

# Oregon OSHA Proposed Changes to the Electrical Standard in Division 2/S, General Industry/Electrical

February 2009

Text proposed to be added/adopted is in **bold and underlined**.

Text proposed to be removed/repealed is in [~~brackets with line through~~].

---

§1910.303 General.

**(a)** Approval. The conductors and equipment required or permitted by this subpart shall be acceptable only if approved, as defined in §1910.399.

**(b)** Examination, installation, and use of equipment.

**(1)** Examination. Electric equipment shall be free from recognized hazards that are likely to cause death or serious physical harm to employees. Safety of equipment shall be determined using the following considerations:

**(i)** Suitability for installation and use in conformity with the provisions of this subpart;

NOTE: Suitability of equipment for an identified purpose may be evidenced by listing or labeling for that identified purpose.

**(ii)** Mechanical strength and durability, including, for parts designed to enclose and protect other equipment, the adequacy of the protection thus provided;

**(iii)** Wire-bending and connection space;

**(iv)** Electrical insulation;

**(v)** Heating effects under conditions of use;

**(vi)** Arcing effects;

**(vii)** Classification by type, size, voltage, current capacity, specific use; and

**(viii)** Other factors which contribute to the practical safeguarding of persons using or likely to come in contact with the equipment.

- (2) Installation and use.** Listed or labeled equipment shall be used or installed in accordance with any instructions included in the listing or labeling.
- (3) Insulation integrity.** Completed wiring installations shall be free from short circuits and from grounds other than those required or permitted by this subpart.
- (4) Interrupting rating.** Equipment intended to interrupt current at fault levels shall have an interrupting rating sufficient for the nominal circuit voltage and the current that is available at the line terminals of the equipment. Equipment intended to interrupt current at other than fault levels shall have an interrupting rating at nominal circuit voltage sufficient for the current that must be interrupted.
- (5) Circuit impedance and other characteristics.** The overcurrent protective devices, the total impedance, the component short-circuit current ratings, and other characteristics of the circuit to be protected shall be selected and coordinated to permit the circuit protective devices used to clear a fault to do so without the occurrence of extensive damage to the electrical components of the circuit. This fault shall be assumed to be either between two or more of the circuit conductors, or between any circuit conductor and the grounding conductor or enclosing metal raceway.
- (6) Deteriorating agents.** Unless identified for use in the operating environment, no conductors or equipment shall be located in damp or wet locations; where exposed to gases, fumes, vapors, liquids, or other agents that have a deteriorating effect on the conductors or equipment; or where exposed to excessive temperatures.
- (7) Mechanical execution of work.** Electric equipment shall be installed in a neat and workmanlike manner.
- (i)** Unused openings in boxes, raceways, auxiliary gutters, cabinets, equipment cases, or housings shall be effectively closed to afford protection substantially equivalent to the wall of the equipment.
  - (ii)** Conductors shall be racked to provide ready and safe access in underground and subsurface enclosures that persons enter for installation and maintenance.
  - (iii)** Internal parts of electrical equipment, including busbars, wiring terminals, insulators, and other surfaces, may not be damaged or contaminated by foreign materials such as paint, plaster, cleaners, abrasives, or corrosive residues.
  - (iv)** There shall be no damaged parts that may adversely affect safe operation or mechanical strength of the equipment, such as parts that are broken, bent, cut, or deteriorated by corrosion, chemical action, or overheating.
- (8) Mounting and cooling of equipment.**
- (i)** Electric equipment shall be firmly secured to the surface on which it is mounted.

Note to paragraph (b)(8)(i) of this section: Wooden plugs driven into holes in masonry, concrete, plaster, or similar materials are not considered secure means of fastening electric equipment.

**(ii)** Electric equipment that depends on the natural circulation of air and convection principles for cooling of exposed surfaces shall be installed so that room airflow over such surfaces is not prevented by walls or by adjacent installed equipment. For equipment designed for floor mounting, clearance between top surfaces and adjacent surfaces shall be provided to dissipate rising warm air.

**(iii)** Electric equipment provided with ventilating openings shall be installed so that walls or other obstructions do not prevent the free circulation of air through the equipment.

**(c)** Electrical connections.

**(1)** General. Because of different characteristics of dissimilar metals:

**(i)** Devices such as pressure terminal or pressure splicing connectors and soldering lugs shall be identified for the material of the conductor and shall be properly installed and used;

**(ii)** Conductors of dissimilar metals may not be intermixed in a terminal or splicing connector where physical contact occurs between dissimilar conductors (such as copper and aluminum, copper and copper-clad aluminum, or aluminum and copper-clad aluminum) unless the device is identified for the purpose and conditions of use; and

**(iii)** Materials such as solder, fluxes, inhibitors, and compounds, where employed, shall be suitable for the use and shall be of a type that will not adversely affect the conductors, installation, or equipment.

**(2)** Terminals.

**(i)** Connection of conductors to terminal parts shall ensure a good connection without damaging the conductors and shall be made by means of pressure connectors (including set-screw type), solder lugs, or splices to flexible leads. However, No. 10 or smaller conductors may be connected by means of wire binding screws or studs and nuts having upturned lugs or equivalent.

**(ii)** Terminals for more than one conductor and terminals used to connect aluminum shall be so identified.

**(3)** Splices.

**(i)** Conductors shall be spliced or joined with splicing devices identified for the use or by brazing, welding, or soldering with a fusible metal or alloy. Soldered splices shall first be spliced or joined to be mechanically and electrically secure without solder and then soldered. All splices and joints and the free ends of

conductors shall be covered with an insulation equivalent to that of the conductors or with an insulating device identified for the purpose.

(ii) Wire connectors or splicing means installed on conductors for direct burial shall be listed for such use.

(d) Arcing parts. Parts of electric equipment that in ordinary operation produce arcs, sparks, flames, or molten metal shall be enclosed or separated and isolated from all combustible material.

(e) Marking.

(1) Identification of manufacturer and ratings. Electric equipment may not be used unless the following markings have been placed on the equipment:

(i) The manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the product may be identified; and

(ii) Other markings giving voltage, current, wattage, or other ratings as necessary.

(2) Durability. The marking shall be of sufficient durability to withstand the environment involved.

(f) Disconnecting means and circuits.

(1) Motors and appliances. Each disconnecting means required by this subpart for motors and appliances shall be legibly marked to indicate its purpose, unless located and arranged so the purpose is evident.

(2) Services, feeders, and branch circuits. Each service, feeder, and branch circuit, at its disconnecting means or overcurrent device, shall be legibly marked to indicate its purpose, unless located and arranged so the purpose is evident.

(3) Durability of markings. The markings required by paragraphs (f)(1) and (f)(2) of this section shall be of sufficient durability to withstand the environment involved.

(4) Capable of accepting a lock. Disconnecting means required by this subpart shall be capable of being locked in the open position.

(5) Marking for series combination ratings.

(i) Where circuit breakers or fuses are applied in compliance with the series combination ratings marked on the equipment by the manufacturer, the equipment enclosures shall be legibly marked in the field to indicate that the equipment has been applied with a series combination rating.

(ii) The marking required by paragraph (f)(5)(i) of this section shall be readily visible and shall state "Caution -- Series Combination System Rated Amperes. Identified Replacement Component Required."

**(g)** 600 Volts, nominal, or less. This paragraph applies to electric equipment operating at 600 volts, nominal, or less to ground.

**(1)** Space about electric equipment. Sufficient access and working space shall be provided and maintained about all electric equipment to permit ready and safe operation and maintenance of such equipment.

**(i)** Working space for equipment likely to require examination, adjustment, servicing, or maintenance while energized shall comply with the following dimensions, except as required or permitted elsewhere in this subpart:

**(A)** The depth of the working space in the direction of access to live parts may not be less than indicated in Table S-1. Distances shall be measured from the live parts if they are exposed or from the enclosure front or opening if they are enclosed;

**(B)** The width of working space in front of the electric equipment shall be the width of the equipment or 762 mm (30 in.), whichever is greater. In all cases, the working space shall permit at least a 90-degree opening of equipment doors or hinged panels; and

**(C)** The work space shall be clear and extend from the grade, floor, or platform to the height required by paragraph (g)(1)(vi) of this section. However, other equipment associated with the electrical installation and located above or below the electric equipment may extend not more than 153 mm (6 in.) beyond the front of the electric equipment.

**(ii)** Working space required by this standard may not be used for storage. When normally enclosed live parts are exposed for inspection or servicing, the working space, if in a passageway or general open space, shall be suitably guarded.

**(iii)** At least one entrance of sufficient area shall be provided to give access to the working space about electric equipment.

**(iv)** For equipment rated 1200 amperes or more and over 1.83 m (6.0 ft) wide, containing overcurrent devices, switching devices, or control devices, there shall be one entrance not less than 610 mm (24 in.) wide and 1.98 m (6.5 ft) high at each end of the working space, except that:

**(A)** Where the location permits a continuous and unobstructed way of exit travel, one means of exit is permitted; or

**(B)** Where the working space required by paragraph (g)(1)(i) of this section is doubled, only one entrance to the working space is required; however, the entrance shall be located so that the edge of the entrance nearest the equipment is the minimum clear distance given in Table S-1 away from such equipment.

(v) Illumination shall be provided for all working spaces about service equipment, switchboards, panelboards, and motor control centers installed indoors. Additional lighting fixtures are not required where the working space is illuminated by an adjacent light source. In electric equipment rooms, the illumination may not be controlled by automatic means only.

(vi) The minimum headroom of working spaces about service equipment, switchboards, panelboards, or motor control centers shall be as follows:

(A) For installations built before August 13, 2007, 1.91 m (6.25 ft); and

(B) For installations built on or after August 13, 2007, 1.98 m (6.5 ft), except that where the electrical equipment exceeds 1.98 m (6.5 ft) in height, the minimum headroom may not be less than the height of the equipment.

Table S-1. – Minimum Depth of Clear Working Space at Electric Equipment, 600 V or Less

Nominal voltage to ground	Minimum clear distance for condition <sup>2 3</sup>					
	Condition A		Condition B		Condition C	
	m	ft	m	ft	m	ft
0-	<sup>1</sup> 0.9	<sup>1</sup> 3.0	<sup>1</sup> 0.9	<sup>1</sup> 3.0	0.9	3.0
150.....	<sup>1</sup> 0.9	<sup>1</sup> 3.0	1.0	3.5	1.2	4.0
.....						
151-						
600.....						
.....						

Notes to Table S-1:

- 1 Minimum clear distances may be 0.7 m (2.5 ft) for installations built before April 16, 1981.
- 2 Conditions A, B, and C are as follows:
  - Condition 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 suitable wood or other insulating material. Insulated wire or insulated busbars operating at not over 300 volts are not considered live parts.
  - Condition B -- Exposed live parts on one side and grounded parts on the other side.
  - Condition C -- Exposed live parts on both sides of the work space (not guarded as provided in Condition A) with the operator between.
- 3 Working space is not required in back of assemblies such as dead-front switchboards or motor control centers where there are no renewable or adjustable parts (such as fuses or switches) on the back and where all connections are accessible from locations other than the back. Where rear access is required to work on deenergized parts on the back of enclosed equipment, a minimum working space of 762 mm (30 in.) horizontally shall be provided.

**(vii)** Switchboards, panelboards, and distribution boards installed for the control of light and power circuits, and motor control centers shall be located in dedicated spaces and protected from damage.

**(A)** For indoor installation, the dedicated space shall comply with the following:

(1) The space equal to the width and depth of the equipment and extending from the floor to a height of 1.83 m (6.0 ft) above the equipment or to the structural ceiling, whichever is lower, shall be dedicated to the electrical installation. Unless isolated from equipment by height or physical enclosures or covers that will afford adequate mechanical protection from vehicular traffic or accidental contact by unauthorized personnel or that complies with paragraph (g)(1)(vii)(A)(2) of this section, piping, ducts, or equipment foreign to the electrical installation may not be located in this area;

(2) The space equal to the width and depth of the equipment shall be kept clear of foreign systems unless protection is provided to avoid damage from condensation, leaks, or breaks in such foreign systems. This area shall extend from the top of the electric equipment to the structural ceiling;

(3) Sprinkler protection is permitted for the dedicated space where the piping complies with this section; and

(4) Control equipment that by its very nature or because of other requirements in this subpart must be adjacent to or within sight of its operating machinery is permitted in the dedicated space.

Note to paragraph (g)(1)(vii)(A) of this section: A dropped, suspended, or similar ceiling that does not add strength to the building structure is not considered a structural ceiling.

**(B)** Outdoor electric equipment shall be installed in suitable enclosures and shall be protected from accidental contact by unauthorized personnel, or by vehicular traffic, or by accidental spillage or leakage from piping systems. No architectural appurtenance or other equipment may be located in the working space required by paragraph (g)(1)(i) of this section.

**(2)** Guarding of live parts.

**(i)** Except as elsewhere required or permitted by this standard, live parts of electric equipment operating at 50 volts or more shall be guarded against accidental contact by use of approved cabinets or other forms of approved enclosures or by any of the following means:

**(A)** By location in a room, vault, or similar enclosure that is accessible only to qualified persons;

**(B)** By suitable permanent, substantial partitions or screens so arranged so that only qualified persons will have access to the space within reach of the live parts. Any openings in such partitions or screens shall be so sized and located that persons are not likely to come into accidental contact with the live parts or to bring conducting objects into contact with them;

**(C)** By placement on a suitable balcony, gallery, or platform so elevated and otherwise located as to prevent access by unqualified persons; or

**(D)** By elevation of 2.44 m (8.0 ft) or more above the floor or other working surface.

**(ii)** In locations where electric equipment is likely to be exposed to physical damage, enclosures or guards shall be so arranged and of such strength as to prevent such damage.

**(iii)** Entrances to rooms and other guarded locations containing exposed live parts shall be marked with conspicuous warning signs forbidding unqualified persons to enter.

**(h)** Over 600 volts, nominal.

**(1)** General. Conductors and equipment used on circuits exceeding 600 volts, nominal, shall comply with all applicable provisions of the paragraphs (a) through (g) of this section and with the following provisions, which supplement or modify the preceding requirements. However, paragraphs (h)(2), (h)(3), and (h)(4) of this section do not apply to the equipment on the supply side of the service point.

**(2)** Enclosure for electrical installations.

**(i)** Electrical installations in a vault, room, or closet or in an area surrounded by a wall, screen, or fence, access to which is controlled by lock and key or other approved means, are considered to be accessible to qualified persons only. The type of enclosure used in a given case shall be designed and constructed according to the hazards associated with the installation.

**(ii)** For installations other than equipment described in paragraph (h)(2)(v) of this section, a wall, screen, or fence shall be used to enclose an outdoor electrical installation to deter access by persons who are not qualified. A fence may not be less than 2.13 m (7.0 ft) in height or a combination of 1.80 m (6.0 ft) or more of fence fabric and a 305-mm (1-ft) or more extension utilizing three or more strands of barbed wire or equivalent.

**(iii)** The following requirements apply to indoor installations that are accessible to other than qualified persons:

**(A)** The installations shall be made with metal-enclosed equipment or shall be enclosed in a vault or in an area to which access is controlled by a lock;

**(B)** Metal-enclosed switchgear, unit substations, transformers, pull boxes, connection boxes, and other similar associated equipment shall be marked with appropriate caution signs; and

**(C)** Openings in ventilated dry-type transformers and similar openings in other equipment shall be designed so that foreign objects inserted through these openings will be deflected from energized parts.

**(iv)** Outdoor electrical installations having exposed live parts shall be accessible to qualified persons only.

**(v)** The following requirements apply to outdoor enclosed equipment accessible to unqualified employees:

**(A)** Ventilating or similar openings in equipment shall be so designed that foreign objects inserted through these openings will be deflected from energized parts;

**(B)** Where exposed to physical damage from vehicular traffic, suitable guards shall be provided;

**(C)** Nonmetallic or metal-enclosed equipment located outdoors and accessible to the general public shall be designed so that exposed nuts or bolts cannot be readily removed, permitting access to live parts;

**(D)** Where nonmetallic or metal-enclosed equipment is accessible to the general public and the bottom of the enclosure is less than 2.44 m (8.0 ft) above the floor or grade level, the enclosure door or hinged cover shall be kept locked; and

**(E)** Except for underground box covers that weigh over 45.4 kg (100 lb), doors and covers of enclosures used solely as pull boxes, splice boxes, or junction boxes shall be locked, bolted, or screwed on.

**(3)** Workspace about equipment. Sufficient space shall be provided and maintained about electric equipment to permit ready and safe operation and maintenance of such equipment. Where energized parts are exposed, the minimum clear work space may not be less than 1.98 m (6.5 ft) high (measured vertically from the floor or platform) or less than 914 mm (3.0 ft) wide (measured parallel to the equipment). The depth shall be as required in paragraph (h)(5)(i) of this section. In all cases, the work space shall be adequate to permit at least a 90-degree opening of doors or hinged panels.

**(4)** Entrance and access to work space.

**(i)** At least one entrance not less than 610 mm (24 in.) wide and 1.98 m (6.5 ft) high shall be provided to give access to the working space about electric equipment.

- (A)** On switchboard and control panels exceeding 1.83 m (6.0 ft) in width, there shall be one entrance at each end of such boards unless the location of the switchboards and control panels permits a continuous and unobstructed way of exit travel, or unless the work space required in paragraph (h)(5)(i) of this section is doubled.
- (B)** Where one entrance to the working space is permitted under the conditions described in paragraph (h)(4)(i)(A) of this section, the entrance shall be located so that the edge of the entrance nearest the switchboards and control panels is at least the minimum clear distance given in Table S-2 away from such equipment.
- (C)** Where bare energized parts at any voltage or insulated energized parts above 600 volts, nominal, to ground are located adjacent to such entrance, they shall be suitably guarded.
- (ii)** Permanent ladders or stairways shall be provided to give safe access to the working space around electric equipment installed on platforms, balconies, mezzanine floors, or in attic or roof rooms or spaces.
- (5) Working space and guarding.**
- (i)** Except as elsewhere required or permitted in this subpart, the minimum clear working space in the direction of access to live parts of electric equipment may not be less than specified in Table S-2. Distances shall be measured from the live parts, if they are exposed, or from the enclosure front or opening, if they are enclosed.
- (ii)** If switches, cutouts, or other equipment operating at 600 volts, nominal, or less, are installed in a room or enclosure where there are exposed live parts or exposed wiring operating at over 600 volts, nominal, the high-voltage equipment shall be effectively separated from the space occupied by the low-voltage equipment by a suitable partition, fence, or screen. However, switches or other equipment operating at 600 volts, nominal, or less, and serving only equipment within the high-voltage vault, room, or enclosure may be installed in the high-voltage enclosure, room, or vault if accessible to qualified persons only.
- (iii)** The following requirements apply to the entrances to all buildings, rooms, or enclosures containing exposed live parts or exposed conductors operating at over 600 volts, nominal:
- (A)** The entrances shall be kept locked unless they are under the observation of a qualified person at all times; and
- (B)** Permanent and conspicuous warning signs shall be provided, reading substantially as follows:

"DANGER -- HIGH VOLTAGE -- KEEP OUT."

(iv) Illumination shall be provided for all working spaces about electric equipment.

(A) The lighting outlets shall be arranged so that persons changing lamps or making repairs on the lighting system will not be endangered by live parts or other equipment.

(B) The points of control shall be located so that persons are prevented from contacting any live part or moving part of the equipment while turning on the lights.

(v) Unguarded live parts above working space shall be maintained at elevations not less than specified in Table S-3.

(vi) Pipes or ducts that are foreign to the electrical installation and that require periodic maintenance or whose malfunction would endanger the operation of the electrical system may not be located in the vicinity of service equipment, metal-enclosed power switchgear, or industrial control assemblies. Protection shall be provided where necessary to avoid damage from condensation leaks and breaks in such foreign systems.

Note to paragraph (h)(5)(vi) of this section: Piping and other facilities are not considered foreign if provided for fire protection of the electrical installation.

Table S-2. – Minimum Depth of Clear Working Space at Electric Equipment, Over 600 V

Nominal voltage to ground	Minimum clear distance for condition <sup>2 3</sup>					
	Condition A		Condition B		Condition C	
	m	ft	m	ft	m	ft
601-2500 V	0.9	3.0	1.2	4.0	1.5	5.0
.....	1.2	4.0	1.5	5.0	1.8	6.0
2501-9000 V	1.5	5.0	1.8	6.0	2.8	9.0
.....	1.8	6.0	2.5	8.0	3.0	10.0
9001 V – 25 kV	2.5	8.0	3.0	10.0	3.7	12.0
.....						
Over 25 – 75 kV <sup>1</sup>						
.....						
Above 75 kV <sup>1</sup>						
.....						

Notes to Table S-2:

1 Minimum depth of clear working space in front of electric equipment with a nominal voltage to ground above 25,000 volts may be the same as that for 25,000 volts under Conditions A, B, and C for installations built before April 16, 1981.

2 Conditions A, B, and C are as follows:

Condition 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 suitable wood or other insulating material. Insulated wire or insulated busbars operating at not over 300 volts are not considered live parts.

Condition B – Exposed live parts on one side and grounded parts on the other side. Concrete, brick, and tile walls are considered as grounded surfaces.

Condition C – Exposed live parts on both sides of the work space (not guarded as provided in Condition A) with the operator between.

3 Working space is not required in back of equipment such as dead-front switchboards or control assemblies that has no renewable or adjustable parts (such as fuses or switches) on the back and where all connections are accessible from locations other than the back. Where rear access is required to work on the deenergized parts on the back of enclosed equipment, a minimum working space 762 mm (30 in.) horizontally shall be provided.

Table S-3. – Elevation of Unguarded Live Parts Above Working Space

Nominal voltage between phases	Elevation	
	m	ft
601 – 7500 V	<sup>1</sup> 2.8[4] 2.8	<sup>1</sup> 9.0[4] 9.0
7501 V – 35 kV	2.8 + 9.5 mm/kV over 35 kV	9.0 + 0.37 in./kV over 35 kV
Over 35 kV		

1 The minimum elevation may be 2.6 m (8.5 ft) for installations built before August 13, 2007. The minimum elevation may be 2.4 m (8.0 ft) for installations built before April 16, 1981, if the nominal voltage between phases is in the range of 601-6600 volts.

[46 FR 4056, Jan. 16, 1981; 46 FR 40185, Aug. 7, 1981; 72 FR 7191, Feb. 14, 2007]

Stat. Auth.: ORS 654.025(2) and 656.726(4).

Stat. Implemented: ORS 654.001 through 654.295.

Hist: OR-OSHA Admin. Order 2-1991, f. 2/4/91, ef. 4/1/91.

OR-OSHA Admin. Order 4-2007, f. 8/15/07, ef. 8/15/07.

**OR-OSHA Admin. Order X-2009, f. X/XX/09, ef. X/XX/09.**

§1910.304 Wiring Design and Protection.

**(a)** Use and identification of grounded and grounding conductors.

**(1)** Identification of conductors.

**(i)** A conductor used as a grounded conductor shall be identifiable and distinguishable from all other conductors.

**(ii)** A conductor used as an equipment grounding conductor shall be identifiable and distinguishable from all other conductors.

**(2)** Polarity of connections. No grounded conductor may be attached to any terminal or lead so as to reverse designated polarity.

**(3)** Use of grounding terminals and devices. A grounding terminal or grounding-type device on a receptacle, cord connector, or attachment plug may not be used for purposes other than grounding.

**(b)** Branch circuits.

**(1)** Identification of multiwire branch circuits. Where more than one nominal voltage system exists in a building containing multiwire branch circuits, each ungrounded conductor of a multiwire branch circuit, where accessible, shall be identified by phase and system. The means of identification shall be permanently posted at each branch-circuit panelboard.

**(2)** Receptacles and cord connectors.

**(i)** Receptacles installed on 15- and 20-ampere branch circuits shall be of the grounding type except as permitted for replacement receptacles in paragraph (b)(2)(iv) of this section. Grounding-type receptacles shall be installed only on circuits of the voltage class and current for which they are rated, except as provided in Table S-4 and Table S-5.

**(ii)** Receptacles and cord connectors having grounding contacts shall have those contacts effectively grounded except for receptacles mounted on portable and vehicle-mounted generators in accordance with paragraph (g)(3) of this section and replacement receptacles installed in accordance with paragraph (b)(2)(iv) of this section.

**(iii)** The grounding contacts of receptacles and cord connectors shall be grounded by connection to the equipment grounding conductor of the circuit supplying the receptacle or cord connector. The branch circuit wiring method shall include or provide an equipment grounding conductor to which the grounding contacts of the receptacle or cord connector shall be connected.

**(iv)** Replacement of receptacles shall comply with the following requirements:

(A) Where a grounding means exists in the receptacle enclosure or a grounding conductor is installed, grounding-type receptacles shall be used and shall be connected to the grounding means or conductor;

(B) Ground-fault circuit-interrupter protected receptacles shall be provided where replacements are made at receptacle outlets that are required to be so protected elsewhere in this subpart; and

(C) Where a grounding means does not exist in the receptacle enclosure, the installation shall comply with one of the following provisions:

(1) A nongrounding-type receptacle may be replaced with another nongrounding-type receptacle; or

(2) A nongrounding-type receptacle may be replaced with a ground-fault circuit-interrupter-type of receptacle that is marked "No Equipment Ground;" an equipment grounding conductor may not be connected from the ground-fault circuit-interrupter-type receptacle to any outlet supplied from the ground-fault circuit-interrupter receptacle; or

(3) A nongrounding-type receptacle may be replaced with a grounding-type receptacle where supplied through a ground-fault circuit-interrupter; the replacement receptacle shall be marked "GFCI Protected" and "No Equipment Ground;" an equipment grounding conductor may not be connected to such grounding-type receptacles.

(v) Receptacles connected to circuits having different voltages, frequencies, or types of current (ac or dc) on the same premises shall be of such design that the attachment plugs used on these circuits are not interchangeable.

(3) Ground-fault circuit interrupter protection for personnel.

(i) All 125-volt, single-phase, 15- and 20-ampere receptacles installed in bathrooms or on rooftops shall have ground-fault circuit-interrupter protection for personnel.

(ii) The following requirements apply to temporary wiring installations that are used during **construction-like activities, including** certain maintenance, remodeling, or repair **activities,** involving [øf] buildings, structures[;] or equipment [~~or during similar construction-like activities~~].

(A) All 125-volt, single-phase, 15-, 20-, and 30-ampere receptacle outlets that are not part of the permanent wiring of the building or structure and that are in use by personnel shall have ground-fault circuit-interrupter protection for personnel.

Note 1 to paragraph (b)(3)(ii)(A) of this section: A cord connector on an extension cord set is considered to be a receptacle outlet if the cord set is used for temporary electric power.

Note 2 to paragraph (b)(3)(ii)(A) of this section: Cord sets and devices incorporating the required ground-fault circuit-interrupter that are connected to the receptacle closest to the source of power are acceptable forms of protection.

**(B)** Receptacles other than 125 volt, single-phase, 15-, 20-, and 30-ampere receptacles that are not part of the permanent wiring of the building or structure and that are in use by personnel shall have ground-fault circuit-interrupter protection for personnel.

**(C)** Where the ground-fault circuit-interrupter protection required by paragraph (b)(3)(ii)(B) of this section is not available for receptacles other than 125-volt, single-phase, 15-, 20-, and 30-ampere, the employer shall establish and implement an assured equipment grounding conductor program covering cord sets, receptacles that are not a part of the building or structure, and equipment connected by cord and plug that are available for use or used by employees on those receptacles. This program shall comply with the following requirements:

(1) A written description of the program, including the specific procedures adopted by the employer, shall be available at the jobsite for inspection and copying by the Assistant Secretary of Labor and any affected employee;

(2) The employer shall designate one or more competent persons to implement the program;

(3) Each cord set, attachment cap, plug, and receptacle of cord sets, and any equipment connected by cord and plug, except cord sets and receptacles which are fixed and not exposed to damage, shall be visually inspected before each day's use for external defects, such as deformed or missing pins or insulation damage, and for indications of possible internal damage. Equipment found damaged or defective shall not be used until repaired;

(4) The following tests shall be performed on all cord sets and receptacles which are not a part of the permanent wiring of the building or structure, and cord- and plug-connected equipment required to be grounded:

(i) All equipment grounding conductors shall be tested for continuity and shall be electrically continuous;

(ii) Each receptacle and attachment cap or plug shall be tested for correct attachment of the equipment grounding conductor. The equipment grounding conductor shall be connected to its proper terminal; and

(iii) All required tests shall be performed before first use; before equipment is returned to service following any repairs; before equipment is used after any incident which can be reasonably suspected to have caused damage (for example, when a cord set is run over); and at intervals not to exceed 3 months, except that cord sets and receptacles which are fixed and not exposed to damage shall be tested at intervals not exceeding 6 months;

(5) The employer shall not make available or permit the use by employees of any equipment which has not met the requirements of paragraph (b)(3)(ii)(C) of this section; and

(6) Tests performed as required in paragraph (b)(3)(ii)(C) of this section shall be recorded. This test record shall identify each receptacle, cord set, and cord- and plug-connected equipment that passed the test and shall indicate the last date it was tested or the interval for which it was tested. This record shall be kept by means of logs, color coding, or other effective means and shall be maintained until replaced by a more current record. The record shall be made available on the jobsite for inspection by the Assistant Secretary and any affected employee.

**(4) Outlet devices.** Outlet devices shall have an ampere rating not less than the load to be served and shall comply with the following provisions:

(i) Where connected to a branch circuit having a rating in excess of 20 amperes, lampholders shall be of the heavy-duty type. A heavy-duty lampholder shall have a rating of not less than 660 watts if of the admedium type and not less than 750 watts if of any other type; and

(ii) Receptacle outlets shall comply with the following provisions:

**(A)** A single receptacle installed on an individual branch circuit shall have an ampere rating of not less than that of the branch circuit;

**(B)** Where connected to a branch circuit supplying two or more receptacles or outlets, a receptacle may not supply a total cord- and plug-connected load in excess of the maximum specified in Table S-4; and

**(C)** Where connected to a branch circuit supplying two or more receptacles or outlets, receptacle ratings shall conform to the values listed in Table S-5; or, where larger than 50 amperes, the receptacle rating may not be less than the branch-circuit rating. However, receptacles of cord- and plug-connected arc welders may have ampere ratings not less than the minimum branch-circuit conductor ampacity.

**(5) Cord connections.** A receptacle outlet shall be installed wherever flexible cords with attachment plugs are used. Where flexible cords are permitted to be permanently connected, receptacles may be omitted.

Table S-4. -- Maximum Cord- and Plug-Connected Load to Receptacle

Circuit rating (amperes)	Receptacle rating (amperes)	Maximum load (amperes)
15 or 20	15	12
.....	20	16
20	30	24
.....		
30		
.....		

Table S-5. – Receptacle Ratings for Various Size Circuits

Circuit rating (amperes)	Receptacle rating (amperes)
15	Not over 15
.....	15 or 20
20	30
.....	40 or 50
30	50
.....	
40	
.....	
50	
.....	

(c) Outside conductors, 600 volts, nominal, or less. The following requirements apply to branch-circuit, feeder, and service conductors rated 600 volts, nominal, or less and run outdoors as open conductors.

(1) Conductors on poles. Conductors on poles shall have a separation of not less than 305 mm (1.0 ft) where not placed on racks or brackets. Conductors supported on poles shall provide a horizontal climbing space not less than the following:

(i) Power conductors below communication conductors – 762 mm (30 in.);

(ii) Power conductors alone or above communication conductors:

(A) 300 volts or less – 610 mm (24 in.);

(B) Over 300 volts – 762 mm (30 in.);

(iii) Communication conductors below power conductors – same as power conductors; and

(iv) Communications conductors alone – no requirement.

(2) Clearance from ground. Open conductors, open multiconductor cables, and service-drop conductors of not over 600 volts, nominal, shall conform to the minimum clearances specified in Table S-6.

Table S-6. – Clearances From Ground

Distance	Installations built before August 13, 2007		Installations built on or After August 13, 2007	
	Maximum Voltage	Conditions	Voltage to ground	Conditions
3.05 m (10.0 ft)	<600 V	Above finished grade or side-walks, or from any platform or projection from which they might be reached. (If these areas are accessible to other than pedestrian traffic, then one of the other conditions applies).	<150 V	Above finished grade or side-walks, or from any platform or projection from which they might be reached. (If these areas are accessible to other than pedestrian traffic, then one of the other conditions applies.)
3.66 m (12.0 ft)	<600 V	Over areas, other than public streets, alleys, roads, and driveways, subject to vehicular traffic other than truck traffic.	<300 V	Over residential property and driveways. Over commercial areas subject to pedestrian traffic or to vehicular traffic other than truck traffic. (This category includes conditions covered under the 3.05m (10.0-ft) category where the voltage exceeds 150 V.)
4.57 m (15.0 ft)	<600 V	Over areas, other than public streets, alleys, roads, and driveways, subject to truck traffic.	<301 to 600 V	Over residential property and driveways. Over commercial areas subject to pedestrian traffic or to vehicular traffic other than truck traffic. (This category includes conditions covered under the 3.05-m (10.0-ft)

				category where the voltage exceeds 300 V.)
5.49 m (18.0 ft)	<600 V	Over public streets, alleys, roads, and driveways.	<600 V	Over public streets, alleys, roads, and driveways. Over commercial areas subject to truck traffic. Other land traversed by vehicles, including land used for cultivating or grazing and forests and orchards.

**(3) Clearance from building openings.**

**(i)** Service conductors installed as open conductors or multiconductor cable without an overall outer jacket shall have a clearance of not less than 914 mm (3.0 ft) from windows that are designed to be opened, doors, porches, balconies, ladders, stairs, fire escapes, and similar locations. However, conductors that run above the top level of a window may be less than 914 mm (3.0 ft) from the window. Vertical clearance of final spans above, or within 914 mm (3.0 ft) measured horizontally of, platforms, projections, or surfaces from which they might be reached shall be maintained in accordance with paragraph (c)(2) of this section.

**(ii)** Overhead service conductors may not be installed beneath openings through which materials may be moved, such as openings in farm and commercial buildings, and may not be installed where they will obstruct entrance to these building openings.

**(4) Above roofs.** Overhead spans of open conductors and open multiconductor cables shall have a vertical clearance of not less than 2.44 m (8.0 ft) above the roof surface. The vertical clearance above the roof level shall be maintained for a distance not less than 914 mm (3.0 ft) in all directions from the edge of the roof.

**(i)** The area above a roof surface subject to pedestrian or vehicular traffic shall have a vertical clearance from the roof surface in accordance with the clearance requirements of paragraph (c)(2) of this section.

**(ii)** A reduction in clearance to 914 mm (3.0 ft) is permitted where the voltage between conductors does not exceed 300 and the roof has a slope of 102 mm (4 in.) in 305 mm (12 in.) or greater.

**(iii)** A reduction in clearance above only the overhanging portion of the roof to not less than 457 mm (18 in.) is permitted where the voltage between conductors does not exceed 300 if:

**(A)** The conductors do not pass above the roof overhang for a distance of more than 1.83 m (6.0 ft), 1.22 m (4.0 ft) horizontally, and

**(B)** The conductors are terminated at a through-the-roof raceway or approved support.

**(iv)** The requirement for maintaining a vertical clearance of 914 mm (3.0 ft) from the edge of the roof does not apply to the final conductor span, where the conductors are attached to the side of a building.

**(d)** Location of outdoor lamps. Lamps for outdoor lighting shall be located below all live conductors, transformers, or other electric equipment, unless such equipment is controlled by a disconnecting means that can be locked in the open position or unless adequate clearances or other safeguards are provided for relamping operations.

**(e)** Services.

**(1)** Disconnecting means.

**(i)** Means shall be provided to disconnect all conductors in a building or other structure from the service-entrance conductors. The service disconnecting means shall plainly indicate whether it is in the open or closed position and shall be installed at a readily accessible location nearest the point of entrance of the service-entrance conductors.

**(ii)** Each service disconnecting means shall simultaneously disconnect all ungrounded conductors.

**(iii)** Each service disconnecting means shall be suitable for the prevailing conditions.

**(2)** Services over 600 volts, nominal. The following additional requirements apply to services over 600 volts, nominal.

**(i)** Service-entrance conductors installed as open wires shall be guarded to make them accessible only to qualified persons.

**(ii)** Signs warning of high voltage shall be posted where unqualified employees might come in contact with live parts.

**(f)** Overcurrent protection.

**(1)** 600 volts, nominal, or less. The following requirements apply to overcurrent protection of circuits rated 600 volts, nominal, or less.

**(i)** Conductors and equipment shall be protected from overcurrent in accordance with their ability to safely conduct current.

**(ii)** Except for motor running overload protection, overcurrent devices may not interrupt the continuity of the grounded conductor unless all conductors of the circuit are opened simultaneously.

**(iii)** A disconnecting means shall be provided on the supply side of all fuses in circuits over 150 volts to ground and cartridge fuses in circuits of any voltage where accessible to other than qualified persons so that each individual circuit containing fuses can be independently disconnected from the source of power. However, a current-limiting device without a disconnecting means is permitted on the supply side of the service disconnecting means. In addition, a single disconnecting means is permitted on the supply side of more than one set of fuses as permitted by the exception in §1910.305(j)(4)(vi) for group operation of motors, and a single disconnecting means is permitted for fixed electric space-heating equipment.

**(iv)** Overcurrent devices shall be readily accessible to each employee or authorized building management personnel. These overcurrent devices may not be located where they will be exposed to physical damage or in the vicinity of easily ignitable material.

**(v)** Fuses and circuit breakers shall be so located or shielded that employees will not be burned or otherwise injured by their operation. Handles or levers of circuit breakers, and similar parts that may move suddenly in such a way that persons in the vicinity are likely to be injured by being struck by them, shall be guarded or isolated.

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

**(vii)** Where circuit breaker handles on switchboards are operated vertically rather than horizontally or rotationally, the up position of the handle shall be the closed (on) position.

**(viii)** Circuit breakers used as switches in 120-volt and 277-volt, fluorescent lighting circuits shall be listed and marked "SWD."

**(ix)** A circuit breaker with a straight voltage rating, such as 240 V or 480 V, may only be installed in a circuit in which the nominal voltage between any two conductors does not exceed the circuit breaker's voltage rating. A two-pole circuit breaker may not be used for protecting a 3-phase, corner-grounded delta circuit unless the circuit breaker is marked 1 $\Phi$  -- 3 $\Phi$  to indicate such suitability. A circuit breaker with a slash rating, such as 120/240 V or 480Y/277 V, may only be installed in a circuit where the nominal voltage of any conductor to ground does not exceed the lower of the two values of the circuit breaker's voltage rating and

the nominal voltage between any two conductors does not exceed the higher value of the circuit breaker's voltage rating.

**(2) Feeders and branch circuits over 600 volts, nominal.** The following requirements apply to feeders and branch circuits energized at more than 600 volts, nominal:

**(i) Feeder and branch-circuit conductors shall have overcurrent protection in each ungrounded conductor located at the point where the conductor receives its supply or at a location in the circuit determined under engineering supervision;**

**(A)** Circuit breakers used for overcurrent protection of three-phase circuits shall have a minimum of three overcurrent relays operated from three current transformers. On three-phase, three-wire circuits, an overcurrent relay in the residual circuit of the current transformers may replace one of the phase relays. An overcurrent relay, operated from a current transformer that links all phases of a three-phase, three-wire circuit, may replace the residual relay and one other phase-conductor current transformer. Where the neutral is not grounded on the load side of the circuit, the current transformer may link all three phase conductors and the grounded circuit conductor (neutral); and

**(B)** If fuses are used for overcurrent protection, a fuse shall be connected in series with each ungrounded conductor;

**(ii)** Each protective device shall be capable of detecting and interrupting all values of current that can occur at its location in excess of its trip setting or melting point;

**(iii)** The operating time of the protective device, the available short-circuit current, and the conductor used shall be coordinated to prevent damaging or dangerous temperatures in conductors or conductor insulation under short-circuit conditions; and

**(iv)** The following additional requirements apply to feeders only:

**(A)** The continuous ampere rating of a fuse may not exceed three times the ampacity of the conductors. The long-time trip element setting of a breaker or the minimum trip setting of an electronically actuated fuse may not exceed six times the ampacity of the conductor. For fire pumps, conductors may be protected for short circuit only; and

**(B)** Conductors tapped to a feeder may be protected by the feeder overcurrent device where that overcurrent device also protects the tap conductor.

**(g) Grounding.** Paragraphs (g)(1) through (g)(9) of this section contain grounding requirements for systems, circuits, and equipment.

**(1) Systems to be grounded.** Systems that supply premises wiring shall be grounded as follows:

- (i) All 3-wire DC systems shall have their neutral conductor grounded;
- (ii) Two-wire DC systems operating at over 50 volts through 300 volts between conductors shall be grounded unless:
  - (A) They supply only industrial equipment in limited areas and are equipped with a ground detector;
  - (B) They are rectifier-derived from an ac system complying with paragraphs (g)(1)(iii), (g)(1)(iv), and (g)(1)(v) of this section; or
  - (C) They are fire-alarm circuits having a maximum current of 0.030 amperes;
- (iii) AC circuits of less than 50 volts shall be grounded if they are installed as overhead conductors outside of buildings or if they are supplied by transformers and the transformer primary supply system is ungrounded or exceeds 150 volts to ground;
- (iv) AC systems of 50 volts to 1000 volts shall be grounded under any of the following conditions, unless exempted by paragraph (g)(1)(v) of this section:
  - (A) If the system can be so grounded that the maximum voltage to ground on the ungrounded conductors does not exceed 150 volts;
  - (B) If the system is nominally rated three-phase, four-wire wye connected in which the neutral is used as a circuit conductor;
  - (C) If the system is nominally rated three-phase, four-wire delta connected in which the midpoint of one phase is used as a circuit conductor; or
  - (D) If a service conductor is uninsulated;
- (v) AC systems of 50 volts to 1000 volts are not required to be grounded under any of the following conditions:
  - (A) If the system is used exclusively to supply industrial electric furnaces for melting, refining, tempering, and the like;
  - (B) If the system is separately derived and is used exclusively for rectifiers supplying only adjustable speed industrial drives;
  - (C) If the system is separately derived and is supplied by a transformer that has a primary voltage rating less than 1000 volts, provided all of the following conditions are met:
    - (1) The system is used exclusively for control circuits;
    - (2) The conditions of maintenance and supervision ensure that only qualified persons will service the installation;

(3) Continuity of control power is required; and

(4) Ground detectors are installed on the control system;

**(D)** If the system is an isolated power system that supplies circuits in health care facilities; or

**(E)** If the system is a high-impedance grounded neutral system in which a grounding impedance, usually a resistor, limits the ground-fault current to a low value for 3-phase ac systems of 480 volts to 1000 volts provided all of the following conditions are met:

(1) The conditions of maintenance and supervision ensure that only qualified persons will service the installation;

(2) Continuity of power is required;

(3) Ground detectors are installed on the system; and

(4) Line-to-neutral loads are not served.

**(2)** Conductor to be grounded. The conductor to be grounded for ac premises wiring systems required to be grounded by paragraph (g)(1) of this section shall be as follows:

(i) One conductor of a single-phase, two-wire system shall be grounded;

(ii) The neutral conductor of a single-phase, three-wire system shall be grounded;

(iii) The common conductor of a multiphase system having one wire common to all phases shall be grounded;

(iv) One phase conductor of a multiphase system where one phase is grounded shall be grounded; and

(v) The neutral conductor of a multiphase system in which one phase is used as a neutral conductor shall be grounded.

**(3)** Portable and vehicle-mounted generators.

(i) The frame of a portable generator need not be grounded and may serve as the grounding electrode for a system supplied by the generator under the following conditions:

**(A)** The generator supplies only equipment mounted on the generator or cord- and plug-connected equipment through receptacles mounted on the generator, or both; and

- (B)** The noncurrent-carrying metal parts of equipment and the equipment grounding conductor terminals of the receptacles are bonded to the generator frame.
- (ii)** The frame of a vehicle need not be grounded and may serve as the grounding electrode for a system supplied by a generator located on the vehicle under the following conditions:

  - (A)** The frame of the generator is bonded to the vehicle frame;
  - (B)** The generator supplies only equipment located on the vehicle and cord- and plug-connected equipment through receptacles mounted on the vehicle;
  - (C)** The noncurrent-carrying metal parts of equipment and the equipment grounding conductor terminals of the receptacles are bonded to the generator frame; and
  - (D)** The system complies with all other provisions of paragraph (g) of this section.
- (iii)** A system conductor that is required to be grounded by the provisions of paragraph (g)(2) of this section shall be bonded to the generator frame where the generator is a component of a separately derived system.

**(4)** Grounding connections.

- (i)** For a grounded system, a grounding electrode conductor shall be used to connect both the equipment grounding conductor and the grounded circuit conductor to the grounding electrode. Both the equipment grounding conductor and the grounding electrode conductor shall be connected to the grounded circuit conductor on the supply side of the service disconnecting means or on the supply side of the system disconnecting means or overcurrent devices if the system is separately derived.
- (ii)** For an ungrounded service-supplied system, the equipment grounding conductor shall be connected to the grounding electrode conductor at the service equipment. For an ungrounded separately derived system, the equipment grounding conductor shall be connected to the grounding electrode conductor at, or ahead of, the system disconnecting means or overcurrent devices.
- (iii)** On extensions of existing branch circuits that do not have an equipment grounding conductor, grounding-type receptacles may be grounded to a grounded cold water pipe near the equipment if the extension was installed before August 13, 2007. When any element of this branch circuit is replaced, the entire branch circuit shall use an equipment grounding conductor that complies with all other provisions of paragraph (g) of this section.

**(5)** Grounding path. The path to ground from circuits, equipment, and enclosures shall be permanent, continuous, and effective.

**(6) Supports, enclosures, and equipment to be grounded.**

**(i) Metal cable trays, metal raceways, and metal enclosures for conductors shall be grounded, except that:**

**(A) Metal enclosures such as sleeves that are used to protect cable assemblies from physical damage need not be grounded; and**

**(B) Metal enclosures for conductors added to existing installations of open wire, knob-and-tube wiring, and nonmetallic-sheathed cable need not be grounded if all of the following conditions are met:**

**(1) Runs are less than 7.62 meters (25.0 ft);**

**(2) Enclosures are free from probable contact with ground, grounded metal, metal laths, or other conductive materials; and**

**(3) Enclosures are guarded against employee contact.**

**(ii) Metal enclosures for service equipment shall be grounded.**

**(iii) Frames of electric ranges, wall-mounted ovens, counter-mounted cooking units, clothes dryers, and metal outlet or junction boxes that are part of the circuit for these appliances shall be grounded.**

**(iv) Exposed noncurrent-carrying metal parts of fixed equipment that may become energized shall be grounded under any of the following conditions:**

**(A) If within 2.44 m (8 ft) vertically or 1.52 m (5 ft) horizontally of ground or grounded metal objects and subject to employee contact;**

**(B) If located in a wet or damp location and not isolated;**

**(C) If in electrical contact with metal;**

**(D) If in a hazardous (classified) location;**

**(E) If supplied by a metal-clad, metal-sheathed, or grounded metal raceway wiring method; or**

**(F) If equipment operates with any terminal at over 150 volts to ground.**

**(v) Notwithstanding the provisions of paragraph (g)(6)(iv) of this section, exposed noncurrent-carrying metal parts of the following types of fixed equipment need not be grounded:**

**(A) Enclosures for switches or circuit breakers used for other than service equipment and accessible to qualified persons only;**

- (B)** Electrically heated appliances that are permanently and effectively insulated from ground;
  - (C)** Distribution apparatus, such as transformer and capacitor cases, mounted on wooden poles, at a height exceeding 2.44 m (8.0 ft) above ground or grade level; and
  - (D)** Listed equipment protected by a system of double insulation, or its equivalent, and distinctively marked as such.
- (vi)** Exposed noncurrent-carrying metal parts of cord- and plug-connected equipment that may become energized shall be grounded under any of the following conditions:
- (A)** If in hazardous (classified) locations (see §1910.307);
  - (B)** If operated at over 150 volts to ground, except for guarded motors and metal frames of electrically heated appliances if the appliance frames are permanently and effectively insulated from ground;
  - (C)** If the equipment is of the following types:
    - (1)* Refrigerators, freezers, and air conditioners;
    - (2)* Clothes-washing, clothes-drying, and dishwashing machines, sump pumps, and electric aquarium equipment;
    - (3)* Hand-held motor-operated tools, stationary and fixed motor-operated tools, and light industrial motor-operated tools;
    - (4)* Motor-operated appliances of the following types: hedge clippers, lawn mowers, snow blowers, and wet scrubbers;
    - (5)* Cord- and plug-connected appliances used in damp or wet locations, or by employees standing on the ground or on metal floors or working inside of metal tanks or boilers;
    - (6)* Portable and mobile X-ray and associated equipment;
    - (7)* Tools likely to be used in wet and conductive locations; and
    - (8)* Portable hand lamps.
- (vii)** Notwithstanding the provisions of paragraph (g)(6)(vi) of this section, the following equipment need not be grounded:
- (A)** Tools likely to be used in wet and conductive locations if supplied through an isolating transformer with an ungrounded secondary of not over 50 volts; and

**(B)** Listed or labeled portable tools and appliances if protected by an approved system of double insulation, or its equivalent, and distinctively marked.

**(7)** Nonelectrical equipment. The metal parts of the following nonelectrical equipment shall be grounded: frames and tracks of electrically operated cranes and hoists; frames of nonelectrically driven elevator cars to which electric conductors are attached; hand-operated metal shifting ropes or cables of electric elevators; and metal partitions, grill work, and similar metal enclosures around equipment of over 750 volts between conductors.

**(8)** Methods of grounding fixed equipment.

**(i)** Noncurrent-carrying metal parts of fixed equipment, if required to be grounded by this subpart, shall be grounded by an equipment grounding conductor that is contained within the same raceway, cable, or cord, or runs with or encloses the circuit conductors. For dc circuits only, the equipment grounding conductor may be run separately from the circuit conductors.

**(ii)** Electric equipment is considered to be effectively grounded if it is secured to, and in electrical contact with, a metal rack or structure that is provided for its support and the metal rack or structure is grounded by the method specified for the noncurrent-carrying metal parts of fixed equipment in paragraph (g)(8)(i) of this section. Metal car frames supported by metal hoisting cables attached to or running over metal sheaves or drums of grounded elevator machines are also considered to be effectively grounded.

**(iii)** For installations made before April 16, 1981, electric equipment is also considered to be effectively grounded if it is secured to, and in metallic contact with, the grounded structural metal frame of a building. When any element of this branch circuit is replaced, the entire branch circuit shall use an equipment grounding conductor that complies with all other provisions of paragraph (g) of this section.

**(9)** Grounding of systems and circuits of 1000 volts and over (high voltage). If high voltage systems are grounded, they shall comply with all applicable provisions of paragraphs (g)(1) through (g)(8) of this section as supplemented and modified by the following requirements:

**(i)** Systems supplying portable or mobile high voltage equipment, other than substations installed on a temporary basis, shall comply with the following:

**(A)** The system shall have its neutral grounded through an impedance. If a delta-connected high voltage system is used to supply the equipment, a system neutral shall be derived.

(B) Exposed noncurrent-carrying metal parts of portable and mobile equipment shall be connected by an equipment grounding conductor to the point at which the system neutral impedance is grounded.

(C) Ground-fault detection and relaying shall be provided to automatically deenergize any high voltage system component that has developed a ground fault. The continuity of the equipment grounding conductor shall be continuously monitored so as to deenergize automatically the high voltage feeder to the portable equipment upon loss of continuity of the equipment grounding conductor.

(D) The grounding electrode to which the portable equipment system neutral impedance is connected shall be isolated from and separated in the ground by at least 6.1 m (20.0 ft) from any other system or equipment grounding electrode, and there shall be no direct connection between the grounding electrodes, such as buried pipe, fence, and so forth.

(ii) All noncurrent-carrying metal parts of portable equipment and fixed equipment, including their associated fences, housings, enclosures, and supporting structures, shall be grounded. However, equipment that is guarded by location and isolated from ground need not be grounded. Additionally, pole-mounted distribution apparatus at a height exceeding 2.44 m (8.0 ft) above ground or grade level need not be grounded.

[46 FR 4056, Jan. 16, 1981; 46 FR 40185, Aug. 7, 1981, as amended at 55 FR 32015, Aug. 6, 1990; 72 FR 7195, Feb. 14, 2007]

Stat. Auth.: ORS 654.025(2) and 656.726(4).

Stat. Implemented: ORS 654.001 through 654.295.

Hist: OR-OSHA Admin. Order 2-1991, f. 2/4/91, ef. 4/1/91.

OR-OSHA Admin. Order 4-2007, f. 8/15/07, ef. 8/15/07.

**OR-OSHA Admin. Order X-2009, f. X/XX/09, ef. X/XX/09.**