

Munted Mondeo

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

Vehicle

2008 Ford Mondeo 2.0L common rail Diesel turbo.

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.

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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.

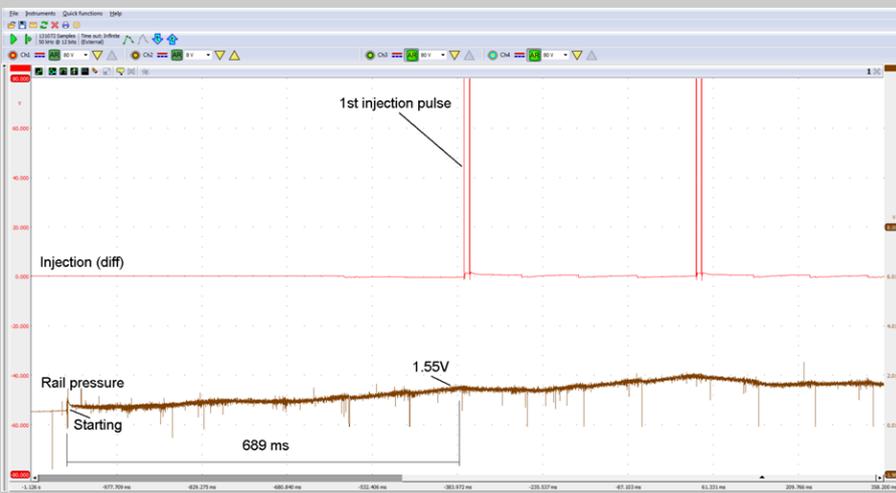
The ATS scope recording looked all normal! (picture1) After about 2/3rd of a second the rail pressure is high enough to allow injection. Please note that injection does not take place when the rail pressure is not high enough.

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

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. (picture 2) The crank shaft sensor signal was trans-



Picture 1: ATS scope recording Injection vs rail pressure.

formed in an analogue RPM signal, showing the crankshaft speed fluctuations as a result of compression/decompression.

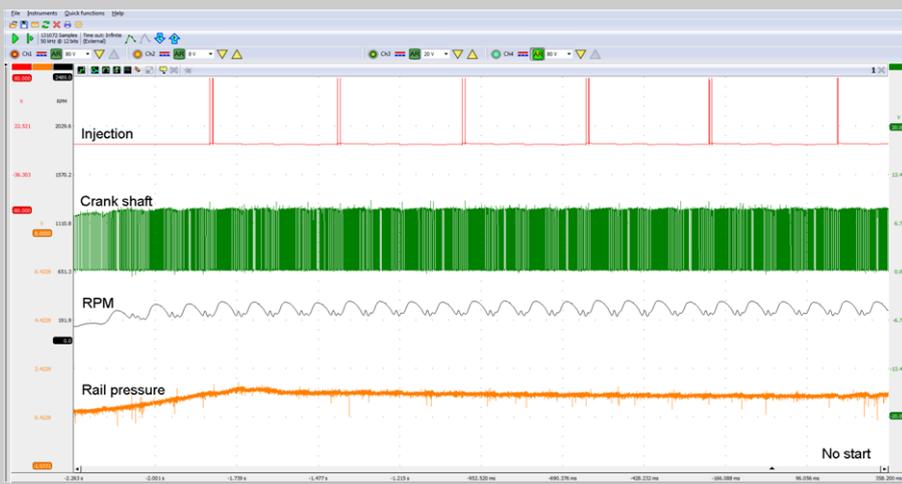
From the recording in picture 3

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.

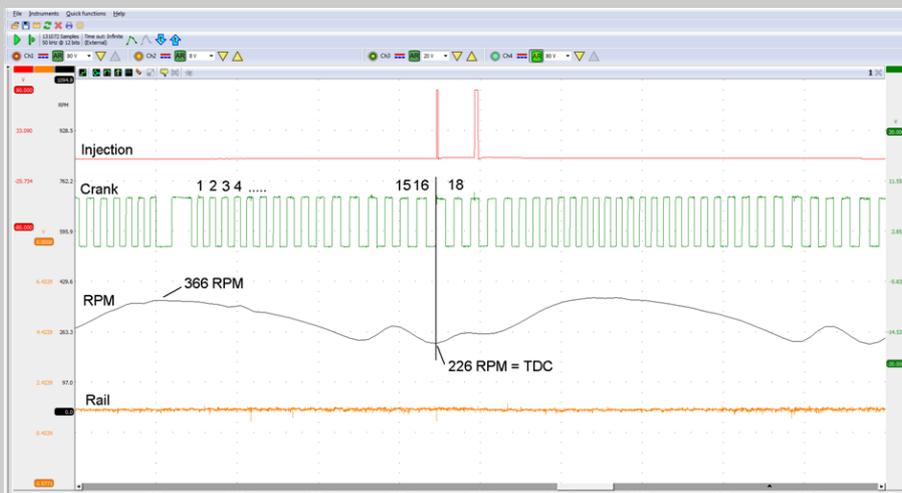
So according to this recording the timing was correct, or was it?

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 fact 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



Picture 2: ATS 5004 3 channel recording with added RPM trace for TDC



Picture 3: ATS recording zoomed in for timing check, non-start car



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going car. (picture 4)

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.

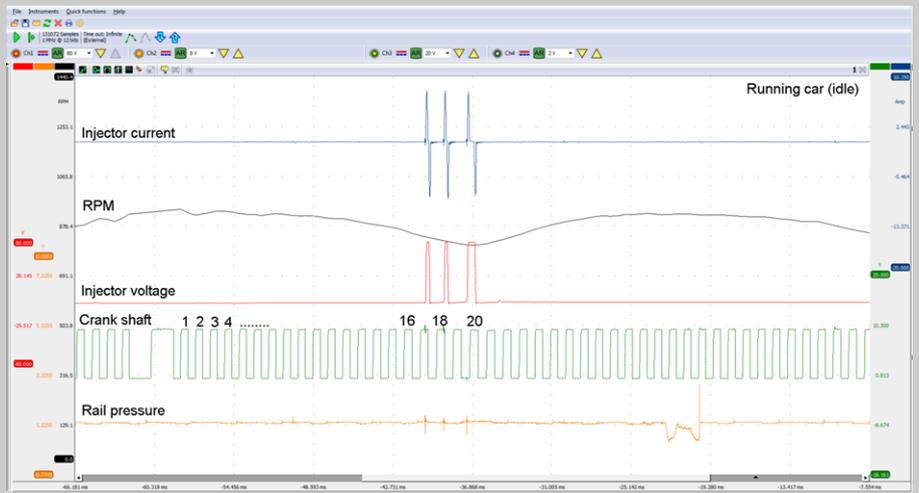
We checked the fuel quality by draining the filter, even though the Diesel smelled differently it burned in a cup just as well as known Diesel from the workshop.

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!!!!!!!!!!!!

What the....?

No way can the ECU suddenly become 360 degrees confused, I cannot think of



Picture 4: ATS recording for timing check, good car.

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 re-flashed by an after-market software file.....

In my view, that would 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.

Super Special

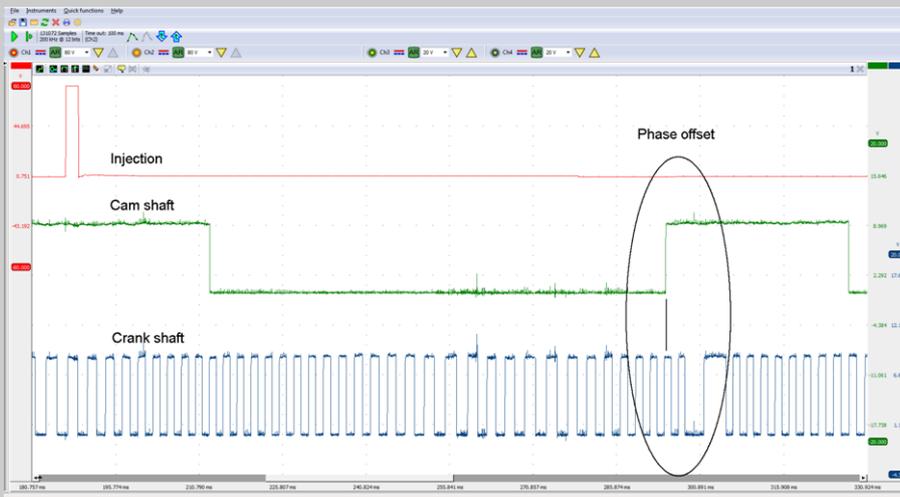
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Picture 5 :Cam crank relation recording on non-starting vehicle

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.

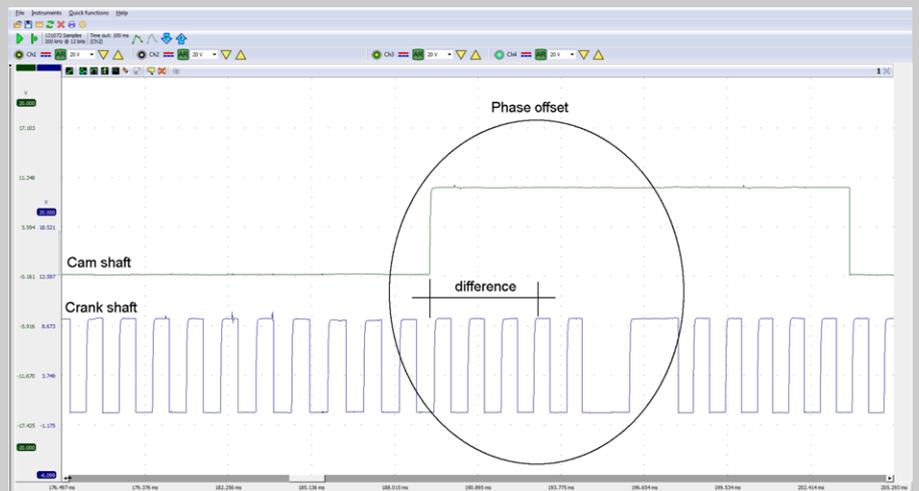
As a diagnostician, I made the clear and common error of taking the information from the technician as true (timing cannot go wrong). I have learned that lesson many times yet sometimes get caught out and fall for it again.

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

In the pattern in picture 5, the injection pattern visible, yet the engine does not start. Please note the phase offset between the cam and crank.

The next pattern in picture 6 is recorded on the running identical vehicle. Please note the phase offset between the cam and crank and compare it with the not going vehicle.



Picture 6: ATS scope recording cam and crank on going vehicle.

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 but 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.

Herbert

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March	April	May	June	July	August
1 YES!	1 Easter Monday	1	1	1	1 Auckland EMS1-4
2	2	2	2	2	2 Auckland EMS1-4
3	3	3	3 Queens birthday	3	3
4	4	4	4	4	4
5	5	5	5	5	5
6	6	6	6	6	6
7	7	7 ChCh SCAN1	7	7	7
8	8	8 ChCh SCAN1	8	8	8
9	9	9 ChCh AED	9	9	9 Gisborne DMS 1-3
10	10	10 ChCh AED	10	10	10 Gisborne DMS 1-3
11 Taranaki Anniversary	11	11	11	11	11 Hastings EMS 1-4
12 Private Training	12	12	12	12	12 Hastings EMS 1-4
13	13	13 ChCh EMS 1-1	13	13	13
14	14	14 ChCh EMS 1-1	14 Private Training	14	14
15	15	15 ChCh ATS 1-1	15	15	15
16	16	16 ChCh ATS 1-1	16	16	16
17	17	17	17	17	17
18	18 Wellington SCAN1	18	18	18	18
19 Auckland AED	19 Wellington SCAN1	19	19	19	19
20 Auckland AED	20	20 Private Training	20	20	20
21 Auckland AIRCON	21	21	21	21	21
22 Auckland AIRCON	22	22	22	22	22
23	23	23	23	23	23
24	24	24	24	24	24
25 otago anniversary	25 Anzac day	25	25 Hamilton DMS 1-3	25	25
26	26	26	26 Hamilton DMS 1-3	26	26 YES!
27	27	27	27 Rotorua AED	27	27 YES!
28	28	28	28 Rotorua AED	28	28 YES!
29 Good Friday	29	29	29	29	29 YES!
30	30	30	30	30 Private Training	30 YES!
31	31	31	31	31	31

Please note:

All effort has been made to ensure the training & course dates are correct, however please contact us first before publishing information from this calendar.

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