Case Study: 2008 Ford Transit 2.4 common rail Turbo Diesel

By Maurice Donovan (the MD)

The customer brought the vehicle to our workshop explaining that it has been running sick on a drive from Sydney to Brisbane. He also reported the vehicle would go into Limp Mode.

My Customer had visited a few different workshops on his trip back to Brisbane, they would clear the codes and the vehicle would then drive ok until 400 or 500 km where the MIL would come back on and the vehicle would go back into limp mode and have no power. The good thing was each time he would have his codes cleared he kept a record and this was vital information that aided me in the following the correct diagnostic path

When I am presented with any vehicle problems my first and most important step is to gain as much info from the customer as possible

- "How long has this problem existed?
- When did this problem first start and what driving conditions were you under? Stationary? Driving in the city? Highway? Under load or cruising?
- What is the service history? Has it had regular services?
- Has any recent repairs been carried out lately?
- Has anyone else looked at this problem before coming here?
- Has the problem started after fuelling up, when was your fuel filter last changed? What fuel are you running on? (I had a Hilux diesel come in once for a hard starting and poor idling issue, it turned out he was running on Bio Diesel, we hooked up a canister of clean diesel and the problem was solved.)

There are more questions I may ask depending on the answers I get and the actual problem I am dealing with. I also document what I am told as I go through the questions with my customer. It has been proven more than once that some info I have received may not at the time seemed relevant but in fact later on has proven to be the missing piece that has directed us to a fix.

I would then want to experience the problem myself in a road test. Unless we can reproduce the problem it can prove very challenging to fix something we ourselves have not verified or experienced. In this case it was obvious the MIL (Malfunction Indicator Lamp) was on, and the vehicle would go into limp mode if driven any distance.

Road testing this vehicle is a vital and necessary step before we even lay a spanner or scan tool on this car. We need to know first-hand if there are any notable drivability issues. We need to write on our job card any noticeable issues, whether related to the customer's complaint or not.

Apart from the Mil light staying on, this car appeared to drive ok, so now if nothing else we had a feel for how the car is driving so we can at least have something to compare with after we complete the repairs and road test the vehicle. (The MIL was on but the car was no longer in Limp Mode at this stage)

Now comes another important part in being efficient in diagnosing vehicles.

We need to do a visual check. This means we lift the bonnet and look for anything that may stand out, such as any vacuum hoses that may have fallen off, a split air induction pipe,maybe an electrical plug/connections disconnected etc.

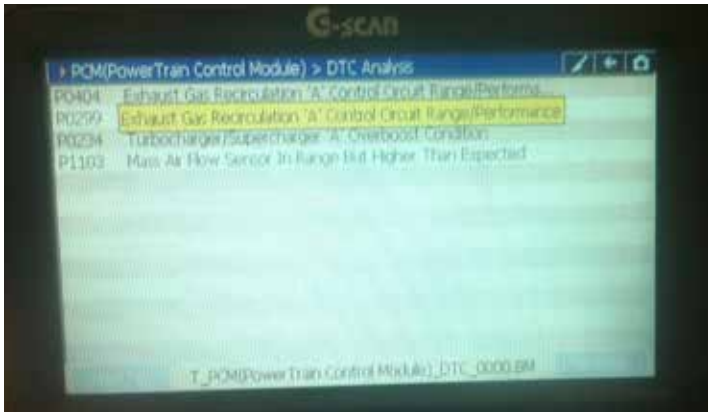
[I was once working on a Volkswagen Golf that had a MIL on and I went straight for the scan tool and started checking and formulating a plan from the code I got out of the car, Once I eventually opened the bonnet I found my problem, the oil cap had simply been left off after a service. I had broken my rule by skipping the visual. Had I done this first I would have saved some time.]

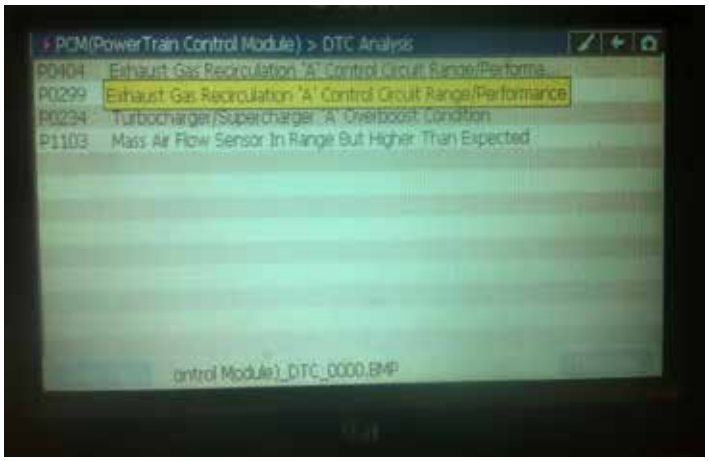
After my visual check it is now time to hook up my scan tool, and it was at this point I discovered not one code but numerous codes.

- P0404 EGR circuit out of range
- P1103 Mass Air Flow Sensor In range but higher than expected
- P1102 Mass Air Flow Sensor In range But lower than expected
- P2563 Turbocharger boost control position sensor A
- P0229 turbo under boost
- P0234 Turbo over boost

What do we do when we are presented with a vehicle that has multiple codes?

It is important to realise that late model cars have highly integrated controls and faults can cascade from one system to another. So in other words one fault could be responsible for more than one DTC (Diagnostic Trouble Code). It is important to document all the





codes and their meanings.

My next step was to go into the OBD2 side of my scan tool, Global OBDII including freeze frame, stored diagnostic trouble codes and vehicle information. Freeze Frame is a record of the available data PIDs stored by the PCM at the same time it matures* a DTC. This can be important information for diagnosis. It helps you recreate the conditions present at the time the trouble code was matured.

***Mature is when a pending trouble code has tripped the MIL on. In other words it has gone through 2 consecutive drive cycles and has now become a mature code. There are 3 types of DTC Pending, Mature, and History. A PCM remembers a code for up to 40 drive cycles and if a pending code has not reoccurred for the 7 drive cycles it turns into a history code.**

I was able to recover info at the time of the fault was logged. It revealed that the vehicle was at full operating temperature and travelling at 80 km/h as well. I also knew the RPM when this code was set. This again is important information that needs to be documented and kept for use as I proceeded to look into this vehicle's problems.

The Serial Data Information Stream of the PCM (Power Control Module) is a "window" into the operation of the system under test. By looking at the values of the suspect components in operation and the computed values of the PCM, we can build a picture of the operation of the system and what is causing the fault. The interpretation of the Data Stream is beyond the scope of this article, but it is one of the most powerful means of identifying abnormalities in the engine management system that can lead you to the source of the problem.

The more time that is taken in preparation, the better chance we have of solving some of our seemingly difficult problems. This is time well spent and is chargeable to the customer. In many cases the more time spent in preparation will save your customer money and often avoid unnecessary wasted time exploring things that are not necessary.

Some of the current codes I found were not included in the codes found on my customer's records and there were a few I did not have. But in all the times the codes were cleared code P0229 turbo under boost and code P0234 Turbo over boost were present. I knew these codes had to be the starting point of my investigation. I also knew this vehicle has a variable geometry turbo which relies on the variable vanes to increase or decrease the vane angles to change the boost on this style of turbo.

What sets P0229 code?

The PCM checks for a minimum throttle intake pressure (TIP) PID reading during engine operation, which indicates an underboost condition. This DTC sets when the PCM detects that the actual throttle intake pressure is less than the desired throttle intake pressure by 4 psi or more for 5 seconds.

Potential causes of a P0299 turbo under boost code include:

- Intake (induction) air restriction or leak Failed or damaged turbocharger (sticking, binding, etc.)
- Faulty boost/charge pressure sensor
- Faulty wastegate bypass regulator valve (VW)
- Low fuel pressure condition (Isuzu)
- Sticking turbo nozzle control solenoid (Isuzu)
- Faulty injector control pressure (ICP) sensor (Ford)
- Low oil pressure (Ford)
- EGR system fault (Ford)
- Variable geometry turbocharger (VGT) actuator (Ford)
- VGT vanes sticking (Ford)

What sets a P0234 Code? The powertrain control module (PCM) senses a dangerously high boost pressure from the engine's forced induction system. Levels of boost in excess of recommended levels can compromise the structural integrity of the engine.

These types of turbo's do not run a wastegate. Instead they use an electronic actuator that controls the variable vanes mounted to a unison ring that can be rotated to change the vane angles. The turbocharger vanes are normally open when the engine is not under load. However, the PCM will often close the turbocharger vanes to create back pressure to drive exhaust gas through the exhaust gas recirculation (EGR) valve as required. At extreme cold temperatures, the PCM may close the vanes at low load conditions in order to accelerate engine coolant heating.

It seems to be common to see excessive carbon build up within these turbo units causing the unison ring to stick therefore not allowing the vanes to open or close properly when the PCM commands such a requirement. This would and could quite easily cause over boosting or under boosting conditions therefore setting a P0229 or a P0234 code.

It has become part of my diesel induction cleaning service these days to use a special chemical that I allow into the induction side of the turbo to soften and clean any carbon deposits from the turbo area as a means to lessening the chances of the unison ring to stick.

I made a diagnostic decision based on the evidence and from previous experience to recommend a chemical clean of the turbo and the induction system as the turbo and intake system components may have been affected by carbon. I also have in the back of my mind the other codes that I had found, which were relating to MAF (Mass Air Flow) sensor and

EGR, of which could also been affected by excessive carbon build up.

Before I made the call to my customer, I decided to remove the Boost sensor which happens to sit at the intake manifold opening. It was no surprise to see the excessive carbon build-up on this sensor and in the opening of the intake system.

I reported my findings to my customer and I recommended that we should start with a chemical clean on both the turbo and the intake system. To protect myself I warned of the possibilities that the carbon build up could quite easily be too far gone, particularly in the Variable Geometry Turbo, but we had a lot to gain if we treated the turbo and the intake system with our chemicals and we could easily fix our problem.

I started my process by choosing my BG petrol intake canister and poured my diesel induction cleaning chemical into it. I removed the induction pipe from the turbo and gave it a generous spray, so as to

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allow penetration. I left this sit while I proceeded to clean the Boost sensor and the MAF sensors.

After some time had passed and I had set up my diesel induction canister apparatus to meter a safe amount of diesel induction cleaner to go through the turbo suction side, I then stared the engine. I set the air pressure that is on the induction apparatus to a much lower pressure than normal and I allowed some more diesel induction cleaner to flow into the running turbo.

A lot of caution is needed not to spray too much into the turbo on a running engine otherwise this could hydraulic* the engine.

(*Hydraulic ie: if we have too much fluid in a combustion chamber it has the same effect as a hydraulic system where hydraulic oil cannot be compressed.)

This would be the last thing any of us would want to have happen and the reason I choose

to use the correct chemical and tooling for this job. After applying a considerable amount of chemical into the turbo, it is now time to add more the induction chemical cleaner into my apparatus and then concentrate on the intake manifold side. I then set my pressure higher and continue the process.

Once finished I cleared all the codes and took the vehicle on a good long road test. It was my opinion the vehicle had much better pick-up and drove a lot better than on my first road test. The MIL light did not come on during my testing. I asked my customer to monitor the situation and let me know of any further problems.

8000k's later…

It has now been 8,000 km since the induction service and the customer reports that the MIL came on for one drive cycle but has since gone off again. The customer brought his vehicle into the workshop and we pulled out a history code P0234 "Turbo over boost", but we did not have code P0229 "Turbo under boost."

Due to the amount of carbon build up it is not always possible to do one chemical treatment and totally eradicate all the carbon. But one thing is for sure, we made a huge improvement.

Before the treatment we were seeing not only the MIL light appearing but the vehicle was going into limp mode and lacking in power. Now after 8.000 km we see the first sign that the turbo unison ring may be starting to stick again. (my suspect component)

This time I want to fix this problem once and for all, so I want to have the Turbo removed and stripped and properly cleaned so as to avoid this problem from reoccurring. I will advise this customer to carry out regular induction servicing both in the turbo and the intake system. This way he should never have to have the turbo or the intake system choke up with carbon again.

At the time of producing this issue, I am now waiting for the customer to come back. We will follow up in a future issue the results and reveal what we find, but this is another case study where carbon is causing some real annoying issues especially if the vehicle and the induction system are not regularly maintained.

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Australian Auto Aftermarket Expo Coming

Industry support for the Australian Auto Aftermarket Expo continues to grow with exhibitors having already booked more than 75% of the available space 10 months out from the 16-18 April, 2015 trade only event.

Organised for the aftermarket industry by the Australian Automotive Aftermarket Association (AAAA), the Expo will be held at the Melbourne Exhibition Centre.

AAAA Executive Director Stuart Charity said the 2015 Expo is experiencing the quickest ever uptake of exhibition space and sponsorship packages. "We welcome the Tenneco brand Monroe as the major corporate sponsor for the third time," said Stuart Charity.

"A committee of senior industry leaders help set the direction for this event and they understand the workshop owners, managers, technicians and apprentices who attend the Expo, because those visitors are also their customers. In addition, we get feedback from actual and potential show visitors through formal research. With all this knowledge of the market, we truly make it an Expo for the industry by the industry."

"The comprehensive display of vehicle repair and servicing equipment, replacement parts, accessories and workshop tools will be balanced by a seminar program featuring industry experts presenting the latest technologies and trends in workshop and retail management. The 2015 Expo also introduces an expanded Australian Auto Aftermarket Awards program recognising innovation and excellence in our industry.

"We are delighted too with the remarkable industry support received for the co-located Collision Repair Expo. More than 90% of that show's exhibition space has been sold. The Collision Repair Expo features state of the art body finishing materials, crash repair equipment and tools, and has its own industry seminar program.

"Together, the Australian Auto Aftermarket Expo and the Collision Repair Expo will offer more than 400 leading Australian and international brands displayed across five acres," said Stuart Charity.