

Basic electrical formulas:

Chart on left shows the formulas used to calculate electricity. Power (watts), current (amperage), resistance, voltage. You must know at least two factors for correct calculations.

<http://waterheatertimer.org/Formulas-for-Ohms-law.html>

Notice there are several ways to calculate each factor.

Resistance Ohms = volts ÷ amps (V/I)

Resistance Ohms = volts² ÷ watts (V²/P)

Resistance Ohms = watts ÷ amps² (P/I²)

Example: test 4500 watt 240 volt water heater element
Correct ohm reading = 240² (V²) ÷ 4500 (P) = 12.8 ohms

volts x amps = watts (power)

Power (watts) = V (volts) x I (amps)

What is maximum wattage that can be achieved from 240 volt circuit with 30 amp breaker.

240 volt x 30 amp = 7200 watt.

Example: 4500 watt element, 240 volt water heater circuit, how many Amps are used?

4500 watt ÷ 240 volt = 18.75 amps

<http://waterheatertimer.org/Figure-Volts-Amps-Watts-for-water-heater.html>

volts = amps x resistance (ohms)

V = I x R is sometimes shown as E (energy) = IR

If the multimeter reads 12 amps on the wire and resistance on the load is 10 ohms, how many volts are present?

12 ohms x 10 amp = 120 volt

1000 watts = 1 kilowatt (Kw)

Run 100 watt light bulb for 10 hours = 1000 watt hours = 1 kilowatt hours (Kwh)

If electricity costs 18¢ per Kwh, then running 100 watt bulb for 10 hours costs 18¢

If you use 100-watt-equivalent LED bulb, it consumes 20 watts for same lumens of light.

Run LED bulb for 10 hours x 20 watts = 200 kilowatt (Kw) or .2 Kwh costing 3.6¢ instead of 18¢.

.002931 Kw needed to raise 1 pound of water 1°F

<http://waterheatertimer.org/How-many-kilowatts-needed-to-heat-water.html>

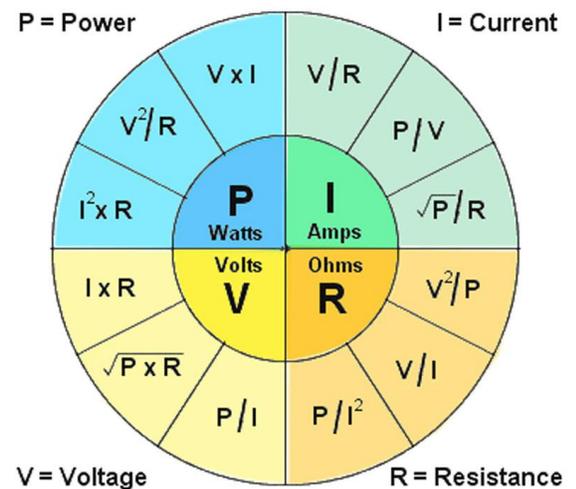
1 horsepower = 745.6998 watts

If you have 2 Hp motor and 240 volt circuit, what size circuit breaker and wire are needed? You have watts and volts, but don't know what amp circuit breaker.

Motors are inductive load, and require more amps when starting.

The inrush needed for motor start means the calculation for motors is not straightforward. Standard Charts are needed that show amp draw, overcurrent protection and wire size.

<http://waterheatertimer.org/Color-codewire.html#motor>



What size wire is used for 30 amp breaker?

Specific size wire is used for each size circuit breaker
Distances over 100 feet require larger wire and breaker
Standard Charts are needed

<http://waterheatertimer.org/Color-codewire.html>



Volts and amps on a wire are inversely proportional.

When volts go up, amps go down.

When volts go down on the line, then amps go up.

If you have a 8000 watt lighting system that can be wired for either 120 volts or 240 volts, which is the best choice?

8000 watts divided by 240 volts = 33.3 amps requiring 40 amp breaker and #8 gauge wire.

8000 watts divided by 120 volts = 66.6 amps requiring 70 amp breaker and #4 gauge wire.

Larger wire costs more, especially if the load is spread over a large area like commercial lighting. The mathematics shows that using 240 volts is a less expensive way to handle the 8000 watt load.

Power companies utilize the inverse relationship between volts and amps when transmitting electricity.

They transmit high voltage, low amperage electricity. This reduces heat loss from high amperage, and lets them use smaller wire and transmit electricity longer distance at less cost.

<http://waterheatertimer.org/What-is-3-phase-electric.html>

When wiring a house, the maximum is 12 boxes per circuit breaker

<http://waterheatertimer.org/Basic-house-wiring.html>

Commercial wiring is 3-phase while residential wiring is single phase.

What is the difference?

<http://waterheatertimer.org/difference-between-single-phase-and-3-phase.html>

More resources:

<http://waterheatertimer.org/pdf/Basic-Water-heater-formulas-and-terminology.pdf>

<http://waterheatertimer.org/pdf/Water-heater-Formulas-and-terminology.pdf>

http://waterheatertimer.org/pdf/Formulas-for-Three-Phase_Circuits.pdf