Technical Myths and Contrary Realities

Our Greek and Roman forebears invented elaborate mythologies to 'explain' the things they saw around them but couldn't understand. Centuries later, we pride ourselves on our scientific knowledge and scoff at those ancient myths. But as I recently discovered while teaching a course in advanced diagnostic techniques, mythmaking is not dead; we've just updated it with modern pseudotechnical fables, again to 'explain' what we see but don't understand.

I'd like to share some of the myths I uncovered and shed some contrary reality-light into automotive diagnostic vistas where murky myth previously darkened the landscape.

Electrical Myths

If you can't see it, it must work by magic.

Myth 1: ***'Resistance Drives Current.' High resistance*** **causes** ***high current. After all, you need a lot of current to overcome that resistance. What's more, there's often high heat at and around the resistance as well, so obviously it must draw a very large current.***

Contrary Reality: ***High resistance*** **limits** ***current flow.***

Explanation: First, think of the extreme cases: of an open circuit and a short circuit. Increase the resistance, and what happens to the heat? An open circuit has infinitely high resistance, but no current flow and no heat at all. Now drop the resistance. How about a short circuit? It has no resistance, gets plenty hot, and certainly flows enough current to melt a metal fuse (after which it becomes an open circuit and drops to room temperature). I teach Ohm's Law as V = C x R, where V is volts, C is current and R is resistance. Usually we see the formula, E = I x R, but I prefer the more familiar characters. Ohm's Law really is a law: Electricity really does behave that way, not the mythical.

Myth 2: ***Check connections with ohmmeters. An ohmmeter is your most effective tool for locating poor cables or connections.***

Contrary Reality: ***Voltage-drop testing with the circuit under load is faster, easier and more reliable.***

Explanation: An ohmmeter tests for resistance using a very low current. For example, a battery cable will usually ohm-test good if just one copper strand remains intact, even though all its other strands are broken. Testing for voltage drop from one end of the cable to the other with the circuit under cranking load provides a truer measure of the cable's capacity to carry a working current. Look for no more than 0.1 volt-drop per connection for most heavy power circuits and 0.05 volt-drop per connection for low-load PCM electronics circuits like those for engine coolant temperature or mass airflow sensors.

Checking connections with an ohmmeter will not yield reliable results. This loose battery terminal connection still produces a relatively low ohm reading.

Testing the same connection with a voltmeter with the circuit under load reveals the true state of the connection. Any voltage dropped here will not be available to the rest of the electrical system.

Exhaust Myths

Thick clouds of gaseous superstition wreathe emissions chemistry.

Myth 1: *High hydrocarbon (HC) readings indicate a rich mixture: More gas in the exhaust must have meant more gas in the intake. Where else could it have come from?*

Contrary Reality: *HC readings simply indicate residual fuel in the exhaust, whether that came from an ignition fault, a mechanical loss of compression, a lean misfire or an overly rich intake mixture. Any of these factors could have caused high sniffer numbers. Most frequently unusual HC readings flag an ignition or compression problem.*

Explanations:

Carbon Monoxide (CO) indicates a *rich mixture* (too much fuel for the air).

Oxygen (O_2) indicates a *lean mixture* (too little fuel for the air).

Oxides of Nitrogen (NO_x) show *hot combustion* with combustion chamber temperatures over 2500 degrees F, often from a lean mixture during high engine loads.

A high HC reading does not automatically indicate a rich fuel mixture, as this emissions graphic illustrates. CO (the true rich mixture indicator) is still relatively low. The high HC reading represents residual fuel that has passed through the engine without being converted into useful energy.

Hydrocarbons (HC) indicate *residual fuel* in the exhaust, from whatever source.

Carbon Dioxide (CO_2) reflects *combustion efficiency*. When everything works right and the fuel/air mixture burns cleanly, CO_2 should be *high*, while HC, CO, O_2, and NO_x should all be low.

Engine Mechanical Myths

What strange beasts lurk in blocks and heads?

Myth 1: Eventual *compression is* good *compression. As long as the compression readings eventually come up, the rings and valves are sealing okay.*

If compression test readings are lower than normal after four compression strokes, internal engine damage may be indicated. Scored cylinder walls, similar to this cutaway example, can reduce the engine's ability to generate adequate compression.

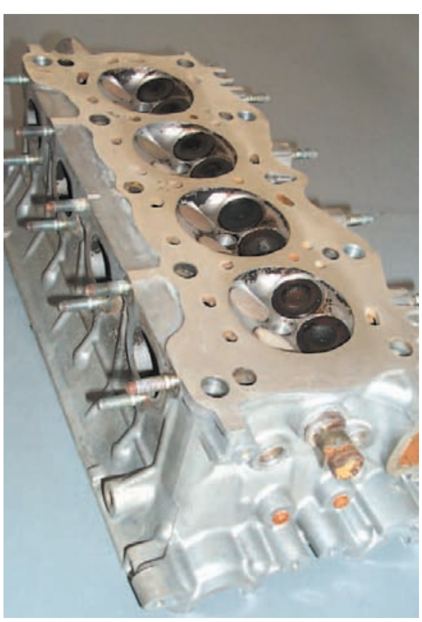
Contrary Reality: ***The first puff of a compression test tells you the most about cylinder wall condition. It should be at least 40 percent of the final (fourth-puff) reading. Under operating conditions, each engine power stroke is preceded by just* one *compression stroke.***

Explanation: Scored cylinder walls, excessive cylinder wall taper or damaged rings will all cause lower than normal 'first-puff' readings. Check engine compression with the battery fully charged, engine hot, all spark plugs removed, ignition disabled and throttle wide open. Four compression strokes (eight crankshaft revolutions) are sufficient to assess a cylinder's condition. For consistency, crank the engine the same number of revolutions for each cylinder.

Myth 2: ***The* higher *the compression reading, the* better. *If some's good, more's better, right?***

Contrary Reality: ***There is most certainly such a thing as* too much *compression. Excessively high compression readings indicate problems resulting from a worn exhaust cam lobe, from excessive milling of the cylinder head or from carbon buildup in the combustion chambers (often from overrich running).***

Explanation: An engine is designed for a specific compression ratio. As the compression exceeds that, the engine's tendency to knock, to destructive detonation, increases rapidly. Ordinarily, engine wear will reduce compression over a long period of time, but if it increases for one reason or another, the damage can be even greater.



Excessive cylinder head resurfacing may raise the compression ratio to an unacceptable level. This cylinder head received minimal resurfacing prior to a head gasket replacement.

Ignition Myths

Sparks come from another dimension, in the *'Cosmic Beyond.'*

Myth 1: ***The safe and effective test for spark is to pull a cable from one plug, roll back the boot, hold the end a quarter of an inch from the block and crank the starter.***

Contrary Reality: ***This procedure can usually tell you whether spark is present, but not whether the spark can ignite the mixture. It's neither a safe nor a reliable test.***

The spark may jump to ground in the open air, but what will it do in the combustion chamber? More scientific testing methods are necessary for reliable results.

This calibrated spark tester is the preferred method of testing the secondary ignition system's ability to produce an adequate spark. Moving the thumbwheel to line up with marks on the tester gives you a more accurate measure of the coil's output voltage capacity.

Explanation: It doesn't take more than a few kV for a spark to jump a quarter-inch gap in open air; it takes much more to jump across the electrodes of a spark plug under the combination of pressure and fuel mixture in the combustion chamber. You want to determine whether the spark is *sufficient*, and not merely whether it's *present*. Using a spark-tester with an adjustable air gap allows you to view the spark more critically. Better still, hook up your ignition scope to view the secondary ignition patterns with the spark plug wires connected.

This was brought home during our class when a great deal of time was spent verifying fuel delivery and flow on a no-start Honda. We had previously verified that spark was present, but it turned out to be *insufficient* due to a weak coil.

As to the safety of the pulled-cable technique, remember any secondary ignition spark will find its way to ground *somehow*. *Somehow* may turn out to be through your hand, up your arm and down your leg to the ground. Then you may feel disposed to sit quietly on the concrete floor for some time while meditating on the role of intense pain in human consciousness.

Myth 2: ***The best way to identify a weak cylinder is to pull plug wires one by one on a running engine.***

Contrary Reality: ***This worked fine on the Hudson Hornet, but it's unlikely to solve any problems on a modern car and can cause some new problems of its own.***

Explanation: Again, any spark *will* find its way to ground somehow. Besides the safety considerations above, that fact may involve using the ignition module as a ground path, with some expensive damage. Then you'll have two independent problems: the one that brought the car in and the one you caused with your 'balance test.' Besides all that, many current engine management systems control idle speed so well that you may not be able to detect any difference in idle speed or quality when temporarily disabling the secondary ignition to individual cylinders.

Removing a spark plug wire from the distributor cap is a crude and often ineffective way of conducting an engine power balance test. The test may damage other engine components, and the engine management system may raise the idle to make up for the temporarily disabled cylinder.

An engine analyzer's power balance test function provides a more reliable method of evaluating individual cylinders. The analyzer disables individual cylinders for a measured period of time, then compares the effects on engine rpm. Always disable the engine management system's idle speed control and set the idle speed to the recommended speed before conducting a power-balance test.

Better by far, use the cylinder balance features of your ignition scope in conjunction with a throttle prop to maintain a modest throttle angle. Where your scope is ineffective (as on some DIS or coil-on-plug systems), try using a length of vacuum hose between the coil tower and the plug wire or between the plug and the coil. Then use your test light, hooked to ground, to attract the spark away from its normal path. If you're going to use this method, be sure to disable the idle speed control and raise the idle speed slightly before you begin.

Fuel Myths

"She just don't seem to be takin' the gas...."

Myth: ***If the fuel pressure meets the manufacturer's specifications, you have some other problem.***

Contrary Reality: ***It is entirely possible to have good fuel pressure coupled with inadequate fuel flow (volume). We have even seen this on cars that have run out of gas.***

This fuel system simulator shows what can happen when an electric fuel pump is deprived of an adequate voltage supply. The fuel pressure is within specifications, but the fuel volume (pencil) isn't high enough to provide enough fuel to the injectors.

Explanation: As the fuel pump flow simulator photo proves, you can have pressure without enough volume. Most commonly, this comes from running out of gas or from excessive resistance in the fuel pump electrical circuit. When coupled with an inaccurate fuel gauge or sending unit, a modern automobile that has run out of gas (without the driver's knowledge) paradoxically can be one of the most difficult no-starts to diagnose. ■

— By Sam Bell