HDi (diesel) Engines

The three HDi engines available, a 1.6-litre and 2.0-litre 4-cylinder engines and a 2.7-litre V6 twin-turbo engine, are fitted with the latest generation of common rail high pressure injection system. The internal pressure can vary between 250 bar and 1,600 bar in the 1.6-litre version and 1,650 bar in the 2.0-litre and 2.7-litre versions depending on demand from the engine management software, as a function of the speed and engine load.

These engines are fitted with particle emission filter (FAP) which retains particulates then burns them in a specific process exclusive to the common rail system with the Eolys II compound. This innovative filter has a refined strategy which, depending on driving style, determines the distance travelled and even the best moment to perform the regeneration. This operation takes place without the driver being aware of it.

The filter replacement interval has been extended so the filter is now changed at the 120,000 km (4-cylinder) or 200,000 km (V6) service.

These engines already comply with Euro 4 emission standards.

1.6-litre HDi Diesel Engine (DV6 TED4 – FAP)

This four-cylinder fully aluminium engine is a development of the DV4 (1.4-litre) in which the displacement (1.6-litre) is obtained by a simultaneous increase in the stroke (+6.3 mm) and bore (+1.3 mm). It has a sixteen valve head with dual overhead camshafts, roller cam followers and hydraulic tappets. Supercharging is provided by a variable geometry turbo, and the engine is equipped with a second generation Bosch common rail injection system giving a substantial reduction in fuel consumption and hence emissions.

With a capacity 1,560 cm3 (bore 75 mm, stroke 88.6 mm), this engine is fitted with a Garrett variable geometry turbo (GT 15) with a front-mounted air/air intercooler. It develops a maximum power of 80 kW at 4,000 rpm and a maximum torque of 240 Nm at 1,750 rpm.

In the three upper gears, the torque can amount to 260 Nm at 1,750 rpm thanks to the "overboost" function (temporary enrichment of air and fuel) activated at full engine load between 1,500 and 3,750 rpm. The maximum torque is thus temporarily increased by 8.3 %.

Cylinder block

The DV6 TED4 engine has a diecast aluminium block and head with cast iron bearings and liners inserted at the foundry. The design and geometry of the block guarantee a high level of reliability, durability and acoustic performance. Diecasting of the block allows the creation of external moulded structures (or ribs) which improve the resistance to thermomechanical stress while simultaneously reducing the sound transmission of the walls. Similarly, the integral structure of the bottom end of the block gives a remarkable rigidity which in turn reduces the NVH emissions from the engine.

The forged steel crankshaft, supported by five bearings, has an AVT (Torsion Vibration Reduction) pulley on the distribution side which drives the cooling compressor and alternator. On the opposite side, the design of the increased inertia double flywheel absorbs the natural acyclic effects of the four cylinder engine.

The flat head alloy pistons act as a combustion chamber and have four bevelled shoulders to avoid contact with the valves. To improve the engine efficiency by promoting the mixing of air and fuel, the combustion chamber has been redesigned to reduce swirl, i.e. the movement of air in the chamber. It has a special "enlarged bowl" design with a more open injection angle. The chamber is cooled by oil circulating in a gallery in the skirt wall and supplied by a jet in the piston base.

The shot-peened, "screwed" forged alloy con rods have a trapezoid foot which increases the support area of the shaft in the piston (better distribution of forces).

Cylinder head
The cross-flow head with four valves per cylinder is made of tempered and hardened AS7 aluminium.

It is made in two parts:

- a lower part which holds the vertically positioned valves of diameter 24.4 mm for intake and 22 mm for exhaust, and for each cylinder two independent air intake channel types: "helicoidal" for the short circuit and "tangential" for the longer circuit.
- an upper part which supports the camshafts, no longer made of cast iron but now made from sintered material cams mounted on a steel tube.

The exhaust camshaft is driven by a toothed belt of width 25.4 mm linked to the crankshaft and coolant pump. A tensioner pulley and a roller pulley complete the drive system. The intake camshaft is driven via a metal timing chain linked to the exhaust camshaft and tensioned by a hydraulic tensioner. The camshafts activate the valves via roller cam followers, and the hydraulic tappets automatically absorb any play.

High pressure injection
The DV6 TED4 engine is fitted with a second generation Bosch common rail direct injection system. Depending on demand from the engine management software, and as a function of speed and engine load, the pressure can vary between 250 bar at idle to 1,600 bar at full load. The rail is connected to four injectors with atomiser heads each fitted with six injection holes of diameter 120µ. This ensures ultrafine atomisation directly into the combustion chamber, giving a more homogeneous mixture while reducing emissions at source. The common rail system is here used to its full potential with the multiple injection technique in which six different injections are managed.

To reduce the nitrous oxide (Nox) quantity emitted in the exhaust gases, the DV6 is also fitted with an exhaust gas recycling device (EGR). To complete the gas processing, an oxidation catalyst is fitted as close as possible to the turbo in order to benefit from the highest exhaust temperatures. A six-fin oil/water exchanger on the engine block is strapped to an "ecological" filter cartridge. This device allows the filter element alone to be changed, to facilitate recycling and hence avoid oil leaks during service.

Cooling is provided by an aluminium radiator core with a surface area of 21 dm2 and fitted with a motorised fan (blade diameter 370 mm and power 525 W) which is controlled by the ECU.

2.0-litre HDi Diesel Engine (DW10 BTED4 – FAP)

With a capacity of 1,997 cm3 (bore 85 mm, stroke 88 mm), this engine features a Garrett variable geometry turbocharger with a vacuum-controlled discharge valve equipped with a front-mounted air/air exchanger. It develops a maximum power of 100 kW at 4,000 rpm and a maximum torque of 320 Nm at 2,000 rpm. The torque can attain 340 Nm at 2,000 rpm thanks to the "overboost" function, which comes into play with the engine under full load between 1,750 and 3,200 rpm. This temporary increase in torque is available in all six gears with the manual 6-speed gearbox, and in the final three gears with the automatic 4-speed box.

Cylinder block

The DW 10 BTED4 engine has a cast iron block with cylinders inserted at the foundry.

The forged steel crankshaft is supported by five bearings, and on the distribution side is fitted with an AVT pulley (Torsion Vibration Damping) which drives the cooling compressor and the alternator.

On the opposite side, the design of the increased inertia double flywheel absorbs the natural acyclic effects of the four cylinder engine.

The flat head alloy pistons act as a combustion chamber and have four bevelled shoulders to avoid contact with the valves. Their design ensures a good mixture of air and fuel.

The shot-peened, "screwed" forged alloy con rods have a trapezoid foot which increases the support area of the shaft in the piston (better distribution of forces).

Cylinder head

The head is a complex component exposed to very high stresses from the temperature variations and the combustion pressure in the chamber (160 bar). Made from aluminium alloy, it has two overhead camshafts which are no longer made of cast iron but with forged steel cams mounted on a tube also made of steel. The four valves per cylinder are positioned vertically.

The exhaust camshaft is driven by a toothed belt 25.4 mm wide linked to the crankshaft and water pump. A tensioner pulley and a roller pulley complete the drive system. The intake camshaft is driven via a metal timing chain linked to the exhaust camshaft and tensioned by a hydraulic tensioner. The camshafts activate the valves via roller cam followers, and the hydraulic tappets automatically absorb any play.

The head integrates two independent types of intake air channel per cylinder: "helicoidal" for the short circuit and "tangential" for the longer circuit.

The helicoidal channel causes a turbulent air movement (swirl) necessary for a good mixture of air/injected fuel in the combustion chamber. The tangential channel is known as the "flow" channel as it gives the gaseous mass greater axial dynamism while ensuring a rotation effect. These two intake air channels work simultaneously.

The aerodynamic design of these foundry-cast channels is optimised by precision machining to avoid dispersion.

The intake air distributor contains the cylinder head and oil separator. Made of glass-fibre reinforced polyamide, it has a stylish acoustic engine cover held on the assembly by four studs. The intake butterfly, like the turbo compressor, is controlled by a vacuum circuit integrated into the engine. The vacuum pump is placed at the end of the intake camshaft.

High pressure injection

The common rail, high pressure, direct injection system has an electronically controlled high pressure pump placed at the end of the exhaust camshaft. In the common rail, the internal pressure can vary between 250 bar and 1,650 bar depending on the demand from the engine management software. The rail is connected to Siemens injectors controlled independently by the ECU and fitted with a "piezo-electric" control head. They have six very small diameter holes (around 120 µ) which ensure ultrafine atomisation directly into the combustion chamber. The unique feature of this injector technology is the control head which allows optimum metering of the fuel quantity and injection duration. Like the 1.6-litre engine, the DW10 BTED4 uses a multiple injection technique managing six different injections.

Environmental performance

Thanks to its design, the diesel engine offers the best thermodynamic efficiency. Furthermore the very high pressure injection of the common rail system allows extremely fine atomisation of the fuel in the chamber for very homogeneous, and hence complete, combustion. This gives improved combustion efficiency which, while reducing emissions at source, easily complies with Euro 4 emissions standards.

This engine has an exhaust gas recycling system EGR which reduces the quantity of nitrous oxide (Nox) in the exhaust gases. To improve dynamics, the electrically controlled EGR valve is managed by the engine ECU as a function of the following criteria: engine speed and load given by the angular position of the electric accelerator pedal, intake air temperature and flow rate.

To complete the gas processing, an oxidation catalyst is fitted as close as possible to the cylinder head in order to benefit from the highest exhaust temperatures which promote emission control.

During cold starting, a "thermomanagement" system optimises the engine heating to reduce emissions and fuel consumption. To achieve this, a valve in the engine coolant circuit controlled by the ECU adjusts the coolant flow as a function of the following parameters: engine load and speed, temperature of the coolant and engine air, and coolant temperature at the heater matrix.

The engine is cooled by a radiator with aluminium core of surface area 21 dm2 and a motorised fan with diameter 370 mm and power 525 W for the manual version, and 600 W for the automatic. It is controlled by the ECU.

A 12-fin oil/water exchanger on the engine block is strapped to an "ecological" filter cartridge. This system, in which only the filter element is changed to facilitate recycling, avoids oil drips during servicing.

2.7 litre V6 HDi Diesel (DT17 TED4 – FAP)

The aim with this engine was to design a top-of-the-range Diesel engine incorporating the latest available technologies to offer the best specification in terms of performance, environmental efficiency and driveability, thanks to a refinement of its operation.

This new 60° V6 engine with a capacity of 2721 cm3 develops a power of 150 kW and a torque of 440 Nm.

Its advanced design enables it to satisfy the Euro IV standard and its new maintenance-free FAP particle filter reduces particle emissions to a barely measurable level.

Cylinder block

In a first for mass production, the engine block is manufactured from compacted graphite castiron to produce an engine that is at once light, compact and extremely rigid. Durability and noise insulation benefit directly, as does performance, thanks to a mass restricted to 199 kg (DIN 70020), or roughly only 15 kilos more than the V6 3.0 l petrol engine (ES9).

Several technical solutions ensure a high level of performance and durability. The relatively low compression ratio (17.3/l) helps to reduce the level of emissions and ensures quieter combustion. The aluminium pistons have a double undulating gallery lubricated by oil mist from the block, helping to promote cooling and thereby contributing indirectly to a reduction of knocking.

Cylinder head and intake system

The DT17 features aluminium cylinder heads, each with four valves per cylinder, controlled by two overhead camshafts.

Multi-valve technology improves the mixture and increases the throughput of air in the engine. In addition, the design of the two intake ducts, machined according to the helical/tangential method, as well as continuous control of the helical duct according to engine speed and engine load, allow the engine to operate as cleanly as possible at all times.

Timing and the injection system are driven by a belt conforming to the very latest technology, offering improved noise insulation and a guarantee of longevity.

The composite cylinder head covers are insulated with an elastic material, which reduces the transmission of vibrations.

The intake system incorporates two low-inertia turbochargers (one per row of cylinders) with an air/air type turbo-charging temperature intercooler.

The variable geometry of the two turbochargers is controlled electronically and significantly enhances performance and the reduction of emissions, thanks to a higher degree of control than that obtained by pressure reduction only.

Injection system and engine management

The latest-generation high-pressure common rail direct injection operates up to 1650 bar and contributes directly to driving pleasure.

The injectors, piloted independently by the ECU, are controlled by a piezo-electric actuator and have four apertures, each with a diameter of 145 microns.

A closed-loop control allows the potential management of six injections per cycle, two pre-injections for noise attenuation, two main injections for torque and power, and two post-injections for regeneration of the FAP.

It should be noted that two accelerometers (one per cylinder head) pilot the pre-injections in a closed loop in order to optimise noise and emission reductions.

The high-capacity processor of the management module continuously monitors engine parameters using information from 23 sensors and 20 actuators, which in particular pilot the exhaust gas recirculation system, the variable geometry turbochargers and the accelerator, and help to make the engine more responsive.

Environmental performance
Through its inherent design, the Diesel engine produces the best thermodynamic efficiency. Thanks to the very high-pressure injection of the common rail system, the extremely fine mist of diesel fuel in the chamber ensures more homogeneous and complete combustion.

This results in improved combustion efficiency, thereby reducing emissions at source. In addition, electronic control of the turbochargers, the exhaust gas recirculation system and control of the intake ducts contribute actively to environmental protection and compliance with the EURO 4 standard.

This engine comes with an octosquare maintenance-free third-generation particle emission filter. The service interval is now more than 200,000 km, a level of performance made possible by improvements to the additive and the filter medium.

The new-generation Eolys additive, exhibiting an increased efficiency that permits a lower dosage in the fuel, reduces the quantity of residues stored on the walls of the filter. The filter medium has a new structure, with an octosquare geometry and inlet channels of larger diameter that significantly increase the residue storage capacity.

Layout
The layout of the new DT17 engine necessitated the development of a new sub-frame. Ambitious targets in terms of comfort led to the development of a new "cruciform" engine mounting with active vertical link rods.

Real-time control of the reaction link rods cancels out vibrations transmitted to the body at low engine speeds, thereby significantly improving comfort in terms of acoustics and vibration. This new engine mounting led to the creation of an additional torque reaction cross member on the sub-frame, in order to secure the front vertical link rod.

Also, the steering cross-member has been strengthened and given a new, improved shape. This cross-member serves to anchor the rear active vertical link rod, and its new helmet style shape allows the exhaust to pass under the sub-frame.

Lastly, the front cross-member has been modified to allow integration of the new dual fan assembly cooling cassette specific to this engine.