AECS Technical Article ~ Crowbar Cefiro

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

Vehicle:
1996 V6 2.5 ltr petrol VQ25DE Nissan Cefiro, Japanese import

Problem presented to the help desk: The car presented to this YES member is a taxi and came in with a slight miss at low revs and seemingly on one cylinder only.
The history is that a new water pump was fitted by another garage in town, it has the miss ever since it came back.
The check engine light is not on and no fault codes are present.

Where would you start? As usual the first check you make on a vehicle to get quick results is to see if there are irregularities in the ignition or injector patterns. Anything wrong with those will have an instant effect on the running of the engine, you don't have to think too deep about that!

A quick check with the ATS 5000 dual channel large buffer recording scope revealed that the ignition was at fault, one coil had really irregular triggering. Below (Figure 1) is the recording of a good and a bad coil trigger pattern of this car:

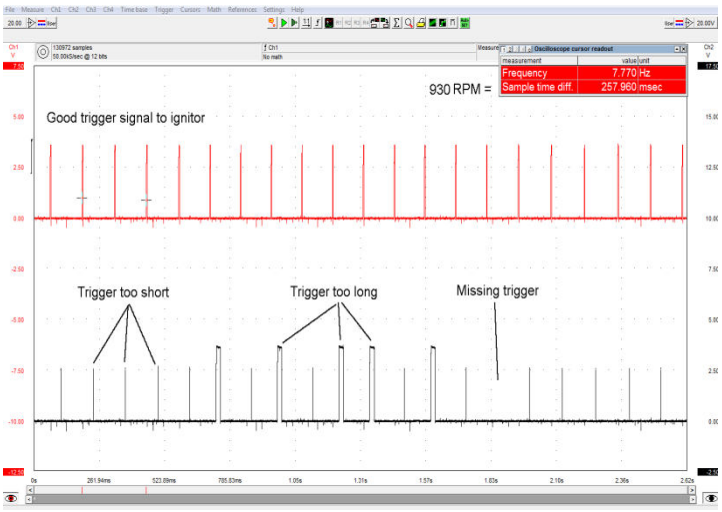

Figure 1 - ATS 2 channel scope recording of ignition

Please note, engine is 'misfiring' as a result of one coil not firing regularly on 2 sparkplugs.

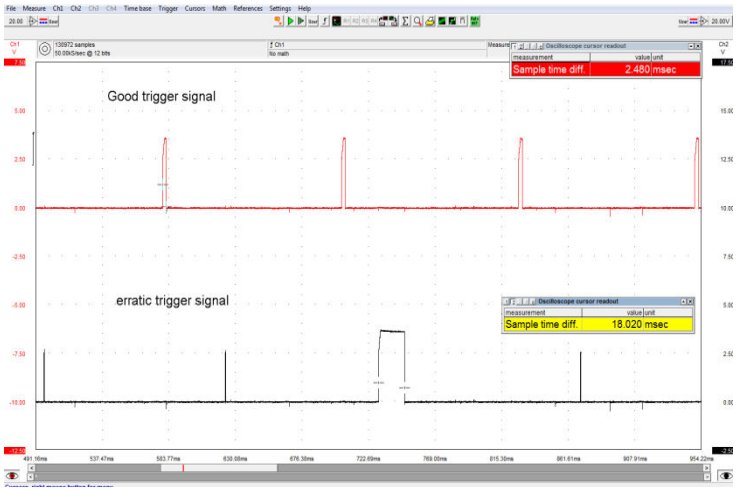

Figure 2 - ATS 2 channel scope recording of ignition

Same signal as in Figure 1, but zoomed in. Note the erratic trigger signal (too narrow and too wide) on CH2.

Please note the value of the recording ability of the ATS scope and the ability to zoom in and scroll smoothly through any portion of the signal.

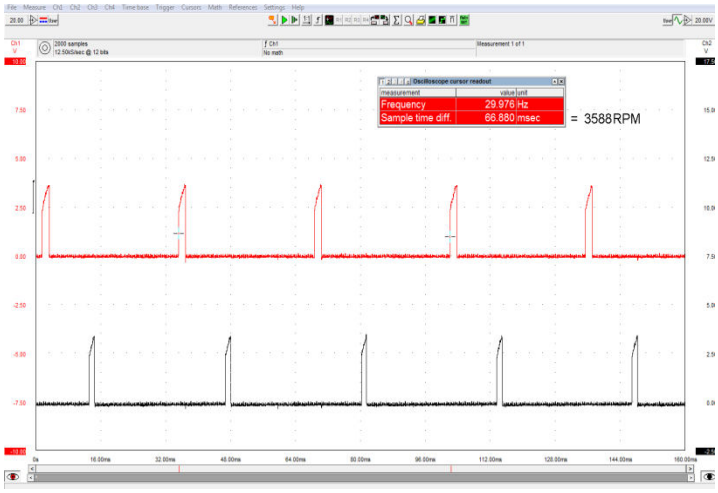

Figure 3

In Figure 3 Recorded signal on the same two coils during high revs. The ignition trigger on channel two is narrower than that on channel, but sufficient to make the coil ignite the mixture during low load (in the workshop).

Why?:
So why is the trigger to the ignitor of just one coil so erratic, while the other coils are perfectly triggered?
This can only be the result of a calculation error in the ECU.
The ECU looks at the relation between the crankshaft and cam shaft signals and calculates from here where the crankshaft is positioned. It needs this position information in order to determine where to ignite, when to ignite and where to inject.

Second measurement:
The VQ25DE engine has 2 crankshaft sensors, one for cylinder top dead centre recognition (120°) and one with fine deviations for precise ignition timing control.
It also has a cam shaft sensor to determine the difference between for example cyl 1 and 6.
Logically the next measurement is the crank shaft vs cam shaft *or* crankshaft rear vs crank shaft front. In case an ATS 5004D (4 channel) gets used all three sensors can be measured at the same time, during the same long buffer time as the 2 channel scope.
The ATS software even allows multiple scopes to be used at the same time, expanding the ability of the laptop to record up to 128 channels with the same high measuring speed and record length!

The ATS software clearly guides you with colour pictures (Figures 4 & 5) how to connect to the car's sensors and how to connect to the scope.

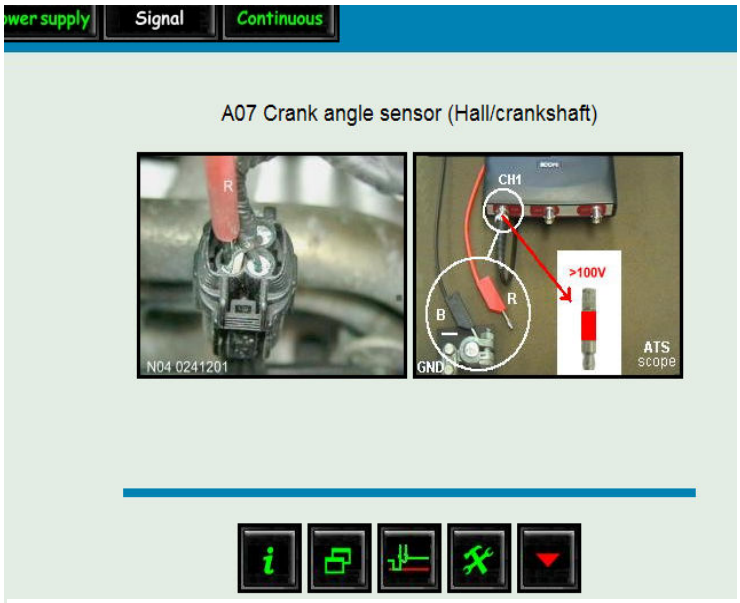

Figure 4

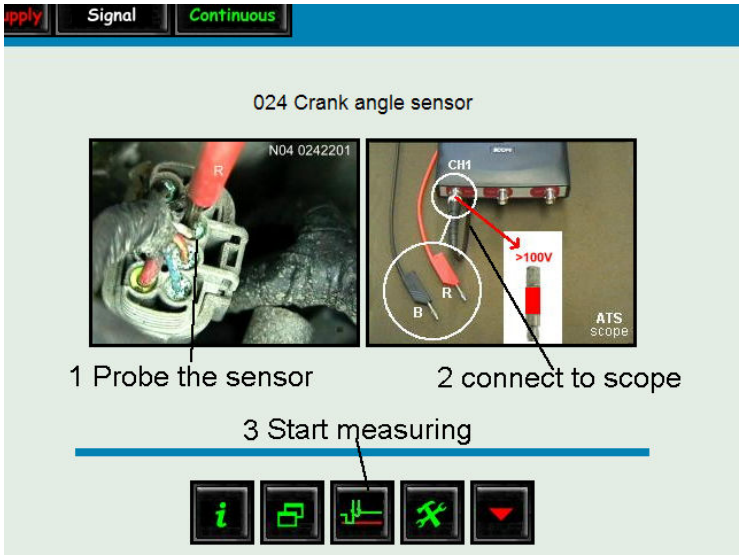

Figure 5

Figure 6

Figure 6 is a 2 channel recording of the Crank shaft front and rear sensor. Partially zoomed in on the 2 crankshaft sensor signals, to inspect the signal for irregularities. Instantly an irregularity on the hall sensor signal stands out, let's zoom in further (Figure 7)

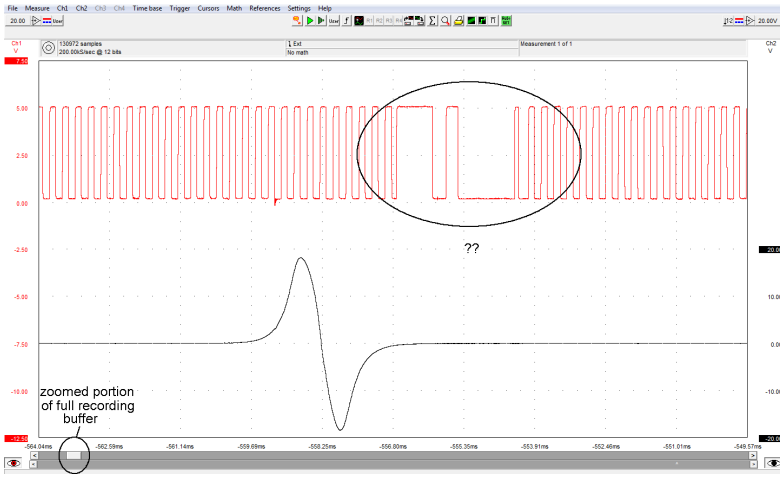

Figure 7

This Hall sensor pattern looks incorrect, let's compare with the ATS scope data base.

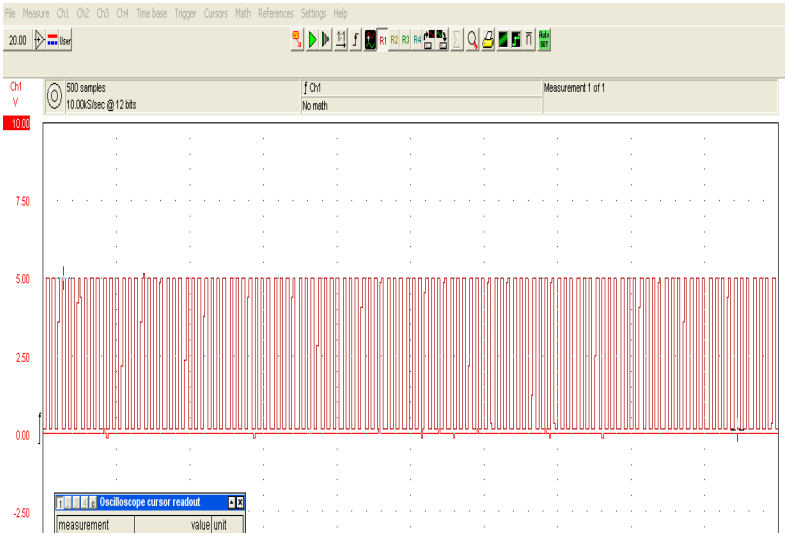

Figure 8

Problem found!

The data base does not show any irregularity in the Hall sensor signal, **problem found and verified.**

Feels good to be certain about the cause of a problem, now only one thing remains, and that is to find the cause of the irregular hall sensor pattern.

Water pump

As said before the water pump had been replaced by another 'garage'. To remove the water pump the crankshaft pulley needs to come off (I am not sure about this H), which is fairly tightly bolted down (49 Nm + 60°).

How do you hold the crankshaft in position while you undo the bolt or while you torque it up?

Put a crow bar into the flywheel ring gear.

What is less work, remove the crankshaft sensor (1 x M6 bolt) or the starter motor, 3 or 4 large bolts to gain access to the ring gear?

Crowbar

The sensor looks at its own ring gear with very weak teeth, compared to the strong teeth of the starter motor ring gear.

You have guessed it, a lazy mechanic held the crankshaft in position with a crow bar and in doing so damaged the sensor's ring gear as that was easier!

A new flywheel job as a result of a water pump job makes sense doesn't it?

Figure 9

Conclusion

How would you have solved this without your fast dual channel (or 4 channel) large buffer recording ATS scope? Hand the job to a specialist, like the lazy mechanic did? How do you charge for a job like the water pump job, if the car comes away from it running worse than it did when it came in? And do you charge for the sparkplugs that where fitted to try to cure the misfire?

The job was quick and profitable for this well trained YES incorporated society member. The diagnostician obviously owns the ATS two channel scope and has technical back up from their equipment provider (AECS).

Ask yourself this, would you have made profit out of this job with confidence?

For *AECS*

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