

# BT50 being shifty

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

## Vehicle

2009 Mazda BT50 3.0Ltr Common Rail Turbo Diesel.



(Picture sourced from internet)

## Problem presented to the Helpdesk

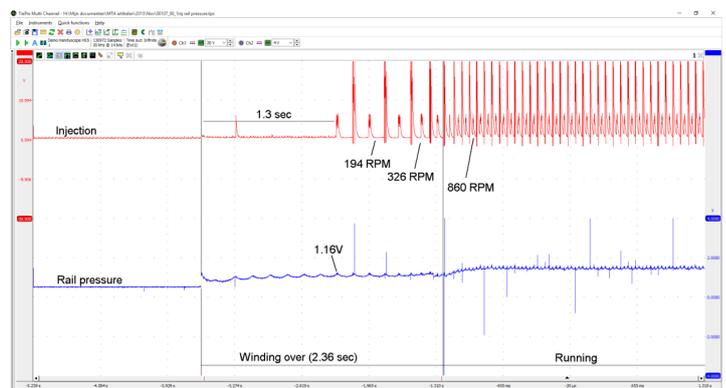
“We have a BT-50 that cranks at good speed but is slow to activate the injectors. It is worse when cold. When it does start it runs fine. To me it seems that the rail pressure is slow to build up and injection doesn't occur until over 1volt is reached.

I have included patterns of injection, crank signal, pressure sensor and suction control. Unfortunately we only have a two channel ATS scope.

There are no fault codes. What are your thoughts?”

## Looking at scope recordings

See the two recordings the diagnostician sent to us. (picture 1 & 2).



*Picture 1: ATS 500XM scope recording of the rail pressure vs injection pattern.*

In this recording it can clearly be seen that the rail pressure rises when the engine is being wound over. It can also be seen that

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We know from reliable sources that, VW is trying to extract this cost from its suppliers by forcing them to lower their purchase prices. This is likely to have a profound effect on VW's supply chain, by varying the quality of some of the car's componentry.

Meanwhile some suppliers are fighting to demonstrate that their product has the lowest total cost over time, which balances the initial purchase price with quality and longevity of their products.

It will be interesting to see how this plays out in the years to come, with suppliers having to "financially mop-up" Volkswagen's deliberate mistake.

### CHECK OUT Facebook



Herbert & Cunie have been visiting suppliers in Europe. Take a look the interesting interactive coffee table at the Ford dealer as the dealer presents the new Mondeo and also see the hybrid vehicles on a charger in a car park in Holland. It seems so normal in Holland compared to New Zealand.

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the injection starts when the rail pressure is up to 1.16V. It took a longish 1.3 seconds before injection started, however it took nearly 2.4 seconds before the engine began to fire up properly.

### What is this telling us?

Yes it takes long for the pressure to build up, but strangely it takes about a second later before the engine fires...

Let's look at the next pattern he sent.



Picture 2: ATS recording of Rail pressure vs suction control valve (SCV).

During winding over it is clear to see that the pressure is building up, AND that the ECU seems happy with the pressure progress as the duty cycle of the suction control valve (SCV) is not rising to 'idiot' values. The pressure progress seems controlled (we discuss the closed loop pressure control in the DMS 1-3 training in detail), however we do not know if the pressure control during starting is closed loop.

### Let's think

In my view the time is too long before injection starts. 1.3 seconds just does not seem right, which is about 5 revolutions or so.

Injection on a common rail Diesel engine starts only when the rail pressure is high enough and when a proper cam and crank sensor signal is received by the ECU.

The rail pressure seems to be there in the beginning of the pattern, if it was enough I am not sure.

### Signal generator

I asked the diagnostician to up the rail pressure sensor's voltage with the ATS 500XM's signal generator. He added up to 0.3 volts, which made no difference in the start ability of the BT50.

We had to concentrate on crank shaft sensor signal.

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#### Starter Motor

We have had a number of real nasty experiences with BT50 and Ranger starter motors, where a good sounding starter motor was upsetting the crank shaft sensor signal just enough to stop the engine from firing up. After rebuilding the starter motor by an auto electrician, the vehicle still would not start.

In those cases replacing the starter motor with an aftermarket

one, had still the exact same result, no start, or very hard to start. This is by the way, is when anyone seriously starts to doubt their skills.

After a lot of further diagnosing, replacing the starter motor with a genuine starter motor, solved the issue on those vehicles.

The diagnostician was aware of the starter motor issues. He rebuilt the starter motor, and found the BT50 was still

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very hard to start. No improvement!

I told him that it was better to analyse the crankshaft pattern first, as the starter motor leaves a very small mark on the crank pattern, before he would purchase a brand new genuine starter motor.

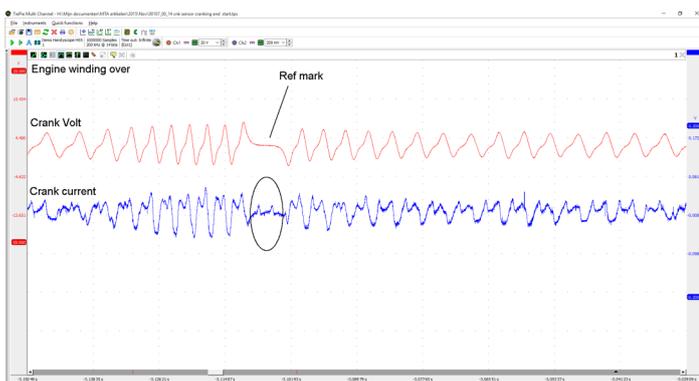
### Decision

The diagnostician made the decision to replace the starter motor without measuring the crank shaft sensor as it is in a bad place. Also this case had every symptom of the common starter motor issues.

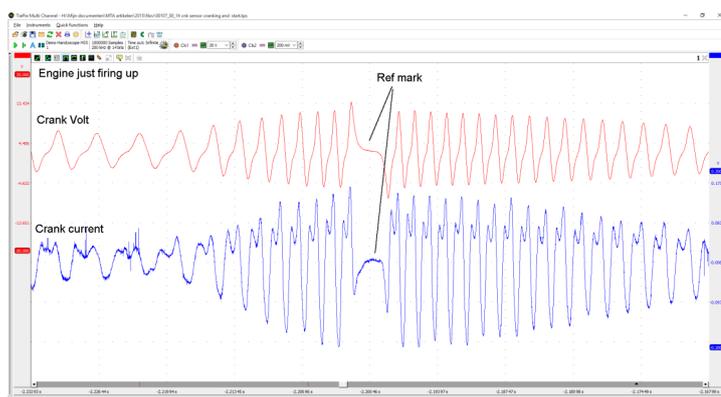
Result: No improvement!

Because I wanted to know if there was a crankshaft sensor issue I asked the diagnostician to please measure the crank shaft sensor (voltage over current). In my mind, it is the ECU responding to current changes in those BT's, rather than voltage changes. He measured this very low current with an AECS signal amplifier as the current is so small.

He captured the moment (picture 3) when the engine fired up after a long bit of winding over (with the new starter motor).



Picture 3: ATS scope recording zoomed in on 'the engine winding over'.



Picture 4: Scope recording zoomed in on 'the engine just firing up'.

In the above two recordings it is clear to see the interference of the starter motor on the reference mark, was that the problem? Well the engine just fired up when the interference was still there, so that was inconclusive.

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### Back to the drawing board

We were rethinking this one when a message on the AECS technical support help desk came through from one of the subscribers, who is a Diesel specialist, stating that these vehicles have got a mechanical pressure relieve valve on the rail which plays up regularly, also displaying the same hard starting symptoms.

### Valve

The valve was inspected and was found to be leaking! That stopped the pressure from building up in a short time alright.

The pressure relief valve was replaced, and the engine started fine every time. It still needed to be wound over a little long, but nothing too bad.

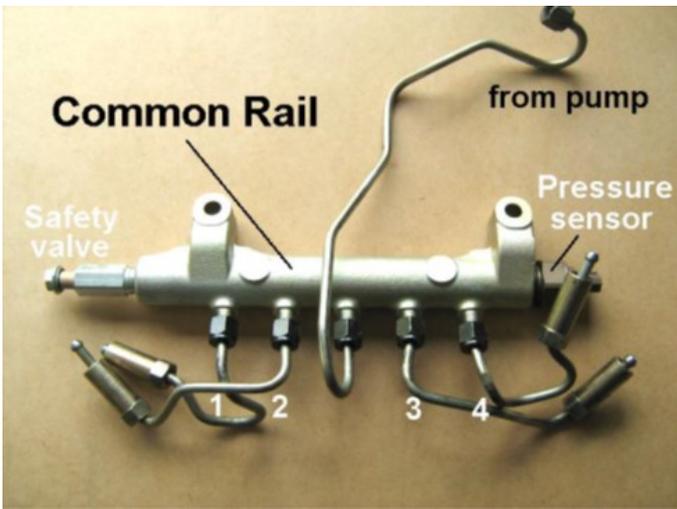
The diagnostician had the courtesy to send a recording he made after the repair. (Picture 5)

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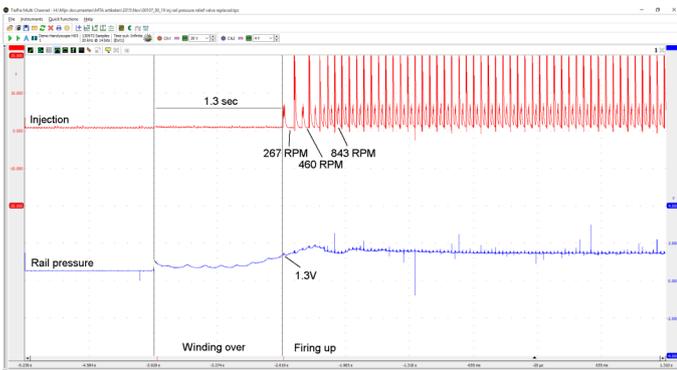
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Picture of common rail with pressure relief valve (safety valve).



Picture 5:ATS 500XM scope recording of injection vs rail pressure.

It is clear to see how the rail pressure builds up a lot quicker and higher, and gets controlled back by the ECU. It is also visible that the engine still needs about 1.3 seconds of winding over before injection starts, but as soon as injection starts the engine picks up and fires.

### Conclusion

Well! This was not a nice and clear-cut case, compared to many of the other support cases we help with. New to us was that, the rail pressure seems to not be controlled in closed loop during winding over. We could have gone down the inclination this respected diagnostician had (rail pressure too slow to build up), potentially that would have got us there more quickly. However, at the AECS help desk we thought too hard about some long-winded cases; where it did turn out to be the starter motor and wanted to save the diagnostician time! How wrong were we?

We learned once again; don't assume, treat each case as a new case, and you should never stop learning!  
Also how would YOU have solved this issue without making

signals visible with a high quality scope? Take also in mind that there were no fault codes.

Traditional mechanics would perhaps have gone down the road of glow plugs and glow timers as the vehicle had outwardly all the symptoms of a vehicle with a crook glow system.

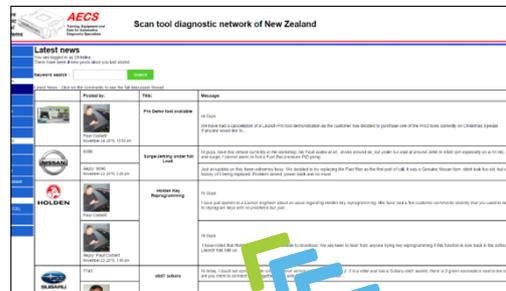
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7		7 AED - Hastings DMS13 - Orange, Australia		7	7 AED - Tauranga (closed)		6 DMS13 - Wanganui		7
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13				12 AEDD - Ohakea - CLOSED	12		12	12	12
14				13 AEDD - Ohakea - CLOSED	13		13	13 AIRCON - Christchurch	13
15				14 EMS14 - Palmerston North ATS12 - Wellington	14		14	14 AIRCON - Christchurch	14
16				15 EMS14 - Palmerston North CanBus - Palmerston North	15		15	15	15
17				16 EMS14 - Auckland ECAC11 - Wellington	16		16	16	16
18				17 EMS14 - Auckland ECAC11 - Wellington	17		17	17	17
19				18 AED - Whangarei	18		18	18	18
20				19 AED - Whangarei	19		19	19	19
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22				21	21 AED - Dunedin		20 DMS13 - Auckland AED - Auckland	20	20
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