

Residential Buildings Only Per 2004 California Electric Codes

Dwelling Unit NM Wiring Summary – Minimum Required Electrical

I) Minimum required receptacle outlet locations

A) General (210 – 50)

- 1) Wherever flexible cords are to be used
- 2) Within 6' of an appliance location

B) Habitable Rooms (210 – 52) Definition of General Use Receptacle Outlet is:

- Within 5 ½' of floor on any wall (or pendant)
- If on floor, less than 18" from any wall
- Not within cabinets, cupboards, or appliance (except baseboard heater)
- Not part of electrical fixture

- 1) Wall spaces 2' or more in width = receptacle outlet
- 2) Maximum spacing between receptacle outlets = 12'
 - (a) No wall space more than 6' from receptacle
 - (b) Measurements
 - Unbroken along floor line at wall
 - Include fixed room divider or railings
 - Fixed panels of exterior walls, such as "patio doors"
 - Around corners

C) Kitchens, pantry, breakfast room, dining room, and similar areas

- 1) General wall space = as per habitable room requirements
- 2) Counter tops (in kitchens and dining rooms)
 - (a) Wall counter space =
 - i Receptacle required if counter is 12" or wider
 - ii No counter space more than 24" from receptacle
 - iii Maximum space between receptacles is 4'
 - (b) Island or peninsular counters require a receptacle if $\geq 12" \times 24"$
 - (c) Receptacle outlet location (for counter top)
 - i Within 18" above top
 - ii Not face-up in work surface or counter
 - iii Must be readily accessible and not in or for a dedicated appliance space

- iv May (if permitted) be not more than 12" below top, if top does not overhang more than 6" for an island or peninsular counter ONLY.

D) Bathroom – definition: is a basin with one or more of toilet, tub, and shower. [CEC 210 -11 (3)(c), 223, 210 -52(d)]

- 1) Wall receptacle required adjacent to each basin location within 36" of basin's edge (not in face-up position in work surface/counter).
- 2) Lights are separate for 2 or more bathrooms.
- 3) A GFI can operate more than one bathroom.

E) Outdoor Outlets – dwelling at grade level [CEC 210-529e)]

- 1) One receptacle required for front of dwelling and one receptacle for back of dwelling.
- 2) Accessible receptacle at grade level within 6'6" of grade.

F) Basement [CEC 210-52(g)]

- 1) Required one general use receptacle
- 2) Cannot be for laundry or other "fixed" appliance

G) Garages [210-529(g)]

- 1) Attached garage requires one general use receptacle (cannot be one for laundry or other fixed appliance)
- 2) Detached garage with power needs one receptacle (cannot be the one for laundry or other fixed appliance or equipment.)

H) Laundry Area [CEC 210-52(h)]

- 1) One receptacle for SFD within 6' of appliance areas.
- 2) No GFI required – 20 amp.

I) Hallways [CEC 210-52(h)]

- 1) If 10' or longer one receptacle

J) Swimming Pool, Spa, or Hot Tub [CEC 680]

- 1) Outdoor swimming pool, spa, or hot tub = one receptacle minimum 10' from, but not more than 20', within 6'6" of floor, platform, or grade.
- 2) Indoor spa or hot tub = one receptacle minimum 5' from, but not more than 10'

K) Heating and Air Conditioning Equipment [CEC 210-63]

- 1) One accessible receptacle required
- 2) Location = at service space, within 25' of equipment.
- 3) Remember Mechanical Code requirements

L) All bedrooms require an ARC-FAULT BREAKER [CEC 200-12]**II) Required Minimum Lighting Outlet Locations [CEC 210-70]**

- A) Habitable Rooms (except kitchen) - one wall switched lighting outlet or wall switched receptacle outlet
- B) Kitchen - one wall switched lighting outlet
- C) Bathroom – one wall switched lighting outlet
- D) Hallway – one lighting outlet controlled by a wall switch, remote control, central control, or automatic control
- E) Stairway
 - 1) One general lighting outlet controlled by a wall switch, remote control, central control, or automatic control
 - 2) Interior stairway with six steps or more – one lighting outlet controlled by a wall switch at each floor level
- F) Garages (attached or detached with electrical power) one wall switched lighting outlet
- G) Outdoor entrances or exits (exterior) – one lighting outlet controlled by a wall switch, remote control, central control, automatic control
- H) Heating and Air Conditioning Equipment – one wall switched lighting outlet in service area with switch at point of entry (remember Mechanical Code Requirements)
- I) Utility, Laundry, Storage Areas, Equipment Areas (including attics, basements, or under floor spaces used for storage or equipment that requires servicing) – one lighting outlet at or near equipment or storage area, controlled by a light switch located at the usual point of entry

III) Minimum Requirements for Branch Circuits

- A) General Lighting [CEC 210-11, 220-3, 220-4] Definition = receptacles and lighting outlets.
 - 1) Volt AMP Ratings = 15A or 20A, 120V
 - 2) Calculations = 3 watts per square foot
 - 3) At least two (including bathroom BC) required
- B) Bathroom [CEC 210-11(c)(3)] – one 20 amp, 120V generally with no other outlets, just receptacles.
- C) Small appliance (kitchen, dining, pantry, breakfast room, or similar) branch circuits (no lighting) – two 20amp, 120V (for calculations 1500 watts each)
- D) Laundry receptacle (no lighting, no other outlets) – one 20 amp, 120 V (for calculations 1500 watts). Not for 240V dryer.
- E) Fixed loads – by load of each branch circuit, 120V or 240V; 15A, 20A, 30A,40A, 50A, 60A, etc.
- F) Permissible loads on circuits [CEC 210-23, 210-24]
- G) Branch circuit conductor sizes (minimums) [CEC T210-24, T310-16] *Copper*.
 - 1) 15 amp = #14
 - 2) 20 amp = #12
 - 3) 30 amp = #10
 - 4) 40 amp = #8

- 5) 50 amp = #6
- 6) Remember variables: number of conductors, ambient temperatures, grouping, etc. See CEC 310-15.

H) Branch circuit conductor identification [CEC 200-6, 210-5, 310-12]

- 1) Insulation required [CEC 310-2]
- 2) White = grounded (neutral) conductor
- 3) Black or red = ungrounded (hot) conductor
- 4) Green = grounding conduction (without insulation = bare is okay).

I) Receptacles

- 1) Ratings [CEC 210-24]
 - (a) 15 amp BC = 15 amp receptacle
 - (b) 20 amp BC = 15A or 20A receptacle
 - (c) 30 amp BC = 30A receptacle
 - (d) 40 amp BC = 40A or 50A receptacle
 - (e) 50 amp BC = 50A receptacle
- 2) Grounding type [CEC 210-7]
- 3) To be grounded (connected to neutral) [CEC 210-7]
- 4) Terminal I.D. [CEC 200-10]
 - (a) Grounded conductor = white (silver)
 - (b) Ungrounded conductor = Brass (black)
 - (c) Grounding conductor = Green and Hexagonal {CEC 250-119}
- 5) Locations: **NOTE: ASK FOR THE POOL AND SPA PACKETS IF NEEDED.**
 - (a) General [CEC 370]
 - (b) Damp or wet [CEC 370-15, 410-57]
 - (c) By swimming pools [CEC 680-6]
 - (d) By spa or hot tub [CEC 680-41]
 - (e) Bathtub [CEC 410-57]

J) Lighting Fixtures

- 1) General [CEC 410]
- 2) No exposed live parts [CEC 410-3]
- 3) Wet or damp locations [CEC 410-4]
- 4) In clothes closet [CEC 410-8]
- 5) Fixture support [CEC 410-15 and 16]
- 6) Grounding [CEC 410-17 and 18]
- 7) Recessed fixtures [CEC 410-65 and 66]
- 8) Lighting tracks [CEC 410-100]
- 9) By bathtub [CEC 410-4]

K) Switches

- 1) Ungrounded conductor switched [CEC 380-2]
- 2) Box required [CEC 380-3]
- 3) Indicating [CEC 380-7]

- 4) Accessible [CEC 380-8]
- 5) By indoor spa or hot tub [CEC 680-41]

L) Multi-wire branch circuits [CEC 210-4]

IV) Panels

- A) Working space [CEC 110-26] *NOTE: See table 110-26(a) for conditions*
- 1) 30" minimum width – clear [600 volts or less]
 - 2) 3' minimum depth – clear [600 volts or less]
- B) Live parts guarded for protection against contact [CEC 110-27, 384-18]
- C) Identification of disconnects, "permanent markings" [CEC 110-21 and 22, 240-83]
- D) Location – free from physical damage, not in clothes closets or bathrooms [CEC 240-24, 110-26]
- E) Number of over current devices total = 42 maximum [CEC 384-15]
- F) Grounding: shall be permanent and follow the grounding path [CEC 250]

V) Service Entrance

- A) Size [CEC 210, 220, 230]
- 1) General lighting
 - 3 watts per sq. ft. = minimum watts
 - watts x volts (120V) = minimum amps
 - (1 – 20 amp for bathroom) [CEC 210-11]
 - 2) Small appliance = 2 – 20 amp B.C. @ 1500 watts each [CEC 210-11, 220-16]
 - 3) Laundry
 - 1 – 20 amp B.C. @ 1500 watts [CEC 210-11, 220-16]
 - 4) Other electric loads
 - (a) Fixed electric space heat [CEC 2002-15]
 - (b) Kitchen cooking appliances [CEC 200-19]
 - (c) Electric clothes dryer 5,000 W minimum [CEC220-18]
 - (d) Can de-rate 4+fixed [CEC 220-17]
 - (e) Other loads at value
 - 5) S.E. = 100 amps minimum or load total (SFD)
- B) Location [CEC 230]
- 1) One service with no more than six disconnects
 - 2) Readily accessible disconnect
 - 3) Marked disconnect
- C) Service drops [CEC 230-21 through 230-29]
- 1) Minimum size = #8 Cu, #6 Al (or by load) [CEC 310-15]
 - 2) Clearances
 - (a) Above roofs
 - i General = 8' above roof, 3' side clearance
 - ii Flat with pedestrian use = 10'
 - iii $>4/12 = 3'$, from edge = within 4', minimum 18" clearance, 6' maximum conductor over roof
 - iv Service entrance mast 42" max. above roof without tri-braced.

- (b) From ground
 - i Sidewalks, walking surfaces = 10'
 - ii Driveways [residential] = 12'
 - iii Streets, public right of ways, etc. = 18'
- (c) From building openings in all direction of reach, porches, decks = 3'
- (d) Point of attachment to building = 10' above grade minimum.

D) Service laterals [CEC 230-30 through 230-32]

- 1) Minimum size #8 Cu, #6 Al (or by load). [CEC 310-15]
- 2) Protect from physical damage

E) Grounding [CEC 250]

- 1) Ground required at each service with grounding electrode [CEC 250-30]
- 2) Neutral to be grounded [CEC 250-20]
- 3) Metal parts of S.E. to be grounded [CEC 250-92]
- 4) Grounding electrode at S.E. to connect to neutral and equipment grounding conductors
- 5) Bonding [CEC 250-26, 28, 30]
 - (a) Main bonding jumper size = T.250-66
 - (b) To metal water piping [no paint]
 - (c) To other metal piping [no paint]
 - (d) To metal building member [no paint]
- 6) Grounding electrode system [CEC 250-50+]
 - (a) Metal underground water pipe with additional grounding elect.
 - (b) Effectively grounded metal building frame [no paint]
 - (c) Concrete encased electrode, #4 re-bar min.20 feet min. in length (uffer)
 - (d) Ground ring, must encircle entire building,#2 bare copper, min 20 ft length, 2 1/2ft. min. depth direct contact to ground.
 - (e) Metal under grounds structures
 - (f) Driven or buried metal rods, 8 ft. min. depth, steel 5/8" min width, non-ferrous 1/2' min., pipe or conduit 3/4" trade size min.
 - (g) Driven or buried metal pipes, 8 ft. min in depth
 - (h) Plate electrodes, shall expose not less than 2 ft. of surface to ext. soil, min. 2 ft. in depth, and 1/4" in. thick when iron or steel and nonferrous min. 0.06
 - (i) Installation of grounding electrode
 - i Required protection, from all damage.[CEC 250-62,64]
 - ii Connection shall be permanent bonded and assessable.[CEC 250-66, 68]
 - iii Size (T250-66)

VI) Feeders - Note: See attached sheet for detailed information.

- A) Loads [CEC 220]
- B) Minimum size by load [CEC 310-15]
- C) Wiring methods
 - 1) NM or NMC [CEC 336]
 - 2) UF [CEC 339]

- 3) SE/USE [CEC 338]
- 4) Outside [CEC 225]

VII) NM Wiring

- A) Permitted uses [CEC 363-4]
 - 1) NM Cable in dry locations – exposed or concealed
 - 2) NMC Cable in dry, moist, or corrosive locations – exposed or concealed
- B) Not permitted uses [CEC 336-5]
 - 1) Embedded in poured cement, concrete, or aggregate
 - 2) NM – where exposed to corrosive fumes or vapor; in shallow chase in masonry, concrete adobe and covered with plaster, adobe, etc.
- C) Sizes [CEC336-30]
 - 1) Copper = #14 through #2
 - 2) Aluminum or copper clad aluminum = #12 through #2
- D) Ampacities [CEC 336-26]
use 60°C (140°F) column on T310-16 [CEC 310-15]
- E) Insulation of conductors [CEC 336-30]
90°C (194°F) rating
- F) Installation
 - 1) Exposed locations [CEC 336-6]
 - (a) Closely follow surface or on running boards
 - (b) Protect from physical damage
 - (c) Through framing members [CEC 300-4(a)]
 - i Bored holes = 1 ¼” from edge or with nailing protector
 - ii Notches = protect with nailing protector
 - (d) Alongside parallel framing members [CEC 330-4(d)] 1 ¼” from edge or protect
 - (e) In unfinished basements [CEC336-6]
 - i 2 - #6 or 3 - #8 may be directly on lower edges of framing.
 - ii Follow framing path for support.
 - iii Through proper bored holes [per: CBC]
 - iv Run parallel to frame on side or face of frame.
 - v Put on running boards
 - (f) In accessible attics [CEC 333-12]
 - i Across the top of or bottom of frame.
 - (i) With permanent (stairs or ladder) access = protect when within 7’ of top of joist (floor/ceiling)
 - (ii) Without permanent (stairs or ladder) access = protect when within 6’ of access opening
 - 2) In concealed locations
 - (a) Through frame members [CEC 300-4(a)]
 - (b) Alongside frame members [CEC 300-4(d)]
 - (c) Protect from physical damage
 - 3) Securing of cable [CEC 336-18]
 - (a) Maximum space = 4 ½’ between all staples of support.
 - (b) Use nail plate protection if 1¼’ or less to exterior of the edge.

- (c) Do not over stack in nail off of wires.
- (d) Within 12" of cabinet, box fitting (may be within 8" of single gang box) [CEC 370-17(c) exc.]
- (e) Secure to any cabinet, box, etc. (may be without clap to single gang box if secured within 8") [CEC 370-17(c) Exc.]
- 4) Bends in cable [CEC 336-1]
 - (a) No sharp bends, minimum radius of bend 5x cable diameter
 - (b) No damage to sheathing, conduit, ect.
- 5) Boxes [CEC 370]
 - (a) Appropriate box for location "rated box in firewalls" [CEC 370-15]
 - (b) Securely supported [CEC 370-23]
 - (c) Openings sealed [CEC 370-17, 370-18]
 - (d) Mounting per listing. [CEC 370-20]
 - i In combustible wall or building construction = flush with or beyond finish wall covering max.
 - ii In noncombustible wall or building construction = ¼" back or project beyond finished surface max.
 - (e) Number of conductors within box [CEC 370-16]
 - (f) Minimum 6" free conductor to exterior of box. [CEC 300-14]
- 6) Bundling cables = (possible) reduction of ampacity (T.310-15(b)(2)(a))
- 7) Cables in high ambient temperature areas = possible reduction of ampacity check (T.310-16) for compliance
- 8) Outside branch circuits "install per listing" [CEC 225]

VIII) Appliances

- A) Branch. Circuits. size [CEC422-10]
- B) Garbage disposals flexible cords 18"min., 36" max. [CEC 422-16(b)]
- C) Dishwasher and trash compactors, flexible cord 36" min., 48" max. [CEC422-16(b)(2)]
- D) Water heaters, 120 gal or less shall be rated 125% or greater. [CEC 422-13]
- E) Cooking units [CEC 370-27]
- F) Support of ceiling fans (paddle) [CEC 422-18]
- G) Disconnects
 - 1) Cord-plug shall be accessible. [CEC 422-32]
 - 2) Switches used as disconnects. [CEC 422-33]

IX) Over current protection [CEC 422-11]

- A) B.C. conductors [CEC 440-31]
- B) Over current protection [CEC 440-5.1]
- C) Disconnect [CEC 440-11]

X) Swimming Pools, Spas & Hot Tubs [CEC 680]

- A) Ask for "Swimming Pool Handout"(total of 8 pages) for compliance.