Service.

Self-Study Programme 303

The V10-TDI engine

with pump-jet fuel injection system

Design and function

303_U2

With the V10-TDI engine, Volkswagen once again sets new standards in diesel technology.
Due to a multitude of innovative techniques, the highest demands in terms of performance, torque and emissions made of a diesel motor are fulfilled for the luxury vehicle class.

The V10-TDI engine crowns 25 years of diesel engine development at Volkswagen.
It is the most powerful series passenger-vehicle diesel engine in the world.

NEW

Caution
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.

At a glance

The V10-TDI engine

The V10-TDI engine is a newly developed diesel engine in which innovative light-weight construction and enormous power are united within compact dimensions.

It has a cylinder block made of aluminium, where the two rows of cylinders are arranged at an angle of 90° to one another.
The control and ancillary unit is driven by gearwheels The tried-and-tested pump-jet fuel injection system ensures a high performance yield at low exhaust emissions.

The V10-TDI engine is used as a high-performance engine in the Volkswagen Touareg and Phaeton.

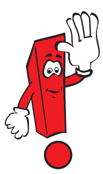
303_001

Engine mechanics technical features

– Cylinder block made of aluminium with an end bracket made of cast-iron
– Joining of cylinder head and cylinder block via tie-rod screw connection
– Contol and ancillary unit driven by gearwheels
– Balancer shaft for reducing vibrations

Engine management technical features

– Two motor controllers
– Charged by two adjustable turbochargers
– Exhaust gas recirculation effected with pneumatically controlled exhaust gas recirculation valves with electrically-operated intake manifold flaps
– Lambda probes for controlling exhaust gas recirculation

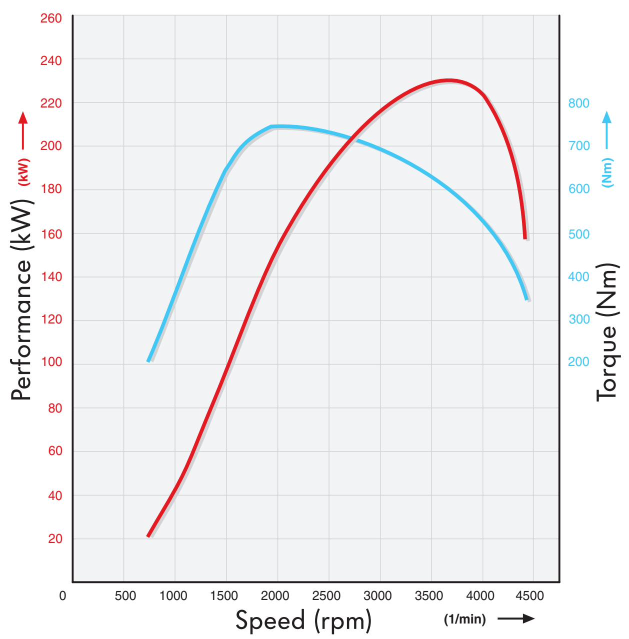


A detailed description of the engine management system for the V10-TDI engine can be found in Self-Study Programme No. 304 ”Electronic Diesel Control EDC 16”.

Technical data

Engine code	AYH (in the Touareg)	AJS (in the Phaeton)
Construction	V engine, 90° V-angle	
Displacement	4921 cm^3	
Bore	81 mm	
Stroke	95.5 mm	
Valves per cylinder	2	
Compression ratio	18 : 1	
Max. output	230 kW at 4000 rpm	
Max. torque	750 Nm at 2000 rpm	
Engine management	Bosch EDC 16	
Fuel	Diesel at least 49 CZ or biodiesel	
Exhaust treatment	Exhaust gas recirculation and oxidation catalytic converter	
Ignition sequence	1 - 6 - 5 - 10 - 2 - 7 - 3 - 8 - 4 - 9	
Exhaust emission standard	EU 3	

Power/torque diagram



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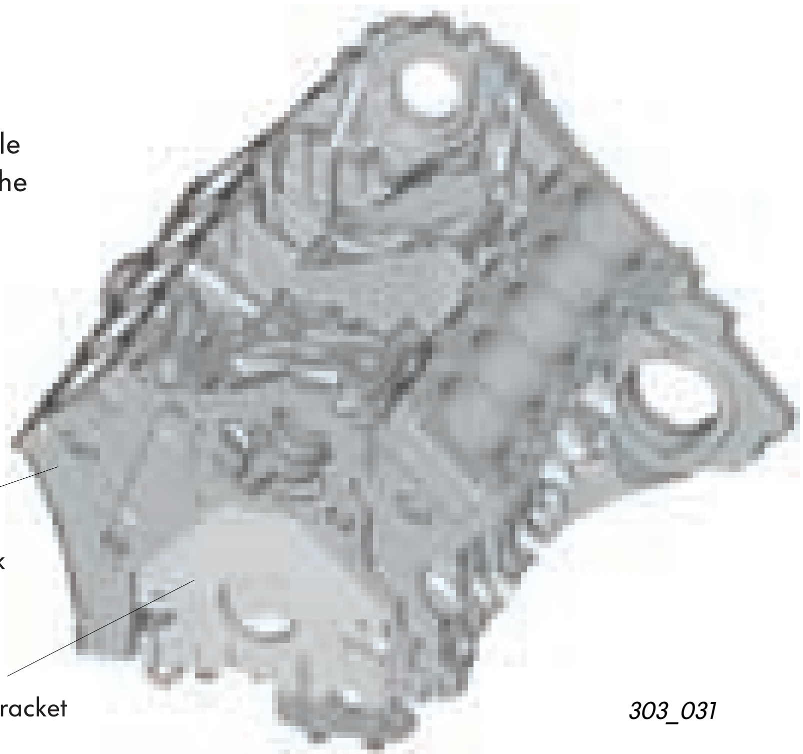
The V10-TDI engine develops a maximum torque of 750 Nm at a speed as low as 2000 rpm.

The nominal output of 230 kW is achieved at 4000 rpm.

Engine mechanics

Cylinder block

The cylinder block consists of the top portion of the cylinder block and the end bracket.
The top portion of the cylinder block is manufactured from an aluminium alloy; this is a significant factor in weight reduction.
The cylinder rows are positioned at a 90° angle to one other, permitting a compact design for the engine as a whole.



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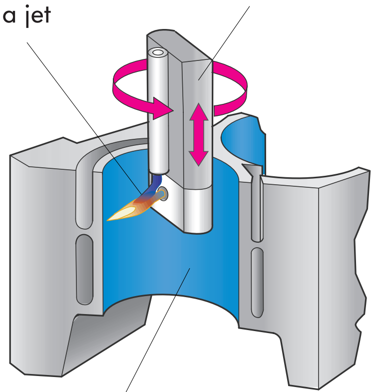
Cylinder walls with plasma-sprayed running film

For the first time for diesel engines, a plasma-sprayed running film is applied to the cylinder walls. As a result, the use of cylinder liners in the aluminium cylinder block is no longer necessary.
This reduces the weight of the engine and permits compact dimensions due to a short distance between the cylinder bores.



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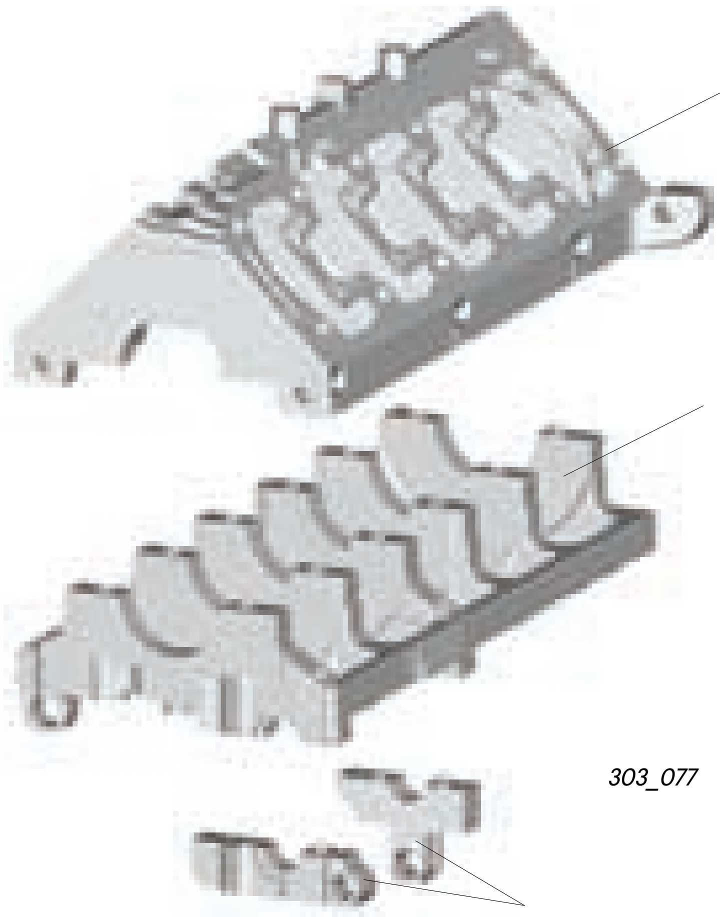
Detailled information regarding the plasma coating principle can be found in Self-Study Programme No. 252 ”The 1.4l/77 kW Engine with Direct Fuel Injection in the Lupo FSI”.

End bracket

The two-part end bracket is manufactured from high-tensile cast-iron.

The upper and lower portions of the end bracket are attached by a press fit; in addition, they are screwed together. This provides the crankshaft bearing with the required sturdiness, so that the high combustion forces can be safely absorbed in the end bracket area.



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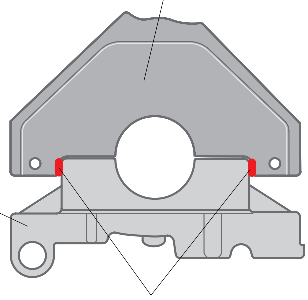

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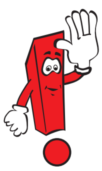
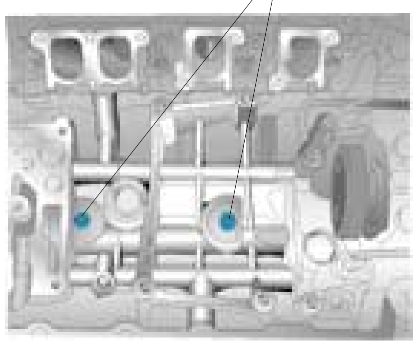


The bolted connection of the cylinder block with the upper portion of the end bracket must not be loosened; otherwise, the cylinder block could deform. Please observe the instructions in the repair guidelines.



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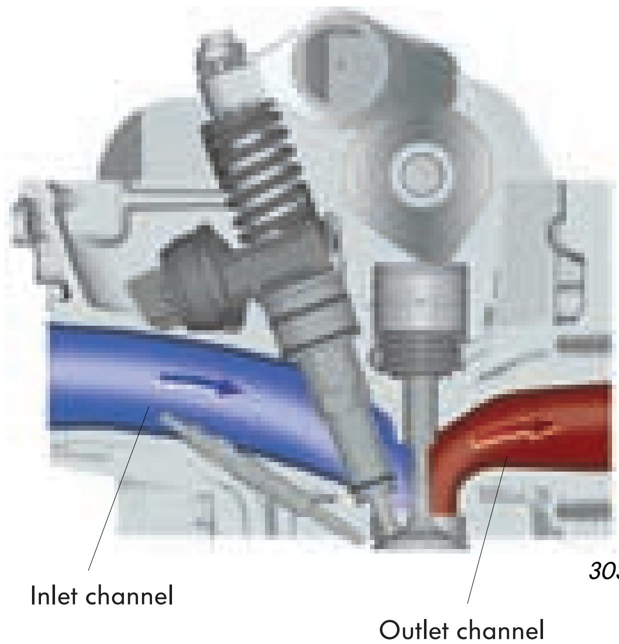
Cylinder head

The V10-TDI engine has two aluminium-alloy cylinder heads. The inlet and outlet channels are arranged according to the crossflow principle. The inlet and outlet channels are located on the side opposite of the cylinder head. This arrangement provides good gas exchange and thus good cylinder filling. The inlet channels are located in the V space of the engine, while the outlet channels are on the engine exterior.



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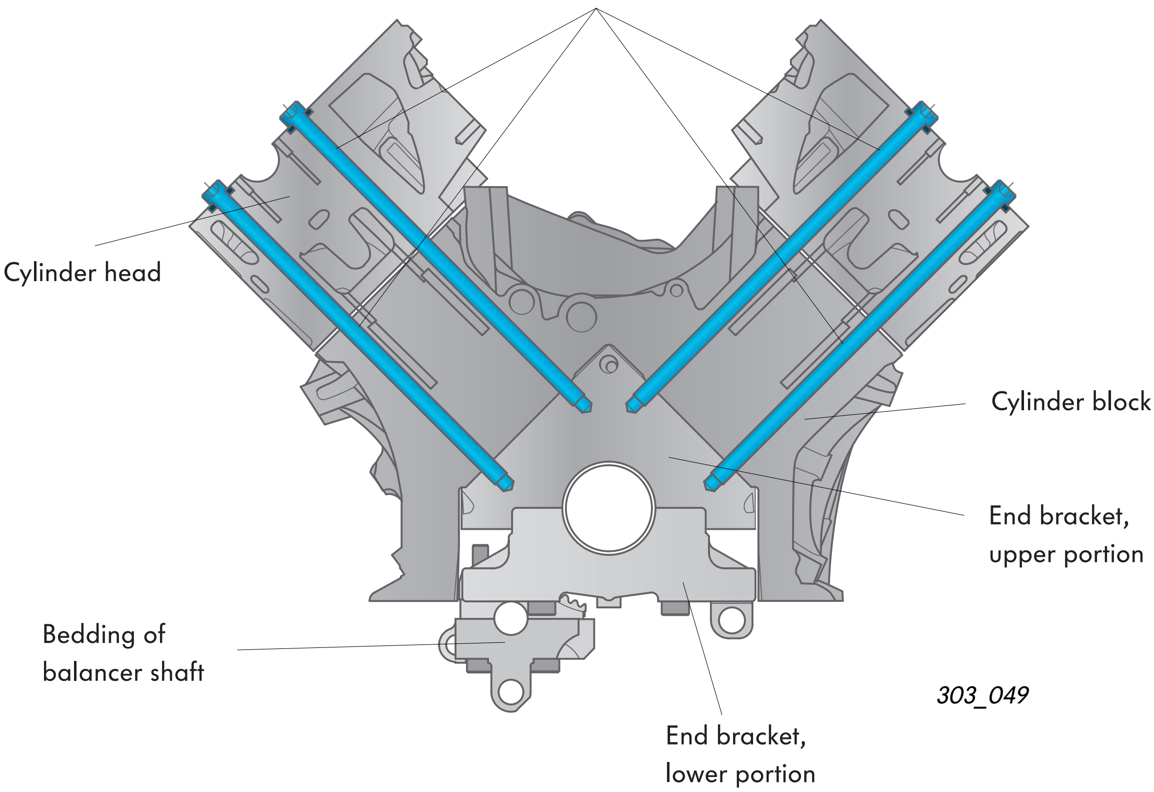
Tie rod principle

In order to prevent tension in the cylinder block, the cylinder heads, the cylinder block and the end bracket are screwed to each other using tie rods.



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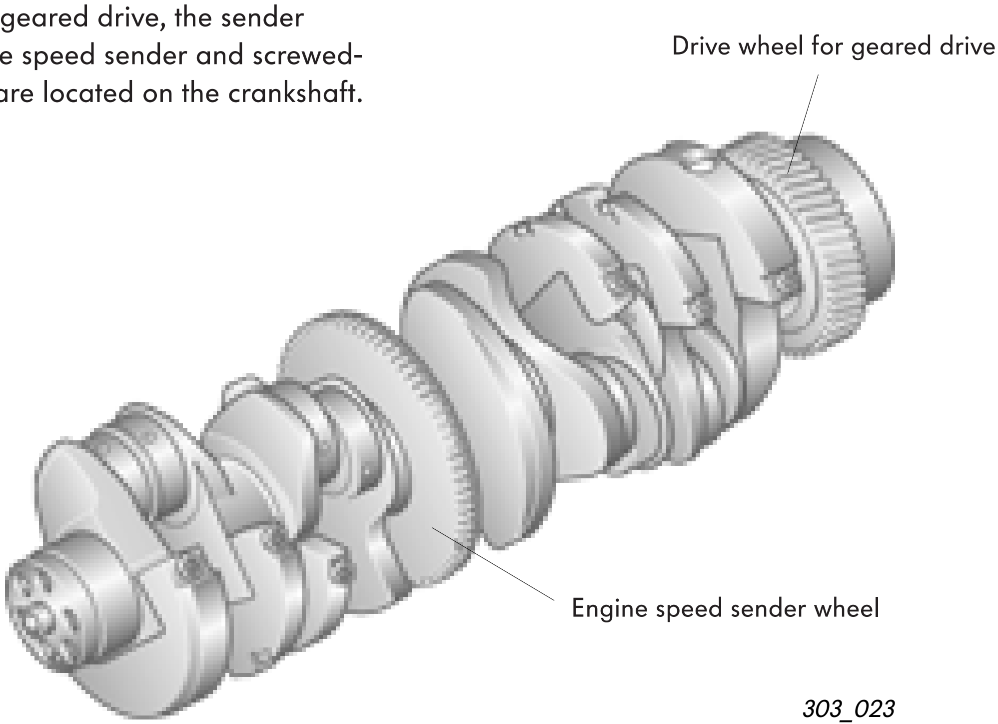
Crankshaft

The crankshaft of the V10-TDI engine is made of tempering steel. It is forged from one part. The drive wheel for the geared drive, the sender wheel for the engine speed sender and screwed-on counterweights are located on the crankshaft.



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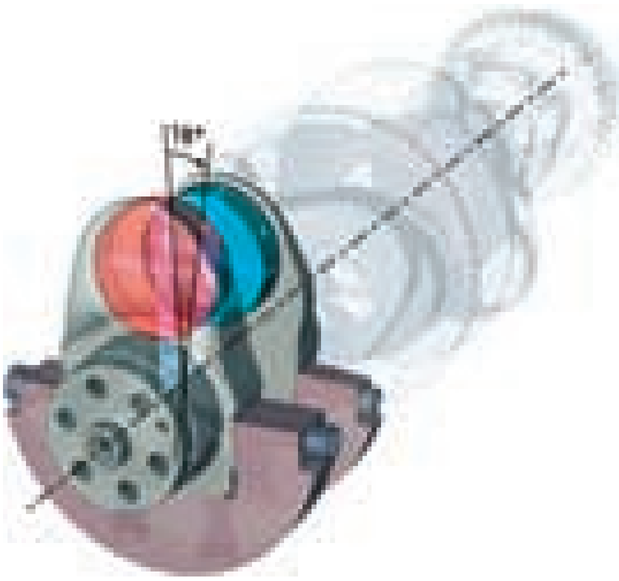
Split pin displacement

All the cylinders of a 4-stroke engine ignite within a crankshaft angle of 720°.
In order to attain uniform ignition, the ignition angle for a 10-cylinder engine must be 72°.

$$\frac{\textbf{720° crankshaft angle}}{\textbf{10 cylinders}} = \textbf{72° ignition angle}$$

A 10-cylinder V-engine must therefore have a V-angle of 72°.
Since the V10-TDI engine has a V-angle of 90°, the split pin must be displaced by 18° in order to attain uniform ignition.



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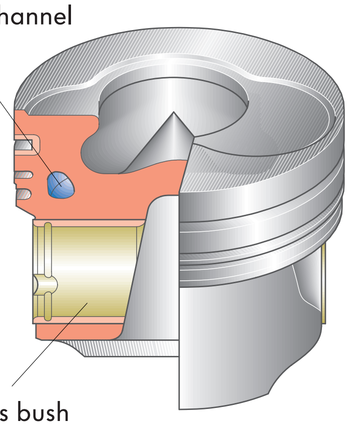
90° V-angle - 72° ignition angle = 18° split pin displacement

Piston and connecting rods

In order keep the demands on the piston and connecting rods low at the high combustion pressures, the piston pin bosses and the connecting rod boss have a trapezoidal shape. This distributes the combustion forces over a broader area. The piston pin bosses are also strengthened by brass bushes.

A cooling channel is infused into the piston to cool the piston ring zone. Oil is injected into this cooling channel from the oil-spraying jets as soon as the piston is located in the bottom dead centre.



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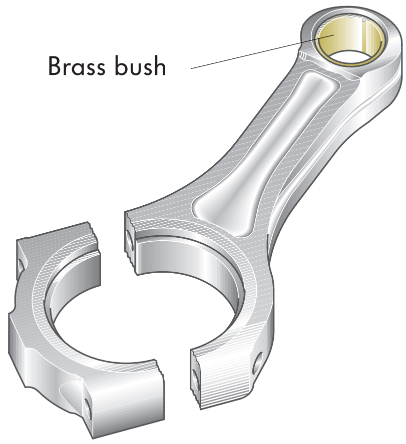
Connecting rod

The connecting rod and the connecting rod lid are separated diagonally; they are separated by the crack procedure.



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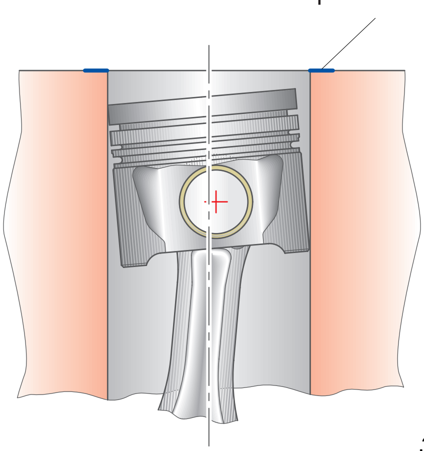
Displacement of the piston pin axis

The piston pin axis is decentrally arranged in order to prevent noise from the tilting of the piston in the top dead centre.

Each time that the connecting rod is in a sloping position, lateral piston forces occur which alternatingly press the piston against the cylinder walls.
The lateral piston force changes direction in the top dead centre. The piston is tilted to the opposite cylinder wall there, thus resulting in noise.
To prevent this, the piston pin axis is decentrally arranged.
Due to the decentral arrangement of the piston pin axis, the piston changes sides before it reaches the top dead centre and then supports itself on the opposite cylinder wall.



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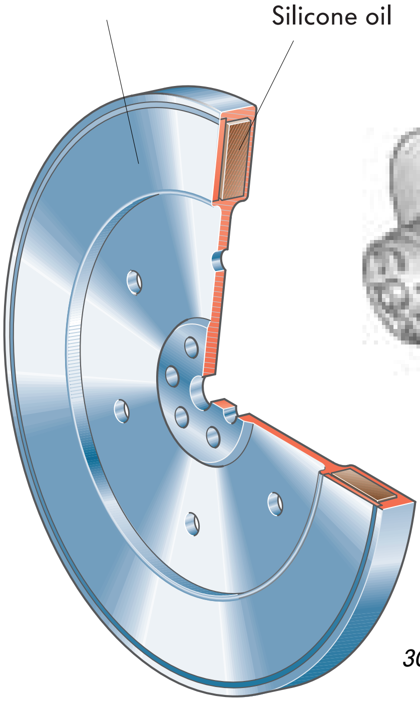
Mass balancing

In order to attain low-vibration running of the engine, the moments of inertia must be balanced.

For this, 6 counterweights are attached to the chrankshaft. In addition, a counter-rotating balancing shaft and a weight located in the drive wheel of the balancing shaft eliminate the moments of inertia. The balancing shaft is driven by the chrankshaft; at the same time, it serves as a driveshaft for the oil pump.

The counterweights are made of a tungsten alloy. As tungsten has a high density, the weights can have small sizes, which saves space.



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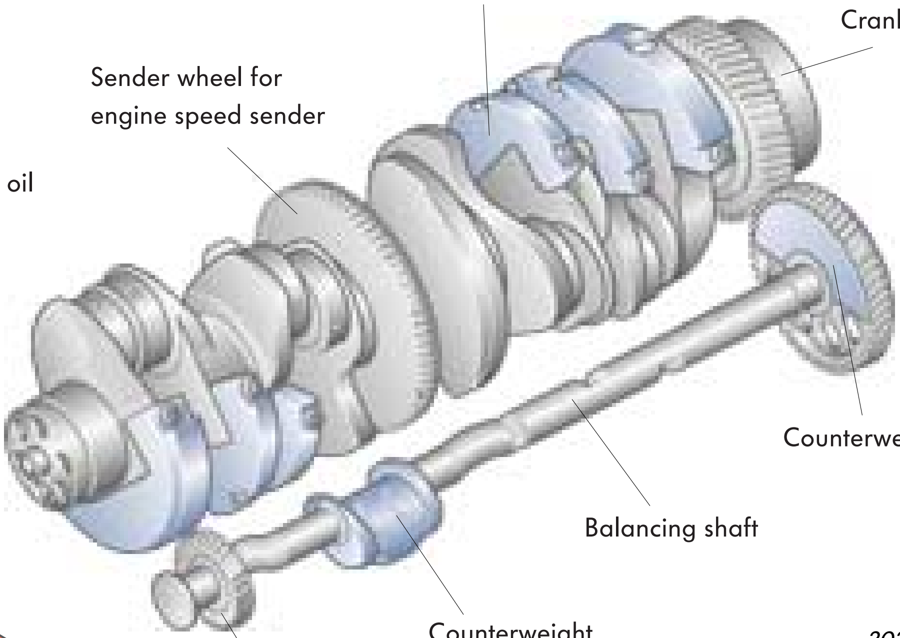

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Vibration damper

The vibration damper reduces the rotational vibrations of the crankshaft. It is filled with a silicone oil.

The rotational vibrations of the crankshaft that occur are eliminated by the shear forces of the silicone oil.

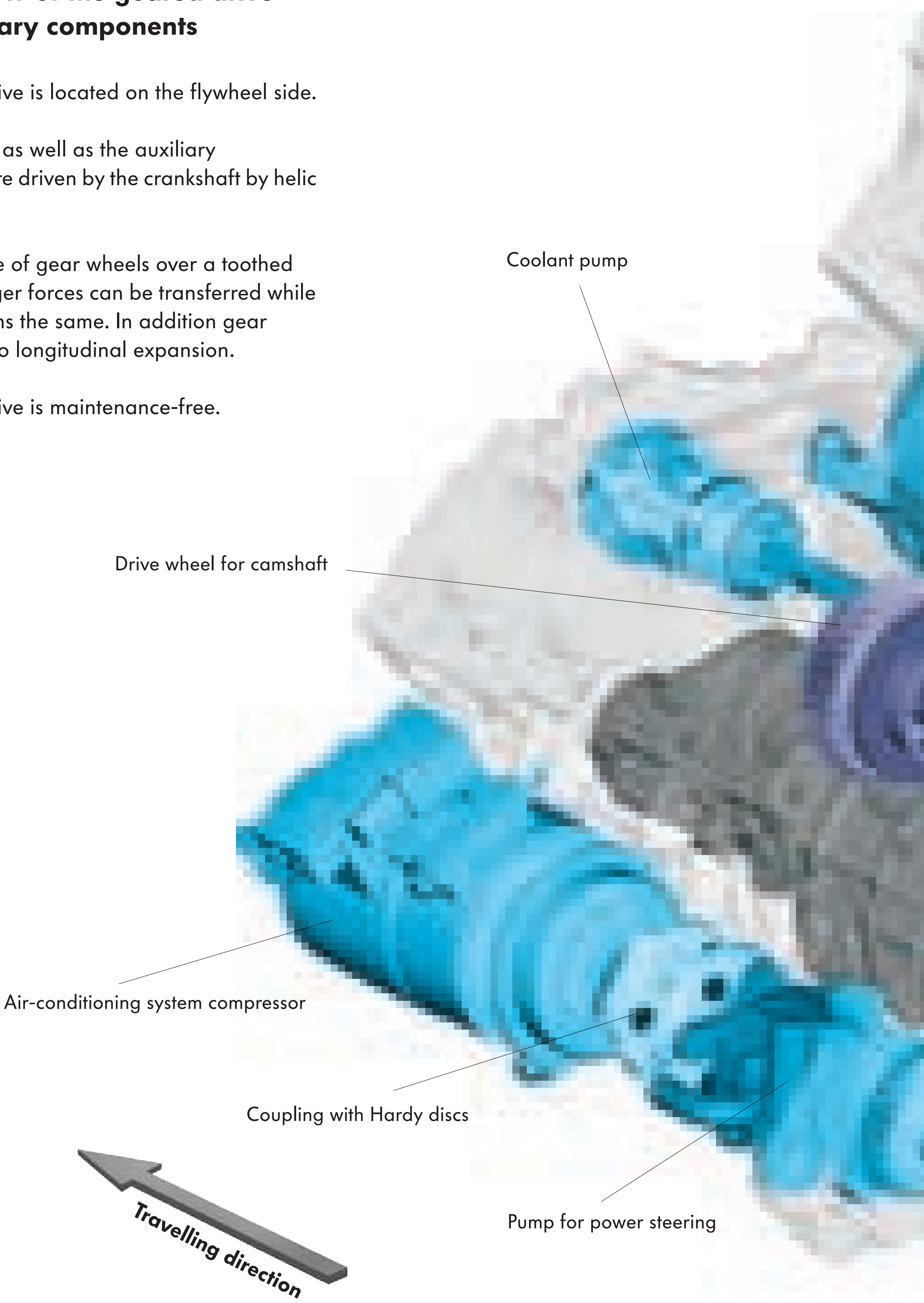
Overall view of the geared drive with auxiliary components

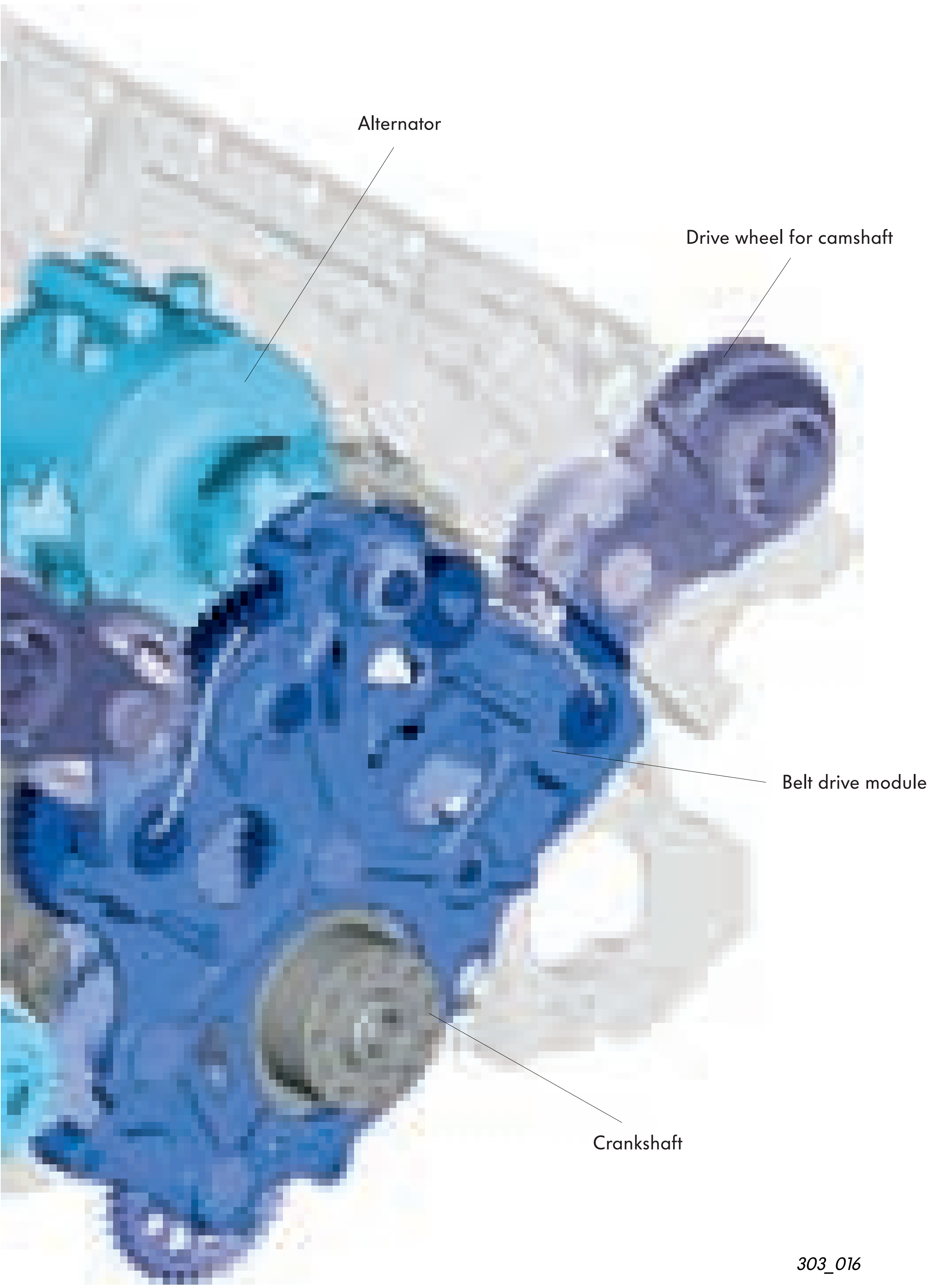
The geared drive is located on the flywheel side.

The camshafts as well as the auxiliary components are driven by the crankshaft by helic gear wheels.

The advantage of gear wheels over a toothed belt is that larger forces can be transferred while the size remains the same. In addition gear wheels have no longitudinal expansion.

The geared drive is maintenance-free.

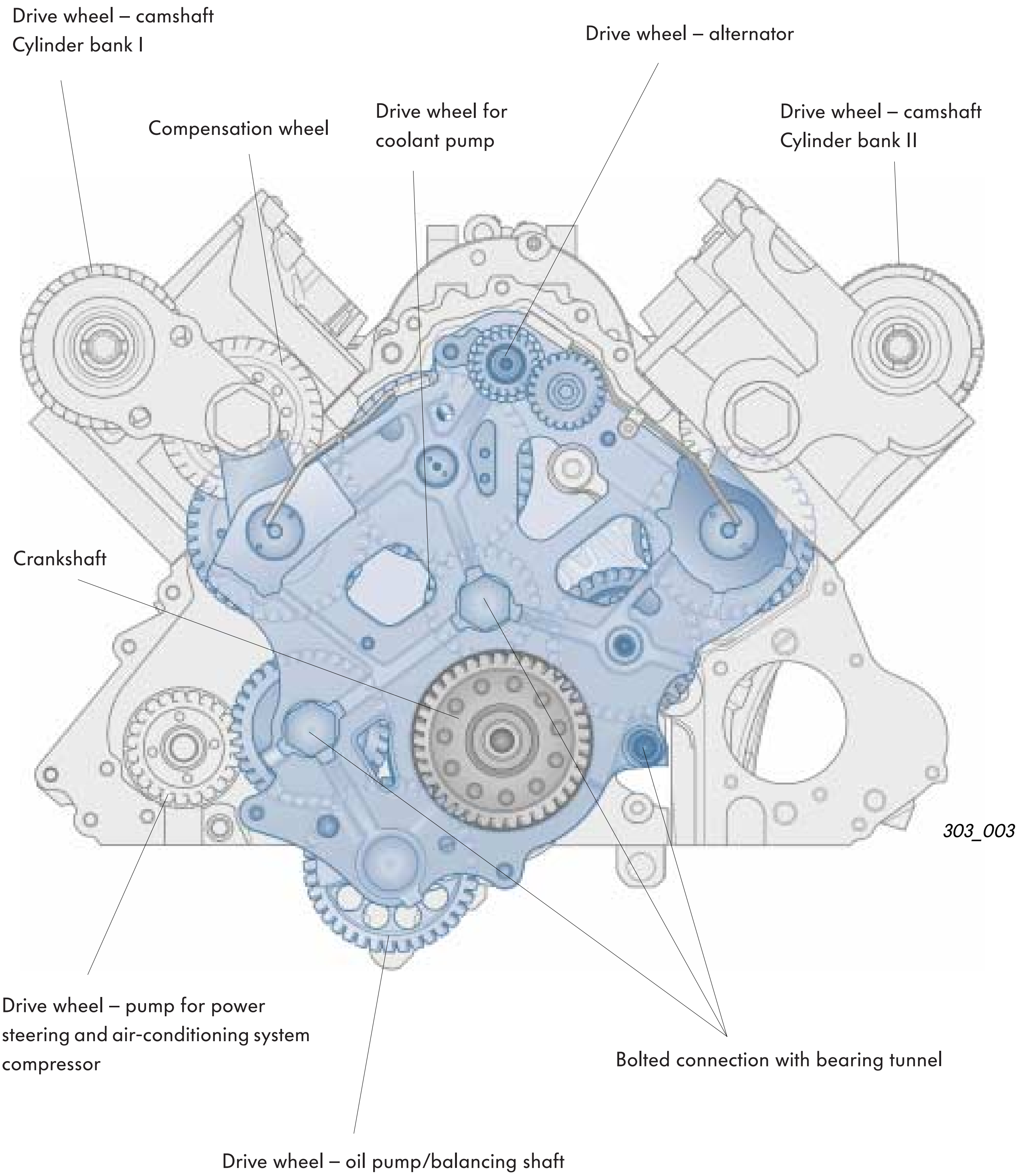



Alternator
Drive wheel for camshaft
Belt drive module
Crankshaft

303_016

Engine mechanics

Geared drive assembly

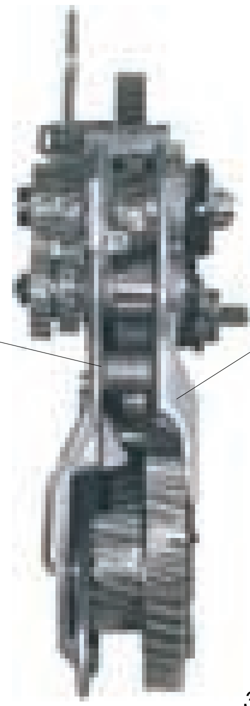


Belt drive module

The belt drive module is a component in which helic gear wheels are positioned between two carrier plates.

To ensure that all components of the belt drive module expand uniformly when exposed to heat and, as a result, to ensure that the face play is the same in all operating states, the carrier plates of the belt drive module are manufactured from tempered cast-iron.
The belt drive module is connected by three screws to the bearing tunnel, which is also manufactured from cast-iron.

The gearwheels are made of steel. They have a helix angle of 15°; as a result, two tooth pairs are always meshing. In comparison to spur-toothed gearwheels, larger forces can be transferred, thus providing a high smoothness of running.



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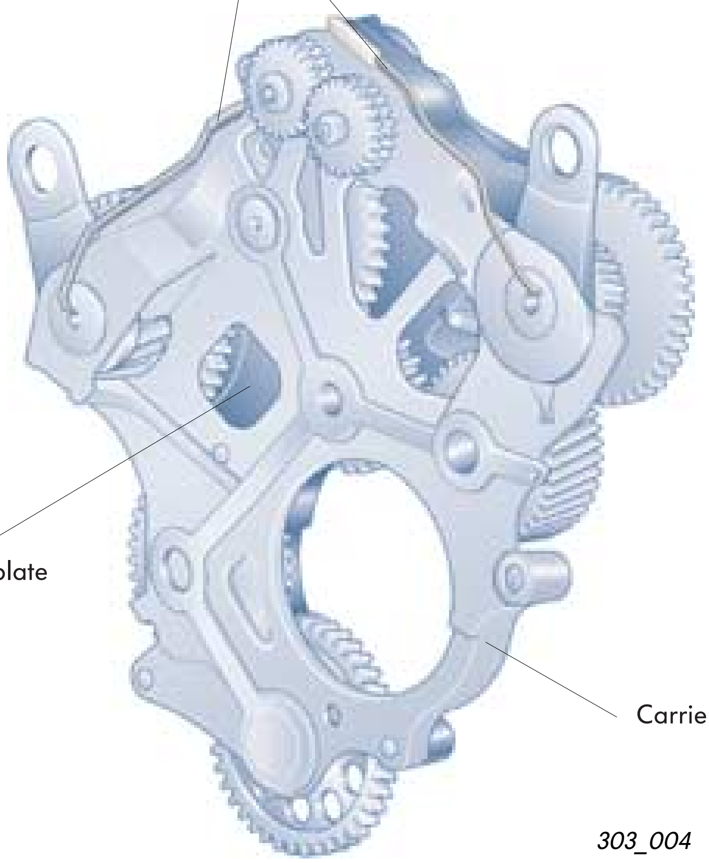

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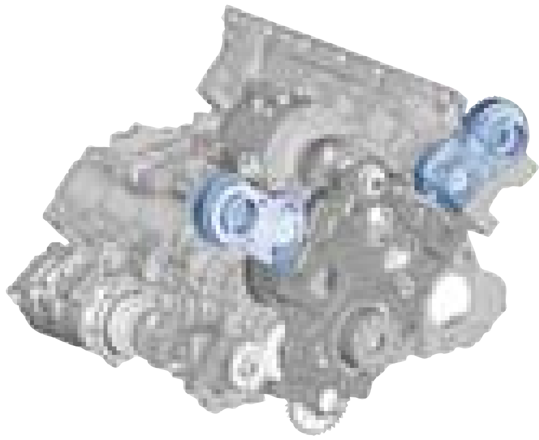
Shackle joint

The drive wheels of the camshafts are connected to the geared drive by a shackle joint.
The camshafts are located in the aluminium cylinder head. The carrier plates of the belt drive module are made of cast iron.

As aluminium expands further when exposed to heat than does cast iron, the face play of the gearwheels must be compensated. For this purpose, a compensation wheel is positioned in a shackle joint between the camshaft wheel and the drive wheel of the belt drive module.



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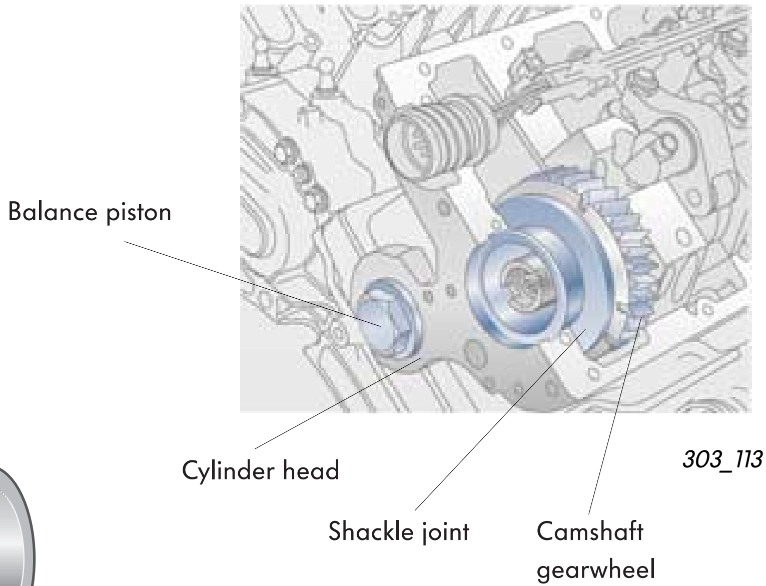

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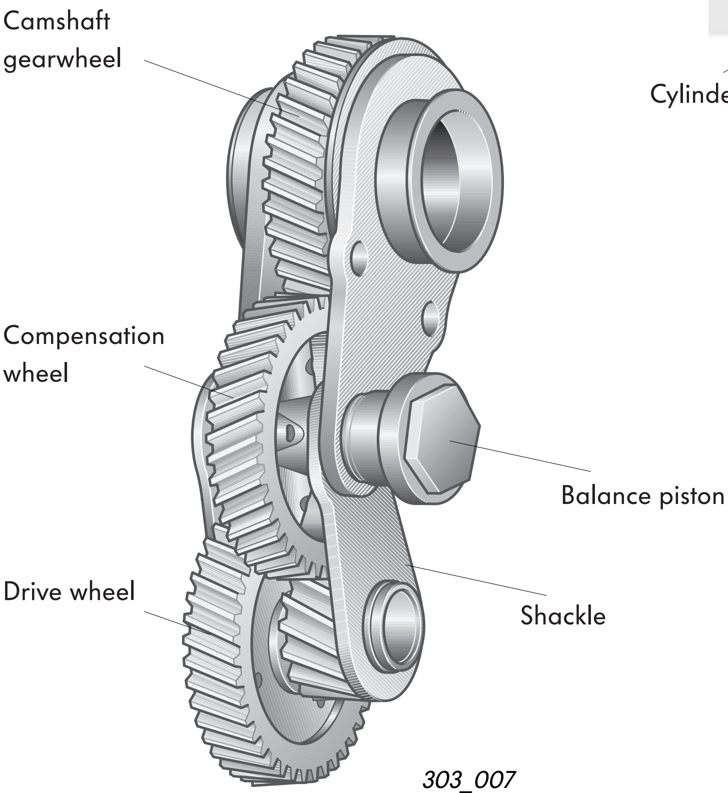

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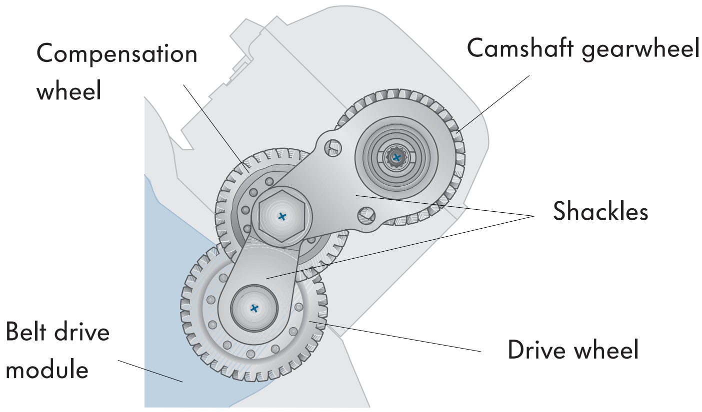
How it works

When subjected to heat, the axle spacing of the camshaft to the belt drive module changes.

The compensation wheel in the shackle joint follows the joint movement; the face play between the wheels within the shackle joint remains equal.

Setting for **"Cold engine"**



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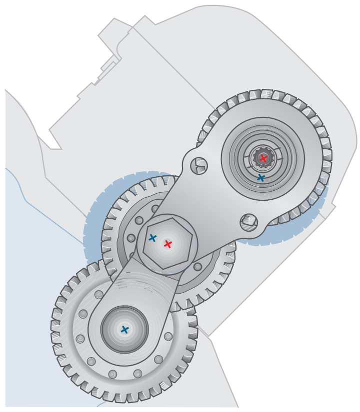
Setting for **"Warm engine"**



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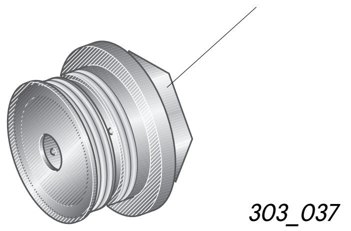
Balance piston

The shackles of the shackle joint are tensioned by a balance piston. The piston consists of a sleeve in which several spring washers are arranged behind one another and are axially tensioned.

The balance piston is screwed into the cylinder head; using a full floating axle, it tensions the two shackle joints. This prevents "dangling movements" of the shackle joint.



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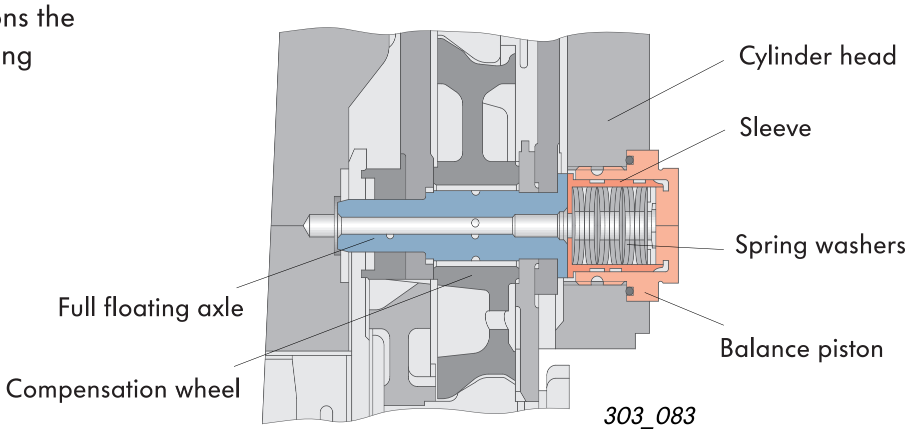

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Engine mechanics

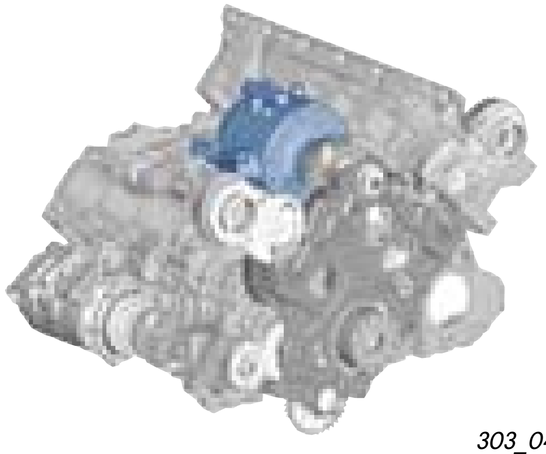
Alternator

The alternator is arranged in a space-saving manner in the V-space of the engine.

It is driven by a geared drive via a transmission shaft and a Hardy disc of the geared drive. Due to the transmission shaft, the alternator speed increases by a factor of 3.6 compared to the engine speed.

This provides an increased alternator performance that can cover high power demands of the vehicle electrical system even when idling.

The alternator is liquid-cooled.



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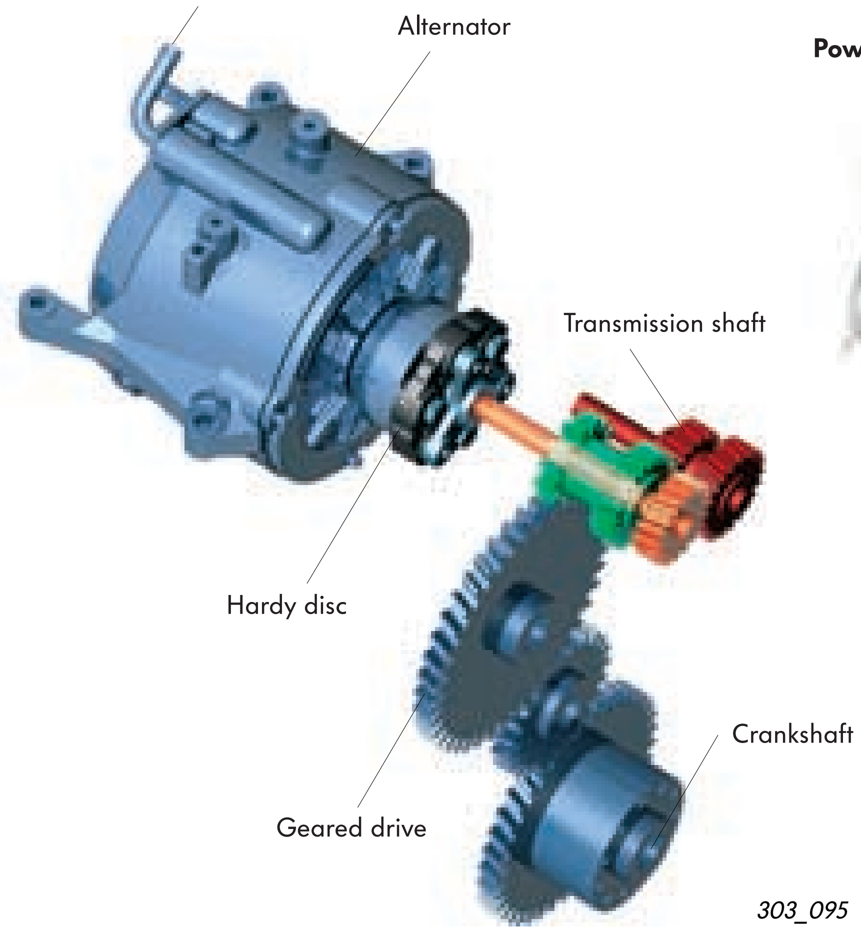

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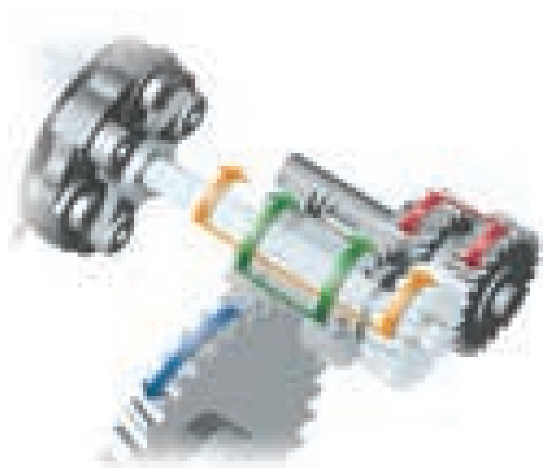
Power flow



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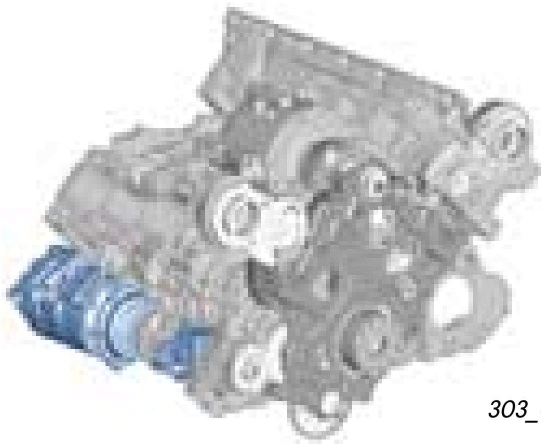
Power steering pump/air-conditioning system compressor

The power steering pump and the air-conditioning system compressor are arranged in a row on the engine block. The power steering pump is driven directly by the geared drive. The air-conditioning system compressor is driven by the shared drive axis and two Hardy discs that are arranged in a row.

The overload protection of the air-conditioning system compressor is implemented by a shaped rubber element.



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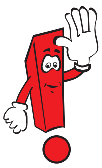
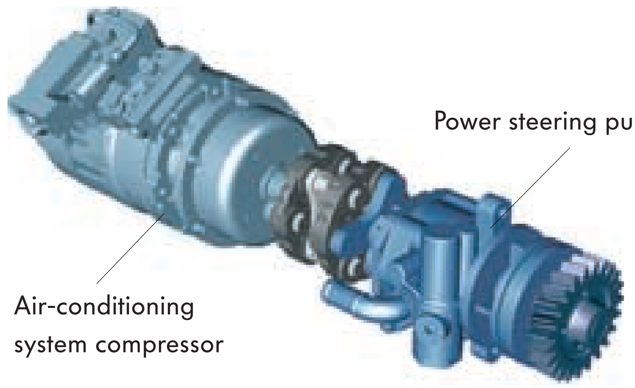


Further information regarding the externally controlled air-conditioning system compressor can be found in Self-Study Programme No. 301 "The Phaeton – Heating/Air-Conditioning System"



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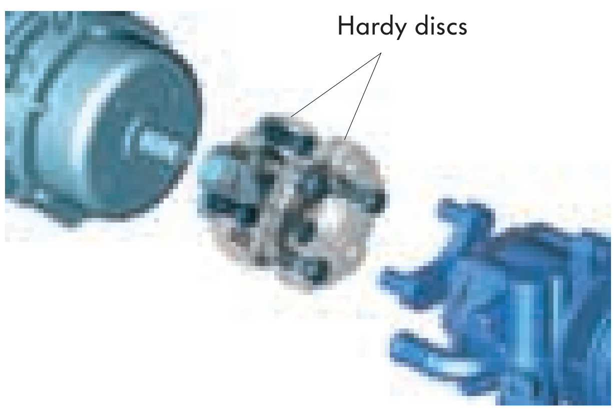
The Hardy disc consists of a rubber body with integrated steel sleeves. It has the advantage that, due to its material elasticity, it permits small bending angles of the rotary axles and compensates for small changes in length between the connecting flanges. In addition, it has a vibration-dampening effect on torque fluctuations.



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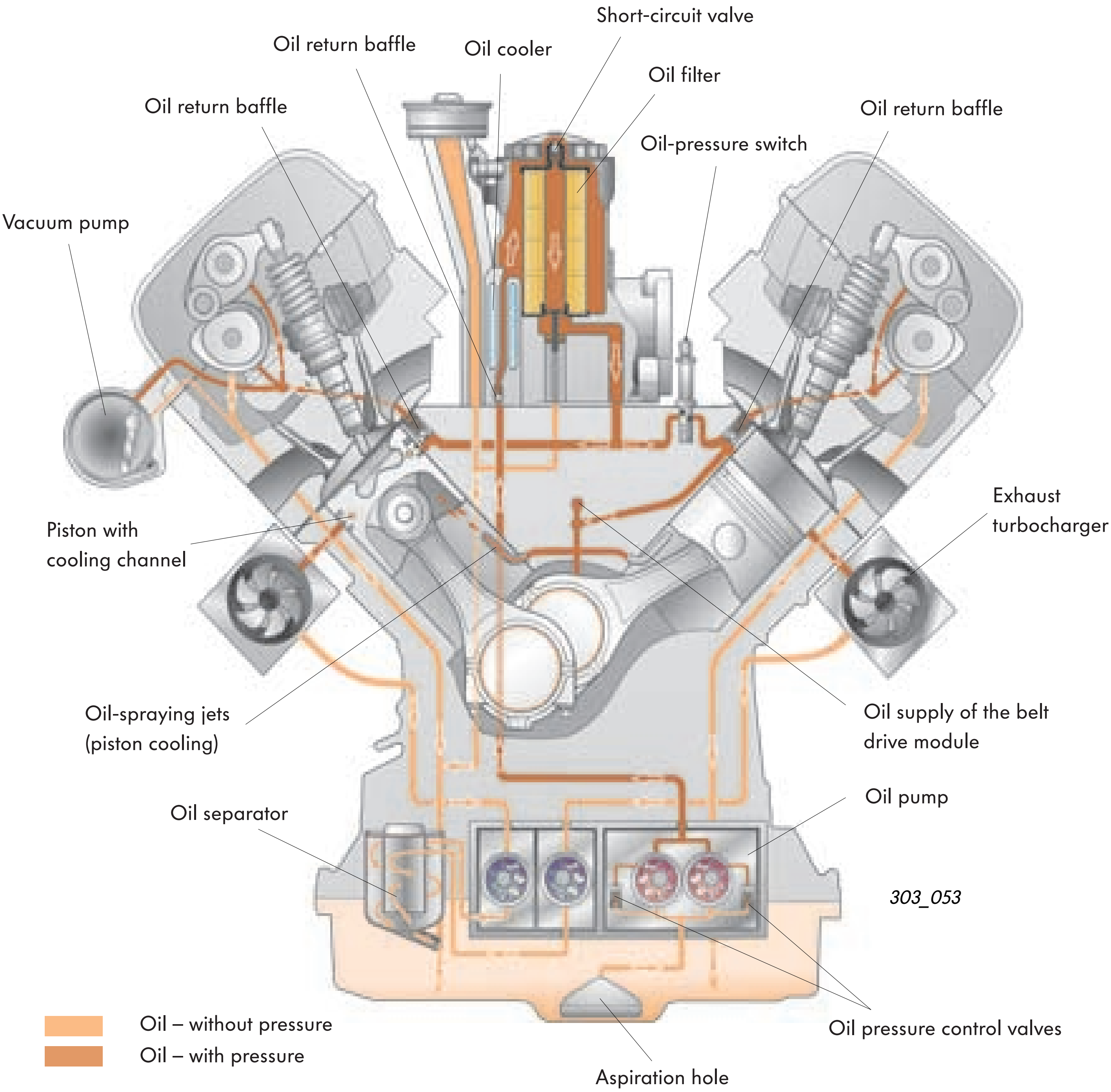
Oil circulation



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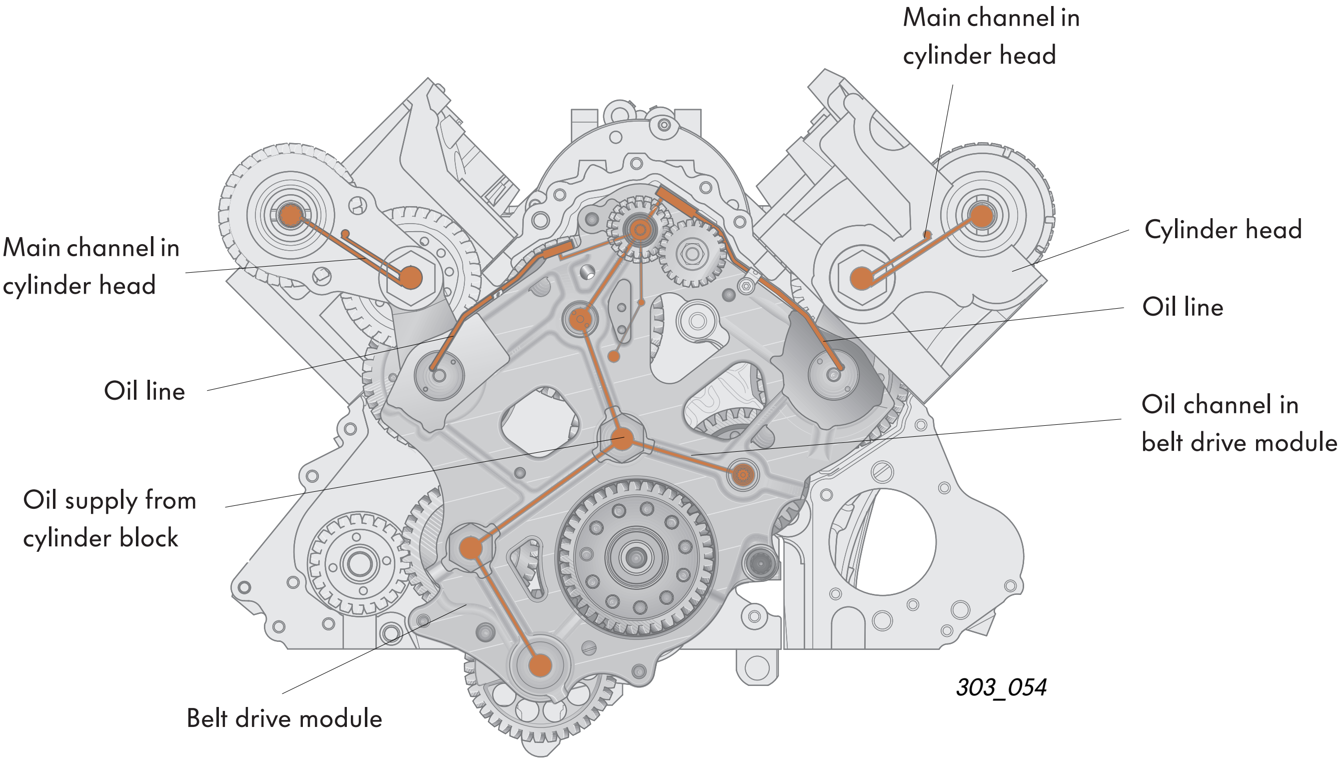
The **oil pressure control valves** control the oil pressure of the engine. They open as soon as the oil pressure reaches the maximum permitted value.

The **oil return baffles** prevent oil from flowing back out of the cylinder head and the oil filter housing into the oil pan when the engine is at a standstill.

The **short-circuit valve** opens when the oil filter is occluded, thus ensuring the oil supply to the engine.

Oil supply in belt drive module



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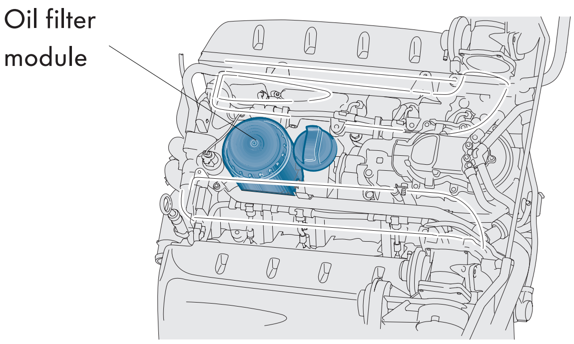
Oil filter module

The oil filter module is located in a space-saving manner in the V-space of the engine. The oil filters, the oil filler neck and the oil cooler are integrated in the oil filter module.



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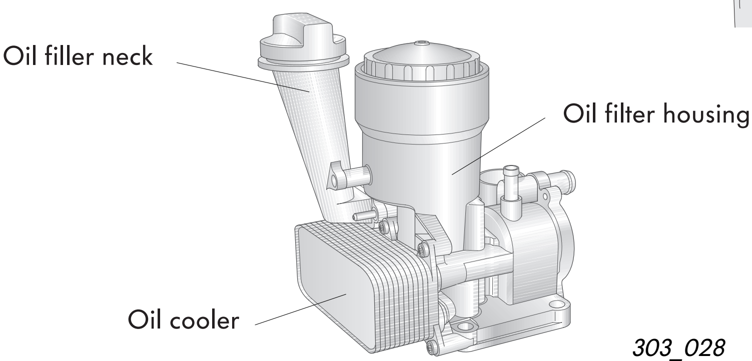

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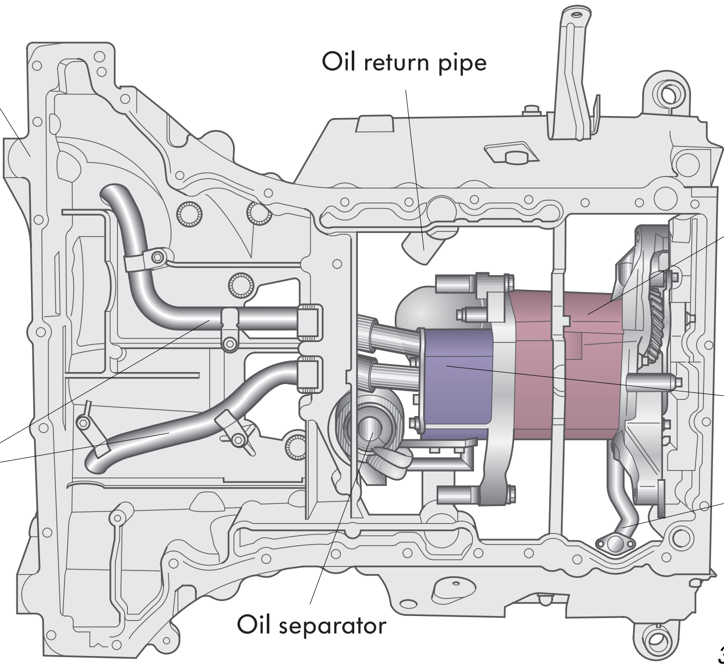
Oil pump

The oil pump is located on the engine face in the oil sump of the oil pan. It has four pairs of toothed wheels, working according to the duocentric principle. Two of these are oil pressure pumps that generate the oil pressure that is required for the oil circulation.

The other two are oil scavenge pumps that suction the oil out of the areas of the exhaust turbocharger oil returns, ensuring that there is a sufficient amount of oil in the oil filler neck in every operating state.

The oil pump is driven by the geared drive via the balancer shaft.



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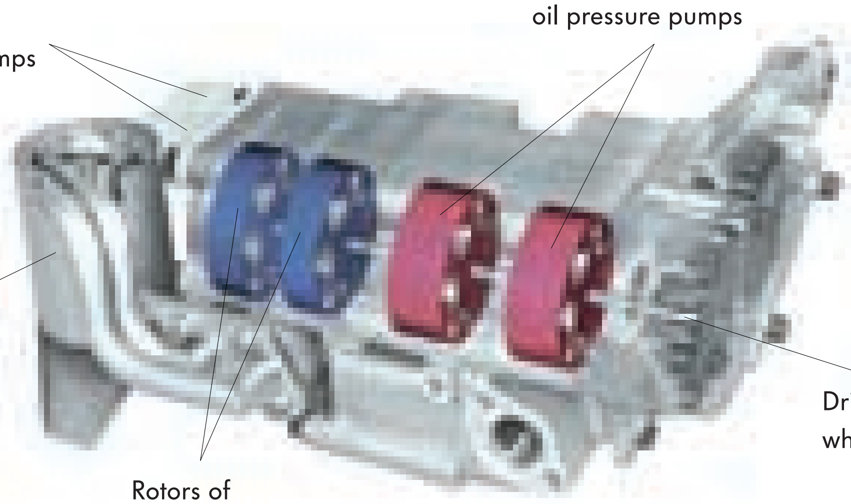

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Oil pan

The oil pan consists of two cast-aluminium parts.

The lines for the oil scavenge pumps are located in the upper part of the oil pan.
The lower part of the oil pan contains the sender for the oil level and the wash plates that are used to calm the oil in the oil sump.
The structural shape of the lower part of the oil pan differs in the Phaeton and the Touareg.

The Touareg has a deeper lower part of the oil pan than the Phaeton, so that it can hold a larger amount of oil. In addition, the lower part of the oil pan of the Touareg has elastic flap traps. These prevent the oil sump from running dry when driving on inclines.

Oil pan, upper portion

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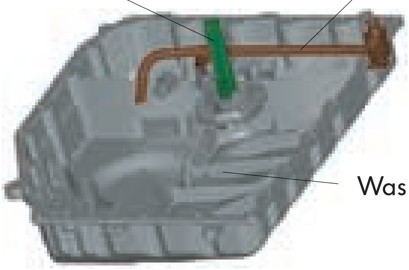
Oil pan, lower portion – Phaeton



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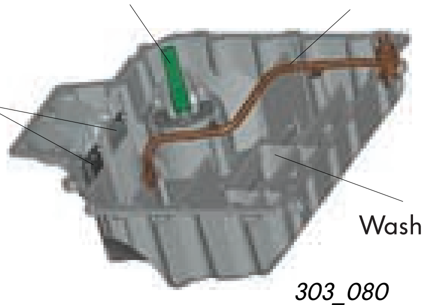
Oil pan, lower portion – Touareg



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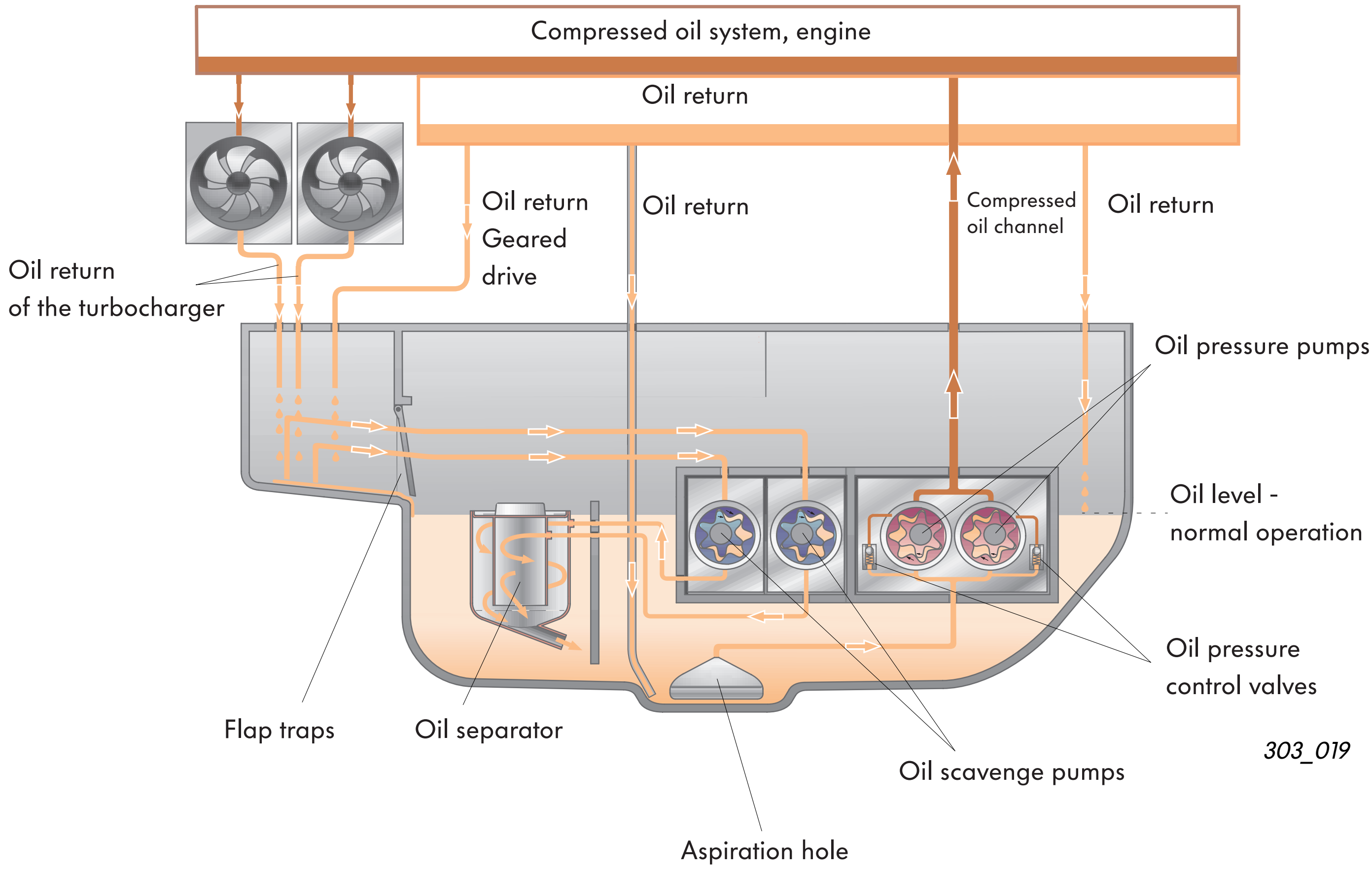
303_081

Functioning of the oil scavenging system in different driving states

In order to ensure functioning of the compressed oil system, with the correct filling level in all driving states, two oil scavenge pumps are used. The following examples describe the oil scavenge system in three different driving states.

Oil scavenge system, normal driving



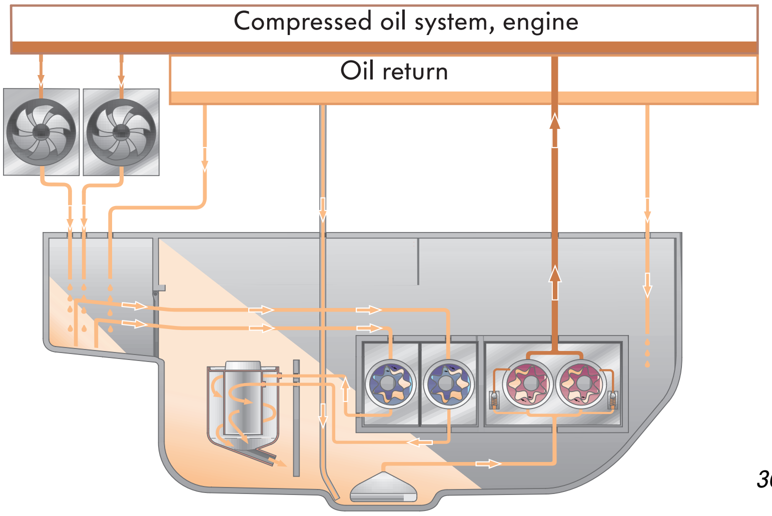
303_019

During uniform, level driving, the two oil pressure pumps suction the oil out of the oil sump via the oil filler neck and pump it into the compressed oil system of the engine.
Part of the returning oil flows directly into the oil sump of the oil pan while the rest flows from the returns of the turbocharger and of the geared drive into the rear area of the oil pan.

There, the oil is suctioned off by oil scavenge pumps and returned to the oil sump by the oil separator.

The oil separator works according to the principle of a cyclone. It separates the oil from the scavenged oil-air mixture before the oil flows back to the oil sump.

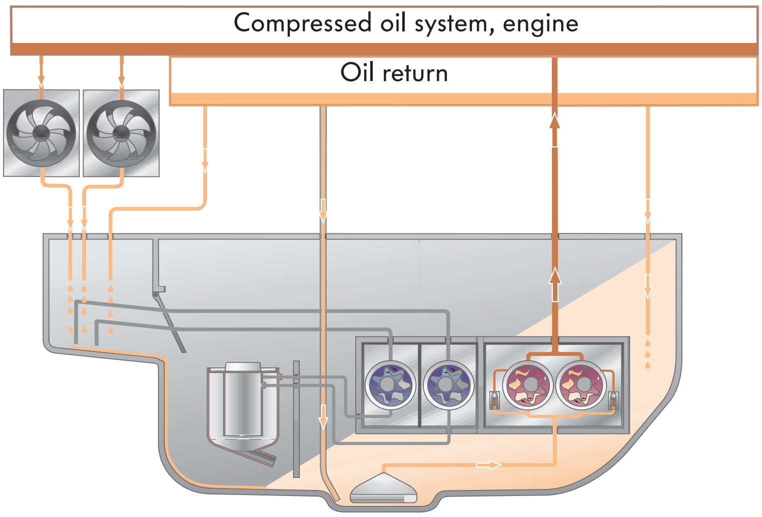
Oil scavenge system, uphill driving



303_020

During uphill driving or when accelerating, the oil flows into the rear area of the oil pan.
The flap traps close, thus preventing all the oil from flowing into the rear area of the oil pan. The oil scavenge pumps suction the oil out of the rear area of the oil pan. This ensures pressure-free oil return from the turbocharger and the geared drive.
The scavenged oil is transported to the sump by the oil separator. This ensures the oil supply of the oil pressure pumps.

Oil scavenge system, downhill driving

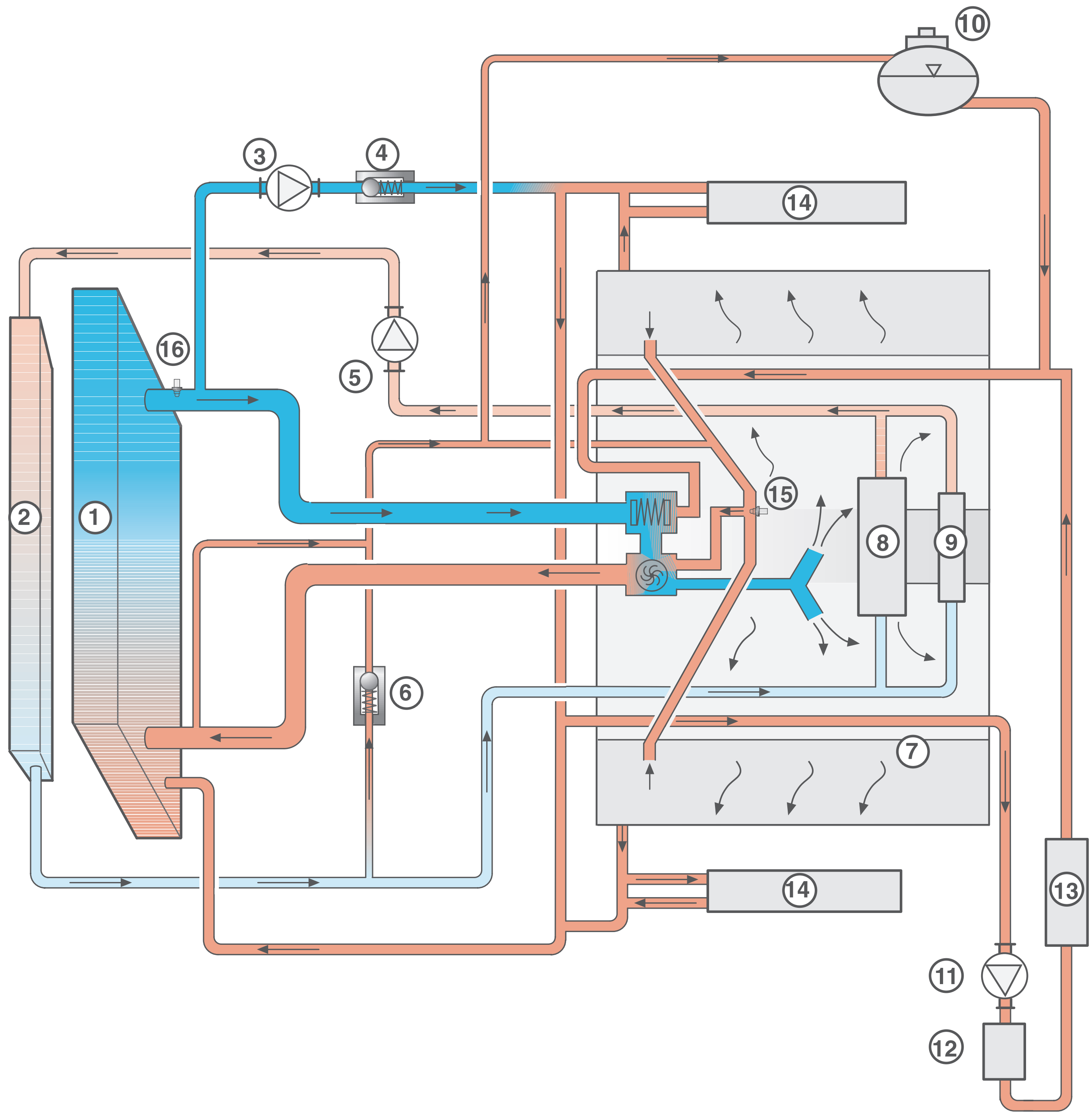


303_021

During downhill driving or when braking, the oil collects in the front part of the oil pan. As a result, the oil level lies above the oil filler neck, ensuring the oil supply of the oil pressure pumps. The oil returning from the turbocharger and the geared drive can flow into the oil sump via the open flap traps.

Coolant circulation system

System overview



Engine coolant circulation

Coolant circulation for alternator and fuel cooling (Touareg only)

303_039

Engine coolant circulation: warm, cold

Coolant circulation for alternator and fuel cooling (Touareg only): warm, cold

1. Cooler for engine coolant circulation
2. Cooler for alternator/fuel cooling
3. Pump for coolant after-run V51
4. Check valve
5. Pump for fuel cooling V166
6. Valve body
7. Cylinder head/cylinder block
8. AC generator
9. Fuel cooler
10. Compensator reservoir
11. Circulation pump V55
12. Heat exchanger for heater
13. Auxiliary water heater (auxiliary heater)
14. Cooler for exhaust return (Phaeton only)
15. Coolant temperature sender G62
16. Coolant temperature sender- cooler outlet G83

Coolant circulation for alternator and fuel cooling (in the Touareg only)

In the Touareg, the V10-TDI engine has a separate coolant circulation for the alternator and the fuel cooling. This is required because the temperature of the coolant is too high to cool the returning fuel when the motor is running.

Pump for coolant after-run V51

The pump for coolant after-run is an electrically driven pump that is activated by the engine control unit.

It fulfils two duties:

1. At low engine speeds, the pump for coolant after-run supports the mechanically driven coolant pump, thus providing for sufficient coolant circulation.

2. To carry out the coolant after-run function, the pump is activated by the engine control unit according to a characteristic map.

Circulation pump V55

The fuel cooling pump is an electrical circulation pump. If required, it is activated by the Climatronic control unit, providing the circulation of coolant in the coolant circulation for the alternator and the fuel cooling.

1. When the engine is running, the pump provides an increased flow of coolant through the heat exchanger for the heater; it also supports the functioning of the auxiliary heater.

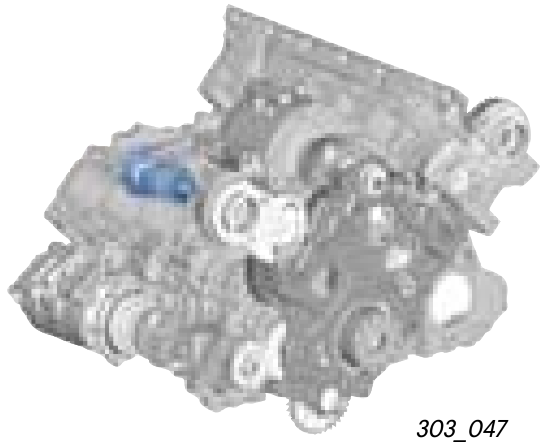
2. The pump fulfils the duties of the residual heat function up until 30 minutes after the engine is stopped. For this purpose, it is activated by the Climatronic control unit when the driver activates the residual heat function.

Pump for fuel cooling V166

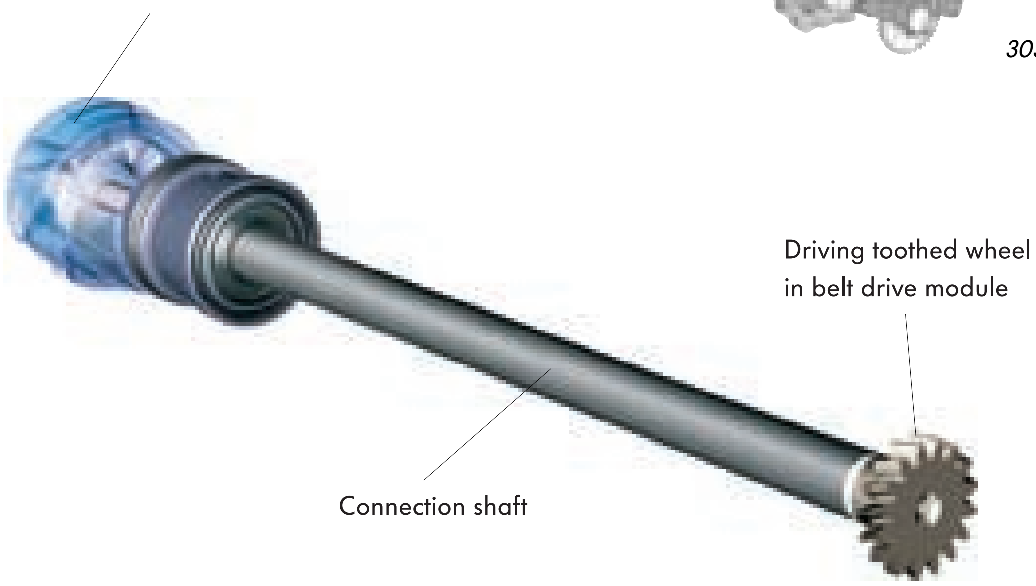
The fuel cooling pump is an electrical circulation pump. If required, it is activated by the engine control unit, providing the circulation of coolant in the coolant circulation for the alternator and the fuel cooling.

Coolant pump

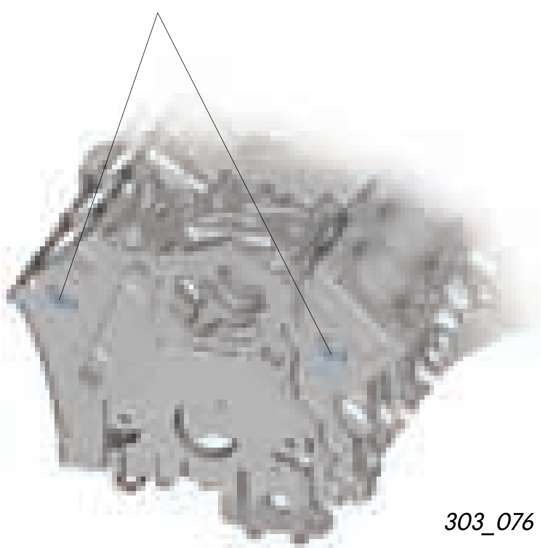
The coolant pump is located on the engine face in the engine block. It is driven by the belt drive module via a connection shaft.



303_047



303_075



303_076

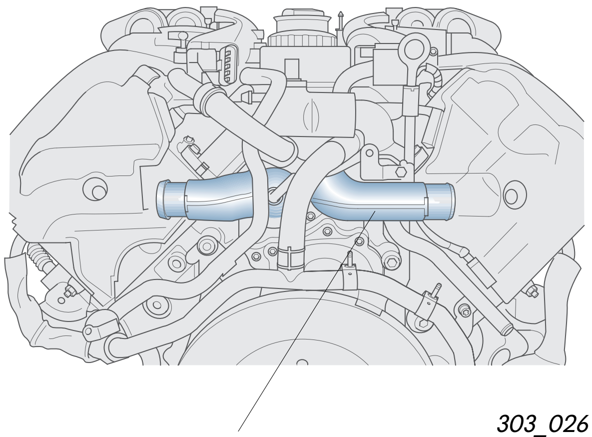
Coolant drain plugs

Two coolant drain plugs are located on the engine face in the cylinder block. When the cylinder heads or another component in the V-space of the motor is to be removed, the coolant drain plugs can be used to drain the coolant down to the level of the coolant pump.

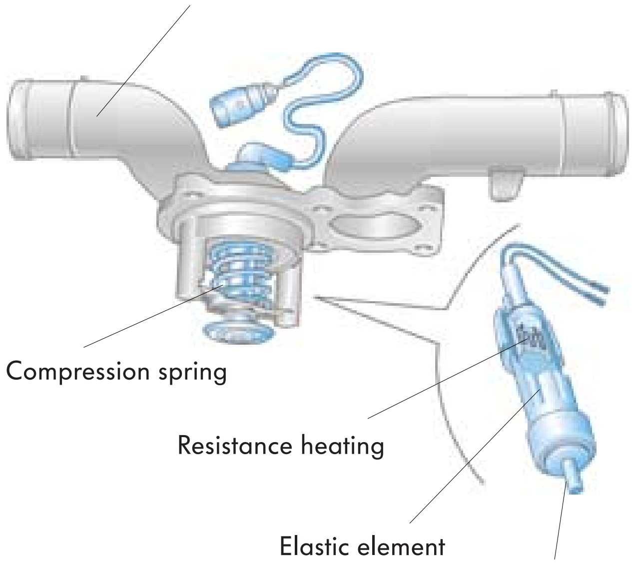
Thermostat for characteristic map-controlled engine cooling

The thermostat for characteristic map-controlled engine cooling is located in the pipe union of the coolant controller housing. Its duty is to switch between the large and the small coolant circulation systems. For this, it is activated by the engine control unit according to the requirements of the engine's operating state. Characteristic maps that contain the nominal value temperature depending on the engine load are stored in the engine control unit.

The advantage of characteristic map-controlled engine cooling is that the coolant temperature level can be adapted to the current operating state of the engine. This helps to reduce fuel consumption in the partial-load range and to reduce exhaust emissions.



303_026



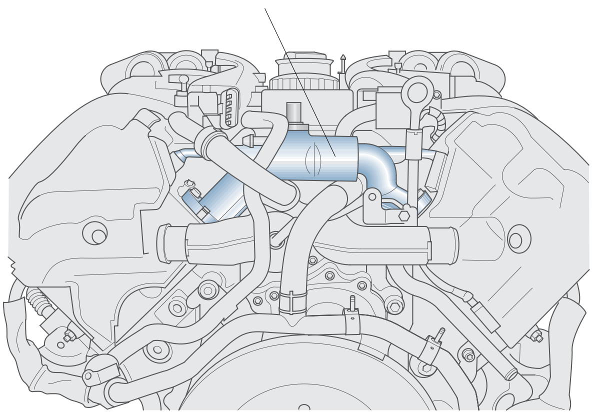
303_015

A detailed description of characteristic map-controlled engine cooling can be found in Self-Study Programme No. 222 ”Electronically Controlled Cooling System”.

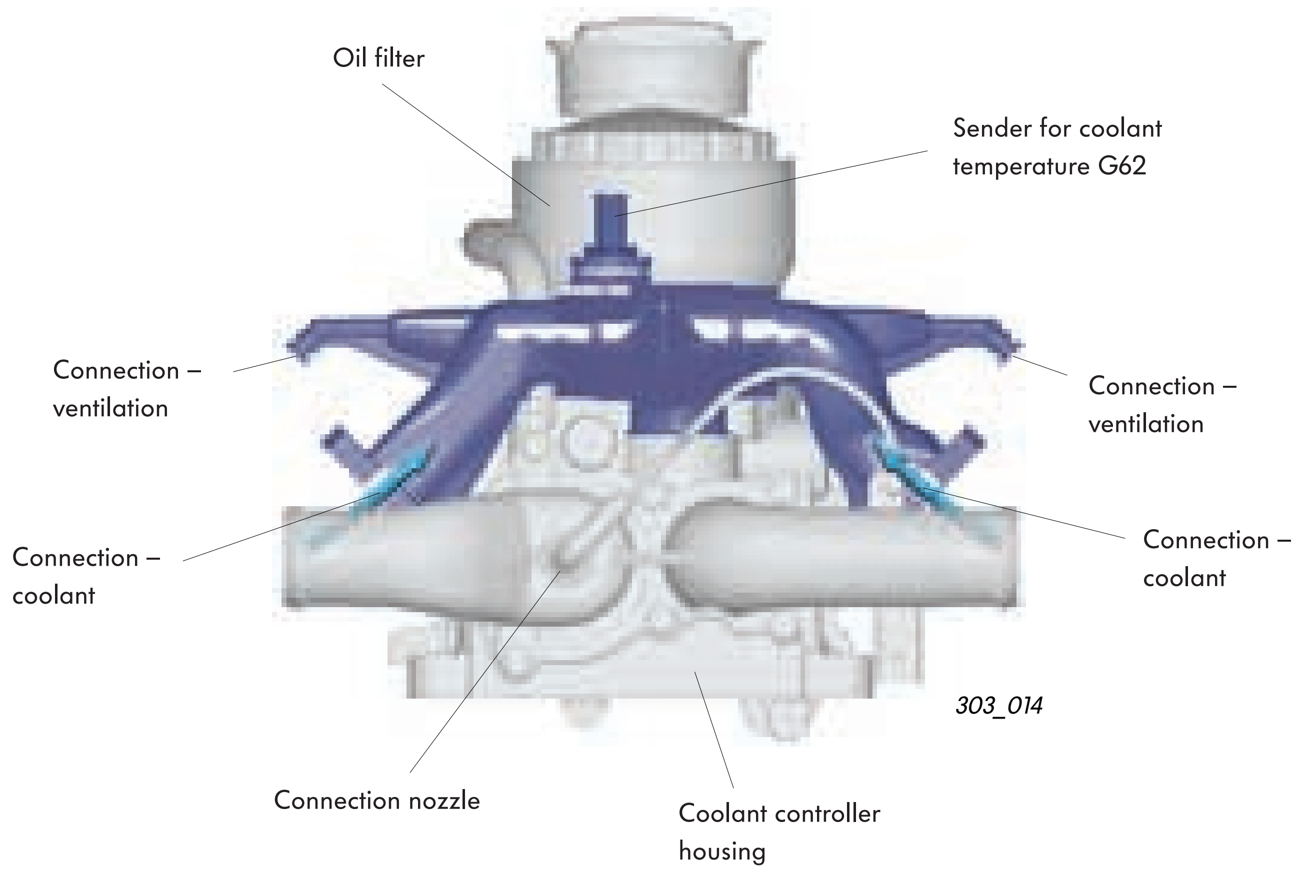
Water connection

The water connection is located in the V-space of the engine, above the coolant controller housing.

It connects the coolant circulation of the two cylinder heads. The coolant is transported out of the cylinder heads through the two large connections to the coolant controller housing. The small connections that are further towards the top are used for ventilation.



303_012

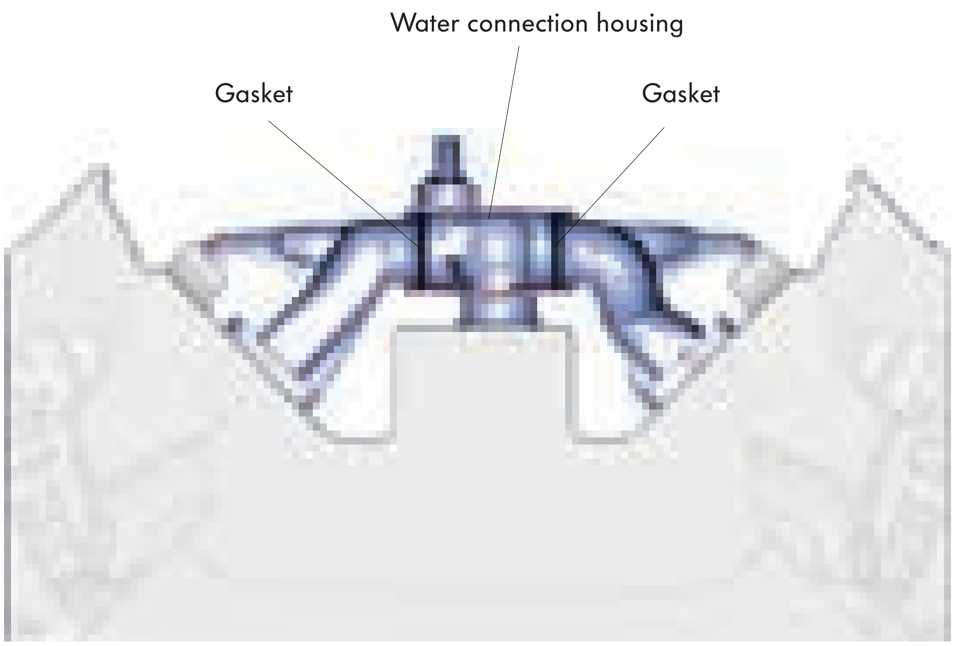


303_014

Removal and installation

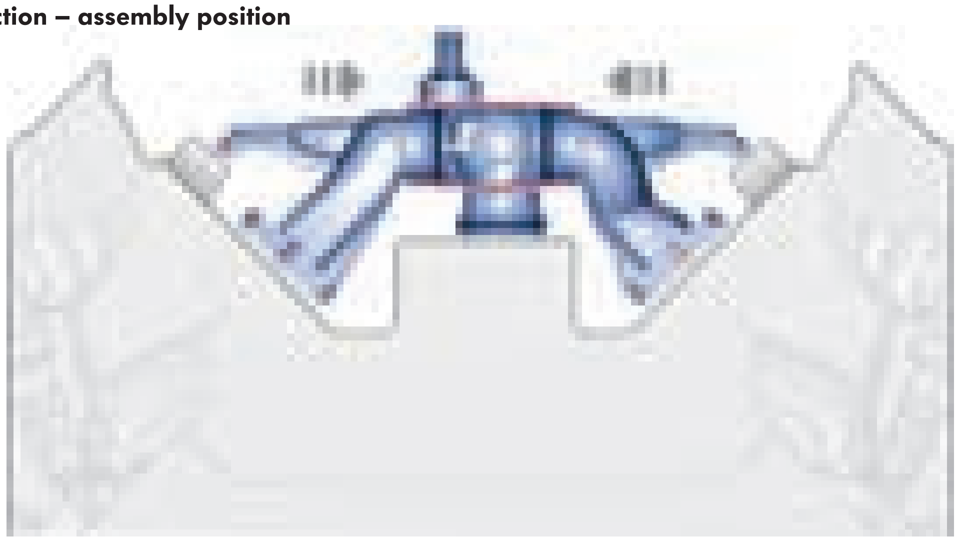
In order to permit the water connection in the V-space of the engine to be removed and installed, the two large connections in the water connection housing can be pushed in/pushed apart.

Water connection – installation position



303_013

Water connection – assembly position

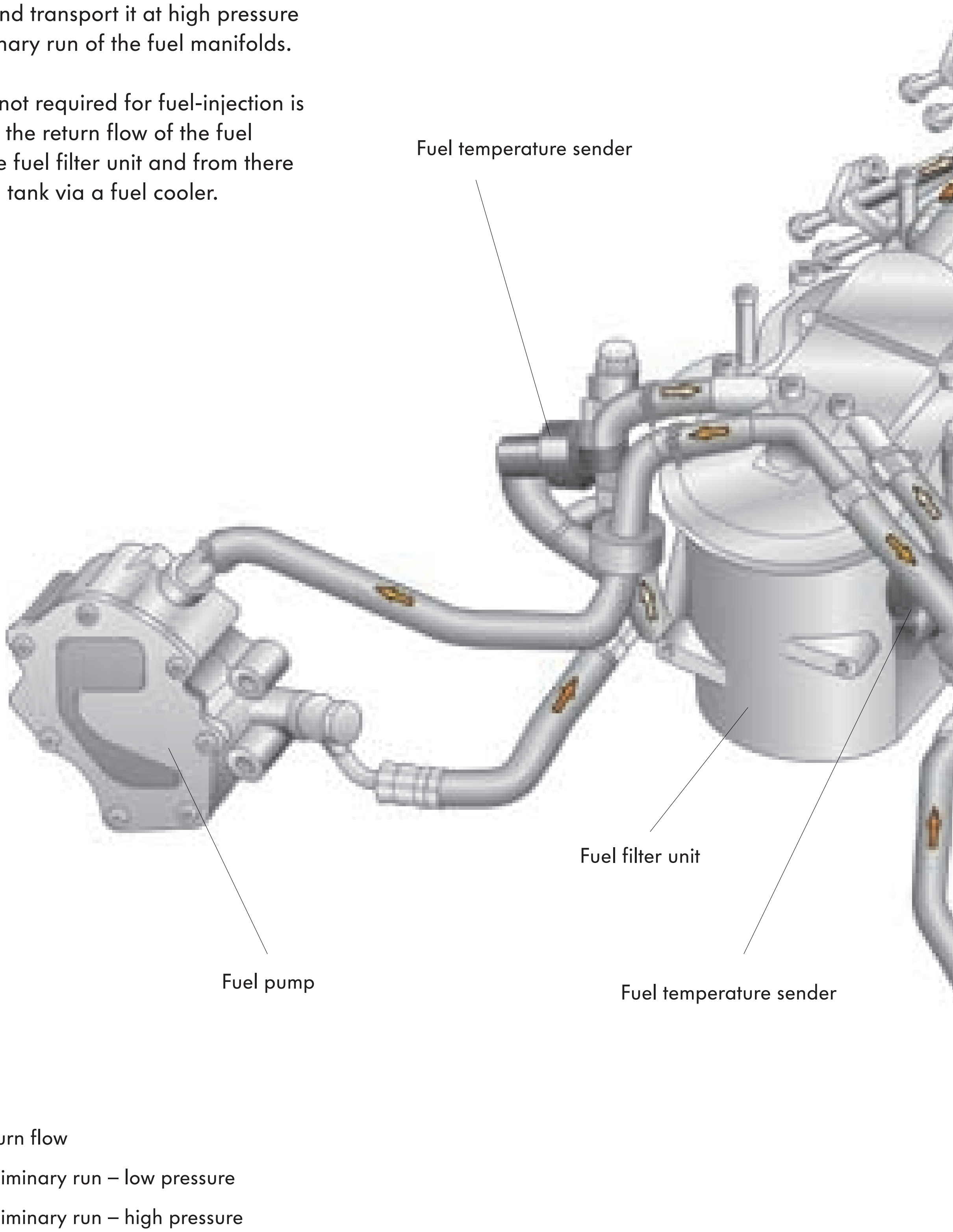


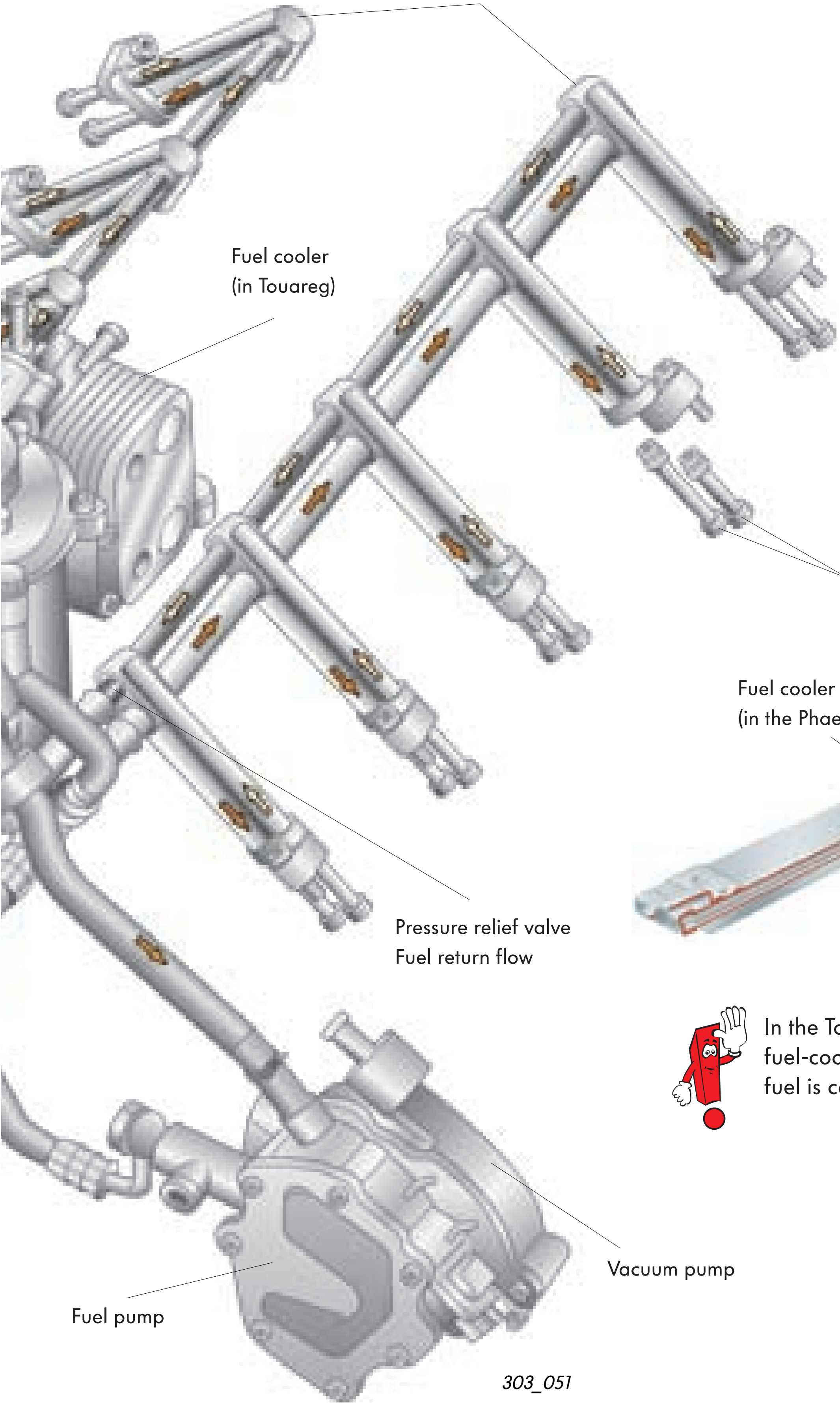
303_105

Fuel system

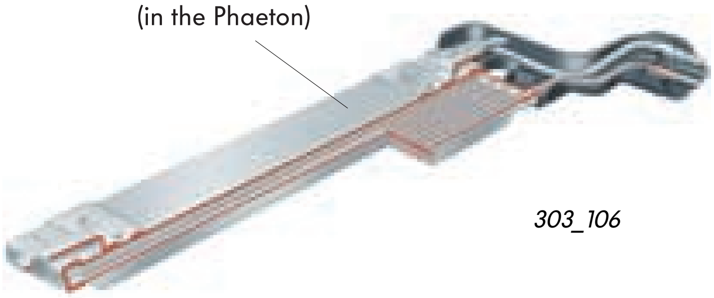
The fuel is transported out of the fuel tank to the fuel filter unit by electrical fuel pumps. The mechanical fuel pumps suck the fuel out of the fuel filter unit and transport it at high pressure into the preliminary run of the fuel manifolds.

The fuel that is not required for fuel-injection is transported via the return flow of the fuel manifolds to the fuel filter unit and from there back to the fuel tank via a fuel cooler.





303_051



303_106

In the Touareg, the fuel is cooled by a fuel-coolant cooler. In the Phaeton, the fuel is cooled by a fuel-air cooler.

Overall schematic diagram

The **electrical fuel pumps** work as preliminary transport pumps, pumping fuel to the fuel filter unit.

The **check valves** prevent fuel from flowing out of the fuel manifold and the preliminary run line back into the fuel tank when the engine is at a standstill.

The **fuel filter unit** protects the injection system from soiling and wear by particles and water.

The **fuel pumps** transport the fuel out of the fuel filter unit and pump it at high pressure into the preliminary run of the fuel manifolds.

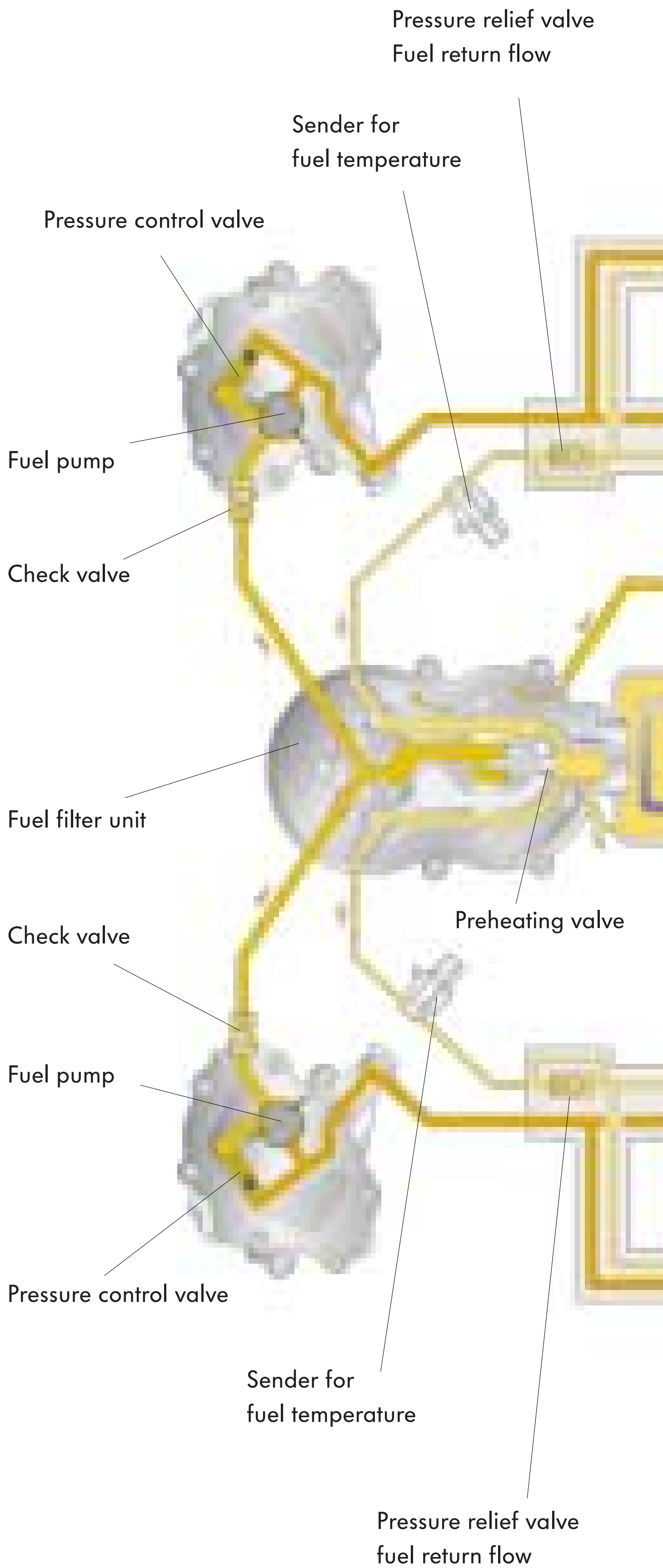
The **pressure control valves** regulate the fuel pressure in the fuel preliminary run to approx. 8.5 bar.

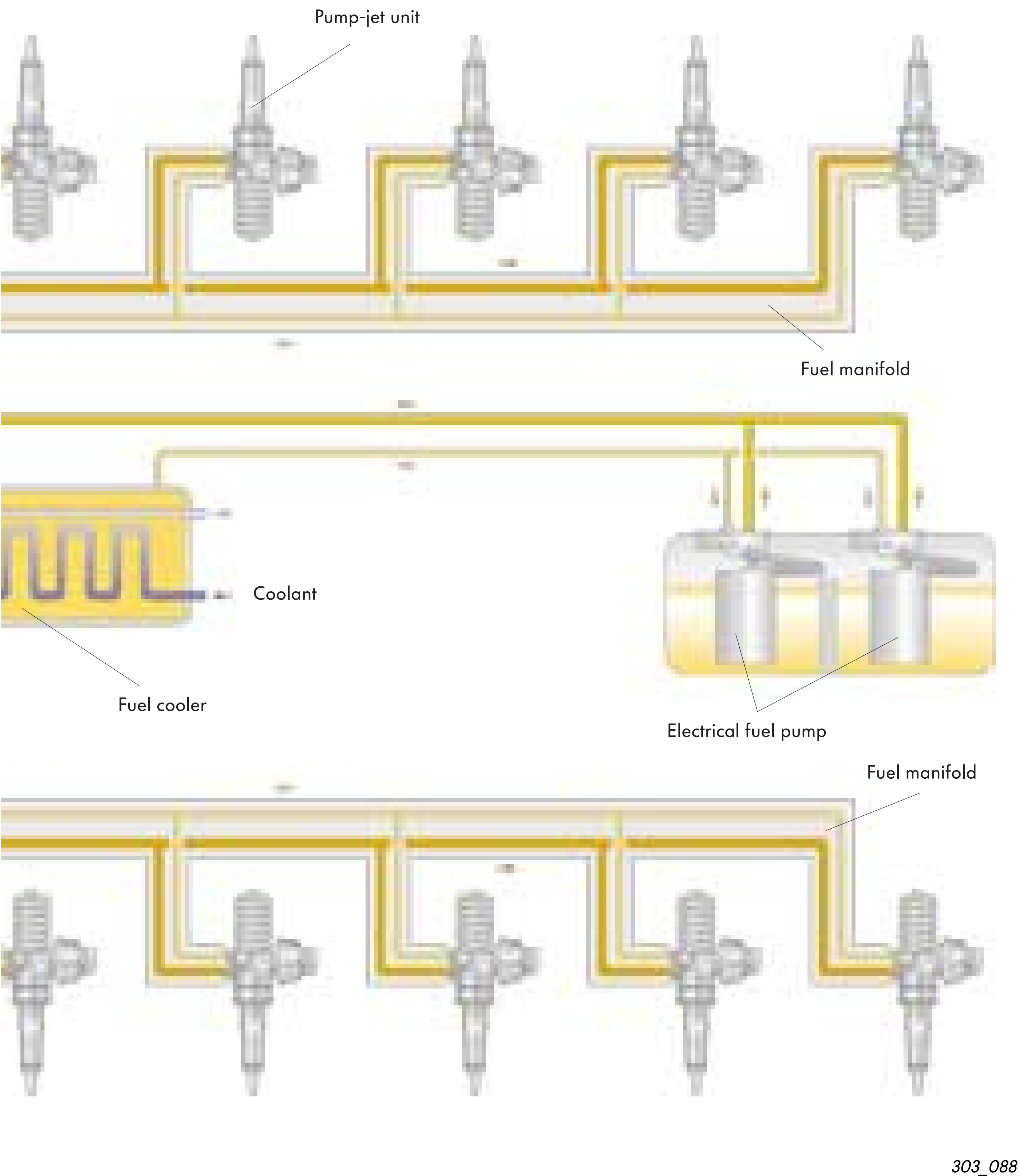
The **pressure relief valves** limit the fuel pressure in the fuel return flow to approx. 1 bar. As a result, the pressure conditions in the fuel system are balanced.

The **fuel temperature senders** are used to record the fuel temperature for the engine control units.

The **preheating valve** guides the fuel in the return flow into the fuel filter unit when the outside temperature is low, thus preventing clogging of the filter inserts.

The **fuel cooler** cools the fuel in the return flow to protect the fuel tank from fuel that is too hot.





Return

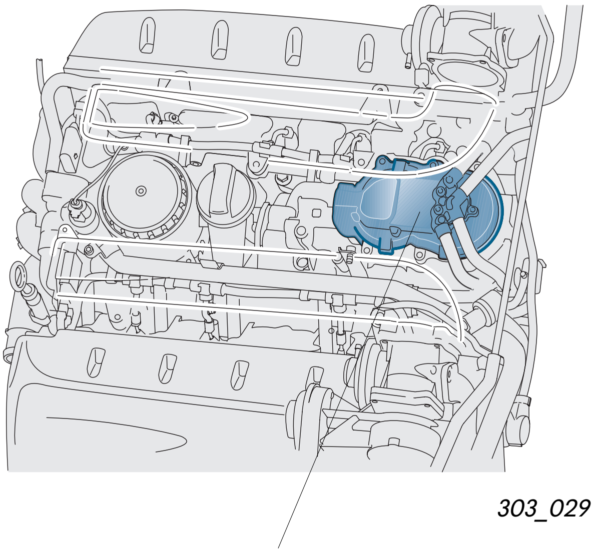
Preliminary run – low pressure

Preliminary run – high pressure

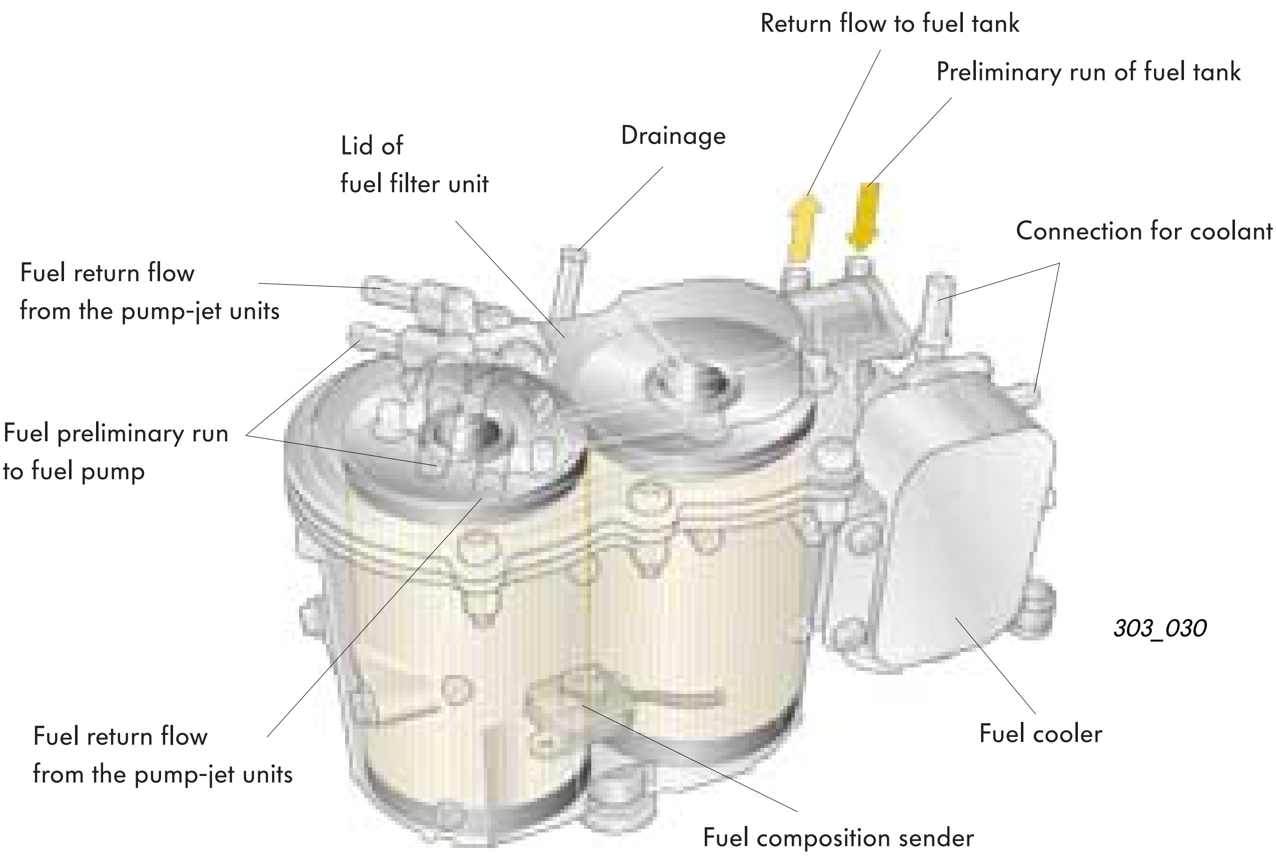
Fuel filter unit

The fuel filter unit is located in a crash-safe position in the V-space of the engine.

It contains two filter inserts and a sender for the fuel composition. The sender for the fuel composition is used to inform the driver if the water level in the filter unit is too high using an indicator light in the dash panel insert. There is a preheating valve in the lid of the fuel filter unit; when the outside temperature is low, this guides the fuel in the return flow from the engine back into the filter. In the Touareg, a coolant-fuel cooler is integrated into the fuel filter unit. It cools the fuel flowing back into the fuel tank, thus preventing damage to the fuel tank by return flow fuel that is too hot. In the Phaeton, a fuel-air cooler is located under the vehicle floor.



303_029



303_030

Preheating valve

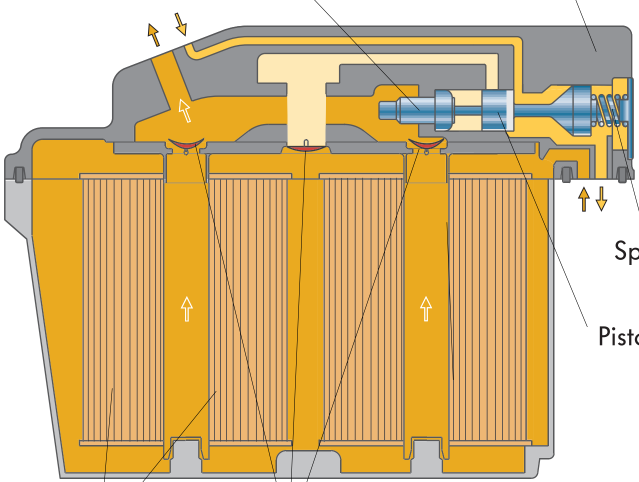
At low outside temperatures, diesel fuel tends to precipitate paraffin. This can clog the fuel filter; as a result, operating the engine may no longer be possible due to a lack of fuel. To prevent this, there is a preheating valve in the lid of the fuel filter unit.

Depending on the outside temperature, the preheating valve guides the fuel that is flowing back from the pump-jet units either to the fuel filters or to the fuel tank.

Warm fuel temperature

At a fuel temperature above 40 °C in the fuel preliminary run, the piston is pressed against the spring by the elastic element. The preheating valve completely opens the way into the fuel return flow. The fuel that is flowing back from the pump-jet units directly enters the return flow to the fuel tank.

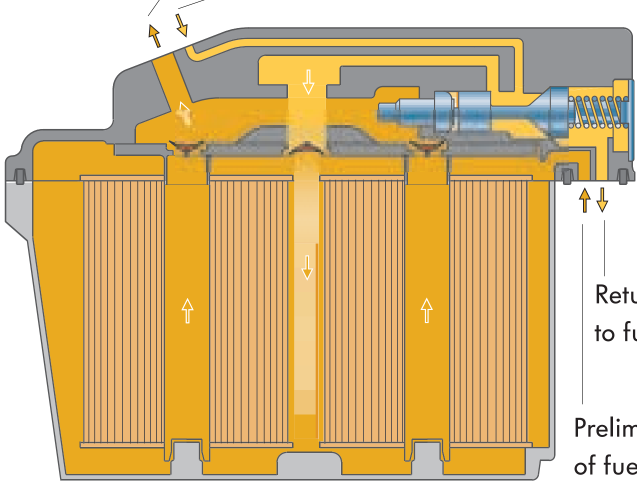
In the fuel preliminary run, the fuel is transported via filter inserts and the flatter valve to the fuel pumps.



303_103

Cold fuel temperature

At a fuel temperature below 10 °C, the elastic element contracts, so that the spring force of the piston closes the way to the fuel tank. As a result, the fuel that is flowing back from the pump-jet units is guided to the filters. The fuel in the filter unit is heated, thus preventing clogging of the filters.



303_104

Pump-jet units

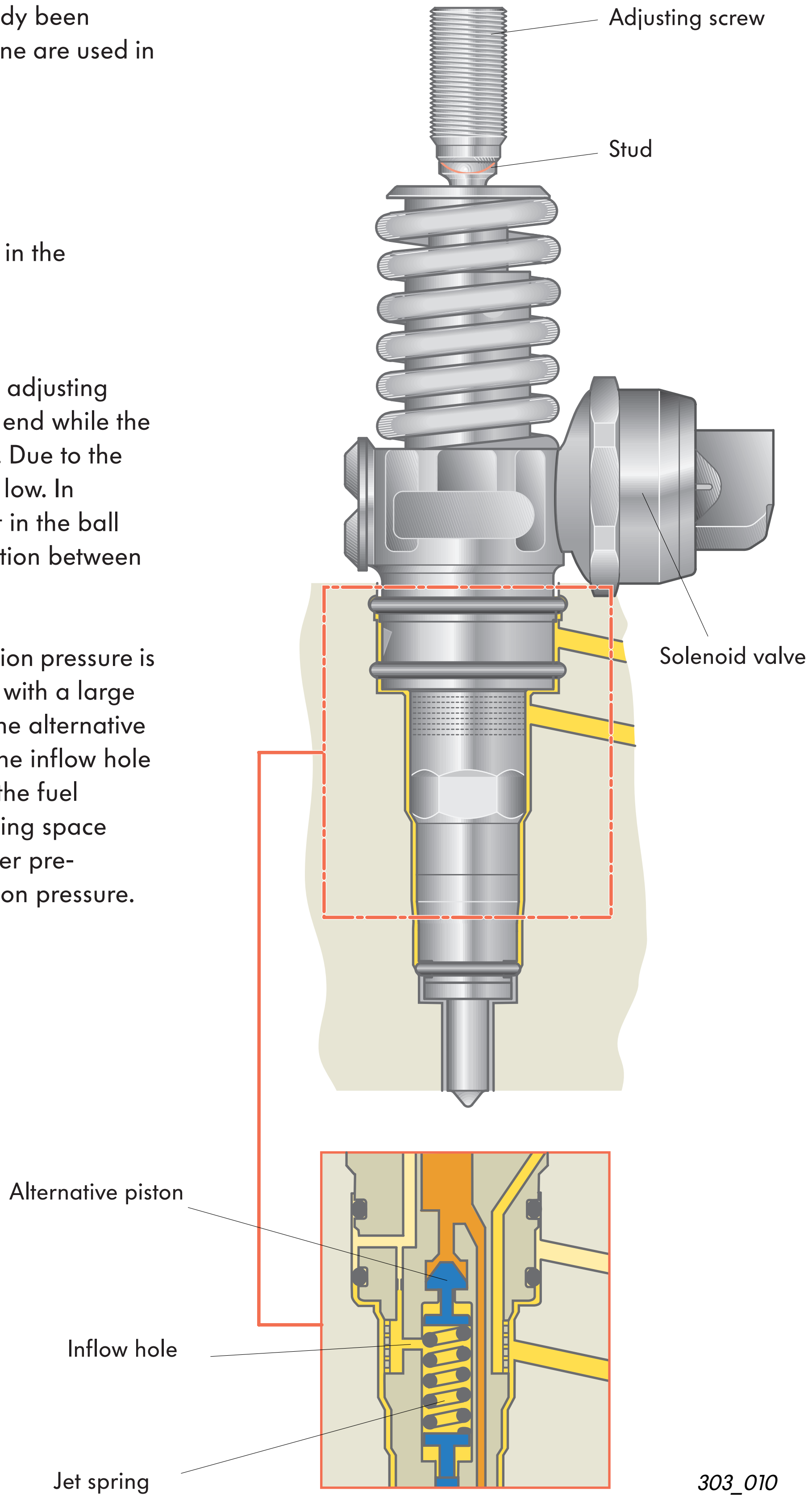
The pump-jet units that have already been installed in the 1.9l/74 kW TDI engine are used in the V10-TDI engine.

They are characterised by:

- a low-friction drive
- an increased injection pressure in the partial load range
- a compact solenoid valve

To provide a low-friction drive, the adjusting screw is equipped with a rounded end while the stud is provided with a ball socket. Due to the large radii, the surface pressure is low. In addition, the engine oil can collect in the ball socket, thus ensuring good lubrication between the adjusting screw and the stud.

In the partial load range, the injection pressure is increased by an alternative piston with a large stroke. Due to the large stroke of the alternative piston and the throttling effect of the inflow hole between the jet spring space and the fuel channel, the pressure in the jet spring space increases. The jet springs are further pre-stressed, thus increasing the injection pressure.



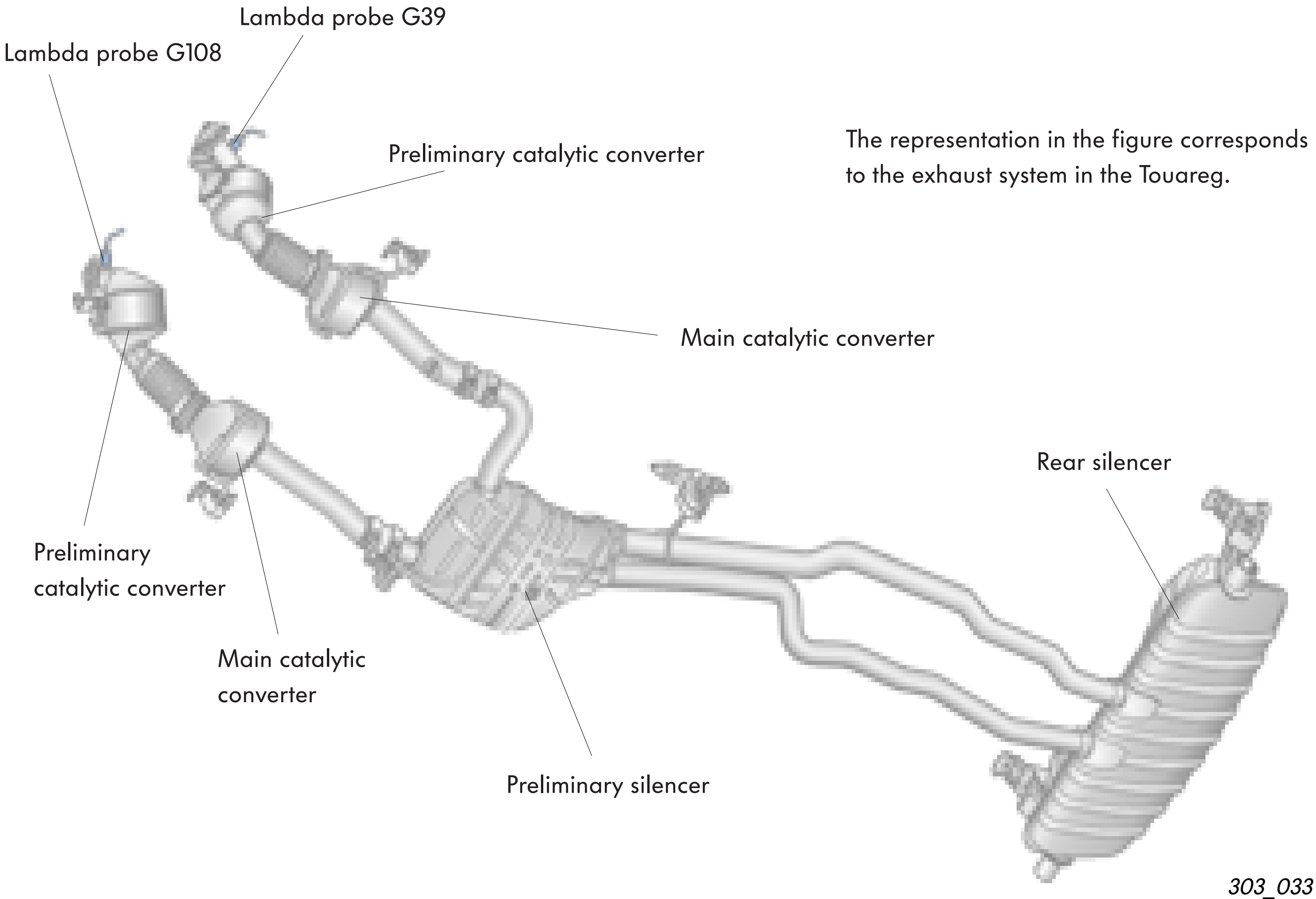
303_010

Exhaust system

The exhaust system of the V10-TDI engine consists of one preliminary catalytic converter and one main catalytic converter per cylinder bank, as well as a preliminary silencer and a main silencer.

All catalytic converters are oxidation catalytic converters.
The preliminary catalytic converters are located near the engine so that the operating temperature can be quickly attained, ensuring a high degree of pollutant reduction. The lambda probes located in front of the preliminary catalytic converters are used to control exhaust gas recirculation.

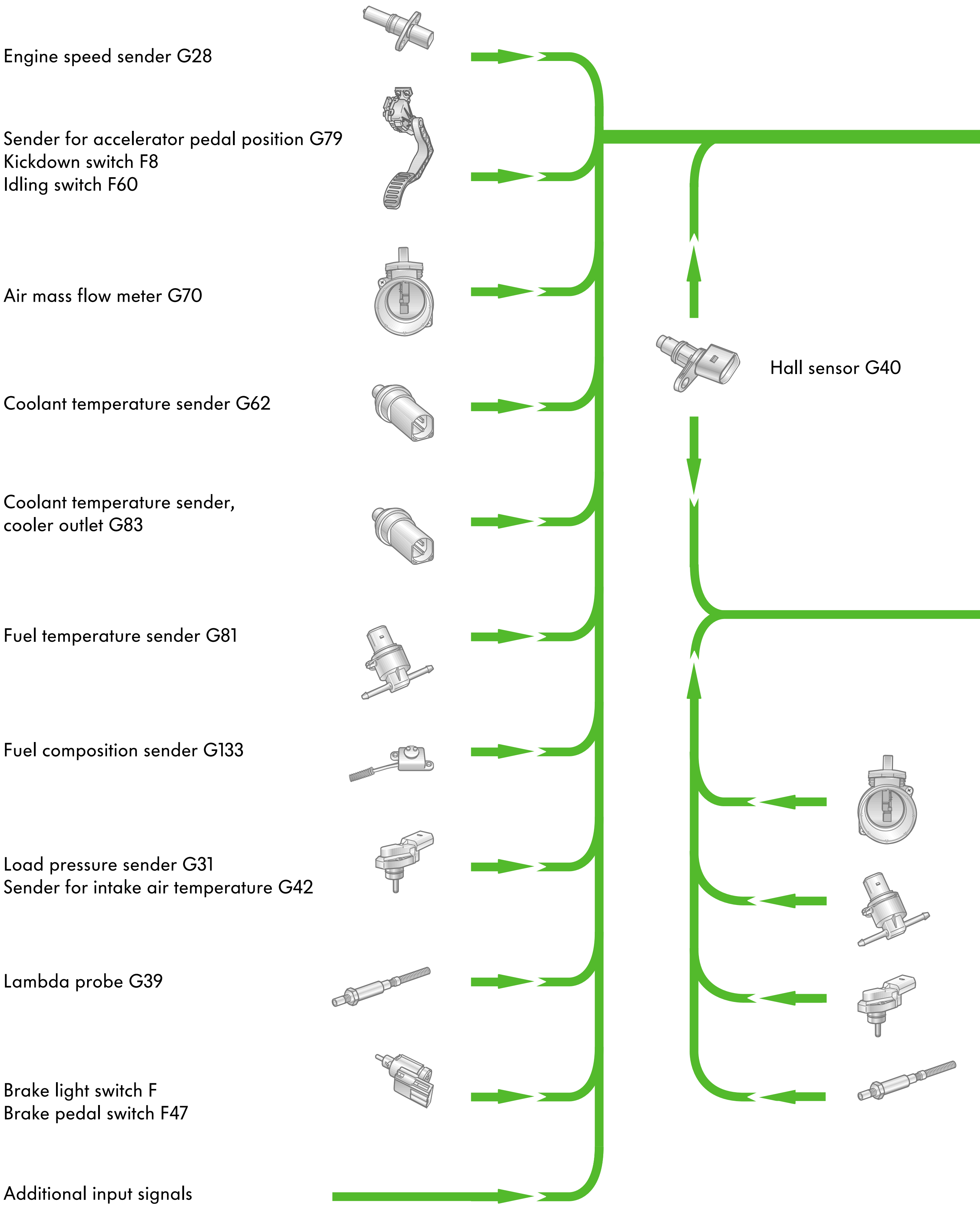
The representation in the figure corresponds to the exhaust system in the Touareg.



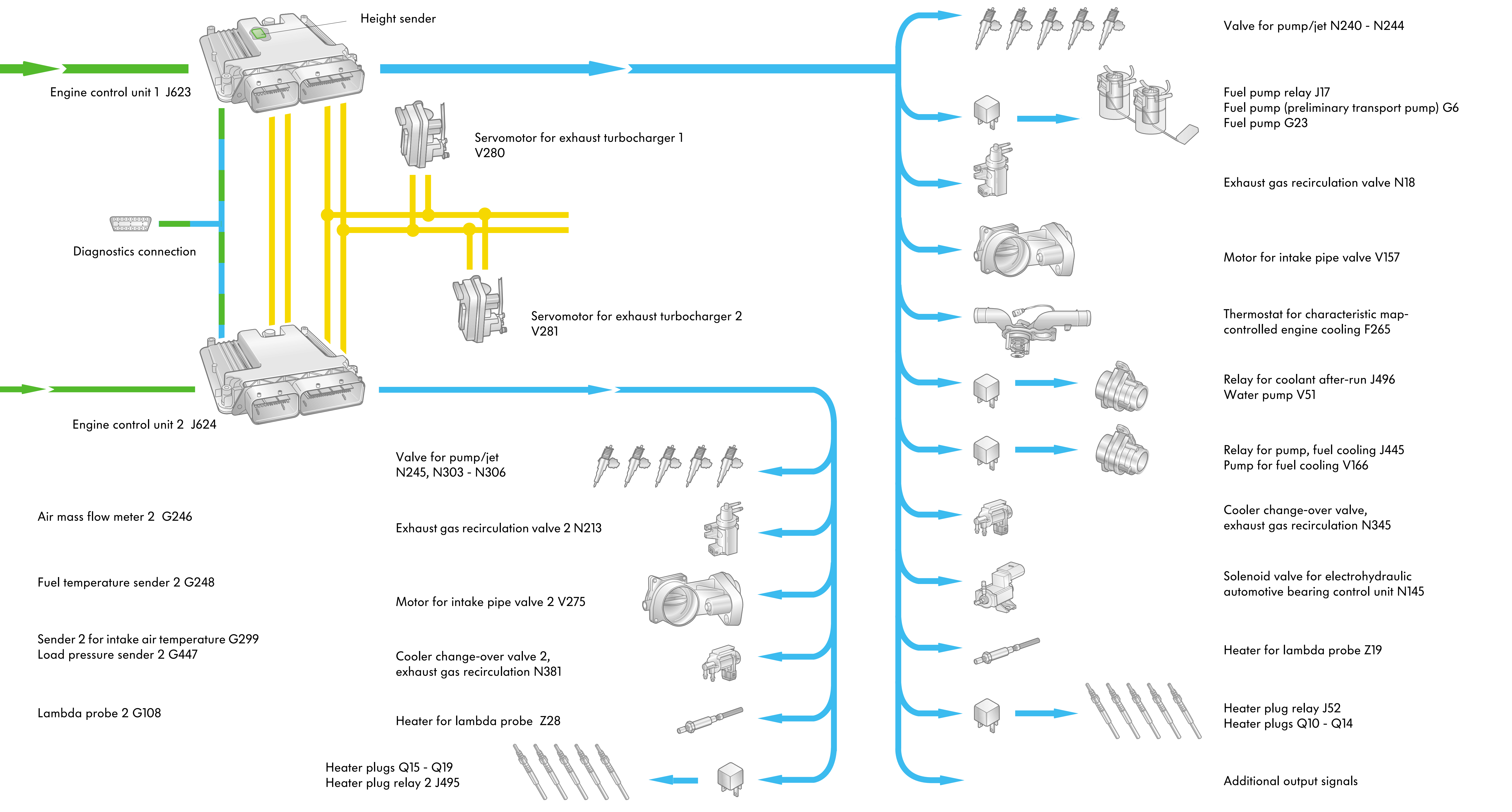
303_033

System overview

Overview of engine management

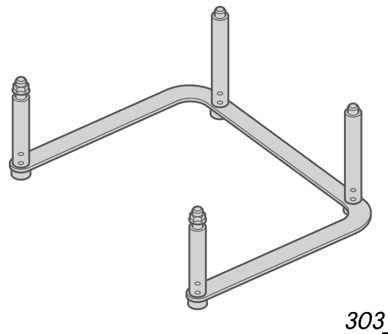
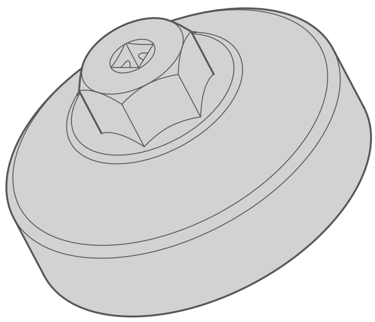
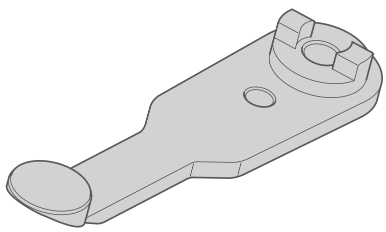
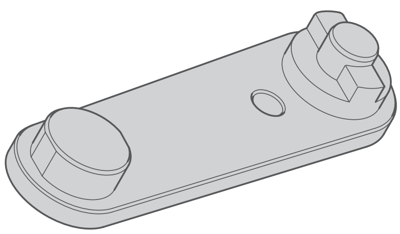


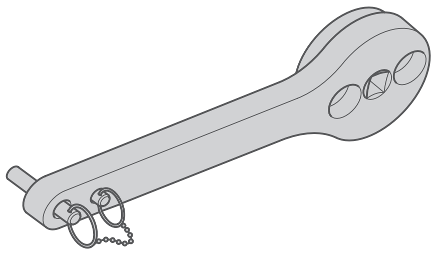
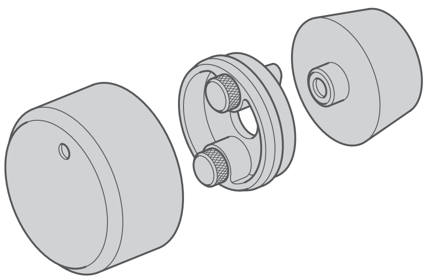
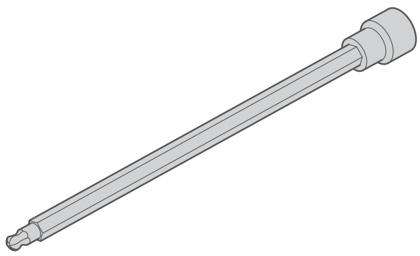
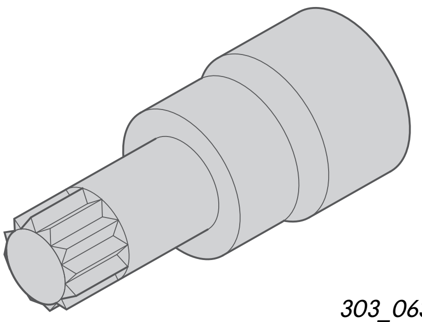
This section provides you with an overview of the V10-TDI engine management system. A detailed description of the sensors, actuators and functions of engine management can be found in Self-Study Programme No. 304 "Electronic Diesel Control EDC 16".

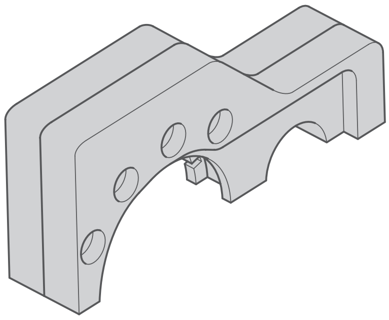
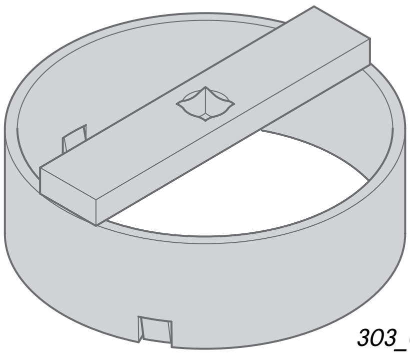


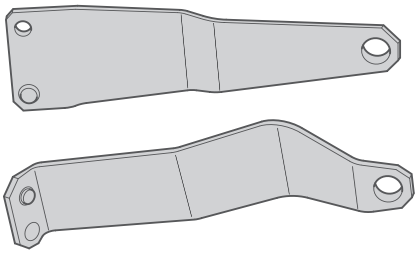
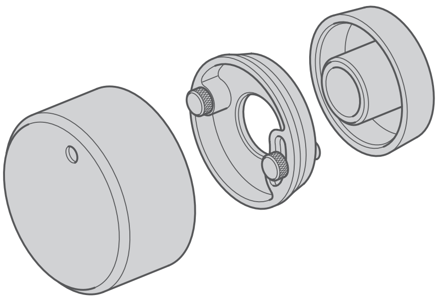
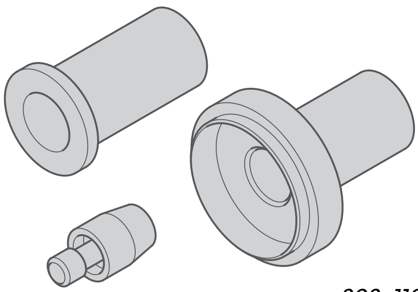
303_036

Special tools

Designation	Tool	Usage
T10191 frame	 303_056	To switch off the V10-TDI engine
T10192 oil filter key	 303_057	Removal and installation of the oil filter lid
T10193 camshaft clamp	 303_058	To fasten the camshaft cylinder bank 1 when setting the control times
T10194 camshaft clamp	 303_059	To fasten the camshaft cylinder bank 2 when setting the control times Removal and installation of the oil filter module

Designation	Tool	Usage
T10195 crankshaft clamp	 303_060	To fasten the crankshaft when setting the control times
T10196 key	 303_061	To install the PTFE crankshaft gasket on the flywheel side
T10197 plug cartridge SW6	 303_062	For removal and installation of various add-on pieces in the V-space of the engine
T10198 plug cartridge XZN16	 303_063	For removal and installation of the camshaft wheel

Designation	Tool	Usage
T10199 clamping device	 303_064	Clamping the camshaft wheels to remove and install the camshaft wheels
T10200 guide pin	Figure was not available at the copy deadline	For removal and installation of the belt drive module
T10201 clamping device	Figure was not available at the copy deadline	For removal and installation of the bearing tunnel
T10202 key	 303_067	For removal and installation of the fuel transport unit

Designation	Tool	Usage
T10126 transport shackle	 303_108	To transport the V10-TDI engine with workshop crane VAS 6100
T10207 assembly equipment	 303_109	To install the PTFE crankshaft gasket on the gearbox side
T10208 assembly equipment	 303_110	To install the PTFE crankshaft gasket on the alternator shaft
T10210 calibre	Figure was not available at the copy deadline	To align the pump-jet units

Check your knowledge

Which answers are correct?
Sometimes only one.
Sometimes more than one – or all of them!

1. The cylinders of the V10-TDI engine have ...

   A. a plasma-sprayed cylinder wall.
   B. wet cylinder liners.
   C. dry cylinder liners.

2. Why are the counterweights on the crankshaft made of tungsten?

   A. Tungsten has a high density, so that the weights can be small, thus saving space.
   B. Tungsten has a high temperature stability.
   C. Tungsten is inexpensive.

3. How are the auxiliary engines of the V10-TDI engine driven?

   A. using a toothed belt drive
   B. using spur-toothed gearwheels
   C. using helic gearwheels
   D. using a chain drive

4. What advantages do gearwheels have over toothed belts?

   A. Gearwheels are lighter, thus reducing weight.
   B. Gearwheels can transfer higher forces per unit size.
   C. Gearwheels have a greater longitudinal extension.

5. What is the duty of the shackle joints?

   A. They compensate for the tooth play between the camshaft wheel and the drive wheel of the belt drive module.
   B. They change the control times under full-load operation.
   C. They increase the camshaft speed when idling.

6. What is the duty of the oil scavenge pumps?

   A. They generate the oil pressure that is required for the oil circulation of the engine.
   B. They suction the oil out of the exhaust turbocharger oil return flow.
   C. They ensure that a sufficient quantity of oil is in the oil filler neck in every operating state.

7. How is fuel transported from the mechanical fuel pumps to the pump-jet units in the V10-TDI engine?

   A. using fuel manifolds
   B. using holes in the cylinder head
   C. using flexible steel hoses

8. Which statement is correct?

   A. In the Phaeton, the return-flow fuel is cooled by a fuel-air cooler under the vehicle floor.
   B. In the Touareg, the return-flow fuel is cooled by a fuel cooler that is integrated in a separate coolant circulation.
   C. The return-flow fuel is not cooled.

Solutions

1. A.; 2. A.; 3. A., C.; 4. B.; 5. A.; 6. B., C.; 7. A.; 8. A., B.

Service.

303

000.2811.23.20 Technical status 09/02