CYLINDER CONTRIBUTION

Other Misfire Diagnostic Methods

Ignition Misfire Downstream O_2 Example

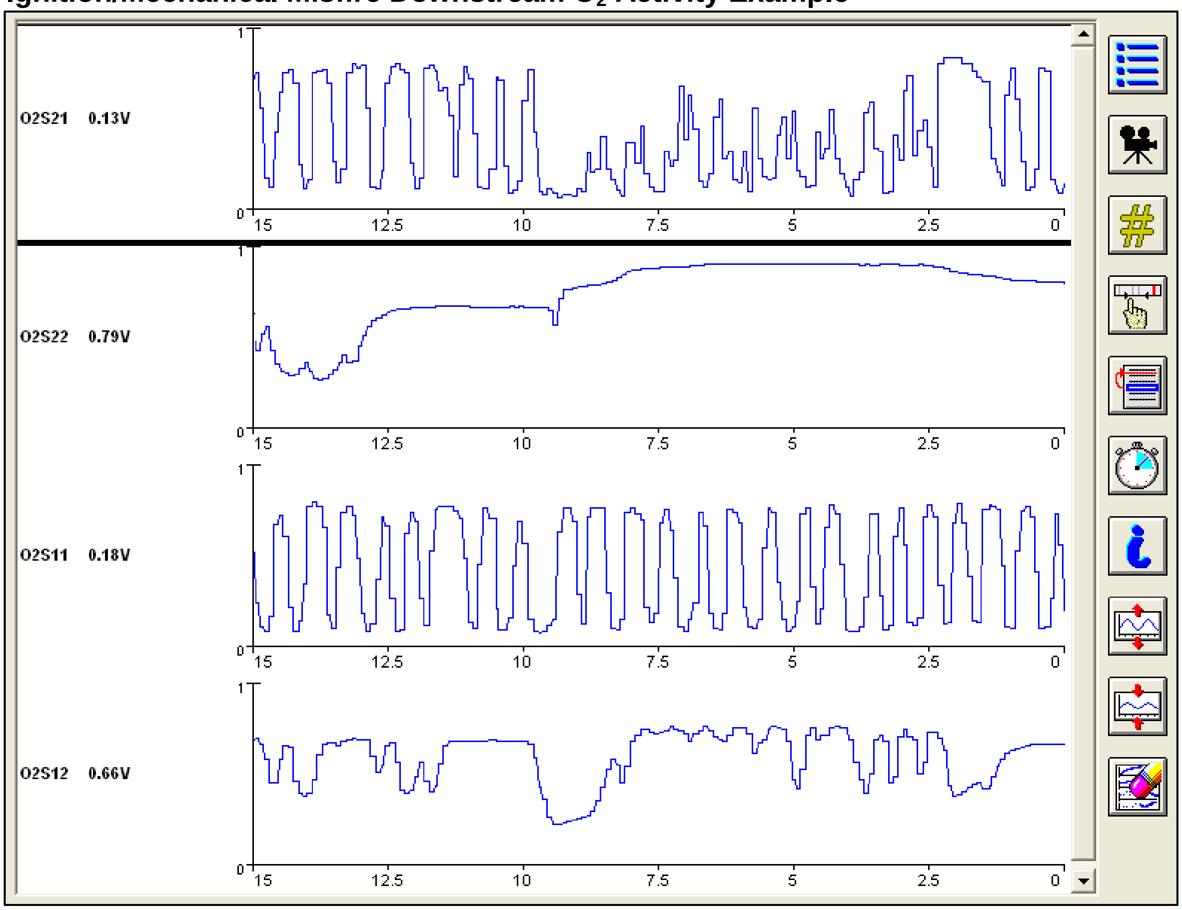
The example below shows the upstream and downstream O_2 sensors for both banks of a Ford application with a V6 engine. The vehicle came in with an intermittent misfire under a steady load. No codes were set, though the Mode $06 data could have been used to identify the offending cylinder(s). Instead, the technician decided to use the Scan Tool to see if the downstream O_2 sensor offered any clues. On a long test drive, the misfire finally occurred, and the technician recorded the graphed PIDs below.

In the example, the upstream sensor for Bank 2 (top trace) immediately started to trend lean, so it was clear that the misfire was on Bank 2. Whether you have a fuel or ignition/mechanical misfire, the upstream sensor will always shift lean because of all the unburned oxygen.

The real story is in the Bank 2 downstream sensor (2nd trace). At the same moment that the misfire started (lean upstream shift), the downstream sensor shifted rich. That was a clear indicator that the catalytic converter was able to use all of the extra O_2 to oxidize unburned HC. Therefore, this misfire was not the result of an injector or other fuel fault.

In this case, a faulty coil was found and replaced. The benefit of this test isn't that it pointed to the fault, but that it took a whole category of tests off the list. This saved time, and led to a faster final diagnosis.

Ignition/Mechanical Misfire Downstream O_2 Activity Example



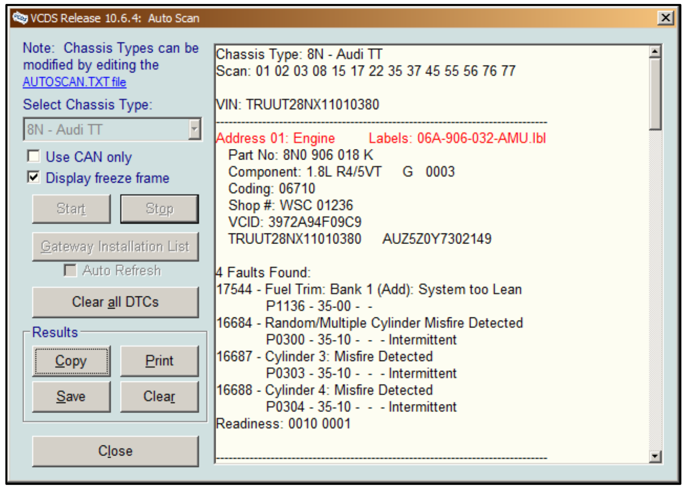
ENGINE FUELING

Fuel Trim

Fuel Trim Case Study #1

A 2000 Audi TT Quattro came in with a complaint of an erratic idle, intermittent stalling, and an illuminated MIL. Before assuming it just needed a throttle body service and relearn, the codes were checked.

The Ross-Tech VCDS PC-based Scan Tool example to the right shows that the PCM had stored codes 17544 (like a P0171 for a lean condition), as well as 3 misfire codes.

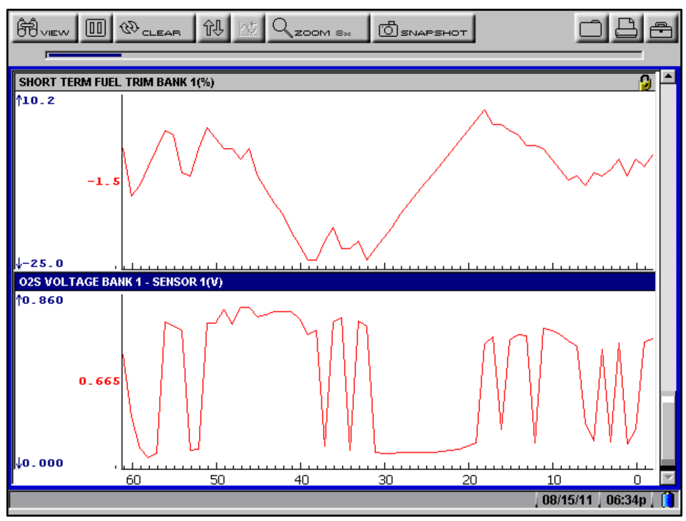


ATG TIP!

When you have Misfire and Fuel Trim codes at the same time, the Fuel Trim fault is almost always the root cause of the Misfiring, so diagnose Fuel Trim first.

Under normal circumstances, you'd want to check Freeze Frame for as many codes as possible to see the conditions under which the fault is occurring. In this case, the idle was noticeably erratic, so the technician skipped that step and immediately checked the following PIDs to see which direction to go:

- Short Term Fuel Trim (STFT)
- HO_2S Voltage
- Commanded RPM
- Actual RPM



The Snap-on Modis example to the right shows the STFT (top) and the upstream HO_2S (bottom). The HO_2S clearly shows that the voltage was high for an extended period of time (between frames 50 and 40). STFT reacted by continuing to pull negative in an attempt to get the HO_2S to switch lean. When STFT hits its limit (-25%), the HO_2S finally drops, and is then stuck lean until STFT is able to climb back up to normal levels. There are lots of faults that can cause rich and lean conditions, but not so erratically. This fault is both common and a clear indication of a sticky HO_2S.

The upstream HO_2S was replaced, the codes were cleared, and the vehicle was driven under a variety of conditions to verify the repair. Like most of our case studies, this one wasn't difficult. So the point of this story is that the root cause was found in just minutes without even lifting the hood. By checking Fuel Trim before being distracted by all other fuel system and misfire tests, lots of diagnostic tests were avoided.

TRANSDUCER-BASED TESTING

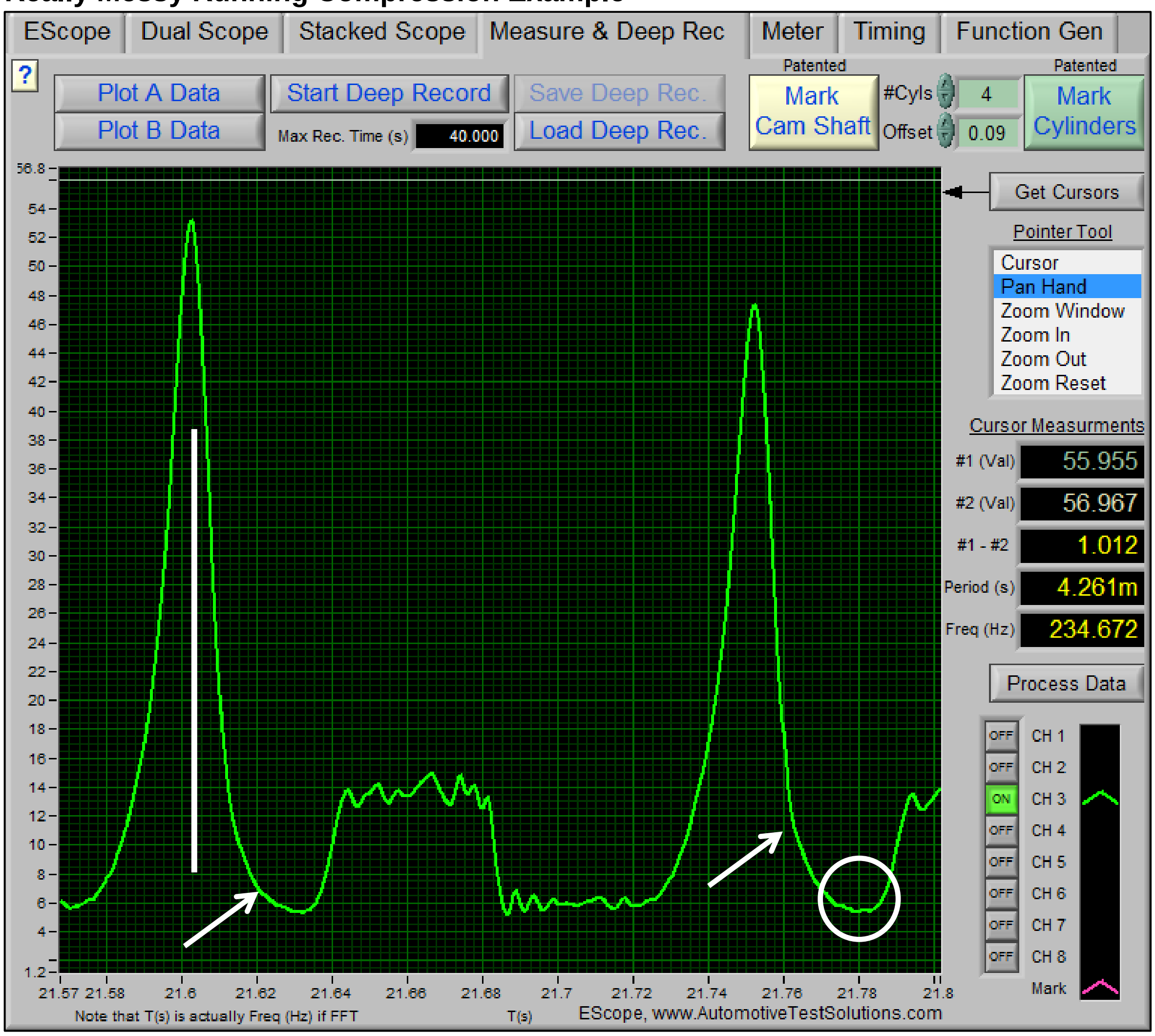
Cylinder Sealing Faults

Broken Exhaust Spring Example

The example below shows the running compression from a 4.0L inline 6 from a 1997 Jeep Grand Cherokee. The engine had a hard misfire on 1 cylinder, and the root cause is pretty clear in this waveform (once you get a little practice).

- **Uneven Low Compression:** The peak compression bounced around a lot. The peaks should be more even than the 53 PSI and 47 PSI samples shown here. And of course that's pretty low even if the peaks were all even.
- **Exhaust Pocket:** This is a great example of what 'not smooth' looks like. The arrows show some variations that are good indicators of exhaust valve faults. These differences are small, but they really should look almost exactly the same. Also, there's some intermittent turbulence in the bottom of the pocket (circled area) indicating seating problems.
- **Leaning Tower:** A vertical line has been drawn into this example so you can see clearly that the power downslope is shifted left, indicating that compression has been lost.

Really Messy Running Compression Example



TRANSDUCER-BASED TESTING

Cylinder Sealing Faults

Broken Exhaust Spring Example – Continued

A Backup Compression Loss Indicator

On a side note, the exhaust pocket is lower than the intake stroke. The tower shows the compression and decompression of the same air, so when there's a leak, there's less pressure, and so it gets decompressed earlier in the power stroke. The piston is still going down, so it simply pulls a vacuum.

Resolution

The leaning tower and low exhaust pocket in the waveform on the previous page are clear indicators of compression loss, and the changing downslope and turbulence in the exhaust pocket make it equally clear that this exhaust valve isn't sealing very well.

Before recommending a valve job, the technician got authorization to pull the valve cover, and discover a broken valve spring as shown in the graphic below. The spring was replaced, but the customer was warned that the valve may have bent slightly or the valve or seat burned. However, the engine ran perfectly with the new spring.

Broken Exhaust Valve Spring