



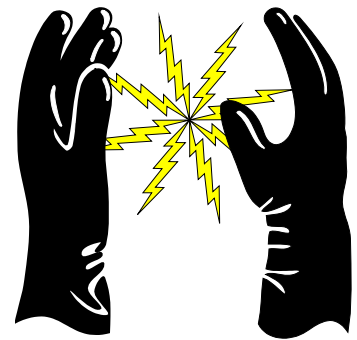
Electrical Safety in Construction

- *29 CFR 1926 Subpart K – Electrical*

Objectives

In this course, we will discuss the following:

- Common electrical hazards
- Standards relating to those hazards
- Electrical equipment defects/hazards
- Tools/techniques used in identifying hazards



29 CFR 1926 – Subpart K

- 1926.400 – Introduction
 - 1926.402 – Applicability
 - 1926.403 – General requirements
 - 1926.404 – Wiring design and protection
 - 1926.405 – Wiring methods, components, & equipment
 - 1926.406 – Specific purpose equipment and installations
 - 1926.407 – Hazardous (classified) locations
 - 1926.408 – Special systems
 - 1926.416, 417, 431, 432, 441 – Safety-related practices and maintenance
 - 1926.449 - Definitions
-

Common Electrical Hazards

- Electric shock/electrocution occurs when current flows through the body damaging the body.
- Electrical burns are caused by arc blast or hot conductors.
- Indirect falls from ladders, scaffolds, or other walking and working surfaces.



Common Electrical Hazards

- Explosions can be caused when electricity provides a source of ignition for an explosive mixture in the atmosphere.
- Fires are caused by overloading a circuit or appliance or by current flowing through high resistance due to faulty wiring, setting fire to insulation and surrounding materials.



General Requirements

1926.403(a)



General Requirements

1926.403(b)(1)

- Electrical equipment must be free from recognized hazards that can cause death or serious physical harm to employees
 - Suitability for installation
 - Mechanical strength and durability
 - Electrical insulation
 - Heating effects under condition of use
 - Arcing effects
 - Classification by type, size, voltage, current capacity, specific use



General Requirements

1926.403(b)(2)

- Listed, labeled, or certified equipment must be installed and used in accordance with instructions included in the listing, labeling or certification.



Testing Laboratories

NRTL'S (Nationally Recognized Testing Laboratories)

Applied Research Laboratories, Inc. (ARL)



Detroit Testing Laboratory, Inc. (DTL)



Intertek Testing Services NA, Inc. (ITSNA) (formerly ETL Testing Laboratories, Inc.)



Southwest Research Institute (SWRI)



Canadian Standards Association (CSA) (also uses initials "US" instead of "NRTL" in its markings)



Electro-Test, Inc. (ETI)



Entela, Inc. (ENT)



MET Laboratories, Inc. (MET)



TUV Rheinland of North America, Inc. (TUV)



Canadian Standards Association (CSA) (time limited use of mark formerly used by the American Gas Association (AGA))



Factory Mutual Research Corporation (FMRC)



NSF International (NSF)



Wyle Laboratories (WL)



Communication Certification Laboratory, Inc. (CCL)



Intertek Testing Services NA, Inc. (ITSNA) (formerly ETL Testing Laboratories, Inc.)



National Technical Systems, Inc. (NTS)



Underwriters Laboratories Inc. UL



SGS U. S. Testing Company, Inc. (SGSUS) (formerly U.S. Testing Company, Inc.)





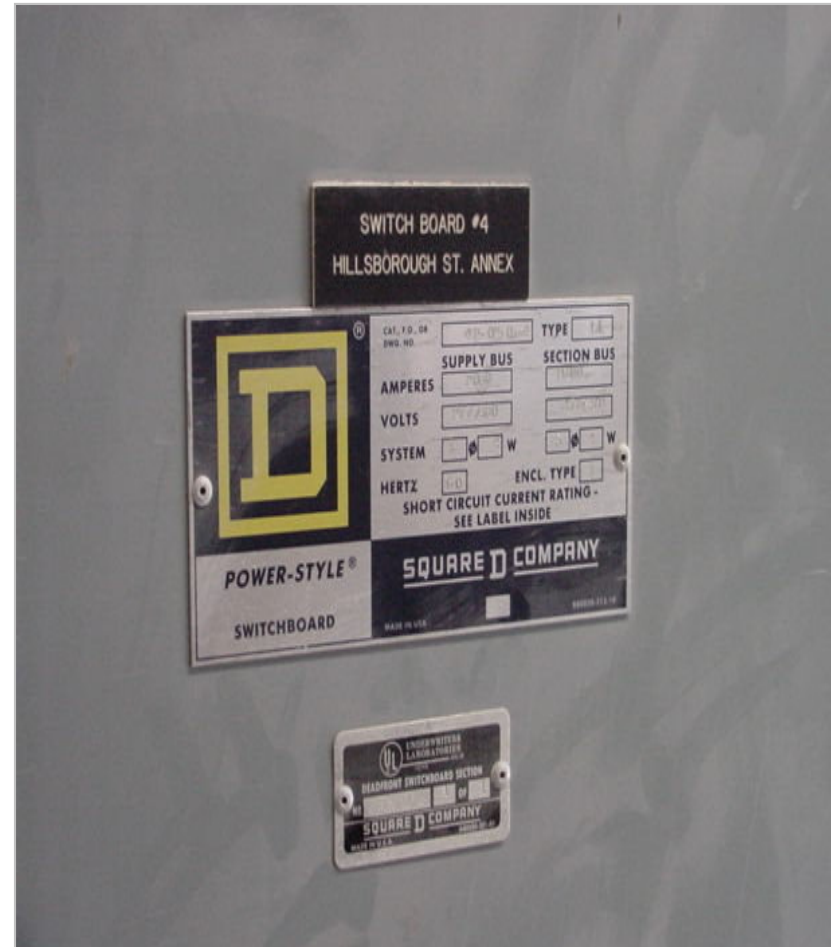
Box Not Approved as a Pendant



General Requirements

1926.403(b)(2)

- Equipment shall be installed and used in accordance with instructions.





Used in Accordance With Instructions

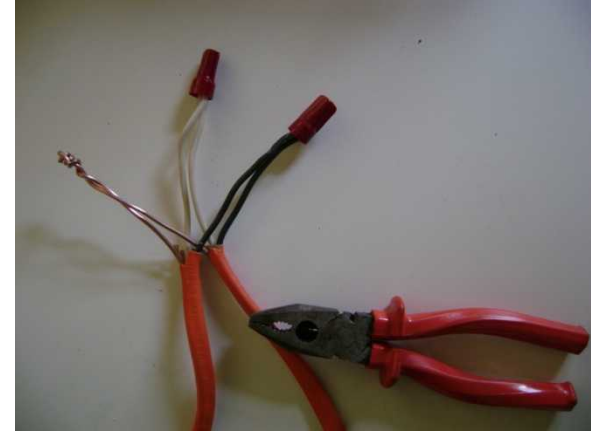


General Requirements

1926.403(e)

● Splices

- Splicing devices suitable for use
- Welding/brazing/soldering
- Mechanically/electrically secure before soldering
- Covered with insulation equivalent to that of the conductors
- Insulating device suitable for purpose



General Requirements

1926.403(h)

- Each service, feeder, and branch circuit, at its disconnecting means or over current device, shall be legibly marked to indicate its purpose.



General Requirements

1926.403(i)

- Live parts of electric equipment operating at 50 volts or more shall be guarded against accidental contact by cabinets or other forms of enclosures, or by another suitable method.

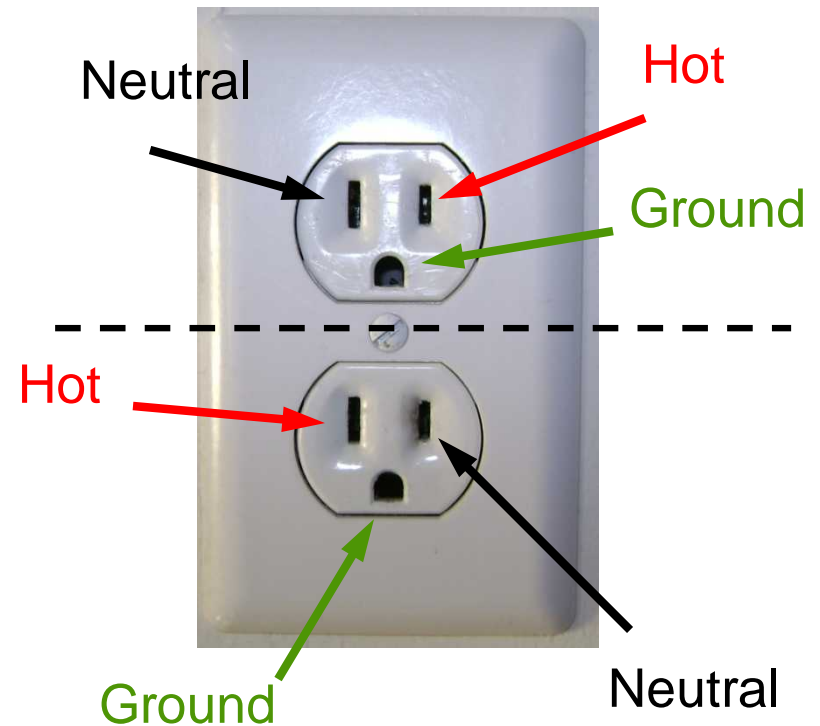


Wiring Design and Protection

1926.404(a)(2)

- Polarity of connections
 - No grounded conductor may be attached to any terminal or lead so as to reverse designated polarity

Correct Polarity

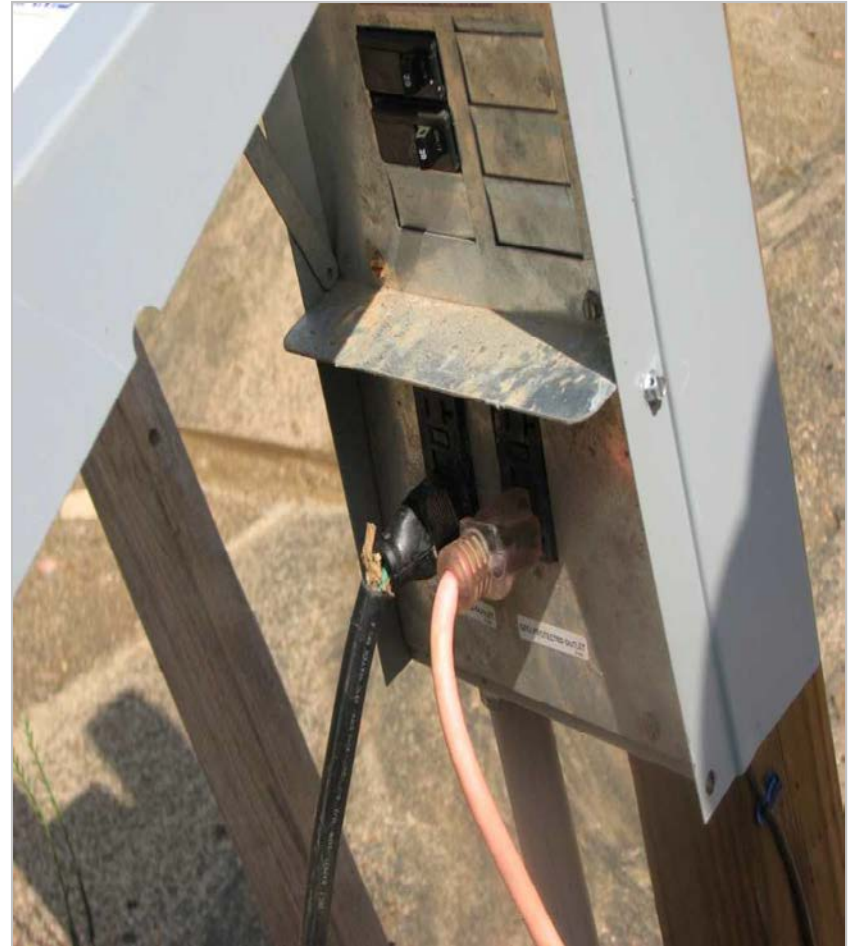


Reversed Polarity

Wiring Design and Protection

1926.404(b)(1)(i)

- Employer shall use either ground fault circuit interrupters, **or**
- An assured equipment grounding conductor program to protect employees



Wiring Design and Protection

1926.404(f)(3)

- Portable generators need not be grounded if:
 - Supplies only equipment mounted on the generator and/or cord and plug equipment is plugged into receptacle mounted on the generator
 - Noncurrent-carrying metal parts of equipment and grounding conductor terminals of the receptacle are bonded to generator frame



Wiring Design and Protection

1926.404(f)(3)

- Vehicle-mounted generators
 - The frame of the generator is bonded to the vehicle frame, **and**
 - Generator supplies only equipment located on the vehicle and/or equipment plugged into the generator, **and...**



Photo courtesy of FEMA.
This picture shows actual disaster site work conditions and may not illustrate proper safety and health procedures.

(cont...)

Wiring Design and Protection

1926.404(f)(3)

- The noncurrent-carrying metal parts of equipment and grounding conductor terminals of the receptacles are bonded to the generator frame, ***and***
- The system complies with all other provisions of this section.



Wiring Design and Protection

1926.404(f)(6)

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



Wiring Design and Protection 1926.404(f)(7)(iv)

- Equipment connected by cord and plug
 - Noncurrent-carrying metal parts which may become energized must be grounded



Wiring Design and Protection

1926.404(f)(7)(iv)

- Equipment connected by cord and plug must be grounded, if:
 - In a hazardous location
 - Operated at over 150 V to ground
 - » Except guarded motors and appliances permanently insulated from ground
 - Hand held motor-operated tools
 - Equipment used in wet and/or conductive locations
 - Portable hand lamps



Wiring Design and Protection 1926.405(a)(2)(ii)[I]

- Flexible cords and cables must be protected from damage.





Wiring Design and Protection 1926.405(a)(2)(ii)(J)

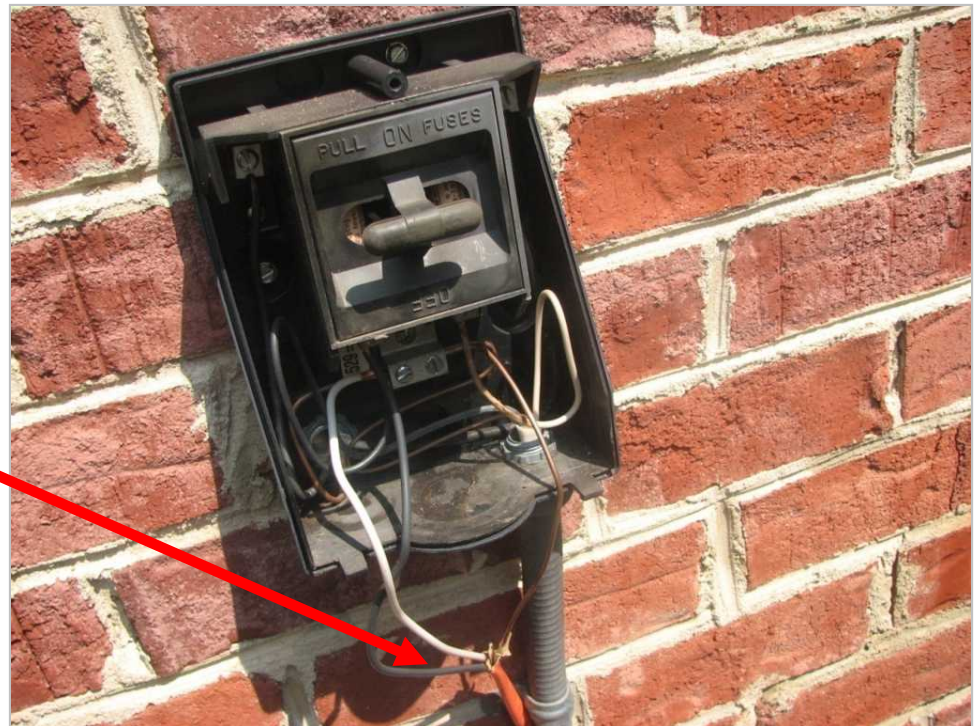
- Extension cord sets used with portable electric tools and appliances must be of three-wire type and must be designed for hard or extra-hard usage.



Wiring Design and Protection

1926.405(b)(1)

- Conductors entering boxes, cabinets, or fittings must be protected from abrasion.





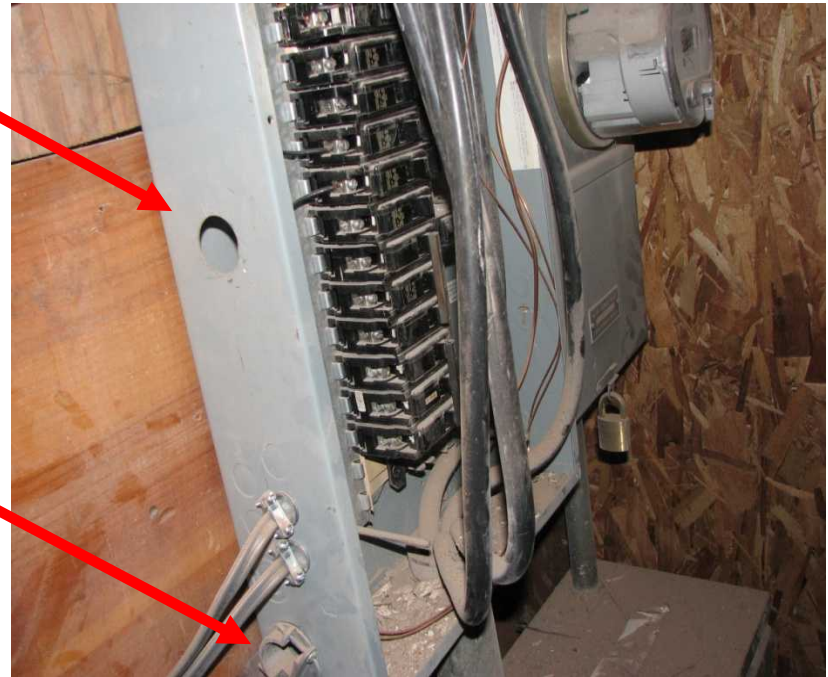
Wiring Design and Protection

1926.405(b)(1)



Wiring Design and Protection 1926.405(b)(1)

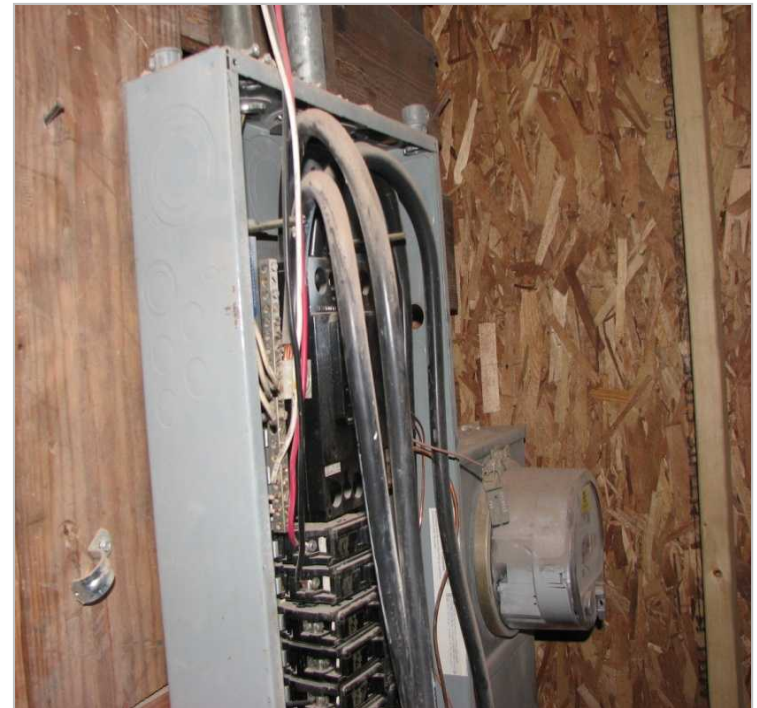
- Unused openings in cabinets, boxes and fittings must be effectively closed.



Wiring Design and Protection

1926.405(b)(2)

- All pull boxes, junction boxes, and fittings must be provided with a cover.
- If metal covers are used, they must be grounded.





Wiring Design and Protection

1926.405(g)(1)

- Flexible cords and cables must be suitable for conditions of use and location.



Wiring Design and Protection

1926.405(g)(1)

- **Permitted** uses of flexible cords and cables
 - Pendants
 - Fixture wiring
 - Portable lamps and appliances
 - Elevators cables, cranes, and hoists
 - Stationary equipment – Frequent interchange
 - Appliances – to permit removal for maintenance and repair



Wiring Design and Protection 1926.405(g)(1)(iii)

- **Prohibited** uses of flexible cords and cables

- As substitute for fixed wiring of structure
- Run through holes in walls, ceilings or floors
- Run through doors, windows or similar openings
- Attached to building surfaces
- Concealed behind building walls, ceilings, or floors





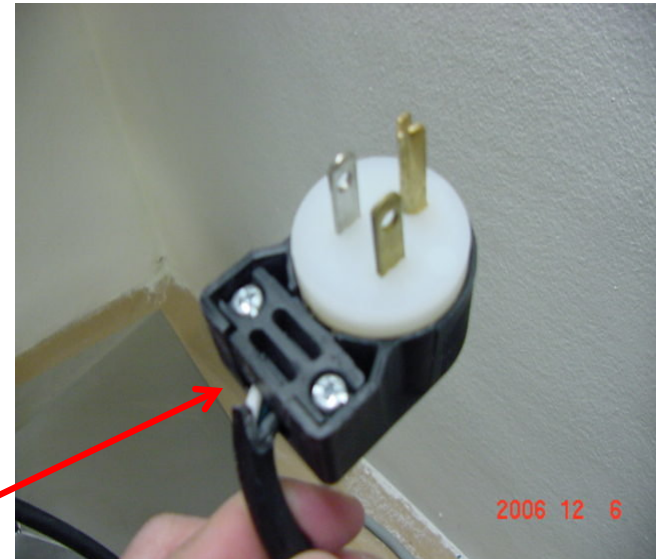
Flexible Cord Run Above Ceiling



Wiring Design and Protection

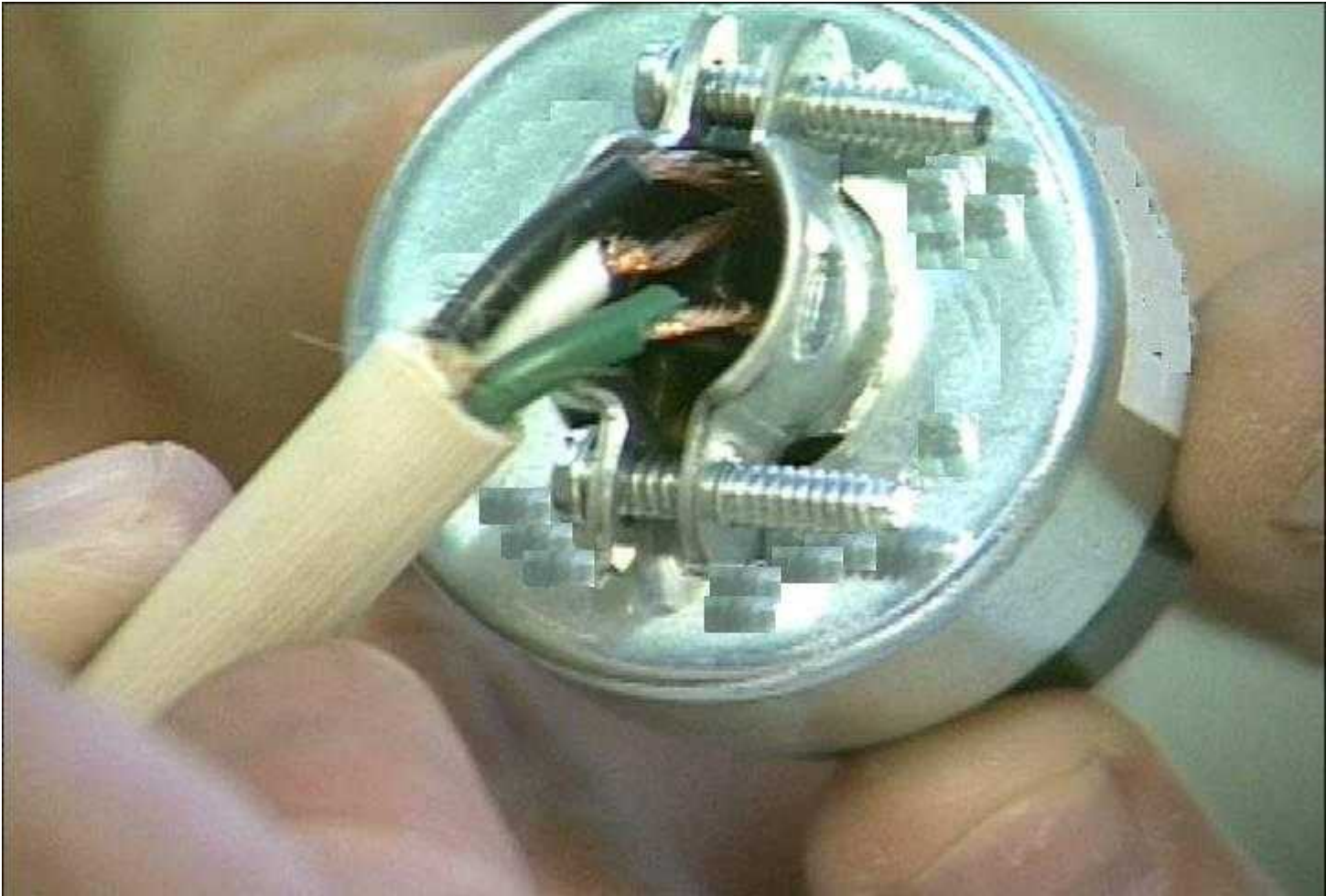
1926.405(g)(2)(iv)

- Flexible cords shall be connected to devices and fittings so that strain relief is provided.
 - Will prevent pull from being directly transmitted to joints or terminal screws





Wiring Design and Protection



Safety-Related Work Practices 1926.416(a)(1)

- Employer must not permit an employee to work in such proximity to any part of an electric power circuit.
 - If employee could contact the power circuit, it must be de-energized or guarded.



Safety-Related Work Practices 1926.416(b)(2)

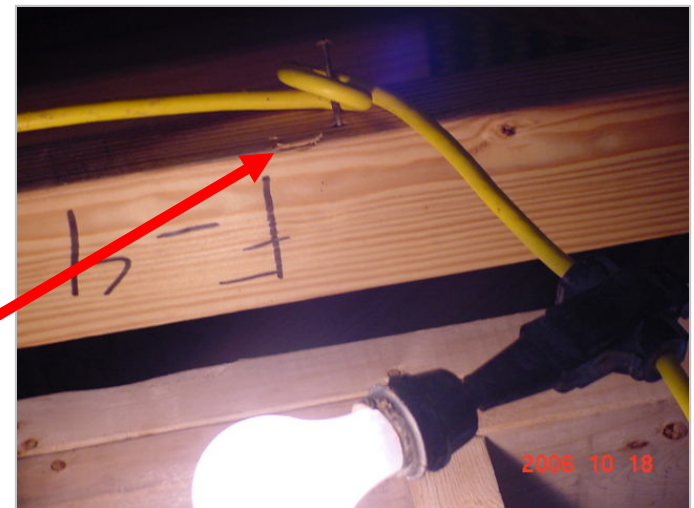
- Working spaces, walkways, and similar locations shall be kept clear of cords so as not to create a hazard to employees.



Safety-Related Work Practices

1926.416(e)

- Worn or frayed electric cords must not be used.
- Extension cords shall not be stapled, hung from nails or suspended by wire.



Tools for Identifying Hazards

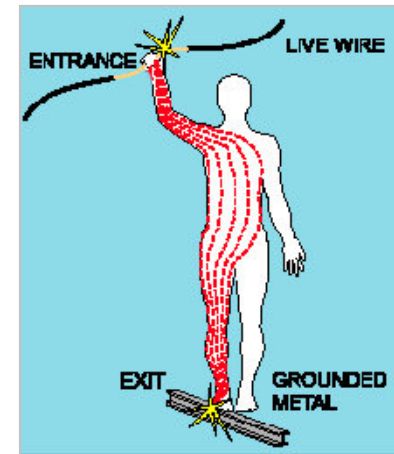
- An electrical receptacle voltage tester with GFCI tester.
 - Line voltage probes



Summary

In this course, we discussed:

- Common electrical hazards
- Standards relating to those hazards
- Electrical equipment defects/hazards
- Tools/techniques used in identifying hazards



Thank You For Attending!

Final Questions?
