

SINGLE-FAMILY DWELLING SERVICE-ENTRANCE CALCULATIONS

1. General Lighting Load (220.12).

$$\underline{3232} \text{ ft}^2 @ 3 \text{ VA per ft}^2 = \underline{9696} \text{ VA}$$

Note: Included in this floor area calculation are all lighting outlets and general-use receptacles. Do not include open porches, garages, or unused or unfinished spaces not adaptable for future use. See NEC 220.12, Table 220.12, and 220.14(J).

2. Minimum Number of 15-ampere Lighting Branch Circuits.

$$\frac{\text{Line 1}}{120} = \frac{9696}{120} = \underline{80.8} \text{ amperes}$$

$$\text{then, } \frac{\text{amperes}}{15} = \frac{80.8}{15} = \underline{5.387} = \underline{6} \text{ 15-ampere branch circuits}$$

3. Small-Appliance Load [210.11(C)(1), 220.52(A), and 210.52(B)].

(Minimum of two 20-ampere branch circuits)

$$\underline{3} \text{ branch circuits @ 1500 VA each} = \underline{4500} \text{ VA}$$

4. Laundry Branch Circuit [210.11(C)(2), 220.52(B), and 210.52(F)].

(Minimum of one 20-ampere branch circuit)

$$\underline{2} \text{ branch circuit(s) @ 1500 VA each} = \underline{3000} \text{ VA}$$

5. Total General Lighting, Small-Appliance, and Laundry Load.

$$\text{Lines 1 + 3 + 4} = \underline{17,196} \text{ VA}$$

6. Net Calculated General Lighting, Small-Appliance, and Laundry Loads (less ranges, ovens, and "fastened-in-place" appliances). Apply demand factors from Table 220.42.

$$\text{a. First 3000 VA @ 100\%} = \underline{3000} \text{ VA}$$

$$\text{b. Line 5 } \underline{17,196} - 3000 = \underline{14,196} @ 35\% = \underline{4969} \text{ VA}$$

$$\text{Total a + b} = \underline{7969} \text{ VA}$$

7. Electric Range, Wall-Mounted Ovens, Counter-Mounted Cooking Units (Table 220.55).

$$= \underline{8800} \text{ VA}$$

8. Electric Clothes Dryer (Table 220.51).

$$= \underline{5700} \text{ VA}$$

9. Electric Furnace (220.54).

Air Conditioner, Heat Pump (Article 440).

(Enter largest value, 220.60)

$$= \underline{13000} \text{ VA}$$

10. Net Calculated General Lighting, Small-Appliance, Laundry, Ranges, Ovens, Cooktop Units, HVAC.

Lines 6 + 7 + 8 + 9

$$= \underline{35,469} \text{ VA}$$

11. List “Fastened-in-Place” Appliances *in addition to* Electric Ranges, Electric Clothes Dryers, Electric Space Heating, and Air-Conditioning Equipment.

Appliance	VA Load
Water heater:	= <u>4500</u> VA
Dishwasher:	= <u>1104</u> VA 9.2×120
Garage door opener:	= <u>696</u> VA 5.8×120
Food waste disposer:	= <u>864</u> VA 7.2×120
Water pump:	= <u>1920</u> VA $8A \times 240$
Gas-fired furnace:	= <u>—</u> VA
Sump pump:	= <u>—</u> VA
Other: <u>Hydro Tub</u>	= <u>1200</u> VA $10A \times 120$
<u>Attic Exhaust Fan</u>	= <u>696</u> VA 5.8×120
<u>Heat/Vent/Light</u>	= <u>3000</u> VA
<u>Freezer</u>	= <u>696</u> VA 5.8×120
Total	= <u>14,676</u> VA

12. Apply 75% Demand Factor (220.53) if Four or More “Fastened-in-Place” Appliances. If Less Than Four, Figure @ 100%. Do not include electric ranges, electric clothes dryers, electric space heating, or air-conditioning equipment.

$$\text{Line 11 Total: } \underline{14,676} \times 0.75 = \underline{11,007} \text{ VA}$$

13. Total Calculated Load (Lighting, Small-Appliance, Ranges, Dryer, HVAC, “Fastened-in-Place” Appliances).

$$\text{Line 10 } \underline{35,469} + \text{Line 12 } \underline{11,007} = \underline{46,476} \text{ VA}$$

14. Add 25% of Largest Motor (220.50 and 430.24).

$$\underline{1920} \times 0.25 = \underline{480} \text{ VA}$$

Note: The largest motor can be difficult to determine because nothing is in place when service-entrance load calculations are made. It might be an air-conditioning unit or a heat pump. If the dwelling is cooled by an evaporative cooler, the largest motor might be a water pump, a large attic exhaust fan, a large food waste disposer, or a sump pump. For simplicity in this example, the water pump was chosen. The additional 25% of the largest motor is a small portion of the total service-entrance load calculation.

15. Grand Total Line 13 + Line 14. = 46,956 VA

16. Minimum Ampacity for Ungrounded Service-Entrance Conductors.

$$\text{Amperes} = \frac{\text{Line 15}}{240} = \frac{46,956}{240} = 195.65 \text{ A} = \underline{196} \text{ amperes}$$

17. Ungrounded Conductor Size (copper). $196 \times 0.83 = 163 \text{ A}$ 2/0 AWG

Note: Table 310.15(B)(7) may be used only for 120/240-volt, 3-wire, residential single-phase service-entrance conductors, service lateral conductors, and feeder conductors that serve as the main power feeder to a dwelling unit.

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

- a. Line 6: = 7969 VA
- b. Line 7: 8800 @ 0.70 = 6160 VA
- c. Line 8: 5700 @ 0.70 = 3990 VA
- d. Line 11: (Include only 120-volt loads.)

<u>Freezer</u> <u>696</u> VA	Hydro Tub 1200 VA
<u>Food Waste</u> <u>864</u> VA	Dishwasher 1104 VA
<u>Garage Opener</u> <u>696</u> VA	
<u>Heat/Vent/Cylt</u> <u>3000</u> VA	
<u>Attic Fan</u> <u>696</u> VA	
Total <u>8256</u> VA	

- e. Line d total @ 75% demand factor if four or more per 220.53, otherwise use 100%.
 $\frac{8256}{} \times 0.75 = \underline{6192}$ VA
- f. Add 25% of largest 120-volt motor.
 $\frac{1200}{} \times 0.25 = \underline{300}$ VA
- Total = 6492 VA
- g. Total a + b + c + e + f. = 24,611 VA

Amperes = $\frac{\text{Line g}}{240} = \frac{24,611}{240} = 102.5$ = 103 amperes

19. Neutral Conductor Size (copper)(220.61). (2 AWG Adequate) _____ | _____ AWG (Specs)

Note: NEC 310.15(B)(7) permits the neutral conductor to be smaller than the ungrounded "hot" conductors if the requirements of 215.2, 220.61, and 230.42 are met. NEC 220.61 states that a feeder or service neutral load shall be the maximum unbalance of the load determined by Article 220. When bare conductors are used with insulated conductors, the conductors' ampacity is based on the lowest temperature rating of the insulated conductors in the raceway, 310.15(B)(4). The neutral conductor shall not be smaller than the grounding electrode conductor, 250.24(C)(1).

20. Grounding Electrode Conductor Size (copper) (Table 250.66). _____ 4 _____ AWG

21. Raceway Size. Bare Neutral 1/4 _____ 1 1/2 _____ Trade Size

Obtain dimensional data from Table 1, Table 4, Table 5, and Table 8, Chapter 9, NEC.

2	2/0	THWN CU	2 x 0.2223	(70-685)
1	1	THWN CU	1 x 0.1562	(70-685)

total 0.6008 in²

"Bare" EMT Trade Size 1 1/2
~~0.0702~~

$A = \frac{\pi d^2}{4}$ ⊖ 0.299 chpt 9, Table 5A