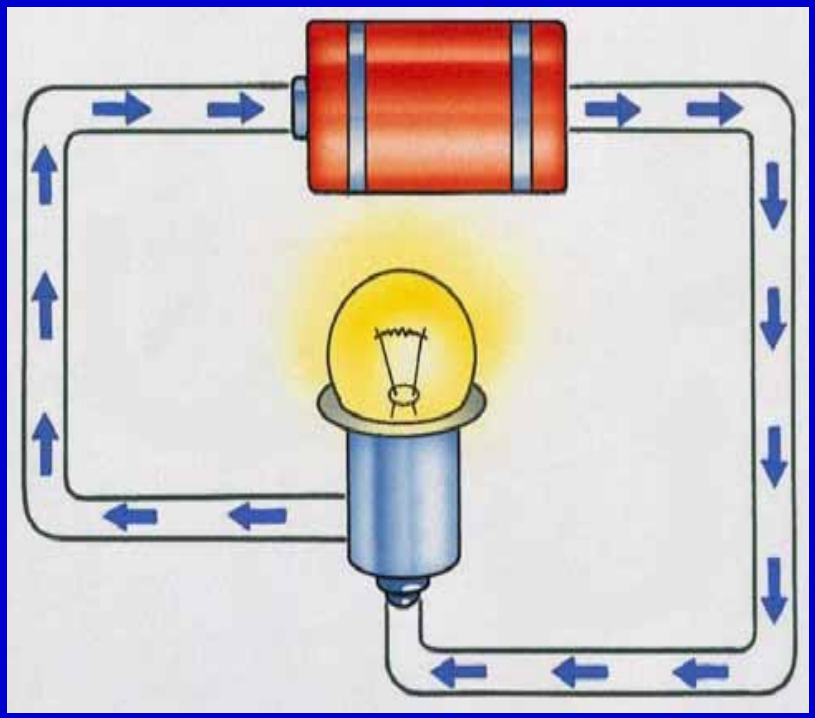
# Electrical Safety - Construction

# 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

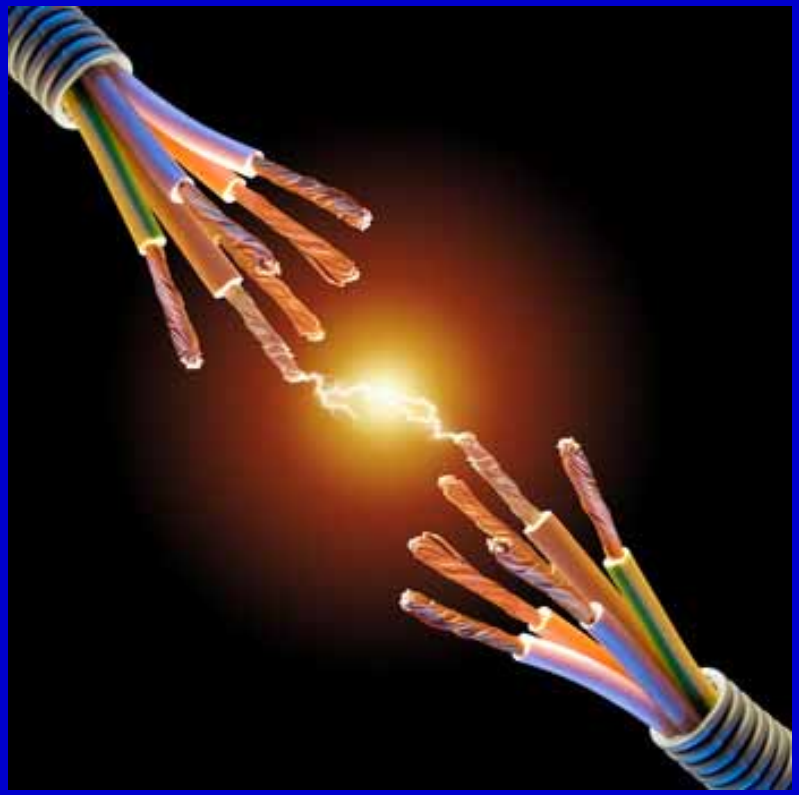
# Electricity – How it Works

- 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)
- **Resistance** -- restriction to electrical flow
- **Grounding** – a conductive connection to the earth which acts as a protective measure



# Electrical Terms

- **Conductors**--substances, like metals, with little resistance to electricity that allow electricity to flow
- **Insulators** -- substances with high resistance to electricity like glass, porcelain, plastic, and dry wood that prevent electricity from getting to unwanted areas
- **Voltage—**measure of electrical force

# Electrical Injuries

There are four main types of electrical injuries:

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

# Electrical Shock

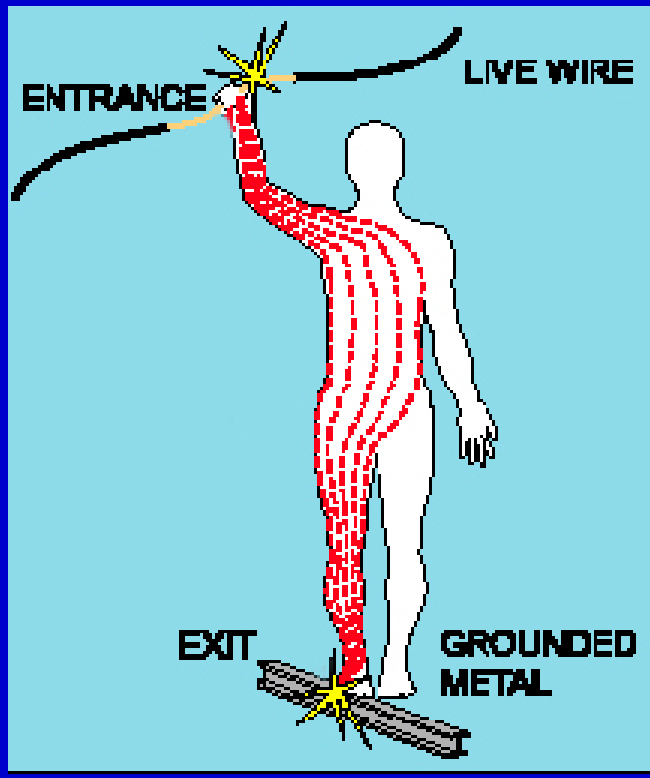
An electrical shock is received when electrical current passes through the body.

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
- Static pressure build up within your body and touch something with a different pressure (example: Metal, wood, person)

# 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
- Serious injury, immediate attention needed

# Indirect Injuries

- **Electric shock can also cause indirect injuries**
  - **Broken bones**
  - **Heart attack**
  - **Cuts**
  - **Scrapes**

# Electrical Hazards and How to Control Them

Electrical accidents are caused by a combination of unsafe factors including:

- Equipment and/or installation,
- Environment, and
- Work practices.

# Hazard – Exposed Electrical Parts

Not Weather Tight

# 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 must be protected, and unused openings 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)

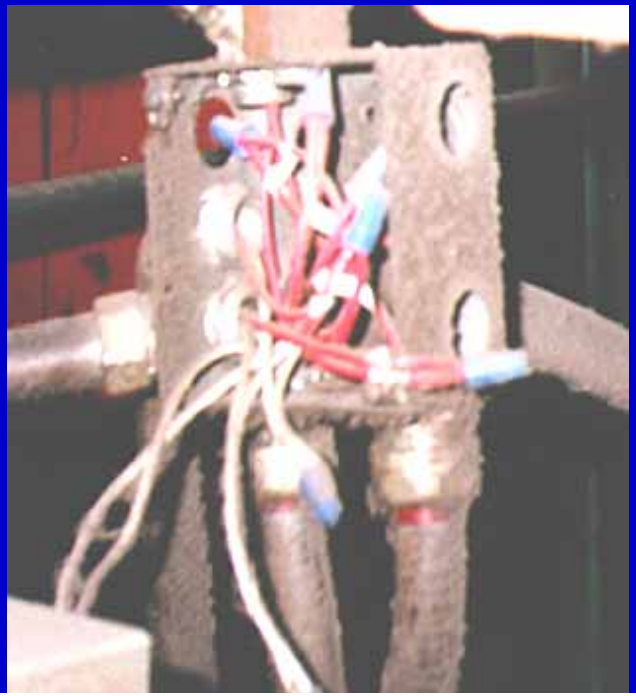


**Photo shows violations of these two requirements**

# Hazard - Overhead Power Lines

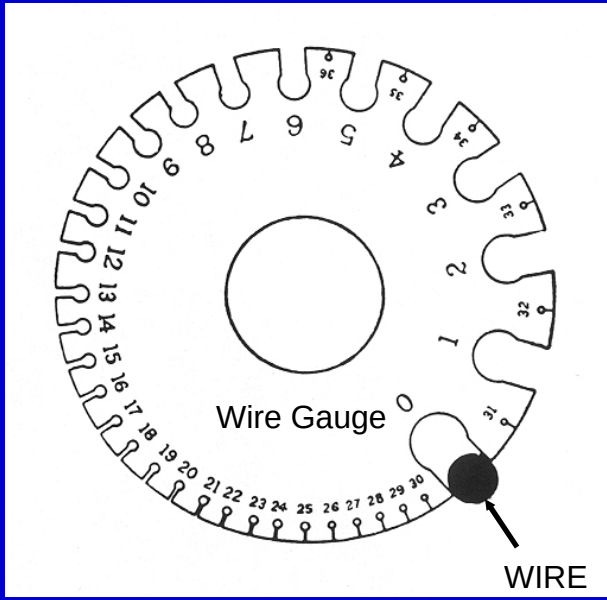
- Usually not insulated
- Equipment that contact power lines:
  - Crane
  - Ladder
  - Scaffold
  - Backhoe
  - Scissors lift
  - Raised dump truck bed
  - Long handled tools

# Control - Overhead Power Lines

- Stay away from
- 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

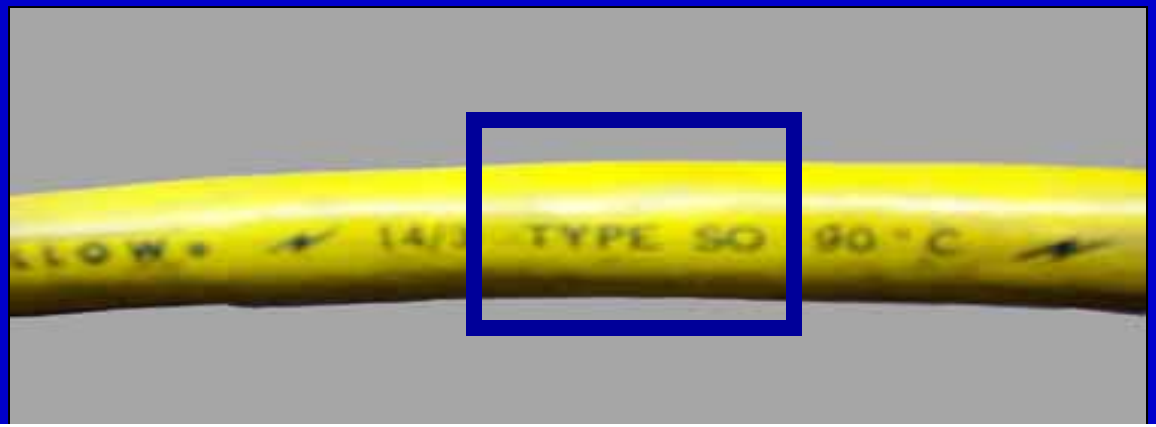
- **Hazard** - wire too small for the current
- **Example** - portable tool with an extension cord that has a wire too small for the tool
  - The tool will draw more current than the cord can handle, causing overheating & possible fire without tripping the circuit breaker
  - The circuit breaker could 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 materials
  - Activity in the area
- Improper use can cause shocks, burns or fire

# Control – Cords & 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

# 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, floors, doorways, windows, or similar openings-unless physically protected, hidden in walls,**

# 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 hot and neutral wires
- If ground fault detected, GFCI shuts off electricity in 1/40$^{th}$ 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.
- Test before use/manufacturers recommendations

# 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**

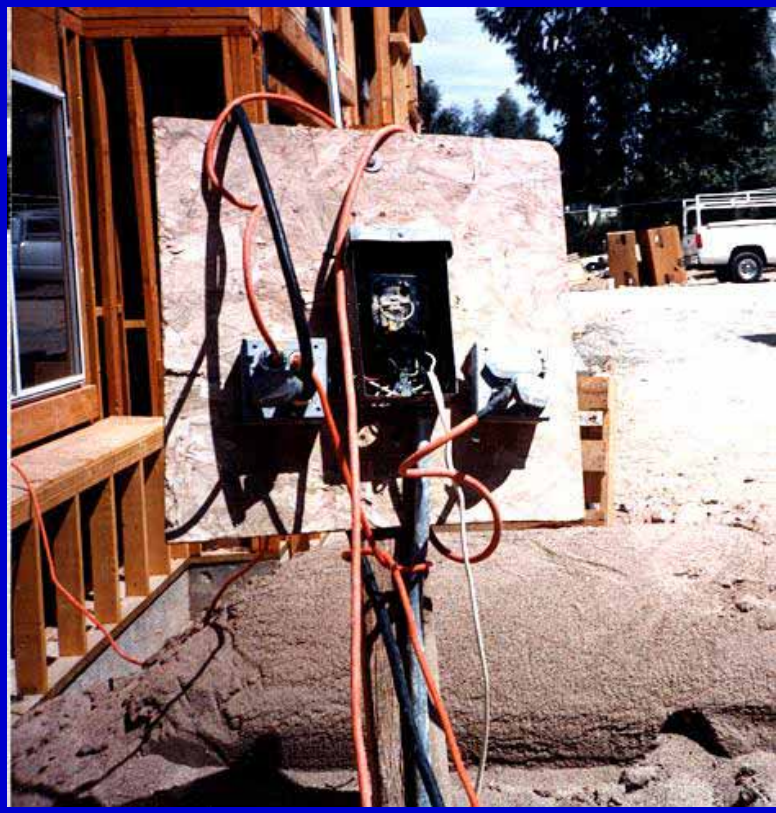
**Program requirements include:**

- **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:**

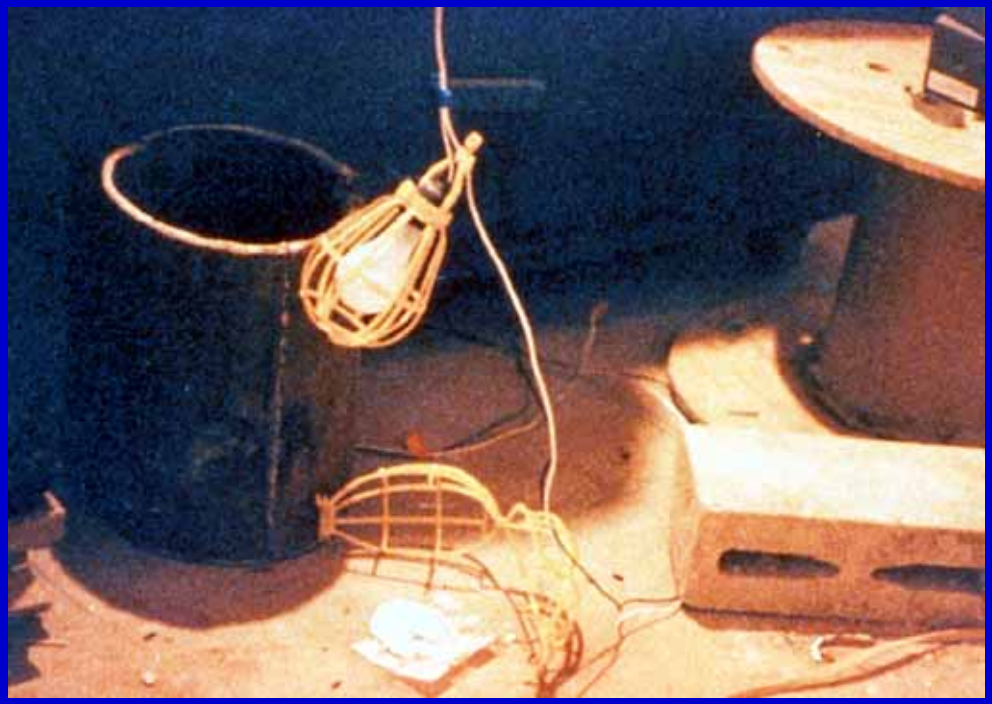
- Too many devices plugged into a circuit, causing heated wires and possibly a fire
- Damaged tools overheating
- Lack of overcurrent protection
- Wire insulation melting, which may cause arcing and a fire in the area where the overload exists, even inside a wall



# 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 over-current devices. When too much current:
  - Fuses melt
  - Circuit breakers trip open

# Temporary Lights



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

# Electrical Problems

- Tripped circuit breakers or blown fuses
- Unlabeled circuit breakers/disconnects
- 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**
- **NFPA 70E Arc flash/blast hazards**

# Safety-Related Work Practices

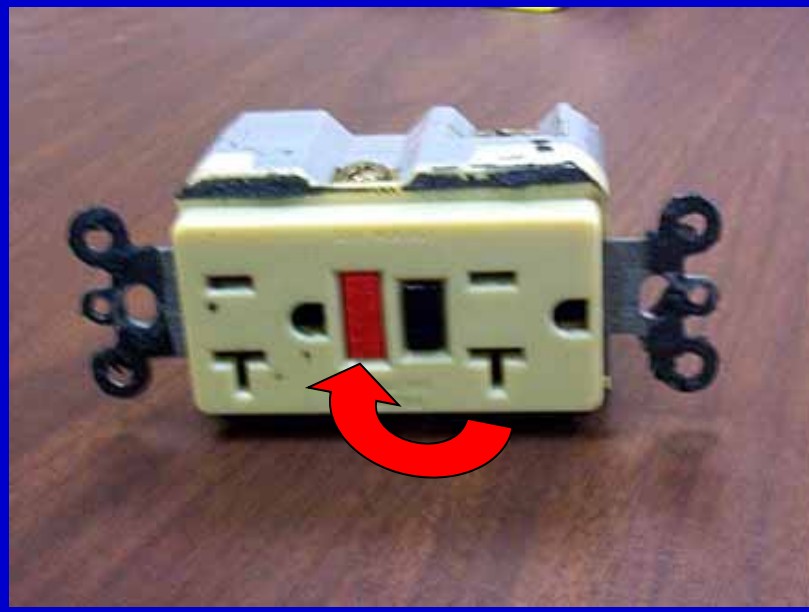
- Use special insulated tools when working on fuses with energized terminals
- Don’t use worn or frayed cords and cables
- Don’t fasten extension cords with staples, hang from nails, or suspend by wire.

# Preventing Electrical Hazards - PPE

- Proper foot protection
- 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 of 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