

Service.



Self-Study Programme 260

The 1.2 ltr. 3-cylinder petrol engines

Design and Function

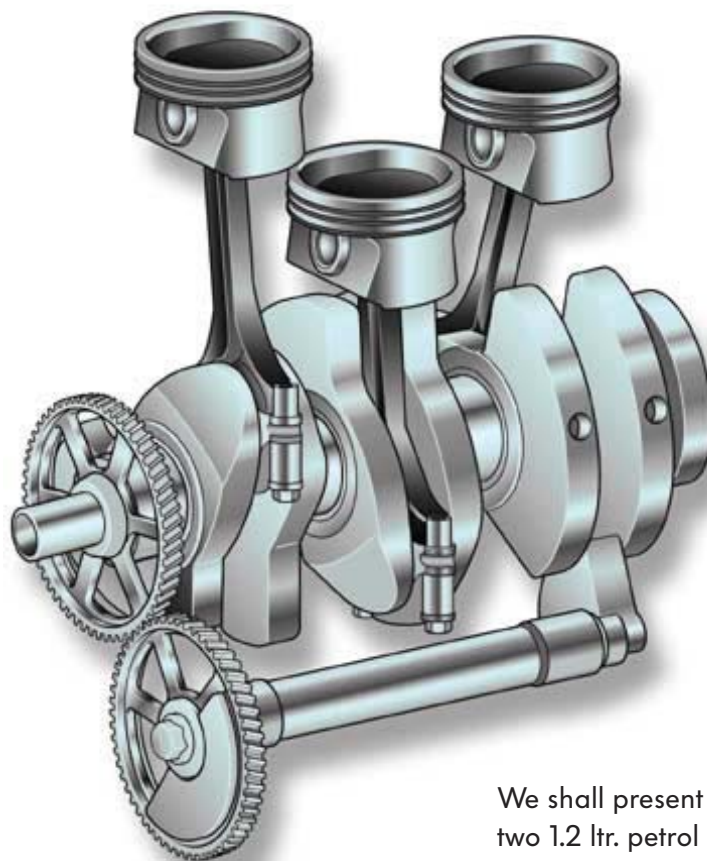


The two 1.2 ltr. engines mark the introduction of 3-cylinder petrol engines at Volkswagen. This pair of entry-level engines rounds off the range of engines of the 2002 Polo.

The one engine featuring 2 valves per cylinder has a power output of 40 kW while the second engine featuring 4 valves per cylinder produces 47 kW.

The following objectives were paramount in the development programme:

- good fuel economy
- compliance with emission standard EU4
- low level of servicing
- low weight
- same smooth running as a 4-cylinder engine



260_011

We shall present the design and function of the two 1.2 ltr. petrol engines to you on the pages which follow.

Because the base engine of both power plants is identical, with the exception of the cylinder head, the description for the most part presents the 1.2 ltr./47 kW engine.

NEW



**Important
Note**



The Self-Study Programme describes the design and function of new developments!
The contents are not updated.

Please always refer to the relevant service literature for up-to-date inspection, adjustment and repair instructions.



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Introduction



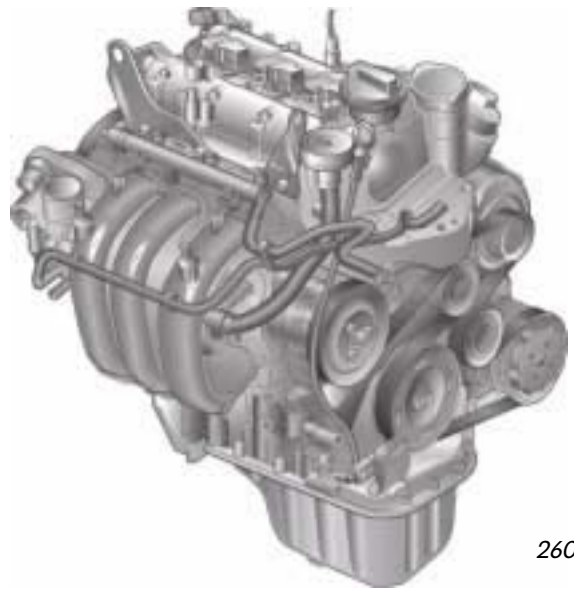
The 1.2 ltr. 3-cylinder petrol engines

The base engine of both power plants is identical, consisting of the cylinder block with the top and bottom parts, the crank assembly, the oil pump, the oil pan and the ancillaries.

The engines differ only in the cylinder heads, with either 2 or 4 valves per cylinder, and the resulting adaptations.



260_012



260_013

The 1.2 ltr./40 kW 3-cylinder petrol engine with 2-valve technology

Technical highlights - engine mechanics

- Camshaft driven by chain
- Split cylinder block
- Crank assembly with balancer shaft
- Cross-flow cooling in cylinder head
- Upright oil filter
- Crankcase ventilation

Technical highlights - engine management

- Single-spark ignition coils
- Emission control system with catalytic converter close to engine and two step-type lambda probes

The 1.2 ltr./47 kW 3-cylinder petrol engine with 4-valve technology

Technical highlights - engine mechanics

- Camshaft driven by chain
- Split cylinder block
- Crank assembly with balancer shaft
- Cross-flow cooling in cylinder head
- Upright oil filter
- Fuel system without return flow
- Crankcase ventilation

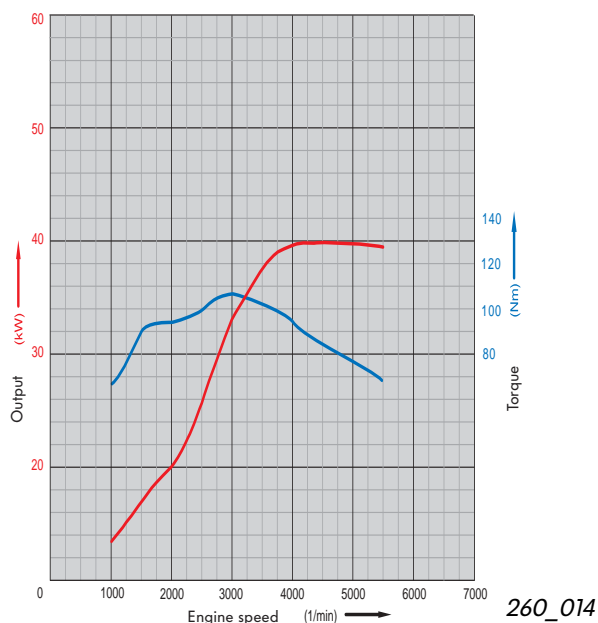
Technical highlights - engine management

- Single-spark ignition coils
- Electric exhaust gas recirculation valve
- Emission control system with catalytic converter close to engine, one broadband pre-cat lambda probe and one step-type post-cat lambda probe

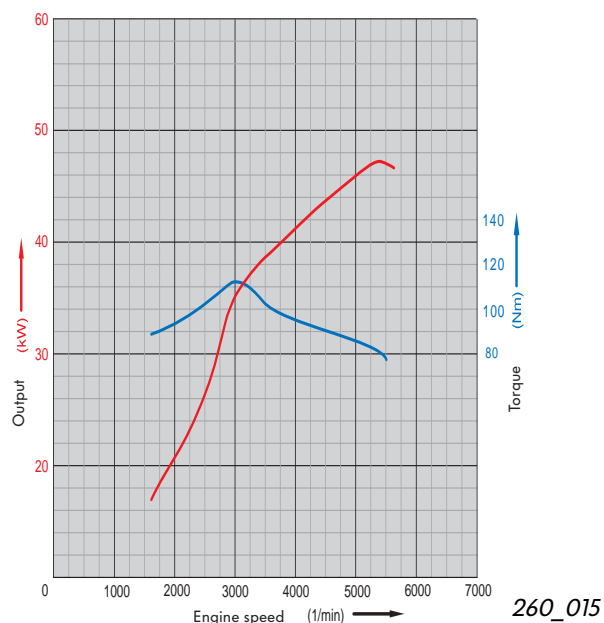
Technical data



**Power and torque curve
of the 1.2 ltr. 6V engine**



**Power and torque curve
of the 1.2 ltr. 12V engine**



| Engine code | AWY | AZQ |
|--------------------------|---|---|
| Displacement | 1198 | 1198 |
| Type | 3-cylinder in-line engine | 3-cylinder in-line engine |
| Valves per cylinder | 2 | 4 |
| Bore | 76.5 mm | 76.5 mm |
| Stroke | 86.9 mm | 86.9 mm |
| Compression ratio | 10.3 : 1 | 10.5 : 1 |
| Maximum power output | 40 kW at 4750 rpm | 47 kW at 5400 rpm |
| Maximum torque | 106 Nm at 3000 rpm | 112 Nm at 3000 rpm |
| Engine management system | Simos 3PD | Simos 3PE |
| Fuel | Unleaded premium with RON 95 (unleaded regular with RON 91 with slight reduction in output) | Unleaded premium with RON 95 (unleaded regular with RON 91 with slight reduction in output) |
| Emission control system | Three-way catalytic converter with lambda control | Three-way catalytic converter with lambda control |
| Emission standard | EU4 | EU4 |

Engine mechanics

Drive of camshafts and of oil pump

Both the camshafts as well as the oil pump are driven by a maintenance-free chain drive from the crankshaft.

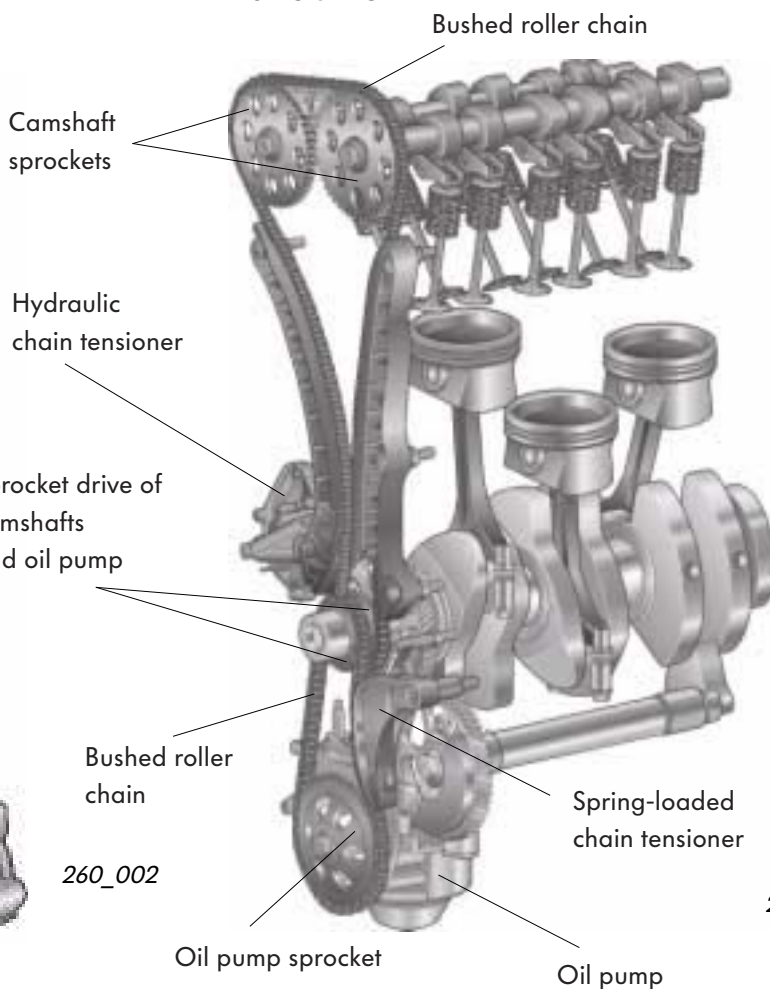
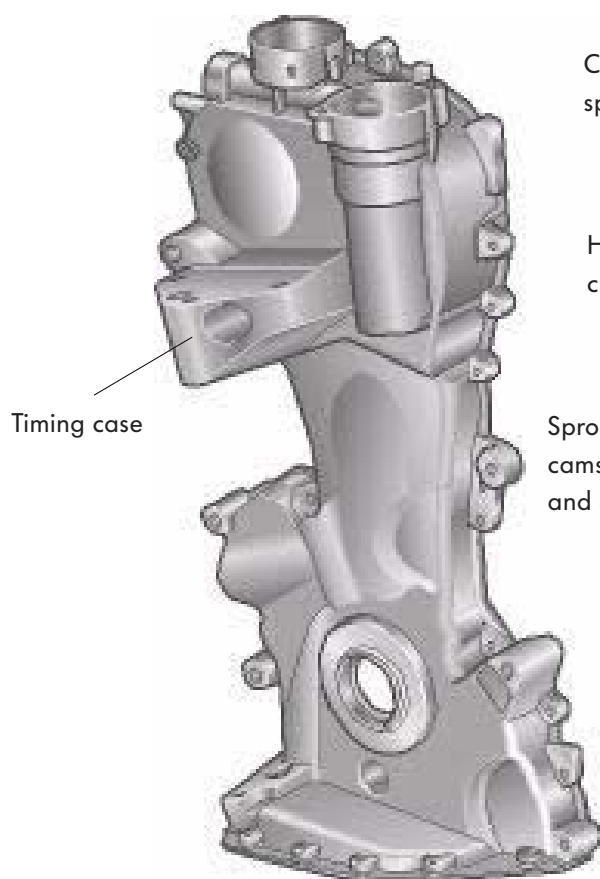
The chain drive for the camshafts is tensioned by a hydraulic chain tensioner, while that for the oil pump has a spring-loaded chain tensioner.

2-valve drive



260_008

4-valve drive



260_007

The timing case

is bolted to the cylinder head, the cylinder block and the oil pan. The chain drive is sealed to the outside by a liquid seal.



If the timing case is removed, it is also necessary to take off the oil pan and to re-seal it.
Refer to the Workshop Manual.

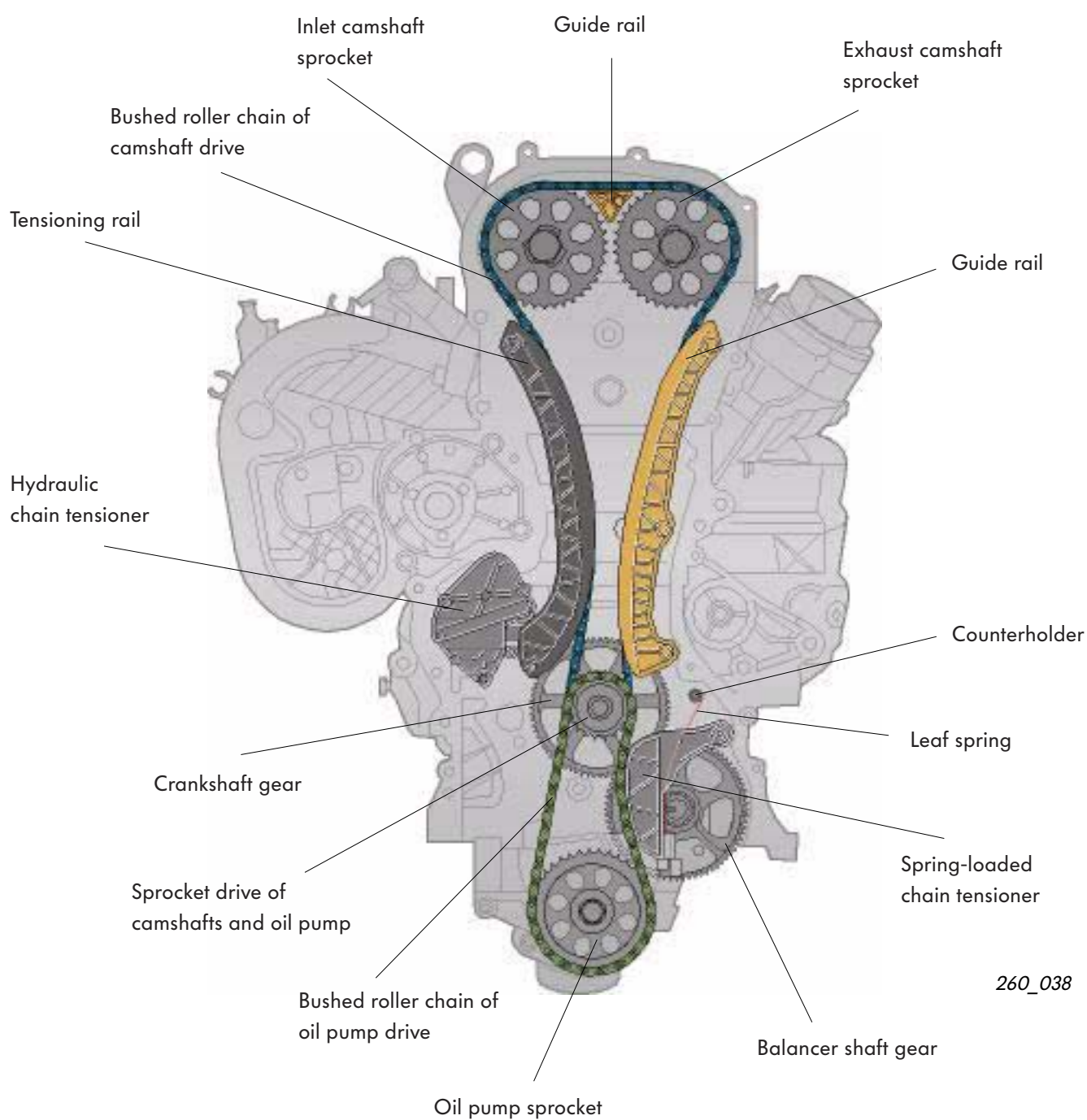
Overview

The illustration below provides you with an overview of the following drives:

- Chain drive of camshafts
- Chain drive of oil pump
- Gear drive of balancer shaft



New special tools are used for holding the camshafts in place and for locking the crankshaft. Please also refer to the appropriate Workshop Manual.



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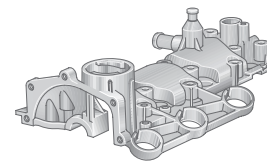
Engine mechanics

The cylinder head and the camshaft housing

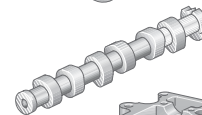
Both components are aluminium die castings.

On the engine with 2-valve technology

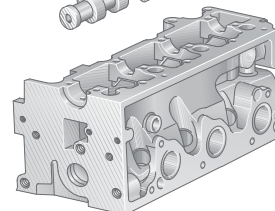
half of the camshaft is mounted in the cylinder head cover and the other half in the cylinder head.



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260_065

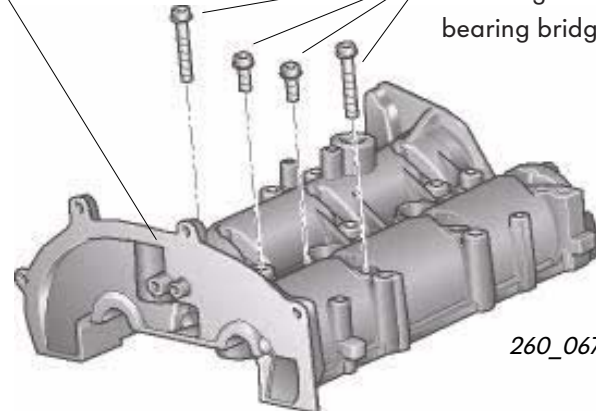
On the engine with 4-valve technology

the inlet camshaft and exhaust camshaft are mounted in the camshaft housing. The mounting features four bearing bridges which are bolted to the camshaft housing.

They are seated in the housing in such a way that they fit flush with the contact surface of the camshaft housing.

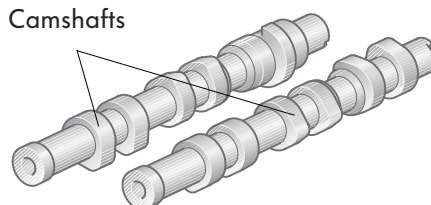
Camshaft housing

Bolts for
attaching
bearing bridge



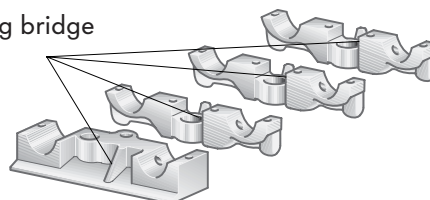
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Camshafts



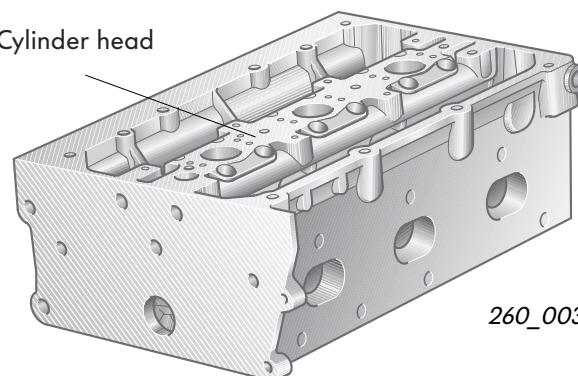
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Bearing bridge



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Cylinder head



260_003



The cooling of the cylinder head is based on the cross-flow cooling principle.

You can find further information regarding this in the section on the cooling system on page 13.

The valve gear

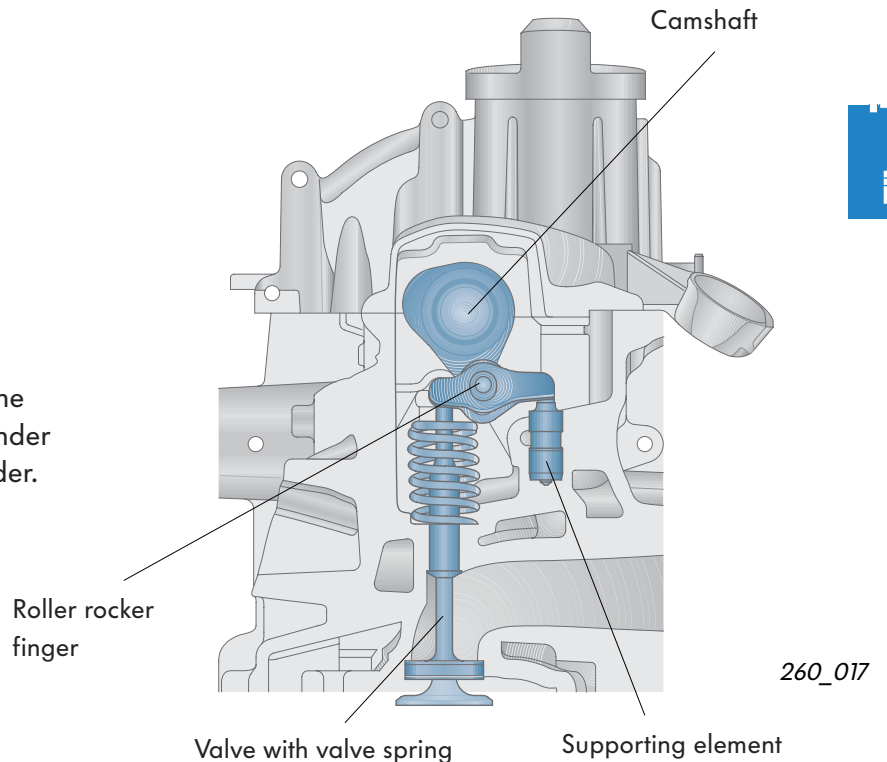
is installed in the cylinder head and in the camshaft housing.

The valve mechanism consists of

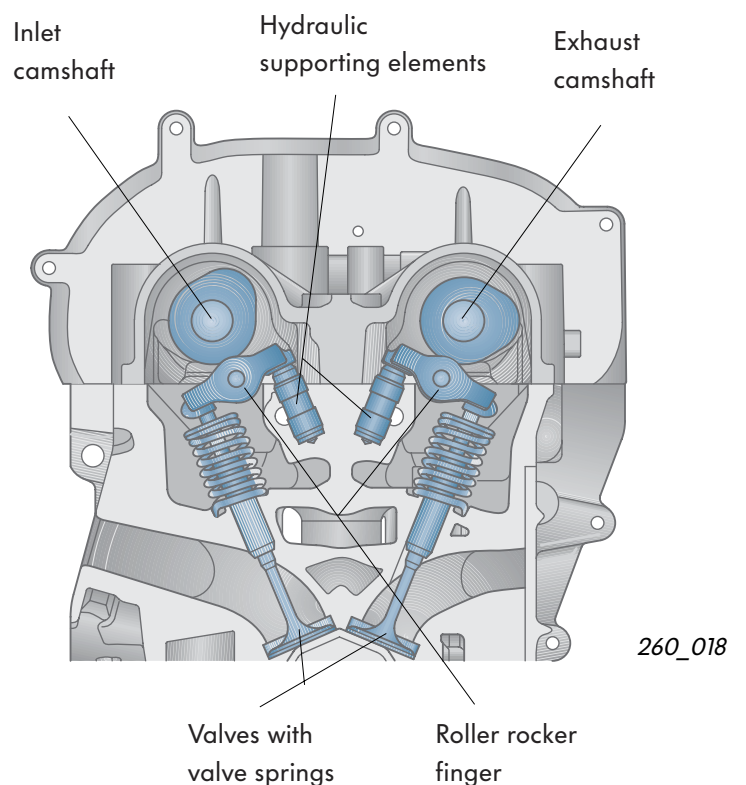
- the camshaft,
- the valve,
- the valve spring,
- the roller rocker finger and
- the supporting element.

The design of the valve gear is basically the same on the engine with 2 valves per cylinder and on the engine with 4 valves per cylinder.

2-valve technology



4-valve technology



You can find further information on the operation of the valve mechanism in the Self-Study Programme 196 „The 1.4 l 16V 55 kW engine“

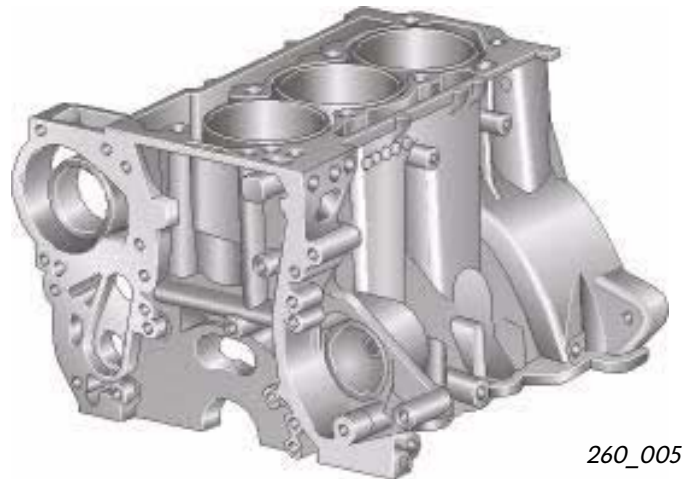
Engine mechanics

The cylinder block

It is an aluminium die casting and is split at the level of the middle of the crankshaft. It is sealed by means of a liquid seal.

Top part of cylinder block

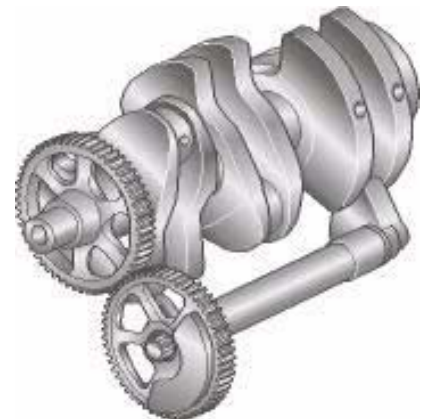
The grey cast iron cylinder liners are cast in the top part of the cylinder block.



260_005

Crankshaft and balancer shaft

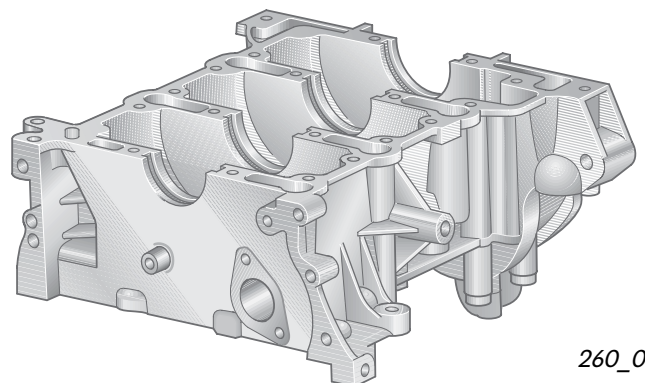
The crankshaft runs in 4 bearings and is mounted half in the top part of the cylinder block and half in the bottom part of the cylinder block. The balancer shaft is installed in the bottom part of the cylinder block and enhances the smooth running of the engine.



260_066

Bottom part of cylinder block

The bottom part of the cylinder block is designed as a stable bearing bridge. This improves the stiffness in the area of the crankshaft and also results in smoother engine running.



260_006



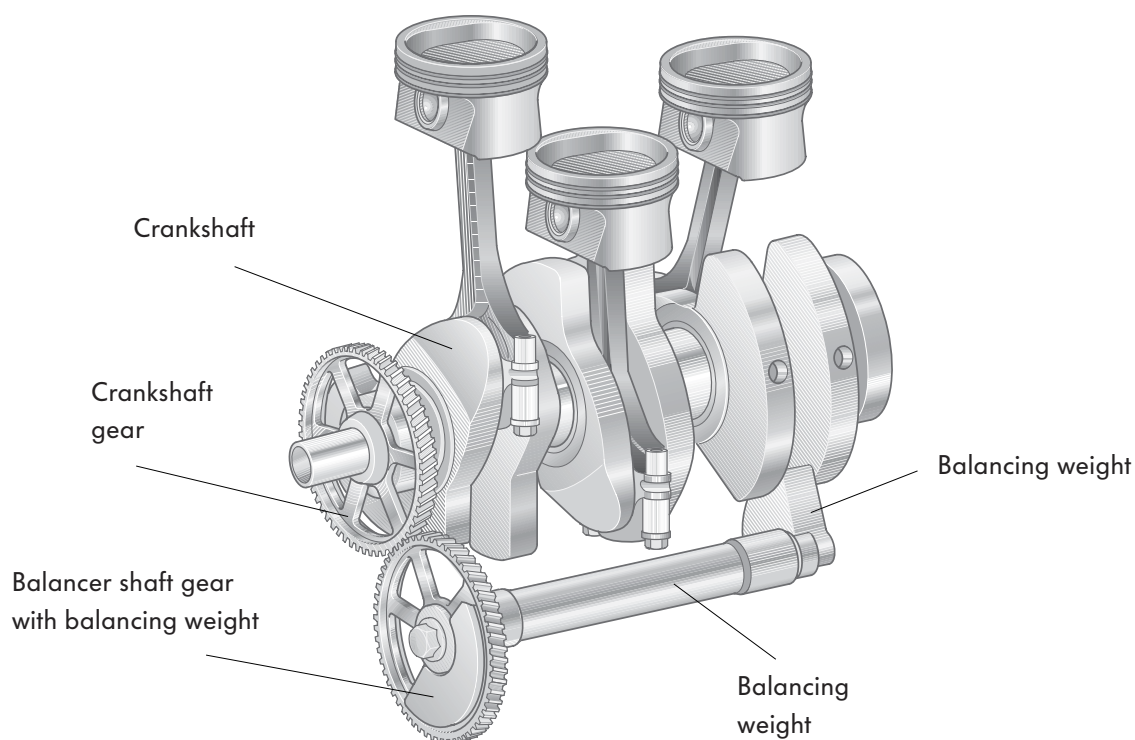
The top part of the cylinder block and the bottom part of the cylinder block must not be separated. If this is done, it will cause stress in the crankshaft bearings and will result in engine damage during operation.

The crank assembly with balancer shaft

The crank assembly features a balancer shaft. Its task is to reduce oscillations and thus to achieve smooth engine running.

The balancer shaft runs in the bottom part of the cylinder block and is driven through two gears by the crankshaft. The balancer shaft rotates in the opposite direction of the crankshaft at engine speed.

The up and down movements of the pistons and conrods produce forces which cause oscillations. These oscillations are transmitted through the assembly mounting to the body. The task of the balancer shaft is to counteract the forces produced by the pistons, conrods and crankshaft in order to minimize such oscillations.



260_031



Please note that you must not remove either the crankshaft or the balancer shaft.



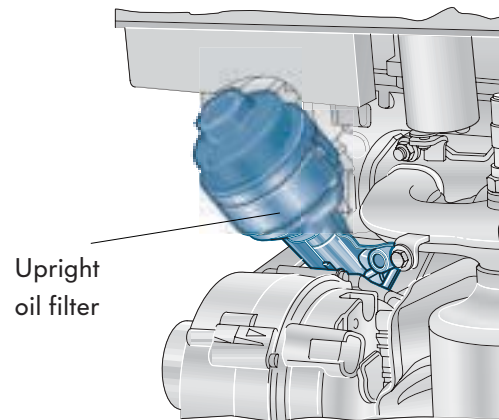
You can find further information regarding the operation of the balancer shaft in Self-Study Programme 223 „The 1.2 ltr. and 1.4 l TDI engine“.

The oil filter and the oil pump

The oil filter

is attached upright to the cylinder block at the exhaust side. It has a paper filter element which can be lifted up and out for replacing, and is therefore easy to service and environmentally friendly.

A further advantage of this arrangement is that it is possible to use a larger exhaust manifold catalytic converter. This is sufficient to comply with the emission standard EU4. At the same time, it eliminates the need for a second catalytic converter.

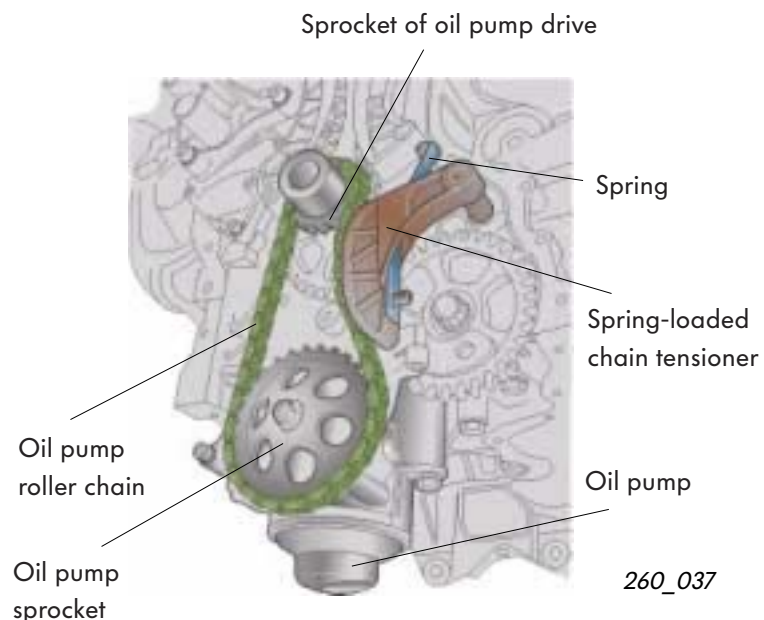


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The oil pump

is known as a duocentric oil pump. It is bolted to the bottom part of the cylinder block and is chain-driven by the crankshaft.

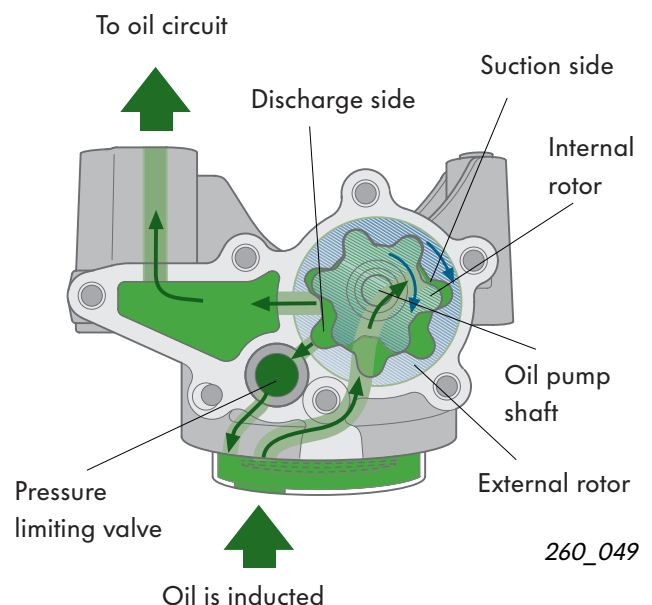
The chain is tensioned by means of a leaf spring at the chain tensioner.



260_037

The drawing opposite shows you the flow of oil in the oil pump.

The function of the oil pump is described in the Self-Study Programme 196 „The 1.4 l 16V 55 kW engine“.



260_049



The cooling system

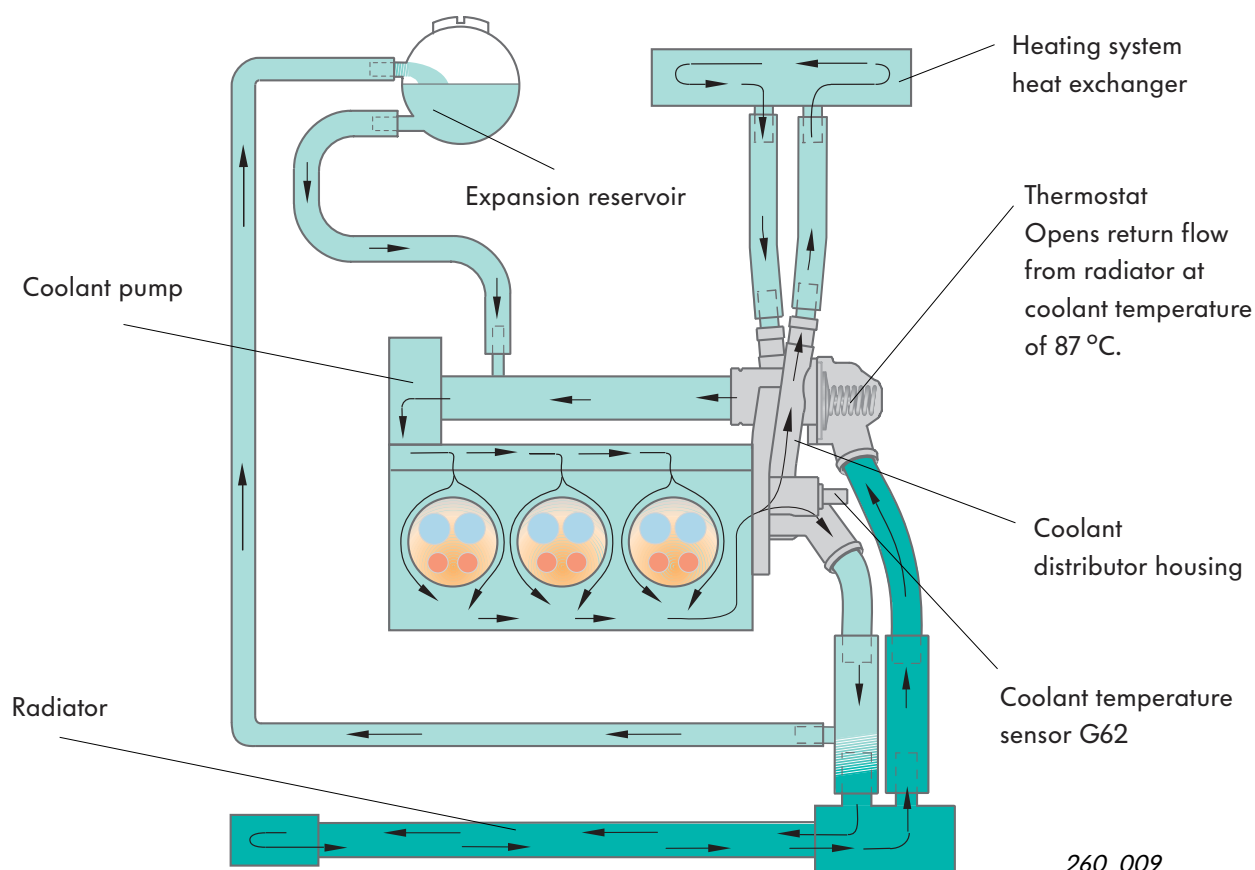
The special feature of the cooling system is the cross-flow cooling of the cylinder head and the flow of the coolant through the cylinder head.

This design offers the following advantages:

- In cross-flow cooling, the coolant flows from the inlet side to the exhaust side of each of the cylinders. This makes it possible to achieve a uniform temperature level at all three cylinders.
- The coolant galleries, arranged in parallel in the cylinder head, collectively result in a larger opening cross-section than is the case for a cylinder head with a back-to-front flow. This in turn reduces the flow resistance and thus also the power consumption of the coolant pump by as much as 30 %.
- The coolant in the cylinder head flows in a focused way at a high speed along the combustion chambers. As a result, they are more efficiently cooled which in turn reduces the knocking tendency.

Colour coding/Legend

-  Small cooling circuit (until operating temperature reached)
-  Large cooling circuit (additionally once operating temperature is reached)



260_009



The fuel system without return flow

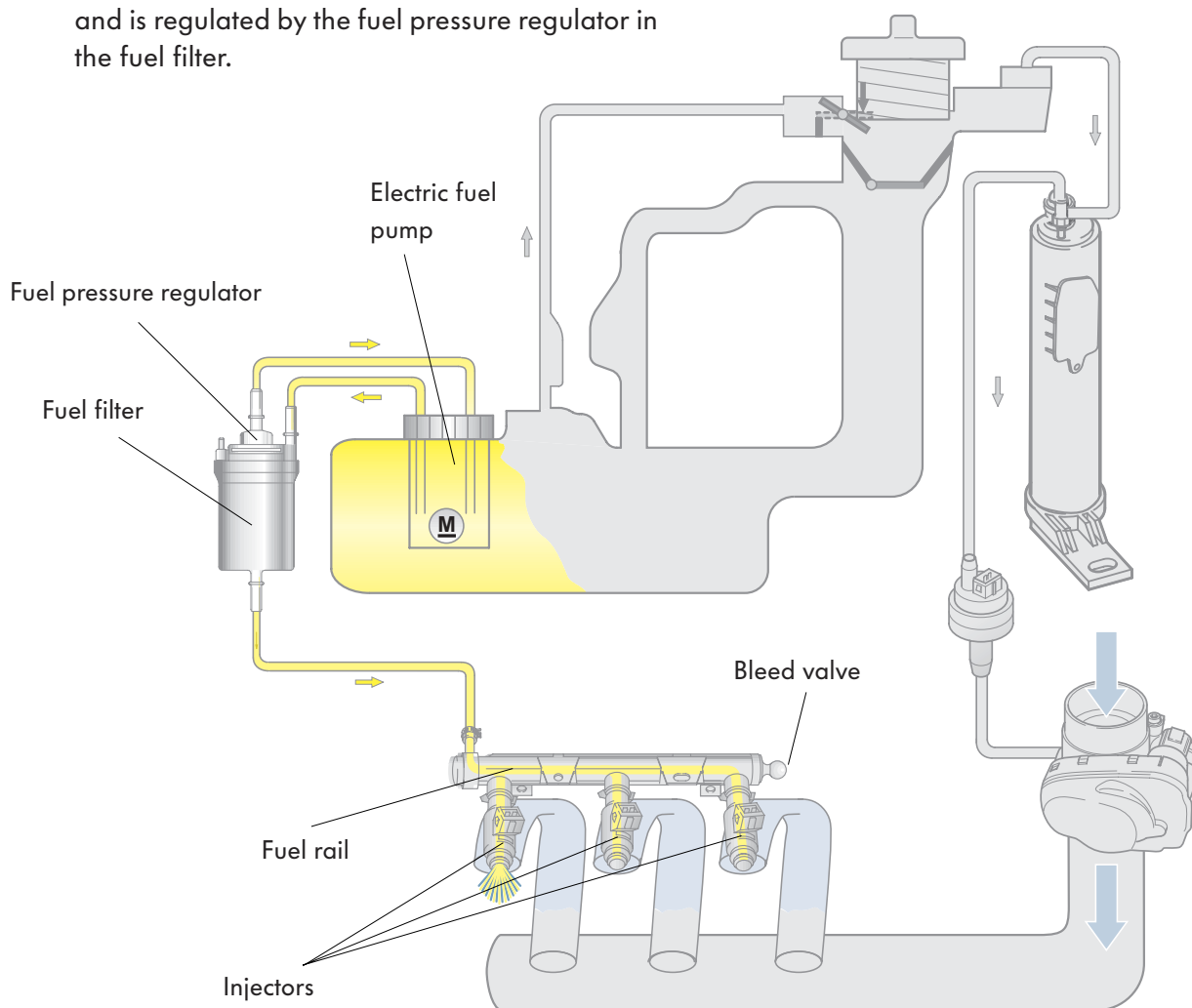
The fuel system without return flow is used on the 1.2 ltr. engines only on the 47 kW version. This fuel system makes it possible to eliminate the return-flow line from the fuel rail up to the fuel tank.

The fuel is pumped by the electric fuel pump to the fuel filter. From this point, it flows to the fuel rail and to the injectors.

The fuel pressure in the system is a constant 3 bar and is regulated by the fuel pressure regulator in the fuel filter.



Because the fuel pressure in the system is a constant 3 bar, but the intake manifold pressure varies, the engine control unit adapts the injection time to the intake manifold pressure. The signal which is required for this is supplied by the intake manifold pressure sensor.



260_010

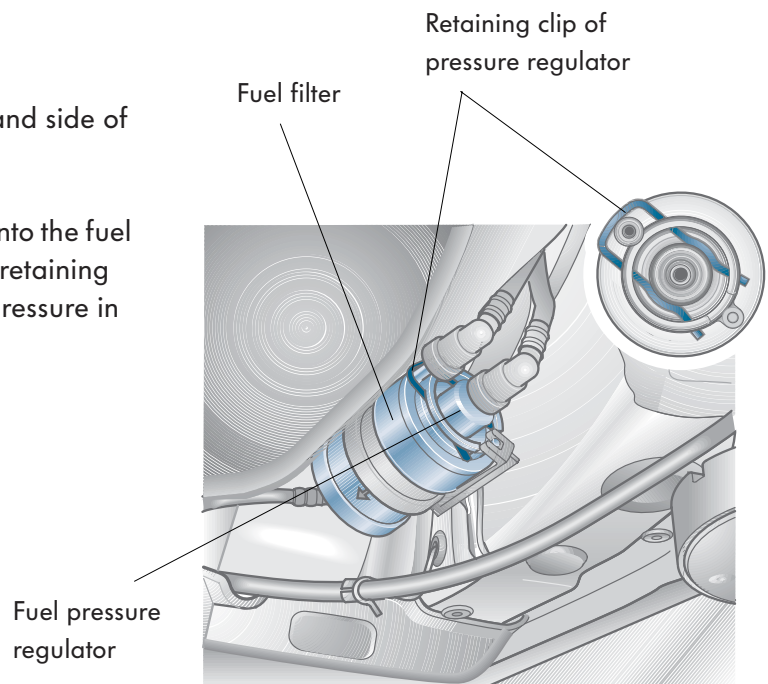


In the return flow-free fuel system there is a bleed valve to the fuel rail. You have to bleed the system after completing any work. Please also refer to the Workshop Manual.

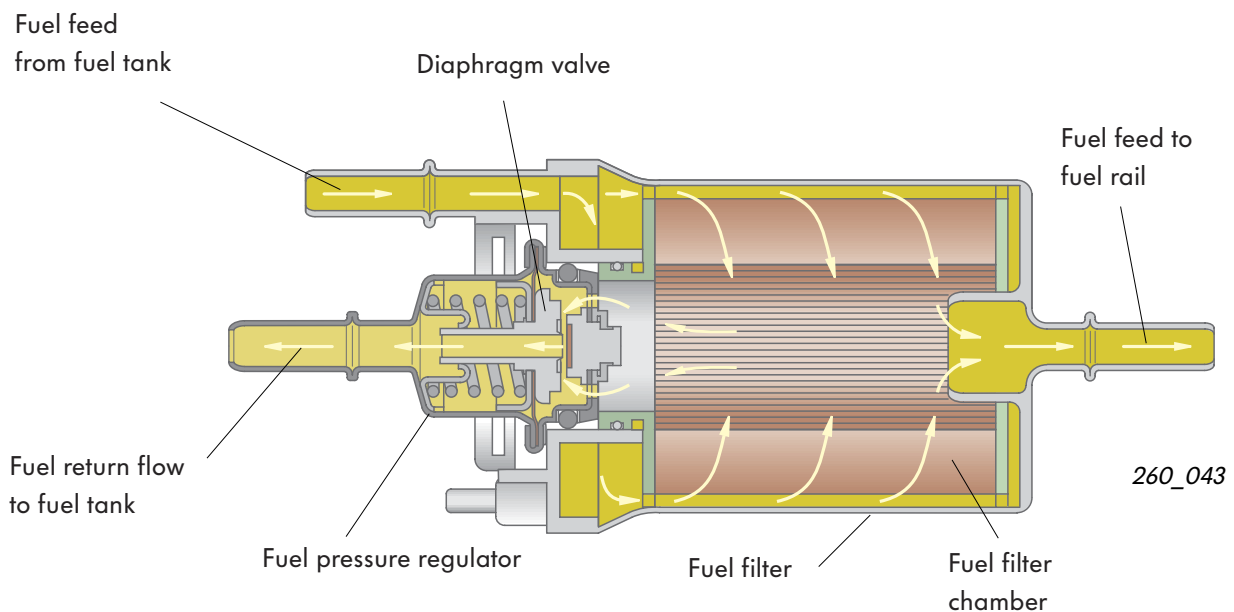
The fuel filter with fuel pressure regulator

The fuel filter is located on the right-hand side of the fuel tank.

The fuel pressure regulator is inserted into the fuel filter and held in place by means of a retaining clip. The regulator maintains the fuel pressure in the fuel system at a constant 3 bar.



260_036



260_043

Function of the fuel pressure regulator:

The electric fuel pump pumps the fuel into the filter chamber of the fuel filter. The fuel is cleaned at this point and flows to the fuel rail and to the injectors.

The fuel pressure of 3 bar is maintained by a spring-loaded diaphragm valve in the fuel pressure regulator. If the pressure rises beyond 3 bar, the diaphragm valve opens the return flow to the fuel tank.

Engine mechanics

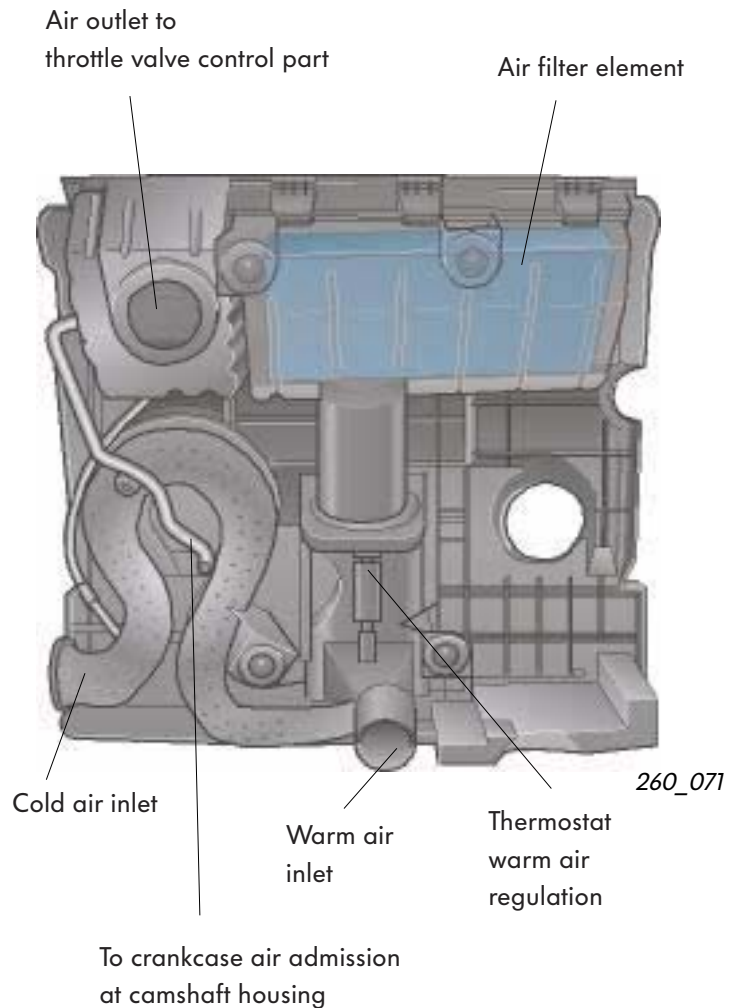
The engine cover with air filter

Engine cover with integrated air filter

The following components are integrated in the engine cover

- the air filter,
- the air guide up to the throttle valve control unit,
- the warm air regulator and
- the insulation of the intake noises.

The result is a compact and low-cost component.



Regulating the warm air

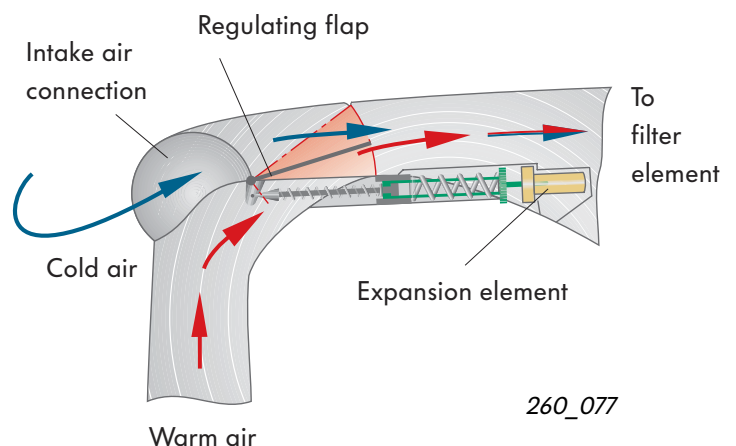
The engine cover contains an expansion element which operates a regulating flap in line with the temperature.

At low temperatures the cross-section to the warm air is increased while it is reduced to the cold air. At high temperatures, this situation is exactly reversed.

This makes it possible to achieve a uniform intake air temperature during engine operation.

It in turn also has a positive effect on engine power output, fuel consumption and emission levels.

Regulating flap in intake air connection



Crankcase ventilation

The crankcase ventilation is a feature of both engines.

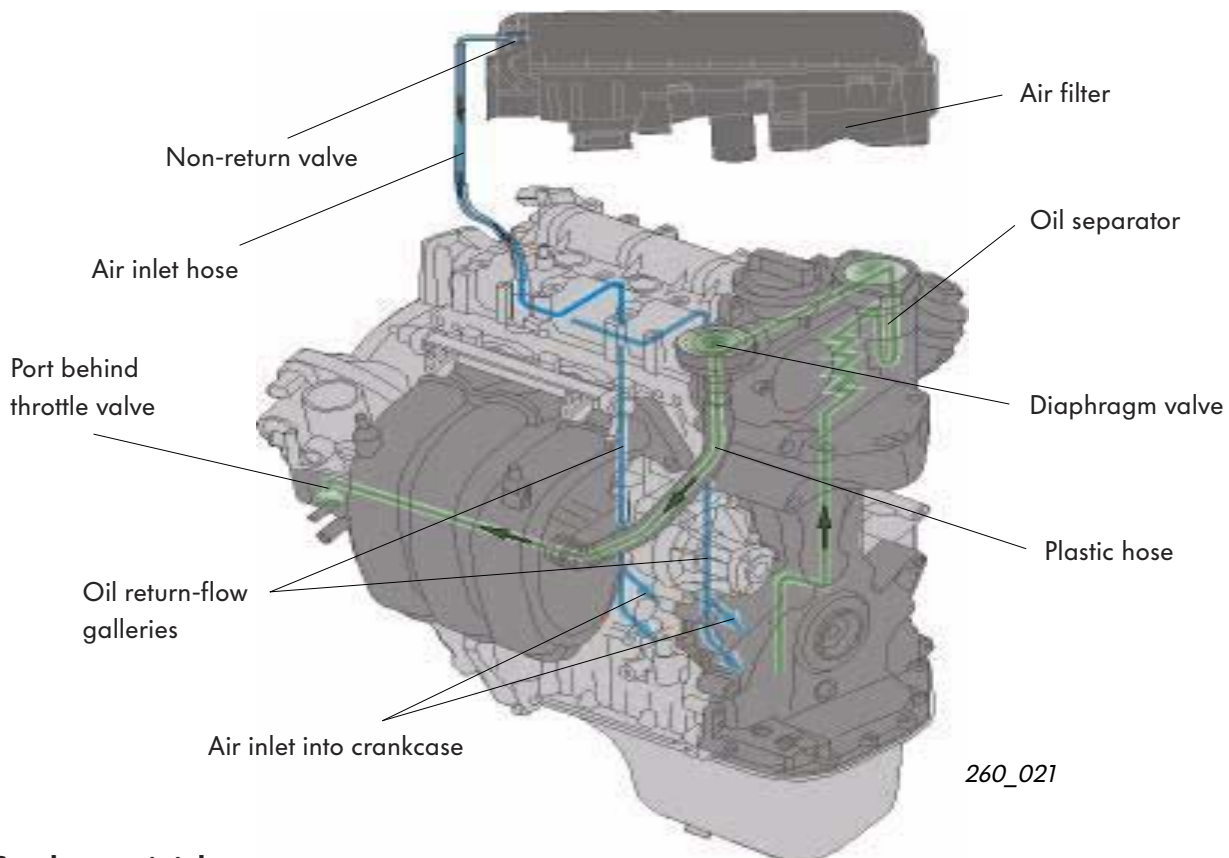
It reduces the formation of water in the oil and prevents oil vapours and uncombusted hydrocarbons escaping to the atmosphere.



The non-return valve prevents oil from being forced out of the camshaft housing into the air filter.

The system consists of:

- an oil separator in the timing case,
- a diaphragm valve at the timing case,
- a plastic hose from the diaphragm valve to intake manifold and
- an air inlet hose with non-return valve from the air filter to the camshaft housing



Crankcase air inlet

Air is admitted to the crankcase through a hose from the air filter.

The fresh air inducted by the vacuum in the intake manifold flows through the oil return-flow galleries into the crankcase.

At this point, it is mixed with the combustion gases before these condense to water on the cold walls of the cylinder block.

Together they then flow through the crankcase air outlet to combustion. The result of this is a reduction in the formation of water in the oil and enhanced security against icing up.