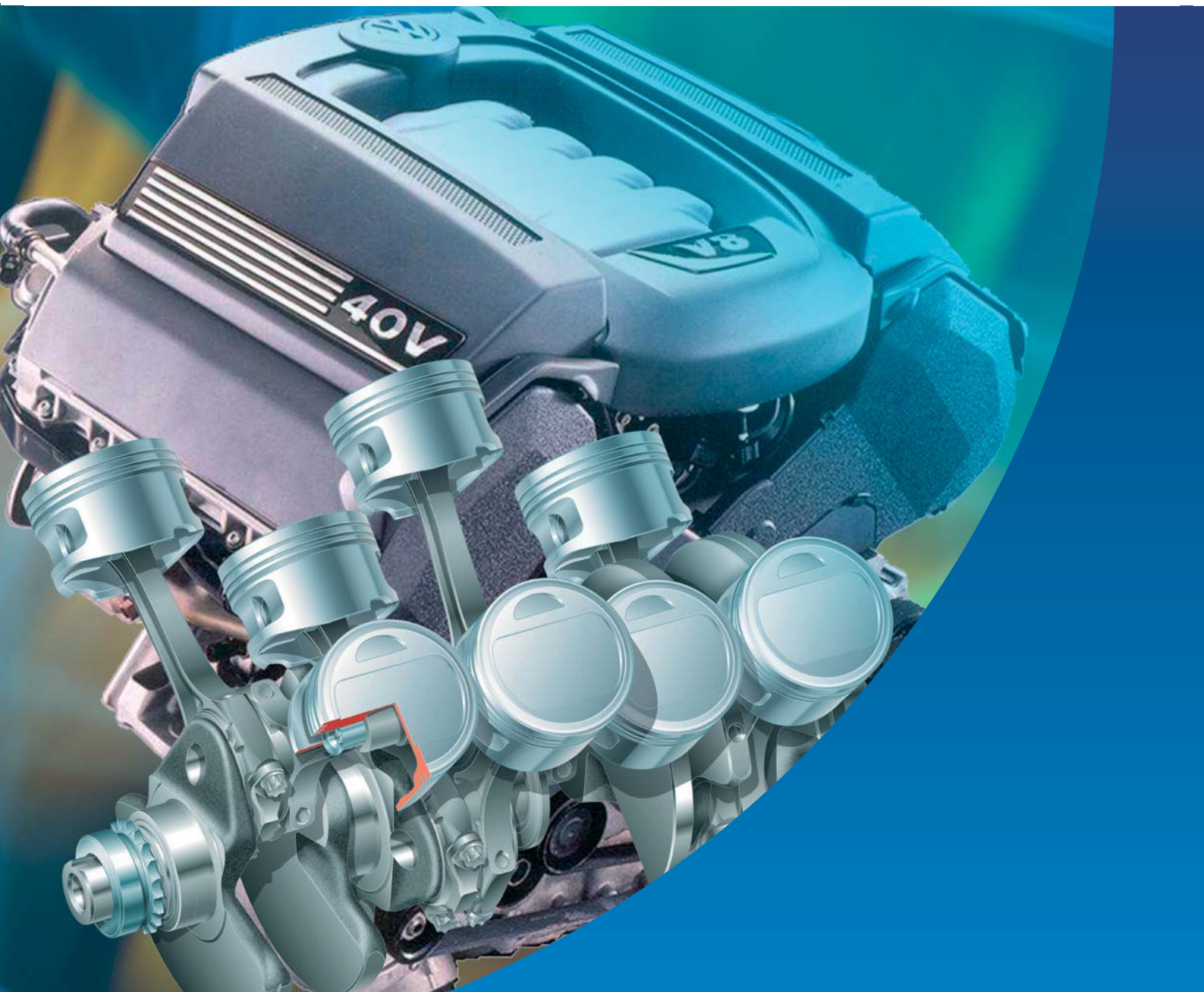
Service Training

Self-study programme 341

The 4.2l V8 5V engine

Design and function



The 4.2l V8 5V engine will be launched in two variants:

- In the Touareg, with an output of 228kW
- In the Phaeton, with an output of 246kW

Besides their differences in output, the two engines will differ primarily as a result of the modifications necessary for the Touareg's off-road capability.

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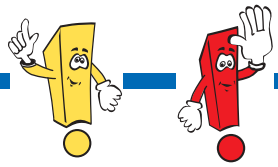
NEW



Attention Note

The self-study programme portrays the design and function of new developments!
The contents will not be updated.

For current testing, adjustment and repair instructions, please refer to the customer service literature intended for this purpose.

At a glance

Introduction

Technical features

Development of the two V8 engines focussed primarily on the following development objectives:

- Compliance with future emission regulations
- Reducing fuel consumption
- Increasing torque and output
- Reducing the weight of the engine
- Improving operating comfort
- Off-road capability in the case of the Touareg

S341_011

Engine mechanical system

- V8 cylinder block
- Cylinder head with 5-valve technology and roller rocker fingers
- Inlet camshaft adjustment
- Two-stage variable intake manifold in the Phaeton
- Three-stage variable intake manifold in the Touareg
- Oil filter module
- Twin-branch intake system

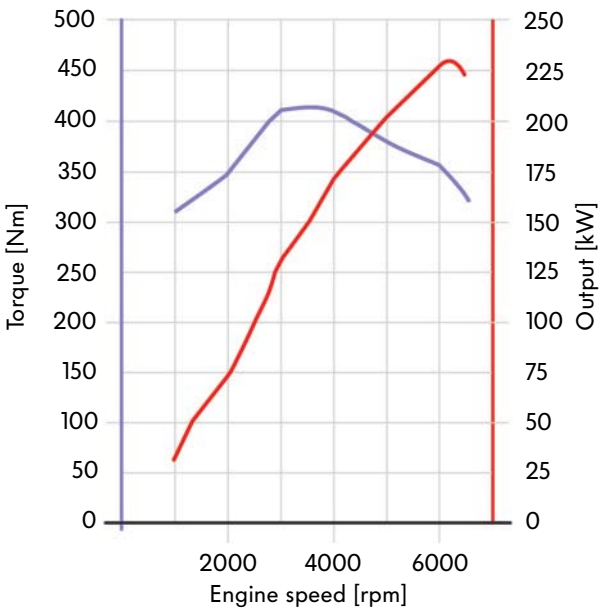
Engine management system

- Bosch Motronic ME 7.1.1
- Sequential fuel injection
- Electronic ignition
- Two hot film air mass sensors
- Secondary air system
- One knock sensor per cylinder bank
- Two primary catalytic converter broadband lambda probes
- Two transient lambda probes after the catalytic converter

Technical data

Engine code	AXQ (Touareg)	BGH (Phaeton)
Design type	8-cylinder V engine with a 90° V angle	
Displacement [cm^3]	4172	
Bore [mm]	84.5	
Stroke [mm]	93	
Valves per cylinder	5	
Compression ratio	11:1	
Maximum output	228kW at 6200 rpm	246kW at 6500 rpm
Maximum torque	410Nm at 3000 to 4000 rpm	430Nm at 3500 rpm
Engine management system	Bosch ME 7.1.1	
Fuel	RON 98, RON 95 with reduced output	
Exhaust gas aftertreatment	4 catalytic converters, 4 lambda probes secondary air system	
Exhaust emission standard	EU 4	

Torque and output graph 228kW



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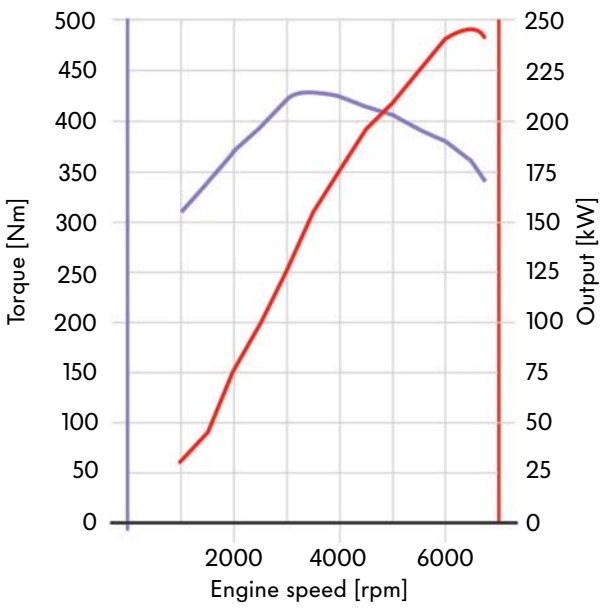
Torque and output graph 246kW



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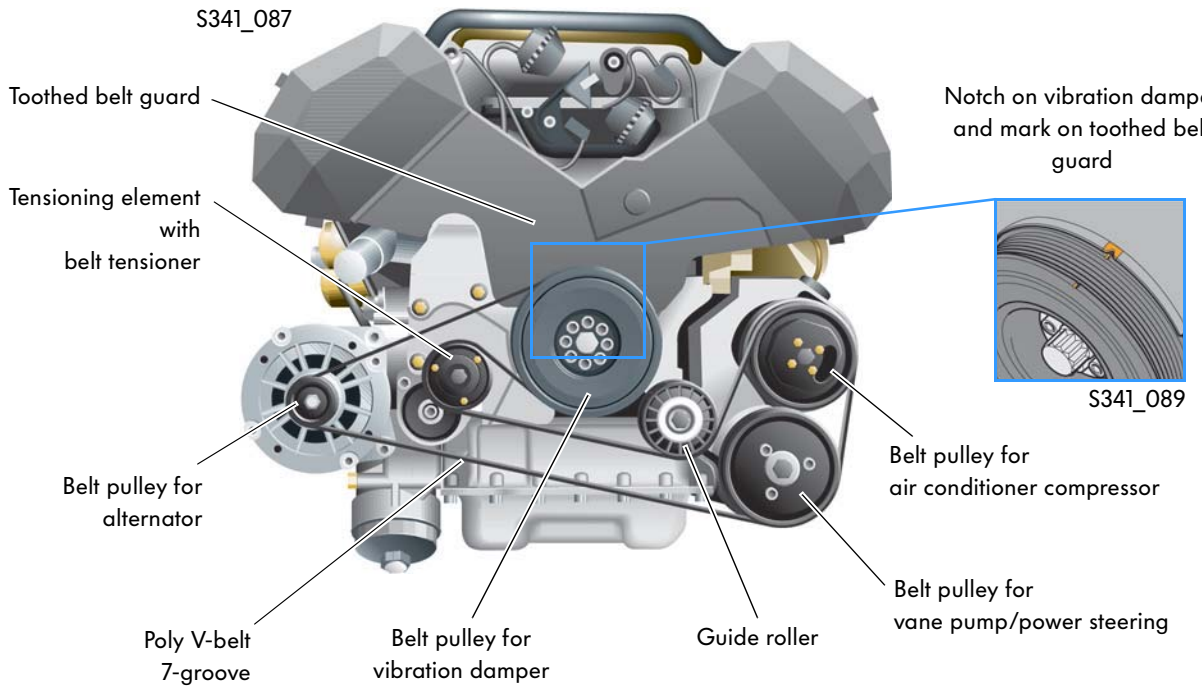
Ancillary unit drive

The ancillary units are driven by means of a 7-groove poly-V belt. The ancillary unit drive fitted in the Phaeton differs from that in the Touareg due to an additional guide roller and the different layout of certain ancillary units.

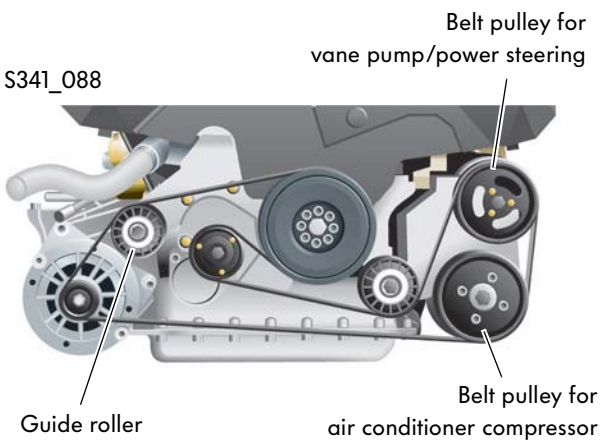
Touareg

In the Touareg, the alternator and air conditioning compressor are installed in a higher location than in the Phaeton. As a result of this, the Touareg is capable of fording water up to a depth of 500 mm.



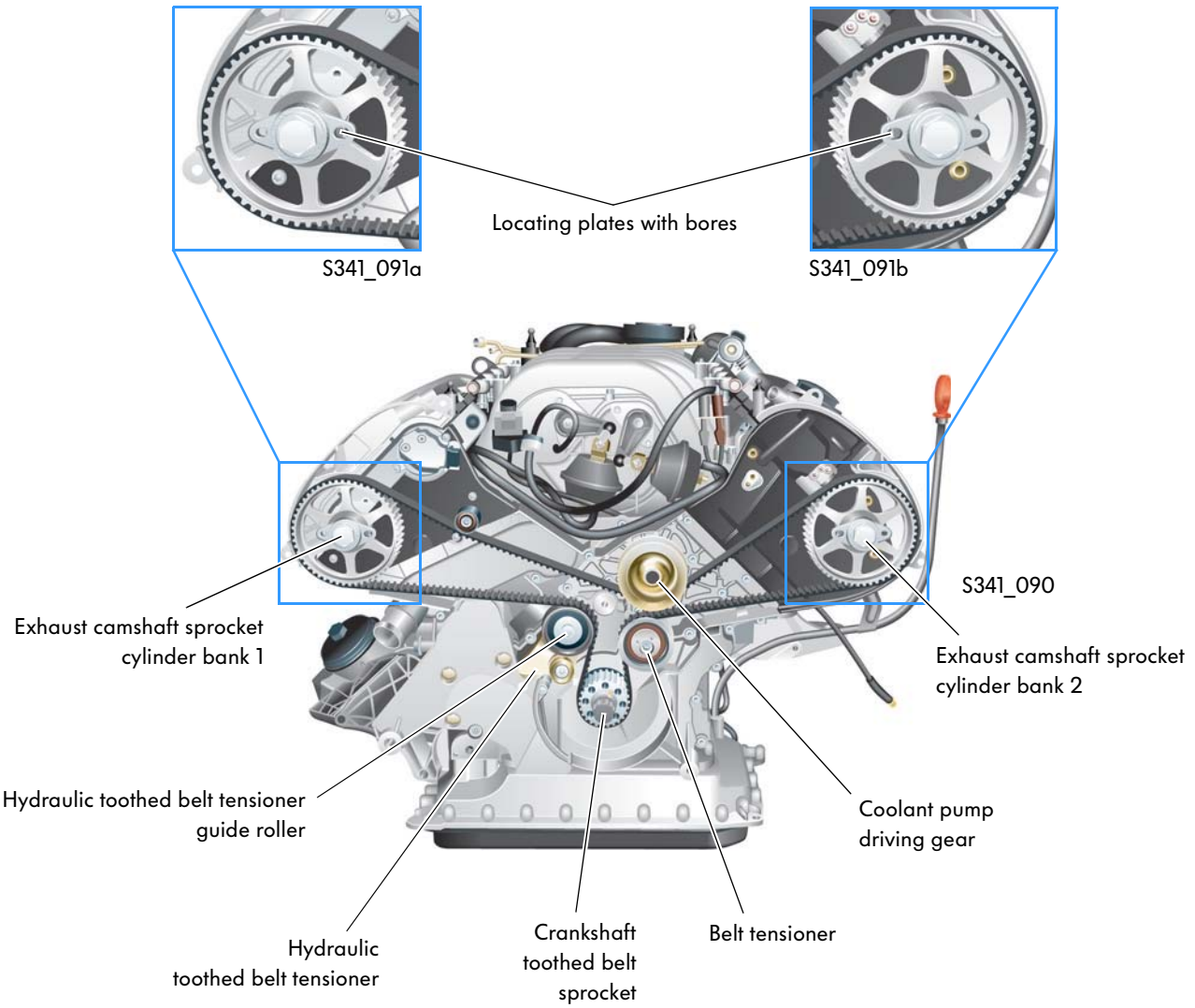
Phaeton

An additional guide roller is required in the Phaeton because the alternator is fitted in a lower position than in the Touareg. This is due firstly to the installation space conditions in the Phaeton and secondly to the Touareg's necessary fording capability.



Toothed belt drive

Both exhaust camshafts and the coolant pump are driven by the crankshaft in the toothed belt drive. The toothed belt is tensioned via a belt tensioner and a hydraulic tensioning element.

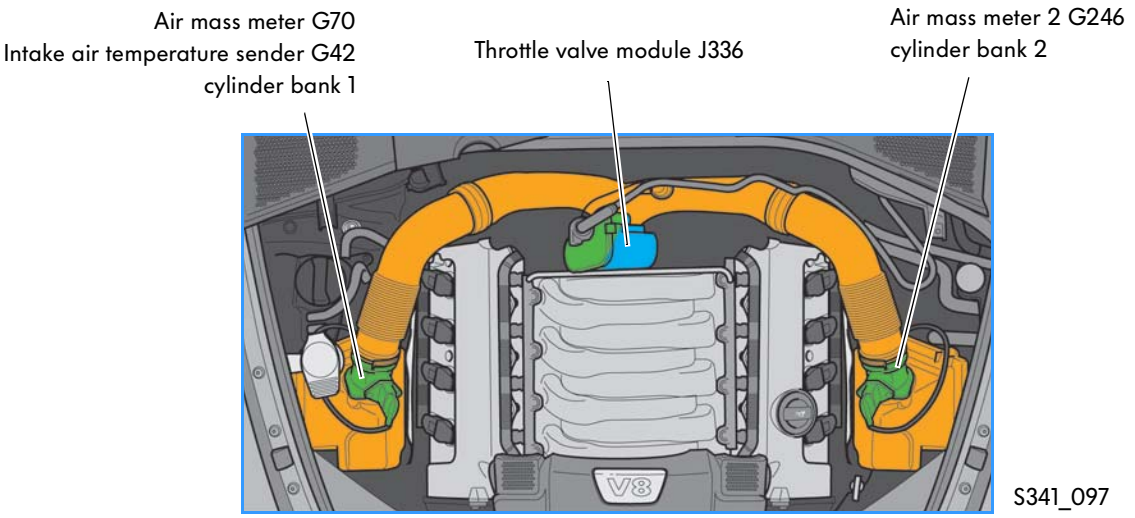


When renewing or replacing the toothed belt, the crankshaft must be set to TDC cylinder No. 5. To achieve this, the notch on the vibration damper must align with the mark on the toothed belt guard, and the locating plates' two large bores must face each other inwards. ELSA provides information on the detailed procedures for removing and installing the toothed belt.

Engine mechanical system

Intake system

The fresh air intake system has a twin-branch design to reduce pressure losses. Both intake tracts are brought together at the intake manifold upstream of the throttle valve module.
A hot film air mass meter per intake tract and an intake air temperature sender in the air mass meter G70 are used to determine the intaken quantity of fresh air.



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Intake manifold

The intake manifold is comprised of four bolted and bonded magnesium components.
The Touareg is fitted with a three-stage variable intake manifold and the Phaeton with a two-stage variable intake manifold. In comparison with the three-stage version, the two-stage design allows intake tracts with high-volume cross-sections to be implemented. This leads to an increase in engine output.

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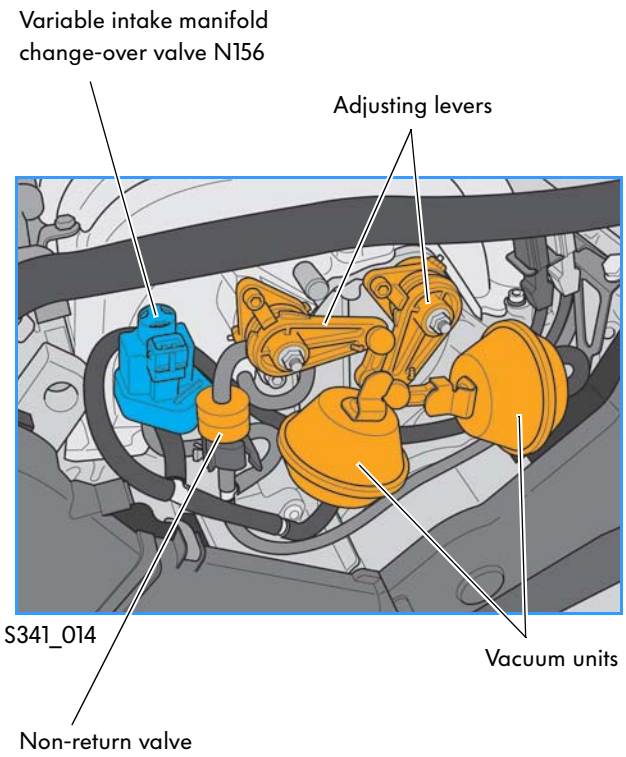
In the event of repair, the entire intake manifold has to be renewed, as the bonded surfaces can no longer be sealed.

Variable intake manifold

The figure shows the two-stage variable intake manifold fitted in the Phaeton.
It is comprised of the variable intake manifold change-over valve, two vacuum units with adjusting levers, a non-return valve, the hoses and the vacuum reservoir in the front area of the vehicle.

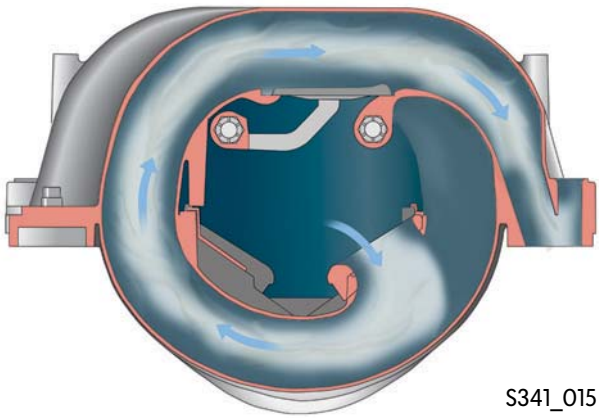


Change-over

- From the torque position (long intake tract) to the output position (short intake tract) at 4600 rpm.
- From the output position to the torque position at 4440 rpm.

Torque position

Long intake ports are used in the torque position. This leads to a high flow speed, extensive turbulence in the cylinder, very good fuel/air mixing andrapid combustion. In turn, this results in the development of high torque.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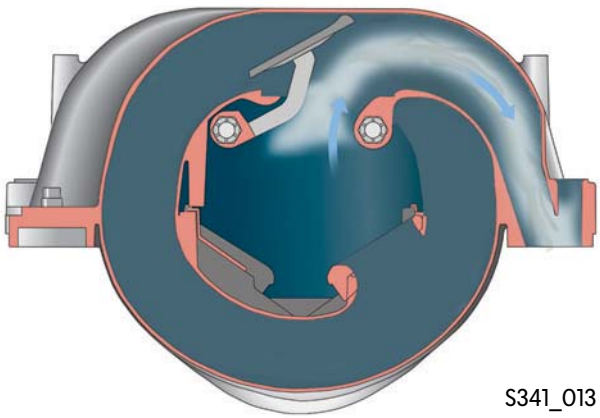
Output position

Short intake ports with the largest possible cross-sections are used in the output position. This results in high air throughput with good charging. In turn, this leads to high power output.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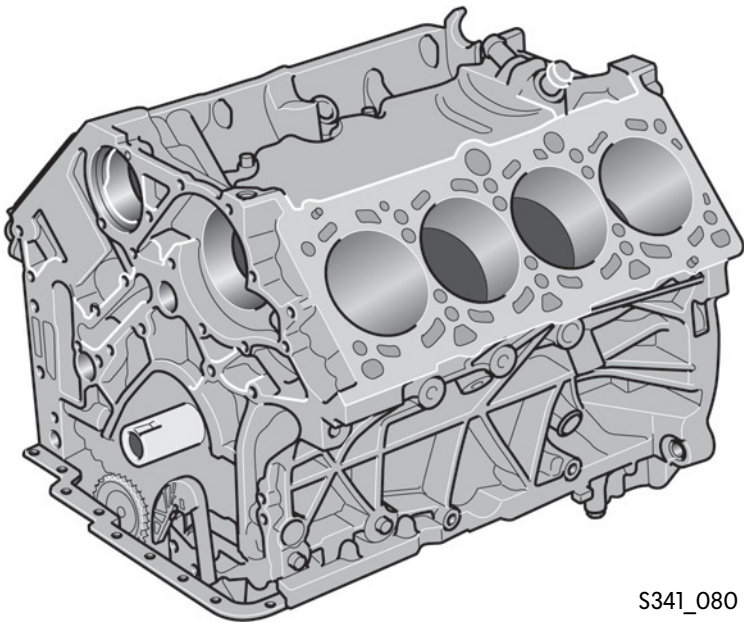
Cylinder block

The aluminium cylinder block has a 90° V angle and is manufactured from an aluminium alloy. The pistons run directly on the aluminium alloy's silicon crystals. As a result of this, no separate cylinder liners are required. The gap between cylinders is 90 mm.



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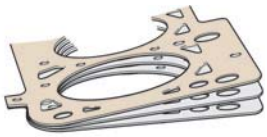
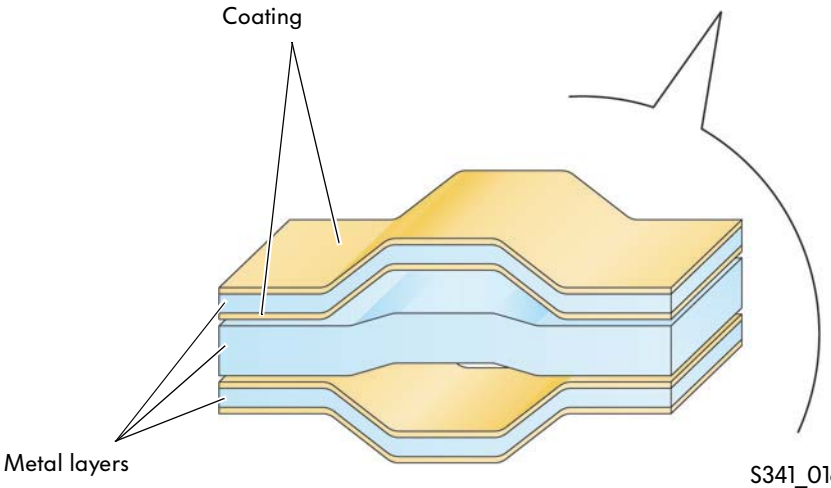
Cylinder head gasket

The cylinder head gasket is a triple-layer metal gasket, whose outer layers are covered with a coating.

Advantages:

- Low settling behaviour
- Long service life





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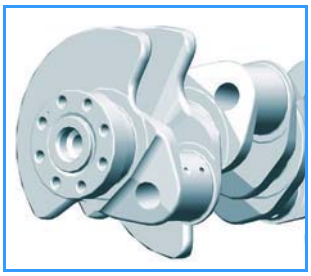
Crankshaft drive

Crankshaft

Supported at five points, the crankshaft is forged from tempered steel.
Two connecting rods are located on each crank pin.
Due to different gearboxes, the crankshaft fitted in the 4.2l V8 5V engine in the Phaeton has an 8-hole pattern, and that in the Touareg a 10-hole pattern, to the drive plate.

Phaeton crankshaft
with 8-hole pattern



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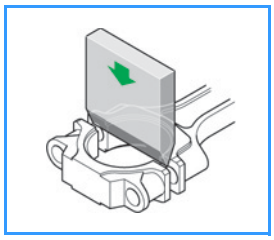
Connecting rods

The connecting rods are machined as complete parts and are finally separated by a tool, exerting great force, to form the connecting rod and connecting rod bearing cap. This process is called "cracking".



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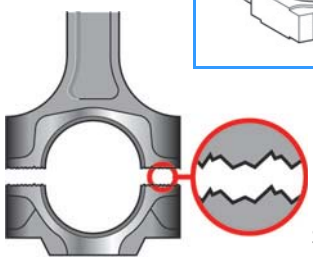

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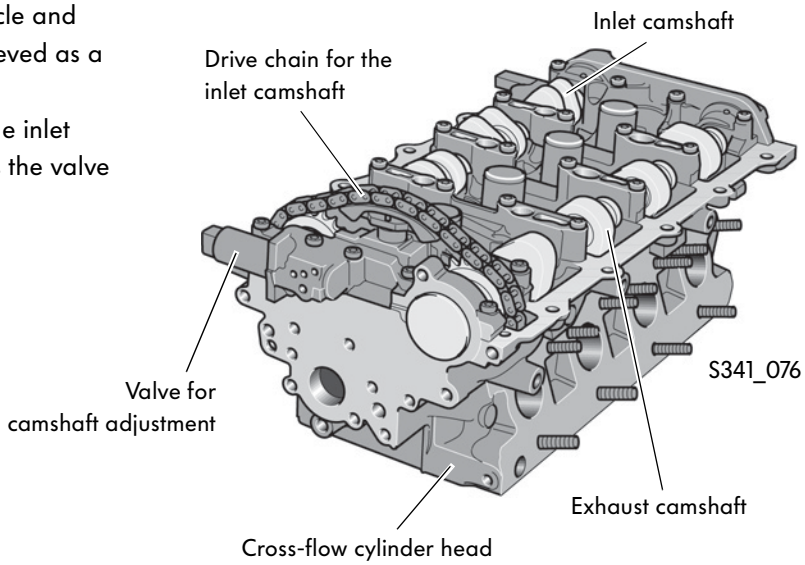
Pistons

The aluminium pistons are equipped with a valve pocket for the centre intake valve. Thanks to the valve pocket, the pistons are cylinder bank-specific.

S341_024

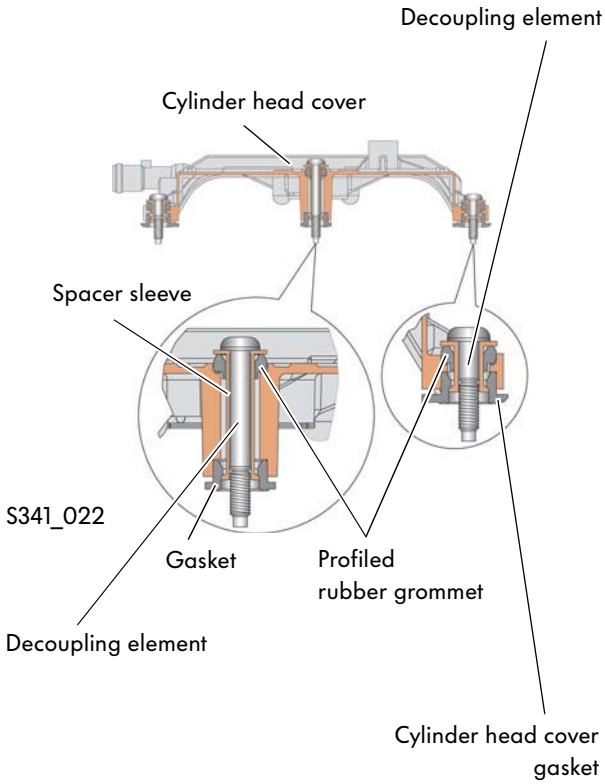
Cylinder head

The aluminium cylinder head has been developed as a cross-flow cylinder head. A good gas cycle and therefore a good cylinder charge are achieved as a result of this.
The cylinder head houses the camshafts, the inlet camshaft drive and adjustment facility plus the valve gear with 5-valve technology.



Cylinder head cover

The thin-walled cylinder head cover is manufactured from a die-cast magnesium alloy.
Sealing between it and the cylinder head is achieved using rubber gaskets. As a result of this, there is no direct connection between the cylinder head cover and the cylinder head, and engine vibrations are not passed on to the cylinder head cover. The cylinder head cover is bolted using what are called decoupling elements.

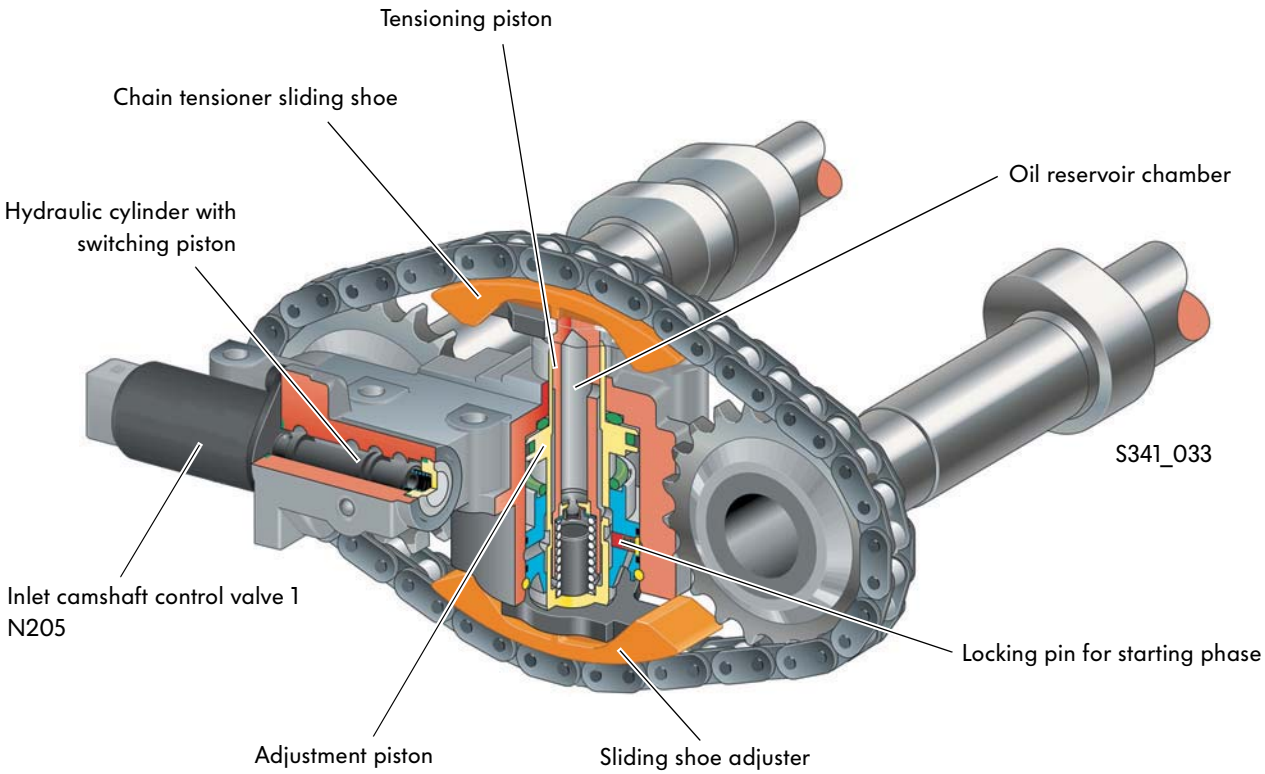


ELSA provides information on the detailed procedures for preventing cylinder head cover warping and guaranteeing reliable sealing.

Camshaft adjustment system

The gas exchange processes in the engine's combustion chamber exert a significant influence on output, torque and pollutant emission. The camshaft adjustment system allows these gas exchange processes to be adapted to the engine's relevant requirements.
This is carried out by changing the valve opening and closing times, depending on the engine speed, with the aid of the inlet camshaft. In this case, the torque is increased in the lower to medium engine speed range, whilst output is raised in the upper engine speed range.
Camshaft adjustment additionally improves internal exhaust gas recirculation.

Adjustment equates to a crank angle of 22° in the "advance" direction.



Engine mechanical system

How it works:

Depending on the manner in which the camshaft adjustment valve is actuated, the oil is guided into two different control ports. The ports are linked to the chambers on both sides of the adjustment piston. Adjustment in the "retard" direction takes place via port A, whilst adjustment in the "advance" direction occurs via port B.

Basic position: From idle speed to approx. 1000 rpm
Torque position: From approx. 1000 rpm to approx. 3600 rpm in the Touareg and approx. 5600 rpm in the Phaeton
Output position: From approx. 3600 rpm in the Touareg and approx. 5600 rpm in the Phaeton

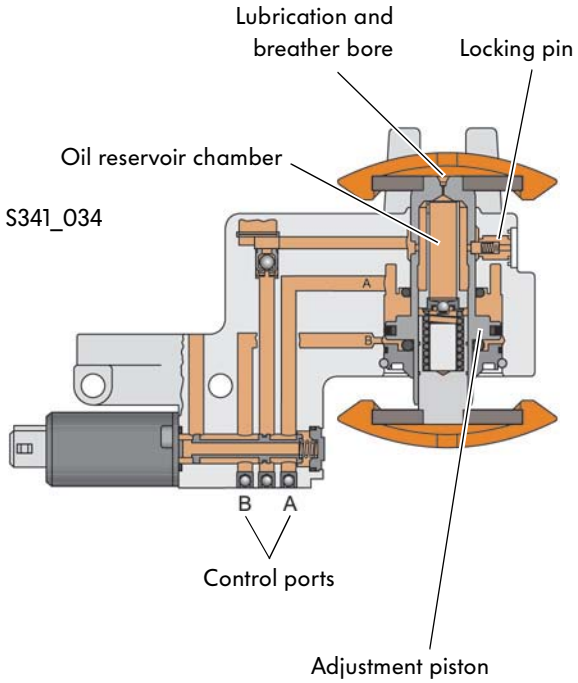
Basic position

Engine off

No oil pressure is available when the engine is switched off. The spring-loaded locking pin is pressed into the adjustment piston's detent groove, locking it.

Starting the engine

When the engine is started, the oil pressure is not yet sufficient to press the locking pin out of the adjustment piston's detent groove.



The locking function and the oil reservoir chamber in the camshaft adjustment unit reduce vibrations in the chain drive. Noise during the starting phase is minimised as a result of this.

Engine running

Once a specific oil pressure has been reached, the oil presses the locking pin - counter to the spring's force - out of the detent groove, and the inlet camshaft can be adjusted.

Torque position

The torque position is activated at an engine speed of between 1000 and 3600 rpm in the Touareg and 5600 rpm in the Phaeton.
Via port B, the oil is conducted to the adjustment piston, pressing it into the torque position. In this position, inlet valve closing is advanced. This is advantageous, as the flow speed in the intake manifold is low in this engine speed range, and the fuel/air mixture follows the movement of the piston. Thanks to advanced inlet valve closing, the mixture can no longer be pushed back into the intake manifold by the cylinder.

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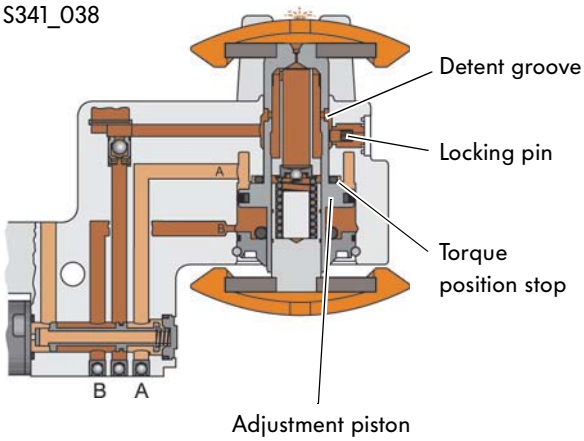

Output position

As of an engine speed of approximately 3600 rpm in the Touareg and 5600 rpm in the Phaeton, the system switches to the output position (basic position).

Via port A, the oil is conducted to the adjustment piston, pressing it into the output position.
In this position, inlet valve closing is retarded.
Thanks to the high flow speed at these high engine speeds, the fuel/air mixture continues to flow into the cylinder, although the piston is already moving up again.

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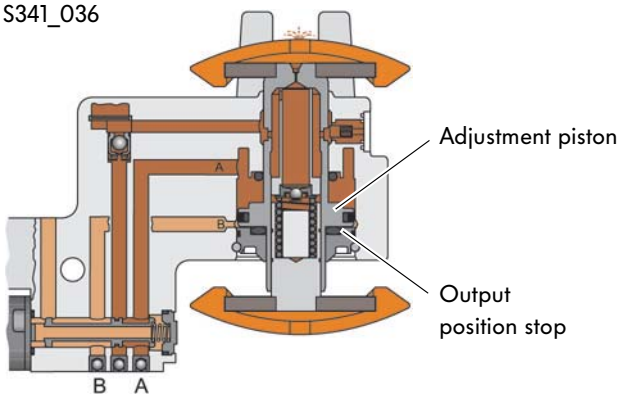
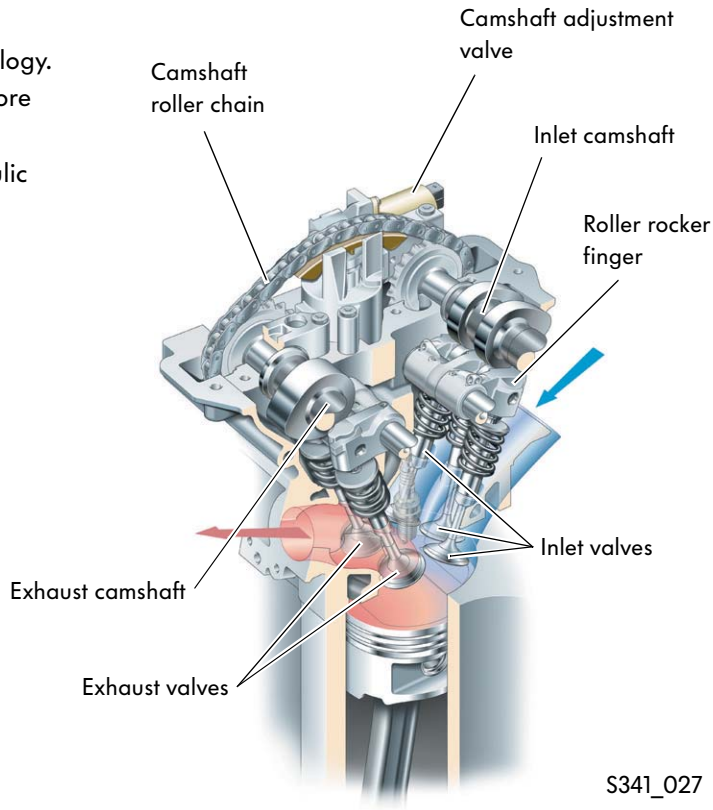


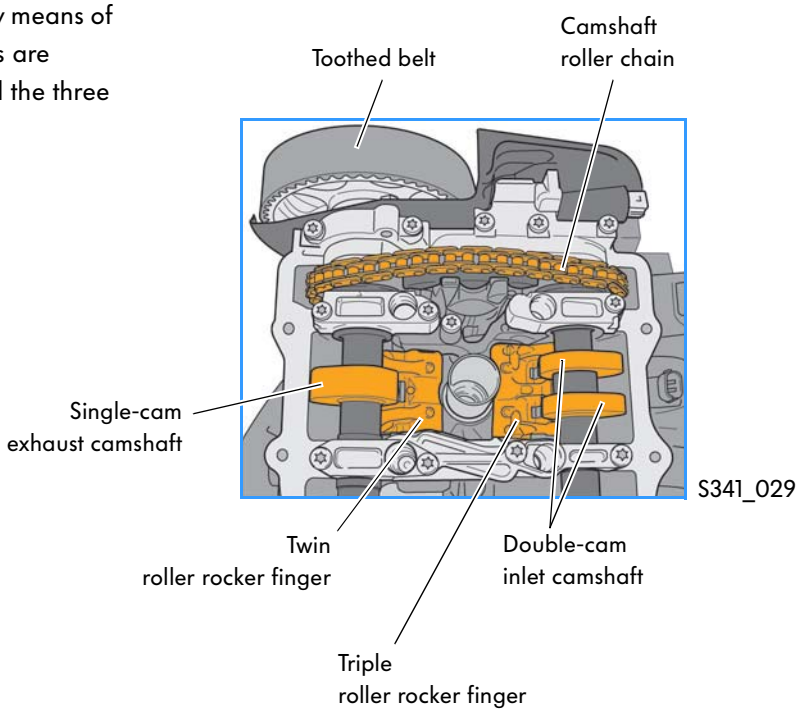
Valve gear

The V8 engine is equipped with 5-valve technology. This offers a large flow crosssection and therefore ensures a very good gas cycle. The valves are actuated via roller rocker fingers with a hydraulic valve clearance compensation element.



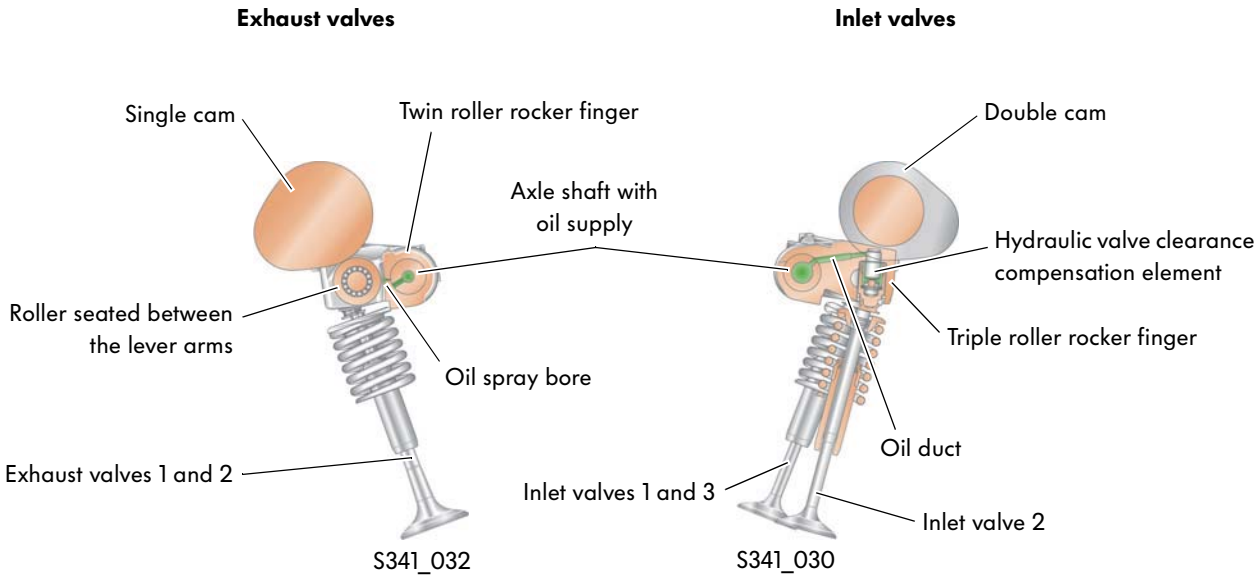
Valve actuation

The valves are actuated by the camshafts by means of roller rocker fingers. The two exhaust valves are actuated via a twin roller rocker finger, and the three inlet valves via a triple roller rocker finger.



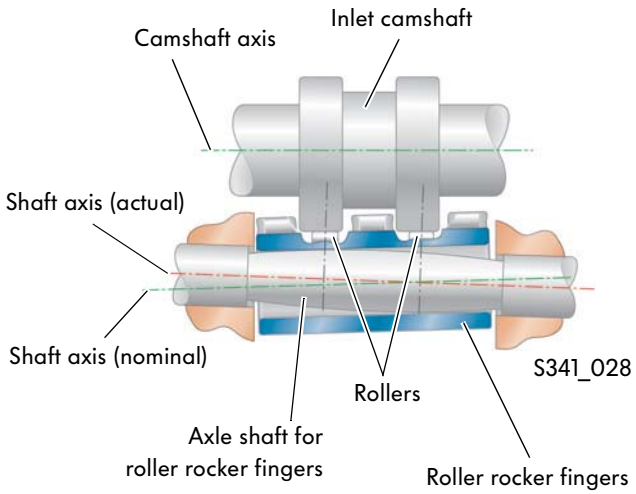
The roller rocker fingers are mounted on an axle shaft. The axle shaft is used to simultaneously supply the bearings and the hydraulic valve clearance compensation elements with oil.

- The hydraulic valve clearance compensation elements are located directly in the lever arm above the valves.
- The rollers are each seated between the lever arms.



Inlet roller rocker finger tolerance compensation

Minor alignment and component tolerances may occur between the inlet camshaft cams and the roller rocker finger rollers.
To guarantee even pressure between the components, the inlet roller rocker finger axle shaft is of a convex design.
This prevents the roller rocker fingers from canting.



The axle shaft's tolerance versus the camshaft is shown in grossly exaggerated form to depict it more clearly.