Section 8 — Circuit loading and demand factors

Scope

8-000 Scope

This Section applies to

a) maximum circuit loading;
b) calculated loads for consumer's services, feeders, and branch circuits;
c) use of demand factors;
d) branch circuit positions required for dwelling units; and
e) heater receptacles for vehicles.

8-002 Special terminology (see Appendix B)

In this Section, the following definitions shall apply:

Basic load — the load of lighting and receptacle circuits, based on the outside dimensions of a specific area of building occupancy, as listed in Table 14.

Calculated load — the load calculated in accordance with the applicable requirements of this Section.

Demonstrated load — historical maximum demand watt information recorded over at least a 24-month period for the same type of facility as the one in question, equated to watts per m^2.

Electric vehicle energy management system — a means used to control electric vehicle supply equipment loads through the process of connecting, disconnecting, increasing, or reducing electric power to the loads and consisting of any of the following: a monitor(s), communications equipment, a controller(s), a timer(s), and other applicable device(s).

General

8-100 Current calculations

When calculating currents that will result from loads, expressed in watts or volt amperes, to be supplied by a low-voltage ac system, the voltage divisors to be used shall be 120, 208, 240, 277, 347, 416, 480, or 600 as applicable.

8-102 Voltage drop (see Appendices B and D)

1) The voltage drop in an installation shall be based on the connected load of the feeder or branch circuit if known; otherwise it shall be based on 80% of the rating of the overload or overcurrent device protecting the branch circuit or feeder, and not exceed
   a) 3% in a feeder or branch circuit; and
   b) 5% from the supply side of the consumer's service (or equivalent) to the point of utilization.
2) Notwithstanding Subrule 1), where overcurrent devices are selected in accordance with other Sections of this Code, the voltage drop shall be based on the calculated demand load of the feeder or branch circuit.
3) Notwithstanding Subrule 1), wiring for general-use branch circuits rated at not more than 120 V or 20 A in dwelling units, with the insulated conductor length measured from the supply side of the consumer's service to the furthest point of utilization in accordance with the values in Table 68, shall be acceptable.
4) Notwithstanding Subrule 1), at industrial establishments where conditions of maintenance and supervision ensure use by qualified persons, the design shall ensure that the voltage at the point of utilization is within the rating or voltage tolerance of the connected device(s).

8-104 Maximum circuit loading (see Appendix B)

1) The ampere rating of a consumer's service, feeder, or branch circuit shall be the ampere rating of the overcurrent device protecting the circuit or the ampacity of the conductors, whichever is less.
2) The calculated load in a circuit shall not exceed the ampere rating of the circuit.

3) The calculated load in a consumer's service, feeder, or branch circuit shall be considered a continuous load unless it can be shown that in normal operation it will not persist for
   a) a total of more than 1 h in any 2 h period if the load does not exceed 225 A; or
   b) a total of more than 3 h in any 6 h period if the load exceeds 225 A.
4) A load of a cyclic or intermittent nature shall be classified as continuous unless it meets the requirements of Subrule 3).

Δ 5) Where a fused switch or circuit breaker is marked for continuous operation at 100% of the ampere rating of its overcurrent devices, the continuous load as determined from the calculated load shall not exceed the continuous operation marking on the fused switch or circuit breaker and
   a) except as required by Item b), shall not exceed 100% of the ampacities of conductors selected in accordance with Section 4; or
   b) shall not exceed 85% of the ampacities of single conductors selected in accordance with Section 4.

Δ 6) Where a fused switch or circuit breaker is marked for continuous operation at 80% of the ampere rating of its overcurrent devices, the continuous load as determined from the calculated load shall not exceed the continuous operation marking on the fused switch or circuit breaker and
   a) except as required by Item b), shall not exceed 80% of the ampacities of conductors selected in accordance with Section 4; or
   b) shall not exceed 70% of the ampacities of single conductors selected in accordance with Section 4.
7) The continuous load as determined from the calculated load connected to a cablebus shall not exceed the values specified in Subrule 5) or 6).

8-106 Use of demand factors (see Appendix B)

1) In any case other than a service calculated in accordance with Rules 8-200 and 8-202, where the design of an installation is based on requirements in excess of those given in this Section, the service and feeder capacities shall be increased accordingly.
2) Where two or more loads are installed so that only one can be used at any one time, the one providing the greatest demand shall be used in determining the calculated demand.
3) Where interlocks are installed to prevent simultaneous operation of electric space-heating and air-conditioning loads, whichever is the greater load shall be used in calculating the demand.
4) Where a feeder supplies loads of a cyclic or similar nature such that the maximum connected load will not be supplied at the same time, the ampacity of the feeder conductors shall be permitted to be based on the maximum load that may be connected at any one time.
5) Where a feeder or service supplies motor or air-conditioning loads, a demand factor as determined by a qualified person shall be permitted to be applied to these loads, provided that a deviation has been allowed in accordance with Rule 2-030.
6) The ampacity of conductors of feeders or branch circuits shall be in accordance with the Section(s) dealing with the respective equipment being supplied.
7) Notwithstanding the requirements of this Section, the ampacity of the conductors of a feeder or branch circuit need not exceed the ampacity of the conductors of the service or of the feeder from which they are supplied.
8) Where additional loads are to be added to an existing service or feeder, the augmented load shall be permitted to be calculated by adding the sum of the additional loads, with demand factors as permitted by this Code, to the maximum demand load of the existing installation as measured over the most recent 12-month period, but the new calculated load shall be subject to Rule 8-104 5) and 6).
9) For loads other than those calculated in accordance with Rules 8-200 and 8-202, feeder and service load calculations shall be permitted to be based on demonstrated loads, provided that such calculations are performed by a qualified person, as determined by the regulatory authority having jurisdiction.
10) Where electric vehicle supply equipment loads are controlled by an electric vehicle energy management system, the demand load for the electric vehicle supply equipment shall be equal to the maximum load allowed by the electric vehicle energy management system.

Δ 11) For the purposes of Rules 8-200 1) a) vi), 8-202 1) a) vii), 8-202 3) d), 8-204 1) d), 8-206 1) d), 8-208 1) d), and 8-210 c), the demand load for the electric vehicle supply equipment shall not be required to be considered in the determination of the calculated load where an electric vehicle energy management system as described in Subrule 10) performs the functions of
   a) monitoring the consumer's service, feeders, and branch circuits; and
   b) controlling the electric vehicle supply equipment loads in accordance with Rule 8-500.

8-108 Number of spaces for branch circuit overcurrent devices (see Appendix B)

1) Panelboards installed in single dwellings shall, at the time of the original installation, have at least four additional spaces left for future overcurrent devices with provision for a two-pole device.
2) Panelboards installed in each dwelling unit in an apartment or similar building shall, at the time of the original installation, have at least two additional spaces left for future overcurrent devices with provision for a two-pole device.

Δ **8-110 Determination of areas**

The living area designated in Rules 8-200 and 8-202 shall be determined from inside dimensions and include the sum of
a) 100% of the area on the ground floor;
b) 100% of any areas above the ground floor used for living purposes; and
c) 75% of only those areas below the ground floor that exceed 1.8 m in height, measured from the lowest part of the ceiling assembly to the ground or other surface below it.

Calculated load for services and feeders

8-200 Single dwellings (see Appendix B)

1) The calculated load for the service or feeder supplying a single dwelling shall be based on the greater of Item a) or b):
   a)
      i) a basic load of 5000 W for the first 90 m^2 of living area (see Rule 8-110); plus
      ii) an additional 1000 W for each 90 m^2 or portion thereof in excess of 90 m^2; plus
      iii) any electric space-heating loads provided for with demand factors as permitted in Section 62 plus any air-conditioning loads with a demand factor of 100%, subject to Rule 8-106 3); plus
      iv) any electric range load provided for as follows: 6000 W for a single range plus 40% of any amount by which the rating of the range exceeds 12 kW; plus
      v) any electric tankless water heaters or electric water heaters for steamers, swimming pools, hot tubs, or spas with a demand factor of 100%; plus
      vi) except as permitted by Rule 8-106 11), any electric vehicle supply equipment loads with a demand factor of 100%; plus
      vii) any loads provided for that have a rating in excess of 1500 W, in addition to those outlined in Items i) to vi), at
         A) 25% of the rating of each load, if an electric range has been provided for; or
         B) 100% of the combined load up to 6000 W, plus 25% of the combined load that exceeds 6000 W, if an electric range has not been provided for; or
   b)
      i) 24 000 W where the floor area, exclusive of the basement floor area, is 80 m^2 or more; or
      ii) 14 400 W where the floor area, exclusive of the basement floor area, is less than 80 m^2.

Δ 2) The calculated load for the consumer's service or feeder conductors supplying two or more dwelling units of row housing shall be based on
   a) the calculated load in the dwelling unit, as determined in accordance with Subrule 1), excluding electric vehicle supply equipment loads described in Rule 8-202 1) a) vii), any electric space-heating loads, and any air-conditioning loads, with application of demand factors to the calculated loads as required by Rule 8-202 3) a) i) to v); plus
   b) the requirements of Rule 8-202 3) b) to e).
3) Notwithstanding Rule 86-302, the total load calculated in accordance with either Subrule 1) or 2) shall not be considered to be a continuous load for application of Rule 8-104.

8-202 Apartment and similar buildings (see Appendix B)

1) The calculated load for the service or feeder from a main service supplying loads in dwelling units shall be the greater of Item a) or b):
   a)
      i) a basic load of 3500 W for the first 45 m² of living area (see Rule 8-110); plus
      ii) an additional 1500 W for the second 45 m² or portion thereof; plus
      iii) an additional 1000 W for each additional 90 m² or portion thereof in excess of the initial 90 m²; plus
      iv) any electric space-heating loads provided for with demand factors as permitted in Section 62 plus any air-conditioning loads with a demand factor of 100%, subject to Rule 8-106 3); plus
      v) any electric range load provided for as follows: 6000 W for a single range plus 40% of any amount by which the rating of the range exceeds 12 kW; plus
      vi) any electric tankless water heaters or electric water heaters for steamers, swimming pools, hot tubs, or spas with a demand factor of 100%; plus
Δ   vii) any electrical vehicle supply equipment loads, if they are supplied from a panelboard installed in a dwelling unit, with a demand factor of 100%; plus
      viii) any loads provided for, in addition to those outlined in Items i) to vi), at
         A) 25% of the rating of each load with a rating in excess of 1500 W, if an electric range has been provided for; or
         B) 25% of the rating of each load with a rating in excess of 1500 W plus 6000 W, if an electric range has not been provided for; or
   b) 60 A.
2) The total load calculated in accordance with Subrule 1) and Subrule 3) a), b), and c) shall not be considered to be a continuous load for the application of Rule 8-104.
3) The calculated load for the consumer's service or feeder supplying two or more dwelling units shall be based on the calculated load obtained from Subrule 1) a) and the following:
Δ a) excluding any electric vehicle supply equipment loads, electric space-heating loads and any air-conditioning loads, the load shall be considered to be
      i) 100% of the calculated load in the unit having the heaviest load; plus
      ii) 65% of the sum of the calculated loads in the next 2 units having the same or next smaller loads to those specified in Item i); plus
      iii) 40% of the sum of the calculated loads in the next 2 units having the same or next smaller loads to those specified in Item ii); plus
      iv) 25% of the sum of the calculated loads in the next 15 units having the same or next smaller loads to those specified in Item iii); plus
      v) 10% of the sum of the calculated loads in the remaining units;
   b) if electric space heating is used, the sum of all the space-heating loads as determined in accordance with the requirements of Section 62 shall be added to the load determined in accordance with Item a), subject to Rule 8-106 3);
   c) if air conditioning is used, the sum of all the air-conditioning loads shall be added, with a demand factor of 100%, to the load determined in accordance with Items a) and b), subject to Rule 8-106 3);
Δ d) except as permitted by Rule 8-106 10) or Rule 8-106 11), any electric vehicle supply equipment loads not supplied from a panelboard installed in a dwelling unit in accordance with Rule 8-202 1) a) vii), shall be added with a demand of 100%; and
   e) in addition, any lighting, heating, and power loads not located in dwelling units shall be added with a demand factor of 75%.
4) The ampacity of feeder conductors from a service supplying loads not located in dwelling units shall be not less than the rating of the equipment installed with demand factors as permitted by this Code.

8-204 Schools

1) The calculated load for the service or feeder shall be based on the following:
   a) a basic load of 50 W/m² of classroom area; plus
   b) 10 W/m² of the remaining area of the building based on the outside dimensions; plus
   c) electric space-heating, air-conditioning, and total loads of other permanently connected equipment based on the rating of the equipment installed; plus
Δ d) except as permitted by Rule 8-106 10) or Rule 8-106 11), any electric vehicle supply equipment loads with a demand factor of 100%; plus
   e) cord-connected equipment intended for connection to receptacles rated more than 125 V or 20 A based on
      i) 80% of the rating of the receptacle; or
      ii) the rating of the equipment intended for connection to the receptacle.
2) Demand factors shall be permitted to be applied as follows:
   a) for a building with an area up to and including 900 m² based on the outside dimensions:
      i) as permitted in Section 62 for any electric space-heating loads provided for; and
      ii) 75% for the balance of the load; and
   b) for a building with an area exceeding 900 m² based on the outside dimensions:
      i) as permitted in Section 62 for any electric space-heating loads provided for; and
      ii) the balance of the load shall be divided by the number of square metres to obtain a load-per-square-metre rating and the demand load may be considered to be the sum of
         A) 75% of the load per square metre multiplied by 900; and
         B) 50% of the load per square metre multiplied by the area of the building in excess of 900 m².

8-206 Hospitals

1) The calculated load for the service or feeder shall be based on the following:
   a) a basic load of 20 W/m² of the area of the building based on the outside dimensions; plus
   b) 100 W/m² for high-intensity areas such as operating rooms; plus
   c) electric space-heating, air-conditioning, and total loads of other permanently connected equipment based on the rating of the equipment installed; plus
Δ d) except as permitted by Rule 8-106 10) or Rule 8-106 11), any electric vehicle supply equipment loads with a demand factor of 100%; plus
   e) cord-connected equipment intended for connection to receptacles rated more than 125 V or 20 A based on
      i) 80% of the rating of the receptacle; or
      ii) the rating of the equipment intended for connection to the receptacle.
2) Demand factors shall be permitted to be applied as follows:
   a) for a building with an area up to and including 900 m² based on the outside dimensions:
      i) as permitted in Section 62 for any electric space-heating loads provided for; and
      ii) 80% for the balance of the load; and
   b) for a building with an area exceeding 900 m² based on the outside dimensions:
      i) as permitted in Section 62 for any electric space-heating loads provided for; and
      ii) the balance of the load shall be divided by the number of square metres to obtain a load-per-square-metre rating and the demand load may be considered to be the sum of
         A) 80% of the load per square metre multiplied by 900; and
         B) 65% of the load per square metre multiplied by the area of the building in excess of 900 m².

8-208 Hotels, motels, dormitories, and buildings of similar occupancy (see Appendix B)

1) The calculated load for the service or feeder shall be based on the following:
   a) a basic load of 20 W/m² of the area of the building, based on the outside dimensions; plus
   b) lighting loads for special areas such as ballrooms, based on the rating of the equipment installed; plus
   c) electric space-heating, air-conditioning, and total loads of other permanently connected equipment based on the rating of the equipment installed; plus

Δ d) except as permitted by Rule 8-106 10) or Rule 8-106 11), any electric vehicle supply equipment loads with a demand factor of 100%; plus
e) cord-connected equipment intended for connection to receptacles rated more than 125 V or 20 A based on
i) 80% of the rating of the receptacle; or
ii) the rating of the equipment intended for connection to the receptacle.

2) Demand factors shall be permitted to be applied as follows:
a) for a building with an area up to and including 900 m^2 based on the outside dimensions:
i) as permitted in Section 62 for any electric space-heating loads provided for; and
ii) 80% for the balance of the load; and
b) for a building with an area exceeding 900 m^2 based on the outside dimensions:
i) as permitted in Section 62 for any electric space-heating loads provided for; and
ii) the balance of the load shall be divided by the number of square metres to obtain a load-per-square-metre rating and the demand load may be considered to be the sum of
A) 80% of the load per square metre multiplied by 900; and
B) 65% of the load per square metre multiplied by the area of the building in excess of 900 m^2.

8-210 Other types of occupancy

The calculated load for the service or feeder for the types of occupancies listed in Table 14 shall be based on

a) a basic load in watts per square metre as required by Table 14 for the area of the occupancy served based on the outside dimensions of the occupancy, with application of demand factors as indicated in Table 14; plus
b) special loads such as electric space-heating, air-conditioning, motor loads, show window lighting, stage lighting, etc., based on the rating of the equipment installed with demand factors permitted by this Code; plus
Δ c) except as permitted by Rule 8-106 10) or Rule 8-106 11), any electric vehicle supply equipment loads with a demand factor of 100%.

8-212 Exit sign, emergency lighting, and show window loads

1) Where a panel is supplying specific types of lighting, such as exit signs or emergency lighting, which may be located throughout a building such that it is impossible to calculate the area served, the connected load of the circuits involved shall be used in determining a feeder size.
2) For show window lighting installations, the demand load shall be determined on the assumption that not less than 650 W/m will be required measured along the base of the window(s), except that a lower figure shall be permitted where a deviation has been allowed in accordance with Rule 2-030.

Branch circuits

8-300 Branch circuits supplying electric ranges

1) Conductors of a branch circuit supplying a range in a dwelling unit shall be considered as having a demand of
a) 8 kW where the rating of the range does not exceed 12 kW; or
b) 8 kW plus 40% of the amount by which the rating of the range exceeds 12 kW.
2) For the purpose of Subrule 1), two or more separate built-in cooking units shall be permitted to be considered as one range.
3) For ranges or cooking units installed in commercial, industrial, and institutional establishments, the demand shall be considered as not less than the rating.
4) The demand loads given in this Rule shall not apply to cord-connected hotplates, rangettes, or other appliances.

8-302 Branch circuits supplying data processing equipment

The total connected load of a branch circuit supplying one or more units of data processing equipment shall be considered to be a continuous load for the application of Rule 8-104.

8-304 Maximum number of outlets per circuit (see Appendix B)

1) Except as permitted by other Rules of this Code, the maximum number of outlets on any 2-wire branch circuit shall not exceed the following:
   a) 12 outlets for a 15 A branch circuit where the fused switch or circuit breaker is marked for continuous operation at 80%;
   b) 15 outlets for a 15 A branch circuit where the fused switch or circuit breaker is marked for continuous operation at 100%;
   c) 16 outlets for a 20 A branch circuit where the fused switch or circuit breaker is marked for continuous operation at 80%; and
   d) 20 outlets for a 20 A branch circuit where the fused switch or circuit breaker is marked for continuous operation at 100%.
2) Except as permitted by Subrule 3), when a receptacle is used as an outlet for the application of Subrule 1), it shall be considered as
   a) 1 outlet per duplex receptacle;
   b) 1.5 outlets per triplex receptacle; and
   c) 2 outlets per quadruplex receptacle.
3) Where the connected load is known, the number of outlets shall be permitted to exceed the maximum number permitted in Subrule 1), provided that the load current does not exceed the continuous operation marking on the overcurrent device protecting the circuit.
4) Where fixed multi-outlet assemblies are used, each 1.5 m or fraction thereof of each separate and continuous length shall be counted as one outlet, but in locations where a number of electrical appliances are likely to be used simultaneously, each 300 mm or fraction thereof shall be counted as one outlet.

Heater receptacles for vehicles powered by flammable or combustible fuels

8-400 Branch circuits and feeders supplying heater receptacles for vehicles powered by flammable or combustible fuels

1) In the application of this Rule, the following definitions shall apply:

   Controlled — power to the receptacle is cycled by other than a manual operation.

   Restricted — pertaining to the block heater only and where the use of an in-vehicle heater or other vehicle heating device is not permitted.

2) At least one branch circuit protected by an overcurrent device rated or set at not more than 20 A shall be provided for each duplex receptacle or for every two single receptacles referred to in Rule 26-700 2).
3) Where the loading in each parking space or stall is not restricted or controlled, a separate branch circuit shall be provided for each parking space or stall and the feeder or service conductor shall be considered as having a demand load as follows:

Number of vehicle spaces or stalls	Demand load per space or stall, W	
	15 A circuit	20 A circuit
First 30	1200	1800
Next 30	1000	1500
All over 60	800	1200

4) Where branch circuits are provided for parking spaces or stalls in which the loading is restricted or controlled, the feeder or service conductors shall be considered as having a demand load as follows:

Number of vehicle spaces or stalls	Demand load per space or stall, W	
	15 A circuit	20 A circuit
First 30	650	975
Next 30	550	825
All over 60	450	675

5) Parking lots that may be fully occupied under normal usage shall be assigned a greater demand load per space or stall.

Electric vehicle energy management systems

8-500 Electric vehicle energy management systems

1) Electric vehicle energy management systems shall be permitted to monitor electrical loads and to control electric vehicle supply equipment loads.
2) An electric vehicle energy management system shall not cause the load of a branch circuit, feeder, or service to exceed the requirements of Rule 8-104 5) or 6).
3) An electric vehicle energy management system shall be permitted to control electrical power by remote means.