CMGT 235 – Electrical and Mechanical Systems

Discussion No. 29 **Unit 3 - Electrical Systems** **2022**

Residential Service Entrance Calculation - Single-Family Dwelling

2017 Edition National Electric Code (NFPA 70)

Example Dwelling Calculation

Total Occupied Area = 3232 ft^2	1 – 4.5 kW Electric Water Heater
3 – Small Appliance Branch Circuits	1 – ¼ hp, 120 V Garage Door Opener
2 – Laundry Branch Circuits	1 – 1/3 hp, 9.2 A, 120V Dishwasher (includes 875-W heater)
1 – 5.7 kW Electric Dryer	1 – 1/3 hp, 7.2 A Food Waste Disposal
1 – 6.6 kW Wall-Mounted Oven	1 – 1 hp, 8 A, 240 V Water Pump
1 – 7450 VA Countertop Range	1 – 10 A, 120 V Hydromassage Tub
1 – 26.4 A – 240 V Central A/C Unit	1 – ¼ hp, 120 V Attic Exhaust Fan
1 – 13 kW Electric Furnace	2- 1500 VA Heat/Vent/Lights
	1 – 5.8 A, 120 V Freezer

Single-Family Dwelling Service-Entrance Calculations **NFPA 70**

Step 1. General Lighting Load – Table 220.12 [pg. **70**-71]

Step 2. Minimum Number of Lighting Branch-Circuits – 210.11(A) [pg. **70**-60]

Step 3. Small Appliance Load – 210.11(C)(1) and 220.52(A) [pg. **70**-60 and **70**-73]

Step 4. Laundry Branch-Circuit - 210.11(C)(2) and 220.52(B) [pg. **70**-60 and **70**-73]

Step 6. Demand Factors – Table 220.42 [pg. **70**-72]

Step 7. Electric Range, Wall-Mounted Oven, Counter-Mounted Cooking Units – 220.55 [pg. **70**-73]

Table 220.55 - See Notes.

Wall-mounted oven 6600 VA

Countertop Range 7450 VA

Total 14,050 VA (14 kW)

14 kW exceeds 12 kW by 2 kW

2 kW X 5% = 10% increase; therefore: 8 kW + 0.8 kW = 8.8 kW = 8,800 VA

Step 8. Electric Clothes Dryer – 220.54 [pg. **70**-73]

Step 9. Heating and Air Conditioning Load – 220.82(C) [pg. **70**-75]

Air conditioner: 26.4 A x 240 V = 6336 VA

Electric furnace: 13,000 VA

(Enter largest value, 220.60) = 13,000 VA

Step 11. List "Fastened-in-place" Appliances *in addition* to Electric Ranges, Air Conditioners, Clothes Dryers, Space Heaters

Appliance		**VA Load**	
Water Heater	=	4500 VA	
Dishwasher 9.2 A x 120 V	=	1104 VA	
Garage Door Opener 5.8 A x 120 V	=	696 VA	
Food Waste Disposer 7.2 A x 120 V	=	864 VA	
Water Pump 8 A v 240 V	=	1920 VA	
Hydromassage Tub 10 A x 120 V	=	1200 VA	
Attic Exhaust Fan 5.8 A x 120 V	=	696 VA	[Table 430.248]
Heat/Vent/Lights 1500 x 2	=	3000 VA	
Freezer 5.8 A x 120 V	=	696 VA	
Total		14,676 VA	

Step 12. Demand Factor – 220.53 [pg. **70**-73]
Step 14. Add 25% OF Largest Motor – 430.24 [pg. **70**-303]
This is the water pump motor: 1920 VA x 0.25 = 480 VA

Step 17. Ungrounded Conductor Size – Table 310.15(B)(16) [pg. **70**-150]
Service Rated 196 A
From 310.15(B)(7)(1) [Page 310.60]
196 A x 0.83 = 163 A

Table 310.15(B)(16)
2/0 AWG THWN 75°C Column (copper)

Note: This could be a 3/0 AWG THW, THHW, THWN, XHHW, or THHN per Table 310.15(B)(16), or a AWG 2/0 (same types) using 310.15(B)(7)(1). 310.15(B)(7)(1) may only be used for 120/240-volt, 3-wire, residential single-phase service-entrance conductors, underground service conductors, and feeder conductors that serve as the main power feeder to a dwelling unit.

Step 18. Minimum Ampacity for Neutral Service-Entrance Conductor – 220.61 and 310.15(B)(7). Do Not Include Straight 240-Volt Loads.

Step 19. Neutral Conductor Size – Table 310.15(B)(16) [pg. **70**-150]
2 AWG 75°C Column (copper)

Check project specifications!

SERVICE-ENTRANCE CONDUCTORS: Service-entrance conductors supplied by the electrical contractor shall be two 2/0 AWG THHN/THWN phase conductors and one 1 AWG bare neutral conductor. Install trade size 1½ EMT from Main Panelboard A to the meter pedestal.

1 AWG specified

Step 20. Grounding Electrode Conductor Size – Table 250.66 [pg. **70**-116]
Step 21. Raceway Size
All conductors same size – Annex C [pg. **70**-713-790]
Conductors different size - Chapter 9 NEC – Table 1, Table 4, Table 5, and Table 8 [pgs.**70**-679-693]

Service Drop Cable -PE and XLP
Either one, two, or three soft-drawn copper conductors covered with HMW or cross-linked polyethylene around a hard-drawn bare copper neutral that serves as the messenger and supporting member.

NEC Article 230 Services
230.1 Scope. This article covers service conductors and equipment for control and protection of services and their installation requirements.