

# Great Western Painting

## Electrical Safety Awareness

### **ELECTRICAL WORK - WORKPLACE SAFETY**

#### **Training. 1910.332**

#### **Selection and use of work practices. 1910.333**

#### **Applicability. - 1926.402**

#### **General requirements. - 1926.403**

#### **Wiring design and protection. - 1926.404**

#### **Special systems. - 1926.408**

#### **General requirements. - 1926.416**

#### **Definitions applicable to this subpart. - 1926.449**

### **NFPA 70E Standard for Electrical Safety in the Workplace**

No electrical work shall be performed on electric distribution circuits or equipment, except by a qualified person or by a person trained to perform electrical work and to maintain electrical equipment under the direct supervision of a qualified person. Disconnecting devices shall be locked out and suitably tagged by the persons who perform such work, except that in cases where locking out is not possible, such devices shall be opened and suitably tagged by such persons. Locks or tags shall be removed only by the persons who installed them or, if such persons are unavailable, by persons authorized by the operator or his agent.

Only qualified or trained personnel may perform electrical work.

All electrical work will be done according to the latest adopted National Electrical Code as well as established local codes.

Only qualified persons may work on electric circuit parts or equipment that have not been deenergized. These persons must be made familiar with the use of special precautionary techniques, PPE, insulating & shielding materials and insulated tools.

NOTE: When dealing with safety related work practices to prevent electric shock or other injuries resulting from either direct or indirect electrical contacts, a Qualified Person is defined as one who: "is permitted to work on or near exposed energized parts" and who, at a minimum, has been trained in and is familiar with:

- a. the skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment, and
- b. the skills and techniques necessary to determine the nominal voltage of exposed live parts, and
- c. the clearance distances specified in §1910.333(c) and the corresponding voltages to which the qualified person will be exposed.

**See Page 10 below.**

APPROACH DISTANCES FOR QUALIFIED  
EMPLOYEES - ALTERNATING CURRENT

Voltage range (phase to phase)	Minimum approach distance
300V and less	Avoid Contact
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).

NOTE: When an unqualified person is working 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:

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.

NOTE: When an unqualified person is 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 above.

## ELECTRICAL SAFETY MEASURES

- a. Daily, prior to use, all electrical equipment -- including extension cords -- will be inspected and defective items will be tagged out of service and not used.
- b. With the exception of double insulated tools (with UL approval), all electrical tools and equipment will be grounded.
- c. Tools will not be hoisted by their flexible electrical cords.
- d. Except in an emergency, load rated switches and circuit breakers will be used for the opening and closing of circuits under load conditions as opposed to fuses and splice connections.
- e. While working on electrical equipment, unauthorized persons will be kept clear by barriers or other means of guarding.
- f. Temporary wiring and extension cords will be kept off of walking working surfaces and vehicle traffic areas or covered to prevent tripping and vehicle damage.
  1. Electrical cords will not be suspended with staples, hung from nails, or suspended by wire.
  2. Worn or frayed electric cords or cables will not be used.

- g. Hands will be dry when working on electrical equipment including plugging in extension cords.
- h. Areas in which electrical work is to be done must be adequately illuminated and temporary lighting must:
  - 1. have guards in place.
  - 2. not be suspended by its cords unless specifically designed for such installation.
- i. A competent person, before work commences, will inform all employees in the work area of both exposed and concealed electrical hazards. If appropriate, warning tags will be used to prevent accidental contact with electrical energy.
- j. When working around any electrical power circuit, employees will:
  - 1. **protect themselves by deenergizing the circuit and grounding it or by establishing insulation between themselves and the current.**
  - 2. ensure that any conductive materials and equipment that are in contact with any part of their body will be handled in a manner that will preclude contact with exposed energized conductors or circuit parts.
  - 3. use portable ladders that have non-conductive siderails.
  - 4. remove or insulate conductive articles of jewelry and clothing that might contact exposed energized parts.
- k. All 15, 20, or 30 amp receptacle outlets that are not part of the permanent wiring of the building or structure and that are used by personnel shall have ground-fault circuit interrupter protection for personnel. GFCI pigtails may be used to meet this requirement if properly sized. Remember, extension cords are considered temporary wiring.
  - 1. Ground fault circuit interrupters will be tested before use.
- l. Only qualified persons may perform testing work on electric circuits or equipment.
- m. Sufficient access and working space must be maintained about all electric equipment to permit ready and safe operation and maintenance. This space must be kept clear, i.e., it can not be used for storage.

- n. If any work is to take place under overhead lines, the lines must be deenergized and grounded or other protective measures taken such as physically preventing approach such as using a barrier.
- o. Portable ladders must have non-conductive side rails.
- p. Conductive items of jewelry or clothing must not be worn around electricity unless rendered non-conductive by covering, wrapping, or other insulating means.
- q. The dimension of the working space in the direction of access to live parts likely to required examination, adjustment, service, or maintenance must not be less that noted below:

Working Clearances

Minimum clear distance for conditions<sup>1</sup>

<u>Nominal voltage to ground</u>	<u>(a) Feet<sup>2</sup></u>	<u>(b) Feet<sup>2</sup></u>	<u>(c) Feet<sup>2</sup></u>
0-150	3	3	3
151-600	3	3 ½	4

Footnote<sup>1</sup> Conditions (a), (b), and (c) are as follows:

- {a} Exposed live parts on one side and no live or grounded parts on the other side of the working space, or exposed live parts on both sides effectively guarded by insulating material. Insulated wire or insulated busbars operating at not over 300 volts are not considered live parts.
- {b} Exposed live parts on one side and grounded parts on the other side.
- {c} Exposed live parts on both sides of the workplace [not guarded as provided in Condition (a)] with the operator between.

Minimum Depth of Clear Working Space in Front of Electric Equipment

Conditions<sup>1</sup>

<u>Nominal voltage to ground</u>	<u>(a) Feet<sup>2</sup></u>	<u>(b) Feet<sup>2</sup></u>	<u>(c) Feet<sup>2</sup></u>
601 to 2,500	3	4	5
2,501 to 9,000	4	5	6
9,001 to 25,000	5	6	9
25,001 to 75 kV	6	8	10
Above 75kV	8	10	12

Footnote<sup>1</sup> Conditions (a), (b), and (c) are as follows:

- {a} Exposed live parts on one side and no live or grounded parts on the other side of the working space, or exposed live parts on both sides effectively guarded by insulating materials. Insulated wire or insulated busbars operating at not over 300 volts are not considered live parts.
- {b} Exposed live parts on one side and grounded parts on the other side. Walls constructed of concrete, brick, or tile are considered to be grounded surfaces.
- {c} Exposed live parts on both sides of the workspace [not guarded as provided in Condition (a)] with the operator between.

1. The importance of working clearances cannot be overstated. At any time, when working with live electrical systems, there is the

possibility of an arcing fault causing an arc flash where the current explosively flows through ionized air at 35,000°F causing incurable burns, hearing loss, collapsed lungs, or even death from the electricity of flying metal shrapnel.

2. As an electrical contractor working in a facility where the possibility of arc flash exists, check to see if an arc flash assessment has been performed on electrical equipment on which you will be working. If it has, follow that specific guidance. If it has not, perform (or have a qualified vendor perform) the arc flash assessment. Refer to NFPA 70E for specific guidance appropriate to the facility's specific electrical equipment.

**Note:** NFPA 70E is a National Consensus Standard which is incorporated by reference within the OSHA standards; specifically, Appendix A to Subpart S, 29 CFR 1910. Failure to comply with NFPA 70E is citable under the general duty clause.

### **Heavy equipment and electrical power lines**

Except where electrical distribution and transmissions lines have been deenergized and visibly grounded at point of work or where insulating barriers (not attached to the vehicle) have been erected to prevent physical contact with the lines, the following clearance -- between any part of the equipment, load line, or load **and** the power line -- will be observed:

**Table A—Minimum Clearance Distances Per 29 CFR 1926.1408 & 1409**

<b>Voltage (nominal, kV, alternating current)</b>	<b>Minimum clearance distance(feet)</b>
<b>up to 50</b>	<b>10</b>
<b>over 50 to 200</b>	<b>15</b>
<b>over 200 to 350</b>	<b>20</b>
<b>over 350 to 500</b>	<b>25</b>
<b>over 500 to 750</b>	<b>35</b>
<b>over 750 to 1,000</b>	<b>45</b>
<b>over 1,000</b>	<b>(As established by the utility owner/operator or registered professional engineer who is a qualified person with respect to electrical power transmission and distribution).</b>

**Note:** The value that follows “to” is up to and includes that value. For example, over 50 to 200 means up to and including 200kV.

A ground guide will be designated to observe clearance of the equipment and give warning to the equipment operator in situations where it is difficult for the equipment operator to maintain the desired clearances by visual means.

An overhead wire will be considered energized unless the owner of the line or the electrical utility authorities indicate that it is not energized and it has been visibly grounded.

The above electrical safety measures are not all inclusive, however they cover many normal job site events. A complete list is found in the cited references and they are incorporated into this safety manual. If in doubt about any safety procedure, contact your supervisor or the competent person for clarification.

### **Electrical Shock/Electrocution**

When working near or on deenergized parts, they will be considered energized **unless** they are locked out or tagged out in accordance with our control of hazardous energy program found in Section III of this safety program.

Electrical equipment and lines must be assumed to be energized until proved to be deenergized. Operating voltages of equipment and lines must be determined before working on or near energized parts. One can avoid the hazards of electricity by:

Determining, prior to starting work, the voltages one will be working with and the condition of equipment; deenergizing the line or equipment; wearing the appropriate PPE; maintaining the prescribed distance; and using the appropriate tools.

No employee is permitted to approach or take any conductive object without an approved insulating handle closer to exposed energized parts than shown below unless:

- a. the employee is insulated or guarded from the energized part (gloves or gloves with sleeves rated for the voltage involved shall be considered insulation of the employee from the energized part), **or**
- b. the energized part is insulated or guarded from the employee and any other conductive object at a different potential, **or**
- c. the employee is isolated, insulated, or guarded from any other conductive object(s), as during live-line bare-hand work.

#### Alternating Current -- Minimum Distances

<i>Voltage range (phase to phase) (kilovolt)</i>	<i><sup>1</sup>Minimum working and clear hot stick distance</i>
2.1 to 15	2 ft. 0 in.
15.1 to 35	2 ft. 4 in.
35.1 to 46	2 ft. 6 in.
46.1 to 72.5	3 ft. 0 in.
72.6 to 121	3 ft. 4 in.
138 to 145	3 ft. 6 in.
161 to 169	3 ft. 8 in.

230	to	242	5 ft. 0 in.
345	to	362	<sup>2</sup> 7 ft. 0 in.
500	to	552	<sup>2</sup> 11 ft. 0 in.
700	to	765	<sup>2</sup> 15 ft. 0 in.

Note<sup>1</sup>: The minimum clear hot stick distance is that for the use of live-line tools held by linemen when performing live-line work.

Note<sup>2</sup>: For 345-362 kv., 500-552 kv., and 700-765 kv., minimum clear hot stick distance may be reduced provided that such distances are not less than the shortest distance between the energized part and the grounded surface.

When deenergizing lines and equipment operated in excess of 600 volts, and the means of disconnecting from electric energy is not visibly open or visibly locked out, essentially the provisions of our control of hazardous energy program will be implemented which includes:

- a. clearly identifying and isolating all sources of voltage (hazardous energy).
- b. notification and assurance from the designated employee will be obtained assuring that:
  1. all switches and disconnectors through which electric energy may be supplied to the particular section of line or equipment to be worked have been deenergized;
  2. all switches and disconnectors are plainly tagged indicating that men are at work and, if design allows, they are rendered inoperable.
  3. after all designated switches and disconnectors have been opened, rendered inoperable, and tagged, visual inspection or tests shall be conducted to insure that equipment or lines have been deenergized.
  4. protective grounds shall be applied on the disconnected lines or equipment to be worked on.
  5. guards or barriers will be erected as necessary to adjacent energized lines.
  6. when more than one independent crew requires the same line or equipment to be deenergized, a prominent tag for each such independent crew shall be placed on the line or equipment by the designated employee in charge.
  7. upon completion of work on deenergized lines or equipment, each designated employee in charge shall determine that all employees in his crew are clear, that protective grounds installed by his crew have been removed, and he shall report to the designated authority that all tags protecting his crew may be removed.

When a crew working on a line or equipment can clearly see that the means of disconnecting from electric energy are visibly open or visibly locked-out, then:

- a. guards or barriers will be erected as necessary to adjacent energized lines.
- b. upon completion of work on deenergized lines or equipment, each designated employee in charge of a crew will determine that all employees in the crew are clear, the protective grounds installed by the crew have been removed, and he/she will report to the designated authority that all tags protecting his crew may be removed.

All live-line tools shall be visually inspected before use each day. Prior to use, tools must be wiped clean. Tools with apparent hazardous defects must be tagged and removed from service until tested with portable or laboratory testing equipment.

All rubber insulating equipment will be visually inspected prior to use and an "air test" will be performed on rubber gloves prior to use.

Hard hats for those who have possible exposure to electrical shock or burns must be manufactured in accordance with the provisions of ANSI Z89.2-1971 Industrial Protective Helmets for Electrical Workers, Class B.

Tools, tape, straps, life lines, belts, hoses, and ladders must be non-conductive.

Only live-line tool poles having a manufacturer's certification to withstand the following minimum tests shall be used:

- a. 100,000 volts per foot of length for 5 minutes when the tool is made of fiberglass.
- b. 75,000 volts per foot of length for 3 minutes when the tool is made of wood.

When working on energized lines with live-line tools, insulating high voltage gloves must be worn (and other insulating protective equipment, as required) during the operating of switching, fusing, or disconnecting devices and energizing or deenergizing oil filled electrical equipment that is being worked on. Proper cross-arm extensions or ropes will be used to hold an energized conductor clear.

When ropes or blocks and ropes are used under strain, they must be securely tied off. When tied off to a vehicle, the vehicle must be chocked with the brakes set.

Portable electric hand tools will be:

- a. equipped with a three-wire cord having the ground wire permanently connected to the tool frame and means for grounding the other end; **or**
- b. of the double insulated type and permanently labeled as "Double Insulated"; **or**
- c. connected to the power supply by means of an isolating transformer, or other isolated power supply.

Pneumatic tools which are used on or around energized lines or equipment will have an accumulator on the compressor to collect moisture.

Provided the "on-off" switch may be activated by a single motion of the finger that turned it on, hydraulic tools may, as drills and similar equipment, have a switch that has a lock-on control.

Chain saws and circular saws and similar equipment will have switches that turn off when released.

Aerial lift trucks, when working near energized lines or equipment, must be grounded or barricaded and considered as energized equipment, or the aerial lift truck shall be insulated for the work being performed.

Equipment or material shall not be passed between a pole or structure and an aerial lift while an employee working from the basket is within reaching distance of energized conductors or equipment that are not covered with insulating protective equipment.

Mechanical equipment including derrick trucks, cranes and other lifting equipment, unless certified for work on the proper voltage, must not operate any closer to energized line or equipment as stated in "Alternating Current - Minimum Distances" on the previous pages unless:

- a. an insulated barrier is installed between the energized part and the mechanical equipment, **or**
- b. the mechanical equipment is grounded, **or**
- c. the mechanical equipment is insulated, **or**
- d. the mechanical equipment is considered as energized.

In all cases, conductors and equipment shall be treated as energized until tested or otherwise determined to be deenergized or until grounded. Ensure there is no possibility of induce voltages or contact with energized lines.

When attaching grounds, the ground end shall be attached first, and the other end shall be attached and removed by means of insulated tools or other suitable devices. When removing grounds, the grounding device shall first be removed from the line or equipment using insulating tools or other

suitable devices. Grounds shall be placed between the work location and all sources of energy and as close as practicable to the work location. Grounds may be temporarily removed only when necessary for test purposes and extreme caution shall be exercised during the test procedures.

When grounding electrodes are utilized, such electrodes shall have a resistance to ground low enough to remove the danger of harm to personnel or permit prompt operation of protective devices.

Grounding to tower shall be made with a tower clamp capable of conducting the anticipated fault current.

A ground lead, to be attached to either a tower ground or driven ground, shall be capable of conducting the anticipated fault current and shall have a minimum conductance of No. 2 AWG copper.

### **Confined and Enclosed Spaces**

When working in confined and/or enclosed spaces containing exposed energized parts, adequate illumination will be provided to ensure that work may be performed safely.

When working in confined and/or enclosed spaces containing exposed energized parts, employees will be protected from inadvertent contact with these parts with company provided protective shields, barriers, or other insulating materials.

### **Training:**

**Note: See page 1, above.**

All employees who face electrical hazards that are not reduced to a safe level by the applicable electrical installation requirements will be trained in **safety-related work practices** and procedural requirements as necessary to provide protection from the electrical hazards associated with **their respective job assignments**. Employees will be trained to identify and understand the relationship between electrical hazards and possible injury.

Training will be in a classroom and/or on-the-job and the degree of training will be determined by the risk to the employee. Training will include applicable requirements of **1910.331 through 1910.335 that pertain to their respective job assignments**.

Employees will receive training in emergency procedures including methods of release from contact with exposed energized electrical conductors or circuit parts; methods of first aid; and CPR if the duties warrant such training. The Safety Director will certify that employees have been trained in approved methods of resuscitation annually.

## **Training for Qualified Persons:**

**Note:** A qualified person has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved.

1. Qualified persons must be trained and knowledgeable of the construction and operation of equipment or a specific work method and to recognize and avoid the electrical hazards with respect to the equipment or work methods.
  - a. Qualified persons will be familiar with the proper use of special precautionary techniques, PPE, including arc-flash, insulating and shielding materials, and insulated tools and test equipment.

**Note:** A person can be qualified with respect to certain equipment and methods but still be unqualified for others.

- b. Qualified persons will be permitted to work with the Limited Approach Boundary of exposed energized electrical conductors and circuit parts operating at 50 volts or more and will be trained in the following:
  - 1) The skills and techniques necessary to distinguish exposed energized electrical conductors and circuits parts from other parts of electrical equipment
  - 2) The skills and techniques necessary to determine the nominal voltage of exposed energized electrical conductors and circuit parts.
  - 3) The approach distances specified in Table 130.2(c) and the corresponding voltages to which the qualified person will be exposed.
  - 4) The decision-making process necessary to determine the degree and extent of the hazard and the PPE and job planning necessary to perform the task safely.
- c. If undergoing OJT and, in the course of the OJT has demonstrated an ability to perform duties safely under the direct supervision of a qualified person, this person will be considered qualified for the performance of these duties.
- d. Tasks performed less often than once per year will require retraining before performance of the work practices involved.
- e. Qualified persons will be trained to select an appropriate voltage detector and demonstrate how to use a device to verify the absence of voltage, including interpreting indications provided by the device. Will be trained to understand all limitations of each specific voltage detector that may be used.

## **Training for Unqualified Persons:**

Unqualified persons will be trained in and be familiar with any of the electrical safety related practices that are necessary for their safety.

**NOTE: Unqualified persons will not be permitted to enter spaces that are required to be accessible to qualified employees only unless the electric conductors and equipment involved are in an electrically safe work condition.**

## **Retraining:**

Retraining will be given when.

- a. Supervisors or annual inspections indicate that the employee is not complying with the safety-related work practices.
- b. New technology, new types of equipment, or changes in procedures necessitate the use of safety-related work practices that are different than those the employee would normally use.
- c. If the employee must employ safety-related work practices that are not normally used during regular job duties.

## **Training Documentation:**

The company will document that each employee has received the training above **after** the employee demonstrates proficiency in the work practices involved and will be maintained for the duration of the employee's employment. Training documentation will contain the employee's name and dates of training.