Service Entrance Grounding and Bonding Diagrams

Prepared by
The Southwestern Section
International Association of Electrical Inspectors
2005 Grounding and Bonding Committee

William Brownell, P.E., Chairman
Scott Davis
Gary Gonzales
Jim Moore
Timothy Owens
Steve Schinko

Nader Shams, P.E.
Ron Takiguchi, P.E.
Tom Trainor
Gerald Williams

Based on the 2005 National Electrical Code

These diagrams are intended to illustrate typical grounding and bonding requirements but are not intended to show the only acceptable grounding and bonding methods.
COMBINATION METER AND SERVICE SECTION FOR
OVERHEAD DWELLING SERVICE

Grounded (neutral) service entrance conductor.

Service entrance raceway.

Hub. Where service entrance raceway is installed with locknuts, install a bonding-type locknut, bushing, or bushing with bonding jumper. See 250.92 (B)(4).

Lay in lug. Where lug is insulated from enclosure, install a bonding jumper or screw.

Main service disconnect.

NOTE:
Accessible means external to enclosures for connecting intersystem bonding and grounding electrode conductors shall be provided. See 250.94.

Neutral terminal bus. Where neutral terminal is insulated from the enclosure, install a main bonding jumper or screw with a green finish. See 250.8, 250.28. Neutral disconnect means. See 230.75.

Conductors entering cabinets. See 312.5.

Bare or insulated grounding electrode conductor. See 250.62 for material, 250.64 for installation, and 250.66 for size.

Connection to electrode. Connect grounding electrode conductor to grounding electrode with listed ground clamp. See 250.70.

Grounding electrode system. See 250.50.

This represents only one method of connecting to grounding electrode.
METER REMOTE FROM SERVICE SECTION FOR
OVERHEAD DWELLING SERVICE

Grounded (neutral) service entrance conductor.

Service entrance raceway.

Hub. Where service entrance raceway is installed with locknuts, install a bonding-type locknut, bushing, or bushing with bonding jumper. See 250.92 (B)(4).

Grounding electrode conductor. See 250.62 for material, 250.64 for installation, and 250.66 for size.

Connection to electrode. Connect grounding electrode conductor to grounding electrode with listed ground clamp. See 250.70.

Grounding electrode system. See 250.50.

NOTE:
Accessible means external to enclosures for connecting intersystem bonding and grounding electrode conductors shall be provided. See 250.94.

Where neutral terminal bus is insulated from the enclosure, install a main bonding jumper or screw with a green finish. See 250.8, 250.28. Neutral disconnect means. See 230.75.

NOTE:
If metallic conduit, bonding required. See 250-92 (A)(3) and 250.102 (C) for size.

Listed connector. See 250.92 (B) and 312.5.

Cable armor or other raceway.
METER AND SERVICE WITH CURRENT TRANSFORMER ENCLOSURE OVERHEAD SUPPLY

Grounded (neutral) service entrance conductor.

Service entrance raceway

Hub. Where service entrance raceway is installed with locknuts, install a bonding-type locknut, bushing, or bushing with bonding jumper. See 250.92 (B)(4).

Main service disconnect

Current transformer

Where neutral terminal bus is insulated from the enclosure, install a main bonding jumper or screw with a green finish. See 250.8, 250.28 Neutral disconnect means. See 230.75.

Lay in lug. Where insulated from enclosure, install a bonding jumper or screw.

NOTE:
Accessible means external to enclosures for connecting intersystem bonding and grounding electrode conductors shall be provided. See 250.94.

If metallic conduit, bonding required. See 250.92 (A)(3). See 250.102 (C) for size.

Grounding electrode conductor. See 250.62 for material, 250.64 for installation, and 250.66 for size.

Connection to electrode. Connect grounding electrode conductor to grounding electrode with listed ground clamp. See 250.70.

Grounding electrode system. See 250.50.
SINGLE-METER COMMERCIAL SERVICE
WITH A NEUTRAL
(WHERE A MAIN DISCONNECTING MEANS IS REQUIRED)

Grounded (neutral) service entrance conductor.
Service entrance raceway.
Hub. Where service entrance raceway is installed with locknuts, install a bonding-type locknut, bushing, or bushing with bonding jumper. See 250.92 (B)(4).

NOTE:
Accessible means external to enclosures for connecting intersystem bonding and grounding electrode conductors shall be provided. See 250.94.

Grounded (neutral) service entrance conductor.
Bonding jumper. See 250.92 (A)(2). See 250.102 (C) for size.
Main service disconnect.
Connection to electrode. Connect grounding electrode conductor to grounding electrode with listed ground clamp. See 250.70.

Lay in lug. Where lug is insulated from enclosure install a bonding jumper or screw.
If metallic conduit, bonding required (both ends), See 250.92 (A)(3).

Grounding electrode conductor. See 250.62 for material, 250.64 for installation, and 250.66 for size.

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Service Entrance Grounding and Bonding Diagrams
by IAEI Southwestern Section, Southern California Chapter
THREE-PHASE, THREE-WIRE DELTA SERVICE WITH ADDED GROUNDING CONDUCTOR¹
(CORNER GROUND DELTA)

1/ Serving utility MUST be consulted for service transformer connections and transformer grounding to determine appropriate equipment ratings/application.

Grounded service entrance conductor.

Service entrance raceway.

Hub. Where service entrance raceway is installed with locknuts, install a bonding-type locknut, bushing, or bushing with bonding jumper. See 250.92 (B)(4).

NOTE:
Accessible means external to enclosures for connecting intersystem bonding and grounding electrode conductors shall be provided. See 250.94.

See 250.66 for size requirements.

Lay in lug. Where lug is insulated from enclosure install a bonding jumper or screw.

If metallic conduit, bonding required (both ends). See 250.92 (A)(3). See 250-102 (C) for size.

Grounding terminal bus (not a neutral), where insulated from enclosure, install a main bonding jumper or screw with a green finish. See 250.8, 250.28.

Grounding electrode conductor. See 250.62 for material, 250.64 for installation, and 250.66 for size.

Connection to electrode. Connect grounding electrode conductor to grounding electrode with listed ground clamp. See 250.70.

Grounding electrode system. See 250.50.
COMMERCIAL SERVICE
OVERHEAD SUPPLY
SIX SUBDIVISIONS OR LESS

Grounded (neutral) service entrance conductor.

Service entrance raceway.

Hub. Where service entrance raceway is installed with locknuts, install a bonding-type locknut, bushing, or bushing with bonding jumper. See 250.92 (B)(4).

Neutral terminal bus. Where neutral terminal is insulated from the enclosure, install a bonding jumper or screw with a green finish. See 250.8, 250.28.

If metallic conduit, bonding required (both ends). See 250.92 (A)(3). See 250.102 (C) for size.

Neutral shall be permitted to be bonded to meter enclosures. See 250.142 (B) Ex. No. 2.

Connection to electrode. Connect grounding electrode conductor to the grounding electrode with listed ground clamp. See 250.70.

Grounding electrode conductor. See 250.62 for material, 250.64 for installation, and 250.66 for size.

Grounding electrode system. See 250.50.

NOTE:
Accessible means external to enclosures for connecting intersystem bonding and grounding electrode conductors shall be provided. See 250.94.
**COMMERCIAL SERVICE**
**OVERHEAD SUPPLY**
**MORE THAN SIX SUBDIVISIONS OF SERVICE**

Grounded (neutral) service entrance conductor.

Service entrance raceway.

Hub. Where service entrance raceway is installed with locknuts, install a bonding-type locknut, bushing, or bushing with bonding jumper. See 250.92 (B)(4).

Where neutral terminal is insulated from the enclosure, install a main bonding jumper or screw with a green finish. See 250.28. Neutral disconnect means. See 230.75.

Connection to electrode. Connect grounding electrode conductor to the grounding electrode with listed ground clamp. See 250.70.

Main service disconnect.

If metallic conduit, bonding required (both ends). See 250.92 (A)(3). See 250.102 (C) for size.

Grounding electrode conductor. See 250.62 for material, 250.64 for installation, and 250.66 for size.

Neutral shall be permitted to be bonded to meter enclosures. See 250.142 (B) Exception No. 2.

Grounding electrode system. See 250.50.

Hub. Where service entrance raceway is installed with locknuts, install a bonding-type locknut, bushing, or bushing with bonding jumper. See 250.92 (B)(4).

Accessible means external to enclosures for connecting intersystem bonding and grounding electrode conductors shall be provided. See 250.94.
COMBINATION METER AND SERVICE FOR UNDERGROUND DWELLING SERVICE

NOTE: Accessible means external to enclosures for connecting intersystem bonding and grounding electrode conductors shall be provided. See 250.94.

Neutral shall be permitted to be bonded to meter enclosures. See 250.142 (B) Exception No. 2.

Where neutral bus is insulated from the enclosure, install a main bonding jumper or screw with a green finish. See 250.28.

Neutral disconnect means. See 230.75.

If metallic conduit, bonding required (both ends). See 250.92 (A)(3). See 250.102 (C) for size.

Bare or insulated grounding electrode conductor. See 250.62 for material, 250.64 for installation, and 250.66 for size.

Connection to electrode. Connect grounding electrode conductor to grounding electrode with listed ground clamp. See 250.70.

Grounding electrode system. See 250.50.

Hub. Where service entrance raceway is installed with locknuts, install a bonding-type locknut, bushing, or bushing with bonding jumper. See 250.92 (B)(4).
COMBINATION METER AND SERVICE FOR
UNDERGROUND MULTI-FAMILY DWELLING SERVICE
SIX SUBDIVISIONS OF SERVICE OR LESS

NOTE:
Accessible means external to enclosures for connecting intersystem bonding and grounding electrode conductors shall be provided, see 250.94.
COMBINATION METER AND SERVICE FOR
UNDERGROUND MULTI-FAMILY DWELLING SERVICE
MORE THAN SIX SUBDIVISIONS

NOTE:
Accessible means external to enclosures for connecting intersystem
bonding and grounding electrode conductors shall be provided. See 250.94.
COMBINATION METER AND SERVICE FOR UNDERGROUND COMMERCIAL SERVICE SIX SUBDIVISIONS OR LESS

Service entrance raceway.
Grounding electrode conductor. See 250.62 for material, 250.64 for installation, and 250.66 for size.
Connection to electrode. Connect grounding electrode conductor to the grounding electrode with listed ground clamp. See 250.70.
Grounding electrode system. See 250.50.

If metallic conduit, bonding required (both ends). See 250.92 (A)(3). See 250.02 (C) for size.

Where neutral terminal bus is insulated from the enclosure, install a bonding jumper or screw. See 250.8, 250.28.

Neutral landing terminal.

Hub. Where service entrance raceway is installed with locknuts, install a bonding-type locknut, bushing, or bushing with bonding jumper. See 250.92 (B)(4).

Grounded (neutral) service conductor.

Pull section
Neutral shall be permitted to be bonded to meter enclosure. See 250.142 (B) Exception No. 2.

NOTE: Accessible means external to enclosures for connecting intersystem bonding and grounding electrode conductors shall be provided. See 250.94.

*Bond neutral terminal in each service disconnect.
COMBINATION METER AND SERVICE FOR
UNDERGROUND COMMERCIAL SERVICE
MORE THAN SIX SUBDIVISIONS OF SERVICE

Main service disconnect.

If metallic conduit, bonding required (both ends). See 250.92 (A)(3). See 250.102 (C) for size.

Neutral landing terminal.

Underground pull box

Service entrance raceway.

Grounded (neutral) service conductor.

Where the neutral bus is insulated from the enclosure, install a bonding jumper or screw. See 250.8, 250.28. Neutral disconnect means. See 230.75.

Connection to electrode. Connect grounding electrode conductor to the grounding electrode with listed ground clamp. See 250.70.

Grounding electrode system. See 250.50.

Hub. Where service entrance raceway is installed with locknuts, install a bonding-type locknut, bushing, or bushing with bonding jumper. See 250.92 (B)(4).

Neutral shall be permitted to be bonded to meter enclosure. See 250.142 (B) Exception No. 2.

Grounding electrode conductor. See 250.62 for material, 250-64 for installation, and 250.66 for size.

NOTE:
Accessible means external to enclosures for connecting intersystem bonding and grounding electrode conductors shall be provided. See 250.94.
SWITCHBOARD SERVICE SECTION

Grounded (neutral) service conductor.

Overhead service entrance raceway.

Bonding jumper. (not required if hub is used)

Grounding electrode conductor.
See 250.62 for material, 250.64 for installation, and 250.66 for size.

Connection to electrode. Connect grounding electrode conductor to the grounding electrode with listed ground clamp. See 250.70.

Neutral landing terminal.

Grounded (neutral) service entrance conductor.

Underground pull section.

Neutral bus.

Main bonding jumper connected ahead of neutral disconnect link, and ground fault sensor (if supplied). See 250.28.

Where metallic conduit is used, install a bond bushing and bond per 250.92 (A)(2). See 250.102 (C) and Table 250.66 for size.

Neutral disconnect link. See 230.75.

Grounding electrode conductor. See 250.62 for material, 250.64 for installation, and 250.66 for size.

Connection to electrode. Connect grounding electrode conductor to the grounding electrode with listed ground clamp. See 250.70.

Grounding electrode connected to ground bus. See 250.24 (A)(4).

Main bonding jumper connected ahead of neutral disconnect link, and ground fault sensor (if supplied). See 250.28.
**UNDERGROUND SERVICE POST**

- **Grounding electrode conductor.** See 250.62 for material, 250.64 for installation, and 250.66 for size.
- **Connection to electrode.** Connect grounding electrode conductor to the grounding electrode with listed ground clamp. See 250.70. For accessibility requirement, see 250.68 (A).
- **Grounding electrode system.** See 250.50 and 250-53 (G).
- **NOTE:** Accessible means external to enclosures for connecting intersystem bonding and grounding electrode conductors shall be provided. See Section 250.94.
- **Neutral landing terminal.**
- **Grounded (neutral) service entrance conductor.**
- **Bonding jumper, see 250.92 (A)(3).** See 250.102 (C) for size.
- **Conductors entering cabinets.** See 312.5.
- **Grounding electrode conductor.** See 250.62 for material, 250.64 for installation, and 250.66 for size.
- **Cable armor or other raceway.**

Where neutral bus is insulated from the enclosure, install a main bonding jumper or screw with a green finish. See 250.8, 250.28. Neutral disconnect means. See 230.75.
CONCRETE-ENCASED ELECTRODE  
(UFER GROUND)

Grounding electrode shall be terminated in a dry location if rebar is used.

Service disconnect.

If neutral bus is insulated from enclosure, install a main bonding jumper or screw with a green finish. See 250.8, 250.28.

Grounding electrode conductor. See 250.62 for material, 250.64 for installation, and 250.66 for size.

Listed system ground clamps. See 250.70.

Bond to interior metallic cold water piping systems. See 250.104 (A).

Ground electrode. See 250.52 (A)(3).

Exterior concrete foundation

Connection to electrode. Connect grounding electrode conductor to the grounding electrode with listed ground clamp. See 250.70.

NOTE: 6.0 m (20 feet) or more of 13 mm (1/2 inch) diameter reinforcing steel or #4 bare copper wire (or larger). See 250.52 (A)(3). Reinforcing rods that are coated with a nonconductive material are not acceptable as an electrode.

See the **Grounding and Bonding Pamphlet** for a thorough explanation of the grounding electrode system.
SEPARATELY DERIVED SYSTEM
GROUNDING AND BONDING
(CUSTOMER’S TRANSFORMER)

Single Phase

Insulated neutral

NOTE: Primary windings are not shown for simplicity.

Grounding electrode conductor. See 250.62 for material, 250.64 for installation, and 250.66 for size.

Connection to electrode. Connect grounding electrode conductor to the grounding electrode with exothermic welding; listed lugs, pressure connectors, clamps; or other listed means. See 250.70.

Grounding Electrode. See 250.50 and 250.30 (A)(7). Use the nearest of:
(1) Metal water pipe grounding electrode
OR
(2) Structural metal grounding electrode

Grounding Electrode Conductor.
See 250.30 (A)(3) for a single separately derived system.
See 250.30 (A)(4)(a), (b) and (c) for Common Grounding Electrode Conductor and Grounding Electrode Conductor Taps permitted from each separately derived system.

NOTES:
1. Primary winding are not shown for simplicity.
2. Grounding and bonding connection as shown above are permitted to be made at any point between the transformer secondary and the first disconnecting means. See 250.30 (A)(1). Exception No. 2 permits bonding at both source and first disconnecting means if no parallel path is established for grounded circuit conductor. Earth is not considered a parallel path.
Three-Phase, Four-Wire Wye

NOTE: Primary windings are not shown for simplicity.

Connection to electrode. Connect grounding electrode conductor to the grounding electrode with exothermic welding; listed lugs, pressure connectors, clamps; or other listed means. See 250.70.

Grounding Electrode. See 250.50 and 250.30 (A)(7). Use the nearest of:
1. Metal water pipe grounding electrode
OR
2. Structural metal grounding electrode

Grounding Electrode Conductor.
See 250.30 (A)(3) for a single separately derived system.
See 250.30 (A)(4)(a), (b) and (c) for Common Grounding Electrode Conductor and Grounding Electrode Conductor Taps permitted from each separately derived system.

NOTES:
1. Primary windings are not shown for simplicity.
2. Grounding & bonding connections as shown above are permitted to be made at any point between the transformer secondary and the first disconnecting means. See 250-30 (A)(1). Exception No. 2 permits bonding at both source and first disconnecting means if no parallel path is established for grounded circuit conductor. Earth is not considered a parallel path.
**SEPARATELY DERIVED SYSTEM**

**GROUNDING AND BONDING**

**(CUSTOMER'S TRANSFORMER)**

**Three-Phase, Four-Wire Delta High-Leg**

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**NOTES:**
1. Primary windings are not shown for simplicity.
2. Grounding & bonding connections as shown above are permitted to be made at any point between the transformer secondary and the first disconnecting means. See 250.30 (A)(1). Exception No. 2 permits bonding at both source and first disconnecting means if no parallel path is established for grounded circuit conductor. Earth is not considered a parallel path.

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**Connection to electrode.** Connect grounding electrode conductor to the grounding electrode with exothermic welding; listed lugs, pressure connectors, clamps; or other listed means. See 250.70.

**Grounding electrode conductor.** See 250.62 for material, 250.64 for installation, and 250.66 for size.

**Grounding Electrode.** See 250.50 and 250.30 (A)(7). Use the nearest of:
- (1) Metal water pipe grounding electrode
- **OR**
- (2) Structural metal grounding electrode

**Grounding Electrode Conductor.**
See 250.30 (A)(3) for a single separately derived system.
See 250.30 (A)(4)(a), (b) and (c) for Common Grounding Electrode Conductor and Grounding Electrode Conductor Taps permitted from each separately derived system.
SEPARATELY DERIVED SYSTEM GROUNDING LOCATIONS

Connection to nearest effectively grounded structural member or effectively grounded metal water pipe within 1.5 m (5 ft) from the point of entrance to the building. Alternatively, a common grounding electrode conductor per 250.30 (A)(2)(b) and 250.30 (A)(3).
HIGH-IMPEDANCE GROUNDED NEUTRAL SYSTEM, SECTION 250.36

All of conditions (1), (2), (3), and (4) must be met:
(1) Qualified persons.
(2) Continuity of power is required.
(3) Ground detectors are installed.
(4) No line-to-neutral loads are served.