Bulletin 8-3-16
Maximum circuit loading and demand factors
Rules 8-102, 8-106, 8-200, 8-202 and 8-304

Issued May 2025
Supersedes Bulletin 8-3-15

Scope

1) Calculation of the minimum ampacity of service or feeder conductors for residential occupancies
    a) Supplying one single dwelling unit (as defined in Section 0);
    b) From a main service supplying two or more single dwelling units such as row-housing, triplex and quadruplex stacked units;
    c) Supplying one dwelling unit (as defined in Section 0) such as apartment unit; and
    d) From a main service supplying two or more dwelling units
2) Classification of different types of row-housing
3) Smoke alarm and carbon monoxide alarm loads on branch circuits
4) Additional loads to a single dwelling unit
5) Use of demonstrated load – Who is a “qualified person”?
6) Maximum number of LED luminaires on an existing circuit
7) Heat pumps load demand

1) Calculation of the minimum ampacity of service or feeder conductors for residential occupancies

The intent of this section of the bulletin is to clarify the code requirements to calculate the minimum ampacity of the service required to one dwelling unit. This section also elaborates on the correct determination of the minimum ampacity of service or feeder conductors from a main service supplying two or more of these dwelling units.

The following examples show the method for calculation carried out for single dwelling units (as per Rule 8-200) versus apartment units (as per Rule 8-202). The ampacity calculations are based on single phase, 120/240 V service.

a) Supplying one single dwelling unit (as defined in Section 0)

Assuming a single dwelling unit with total living area of 140 m^2 (1500 sq.ft.)*and other loads as described below:

Rule Ref.	Load Designation	Calculated load (W)
8-200 1) a) i)	Basic load for the first 90 m^2	5000
8-200 1) a) ii)	Basic load for additional area	1000
8-200 1) a) iii), 62-118	Electric space heating (N/A in this example)	4000
8-200 1) a) iii)	Air conditioning (4 kW @100% = 4000 W)	
8-200 1) a) iii) 8-106 3)	The greater of electrical space-heating and air conditioning loads above (when interlocks prevent simultaneous operation)	
8-200 1) a) iv)	Electric Range (rated up to 12 kW)	6000
8-200 1) a) v)	Electric tankless water heaters (N/A)	0
8-200 1) a) vi)	Electric vehicle supply equipment – Level 2 (32 A, 240 V @100% = 7680W)**	7680
8-200 1) a) vii)	Other loads @ 25% : - Clothes Dryer (5000W) - Electric storage water heater (4500 W)	2375
	Total Calculated load for the unit	26055
The calculated min. ampacity (A) of the service (240 V, single Phase)		108.6 A
8-200 1)	The required min. service rating after applying Rule 8-200 1) b) i)	125 A
4-004(26) & Table 39	**The required min. size 3-wire 120/240V service conductors for this dwelling unit**	**No. 2 AWG(Cu) or No. 1/0 AWG(Al)**
14-104	**The selected overcurrent protection for this service**	**125 A**

(*) Determination of total living area shall be based on Rule 8-110
(**) The calculation does not account for electrical vehicle energy management system

b) From a main service supplying two or more single dwelling units such as row-housing, triplex and quadruplex stacked units

As per Rule 8-200 2), the minimum ampacity of a service or feeder conductors from a main service supplying six (6) of the above single dwelling units in a row-housing installation (including electric vehicle supply equipment (EVSE) supplied from the panel board within the dwelling units) together with an assumed 3 kW of common area lighting (outside of the single dwellings):

- The minimum ampacity of each unit feeder conductor, obtained from Subrule 8-200 1), less the electrical heating and air conditioning loads = 108.6 A - (4000/240) = 91.9 A; plus

- Rule 8-200 2) a) references the application of Rule 8-202 3) a) i) to v):

8-202 3) a) i)	100% of the load of first unit (A)	= 91.9 x 100%	**91.9 A**
8-202 3) a) ii)	65% of the load of the next 2 units (A)	= 91.9 x 2 x 65%	**119.47 A**
8-202 3) a) iii)	40% of the load of the next 2 units (A)	= 91.9 x 2 x 40%	**73.52 A**
8-202 3) a) iv)	25% of the load of the next 1 units (A)	= 91.9 x 1 x 25%	**22.9 A**

- Adding other loads as per Rule 8-200 2) b) which references Rule 8-202 3) b) to e)

8-202 3) b)	Total electrical space heating loads (A)	N/A	**N/A**
8-202 3) c)	Total air conditioning loads (A)	= (4000/240) x 6 x 100%	**100 A**
8-202 3) e)	Other loads outside of the dwelling units @ 75% (exterior lighting, etc.)	= (3000/240) x 75%	**9.4 A**
	Total Calculated load for six (6) units (A) = *91.9+119.47+73.52+22.9+100+(9.4 / 80%)*[#]		***419.5*** **A**

([#]) Rationale for considering external lighting as a continuous load:
Row housing loads that are not supplied from the dwelling unit panelboard and external to the dwelling units are similar in concept to apartment buildings loads external to apartment dwellings. Subrule 8-202 2) illustrates that loads within 8-202 3) a) b) and c) shall be considered non-continuous, and does not include 8-202 3) d) and e). This is interpreted to be considered as continuous for the application of this Rule. Subrule 8-202 2) is being extended to be applied to row housing in addition to 8-200 2).

Note: The correction factor used for the continuous load portion of the calculation shall be as specified by Rule 8-104 5) or 6). In this example 80% is being used as per 8-104 6) a).

c) Supplying one dwelling unit (as defined in Section 0) such as apartment unit

Assuming an apartment unit with total living area of 140 m^2 (1500 sq.ft)+ and other loads as described below:

Rule Ref.	Load Designation	Calculated load (W)
8-202 1) a) i)	Basic load for the first 45 m^2	3500
8-202 1) a) ii)	Basic load for the second 45 m^2	1500
8-202 1) a) iii)	Basic load for additional area	1000
8-202 1) a) iv), 62-118	Electric space heating (N/A in this example)	4000
8-202 1) a) iv)	Air conditioning (4kW @100%)	
8-202 1) a) iv) 8-106 *3)*	The greater of electrical space-heating and air conditioning loads above (when interlocks prevent simultaneous operation)	
8-202 1) a) v)	Electric range (rated up to 12 kW)	6000
8-202 1) a) vi)	Electric tankless water heaters (N/A in this example)	-
8-202 1) a) vii)	Other loads @ 25% : - Clothes dryer (5 kW)	1250
	Total Calculated load for the apartment	17250
8-202 1) a)	The calculated min. ampacity (A) of the service (240 V, single Phase)	71.87 A
8-202 1)	The required min. service ampacity after applying Rule 8-202 1) b)	71.87 A
4-004 26) & Table 39	**The required min. size 3-wire 120/240 V service conductors for this dwelling unit**	**No.3 AWG(Cu) or No.2 AWG(Al)**
14-104	**The selected overcurrent protection for this service**	**100 A**

(+) Determination of living area shall be based on Rule 8-110

d) From a main service supplying two or more dwelling units

Applying Rule 8-202 3) a) to calculate the minimum ampacity of a service or feeder conductors from a main service supplying eighteen (18) of the above dwelling units in a building, with an assumed 3 kW of common area lighting and seven (7) EVSE without EVEMS (both common area lighting and EVSE are supplied from panelboards outside of the dwelling units):

- Calculated ampacity, obtained from Subrule 8-202 1) a), less the electrical heating and air conditioning loads = 71.87 A - (4000/240) = 55.2 A.

- Applying Rule 8-202 3) a) i) to v)

8-202 3) a) i)	100% of the load of first unit (A)	= 55.2 x 100%	**55.2 A**
8-202 3) a)(ii)	65% of the load of the next 2 units (A)	= 55.2 x 2 x 65%	**71.76 A**
8-202 3) a) iii)	40% of the load of the next 2 units (A)	= 55.2 x 2 x 40%	**44.16 A**
8-202 3) a) iv)	25% of the load of the next 13 units (A)	= 55.2 x 13 x 25%	**179.4 A**

- Adding other loads as per Rule 8-202 3) b), c) and d)

8-202 3) b)	Total electrical space heating loads (A)	N/A	**N/A**
8-202 3) c)	Total air conditioning loads (A)	= (4000/240) x 18 x 100%	**300 A**
8-202 3) d)	Total electrical vehicle supply equipment Level-2 @ 100% (A)	= 32 x 7 x 100%	**224A**
8-202 3) e)	Other loads outside of the apartment units @ 75% (exterior lighting, etc.)	= (3000/240) x 75%	**9.4 A**
	Total Calculated load for eighteen (18) units (A) *55.2 + 71.76 + 44.16 + 179.43 + 300 + ((224 + 9.4) / 80%)*		**942.3 A**

Note: The correction factor used for the continuous load portion of the calculation shall be as specified by Rule 8-104 5) or 6). In this example 80% is being used as per 8-104 6) a).

The next standard size for service equipment and feeder conductors for this building is 1000 A.

2) Classification of different types of row-housing

Background
A question had been asked about the classification of different types of row housing for the purpose of applying Rules 8-200 and 8-202.

Question 1
When cities and townships define a block of back-to-back townhouses and/or stacked townhouses as “Apartment”, does the Ontario Electrical Safety Code (OESC) concur

with these definitions for the purpose of applying Rules 8-200 and 8-202 to size the main service feeder supplying two or more of those units?

Answer 1
No. The units of a block of back-to-back townhouses fall under the OESC definition of "single dwelling" as a form of row housing. Rule 8-200 shall be used to determine the minimum ampacity for the main service feeder supplying two or more of those units. The same concept applies to stacked townhouses with individual ground access.

Rationale 1
The OESC defines a single dwelling as "a dwelling unit consisting of a detached house, one unit of row housing, or one unit of a semi-detached, duplex, triplex, or quadruplex house."

Back to back row housing units which do not have back yards and instead share a common rear wall are still considered as row housing (single dwelling units) for application of the OESC. Stacked units of row housing with individual ground access will also be considered as row housing.

3) Smoke alarms and carbon monoxide alarms loads on branch circuits

Question 2
In dwelling units, how many smoke/carbon monoxide alarms can be connected to a branch circuit?

Answer 2
- For branch circuits where the load is unknown (such as circuits that supply a mix of lighting and general purpose receptacles), each smoke alarm shall be counted as one outlet.
- For branch circuits where the load is known (such as a circuit with only lighting and no receptacles):
    - Rule 8-304 3) permits, on any 2-wire circuit, the number of outlets per branch circuit (prescribed in Subrule 1)) to be exceeded, provided that the total connected load does not exceed the continuous operation rating of the overcurrent protection device (OCPD) protecting the circuit
    - Example 1: more than 12 smoke alarms can be connected to an unmarked (or 80% continuous operation rating) 15 A OCPD, provided that the total connected load does not exceed 80% of the continuous operation rating of the OPCD
    - Example 2: more than 15 smoke alarms can be connected to a 100% continuous operation rated 15 A OCPD, provided that the connected load does not exceed 100% of the continuous operation rating of the OCPD

Rationale 2
Smoke alarms with a visual component (strobe) may have a current rating of up to 1 A; therefore each of these alarms shall be counted as one outlet for the application of Rule 8-304.

Notes

1. Overall length of branch circuit wiring feeding alarms (up to the furthest point on the circuit) is required to comply with voltage drop requirements in Rule 8-102 and bulletin 8-6-*.
2. A manufacturer may limit the number of interconnected smoke alarms on a circuit, refer to manufacturer installation instructions

4) Additional loads to a single dwelling unit

Questions have been asked if a service upgrade is required when additional loads, such as a hot tub or electrical vehicle supply equipment, are added to the existing service of a single dwelling unit.

A typical service calculation using Rule 8-200 for an average 2500 ft^2 dwelling (without electric heat) containing a range, an air conditioner and a dryer results in a demand load of 85 A. It has been found that the actual demand for this typical dwelling is below the calculated load, as per Rule 8-200.

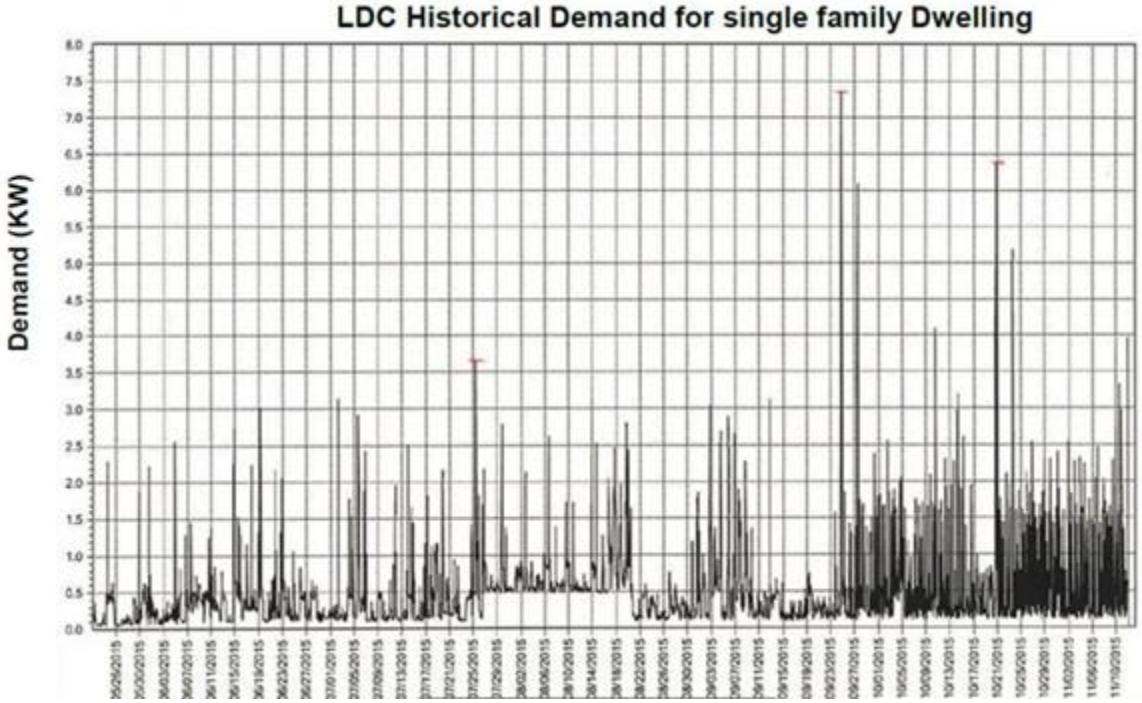
Question 3
When is it permitted to connect a hot tub to an existing 100 A service without increasing the service size?

Answer 3
Based on Rule 8-106 8), it is permitted to use a detailed load (demonstrated load), as obtained from the local distribution company (LDC), indicating the existing peak demand over the last 12 months (see Diagram B1 for example), plus the hot tub nameplate rating to calculate the new demand. The existing service size is sufficient if the sum of the existing peak demand (refer to Answer and Question 4 for peak demand) and 100% nameplate rating of the added hot tub is less than or equal to the ampere rating of the service conductors or the overcurrent device which ever is less.

Calculation
Peak Demand Ampacity + 100% Hot Tub Nameplate Ampacity ≤ Service ampere rating

Examples for a 100 A main service breaker
Service ampere rating = 90 A with No. 2 AWG Al conductor as per Table 39
Service ampere rating = 100 A with No. 1 AWG Al conductor as per Table 4

Diagram B1 – Example, LDC Historical Demand over the last 12 months for single-family dwelling



Question 4
How is the existing peak demand for a dwelling unit determined using LDC historical data from the most recent 12 month period.

Answer 4
In order to assist users in determining the peak demand, the following shall be permitted:

Peak demand (Amps) = ((highest LDC supplied value in a hourly interval kWh) X 125%) X 1000 / 240 V

Note: The inclusion of 25% is to make provision for diversity that might occur during the hour.

Example for a 100A service for a single dwelling unit
Max kWh reading from most recent 12 month period = 9.99 kWh
Peak demand = (9.99 x 1.25) X 1000 = 12490 ÷ 240 = 52.04 A
100 A service limited to 90 A maximum load using No. 2 AWG Al (90 A) – 52.04 A = 37.96 A. for future loads.
100 A service using No. 1 AWG Al (100 A) – 52.04 A = 47.96 A for future loads.

Hourly Usage for Sunday October 1, 2017 - Wednesday Octobe

Date	Time	Rate Type	Consumption (kWh)
07/29/2018	5:00 PM	Off-Peak	9.99
07/29/2018	4:00 PM	Off-Peak	9.75
08/18/2018	3:00 PM	Off-Peak	8.98
07/21/2018	1:00 PM	Off-Peak	8.93
04/15/2018	10:00 PM	Off-Peak	8.89
07/27/2018	8:00 PM	Off-Peak	8.87
07/21/2018	6:00 PM	Off-Peak	8.76
07/15/2018	5:00 PM	Off-Peak	8.72
04/22/2018	9:00 PM	Off-Peak	8.67
07/15/2018	4:00 PM	Off-Peak	8.46

5) Use of demonstrated load - Who is a "qualified person"?

Background
Rules 8-106 5) and 8-106 9) of the OESC permit a "qualified person" to determine the demand factors for air conditioning or motor loads, and to use demonstrated load (as defined in Section 8) for feeder and service calculations for facilities other than residential.

This bulletin intends to address some questions related to the application of Rule 8-106.

Question 5
For the purpose of application of Rules 8-106 5) and 8-106 9), who can be considered a "qualified person"?

Answer 5
ESA will consider a person such as a professional engineer, designer, licensed electrical contractor, facility operator/ owner or other representative as the qualified person to:

- use different demand factors for motor or air conditioning loads (based on knowledge of the process and sequence of operation of these loads), as per Rule 8-106 5); or
- utilize historical demonstrated load for a facility, as per Rule 8-106 9).

An individual that chooses to use a demonstrated load and/or uses demands factors for motor or air conditioning loads not stated in the OESC, is responsible for any undesired consequences of system(s) malfunction or nuisance service interruption to these feeders.

Question 6
Does ESA require the submission of a deviation request to use different demand factors for motors and air conditioning loads?

Answer 6
No. Notwithstanding Rule 8-106 5), a deviation request is not required to be submitted to ESA for the application of Rule 8-106 5).

6) Maximum number of LED luminaires on an existing circuit

Background
Rule 8-304 1) a) b) does not permit, on any 2-wire branch circuit where the loads are unknown, the number of outlets to exceed 12 per 15 A branch circuit where the OCPD is unmarked (or marked 80% continuous operation rating) and 15 outlets per 15 A branch circuit where the OCPD is marked for 100% continuous operation. For unknown loads, outlets are considered to be 1 A loads.

With more efficient lighting such as LEDs, questions have been raised regarding the application of Rule 8-304 3), where medium base socket luminaires are replaced with low watt LED luminaires and additional low wattage LED luminaires are installed.

Subrule 3) permits the maximum number of outlets to exceed the prescribed number of outlets in Subrule 1), provided that the load is known and that it does not exceed the maximum continuous operation rating of the OCPD.

Direction
Notwithstanding Rule 8-304 1), it shall be permitted to replace a medium base socket luminaire with multiple LED luminaires, provided the combined wattage of the newly installed LED luminaires does not exceed:

1. The wattage of the replaced luminaire (the number of devices is permitted to exceed 12 or 15 on a 15 A branch circuit as required by Rule 8-304 1)); and
2. The wattage specifically allowed by the switch controlling those LED lights (e.g. dimmer switch). See Photo B1

LEDs have inrush current and repetitive peak current that differ from incandescent and halogen lamps. The connected load of LEDs shall not exceed the maximum rating of the switch (e.g. dimmer switch).
Where mixing of lighting types will occur, follow manufacturers direction for the wattage limits of LEDs/CFLs and Incandescent/Halogens.
Note: The LED luminaire can be a recessed type or any other type that have the LEDs integral with luminaire.

Photo B1 – Example of Wattage Ratings marked on a dimmer switch

7) Heat pumps load demand calculations

Background

Advancements in heat pump technology has extended the use of heat pumps in colder climates, and made it possible to replace the existing main heat source with a heat pump, used for both heating and air conditioning. There are several different technologies available, including systems where the heat pump is the main source of heat and supplemented by another source of heat, such as a gas furnace or electric heating element.

Air-source heat pumps enter defrost mode while operating during cold seasons and it can be simultaneously supported by the supplemental heating source (if installed). Load demand calculations for Heat pumps and supplemental electric heating are not included in the OESC.

Question 7

When a heat pump is installed without supplementary electric heating to be used for heating and air conditioning of a building, would the OESC Section 62 demand factors apply for the heat pump load?

Answer 7

No, the heat pump nameplate rating(s) shall be taken at 100% demand factor.

Rationale 7

Heat pumps are similar technology as Air Conditioners (AC) with the capability to reverse the process and be used as both heating and cooling sources. AC units have a

demand factor of 100% as per Rules 8-200 to 8-210 and heat pumps shall be treated similarly.

Question 8
When a heat pump is installed and supplemented with electric heating, how is the total load demand calculated if there are no interlocks to prevent simultaneous operation of both the heat pump and supplemental heating?

Answer 8
i. The heat pump nameplate rating(s) shall be taken at 100% demand factor plus any supplemental electric heating loads with demand factors applied as permitted in Section 62.
ii. A deviation request may be considered if a qualified person determines the load for both the heat pump and supplementary electric heat is lower than the calculation results from Answer 8.i.

Note: When a heat pump is supplemented with electric heat and interlocked to prevent simultaneous operation of both the heat pump and a supplementary heat source, Rule 8-106 2) applies.

Rationale 8
Air source heat pumps are known to enter in defrost mode. During this mode, some systems run the supplementary heating load simultaneously with the heat pump to compensate for heat loss and to support the heat pump during the defrosting cycle. A deviation can be considered since different systems can vary in operation and load demand.