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

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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.

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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 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 1/40th 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.
- 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

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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