

Chapter E 210

BRANCH CIRCUITS

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E 210.01. Scope. The provisions of this chapter shall apply to branch circuits supplying lighting or appliance loads or combinations of such loads. Where motors, or motor-operated appliances, are connected to any circuit supplying lighting or other appliance loads, the provisions of both this chapter and chapter E 430 shall apply. Chapter E 430 shall apply where branch circuit supplies only motor loads.

History: Cr. Register, April, 1964, No. 100, eff. 5-1-64.

E 210.02. Specific purpose branch circuit. The provisions applying to branch circuits referred to in the following table are exceptions to the provisions of this chapter or are supplementary thereto, and shall apply to branch circuits supplying the loads referred to therein:

Busways	Section E 364.08
Cranes and Hoists	Section E 610.42
Infra-red Industrial Heating Equipment	Section E 422.11
Inductive and Dielectric Heat Generating Equipment	Chapter E 665
Instruments	Section E 384.22
Motion Picture Studios and Similar Locations	Chapter E 530
Motors and Motor Controllers	Chapter E 430
Organs	Section E 650.06
Remote-Control, Low-Energy Power, Low-Voltage Power and Signal Circuits	Chapter E 725
Signs and Outline Lighting	Section E 600.06
Sound Recording and Reproduction	Section E 640.06
Space Heating; Panel and Embedded Types	Chapter E 422
Systems over 600 Volts	Chapter E 710
Systems under 50 volts	Chapter E 720
Theatres and Assembly Halls	Sections E 520.41, E 520.52 and E 520.62
Welders	Chapter E 630
X-ray Equipment	Section E 660.03

History: Cr. Register, April, 1964, No. 100, eff. 5-1-64.

E 210.03 Classifications. Branch circuits recognized by this chapter shall be classified in accordance with the maximum permitted rating or setting of the overcurrent device, and the classification for other than

individual branch circuits shall be 15, 20, 30 and 50 amperes. When conductors of higher capacity are used for any reason, the rating or setting of the specified overcurrent device shall determine the circuit classification.

History: Cr. Register, April, 1964, No. 100, eff. 5-1-64.

A. GENERAL PROVISIONS

E 210.04 Multi-wire branch circuits. Branch circuits recognized by this chapter may be installed as multi-wire circuits. (See section E 100.02 for definition).

History: Cr. Register, April, 1964, No. 100, eff. 5-1-64.

E 210.05 Color code. (1) Where installed in raceways, as aluminum sheathed cable, as open work, or as concealed knob-and-tube work, the conductors of multi-wire branch circuits and two-wire branch circuits connected to the same system shall conform to the following color code. Three-wire circuits—one black, one white, one red; four-wire circuits—one black, one white, one red, one blue; five-wire circuits—one black, one white, one red, one blue, one yellow. Where more than one multi-wire branch circuit is carried through a single raceway the ungrounded conductors of the additional circuit may be of colors other than those specified. All circuit conductors of the same color shall be connected to the same ungrounded feeder conductor throughout the installation.

(2) Any conductor intended solely for grounding purposes shall be identified by a green color unless it be bare. Except for public highway traffic control, communications, metering, railway, and railroad signal installations, branch circuit conductors and equipment lead wires to which branch circuit conductors attach, having a green covering, shall not be used for other than grounding purposes.

Note 1: The above is not intended to prohibit the use of green colored internal wiring of equipment, except where such wiring serves as the lead wires to which the branch circuit conductors attach.

Note 2: See section E 200.07 for use of white or natural gray for grounded or neutral conductors.

History: Cr. Register, April, 1964, No. 100, eff. 5-1-64.

E 210.06 Voltage. (1) **VOLTAGE.** The voltage to ground on branch circuits supplying lampholders, fixtures, or standard receptacles of 15-ampere or less rating shall not exceed 150 volts, except as follows:

(a) *Exception No. 1.* In industrial establishments or in stores where the conditions of maintenance and supervision assure that only competent individuals will service the lighting fixtures the voltage of branch circuits which supply only lighting fixtures that are equipped with mogul-base screw-shell lampholders or with lampholders of other types approved for the application, mounted not less than 8 feet from the floor, which do not have switch control as an integral part of the fixture shall not exceed 300 volts to ground;

(b) *Exception No. 2.* In industrial establishments, office buildings, schools, stores, and public and commercial areas of other buildings, such as hotels or transportation terminals, the voltage of branch circuits which supply only the ballasts for electric discharge lamps

mounted in permanently installed fixtures, by other than screw-shell type lampholders, which do not have manual switch control as an integral part of the fixture shall not exceed 300 volts to ground. Where screw-shell type lampholders are used for electric discharge lamps the fixtures shall be installed not less than 8 feet from the floor;

(c) *Exception No. 3.* For infra-red industrial heating appliances as described in section E 422.11;

(d) *Exception No. 4.* In railway properties as described in section E 195.18.

(2) **VOLTAGE BETWEEN CONDUCTORS—DWELLINGS.** In dwelling occupancies, the voltage between conductors supplying lampholders of the screw-shell type, receptacles, or appliances, shall not exceed 150 volts, except as follows: Exception: The voltage between conductors may exceed 150 volts when supplying only:

- (a) Permanently connected appliances,
- (b) Portable appliances of more than 1,380 watts,
- (c) Portable motor-operated appliances of $\frac{1}{4}$ horsepower or greater rating.

History: Cr. Register, April, 1964, No. 100, eff. 5-1-64.

E 210.07 Grounding receptacles. Receptacles and cord connectors equipped with grounding contacts shall have those contacts effectively grounded. The branch circuit or branch circuit raceway shall include or provide a grounding conductor to which the grounding contacts of the receptacle or cord connector shall be connected. The metal armor of type AC metal-clad cable, the sheath of aluminum sheathed cable, or a metallic raceway is acceptable as a grounding conductor. See subsection E 210.21(2) and sections E 250.045 and E 250.059.

(1) **EXCEPTION:** For extensions only in existing installations which do not have a grounding conductor in the branch circuit, the grounding conductor of a grounding type receptacle outlet may be grounded to a grounded cold water pipe near the equipment.

History: Cr. Register, April, 1964, No. 100, eff. 5-1-64.

E 210.08 Heavy-duty lampholders. Heavy-duty lampholders referred to in this chapter shall include lampholders rated at not less than 750 watts.

(1) **EXCEPTION:** Admedium lampholders rated at 660 watts shall be considered to be heavy duty type.

History: Cr. Register, April, 1964, No. 100, eff. 5-1-64.

E 210.09 Grounding conductor for swimming pool equipment. Branch circuits supplying fixed, movable or portable equipment and lighting in or on swimming pools shall include a grounding conductor for the purpose of grounding the non-current carrying metal parts of such equipment or lighting. The metal armor of metal-clad cable or a metallic raceway is not acceptable as the required grounding conductor in this application. (See chapter E 680).

History: Cr. Register, April, 1964, No. 100, eff. 5-1-64.

B. SPECIFIC REQUIREMENTS

E 210.19 Conductors. Circuit conductors shall conform to the following:

(1) **CARRYING CAPACITY.** Shall have a carrying capacity of not less than the rating of the branch circuit and not less than the maximum load to be served.

(2) **MINIMUM SIZE.** Shall not be smaller than No. 8 for ranges of 8¾ kw or more rating, nor smaller than No. 14 for other loads.

(3) **EXCEPTIONS:** (a) *Exception No. 1.* Range loads. See note 5 of table E 220.05. Where the maximum demand of a range of 8¾ kw or more rating is computed according to column A of table E 220.05, the neutral conductor of a 3-wire branch circuit supplying a household electric range, a wall-mounted oven or a counter-mounted cooking unit may be smaller than the ungrounded conductors but shall have a carrying capacity at least 70% of the current-carrying capacity of the ungrounded conductors and shall not be smaller than No. 10.

Note: Cable assemblies with the neutral conductor smaller than the ungrounded conductor shall be so marked.

(b) *Exception No. 2. Tap conductors.* Tap conductors may be of less capacity than the branch circuit rating provided no tap conductor is of less capacity than the load to be served and provided the rating is not less than 20 amperes for 50 ampere circuits or 15 amperes for circuits rated less than 50 amperes and only where these tap conductors supply either:

1. Individual lampholders or fixtures with taps extending not longer than 18 inches beyond any portion of the lampholder or fixture, except as required in subsection E 410.65(2)(b); or,

2. Individual outlets with taps not over 18 inches long; or,

3. Infra-red lamp industrial heating appliances.

(c) *Exception No. 3. Fixture wires and cords.* Fixture wires and cords may be of smaller size, but not less than the size specified in exception No. 3 of section E 240.05. See tables subsection E 400.09(2) and section E 402.04.

(d) *Exception No. 4. Outlet devices.* Outlet devices may have less carrying capacity than the branch circuit rating, but not less than the types and ratings specified in subsections E 210.21(1)-(3).

(e) *Exception No. 5.* Where tap conductors supply electric ranges, wall-mounted electric ovens and counter-mounted electric cooking units from 50 ampere branch circuits they shall be of suitable capacity for the load to be served, not less than 20 amperes in rating and no longer than necessary for servicing the appliance.

History: Cr. Register, April, 1964, No. 100, eff. 5-1-64.

E 210.20 Overcurrent protection. The rating or setting of overcurrent devices shall conform to the following:

(1) **RATING.** Shall not be in excess of the value specified in section E 240.05.

(a) *Exception: Tap conductors and fixture wires.* Tap conductors, fixture wires and cords as permitted in subsection E 210.19(3) may be considered as protected by the circuit overcurrent device.

(2) **SINGLE APPLIANCE.** Shall not exceed 150% of the rating of the appliance, where the circuit supplies only a single appliance of 10-ampere or more rating.

History: Cr. Register, April, 1964, No. 100, eff. 5-1-64.

E 210.21 Outlet devices. Outlet devices shall have a rating not less than the load to be served and shall conform to the following:

(1) **LAMP HOLDERS.** Lampholders when connected to circuits having a rating of over 20 amperes shall be of the heavy duty type.

(2) **RECEPTACLES.** (a) Receptacles installed on 15 ampere and 20 ampere branch-circuits shall be of the grounding type and they shall be installed in accordance with section E 210.07. The installation of grounding type outlets shall not be used as a requirement that all portable equipment be of the grounded type. See chapter E 250 for requirements for the grounding of portables.

(b) When connected to circuits having two or more outlets, receptacles shall conform to the following:

15-amp. circuits	-----	Not over 15-amp. rating
20-amp. circuits	-----	15 or 20 amp. rating
30-amp. circuits	-----	30-amp. rating
50-amp. circuits	-----	50-amp. rating

(c) Receptacles connected to circuits having different voltages, frequencies or types of current (AC or DC) on the same premises shall be of such design that attachment plugs used on such circuits are not interchangeable.

(d) Grounding receptacles rated at 15 or 20 amperes and installed in circuits of less than 150 volts between conductors shall be approved for use only on potentials less than 150 volts. Grounding receptacles rated at 15 amperes and installed in circuits of 151 to 300 volts between conductors shall be approved for use only on potentials not less than 151 volts.

(e) Receptacles rated at 15 amperes connected to 15 or 20 ampere branch circuits serving 2 or more outlets shall not supply a total load in excess of 12 amperes for portable appliances. Receptacles rated at 20 amperes connected to 20 ampere branch circuits serving 2 or more outlets shall not supply a total load in excess of 16 amperes for portable appliances.

(3) **CAPACITY OF RANGE RECEPTACLES.** Capacity of range receptacles may be based on single range loads as computed from table E 220.05.

History: Cr. Register, April, 1964, No. 100, eff. 5-1-64.

E 210.22 Receptacle outlets required. Receptacle outlets shall be installed as follows:

(1) **GENERAL.** Where portable cords are used, except where the attachment of cords by other means is specifically permitted.

Note: A cord connector that is supported by a permanently connected cord pendant is considered a receptacle outlet.

(2) DWELLING TYPE OCCUPANCIES. In every kitchen, dining room, breakfast room, living room, parlor, library, den, sun room, recreation room, family room, and bedroom, one receptacle outlet shall be provided for every 12 linear feet or major fraction thereof of the total (gross) distance around the room as measured horizontally along the wall at the floorline. The receptacle outlets shall, insofar as practicable be spaced equal distances apart. There shall be at least one receptacle in any usable isolated wall space 3 feet wide or greater. Receptacle outlets in floor shall not be counted as part of the required number of receptacle outlets unless located close to the wall.

History: Cr. Register, April, 1964, No. 100, eff. 5-1-64.

E 210.23 Maximum load. The maximum load shall conform to the following: (1) MOTOR-OPERATED APPLIANCES. The total load shall not exceed 80% of the branch circuit rating if motor-operated appliances are supplied. Where circuit supplies only motor-operated appliance loads, chapter E 430 is to apply.

(2) OTHER LOADS. The total load shall not exceed the branch circuit rating, and shall not exceed 80% of the rating where in normal operation the load will continue for long periods such as store lighting and similar loads. In computing the load of lighting units which employ ballasts, transformers or auto-transformers, the load shall be based on the total of the ampere rating of such units and not on the wattage of the lamps.

(a) *Exception:* Range loads. See note 5 of table E 220.05.

History: Cr. Register, April, 1964, No. 100, eff. 5-1-64.

E 210.24 Permissible loads. Individual branch circuits may supply any loads. Branch circuits having 2 or more outlets may supply only loads as follows:

(1) 15- AND 20-AMPERE BRANCH CIRCUITS. Lighting units and/or appliances. The rating of any one portable appliance shall not exceed 80% of the branch circuit rating. The total rating of fixed appliances shall not exceed 50% of the branch circuit rating when lighting units or portable appliances are also supplied.

(2) 30-AMPERE BRANCH CIRCUITS. Fixed lighting units with heavy duty lampholders in other than dwelling occupancies; or appliances in any occupancy. The rating of any one portable appliance shall not exceed 24 amperes.

(3) 50-AMPERE BRANCH CIRCUITS. Fixed lighting units with heavy duty lampholders in other than dwelling occupancies; or fixed cooking appliances; or fixed range and water heater; or infra-red lamp industrial heating appliances.

Note: The term "fixed" as used in this section recognizes cord connections where otherwise permitted.

History: Cr. Register, April, 1964, No. 100, eff. 5-1-64.

E 210.25 Table of requirements. The requirements for circuits having 2 or more outlets [other than the receptacle circuits of subsection E 220.03 (2)] as specifically provided for above are summarized in table E 210.25.

TABLE E 210.25

BRANCH CIRCUIT REQUIREMENTS

(Type R, RW, RU, RUW, RH-RW, SA, T, TW, RH, RUH, RHW, RHH, THW, and THWN conductors in raceway or cable)

Circuit Rating	15 Amp.	20 Amp.	30 Amp.	50 Amp.
Conductors: (Min. Size)				
Circuit Wires.....	14	12	10	6
Taps.....	14	14	14	12
Fixture Wires and Cords.....	Refer to Rule E 240.05, Exception No. 3			
Overcurrent Protection.....	15 Amp.	20 Amp.	30 Amp.	50 Amp.
Outlet Devices: Lampholders Permitted Receptacle Rating.....	Any Type 15 Max. Amp.	Any Type 15 or 20 Amp.	Heavy Duty 30 Amp.	Heavy Duty 50 Amp.
Maximum Load.....	15 Amp.	20 Amp.	30 Amp.	50 Amp.
Permissible Load.....	Refer to Rule E 210.24(1)	Refer to Rule E 210.24(1)	Refer to Rule E 210.24(2)	Refer to Rule E 210.24(3)

History: Cr. Register, April, 1964, No. 100, eff. 5-1-64.