VOLVO

Press Release

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Volvo Cars' new V40 Drive-E powertrains - efficient driving pleasure

General
Volvo Car Group's (Volvo Cars) new Drive-E range of powertrains takes efficient driving pleasure to a new dimension in which the number of cylinders is no longer important to describe power and drivability. In the UK, the first engine from the new 2-litre, 4-cylinder Drive-E powertrain family, the D4, has been available in the S60, V60, XC60, V70, XC70 and S80 for almost a year and has already been a success with class leading power and emissions in their respective segments. This new D4 is now available to order in the V40, V40 R-Design and V40 Cross Country with an increased 190hp, and has also be joined by the first petrol from the new engine family to be offered in the UK, the T5.

Volvo Cars have created smaller, more intelligent engines with power curves that give exciting driveability compared with engines with more cylinders, yet deliver the fuel economy of only four cylinders.

The whole Drive-E engine range basically consists of two 4-cylinder engines, one common rail diesel and one direct-injected petrol version. They replace eight engine architectures on three platforms. In the future, Drive-E diesels will range from 120 to 230hp while petrol versions will start at 140hp and go all the way up to 300-plus hp.

Several levels of turbo charging open up the flexibility to cover the whole range, from fuel-efficient derivatives through to high power and torque variants. In order to cover all customer requirements, some engines will also gain added performance via electrification or other spearhead technology.

The Drive-E powertrains project started back in 2008 and has commanded a 2 billion SEK investment in the engine plant. It is expected that the new Drive-E engines will be fully implemented in all Volvo cars by the end of 2015.

Volvo Cars' powertrain experts have developed the engines in-house and they are built at Volvo Cars' high-tech engine plant in Skövde, Sweden.

The sophisticated Drive-E technologies give the customer high performance, improved fuel economy, considerably lower emissions and a powerful sound character. The 4-cylinder engines offer higher performance than today's 6-cylinder units and lower fuel consumption than the current 4-cylinder generation. Comparing a 4-cylinder Drive-E engine to any 6-cylinder engine, there's a noticeable weight and size reduction for the same power. Fuel economy savings are anything from 10 to 30 per cent, depending on which engines are being compared.

Downsizing without compromises

Volvo Car Group is highly confident that the focus on 4-cylinder Drive-E powertrains is the right way to create the desirable blend of power, drivability and fuel efficiency.
The power from an engine it not related to its size; it is about the amount of air that can flow through it. A smaller engine is also more efficient, therefore, the more air through a smaller engine, the better the power and efficiency.

Prepared for electrification

The Drive-E engines are prepared for future electrification from the start. Key components, such as the Integrated Starter Generator (first seen in the world's first plug-in diesel hybrid, the V60 D6 AWD), can be connected easily - and the compact size of the 4-cylinder engines means that the electric motor can be fitted in the front or rear of the vehicle. The battery pack will be located in the centre of the car.

Fleet Proposition

With high performance and low CO_2, the new D4 engine gives company car buyers a no compromise choice with beneficial monthly BIK tax payments. In comparable power and transmission combinations, Volvo now offers class-leading emissions resulting in class-leading BIK figures.

Example:

MAKE/MODEL	HP	Nm	CO_2 G/KM	BIK	MPG COMBINED	P11D	20% TAXPAYER	40% TAXPAYER
Volvo V40 D4 R-Design Manual	190	400	99	15%	74.3	£25,290	£63.23	£126.45
BMW 120d Sport Manual	184	380	114	18%	65.7	£24,900	£74.70	£149.40
Audi A3 2.0 TDI Sport Manual	184	380	110	18%	67.3	£24,980	£74.94	£149.88
Mercedes-Benz A200 CDI Sport Manual	136	350	116	19%	64.2	£23,805	£75.38	£150.77
VW Golf 2.0 TDI GTD Manual	184	380	109	17%	67.3	£26,165	£74.13	£148.27

Technical Information

All engines produced fulfil the stringent requirements for consumption and emissions with environmental impact and meet all global exhaust requirements in force between 2013-2017 (EURO6b, LEVIII and PZEV).

Compared with existing engines with equivalent output, a significant weight saving of between 30kg and 50kg per car can be made.

The basic engine design is very similar to previous engines used within Volvo cars for both petrol and diesel. Both the engine block and cylinder head are produced in aluminium while the cylinder head itself is chill cast while the cylinder block and sump are pressed aluminium alloy.

The crank system in the new engine family is largely the same regardless of whether it is a petrol or diesel engine. The same crankshaft is used for all variants, while there are small differences in pistons and connecting rods.

Increasing stringent legislation for exhaust emissions has meant the demand for efficient exhaust after treatment. A close-coupled catalytic converter is used on both diesel and petrol variants and due to the converter's compact design and location facilitates very fast heating, good flow and efficient purification.

Petrol – T5

The T5 launched in the V40 is the first petrol Drive-E engine to be sold in the UK. Fitted with an 8-speed automatic gearbox as standard, the new engine benefits from far greater fuel economy while increasing overall driveability over its previous 5-cylinder engine and 6-speed automatic gearbox.

The petrol Drive-E engines have a number of efficiencies gained through:
Variable Valve system - A rapidly flexible valve system facilitates good driveability, improved

efficiency and lower fuel consumption.

Reduced Inner Friction - Generally improves the engine's efficiency, resulting in lower fuel consumption and higher power output. Examples of friction-improving measures include ball-bearing mounted camshafts, improved surface treatment of cylinder bore and crankshaft, as well as a fully variable oil pump.

Smart Heat Management – By using an electric water pump and an electrically heated thermostat, all heating and cooling can be optimised, resulting in improvements in fuel economy.

Advanced Combustion Control - Optimised combustion chambers and inlet ducts, together with an injection pressure of up to 200 bar, are parameters that ensure the conditions for high performance and low emissions.

The turbocharger fitted to the T5 in the V40 is of a single scroll design using exhaust gases to force more air through the induction system for increased performance.

Diesel – D4

The new diesel Drive-E engine family is characterised by the following:

Reduced Inner Friction - Generally improves the engine's efficiency, resulting in lower fuel consumption and higher power output. Examples of friction-improving measures include improved surface treatment of cylinder bore and crankshaft, as well as a fully variable oil pump. A new thinner synthetic engine oil is also used to improve friction.

Smart Heat Management - The facility to "short circuit" the water pump enables the coolant flow to be minimised and the warming-up phase to be shortened. From this, climate performance and fuel economy can be optimised.

Fuel Injection with Pressure Control - The fuel injections can be controlled very effectively using the advanced i-ART nozzles.

Advanced Combustion Control - Optimised combustion chambers and inlet ducts, together with swirl dampers and an injection pressure of up to 2500 bar, are parameters that ensure the conditions for high performance and low emissions.

Belt-driven Fuel Pump - The high-pressure fuel pump needed a higher speed in order to provide for the high rail pressure of up to 2500 bar. The pump is therefore driven at the same speed as the crankshaft via the camshaft's drive belt.

Exhaust After-treatment with LNT (Lean NOx Trap) - Euro 6 is fulfilled by means of a very precise control of the fuel injections, in combination with a change in hardware in the catalytic converter.

i-ART is the result of a close collaboration with Denso, creating a new common-rail diesel injection system. The ECM (Engine Control Module) measures the pressure and temperature in each injector via sensors in each of the injectors. By monitoring the pressure and temperature in each cylinder, the fuel injection can be adjusted for each individual cylinder. Conventional diesel injection systems use a single pressure sensor in the fuel rail, which only controls the injection pump. However, on Drive-E engines, each injector has a pressure and temperature sensor that monitors the injection process. This information ensures that the i-ART system injects the ideal amount of fuel into each cylinder.

The combination of higher injection pressure (up to 2500bar compared to existing 1800bar) and i-ART technology improves fuel economy and results in lower emissions and higher engine power output. This can provide up to 2% improved fuel economy.

The new D4 engine has a two-stage turbocharging system consisting of turbochargers from Borg-Warner. The engine is set-up with a small and a large turbo, very similar to the system on the existing 5-cylinder D5 diesel engine. The small turbo helps at the lower engine speeds and when the engine reaches higher engine speeds, the second turbo kicks in. This helps to build torque quickly, smoothly and efficiently with minimal turbo-lag, and compared to the previous D4, allows the torque curve to continue for a longer period of time.

Transmission

The same thinking behind the reduction of the number of engines available was also behind the new gearbox strategy. Up to eight different types of gearbox have been available world-wide, but with the introduction of the Drive-E family, this reduces to just two, the 6-speed manual and 8-speed automatic.

New 6-speed Manual Gearbox – D4 only

The manual gearbox has been revised and modified in several areas:

- Lower weight
- Revised internal components
- Reduced oil volume
- Internal friction reduction

New 8-speed automatic gearbox – T5 and D4

To deliver an increased responsive, smooth and fuel-efficient drive, the new 8-speed automatic gearbox is optional on the D4 but fitted as standard on the T5.

The driver is able to change gear manually using the gear-lever and is also able to put the gearbox into Sport mode that quickens up the accelerator pedal response and provides gearshift points at higher engine speeds. Also available as a cost option is Paddle Shifters which are fitted on the rear of the steering wheel, allowing the driver to change gear manually without moving his/her hands from the steering wheel.

The new gearbox is an electronically controlled 8-speed automatic gearbox developed together with Aisin AW. By using eight gears, the engine is allowed to operate at a load where the efficiency is highest. The engine's speed can be kept low, resulting in low fuel consumption and thus also low CO_2 emissions.

The eight gears allows for a wider gear range, the first gear being lower to help acceleration and the top gear being higher to benefit fuel consumption at higher cruising speeds, with the entire range helping to increase drivability. The gear changes themselves have been improved and the speed at which the gears change has also been increased.

ECO+ is a function for cars with the automatic gearbox and can reduce fuel consumption by up to 5% depending on the driver's driving behaviour. The function allows the driver to drive the car in a more environmentally conscious manner.

NB. Published fuel consumption figures are conducted WITHOUT using ECO+ mode.

On activation of ECO+, the following are activated:

- Eco Coast - means in practice that engine braking is deactivated at certain speeds
- Accelerator pedal response - a softer application of the response, which then requires longer pedal travel
- Gearshift points - changed gearshift pattern
- Climate control system - air conditioning deactivated, amongst other things
- Changed behaviour of Start/Stop
- Changed strategy for activating the turbo

Eco Coast is a function that helps the driver to maintain the car's kinetic energy when the accelerator pedal is released, at which point engine braking is deactivated and the engine changes down to idling speed.

For further reduction of fuel consumption, the internal combustion engine will be switched off directly during braking, as soon as the speed has dropped to approximately 4mph, up from the standard 0mph.

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All information is correct at time of going to press and may be altered without prior notification.

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