NEC® Article 250: Grounding and Bonding

Grounding & Bonding Definitions – Art 100

Bonded (Bonding). Connected to establish electrical continuity and conductivity.

Bonding Conductor or Jumper. A reliable conductor to ensure the required electrical conductivity between metal parts required to be electrically connected.

Bonding Jumper, Equipment. The connection between two or more portions of the equipment grounding conductor.

Bonding Jumper, Main. The connection between the grounded circuit conductor and the equipment grounding conductor at the service.

Bonding Jumper, System. The connection between the grounded circuit conductor and the supply-side bonding jumper, or the equipment grounding conductor, or both, at a separately derived system.

Ground. The earth.

Ground Fault. An unintentional, electrically conducting connection between an ungrounded conductor of an electrical circuit and the normally non–current-carrying conductors, metallic enclosures, metallic raceways, metallic equipment, or earth.

Grounded (Grounding). Connected (connecting) to ground or to a conductive body that extends the ground connection.

Grounded, Solidly. Connected to ground without inserting any resistor or impedance device.

Grounded Conductor. A system or circuit conductor that is intentionally grounded.

Grounding Conductor, Equipment (EGC). The conductive path(s) installed to connect normally non–current-carrying metal parts of equipment together and to the system grounded conductor or to the grounding electrode conductor, or both.

Informational Note No. 1: It is recognized that the equipment grounding conductor also performs bonding.

Informational Note No. 2: See 250.118 for a list of acceptable equipment grounding conductors.

Grounding Electrode. A conducting object through which a direct connection to earth is established.

Grounding Electrode Conductor. A conductor used to connect the system grounded conductor or the equipment to a grounding electrode or to a point on the grounding electrode system.

Neutral Conductor. The conductor connected to the neutral point of a system that is intended to carry current under normal conditions.

Neutral Point. The common point on a wye-connection in a polyphase system or midpoint on a single-phase, 3-wire system, or midpoint of a single-phase portion of a 3-phase delta system, or a midpoint of a 3-wire, direct-current system.

Informational Note: At the neutral point of the system, the vectorial sum of the nominal voltages from all other phases within the system that utilize the neutral, with respect to the neutral point, is zero potential.

Separately Derived System. A premises wiring system whose power is derived from a source of electric energy or equipment other than a service. Such systems have no direct connection from circuit conductors of one system to circuit conductors of another system, other than connections through the earth, metal enclosures, metallic raceways, or equipment grounding conductors.

Ungrounded. Not connected to ground or to a conductive body that extends the ground connection.

Table 250.66

Grounding Electrode Conductor for Alternating-Current Systems 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	3/0	250

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. Where 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.

This table also applies to the derived conductors of separately derived ac systems.

For Aluminum GEC conductors, see installation restrictions in 250.64(A).

American Wire Gauge (AWG) to circular mil (CMIL) Conversion → See NEC Chapter 9 Table 8

AWG	CMIL	AWG	CMIL
4	41,740	1/0	105,600
3	52,620	2/0	133,100
2	66,360	3/0	167,800
1	83,690	4/0	211,600

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. If the ungrounded supply conductors are 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 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 and will have an ampacity equivalent to that of the installed ungrounded supply conductors.

3. If multiple sets of service-entrance conductors are used as permitted in 230.40, Exception No. 2, or if multiple sets of ungrounded supply conductors are installed for a separately derived system, the equivalent size of the largest ungrounded supply conductor(s) shall be determined by the largest sum of the areas of the corresponding conductors of each set

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.
*For the purposes of this table, the term bonding jumper refers to main bonding jumpers, system bonding jumpers, and supply-side bonding jumpers.

Table 250.122

Table 250.122 Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment

Rating or Setting of Automatic Overcurrent Device in Circuit Ahead of Equipment, Conduit, etc., Not Exceeding (Amperes)	Size (AWG or kcmil)	
	Copper	Aluminum or Copper-Clad Aluminum*
15	14	12
20	12	10
30	10	8
40	10	8
60	10	8
100	8	6
200	6	4
300	4	2
400	3	1
500	2	1/0
600	1	2/0
800	1/0	3/0
1000	2/0	4/0
1200	3/0	250
1600	4/0	350
2000	250	400
2500	350	600
3000	400	600
4000	500	800
5000	700	1200
6000	800	1200

Note: Where necessary to comply with 250.4(A)(5) or (B)(4), the equipment grounding conductor shall be sized larger than given in this table.
*See installation restrictions in 250.120.

For all of Chapter 3 wiring methods, specific grounding rules can be found at .60 of each wiring method. Eg 350.60. In most of the Communications articles .49 through .106 gives grounding rules. Eg. 820.49; 820.93; 820.100 etc.

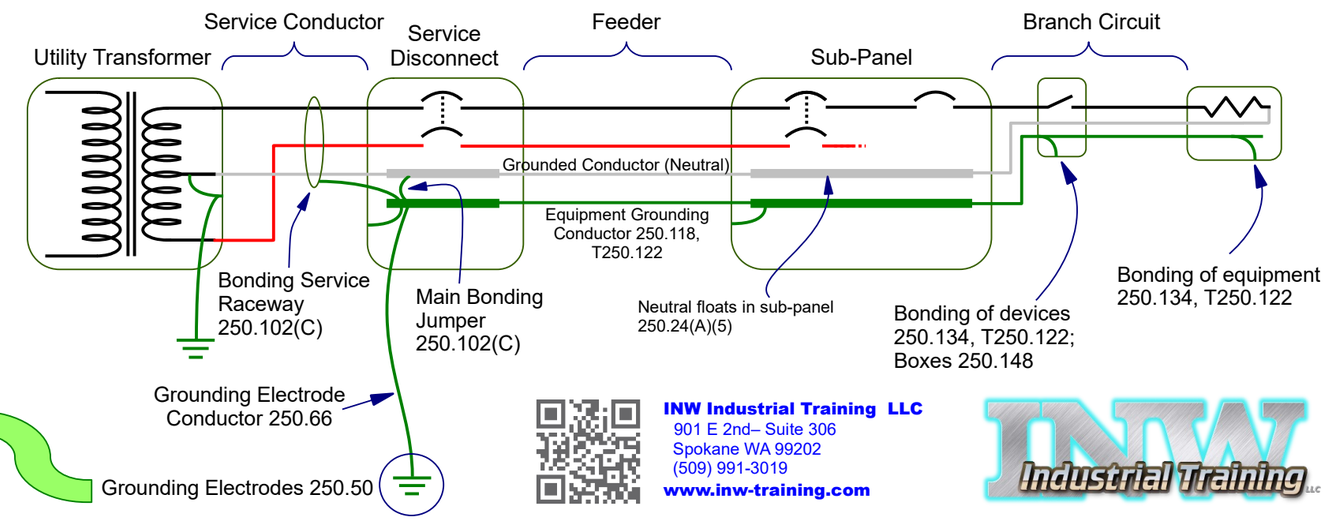
Part III: Grounding Electrode System

	Grounding Electrode Descriptions: 250.52(A)	Installation Instructions 250.53	Other Requirements	250.66 Sizing of Grounding Electrode Conductor
(1) through (7), if present, must be connected together to form the Grounding Electrode System 250.50	(1) Metal Underground Water Pipe	(D)(1) Jumper meter & similar devices (D)(2) Supplemental electrode required		Table 250.66
	(2) Metal Frame of Building or Structure			Table 250.66
	(3) Concrete Encased Electrode		250.52(3) Min 4AWG, 20' length in footing or foundation	250.66(B) Not required to be larger than 4 AWG
	(4) Ground Ring	(G) Min burial depth 30"	250.52(4) Min size 2AWG	250.66(C), not required to be larger than ground ring
	(5) Rod & Pipe Electrodes	(A) Below permanent moisture level (B) Min separation of 6' (G) Min soil contact 8', drive straight down, if unable 45 deg angle, if unable lay in ditch 30" deep	250.56 Single electrode more than 25 Ohms to ground must be augmented with at least one other	250.66(A) Not required to be larger than 6 AWG
	(6) Other Listed Electrodes	Install per Listing 110.3(B)		
	(7) Plate Electrodes	(A) Below permanent moisture level (B) Min separation of 6' (H) Min burial depth 30"	250.56 Single electrode more than 25 Ohms to ground must be augmented with at least one other	250.66(A) Not required to be larger than 6 AWG
	(8) Other Local UG Metal Structures			Table 250.66

250.52(B) Prohibited as Grounding Electrode: Aluminum, as well as Gas Pipe (does not prohibit Bonding on the customer side - See 250.104(B) for bonding requirements of gas piping.

250.54 Auxiliary Grounding Electrode: Permitted to be attached to equipment grounding conductors of equipment, not required to follow sizing, installation, and bonding instructions of Art 250 Part III. May not replace the Grounded Conductor

250.58 Common Grounding Electrode System: All Electrical Systems installed at a building or structure shall use the same Grounding Electrode System



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