Automotive Electronic Control Systems

AECS
Training, Equipment and Data for Automotive Diagnostic Specialists

July 2015 - Technical Newsletter

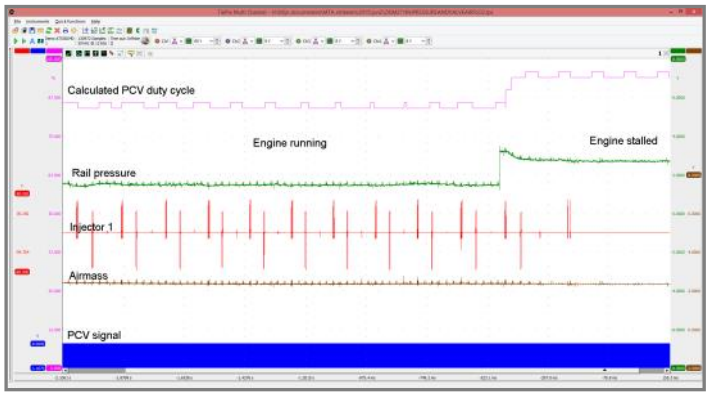
Broken Beamer

This article is a true description of an AECS technical help desk problem and how it was solved.

Vehicle: Vehicle
2002 BMW 530d dde40 M57 Diesel.

Problem presented to the Helpdesk
The customer complaint is that the car starts perfect, it idles and it revs perfectly.
After about 10 minutes car will either start running rough and then stall or cut straight out after starting and will not restart until it has cooled down. There are no fault codes.

The diagnostician who owns AECS Diagnostic equipment with technical support told us;
"I have not driven the car, as I do not want to be stuck in Auckland traffic". Fuel pre-delivery pressure and flow to the high-pressure pump stays constant.
Just looking at an ATS scope pattern on a big screen I wonder if I have a control unit (ECU) issue. The sudden pressure rise followed by a loss of the injector signal with still good crankshaft signal would point that way, would you not agree?
The Scan tool also shows that the pressure reading is going up just before stalling. The increase of duty cycle indicates the rail pressure increase is commanded by the ECU, why?



Picture 1: ATS 5004D scope recording of the moment the engine stalled.

Let's see where this diagnostician is coming from.
Plenty of rail pressure, a good crankshaft signal, and a disappearing injector signal followed by engine stall (Picture 1) certainly looks like an illogical ECU

response, making the ECU suspect I agree. The scan tool confirmed that the rail pressure rise signal, arrived at the ECU, so the signal should have been processed.
I can see why this diagnostician made the conclusion, suspecting the ECU.

Look at the recorded signal
However, let us look at the recorded signal again, but now in more detail.

In the above pattern (Picture 1), the diagnostician sent to the help desk we zoomed in on the moment the voltage of the pressure sensor jumped from 1.4V to 3.2V. (Picture 2). Obvious was that the duty cycle went 'up' AFTER the 'pressure' suddenly rose….

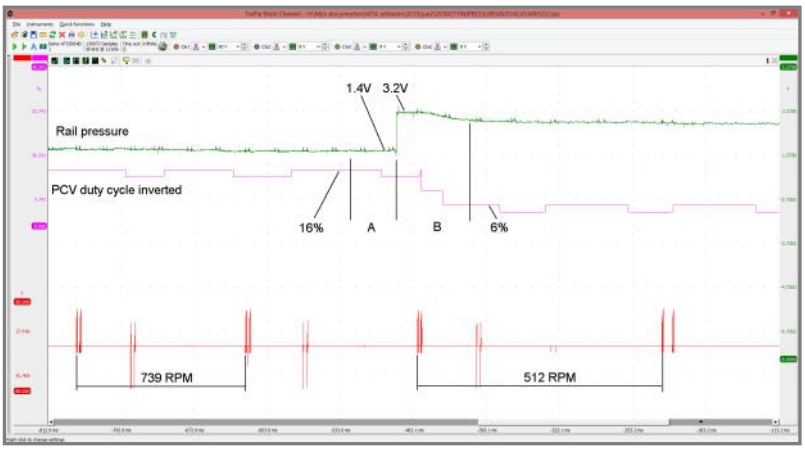
Background knowledge
The scope software has the option to display the PCV's duty cycle as an analogue line. However, some valves are positively switched and some are negatively switched. Some PCV's are normally open and some are normally closed. This means that you sometimes have to switch the scope's ability to display the analogue DC line to an inverted state.

In picture 2, we inverted the line and suddenly the pattern started talking!

ECU demands less
It was now immediately clear that the ECU did not try to increase the pressure as a result of 'something wrong' in the ECU. The ECU noticed the sudden increase in pressure and tried correctly to reduce the rail pressure by changing the duty cycle from 16% (running fine) to 6%! Straight after cutting the PCV's duty cycle back the revs go down and soon after, the engine stalled.

That shifts the focus away from replacing the ECU.
Better, confirm that the ECU is not suspect, by looking at the injection pulse width. On a good working system, when an idling engine suddenly gets a higher rail pressure, than more Diesel will be injected. To prevent that from happening the ECU will cut back the injection pulse width.

Zoomed in on just the injection pattern in this single recording: (Picture 3)

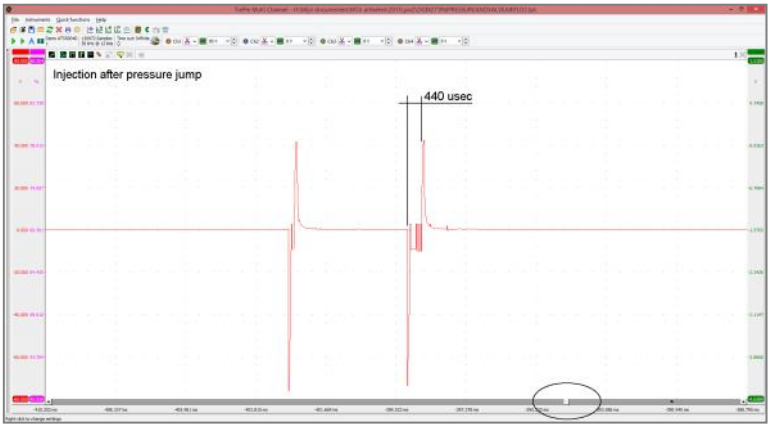


Picture 2: ATS scope recording zoomed in and most importantly with the duty cycle inverted

Picture 3: Zoomed in section of the recording on the injection pulse just before the sudden pressure rise

The main injection pulse width is 0.819 msec when the engine is still running perfect. (Picture 4)

The ECU has cut back the injection duration to almost half…. Combine this with the fact that the ECU has also controlled the rail pressure back. Makes you think!



Picture 4: Zoomed in section of the injection pulse just after the sudden pressure rise

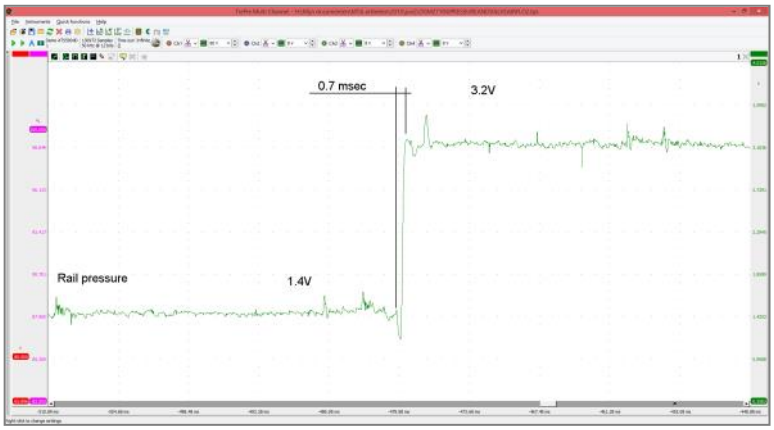
Focus on pressure sensor

Looking at the pressure sensor's signal in detail (zoom in), shows that the sensor's voltage jumps up 1.8 volts (this represents roughly 1000 Bars!) in 0.7 msec.

That is simply not possible. With test engines, we have tried many things, even suddenly opening PCV's fully. We have never been able to get such a quick pressure rise.

Then look at the 'aftermath' in the first picture (Picture 1), where the engine had stalled already (no more pumping). The pressure sensor reading is at the same voltage level as when the last injection pulses took place…

We were convinced that the pressure sensor is faulty as a conclusion by looking at this single recording in more detail (Picture 5).



Picture 5: Same recording, but now zoomed in on the pressure sensor signal.

Conclusion

A new pressure sensor was ordered and fitted. The car runs fine now for some time already.

ECUs do fail, but seldom. Make sure that you have done all your checks and balances before you own a spare ECU!
Diagnostic equipment can be a great help in making sure. However in many instances is an extra pair of eyes (AECS help desk) helpful, as it was in this case.
This job was not long, arduous and expensive. It was a nice and profitable piece of work.

Please select your equipment, and technical support provider carefully. There are many equipment providers, but look at the technical ability and credentials of such a provider before you decide to invest in such capital equipment.
The role of diagnostic equipment is increasing in importance every day. Our colleagues in Europe report a dramatic increase in electronic faults and complexity of electronics on even common vehicles.

We see the same here; this flood will not pass your workshop (unless you close the doors).
It is hard enough to keep up, but the speed with which you are falling behind if you turn a blind eye is incredible!

AECS has three diagnostic trainers all of us working as hard as we can to keep up with demand.
Contact one of us (team of six) to see how we can assist you. Just a training seminar is not that expensive, yet it can satisfy a great deal of technical hunger!

For *AECS* Ltd
Herbert Leijen
(trainer/research)
06 8749 077
info@aecs.net
www.aecs.net

Did you know? **"We have replaced our training scopes for the latest ATS 500XM's. Are you interested in the last 2 ex-training scopes (ATS 5000)?
They are fully functioning and are still a current model. The kit comes complete with Laptop (older XP units), tool case, leads, ATIS lite, probes and clips.
The whole kit (still tidy as) ready to go for $3000+gst! If you wish, add *AECS* tech support for $250+gst."**

AECS 2015 training:

Enclosed is a quick view of our 2 Day training courses for 2015. Enrolling early ensures you secure your place on our popular training courses.

AED- Automotive Electronic Diagnostics
13 - 14 July 2015 - New Plymouth
7 - 8 September 2015 - Hamilton

EMS1-3 Engine Management Systems
22 - 23 July 2015 - Auckland

EMS1-1 Engine Management Systems
15 - 16 October 2015 - Auckland

SCAN1 - Scan tool Diagnostics
13 - 14 October 2015 - Auckland

ECAC1 - Air-conditioning
8 - 9 September 2015 - Whangarei
19 - 20 October 2015 - Auckland

CANBus 1 - 4 hrs ($155+gst) ****New Training****
17 July 2015 - Palmerston North
11 September 2015 - Taupo
3 October 2015 - Auckland

Pre-enrol now for 2016 training courses

Ph:06-874 9077 ***www.aecs.net***

NB: Course dates subject to change, please check our website for current course dates.

Please note: training scopes differs from picture