

Electrical

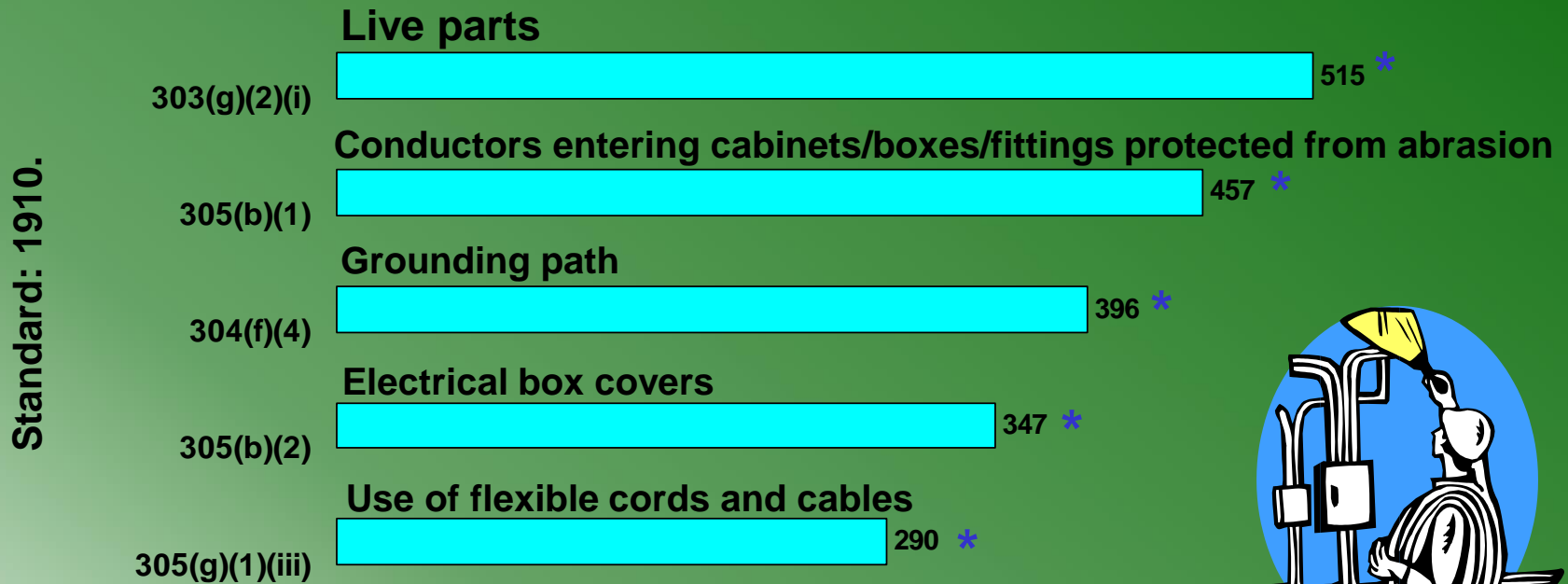
Safety

Subpart S 1910.301-399

Trainer Objectives

- Discuss the scope and structure of Subpart S
- Discuss pertinent sections of Design Safety Standards for Electrical Equipment, sections 301 - 305
- Emphasize equipment grounding and the proper use of flexible cords
- Discuss Safety-Related work practices; sections 331 - 335

Subpart S - Electrical (1910.301 - 399)



*Average number of Federal OSHA citations issued

1910.301 Introduction

- Addresses electrical safety requirements necessary for safeguarding employees in their workplaces
- Divided into four major divisions as follows:
 - (a). Design safety standards for electrical systems
 - (b). Safety-related work practices
 - (c). Safety-related maintenance requirements
 - (d). Safety requirements for special equipment

1910.301 Introduction



- **Two main groups:**
- **1. Design safety standards for electrical systems.**
 - Standards found in 1910.302-308 are design safety standards
- **2. Safety - related work practices.**
 - These regulations are contained in 1910.331-.335 and require the employer to train and equip designated employees to maintain facility's electrical equipment

1910.303 General Requirements

(a) Approval. The conductors and equipment required or permitted by this subpart shall be acceptable only if approved

- **1910.303(a) Approval**

- All electrical conductors and equipment shall be approved.



1910.303(a)
NEC Article 110-2

1910.303 (b) Examination, installation and use

- *Employer Obligation:*
 - (1) Electrical equipment shall be free from recognized hazards that are likely to cause death or serious physical harm to employees

1910.303 (b) Examination, installation, and use

- (1) Examination. Safety of equipment shall be determined using the following considerations:
 - (i) **Suitability of equipment** for an identified purpose may be evidenced by listing or labeling for that identified purpose



1910.303(d) Arcing parts

- Parts of electric equipment which in ordinary operation produce arcs, sparks, flames, or molten metal shall be enclosed or separated and isolated from all combustible material



1910.303 (e) Marking

- Electrical equipment may not be used unless the manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the product may be identified is placed on the equipment



D

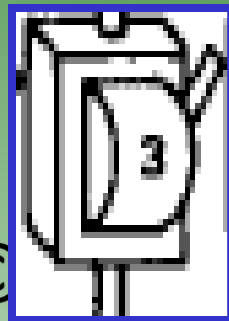
1910.303 (e) Marking

- Other markings shall be provided giving voltage, current, wattage, or other ratings as necessary. The marking shall be of sufficient durability to withstand the environment involved



1910.303 (f) Identification of Disconnecting Means and Circuits

- Each disconnecting means (dm) legibly marked to indicate its purpose
 - (Unless so arranged so the purpose is evident)
- A dm is a switch used to disconnect the conductors of a circuit from the source of current

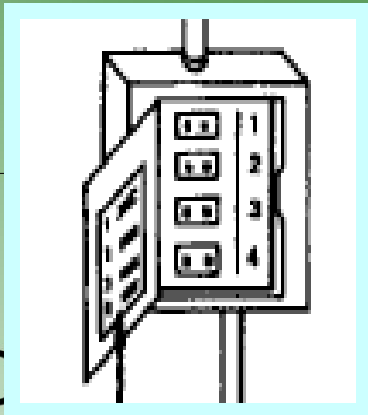


Disconnect switch for motor number 3

1910.303 (f) Identification of Disconnecting Means and Circuits

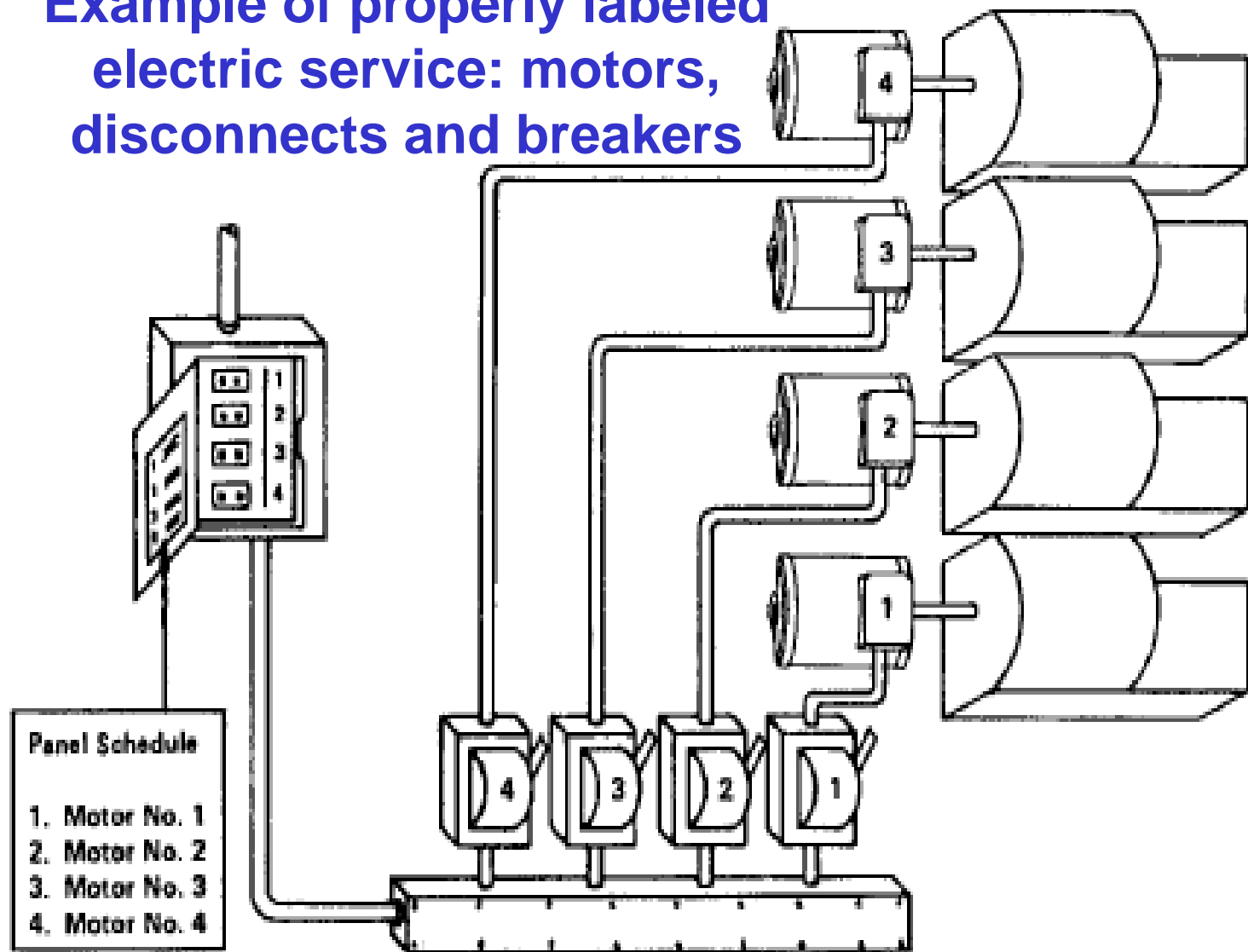
Means and Circuits

- Each service, feeder, and branch circuit, at its dm or overcurrent device, legibly and durably marked to indicate its purpose
- Switches and circuit breakers must be clearly labeled to indicate its circuit's function



Circuit breaker for motors
1,2,3, and 4

Example of properly labeled electric service: motors, disconnects and breakers

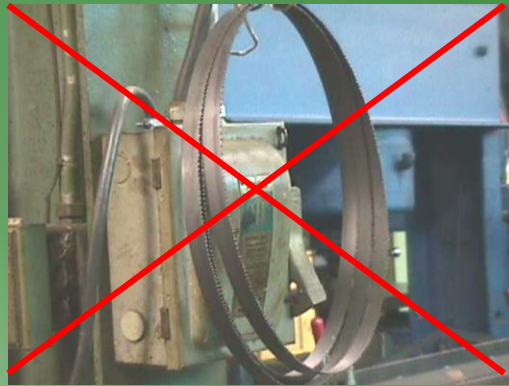


Motor No. 1 is Controlled by
Disconnect No. 1 and Circuit
Breaker No. 1

1910.303(g) Working Space about Electric Equipment

- (1) Sufficient access and working space around all electrical equipment, provided & maintained to provide ready and safe operation and maintenance

- (ii) Not used for storage



- (ii) If located in aisle or general open area, working space shall be suitably guarded

TABLE S-1 - WORKING CLEARANCES

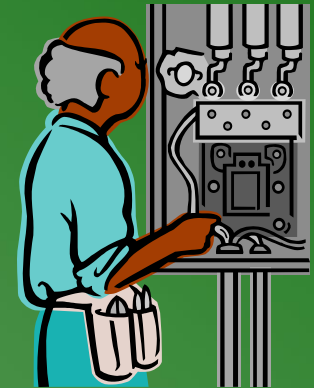
Nominal voltage to ground	Minimum clear distance for condition (2)(ft)		
	(a)	(b)	(c)
0-150	(1)3	(1)3	3
151-600	(1)3	3 1/2	4

Footnote(1) Minimum clear distances may be 2 feet 6 inches for installations built prior to April 16, 1981.

Standard Interpretations

05/28/1999 - Access and working space requirements for electric equipment (600V or less)

- In addition to the dimensions shown in Table S-1, work space may not be less than 30 inches wide in front of the covered electric equipment
- This access and working space shall be kept clear at all times for operation and maintenance personnel
- May not be used for intermittent/incidental storage of non-permanent equipment or furniture



← 30" min →

1910.303(g)(1)(v) Illumination

- Illumination provided for all working spaces about service equipment, switchboards, panelboards, and motor control centers installed indoors.



1910.303(g)(1)(vi) Headroom



- The minimum headroom of working spaces about service equipment, switchboards, panelboards, or motor control centers shall be 6 feet 3 inches

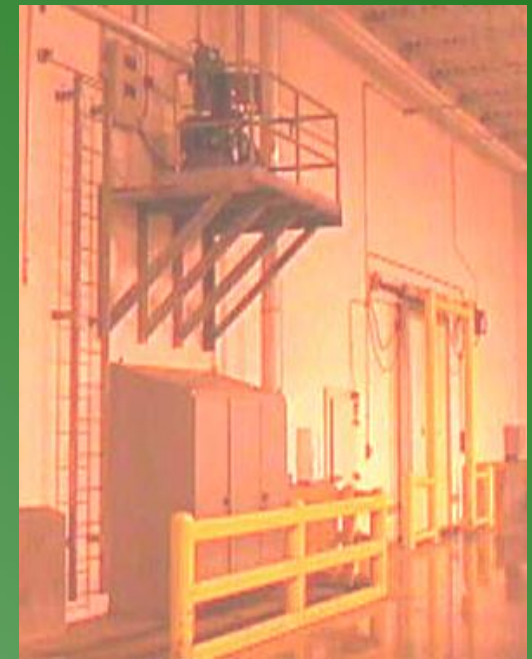
1910.303(g) Guarding of live parts

- (2)(i) Live parts of electric equipment operating at 50 volts or more guarded against accidental contact by approved cabinets



1910. 303 Guarding live parts

- (g)(2)(i) or other forms of approved enclosures, or by any of the following means:
 - (A) By location in a room, vault, accessible only to qualified persons
 - (B) By permanent, substantial partitions or screens
 - (C) By location on a suitable balcony or platform as to exclude unqualified persons
 - (D) By elevation of 8 feet or more above the floor or other working surface



1910. 303(g) Guarding live parts

- (2)(iii) Entrances to rooms and other guarded locations containing exposed live parts shall be marked with conspicuous warning signs forbidding unqualified



1910.303(h)(3)(ii) Illumination

- Adequate illumination for all working spaces about electric equipment



1910.304

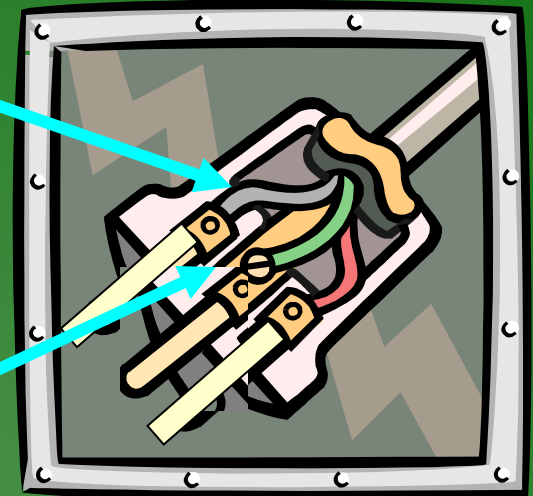
Wiring Design

and

Protection

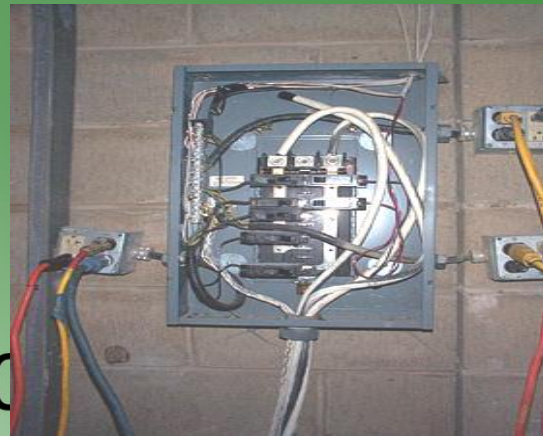
1910.304(a)(1) Identification of Conductors

- A conductor used as a grounded conductor shall be identifiable and distinguishable from all other conductors.
- A conductor used as an equipment grounding conductor shall be identifiable and distinguishable from all other



Identification of Conductors

- Grounded conductor and equipment grounding conductors marked or color coated
- So that employees can i.d. and tell apart
- **Grounded conductor is an energized circuit** (conductor that is connected to earth through the system ground) Commonly referred to as the *neutral*

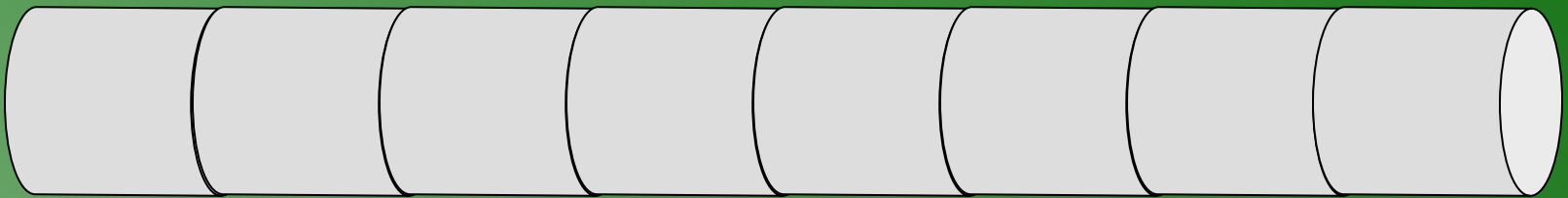


Grounding Conductors

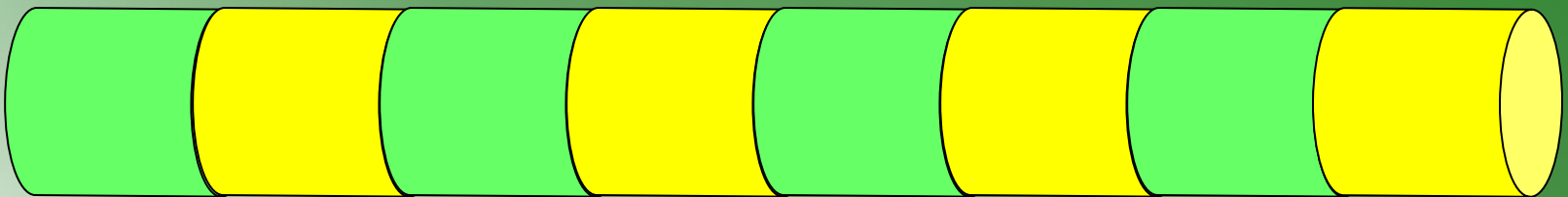
- **Equipment grounding conductor** acts as a safeguard against insulation failure or faults in the other circuit conductors
- **Not an energized conductor** under normal conditions.
- Energized if a leak or fault in the normal current path
- Directs current back to the source
- Enabling fuses or circuit breakers to operate

Identification of Conductors

- **Grounded conductor** i.d. and distinguished from other conductors w/ white or gray



- Equipment **grounding conductor** i.d. and distinguished w/ green, green w/ yellow stripes, or bare



Standard Interpretations

12/18/1997 - Electrical Conductor Identification

- **The use of a diagram not an acceptable form of identifying and distinguishing grounded circuit conductors and equipment grounding circuits**
- **Under paragraph 1910.304(a), a grounded conductor and an equipment grounding conductor must be identifiable and distinguishable from all other conductors**
- **Employee must be able to distinguish an equipment grounding conductor from any other type of conductor in a plant**

Standard Interpretations

12/18/1997 - Electrical Conductor Identification

- If a wiring diagram were the only means of identifying these conductors, an employee (to perform work safely) would have to look up the color coding each time there is need to identify circuit or equipment conductors



Standard Interpretations

12/18/1997 - Electrical Conductor Identification

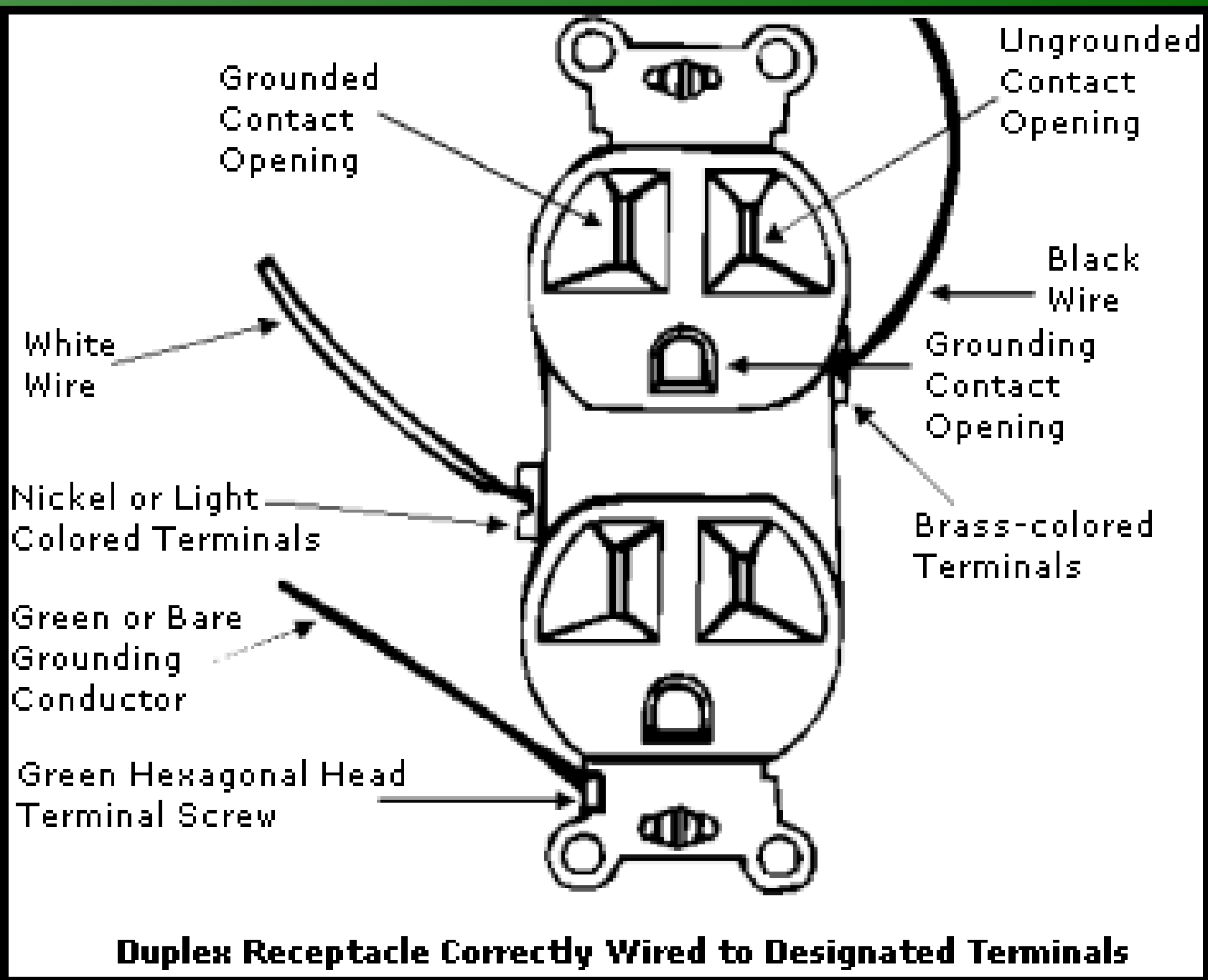
- Non-standardized use of colors makes it much more likely that an employee would confuse a red ungrounded circuit conductor with an equipment grounding conductor in a similar panel
- Such a mistake could lead to an employee being exposed to hazardous electrical energy
- Of particular concern are employees of electrical contractors, who are familiar with *standard color coding schemes*, making this mistake

1910.304(a) Use and identification of grounded and grounding conductors

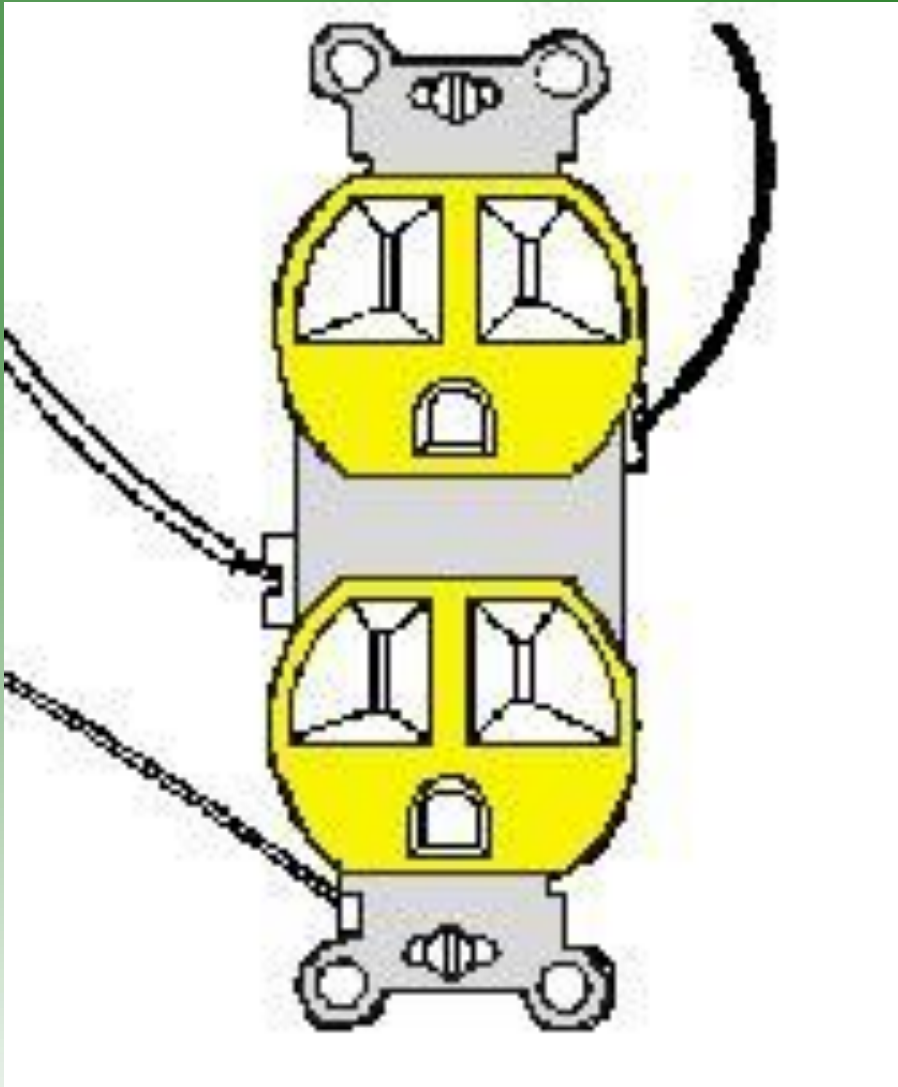
- (2) No grounded conductor may be attached to any terminal or lead so as to reverse polarity

correct polarity between the ungrounded (hot) conductor, the grounded (neutral) conductor, and the grounding conductor must be maintained

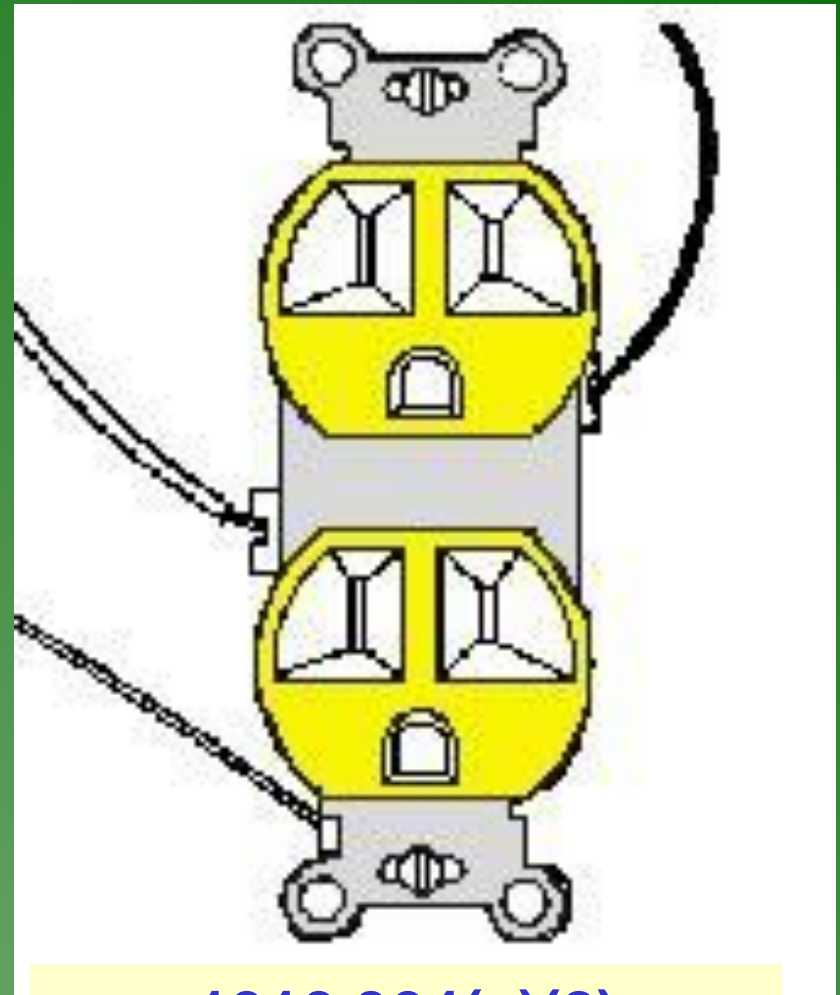




Normal Wiring



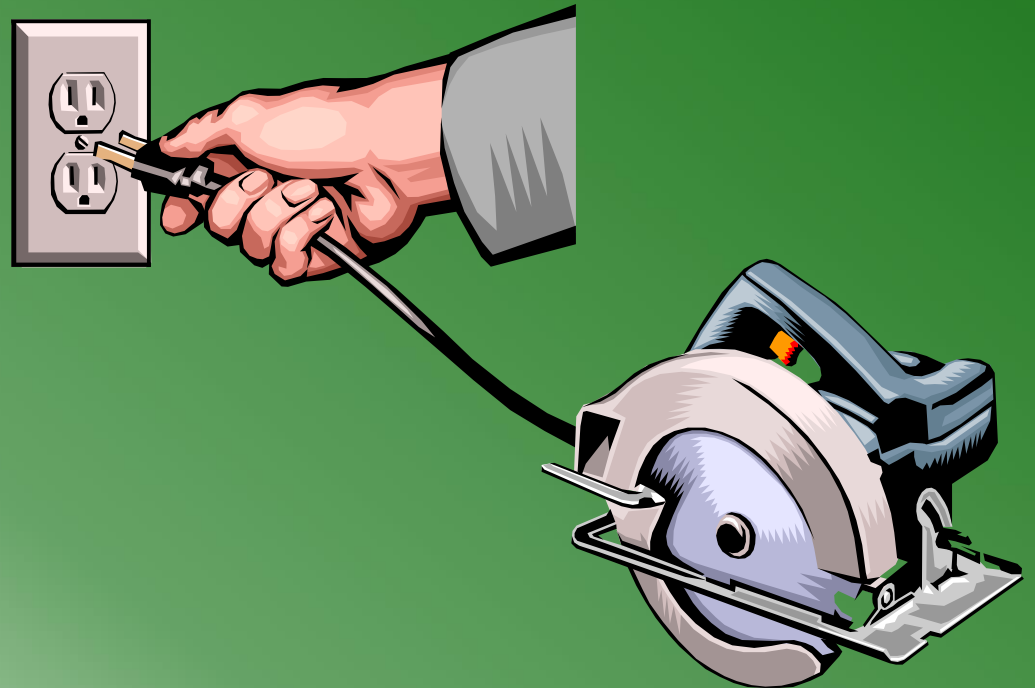
1910.304(a)(2) Reverse Polarity



1910.304(a)(2)
NEC Article 200-11

1910. 304(b) Branch circuits

1. Reserved
2. Outlet devices. Outlet devices shall have an ampere rating not less than the load to be served



1910. 304 (d)(1) Disconnecting means

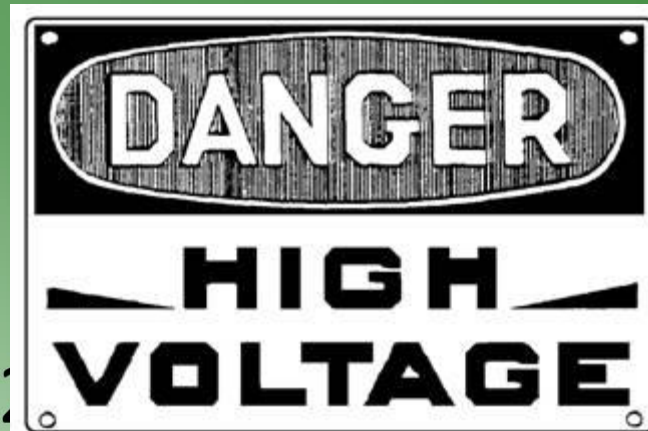
- General. Means provided to disconnect all conductors in a building from the service-entrance conductors.
- The disconnecting means shall plainly indicate whether it is in the open or closed position
- Installed at a readily accessible location



1000kV

1910. 304 (d)(2) Services over 600 volts, nominal

- (i) Guarded to make them accessible only to qualified persons
- (ii) Signs warning of high voltage shall be posted where other than qualified employees might come in contact with live parts



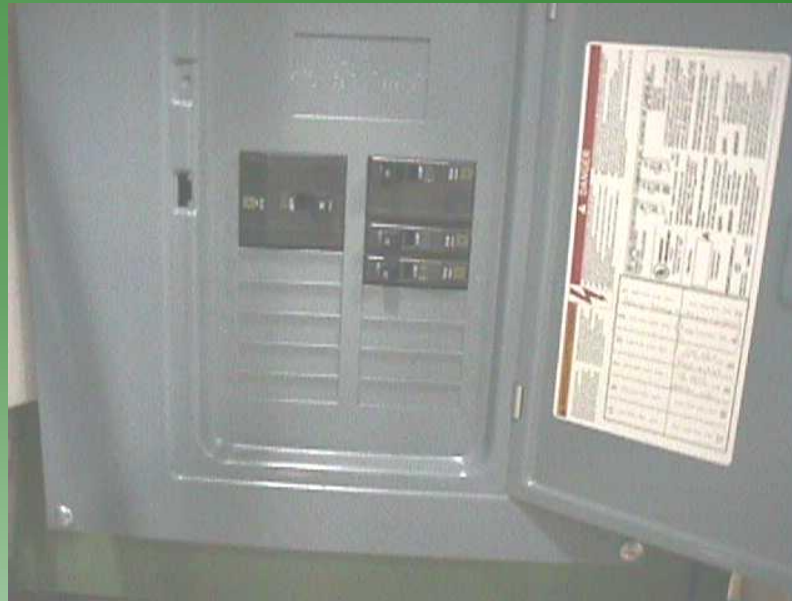
V

1910. 304 (e) Overcurrent protection

- **(1) 600 volts or less:**
- (iv) Overcurrent devices readily accessible to each employee
- May not be located where they will be exposed to physical damage nor in the vicinity of easily ignitable material
- (v) Fuses and circuit breakers located or shielded that employees will not be burned or otherwise injured by their operation

1910. 304 (e)(1)(vi) Circuit breakers

- Circuit breakers shall clearly indicate whether they are in the open (off) or closed (on) position



1000kV

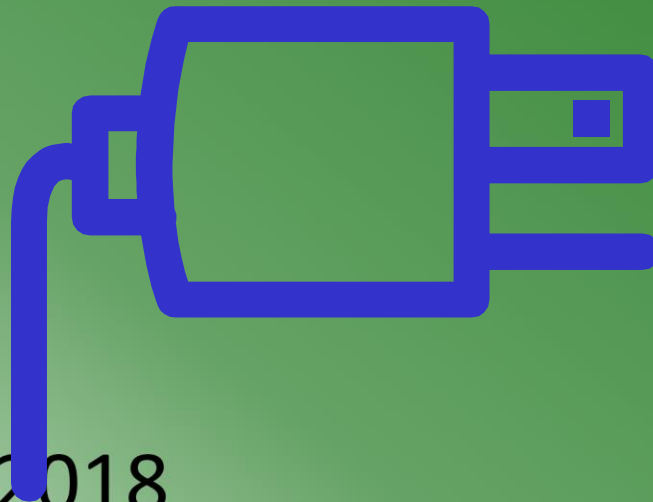
1910. 304 (f) Grounding

- (2) For AC premises wiring systems the identified conductor shall be grounded
- (4) The path to ground from circuits, equipment, and enclosures shall be permanent and continuous



Grounding

- Required to protect employees against:
 - Shock
 - Safeguard against fire
 - Protect equipment from damage



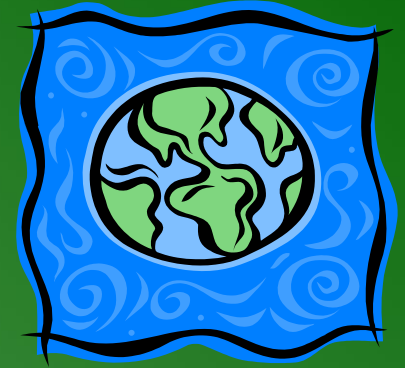
Grounding

- There are two kinds of grounding:
 - 1. Electrical circuit or system grounding
 - 2. Electrical equipment grounding



Electrical System Grounding

- One conductor of the circuit is intentionally grounded to earth
- Protects circuit from lightning, or other high voltage contact
- Stabilizes the voltage in the system so “expected voltage levels” are not exceeded under normal conditions



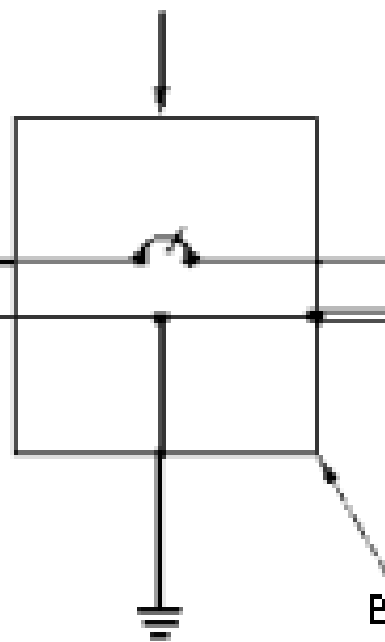
Equipment Grounding

- All metal frames & enclosures of equipment are grounded by a permanent connection or bond

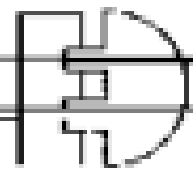


- The equipment grounding conductor provides a path for dangerous fault current to return to the system ground at the supply source should a

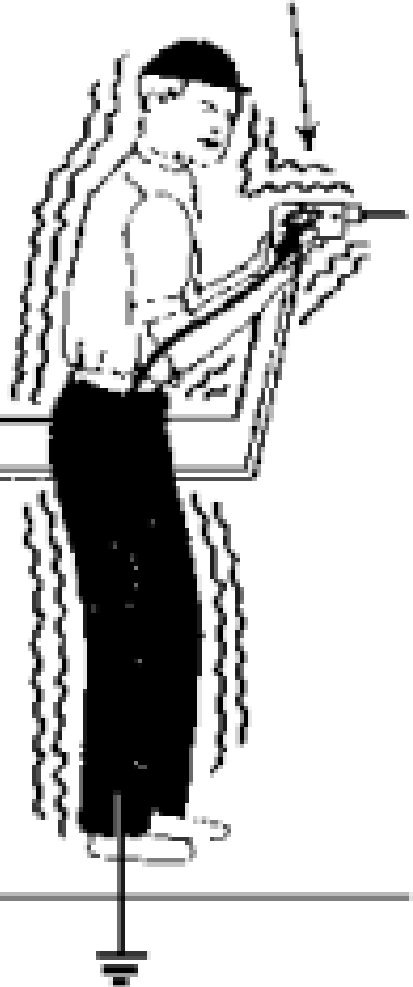
Source of Supply
Service Entrance



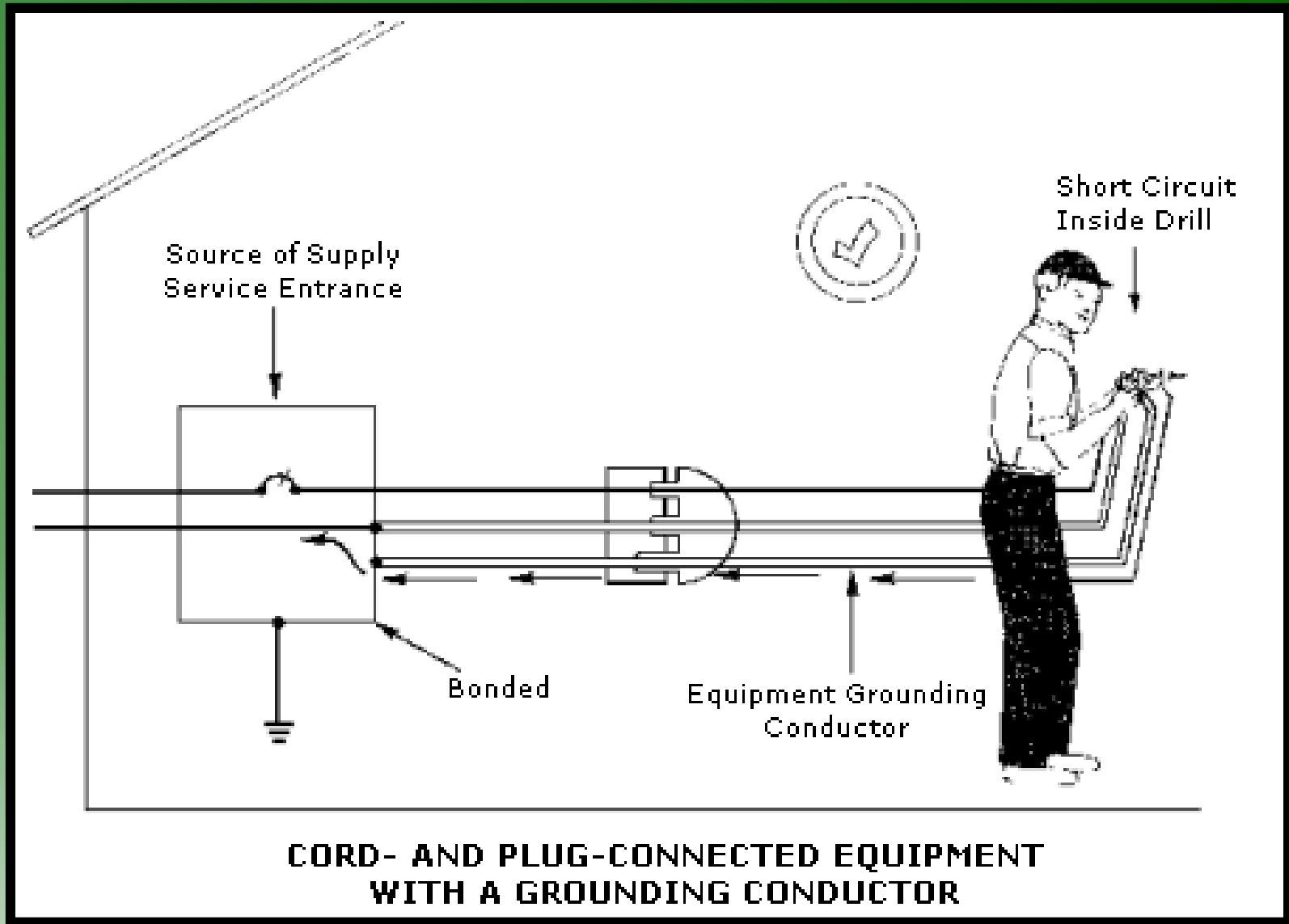
Bonded



A Short Circuit Inside
the Drill Will Energize
the Case



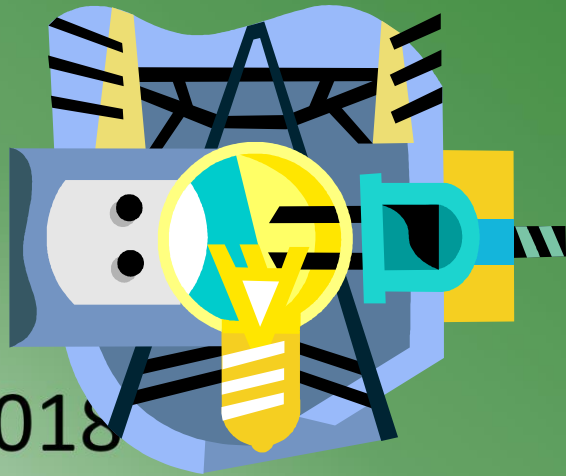
**CORD- AND PLUG-CONNECTED EQUIPMENT
WITHOUT A GROUNDING CONDUCTOR**



Note that properly bonded conduit and associated metal enclosures can also serve as a grounding conductor.

1910.305

Wiring methods, components,
and
equipment
for general use



1910.305(a)(1)(ii) Wiring in ducts

- No wiring systems of any type installed in ducts used to transport dust, loose stock or flammable vapors



1910.305(a)(2) Temporary wiring

- (iii)(F) Lamps for general illumination shall be protected from accidental contact or breakage
- Protection shall be provided by elevation of at least 7 feet from normal working surface or by a suitable fixture or lampholder with a guard



1910.305(a)(2) Temporary wiring

- (iii)(G) Flexible cords and cables shall be protected from accidental damage
- Sharp corners and projections shall be avoided.
- Where passing through doorways or other pinch points, flexible cords and cables shall be provided with protection to avoid damage



1910.305(a)(2)(iii)(G) Flexible Cords

- Where passing through doorways or other pinch points, flexible cords and cables shall be provided with protection to avoid damage



1910.305 (b) Conductors Entering Boxes, Cabinets or Fittings

- Conductors can be damaged if they rub against the sharp edges of cabinets, boxes, or fittings
- Where they enter they must be protected by some type of clamp or rubber grommet
- The device used must close the hole through which the conductor passes as well as provide



1910.305 (b) Conductors Entering Boxes, Cabinets or Fittings



- If the conductor is in a conduit and the conduit fits tightly in the opening, additional sealing is not required
- The knockouts in cabinets, boxes, and fittings should be removed only if conductors are to be run through them
- Open knockouts and other holes must be closed

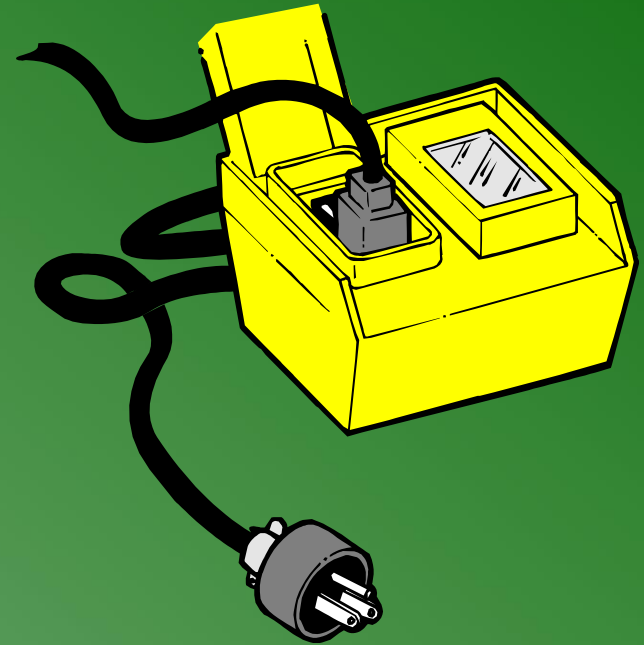
1910.305 (c) Conductors Entering Boxes, Cabinets or Fittings

- All pull boxes, junction boxes and fittings must be provided with approved covers
- If covers are metal they must be grounded.
- Each outlet box must have a cover, faceplate or fixture canopy



1910.305(e) Enclosures for damp or wet locations

- Cabinets, cutouts boxes, fittings, and panelboards weatherproof
- Switches, circuit breakers, and switchboards in weatherproof enclosures



1910.305 (g)(1) Use of Flexible Cords & Cables

- Flexible cords and shall be approved and suitable for conditions of use and location*



* The OSHA electric standard (1910.305) lists specific situations in which flexible cords may be used

Standard Interpretations

09/09/1997 - Clarification of the Electrical Standard as it applies to flexible power cords on appliances

- Under paragraph 1910.303(a), electrical conductors and equipment are acceptable for use in the workplace only if approved
- An electrical appliance which is certified by a NRTL is considered to be approved by the Occupational Safety and Health Administration (OSHA) *as long as it is used in accordance with the condition(s) of NRTL certification*

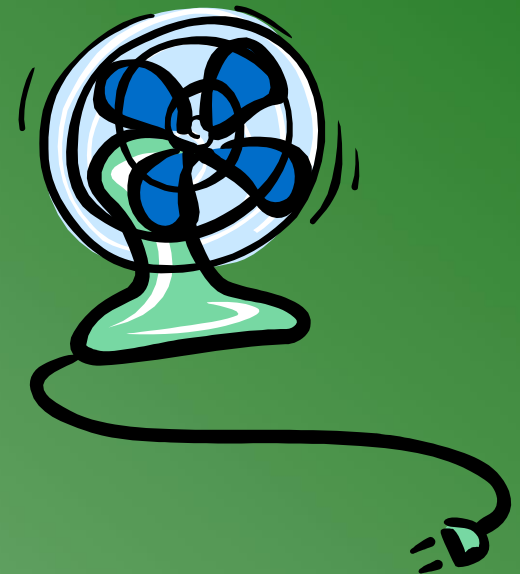
Standard Interpretations

09/09/1997 - Clarification of the Electrical Standard as it applies to flexible power cords on appliances

- **Can I put a longer cord on a portable fan?**
- Replacing the existing cord (with a longer cord, perhaps 15-25 feet long) *is a violation of the NRTL certification of the appliance*

Flexible cords and cables may not be used as a substitute for the fixed wiring of a structure

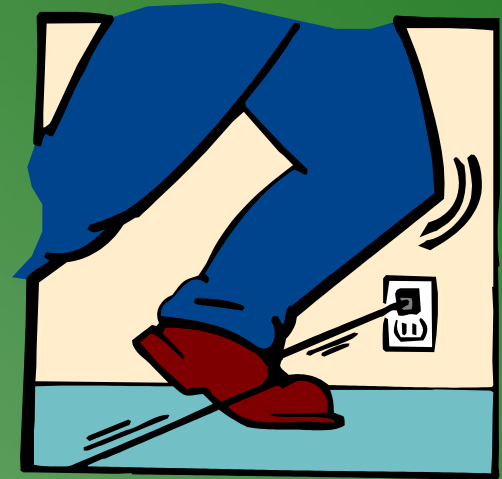
A new receptacle, readily accessible to the fan, must be provided



Standard Interpretations

09/09/1997 - Clarification of the Electrical Standard as it applies to flexible power cords on appliances

- Use of an appliance with flexible cord and cable as short as possible plugged into a nearby receptacle promotes workplace safety by reducing the likelihood of being a tripping hazard and being damaged



Standard Interpretations

09/09/1997 - Clarification of the Electrical Standard as it applies to flexible power cords on appliances

- Can electrical tape be used to cover minor nicks and abrasions in the outer jacket of a flexible cord? Under what circumstances, if any, may "electrical tape" be used to repair the outer cover of a flexible cord?
- Nicks and abrasions which do not penetrate completely through the outer jacket of a flexible cord are not considered a safety concern for which corrective action, that is, repair or replacement of the flexible cord, would be

Standard Interpretations

09/09/1997 - Clarification of the Electrical Standard as it applies to flexible power cords on appliances

- Repair or replacement of the flexible cord is required when the outer jacket is penetrated or the conductors or their insulation, inside are damaged.
- Flexible cord not less than No. 12 American Wire Gauge (AWG) may be repaired by splicing the conductors with a suitable vulcanized or molded

1910.305 (g)(1) Use of Flexible Cords & Cables

- (i) Flexible cords and cables shall be used only for:
 - (A) Pendants (a lampholder or cord-connector body suspended by a length of cord properly secured and terminated directly above the suspended device);
 - (B) Wiring of fixtures;



1910.305 (g)(1) Use of Flexible Cords & Cables

- (C) Connection of portable lamps or appliances;
- (D) Elevator cables;
- (E) Wiring of cranes and hoists;



1910.305 (g)(1) Use of Flexible Cords & Cables

- (F) Connection of stationary equipment to facilitate their frequent interchange (equipment which is not normally moved, but might be on occasion);
- (G) Prevention of the transmission of noise or vibration (In such cases vibration might fatigue fixed wiring and result in a fire or explosion situation);



1910.305 (g)(1) Use of Flexible Cords & Cables



- (H) Appliances where the fastening means and mechanical connections are designed to permit removal for maintenance (e.g. water coolers, exhaust fans);

• Data processing cables

1910.305 (g)(1)(iii) Prohibited uses of flexible cords

- Except for the previously listed exemptions, flexible cords ***may not be used for***:
 - (A) As a substitute for fixed wiring of the structure;
 - (B) Where run through holes in walls, ceilings, or floors;



Identification, Splices and Terminations

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



1910.305 (g)(2)(ii)

- Flexible cords shall be used only in continuous lengths without splice or tap.
- Hard service flexible cords No. 12 or larger may be repaired if spliced so that the splice retains the insulation, outer sheath properties, and usage characteristics of the cord being spliced.

Note: The National Electric Code allows

 ExperiDoc[®] ©2018 splice in 14 gauge or greater wire

Standard Interpretations

06/17/1992 - Acceptable job-made extension cords

- We have prepared the following analysis, which indicates that shop-made extension cords and other temporary wiring is acceptable in certain circumstances.
- It is not required in all circumstances that an extension cord be approved as an assembly.

Standard Interpretations

06/17/1992 - Acceptable job-made extension cords

- Normally, electrical equipment must be approved as an assembly by a nationally recognized testing laboratory to be acceptable under the General Industry or Construction Electrical Standards (Part 1910, Subpart S and Part 1926, Subpart K, respectively).
- However, it is also true that cord sets, assembled in the field by qualified persons, are appropriately used in both general industry and in the construction industry, under limited circumstances. Such cord sets are considered to be temporary wiring extensions of

Standard Interpretations

06/17/1992 - Acceptable job-made extension cords

- When the temporary wiring consists of shop-made cord sets, etc., using approved parts, as permitted by 1910.305(a)(2) and 1926.405(a)(2) the requirements for listing by a nationally recognized testing laboratory do not apply.
- The practice of assembling electrical extension cords is considered to be in compliance with OSHA standards provided the assembled cord sets are assembled in a manner equivalent to those that are factory-assembled and approved. Criteria for determining whether shop-made cord sets meet existing electrical standards include:

Standard Interpretations

06/17/1992 - Acceptable job-made extension cords

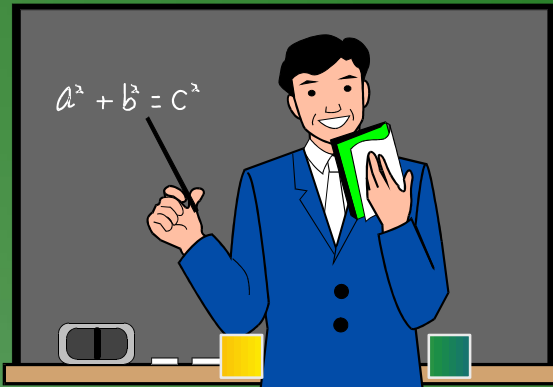
- All components must be approved for the purpose by a nationally recognized testing laboratory (1910.303(a)) and (1926.403(a)). Individual components must be compatible for use with the other components of the completed assembly.
- The cord set must be assembled by a qualified person.

Standard Interpretations

06/17/1992 - Acceptable job-made extension cords

- The wiring of the completed assembly must be inspected by a qualified person before the cord set is used initially.
- For example, the following checks and tests, or equivalent, should be performed:
 - (a) Determine that all equipment grounding conductors are electrically continuous.
 - (b) Test all equipment grounding conductors for electrical continuity.
 - (c) Determine that each equipment grounding conductor is connected to its proper terminal.
 - (d) Test each receptacle and attachment plug to ensure correct attachment of the equipment grounding conductor.

Skills Development



Training

Interlude

General Requirements 1910.303

- Suitability of equipment may be evidenced by listing or labeling
- Safety of equipment may be determined by:
 - Mechanical strength
 - Electrical insulation
 - Heating or arcing effects
 - Classification by type, size,



General Requirements 1910.303

- Electrical equipment may not be used unless it is suitably marked



General Requirements 1910.303

- Each disconnecting means legibly marked to indicate its purpose
- Switches and circuit breakers legibly marked
- Guarding of live parts >50 V by:
 - Approved cabinets
 - Room, vault, partitions or location
 - Elevations greater than eight feet

General Requirements 1910.303

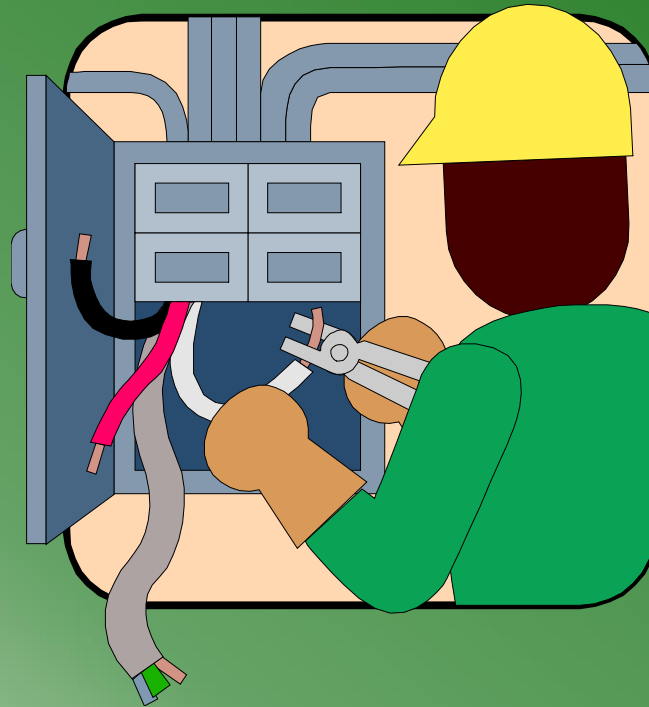
- Illumination provided for all working spaces



- Minimum headroom of 6 feet, three

Identification Conductors 1910.304

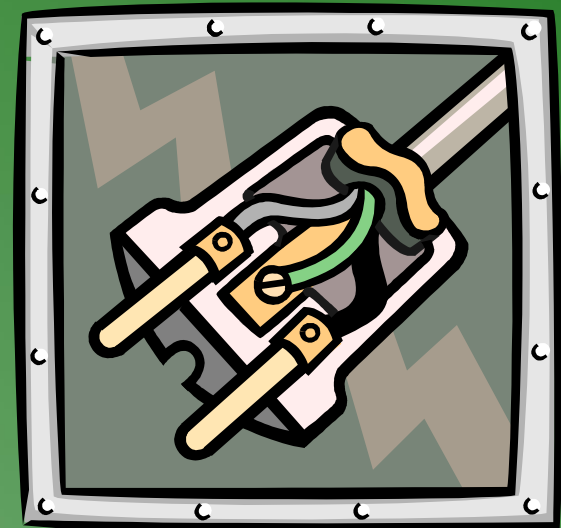
- Grounded and grounding conductor marked or color coded



- Employees can identify and tell apart

Identification Conductors 1910.304

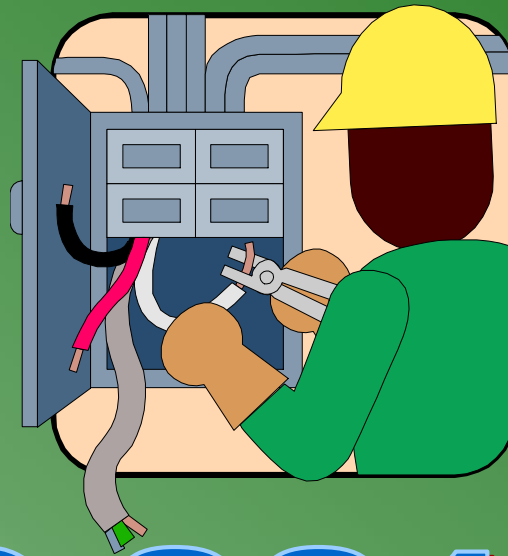
- Grounded conductor is an energized conductor
- Grounding conductor acts as a safeguard:
 - Not normally energized
 - Energized for fault or leak in current path
 - Enables fuses or circuit breakers to operate
- Conductor colors:
 - Black or bare
 - Green or green with yellow
 - White or gray



1910.305 (g) Flexible cords

- Flexible cords and cables shall be approved and suitable for conditions of use and location
- Flexible cords and cables shall be used only for:
 - Pendants;
 - Wiring of fixtures;
 - Connection of portable lamps or appliances;
 - Elevator cables;
 - Wiring of cranes and hoists;
 - Connection of stationary equipment to facilitate their frequent interchange;
 - Prevention of the transmission of noise or vibration;

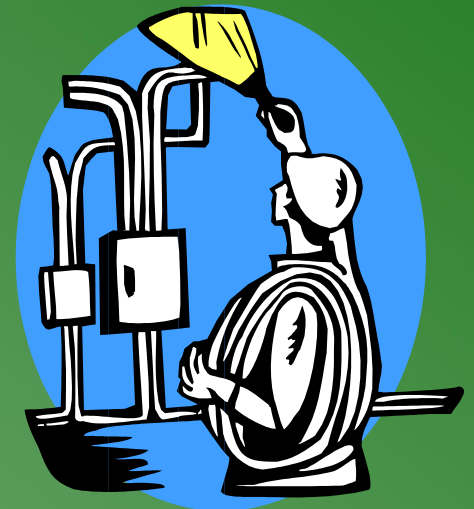
Safety-Related Work Practices



1910.331-335

1910.331 Scope

- Covers:
 - Qualified persons (those who have training in avoiding the electrical hazards)
 - Unqualified persons (those with little or no such training)
- Working on or near the following:
 - Premises wiring
 - Wiring for connection to supply
 - Other wiring



1910.332 Training

- Scope:
 - Applies to employees who face a risk of electric shock that is not reduced to a safe level by the electrical installation requirements of 1910.303 through 1910.308
 - Employees trained in and familiar with the safety-related work practices that pertain to their jobs

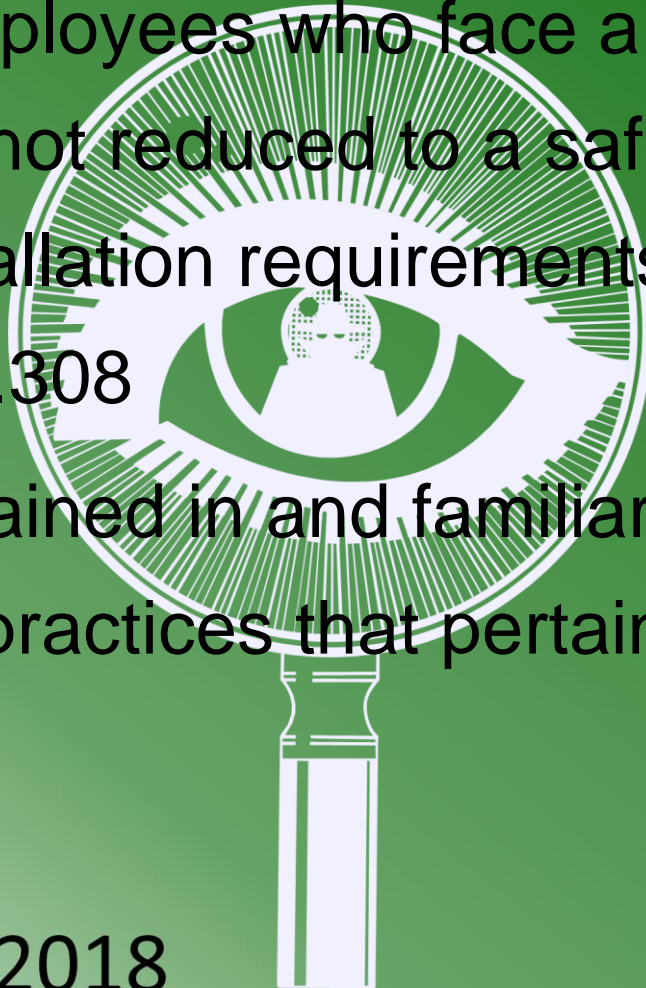


TABLE S-4. -- Typical Occupational Categories of Employees Facing a Higher Than Normal Risk of Electrical Accident

Occupation

- Blue collar supervisors(1)
- Electrical and electronic engineers(1)
- Electrical and electronic equipment assemblers(1)
- Electrical and electronic technicians(1)
- Electricians
- Industrial machine operators(1)
- Material handling equipment operators(1)
- Mechanics and repairers(1)
- Painters(1)
- Riggers and roustabouts(1)
- Stationary engineers(1)
- Welders



Footnote to Table S-4

- (1) Workers in these groups do not need to be trained if their work or the work of those they supervise does not bring them or their employees close enough to exposed parts of electric circuits operating at 50 volts or more to ground for a hazard to exist.



1910.332 Training

- (b)(3) Qualified persons: (i.e. those permitted to work on or near exposed energized parts) shall, at a minimum, be trained in and familiar with the following:
 - (i) The skills and techniques necessary to **distinguish exposed live parts** from other parts of electric equipment
 - (ii) The skills and techniques necessary to **determine the nominal voltage** of exposed live parts
 - (iii) The **clearance distances** specified in

1910.333 (a)(1) Deenergized parts

- Live parts to which an employee may be exposed shall be deenergized before the employee works on or near them:
 - Unless the employer can demonstrate that deenergizing introduces additional or increased hazards or is infeasible
 - Live parts that operate at less than 50 volts to ground need not be deenergized if there will be no increased exposure to electrical burns or to explosion due to electric arcs



1910.333 (a)(1) Deenergized parts

- Examples of increased or additional hazards include:
 - Interruption of life support equipment,
 - Deactivation of emergency alarm systems,
 - Shutdown of hazardous location ventilation equipment, or;
 - Removal of illumination for an area.

1910.333(b) Working on or near exposed deenergized parts

- (1) Conductors and parts of electric equipment that have been deenergized but have not been locked out or tagged in accordance with paragraph (b) of this section shall be treated as energized parts



1910.333(b) Working on or near exposed deenergized parts

- (2) While any employee is exposed to contact with parts of fixed electric equipment or circuits which have been deenergized, the circuits energizing the parts shall be locked out or tagged or both*



1910.333(b) Working on or near exposed deenergized parts - Note 2

- *Lockout and tagging procedures that comply with paragraphs (c) through (f) of 1910.147 will also be deemed to comply with paragraph (b)(2) of this section provided that:
 - [1] The procedures address the electrical safety hazards covered by this Subpart; and
 - [2] The procedures also incorporate the requirements of paragraphs (b)(2)(iii)(D) and (b)(2)(iv)(B) of this section (tags w/out locks &

1910.333 (c)(2) Work on energized equipment

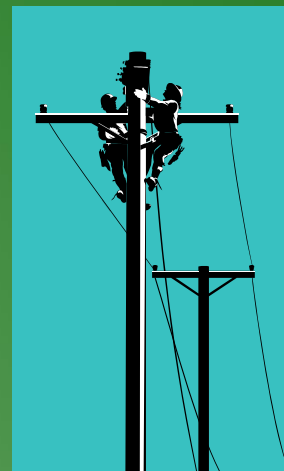
- Work on energized equipment:
 - Only qualified persons may work on electric circuit parts



- Overhead lines:
 - If work is to be performed near overhead lines, the lines shall be deenergized and grounded, or other protective measures shall be provided before work

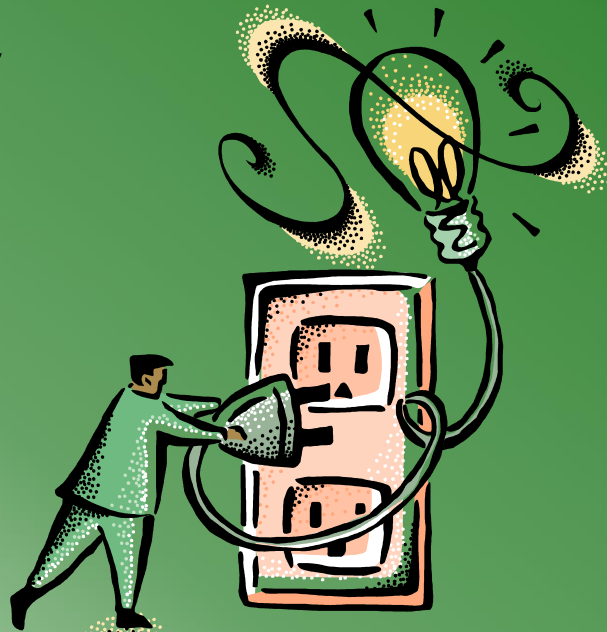
1910.333 (c)(3)(i) Selection and use of work practices

- Unqualified person working near overhead lines, the person and the longest conductive object they may contact cannot come closer to any energized overhead line than the following distances:
 - For voltages to ground 50kV or below - 10 feet
 - For voltages to ground over 50kV - 10 feet plus 4 inches for every 10kV over 50kV

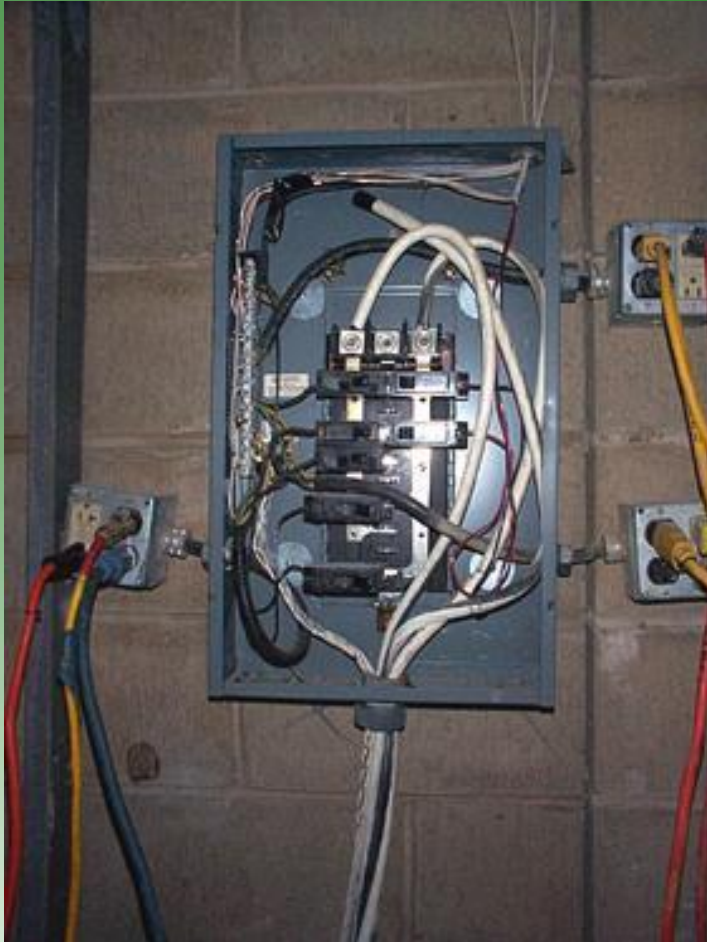


1910.333(c)(4) Illumination

- Employees may not enter spaces containing exposed energized parts, unless illumination is provided that enables the employees to perform the work safely



1910.333(c)(4) Illumination



- Employees may not reach blindly into areas which may contain energized parts.

1910.333(c)(5) Confined spaces

- When an employee works in a confined or enclosed space (such as a manhole or vault) that contains exposed energized parts, the employer shall provide, and the employee shall use:

- Protective shields,
- Protective barriers, or;
- Insulating materials as necessary to avoid

inadvertent contact with these parts



1910.333(c)(7) Portable ladders

- Portable ladders shall have nonconductive siderails if they are used where the employee or the ladder could contact exposed energized parts



1910.333(c)(8) Conductive apparel

- Conductive articles of jewelry and clothing (such as watch bands, bracelets, rings, key chains, necklaces, etc...) may not be worn if they might contact exposed energized parts



1910.333(c)(10) Interlocks

- Only a qualified person following the requirements of paragraph (c) of this section may defeat an electrical safety interlock,
- and then only temporarily while he or she is working on the equipment



1910.334 Use of equipment

- Portable equipment shall be handled in a manner which will not cause damage
- Flexible electric cords connected to equipment may not be used for raising or lowering the equipment
- Flexible cords may not be fastened with staples or otherwise hung in such a fashion as could damage the outer



1910.334 (a)(2)(i) Use of equipment

- Portable cord and plug connected equipment and flexible cord sets (extension cords) *visually inspected before use for external defects* (such as loose parts, or damage to outer jacket or insulation) and for evidence of possible internal damage (pinched or crushed outer jacket)
- Extension cords which remain connected once they are put in place and are not exposed to damage need not be visually inspected until they are relocated

1910.334 Use of equipment

- A flexible cord used with grounding type equipment shall contain an equipment grounding conductor
- Attachment plugs and receptacles may not be connected or altered in a manner which would prevent proper continuity of the equipment grounding conductor at the point where plugs are attached to receptacles



1910.334 Use of equipment

- (a)(4) Portable electric equipment and flexible cords used in highly conductive work locations, or in job locations where employees are likely to contact water or conductive liquids, shall be approved for those locations

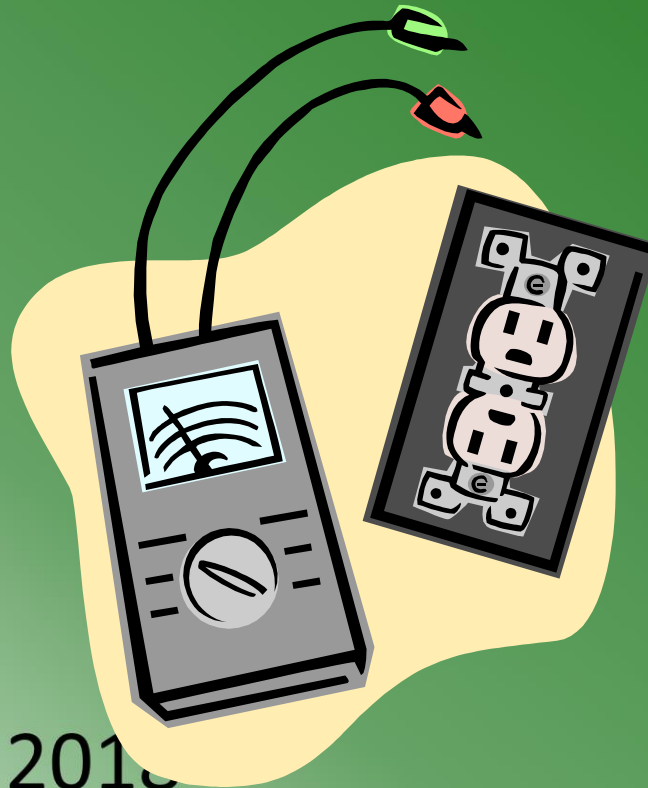


1910.334 Use of equipment

- (a)(5)(i) Employees' hands may not be wet when plugging and unplugging flexible cords and cord and plug connected equipment, if energized equipment is involved

1910.335 (c)(1) Use

- Only qualified persons may perform testing work on electric circuits or equipment



1910.335 Safeguards for personnel protection

- (a)(1) Employees working in areas where there are potential electrical hazards shall be provided with, and shall use, electrical protective equipment that is appropriate for the specific parts of the body to be protected and for the work to be performed



1910.335 Safeguards for personnel protection

- Protective equipment shall be maintained in a safe, reliable condition and shall be periodically inspected or tested, as required by 1910.137 *



1910.335 Safeguards for personnel protection

- Employees shall wear nonconductive head protection wherever there is a danger of head injury from electric shock or burns due to contact with exposed energized parts



1910.335 Safeguards for personnel protection

- Employees shall wear protective equipment for the eyes or face wherever there is danger of injury to the eyes or face from electric arcs or flashes or from flying objects resulting from electrical



1910.335 Safeguards for personnel protection

- When working near exposed energized conductors or circuit parts, each employee shall use insulated tools or handling equipment if the tools or handling equipment might make contact with such conductors or parts



1910.335 Safeguards for personnel protection

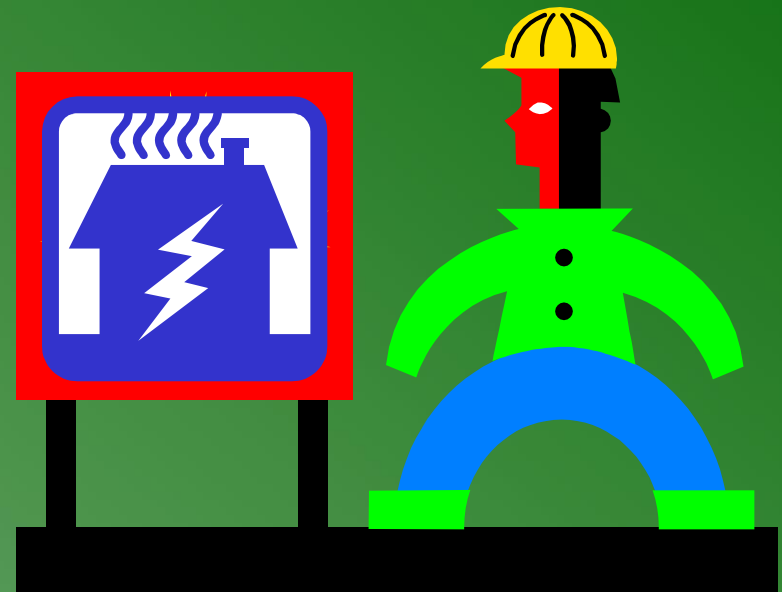
- The following alerting techniques shall be used to warn and protect employees from hazards which could cause injury due to electric shock, burns, or failure of electric equipment parts:
 - Safety signs and tags
 - Barricades
 - Attendants



CAUTION

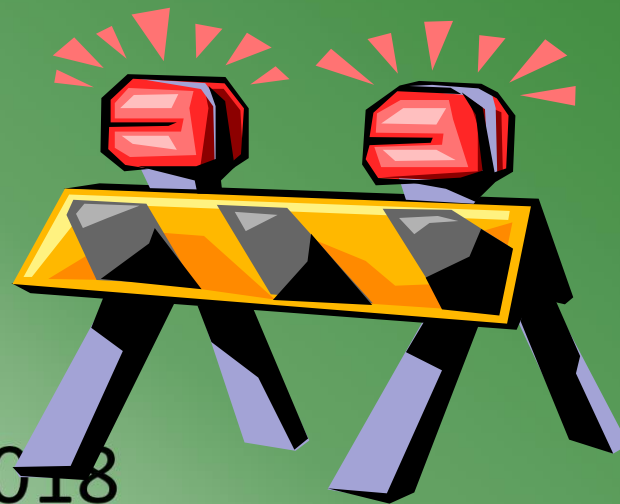
1910.335 Safeguards for personnel protection

- Safety signs, safety symbols, or accident prevention tags shall be used where necessary to warn employees about electrical hazards which may endanger them, as



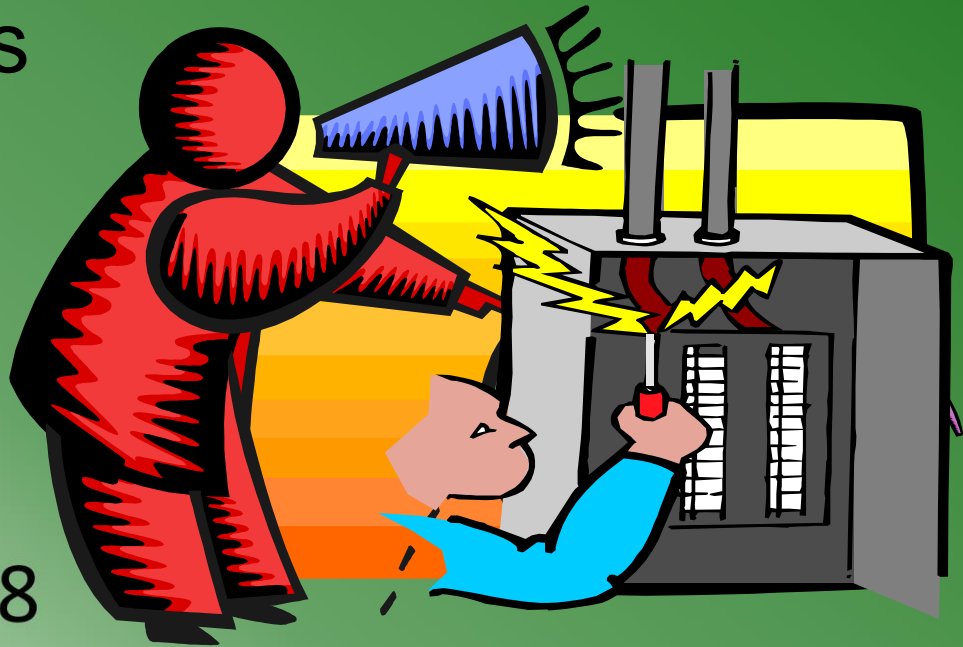
1910.335 Safeguards for personnel protection

- Barricades shall be used in conjunction with safety signs where it is necessary to prevent or limit employee access to work areas exposing employees to uninsulated energized conductors or circuit parts

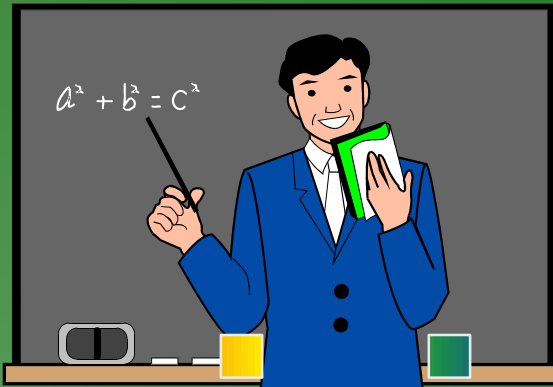


1910.335 Safeguards for personnel protection

- If signs and barricades do not provide sufficient warning and protection from electrical hazards, an attendant shall be stationed to warn and protect employees



Skills Development



Training

Interlude

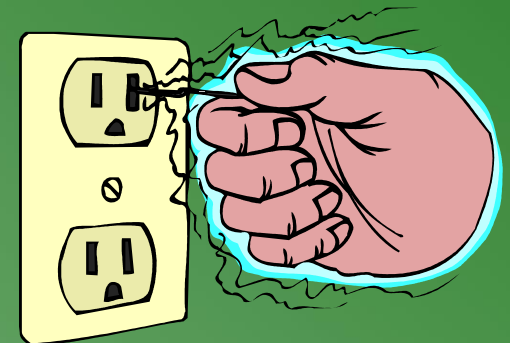
Safety Related Work Practices

1910.331-335

- Covers:
 - Qualified persons (those who have training in avoiding the electrical hazards)



- Unqualified persons (those with little or no such training)

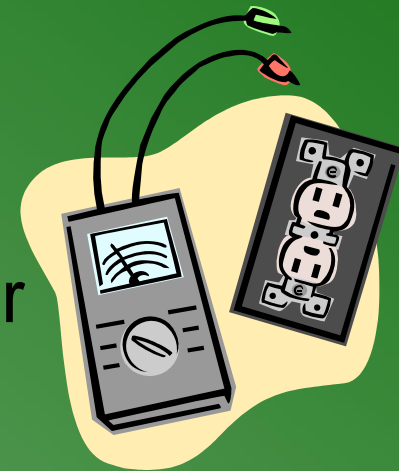


Safety Related Work Practices

1910.331-335

- Qualified persons: (i.e. those permitted to work on or near exposed energized parts) shall, at a minimum, be trained in and familiar with the following:

- The skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment

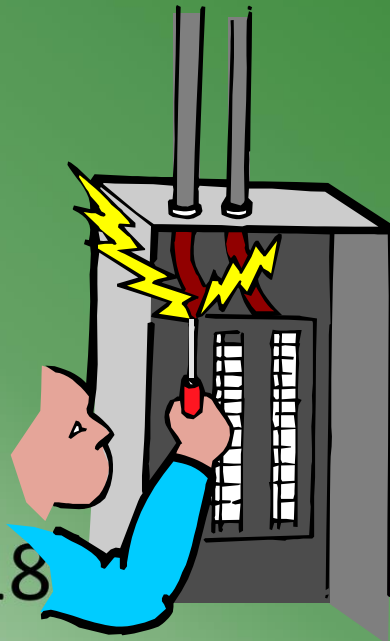


- The skills and techniques necessary to determine

Safety Related Work Practices

1910.331-335

- The training requirements contained in this section apply to employees who face a risk of electric shock that is not reduced to a safe level by the electrical installation requirements of 1910.303 through 1910.308



Safety Related Work Practices

1910.331-335

- Employees shall be trained in and familiar with the safety-related work practices required by 1910.331 through 1910.335 that pertain to their respective job assignments; examples include:
 - Blue collar supervisors(1)
 - Electrical and electronic engineers(1)
 - Electrical and electronic equipment assemblers(1)
 - Electrical and electronic technicians(1)
 - Electricians
 - Industrial machine operators(1)

Safety Related Work Practices

1910.331-335

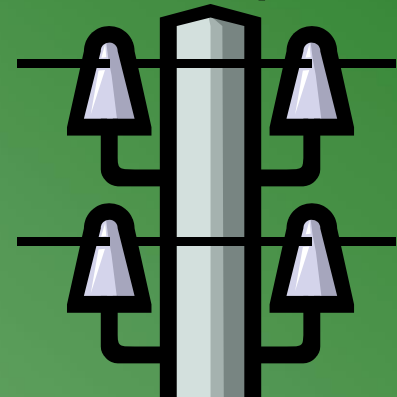
- While any employee is exposed to contact with parts of fixed electric equipment or circuits which have been deenergized, the circuits energizing the parts shall be locked out or tagged or both*



Safety Related Work Practices

1910.331-335

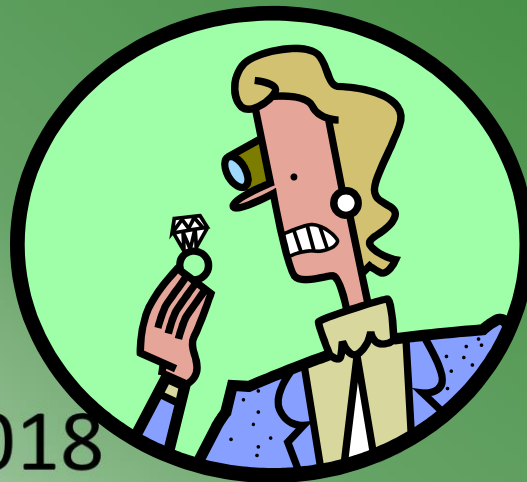
- Unqualified person working near overhead lines, the person and the longest conductive object they may contact cannot come closer to any energized overhead line than the following distances:
 - For voltages to ground 50kV or below - 10 feet
 - For voltages to ground over 50kV - 10 feet plus 4 inches for every 10kV over 50kV



Safety Related Work Practices

1910.331-335

- Conductive articles of jewelry and clothing (such a watch bands, bracelets, rings, key chains, necklaces, etc...) may not be worn if they might contact exposed energized parts



Safety Related Work Practices

1910.331-335

- Portable electric equipment and flexible cords used in highly conductive work locations, or in job locations where employees are likely to contact water or conductive liquids, shall be approved for those



Work
Shouldn't be...



Shocking!