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| Station | | Task | |
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| ELECTRIC TESTS | | | |
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# Voltage drop test / Series circuit

## TASK OBJECTIVE

At the completion of this task the technician will be able to properly perform a voltage drop test on an electric circuit. The technician will be able to explain the results of the test as well as the meaning of the results obtained when higher or lower than expected.

**VOLTAGE DROP**

A voltage drop test is one of the easiest electrical tests to perform; yet, in terms of diagnostic effectiveness, it is one of the most valuable. Voltage drop in a circuit represents lost voltage or pressure. Voltage (electrical pressure) is normally lost in a circuit as current passes through the resistance offered by each of the circuit’s electrical components. Switches, circuit and terminal connections and relays, however, should add little or no resistance to a circuit.

Voltage drop measurement can be very effective in detecting the presence of interference resistance in a circuit. As we know, in a series circuit, total resistance (Rt = R1 + R2 + R3 + R, etc.) is equal to sum of all of the resistors (loads) in the circuit. If there is additional resistance in a circuit due to a corroded connection or damaged wire, voltage available to the component will be reduced.

Total voltage in a series circuit is Et = El + E2 + E3 + E etc. In other words each part of the circuit will consume an amount of voltage proportional to its resistance.

For example, if there is excessive resistance between the battery and starter which causes a voltage drop of 2 additional volts across the circuit, voltage available at the starter motor would be reduced by 2 volts. This would result in the same starter motor performance as would occur if the battery in an otherwise good system was discharged to 10 volts. If you have ever tried to start a vehicle with only 10 volts available at the battery, you can appreciate what a reduction of 2 volts can do to the performance of a starter system.

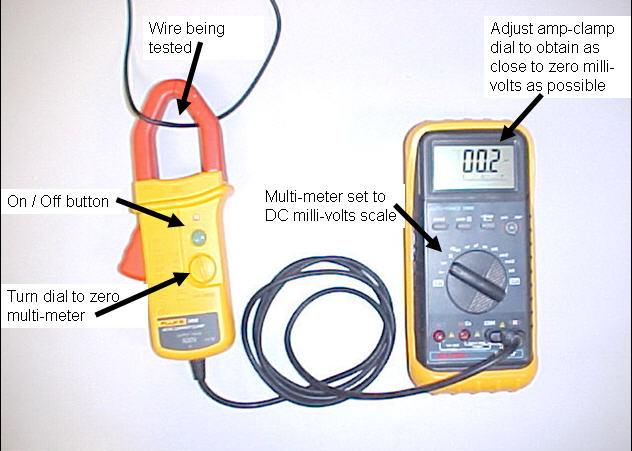
Again, a voltage drop test is a quick and effective way to detect resistance interference in a starter circuit.

## INDUCTIVE METERS

An inductive ammeter is usually recommended for measuring current flow beyond 10 amps. An inductive ammeter, for example, measures current flow through a circuit without actually having to be connected to the circuit. As the name implies, an inductive ammeter measures current flow indirectly by sampling the magnetic field produced by current flowing through a circuit. The larger the magnetic field the greater the amount of amperage. The amp clamp senses this magnetic field and converts the strength of the magnetic field to a direct current (DC) voltage reading.

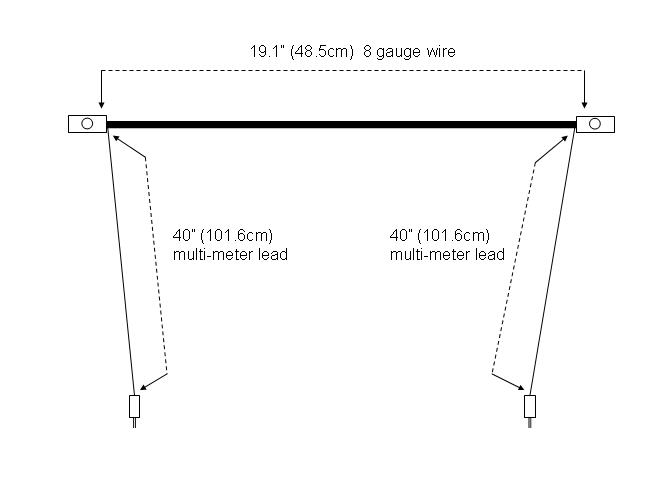
The amp clamp will measure amperage well beyond 100 amps in a DC circuit by simply clamping the unit over the wire to be tested. To use the amp clamp follow the simple instructions below.

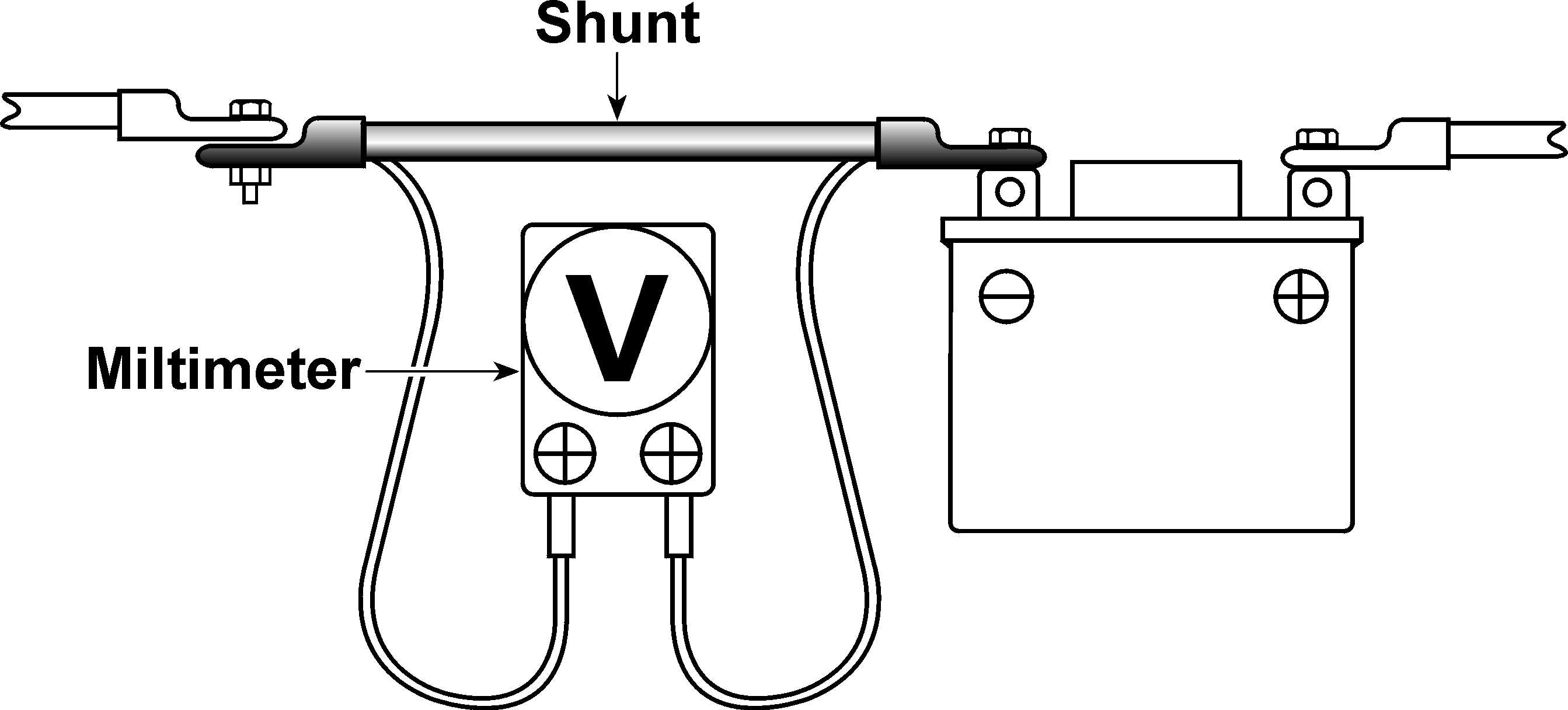
1. Plug the amp clamp probes into the "Common" and "Voltage" terminals of the multi-meter.
2. Turn the amp clamp on to DC amps. (Some amp clamps just need to be turned on.) (Allow the amp clamp to warm for around 1 minute)
3. Turn the multi-meter on to the milli-volts scale.
4. Adjust the dial on the amp clamp until the multi-meter reads as close to zero as possible.
5. Clamp the amp clamp around the wire to be tested on either the positive or negative side.
6. Turn on or activate the electrical circuit.
7. The multi-meter reading in milli-volts can now be read as a direct amperage reading.



**HIGH AMPERAGE CURRENT SHUNT**

A high-amperage shunt is simply a piece of heavy gauge wire (usually around 8 gauge) cut to an exact length with a terminal soldered to each end. The shunt is installed in series with negative battery cable and a digital voltmeter attached as illustrated below. When the starter circuit is activated, the voltmeter will indirectly measure current flow by measuring the voltage drop across the shunt. The exact construction of the shunt, the material from which it is made, its diameter and length, ensure that the voltage reading accurately represents the amperage passing through the circuit. Generally speaking, when using a shunt, 0.010 volts equals 10 amperes of current flow.





**PROCEDURES**

**Before to start:**

**Check the switches 13, 14, 15, 16, 17 are to the left**

**Switch on the switch #1**

**Only the orange light should come on**

**Switch off any other light**

**Switch off the switch #1**

**Check the resistance of the multimeter leads and adjust it to 0**

**If the multimeter doesn’t have the reset option, subtract that value from every further resistance measurement.**

**The bulbs are welded under the board. Don’t try to remove them.**

**PROCEDURES**

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| --- |
| 1. Check the continuity of the battery red wire between A and B |
| 1. Is the tester showing good continuity?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 1. Check the resistance of the wire between A and B |
| 1. Is the resistance correct? |
| 1. Is the wire good? |
| 1. Remove the wire from B terminal and take out the cover |
| 1. Is the wire good? YES NO |
| **The next tests will show you how a non desired resistance on a circuit can affect the main electrical component performance.**  **The orange bulb represents the main component and the white ones represent defective components such as switches, connections, relays or corroded wires.**  **We won't measure resistances since it can give us a wrong conclusion (as demonstrated on the red wire). We will measure the voltage drop that the resistance creates, if there is any.** |
| 1. Check voltage between E and F: |
| 1. Check voltage between F and ground J: |
| 1. Switch ON #1 |
| 1. What is the switch #1 supplying? Positive Ground |
| 1. Check voltage between E and F:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 1. Check amperage at I:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 1. Switch #1 OFF |
| 1. Switch #4 ON (Note this switch is on the positive side of the orange bulb) |
| 1. Check voltage between F and J:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 1. Check amperage at I:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 1. Switch #1 ON |
| 1. Is the orange bulb lighting? YES NO Slightly |
| 1. Check voltage again between E and F:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 1. Check voltage again between F and J: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 1. What was the voltage between F and J before to switch #1 ON?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 1. What is the voltage drop between E and G?\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 1. What is the voltage drop between J and G?\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 1. What is the voltage drop between J and F?\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 1. Switch #4 OFF |
| 1. Switch #2 ON (Note this switch is on the negative side of the orange bulb) |
| 1. Is the orange bulb lighting? YES NO Slightly |
| 1. Check voltage between E and F:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 1. Check AMPS at I:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 1. Check voltage between J and F: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 1. What is the voltage drop between C and D?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 1. Switch #5 ON |
| 1. What is the voltage between E and F?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 1. Check AMPS:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 1. Switch #1 OFF and remember #2 and #5 are ON |
| 1. What is the voltage between J and F?\_\_\_\_\_\_\_\_\_\_\_ |
| 1. Place the test light between J and F |
| 1. Is it lighting? YES NO Slightly |
| 1. Place the test light between J and H |
| 1. Can you see the difference?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 1. Switch #1 ON |
| 1. Place the test light between J and F |
| 1. Place the test light between J and H |
| 1. Can you see the difference?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 1. Switch OFF #2 and #5 |
| 1. Switch ON #3 and #4 |
| 1. Note the voltage between:   D and E  E and F  F and G |
| 1. Sum the three values above:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 1. Switch OFF #3 and #4 |
| 1. Switch OFF # 1 |

**CONSIDERATIONS**

* Switch 1 doesn’t send negative current to E ( like rivers don’t go upstream)
* Switch 1 only opens the path for the high potential at H to reach J which is at low potential.
* When switch 1 is OFF, C and H are at the same potential because no current is traveling between them
* If voltage is checked between J and F (positive side of the bulb) and then between J and E (negative side of the bulb) the readings will be exactly the same.
* This is sometimes misunderstood as the negative side is shorted to battery.

**Instructor sign off-- Go \_\_\_\_\_\_\_\_\_\_**