WELLS Counter Point
Volume 4 Issue 4, October 2000
THE ELECTRONIC, DIAGNOSTIC AND DRIVEABILITY RESOURCE.

Knock Sensors Do Two Jobs

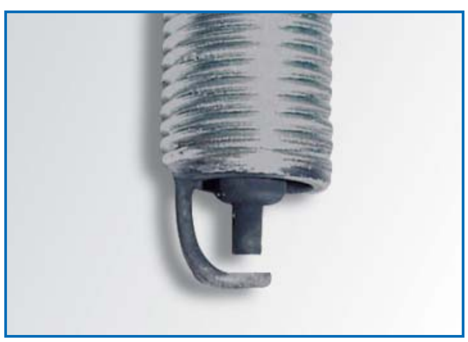
Knock sensors play a dual role on OBD-II engines. Like other sensors, knock sensors monitor engine operation to optimize performance. In addition, knock sensors protect the engine against power-robbing, and potentially destructive, engine knock.

Ideal conditions would have the spark occur when the piston reaches top dead center (TDC). The flame front would travel across the combustion chamber for a complete burn of the air-fuel mixture just as the piston returns down the cylinder. Realistically, the air-fuel mixture takes longer to burn. The difference is a fraction of a second and must be compensated for. As a result, advanced timing is required. The design of the chamber and advanced timing generate optimal performance in terms of power, fuel economy, and reduced emissions.

SOUNDS LIKE MARBLES

Up to a point, more power can be produced in an engine by increasing spark advance. But too much advance causes engine knock. Once knock starts, performance decreases and there is a risk of serious engine damage. Knock gets its name because it causes vibrations and banging in the cylinder. Mild knock causes a "pinging" noise that sounds like marbles or small ball bearings bouncing on a piece of metal.

Severe knock sounds like someone banging on a door. Mild knock reduces power, wastes fuel and increases emissions. Severe knock can destroy internal engine parts including the pistons, connecting rods, exhaust valves, head gaskets and spark plugs.



Damaged Spark Plug

Knock occurs when the air-fuel mixture doesn't burn smoothly or is ignited too soon. Knock can be caused by "hot spots" in the cylinder, such as carbon deposits or spark plugs that are too hot for the engine, or high combustion chamber temperatures.

These hot spots ignite the air-fuel mixture before the spark plug fires. The result is two flame fronts, one from the hot spot and one from the spark plug, occurring at the same time. The fronts slam into each other violently as the burning gases rapidly expand.

Knocking also occurs if spark timing is advanced too far. In this type of situation, there is only one flame front, but it happens while the piston is too far before TDC. Instead of a collision between flame fronts, there is a "collision" between the rapidly expanding gases from combustion and the top of the piston as it moves up the cylinder wall. In an OBD-II system with electronic spark timing, the PCM continually reads a number of input signals, including base timing, throttle position, intake manifold pressure, transmission gear and vehicle speed. Some PCMs will even read a rapid change in throttle position, indicating the driver wants to accelerate quickly. Based on its programming, the PCM advances spark to a preset level for different conditions. The preset spark advance is typically close to the knock point because the system relies on the knock sensor as a warning device.

Most knock sensors send a base or "no knocking" reference signal to the PCM. If knocking occurs, the sensor detects the increased vibration and increases its signal to the PCM. The PCM then slightly retards timing until the sensor signal returns to the reference level.

If a temporary condition caused the knock, the PCM will set spark timing to the programmed advance. If the knock returns, the PCM will cycle spark timing, advancing timing until knock is encountered and then retarding timing until the knock is gone.

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Fine Tuning

*Fine Tuning questions are answered by Mark Hicks, Technical Services Instructor. Please send your questions to: Mark Hicks 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: On a 1997 Taurus 3.0 L, DIS, automatic, with 40,000 miles, the engine starts and runs OK, but it will set codes P0303 (misfire #3) and P0304 (misfire #4) after a few minutes of driving. The scope shows no problem with secondary ignition. Cylinders 3 and 4 share a coil, which was replaced, but the problem continues. What now?

South Hampton Shell, South Hampton, NJ

Recheck the scope readings and spark plug wire routing. When replacing a coil pack, you may also want to check the spark plug wires. High secondary resistance can cause high RFI levels, which can affect the vehicles wiring and trigger false misfire codes.

Q: We have a 1997 Chevrolet Malibu that seems to have a carbon-tracking problem in the ignition coil housing. We replaced the housing and spark plugs some time back, but not the coils. The car is in for a hard starting/poor performance complaint and needs new coils. When we removed them, we noticed that the carbon tracking was back. The plugs look OK and so does the rest of the housing. The weird thing is, you can wipe off some of the carbon tracking with a rag. What causes this?

Will's Autoworks, Trenton, NJ

Many ignition coil housings from the Quad 4 and Twin Cam engines can develop a characteristic marking that is often mistaken for carbon tracking. These marks are a characteristic of the high voltage distribution through the coil housing that can develop over a period of time. Vehicle operation and climate are also a factor. These false "carbon tracks," which can be wiped off with a damp cloth, can be often seen on the bottom of the housing between the secondary ignition terminals. Real carbon tracking from a high voltage arc is characterized by damage to the coil housing with black residue or carbon imbedded in the housing material. This type of damage can not be wiped away very well, and can often be felt as well as seen.

Q: We have a 1996 Ford Aerostar, 4.0 L engine and automatic, that keeps setting a DTC P1443 (Evaporative Emission). The first time, we ran the diagnostic procedure, we replaced the evaporative canister purge solenoid, and cleared the code. But P1443 returns after the van has been driven for about an hour or so. Repeating the diagnostic procedure doesn't turn up any other problem. What do you think?

Phil's Mobil Service, Denver, CO

Be sure to check the fuel tank filler cap seal carefully. The P1443 DTC can also be set by problems with the purge flow sensor. If the code keeps coming back, but the diagnostic routine doesn't uncover a problem, be sure to check the purge flow sensor as well.

Diagnose The Problem Win A Shirt

A 1997 Ford Taurus 3.0 L keeps setting misfire codes. The codes vary among cylinders #1, #4, #5, and #6, but no miss is felt, even when driving the car very hard. The PCM has been reprogrammed according to a Ford TSB on false misfire codes. All of the spark plugs, spark plug wires, and the fuel filter have been replaced. The ignition coil pack output, spark plug wire resistance, fuel injector supply voltage, resistance, voltage drop under load, fuel pressure and pressure drop at the injectors are all within specification. The crankshaft-position sensor appears to operate normally. No mechanical problems were found on the engine. What could be causing the random misfire codes?

The first reader to respond with the most accurate answer via e-mail or fax, and the first reader to respond with the most accurate answer via snail-mail, each will receive a Wells golf shirt. The answer, and the winners' names, will appear in the next issue.

Here is the answer to last issue's question regarding the backfiring 1995 Mercury 4.6L:

Rapid spark plug fouling indicates an extremely rich condition. Rich fuel mixtures usually backfire through the exhaust, not the intake manifold, unless the exhaust is blocked. In these cases, check for a restriction in the exhaust or catalytic converter, as was the problem here.

The first correct answer we received by e-mail/fax was from Mike Smith (AC Delco, ATSG certified instructor) of Smitty's Garage in Cogan Station, PA.

The first correct answer we received by "snail mail" was from William Sherman (ASE Master Auto, Truck, Machinist, L1, and Advanced Truck electrical diesel engine diagnosis) of The Original Auto-Doctor of Oak-Hill, FL. Congratulations!

Quality Points

Wells Introduces New Product Lines Using Lead-Free Solder

To keep with international standards and prevent the environmental and health concerns related to lead bearing solders, Wells has taken the leadership role and implemented lead-free solder on its new DIS (distributorless ignition systems) family of products along with its OEM line of GM regulators.

To implement lead-free solder on these products, Wells had to revise its soldering process. Instead of the past practice of using IR (infrared) or convection heating where the component was close to or hotter than the solder being melted, Wells went to a conduction method of heating. With the conduction method of heating the component, temperature could be 30 degrees cooler than the solder temperature. This soldering method allowed the re-flow temperature to be high enough to process the lead-free solder and still not damage the components. Wells also had to develop a solder paste, which would handle the demands of the automotive environment. Wells worked with its solder paste vendors to create a solder alloy that would handle the severe thermal shocks seen in underhood automotive applications. The material had to be process friendly and maintain the high quality levels for which Wells is known. In conjunction with the great support from our suppliers, Wells was able to obtain a paste that would meet our requirements. Today Wells is processing millions of parts with this environmentally-friendly solder while continuing to maintain its world-class quality levels.

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Knock Sensors Do Two Jobs

DIAGNOSTICS

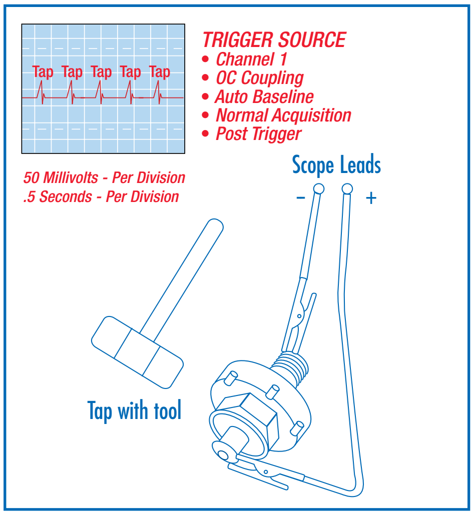
Check the functioning of the knock sensor and look for things that cause knocking like engine condition, timing, temperature, etc. Although the noise that knocking makes is hard to miss, some customers may not tell you they hear a knocking sound. Instead, the complaint will be typical of poor engine performance – loss of power, poor acceleration, drop in fuel economy, etc.

To prevent knock damage, some manufacturers program the PCM to retard timing if no knock sensor signal is detected. On these engines, if the knock sensor fails, instead of constant knocking, the engine will perform poorly because timing will be retarded all the time.

The knock sensor is normally placed in the engine block, but occasionally you'll find a sensor mounted in the cylinder head. One sensor is used on inline engines. On a "V" engine, there are usually two sensors, one in each bank of the "V." In an OBD-II system, a failed knock sensor should set a DTC of P0324 to P0329. If the engine has two knock sensors; the second sensor will set DTC of P0330 to P0334.

A scope can be used to check the operation of the knock sensor. You can also use your scan tool to check for codes as well as watching the timing changes as you check the operation of the knock sensor. Monitor the knock sensor signal and spark timing while simulating a knocking condition by tapping on the engine block or cylinder head with a soft face mallet. To the sensor, the vibration caused by striking the engine is the same as knock. You should see a signal going from the sensor to the PCM. The PCM, in response to the signal, should retard timing as long as you keep striking the engine block.

When you stop hitting the engine block, the sensor signal should return to the base level and the PCM should advance timing.



If you can simulate a knock signal, you should see timing retarded on the scan tool or timing light. This would indicate that the PCM is functioning properly and the problem is with the sensor or the wiring. If the timing doesn't retard with a simulated signal, the PCM or its wiring may be faulty.

The knock sensor can also be checked using a tester that connects across the sensor terminals. With the engine warmed up and running, rap on the block near the sensor. The tester should flash as you hit the block, indicating that the sensor is sending a signal to the PCM.

REPLACEMENT TIPS

Knock sensors are dependable, so you may not get a lot of experience changing them. These tips will help you do the job properly:

1.) Many sensors look alike, physically. But the sensor is matched to the engine and the PCM. Since all engines vibrate, the engineers must spec the knock sensor so that it doesn't react to "normal" vibration and only reacts to knocking. The wrong sensor, even though it fits, may not work properly because it won't correctly identify normal and knocking vibration.
2.) Make sure you use the right part number.

Knock sensors are either threaded into the block, or inserted and held with a clamp. With threaded sensors, use the vehicle manufacturer's specified torque to tighten the sensor. If you can't find a torque setting, snug the sensor down securely. If the sensor isn't secure in the block, it won't be able to properly detect vibration.

A new sensor may be dry, or it may have coated threads. Install the sensor as it comes from the box. Never add any locking compound or other coating to a dry sensor.

Knock sensors operate in a tough environment. They must tolerate the dirt and grease that is normally found under the hood, plus all the moisture, dirt, road salt, etc. that may accumulate. Be sure to check all connections and wiring for corrosion and damage before condemning the sensor.

KNOCKING

If there is a knock complaint, and the knock sensor and PCM are operating properly, this could mean that there is a serious problem with the engine. There are many possible sources for knocking.

Some engines are prone to knocking. The engines that are likely to knock are usually high performance and poorly maintained. Both situations require the engine to continually operate at the edge of knocking.

Using gas with a low octane rating can cause knocking too. Always use the octane rating recommended by the vehicle manufacturer. With gas prices increasing, ask the owner if he or she has switched to a lower octane fuel than the vehicle requires in order to save money.

Anything that increases combustion chamber temperature can cause knocking such as failure of the EGR, a cooling system problem, burning engine oil, or incorrect spark plug heat range.

A too lean condition, such as a PCM, fuel system or a vacuum leak problem, can also cause knocking.

On an older vehicle, especially one used primarily for stop-and-go driving, deposits can build up in the combustion chamber leading to the hot spots that cause knocking. Identifying the source of knocking can take some detective work, but the problem has to be corrected. Constant knock not only hurts performance and increases emissions, it can severely damage the engine.

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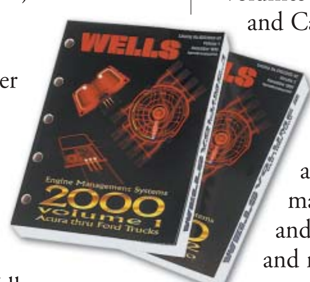
Hot off the Wire

Wells Wins Its Ninth National Catalog Manager's Association Award

Wells Manufacturing Corporation has recently been awarded its ninth President's Award for Catalog Excellence by the National Catalog Manager's Association (NCMA).

Each year the association bestows an award to a member company based on their catalog's layout, ease of use and cover design.



"We're proud to have our work recognized by our peers." said Tom Hobson, Wells Marketing Manager. "Our catalogs are much more than lists of parts and car models, our customers can now maximize their return on investment.... By incorporating Well's Alpha Locator Plan-O-Gram System into our catalogs, our retailers, distributors and installers can use their space and time more efficiently."

Wells offers catalogs covering its 19,000 part numbers. They are Engine Management Volumes 1 & 2, Illustrated Parts Guide, Wire and Cable, Fuel Systems, Farm, Industrial, Medium/Heavy Duty Truck, Fuel Injection and Marine. Products covered are engine management, including ignition, emissions, wire and cable, battery accessories and fuel management components for domestic and import cars, trucks, vans, agriculture and marine applications.

Parts stores and shop owners can get copies of Wells' catalogs by calling their Wells supplier.

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Counter Point is a quarterly publication of Wells Manufacturing Corp., P.O. Box 70, Fond du Lac, WI 54936-0070. Letters and comments should be directed to: Counter Point Editor, c/o Wells Manufacturing Corp, P.O. Box 70, Fond du Lac, WI 54936-0070.