WELLS Counter Point

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THE ELECTRONIC, DIAGNOSTIC AND DRIVEABILITY RESOURCE.

Don't Get Hot Under The Collar:

You Can Master Coolant Sensors

The coolant sensor is often called the "master" sensor because the powertrain control module (PCM) uses the sensor's input along with that from the oxygen sensor to go into the "closed loop" mode of controlling the fuel mixture.

It also uses input from the coolant sensor to regulate the operation of many other important functions, including:

- Start-up fuel enrichment on fuel-injected engines. Injector pulse width is increased to create a richer fuel mixture when the coolant sensor indicates a cold engine.
- Spark advance and retard. Spark advance is often limited for emission purposes until the engine reaches normal operating temperature.
- EGR flow is blocked while the engine is cold to improve cold driveability.
- Canister purge does not occur until the engine is warm to improve cold driveability.
- Energizing the electric heater grid under the carburetor on older engines to improve early fuel evaporation when the engine is cold.
- Operation of the throttle kicker or idle speed when the engine is cold.
- Transmission torque converter clutch lockup when the engine is cold.
- Operation of the electric cooling fan (if a separate fan thermostat isn't used) when a certain temperature is reached.

DIFFERENT TYPES OF SENSORS

Located on the cylinder head or intake manifold where it screws into the water jacket, the coolant sensor may be one of two basic types. Most are variable resistor type sensors called "thermistors" because their electrical resistance changes with temperature. Most are the "negative temperature coefficient" type which means the sensor's resistance decreases as the temperature goes up.

The other type of coolant sensor is an on/off switch that works like a conventional temperature sending unit or thermostat by closing or opening at a pre-set temperature.

The variable resistor type of coolant sensors are "smarter" than the on/off switches because they provide the PCM with a more accurate indication of actual engine temperature. The PCM feeds the sensor a fixed reference voltage (VRef) of usually 5 volts when the engine is on. The resistance in the sensor is high when cold and drops as the sensor warms up to alter the return voltage signal back to the PCM. The PCM uses this changing voltage to determine engine temperature.

The switch-type sensor may be designed to remain closed within a certain temperature range (say between 55 and 235 degrees F, for example) or to open only when the engine is warm (above 125 degrees F). Switch-type coolant sensors are found on older GM "T" car minimum function systems, Ford MCU and Chrysler Lean Burn systems.

DRIVEABILITY SYMPTOMS

Because of the coolant sensor's central role in triggering so many engine functions, a faulty coolant sensor (or sensor circuit) can cause a variety of cold performance problems as well as emission failures.

The most common symptom that indicates a bad coolant sensor is an engine control system that fails to go into closed loop once the engine is warm.

Other symptoms that might be caused by a bad coolant sensor include:

- Poor cold idle (due to a rich fuel mixture, no Early Fuel Evaporation -EFE- or lack of heated air).
- Stalling (rich mixture, retarded timing, slow idle speed).
- Cold hesitation or stumble (no EFE or EGR occurring too soon).
- Poor fuel mileage (rich mixture, open loop, spark retarded).

Keep in mind that coolant sensor problems may also be due to wiring faults or loose or corroded connections rather that a failure of the sensor itself. Correct operation of the sensor can also be upset by installing the wrong temperature range thermostat (too cold for the application), or by incomplete filling of the cooling system or coolant loss. To give an accurate reading, the sensor element must be in direct contact with liquid coolant.

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Fine Tuning

Fine Tuning questions are answered by Jim Bates, Technical Services Director. Please send your questions to: Jim Bates C/O WELLS Manufacturing Corp., P.O. Box 70, Fond du Lac, WI 54936-0070 or e-mail him at technical@wellsmfgcorp.com. We'll send you a WELLS' shirt if your question is published. So please include your shirt size with your question.

Q. "We have been working on a '92 Nissan Pathfinder 3.0L SOHC MFI with a constant Check Engine Light and Code 45 (injector leak). After leak testing and clearing the code, the light comes back on with the same code again! Any help would be appreciated."

John Truman, City Auto Parts, Syracuse, NY

Any sensor input that results in a rich mixture can cause an injector leak code. The best way to resolve a code 45 on these vehicles in addition to the injector leak down test is to carefully check the Mass Air Flow Sensor, coolant and O2 sensors along with a fuel pressure regulator test.

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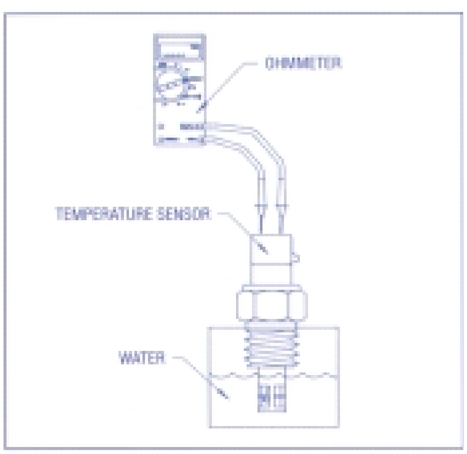
Q: "I have a '95 Dodge Neon with a cold hesitation and rough idle condition. There's also a lot of black smoke in the exhaust. I've replaced the oxygen sensor and spark plugs but it made no difference. There are no fault codes and compression and timing are okay. Help!"

Skip Dorman, Akron, OH

Have you checked the intake air temperature sensor? The powertrain control module uses input from this sensor and the throttle position sensor to vary fuel delivery. If the intake air temperature sensor is faulty, it can upset the air/fuel mixture causing it to run rich.



To test the sensor, remove it from the manifold and connect an ohmmeter across the terminals. Alter the sensor's temperature by immersing the tip of the sensor in either warm or cold water.

As the temperature changes, you should see a change in the ohmmeter reading. No change would tell you the sensor has failed and needs to be replaced.

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Q: "We have an Oldsmobile Cutlass Calais with a 2.3L Quad Four engine. The engine cranks but won't start. Compression and fuel pressure are normal, but there's no spark. We replaced the coil assembly and module, but still no spark. What are we overlooking?"

Confused, Amarillo, TX

You didn't mention the crankshaft position sensor. The magnetic sensor used on this engine is mounted on the side if the engine block, and must have an air gap of less than .050 inches from the crankshaft to generate a good signal.

To check the sensor, unplug its electrical connector and measure resistance between the appropriate terminals. On the 2.3L Quad 4, you should read between 500 and 900 ohms.

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Q: "I'm trying to figure out why a 1984 Buick 3800 is behaving strangely. It starts fine when cold, but stalls when you put it into gear and try to drive away. After the engine warms up, it runs fine. I've checked and adjusted the choke with no effect. I also replaced the spark plugs and plug wires."

Bill Johnson, Bloomington, IL

Try replacing the rotor. When the engine is cold, the load on the ignition system is higher than normal. If the rotor is leaking voltage, it will short to ground causing the engine to stall. When the engine warms up, the voltage demands are less and the rotor will pass the voltage to the plugs rather than ground. Also, carefully inspect the distributor cap, particularly the carbon button between the coil and rotor, for wear, damage or burn through. Also check coil primary and secondary resistance.

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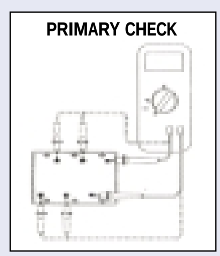
Tips For Testing DIS Ignition Coils

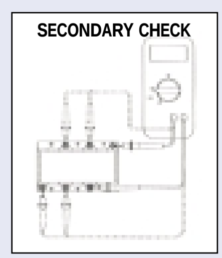
The coils used in distributorless ignition systems (DIS) function the same as coils in conventional ignition systems. The coil steps up the primary voltage to produce a high-voltage spark for the spark plugs. But instead of passing through a distributor, voltage goes directly to the spark plug(s).

To reduce cost and complexity, many DIS systems have one coil for every two spark plugs. Others may have a separate coil for each plug. Those that share coils connect each coil to two plugs which are opposite one another in the engine's firing order. Both plugs fire at the same time, but because one cylinder is on its exhaust stroke, the "waste spark" that occurs in that cylinder does nothing.

An important thing to remember here is that if the coil's output is weak, misfire may occur in both of the engine's cylinders associated with that coil. Symptoms may include hard starting, rough idle, misfire on acceleration, hesitation, stalling, poor fuel economy and elevated hydrocarbon (HC) emissions. A no-start condition would more likely be caused by a bad DIS module or crankshaft position sensor failure rather than an individual coil failure.

DIS coils are tested in essentially the same way as epoxy-filled (square-type) ignition coils. First, isolate the coil pack by disconnecting all the leads. Set the ohmmeter in the low range, and recalibrate if necessary. Connect the ohmmeter leads across the coil's primary terminals, and compare the primary resistance reading to specifications (typically less than 2 ohms). Then connect the ohmmeter, set in the high range, across the coil's secondary terminals and compare the secondary resistance reading to specifications (typically 6,000 to 30,000 ohms).





In most cases, you'll find a coil where the secondary resistance is reading too high. Some coils may also test okay when cold, but be out of specifications when the coil heats up.

HINT: *If measuring the secondary resistance of a DIS coil is difficult because of the coil's location, try this: remove the wires from the spark plugs and measure secondary resistance though the plug wires rather than at the secondary terminals on the coils. Just remember to add in a maximum of 8,000 ohms of resistance per foot for the plug wires.*

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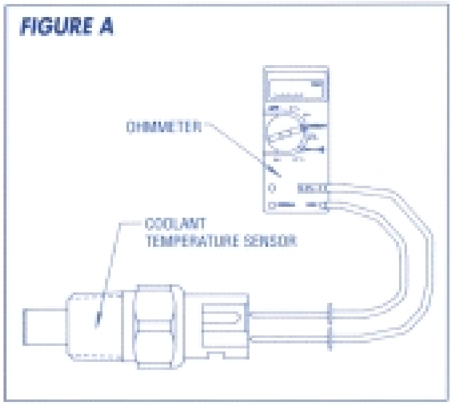
SENSOR CHECKS

One simple way of testing a coolant temperature sensor is by performing a "sweep test" with an ohmmeter (Fig. A):



- Start with a cold engine. With the ignition off, disconnect the wiring connector from the coolant sensor.
- Attach an ohmmeter across the sensor's terminals.
- Measure the sensor's resistance and record the reading.
- Reconnect the sensor's wiring connector.
- Start and run the engine for two minutes and then shut the engine off.
- Disconnect the sensor's wiring harness again, and take an ohmmeter reading across the sensor's terminals.
- Compare the two readings. There should be a difference of at least 200 ohms. If not, the sensor is defective or suffers from a buildup of cooling system sludge which makes it less sensitive to changes in engine temperature. Remove and inspect the sensor, clean if necessary and retest.

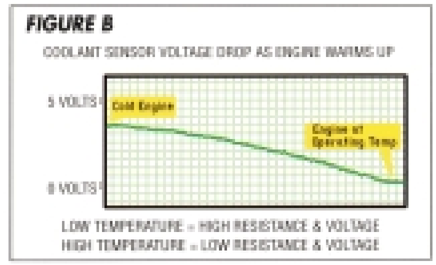
You can also measure the sensor's resistance at various temperatures, and compare the readings against the resistance values specified by the vehicle manufacturer.

Another way to check the sensor's operation is to measure the sensor's reference voltage and return voltage signal as the engine warms up with a voltmeter. If you have access to a digital storage oscilloscope (DSO), you can also observe the sensor's waveform.

The reference voltage (VRef) to the sensor from the PCM should be about 5 volts on most applications. The return voltage signal should be around 3 to 4 volts when the engine is cold, and gradually drop to 2 volts or less as the engine reaches normal operating temperature. (Fig. B)

- No change in the return signal would indicate a faulty sensor. No return voltage reading would indicate an open sensor.
- No VRef reading would indicate a wiring fault.

NOTE: Some 1985 and newer Chrysler coolant sensors switch a 1000 ohm resistor into the circuit when the coolant temperature reaches about 125 degrees F, causing a sudden rise or step up in the return voltage signal before it continues to drop.



If a vehicle provides live sensor data through its diagnostic connector, you can also read the coolant sensor's output directly with a scan tool (usually in degrees Centigrade or Fahrenheit).

Trouble codes that indicate a problem in coolant sensor circuit:

- General Motors: Code 14 (shorted) and 15 (open)
- Ford: Codes 21, 51 & 61
- Chrysler: Code 17 & 22
- OBD II applications: P0117, P0118, P0125, P1114, P1115 & P1620

Quality Points

For Technicians, QS-9000 Means Extra Protection

You've probably heard a lot about QS-9000 Certification lately, and rightly so. QS-9000 is a quality standard developed jointly by Ford, Chrysler, General Motors and the heavy-duty truck industry for OEM component parts suppliers. The "Automotive Quality System Requirements" (QS-9000) is based on similar quality standards that were developed as a worldwide benchmark for primary manufacturers of many different types of products (ISO9000). QS-9000 supersedes Ford's Q1, Chrysler's QAM (Quality Assurance Manual) and GM's TFE (Targets For Excellence) programs and all Tier 1 OEM suppliers must meet the QS-9000 standard.

IGNITION COMPONENTS ARE TESTED FOR FUNCTIONAL STABILITY UNDER EXTREME VARIATIONS IN WELLS' TEST LABS.

QS-9000 was created to combine the various quality requirements of the domestic vehicle manufacturers into a single, uniform standard that is on par with the world-wide ISO9000 standard. But its basic purpose is to raise the quality benchmark for all automotive parts, be they new parts or replacement parts.

Compliance with the QS-9000 standard requires the implementation of a closely audited and ongoing monitoring system for checking parts as they are manufactured. Each and every part must pass a rigid inspection before it goes out the door. The overall goal of such intense scrutiny is zero defects.

Though QS-9000 quality certification is now required for OEM suppliers, many aftermarket manufacturers do not yet meet this new standard. But WELLS Manufacturing Corp. does. WELLS was the first manufacturer of electronic engine management

100% INSPECTION IS CONDUCTED ON EVERY COMPONENT IN WELLS' STATE-OF-THE-ART ELECTRONICS MANUFACTURING FACILITIES.

systems, charging systems and sensors to achieve compliance with the prestigious QS-9000 standard. WELLS did this in August, 1996, and is still the only full-line ignition manufacturer to achieve QS-9000 certification.

"WELLS has been supplying quality ignition products to the automotive industry since 1903," said Gavin Spence, WELLS' Vice-President of Sales. "Quality is a vital part of this company's heritage."

So what does QS-9000 mean to you? For parts made by manufacturers who meet the QS-9000 quality certification, it means a consistently high level of quality in the parts they produce. That, in turn, means better value for your money, longer-lived repairs, fewer premature failures and comebacks, and most importantly, a higher lever of satisfaction among your customers.

Look for the QS-9000 quality certification. It's your best guarantee of consistent quality in the replacement parts you buy.

WELLS

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Hot off the Wire

Technicians: We Want Your Questions!

Is a driveability problem related to electronic ignition components causing you frustration? WELLS wants to help.

Just send us the problem in the form of a question. We'll answer as many as space allows, usually about five, in each issue of Counter Point. Just send your questions to:

Jim Bates, Technical Service Director
WELLS Manufacturing Corp.
P.O. Box 70
Fond du Lac, WI 54936-0070

or e-mail Jim at technical@wellsmfgcorp.com.

If your question is chosen for publication, we'll send you a FREE WELLS shirt. So, be sure to include your shirt size along with your question.

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