Terrible Transit

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

Vehicle
2008 Ford Transit TDCi 2.4L Duratorq Common rail Diesel

Picture sourced from the internet

Problem presented to the Helpdesk
Vehicle was brought to a workshop equipped with AECS gear from another workshop who wasn't keen in learning the "new" technology (?) on this now 8-year-old vehicle. Customer complaint was that the vehicle was hard starting especially when cold, stalling just after start-up and engine not revving until it warmed up, when warm it runs fine for the rest of the day. The vehicle sometimes lacks power which required pulling off the road until throttle response comes back.
This vehicle has done over 200,000kms.

First things first
The AECS trained technician's experience told him to check glow-plugs and cranking speed. The glow current was measured at 25Amps initial glow and the cranking speed was low at only 150rpm. While replacing the glow-plugs (which required removing the manifold).
The technician also visually checked the suction control valve on the injector pump, which was scoured and therefore also replaced. A new starter motor was also fitted.
Initial glow current was now up to spec and it cranked like new again. But the cold start problem persisted with no fault codes being logged!
This is where the AECS technical support desk was contacted.

Time to scope
The ATS5004D differential 4 channel oscilloscope was used to capture the injector pulse, rail pressure sensor voltage, crank sensor and camshaft position sensor (not shown). The recording below, captured during the engine stalling, shows that the ECU keeps on firing the injectors, rail pressure remains at a nice 1.5V and the crank angle and CAM shaft position sensor pulse remain present till the "very end".
A closer look at the rail pressure sensor zoomed in shows that the rail pressure sensor pattern isn't as smooth as what we would've expected.

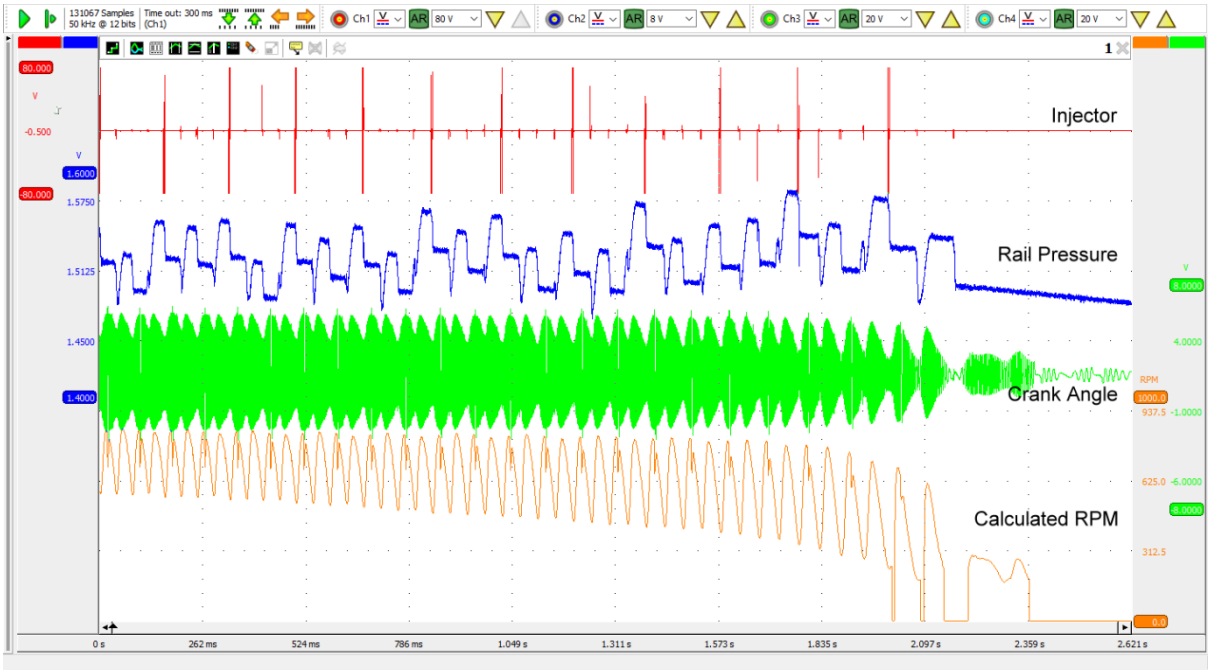

Figure 1: Injector, rail pressure, crankshaft and calculated RPM during the engine stalling.

Clear fuel line was fitted between the filter and the pump and the injector return. The fuel lines showed that the fuel was aerated, the filter and its housing were replaced with genuine parts fixing 99% of the air issues. The vehicle now starts and runs.

Fixed!

Sorry life is not that easy…the next morning the vehicle needed to be moved, it started and stalled 3-4 times before suddenly coming to life. A closer look at the poor starting rpm patterns reveals that the slope of the delta-N pattern as a result of compression is shallower then the slope of the increase in RPM due to ignition (injection).

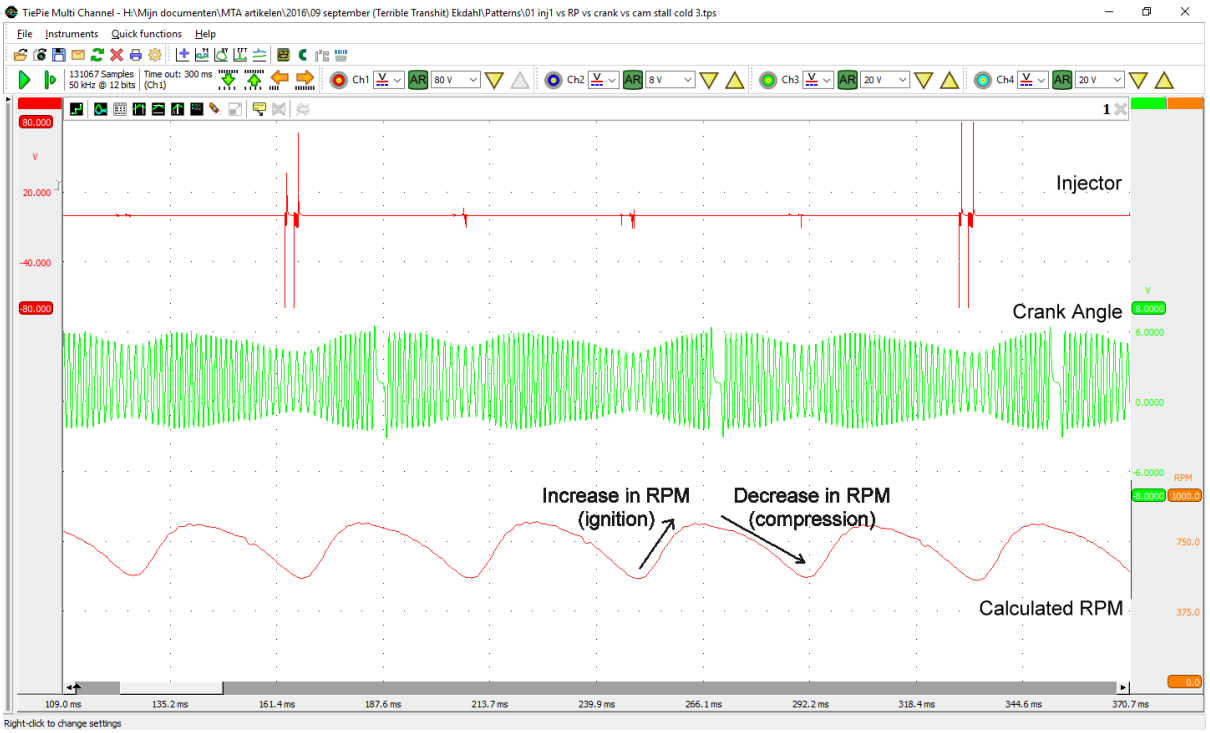

Figure 2: visual comparison of Delta-N (RPM) slopes.

Figure 2 also shows that all four beats of the engine show the same behaviour so we know it is something related to all cylinders. The ATS scope software actually allows the user to automatically differentiate (calculate the slope of) a recorded or even calculated scope trace such as an RPM trace.

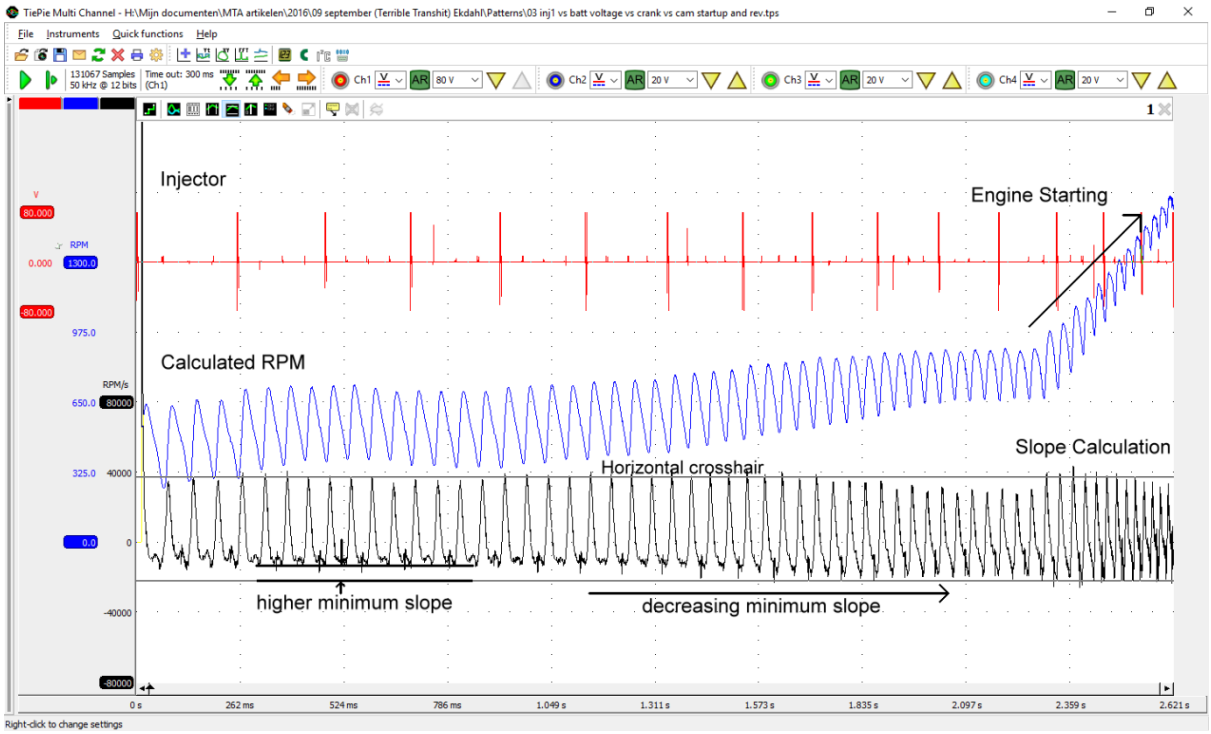

Figure 3: injection vs. calculated RPM showing the slope calculation.

Figure 3 shows the change-over between episodes of not starting and the engine suddenly coming to life and running perfectly. The calculated slope line show that where the engine is running poorly (low rpm) that there is a higher minimum slope indicating a compression problem.
This is difficult to understand. So, please think of a piston travelling up connected to a con-rod connected to a crankshaft. The piston is in bottom dead centre, we can all agree that the piston is momentarily stationary when it changes direction from travelling down to travelling up. This point is indicated by a zero crossing of the slope calculation line. When the piston starts to travel up there is little pressure in the combustion chamber so it travels up easy. When pressure starts to build above the piston it becomes more and more difficult for the crankshaft to push the piston up, resulting in an increasing deceleration rate until the piston is eventually stationary at top dead centre. So, the faster the piston slows down, indicated by the minimum slope value, during its upwards stroke is an indication of the compression within that cylinder.
When a leak is introduced, for example a valve that isn't sealing, worn piston rings, a hole in the piston etc. the amount of pressure that builds up above the piston is less. Meaning that the crankshaft doesn't decelerate as much during its upwards stroke because it is easier to push the piston up, indicated by the higher minimum slope.
Delta-N and slope calculations are covered in detail in the AECS ATS oscilloscope courses, the diagnostics of Delta-N measurements are covered in the AECS EMS1-3 (VVTi and directed injection) and DMS1-3 (common rail) courses.

So how can compression be low, and after 3-4 start/stall episodes suddenly come right?

Hydraulic lifters
After quizzing the customer some more about the vehicles service history and when the problem started to develop it turned out that the vehicle had a small oil leak and that the owner had been topping the vehicle up with the same oil that he uses in his tractor. Of course the tractor oil was a heavier grade than what was required for this transit, which meant that the hydraulic lifters would pump up and keep the intake and or exhaust valves open, resulting in the low compression!
Warmed up oil (oil thinner) or enough pressure from the valve springs on the lifters (push the lifters in against the thick oil in the lifter as a result of the rapid movement of the cam shaft), will push the lifter down, closing the valves again.
After a number of start / stalls the valves in the cylinders would seal properly and the engine would run perfectly.

Fixed!
The oil and filter was changed with the correct grade oil after which the engine started and runs perfectly. Several weeks after the repair the customer is now also reporting an improvement to his fuel consumption of around 20% and he's very happy.

Conclusion
All in all, this repair was expensive for the customer, glow plugs, batteries, starter motor, filter housing, oil change and time. All for the sake of filling up the engine with the wrong grade oil!
A relatively simple fix for a complicated problem.
At AECS our aim is to make the complicated jobs more profitable for you and less problematic by giving you the confidence to diagnose vehicles quickly and efficiently.
Quality equipment and training are essential for solving issues like this.
Having AECS technical assistance will give you the reassurance that jobs that are difficult can still be solved efficiently.
Make sure you have the best equipment and training available in the market, contact AECS today.

For ***AECS*** Ltd.
Peter Leijen, BE(Hons), PhD
www.aecs.net
info@aecs.net
Ph 06 8749 077

Did you know…..?

A/F sensor training

We have finally finished and delivered (for the YES association) the brand new “EMS 1-6 Broadband oxygen sensor diagnostics” training seminar this last August. The training was very well attended and received glowing reviews, like of most value to me was: “The way it was broken down + explained, I really understood the material” and “understanding the correlation between the AFS and opamp plus how that is displayed on the scantool” and “O2 sensor disconnected from the car (ECU)”.
We will be delivering that course in a 3 day format for a large company this October.
In 2017 it will be available for you, as a 3 day course. Please click on the link below for an in depth descriptor.
http://www.aecs.net/products/productCategory.php?catId=11
Please scroll down to Engine Management Systems 1-6 (A/F sensors)


Pictures of the EMS 1-6 training Aug 2016

New shipment from Launch

We have just taken delivery of a full van load of brand new Lovely Launch scanners.

At the time of writing we have already send out 7 brand new Pro3v2 tools to happy customers.
Great tool with awesome coverage.

The Launch Pro3 tools are expandable with the 24V Launch HD truck kit.

Tim has joined our team

Tim, who is a Nissan Master technician in UK/Europe and NZ/Australia, has joined our team. Tim is a long term ATS scope user and is keen and ready to assist you with any technical issues!

Peter gained his PhD

Peter, who many of you have met already during our AED, Scan, ATS and CAN databus training seminars throughout the country, has successfully defended his PhD thesis last month. His thesis was based on hybrid battery analyses. We at AECS are very proud of his achievement!

Training Dollars

Remember to ask us for the training Dollars during your next equipment purchase!