



DRIVE-E

A technology factsheet on
Volvo Cars' T8 Twin Engine AWD powertrain technology



ELECTRIFICATION
CLEAN EFFICIENCY
RESPONSIVE POWER

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Twin Engine Technology

Plug-in hybrids

"Volvo Cars has made a clear commitment to electrification across our entire product range. Our Twin Engine technology is a confident first step forward. This technology delivers a no compromise balance of clean, efficient performance and exceptional driving pleasure. It is all about using the latest available technology to address unmet consumer needs," *says Dr Peter Mertens, Senior Vice President Research & Development at Volvo Car Group.*

PURE



HYBRID



POWER



Twin Engine Definition

Volvo's Twin Engine technology is essentially a combination of an internal combustion engine and electric power. Electric energy from the grid can be stored in a High Voltage Battery. The technology is more commonly known as Plug-in Hybrid Technology (PHEV).

Volvo's technology is designed to deliver three cars experiences in one.

- **PURE** – where the car runs on electric power alone.
- **HYBRID** – where an optimal combination of the engine and electric machine propels the cars in a balanced and sustainable way.
- **POWER** – where all available power is used to deliver maximum performance.

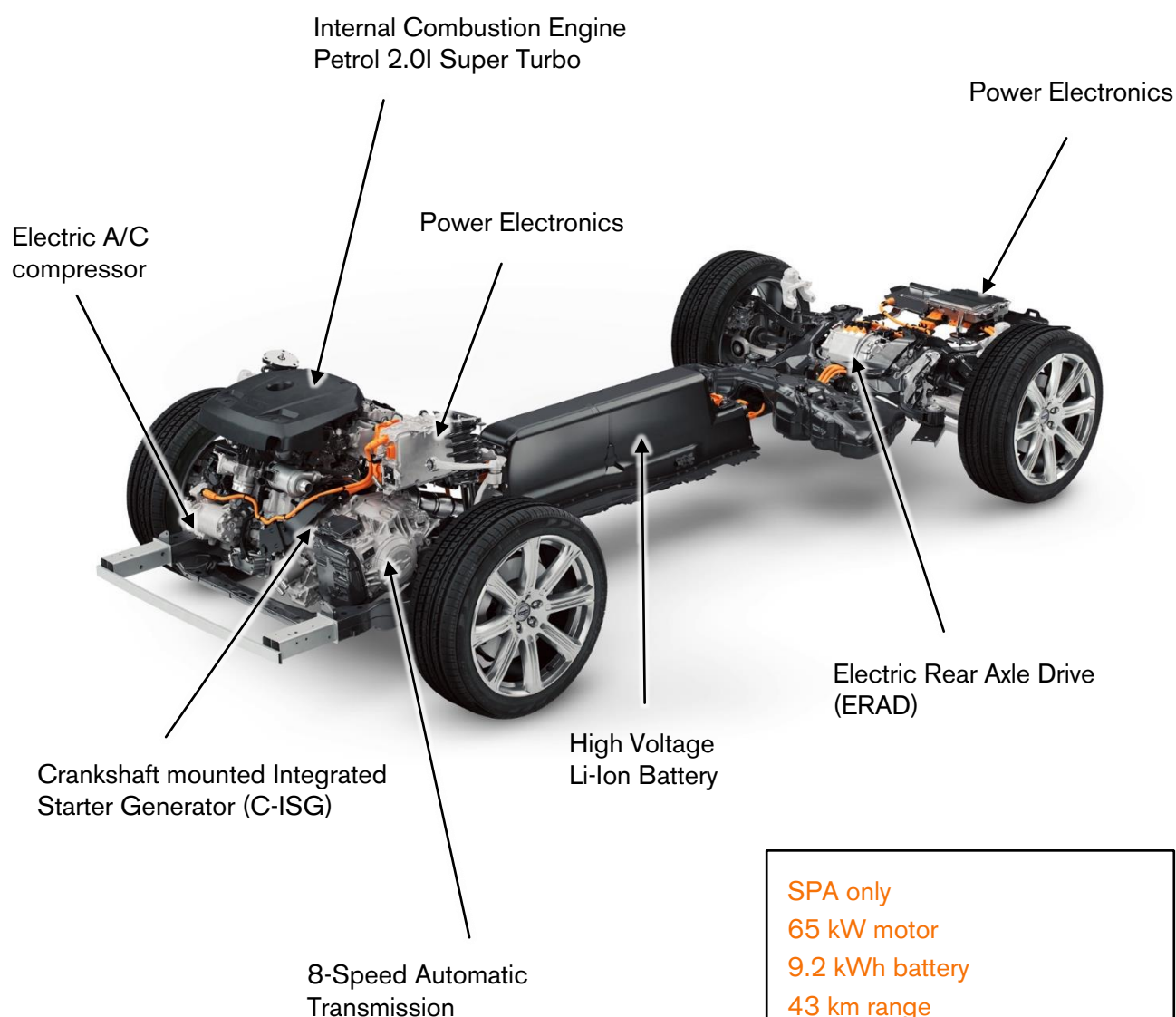
Volvo's Twin Engine set-up means that the high voltage battery is positioned in the tunnel console for maximum safety and also improved weight distribution that gives an improved driving experience.

Twin Engine technology delivers a no compromise mix of performance, driving pleasure, efficiency interior, cargo space and flexibility.



T8 Twin Engine Technology

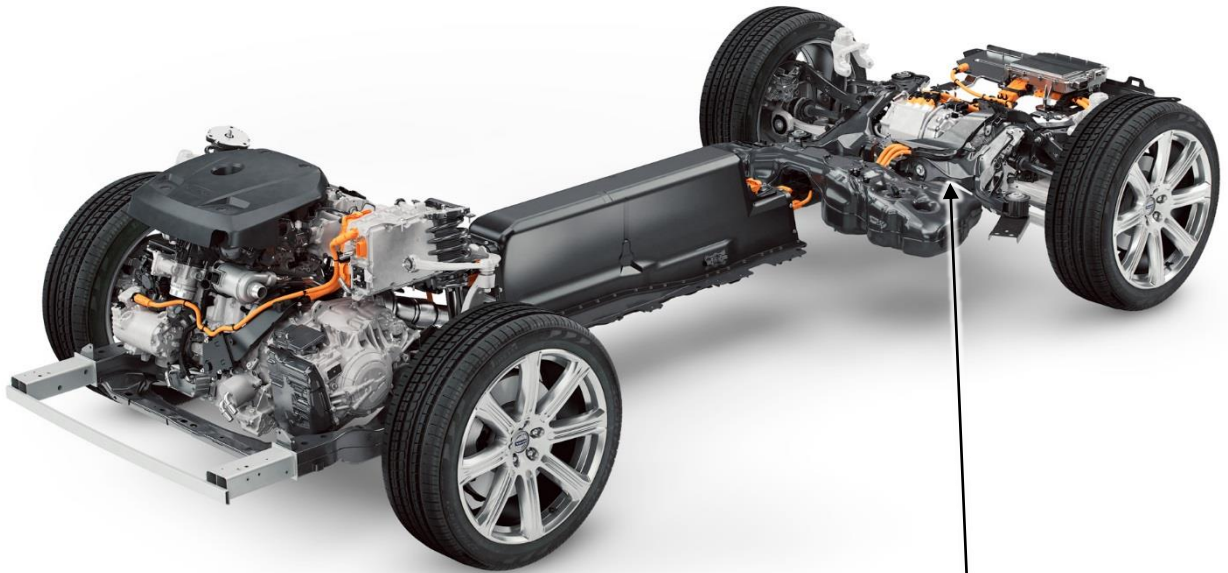
All Wheel Drive



T8 Twin Engine Technology

Electric Rear Axle Drive

- Propels vehicle in electric mode
- Provides electric boost torque and power during acceleration
- Provides electric all wheel drive functionality
- Performs brake energy recuperation



Permanent Magnet Synchronous Machine

Peak power: 65 kW

Peak torque 240 Nm

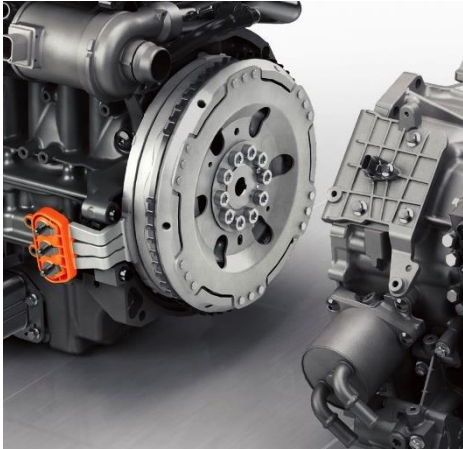
Weight: 34 kg

Cooling: Water cooled stator

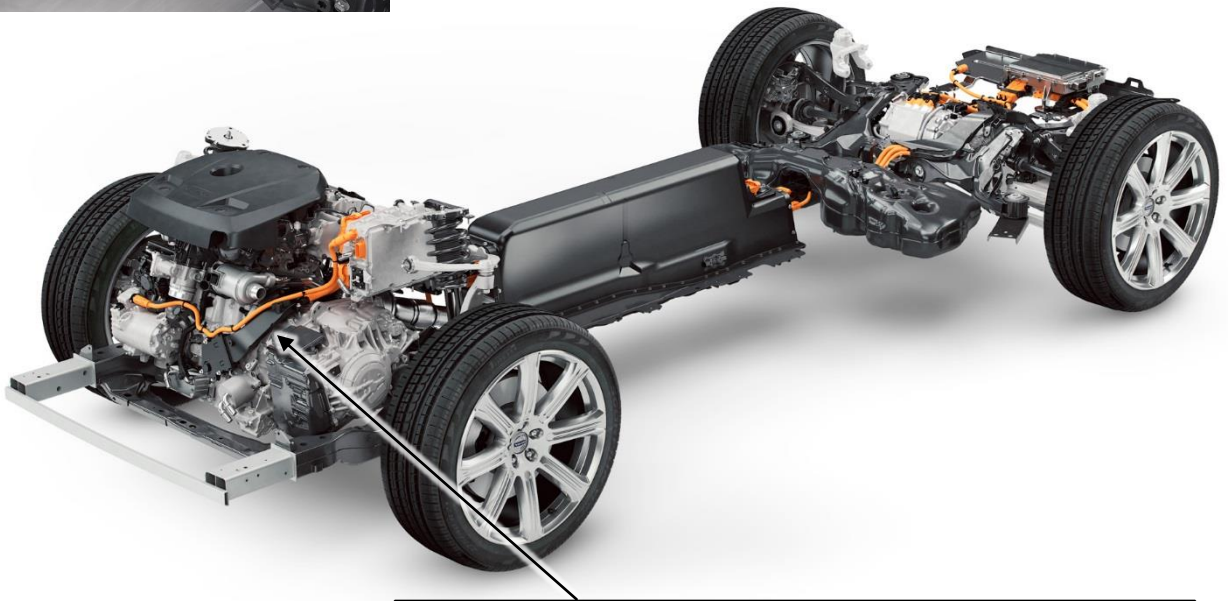


T8 Twin Engine Technology

Crank-Integrated Starter Generator



- Charges the battery
- Starter for the combustion engine
- Can support the combustion engine with electric boost power



Permanent Magnet Synchronous Machine

Peak power: 34 kW

Peak torque: boost 150 Nm, cold crank = 180 Nm 240 Nm

Weight: 18kg

Cooling: Water cooled

T8 Twin Engine Technology

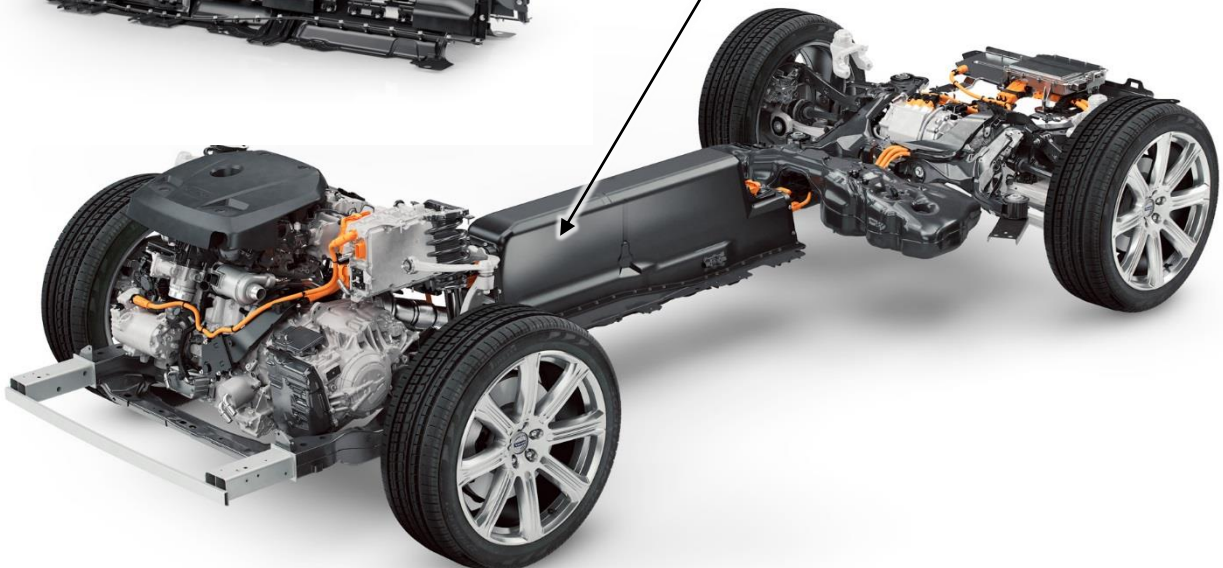
High Voltage Battery

The function of the high voltage battery is to store energy. It receives energy from electric grid charging and also from regenerative braking of the vehicle or from the C-ISG.

The high voltage battery delivers power for pure electric drive and also to run the electric air conditioning for pre-climatisation of the passenger compartment.



96 Li-ion cells
270-400V
9.2 kWh (nominal)
Lithium Manganese Oxide – Nickel
Manganese Cobalt/Graphite
Weight: 113 kg (excluding coolant)
Manual service disconnect



T8 Twin Engine Technology

On board charger

World-wide use, adapted to EU, US and China standards for AC charging

AC input voltage: 85–265V

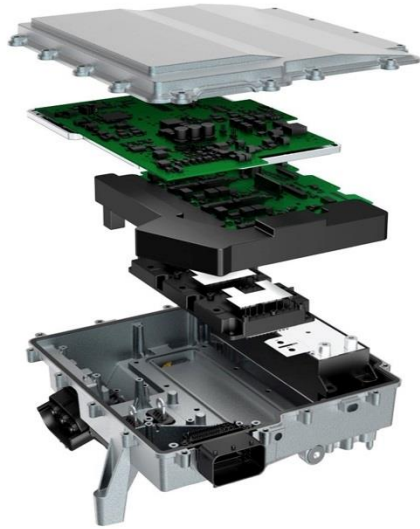
Output power 3,5 kW@230V, 1,4 kW@120V

Charging time: 3h@16A, 8h@10A. Extended time due to climatisation may occur



T8 Twin Engine Technology

Power Electronics



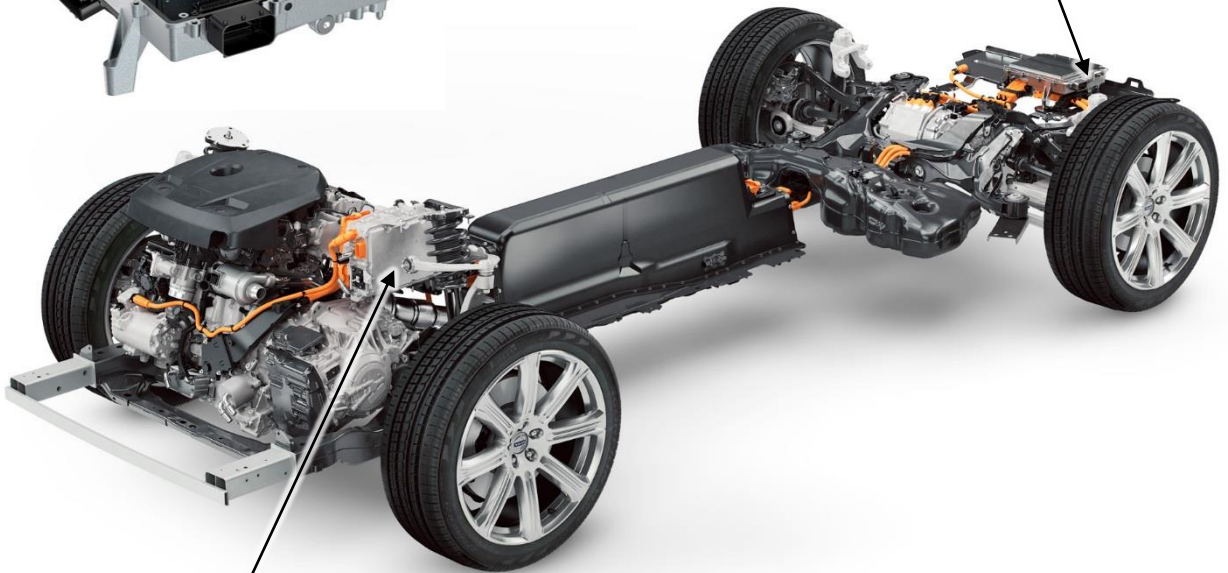
ERAD inverter

Controls the ERAD EM

Provides/receives AC current and voltage to/from the ERAD EM

600 A/650 V rated power module

10 kHz switch frequency (variable)



CIDD (Combined Inverter and DC/DC)

Controls the C-ISG

Voltage converter 400V-12V

Provides/receives AC current and voltage to/from the C-ISG

650 V rated power module

10 kHz switch frequency (variable)

T8 Twin Engine Technology

Cooling and Brake systems



Cooling system

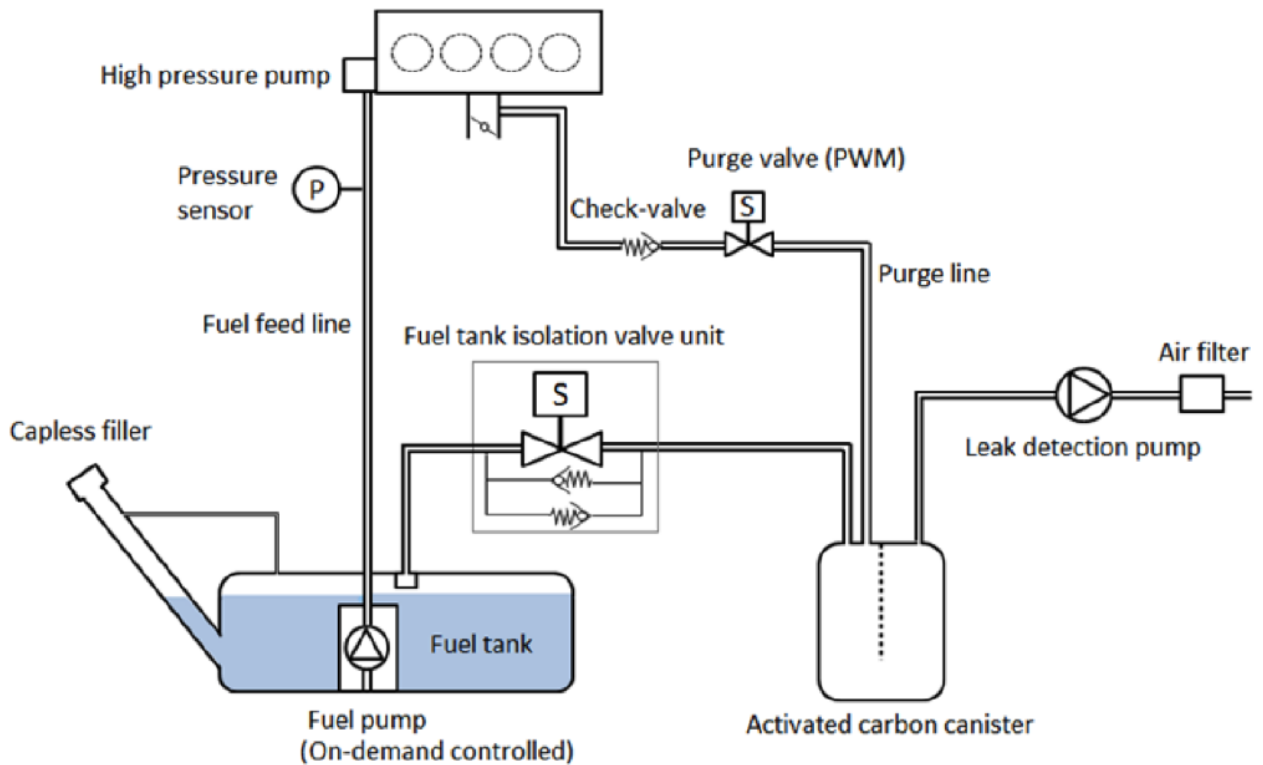
- The C-ISG is cooled by the base engine cooling circuit.
- One extra cooling circuit cools the ERAD and the power electronics.
- A second, extra cooling circuit, cools the battery in one of two ways; either passively, via the radiator, or actively, through integration with the car's climate system.

Brake system

- The T8 Twin Engine's intelligent blended braking system uses brake-by-wire technology to automatically recover and transmit regenerated energy to recharge the battery or for immediate use.
- The system is also equipped with a stability function that controls the amount of energy that may be regenerated while maintaining both optimal stability and traction.

T8 Twin Engine Technology

Fuel and Control Systems



Fuel system

- Non vented tank.
- Canister adsorbs fuel vapour in combination with refuel or high tank pressure.
- Canister is purged from adsorbed fuel when engine is running.

Control system

- Hybrid master control in Engine Control Module.
- Control of subsystem via CAN.
- Model based in-house developed software for hybrid control.

Petrol Engine Technology

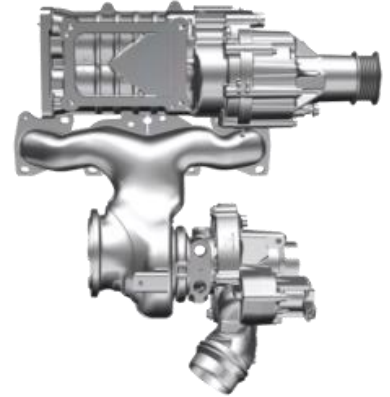
Advanced Boosting

Volvo Cars has taken advanced boosting to a new level, using a modular based system that effectively offers Volvo owners a range of power levels and engine performance attributes. Advanced boosting means that our compact engines can deliver power levels equivalent to those of larger six- and eight-cylinder units. Advanced boosting also ensures high torque availability across a wider speed range.

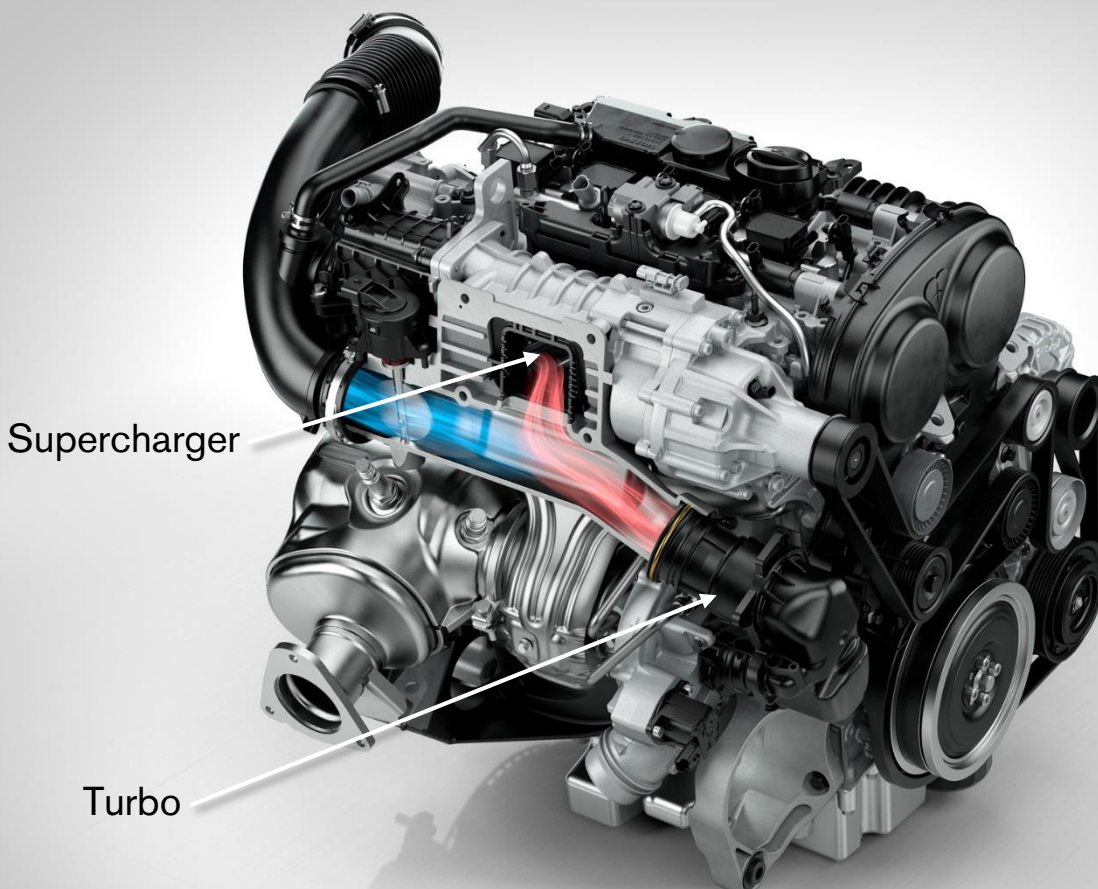
We use state-of-the-art charging systems consisting of turbochargers and superchargers designed to our precise specifications to deliver improved fuel economy, leading performance and drivability.

Supercharger & Turbos

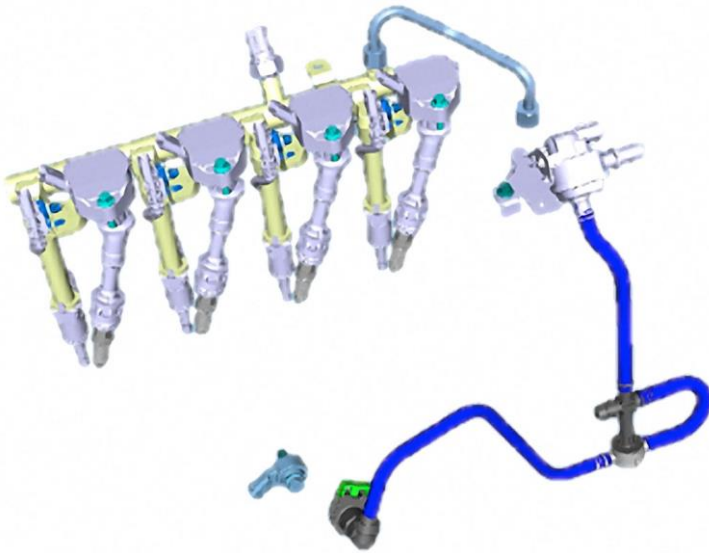
Superchargers deliver low-end torque and response. Turbos deliver horsepower. Below 3500 rpm the supercharger and turbo are active. Above 3500 rpm, only the turbo is applied.



Supercharger & Turbo (T6)



Petrol Engine Technology



Advanced Combustion

The combustion system designed for the petrol engines is comprised of a centrally mounted spark plug and injector with a unique spray layout that provides a homogeneous air-fuel mixture.

This central **direct injection** technique enables:

- Stratified start and an effective catalyst heating mode that outperforms Port Fuel Injection (PFI) and side mounted Direct Injection engines, resulting in low fuel consumption and enabling Euro6 and LEVIII emission compliance.
- Improved low-end torque compared with PFI by using scavenging and charge cooling by direct fuel injection.

The intake ports are designed to generate a high

tumble motion, promoting the mixing of air and fuel during the intake stroke. In the succeeding compression stroke, this tumble motion is broken down into turbulence, accelerating the combustion speed. The combustion is therefore very stable, enabling a high degree of internal EGR, which minimizes pumping losses, hence reducing the fuel consumption. Special efforts were made to achieve a combustion system that is knock resistant. The cooling water jacket, intake ports, spray target and combustion chamber geometry were fine-tuned, enabling a fuel-efficient, high compression ratio of 10.8 for the gasoline T5 and 10.3 for the gasoline T6.

Petrol Engines

T6 – the base engine for T8 Twin Engine AWD

Displacement	2.0l
Charging system	One supercharger + one turbo with waste gate
Balancer shafts	Yes
Engine structure	Light weight high-pressure die cast aluminium crank cases and bedplates with cast-in iron liners and nodular cast iron bearing reinforcements.
Crank system	Similar pistons i.e. forged steel crank shafts to minimise bearing sizes, different machining of the piston top for different compression ratios. Friction reduced by 50%, ring tangential load reduction with Physical Vapour Deposition-coating (PVC) on the top ring and new honing specification. Piston pins are coated with Diamond-like Carbon (DLC).
Cylinder head	The T6 utilizes a double water jacket design to aid cooling and flow.
Valve system	Direct-acting high-speed variable valve system with service-free DLC-coated mechanical tappets. Roller bearings on first cam bearing position to reduce friction. Cam phasers on both intake and exhaust camshafts enables flexibility in the trade-off between emissions, fuel consumption and drivability.
Oil system <small>(with variable oil pump)</small>	The oil pump is fully variable and the oil pressure is controlled by a solenoid actuator for friction reduction.
Cooling system / Thermal management	The petrol engines are equipped with a 400 W electrical water pump to reduce friction losses and create the possibility to control the coolant flow for fast engine warm-up and friction reduction
Combustion system	A centrally mounted spark plug and injector with a unique spray layout that provides a very homogeneous air-fuel mixture.
Exhaust gas after-treatment	Volvo's compact modular exhaust gas after-treatment system shows very low pressure drop and high uniformity qualities and shares a similar base design for both petrol and diesel applications. The petrols fulfill all Euro 6b/ULEV and PZEV requirements.

Petrol Engines

T6 Rear



T6 Front



Transmissions

8 speed automatic



- Best in class efficiency
- Quick and smooth shifting
- Converter technology for powerful launches
- High torque capacity considering small size and low weight

The Volvo eight-speed planetary automatic transmission is a vital part of Drive-E powertrain technology.

The number of gears means that the engine's torque and power band can be utilized more efficiently.

Two of the gears are 'overdrives', which save fuel when cruising at constant speeds.

The Lock-up (LU) system is comprised of the latest Noise, Vibration, Harshness damping technology (super long travel damper for the petrol engine). This enables frequent use of LU and allows the engine to run on low revs for best fuel economy.

T8 Twin Engine

The maximum torque level is increased to enable better use of the C-ISG for performance boosting purposes.

To secure transmission lubrication in pure electric mode and a quick transmission engagement (incl. start-stop response) at engine starts, an enlarged electric oil pump is integrated onto the transmission.

Shift by Wire technology

Added to transmission is an electric actuator that shift the transmission between P, R, N and D.

T8 Twin Engine variant has a unique engine-braking mode (B on shifter). Manual downshifting can be done by shifter and/or paddles.

DRIVE-E

Efficient Power, No Compromise



V O L V O

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