

WAC 296-155-449 Wiring methods, components, and equipment for general use. (1) **Wiring methods.** The provisions of this subsection do not apply to conductors which form an integral part of equipment such as motors, controllers, motor control centers and like equipment.

(a) **General requirements.**

(i) **Electrical continuity of metal raceways and enclosures.** Metal raceways, cable armor, and other metal enclosures for conductors must be metallically joined together into a continuous electric conductor and must be so connected to all boxes, fittings, and cabinets as to provide effective electrical continuity.

(ii) **Wiring in ducts.** You must not install any wiring systems of any type in ducts used to transport dust, loose stock or flammable vapors. You must not install any wiring system of any type in any duct used for vapor removal or in any shaft containing only such ducts.

(iii) Receptacles for attachment plugs must be approved, concealed contact type with a contact for extending ground continuity and must be so designed and constructed that the plug may be pulled out without leaving any live parts exposed to accidental contact. All temporary outlet boxes must be of a type suitable for use in wet or damp locations.

(iv) Attachment plugs or other connectors supplying equipment at more than 300 volts must be of the skirted type or otherwise so designed that arcs will be confined.

(b) **Temporary wiring.**

(i) Scope. The provisions of (b) of this subsection apply to temporary electrical power and lighting wiring methods which may be of a class less than would be required for a permanent installation. Except as specifically modified in (b) of this subsection, all other requirements of this part for permanent wiring must apply to temporary wiring installations. You must remove temporary wiring immediately upon completion of construction or the purpose for which the wiring was installed.

(ii) General requirements for temporary wiring.

(A) Feeders must originate in a distribution center. The conductors must be run as multiconductor cord or cable assemblies or within raceways; or, where not subject to physical damage, they may be run as open conductors on insulators not more than 10 feet (3.05 m) apart.

(B) Branch circuits must originate in a power outlet or panel-board. Conductors must be run as multiconductor cord or cable assemblies or open conductors, or must be run in raceways. You must protect all conductors by overcurrent devices at their ampacity. You must locate runs of open conductors where the conductors will not be subject to physical damage, and the conductors must be fastened at intervals not exceeding 10 feet (3.05 m). You must not lay any branch-circuit conductors on the floor. Each branch circuit that supplies receptacles or fixed equipment must contain a separate equipment grounding conductor if the branch circuit is run as open conductors.

(C) Receptacles must be of the grounding type. Unless installed in a complete metallic raceway, each branch circuit must contain a separate equipment grounding conductor, and all receptacles must be electrically connected to the grounding conductor. You must not install receptacles for uses other than temporary lighting on branch circuits which supply temporary lighting. You not connect receptacles to the same ungrounded conductor of multiwire circuits which supply temporary lighting.

(D) You must install disconnecting switches or plug connectors to permit the disconnection of all ungrounded conductors of each temporary circuit.

(E) You must protect all lamps for general illumination from accidental contact or breakage. Metal-case sockets must be grounded.

(F) Temporary lights must be equipped with hard usage (S or SJ types) electric cords with connections and insulation maintained in safe condition. "Brewery" cord (type CBO or NB) may be substituted for hard usage cord provided it is protected from physical damages. You must not suspend temporary lights by their electric cords unless cords and lights are designed for this means of suspension. Splices must retain the insulation, outer sheath properties, flexibility, and usage characteristics of the cord being spliced.

When pin-type connectors or lampholders are utilized, the area of perforations caused by lampholder removal must be restored to the insulation capabilities of the cord.

(G) You must operate portable electric lighting used in wet and/or other conductive locations, as for example, drums, tanks, and vessels at 12 volts or less. However, 120-volt lights may be used if protected by a ground-fault circuit interrupter.

(H) You must use a box wherever a change is made to a raceway system or a cable system which is metal clad or metal sheathed.

(I) You must protect flexible cords and cables from damage. You must avoid sharp corners and projections. Flexible cords and cables may pass through doorways or other pinch points, if protection is provided to avoid damage.

(J) Extension cord sets used with portable electric tools and appliances must be of 3-wire type and must be designed for hard or extra-hard usage. Flexible cords used with temporary and portable lights must be designed for hard or extra-hard usage.

Note: The National Electrical Code, ANSI/NFPA 70, in Article 400, Table 400-4, lists various types of flexible cords, some of which are noted as being designed for hard or extra-hard usage. Examples of these types of flexible cords include hard service cord (types S, ST, SO, STO) and junior hard service cord (types SJ, SJO, SJT, SJTO).

(iii) **Guarding.** For temporary wiring over 600 volts, you must provide nominal, fencing, barriers, or other effective means to prevent access of other than authorized and qualified personnel.

(2) **Cabinets, boxes, and fittings.**

(a) **Conductors entering boxes, cabinets, or fittings.** You must protect conductors entering boxes, cabinets, or fittings from abrasion, and you must effectively close openings through which conductors enter. You must also effectively close openings in cabinets, boxes, and fittings.

(b) **Covers and canopies.** You must provide all pull boxes, junction boxes, and fittings with covers. If metal covers are used, they must be grounded. In energized installations each outlet box must have a cover, faceplate, or fixture canopy. You must provide covers of outlet boxes having holes through which flexible cord pendants pass with bushings designed for the purpose or they must have smooth, well-rounded surfaces on which the cords may bear.

(c) Pull and junction boxes for systems over 600 volts, nominal. In addition to other requirements in this section for pull and junction boxes, the following must apply to these boxes for systems over 600 volts, nominal:

(i) **Complete enclosure.** Boxes must provide a complete enclosure for the contained conductors or cables.

(ii) **Covers.** You must close boxes by covers securely fastened in place. Underground box covers that weigh over 100 pounds (43.6 kg)

meet this requirement. You must permanently mark covers for boxes "HIGH VOLTAGE." The marking must be on the outside of the box cover and must be readily visible and legible.

(3) **Knife switches.** Single-throw knife switches must be so connected that the blades are dead when the switch is in the open position. Single-throw knife switches must be so placed that gravity will not tend to close them. You must provide single-throw knife switches approved for use in the inverted position with a locking device that will ensure that the blades remain in the open position when so set. Double-throw knife switches may be mounted so that the throw will be either vertical or horizontal. However, if the throw is vertical, you must provide a locking device to ensure that the blades remain in the open position when so set.

(4) **Switchboards and panelboards.** You must locate switchboards that have any exposed live parts in permanently dry locations and accessible only to qualified persons. You must mount panelboards in cabinets, cutout boxes, or enclosures designed for the purpose and they must be dead front. However, panelboards other than the dead front externally operable type are permitted where accessible only to qualified persons. Exposed blades of knife switches must be dead when open.

(5) **Enclosures for damp or wet locations.**

(a) **Cabinets, fittings, and boxes.** You must install cabinets, cutout boxes, fittings, boxes, and panelboard enclosures in damp or wet locations so as to prevent moisture or water from entering and accumulating within the enclosures. In wet locations the enclosures must be weatherproof.

(b) **Switches and circuit breakers.** Switches, circuit breakers, and switchboards installed in wet locations must be enclosed in weatherproof enclosures.

(6) **Conductors for general wiring.** All conductors used for general wiring must be insulated unless otherwise permitted in this part. The conductor insulation must be of a type that is suitable for the voltage, operating temperature, and location of use. Insulated conductors must be distinguishable by appropriate color or other means as being grounded conductors, ungrounded conductors, or equipment grounding conductors.

(7) **Flexible cords and cables.**

(a) **Use of flexible cords and cables.**

(i) **Permitted uses.** Flexible cords and cables must be suitable for conditions of use and location. You must use flexible cords and cables only for:

(A) Pendants;

(B) Wiring of fixtures;

(C) Connection of portable lamps or appliances;

(D) Elevator cables;

(E) Wiring of cranes and hoists;

(F) Connection of stationary equipment to facilitate their frequent interchange;

(G) Prevention of the transmission of noise or vibration; or

(H) Appliances where the fastening means and mechanical connections are designed to permit removal for maintenance and repair.

(ii) **Attachment plugs for cords.** If used as permitted in (a)(i)(C), (F), or (H) of this subsection, the flexible cord must be equipped with an attachment plug and must be energized from a receptacle outlet.

(iii) **Prohibited uses.** Unless necessary for a use permitted in (a)(i) of this subsection, flexible cords and cables must not be used:

- (A) As a substitute for the fixed wiring of a structure;
- (B) Where run through holes in walls, ceilings, or floors;
- (C) Where run through doorways, windows, or similar openings, except as permitted in subsection (1)(b)(ii)(I) of this section;
- (D) Where attached to building surfaces; or
- (E) Where concealed behind building walls, ceilings, or floors.

(b) **Identification, splices, and terminations.**

(i) **Identification.** A conductor of a flexible cord or cable that is used as a grounded conductor or an equipment grounding conductor must be distinguishable from other conductors.

(ii) **Marking.** You must not use type SJ, SJO, SJT, SJTO, S, SO, ST, and STO cords unless durably marked on the surface with the type designation, size, and number of conductors.

(iii) **Splices.** You must only use flexible cords in continuous lengths without splice or tap. Hard service flexible cords No. 12 or larger may be repaired if spliced so that the splice retains the insulation, outer sheath properties, and usage characteristics of the cord being spliced.

(iv) **Strain relief.** You must connect flexible cords to devices and fittings so that strain relief is provided which will prevent pull from being directly transmitted to joints or terminal screws.

(v) **Cords passing through holes.** You must protect flexible cords and cables by bushings or fittings where passing through holes in covers, outlet boxes, or similar enclosures.

(vi) Trailing cables must be protected from damage.

(vii) You must cover or elevate cord and cable passing through work areas to protect it from damage which would create a hazard to employees.

(8) **Portable cables over 600 volts, nominal.** Multiconductor portable cable for use in supplying power to portable or mobile equipment at over 600 volts, nominal, must consist of No. 8 or larger conductors employing flexible stranding. You must shield cables operated at over 2000 volts for the purpose of confining the voltage stresses to the insulation. You must provide grounding conductors. Connectors for these cables must be of a locking type with provisions to prevent their opening or closing while energized. You must provide strain relief at connections and terminations. You must not operate portable cables with splices unless the splices are of the permanent molded, vulcanized, or other equivalent type. Termination enclosures must be marked with a high voltage hazard warning, and terminations must be accessible only to authorized and qualified personnel.

(9) **Fixture wires.**

(a) **General.** Fixture wires must be suitable for the voltage, temperature, and location of use. You must identify a fixture wire which is used as a grounded conductor.

(b) **Uses permitted.** Fixture wires may be used:

(i) For installation in lighting, fixtures and in similar equipment where enclosed or protected and not subject to bending or twisting in use; or

(ii) For connecting lighting fixtures to the branch-circuit conductors supplying the fixtures.

(c) **Uses not permitted.** You must not use fixture wires as branch-circuit conductors except as permitted for Class 1 power-limited circuits.

(10) **Equipment for general use.**

(a) Lighting fixtures, lampholders, lamps, and receptacles.

(i) **Live parts.** Fixtures, lampholders, lamps, rosettes, and receptacles must have no live parts normally exposed to employee contact. However, rosettes and cleat-type lampholders and receptacles located at least 8 feet (2.44 m) above the floor may have exposed parts.

(ii) **Support.** Fixtures, lampholders, rosettes, and receptacles must be securely supported. A fixture that weighs more than 6 pounds (2.72 kg) or exceeds 16 inches (406 mm) in any dimension must not be supported by the screw shell of a lampholder.

(iii) **Portable lamps.** Portable lamps must be wired with flexible cord and an attachment plug of the polarized or grounding type. If the portable lamp uses an Edison-based lampholder, the grounded conductor must be identified and attached to the screw shell and the identified blade of the attachment plug. In addition, portable handlamps must comply with the following:

(A) You must not use metal shell, paperlined lampholders;

(B) Handlamps must be equipped with a handle of molded composition or other insulating material;

(C) Handlamps must be equipped with a substantial guard attached to the lampholder or handle;

(D) Metallic guards must be grounded by the means of an equipment grounding conductor run within the power supply cord.

(iv) **Lampholders.** You must install lampholders of the screw-shell type for use as lampholders only. Lampholders installed in wet or damp locations must be of the weatherproof type.

(v) **Fixtures.** You must identify fixtures installed in wet or damp locations for the purpose and you must install them so that water cannot enter or accumulate in wireways, lampholders, or other electrical parts.

(b) **Receptacles, cord connectors, and attachment plugs (caps).**

(i) **Configuration.** Receptacles, cord connectors, and attachment plugs must be constructed so that no receptacle or cord connector will accept an attachment plug with a different voltage or current rating than that for which the device is intended. However, a 20-ampere T-slot receptacle or cord connector may accept a 15-ampere attachment plug of the same voltage rating. Receptacles connected to circuits having different voltages, frequencies, or types of current (AC or DC) on the same premises must be of such design that the attachment plugs used on these circuits are not interchangeable.

(ii) Damp and wet locations. A receptacle installed in a wet or damp location must be designed for the location.

(c) **Appliances.**

(i) **Live parts.** Appliances, other than those in which the current-carrying parts at high temperatures are necessarily exposed, must have no live parts normally exposed to employee contact.

(ii) **Disconnecting means.** You must provide a means to disconnect each appliance.

(iii) **Rating.** Each appliance must be marked with its rating in volts and amperes or volts and watts.

(d) **Motors.** This subdivision applies to motors, motor circuits, and controllers.

(i) **In sight from.** If specified that one piece of equipment must be "in sight from" another piece of equipment, one must be visible and not more than 50 feet (15.2 m) from the other.

(ii) **Disconnecting means.**

(A) You must locate a disconnecting means in sight from the controller location. The controller disconnecting means for motor branch circuits over 600 volts, nominal, may be out of sight of the control-

ler, if the controller is marked with a warning label giving the location and identification of the disconnecting means which is to be locked in the open position.

(B) The disconnecting means must disconnect the motor and the controller from all ungrounded supply conductors and must be so designed that no pole can be operated independently.

(C) If a motor and the driven machinery are not in sight from the controller location, the installation must comply with one of the following conditions:

(I) The controller disconnecting means must be capable of being locked in the open position.

(II) You must place a manually operable switch that will disconnect the motor from its source of supply in sight from the motor location.

(D) The disconnecting means must plainly indicate whether it is in the open (off) or closed (on) position.

(E) The disconnecting means must be readily accessible. If more than one disconnect is provided for the same equipment, only one need be readily accessible.

(F) You must provide an individual disconnecting means for each motor, but a single disconnecting means may be used for a group of motors under any one of the following conditions:

(I) If a number of motors drive special parts of a single machine or piece of apparatus, such as a metal or woodworking machine, crane, or hoist;

(II) If a group of motors is under the protection of one set of branch-circuit protective devices; or

(III) If a group of motors is in a single room in sight from the location of the disconnecting means.

(iii) **Motor overload, short-circuit, and ground-fault protection.** You must protect motors, motor-control apparatus, and motor branch-circuit conductors against overheating due to motor overloads or failure to start, and against short-circuits or ground faults. These provisions do not require overload protection that will stop a motor where a shutdown is likely to introduce additional or increased hazards, as in the case of fire pumps, or where continued operation of a motor is necessary for a safe shutdown of equipment or process and motor overload sensing devices are connected to a supervised alarm.

(iv) **Protection of live parts - All voltages.**

(A) Stationary motors having commutators, collectors, and brush rigging located inside of motor end brackets and not conductively connected to supply circuits operating at more than 150 volts to ground need not have such parts guarded. Exposed live parts of motors and controllers operating at 50 volts or more between terminals must be guarded against accidental contact by any of the following:

(I) By installation in a room or enclosure that is accessible only to qualified persons;

(II) By installation on a balcony, gallery, or platform, so elevated and arranged as to exclude unqualified persons; or

(III) By elevation 8 feet (2.44 m) or more above the floor.

(B) Where live parts of motors or controllers operating at over 150 volts to ground are guarded against accidental contact only by location, and where adjustment or other attendance may be necessary during the operation of the apparatus, insulating mats or platforms must be provided so that the attendant cannot readily touch live parts unless standing on the mats or platforms.

(e) **Transformers.**

(i) **Application.** The following subsections cover the installation of all transformers, except:

(A) Current transformers;

(B) Dry-type transformers installed as a component part of other apparatus;

(C) Transformers which are an integral part of an X-ray, high frequency, or electrostatic-coating apparatus;

(D) Transformers used with Class 2 and Class 3 circuits, sign and outline lighting, electric discharge lighting, and power-limited fire-protective signaling circuits.

(ii) **Operating voltage.** The operating voltage of exposed live parts of transformer installations must be indicated by warning signs or visible markings on the equipment or structure.

(iii) **Transformers over 35 kV.** Dry-type, high fire point liquid-insulated, and askarel-insulated transformers installed indoors and rated over 35 kV must be in a vault.

(iv) **Oil-insulated transformers.** If they present a fire hazard to employees, oil-insulated transformers installed indoors must be in a vault.

(v) **Fire protection.** You must safeguard combustible material, combustible buildings and parts of buildings, fire escapes, and door and window openings from fires which may originate in oil-insulated transformers attached to or adjacent to a building or combustible material.

(vi) **Transformer vaults.** Transformer vaults must be constructed so as to contain fire and combustible liquids within the vault and to prevent unauthorized access. You must arrange locks and latches so that a vault door can be readily opened from the inside.

(vii) **Pipes and ducts.** Any pipe or duct system foreign to the vault installation must not enter or pass through a transformer vault.

(viii) **Material storage.** You must not store materials in transformer vaults.

(f) **Capacitors.**

(i) **Drainage of stored charge.** You must provide all capacitors, except surge capacitors or capacitors included as a component part of other apparatus, with an automatic means of draining the stored charge and maintaining the discharged state after the capacitor is disconnected from its source of supply.

(ii) **Over 600 volts.** Capacitors rated over 600 volts, nominal, must comply with the following additional requirements:

(A) Isolating or disconnecting switches (with no interrupting rating) must be interlocked with the load interrupting device or you must provide them with prominently displayed caution signs to prevent switching load current.

(B) For series capacitors the proper switching must be assured by use of at least one of the following:

(I) Mechanically sequenced isolating and bypass switches;

(II) Interlocks; or

(III) Switching procedure prominently displayed at the switching location.

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