Troubleshooting Distributorless Ignition

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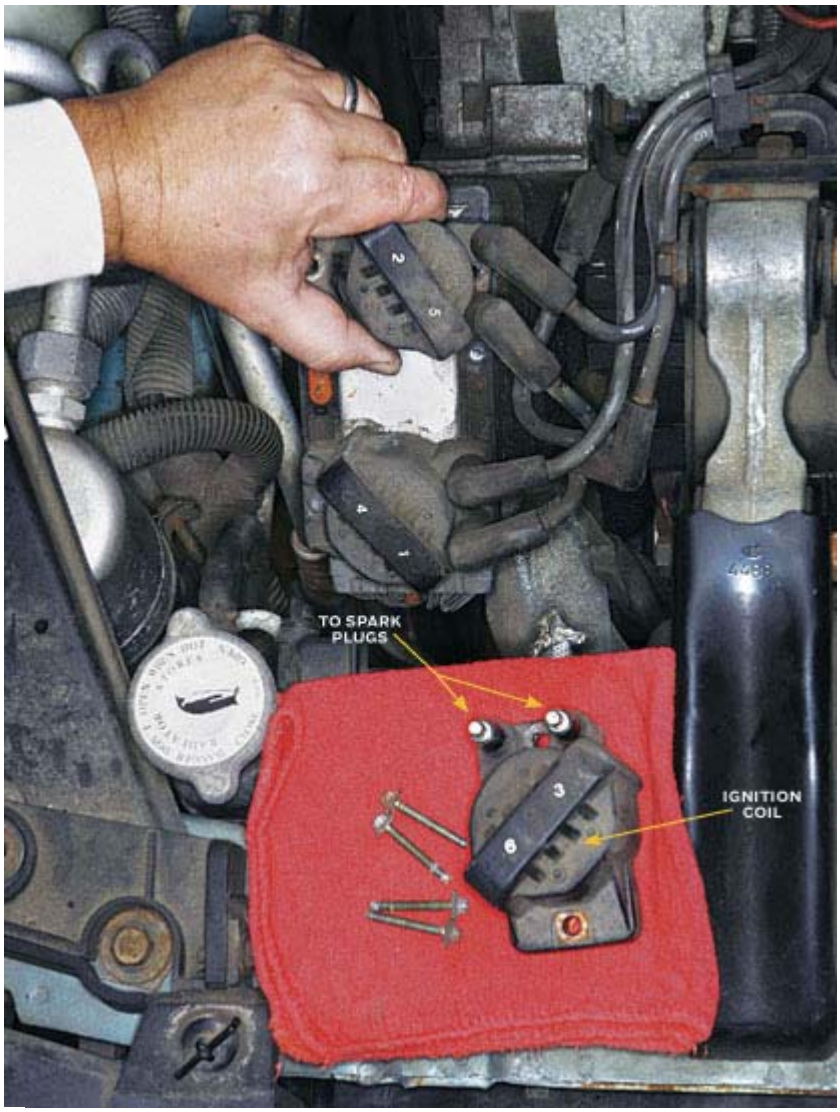


Swapping ignition coils in the coil pack of this GM minivan will tell us if one particular coil is the culprit. If it is, the misfire will move to a different cylinder.

Today is the worst day for your Check Engine light to come on. And this time it's not just because a careless

gas station attendant failed to tighten the gas cap. (Yes, gentle reader, a loose gas cap can make your engine think there's a leak in the evaporative emissions system.) This time it's Something Serious because not only is the indicator light glowing brightly, there's a definite miss in the engine. So, it must be time to do what Dad always did when the Buick started to misfire--install a new distributor cap and plug wires. Fixed it every time.

Opening the hood, you immediately see a problem--there is no distributor. Or plug wires. You're not in Kansas--or the 1970s--anymore.

Cars today don't have distributors or distributor caps.

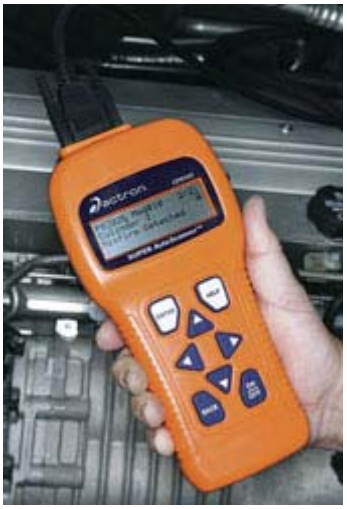
Okay, some do. But a lot don't. How in tarnation do they get the sparks to travel from the ignition coil to the plugs? How do the plugs know when they are supposed to fire? Where are the plugs, anyway? And the plug wires?

Cars don't have spark plug wires anymore.

Okay, again, some do. But many don't use the standard bundle of snakes of fat high-voltage wires. Or if they do, there are stubby little plug wires that lead not from the distributor (which isn't there anyway) to the plugs, but only from one plug to another plug.

BRAVE NEW WORLD

The need to achieve a fat, high-voltage, long-duration spark across an ultrawide spark gap has outdistanced the ability of a conventional coil to supply the needed energy, especially when its output has to be divided among four, six or eight cylinders. An ignition coil is essentially a transformer that turns the 12-volt signal from the ignition amplifier to the 20,000 to 30,000 volts needed to arc across the plug. Traditionally, one high-voltage pulse was generated to fire each plug as its cylinder came around to the beginning of the combustion (power) stroke. A mechanical rotor inside the distributor switched the high voltage around to the individual plugs through the plug wires. Now, two different systems (with some variations) are used to replace the unreliable distributor.



CLICK TO ENLARGE

Scan tools will quickly pinpoint misfiring cylinders.

The simpler of the two systems uses a single ignition coil for each cylinder, mounted directly on top of each plug or at least nearby. This way the ignition amplifier can send low-voltage pulses to each coil individually, without relying on the distributor. Simple and elegant-but expensive for six- or eight-cylinder engines.

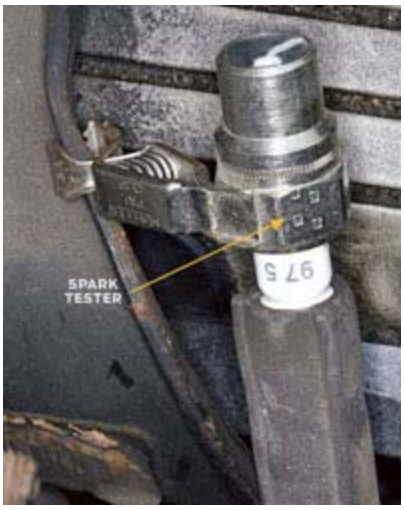
The other class of ignition systems uses a single coil to fire a pair of cylinders. Huh? Well, when one cylinder (say, No. 1) is at top dead center (TDC) at the beginning of the power stroke, another piston somewhere in the engine is at TDC on the exhaust stroke. At this point there's no pressure in the second cylinder because both valves are open a touch, and the burned combustion gases have been swept out the exhaust. A single coil is used to fire across both of these plugs--and the spark in the exhaust-stroke cylinder is wasted.

Four-cylinder engines using wasted-spark-type coils can mount a coil on one plug and use a short wire to fire the plug two cylinders away. V6 and V8 engines have opposed cylinders firing on opposite banks, so they generally use some sort of coil pack and almost-normal ignition wires.

A LITTLE KNOWLEDGE IS A VALUABLE THING

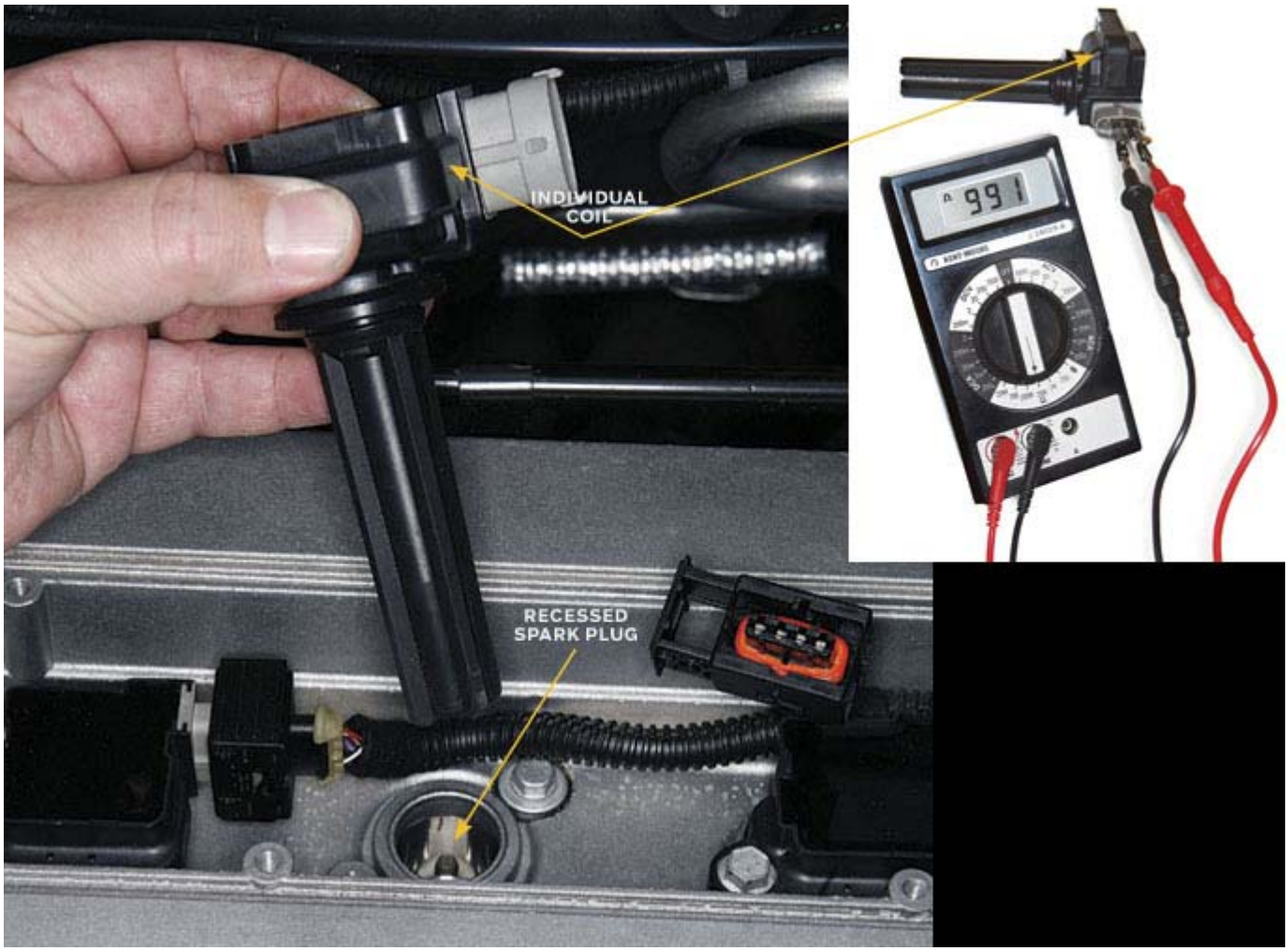
If you have issues with your ignition system that don't respond to simple diagnostics (like, say, the ignition amplifier has lost a crankshaft position sensor and the engine won't start at all), then you need to get a proper shop manual and slavishly follow the troubleshooting instructions in it because car manufacturers differ widely in their implementations of this system.

But you have an engine with a misfiring condition and a Check Engine light, not a no-start.



CLICK TO ENLARGE

Spark testers are a safe way to see if coil output is up to snuff.



Individual coils mounted directly on each plug are easy to check. Secondary windings will have several thousand ohms resistance.

WHICH PLUG?

Which cylinder isn't firing? You could pull all the plugs and see which one is cold and wet with fuel, but that involves actual work. Here's an old mechanic's trick. Let the engine cool to room temp. Then idle it for 1 minute, no longer. This should make the exhaust manifold warm to the touch--except near the cylinder that's misfiring, which will be perceptibly cooler. Now it's time to remove this plug and use a spark tester to confirm that there's no spark. This inexpensive device is simply a dummy spark plug with a visible spark gap. Plug the wire from the suspect cylinder into the tester, clip it to something grounded nearby and idle the engine to look for spark.

WARNING! Danger, Will Robinson! Do not simply pull the plug wire loose from the plug and hold it near the head to look for spark. Old-line mechanics learned to do this in the days of low-voltage breaker-point Kettering ignition systems. The much hotter sparks found on modern engines can damage ignition components if the spark is grounded out. Also, if the gap between the plug wire and the head is too large, the current will find a ground through your hand and arm to some metal on the car. You'll wake up 10 minutes later, lying on top of the lawnmower with no feeling in your arm and drool running off your chin. Just call me Lefty.

An alternative, safer way to find the bad plug is with a scan tool, which will tell you which cylinder or cylinders aren't firing. The scan tool may also tell you if you have a misfire caused by a bad injector or a bad spark. The engine control module, or ECM (on some vehicles at least), can monitor the current to each coil and each injector, and will set an error code if one is out of range. You'll need a scan tool to check this.

If you have individual coils and one cylinder isn't firing (a fact you've confirmed with the spark tester), try swapping that coil with one from a cylinder that is firing normally. If the misfire stays with the coil, you've found the problem and you can simply replace the single bad coil. If the misfire remains at that cylinder, you have other issues-probably poor compression from a burned or bent valve, failed head gasket or bad rings. And, a mechanical issue probably won't affect two cylinders that aren't adjacent.

If you have coil packs that fire two cylinders from a single coil and neither of those cylinders is burning, odds are the coil is bad. It's simple to swap the coils from one position to another to see if the misfire follows along. If only one cylinder on a coil has no spark, the problem is probably in the plug wire, or it's a duff plug.

ALMOST GOOD ENOUGH

Got an intermittent misfire? Say, only at high throttle settings or at idle? Maybe one of the coils is still working, but has an internal short that grounds out part of the coil's internal windings and lowers the output voltage. One thing you can check with a simple ohmmeter is the internal resistance of the primary and secondary windings in the individual coils. The exact values will be in the shop manual-but even if you don't have one of those, the individual coils should be within 10 percent of each other. Follow the wiring in the harness to the coils to help determine which pins to meter.