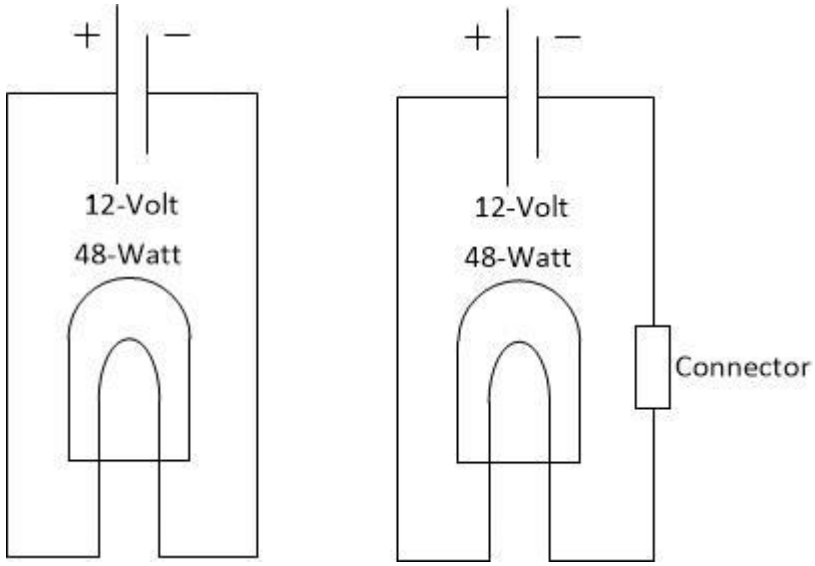
Understanding "Voltage Drop"

Note: To make the math simple, we are using 12 volts rather than the actual voltage of a 12-volt automotive battery.

We'll need some simple algebra and Ohms law:
I = E/R (Current = Voltage/Resistance)
E=I*R (Voltage = Current * Resistance)
R = E/I (Resistance = Voltage / Current)
P = I*E (Watts = Current * Voltage)



Looking at the drawing on the left, we have a 12-volt battery directly connected to a 48 watt light bulb.

For the bulb to use 48 watts, 48 = I*12 so I = 4 amps. R = 12/4 so the resistance is 3 ohms. It's not intuitive yet, but the voltage drop across the light bulb is 12 volts. Try it, measure across the battery – get 12 volts. Measure across the bulb – get 12 volts.

Now look at the drawing on the right. We still have a 12-volt battery and a 48 watt light bulb connected in series but we also have a connector between them. If the connector is in good shape it has zero resistance. A connector with zero resistance is just like a wire so nothing is electrically different from the left picture.

Now consider what happens when the connector between the bulb and battery is corroded and adds 3 ohms of resistance to the circuit. We know that the bulb is 3 ohms each and the connector is 3 ohms so we now have 6 ohms in the circuit. I=E/R so the current is 2 amps (12/6) which is half of 4 amps the bulb needs! The bulb will light with 24 watts, not 48 watts. Put another way, the voltage would have to be 24 to get 4 amps through the bulb and 4 amps through the connector but we only have a 12 volt battery!

Often, a bad connection will add less than an ohm to a circuit. Considering that let's say it is 0.5 ohms. So, now we have 3.5 ohms in our circuit and our current is 12/3.5 so 3.43 amps. This means that the connector will drop 1.72 volts leaving 10.28 volts for the bulb (about 35 watts). That's often not obvious in lighting but electronic ignitions certainly don't like it! Also, the connector will definitely get hot with that little bit of power (about 5.9 watts).

Connectors must all have ZERO resistance. The best way to test is to use a voltmeter across the connector. Measuring 0.5 ohms is difficult, but even a small amount of voltage drop across a connector is easy to measure.