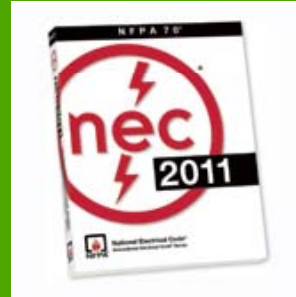


# 2011 National Electrical Code Changes

Alan Manche, P.E.  
Director, Industry Standards



**Schneider**  
Electric

## 2011 NEC Facts

- 5,016 public proposals
- 2,910 public comments
- 22 Certified Amending Motions at the NFPA Annual Meeting (7 were successful on the floor)
- 7 appeals to the Standards Council (all were denied)
- Issued by the NFPA Standards Council in August 2010 with an effective date of August 25, 2010
- Timing of the adoption of the NEC will vary by state and local jurisdiction

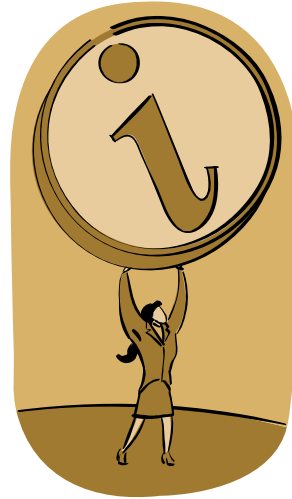
## 90.5(C) and (D) – Explanatory Material and Annexes

- **Fine Print Notes are now Informational Notes**

- FPN No.1..... Becomes..... Informational Note No. 1
- Information only and not enforceable as part of the code rules

- **New (D) added for Informative Annexes**

- Annexes A thru I are included for informational purposes and are not enforceable as part of the code rules



## 90.2(B)(5)(d) – Scope, Not Covered

- **Revised to add reference to “written agreements” to permit exemption of utility installations from code requirements**

- **Limited to:**

- Purpose of communications, metering, generation, control, transformation, transmission, or distribution of electric energy where legally established easements or rights-of-way cannot be obtained
- Federal lands, native American reservations, military bases, lands controlled by port authorities and state agencies and lands owned by railroads



## Article 100 – “Automatic”/ “Nonautomatic”

- **Automatic**

- Performing a function without the necessity of human intervention

- **Non Automatic**

- Requiring human intervention to perform a function



## Article 100 - Bathroom

An area consisting of a:



Toilet



Urinal



Basin

**Plus one or more of**



Tub



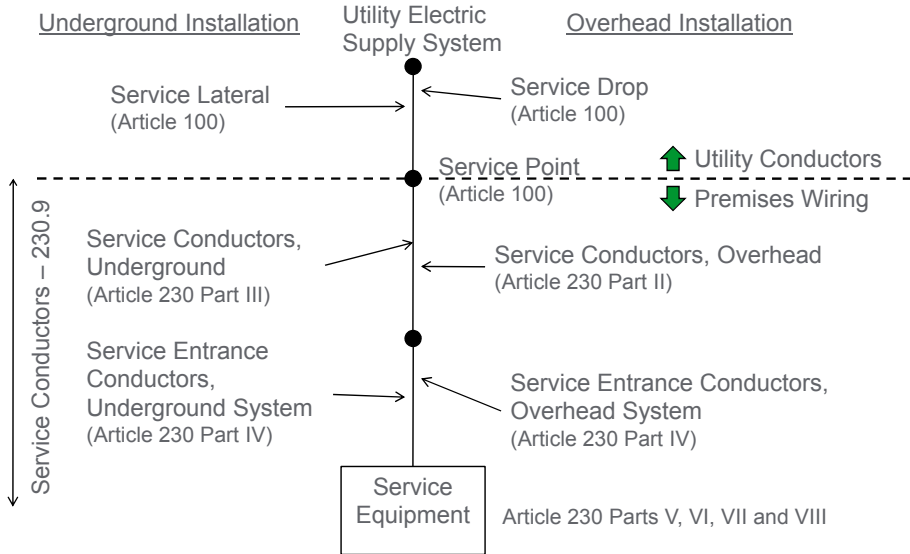
Shower



Bidet

**or similar plumbing fixture**

## Article 100 – Service Definitions



## 110.3(A)(1) – Examination of Equipment

### ● Informational Note revised to indicate that additional limitations may be found in:

- Product instructions
- Included with the listing and labeling information

- Do not connect circuit breaker to more than 250 ft. (76 m) of load conductor for the total one-way run.



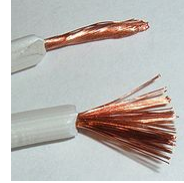
## NEC 110.14 – Electrical Connections

- Connectors and terminals for conductors more finely stranded than Class B and Class C stranding as shown in Chapter 9, Table 10, shall be identified for the specific conductor class or classes.

**Table 10 – Conductor Stranding**

Conductor Size		Number of strands		
AWG or kcmil	(mm <sup>2</sup> )	Copper		Aluminum
		Class B	Class C	Class B
24 – 30	0.20 – 0.05	<sup>a</sup>	–	–
22	0.32	7	–	–
20	0.52	10	–	–
18	0.82	16	–	–
16	1.3	26	–	–
14 – 2	2.1 – 33.6	7	19	7 <sup>b</sup>
1 – 4/0	42.4 – 107	19	37	19
250 – 500	127 – 253	37	61	37
600 – 1000	304 – 508	61	91	61
1250 – 1500	635 – 759	91	127	91
1750 – 2000	886 – 1016	127	271	127

<sup>a</sup> Number of strands vary.  
<sup>b</sup> Aluminum 14 AWG (2.1 mm<sup>2</sup>) is not available.



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## 110.24 - Available Fault Current

- (A) Service equipment to be marked in the field with the maximum available fault current.
  - Excludes Dwellings
  - Must include date the fault current calculation was performed
  - Sufficient durability to withstand the environment
- (B) Modifications
  - Must verify or recalculate the value
  - Adjust marking if necessary



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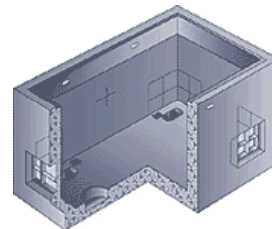
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## 110.28 Enclosure Types

- List of equipment to be marked with an enclosure-type expanded
- 110.28 relocated from 110.20
- Enclosures of switchboards, panelboards, industrial control panels, motor control centers, meter sockets, enclosed switches, transfer switches, power outlets, circuit breakers, adjustable-speed drive systems, pullout switches, portable power distribution equipment, termination boxes, general purpose transformers, fire pump controllers, fire pump motors, and motor controllers shall be marked with an enclosure-type number as shown in Table 110.28

## 110.31(A) – Electrical Vaults

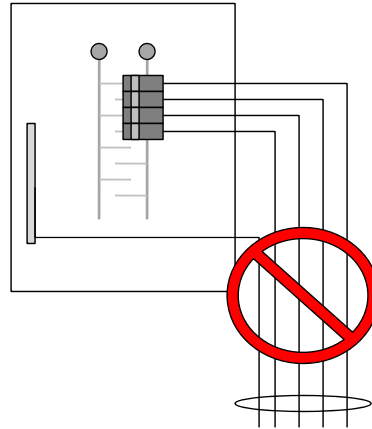
- Where a vault is required or specified for over 600V the section applies
- Construction
  - Walls and roof – 3 hour construction
  - Floors – not less than 4" thick, if constructed on upper floors must have a 3 hr rating
  - Doors – tight fitting with 3 hr rating
  - Can move to 1 hr rating if the vault is protected with automatic fire suppression
- Doors must be equipped with locks
- Transformer vaults must comply with Article 450



## 200.4 – Neutral Conductors

### ● Prohibits a single neutral conductor for:

- More than one branch circuit
- More than one multi-wire branch circuit
- More than one set of ungrounded feeder conductors unless specifically permitted elsewhere in the code



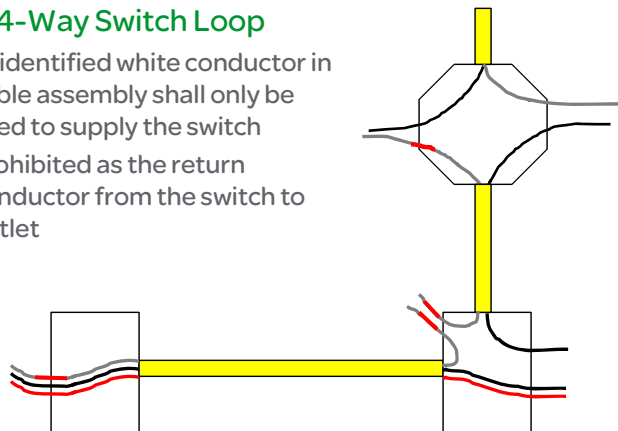
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## 200.7(C)(1) – White Conductor Identification

### ● 3 or 4-Way Switch Loop

- Reidentified white conductor in cable assembly shall only be used to supply the switch
- Prohibited as the return conductor from the switch to outlet



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## 210.8 – GFCI Accessibility

- The GFCI shall be installed in a readily accessible location
- Circuit breaker GFCIs are, by default, readily accessible because of requirements in 240.24(A)
- Caution must be used in placing GFCI receptacles where they may be blocked by items such as:
  - Furniture
  - Refrigerators
  - Vending machines

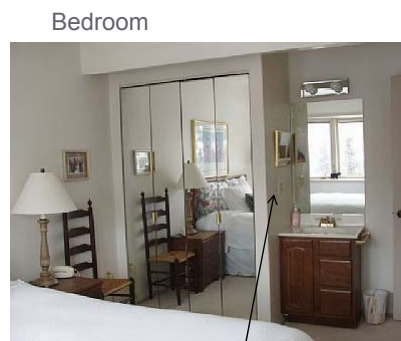


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## 210.8(A)(7) – Sinks (Dwelling Units)

- GFCI protection is required for all receptacles installed within 6' of any sink
- Kitchens are still covered by 210.8(A)(6)
- No exceptions for fixed equipment of special loads



GFCI required

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## 210.8(B) – GFCI Additions (other than dwelling units)

(6) Indoor wet Locations

(7) Locker rooms with associated showering facilities

(8) Garages, service bays, and similar areas where electrical diagnostic equipment, electrical hand tools, or portable lighting equipment are to be used



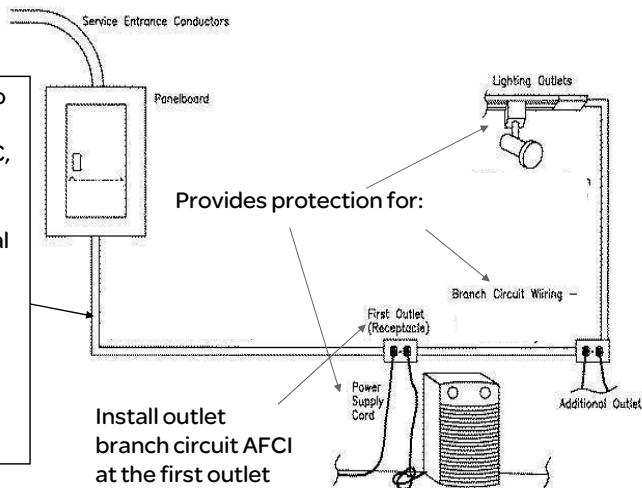
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## 210.12(A) Ex #1 and #2– AFCI at the 1<sup>st</sup> Outlet

Wiring from panel to first outlet must be installed in RMC, IMC, EMT, MC or steel jacketed AC cable. Must also have metal outlet and junction boxes.

Also permits nonmetallic conduit where encased in 2" of concrete



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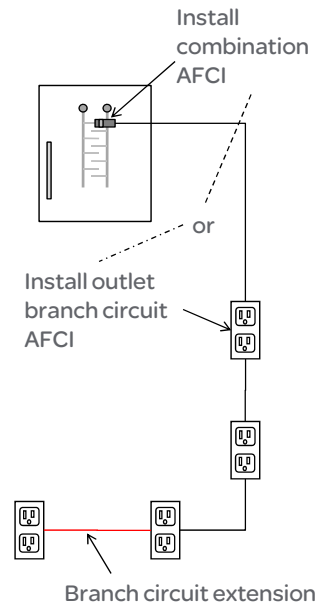
## 210.12(B) – Branch Circuit Extensions or Modifications (dwelling units)

- Requires that AFCI protection be provided where:

- Branch circuit wiring is modified, replaced or extended
- Applies to branch circuits in any of the areas specified in 210.12(A)

- The protection can be a combination AFCI at the origin of the branch circuit, or;

- It can be an Outlet Branch Circuit AFCI at the first receptacle outlet of the branch circuit



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## 210.52(A)(2)(1) – Wall Space

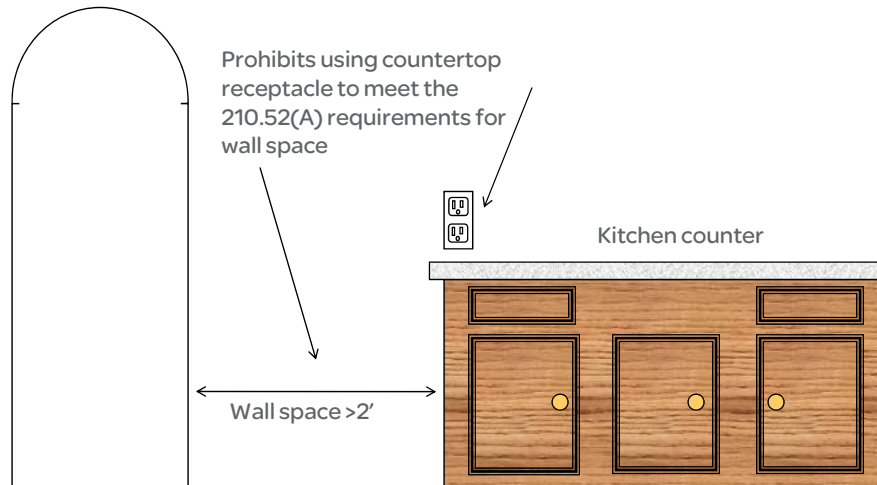
- Permits exclusion of fixed cabinets from wall space determination



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## 210.52(A)(4) – Countertop Receptacles



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## 210.52(E)(3) – Balconies, Decks and Porches

- Removes exception for small balconies, decks or porches
- At least one receptacle is required to be installed



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## 210.52(G) – Accessory Buildings (one family dwellings)

- A receptacle is required to be installed in an accessory building if electric power is provided to the accessory building



## 210.52(I) - Foyers

- Requires receptacles to be installed in foyers:
  - Foyer area greater than 60 sq ft
  - Foyer is not part of a hallway
  - Required at each wall space 3' or more in width (unbroken by doorways, floor to ceiling windows, etc.)



## 220.43(B) Exception – Track Lighting

- Example: 100' of 120V track lighting protected by a 20A overcurrent device



- 2008 NEC Feeder Load
  - $(100/2\text{ft}) \times 150\text{VA} = 7,500\text{VA}$
- 2011 NEC Feeder Load
  - $20\text{A} \times 120\text{V} = 2,400\text{VA}$



Calculation permitted to be based on the device that limits current to the track – could be the branch protective device or a supplemental device.

## 225.27 – Raceway Seal

- Raceways entering a building from an underground distribution system shall be sealed
  - Spare raceways must also be sealed
  - Sealant to be identified for use with cable



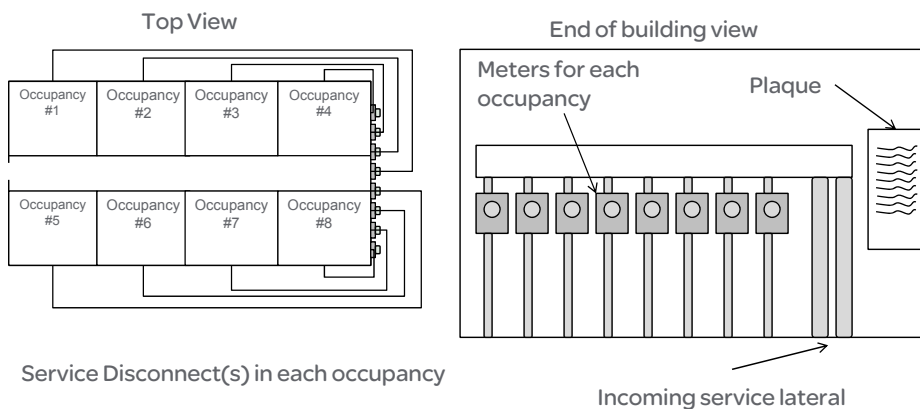
## 230.40 Exception No.1 – Number of Service Entrance Conductor Sets

- Buildings with more than one occupancy can have service entrance conductors run to each occupancy
- If the number of disconnect locations does not exceed six:
  - 230.2(E) applies (plaques or directory at each service disconnect location)
- If number of disconnect locations exceeds six:
  - All service along with any feeder or branch supplies must be clearly described using suitable graphics, text or both.
  - Plaque must be located in an approved, readily accessible location on the building or structure
    - Near as practicable to the point of attachment or entries for each service drop or lateral and for each set of overhead or underground service conductors

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## 230.40 – Exception No. 1



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## 240.87 - Non-instantaneous Trip

- Requires additional measures be installed where a circuit breaker without an instantaneous trip function is used
- Requires one of the following or an approved equivalent:
  - (1) Zone-selective interlocking
  - (2) Differential relaying
  - (3) Energy-reducing maintenance switching with a local status indicator



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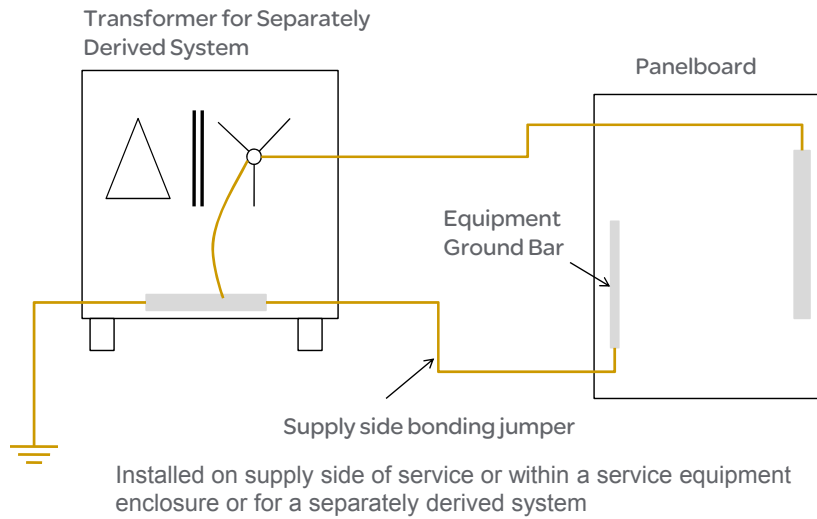
## 240.91(B) – Devices Rated Over 800 Amperes

- Applies in Supervised Industrial Locations Only
- Permits rounding up of overcurrent devices rated over 800A where:
  - The ampacity of the conductors protected by the device are 95% or greater of the rating of the device
  - The conductors are protected within recognized time vs. current limits for short circuit currents
  - All equipment in which the conductors terminate is **listed and marked** for the application
- Issues:
  - There are no products for this application
  - There are no standards developed to support the listing and marking
  - Utilization of smaller conductors raises the operating temperature of the equipment

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## 250.2 – Supply Side Bonding Jumper



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## 250.21(C) – Marking (ungrounded systems)

### ● Marking for ungrounded systems:

- Be marked “Ungrounded System”
- At the source or first disconnecting means of the system
- Sufficient durability to withstand the environment



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## 250.30(C) – Outdoor Source

- If source of separately derived system is located outside building or structure:

- Grounding electrode connection must be made at the source location
- Grounding electrode must comply with 250.50



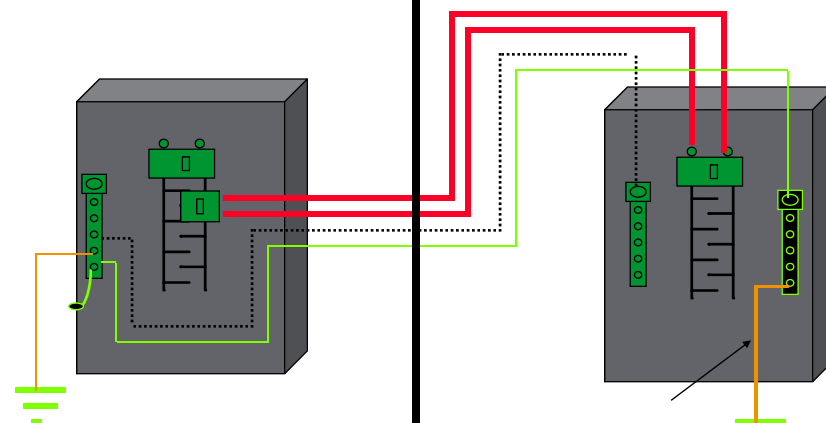
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## 250.32(B) – Two or More Buildings/Structures

Service Equip - Bldg #1

Bldg #2



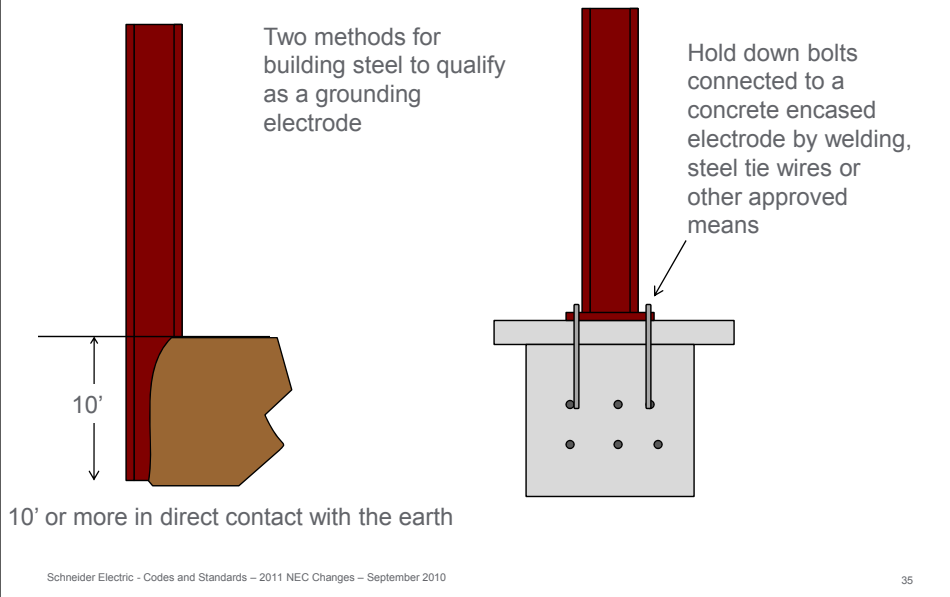
Ex: **Existing Installations** still permit bonding of grounded conductor at second building meeting 3 conditions

- 1) No EGC
- 2) No continuous metal path
- 3) GFPE not installed on supply side

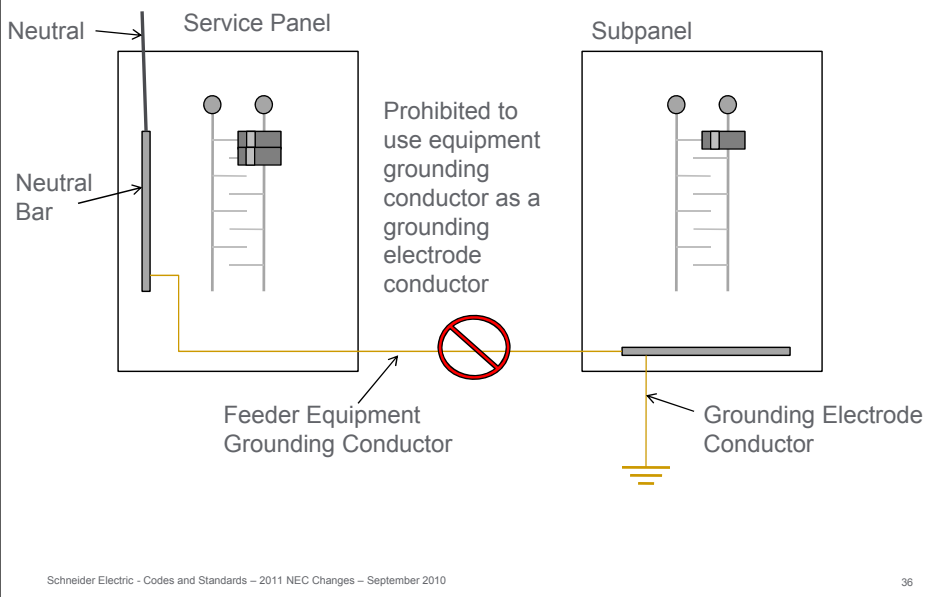
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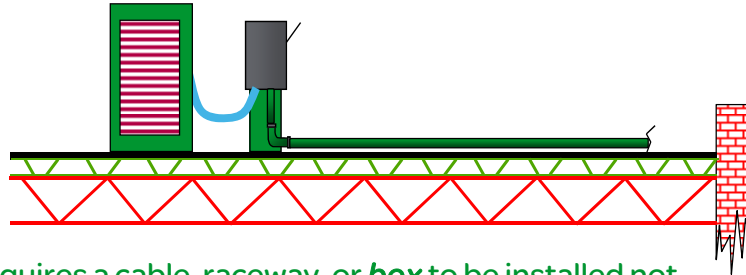
## 250.52(A)(2) – Metal Frame of Building or Structure



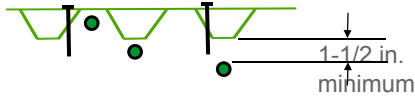
## 250.121 – Use of Equipment Grounding Conductors



### 300.4(E) – Raceways Under Roof Decking



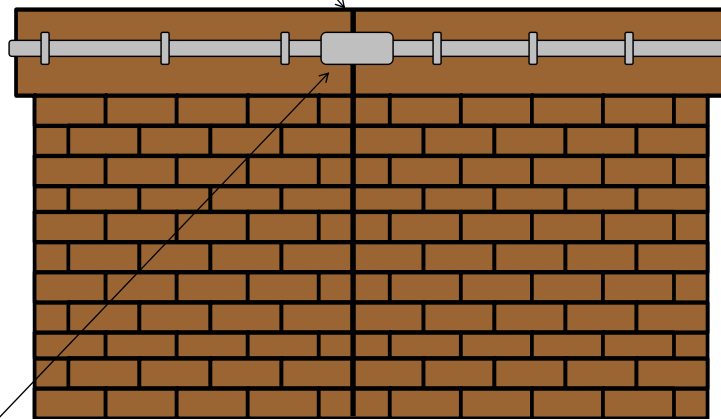
- Requires a cable, raceway, or **box** to be installed not less than 38 mm (1½ in.) from the nearest surface of the metal-corrugated sheet roof decking.



RMC and IMC are not required to comply with the spacing

### 300.4(H) – Structural Joints

Structural joint intended for expansion, contraction or deflection



Listed expansion/deflection fitting or other approved means

## Ampacity Tables Renumbered

- Extensive renumbering of the tables and related sections
- 310.15(B)(2)(a) → 310.15(B)(3)(a)
- 310.15(B)(2)(c) → 310.15(B)(3)(c)
- 310.15(B)(6) → 310.15(B)(7)
- 310.16 → 310.15(B)(16)

Table 310.15(B)(3)(a) (formerly Table 310.16) Allowable Ampacity of Insulated Conductors Based Upon and Including 200% Value, 90 °C Through 90 °C (194 °F Through 194 °F), Not More Than Three Current-Carrying Conductors in Raceway, Cable, or Fault-Induced Burned, Based on Ambient Temperature of 30 °C (86 °F)

Size (AWG or kcmil)	Temperature Rating of Conductors (See Table 310.15(B)(1))						Size (AWG or kcmil)
	90 °C (194 °F)		75 °C (167 °F)		60 °C (144 °F)		
	THHN, THWN-2, FEP, XHHW, XHHW-2, FEPN, FEPN-2, THHN-2, THWN-2, XHHW-2, XHHW-2, FEPN-2, FEPN-2	THHN, THWN-2, FEP, XHHW, XHHW-2, FEPN, FEPN-2	THHN, THWN-2, FEP, XHHW, XHHW-2, FEPN, FEPN-2	THHN, THWN-2, FEP, XHHW, XHHW-2, FEPN, FEPN-2	THHN, THWN-2, FEP, XHHW, XHHW-2, FEPN, FEPN-2	THHN, THWN-2, FEP, XHHW, XHHW-2, FEPN, FEPN-2	
COPPER							ALUMINUM
10	40	35	30	25	20	25	20
12	35	30	25	20	15	20	15
14	30	25	20	15	10	15	10
16	25	20	15	10	5	10	5
18	20	15	10	5	0	5	0
20	15	10	5	0	0	0	0
22	10	5	0	0	0	0	0
24	5	0	0	0	0	0	0
26	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0
54	0	0	0	0	0	0	0
56	0	0	0	0	0	0	0
58	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0
72	0	0	0	0	0	0	0
74	0	0	0	0	0	0	0
76	0	0	0	0	0	0	0
78	0	0	0	0	0	0	0
80	0	0	0	0	0	0	0
82	0	0	0	0	0	0	0
84	0	0	0	0	0	0	0
86	0	0	0	0	0	0	0
88	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0
92	0	0	0	0	0	0	0
94	0	0	0	0	0	0	0
96	0	0	0	0	0	0	0
98	0	0	0	0	0	0	0
100	0	0	0	0	0	0	0
102	0	0	0	0	0	0	0
104	0	0	0	0	0	0	0
106	0	0	0	0	0	0	0
108	0	0	0	0	0	0	0
110	0	0	0	0	0	0	0
112	0	0	0	0	0	0	0
114	0	0	0	0	0	0	0
116	0	0	0	0	0	0	0
118	0	0	0	0	0	0	0
120	0	0	0	0	0	0	0
122	0	0	0	0	0	0	0
124	0	0	0	0	0	0	0
126	0	0	0	0	0	0	0
128	0	0	0	0	0	0	0
130	0	0	0	0	0	0	0
132	0	0	0	0	0	0	0
134	0	0	0	0	0	0	0
136	0	0	0	0	0	0	0
138	0	0	0	0	0	0	0
140	0	0	0	0	0	0	0
142	0	0	0	0	0	0	0
144	0	0	0	0	0	0	0
146	0	0	0	0	0	0	0
148	0	0	0	0	0	0	0
150	0	0	0	0	0	0	0
152	0	0	0	0	0	0	0
154	0	0	0	0	0	0	0
156	0	0	0	0	0	0	0
158	0	0	0	0	0	0	0
160	0	0	0	0	0	0	0
162	0	0	0	0	0	0	0
164	0	0	0	0	0	0	0
166	0	0	0	0	0	0	0
168	0	0	0	0	0	0	0
170	0	0	0	0	0	0	0
172	0	0	0	0	0	0	0
174	0	0	0	0	0	0	0
176	0	0	0	0	0	0	0
178	0	0	0	0	0	0	0
180	0	0	0	0	0	0	0
182	0	0	0	0	0	0	0
184	0	0	0	0	0	0	0
186	0	0	0	0	0	0	0
188	0	0	0	0	0	0	0
190	0	0	0	0	0	0	0
192	0	0	0	0	0	0	0
194	0	0	0	0	0	0	0
196	0	0	0	0	0	0	0
198	0	0	0	0	0	0	0
200	0	0	0	0	0	0	0

## 310.15(B)(3)(a) – More than Three Current Carrying Conductors

- Requires that all conductors in the raceway or cable be counted
  - Adjusted for 310.15(B)(5) – conductors that carry only imbalance
  - Adjusted for 310.15(B)(6) – grounding and bonding conductors
- Previous exceptions have been turned into positive language

Table 310.15(B)(3)(a) Adjustment Factors for More Than Three Current-Carrying Conductors in a Raceway or Cable

Number of Conductors <sup>1</sup>	Percent of Values in Table 310.15(B)(16) through Table 310.15(B)(19) as Adjusted for Ambient Temperature if Necessary
4–6	80
7–9	70
10–20	50
21–30	45
31–40	40
41 and above	35

<sup>1</sup>Number of conductors is the total number of conductors in the raceway or cable adjusted in accordance with 310.15(B)(5) and (6).

## 310.15(B)(16) – Allowable Ampacity Table

- A few conductor ampacities have been adjusted to harmonize with the CEC
- Ambient correction factors have been moved to their own table [310.15(B)(2)(a)]

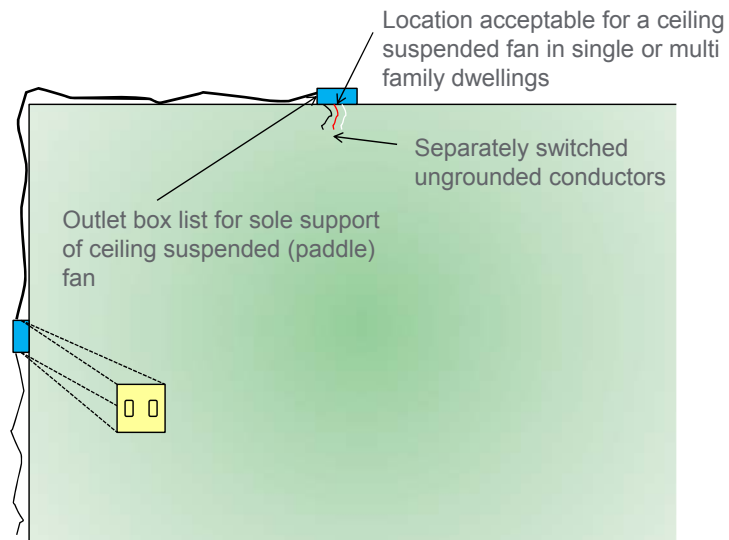
Table 310.15(B)(16) (formerly Table 310.16) Allowable Ampacities of Insulated Conductors Rated Up to and Including 2000 Volts, 60°C Through 90°C (140°F Through 194°F), Not More Than Three Current-Carrying Conductors in Raceway, Cable, or Earth (Directly Buried), Based on Ambient Temperature of 30°C (86°F)

Size AWG or kcmil	Temperature Rating of Conductor (See Table 310.10(A).)						Size AWG or kcmil
	60°C (140°F)	75°C (167°F)	90°C (194°F)	60°C (140°F)	75°C (167°F)	90°C (194°F)	
	Type TW, UF	Type THW, THWN, XHHW, USE-2, ZW	Types TBS, SA, SIS, FEP, FEP, XL, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, USE-2, XHH, XHHW, XHHW-2, ZW-2	Type TW, UF	Types RHW, THHW, THWN, XHHW, USE	Types TBS, SA, SIS, THHN, THHW, THW-2, THWN-2, RHH, RHW-2, USE-2, XHH, XHHW, XHHW-2, ZW-2	
COPPER							
18	—	—	14	—	—	—	—
16	—	—	15	—	—	—	—
14	15	20	25	15	—	—	—
12	20	25	30	25	20	25	12
10	30	35	40	35	30	35	10
8	40	50	55	45	40	45	8
6	55	65	75	40	50	55	6
4	70	85	95	55	65	75	4
3	85	100	110	65	75	85	3
2	95	115	130	75	90	100	2
1	110	130	145	85	100	115	1
1/2	125	150	170	100	120	135	1/2
3/8	145	175	195	115	135	150	3/8
1/4	165	200	225	130	155	175	1/4
1/8	195	250	260	150	180	205	1/8
ALUMINUM OR COPPER-CLAD ALUMINUM							
250	215	255	260	170	205	230	250
300	240	285	320	195	230	260	300
350	260	310	350	210	250	290	350
400	280	335	380	225	270	315	400
500	320	380	430	260	310	350	500
600	380	420	475	285	340	385	600
750	395	460	520	300	375	420	750
900	400	475	535	320	385	435	900
1000	410	490	555	330	395	445	1000
1250	455	520	585	375	445	500	1250
1500	495	565	605	405	485	545	1500
1750	525	625	705	435	520	585	1750
2000	545	650	735	455	545	615	2000
2500	585	665	750	470	560	630	2500

\*Refer to 310.15(B)(2) for the ampacity correction factors where the ambient temperature is other than 30°C (86°F).

\*\*Refer to 240.4(D) for conductor overcurrent protection limitations.

## 314.27(C) – Boxes at Ceiling Suspended (Paddle) Fan Outlets



## 334.10(1) – Uses Permitted (NM Cable)



One and two family dwellings



Detached garages  
(of one or two  
family dwellings)

Storage buildings (or one  
or two family dwellings)



## 338.10(B)(4)(a) – Interior Installations (SE cable)

- Installation must comply with Part II of Article 334, excluding 334.80 (ampacity limitations)
- If SE cable is installed in thermal insulation, the ampacity shall be 60C
  - Still permits actual temperature rating of cable to be used for ampacity adjustment and correction



## Article 399 – Outdoor, Overhead Conductors, Over 600V

- New article for the installation of outdoor overhead conductors
- NEC was lacking detailed information for installations over 600V
- Single conductors, insulated, covered or bare, installed outdoors on support structures
- 399.30 – Documentation of design
  - By licensed professional engineer
  - Engaged primarily in design of such systems
  - Spacing between conductors
  - Available upon request of AHJ

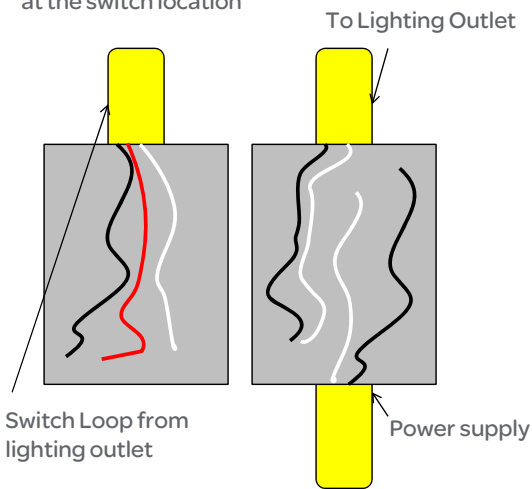


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## 404.2(C) – Switches Controlling Lighting Loads

Grounded circuit conductor shall be provided at the switch location



Raceway installations exempt if sized to accommodate extension of the grounded conductor

Not required if cable assemblies enter the box through a framing cavity that is open at top or bottom on same floor level

Not required if cable assemblies enter the box through a framing cavity that is open on one side

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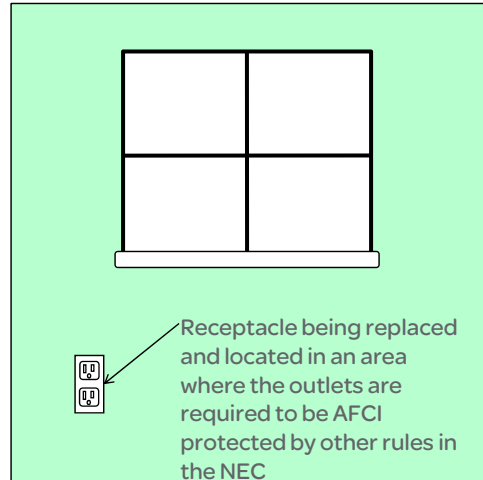
46

## 406.4(D)(4) – AFCI Protection

- **Must be replaced by:**

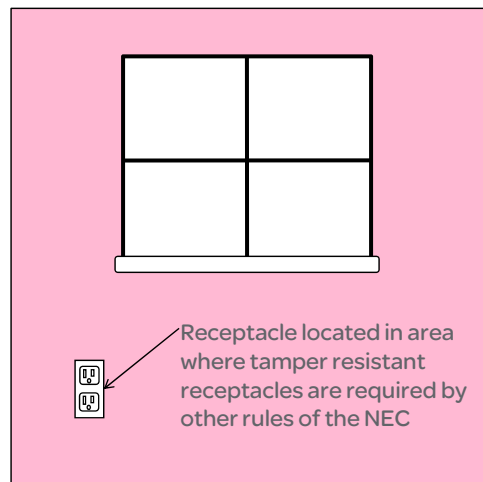
- A listed outlet branch circuit type AFCI receptacle
- A receptacle protected by a listed outlet branch circuit type AFCI receptacle
- A receptacle protected by a listed combination type AFCI circuit breaker

- **Requirement becomes effective January 1, 2014**



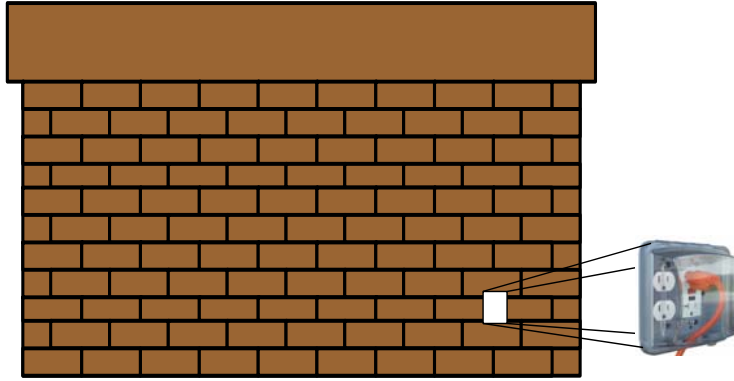
## 406.4(D)(5) – Tamper Resistant Receptacles

- **When replacement is made, the receptacle must be replaced with a listed tamper resistant receptacle**





## 406.4(D)(6) – Weather Resistant Receptacles



Requires weather resistant receptacles to be used as replacements where the receptacle is located where weather resistant receptacles are required by other NEC rules

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## 406.9(B)(1) - 15- and 20-Ampere Receptacles in a Wet Location

### ● Adds a new requirement that in other than one and two family dwellings:

- Outlet box hood must be listed
- Where installed on an enclosure supported from grade as described in 314.23(B) or 314.23(F), the hood must be identified as “extra-duty”

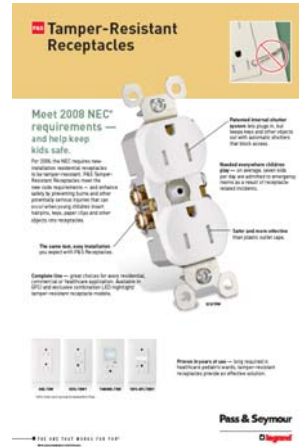


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## 406.12 – Tamper Resistant Receptacles in Dwelling Units

- Adds new exception to TR requirement in dwelling units.
- TR not required on:
  - Receptacles located above 5½ feet above the floor
  - Receptacles that are part of a luminaire or appliance
  - A single receptacle or duplex receptacle for two appliances located in a dedicated space
    - Not easily moved
    - Cord and plug connected
  - Nongrounding receptacles used as replacements



## 406.13 – Tamper Resistant Receptacles in Guest Rooms and Guest Suites

- 125V, 15 and 20A nonlocking receptacles
- Located in guest rooms and guest suites
- Listed TR receptacles required



## 406.14 – Tamper Resistant Receptacles in Child Care Facilities

- Includes all child care facilities
- 125V, 15 and 20A nonlocking receptacles
- Listed TR receptacles required



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## 408.4(B) – Source of Supply (identification)

- Requires marking to indicate the device or equipment where the power supply originates
- Includes all switchboards and panelboards supplied by a feeder
- One and two family dwellings not included



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## 409.110(3) – Marking (industrial control panels)

- Panels supplied by more than one source
- If more than one disconnecting means must be opened to disconnect all power
- Panel must be marked to indicate that more than one disconnecting means is required to be operated to de-energize the equipment



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## 410.130(G)(1) – Disconnecting Means (luminaires)

- Requires installation of a disconnecting means on existing luminaires:
  - When ballast is changed and;
  - Luminaire does not have a disconnecting means installed



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## 430.22(G) – Conductors for Small Motors

### ●(1) - #18 AWG permitted where

- Installed in a cabinet or enclosure
- Part of jacketed multi-conductor cable or flexible cord
- Motor circuit FLA greater than 3.5 and up to 5A
  - Circuit protected by 430.52
  - Provided with minimum Class 10 overload protection
  - OCP meets 240.4(D)(1)(2)
- Motor circuit with ampacity of 3.5A or less
  - Circuit protected by 430.52
  - Provided with minimum Class 20 overload protection
  - OCP meets 240.4(D)(1)(2)



### ●(2) – covers #16 AWG



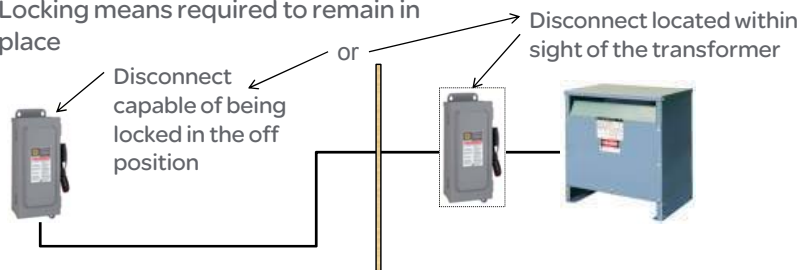
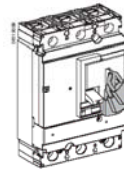
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## 450.14 – Transformer Disconnect

### ●A disconnecting means required for transformers

- Must be located either in sight of the transformer or
- Remotely provided with capability of being locked in the off position
- Locking means required to remain in place



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## 514 – Circuit Disconnects

### 514.11 – Emergency Controls

- Readily Accessible and Remote from pump

### 514.13 – Provisions for Maintenance

- Means shall be capable of being locked in the open position

- **Both require simultaneous disconnect for all power and communications circuits going to dispenser**

- Clarifies video and data also included



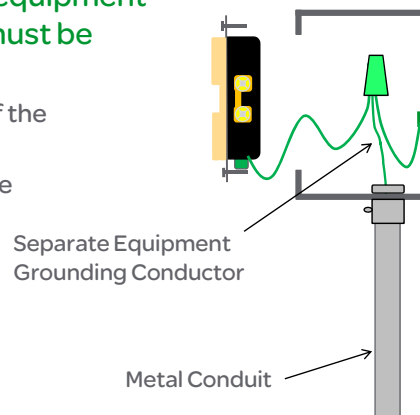
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## 517.13(B) – Grounding of Receptacles in Patient Care Areas

- **The separate insulated equipment grounding conductors must be connected to:**

- The grounding terminal of the receptacle
- The metal box or enclosure



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## 517.16 – Receptacles with Insulated Ground

- Receptacles in patient care areas prohibited to have an insulated ground terminal

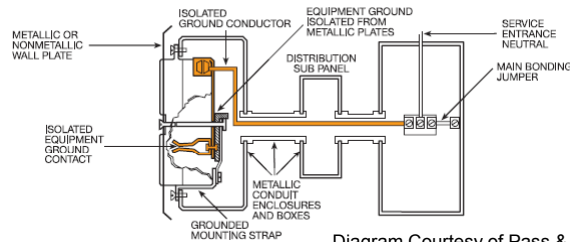
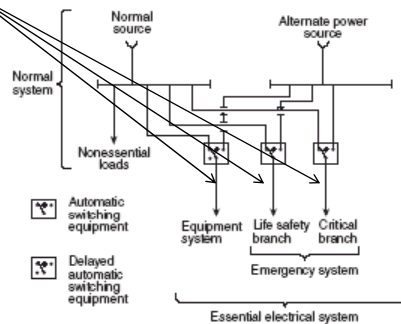


Diagram Courtesy of Pass & Seymour

## 517.17(B) – Feeders (Ground Fault Protection)

- Now clarifies that the prohibition of 2<sup>nd</sup> level of ground fault is only on the load side of an essential system transfer switch.
- 2<sup>nd</sup> levels of GFPE are permitted elsewhere in the essential system
  - Can help with coordination
  - Article 700 does not prohibit GFPE on emergency system



## 517.17(C) - Selectivity

- Deleted the 6 cycles of separation for the GFPE selectivity
- Now requires:
  - Conformance to manufacturers recommendations
  - Consider all required tolerances and operating time to achieve 100% selectivity



## 547.5(G) – Agricultural Buildings - GFCI

- Exception to eliminate GFCI protection has been deleted
- All 125-volt, single-phase, 15- and 20-ampere general-purpose receptacles required to have GFCI protection:
  - Areas having an equipotential plane
  - Outdoors
  - Damp or wet locations
  - Dirt confinement areas for livestock





## 555.3 – Marinas - Ground Fault Protection

- Main overcurrent protective device feeding the marina:

- Required to have Ground Fault Protection of Equipment (GFPE)
- GFPE level shall not exceed 100mA
- GFPE protection of each individual feeder or branch circuit is permitted as an alternative



- GFCI protection still required for receptacles in accordance with 555.19(B)(1)

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## 590.6(A)(3) – Receptacles on 15KW or less Portable Generator

- All 125- and 125/250- volt, single-phase, 15-, 20-, and 30-ampere receptacle outlets, shall have GFCI protection on the generator

- Challenges

- Installing GFCI on the generator means that the neutral of the generator will be bonded
- Bonding the neutral creates issues for transfer equipment that does not switch the neutral because neutral would now be bonded downstream of the service disconnect
- Will now need transfer equipment that switches the neutral if intended to be used with a portable generator



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## 600.33 LED Signs

- New provisions governing the wiring method and materials for light-emitting diode (LED) type sign systems have been added to Article 600
- Clear and concise requirements for Class 2 LED circuits are needed for electric signs and outline lighting
- LED lighting systems have become an increasingly popular light source over the past decade or so
- This new section is designed to consolidate the majority of the rules for Class 2 power limited wiring used in signs and outline lighting into Article 600

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## 600.33 LED Signs

### 600.33 LED Sign Illumination Systems, Secondary Wiring *(Electric Signs and Outline Lighting)*

The wiring methods and materials shall be installed in accordance with the sign manufacturer's installation instructions using any applicable wiring methods from Chapter 3 and the requirements for Class 2 circuits contained in Part III of Article 725.

(A) Insulation and Sizing of Class 2 Conductors

(B) Installation

(C) Protection Against Physical Damage

(D) Grounding and Bonding

*(See NEC for complete text)*

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## 625.2 – Definitions

### ● Electric Vehicle now includes

- Electric motorcycles
- Plug-in hybrid electric vehicles



### ● Plug-in Hybrid Electric Vehicle (PHEV)

- A hybrid vehicle intended for on-road use with the ability to store and use off-vehicle electrical energy in the rechargeable energy storage system and has a second source of motive power

### ● Rechargeable Energy Storage System

- A power source that can be charged and discharged.
  - Examples include batteries, capacitors, and electromechanical flywheels



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## 645.2 – Definitions (ITE)

### ● Critical Operations Data System

- requires continuous operation for the reasons of public safety, emergency management, national security, or business continuity

### ● Zone

- A physically identifiable area (such as barriers or separation by distance) within an information technology equipment room with dedicated power and cooling systems for the information technology equipment or systems.



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## 645.10 – Disconnecting Means

### ●(A) Remote Disconnect Controls

- Allows Emergency Power Off actuator to be located in an approved alternative location (rather than at principal exit doors)

### ●(D) Critical Operations Data Centers are not required to have remote disconnect controls where:

- Approved procedure
- Qualified personnel continuously available to meet emergency responders
- Fire detection and suppression systems
- Cables installed under a raised floor, other than branch circuit wiring and power cords installed in compliance with 645.5(D)(2) or (3), are in compliance with 300.22(C), 725.154(A), 770.154(A), or 800.154(A).

## 645.25 – Engineering Supervision

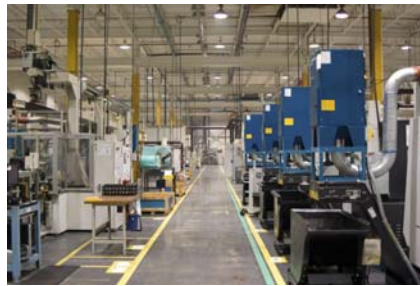
### ●Feeder and service load calculations for new or existing loads shall be permitted by a licensed and qualified professional engineer

- Feeders shall not be required to be of greater ampacity than the service conductors.
- Service or feeder conductors shall be permitted to have neutral load determined by 220.61.



## 670.5 – Short Circuit Current Rating

- Industrial machinery is not permitted to be installed where it does not have a short circuit current rating adequate for the available fault current
- Short-circuit current rating for the machinery is required by 670.3(A)(4).



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## 680.2 – Low Voltage Contact Limit

- A voltage not exceeding the following values:
  - (1) 15 volts (RMS) for sinusoidal ac
  - (2) 21.2 volts peak for nonsinusoidal ac
  - (3) 30 volts for continuous dc
  - (4) 12.4 volts peak for dc that is interrupted at a rate of 10 to 200 Hz.



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## 680.10 – Underground Wiring Locations – Minimum Cover Depths

- Revises the minimum cover depth table to permit NM conduit buried under 4" thick concrete slab
- Conduit depth permitted to be 6 inches
- Concrete slab must extend at least 6" beyond area of underground installation

Wiring Method	Minimum Cover	
	mm	in.
Rigid metal conduit	150	6
Intermediate metal conduit	150	6
Nonmetallic raceways listed for direct burial under minimum of 102 mm (4 in.) thick concrete, exterior slab and extending not less than 162 mm (6 in.) beyond the underground installation.	150	6
Nonmetallic raceways listed for direct burial without concrete encasement	450	18
Other approved raceways*	450	18

\*Raceways approved for burial only where concrete encased shall require a concrete envelope not less than 50 mm (2 in.) thick.

## 680.26(B)(7) – Equipotential Bonding

- Adds to the list of fixed metal parts that are required to be bonded around a pool:
  - Metal awnings
  - Metal fences
  - Metal door and window frames
  - Deletes the words "all metal parts" but now includes the words "including, but not limited to..."
- Exceptions remain for:
  - Parts separated by a permanent barrier
  - Parts more than 5 feet horizontally from the walls of the pool
  - Parts more than 12 feet vertically from maximum water level



## 680.43 Exception No. 2 - Indoor Installations

- Basic rule requires indoor installations of spas and hot tubs to comply with Parts I and II of Article 680
- Includes 680.26 for equipotential bonding
- Exception for spas and hot tubs that are:
  - Listed, self-contained units, and
  - Installed above the finished floor



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## 680.73 – Accessibility

- Adds a new sentence to require that cord and plug connected hydromassage tubs:

If supply receptacles are accessible only through a service access opening,

Receptacle must be installed such that its face is in direct view and not more than 12 inches from the opening



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## 690.4(B) – Identification and Grouping

- PV system conductors must be separated from conductors, feeders or branch circuits of non-PV systems:

- In raceways, cable tray, cable, outlet box, junction box or similar fitting
- Unless separated by partition

- PV system conductors shall be identified and grouped:

- By separate color coding, marking tape, tagging or other approved means
- PV source circuits, PV output circuits, Inverter input and output circuits
  - at all terminations, connections and splices
- Where there is more than one PV system in same box, raceway or equipment - each system must be identified



## 690.4(B) – Identification and Grouping

- (4) More than one PV system in a junction box or raceway with removable covers

- AC and DC conductors for each system shall be grouped separately by wire ties or similar means
- Must be grouped at least once and then at intervals not to exceed 6 feet





## 690.4(E) – Wiring and Connections

- Requires that PV systems and all associated wiring and interconnections shall be installed only by qualified persons
- Article 100 – Qualified Person
  - One who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved.



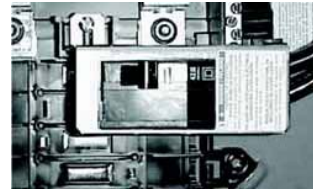
## 690.4(H) – Multiple Inverters

- Permits multiple utility-interactive inverters in or on a single building or structure
- Where remotely located from each other, a directory denoting all power sources on or in the premises at:
  - Each DC PV system disconnecting means
  - Each AC disconnecting means
  - Main service disconnecting means showing the location of all AC and DC PV system disconnecting means
- Exception where all inverters and PV dc disconnecting means are grouped at the main service disconnecting means.



## 690.10(E) – Backfed Circuit Breakers

- Plug-in backfed breakers are now required to be secured per 408.36(D). Previous allowance to omit for PV has been removed.
- 408.36(D) Backfed plug-in breakers must have an additional fastener that requires other than a pull to release the device from the mounting means on the panel



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## 690.11 – Arc-Fault Circuit Protection (DC) – PV Systems

- Required for:
  - dc source and/or output circuits located on or penetrating a building and operating at a PV system maximum voltage of 80 V or greater
- Listed (dc) AFCI, PV type or other system listed to provide the protection
- Must detect and interrupt arcing faults
  - Failure of intended continuity of conductor, connection, module or other DC source component
- Must disable or disconnect one of the following:
  - Inverters or charge controllers in the faulted circuit
  - System components within the arcing circuit



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## NEC 694 – Small Wind Electric Systems

### ●694.1 - Scope

- Small wind (turbine) electric systems
- One or more wind electric generators
- Individual generators rated power up to and including 100kW
- Covers stand alone or interactive systems



### ●694.10 – Maximum Voltage

- One and two family dwellings – turbine output voltage limited to 600V max
- Over 600V permitted for other installations

### ●694.22(C)(1) – Disconnect Location

- On or adjacent to the turbine, OR
- Outside building or structure or inside at point of entrance



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## 695.3 – Fire Pump Power Source(s)

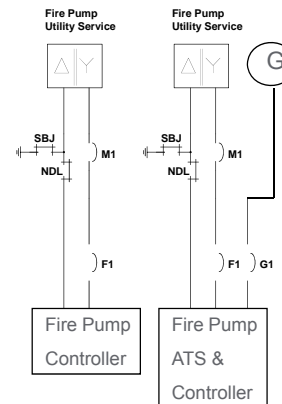
### ●Article 695 reorganized for clarity

### ●Individual Sources

- 695.3(A)(3) – Dedicated feeder derived from a 695.3(A)(1) service connection is permitted

### ●Multiple Sources

- 695.3(B)(2) – clearly allows a 695.3(A) source and generator to serve as a power source
- 695.3(C)(2) clarify that an individual/dedicated feeder source and alternate source/on-site standby generator are permitted for multi-building campus style installations



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## 695.4(B)(3) – Disconnecting Means – Features and Location – Onsite Standby Generator

- Disconnecting means for the generator must be installed to meet 700.10(B)(5) for emergency circuits
- 700.10(B)(5) requires that emergency, legally required and optional standby loads be supplied from separate enclosure or from separate switchboard sections



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## 700.10(D)(1) – Fire Protection (emergency feeders)

- Fire rating requirements increased from 1 hr to 2 hrs
- Feeders must protected by:
  - Being installed in spaces fully protected by fire suppression
  - Listed electrical circuit protective system with a minimum of 2 hr rating
  - Listed thermal barrier system with minimum 2 hr rating
  - Listed fire-rated assembly that has a minimum 2 hr rating
  - Being encased in 2" of concrete



Assembly occupancies 1000 persons or greater

Buildings over 75' – assembly, educational, residential, detention/correctional, business, mercantile

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## 701.6(D) – Signals - Ground Fault (legally required systems)

- Ground fault indication required  
701.26
- Audible and visual signal devices for ground faults indication



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## Additional Resources

- Schneider Electric Codes and Standards Website

[www.schneider-electric.us/go/codes](http://www.schneider-electric.us/go/codes)

- Electrical Shortz
- InfoZone
- Electrical Inspector Resource Area
- Articles and Publications

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## About the Instructor



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