Office of Education and Data Management
Fall 2018 Career Development Seminar

December 2018

Residential Electrical Inspections

Presented by
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Office of State Building Inspector

Who Are You

- Building Officials, Electricians/ EI, Contractors, Fire Marshals
- Inspectors are responsible for ensuring equipment is installed in accordance with listing instructions/ manufacturer instructions
- Inspectors are to ensure safety of the town structures and the buildings (life safety devices, health and integrity of building)
- Level of consistency depends on experience and training
- Violations are to be cited to the installer in written form with code section noted.

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Single Family Dwelling

5

New Construction Inspections

230.9 220.40 230.6
230.24 230.26 230.54
230.66 230.79 110.26
110.14 110.13 250.24
250.92 250.94 250.122
250.66 250.50 250.52
250.53 250.64 408.36
408.4 408.7 800.100
820.100 250.104 250.12

New construction

Single family dwelling

200a 120/240v overhead utility service

Natural Gas

City Water City Sewer

Pretty straight forward, but there are many code sections that apply.

Let's start outside.

6

What's mine is mine, what's yours is yours

Utility determines the Service Point

Customer owns (NEC covers) house side of service point.

Utility owns (NEC does not cover) utility side of service point.

Typically the connection at the weather head is the service point

7

Service Point

8

Attachment broken, Lost Neutral

11

Let me be clear…

2017 NEC 230.24

Overhead service conductors

From finish grade: 10’ to drip loop

10’ over pedestrians

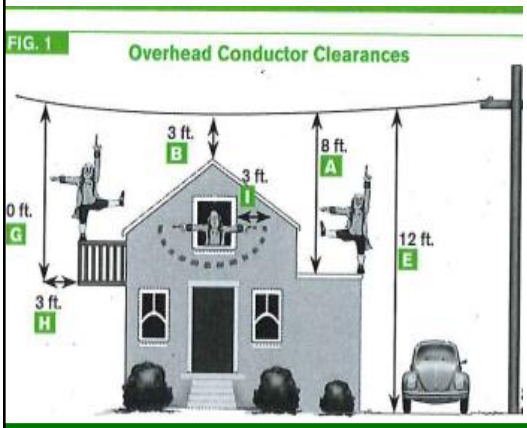
12’ over residential property and driveways, (commercial areas NOT subject to truck traffic)

18’ over public street, roads and parking areas subject to truck traffic, other land such as grazing, orchards, and forest

(NEW 2017) 24 1/2’ over railroad tracks

12

Code Check Electrical



230.9 Clearances of Open Conductors:
Above Decks: 10’

Operable Windows, Porches, Stairs, Doors: 3’

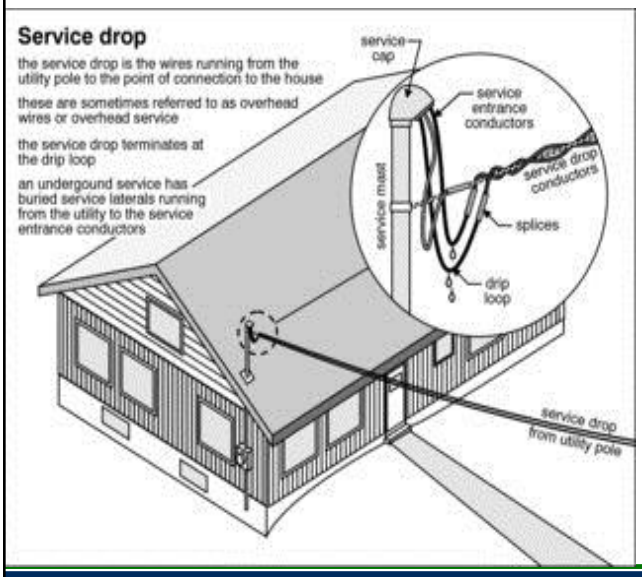
230.24
Over Flat Roof: 8’
Over Steep Roof: 3’

13

Can’t Touch This…

14

Drip Loop



230.54 A and B
(E3605.9.1 and .2)
Service Cap
Service Head
Weather Head

230.54 F (E3605.9.5)
Drip Loops
Individual conductors stripped from cable

15

Any Violations?

230.9 A 3’ under window

230.54 C weather head to be above point of attachment

Meter socket at 5’?

Service drop over roof?

Are those taped up *couple taps*?

18

230.24 Exception 3 min 18" (E3604.2.1)

20

Point of Attachment (E3604.3)

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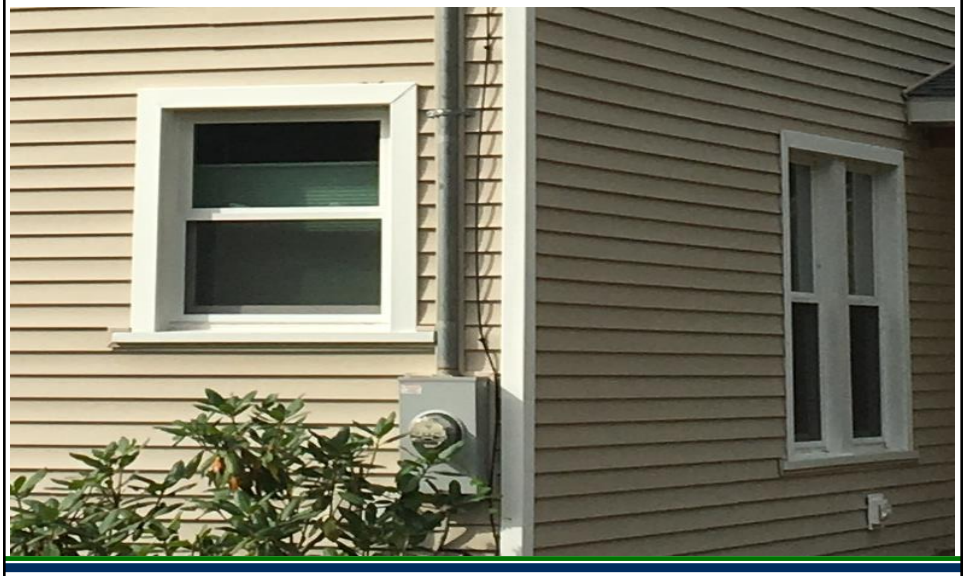
Mast Support



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Mast Service

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Guy Wire Support

Outside the building, 230.6 (5) passing through an eave

230.28 A
(E3604.5.1)
Service Mast support. Guy wire opposite pull of conductors.

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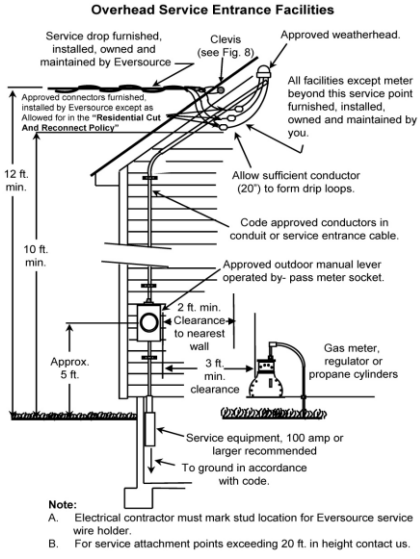
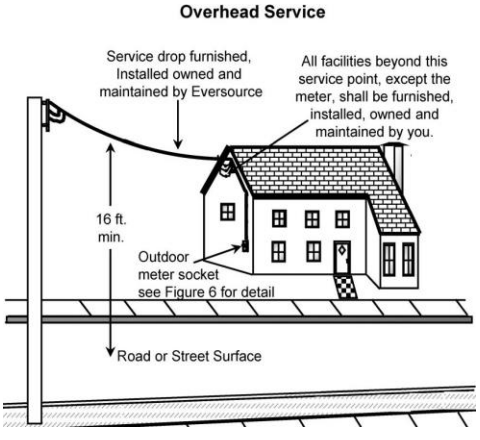
Eversource I&R Guide





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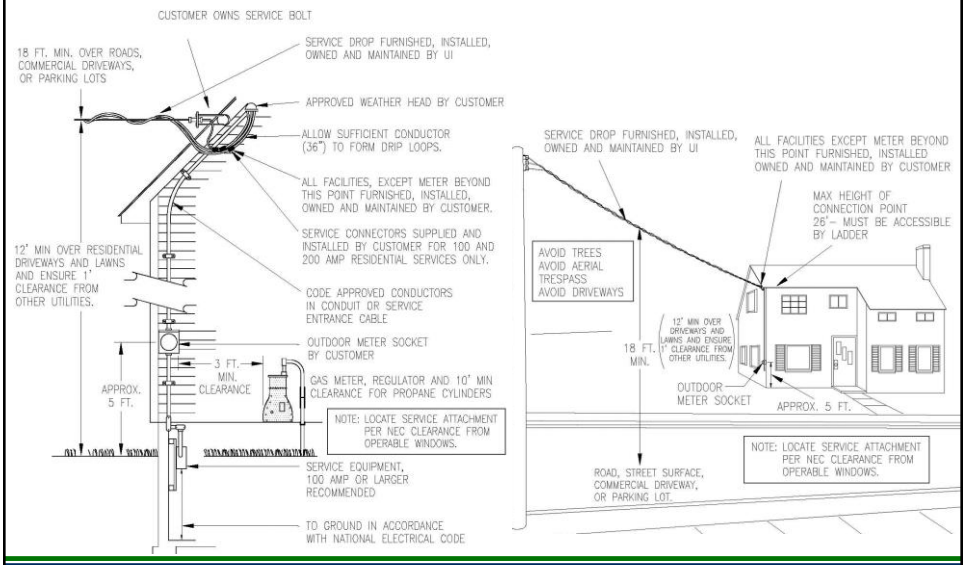
United Illuminating Guide



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Eversource vs UI

Drip Loop Conductors	20”	36”
Meter from Gas Meter	3’	3’
Meter from Regulator	3’	3’
Meter from Propane Tank	3’	10’
Meter from Wall	2’	?
Meter Height	5’	5’

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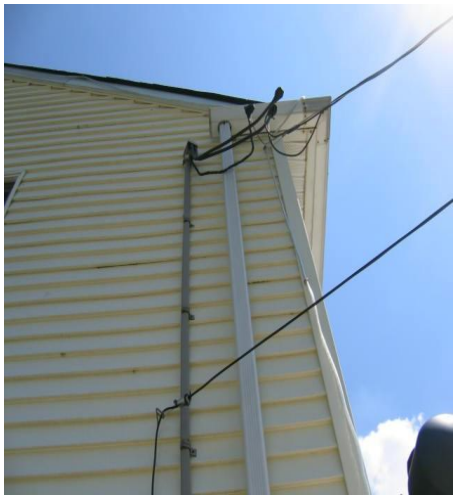
Service Entrance Conductors



Service Cable Support

230.51 (E3605.7)
12” from weather head
30” strap to strap
12” from meter
12” from enter house

230.54 C (E3605.9.3)
Service head shall be located ABOVE the point of attachment.
Exception: impracticable; within 24”

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SE Cable

338.10 A SE Cable as Service Entrance Conductors

338.10 B Feeder – old method of wiring stove, dryer, wall oven (see 250.140 commentary)

338.24 Bends, 5 x diameter

338.120 Marking IAW 310.120
Cable assembly , not individual conductors stripped out.

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Size does matter

230.42 (E3602.1) Service entrance conductors shall have ampacity of not less than the maximum load to be served.

310.15 B (7) (1)
Service conductors supplying entire load of SFD, ampacity of conductors to be 83% of service rating.

200 amp x 83% = 166 amp

Table 310.15 B (16) 75 degree column (due to terminal lug rating)
4/0 Aluminum = 180 amp

What about 100 amp service? 400 amp service?
Size printed on cable assembly or individual conductors 310.120

30

Duct Seal Putty

230.54 G
Arranged so that water will not enter service raceway or equipment.
230.66
Suitable for use as service equipment (bonding, fault current, bypass handle)
Listed for voltage and amperage of service
230.79
120/240v minimum 100amp
200amp, 320amp
Nice strap within 12”
Screws for application-coated

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Meter

Approved, listed in I&R book.
Height 5’ center.
Line on top, Load on bottom.
Proper screws to house. 110.13
Bond to frame jumper 250.92
Anti-oxidant on lugs(trade practice)
Same size wire in and out, stripped back so wire is under lug.
Terminals torqued.
Watertight, sealed.
Connector out bottom or out back to panel.

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Meter Enclosure bonding jumper

33

Listed Meter Socket

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Or a Meter with Main outside

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Main Service Disconnect Bonding

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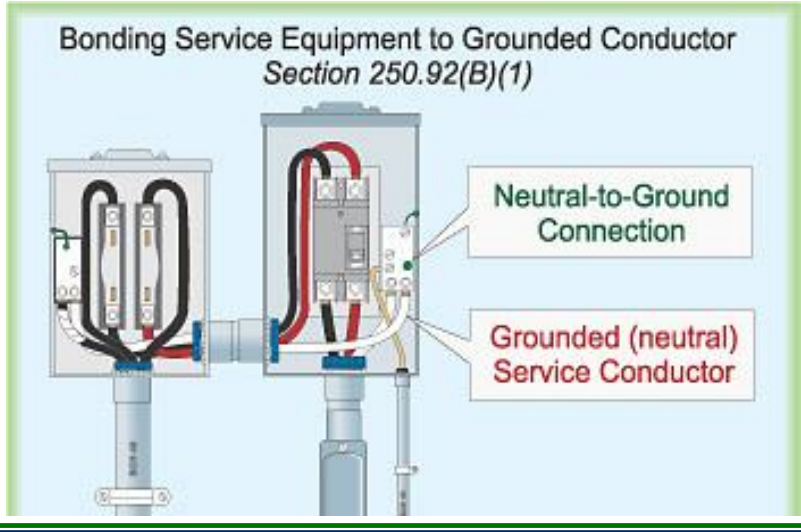
Neutral Bonded to Meter Can



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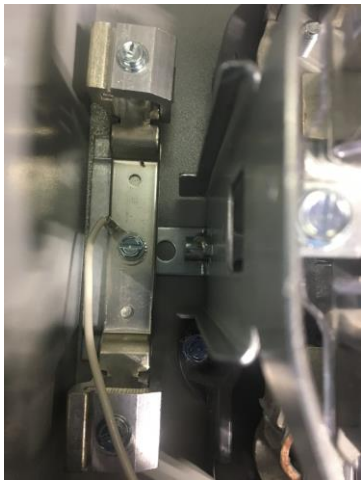
Service Raceways and Enclosures must be Bonded



250.80 Metal Enclosures (meter sockets, cold sequence meter disconnects, fire pump disconnect, troughs, nipples) and metal raceways, containing service conductors, MUST be bonded to the Service Neutral conductor.

Any metal installed AHEAD of the Main breaker.

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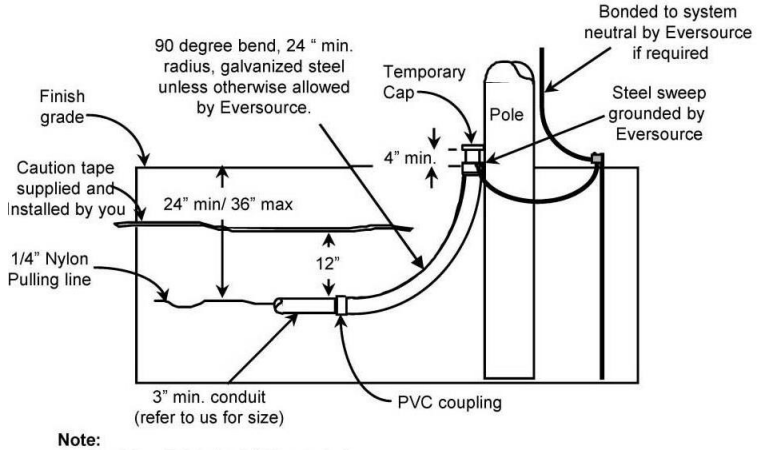
Underground Steel 90 at pole



Note:

1. Provide suitable backfill (no rocks)
2. All conduit shall be inspected by the local municipal authority prior to backfilling.
3. Electric service sweeps shall be located on the pole side away from oncoming traffic.

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Metal Sweep and Expansion Coupling

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The Green Screw

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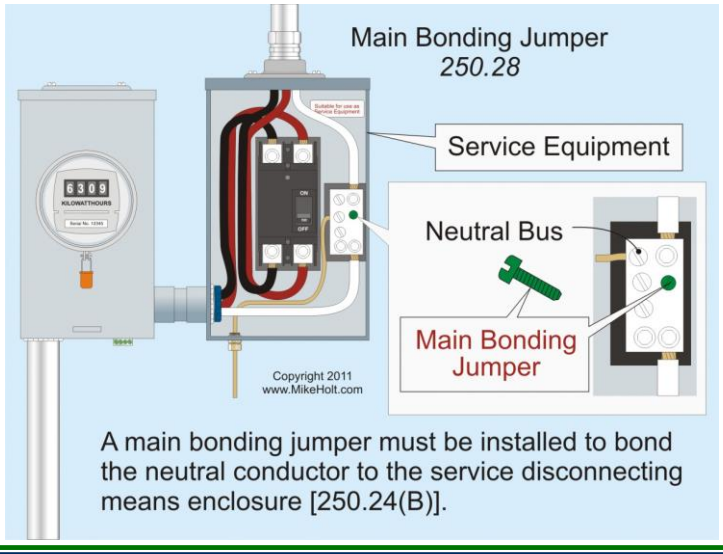
Grounds and Neutrals Bonded at Main



A main bonding jumper must be installed to bond the neutral conductor to the service disconnecting means enclosure [250.24(B)].

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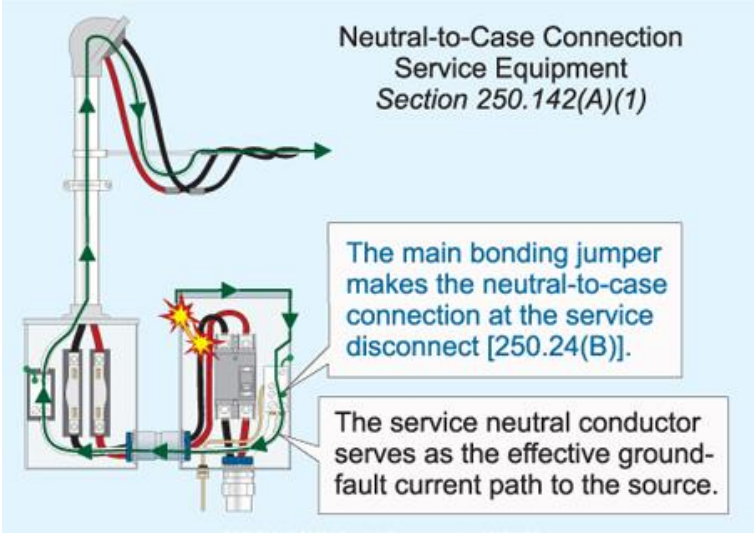
Service Fault Current Path



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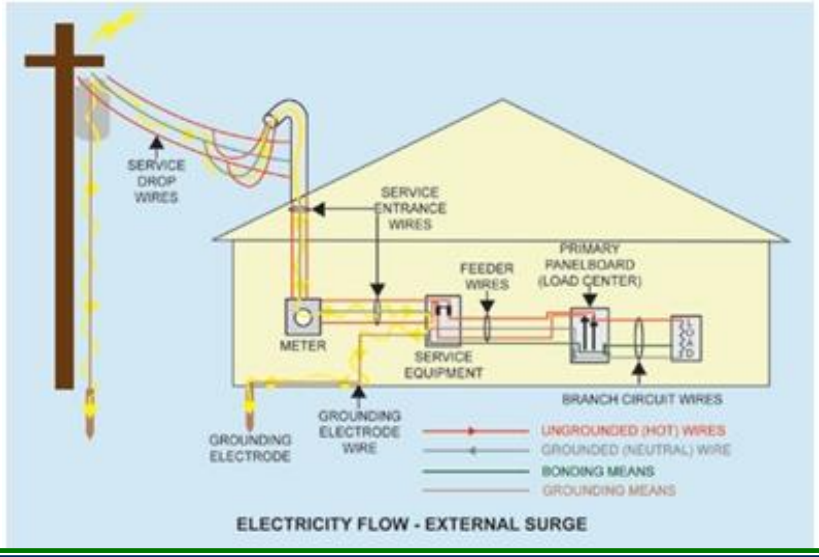
Path for Lightning



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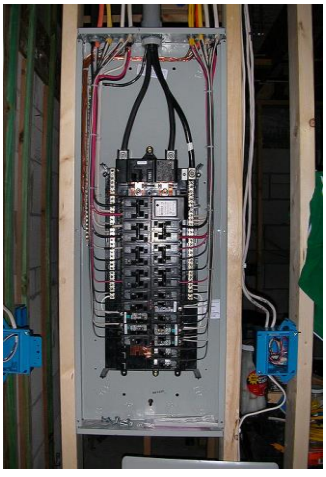
Service Panel (first means of disconnect)



Main breaker, first means of disconnect, grounds and neutrals bonded together (and never again!) 250.24 (except on the 3 wire stove and dryer you still have 250.104).

230.70 A 1 "*The service disconnecting means (main) shall be installed at a readily accessible location either outside of the building or structure, OR, inside nearest the point of entrance of the service conductors.*"

A: Outside of the building or structure

B: Inside nearest the point of entrance of the service conductors

230.6 "outside" is outside, not inside. 5 other conditions considered "outside".

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Oh By the way…

250.140 Exception (3)

" the grounded conductor is uninsulated and part of a Type SE service entrance cable and branch circuit originates at the service equipment."

If a transfer switch is installed, that is Main disconnect rated, the original "Main" Panel is now a sub panel. Fed with a 4 wire, separate grounds and neutrals.

That old 3 wire, flat SEU that feeds the stove and the dryer…needs to be changed to 4 wire.

"Fed from main service panel" which now is the transfer switch Main.

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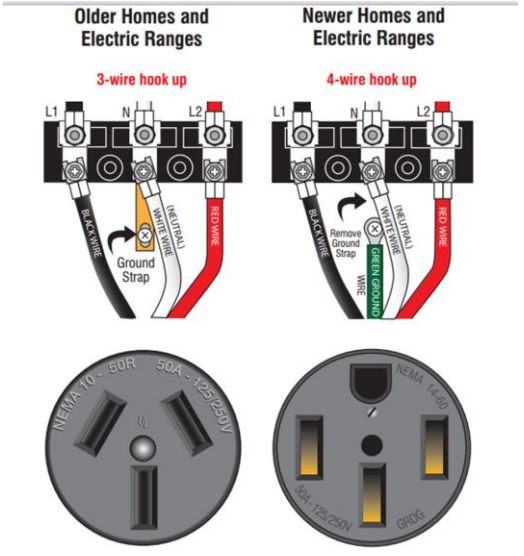
250.140



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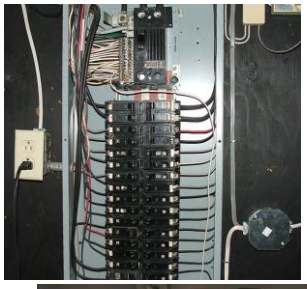
Breaker Breaker



How many breakers can be in a panel?

How many “mini’s”?

How many circuits is the panel listed to supply? 408.54

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Some Ground Rules
Grounding vs Bonding

Grounding is Bonding
Bonding is not Grounding

Bonding – connecting together to establish electrical continuity and conductivity
Grounding – connecting to ground (the earth)

Grounding – green or bare
Grounded – dead- white or gray

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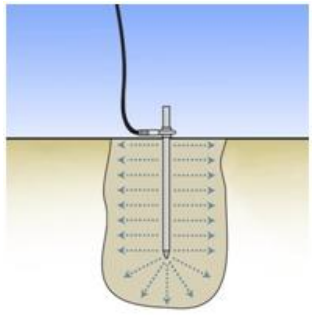
Grounding Electrode Function

Connects the electrical System to the earth

Connects electrical Equipment to the earth

Dissipate overvoltage into the earth:

Lightning
High volt wire to low volt wire
Transformer fault



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250.52 Grounding Electrode

A 1 Underground Metal Water Pipe * 10’ of pipe in **direct** contact with earth *

A 2 Metal In-Ground (earth) Support Structure (new 2017) piles 10’ vertical

A 3 Concrete Encased Electrode (Ufer)- 20’- ½” rebar continuous OR #4 bare copper in 2” of concrete in footing or foundation in **direct** contact with earth (no vapor). (Building official to verify and tag?)

A 4 Ground Ring Electrode- encircle building 30” deep, min 20’ #2 bare copper

A 5 Rod and Pipe Electrode * 5/8” x 8’ , 45°, in ditch 30” deep *

A 6 Listed Electrode

A 7 Plate Electrode * 1ft x 1ft = 2ft² (two sides exposed to soil 30” deep) 250.53 H *

A 8 Metal Underground System well casing, tanks

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CT Amendment

(Amd) **250.50 Grounding Electrode System.** If available on the premises at each *building* or structure served, each item in 250.52 (A)(1) to (A)(7), inclusive, shall be bonded together to form the grounding electrode system. Where none of these grounding electrodes are available, one or more of the grounding electrodes specified in 250.52 (A)(4) to (A)(8), inclusive, *shall* be installed and used.

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250.52 Grounding Electrode

A 1 Underground Metal Water Pipe * 10’ of pipe in **direct** contact with earth *

A 2 Metal In-Ground (earth) Support Structure (new 2017) piles 10’ vertical

A 3 Concrete Encased Electrode (Ufer)- 20’- ½” rebar continuous OR #4 bare copper in 2” of concrete in footing or foundation in **direct** contact with earth (no vapor)

A 4 Ground Ring Electrode- encircle building 30” deep, min 20’ #2 bare copper

A 5 Rod and Pipe Electrode * 5/8” x 8’ , 45°, in ditch 30” deep *, or pipe ¾” x 8’ galvanized

A 6 Listed Electrode

A 7 Plate Electrode * 1ft x 1ft = 2ft² (two sides exposed to soil 30” deep) 250.53 H *

A 8 Metal Underground System well casing, tanks

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Grounding Electrode Conductor

100 Amp Service
#6 to Water Main
#8 to Rods

200 Amp Service
#4 to Water Main
#6 to Rods

Subject to physical damage

250.66 Size of Grounding (green or bare) Conductor

250.68 Termination to Grounding Electrode
A. Accessible (except buried)
B. Effective Grounding Path - bond around insulated joints and parts to be removed.
C. GEC connection – 1) water-5' from point of entry 2) metal frame 3) rebar type

250.70 GEC Termination Fittings - LISTED

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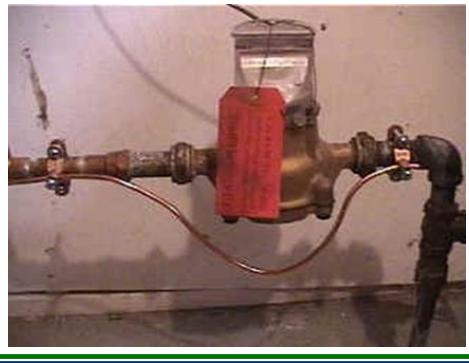
Water Line as Grounding Electrode

Jump the Meter to Bond water system



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Well, Well, Well

A metal well casing is an underground metal structure and is permitted to be used as a grounding electrode. The water piping might be plastic, but the well casing is usually steel, threaded together, and is driven more than 10' into the earth.

Bonus: the metal casing is NOT a water pipe, therefore does not need to be supplemented with rods!
250.52 A (8).

GEC is sized IAW 250.66

56

I Got Nothin'

"Water pipe is plastic. Too late for Ufer. No building steel.
I got nothin' to ground the service to."

Soooooolllee Train…

Sole Connection
250.66 A GEC no larger than #6 to rod (250.52 A(5))

250.53 A If you drive 1 rod, you must drive another one minimum 6' apart (250.53 B).
Connect with #6 (bonding jumper)

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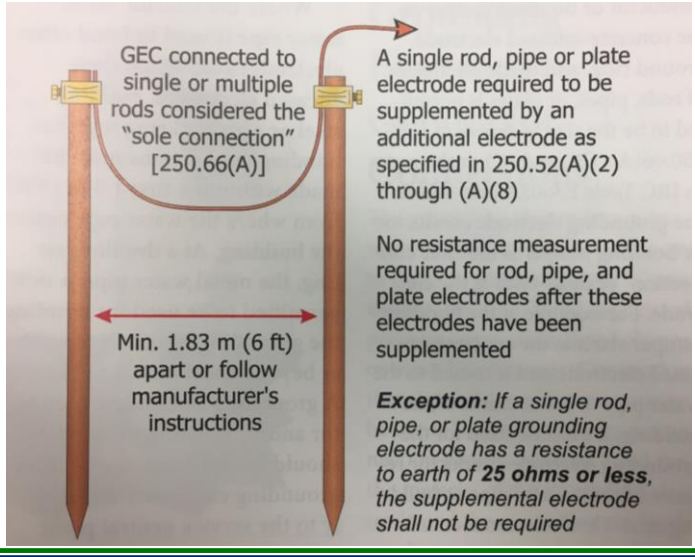
Drive One, Drive Two



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One Piece or Two Piece

"Does the Ground Wire need to be one continuous length from the panel to the rod to the other rod?"

59

One Piece or Two Piece

"**Does the Ground Wire need to be one continuous length from the panel to the rod to the other rod?**"

The "wire" from the panel to the FIRST rod is the Grounding Electrode Conductor. 250.64C states that this must be continuous.
The "other rod" is required by 250.53 A (2) (supplement)
The "wire" from rod to rod is a Bonding Jumper (sized by 250.66 A, #6). It does **not** have to be continuous from the panel to rod to rod, 250.53 C (250.64 C is not in the list).

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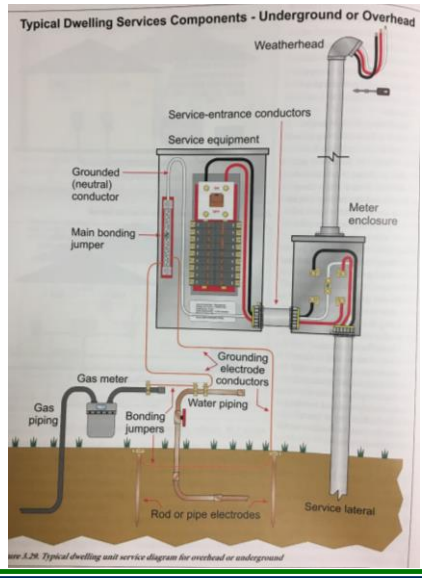
Typical Dwelling Service



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What Am I Looking For?

250.12 Clean Surface/ Contact point	Shiny metal, scrape marks, tapped threads (no TEK screw), doesn't roll around pipe or rod
110.14 A Terminals, ONE CONDUCTOR (more than 1 wire term to be identified) good connection without damaging conductors.	All strands under lug, strands not damaged, 1 wire/ lug 1 Acorn/ 1 Wire
110.14 D (new 2017) Installation, torqueing values.	Not loose, can't pull them out

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250.68
Terminations to Grounding Electrode must be accessible, buried full 8' (250.53 G)
Ex 1 buried or concrete

250.70
GEC terminate to GE with listed lugs, listed clamps, listed pressure connectors (acorns)
How many wires can go under acorn? ONE !!

How many wires can go under a terminal? ONE
(unless listed for more than one)

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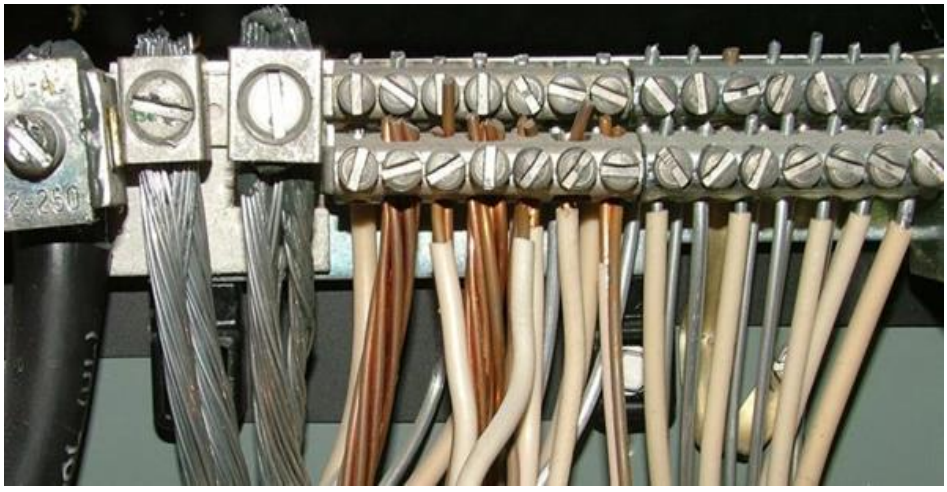
110.14 D Identified for 2 wires



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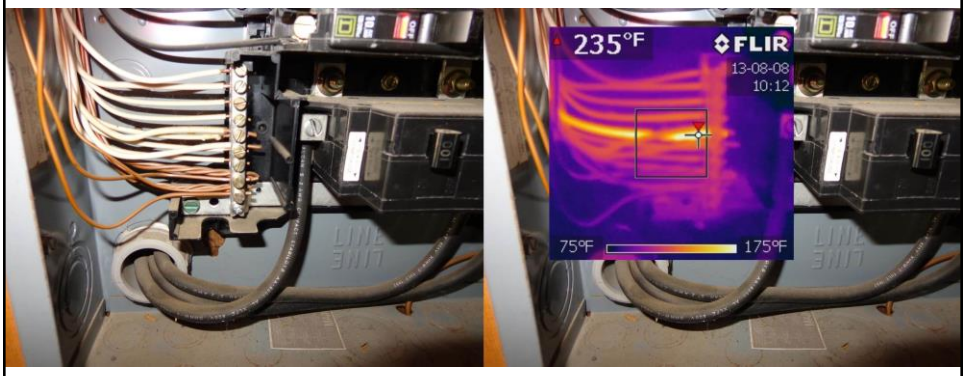
110.14 D

65

110.14 (A) 2 wires under 1 lug



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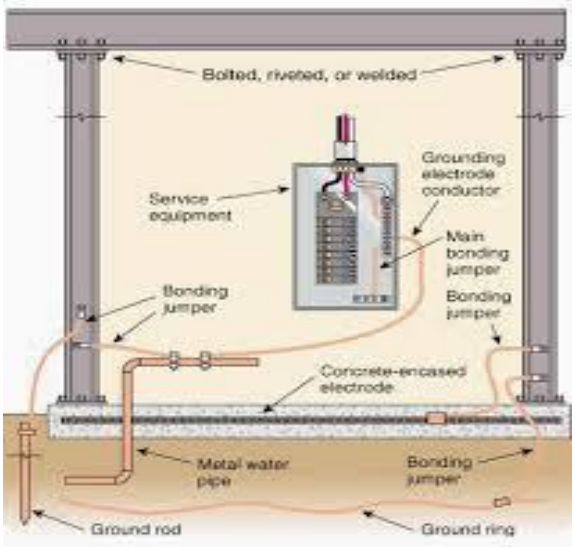
Bonding Jumpers

E3608 IRC does not include building steel as a grounding electrode. Scope of IRC 3401.2



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250.94 Intersystem Bonding

#6 to terminal

Bond communication systems

Accessible

Required for new services

Not required for service changes on existing buildings.

68

250.104 Bonding Other Metal Piping Systems

EGC for circuit that is likely to energize the piping system

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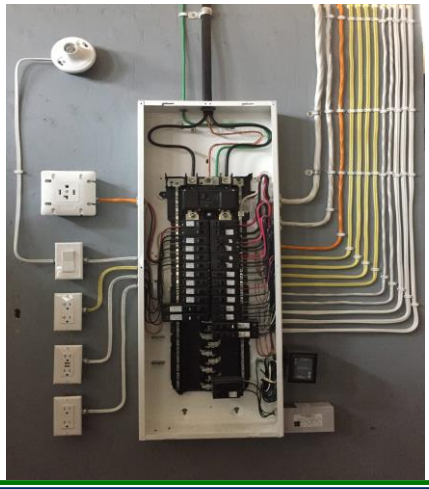
Bond the Black Iron with #6

70

BREAK

71

Let there be Light



110.26 D
Illumination shall be provided for space around service equipment.

210.70 A (3)
Lighting outlet at or near equipment requiring service.

210.64
1 receptacle (GFCI) installed within 25' of service equipment.
(new) Shall be within same room.

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110.26 Working Clearance 30" x 3'

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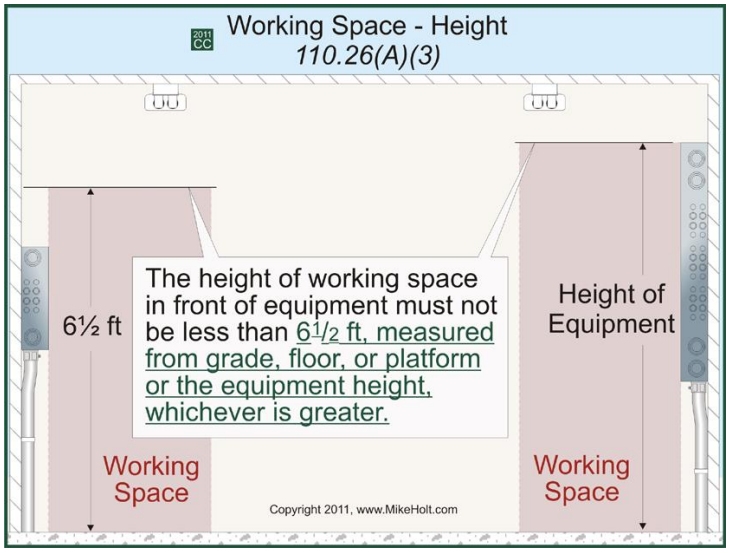
110.26 Working Space 30” x 3’ x 6 ½ ‘



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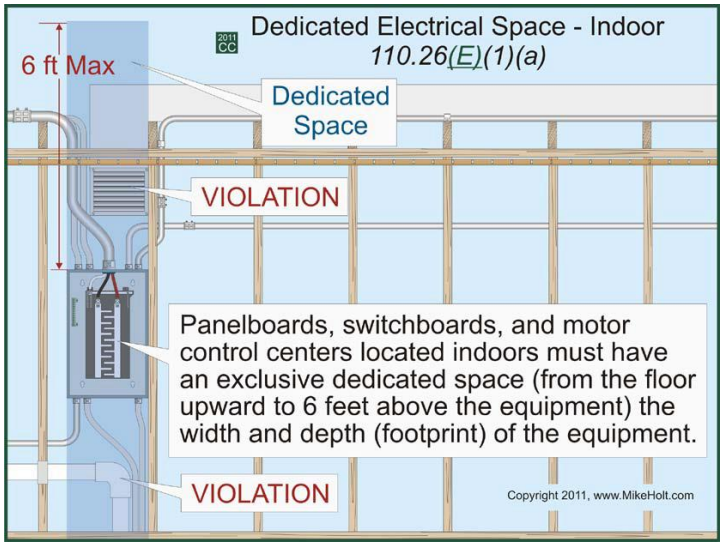
110.26 E 1 a Dedicated Space



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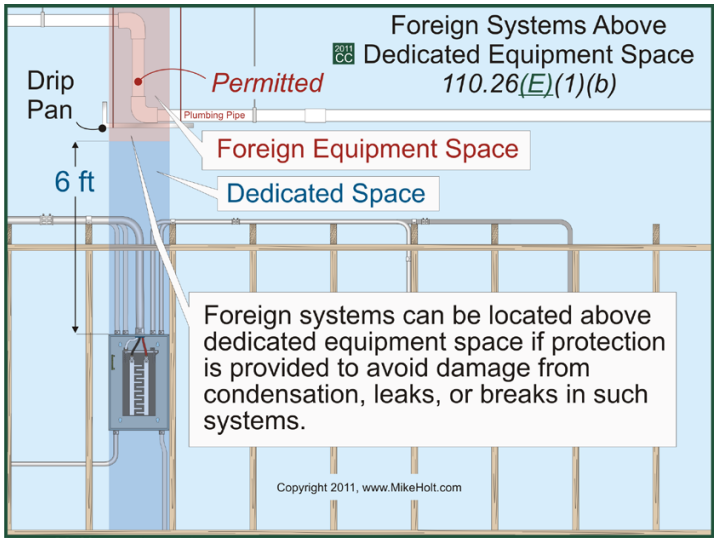
Provide Protection



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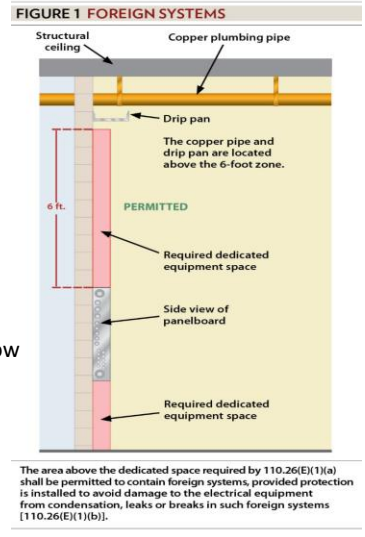
110.26 E 1 b Dedicated space

Depth of panel above and below



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210.11 Branch Circuits Required

220.12 ***(3 volt-amps (watts) x square footage) / 120v = Amps for general purpose lighting***

Amps for gen purpose lighting / 15amps = Number of circuits

Example:

3VA x 2500 sqft = 7500 / 120v = 62.5amps for gen lighting

62.5 amps/ 15amps= 4.16 lighting circuits

Minimum 5 circuits for general lighting

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210.11 Branch Circuits Required

(C) Dwelling Units. - (1) Small-Appliance Branch Circuits. 2 20 amp small-appliance branch circuits. (normally split by sink, R and L)

(2) Laundry Branch Circuit. 1 20 amp laundry circuit and no other outlets.

(3) Bathroom Branch Circuit. 1 20 amp circuit to supply bathroom receptacle outlets and no other outlets. *Can serve other bathrooms, but nothing else.*

(new 2017) ***(4) Garage Branch Circuit.*** *1 20 amp circuit (GFCI) to serve garage receptacles. Can also serve outside receptacles.*

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220.14 I

How many receptacles per circuit?

180 VA (watts) for each receptacle (single yoke)

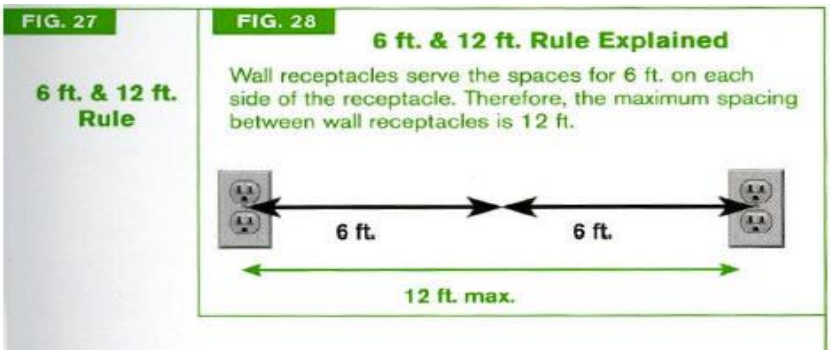
20 amps x 120 volt = 2400 VA (watts)
2400 VA / 180 VA = 13.33
13 Receptacles per 20 amp circuit

15amps x 120 volts = 1800 VA (watts)
1800 VA / 180 VA = 10
10 Receptacles per 15 amp circuit

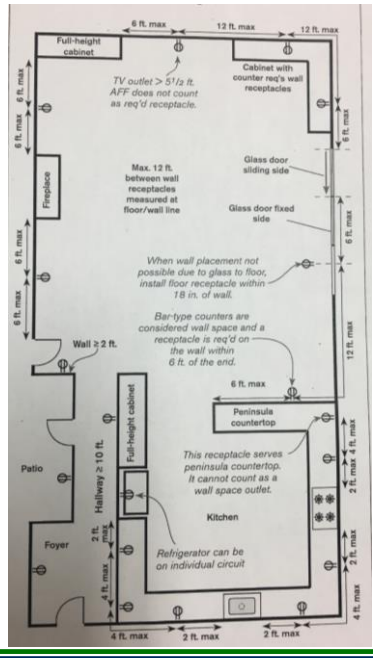
80

210.52 Required receptacles

210.52(A) Proper spacing of receptacle outlets. No point along wall space greater than 6' – any wall space 2' or longer.

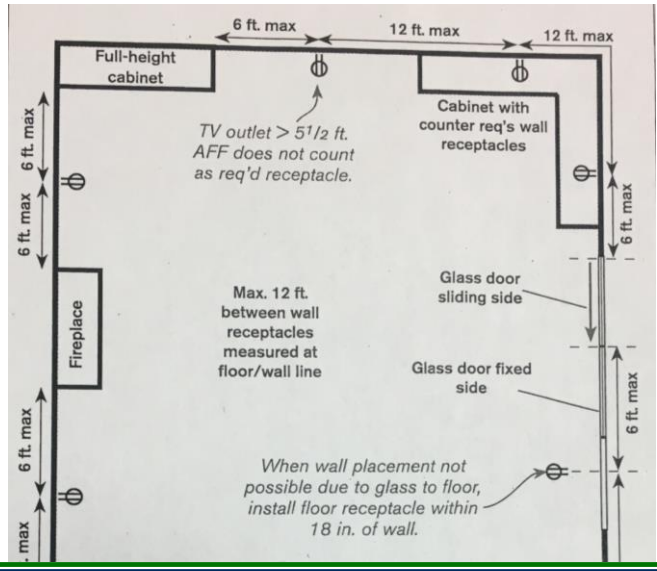


81



82

Receptacle Spacing



83

Kitchen

210.11 C 1
2 or more 20a small appliance branch circuits,
(210.52 B 1) shall serve all wall and floor receptacles covered by 210.52 A, all countertop outlets covered by 210.52 C and receptacle for refrigerator.

That is awful lot to ask 2 circuits to do!

84

210.52 C Required Receptacles

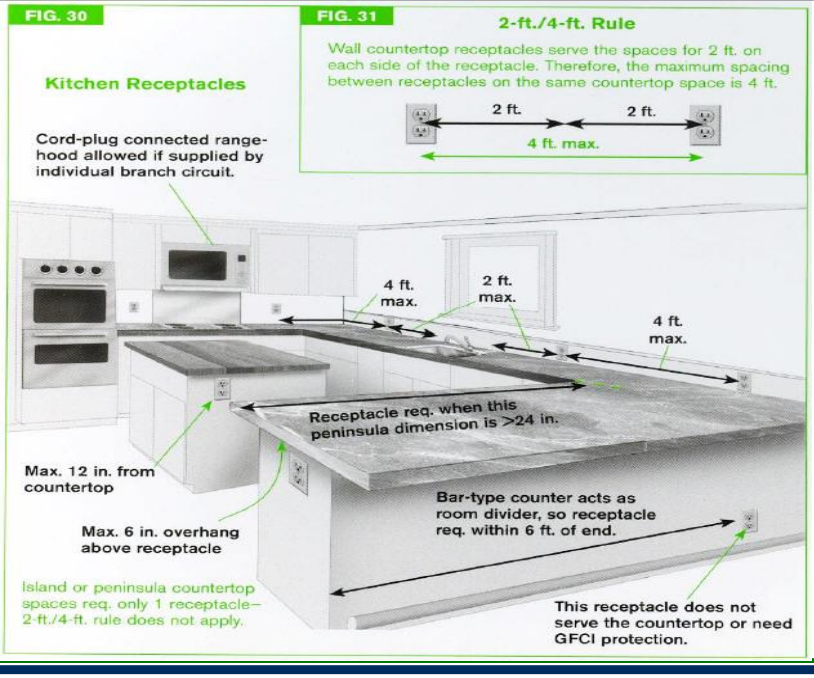
C (1) Along the wall line wider than 12" – left to right – we know the countertop is 24" deep. C(5) not more than 20" above surface.

Any point along the wall line is no more than 24".
Separated by sink, range, refrigerator, wall oven, range top
Start measure from sink edge.

C (2) Island – 1 receptacle for each section (perhaps separated by sink or cooktop) that measures 24" x 12"

C (3) Peninsular – measured from connecting wall long 24"x short 12" (E3901.4.3)

85



86

Cut out for cook top. Each side gets 1 receptacle.

87

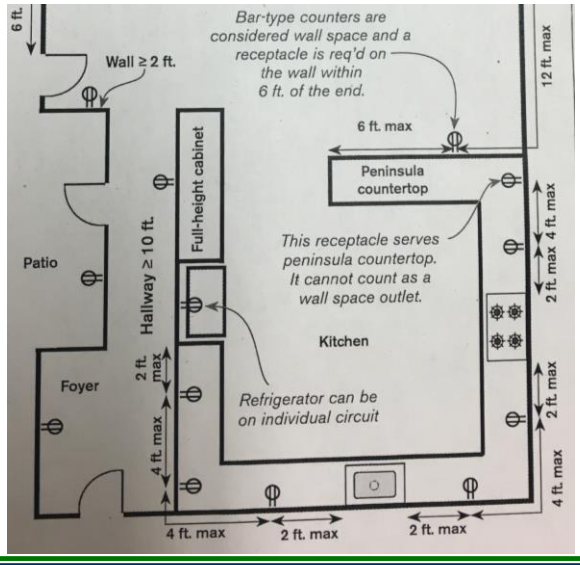
Peninsular

88

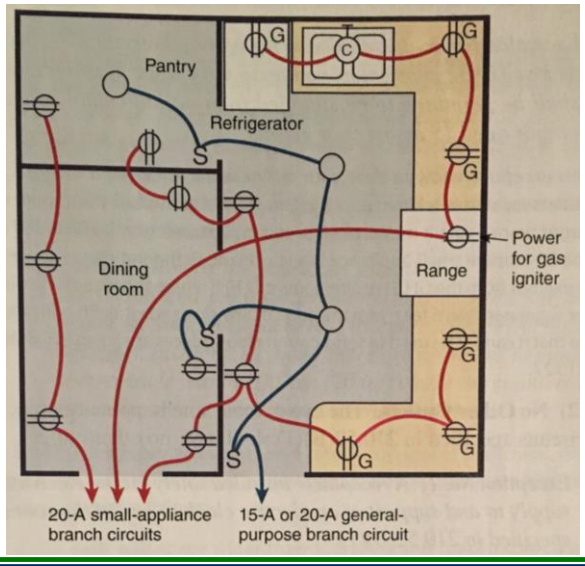
Listed Pop up GFCI

89

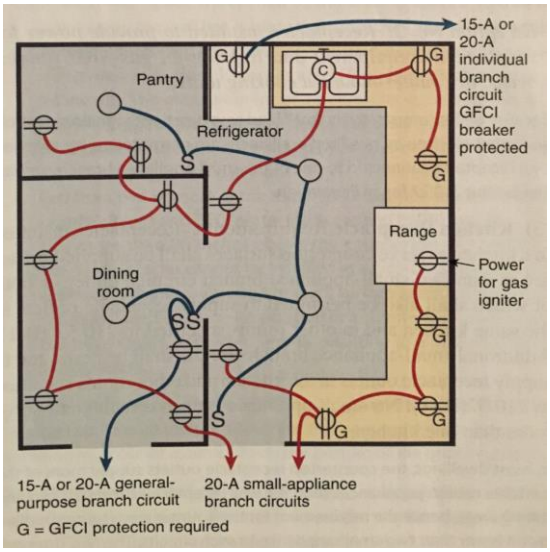
Receptacle Spacing



Kitchen circuits



Kitchen circuits Exception 2 (2017)



92

Arc Fault Circuit Interrupter

210.12A (E3902.16)

All 15A & 20A, 120V all *Branch circuits* installed in:

- Kitchens
- Family rooms
- Dining rooms
- Living rooms
- Parlors, libraries, dens, etc.
- Bedrooms
- Sunrooms, Rec Rooms
- Closets, hallways, etc.
- Laundry
- All 'similar' areas

NOTE: Some outlets must be both AFCI & GFCI protected

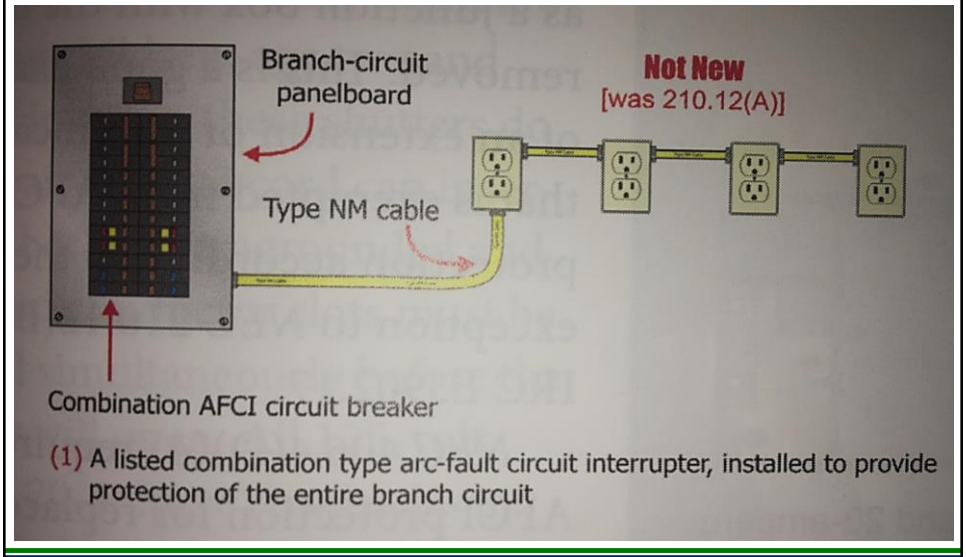
93

Arc Fault

- E3902.16 Arc-Fault Circuit Interrupter
  - 6 Protection Options:
    - 1) Combination AFCI & OCPD Breaker
      - Most common for new installations
    - 2) AFCI Protection at feeder or branch origin
      - Branch circuit protection device at first outlet
    - 3) Supplemental Arc Protection Breaker
      - Arc fault interrupter at first outlet
    - 4) Branch circuit OCPD
      - AFCI Interrupter at first outlet
    - 5) AFCI at first outlet
      - Requires circuit conductor be in metal raceways
    - 6) AFCI at first outlet
      - Requires circuit wires be partially encased in concrete

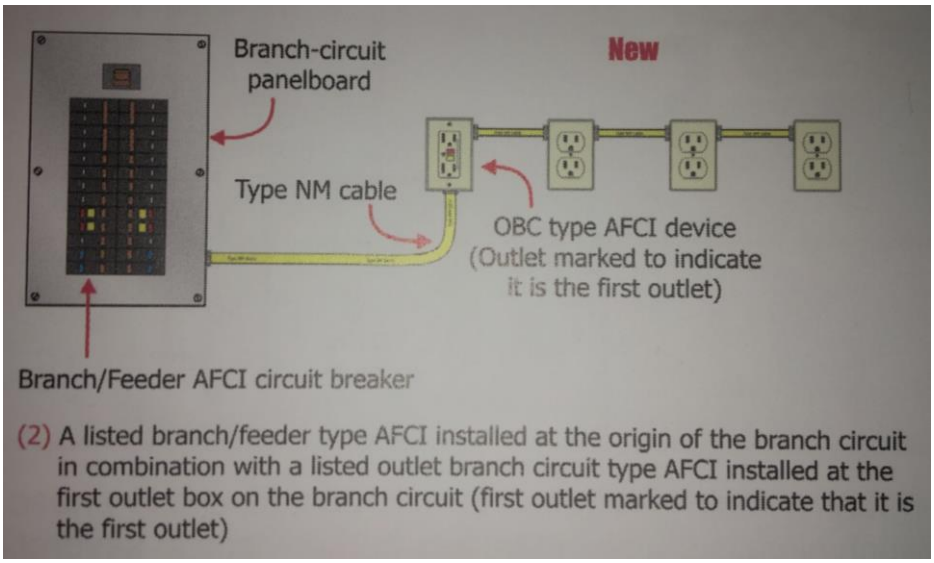
94

AFCI 1



95

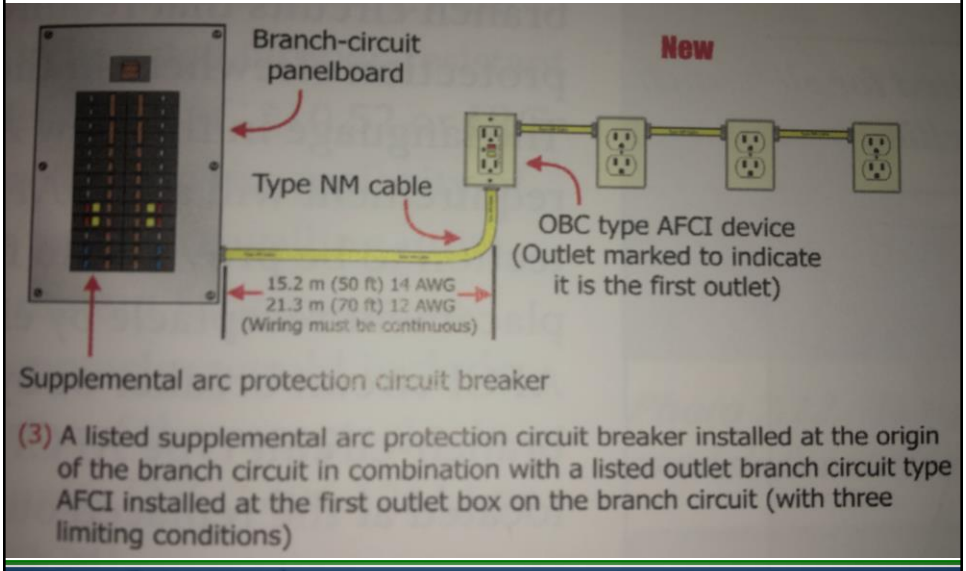
AFCI 2



(2) A listed branch/feeder type AFCI installed at the origin of the branch circuit in combination with a listed outlet branch circuit type AFCI installed at the first outlet box on the branch circuit (first outlet marked to indicate that it is the first outlet)

96

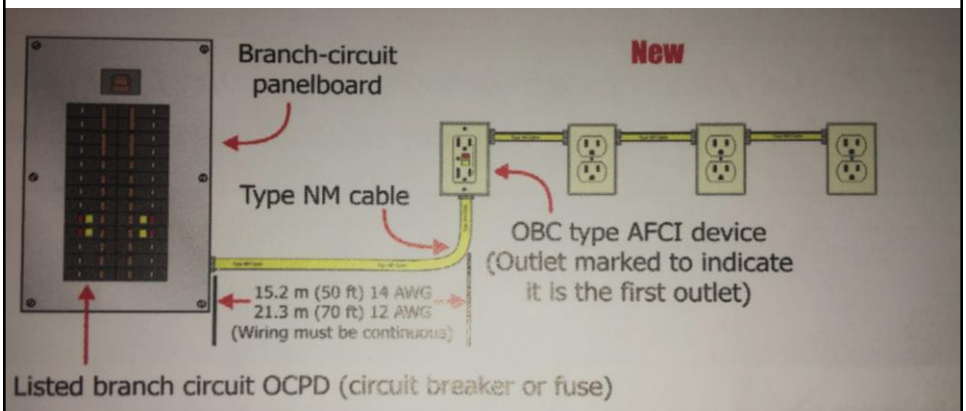
AFCI 3



(3) A listed supplemental arc protection circuit breaker installed at the origin of the branch circuit in combination with a listed outlet branch circuit type AFCI installed at the first outlet box on the branch circuit (with three limiting conditions)

97

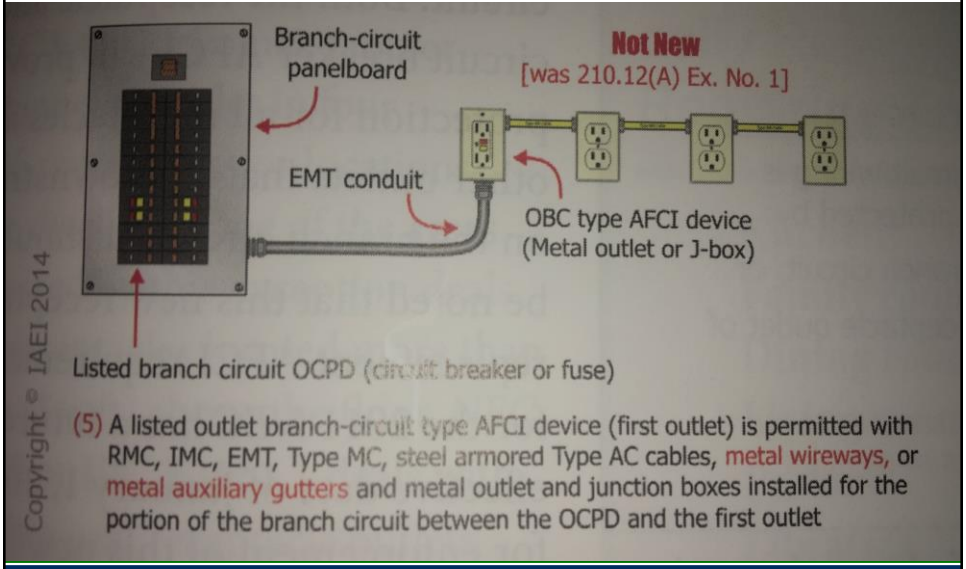
AFCI 4



(4) **System Combination Type AFCI.** A listed outlet branch circuit type AFCI installed at the first outlet in combination with a listed branch circuit over-current protective device (with four limiting conditions) (OCPD & OBC AFCI device must be identified and listed as "System Combination" type AFCI)

98

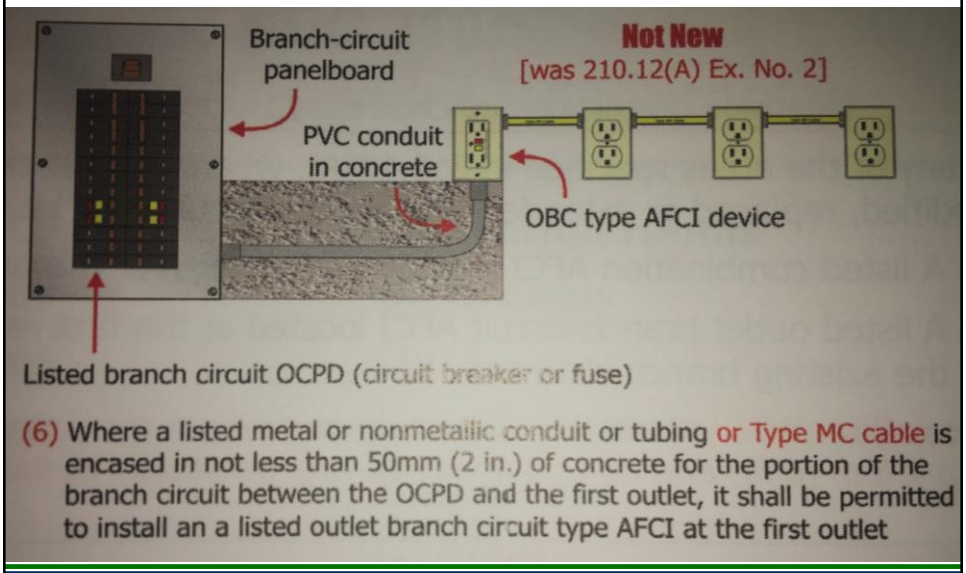
AFCI 5



(5) A listed outlet branch-circuit type AFCI device (first outlet) is permitted with RMC, IMC, EMT, Type MC, steel armored Type AC cables, metal wireways, or metal auxiliary gutters and metal outlet and junction boxes installed for the portion of the branch circuit between the OCPD and the first outlet

99

AFCI 6



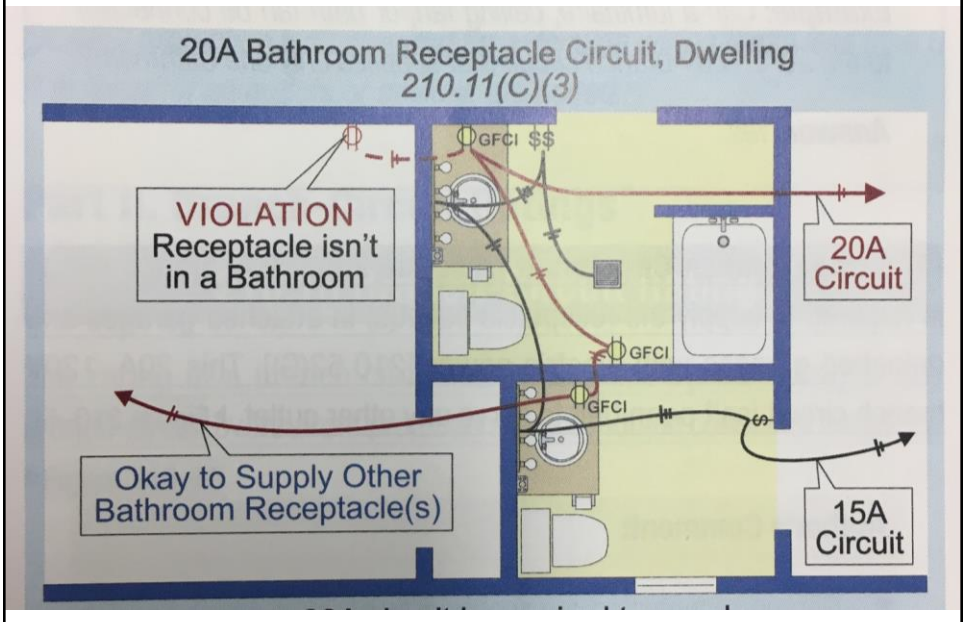
(6) Where a listed metal or nonmetallic conduit or tubing or Type MC cable is encased in not less than 50mm (2 in.) of concrete for the portion of the branch circuit between the OCPD and the first outlet, it shall be permitted to install an a listed outlet branch circuit type AFCI at the first outlet

100

Bathroom

210.52 D
At least 1 15a or 20a 125v receptacle within 3' of EACH basin not below top of basin more than 12"
210.8 A 1
GFCI – all receptacles
406.12
Tamper-Resistant Receptacle
210.11 C 3
At least 1 20a 120v branch circuit for receptacle. Not permitted to serve lighting in bath, but can supply other bathroom receptacles.
210.70 A 1
At least one wall switch. Occupancy sensors allowed (vacancy sensor better?)
404.2 C
Grounded (neutral) conductor to be in switch box

101



102

In Any Room

Proper box for application: fan 3 wire or smoke (422.18)

Neutral for occ sensor, Identify white as current carrier (200.7)

Draft stopping drilled holes (E3402)

Box fill (314.16)

Grounds are made up (250.148, E3908.13)

Any point along the wall to be within 6' of a receptacle. (210.52A)

Switch location (210.70)

Cables 1 ¼" from edge of framing, thru holes, nail plates, inside corners (300.4)

Support/Staples- 12" from box, 4 ½ ' apart, flat, 1 cable, 2 cables, stackers (334.30)

103

Smoke Detectors/CO Detectors 2015 IRC 314

Smokes UL 217
Each story, including basement and habitable attic (story?)
Each sleeping room and adjoining area (hall) 314.3
3' from bath door
3' from vent or paddle fan zone
House power and battery back up 314.6
Interconnected (NEST system OK) 314.4
AFCI

CO
Outside sleeping area 315.3
In bedroom w fuel fired appliance (log) 315.3
House power and battery backup 315.5
Dwelling with fuel fired system and/or attached garage 315.2.1

104

WiFi Smoke detectors

Requires 120v at each device

Each device requires battery back up

WiFi needed to program, but not after that. The devices will signal each other.

105

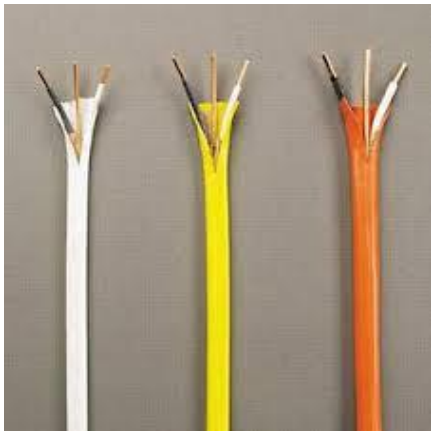
Let's start roughing

106

Bit and Brace

107

Color Blind



White	14 AWG	15a
Yellow	12 AWG	20a
Orange	10 AWG	30a
Black	read it	
Gray	UF, SE	

60 degree C rating T 310.15(B)(16)

108

I Joists Drilling and Notching

109

WOW, What a Knock-out

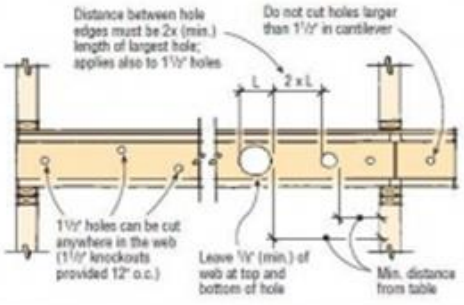
110

Multiple holes

111

Rules for wood I joists

Hole-Cutting Rules for Wood I-Joists



With wood I-joists and other types of engineered lumber, it's best to consult the manufacturer's literature. The example provided here is courtesy of Trus Joist MacMillan. ("Repiping With PEX," 10/99)

Min. Distance from Inside Face of Support to Near Edge of Hole

Depth	TJI/Pro	2"	3"	4"	5"	6"
9½"	150	1'-0"	1'-6"	3'-0"	5'-0"	6'-6"
	250	1'-0"	2'-6"	4'-0"	5'-6"	7'-6"
11⅞"	150	1'-0"	1'-0"	1'-0"	2'-0"	3'-0"
	250	1'-0"	1'-0"	2'-0"	3'-0"	4'-6"
	350	1'-0"	2'-0"	3'-0"	4'-6"	5'-6"
	550	1'-0"	1'-6"	3'-0"	4'-6"	6'-0"
14"	250	1'-0"	1'-0"	1'-0"	1'-0"	1'-6"
	350	1'-0"	1'-0"	1'-0"	1'-6"	3'-0"
	550	1'-0"	1'-0"	1'-0"	2'-6"	4'-0"
16"	250	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"
	350	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"
	550	1'-0"	1'-0"	1'-0"	1'-0"	2'-0"

General Notes:
*Distances in the charts above are based on uniformly loaded joists using the maximum loads shown [in TJMI's] brochure. For other load conditions or hole configurations, contact TJMI representative.
*For simple span (5-foot minimum) uniformly loaded joists, one maximum-size hole may be located at the center of the joist span provided no other holes occur in the joist. DO NOT cut into joist flanges when cutting out web.

112

I-Joist Manufacturer Notes

NOTES:
1. Holes may be placed anywhere within the depth of the joist. A minimum 1/4" clear distance is required between the hole and the flanges.
2. Round holes up to 1-1/2" diameter may be placed anywhere in the web.
3. Perforated "knockouts" may be neglected when locating web holes.
4. Holes larger than 1-1/2" are not permitted in cantilevers without special engineering.
5. Multiple holes shall have a clear separation along the length of the joist of at least twice the length of the larger adjacent hole, or a minimum of 12" center-to-center, whichever is greater.

113

Multiple holes

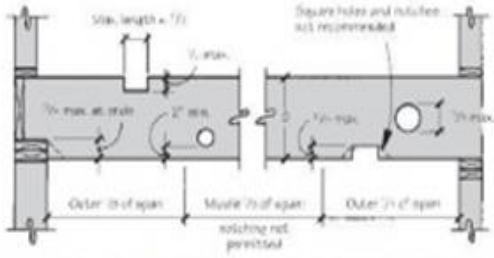
114

Solid wood framing

FRAMING GUIDELINES

Cutting, Notching, and Boring Lumber Joists

Joist Size	Maximum Hole	Maximum Notch Depth	Maximum End Notch
2x4	None	None	None
2x6	1 1/2	7/8	1 3/4
2x8	2 3/8	1 1/4	1 7/8
2x10	3	1 1/2	2 3/8
2x12	3 3/4	1 7/8	2 7/8



In joists, never cut holes closer than 2 inches to joist edges, nor make them larger than 1/3 the depth of the joist. Also, don't make notches in the middle third of a span, where the bending forces are greatest. They should also not be deeper than 1/6 the depth of the joist, or 1/4 the depth if the notch is at the end of the joist. Limit the length of notches to 1/3 of the joist's depth. Use actual, not nominal, dimensions. ("Field Guide to Common Framing Errors," 10/91)

115

Things that make you go…Hmmmm

116

Electrical Rough Inspection

117

Not a Rough Inspection

118

Wiring Quiz

- Type NM Cable
  - 1) How far from edge of wood when cable runs along a stud or joist?
  - 2) How far from edge of wood to pass-through stud or joist to avoid using a nail plate?
  - 3) Thickness of the nail plate?
  - 4) How many cables under a blue insulated staple?
  - 5) Distance between supporting staples?
  - 6) First support /staple distance from box?

1) Stack it

300.4 D Parallel to framing

"supported so that the nearest outside surface of the cable or raceway is not less than 1 ¼" from the nearest edge of the framing member "

120

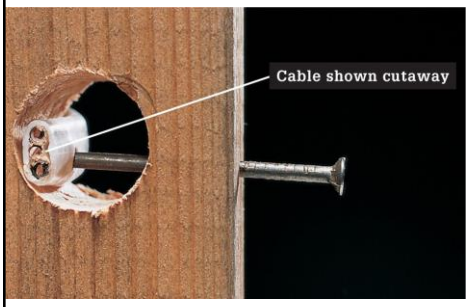
2), 3) Nail Plate

300.4 A 1 Protection

Edge of drilled *hole* is 1 ¼" or less – requires a nail plate – 1/16" thick - cover the width of the area

121

Boring subject



122

4) Staples

SN 40 IB

1/2" Wide, 1" Long, Zinc Plated Low Carbon Steel, LDPE Blue Plastic Insulator

UL LISTED

Armored Cable 14/2 And 14/3
Non-metallic Sheathed 14/2 Through 10/3

Metal Clad 14/2 And 14/3
Underground Feeder 14/2 And 12/2

CATALOG NUMBER	UPC # 780227	UNIT QUANTITY	MASTER CARTON	MASTER WEIGHT
SN 40 IB 100	71981	100	5000	27
SN 40 IB 500	71984	500	5000	27

SN 150 IB

1/2" Wide, 1-1/2" Long, Zinc Plated Low Carbon Steel, LDPE Red Plastic Insulator, Extra Long For Securing Up To Two Cables

UL LISTED

One Cable
Non-metallic Sheathed 14/2 Through 10/3
Underground Feeder 14/2 And 12/2

Two Cables
Non-metallic Sheathed 14/2 Through 12/3
Underground Feeder 14/2 And 12/2

CATALOG NUMBER	UPC # 780227	UNIT QUANTITY	MASTER CARTON	MASTER WEIGHT
SN 150 IB 100	75027	100	5000	51
SN 150 IB 250	75028	250	2500	25
SN 150 IB 3M	75026	3000	BUCKET	29

123

SN 40 IB Staples

124

SN 150 Staples

125

5), 6) 314.17 C Exception

334.30 Support of NM cable

12” from every box
4 ½’ intervals along length

314.17 C exception

Single gang box with no clamps (smash the knockout out), NM cable ¼” inside box, stapled 8” from box.

126

Type of box for application

314.27 A (2)
Box listed to support weight:

Fixture/ luminaire up to 50lbs

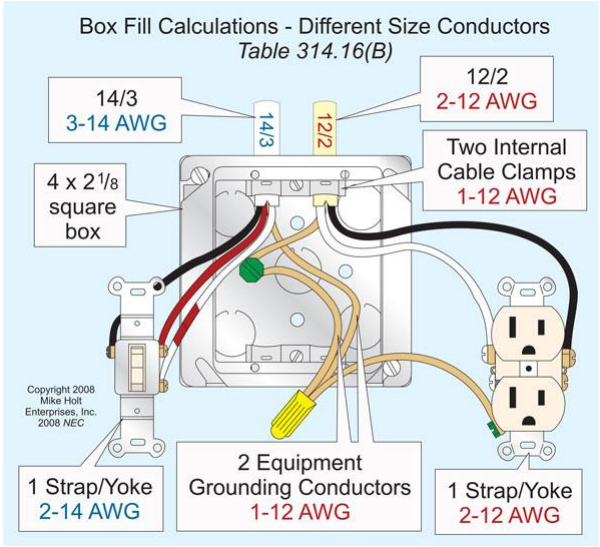
Paddle Fan (314.27 C)

Chandelier over 50lbs, listed, support independently of box

Pendant

127

Box Fill



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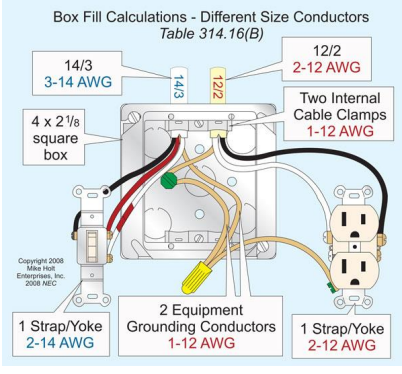
Box Fill Calculation



	Volume allowance	unit volume	total
14 AWG	3 conductors	2.0	6
12 AWG	2 conductors	2.25	4.5
Grounds	1 12 awg	2.25	2.25
Clamps	1 12 awg	2.25	2.25
Device sw	2 14awg	2.0	4.0
Device rec	2 12 awg	2.25	4.5

=23.5 cuin

4 x 4 x 2 1/8" sq box metal = 30.3 cuin (T314.16A)
(plus the plaster ring) OK
Don't count tails and wirenuts

129

Box Fill? And Grounds must be continuous

130

Box Fill Calculation

Yellow #12/2 and 12/3 Romex + 1 device

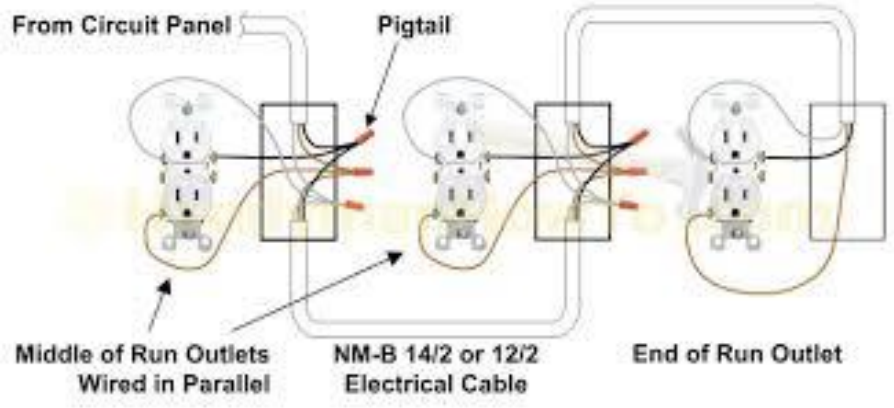
Conductors 5 x 2.25=		11.25 (2 white,2 black,1 red)
Grounds= 1 x 2.25 =	+	2.25
Device = 2 x 2.25 =	+	4.5
	min	18.0 cuin box

Don't count tails and wire nuts, no clamps

Minimum conductor into box 6"
Minimum conductor outside of box 3" 300.14
(*length of a set of linesman pliers*)

131

AFCI and GFCI device not wired like this



132

Final Inspection

133

Final Inspection

Proper labeling of Directory at Panel 408.4

Clearance in front and around Panel, light in panel area 110.26

Receptacle in area to be serviced 210.64

134

Rough or Final Inspection?

314.20 Flush Mounted

314.22 Surface Extension

What is the finish surface?

Noncombustible ¼" Tile, gypsum (sheetrock)

Combustible Flush Wood, fabric, wallpaper

135

Finished Surface

314.20
Installations within or behind a surface of concrete, tile, gypsum, plaster or other noncombustible material, SHALL BE *MADE* so that the front edge of the box will not be set back of the finished surface more than ¼".
Installation within a surface of wood or other combustible material, box shall *extend to* the finished surface.

314.21
Noncombustible surfaces that are broken OR incomplete around boxes employing a flush-type cover or faceplate SHALL BE REPAIRED so there will be no gaps or open spaces greater than 1/8" at the edge of the box.

136

Final Inspection

406.6 Faceplates seat against surface

139

Final Inspection

Test receptacles for proper operation and Polarity 200.10

Grounding Type 406.4 A

Secured 314.23
6-32 machine screw 406.5

Tamper Proof 406.12

GFCI, AFCI location 210.8, 210.12

Finish flush with surface 314.19, 314.20, 314.21, 406.5, 406.6

140

Outdoor Receptacle

Wet Location 406.9 B
(E4002.9)

15 and 20 amp 125v receptacle to be *WR* type

Weatherproof enclosure regardless if plug is inserted

Extra Duty type

GFCI protected

141

Final Inspection

Testing of Smoke Detectors/ CO detectors IRC R314/ R315

Interconnected R314.4

AFCI *is* required for bedroom smoke circuits 210.12 A

Only a fire alarm system is exempt from AFCI protection

AC/DC

142

Final Inspection

Service switches for fixed appliances

Oil Burners and Furnaces
Gas Burners
AC Air handlers
AC Compressors
AC Split Systems
Water Heaters
Water pump

143

Final Inspection

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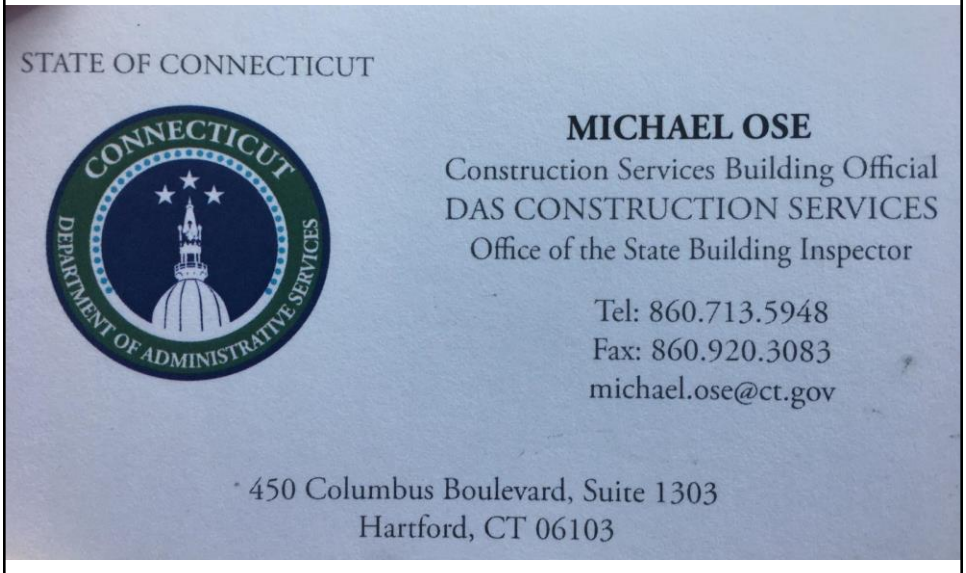

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Use of OEDM Training Materials

Use of Office of Education and Data Management (OEDM) training materials must be approved in writing by the State of Connecticut, Department of Administrative Services' Office of Communications. In approving of such use, the State of Connecticut assumes no liability associated with such use, including, but not limited to, the user's dissemination of any inaccurate information or interpretation in connection with its use of these training materials. Use of the training materials is at the sole risk of the user, and the State's approval of the use does not constitute an endorsement of the user or its intended use.

148