

This handout is intended to be a **general overview** of residential electrical requirements as noted in the **2023 National Electrical Code**. This handout is **NOT** all inclusive and may not be helpful to a homeowner who is unfamiliar with electrical terminology. Additional information and knowledge are needed to properly install electrical wiring that is essentially free from fire and electric shock hazard. For complete information and assistance, please refer to authoritative publications based on the 2023 National Electrical Code ©.

A homeowner as defined by: MN Statute 326B.31 Subdivision 23: An “Owner” is an individual who physically performs electrical work on premises the individual owns, homesteads, and occupies as a residence is exempt from having to possess a personal electrical license. However, it is illegal for unlicensed homeowners to install wiring in two-family dwellings, apartment buildings, condo buildings or other common interest community settings, certain townhouse buildings, manufactured homes in parks, recreational vehicles in parks, floating buildings on public waterways, or in or on any property that is rented, leased, or occupied by others.

A rough-in inspection must be made before insulation, sheetrock, paneling, or other materials cover any electrical wiring. Underground wiring must be inspected before the trench is backfilled. Where wiring is concealed before inspection, the person responsible for concealing the wiring shall be responsible for all costs resulting from uncovering and replacing the covering material. Except for the final connection to switches, receptacles, and lighting fixtures, all ground wires and other wires in boxes must be spliced and pigtailed for the rough-in inspection.

The installer must schedule a **final inspection** when the electrical work is completed prior to the wiring being utilized and the space occupied.

If wiring is concealed before inspection, the person responsible for concealing the wiring is responsible for all costs associated with uncovering and replacing the covering material.

GENERAL ROUGH IN REQUIREMENTS

Except for the final connection to switches, receptacles, and lighting fixtures, all ground wires and other wires in boxes must be spliced and pigtailed for the rough-in inspection.

NEC 110.14(B) Splices. Wires shall be spliced and joined with splicing devices (wire nuts) identified for the use.

NEC 110.14(A) Only one wire shall be installed under a terminal screw. In boxes with more than one grounding wire, the grounding wires shall be tied together with splicing devices (wire nuts) with a 6 inch “pigtail” for attaching to the grounding terminal of the switch, receptacle or any other device.

NEC 300.4 (A)(1) Cables and raceways where installed through bored holes in wood framing members. Cables and raceways shall be protected from damage. Where installed through bored holes in wood framing members, the holes shall be bored so that the edge of the hole is not less than 1¼ inch from the nearest edge of the wood member. Where this distance cannot be maintained, the cable or raceway shall be protected from penetration by nails or screws by a steel plate, sleeve, or equivalent at least 1/16 inch thick.

NOTE: Local building codes will help you determine where holes or notches may be safely made in joists.

NEC 300.4(D) Cables and raceways installed parallel to framing members and furring strips. In both exposed and concealed locations, where a cable- or raceway-type wiring method is installed parallel to framing members, such as joists, rafters, or studs, or is installed parallel to furring strips, the cable or raceway shall be installed and supported so that the nearest outside surface of the cable or raceway is not less than 1¼ inch from the nearest edge of the framing member or furring strips where nails or screws are likely to penetrate. Where this distance cannot be maintained, the cable or raceway shall be protected from penetration by nails or screws by a steel plate, sleeve, or equivalent at least 1/16 inch thick.

NEC 334.30 Securing NM (Romex) cable. Type NM (nonmetallic) cables shall be secured every 4.5 feet and within 12 inches of all two or more opening nonmetallic boxes & 8 inches of all single opening nonmetallic boxes (**NEC 314.17(B)(2) Exc**)

NEC 314.17(B)(1-4) The outer jacket of type NM cable shall be secured to the box and extend into the box and beyond any cable at least ¼ inch.

NEC 300.14 The minimum length of wires, including grounding wires, at all boxes shall be a minimum of 6 inches and extend at least 3 inches beyond the front edge of the box.

NEC 300.22(C)(Exc) Plenum spaces (cold air returns) Type NM cable shall not be installed in plenum spaces (cold air returns), but in dwelling units may be installed perpendicular through joist or stud spaces used as such.

NEC 334.12 Types NM and NMS cables shall not be used under the following conditions or in the following locations:

- (1) Where exposed to corrosive fumes or vapors.
- (2) Where embedded in masonry, concrete, adobe, fill, or plaster.
- (3) In a shallow chase in masonry, concrete, or adobe and covered with plaster, adobe, or similar finish
- (4) **In wet or damp locations** such as the interior of all raceways installed above grade as on the exterior of a structure or below grade underground.

NEC 314.29 Junction boxes shall be installed so that the wiring contained in them can be rendered accessible without removing any part of the building or structure.

NEC 314.23 All electrical boxes shall be rigidly secured to the building structure.

NEC 314.27(C) Outlet boxes mounted in the ceilings of habitable rooms of dwelling occupancies in a location acceptable for the installation of a ceiling-suspended (paddle) fan shall comply with one of the following:

- (1) Listed for the sole support of ceiling-suspended (paddle) fans
- (2) Installed so as to allow direct access through the box to structural framing capable of supporting a ceiling-suspended (paddle) fan without removing the box

NEC 110.12(A) Unused openings in boxes shall be effectively closed. A non-metallic box shall be replaced if cable openings are punched but not used.

The Minnesota Energy Code requires that all penetrations through an air barrier be sealed. Sealing applies to all penetrations including the service entrance, conduit, cables, panels, recessed luminaires and electrical boxes

NEC 314.4 Metal boxes shall be grounded and bonded.

NEC 250.134 All electrical equipment, including raceways, metal boxes and equipment shall be connected to an equipment grounding conductor.

NEC 404.2(C) The grounded (white) conductor for lighting circuit(s) shall be provided at a minimum of one location where switches control that room lighting loads.

NEC 200.7(C) Where permanently re-identified at each location where it is visible and accessible the conductor with white colored insulation in type NM cable may be used as an ungrounded (hot) conductor. The re-identified conductor shall not be used as the return conductor from a switch to an outlet.

NEC 300.3(B) All conductors of the same circuit, the grounded conductor and all equipment grounding conductors and bonding conductors shall be contained within the same raceway, conduit body, trench, cable, or cord.

NEC 314.16 The number of conductors and devices contained within electrical boxes determine the cubic inch size of box needed. Nonmetallic boxes are marked with their cubic inch capacity.

<u>Cubic Inches Required for Boxes</u>			
<u>Conductor Size</u>	14 AWG	12 AWG	10 AWG
Each insulated wire	2	2.25	2.5
All grounding wires (combined)	2	2.25	2.5
Each switch or receptacle	4	4.5	5
All internal cable clamps	2	2.25	2.5

EXAMPLE:

8 insulated wires = 16 cubic inches
 All 4 grounding wires = 2 cubic inches
 1 switch = 4 cubic inches
 1 receptacle = 4 cubic inches
 All cable clamps = 2 cubic inches
Minimum Box Volume = 28 cubic inches

NOTE: If you have more than 4 equipment grounding conductors in a box, a further adjustment of ¼ volume allowance needs to be added for each conductor based on the largest wire in the box.

NEC 240.4 Conductors shall be protected in accordance with their ampacity per Table 310.15 and 240.4(A-H)

Table: NEC 310.15 Maximum Overcurrent Protection		
Fuse or Circuit Breaker	Minimum Wire Size	
	Copper	Aluminum
15 amp	14	N/A
20 amp	12	N/A
30 amp	10	8
40 amp	8	6
50 amp	6	4

Note: For certain specific installations, conductors that supply motors, Air conditioning units, and other equipment may be permitted to have overcurrent protection that exceeds the basic limitations in the above chart.

Branch Circuits & Receptacle Outlets Required

NEC 210.52(A)(1-4) Receptacle outlet spacing in habitable rooms. Receptacles shall be installed such that no point measured horizontally along the floor line of any wall space is more than 6 feet from a receptacle outlet.

Definition of a Wall Space: As used in this section, a wall space shall include the following:

- (1) Any space 2 feet or more in width (including space measured around corners) and unbroken along the floor line by doorways and similar openings, fireplaces, and fixed cabinets.
- (2) The space occupied by fixed panels in exterior walls, excluding sliding panels.
- (3) The space afforded by fixed room dividers, such as freestanding bar-type counters or railings

NEC 210.11(C)(1)(2)(3)&(4) and 422.12 Required branch circuits. In addition to the branch circuits installed to supply general illumination and receptacle outlets in dwelling units, the following minimum requirements apply:

- Two 20-amp circuits for the kitchen countertop receptacles
(Note: will need to carefully examine all kitchen small appliances you are purchasing as to the total Amp/Watts requirements of each appliance. (Examples: microwave, coffee makers, espresso machines, dishwasher, disposal etc.) If not fixed in place shall not exceed 80% (16 amps or 1920 watts) of the 20-amp circuit. If fixed in place shall not exceed 50% (10 amps or 1200 watts) of the 20-amp circuit)
- One 20-amp circuit for the laundry receptacle(s)
- One 20-amp circuit for the bathroom receptacle(s)
- One 20-amp circuit for attached or detached garage receptacle(s)
- An individual branch circuit for central heating equipment (i.e. furnace)

NEC 210.11(C)(1) Receptacles installed in the kitchen to serve countertop spaces shall be supplied by not less than two separate 20-amp small appliance branch circuits.

NEC 210.52(C) Countertops. In kitchens, pantries, breakfast rooms, dining rooms, and similar areas of dwelling units, receptacle outlets for countertop spaces 12 inches or more shall be installed in accordance with 210.52(C)(1) through (C)(3).

(1) Wall Spaces. A receptacle outlet shall be installed at each wall space that is 12 inches or wider. Receptacle outlets shall be installed so that no point along the wall line is more than 24 inches measured horizontally from a receptacle outlet in that space. Countertop wall spaces separated by range tops, sinks or refrigerators are separate wall spaces.

(2) Island and Peninsular Countertops and Work Surfaces.

Receptacle outlets, if installed to serve an island or peninsular countertop or work surface, shall be installed in accordance with: **NEC 210.52(C)(3)**

IMPORTANT NOTE: It is no longer permissible to install a receptacle below the countertop in kitchens, pantries, breakfast rooms, dining rooms, and similar areas. This includes Islands and peninsulas.

NEC 210.52(C)(3). Receptacle Outlet Location.

Receptacle outlets shall be located in one or more of the following:

- (1) On or above, but not more than 20 inches above, a countertop or work surface
 - (2) In a countertop using receptacle outlet assemblies listed for use in countertops
 - (3) In a work surface using receptacle outlet assemblies listed for use in work surfaces or listed for use in countertops
- If a receptacle outlet is not provided to serve an island or peninsular countertop or work surface, provisions shall be provided at the island or peninsula for future addition of a receptacle outlet to serve the island or peninsular countertop or work surface.

Note: Receptacle outlets rendered not readily accessible by appliances fastened in place, appliance garages, sinks, range tops or appliances occupying dedicated space shall not be considered as these required outlets.

NEC 210.11(C)(3) Bathroom Branch Circuits. At least one 120-volt, 20-ampere branch circuit shall be provided to supply a bathroom receptacle outlet(s). Such circuits shall have no other outlets. *Exception: Where the 20-ampere circuit supplies a single bathroom, outlets for other equipment within the same bathroom shall be permitted to be supplied by this circuit, this circuit shall NOT extend beyond this single bathroom.*

NEC 210.52(D) & 406.9(C) At least one receptacle outlet shall be installed in bathrooms within 3 ft of the outside edge of each sink. The receptacle outlet shall be located on a wall or partition that is adjacent to the sink or sink countertop, located on the countertop, or installed on the side or face of the sink cabinet. In no case shall the receptacle be located more than 300 mm (12 in.) below the top of the sink or sink countertop. Receptacle outlet assemblies listed for use in countertops shall be permitted to be installed in the countertop.

NEC 406.9(C) Receptacles shall not be installed inside of the tub or shower or within a zone measured 3 ft horizontally from any outside edge of the bathtub or shower stall, including the space outside the bathtub or shower stall space below the zone.

The zone also includes the space measured vertically from the floor to 8 ft above the top of the bathtub rim or shower stall threshold. The identified zone is all-encompassing and shall include the space directly over the bathtub or shower stall and the space below this zone, but not the space separated by a floor, wall, ceiling, room door, window, or fixed barrier.

Exception No. 1: Receptacles installed in accordance with NEC 680.73 shall be permitted.

Exception No. 2: In bathrooms with less than the required zone, the receptacle(s) required by 210.52(D) shall be permitted to be installed opposite the bathtub rim or shower stall threshold on the farthest wall within the room.

Exception No. 4: In a dwelling unit, a single receptacle shall be permitted for an electronic toilet or personal hygiene device such as an electronic bidet seat. The receptacle shall be readily accessible and not located in the space between the toilet and the bathtub or shower.

NEC 210.52(H) Hallways of 10 feet or more in length shall have at least one receptacle outlet. As used in this subsection, the hallway length shall be considered the length along the centerline of the hallway without passing through a doorway.

NEC 210.52(I) Foyers that are not part of a hallway in accordance with 210.52(H) and that have an area that is greater than 60 square ft shall have a receptacle(s) located in each wall space 3 ft or more in width. Doorways, door-side windows that extend to the floor, and similar openings shall not be considered wall space.

Outdoor Receptacle Requirements

NEC 210.52(E)(1) Front and back receptacle location for a dwelling. At least one 15 or 20 amp 120-volt receptacle outlet accessible at grade level shall be installed at the front and back of a dwelling.

NEC 210.52(E)(3) Balconies, decks and porches, regardless of size, that are accessible from inside a dwelling unit shall have at least one receptacle outlet installed within the perimeter.

NEC 210.63 Air-Conditioning and Heating equipment a 125-volt 15- or 20-amp receptacle shall be installed at an accessible location for the servicing of air-conditioning and heating, equipment. The receptacle shall be located on the same level and within 25 feet of the air-conditioning and heating equipment.

NEC 406.9(B)(1) & 406.4(D)(6) All new receptacles installed in damp or wet locations and existing receptacles in damp or wet locations that are being replaced shall be:

1. GFCI protected.
2. Listed as **weather-resistant (WR) & tamper-resistant (TR) type**.
3. When installed in a wet location shall have an in-use weatherproof cover installed, the in-use cover shall be listed and identified as **“Extra Duty”**.

NEC 210.52(G) Basements, Garages, and Accessory Buildings. For a one-family dwelling, at least one receptacle outlet shall be installed in the areas specified in 210.52(G) (1) through (3). These receptacles shall be in addition to receptacles required for specific equipment.

(1) Garages. In each attached garage and in each detached garage with electric power you shall supply at least one 120-volt, 20-ampere branch circuit to supply required receptacle outlets (At least one receptacle for each vehicle bay located within 5-1/2 feet from the floor). Exception: This circuit shall be permitted to supply garage door opener receptacles and exterior garage receptacles.

(2) Accessory Buildings. In each accessory building with electric power.

(3) Basements. In each separate unfinished portion of a basement.

Note: GFCI protection is required by 210.8(A)(5) for ALL 125-volt through 250-volt receptacles in lower levels (basements) both finished and unfinished areas and by 210.8(A)(2) for ALL receptacles installed in garages & accessory buildings.

NEC 625.40 Electric Vehicle Branch Circuit. An outlet(s) installed for the sole purpose of charging electric vehicles shall be supplied by a separate branch circuit. This circuit shall have no other outlets.

Lighting Outlets Required

NEC 210.70(A)(1) Habitable Rooms, Kitchens, Laundry Areas, and Bathrooms.

At least one lighting outlet controlled by a listed wall-mounted control device shall be installed in every habitable room, kitchen, laundry area, and bathroom. The wall-mounted control device shall be located near an entrance to the room on a wall.

Exception: Lighting outlets shall be permitted to be controlled by occupancy sensors that are (1) in addition to listed wall-mounted control devices or (2) located at a customary wall switch location and equipped with a manual override that will allow the sensor to function as a wall switch.

NEC 210.70(A)(2) Additional Locations Hallways, stairways, attached garages, detached garages, and accessory buildings with electric power. Where one or more lighting outlet(s) are installed for interior stairways, there shall be a wall switch at each floor level, and landing level that includes an entryway, to control the lighting outlet(s) where the stairway between floor levels has six risers or more. For dwelling units, attached garages, and detached garages with electric power, at least one exterior lighting outlet controlled by a listed wall-mounted control device shall be installed to provide illumination on the exterior side of outdoor entrances or exits with grade-level access. A vehicle door in a garage shall not be considered as an outdoor entrance or exit.

NEC 314.27(C) A listed fan box or a ceiling box with access to a framing member shall be installed in all locations where a ceiling paddle could be installed in a habitable room.

NEC 210.70(C) Storage or Equipment Spaces. For attics and underfloor spaces, utility rooms, and basements, at least one lighting outlet containing a switch or controlled by a wall switch or listed wall-mounted control device shall be installed where these spaces are used for storage or contain equipment requiring servicing. A point of control shall be at each entry that permits access to the attic and underfloor space, utility room, or basement. Where a lighting outlet is installed for equipment requiring service, the lighting outlet shall be installed at or near the equipment.

GENERAL REQUIREMENTS FOR FINAL INSPECTION

NEC 404.10(B) & 406.5 Switches & Receptacle devices shall be secured to electrical boxes with the provided machine screws or shall be machine screws having 32 threads per inch in accordance with the manufacturer's instructions. **Note: This means the use of drywall screws or any screw, other than a machine screw, is prohibited.**

NEC 406.4(A) & NEC 200.11 Receptacle outlets shall be of the grounding type, be grounded, and have proper polarity.

NEC 406.12 & 406.4(D)(5) All 125-volt through 250-volt, 15- and 20- amp receptacles installed or replaced in dwelling units shall be listed **tamper-resistant**. This includes receptacles installed outdoors, in basements and in garages. 3 exceptions include receptacles located 5½ feet or more above the floor, a receptacle in space dedicated for an appliance that is not readily moved and receptacles that are part of a luminaire.

NEC 408.4(A) Every circuit and circuit modification shall be legibly identified as to its clear, evident and specific purpose or use in sufficient detail on a directory located on the face or inside of the electrical panel doors.

NEC 406.9(B)(1) & 406.4(D)(6) All new receptacles installed in damp or wet locations and existing receptacles in damp or wet locations that are being replaced shall be:

1. GFCI protected.
2. Listed as **weather-resistant (WR) & tamper-resistant (TR) type**.
3. When installed in a wet location shall have an in-use weatherproof cover installed, the in-use cover shall be listed and identified as **"Extra Duty"**.

Arc-Fault Circuit Interrupter (AFCI) Requirements

NEC 210.12(A) All 120 volt, single-phase, 15 and 20 amp branch circuits supplying outlets or devices installed in dwelling unit kitchens, family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, laundry areas, or similar rooms or areas shall be protected by a listed (AFCI) arc-fault circuit interrupter, combination type, installed to provide protection of the entire branch circuit.

NEC 210.12(B) In **any** of the areas specified above where branch circuit wiring is **modified, replaced, or extended**, the branch circuit shall be protected by a listed (AFCI) **arc-fault circuit interrupter, combination type** installed to provide protection of the entire branch circuit or a listed **outlet branch-circuit type AFCI** located at the first receptacle outlet of the existing branch circuit.

NEC 406.4(D)(4)(1-3) Where an existing receptacle outlet is replaced in an area of a house that is required elsewhere in this Code to be protected by AFCI (Arc-Fault Circuit Interrupter) it shall be AFCI protected by 1 of the 3 following methods.

1. An AFCI circuit breaker installed in the electric panel.
2. An AFCI receptacle.
3. A receptacle protected by being installed on the load side of method 1 or 2 above.

The reset/test button for all AFCI protected circuits shall be installed in a “Readily Accessible” Location.
NEC Definition of “Readily Accessible” Capable of being reached quickly for operation, renewal, or inspections without requiring those to whom ready access is requisite to actions such as to use tools, to climb over or remove obstacles, or to resort to portable ladders, and so forth.

Ground Fault Circuit-Interrupter (GFCI) Requirements

NEC 210.8(A)(1-12) Ground-fault circuit-interrupter (GFCI) protection shall be provided for all 125-volt through 250-volt receptacle outlets installed in.

- (1) **Bathrooms** including receptacles that are integral with luminaires. There are no exceptions to the bathroom receptacle outlet GFCI requirement.
- (2) **Garages**, and accessory buildings that have a floor located at or below grade level not intended as habitable rooms and limited to storage areas, work areas, and areas of similar use. **Note:** All 125-Volt through 250-Volt, single-phase receptacles installed in garages must be GFCI protected. There are **NO** exceptions.
- (3) **Outdoors**
- (4) **Crawl spaces** — at or below grade level.
- (5) **Lower Levels** – below grade level, **both finished and unfinished areas.**
- (6) **Kitchens.**

Note: All 125-Volt through 250-Volt, single-phase receptacles installed in kitchens must be GFCI protected. There are **NO** exceptions.

- (7) **Areas with sinks and permanent provisions for food preparation**, beverage preparation, or cooking.
- (8) **All sinks** — where receptacles are installed within 1.8 m (6 ft) from the top inside edge of the bowl of the sink. When determining the need for GFCI protection of a receptacle in the vicinity of a sink the distance is to be measured as the shortest path a 6 ft long appliance cord would follow from the top inside edge of the bowl of the sink to the receptacle, without piercing a floor, wall, ceiling, or fixed barrier.
- (9) **Boathouses.**
- (10) **Bathtubs or shower stalls** — where receptacles are installed within 1.8 m (6 ft.) of the outside edge of the bathtub or shower stall.
- (11) **Laundry areas** All 125-Volt through 250-Volt receptacles.
- (12) **Indoor damp and wet locations**

NEC 210.8(C) Crawl Space Lighting Outlets. GFCI protection shall be provided for lighting outlets installed in crawl spaces

NEC 210.8(D) Specific Appliances.

GFCI protection shall be provided for the branch circuit or outlet supplying the following appliances:

- (1) Drinking water coolers and bottle fill stations
- (2) Electric ranges
- (3) Wall-mounted ovens
- (4) Counter-mounted cooking units
- (5) Microwave ovens

NEC 210.8(F) GFCI protection shall be provided for ALL outdoor outlets 125-volt through 250-volt 50 amps or less.

Exception No. 1: GFCI protection shall not be required on outdoor lighting outlets

Exception No. 2: GFCI protection shall not be required for listed HVAC equipment. This exception shall expire September 1, 2026

NEC 680.71 Hydromassage (whirlpool) bathtubs and their associated electrical components shall be on an individual branch circuit(s) and protected by a readily accessible ground-fault circuit interrupter. **Note:** *often these units require 2 individual circuits, one for the pump and one for the in-line water heater.* All 125-volt receptacles not exceeding 30 amperes installed within 6 feet of the inside walls of a hydromassage bathtub shall be GFCI protected.

NEC 680.73 Hydromassage (whirlpool) bathtub electrical equipment shall be accessible without damaging the building structure or building finish. Where the hydromassage bathtub is cord and plug connected with the supply receptacle accessible only through a service access opening, the receptacle shall be installed so that its face is within direct view and not more than 12 inches from the opening.

NEC 680.21(C) All 15- and 20-amp, single-phase, 120 volt through 240-volt pool pump motors, whether cord and plug connected or direct wired, shall be provided with GFCI protection.

The reset/test button for all GFCI protected circuits shall be installed in a “Readily Accessible” Location.

NEC Definition of “Readily Accessible” Capable of being reached quickly for operation, renewal, or inspections without requiring those to whom ready access is requisite to take actions such as to use tools (other than keys), to climb over or under, to remove obstacles, or to resort to portable ladders, and so forth.

NEC 680.26 An equipotential bonding grid to mitigate step and touch voltage potential shall be installed at outdoor swimming pools, spas and hot tubs and at electrical equipment installed outdoors adjacent to natural and artificially made bodies of water.

Luminaires (Light Fixtures)

NEC 410.6 All luminaires, lamp holders, and retrofit kits shall be listed.

NEC 410.16(A)(C) Only luminaires of the following types shall be permitted in a closet:

- (1) Surface-mounted totally enclosed incandescent or LED luminaires with a completely enclosed light source installed **on** the wall above the door or **on** the ceiling, if installed 12 inches or more from the nearest point of closet combustibles.
- (2) Surface-mounted or recessed fluorescent recessed incandescent with a completely enclosed trim or recessed LED luminaires with a completely enclosed light source, if installed 6 inches or more from the nearest point of closet combustibles.
- (3) Surface-mounted fluorescent or LED luminaires identified as suitable for installation within the closet storage space.

NEC 410.16(B) Incandescent luminaires with open or partially enclosed lamps and pendant fixtures or lamp-holders are **NOT** permitted in clothes closets.

NEC 410.2 Closet storage space is the area bounded by the sides and back closet walls extending from the closet floor to a height of 6-feet' or the highest clothes-hanging rod and then out 24-inches from the sides and back of the closet walls respectively, and then continuing from there to the ceiling at a distance of 12-inches or the shelf width, whichever is greater.

NEC 410.10(A) Luminaires installed in wet or damp locations shall be marked as "suitable for use in wet or damp locations", correspondingly.

Equipment Listing and Labeling

Minnesota Rules 3800.3620 All electrical equipment, including luminaires, devices and appliances used as part of or in connection with an electrical installation shall be listed and labeled by a Nationally Recognized Testing Laboratory (NRTL) as having been tested and found suitable for a specific purpose.

NEC 110.3(B) All electrical equipment shall be **listed, labeled** or both and shall be installed and used in accordance with any instructions included in the listing or labeling.

ELECTRICAL SERVICES CONDUCTOR SIZE

CONDUCTOR SIZES FOR 120/240 VOLT DWELLING SERVICES AND FEEDERS		
Copper	Aluminum	Service Rating
4 AWG	2 AWG	100 amps
1 AWG	2/0	150 amps
2/0	4/0	200 amps
400 kcmil	600 kcmil	400 amps

OVERHEAD ELECTRICAL SERVICES

NEC 230.9(A)(B)&(C) Clearances of overhead Service Conductors. Service conductors shall have a clearance of not less than 3 feet from windows that are designed to be opened, doors, porches, balconies, ladders, stairs, fire escapes, or similar locations. *Exception: Conductors run above the top level of a window shall be permitted to be less than the 3 feet requirement.*

NEC 230.24(B) Vertical Clearance for Overhead Service Conductors. Overhead service conductors shall have the following minimum clearance from final grade:

- (1) 10 feet — at the electrical service entrance to buildings, also at the lowest point of the drip loop of the building electrical entrance, and above areas or sidewalks accessible only to pedestrians, measured from final grade or other accessible surface such as platforms, projections, decks, stair landings or surfaces from which they might be reached.
- (2) 12 feet — over residential property and driveways.

NEC 230.28 Service Masts used as Supports must meet the requirements of both A & B below.

(A) Strength. The service mast shall be of adequate strength and extend a Maximum of 3 feet above the roof if more than 3 feet it shall be supported by braces or guy wires to withstand safely the strain imposed by the overhead service conductors. Hubs intended for use with a conduit that serves as a service mast shall be identified for use with service-entrance equipment.

(B) Attachment. Service-drop or overhead service conductors shall not be attached to a service mast between a weatherhead or the end of the conduit and a coupling, where the coupling is located above the last point of securement to the building or other structure or is located above the building or other structure.

NEC 230.7 Other Conductors in Raceway or Cable Circuit conductors other than service conductors, shall not be installed in the same raceway, cable, handhole enclosure, or underground box as the service conductors.

ELECTRICAL SERVICE DISCONNECTS AND PANELBOARDS

230.85 Emergency Disconnects.

For one- and two-family dwelling units, an emergency disconnecting means shall be installed. **This includes BOTH new & replaced Service Panel/Equipment.**

Location: The disconnecting means shall be installed in a readily accessible outdoor location on or within sight of the dwelling unit. If more than one disconnecting means is provided, they shall be grouped.

The disconnecting means shall be marked as follows: **EMERGENCY DISCONNECT/SERVICE DISCONNECT**

The marking or labels shall be located on the outside front of the disconnect enclosure. The letters shall be at least 1/2 inch high.

NEC 250.28 A main bonding jumper or the green bonding screw provided by the manufacturer shall be installed in the Service Disconnect.

NEC 230.67(A)(B)(C)&(D) Surge-Protective Device. All new and replaced electrical services shall be provided with a Type 1 or Type 2 SPD.

Exception: The SPD shall not be required to be located at the service equipment as required in 230.67(B) if located at each next level distribution equipment downstream toward the load.

NEC 240.24(E) Electrical panels shall be readily accessible and shall not be located in **bathrooms**.

NEC 240.24(D) Electrical panels shall not be located in the vicinity of easily ignitable materials such as **clothes closets**.

NEC 408.36(D) Plug-in type overcurrent devices that are back-fed shall be secured by an additional approved device if used as a service disconnect.

NEC 110.26 Sufficient working space shall be provided around electrical equipment. The depth of that space in the direction of access to live parts shall be a minimum of 3-feet. The minimum width of that space in front of electrical equipment shall be the width of the equipment or 30 inches whichever is greater. This workspace shall be clear and extend from the floor to a height of 6 feet 6 inches. This space shall not be used for storage, countertops, cloths washing or drying appliances or any other equipment or obstructions that blocks access to this designated electrical space.

NEC 225.30 Number of supplies to Detached Garage, Buildings or Structures

A building or other structure that is served by a branch circuit or feeder on the load side of a service disconnect means shall be supplied by only one feeder or branch circuit. A multiwire branch circuit shall be considered a single circuit.

EXCEPTION: Electrical vehicle charging systems

NEC 210.4(B) Each multi-wire (2 phase (hot) conductors and one neutral (white) conductors all in same cable) branch circuits shall be provided with a 2-pole breaker or listed handle ties that will simultaneously disconnect both ungrounded (hot) conductors.

NEC 210.4(D) The ungrounded (hot) and grounded (neutral/white) circuit conductors of each multiwire branch circuit shall be grouped by cable ties or similar means in at least one location within the panelboard.

NEC 408.4(A) Every circuit and circuit modification shall be provided with a legible and permanent description that complies with all of the following conditions as applicable:

- (1) Located at each switch or circuit breaker in a switchboard or switchgear
- (2) Included in a circuit directory that is located on the face of, inside of, or in an approved location adjacent to the panel door in the case of a panelboard
- (3) Clear, evident, and specific to the purpose or use of each circuit including spare positions with an unused overcurrent device
- (4) Described with a degree of detail and clarity that is unlikely to result in confusion between circuits
- (5) Not dependent on transient conditions of occupancy
- (6) Clear in explaining abbreviations and symbols when used

NEC 110.26(D) Illumination shall be provided for all working spaces about service equipment and panelboards.

NEC 408.41 Each grounded (neutral/white) circuit conductor within a panelboard shall terminate in an individual terminal.

NEC 110.14 Conductors of dissimilar metals shall not be intermixed unless the device is identified for the purpose. Listed anti-oxidant compound shall be used on all aluminum conductor terminations, unless the device manufacturer states that it is not required.

RACEWAYS

NEC 300.7(A) Portions of raceways or sleeves subject to different temperatures (i.e. passing from the interior to the exterior of a building) shall be sealed with an approved material to prevent condensation from entering equipment.

225.22 Raceways on Exterior Surfaces of Buildings or Other Structures.

Raceways on exteriors of buildings or other structures shall be arranged to drain and shall be listed or approved for use in wet locations.

NEC 300.9 The interior of raceways installed in wet locations above grade shall be considered wet locations and the wire type installed shall comply with **NEC 310.10(C)** (type NM (Romex) cannot be used in conduit attached to outside of a building)

NEC 300.4(G) Where raceways contain 4 AWG or larger insulated circuit conductors, and these conductors enter a cabinet, a box, an enclosure, or a raceway, prior to the installation of conductors, the conductors shall be protected in accordance with any of the following:

- (1) An identified fitting providing a smoothly rounded insulating surface
- (2) A listed metal fitting that has smoothly rounded edges
- (3) Separation from the fitting or raceway using an identified insulating material that is securely fastened in place
- (4) Threaded hubs or bosses that are an integral part of a cabinet, box, enclosure, or raceway providing a smoothly rounded or flared entry for conductors

Conduit bushings constructed wholly of insulating material shall not be used to secure a fitting or raceway.

GROUNDING and BONDING

NEC 250.50 All grounding electrodes as described in 250.52(A)(1) through (A)(7) that are present at each building or structure served shall be bonded together to form the grounding electrode system. If none of these grounding electrodes exist, one or more of the grounding electrodes specified in 250.52(A)(4) through (A)(8) shall be installed and used.

NEC 250.52(A)(1) Electrodes include all metal underground water pipe including abandoned well piping, a concrete encased electrode, ground rod, metal well casing.

NEC 250.68(C) Connection of the grounding electrode conductor to the metal underground water pipe must be within 5 feet of where the metal underground water pipe enters the building or structure.

NEC 250.53(D)(2) A metal underground water pipe shall be supplemented by an additional electrode, such as a concrete encased electrode, ground rod, well casing or underground well metal well piping.

NEC 250.53(A)(2) If a ground rod is installed as part of the grounding electrode system it shall be supplemented by an additional ground rod, spaced at least 6 feet apart. *Note: many rod manufactures require their rods to be driven twice the distance apart as length of the rod*

NEC 250.64(C) The grounding electrode conductor shall be continuous, securely fastened and protected from physical damage.

NEC 250.66 The size of the grounding electrode conductor shall be determined by the size of the service-entrance conductors, per the chart:

100-amp Service	# *8 copper or # 6 Aluminum (*#8 only if protected from physical damage)
150-amp Service	# 6 copper or # 4 Aluminum
200-amp Service	# 4 copper or # 2 Aluminum
400-amp Service	# 1/0 copper or # 3/0 Aluminum

NEC 250.94 An intersystem bonding termination with a minimum of 3 open conductor terminals for the bonding of other systems such as telephone, cable TV, satellite system, etc. must be provided at all new and updated electrical services.

NEC 250.32(A) Buildings supplied by a branch circuit or feeder shall have an equipment grounding conductor run with the supply conductors and connected to the grounding electrode system at the separate building.

UNDERGROUND WIRING

NEC 300.5(A) Direct buried cable or conduit or other raceways shall meet the following minimum cover requirements:

Direct Burial Cable	Ridge or Metal Conduit	Non-Metallic Raceway (PVC)
24 inches	6 inches	18 inches

NOTE: Residential branch circuits rated 20 amps or less at 120 volts or less and with GFCI protection at their source are allowed a minimum cover of 12 inches.

NEC 300.5(D)(3) Underground service laterals shall have their location identified by a warning ribbon placed in the trench at least 12" above the underground installation.

NEC 300.5(J) Where subject to ground movement, direct buried cables and raceways shall be installed with expansion capability to prevent damage to the enclosed conductors or to the connected equipment.

NEC 110.14(B) Wire splicing means for direct burial conductors shall be listed for such use.

NEC 300.5(D)(1) Conductors emerging from underground shall be installed in rigid metal conduit, intermediate metal conduit, or Schedule 80 rigid nonmetallic conduit from 18" below grade or the minimum cover distance to the point of termination above ground. The bottom of the pipe shall be protected by a bushing or other effective means.

NEC 680.11 Underground wiring is not permitted under pools or within 5-feet horizontally from the walls of the pool, unless supplying permitted pool equipment.

An equipotential bonding grid to mitigate step and touch voltage potential shall be installed at outdoor swimming pools, spas, and hot tubs and at electrical equipment installed outdoors adjacent to natural and artificially made bodies of water