THE EXPERT
STEWART SANDERSON

Having worked as a tuner for 17 years, Stewart 'Stu' Sanderson is one of the most-respected names in the business.

A Level 5-trained fuel-injection technician, Stu has worked for a Ford Rallye Sport dealer, a well-known fuel-injection specialist and various tuning companies.

Eight years ago he joined forces with Kenny Walker and opened up Motorsport Developments near Blackpool (01253 508400, **www.remapping.co.uk**), specialising in engine management live remapping, as well as developing a range of Evolution chips which are now sold all over the world.

He is the creator and administrator of **www.passionford.com**, which he started in 2003. It has grown rapidly from a few friends contributing, to one of the biggest Ford communities on the web.

Stu's enviable knowledge of the workings of modern-day Ford performance engines means that every month he's just the man to explain how and why things work, and importantly how they can be improved.

Words: Stewart Sanderson and James Wills

EXHAUST GAS RECIRCULATION

STU EXPLAINS ALL WE NEED TO KNOW ABOUT THE MYTHICAL EGR VALVE

Before we begin we'd best answer the question 'what is EGR?' Well, it simply stands for Exhaust Gas Recirculation and does exactly what the name suggests and recirculates the exhaust's gases.

Tighter emissions legislation mean manufacturers are forever reducing the levels of pollutants produced, but in order to do so vehicles are forced to run leaner and hotter than ever before. One of the many complications to doing this is the production of Nitrogen Oxide (NOx) in the exhaust gas. This particular gas is created at high temperatures when Oxygen and Nitrogen mix together and is the main cause of smog; the effect caused when NOx reacts with sunlight.

To combat production of this harmful gas and prevent it being pumped into the atmosphere, a lot of manufacturers are using Exhaust Gas Recirculation systems to recycle and re-burn part of the exhaust gas, which brings the exhaust gas temperatures down.

EGR is actually used in both petrol and diesel vehicles and has been around for a very long time, but they are becoming increasingly popular due to the tightening emission regulations that vehicle manufacturers are forced to meet in order to gain 'Type Approval'.

We will concentrate on the diesel EGR system in this article and will cover petrol systems at a later date. EGR works with other emission control systems in order to create the cleanest and most environmentally friendly vehicles possible whilst not hindering the performance too much. Reliability has been

a big problem in the past for these systems, but new designs are becoming ever more reliable.

SO, HOW DOES IT WORK?

There are many different variations of this system out there, all working in slightly different ways using different valves and take off points. However, fundamentally they all work to achieve the same goal in a very similar manner.

The EGR system will process a proportion of the exhaust gas, either from the combustion chamber itself, or from the exhaust manifold area. Some engines even have ports internally in the head to feed the EGR system.

This exhaust gas is fed to an EGR valve, which is usually just a simple plunge valve operated by a solenoid which can open and close when told to do so by the ECU. Think of it as a valve which is either open or closed.

As the valve opens, the exhaust gases will be allowed to flow back into the intake system where they will flow through into the combustion chamber along with the fresh air coming in through the air filter (and turbocharger if fitted). This exhaust gas will contain some heavy soot particles, and various harmful gases as is all exhaust gas, and this is then combusted in the normal manner by the engine.

WHY IS IT FITTED?

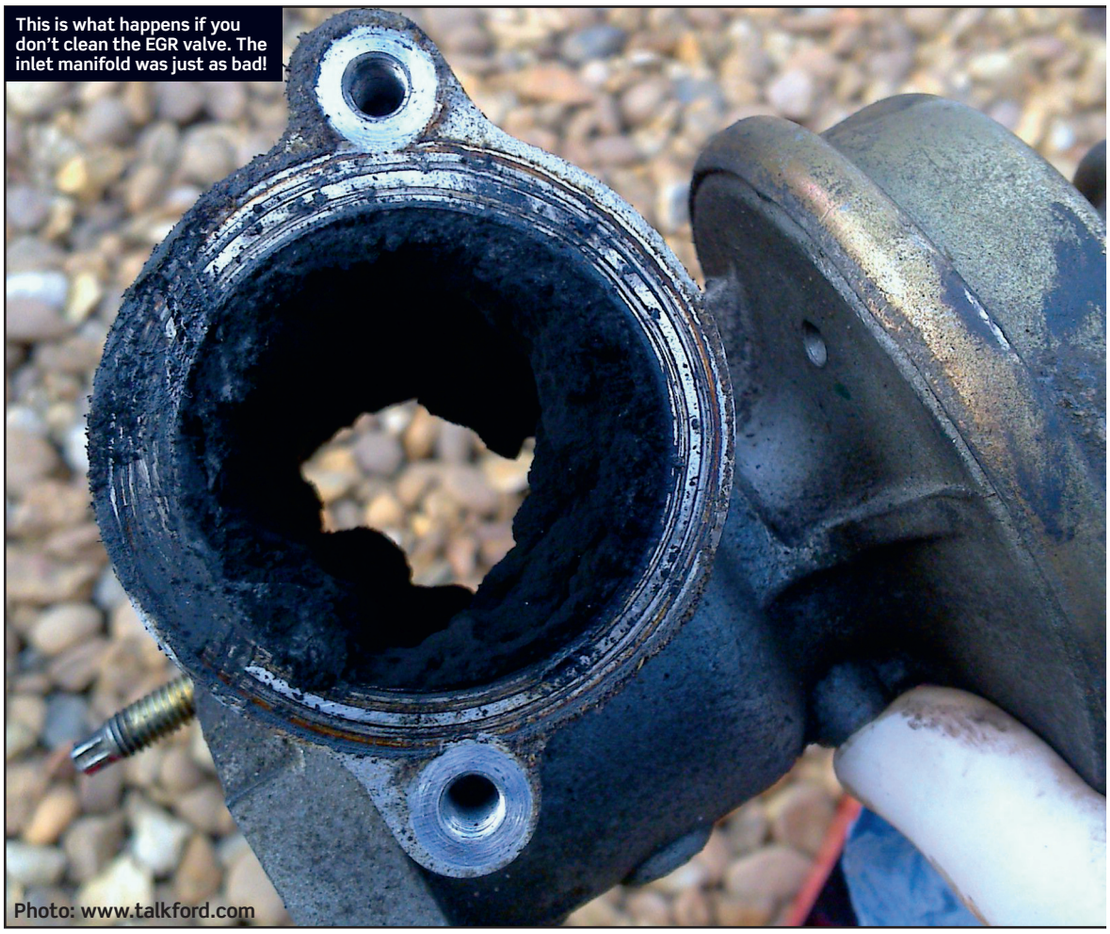
Now this is where it starts to get interesting. We do not take this exhaust gas and burn it again in order to get rid of this gas and particulate matter; that is the very common mistake made by lots of people when explaining how EGR operates.

The gases are re-burnt in order to effectively slow down the combustion process by partly filling the cylinder with what is known as 'dead gas'.

Slowing down the combustion process will in turn drop the exhaust gas temperature (EGT) by a few hundred degrees, preventing the harmful Nitrogen Oxide gases from being produced in the first place. This means that we then have less work to do in order to clean our exhaust emissions, as many of the harmful by-products are no longer present in the exhaust gases at all.

However, slowing down the combustion process and reducing the effective size of the engine's cylinders does have its drawbacks. The main one being that the engine will lose anything up to 30% of its power output during normal use. So how do we overcome this problem?

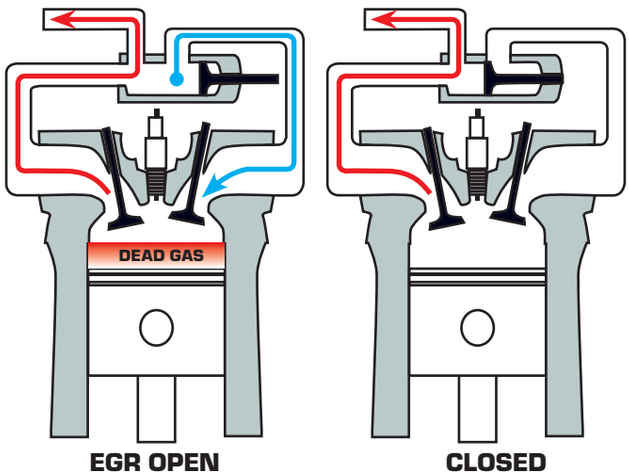
In order to ensure full power is always available when it is needed, the EGR valve will close when full power is needed or when the engine is cold and inherently inefficient, meaning the driver is virtually unaware of the EGR sysem's function.



This is what happens if you don't clean the EGR valve. The inlet manifold was just as bad!

Photo: www.talkford.com

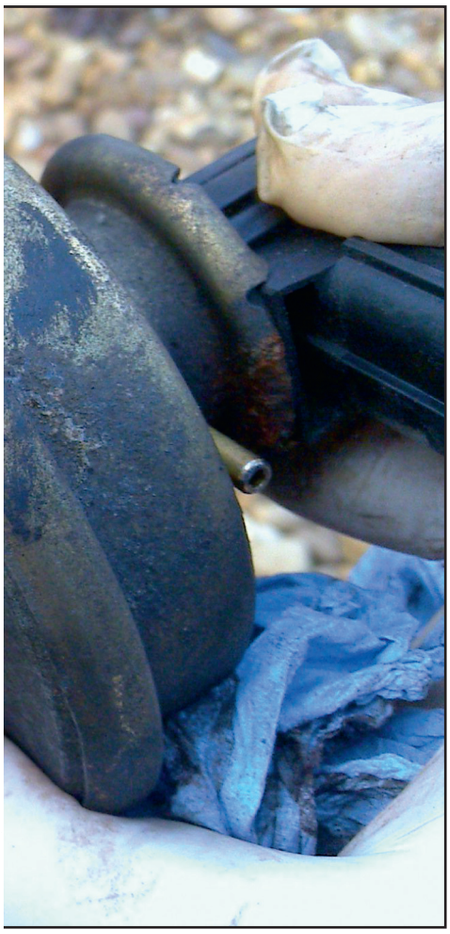
HOW IT WORKS



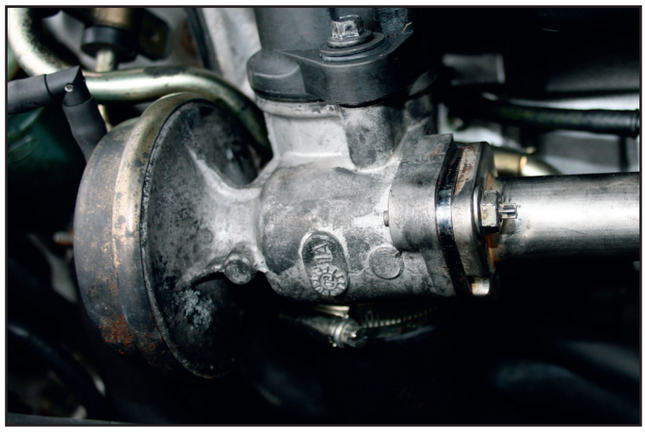
TYPE APPROVAL

Within Europe two systems of type approval have been in existence for over 20 years. One is based around EC directives and provides for the approval of whole vehicles, vehicle systems, and separate components. The other is based around ECE (United Nations) Regulations and provides for approval of vehicle systems and separate components, but not whole vehicles.

Type approval is the confirmation that production samples of a design will meet specified performance standards. The spec of the product is recorded and only that spec is approved.



The plunge valve can be seen inside the EGR



EGR PROBLEMS!

The most common problem with any EGR system is the valve itself, especially on the diesel variants. As exhaust gases on diesel vehicles will contain soot, and the inlet manifold will always contain traces of oil and vapour, these two products mix and create what looks like black sludge!

This sticks to the internals of the manifold, blocking any and all reference hoses that should get in the way. But most commonly will actually cause the valve to seize or stick either open or closed, which is usually the cause of an EGR code when the Engine Management Light comes on.

If the valve sticks open the exhaust gases will pour into the inlet under all conditions making cold starting very hard, and dropping available power levels massively. On the flip side if the valve sticks shut then no exhaust gas will enter the inlet, meaning harmful gases will be produced again due to the increased EGTs. Turbo boost pressure may increase slightly and cylinder pressures may also rise a little too, however most engines can deal with all of these issues without a problem and may actually run better!

REMAPPING AND EGR REMOVAL

The remapping of engines with EGR is possible and causes no issues whatsoever if they are carried out correctly, but poor quality remapping can cause problems due to the amount of smoke and soot these engines can produce as this is of course being fed back into the inlet manifold. As usual, the poor owner knows nothing of this problem until it completely gums up his engine internals and causes an engine failure.

We have seen some pretty horrific diesel internals due to this problem caused by bad mapping.

It is becoming quite popular for the EGR function to be deleted from the ECU calibration completely. As these systems age, the problems we have mentioned above can cause serious running issues, and people often choose to either remove the EGR valve completely and bypass it or block it off from the inlet manifold permanently, you can even buy blanking plates which simply bolt into place blocking the valve off.

On more modern engines like the Euro4 Mondeo TDCi units, removing the EGR without a modification to the mapping will flag an immediate engine management fault, and usually puts the engine management light on to indicate to the driver that the system is not operating correctly. On older engines like the Euro3 Mondeo TDCi engine, removing the EGR won't cause any adverse effects other than the rise in NOx emissions, and in many cases will actually help the engine to run better, increase performance, and add engine longevity.

A blanking plate can be used to prevent the flow of exhaust gases back into the combustion chamber

NEXT MONTH

WE TAKE A LOOK AT DIESEL ENGINE MANAGEMENT SENSORS