You Gotta Have the Right Tool

I have two tool chests, one for metric and the other for SAE. Plus a bevy of diagnostic equipment, including: mechanical devices, computer scan tools and electric test equipment. Without these, it'd be impossible to determine the nature of an automotive problem, formulate a diagnostic plan and repair strategy.

A few weeks ago, the XC90 V8 began to run rough and shake. The money light (Check Engine) flashed violently, the information display commanded: "S T O P". Near home, I coasted into the driveway; then reached for the Volvo scan tool to probe the trouble codes. Expecting a few codes, I was met with 20. Apparently, the world was flying apart.

The messages indicated: misfires on all cylinders, especially cylinders 6 and 8, general ignition coil primary circuit failures (all cylinders), ECU failure and assorted emissions codes. Where do you begin? I made a mental list of possible component failures, including: defective ignition coils, defective ECU, broken wire, low fuel pressure, failing fuel injectors, fouled spark plugs, jumped engine timing, or bent valves. It took 3 hours over a week to identify and repair the problem.

This story is presented so you can understand how I troubleshoot electrical gremlins and learn from my experience. First, I pondered, "How/where to begin?" The code pointing to the failure of the primary ignition coil circuits was just plain weird. There are two reasons a primary circuit failure message is generated; engine overheating cooks the ignition coils or by low voltage from a failing alternator. I knew the engine did not overheat, so I checked the operating (engine running) voltage. It was 14.5 VDC. I discard that possibility. Next, perhaps the 6 & 8 ignition coils were defective, so I swapped them with the 1 & 3 cylinder coils. Next, I inspected the sparkplugs for 6 & 8 cylinders. They looked good and were wet. This told me failed fuel injectors and bad spark plugs were an unlikely possibility. I cleared the ECU of codes, started the motor: no change. I discard those possibilities.

At this point, recognize an engine computer's diagnostic codes may send you down the wrong rabbit hole. Thinking outside the box is necessary. I knew low fuel pressure at the injectors could cause similar symptoms and trouble codes as the ECU's diagnostics may interpret low fuel pressure as electric component failure. Key were the codes pointing to multiple misfires on cylinders 1-5 &7; yet the ECU was absent fuel pressure regulator and fuel pump codes. A fuel pressure gauge recorded 50-60 psi at the fuel rail at 650 RPM. Well, that's normal; discard fuel related issues as a possibility.

As it was too cold to work outside, I spent two days thinking about the problem. Jumped timing and bent valves were discarded as remote possibilities. I concluded the problem was electrical, either a broken wire created by a squirrel seeking tasty soy based wire insulation meal. [Rodents eat wire insulation because it is made from soy bean oil: rodent tofu.]

To proceed, I must determine whether cylinders 1-5 & 7 ignition coils were firing erratically and whether 6 & 8 were firing at all. I did not have a tool to easily diagnose a failing ignition coil. Reasoning the best tool is one that'd detect whether or not an ignition coil energizes. Plus such a tool must not require a hard wire connection, but detect by induction an energized electromagnetic field and be inexpensive. I found such a device, the MST-101 on Amazon for $28. The device flashes in sync with the EMF pulse emitted by a firing ignition coil. The MST-101 detects other electromagnetic fields; among others, a switching relay and fuel injector.

With the engine running, I placed the MST-101 probe on each ignition coil, observed the pulsing light and determined cylinders 1-5 & 7 fired normally, while 6 & 8 were dead. Discarding, again the general primary circuit failure fault possibility and believed the problem to be an open ground or broken power or signal wire. This possibility stuck out as odd, because the only wire in common for the 6 & 8 coils was the ground wire.

Using a 12 VDC circuit test probe, each coil ground wire from the 4 pin connector to ground was validated.

The grounds were good; the non firing ignition coils were not being powered or triggered. This confirmed the broken wire theory and a rodent breach. I traced the wires from coils 6 & 8 back to the ECU. No breaks, no rodent damaged wires.

ECU failure remained unexamined. I removed the ECU cover and inspected the 80 pin multi-connector and observed it may not be fully seated. I removed the connector and firmly reseated it. Then cranked the engine; it fired and ran smoothly. Problem solved. [I still have to change that pesky countershaft bearing.]

I could not have made the diagnosis as easily without the MST-101. Consider adding such a useful inexpensive device plus a circuit probe to your own tool box.

Epilogue: Not all technicians are equally gifted identifying esoteric electrical problems. Typically, shop would install a new set of spark plugs, ignition coils and fuel injectors generating a $1500 invoice without problem resolution. At this moment, some owners decide to junk or trade an older car. In modern cars, if it's not an obvious electrical component failure, the problem is either: a bad ground, a broken wire or bad connector. Remember this!

I can hardly wait to see the problems all electric vehicles experience. You can save on fuel, but spend a wad on diagnosing and repairing quirky electronics. Not me!

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For other tips, check out the Blue Ridge Chapter website. http://blueridgevolvonc.org/