ILLUSTRATED RESIDENTIAL

ELECTRICAL CODE REQUIREMENTS

Electrical Inspections
225 4th Street North
Fargo ND, 58102
701-476-6626 (South of Interstate 94)
701-476-4181 (North of Interstate 94)

Table of Contents

SMOKE DETECTORS....3
HEAT DETECTORS....3
CARBON MONOXIDE DETECTORS....3
GENERAL INFORMATION AND REQUIREMENTS....4
WIRE PLACEMENT AND INSTALLATION....5
PLASTIC BOX ILLUSTRATION....6
REQUIRED GROUNDING METHOD....7
METAL BOX ILLUSTRATION....7
WHAT SIZE BOX MEETS CODE?....8
BOX EXAMPLE ILLUSTRATION NOTES....8
PROPER WIRE SIZES....9
CIRCUIT LOAD....9
OUTLET REQUIREMENTS....10
RECEPTACLE SPACING OF KITCHEN/DINING AREA COUNTERTOPS....11
KITCHEN....11
LAUNDRY....12
At least one wall switched lighting outlet ***must*** be installed in every:....12
BASEMENT....12
GFCI protected receptacle outlets are required in:....12
BATHROOM....13
RECESSED LIGHTING FIXTURE REQUIREMENTS....14
RESIDENTIAL ELECTRICAL SERVICE REQUIREMENTS....16
EMERGENCY DISCONNECT....16

ADDENDA TO THIS BOOKLET

This handout does not address any covenants or easements assigned to the property, nor does it relieve you of code compliance with items that may not have been included from the 2020/2023 National Electric Code.

If you have any questions or need more information, please contact the electrical inspector at 701-476-6626 (South of Interstate 94) or 701-476-4181 (North of Interstate 94).

SMOKE DETECTORS

In dwelling units, a detector must be installed in each sleeping room, and at a point centrally-located in the corridor (or area) giving access to each separate sleeping area. When the dwelling unit has more than one story, and in dwellings with basements, a detector must be installed on each story and in the basement.

In dwelling units where a story or basement is split into two or more levels; the smoke detectors must be installed on the upper level. When the lower level contains a sleeping area, a detector must be installed on each level. When sleeping rooms are on an upper level, the detector shall be placed at the ceiling of the upper level in close proximity to the stairway.

Keep smoke detectors 36” from bathrooms with showers and/or tubs.

In dwelling units, where the ceiling height of a room which is open to the hallway serving the bedrooms exceeds that of the hallway by 24” (60.96 centimeters) or more, smoke detectors must be installed in the hallway and in the adjacent room. Detectors must be installed in accordance with the approved manufacturer’s installation instructions.

HEAT DETECTORS

For new construction, an approved heat detector shall be installed in the attached garage of a dwelling and interconnected with the smoke alarms within the dwelling.

CARBON MONOXIDE DETECTORS

Carbon monoxide detectors shall be installed outside of each separate sleeping area in the immediate vicinity of the bedrooms. Where a fuel-burning appliance is located within a bedroom, or its attached bathroom, a carbon monoxide alarm shall be installed within the bedroom.

Combination carbon monoxide and smoke alarms are permitted to be used in place of carbon monoxide alarms.

GENERAL INFORMATION AND REQUIREMENTS

- For rough-in inspections, boxes and lights must be spliced out.

- All receptacles on 15- Amp & 20- Amp, 120-volt, and 250-volt circuits ***must be tamper-resistant***.

- All 120-volt, single phase, 15- Amp & 20- Amp branch circuits supplying outlets installed in the types of rooms mentioned below, shall be protected by a listed arc-fault circuit interrupter, combination-type breaker, installed to provide protection of the branch circuit:

    - dwelling unit kitchens, laundry areas, family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, or similar rooms (or areas)

- When wiring fireplaces, the wire for power and the wire for the gas valve ***must*** have a barrier between them if mounted in the same box. This is because of the different voltages on the wires.

- Recessed lights can be wired with the clamps provided with them, or by using connectors listed for that purpose.

- Be aware of "box fill" when wiring with NM cable. Each size 14 wire requires 2 cubic inches in the box, size 12 wire requires 2.25 cubic inches, and size 10 wire requires 2.5 cubic inches. The switch or receptacle requires a double volume allowance (2x cubic inches per device). The ground wires are counted as 1 wire. Where there are more than 4 ground wires in a box, and extra ¼ volume allowance shall be counted for every ground wire over 4.

    For example:

	5 14-2 NM cable wires	(10x2=20)
	1 receptacle	(2x2=4)
+	1 ground + ¼ for each ground over 4	(1x2+(.25x2)=2.5 total)
+	***This would require a box of a minimum***	***26.5 cubic inches***

- When using dimmers and GFCI receptacles, a larger cubic inch box is desirable.

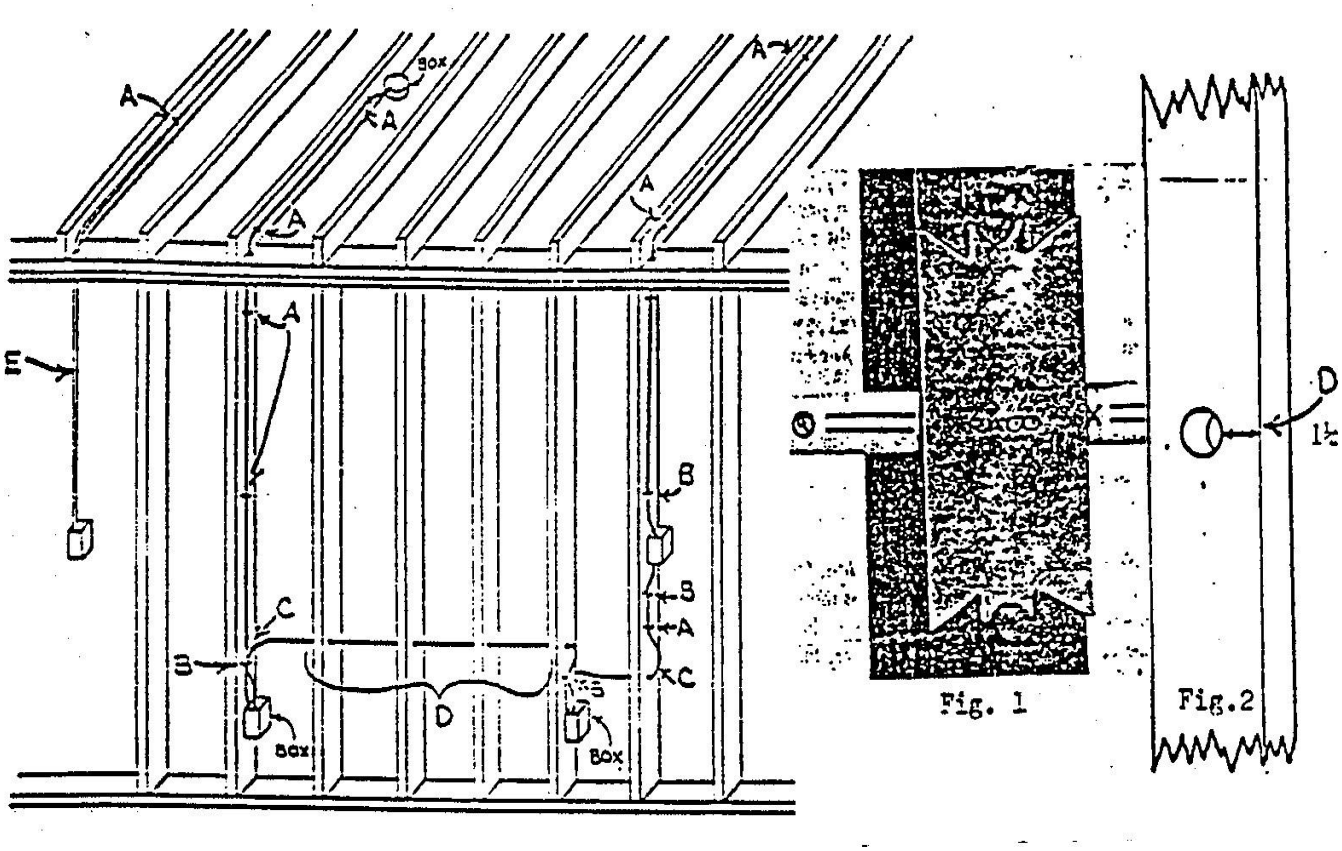
- You are allowed 1 ¼" of space from the side of a 2x4 to the edge of the cable. Center all cables on studs, and use stacker straps if more than two cables are run under a staple.

- No more than two cables may be run through a maximum ⅝" hole in a stud. Such holes ***must*** be centered in the stud.

- No receptacle outlets are allowed above electric baseboard heaters.

- For garages, at least 1 receptacle outlet shall be installed in each vehicle bay, and not more than 5 ½ feet above the floor. These receptacles shall be supplied by a dedicated branch circuit.

WIRE PLACEMENT AND INSTALLATION



A. NM cable ***must*** be secured by staples designed and installed so as not to damage the cable (every 54”).

B. A staple ***must*** be installed no further than 12” from a metal box with NM cable clamps, or 8” from a plastic box without clamps.

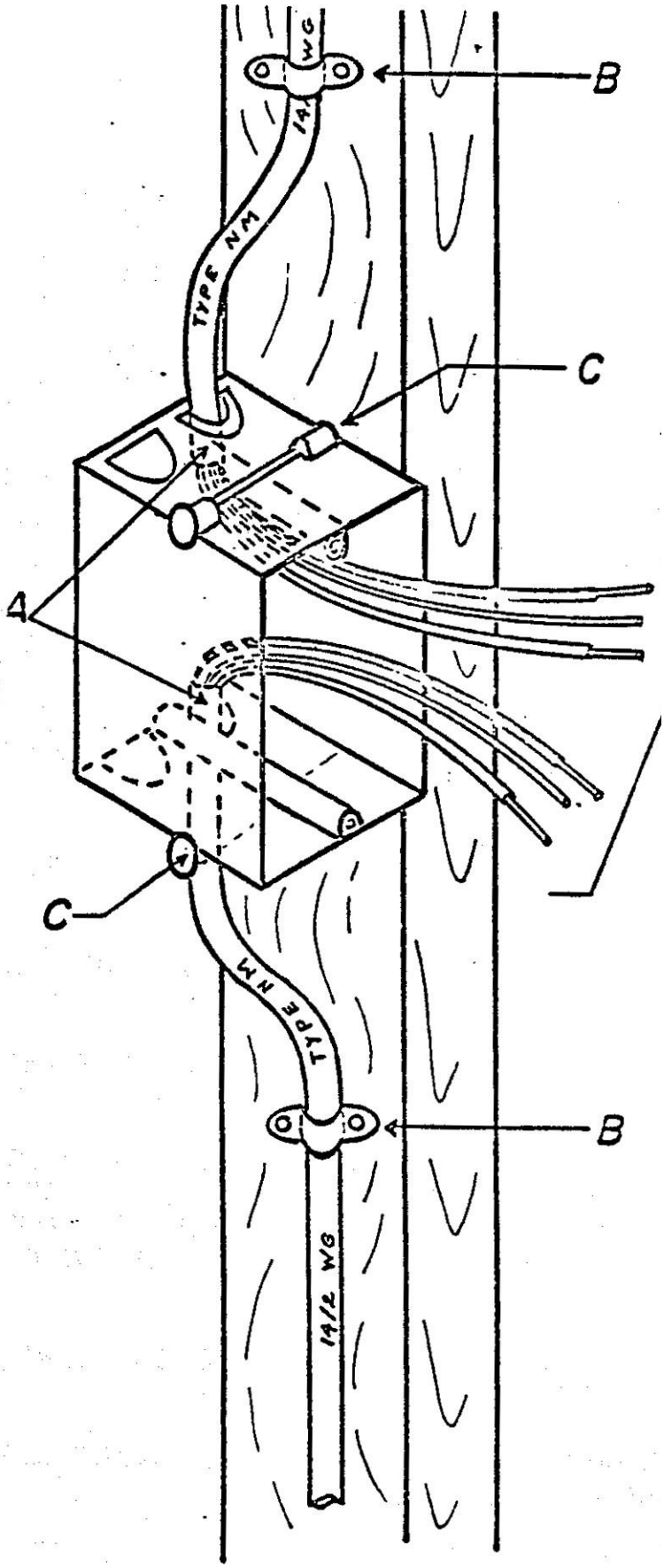
C. NM cable bends ***must not*** be sharper than 5 times the diameter of the cable. ***Wires must not be tight.***

D. Holes must be drilled in the center of 2x4 studs and placed in straight lines. 1 ¼” of wood ***must*** cover wire. (Center drilled 2x4’s are acceptable).

    a. If 1 ¼” cover cannot be obtained, metal protective plates ***must*** be installed. Metal plates ***must*** be 1/16” thick steel. (See Figure 1 and Figure 2 above.)

E. On concrete walls or surface wiring, conduit (plastic or metal) or other approved means of protections ***must*** be used.

F. In unfinished basements, NM cable ***must*** be run and fastened on the side of the joists or through bored holes in the joist.



Wires ***must*** be 6” long, measured from where they enter the box, to their ends.

The wires ***must*** extend past the front of the box by at least 3”.

PLASTIC BOX ILLUSTRATION

A. Cable sheathing ***must*** extend at least ¼“ inside of box.

B. Wire ***must*** be stapled:

- Within 8” of any box that is not equipped with clamps

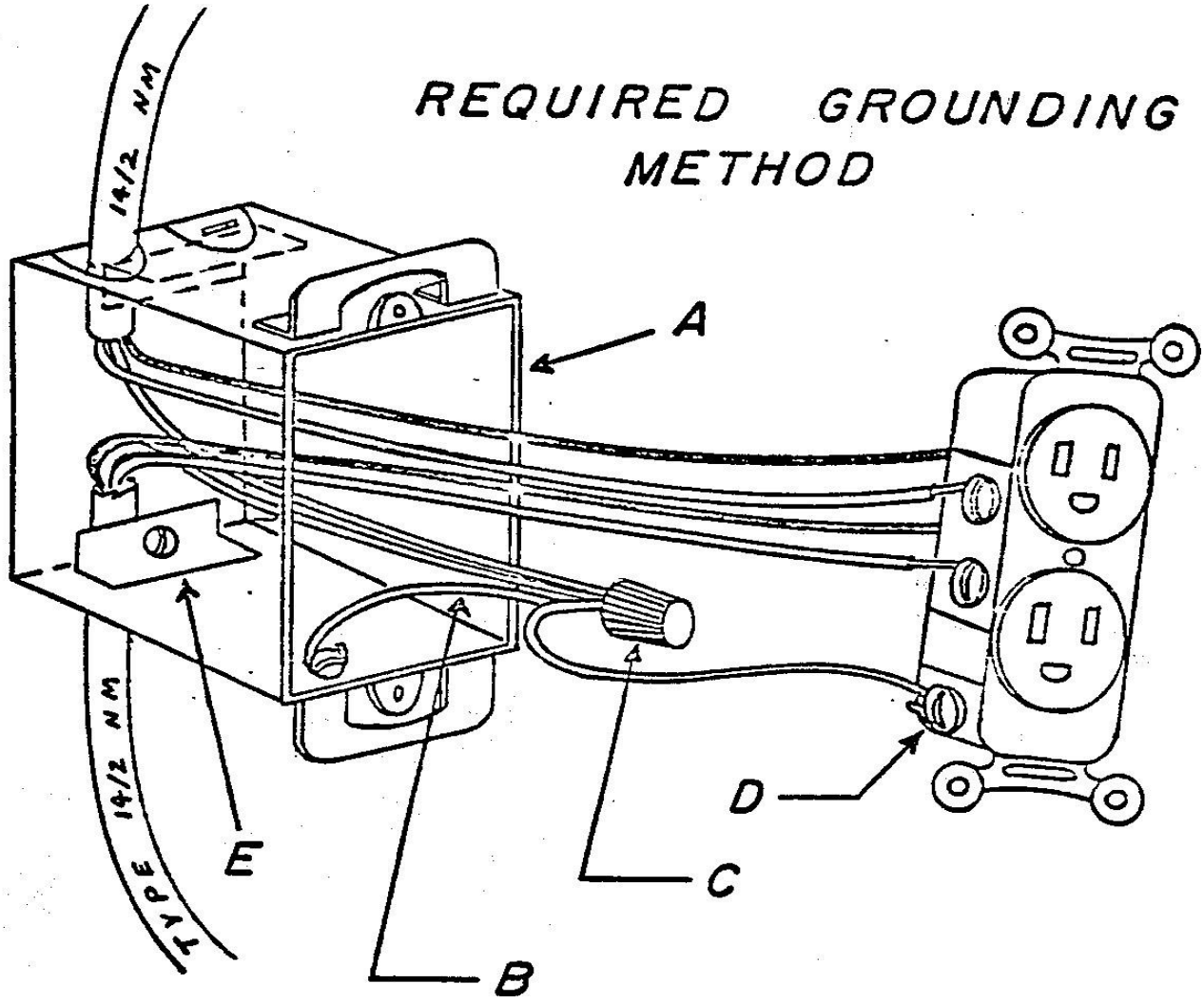
Or

- Within 12” of any box that is equipped with clamps.

C. Box mounting must be of an approved type:

- Nails outside of box
- Nails immediately inside of box
- Brackets secured to box

REQUIRED GROUNDING METHOD



METAL BOX ILLUSTRATION

A. If plastic box is used, bonding jumper (B) is not required.

B. Bonding jumper required when using metal outlet boxes. ***Must*** be attached with a screw or UL approved clip designed for such use.

C. Approved wire connector ***must*** be used for ground wire junction. ***Solder is not approved.***

D. Only one (1) wire may be placed under a terminal screw on any device (i.e. switch, outlet, etc).

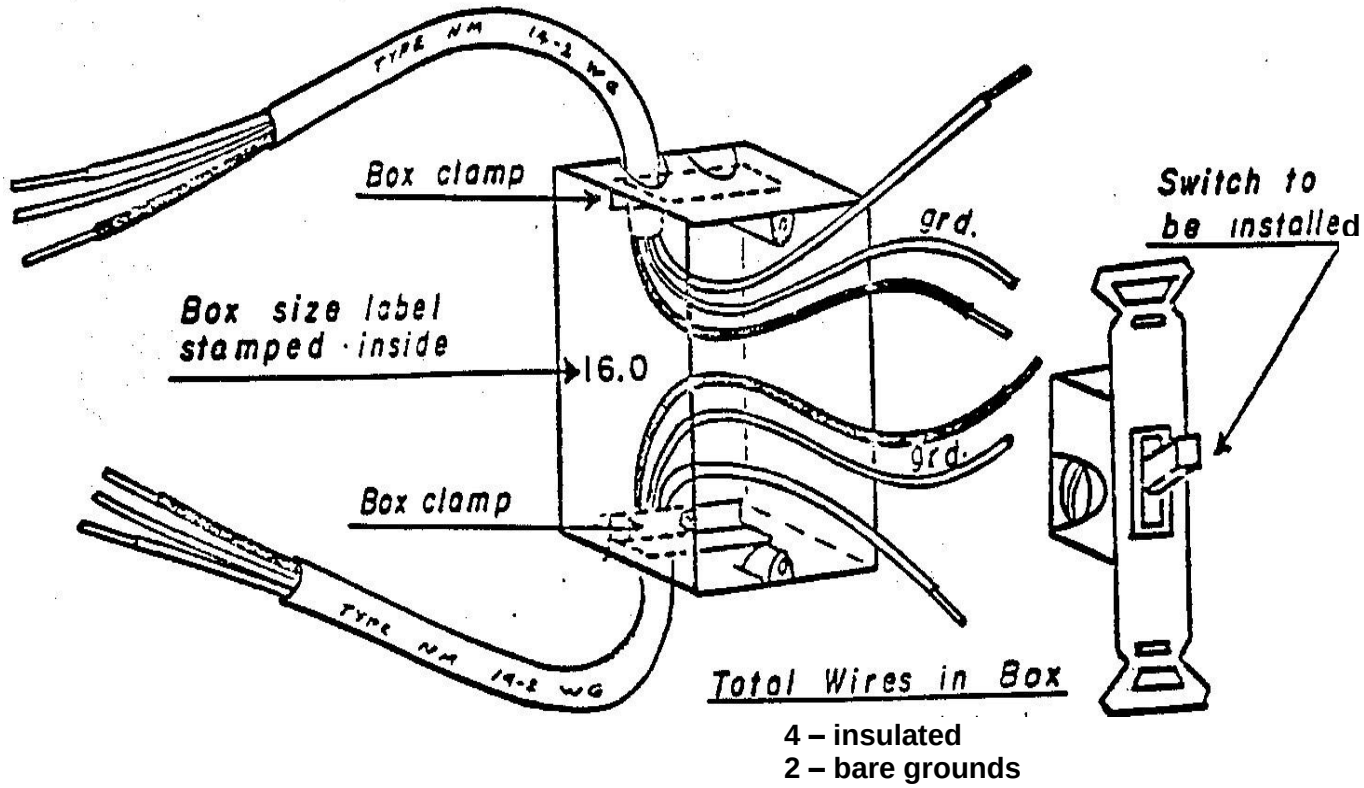
E. Cable straps are required in steel boxes and plastic cut-in boxes

WHAT SIZE BOX MEETS CODE?

- All boxes are calculated in cubic inches (cu. in.) of volume.

- Wires, clamps, switches, and outlets are designated in cubic inch numbers for calculation purposes.

EXAMPLE



BOX EXAMPLE ILLUSTRATION NOTES

A. Each insulated wire in the box (not cable sheath) ***must*** be counted. In the example above, there are four insulated wires in the box.]

B. For ground wires, up to 4 ground wires can be counted as 1 wire. When more than 4 ground wires enter the box, **each extra ground wire over 4 shall be counted as ¼ wire.**

C. Cable clamps (if in the box) count as ***one wire***.

D. The switch or outlet counts as ***two wires.***

E. The table for calculating is:
   i. 2.0 cu. in. for each #14 wire
   ii. 2.25 cu. in. for each #12 wire
   iii. 2.50 cu. in. for each #10 wire

The Box Example Illustration would require what size box?

4 – insulated wires, #14 @ 2.0 cu. in. for each wire (see notes A & E)	= 8.0 CU. IN.
2 – ground wires, #14 counts as 1 insulated wire (see notes B & E)	= 2.0 CU. IN.
1 – set of clamps (see notes C & E)	= 2.0 CU. IN.
1 - switch	= 4.0 CU. IN.
TOTAL	***= 16.0 CU. IN.***

Therefore, the minimum size box that code would allow would be 16.0 cubic inches.

Keep in mind that a larger box is legal (much easier to work with) and the difference in cost is minimal. This is especially true when installing GFCI outlets and dimmer switches.

PROPER WIRE SIZES

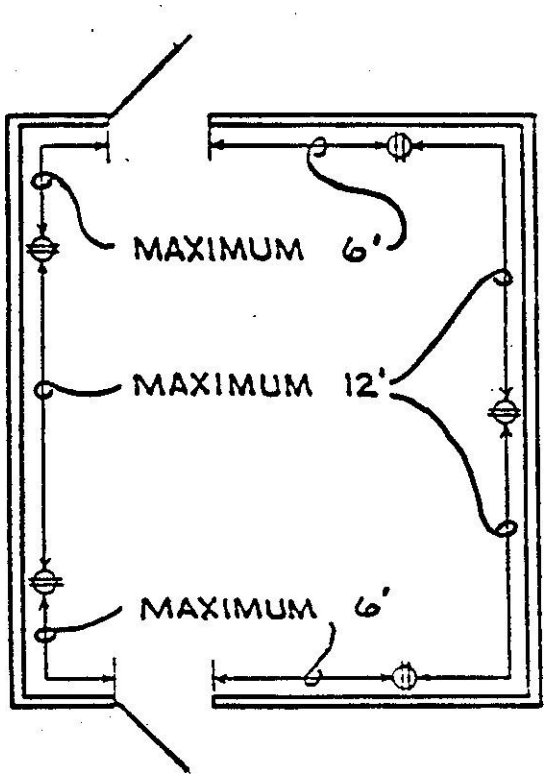
- General lighting and outlet circuits: minimum #14 fused @ 15- Amps.
- Appliance circuits in kitchen, dining room, pantry, family room, or breakfast room: minimum #12 (3 circuits required) fused @ 20- Amps.
- Laundry: minimum #12 fused @ 20- Amps.

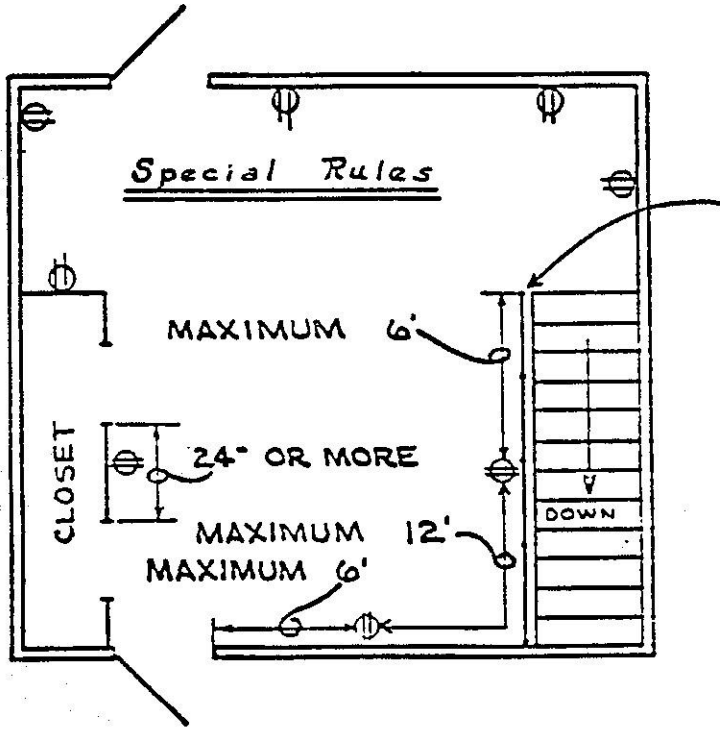
CIRCUIT LOAD

- A maximum of 10 lights and outlets (per circuit) should be used as a guideline where minimum loads are expected.

OUTLET REQUIREMENTS

- According to the NEC, outlets should be installed so that ***no point along the wall is more than 6 feet from an outlet.***
- This means that outlets should be spaced no more than 12 feet apart on any wall.
- This is a minimum, you may add more if you want.

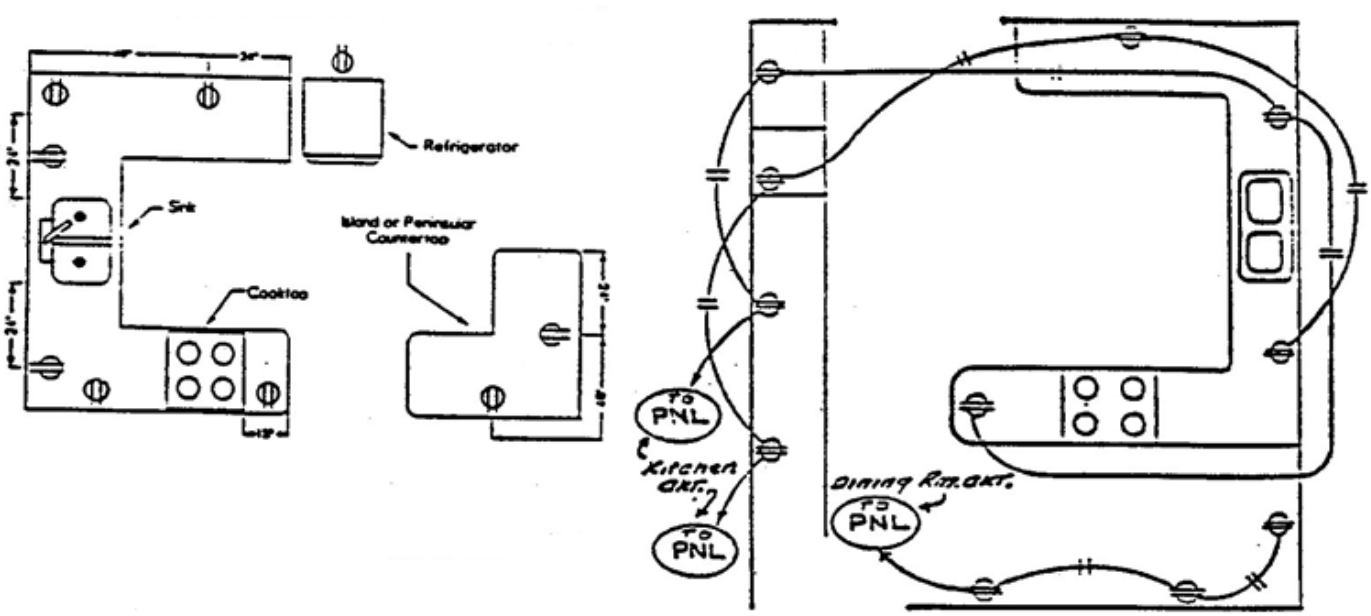




- Railing along the stairwell counts as wall space
- Any wall space 24" or more requires an outlet.
- The stationary part of a sliding door is included as wall space.
- Outlets ***must*** be within 5 ½" of the floor to count as "required outlets."

- Floor outlets must be within 18" of the wall to count as "required outlets."
- All floor outlets must have a listed faceplate.

RECEPTACLE SPACING OF KITCHEN/DINING AREA COUNTERTOPS



The spacing for receptacles at countertops in kitchens and dining areas of dwelling units shall be less than 24” measured horizontally from a receptacle outlet along the wall line.

Island and peninsula countertops shall have:

- One (1) receptacle outlet for the first 9 square feet (or fraction thereof)
- An additional receptacle outlet for every additional 18 square feet.
- At least one (1) receptacle outlet shall be within 2 feet of the outer end of the peninsula countertop.

KITCHEN

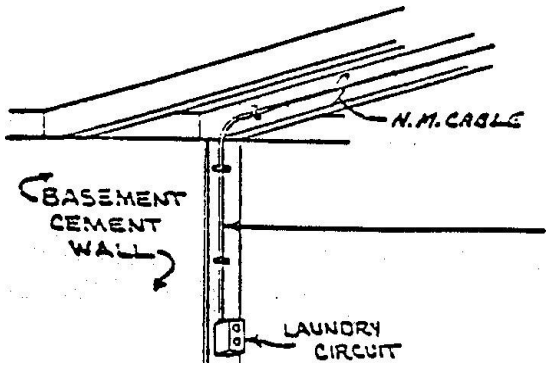
- All 20 Amp receptacles required by section 210-52(B) for countertop surfaces shall have ground fault circuit interrupter protection for personnel and arc-fault protection.
- They shall be located within 20” above the countertop.
- For #12 wire – 20- Amp circuits, wiring of kitchen outlets alternate, so no two adjacent outlets are on the same circuit. (seen in the above-right illustration)
- Two 20- Amp kitchen circuits are required along with one (1) 20- Amp dining area circuit.
- Kitchen and dining area 20- Amp circuits are allowed to feed receptacle outlets only.
- Range hoods, disposal units, and other appliances must be fed from other circuits.

LAUNDRY

(protected in pipe or stapled on wood strip)
Code requires a separate 20- Amp circuit for laundry room receptacle(s).

The outlets in the laundry room must be located within 6 feet of appliances.

At least one wall switched lighting outlet *must* be installed in every:



- Habitable room
- Kitchen
- Bathroom
- Hallway
- Stairway
- Attached garage
- Detached garage
- All outdoor entrances
- Attic
- Underfloor space
- Utility room
- Basement used for storage or containing equipment requiring service

**Wall-switched receptacle(s) may be used instead of a lighting outlet in habitable rooms other than kitchens and bathrooms.*

BASEMENT

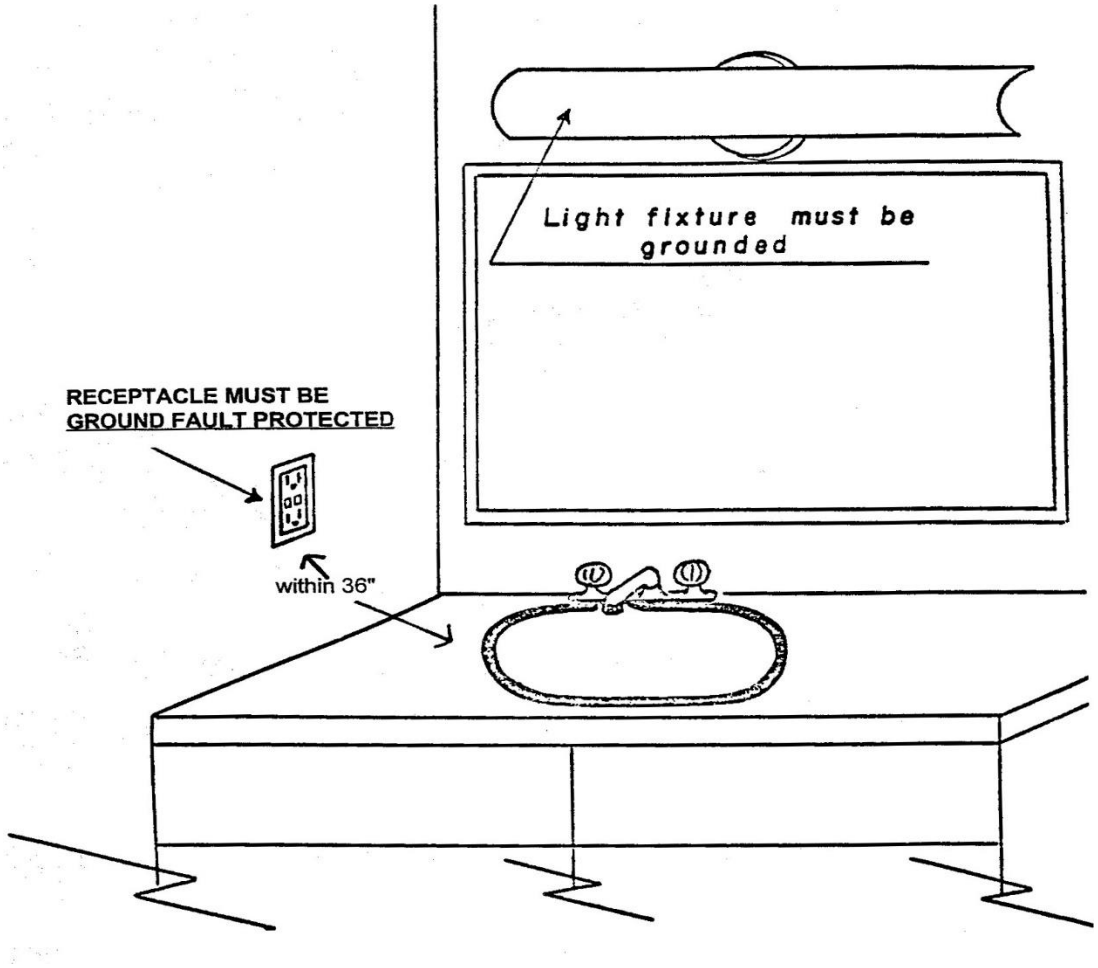
At least one (1) receptacle outlet ***must*** be installed in each basement of a dwelling occupancy.

For a single-family dwelling, and each unit of a two-family dwelling that is grade-level, at least one (1) receptacle outlet within 6 ½ feet of grade shall be installed at the front and back of dwelling.

GFCI protected receptacle outlets are required in:

- Bathrooms
- Attached garage
- Detached garage
- Accessory buildings
- Crawl spaces
- Basements
- Kitchens (outlets that serve countertop)
- Sinks (within 6 feet of top inside edge of the bowl of the sink)
- Bathtubs and shower stalls (within 6 feet of outer edge)
- Laundry areas
- Outdoors (except lighting outlets)
- Dishwasher
- Crawl Space lighting outlets

BATHROOM

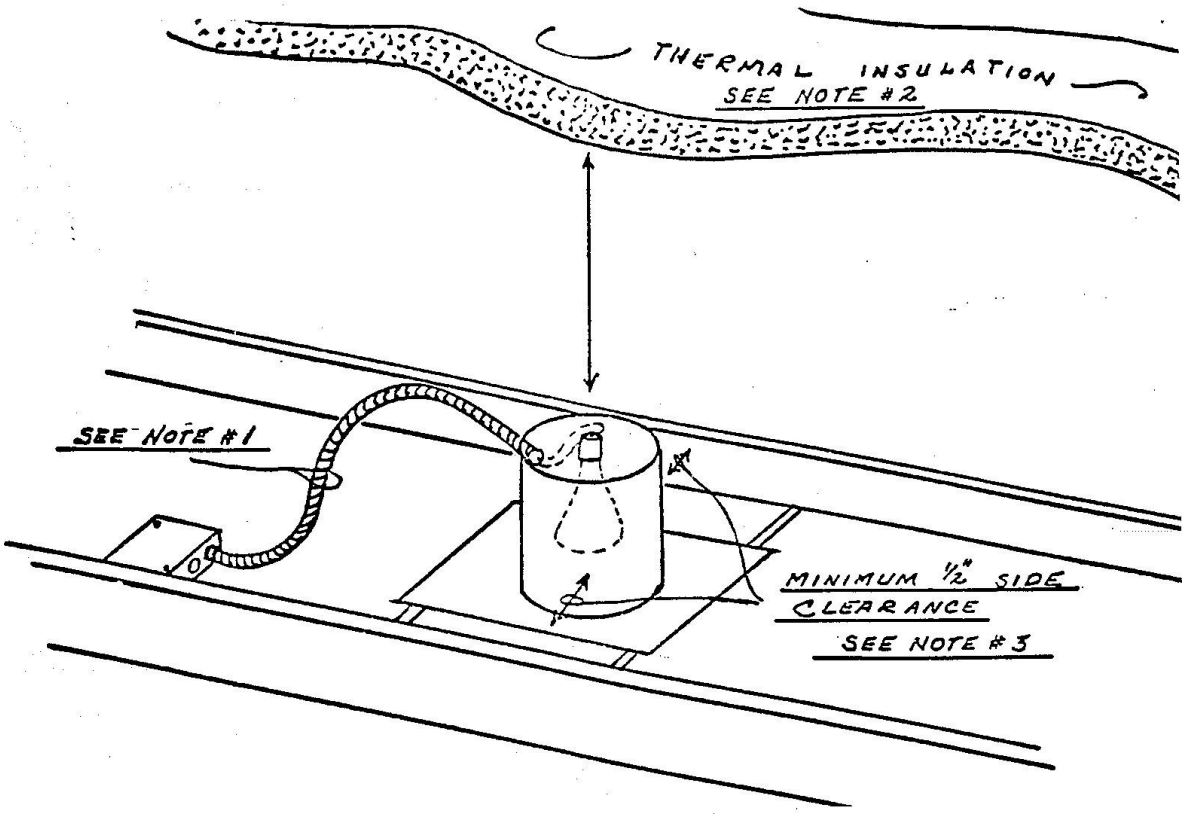


Code rule Section 210.11(c)(3):
“At least one (1) 20- Amp branch circuit shall be provided to supply only bathroom receptacle outlets that serve countertops & work surfaces. If this branch circuit only serves receptacle outlets required at the sink, then this circuit cannot serve more than two separate bathrooms.”

Exception: When 20- Amp circuit supplies a single bathroom, outlets for other equipment within the same bathroom shall be permitted. ***Other equipment shall not exceed 10- Amps.***

At least one (1) receptacle outlet shall be installed within 36” of the outside edge of each basin, on a wall adjacent to the sink, located on the countertop, or installed on the side or face of the basin cabinet. ***Never shall it be more than 12” below the top of the basin or basin countertop.***

RECESSED LIGHTING FIXTURE REQUIREMENTS



1. Flex conduit not less than 18” but not more than 6 feet wired with ***90-degree C wire,*** unless U.L approved “rewired” and designed for connection to 60-degree C rated wire.

2. Thermal insulation shall ***not*** be installed above or within 3” of the side of a recessed fixture enclosure, wiring compartment, or ballast unless labeled for the purpose.

3. Recessed portions of enclosures other than at points of support shall be spaced at least ½” from combustible material.

4. All recessed fixtures must be labeled as thermally protected.

5. Light fixtures must be installed according to manufactures instructions. ***Be careful on light fixtures with junction boxes mounted on top of housing.***

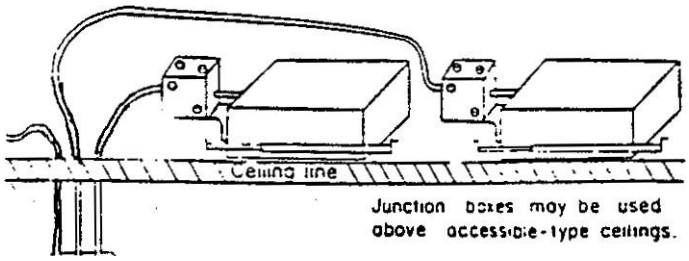


Figure 1: Branch-circuit conductors terminating at each fixture (no feedthrough)

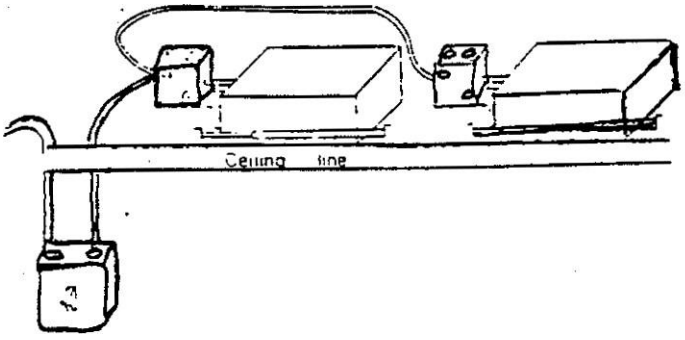


Figure 2: Lighting fixtures that are designed for “feed-through” branch-circuit conductors.

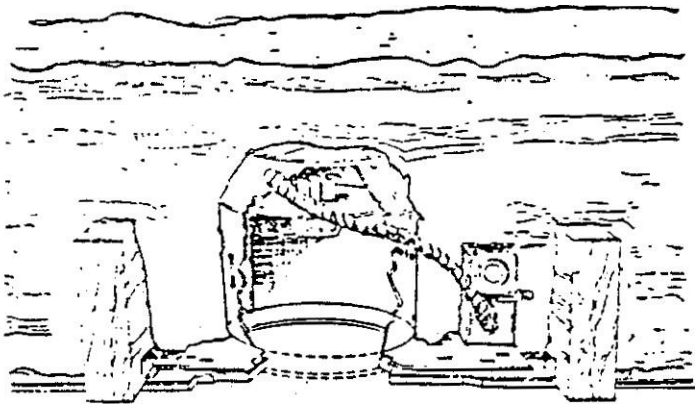


Figure 3: A listed recessed fixture suitable for use in insulated ceilings in direct contact with thermal insulations.

- These are classified as pre-wired fixtures and therefore do not need the flex and junctions’ box (as shown in Figures 1 and 2).

- This type of fixture can be used in direct contact with thermal insulation but must be listed or labeled as I.C. rating. (See Figure 3).

RESIDENTIAL ELECTRICAL SERVICE REQUIREMENTS

The requirement is a minimum of 100- Amp service:

- 100- Amp panels require 20 full breaker spaces.
- Greater than 100- Amp panels and less than 200- Amp panels require 20 full breaker spaces.
- 200- Amp and greater panels require 40 full breaker spaces.

By-pass meter socket (required by utility)

For underground services, you need to provide expansion fitting in PVC raceway on the utility side of the meter.

If installing an overhead service, you need to provide 2" rigid metal conduit (RMC) for support of the overhead wires from the utility.

You need to properly ground the electrical system using available grounding electrodes. Electrodes that may be available at the dwelling unit include:

- Metal underground water pipe
    - If a metal underground water pipe is all that is available, you must supplement with 2 ground rods driven in the ground 6 feet apart.
- Concrete encased electrode (in dwellings built after 1999)

The minimum size wire to each electrode should be based on Table 1 (see last page of handout). Use the "Copper Grounding Electrode Conductor Size" column.

EMERGENCY DISCONNECT

You need to provide an emergency disconnect on the exterior of the dwelling. It must be in a readily accessible location.

Provide 1 of 2 labels on emergency disconnect (based on if it's also to serve as the service disconnect).

If emergency disconnect is to serve as the service disconnect, the feeder wires to the sub panel down the line must include a properly sized equipment grounding conductor.

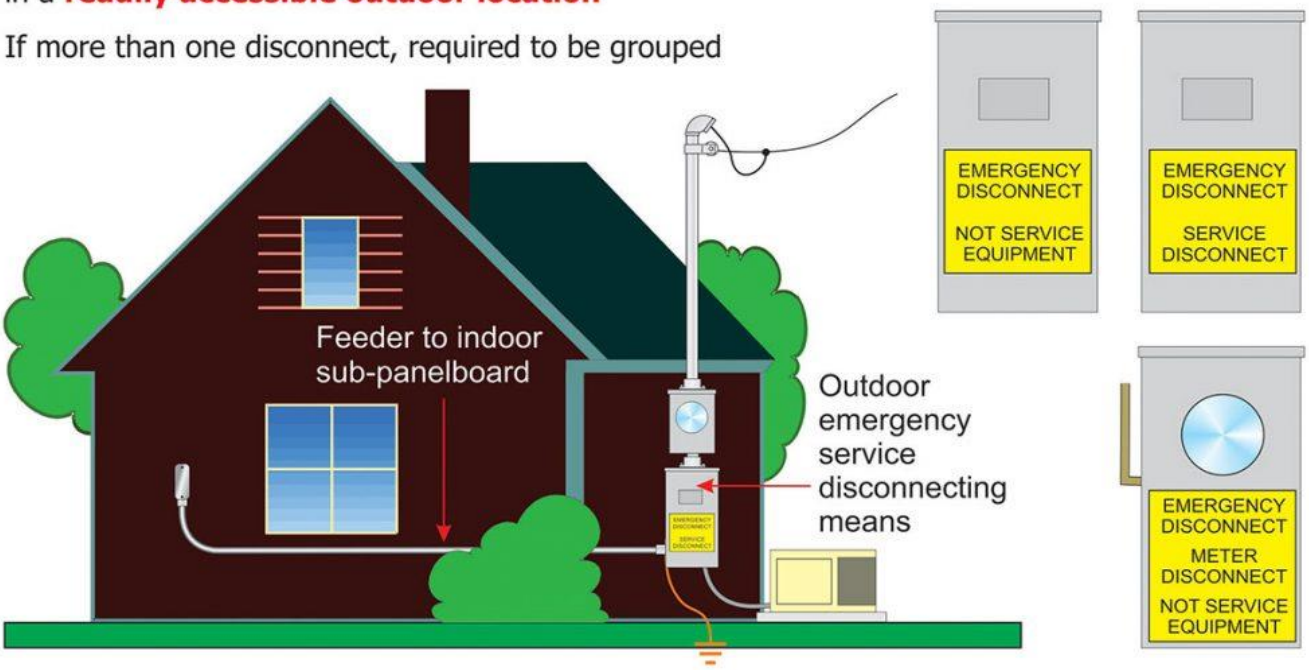
- The minimum size wire to each electrode should be based on Table 1 (see last page of handout). Use the "Grounding Electrode Conductor Size" column.

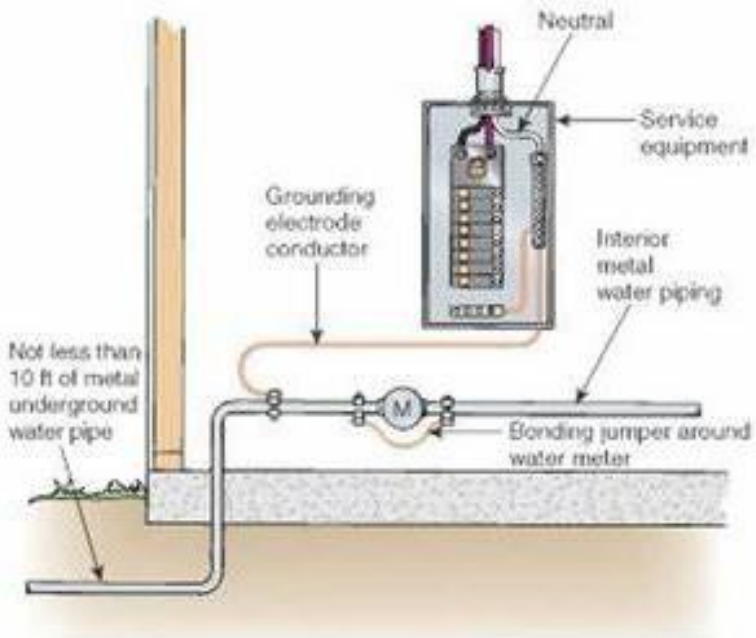
Need to provide intersystem bonding jumper connection with a minimum of three terminals for terminating intersystem bonding conductors. This must be at the service disconnect location.

230.85 Exterior Emergency Disconnect(s) for Dwelling Units

All one- and two-family dwelling unit service conductors shall terminate in disconnecting means having a short-circuit current rating equal to or greater than the available fault current, installed in a **readily accessible outdoor location**

If more than one disconnect, required to be grouped





SERVICE SIZE	CONDUIT SIZE FOR ALUMINUM WIRE	ALUMINUM CONDUCTOR SIZE	COPPER CONDUCTOR SIZE	CONDUIT SIZE FOR COPPER WIRE	COPPER GROUNDING ELCTRODE CONDUCTOR	ALUMINUM EQUIPMENT GROUNDING CONDUCTOR SIZE	COPPER EQUIPMENT GROUNDING CONDUCTOR SIZE
100	1 1/4"	2	4	1"	8	6	8
110	1 1/4"	1	3	1 1/4"	8	4	6
125	1 1/2"	1/0	2	1 1/4"	8	4	6
150	1 1/2"	2/0	1	1 1/4"	6	4	6
175	2"	3/0	1/0	1 1/2"	6	4	6
200	2"	4/0	2/0	1 1/2"	4	4	6

Inspections Division
200 Third Street North
Fargo ND 58102
phone 701-241-1561
fax 701-476-6779

Memorandum

DATE: March 10, 2017

TO: Electrical and Residential Remodeling Contractors

FROM: Bruce Taralson

SUBJECT: Smoke and Carbon Monoxide Alarms

As there has been some continuing question regarding the requirements for smoke and carbon monoxide alarms, this memorandum seeks to clarify the enforcement of the code sections relating to smoke alarms and carbon monoxide alarms for remodeling projects.

The 2015 International Residential Code was adopted as the City of Fargo's building code under Fargo Municipal Code section 21.1-0101. As of January 1, 2017, all projects requiring permits are required to comply with the provisions of that code.

Any interior remodel triggers the requirement, under Section R314.2.2, that these alarms be brought up to current code for new construction. This includes one smoke alarm in each bedroom, one outside each sleeping area, one on each story even if there are no bedrooms, and one in the main living area of the house where the ceiling height of a room exceeds that of the sleeping area by 24 inches or more.

The code requires that smoke alarms be interconnected, whether physically, using a wireless system, or some combination of the two. If you use physical interconnection you must hard-wire those alarms to the building's wiring.

Carbon monoxide alarms are required in each sleeping area, in the immediate vicinity of the bedrooms. Combination smoke and carbon monoxide alarms are permitted.

The permit holder is responsible for complying with the code and requesting all required inspections. If you choose to install a wireless system and not to hard-wire your alarms *the alarms to be installed must be on-site at the time of the electrical rough-in inspection* so that the inspector can accurately perform his assessment of any wiring requirements. Compliant smoke and carbon monoxide alarms are required for the final building inspection.

Please see the specific code language on the enclosed page. Emphasis has been added via underline to clarify the provisions of these sections.

R314.2.2 Alterations, repairs and additions. Where *alterations*, *repairs* or *additions* requiring a permit occur, or where one or more sleeping rooms are added or created in existing *dwellings*, the individual *dwelling unit* shall be equipped with smoke alarms located as required for new *dwellings*.

Exceptions:

1. Work involving the exterior surfaces of *dwellings*, such as the replacement of roofing or siding, the *addition* or replacement of windows or doors, or the addition of a porch or deck, are exempt from the requirements of this section.
2. Installation, alteration or repairs of plumbing or mechanical systems are exempt from the requirements of this section.

R314.4 Interconnection. Where more than one smoke alarm is required to be installed within an individual dwelling unit in accordance with Section R314.3, the alarm devices shall be interconnected in such a manner that the actuation of one alarm will activate all of the alarms in the individual *dwelling unit*. Physical interconnection of smoke alarms shall not be required where listed wireless alarms are installed and all alarms sound upon activation of one alarm.

Exception: Interconnection of smoke alarms in existing areas shall not be required where *alterations* or repairs do not result in removal of interior wall or ceiling finishes exposing the structure, unless there is an attic, crawl space or basement available that could provide access for interconnection without the removal of interior finishes.

R314.6 Power source. Smoke alarms shall receive their primary power from the building wiring where such wiring is served from a commercial source and, where primary power is interrupted, shall receive power from a battery. Wiring shall be permanent and without a disconnecting switch other than those required for overcurrent protection.

Exceptions:

1. Smoke alarms shall be permitted to be battery operated where installed in buildings without commercial power.
2. Smoke alarms installed in accordance with Section R314.2.2 shall be permitted to be battery powered.