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VOLTAGE DROP

Voltage drop is one of the most neglected and least understood test procedures. Ironically, it is also the most useful test procedure for locating faults and potential faults.

Simply, voltage drop is the measure of the voltage required to cause the current flow through a component.

If you have a voltmeter, take some time to do a little playing, which will both make you more familiar with the use of the meter and maybe prevent some future electrical problems. Set your meter onto a scale, which is just above 12 volts DC, and prepare to do some testing.

Refer to your wiring diagram (either from shop manual or downloaded) and locate the horn circuit. You should be able to trace backwards from the horn to the horn switch, ignition switch to battery positive. It's not easy to find and trace the wires but becomes easier with practice. Now let's trace the circuit the easy way! Put the negative (black) voltmeter lead onto the horn Brown wire terminal and connect the positive (red) voltmeter lead onto the battery positive. What does the meter read? Well, the meter "sees" the voltage difference between the battery positive and negative because there is no current flow so no work is being done and so there will be no voltage drop between the two points being monitored. OK, so now let's do some work! Switch the ignition on and hit the horn....the voltage measured now becomes the voltage necessary to make current flow through the resistance of the circuit between the meter leads. In other words the voltage now displayed is the voltage required to make the horn circuit current flow through the battery + cable, wires, fuse, ignition switch, horn button and up to (but not including) the horn. Record the voltage. This is the voltage drop across the positive side of the horn circuit.

Now move the negative (black) voltmeter lead to the ground side (black wire) connector on the horn. Honk and measure the voltage drop across the horn. This is the only useful voltage drop in the circuit but more on that later.

Finally, connect the voltmeter positive (red) lead to the ground side (black wire) connector on the horn and the negative (black) voltmeter lead to the ground side of the battery. Honk and measure the voltage drop across the ground side of the horn circuit.

We have three voltage drops; the Vd in the circuit from battery to horn; Vd across the horn; and Vd in the circuit from horn to battery. The total of the three voltage drops will equal the battery voltage during the honk.

Now let's consider the meanings of the three voltage drops...which one is the Vd across the useful work being done? Of course! The Vd across the horn is the one indicating the work we want to be done so the others must be unwanted. Since we have (in round numbers) 12 volts available to push current through our horn, we want to use the whole 12 volts across the horn to make the maximum current flow through the horn but if any voltage is required to make current flow in any other part of the circuit then that much less voltage is available to make current flow through the horn.

So what we want to do is to use the measure of voltage drop to find unwanted voltage drops so that we can decide if they are a problem, which needs to be removed.

Some Ohm's Law and Watts:

The horn is rated at 2.5 amps, 12 volts according to the wiring diagram. What does this translate to?

Work being done in an electrical circuit will usually be expressed in Watts. 60-Watt bulb for example.

Watts can be calculated Amps x Volts = Watts. Thus the 60 Watt /12 volt bulb requires 5 amps while a 60 watt/120 volt bulb requires 0.5 amp. Different volts and amps but the same work being done, the same watts.

We will over simplify by disregarding the dynamic loads but the pattern will be true.

The horn 2.5 amps x 12 volts = 30 watts. OK, but what happens if we don't see a Vd across the horn of 12 volts? Hmmm, here comes Ohm's

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Law to the rescue! Ohm's Law tells us that one volt is required to force one amp through one ohm of resistance. So the horn 12 volts divided by 2.5 amps = 4.8 ohms.

Let's say that we have a Vd of 1 volt in the horn positive circuit. That leaves 11 volts, which we will measure across the horn, right? Right. Since the horn has 4.8 ohms of resistance with 11 volts, 11 volts divided by 4.8 ohms = 2.9 amps. How much work (honk) will be done? 2.3 amps x 11 volts = 25.3 watts, not as loud! Not as much work done.

To turn the problem around, the voltage drop will show the work being done. There should be next to no voltage drop where we want no work to be done. Do we want work to be done to force current through the horn button? No, we don't. That will simply result in heating of the button.

What will happen if we install a louder horn? Unless the horn is louder because it is more efficient then it must be louder because it does more work, has less resistance so more current flow results in more watts of work at the same voltage. OK but if there is more current flow through the same circuit, there will be more voltage drop in that circuit because there is more current flow through the same resistance.

Ok, say we install the new horn and it isn't a loud as we hoped? (Is it ever?) We can do our voltage drop measurements to see how much Vd is occurring in the circuits. There should, ideally, be no drop except across the horn. If we find a drop elsewhere we can use the voltmeter to find it and eliminate it. Voltage drops can be done across parts of the positive circuit such as across the horn button itself. If we find more than (as a rule of thumb) 0.2 volts or more across any wire or component (other than the one we want doing the work) we should find a way to eliminate it.

One easy way to eliminate the voltage drop across part of the horn circuit will be to install a relay. The relay will use the horn button and the other positive side wiring to operate the relay, which requires a very small current, which results in a small voltage drop. This means that full battery voltage will be available to operate the relay. The relay will have low resistance (low Vd) in the switched circuit so full battery voltage will be available to the horn. This will result in a loud honk and long life for the horn button.

Try similar measures to the headlight, taillight, starter and other circuits. Any Vd of 0.2 volts or more except across the component intended to do the work can be located by moving the voltmeter leads along the circuit in question until we have the Vd between the leads. Now we can decide

how to eliminate the drop.

Brighter lights and longer component life can be had with a little voltmeter work. The more you do, the easier you will find it to be. The voltmeter is a window to what is happening in most circuits.