even if it means going through a person

  Even the “small” voltage can cause serious injury

  Always inspect power tools and cords before each use and do not use them if damaged

## In Summary

- Immediately report any faulty equipment, exposed wires, missing covers or broken plates.
- Turning off a switch does not always turn off all electricity.
- Never use electrical equipment if you suspect flammable or explosive vapors are in the area.

## In Summary

- Never use electrical tool or equipment around water
- Never use a power cord if the ground plug is broken.

**THANK YOU!**