Technical Training Tip of the Month

"Wean Yourself from the Ohmmeter"

By Grant Wolter

In the field, use of an Ohmmeter to diagnose problems with circuit and component continuity is notoriously unreliable when compared to the use of volt or amperage measurements. Misunderstood Ohmmeter readings and improper Ohmmeter testing procedures are a major cause of incorrect diagnosis and unnecessary parts replacement.

Those are some harsh words for the poor defenseless Ohmmeter, but the fact is an Ohmmeter requires a circuit to be set up in a very specific set of conditions in order to obtain, not just accurate, but relevant readings. Once more, an Ohmmeter is of limited use for checking circuits that carry more than a few amps of current. And finally, a great number of technicians are unaware of the limitations of an Ohmmeter and the pitfalls of using an Ohmmeter to take measurements on the circuits in a vehicle.

To understand the pessimism that surrounds the use of an Ohmmeter, let's have a look at how it works, and offer up some examples of a few Ohmmeter pitfalls.

How it works:

An Ohmmeter supplies it's own calibrated voltage and current to a circuit under test. The voltage output from the meter is typically less than 0.5 Volts. The Ohmmeter is hooked-up to a circuit or component using the test leads so that it temporarily becomes a regulated power supply for the circuit or component under test. In layman's terms, the meter internally takes a measurement of the voltage that is being supplied to the circuit, and also measures the resultant amperage that it is able to push through the circuit under test. A kind of ad-hoc Ohm's Law calculation is then done, which comes up with a value for resistance that is displayed on the meter screen. A typical Ohmmeter can accurately measure resistances from about 10 million Ohms (10MΩ), down to about 1 tenth of an Ohm (0.1Ω).

How does Ohmmeter operation translate into issues?

- To hook up the Ohmmeter properly, the circuit usually has to be *taken apart* to isolate the circuit or component under test.
- The circuit or component is not being tested under live, real world (i.e., loaded) conditions.
- Any voltage or current already in the circuit being tested will interfere with the Ohmmeter readings.
- Large gauge wire with resistances of less than 0.1Ω are often necessary in order to feed high current loads such as door motors, paratransit lifts, and electric A/C compressors. This is out of the range that an Ohmmeter can accurately measure.

- Because an Ohmmeter screen can only display three of four digits, numbers with five or more digits must be displayed in an abbreviated format commonly called the "metric" annotation. This uses a "K" to represent numbers times 1000, "M" to represent numbers times 1,000,000 etc.

Some real world examples of Ohmmeter pitfalls:

- Taking apart a circuit to isolate a portion of it can be a tedious task for technicians in the field. The result is that circuits are often not properly isolated for testing, and other circuits tied into the one under test are feeding voltage and current into the Ohmmeter, yielding completely erroneous results. This problem is particularly common when a technician tries to check a ground circuit by putting one Ohmmeter lead on the ground wire they wish to test, and the other Ohmmeter lead on battery negative. There is always some current flowing through the cable going to battery negative, even with the ignition off, and the Ohmmeter readings are completely erroneous because of it. A simple test to see if extraneous voltages and current are being fed to the Ohmmeter, is to reverse the leads, and see if you get a different Ohm reading. If you do get different results when you switch the leads, the readings are wrong (neither reading is correct, so you can't use an Ohmmeter for the test unless you isolate the circuit differently).
- The resistance of bad relay and switch contacts can change dramatically when heated up from a load current. Since an Ohmmeter only puts out a few microamps of current, bad relay or switch contacts often test "good" with an Ohmmeter, but still fail to work correctly when hooked up in the circuit.
- The resistance of components such as bulbs and electric motors are often less that 0.3Ω when they are cold, not lit or not running. An Ohmmeter check of the supply wire to an electric door motor compared to ground, for example, looks like a dead short to ground. This might lead the tech to believe that the motor is shorted internally and needs replacement.
- A 10 foot section of stranded 12 gauge wire, with all but one strand cut through, has about 0.1Ω of resistance. "Good" by Ohmmeter standards, but not likely to conduct enough current to allow a lift motor to operate properly. Since the wire Ohms out "good", however, the lift motor is likely to be replaced first.
- The metric annotation of "M"s and "K"s on most meters is very small on the meter screen. In their haste, technicians often overlook the annotation, and a presumed reading of .213Ω, may actually be .213MΩ. The technician is off by a factor of 1 million. If measuring a wire, this would be the difference between good continuity, and an open circuit.

So what's the alternative?

Available Voltage and Voltage drop checks can effectively take the place of all of the Ohmmeter checks in the examples listed. Mind you, to use a Voltmeter correctly and understand the readings also requires some training, but the pitfalls are far fewer and more easily corrected. We'll save that discussion for another time, however.

Using a Voltmeter allows you to make tests under actual load conditions without disturbing the circuit. It's also unlikely that you'd run into issues with metric annotation for the voltage ranges, since most measurements for automotive applications would be in a 0-20 Volt or 0-50 Volt range. If a capital "M" appears in front the "V" on the meter screen, you should run away.

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