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PUBLIC EMPLOYER ALERT #1 (R9-99)

SAFETY BULLETIN

HIGH VOLTAGE CONTACT

ATTENTION: FIRE SERVICE MANAGERS

September 1999

Incident #1

On March 20, 1993 while fighting a structural fire a firefighter was electrocuted and a second firefighter was seriously injured. The firefighters from this large metropolitan fire department were positioning a 35 foot aluminum extension ladder at the fire scene when the ladder contacted a high voltage line. A third firefighter received a minor electric shock but was not injured.

Incident #2

On October 29, 1994 a similar incident occurred in another metropolitan fire department when a firefighter lost his life and a second firefighter suffered severe burns. During the course of firefighting the ladder of an aerial apparatus was extended between overhead high voltage electrical power lines. While working on the ladder, equipment carried be the firefighter came in contact with the power line resulting in the death of one firefighter and serious injury to a colleague.

In response to these and other similar incidents unions and associations representing firefighters of all levels have requested that the N.J. Department of Labor distribute the OSHA standard covering electrical safety-related work practices. Enclosed you will find the standard. The provisions of 1910.331 through 1910.335 cover electrical safety related work practices for qualified and unqualified personnel.

The importance of electrical safety must be stressed in light of the fatalities and serious injuries in the fire service. The necessity of providing adequate training cannot be understated. Specific consideration must be given to the following critical standards.

1) 29 CFR 1910.332(b)(1): Employees shall be trained in and familiar with the safety-related work practices required by 29 CFR 1910.335 that pertain to his or her respective job assignment.

2) 29 CFR 1910.333(c)(3): Grounding, deenergization, or other protective measures are required when is performed near overhead power lines. Employees working in elevated positions or from the ground shall be a minimum of ten (10) feet from voltages to ground of 50kv or below.

The Office of Public Employee Safety is here to assist you in any way possible. Your comments and suggestions will be appreciated. If you need additional information please contact Assistant Chief Smayda at (609) 292-0767 or via fax at (609) 292-3749.

1910.331(1)

Title	Scope
Subpart	S
Subpart Title	Electrical - Safety-Related Work Practices

(a) Covered work by both qualified and unqualified persons. The provisions of 1910.331 through 1910.335 cover electrical safety 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:

(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;

(2) Wiring for connection to supply. Installations of conductors that connect to the supply of electricity; and

(3) Other wiring. Installations of other outside conductors on the premises.

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

Note: See 1910.399 for the definition of "qualified person." See 1910.332 for training requirements that apply to qualified and unqualified persons.

(b) Other covered work by unqualified persons. The provisions of 1910.331 through 1910.335 also cover work performed by unqualified persons on, near, or with the installations listed in paragraphs (c)(1) through (c)(4) of this section.

(c) Excluded work by qualified persons. The provisions of 1910.331 through 1910.335 do not apply to work performed by qualified persons on or directly associated with the following installations:

(1) Generation, transmission, and distribution of electric energy (including communication and metering) located in buildings used for such purposes or located outdoors.

Note 1: Work on or directly associated with installations of utilization equipment used for purposes other than generating, transmitting, or distributing electric energy (such as installations which are in office buildings, warehouses, garages, machine shops, or recreational buildings, or other utilization installations which are not an integral part of a generating installation, substation, or control center) is covered under paragraph (a)(1) of this section.

Note 2: For work on or directly associated with utilization installations, an employer who complies with the work practices of 1910.269 (electric power generation, transmission, and distribution)

will be deemed to be in compliance with 1910.333(c) and 1910.335. However, the requirements of 1910.332, 1910.333(a), 1910.333(b), and 1910.334 apply to all work on or directly associated with utilization installations, regardless of whether the work is performed by qualified or unqualified persons.

Note 3: Work on or directly associated with generation, transmission, or distribution installations includes:

{1} Work performed directly on such installations, such as repairing overhead or underground distribution lines or repairing a feed-water pump for the boiler in a generating plant.

{2} Work directly associated with such installations, such as line-clearance tree trimming and replacing utility poles.

{3} Work on electric utilization circuits in a generating plant provided that:

{A} Such circuits are commingled with installations of power generation equipment or circuits, and

{B} The generation equipment or circuits present greater electrical hazards than those posed by the utilization equipment or circuits (such as exposure to higher voltages or lack of overcurrent protection).

This work is covered by 1910.269 of this Part.

(2) Communications installations. Installations of communication equipment to the extent that the work is covered under 1910.268.

(3) Installations in vehicles. Installations in ships, watercraft, railway rolling stock, aircraft or automotive vehicles other than mobile homes and recreational vehicles.

(4) Railway installations. Installations of railways for generation, transformation, transmission, or distribution of power used exclusively for operation of rolling stock or installations of railways used exclusively for signaling and communication purposes.

[55 FR 32016, Aug. 6, 1990; 59 FR 4476, Jan. 31, 1994]

1910.332(1)

Title	Training
Subpart	S
Subpart Title	Electrical - Safety-Related Work Practices

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

Note: Employees in occupations listed in Table S-4 face such a risk and are required to be trained. Other employees who also may reasonably be expected to face comparable risk of injury due to electric shock or other electrical hazards must also be trained.

(b)(2) Content of training. **(1)** Practices addressed in this standard. Employees shall be trained in and familiar with the safety-related work practices required by 1910.331 through 1910.335 that pertain to their respective job assignments.

(2) Additional requirements for unqualified persons. Employees who are covered by paragraph (a) of this section but who are not qualified persons shall also be trained in and familiar with any electrically related safety practices not specifically addressed by 1910.331 through 1910.335 but which are necessary for their safety.

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

(i)(3) The skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment.

(ii)(4) The skills and techniques necessary to determine the nominal voltage of exposed live parts, and

(iii)(5) The clearance distances specified in 1910.333(c) and the corresponding voltages to which the qualified person will be exposed.

Note 1: For the purposes of 1910.331 through 1910.335, a person must have the training required by paragraph (b)(3) of this section 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 to meet 1910.333(C)(2).

(c)(6) Type of training. The training required by this section shall be of the classroom or on-the-job type. The degree of training provided shall be determined by the risk to the employee.

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

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

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

[55 FR 32016, Aug. 6, 1990]

OSHA Regulations (Standards - 29 CFR)
Selection and use of work practices - 1910.333

OSHA Regulations (Standards - 29 CFR) - Table of Contents

- **Standard Number:** 1910.333
- **Standard Title:** Selection and use of work practices
- **SubPart Number:** S
- **SubPart Title:** Electrical - Safety-Related Work Practices
- **Applicable Standard:** Applicable Standard:

Interpretation(s)

(a)

"General." Safety-related work practices shall be employed to prevent electric shock or other injuries resulting from either direct or indirect electrical contacts, when 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.

(a)(1)

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

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 infeasibility 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 chemical plant that would otherwise need to be completely shut down in order to permit work on one circuit or piece of equipment.

Note 3: Work on or near deenergized parts is covered by paragraph (b) of this section.

..1910.333(a)(2)

(a)(2)

"Energized parts." If the exposed live parts are not deenergized (i.e., for reasons of increased or additional hazards or infeasibility), other safety-related work practices shall be 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 or circuit parts. Specific work practice requirements are detailed in paragraph (c) of this section.

(b)

"Working on or near exposed deenergized parts."

(b)(1)

"Application." This paragraph applies to work on exposed deenergized parts or near enough to them to expose the employee to any electrical hazard they present. Conductors and parts of electric equipment that have been deenergized but have not been locked out or tagged in accordance with paragraph (b) of this section shall be treated as energized parts, and paragraph (c) of this section applies to work on or near them.

(b)(2)

"Lockout and Tagging." While any employee is exposed to contact with parts of fixed electric equipment or circuits which have been deenergized, the circuits energizing the parts shall be locked out or tagged or both in accordance with the requirements of this paragraph. The requirements shall be followed in the order in which they are presented (i.e., paragraph (b)(2)(i) first, then paragraph (b)(2)(ii), etc.).

Note 1: As used in this section, fixed equipment refers to equipment fastened in place or connected by permanent wiring methods.

Note 2: Lockout and tagging procedures that comply with paragraphs (c) through (f) of 1910.147 will also be deemed to comply with paragraph (b)(2) of this section provided that:

[1] The procedures address the electrical safety hazards covered by this Subpart; and

[2] The procedures also incorporate the requirements of paragraphs (b)(2)(iii)(D) and (b)(2)(iv)(B) of this section.

(b)(2)(i)

"Procedures." The employer shall maintain a written copy of the procedures outlined in paragraph (b)(2) and shall make it available for inspection by employees and by the Assistant Secretary of Labor and his or her authorized representatives.

Note: The written procedures may be in the form of a copy of paragraph (b) of this section.

..1910.333(b)(2)(ii)

(b)(2)(ii)

"Deenergizing equipment."

(b)(2)(ii)(A)

Safe procedures for deenergizing circuits and equipment shall be determined before circuits or equipment are deenergized.

(b)(2)(ii)(B)

The circuits and equipment to be worked on shall be disconnected from all electric energy sources. Control circuit devices, such as push buttons, selector switches, and interlocks, may not be used as the sole means for deenergizing circuits or equipment. Interlocks for electric equipment may not be used as a substitute for lockout and tagging procedures.

(b)(2)(ii)(C)

Stored electric energy which might endanger personnel shall be released. Capacitors shall be discharged and high capacitance elements shall be short-circuited and grounded, if the stored electric energy might endanger personnel.

Note: If the capacitors or associated equipment are handled in meeting this requirement, they shall be treated as energized.

(b)(2)(ii)(D)

Stored non-electrical energy in devices that could reenergize electric circuit parts shall be blocked or relieved to the extent that the circuit parts could not be accidentally energized by the device.

(b)(2)(iii)

"Application of locks and tags."

(b)(2)(iii)(A)

A lock and a tag shall be placed on each disconnecting means used to deenergize circuits and equipment on which work is to be performed, except as provided in paragraphs (b)(2)(iii)(C) and (b)(2)(iii)(E) of this section. The lock shall be attached so as to prevent persons from operating the disconnecting means unless they resort to undue force or the use of tools.

..1910.333(b)(2)(iii)(B)

(b)(2)(iii)(B)

Each tag shall contain a statement prohibiting unauthorized operation of the disconnecting

means and removal of the tag.

(b)(2)(iii)(C)

If a lock cannot be applied, or if the employer can demonstrate that tagging procedures will provide a level of safety equivalent to that obtained by the use of a lock, a tag may be used without a lock.

(b)(2)(iii)(D)

A tag used without a lock, as permitted by paragraph (b)(2)(iii)(C) of this section, shall be supplemented by at least one additional safety measure that provides a level of safety equivalent to that obtained by use of a lock. Examples of additional safety measures include the removal of an isolating circuit element, blocking of a controlling switch, or opening of an extra disconnecting device.

(b)(2)(iii)(E)

A lock may be placed without a tag only under the following conditions:

(b)(2)(iii)(E)(1)

Only one circuit or piece of equipment is deenergized, and

(b)(2)(iii)(E)(2)

The lockout period does not extend beyond the work shift, and

(b)(2)(iii)(E)(3)

Employees exposed to the hazards associated with reenergizing the circuit or equipment are familiar with this procedure.

..1910.333(b)(2)(iv)

(b)(2)(iv)

Verification of deenergized condition. The requirements of this paragraph shall be met before any circuits or equipment can be considered and worked as deenergized.

(b)(2)(iv)(A)

A qualified person shall operate the equipment operating controls or otherwise verify that the equipment cannot be restarted.

(b)(2)(iv)(B)

A qualified person shall use test equipment to test the circuit elements and electrical parts of equipment to which employees will be exposed and shall verify that the circuit elements and equipment parts are deenergized. The test shall also determine if any energized condition exists as a result of inadvertently induced voltage or unrelated voltage backfeed even though

specific parts of the circuit have been deenergized and presumed to be safe. If the circuit to be tested is over 600 volts, nominal, the test equipment shall be checked for proper operation immediately after this test.

(b)(2)(v)

"Reenergizing equipment." These requirements shall be met, in the order given, before circuits or equipment are reenergized, even temporarily.

(b)(2)(v)(A)

A qualified person shall conduct tests and visual inspections, as necessary, to verify that all tools, electrical jumpers, shorts, grounds, and other such devices have been removed, so that the circuits and equipment can be safely energized.

..1910.333(b)(2)(v)(B)

(b)(2)(v)(B)

Employees exposed to the hazards associated with reenergizing the circuit or equipment shall be warned to stay clear of circuits and equipment.

(b)(2)(v)(C)

Each lock and tag shall be removed by the employee who applied it or under his or her direct supervision. However, if this employee is absent from the workplace, then the lock or tag may be removed by a qualified person designated to perform this task provided that:

(b)(2)(v)(C)(1)

The employer ensures that the employee who applied the lock or tag is not available at the workplace, and

(b)(2)(v)(C)(2)

The employer ensures that the employee is aware that the lock or tag has been removed before he or she resumes work at that workplace.

(b)(2)(v)(D)

There shall be a visual determination that all employees are clear of the circuits and equipment.

(c)

"Working on or near exposed energized parts."

(c)(1)

"Application." This paragraph applies to work performed on exposed live parts (involving either direct contact or by means of tools or materials) or near enough to them for employees

to be exposed to any hazard they present.

..1910.333(c)(2)

(c)(2)

"Work on energized equipment." Only qualified persons may work on electric circuit parts or equipment that have not been deenergized under the procedures of paragraph (b) of this section. Such persons shall be capable of working safely 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.

(c)(3)

"Overhead lines." if work is to be performed near overhead lines, the lines shall be deenergized and grounded, or other protective measures shall be provided before work is started. If the lines are to be deenergized, arrangements shall be made with the person or organization that operates or controls the electric circuits involved to deenergize 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.

Note: The work practices used by qualified persons installing insulating devices on overhead power transmission or distribution lines are covered by 1910.269 of this Part, not by 1910.332 through 1910.335 of this Part. Under paragraph (c)(2) of this section, unqualified persons are prohibited from performing this type of work.

(c)(3)(i)

"Unqualified persons."

(c)(3)(i)(A)

When an unqualified person 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:

(c)(3)(i)(A)(1)

For voltages to ground 50kV or below - 10 feet (305 cm);

(c)(3)(i)(A)(2)

For voltages to ground over 50kV - 10 feet (305 cm) plus 4 inches (10 cm) for every 10kV over 50kV.

..1910.333(c)(3)(i)(B)

(c)(3)(i)(B)

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 in paragraph (c)(3)(i)(A) of this section.

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

(c)(3)(ii)

"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 unless:

(c)(3)(ii)(A)

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), or

(c)(3)(ii)(B)

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

(c)(3)(ii)(C)

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

TABLE S-5 - 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).

..1910.333(c)(3)(iii)

(c)(3)(iii)

"Vehicular and mechanical equipment."

(c)(3)(iii)(A)

Any vehicle 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:

(c)(3)(iii)(A)(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 10 kV over that voltage.

(c)(3)(iii)(A)(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 the vehicle or its raised structure, the clearance may be reduced to a distance within the designed working dimensions of the insulating barrier.

(c)(3)(iii)(A)(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.

(c)(3)(iii)(B)

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

(c)(3)(iii)(B)(1)

The employee is using protective equipment rated for the voltage; or

..1910.333(c)(3)(iii)(B)(2)

(c)(3)(iii)(B)(2)

The equipment is located so that no uninsulated 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 permitted in paragraph (c)(3)(iii) of this section.

(c)(3)(iii)(C)

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.

(c)(4)

"Illumination."

(c)(4)(i)

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

(c)(4)(ii)

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.

..1910.333(c)(5)

(c)(5)

"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, the employer shall provide, and the employee shall use, protective shields, protective barriers, or insulating materials as necessary to avoid inadvertent contact with these parts. 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.

(c)(6)

"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. If an employee must handle long dimensional conductive objects (such as ducts and pipes) in areas with exposed live parts, the employer shall institute work practices (such as the use of insulation, guarding, and material handling techniques) which will minimize the hazard.

(c)(7)

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

(c)(8)

"Conductive apparel." Conductive articles of jewelry and clothing (such a 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. However, such articles may be worn if they are rendered nonconductive by covering, wrapping, or other insulating means.

..1910.333(c)(9)

(c)(9)

"Housekeeping duties." Where live 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.

(c)(10)

"Interlocks." Only a qualified person following the requirements of paragraph (c) of this section may defeat an electrical safety interlock, and then only temporarily while he or she is working on the equipment. The interlock system shall be returned to its operable condition when this work is completed.

[55 FR 32016, Aug. 6, 1990; 55 FR 42053, Nov. 1, 1990; as amended at 59 FR 4476, Jan. 31, 1994]

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1910.334(1)

Title Use of equipment.

Subpart S

Subpart Title Electrical - Safety-Related Work Practices

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

(1)(2) "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.

(2)(3) "Visual inspection." **(i)** 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.

(ii)(4) 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.

(iii)(5) When an attachment plug is to be connected to a receptacle (including an 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.

(3)(6) "Grounding type equipment." **(i)** A flexible cord used with grounding type equipment shall contain an equipment grounding conductor.

(ii)(7) 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.

(iii)(8) Adapters which interrupt the continuity of the equipment grounding connection may not be used.

(4)(9) "Conductive work locations." Portable electric equipment and flexible cords used in highly conductive work locations (such a 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.

(5)(10) "Connecting attachment plugs." **(i)** Employees' hands may not

be wet when plugging and unplugging flexible cords and cord and plug connected equipment, if energized equipment is involved.

(ii)(11) 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).

(iii)(12) Locking type connectors shall be properly secured after connection.

(b)(13) "Electric power and lighting circuits." **(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.

(2)(14) "Reclosing circuits after protective device operation." After a circuit is deenergized by a circuit protective device, the 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.

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

(c)(16) "Test instruments and equipment." **(1)** "Use." Only qualified persons may perform testing work on electric circuits or equipment.

(2)(17) "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.

(3)(18) "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.

(d)(19) "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 flyings.

Note: Electrical installation requirements for locations where flammable materials are present on a regular basis are contained in 1910.307.

1910.335(1)

Title	Safeguards for personnel protection.
Subpart	S
Subpart Title	Electrical - Safety-Related Work Practices

(a)(2) Use of protective equipment.(1) Personal protective equipment. (i) 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 this part.

(ii)(3) Protective equipment shall be maintained in a safe, reliable condition and shall be periodically inspected or tested, as required by 1910.137.

(iii)(4) 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.)

(iv)(5) 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.

(v)(6) 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.

(2)(7) General protective equipment and tools.(i) 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.

(A)(8) Fuse handling equipment, insulated for the circuit voltage, shall be used to remove or install fuses when the fuse terminals are energized.

(B)(9) Ropes and handlines used near exposed energized parts shall be nonconductive.

(ii)(10) 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. 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.

(b) Alerting techniques. The following 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:

(1)(11) 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 1910.145.

(2)(12) 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 uninsulated energized conductors or circuit parts. Conductive barricades may not be used where they might cause an electrical contact hazard.

(3)(13) 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.

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