

**STANDARD PRACTICE INSTRUCTION**

**DATE IMPLEMENTED:** 04 April 2019

**SUBJECT:** Safe Electrical Work Practices

**REGULATORY STANDARD:** OSHA - 29 CFR 1910.331 – 335 & 269  
- 29 CFR 1926 Subparts K & V  
- NFPA 70(E)

**BASIS:** The National Safety Council estimates that there are at least 300 deaths annually from on-the-job electrocutions in the United States. Most of these are preventable.

**GENERAL:** Nowland Associates, Inc. will ensure that work practices performed on or in proximity to electrical equipment/energy sources are evaluated to determine if proper safety precautions are instituted. The Occupational Safety and Health Administration (OSHA), recommends that certain guidelines be adhered to regarding these hazards. This standard practice instruction is intended to address comprehensively the issues of; evaluating and identifying potential energy sources where work is performed, evaluating the associated potential hazards, communicating information concerning these hazards, and establishing appropriate procedures, and protective measures for our employees.

**RESPONSIBILITY:** The company Safety Officer is solely responsible for all facets of this program and has full authority to make necessary decisions to ensure success of the program. The Safety Officer will develop written detailed instructions covering each of the basic elements in this program, and is the sole person authorized to amend these instructions. This company has expressly authorized the Safety Officer to halt any operation of the company where there is danger of serious personal injury.

## **Contents of the Electrical Safety Program**

1. **Written Program.**
2. **Facility/Department Evaluation.**
3. **General.**
4. **Training.**
5. **Selection and Use of Work Practices.**
6. **Use of Equipment.**
7. **Safeguards for Personnel Protection.**
8. **Definitions.**

## Nowland Associates, Inc. Electrical Safety Program

**1. Written Program.** Nowland Associates, Inc. will review and evaluate this standard practice instruction on an annual basis, or when changes occur to 29 CFR, or NFPA that prompt revision of this document, or when company operational changes occur that require a revision of this document. Effective implementation of this program requires support from all levels of management within this company. This written program will be communicated to all personnel that are affected by it. It encompasses the total workplace, regardless of number of workers employed or the number of work shifts. It is designed to establish clear goals, and objectives.

**2. Facility/Department Evaluation.** This employer shall evaluate work areas to determine where high-risk from electrical hazards exist. Jobs/areas that present such risks will meet the criteria for designation as an electrical hazard area. When working at host facilities, their designations, labeling and policies will be adhered to. Job briefings may be necessary to coordinate activities and hazards. Details of job briefings will be discussed prior to work on live equipment. This company will advise the host employer of unique hazards in the workplace presented by the contractor's work, unanticipated hazards, and any measures taken to correct hazards reported to them by the host employer.

2.1 Employee notification. This employer shall inform exposed employees, by posting danger signs, conducting awareness training, or by any other equally effective means, of the existence and location of and the danger posed by electrical hazard areas. A sign reading "DANGER ELECTRICAL HAZARD, AUTHORIZED PERSONNEL ONLY" or similar language in accordance with 29 CFR 1910.145 will be used to satisfy the requirement for untrained employee/visitor notification. (See Section 5 for NFPA 70(E) labeling)

2.2 High risk electrical hazard jobs.

### High Risk Electrical Hazard Jobs Listing

#### Job Activity

1. Analyzing electrical issues, troubleshooting
2. Installing MCC, breakers, etc.

2.3 Alerting techniques. 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:

2.3.1 Safety signs and tags. Safety signs, safety symbols, or accident prevention tags shall be used where necessary to warn employees about electrical hazards which may endanger them, as required by 29 CFR 1910.145.

2.3.2 Barricades. 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 un-insulated energized conductors or circuit parts. Conductive barricades may not be used where they might cause an electrical contact hazard. The authorized person shall be responsible for removing from the work area any temporary personnel protective equipment and reinstalling all permanent barriers or covers.

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

**3. General.** This standard practice instruction will cover work by both qualified and unqualified persons. The provisions of 29 CFR 1910 Subpart S, 1910.269, 29 CFR 1926 Subpart K and NFPA 70(E) will be detailed to cover electrical safety-related work practices for both qualified persons (those who have training in avoiding the electrical hazards of working on or near exposed energized parts) and unqualified persons (those with little or no such training) working on, near, or with the following installations:

3.1 Premises wiring. Installations of electric conductors and equipment within or on buildings or other structures, and on other premises such as yards, carnival, parking, and other lots, and industrial substations.

3.2 Wiring for connection to supply. Installations of conductors that connect to the supply of electricity.

3.3 Other wiring. Installations of other outside conductors on the premises, including overhead power lines.

3.4 Optical fiber cable. Installations of optical fiber cable where such installations are made along with electric conductors.

3.5 General electrical safety work practices by Nowland Associates, Inc. employees.

#### **4. Training.**

4.1 Employees to be trained once an evaluation of jobs and other work areas is performed. Training will be conducted for employees who face a risk of electric shock that is not reduced to a safe level by the existing source.

4.2 High risk occupations. Employees in occupations listed in Table S-4 (29 CFR 1910.332) face such a risk and are required to be trained. Other employees who also may reasonably be expected to face a comparable risk of injury due to electric shock or other electrical hazards must also be trained. These employees will be identified based upon their job title and or area(s) of the facility they are exposed to. The work area evaluation data referenced in section 2 of this SPI will be used to develop a personnel training listing by job and hazard area(s) exposure.

**Table S-4 (29 CFR 1910.332)**  
**Typical Occupational Categories of Employees**  
**Facing a Higher Than Normal Risk of Electrical Accident**

OCCUPATION

First line supervisors.  
Electrical and electronic engineers.  
Electrical and electronic equipment assemblers.  
Electrical and electronic technicians.  
Electricians.  
Industrial machine operators.  
Material handling equipment operators.  
Mechanics and repairers.  
Painters.  
Riggers and roustabouts.  
Stationary engineers.  
Welders.

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

4.3 Content of training.

4.3.1 General electrical safety policy. The Safety Officer will develop a company-wide electrical policy that details this company's' general electrical safety policy.

4.3.2 Employee job specific training (unqualified). Employees who are classified as "unqualified" (i.e., those not permitted to work on or near exposed energized parts) persons shall also be trained in and familiar with any electrically related safety practices inherent to their jobs which are necessary for their safety. First line supervisors in coordination with the Safety Officer, will develop a training outline detailing the electrical hazards associated with a work area or job when an initial evaluation reveals a risk of electrocution.

4.3.3 Employee job specific training (qualified). Employees who are classified as "qualified" (i.e., those permitted to work on or near exposed energized parts) persons shall be trained in and familiar with the safety-related work practices that pertain to their respective job assignments. First line supervisors in coordination with the Safety Officer, will develop a training outline detailing the electrical hazards associated with a work area or job when an initial evaluation reveals a risk of electrocution. 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:

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

4.3.3.2 The skills and techniques necessary to determine the nominal voltage of exposed live parts, and

4.3.3.3 The clearance distances specified in 29 CFR 1910.333(c), and/or NFPA 70(E), and the corresponding voltages to which the qualified person will be exposed. (Specific Approach Boundaries)

NOTE 1: For the purposes of this SPI, Employee's must have the training required by the definition of a "qualified person" detailed above in order to be considered a qualified person.

NOTE 2: Qualified persons whose work on energized equipment involves either direct contact or contact by means of tools or materials must also have the training needed for safe exposure to energized part (see below).

4.4 Type of training. The training required by this SPI shall be of the classroom and/or on-the-job type. The degree of training provided shall be determined by the evaluated risk to the employee. The guidelines in NFPA 70(E) will be followed.

4.4.1 Initial training. This employer shall provide training to ensure that the electrical hazards associated with their job are understood by employees and that the knowledge and skills required for the safe application, usage, of work place equipment, and removal of the energy controls are acquired by employees. The training shall include the following:

4.4.1.1 Each authorized employee shall receive training in the recognition of applicable hazardous energy sources, the type and magnitude of the energy available in the workplace, and the methods and means necessary for energy isolation and control. Hazard Risk Categories will be explained.

4.4.1.2 Each affected employee shall be instructed in the purpose and use of energy control procedures.

4.4.1.3 All other employees whose work operations are or may be in an area where energy control procedures may be utilized, shall be instructed about the procedure, and about the prohibition relating to attempts to restart or reenergize machines or equipment which are locked out or tagged out.

#### 4.5 Refresher Training.

4.5.1 Retraining shall be provided for all authorized and affected employees whenever there is a change in their job assignments, a change in machines, equipment or processes that present a new hazard, when their work takes them into hazardous areas, or when there is a change in the energy control procedures.

4.5.2 Additional retraining shall also be conducted whenever a periodic inspection reveals, or whenever this employer has reason to believe, that there are deviations from or inadequacies in the employee's knowledge of known hazards, or use of the energy control procedures.

4.5.3 The retraining shall reestablish employee proficiency and introduce new or revised control methods and procedures, as necessary.

4.5.4 Retraining for NFPA 70(E) standards will be conducted at least every 3 years.

4.6 Certification. This employer shall certify that employee training has been accomplished and is being kept up to date. The certification shall contain each employee's name and dates of training and be retained for the length of employment.

- 5. Selection and Use of Work Practices.** Supervisors shall develop and ensure use of standardized safety-related work practices to prevent electric shock or other injuries resulting from either direct or indirect electrical contacts. This will be accomplished whenever work is performed near or on equipment or circuits which are or may be energized. The specific safety-related work practices shall be consistent with the nature and extent of the associated electrical hazards, and will follow NFPA 70(E) guidelines and Hazard Risk Categorization. Nowland Associates, Inc. will ensure that all electrical equipment will be evaluated, identified and treated as energized initially. This is also the responsibility of the host company. The purpose is to identify the hazards, the types of PPE required to work on a particular electrical system, and the safe working distances therein. The data resulting from the evaluations is incorporated into labels which are affixed to all electrical equipment such as switchboards, panel boards, industrial

control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized. These labels are to be visible to qualified persons before examination, adjustment, servicing, or maintenance. Procedures for a hazard/risk evaluation will be reviewed prior to work being done within the Limited Approach Boundary.


 <b>WARNING</b>	
<b>Arc Flash and Shock Hazard</b>	
<b>Appropriate PPE Required</b>	
<b>104 inches</b>	Flash Hazard Boundary
<b>21 cal/cm<sup>2</sup></b>	Flash Hazard at <b>18 inches</b>
<b>Category 3</b>	Arc-rated FR Shirt & Pants & Arc Flash Suit
<b>208 VAC</b>	Shock Hazard when cover is removed
<b>00</b>	Glove Class
<b>42 inches</b>	Limited Approach
<b>Avoid Contact</b>	Restricted Approach
<b>Avoid Contact</b>	Prohibited Approach
<b>Location:</b>	<b>TS2</b>

Figure 1: Example of Equipment Label

<b>Explanation of Label Contents</b>	
<b><i>Label Text</i></b>	<b><i>Text Meaning</i></b>
"Warning or Danger"	Classification and corresponding orange or red background coloring per OSHA 29 CFR
" <i>Arc Flash and Shock Hazard</i> "	Standard warning on all labels
"Appropriate PPE Required"	Standard warning on all labels
"Flash Hazard Boundary"	in inches at bus as calculated
"Flash Hazard at 18 inches"	The incident energy in cal/cm <sup>2</sup> as calculated at the set working distance
"Arc-rated FR Shirt & Pants"	The hazard risk category based on the available incident energy from Category 0 up to Dangerous! Along with a brief description of the Corresponding PPE listed in NFPA 70E Article 130
"Shock Hazard when cover is removed"	Line to line available voltage of equipment
"Glove Class"	The ANSI/ASTM class of gloves corresponding to the maximum line to line voltage of the equipment
"Limited Approach"	The noted approach boundary to energized conductors or circuits parts as defined in NFPA 70E table 130.2 based upon the line to line voltage
"Restricted Approach"	The noted approach boundary to energized conductors or circuits parts as defined in NFPA 70E table 130.2 based upon the line to line voltage
"Prohibited Approach"	The noted approach boundary to energized conductors or circuits parts as defined in NFPA 70E table 130.2 based upon the line to line voltage
"Location:"	The corresponding point or bus on the system one line as entered into the software where the label information is applicable

To further understand the boundaries identified in the label, the following diagram (Figure 2) has been provided:



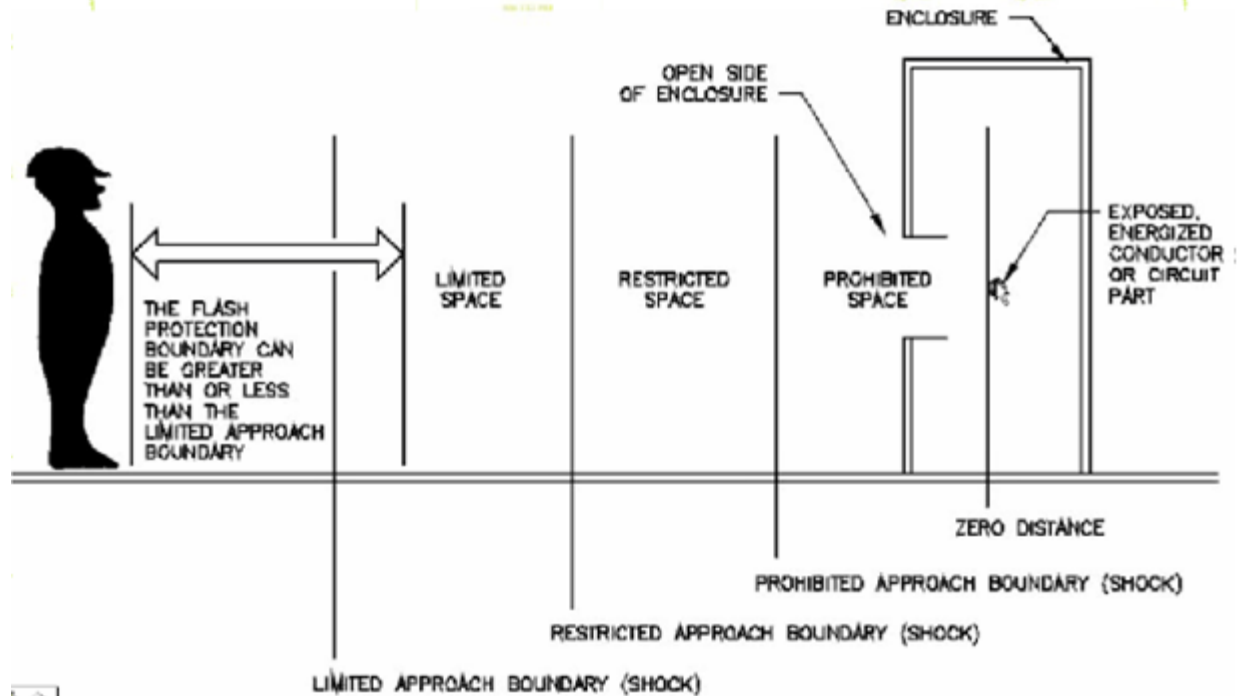


Figure 2: Boundaries

**Flash Protection/Hazard Boundary:** The flash protection boundary (FPB) is the distance from exposed live parts within which a person could receive a second-degree burn or worse, if an electric arc were to occur. Work outside of this boundary does not require the use of PPE other than non-flammable, non-melting clothing, i.e. natural fibers (PPE Category 1). When work is to be done on exposed energized electrical conductors or circuit parts, it is recommended to use safety tape and/or cones to mark the flash protection boundary.

**Limited Approach Boundary:** Not related to arc flash, an approach limit at a distance from an exposed energized electrical conductor or circuit part within which a shock hazard exists. This is a shock protection boundary and is intended to define the approach limit for unqualified workers and to eliminate the risk of contact with an exposed energized electrical conductor. Only qualified persons shall complete tasks such as testing, troubleshooting and voltage measuring within the limited approach boundary.

**Prohibited Approach Boundary:** Not related to arc flash, an approach limit at a distance from an exposed energized electrical conductor or circuit part within which work is performed is considered the same as making contact with the electrical conductor or circuit part. The distance determined to be the prohibited approach boundary must not be crossed without PPE that protects the worker from the full circuit voltage.

**Restricted Approach Boundary:** Not related to arc flash, an approach limit at a distance from an exposed energized electrical conductor or circuit part within which there is an increased risk of shock, due to electrical arc over combined with inadvertent movement, for personnel working in close proximity to the energized electrical conductor or circuit part.

Where no label is present, refer to the default NFPA Electrical Shock Hazard Approach Boundaries as shown below in Table 2.

Default Electrical Shock Hazard Approach Boundaries (where no label is present)				
Nominal Voltage, Phase to Phase	Limited Approach Boundary		Restricted Approach Boundary	Prohibited Approach Boundary
	Exposed Moveable	Exposed Fixed Circuit Part		
Less than 50	Not Specified	Not Specified	Not Specified	Not Specified
50 to 300	10 ft. 0 in	3 ft. 6 in	Avoid Contact	Avoid Contact
301 to 750	10 ft. 0 in	3 ft. 6 in	1 ft. 0 in	0 ft. 1 in

Table 2: NFPA default approach boundaries

5.1 De-energized parts. Conductors and parts of electrical equipment that have been de-energized but have not been locked out or tagged out shall be treated as live parts. Live parts to which an employee may be exposed shall be de-energized before the employee works on or near them, unless it can be demonstrated that de-energizing introduces additional or increased hazards or is unfeasible due to equipment design or operational limitations. Live parts that operate at less than 50 volts to ground need not be de-energized if there will be no increased exposure to electrical burns or to explosion due to electric arcs.

NOTE 1: 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.

NOTE 2: Examples of work that may be performed on or near energized circuit parts because of unfeasibility due to equipment design or operational limitations include testing of electric circuits that can only be performed with the circuit energized and work on circuits that form an integral part of a continuous industrial process in a plant that would otherwise need to be completely shut down in order to permit work on one circuit or piece of equipment.

5.2 Lockout and tagging. While any employee is exposed to contact with parts of fixed electric equipment or circuits which have been de-energized, the circuits energizing the parts shall be locked out or tagged or both in accordance with the requirements of this company's lock-out/tag-out procedures program.

5.3 Energized parts. If the exposed live parts are not de-energized (i.e., for reasons of increased or additional hazards or unfeasibility), supervisors will ensure that other safety-related work practices are used to protect employees who may be exposed to the electrical hazards involved. Such work practices shall protect employees against contact with energized circuit parts directly with any part of their body or indirectly through some other conductive object. The work practices that are used shall be suitable for the conditions under which the work is to be performed and for the voltage level of the exposed electric conductors, circuit parts, or materials. All test instruments, equipment and their accessories be rated for circuits and equipment to which they will be connected. Test instruments will be verified to be in proper working order before and after an absence of voltage test is performed. Work on exposed live parts must only be performed utilizing a "Live Electrical Work Permit". A "Live Electrical Work Permit" (see attachment) must be completed prior to work on exposed live parts. Only qualified company employees may work on electric circuit parts or equipment that have not been de-energized. Work shall not be performed on exposed energized parts of equipment or systems until responsible supervision has determined the work needs to be performed while the equipment or systems are energized, involved personnel have received instructions on the work techniques and hazards involved in working on energized equipment, and suitable personal protective equipment and safe guards are provided and used.

5.4 Contractor personnel. Contractor personnel will be notified that they may be required to provide proof of certification for working on energized circuits, and shall be familiar with the proper use of special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools.

5.5 Overhead lines- **(See section 8 also)** If work is to be performed near overhead lines, the lines shall be de-energized and grounded, or other protective measures shall be provided before work is started. If the lines are to be de-energized, arrangements shall be made with the person or organization that operates or controls the electric circuits involved to de-energize and ground them. If protective measures, such as guarding, isolating, or insulating are provided, these precautions shall prevent employees from contacting such lines directly with any part of their body or indirectly through conductive materials, tools, or equipment. Unqualified persons are prohibited from performing this type of work.

5.5.1 Unqualified employees (elevated). When an unqualified employee is working in an elevated position near overhead lines, the location shall be such that the person and the longest conductive object he or she may contact cannot come closer to any unguarded, energized overhead line than the following distances:

5.5.1.1 For voltages to ground 50kV or below--10 ft. (305 cm)

5.5.1.2 For voltages to ground over 50kV--10 ft. (305 cm) plus 4 in. (10 cm) for every 10kV over 50kV.

5.5.2 Unqualified employees (ground). Unqualified employees working on the ground in the vicinity of overhead lines, the person may not bring any conductive object closer to unguarded, energized overhead lines than the distances given below.

5.5.2.1 For voltages to ground 50kV or below--10 ft. (305 cm)

5.5.2.2 For voltages to ground over 50kV--10 ft. (305 cm) plus 4 in. (10 cm) for every 10kV over 50kV.

NOTE: For voltages normally encountered with overhead power lines, objects which do not have an insulating rating for the voltage involved are considered to be conductive.

5.5.3 Qualified persons. When a qualified person is working in the vicinity of overhead lines, whether in an elevated position or on the ground, the person may not approach or take any conductive object without an approved insulating handle closer to exposed energized parts than shown in Table S-5 (29 CFR 1910.333 unless:

5.5.3.1 The person is insulated from the energized part (gloves, with sleeves if necessary, rated for the voltage involved are considered to be insulation of the person from the energized part on which work is performed).

5.5.3.2 The energized part is insulated both from all other conductive objects at a different potential and from the person.

5.5.3.3 The person is insulated from all conductive objects at a potential different from that of the energized part.

**Table S-5 (29 CFR 1910.333)****Approach Distances for Qualified Employees--Alternating Current**

<b>Voltage range (phase to phase)</b>	<b>Minimum approach distance</b>
<u>300V and less</u>	<u>Avoid contact</u>
Over 300V, not over 750V	1 ft. 0 in. (30.5 cm).
Over 750V, not over 2kV	1 ft. 6 in. (46 cm).
Over 2kV, not over 15kV	2 ft. 0 in. (61 cm).
Over 15kV, not over 37kV	3 ft. 0 in. (91 cm).
Over 37kV, not over 87.5kV	3 ft. 6 in. (107 cm).
Over 87.5kV, not over 121kV	4 ft. 0 in. (122 cm).
Over 121kV, not over 140kV	4 ft. 6 in. (137 cm).

## 5.5.4 Vehicular and mechanical equipment.

5.5.4.1 Company vehicles or mechanical equipment capable of having parts of its structure elevated near energized overhead lines shall be operated so that a clearance of 10 ft. (305 cm) is maintained. If the voltage is higher than 50kV, the clearance shall be increased 4 in. (10 cm) for every 10kV over that voltage. However, under any of the following conditions, the clearance may be reduced:

5.5.4.1.1 If the vehicle is in transit with its structure lowered, the clearance may be reduced to 4 ft. (122 cm). If the voltage is higher than 50kV, the clearance shall be increased 4 in. (10 cm) for every 10kV over that voltage.

5.5.4.1.2 If insulating barriers are installed to prevent contact with the lines, and if the barriers are rated for the voltage of the line being guarded and are not a part of or an attachment to the vehicle or its raised structure, the clearance may be reduced to a distance within the designed working dimensions of the insulating barrier.

5.5.4.1.3 If the equipment is an aerial lift insulated for the voltage involved, and if the work is performed by a qualified person, the clearance (between the uninsulated portion of the aerial lift and the power line) may be reduced to the distance given in Table S-5.

5.5.4.2 Employees standing on the ground may not contact the vehicle or mechanical equipment or any of its attachments, unless:

5.5.4.2.1 The employee is using protective equipment rated for the voltage.

5.5.4.2.2 The equipment is located so that no un-insulated part of its structure (that portion of the structure that provides a conductive path to employees on the ground) can come closer to the line than 10 ft. (305 cm). If the voltage is higher than 50kV, the clearance shall be increased 4 in. (10 cm) for every 10kV over that voltage.

5.5.4.2.3 If any vehicle or mechanical equipment capable of having parts of its structure elevated near energized overhead lines is intentionally grounded, employees working on the ground near the point of grounding may not stand at the grounding location whenever there is a possibility of overhead line contact. Additional precautions, such as the use of barricades or insulation, shall be taken to protect employees from hazardous ground potentials, depending on earth resistivity and fault currents, which can develop within the first few feet or more outward from the grounding point.

## 5.6 Illumination.

5.6.1 Supervisors will ensure that employees do not enter spaces containing exposed energized parts, unless illumination is provided that enables the employees to perform the work safely.

5.6.2 Where lack of illumination or an obstruction precludes observation of the work to be performed, employees may not perform tasks near exposed energized parts. Employees may not reach blindly into areas which may contain energized parts. Additionally, unless known otherwise the space shall be evaluated to determine if it meets the criteria for designation as a confined space. The company confined space program will be implemented to manage the entry.

5.7 Confined or enclosed work spaces. When an employee works in a confined or enclosed space (such as a manhole or vault) that contains exposed energized parts, this employer shall provide, and the employee shall use, protective shields, protective barriers, or insulating materials as necessary to avoid inadvertent contact with these parts. Doors, hinged panels, and the like shall be secured to prevent their swinging into an employee and causing the employee to contact exposed energized parts. Additionally, unless known otherwise the space shall be evaluated to determine if it meets the criteria for designation as a confined space. The company confined space program will be implemented to manage the entry. Unqualified persons shall not be permitted to enter spaces that are required to be accessible to qualified employees only.

5.8 Conductive materials and equipment. Conductive materials and equipment that are in contact with any part of an employee's body shall be handled in a manner that will prevent them from contacting exposed energized conductors or circuit parts. Supervisors will ensure pre-written safety procedures are in place, and that all employees are trained when long dimensional conductive objects (such as ducts and pipes) in areas with exposed live parts, are used. Other protective measures (such as the use of insulation, guarding, and material handling techniques) will considered and used to minimize the hazard.

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

5.10 Conductive apparel. Conductive articles of jewelry and clothing (such as watch bands, bracelets, rings, key chains, necklaces, metalized aprons, cloth with conductive thread, or metal headgear) may not be worn if they might contact exposed energized parts.

5.11 Housekeeping duties. Where energized parts present an electrical contact hazard, employees may not perform housekeeping duties at such close distances to the parts that there is a possibility of contact, unless adequate safeguards (such as insulating equipment or barriers) are provided. Electrically conductive cleaning materials (including conductive solids such as steel wool, metalized cloth, and silicon carbide, as well as conductive liquid solutions) may not be used in proximity to energized parts unless procedures are followed which will prevent electrical contact.

5.12 Interlocks. Only a qualified employee may defeat an electrical safety interlock, and then only temporarily while he or she is working on the equipment. The interlock system shall be returned to its operable condition when this work is completed.

## 6. Use of Equipment.

6.1 Portable electric equipment. This paragraph applies to the use of cord- and plug-connected equipment, including flexible cord sets (extension cords).

6.1.1 Handling. 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 jacket or insulation.

6.1.2 Visual inspection.

6.1.2.1 Portable cord- and plug-connected equipment and flexible cord sets (extension cords) shall be visually inspected before use on any shift for external defects (such as loose parts, deformed and missing pins, or damage to outer jacket or insulation) and for evidence of possible internal damage (such as pinched or crushed outer jacket). Cord- and plug-connected equipment and flexible cord sets (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.

6.1.2.2 If there is a defect or evidence of damage that might expose an employee to injury, the defective or damaged item shall be removed from service, and no employee may use it until repairs and tests necessary to render the equipment safe have been made.

6.1.2.3 When an attachment plug is to be connected to a receptacle (including any on a cord set), the relationship of the plug and receptacle contacts shall first be checked to ensure that they are of proper mating configurations.

6.1.3 Grounding-type equipment.

6.1.3.1 A flexible cord used with grounding-type equipment shall contain an equipment grounding conductor.

6.1.3.2 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. Additionally, these devices may not be altered to allow the grounding pole of a plug to be inserted into slots intended for connection to the current-carrying conductors.



6.1.3.3 Adapters which interrupt the continuity of the equipment grounding connection may not be used.

6.1.4 Conductive work locations. Portable electric equipment and flexible cords used in highly conductive work locations (such as those inundated with water or other conductive liquids), or in job locations where employees are likely to contact water or conductive liquids, shall be approved for those locations.

6.1.5 Connecting attachment plugs.

6.1.5.1 Employees' hands may not be wet when plugging and unplugging flexible cords and cord- and plug-connected equipment, if energized equipment is involved.

6.1.5.2 Energized plug and receptacle connections may be handled only with insulating protective equipment if the condition of the connection could provide a conducting path to the employee's hand (if, for example, a cord connector is wet from being immersed in water).

6.1.5.3 Locking-type connectors shall be properly secured after connection.

6.2 Electric power and lighting circuits.

6.2.1 Routine opening and closing of circuits. Load rated switches, circuit breakers, or other devices specifically designed as disconnecting means shall be used for the opening, reversing, or closing of circuits under load conditions. Cable connectors not of the load-break type, fuses, terminal lugs, and cable splice connections may not be used for such purposes, except in an emergency.

6.2.2 Reclosing circuits after protective device operation. After a circuit is de-energized by a circuit protective device, the circuit may not be manually reenergized until it has been determined that the equipment and circuit can be safely energized. The repetitive manual reclosing of circuit breakers or reenergizing circuits through replaced fuses is prohibited.

**NOTE: When it can be determined from the design of the circuit and the overcurrent devices involved that the automatic operation of a device was caused by an overload rather than a fault condition, no examination of the circuit or connected equipment is needed before the circuit is reenergized.**

6.2.3 Overcurrent protection modification. Overcurrent protection of circuits and conductors may not be modified, even on a temporary basis, beyond that allowed by 29 CFR 1910.304(e), the installation safety requirements for overcurrent protection.

### 6.3 Test instruments and equipment.

6.3.1 Use. Only company qualified persons may perform testing work on electric circuits or equipment.

6.3.2 Visual inspection. Test instruments and equipment and all associated test leads, cables, power cords, probes, and connectors shall be visually inspected for external defects and damage before the equipment is used. If there is a defect or evidence of damage that might expose an employee to injury, the defective or damaged item shall be removed from service, and no employee may use it until repairs and tests necessary to render the equipment safe have been made.

6.3.3 Rating of equipment. Test instruments and equipment and their accessories shall be rated for the circuits and equipment to which they will be connected and shall be designed for the environment in which they will be used.

6.4 Occasional use of flammable or ignitable materials. Where flammable materials are present only occasionally, electric equipment capable of igniting them shall not be used, unless measures are taken to prevent hazardous conditions from developing. Such materials include, but are not limited to: flammable gases, vapors, or liquids; combustible dust; and ignitable fibers or filings.

**NOTE: Electrical installation requirements for locations where flammable materials are present on a regular basis are contained Safeguards for personnel protection.**

## 7. Safeguards for Personnel Protection.

7.1 Use of protective equipment.

7.1.1 Personal protective equipment.

7.1.1.1 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.

**NOTE: Personal protective equipment requirements are contained in subpart I of 29 CFR 1910, and NFPA 70(E).**

7.1.1.2 Protective equipment shall be maintained in a safe, reliable condition and shall be periodically inspected or tested, as required by 29 CFR 1910.137.

7.1.1.3 If the insulating capability of protective equipment may be subject to damage during use, the insulating material shall be protected. (For example, an outer covering of leather is sometimes used for the protection of rubber insulating material.)

7.1.1.4 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.

7.1.1.5 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 explosion.

#### 7.1.2 General protective equipment and tools.

7.1.2.1 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. If the insulating capability of insulated tools or handling equipment is subject to damage, the insulating material shall be protected.

7.1.2.1.1 Fuse handling equipment, insulated for the circuit voltage, shall be used to remove or install fuses when the fuse terminals are energized.

7.1.2.1.2 Ropes and hand-lines used near exposed energized parts shall be nonconductive.

7.1.2.2 Protective shields, protective barriers, or insulating materials shall be used to protect each employee from shock, burns, or other electrically related injuries while that employee is working near exposed energized parts which might be accidentally contacted or where dangerous electric heating or arcing might occur. See NFPA 70(E)'s Hazard Risk Categorization for determining proper levels of protection. When normally enclosed live parts are exposed for maintenance or repair, they shall be guarded to protect unqualified persons from contact with the live parts.

7.1.2.3 Clothing. Employees shall use the following chart to select the correct level of clothing when preparing to engage in live electrical work:

Hazard/Risk Category	Required Minimum Arc Rating (Cal/cm <sup>2</sup> )	Clothing Description
0	N/A	Nonmelting, flammable materials (i.e. untreated cotton, wool, rayon, or silk) with a fabric weight at least 4.5 oz/yd <sup>2</sup>
1	4	Arc-rated FR shirt and FR pants or FR coverall
2	8	Arc-rated FR shirt and FR pants or FR coverall
3	25	Arc-rated FR shirt and pants or FR coverall, and arc flash suit selected so that the system arc rating meets the required minimum
4	40	Arc-rated FR shirt and pants or FR coverall, and arc flash suit selected so that the system arc rating meets the required minimum

Note that other PPE may be required as listed in Attachment C and Attachment D such as arc-related face shields or flash suit hoods, FR hardhats, safety flasks or safety goggles, hearing protection, leather gloves, voltage-rated gloves, and voltage-rated tools.

7.1.2.4 Hand and Arm Protection.

1. Employees shall wear appropriate rubber insulated gloves with leather/goat skin/cow hide protectors when engaged in Hot Work. These gloves shall be inspected before each use and tested every 6 month. The following chart is provided to assist in selecting the proper gloves.

Voltage Rating for Gloves			
Class	Max. Use Voltage AC	Class	Max. Use Voltage AC
Low Voltage		High Voltage	
00	500	1	7,500
0	1,000	2	17,000
		3	26,500
		4	36,000

2. Employees shall wear appropriate arm protection when there is a danger of the arms contacting live parts or when there is possible exposure to arc flash burns. These sleeves shall be inspected prior to each use and tested annually. In most cases, an employee’s clothes and gloves provide sufficient protection, but certain situations like reaching into an electrical enclosure or improper body coverage may require the use of sleeves.

3. When wearing voltage rated gloves and protectors, employees shall ensure there is an appropriate “Flashover Gap Distance” as indicated in the following chart.

Flashover Gap Distance	
Classification	Gap Distance
Class 00	.5"
Class 0, 1	1"
Class 2	2"
Class 3	3"
Class 4	4"

7.1.2.5 Footwear. Where insulated footwear is used as protection against step and touch potential, dielectric overshoes shall be required. Insulated soles shall not be used as primary electrical protection.

2015 NFPA 70(E) PPE CHART

Table 130.7(C)(15)(A)(a) Arc Flash Hazard Identification for Alternating Current (ac) and Direct Current (dc) Systems		
Task	Equipment Condition*	Arc Flash PPE Required
Reading a panel meter while operating a meter switch	Any	No
Normal operation of a circuit breaker (CB), switch, contactor or starter	All of the following: The equipment is properly installed The equipment is properly maintained All equipment doors are closed and secured All equipment covers are in place and secured There is no evidence of impending failure	No
	One or more of the following: The equipment is not properly installed The equipment is not properly maintained Equipment doors are open or not secured Equipment covers are off or not secured There is evidence of impending failure	Yes

For ac systems: Work on energized electrical conductors and circuit parts, including voltage testing	Any	Yes
For dc systems: Work on energized electrical conductors and circuit parts of series-connected battery cells, including voltage testing	Any	Yes
Voltage testing on individual battery cells or individual multi-cell units	All of the following: The equipment is properly installed The equipment is properly maintained Covers for all other equipment are in place and secured There is no evidence of impending failure	No
	One or more of the following: The equipment is not properly installed The equipment is not properly maintained Equipment doors are open or not secured Equipment covers are off or not secured There is evidence of impending failure	Yes
Removal or installation of CBs or switches	Any	Yes
Removal or installation of covers for equipment such as wireways, junction boxes, and cable trays that does not expose bare energized electrical conductors and circuit parts	All of the following: The equipment is properly installed The equipment is properly maintained There is no evidence of impending failure	No
	Any of the following: The equipment is not properly installed The equipment is not properly maintained There is evidence of impending failure	Yes
Removal of bolted covers (to expose bare energized electrical conductors and circuit parts). For dc systems, this includes bolted covers, such as battery terminal covers.	Any	Yes

Table 130.7(C)(15)(A)(a) Arc Flash Hazard Identification for Alternating Current (ac) and Direct Current (dc) Systems

Task	Equipment Condition*	Arc Flash PPE Required
Removal of battery intercell connector covers	All of the following: The equipment is properly installed The equipment is properly maintained Covers for all other equipment are in place and secure There is no evidence of impending failure	No
	One or more of the following: The equipment is not properly installed The equipment is not properly maintained Equipment doors are open or not secured Equipment covers are off or not secured There is evidence of impending failure	Yes

Opening hinged door(s) or cover(s) (to expose bare energized electrical conductors and circuit parts)	Any	Yes
Perform infrared thermography and other noncontact inspections outside the restricted approach boundary. This activity does not include opening of doors or covers.	Any	No
Application of temporary protective grounding equipment after voltage test	Any	Yes
Work on control circuits with exposed electrical conductors and circuit parts, 120 volts or below without any other exposed energized equipment over 120 volts including opening of hinged covers to gain access	Any	No
Work on control circuits with exposed energized electrical conductors and circuit parts, greater than 120 V	Any	Yes
Insertion or removal (racking) of CBs or starters from cubicles, doors open or closed	Any	Yes
Insertion or removal of plug-in devices into or from busways	Any	Yes
Insulated cable examination with no manipulation of cable	Any	No
Insulated cable examination with manipulation of cable	Any	Yes
Work on exposed energized electrical conductors and circuit parts of equipment directly supplied by a panelboard or motor control center	Any	Yes
Insertion and removal of revenue meters (kW-hour at primary voltage and current)	Any	Yes
For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an enclosure	Any	Yes
For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an open rack	Any	No

Table 130.7(C)(15)(A)(a) Arc Flash Hazard Identification for Alternating Current (ac) and Direct Current (dc) Systems

Task	Equipment Condition*	Arc Flash PPE Required
For dc systems, maintenance on a single cell of a battery system or multi-cell units in an open rack	Any	No
For dc systems, work on exposed energized electrical conductors and circuit parts or utilization equipment directly supplied by a dc source	Any	Yes
Arc-resistance switchgear Type 1 or 2 (for cleaning times of <0.5 sec with a prospective fault current not to exceed the arc-resistant rating of the equipment) and metal enclosed interrupter switchgear, fused or unfused of arc resistant type construction tested in accordance with IEEE C37.20.7: <ul style="list-style-type: none"> <li>• Insertion or removal (racking) of CBs from cubicles</li> <li>• Insertion or removal (racking) of ground and test device</li> <li>• Insertion or removal (racking) of voltage transformers on or off the bus</li> </ul>	All of the following:  The equipment is properly installed The equipment is properly maintained All equipment doors are closed and secured All equipment covers are in place and secured There is no evidence of impending failure	No
	One or more of the following:  The equipment is not properly installed The equipment is not properly maintained Equipment doors are open or not secured Equipment covers are off or not secured There is evidence of impending failure	Yes
Opening voltage transformer or control power transformer compartments	Any	Yes
Outdoor disconnect switch operation (hookstick operated) at 1 kV through 15 kV	Any	Yes
Outdoor disconnect switch operation (gang-operated, from grade) at 1 kV through 15 kV	Any	Yes
Note: Hazard identification is one component of risk assessment. Risk assessment involves a determination of the likelihood of occurrence of an incident, resulting from a hazard that could cause injury or damage to health. The assessment of the likelihood of occurrence contained in this table does not cover every possible condition or situation. Where the table indicates that arc flash PPE is not required, an arc flash is not likely to occur.  *The phrase properly installed , as used in this table, means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer's recommendations. The phrase properly maintained , as used in this table, means that the equipment has been maintained in accordance with the manufacturer's recommendations and applicable industry codes and standards. The phrase evidence of impending failure , as used in this table, means that there is evidence of arcing, overheating, loose or bound equipment parts, visible damage, deterioration, or other damage.		



## 8. Definitions Applicable to this Standard Practice Instruction.

**Acceptable.** An installation or equipment is acceptable to the Assistant Secretary of Labor, and approved within the meaning of this 29 CFR 1910 Subpart S:

- If it is accepted, or certified, or listed, or labeled, or otherwise determined to be safe by a nationally recognized testing laboratory; or
- With respect to an installation or equipment of a kind which no nationally recognized testing laboratory accepts, certifies, lists, labels, or determines to be safe, if it is inspected or tested by another Federal agency, or by a State, municipal, or other local authority responsible for enforcing occupational safety provisions of the National Electrical Code and found in compliance with the provisions of the National Electrical Code as applied in this Subpart; or
- With respect to custom-made equipment or related installations which are designed, fabricated for, and intended for use by a particular customer, if it is determined to be safe for its intended use by its manufacturer on the basis of test data which the employer keeps and makes available for inspection to the Assistant Secretary and his authorized representatives. Refer to 29 CFR 1910.7 for definition of nationally recognized testing laboratory.

**Accepted.** An installation is "accepted" if it has been inspected and found by a nationally recognized testing laboratory to conform to specified plans or to procedures of applicable codes.

**Accessible.** (As applied to wiring methods.) Capable of being removed or exposed without damaging the building structure or finish, or not permanently closed in by the structure or finish of the building. (See "concealed" and "exposed.")

**Accessible.** (As applied to equipment.) Admitting close approach; not guarded by locked doors, elevation, or other effective means. (See "Readily accessible.")

**Ampacity.** Current-carrying capacity of electric conductors expressed in amperes.

**Appliances.** Utilization equipment, generally other than industrial, normally built in standardized sizes or types, which is installed or connected as a unit to perform one or more functions such as clothes washing, air conditioning, food mixing, deep frying, etc.

**Approved.** Acceptable to the authority enforcing 29 CFR 1910 subpart S. The authority enforcing this subpart is the Assistant Secretary of Labor for Occupational Safety and Health. The definition of "acceptable" indicates what is acceptable to the Assistant Secretary of Labor, and therefore approved within the meaning of 29 CFR 1910 Subpart S.

**Approved for the purpose.** Approved for a specific purpose, environment, or application described in a particular standard requirement. Suitability of equipment or materials for a specific purpose, environment or application may be determined by a nationally recognized testing laboratory, inspection agency or other organization concerned with product evaluation as part of its listing and labeling program. (See "Labeled" or "Listed.")

**Armored cable.** Type AC armored cable is a fabricated assembly of insulated conductors in a flexible metallic enclosure.

**Askarel.** A generic term for a group of nonflammable synthetic chlorinated hydrocarbons used as electrical insulating media. Askarels of various compositional types are used. Under arcing conditions the gases produced, while consisting predominantly of noncombustible hydrogen chloride, can include varying amounts of combustible gases depending upon the askarel type.

**Attachment plug (Plug cap) (Cap).** A device which, by insertion in a receptacle, establishes connection between the conductors of the attached flexible cord and the conductors connected permanently to the receptacle.

**Automatic.** Self-acting, operating by its own mechanism when actuated by some impersonal influence, as, for example, a change in current strength, pressure, temperature, or mechanical configuration.

**Bare conductor.** See "Conductor."

**Bonding.** The permanent joining of metallic parts to form an electrically conductive path which will assure electrical continuity and the capacity to conduct safely any current likely to be imposed.

**Bonding jumper.** A reliable conductor to assure the required electrical conductivity between metal parts required to be electrically connected.

**Branch circuit.** The circuit conductors between the final overcurrent device protecting the circuit and the outlet(s).

**Building.** A structure which stands alone or which is cut off from adjoining structures by fire walls with all openings therein protected by approved fire doors.

**Cabinet.** An enclosure designed either for surface or flush mounting, and provided with a frame, mat, or trim in which a swinging door or doors are or may be hung.

**Cable tray system.** A cable tray system is a unit or assembly of units or sections, and associated fittings, made of metal or other noncombustible materials forming a rigid structural system used to support cables.

- Cable tray systems include ladders, troughs, channels, solid bottom trays, and other similar structures.

**Cablebus.** Cablebus is an approved assembly of insulated conductors with fittings and conductor terminations in a completely enclosed, ventilated, protective metal housing.

**Center pivot irrigation machine.** A center pivot irrigation machine is a multi-motored irrigation machine which revolves around a central pivot and employs alignment switches or similar devices to control individual motors.

**Certified.** Equipment is "certified" if it:

- Has been tested and found by a nationally recognized testing laboratory to meet nationally recognized standards or to be safe for use in a specified manner, or
- Is of a kind whose production is periodically inspected by a nationally recognized testing laboratory, and
- It bears a label, tag, or other record of certification.

**Circuit breaker.**

- (600 volts nominal, or less). A device designed to open and close a circuit by nonautomatic means and to open the circuit automatically on a predetermined overcurrent without injury to itself when properly applied within its rating.
- (Over 600 volts, nominal). A switching device capable of making, carrying, and breaking currents under normal circuit conditions, and also making, carrying for a specified time, and breaking currents under specified abnormal circuit conditions, such as those of short circuit.

**Class I locations.** Class I locations are those in which flammable gases or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitable mixtures. Class I locations include the following:

- Class I, Division 1. A Class I, Division 1 location is a location:
  - In which hazardous concentrations of flammable gases or vapors may exist under normal operating conditions; or
  - In which hazardous concentrations of such gases or vapors may exist frequently because of repair or maintenance operations or because of leakage; or

- In which breakdown or faulty operation of equipment or processes might release hazardous concentrations of flammable gases or vapors, and might also cause simultaneous failure of electric equipment.

Note: This classification usually includes locations where volatile flammable liquids or liquefied flammable gases are transferred from one container to another; interiors of spray booths and areas in the vicinity of spraying and painting operations where volatile flammable solvents are used; locations containing open tanks or vats of volatile flammable liquids; drying rooms or compartments for the evaporation of flammable solvents; locations containing fat and oil extraction equipment using volatile flammable solvents; portions of cleaning and dyeing plants where flammable liquids are used; gas generator rooms and other portions of gas manufacturing plants where flammable gas may escape; inadequately ventilated pump rooms for flammable gas or for volatile flammable liquids; the interiors of refrigerators and freezers in which volatile flammable materials are stored in open, lightly stoppered, or easily ruptured containers; and all other locations where ignitable concentrations of flammable vapors or gases are likely to occur in the course of normal operations.

- Class I, Division 2. A Class I, Division 2 location is a location:
  - In which volatile flammable liquids or flammable gases are handled, processed, or used, but in which the hazardous liquids, vapors, or gases will normally be confined within closed containers or closed systems from which they can escape only in case of accidental rupture or breakdown of such containers or systems, or in case of abnormal operation of equipment; or
  - In which hazardous concentrations of gases or vapors are normally prevented by positive mechanical ventilation, and which might become hazardous through failure or abnormal operations of the ventilating equipment; or
  - That is adjacent to a Class I, Division 1 location, and to which hazardous concentrations of gases or vapors might occasionally be communicated unless such communication is prevented by adequate positive-pressure ventilation from a source of clean air, and effective safeguards against ventilation failure are provided.

Note: This classification usually includes locations where volatile flammable liquids or flammable gases or vapors are used, but which would become hazardous only in case of an accident or of some unusual operating condition. The quantity of flammable material that might escape in case of accident, the adequacy of ventilating equipment, the total area involved, and the record of the industry or business with respect to explosions or fires are all factors that merit consideration in determining the classification and extent of each location. Piping without valves, checks, meters, and similar devices would not ordinarily introduce a hazardous condition even though used for flammable liquids or gases. Locations used for the storage of flammable liquids or a liquefied or compressed gases in sealed containers would not normally be considered hazardous unless also subject to other hazardous conditions. Electrical conduits and their associated enclosures separated from process fluids by a single seal or barrier are classed as a Division 2 location if the outside of the conduit and enclosures is a nonhazardous location.

**Class II locations.** Class II locations are those that are hazardous because of the presence of combustible dust. Class II locations include the following:

- Class II, Division 1. A Class II, Division 1 location is a location:
  - In which combustible dust is or may be in suspension in the air under normal operating conditions, in quantities sufficient to produce explosive or ignitable mixtures; or
  - Where mechanical failure or abnormal operation of machinery or equipment might cause such explosive or ignitable mixtures to be produced, and might also provide a source of ignition through simultaneous failure of electric equipment, operation of protection devices, or from other causes, or
  - In which combustible dusts of an electrically conductive nature may be present.

Note: This classification may include areas of grain handling and processing plants, starch plants, sugar-pulverizing plants, malting plants, hay-grinding plants, coal pulverizing plants, areas where metal dusts and powders are produced or processed, and other similar locations which contain dust producing machinery and equipment (except where the equipment is dust-tight or vented to the outside). These areas would have combustible dust in the air, under normal operating conditions, in quantities sufficient to produce explosive or ignitable mixtures. Combustible dusts which are electrically nonconductive include dusts produced in the handling and processing of grain and grain products, pulverized sugar and cocoa, dried egg and milk powders, pulverized spices, starch and pastes, potato and woodflour, oil meal from beans and seed, dried hay, and other organic materials which may produce combustible dusts when processed or handled. Dusts containing magnesium or aluminum are particularly hazardous and the use of extreme caution is necessary to avoid ignition and explosion.

- Class II, Division 2. A Class II, Division 2 location is a location in which:
  - Combustible dust will not normally be in suspension in the air in quantities sufficient to produce explosive or ignitable mixtures, and dust accumulations are normally insufficient to interfere with the normal operation of electrical equipment or other apparatus; or
  - Dust may be in suspension in the air as a result of infrequent malfunctioning of handling or processing equipment, and dust accumulations resulting therefrom may be ignitable by abnormal operation or failure of electrical equipment or other apparatus.

Note: This classification includes locations where dangerous concentrations of suspended dust would not be likely but where dust accumulations might form on or in the vicinity of electric equipment. These areas may contain equipment from which appreciable quantities of dust would escape under abnormal operating conditions or be adjacent to a Class II Division 1 location, as described above, into which an explosive or ignitable concentration of dust may be put into suspension under abnormal operating conditions.

**Class III locations.** Class III locations are those that are hazardous because of the presence of easily ignitable fibers or flyings but in which such fibers or flyings are not likely to be in suspension in the air in quantities sufficient to produce ignitable mixtures. Class III locations include the following:

- Class III, Division 1. A Class III, Division 1 location is a location in which easily ignitable fibers or materials producing combustible flyings are handled, manufactured, or used.

Note: Such locations usually include some parts of rayon, cotton, and other textile mills; combustible fiber manufacturing and processing plants; cotton gins and cotton-seed mills; flax-processing plants; clothing manufacturing plants; woodworking plants, and establishments; and industries involving similar hazardous processes or conditions. Easily ignitable fibers and flyings include rayon, cotton (including cotton linters and cotton waste), sisal or henequen, istle, jute, hemp, tow, cocoa fiber, oakum, baled waste kapok, Spanish moss, excelsior, and other materials of similar nature.

- Class III, Division 2. A Class III, Division 2 location is a location in which easily ignitable fibers are stored or handled, except in process of manufacture.

**Collector ring.** A collector ring is an assembly of slip rings for transferring electrical energy from a stationary to a rotating member.

**Concealed.** Rendered inaccessible by the structure or finish of the building. Wires in concealed raceways are considered concealed, even though they may become accessible by withdrawing them. [See "Accessible. (As applied to wiring methods.)"]

**Conductor.**

- Bare. A conductor having no covering or electrical insulation whatsoever.
- Covered. A conductor encased within material of composition or thickness that is not recognized as electrical insulation.
- Insulated. A conductor encased within material of composition and thickness that is recognized as electrical insulation.

**Conduit body.** A separate portion of a conduit or tubing system that provides access through a removable cover(s) to the interior of the system at a junction of two or more sections of the system or at a terminal point of the system. Boxes such as FS and FD or larger cast or sheet metal boxes are not classified as conduit bodies.

**Controller.** A device or group of devices that serves to govern, in some predetermined manner, the electric power delivered to the apparatus to which it is connected.

**Cooking unit, counter-mounted.** A cooking appliance designed for mounting in or on a counter and consisting of one or more heating elements, internal wiring, and built-in or separately mountable controls. (See "Oven, wall-mounted.")

**Covered conductor.** See "Conductor."

**Cutout.** (Over 600 volts, nominal.) An assembly of a fuse support with either a fuseholder, fuse carrier, or disconnecting blade. The fuseholder or fuse carrier may include a conducting element (fuse link), or may act as the disconnecting blade by the inclusion of a nonfusible member.

**Cutout box.** An enclosure designed for surface mounting and having swinging doors or covers secured directly to and telescoping with the walls of the box proper. (See "Cabinet.") Damp location. See "Location."

**Dead front.** Without live parts exposed to a person on the operating side of the equipment.

**Device.** A unit of an electrical system which is intended to carry but not utilize electric energy.

**Dielectric heating.** Dielectric heating is the heating of a nominally insulating material due to its own dielectric losses when the material is placed in a varying electric field.

**Disconnecting means.** A device, or group of devices, or other means by which the conductors of a circuit can be disconnected from their source of supply.

**Disconnecting (or Isolating) switch.** (Over 600 volts, nominal.) A mechanical switching device used for isolating a circuit or equipment from a source of power.

**Dry location.** See "Location."

**Electric sign.** A fixed, stationary, or portable self-contained, electrically illuminated utilization equipment with words or symbols designed to convey information or attract attention.

**Enclosed.** Surrounded by a case, housing, fence or walls which will prevent persons from accidentally contacting energized parts.

**Enclosure.** The case or housing of apparatus, or the fence or walls surrounding an installation to prevent personnel from accidentally contacting energized parts, or to protect the equipment from physical damage.

**Equipment.** A general term including material, fittings, devices, appliances, fixtures, apparatus, and the like, used as a part of, or in connection with, an electrical installation. Equipment grounding conductor. See "Grounding conductor, equipment."

**Explosion-proof apparatus.** Apparatus enclosed in a case that is capable of withstanding an explosion of a specified gas or vapor which may occur within it and of preventing the ignition of a specified gas or vapor surrounding the enclosure by sparks, flashes, or explosion of the gas or vapor within, and which operates at such an external temperature that it will not ignite a surrounding flammable atmosphere.

**Exposed.** (As applied to live parts.) Capable of being inadvertently touched or approached nearer than a safe distance by a person. It is applied to parts not suitably guarded, isolated, or insulated. (See "Accessible." and "Concealed.")

**Exposed.** (As applied to wiring methods.) On or attached to the surface or behind panels designed to allow access. [See "Accessible. (As applied to wiring methods.)"]

**Exposed.** (For the purposes of 29 CFR 1910.308(e), Communications systems.) Where the circuit is in such a position that in case of failure of supports or insulation, contact with another circuit may result.

**Externally operable.** Capable of being operated without exposing the operator to contact with live parts.

**Feeder.** All circuit conductors between the service equipment, or the generator switchboard of an isolated plant, and the final branch-circuit overcurrent device.



**Fitting.** An accessory such as a locknut, bushing, or other part of a wiring system that is intended primarily to perform a mechanical rather than an electrical function.

**Fuse.** (Over 600 volts, nominal.) An overcurrent protective device with a circuit opening fusible part that is heated and severed by the passage of overcurrent through it. A fuse comprises all the parts that form a unit capable of performing the prescribed functions. It may or may not be the complete device necessary to connect it into an electrical circuit.

**Ground.** A conducting connection, whether intentional or accidental, between an electrical circuit or equipment and the earth, or to some conducting body that serves in place of the earth.

**Grounded.** Connected to earth or to some conducting body that serves in place of the earth.

**Grounded, effectively.** (Over 600 volts, nominal.) Permanently connected to earth through a ground connection of sufficiently low impedance and having sufficient ampacity that ground fault current which may occur cannot build up to voltages dangerous to personnel.

**Grounded conductor.** A system or circuit conductor that is intentionally grounded.

**Grounding conductor.** A conductor used to connect equipment or the grounded circuit of a wiring system to a grounding electrode or electrodes.

**Grounding conductor, equipment.** The conductor used to connect the non-current-carrying metal parts of equipment, raceways, and other enclosures to the system grounded conductor and/or the grounding electrode conductor at the service equipment or at the source of a separately derived system.

**Grounding electrode conductor.** The conductor used to connect the grounding electrode to the equipment grounding conductor and/or to the grounded conductor of the circuit at the service equipment or at the source of a separately derived system.

**Ground-fault circuit-interrupter.** A device whose function is to interrupt the electric circuit to the load when a fault current to ground exceeds some predetermined value that is less than that required to operate the overcurrent protective device of the supply circuit.

**Guarded.** Covered, shielded, fenced, enclosed, or otherwise protected by means of suitable covers, casings, barriers, rails, screens, mats, or platforms to remove the likelihood of approach to a point of danger or contact by persons or objects.

**Health care facilities.** Buildings or portions of buildings and mobile homes that contain, but are not limited to, hospitals, nursing homes, extended care facilities, clinics, and medical and dental offices, whether fixed or mobile.

**Heating equipment.** For the purposes of 29 CFR 1910.306(g), the term heating equipment includes any equipment used for heating purposes if heat is generated by induction or dielectric methods.

**Hoistway.** Any shaftway, hatchway, well hole, or other vertical opening or space in which an elevator or dumbwaiter is designed to operate.

**Identified.** Identified, as used in reference to a conductor or its terminal, means that such conductor or terminal can be readily recognized as grounded.

**Induction heating.** Induction heating is the heating of a nominally conductive material due to its own  $I^2R$  losses when the material is placed in a varying electromagnetic field.

Insulated conductor. See Conductor.

**Interrupter switch.** (Over 600 volts, nominal.) A switch capable of making, carrying, and interrupting specified currents.

**Irrigation machine.** An irrigation machine is an electrically driven or controlled machine, with one or more motors, not hand portable, and used primarily to transport and distribute water for agricultural purposes.

**Isolated.** Not readily accessible to persons unless special means for access are used.

**Isolated power system.** A system comprising an isolating transformer or its equivalent, a line isolation monitor, and its ungrounded circuit conductors.

**Labeled.** Equipment is labeled if there is attached to it a label, symbol, or other identifying mark of a nationally recognized testing laboratory which, (a) makes periodic inspections of the production of such equipment, and (b) whose labeling indicates compliance with nationally recognized standards or tests to determine safe use in a specified manner.

**Lighting outlet.** An outlet intended for the direct connection of a lampholder, a lighting fixture, or a pendant cord terminating in a lampholder.

**Line-clearance tree trimming.** The pruning, trimming, repairing, maintaining, removing, or clearing of trees or cutting of brush that is within 10 feet (305 cm) of electric supply lines and equipment.

**Listed.** Equipment is listed if it is of a kind mentioned in a list which, (a) is published by a nationally recognized laboratory which makes periodic inspection of the production of such equipment, and (b) states such equipment meets nationally recognized standards or has been tested and found safe for use in a specified manner.

## Location

- **Damp location.** Partially protected locations under canopies, marquees, roofed open porches, and like locations, and interior locations subject to moderate degrees of moisture, such as some basements, some barns, and some cold-storage warehouses.
- **Dry location.** A location not normally subject to dampness or wetness. A location classified as dry may be temporarily subject to dampness or wetness, as in the case of a building under construction.
- **Wet location.** Installations underground or in concrete slabs or masonry in direct contact with the earth, and locations subject to saturation with water or other liquids, such as vehicle-washing areas, and locations exposed to weather and unprotected.

**May.** If a discretionary right, privilege, or power is conferred, the word "may" is used. If a right, privilege, or power is abridged or if an obligation to abstain from acting is imposed, the word "may" is used with a restrictive "no," "not," or "only." (E.g., no employer may . . . ; an employer may not . . . ; only qualified persons may. . . )

**Medium voltage cable.** Type MV medium voltage cable is a single or multi-conductor solid dielectric insulated cable rated 2000 volts or higher.

**Metal-clad cable.** Type MC cable is a factory assembly of one or more conductors, each individually insulated and enclosed in a metallic sheath of interlocking tape, or a smooth or corrugated tube.

**Mineral-insulated metal-sheathed cable.** Type MI mineral-insulated metal-sheathed cable is a factory assembly of one or more conductors insulated with a highly compressed refractory mineral insulation and enclosed in a liquidtight and gastight continuous copper sheath.

**Mobile X-ray.** X-ray equipment mounted on a permanent base with wheels and/or casters for moving while completely assembled. Nonmetallic-sheathed cable.

**Nonmetallic-sheathed cable** is a factory assembly of two or more insulated conductors having an outer sheath of moisture resistant, flame-retardant, nonmetallic material. Nonmetallic sheathed cable is manufactured in the following types:

- Type NM. The overall covering has a flame-retardant and moisture-resistant finish.
- Type NMC. The overall covering is flame-retardant, moisture-resistant, fungus-resistant, and corrosion-resistant. Oil (filled) cutout. (Over 600 volts, nominal.) A cutout in which all or part of the fuse support and its fuse link or disconnecting blade are mounted in oil with complete immersion of the contacts and the fusible portion of the conducting element (fuse link), so that arc interruption by severing of the fuse link or by opening of the contacts will occur under oil.

**Open wiring on insulators.** Open wiring on insulators is an exposed wiring method using cleats, knobs, tubes, and flexible tubing for the protection and support of single insulated conductors run in or on buildings, and not concealed by the building structure.

**Outlet.** A point on the wiring system at which current is taken to supply utilization equipment.

**Outline lighting.** An arrangement of incandescent lamps or electric discharge tubing to outline or call attention to certain features such as the shape of a building or the decoration of a window.

**Oven, wall-mounted.** An oven for cooking purposes designed for mounting in or on a wall or other surface and consisting of one or more heating elements, internal wiring, and built-in or separately mountable controls. (See Cooking unit, counter mounted.)

**Overcurrent.** Any current in excess of the rated current of equipment or the ampacity of a conductor. It may result from overload (see definition), short circuit, or ground fault. A current in excess of rating may be accommodated by certain equipment and conductors for a given set of conditions. Hence the rules for overcurrent protection are specific for particular situations.

**Overload.** Operation of equipment in excess of normal, full load rating, or of a conductor in excess of rated ampacity which, when it persists for a sufficient length of time, would cause damage or dangerous overheating. A fault, such as a short circuit or ground fault, is not an overload. (See Overcurrent.)

**Panelboard.** A single panel or group of panel units designed for assembly in the form of a single panel; including buses, automatic overcurrent devices, and with or without switches for the control of light, heat, or power circuits; designed to be placed in a cabinet or cutout box placed in or against a wall or partition and accessible only from the front. (See Switchboard.)

**Permanently installed decorative fountains and reflection pools.** Those that are constructed in the ground, on the ground, or in a building in such a manner that the pool cannot be readily disassembled for storage and are served by electrical circuits of any nature. These units are primarily constructed for their aesthetic value and not intended for swimming or wading.

**Permanently installed swimming pools, wading and therapeutic pools.** Those that are constructed in the ground, on the ground, or in a building in such a manner that the pool cannot be readily disassembled for storage whether or not served by electrical circuits of any nature.

**Portable X-ray.** X-ray equipment designed to be hand-carried.

**Power and control tray cable.** Type TC power and control tray cable is a factory assembly of two or more insulated conductors, with or without associated bare or covered grounding conductors under a nonmetallic sheath, approved for installation in cable trays, in raceways, or where supported by a messenger wire.

**Power fuse.** (Over 600 volts, nominal.) See Fuse.

**Power-limited tray cable.** Type PLTC nonmetallic-sheathed power limited tray cable is a factory assembly of two or more insulated conductors under a nonmetallic jacket.

**Power outlet.** An enclosed assembly which may include receptacles, circuit breakers, fuse-holders, fused switches, buses and watt-hour meter mounting means; intended to supply and control power to mobile homes, recreational vehicles or boats, or to serve as a means for distributing power required to operate mobile or temporarily installed equipment.

**Premises wiring system.** That interior and exterior wiring, including power, lighting, control, and signal circuit wiring together with all of its associated hardware, fittings, and wiring devices, both permanently and temporarily installed, which extends from the load end of the service drop, or load end of the service lateral conductors to the outlet(s). Such wiring does not include wiring internal to appliances, fixtures, motors, controllers, motor control centers, and similar equipment.

**Qualified person.** One familiar with the construction and operation of the equipment and the hazards involved.

- Note 1: Whether an employee is considered to be a "qualified person" will depend upon various circumstances in the workplace. It is possible and, in fact, likely for an individual to be considered "qualified" with regard to certain equipment in the workplace, but "unqualified" as to other equipment. (See 29 CFR 1910.332(b)(3) for training requirements that specifically apply to qualified persons.)

- Note 2: An employee who is undergoing on-the-job training and who, in the course of such training, has demonstrated an ability to perform duties safely at his or her level of training and who is under the direct supervision of a qualified person is considered to be a qualified person for the performance of those duties.

**Raceway.** A channel designed expressly for holding wires, cables, or busbars, with additional functions as permitted in this subpart. Raceways may be of metal or insulating material, and the term includes rigid metal conduit, rigid nonmetallic conduit, intermediate metal conduit, liquid-tight flexible metal conduit, flexible metallic tubing, flexible metal conduit, electrical metallic tubing, underfloor raceways, cellular concrete floor raceways, cellular metal floor raceways, surface raceways, wireways, and busways.

**Readily accessible.** Capable of being reached quickly for operation, renewal, or inspections, without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders, chairs, etc. (See "Accessible.")

**Receptacle.** A receptacle is a contact device installed at the outlet for the connection of a single attachment plug. A single receptacle is a single contact device with no other contact device on the same yoke. A multiple receptacle is a single device containing two or more receptacles.

**Receptacle outlet.** An outlet where one or more receptacles are installed.

**Remote-control circuit.** Any electric circuit that controls any other circuit through a relay or an equivalent device.

**Sealable equipment.** Equipment enclosed in a case or cabinet that is provided with a means of sealing or locking so that live parts cannot be made accessible without opening the enclosure. The equipment may or may not be operable without opening the enclosure.

**Separately derived system.** A premises wiring system whose power is derived from generator, transformer, or converter winding and has no direct electrical connection, including a solidly connected grounded circuit conductor, to supply conductors originating in another system.

**Service.** The conductors and equipment for delivering energy from the electricity supply system to the wiring system of the premises served.

**Service cable.** Service conductors made up in the form of a cable.

**Service conductors.** The supply conductors that extend from the street main or from transformers to the service equipment of the premises supplied.

**Service drop.** The overhead service conductors from the last pole or other aerial support to and including the splices, if any, connecting to the service-entrance conductors at the building or other structure.

**Service-entrance cable.** Service-entrance cable is a single conductor or multiconductor assembly provided with or without an overall covering, primarily used for services and of the following types:

- **Type SE**, having a flame-retardant, moisture-resistant covering, but not required to have inherent protection against mechanical abuse.
- **Type USE**, recognized for underground use, having a moisture-resistant covering, but not required to have a flame-retardant covering or inherent protection against mechanical abuse. Single-conductor cables having an insulation specifically approved for the purpose do not require an outer covering.

**Service-entrance conductors, overhead system.** The service conductors between the terminals of the service equipment and a point usually outside the building, clear of building walls, where joined by tap or splice to the service drop.

**Service entrance conductors, underground system.** The service conductors between the terminals of the service equipment and the point of connection to the service lateral. Where service equipment is located outside the building walls, there may be no service-entrance conductors, or they may be entirely outside the building.

**Service equipment.** The necessary equipment, usually consisting of a circuit breaker or switch and fuses, and their accessories, located near the point of entrance of supply conductors to a building or other structure, or an otherwise defined area, and intended to constitute the main control and means of cutoff of the supply.

**Service raceway.** The raceway that encloses the service-entrance conductors.

**Shielded nonmetallic-sheathed cable.** Type SNM, shielded nonmetallic-sheathed cable is a factory assembly of two or more insulated conductors in an extruded core of moisture-resistant, flame-resistant nonmetallic material, covered with an overlapping spiral metal tape and wire shield and jacketed with an extruded moisture-, flame-, oil-, corrosion-, fungus-, and sunlight-resistant nonmetallic material.

**Show window.** Any window used or designed to be used for the display of goods or advertising material, whether it is fully or partly enclosed or entirely open at the rear and whether or not it has a platform raised higher than the street floor level. Sign. See Electric Sign.

**Signaling circuit.** Any electric circuit that energizes signaling equipment.

**Special permission.** The written consent of the authority having jurisdiction.

**Storable swimming or wading pool.** A pool with a maximum dimension of 15 feet and a maximum wall height of 3 feet and is so constructed that it may be readily disassembled for storage and reassembled to its original integrity.

**Switchboard.** A large single panel, frame, or assembly of panels which have switches, buses, instruments, overcurrent and other protective devices mounted on the face or back or both. Switchboards are generally accessible from the rear as well as from the front and are not intended to be installed in cabinets. (See Panelboard.)

### Switches.

- **General-use switch.** A switch intended for use in general distribution and branch circuits. It is rated in amperes, and it is capable of interrupting its rated current at its rated voltage.
- **General-use snap switch.** A form of general-use switch so constructed that it can be installed in flush device boxes or on outlet box covers, or otherwise used in conjunction with wiring systems recognized by this subpart.
- **Isolating switch.** A switch intended for isolating an electric circuit from the source of power. It has no interrupting rating, and it is intended to be operated only after the circuit has been opened by some other means.
- **Motor-circuit switch.** A switch, rated in horsepower, capable of interrupting the maximum operating overload current of a motor of the same horsepower rating as the switch at the rated voltage.
- **Switching devices.** (Over 600 volts, nominal.) Devices designed to close and/or open one or more electric circuits. Included in this category are circuit breakers, cutouts, disconnecting (or isolating) switches, disconnecting means, interrupter switches, and oil (filled) cutouts.

**Transportable X-ray.** X-ray equipment installed in a vehicle or that may readily be disassembled for transport in a vehicle. Utilization equipment. Utilization equipment means equipment which utilizes electric energy for mechanical, chemical, heating, lighting, or similar useful purpose.

**Utilization system.** A utilization system is a system which provides electric power and light for employee workplaces, and includes the premises wiring system and utilization equipment.

**Ventilated.** Provided with a means to permit circulation of air sufficient to remove an excess of heat, fumes, or vapors.



**Volatile flammable liquid.** A flammable liquid having a flash point below 38 degrees C (100 degrees F) or whose temperature is above its flash point.

**Voltage (of a circuit).** The greatest root-mean-square (effective) difference of potential between any two conductors of the circuit concerned.

**Voltage, nominal.** A nominal value assigned to a circuit or system for the purpose of conveniently designating its voltage class (as 120/240, 480Y/277, 600, etc.). The actual voltage at which a circuit operates can vary from the nominal within a range that permits satisfactory operation of equipment.

**Voltage to ground.** For grounded circuits, the voltage between the given conductor and that point or conductor of the circuit that is grounded; for ungrounded circuits, the greatest voltage between the given conductor and any other conductor of the circuit.

**Watertight.** So constructed that moisture will not enter the enclosure.

**Weatherproof.** So constructed or protected that exposure to the weather will not interfere with successful operation. Rainproof, raintight, or watertight equipment can fulfill the requirements for weatherproof where varying weather conditions other than wetness, such as snow, ice, dust, or temperature extremes, are not a factor.

**Wet location.** See Location.

**Wireways.** Wireways are sheet-metal troughs with hinged or removable covers for housing and protecting electric wires and cable and in which conductors are laid in place after the wireway has been installed as a complete system.