

Direct injection bad connection

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

Vehicle:

Toyota 1999 Toyota Nadia with a 3S-FE D4 Direct injection engine.

Problem presented to the help desk

This vehicle is sometimes impossible to start; it winds over but does not fire up at all. Other days it runs beautifully and starts perfectly. No fault codes are present.

Where do we start?

The vehicle was offered to a workshop with the right equipment by another workshop who had given up. The car was starting beautifully and did all it should, so during first intake even this YES inc. member could do little but to check a few basics.

The ignition quality was checked on all four coils without removing them or disconnecting anything (secondary pattern in dual channel mode with the ignition feedback IGF signal). The ignition pattern was good enough for this diagnostician's taste, and the IGF signal confirmed this.

The IGF signal prevents the ECU from injecting when the spark is of poor quality to prevent catalytic converter damage.

Bad ignition could result in an intermittent non starting engine.

The power supply and earth of all coils was checked and was also found to be alright. We should therefore not look at intermittent power supply/earth problems to the coil.

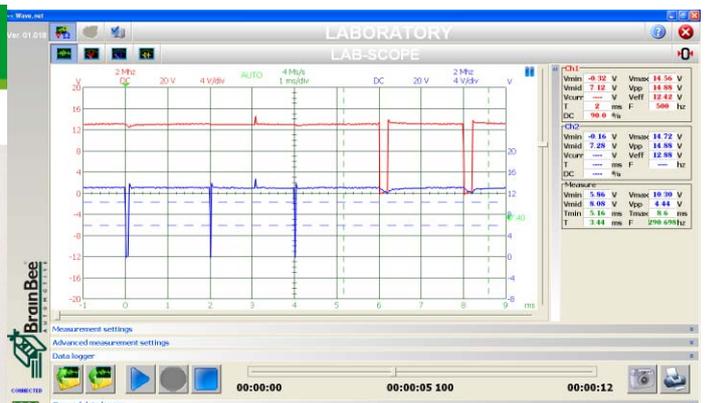
Fuel pressure readings

We from AECS were not sure if, for example low fuel rail pressure readings by the ECU would stop injection and therefore prevent the vehicle from starting, as is the case with common rail injected diesel. For example an intermittent failing (worn) electric lift pump would prevent fuel from flowing to the high pressure pump, causing low rail pressure.

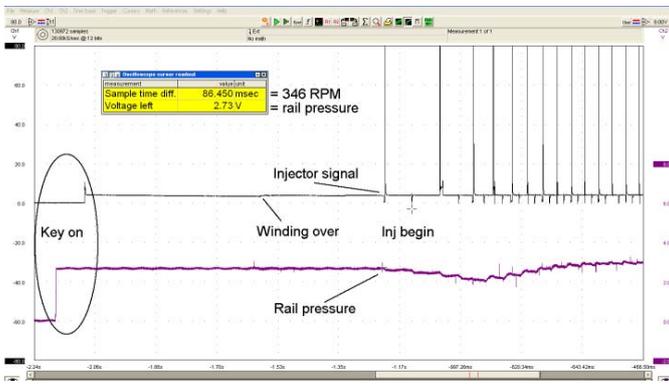
We needed to check. A recording of fuel pressure vs. injectors was made. It showed that the injectors get actuated immediately upon winding over of the engine, with or without pressure.



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Picture 1: 2 Channel ATS recording of injection vs. Injector rail pressure.

This knowledge made it functional to measure ignition (IGT=trigger) over injection, and leave the scope connected for some time so that during the use of the vehicle a recording can be made to capture the fault when it occurred.

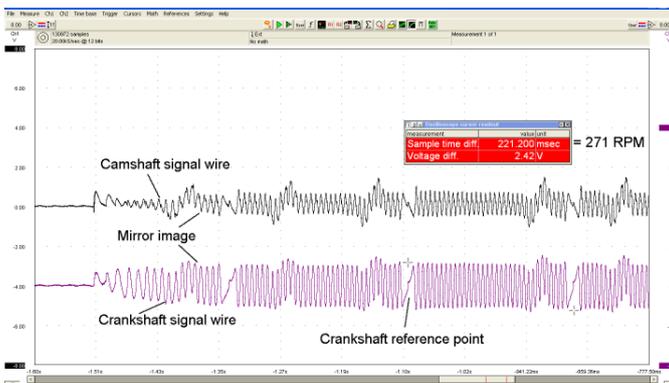
Problem, great!

Several days went by without any problems, until one morning the vehicle refused to start, great!

The recording showed no injection and only two out of four coils firing. Unfortunately the recording of this was not saved.

Beautiful, this gets us on track. This can only be the result of a calculation error in the ECU. It sees for example part of the crankshaft signal correct, while the rest is distorted, or it sees the relation between the crank and cam incorrect, or the cam signal is faulty.

In any case we wanted to see the crank and cam shaft signals in a dual channel mode.



PICTURE 2 : ATS 5000 scope recording of faulty Cam vs. Crank sensor signal while engine refuses to start. Both patterns are almost each other's mirror image.

From the help desk we told the diagnostician that the patterns could not be each other's mirror image! The cam has to be different from the crank signal. Also the signal was not steady in height. The combination of these remarks made the AECS support person query if the scope's earth lead was properly connected to the battery negative (!) or that the earth lead was perhaps connected to a bad earth like for example the engine block.

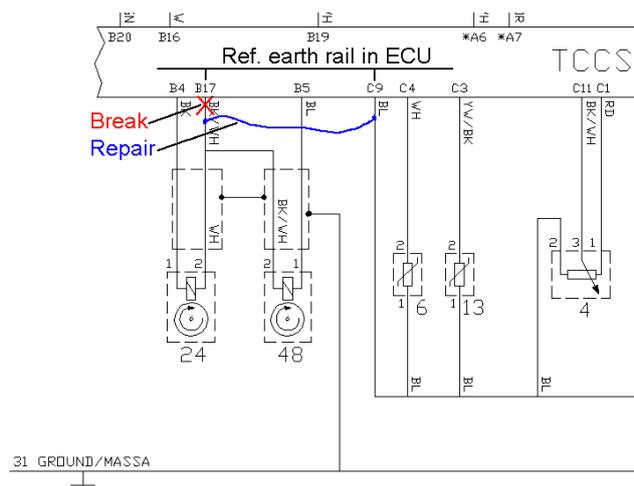
This diagnostician had been to many of the AECS diagnostic training seminars and understood the importance of proper earth connections; he had the scope connected properly.

This could only mean one thing; the shared earth of the inductive sensors was disconnected. Many vehicles have their inductive sensors connected floating, but not on Toyota.

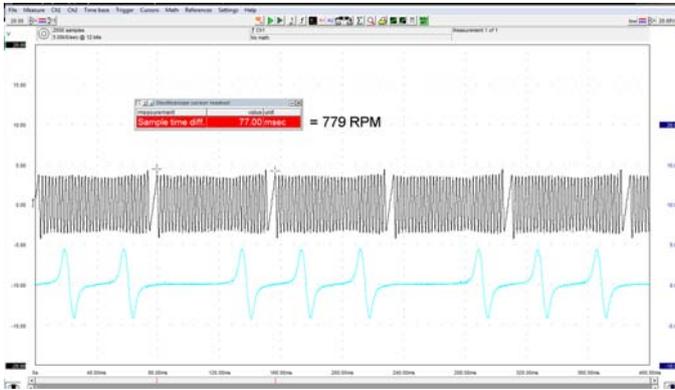
We asked the diagnostician to measure, for example the TPS reference earth to see if the problem was in the ECU. This showed a beautiful flat line on zero volt and also during starting. The conclusion was that the ECU was fine.

The reference earth of the TPS and the crank cam sensor are joined inside the ECU, so it had to be a wiring / connector problem.

We advised the diagnostician to connect one of the two AC wave form crankshaft wires to the TPS reference earth with a temporary jumper wire to test our conclusion. The result was a perfectly running car. Disconnecting the wire made it stall again.



Closer inspection of the wiring loom and ECU connector showed that the pin in the ECU connector was damaged most likely caused by someone back probing the pin at some stage. The pins are so small and fragile that remove/repair was not really an option. A permanent jumper wire was fitted from the cam/crank shaft earth to the TPS earth close to the ECU, as a lasting fix.



PICTURE 4: Recorded scope pattern of Cam (Ch2) and crank (Ch1) sensor signals with fixed earth.

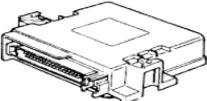
The car is in good condition now and running how it should.

Conclusion

This diagnostic shop obviously owns the ATS recording scope and has technical back up from their equipment provider (AECS). The problem was easy to find for this well trained YES (Your Electronic Specialist Network) inc. member.

The only time consuming part was the intermittent nature of the fault. We from the YES diagnostic society find more and more often that faults like as described above are proving a real headache for most garages. It should not be, but be assured that the NZ / Australian YES network is there to help other garages with these “elusive” diagnostic cases.

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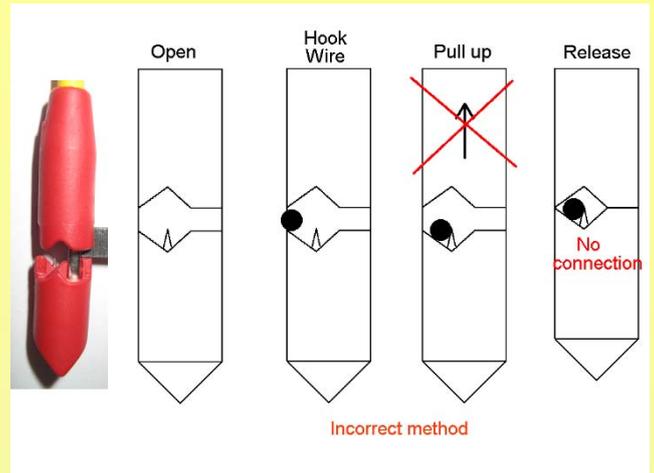
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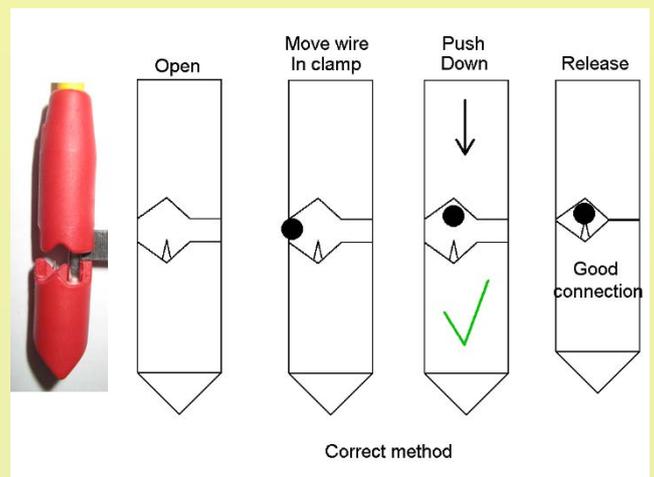
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AECS is a proud member of the "YES (Your Electronic Specialist)" Automotive diagnostic network. This international group of highly trained, well equipped and highly motivated electronic diagnostic specialists was established in 2004. The network is there to help each other and other garages with automotive electronic problem cases. Some of the cases that get solved within the network are truly impressive.

This incorporated society is the avant garde of the diagnostic industry. What makes it really different from even overseas organisations is that members can look over each others shoulder via the internet when a problem case is being sorted out. We use the most of modern technologies to be there for each other.

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