Audi 3.0l V6 TFSI engine of EA839 series

Self Study Programme 655

For internal use only.

The new 3.0l V6 TFSI engine of the EA839 series supersedes the previously installed 3.0l V6 TFSI EA837. It will initially be used in the Audi S4 (type 8W), where it provides better performance and fuel economy than its predecessor.
The engine will be available in several performance classes, either as a mono-turbo or a biturbo, in Audi models and also in other group models.
The development goals were not only to improve fuel economy for end users, but also to meet the mandatory emission limits in all markets. This is achieved by a range of modifications including reduced friction, innovative thermal management, lightweight design and cutting-edge engine management technology.

Other innovative features of the new V6 engine are:

- Thermostat controlled oil circuit
- Cylinder heads with integrated exhaust manifold and "Hot Side Inside" (HSI) technology
- New timing assembly with balancer shaft
- New combustion process (Miller cycle) with central injector configuration

This SSP contains QR codes which you can use to access additional interactive content (refer to page 58).

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Learning objectives of this self study programme:

This self study programme describes the design and function of the fourth-generation 3.0l V6 TFSI engine of the EA839 series in the Audi S4 (type 8W).
After you have completed this self study programme you will be able to answer the following questions:

- What are the differences between the EA839 and the EA837?
- Which structural design measures are used to achieve lightweight design?
- How do the oil supply and engine cooling systems work?
- What are the special features of the air supply system?
- How do the new injection process and the engine management system work?

Contents

Introduction

Engine mechanicals

Oil supply

Air supply and turbocharging

Cooling system

Fuel system

Engine management

Exhaust system

Inspection and maintenance

Appendix

The self study programme teaches a basic understanding of the design and mode of operation of new models, new automotive components or new technologies.
It is not a repair manual! Figures are given for explanatory purposes only and refer to the data valid at the time of preparation of the SSP.
This content is not updated.
For further information about maintenance and repair work, always refer to the current technical literature.
In the glossary at the end of this self study programme you will find an explanation of all terms written in *italics* and indicated by an arrow ↗.

Note

Reference

Introduction

Engine description and special features

- V6 petrol engine
- Aluminium engine block
- FSI petrol direct injection with on-demand high and low pressure systems
- DOHC valve timing with 4 valves per cylinder
- Exhaust turbocharging in inner V ("Hot Side Inside")
- On-demand high and low pressure fuel systems
- Variable intake valve adjustment with Audi valvelift system (AVS)
- Direct charge air cooling

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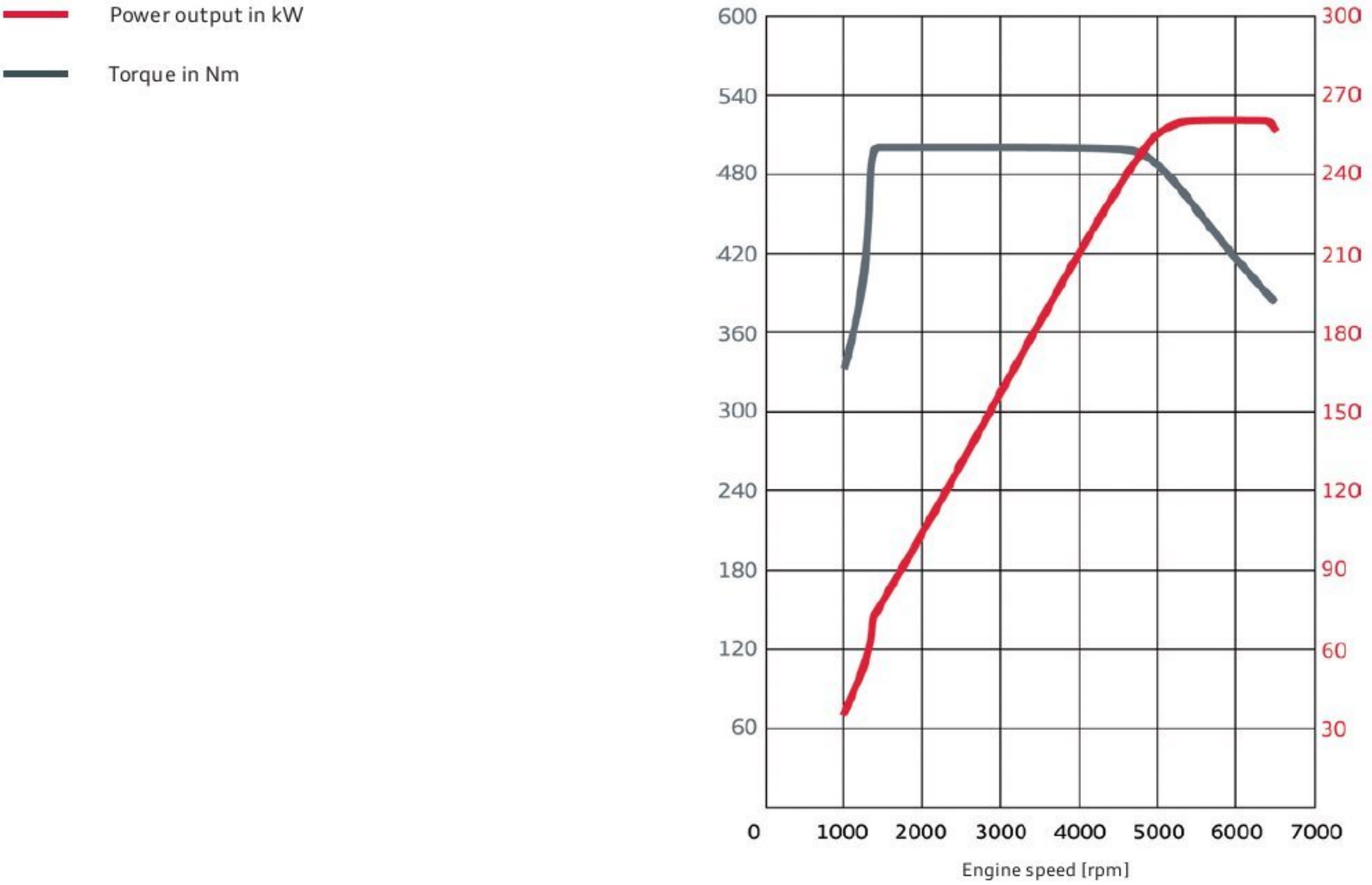
Specifications

Torque-power curve of 3.0l V6 FSI engine (engine code CWGD)



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Features	Specifications
Engine code	CWGD
Type	6-cylinder engine with 90° V angle
Displacement in cm^3	2995
Stroke in mm	89
Bore in mm	84.5
Cylinder spacing in mm	93
Number of valves per cylinder	4
Firing order	1-4-3-6-2-5
Compression ratio	11.2 : 1
Power output in kW at rpm	260 at 5400 - 6400
Torque in Nm at rpm	500 at 1370 - 4500
Fuel type	Premium unleaded 95 RON
Turbocharging	Exhaust turbocharger (maximum charge pressure 2.3 bar absolute)
Engine management	Bosch MDG 1
Engine weight acc. to *DIN GZ* ↗ in kg	172
Exhaust gas treatment	2 close-coupled ceramic calatysts, oxygen sensor before and after catalytic converter
Emission standard	EU6ZD/ULEV50

Engine mechanicals

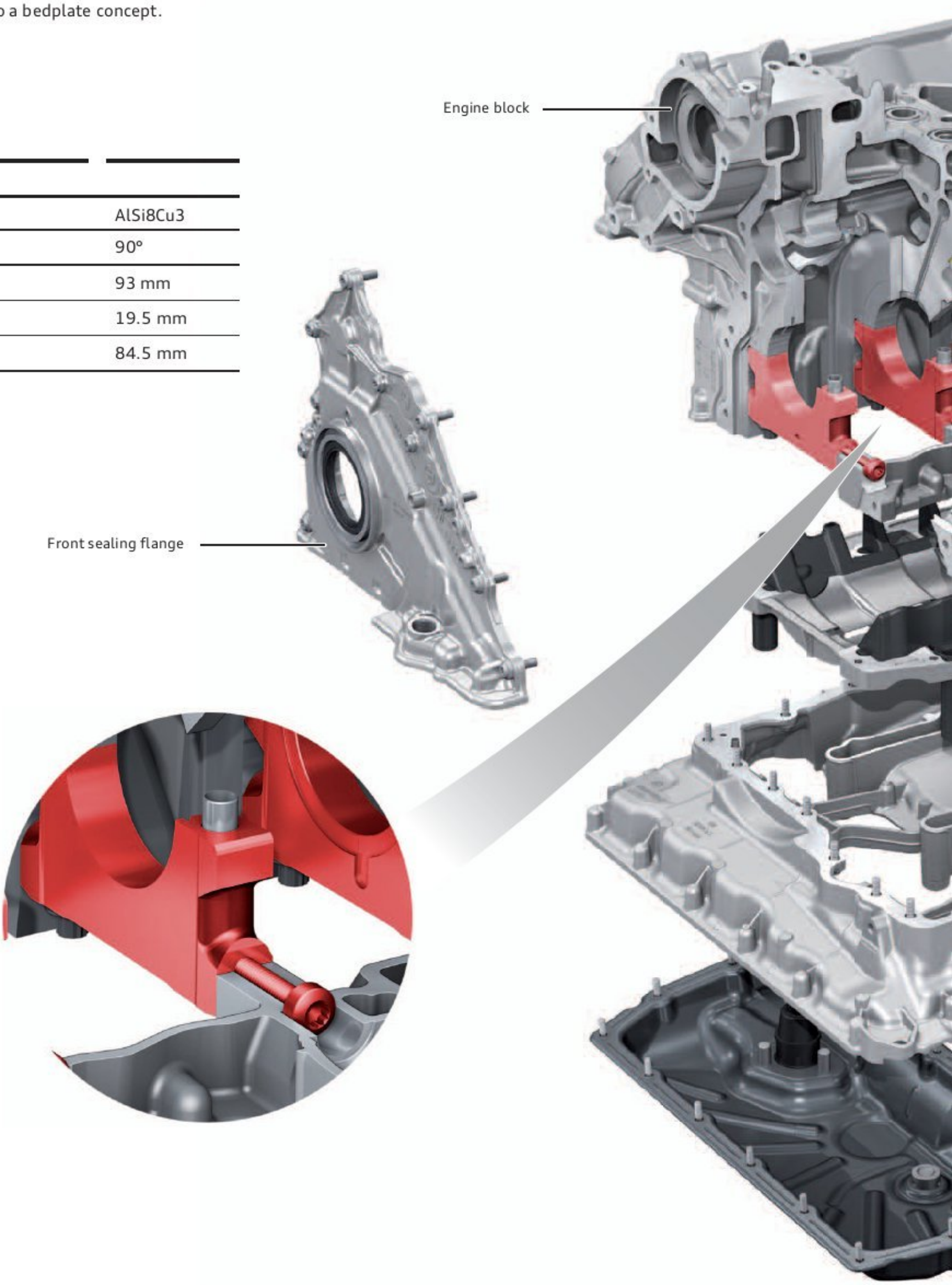
Engine block

The engine block is a closed-deck design and made from a *hypoeutectic aluminium alloy* ↗. It is manufactured in a sand casting process. Thin-wall bushings made from *GJL* ↗ serve as cylinder liners. They have a wall thickness of 1.5 mm and are thermally joined (shrink-fitted).

The side walls of the engine block are a deep skirt design, which also allows the main bearings to be bolted transversely. This saves weight and cost compared to a bedplate concept.

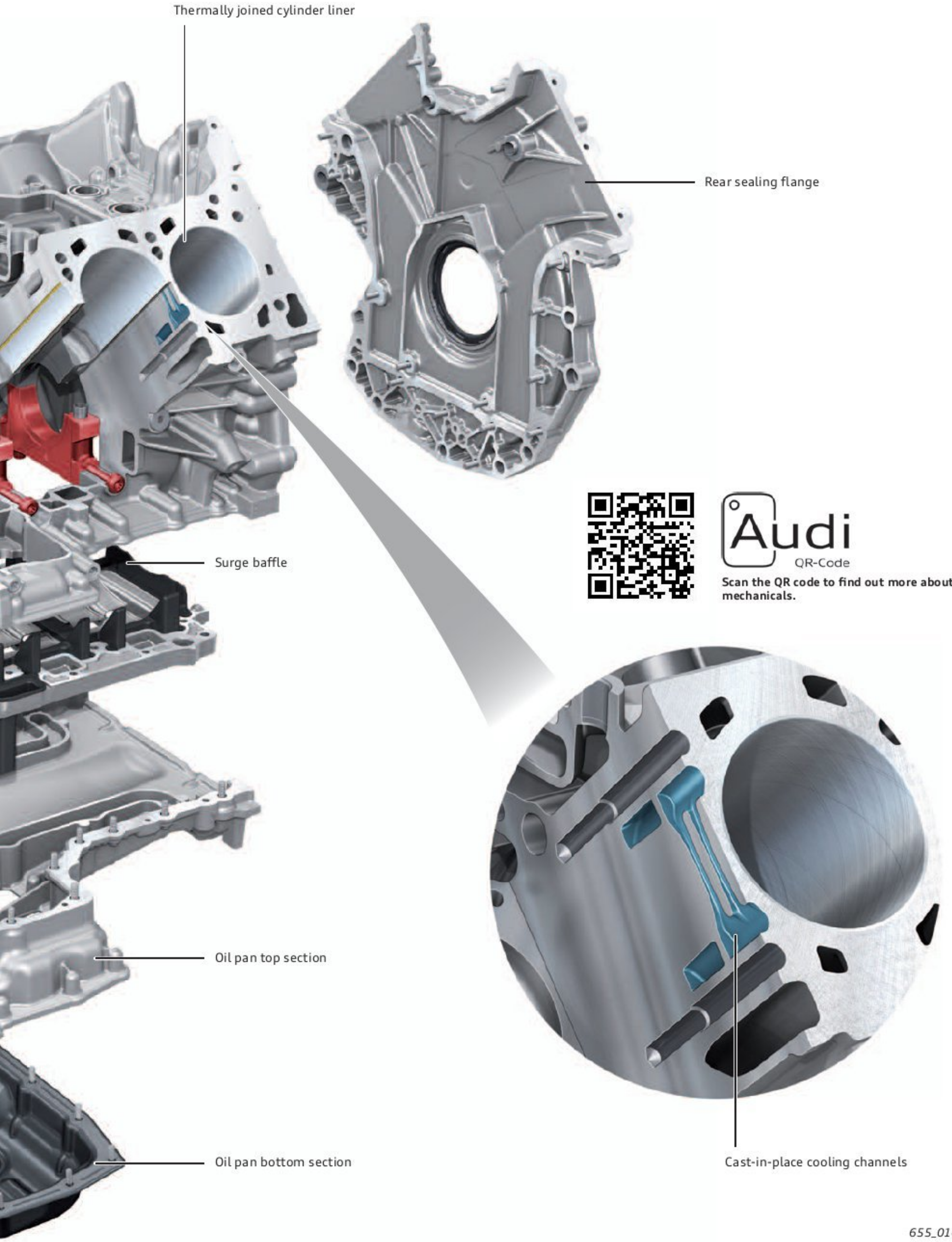
The cylinder liners are finished by spiral slide honing and plate honing. This optimised honing process reduces friction losses within the engine.

Features	
Material	AlSi8Cu3
Cylinder bank angle	90°
Cylinder spacing	93 mm
Bank offset	19.5 mm
Port	84.5 mm



Inter-cylinder partition wall cooling

By enlarging the spacing between the cylinders to 93 mm from 90 mm, space was created for the integration of cast-in-place cooling channels into the inter-cylinder partition walls. This means that the temperatures at the inter-cylinder partition walls are 20 °C lower than in the engines of the EA837 series.



Audi QR-Code

Scan the QR code to find out more about the engine mechanicals.

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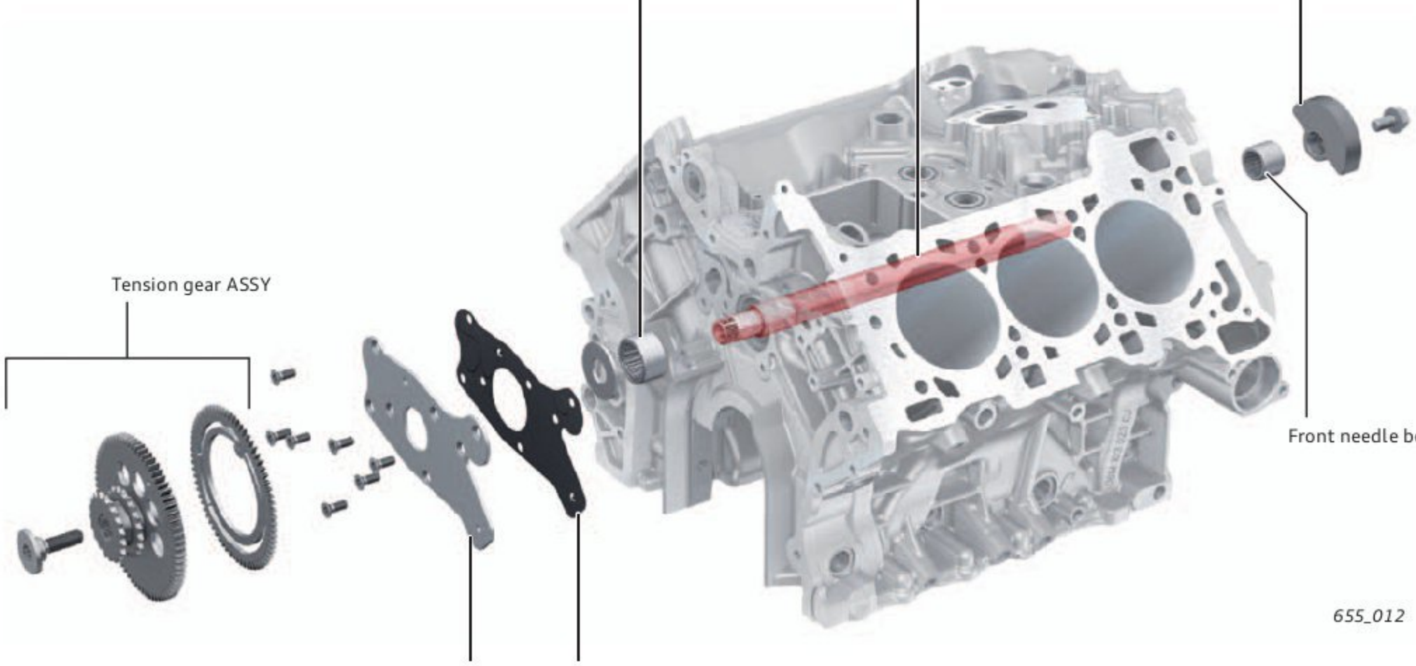
Balancer shaft

The balancer shaft in the inner V is driven by the crankshaft via a gear step. It rotates in the opposite direction to the engine at engine speed, thereby compensating for first-order moments of inertia. To reduce friction loss, the balancer shaft is mounted in needle bearings in the engine block.



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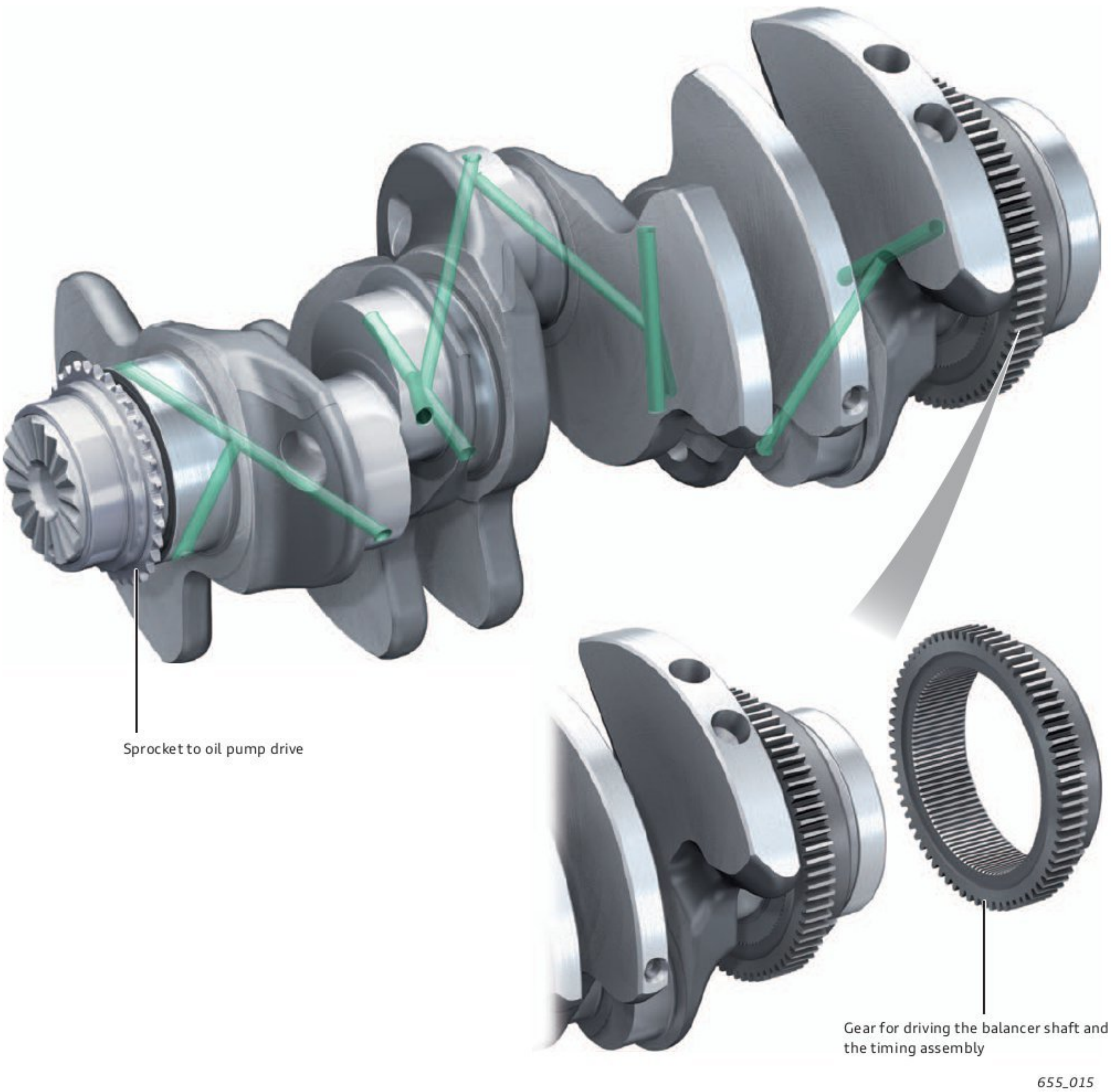
Crankshaft drive

Crankshaft

The 3.0l V6 TSFI engine uses a crankshaft mounted in 4 bearings with 3 split-pin crank pins. The crankshaft is made from forged steel. All fillet radii are induction-hardened to increase strength. The main bearing shells are identical in design. The only difference is a slot in the upper bearing shell. The bearing shells consist of a steel back and an aluminium alloy serving as a bearing material as well as a wear-resistant run-in and dry running coating (PC-11 IROX® polymer coating). The crankshaft is located axially at main bearing 3. The crankshaft has six counterweights. The conrods are lubricated via ports arranged in a T configuration in the crankshaft.

Depending on gearbox version, either the flywheel or the driver plate is bolted on the power output side. The multi-pole wheel (magnetic ring) is also fitted here. Together with the engine speed sensor G28, it generates the engine speed signal for the engine control unit. A gear which drives the timing assembly is also fitted here. This gear is press-fitted onto the crankshaft during production. To ensure correct timing, a spline is attached to the crankshaft and to the inside of the gear.
The shrink-fitted chain sprocket on the belt side drives the oil pump. The belt pulley is designed as a torsional vibration damper and attached by means of a Hirth spline and a central bolt. A locator pin is used to ensure that the belt pulley is installed in correct alignment with TDC mark.



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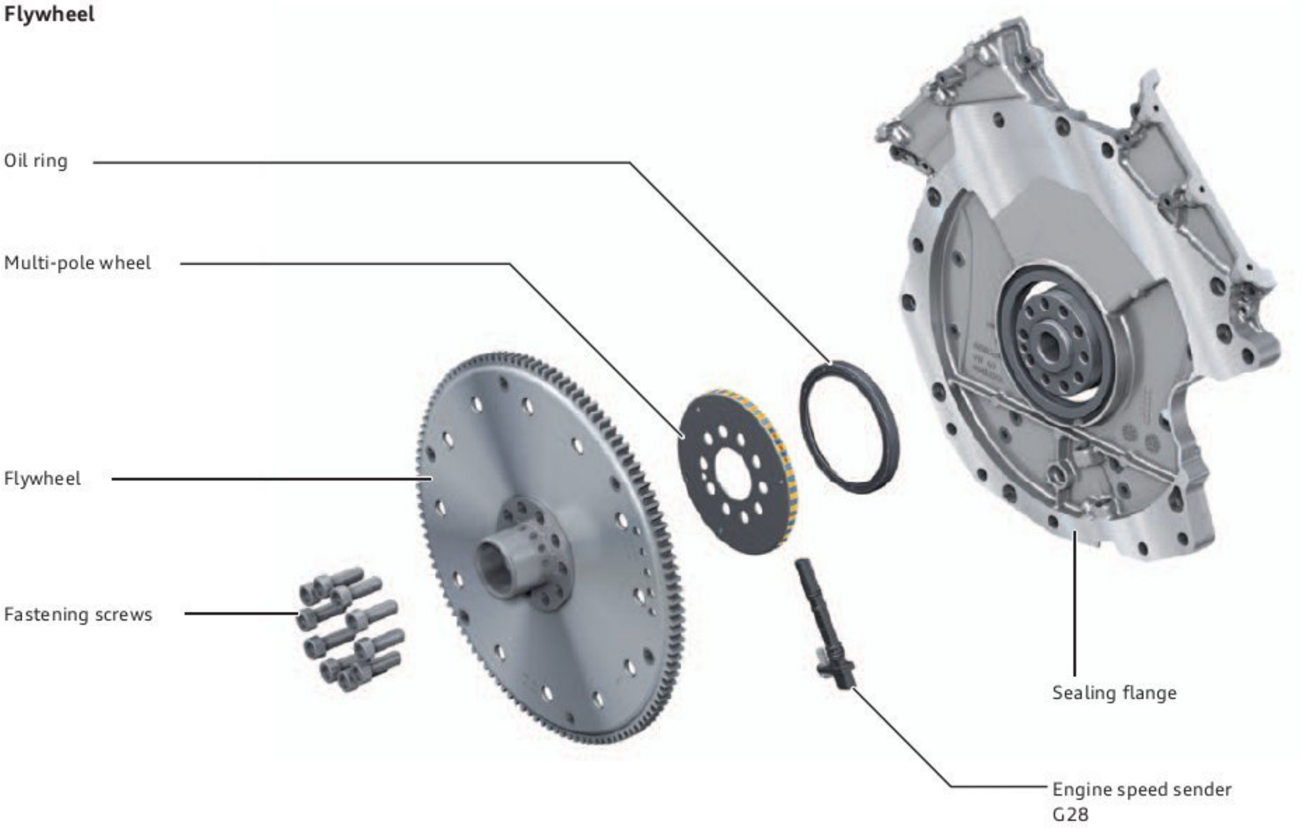
Flywheel



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Pistons

To reduce friction, the cast aluminium pistons with ring land have an anti-friction coating on the piston skirt as well as piston rings with a low overall tangential force.

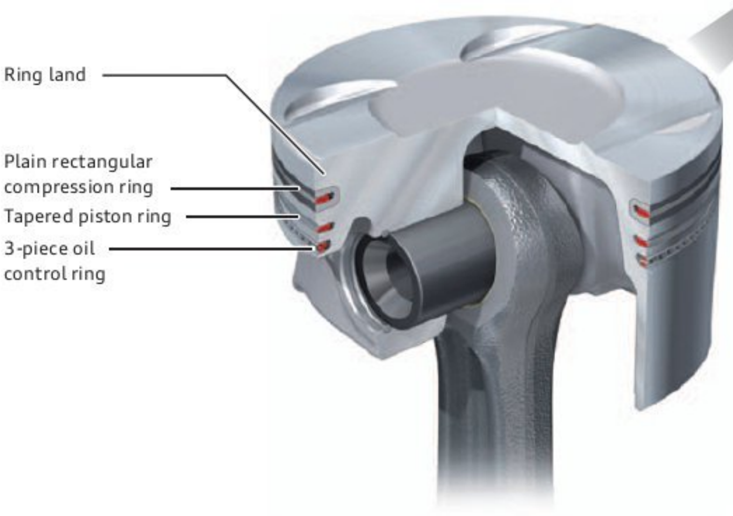
- **Piston ring 1:** Rectangular ring (upper ring in ring land)
- **Piston ring 2:** Tapered piston ring
- **Piston ring 3:** 3-part oil scraper ring (1 spring, 2 fins)

A further friction-reducing measure is the increase in piston fitting clearance (approx. 0.06 mm)

- **Nominal piston size** 84.45 mm
  (including coating; incurs 0.04 mm of wear)
- **Nominal cylinder bore size** 84.510 ± 0.005

Connecting rod

The cracked trapezoidal conrods are made of high-strength steel. The gudgeon pin has a diameter of 20 mm. The conrod bush in the upper conrod boss is made from a copper alloy. The conrod bearings are 16.8 mm wide. Both bearing shells are identical. They are three-material bearings consisting of a steel substrate, a bismuth-bronze alloy intemediate layer and a thin crystal bismuth lining.



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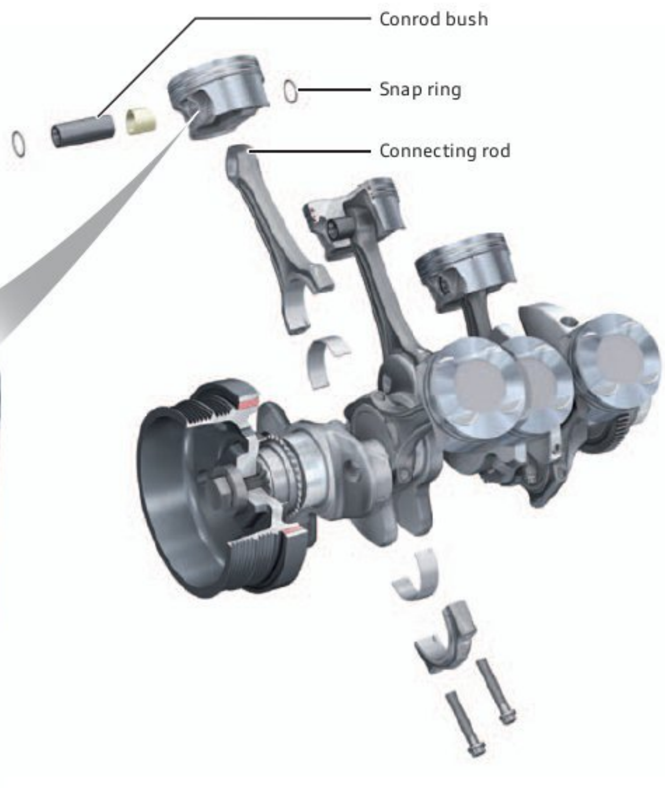

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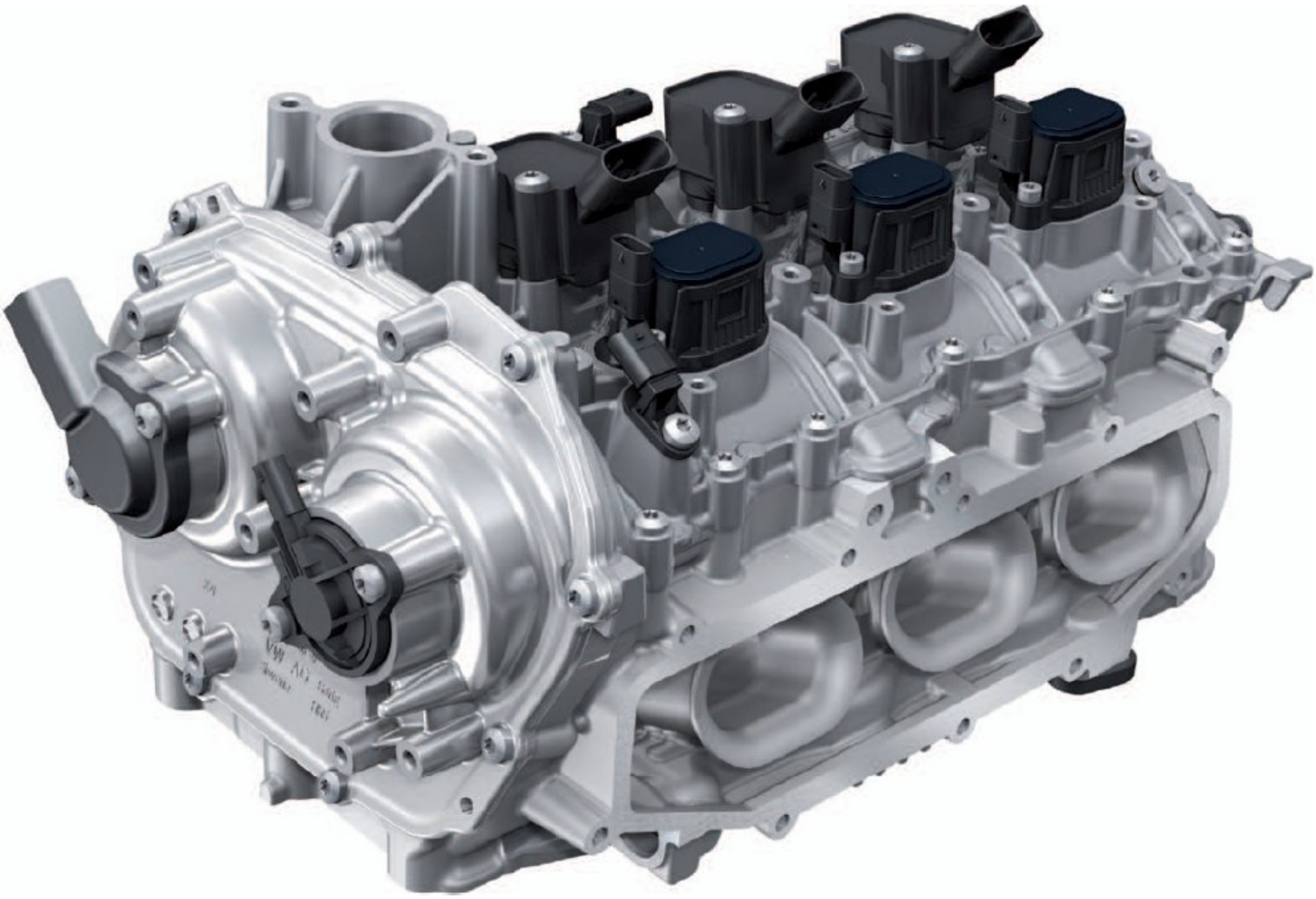
Cylinder head and valve gear

The all-new cylinder heads have the following technical features:

- DOHC, 4 valves per cylinder
- Roller cam follower
- Integral exhaust manifold
- "Hot Side Inside" (HSI)
- New direct injection combustion process with central injector position
- Audi valvelift system (AVS) on the intake side with 2 different cam strokes and event durations (extended Miller process)
- Intake valves: hardened and tempered
- Exhaust valves: hardened and tempered, sodium-filled hollow stem valves

Features	
Material	AlSi7MgCu0,5
Cylinder spacing	93 mm
Bore	84.5 mm
Intake valve angle[1)] α	23.6°
Exhaust valve angle[1)] α	25.2°
Intake valve diameter	32 mm
Exhaust valve diameter	28 mm

View showing intake side of cylinder head bank 1



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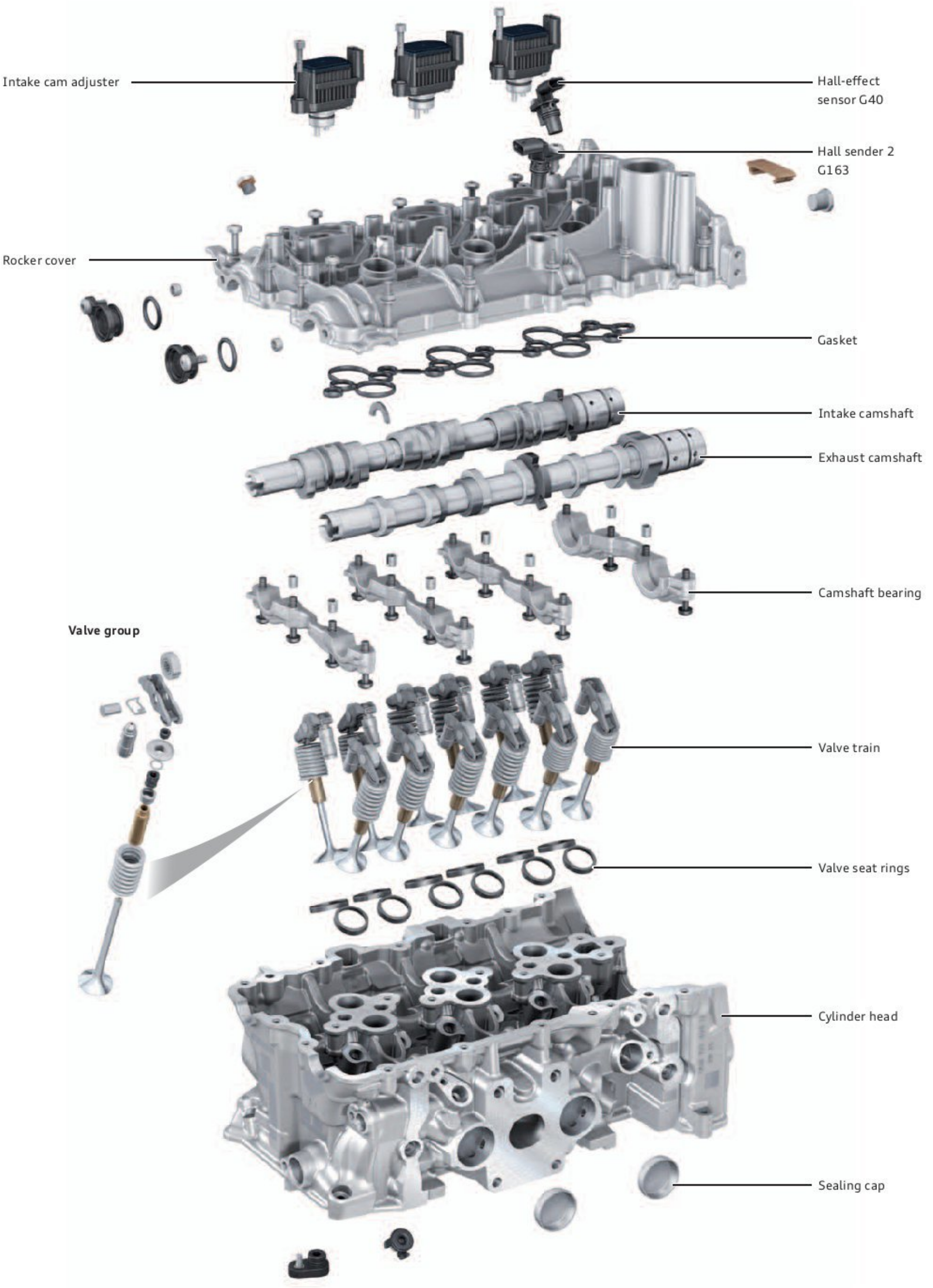
QR-Code

Scan the QR code to find out more about the cylinder head.

[1)] To cylinder axis.

Design



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Camshafts

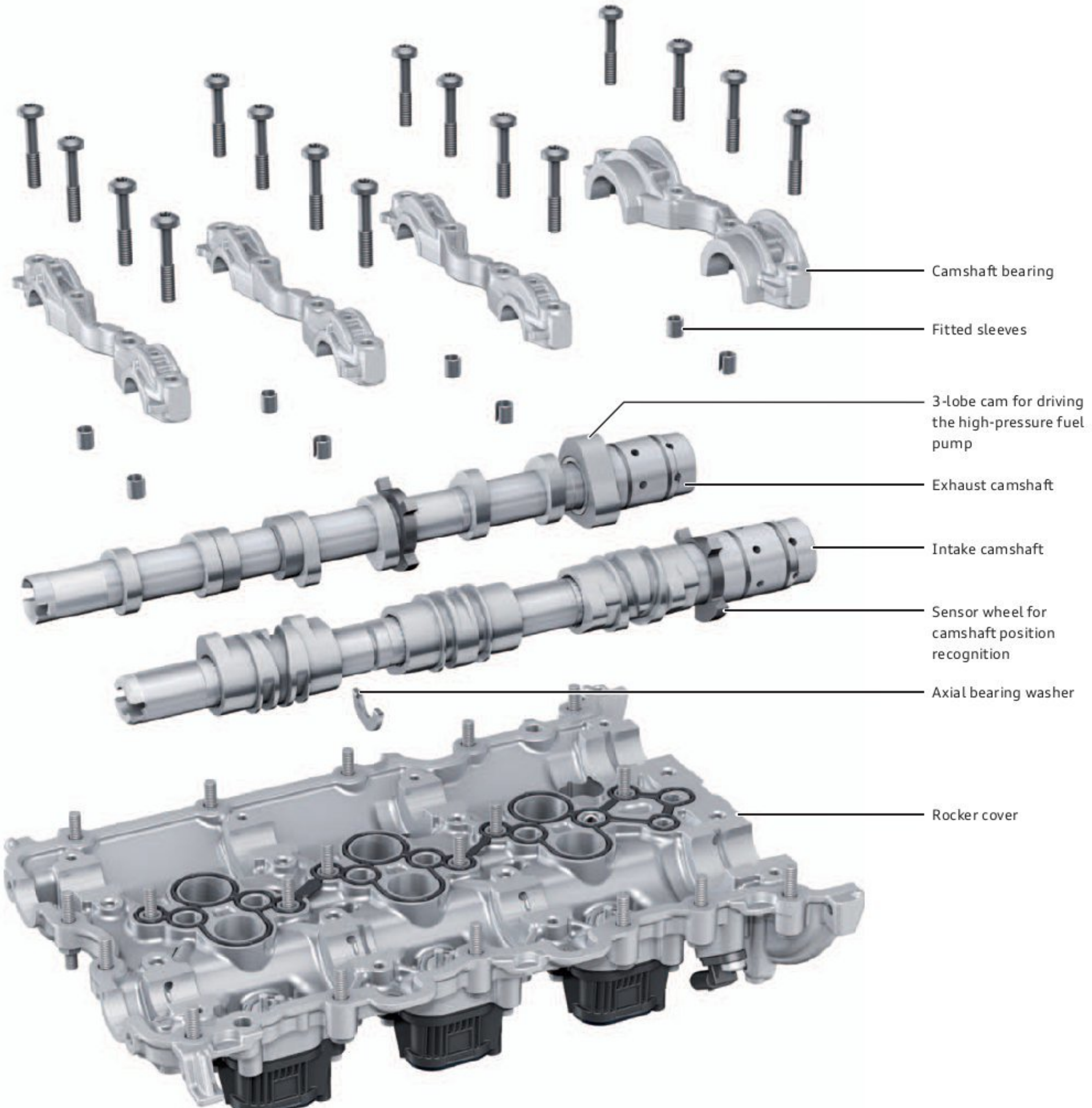
There are 2 camshafts per cylinder bank whereby one of the camshafts drives the 2 intake valves and the other camshaft the 2 exhaust valves of each cylinder. The camshafts are mounted in four antifriction bearings in the rocker cover. The bearings are partially integrated in the rocker cover. The four individual bearing caps covering the intake and exhaust camshafts form the opposite side of the bearing assembly.

The camshafts are driven by the timing assembly (chain gear) via hydraulic vane cell adjusters with trioval sprockets. Power is transmitted from the camshafts to the valves via roller bearing mounted roller cam followers and hydraulic tappets. To reduce engine friction, the cam followers are equipped with oil spray jets.

To set and check the valve timing, recesses are machined into the ends of all camshafts (belt side).
The special camshaft locking tool T40331 engages with this slot and locks the camshafts in the starting position of the engine.

For position recognition, a sensor wheel is attached to each camshaft.

Diagram showing rocker cover of cylinder bank 1



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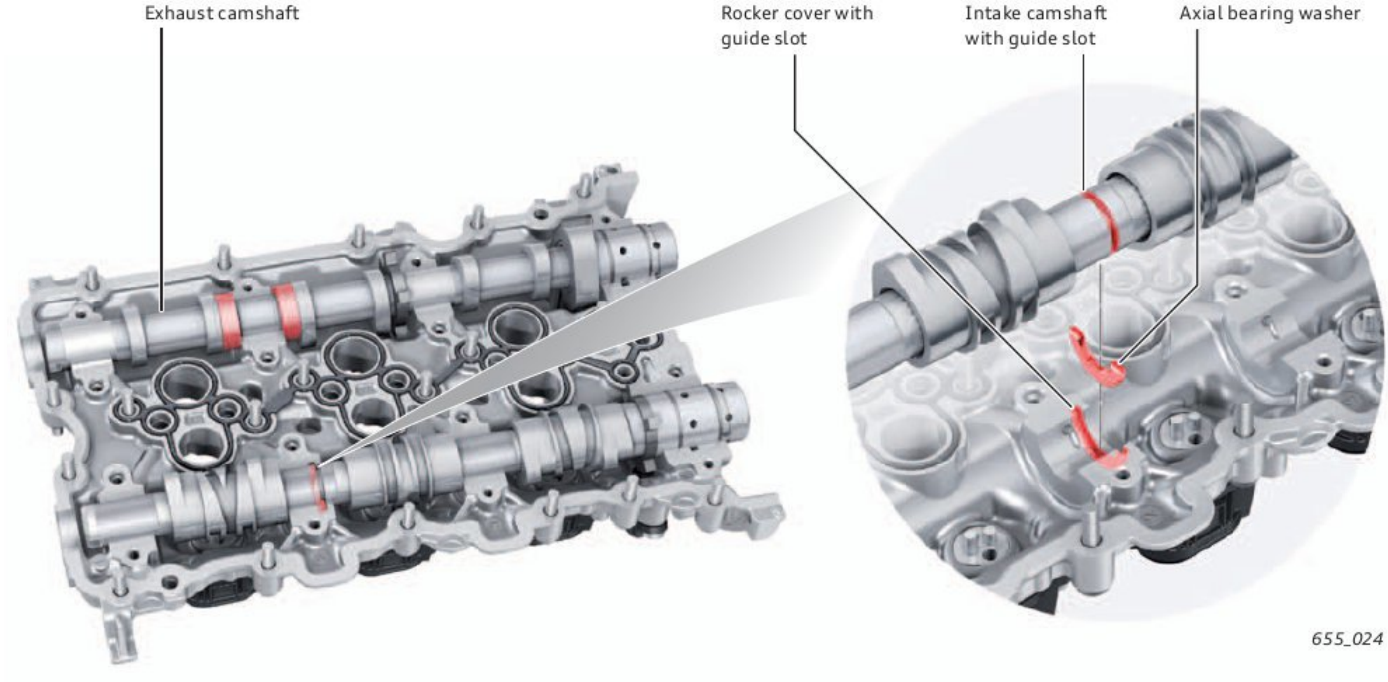
Axial bearing

For axial location, slots are machined into the intake camshafts and into the rocker covers. Axial bearing washers are located in these slots.

In the case of the exhaust camshafts, axial location is provided by cams on the camshaft. The cams are supported at the side by a camshaft bearing.



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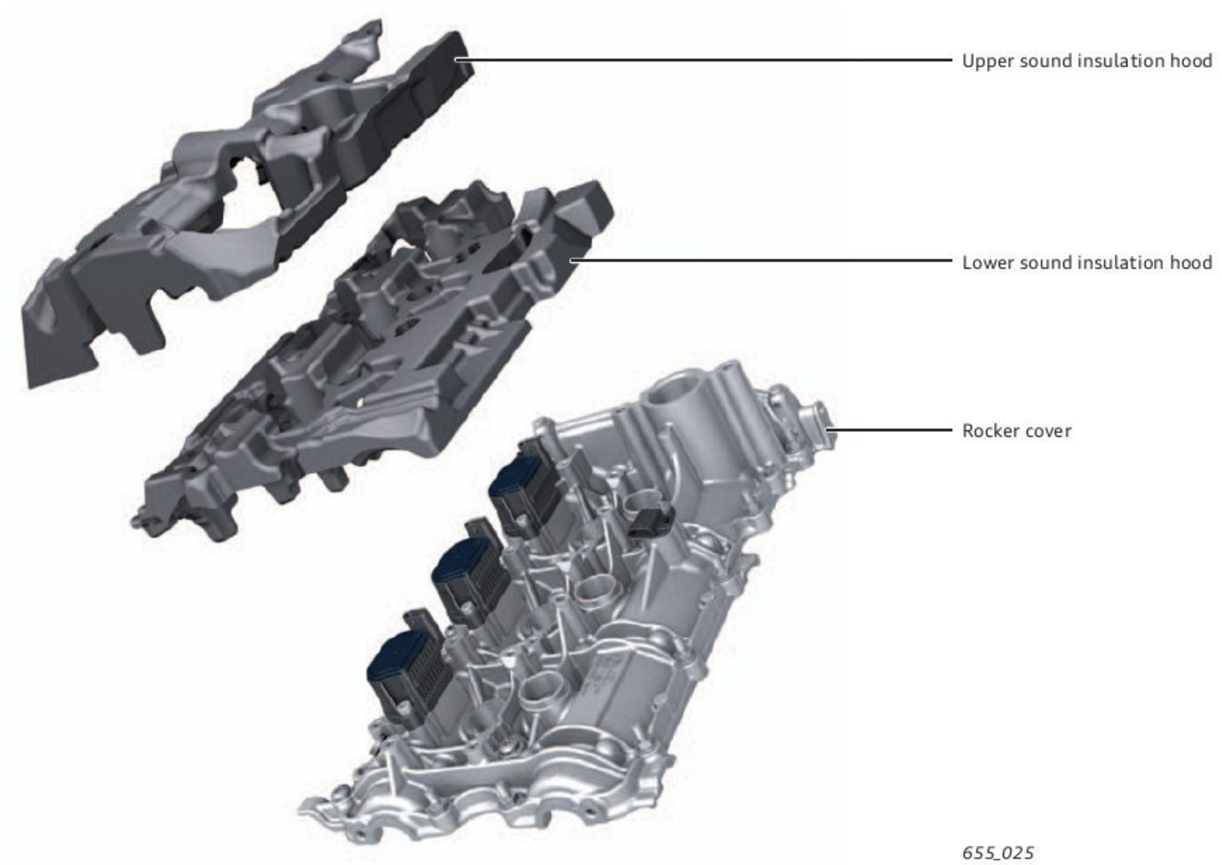
Measures for noise reduction at the rocker covers

As an additional noise reduction measure, a two-part sound insulation hood made of polyurethane is fitted over each rocker cover.



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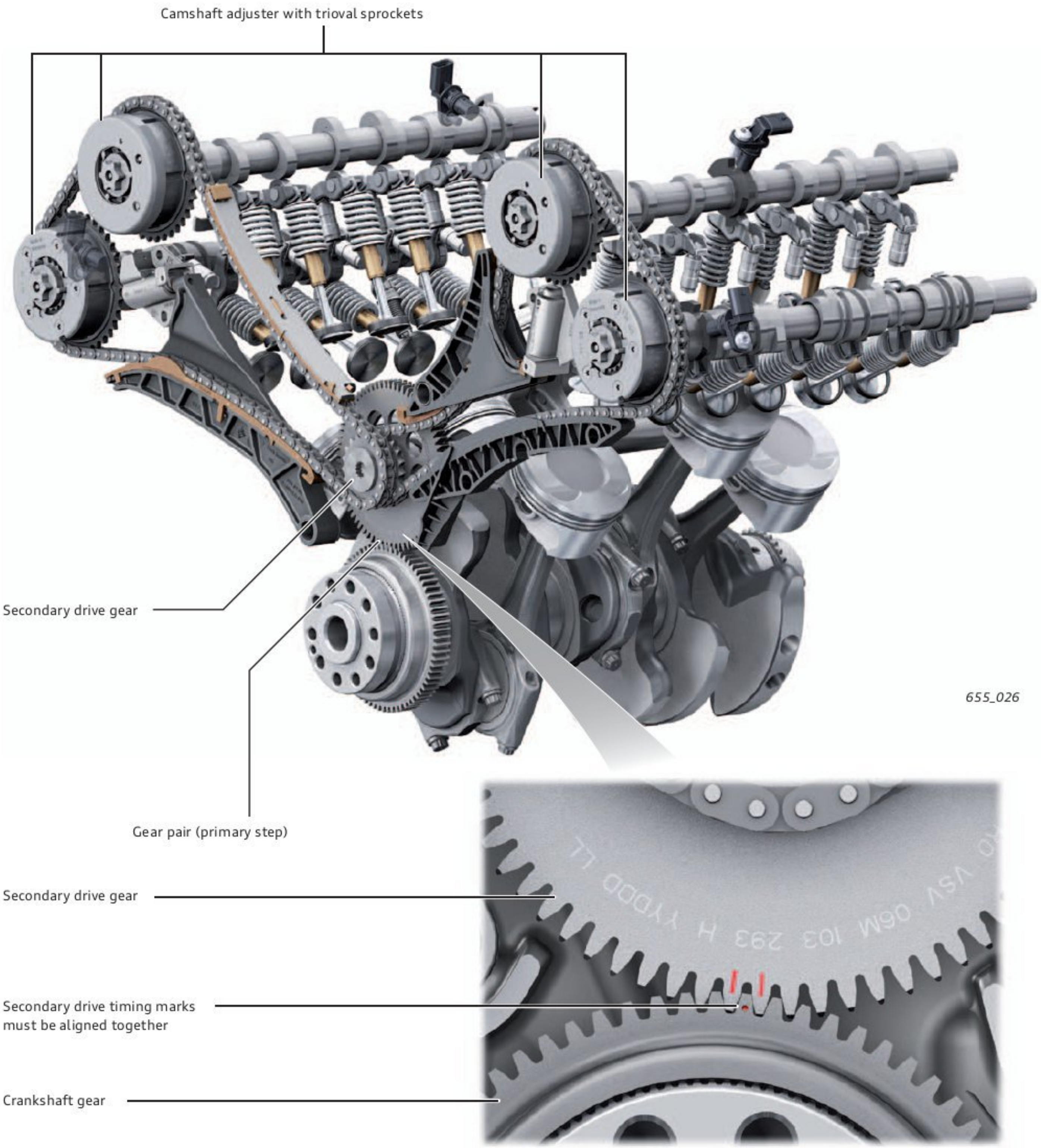
Timing assembly

The key development goals for the timing assembly were to minimise weight and friction. 8 mm bush chains are used here. To reduce the rotational masses in the timing assembly, the trioval sprockets of the camshaft adjusters are manufactured from sintered aluminium.

The timing assembly is driven by the crankshaft via a gear pair (primary step). The balancer shaft and the sprocket for the camshaft drives (secondary drive) are driven by this gear pair. To reduce noise and to compensate for backlash in the gearing, the drive gear is designed as a tension gear. See diagram 655_012 page 8.



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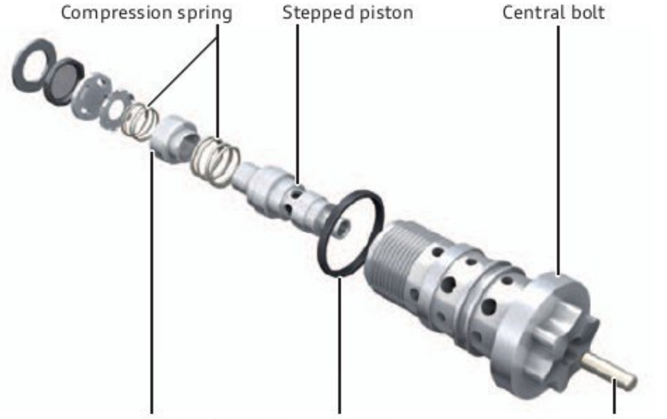
Note
The engine is in the starting position when the second cylinder is at ignition TDC. The crankshaft can then be locked in place at the vibration damper using T40264/3 or, if the engine has been removed, using the locking pin T40069. It must be possible to insert the camshaft locking tool T40332/1 in this position. The trioval sprockets must be positioned correctly during assembly work (workshop manual).

Camshaft adjuster

The 3.0l V6 TFSI engine is equipped with an intake camshaft adjuster and exhaust camshaft adjuster per cylinder bank. Hydraulic vane cell adjusters are used.



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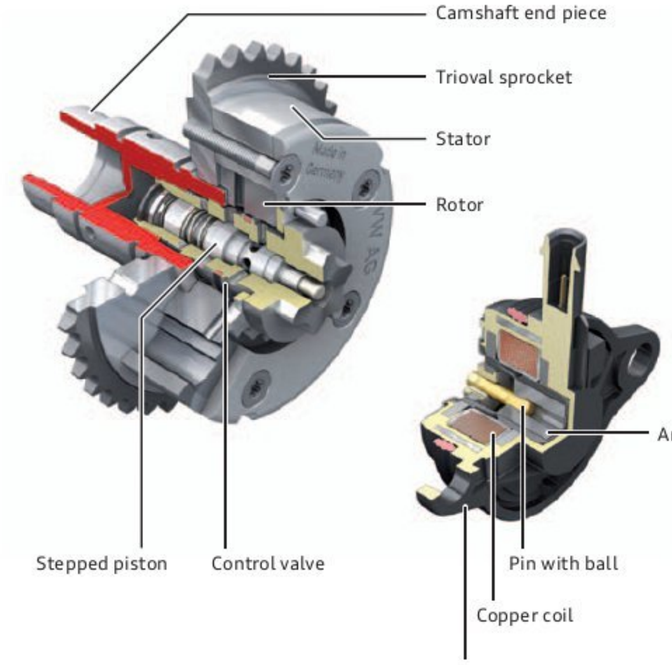
Intake vane cell adjuster



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Adjustment range

Intake camshaft phaser

The adjustment range is 25° (50° CA[1]). When the solenoid is de-energised the camshaft is locked in the retard position by means of a spring-loaded pin.

Exhaust camshaft adjuster

The adjustment range is 25° (50° CA[1]). When the solenoid is de-energised the camshaft is locked in the advance position by means of a spring-loaded pin. An auxiliary spring is fitted here to ensure that the camshaft always reaches the locked position.

[1] CA = crank angle

Control valve

The camshaft adjuster is bolted to the camshaft end piece together with the timing valve. A diamond-coated disc is used to increase the friction between the adjuster and the camshaft end piece.

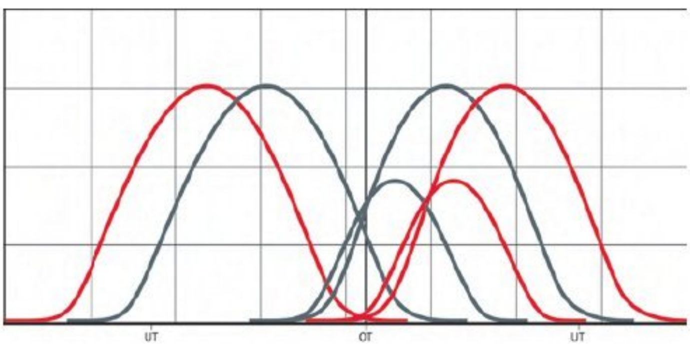
Function

Camshaft adjustment valves N205, 208, 318 and 319 (solenoid) are activated by the engine control unit by means of pulse width modulation (PWM). The adjuster pin is moved into a defined position by the resultant magnetic force. The adjuster pin displaces the stepped piston in the pilot valve over the needle roller against the spring force produced by the compression springs, thereby feeding engine oil into the corresponding chamber of the vane cell adjuster. The vane cell adjuster rotates and is moved into the desired position, which is monitored by the corresponding Hall effect sensor The camshaft adjustment valves are integrated in the chain case covers. See diagram 655_086 page 11.

Timing diagram

This diagram shows adjustment curves for the exhaust valves, as well as the large lift and small lift intake valves (AVS).

- Camshaft adjuster in locking position (intake in retard position and exhaust in advance position)
- Camshaft adjuster in max. position (intake in retard position and exhaust in advance position)



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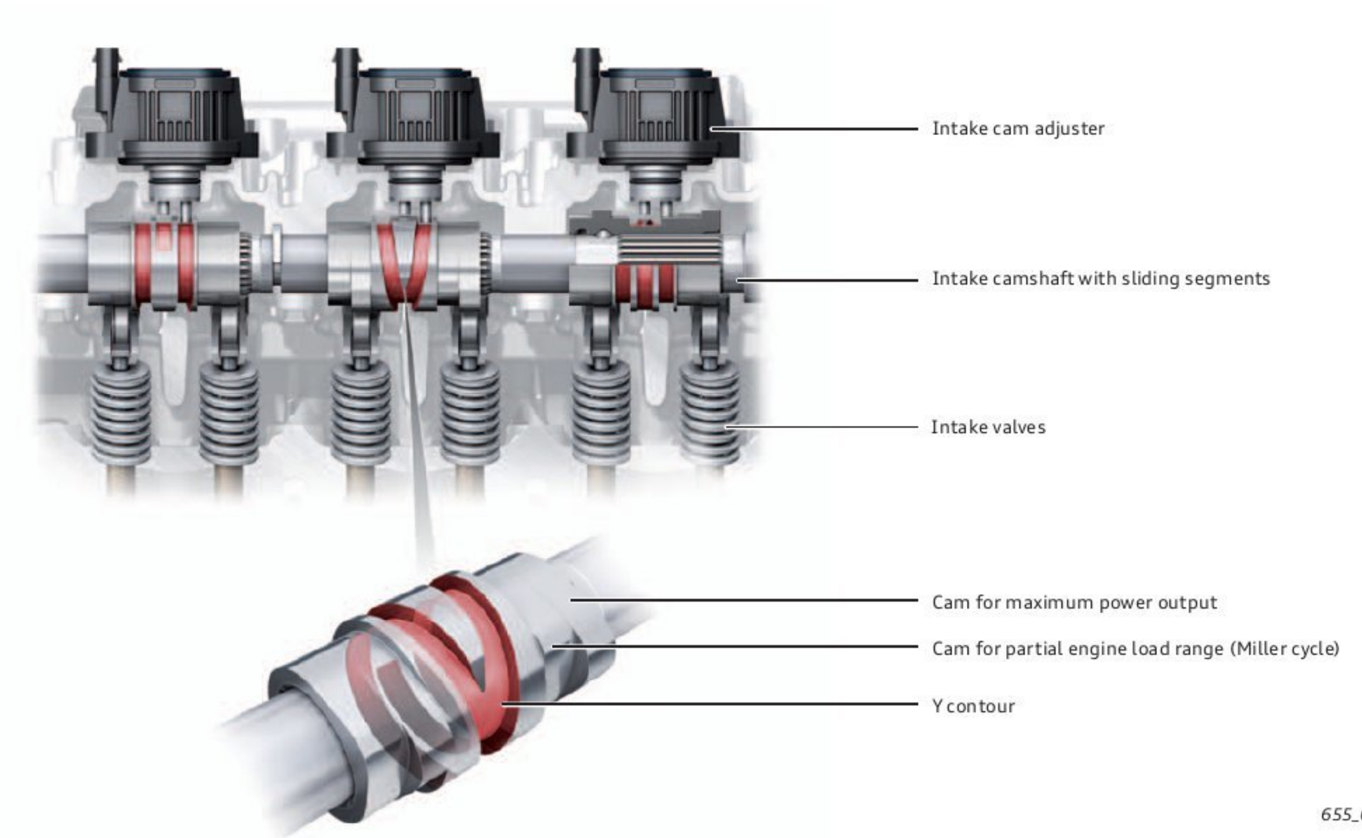
Audi valvelift system (AVS)

The AVS is positioned on the intake side of the 3.0l V6 TFSI engine. Two different cam lifts and event durations are shown here. A very short intake opening duration of 130 ° CA with early intake shut-off is implemented in the partial engine load range (Miller cycle).

In addition, valve lift is limited symmetrically to 6 mm at both intake valves. The cam is switched to large lift when the partial engine load range is exceeded. The full lift cam contour is configured for maximum power output.



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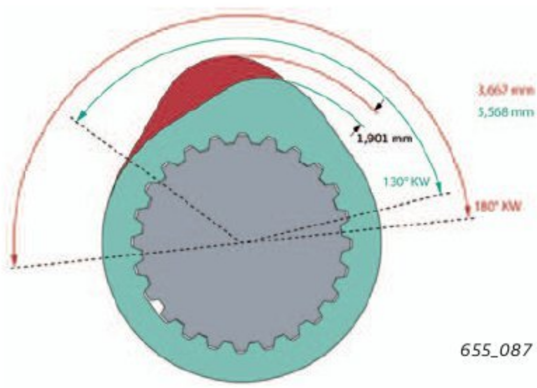
Cam contour

- Cam for maximum power output (red)
- Cam for partial engine load range (Miller cycle) (green)



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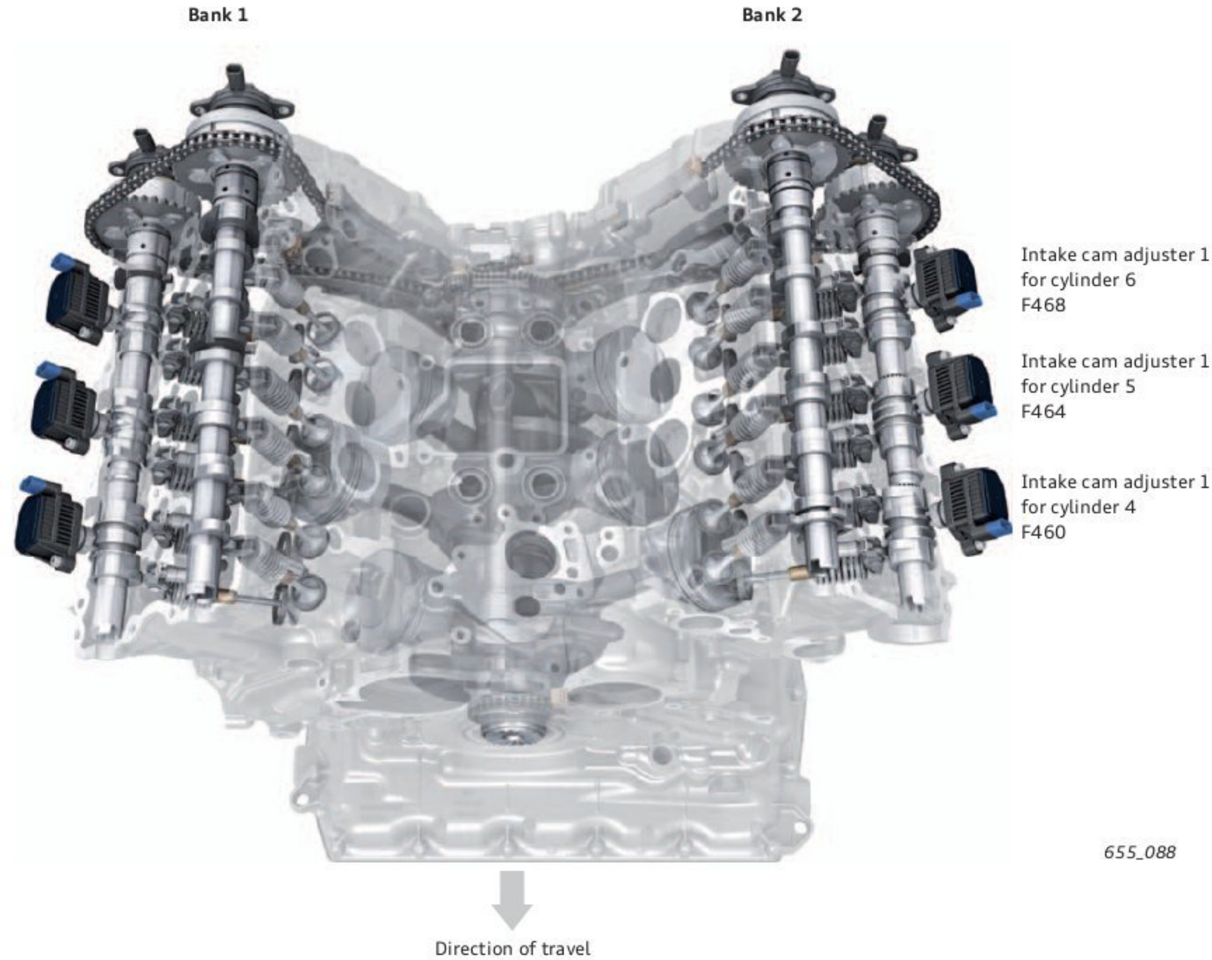
Note

The cam units mounted on the intake camshaft can be taken off after the camshaft has been removed. They are not marked or mechanically encoded. To make sure that the cam timings are correct, a new camshaft must be used when a cam unit has been taken off.

Cam adjuster assignments

A cam adjuster and a cam unit are used for each cylinder. Each cam unit carries both cam contours for both intake valves. The cam is switched to small lift when coil 1 in the cam adjuster is activated by the engine control unit. Lifter 1 is then extended, with the result that the cam unit on the camshaft switches to small lift. The cam is switched to large lift through the activation of coil 2.



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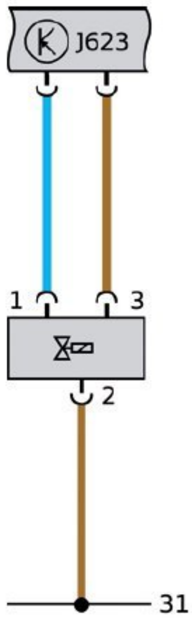
Pin connections on the cam adjuster

Pin 1 Ground to coil / lifter 1 = adjustment to small cam contour
Pin 2 Power supply to PIN 1+2
Pin 3 Ground to coil / lifter 2 = adjustment to large cam contour

Lifter 1 is positioned opposite the cam adjuster connecting plug.



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Reference

For more general information about how the Audi valvelift system (AVS) works, please refer to Self Study Programme 411 "Audi 2.8l and 3.2l FSI engine with Audi valvelift system".

Exhaust camshafts

The camshafts are composite camshafts. Each has a sensor wheel for current position recognition. Two collared cams support the camshaft on an anti-friction bearing.
The high-pressure fuel pump is driven by the exhaust camshaft of cylinder bank 1 by means of three-lobe cams.

The vacuum pump is driven by the exhaust camshaft of cylinder bank 2 via drivers.

Exhaust camshafts, cylinder bank 1

655_031

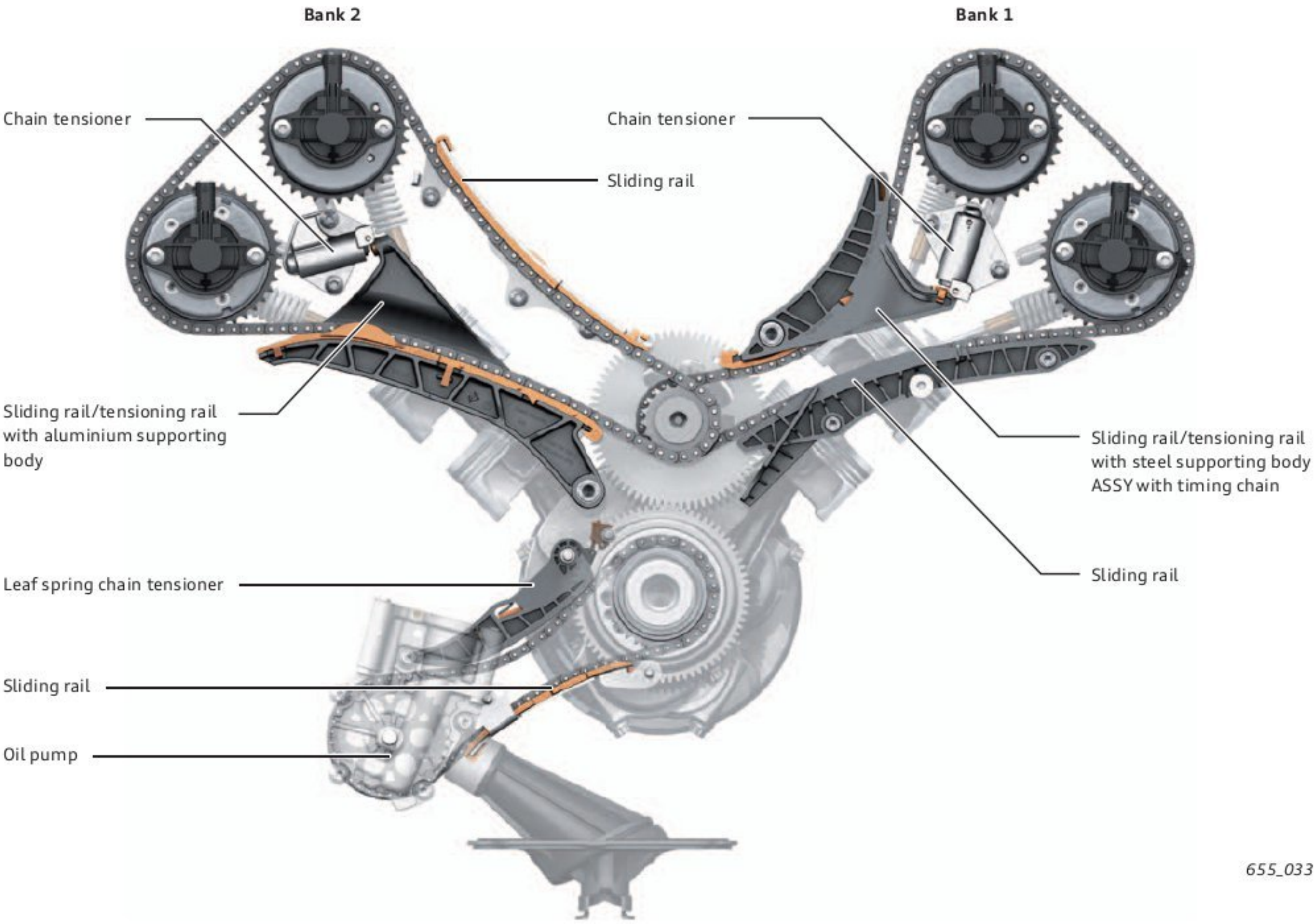
Exhaust camshafts, cylinder bank 2

655_032

Chains, chain tensioner, chain guide

Oil pump drive
The oil pump is driven by the crankshaft on the belt side of the engine via a 7 mm bush chain. The chain is tensioned by means of polyamide leaf spring chain tensioners without hydraulic damping. This simple and rugged design is cost-effective. In addition, the circulating oil volume is reduced.

Timing assembly
Polyamide sliding rails and tensioning rails are used for location of the 8 mm timing chains. The chain tensioners operate using spring force and are damped by applying engine oil pressure.



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Crankcase ventilation and fuel tank ventilation systems

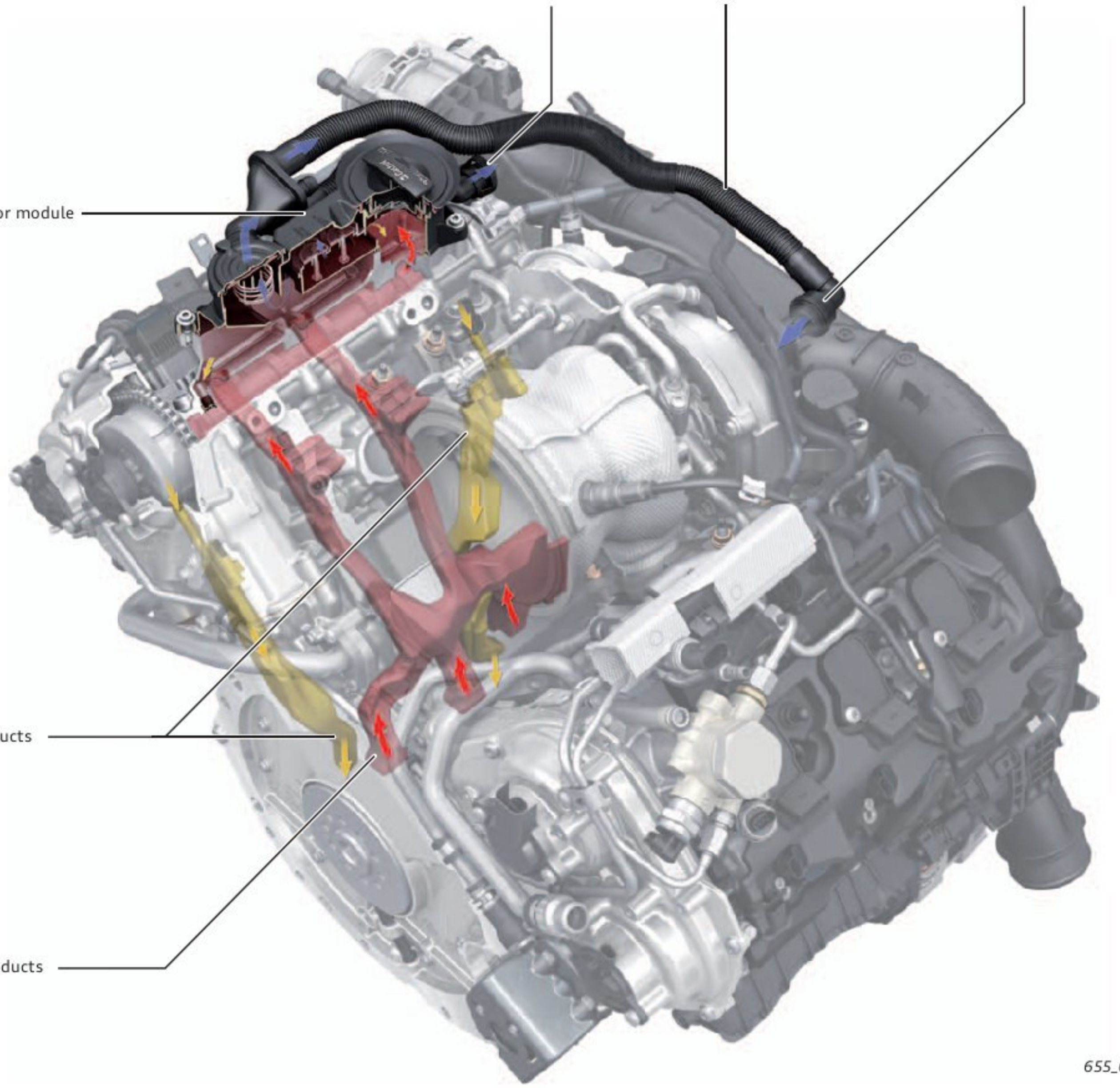
Despite having different tasks, these systems have several functional features in common. The aim of these ventilation systems is to prevent gases from escaping from the fuel tank or from the engine into the atmosphere. However, it is also important to make sure that a system such as the engine ventilation system is supplied with fresh air in a controlled fashion.

Crankcase ventilation system

The crankcase is ventilated via cylinder bank 2. The blow-by gases are extracted in the engine block behind the oil windage tray. From here, the gas flows through ducts in the oil pan upper part and in the engine block to the cylinder head. The breather module is attached to the rocker cover of cylinder bank 2 by bolts. The blow-by gas is finely treated. The separated oil in the oil separator module is collected in the oil collection chamber of the breather module. A gravitational valve is located here. It opens when:

- the standing oil column exceeds 8 mbar
- after the engine stops
- the engine is idling

The oil flows back into the oil pan through the cylinder head and engine block return ducts.
The pressure control valve is fitted at the oil separator module outlet. It is rated for a crankcase pressure of -150 mbar. Depending on engine load (compression ratio in the air supply during engine operation), the treated gases are introduced upstream of the exhaust turbocharger or downstream of the throttle valve. The required automatically acting, mechanical diaphragm valves are integrated in the ventilation line ASSY[1].



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[1] Assembly or subassembly.

Fine oil separation

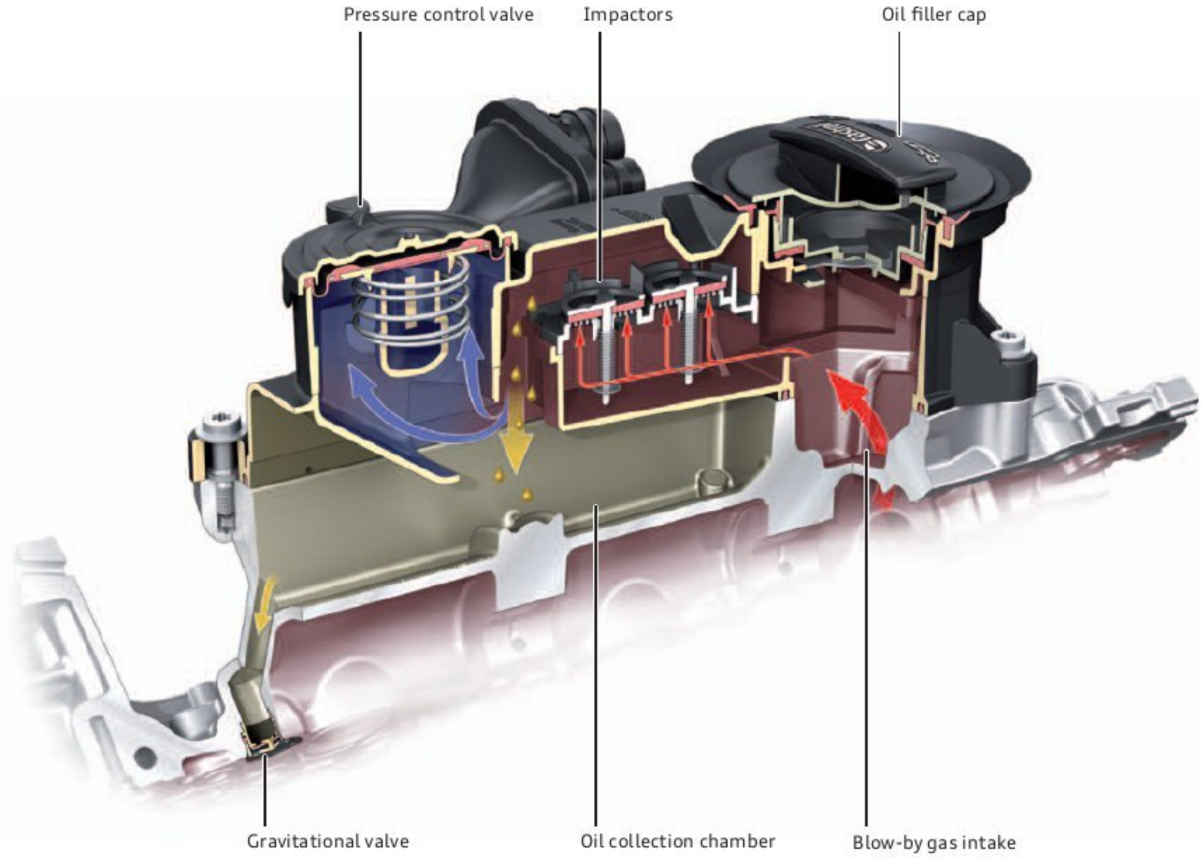
The system consists of a housing with mounting for the oil filler cap, the fine oil separator, the pressure control valve, a rocker cover gasket, the secure-fitting and captive screws, the separated oil collecting chamber and the gravitational valve for automatic evacuation of the reservoir, as well as a connection for the downstream valve unit to distribute the treated blow-by gases. The oil separator assembly is attached to the rocker cover.

Function

The high-volume cylinder head reduces the flow rate of the blow-by gases and acts as a coarse oil separator.

In the breather module the blow-by gas is finely separated by channeling it through a chamber containing baffles beneath the oil filler cap. The middle chamber houses two impactors in which the gases flow through a nonwoven material. The task of this nonwoven material is to break down the oil spray. Oil droplets form. By reversing the flow direction, the oil droplets are trapped by the downstream baffles due to the force of gravity. The oil droplets collect in the oil collecting chamber.

The impactors are rated for a defined maximum volumetric flow rate. When this maximum level is exceeded, the impactors open against the force of the spring allowing a portion of the blow-by gases to pass by.



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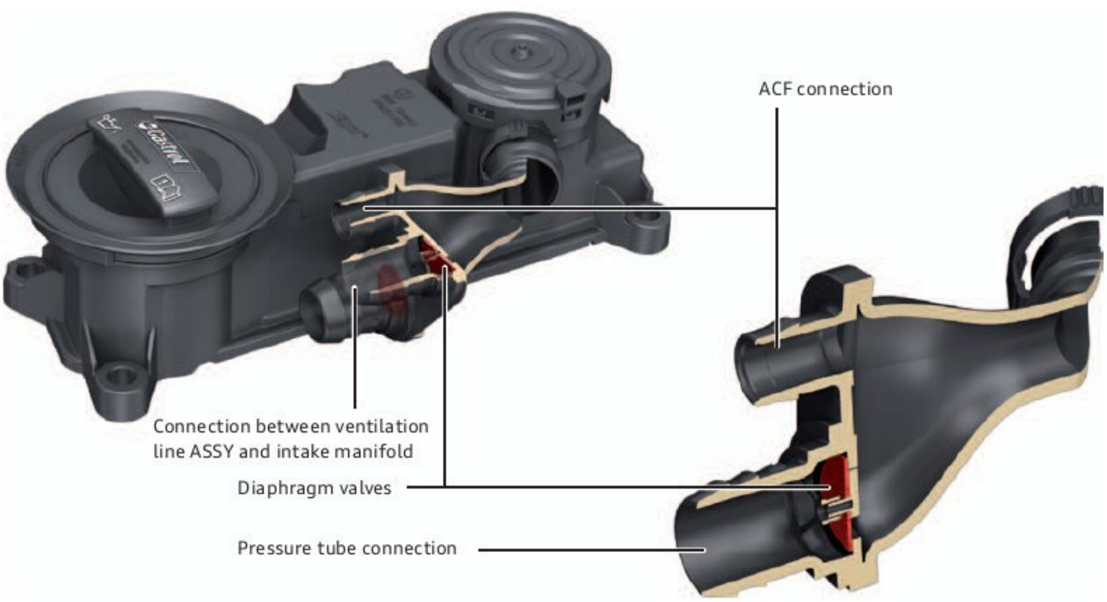

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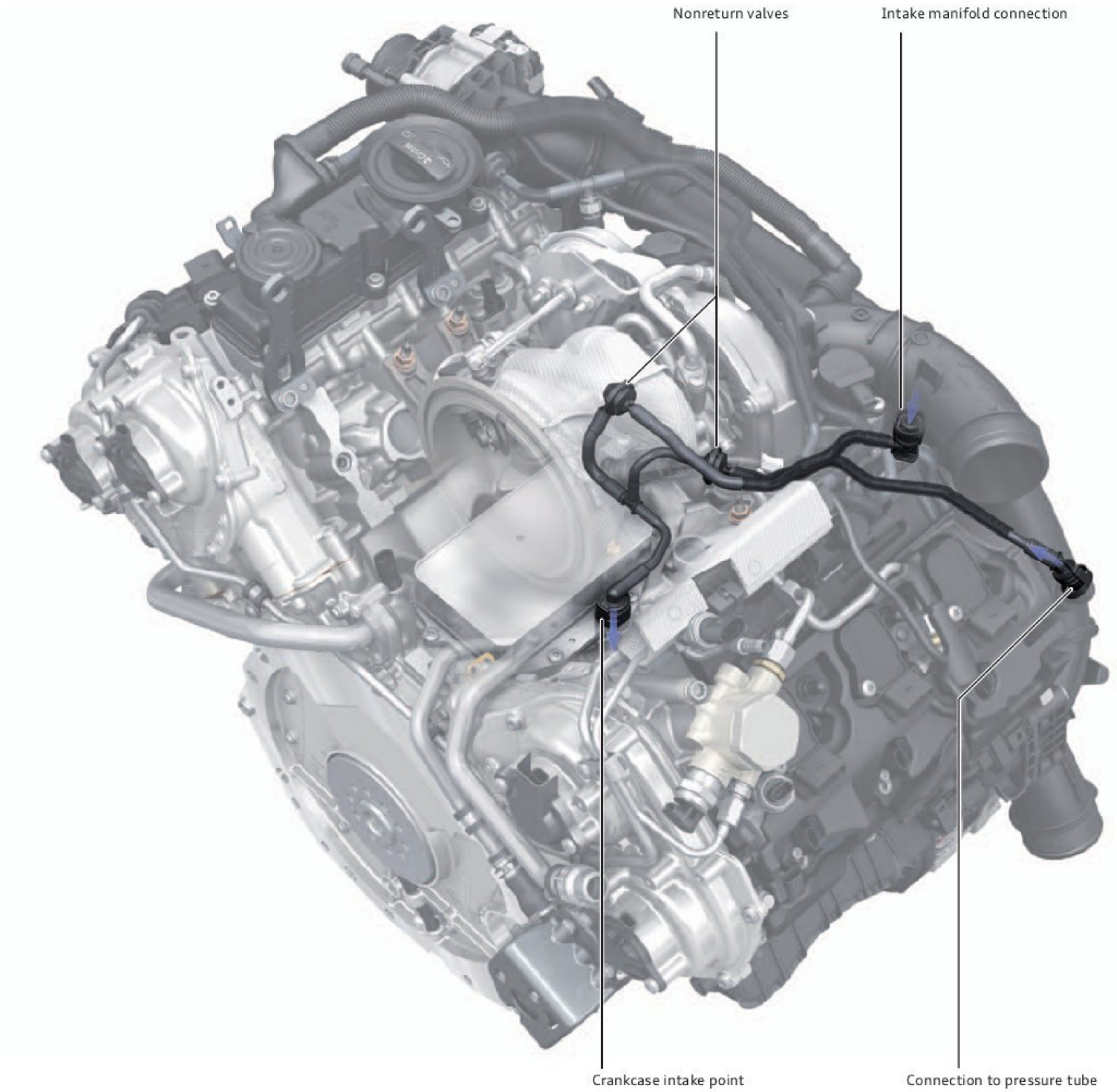
Positive crankcase ventilation (PCV)

The PCV system of the 3.0l V6 TFSI engine is positioned over the engine block. Installing the PVC system in the engine hot zone ensures that it is protected against freezing down to a temperature of -40 °C.

Fresh air is introduced at a connection in the inner V adjacent to the oil cooler. The fresh air is extracted from the engine air system.

To ensure that sufficient air is available in all engine load states, the air can be extracted at different points. For control purposes, automatic acting nonreturn valves are integrated in the ventilation line.
The system is rated for an air intake rate of up to 60 l/min. This is provided by a flow restrictor with a diameter of 1.5 mm at the intake point.



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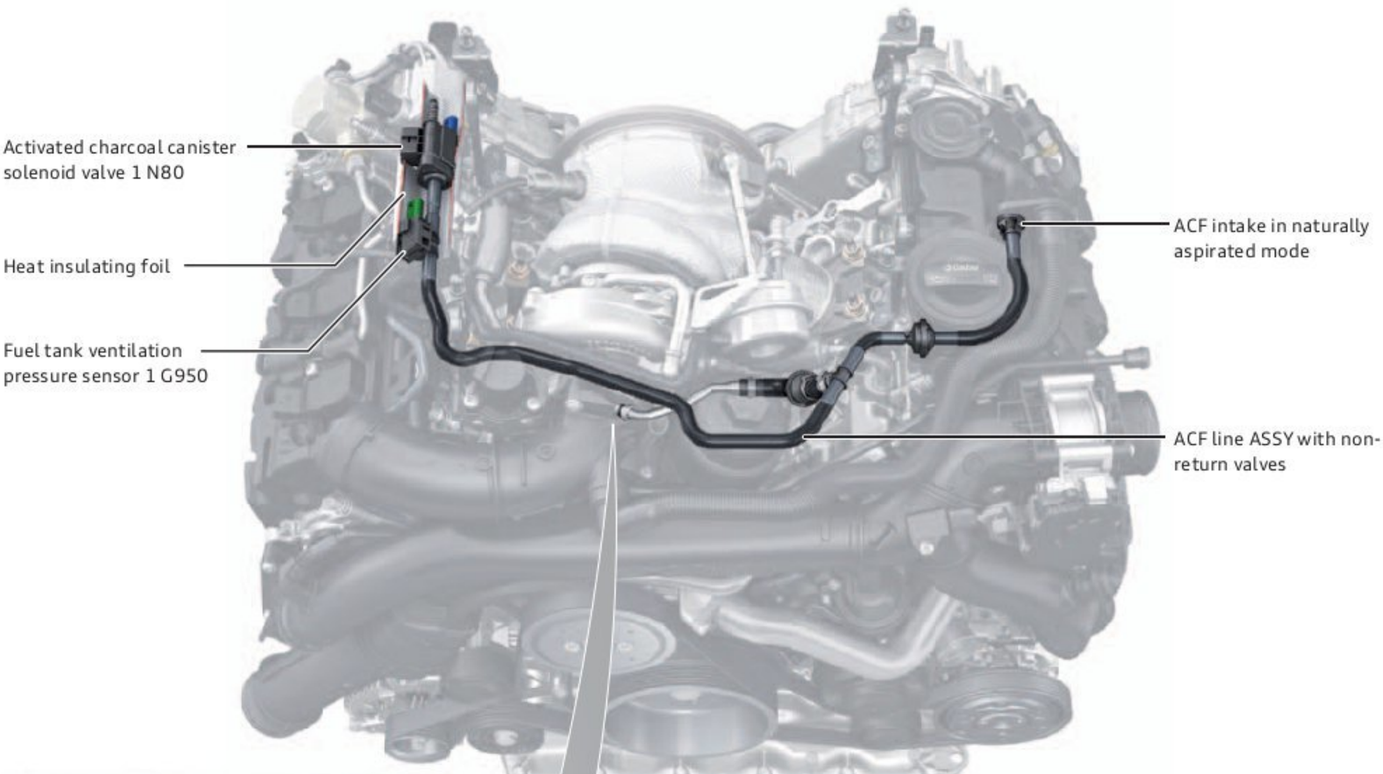
Fuel tank ventilation (ACF)

The fuel vapours collected in the ACF tank are drawn off by the engine control unit and combusted while the engine is running. For this purpose, the engine control until activates the ACF valve so that the path from the ACF tank to the engine air system is open. Depending on the compression ratio in the air system, fuel vapours are introduced at various points (controlled by nonreturn valves).

When the engine is running at idle and at partial load (partial vacuum in the air system), the fuel vapours flow through the valve unit at the crankcase ventilation system and from here into the ventilation line ASSY and, thus, into the intake manifold (see diagram on page 20).
When the turbocharger is active, the fauel vapours are introduced on the intake side of the turbine.

In mapped areas where no vacuum is present in the intake manifold the fuel tank ventilation system discharges into the turbocharger compressor housing.
This is provided by a Venturi nozzle which utilises the pressure gradient between the pressure and intake sides of the compressor. The accelerated air flow produces a vacuum which is used to ventilate the fuel tank.

The fuel tank ventilation pressure sensor 1 G950 is positioned downtream of the ACF valve in the ventilation line ASSY. It is used to check whether sufficient vacuum is present in the ACF line. If the ACF line was disconnected or leaky, a pressure drop would not be measurable. The check engine lamp (MIL) is then switched on. This function is only implemented in the NAR models. The RoW[1] variants have a dummy to close the line instead of the sensor



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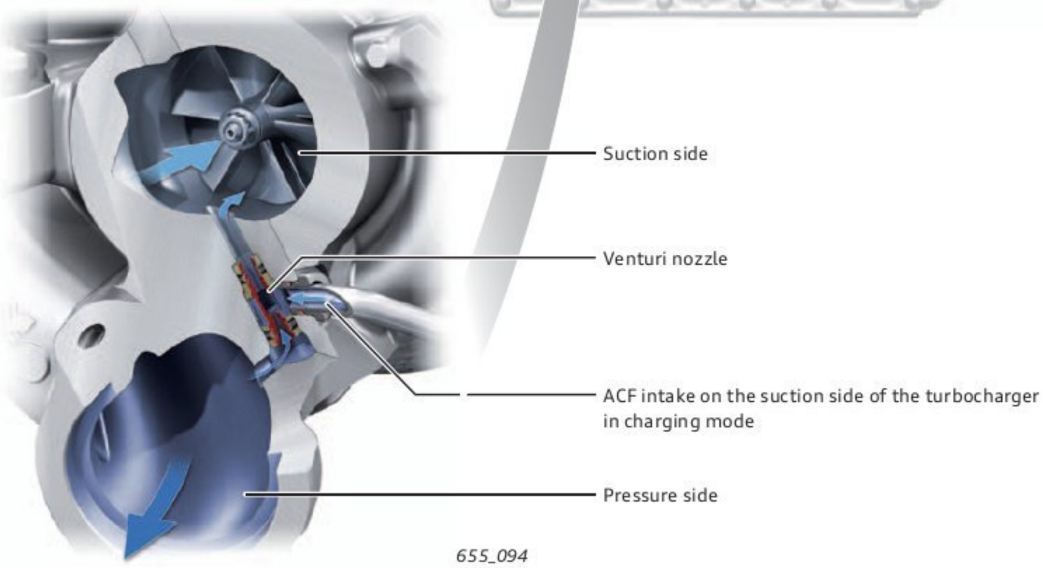
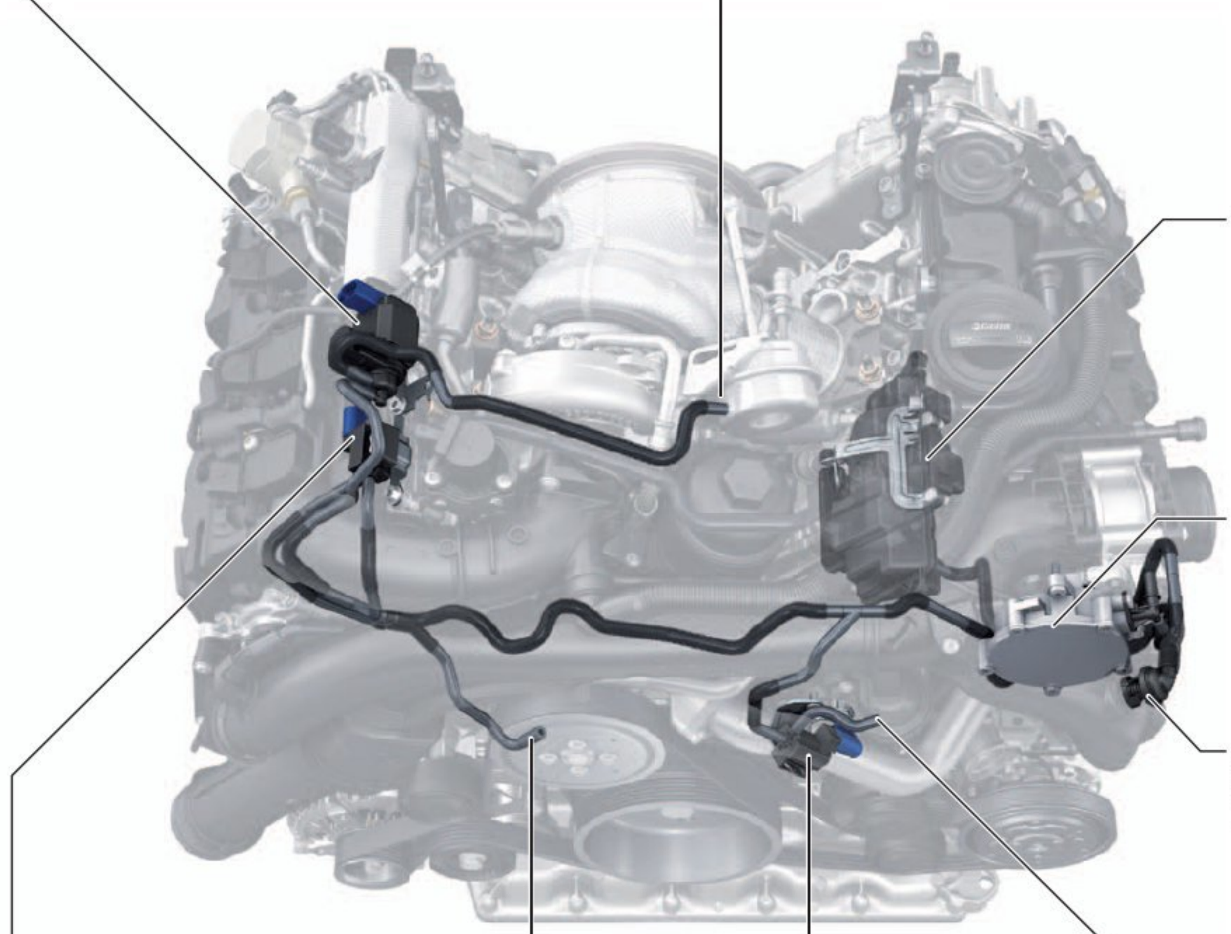


655_094

[1] Rest of world.

Vacuum supply system

Vacuum is supplied by the vacuum pump while the engine is running. The pump is driven by the exhaust camshaft of cylinder bank 2.
When vacuum is present in the air system at low engine speeds, the system is also supplied with vacuum at the connection to the intake manifold of cylinder bank 2 (vacuum distributor with nonreturn valve).



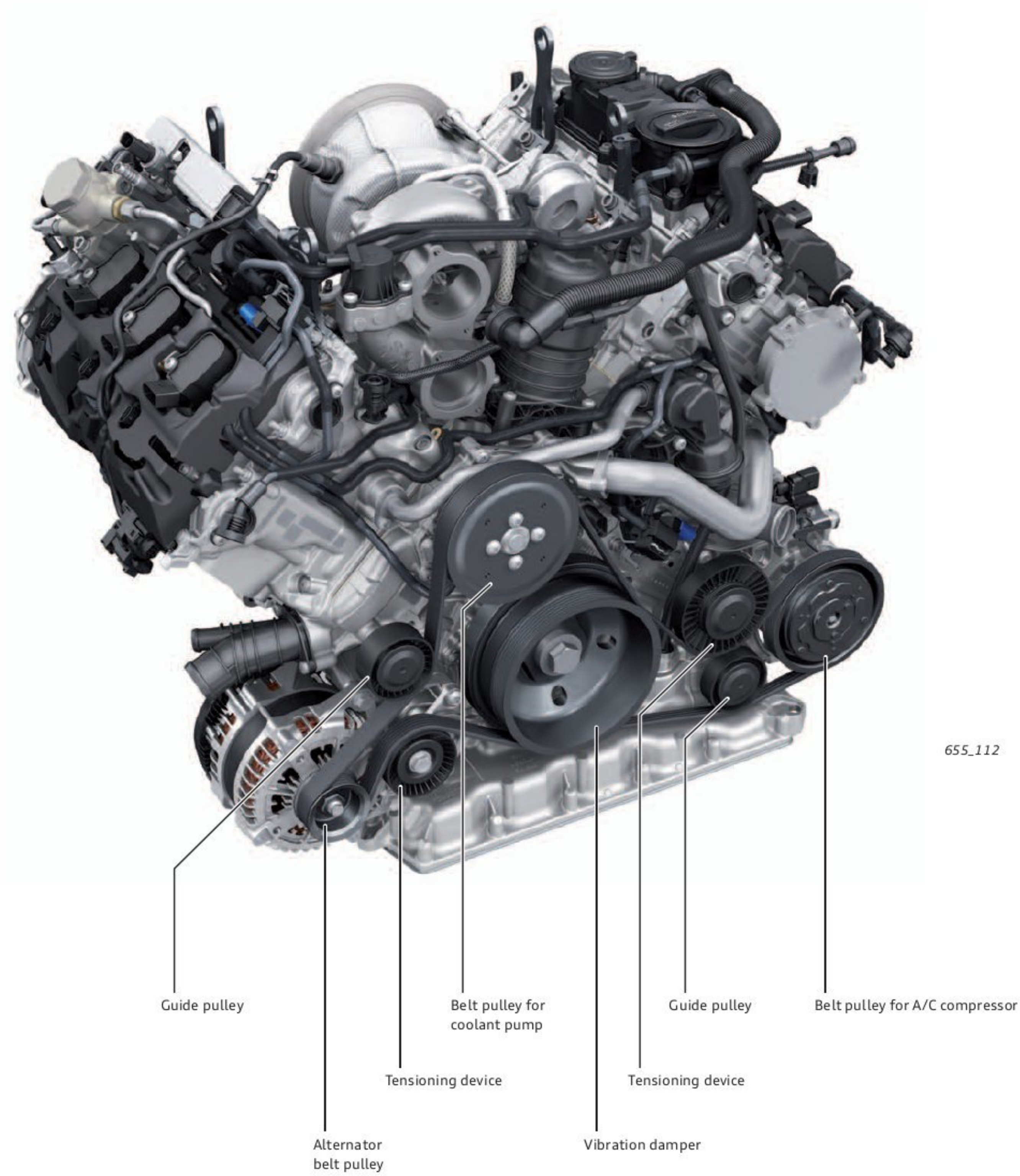
655_111

655_115

Belt drive

The ancillary units are driven by the crankshaft vibration damper by means of poly V belts.
The belt drive is of two parts. The inner belt drive is responsible for driving the A/C compressor, while the outer belt drive is responsible for driving the alternator.

The belt drive assembly does not require any maintenance.
Both belt drives have automatic tensioning devices which ensure that the belts are tensioned correctly.



Oil supply

Oil circuit

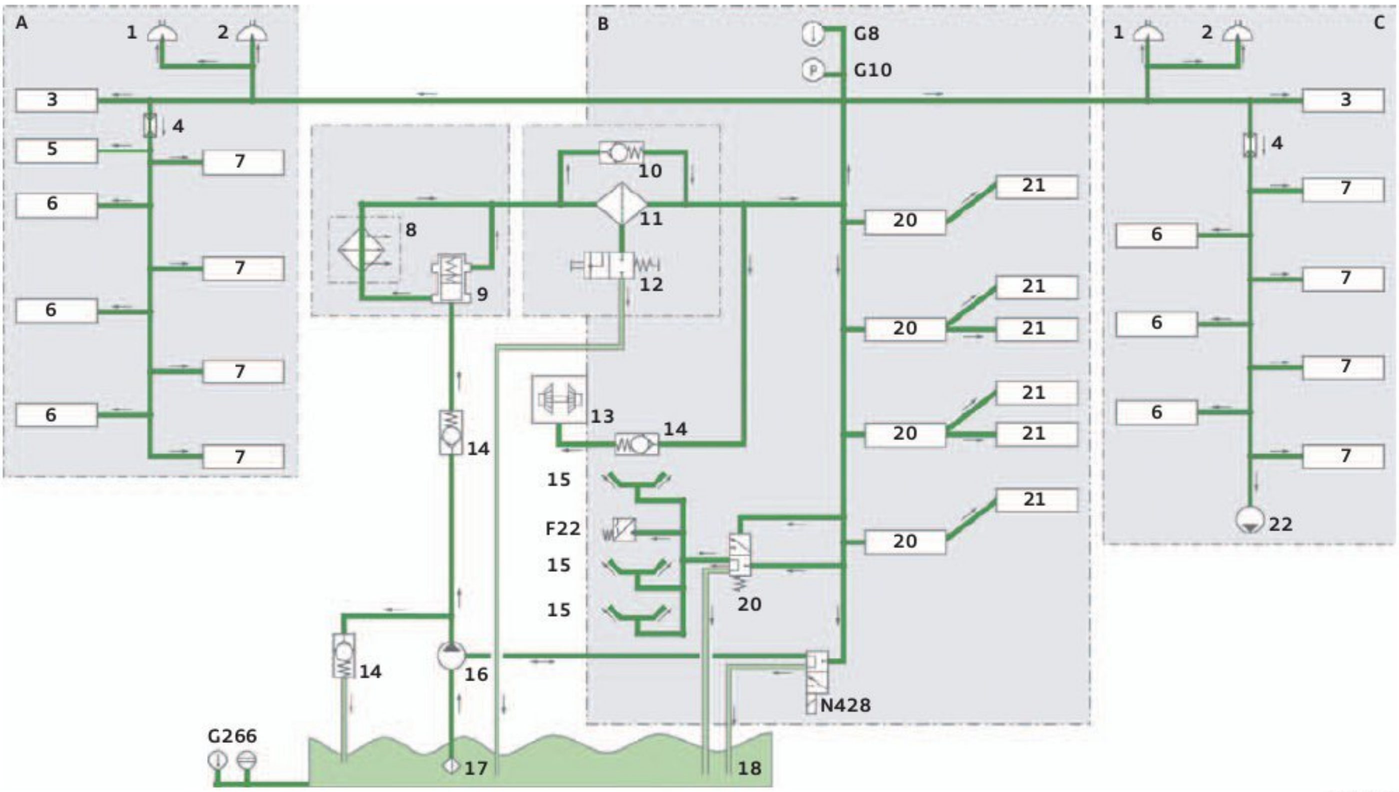
The key objective during the development of the oil circuit was to keep pressure losses to a minimum. The oil ducts are therefore designed for optimal flow.

The lubrication system is rated for specification 0W-20 and VW50400 engine oil.

The technical features of the oil circuit are:

- Fully variable map-controlled vane cell oil pump
- Active piston cooling jets
- Thermostat controlled engine oil cooler

Overview



655_008

Key:

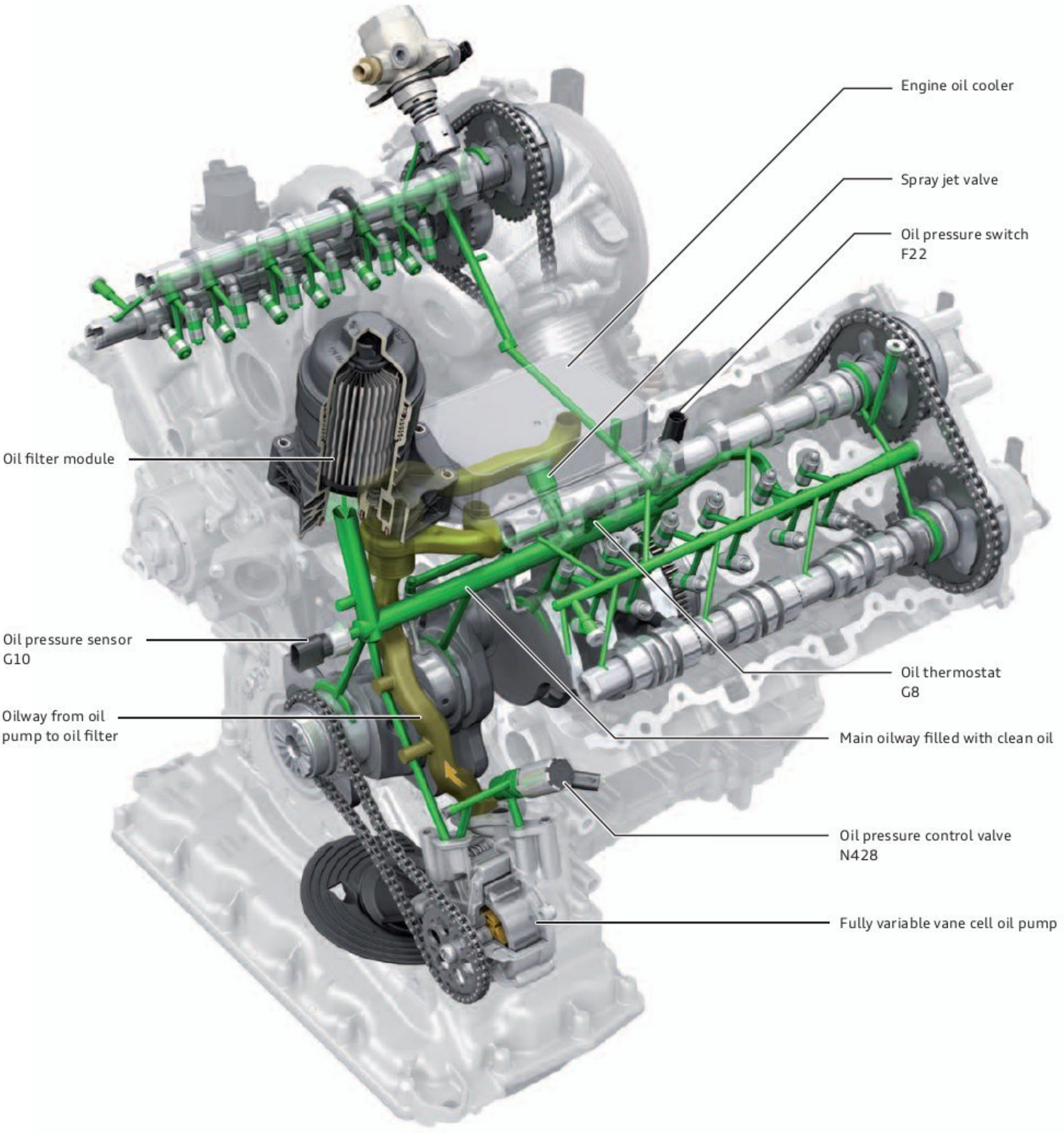
A Cylinder head 1
B Engine block
C Cylinder head 2

1 Intake camshaft adjuster
2 Exhaust camshaft adjuster
3 Chain tensioner
4 Flow restrictor
5 High-pressure fuel pump
6 Hydraulic valve clearance compensation element
7 Camshaft bearing
8 Oil/coolant heat exchanger (engine oil cooler)
9 Engine oil cooler thermostat
10 Oil filter bypass valve
11 Oil filter
12 Oil drain valve
13 Exhaust turbocharger

14 Nonreturn valve
15 Piston cooling jet
16 Oil pump
17 Oil pump intake sieve
18 Oil pan
19 Spray jet valve
20 Crankshaft bearing
21 Conrod bearing
22 Vacuum pump

F22 Oil pressure switch
G8 Oil temperature sensor
G10 Oil pressure sensor
G266 Oil level/oil temperature sensor
N428 Oil pressure control valve

Components on the engine



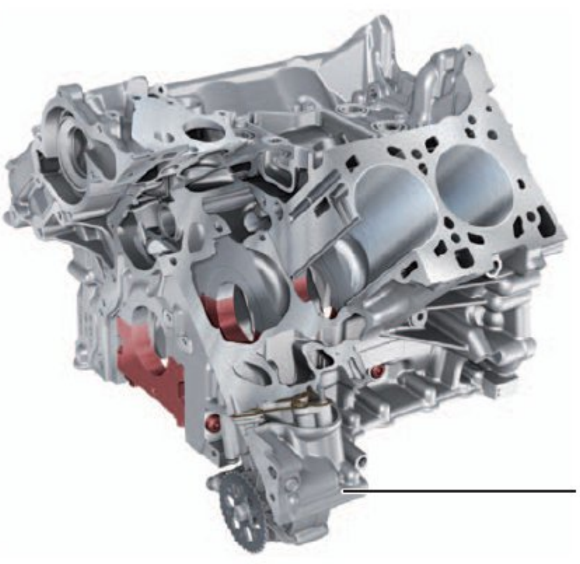
655_095

Oil pump

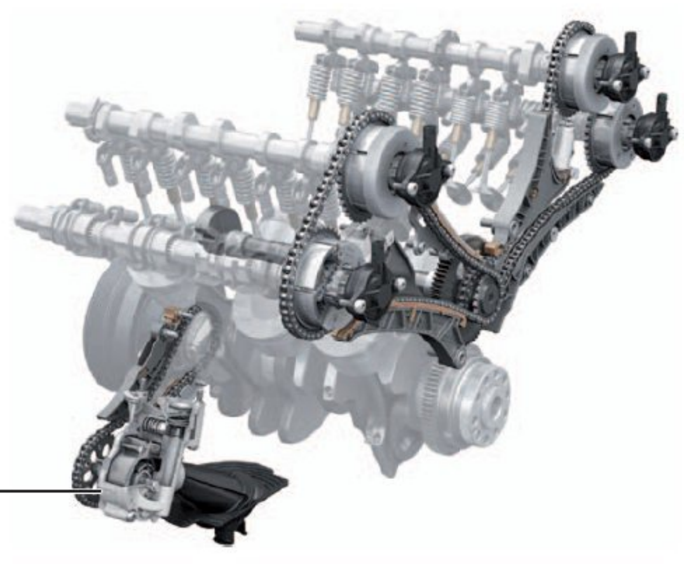
The vane cell pump is driven by the crankshaft via the chain drive on the front side of the engine. The gear ratio is 1 : 0.94 (Z32 crankshaft : Z34 pump sprocket).

A 7 mm bush chain and a lead spring chain tensioner without hydraulic damping are used.

Installation location

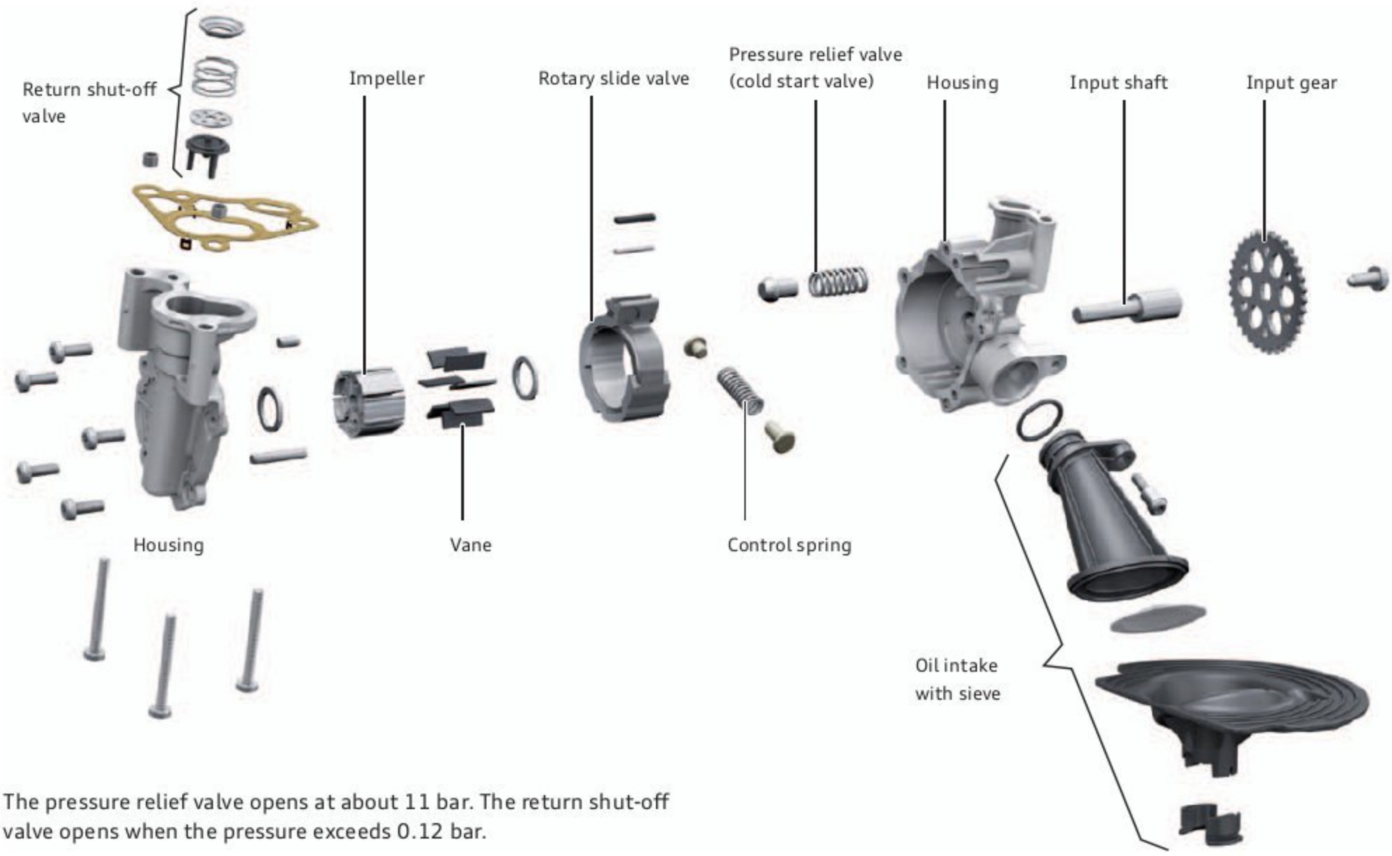


655_036



655_037

Design



The pressure relief valve opens at about 11 bar. The return shut-off valve opens when the pressure exceeds 0.12 bar.

655_038

Oil pressure control function

The required oil pressure is dependent on load demand and engine speed, and is computed on the basis of various ambient conditions, such as engine temperature.
The required oil pressure is computed on the basis of a characteristic map. The signal for the oil pressure control valve N428 is now generated, taking into account the requirements of the various individual systems such as the camshaft adjuster, exhaust turbocharger, conrod bearing and piston cooling. Engine oil is pumped from the main oil gallery into the pump control chamber by activating N428 (by PWM). The position of the adjusting ring in the pump changes, thereby adjusting the delivery rate and oil pressure.

655_096

Maximum delivery

- Low duty cycle
- No application of pressurised oil to the rotary valve

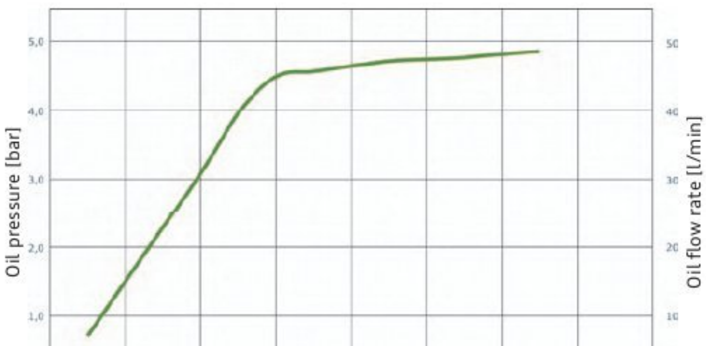
655_039

Partial delivery

- High duty cycle
- Application of pressurised oil to the rotary valve

Oil pump pressure characteristic

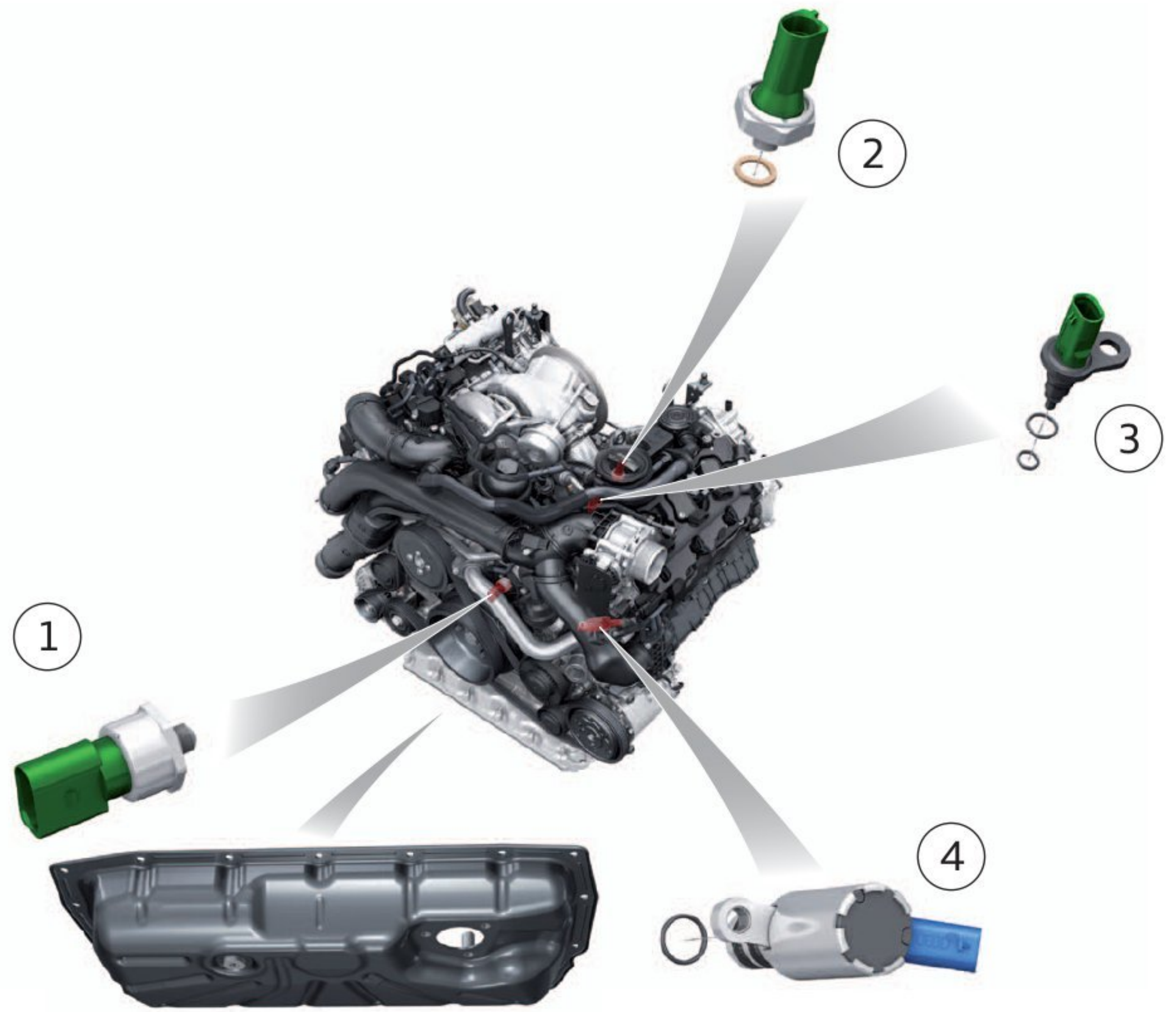
The diagram below shows the pressure curve as a function of engine speed at maximum delivery.



655_006

Note
For a more detailed explanation of the design and function of the vane cell pump as well as the control function, refer to Self Study Programme 639 "Audi 1.0l 3-cylinder TFSI engine of the EA211 series".

Oil supply sensor and actuators



655_040

655_041

Key:

1 **Oil pressure sensor G10**
Measures the current oil pressure for the regulation of the fully variable oil pump. The measured oil pressure is transmitted to the engine control unit by SENT protocol.

2 **Oil pressure switch F22**
Indicates to the engine control unit whether the spray jet valve has been closed. Switches at 0.3 – 0.6 bar.

3 **Oil temperature sensor G8**
NTC measures the current oil temperature in the main oilway.

4 **Oil pressure control valve N428**
Is activated by 12 volt input signal
PWM at 250 Hz, 0 – 1 A

Fail safe:
In the event of failure of the electrical control element, the oil pump delivers oil at high pressure.

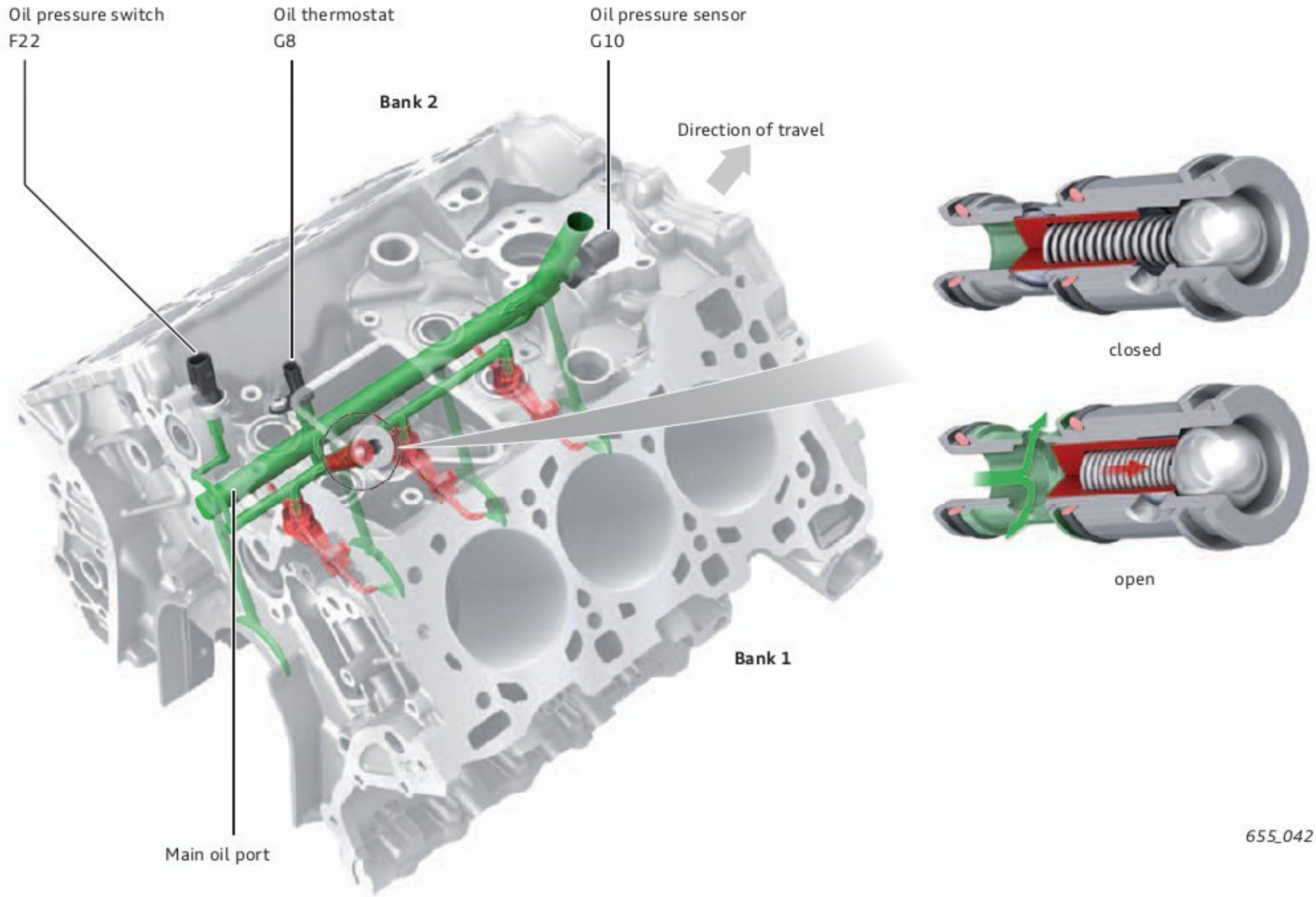
5 **Oil level/temperature sensor G266**
For measuring the engine oil tempeature and the engine oil level. The information on oil fill level and oil temperature is transferred by PWM signal.

Active piston cooling jets

It is not necessary to cool the piston crowns with oil spray in all engine operating conditions. This is why the piston cooling system is active.

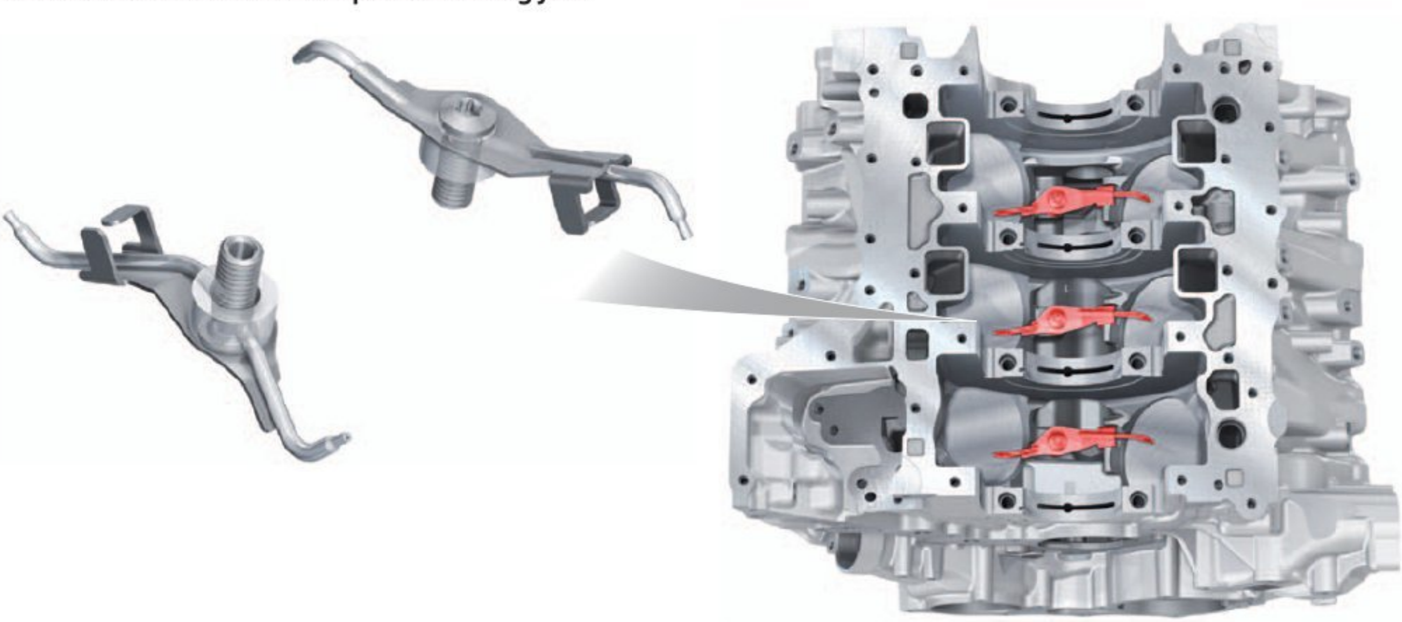
The piston is cooled by increasing the engine oil pressure. When a pressure of 2.5 bar (rel.) is exceeded, the spray jet valve opens against the force of the compression spring and connects the main engine oilway to the duct to which the piston spray jets as well as the oil pressure switch F22 are connected. The spray jet valve is mounted below the oil cooler in the engine block.

Spray jet valve



655_042

Installation location of the piston cooling jets

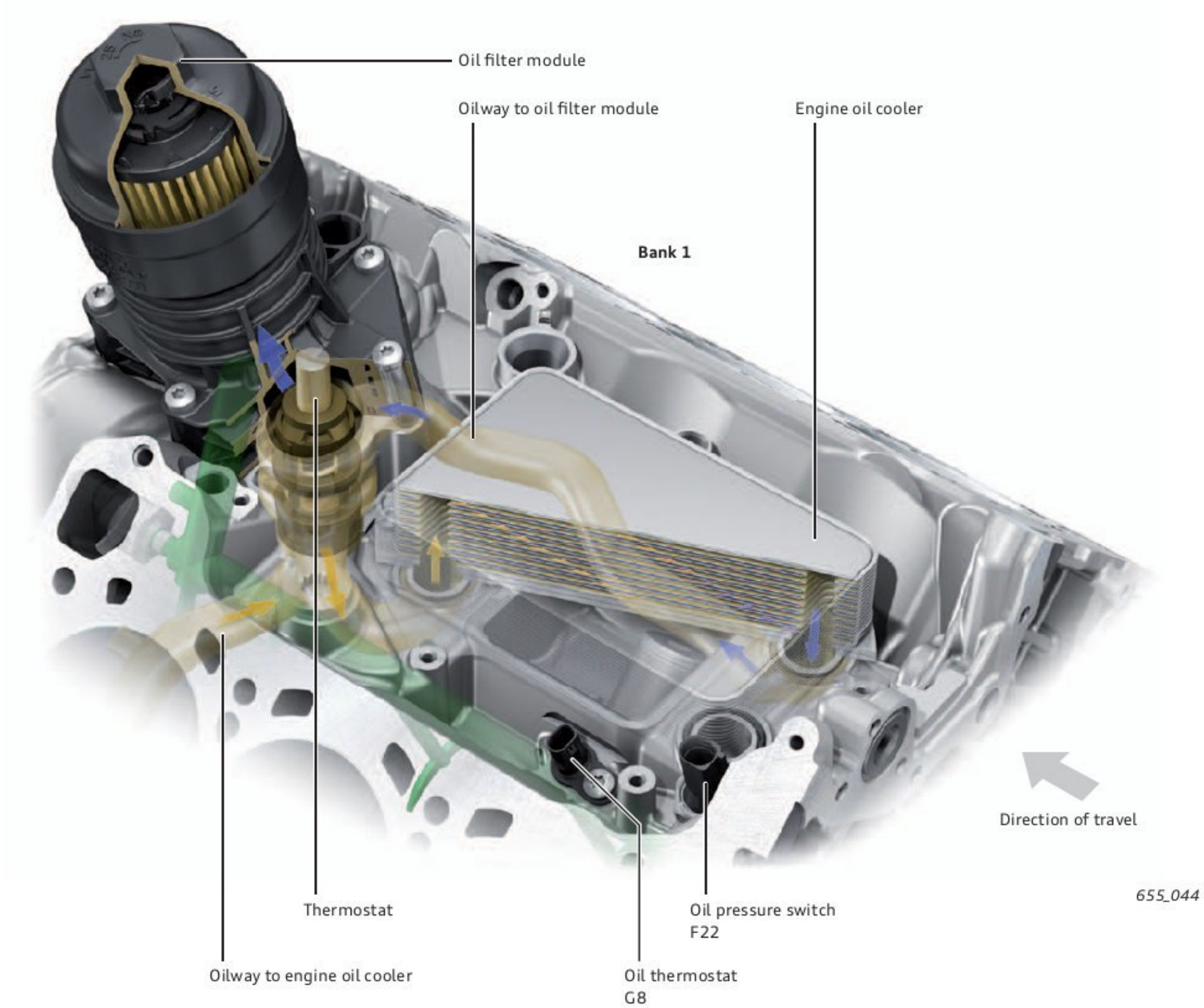


655_043

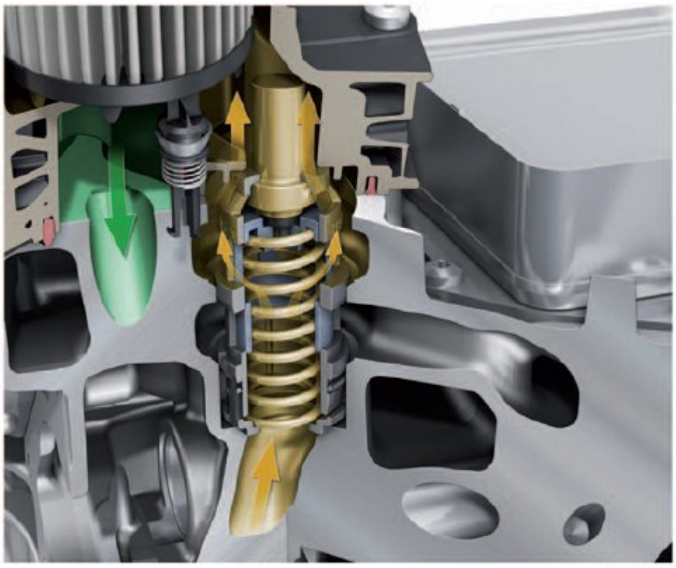
Thermostat controlled engine oil cooler

The engine oil does not have to be cooled in most engine operating ranges. Bypassing the oil cooler by means of a bypass reduces the pressure loss throughout the entire circuit. The oil pump has less delivery work to do. A further advantage is that the engine oil takes less time to heat up after a cold start.

A thermostat installed upstream of the engine oil cooler opens and closes the bypass.
The bypass starsts to open when a temperature of about 110 °C is exceeded and is fully open when an oil temperature of about 125 °C is reached.

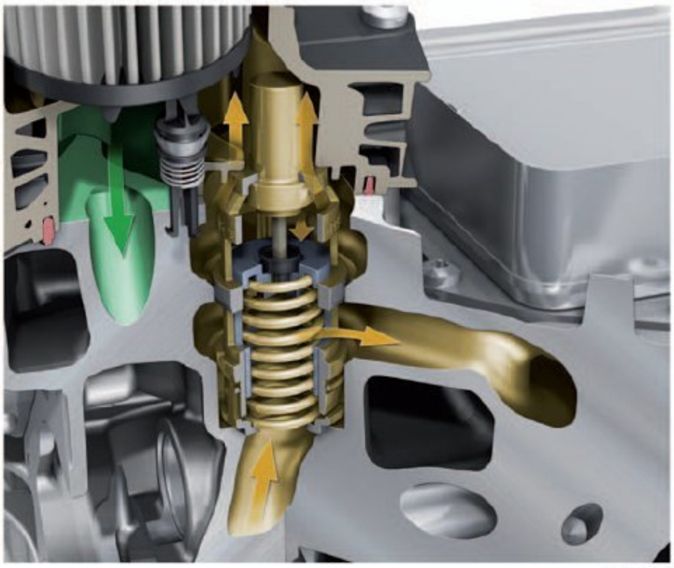


655_044



655_113

Bypass closed
Engine oil bypasses the oil cooler and flows directly to the oil filter

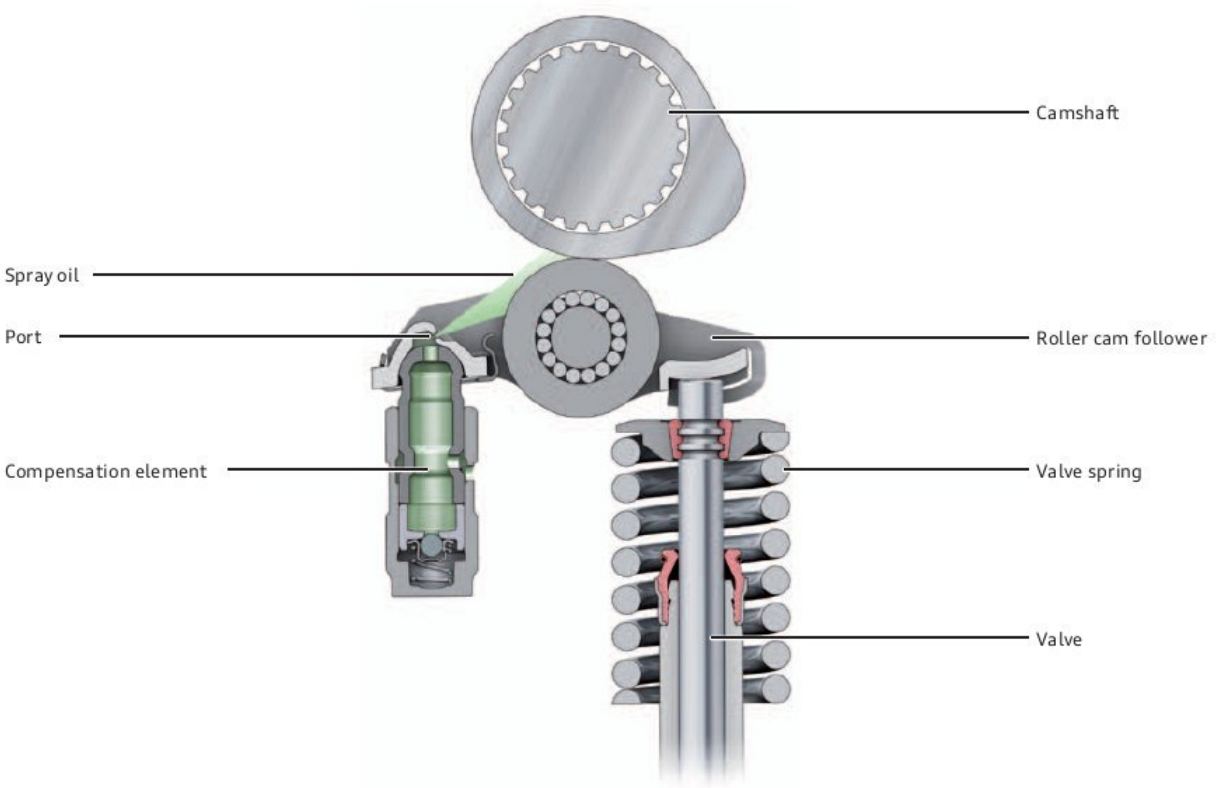


655_114

Bypass open
Engine oil flows through the oil cooler

Roller cam followers with oil spray jets

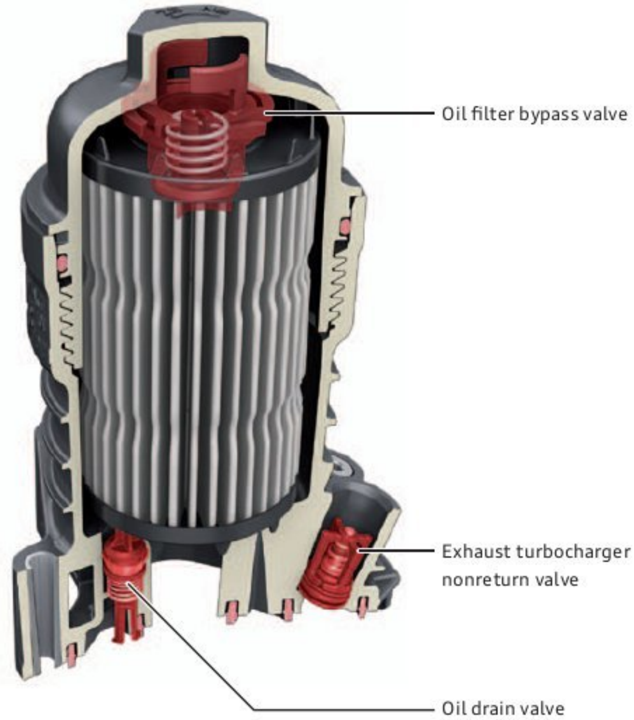
The roller cam followers of all valves are equipped with oil spray jets. Oil is channeled to the roller cam follower through a port in the hydraulic valve clearance compensation element and sprayed onto the roller lining, thereby reducing engine friction.



655_045

Oil filter module

The oil filter module is installed in the inner V of the engine for easy servicing. A nonreturn valve integrated in the module housing prevents the engine oil level in the exhaust turbocharger from dropping when the engine is shut off. This ensures that the required oil pressure is built up very quickly at the exhaust turbocharger lubrication points after starting the engine. The oil drain valve is required to drain the engine oil from the oil filter module into the oil pan when changing the filter cartridge.
The oil filter module lid accommodates the oil filter bypass valve which is designed to open at a pressure of about 2.5 bar (rel.).

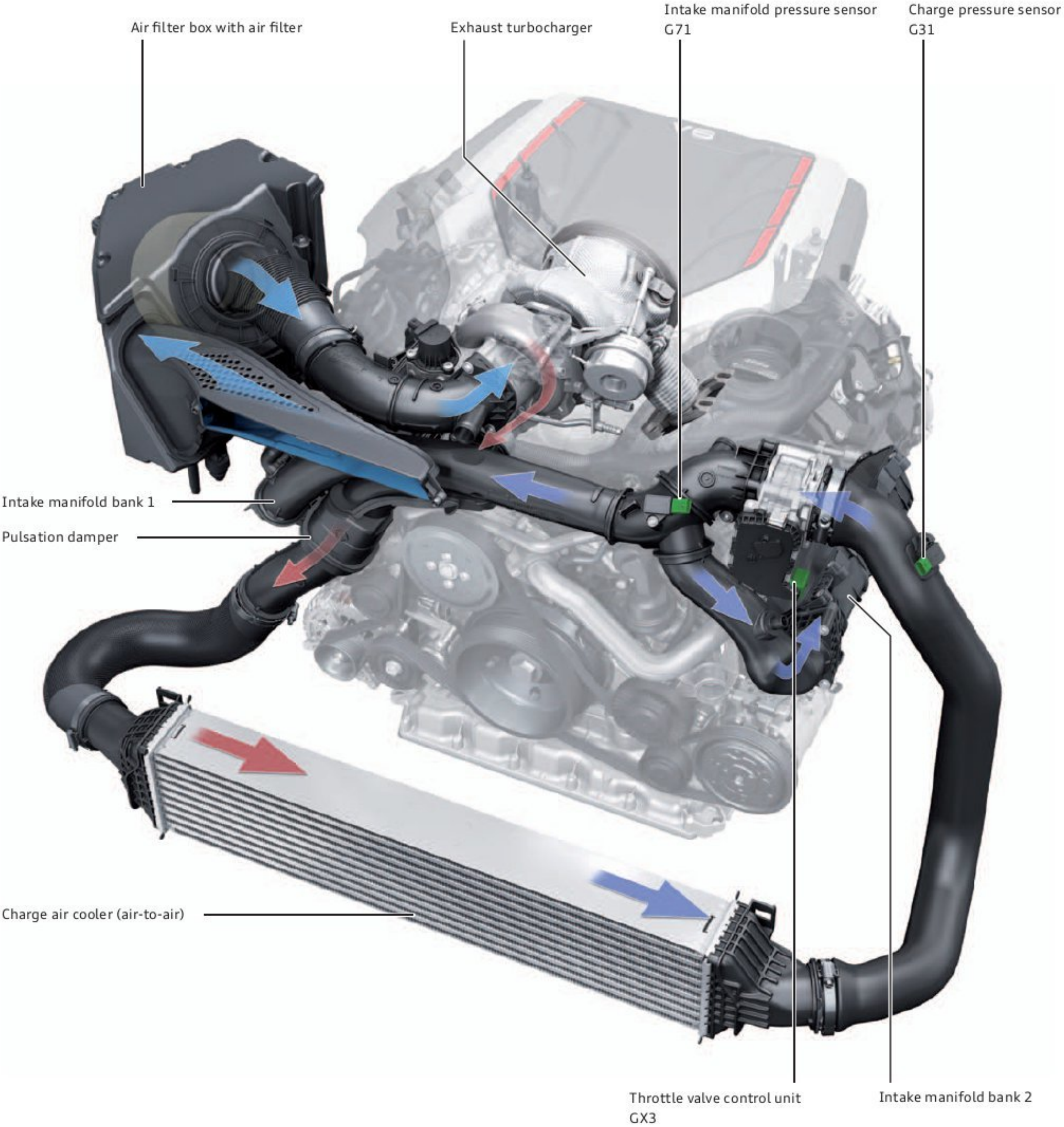


655_046

Air supply and turbocharging

Overview

Thanks to the use of HSI technology, the clean air side of the engine is on the outside. The gas flow paths are designed to be as short as possible and to allow for optimal flow. All air-carrying pipes and the intake manifolds are made from a polymer. To improve noise behaviour, a pulsation damper is integrated in the pressure tube between the exhaust turbocharger and the charge air cooler. Downstream of the throttle valve, the air flow branches off to the two intake manifolds bolted to the cylinder heads. From here, the fresh air flows through the one-piece air ducts (not the intake manifold flaps) of the cylinder heads to the individual cylinders.



655_047

Air flow in the cylinder head

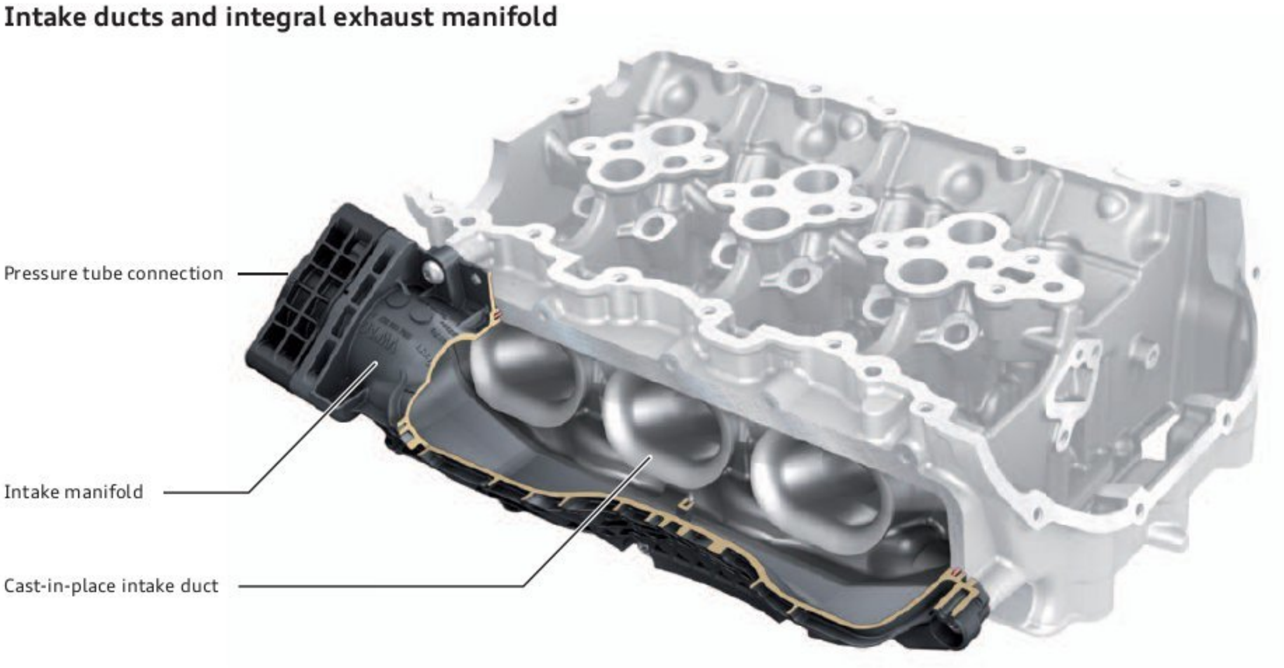
The intake manifold of the 3.0l V6 TFSI engine is a two-piece design. The outer part, which is flange-mounted to the pressure tube, is bolted to the cylinder head.
The inner part of the air flow is cast into the cylinder head. The trumpet-shaped intake ports are a one-piece design. No intake manifold flaps are used.

The integrated exhaust manifold is also cast in place. It has a very important part to play with regard to fuel savings because the downstream exhaust turbocharger does not have to be cooled with fuel.

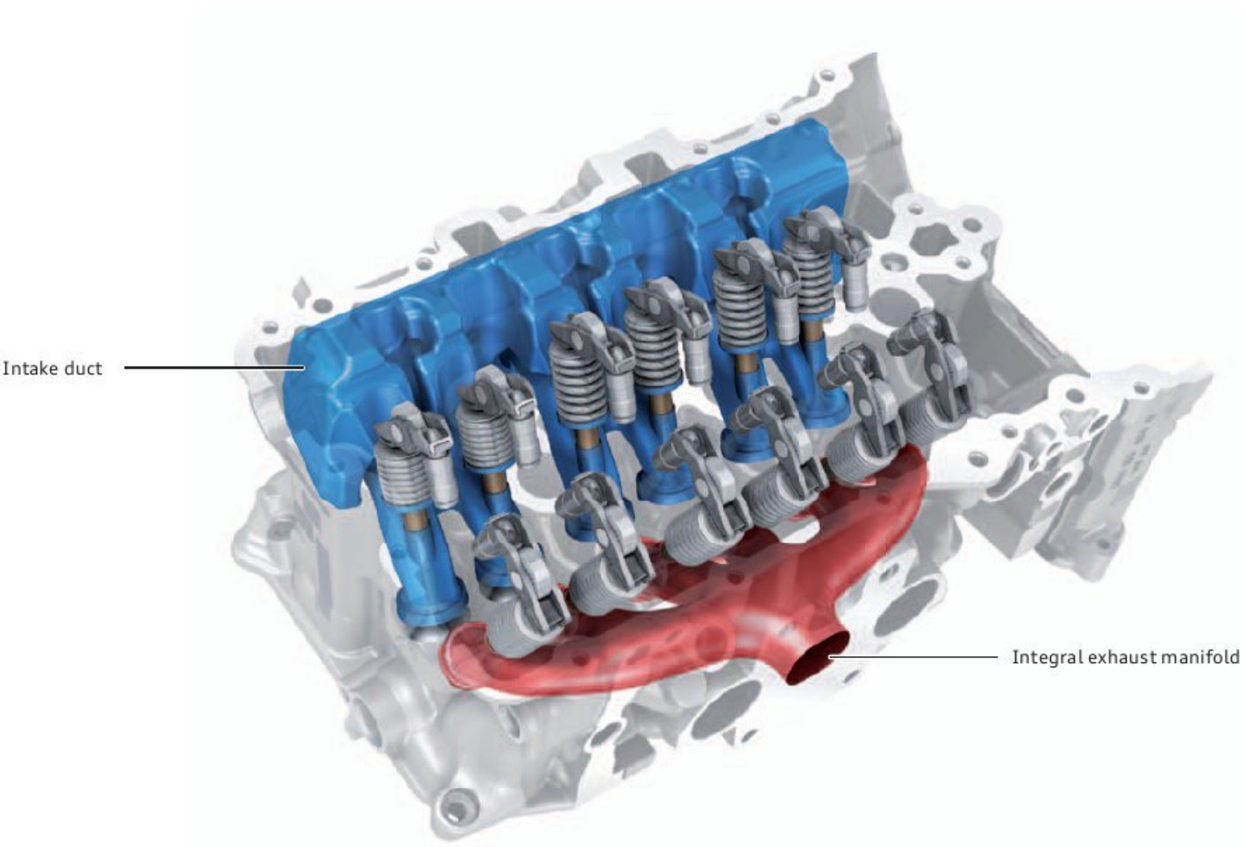
Other advantages are:

- Less weight
- Less heat transfer to the engine bay
- Less assembly space is required
- Lower material costs
- Faster "light off" of the catalytic converter
- Faster heating-up of the coolant

Intake ducts and integral exhaust manifold



655_092



655_097

Exhaust turbocharger

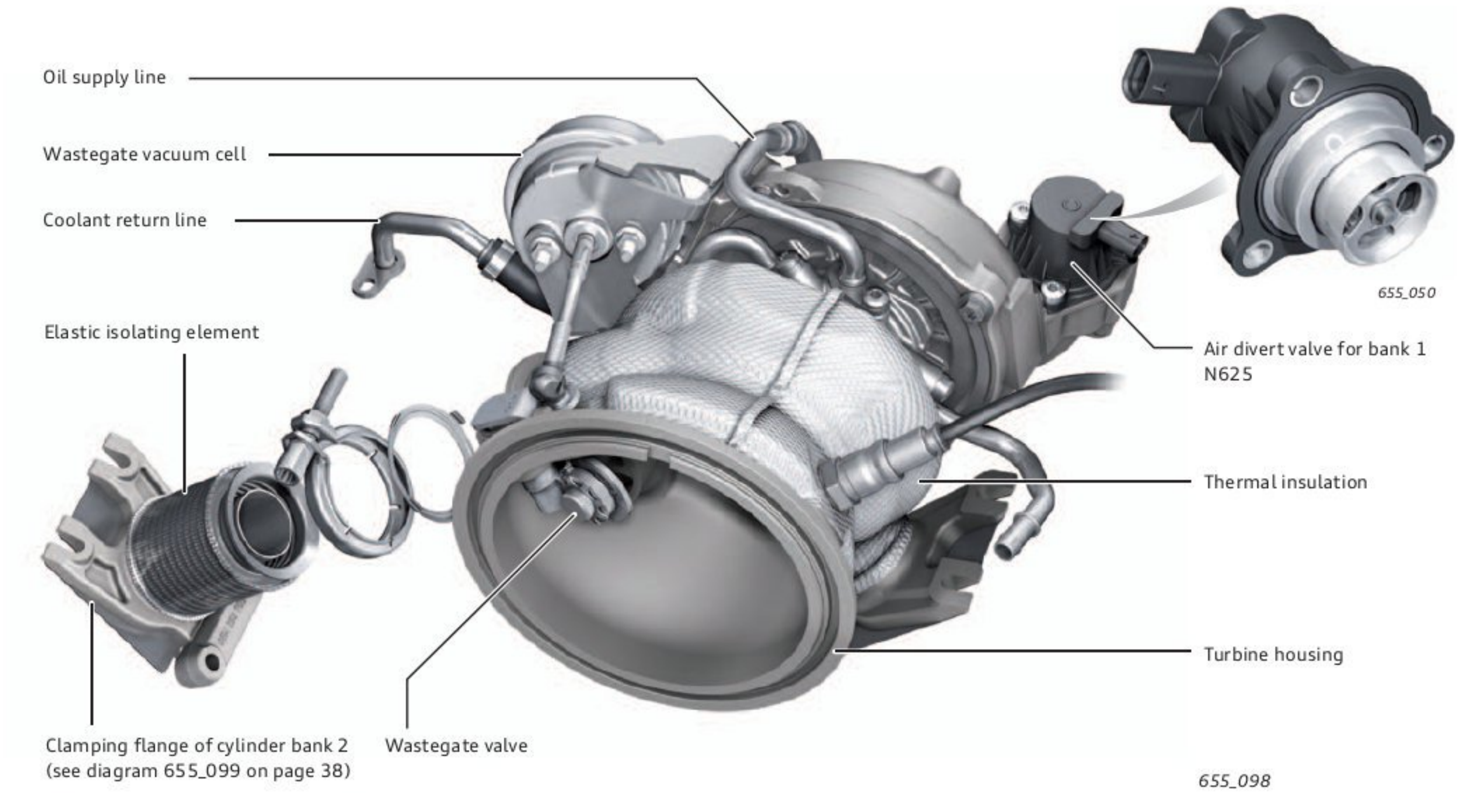
The exhaust turbocharger module is one of the many innovative features of the 3.0l V6 TFSI engine. The following development goals were pursued:

- Improved performance and torque, while at least matching the response of the predecessor engine with supercharging.
- Positioning of the exhaust turbocharger module in the inner V for short gas flow paths and minimal flow losses.
- Installation of the catalytic converter directly downstream of the turbine to achieve rapid light-off
- Limitation of assembly space due installation of the oil filter and the oil cooler in the inner V and upwards due to the need for compliance with pedestrian impact mitigation regulations.
- Staying below the upper limit temperatures of the engine bay

The exhaust turbocharger is bolted directly to the cylinder head of bank 1. As there is a need to compensate for length differences, the turbocharger is connected to bank 2 by means of a flexible isolating element. This element, in turn, is connected to the exhaust turbocharger by means of a spring band clamp. The turbocharger is connected to the cylinder head by means of a clamping flange.
The turbine housing is rated for exhaust temperatures of up to 1000 |. For thermal insulation purposes, it is enclosed in a metal-cased silicate fibre mat. This eliminates the need for elaborate heat insulation measures in the area of the inner V.

Air circulation control

If the driver driver takes his/her foot quickly off the accelerator, charge pressure is still produced momentarily due to the inertia of the exhaust turbocharger. This could potentially produce noise in the intake system. In order to avoid this noise, the bypass duct from the intake side to the pressure side in exhaust turbocharger is opened for 1 – 2 seconds by means of the divert air valve for bank 1 N625. To this end, the 12-volt valve is switched to ground by the engine control unit.



655_098

Charge air pressure control

Due to the space contraints and temperature conditions in the inner V, a pneumatic wastegate control system is used. The system is activated by applying vacuum.

An advantage of vacuum activation is that the wastegate can already be opened when the engine is cold started. This facilitates a quicker light-off (heating-up) of the catalytic converter. The vacuum cell is activated by the engine control unit via the charge pressure control solenoid valve N75.

Note
The exhaust turbocharger vacuum cell can be replaced at service centres. Follow the instructions in the workshop manual.

Load sensors

Pressure-based load sensing is performed in the engine control unit J623 by evaluating the signals from the intake manifold presure sensor G71 (downstream of the throttle flap) as well as the charge pressure sensor G31 (upstream of the throttle flap). Both sensors measure air pressure and temperature. The signals are transmitted to the engine control unit by SENT protocol.

Charge pressure sensor G31

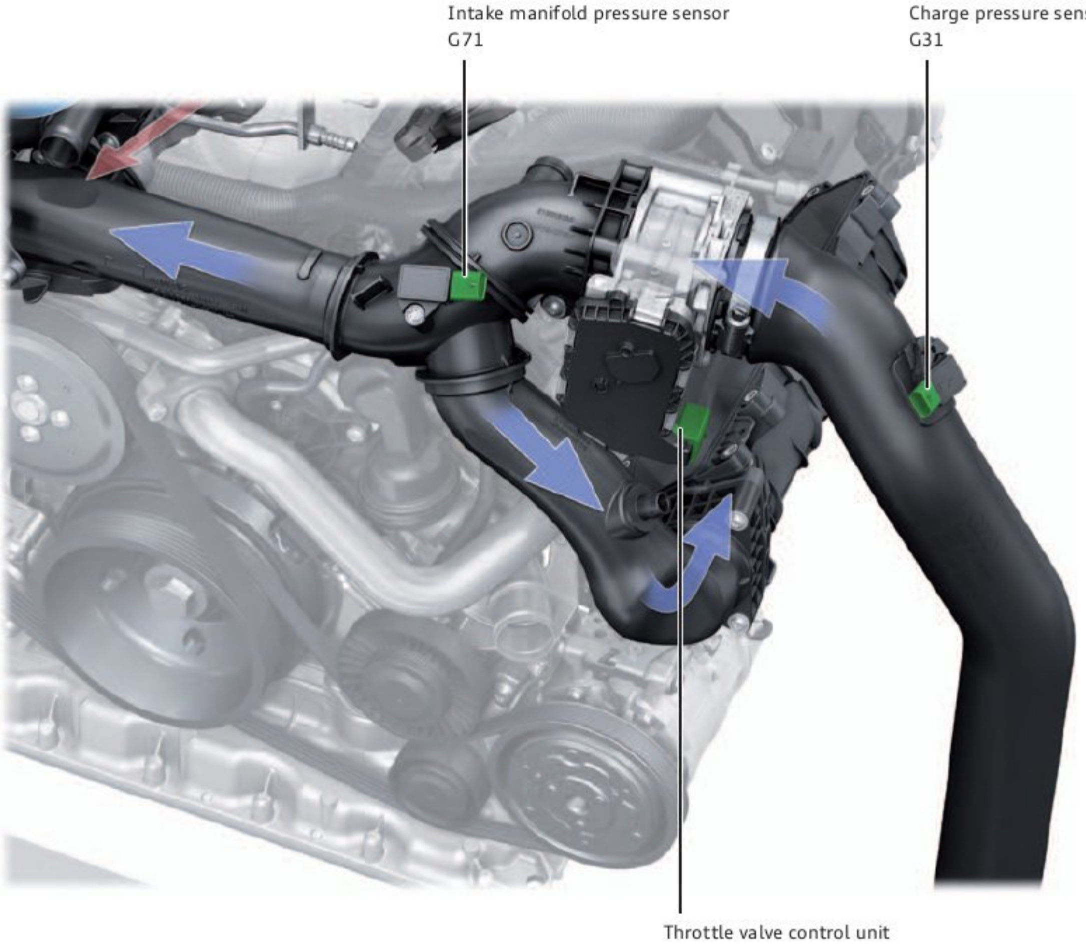
The charge pressure sensor G31 has 2 functions:

- **Function 1:** It measures the charge pressure as an input variable for the charge pressure control system. This is used to compute the control voltage for activation of the charge pressure control solenoid valve N75, in order that the required charge pressure is produced.
- **Function 2:** The signals for pressure and temperature upstream of the throttle valve serve as input variables for determining the air mass flowing through the throttle flap.

Intake manifold pressure sensor G71

The intake manifold pressure sensor G71 also has 2 functions:

- **Function 1:** It measures the pressure and temperature of the air downstream of the throttle flap. These measurement variables are used by the engine control unit to measure the volumetric efficiency of the engine. From this is determined the mass density of the air which actually flows into the combustion chambers. This so-called process of volumetric efficiency measurement is used to calculate the mass of the injected fuel. In this case, the lambda ratio is normally set to 1.
- **Function 2:** The signals for pressure and temperature downstream of the throttle valve serve as input variables for determining the mass density of the air flowing through the throttle flap.



655_100

The throttle flap is controlled by measuring the pressure and the temperature of the upstream and downstream air flows. The throttle flap is always positioned in such a way that the engine receives the required nominal fresh air mass (throttle flap control).

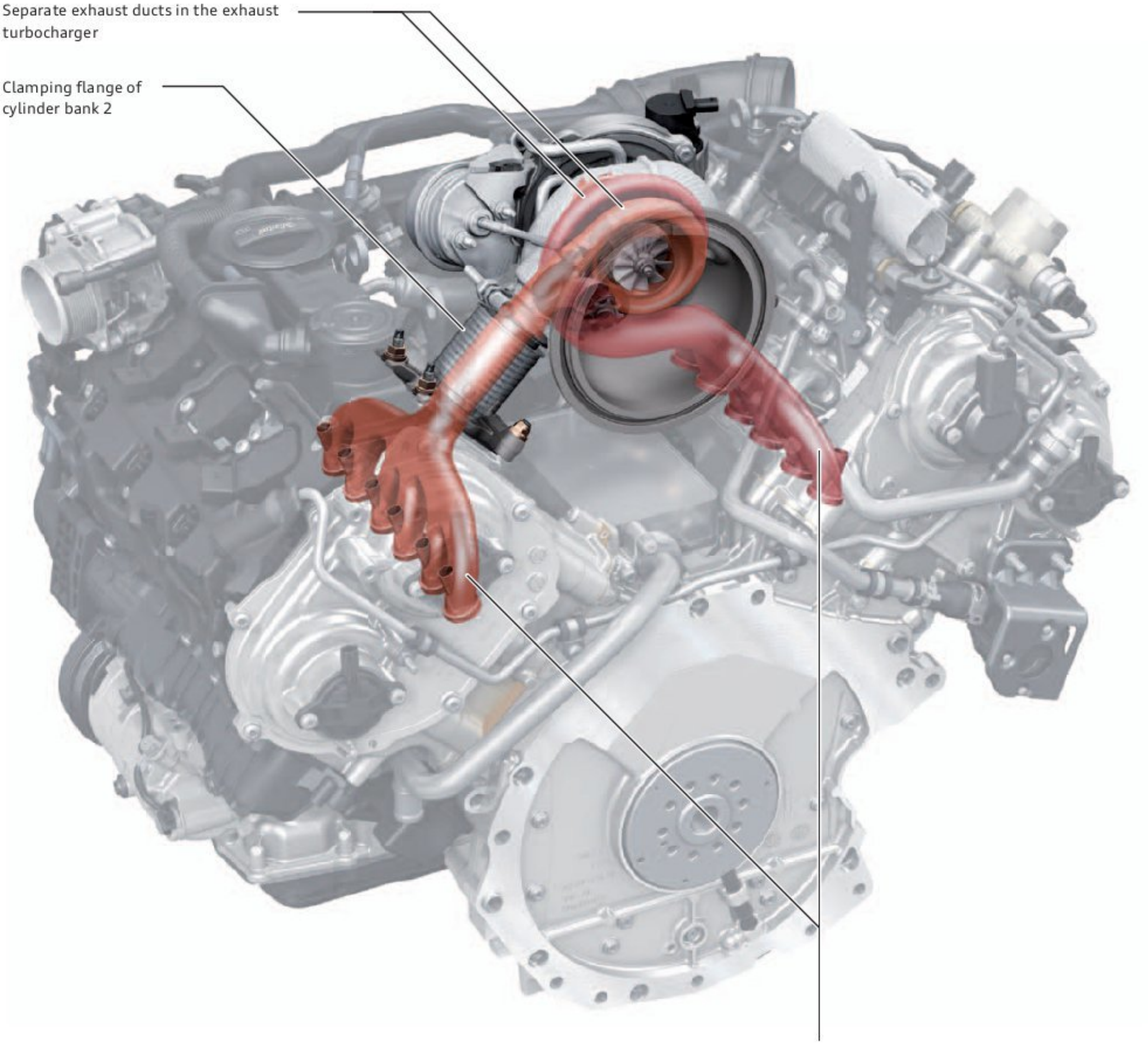
At low engine load and speed, the pressure lies within a range of between 300 mbar and 1 bar, based on the position of the throttle flap. The exhaust turbocharger always produces a small amount of charge pressure (basic charge pressure) due to the energy of the exhaust gases, resulting in different pressures upstream and downstream of the throttle valve. Here, the signals from G71 are particularly important for the measurement of volumetric efficiency.

At higher engine loads, the throttle flap is open at a wider angle and charge pressure (max. 2.3 bar absolute) is built up by the exhaust turbocharger. In this case the signals from G31 are used mainly to measure the engine load for the charge pressure control system.

Twinscroll technology

The 3.0l V6 TFSI engine attributes its dynamic response to, among other things, the exhaust turbocharger module with twinscroll technology.
The exhaust ducts in each bank channel the exhaust gas to directly upstream of the turbine with a minimum of loss. This prevents cross-interference with the exhaust flows in the opposite cylinder bank.

The gas flow paths are very short owing to the positioning of the exhaust turbocharger module in the inner V. The catalytic converter is bolted directly to the exhaust turbocharger outlet. This allows the exhaust turbocharger to achieve light-off very quickly after a cold start.



655_099

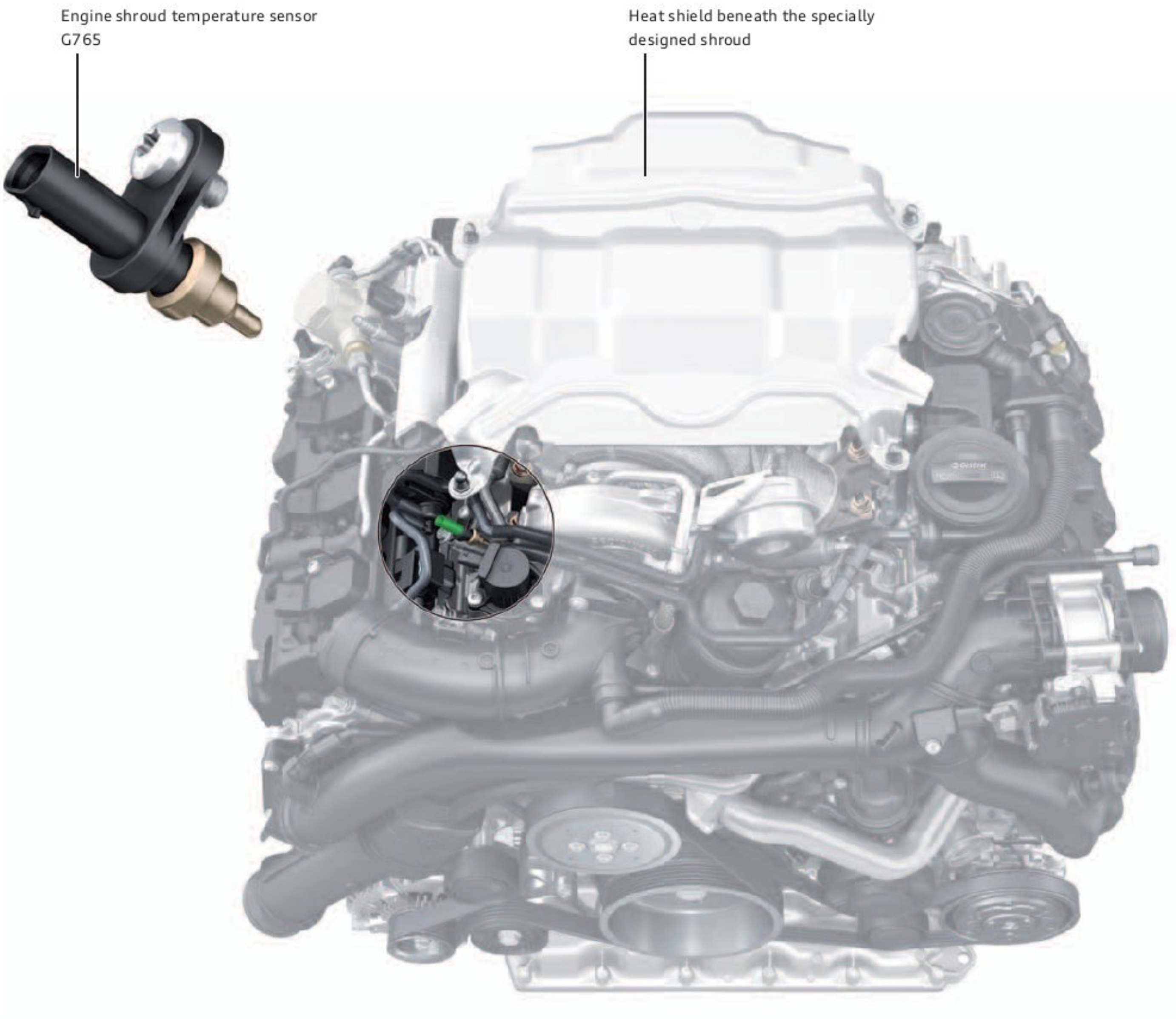
Audi QR-Code

Scan the QR code to find out more about the exhaust turbocharger.

Temperature monitoring in the inner V

The turbine housing is rated for temperatures of up to 1000 |. As a safeguard against excessively high temperatures in the inner V, the turbine housing is enclosed in a metal-cased silicate fibre mat.

The engine shroud temperature sensor G765 is located beneath the specially designed engine shroud and the heat shield. This NTC sensor measures the temperature inside the engine bay. The engine control unit utilises this signal to compute and implement various protective measures.



655_101

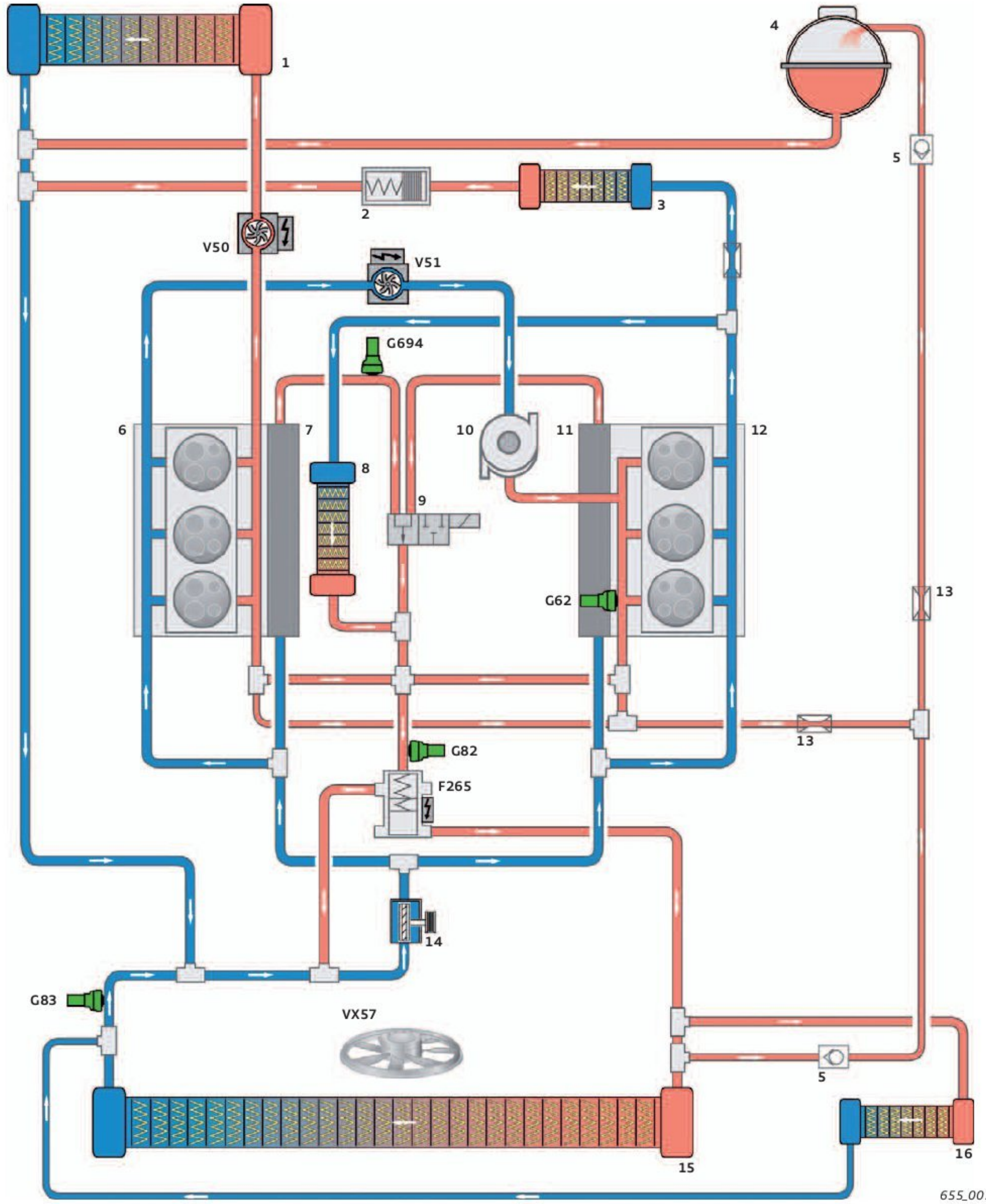
Cooling system

The main focus of research and development was on bringing the engine up to operating temperature quickly. The 3.0l V6 TFSI engine has a latest-generation innovative thermal management system. Furthermore, the entire system is designed in such a way as to minimise pressure losses. To facilitate this, many lines are integrated in the cast iron parts of the engine.

The following systems are used in the new thermal management system:

- Active coolant pump
- Thermostat controlled engine oil cooler
- Electrically heated thermostat (mapped engine cooling thermostat F265)
- Separate cooling circuits in the cylinder head and engine block

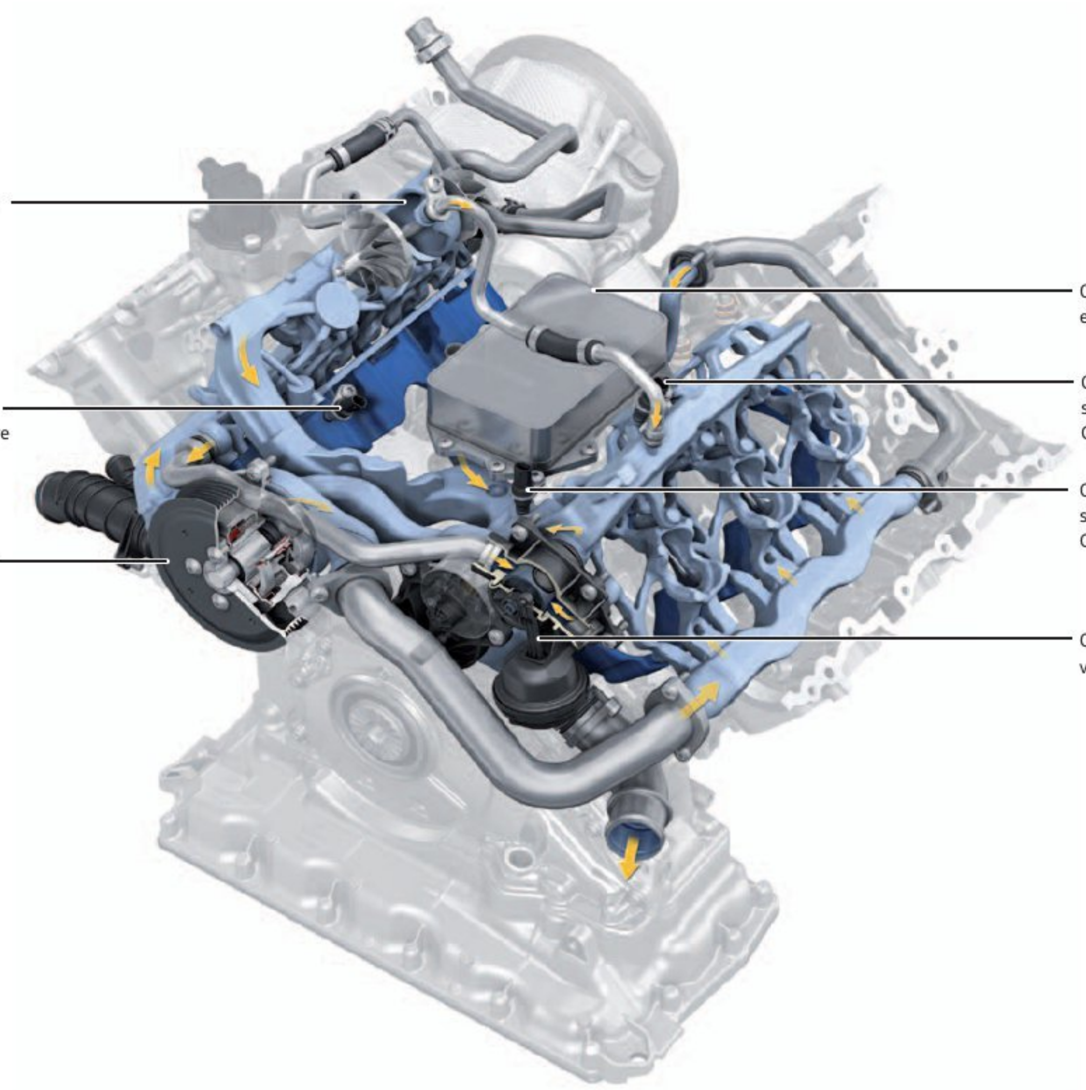
System overview



655_007

Components of the engine cooling system

The numbers in brackets indicate the position of the component in the system overview on page 40.



655_051

Key to figure on page 40:

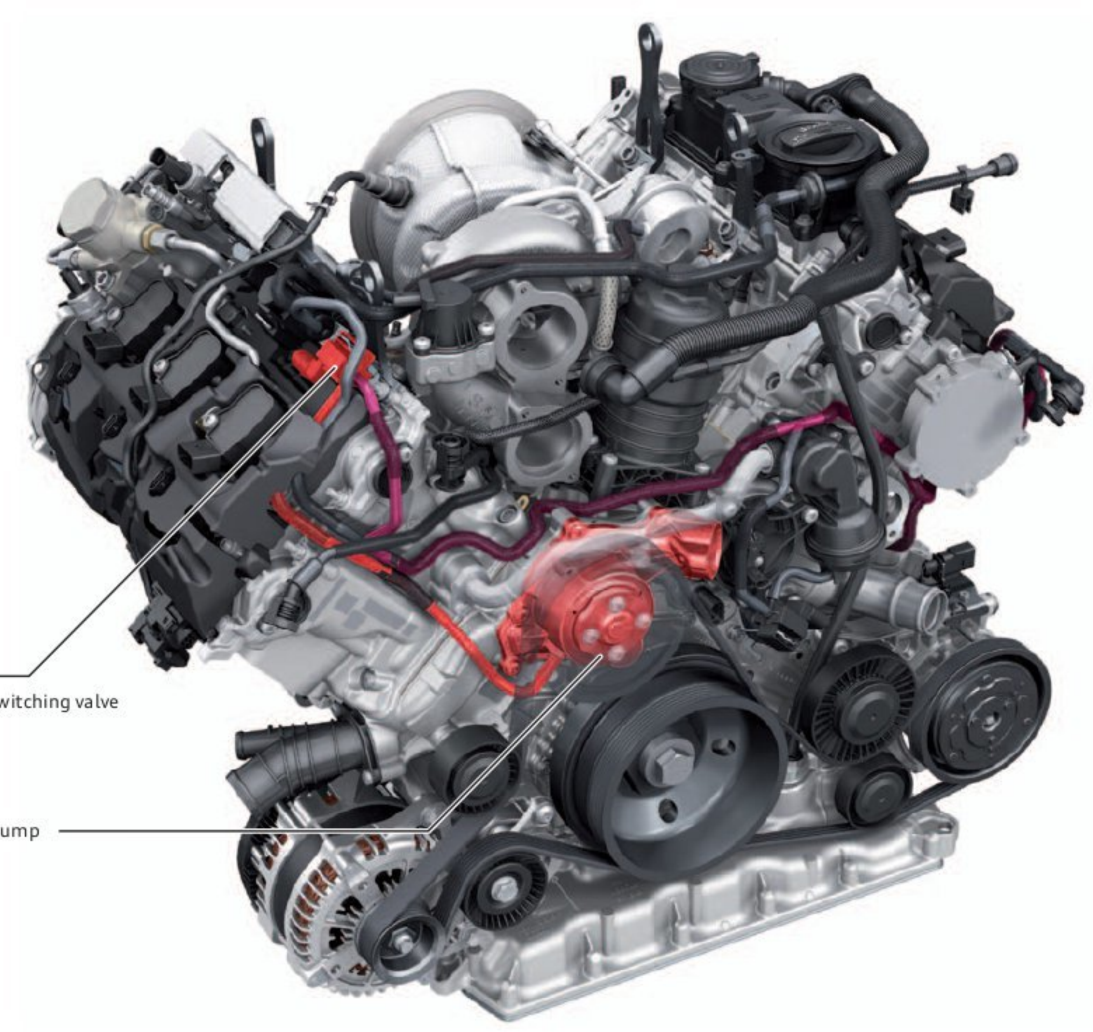
1	Heater heat exchanger
2	Coolant circuit thermostat for ATF cooling, see SSP 486, page 31
3	ATF cooler
4	Coolant expansion tank
5	Nonreturn valve
6	Cylinder head, bank 1
7	Engine block in the area of bank 1
8	Oil/coolant heat exchanger (engine oil cooler)
9	Coolant shutoff valve, activated by cylinder head coolant valve N489
10	Exhaust turbocharger
11	Engine block in the area of bank 2
12	Cylinder head, bank 2
13	Flow restrictor
14	Coolant pump, activated by mechanical coolant pump switching valve N694
15	Radiator
16	Auxiliary radiator

F265	Thermostat for mapped engine cooling
G62	Coolant temperature sensor
G82	Coolant temperature sensor at engine outlet
G83	Coolant temperature sensor at radiator outlet
G694	Temperature sensor for engine temperature regulation
V50	Coolant circulation pump
V51	Continued coolant circulation pump
VX57	Radiator fan

Cooled coolant
Warm coolant

Active coolant pump

The coolant pump is positioned at the front side of the engine and is driven continuously by means of a poly V belt. It conveys the coolant on the left and right hand sides of the engine into the engine block cooling circuits and the cylinder heads. In addition, the exhaust turbocharger, the engine oil cooler and the cabin heating system are integrated in the cylinder head circuit. The Coolant flows diagonally and longitudinally through the engine block. The cylinder heads have a cross-flow cooling system. The active coolant pump is equipped with a sliding sleeve. The sleeve is pushed over the pump gear by vacuum, thereby stopping the circulation of coolant when required. The pump is activated by the engine control unit and by the mechanical coolant pump switching valve N649.



655_052

Coolant pump closed (shutter covers the pump gear)

655_103

Coolant pump open

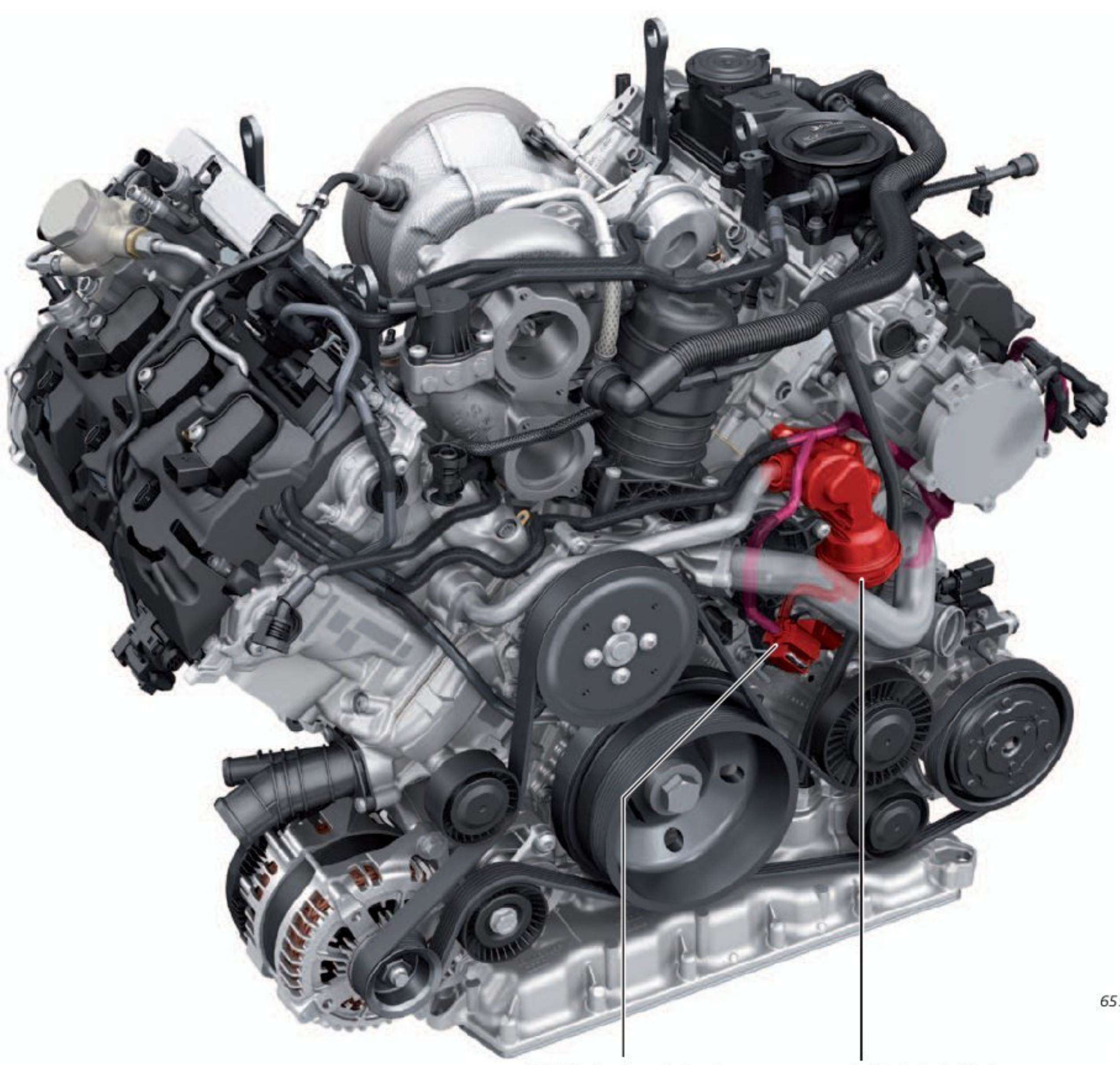
655_104

Reference
For a functional description of this type of active coolant pump, refer to Self Study Programme 485 "Audi 1.2l TFSI engine".

Coolant shut-off valve

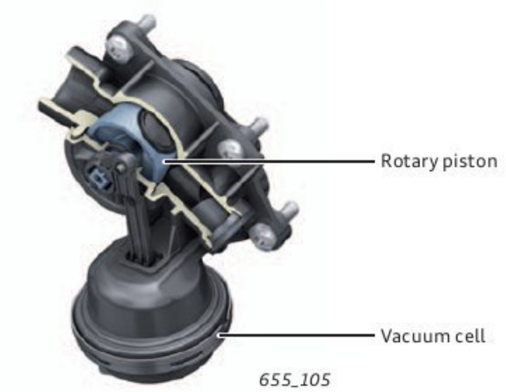
The coolant shut-off valve is mounted to the cylinder head of bank 2 at the front.
For faster engine warm-up, the flow of coolant from the engine block to the cylinder head can be interrupted. Coolant then only flows through the cylinder heads and connecting components, such as the exhaust turbocharger, the oil cooler and the cabin heating system.

After the coolant has heated up within the engine block, the coolant shut-off valve is opened.
The shut-off valve is a mechanical rotary piston valve. When this valve is activated, the piston is rotated through 90° via a linkage by means of a vacuum cell. The valve is activated by the engine control unit by means of the cylinder head coolant valve N489 (solenoid valve). The shut-off valve is not activated (it is held open by the force of the spring).



655_053

Shut-off valve open



655_105

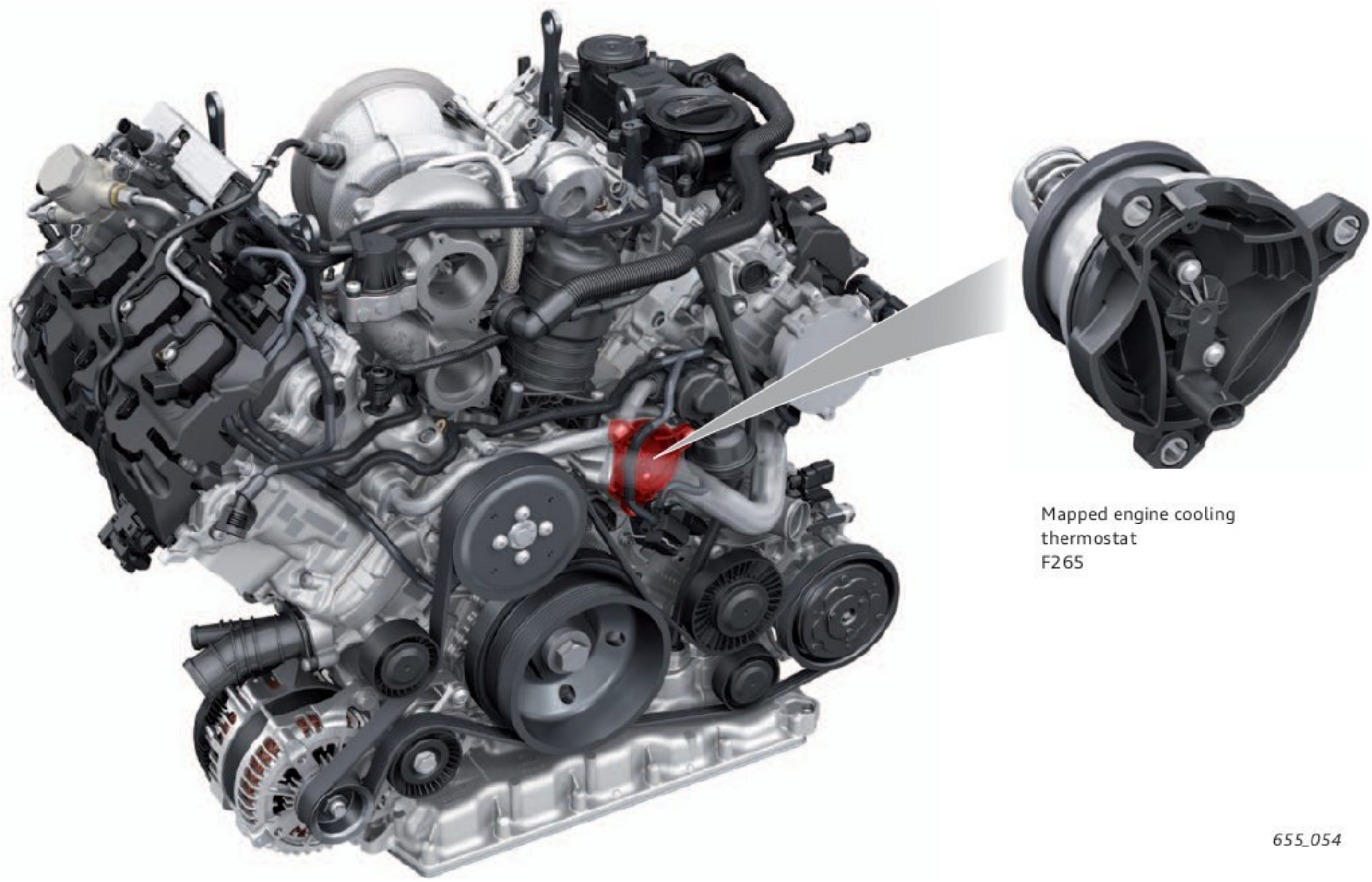
Shut-off valve closed


655_106

Coolant regulator (mapped engine cooling thermostat F265)

The coolant thermostat is installed in the engine block from the front. It controls the distribution of all coolant flows between the small circuit and the large circuit and redirects the volumetric flows to the coolant pump.
The map-controlled thermostat regulates the coolant temperature at the engine outlet depending on the operating conditions (engine load). This is measured by the coolant temperature sensor at engine outlet G82. At partial engine load the temperature is kept to a maximum of 105 °C thereby reducing friction within the engine. At higher engine loads the coolant temperature is set to 90°.

The coolant thermostat, which is controlled by means of an expanding wax element, opens the cross section towards the main radiator when the opening temperature is reached. At the same time, the cross section of the bypass duct is closed.
The opening temperature can be reduced according to the map by means of an electrical heating element in the wax cartridge. The heating element is activated by the engine control unit. The actuator is driven by a PWM operating voltage signal (12 volts). "PWM high" means that the heater is activated by applying voltage thereby ensuring a low coolant temperature.



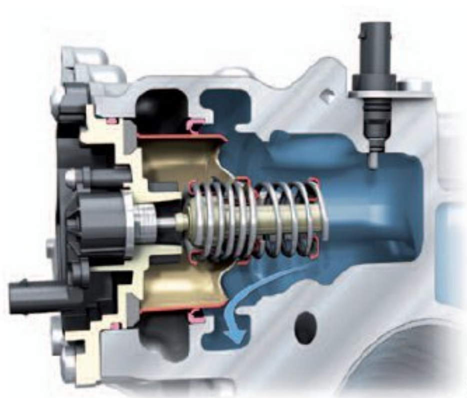
Mapped engine cooling thermostat F265

655_054

Thermostat open

655_056

Thermostat closed



655_055

Reference
A functional description of the mapped engine cooling thermostat can be found in Self Study Programme 222 "Electronically controlled cooling system".

1 – Coolant run-on pump V51 (heater heat exchanger cooling circuit)

2 – Coolant circulation pump V50 (exhaust turbocharger cooling circuit)

Both pumps are identical. They are bolted to the chain case cover of cylinder head bank 1 at the back of the engine. The pumps consist of the following components:

- EC electric motor with protective circuit and plug connection
- Pump unit comprising impeller and impeller bearing
- Statically sealed housing with inlet and outlet connections

Electrical activation

Both pumps are activated by the engine control unit by means of a PWM signal. The delivery rate of the pumps can therefore be adapted to the thermodynamic conditions in the cooling circuit. The electronics integrated in the pump convert the signal from the engine control unit as well as determining the speed of the pump motor and, thus, the delivery rate. In addition to this, the pump electronics are able to diagnose the electrical and mechanical condition of the pump and to transmit this information to the engine control unit. The signals generated for this purpose are applied to the PWM signal line.

V50 activation

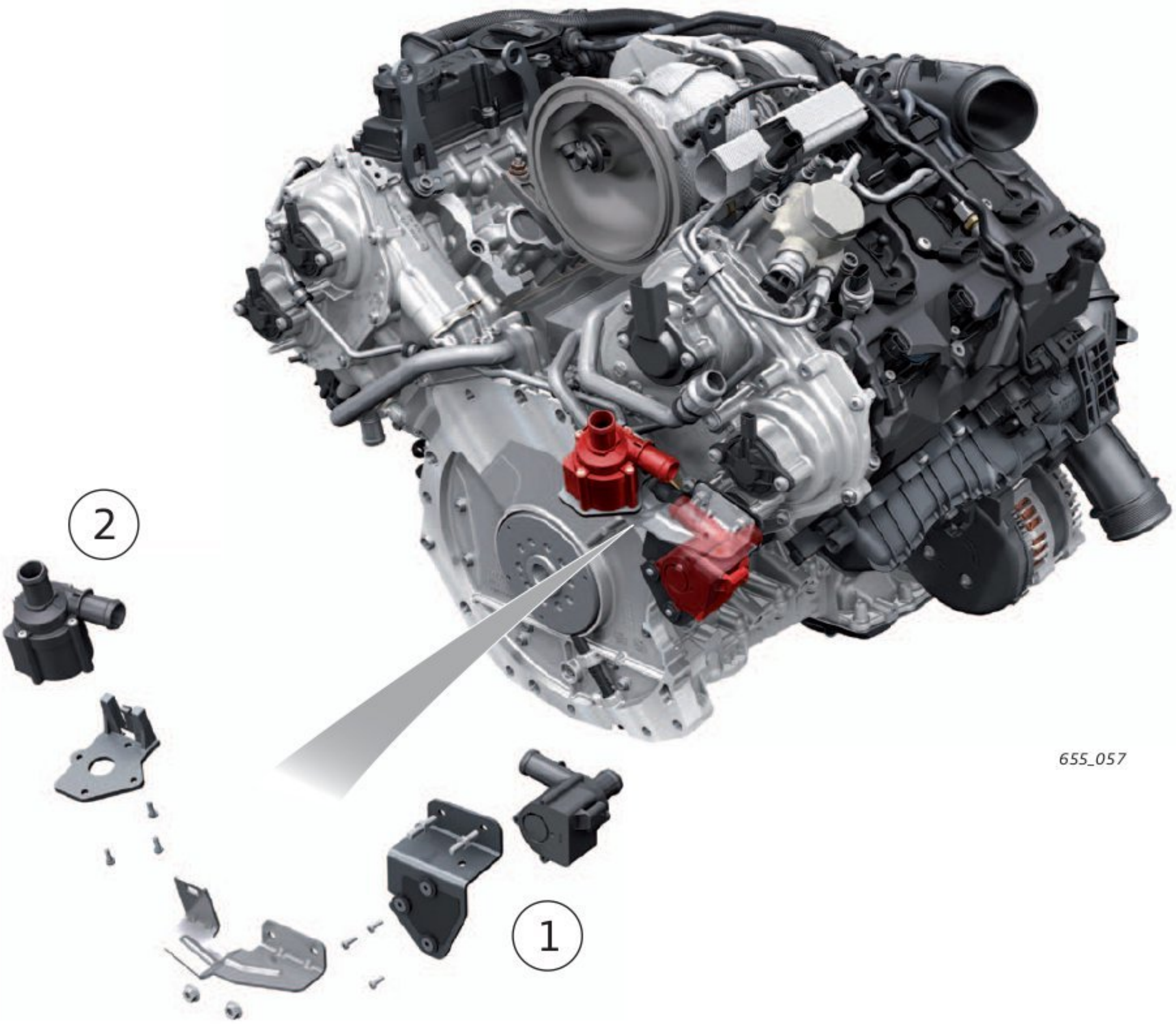
The activation request is issued by the A/C control unit. The activation signal is generated when a heating request is issued, when the engine is at a standstill in start-stop mode and when residual heat is requested.

V51 run-on function

After the engine is shut off, after-heating effects can cause the coolant in the cooling system to overheat when certain operating conditions apply (the vehicle has been driven at top speed and/or up a long climb at high ambient temperatures). This is prevented by the pump run-on function V51.
After the engine is switched off, the pump V51 runs on for a set amount of time according to a data map stored on the engine management ECU. The electric radiator fan starts to run at the same time.

V51 pump function during engine operation

Pump V51 is activated in dependence on the map stored in the engine control unit, in order to assist the main mechanical water pump. This occurs at between idling speed and medium engine speed when the engine has reached its operating temperature.



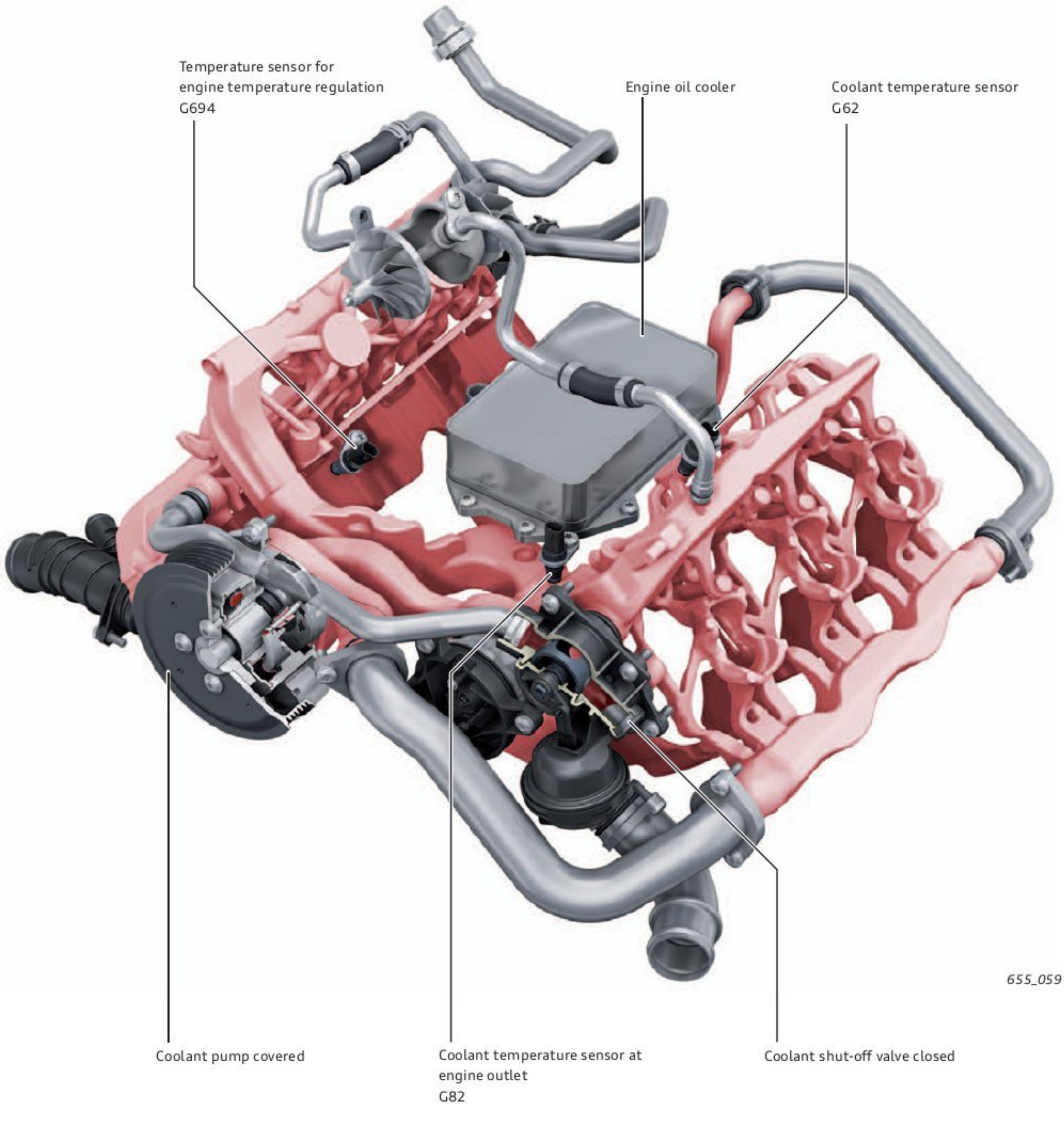
655_057

Note
In vehicles with an auxiliary heater the function of V5 is performed by the circulation pump V55.

Coolant characteristic during the engine warm-up phase

Cold starting

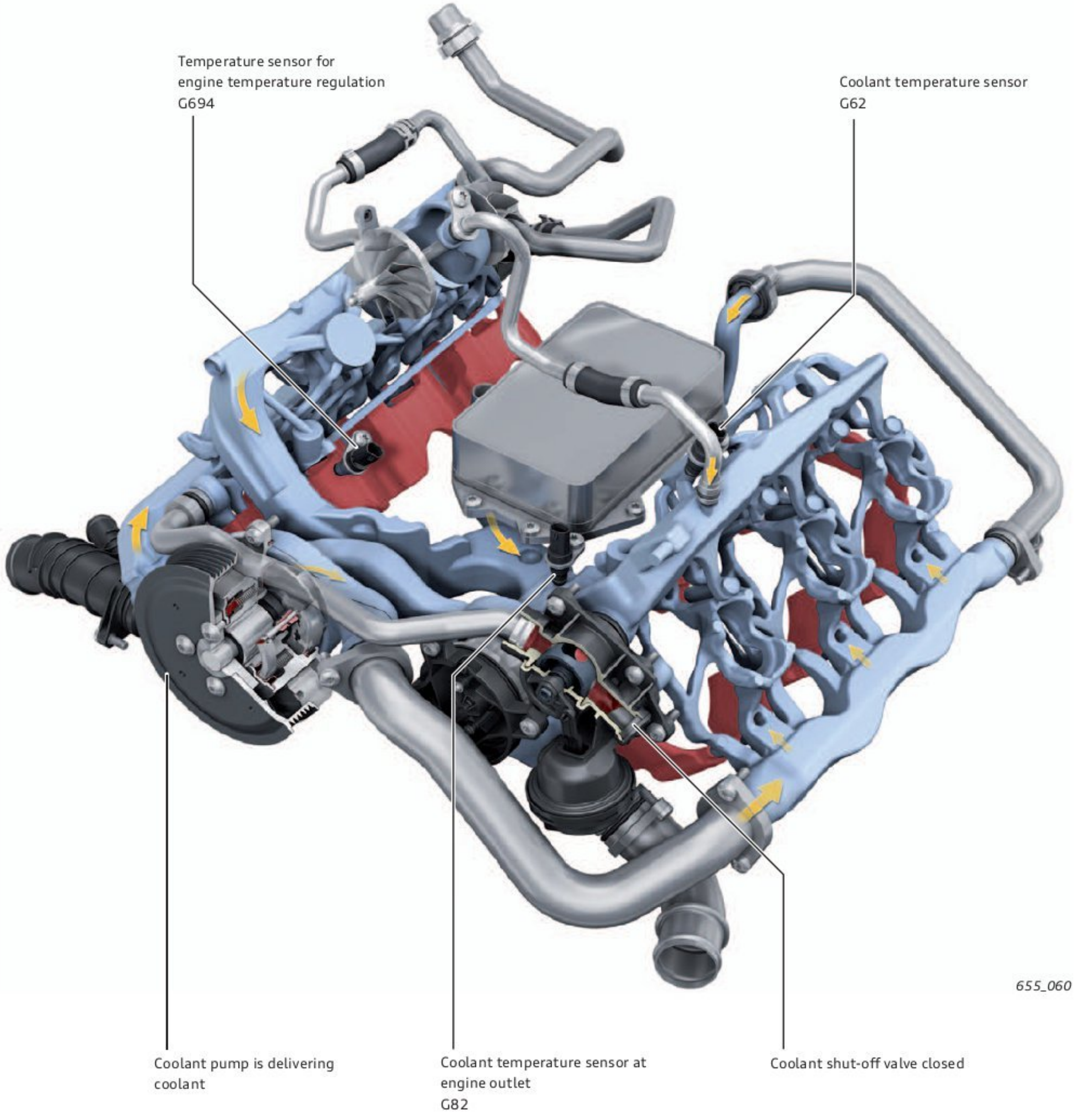
The active coolant pump is activated by the engine control unit and switches to zero flow. This stops the circulation of coolant throughout the engine and ensures the rapid heating of the coolant - especially in the cylinder heads, as they have integrated exhaust manifolds. As no oil flows through the engine oil cooler, the coolant heats up more quickly.



Scan the QR code to find out more about the innovative thermal management system.

Warm-up

Due to rapid heating of the coolant in the cylinder head, the cylinder head circuit is closed via the coolant pump. The signal from the coolant thermostat G62 is utilised by the engine control unit for this purpose. The circulation of coolant within the engine block is stopped as the coolant shutoff valve is activated and thereby closed. As a result, the coolant heats up very quickly within the engine block.

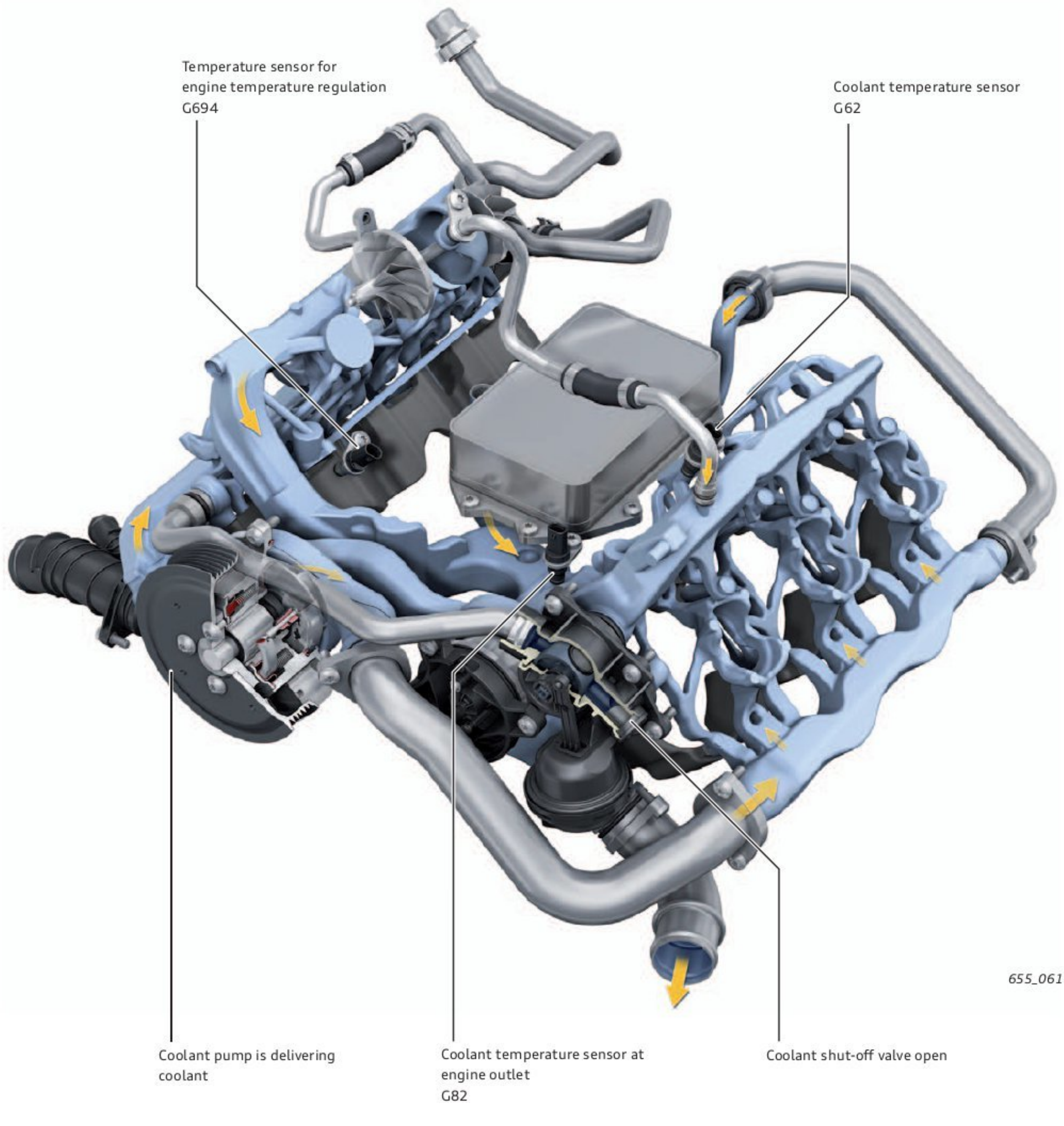


655_060

Engine at normal operating temperature

The coolant shut-off valve is opened when the engine block reaches its operating temperature (about 100 °C, signal from temperature sensor for engine temperature regulation G694). This means that coolant flows through the cylinder head and the engine block. Depending on the map stored in the engine control unit, the engine outlet temperature is now set to between 90 °C and 105 °C by the electrically heated thermostat. To this end, the engine control unit evaluates the signal from the coolant temperature sensor at coolant outlet G82.

When the oil temperature exceeds 115 °C, the oil cooler thermostat opens so that engine oil can flow through the oil cooler.



655_061

Fuel system

Overview

A high-pressure fuel system with an operating pressure of 250 bar and 7-port solenoid injectors are used in the 3.0l V6 TFSI engine.

Development goals

- Production of an air-fuel mixture through internal mixture formation for the entire operating range.
- Suitability for world-wide use and resistance to fluctuations in fuel quality
- Weight and cost savings through reduced complexity and parts diversity compared to the MPI / FSI injection system
- High maintainability and ease of access to injection system components

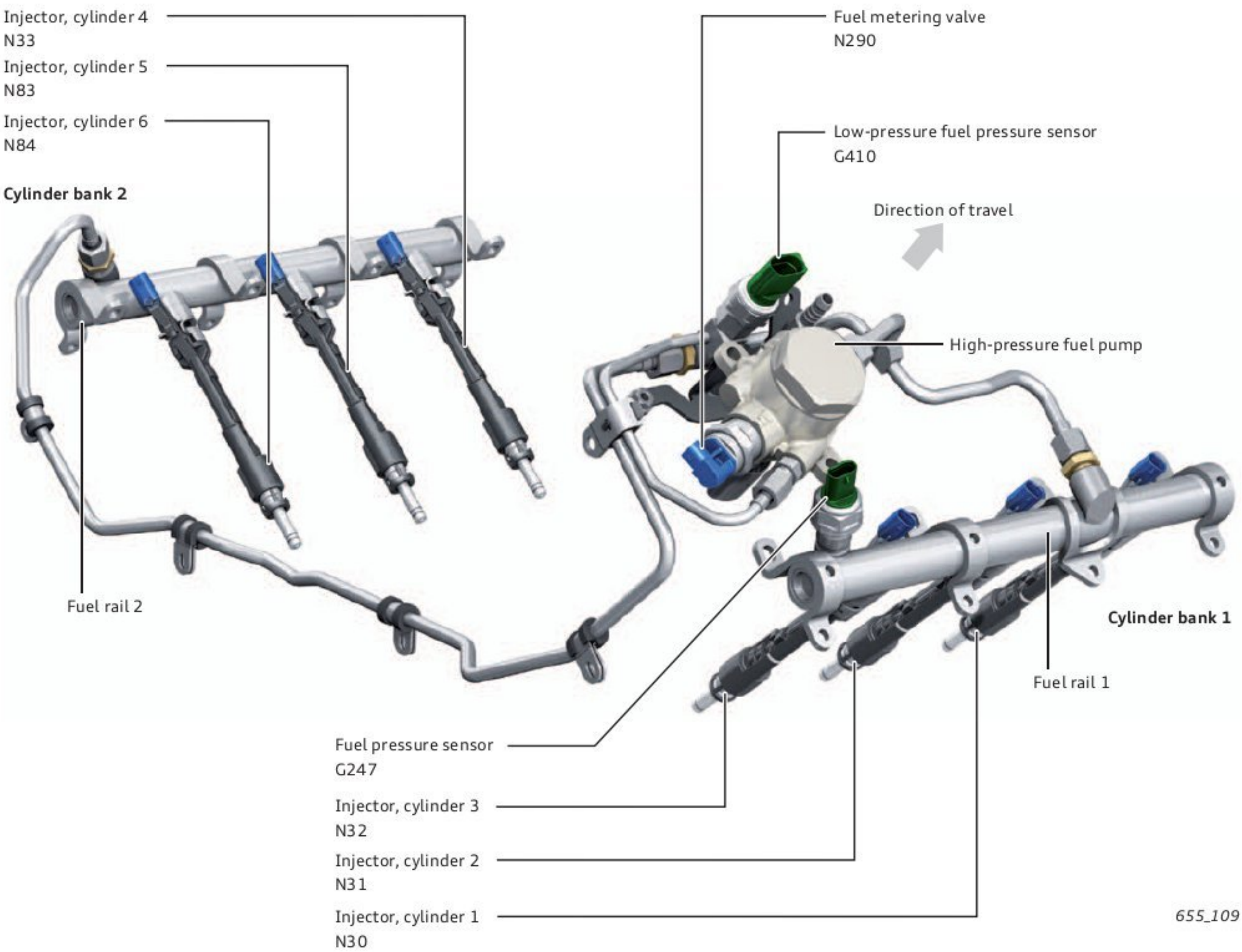
Fuel injectors

The new injectors are positioned centrally in the combustion chamber adjacent to the spark plugs. They are able to inject fuel multiple times per mixture formation cycle and working stroke, as well as delivering tiny quantities of fuel (3 – 5 mg) when required. This is particularly effective during the light-off phase of the catalytic converter.
The solenoid injectors are activated by the engine control unit by applying a voltage of 65 V.

High-pressure fuel pump

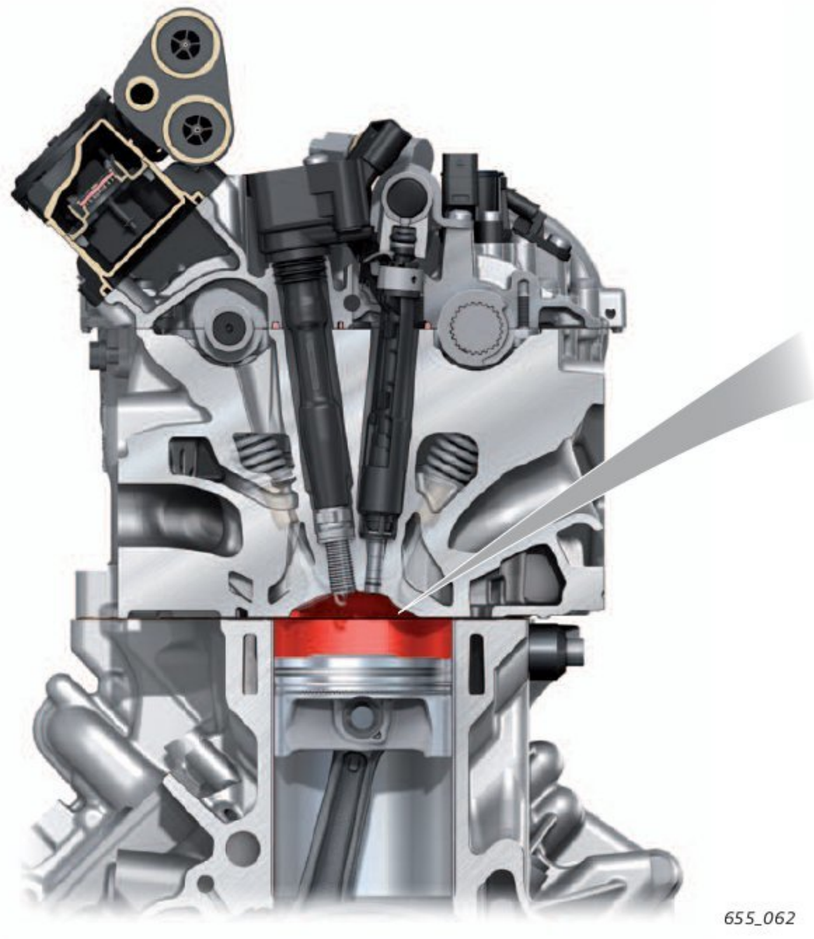
The high-pressure fuel pump is driven by a three-lobe cam of the exhaust camshaft of cylinder bank 1 (see diagram showing an overview of the oil circuit).

When the fuel metering valve N290 is activated, the fuel pressure is set to between 30 bar and 250 bar (this is calculated by a map). If N290 is not activated (de-energised), high fuel pressure is not required.



655_109

Combustion chamber design with central injector configuration



655_062

655_063

Combustion process

The key development goals were to improve fuel economy still further compared to the predecessor model (ES837), in addition to meeting the more stringent international limits on exhaust emissions.

In order to achieve these goals, a new combustion process was developed.

This so-called "jet-guided combustion process", developed by AUDI AG, has the following technical features:

- Monovalent fuel injection system (FSI only)
- Central injector configuration
- Use of the Miller cycle
- Optimised combustion chamber geometry with flat pistons
- Rapid light-off of the catalytic converter (multi injection)
- No secondary air system
- Lambda 1 in most operating ranges

Miller cycle

The process employed in the 3.0l V6 TFSI engine is a derivation of the B-cycle process employed in the 2.0l TFSI engine of the EA888 series (see SSP 645). The compression and expansion ratio changes due to the shorter compression phase, in combination with a significantly higher geometric compression ratio. Efficiency advantages can be achieved in this way. The shorter the intake opening duration and the higher the compression ratio, the greater the efficiency gains.

The Audi valvelift system (AVS) is used to implement a very short intake opening duration of 130° crank angle with early intake shut-off (camshaft adjustment) in the partial load system (see control diagram on page 16).

Engine management

Engine control unit

The latest generation of engine control units MDG1[1] by Bosch with pressure-based load sensing is utilised in the 3.0l V6 TFSI engine.

655_064

Task

The electronic engine control unit is the central control unit and the core element of the engine management system.

- Controls fuel supply, air flow, fuel injection and ignition
- Contributes to meeting the functional safety requirements as defined in ISO 26262
- The exhaust system, gearbox functions and/or vehicle functions can also be activated thanks to the ECU's scalability and enhanced performance
- Use in diesel and petrol engines as well as for alternative fuels
- Features a new form of access and tuning security
- Meets current and future requirements under international legislation on exhaust emissions

[1] M Engine management
D Diesel
G Gasoline
1 1st generation

Properties

- High-performance multicore microcontroller
- New interfaces, such as CAN-FD, Ethernet, PSI5

Function

A software in the electronic engine control unit processes the incoming system information and controls the various functional groups.
In this way, the individual functions are networked to build an efficient overall system. To accomplish this task, the ECU features a new-generation, high-performance microcontroller. The introduction of a multicore architecture in the engine control unit provides resources for innovative developments. The software platform also guarantees maximum functional flexibility.

System overview

Sensors

Engine speed sensor G28

Intake manifold pressure sensor G71

Charge pressure sensor G31

Throttle valve control unit GX3

Engine cover temperature sensor G765

Hall-effect sensor G40
Hall sender 2 G163
Hall sender 3 G300
Hall sender 4 G301

Accelerator pedal module GX2

Brake light switch F

Knock sensor 1 G61
Knock sensor 2 G66

Fuel pressure sensor G247

Low-pressure system fuel pressure sensor G410

Fuel tank ventilation pressure sensor 1 G950

Coolant temperature sensor at engine outlet G82

Coolant temperature sensor G62

Radiator outlet coolant temperature sensor G83

Oil level/temperature sensor G266

Oil temperature sensor G8

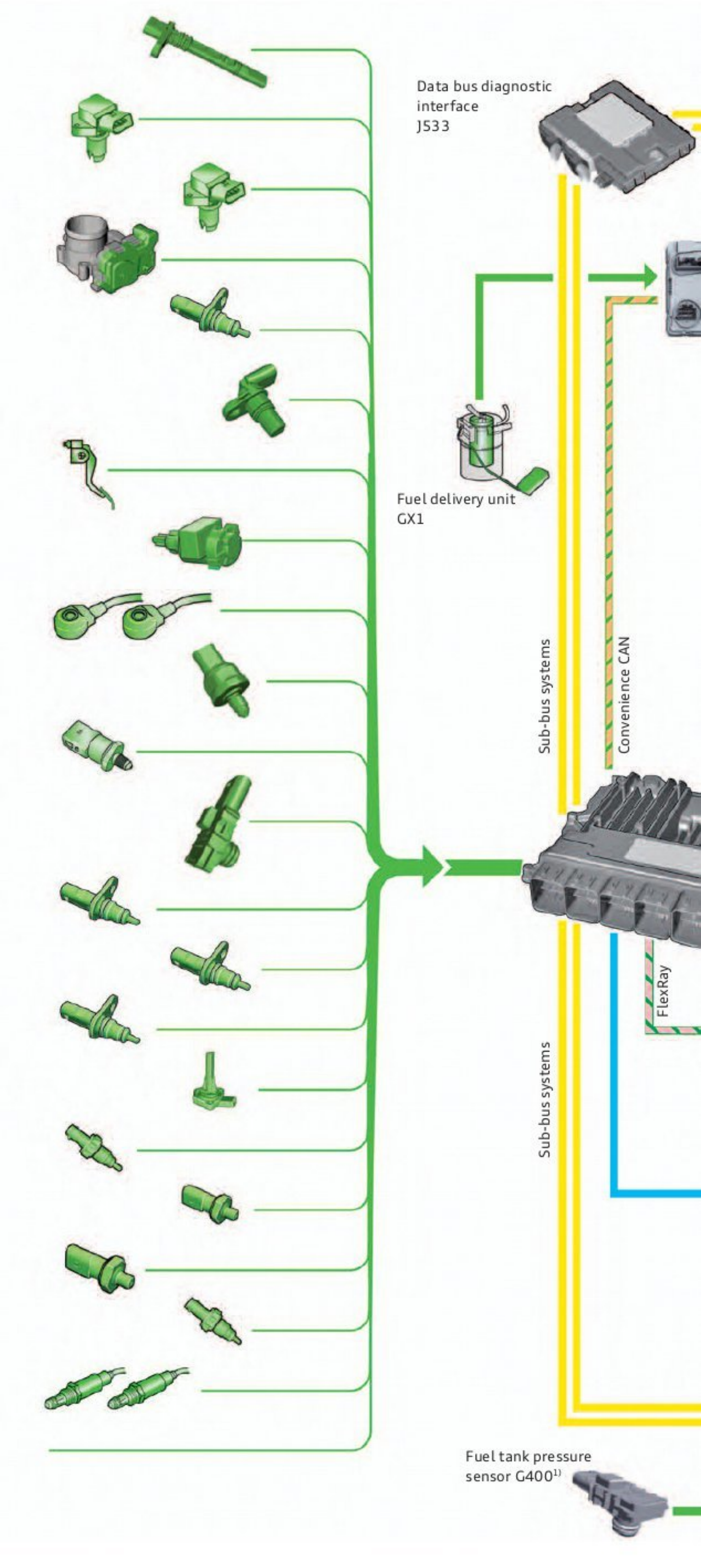
Oil pressure sensor G10

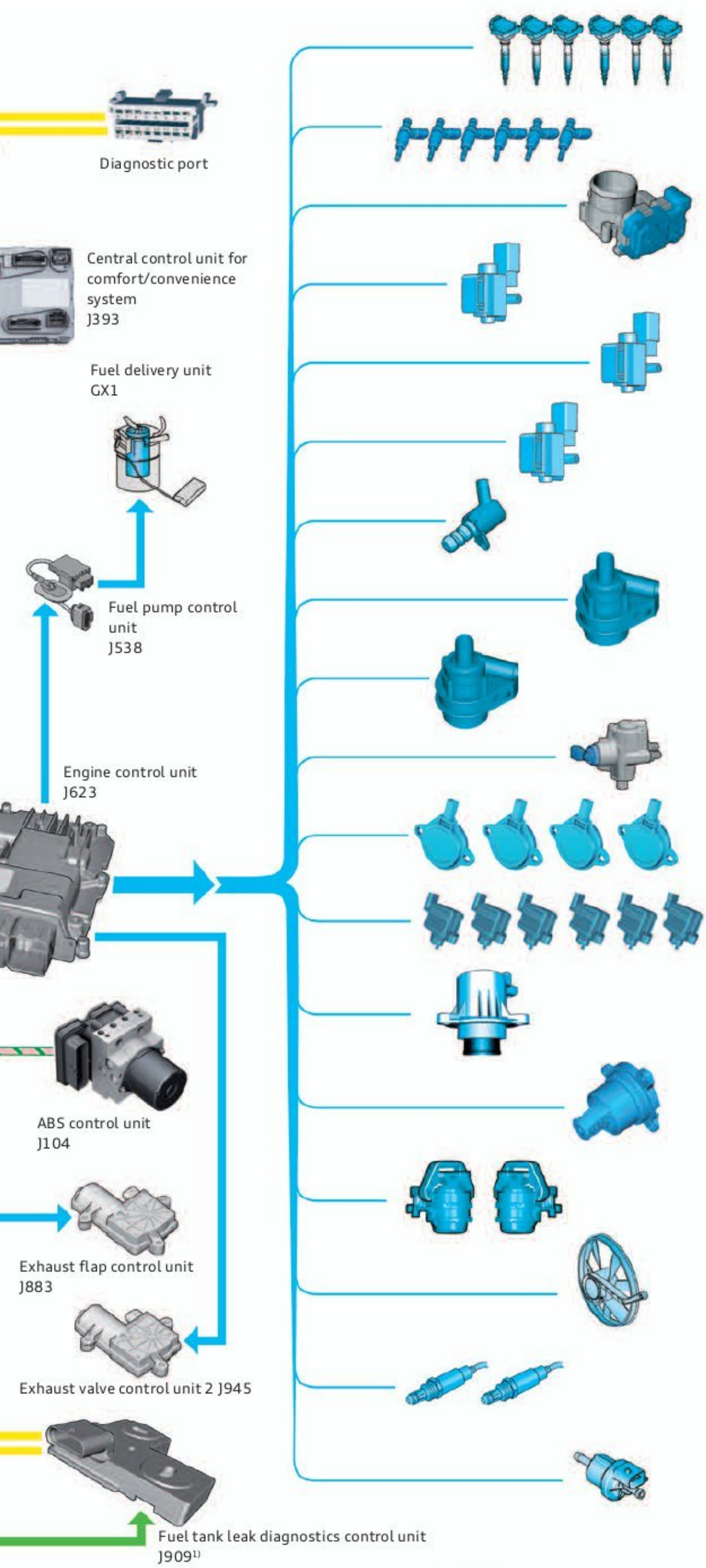
Oil pressure switch F22

Temperature sender for engine temperature control G694

Oxygen sensor 1 after catalytic converter GX7
Oxygen sensor 1 before catalytic converter G10

CCS switch E45





655_003

Actuators

Ignition coils with output stages 1 – 6
N70, N127, N291, N292, N323, N324

Injector for cylinders 1 – 6
N30 – 33, N83, N84

Throttle valve control unit GX3

Cylinder head coolant valve N489

Charge pressure limitation solenoid valve N75

Mechanical coolant pump switching valve N649

Oil pressure control valve N428

Coolant run-on pump V51

Coolant circulation pump V50

Fuel metering valve N290

Camshaft timing adjustment valves 1+2 N205, N208
Exhaust camshaft timing adjustment valves 1+2 N318, N319

Intake cam adjuster 1 for cylinders 1 - 6
F448, F452, F456, F460, F464, F468

Air divert valve for bank 1 N625

Thermostat for mapped engine cooling F265

Electro-hydraulic engine mounting solenoid valve, left and right N144, N145

Radiator fan VX57

Oxygen sensor 1 after catalytic converter GX7
Oxygen sensor 1 before catalytic converter G10

Activated charcoal canister solenoid valve 1 N80

[1)] NAR only

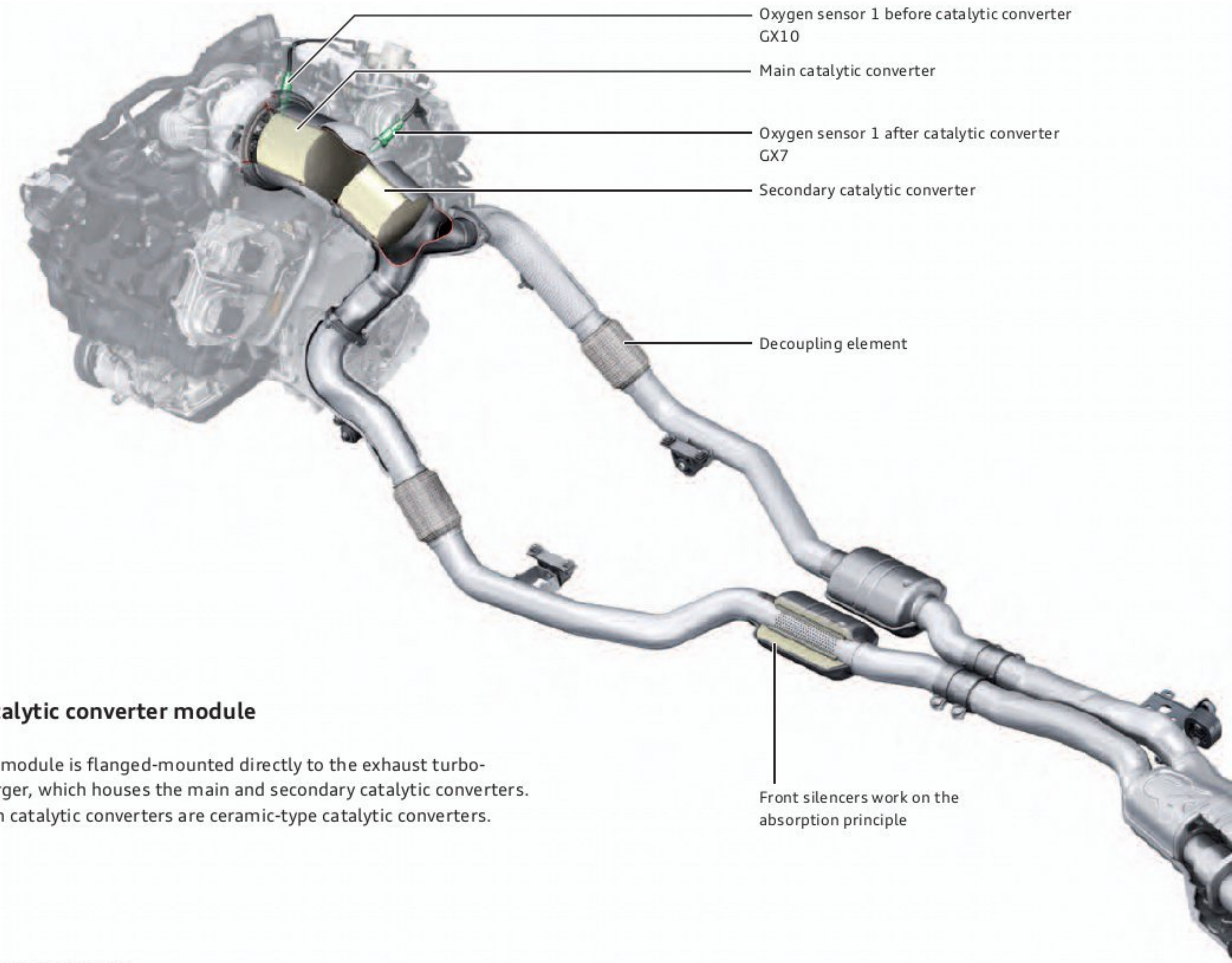
Exhaust system

Overview

Due to the various vehicle configurations, there are also differences in terms of vehicle acoustics.
These differences include:

- Roof type: with / without sliding sunroof
- Body type: saloon / Avant / coupé / cabriolet

This is why the exhaust systems have different specifications. From a functional viewpoint, however, the exhaust systems are identical. The illustration below shows the exhaust system of the S4 saloon.



Catalytic converter module

The module is flanged-mounted directly to the exhaust turbocharger, which houses the main and secondary catalytic converters. Both catalytic converters are ceramic-type catalytic converters.

Oxygen sensors

Oxygen sensor 1 before catalytic converter GX10 consists of:

- Oxygen sensor G39
- Oxygen sensor heater Z19

The broadband probe is held in position by screws in the exhaust turbocharger housing.

Oxygen sensor 1 after catalytic converter GX7 consists of:

- Oxygen sensor downstream of catalytic converter G130
- Heater for oxygen sensor 1 downstream of catalytic converter Z29

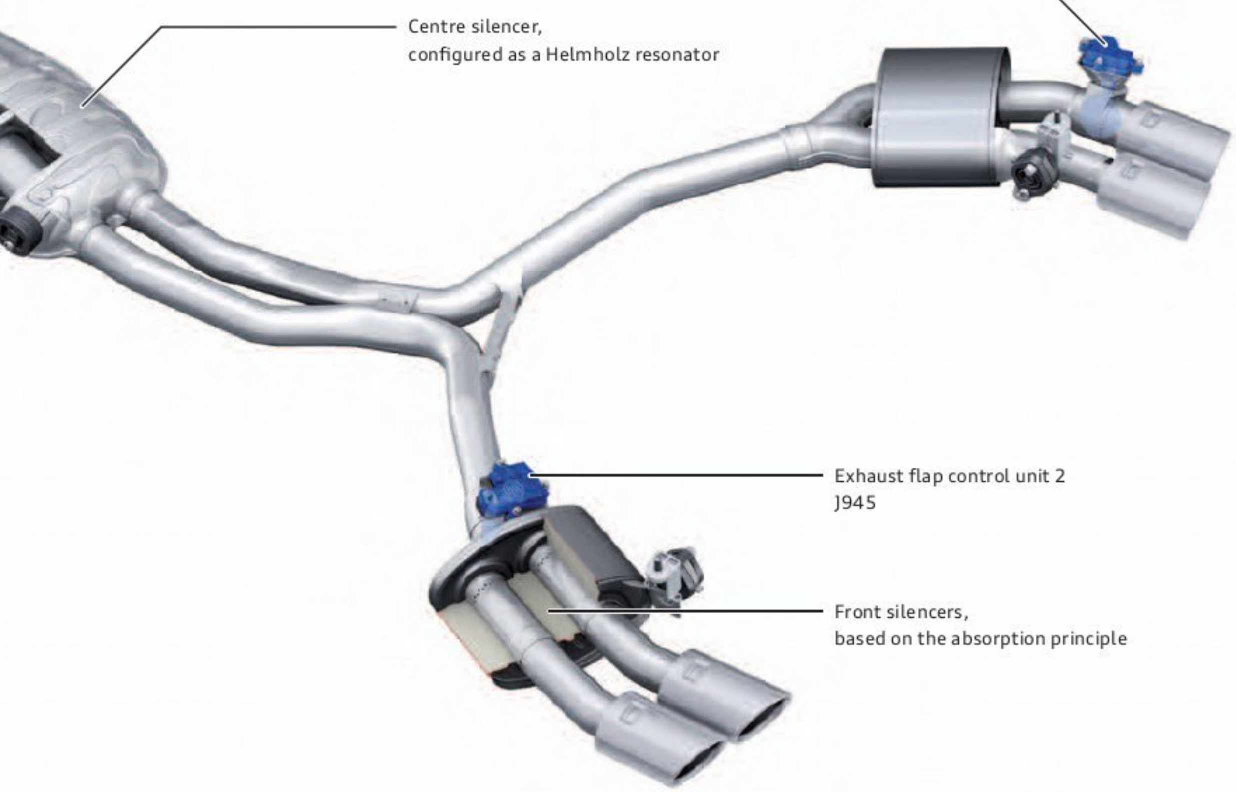
The non-linear probe is held in position by screws in the catalytic converter module housing downstream of the pre-catalyst.

! **Note**
The exhaust flap is actuated by the exhaust flap control unit via a worm gear. Given that this is a "self-locking" gear, it is essential that the servomotor be removed before testing the ease of movement of the flap. The functional principle of the exhaust flaps is explained in Self Study Programme 607 "Audi 4.0l V8 TFSI engine with bi-turbo charging".

Exhaust flaps

For acoustic reasons, the exhaust flap is positioned upstream of the rear silencer on the left-hand side.
By positioning a flap upstream of the secondary silencer and a flap downstream of the secondary silencer, either 1,2 or 3 of the 4 tail pipes can be closed.
The result is an increased number of activation options for acousticians.

655_108



655_107

Inspection and maintenance

Service information and operations

Engine oil specification	0-W20
Changing the oil	According to service interval display, between 15,000 km / 1 year and 30,000 km / 2 years depending on driving style and conditions of use.
Inspection	30,000 km / 2 years
Air filter change interval	90,000 km
Spark plug change interval	60,000 km / 6 years
Fuel filter change interval	–
Timing assembly	Chain (lifetime)

Special tools and workshop equipment

T40330 Counterhold tool

655_072

For counterholding the vibration damper.

T40331 Camshaft locking tool

655_073

For locating the crankshafts in the TDC position.

T40357 Thrust piece

655_074

For reliable mounting of the shaft oil seal to the thermostat of the map-controlled engine cooling system.

VAS 6919 Spark plug socket adapter - 3/8"

655_083

For installation/removal of 14 mm spark plugs with hexagon and double hexagon fitting. Holds the spark plug secure by means of a crown spring.

T40362 Locking pin

655_075

For locking the tensioning sprocket on the timing assembly.

T40363 Socket insert

655_076

For the removal of oil pressure sensor G10.

Note
The specifications in the current service literature generally apply.

T40369 Funnel

655_077

For reliable installation of the piston in the cylinder.

T90000 Socket insert

655_078

For loosening and tightening the central screw/timing valves of the camshaft adjusters.

VAS 261 001 Ring tool attachment, width across flats 41

655_085

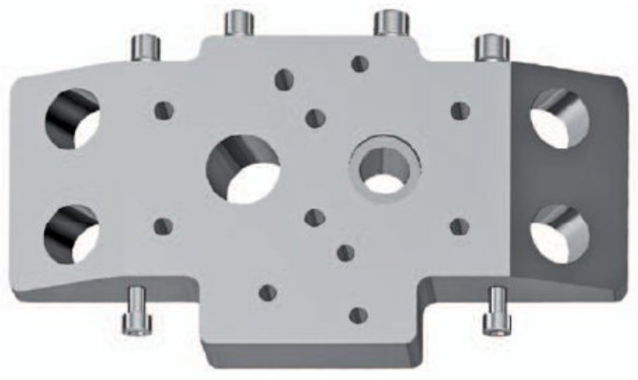
For installing and removing camshaft adjuster on the engine (for counterhold tool T90001).

T90002 Counterhold tool

655_080

For tightening the central screw of the camshaft adjusters.

VAS 5161A/38 Adapter



655_081

Removal and installation device for valve cotters -VAS 5161 A- with guide plate -VAS 5161A/38.

VAS 6095/1-15 Engine bracket

655_082

For clamping the engine onto the engine and gearbox bracket VAS 6095.

VAS 6606/25 Test adapter

655_084

Used in connection with test box VAS 6606 for checking 280 and 336-pin engine control units.

T90001 Counterhold tool

655_079

For counterholding the camshaft adjusters when the timing valves are loosened or tightened.

Appendix

Glossary

This glossary explains all terms in this self study programme which are indicated in *italics*and by an arrow ↗.

↗ Eutectic aluminium alloy

A eutectic has the lowest melting point of any alloy made from the same constituent materials. During solidification, all consituent materials precipitate simultaneously as very fine crystals, producing a fine and homogeneous microstructure which typically has a lamellar structure.

Hypereutectic alloy:
Silicon content > 12 %, e.g. for engine blocks in which the exposed silicon crystals form the cylinder liner.

Hypoeutectic alloy:
Silicon content < 12 %, e.g. for engine blocks in combination with coated cylinder liners or cast-in-place liners.

↗ GJL

Lamellar graphite cast iron (GGL/GJL) / grey cast iron – The graphite in the form of lamellae essentially determine the typical properties of these materials, e.g. workability, strength, wear resistance, thermal conductivity or damping capacity.

GJL has the following properties:
- Good lubrication properties
- Pressure tight
- Heat resistant
- Hard wearing
- Very easy to work

↗ DIN GZ

DIN 70020-GZ – A German standard which defines the engine mass of internal combustion engines in passenger cars powered exclusively by internal combustion engines. An engine with classification G attachment parts is referred to as a base engine. An engine with classification G and Z (GZ) attachment parts is referred to as a complete engine. Classification Z denotes additional parts. It should be noted, however, that it is only possible to ascertain whether given mass data include specific attachment parts, e.g. exhaust turbochargers for supercharged engines, when dealing with defined engine types (e.g. petrol/diesel engine, naturally aspirated/supecharged engine, water/air-cooled engine). Allowance has to be made for drive belts, drive chains or the like in the corresponding engine types. Attachment parts and other parts for which no allowance is made are defined in the standard. The mass data do not include operating fluids.

Information on QR codes

This SSP has been enhanced by electronic media (animations, videos and mini-WBTs) for more effective illustration of the content. The references on the pages to the e-media are concealed within QR codes, which are two-dimensional pixel patterns. You can scan those codes using a tablet or smartphone running the appropriate app, which will decipher the hidden web address. To follow the link you require an Internet connection.

To read the QR codes, you need to obtain a QR scanner from the Apple® or Google® app store and install it on your mobile device. For some media, other players may be required.

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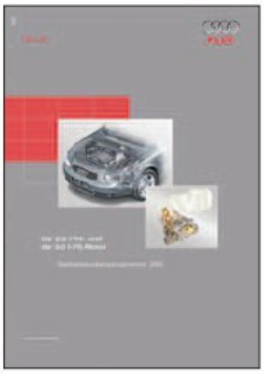
Self study programmes

For further information about the 3.0l V6 TFSI engine of the EA839 series, refer to the following self study programmes.



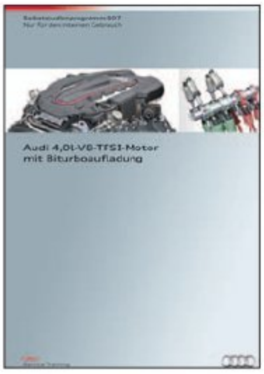
SSP 255 The 2.0 l R4 and 3.0 l V6 engines

SSP 384 The Audi 1.8l 4V TFSI Engine with Timing Chain

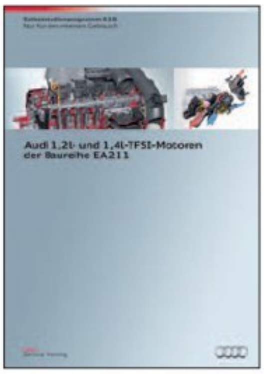
SSP 411 The Audi 2.8l and 3.2l FSI engine with Audi valvelift system

SSP 436 Modifications to the chain-driven 4-cylinder TFSI engine

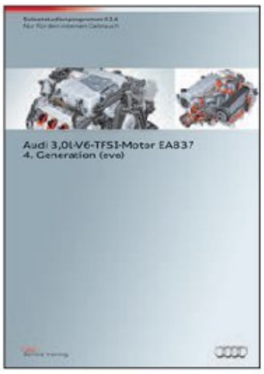
SSP 606 Audi 1.8l and 2.0l series EA888 TFSI engines (3rd Generation)



SSP 607 Audi 4.0l V8 TFSI engine with biturbo charging



SSP 616 Audi 1.2l and 1.4l TFSI engines of the EA211 series



SSP 624 fourth-generation Audi 3.0l V6 TFSI engine (evo)

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