Jim Investigates...
Mazda 5 DPF issue

Written by Jim Gilmour Blue Print's Technical Consultant.

Part of my job is to support customers who have bought a Blue Print G-Scan and there's nothing better than working through a real life situation to really get to grips with it. On one visit to Suffolk late last year, I was presented with a Mazda 5, 2.0D Sport.

The owner had reported to the technician, poor performance and warning lights illuminated on the dash.

The vehicle was mainly used for short journeys travelling mostly on rural roads. Earlier in the summer the DPF light came on and the vehicle was taken to the Mazda dealer – the vehicle was returned with the light out.

The engine oil was changed as part of a service in June (not conducted by the main dealer) and the vehicle had done 3,000 miles since then.

Whilst the vehicle was being driven to Cornwall the DPF light came back on and then went out again. Since then, the light had come back on permanently and the engine had lost power.

Having dealt with a similar issue in the past, I assumed that during the period following the long run to Cornwall, the car was once again being used for short journeys and because of the driving style, the system had failed to passively regenerate and consequently had aborted several active regenerations and the system had built up an accumulation of soot.

If this was the case, I could expect to see some oil dilution, and there it was, the oil level was a good 15mm above the high mark.

Passive Regeneration

As long as the temperature remains high enough, the carbon particles will react with NO_x to produce CO_2 and Nitrogen; under low load conditions the temperature drops and soot particles build up in the filter.

Active Regeneration

Extra fuel is injected into the cylinder in a late or post injection. This sends hot, burning gasses into the oxidation catalyst and DPF, raising its temperature sufficiently to cause the carbon to burn off with the excess oxygen.

Note: The dipstick on the Mazda has an 'X' mark some way above the maximum fill mark, which indicates up to two litres of oil dilution.
This is caused by fuel injected late in the cycle for regeneration getting past the piston rings and into the sump. This fuel is normally evaporated off and drawn back into the engine through the crankcase ventilation system where it is burned off, but if the system fails to complete a regeneration, subsequent attempts cause a build up of diesel in the engine oil.

The G-Scan was plugged in and the following codes retrieved:

PCM(Powertrain Control Module) > DTC Analysis		
P242F	Diesel Particulate Filter Restriction - Ash Accumulation	Pres...
P2458	Diesel Particulate Filter Regeneration Duration	Pres...

These are typical codes relating to a blocked DPF.

Parameters were monitored and it was noted that the EGR Valve was commanded closed and that the Air Mass Meter indicated that this was the case. The vehicle was in a restricted mode and under those circumstances EGR is switched off.

With the engine off, the differential pressure sensor indicated 0.02kPa, which is a plausible reading.

Engine Status	Stalled		-	-
Equivalence Ratio(Lambda)(Ba...	1.00		1.00	1.00
Exhaust Gas Differential Pressu...	0.02	kPa	0.02	0.02
Exhaust Gas Differential Pressu...	1.00	V	1.00	1.00

To continue reading...

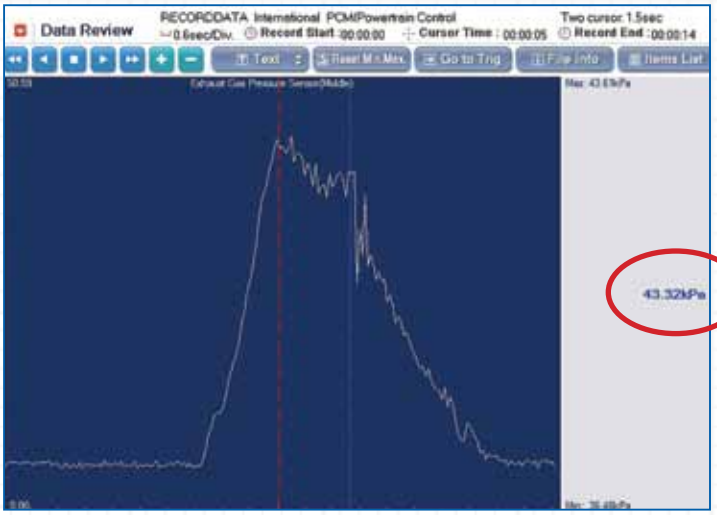
The engine was started and brought up to temperature – the G-Scan was set to record the differential pressure. The differential pressure sensor should be monitored at idle and at varying engine speeds without load.

A typical value at idle would be around 0.5kPa (5mbar) rising to around 3kPa (30mbar) at 4,500rpm.

In this case the data was recorded during acceleration in order to condense it. This increased the maximum back pressure and when compared with a reading from a known good DPF, it gave us an instant comparison and an indication of how blocked the DPF was.

Firstly below is a graph of a known good DPF I had made and stored on the G-Scan for comparison – this is another nice feature of the G-Scan:

Now let's look at what our troublesome Mazda produced:



What the graphs tells us:

The idle differential pressure (Δp) at idle was more than 10 times that of a known good DPF at 5.9kPa (59mbar) and maximum Δp is 43.61kPa (436mbar), more than 3 times the pressure of a known good DPF.

As illustrated the (Δp) is very high and indicates a blocked DPF, we can also see that the pressure stays higher for longer on the blocked DPF.

There are lots of reasons why a DPF becomes blocked:

1. **Drive cycles** – short drive cycles prevent the exhaust temperature rising high enough for passive regeneration to occur.
2. **Excessive oil consumption** – partially burnt oil normally seen as blue smoke is trapped in the DPF and increases the need for regeneration.
3. **The wrong oil being used** – high ash content in oil causes silica particles to clog the DPF. Silica cannot be burned out.
4. **EGR Valve sticking or slow to respond** – if an EGR Valve does not close completely or is slow there will be less air in the cylinder and particulate matter (soot) will increase.
5. **Engine running too cool** – cold engines produce more particulates.
6. **Injector issues** – poor atomisation of the fuel causes black smoke.
7. **Lambda feedback issues** – you may have noticed the equivalence ratio parameter in the second line of data. The oxygen sensor in a diesel engine gives the ECM feedback about the oxygen in the exhaust for accurate EGR control.

The most obvious reason for the DPF failure was the type of journeys the driver made but it is never smart to be complacent. Further investigation into the operation of the other systems would have to be made.

From previous experience with this degree of clogging it was unlikely that the ECM's software would allow a forced regeneration and this was the case. Forced regeneration is not something that should be done without due consideration because it puts the exhaust system under high thermal stress and can damage components. Some manufacturers have removed the ability to do this from their scan tool's special functions.

The technician decided to fit a new Blue Print DPF and use his G-Scan to reset the ECU. Only when this was done could he check the operation and condition of the EGR, Air Mass Meter and engine temperature etc, which, to all indications were performing correctly.

After some polite advice and explanation about driving style, the vehicle was returned to its owner. As luck would have it the owner has since changed jobs which means travelling 60 miles a day on the A14. For the last four months the car has performed as it should.

Note: The DPF warning light on the Mazda, is also used as the service interval light, so don't assume a DPF issue when it comes on, unless it is accompanied by the appropriate DTC's.