

IQ ELECTRICAL TRAINING
Presents:

**INSPECTING
ELECTRICAL
SERVICES**

**250.24—250.28—and PART III
of Article 250**

Copyright © IAEI 2011

Frederick S. Mertz

- “ **Electrical Inspector City of Bristol**
- “ **Ct. Licensed Building Official**
- “ **Ct. Licensed Electrical Inspector**
- “ **Ct. and Virginia Master Electrician**
- IAEI Master Electrical Inspector**

Copyright © IAEI 2011

Definitions

- **Service**
- **The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served. (Handbook) If power is supplied by other than the utility the conductors are considered a feeder.**

5/20/2015 3

Definitions

- **“Feeder”**
- **All circuit conductors between the service equipment, or other power supply source and the final branch-circuit overcurrent device.**

5/20/2015 4

Definitions

- **“Branch Circuit”**
- **The circuit conductors between the final overcurrent device protecting the circuit and the outlet(s).**

5/20/2015 5

Definitions

- **“Service Conductors”**
- **The conductors from the service point to the service disconnecting means.**

5/20/2015 6

Definitions

- “Service Equipment”
- The necessary equipment, usually consisting of circuit breaker(s) or switch(es) and fuse(s) connected to the load end of the service conductors and intended to constitute the main cutoff of the supply.

5/20/2015 7

110.3(B)

110.3(B)-Installation and Use

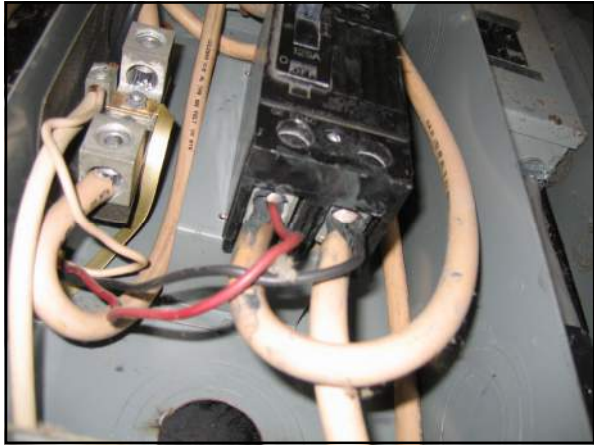
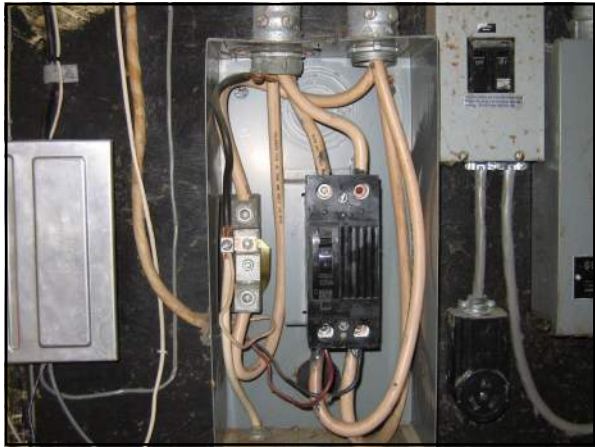
Listed or labeled equipment shall be installed and used in accordance with any instructions included in the listing or labeling.

Copyright © IAEEI 2011

110.14 Electrical Connections.

“ Because of the different characteristics of metals, devices such as terminals shall be identified for the material of the conductor. Conductors of dissimilar metals (CU-AL) shall not be intermixed in a terminal where physical contact occurs between them.

Copyright © IAEEI 2011



110.26 Spaces About Electrical Equipment

“ Sufficient access and working space shall be provided and maintained about all electric equipment to permit ready and safe operation and maintenance of such equipment.

Copyright © IAEEI 2011



110.26(A)(2) Width of Working Space

“ The width of the working space in front of the electric equipment shall be the width of the equipment or 30 in. whichever is greater. In all cases, the work space shall permit at least a 90 degree opening of equipment doors or hinged panels.

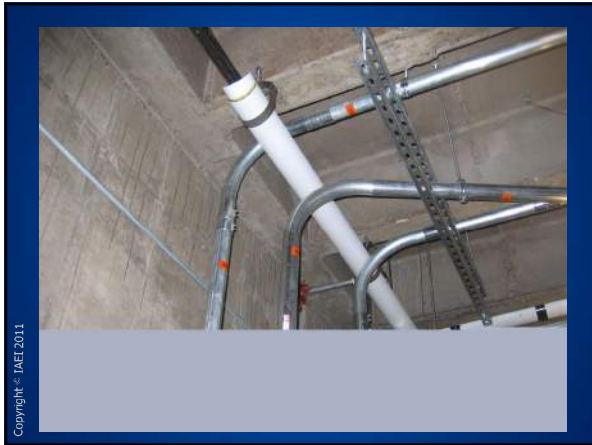
Copyright © IAEE 2011



110.26(E) Dedicated Equipment Space

“ Dedicated Equipment Space. All switchboards, panelboards, distribution boards, and motor control centers shall be located in dedicated spaces and protected from damage.

Copyright © IAEE 2011



Article 230 Services

230.2 Number of Services

“ A building or other structure served shall be supplied by only one service unless permitted in 230.2(A) through (D).

- 230.2 Number of Services**
- “ (A) Special Conditions**
 - “ (B) Special Occupancies**
 - “ (C) Capacity Requirements**
 - “ (D) Different Characteristics**

230.2 Number of Services

(A) Special Conditions. Additional services shall be permitted to supply the following:

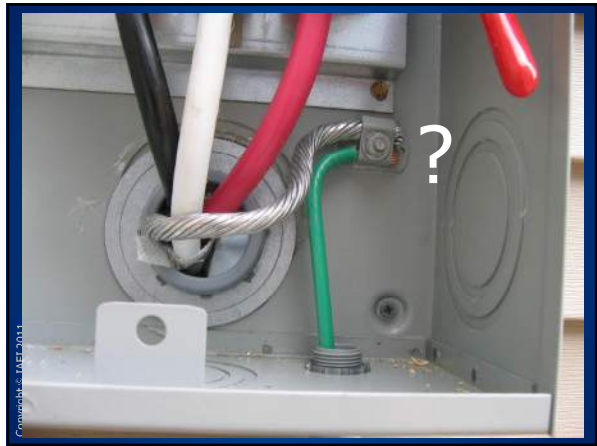
- (1) Fire pumps
- (2) Emergency systems
- (3) Legally required standby systems
- (4) Optional standby systems
- (5) Parallel power production systems
- (6) Systems designed for connection to multiple sources of supply for the purpose of enhanced reliability

Copyright © IAFET 2011

230.6-Conductors Considered Outside the Building

- (1) Where installed under not less than 2 in. of concrete beneath a building or other structure
- (2) Where installed within a building or other structure in a raceway that is encased in concrete or brick not less than 2 in. thick
- (4) Where installed in conduit and under not less than 18 in. of earth beneath a building or other structure
- (5) Where installed in overhead service masts on the outside surface of the building traveling through the eave.

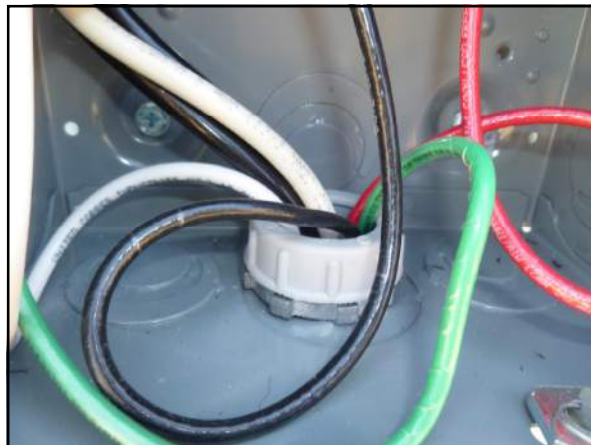
Copyright © IAFET 2011



230.7-Other Conductors in Raceway or Cable

- “ **Conductors other than service conductors shall not be installed in the same service raceway or service cable.**
- “ **Exception No. 1: Grounding conductors and bonding jumpers.**
- “ **Exception No. 2: Load management control conductors having overcurrent protection.**

Copyright © IAEE 2011



230.71 Maximum Number of Disconnects

- “ **(A) General.**
- “ **The service disconnecting means for each service permitted by 230.2 shall consist of not more than six switches or sets of circuit breakers.**

Copyright © IAEE 2011

230.72 Grouping of Disconnects.

- “ **(A) General. The two to six disconnects as permitted in 230.71 shall be grouped. Each disconnect shall be marked to indicate the load served.**

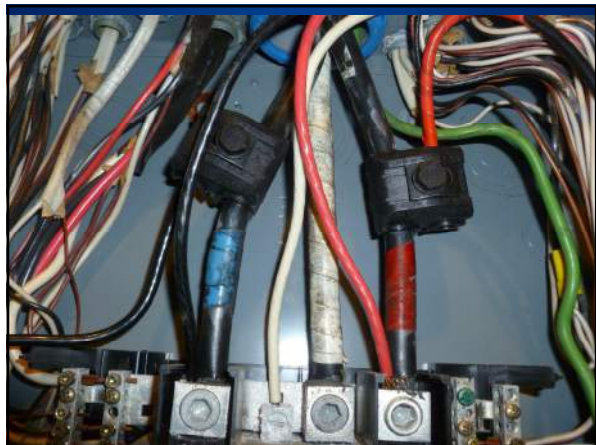
Copyright © IAEE 2011



230.75 Disconnection of Grounded Conductor

Where the service disconnecting means does not disconnect the grounded conductor, other means shall be provided for this purpose. A terminal or bus to which all grounded conductors (neutrals) can be attached by means of pressure connectors shall be permitted for this purpose.

Copyright © IAEE 2011



**Article 240
Overcurrent
Protection**

Copyright © IAEE 2011

240.21-Location in Circuit

240.21(B) Feeder Taps. Conductors shall be permitted to be tapped, without overcurrent protection at the tap, to a feeder as specified in 240.21(B)(1) through (B)(5).

Copyright © IAEE 2011

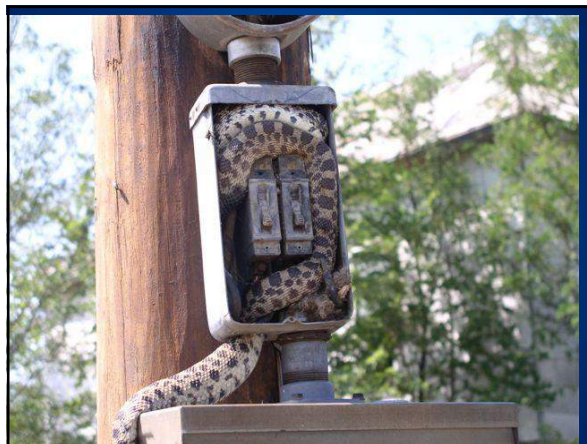
Definitions

“Feeder”

“All circuit conductors between the service equipment, or other power supply source and the final branch-circuit overcurrent device.”

Copyright © IAEE 2011
5/20/2015

43



Definition from Article 240

“Tap Conductors. As used in this article, a tap conductor is defined as a conductor, *other than a service conductor*, that has overcurrent protection ahead of its point of supply that exceeds the value permitted for similar conductors that are protected as described elsewhere in 240.4.”

Copyright © IAEE 2011

240.21(D)

“(D) Service Conductors. Service conductors shall be permitted to be protected by overcurrent devices in accordance with 230.91.”

Copyright © IAEE 2011

Article 250 Grounding and Bonding

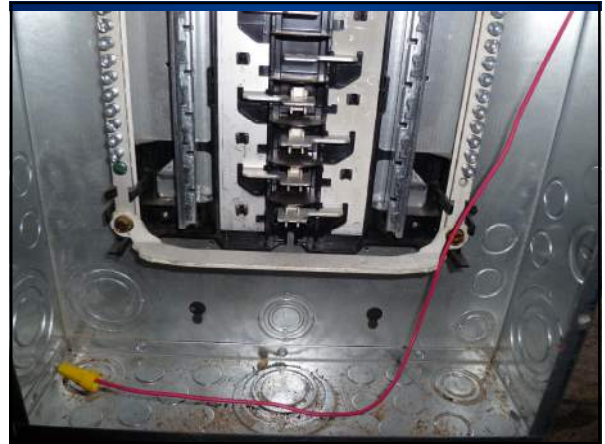
Copyright © IAEE 2011

250.6-Objectionable Current over Grounding Conductors

“(A) Arrangement to Prevent Objectionable Current.
“The grounding of electrical systems, circuit conductors, and conductive non-current-carrying materials and equipment shall be installed and arranged to prevent objectionable current over the grounding conductors or paths.”

Copyright © IAEE 2011

Fred’s note--This the sub-panel rule.

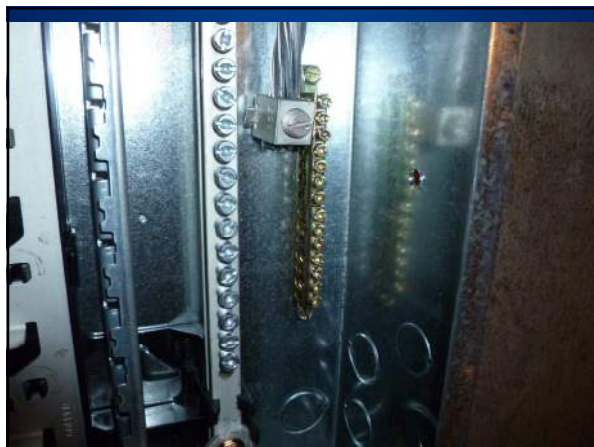
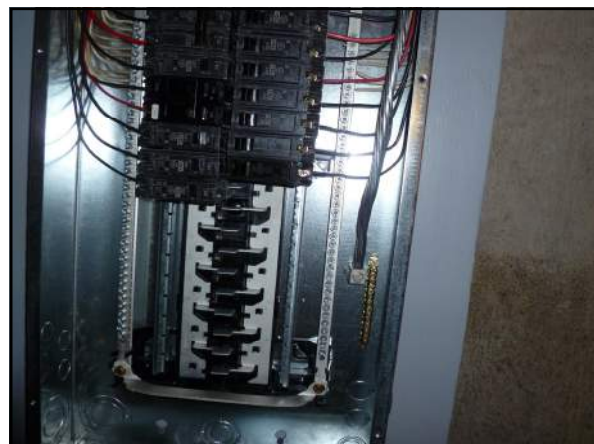
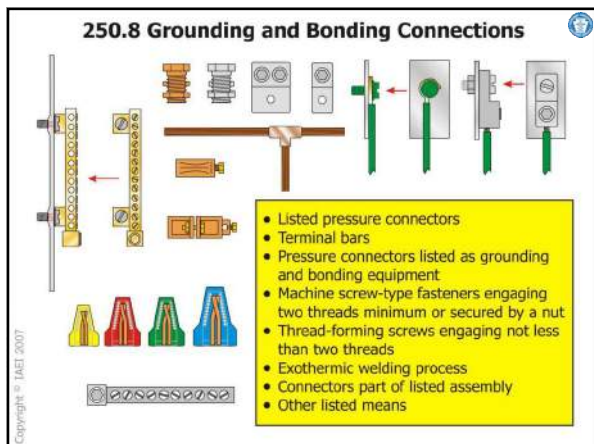


250.8 Connection of Grounding and Bonding Equipment.

“Grounding conductors and bonding jumpers shall be connected by listed means. Sheet metal screws shall not be used to connect grounding conductors or connection devices to enclosures.

Copyright © IAEE 2011





250.24 Grounding Service-Supplied Alternating Current Systems.

“(A) System Grounding Connections. A premises wiring system supplied by a grounded ac service shall have a grounding electrode conductor connected to the grounded service conductor, at each service, in accordance with 250.24(A)(1) through (A)(5).

Copyright © JAEI 2011

250.24(A)(1)

“(1) General. The connection shall be made at any accessible point from the load end of the service drop or service lateral to and including the terminal or bus to which the grounded service conductor is connected at the service disconnecting means.

Copyright © JAEI 2011

250.24(A)(4)

“4) Main Bonding Jumper as Wire or Busbar.

“ Where the main bonding jumper specified in 250.28 is a wire or busbar and is installed from the grounded conductor terminal bar to the equipment grounding terminal bar in the service equipment, the grounding electrode conductor shall be permitted to be connected to the equipment grounding bar to which the main bonding jumper is connected.

Copyright © JAEI 2011



250.24(A)(5) Load-Side Grounding Connections.

A grounded conductor shall not be connected to normally non current carrying metal parts of equipment, to equipment grounding conductors or be reconnected to ground on the load side of the service disconnecting means.

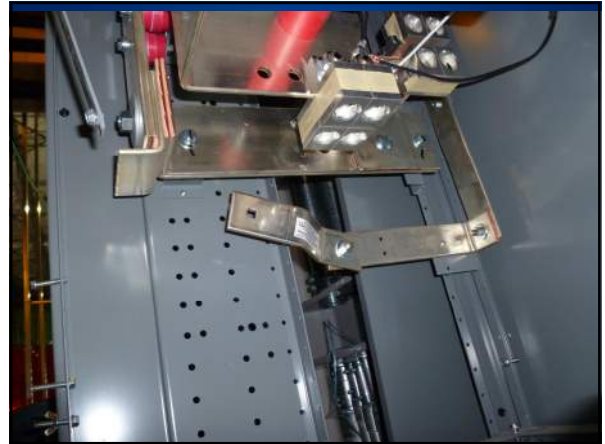
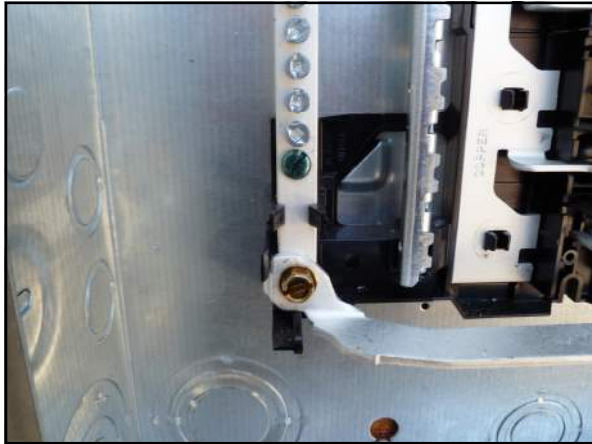
Copyright © IAEEI 2011

250.24(B) Main Bonding Jumper

For a grounded system, an unspliced main bonding jumper shall be used to connect the equipment grounding conductor(s) and the service-disconnect enclosure to the grounded conductor within the enclosure for each service disconnect in accordance with 250.28.

Copyright © IAEEI 2011





250.24(C) Grounded Conductor Brought to Service Equipment

“ Where an ac system operating at less than 1000 volts is grounded at any point, the grounded conductor(s) shall be run to each service disconnecting means and shall be bonded to each disconnecting means enclosure.

The 2011 NEC added wording to make it clear that grounded conductor was to be connected to the panel terminal or bus.

Copyright © IAET 2011



250.24(D)

“(D) Grounding Electrode Conductor. A grounding electrode conductor shall be used to connect the equipment grounding conductors, the service-equipment enclosures, and, where the system is grounded, the grounded service conductor to the grounding electrode(s) required by Part III of this article.

The 2008 NEC added wording that states “The conductor shall be sized in accordance with 250.66

Copyright © IAEE 2011

250.28 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 or other corrosion-resistant material. A main bonding jumper and a system bonding jumper shall be a wire, bus, screw, or similar suitable conductor.

Copyright © IAEE 2011

250.28 continued

“(B) Construction. Where a main 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 attached in the manner specified by 250.8.

Copyright © IAEE 2011



250.28(D) Size

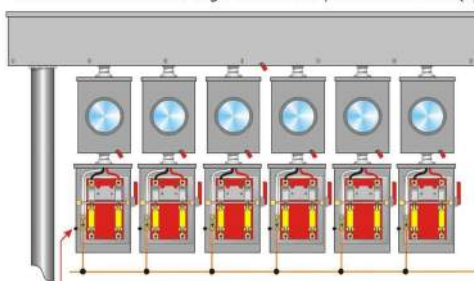
~ (D) Size. Main bonding jumpers and system bonding jumpers shall not be smaller than the sizes shown in Table 250.66.

~ This section was updated for 2008 to more clearly lay out requirements for services that consist of more than one enclosure.

Copyright © IAET 2011

250.28(D)(2) Main Bonding Jumper Size

Service with more than a single enclosure as permitted in 230.71(A)



Wire-type main bonding jumper in each enclosure sized in accordance with 250.28(D)(1) based on the largest ungrounded service conductor serving that enclosure

Copyright © IAET 2007



250.53 Grounding Electrode System Installation.

Copyright © IAET 2011

250.53(D) Metal Underground Water Pipe

~ If used as a grounding electrode metal water pipe shall meet the requirements of 250.53(D)(1) and (D)(2)

(D)(1)-Continuity-Water Meters / Filtering Bonding Jumpers required

~ (D)(2)-Supplemental Electrode Required
May be Metal Frame of Building, UFER, Ground Ring, Rod or other local underground system or structure.

Copyright © IAET 2011



Photo: IAET Archives

250.53(E)

Where 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 wire.

Copyright © JAEI 2011

250.53(G) Rod and Pipe Electrodes

The electrode shall be installed such that at least 8 ft of length is in contact with the soil. Where rock bottom is encountered, the electrode shall be driven at an angle not to exceed 45 degrees.

Where rock bottom is encountered the electrode shall be permitted to be buried in a trench that is at least 30 in. deep.

Copyright © JAEI 2011



250.53(G) Rod and Pipe Electrodes

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.

Copyright © JAEI 2011

250.53(G)



Copyright © JAEI 2011



250.64 Grounding Electrode Conductor (GEC) Installation

" GEC's at the service, at each building or structure where supplied by a feeder or branch circuit, shall be installed as specified in 250.64 (A) through (F)

Copyright © IAEE 2011

250.64(C) Continuous

- " GEC's shall be installed in one continuous length. Splices shall be made with one of the following methods.
- " Irreversible Connectors
- " Sections of busbars connected together
- " Metal frames of buildings
- " Threaded, soldered, or bolted flange connections of metal water piping.

Copyright © IAEE 2011



Copyright © IAEE 2011

250.64(D)(1)-Buildings or Structures with Multiple Disconnecting Means In Separate Enclosures

" 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.

Copyright © IAEE 2011

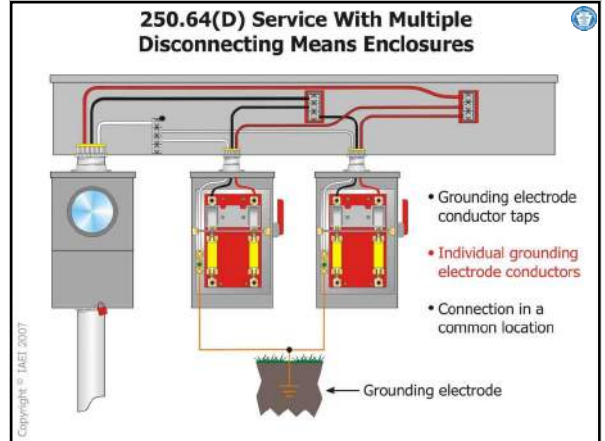
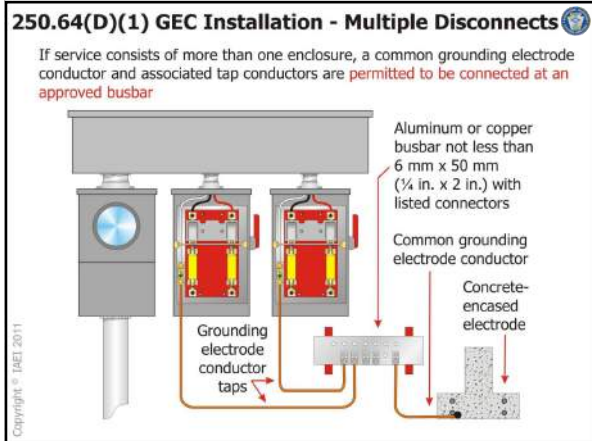
Common Grounding Electrode Conductor and Taps.

- " 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) An aluminum or copper busbar ¼ in. thick by 2 in. wide

Copyright © IAEE 2011



Copyright © IAEE 2011



250.64(D)(3)

“(3)-Common Location-A grounding electrode conductor shall be connected to the grounded service conductor in a wireway or other accessible enclosure on the supply side of the service disconnecting means.

Copyright © IAEE 2011

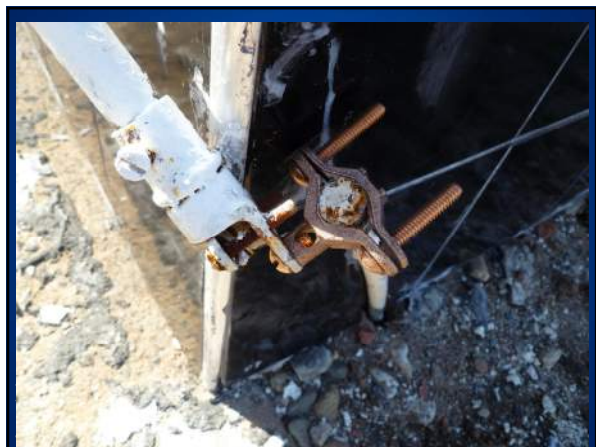


250.64(E) Enclosures for GEC's

“ Ferrous metal enclosures for grounding electrode conductors shall be electrically continuous from the cabinets to the grounding electrode and shall be securely fastened to the ground clamp or fitting.

“ Nonferrous metal enclosures shall not be required to be electrically continuous.

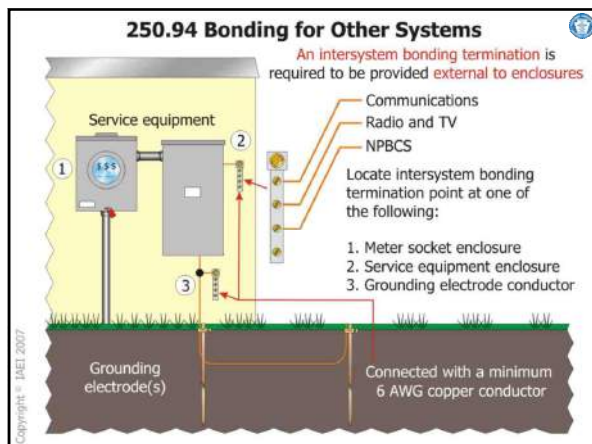
Copyright © IAEE 2011



250.94-Bonding for Other Systems

- “ Intersystem Bonding Termination requirements
- “ Accessible
- “ Capacity of not less than 3 connections
- “ Does not interfere with opening enclosures
- “ Securely mounted and bonded with #6CU
- “ Terminal listed for grounding and bonding.

Copyright © IAEE 2011



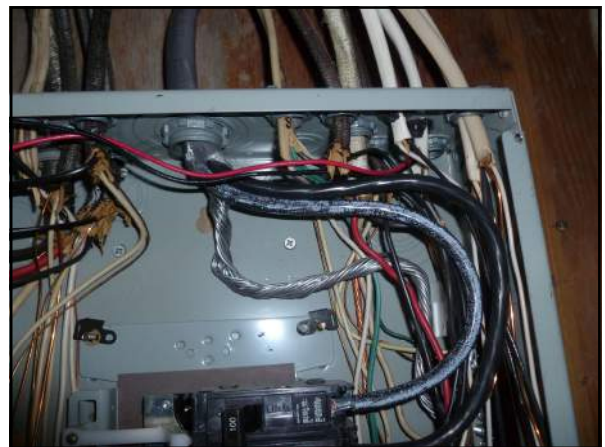
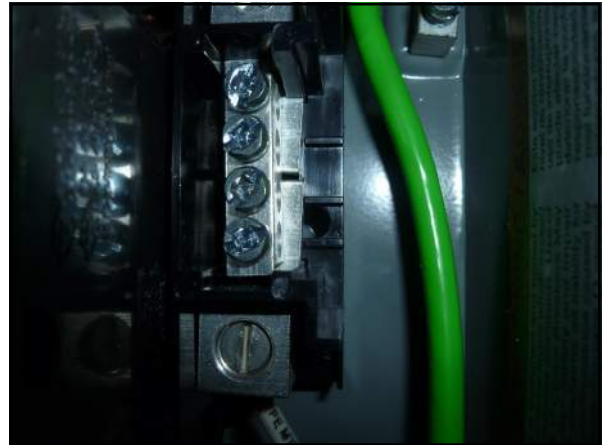
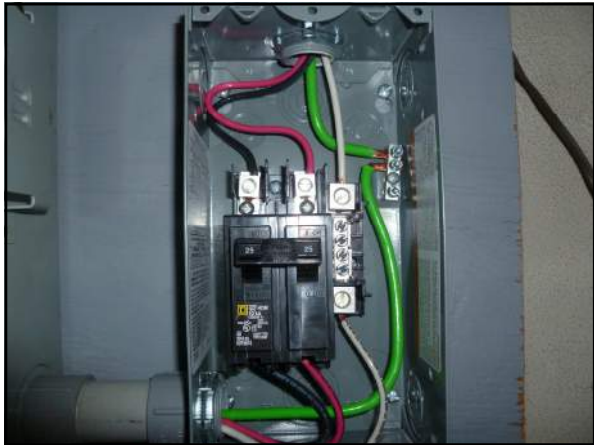
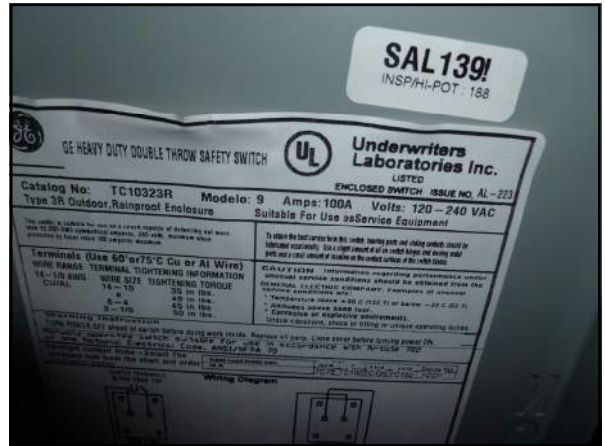
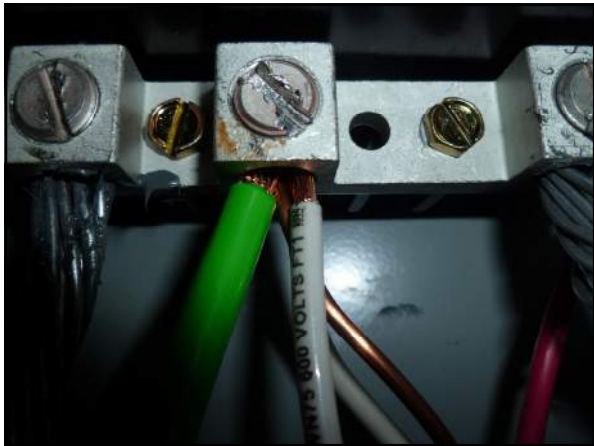
Case Study One





Case Study Two







ODDS AND ENDS

