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GUIDELINES FOR WIRING SINGLE FAMILY DWELLING UNITS

Wiring must comply with the currently adopted National Electrical Code (NEC), a code that is neither intended as a design specification nor instruction manual for untrained individuals. Its purpose is the practical safeguarding of persons and properties from hazards arising from the use of electricity. This handout is an overview of the NEC requirement for single family dwellings. The information does not cover requirements for every installation; it is to be used along with the N.E.C.

INSPECTIONS

Review the following information to understand what work needs to be completed before requesting inspections.

WORKMAN LIKE MANNER- All wire must follow the building lines, and in no case will "Spider Webbing" or "as the crow flies" will be allowed. This rule is the interpretation of neat and workman like manor by the "Authority having Jurisdiction".

ROUGH INSPECTION - All wire must be pulled, stapled properly, and all splices made and ready to accept devices and fixtures. Do not install any devices or fixtures or cover any wiring with insulation or wall covering, such as drywall prior to the rough-in inspection.

FINAL INSPECTION - The electrical installation must be complete when you request the final inspection. All devices and fixtures must be installed, and service equipment complete and labeled properly. All wiring must be free from short circuits, ground fault and open circuits. All light fixtures and light switches must be grounded. All kitchen cabinets must be installed.

SERVICE –

The service equipment must be large enough to supply the connected load which is calculated using the NEC. The minimum wire size for service entrance conductors are listed below. The service equipment must be grounded in accordance with the NEC. The neutral must be bonded to the service enclosure and the grounding electrode system defined in the NEC. The neutral shall be identified white.

The main service panel must be mounted either outside or inside the dwelling as near as possible to the point of entrance of the service conductors to the structure.

All service equipment and electrical panels must have a clear area of 30 inches wide and 36 inches deep in front of the equipment.

This clear area must extend from the floor to ceiling with no intrusions from other equipment, cabinets, counters, pipes, appliances, etc.

Service equipment/panels are NOT allowed in clothes closets or bathrooms, or over stairs.

CONDUCTOR TYPES AND SIZES

(RH - RHH - THHW - THW - THWN - THHN - XHHW – USE

Service Rating	Copper	Aluminum & Copper Clad AL
In Amps	AWG	AWG
100	4	2
110	3	1
125	2	1/0
150	1	2/0
175	1/0	3/0
200	2/0	4/0
225	4/0	250 kcmil
250	4/0	300 kcmil
300	250 kcmil	350 kcmil
350	350 kcmil	500 kcmil
400	400 kcmil	600 kcmil

GROUNDING REQUIREMENTS-

The service equipment must be grounded to comply with the provisions of the NEC, stating that the neutral must be bonded to the service enclosure and the grounding electrode system as defined in the NEC.

Grounding Electrode System. All grounding electrodes as described in the NEC that are present at each building or structure served shall be bonded together to form the grounding electrode system. Concrete-encased Electrode.

An electrode encased by a minimum of 2 inches of concrete located within and near the bottom of the concrete foundation or footing that is in direct contact with the earth, consisting of at least 20 feet of one or more bare or zinc galvanized or other electrically conductive coated steel reinforcing bars or rods of not less than 1/2 inch in diameter, or consisting of at least 20 feet of bare copper conductor not smaller than 4 AWG.

Reinforcing bars are permitted to be bonded together by the usual tie wires or other effective means. (Refer to Ufer Grounding handout) In the main service equipment, the neutral and the equipment grounding conductors are bonded together; in sub-panels the neutral is isolated from the ground.

All equipment grounding conductors must be connected with solder-less pressure connectors such as wire nuts or crimp sleeves, leaving sufficient extra conductor for attachment to the metal box and/or device. When crimp type connectors are used, they must be crimped using the tool recommended by the manufacturer.

All metal junction and outlet boxes must be grounded by attaching the equipment grounding conductor out of the NM cable to the metal box using an approved screw or grounding clip. Before circuit conductors are terminated, three inches of free conductor measured from the front of the box must be available for use in termination of the conductors.

Note: Sec, 4-3-2, N.E.C. amendments:

Meter base- The length of service entrance conductors from the meter base to the main disconnecting means shall be located immediately back-to-back or side to side of the meter.

Meter base height for new structures. The height of meter enclosure shall be installed between four (4) feet and five and one-half (5½) feet from bottom of the meter enclosure to finish grade.

Above finish grade. Clearances shall be provided between bottom of panel and finish grade a minimum of 24 inches above finish grade.

Additional Space in Panelboards. A new panelboard shall have sufficient ampacity and space for at least four (4) full-size circuit breakers for future usage.

BRANCH CIRCUIT WIRING-

- NM cable (Romex) is universally used in residential dwellings. NM cable must have a 90º conductor insulation rating designated by a “B” on the cable sheath
- NM-B #12 and #14 are used for lighting and general-purpose receptacle circuits
- #10/2 w/ground is commonly used for electric water heaters
- #10/3 w/ground is used for electric dryers
- #8/3 and #6/3 w/ ground are used for ranges and wall mounted ovens

• Type SER cable with an insulated neutral is permitted for electric ranges, wall ovens and dryers. Cables must be protected by over-current devices (circuit breakers) that do not exceed their rated amp capacity.

COPPER NM CABLE SE & SER ALUMINUM CABLE

Copper-

14 awg -- 15amp

12 awg – 20 amp

10 awg – 30 amp

8 awg – 40 amp

6 awg – 55 amp

Aluminum-

8 awg -- 40 amp

6 awg – 50 amp

NOTE: Ampacities for SE to SER reflect installation in thermal insulation.

Do not mix wire sizes on the same branch circuit. If you begin a circuit with #12, the same size wire is used throughout.

INSTALLATION OF NM CABLE (ROMEX) - Nm cable must be stapled within 12 inches of metal boxes, 12 inches of plastic boxes, and every 4 1/2 feet thereafter. Proper connectors must be used where NM cable enters any cabinets, boxes, or panel boards.

When NM cable is installed parallel to framing members or in bored holes, it must be located at least 1 1/4 inches from the nearest edge of the framing member to avoid nails or screws from penetrating the cables, The use of nail guards may be required if the distance is not maintained.

CEILING MOUNTED PADDLE FANS - Ceiling mounted paddle fan outlet boxes must be listed and specified for this use by the manufacturer. Refer to the currently adopted NEC for specific requirements.

SUBPANELS - Subpanels intended to supply power to hot tubs (including hot tubs in future scope of work) are required to have an insulated equipment grounding conductor in corrosive environment.

REQUIRED BRANCH CIRCUITS-

ARC FAULT PROTECTION - All 120-volt, single phase, 15 and 20 ampere branch circuits supplying outlets, lights, receptacles, devices, etc. in areas specified in the currently adopted NEC must have combination AFCI protection. AFCI devices must be readily accessible.

GENERAL LIGHTING BRANCH CIRCUITS - Circuits must be computed on a three watts per foot basis. Up to 500 square feet of living area may be wired on a 15-ampere branch circuit or up to 640 square feet on a 20-ampere circuit. These branch circuits may supply lighting outlets in all areas of the dwelling and receptacle outlets other than those described in the following paragraphs of this section.

BATHROOM - One or more 120 volt 20-amp branch circuit shall be provided to supply bathroom(s) receptacles. This circuit shall not serve other loads. Exception: A single 20Amp circuit may supply the

whole bathroom and not leave this bathroom. A separate circuit must be used for a whirlpool or hot tub**.**

CENTRAL HEATING - Central heating equipment must be supplied by an individual branch circuit per the manufacture. A 15amp or 20amp receptacle must be installed with-in 25' of the unit.

SMALL APPLIANCE BRANCH CIRCUITS - A minimum of two 20 ampere branch circuits are required to feed receptacle outlets for small appliance loads, including refrigeration equipment in the kitchen, pantry, breakfast room, and dining room. These circuits shall not serve other loads. Lighting outlets and built-in appliances, such as garbage disposals, dishwashers, and trash compactors, are NOT permitted on these circuits. Exception: The receptacle outlet for refrigeration equipment is permitted to be supplied from an individual branch circuit rated 15 amperes or greater.

LAUNDRY BRANCH CIRCUITS - A single 20-amp branch circuit must be provided for the laundry. This circuit is limited to receptacles within the laundry room. No other outlets are permitted in this circuit.

GARAGE BRANCH CIRCUIT - A single branch circuit must be provided for attached garages and for detached garages with electric power. At least one receptacle outlet must be installed for each car space.

LIGHTING OUTLETS-

COMMON LOCATION REQUIREMENTS - At least one wall switch-controlled lighting outlet must be installed in every habitable room, bathrooms, hallways, stairways, attached garages, detached garages with electric power, and outdoor entrances or exits. The lighting outlet for interior stairways will have a wall switch at each floor level where the difference between floor levels is six steps or more.

STORAGE AND EQUIPEMENT AREAS - At least one wall switch-controlled lighting outlet shall be installed in an attic, under-floor space, utility room and basement where these spaces are used for storage or contain equipment that requires servicing. The switch must be located at the point of entry to the area and the lighting outlet located at or near the equipment that requires servicing.

RECEPTACLES-

(TAMPER RESISTANT RECEPTACLES REQUIRED)

BASEMENT - At least one receptacle must be installed in each unfinished basement. This receptacle is in addition to any that may be installed for a specific purpose.

BATHROOMS - At least one outlet must be installed within 36 inches of the outside edge of each basin. The receptacle outlet will be located on a wall that is adjacent to the basin. Receptacles must not be located with-in 36" of a tub or shower.

FLOOR RECEPTACLES - Receptacles installed in the floor must be listed for its intended use. If installed in the floor within 18 inches of the wall, it can be used as part of the wall spacing requirement.

HALLWAY - A receptacle outlet is required in any dwelling unit hallway that is 10 feet or more in length.

HEATING, AC, REFREGERATION EQUIPMENT - A 125 volt, 15 or 20 ampere receptacle outlets must be installed at an accessible location for servicing of this equipment. The outlet must be located on the same level and within 25 feet of equipment, including those mounted on the roof. Exception: evaporative coolers**.**

FOYERS - Foyers 60 sq. ft. or greater will require receptacles per the NEC

KITCHEN AND DINING COUNTERTOP - A receptacle outlet must be installed at each counter space 12" or wider. Receptacles will be installed so that no point along the wall line is more than 24 inches measured horizontally form a receptacle outlet in that space.

Island and Peninsular- One receptacle outlet shall be installed for the first 9 square ft, or fraction thereof, additional receptacle for every 18 square ft, or fraction thereof, of countertop or work surface.

ROOMS - In every kitchen, family room, dining room, living room, parlor, library, den, sun room, bedroom, recreation room, or similar room of a dwelling unit, receptacle outlets must be installed so that no point along the floor line in any wall space is more than six feet horizontally, from an outlet in that space, two feet or more in width, and excluding only that space occupied by sliding panels in exterior walls. The wall space afforded by fixed room divider, such as freestanding bar type counter, will be included in the six-foot measurement. No outlet may be installed over an electric baseboard heater.

GARAGES - At least one outlet must be installed for each car space in each attached garage, and in each detached garage with electric power.

OUTDOOR OUTLETS - At least two outlets must be installed outdoors, one in front and one behind the dwelling and be accessible at grade level. When installed in wet locations, a weatherproof enclosure is required whether the attachment plug cap is inserted. Wet location, tamper resistant receptacles must be used.

GROUND FAULT PROTECTION-

All 125-volt through 250-Volt receptacles required to be protected by a ground fault circuit interrupter:

- Bathroom receptacles
- All outdoor receptacles
- Kitchen receptacles that serve countertop surfaces
- Receptacles within 6 feet of a wet bar, laundry, or utility sink
- Hydro massage bathtubs
- Spas and hot tubs and associated components
- Garage and accessory building with a floor located at or below grade level, not intended as habitable rooms and limited to storage or work areas
- All receptacles in an unfinished or finished basement or crawl space at or below grade
- Kitchen dishwasher branch circuit
- Laundry areas

ARC FAULT PROTECTION –

All 120-volt, single phase, 15 and 20 ampere branch circuits supplying outlets, lights, receptacles, devices, etc. in areas specified in the currently adopted NEC must have combination AFCI protection. AFCI devices must be readily accessible.

DISCONNECTING MEANS-

Disconnects are required in sight of the following: (Check the adopted N.E.C for exceptions)

- Electric water heaters
- Well pump controllers
- Central heating equipment (furnaces, boilers, etc.)
- Spas and hot tubs
- Hydro massage bathtubs
- Built in direct wired appliances. Example ovens, cook top etc. (must have a locking breaker tie installed)