EURO 6 UNCOVERED

As Euro 6 engines become more common, technicians need additional training. Brian Tinham talks to Keith Gallon, technical instructor with Scania

At first glance, the OEMs' Euro 6 heavy-duty diesel engines – though technically more complex than Euro 5 – require no more maintenance than the engines they replace. Technicians looking at the standard service schedules will notice virtually no difference, in terms of inspection items, consumables or even service intervals. However, under the covers, the engine management controls are even more sophisticated – particularly around the SCR (selective catalytic reduction) after-treatment. So the challenges come when drivers report dashboard warning lamps up: fault-finding, intervention and repair will be different.

Let's go back: for new trucks registered since 1 January 2014, the Euro 6 regulations require that engines are certified to reduce NOx emissions by 77% and diesel particulates by 50%, compared to Euro 5. Those are savage cuts on top of what were already swingeing reductions from Euro 4 and Euro 5. The point is that achieving the reductions demands serious interventions by engines, depending on parameters including ambient temperature and pressure, engine temperature and the duty cycle demands.

At a base level, most engine manufacturers have tackled Euro 6 using a combination of EGR (exhaust gas recirculation – with its associated boosts, inter-coolers, etc) – and SCR. Each has added one or the other to their existing designs, depending on the choices they made at Euro 5, or built new engines from the ground up. There are exceptions, such as Iveco (SCR only) and Scania (some engines on SCR only). But the bottom line is that technicians not familiar with SCR need some training. Even if you are used to SCR, you may need to review your understanding in light of more sophisticated systems and probably also new tools for service interventions.

13-LITRE EXAMPLE

Looking at Scania's EGR/SCR engines will help, so let's focus on its 13-litre, six-cylinder unit, which is available as 370, 410, 450 and 490bhp. Combustion is managed by the XPI fuel-injection system (designed to deliver up to seven injections, depending on temperature, demand and running revs). The main inlet components include the VGT (variable geometry turbocharger), which compresses some of the exhaust gas for recirculation into the fresh air charge side, via an intercooler and EGR valve. EGR reduces engine-out NOx by 50% before the gases enter the tailpipe for after-treatment.

Other relevant components include: the intake throttle butterfly valve, used to control draft through the engine; and the engine brake. Modifying the engine draft, EGR rate (via the EGR valve and VGT) and engine brake varies the combustion rate and alters the exhaust temperature – critical for correct functioning of the after-treatment package. On some engines

Scania's Keith Gallon prepares to extract a DPF assembly

✓Checklist

✓ Always wear appropriate PPE (personal protective equipment) when working with after-treatment systems: P3 overalls, mask and sturdy gloves are generally considered to be standard health protection requirements for this task.

✓ Remember the basics: if NOx light on but no fault codes on diagnostics, check AdBlue quantity and quality, but also fuel tank. Euro 6 needs 10ppm fuel to get heat to the SCR.

✓ Note: AdBlue pump continues running after engine off: this is the normal cooling routine through the recirculation loop.

✓ If multiple forced (parked or service – the latter, being extremely rare) DPF regenerations are required, engine oil may be contaminated: change filter and engine oil, using LDF (long drain fluid), low SAPS oil.

✓ If the DPF needs checking (approx every 240,000km), remove the service cover, plug the sensor containments and extract the dosing unit.

✓ Before proceeding, use an endoscope to check inside the DOC for cracks, distortion, debris, oil residue (a sign of turbocharger problems), as well as urea stones, which can form – albeit rarely – when AdBlue is not injected correctly. Symptom: low NOx even when AdBlue is not dosed.

✓ Both the DOC and the particulate filter(s) are replaceable. Use special tool to draw out catalyst and filter packs, taking care to use blank plate to prevent loss of bolts.

✓ Inspect replaceable items. If damaged, then replace; if not, then return to assembly.

✓ With reassembly complete, pressure test (to 2 bar) to ensure integrity of new graphite seal.

(although not Scania's 13-litre) there is an additional water-cooled fuel injector after the engine brake. This takes low-pressure fuel from the XPI system and air from the auxiliary side, and drops the mixture into the exhaust to further raise its temperature, if necessary.

Moving on to after-treatment, this starts with the AdBlue circuit, which comprises the insulated (plastic) tank and its associated sensors, hoses, controls and the dosing pump. In Scania's case, the tanks' internal stack has a temperature and reductant fluid (urea) dilution sensor. Reductant is pulled up by the dosing pump, which spins up to 3,500rpm under PWM (pulse width modulated) control, with recirculation hoses connecting tank to pump. The urea doser (injector) itself sits in the silencer box.

Temperature management of the tank contents is important, because urea freezes at -11°C. So not only are the hoses electrically heat-traced, but the tank is served with hot coolant from the engine, via a valve. Below 8°C ambient, the engine ECU switches on all of the above (including the coolant flow, once it reaches 50°C) to ensure that AdBlue is fluid. Dosing will not commence until that condition has been satisfied. Above 8°C, the system assumes that urea is fluid and only the pump and dosing circuits are activated.

Lastly, we come to what many in the trade term the 'chemical factory' – the after-treatment itself, which is packed into the exhaust box assembly after the silencer. This comprises a sequence of: the DOC (diesel oxidation catalyst) ceramics, the DPF (diesel particulate filter), the AdBlue dosing unit and the SCR cylinder(s) it serves, and finally an ammonia slip catalyst.

Apart from these components – which are tightly packaged, with internal convolutions to minimise space on tractor chassis – numerous sensors are built in to ensure correct operation.

Two NOx sensors provide readings both in front of and after the assembly. The first determines engine-out NOx (which varies according to the EGR, VGT, fuel injection, and inlet valve and exhaust brake settings) for its local controller. Its counterpart, at the exit, then provides feedback that the prescribed NOx level has been achieved.

Heat management, however, is critical for the efficient functioning of both the DPF and SCR. So the chemical factory has three temperature sensors – one before the DOC, one before the DPF and one before the SCR catalyst. Together, these enable the controller to regulate the temperature: first, for the DPF (so that it burns off soot and successfully runs its periodic regeneration); and second, for urea dosing. The latter has to be hot enough to enable the SCR reaction that knocks out NOx, but not so hot that AdBlue simply evaporates and blows through to the ammonia catalyst.

Finally, differential pressure (DP) sensors (before and after the DPF) look for pressure drops. Increasing DP indicates that the filter is blocking up. Incidentally, on Scania systems, the local controller links via CANbus to the EMU (engine management unit) – the pair effectively working in tandem. TE

Euro 6 trucks' after-treatment packages have multiple sensors that monitor system health