New Generation Of Five-Cylinder Diesel Engines From Volvo Cars

- Higher performance and lower emissions
- Larger, electronically controlled turbo
- Improved injection system
- More powerful engine management system
- More efficient EGR system
- Maintenance-free particulate filter
- Six-speed gearboxes
- All Wheel Drive with Instant Traction for all larger Volvo models

The Volvo Car Corporation is unveiling a new generation of our own five-cylinder diesel engines for the Volvo S60, V70, XC70, and XC90. The engine, which was introduced in 2001, has been extensively improved and refined. The improvements have resulted in an entirely new driving experience with considerably higher performance, and improved drivability. At the same time, there has been a sharp reduction in emissions.

This new diesel engine is actually three different ones, all of which are turbocharged. The most powerful version, the D5, has been given an extra 22 horsepower and has a maximum output of 185 hp (136 kW). The increase provides excellent high-speed performance, with fast acceleration and efficient pulling power, even when driving up long, steep hills, with no need to change down. Torque has also increased dramatically, from 340 to 400 Nm. This provides extra power and considerably quicker response at both high and low rpm.

“We have improved nearly everything in the engine,” says Jörgen Svensson, Chief Programme Engineer. “The driver will perceive it as a lively petrol engine, only more powerful and more environmentally efficient.”

New-generation turbo-charger
Most of the increase in performance can be attributed to an upgraded air and exhaust gas exchange system, a new turbocharger, and an improved injection system.
Most of the air and exhaust channels have been given increased volume and more gentle bends for more efficient gas-flow with low losses.
The new-generation turbocharger has electronic control, resulting in fast and precise control of the charge pressure. A larger compressor wheel provides higher torque and output. Furthermore, the variable vanes have been cambered for a more efficient flow of gas at all settings, resulting in an increased level of turbo efficiency. The improvements contribute to both faster acceleration and better high-speed performance.
The turbo centre housing is now water-cooled, which is unusual in diesel engines. This is caused by the higher performance of the new engine and provides continued cooling of the turbo after the engine has been switched off. This is particularly beneficial during short stops after high-speed driving, such as when refuelling on the highway.

Refined injection technology
As was previously the case, air swirls in the cylinders’ combustion chambers. The use of a new electronically controlled multi-throttle system in the inlet ports allows for infinitely variable regulation of the swirl level, and combustion can be adjusted extremely accurately according to the driving situation and the current engine speed and load.
“We have also made the combustion chambers larger, thereby lowering compression,” says Jörgen Svensson. “By doing so, we have gained two things: higher performance and lower emissions.”

The injection system has been fitted with new injectors with seven finer nozzle openings as opposed to five in the previous engine. This results in a more finely atomized fuel mixture, and more efficient combustion. Injection takes place in three steps: pre-injection, primary injection, and post-injection. The last step is new and contributes not only to cleaner combustion but also to regeneration of the particulate filter.

A completely new, electronically regulated quick glow system results in considerably reduced glow times, also making it easier to start the engine in cold weather.

**New management system contributes to reduced emissions**

The new diesel engine has very low emissions, thanks to a number of new and refined functions. For example, emissions of nitrogen oxides (NOx) have been halved. A new-generation engine management system, with increased capacity and a greater number of sensors offers more accurate control of the engine’s functions. This includes electronic control of the throttle and the new, more powerful EGR (Exhaust Gas Recirculation) valve for more precise regulation of the air supply and recirculation of exhaust gases.

“We also have a completely new EGR cooler,” says Jörgen Svensson. “This lowers the combustion temperature very efficiently, thereby reducing emissions.”

The catalytic converter is now fitted close to the engine, not just on manual but also on automatic versions, to promote faster warming and thus faster startup of the exhaust cleaning process. The catalytic converter is also larger than before. In addition it has been supplemented with an oxygen sensor that precisely regulates the fuel mixture and emissions.

**Particulate filter is standard**

All versions of the new diesel engine have a particulate filter as standard equipment. It very effectively removes soot particulates from the exhaust gases, with filtration efficiency above 95%. The filter is a CDPF – Coated Diesel Particulate Filter, in which a special coating helps burn the particulates. Therefore, no additives are needed, and the filter requires no maintenance. Burning away soot particulates takes approximately 20 minutes and occurs automatically at 500 to 1000 km intervals, depending on driving conditions.

**Three engine versions**

The new diesel engine is available in three versions, all with the same cylinder volume and common technology:

**Engine Output hp/kW Torque Drive**

- D5 185/136 (previously 163/120) 400 Nm (previously 340) AWD/FWD
- 2.4D 163/120 (previously 130/96) 340 Nm (previously 280) FWD
- D 126/92 (previously 116/85) 300 Nm (previously 280) FWD

In addition to the technical changes, the diesel engines’ service interval has been extended from 20,000 till 30,000 km.

**Six-speed manual and automatic gearboxes**

As standard equipment, the D5 engine is combined with a six-speed manual gearbox to accommodate its very high torque. The six speeds contribute to sportier driving. This gearbox is also available as an option with the 2.4D engine.

Furthermore, a new automatic gearbox will be introduced during the course of the year. It also has six speeds and is available as an option with the D5 and 2.4D. The new automatic transmission contributes to very fast response, particularly when the kick-down function is used. It also has a lock-up feature that is allowed to slip over a wide range of engine speeds for effective pulling power and good drivability, particularly when transporting heavy loads or towing a caravan.

**All Wheel Drive with Instant Traction**

The improved AWD system with Instant Traction, which was introduced on the Volvo XC90 V8, can now be combined with other XC90 engines. The system will also become available for four-wheel driven Volvo S60, S80, V70 and XC70s. Instant Traction makes starting easier on slippery surfaces by immediately distributing the right amount of power to the rear wheels the instant the car starts to move.

“The D5 engine with a six-speed gearbox and All Wheel Drive is a nearly unbeatable combination,”
The new diesel engine is available in three versions, all with the same cylinder volume and

For increased performance
- The injection system has been improved with new injectors and a more advanced injection process
- A new-generation turbocharger, with larger compressor wheel, cambered vanes and electronic control
- The gas exchange system has been upgraded for optimum flow of air and exhaust gases, with low pressure losses

For lower emissions
- A new-generation engine management system with a greater number of sensors for more precise regulation
- The EGR (Exhaust Gas Recirculation) system is new, with faster regulation of the flow
- The EGR cooling is new with higher capacity
- The air throttle is new and electronically controlled in order to more effectively control EGR flow, reduce noise and regulate the temperature
- Air swirl in the combustion chamber is infinitely variable for more efficient combustion
- The lowered compression ratio (from 18:1 to 17:1) with new and larger combustion chambers lowers compression temperatures and reduces emissions
- The quick glow system is new and electronically controlled for faster cold starts
- The catalytic converter is larger and fitted with an oxygen sensor for precise emission control
- The Coated Diesel Particulate Filter (CDPF) is standard on all versions

Related Images
The improved AWD system with Instant Traction, which was introduced on the Volvo XC90 V8, can now be combined with other XC90 engines. The system will also become available for four- and six-cylinder engines.

A completely new, electronically regulated quick glow system results in considerably reduced glow regeneration of the particulate filter. This new system is faster and cleaner. In short, the new glow system will make the engine start faster and the vehicle will be warmer sooner.

For example, emissions of nitrogen oxides (NOx) have been halved. The new diesel engine has very low emissions, thanks to a number of new and refined functions.

The quick glow system is new and electronically controlled for faster cold starts. In addition, it is equipped with a glow plug that is also used in conjunction with the diesel particulate filter. Together, these features ensure rapid and reliable startup even in extremely cold conditions.

A new-generation turbocharger, with larger compressor wheel, cambered vanes and electronic control, has been developed for this engine. The turbo centre housing is now water-cooled, which is unusual in diesel engines. This is caused by the higher performance of the new engine and provides continued cooling of the turbo after the engine has been switched off. This is particularly beneficial during short stops after high-speed driving, such as when refuelling on the highway.

The turbo has been extensively improved and refined. The improvements have resulted in an entirely new driving characteristic.

The engine has undergone a complete redesign, including new pistons, a new camshaft and a new valve train with an electro-magnetic valve lift mechanism. The intake and exhaust valves are now of unequal size, with the exhaust valves being larger. This has led to a lowering of the compression ratio from 18:1 to 17:1. The new camshaft has an advanced timing, which results in an increase of the boost pressure.

For lower emissions, the gas exchange system has been upgraded for optimum flow of air and exhaust gases, with low loss. A new-generation exhaust gas recirculation system (EGR) has also been developed, providing better control of the gas exchange system. The new arrangement of the EGR system has facilitated the use of larger combustion chambers.

As was previously the case, air swirls in the cylinders' combustion chambers. The use of a new electro-magnetic valve lift mechanism has led to an increase in swirl air for better mixture formation and combustion.

A new-generation engine management system with a greater number of sensors for more precise control and regulation of the air supply and recirculation of exhaust gases has been developed. The increased number of sensors provides more accurate control of the engine's functions. This includes electronic control of the swirl level, and combustion can be adjusted extremely accurately according to driving conditions.

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Another newly developed sensor is the particulate filter pressure sensor. It allows us to determine when it is necessary to start the regeneration process automatically. The lowered compression ratio (from 18:1 to 17:1) with new and larger combustion chambers lowers the emissions. Air swirl in the combustion chamber is infinitely variable for more efficient combustion.

Refined injection technology has been developed, including a new injector with a higher number of opening and closing cycles per minute. A coated diesel particulate filter is standard on all versions, as is a dually dosing urea injection, ensuring that harmful NOx emissions are reduced by 90%.

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