



# **Electrical Safety: Electrical Hazards and Electrical Protection Methods**

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# Lessons learnt last time



- Introduction
- Common work-related musculoskeletal disorders (MSDs)
- Risk factors associated with work-related MSDs
- Ergonomic control methods for eliminating/reducing work-related MSDs
- Employer/Employee requirements
- 5 steps to perform ergonomic workspace with PC

# What we gonna discuss today?

- Datacenter safety and security
- Major electrical hazards
- Types of electrical hazards
- Electrical protection methods
- Employer requirements to protect workers from electrical hazards

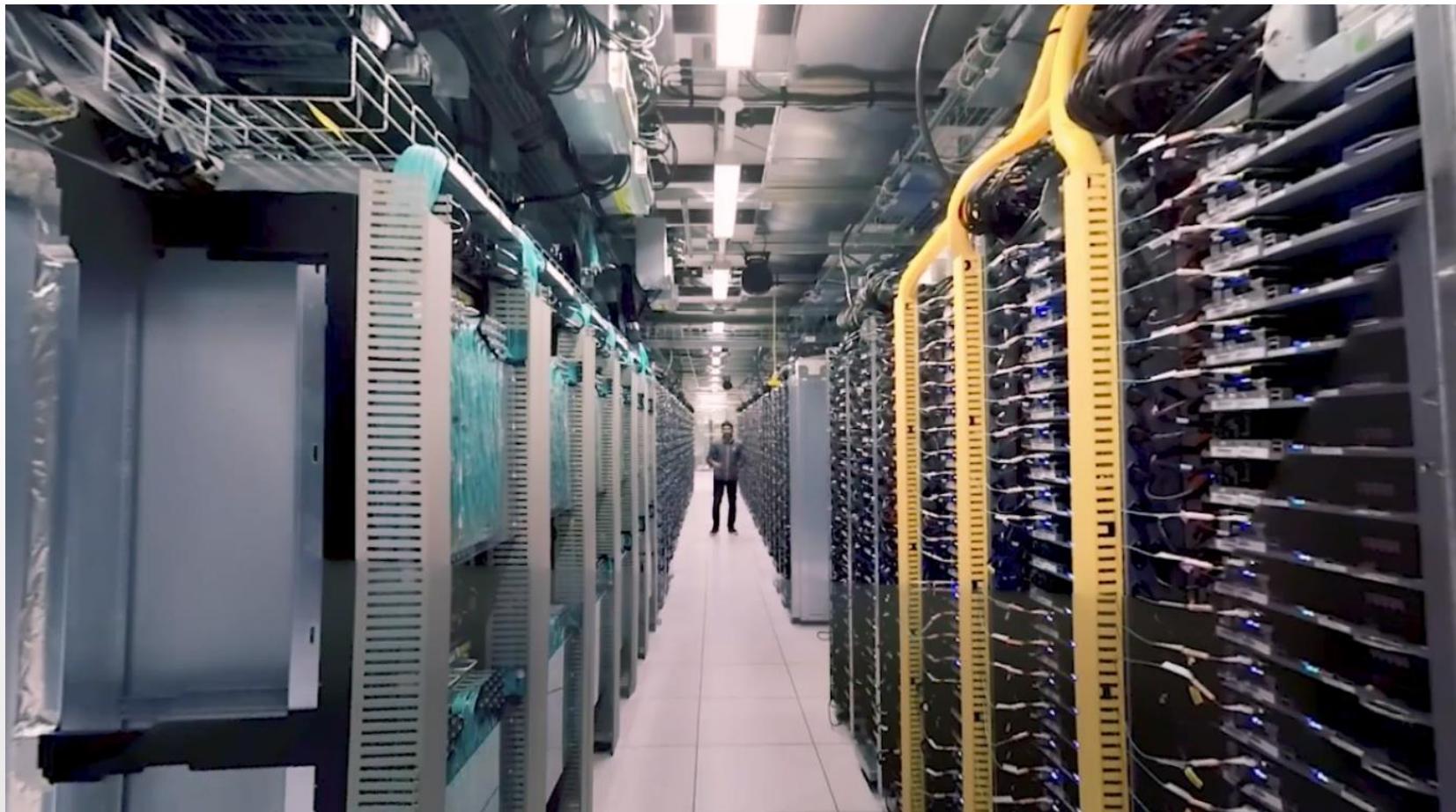


**Naryn, 5:49pm, Sept 17, 2021**



# Datacenter safety and security

- Google Data Center 360° Tour



# Datacenter safety and security



<https://www.youtube.com/watch?v=dBxZWyJf1oo>

- Iron Mountain Data Center Safety and Security Video

# Datacenter safety and security

<https://www.youtube.com/watch?v=pGthey0Q1dw>

- How to Perform a UPS Transfer in a Critical Data Center

**MARKLEY**  
ONE SUMMER STREET

# Major electrical hazards



- Some definitions:

- Electricity – movement of free electrons between atoms
- Current – the movement of electrical charge
- Resistance – opposition to current flow
- Voltage – a measurement of electrical force
- Conductors – substances, such as metals, that have little resistance to electricity
- Insulators – substances, such as dry wood, rubber, glass and Bakelite, that have high resistance to electricity
- Grounding – a conductive connection to the earth which acts as a protective measure

# Major electrical hazards

- **BE SAFE:**

- Burns
- Electrocution
- Shock
- Arc flash/arc blast
- Fire
- Explosions



# Major electrical hazards

- Burns:
  - Most common shock-related injury
  - Three types of electrical burns:
    - Electrical
    - Arc flash
    - Thermal contact



# Major electrical hazards



- **Electrocution**
  - Is fatal
  - Meaning: to kill with electrical shock
  - Results when a human is exposed to a lethal amount of electrical energy
- **Electrical shock**
  - Body becomes part of electrical circuit
  - Reflex response to passage of electric current through the body
- **Arc Flash**
  - Sudden release of electrical energy through air when a high-voltage gap exists and there is a breakdown between conductors
  - Gives off thermal radiation (heat) and bright, intense light that can cause burns; *temperatures as high as 35,000°F*
- **Arc Blast:** high-voltage arcs can also produce considerable pressure waves by rapidly heating the air and creating a blast

# Major electrical hazards

- Fire
  - Most result from problems with "fixed wiring"
  - Problems with cords, plugs, receptacles, and switches also cause electrical fires
- Explosions
  - Occur when electricity ignites explosive mixture of material in the air
  - Reflex response to passage of electric current through the body
- Note
  - Electricity is source of these hazards
  - All hazards are of equal importance
  - Lesson focuses on eliminating electrical hazards



# Major electrical hazards

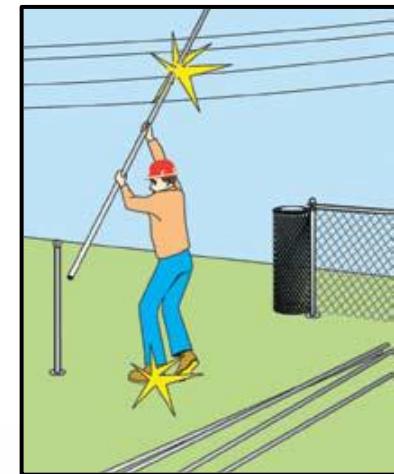


- Examples of fatal accidents:

- Case #1: Worker electrocuted when the ladder came in contact with overhead power lines
- Case #2: Worker electrocuted when mast came in contact with high voltage overhead lines

Your examples are welcome

# Types of Electrical Hazards



- Contact with overhead power lines
  - Overhead and buried power lines carry extremely high voltage
  - Risks
    - Electrocution (main risk)
    - Burns and falls
- Cranes are not the only equipment that can reach overhead power lines
- Use of ladders or suspension in a man-basket under or near power lines are risks

# Types of Electrical Hazards



- **Important:** the covering on an overhead power line is primarily for weather protection; therefore, workers need to know that if they touch a power line, covered or bare, death is probable

(1,000 milliamperes = 1 amp; therefore, 15,000 milliamperes = 15 amp circuit)	
Current	Reaction
Below 1 millampere	Generally not perceptible
1 millampere	Faint tingle
5 millampere	Slight shock felt; not painful but disturbing. Average individual can let go. Strong involuntary reactions can lead to other injuries
6-25 milliamperes (women)	Painful shock, loss of muscular control
9-30 milliamperes (men)	The freezing current or “let-go” range. Individual cannot let go, but can be thrown away from the circuit if extensor muscles are stimulated.
50-150 millamps	Extreme pain, respiratory arrest, severe muscular contractions. Death is possible.
1,000-4,300 milliamperes	Rhythmic pumping action of the heart ceases. Muscular contraction and nerve damage occur; death likely
10,000 milliamperes	Cardiac arrest, severe burns; death probable

# Types of Electrical Hazards

- Damaged or bare wires

Fault current may travel through a body, causing electrical burns or death, if

Power supply is not grounded

Path has been broken

There are live parts or bare wires



Extreme conditions and rough treatment can change electrical equipment from safe to hazardous

# Types of Electrical Hazards

- Improper repairs: Examples of incidents
    - Ballast strap not replaced after repair = Electrocution
    - Cutting off bleed resistor on capacitor= causes 370-volt shock
    - Removing and leaving off terminal insulator on capacitor = causes 440-volt shock



## A modern ballast for powering a variety of T8 office lamps

# Types of Electrical Hazards

- Improper use
  - Extension and flexible cords
    - Care
    - Connection
    - Capacity



# Types of Electrical Hazards

- Capacity affected by

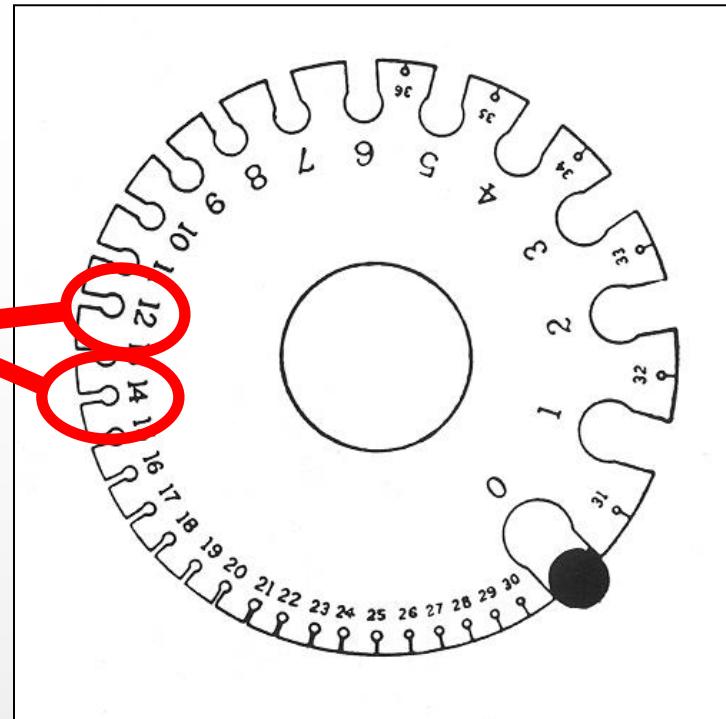
- Size of wire

- 14 gauge = 15 amps

- 12 gauge = 20 amps

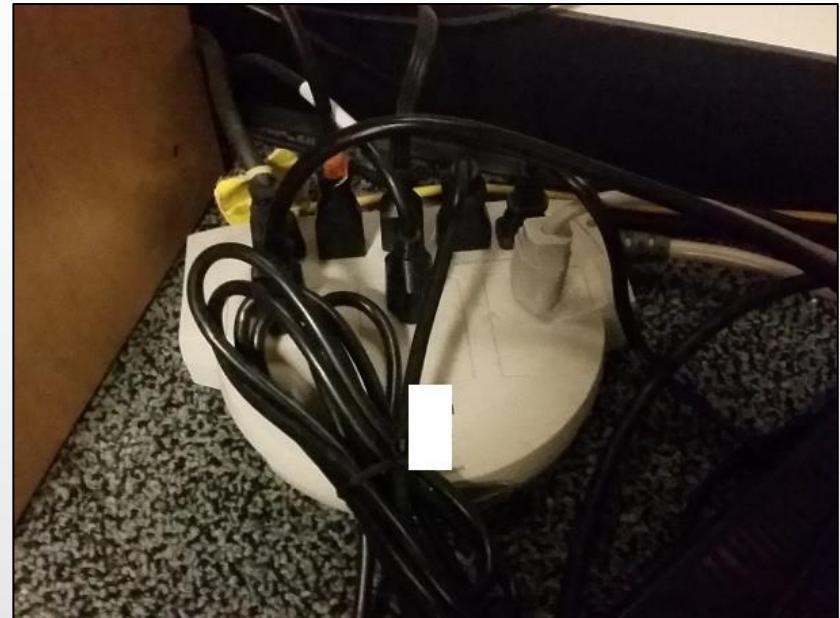
- Length of the cord

- In general, any cord over 100 ft. requires one size larger cord  
(14 gauge to 12 gauge)



# Types of Electrical Hazards

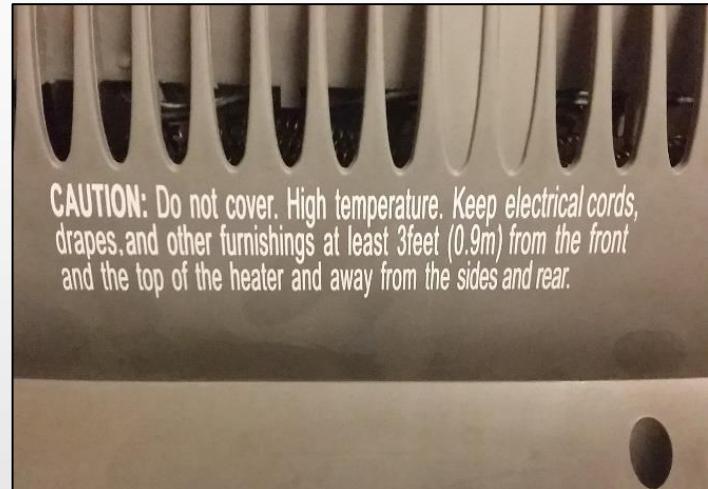
- Power strips
  - Can be overloaded because of multiple plug arrangement
  - Most have overload protection but often malfunction causing fire
  - Use fixed wiring when possible



# Types of Electrical Hazards



- Portable heaters and appliances
  - Manufacturer recommendations not followed
  - Do not plug into a power strip! This causes overloads and fires.



# Electrical Protection Methods

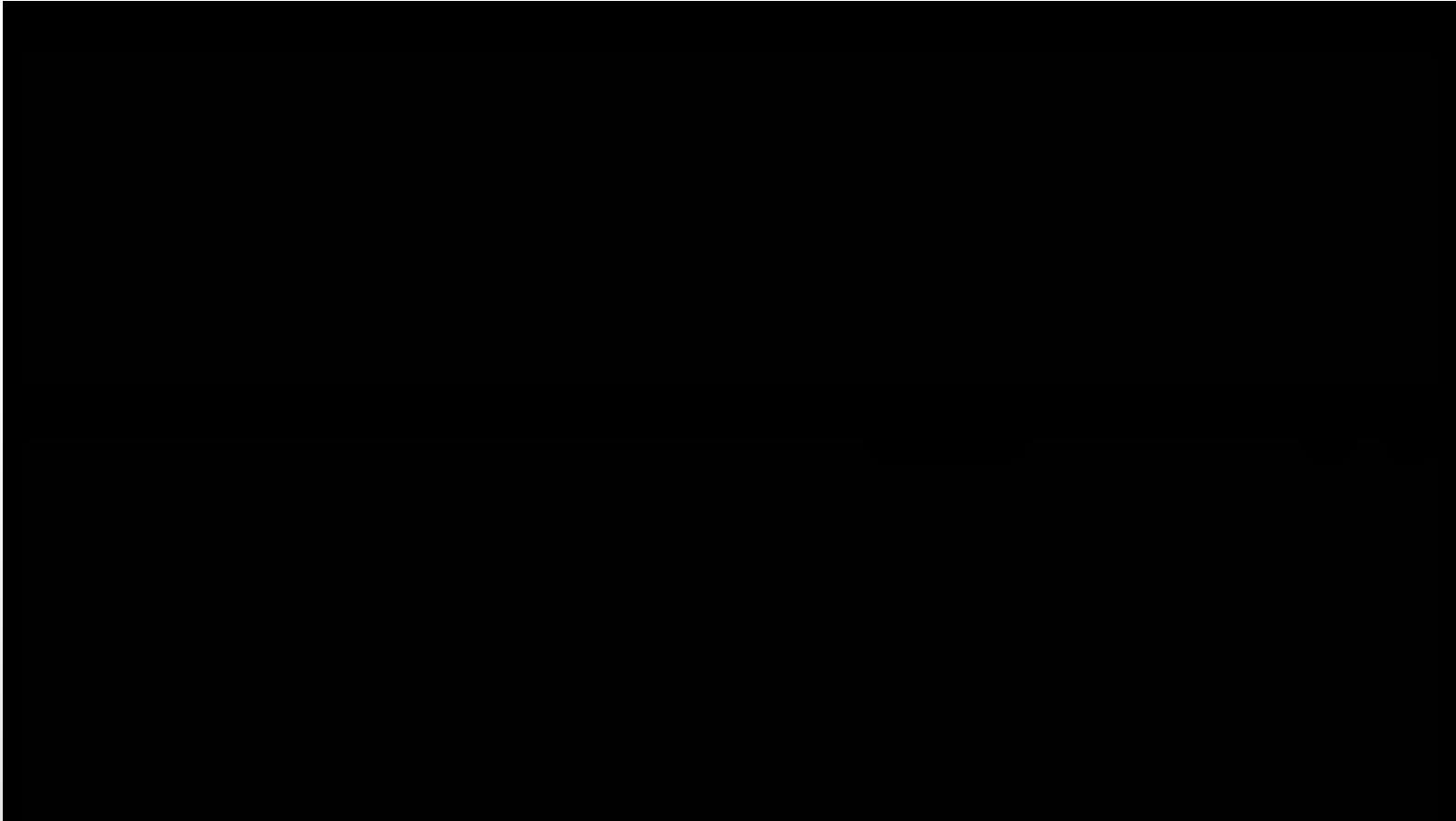
- Maintain safe distance from overhead power lines
  - Staying away
  - Following table shows the safe power line clearance distance for various line voltages

Voltage (nominal, kV, alternating current)	Minimum Clearance Distance (feet)
Up to 50	10
Over 50 to 200	15
Over 200 to 350	20
Over 350 to 500	25
Over 500 to 750	35
Over 750 to 1000	45
Over 1000	(As established by the power line owner/operator or registered professional engineer who is a qualified person with respect to electrical transmission and distribution)

# Electrical Protection Methods

<https://www.youtube.com/watch?v=Y2MwX738e1Y&feature=youtu.be>

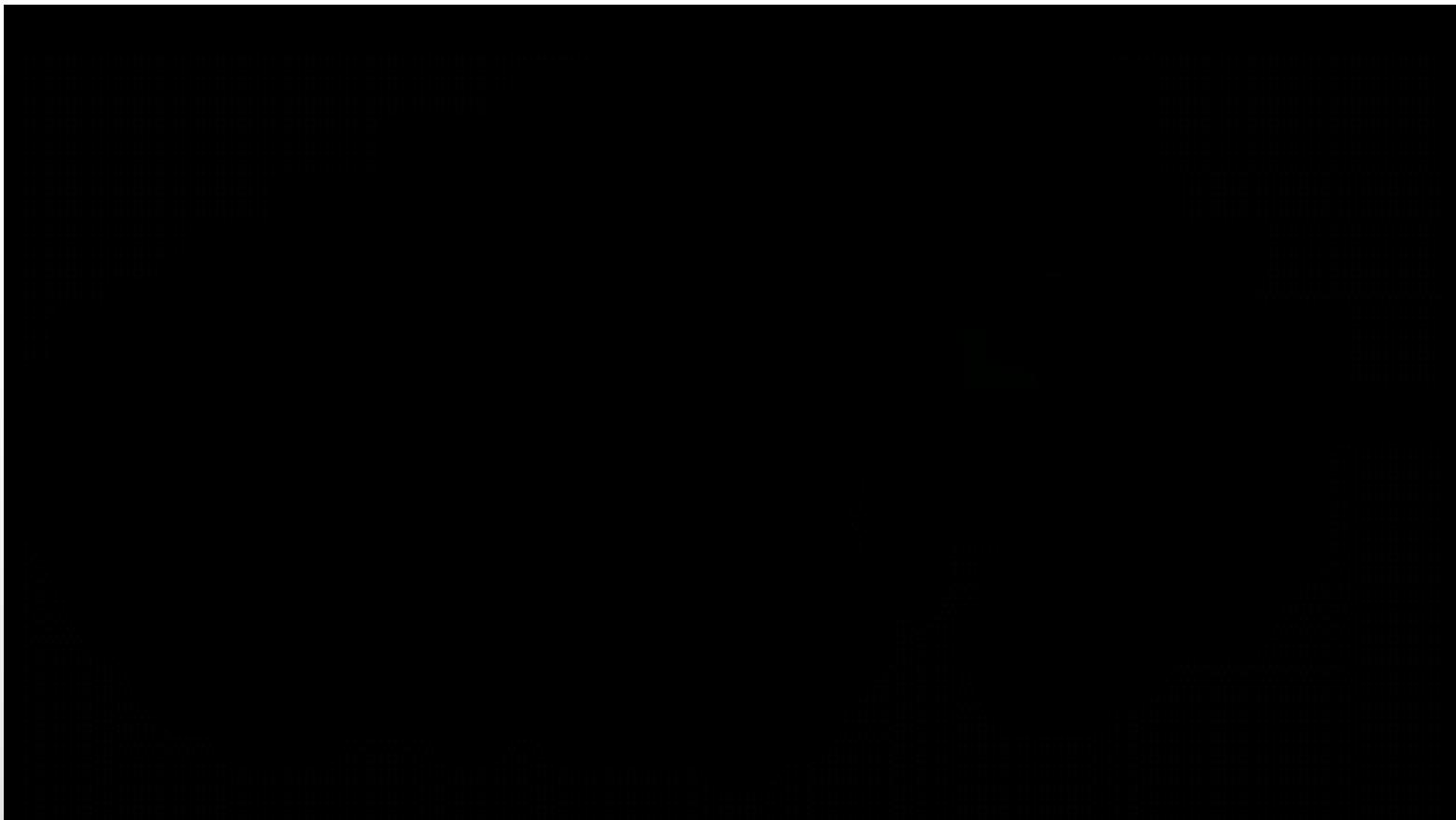
- Maintain safe distance from overhead power lines:  
Work Safely with Cranes near Power Lines



# Electrical Protection Methods

<https://www.youtube.com/watch?v=4QcctfnUeOM>

- Maintain safe distance from overhead power lines:  
Electrocution/Work Safely with Ladders Near Power Lines



# Electrical Protection Methods

- Use ground-fault circuit interrupters (GFCI):
  - Designed to protect people from electrical shock
  - Detects ground faults and interrupts electric current
  - Limits duration of electrical shock



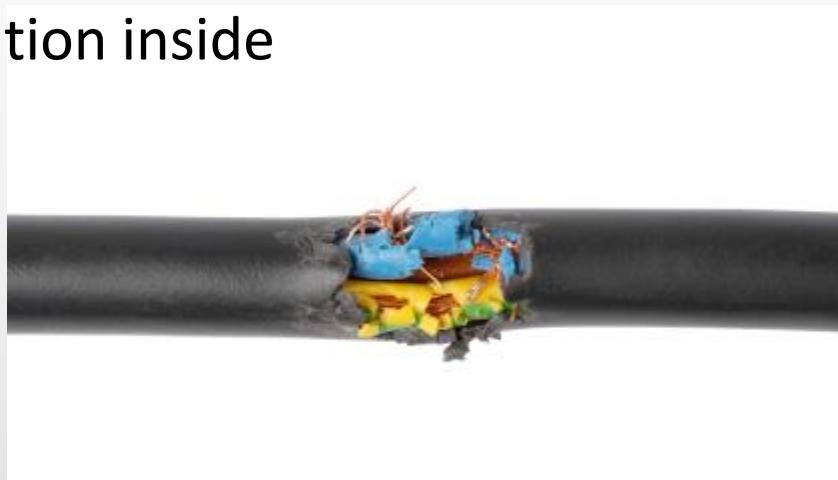
# Electrical Protection Methods

- Three types of ground-fault circuit interrupters (GFCI):
  - Receptacle GFCI
  - Temporary/portable GFCI
  - Circuit Breaker GFCI



# Electrical Protection Methods

- Inspect portable tools and extension cords
  - Workers need to inspect extension cords prior to their use for any cuts or abrasion
  - Electric hand tools that are old, damaged, or misused may have damaged insulation inside



# Electrical Protection Methods

- Use power tools and equipment as designed
  - Follow tool safety tips to avoid misusing equipment
  - Follow manufacturer's instructions



# Electrical Protection Methods

- Tool safety tips
  - Never carry a tool by the cord
  - Never yank the cord to disconnect it
  - Keep cords away from heat, oil, and sharp edges
  - Disconnect when not in use and when changing accessories such as blades and bits
  - Avoid accidental starting. Do not hold fingers on the switch button while carrying a plugged-in tool
  - Use gloves and appropriate footwear
  - Store electrical equipment in a dry place when not using
  - Don't use electrical equipment in wet/damp environments
  - Keep working areas well lit
  - Ensure that cords do not cause a tripping hazard
  - Remove damaged tools from use
  - Use double-insulated tools



# Electrical Protection Methods

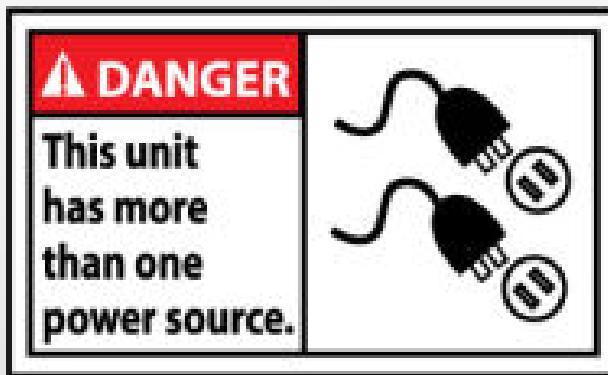


- Follow lockout/tagout (LOTO) procedures:
  - Lockout/tagout
    - Essential safety procedure
    - Protects workers from injury while working on or near electrical circuits and equipment
    - Prevents contact with operating equipment parts such as, blades, gears, shafts, etc.



# Electrical Protection Methods

- Power source identification
  - Mark all breakers accordingly for the circuits they protect
  - Mark all disconnect means accordingly for the equipment they service
  - Identify all voltages with proper labeling



# Employer Requirements

- Employer requirements to protect workers
  - Ensure overhead power line safety
  - Isolate electrical parts
  - Supply ground-fault circuit interrupters (GFCI) protection
  - Establish and implement an assured equipment grounding control program (AEGCP)
  - Ensure power tools are maintained in a safe condition
  - Ensure proper guarding
  - Provide training
  - Enforce LOTO safety related work practices
  - Ensure proper use of flexible cords and power strips
  - Ensure proper identification of power sources



# What's Wrong?



# What's Wrong?



Do you have any  
questions or  
comments?





Thank you  
for your attention !



In this presentation:

- Some icons were downloaded from flaticon.com and iconscout.com