MIIA Massachusetts Based Member Driven

OSHA Topic Review "Electrical Safety for Non-Qualified Employees"

- OSHA - 29 CFR 1910 Subpart S.

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1910 Subpart S - Electrical

- 1910.301 - Introduction.
- 1910.302 - Electric utilization systems.
- 1910.303 - General requirements.
- 1910.304 - Wiring design and protection.
- 1910.305 - Wiring methods, components, and equipment for general use.
- 1910.306 - Specific purpose equipment and installations.
- 1910.307 - Hazardous (classified) locations.
- 1910.308 - Special systems.
- 1910.331 - Scope
- 1910.332 - Training
- 1910.333 - Selection and use of work practices
- 1910.334 - Use of equipment.
- 1910.335 - Safeguards for personnel protection.

The facts...

25% of all fires occur due to electricity

411 deaths from job related electrical accidents per year (NIOSH)

Electrocution - the fifth leading cause of death (1982 - 1990) NIOSH

Basics about electricity

Electricity travels in a completed circuit

Electricity always travels in the path of least resistance

Electricity tries to travel to ground

People and Electricity

A person usually offers less resistance for the electricity

A person forms a completed circuit when the person is touching the ground

Electricity always tries to travel to ground

Types of Electrical Injuries

There are four main types of electrical injuries:

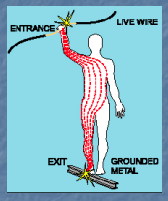
- Electrocution (death due to electrical shock)
- Electrical shock
- Burns
- Falls

Electrical Shock

Received when current passes through the body

Severity of the shock depends on:

- Path of current through the body
- Amount of current flowing through the body
- Length of time the body is in the circuit



Effects of Electrical Current On The Body

Current	Reaction
1 milliamp	Just a faint tingle.
5 milliamps	Slight shock felt. Disturbing, but not painful. Most people can "let go." However, strong involuntary movements can cause injuries.
6–25 milliamps (women)† 9–30 milliamps (men)	Painful shock. Muscular control is lost. This is the range where "freezing currents" start. It may not be possible to "let go."
50–150 milliamps	Extremely painful shock, respiratory arrest (breathing stops), severe muscle contractions. Flexor muscles may cause holding on; extensor muscles may cause intense pushing away. Death is possible.
1,000–4,300 milliamps (1–4.3 amps)	Ventricular fibrillation (heart pumping action not rhythmic) occurs. Muscles contract; nerve damage occurs. Death is likely.
10,000 milliamps (10 amps)	Cardiac arrest and severe burns occur. Death is probable.
15,000 milliamps (15 amps)	Lowest overcurrent at which a typical fuse or circuit breaker opens a circuit!

*Effects are for voltages less than about 600 volts. Higher voltages also cause severe burns.
†Differences in muscle and fat content affect the severity of shock.

Dangers of Electrical Shock

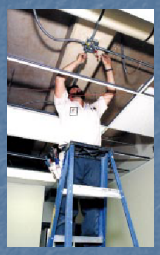
- Currents greater than 75 mA can cause ventricular fibrillation (rapid, ineffective heartbeat)
- Will cause death in a few minutes unless a defibrillator is used
- 75 mA is not much current – a small power drill uses 30 times as much

Electrical Burns

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

Falls

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



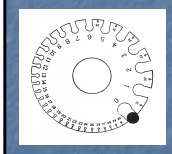
General Electrical Hazards

- High-voltage overhead power lines
- Damaged insulation on wires
- Digging or trenching near buried lines
- Broken switches or plugs
- Overloaded circuits
- Overheated appliances or tools
- Static electricity
- Flammable materials

Inadequate Wiring Hazards

A hazard exists when a conductor is too small to safely carry the current

Example: using a portable tool with an extension cord that has a wire too small for the tool



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

- 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

Overload Hazards

If too many devices are plugged into a circuit, the current will heat the wires to a very high temperature, which may cause a fire

If the wire insulation melts, arcing may occur and cause a fire in the area where the overload exists, even inside a wall

Electrical Protective Devices

These devices shut off electricity flow in the event of an overload or ground-fault in the circuit

Include fuses, circuit breakers, and ground-fault circuit-interrupters (GFCI's)

Fuses and circuit breakers are overcurrent devices

- When there is too much current:
  - Fuses melt
  - Circuit breakers trip open

Ground-Fault Circuit Interrupter

This device protects you from dangerous shock

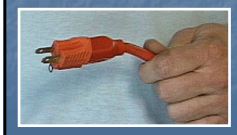
The GFCI detects a difference in current between the black and white circuit wires

This could happen when electrical equipment is not working correctly, causing current "leakage" – known as a *ground fault*.

If a ground fault is detected, the GFCI can shut off electricity flow in as little as 1/40 of a second, protecting you from a dangerous shock

Grounding Hazards

- Most electrical equipment is designed with a grounding system
- Do not use equipment with damaged grounding connectors
- Do not use adapters that interrupt the grounding connection



Static Electricity

- Created when materials rub together
- Can cause shocks or even minor skin burns
- Reduced or prevented by:
  - Proper grounding
  - Rubber matting
  - Grounding wires, gloves, or shoes

Overhead Powerline Hazards

- Most people don't realize that overhead powerlines are usually not insulated
- Powerline workers need special training and personal protective equipment (PPE) to work safely
- Do not use metal ladders – instead, use fiberglass ladders
- Beware of powerlines when you work with ladders and scaffolding

Some Examples of OSHA Electrical Requirements . . . .

Grounding Path

The path to ground from circuits, equipment, and enclosures must be permanent and continuous

Violation shown here is an extension cord with a missing grounding prong

Hand-Held Electric Tools

Hand-held electric tools pose a potential danger because they make continuous good contact with the hand

To protect you from shock, burns, and electrocution, tools must:

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

Guarding of Live Parts

- Must guard live parts of electric equipment operating at 50 volts or more against accidental contact by:
  - Approved cabinets/enclosures, or
  - Location or permanent partitions making them accessible only to qualified persons, or
  - Elevation of 8 ft. or more above the floor or working surface
- Mark entrances to guarded locations with conspicuous warning signs

Guarding of Live Parts

Must enclose or guard electric equipment in locations where it would be exposed to physical damage

Violation shown here is physical damage to conduit

Cabinets, Boxes, and Fittings

- 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

Use of flexible cords

More vulnerable than fixed wiring

Do not use if one of the recognized wiring methods can be used instead

Flexible cords can be damaged by:

- Aging
- Door or window edges
- Staples or fastenings
- Abrasion from adjacent materials
- Activities in the area

Improper use of flexible cords can cause shocks, burns or fire

Electrical cord safety

- Inspect Cords Before Each Use
- Be Sure Plug And Receptacle Have Proper Mating Configuration
- To Unplug, Never Pull On The Cord, Pull On The Plug
- Don't Use Nails, Staples, Screws, Etc., To Attach Or Fasten A Cord Or Plug
- Two Conductor Cords Are Illegal
- Damaged Cords Should Never Be Used

Electrical cord safety (continued)

- Ensure Enough Slack To Prevent Strain On Plug Or Receptacle
- A Plug-Receptacle Should Have At Least 8 Ounces Of Contact Tension
- Cords Should Be Kept Clean And Free Of Kinks And Insulation Breaks
- Cords Crossing Vehicular Or Personnel Passageways Should Be Protected, Sign Posted, And Used Temporarily Or In An Emergency
- Cords Should Be Of Continuous Length And Without Splices

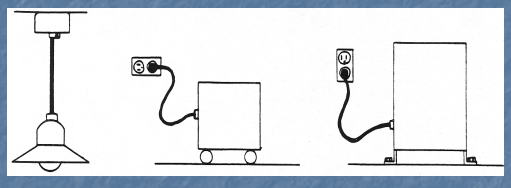
Approved uses of flexible cords

- Pendants
- Wiring of fixtures
- Connection of portable lamps or appliances
- Elevator cables
- Wiring of cranes and hoists
- Connection of stationary equipment to facilitate their interchange
- Prevention of the transmission of noise or vibration
- Appliances where the fastening means and mechanical connections are designed to permit removal for maintenance and repair
- Data processing

Situations where use of flexible cables not permitted

- As a substitute for the fixed wiring of the structure
- Where run through holes in walls, ceilings or floors
- Where run through doorways, windows or similar openings
- Where attached to building surfaces
- Where concealed behind building walls, ceilings or floors

Permissible Uses of Flexible Cords
Examples

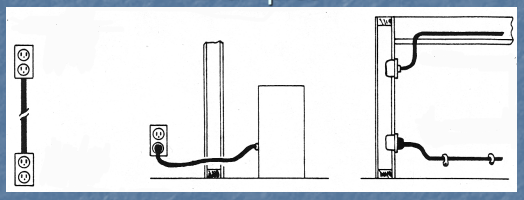


Pendant, or Fixture Wiring

Portable lamps, tools or appliances

Stationary equipment- to facilitate interchange

Prohibited Uses of Flexible Cords
Examples



Substitute for fixed wiring

Run through walls, ceilings, floors, doors, or windows

Concealed behind or attached to building surfaces

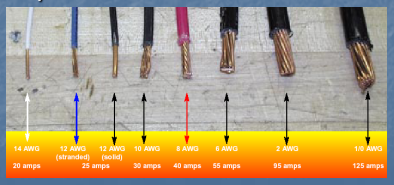
Clues that Electrical Hazards Exist

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



What to do if someone is being electrocuted

DO NOT Touch The Victim Or The Conductor

Shut Off The Current At The Control Box

If Shutoff Not Immediately Available, Use Non-Conducting Material To Free Victim

Call For Help If Necessary

And If You Know How, Begin CPR

In Dealing With Electricity, Never Exceed Your Expertise

Procedures for using portable electrical equipment

Proper handling of cords

- Don't raise or lower equipment by its cord
- Don't unplug the equipment by pulling on its cord
- Don't staple or fasten the cord as to damage the outer jacket

Procedures for using portable electrical equipment

Equipment inspection

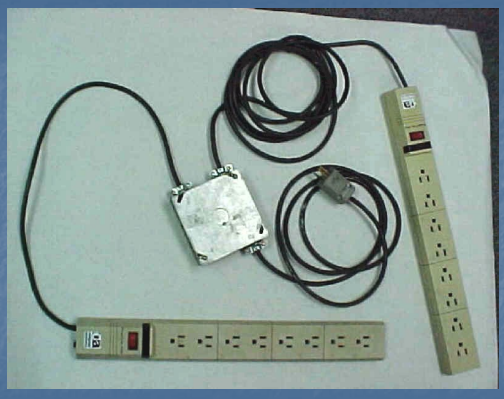
- Visually check for:
  - loose parts
  - deformed or missing parts
  - damaged jackets or insulation
- Inspect for internal defects, as indicated by pinched or crushed outer jackets
- Perform inspections prior to beginning of each shift
- Remove defective equipment from service
- Check the plug and receptacle mating configuration before connecting

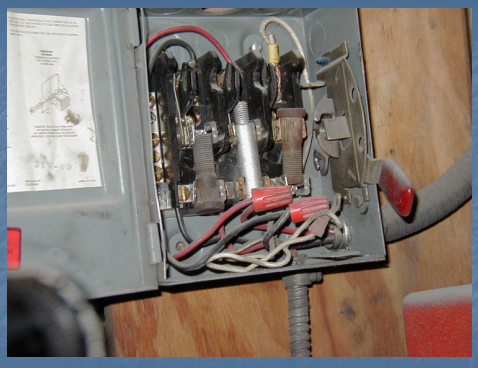
Procedures for using portable electrical equipment

Flexible cords

- Flexible cords with grounding-type of equipment must have an equipment grounding conductor
- Never remove or alter the cord's grounding pin
- Never use an adapter with a missing grounding pin

Electrical equipment and cords to be used near water must be approved for this use





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Safe electrical work practices

- Know Where The Hazards Are
- Properly Maintain Equipment
- No Exposed Parts Or Energized Surfaces
- Use Barriers And Devices Where Appropriate
- No Conductors To Walk On Or Trip On
- No Jewelry, Or Other Metal Objects Around Electricity
- Never Use Plugs Or Receptacles That Can Alter Polarity
- Properly Plug All Connecting Plug-Ins
- Install And Use Protective Devices
- Stay Away From All Unguarded Conductors
- Never Overload A Circuit Or A Conductor