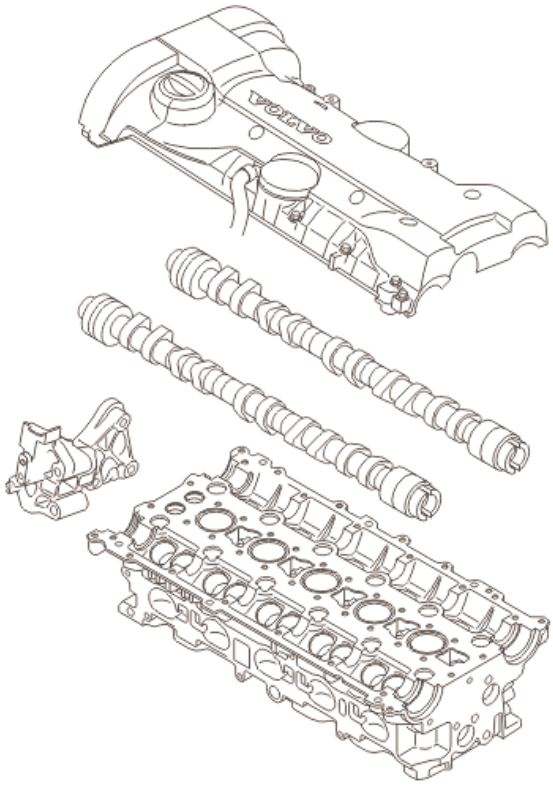
Design

Cylinder head, camshaft bearing housing



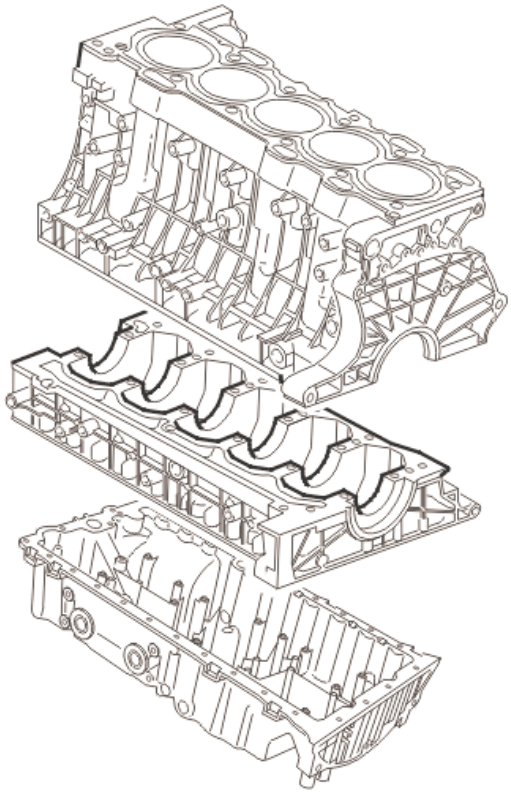
The entire engine is manufactured in aluminum. The engine block is divided up into five sections. The cylinder head consists of two sections and the cylinder block of three sections. The seal between the cylinder head and cylinder block is a conventional cylinder head gasket. The seal between the other gasket faces is a liquid gasket.

There is a cover over the sparkplug wells for protection against dirt and water. The two camshafts are carried on six bearing caps each in the two halves of the cylinder head. The upper half is a combined valve and camshaft cover. It has cast oil ducts on the underneath which ensure good oil supply to the camshafts and the mechanical valve lifters. The lower half contains the maintenance-free mechanical valve lifters, the valve springs and valves.

The compact "pent roof" design of the combustion chamber and the V shaped arrangement of the valves optimize injection and evacuation via the intake passage and

combustion chamber (cross-flow) and the exhaust passage. The swirl surfaces of the combustion chamber and the centrally positioned spark plug ensures optimal combustion, low sensitivity to knocking and low, stable exhaust emissions.
The engine, which is pendulum mounted, consists of an engine bracket which is secured to the side member. The cylinder head is ”gravity” cast, which is a slower process than for die casting. This is so that the exhaust and intake passages and the coolant and oil mantle are integrated during construction.

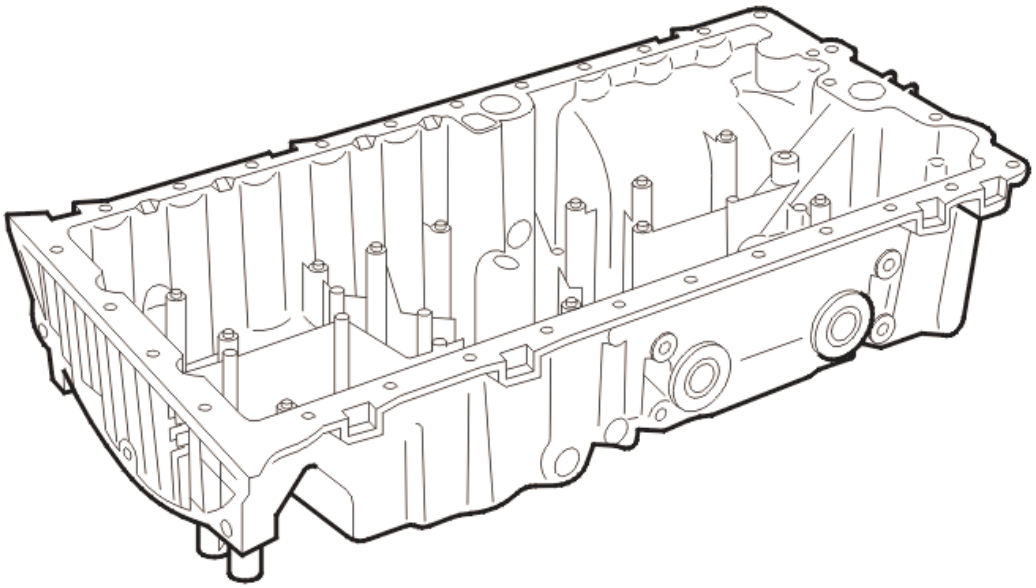
Cylinder block



The engine block is divided into three sections, the cylinder block, intermediate section and oil pan. The mating flange between the cylinder block and intermediate section is in the center line of the crankshaft.
The cylinder block has five cast iron cylinder sleeves cast into the cylinder block which cannot be replaced. The six main bearing seats have cast iron reinforcements in the intermediate section. On the top of the intermediate section there are cast oil channels which distribute the oil to the main bearings and on via the crankshaft to the big

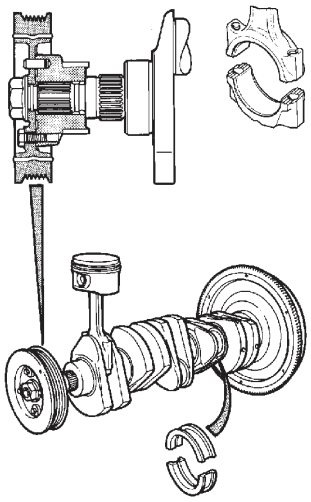
ends.
The oil pan contributes to the rigid construction and acts as additional reinforcement. There is central smooth-bore oil duct for piston cooling.

Oil pan



The oil pan is made of die cast aluminum with baffles. This is so that the oil does not splash excessively. It is secured in the cylinder block with a liquid LOCTITE gasket, which ensures the seal between the cylinder block and oil pan.

Crankshaft



The crankshaft has six main bearings. The 5th main bearing is a throw-out bearing. At the front end of the crankshaft are two spline joints, the inner of which drives the oil pump. The drive gear for the timing belt and vibration damper is on the outer joint.
A blind spline ensures that the position and control of the drive gear is correct. The connecting rods are forged. The cover is held in the correct position by the saw-toothed joint between the connecting rod and cover. B5244SX and B5254TX have forged crankshafts ensuring both maximum strength and low noise levels

Piston

The piston has a homogenous aluminum alloy with graphite coating on both sides. This coating provides a certain reduction in friction as well as noise absorption. The piston rings are made of different material depending on where they are located in the piston. The upper compression ring is a nitrified steel ring. The lower compression ring is made of cast iron and the oil scraper ring is a design comprising three parts, all in nitrified steel (not applicable to B5xx4Sx). For the B5244S7 engine the oil scraper ring is divided into 2 parts instead of 3. It is slightly more hardwearing than the 3 part ring. The height of the ring is 2.5 mm compared with 2.0 mm for the 3 part ring.

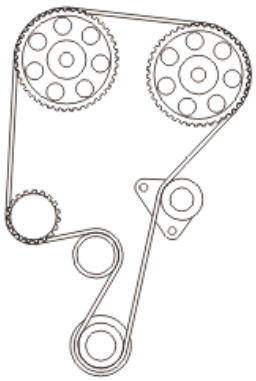
The gudgeon pin is hardened steel and is held in place with steel snap rings. The piston is oval and conical and flat at the top. By reducing the area

from the upper piston ring to the top of the piston, the release of hydrocarbons from the engine to the catalytic converter is reduced.
The pistons are oil cooled so that they can have a lower compression height. Oil is led through a valve in a longitudinal channel in the lower section of the cylinder block on the exhaust side. There is a nozzle screwed to the channel at each cylinder. This leads the oil towards the underside of the piston.

Camshafts, Valve system

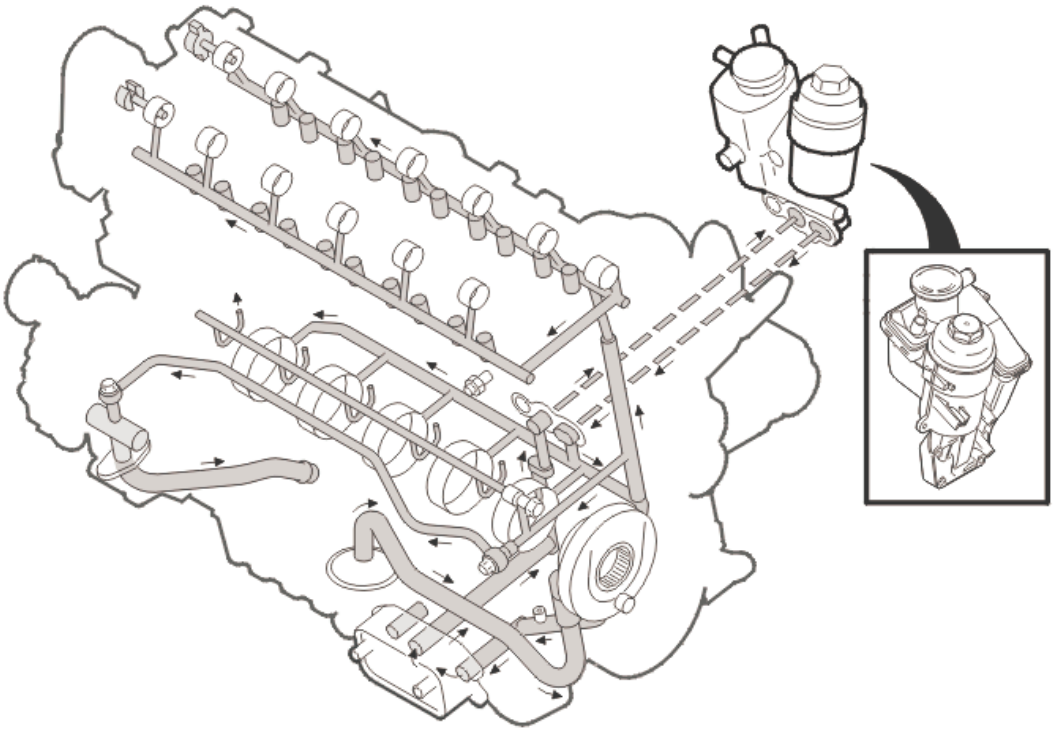
The camshafts are cast iron. The cams lobes which press against the valve lifters are harder to tolerate the contact pressure. The valve lifters are steel and mechanical, not hydraulic.
There is a certain amount of valve clearance between the valve lifters and cam lobes. The valve clearance is adapted to compensate for differences in length between the valve and cylinder head due to expansion when warming up. Mechanical valve lifters ensure more precise valve timing, reduced friction, more stable combustion and reduced mass.
The material in the lifters is case-hardened steel. The surfaces between the camshaft and valve are slightly convex to guarantee centered contact.

Mechanical timing belt tensioner



The tensioner consists or a spring and a friction element. The friction element provides the required damping to absorb small oscillations and speed variations. The spring ensures correct belt tension, irrespective of wear and temperature. The belts are made of cord reinforced rubber.

Lubrication system

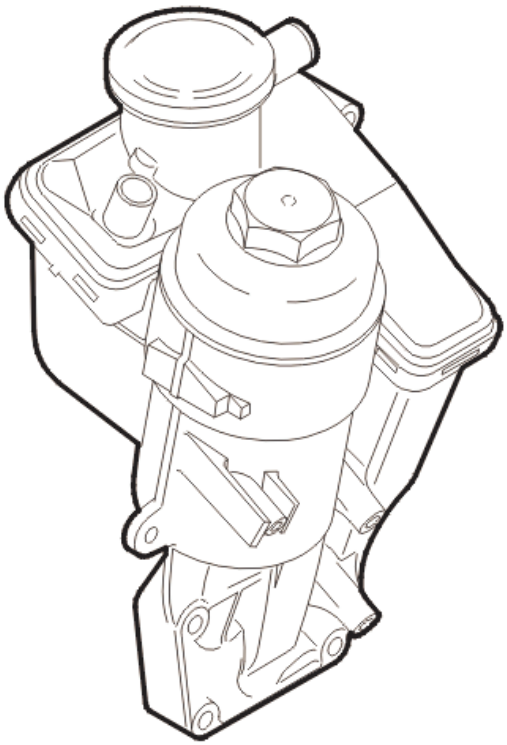


The oil is led from the oil pan via a suction nozzle to the oil pump. The oil pump is located on the engine block. The oil is then pumped onwards to the oil cooling system and then to the oil filter.

The oil flows from the filter through a cast oil duct in the intermediate section to the main bearings. The oil then flows through bored channels in the crankshaft to the connecting rod bearings.
The camshafts are supplied with oil by a bored channel in the cylinder block. The channel runs through the cylinder head, where it flows out at the bottom of the upper half of the cylinder head. There is a cross duct in the channel to the cylinder head which carries oil to the pistons via a piston cooling valve.

The oil flows on via an oil duct to the bearing for the left-hand camshaft and the valve lifters (intake side). The bearings for the right-hand side camshaft (exhaust side) are supplied by a cast cross duct at the front edge of the upper half. This cast cross duct also supplies pressurized oil to the solenoids for the VVT unit. Drain holes in the cylinder block release the oil from the cylinder head and crankshaft bearing back to the oil pan.

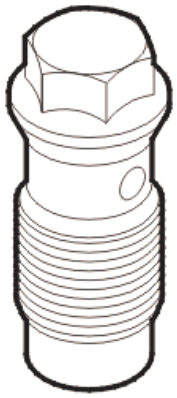
Oil filter



The oil filter holder is made of die cast aluminum. It is on the cold side of the engine. The oil filter cover is plastic. There is a by-pass valve in the cover. An O-ring in the cover ensures that it is

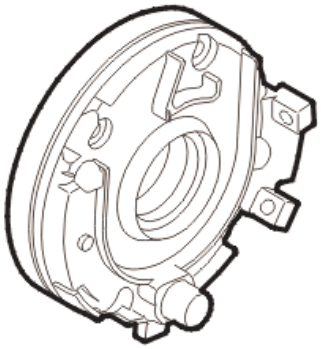
sealed.

Piston cooling valve



The piston cooling valve is manufactured in steel with a hardened piston, a spring and a spring stop. A copper washer ensures that oil does not leak onto the cylinder block.

Oil pump



The oil pump pumps oil from the oil pan via channels in the intermediate section and cylinder block into the cylinder head and onwards in the system. The oil pump is on the end of the crankshaft. The crankshaft runs through the oil pump.
A duo-centric gear wheel reduces the flow of oil, increasing the pressure. This results in a pulse action which forces out the oil. The oil can only flow in one direction.

Injector

The valve is enclosed in a plastic casing with O-rings on each end which act as seals. There is a coil in the valve which creates a magnetic field. This overpowers the force of the spring which holds the fuel needle in place. The fuel is let

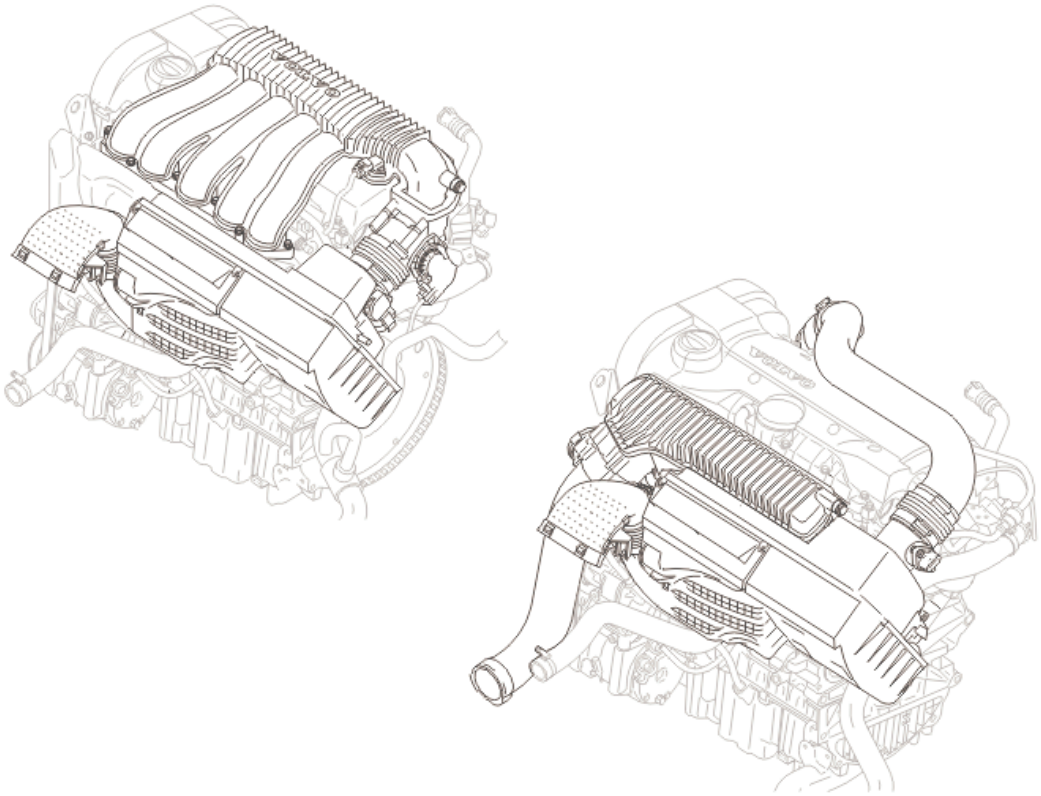
through and mixes with the intake air.

Evaporative emission (EVAP) system

The housing for the EVAP valve is plastic and contains a solenoid valve. The EVAP canister consists of a plastic holder with active carbon and a filter. Internally, the plastic holder is divided up into chambers depending on the market and the prevailing emissions requirements.

All the active carbon in the canisters is held by springs and pressure plates so that no air columns are created by vibration for example. This could lead to hydrocarbon leakage at the carbon beds. The connector pipe has a filter so that carbon dust cannot leak out and damage the leak diagnostic pump and the EVAP valve.
The leak diagnostic pump consists of a plastic housing with an electric motor, pump, valves, leak calibration and a PTC heater element.

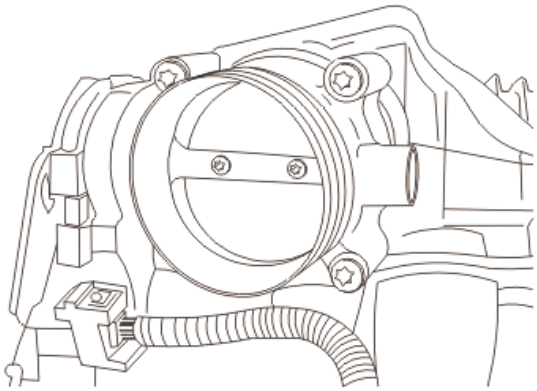
Intake system



The intake system is divided into two sections, the upper and lower intake manifolds. The upper intake manifold is made of plastic for naturally aspirated and turbocharged engines. The lower intake manifold is aluminum for both types of

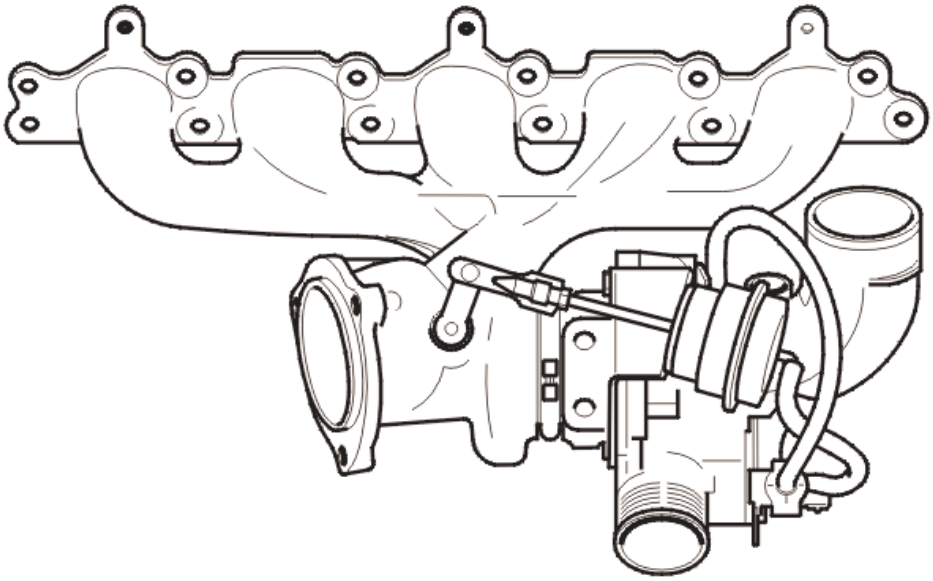
engine to protect the fuel injection nozzles in the event of a collision.
The intake system for naturally aspirated engines has a total volume of 5.3 liters with fixed barrel lengths. On turbocharged engines the total volume is 3.0 liters with short barrels.
The gasket between the lower intake manifold and cylinder head on naturally aspirated engines is a calibrated single gasket. On turbocharged engines there is a double gasket with a built in non-return valve.

Throttle body (TB)



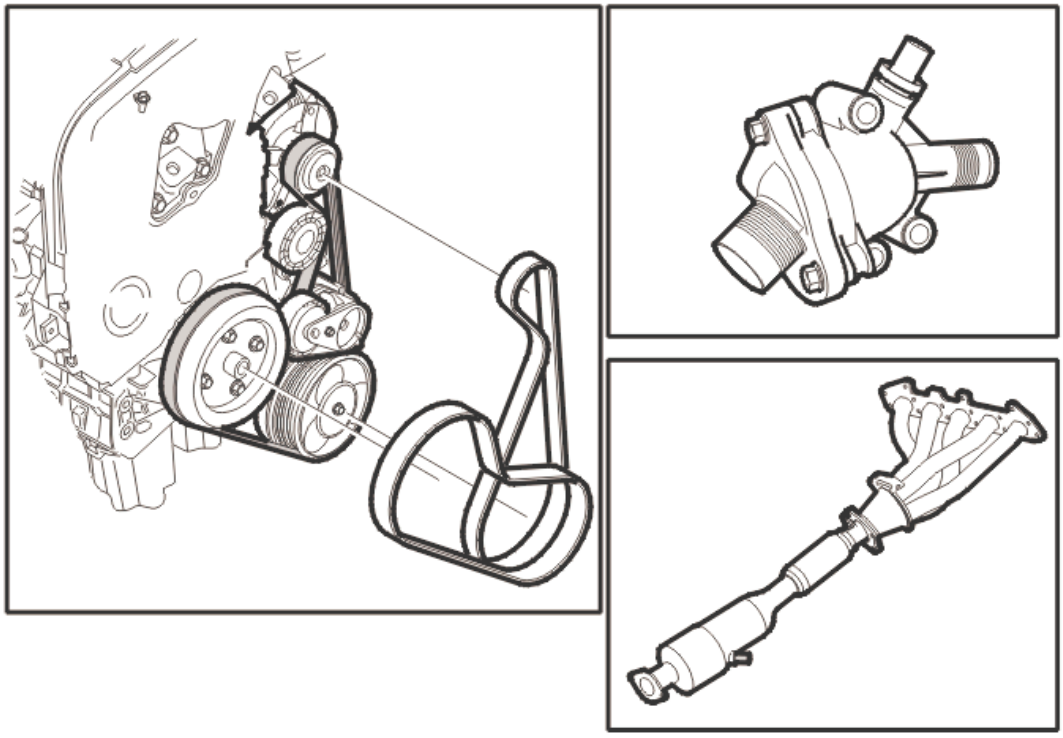
The throttle body (TB) is die cast aluminum. The throttle disc is brass on naturally aspirated engines and aluminum on turbocharged engines. The position sensors are under the plastic cover. These read the position of the throttle disc. There are also two connections to the engine in the cover. These turn the throttle disc to the angle requested by the driver.
The throttle body (TB) does not need to be cooled, but may need to be heated. An O-ring in the intake manifold ensures the seal between the intake manifold and throttle body (TB).

Turbocharger (TC)



The integrated manifold and turbine housing are made of austenite forged steel to tolerate exhaust temperatures up to 1050 °C.
The bearing housing and turbine housing are held together by a V-shaped clamp. The compressor housing is made of die cast aluminum. The bearing housing is cooled by the oil and coolant system to prevent coking in the bearing for the turbine shaft which spins at up to 170,000 rpm.

Exhaust system



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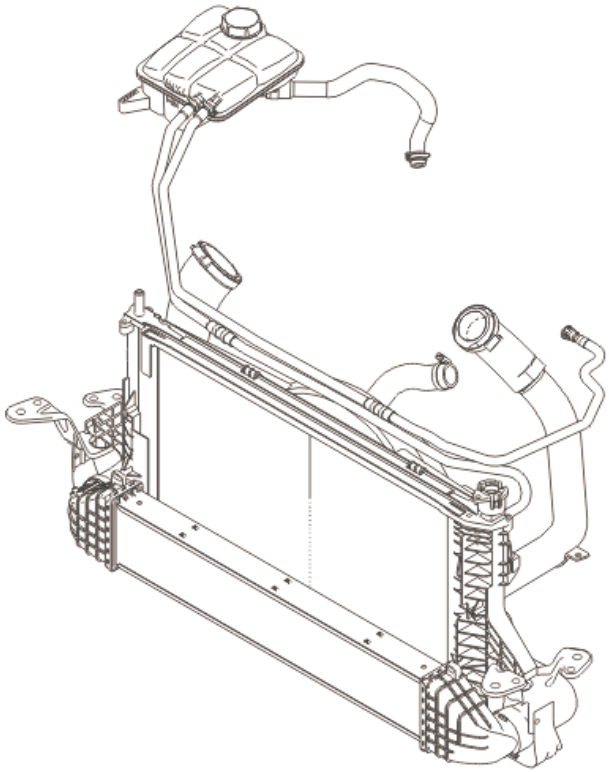
The exhaust system primarily consists of four sections. Manifold (and turbocharger (TC) if the engine is turbocharged), three-way catalytic converter (TWC), heated oxygen sensors (HO2S) and muffler. The exhaust system is manufactured from chromium steel sections welded together. The pipes are isolated so that the gas flow from the cylinders do not clash and to ensure good flow distribution in the three-way catalytic converter (TWC). There is a boot on the three-way catalytic converter (TWC) to compensate for manufacturing and installation tolerances.

The entire exhaust system is manufactured in chromium steel. A catalytic converter consists of perforated ceramic beads or metal substrates. These are coated with a Wash-coat and then a further coating of the catalytic inert metals, platinum, palladium and rhodium. Heated oxygen sensors are used to control the engine and monitor the catalytic converter. There is one heated oxygen sensor before and one heated oxygen sensor in the catalytic converter. There is a further heated oxygen sensor fitted on the manifold for B5244S7.

Flame trap

The flame trap is made of die cast aluminum and integrated with the oil filter. The cyclone separators are plastic and cannot be replaced.

Cooling system



The coolant pump pumps coolant through the cylinder block, and also cools the cylinder head, cylinder sleeves, spark plug wells, intake ducts and fuel injection nozzles.
The coolant flows in at the pump and passes through a number of channels before it collects and then flows out to the thermostat housing. If the thermostat housing is closed, the coolant passes via the by-pass channel directly to the coolant pump to then circulate through the cylinder block again.

In principle, its appearance is the same as the oil cooler for the transmission. Both have an inlet and outlet. The oil cooler is constructed in layers where water and oil flow around each other. Having flowed through the restrictions in the oil ways, the pressure in the system falls.
When the fuel combusts in the engine, the result is both mechanical work and excess energy. The excess heat is taken away from the engine via the exhaust gases by convection to the air in the

engine compartment and also by transfer to the coolant and engine oil. The cooling system is a closed system.

Radiator

The radiator is made of aluminum to tolerate the thermal variances when the radiator is being both cooled by cool air and heated by hot coolant.

Thermostat

The thermostat is in the thermostat housing which is in the connection to the coolant outlet from the cylinder head. At the heart of the thermostat is a wax body which expands with energy in the form of heat. In modern cooling systems, the thermostat begins to expand when the surrounding coolant temperature is 90 °C.