

## Failing Vito

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

### Vehicle:

2001 Vito 108 CDI Engine 2.2 L (611.980)  
Common Rail Diesel.

### Problem presented to the help desk

This high mileage van had been in for a major Diesel system overhaul. It left the workshop in perfect running condition, it started fine and ran well. The customer took the van home (3 hrs drive) and phoned several days later that the vehicle would not start anymore. The vehicle was taken back to the workshop on a tow truck.

The mechanic found that the engine was winding over but that it would not fire up. He scanned it for codes and found that an oil level/pressure/quality sensor fault code was logged.

### Where to go from here?

Does a fault reported in the oil sensor circuit perhaps stop the engine from firing up? A quick look at the wiring diagram revealed that the sensor is connected to the engine management. It could be conceivable that the sensor on for example low oil levels stops the engine from running. This engine had enough oil, but the sensor was logged in the ECU as being faulty, maybe with the same end result..... Who knows how they tie things together in the software these days...? Do you feel the doubt already settling in? Would you as a technician rather be sure, or would you just let your mind run away with you, based on assumptions?

I rather be sure and sort the problem out.

### System knowledge and tools

Lets first go by systems knowledge and work out from there what we need to measure first with the high quality ATS 5000 scope which was present at

## Did you know?

Handy tips for REAL diagnostic technicians.

On the ATIS CD/DVD is a file which enables you to open and view *any ATS scope patterns on any PC* without the need to connect the scope, or dongle. The ATIS CD/DVD comes with the ATS 5000 and ATS 5004 scope.

### Procedure:

1. Insert the disk in the PC/Laptop.
2. Open Windows Explorer.
3. In the LH window click on the plus (or arrow) in front of DVD/CD Drive ATISv307-5000.
4. Click on the plus (or arrow) in front of "setup"
5. Click on the folder "ATSVWR" (ATS Viewer).
6. In the RH window double click on "setup.exe"

**Please note: Do NOT** do this on the PC/Laptop where you want to connect the actual ATS scope to!

Open any pattern as usual. To view patterns away from the scope is particularly useful if you want to view patterns e-mailed to you by colleague ATS scope users or by **AECS** Ltd as additional information, without the need to take the scope out of the workshop.

this Diesel specialist shop.

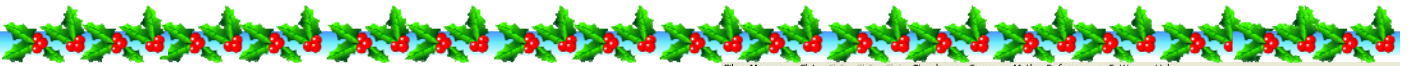
The van has a common rail Diesel engine, so look at the system with knowledge gained from the AECS DMS1-3 training seminar.

In a no start situation I would like to know if there is any injector activity; no injection means 'no go'.

The rail needs to be pumped up by the high pressure pump, connected to the rail are four 'fuel leaks' (the injectors). The ECU is measuring the rail pressure and controls the pressure with a duty cycle controlled solenoid valve.

The ECU will not allow the 'leaks' to be opened





(injector activation) when the rail pressure is not high enough, simply because what is the point of draining Diesel away (through the injectors) when there is not enough coming in.

Also the spray pattern will be very poor with the low rail pressure; it makes no sense to 'hose' Diesel into the combustion chamber as it will not ignite.

So equally important during the first measurement is to measure the rail pressure.

### Bugger hard to get at!

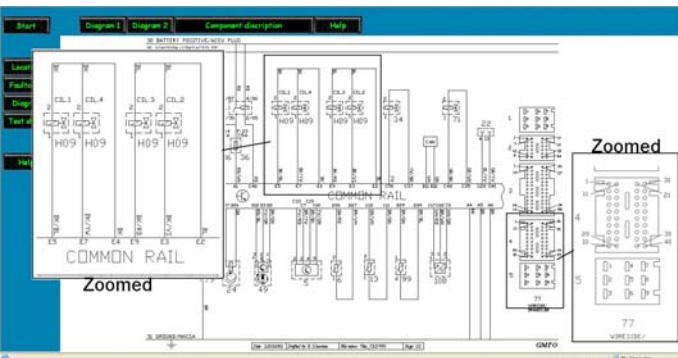
Looking under the bonnetlet (this small size engine cover does not deserve the name bonnet), all you could see is the intake manifold, how are we going to measure on the injectors and rail pressure sensor?

Let's look in the scope software ATIS and see where the ECU is fitted so we can make our measurements at the ECU.

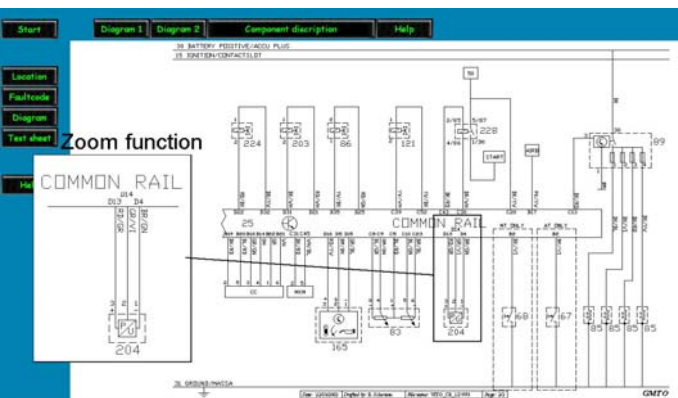
Then look at the wiring diagrams in the ATIS software for which pins to connect to.

Next look at the sample patterns, so we know what signals to expect.

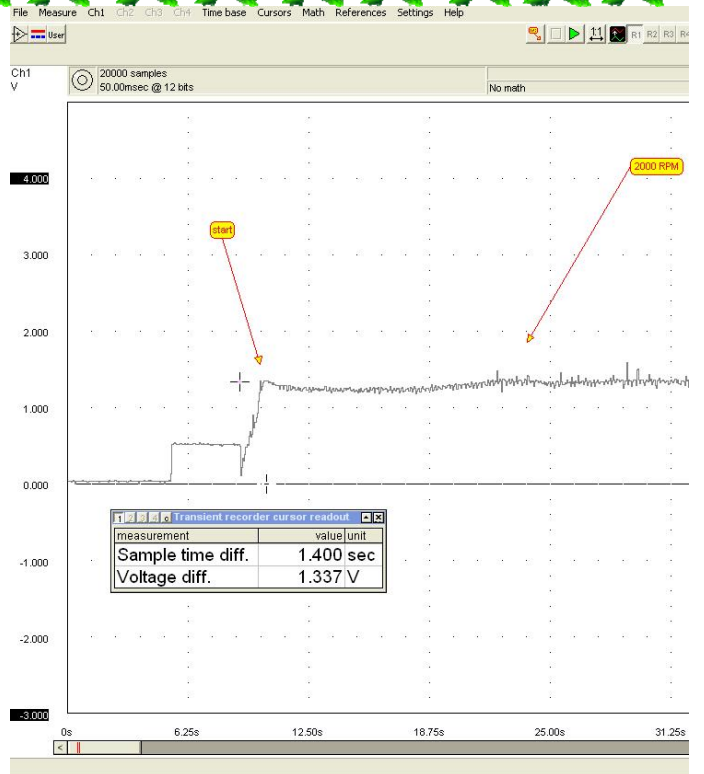
### Short and simple.



**Picture 1 :** ATIS scope software wiring diagram part 1, injectors and connector section are zoomed in.



**Picture 2 :** ATIS wiring diagram part 2 of the VITO. The rail pressure sensor (component 204) is zoomed in but also the oil sensor is visible (component 165).



**Picture 3 :** ATIS sample scope pattern of the rail pressure sensor. Please note that in 1.4 seconds the pressure should be up to around 1.3 Volt in this sample recording which is loaded in the ATS 5000 scope.

### Measure

The scope got connected to the wires at the ECU under the driver's side dash board, the signals were recorded and is shown in Picture 4.

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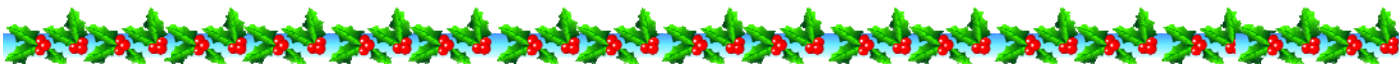
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pressure in the rail. There are several things to consider, we need to consider them all and then start looking at the most logical of the possibilities. Starting from the back of the vehicle to the front:

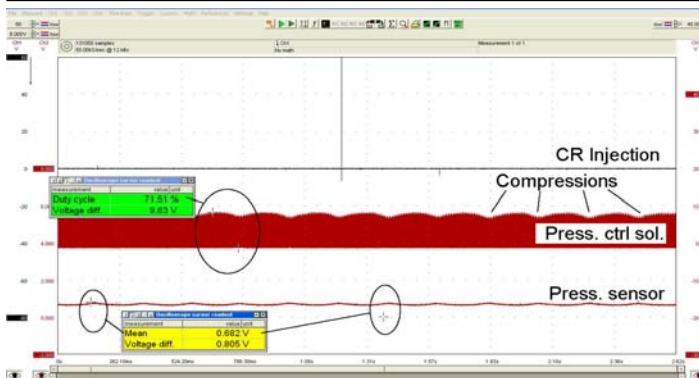
- Tank empty, with a faulty gauge
- Electric lift pump faulty
- Fuel line broken
- Filter blocked
- Fuel line leak
- Pressure control solenoid seized open
- High pressure pump broken

Just to name a few!

The tank was not empty, there was no electric fuel lift pump in the tank, the fuel line was not broken (visually), the filter blocked would in my view be a good place to start, I'll get back to that later. Leaking fuel lines letting air in, the pressure control solenoid and the high pressure pump we would leave for last to check as they are expensive and a lot of work to check.

### Simple is good

Just a quick check at the filter revealed that there was a lot of air in the filter, there are no means to bleed these systems, it all has to be done with the mechanical lift pump in the high pressure pump.



**Picture 4 :** *ATS 5004D scope recording of the Common Rail Injector (CH1), the Pressure control solenoid (CH2) and the Rail pressure sensor (CH3) when the engine refuses to start.*

It became directly visible in the scope's recording mode that the rail pressure was not being build up, in 2.6 seconds the rail sensor voltage averaged at 0.68V, up from 0.5Volt at key on engine off (no pressure). The pressure control solenoid valve was being actuated at 75% duty cycle during cranking which is indicating that the ECU was trying to get the pressure up.

No injection took place during the six or so revolutions, other than the single pulse in the middle of the screen which acts as a charge pulse for the high voltage generator.

Makes sense doesn't it? No injection = no go. No pressure = no injection.

### Why no pressure?

So now we only had to find out why we had no

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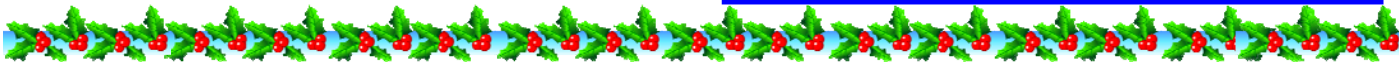
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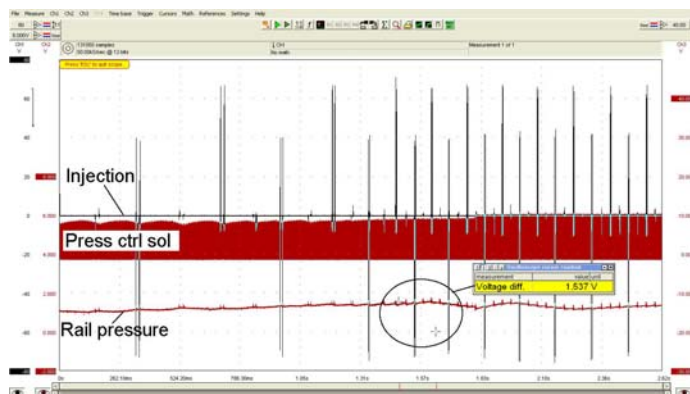
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Since it had been wound over plenty of times it was obvious that the lift pump could not get the fuel from the tank by itself. The diagnostician fitted a hand primer pump in series with the filter. While we had the return to the tank disconnected from the filter he pumped until all the air had gone. The van started almost immediately as the high pressure pump made pressure in the rail, see the recording below.



**Picture 5:** *ATS 5004D scope recording when the engine fires up.*

As soon as the pressure sensor's signal rose above the 1 volt the injectors started to work and the engine burst into life. Highlighted is the moment where the pressure sensor signal peaks at 1.5 Volt, and where the duty cycle controlled solenoid 'back's off' the pressure. The 'over shooting' of the pressure can also be seen zoomed out in the ATIS sample pattern printed at the beginning of the article.

So no new pump or other expensive parts were needed, also we had conclusive evidence that the oil sensor fault code had nothing to do with the no start situation. It feels good to be sure!

Should he really have started by reading the fault codes (oil sensor), or did this just made him doubt and waste time?

With hind sight he should have started by bleeding the system. Remember there are no provisions for bleeding the system on this vehicle. It would have made a small time difference, as making the measurements and exposing the ECU took about 15 minutes or so. Also you cannot see on the outside of the system that there is air present in the filter.

In my view he was not too far off the mark with making the measurements.

#### Where did the air came from?

How did the air came into the system while the

vehicle was parked up for the weekend?

The plastic fuel heater return valve on top of the filter unit had a small crack in one of the tubes, allowing air back into the filter draining all the Diesel from the filter (highest point) to drain back to the tank.

The filter might have been damaged during transport or during installation, that will never be known. A fact is that the Vito is going well now, even after a weekend sitting without being used.

#### Conclusion

This diagnostic shop obviously owns the ATS 4 channel scope and has technical back up from their equipment provider (*AECS*). The problem was quickly found for this well trained YES (Your Electronic Specialist network) incorporated society member when the scope got used.

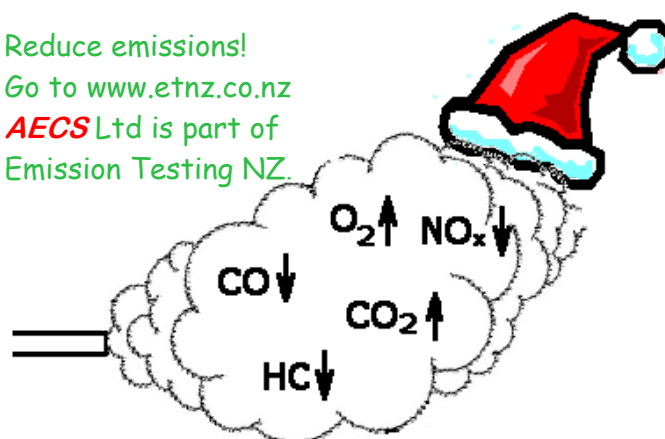
The job was not profitable as the filter was fitted by this shop in the first place.

With hind sight could the van be made to go by bleeding the system before anything else, but why would you start bleeding a seemingly good vehicle with plenty of fuel in the tank? Take also in account that these systems do not have a bleed hand pump, making the bleeding process cumbersome.

#### The scope measurement provided a quick and conclusive answer.

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