PURDUE UNIVERSITY | Extension - 4-H Youth Development

Electric Level 5

Sizing Service or Feeder Circuit

What's it all About?

Electricians, architects, engineers, energy auditors, and technicians need to be able to assess the adequacy of an existing electric service. Overtaxing a service with loads can create a safety hazard; it can also lead to nuisances like dimming lights, tripped breakers, and wear and tear on motors and electronics. This project sheet will guide you through the National Electric Code (NEC 220.83) steps to determine sufficiency of an electrical service.

Keys to Remember

- The 2017 NEC 220.83 describes the steps to determine if an electrical service can safely accommodate new loads. If you plan to perform these calculations, it is strongly recommended that you read the relevant sections of the NEC.
- Before diving into the service load calculations, do a quick visual inspection of the panel and meter base. Currently note the amperage of the main breaker and meter base if possible. Also make note of the age and condition of the equipment, checking for corrosion, missing parts, and other damage.
- Problems noted during the visual inspection may suggest a service upgrade, even if the existing capacity is sufficient (although old-style panels with fuses sometimes passes the criteria listed in NEC 220.83, they do not meet modern standards for safety or reliability and should always be considered for an upgrade).
- With any wiring project, safety for people and property is most important. Consult with a parent or professional to assist you whenever needed.

Determining General Loads

The following steps walk you through the NEC 220.83 service calculations. Numbers correspond to sections in the worksheet shown below. (Volts x Amps = Watts/VA)

1. Calculate lighting and general use receptacle loads based on the square footage. Use exterior dimensions, but do not include garages, open porches, or basements that will not be finished in the future. Multiply the finished square footage by 3 VA/sq. ft.

2. Tally laundry and small appliance branch circuits. Add 1500 VA for each 2-wire, 20-ampere small-appliance branch circuit. These are circuits like kitchen countertop circuits to which no permanently installed light fixtures (other than appliance lights) are connected. Add an additional 1500 VA for each laundry branch circuit. By code, each dwelling unit must have at least two 20A small-appliance branch circuits and one laundry circuit, so the minimum value allowed for line 2 is 4500 VA.

3. Tally fixed appliances. Next, list the nameplate rating, in VA, of all fixed appliances. These are defined as "all appliances that are fastened in place, permanently connected, or located to be on a specific circuit". The code specially mentions ranges, ovens, and cooktops; electric water heaters, and clothes dryers that are not connected to the laundry branch circuit (i.e. electric dryers with their own dedicated 240V circuit – these are tallied as the larger of 5000 VA or nameplate VA). A complete tally will include other fixed appliances and motors such as well pumps, sump pumps, garage door openers, and hot tubs.

4. Sum general loads and supply a demand factor. The code recognizes that not all lights and appliances will be used at once, and derates the general load total accordingly. The first 8000 VA of general load are counted at 100%, but additional general loads are counted at only 40%.

5. Heating and air-conditioning load. The code assumes that the heating and cooling loads do not occur at the same time, and so only count the larger of the two following loads:

    - The full nameplate VA rating of the air conditioning system (full load amps X volts for the outdoor condensing unit, plus the same for the air handler).

    Or

    - The full nameplate VA ratings of the electric central heat (i.e. heat pump) plus central electric backup heat plus electric baseboards or space heaters, if present.

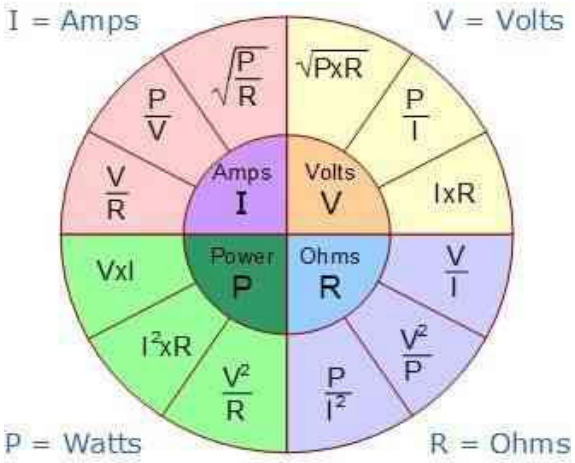
6. Total VA and service amps. The total load in VA is calculated by adding the adjusted General Loads to the maximum Heating and Air-Conditioning Load. The required service rating in amps is calculated by dividing the total load by the service voltage (typically 240v.)

*What if the existing service does not meet the load? When the existing service is too small, a service upgrade will be required. It is worth mentioning that electrical equipment, like other building systems, have a finite life expectancy. A service upgrade may represent an improvement in safety and reliability and may also make possible other quality-of-life enhancements such as additional lighting, outdoor receptacles, or car charging stations.

Sources; NEC, Green Builder Advisor, Jon Harrod -article.

For the Project

- Material List with Costs
- References
- Diagrams
- Planning and Research
- Dimensions
- Title and Labels
- Pictures (if exhibiting a report or poster)
- Record Sheet
- 4-H Exhibit Skills & Knowledge Sheet



General loads

1. House finished square footage _____ x 3 VA/ft _____VA
2. 20A small appliance and laundry branch circuits (_____, minimum 3) x 1500 VA _____VA
3. Fixed appliances

Oven	_____VA
Cooktop	_____VA
Fixed microwave	_____VA
Water heater	_____VA
Electric clothes dryer (5000 VA minimum)	_____VA
Dishwasher	_____VA
Disposal	_____VA
Well pump	_____VA
Sump pump	_____VA
Garage door opener	_____VA
Hot tub	_____VA
Other	_____VA

4. Adjust general and appliance loads

a. Sum all above loads	_____VA
b. Take the first 8000 VA at 100%	_____VA
c. Take the remainder at 40%	_____VA

d. Add 4b and 4c to get adjusted general load _____VA

5. Heating and cooling load

a. Cooling load

Outdoor unit	_____VA
Air handler	_____VA
Total cooling	_____VA

b. Heating load

Heat pump outdoor unit	_____VA
Air handler	_____VA
Backup electric heat	_____VA
Electric baseboard/space heaters	_____VA
Total heating	_____VA

c. Larger of total heating or total cooling _____VA

6. Total load and required amps

a. Total load (4d + 5c)	_____VA
b. Required service (6a / 240V)	_____A