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| **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**

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| Total Occupied Area = 3232 ft23 – Small Appliance Branch Circuits2 – Laundry Branch Circuits1 – 5.7 kW Electric Dryer1 – 6.6 kW Wall-Mounted Oven1 – 7450 VA Countertop Range1 – 26.4 A – 240 V Central A/C Unit1 – 13 kW Electric Furnace | 1 – 4.5 kW Electric Water Heater1 – ¼ hp, 120 V Garage Door Opener1 – 1/3 hp, 9.2 A, 120V Dishwasher (includes 875-W heater)1 – 1/3 hp, 7.2 A Food Waste Disposal1 – 1 hp, 8 A, 240 V Water Pump1 – 10 A, 120 V Hydromassage Tub1 – ¼ hp, 120 V Attic Exhaust Fan2- 1500 VA Heat/Vent/Lights1 – 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 = 0696 VA

Food Waste Disposer 7.2 A x 120 V = 0864 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 = 0696 VA [Table 430.248]

Heat/Vent/Lights 1500 x 2 = 3000 VA

Freezer 5.8 A x 120 V = 0696 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!**



**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.