WELLS Counter Point
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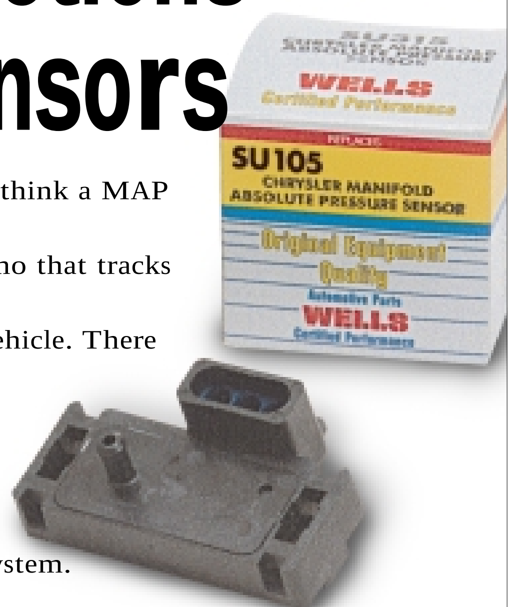
THE ELECTRONIC, DIAGNOSTIC AND DRIVEABILITY RESOURCE.

Helpful Directions for MAP Sensors



Some vehicle owners might think a MAP sensor is some kind of gizmo that tracks the whereabouts of their vehicle. There are high-tech on-board navigational systems that can do just that, but the MAP sensor plays no role in such a system.

It's an engine sensor that provides directions of a different sort. The MAP sensor's job is to keep the computerized engine control system informed about engine load so the fuel mixture, spark timing and other emission functions can be adjusted to suit changing operating conditions. It's an essential job that requires accurate calibration and trouble-free operation for good engine performance and driveability. So here are some directions of our own about MAP sensors along with diagnostic procedures you can use to troubleshoot this crucial sensor.

Follow These Directions To Find Problems With MAP Sensors

MAP stands for "Manifold Absolute Pressure", which is the pressure inside the engine's intake manifold. Pressure is low when intake vacuum is high (as at idle), and pressure is high when vacuum is low (as at wide-open throttle). It's called an "absolute" pressure reading because it depends solely on pressure inside the manifold, though some types of MAP sensors are actually "differential" pressure sensors that measure the difference between intake vacuum and atmospheric (barometric) pressure.

A MAP sensor reads engine vacuum through a hose connected to the intake manifold. A pressure sensitive ceramic or silicon element and electronic circuit inside the sensor generates a voltage signal that changes with intake vacuum. The sensor itself may be located in the engine compartment or under the dashboard.

Most MAP sensors have three terminals: a ground terminal, a voltage reference (VRef) supply terminal (typically 5 volts, which is provided by the computer), and an output terminal for sending data back to the computer.

As engine load changes, so does the MAP sensor's output. The sensor's output voltage will vary

continued on page 2

Welcome To The First Counter Point Newsletter

Welcome to the first issue of Wells' Counter Point newsletter, a publication created to be a valuable resource for today's automotive technicians. It will be published four times a year.

Each Counter Point will feature an in-depth technical article, such as the one in this issue on MAP sensors. That's the goal of Counter Point: no fluff, just valuable information presented in a straight-forward easy-to-read style.

We're even providing a feature, "Fine Tuning," where technicians can direct questions about automotive diagnostics to Wells' Technical Services Director Jim Bates, a nationally recognized expert.

And we'll give a free Wells shirt to people whose questions are published, so please send your shirt size along with those questions.

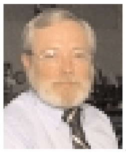
Counter Point will contain other useful information as well, such as the article in this issue which explains the advantages of Wells' replacement ignition control module for Ford over its OE counterpart.

In conjunction with the Counter Point newsletter, we will issue Counter Point Bulletins containing technical updates as needed.

We hope that you'll find a great deal of interest in this first newsletter. That is, after all, the point of Counter Point: to provide you with valuable information. We welcome your comments. Let us know what you think.

WHAT'S INSIDE:
Directions for MAP Sensors…Page 1 / Welcome to Counter Point…Page 1 / FINE TUNING…Page 2
QUALITY POINTS: Ford Ignition Modules…Page 3 HOT OFF THE WIRE: QS-9000 Certification…Page 4 / Publisher's Information…Page 4

Fine Tuning



Fine Tuning questions are answered by Jim Bates, Technical Services Director. Please send your questions to: Jim Bates c/o WELLS Mfg. 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.

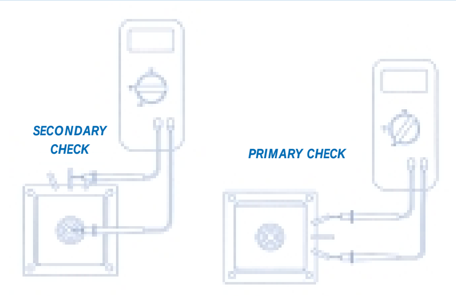
Q: "I'm working on a 1978 Chevy Pickup 350 V8 that misfires under load and occasionally dies and won't restart. I suspect a bad coil but want to confirm my diagnosis before I replace it. What should I check?"

Larry Stanfel, Bellview, WA

If the engine is running but hesitates or bucks when accelerating, or idles roughly, the coil may be arcing. Inspect the coil for obvious signs of arcing such as carbon tracks or cracks in the vicinity of the center tower and terminals. Corroded or discolored terminals would be another clue to arcing. Also, make sure the tower boot on the high voltage output wire fits snugly.

Observe the coil while the engine is running. Arcing will be most visible if this is done outdoors after dark. Have a helper blip the throttle or rev the engine intermittently. The sudden change in load will often reveal an intermittent arcing condition that may not be visible when the engine is idling or under light load.

You can also check the primary and secondary resistance of the coil (refer to the accompanying diagram). Primary resistance should be 0.3 to 1.0 ohms. Secondary resistance should be 6,000 to 30,000 ohms. If the coil does not test within specifications, it needs to be replaced.



NOTE: Before you measure the primary resistance in any coil, you should always "baseline" the ohmmeter by touching the two test leads together to see how much resistance is in the leads. Then remember to subtract this amount from the actual coil reading to accurately measure the coil's primary resistance. Forget this step and a bad coil may test good or vice versa.

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Q: "We have a 1985 BMW 325i that ran fine until we changed the oil. Now it idles poorly like it's sucking air. What gives?"

Jimmy Nash – Auto Clinic
Neenah, WI

All engines can be affected by vacuum leaks, but especially fuel injected engines. This includes air leaks anywhere downstream of the throttle, including the PCV system. Unmetered air that is pulled into the manifold past leaky gaskets, leaky injector O-ring seals, or even air leaks in the crankcase can all upset the idle mixture creating an idle quality problem.

Check the dipstick. If the dipstick isn't tightly seated, air can enter the crankcase and be pulled into the intake manifold through the PCV system and act like a vacuum leak.

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Q: "We've replaced three control modules in the past two weeks on a 1985 Chevy Suburban 350. What's causing the modules to burn out?"

John Pauk
Topeka, KS

They might be failing because of a bad distributor ground. The area where the distributor housing mates with the intake manifold on this engine can become corroded and oily, reducing the area of contact preventing a good ground connection. Cleaning the base of the housing and the distributor holddown clamp can restore a good electrical connection.

A digital Volt/Ohm meter can be used to find bad grounds. The test is done by placing the negative (black) test lead of a DVOM on the battery negative post. Then turn the ignition key ON and probe various ground points on the engine with the positive (red) test lead. If the ground connections are good, the DVOM reading should remain at zero. A DVOM reading of 0.4 volts or higher would indicate a bad connection. Check for loose or corroded cables, ground straps, etc.

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Q: "I've worked on a 1981 Volvo 244 that gradually loses power. Ignition, fuel pressure and compression all seem to be fine. I'm stumped."

H. Mattheis
Massena, IA

This could be a "spark arrestor" problem. This particular engine does not have a PCV valve, but does have a flame trap (spark arrestor) in the vent hose that runs from the valve cover to the throttle bypass. If the spark arrestor becomes clogged, it will block the flow of air and upset the air/fuel mixture causing the gradual loss of power described. The cure here is to remove and clean or replace the spark arrestor.

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continued from page 1

Directions for MAP Sensors

depending on the application, but a typical GM sensor reading might be 1.25 volts at idle and just under 5 volts at wide-open throttle. Voltage reads low when vacuum is high, and increases as vacuum drops. Output generally changes about 0.7 to 1.0 volts for every 5 inches of change in vacuum.

Ford MAP sensors work somewhat differently in that they produce a digital frequency signal rather than an analog D.C. voltage signal. These sensors output a square wave signal that increases in frequency as vacuum drops. A typical reading at idle might be 95 Hertz (Hz or cycles per second) when vacuum is high, and 150 Hz at wide-open throttle when vacuum is low.

The MAP sensor's signal is used by the powertrain control module (PCM) to adjust the air/fuel mixture and spark timing. Under low load, high-vacuum conditions, the PCM typically leans the air/fuel mixture and advances spark timing for better fuel economy. Under high-load low-vacuum conditions, the PCM richens the air/fuel mixture for more power and retards spark timing to prevent detonation (spark knock). These control functions are programmed into the computer and require accurate sensor inputs. So if the MAP sensor is defective or out of calibration, driveability and performance problems can occur.

Engines with a "speed-density" type of electronic fuel injection system (no airflow sensor) are especially dependent on the MAP sensor's signal because the PCM uses it along with engine rpm, throttle-position and ambient air temperature to calculate air flow. Engines that do not have a MAP sensor estimate engine load using input from the airflow and throttle-position sensors.

Driveability symptoms that can be caused by a bad MAP sensor, grounds or opens in the sensor's wiring circuit, vacuum leaks in the sensor hose or intake manifold include hard starting, hesitation, engine misfires, stalling, rough or erratic idle, pinging, black exhaust smoke (rich fuel condition resulting in high hydrocarbon emissions), poor fuel economy and generally poor engine performance.

MAP SENSOR CHECKS

There are numerous ways to check a MAP sensor, including using a scan tool to check for MAP sensor trouble codes, observing the sensor's output as a waveform on a digital storage oscilloscope, and/or comparing the sensor's output voltage or frequency (Ford) to specifications in a manual. But here are two relatively simple procedures that can quickly tell you

continued on page 3

Quality Points

WELLS' Ignition Modules for FORD: We've Improved on Original Equipment

You can't judge a book by its cover, and neither can you judge the quality of an ignition module by the external appearance of the case.

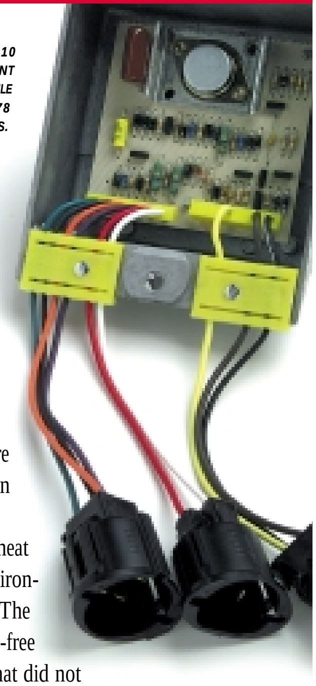
It's what's inside that counts.

When Wells develops an aftermarket replacement module for an application, our engineers evaluate the original equipment design to see if there's room for improvement. Often there is. A classic example is how Wells reengineered the "large box" ignition module that was used from 1975 to 1989 on numerous Ford vehicles.

The original equipment module used ballast resistors, because electronic current limiters were not yet in use when Ford designed the module's electronics.

These resistors created a lot of heat inside the module, which caused a high failure rate on many of the OE modules. Replacing a bad module with another OE unit may have solved the ignition problem, but it did not solve the underlying heat problem because the OE replacement modules also contained these ballast resistors. Consequently, repeat failures were common.

When Wells evaluated the original Ford design years ago, we decided to get rid of the troublesome ballast resistors and replace them with state-of-the-art electronic current limiters. New cooler running, longer lasting transistors were also added to improve reliability. The electronics were also embedded in an improved potting material for better heat dissipation and environmental protection. The result was a trouble-free replacement unit that did not suffer repeat failures like the OE unit.



WELLS' F110 REPLACEMENT IGNITION MODULE FOR 1978 TO 1980 FORDS.

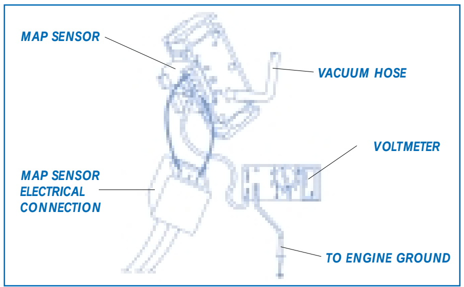
This is only one of many examples of how Wells has engineered improved replacement products for the aftermarket. And because we know what goes into our modules, we're able to back them up with a lifetime warranty — and the OE's can't beat that!

continued from page 2

Directions for MAP Sensors

whether or not a MAP sensor is responding to changes in intake vacuum.

You can test General Motors and Chrysler MAP sensors on the vehicle using a digital voltmeter (DVOM) and two jumper wires:



1. Disconnect the MAP sensor's electrical connector.
2. Connect one jumper wire between the connector and the MAP sensor's terminal "A".
3. Connect another jumper wire from the connector to terminal "C".
4. Connect the positive lead on the DVOM to terminal "B" (the sensor's output terminal) and the negative DVOM test lead to a good engine ground.
5. Turn the ignition key ON and observe the voltage. If the reading falls in the voltage range of 4 to 5 volts (2 to 3 volts for turbocharged engines) at sea level, the sensor is functioning properly at this point.
6. Be sure the vacuum hose between the MAP sensor and engine is in good condition and does not leak. Then start the engine and let it idle.

An idling engine will produce a large amount of intake vacuum, which should pull the MAP sensor's voltage down to a low reading of 1 to 2 volts (note: readings will vary with altitude).

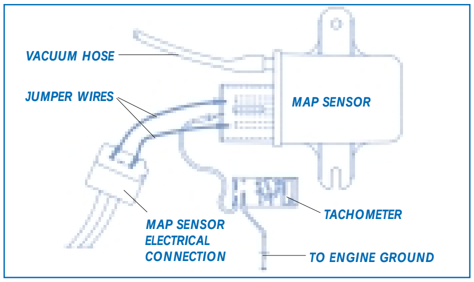
You can also do this test with the key on, engine off by applying vacuum to the MAP sensor's hose with a hand-held vacuum pump. But do NOT apply more than 20 inches of vacuum (excessive vacuum may damage the sensor).

This test verifies that the MAP sensor is responding to changes in engine vacuum. If the reading does not change, it means the sensor is faulty or the vacuum hose is plugged or leaking.

On Ford applications, a multimeter that can read frequency is normally required to check the sensor's output. But you can also use an ordinary tachometer because a tach can display a frequency signal.

Here's the procedure:

1. Set the tachometer to the four-cylinder scale (regardless of how many cylinders the engine has).
2. Connect one tachometer lead to the middle terminal on the MAP sensor and the other tachometer test lead to ground.



3. Connect the two jumper cables the same as before, attaching each end terminal on the sensor to its respective wire in the wiring connector.
4. If you want to measure engine vacuum so you can correlate it to a specific frequency reading, connect a vacuum gauge to a source of manifold vacuum on the engine, or tee the gauge into the MAP sensor hose.
5. Turn the ignition ON and note the initial reading. The reading on the tachometer should be about 454 to 464 at sea level, which corresponds to a frequency output of 152 to 155 Hz.
6. Start the engine and check the reading again. If the MAP sensor is functioning properly, the reading should drop to about 290 to 330 on the tachometer, which corresponds to a frequency output of about 93 to 98 Hz. No change would indicate a defective sensor or leaky or plugged vacuum hose.

INSIDE: DIAGNOSING MAP SENSORS

WELLS

WELLS MANUFACTURING CORPORATION
P.O. Box 70
Fond du Lac, WI 54936-0070

Hot off the Wire

WELLS: The First With QS-9000 Certification

Wells has undergone two successful quality audits since becoming the first manufacturer of electronic engine management systems, charging systems and sensors to achieve prestigious QS-9000 quality compliance late last year.

Based on internationally recognized ISO-9000 standards, QS-9000 is an automotive quality requirement established by the Big Three U.S. automakers to promote continuous product improvement and customer satisfaction.

All Tier 1 suppliers to the Big Three must be in QS-9000 compliance by the end of this year.

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

Wells had to pass a series of compliance audits to be registered. The company will receive twice-a-year audits to ensure that it maintains the required exacting standards. Audits will focus on one of the more than 20 components of Wells' quality control programs, including quality systems, internal quality audits and production part approval process.

Publisher's Information

Wells' President......................Bill Allen

Vice President Sales........Gavin Spence

Technical Services Director .....Jim Bates

Newsletter Editor ....Ron Raposa

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