

# Heiners Workshop Lessons : The Theoretical Basics in a Nutshell Ep. 1

## Electrical units:

Compare to water for easier understanding.

*Voltage (U)* - **Unit: Volt** = Water Pressure (psi or bar)

*Current (I)* - **Unit: Ampere** = Water Flow (liter per minute)

*Resistance (R)* – **Unit: Ohm** = Congestion or Restriction in hose / pipe that limits water flow

*Power (P)* – **Unit: Watt** = Voltage times Current or Water Pressure times Water Flow

*Amp Hour (Ah)* = Amount of Amps you can take out of a battery over a 20 hours time period / amount of Amps stored in a battery. Amount of water stored in a tank.

*Watt Hour (Wh)* = Amount of Energy stored in a Battery. This is also taking into consideration the voltage of the battery and represents the correct unit to measure stored electrical energy. Another unit would be Coulomb but this is only used in more scientific applications.

Difference in between Amp Hour and Watt Hour.

- A 100 Ah 12VV (12.5V) battery has got 1250 Watt Hours of Energy stored in it.
- A 100Ah 48V (50V) battery has got 5000Watt Hours of Energy stored in it.

The correct way to measure and name the amount of energy in a battery is Watt Hours because it includes the Voltage and the Amps.

## The most basic Formulas:

$$U = R * I$$

U = Voltage

R = Resistance

I = Current

$$P = U * I$$

P = Power

U = Voltage

I = Current

Example: We want to know the value of a resistor to simulate the load of 3 indicator globes when we replace it with a LED lights. An indicator globe has got 21 Watt and we are using it in a 12V system.

$$U = 12 \text{ Volt}$$

$$P = 21 \text{ Watt} \times 3$$

We use the following formula:

$$P = U * I$$

When we change this formula, we can calculate the current:

$$P / U = I$$

When we insert our given values, we get:

$$63 \text{ Watt} / 12 \text{ Volt} = 5.25 \text{ Amp}$$

(This can also be used when you need to know the current of an accessory you want to install, and you want to make sure you pick the right cable and fuse for it)

Since we now got the current and still know the voltage, we can use the following formula to calculate the resistance:

$$U = 12 \text{ Volt}$$

$$I = 5.25 \text{ Amp}$$

$$U = R * I$$

When we change this formula, we can calculate the resistance:

$$U / I = R$$

When we insert our given values, we get:

$$12 \text{ Volt} / 1.75 \text{ Amp} = 6.9 \text{ Ohm}$$

So now we know the correct value for a resistor to replace a 21-Watt indicator globe is 6.9 Ohm.

In real life we would use something that our suppliers would say is right for the job, but it is good to know how to calculate these values if we need to.

The most used formula is the one for the power. With that one we can calculate the current draw when we know the Wattage of an accessory and that way, we can calculate the right fuse rating and wire gauge.