THE EFFECTS OF CORROSION AND WIRE LENGTH ON ELECTRICAL CIRCUITS

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SERIES CIRCUIT

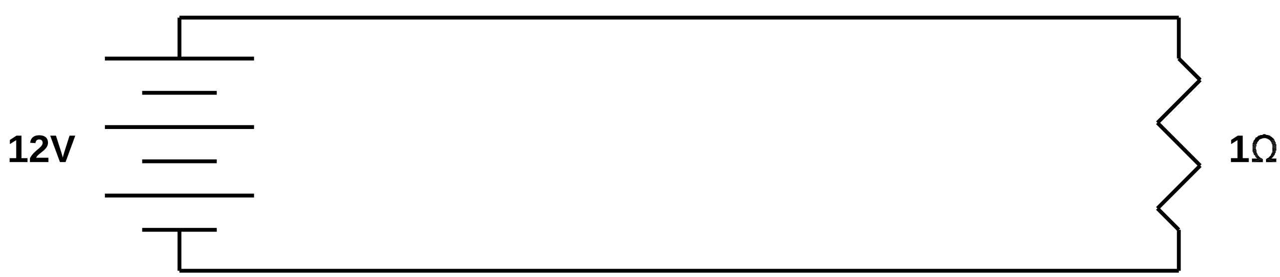
When trying to determine the cause of electrical malfunctions, voltage is probably the most common cause. The problem is, usually the cause for low voltage is misdiagnosed. People normally concentrate on battery voltage which in many cases will prove to be ok. Often this will remove the focus from a voltage problem and parts that are not bad are replaced. Although knowing the actual battery voltage is necessary, where the voltage test needs to be performed is at the component that is not functioning properly.

Wire length and corrosion can increase the resistance in an electrical circuit. Excessive resistance in the circuit can and usually will cause voltage problems. The diagrams used in the paper will illustrate this. To understand the diagrams, it is important to understand some things about basic electrical circuits. The circuit we will use in this discussion is a SERIES CIRCUIT.

1. The current through each resistor (point of resistance such as a coil or some corrosion) is the same.
2. The voltage drops across each resistor will be different if the resistances are different.
3. The sum of the voltage drops across each resistance equals the source voltage.
4. The total resistance in a series circuit is the sum of all the resistors in that circuit.

We use Ohm's law to figure current and voltage drops in the circuit. V is voltage, I is current (amps) and R is resistance (ohms). Ohm's law is:
V=IxR or voltage is equal to the current times resistance.
I=V ÷ R or current is equal to the voltage divided by resistance.
R=V÷I or resistance is equal to the voltage divided by current.

IMPORTANT: The following examples are approximate figures and should not be used for actual diagnostics.



Current (I) = 12 (volts) ÷ 1 (ohms) = 12 amps
Voltage (V) across the resistor is V = 12 (amps) x 1 (ohm) or 12 volts

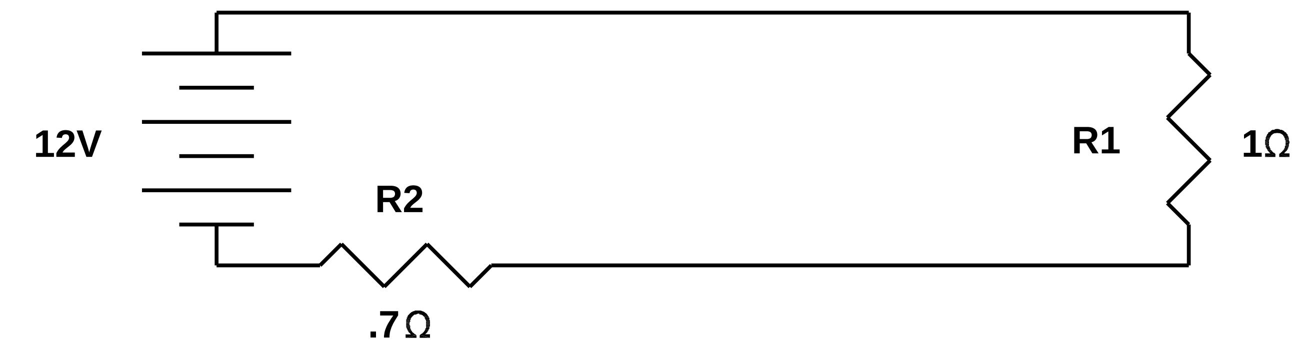
This circuit is approximately the same as an HWH leveling system with one solenoid valve. Note that there was no resistance figured for the wires. There is no loss of voltage in this system.

Current (I) = 12 (volts) ÷ 2 (1 ohm + 1 ohm) = 6 amps
Voltage (V) across each resistance is V = 6 (amps) x 1 (ohm) or 6 volts

This circuit shows what happens to the voltage when a second resistance is added to the circuit. The second resistance could be a second solenoid valve or some corrosion problem. There is only 6 volts available for R1, the solenoid valve.

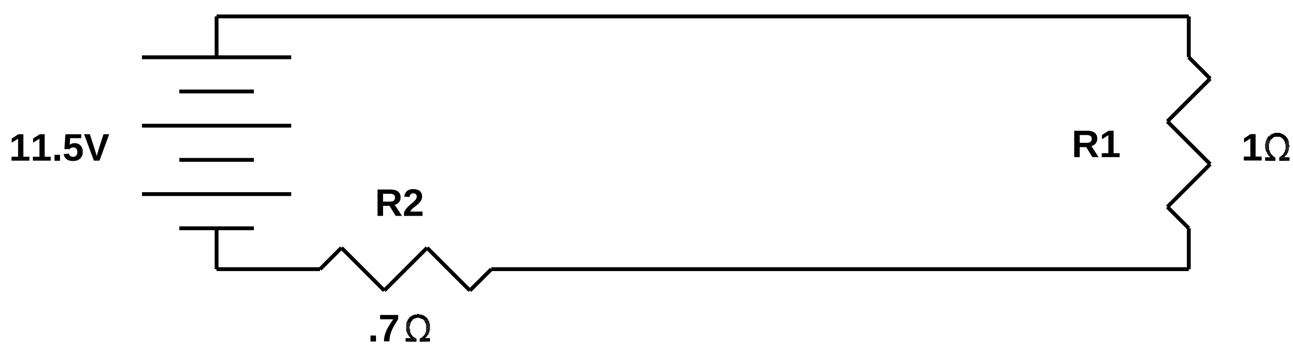
SERIES CIRCUIT

Circuit 1



Current (I) = 12 (volts) ÷ 1.7 (1 ohm + .7 ohm) = 7.06 amps
Voltage available for R1 is: 7.06 (amps) x 1 (ohm) = 7.06 volts

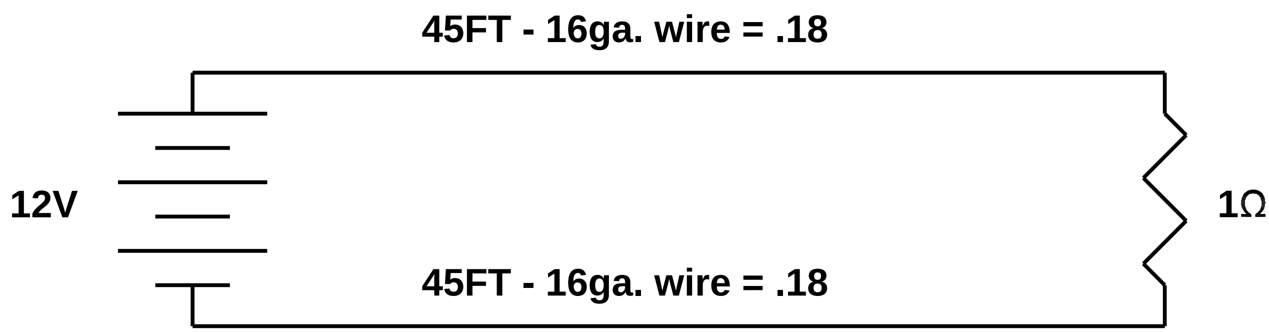
Circuit 2



Current (I) = 11.5 (volts) ÷ 1.7 (1 ohm + .7 ohm) = 6.76 amps
Voltage available for R1 is: 6.76 (amps) x 1 (ohm) = 6.76 volts

The two circuits above demonstrate what happens when the supply voltage starts to decrease slightly. Because an HWH solenoid valve needs approximately 7 volts to be able to pull in, (valves must pull in by 8.5 volts) a small amount of corrosion can cause issues when supply voltage has dropped slightly. Even though there is an added corrosion resistance (R2) causing a voltage drop in circuit 1, the solenoid valve (R1) will still open. In circuit 2, with the supply voltage down just ½ volt and the corrosion resistance (R2) the same as circuit 1, the solenoid valve (R1) will not open because the available voltage is now too low to open the valve. Because there can be slight differences between the coils of different valves and the available voltage is just below 7 volts, a different solenoid valve may still function. That is why it should not be assumed that because one valve will operate, the system voltage should be adequate to operate all the valves in the circuit.

SERIES CIRCUIT



Current (I) = 12 (volts) ÷ 1.36 (1 ohm + .18 ohm + .18 ohm) = 8.82 amps
Voltage drop caused by each wire is V = 8.82 (amps) x .18 (ohms) or 1.59 volts
Voltage available for the valve is 12 volts - 3.18 (1.59 + 1.59) volts or 8.82 volts.

This last diagram demonstrates possible issues associated with systems that have long wiring harnesses. A 1 volt decrease in system voltage would decrease the available voltage for the solenoid valve in the above diagram to just a little over 8 volts. Corrosion in this circuit equaling .5 ohms of resistance would drop the available voltage to the valve to a little less than 6 volts. The solenoid valve may not function.

When diagnosing a system, in most cases we do not want to take resistance readings and figure current and voltage drops. But, it is important to understand how things like corrosion, loose connections, low battery voltage and other possible system voltage issues can affect the operation of the HWH leveling and/or room extension system. Checking batteries is important, but as these diagrams show, a good battery with a full charge does not mean the HWH systems will function correctly. It is important that every connection, wire or other components in the 12 volt electrical system that supplies power and ground to the HWH system is functioning at its peak capability. The most overlooked part of a vehicle electrical system is the connection of the battery ground cable to the frame of the vehicle. Even the way the chassis is constructed can cause issues. The frame rail the batteries are grounded to may not have a good electrical connection to the other frame rail, support members of the chassis or to the mounting surface of the leveling system power unit which is the central grounding point for the leveling and room extension systems.

Make sure you have good equipment that is functioning properly. Always check your test light to make sure it works. Understand how to use your volt/ohm meter. Although most of your diagnostics can be done with a test light, when it is time to check voltage with the volt meter, know where to check and don't assume because one component functions OK the rest of the components in the system must have good voltage. Don't assume because a connection looks good it is. Just because the batteries have just been replaced doesn't mean there isn't a battery voltage problem. Don't rely on vehicle monitoring systems to check voltage. And finally, just because the vehicle engine will start, that doesn't mean anything else on the vehicle will work properly.