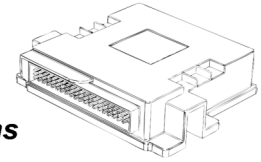
November 2012

Technical Newsletter

Automotive Electronic Control Systems



AECS

Training, Equipment and Data for Automotive Diagnostic Specialists

Grand Elgrand

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

Vehicle
2003 Nissan Elgrand 3.5 Ltr V6 Petrol A/T.

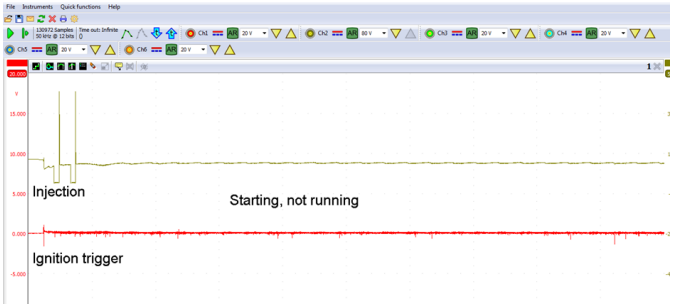
Problem presented to the Helpdesk
This Nissan people mover has had engine failure after the manifold length adjustment valves had fallen into the cylinders. The engine had been removed and rebuilt.
After fitting the rebuilt engine, it does not fire up anymore.
The engine has been out 2 times since (removal of sub frame required!) to check cam and crank timing amongst various other things.
The vehicle has been to several garages, some with scopes over a period of at least 6 months. No fault codes were ever set by the ECU according to the technicians we spoke to.

Everything has been done to this vehicle to try to make it go. Some garages had measured ignition vs. injection and had noted that the engine sometimes has only one ignition pulse and always one or sometimes two injection pulses.
The cam and crankshaft sensors had been replaced, the vehicle has had twice a new ECU fitted; the wiring between the crankshaft sensor and ECU has been replaced.

New keys had been programmed and the CAN data bus was checked as the immobiliser function of the ECU was suspected.
After months, the vehicle ended up in a workshop of which the owner owns the ATS scope and enjoys AECS technical support.
After a number of measurements, they decided to call us for advice.

Please read all the detail in this report to fully appreciate how YOU could get into trouble!

Start fresh.
In cases like this, it is best to start clean with no regard for what has happened in the past.
When an engine does not go, the usual first measurement is ignition vs. injection:

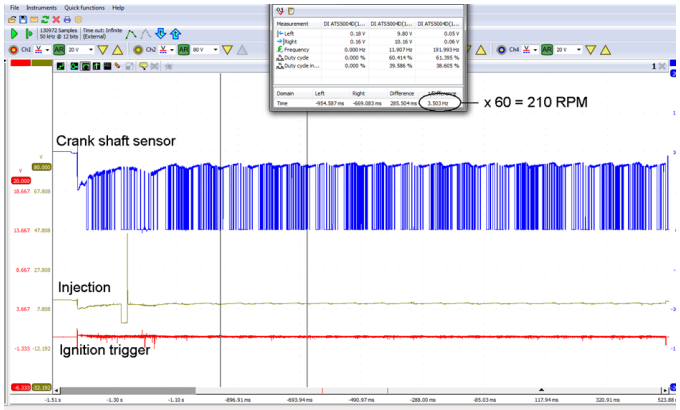


ATS scope recording of ignition trigger vs. injection while winding over.

We had no ignition trigger and a couple of injection pulses. To us at the help desk it looked like a clear crankshaft or crank/cam shaft sensor issue. It seems as if the ECU dumped some start fuel and then continued waiting for a proper crank position.

Crank!

Logic next measurement was crankshaft vs. ign/inj.



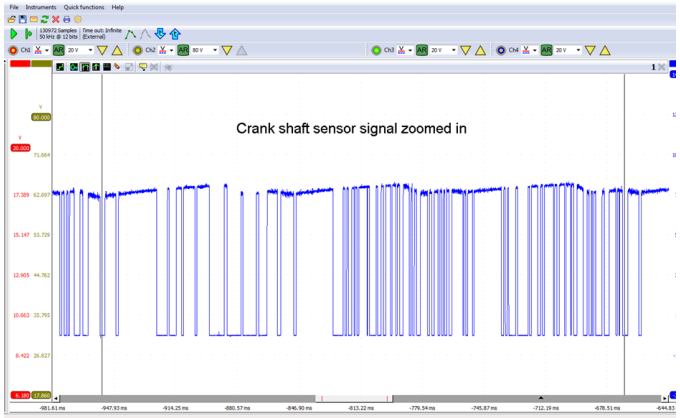
ATS 4 channel scope recording of crank sensor vs. injection and ignition

Again, no ignition and only one injection pulse. We had to look at the crankshaft pattern in detail. It always helps to knowingly look at one full crankshaft revolution or else it can be very hard to look at a repetitive pattern finding irregularities.

We placed the cross hairs so that they lined up with approx. 3 dips in the crankshaft sensor signal; this represents the starter motor fighting 3 compressions (pulling battery voltage down). Three compressions equals one revolution on this 6 cylinder engine. To double check, the frequency in the 'value window' on the screen indicates a crank speed of 210 RPM, which is normal start speed.

Crank?

Zooming in on the one revolution section of the crankshaft sensor pattern revealed the following:



Zoomed in on the crankshaft sensor pattern section between the cross hairs.

We started doubting if we were connected to the correct wires and if we measured at the correct sample speed, as this is a very irregular pattern. We have never seen a good running Nissan producing a signal like this. However, I have dealt with some 'strange' Nissan Hall-effect sensor signals before. In all cases, the magnetic balance of the sensor was disturbed by removing steel brackets, leaving bell-housing bolts out etc. I have even published an article about one some time ago (see www.aecs.net/techsupport).

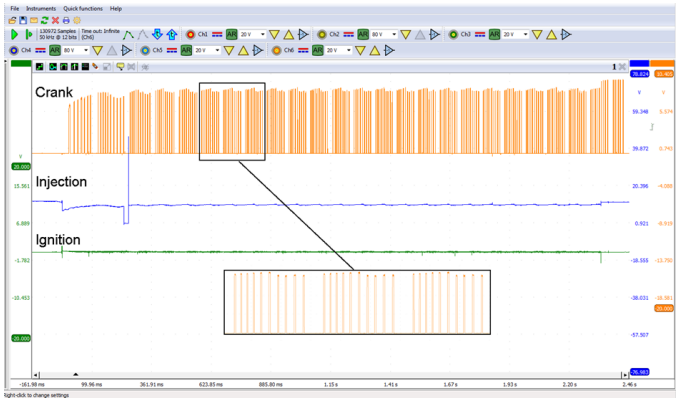
By just looking at the plastic sensor and the aluminium bell housing it looked like a cage was missing, a steel cage that alters the magnetic field of the sensor. Often placing anything of steel attached to earth close to the sensor will overcome that problem. We placed part of a washer around the sensor. The ins and outs of this are dealt with in the AECS AED training.

Half washer fitted around crank sensor

Washer?

The washer fitted, created a beautiful crankshaft pattern, but the engine still would not go!

We still had exactly the same ignition and injection pattern but the crankshaft pattern was fine.

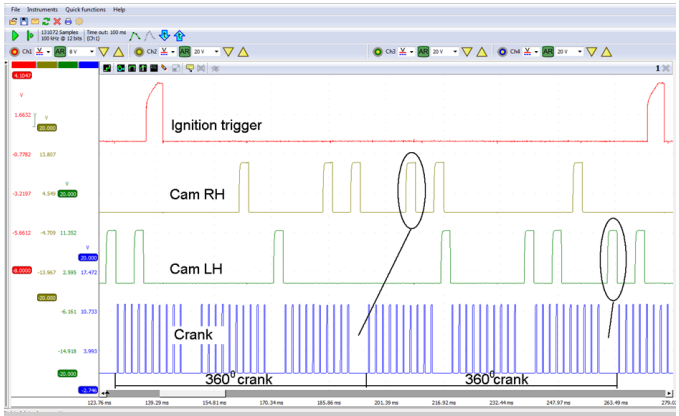


Two problems?

We had to consider that we had multiple problems as this engine had gone through so many hands. In our view, we still had a crank/cam shaft relation problem.

We recorded the crankshaft and both camshaft sensor and found that the RH cam sensor pattern was NOT 360 crankshaft degrees out of phase with the LH cam sensor pattern.

We looked at the pattern in detail and noted that the RH sensor did not switch at logic crankshaft positions. The LH sensor made more sense. We disconnected the RH sensor and started the engine.



Ignition trigger, RH cam, LH cam and crank recording zoomed to 2 revolutions. Please look at cam off set difference.

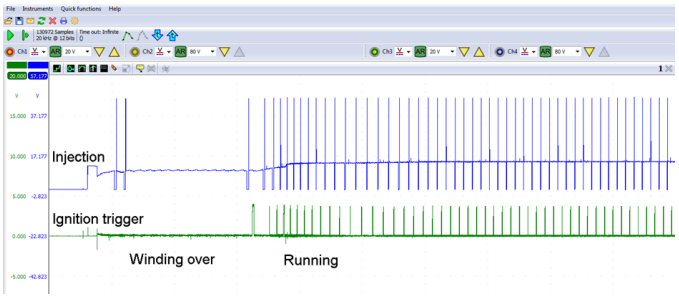
Engine noise!

Yes, that started the engine for the first time in many months! It took a while before it fired, but it went. The pattern recorded is after the engine started. While running we plugged the cam sensor in to have a nice clean signal of a stable running engine. This made it easier to see the phase offset.

It was now obvious why the engine was not firing up; two problems, the crankshaft signal, and the camshaft sensor signal were both incorrect, getting the ECU into calculation trouble.

It was still hard to start as the ECU was waiting for the RH sensor signal but after a few revolutions, it would go into limp home and would fire up anyway.

Below is a recording of ignition vs. injection with the RH sensor disconnected.



Injection vs. ignition after steel washer placed and RH camshaft sensor disconnected.

Further tests for confirmation

Cam

With the RH cam sensor connected, the engine would not fire up. Connecting the sensor with the engine running had no influence on the running of the engine; however, a RH cam sensor fault code was logged. Resetting this code with a scan tool while the engine was running stalled the engine.

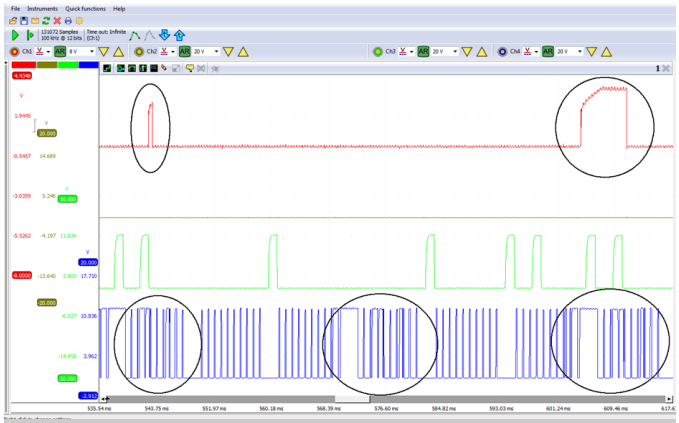
Starting the engine with RH sensor connected and LH disconnected gave us Ignition and injection but the engine would not run (timing out of phase).

This confirmed for us the RH cam shaft tone

wheel has to be repositioned on the cam shaft, which means engine removal (3rd time!!!).

Crank

With the washer removed from the crank sensor and the RH camshaft sensor disconnected, the engine would run briefly and stall during our first attempt, later it would not start at all. We recorded the crankshaft, camshaft and ignition trigger pattern and zoomed in to just before the engine stalled. The crankshaft sensor is back to being irregular.



Ignition trigger vs LHcam vs crank shaft sensor with the washer removed, just before stall.
Please note the RH cam sensor is disconnected to make the engine start.

With the washer back around the sensor, the engine would run beautiful again.

Conclusion

This very, VERY expensive story came to a good conclusion in the end as a result of ***AECS*** equipment, ***AECS*** technical support and AECS training. Also the fact that at we at AECS (here in NZ…) could 'look over the shoulder' of the technician made a big difference. Looking at his recorded patterns via the internet is very useful, as so often has been proven already in the past 12 years. Operating the AECS technical help desk are Peter, an electronics university graduate, Paul an ex Williams F1 sensor technician and Herbert Leijen.

Understanding

Most of the steps taken in the process by the other garages I understand; the replacement of the crank sensor, the replacement of the ECU, the new wire installed between the crank sensor and the ECU. The technicians were in the right area and in their mind they had done all they could by replacing all. I also understand that they started to doubt the immobiliser, after all the ECU was not switching the coils and injectors as it should while all inputs were checked and came from replaced items.

But why a decent scope was not used very early on in the process is hard to comprehend. I personally would have started with the scope recording exactly how it has been described in this report. It took in actual diagnostic time only just over 3 hours labour, of which a large part was used to get the wires probed up. To say that the bonnet space on the Elgrand is not very grand is an understatement.

Herbert

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