Have your cake & eat it too

Technical articles will often focus on gaining more bangs per buck, but these days engine efficiency is equally as important. This month resident tech-head David Bywater talks us through the importance of having a healthy powerplant to begin with.

Words: David Bywater
Photos: Various

When we consider improving an engine there's a tendency to concentrate on the interesting bits that are there to make power. However, if you were designing a new engine there would be a very strong emphasis on controlling the emissions that are a by-product of combustion, and there is lots of legislation surrounding this. One of the simplest ways to reduce emissions is simply to burn less fuel in a smaller engine fitted to a lighter car, but if that was our favoured solution, the magazine would have a different title! As a result, those of us driving around with engines less than 20 years old will have some sort of emissions control on there.

Emission Controls

Fuel injection has improved the matching of fuel delivery and engine timing to driving requirements, which has helped improve performance, efficiency and emissions. Other systems specifically for emissions control include lambda sensors, catalytic converters, secondary air valves and exhaust gas recirculation (EGR) systems. Diesel engines might have a particulates filter (DPF). We might moan about the lost performance or extra expense associated with these parts, but engines are still going to require some sort of emissions control, if only to pass the MoT test.

Potential Problems

It's not always easy to see when emissions control components are working properly or beginning to wear out. Certainly, if your catalytic converter implodes and blocks the exhaust, or the MoT throws up a failure on emissions you will know that something needs to be done. However, most parts deteriorate over a period of time, and any item has the potential to cause a problem when it is not performing properly. Something as small as a coolant temperature sensor can cause an engine to over-fuel, if it is out of range.

The thing to remember is that not all emissions systems are to do with reducing the amount of fuel put into the engine, although modern lambda-influenced ECUs do head in that direction. Remember that they are control systems, not economy management. For example, the DPF on a modern diesel is there to catch soot particles when a car is pulling away. This is trapped in the filter in the exhaust pipe, and because it blocks flow quite quickly there is a regeneration function. When the filter is being regenerated, extra fuel is injected to raise the temperature of the DPF and turn the soot to ash. The point is that this extra fuel burn does not contribute to propelling your car down the road, but still adds to the total fuel consumption. Emissions have been controlled in that the soot didn't emerge when it was created, which contributes to keeping city air clean. The burn-off is at low load, medium engine speed; steady driving, which you are never likely to achieve in town.

Look at how the components of any emissions control system work and you can see various ways that a poorly performing part can have an adverse effect on the vehicle. Although the fuel injection computer should identify a failed component, it won't necessarily notice a part that is slightly under par.

EGR Investigation

Some recent long drives down the motorway made me start thinking about fuel economy. Traffic was forcing a slower pace, so to pass the time I started taking an unnatural interest in the fuel consumption meter on the instrument panel. The end result was a little disappointing, so when I had to repeat the drive a week later, I repeated the driving style and obtained the same result – 39.9mpg. I know that my Audi 3.0 TDI has a reputation for being a little thirsty, and I'm not expecting the meter on the clocks to be accurate (merely consistent), but I was curious as to whether there was something not quite right.

I had noticed an occasionally excessive puff of black smoke from the tailpipes when pulling away, and the car wasn't picking up as well as I felt it should, so I made the simplest change and blanked off the EGR valve. The difference was really rather impressive – a test-drive immediately showed more sparkle, with the car picking up more quickly and more smoothly. There was a fault code logged (P0401 EGR System: Insufficient Flow) which eventually brought up the management light, but that isn't a major problem when you have a copy of VAG-Com!

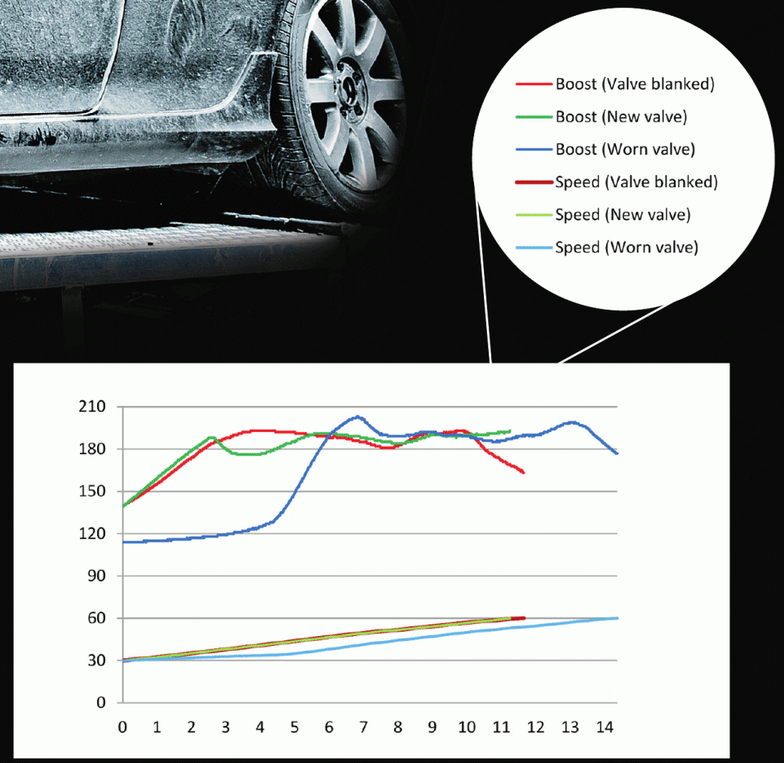
So, the next test was fuel consumption. The same four-hour round trip returned 41.5mpg – not a massive improvement, but enough to prove a point. Now I wanted some data to demonstrate how the car picked up, which required a more immediate, repeatable test.

Using a CAN data logger on the diagnostic port, I recorded some acceleration runs down the same stretch of road. To keep things repeatable, I used the resume function on the cruise control to go from just below 30mph up to 60mph in fourth gear. With the road speed and manifold pressure data from different runs superimposed, it showed how the worn EGR valve gave a much more scattered result compared to the blanked pipe. It was also easy to see just why the car felt much more satisfying to drive – the boost comes in so much more quickly, knocking nearly three seconds off the acceleration run!

The graph shows how the boost relates to the road speed – I've shown representative data rather than data for all of the runs. Boost reading is in tens of millibars of absolute pressure, and road speed is in miles per hour. It's interesting that the maximum boost logged with the blanked valve or it replaced is slightly lower than with the worn valve. This reduction is about 4%, startlingly similar to the improvement in fuel consumption.

Once the measurements had been taken with the old valve and the blanking plate, it was time to replace it with a new, shiny part.

Other interesting points are that acceleration for the car with a new valve seems to be slightly faster than with the valve blanked, although that is probably just the margin of error for the tests. Also, there is a dip in boost after the initial peak when the valve is in use, but not when blanked. This suggests that the EGR valve is being used as part of the turbo control system.



Conclusions

There are obvious benefits in keeping the emissions control systems in good working order. Even though they don't add to the performance of the vehicle, they certainly can detract from it as they age.

It's tempting to say that blanking off the EGR valve is as good as replacing it with a new one, but in the case of my car, that assumes that you are prepared to tolerate engine fault codes. Personally, I prefer to have the MIL off until it has something new and interesting to warn me about. That makes me inclined to run with the replacement part, although knowing that the EGR valve on my car is involved with turbo control is a nugget of information that might be useful in future tuning work.

This has been a worthwhile exercise in that the improved fuel consumption will pay for the cost of the valve in a few months, while I can enjoy the improved performance all the time. It's satisfyingly close to having your cake and eating it! ●