NEC 2014 Code Changes

Articles 250-250.191

CHANGES FROM 2011 TO 2014 CODE ARE IN RED

ARTICLE 250 – Grounding and Bonding

Chapter 1- Grounding and Bonding

II – System Grounding

250.20 Alternating-Current Systems to be Grounded

(C) Alternating-Current Systems of over 1000 Volts.

Alternating-current systems supplying mobile or portable equipment must be grounded as specified in 250.188. When they are supplying other than mobile or portable equipment, those systems are allowed to be grounded.

(D) Impedance Grounded Neutral Systems. Impedance grounded neutral systems are to be grounded in accordance with 250.36 or 250.187.

250.21 Alternating-Current Systems of 50 Volts to 1000

Volts Not Required to Be Grounded.

(A) General. The following ac systems of 50 volts to 1000 volts are permitted to be but not required to be grounded:

(1) Electrical systems used exclusively to supply industrial electric furnaces for melting, refining, tempering, and similar

(2) Separately derived systems used only for rectifiers that supply only adjustable-speed industrial drives

(3) Separately derived systems supplied by transformers that have a primary voltage rating of 1000 volts or less, provided that all the following conditions are met:

a. The system is used exclusively for control circuits.

b. The conditions of maintenance and supervision ensure that only qualified persons service the installation.

c. Continuity of control power is required.

(B) Ground Detectors. Ground detectors are to be installed in accordance with 250.21(B)(1) and (B)(2).

(1) Ungrounded A/C systems as permitted in 250.21(A)(1) through (A)(4) operating at not less than 120 volts and at 1000 volts or less are required to have ground detectors installed on the system.

(C) Marking. Ungrounded systems must be legibly marked "Caution: Ungrounded System Operating — _____ Volts Between Conductors" at the source or first disconnecting means of the system. The marking shall be durable enough to withstand the environment involved.

250.3 Grounding Separately Derived Alternating Current Systems

(A)(2)(b) Supply-Side Bonding Jumper

A supply-side bonding jumper of the bus type shall have a cross-sectional area not smaller than a supply-side bonding jumper of the wire type as determined in 250.102(C).

Exception: A supply-side bonding jumper shall not be required between enclosures for installations made in compliance with 250.30(A)(1), Exception No. 2.

250.32 Building Structures Supplied by (a) Feeder(s) or Branch Circuit(s)

(B) Grounded Systems

(1) Supplied by a Feeder or Branch Circuit: An equipment grounding conductor, as described in 250.118, shall be run with the supply conductors and be connected to the building or structure disconnecting means and to the grounding electrode(s).

Exception No. 2: If system bonding jumpers are installed in accordance with 250.30(A)(1),

Exception No. 2: the feeder grounded circuit conductor at the building or structure it serves must be connected to the equipment grounding conductors, grounding electrode conductor, and the enclosure for the first disconnecting means.

250.62 Grounding Electrode Conductor Material.

The grounding electrode conductor must be of copper, aluminum, copper-clad aluminum, or the items as permitted in 250.68(C). The material selected shall be resistant to any corrosive condition existing at the installation or shall be protected against corrosion. Conductors of the wire type shall be solid or stranded, insulated, covered, or bare.

(D)(2) Individual Grounding Electrode Conductors. A grounding electrode conductor shall be connected between the grounding electrode system and one or more of the following, as applicable:

(1) Grounded conductor in each service equipment disconnecting means enclosure

(2) Equipment grounding conductor installed with the feeder

(3) Supply-side bonding jumper

Each grounding electrode conductor shall be sized in accordance with 250.66 based on the service-entrance or feeder conductor(s) supplying the individual disconnecting means.

(3) Common Location. A grounding electrode conductor shall be connected in a wireway or other accessible enclosure on the supply side of the disconnecting means to at least one of the following, as applicable:

(1) Grounded service conductor(s)

(2) Equipment grounding conductor installed with the feeder

(3) Supply-side bonding jumper

250.66 Grounding Electrode Conductor for Alternating-Current Systems

(C) Grounding Electrode Connections

(2) The metal structural frame of a building shall be permitted to be used as a conductor to interconnect electrodes that are part of the grounding electrode system,

or as a grounding electrode conductor.

(3) A concrete-encased electrode of either the conductor type, reinforcing rod or bar installed in accordance with 250.52(A)(3) extended from its location within the concrete

to an accessible location above the concrete shall be allowed.

250.104 Bonding of Piping Systems and Exposed Structural Metal

(B) Other Metal Piping

If they are installed in or attached to a building, metal piping systems that are likely to become energized must be bonded to any of the following:

(1) An equipment grounding conductor for the circuit that is likely to energize the piping system

(2) A service equipment enclosure

(3) A grounded conductor at the service

(4) A grounding electrode conductor, if of sufficient size

(5) One or more grounding electrodes used

The bonding conductors or jumpers must be sized according to section 250.122, using the circuit rating that is most likely to energize the piping systems. The equipment grounding conductor for the circuit that is most likely to energize the piping systems. ~~must be allowed to serve as the means of bonding.~~ The ~~attachment~~ points of the bonding jumpers must be easily reached.

Further Information #2: Additional information for gas piping systems can be found in section 7.13 of NFPA 54-2009, National Fuel Gas Code

(C) Structural Metal

Exposed structural metal that is interconnected to form a metal building frame and is not intentionally grounded or bonded and is likely to become energized must be bonded to the service equipment enclosure; the disconnecting means for buildings supplied by a feeder or branch circuit; another permitted location, or to one or more of the grounding electrodes used. The bonding jumpers must be sized according to section 250.64(A), (B), and (E). The points of attachment of the bonding jumpers must be easily reached unless installed in compliance with section 250.68(A), Exception #2.

(3) Common Grounding Electrode Conductor

If a common grounding electrode conductor is installed for multiple separately derived systems as allowed by section 250.30(A)(4), and exposed structural metal that is interconnected to form the building frame, or if interior metal piping exists in the area served by the separately derived system, the metal piping and the structural metal member must be bonded to the grounding electrode conductor in the area served by the separately derived system.

250.106 Lightning Protection Systems

Further Information # 1: See section 250.60 for use of strike termination devices. For further information, see NFPA 780-2011, Standard for the Installation of Lightning Protection Systems, which contains detailed information on grounding, bonding, and sideflash distance from lightning protection systems.

VI. Equipment Grounding and Equipment Grounding Conductors

250.110 Equipment Fastened in Place (Fixed) or Connected by Permanent Wiring Methods

Exposed, normally non-current-carrying metal parts of fixed equipment supplied by or enclosing conductors or components that are likely to become energized must be connected to an equipment grounding conductor should any of the following conditions exist:

(5) If it is supplied by a wiring method that provides an equipment grounding conductor, except as allowed by section 250.86, Exception #2, for short sections of metal enclosures.

Exception #1: If it is exempted by special permission, the metal frame of electrically heated appliances that have the frame permanently and effectively insulated from ground will not be required to be grounded.

Exception #2: Distribution apparatus, such as transformer and capacitor cases, mounted on wooden poles at a height exceeding 2.5 m above the ground level, grounding will not be required.

250.112 Specific Equipment Fastened in Place (Fixed) or Connected by Permanent Wiring Methods

Except as allowed in section 250.112(F) and (I), exposed, normally non-current-carrying metal parts of equipment which are described in section 250.112(A) through section 250.112(K), and normally non-current-carrying metal parts of equipment and enclosures which are described in section 250.112(L) and section 250.112(M), must be connected to an equipment grounding conductor regardless of its voltage.

(A) Switchgear and Switchboard Frames and Structures.

Switchgear or switchboard frames and structures supporting switching equipment, except frames of 2-wire D/C switchgear or switchboards where effectively insulated from ground.

250.114 Equipment Connected by Cord and Plug

Under any of the conditions described in section 250.114(1) through section 250.114(4), exposed normally non-current-carrying metal parts of cord-and-plug-connected equipment in residential occupancies such as clothes-washing, clothes-drying, dish-washing machines; ranges; kitchen waste disposers; information technology equipment; sump pumps and electrical aquarium equipment will be connected to the equipment grounding conductor.

250.118 Types of Equipment Grounding Conductors

(5) Listed flexible metal conduit meeting all of the following conditions:

c. If the combined length of flexible metal conduit and flexible metallic tubing and water tight flexible metal conduit in the same ground-fault current path doesn't exceed 1.8 m.

d. If used to connect equipment where flexibility is necessary to minimize the transmission of vibration from equipment or to provide flexibility for equipment that requires movement after installation, an equipment grounding conductor must be installed.

(6) Listed water tight flexible metal conduit meeting all of the following conditions:

c. For metric designators 21 through 35 (trade sizes ¾ through 1 ¼), the circuit conductors contained in the conduit are protected by overcurrent devices rated no more than 60 amperes and there is no flexible metal conduit, flexible metallic tubing, or water tight flexible metal conduit in trade sizes metric designators 12 through16 (trade sizes 3/8 through ½) in the ground-fault current path.

d. The combined length of flexible metal conduit and flexible metallic tubing and water tight flexible metal conduit in the same ground-fault current path doesn't exceed 1.8 m.

e. If used to connect equipment where flexibility is necessary to minimize the transmission of vibration from equipment or to provide flexibility for equipment that requires movement after installation, an equipment grounding conductor must be installed.

(7) Flexible metallic tubing where the tubing is terminated in listed fittings and meeting the following conditions:

b. The combined length of flexible metal conduit and flexible metallic tubing and water tight flexible metal conduit in the same ground-fault current path does not exceed 1.8 m.

(10) Type MC Cable that provides an effective ground-fault current path according to one or more of the following:

a. It contains an insulated or non insulated equipment grounding conductor that complies with section 250.118(1)

b. The combined metallic sheath and un-insulated equipment grounding/bonding conductor of interlocked metal tape-type MC Cable that is listed and identified as an equipment grounding conductor

c. The metallic sheath or the combined metallic sheath and equipment grounding conductors of the smooth or corrugated tube-type MC Cable that is listed and identified as an equipment grounding conductor.

250.119 Identification of Equipment Grounding Conductors

Unless required elsewhere in this *Code,* equipment grounding conductors shall be permitted to be bare, covered, or insulated.

Exception 1: Power-limited, Class 2 or Class 3 cables, power-limited fire alarm cables, or communications cables containing only circuits operating at less than 50 volts where connected to equipment not required to be grounded according to section 250.112(I) will be allowed to use a conductor with green insulation or green with one or more yellow stripes for other than equipment grounding purposes.

Exception No. 2: Flexible cords having an integral insulation and jacket without an equipment grounding conductor shall be permitted to have a continuous outer finish that is green.

Informational Note: An example of a flexible cord with integral-type insulation is Type SPT-2, 2 conductor.

Exception No. 3: Conductors with green insulation shall be allowed to be used as ungrounded signal conductors where installed between the output terminations of traffic

signal control and traffic signal indicating heads. Signaling circuits installed in accordance with this exception shall include an equipment grounding conductor in accordance with 250.118. Wire-type equipment grounding conductors shall be bare or have insulation or covering that is green with one or more yellow stripes.

(A) Conductors 4 AWG and Larger. Equipment grounding conductors 4 AWG and larger must comply with 250.119(A)(1) and (A)(2).

(1) An insulated or covered conductor 4 AWG and larger shall be allowed, at the time of installation, to be permanently identified as an equipment grounding conductor at each end and at every point where the conductor is accessible.

Exception: Conductors 4 AWG and larger shall not be required to be marked in conduit bodies that contain no splices or unused hubs.

250.120 Equipment Grounding Conductor Installation

(C) Equipment Grounding Conductors Smaller Than 6 AWG

Where not routed with circuit conductors as allowed in section 250.130(C) and section 250.134(B) Exception #2, equipment grounding conductors smaller than 6 AWG will be protected from physical damage by an identified raceway or cable armor unless it is installed within a hollow space of the framing members of buildings and where it will not be subject to physical damage.

250.121 Use of Equipment Grounding Conductors

An equipment grounding conductor will not be used as a grounding electrode conductor.

Exception: A wire-type equipment grounding conductor installed in compliance with 250.6(A) and the applicable requirements for both the equipment grounding conductor and the grounding electrode conductor in Parts II, III, and VI of this article shall be permitted to serve as both an equipment grounding conductor and a grounding electrode conductor.

250.122 Size of Equipment Grounding Conductors

(A) General

Copper, aluminum, or copper-clad aluminum equipment grounding conductors that are of the wire type will not be smaller than shown in Table 250.122, but they will not be required to be larger than the circuit conductors supplying the equipment. Where a cable tray, a raceway, or a cable armor or sheath is used as the equipment grounding conductor, as provided in section 250.118 and section 250.134(A), it will adhere to section 250.4(A)(5) or (B)(4).

Equipment grounding conductors will be allowed to be sectioned within a multicolor cable, provided the combined circular mil area adheres to Table 250.122.

(B) Increased in Size. Where ungrounded conductors are increased in size from the minimum size that has sufficient ampacity for the intended installation, wire-type equipment grounding conductors, where installed, must be increased in size proportionately according to the circular mil area of the ungrounded conductors.

(F) Conductors in Parallel

Where conductors are installed in parallel in multiple raceways as allowed in section 310.10(H), the equipment grounding conductors must be installed in parallel in each raceway. Where

conductors are installed in parallel in the same raceway or cable tray as allowed by section 310.10(H), a single equipment grounding conductor must be allowed. Equipment grounding conductors installed in a cable tray must meet the minimum requirements of section 392.10(B)(1)(c).

Each equipment grounding conductor must be sized according to section 250.122.

VII. Methods of Equipment Grounding

250.130 Equipment Grounding Conductor Connections

(C) Non-Grounding Receptacle Replacement or Branch Circuit Extensions

(1) Any accessible point on the grounding electrode system as described in 250.50

(2) Any accessible point on the grounding electrode conductor

(3) The equipment grounding terminal bar within the enclosure where the branch circuit for the receptacle or branch circuit originates

(4) An equipment grounding conductor that is part of another branch circuit that originates from the enclosure where the branch circuit for the receptacle or branch circuit originates

(5) For grounded systems, the grounded service conductor within the service equipment enclosure

(6) For ungrounded systems, the grounding terminal bar within the service equipment enclosure

250.142 Use of grounded Circuit Conductor for grounding Equipment

(B) Load-Side Equipment

Except as allowed in section 250.30(A)(1) and section 250.32(B) Exception, a grounded circuit conductor must not be used for grounding non-current-carrying metal parts of equipment on the

load side of the service means of disconnect or on the load side of a separately derived system means of disconnect or the overcurrrent devices for a separately derived system not having a main means of disconnecting the service.

250.146 Connecting Receptacle Grounding Terminal to Box

(A) Surface-Mounted Box

Where the box is mounted on the surface, direct metal-to-metal contact between the device yoke and the box or a contact yoke or device that adheres to section 250.146(B) will be allowed to ground the receptacle to the box. At least one of the insulation washers will be removed from receptacles that do not have a contact yoke or device that adheres to section 250.146(B) to ensure direct metal-to-metal contact. This provision will not apply to cover-mounted receptacles unless the box and cover combination are listed as providing satisfactory ground continuity between the box and the receptacle. A listed exposed work cover will be allowed to be the grounding and bonding means when:

(1) The device is attached to the cover with at least two fasteners that are permanent or have a thread locking or screw or nut locking means and

(2) When the cover mounting holes are located on a flat non-raised portion of the cover.

B) Contact Devices or Yokes. Contact devices or yokes designed and listed as self-grounding shall be permitted in conjunction with the supporting screws to establish equipment bonding between the device yoke and flush-type boxes.

(D) Isolated Ground Receptacles: When a receptacle is installed for the reduction of electrical noise (electromagnetic interference) on the grounding circuit, a receptacle in which the grounding terminal is purposely insulated from the receptacle mounting means shall be allowed

VIII. Direct-Current Systems

250.162 Direct-Current Circuits and Systems to Be Grounded.

Direct-current circuits and systems shall be grounded as provided for in 250.162(A) and (B).

(A) Two-Wire, Direct-Current Systems. A 2-wire, D/C system supplying premises wiring and operating at greater than 60 volts but not greater than 300 volts shall be grounded.

Exception No. 1: A system equipped with a ground detector

and supplying only industrial equipment in limited areas shall not be required to be grounded where installed adjacent to or integral with the source of supply.

250.167 Direct-Current Ground-Fault Detection.

(A) Ungrounded Systems. Ground-fault detection systems are required for ungrounded systems.

(B) Grounded Systems. Ground-fault detection are allowed for grounded systems.

(C) Marking. Direct-current systems must be legibly marked to indicate the grounding type at the D/C source or the first disconnecting means of the system. The marking must be durable enough to withstand the environment.

250.174 Cases of Instruments, Meters, and Relays Operating at 1000 Volts or Less.

Instruments, meters, and relays operating with windings or working parts at 1000 volts or less shall be connected to the equipment grounding conductor

IX. Instruments, Meters, and Relays

250.178 Instrument Equipment Grounding Conductor

The equipment grounding conductor for secondary circuits of instrument transformers and for instrument cases must not be smaller than 12 AWG copper or 10 AWG aluminum. Cases of instrument transformers, instruments, meters, and relays that are mounted directly on grounded metal surfaces of enclosures or grounded metal switchboard panels will be considered to be grounded, and no additional equipment grounding conductor will be required.

X. Grounding of systems and Circuits over 1000 volts

250.180 General

Where systems over 1000 volts are grounded, they must adhere to all applicable provisions of the preceding sections of this article and with section 250.182 through section 250.194, which supplement and modify the preceding sections.

250.182 Derived Neutral Systems

A system neutral point derived from a grounding transformer will be allowed to be used for grounding systems over 1 kV.

250.186 Ground-Fault Circuit Conductor Brought to Service Equipment

(A) Location

The grounding impedance must be installed in the grounding electrode conductor between the grounding electrode of the supply system and the neutral point of the supply transformer or generator.

250.186 Ground-Fault Circuit Conductor Brought to Service Equipment.

(A) Systems with a Grounded Conductor at the Service Point.

Where an ac system operating at over 1000 volts is grounded at any point and is provided with a grounded conductor at the service point, a grounded conductor(s) must be installed and routed with the ungrounded conductors to each service disconnecting means and must be connected to each disconnecting means grounded conductor(s) terminal or bus. A main bonding jumper shall connect the grounded conductor(s) to each service disconnecting means enclosure.

Exception: Where two or more service disconnecting means are located in a single assembly listed for use as service equipment, it shall be permitted to connect the grounded conductor(s) to the assembly common grounded conductor(s) terminal or bus. The assembly shall include a main bonding jumper for connecting the grounded conductor(s) to the assembly enclosure.

(1) Sizing for a Single Raceway or Overhead Conductor.

The grounded conductor shall not be smaller than the required grounding electrode conductor specified in Table 250.66 but shall not be required to be larger than the largest ungrounded service-entrance conductor(s). In addition, for sets of ungrounded service-entrance conductors larger than 1100 kcmil copper or 1750 kcmil aluminum, the grounded conductor must not be smaller than 12 1⁄2 percent of the circular mil area of the largest set of service-entrance ungrounded conductor(s).

(2) Parallel Conductors in Two or More Raceways or Overhead Conductors. If the ungrounded service-entrance conductors are installed in parallel in two or more raceways

or as overhead parallel conductors, the grounded conductors shall also be installed in parallel. The size of the grounded conductor in each raceway or overhead shall be based on the total circular mil area of the parallel ungrounded conductors in the raceway or overhead, as indicated in 250.186(A)(1), but not smaller than 1/0 AWG.

Informational Note: See 310.10(H) for grounded conductors connected in parallel.

(3) Delta-Connected Service. The grounded conductor of a 3-phase, 3-wire delta service shall have an ampacity not less than that of the ungrounded conductors.

(4) Impedance Grounded Neutral Systems. Impedance grounded neutral systems shall be installed in accordance with 250.187.

(B) SystemsWithout a Grounded Conductor at the Service Point. Where an ac system operating at greater than 1000 volts is grounded at any point and is not provided with a grounded conductor at the service point, a supplyside bonding jumper shall be installed and routed with the ungrounded conductors to each service disconnecting means and shall be connected to each disconnecting means equipment grounding conductor terminal or bus. The supply-side bonding jumper shall be installed in accordance with 250.186(B)(1) through (B)(3).

Exception: Where two or more service disconnecting means are located in a single assembly listed for use as service equipment, it shall be permitted to connect the supply-side bonding jumper to the assembly common equipment grounding terminal or bus.

(1) Sizing for a Single Raceway or Overhead Conductor. The supply-side bonding jumper shall not be smaller than the required grounding electrode conductor specified in Table 250.66 but shall not be required to be larger than the largest ungrounded service-entrance conductor(s). In addition, for sets of ungrounded service-entrance conductors larger than 1100 kcmil copper or

1750 kcmil aluminum, the supply-side bonding jumper shall not be smaller than 12½ percent of the circular mil area of the largest set of service-entrance ungrounded conductor(s).

(2) Parallel Conductors in Two or More Raceways or Overhead Conductors. If the ungrounded service-entrance conductors are installed in parallel in two or more raceways or overhead conductors, the supply-side bonding jumper shall also be installed in parallel. The size of the supply side bonding jumper in each raceway or overhead shall be based on the total circular mil area of the parallel ungrounded conductors in the raceway or overhead, as indicated in 250.186(A)(1), but not smaller than 1/0 AWG.

(3) Impedance Grounded Neutral Systems. Impedance grounded neutral systems shall be installed in accordance with 250.187.

250.188 Grounding of Systems Supplying Portable or Mobile Equipment

Systems supplying portable or mobile equipment over 1000 volts, other than substations installed on a temporary basis, must adhere to section 250.188(A) through section 250.188(F)

(A) Portable or Mobile Equipment

Portable or mobile equipment over 1000 volts must be supplied from a system having its neutral conductor grounded through an impedance. Where a delta-connected system over 1000 volts is used to supply portable or mobile equipment, a system neutral point and associated neutral conductor will be derived

(D) Ground-Fault Detection and Relaying

Ground-fault detection and relaying must be provided to automatically de-energize any component of a system over 1000 volts that has developed a ground fault. The continuity of the equipment grounding conductor must be continuously monitored so as to automatically de-

energize the circuit of the system over 1000 volts to the portable or mobile equipment upon loss of continuity of the equipment grounding conductor.

(F) Trailing Cable and Computers

Trailing cable and couplers of systems over 1000 volts for interconnection of portable or mobile equipment must meet the requirements of Part III of Article 400 for cables and 490.55 for couplers.

250.190 Grounding of Equipment

(A) Equipment Grounding

All non-current-carrying metal parts of fixed, portable, and mobile equipment and associated fences, housings, enclosures, and supporting structures will be grounded.

Exception: Where isolated from ground and located such that any person in contact with ground cannot contact such metal parts when the equipment is energized, the metal parts will not be required to be grounded.

Further Information: See section 250.110, Exception #2 for pole-mounted distribution apparatus.

(B) Grounding Electrode Conductor

If a grounding electrode conductor connects non-current-carrying metal parts to ground, the grounding electrode conductor must be sized according to Table 250.66, based on the size of the largest ungrounded service, feeder, or branch-circuit conductors supplying the equipment. The grounding electrode conductor must not be smaller than 6 AWG copper or 4 AWG aluminum.

(C) Equipment Grounding Conductor

Equipment grounding conductors will adhere to section 250.190(C)(1) through section 250.190(C)(3).

(1) General

Equipment grounding conductors that are not an integral part of a cable assembly must not be smaller than 6 AWG copper and 4 AWG aluminum.

(2) Shielded Cables

The metallic insulation shield encircling the current-carrying conductors must be allowed to be an equipment grounding conductor, if it is rated for clearing time of ground fault current protective device operation without damaging the metallic shield. The metallic tape insulation shield and drain wire insulation shield must not be used as an equipment grounding conductor for solidly grounded systems.

(3) Sizing

Equipment grounding conductors must be sized according to Table 250.122 based on the current rating of the fuse or the overcurrent setting of the protective relay.

Further Information: The overcurrent rating for a circuit breaker is the combination of the current

250.191 Grounding System at Alternating-Current Substations

For ac substations, the grounding system will be according to Part III Article 250.

Further Information: For further information on outdoor A/C substation grounding, see ANSI/IEEE 820-2000, IEEE guide for Safety in AC Substation Grounding.

250.194 Grounding and Bonding of Fences and Other Metal Structures.

Metallic fences enclosing, and other metal structures in or surrounding, a substation with exposed electrical conductors and equipment must be grounded and bonded to limit step, touch, and transfer voltages.

(A) Metal Fences.

Where metal fences are located within 5 m (16 ft) of the exposed electrical conductors or equipment, the fence must be bonded to the grounding electrode system with wire-type bonding jumpers as follows:

(1) Bonding jumpers must be installed at each fence corner and at maximum 50 m (160 ft) intervals along the fence.

(2) Where bare overhead conductors cross the fence, bonding jumpers must be installed on each side of the crossing.

(3) Gates are to be bonded to the gate support post, and each gate support post must be bonded to the grounding electrode system.

(4) Any gate or other opening in the fence shall be bonded across the opening by a buried bonding jumper.

(5) The grounding grid or grounding electrode systems shall be extended to cover the swing of all gates.

(6) The barbed wire strands above the fence shall be bonded to the grounding electrode system.

Alternate designs performed under engineering supervision shall be permitted for grounding or bonding of metal fences.

Informational Note No. 1: A non-conducting fence or section may provide isolation for transfer of voltage to other areas.

(B) Metal Structures.

All exposed conductive metal structures, including guy wires within 2.5 m (8 ft) vertically or 5 m (16 ft) horizontally of exposed conductors or equipment and subject to contact by persons, are to be bonded to the grounding electrode systems in the area.