ISSUE 122: DECEMBER 2016

DIESEL TORQUE

OFFICIAL MAGAZINE OF THE ASSOCIATION OF AUSTRALASIAN DIESEL SPECIALISTS INC. (AADS)

Inside this issue

AADS Committee

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President's Report

by Craig Mills, President

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It seems like only yesterday we had our Christmas break… Hasn't 2016 gone fast? It's hard to believe we only have a couple of weeks of the year left!!

I think it'd be fair to say 2016 has been a busy year for most. This year has brought many challenges and changes affecting the industry from vehicle manufacturing branches closing to the increased amount of electronics affecting our working day and product changes in 2016. I would suggest that 2017 will bring more of the same. The rate of technology advancement is increasing at an alarming rate and its becoming a full time job just to keep up with it. Sure, we aren't seeing radical changes like the introduction of Common Rail, but the refinement and electronic control over DFI and Turbocharging hasn't slowed in the least.

Last Diesel Torque I talked about the 2017 AADS Conference being in Melbourne in March. Unfortunately, the Formula1 circus took one of the dates we were looking at and the other date became complicated. As a Committee, we found this year's date in May worked for us, so we have decided to move to May yet again. The dates for this year's AADS Annual Conference will be 5-6th May 2017.

2017 is an Election year for the Committee and I personally, couldn't be happier with the current Committee and how they everyone has be able to contribute and help the association reach its goals. Now is a good time to start thinking about how you might be able to assist the association by putting your name forward to join the Committee. You can find the nomination forms on the www.aads.com.au website. If you have any questions about what is involved or how you might be able to contribute, please contact myself or any of the current Committee members. As I mentioned in Wellington I won't be standing for President going into the next term, but I may still consider being on the Committee should I be nominated. I have found the role of President very rewarding and I have made some great new friends along the way. The Committee positions are not difficult, but it does take a little time (an hour or 2) each week to keep the wheels turning. If you have ever thought you might like to try it, bite the bullet and do it. You won't regret it, I promise you!

It is with sadness we said farewell to one of the AADS founding members late this year with the passing of Keith Jergs. Many of you will remember Keith and his enthusiasm for the industry and in particularly the AADS. Keith was active within the association for many years and always took a great deal if interest in what the AADS was doing. He was a life member of the association.

I'd like to take the opportunity to pass on a very special thanks from the current Committee to Marty Kemp for his valued years of being the AADS NZ Branch Chairperson. Marty has lead from the front and put a tremendous amount of work and effort into the NZ Branch and has been held a key role in developing the education and apprenticeship roles for our industry in NZ. Thank you for your efforts Marty,

As Marty steps back, I would like to extend a warm welcome to Lance Anderson as the new AADS NZ Branch Chairperson. Many of you will know Lance and this isn't the first time he has led the NZ Branch. I am confident the NZ branch will continue to maintain its strength with Lance's leadership.

I hope you enjoy this issue of Diesel Torque and on behalf of the AADS, I would like to wish you all a very Merry Christmas and a prosperous 2017!

Election of Committee Member 2017 NOMINATION FORM

Please complete a separate form for each person being nominated.

If a person is being nominated for more than one position, please complete a separate form for each position that the person is being nominated for.

Name of person being nominated:

Being nominated for the position of:

- ☐ President
- ☐ Vice-President
- ☐ Treasurer
- ☐ Secretary
- ☐ Committee Member

(At least 5 committee members are to be appointed. There are to be a maximum of 10 on the Committee, including the officer bearers)

Name of first nominator:

Signature:

Name of second nominator:

Signature:

I confirm that I am a voting* member of the Association of Australasian Diesel Specialists and agree to this nomination to the National AADS Committee.

Signed:

Date:

Please return completed form to the Secretariat by 15 February 2017

**voting members as per the AADS Constitution: Service, Manufacturing, and Honorary Life Members*

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Muted Mondeo

Vehicle 2008 Ford Mondeo 2.0L common rail Diesel Turbo

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

Problem presented to the Helpdesk

This vehicle came into our workshop for a standard timing belt replacement around 4 weeks ago. The car has not started since the timing belt replacement. There are no fault codes in any of the ECU's in the vehicle. We scoped several signals with our own scope (not an ATS scope) and can only see that the piezo injector pattern looks different on this car than on an identical car which goes fine.

We have redone the cam belt timing maybe 10 times and 3 different senior technicians from our shop have performed the procedure from scratch.

We have replaced the crank and cam sensors, in case we damaged them. We have even tried a second hand ECU, but that stopped the vehicle from being wound over with the starter motor as that ECU was not programmed into the vehicle.

When the car is winding over there is no smoke or Diesel smell coming from the exhaust.

When spraying ether (quick start) into the intake, the engine fires, sounds normal but dies when you stop spraying the ether.

"Can you or one of the ATS scope owners throughout the country please assist?"

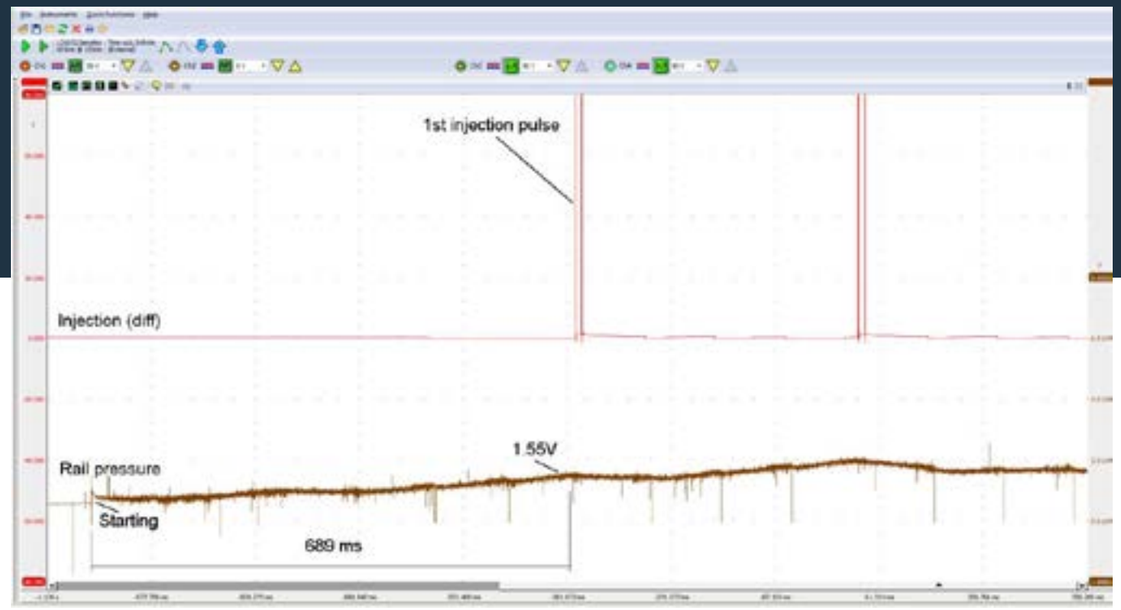
Where Do You Start?

So where do you start in a case like this. The people in the workshop where the belt was done are highly skilled technicians, all with a high level of experience and training. Looking from a distance, the only thing missing to diagnose this car, is a proper recording scope like the ATS scope. They even indicated that themselves. Let's see how expensive the lack of a scope and the making of a simple mistake can get!

As in almost all common rail diagnostic cases you start with rail pressure vs injection. That measurement would also take care of the 'funny' pattern the technician recorded himself.

The ATS scope recording looked all normal! After about 2/3rd of a second the rail pressure is high enough to allow injection. Please note that injection does not take place when the rail pressure is not high enough.

Zooming in on the injector pattern at first glance did not reveal anything odd. The injectors are Piezo injectors.



ATS scope recording Injection vs rail pressure.

Timing?

So according to the injection and rail pressure the engine should run! Maybe incorrect timing? The timing belt was done after all.

A recording of the rail pressure, injection and crank shaft sensor was made. The crank shaft sensor signal was transformed in an analogue RPM signal, showing the crankshaft speed fluctuations as a result of compression/ decompression.

From the recording above it is clearly visible that the injector fires at around TDC (slowest crank speed), which is normal for a common rail low compression engine while turning slow.

So according to this recording the timing was correct, or was it?

Maybe the timing was only off by 10 or 20 degrees? The fact that no Diesel smoke or smell came from the exhaust should have alerted us to the facts that the timing was not off by a small amount, but at this stage it just disturbed us.

To be sure about the timing we compared the bad car with an identical going car.

This showed clearly that the injector fired at approximately the same spot on the crank shaft as the non-starting car.

We were sure now that the timing was very close to correct to at least make a sound and smoke.

We also compared the current of the Piezo injectors of both cars, they were identical.

Crook Injectors?

The technician followed the high pressure system bleed procedure several times to make sure that there was no air in the injector. Always with the same result; no go.

Everything looked fine, no fuel smell came from the exhaust and since measuring with an petrol emission tester showed only a tiny 180 PPM HC (Fuel? Oil? Ether fumes?).

We came to the conclusion that the Piezo injectors were faulty. There is worldwide a real problem with some Piezo injectors stopping with injection as soon as they have been exposed to air for even a very short period of time.

The Mondeo's injectors had not been exposed to air but who knows. The injectors were tested and found to be pumping the correct amount of fuel!

Reverse Control

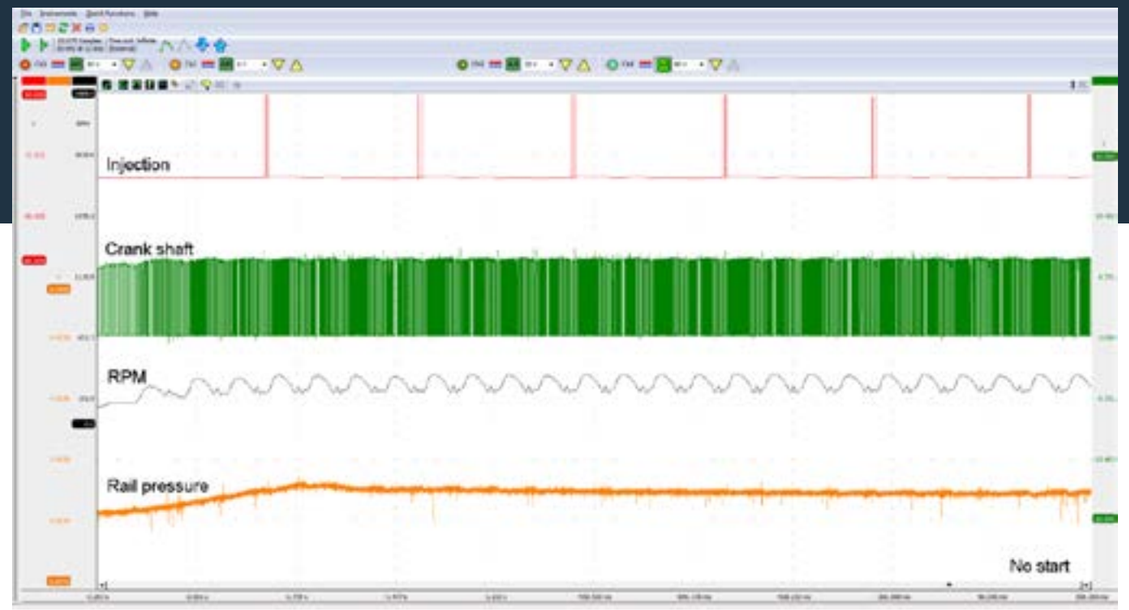
That would make anyone doubt about their skill, I do not belittle that!

All sensors were good, injection took place at the correct time, the engine had compression, the cam timing was checked 10 times at least, yet no go.

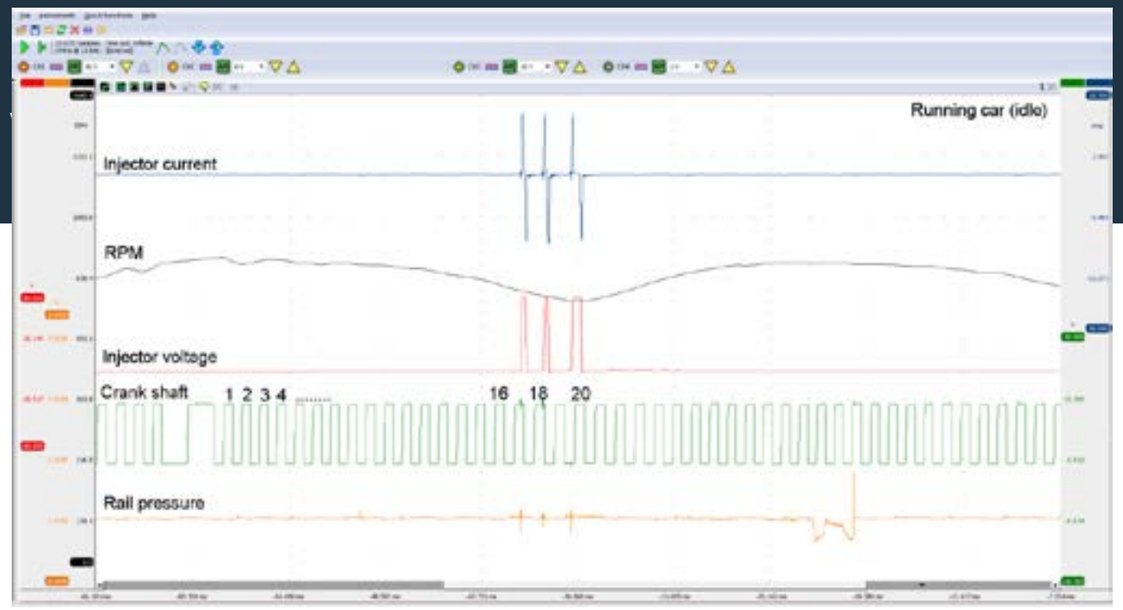
We checked the fuel quality by draining the filter, even though the Diesel smelled differently it burned in a cup just as well as known Diesel from the workshop.

We asked the technician to reverse the wiring of the injectors, number 1 to 4 and 2 to 3, etc.

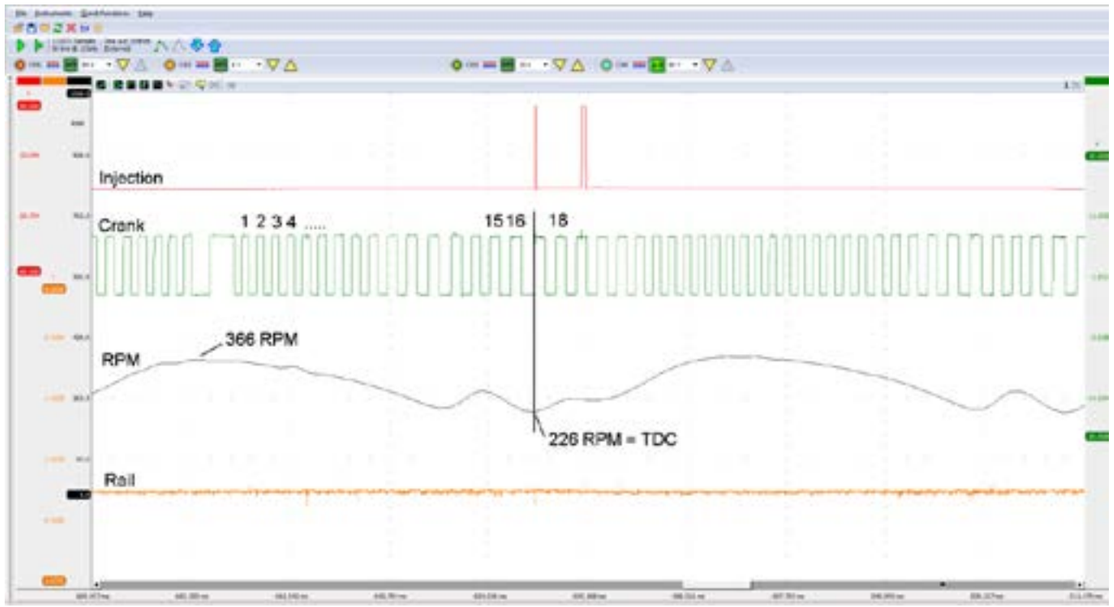
The engine started and ran fine!!!!!!!!!!



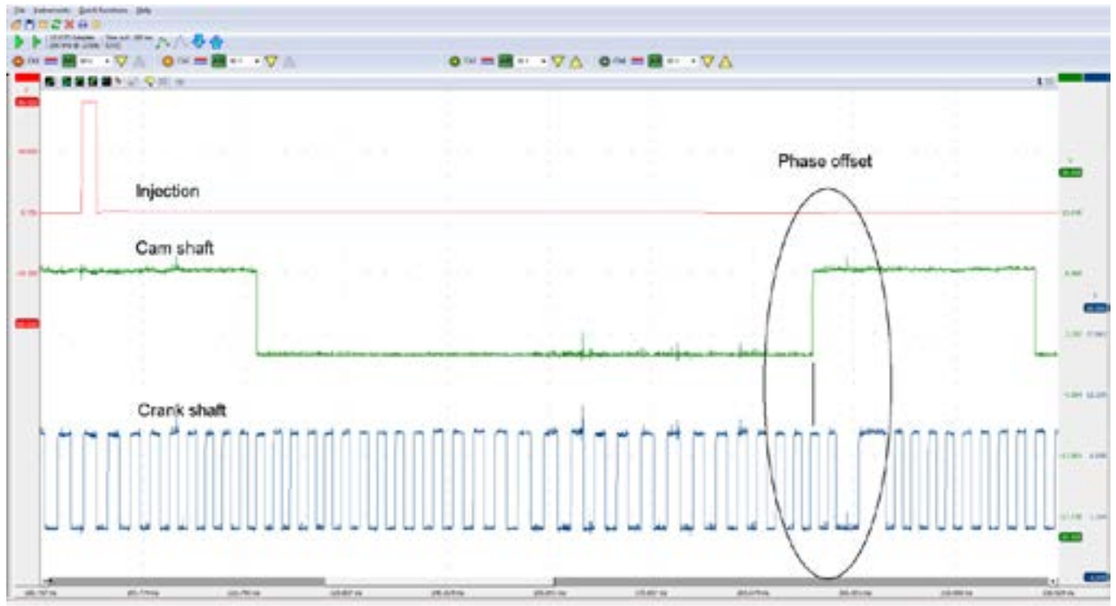
ATS 5004 3 channel recording with added RPM trace for TDC detection.



ATS recording for timing check, good car.



ATS recording zoomed in for timing check, non-start car.



Cam crank relation recording on non-starting vehicle

What The….?

No way can the ECU suddenly become 360 degrees confused, I cannot think of any scenario that would make that happen except magic. Yet the workshop prepared for fitting a brand new ECU and to have the old ECU reflashed by an aftermarket software file……

In my view would that have led to nothing but I had no other solution at that moment either.

We demagnetised the cam gear in the micro wave as that was partially magnetic, which can affect the Hall effect sensor signal, but all had no result.

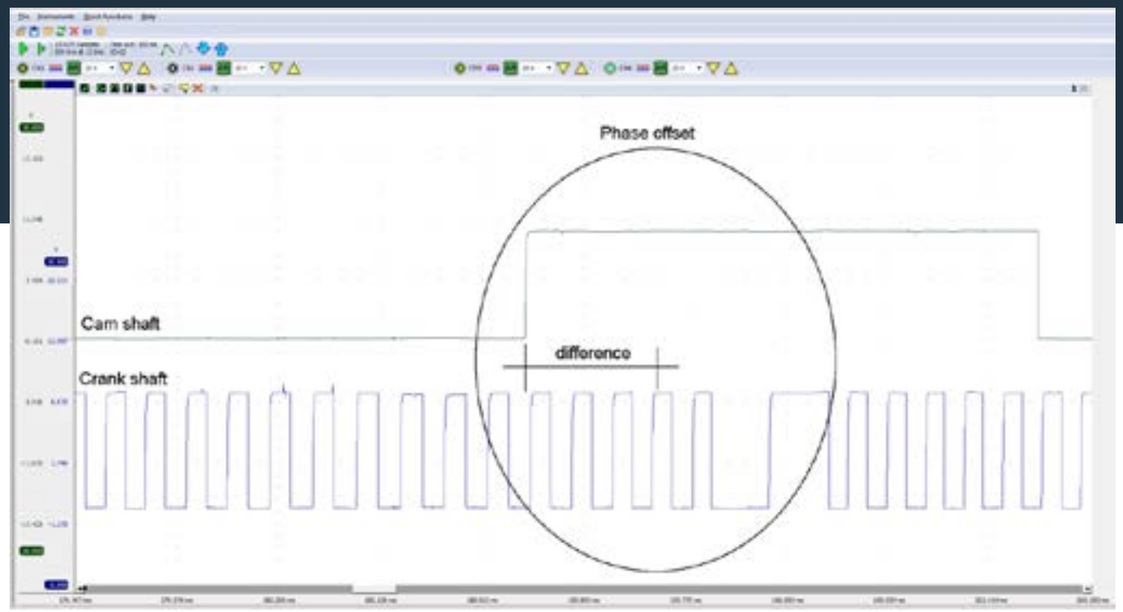
Back To The Start

Back to the beginning. The cam belt had been replaced, we had to measure the relation between the cam and crank.

We had to ignore the statement that the cam timing on these engines is real easy and CANNOT go wrong! A dowel in the cam, a dowel in the crank and put the new belt on. It's real easy. Is it possible that +/- 10 times checking by three different techs could still make this go wrong?

Yep, it is.

In the above pattern is the injection pattern visible, yet the engine does not start. Please note the phase offset between the cam and crank.



ATS scope recording cam and crank on going vehicle.

The next pattern is recorded on the running identical vehicle. Please note the phase offset between the cam and crank and compare with the not going vehicle.

The phase difference is a bit more than 3 teeth on the tone wheel. On the circumference of the tone wheel are 58 teeth and 2 missing teeth. This makes that from teeth to teeth the crank shaft has rotated 6 degrees. In crank angle degrees is 3 teeth 18 degrees. That is equal to one having the timing belt on the crank shaft sprocket 1 tooth out.

Bingo

The timing belt was redone and the car started perfectly (after connecting the injectors correctly back up again).

Conclusion

This job ended up being very expensive as a result of the same mistake made by three technicians. I have not read the workshop manual, but the manual which was used clearly leaves room for error.

As a diagnostician I made the clear and common error that I took the information from the technician as true (timing cannot go wrong). I have learned that lesson many times jet sometimes get caught out and fall for it again.

Without the aid of the 4 channel ATS 5004d scope this job would not have been resolved, the bill would have been higher with a new ECU and a reprogrammed ECU added, all to no avail.

To leave the injector connectors on the wrong injectors was also not an option as each injector is programmed to each cylinder, or connector….? Also the misfire detection and quantity correction in the ECU would not have worked anymore. Also whatever caused the phase to shift 360 degrees crankshaft could have corrected itself, you cannot leave these things half fixed, certainly not on a DPF equipped vehicle. The 180 PPM HC on the emission tester was non atomised Diesel, the injectors were only spraying in the exhaust stroke (no compression, no heat).

Properly getting to the bottom of the fault is the only way to resolve a situation like this.

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(trainer/research)
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Ph 06 8749 077

Branch Updates

Nichole *QLD*

Our last meeting held in Bundaberg on the 29.10.16 was poorly attended by members, which is always disappointing, however as QLDers it didn't stop us having a great weekend!

Our meeting kicked off with Andrea from Austbrokers give us an interesting talk on Business Insurance, and to make sure you have the right cover for your current needs, so if you haven't checked your policy in a while or would like a free check give her a call on 07 3423 600.

We also had a demo on a carbon cleaning tool with Coby from Diesel Distributors. We broke for morning tea which, we all agreed that it was the biggest one we have had and then we rolled onto the afternoons activities. We travelled to Bundy Brewed drinks to find out the history of the famous brand, then we finished with a Fantastic night at the Spotted dog tavern.

Christine East (and Peter) have sadly sold their business and are now in retirement mode so Christine has resigned as state secretary!! Nichole from Diesel Injection Technology has volunteered to take over and was voted into the position.

We are pleased to hear Guy from Diesel Australia is making a speedy recovery! We also welcome Tim Barnes as new owner of Hervey Bay Diesel, Congrats.

Our next meeting will be held at Oaks Oasis Caloundra on the 25th Feb. We will be having mini putt putt for our fun activity and hope MORE QLD businesses/members attend the meeting.

If Any company wishes to attend and do any sort of talk/ advertising at our next meeting, please contact Nichole.

Merry Christmas to All!

AADS Conference 2017

Dates are now finalised, mark your diaries!

Join us in Melbourne for the annual AADS Conference

5-6 May 2017

We will be back with more information early in the New Year!

Hi H1

2008 Hyundai H1
Common Rail Turbo Diesel Van

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

Problem presented to the Helpdesk

This van has had its sump holed by hitting a rock or something, spilling almost all of its engine oil. The engine has been replaced by an engine from a 2012 identical H1 van which was damaged in an accident. The engines appeared to be identical so were most of the sensors and actuators. There were many problems getting the van to go, it got going by swapping all the engine's sensor and actuators.

The engine is accelerating fine when you take it slow but bogs down when you accelerate fully. After it bogging down it goes into limp home mode and only drives very slowly.

Every time the engine goes into limp home a fault code is set: "rail pressure too low". The vehicle has been to a number of garages and specialists before it came to us. It has been off the road for 4 months. We cannot put our finger on the problem, can you please assist?

Technical Support Help Desk

The garage that had the problem vehicle has technical support from AECS as part of an equipment purchase package.

Since the garage only bought a Launch scantool we tried to test as much as we could but we had to give up as a number of oscilloscope recordings were needed.

In this case we mutually decided to have the vehicle transported to AECS in Hastings, rather than send this vehicle to an ATS scope owner, as we normally would do.

Where To Start?

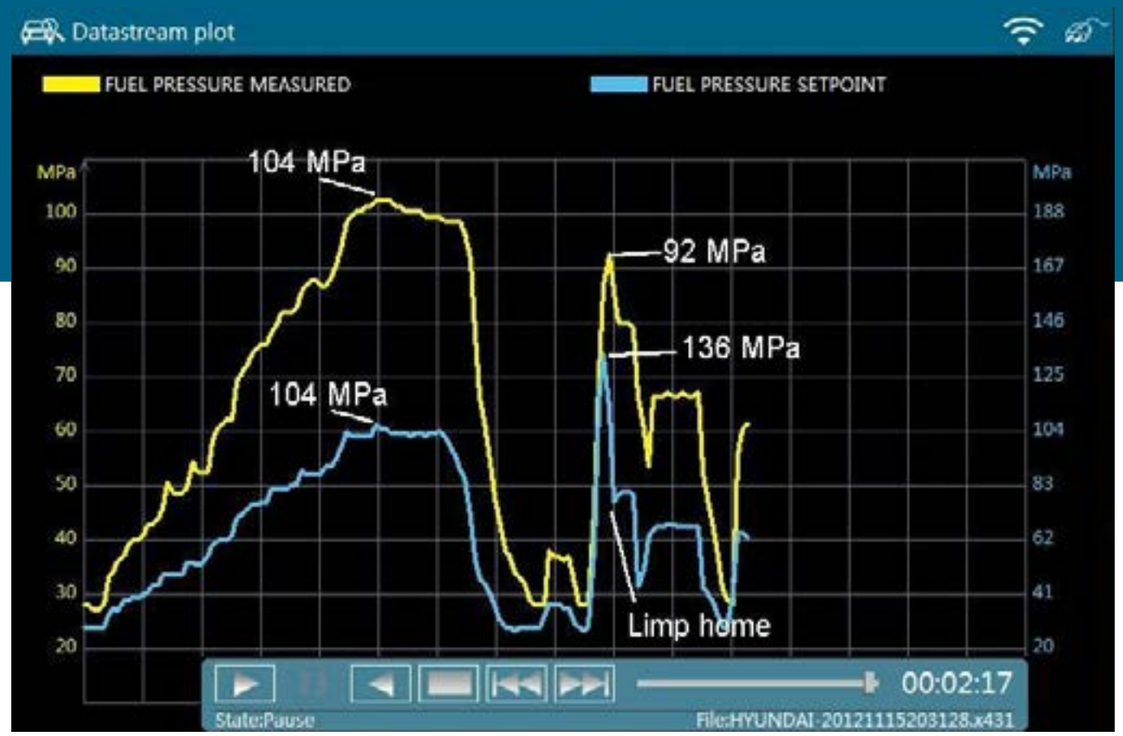
As is almost all cases with common rail Diesel, are the most important tell tales the rail pressure and the injector pattern. However in this case the engine was running well, it was only that rail pressure fault followed by the limp home was trouble.

We decided to start with a scantool recording

System Knowledge

Knowledge of the system is vital before you can do any diagnostics. The rail pressure in this Hyundai Bosch CP3 system is achieved by a gear lift pump inside the high pressure pump, which draws fuel from the tank and pushes the fuel through a Suction Control Valve (SCV) into the high pressure pump.

The high pressure pump pumps into the fuel rail, which has the injector tubes and a pressure sensor connected to it. Also connected to the end of the fuel rail is a Pressure Discharge Valve (PDV).



Launch GDS scantool recording of the actual rail pressure (yellow trace) vs desired pressure (blue trace). Please note the different MPa scales.

The SCV controls the pressure in the rail by allowing Diesel fuel into the pump. Allowing more Diesel into the pump than what is used will increase the pressure and vice versa.

The PDV controls the pressure in the rail by opening or closing the rail to the return a certain amount. The opening rate of the PDV valve is a variable electromagnetic force working in against the variable hydraulic Diesel fuel pressure.

The ECU will determine the rail pressure set point (desired rail pressure) based on operating conditions.

Both the SCV and PDV will get to work to make the actual rail pressure match the desired rail pressure by changing the current through both those valves, through duty cycle control.

Let's Measure!

We used the Launch scantool's recording function just to see where we had to go.

The actual pressure kept perfectly following the desired pressure while slowly accelerating to cut off speed and decelerating (first part of the graph).

When full acceleration takes place the desired pressure goes up to 136 MPa but the actual pressure does not rise above 92 MPa when the vehicle falls into limp home, yet the pressure is able to get up higher than 92 MPa.

Why?

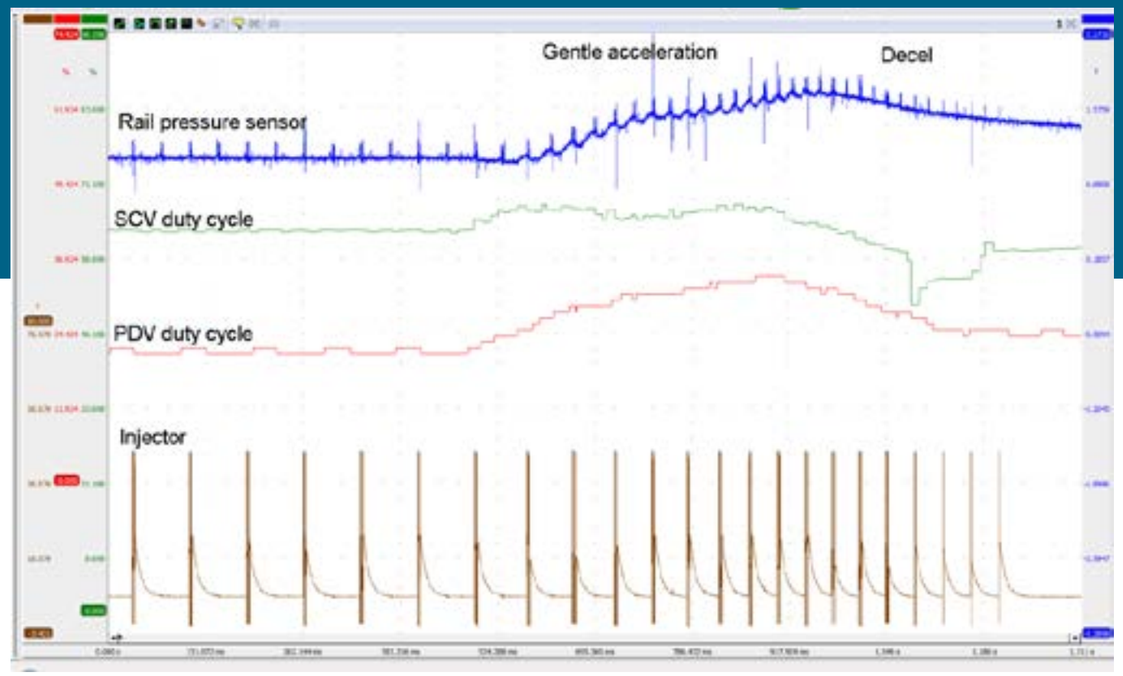
Why does the pressure follow fine while slowly getting up to max and not when getting up to max pressure quickly? Remember there are no hints or tips under the bonnet. At first we suspected the frequency airmass sensor as a quick snap open of the electronic throttle might have created a sudden air rush. The sudden air rush could have set the requested torque (and desired rail pressure) too high. We have seen a number of similar frequency airmass sensors reporting an air quantity which was too high. The SCV, pump and PDV might not have been able to raise the pressure quick enough, causing the fault. Lowering the frequency with the ATS scope signal generator made this engine run beautiful. A new airmass sensor was ordered but did not fix the problem.

Scope

This is where the scope is a must. We recorded with the ATS 5004d 4 channel scope.

The channels recorded are: Ch1 Press dump valve, Ch2 Injector, Ch3 Suction control valve, Ch4 Rail Pressure sensor.

The PDV (Ch1) and SVC (Ch3) were converted by the scope software into analogue lines. Both were set up so that an increase in the duty cycle should have an increase in pressure as result. We tested that with the ATS 5000 signal generator.



ATS 4 channel scope recording of rail pressure, SCV, PDV and injector.

First we accelerated gently, just like the recording with the scantool. Both the SCV and the PDV traces do not move to ridiculous values, meaning that the ECU has the rail pressure under control, i.e. the actual rail pressure follows the desired rail pressure.

Next We Had To Accelerate Fully

The full acceleration recording told us an important story. The pressure does not rise linear, at the indicated area the pressure seems to suddenly stop rising quickly, yet the only items that are affecting the pressure (pump, SCV and PDV) seem not to be responsible for backing the pressure increase off.

What's Faulty?

We could still have four possible faults: SCV, PDV, Pump, Rail pressure sensor. All of these items had been replaced at some stage by someone we were told. Testing was the next step.

With the ATS 5000 scope and signal generator we activated the SCV to fully open and the PDV to fully closed. This should increase the rail pressure dramatically on this running engine. No matter what we did we could according to the scantool not get the pressure above 110 MPa at 4500 RPM. The rail pressure should easily go up to double that.

We supplied the pump with external Diesel to make sure there were no restrictions in the supply. No difference.

Next we suspected the rail pressure sensor. We altered the signal from the rail pressure sensor to a higher value, but still the engine was bogging down with fully activated SCV and PDV valves.

Pressure Relief Valve

Look again what is in front of us. Look at the scope recording where the kink is in the pattern. This looks just like the pressure graph of a mechanical Diesel pump increasing rotational speed, when the mechanical pressure relief valve opens to the return.

However this system has no mechanical pressure relief valve! Or has it….

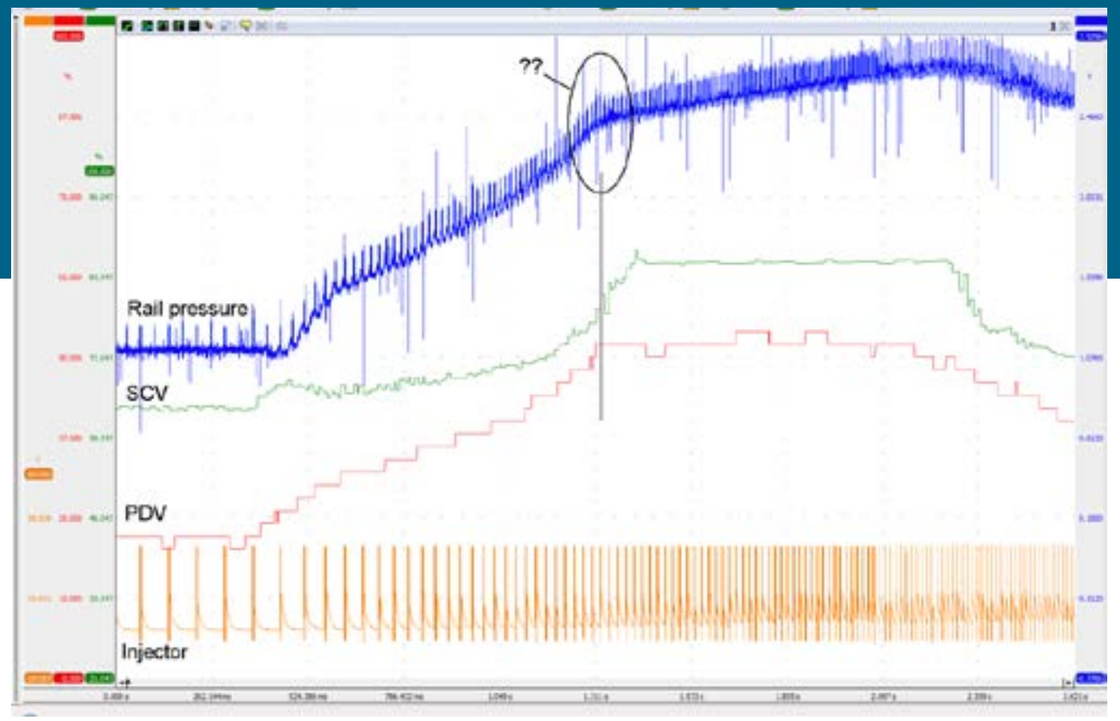
The only return to the tank in this system is the PDV discharge line, so if there is a faulty pressure relief valve, it will be this valve which is leaking.

Bingo!

We checked the return line with a clear hose while the valve was fully activated (closed) with the signal generator of the ATS scope. During light acceleration a tiny bit of return flow was visible, but during hard acceleration full flow took place, just as the kink appeared in the graph.

A new rail with PDV was ordered and fitted with perfect results.

The old PDV was taken apart and some dirt was found in the valve. The ball bearing needs to seal properly when the magnetic field of the solenoid pushes onto the ball. In this case a tiny bit of grit kept the valve open on a small leak, increasing the square surface area of the valve where the hydraulic rail pressure acted upon. An increase in pressure created a strong enough force to open the ball bearing valve in against the electromagnetic force the solenoid valve needle put on the ball bearing.



ATS recording during full acceleration, when engine falls into limp home.

Conclusion

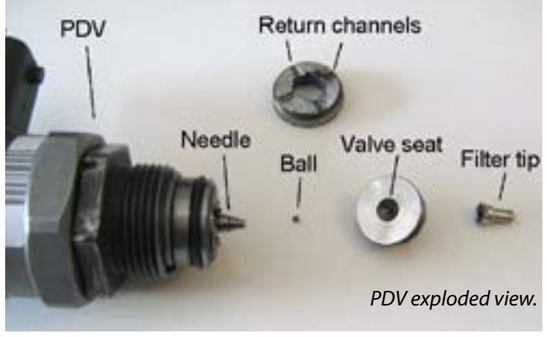
This job ended up being very expensive as a result of the work all workshops involved had done. There is a lot more detail to this job than you read in this article. We spend 24 hours on this job here at AECS, which puts it right amongst the harder cases we have dealt with. Yet it was so simple in the end, it always is. Prepare for cases like this with appropriate training, a backup team and real equipment. Make AECS your partner in diagnostics.

Additional Training Note

During our DMS 1-3 common rail Diesel training we advise to fit to any common rail Diesel vehicle (also brand new ones) an extra filter unit with water separation bowl. If water enters the fuel system, the pump, valves and injectors need to be replaced. The genuine filters used on many modern vehicles are not having enough water separation area, plus the water sensor with electrodes protruding into the filter react often too late. It is incredibly expensive to replace the damaged items. It will always end up in a battle with your customer, as water damage to these components is not covered by any warranty and fuel companies do not like to admit that the water came from their fuel station (prove it…).

Many common rail Diesel vehicles have electric lift pumps in the tank pushing fuel up to the high pressure pump. The pressure from the lift pump is often 5 bars.

Use as hoses to and from the extra filter unit SAE 30R9 not SAE 30R7 as I did.



PDV exploded view.

Extra filter unit with glass bowl (bowl not visible).

Positions Vacant

We have a AADS member who is looking for the following positions to fill:

1. **Qualified Technicians for our Diesel Injector Workshop**
   Must be qualified and able to work independently, testing, repairing and diagnosing faults with Bosch, Siemens and Denso injectors (Common Rail and Non-Common Rail)
2. **Qualified Technicians for our Diesel Injection Pump Room**
   Must be qualified and able to work independently testing, reconditioning and diagnosing faults with various types of diesel injection pumps in Australia
3. **Qualified Diesel Mechanics for our Light Vehicle Workshop**
   Must be qualified and able to work independently on light vehicles including general servicing, maintenance, diagnostics etc

All applications to be via email to aads@aads.com.au by 6 January 2016

FOR SALE

Raglan Diesel Injection Ltd New Zealand

Raglan Diesel Injection Ltd is a diesel fuel injection & turbocharger specialist located in New Zealand.

Established in 1993, we operate in a niche market servicing the equipment in the Mining, Earthmoving, Transport, Agricultural, Marine & Industrial industries.

- This is a successful business with proven and consistent profitability and cash flows.
- Authorised Stanadyne, Delphi, Holset, & Garrett Dealer.
- Test Equipment: Hartridge AVM PC2, Bosch 815/ VP/CR, Bosch EPS200, Bosch 500.
- Specialising in EUI, CR, VP, CAT, KOMATSU & all other fuel systems.

After being in the industry for over 25 years current owners are wanting to pursue other business and lifestyle interests.

More information
Contact Matt Hubbard
Email: matt@raglandiesel.co.nz
Tel: 0064 07 8255100

In Memoriam

It is with regret that we advise of the passing of Keith Jurgs.

Keith was one of the founding members of the AADS and, without him and his peers at the time, the AADS may not ever have developed or come into existence. In his earlier years with the AADS, Keith contributed significantly to the growth and promotion of the Association and we are extremely thankful for his dedication to our industry.

Those who would like to pay their respects to Keith are invited to attend an informal gathering on Sunday the 8th of January, 2017, at 11.00am at the Novar Gardens Bowling Club in Adelaide (489 Anzac Hwy, Novar Gardens, SA, 5040). If you plan to attend, please advise Keith's daughter, Desiree, at djaprint@gmail.com before the end of December.

DIESEL TORQUE

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Diesel Torque all artwork to be supplied as high res pdf file
Website Banner all artwork to be supplied as jpg

Completed artwork can be emailed to:
aads@aads.com.au

Bookings

☐ Yes, I have studied the Advertising Rates above and wish to book the following:

☐ Service Member ☐ Full page ☐ Half page ☐ Quarter page ☐ Website banner
☐ Member ☐ Full page ☐ Half page ☐ Quarter page ☐ Website banner
☐ Non-member ☐ Full page ☐ Half page ☐ Quarter page ☐ Website banner

To appear in: ☐ 4 issues ☐ 1 issue

COMPANY: _____

ADDRESS: _____ POSTCODE: _____

CONTACT NAME: _____ TEL: _____

EMAIL: _____

☐ My cheque for $_____ is enclosed OR

☐ Please Charge $_____ to my ☐ Diners Club ☐ American Express ☐ MasterCard ☐ Visa

Card number: ☐☐☐☐ ☐☐☐☐ ☐☐☐☐ ☐☐☐☐

Cardholder's name _____ Expiry date _____

Cardholder's signature _____