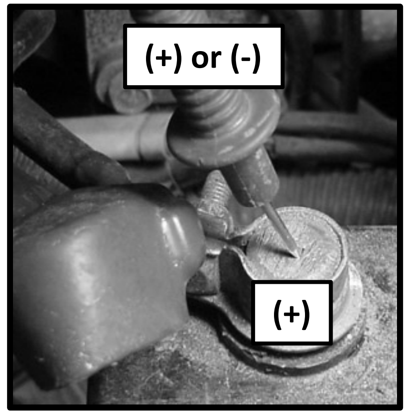
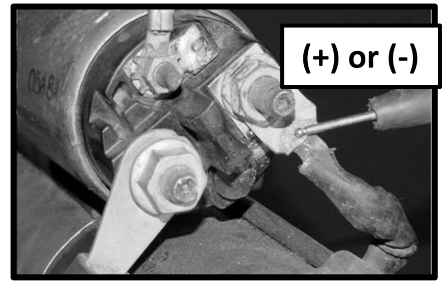
How to do "Base System Testing", cont.

To do a voltage drop test between the battery positive (+) terminal and the starter motor armature correctly on a post top battery design, one voltmeter probe is placed on the top center of the post. It makes no difference which probes you use where as voltage drop testing is not polarity sensitive. The other voltmeter probe is placed on the metal of the wire that is carrying current into the starter motor:





Once set up, the test results are recorded while the engine is cranking. You can interpret the results two different ways depending upon whether the voltmeter probe at the battery positive (+) terminal was positive (+) or negative (-). If the positive (+) probe of the voltmeter was at the battery positive terminal, the voltmeter will display the *actual* voltage drop that is occurring between the probe location. The maximum allowable for this test is 2 1/2V

If the voltmeter negative (-) probe was at the battery positive terminal, the voltmeter will show the *voltage available* to the starter motor at the point of location of the meter's positive (+) probe. This should be within 2 1/2V of battery voltage or *source voltage.*

It makes more sense to always use the voltmeter's positive (+) probe at the battery's positive (+) terminal so you do not have to do any math in order to see if there is an excessive voltage drop in this current path. What you see is what is actually dropping during the test (cranking).

Before I continue to explain this base system testing concept by looking at the transmission ground current path, let me first explain my "parts and pieces" base system testing used only in the event that you did find an excessive voltage drop (greater than 2.5V as in the case of our starter voltage feed current path) with your initial "all-inclusive" test. Even if I see 2.51 volts I will test the "parts and pieces" that make up the entire starter motor armature voltage feed side current path. Depending on the vehicle, the parts and pieces that make up this current path could include the following: battery positive (+) terminal, clamp connected to the terminal, the connection of this clamp to the cable, the cable itself, the connection at the other end of this cable to the metal eyelet, the connection where this eyelet connects, a solenoid disk if used, the connection on the exit side of the solenoid, the connection of the exit side solenoid eyelet. Or, any thing that may make up the starter motor armature current path of the vehicle you are working on.

How to do “Base System Testing”, cont.

Once you study the current path for the vehicle you are testing, parts and pieces testing is simply keeping your voltmeter probe at the battery positive (+) terminal and *moving* the other probe beyond the “next connection” and the “next connection”, etc. Remember, each new placement of the movable voltmeter probe requires another cranking of the starter motor. Once you find an acceptable voltage drop, your problem is between the previous location of your moving probe and the probes current position.

Now, on to the second current path I will use to reinforce the concept of initial “all inclusive” and “parts and pieces” base system testing – the transmission ground current path.

Voltage provided to the input side of any load is pretty straight forward because you can trace it on a wiring diagram. You can know which wire, what color, and what gage the wire was when the vehicle left the factory. This is no so on any ground return. This is why “base system testing” is so important. The transmission may have a “case ground”, or one or more ground wires exiting the transmission housing and connecting to some point on the frame or sheet metal either individually, or through a “splice pack”. The initial all inclusive test of the transmission ground current path is between the battery negative (-) terminal and the transmission grounding point/s beyond the ground connection on the transmission side.

If the complaint is a shifting problem and I want to eliminate a bad transmission ground as the cause, I prefer to use my MIN/MAX meter feature. I would previously have tested my battery posts connection and know that they are good. Then , for a transmission ground, I clip one end of a jumper wire to the transmission housing (clean metal) if case grounded, or to the transmission ground wire/s testing each where there are numerous, routing the other end into the vehicle. Another jumper wire is clipped to the cleared battery negative (-) terminal with the other end of this wire routed into the vehicle. I then set the meter to MIN/MAX and hook the meter probes to the ends of the wire. I want the minimum value seen by my voltmeter to appear in the “minimum screen”, so I will keep the polarity of my meter matched to the vehicle battery polarity. This simply means that the negative (-) voltmeter probe connects to the wire connected to the battery negative (-) terminal.

The voltmeter positive (+) probe, even though it is on a negative side of a current path is just “more positive” or “closer to the battery positive (+) terminal than the other probe attached to the battery negative (-) terminal.

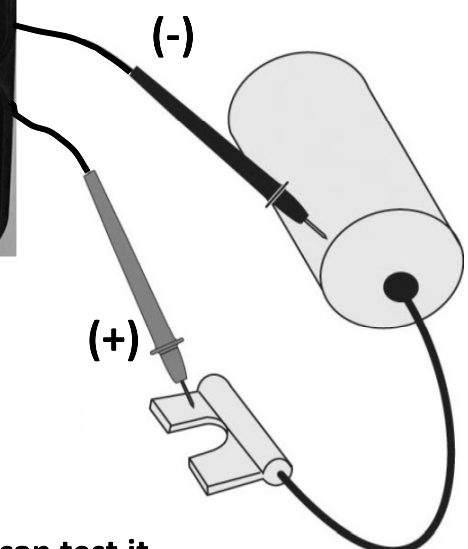
Once I am hooked up, I drive the vehicle and shift it through all of its gears. I try to hit railroad tracks, bad road, etc. as I test drive. Upon return, I *do not shut the vehicle off* until I have recorded both the minimum and maximum values recorded by the voltmeter during the test drive.

Now, this is where it gets interesting. The current traveling to ground has *many different* paths back to the battery negative (-) terminal. If my meter recorded more than .100V/100mV there is excessive resistance causing an excessive voltage drop somewhere between the initial all-inclusive probe placements. (Continue on the next page).

How to Test a Condenser/Capacitor With an analog meter

Capacitors (condensers) are sometimes engineered “across" motor brushes.
If they fail, the radio frequency interference (“electrical noise” resulting from electrons jumping air gaps between brushes and armature) can increase.
If you listen to the “noise” (radio static), you can sometimes determine the source.
If the noise changes with engine speed, test the capacitor at the generator.
If it remains constant regardless of engine speed, test the capacitor/s across the electric fan motors.
If it changes with speed changes to the heater blower motor, check the capacitor/s across the blower motor.

Capacitor illustration
Used with permission from Fluke



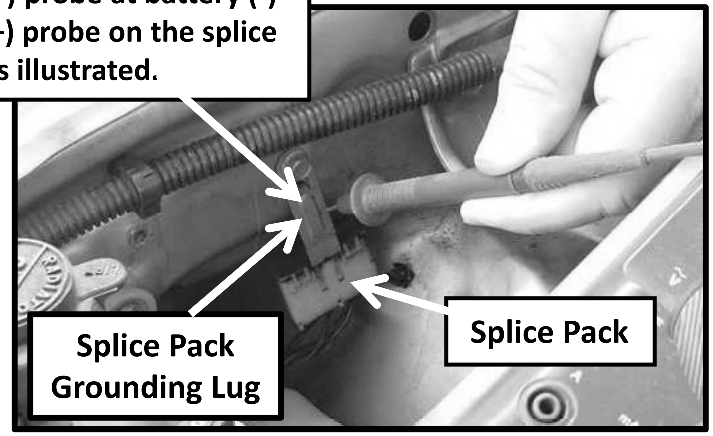
If you suspect a bad capacitor,
put in a new one, it saves time over testing.

If you want to test the capacitor, do this:

Use an *analog* ohmmeter.
Set the meter to the low ohm’s scale.
Hook the positive (+) lead to the capacitor lead.
Hook the negative (-) lead to the capacitor case.
You should see *quick needle sweeps up*, then the *needle should settle*.
If this happens, the capacitor is good.
If there are no needle sweeps – the capacitor is open.
If just one sweep, and the needle stays put, the capacitor is shorted.
Capacitors are not expensive, replacement with a new one is cheaper than the time it takes to test one.
This test is given here in case you think you got a bad one out of the box, you can test it.

How to Troubleshoot a Ground "Splice Pack"

These testing methods are for the ground side only after the voltage feed side has been tested and cleared of any excessive voltage drop.



Voltage drop test method:
Engine running, loads grounded by splice pack operating.
Set the voltmeter to read mV (millivolts).
Place the voltmeter negative (-) probe on the battery negative (-) terminal.
Place the voltmeter positive (+) probe *on the grounding lug* as illustrated in the photo to the right. This initial placement will assure that if the problem is between the metal to which the splice pack connects and the battery negative (-) terminal, the voltmeter will pick up any voltage drop that is occurring as a result of a loose or corroded connection.
What you have done initially is to test the sheet metal to sheet metal or sheet metal to frame, battery negative (-) cable attachment points at the frame or block and the connection between the post and the clamp. If this is excessive (more than 100mV (.100V), start by cleaning the negative (-) battery cable connections at both ends. Then look for rusted sheet metal between your positive (+) voltmeter location and the battery negative (-) cable locations. Once this is cleared, proceed to testing the splice pack connections as follows:

Engine running, loads grounded by splice pack operating:

1. **You can leave the voltmeter positive (+) probe where you started initially, or put the voltmeter negative (-) probe there as voltage drop testing is not polarity sensitive.**
2. **Back probe each ground wire in the splice pack. One probe is a short distance from where the splice pack connects, and the other probe is back-probing each ground wire connection – one at a time. What you are doing here is testing the voltage drop of the ground wire connection to the splice pack, and the splice pack grounding lug connection to the sheet metal. Maximum allowable is 100mV (.100V).**

If excessive for all ground wires, clean the splice pack lug connection.
If excessive for *some* ground wires but not all, the problem is in the individual ground wire connections to the splice pack. Check for looseness, or corrosion, or broken wires under the metal connector or the affected ground wire/s.