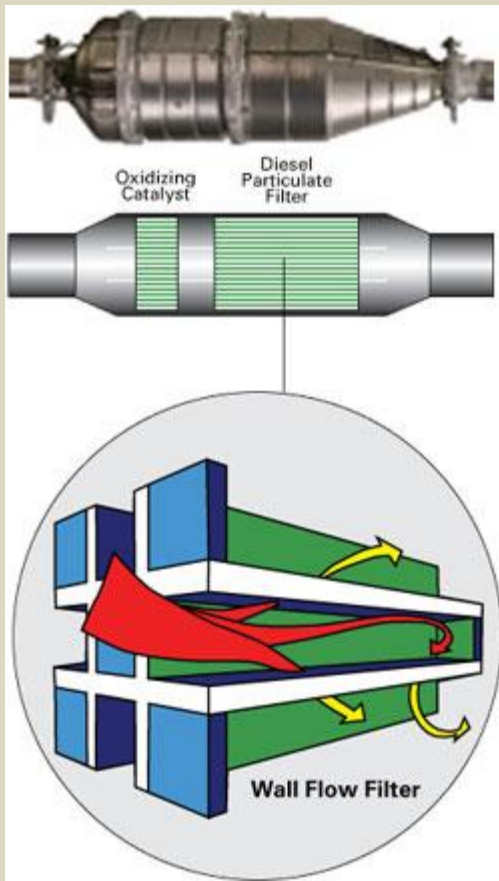


New Diesel Emissions Systems

It's not so long ago that we were all in fear of the imminent arrival of exhaust gas recirculation (EGR) on 4x4 diesels. Now EGR is old hat. Sure, there were early problems, including jammed EGR valves on Jackaroos and the well documented difficulties with three-litre Nissan Patrol engines, but generally EGR arrived and worked.



Why EGR? This system involves returning a variable amount of exhaust gas into the inlet manifold. The gas reduces the amount of free oxygen in the cylinder and restricts the amount of oxides of nitrogen (NO_x) produced.

However, there's an unfortunate relationship between NO_x and particulate material (Pm): lower NO_x and Pm goes up; lower Pm and NO_x goes up.

As emissions laws tightened we started to see many new diesels arriving fitted with diesel particulate filters (DPFs). Engine makers who tuned their engines for lower NO_x used DPFs to capture the Pm emissions.

As well as EGR and DPFs some engine makers use diesel oxidation catalysts (DOCs). These units have the capacity to post-treat emissions and have proved useful in reducing Pm and smoke from older-design engines. DOCs can also reduce carbon monoxide (CO), which is not normally a problem in diesel engines and unburnt hydrocarbons (HC) that are usually fuel and engine oil emissions.

An alternative route that's been adopted by some truck engine makers and is starting to appear on some European car and 4x4 diesels is selective catalytic reduction (SCR). For this emissions control system the engine designer tunes the engine for low Pm and higher NO_x – remember you can't lower both simultaneously in the combustion chamber – and uses SCR in the exhaust system to 'scrub' the NO_x and convert it to water and nitrogen. SCR relies on injection of urea (euphemistically called by proprietary names such as AdBlue) into the SCR catalyst. The urea is carried in a separate tank that's typically one tenth of fuel tank capacity.

DPFs Under the Microscope

The latest drama over emissions gear concerns DPFs. The most effective DPFs are known as 'closed', 'high efficiency' or 'wall flow' types. In these units, Pm is trapped in porous, honeycomb ceramic material and 99.9 percent Pm-free gas flows out the tailpipe. The problem is that these units can clog up, reducing engine performance and increasing fuel consumption. A 'DPF regeneration' cycle is built into the engine injection electronics, so that the DPF is burnt clean of Pm build-up.

Engines that achieve high exhaust gas temperatures don't normally need this regeneration, but low-load, stop-start use may mean frequent regeneration cycles. Hence the varying economy and performance results experienced by different users of 'closed' DPFs.

Another type of DPF is 'open', in which the Pm collection traps can fill without clogging the filter. The trick with this type of DPF is for the engine designer to have sufficient filter capacity to ensure that the filter is cleaned by exhaust heat during typical duty cycles, before it fails to restrict Pm emissions.

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