Use: General customer information for grounding and bonding

GROUNDING AND BONDING

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GENERAL INFORMATION

INTRODUCTION

TEP/UES recognizes the value of the NEC Grounding and Bonding requirements. We are pleased to share the following illustrations and data applicable to the requirements.

This information will provide assistance and guidance to person's installing Service Entrance equipment in areas served by TEP/UES.

The methods of Grounding and Bonding of Service Entrance equipment shown in this manual are recommended to maintain consistency throughout our service territory.

The following drawings and tables will assist in assuring a safe and adequate grounding installation, acceptable under any code. **Please consult your local governmental agency that has provided you with a permit for all applicable codes within their jurisdiction.**

NFPA 70 NEC

1. **Customer wire shall not be run through utility sealed areas.**
2. **Weatherproof hubs, etc.**, shall be used on any penetrations of equipment at the same height or above energized areas. A good rule of thumb is; that unless the penetration is on the bottom surface of a can, it shall be done with a weatherproof connection. Indoor equipment is an exception to this requirement.
3. **Bonding hubs (Meyers or equivalent) shall not be used on multi-centric knockouts, unless the largest knockout is used.**
4. Interior metal water piping systems, complying with NEC requirements are permitted for grounding and shall be bonded to the service entrance enclosure with conductors sized per NEC. In multiple occupancy buildings where the interior metal water piping system for the individual occupancies is isolated from all other occupancies by the use of non-metallic pipe, each water system may be bonded to the panel board or switchboard enclosure supplying that occupancy, sized per NEC.
5. Other metal piping systems (e.g. gas pipe) shall be bonded to the service equipment enclosure with a conductor sized per NEC.
6. **Nonconductive paint must be removed at threads, contact points and contact surfaces of any ground/bond lugs, terminal strips, etc., to assure a good electrical connection.**

GROUNDING

The grounding electrode conductor may be either bare or with green insulation. Ground electrode conductors not encased in conduit shall be a minimum size of No. 4 copper or larger and must be securely fastened to the building or structure with approved fastening devices. The spacing of such devices shall not exceed 2 feet.

If a ground rod is used as an electrode, **they shall be at least 6 feet apart and at least 8 feet shall be in contact with the soil.**

Grounding Electrode conductors smaller than size No. 4 copper shall be solid copper wire, or shall be attached to the ground rod using the exothermic welding process.

BONDING (Unfused areas)

Bonding is required on all enclosures, equipment, raceways, and fittings which contain unfused service conductors. Nipples and bushings installed through eccentric or concentric knockouts must be bonded with ground bushings, wedges, or other approved devices. **Bond conductor size shall be per NEC.**

MINIMUM SIZE OF BONDING/EQUIPMENT GROUNDING/GROUNDING ELECTRODE CONDUCTORS AND GROUND BUS

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Table 250.122 Minumum 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)	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
	Size (AWG or kcmil)	

1. For sizing bonding conductor for gas line, per NEC 250.104.
2. For sizing any bond conductor required on the load side of fuses or circuit breakers per NEC 250.102.

MINIMUM SIZE OF BONDING/EQUIPMENT GROUNDING/GROUNDING ELECTRODE CONDUCTORS AND GROUND BUS

Use: General customer information for grounding and bonding

Table 250.66 Grounding Electrode Conductor for Alternating Current Systems			
Size of Largest Ungrounded Service-Entrance 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 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

Review the notes below this table and in the NEC.

1. For metal water pipe bonding refer to the NEC 250.104
2. For sizing main bonding jumper from equipment grounding bus to neutral bus refer to the NEC 250.28.
3. Where exposed, a grounding electrode conductor or its enclosure shall be securely fastened to the surface on which it is carried. A 4 AWG or larger copper or aluminum grounding electrode conductor shall be protected where exposed to physical damage. A 6 AWG grounding electrode conductor that is free from exposure to physical damage shall be permitted to be run along the surface of the building construction without metal covering or protection where it is securely fastened to the construction; otherwise, it shall be in rigid metal conduit, intermediate metal conduit, rigid nonmetallic conduit, electrical metallic tubing, or cable armor. Grounding electrode conductors smaller than 6 AWG shall be in rigid metal conduit, intermediate metal conduit, rigid nonmetallic conduit, electrical metallic tubing, or cable armor. Refer to the NEC 250.64

CONCRETE ENCASED ELECTRODE
(UFER GROUND)

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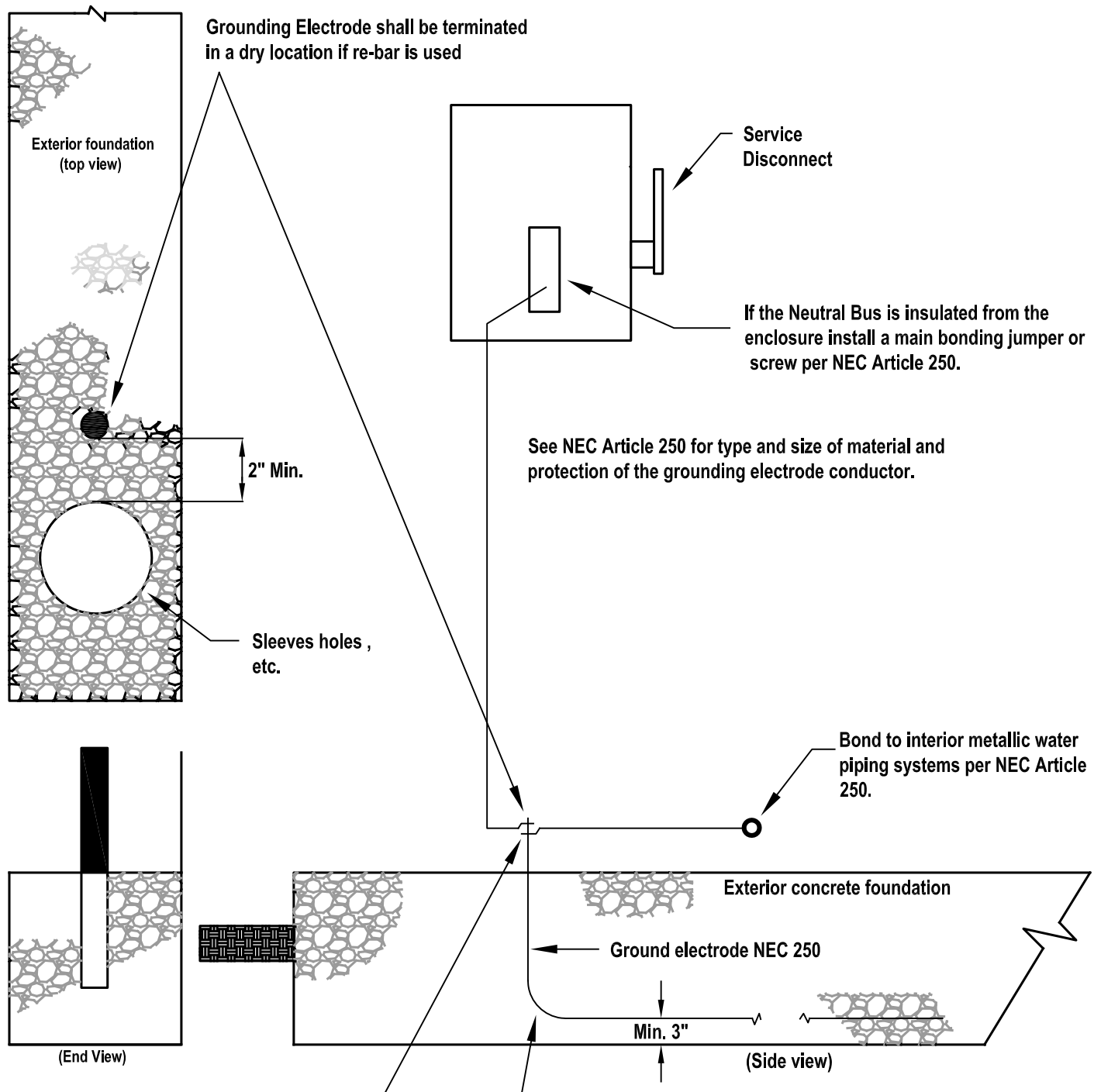

SINGLE PHASE METER PEDESTAL

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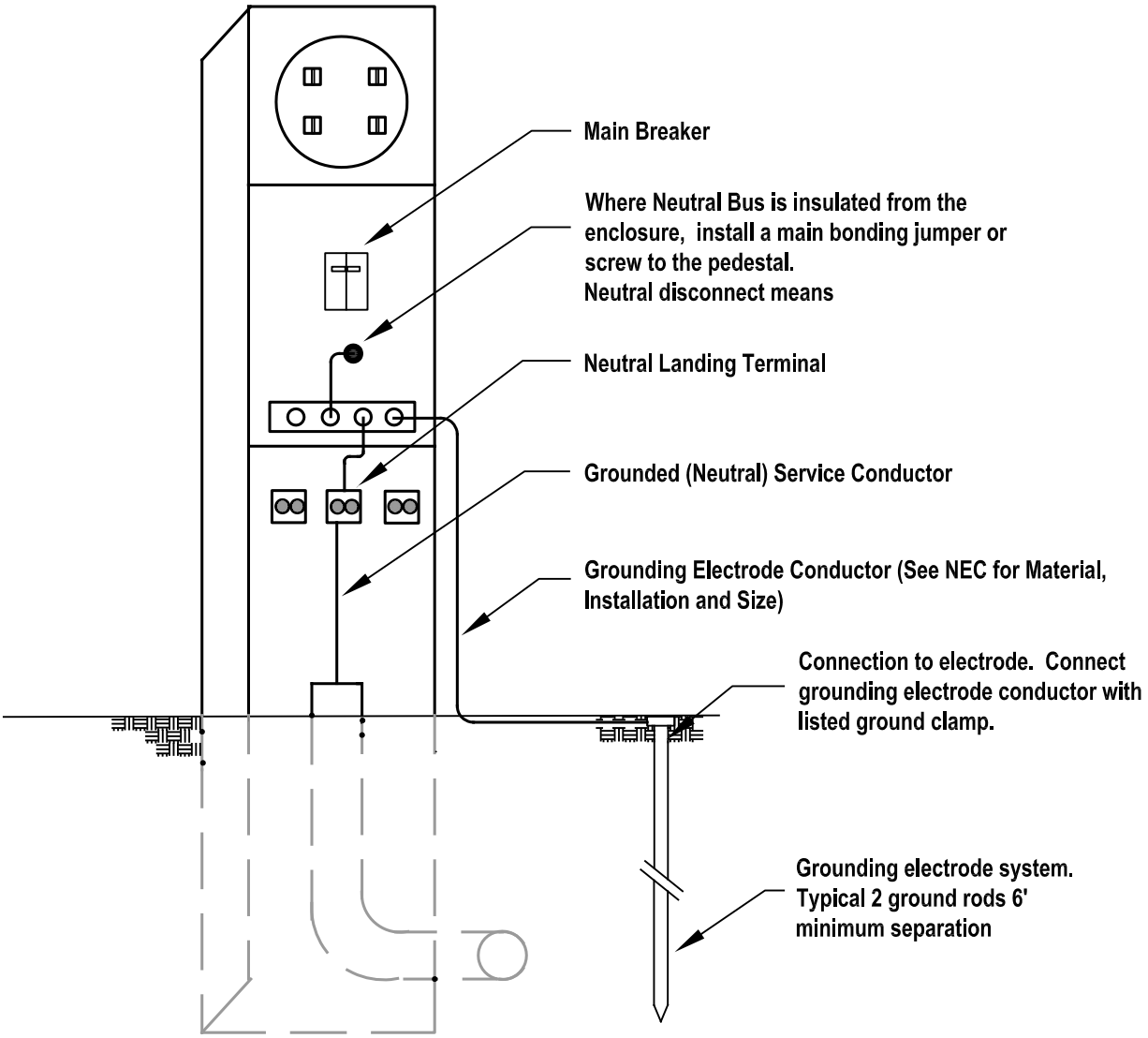
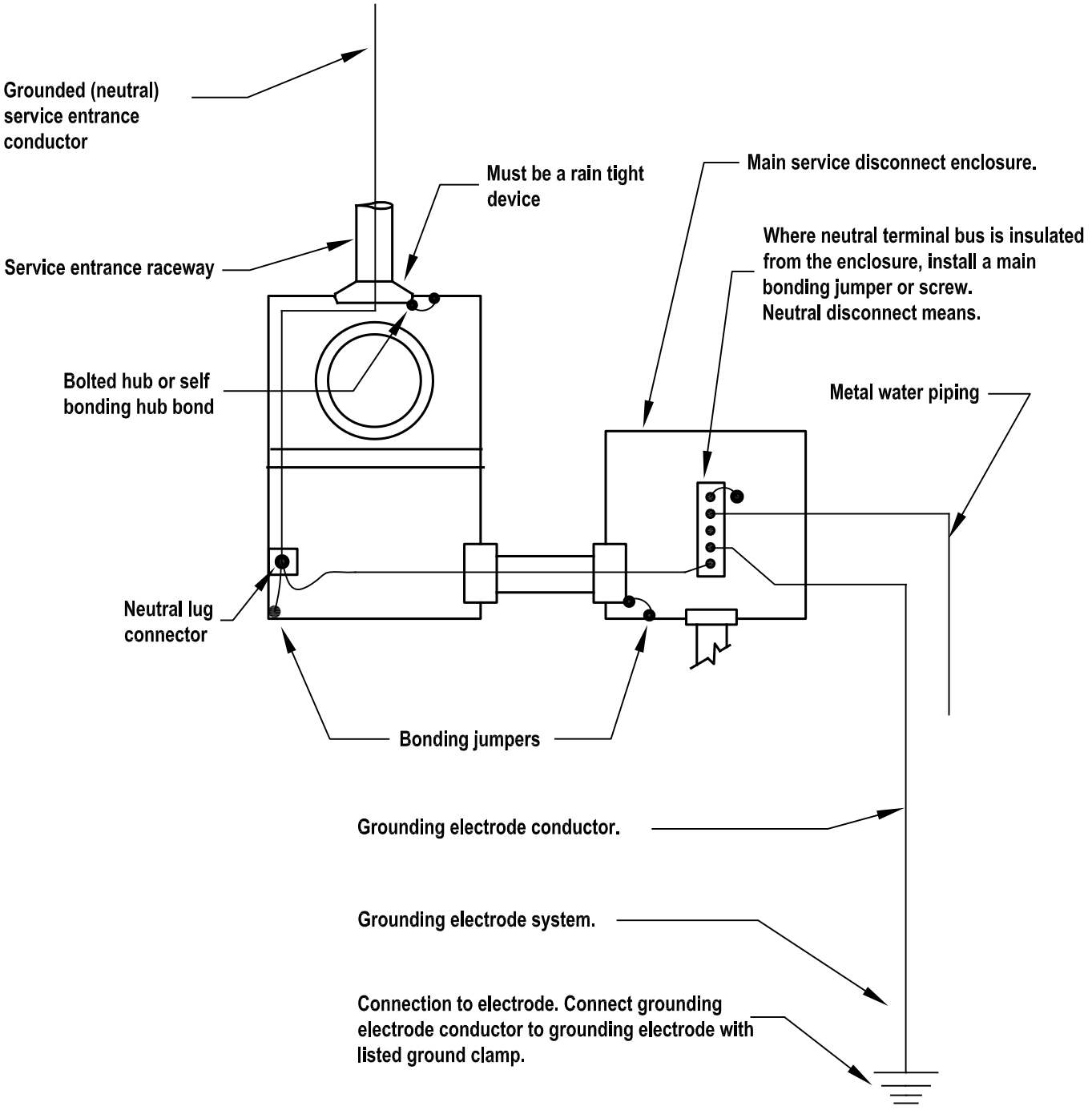


See NEC Article 250 for reference.

SINGLE OR THREE PHASE RESIDENTIAL OVERHEAD SERVICE (METER SOCKET AND DISCONNECTS)

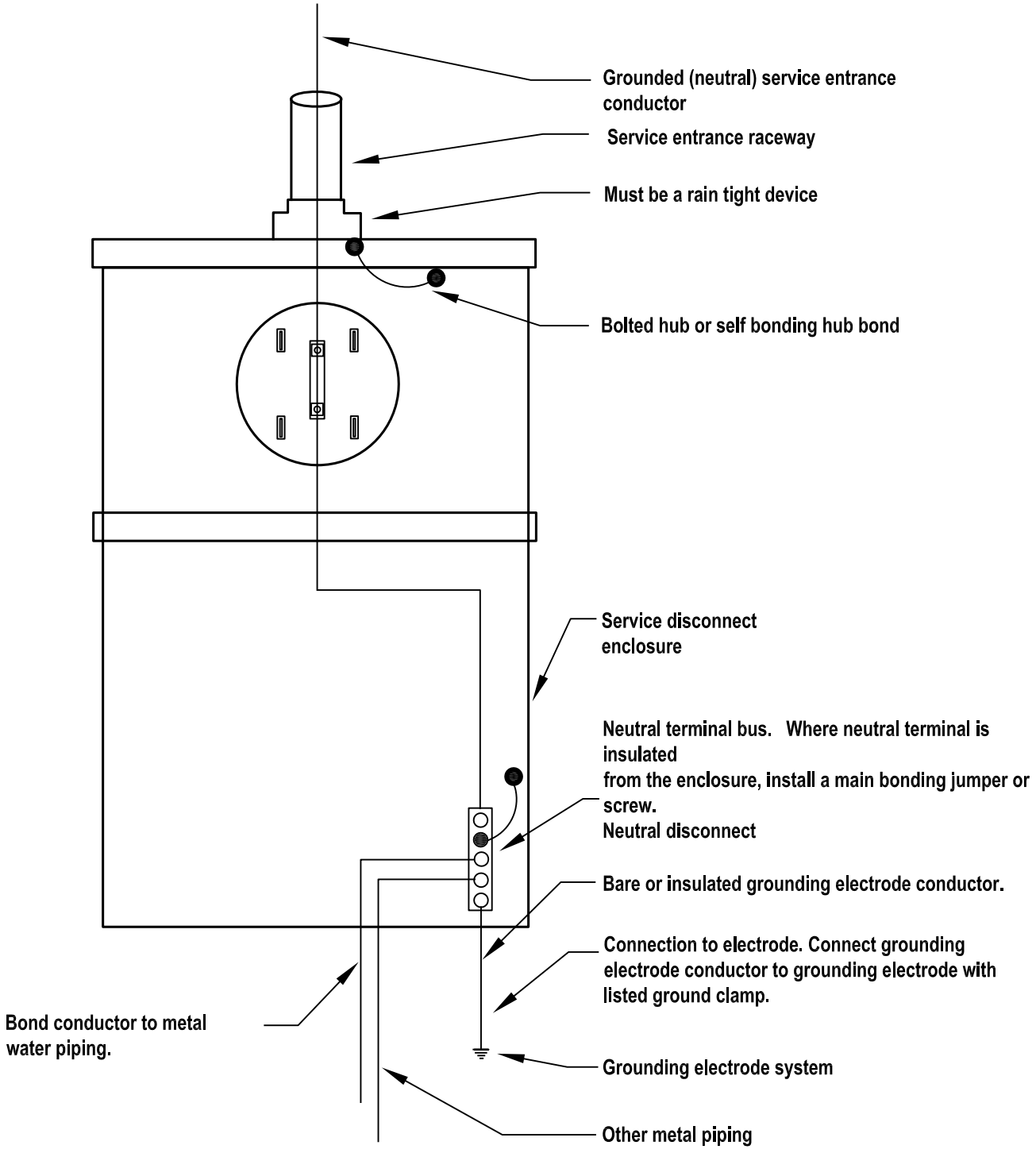
Use: General customer information for grounding and bonding



See NEC Article 250 for reference.

SINGLE PHASE RESIDENTIAL OVERHEAD SERVICE
(METER SOCKET AND LOAD CENTER)

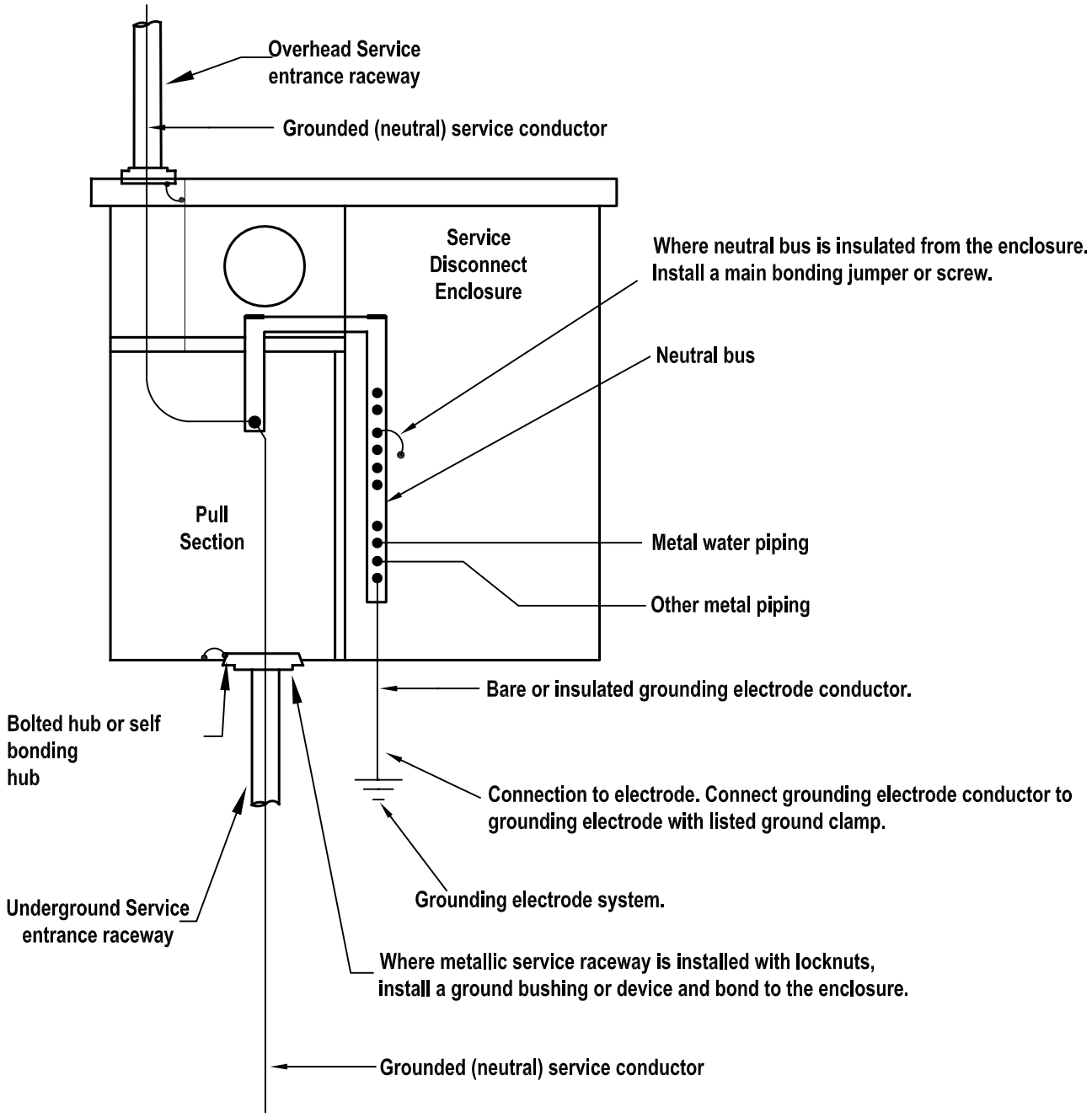
Use: General customer information for grounding and bonding



See NEC Article 250 for reference.

SINGLE PHASE OVERHEAD OR UNDERGROUND SERVICE
(ALL IN ONE)

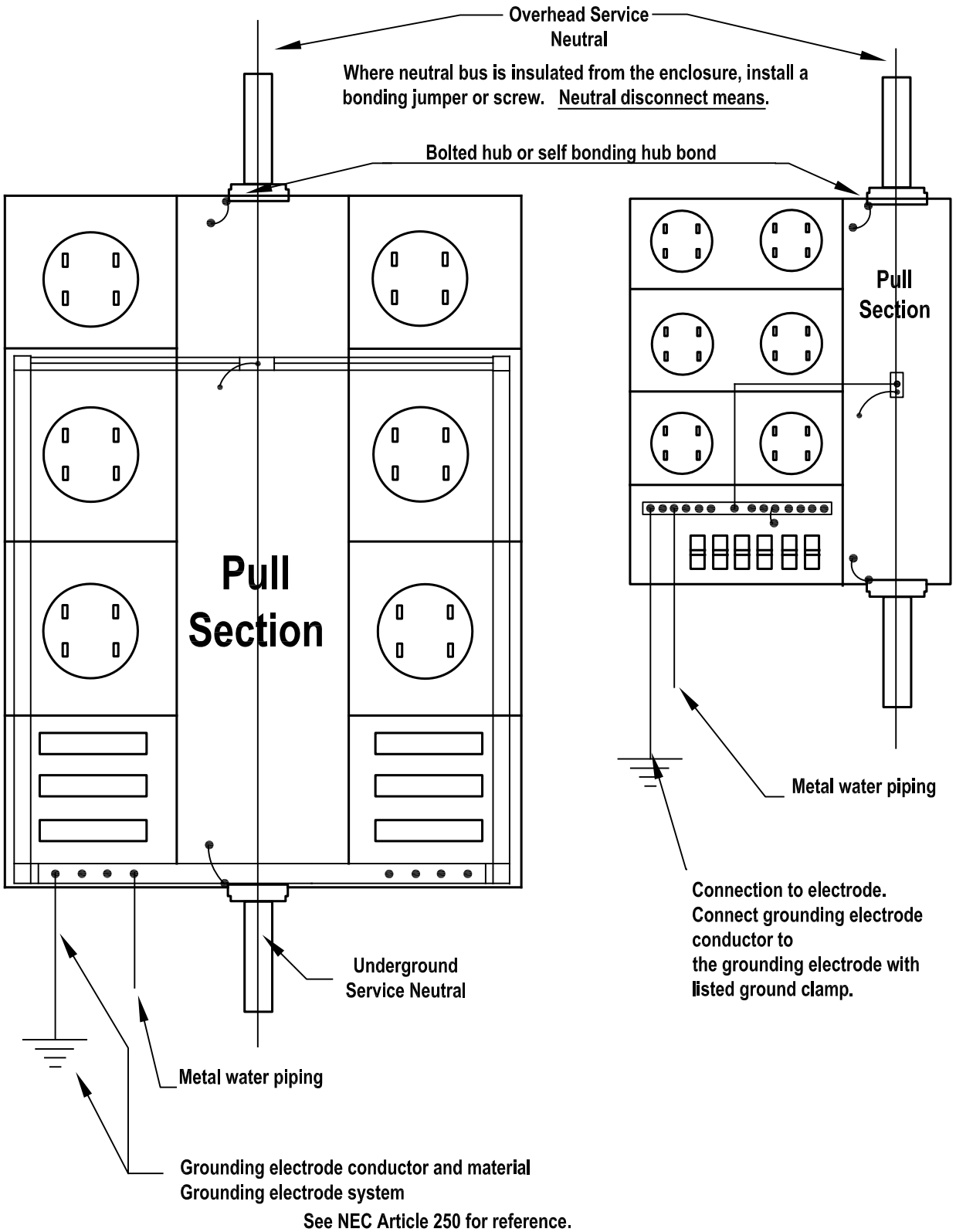
General customer information for grounding and bonding



See NEC Article 250 for reference.

SINGLE PHASE OVERHEAD OR UNDERGROUND
(MULTI-PAK SERVICE)

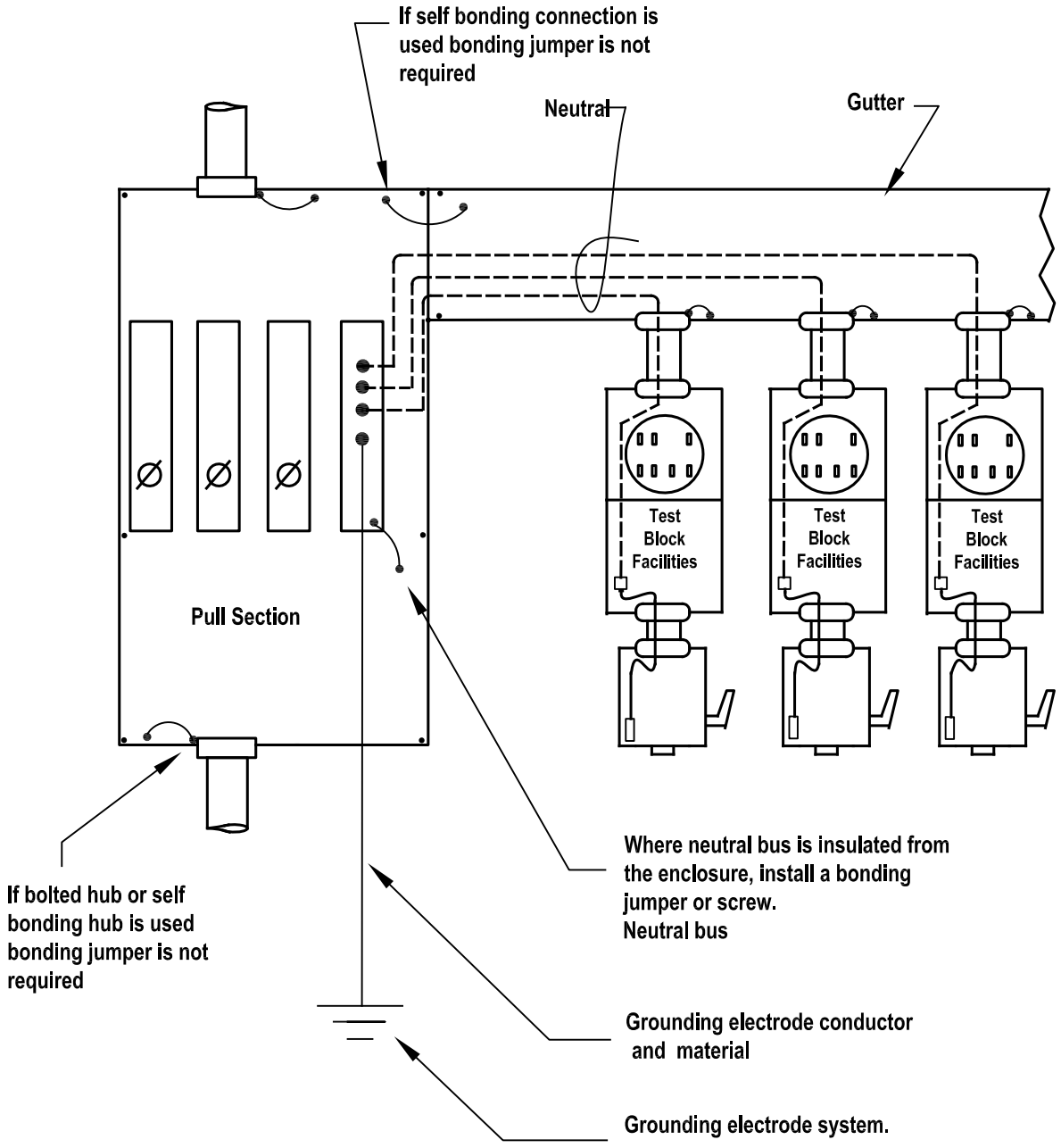
Use: General customer information for grounding and bonding



See NEC Article 250 for reference.

THREE PHASE SERVICE OVERHEAD OR UNDERGROUND
(PULL SECTION, RACEWAY AND SOCKETS)

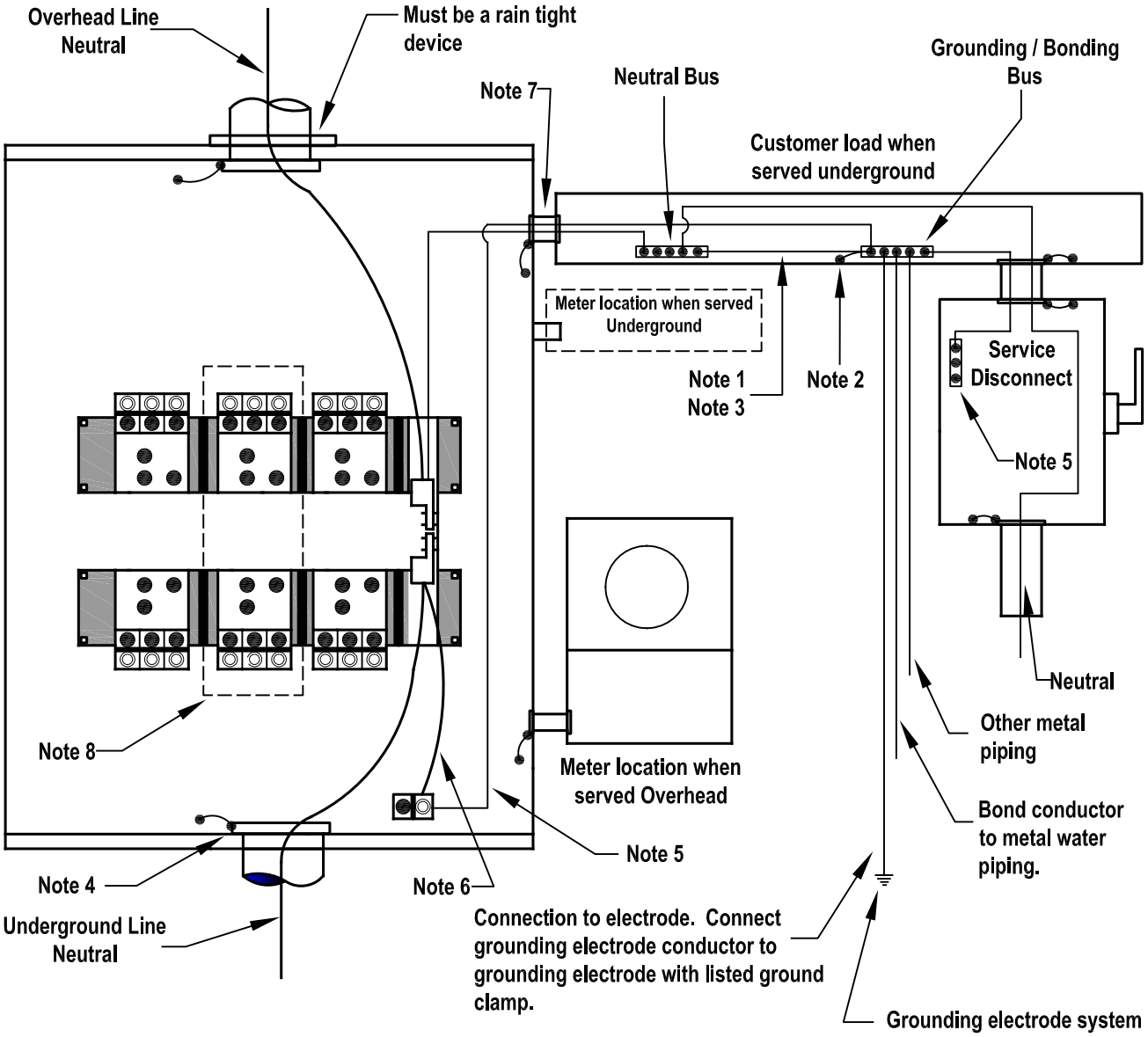
General customer information for grounding and bonding



See NEC Article 250 for reference.

TRANSFORMER RATED SERVICE WITH CT CAN
OVERHEAD OR UNDERGROUND

General customer information for grounding and bonding

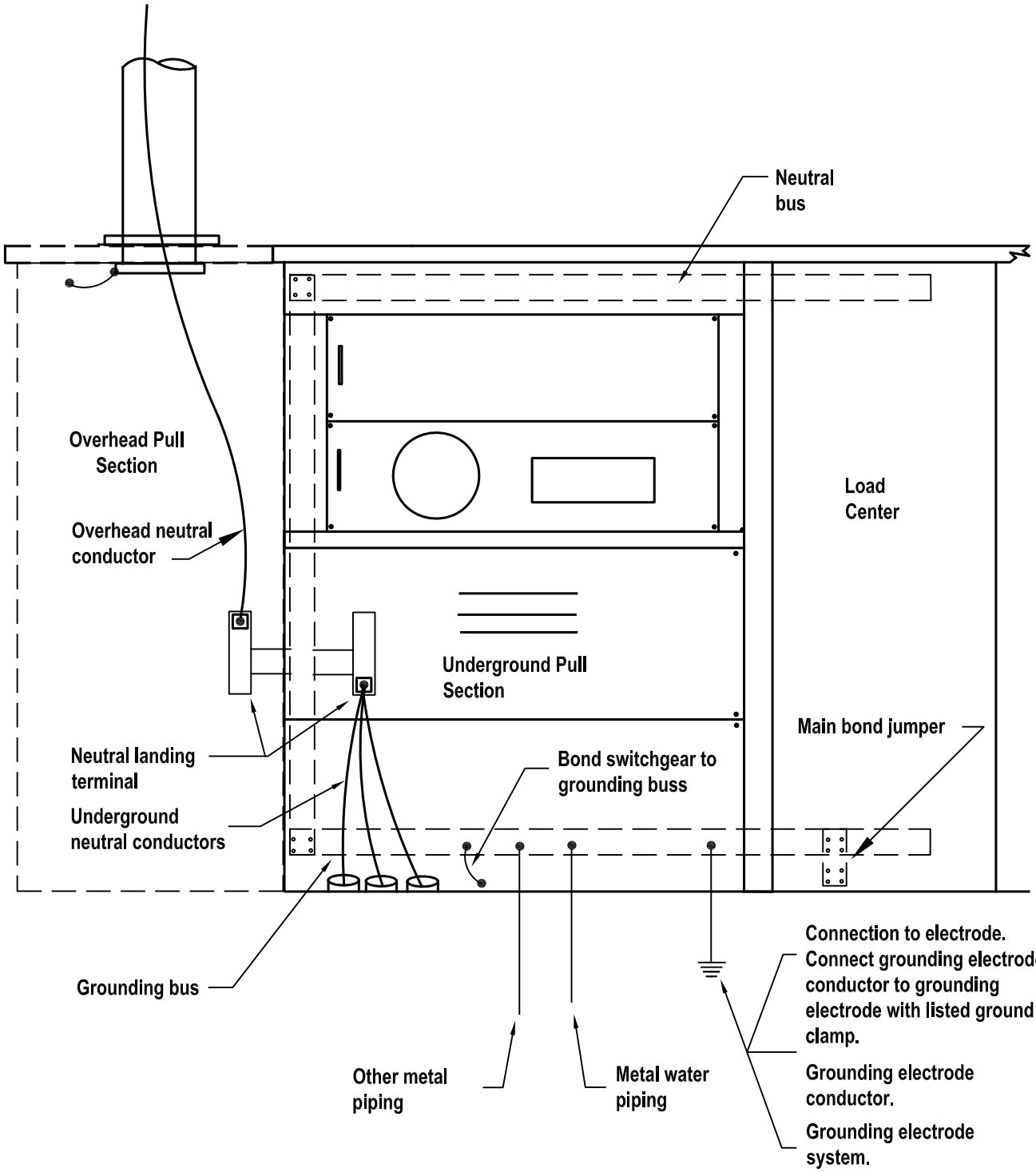


1. Main bonding jumper required per NEC
2. Grounding bond bus to be tied to metal gutter.
3. Bond conductor sized per the NEC.
4. If bolted hub or self bonding hub is used bonding jumper is not required .
5. Bond terminal bar to be tied to the metal enclosure.
6. Neutral terminal shall be bonded to the CT can.
7. If parallel conductors run from the can into the gutter, a bond wire must be installed in each conduit per the NEC.
8. Middle bus is not present on a single phase installation.

See NEC Article 250 for reference.

TRANSFORMER RATED SERVICE SWITCHGEAR
OVERHEAD OR UNDERGROUND

General customer information for grounding and bonding



See NEC Article 250 for reference.