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WORKING DRAFT OF NEC CODE-MAKING PANEL 5 MEETING OUTPUT

CONTENT NOT FINAL – SUBJECT TO REVISION PRIOR TO LETTER BALLOT AND PUBLICATION OF FIRST DRAFT REPORT

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This is a working draft, prepared by NFPA staff, to record the output generated at the Code-Making Panel 5 First Draft Meeting. It includes draft copies of the First Revisions and any Global Revisions.

It is being made available to Panel members for the purpose of facilitating early review, particularly for those Panel members who may be seeking input from their respective organizations in preparation for the First Draft Ballot.

First Revision No. 8825-NFPA 70-2024 [Global Input]

Delete 250, Part X [Title only]

Delete 250.180.

See attached Word file for new Article 252.

Supplemental Information

File Name	Description	Approved
NEC_CMP5_FR-8825_NewArticle252_Global_JS.docx		
NEC_CMP5_FR-8825_NewArticle252_Global.docx	For editorial use	

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Tue Jan 23 23:37:59 EST 2024

Committee Statement

Committee Statement: This new article is being created based on direction from the NEC Correlating Committee to provide separate articles for systems over 1000 volts ac and 1500 volts dc, nominal, as part of an overall revision to the NEC. It is noted that there will be a lot of duplicated material from Article 250.

Tables 350.122(A) and 350.122(B) for Equipment grounding conductors are based on UL 1072, UL Standard for Safety Medium-Voltage Power Cables, Tables 23-1 and 23-2 respectively. This consensus standard has been used successfully in the industry for sizing equipment grounding conductors in MV-90 and MV-105 cables since it was first published in 1986. Table ranges are 2001 – 35,000 volts, to align with tables in Article 315. Voltages above this are often bare overhead lines (with cables being the exception).

Note: The new article was proposed as a new 350 but was renumbered to 252.

Response Message: FR-8825-NFPA 70-2024

Public Input No. 3506-NFPA 70-2023 [Section No. 250.194]

Public Input No. 3499-NFPA 70-2023 [Section No. 250.184]

Public Input No. 3498-NFPA 70-2023 [Section No. 250.182]

Public Input No. 3495-NFPA 70-2023 [Part X.]

Public Input No. 3584-NFPA 70-2023 [New Part after X.]

Public Input No. 3500-NFPA 70-2023 [Section No. 250.186]

Public Input No. 3496-NFPA 70-2023 [Section No. 250.180]

Public Input No. 3503-NFPA 70-2023 [Section No. 250.188]

Public Input No. 3504-NFPA 70-2023 [Section No. 250.190]

~~**Part X. Grounding of Systems and Circuits of over 1000 Volts**~~

~~**250.180 General.**~~

~~If systems over 1000 volts are grounded, they shall comply with all applicable requirements of 250.1 through 250.178 and with 250.182 through 250.194, which supplement and modify the preceding sections.~~

Commented [JS1]: Delete 252, Part X title and 250.180.

NEW Article 252 Grounding and Bonding of Systems over 1000 Volts ac, 1500 Volts dc, Nominal

Part I. General

350.1 Scope.

This article covers general requirements for grounding and bonding of electrical installations over 1000 volts ac, 1500 volts dc, nominal and the following specific requirements:

(1) Systems, circuits, and equipment required, or permitted to be grounded

(2) Circuit conductor to be grounded on grounded systems

(3) Location of grounding connections

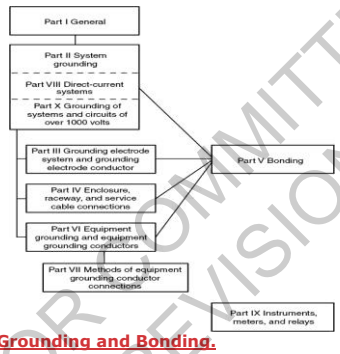
(4) Types and sizes of grounding and bonding conductors and electrodes

(5) Methods of grounding and bonding

(6) Conditions under which isolation, insulation, or guards are permitted to be substituted for grounding

Informational Note: See Informational Note Figure 350.1 for information on the organization of this article covering grounding and bonding requirements.

Figure Informational Note Figure 350.1 Grounding and Bonding.



350.4 General Requirements for Grounding and Bonding.

The following general requirements identify what grounding and bonding of electrical systems are required to accomplish. The prescriptive methods contained in this article shall be followed to comply with the performance requirements of this section.

(A) Grounded Systems.

(1) Electrical System Grounding.

Electrical systems that are grounded shall be connected to earth in a manner that will limit the voltage imposed by lightning, line surges, or unintentional contact with higher-voltage lines and that will stabilize the voltage to earth during normal operation. **[Moved from 250.182]** ~~**250.182 Derived Neutral Systems.**~~ A system neutral point derived from a grounding transformer shall be permitted to be used for grounding systems ~~over 1kV~~.

Informational Note No. 1: An important consideration for limiting the imposed voltage is the routing of bonding and grounding electrode conductors so that they are not any longer than necessary to complete the connection without disturbing the permanent parts of the installation and so that unnecessary bends and loops are avoided.

Informational Note No. 2: See NFPA 780-2020, *Standard for the Installation of Lightning Protection Systems*, for information on installation of grounding and bonding for lightning protection systems.

(2) Grounding of Electrical Equipment.

Normally non-current-carrying conductive materials enclosing electrical conductors or equipment, or forming part of such equipment, shall be connected to earth so as to limit the voltage to ground on these materials.

(3) Bonding of Electrical Equipment.

Commented [JS2]: Editorial to renumber all 350 references to 252.

Normally non-current-carrying conductive materials enclosing electrical conductors or equipment, or forming part of such equipment, shall be connected together and to the electrical supply source in a manner that establishes an effective ground-fault current path.

(4) Bonding of Electrically Conductive Materials and Other Equipment.

Normally non-current-carrying electrically conductive materials that are likely to become energized shall be connected together and to the electrical supply source in a manner that establishes an effective ground-fault current path.

(5) Effective Ground-Fault Current Path.

Electrical equipment and wiring and other electrically conductive material likely to become energized shall be installed in a manner that creates a low-impedance circuit facilitating the operation of the overcurrent device or ground detector for impedance grounded systems. It shall be capable of safely carrying the maximum ground-fault current likely to be imposed on it from any point on the wiring system where a ground fault occurs to the electrical supply source. The earth shall not be considered as an effective ground-fault current path.

(B) Ungrounded Systems.

(1) Grounding Electrical Equipment.

Non-current-carrying conductive materials enclosing electrical conductors or equipment, or forming part of such equipment, shall be connected to earth in a manner that will limit the voltage imposed by lightning or unintentional contact with higher-voltage lines and limit the voltage to ground on these materials.

Informational Note: See NFPA 780-2020, *Standard for the Installation of Lightning Protection Systems*, for information on installation of grounding and bonding for lightning protection systems.

(2) Bonding of Electrical Equipment.

Non-current-carrying conductive materials enclosing electrical conductors or equipment, or forming part of such equipment, shall be connected together and to the supply system grounded equipment in a manner that creates a low-impedance path for ground-fault current that is capable of carrying the maximum fault current likely to be imposed on it.

(3) Bonding of Electrically Conductive Materials and Other Equipment.

Electrically conductive materials that are likely to become energized shall be connected together and to the supply system grounded equipment in a manner that creates a low-impedance path for ground-fault current that is capable of carrying the maximum fault current likely to be imposed on it.

(4) Path for Fault Current.

Electrical equipment, wiring, and other electrically conductive material likely to become energized shall be installed in a manner that creates a low-impedance circuit from any point on the wiring system to the electrical supply source to facilitate the operation of overcurrent devices should a second ground fault from a different phase occur on the wiring system. The earth shall not be considered as an effective fault-current path.

350.6 Objectionable Current.

(A) Arrangement to Prevent Objectionable Current.

The grounding and bonding of electrical systems, circuit conductors, surge arresters, surge-protective devices, and conductive normally non-current-carrying metal parts of equipment shall be installed and arranged in a manner that will prevent objectionable current.

(B) Alterations to Stop Objectionable Current.

If the use of multiple grounding or bonding connections results in objectionable current and the requirements of 350.4(A)(5) or (B)(4) are met, one or more of the following alterations shall be permitted:

(1) Discontinue one or more but not all of such grounding or bonding connections.

(2) Change the locations of the grounding or bonding connections.

(3) Interrupt the continuity of the conductor or conductive path causing the objectionable current.

(4) Take other remedial and approved action.

(C) Currents Not Classified as Objectionable Currents.

Currents resulting from abnormal conditions such as ground faults, and from currents resulting from required grounding and bonding connections shall not be classified as objectionable current for the purposes specified in 350.6(A) and (B).

(D) Limitations to Permissible Alterations.

This section shall not be considered as permitting electronic equipment to be operated on ac systems or branch circuits that are not connected to an equipment grounding conductor as required by this article. Currents that introduce electromagnetic interference or data errors in electronic equipment shall not be considered the objectionable currents addressed in this section.

(E) Isolation of Objectionable Direct-Current from Cathodic Protection Systems.

If isolation of objectionable direct currents from a cathodic protection system is required, a listed isolator device shall be permitted in the equipment grounding conductor path to provide an effective return path for ac ground-fault current while blocking the flow of direct currents.

350.8 Connection of Grounding and Bonding Equipment.

(A) Permitted Methods.

Equipment grounding conductors, grounding electrode conductors, and bonding jumpers shall be connected by one or more of the following means:

(1) Listed pressure connectors

(2) Terminal bars

(3) Pressure connectors listed as grounding and bonding equipment

(4) Exothermic welding process

(5) Machine screw-type fasteners that engage not less than two threads or are secured with a nut

(6) Thread-forming machine screws that engage not less than two threads in the enclosure

(7) Connections that are part of a listed assembly

(8) Other listed means

(B) Methods Not Permitted.
Connection devices or fittings that depend solely on solder shall not be used.

350.10 Protection of Ground Clamps and Fittings.
Ground clamps or other fittings exposed to physical damage shall be enclosed in metal, wood, or equivalent protective covering.

350.12 Clean Surfaces.
Nonconductive coatings (such as paint, lacquer, and enamel) on equipment to be grounded or bonded shall be removed from threads and other contact surfaces to ensure electrical continuity or shall be connected by means of fittings designed to make such removal unnecessary.

~~250.191~~**350.13 Grounding System at Alternating-Current Substations. [Move 250.191 to 350.13]**
For ac substations, the grounding system shall be in accordance with Part III of this article.
Informational Note: See IEEE 80, *IEEE Guide for Safety in AC Substation Grounding*, for further information on outdoor ac substation grounding.

~~250.194~~**350.14 Grounding and Bonding of Fences and Other Metal Structures. [Move 250.194 to 350.14]**
Metal fences enclosing, and other metal structures in or surrounding, a substation with exposed electrical conductors and equipment shall be grounded and bonded to limit step, touch, and transfer voltages.

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

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

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

(3) Gates shall be bonded to the gate support post, and each gate support post shall 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 nonconducting fence or section may provide isolation for transfer of voltage to other areas.
Informational Note No. 2: See IEEE 80, *IEEE Guide for Safety In AC Substation Grounding,* for design and installation of fence grounding.

(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, shall be bonded to the grounding electrode systems in the area

Part II. System Grounding

350.20 Alternating-Current Systems to Be Grounded.

Alternating-current systems shall be grounded in accordance with 350.20(A) or (B), unless prohibited elsewhere in this *Code*. Other systems shall be permitted to be grounded. If such systems are grounded, they shall comply with the applicable provisions of this article.

Informational Note No. 1: An example of a system permitted to be grounded is a corner-grounded delta transformer connection.

(A) Alternating-Current Systems.

Alternating-current systems supplying mobile or portable equipment shall be grounded in accordance with 350.115. If supplying other than mobile or portable equipment, such systems shall be permitted to be grounded.

(B) Impedance Grounded Systems.

Impedance grounded systems shall be grounded in accordance with 350.36

350.21 Alternating-Current Systems Not Required to Be Grounded.

(A) General.

The following ac systems shall be permitted to be grounded but shall not be required to be grounded:

(1) Electrical systems used exclusively to supply industrial electric furnaces used for applications such as melting, refining, or tempering

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

(B) Ground Detectors.

Ground detectors shall be installed in accordance with the following:

(1) Ungrounded ac systems as permitted in 350.21(A)(1) through (A)(2) shall have ground detectors installed on the system.

(2) The ground detection sensing equipment shall be connected as close as practicable to where the system receives its supply.

(C) Marking.

Ungrounded systems shall be legibly marked "Caution: Ungrounded System Operating — Volts Between Conductors" at the source or first disconnecting means of the system. The marking shall be of sufficient durability to withstand the environment involved.

~~**250.186**~~**350.24 Grounding of Service-Supplied Alternating-Current Systems. [Move 250.186 to 350.24]**

(A) Systems with a Grounded Conductor at the Service Point.
If an ac system is grounded at any point and is provided with a grounded conductor at the service point, a grounded conductor(s) shall be installed and routed with the ungrounded conductors to each service disconnecting means and shall 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. The grounded conductor(s) shall be installed in accordance with 250.186(A)(1) through (A)(4). The size of the solidly grounded circuit conductor(s) shall be the larger of that determined by 250.184 or 250.186(A)(1) or (A)(2).
Exception: If 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~~350.102(C)(1) but shall not be required to be larger than the largest ungrounded service-entrance 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(G) 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 Systems.
Impedance grounded systems shall be installed in accordance with 250.187.

(B) Systems Without a Grounded Conductor at the Service Point.
If an ac system is grounded at any point and is not provided with a grounded conductor at the service point, a supply-side 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: If 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~~350.102(C)(1) but shall not be required to be larger than the largest ungrounded service-entrance 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 Systems.
Impedance grounded systems shall be installed in accordance with 250.187.

350.25 Grounding of Systems Permitted to Be Connected on the Supply Side of the Service Disconnect.

The grounding of systems connected on the supply side of the service disconnect, in accordance with 230.82, that are in enclosures separate from the service equipment enclosure shall comply with 350.25(A) or (B).

(A) Grounded System.

If the utility supply system is grounded, the grounding of systems permitted to be connected on the supply side of the service disconnect and are installed in one or more separate enclosures from the service equipment enclosure shall comply with the requirements of 350.24(A) through (D).

(B) Ungrounded Systems.

If the utility supply system is ungrounded, the grounding of systems permitted to be connected on the supply side of the service disconnect and are installed in one or more separate enclosures from the service equipment enclosure shall comply with the requirements of 350.24(F).

350.26 Conductor to Be Grounded — Alternating-Current Systems.

If an ac premises wiring system is grounded, the conductor to be grounded shall be one of the following:

(1) Single-phase, 2-wire — one conductor

(2) Single-phase, 3-wire — the neutral conductor

(3) Multiphase systems having one wire common to all phases — the neutral conductor

(4) Multiphase systems if one phase is grounded — that phase conductor

~~250.184~~350.27 Solidly Grounded Neutral Systems. [Move 250.184 to 350.27]

Solidly grounded neutral systems shall be permitted to be either single point grounded or multigrounded neutral.

(A) Neutral Conductor.

(1) Insulation Level.
The minimum insulation level for neutral conductors of solidly grounded systems shall be 600 volts.
Exception No. 1: For multigrounded neutral systems as permitted in 250.184(C), bare copper conductors shall permitted to be used for the neutral conductor of the following:

(1) Service-entrance conductors

(2) Service laterals or underground service conductors

(3) Direct-buried portions of feeders

Exception No. 2: Bare conductors shall be permitted for the neutral conductor of overhead portions installed outdoors.
Exception No. 3: The grounded neutral conductor shall be permitted to be a bare conductor if isolated from phase conductors and protected from physical damage.

~~Informational Note: See 225.4 for conductor covering where within 3.0 m (10 ft) of any building or other structure.~~

(2) Ampacity.
The neutral conductor shall have an ampacity that is not less than the load imposed and be not less than 33**1/3** percent of the ampacity of the phase conductors.
Exception: In industrial and commercial premises under engineering supervision, it shall be permissible to size the ampacity of the neutral conductor to not less than 20 percent of the ampacity of the phase conductor.

(B) Single-Point Grounded Neutral System.
If a single-point grounded neutral system is used, the following shall apply:

(1) A single-point grounded neutral system shall be permitted to be supplied from one of the following:

a. A separately derived system

b. A multigrounded neutral system with an equipment grounding conductor connected to the multigrounded neutral conductor at the source of the single-point grounded neutral system

(2) A grounding electrode shall be provided for the system.
(3) A grounding electrode conductor shall connect the grounding electrode to the system neutral conductor.
(4) A bonding jumper shall connect the equipment grounding conductor to the grounding electrode conductor.
(5) An equipment grounding conductor shall be provided to each building, structure, and equipment enclosure.
(6) A neutral conductor shall only be required if phase-to-neutral loads are supplied.
(7) The neutral conductor, if provided, shall be insulated and isolated from earth except at one location.
(8) An equipment grounding conductor shall be run with the phase conductors and shall comply with all of the following:

a. Shall not carry continuous load.

b. Shall be bare, covered, or insulated.

c. Shall have ampacity for fault current duty.

(C) Multigrounded Neutral Systems.
If a multigrounded neutral system is used, the following shall apply:

(1) The neutral conductor of a solidly grounded neutral system shall be permitted to be grounded at more than one point. Grounding shall be permitted at one or more of the following locations:

a. Transformers supplying conductors to a building or other structure

b. Underground circuits if the neutral conductor is exposed

c. Overhead circuits installed outdoors

(2) The multigrounded neutral conductor shall be grounded at each transformer and at other additional locations by connection to a grounding electrode.
(3) At least one grounding electrode shall be installed and connected to the multigrounded neutral conductor every 400 m (1300 ft).

(4) The maximum distance between any two adjacent electrodes shall not be more than 400 m (1300 ft).
(5) In a multigrounded shielded cable system, the shielding shall be grounded at each cable joint that is exposed to personnel contact.

Exception: In a multipoint grounded system, a grounding electrode shall not be required to bond the neutral conductor in an uninterrupted conductor exceeding 400 m (1300 ft) if the only purpose for removing the cable jacket is for bonding the neutral conductor to a grounding electrode

350.28 Main Bonding Jumper and System Bonding Jumper.

For a grounded system, main bonding jumpers and system bonding jumpers shall be installed as follows:

(A) Material.

Main bonding jumpers and system bonding jumpers shall be of copper, aluminum, copper-clad aluminum, or other corrosion-resistant material. A main bonding jumper and a system bonding jumper shall be a wire, bus, screw, or similar suitable conductor.

(B) Construction.

If a main bonding jumper or a system bonding jumper is a screw only, the screw shall be identified with a green finish that shall be visible with the screw installed.

(C) Attachment.

Main bonding jumpers and system bonding jumpers shall be connected by one or more of the methods in 350.8 that is suitable for the material of the bonding jumper and enclosure.

(D) Size.

Main bonding jumpers and system bonding jumpers shall be sized in accordance with 350.28(D)(1) through (D)(3).

(1) General.

Main bonding jumpers and system bonding jumpers shall not be smaller than specified in Table 350.102(C)(1).

(2) Main Bonding Jumper for Service with More Than One Enclosure.

If a service consists of more than a single enclosure as permitted in 230.71(B), the main bonding jumper for each enclosure shall be sized in accordance with 350.28(D)(1) based on the largest ungrounded service conductor serving that enclosure.

(3) Separately Derived System with More Than One Enclosure.

If a separately derived system supplies more than a single enclosure, the system bonding jumper for each enclosure shall be sized in accordance with 350.28(D)(1) based on the largest ungrounded feeder conductor serving that enclosure, or a single system bonding jumper shall be installed at the source and sized in accordance with 350.28(D)(1) based on the equivalent size of the largest supply conductor determined by the largest sum of the areas of the corresponding conductors of each set.

350.30 Grounding Separately Derived Alternating-Current Systems.

In addition to complying with 350.30(A) for grounded systems, or as provided in 350.30(B) for ungrounded systems, separately derived systems shall comply with 350.20, 350.21, or 350.26, as applicable. Multiple power sources of the same type that are connected in parallel to form one system that supplies premises wiring shall be treated as a single separately derived system and shall be installed in accordance with 350.30.

Informational Note No. 1: An alternate ac power source, such as an on-site generator, is not a separately derived system if the grounded conductor is solidly interconnected to a service-supplied system grounded conductor. An example of such a situation is if the alternate source transfer equipment does not include a switching action in the grounded conductor and allows it to remain solidly connected to the service-supplied grounded conductor when the alternate source is operational and supplying the load served.

Informational Note No. 2: See 445.13 for the minimum size of conductors that carry fault current.

(A) Grounded Systems.

A separately derived ac system that is grounded shall comply with 350.30(A)(1) through (A)(8). Except as otherwise permitted in this article, a grounded conductor shall not be connected to normally non-current-carrying metal parts of equipment, be connected to equipment grounding conductors, or be reconnected to ground on the load side of the system bonding jumper.

Informational Note: See 350.32 for connections at separate buildings or structures and 350.142 for use of the grounded circuit conductor for grounding equipment.

Exception: Impedance grounded system grounding connections shall be made in accordance with 350.36 .

(1) System Bonding Jumper.

An unspliced system bonding jumper shall comply with 350.28(A) through (D). This connection shall be made at any single point on the separately derived system from the source to the first system disconnecting means or overcurrent device, or it shall be made at the source of a separately derived system that has no disconnecting means or overcurrent devices, in accordance with 350.30(A)(1)(a) or (A)(1)(b). The system bonding jumper shall remain within the enclosure where it originates. If the source is located outside the building or structure supplied, a system bonding jumper shall be installed at the grounding electrode connection in compliance with 350.30(C).

Exception No. 1: For parallel sources or systems a single system bonding jumper connection to the tie point of the grounded circuit conductors from each power source shall be permitted.

Exception No. 2: If a building or structure is supplied by a feeder from an outdoor separately derived system, a system bonding jumper at both the source and the first disconnecting means shall be permitted if doing so does not establish a parallel path for the grounded conductor. If a grounded conductor is used in this manner, it shall not be smaller than the size specified for the system bonding jumper but shall not be required to be larger than the ungrounded conductor(s). For the purposes of this exception, connection through the earth shall not be considered as providing a parallel path.

(a) *Installed at the Source.* The system bonding jumper shall connect the grounded conductor to the supply-side bonding jumper and the normally non-current-carrying metal enclosure.

(b) *Installed at the First Disconnecting Means.* The system bonding jumper shall connect the grounded conductor to the supply-side bonding jumper, the disconnecting means enclosure, and the equipment grounding conductor(s).

Exception: Separately derived systems consisting of multiple sources of the same type that are connected in parallel shall be permitted to have the system bonding jumper installed at the paralleling switchgear, switchboard, or other paralleling connection point instead of at the disconnecting means located at each separate source.

(2) Supply-Side Bonding Jumper.

If the source of a separately derived system and the first disconnecting means are located in separate enclosures, a supply-side bonding jumper shall be installed with the circuit conductors from the source enclosure to the first disconnecting means enclosure. A supply-side bonding jumper shall not be required to be larger than the derived ungrounded conductors. The supply-side bonding jumper shall be permitted to be of nonflexible metal raceway type or of the wire or bus type as follows:

(1) A supply-side bonding jumper of the wire type shall comply with 350.102(C), based on the size of the derived ungrounded conductors.

(2) 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 350.102(C).

Exception: A supply-side bonding jumper shall not be required between enclosures for installations made in compliance with 350.30(A)(1), Exception No. 2.

(3) Grounded Conductor.

If a grounded conductor is installed and the system bonding jumper connection is not located at the source, 350.30(A)(3)(a) through (A)(3)(d) shall apply. The grounded conductor shall not be required to be larger than the derived ungrounded conductors.

(a) *Sizing for a Single Raceway.* The grounded conductor shall not be smaller than specified in Table 350.102(C)(1).

(b) *Conductors Connected in Parallel in Two or More Raceways or Cables.* If the ungrounded conductors are connected in parallel in two or more raceways or cables, the grounded conductors shall also be installed in each raceway or cable and shall be connected in parallel. The size of the grounded conductor(s) in each raceway or cable shall be based on the largest derived ungrounded conductor in each raceway or cable, or the sum of the circular mil areas of the largest derived ungrounded conductors from each set connected in parallel in each raceway or cable, in accordance with 350.30(A)(3)(a), but not smaller than 1/0 AWG.

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

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

(d) *Impedance Grounded System.* The impedance grounding conductor of an impedance grounded system shall be installed in accordance with 350.36.

(4) Grounding Electrode.

The building or structure grounding electrode system shall be used as the grounding electrode for the separately derived system. If located outdoors, the grounding electrode shall be in accordance with 350.30(C).

Exception: If a separately derived system originates in equipment that is listed and identified as suitable for use as service equipment, the grounding electrode used for the service or feeder equipment shall be permitted to be used as the grounding electrode for the separately derived system.

Informational Note No. 1: See 350.104(D) for bonding requirements for interior metal water piping in the area served by separately derived systems.

Informational Note No. 2: See 350.50 and 350.58 for requirements for bonding all electrodes together if located at the same building or structure.

(5) Grounding Electrode Conductor, Single Separately Derived System.

A grounding electrode conductor for a single separately derived system shall be sized in accordance with 350.66 for the derived ungrounded conductors. It shall be used to connect the grounded conductor of the derived system to the grounding electrode in accordance with 350.30(A)(4), or as permitted in 350.68(C)(1) and (C)(2). This connection shall be made at the same point on the separately derived system where the system bonding jumper is connected.

Exception No. 1: If the system bonding jumper specified in 350.30(A)(1) is a wire or busbar, it shall be permitted to connect the grounding electrode conductor to the equipment grounding terminal, bar, or bus if the equipment grounding terminal, bar, or bus is of sufficient size for the separately derived system.

Exception No. 2: If the source of a separately derived system is located within equipment listed and identified as suitable for use as service equipment, the grounding electrode conductor from the service or feeder equipment to the grounding electrode shall be permitted as the grounding electrode conductor for the separately derived system, if the grounding electrode conductor is of sufficient size for the separately derived system. If the equipment grounding bus internal to the equipment is not smaller than the required grounding electrode conductor for the

separately derived system, the grounding electrode connection for the separately derived system shall be permitted to be made to the bus.

(6) Grounding Electrode Conductor, Multiple Separately Derived Systems.

A common grounding electrode conductor for multiple separately derived systems shall be permitted. If installed, the common grounding electrode conductor shall be used to connect the grounded conductor of each separately derived system to the grounding electrode as specified in 350.30(A)(4). A grounding electrode conductor tap shall then be installed from each separately derived system to the common grounding electrode conductor. Each tap conductor shall connect the grounded conductor of the separately derived system to the common grounding electrode conductor. This connection shall be made at the same point on the separately derived system where the system bonding jumper is connected.

Exception No. 1: If the system bonding jumper specified in 350.30(A)(1) is a wire or busbar, it shall be permitted to connect the grounding electrode conductor tap to the equipment grounding terminal, bar, or bus, provided the equipment grounding terminal, bar, or bus is of sufficient size for the separately derived system.

Exception No. 3: If the source of a separately derived system is located within equipment listed and identified as suitable for use as service equipment, the grounding electrode conductor from the service or feeder equipment to the grounding electrode shall be permitted as the grounding electrode conductor for the separately derived system, if the grounding electrode conductor is of sufficient size for the separately derived system. If the equipment grounding bus internal to the equipment is not smaller than the required grounding electrode conductor for the separately derived system, the grounding electrode connection for the separately derived system shall be permitted to be made to the bus.

(a) *Common Grounding Electrode Conductor.* The common grounding electrode conductor shall be permitted to be one of the following:

(1) A conductor of the wire type not smaller than 3/0 AWG copper or 350 kcmil aluminum

(2) A metal water pipe in accordance with 350.68(C)(1)

(3) The metal structural frame of the building or structure in accordance with 350.68(C)(2) or is connected to the grounding electrode system by a conductor not smaller than 3/0 AWG copper or 350 kcmil aluminum

(b) *Tap Conductor Size.* Each tap conductor shall be sized in accordance with 350.66 based on the derived ungrounded conductors of the separately derived system it serves.

Exception to (a)(1) and (b): If the only electrodes that are present are of the types in 350.66(A), (B), or (C), the size of the common grounding electrode conductor shall not be required to be larger than the largest conductor required by 350.66(A), (B), or (C) for the type of electrode that is present.

(c) *Connections.* All tap connections to the common grounding electrode conductor shall be made at an accessible location by one of the following methods:

(1) A connector listed as grounding and bonding equipment.

(2) Listed connections to aluminum or copper busbars not smaller than 6 mm thick × 50 mm wide (**1/4** in. thick × 2 in. wide) and of a length to accommodate the number of terminations necessary for the installation. If aluminum busbars are used, the installation shall also be in accordance with 350.64(A).

(3) The exothermic welding process.

Tap conductors shall be connected to the common grounding electrode conductor in such a manner that the common grounding electrode conductor remains without a splice or joint.

(7) Installation.

The installation of all grounding electrode conductors shall comply with 350.64(A), (B), (C), and (E).

(8) Bonding.

Structural steel and metal piping shall be connected to the grounded conductor of a separately derived system in accordance with 350.104(D).

(B) Ungrounded Systems.

The equipment of an ungrounded separately derived system shall be grounded and bonded as specified in 350.30(B)(1) through (B)(3).

(1) Grounding Electrode Conductor.

A grounding electrode conductor, sized in accordance with 350.66 for the largest derived ungrounded conductor(s) or set of derived ungrounded conductors, shall be used to connect the metal enclosures of the derived system to the grounding electrode as specified in 350.30(A)(5) or (A)(6), as applicable. This connection shall be made at any point on the separately derived system from the source to the first system disconnecting means. If the source is located outside the building or structure supplied, a grounding electrode connection shall be made in compliance with 350.30(C).

(2) Grounding Electrode.

Except as permitted by 350.34 for portable and vehicle-mounted generators, the grounding electrode shall comply with 350.30(A)(4).

(3) Bonding Path and Conductor.

A supply-side bonding jumper shall be installed from the source of a separately derived system to the first disconnecting means in compliance with 350.30(A)(2).

(C) Outdoor Source.

If the source of the separately derived system is located outside the building or structure supplied, a grounding electrode connection shall be made at the source location to one or more grounding electrodes in accordance with 350.50. In addition, the installation shall be in accordance with 350.30(A) for grounded systems or with 350.30(B) for ungrounded systems.

Exception: The grounding electrode conductor connection for impedance grounded systems shall be in accordance with 350.36.

350.32 Buildings or Structures Supplied by a Feeder(s) or Branch Circuit(s).

(A) Grounding Electrode System and Grounding Electrode Conductor.

A building(s) or structure(s) supplied by a feeder(s) or branch circuit(s) shall have a grounding electrode system and grounding electrode conductor installed in accordance with Part III of Article 350.

Exception: A grounding electrode system and grounding electrode conductor shall not be required if only a single branch circuit, including a multiwire branch circuit, supplies the building or structure and the branch circuit includes an equipment grounding conductor for grounding the normally non-current-carrying metal parts of equipment.

(B) Grounded Systems.

(1) Supplied by a Feeder or Branch Circuit.

An equipment grounding conductor, as described in 350.118, shall be run with the supply conductors and be connected to the building or structure disconnecting means and to the grounding electrode(s). The equipment grounding conductor shall be used for grounding or bonding of equipment, structures, or frames required to be grounded or bonded. The equipment grounding conductor shall be sized in accordance with 350.122. Any installed grounded conductor shall not be connected to the equipment grounding conductor or to the grounding electrode(s).

Exception No. 1: For installations made in compliance with previous editions of this Code that permitted such connection, the grounded conductor run with the supply to the building or structure shall be permitted to serve as the ground-fault return path if all of the following requirements continue to be met:

(1) An equipment grounding conductor is not run with the supply to the building or structure.

(2) There are no continuous metallic paths bonded to the grounding system in each building or structure involved.

(3) Ground-fault protection of equipment has not been installed on the supply side of the feeder(s).

If the grounded conductor is used for grounding in accordance with the provision of this exception, the size of the grounded conductor shall not be smaller than the larger of either of the following:

(1) The calculated neutral load in accordance with 220.61

(2) The minimum equipment grounding conductor sized in accordance with 350.122

Exception No. 2: If system bonding jumpers are installed in accordance with 350.30(A)(1), Exception No. 2, the feeder grounded circuit conductor at the building or structure served shall be connected to the equipment grounding conductors, grounding electrode conductor, and the enclosure for the first disconnecting means.

(2) Supplied by Separately Derived System.

(a) *With Overcurrent Protection.* If overcurrent protection is provided where the conductors originate, the installation shall comply with 350.32(B)(1).

(b) *Without Overcurrent Protection.* If overcurrent protection is not provided where the conductors originate, the installation shall comply with 350.30(A). If installed, the supply-side bonding jumper shall be connected to the building or structure disconnecting means and to the grounding electrode(s).

(C) Ungrounded Systems.

(1) Supplied by a Feeder or Branch Circuit.

An equipment grounding conductor, as described in 350.118, shall be installed with the supply conductors and be connected to the building or structure disconnecting means and to the grounding electrode(s). The grounding electrode(s) shall also be connected to the building or structure disconnecting means.

(2) Supplied by a Separately Derived System.

(a) *With Overcurrent Protection.* If overcurrent protection is provided where the conductors originate, the installation shall comply with 350.32(C)(1).

(b) *Without Overcurrent Protection.* If overcurrent protection is not provided where the conductors originate, the installation shall comply with 350.30(B). If installed, the supply-side bonding jumper shall be connected to the building or structure disconnecting means and to the grounding electrode(s).

(D) Disconnecting Means Located in Separate Building or Structure on the Same Premises.

If one or more disconnecting means supply one or more additional buildings or structures under single management, and where these disconnecting means are located remote from those buildings or structures in accordance with 225.31(B), Exception No. 1 and No. 2, 700.12(D)(4), 701.12(D)(3), or 702.12, all of the following conditions shall be met:

(1) The connection of the grounded conductor to the grounding electrode, to normally non-current-carrying metal parts of equipment, or to the equipment grounding conductor at a separate building or structure shall not be made.

(2) An equipment grounding conductor for grounding and bonding any normally non-current-carrying metal parts of equipment, interior metal piping systems, and building or structural metal frames is run with the circuit conductors to a separate building or structure and connected to existing grounding electrode(s) required in Part III of this article, or, if there are no existing electrodes, the grounding electrode(s) required in Part III of this article shall be installed if a separate building or structure is supplied by more than one branch circuit.

(3) The connection between the equipment grounding conductor and the grounding electrode at a separate building or structure shall be made in a junction box, panelboard, or similar enclosure located immediately inside or outside the separate building or structure.

(E) Grounding Electrode Conductor.

The size of the grounding electrode conductor to the grounding electrode(s) shall not be smaller than given in 350.66, based on the largest ungrounded supply conductor. The installation shall comply with Part III of this article.

350.34 Portable, Vehicle-Mounted, and Trailer-Mounted Generators.

(A) Portable Generators.

The frame of a portable generator shall not be required to be connected to a grounding electrode as defined in 350.52 for a system supplied by the generator under both of the following conditions:

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

(2) The normally non-current-carrying metal parts of equipment and the equipment grounding conductor terminals of the receptacles are connected to the generator frame.

(B) Vehicle-Mounted and Trailer-Mounted Generators.

The frame of a vehicle or trailer shall not be required to be connected to a grounding electrode as defined in 350.52 for a system supplied by a generator located on this vehicle or trailer under all of the following conditions:

(1) The frame of the generator is bonded to the vehicle or trailer frame.

(2) The generator supplies only equipment located on the vehicle or trailer; cord-and-plug-connected equipment through receptacles mounted on the vehicle; or both equipment located on the vehicle or trailer and cord-and-plug-connected equipment through receptacles mounted on the vehicle, trailer, or on the generator.

(3) The normally non-current-carrying metal parts of equipment and the equipment grounding conductor terminals of the receptacles are connected to the generator frame.

(C) Grounded Conductor Bonding.

A conductor that is required to be grounded by 350.26 shall be connected to the generator frame if the generator is a component of a separately derived system.

Informational Note: See 350.30 for grounding portable generators supplying fixed wiring systems.

350.35 Permanently Installed Generators.

A conductor that provides an effective ground-fault current path shall be installed with the supply conductors from a permanently installed generator(s) to the first disconnecting mean(s) in accordance with 350.35(A) or (B).

(A) Separately Derived System.

If the generator is installed as a separately derived system, the requirements in 350.30 shall apply.

(B) Non-integral overcurrent protection.

If the generator is installed as a nonseparately derived system, and overcurrent protection is not integral with the generator assembly, a supply-side bonding jumper shall be installed between the generator equipment grounding terminal and the equipment grounding terminal, bar, or bus of the disconnecting mean(s) where the overcurrent protective device is located. It shall be sized in accordance with 350.102(C) based on the size of the conductors supplied by the generator.

~~250.187~~350.36 **Impedance Grounded Systems** [Move 250.187 to 350.36]

Impedance grounded systems in which a grounding impedance device, typically a resistor, limits the ground-fault current shall be permitted if all of the following conditions are met:

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

(2) Ground detectors are installed on the system.

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

Impedance grounded systems shall comply with 250.187(A) through (D).

(A) Location.

The grounding impedance device shall be installed between the grounding electrode conductor and the impedance grounding conductor connected to the system neutral point.

(B) Insulated.

The impedance grounding conductor shall be insulated for the maximum neutral voltage.

Exception: A bare impedance grounding conductor shall be permitted if the bare portion of the grounding impedance device and conductor are not in a readily accessible location and securely separated from the ungrounded conductors.

Informational Note: The maximum neutral voltage in a 3-phase wye system is 57.7 percent of the phase-to-phase voltage.

(C) System Neutral Point Connection.

The system neutral point shall not be connected to ground, except through the grounding impedance device.

(D) Equipment Grounding Conductors.
Equipment grounding conductors shall be permitted to be bare and shall be electrically connected to the ground bus and grounding electrode conductor.

Part III. Grounding Electrode System and Grounding Electrode Conductor
350.50 Grounding Electrode System.
All grounding electrodes as described in 350.52(A)(1) through (A)(8) that are present at each building or structure served shall be bonded together to form the grounding electrode system. If none of these grounding electrodes exist, one or more of the grounding electrodes specified in 350.52(A)(4) through (A)(8) shall be installed and used.
Exception: Concrete-encased electrodes of existing buildings or structures shall not be required to be part of the grounding electrode system if the rebar is not accessible for use without disturbing the concrete.
350.52 Grounding Electrodes.
(A) Electrodes Permitted for Grounding.
(1) Metal Underground Water Pipe.
A metal underground water pipe in direct contact with the earth for 3.0 m (10 ft) or more (including any metal well casing bonded to the pipe) and electrically continuous (or made electrically continuous by bonding around insulating joints or insulating pipe) to the points of connection of the grounding electrode conductor and the bonding conductor(s) or jumper(s), if installed.
(2) Metal In-ground Support Structure(s).
One or more metal in-ground support structure(s) in direct contact with the earth vertically for 3.0 m (10 ft) or more, with or without concrete encasement. If multiple metal in-ground support structures are present at a building or a structure, it shall be permissible to bond only one into the grounding electrode system.
Informational Note: Metal in-ground support structures include, but are not limited to, pilings, casings, and other structural metal.
(3) Concrete-Encased Electrode.
A concrete-encased electrode shall consist of at least 6.0 m (20 ft) of either of the following:

(1) One or more bare or zinc galvanized or other electrically conductive coated rebar of not less than 13 mm (**1/2** in.) in diameter, installed in one continuous 6.0 m (20 ft) length, or if in multiple pieces, the rebar shall be connected together by steel tie wires, exothermic welding, welding, or other effective means to create a 6.0 m (20 ft) or greater length

(2) Bare copper conductor not smaller than 4 AWG

Metal components shall be encased by at least 50 mm (2 in.) of concrete and shall be located horizontally within that portion of a concrete foundation or footing that is in direct contact with the earth or within vertical foundations or structural components or members that are in direct contact with the earth. If multiple concrete-encased electrodes are present at a building or structure, it shall be permissible to bond only one into the grounding electrode system.
Informational Note: Concrete installed with insulation, vapor barriers, films, or similar items separating the concrete from the earth is not considered to be in "direct contact" with the earth.
(4) Ground Ring.
A ground ring encircling the building or structure, in direct contact with the earth, consisting of at least 6.0 m (20 ft) of bare copper conductor not smaller than 2 AWG.
(5) Rod and Pipe Electrodes.
Rod and pipe electrodes shall not be less than 2.44 m (8 ft) in length and consist of the following materials.

(1) Grounding electrodes of pipe or conduit shall not be smaller than metric designator 21 (trade size **3/4**) and, where of steel, shall have the outer surface galvanized or otherwise metal-coated for corrosion protection.

(2) Rod-type grounding electrodes of stainless steel and copper or zinc-coated steel shall be at least 15.87 mm (**5/8** in.) in diameter, unless listed.

(6) Other Listed Electrodes.
Other listed grounding electrodes shall be permitted.
(7) Plate Electrodes.
Each plate electrode shall expose not less than 0.186 m^2 (2 ft^2) of surface to exterior soil. Electrodes of bare or electrically conductive coated iron or steel plates shall be at least 6.4 mm (**1/4** in.) in thickness. Solid, uncoated electrodes of nonferrous metal shall be at least 1.5 mm (0.06 in.) in thickness.

(8) Other Local Metal Underground Systems or Structures.
Other local metal underground systems or structures such as piping systems, underground tanks, and underground metal well casings that are not bonded to a metal water pipe.

(B) Not Permitted for Use as Grounding Electrodes.
The following systems and materials shall not be used as grounding electrodes:

(1) Metal underground gas piping systems

(2) Aluminum

(3) The structures and structural rebar described in 680.26(B)(1) and (B)(2)

Informational Note: See 350.104(B) for bonding requirements of gas piping.

350.53 Grounding Electrode System Installation.

(A) Rod, Pipe, and Plate Electrodes.
Rod, pipe, and plate electrodes shall be free from nonconductive coatings such as paint or enamel. Rod, pipe, and plate electrodes shall meet the requirements of 350.53(A)(1) through (A)(3).

(1) Below Permanent Moisture Level.
If practicable, rod, pipe, and plate electrodes shall be embedded below permanent moisture level.

(2) Supplemental Electrode Required.
A single rod, pipe, or plate electrode shall be supplemented by an additional electrode of a type specified in 350.52(A)(2) through (A)(8). The supplemental electrode shall be permitted to be bonded to one of the following:

(1) Rod, pipe, or plate electrode

(2) Grounding electrode conductor

(3) Grounded service-entrance conductor

(4) Nonflexible grounded service raceway

(5) Any grounded service enclosure

Exception: If a single rod, pipe, or plate grounding electrode has a resistance to earth of 25 ohms or less, the supplemental electrode shall not be required.

(3) Supplemental Electrode.
If multiple rod, pipe, or plate electrodes are installed to meet the requirements of this section, they shall not be less than 1.8 m (6 ft) apart.
Informational Note: The paralleling efficiency of rods is increased by spacing them twice the length of the longest rod.

(4) Rod and Pipe Electrodes.
The electrode shall be installed such that at least 2.44 m (8 ft) of length is in contact with the soil. It shall be driven to a depth of not less than 2.44 m (8 ft) except that, where rock bottom is encountered, the electrode shall be driven at an oblique angle not to exceed 45 degrees from the vertical or, where rock bottom is encountered at an angle up to 45 degrees, the electrode shall be permitted to be buried in a trench that is at least 750 mm (30 in.) deep. The upper end of the electrode shall be flush with or below ground level unless the aboveground end and the grounding electrode conductor attachment are protected against physical damage as specified in 350.10.

(5) Plate Electrode.
Plate electrodes shall be installed not less than 750 mm (30 in.) below the surface of the earth.

(B) Electrode Spacing.
If more than one of the electrodes of the type specified in 350.52(A)(5) or (A)(7) are used, each electrode of one grounding system (including that used for strike termination devices) shall not be less than 1.83 m (6 ft) from any other electrode of another grounding system.

(C) Bonding Jumper.
The bonding jumper(s) used to connect the grounding electrodes together to form the grounding electrode system shall be installed in accordance with 350.64(A), (B), and (E), shall be sized in accordance with 350.66, and shall be connected in the manner specified in 350.70. Rebar shall not be used as a conductor to interconnect the electrodes of grounding electrode systems.

(D) Metal Underground Water Pipe.
If used as a grounding electrode, metal underground water pipe shall meet the requirements of 350.53(D)(1) and (D)(2).

(1) Continuity.
Continuity of the grounding path or the bonding connection to interior piping shall not rely on water meters or filtering devices and similar equipment.

(2) Supplemental Electrode Required.
A metal underground water pipe shall be supplemented by an additional electrode of a type specified in 350.52(A)(2) through (A)(8). If the supplemental electrode is of the rod, pipe, or plate type, it shall comply with 350.53(A). The supplemental electrode shall be bonded to one of the following:

(1) Grounding electrode conductor

(2) Grounded service-entrance conductor

(3) Nonflexible grounded service raceway

(4) Any grounded service enclosure

(5) As provided by 350.32(B)

Exception: The supplemental electrode shall be permitted to be bonded to the interior metal water piping as specified in 350.68(C)(1).

(E) Supplemental Grounding Electrode Bonding Jumper Size.
If the supplemental electrode is a rod, pipe, or plate electrode, that portion of the bonding jumper that is the sole connection to the supplemental grounding electrode shall not be required to be larger than 6 AWG copper wire or 4 AWG aluminum or copper-clad aluminum wire.

(F) Ground Ring.
The ground ring shall be installed not less than 750 mm (30 in.) below the surface of the earth.

350.54 Auxiliary Grounding Electrodes.
One or more grounding electrodes shall be permitted to be connected to the equipment grounding conductors specified in 350.118 and shall not be required to comply with the electrode bonding requirements of 350.50 or 350.53(C) or the resistance requirements of 350.53(A)(2) Exception, but the earth shall not be used as an effective ground-fault current path as specified in 350.4(A)(5) and (B)(4).

350.58 Common Grounding Electrode.
If an ac system is connected to a grounding electrode in or at a building or structure, the same electrode shall be used to ground conductor enclosures and equipment in or on that building or structure. If separate services, feeders, or branch circuits supply a building and are required to be connected to a grounding electrode(s), the same grounding electrode(s) shall be used.

350.60 Use of Strike Termination Devices.
Conductors and driven pipes, rods, or plate electrodes used for grounding strike termination devices shall not be used in lieu of the grounding electrodes required by 350.50 for grounding wiring systems and equipment. This provision shall not prohibit the required bonding together of grounding electrodes of different systems.
Informational Note No. 1: See 350.106 for the bonding requirement of the lightning protection system components to the building or structure grounding electrode system.
Informational Note No. 2: Bonding together of all separate grounding electrodes will limit voltage differences between them and between their associated wiring systems.

350.62 Grounding Electrode Conductor Material.
The grounding electrode conductor shall be of copper, aluminum, copper-clad aluminum, or the items as permitted in 350.68(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.

350.64 Grounding Electrode Conductor Installation.
Grounding electrode conductors at the service, at each building or structure where supplied by a feeder(s) or branch circuit(s), or at a separately derived system shall be installed as specified in 350.64(A) through (G).

(A) Aluminum or Copper-Clad Aluminum Conductors.
Grounding electrode conductors of bare, covered, or insulated aluminum or copper-clad aluminum shall comply with the following:

(1) Bare or covered conductors without an extruded polymeric covering shall not be installed where subject to corrosive conditions or be installed in direct contact with concrete.

(2) Terminations made within outdoor enclosures that are listed and identified for the environment shall be permitted within 450 mm (18 in.) of the bottom of the enclosure.

(3) Aluminum or copper-clad aluminum conductors external to buildings or equipment enclosures shall not be terminated within 450 mm (18 in.) of the earth.

(B) Securing and Protection Against Physical Damage.
If exposed, a grounding electrode conductor or its enclosure shall be securely fastened to the surface on which it is carried. Grounding electrode conductors shall be permitted to be installed on or through framing members.

(1) Not Exposed to Physical Damage.
A 6 AWG or larger copper, copper-clad aluminum, or aluminum grounding electrode conductor not exposed to physical damage shall be permitted to be run along the surface of the building construction without metal covering or protection.

(2) Exposed to Physical Damage.
A 6 AWG or larger copper, copper-clad aluminum, or aluminum grounding electrode conductor exposed to physical damage shall be protected in rigid metal conduit (RMC), intermediate metal conduit (IMC), Schedule 80 rigid polyvinyl chloride conduit (PVC), reinforced thermosetting resin conduit Type XW (RTRC-XW), electrical metallic tubing (EMT), or cable armor.

(3) Smaller Than 6 AWG.
Grounding electrode conductors smaller than 6 AWG shall be protected in RMC, IMC, Schedule 80 PVC, RTRC-XW, EMT, or cable armor.
(4) In Contact with the Earth.
Grounding electrode conductors and grounding electrode bonding jumpers in contact with the earth shall not be required to comply with 300.5 or 305.15 but shall be buried or otherwise protected if subject to physical damage.
(C) Continuous.
Except as provided in 350.30(A)(5) and (A)(6), 350.30(B)(1), and 350.68(C), grounding electrode conductor(s) shall be installed in one continuous length without a splice or joint. If necessary, splices or connections shall be made as permitted in the following:

(1) Splicing of the wire-type grounding electrode conductor shall be permitted only by irreversible compression-type connectors listed as grounding and bonding equipment or by the exothermic welding process.

(2) Sections of busbars shall be permitted to be connected together to form a grounding electrode conductor.

(3) Bolted, riveted, or welded connections of structural metal frames of buildings or structures.

(4) Threaded, welded, brazed, soldered or bolted-flange connections of metal water piping.

(D) Building or Structure with Multiple Disconnecting Means in Separate Enclosures.
If a building or structure is supplied by a service or feeder with two or more disconnecting means in separate enclosures, the grounding electrode connections shall be made in accordance with 350.64(D)(1), (D)(2), or (D)(3).
(1) Common Grounding Electrode Conductor and Taps.
A common grounding electrode conductor and grounding electrode conductor taps shall be installed. The common grounding electrode conductor shall be sized in accordance with 350.66, based on the sum of the circular mil area of the largest ungrounded conductor(s) of each set of conductors that supplies the disconnecting means. If the service-entrance conductors connect directly to the overhead service conductors, service drop, underground service conductors, or service lateral, the common grounding electrode conductor shall be sized in accordance with Table 350.66, note 1.
A grounding electrode conductor tap shall extend to the inside of each disconnecting means enclosure. The grounding electrode conductor taps shall be sized in accordance with 350.66 for the largest service-entrance or feeder conductor serving the individual enclosure. The tap conductors shall be connected to the common grounding electrode conductor by one of the following methods in such a manner that the common grounding electrode conductor remains without a splice or joint:

(1) Exothermic welding.

(2) Connectors listed as grounding and bonding equipment.

(3) Connections to an aluminum or copper busbar not less than 6 mm thick × 50 mm wide (**1/4** in. thick × 2 in. wide) and of a length to accommodate the number of terminations necessary for the installation. The busbar shall be securely fastened and shall be installed in an accessible location. Connections shall be made by a listed connector or by the exothermic welding process. If aluminum busbars are used, the installation shall comply with 350.64(A).

(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(s) or branch circuit(s) for other than services

(3) Supply-side bonding jumper

Each grounding electrode conductor shall be sized in accordance with 350.66 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 one or more of the following, as applicable:

(1) Grounded service conductor(s)

(2) Equipment grounding conductor installed with the feeder

(3) Supply-side bonding jumper

The connection shall be made with exothermic welding or a connector listed as grounding and bonding equipment. The grounding electrode conductor shall be sized in accordance with 350.66 based on the service-entrance or feeder conductor(s) at the common location where the connection is made.

(E) Raceways, Cable Armor, and Enclosures for Grounding Electrode Conductors.

(1) General.

Ferrous metal raceways, enclosures, and cable armor for grounding electrode conductors shall be electrically continuous from the point of attachment to cabinets or equipment to the grounding electrode and shall be securely fastened to the ground clamp or fitting. Ferrous metal raceways, enclosures, and cable armor shall be bonded at each end of the raceway or enclosure to the grounding electrode or grounding electrode conductor to create an electrically parallel path. Nonferrous metal raceways, enclosures, and cable armor shall not be required to be electrically continuous.

(2) Methods.

Bonding shall be in compliance with 350.92(B) and ensured by one of the methods in 350.92(B)(2) through (B)(4).

(3) Size.

The bonding jumper for a grounding electrode conductor(s), raceway(s), enclosure(s), or cable armor shall be the same size as, or larger than, the largest enclosed grounding electrode conductor.

(4) Wiring Methods.

If a raceway is used as protection for a grounding electrode conductor, the installation shall comply with the requirements of the applicable raceway article.

(F) Installation to Electrode(s).

Grounding electrode conductor(s) and bonding jumpers interconnecting grounding electrodes shall be installed in accordance with one of the following. The grounding electrode conductor shall be sized for the largest grounding electrode conductor required among all the electrodes connected to it.

(1) The grounding electrode conductor shall be permitted to be run to any convenient grounding electrode available in the grounding electrode system where the other electrode(s), if any, is connected by bonding jumpers that are installed in accordance with 350.53(C).

(2) Grounding electrode conductor(s) shall be permitted to be run to one or more grounding electrode(s) individually.

(3) Bonding jumper(s) from grounding electrode(s) shall be permitted to be connected to an aluminum or copper busbar not less than 6 mm thick × 50 mm wide (**1/4** in. thick × 2 in wide.) and of sufficient length to accommodate the number of terminations necessary for the installation. The busbar shall be securely fastened and shall be installed in an accessible location. Connections shall be made by a listed connector or by the exothermic welding process. The grounding electrode conductor shall be permitted to be run to the busbar. Where aluminum busbars are used, the installation shall comply with 350.64(A).

(G) Enclosures with Ventilation Openings.

Grounding electrode conductors shall not be installed through a ventilation opening of an enclosure.

350.66 Size of Alternating-Current Grounding Electrode Conductor.

The size of the grounding electrode conductor and bonding jumper(s) for connection of grounding electrodes shall not be smaller than given in Table 350.66, except as permitted in 350.66(A) through (C).

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Table 350.66 Grounding Electrode Conductor for Alternating-Current Systems

Size of Largest Ungrounded Conductor or Equivalent Area for Parallel Conductors (AWG/kcmil)		Size of Grounding Electrode Conductor (AWG/kcmil)	
Copper	Aluminum or Copper-Clad Aluminum	Copper	Aluminum or Copper-Clad Aluminum
2 or smaller	1/0 or smaller	8	6
1 or 1/0	2/0 or 3/0	6	4
2/0 or 3/0	4/0 or 350	4	2
Over 3/0 through 350	Over 350 through 500	2	1/0
Over 350 through 600	Over 500 through 900	1/0	3/0
Over 600 through 1100	Over 900 through 1750	2/0	4/0
Over 1100	Over 1750	3/0	350

Notes:

1. If multiple sets of service-entrance conductors connect directly to a service drop, set of overhead service conductors, set of underground service conductors, or service lateral, the equivalent size of the largest service-

entrance conductor shall be determined by the largest sum of the areas of the corresponding conductors of each set.
2. If there are no service-entrance conductors, the grounding electrode conductor size shall be determined by the equivalent size of the largest service-entrance conductor required for the load to be served.
3. See installation restrictions in 350.64.

(A) Connections to a Rod, Pipe, or Plate Electrode(s).

If the grounding electrode conductor or bonding jumper connected to a single or multiple rod, pipe, or plate electrode(s), or any combination thereof, as described in 350.52(A)(5) or (A)(7), does not extend on to other types of electrodes that require a larger size conductor, the grounding electrode conductor shall not be required to be larger than 6 AWG copper wire or 4 AWG aluminum or copper-clad aluminum wire.

(B) Connections to Concrete-Encased Electrodes.

If the grounding electrode conductor or bonding jumper connected to a single or multiple concrete-encased electrode(s), as described in 350.52(A)(3), does not extend on to other types of electrodes that require a larger size of conductor, the grounding electrode conductor shall not be required to be larger than 4 AWG copper wire.

(C) Connections to Ground Rings.

If the grounding electrode conductor or bonding jumper connected to a ground ring, as described in 350.52(A)(4), does not extend on to other types of electrodes that require a larger size of conductor, the grounding electrode conductor shall not be required to be larger than the conductor used for the ground ring.

350.68 Grounding Electrode Conductor and Bonding Jumper Connection to Grounding Electrodes.

The connection of a grounding electrode conductor at the service, at each building or structure where supplied by a feeder(s) or branch circuit(s), or at a separately derived system and associated bonding jumper(s) shall be made as specified 350.68(A) through (C).

(A) Accessibility.

All mechanical elements used to terminate a grounding electrode conductor or bonding jumper to a grounding electrode shall be accessible.

Exception No. 1: An encased or buried connection to a concrete-encased, driven, or buried grounding electrode shall not be required to be accessible.

Exception No. 2: Exothermic or irreversible compression connections used at terminations, together with the mechanical means used to attach such terminations to fireproofed structural metal whether or not the mechanical means is reversible, shall not be required to be accessible.

(B) Effective Grounding Path.

The connection of a grounding electrode conductor or bonding jumper to a grounding electrode shall be made in a manner that will ensure an effective grounding path. Where necessary to ensure the grounding path for a metal piping system used as a grounding electrode, bonding shall be provided around insulated joints and around any equipment likely to be disconnected for repairs or replacement. Bonding jumpers shall be of sufficient length to permit removal of such equipment while retaining the integrity of the grounding path.

(C) Grounding Electrode Conductor Connections.

Grounding electrode conductors and bonding jumpers shall be permitted to be connected at the following locations and used to extend the connection to an electrode(s):

(1) Interior metal water piping that is electrically continuous with a metal underground water pipe electrode and is located not more than 1.52 m (5 ft) from the point of entrance to the building, as measured along the water piping, shall be permitted to extend the connection to an electrode(s). Interior metal water piping located more than 1.52 m (5 ft) from the point of entrance to the building, as measured along the water piping, shall not be used as a conductor to interconnect electrodes of the grounding electrode system.

Exception: In industrial, commercial, and institutional buildings or structures, if conditions of maintenance and supervision ensure that only qualified persons service the installation, interior metal water piping located more than 1.52 m (5 ft) from the point of entrance to the building, as measured along the water piping, shall be permitted as a bonding conductor to interconnect electrodes that are part of the grounding electrode system, or as a grounding electrode conductor, if the entire length, other than short sections passing perpendicularly through walls, floors, or ceilings, of the interior metal water pipe that is being used for the conductor is exposed.

(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. Hold-down bolts securing the structural steel column that are connected to a concrete-encased electrode complying with 350.52(A)(3) and located in the support footing or foundation shall be permitted to connect the metal structural frame of a building or structure to the concrete-encased grounding electrode. The hold-down bolts shall be connected to the concrete-encased electrode by welding, exothermic welding, steel tie wires, or other approved means.

(3) A rebar-type concrete-encased electrode installed in accordance with 350.52(A)(3) with an additional rebar section extended from its location within the concrete foundation or footing to an accessible location that is not subject to corrosion shall be permitted for connection of grounding electrode conductors and bonding jumpers in accordance with the following:

a. The additional rebar section shall be continuous with the grounding electrode rebar or shall be connected to the grounding electrode rebar and connected together by steel tie wires, exothermic welding, welding, or other effective means.

b. The rebar extension shall not be exposed to contact with the earth without corrosion protection.

c. Rebar shall not be used as a conductor to interconnect the electrodes of grounding electrode systems.

350.70 Methods of Grounding and Bonding Conductor Connection to Electrodes.
(A) General.
The grounding or bonding conductor shall be connected to the grounding electrode by exothermic welding, listed lugs, listed pressure connectors, listed clamps, or other listed means. Connections depending on solder shall not be used. Ground clamps shall be listed for the materials of the grounding electrode and the grounding electrode conductor and, if used on pipe, rod, or other buried electrodes, shall also be listed for direct soil burial or concrete encasement. Not more than one conductor shall be connected to the grounding electrode by a single clamp or fitting unless the clamp or fitting is listed for multiple conductors.
(B) Indoor Communications Systems.
For indoor communications purposes only, a listed sheet metal strap-type ground clamp having a rigid metal base that seats on the electrode and having a strap of such material and dimensions that it is not likely to stretch during or after installation shall be permitted.
Informational Note: Listed ground clamps that are identified for direct burial are also suitable for concrete encasement.

Part IV. Enclosure, Raceway, and Service Cable Connections
350.80 Service Raceways and Enclosures.
Metal enclosures and raceways for service conductors and equipment shall be connected to the grounded conductor if the electrical system is grounded or to the grounding electrode conductor for electrical systems that are not grounded.
Exception: Metal components that are installed in a run of underground nonmetallic raceway(s) and are isolated from possible contact by a minimum cover of 450 mm (18 in.) to all parts of the metal components shall not be required to be connected to the grounded conductor, supply-side bonding jumper, or grounding electrode conductor.
350.84 Underground Service Cable or Raceway.
(A) Underground Service Cable.
The sheath or armor of a continuous underground metal-sheathed or armored service cable system that is connected to the grounded conductor on the supply side shall not be required to be connected to the grounded conductor at the building or structure. The sheath or armor shall be permitted to be insulated from the interior metal raceway or piping.
(B) Underground Service Raceway Containing Cable.
An underground metal service raceway that contains a metal-sheathed or armored cable connected to the grounded conductor shall not be required to be connected to the grounded conductor at the building or structure. The sheath or armor shall be permitted to be insulated from the interior metal raceway or piping.
350.86 Other Conductor Enclosures and Raceways.
Metal enclosures and raceways for other than service conductors shall be connected to the equipment grounding conductor.
Exception No. 1: Metal enclosures and raceways for conductors added to existing installations of open wire, and nonmetallic-sheathed cable shall not be required to be connected to the equipment grounding conductor if these enclosures or wiring methods comply with all the following:

(1) Do not provide an equipment ground

(2) Are in runs of less than 7.5 m (25 ft)

(3) Are free from probable contact with ground, grounded metal, metal lath, or other conductive material

(4) Are guarded against contact by persons

Exception No. 2: Short sections of metal enclosures or raceways used to provide support or protection of cable assemblies from physical damage shall not be required to be connected to the equipment grounding conductor.
Exception No. 3: Metal components shall not be required to be connected to the equipment grounding conductor or supply-side bonding jumper if either of the following conditions exist:

(1) The metal components are installed in a run of nonmetallic raceway(s) and isolated from possible contact by a minimum cover of 450 mm (18 in.) to any part of the metal components.

(2) The metal components are part of an installation of nonmetallic raceway(s) and are isolated from possible contact to any part of the metal components by being encased in not less than 50 mm (2 in.) of concrete.

Part V. Bonding

350.90 General.

Bonding shall be provided if necessary to ensure electrical continuity and the capacity to conduct safely any fault current likely to be imposed.

350.92 Services.

(A) Bonding of Equipment for Services.

The normally non-current-carrying metal parts of equipment indicated in the following shall be bonded together:

(1) All raceways, cable trays, cablebus framework, auxiliary gutters, or service cable armor or sheath that enclose, contain, or support service conductors, except as permitted in 350.80

(2) All enclosures containing service conductors, including meter fittings, boxes, or the like, interposed in the service raceway or armor

(B) Method of Bonding at the Service.

Bonding jumpers meeting the requirements of this article shall be used around impaired connections, such as reducing washers or oversized, concentric, or eccentric knockouts. Standard locknuts or bushings shall not be the only means for the bonding required by this section but shall be permitted to be installed to make a mechanical connection of the raceway(s).

Electrical continuity at service equipment, service raceways, and service conductor enclosures shall be ensured by one or more of the following methods:

(1) Bonding equipment to the grounded service conductor by an applicable method in 350.8(A)

(2) Connections made up wrenchtight using threaded couplings, threaded entries, or listed threaded hubs on enclosures

(3) Threadless couplings and connectors if made up tight for metal raceways and metal-clad cables

(4) Other listed devices, such as bonding-type locknuts, bushings, or bushings with bonding jumpers

350.94 Bonding for Communications Systems.

Communications system bonding conductor terminations shall be connected in accordance with 350.94(A) or (B).

(A) The Intersystem Bonding Termination Device.

An intersystem bonding termination (IBT) for connecting intersystem bonding conductors shall be provided external to enclosures at the service equipment or metering equipment enclosure and at the disconnecting means for any buildings or structures that are supplied by a feeder or branch circuit. If an IBT is used, it shall comply with the following:

(1) Be accessible for connection and inspection

(2) Consist of a set of terminals with the capacity for connection of not less than three intersystem bonding conductors

(3) Not interfere with opening the enclosure for a service, building or structure disconnecting means, or metering equipment

(4) Be securely mounted as follows:

a. At the service equipment, to a metal enclosure for the service equipment, to a metal meter enclosure, or to an exposed nonflexible metal service raceway, or be connected to the metal enclosure for the grounding electrode conductor with a minimum 6 AWG copper conductor.

b. At the disconnecting means for a building or structure that is supplied by a feeder or branch circuit, be electrically connected to the metal enclosure for the building or structure disconnecting means, or be connected to the metal enclosure for the grounding electrode conductor with a minimum 6 AWG copper conductor.

(5) Be listed as grounding and bonding equipment

Exception: In existing buildings or structures, if any of the intersystem bonding and grounding electrode conductors required by 770.100(B)(2), 800.100(B)(2), 810.21(F)(2), and 820.100 exist, installation of an IBT shall not be required. An accessible means external to enclosures for connecting intersystem bonding and grounding

electrode conductors shall be permitted at the service equipment and at the disconnecting means for any buildings or structures that are supplied by a feeder or branch circuit by at least one of the following means:

(1) Exposed nonflexible metal raceways

(2) An exposed grounding electrode conductor

(3) Approved means for the external connection of a copper or other corrosion-resistant bonding or grounding electrode conductor to the grounded raceway or equipment

Informational Note: See 770.100, 800.100, 810.21, and 820.100 for intersystem bonding and grounding requirements for conductive optical fiber cables, communications circuits, radio and television equipment, CATV circuits, and network-powered broadband communications systems, respectively.

(B) Other Means.

Connections to an aluminum or copper busbar not less than 6 mm thick × 50 mm wide (**1**/**4** in. thick × 2 in. wide) and of a length to accommodate at least three terminations for communication systems in addition to other connections. The busbar shall be securely fastened and shall be installed in an accessible location. Connections shall be made by a listed connector. If aluminum busbars are used, the installation shall also comply with 350.64(A). The busbar shall be connected to the grounding electrode system by a conductor that is the larger of the following:

(1) The largest grounding electrode conductor that is connected to the busbar

(2) As required or permitted in 350.94(A)

Exception to (A) and (B): Means for connecting intersystem bonding conductors are not required if communications systems are not likely to be used in or on the building or structure.

Informational Note: The use of an IBT can reduce electrical noise on communication systems.

350.96 Bonding Other Enclosures.

(A) General.

Metal raceways, cable trays, cable armor, cable sheath, enclosures, frames, fittings, and other metal non-current-carrying parts that are to serve as equipment grounding conductors, with or without the use of wire-type supplementary equipment grounding conductors, shall be bonded if necessary to ensure electrical continuity and the capacity to conduct fault current likely to be imposed on them. Any nonconductive paint, enamel, or similar coating shall be removed at threads, contact points, and contact surfaces or shall be connected by means of fittings designed so as to make such removal unnecessary.

350.97 Bonding.

The electrical continuity of metal raceways and cables with metal sheaths that contain any conductor other than service conductors shall be ensured by one or more of the methods specified for services in 350.92(B), except for (B)(1).

Exception: If oversized, concentric, or eccentric knockouts are not encountered, or if a box or enclosure with concentric or eccentric knockouts is listed to provide a reliable bonding connection, the following methods shall be permitted:

(1) Threadless couplings and connectors for cables with metal sheaths

(2) Two locknuts, on rigid metal conduit or intermediate metal conduit, one inside and one outside of boxes and cabinets

(3) Fittings with shoulders that seat tightly against the box or cabinet, such as electrical metallic tubing connectors, flexible metal conduit connectors, and cable connectors, with one locknut on the inside of boxes and cabinets

(4) Listed fittings

350.98 Bonding Loosely Jointed Metal Raceways.

Expansion, expansion-deflection, or deflection fittings and telescoping sections of metal raceways shall be made electrically continuous by equipment bonding jumpers or other means.

350.100 Bonding in Hazardous (Classified) Locations.

Regardless of the voltage of the electrical system, the electrical continuity of normally non-current-carrying metal parts of electrical equipment, raceways, metal-clad cable, and metal enclosures containing electrical equipment in any hazardous (classified) location, as defined in 500.5, 505.5, and 506.5, shall be ensured by any of the bonding methods specified in 350.92(B)(2) through (B)(4). One or more of these bonding methods shall be used whether or not equipment grounding conductors of the wire type are installed in the raceway or in a multiconductor cable assembly.

Informational Note: See 501.30, 502.30, 503.30, 505.30, or 506.30 for specific bonding requirements.

350.102 Grounded Conductor, Bonding Conductors, and Jumpers.

(A) Material.

Bonding jumpers shall be of copper, aluminum, copper-clad aluminum, or other corrosion-resistant material. A bonding jumper shall be a wire, bus, or similar suitable conductor.

(B) Attachment.

Bonding jumpers shall be attached in the manner specified in 350.8 for circuits and equipment and in 350.70 for grounding electrodes.

(C) Size — Supply-Side Bonding Jumper.

(1) Size for Supply Conductors in a Single Raceway or Cable.

The supply-side bonding jumper shall not be smaller than specified in Table 350.102(C)(1).

(2) Size for Parallel Conductor Installations in Two or More Raceways or Cables.

If the ungrounded supply conductors are connected in parallel in two or more raceways or cables, the supply-side bonding jumper shall be sized in accordance with either of the following:

(1) An individual bonding jumper for each raceway or cable shall be selected from Table 350.102(C)(1) based on the size of the largest ungrounded supply conductor in each raceway or cable.

(2) A single bonding jumper installed for bonding two or more raceways or cables shall be sized in accordance with Table 350.102(C)(1) based on the sum of the circular mil areas of the largest ungrounded conductors from each set connected in parallel in each raceway or cable. The size of the grounded conductor(s) in each raceway or cable shall be based on the largest ungrounded conductor in each raceway or cable, or the sum of the circular mil areas of the largest ungrounded conductors from each set connected in parallel in each raceway or cable.

Informational Note No. 1: The term *supply conductors* includes ungrounded conductors that do not have overcurrent protection on their supply side and terminate at service equipment or the first disconnecting means of a separately derived system.

Informational Note No. 2: See Chapter 9, Table 8, for the circular mil area of conductors 18 AWG through 4/0 AWG.

Table 350.102(C)(1) Grounded Conductor, Main Bonding Jumper, System Bonding Jumper, and Supply-Side Bonding Jumper for Alternating-Current Systems

Size of Largest Ungrounded Conductor or Equivalent Area for Parallel Conductors (AWG/kcmil)		Size of Grounded Conductor or Bonding Jumper (AWG/kcmil)	
Copper	Aluminum or Copper-Clad Aluminum	Copper	Aluminum or Copper-Clad Aluminum
2 or smaller	1/0 or smaller	8	6
1 or 1/0	2/0 or 3/0	6	4
2/0 or 3/0	4/0 or 350	4	2
Over 3/0 through 350	Over 350 through 500	2	1/0
Over 350 through 600	Over 500 through 900	1/0	3/0
Over 600 through 1100	Over 900 through 1750	2/0	4/0
Over 1100	Over 1750	See Notes 1 and 2.	

Notes:

1. If the circular mil area of ungrounded supply conductors that are connected in parallel is larger than 1100 kcmil copper or 1750 kcmil aluminum, the grounded conductor or bonding jumper shall have an area not less than 12 ½ percent of the area of the largest ungrounded supply conductor or equivalent area for parallel supply conductors. The grounded conductor or bonding jumper shall not be required to be larger than the largest ungrounded conductor or set of ungrounded conductors.
2. If the circular mil area of ungrounded supply conductors that are connected in parallel is larger than 1100 kcmil copper or 1750 kcmil aluminum and if the ungrounded supply conductors and the bonding jumper are of different materials (copper, aluminum, or copper-clad aluminum), the minimum size of the grounded conductor or bonding jumper shall be based on the assumed use of ungrounded supply conductors of the same material as the grounded conductor or bonding jumper that has an ampacity equivalent to that of the installed ungrounded supply conductors.
3. If there are no service-entrance conductors, the supply conductor size shall be determined by the equivalent size of the largest service-entrance conductor required for the load to be served.

(D) Size — Equipment Bonding Jumper on Load Side of an Overcurrent Device.

The equipment bonding jumper on the load side of an overcurrent device(s) shall be sized in accordance with 350.122.

A single common continuous equipment bonding jumper shall be permitted to connect two or more raceways or cables if the bonding jumper is sized in accordance with 350.122 for the largest overcurrent device supplying circuits therein.

(E) Installation.
Bonding jumpers or conductors and equipment bonding jumpers shall be permitted to be installed inside or outside of a raceway or an enclosure.
(1) Inside a Raceway or an Enclosure.
If installed inside a raceway, equipment bonding jumpers and bonding jumpers or conductors shall comply with the requirements of 350.119 and 350.148.
(2) Outside a Raceway or an Enclosure.
If installed on the outside, the length of the bonding jumper or conductor or equipment bonding jumper shall not exceed 1.8 m (6 ft) and shall be routed with the raceway or enclosure.
Exception: An equipment bonding jumper or supply-side bonding jumper longer than 1.8 m (6 ft) shall be permitted at outside pole locations for the purpose of bonding or grounding isolated sections of metal raceways or elbows installed in exposed risers of metal conduit or other metal raceway, and for bonding grounding electrodes, and shall not be required to be routed with a raceway or enclosure.
(3) Protection.
Bonding jumpers or conductors and equipment bonding jumpers shall be installed in accordance with 350.64(A) and (B).
350.104 Bonding of Piping Systems and Exposed Structural Metal.
(A) Metal Water Piping.
The metal water piping system shall be bonded as required in 350.104(A)(1), (A)(2), or (A)(3).
(1) General.
Metal water piping system(s) installed in or attached to a building or structure shall be bonded to any of the following:

(1) Service equipment enclosure

(2) Grounded conductor at the service

(3) Grounding electrode conductor, if of sufficient size

(4) One or more grounding electrodes used, if the grounding electrode conductor or bonding jumper to the grounding electrode is of sufficient size

The bonding jumper(s) shall be installed in accordance with 350.64(A), (B), and (E). The points of attachment of the bonding jumper(s) shall be accessible. The bonding jumper(s) shall be sized in accordance with Table 350.102(C)(1) except that it shall not be required to be larger than 3/0 copper or 350 kcmil aluminum or copper-clad aluminum and except as permitted in 350.104(A)(2) and (A)(3).
(2) Buildings of Multiple Occupancy.
In buildings of multiple occupancy where the metal water piping system(s) installed in or attached to a building or structure for the individual occupancies is metallically isolated from all other occupancies by use of nonmetallic water piping, the metal water piping system(s) for each occupancy shall be permitted to be bonded to the equipment grounding terminal of the switchgear, switchboard, or panelboard enclosure (other than service equipment) supplying that occupancy. The bonding jumper shall be sized in accordance with 350.102(D).
(3) Buildings or Structures Supplied by a Feeder(s) or Branch Circuit(s).
The metal water piping system(s) installed in or attached to a building or structure shall be bonded to any of the following:

(1) Building or structure disconnecting means enclosure where located at the building or structure

(2) Equipment grounding conductor run with the supply conductors

(3) One or more grounding electrodes used

The bonding jumper(s) shall be sized in accordance with 350.102(D). The bonding jumper shall not be required to be larger than the largest ungrounded feeder or branch-circuit conductor supplying the building or structure.
(B) Other Metal Piping.
If installed in or attached to a building or structure, a metal piping system(s), including gas piping, that is likely to become energized shall be bonded to any of the following:

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

(2) Service equipment enclosure

(3) Grounded conductor at the service

(4) Grounding electrode conductor, if of sufficient size

(5) One or more grounding electrodes used, if the grounding electrode conductor or bonding jumper to the grounding electrode is of sufficient size

The bonding conductor(s) or jumper(s) shall be sized in accordance with Table 350.122, and equipment grounding conductors shall be sized in accordance with Table 350.122 using the rating of the circuit that is likely to energize the piping system(s). The points of attachment of the bonding jumper(s) shall be accessible.
Informational Note No. 1: Bonding all piping and metal air ducts within the premises will provide additional safety.
Informational Note No. 2: See NFPA 54, *National Fuel Gas Code*, and NFPA 780, *Standard for the Installation of Lightning Protection Systems*, for information on gas piping systems.

(C) Structural Metal.

Exposed structural metal that is interconnected to form a metal building frame, is not intentionally grounded or bonded, and is likely to become energized shall be bonded to any of the following:

(1) Service equipment enclosure

(2) Grounded conductor at the service

(3) Disconnecting means for buildings or structures supplied by a feeder or branch circuit

(4) Grounding electrode conductor, if not smaller than a conductor sized in accordance with Table 350.102(C)(1)

(5) One or more grounding electrodes used, if the grounding electrode conductor or bonding jumper to the grounding electrode is not smaller than a conductor sized in accordance with Table 350.102(C)(1)

The bonding conductor(s) or jumper(s) shall be sized in accordance with Table 350.102(C)(1), except that it shall not be required to be larger than 3/0 AWG copper or 350 kcmil aluminum or copper-clad aluminum, and installed in accordance with 350.64(A), (B), and (E). The points of attachment of the bonding jumper(s) shall be accessible unless installed in compliance with 350.68(A), Exception No. 2.

(D) Separately Derived Systems.

Metal water piping systems and structural metal that is interconnected to form a building frame shall be bonded to separately derived systems in accordance with 350.104(D)(1) through (D)(3).

(1) Metal Water Piping System(s).

The grounded conductor of each separately derived system shall be bonded to the nearest accessible point of the metal water piping system(s) in the area served by each separately derived system. This connection shall be made at the same point on the separately derived system where the grounding electrode conductor is connected. Each bonding jumper shall be sized in accordance with Table 350.102(C)(1) based on the largest ungrounded conductor of the separately derived system except that it shall not be required to be larger than 3/0 AWG copper or 350 kcmil aluminum or copper-clad aluminum.
Exception No. 1: A separate bonding jumper to the metal water piping system shall not be required if the metal water piping system is used as the grounding electrode or grounding electrode conductor for the separately derived system and the connection to the water piping system is in the area served by the separately derived system.
Exception No. 2: A separate bonding jumper to the metal water piping system shall not be required if the metal in-ground support structure is used as a grounding electrode or the metal frame of a building or structure is used as the grounding electrode conductor for a separately derived system and is bonded to the metal water piping system in the area served by the separately derived system.

(2) Structural Metal.

If exposed structural metal that is interconnected to form the building frame exists in the area served by the separately derived system, it shall be bonded to the grounded conductor of each separately derived system. This connection shall be made at the same point on the separately derived system where the grounding electrode conductor is connected. Each bonding jumper shall be sized in accordance with Table 350.102(C)(1) based on the largest ungrounded conductor of the separately derived system except that it shall not be required to be larger than 3/0 AWG copper or 350 kcmil aluminum or copper-clad aluminum.
Exception No. 1: A separate bonding jumper to the building structural metal shall not be required if the metal in-ground support structure is used as a grounding electrode or the metal frame of a building or structure is used as the grounding electrode conductor for the separately derived system.
Exception No. 2: A separate bonding jumper to the building structural metal shall not be required if the water piping system of a building or structure is used as the grounding electrode or grounding electrode conductor for a separately derived system and is bonded to the building structural metal in the area served by the separately derived system.

(3) Common Grounding Electrode Conductor.

If a common grounding electrode conductor is installed for multiple separately derived systems as permitted by 350.30(A)(6), and exposed structural metal that is interconnected to form the building frame or interior metal water piping exists in the area served by the separately derived system, the metal water piping and the structural metal member shall be bonded to the common grounding electrode conductor in the area served by the separately derived system.
Exception: A separate bonding jumper from each derived system to metal water piping and to structural metal members shall not be required if the metal water piping and the structural metal members in the area served by the separately derived system are bonded to the common grounding electrode conductor.

350.106 Lightning Protection Systems.

The lightning protection system ground terminals shall be bonded to the building or structure grounding electrode system.
Informational Note No. 1: See 350.60 for use of strike termination devices.
Informational Note No. 2: See NFPA 780, *Standard for the Installation of Lightning Protection Systems*, which contains detailed information on grounding, bonding, and sideflash distance from lightning protection systems.

Part VI. Equipment Grounding and Equipment Grounding Conductors

350.109 Metal Enclosures.

Metal enclosures shall be permitted to be used to connect bonding jumpers or equipment grounding conductors, or both, together to become a part of an effective ground-fault current path. If installed, metal covers, plaster rings, extension rings, and metal fittings shall be attached to these metal enclosures to ensure an effective ground-fault current path or shall be connected with bonding jumpers or equipment grounding conductors, or both.

Informational Note: See 350.97 for bonding requirements for over 350 volts to ground.

350.110 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 shall be connected to an equipment grounding conductor under any of the following conditions:

(1) If within 2.5 m (8 ft) vertically or 1.5 m (5 ft) horizontally of ground or grounded metal objects and subject to contact by persons

(2) If located in a wet or damp location and not isolated

(3) If in electrical contact with metal

(4) If in a hazardous (classified) location

(5) If supplied by a wiring method that provides an equipment grounding conductor, except as permitted by 350.86, Exception No. 2, for short sections of metal enclosures

(6) If equipment operates with any terminal at over 150 volts to ground

Exception No. 1: If exempted by special permission, the metal frame of electrically heated appliances that have the frame permanently and effectively insulated from ground shall not be required to be grounded.

Exception No. 2: Distribution apparatus, such as transformer and capacitor cases, mounted on wooden poles at a height exceeding 2.5 m (8 ft) above ground or grade level shall not be required to be grounded.

Exception No. 3: Listed equipment protected by a system of double insulation, or its equivalent, shall not be required to be connected to the equipment grounding conductor. If such a system is employed, the equipment shall be distinctively marked.

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

Exposed, normally non-current-carrying metal parts of equipment described in 350.112(A) through (G), and normally non-current-carrying metal parts of equipment and enclosures described in 350.112(F) and (G), shall be connected to an equipment grounding conductor, regardless of voltage.

(A) Switchgear and Switchboard Frames and Structures.

Switchgear or switchboard frames and structures supporting switching equipment, except frames of 2-wire dc switchgear or switchboards if effectively insulated from ground.

(B) Motor Frames.

Motor frames, as provided by 430.242.

(C) Enclosures for Motor Controllers.

Enclosures for motor controllers unless attached to ungrounded portable equipment.

(D) Electric Signs.

Electric signs, outline lighting, and associated equipment as provided in 600.7.

(E) Skid-Mounted Equipment.

Permanently mounted electrical equipment and skids shall be connected to the equipment grounding conductor. Wire-type equipment grounding conductors shall be sized as required by 350.122.

(F) Motor-Operated Water Pumps.

Motor-operated water pumps, including the submersible type.

(G) Metal Well Casings.

If a submersible pump is used in a metal well casing, the well casing shall be connected to the pump circuit equipment grounding conductor.

~~250.190~~350.114 Grounding of Equipment. [Move 250.190 to 350.114]
(A) Equipment Grounding.
All non-current-carrying metal parts of fixed, portable, and mobile equipment and associated fences, housings, enclosures, and supporting structures shall be grounded.
Exception: If 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 shall not be required to be grounded.
Informational Note: See ~~250~~350.110, Exception No. 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 shall be sized in accordance with Table ~~250~~350.66, based on the size of the largest ungrounded service, feeder, or branch-circuit conductors supplying the equipment. The grounding electrode conductor shall not be smaller than 6 AWG copper or 4 AWG aluminum or copper-clad aluminum.

(C) Equipment Grounding Conductor.
Equipment grounding conductors shall comply with 250.190(C)(1) through (C)(3).

(1) General.
Equipment grounding conductors that are not an integral part of a cable assembly shall not be smaller than 6 AWG copper or 4 AWG aluminum or copper-clad aluminum.

(2) Shielded Cables.
The metallic insulation shield encircling the current-carrying conductors shall be permitted to be used as 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 shall not be used as an equipment grounding conductor for solidly grounded systems.

(3) Sizing.
Equipment grounding conductors shall be sized in accordance with Table ~~250~~350.122 based on the current rating of the fuse or the overcurrent setting of the protective relay.
Informational Note: The overcurrent rating for a circuit breaker is the combination of the current transformer ratio and the current pickup setting of the protective relay.

~~250.188~~350.115 Grounding of Systems Supplying Portable or Mobile Equipment. [Move 250.188 to 350.115]
Systems supplying portable or mobile equipment ~~over 1000 volts~~, other than substations installed on a temporary basis, shall comply with 250.188(A) through (F).

(A) Portable or Mobile Equipment.
Portable or mobile equipment ~~over 1000 volts~~ shall be supplied from a system having its neutral conductor grounded through an impedance. If a delta-connected system ~~over 1000 volts~~ is used to supply portable or mobile equipment, a system neutral point and associated neutral conductor shall be derived.

(B) Exposed Non-Current-Carrying Metal Parts.
Exposed non-current-carrying metal parts of portable or mobile equipment shall be connected by an equipment grounding conductor to the point at which the system neutral impedance is grounded.

(C) Ground-Fault Current.

The voltage developed between the portable or mobile equipment frame and ground by the flow of maximum ground-fault current shall not exceed 100 volts.

(D) Ground-Fault Detection and Relaying.
Ground-fault detection and relaying shall 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 shall 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.

(E) Isolation.
The grounding electrode to which the portable or mobile equipment system neutral impedance is connected shall be isolated from and separated in the ground by at least 6.0 m (20 ft) from any other system or equipment grounding electrode, and there shall be no direct connection between the grounding electrodes, such as buried pipe and fence, and so forth.

(F) Trailing Cable and Couplers.

Trailing cable and couplers of systems ~~over 1000 volts~~ for interconnection of portable or mobile equipment shall meet the requirements of Part III of Article 400 for cables and 495.65 for couplers.

350.118 Types of Equipment Grounding Conductors.

(A) Permitted.

Each equipment grounding conductor run with or enclosing the circuit conductors shall be one or more or a combination of the following:

(1) A copper, aluminum, or copper-clad aluminum conductor. This conductor shall be solid or stranded; insulated, covered, or bare; and in the form of a wire or a busbar of any shape.

(2) Rigid metal conduit.

(3) Intermediate metal conduit.

(4) Electrical metallic tubing.

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

a. The conduit is terminated in listed fittings.

b. The circuit conductors contained in the conduit are protected by overcurrent devices rated at 20 amperes or less.

c. The size of the conduit does not exceed metric designator 35 (trade size 1**1/4**).

d. The combined length of flexible metal conduit, flexible metallic tubing, and liquidtight flexible metal conduit in the same effective ground-fault current path does not exceed 1.8 m (6 ft).

e. If flexibility is necessary to minimize the transmission of vibration from equipment or to provide flexibility for equipment that requires movement after installation, a wire-type equipment grounding conductor or a bonding jumper in accordance with 350.102(E)(2) shall be installed.

f. If flexible metal conduit is constructed of stainless steel, a wire-type equipment grounding conductor or bonding jumper in accordance with 350.102(E)(2) shall be installed.

(6) Listed liquidtight flexible metal conduit meeting all the following conditions:

a. The conduit is terminated in listed fittings.

b. For metric designators 12 through 16 (trade sizes 3/8 through 1/2), the circuit conductors contained in the conduit are protected by overcurrent devices rated at 20 amperes or less.

c. For metric designators 21 through 35 (trade sizes 3/4 through 11/4), the circuit conductors contained in the conduit are protected by overcurrent devices rated not more than 60 amperes

and there is no flexible metal conduit, flexible metallic tubing, or liquidtight flexible metal conduit in metric designators 12 through 16 (trade sizes 3/8 through 1/2) in the effective ground-fault current path.

d. The combined length of flexible metal conduit, flexible metallic tubing, and liquidtight flexible metal conduit in the same effective ground-fault current path does not exceed 1.8 m (6 ft).

e. If flexibility is necessary to minimize the transmission of vibration from equipment or to provide flexibility for equipment that requires movement after installation, a wire-type equipment grounding conductor or a bonding jumper in accordance with 350.102(E)(2) shall be installed.

f. If liquidtight flexible metal conduit contains a stainless steel core, a wire-type equipment grounding conductor or a bonding jumper in accordance with 350.102(E)(2) shall be installed.

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

a. The circuit conductors contained in the tubing are protected by overcurrent devices rated at 20 amperes or less.

b. The combined length of flexible metal conduit, flexible metallic tubing, and liquidtight flexible metal conduit in the same effective ground-fault current path does not exceed 1.8 m (6 ft).

(8) Armor of Type AC cable as provided in 320.108.

(9) The copper sheath of mineral-insulated, metal-sheathed cable Type MI.

(10) Type MC cable that provides an effective ground-fault current path in accordance with one or more of the following:

a. It contains an insulated or uninsulated equipment grounding conductor in compliance with 350.118(1).

b. The combined metallic sheath and uninsulated 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.

(11) Cable trays as permitted in 392.10 and 392.60.

(12) Cablebus framework as permitted in 370.60(1).

(13) Other listed electrically continuous metal raceways and listed auxiliary gutters.

(14) Surface metal raceways listed for grounding.

Informational Note: See Article 100 for a definition of *effective ground-fault current path*.

(B) Not Permitted.

The following shall not be used as equipment grounding conductors.

(1) Grounding electrode conductors

Exception: A wire-type equipment grounding conductor installed in compliance with 350.6(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.

(2) Structural metal frame of a building or structure

350.119 Identification of Wire-Type Equipment Grounding Conductors.

(A) General.

Unless required elsewhere in this *Code,* equipment grounding conductors shall be permitted to be bare, covered, or insulated. Individually covered or insulated equipment grounding conductors of the wire type shall have a continuous outer finish that is either green or green with one or more yellow stripes except as permitted in this section. Conductors with insulation or individual covering that is green, green with one or more yellow stripes, or otherwise identified as permitted by this section shall not be used for ungrounded or grounded circuit conductors.

(B) Conductors 4 AWG and Larger.

Equipment grounding conductors 4 AWG and larger shall comply with the following:

(1) At the time of installation, if the insulation does not comply with 350.119(A), it shall 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.

(2) Identification shall encircle the conductor and shall be accomplished by one of the following:

a. Stripping the insulation or covering from the entire exposed length

b. Coloring the insulation or covering green at the termination

c. Marking the insulation or covering with green tape or green adhesive labels at the termination

(C) Multiconductor Cable.

One or more insulated conductors in a multiconductor cable, at the time of installation, shall be permitted to be permanently identified as equipment grounding conductors at each end and at every point where the conductors are accessible by one of the following means:

(1) Stripping the insulation from the entire exposed length.

(2) Coloring the exposed insulation green.

(3) Marking the exposed insulation with green tape or green adhesive labels. Identification shall encircle the conductor.

(D) Flexible Cord.

Equipment grounding conductors in flexible cords shall be insulated and shall have a continuous outer finish that is either green or green with one or more yellow stripes.

350.120 Equipment Grounding Conductor Installation.

An equipment grounding conductor shall be installed in accordance with 350.120(A), (B), and (C).

(A) Raceway, Cable Trays, Cable Armor, Cablebus, or Cable Sheaths.

If it consists of a raceway, cable tray, cable armor, cablebus framework, or cable sheath or if it is a wire within a raceway or cable, it shall be installed in accordance with the applicable provisions in this *Code* using fittings for joints and terminations approved for use with the type of raceway or cable used. All connections, joints, and fittings shall be made tight using suitable tools.

Informational Note: See the UL Guide Information for Electrical Circuit Integrity Systems (FHIT) for equipment grounding conductors installed in a raceway that are part of a listed electrical circuit protective system or a listed fire-resistive cable system.

(B) Aluminum and Copper-Clad Aluminum Conductors.

Equipment grounding conductors of bare, covered, or insulated aluminum or copper-clad aluminum shall comply with the following:

(1) Unless part of an applicable cable wiring method, bare or covered conductors shall not be installed if subject to corrosive conditions or be installed in direct contact with concrete, masonry, or the earth.

(2) Terminations made within outdoor enclosures that are listed and identified for the environment shall be permitted within 450 mm (18 in.) of the bottom of the enclosure.

(3) Aluminum or copper-clad aluminum conductors external to buildings or enclosures shall not be terminated within 450 mm (18 in.) of the earth, unless terminated within a listed wire connector system.

(C) Equipment Grounding Conductors Smaller Than 6 AWG.

If not routed with circuit conductors as permitted in 350.130(C) and 350.134, Exception No. 2, equipment grounding conductors smaller than 6 AWG shall be protected from physical damage by an identified raceway or cable armor unless installed within hollow spaces of the framing members of buildings or structures and if not subject to physical damage.

350.122 Size of Equipment Grounding Conductors.

(A) General

Unless permitted elsewhere in the Code, the equipment grounding conductor shall be one, or more, of the combination of the type provided in 350.118. Equipment grounding conductors shall comply with 350.4(A)(5) and 350.4(B)(4).

(B) Wire Type Equipment Grounding Conductor

Equipment grounding conductors of the wire type shall be sized according to (1)(2) or (3) below but shall not be required to be larger than the circuit conductors.

1. Equipment Grounding conductor for multiple conductor cable for 1001- 2000 V application shall not be smaller than as shown in Table 350.122 (B)(1)) Equipment grounding conductors shall be permitted to be sectioned within a multiconductor cable, provided the combined circular mil area complies with Table 350.122(B)(1)

2. Equipment Grounding conductor for Type MV -90 multiple conductor cable for 2001- 35.000 V application shall not be smaller than as shown in Table 350.122 (B)(2)) Equipment grounding conductors shall be permitted to be sectioned within a multiconductor cable, provided the combined circular mil area complies with Table350.122(B)2)

3. Equipment Grounding conductor for Type MV-105 multiple conductor cable for 2001- 35,000 V application shall not be smaller than as shown in Table 350.122 (B)(3))) Equipment grounding conductors shall be permitted to be sectioned within a multiconductor cable, provided the combined circular mil area complies with Table 350.122(B)(3)

Exception to (1) (2) and (3)*: Equipment grounding conductors shall be permitted to be sized by a qualified person to provide an effective ground fault current path in accordance with 350.4(A)(5) or (B)(4).*

(C) Metallic insulation shield or armor of the Cables.

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

(D) Multiple Circuits.

A single equipment grounding conductor shall be permitted to be installed for multiple circuits that are installed in the same raceway, cable, trench, or cable tray. It shall be sized according to 350.122(B) for the largest circuit conductors in the raceway, cable, trench, or cable tray. Equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c).

(F) Conductors in Parallel.

For circuits of parallel conductors as permitted in 310.10(G), the equipment grounding conductor shall be installed in accordance with 350.122(F)(1) or (F)(2).

(1) Conductor Installations in Raceways, Auxiliary Gutters, or Cable Trays.

(a) *Single Raceway or Cable Tray, Auxiliary Gutter, or Cable Tray*. If circuit conductors are connected in parallel in the same raceway, auxiliary gutter, or cable tray, a single wire-type conductor shall be permitted as the equipment grounding conductor. The wire-type equipment grounding conductor shall be sized in accordance with 350.122(B) based on the largest circuit conductor within the raceway or cable.

(b) *Multiple Raceways*. If conductors are installed in multiple raceways and are connected in parallel, a wire-type equipment grounding conductor, if used, shall be installed in each raceway and shall be connected in parallel. The equipment grounding conductor installed in each raceway shall be sized in accordance with 350.122 (B) based on the largest circuit conductor in each raceway or cable

(c) *Wire-Type Equipment Grounding Conductors in Cable Trays*. Wire-type equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c).

(2) Multiconductor Cables.

(a) Except as provided in 350.122(F)(2)(c) for raceway or cable tray installations, the equipment grounding conductor in each multiconductor cable shall be sized in accordance with 350.122 (B) based on the largest circuit conductor in the cable

(b) If circuit conductors of multiconductor cables are connected in parallel, the equipment grounding conductor(s) in each cable shall be connected in parallel.

(c) If multiconductor cables are paralleled in the same raceway, auxiliary gutter, or cable tray, a single equipment grounding conductor that is sized in accordance with 350.122 (B) shall be permitted in combination with the equipment grounding conductors provided within the multiconductor cables and shall all be connected together.

(G) Feeder Taps.

Equipment grounding conductors installed with feeder taps shall not be smaller than shown in 350.122(B) based on the largest circuit conductor of the feeder on the supply side ahead of the tap but shall not be required to be larger than the tap conductors.

Table 350-122 (A) Smallest acceptable Grounding conductor in Multiple conductor cables, or with two or more insulated conductors such as duplexed, triplexed and quadruplex type 1001- 2000 Volts

Copper (AWG or kcmil)	Aluminum (AWG or kcmil)

Size of Circuit Conductor	Smallest Size of unsectioned Grounding Conductor	Size of Circuit Conductor	Smallest Size of unsectioned Grounding Conductor
14	14	12	12
12	12	10	10
10-8	10	8-6	8
8	10	4-1	6
6-3	8	1/0-4/0	4
2-3/0	6	250-400	2
4/0-300	4	500-800	1
350-500	3	900-1000	1/0

Based on UL 1277 Tables 8.1 and 8.2 and UL 1569 Table 6.2

Table 350-122 (B) Smallest acceptable Grounding conductor in Multiple -conductor cables, or with two or more Type MV-90 insulated conductors 2001-35,000 Volts	
Copper	Aluminum

Size of circuit conductors AWG or kcmil	Smallest size of sectioned Grounding conductor AWG	Size of circuit conductor AWG or kcmil	Smallest size of sectioned Grounding conductor AWG
8	8	8- 6	6
6-2	6	4-1/0	4
1-2/0	4	2/0- 250	2
3/0- 250	3	300-400	1
300-400	2	450-600	1/0
450-600	1	750-900	2/0
750-1000	1/0	1000	3/0

Based on UL 1072 Table 23.1

Table 350-122 (C) Smallest acceptable Grounding conductor in Multiple -conductor cables, or with two or more Type MV-105 insulated conductors 2001-35,000 Volts

Copper		Aluminum	
Size of circuit conductors AWG or kcmil	Smallest size of sectioned Grounding conductor AWG	Size of circuit conductor AWG or Kcmil	Smallest size of sectioned Grounding conductor AWG
8	8	8- 6	6
6-2	6	4-1/0	4
1-2/0	4	2/0- 4/0	2
3/0- 4/0	3	250-350	1
250-350	2	400-500	1/0
400-500	1	550-750	2/0
550-750	1/0	800-1000	3/0
800-1000	2/0	-	-

Based on UL1072 Table 23.2

350.124 Equipment Grounding Conductor Continuity.

(A) Separable Connections.

Separable connections such as those provided in drawout equipment or attachment plugs and mating connectors and receptacles shall provide for first-make, last-break of the equipment grounding conductor. First-make, last-

break shall not be required if interlocked equipment, plugs, receptacles, and connectors preclude energization without grounding continuity.

(B) Switches.

No automatic cutout or switch shall be placed in the equipment grounding conductor of a premises wiring system unless the opening of the cutout or switch disconnects all sources of energy.

Part VII. Methods of Equipment Grounding Conductor Connections

350.130 Equipment Grounding Conductor Connections.
Equipment grounding conductor connections at the source of separately derived systems shall be made in accordance with 350.30(A)(1). Equipment grounding conductor connections at service equipment shall be made as indicated in 350.130(A) or (B).

(A) For Grounded Systems.
The connection shall be made by bonding the equipment grounding conductor to the grounded service conductor and the grounding electrode conductor.

(B) For Ungrounded Systems.
The connection shall be made by bonding the equipment grounding conductor to the grounding electrode conductor.

350.132 Short Sections of Raceway or Cable Armor.
Isolated sections of metal raceway or cable armor, if required to be connected to an equipment grounding conductor, shall be connected in accordance with 350.134.

350.134 Equipment Fastened in Place or Connected by Permanent Wiring Methods (Fixed).
Unless connected to the grounded circuit conductor as permitted by 350.32, 350.140, and 350.142, non-current-carrying metal parts of equipment, raceways, and other enclosures, if grounded, shall be connected to an equipment grounding conductor by one of the following methods:

(1) By connecting to any of the equipment grounding conductors permitted by 350.118(2) through (14)

(2) By connecting to an equipment grounding conductor of the wire type that is contained within the same raceway, contained within the same cable, or otherwise run with the circuit conductors

Exception No. 2: For dc circuits, the equipment grounding conductor shall be permitted to be run separately from the circuit conductors

Informational Note No. 1: See 350.102 and 350.168 for equipment bonding jumper requirements.

Informational Note No. 2: See 400.10 for use of flexible cords and flexible cables for fixed equipment.

350.136 Equipment Secured to a Metal Rack or Structure.
If a metal rack or structure is connected to an equipment grounding conductor in accordance with 350.134, it shall be permitted to serve as the equipment grounding conductor for electrical equipment secured to and in electrical contact with the metal rack or structure.

350.138 Cord-and-Plug-Connected Equipment.
Non–current-carrying metal parts of cord-and-plug-connected equipment, if required to be connected to an equipment grounding conductor, shall be connected by one of the methods in 350.138(A) or (B).

(A) By Means of an Equipment Grounding Conductor.
By means of an equipment grounding conductor run with the power supply conductors in a cable assembly or flexible cord properly terminated in a grounding-type attachment plug with one fixed grounding contact.

(B) By Means of a Separate Flexible Wire or Strap.
By means of a separate flexible wire or strap, insulated or bare, connected to an equipment grounding conductor, and protected as well as practicable against physical damage, if part of equipment.

350.140 Frames of Ranges and Clothes Dryers.
Frames of electric ranges, wall-mounted ovens, counter-mounted cooking units, clothes dryers, and outlet or junction boxes that are part of the circuit shall be connected to the equipment grounding conductor in accordance with 350.140(A)

(A) Equipment Grounding Conductor Connections.
The circuit supplying the equipment shall include an equipment grounding conductor. The frame of the equipment shall be connected to the equipment grounding conductor in the manner specified by 250.134 or 250.138.

350.142 Use of Grounded Circuit Conductor for Grounding Equipment.
(A) Supply-Side Equipment.
A grounded circuit conductor shall be permitted to be connected to non-current-carrying metal parts of equipment, raceways, and other enclosures at any of the following locations:

(1) On the supply side or within the enclosure of the ac service disconnecting means

(2) On the supply side or within the enclosure of the main disconnecting means for separate buildings as provided in 350.32(B)(1) Exception No. 1

(3) On the supply side or within the enclosure of the main disconnecting means or overcurrent devices of a separately derived system where permitted by 350.30(A)(1)

(B) Load-Side Equipment.
Except as permitted in 350.30(A)(1), 350.32(B)(1), Exception No. 1, a grounded circuit conductor shall not be connected to non–current-carrying metal parts of equipment on the load side of the service disconnecting means or on the load side of a separately derived system disconnecting means or the overcurrent devices for a separately derived system not having a main disconnecting means.
Exception No. 1: It shall be permissible to connect meter enclosures to the grounded circuit conductor on the load side of the service disconnect if all of the following conditions apply:

(1) Ground-fault protection of equipment is not installed.

(2) All meter enclosures are located immediately adjacent to the service disconnecting means.

(3) The size of the grounded circuit conductor is not smaller than the size specified in Table 350.122 for equipment grounding conductors.

Exception No. 3: Electrode-type boilers operating at over 1000 volts shall be grounded as required in 495.72(E)(1) and 495.74.
350.144 Multiple Circuit Connections.
If equipment is required to be grounded and is supplied by more than one circuit containing an equipment grounding conductor, a means to terminate each equipment grounding conductor meeting the requirements of 350.8 shall be provided as specified in 350.134 and 350.138.
350.148 Continuity of Equipment Grounding Conductors and Attachment in Boxes.
If circuit conductors are spliced within a box or terminated on equipment within or supported by a box, the installation shall comply with 350.148(A) through (D).
Exception: The equipment grounding conductor permitted in 350.146(D) shall not be required to be connected to the other equipment grounding conductors or to the box.
(A) Connections and Splices.
All equipment grounding conductors that are spliced or terminated within the box shall be connected together. Connections and splices shall be made in accordance with 110.14(B) and 350.8 except that insulation shall not be required.

(B) Metal Boxes.
A connection used for no other purpose shall be made between the metal box and the equipment grounding conductor(s). The equipment bonding jumper or equipment grounding conductor shall be sized from Table 350.122 based on the largest overcurrent device protecting circuit conductors in the box.
(C) Nonmetallic Boxes.
One or more equipment grounding conductors brought into a nonmetallic box shall be arranged to provide a connection to any fitting or device in that box requiring connection to an equipment grounding conductor.

Part VIII. Direct-Current Systems
350.160 General.
Direct-current systems shall comply with Part VIII and other sections of Article 350 not specifically intended for ac systems.
350.162 Direct-Current Circuits and Systems to Be Grounded.
Direct-current circuits and systems shall be grounded as provided for in 350.162(A) and (B).
(A) Two-Wire, Direct-Current Systems.
A system equipped with a ground detector and supplying only industrial equipment in limited areas shall not be required to be grounded if installed immediately adjacent to, or integral with, the source of supply.
A rectifier-derived dc system supplied from an ac system complying with 350.20 shall not be required to be grounded.
(B) Three-Wire, Direct-Current Systems.
The neutral conductor of all 3-wire, dc systems supplying premises wiring shall be grounded.
350.164 Point of Connection for Direct-Current Systems.

(A) Off-Premises Source.
Direct-current systems to be grounded and supplied from an off-premises source shall have the grounding connection made at one or more supply stations. A grounding connection shall not be made at individual services or at any point on the premises wiring.
(B) On-Premises Source.
If the dc system source is located on the premises, a grounding connection shall be made at one of the following:

(1) The source

(2) The first system disconnection means or overcurrent device

(3) By other means that accomplish system protection and that use equipment listed and identified for the use

350.166 Size of the Direct-Current Grounding Electrode Conductor.
The size of the grounding electrode conductor for a dc system shall be as specified in 350.166(A) and (B), except as permitted by 350.166(C) through (E). The grounding electrode conductor for a dc system shall meet the sizing requirements in this section but shall not be required to be larger than 3/0 copper or 350 kcmil aluminum or copper-clad aluminum.
(A) Not Smaller Than the Neutral Conductor.
If the dc system consists of a 3-wire balancer set or a balancer winding with overcurrent protection as provided in 445.12(D), the grounding electrode conductor shall not be smaller than the neutral conductor and not smaller than 8 AWG copper or 6 AWG aluminum or copper-clad aluminum.
(B) Not Smaller Than the Largest Conductor.
If the dc system is other than as in 350.166(A), the grounding electrode conductor shall not be smaller than the largest conductor supplied by the system and not smaller than 8 AWG copper or 6 AWG aluminum or copper-clad aluminum.
(C) Connected to Rod, Pipe, or Plate Electrodes.
If connected to rod, pipe, or plate electrodes as in 350.52(A)(5) or (A)(7), that portion of the grounding electrode conductor that is the sole connection to the grounding electrode shall not be required to be larger than 6 AWG copper wire or 4 AWG aluminum or copper-clad aluminum wire.
(D) Connected to a Concrete-Encased Electrode.
If connected to a concrete-encased electrode as in 350.52(A)(3), that portion of the grounding electrode conductor that is the sole connection to the grounding electrode shall not be required to be larger than 4 AWG copper wire.
(E) Connected to a Ground Ring.
If connected to a ground ring as in 350.52(A)(4), that portion of the grounding electrode conductor that is the sole connection to the grounding electrode shall not be required to be larger than the conductor used for the ground ring.
350.167 Direct-Current Ground-Fault Detection.
(A) Ungrounded Systems.
Ground-fault detection systems shall be required for ungrounded systems.
(B) Grounded Systems.
Ground-fault detection shall be permitted for grounded systems.
(C) Marking.
Direct-current systems shall be legibly marked to indicate the grounding type at the dc source or the first disconnecting means of the system. The marking shall be of sufficient durability to withstand the environment involved.
Informational Note: See NFPA *70E*-2018, *Standard for Electrical Safety in the Workplace*, which identifies four dc grounding types in detail.
350.168 Direct-Current System Bonding Jumper.
For direct-current systems that are to be grounded, an unspliced bonding jumper shall be used to connect the equipment grounding conductor(s) to the grounded conductor at the source or to the first system disconnecting means where the system is grounded. The size of the bonding jumper shall not be smaller than the system grounding electrode conductor specified in 350.166 and shall comply with 350.28(A), (B), and (C).
350.169 Ungrounded Direct-Current Separately Derived Systems.
Except as otherwise permitted in 350.34 for portable and vehicle-mounted generators, an ungrounded dc separately derived system supplied from a stand-alone power source (such as an engine–generator set) shall have a grounding electrode conductor connected to an electrode that complies with Part III of this article to provide for grounding of metal enclosures, raceways, cables, and exposed non–current-carrying metal parts of equipment. The grounding electrode conductor connection shall be to the metal enclosure at any point on the separately derived system from the source to the first system disconnecting means or overcurrent device, or it shall be made at the source of a separately derived system that has no disconnecting means or overcurrent devices.
The size of the grounding electrode conductor shall be in accordance with 350.166.

Part IX. Instruments, Meters, and Relays

350.170 Instrument Transformer Circuits.

Secondary circuits of current and potential instrument transformers shall be grounded.

Exception No. 1: Current transformer secondaries connected in a three-phase delta configuration shall not be required to be grounded.

350.172 Instrument Transformer Cases.

Cases or frames of instrument transformers shall be connected to the equipment grounding conductor if accessible to other than qualified persons.

350.176 Cases of Instruments, Meters, and Relays — Operating at Over 1000 Volts.

If instruments, meters, and relays have current-carrying parts of over 1000 volts to ground, they shall be isolated by elevation or protected by a barrier(s), grounded metal, or insulating covers or guards. Their cases shall not be connected to the equipment grounding conductor.

Exception: Cases of electrostatic ground detectors shall be permitted to be connected to an equipment grounding conductor if the internal ground segments of the instrument are connected to the instrument case and grounded and the ground detector is isolated by elevation.

350.178 Instrument Equipment Grounding Conductor.

The equipment grounding conductor for secondary circuits of instrument transformers and for instrument cases shall not be smaller than 12 AWG copper or 10 AWG aluminum or copper-clad aluminum. Cases of instrument transformers, instruments, meters, and relays that are mounted directly on grounded metal surfaces of enclosures or grounded metal of switchgear or switchboard panels shall not be required to be connected to an additional equipment grounding conductor.

First Revision No. 8827-NFPA 70-2024 [Global Input]

See attached Word file for new Article 251.

Supplemental Information

File Name	Description	Approved
NEC_CMP5_FR-8827_NewArticle251_Global_JS.docx		
NEC_CMP5_FR-8827_NewArticle251_Global.docx	For editorial use	

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Wed Jan 24 00:03:00 EST 2024

Committee Statement

Committee Statement: The NEC Correlating Committee has created several task groups for the 2026 cycle, but specifically, has created one group to look at the long-term enhancement of the National Electrical Code. This group has looked at and determined that the rapidly changing technology landscape requires that the Limited Power Articles of Chapter 7 and the Communication Articles of Chapter 8, be revised to provide greater usability and clarity for today's world.

This Public Input is one of a series of Public Inputs to increase the usability of the existing limited energy requirements.

Nearly 30 industry professionals were split among five different Sub Task Groups. Additional meetings were held among the Sub Task Group Chairs to share ideas, complications, correlation issues and other information. Overall dozens of meetings were held to work on this project.

The Task group members for this work include: Derrick Atkins, Tom Domitrovich, Ernie Gallo, Scott Harding, Mark Hilbert, Chad Jones, Alan Manche, Ken McKinney, Nathan Phillips, Dan Ashton, George Bish, Trevor Bowmer, Shane Clary, Michael Cogbill, Jim Conrad, Adam Corbin, Dale Crawford, Ray Horner, Ryan Jackson, Stan Kaufman, Kyle Krueger, William McCoy, Tim Mikloiche, Samuel Rokowski, Anthony Tassone, Ron Tellas, Keith Waters, John Williams and George Zimmerman.

The task group recommends restructuring of the limited energy articles to include protection, cable installation requirements and equipment, similar in concept to the structure used in other parts of the NEC.

To accomplish this, the following is a suggested course of action:

1. Create a limited power NEC structure where the main focus is not the technology but rather the installation requirements of the cable.

2. Articles that look similar to general requirements, wiring, overcurrent protection and grounding.

3. Restructuring of Articles as follows:

a. Existing Article 722, will take on the look and theme of 310 and 315 and placed in new Article X22

b. New grounding and bonding Article X50 will be similar to 250.

c. New overcurrent protection Article X90 will be similar to current Article 240. New Article X90 was chosen in lieu of X40, since there currently is an Article 840 (in case the new Articles are placed in Article 800)

d. Existing Articles 724, 725, and 726, will take on the look and theme of branch circuits with the general requirements placed in new Article X00, the installation requirements in X22, the grounding requirements in X50 and the protection requirements X90.

The goal of these Articles both existing and new is to ultimately locate all content into one chapter in 2029.

The following information and diagrams are provided to outline the thought process.

Section X00.100 combines the separation requirements from 133, 136 and 139 in 725, 726, 760, 770 along with the separation requirements in 800, 805 and 815.

This was the logic the sub task group used to develop what we are calling the X00.100 separation requirements.

The structure follows this logic:

• The list of all limited energy cables is called for in X22.

• A Limited Energy cable has the following construction when placed in a Limited Energy System.

Response Message: FR-8827-NFPA 70-2024

Public Input No. 3333-NFPA 70-2023 [Global Input]

[NEW] ARTICLE 251

Grounding, Bonding, and Overvoltage Protection of Limited Energy Systems

Part I. General

251.1 Scope.

This article covers the grounding, bonding and overvoltage protection requirements for Class 1 Power-limited Circuits, Class 2 Circuits, Class 3 Circuits, Class 4 Circuits, Optical Fiber Systems, Communications Systems, Antenna Systems, Community Antenna Systems, Network-Powered Broadband Communications Systems, Premises-Powered broadband Communications Systems, and Power Limited Fire Alarm Systems.

251.2 Listing.

(A) Grounding and Bonding Devices.

If grounding or bonding is required, devices used to connect a shield, a sheath, a non-current-carrying metal member of a cable, metal parts of equipment, or metal parts of antennas to a grounding electrode conductor or bonding conductor shall be listed or be part of listed equipment.

(B) Primary and Secondary Protectors.

Primary and secondary protectors shall be listed.

Informational Note: See UL 497A-2019, Standard for Secondary Protectors for Communications Circuits, to determine applicable requirements for a listed secondary protector.

(C) Antenna Systems Lead-In Protectors.

Antenna lead-in surge protectors shall be listed.

Informational Note: See UL 497E-2011, Outline of Investigation for Protectors for Antenna Lead-In Conductors, for information concerning protectors for antenna lead-in conductors.

251.3 Reconditioned Equipment. The installation of the following reconditioned equipment shall not be permitted:

(1) Primary Protectors

(2) Secondary Protectors

(3) Antenna Lead-In Protectors

(4) Antenna Discharge Units

251.5 Identification of Conductors.

(A) Grounded Conductors.

Grounded conductors shall be identified in accordance with 200.6. The use of conductors with white or gray insulation shall comply with 200.7.

Exception (1): Cables that do not contain a grounded conductor shall be permitted to use a conductor with white or gray insulation, or white or gray insulation with one or more colored stripes, for use other than as a grounded conductor.

Exception (2): The use of white or gray insulation shall be permitted for identification of ungrounded conductors, excluding Class I power-limited circuits.

(B) Wire-Type Equipment Grounding Conductors.

Wire-type equipment grounding conductors shall be identified in accordance with 250.119.

Part II. Conductors and Equipment Outside and Entering Buildings

251.42 Metal Entrance Raceway Grounding.

Metal raceways containing entrance wire or cable shall be connected to a grounding electrode by a bonding conductor or grounding electrode conductor in accordance with 251.100.

251.48 Grounding, Bonding, or Interruption of Non-Current-Carrying Metal Sheath Members.

Grounding, bonding, or interruption of non-current-carrying metallic sheath members shall comply with 251.48(A), (B), (C), or (D).

Informational Note: Selecting a grounding location to achieve the shortest practicable bonding conductor or grounding electrode conductor helps limit potential differences between limited energy circuits and other metal systems.

(A) Communications Cables.

Communications cables entering the building or terminating on the outside of the building shall comply with 251.48(A)(1) or (A)(2).

(1) Entering Buildings.

If the communications cable enters a building, the metal sheath members of the cable shall be grounded or bonded as specified in 251.100 or interrupted by an insulating joint or equivalent device. The grounding, bonding, or interruption shall be as close as practicable to the point of entrance.

(2) Terminating on the Outside of Buildings.
If the communications cable is terminated on the outside of the building, the metal sheath members of the cable shall be grounded or bonded as specified in 251.100 or interrupted by an insulating joint or equivalent device. The grounding, bonding, or interruption shall be as close as practicable to the point of termination of the cable.

(B) Grounding of Outer Conductive Shield of Coaxial Cables.

Coaxial cables entering buildings or attached to buildings shall comply with 251.48(B)(1) or (B)(2). If the outer conductive shield of a coaxial cable is grounded, no other protective devices shall be required. For purposes of this section, grounding located at mobile home service equipment located within 9.0 m (30 ft) of the exterior wall of the mobile home it serves, or at a mobile home disconnecting means grounded in accordance with 250.32 and located within 9.0 m (30 ft) of the exterior wall of the mobile home it serves, shall be considered to meet the requirements of this section.

(1) Entering Buildings.
If the coaxial cable enters the building, the outer conductive shield shall be grounded in accordance with 251.75. The grounding shall be as close as practicable to the point of entrance.

(2) Terminating Outside of the Building.
If the coaxial cable is terminated outside of the building, the outer conductive shield shall be grounded in accordance with 251.75. The grounding shall be as close as practicable to the point of attachment or termination.

(C) Metal Members of Network-Powered Broadband Communications Cables.

Network-powered communications cables entering buildings or attaching to buildings shall comply with 251.48(C)(1)(C)(2).

For purposes of this section, grounding located at mobile home service equipment located within 9.0 m (30 ft) of the exterior wall of the mobile home it serves, or at a mobile home disconnecting means grounded in accordance with 250.32 and located within 9.0 m (30 ft) of the exterior wall of the mobile home it serves, shall be considered to meet the requirements of this section.

(1) Entering Buildings.

If the network-powered communications cable enters the building, the shield shall be grounded in accordance with 251.100, and metallic members of the cable not used for communications or powering shall be grounded in accordance with 251.100 or interrupted by an insulating joint or equivalent device. The grounding or interruption shall be as close as practicable to the point of entrance.

(2) Terminating Outside of the Building.

If the network-powered communications cable is terminated outside of the building, the shield shall be grounded in accordance with 251.100, and metallic members of the cable not used for communications or powering shall be grounded in accordance with 251.100 or interrupted by an insulating joint or equivalent device. The grounding or interruption shall be as close as practicable to the point of attachment of the Network Interface Unit (NIU).

(D) Premises-Powered Broadband Communications Systems.

Non-current-carrying metallic members of optical fiber cables, communications cables, or coaxial cables entering buildings or attaching to buildings shall comply with 251.48(D)(1), (D)(2), or (D)(3), respectively.

(1) Non-Current-Carrying Metallic Members of Optical Fiber Cables.

Non-current-carrying metallic members of optical fiber cables entering a building or terminating on the outside of a building shall comply with 251.48(D)(1)(a) or (b).

(a) *Entering Buildings.* If an optical fiber cable is exposed to contact with electric light or power conductors and the cable enters the building, the non–current-carrying metal members shall be either grounded or bonded as specified in 251.100 or interrupted by an insulating joint or equivalent device. The grounding or interruption shall be as close as practicable to the point of entrance.

(b) *Terminating on the Outside of Buildings.* If an optical fiber cable is exposed to contact with electric light or power conductors and the cable is terminated on the outside of the building, the non–current-carrying metal members shall be either grounded or bonded as specified in 251.100 or interrupted by an insulating joint or equivalent device. The grounding, bonding, or interruption shall be as close as practicable to the point of termination of the cable.

(2) Communications Cables.

The grounding or interruption of the metallic sheath of communications cable shall comply with 251.48(A).

(3) Coaxial Cables.
If coaxial cables are terminated at the network terminal (installed inside or outside of the building), then the outer conductive shield of coaxial cables shall comply with 251.48(B).

251.60 Antenna Systems Grounding or Bonding.

(A) Lead-in Protectors.

If an antenna lead-in surge protector is installed, it shall be connected between the conductors and the grounded shield or other ground connection. The antenna lead-in protector shall be grounded using a bonding conductor or grounding electrode conductor installed in accordance with 251.66(F).

(B) Support Systems.

Masts and metal structures supporting antennas shall be grounded or bonded in accordance with 251.66, unless the antenna and its related supporting mast or structure are within a zone of protection defined by a 46 m (150 ft) radius rolling sphere.

> Informational Note: See NFPA 780-2023, Standard for the Installation of Lightning Protection Systems, 4.7.3.1, for the application of the term rolling sphere.

(C) Discharge Unit – Receiving Stations.

The antenna discharge unit shall be grounded or bonded in accordance with 251.66.

(D) **Controls.**

All external metal handles and controls accessible to the operating personnel shall be connected to an equipment grounding conductor if the transmitter is powered by the premises wiring system or grounded with a conductor in accordance with 251.66.

251.66 Antenna Systems and Receiving Stations - Bonding Conductors and Grounding Electrode Conductors.

Bonding conductors and grounding electrode conductors shall comply with 251.66(A) through 251.66(K).

(A) Material.
The bonding conductor or grounding electrode conductor shall be of copper, aluminum, copper-clad steel, copper-clad aluminum, bronze, or similar corrosion-resistant material. Aluminum or copper-clad aluminum bonding conductors or grounding electrode conductors shall not be used if subject to corrosive conditions or in direct contact with masonry or the earth or where subject to corrosive conditions. If used outside, aluminum or copper-clad aluminum conductors shall not be installed within 450 mm (18 in.) of the earth.

(B) Insulation.
Insulation on bonding conductors or grounding electrode conductors shall not be required.

(C) Supports.
The bonding conductor or grounding electrode conductor shall be securely fastened in place and shall be permitted to be directly attached to the surface wired over without the use of insulating supports.

Exception: If proper support cannot be provided, the size of the bonding conductors or grounding electrode conductors shall be increased proportionately.

(D) Physical Protection.
Bonding conductors and grounding electrode conductors shall be protected where exposed to physical damage. If the bonding conductor or grounding electrode conductor is installed in a metal raceway, both ends of the raceway shall be bonded to the contained conductor or to the same terminal or electrode to which the bonding conductor or grounding electrode conductor is connected.

(E) Run in Straight Line.
The bonding conductor or grounding electrode conductor for an antenna mast or antenna discharge unit shall be run in as straight a line as practicable.

(F) Electrode.
The bonding conductor or grounding electrode conductor shall be connected as required in 251.66(F)(1) through (F)(3).

(1) In Buildings or Structures with an Intersystem Bonding Termination.
If the building or structure served has an intersystem bonding termination as required by 250.94, the bonding conductor shall be connected to the intersystem bonding termination.

(2) In Buildings or Structures with Grounding Means.
If the building or structure served has no intersystem bonding termination, the bonding conductor or grounding electrode conductor shall be connected to the nearest accessible location on one of the following:

(1) The building or structure grounding electrode system as covered in 250.50

(2) The power service accessible means external to the building, as covered in 250.94

(3) The nonflexible metal power service raceway

(4) The service equipment enclosure

(5) The grounding electrode conductor or the grounding electrode conductor metal enclosures of the power service

(6) The grounded interior metal water piping systems, within 1.52 m (5 ft) from its point of entrance to the building, as covered in 250.52.

A bonding device intended to provide a termination point for the bonding conductor (intersystem bonding) shall not interfere with the opening of an equipment enclosure. A bonding device shall be mounted on nonremovable parts. A bonding device shall not be mounted on a door or cover even if the door or cover is nonremovable.

(3) In Buildings or Structures Without an Intersystem Bonding Termination or Grounding Means.
If the building or structure served has no intersystem bonding termination or grounding means as described in 251.66(F)(2), the grounding electrode conductor shall be connected to a grounding electrode as described in 250.52.

(G) Inside or Outside Building.
The bonding conductor or grounding electrode conductor shall be permitted to be run either inside or outside the building.

(H) Size.
The bonding conductor or grounding electrode conductor shall not be smaller than 10 AWG copper, 8 AWG aluminum, or 17 AWG copper-clad steel or bronze.

(I) Common Ground.
A single bonding conductor or grounding electrode conductor shall be permitted for both protective and operating purposes.

(J) Bonding of Electrodes.
A bonding jumper not smaller than 6 AWG copper or equivalent shall be connected between the radio and television equipment grounding electrode and the power grounding electrode system at the building or structure served if separate electrodes are used.

(K) Electrode Connection.
Connections to grounding electrodes shall comply with 250.70.

251.68 Antenna Discharge Units – Transmitting Stations.

Each lead-in conductor for outdoor antennas shall be provided with an antenna discharge unit or other suitable means that drain static charges from the antenna system.

Exception No. 1: If the lead-in conductor is protected by a continuous metal shield that is grounded with a conductor in accordance with 251.70, an antenna discharge unit or other suitable means shall not be required for the lead-in conductor.

Exception No. 2: If the antenna is grounded or bonded with a conductor in accordance with 251.70, an antenna discharge unit or other suitable means shall not be required.

251.70 Antenna Systems - Bonding Conductors and Grounding Electrode Conductors – Amateur and Citizen Band Transmitting and Receiving Stations.

Bonding conductors and grounding electrode conductors shall comply with 251.70(A) through 251.70(C).

(A) Other Sections.
All bonding conductors and grounding electrode conductors for amateur and citizen band transmitting and receiving stations shall comply with 251.66(A) through 251.66(C).

(B) Size of Protective Bonding Conductor or Grounding Electrode Conductor.
The protective bonding conductor or grounding electrode conductor for transmitting stations shall be as large as the lead-in but not smaller than 10 AWG copper, bronze, or copper-clad steel.

(C) Size of Operating Bonding Conductor or Grounding Electrode Conductor.

The operating bonding conductor or grounding electrode conductor for transmitting stations shall not be less than 14 AWG copper or its equivalent.

251.75 Cable Bonding and Grounding of Coaxial Cables for Community Antenna Television and Radio Distribution Systems.

The shield of the coaxial cable shall be bonded or grounded as specified in 251.75(A) and (B).

Exception: For communications systems using coaxial cable completely contained within the building (i.e., they do not exit the building) or the exterior zone of protection defined by a 46 m (150 ft) radius rolling sphere and isolated from outside cable plant, the shield shall be permitted to be grounded by a connection to an equipment grounding conductor as described in 250.118. Connecting to an equipment grounding conductor through a grounded receptacle using a dedicated bonding jumper and a permanently connected listed device shall be permitted. Use of a cord and plug for the connection to an equipment grounding conductor shall not be permitted.

Informational Note: See NFPA 780-2023, Standard for the Installation of Lightning Protection Systems, 4.7.3.1, for the application of the term rolling sphere.

(A) General Requirements.
The installation shall be in accordance with 251.100.

(B) Shield Protection Devices.
Grounding of a coaxial drop cable shield by means of a protective device that does not interrupt the grounding system within the premises shall be permitted.

251.77 Equipment Grounding for Community Antenna Television and Radio Distribution Systems.

Unpowered equipment and enclosures or equipment powered by the coaxial cable shall be considered grounded if connected to the metallic cable shield.

251.80 Premises Circuits of Premises-Powered Broadband Communications Systems Not Leaving the Building.

If the network terminal is served by a nonconductive optical fiber cable, or if any non-current-carrying metal member of a conductive optical fiber cable is interrupted by an insulating joint or equivalent device, and circuits that terminate at the network terminal are completely contained within the building (i.e., they do not exit the building), 251.80(A), (B), or (C) shall apply, as applicable.

(A) Coaxial Cable Shield Grounding.

The shield of coaxial cable shall be grounded by one of the following:

(1) Any of the methods described in 251.75 or 251.106

(2) A fixed connection to an equipment grounding conductor as described in 250.118

(3) Connection to the network terminal grounding terminal provided that the terminal is connected to ground by one of the methods described in 251.75 or 251.106 or to an equipment grounding conductor through a listed grounding device that will retain the ground connection if the network terminal is unplugged

(B) Communications Circuit Grounding.

Communications circuits shall not be required to be grounded.

(C) Network Terminal Grounding.

The network terminal shall not be required to be grounded unless required by its listing. If the coaxial cable shield is separately grounded as described in 251.80(A)(1) or 251.80(A)(2), the use of a cord and plug for the connection to the network terminal grounding connection shall be permitted.

> Informational Note: If required to be grounded, a listed device that extends the equipment grounding conductor from the receptacle to the network terminal equipment grounding terminal is permitted. Sizing of the extended equipment grounding conductor is covered in Section 250.122.

Part III. Grounding methods

251.100 Cable and Primary Protector Bonding and Grounding

(A) Bonding Conductor or Grounding Electrode Conductor.

(1) Insulation.

The bonding conductor or grounding electrode conductor shall be listed and shall be permitted to be insulated, covered, or bare.

(2) Material.

The bonding conductor or grounding electrode conductor shall be copper or other corrosion-resistant conductive material, stranded or solid.

(3) Size.

The bonding conductor or grounding electrode conductor shall not be smaller than 14 AWG. The bonding conductor or grounding electrode conductor shall have an ampacity not less than the aggregate of the grounded metal cable sheath member, the metal strength member(s), and the protected conductor(s) of the communications cable, or the outer sheath of the coaxial cable, as applicable. The bonding conductor or grounding electrode conductor shall not be required to exceed 6 AWG.

(4) Length.

The bonding conductor or grounding electrode conductor shall be as short as practicable. In one- and two-family dwellings, the bonding conductor or grounding electrode conductor shall be as short as practicable, not to exceed 6.0 m (20 ft) in length.

> Informational Note: Similar bonding conductor or grounding electrode conductor length limitations applied at apartment buildings and commercial buildings help to reduce voltages that may be developed between the building's power and communications systems during lightning events. See ANSI/TIA-607-D-2019, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises, which includes useful information to reduce such voltages.

Exception:
In one- and two-family dwellings if it is not practicable to achieve an overall maximum bonding conductor or grounding electrode conductor length of 6.0 m (20 ft), a separate ground rod meeting the minimum dimensional criteria of 251.100(B)(3)(2) or (B)(3)(3) shall be driven, the bonding conductor or grounding electrode conductor shall be connected to the ground rod in accordance with 251.100(C), and the ground rod shall be connected to the power grounding electrode system in accordance with 251.100(D).

(5) Run in Straight Line.

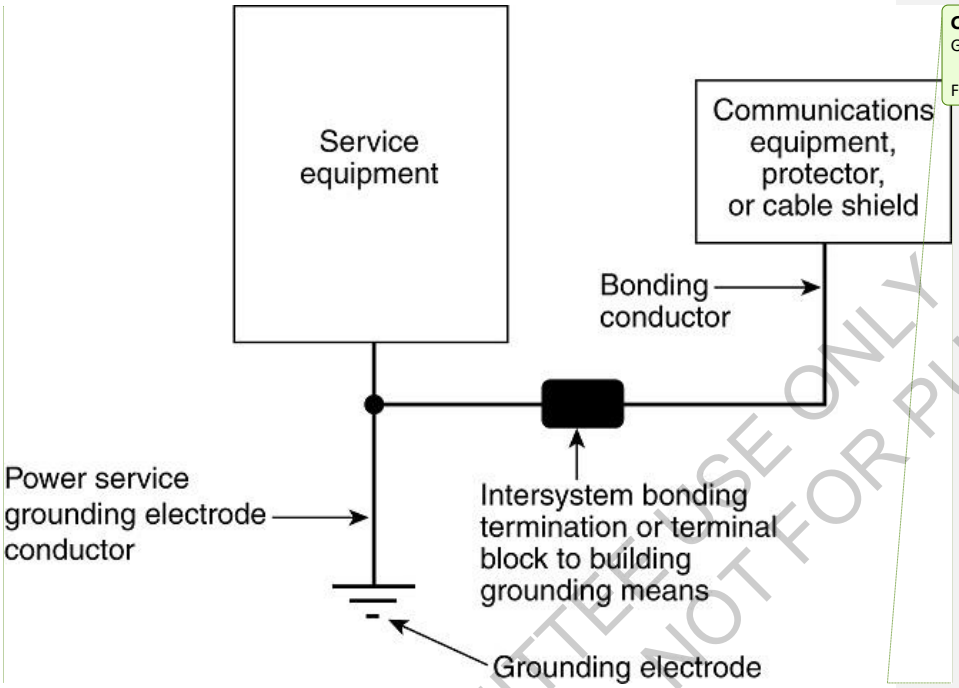
The bonding conductor or grounding electrode conductor shall be run in as straight a line as practicable.

(6) Physical Protection.
Bonding conductors and grounding electrode conductors shall be protected where exposed to physical damage. If the bonding conductor or grounding electrode conductor is installed in a metal raceway, both ends of the raceway shall be bonded to the contained conductor or to the same terminal or electrode to which the bonding conductor or grounding electrode conductor is connected.

(B) Electrode.
The bonding conductor or grounding electrode conductor shall be connected in accordance with 251.100(B)(1), (B)(2), or (B)(3).

(1) In Buildings or Structures with an Intersystem Bonding Termination.
If the building or structure served has an intersystem bonding termination as required by 250.94, the bonding conductor shall be connected to the intersystem bonding termination.

Informational Note:
Informational Note Figure 251.100(B)(1) illustrates the connection of the bonding conductor in buildings or structures equipped with an intersystem bonding termination or a terminal block providing access to the building grounding means.



Commented [JS1]: In Figure, change "Power Service Grounding Electrode" to "Service Grounding Electrode"

Figure 800.100(B)(1) in the 2023 NEC

Informational Note Figure 251.100(B)(1) Illustration of a Bonding Conductor in a Communications Installation Equipped with an Intersystem Bonding Termination or Terminal Block Providing Access to the Building Grounding Means.

(2) In Buildings or Structures with Grounding Means.

If an intersystem bonding termination is established, 250.94(A) shall apply. If the building or structure served has no intersystem bonding termination, the bonding conductor or grounding electrode conductor shall be connected to the nearest accessible location on one of the following:

(1) The building or structure grounding electrode system as covered in 250.50

(2) The power service accessible means external to enclosures using the options indicated in 250.94(A), Exception

(3) The nonflexible metal service raceway

(4) The service equipment enclosure

(5) The grounding electrode conductor or the grounding electrode conductor metal enclosure of the power service

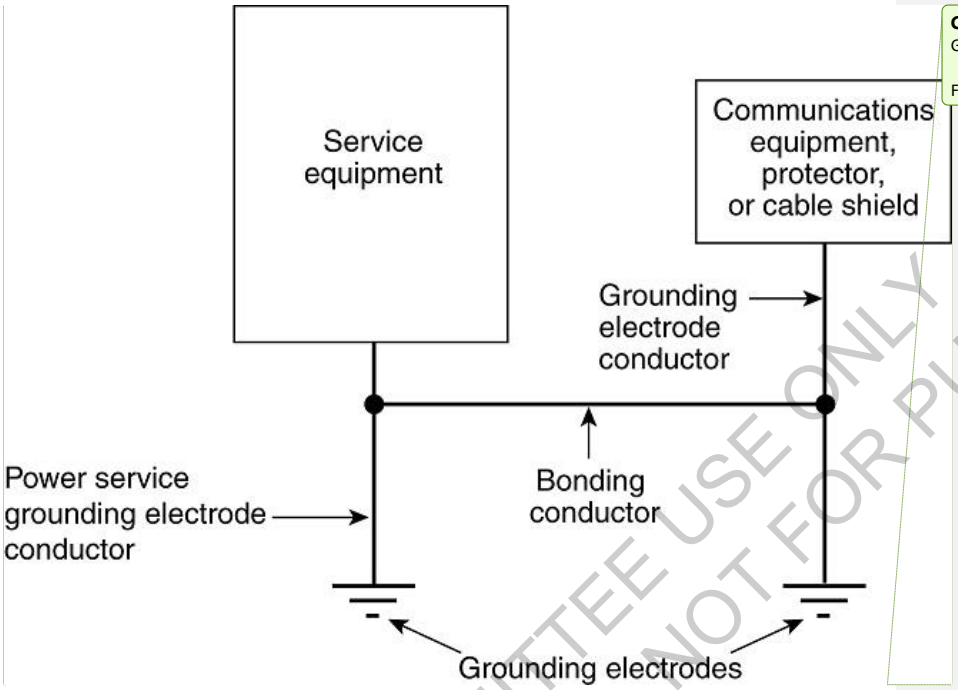
(6) The grounding electrode conductor or the grounding electrode of a building or structure disconnecting means that is connected to a grounding electrode as covered in 250.32

(7) The grounded interior metal water piping system, within 1.5 m (5 ft) from its point of entrance to the building, as covered in 250.52

A bonding device intended to provide a termination point for the bonding conductor (intersystem bonding) shall not interfere with the opening of an equipment enclosure. A bonding device shall be mounted on nonremovable parts. A bonding device shall not be mounted on a door or cover even if the door or cover is nonremovable.

For purposes of this section, the mobile home service equipment or the mobile home disconnecting means located within 9.0 m (30 ft) of the exterior wall of the mobile home it serves, or at a mobile home disconnecting means connected to an electrode by a grounding electrode conductor in accordance with 250.32 and located within 9.0 m (30 ft) of the exterior wall of the mobile home it serves, shall be considered to meet the requirements of this section.

Informational Note:
See Informational Note Figure 251.100(B)(2) for an illustration of a grounding electrode conductor and a bonding conductor in a communications installation not equipped with an intersystem bonding termination or terminal block.



Commented [JS2]: In Figure, change "Power Service Grounding Electrode" to "Service Grounding Electrode"

Figure 800.100(B)(2) in the 2023 NEC.

Informational Note Figure 251.100(B)(2) Illustration of a Grounding Electrode Conductor and a Bonding Conductor in a Communications Installation Not Equipped with an Intersystem Bonding Termination or Terminal Block Providing Access to the Building Grounding Means.

(3) In Buildings or Structures Without an Intersystem Bonding Termination or Grounding Means.

If the building or structure served has no intersystem bonding termination or grounding means, as described in 800.20(B)(2), the grounding electrode conductor shall be connected to one of the following:

(1) To any one of the individual grounding electrodes described in 250.52(A)(1), (A)(2), (A)(3), or (A)(4)

(2) If the building or structure served has no intersystem bonding termination or grounding means, as described in 251.100(B)(2) or (B)(3)(1), to any one of the individual grounding electrodes described in 250.52(A)(5), (A)(7), and (A)(8)

(3) For communications circuits or network-powered broadband communications systems, to a ground rod or pipe not less than 1.5 m (5 ft) in length and 12.7 mm (0.5 in.) in diameter, driven, where practicable, into permanently damp earth and separated from lightning protection system conductors, as covered in 251.48, and at least 1.8 m (6 ft) from electrodes of other systems

Steam pipes, hot water pipes, or lightning protection system conductors shall not be employed as grounding electrodes or as a bonding or grounding electrode conductor for protectors and grounded metal members.

(C) Electrode Connection.

Connections to grounding electrodes shall comply with 250.70.

(D) Bonding of Electrodes.

A bonding jumper not smaller than 6 AWG copper or equivalent shall be connected between the grounding electrode and power grounding electrode system at the building or structure served if separate electrodes are used.

Exception:
Bonding of electrodes at mobile homes shall be in accordance with 251.106.

Informational Note No. 1: See 250.60 for connection to a lightning protection system.

Informational Note No. 2: Bonding together of all separate electrodes limits potential differences between them and between their associated wiring systems.

251.106 Primary Protector Grounding and Bonding at Mobile Homes

(A) Grounding.

Grounding shall comply with 251.106(A)(1) and (A)(2).

(1) Mobile Home Service Equipment.

If there is no mobile home service equipment located within 9.0 m (30 ft) of the exterior wall of the mobile home it serves, grounding shall comply with one of the following:

(1) The following components (if present) shall be connected to a grounding electrode in accordance with 251.100(B)(3):

a. Primary protector grounding terminal

b. Network interface unit

c. Coaxial cable shield ground

d. Surge arrester grounding terminal

e. Network-powered broadband communications cable shield

f. Network-powered broadband communications cable metal members not used for communications or powering

(2) The non-current-carrying metal members of optical fiber cables shall be connected to a grounding electrode in accordance with 251.108(A)(1). The network terminal, if required to be grounded, shall be connected to a grounding electrode in accordance with 251.100(A)(1)(1). The grounding electrode shall be bonded in accordance with 251.108(B).

(2) Mobile Home Feeder Disconnecting Means.

If there is no mobile home disconnecting means grounded in accordance with 250.32 and located within 9.0 m (30 ft) of the exterior wall of the mobile home it serves, grounding shall comply with one of the following:

(1) The following components (if present) shall be connected to a grounding electrode in accordance with 251.100(B)(3):

a. Primary protector grounding terminal

b. Network interface unit

c. Network-powered broadband communications shield

d. Network-powered broadband communications cable metal members not used for communications or powering

(2) The non-current-carrying metal members of optical fiber cables shall be connected to a grounding electrode in accordance with 251.108(A)(2). The network terminal, if required to be grounded, shall be connected to a grounding electrode in accordance with 251.106(A)(2). The grounding electrode shall be bonded in accordance with 251.108(B).

(B) Bonding.

The primary protector grounding terminal or grounding electrode, network-powered broadband communications cable grounding terminal, or network interface unit grounding terminal shall be bonded together and connected to the metal frame or available grounding terminal of the mobile home with a copper conductor not smaller than 12 AWG under either of the following conditions:

(1) If there is no mobile home service equipment or disconnecting means as in 251.106(A)

(2) If the mobile home is supplied by cord and plug

251.108 Grounding and Bonding of Optical Fiber Entrance Cables at Mobile Homes.

(A) Grounding.

Grounding shall comply with 251.108(A)(1) and (A)(2).

(1) Installations Without Mobile Home Service Equipment.

If there is no mobile home service equipment located within 9.0 m (30 ft) of the exterior wall of the mobile home it serves, the non-current-carrying metallic members of optical fiber cables entering the mobile home shall be grounded in accordance with 251.100(B)(3).

(2) Installations Without Mobile Home Disconnecting Means.

If there is no mobile home disconnecting means grounded in accordance with 250.32 and located within 9.0 m (30 ft) of the exterior wall of the mobile home it serves, the non-current-carrying metallic members of optical fiber cables entering the mobile home shall be grounded in accordance with 251.100(B)(3).

(B) Bonding.

The grounding electrode shall be bonded to the metal frame or available grounding terminal of the mobile home with a copper conductor or other equivalent corrosion-resistant material not smaller than 12 AWG under either of the following conditions:

(1) If there is no mobile home service equipment or disconnecting means as in 251.106(A)

(2) If the mobile home is supplied by cord and plug

PART IV. Primary and Secondary Protection

251.150 Primary Protection

(A) Application.

A listed primary protector shall be provided on each communication circuit run partly or entirely in aerial wire or aerial cable not confined within a block. Also, a listed primary protector shall be provided on each circuit, aerial or underground, located within the block containing the building served so as to be exposed to accidental contact with electric light or power conductors operating at over 300 volts to ground. In addition, where there exists a lightning exposure, each interbuilding circuit on a premises shall be protected by a listed primary protector at each end of the interbuilding circuit.

Exception: Primary electrical protection shall not be required on the network-powered broadband communications conductors where electrical protection is provided on the derived circuit(s) (output side of the NIU) in accordance with 251.150(D)(3).

Informational Note No. 1: On network-powered broadband communications conductors not exposed to lightning or accidental contact with power conductors, providing primary electrical protection in accordance with this section helps protect against other hazards, such as ground potential rise caused by power fault currents, and above-normal voltages induced by fault currents on power circuits in proximity to the network-powered broadband communications conductors.

Informational Note No. 2: -Communications circuits are considered to have a lightning exposure unless one or more of the following conditions exist:

(1) Circuits in large metropolitan areas where buildings are close together and sufficiently high to intercept lightning.

(2) Areas having an average of five or fewer thunderstorm days each year and earth resistivity of less than 100 ohm-meters. Such areas are found along the Pacific coast.

Informational Note No. 3: On a circuit not exposed to accidental contact with power conductors, providing a listed primary protector in accordance with this section helps protect against other hazards, such as lightning and above-normal voltages induced by fault currents on power circuits in proximity to the communications circuit.

Informational Note No. 4: Interbuilding circuits are considered to have a lightning exposure unless one or more of the following conditions exist:

(1) Circuits in large metropolitan areas where buildings are close together and sufficiently high to intercept lightning.

(2) Interbuilding cable runs of 42 m (140 ft) or less, directly buried or in underground conduit, where a continuous metallic cable shield or a continuous metal conduit containing the cable is connected to each building grounding electrode system.

(3) Areas having an average of five or fewer thunderstorm days per year and earth resistivity of less than 100 ohm-meters. Such areas are found along the Pacific coast.

Informational Note No. 5: See NFPA 780-2023, *Standard for the Installation of Lightning Protection Systems,* for information on lightning protection systems.

(B) Fuseless Primary Protectors.

Fuseless-type primary protectors shall be permitted under any of the following conditions:

(1) If conductors enter a building through a cable with grounded metallic sheath member(s) and if the conductors in the cable safely fuse on all currents greater than the current-carrying capacity of the primary protector and of the primary protector bonding conductor or grounding electrode conductor

(2) If insulated conductors in accordance with 805.50(A) are used to extend circuits to a building from a cable with an effectively grounded metallic sheath member(s) and if the conductors in the cable or cable stub, or the connections between the insulated conductors and the plant exposed to accidental contact with electric light or power conductors operating at greater than 300 volts to ground, safely fuse on all currents greater than the ampere rating of the primary protector, or the ampacity of the associated insulated conductors and of the primary protector bonding conductor or grounding electrode conductor

(3) If insulated conductors in accordance with 805.50(A) or (B) are used to extend circuits to a building from other than a cable with metallic sheath member(s), if (a) the primary protector is listed as being suitable for this purpose for application with circuits extending from other than a cable with metallic sheath members and (b) the connections of the insulated conductors to the plant exposed to accidental contact with electric light or power conductors operating at greater than 300 volts to ground or the conductors of the plant exposed to accidental contact with electric light or power conductors operating at greater than 300 volts to ground safely fuse on all currents greater than the ampere rating of the primary protector, or ampacity of the associated insulated conductors and of the primary protector bonding conductor or grounding electrode conductor

(4) If insulated conductors in accordance with 805.50(A) are used to extend circuits aerially to a building from a buried or underground circuit that is unexposed to accidental contact with electric light or power conductors operating at greater than 300 volts to ground

(5) Where insulated conductors in accordance with 805.50(A) are used to extend circuits to a building from cable with an effectively grounded metallic sheath member(s), and where (a) the combination of the primary protector and insulated conductors is listed as being suitable for this purpose for application with circuits extending from a cable with an effectively grounded metallic sheath member(s) and (b) the insulated conductors safely fuse on all currents greater than the ampere rating of the primary protector and the ampacity of the primary protector bonding conductor or grounding electrode conductor

Informational Note: See ANSI/IEEE C2-2023, *National Electrical Safety Code*, Section 9, for examples of methods of protective grounding that can achieve effective grounding of communications cable sheaths for cables from which communications circuits are extended.

(C) Fused Primary Protectors.

Where the requirements listed under 251.150(B)(1) through (B)(5) are not met, fused-type primary protectors shall be used. Fused-type primary protectors shall consist of an arrester

connected between each line conductor and ground, a fuse in series with each line conductor, and an appropriate mounting arrangement. Primary protector terminals shall be marked to indicate line, instrument, and ground, as applicable.

(D) Location of Primary Protector for Network-Powered Broadband Communications Systems

The location of the primary protector, where required, shall comply with the following:

(1) A listed primary protector shall be applied on each network-powered broadband communications cable external to and on the network side of the network interface unit.
(2) The primary protector function shall be an integral part of and contained in the network interface unit. The network interface unit shall be listed as being suitable for application with network-powered broadband communications systems and shall have an external marking indicating that it contains primary electrical protection.
(3) The primary protector(s) shall be provided on the derived circuit(s) (output side of the NIU), and the combination of the NIU and the protector(s) shall be listed as being suitable for application with network-powered broadband communications systems.

A primary protector, whether provided integrally or external to the network interface unit, shall be located as close as practicable to the point of entrance.

For purposes of this section, a network interface unit and any externally provided primary protectors located at mobile home service equipment located in sight from and not more than 9.0 m (30 ft) from the exterior wall of the mobile home it serves, or at a mobile home disconnecting means grounded in accordance with 250.32 and located in sight from and not more than 9.0 m (30 ft) from the exterior wall of the mobile home it serves, shall be considered to meet the requirements of this section.

Informational Note: Selecting a network interface unit and primary protector location to achieve the shortest practicable primary protector bonding conductor or grounding electrode conductor helps limit potential differences between communications circuits and other metallic systems.

251.160 Secondary Protection.

Any overvoltage protection, arresters, or grounding connection shall be connected on the equipment terminal side of the secondary protector current-limiting means.

251.170 Installation of Primary and Secondary Protectors.

(A) Primary Protectors.

The primary protector shall consist of an arrester connected between each line conductor and the grounding electrode system in an appropriate mounting. Primary protector terminals shall be marked to indicate line and ground as applicable.

(B) Secondary Protectors.

The connection of overvoltage protection devices, arresters, or grounding and bonding conductors shall be made on the equipment terminal side of the secondary protector current-limiting means.

(C) Location.

If installed, a listed primary protector shall be applied on each community antenna and radio distribution (CATV) cable external to the premises. The listed primary protector shall be located as close as practicable to the entrance point of the cable on either side or integral to the ground block.

(D) Hazardous (Classified) Locations.

If a primary protector or equipment providing the primary protection function is used, it shall not be located in any hazardous (classified) location as described in 500.5 and 505.5 or in the vicinity of easily ignitable material.

Exception: Primary protection equipment shall be used only if permitted by 501.150, 502.150, and 503.150.

First Revision No. 8298-NFPA 70-2024 [Detail]

[250.32(D)]

(D) Disconnecting Means Located in Separate Building or Structure on the Same Premises.

If one or more disconnecting means supply one or more additional buildings or structures under single management, and where these disconnecting means are located remote from those buildings or structures in accordance with 225.31(B), Exception No. 1 and No. 2, 700.12(D)(4), 701.12(D)(3), or 702.12, all of the following conditions shall be met:

(1) The connection of the grounded conductor to the grounding electrode, to normally non-current-carrying metal parts of equipment, or to the equipment grounding conductor at a separate building or structure shall not be made.

(2) An equipment grounding conductor for grounding and bonding any normally non-current-carrying metal parts of equipment, interior metal piping systems, and building or structural metal frames is run with the circuit conductors to a separate building or structure and connected to existing grounding electrode(s) required in Part III of this article, or, if there are no existing electrodes, the grounding electrode(s) required in Part III of this article shall be installed if a separate building or structure is supplied by more than one branch circuit.

(3) The connection between the equipment grounding conductor and the grounding electrode at a separate building or structure shall be made in a junction box, panelboard enclosure, or similar enclosure located immediately inside or outside the separate building or structure.

Supplemental Information

File Name	Description	Approved
NEC_CMP5_FR-8298_250.32_D_Detail.docx	For Staff Use	

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Sun Jan 21 11:07:07 EST 2024

Committee Statement

Committee Statement: The requirement is revised to clarify that the connection of the equipment grounding conductor and the grounding electrode conductor is made inside of the panelboard enclosure.

Response Message: FR-8298-NFPA 70-2024

Public Input No. 788-NFPA 70-2023 [Section No. 250.32(D)]

Public Input No. 2069-NFPA 70-2023 [Section No. 250.32(D)]

Public Input No. 241-NFPA 70-2023 [Section No. 250.32(D)]

First Revision No. 8521-NFPA 70-2024 [Detail]

250.119

(A) General.

Unless required elsewhere in this Code, equipment grounding conductors shall be permitted to be bare, covered, or insulated. Individually covered or insulated equipment grounding conductors of the wire type shall have a continuous outer finish that is either green or green with one or more yellow stripes except as permitted in this section. Conductors with insulation or individual covering that is green, green with one or more yellow stripes, yellow with one or more green stripes, or otherwise identified as permitted by this section shall not be used for ungrounded or grounded circuit conductors.

Exception No. 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 ac or 60 volts dc if connected to equipment not required to be grounded shall be permitted 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 permitted 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.

Supplemental Information

File Name	Description	Approved
NEC_CMP5_FR-8521_250.119_A_Detail.docx	For Staff Use	

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Mon Jan 22 15:19:05 EST 2024

Committee Statement

Committee Statement: The additional wording clarifies that the use of a yellow conductor with one or more green stripes is prohibited from being used as an ungrounded or grounded circuit conductor. A yellow conductor with one or more green stripes is recognized in manufacturing standards for internal equipment wiring but is not allowed as a field installed equipment grounding conductor.

Response Message: FR-8521-NFPA 70-2024

Public Input No. 2915-NFPA 70-2023 [Section No. 250.119(A)]

First Revision No. 8618-NFPA 70-2024 [Detail]

[New Section After 250.187(D)]

(E) Impedance Bonding Jumper

(1) Connection.

The impedance bonding jumper shall be an unspliced conductor run from the first system disconnecting means or overcurrent device to the grounding electrode side of the grounding impedance device.

(2) Size.

The Impedance Bonding Jumper shall be not less than the larger of 250.187(E)(2)(a) or (E)(2)(b), but in no case shall the impedance bonding jumper be smaller than 8 AWG copper or 6 AWG aluminum.

(a) Connected at the Impedance Grounding Device. If the grounding electrode conductor connection is made at the impedance grounding device, the impedance bonding jumper shall be sized in accordance with 250.66, based on the size of the service entrance conductors for a service or the derived phase conductors for a separately derived system.

(b) Connected at the First System Disconnection Means. If the grounding electrode conductor is connected at the first system disconnecting means or overcurrent device, the impedance bonding jumper shall be sized the same as the impedance grounding conductor.

Informational Note: If the grounding electrode conductor is connected at the impedance grounding device location, the impedance bonding jumper is also the path for lightning impulse currents to the grounding electrode system.

Supplemental Information

File Name	Description	Approved
NEC_CMP5_FR-8618_250.187_Detail.docx		
NEC_CMP5_FR-8618_250.187_Detail.docx	For prod use	

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Tue Jan 23 08:00:35 EST 2024

Committee Statement

Committee Statement: This new subdivision recognizes the new definition of impedance bonding jumper and better describes the purpose of the conductor that bonds the grounding electrode conductor to the system equipment grounding conductors. This conductor carries ground fault current to the impedance and is a path for imposed voltages from sources identified in 250.4(A)(1).

This new subdivision provides methods to size the impedance bonding jumper. It accounts for the multiple purposes of the bonding jumper, including providing a path for impulses caused by lightning.

Response Message: FR-8618-NFPA 70-2024

Public Input No. 2127-NFPA 70-2023 [New Section after 250.187(D)]

Public Input No. 2129-NFPA 70-2023 [New Section after 250.187(D)]

[New Section After 250.187(D)]

(E) Impedance Bonding Jumper

(1) Connection.

The impedance bonding jumper shall be an unspliced conductor run from the first system disconnecting means or overcurrent device to the grounding electrode side of the grounding impedance device.

(2) Size.

The Impedance Bonding Jumper shall be not less than the larger of 250.187(E)(2)(a) or (E)(2)(b), but in no case shall the impedance bonding jumper be smaller than 8 AWG copper or 6 AWG aluminum.

(a) Connected at the Impedance Grounding Device.

If the grounding electrode conductor connection is made at the impedance grounding device, the impedance bonding jumper shall be sized in accordance with 250.66, based on the size of the service entrance conductors for a service or the derived phase conductors for a separately derived system.

(b) Connected at the First System Disconnection Means.

If the grounding electrode conductor is connected at the first system disconnecting means or overcurrent device, the impedance bonding jumper shall be sized the same as the impedance grounding conductor.

Informational Note: If the grounding electrode conductor is connected at the impedance grounding device location, the impedance bonding jumper is also the path for lightning impulse currents to the grounding electrode system.

First Revision No. 8621-NFPA 70-2024 [Detail]

[New Section 250.187(F) after existing 250.187(D) and proposed new 250.187(E)]

(F) Grounding Electrode Conductor Connection Location.

For services or separately derived systems, the grounding electrode conductor shall be connected at any point from the grounded side of the grounding impedance device to the equipment grounding connection at the service equipment or the first system disconnecting means of a separately derived system.

Supplemental Information

File Name	Description	Approved
NEC_CMP5_FR-8621_250.187_F_Detail.docx	For Staff Use	

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Tue Jan 23 08:07:47 EST 2024

Committee Statement

Committee Statement: This new subdivision provides consistency between 250.36 and 250.187. The language is taken from 250.36(F).

Response Message: FR-8621-NFPA 70-2024

Public Input No. 2128-NFPA 70-2023 [New Section after 250.187(D)]

First Revision No. 8750-NFPA 70-2024 [Detail]

[New Definition after Definition for Bonding Conductor, Equipment]

Bonding Conductor, Grounding Electrode. (Grounding Electrode Bonding Conductor) (Grounding Electrode Bonding Jumper)

Conductor(s), other than the grounding electrode conductor, used to interconnect two or more grounding electrodes to form the grounding electrode system. (CMP-5)

Supplemental Information

File Name	Description	Approved
NEC_CMP5_FR-8750_Article100.docx		
NEC_CMP5_FR-8750_Article100_Bonding_Conductor_Grounding.docx	For prod use	

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Tue Jan 23 14:23:44 EST 2024

Committee Statement

Committee Statement: This new term clarifies the difference between bonding conductors and the grounding electrode conductor. A conductor used to interconnect grounding electrodes together is a bonding conductor and not the grounding electrode conductor.

Response Message: FR-8750-NFPA 70-2024

Public Input No. 2318-NFPA 70-2023 [New Definition after Definition: Grounding Electrode Conduc...]

[New Definition after Definition for Bonding Conductor, Equipment]

Bonding Conductor, Grounding Electrode. (Grounding Electrode Bonding Conductor) (Grounding Electrode Bonding Jumper)

Conductor(s), other than the grounding electrode conductor, used to interconnect two or more grounding electrodes to form the grounding electrode system. (CMP-5)

First Revision No. 8725-NFPA 70-2024 [Definition: Bonding Jumper, Equipment. (Equipment Bonding J...]

Bonding ~~Jumper~~ Conductor , Equipment. (Equipment Bonding ~~Jumper~~ Conductor)

The connection between two or more portions of the equipment grounding conductor. (CMP-5)

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Tue Jan 23 13:26:18 EST 2024

Committee Statement

Committee Statement: The term was revised to remove “jumper” in the term and replace it with the more technically accurate term of conductor. The synonym will be retained in the term for at least one cycle.

Response Message: FR-8725-NFPA 70-2024

Public Input No. 3952-NFPA 70-2023 [Definition: Bonding Jumper, Equipment. (Equipment Bonding J...]

First Revision No. 8731-NFPA 70-2024 [Definition: Bonding Jumper, Main. (Main Bonding Jumper)]

Bonding ~~Jumper~~ Conductor , Main. (Main Bonding Conductor) (Main Bonding Jumper)

The connection between the grounded circuit conductor and the equipment grounding conductor, or the supply-side bonding ~~jumper~~ conductor , or both, at the service equipment . (CMP-5)

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Tue Jan 23 13:39:24 EST 2024

Committee Statement

Committee Statement: The term was revised to remove “jumper” in the term and replace it with the more technically accurate term of conductor. The synonym will be retained in the term for at least one cycle.

The correlating committee may want to direct all panels to review use of this term for consistency with the revised definition.

Response Message: FR-8731-NFPA 70-2024

Public Input No. 3956-NFPA 70-2023 [Definition: Bonding Jumper, Main. (Main Bonding Jumper)]

Public Input No. 3100-NFPA 70-2023 [Definition: Bonding Jumper, Main. (Main Bonding Jumper)]

First Revision No. 8738-NFPA 70-2024 [Definition: Bonding Jumper, Supply-Side. (Supply-Side Bondi...]

Bonding ~~Jumper~~ Conductor , Supply-Side. (Supply-Side Bonding Conductor) (Supply-Side Bonding Jumper)

A conductor installed on the supply side of a service or within a service equipment enclosure(s), or for a separately derived system, that ensures the required electrical conductivity between metal parts required to be electrically connected. (CMP-5)

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Tue Jan 23 13:48:04 EST 2024

Committee Statement

Committee Statement: The term was revised to remove “jumper” in the term and replace it with the more technically accurate term of conductor. The synonym will be retained in the term for at least one cycle.

Response Message: FR-8738-NFPA 70-2024

Public Input No. 3989-NFPA 70-2023 [Definition: Bonding Jumper, Supply-Side. (Supply-Side Bondi...]

Public Input No. 4002-NFPA 70-2023 [Definition: Bonding Jumper, Supply-Side. (Supply-Side Bondi...]

First Revision No. 8740-NFPA 70-2024 [Definition: Bonding Jumper, System. (System Bonding Jumper)]

Bonding ~~Jumper~~ Conductor , System. (System Bonding Conductor) (System Bonding Jumper)

The connection between the grounded circuit conductor and the supply-side bonding ~~jumper~~ conductor , or the equipment grounding conductor, or both, at a separately derived system. (CMP-5)

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Tue Jan 23 13:51:15 EST 2024

Committee Statement

Committee Statement: The term was revised to remove “jumper” in the term and replace it with the more technically accurate term of conductor. The synonym will be retained in the term for at least one cycle.

Response Message: FR-8740-NFPA 70-2024

Public Input No. 3990-NFPA 70-2023 [Definition: Bonding Jumper, System. (System Bonding Jumper)]

First Revision No. 8742-NFPA 70-2024 [Definition: Ground.]

Ground.

The ~~earth~~ Earth . (CMP-5)

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Tue Jan 23 14:02:17 EST 2024

Committee Statement

Committee Statement: The committee determined that the term is a proper noun and should be capitalized.

Response Message: FR-8742-NFPA 70-2024

Public Input No. 1793-NFPA 70-2023 [Definition: Ground.]

First Revision No. 8402-NFPA 70-2024 [New Definition after Definition: Bonding Jumper, Equipment....]

Bonding Jumper, Impedance. (Impedance Bonding Jumper).
The connection in an impedance grounded system between the equipment grounding conductor(s) and the grounding electrode side of the impedance grounding device. (CMP-5)

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Mon Jan 22 08:34:06 EST 2024

Committee Statement

Committee Statement: A new definition is needed to describe the unique bonding jumper that carries fault current at a level less than the value determined by either Table 250.122 or Table 250.102(C)(1).

Response Message: FR-8402-NFPA 70-2024

First Revision No. 8635-NFPA 70-2024 [Section No. 200.2(A)]

(A) Insulation.

The grounded conductor, if insulated, shall have insulation that complies with either one of the following:

(1) Is suitably rated, other than color, for any ungrounded conductor of the same circuit for systems of 1000 volts or less.

(2) Is rated not less than 600 volts for solidly grounded neutral systems of over 1000 volts in accordance with 250.184(A)(1)

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Tue Jan 23 09:01:51 EST 2024

Committee Statement

Committee Statement: The panel added the suffix (1) at the end of the 250.184(A) to clarify that only the insulation requirement is being referenced.

Response Message: FR-8635-NFPA 70-2024

Public Input No. 1681-NFPA 70-2023 [Section No. 200.2(A)]

First Revision No. 8638-NFPA 70-2024 [Section No. 200.6(A)]

(A) Sizes 6 AWG or Smaller.

The insulation of grounded conductors of 6 AWG or smaller shall be identified by one of the following means:

(1) A continuous white outer finish.

(2) A continuous gray outer finish.

(3) Three continuous white or gray stripes along the conductor's entire length on other than green insulation.

(4) Conductors with white or gray insulation and colored tracer threads in the braid identifying the source of manufacture.

(5) A single-conductor, sunlight-resistant, outdoor-rated cable used as a solidly grounded conductor in photovoltaic power systems, as permitted by 690.31(C)(1), shall be identified at the time of installation by markings at terminations in accordance with 200.6(A)(1) through (A)(4).

(6) The grounded conductor of a mineral-insulated, metal-sheathed cable (Type MI) shall be identified at the time of installation by a distinctive white or gray marking at its terminations The marking shall encircle the conductor insulation.

(7) Fixture wire shall comply with the requirements for grounded conductor identification in accordance with 402.8.

(8) For aerial cable, the identification shall comply with one of the methods in 200.6(A)(1) through (A)(5), or by means of a ridge located on the exterior of the cable so as to identify it.

(9) Conductors with a continuous white or gray outer finish shall be permitted to have a single colored stripe, other than green, for circuit identification.

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Tue Jan 23 09:09:05 EST 2024

Committee Statement

Committee Statement: The addition of the list item (9) offers a way to associate grounded conductors of the same voltage system with the circuit conductors where multiple grounded conductors are present such as in a wireway.

Response Message: FR-8638-NFPA 70-2024

Public Input No. 180-NFPA 70-2023 [Section No. 200.6(A)]

First Revision No. 8642-NFPA 70-2024 [Section No. 200.6(E)]

(E) Grounded Conductors of Multiconductor Cables.

The insulated grounded conductor(s) in a multiconductor cable shall be identified by a continuous white or gray outer finish or by three continuous white or gray stripes on other than green insulation along its entire length. For conductors that are 4 AWG or larger in cables, identification of the grounded conductor shall be permitted to comply with 200.6(B). For multiconductor flat cable with conductors that are 4 AWG or larger, an external ridge shall be permitted to identify the grounded conductor.

Exception No. 1: Conductors within multiconductor cables shall be permitted to be re-identified at their terminations at the time of installation by a distinctive white or gray marking or other equally effective means.

Exception No. 2: The grounded conductor of a multiconductor varnished-cloth-insulated cable shall be permitted to be identified at its terminations at the time of installation by a distinctive white marking or other equally effective means.

Informational Note: ~~The color gray~~ Gray insulation may have been used in the past ~~as an~~ on ungrounded ~~conductor~~ conductors . ~~Care~~ Caution should be ~~taken~~ used when working on existing systems.

Submitter Information Verification

Committee: NEC-P05
Submittal Date: Tue Jan 23 09:15:18 EST 2024

Committee Statement

Committee Statement: The Informational Note was revised to comply with the NEC Style Manual 2.1.10.

This action is consistent with the action requested by Global PI-3085 assigned to CMP-1.

Response Message: FR-8642-NFPA 70-2024

First Revision No. 9249-NFPA 70-2024 [Section No. 200.7(C)]

(C) Circuits of 50 Volts or More.

The use of conductors that have insulation that is white or gray or that has three continuous white or gray stripes for other than a grounded conductor ~~for circuits of 50 volts or more~~ shall be permitted only as in ~~the following:~~ 200.7(C)(1) or (C)(2).

(1) Cable Assembly

(a) If part of a cable assembly that has the insulation permanently reidentified to indicate its use as an ungrounded conductor by marking tape, painting, or other effective means at its termination and at each location where the conductor is visible and accessible. Identification shall encircle the insulation and shall be a color other than white, gray, or green.

(b) If used for single-pole, 3-way or 4-way switch loops, the reidentified conductor with white or gray insulation or three continuous white or gray stripes shall be used only for the supply to the switch, but not as a return conductor from the switch to the outlet.

~~A flexible~~

(2) Flexible Cord.

A fl exible cord having one conductor identified by a white or gray outer finish or three continuous white or gray stripes, or by any other means in accordance with 400.22 , that is used for connecting an appliance or equipment in accordance with 400.10 . This shall apply to flexible cords connected to outlets whether or not the outlet is supplied by a circuit that has a grounded conductor.

Informational Note: ~~The color gray~~ Gray insulation may have been used in the past ~~as an~~ on ungrounded ~~conductor~~ conductors . ~~Care~~ Caution should be ~~taken~~ used when working on existing systems.

Supplemental Information

File Name	Description	Approved
NEC_CMP5_FR-9429_200.7_C_.docx		
NEC_CMP5_FR-9249_200.7_C_.docx	For prod use	

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Fri Jan 26 11:46:53 EST 2024

Committee Statement

Committee Statement: The list item (1) of 200.7(C) was broken up into subdivisions to comply with the NEC Style Manual 3.5.1.2

Revised the Informational Note to comply with the NEC Style Manual and be consistent with the IN at 200.6(E)

Response Message: FR-9249-NFPA 70-2024

Public Input No. 3643-NFPA 70-2023 [Section No. 200.7(C)]

(C) Circuits of 50 Volts or More. [Move list items to (1) and (2)]

The use of conductors that have insulation that is white or gray or that has three continuous white or gray stripes for other than a grounded conductor ~~for circuits of 50 volts or more~~ shall be permitted only as in ~~the following:~~200.7(C)(1) or 200.7(C)(2).

~~(1) If part of a cable assembly that has the insulation permanently reidentified to indicate its use as an ungrounded conductor by marking tape, painting, or other effective means at its termination and at each location where the conductor is visible and accessible. Identification shall encircle the insulation and shall be a color other than white, gray, or green. If used for single-pole, 3-way or 4-way switch loops, the reidentified conductor with white or gray insulation or three continuous white or gray stripes shall be used only for the supply to the switch, but not as a return conductor from the switch to the outlet.~~

~~(2) A flexible cord having one conductor identified by a white or gray outer finish or three continuous white or gray stripes, or by any other means in accordance with 400.22, that is used for connecting an appliance or equipment in accordance with 400.10.This shall apply to flexible cords connected to outlets whether or not the outlet is supplied by a circuit that has a grounded conductor.~~

~~Informational Note: The color gray may have been used in the past as an ungrounded conductor. Care should be taken when working on existing systems.~~

(1) Cable Assembly.

(a) If part of a cable assembly that has the insulation permanently reidentified to indicate its use as an ungrounded conductor by marking tape, painting, or other effective means at its termination and at each location where the conductor is visible and accessible. Identification shall encircle the insulation and shall be a color other than white, gray, or green.

(b) If used for single-pole, 3-way or 4-way switch loops, the reidentified conductor with white or gray insulation or three continuous white or gray stripes shall be used only for the supply to the switch, but not as a return conductor from the switch to the outlet.

(2) Flexible Cord.

A flexible cord having one conductor identified by a white or gray outer finish or three continuous white or gray stripes, or by any other means in accordance with 400.22, that is used for connecting an appliance or equipment in accordance with 400.10. This shall apply to flexible cords connected to outlets whether or not the outlet is supplied by a circuit that has a grounded conductor.

Informational Note: ~~The color gray~~Gray insulation may have been used in the past ~~as an~~on ungrounded conductors. ~~Care~~ Caution should be ~~taken~~ used when working on existing systems.

First Revision No. 8647-NFPA 70-2024 [Section No. 200.10(D)]

(D) Screw Shell Devices with Leads.

For screw shell devices with attached leads, the conductor attached to the screw shell shall have a white or gray finish. The outer finish of the other conductor shall be of a solid color that will not be confused with the white or gray finish used to identify the grounded conductor.

Informational Note: ~~The color gray~~ Gray insulation may have been used in the past ~~as an~~ on ungrounded ~~conductor~~ conductors . Caution should be ~~taken~~ used when working on existing systems.

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Tue Jan 23 09:32:04 EST 2024

Committee Statement

Committee Statement: Revised the Informational Note to comply with the NEC Style Manual and be consistent with the IN at 200.6(E).

This action is consistent with the action requested by Global PI-3085 assigned to CMP-1.

Response Message: FR-8647-NFPA 70-2024

First Revision No. 8247-NFPA 70-2024 [Section No. 250.4(A)]

(A) Grounded Systems.

(1) Electrical System Grounding.

Electrical systems that are grounded shall be connected to earth in a manner that will limit the voltage imposed by lightning, line surges, or unintentional contact with higher-voltage lines and that will stabilize the voltage to earth during normal operation.

Informational Note No. 1: An important consideration for limiting the imposed voltage is the routing of bonding and grounding electrode conductors so that they are not any longer than necessary to complete the connection without disturbing the permanent parts of the installation and so that unnecessary bends and loops are avoided.

Informational Note No. 2: See NFPA 780-2020, *Standard for the Installation of Lightning Protection Systems*, for information on installation of grounding and bonding for lightning protection systems.

(2) Grounding of Electrical Equipment.

Normally non-current-carrying conductive materials enclosing electrical conductors or equipment, or forming part of such equipment, shall be connected to earth so as to limit the voltage to ground on these materials.

(3) Bonding of Electrical Equipment.

Normally non-current-carrying conductive materials enclosing electrical conductors or equipment, or forming part of such equipment, shall be connected together and to the electrical supply source in a manner that establishes an effective ground-fault current path.

(4) Bonding of Electrically Conductive Materials and Other Equipment.

Normally non-current-carrying electrically conductive materials that are likely to become energized shall be connected together and to the electrical supply source in a manner that establishes an effective ground-fault current path.

(5) Effective Ground-Fault Current Path.

(a) Opening Overcurrent Protective Device. Electrical equipment and wiring and other electrically conductive material likely to become energized shall be installed in a manner that creates a low-impedance circuit facilitating the operation of the overcurrent device or ground detector for impedance grounded systems. ~~It~~

(b) Carrying Ground-Fault Current. The effective ground-fault current path shall be capable of safely carrying the maximum ground-fault current likely to be imposed on it from any point on the wiring system where a ground fault occurs to the electrical supply source.

(c) Earth Not Suitable as Effective Ground-Fault Current Path. The earth shall not be considered as an effective ground-fault current path.

Supplemental Information

File Name	Description	Approved
NEC_CMP5_FR-8247_250.4_A_.docx		

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Sun Jan 21 08:58:01 EST 2024

Committee Statement

Committee Statement: The language in the subdivision has changed to multiple subdivisions to increase usability of the Code. This complies with 3.5.1.2 of NEC Style Manual.

Response Message: FR-8247-NFPA 70-2024

Public Input No. 3805-NFPA 70-2023 [Section No. 250.4(A)(5)]

(A) Grounded Systems.

(1) Electrical System Grounding.
Electrical systems that are grounded shall be connected to earth in a manner that will limit the voltage imposed by lightning, line surges, or unintentional contact with higher-voltage lines and that will stabilize the voltage to earth during normal operation.

Informational Note No. 1: An important consideration for limiting the imposed voltage is the routing of bonding and grounding electrode conductors so that they are not any longer than necessary to complete the connection without disturbing the permanent parts of the installation and so that unnecessary bends and loops are avoided.

Informational Note No. 2: See NFPA 780-2020, *Standard for the Installation of Lightning Protection Systems,* for information on installation of grounding and bonding for lightning protection systems.

(2) Grounding of Electrical Equipment.
Normally non-current-carrying conductive materials enclosing electrical conductors or equipment, or forming part of such equipment, shall be connected to earth so as to limit the voltage to ground on these materials.

(3) Bonding of Electrical Equipment.
Normally non-current-carrying conductive materials enclosing electrical conductors or equipment, or forming part of such equipment, shall be connected together and to the electrical supply source in a manner that establishes an effective ground-fault current path.

(4) Bonding of Electrically Conductive Materials and Other Equipment.
Normally non-current-carrying electrically conductive materials that are likely to become energized shall be connected together and to the electrical supply source in a manner that establishes an effective ground-fault current path.

(5) Effective Ground-Fault Current Path. [Move text to (a)—(c)]
~~Electrical equipment and wiring and other electrically conductive material likely to become energized shall be installed in a manner that creates a low-impedance circuit facilitating the operation of the overcurrent device or ground detector for impedance grounded systems. It shall be capable of safely carrying the maximum ground-fault current likely to be imposed on it from any point on the wiring system where a ground fault occurs to the electrical supply source. The earth shall not be considered as an effective ground-fault current path.~~

(a) Opening Overcurrent Protective Device. Electrical equipment and wiring and other electrically conductive material likely to become energized shall be installed in a manner that creates a low-impedance circuit facilitating the operation of the overcurrent device or ground detector for impedance grounded systems.

(b) Carrying Ground-Fault Current. ~~It~~ The effective ground-fault current path shall be capable of safely carrying the maximum ground-fault current likely to be imposed on it from any point on the wiring system where a ground fault occurs to the electrical supply source.

(c) Earth Not Suitable as Effective Ground-Fault Current Path. The earth shall not be considered as an effective ground-fault current path.

First Revision No. 8244-NFPA 70-2024 [Section No. 250.4 [Excluding any Sub-Sections]]

The following general requirements identify what grounding and bonding of electrical systems, electrical equipment, and electrically conductive materials are required to accomplish. The prescriptive methods contained in this article shall be followed to comply with the performance requirements of this section.

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Sun Jan 21 08:50:03 EST 2024

Committee Statement

Committee Statement: The parent text of 250.4 is revised to clarify that grounding and bonding applies both to electrical equipment and electrically conductive materials as listed in the subdivisions of 250.4(A) and (B).

Response Message: FR-8244-NFPA 70-2024

Public Input No. 580-NFPA 70-2023 [Section No. 250.4 [Excluding any Sub-Sections]]

First Revision No. 8259-NFPA 70-2024 [Section No. 250.8(A)]

(A) Permitted Methods.

Equipment grounding conductors, grounding electrode conductors, bonding jumpers, and grounding and bonding ~~jumpers~~ terminations shall be connected by one or more of the following means:

(1) Listed pressure connectors

(2) Terminal bars

(3) Pressure connectors listed as grounding and bonding equipment

(4) Exothermic welding process

(5) Machine screw-type fasteners that engage not less than two threads or are secured with a nut

(6) Thread-forming machine screws that engage not less than two threads in the enclosure

(7) Connections that are part of a listed assembly

(8) Other listed means

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Sun Jan 21 09:23:34 EST 2024

Committee Statement

Committee Statement: Adding the term grounding and bonding terminations clarifies the intent of the requirement to apply to the terminations as well as to the conductors.

Response Message: FR-8259-NFPA 70-2024

Public Input No. 186-NFPA 70-2023 [Section No. 250.8(A)]

Public Input No. 2342-NFPA 70-2023 [Section No. 250.8(A)]

First Revision No. 8650-NFPA 70-2024 [Section No. 250.20(B)]

(B) Alternating-Current Systems of 50 Volts to 1000 Volts.

Alternating-current systems of 50 volts to 1000 volts that supply premises wiring and premises wiring systems shall be grounded under any of the following conditions:

(1) If the system can be grounded so that the maximum voltage to ground on the ungrounded conductors does not exceed 150 volts

(2) If the system is 3-phase, 4-wire, wye connected in which the neutral conductor is used as a circuit conductor

(3) If the system is 3-phase, 4-wire, delta connected in which the midpoint of one phase winding is used as a circuit conductor

Informational Note: See NFPA *70E* ~~2021~~ 2024 , *Standard for Electrical Safety in the Workplace*, Annex O, for information on ~~impedance grounding~~ methods to reduce arc-flash hazards.

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Tue Jan 23 09:37:20 EST 2024

Committee Statement

Committee Statement: The Informational Note was revised to latest edition and to add clarity for the reference to Annex O of NFPA 70E.

This action is consistent with the action requested by Global PI-3085 assigned to CMP-1.

Response Message: FR-8650-NFPA 70-2024

First Revision No. 8649-NFPA 70-2024 [Section No. 250.20 [Excluding any Sub-Sections]]

Alternating-current systems shall be grounded in accordance with 250.20(A), (B), (C), or (D), unless prohibited elsewhere in this *Code*. Other systems shall be permitted to be grounded. If such systems are grounded, they shall comply with the applicable provisions of this article.

Informational Note No. 1:~~An example of a system permitted~~ See 250.26(4) for the conductor to be grounded ~~is a corner-grounded delta transformer connection~~ on a three phase, 3-wire, corner grounded system .

Informational Note No. 2: See 503.155, 517.61, 517.160, 668.10, and 680.23(A)(2) for examples of circuits prohibited to be grounded.

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Tue Jan 23 09:35:34 EST 2024

Committee Statement

Committee Statement: The Informational Note was revised to comply with 2.1.10 of the NEC Style Manual.

This action is consistent with the action requested by Global PI-3085 assigned to CMP-1.

Response Message: FR-8649-NFPA 70-2024

First Revision No. 8264-NFPA 70-2024 [Section No. 250.21(C)]

(C) Marking.

Ungrounded systems shall be legibly marked "Caution: Ungrounded System Operating — _____Volts Between Conductors" at the source or first disconnecting means of the system. ~~The marking shall be of sufficient durability to withstand the environment involved.~~

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Sun Jan 21 09:37:54 EST 2024

Committee Statement

Committee Statement: The redundant language is removed in accordance with the NEC Style Manual Section 4.1.1 as the marking requirements for an ungrounded system are required to comply with 110.21(B)(1).

Response Message: FR-8264-NFPA 70-2024

Public Input No. 3190-NFPA 70-2023 [Section No. 250.21(C)]

First Revision No. 8265-NFPA 70-2024 [Section No. 250.24(D)(2)]

(2) Conductors Connected in Parallel in Two or More Raceways or Cables.

If the ungrounded service-entrance conductors are connected in parallel in two or more raceways or cables, the grounded conductors shall also be installed in each raceway or cable and shall be connected in parallel. The size of each grounded conductor(s) in each raceway or cable shall not be smaller than 1/0 AWG and shall be sized in accordance with 250.24(D)(2)(a) or (D)(2)(b) in accordance with 250.24(D)(1).

(a) Shall be based on the largest ungrounded conductor in each raceway or cable.

(b) Shall be based on the sum of the circular mil areas of the largest ungrounded conductors from each set connected in parallel in each raceway or cable.

Informational Note No. 1 : See 310.10(G) for grounded conductors connected in parallel.

Informational Note No. 2: See Informative Annex D, example D14, for information on sizing grounded conductors in parallel applications.

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Sun Jan 21 09:47:15 EST 2024

Committee Statement

Committee Statement: The informational note is added to assist the Code user with locating the new example in Annex D, No. D14 for sizing grounded conductors.

Response Message: FR-8265-NFPA 70-2024

Public Input No. 3963-NFPA 70-2023 [Section No. 250.24(D)(2)]

First Revision No. 8272-NFPA 70-2024 [Section No. 250.25(A)]

(A) Grounded System.

If the utility supply system is grounded, the grounding of systems permitted to be connected on the supply side of the service disconnect and are installed in one or more separate enclosures from the service equipment enclosure shall comply with the requirements of 250.24(A) through 250.24 (~~D~~ E).

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Sun Jan 21 10:05:55 EST 2024

Committee Statement

Committee Statement: The charging text is updated to 250.24(A) through (E) due to the change from 250.24(A)(5) to 250.24(B) during the 2023 NEC cycle.

Response Message: FR-8272-NFPA 70-2024

Public Input No. 3680-NFPA 70-2023 [Section No. 250.25(A)]

Public Input No. 893-NFPA 70-2023 [Section No. 250.25(A)]

First Revision No. 8653-NFPA 70-2024 [Section No. 250.32(A)]

(A) Grounding Electrode System and Grounding Electrode Conductor.

A building(s) or structure(s) supplied by a feeder(s) or branch circuit(s) shall have a grounding electrode system and grounding electrode conductor installed in accordance with ~~Part III of~~ Article 250, Part III .

Exception: A grounding electrode system and grounding electrode conductor shall not be required if only a single branch circuit, including a multiwire branch circuit, supplies the building or structure and the branch circuit includes an equipment grounding conductor for grounding the normally non-current-carrying metal parts of equipment.

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Tue Jan 23 09:43:55 EST 2024

Committee Statement

Committee Statement: The panel has revised the text to comply with the NEC Style Manual, 2023 Section 4.1.4 when referencing specific parts of an article.

Response Message: FR-8653-NFPA 70-2024

Public Input No. 2649-NFPA 70-2023 [Section No. 250.32(A)]

First Revision No. 8285-NFPA 70-2024 [Section No. 250.32(B)(1)]

(1) Supplied by a Feeder or Branch Circuit.

An equipment grounding conductor, as described in 250.118(A) , shall be run with the supply conductors and be connected to the building or structure disconnecting means and to the grounding electrode ~~(s)~~ conductor . The equipment grounding conductor shall be used for grounding or bonding of equipment, structures, or frames required to be grounded or bonded. The equipment grounding conductor shall be sized in accordance with 250.122. Any installed grounded conductor shall not be connected to the equipment grounding conductor or to the grounding electrode(s).

Exception No. 1: For installations made in compliance with previous editions of this Code that permitted such connection, the grounded conductor run with the supply to the building or structure shall be permitted to serve as the ground-fault return path if all of the following requirements continue to be met:

(1) An equipment grounding conductor is not run with the supply to the building or structure.

(2) There are no continuous metallic paths bonded to the grounding system in each building or structure involved.

(3) Ground-fault protection of equipment has not been installed on the supply side of the feeder(s).

If the grounded conductor is used for grounding in accordance with the provision of this exception, the size of the grounded conductor shall not be smaller than the larger of either of the following:

(1) The calculated neutral load in accordance with 220.61

(2) The minimum equipment grounding conductor sized in accordance with 250.122

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 served shall be connected to the equipment grounding conductors, grounding electrode conductor, and the enclosure for the first disconnecting means.

Submitter Information Verification

Committee: NEC-P05
Submittal Date: Sun Jan 21 10:50:52 EST 2024

Committee Statement

Committee Statement: The requirement is modified to clarify that the equipment grounding conductor terminates to the grounding electrode conductor.

The reference to 250.118 was corrected to refer to permitted equipment grounding conductors.

Response Message: FR-8285-NFPA 70-2024

Public Input No. 227-NFPA 70-2023 [Section No. 250.32(B)(1)]

Public Input No. 4533-NFPA 70-2023 [Section No. 250.32(B)(1)]

First Revision No. 8286-NFPA 70-2024 [Section No. 250.32(C)(1)]

(1) Supplied by a Feeder or Branch Circuit.

An equipment grounding conductor, as described in 250.118(A) , shall be installed with the supply conductors and be connected to the building or structure disconnecting means and to the grounding electrode ~~(s)~~ conductor . The grounding electrode(s) shall also be connected to the building or structure disconnecting means.

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Sun Jan 21 10:53:38 EST 2024

Committee Statement

Committee Statement: The requirement is modified to clarify that the equipment grounding conductor terminates to the grounding electrode conductor.

The reference to 250.118 was corrected to refer to permitted equipment grounding conductors.

Response Message: FR-8286-NFPA 70-2024

Public Input No. 228-NFPA 70-2023 [Section No. 250.32(C)(1)]

First Revision No. 8300-NFPA 70-2024 [Section No. 250.32(D)]

(D) Disconnecting Means Located in Separate Building or Structure on the Same Premises.

If one or more disconnecting means supply one or more additional buildings or structures under single management, and where these disconnecting means are located remote from those buildings or structures in accordance with 225.31(B), Exception No. 1 and No. 2, 700.12(D)(4), 701.12(D)(3), or 702.12, all of the following conditions shall be met:

(1) The connection of the grounded conductor to the grounding electrode, to normally non-current-carrying metal parts of equipment, or to the equipment grounding conductor at a separate building or structure shall not be made.

(2) An equipment grounding conductor for grounding and bonding any normally non-current-carrying metal parts of equipment, interior metal piping systems, and building or structural metal frames is run with the circuit conductors to a separate building or structure and connected to ~~existing grounding electrode(s) required in Part III of this article, or, if there are no existing electrodes, the grounding electrode(s) required in Part III of this article shall be installed if a separate building or structure is supplied by more than one branch circuit~~ the grounding electrode conductor .

(3) The connection between the equipment grounding conductor and the grounding electrode conductor at a separate building or structure shall be made in a junction box, panelboard, or similar enclosure located immediately inside or outside the separate building or structure.

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Sun Jan 21 11:11:37 EST 2024

Committee Statement

Committee Statement: The requirement is modified to clarify that the equipment grounding conductor terminates to the grounding electrode conductor.

Response Message: FR-8300-NFPA 70-2024

Public Input No. 229-NFPA 70-2023 [Section No. 250.32(D)]

First Revision No. 8563-NFPA 70-2024 [Section No. 250.35(B)]

(B) Nonseparately Derived System.

If the generator is installed as a nonseparately derived system, and overcurrent protection is not integral with the generator assembly, a supply-side bonding jumper shall be installed between the generator equipment grounding terminal and the equipment grounding terminal, bar, or bus of the disconnecting mean(s). ~~It shall be~~ The supply-side bonding jumper shall be one of the following:

(1) A nonflexible metal raceway

(2) A supply-side bonding jumper of the wire type sized in accordance with 250.102(C) ~~based on the size of the conductors supplied by the generator.~~

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

Supplemental Information

File Name	Description	Approved
NEC_CMP5_FR-8563_250.35_B_.docx		

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Mon Jan 22 16:57:25 EST 2024

Committee Statement

Committee Statement: The requirement is modified to be consistent with allowances for a nonflexible metal raceway or bus to be used as a supply-side bonding jumper for separately derived systems as allowed in 250.30(A)(2). It is changed to a list format for usability.

Response Message: FR-8563-NFPA 70-2024

Public Input No. 3621-NFPA 70-2023 [Section No. 250.35(B)]

(B) Nonseparately Derived System.

If the generator is installed as a nonseparately derived system, and overcurrent protection is not integral with the generator assembly, a supply-side bonding jumper shall be installed between the generator equipment grounding terminal and the equipment grounding terminal, bar, or bus of the disconnecting mean(s). ~~It~~The supply-side bonding jumper shall be ~~sized in accordance with 250.102(C) based on the size~~one of the ~~conductors supplied by the generator.~~following:

(1) A nonflexible metal raceway
(2) A supply-side bonding jumper of the wire type sized in accordance with 250.102(C)
(3) A supply-side bonding jumper of the bus type with a cross-sectional area not smaller than a supply-side bonding jumper of the wire type as determined in 250.102(C)

First Revision No. 8673-NFPA 70-2024 [Section No. 250.36(C)]

(C) System ~~Grounding~~ Neutral Point Connection.

The system neutral point shall not be connected to ground except through the grounding impedance device.

Informational Note No. 1 : See IEEE 3003.1-2019, *Recommended Practice for System Grounding of Industrial and Commercial Power Systems,* for guidance on transient overvoltages.

Informational Note No. 2: The impedance is normally selected to limit the ground-fault current to a value slightly greater than or equal to the capacitive charging current of the system. This value of impedance will also limit transient overvoltages ~~to safe values~~ . ~~For guidance, refer to criteria for limiting transient overvoltages in IEEE 3003.1-2019, *Recommended Practice for System Grounding of Industrial and Commercial Power Systems* .~~

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Tue Jan 23 10:48:40 EST 2024

Committee Statement

Committee Statement: This revision clarifies that the connection is between the neutral point and the grounding electrode. This change makes the language consistent with 250.187. The informational note is revised to meet NEC Style Manual criteria. The phrase in the informational note “to safe values” is removed since safe is an arbitrary value without a technical threshold.

Response Message: FR-8673-NFPA 70-2024

Public Input No. 2125-NFPA 70-2023 [Section No. 250.36(C)]

First Revision No. 8397-NFPA 70-2024 [Section No. 250.36(E)]

(E) Impedance Bonding Jumper.

(1) Connection.

The impedance bonding jumper ~~(the connection between the equipment grounding conductors and the grounding impedance device)~~ shall be an unspliced conductor run from the first system disconnecting means or overcurrent device to the ~~grounded~~ grounding electrode side of the impedance grounding ~~impedance~~ device.

(2) Size.

The impedance bonding jumper shall be sized according to 250.36(B).

Supplemental Information

File Name	Description	Approved
NEC_CMP5_FR-8397_250.36_E_.docx		

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Mon Jan 22 08:27:00 EST 2024

Committee Statement

Committee Statement: This revision consolidates subdivisions 250.36(E) and 250.36(G) for clarity and conciseness. The text is placed into list format for usability. As part of this revision 250.36(G) is deleted in a related action and a new definition for Impedance Bonding Jumper is established allowing the removal of the definition from the existing text. The term grounded is changed to grounding electrode to match the language in the new definition. The impedance bonding jumper carries the same current as the impedance grounding conductor and can be sized in the same method.

Response Message: FR-8397-NFPA 70-2024

Public Input No. 3591-NFPA 70-2023 [Section No. 250.36(E)]

(E) Impedance Bonding Jumper. [Move text to (1)]

~~The impedance bonding jumper (the connection between the equipment grounding conductors and the grounding impedance device) shall be an unspliced conductor run from the first system disconnecting means or overcurrent device to the grounded side of the grounding impedance device.~~

(1) Connection.

The impedance bonding jumper ~~(the connection between the equipment grounding conductors and the grounding impedance device)~~ shall be an unspliced conductor run from the first system disconnecting means or overcurrent device to the ~~grounded~~ grounding electrode side of the impedance grounding ~~impedance~~ device.

(2) Size.

The impedance bonding jumper shall be sized according to 250.36(B).

First Revision No. 8404-NFPA 70-2024 [Section No. 250.36(G)]

~~**(G)** Impedance Bonding Jumper Size.~~

~~The impedance bonding jumper shall be sized in accordance with either of the following:~~

(1) ~~If the grounding electrode conductor connection is made at the grounding impedance device, the equipment bonding jumper shall be sized in accordance with 250.66 , based on the size of the service entrance conductors for a service or the derived phase conductors for a separately derived system.~~

(2) ~~If the grounding electrode conductor is connected at the first system disconnecting means or overcurrent device, the impedance bonding jumper shall be sized the same as the impedance grounding conductor in 250.36(B) .~~

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Mon Jan 22 08:38:12 EST 2024

Committee Statement

Committee Statement: This revision consolidates subdivisions 250.36(E) and 250.36(G) for clarity and conciseness since both refer to the same conductor. As part of this revision 250.36(G) is deleted and a new definition for Impedance Bonding Jumper is established.

Response Message: FR-8404-NFPA 70-2024

Public Input No. 3592-NFPA 70-2023 [Section No. 250.36(G)]

Public Input No. 2130-NFPA 70-2023 [Section No. 250.36(G)]

First Revision No. 8655-NFPA 70-2024 [Section No. 250.36 [Excluding any Sub-Sections]]

Impedance grounded systems in which a grounding impedance device, typically a resistor, limits the ground-fault current shall be permitted for 3-phase ac systems of 480 volts to 1000 volts if all the following conditions are met:

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

(2) Ground detectors are installed on the system.

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

Impedance grounded systems shall comply with 250.36(A) through (G).

Informational Note: See NFPA *70E* ~~2021~~ 2024 , *Standard for Electrical Safety in the Workplace*, Annex O, for information on ~~impedance grounding~~ methods to reduce arc-flash hazards.

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Tue Jan 23 09:46:59 EST 2024

Committee Statement

Committee Statement: The Informational Note was revised latest edition and add clarity for the reference to Annex O of NFPA 70E.

This action is consistent with the action requested by Global PI-3085 assigned to CMP-1.

Response Message: FR-8655-NFPA 70-2024

First Revision No. 8681-NFPA 70-2024 [Section No. 250.52(A)(3)]

(3) Concrete-Encased Electrode.

A concrete-encased electrode shall consist of at least 6.0 m (20 ft) of either of the following:

(1) One or more bare or zinc galvanized or other electrically conductive coated rebar of not less than 13 mm (½ in.) in diameter, installed in one continuous 6.0 m (20 ft) length, or if in multiple pieces, the rebar shall be connected together by steel tie wires, exothermic welding, welding, or other effective means to create a 6.0 m (20 ft) or greater length

(2) Bare copper conductor not smaller than 4 AWG

Metal components shall be encased by at least 50 mm (2 in.) of concrete and shall be located horizontally within that portion of a concrete foundation or footing that is in direct contact with the earth or within vertical foundations or structural components or members that are in direct contact with the earth. If multiple concrete-encased electrodes are present at a building or structure, it shall be permissible to bond only one into the grounding electrode system.

~~Informational Note: Concrete installed with insulation, vapor barriers, films, or similar items separating the concrete from the earth is not considered to be in "direct contact" with the earth.~~

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Tue Jan 23 11:13:02 EST 2024

Committee Statement

Committee Statement: The current language of the informational note contains mandatory language, contains requirements, and makes interpretations which are not permitted by 2.10.2.1 of the NEC Style Manual.

Response Message: FR-8681-NFPA 70-2024

First Revision No. 8372-NFPA 70-2024 [Section No. 250.53(A)(4)]

(4) Rod and Pipe Electrodes.

The electrode shall be installed such that at least 2.44 m (8 ft) of length is in contact with the soil. ~~It shall be driven to a depth of not less than 2.44 m (8 ft) except that, where~~ If necessary, when rock bottom is encountered it shall comply with the following:

(1) The electrode shall be driven such that it is vertically in contact with the soil for a minimum length of 2.44 m (8 ft)

Exception No. 1: If rock bottom is encountered, the electrode shall be driven at an oblique angle not to exceed 45 degrees from the vertical

~~or, where~~

.

Exception No. 2: If rock bottom is encountered at an angle up to 45 degrees, the electrode shall be permitted to be buried in a trench that is at least

~~750 mm~~
750 mm (

~~30 in~~
30 in .) deep.

(2) The upper end of the electrode shall be flush with or below ground level unless the aboveground end and the grounding electrode conductor attachment are protected against physical damage as specified in 250.10 .

Supplemental Information

File Name	Description	Approved
NEC_CMP5_FR-8372_250.53_A_4_.docx		
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Submitter Information Verification

Committee: NEC-P05
Submittal Date: Sun Jan 21 16:19:51 EST 2024

Committee Statement

Committee Statement: The wording was revised into a list format for usability.
Response Message: FR-8372-NFPA 70-2024

Public Input No. 3813-NFPA 70-2023 [Section No. 250.53(A)(4)]

[250.53(A)(4)]
(4) Rod and Pipe Electrodes.
The electrode shall be installed such that at least 2.44 m (8 ft) of length is in contact with the soil. If necessary, when rock bottom is encountered it shall comply with the following:

(1) The electrode~~It~~ shall be driven such that it is vertically in contact with the soil for a minimum length of~~to a depth of not less than~~ 2.44 m (8 ft).
Exception No. 1: ~~except that, where~~If rock bottom is encountered, the electrode shall be driven at an oblique angle not to exceed 45 degrees from the vertical.
Exception No. 2: ~~or, where~~ If rock bottom is encountered at an angle up to 45 degrees, the electrode shall be permitted to be buried in a trench that is at least 750 mm (30 in.) deep.
(2) The upper end of the electrode shall be flush with or below ground level unless the aboveground end and the grounding electrode conductor attachment are protected against physical damage as specified in 250.10.

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First Revision No. 8375-NFPA 70-2024 [Section No. 250.53(C)]

(C)– Grounding Electrode Bonding Jumper.

The bonding jumper(s) used to connect the grounding electrodes together to form the grounding electrode system shall be installed in accordance with 250.64(A), (B), and (E), shall be sized in accordance with 250.66, and shall be connected in the manner specified in 250.70. Rebar shall not be used as a conductor to interconnect the electrodes of grounding electrode systems.

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Sun Jan 21 16:29:54 EST 2024

Committee Statement

Committee Statement: The words “grounding electrode” were added to be consistent with the terms used in 250.53(E) and 250.64(B)(4).

Response Message: FR-8375-NFPA 70-2024

Public Input No. 2317-NFPA 70-2023 [Section No. 250.53(C)]

First Revision No. 8571-NFPA 70-2024 [Section No. 250.64(C)]

(C) Continuous.

Except as provided in 250.30(A)(5) and (A)(6), 250.30(B)(1), and 250.68(C), grounding electrode conductor(s) shall be installed in one continuous length without a splice or joint. ~~If necessary, splices~~ Splices or connections shall be ~~made as permitted in~~ permitted to be made by any of the following:

(1) Splicing of the wire-type grounding electrode conductor shall be permitted ~~only~~ by irreversible compression-type connectors listed as grounding and bonding equipment or by the exothermic welding process.

(2) Where the splice is made at an accessible location, the splice of the wire-type grounding electrode conductor shall be permitted by listed grounding and bonding equipment.

(3) Sections of busbars shall be permitted to be connected together to form a grounding electrode conductor.

(4) Bolted, riveted, or welded connections of structural metal frames of buildings or structures.

(5) Threaded, welded, brazed, soldered or bolted-flange connections of metal water piping.

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Mon Jan 22 17:17:59 EST 2024

Committee Statement

Committee Statement: The requirement is revised to allow the splicing of grounding electrode conductors with listed grounding and bonding equipment to be used where the splice is made at an accessible location. Splicing by exothermic welding process and irreversible compression-type connectors is still permitted for accessible or non-accessible locations.

Response Message: FR-8571-NFPA 70-2024

First Revision No. 8318-NFPA 70-2024 [Section No. 250.64(D)(1)]

(1) Common Grounding Electrode Conductor and Taps.

A common grounding electrode conductor and grounding electrode conductor taps shall be installed as permitted by 250 .64(D)(1)(a) and (D)(1)(b).

(a) Common Grounding Electrode Conductor. The common grounding electrode conductor shall be sized in accordance with 250.66, based on the sum of the circular mil area of the largest ungrounded conductor(s) of each set of conductors that supplies the disconnecting means. If the service-entrance conductors connect directly to the overhead service conductors, service drop, underground service conductors, or service lateral, the common grounding electrode conductor shall be sized in accordance with Table 250.66, note 1.

(b) Grounding Electrode Conductor Taps. A grounding electrode conductor tap shall extend to the inside of each disconnecting means enclosure. The grounding electrode conductor taps shall be sized in accordance with 250.66 for the largest service-entrance or feeder conductor serving the individual enclosure. The tap conductors shall be connected to the common grounding electrode conductor by one of the following methods in such a manner that the common grounding electrode conductor remains without a splice or joint:

(1) Exothermic welding.

(2) Connectors listed as grounding and bonding equipment.

(3) Connections to an aluminum or copper busbar not less than 6 mm thick × 50 mm wide (¼ in. thick × 2 in. wide) and of a length to accommodate the number of terminations necessary for the installation. The busbar shall be securely fastened and shall be installed in an accessible location. Connections shall be made by a listed connector or by the exothermic welding process. If aluminum busbars are used, the installation shall comply with 250.64(A).

Supplemental Information

File Name	Description	Approved
NEC_CMP5_FR-8318_250.64_D_1_.docx		

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Sun Jan 21 13:17:53 EST 2024

Committee Statement

Committee Statement: The section is revised to multiple subdivisions for compliance with NEC Style Manual 3.5.2.

Response Message: FR-8318-NFPA 70-2024

Public Input No. 3821-NFPA 70-2023 [Section No. 250.64(D)(1)]

(1) Common Grounding Electrode Conductor and Taps. [Move text to (a) and (b)]
A common grounding electrode conductor and grounding electrode conductor taps shall be installed as permitted by 250.64(D)(1)(a) and 250.64(D)(1)(b) . ~~The common grounding electrode conductor shall be sized in accordance with 250.66, based on the sum of the circular mil area of the largest ungrounded conductor(s) of each set of conductors that supplies the disconnecting means. If the service-entrance conductors connect directly to the overhead service conductors, service drop, underground service conductors, or service lateral, the common grounding electrode conductor shall be sized in accordance with Table 250.66, note 1.~~

~~A grounding electrode conductor tap shall extend to the inside of each disconnecting means enclosure. The grounding electrode conductor taps shall be sized in accordance with 250.66 for the largest service-entrance or feeder conductor serving the individual enclosure. The tap conductors shall be connected to the common grounding electrode conductor by one of the following methods in such a manner that the common grounding electrode conductor remains without a splice or joint:~~

~~1. Exothermic welding.~~
~~2. Connectors listed as grounding and bonding equipment.~~
~~3.~~1. ~~Connections to an aluminum or copper busbar not less than 6 mm thick × 50 mm wide (1⁄4 in. thick × 2 in. wide) and of a length to accommodate the number of terminations necessary for the installation. The busbar shall be securely fastened and shall be installed in an accessible location. Connections shall be made by a listed connector or by the exothermic welding process. If aluminum busbars are used, the installation shall comply with 250.64(A).~~

(a) Common Grounding Electrode Conductor. The common grounding electrode conductor shall be sized in accordance with 250.66, based on the sum of the circular mil area of the largest ungrounded conductor(s) of each set of conductors that supplies the disconnecting means. If the service-entrance conductors connect directly to the overhead service conductors, service drop, underground service conductors, or service lateral, the common grounding electrode conductor shall be sized in accordance with Table 250.66, note 1.

(b) Grounding Electrode Conductor Taps. A grounding electrode conductor tap shall extend to the inside of each disconnecting means enclosure. The grounding electrode conductor taps shall be sized in accordance with 250.66 for the largest service-entrance or feeder conductor serving the individual enclosure. The tap conductors shall be connected to the common grounding electrode conductor by one of the following methods in such a manner that the common grounding electrode conductor remains without a splice or joint:

1. Exothermic welding.
2. Connectors listed as grounding and bonding equipment.
3. Connections to an aluminum or copper busbar not less than 6 mm thick × 50 mm wide (1⁄4 in. thick × 2 in. wide) and of a length to accommodate the number of terminations necessary for the installation. The busbar shall be securely fastened and shall be installed in an accessible location. Connections shall be made by a listed connector or by the

exothermic welding process. If aluminum busbars are used, the installation shall comply with 250.64(A).

First Revision No. 8320-NFPA 70-2024 [Section No. 250.64(E)(1)]

(1) General.

Ferrous metal raceways, enclosures, and cable armor for grounding electrode conductors shall be electrically continuous from the point of attachment to cabinets or equipment to the grounding electrode and shall be securely fastened to the ground clamp or fitting. Ferrous metal raceways, enclosures, and cable armor shall be bonded at each end of the raceway, cable armor, or enclosure to the grounding electrode or grounding electrode conductor to create an electrically parallel path. Nonferrous metal raceways, enclosures, and cable armor shall not be required to be electrically continuous.

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Sun Jan 21 13:21:03 EST 2024

Committee Statement

Committee Statement: The term cable armor is added to clarify that the bonding requirement for ferrous cable armor applies to both ends of the cable armor.

Response Message: FR-8320-NFPA 70-2024

Public Input No. 102-NFPA 70-2023 [Section No. 250.64(E)(1)]

First Revision No. 8323-NFPA 70-2024 [Section No. 250.64(G)]

(G) Enclosures with Ventilation, Mounting, or Drainage Openings.

Grounding electrode conductors shall not be installed through a ventilation, mounting, or drainage opening of an enclosure.

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Sun Jan 21 13:30:08 EST 2024

Committee Statement

Committee Statement: The requirement is revised to clarify that grounding electrode conductors are not to be installed through mounting and drainage openings as those are not intended for the installation of a grounding electrode conductor but for mounting and drainage purposes.

Response Message: FR-8323-NFPA 70-2024

Public Input No. 1084-NFPA 70-2023 [Section No. 250.64(G)]

First Revision No. 8384-NFPA 70-2024 [Section No. 250.70]

250.70 Methods of Grounding and Bonding Conductor Connection to Electrodes.

(A) General.

Ground clamps shall be listed for both the grounding electrode and the grounding electrode conductor materials. Not more than one conductor shall be connected to the grounding electrode by a single clamp or fitting unless the clamp or fitting is listed for multiple conductors.

(1) Connections

The grounding or bonding conductor shall be connected to the grounding electrode by

~~exothermic welding, listed lugs, listed pressure connectors, listed clamps, or other listed means.~~

any of the following means:

(1) Exothermic welding.

(2) Listed lugs.

(3) Listed pressure connectors.

(4) Listed clamps.

(5) Other listed means.

Connections depending on solder shall not be used.

(2) Ground clamps

~~shall be listed for the materials of the grounding electrode and the grounding electrode conductor and, if~~

for Direct Burial or Concrete Encasement.

Ground clamps used on pipe, rod, or other buried electrodes, shall also be listed for direct soil burial or concrete encasement.

~~Not more than one conductor shall be connected to the grounding electrode by a single clamp or fitting unless the clamp or fitting is listed for multiple conductors~~

Informational Note: Listed ground clamps that are identified for direct burial are also suitable for concrete encasement .

(B) Indoor Communications Systems.

For indoor communications purposes only, a listed sheet metal strap-type ground clamp having a rigid metal base that seats on the electrode and having a strap of such material and dimensions that it is not likely to stretch during or after installation shall be permitted.

~~Informational Note: Listed ground clamps that are identified for direct burial are also suitable for concrete encasement.~~

Supplemental Information

File Name	Description	Approved
NEC_CMP5_FR-8384_250.70.docx		
NEC_CMP5_FR-8384_250.70.docx	For prod use	

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Sun Jan 21 16:55:54 EST 2024

Committee Statement

Committee Statement: The wording was separated into a list format and titles were added to improve usability.

The informational Note was relocated after 250.70(A) because it applies to that subdivision.

Response Message: FR-8384-NFPA 70-2024

Public Input No. 4448-NFPA 70-2023 [Section No. 250.70]

Public Input No. 3825-NFPA 70-2023 [Section No. 250.70(A)]

250.70 Methods of Grounding and Bonding Conductor Connection to Electrodes.

(A) General.

Ground clamps shall be listed for both the grounding electrode and the grounding electrode conductor materials. Not more than one conductor shall be connected to the grounding electrode by a single clamp or fitting unless the clamp or fitting is listed for multiple conductors.

(1) Connections.

The grounding or bonding conductor shall be connected to the grounding electrode by any of the following means:

(1) ~~,~~ Eexothermic welding.
(2) ~~,~~ Listed lugs.~~,~~
(3) ~~,~~ Listed pressure connectors.~~,~~
(4) ~~,~~ Listed clamps.~~, or~~
(5) ~~a~~Other listed means.

Connections depending on solder shall not be used.

(2) Ground Clamps for Direct Burial or Concrete Encasement.

Ground clamps ~~shall be listed for the materials of the grounding electrode and the grounding electrode conductor and, if~~ used on pipe, rod, or other buried electrodes, shall also be listed for direct soil burial or concrete encasement. ~~Not more than one conductor shall be connected to the grounding electrode by a single clamp or fitting unless the clamp or fitting is listed for multiple conductors.~~

Informational Note: Listed ground clamps that are identified for direct burial are also suitable for concrete encasement.

(B) Indoor Communications Systems.

For indoor communications purposes only, a listed sheet metal strap-type ground clamp having a rigid metal base that seats on the electrode and having a strap of such material and dimensions that it is not likely to stretch during or after installation shall be permitted.

~~Informational Note: Listed ground clamps that are identified for direct burial are also suitable for concrete encasement.~~

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First Revision No. 8767-NFPA 70-2024 [Section No. 250.94(A)]

(A) The Intersystem Bonding Termination Device.

An intersystem bonding termination (IBT) for connecting intersystem bonding conductors shall be provided external to enclosures at the service equipment or metering equipment enclosure and at the disconnecting means for any buildings or structures that are supplied by a feeder or branch circuit. If an IBT is used, it shall comply with the following:

(1) Be accessible for connection and inspection

(2) Consist of a set of terminals with the capacity for connection of not less than three intersystem bonding conductors

(3) Not interfere with opening the enclosure for a service, building or structure disconnecting means, or metering equipment

(4) Be securely mounted as follows:~~At the service equipment, to~~

a. Connected to any of the following at the service equipment:

1. a metal enclosure for the service equipment

~~, to~~

2. a metal meter enclosure

~~, or to~~

3. an exposed nonflexible metal service raceway

~~, or be connected to~~

4. the metal enclosure for

~~the~~
a grounding electrode conductor with a minimum

~~6 AWG~~
6 AWG copper conductor

~~At the~~
5. a minimum 6 AWG copper grounding electrode conductor and attached to a building or structure.

b. To any of the following at the disconnecting means for a building or structure that is supplied by a feeder or branch circuit

~~, be electrically connected to~~
:

1. the metal enclosure for the building or structure disconnecting means

~~, or be connected to~~

2. the metal enclosure for

~~the~~
grounding electrode conductor with a

~~minimum 6 AWG copper conductor~~
minimim 6 AWG copper conductor

3. a minimum 6 AWG copper grounding electrode conductor and attached to a building or structure.

(1) Be listed as grounding and bonding equipment

Exception: In existing buildings or structures, if any of the intersystem bonding and grounding electrode conductors required by 770.100(B)(2), 800.100(B)(2), 810.21(F)(2), and 820.100 exist, installation of an IBT shall not be required. An accessible means external to enclosures for connecting intersystem bonding and grounding electrode conductors shall be permitted at the service equipment and at the disconnecting means for any buildings or structures that are

supplied by a feeder or branch circuit by at least one of the following means:

(1) Exposed nonflexible metal raceways

(2) An exposed grounding electrode conductor

(3) Approved means for the external connection of a copper or other corrosion-resistant bonding or grounding electrode conductor to the grounded raceway or equipment

Informational Note: See 770.100, 800.100, 810.21, and 820.100 for intersystem bonding and grounding requirements for conductive optical fiber cables, communications circuits, radio and television equipment, CATV circuits, and network-powered broadband communications systems, respectively.

Supplemental Information

File Name	Description	Approved
NEC_CMP5_FR-8767_250.94_A_4_.docx		
NEC_CMP5_FR-8767_250.94_A_4.docx	For prod use	

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Tue Jan 23 15:24:21 EST 2024

Committee Statement

Committee Statement: The additional language is added to permit the commonly used Intersystem Bonding Termination device mounted directly to a building or structure. Text is arranged in list format to comply with the style manual and for clarity.

Response Message: FR-8767-NFPA 70-2024

Public Input No. 2339-NFPA 70-2023 [Section No. 250.94(A)]

[250.94]
(A) The Intersystem Bonding Termination Device.

An intersystem bonding termination (IBT) for connecting intersystem bonding conductors shall be provided external to enclosures at the service equipment or metering equipment enclosure and at the disconnecting means for any buildings or structures that are supplied by a feeder or branch circuit. If an IBT is used, it shall comply with the following:

(1) Be accessible for connection and inspection

(2) Consist of a set of terminals with the capacity for connection of not less than three intersystem bonding conductors

(3) Not interfere with opening the enclosure for a service, building or structure disconnecting means, or metering equipment

(4) Be securely mounted as follows:

a. Connected to any of the following ~~A~~at the service equipment:

1. ~~, to~~ a metal enclosure for the service equipment~~, to~~

2. a metal meter enclosure~~, or to~~

3. an exposed nonflexible metal service raceway~~, or~~

4. ~~be connected to~~ the metal enclosure for ~~the~~ a grounding electrode conductor with a minimum 6 AWG copper conductor

5. a minimum 6 AWG copper grounding electrode conductor and attached to a building or structure.

b. To any of the following at~~At~~ the disconnecting means for a building or structure that is supplied by a feeder or branch circuit:

~~,~~1. ~~be electrically connected to~~ the metal enclosure for the building or structure disconnecting means~~, or be connected to~~

2. the metal enclosure for ~~the~~ a grounding electrode conductor with a minimum 6 AWG copper conductor

3. a minimum 6 AWG copper grounding electrode conductor and attached to a building or structure.

(5) Be listed as grounding and bonding equipment

Exception: In existing buildings or structures, if any of the intersystem bonding and grounding electrode conductors required by 770.100(B)(2), 800.100(B)(2), 810.21(F)(2), and 820.100 exist, installation of an IBT shall not be required. An accessible means external to enclosures for connecting intersystem bonding and grounding electrode conductors shall be permitted at the service equipment and at the disconnecting means for any buildings or structures that are supplied by a feeder or branch circuit by at least one of the following means:

(1) Exposed nonflexible metal raceways

(2) An exposed grounding electrode conductor

(3) Approved means for the external connection of a copper or other corrosion-resistant bonding or grounding electrode conductor to the grounded raceway or equipment

Informational Note: See 770.100, 800.100, 810.21, and 820.100 for intersystem bonding and grounding requirements for conductive optical fiber cables, communications circuits, radio and television equipment, CATV circuits, and network-powered broadband communications systems, respectively.

First Revision No. 8467-NFPA 70-2024 [Section No. 250.96(B)]

(B) Isolated Grounding Circuits.

~~If installed for the reduction of electromagnetic interference on the grounding circuit, an~~ An equipment enclosure supplied by a branch circuit shall be permitted to be isolated from a raceway containing circuits supplying only that equipment by one or more listed nonmetallic raceway fittings located at the point of attachment of the raceway to the equipment enclosure. The metal raceway shall comply with this article and shall be supplemented by an internal insulated equipment grounding conductor installed in accordance with 250.146(D) to ground the equipment enclosure.

Informational Note: Use of an isolated equipment grounding conductor does not relieve the requirement for ~~grounding the raceway system~~ an effective ground-fault current path .

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Mon Jan 22 12:29:20 EST 2024

Committee Statement

Committee Statement: An effective ground fault current path is required regardless of the reason for isolation of equipment.

The informational note is modified to better reflect its purpose.

Response Message: FR-8467-NFPA 70-2024

Public Input No. 3867-NFPA 70-2023 [Section No. 250.96(B)]

First Revision No. 8469-NFPA 70-2024 [Section No. 250.102(A)]

(A) Material.

Bonding jumpers shall be of copper, aluminum, copper-clad aluminum, or other corrosion-resistant material. A bonding jumper shall be a wire, bus, screw, non-flexible metal raceway and fittings, or similar suitable conductor.

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Mon Jan 22 12:32:05 EST 2024

Committee Statement

Committee Statement: Non-flexible metal raceway and fittings is added to coordinate with 250.30(A)(2).

Response Message: FR-8469-NFPA 70-2024

Public Input No. 3487-NFPA 70-2023 [Section No. 250.102(A)]

Public Input No. 3626-NFPA 70-2023 [Section No. 250.102(C)]

First Revision No. 8471-NFPA 70-2024 [Section No. 250.102(C)(2)]

(2) Size for Parallel Conductor Installations in Two or More Raceways or Cables.

If the ungrounded supply conductors are connected in parallel in two or more raceways or cables, the supply-side bonding jumper shall be sized in accordance with either of the following:

(1) An individual bonding jumper for each raceway or cable shall be selected from Table 250.102(C)(1) based on the size of the largest ungrounded supply conductor in each raceway or cable.

(2) A single bonding jumper installed for bonding two or more raceways or cables shall be sized in accordance with Table 250.102(C)(1) based on the sum of the circular mil areas of the largest ungrounded conductors from each set connected in parallel in each raceway or cable. The size of the grounded conductor(s) in each raceway or cable shall be based on the largest ungrounded conductor in each raceway or cable, or the sum of the circular mil areas of the largest ungrounded conductors from each set connected in parallel in each raceway or cable.

Informational Note No. 1: The term *supply conductors* includes ungrounded conductors that do not have overcurrent protection on their supply side and terminate at service equipment or the first disconnecting means of a separately derived system.

Informational Note No. 2: See Chapter 9, Table 8, for the circular mil area of conductors 18 AWG through 4/0 AWG.

Table 250.102(C)(1) Grounded Conductor, Main Bonding Jumper, System Bonding Jumper, and Supply-Side Bonding Jumper for Alternating-Current Systems

Size of Largest Ungrounded Conductor or Equivalent Area for Parallel Conductors (AWG/kcmil)		Size of Grounded Conductor or Bonding Jumper (AWG/kcmil)	
Copper	Aluminum or Copper-Clad Aluminum	Copper	Aluminum or Copper-Clad Aluminum
2 or smaller	1/0 or smaller	8	6
1 or 1/0	2/0 or 3/0	6	4
2/0 or 3/0	4/0 or 250	4	2
Over 3/0 through 350	Over 250 through 500	2	1/0
Over 350 through 600	Over 500 through 900	1/0	3/0
Over 600 through 1100	Over 900 through 1750	2/0	4/0
Over 1100	Over 1750	See Notes 1 and 2.	

Notes:

1. If the circular mil area of ungrounded supply conductors that are connected in parallel is larger than 1100 kcmil copper or 1750 kcmil aluminum, the grounded conductor or bonding jumper shall have an area not less than 12½ percent of the area of the largest ungrounded supply conductor or equivalent area for parallel supply conductors.

2. The grounded conductor or bonding jumper shall not be required to be larger than the largest ungrounded conductor or set of ungrounded conductors.

~~2~~ 3. If the circular mil area of ungrounded supply conductors that are connected in parallel is larger than 1100 kcmil copper or 1750 kcmil aluminum and if the ungrounded supply conductors and the bonding jumper are of different materials (copper, aluminum, or copper-clad aluminum), the minimum size of the grounded conductor or bonding jumper shall be based on the assumed use of ungrounded supply conductors of the same material as the grounded conductor or bonding jumper that has an ampacity equivalent to that of the installed ungrounded supply conductors.

~~3~~ 4. If there are no service-entrance conductors, the supply conductor size shall be determined

by the equivalent size of the largest service-entrance conductor required for the load to be served.

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Mon Jan 22 12:34:48 EST 2024

Committee Statement

Committee Statement: Editorial change to separate out distinct parts to comply with the NEC Style Manual 3.5.1.2

Response Message: FR-8471-NFPA 70-2024

Public Input No. 3216-NFPA 70-2023 [Section No. 250.102(C)]

First Revision No. 8473-NFPA 70-2024 [Section No. 250.104(A)(2)]

(2) Buildings of Multiple Occupancy.

In buildings of multiple occupancy where the metal water piping system(s) installed in or attached to a building or structure for the individual occupancies is metallically isolated from all other occupancies by use of nonmetallic water piping or insulating fittings , the metal water piping system(s) for each occupancy shall be permitted to be bonded to the equipment grounding terminal of the switchgear, switchboard, or panelboard enclosure (other than service equipment) supplying that occupancy. The bonding jumper shall be sized in accordance with 250.102(D).

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Mon Jan 22 12:39:52 EST 2024

Committee Statement

Committee Statement: There are non-electrical metal water piping fittings that may not provide the bonding required by the NEC and have not been evaluated for grounding continuity.

Response Message: FR-8473-NFPA 70-2024

Public Input No. 3486-NFPA 70-2023 [Section No. 250.104(A)(2)]

First Revision No. 8534-NFPA 70-2024 [Section No. 250.109]

250.109 Metal and Nonmetallic Enclosures.

Metal enclosures shall be permitted as part of the effective ground fault current path in accordance with 250.109(A). Nonmetallic boxes and enclosures installed with metal wiring methods shall be installed in accordance with 250.109(B).

(A) Metal Enclosures. Metal enclosures shall be permitted to be used to connect bonding jumpers or equipment grounding conductors, or both, together to become a part of an effective ground-fault current path. If installed, metal covers, plaster rings, extension rings, and metal fittings shall be attached to these metal enclosures to ensure an effective ground-fault current path or shall be connected with bonding jumpers or equipment grounding conductors, or both.

Informational Note: See 250.97 for bonding requirements for over 250 volts to ground.

(B) Nonmetallic Boxes and Enclosures Installed with Metallic Wiring Methods

Nonmetallic boxes and enclosures installed with metal raceways or metal armored cable shall comply with 250.109(B)(1)and 250.109(B)(2).

(1) Bonding.

Nonmetallic Boxes and Enclosures using metal wiring methods shall comply with 250.109(B)(1)(a) or 250.109(B)(1)(b).

(a) A listed nonmetallic box or enclosure with integral bonding means to interconnect all metallic raceway or cable armor entries and provide bonding for any metal cover installed shall not be required to have additional bonding means or equipment bonding jumpers installed.

(b) Nonmetallic boxes and enclosures installed with metallic wiring methods shall have bonding means and equipment bonding jumpers installed for each metal raceway or metal armored cable entry to ensure continuity of the metal wiring method and effective ground fault current path.

(2) Metal Covers.

Metal covers installed on nonmetallic enclosures shall have an equipment bonding jumper or other bonding means installed from the metal cover to the bonding means provided for the metal raceway or cable armor.

Exception: A nonmetallic box or enclosure that is supplied by a single metal raceway or single metal armored cable shall not be required to have bonding where all the following conditions are met:

1. There are no other metal raceways, or armored type cables entering the box or enclosure.

2. The supply end of the metal raceway or metal armored cable is bonded meeting the requirements of 250.86.

3. There is a wire type equipment grounding conductor sized in accordance with 250.122 installed in the metal raceway or armored cable, or an equipment bonding jumper attached to the metal raceway or metal sheathed cable that complies with 250.118, connected to the equipment or device to complete the effective ground fault current path.

4. The conductors installed in the metal raceway or armored cable are not service conductors, grounding electrode conductors, or bonding jumpers interconnecting grounding electrodes.

5. The installation complies with 314.29 for accessibility.

Supplemental Information

File Name	Description	Approved
NEC_CMP5_FR-8534_250.109.docx		
NEC_CMP5_FR-8534_250.109.docx	For prod use	

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Mon Jan 22 15:42:54 EST 2024

Committee Statement

Committee Statement: Separated distinct parts out to comply with the NEC Style Manual 3.5.1.2

This FR will provide additional guidance for installation of metal raceways systems into non-metallic boxes or enclosures which is now commonly being seen in the field.

Response Message: FR-8534-NFPA 70-2024

Public Input No. 1768-NFPA 70-2023 [Section No. 250.109]

Public Input No. 3470-NFPA 70-2023 [Section No. 250.109]

250.109 Metal and Nonmetallic Enclosures.

Metal enclosures shall be permitted as part of the effective ground fault current path in accordance with 250.109(A). Nonmetallic boxes and enclosures installed with metal wiring methods shall be installed in accordance with 250.109(B).

(A) Metal Enclosures.
Metal enclosures shall be permitted to be used to connect bonding jumpers or equipment grounding conductors, or both, together to become a part of an effective ground-fault current path. If installed, metal covers, plaster rings, extension rings, and metal fittings shall be attached to these metal enclosures to ensure an effective ground-fault current path or shall be connected with bonding jumpers or equipment grounding conductors, or both.

Informational Note: See 250.97 for bonding requirements for over 250 volts to ground.

(B) Nonmetallic Boxes and Enclosures Installed with Metallic Wiring Methods.
Nonmetallic boxes and enclosures installed with metal raceways or metal armored cable shall comply with 250.109(B)(1)and 250.109(B)(2).

(1) Bonding.
Nonmetallic Boxes and Enclosures using metal wiring methods shall comply with 250.109(B)(1)(a) or 250.109(B)(1)(b).

(a) A listed nonmetallic box or enclosure with integral bonding means to interconnect all metallic raceway or cable armor entries and provide bonding for any metal cover installed shall not be required to have additional bonding means or equipment bonding jumpers installed.
(b) Nonmetallic boxes and enclosures installed with metallic wiring methods shall have bonding means and equipment bonding jumpers installed for each metal raceway or metal armored cable entry to ensure continuity of the metal wiring method and effective ground fault current path.

(2) Metal Covers.
Metal covers installed on nonmetallic enclosures shall have an equipment bonding jumper or other bonding means installed from the metal cover to the bonding means provided for the metal raceway or cable armor.

Exception: A nonmetallic box or enclosure that is supplied by a single metal raceway or single metal armored cable shall not be required to have bonding where all the following conditions are met:
1. There are no other metal raceways, or armored type cables entering the box or enclosure.
2. The supply end of the metal raceway or metal armored cable is bonded meeting the requirements of 250.86.
3, There is a wire type equipment grounding conductor sized in accordance with 250.122 installed in the metal raceway or armored cable, or an equipment bonding jumper attached to the metal raceway or metal sheathed cable that complies with 250.118, connected to the equipment or device to complete the effective ground fault current path.
4. The conductors installed in the metal raceway or armored cable are not service conductors, grounding electrode conductors, or bonding jumpers interconnecting grounding electrodes.

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5. The installation complies with 314.29 for accessibility.

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First Revision No. 8686-NFPA 70-2024 [Section No. 250.112(J)]

(J) Luminaires.

Luminaires as provided in ~~Part V of~~ Article 410, Part V .

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Tue Jan 23 11:20:16 EST 2024

Committee Statement

Committee Statement: The panel has revised the text to comply with 4.1.4 of the NEC Style Manual, 2023 when referencing specific parts of an article.

Response Message: FR-8686-NFPA 70-2024

Public Input No. 2650-NFPA 70-2023 [Section No. 250.112(J)]

First Revision No. 8688-NFPA 70-2024 [Section No. 250.116]

250.116 Nonelectrical Equipment.

The metal parts of the following nonelectrical equipment described in this section shall be connected to the equipment grounding conductor:

(1) Frames and tracks of electrically operated cranes and hoists

(2) Frames of nonelectrically driven elevator cars to which electrical conductors are attached

(3) Hand-operated metal shifting ropes or cables of electric elevators

~~Informational Note: If extensive metal in or on buildings or structures may become energized and is subject to personal contact, adequate bonding and grounding will provide additional safety.~~

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Tue Jan 23 11:21:30 EST 2024

Committee Statement

Committee Statement: The Informational Note was removed as it did not provide enough information or clarity to be useful.

This action is consistent with the action requested by Global PI-3085 assigned to CMP-1.

Response Message: FR-8688-NFPA 70-2024

First Revision No. 8692-NFPA 70-2024 [Section No. 250.118]

250.118 Types of Equipment Grounding Conductors.

(A) Permitted.

Each equipment grounding conductor run with or enclosing the circuit conductors shall be one or more, or a combination of the following, as a part of an effective ground-fault path :

(1) A copper, aluminum, or copper-clad aluminum conductor. This conductor shall be solid or stranded; insulated, covered, or bare; and in the form of a wire or a busbar of any shape.

(2) Rigid metal conduit.

(3) Intermediate metal conduit.

(4) Electrical metallic tubing.

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

(6) The conduit is terminated in listed fittings.

(7) The circuit conductors contained in the conduit are protected by overcurrent devices rated at 20 amperes or less.

(8) The size of the conduit does not exceed metric designator 35 (trade size 1 1/4).

(9) The combined length of flexible metal conduit, flexible metallic tubing, and liquidtight flexible metal conduit in the same effective ground-fault current path

~~does~~

a. shall not exceed 1.8 m (6 ft).

b. If flexibility is necessary to minimize the transmission of vibration from equipment or to provide flexibility for equipment that requires movement after installation, a wire-type equipment grounding conductor or a bonding jumper in accordance with 250.102(E)(2) shall be installed.

c. If flexible metal conduit is constructed of stainless steel, a wire-type equipment grounding conductor or bonding jumper in accordance with 250.102(E)(2) shall be installed.

(10) Listed liquidtight flexible metal conduit meeting all the following conditions:

(11) The conduit is terminated in listed fittings.

(12) For metric designators 12 through 16 (trade sizes 3/8 through 1/2), the circuit conductors contained in the conduit are protected by overcurrent devices rated at 20 amperes or less.

(13) For metric designators 21 through 35 (trade sizes 3/4 through 1 1/4), the circuit conductors contained in the conduit are protected by overcurrent devices rated not more than 60 amperes and there is no flexible metal conduit, flexible metallic tubing, or liquidtight flexible metal conduit in metric designators 12 through 16 (trade sizes 3/8 through 1/2) in the effective ground-fault current path.

(14) The combined length of flexible metal conduit, flexible metallic tubing, and liquidtight flexible metal conduit in the same effective ground-fault current path

~~does~~

a. shall not exceed 1.8 m (6 ft).

b. If flexibility is necessary to minimize the transmission of vibration from equipment or to provide flexibility for equipment that requires movement after installation, a wire-type equipment grounding conductor or a bonding jumper in accordance with 250.102(E)(2) shall be installed.

c. If liquidtight flexible metal conduit contains a stainless steel core, a wire-type equipment grounding conductor or a bonding jumper in accordance with 250.102(E)(2) shall be installed.

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

(16) The circuit conductors contained in the tubing are protected by overcurrent devices rated at 20 amperes or less.

(17) The combined length of flexible metal conduit, flexible metallic tubing, and liquidtight flexible metal conduit in the same effective ground-fault current path

~~does~~

a. shall not exceed 1.8 m (6 ft).

(18) Armor of Type AC cable as provided in 320.108.

(19) The copper sheath of mineral-insulated, metal-sheathed cable Type MI.

(20) Type MC cable that provides an effective ground-fault current path in accordance with one or more of the following:

(21) It contains an insulated or uninsulated equipment grounding conductor in compliance with 250.118 (1).

(22) The combined metallic sheath and uninsulated equipment grounding/bonding conductor of interlocked metal tape–type MC cable that is listed and identified as an equipment grounding conductor

(23) 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

(24) Cable trays as permitted in 392.10 and 392.60.

(25) Cablebus framework as permitted in 370.60(1).

(26) Other listed electrically continuous metal raceways and listed auxiliary gutters.

(27) Surface metal raceways listed for grounding.

Informational Note: See Article 100 for a definition of *effective ground-fault current path*.

(B) Not Permitted.

The following shall not be used as equipment grounding conductors.

(1) Grounding electrode conductors

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.

(2) Structural metal frame of a building or structure

Supplemental Information

File Name	Description	Approved
NEC_CMP5_FR-8692_250.118.docx	For Staff Use	

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Tue Jan 23 11:34:50 EST 2024

Committee Statement

Committee Statement:	The committee revised the charging paragraph to ensure that all wiring methods permitted for equipment grounding be installed as part of an effective ground-fault current path and used the mandatory language “shall” in each of the flexible metal raceways and tubing length limitations in the effective ground-fault current path.
Response Message:	FR-8692-NFPA 70-2024

First Revision No. 8519-NFPA 70-2024 [Section No. 250.119(A)]

(A) General.

Unless required elsewhere in this *Code,* equipment grounding conductors shall be permitted to be bare, covered, or insulated. Individually covered or insulated equipment grounding conductors of the wire type shall have a continuous outer finish that is either green or green with one or more yellow stripes except as permitted in this section. Conductors with insulation or individual covering that is green, green with one or more yellow stripes, or otherwise identified as permitted by this section shall not be used for ungrounded or grounded circuit conductors.

Exception No. 1: Power-limited Class 2 or Class 3 cables, Fault Managed Power Class 4 cables, power-limited fire alarm cables, or communications cables containing only circuits operating at less than 50 volts ac or 60 volts dc if connected to equipment not required to be grounded shall be permitted 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 permitted 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.

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Mon Jan 22 15:16:13 EST 2024

Committee Statement

Committee Statement: The revision provides consistency with grouping of Fault Managed Power Class 4 cables as found elsewhere in the code such as Article 722.

Response Message: FR-8519-NFPA 70-2024

Public Input No. 3884-NFPA 70-2023 [Section No. 250.119(A)]

First Revision No. 8713-NFPA 70-2024 [Section No. 250.120(A)]

(A) ~~Raceway~~ Raceways , Cable Trays, Cable Armor, Cablebus, or Cable Sheaths.

~~If it consists~~ Equipment grounding conductors consisting of a raceway, cable tray, cable armor, cablebus framework, or cable sheath ~~or if it is~~ or a wire within a raceway or cable, ~~it~~ shall be installed ~~in accordance with the applicable provisions in this *Code* using fittings for joints and terminations approved for use with the type of raceway or cable used. All~~ with all connections, joints, and fittings ~~shall be~~ made tight~~- using suitable tools~~ .

Informational Note: See the UL Guide Information for Electrical Circuit Integrity Systems (FHIT) for equipment grounding conductors installed in a raceway that are part of a listed electrical circuit protective system or a listed fire-resistive cable system.

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Tue Jan 23 13:04:45 EST 2024

Committee Statement

Committee Statement: The section has been revised to remove redundant language and to comply with the NEC Manual of Style 3.5

Response Message: FR-8713-NFPA 70-2024

First Revision No. 8425-NFPA 70-2024 [Section No. 250.122(A)]

(A) General.

(1) Sizing.

Copper, aluminum, or copper-clad aluminum equipment grounding conductors of the wire type shall not be smaller than shown in Table 250.122. The equipment grounding conductor shall not be required to be larger than the circuit conductors supplying the equipment.

(2) Cable Tray.

If a cable tray, a raceway, or a cable armor or sheath is used as the equipment grounding conductor, as provided in 250.118 and 250.134(1), it shall comply with 250.4(A)(5) or (B)(4).

(3) Sectioned.

Equipment grounding conductors shall be permitted to be sectioned within a multiconductor cable, provided the combined circular mil area complies with Table 250.122.

Supplemental Information

File Name	Description	Approved
NEC_CMP5_FR-8425_250.122_A_.docx		

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Mon Jan 22 09:56:55 EST 2024

Committee Statement

Committee Statement: This subdivision is formatted into multiple subdivisions to comply with NEC Style Manual 3.5.1.2.

Response Message: FR-8425-NFPA 70-2024

Public Input No. 3221-NFPA 70-2023 [Section No. 250.122(A)]

(A) General. [Move text to (1)—(3)]

~~Copper, aluminum, or copper-clad aluminum equipment grounding conductors of the wire type shall not be smaller than shown in Table 250.122. The equipment grounding conductor shall not be required to be larger than the circuit conductors supplying the equipment. If a cable tray, a raceway, or a cable armor or sheath is used as the equipment grounding conductor, as provided in 250.118 and 250.134(1), it shall comply with 250.4(A)(5) or (B)(4).~~

~~Equipment grounding conductors shall be permitted to be sectioned within a multiconductor cable, provided the combined circular mil area complies with.Table 250.122.~~

(1) Sizing.

Copper, aluminum, or copper-clad aluminum equipment grounding conductors of the wire type shall not be smaller than shown in Table 250.122. The equipment grounding conductor shall not be required to be larger than the circuit conductors supplying the equipment.

(2) Cable Tray.

If a cable tray, a raceway, or a cable armor or sheath is used as the equipment grounding conductor, as provided in 250.118 and 250.134(1), it shall comply with 250.4(A)(5) or 250.4(B)(4).

(3) Sectioned.

Equipment grounding conductors shall be permitted to be sectioned within a multiconductor cable, provided the combined circular mil area complies with. Table 250.122.

Commented [SB1]: Delete period and add space

First Revision No. 8427-NFPA 70-2024 [Section No. 250.122(B)]

(B) Increased in Size.

If ungrounded conductors are increased in size for any reason other than as required in 310.15(B) or 310.15(C), wire-type equipment grounding conductors, if installed, shall be increased in size proportionately to the increase in circular mil area of the ungrounded conductors.

Exception: Equipment grounding conductors shall be permitted to be sized by a qualified person to provide an effective ground fault current path in accordance with 250.4(A)(5) or (B)(4).

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Mon Jan 22 10:02:28 EST 2024

Committee Statement

Committee Statement: This action corrects an editorial omission of a period at the end of the exception.

Response Message: FR-8427-NFPA 70-2024

Public Input No. 1796-NFPA 70-2023 [Section No. 250.122(B)]

First Revision No. 8430-NFPA 70-2024 [Section No. 250.122(D)(2)]

(2) Instantaneous-Trip Circuit Breaker and Motor Short-Circuit Protector.

If the ~~overcurrent~~ motor branch-circuit short-circuit and ground-fault protective device is an instantaneous-trip circuit breaker or a motor short-circuit protector, the equipment grounding conductor shall be sized not smaller than ~~that given by~~ 250.122(A) using the maximum permitted rating of a dual element time-delay fuse selected for branch-circuit short-circuit and ground-fault protection in accordance with 430.52(C)(1), Exception No. 1.

Submitter Information Verification

Committee: NEC-P05
Submittal Date: Mon Jan 22 10:15:58 EST 2024

Committee Statement

Committee Statement: The revised language is consistent with 430.52(A) and improves clarity for users.
Response Message: FR-8430-NFPA 70-2024

Public Input No. 768-NFPA 70-2023 [Section No. 250.122(D)(2)]

First Revision No. 8446-NFPA 70-2024 [Section No. 250.122(F)]

(F) Conductors in Parallel.

For circuits of parallel conductors as permitted in 310.10(G), the equipment grounding conductor shall be installed in accordance with 250.122(F)(1) or (F)(2).

(1) Conductor Installations in Raceways, Auxiliary Gutters, or Cable Trays.

(a) *Single Raceway or Cable Tray, Auxiliary Gutter*, *or Cable Tray*. If circuit conductors are connected in parallel in the same raceway, auxiliary gutter, or cable tray, a single wire-type conductor shall be permitted as the equipment grounding conductor. The wire-type equipment grounding conductor shall be sized in accordance with 250.122 based on the overcurrent protective device for the feeder or branch circuit.

(b) *Multiple Raceways*. If conductors are installed in multiple raceways and are connected in parallel, a wire-type equipment grounding conductor, if used, shall be installed in each raceway and shall be connected in parallel. The equipment grounding conductor installed in each raceway shall be sized in accordance with 250.122 based on the rating of the overcurrent protective device for the feeder or branch circuit. The equipment grounding conductor in each raceway shall not be required to be larger than the largest ungrounded conductor in the raceway.

(c) *Wire-Type Equipment Grounding Conductors in Cable Trays.* Wire-type equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c).

(d) *Metal Raceways, Auxiliary Gutters, or Cable Trays.* Metal raceways or auxiliary gutters in accordance with 250.118 or cable trays complying with 392.60(B) shall be permitted as the equipment grounding conductor.

(2) Multiconductor Cables.

(a) Except as provided in 250.122(F)(2)(c) for raceway, trench, or cable tray installations, the equipment grounding conductor in each multiconductor cable shall be sized in accordance with 250.122 based on the overcurrent protective device for the feeder or branch circuit.

(b) If circuit conductors of multiconductor cables are connected in parallel, the equipment grounding conductor(s) in each cable shall be connected in parallel.

(c) If multiconductor cables are paralleled in the same raceway, auxiliary gutter, trench, or cable tray, a single equipment grounding conductor that is sized in accordance with 250.122 shall be permitted in combination with the equipment grounding conductors provided within the multiconductor cables and shall all be connected together.

(d) Equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c). Cable trays complying with 392.60(B), metal raceways in accordance with 250.118, or auxiliary gutters shall be permitted as the equipment grounding conductor.

Submitter Information Verification

Committee: NEC-P05
Submittal Date: Mon Jan 22 11:07:13 EST 2024

Committee Statement

Committee Statement: The revision to 250.122(F)(1)(b) is necessary to be consistent with requirements elsewhere in the NEC that size wire-type conductors intended to carry fault current. For example, 215.2(B), 250.24(D)(2), and 250.102(C)(2) have for many years limited the size of ground-fault-carrying conductors in parallel to no more than the size of the largest ungrounded conductor in each raceway with no reports of failure. As the number of paralleled raceways increases and the size of the paralleled circuit conductors decreases, it is unnecessary to have a paralleled EGC to be larger than the fault current supplying conductor.

Adding the trench location in 250.122(F)(2) aligns with 250.122(C).

Response Message: FR-8446-NFPA 70-2024

Public Input No. 2573-NFPA 70-2023 [Section No. 250.122(A)]

Public Input No. 3222-NFPA 70-2023 [Section No. 250.122]

Public Input No. 2571-NFPA 70-2023 [Section No. 250.122(F)(2)]

First Revision No. 8694-NFPA 70-2024 [Section No. 250.142(B)]

(B) Load-Side Equipment.

Except as permitted in 250.30(A)(1), ~~,~~ and 250.32(B)(1), Exception No. 1, ~~and Part X of Article 250~~ ~~,~~ a grounded circuit conductor shall not be connected to non–current-carrying metal parts of equipment on the load side of the service disconnecting means or on the load side of a separately derived system disconnecting means or the overcurrent devices for a separately derived system not having a main disconnecting means.

Exception No. 1: The frames of ranges, wall-mounted ovens, counter-mounted cooking units, and clothes dryers under the conditions permitted for existing installations by 250.140 shall be permitted to be connected to the grounded circuit conductor.

Exception No. 2: It shall be permissible to connect meter enclosures to the grounded circuit conductor on the load side of the service disconnect if all of the following conditions apply:

(1) Ground-fault protection of equipment is not installed.

(2) All meter enclosures are located immediately adjacent to the service disconnecting means.

(3) The size of the grounded circuit conductor is not smaller than the size specified in Table 250.122 for equipment grounding conductors.

Exception No. 3: Electrode-type boilers operating at over 1000 volts shall be grounded as required in 495.72(E)(1) and 495.74.

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Tue Jan 23 11:42:01 EST 2024

Committee Statement

Committee Statement: This reference is for over 1000 volt installations, this section covers less than 1000 volt installations, so Article 250, Part X would not apply, therefore, the reference is deleted.

Response Message: FR-8694-NFPA 70-2024

Public Input No. 2651-NFPA 70-2023 [Section No. 250.142(B)]

First Revision No. 8546-NFPA 70-2024 [Section No. 250.146(A)]

(A) Surface-Mounted Box.

(1) Metal Box. If a metal box is mounted on the surface, the direct metal-to-metal contact between the device yoke or strap to the box shall be permitted to provide the required effective ground-fault current path. At least one of the insulating washers shall be removed from receptacles that do not have a contact yoke or device to ensure direct metal-to-metal contact. Direct metal-to-metal contact for providing continuity applies to cover-mounted receptacles if the box and cover combination are listed as providing continuity between the box and the receptacle.

(2) Metal Exposed Work Cover. A listed exposed work cover shall be permitted to be the grounding and bonding means under both of the following conditions:

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

(2) The cover mounting holes are located on a flat nonraised portion of the cover.

Supplemental Information

File Name	Description	Approved
NEC_CMP5_FR-8546_250.146_A_.docx		
NEC_CMP5_FR-8546_250.146_A.docx	For prod use	

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Mon Jan 22 16:12:51 EST 2024

Committee Statement

Committee Statement: Editorial revision to reformat the section into distinct parts per NEC Style Manual 3.5.1.2

Response Message: FR-8546-NFPA 70-2024

Public Input No. 2462-NFPA 70-2023 [Section No. 250.146(A)]

Public Input No. 3830-NFPA 70-2023 [Section No. 250.146(A)]

[250.146]

(A) Surface-Mounted Box.

(1) Metal Box. If a metal box is mounted on the surface, the direct metal-to-metal contact between the device yoke or strap to the box shall be permitted to provide the required effective ground-fault current path. At least one of the insulating washers shall be removed from receptacles that do not have a contact yoke or device to ensure direct metal-to-metal contact. Direct metal-to-metal contact for providing continuity applies to cover-mounted receptacles if the box and cover combination are listed as providing continuity between the box and the receptacle.

(2) Metal Exposed Work Cover. A listed exposed work cover shall be permitted to be the grounding and bonding means under both of the following conditions:

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

(2) The cover mounting holes are located on a flat nonraised portion of the cover.

First Revision No. 8550-NFPA 70-2024 [Section No. 250.146(D)]

(D) Isolated Ground Receptacles.

~~If installed for the reduction of electromagnetic interference on the equipment grounding conductor, a~~ (1) Insulated Equipment Grounding Conductor. A receptacle in which the grounding terminal is purposely insulated from the receptacle mounting means shall be permitted. The receptacle grounding terminal shall be connected to an insulated equipment grounding conductor run with the circuit conductors.

(2) Connection to Grounding Terminal. This equipment grounding conductor shall be permitted to pass through one or more ~~panelboards~~ panelboard enclosures without a connection to the ~~panelboard~~ grounding terminal bar as permitted in 408.40, Exception, so as to terminate within the same building or structure directly at an equipment grounding conductor terminal of the applicable derived system or service. If installed in accordance with this section, this equipment grounding conductor shall also be permitted to pass through boxes, wireways, or other enclosures without being connected to such enclosures.

Informational Note: Use of an isolated equipment grounding conductor does not relieve the requirement for connecting the raceway system and outlet box to an equipment grounding conductor.

Supplemental Information

File Name	Description	Approved
NEC_CMP5_FR-8550_250.146_D_.docx		

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Mon Jan 22 16:15:58 EST 2024

Committee Statement

Committee Statement: The section is reformatted into distinct parts per 3.5.1.2 of the NEC Style Manual.

The change to the first line in 250.146(D)(1) is because there can be an isolated ground receptable for reasons other than electromagnetic interference.

Adding the term “panelboard enclosures” where the conductors pass through makes the text technically correct. The second instance of the term “panelboard” was deleted as grounding terminal bars are attached to the enclosure not the panelboard.

Response Message: FR-8550-NFPA 70-2024

Public Input No. 2070-NFPA 70-2023 [Section No. 250.146(D)]

Public Input No. 3833-NFPA 70-2023 [Section No. 250.146(D)]

(D) Isolated Ground Receptacles. [Move text and IN to (1) and (2)]

~~If installed for the reduction of electromagnetic interference on the equipment grounding conductor, a receptacle in which the grounding terminal is purposely insulated from the receptacle mounting means shall be permitted. The receptacle grounding terminal shall be connected to an insulated equipment grounding conductor run with the circuit conductors. This equipment grounding conductor shall be permitted to pass through one or more panelboards without a connection to the panelboard grounding terminal bar as permitted in 408.40, Exception, so as to terminate within the same building or structure directly at an equipment grounding conductor terminal of the applicable derived system or service. If installed in accordance with this section, this equipment grounding conductor shall also be permitted to pass through boxes, wireways, or other enclosures without being connected to such enclosures.~~

~~Informational Note: Use of an isolated equipment grounding conductor does not relieve the requirement for connecting the raceway system and outlet box to an equipment grounding conductor.~~

(1) Insulated Equipment Grounding Conductor.

~~If installed for the reduction of electromagnetic interference on the equipment grounding conductor, a~~ A receptacle in which the grounding terminal is purposely insulated from the receptacle mounting means shall be permitted. The receptacle grounding terminal shall be connected to an insulated equipment grounding conductor run with the circuit conductors.

(2) Connection to Grounding Terminal.

This equipment grounding conductor shall be permitted to pass through one or more ~~panelboards~~ panelboard enclosures without a connection to the ~~panelboard~~ grounding terminal bar as permitted in 408.40, Exception, so as to terminate within the same building or structure directly at an equipment grounding conductor terminal of the applicable derived system or service. If installed in accordance with this section, this equipment grounding conductor shall also be permitted to pass through boxes, wireways, or other enclosures without being connected to such enclosures.

Informational Note: Use of an isolated equipment grounding conductor does not relieve the requirement for connecting the raceway system and outlet box to an equipment grounding conductor.

First Revision No. 8696-NFPA 70-2024 [Section No. 250.160]

250.160 General.

Direct-current systems shall comply with Article 250, Part VIII and other sections ~~of Article 250~~ - not specifically intended for ac systems.

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Tue Jan 23 11:44:56 EST 2024

Committee Statement

Committee Statement: The panel as revised the text to comply with the NEC Style Manual, 2023 Section 4.1.4 when referencing specific parts of an article.

Response Message: FR-8696-NFPA 70-2024

Public Input No. 2652-NFPA 70-2023 [Section No. 250.160]

First Revision No. 8697-NFPA 70-2024 [Section No. 250.167(C)]

(C) Marking.

Direct-current systems shall be legibly marked to indicate the grounding type at the dc source or the first disconnecting means of the system. The marking shall be of sufficient durability to withstand the environment involved.

Informational Note: See NFPA *70E* ~~2018~~ 2024 , *Standard for Electrical Safety in the Workplace*, which identifies four dc grounding types in detail.

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Tue Jan 23 11:49:23 EST 2024

Committee Statement

Committee Statement: The date was revised in the Informational Note to reflect the current edition.

This action is consistent with the action requested by Global PI-3085 assigned to CMP-1.

Response Message: FR-8697-NFPA 70-2024

First Revision No. 8405-NFPA 70-2024 [Section No. 250.187(A)]

(A) Location.

The grounding impedance device shall be installed between the grounding electrode conductor and the impedance grounding conductor connected to the system neutral point. If a neutral point is not available, the grounding impedance shall be installed between the grounding electrode conductor and the impedance grounding conductor connected to the neutral point derived from a grounding transformer.

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Mon Jan 22 08:45:15 EST 2024

Committee Statement

Committee Statement: This revision provides consistency between the rules in 250.36 and 250.187. This language has been in 250.36 for several cycles and applies to impedance grounded systems in a medium voltage application.

Response Message: FR-8405-NFPA 70-2024

Public Input No. 2122-NFPA 70-2023 [Section No. 250.187(A)]

First Revision No. 8417-NFPA 70-2024 [Section No. 250.187(C)]

(C) System Neutral Point Connection.

The system neutral point shall not be connected to ground, except through the grounding impedance device.

Informational Note: See IEEE 3003.1-2019, Recommended Practice for System Grounding of Industrial and Commercial Power Systems for guidance on limiting transient overvoltages.

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Mon Jan 22 09:19:27 EST 2024

Committee Statement

Committee Statement: The informational note is added to be consistent with 250.36 since the information also applies to 250.187 systems.

Response Message: FR-8417-NFPA 70-2024

Public Input No. 2124-NFPA 70-2023 [Section No. 250.187(C)]

First Revision No. 8418-NFPA 70-2024 [Section No. 250.187(D)]

(D) ~~Equipment Grounding Conductors~~ Impedance Grounding Conductor Routing .

~~Equipment~~ The impedance grounding ~~conductors~~ conductor shall be permitted to be ~~bare and shall be electrically connected to the ground bus and grounding electrode conductor~~ installed in a separate raceway from the ungrounded conductors. It shall not be required to run this conductor with the phase conductors to the first system disconnecting means or overcurrent device .

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Mon Jan 22 09:21:31 EST 2024

Committee Statement

Committee Statement: The revisions incorporate proper terminology and reconciles the language with 250.36(D). The allowance for the impedance grounding conductor to be bare is removed since it is redundant with the exception to 250.187(B).

Response Message: FR-8418-NFPA 70-2024

Public Input No. 2126-NFPA 70-2023 [Section No. 250.187(D)]

First Revision No. 8422-NFPA 70-2024 [Section No. 250.187 [Excluding any Sub-Sections]]

Impedance grounded systems in which a grounding impedance device, typically a resistor, limits the ground-fault current shall be permitted if all of the following conditions are met:

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

(2) Ground detectors are installed on the system.

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

Impedance grounded systems shall comply with 250.187(A) through 250.187 (~~D~~ G).

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Mon Jan 22 09:38:48 EST 2024

Committee Statement

Committee Statement: This action recognizes new subsections added to 250.187.

Response Message: FR-8422-NFPA 70-2024

Public Input No. 2121-NFPA 70-2023 [Section No. 250.187 [Excluding any Sub-Sections]]

First Revision No. 8698-NFPA 70-2024 [Section No. 250.188(F)]

(F) Trailing Cable and Couplers.

Trailing cable and couplers of systems over 1000 volts for interconnection of portable or mobile equipment shall meet the requirements of ~~Part III of~~ Article 400, Part III for cables and 495.65 for couplers.

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Tue Jan 23 11:51:51 EST 2024

Committee Statement

Committee Statement: The panel has revised the text to comply with the NEC Style Manual, 2023 Section 4.1.4 when referencing specific parts of an article.

Response Message: FR-8698-NFPA 70-2024

Public Input No. 2653-NFPA 70-2023 [Section No. 250.188(F)]

First Revision No. 8241-NFPA 70-2024 [New Definition after Definition: Example D13 Cable Tray Cal...]

Example D14 Grounded Service Conductor

[see 250.24(D)]

A service installation with four parallel sets of 350kcmil ungrounded service entrance conductors. All conductors are copper. No additional considerations for adjustments or corrections are included.

(a) Parallel Grounded Service Conductors in a Single Raceway/Wireway

Section 250.24(D)(1) requires a single grounded conductor be installed in the raceway and be not smaller than specified in Table 250.102(C)(1). The size of the grounded conductor is based off the size of the equivalent area for parallel conductors.

350kcmil x 4 = 1400kcmil of equivalent area.

According to Table 250.102(C)(1), Note 1, the grounded conductor shall not be smaller than 12.5 percent of the equivalent area of the parallel ungrounded conductors.

1400kcmil x 12.5% = 175kcmil

The smallest standard size wire that meets this criteria is 4/0 AWG copper.

(b) Parallel Grounded Service Conductors in Four Separate Raceways/Wireways

Section 250.24(D) states that a grounded conductor is to be routed with the ungrounded service conductors. There will be four grounded service conductors in total, one in each raceway or wireway. Section 250.24(D)(2) requires that each grounded conductor be sized in accordance with Table 250.102(C)(1), based in the size of the largest ungrounded conductor in the raceway, and not smaller than 1/0 AWG. See 310.10(G) for the requirements of circuit conductors installed in parallel. For this installation, Table 250.102(C)(1) would require the installation of a #2 conductor in each raceway. However, 250.24(D)(2) states that the grounded conductor installed shall not be smaller than 1/0 AWG. A 1/0 AWG copper grounded service conductor shall be installed in each of the four raceways containing ungrounded service conductors.

(c) Parallel Grounded Service Conductors in Two Separate Raceways/Wireways

As noted in D.14(b), a grounded conductor shall be routed with the ungrounded service conductors. In this example, two parallel sets of the 350kcmil ungrounded service conductors will be installed in each raceway or wireway. There will be two grounded service conductors in total, one in each raceway or wireway. Section 250.24(D)(2) applies, as well as the rules in 310.10(G). With two sets installed in one raceway, the size of the grounded conductor shall be sized in accordance with Table 250.102(C)(1), and based off the equivalent area of the two sets of 350kcmil ungrounded service conductors, or 700kcmil. A 2/0 AWG grounded service conductor shall be installed in each of the two raceways containing ungrounded service conductors.

Submitter Information Verification

Committee: NEC-P05

Submittal Date: Sun Jan 21 08:43:03 EST 2024

Committee Statement

Committee Statement:	The example is added in Annex D14 to provide examples for sizing grounded service conductors in accordance with 250.24(D) to assist users of the NEC.
Response Message:	FR-8241-NFPA 70-2024

Public Input No. 3955-NFPA 70-2023 [New Definition after Definition: Example D13 Cable Tray Cal...]