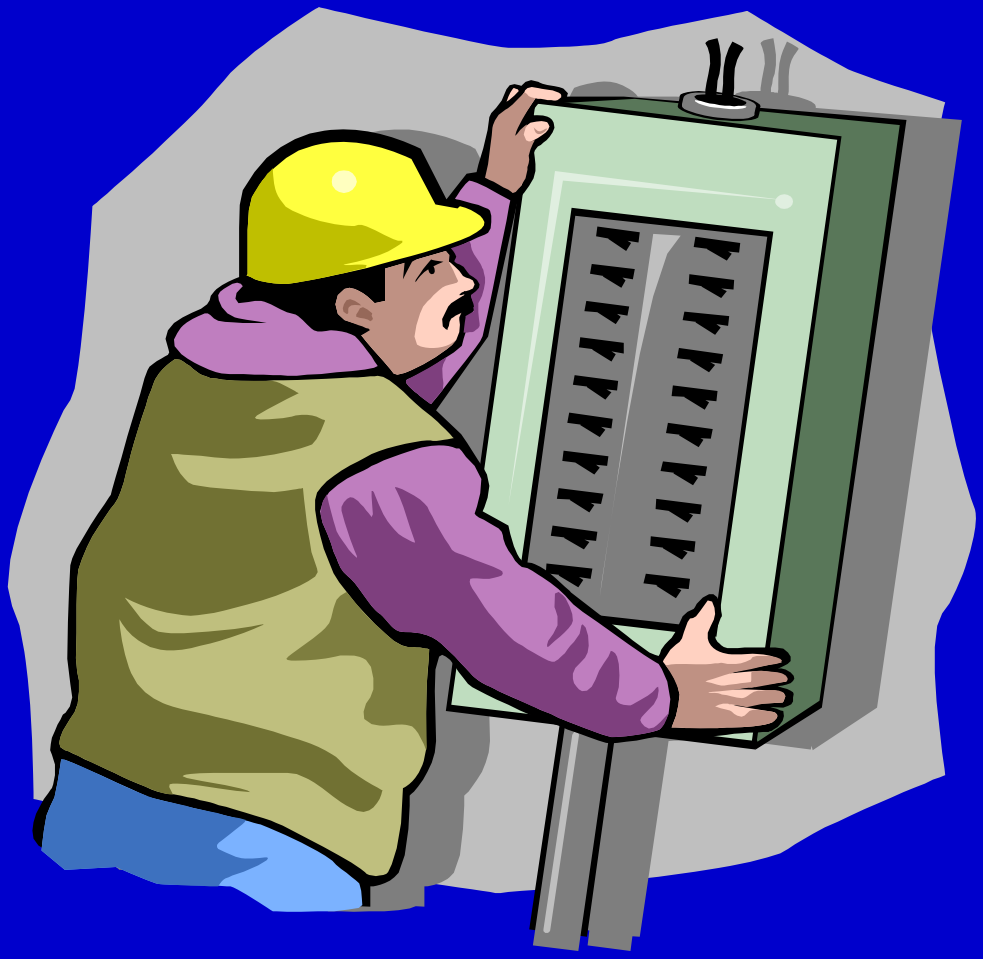
Electrical Safety - Construction

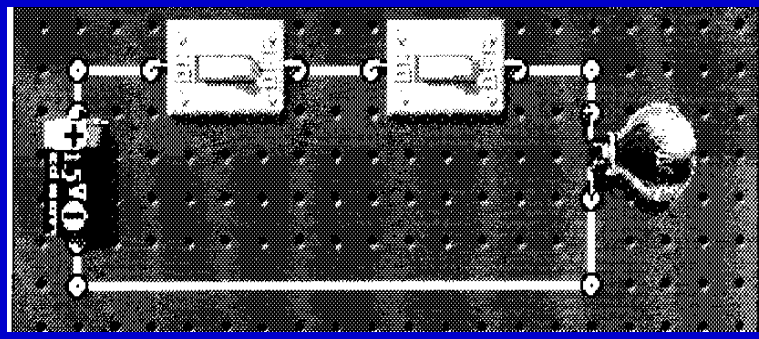


Electricity - The Dangers

- About 5 workers are electrocuted every week
- Causes 12% of young worker workplace deaths
- Takes very little electricity to cause harm
- Significant risk of causing fires

Electricity – How it Works

- Electricity is the flow of energy from one place to another
- Requires a source of power: usually a generating station
- A flow of electrons (current) travels through a conductor
- Travels in a closed circuit



Electrical Terms

- **Current** -- electrical movement (measured in amps)
- **Circuit** -- complete path of the current. Includes electricity source, a conductor, and the output device or load (such as a lamp, tool, or heater)
- **Resistance** -- restriction to electrical flow
- **Conductors** – substances, like metals, with little resistance to electricity that allow electricity to flow
- **Grounding –** a conductive connection to the earth which acts as a protective measure
- **Insulators** -- substances with high resistance to electricity like glass, porcelain, plastic, and dry wood that prevent electricity from getting to unwanted areas

Electrical Injuries

There are four main types of electrical injuries:

- Direct:
  - Electrocution or death due to electrical shock
  - Electrical shock
  - Burns
- Indirect - Falls

Electrical Shock

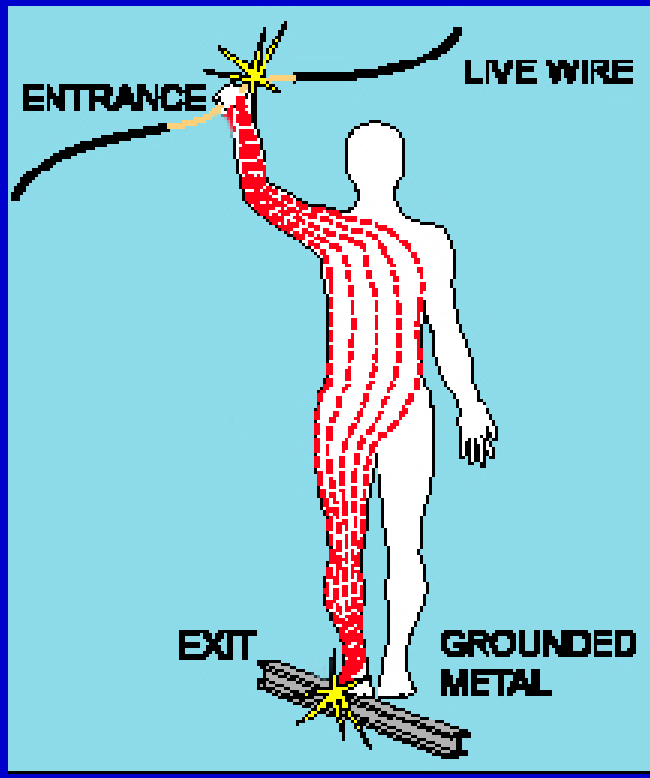
An electrical shock is received when electrical current passes through the body.

You will get an electrical shock if a part of your body completes an electrical circuit by…

- Touching a live wire and an electrical ground, or
- Touching a live wire and another wire at a different voltage.

Shock Severity

- Severity of the shock depends on:
  - Path of current through the body
  - Amount of current flowing through the body (amps)
  - Duration of the shocking current through the body,
- LOW VOLTAGE DOES NOT MEAN LOW HAZARD



Dangers of Electrical Shock

- **Currents above 10 mA* can paralyze or “freeze” muscles.**
- **Currents more than 75 mA can cause a rapid, ineffective heartbeat -- death will occur in a few minutes unless a defibrillator is used**
- **75 mA is not much current – a small power drill uses 30 times as much**

Defibrillator in use

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* mA = milliampere = 1/1,000 of an ampere

Burns

- Most common shock-related injury
- Occurs when you touch electrical wiring or equipment that is improperly used or maintained
- Typically occurs on hands
- Very serious injury that needs immediate attention

Falls

- Electric shock can also cause indirect injuries
- Workers in elevated locations who experience a shock may fall, resulting in serious injury or death

Electrical Hazards and How to Control Them

Electrical accidents are caused by a combination of three factors:

- Unsafe equipment and/or installation,
- Workplaces made unsafe by the environment, and
- Unsafe work practices.

Hazard – Exposed Electrical Parts

Cover removed from wiring or breaker box

Control – Isolate Electrical Parts

- **Use guards or barriers**
- **Replace covers**

Guard live parts of electric equipment operating at 50 volts or more against accidental contact

Control – Isolate Electrical Parts - Cabinets, Boxes & Fittings

Conductors going into them must be protected, and unused openings must be closed

Control – Close Openings

- Junction boxes, pull boxes and fittings must have approved covers
- Unused openings in cabinets, boxes and fittings must be closed (no missing knockouts)

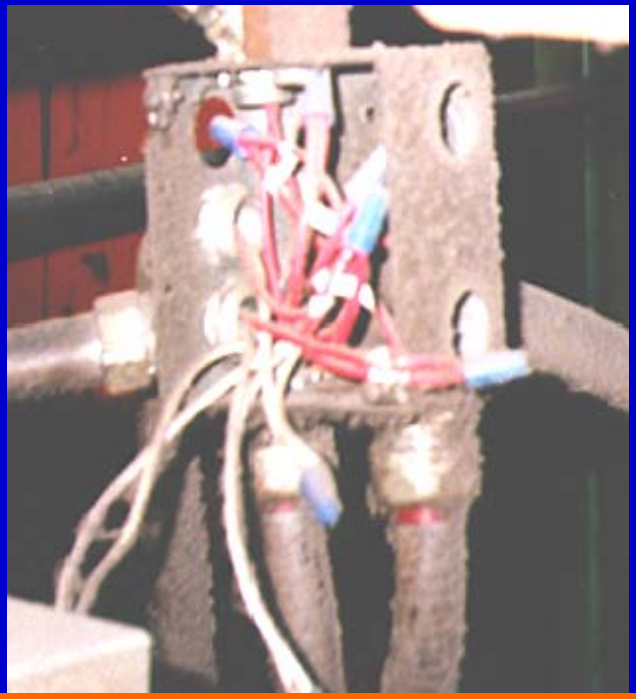


Photo shows violations of these two requirements

Hazard - Overhead Power Lines

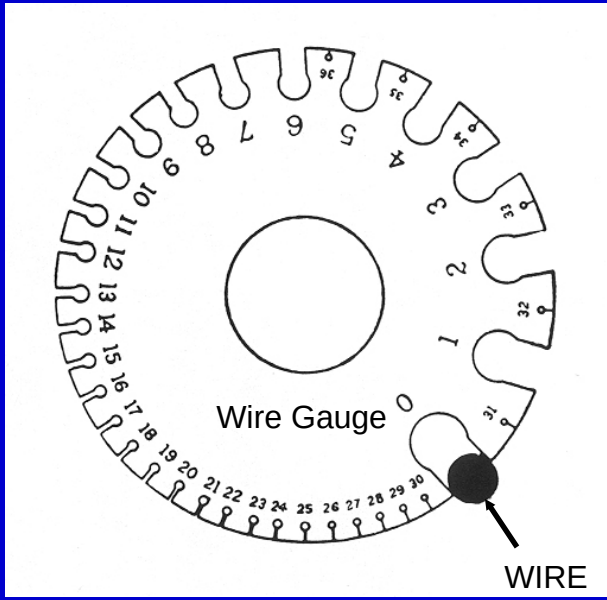
- Usually not insulated
- Examples of equipment that can contact power lines:
  - Crane
  - Ladder
  - Scaffold
  - Backhoe
  - Scissors lift
  - Raised dump truck bed
  - Aluminum paint roller

Control - Overhead Power Lines

- Stay at least 10 feet away
- Post warning signs
- Assume that lines are energized
- Use wood or fiberglass ladders, not metal
- Power line workers need special training & PPE

Hazard - Inadequate Wiring

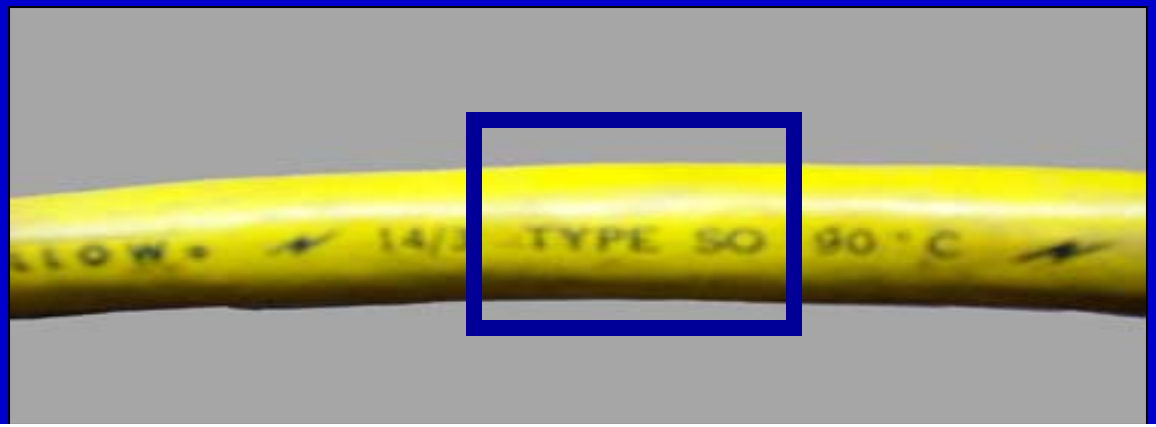
- **Hazard** - wire too small for the current
- **Example** - portable tool with an extension cord that has a wire too small for the tool
  - The tool will draw more current than the cord can handle, causing overheating and a possible fire without tripping the circuit breaker
  - The circuit breaker could be the right size for the circuit but not for the smaller-wire extension cord



Wire gauge measures wires ranging in size from number 36 to 0 American wire gauge (AWG)

Control – Use the Correct Wire

- Wire used depends on operation, building materials, electrical load, and environmental factors
- Use fixed cords rather than flexible cords
- Use the correct extension cord



Must be 3-wire type and designed for hard or extra-hard use

Hazard – Defective Cords & Wires

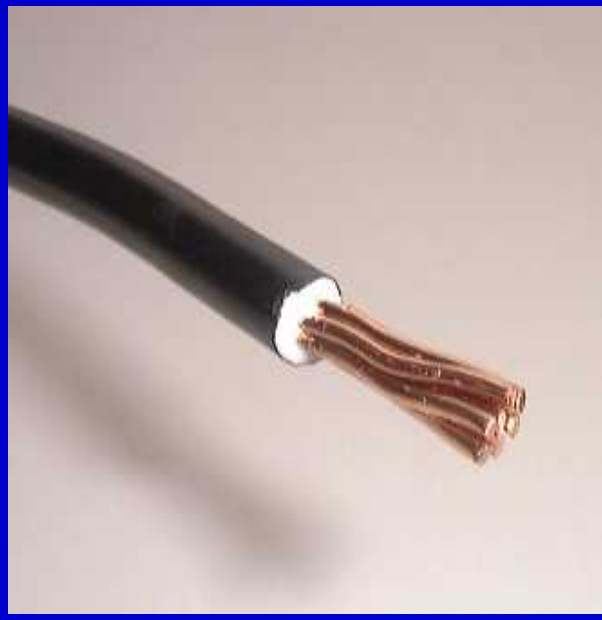
- Plastic or rubber covering is missing
- Damaged extension cords & tools

Hazard – Damaged Cords

- Cords can be damaged by:
  - Aging
  - Door or window edges
  - Staples or fastenings
  - Abrasion from adjacent materials
  - Activity in the area
- Improper use can cause shocks, burns or fire

Control – Cords & Wires

- Insulate live wires
- Check before use
- Use only cords that are 3-wire type
- Use only cords marked for hard or extra-hard usage
- Use only cords, connection devices, and fittings equipped with strain relief
- Remove cords by pulling on the plugs, not the cords
- Cords not marked for hard or extra-hard use, or which have been modified, must be taken out of service immediately

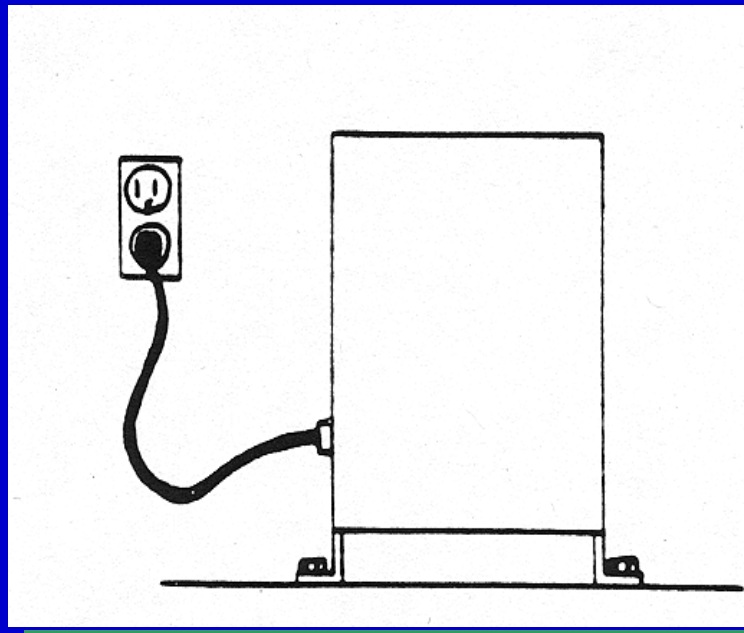


Permissible Use of Flexible Cords

DO NOT use flexible wiring where frequent inspection would be difficult or where damage would be likely.

Flexible cords must not be . . .

- **run through holes in walls, ceilings, or floors;**
- **run through doorways, windows, or similar openings (unless physically protected);**
- **hidden in walls, ceilings, floors, conduit or other raceways.**



Stationary equipment-to facilitate interchange

Grounding

Grounding creates a low-resistance path from a tool to the earth to disperse unwanted current.

When a short or lightning occurs, energy flows to the ground, protecting you from electrical shock, injury and death.

Hazard – Improper Grounding

- Tools plugged into improperly grounded circuits may become energized
- Broken wire or plug on extension cord
- Some of the most frequently violated OSHA standards

Control – Ground Tools & Equipment

- Ground power supply systems, electrical circuits, and electrical equipment
- Frequently inspect electrical systems to insure path to ground is continuous
- Inspect electrical equipment before use
- Don’t remove ground prongs from tools or extension cords
- Ground exposed metal parts of equipment

Control – Use GFCI (ground-fault circuit interrupter)

- Protects you from shock
- Detects difference in current between the black and white wires
- If ground fault detected, GFCI shuts off electricity in 1/40th of a second
- Use GFCI's on all 120-volt, single-phase, 15- and 20-ampere receptacles, or have an assured equipment grounding conductor program.

Control - Assured Equipment Grounding Conductor Program

Program must cover:

- **All cord sets**
- **Receptacles not part of a building or structure**
- **Equipment connected by plug and cord**

Program requirements include:

- **Specific procedures adopted by the employer**
- **Competent person to implement the program**
- **Visual inspection for damage of equipment connected by cord and plug**

Hazard – Overloaded Circuits

Hazards may result from:

- Too many devices plugged into a circuit, causing heated wires and possibly a fire
- Damaged tools overheating
- Lack of overcurrent protection
- Wire insulation melting, which may cause arcing and a fire in the area where the overload exists, even inside a wall

Control - Electrical Protective Devices

- Automatically opens circuit if excess current from overload or ground-fault is detected – shutting off electricity
- Includes GFCI's, fuses, and circuit breakers
- Fuses and circuit breakers are overcurrent devices. When too much current:
  - Fuses melt
  - Circuit breakers trip open

Power Tool Requirements

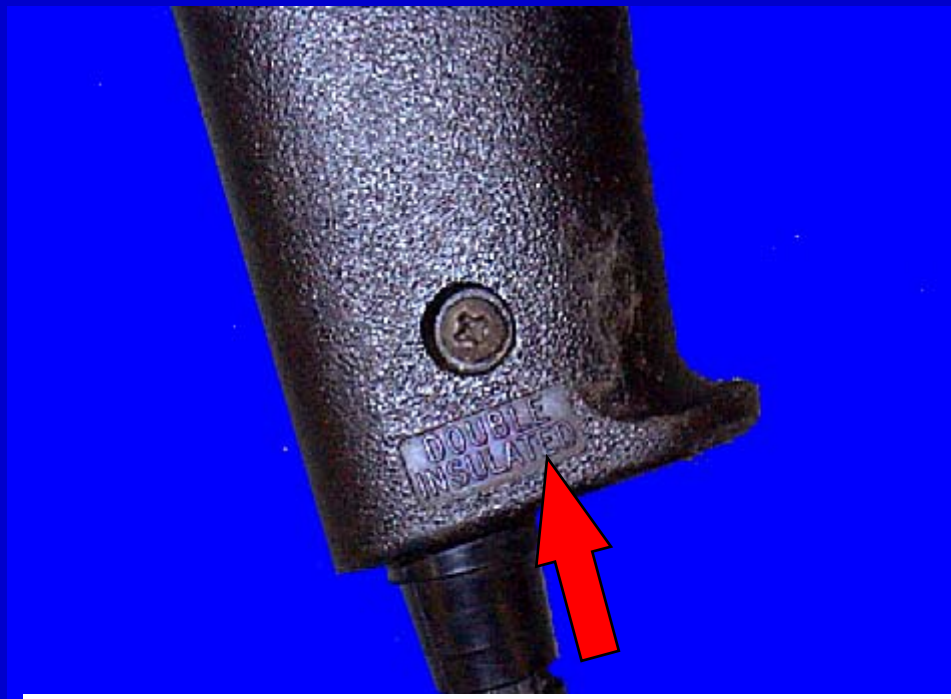
- Have a three-wire cord with ground plugged into a grounded receptacle, or
- Be double insulated, or
- Be powered by a low-voltage isolation transformer

Tool Safety Tips

- Use gloves and appropriate footwear
- Store in dry place when not using
- Don’t use in wet/damp conditions
- Keep working areas well lit
- Ensure not a tripping hazard
- Don’t carry a tool by the cord
- Don’t yank the cord to disconnect it
- Keep cords away from heat, oil, & sharp edges
- Disconnect when not in use and when changing accessories such as blades & bits
- Remove damaged tools from use

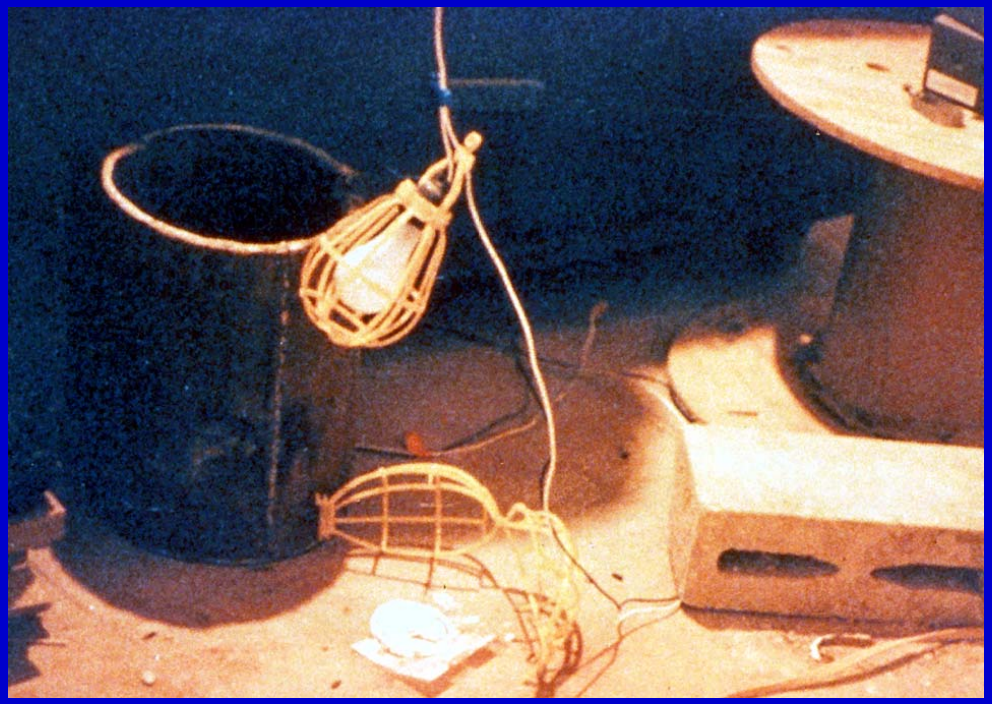
Preventing Electrical Hazards - Tools

- Inspect tools before use
- Use the right tool correctly
- Protect your tools
- Use double insulated tools



Double Insulated marking

Temporary Lights



Protect from contact and damage, and don’t suspend by cords unless designed to do so.

Clues that Electrical Hazards Exist

- Tripped circuit breakers or blown fuses
- Warm tools, wires, cords, connections, or junction boxes
- GFCI that shuts off a circuit
- Worn or frayed insulation around wire or connection

Lockout and Tagging of Circuits

- Apply locks to power source after de-energizing
- Tag deactivated controls
- Tag de-energized equipment and circuits at all points where they can be energized
- Tags must identify equipment or circuits being worked on

Safety-Related Work Practices

To protect workers from electrical shock:

- **Use barriers and guards to prevent passage through areas of exposed energized equipment**
- **Pre-plan work, post hazard warnings and use protective measures**
- **Keep working spaces and walkways clear of cords**

Safety-Related Work Practices

- Use special insulated tools when working on fuses with energized terminals
- Don’t use worn or frayed cords and cables
- Don’t fasten extension cords with staples, hang from nails, or suspend by wire.

Preventing Electrical Hazards - Planning

- Plan your work with others
- Plan to avoid falls
- Plan to lock-out and tag-out equipment
- Remove jewelry
- Avoid wet conditions and overhead power lines

Avoid Wet Conditions

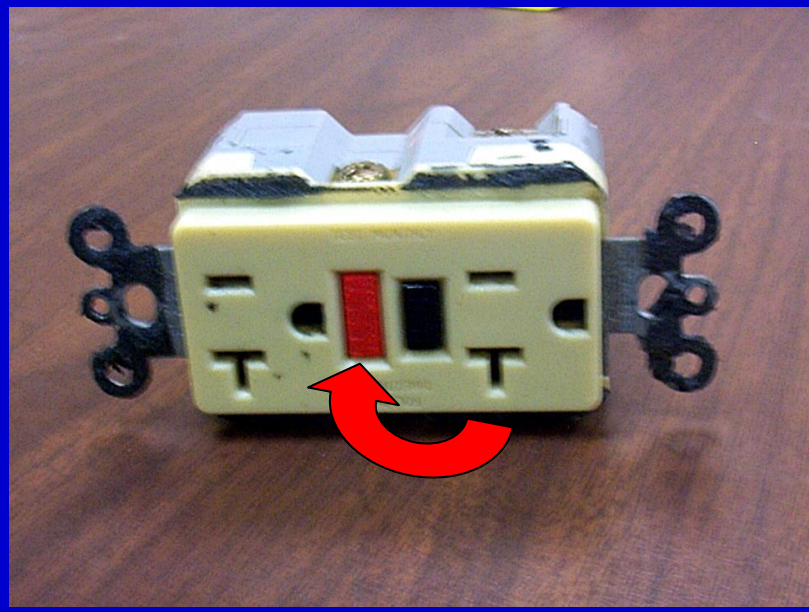
- If you touch a live wire or other electrical component while standing in even a small puddle of water you'll get a shock.
- Damaged insulation, equipment, or tools can expose you to live electrical parts.
- Improperly grounded metal switch plates & ceiling lights are especially hazardous in wet conditions.
- Wet clothing, high humidity, and perspiration increase your chances of being electrocuted.

Preventing Electrical Hazards - PPE

- Proper foot protection (not tennis shoes)
- Rubber insulating gloves, hoods, sleeves, matting, and blankets
- Hard hat (insulated - nonconductive)

Preventing Electrical Hazards – Proper Wiring and Connectors

- Use and test GFCI's
- Check switches and insulation
- Use three prong plugs
- Use extension cords only when necessary & assure in proper condition and right type for job
- Use correct connectors



Training

Train employees working with electric equipment in safe work practices, including:

- Deenergize electric equipment before inspecting or repairing
- Using cords, cables, and electric tools that are in good repair
- Lockout / Tagout recognition and procedures
- Use appropriate protective equipment

Summary – Hazards & Protections

Hazards

- Inadequate wiring
- Exposed electrical parts
- Wires with bad insulation
- Ungrounded electrical systems and tools
- Overloaded circuits
- Damaged power tools and equipment
- Using the wrong PPE and tools
- Overhead powerlines
- All hazards are made worse in wet conditions

Protective Measures

- Proper grounding
- Use GFCI's
- Use fuses and circuit breakers
- Guard live parts
- Lockout/Tagout
- Proper use of flexible cords
- Close electric panels
- Training

Summary

Electrical equipment must be:

- Listed and labeled
- Free from hazards
- Used in the proper manner

If you use electrical tools you must be:

- Protected from electrical shock
- Provided necessary safety equipment