

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, January, 1968, No. 145, eff. 2-1-68.

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:

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| 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, January, 1968, No. 145, eff. 2-1-68.

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, 40 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, January, 1968, No. 145, eff. 2-1-68.

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, January, 1968, No. 145, eff. 2-1-68.

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.

(a) *Exception:* Color coding is not required for electric range or clothes dryer circuits.

(2) Any conductor intended solely for grounding purposes shall be identified by a continuous green color or a continuous green color with a yellow stripe 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 continuous green color or a continuous green color with a yellow stripe shall not be used for other than grounding purposes.

Note 1: The above is not intended to prohibit the use of a conductor having a continuous green color or a continuous green color with a yellow stripe, insulation for 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, January, 1968, No. 145, eff. 2-1-68.

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 195.19.

(e) *Exception No. 5.* The branch circuits supplying the ballasts for electric discharge lamps mounted in permanently installed fixtures on poles for the illumination of areas such as highways, bridges, athletic fields, parking lots, at a height not less than 22 feet, or on other structures such as tunnels at a height not less than 18 feet, shall not exceed 500 volts between conductors when installed as provided in section E 730.07 (1).

(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.

(3) **VOLTAGE DROP.** The size of the conductors for branch circuits as defined in chapter E 100 should be such that the voltage drop would not exceed 3% to the farthest outlet for power, heating, lighting, or combinations thereof. Providing further that the maximum total voltage drop for feeders and branch circuits should not exceed 5% over all.

History: Cr. Register, January, 1968, No. 145, eff. 2-1-68.

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 section 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, January, 1968, No. 145, eff. 2-1-68.

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, January, 1968, No. 145, eff. 2-1-68.

B. SPECIFIC REQUIREMENTS

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

(1) **AMPACITY.** Shall have an ampacity 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 8 $\frac{1}{4}$ 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 8 $\frac{1}{4}$ 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 an ampacity at least 70% of the ampacity 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 section E 410.65 (2) (b); or,

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

3. Infra-red lamp industrial heating appliances.

4. Nonheating leads of snow and ice melting cables and mats.

(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 section 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 sections 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, January, 1968, No. 145, eff. 2-1-68.

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 section 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.

(3) **CONTINUOUS LOADS.** Where loads other than motor loads will constitute continuous loads see section E 210.23 (2) and sections E 220.02 and E 240.02.

History: Cr. Register, January, 1968, No. 145, eff. 2-1-68.

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. Grounding type receptacles which are of a type that reject nongrounding type attachment plugs or which are of the locking type may be used for specific purposes or in special locations.

(b) When grounding type receptacles are used as replacements for existing nongrounding types a grounding conductor installed in accordance with section E 250.057 shall be provided. If it is impractical to reach a source of ground a nongrounding type receptacle shall be used. 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.

(c) Receptacles required in Wis. Adm. Code section E 517.03 (4) are considered as meeting the requirements of this section.

(d) When connected to circuits having 2 or more outlets, receptacles shall conform to the following:

| | | |
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| 15-amp. circuits | ----- | Not over 15-amp. rating |
| 20-amp. circuits | ----- | 15 or 20-amp. rating |
| 30-amp. circuits | ----- | 30-amp. rating |
| 40-amp. circuits | ----- | 40 or 50-amp. rating |
| 50-amp. circuits | ----- | 50-amp. rating |

(e) 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.

(f) 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.

(g) 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, January, 1968, No. 145, eff. 2-1-68.

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, receptacle outlets shall be installed so that no point along the floor line in any usable wall space is more than 6 feet, measured horizontally, from an outlet in that space including any wall space 3 feet wide or greater and the wall space occupied by sliding panels in exterior walls. The receptacle outlets shall, insofar as practicable, be spaced equal distances apart. Receptacle outlets on the floor shall not be counted as part of the required number of receptacles unless located within one foot of the wall. Receptacle outlets in fixtures and appliances shall not be counted as part of the required number of receptacles. At least one outlet shall be installed for the laundry.

(a) Outlets in other sections of the dwelling for special appliances such as laundry equipment shall be placed within 6 feet of the intended location of the appliance.

(3) **OTHER OCCUPANCIES.** Guest or sleeping rooms in hotels, motels, dormitories, rooming houses, homes for the aged and similar occupancies shall have receptacles installed in accordance with section E 210.22 (2).

History: Cr. Register, January, 1968, No. 145, eff. 2-1-68.

E 210.23 Maximum load. The maximum load shall conform to the following:

(1) **APPLIANCES CONSISTING OF MOTORS AND OTHER LOADS.** Where a circuit supplies only motor operated appliance loads, chapter E 430 shall apply. For other than a portable appliance, the branch circuit size shall be calculated on the basis of 125% of motor load where the motor is larger than $\frac{1}{2}$ hp plus the sum of the other loads.

(2) **OTHER LOADS.** The total load shall not exceed the branch circuit rating, and shall not exceed 80% of the rating when load will constitute a continuous load 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 No. 1.* When the assembly including the overcurrent device protecting the branch circuit is approved for continuous operation at 100 per cent of its rating, the total load may equal the branch circuit rating.

(b) *Exception No. 2.* Where branch circuits are derated in accordance with note 8 of tables E 310.12 through E 310.15 the derating factor for continuous loading shall not apply.

(c) *Exception No. 3.* Range loads. See note 5 of table E 220.5.

History: Cr. Register, January, 1968, No. 145, eff. 2-1-68.

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) 40-AMPERE BRANCH CIRCUITS. Fixed or stationary cooking appliances or fixed water heaters; or clothes dryers; in other than dwelling occupancies fixed lighting units with heavy-duty lampholders or infra-red heating units.

(4) 50-AMPERE BRANCH CIRCUITS. Fixed lighting units with heavy duty lampholders in other than dwelling occupancies; or fixed cooking appliances; or infra-red lamp industrial heating appliances.

Note 1: The term "fixed" as used in this section recognizes cord connections where otherwise permitted.

Note 2: Fixed outdoor electric snow melting and deicing installations may be supplied by any of the branch circuits described herein provided the circuit supplies no other load.

History: Cr. Register, January, 1968, No. 145, eff. 2-1-68.

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

**TABLE E 210.25
BRANCH CIRCUIT REQUIREMENTS**

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

| CIRCUIT RATING | 15 Amp. | 20 Amp. | 30 Amp. | 40 Amp. | 50 Amp. |
|-------------------------------------|--|----------------------------------|----------------------------------|----------------------------------|----------------------------------|
| CONDUCTORS: | | | | | |
| (Min. Size) | | | | | |
| Circuit Wires*----- | 14 | 12 | 10 | 8 | 6 |
| Taps----- | 14 | 14 | 14 | 12 | 12 |
| Fixture Wires and Cords | Refer to Section E 240.05, Exception No. 3 | | | | |
| OVERCURRENT PROTECTION ----- | 15 Amp. | 20 Amp. | 30 Amp. | 40 Amp. | 50 Amp. |
| OUTLET DEVICES: | | | | | |
| Lampholders permitted | Any Type | Any Type | Heavy Duty | Heavy Duty | Heavy Duty |
| Receptacle Rating----- | 15 Max. Amp. | 15 or 20 Amp. | 30 Amp. | 40 & 50 Amp. | 50 Amp. |
| MAXIMUM LOAD ----- | 15 Amp. | 20 Amp. | 30 Amp. | 40 Amp. | 50 Amp. |
| PERMISSIBLE LOAD --- | Refer to Subsection E 210.24 (1) | Refer to Subsection E 210.24 (1) | Refer to Subsection E 210.24 (2) | Refer to Subsection E 210.24 (3) | Refer to Subsection E 210.24 (4) |

*These ampacities are for copper conductors where derating is not required. See tables E 310.12 through E 310.15.

History: Cr. Register, January, 1968, No. 145, eff. 2-1-68.