

## Press Release

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# VOLVO'S NEW EURO 5 D5 DIESEL ENGINE OFFERS INCREASED PERFORMANCE AND LOWER FUEL CONSUMPTION

## **VOLVO'S NEW EURO 5 D5 DIESEL ENGINE OFFERS INCREASED PERFORMANCE AND LOWER FUEL CONSUMPTION**

Volvo Cars is introducing a new 2.4-litre 5-cylinder diesel engine in the Volvo S80. Sharing only the D5 badge and the five-cylinder configuration with the previous generation, the new engine is now Euro 5 compliant and is significantly more efficient than its predecessor. The new D5 engine will be available in the UK from mid-2009 and pricing and specifications will be announced nearer the time.

With innovative engineering solutions such as sequential twin turbochargers, ceramic glow-plugs and piezoelectric fuel injectors, Volvo's engineers have succeeded in cutting fuel consumption to some of the lowest levels for a car of this size - 45.6mpg, while CO<sub>2</sub> emissions are only 164 g/km. These low levels of fuel consumption, in combination with improved power output of 205 hp and 420 Nm of torque, means the Volvo S80 with D5 engine is bidding for the best in class title.

"Our brief was to develop a modern performance diesel engine that meets the Euro 5 standard," says Derek Crabb, Vice President, Powertrain Engineering. "The previous engine has undergone constant development but has now reached the end of its potential. We therefore decided to start with a clean sheet of paper and harness the advanced technology which we have access to today. The result is even better than we dared hope. What is more, this engine has been developed entirely in-house at Volvo."

### **Performance and driving comfort of top class**

Volvo's new D5 engine has a displacement of 2.4 litres, offering power and response as soon as the accelerator is depressed. The performance and driveability enhancements have been made with the use of twin different-sized turbochargers that operate in sequence to provide added power within a broader rev range. The result is an immediate response and rapid acceleration at all speeds, with smooth power delivery between the two turbo ranges.

At lower rev ranges, the smaller turbocharger ensures rapid acceleration without any perceptible lag, while at higher ranges, the larger turbocharger delivers the high levels of power torque not available with a single unit. This power means there are always ample resources for quick overtaking, particularly between 50 and 75 mph.

This twin-turbo technology has also made it possible to introduce higher levels of exhaust gas recirculation (EGR) across a wider rev range than before. This harnesses the two turbochargers' different properties optimally to deliver high performance and low fuel consumption.

Advanced injection technology using piezoelectric fuel injectors provides precise distribution of the atomised fuel in the combustion chamber, resulting in efficient combustion and low emissions. At the same time, this technology and the efficient combustion deliver a refined engine note, bearing a closer resemblance to the noise of a six-cylinder petrol engine. The engine offers excellent results in terms of noise comfort and noise perception, technically known as NVH or Noise, Vibration and Harshness.

The injection system with its piezoelectric fuel injectors and high-efficiency fuel pump also help cut fuel consumption through extremely rapid and precise injection sequences and high injection pressure, resulting in particularly effective combustion.

### **Lower fuel consumption**

"When the project got under way, our goal was to bring fuel consumption down to 44.1mpg in the Volvo S80, which, after all, is a relatively large car," recalls Derek Crabb. "As the work progressed, we saw that we could beat that target and today we are actually up to 45.6mpg. With an automatic gearbox we have been able to reduce the consumption by more than 8 percent, from 38.7 to 42.2mpg, which is a significant improvement."

### **Low emissions and easy breathing**

"The technical solutions that contribute to this low fuel consumption also help reduce the engine's environmental footprint," explains Derek Crabb. "Reducing emissions and particulates was one of the basic requirements when the new engine was being developed."

In addition to twin turbochargers, piezoelectric fuel injectors and improved EGR control, the new D5 engine has been equipped with ceramic glow-plugs, an innovative solution that delivers excellent cold-starting properties thanks to a very quick warm up period. They reach a temperature of 1000 degrees Celsius in just two seconds, making the engine easy to start and thus cutting emissions. In certain driving conditions, such as at very low revs, the heat generated by the ceramic glow-plugs can also be used to increase the temperature in the cylinders, further improving combustion efficiency.

The advanced injection technology makes it possible to supply additional fuel in tiny increments after the main injection charge, a process known as post-injection, with the aim of removing any soot particulates in the exhaust gases.

In order to ensure low particulate emissions, the engine has to be able to breathe easily and efficiently. And here Volvo's engineers have succeeded again thanks to optimised control of air delivery to the cylinders.

### **Three years from project start to delivery**

The new five-cylinder diesel is the first engine from Volvo's new project office for diesel engine development.

"The entire process from receiving the brief to installing the first engine in a car has taken less than three years" says Derek Crabb. "The aim was to develop a diesel engine with performance and driving comfort that satisfied the high demands of customers in the S80 segment. It also had to be tailored to meet forthcoming strict environmental requirements," he added.

The engine was developed on a modular basis in terms of both design and building method, using standardised mountings for the turbochargers and other components. This makes it easier to install in other Volvo models and gives more scope for further development to meet future demands.

### **The technology in brief**

- The D5 engine is made entirely out of aluminium, giving low weight and good heat dissipation properties.
- Transverse cooling gives uniform cooling of the cylinder head and engine block. This promotes a controlled temperature throughout the engine and contributes to high reliability and long lifetime.
- The two turbochargers are of different sizes and together deliver high boost pressure, 1.8 bar, across a particularly broad rev range. The smaller turbocharger is used primarily at lower revs. It reacts more quickly than the larger one and provides immediate response to quick throttle movements. At higher revs, the larger turbocharger takes over to provide more performance when accelerating at higher speeds. In addition to increased performance and reduced fuel consumption, the twin-turbo approach makes it possible to exploit the EGR system more efficiently.
- By increasing the volume of the EGR cooler and equipping it with effective cooling fins, it has been possible to increase heat dissipation efficiency by no less than 25 percent. This in turn cools the returning exhaust gases to a far lower temperature, thus reducing emissions of nitrogen oxides (NO<sub>x</sub>) to a level that easily matches the Euro 5 requirements.
- The piezoelectric fuel injectors are used in combination with an efficient high-pressure fuel pump to achieve a high injection pressure of 1800 bar. These injectors has a response time that is twice as fast as that of a conventional injector. The effect of increased fuel pressure and fast injection response time is positive for emission reductions, engine power, engine noise and fuel consumption. As a result, the

amount of fuel injected can be tailored precisely to suit any operating condition which, in turn, delivers effective combustion, lower fuel consumption and reduced emissions of harmful substances. Owing to its speed, a piezoelectric injector nozzle can deliver up to seven separate injections during each operating cycle. Thanks to this speed and the high fuel delivery pressure, the injector nozzle can provide short pre-delivery injections even when engine revs exceed 3000 rpm, ensuring a refined engine note. The piezoelectric injector nozzle can also produce extremely short post-delivery injections of fuel after the main injection sequence.

- The D5 engine features common-rail injection via a fuel rail that is specially designed to withstand the high pressures. Injection pressure can be as high as 1800 bar.
- The high pressure fuel pump efficiency has been improved. The improved efficiency and a significant weight reduction has a positive impact on fuel consumption.
- Ceramic glow-plugs are components that offer excellent starting properties. They are heated up almost instantaneously and reach 1000 degrees Celsius just two seconds after a cold start. Maximum operating temperature is 1300 degrees, which is about 30 percent higher than that of a conventional glow-plug. With ceramic glow-plugs, the engine can be started immediately without pre-heating, even at temperatures as low as minus 30 degrees Celsius.
- Instead of using an oil dipstick the driver is alerted via the information display if the oil needs replenishing. The system even specifies how much oil is needed.
- Finally, the engine mountings have been further developed and tailored to suit the high torque levels. They are supplemented with a third torque rod to stabilise the engine during firm acceleration.

### **Engine specification, new D5, Euro 5 (Volvo S80)**

|                            |  |
|----------------------------|--|
| No. of cylinders           | 5  |
| Displacement, cc/cu inches | 2400/146.5   |
| Bore, mm/inches            | 81.0/3.19  |
| Stroke, mm/inches          | 93.15/3.667  |
| No. of valves              | 20   |
| Camshafts                  | Twin overhead  |
| Compression ratio          | 16.5:1   |
| Idling revs                | 700  |
| Max revs                   | 5000   |
| Max output (kW/rps)        | 151/67   |
| Max output (hp/rpm)        | 205/4000   |
| Max output (Eng hp/rpm)    | 202/4000   |
| Max torque (Nm/rps)        | 420/29-50  |
| Max torque (kpm/rpm)       | 42.8/1500-3250   |
| Max torque (ft.lbf/rpm)    | 310/1500-3250  |
| Engine management system   | Electronically controlled common rail direct injection |
| Injection pressure, bar    | 1800   |
| Turbo pressure, kPa        | 180  |
| Particulate filter         | Self-regenerating                                      |

"In conclusion, Volvo's new high-tech 5-cylinder diesel engine marks yet another step in our determination to reduce the combustion engine's environmental impact, at the same time as we give S80 customers a truly quiet and sophisticated engine with excellent performance," concludes Derek Crabb.

Ends

### **Keywords:**

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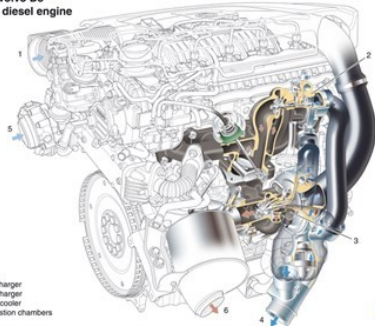
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## **Related Images**

New Volvo D5  
twin-turbo diesel engine

2.4 litre  
Euro 5  
205 hp  
400 Nm

- 1. Air induction
- 2. Small turbocharger
- 3. Large turbocharger
- 4. Air to chargecooler
- 5. Air to combustion chambers
- 6. Exhaust



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