

Audi move to the third generation of its four engines EA888 success cylinders. The reasons for the new phase of development is emission standards more stringent (Euro 6) and, of course, consumption reduction requirements, accompanied by a reduction in CO emissions. **The powertrain was in all respects redesigned from top to bottom.**

In addition to downsizing the *downspeeding* *playing an increasing role. The "global engine" is produced at the factory Audi engines of Győr, Silao (Mexico) as well as in China. Here, the EA888 engine line is produced in Shanghai and Dalian will also subsequently produced in Changchun. Like its predecessor, the engine is available with a displacement of 1.8 l and a displacement of 2.0 liters. It is used on car platforms and brands of the most diverse group. The range of engine performance is very broad.

Ingolstadt engineers have, during development, paid particular attention to the following points:

- large number of identical parts for all engine versions
- Reduction in engine weight
- Reduction of engine internal friction
- Increased power and torque accompanied by a reduction in consumption
- Improved comfort features. In addition, the motors must be implemented in all markets, including those in fuel quality is poorer. The "global engine" also plays an important role for increasing hybridization.

You will find the precise technical description of engine development level 0 in the self-study program 384 "engine TFSI 4-cylinder 1.8l Audi chain drive." You can notify you of changes between the development level 0 and 1 and 2 levels of development in the self-study program 436 "Changes to the engine TFSI 4-cylinder chain drive."

1.8l TFSI engine



e-media



This self-study program includes QR codes allowing you to access additional interactive media, cf. "Information on QR codes" on page 63.

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New innovative technologies implemented are:

- manifold integrated into the cylinder head exhaust
- dual injection system with direct injection in the intake manifold
- new compact turbocharger module with turbine housing cast iron, electric wastegate actuator and lambda probe upstream of the turbine
- Innovative thermal management with full electronic control of the coolant

educational objectives of this self-study program:

This self-study program aims to familiarize yourself with the engine technical TFSI 4-cylinder EA888 engine line (3rd generation). It focuses on the TFSI engine technology 1.8l. After processing this self-study program, you will answer the following questions:

- What are the main technical measures carried out during the development of the line of EA888 engines?
- How do new innovative technologies?
- What's new in the service area and service?

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The self-study program provides basic notions of design and function of new vehicle models, new vehicle components or new technologies.

The Self-Study Programme is not a repair manual! The values shown are for information only and refer to the software version valid in the drafting of the self-study program.

For maintenance and repair, please refer to the current technical documentation. Please refer to the glossary at the end of this self-study program, an explanation of all terms in italics and marked with an asterisk.



Note



return

Introduction

Design Goals

When developing the 3rd generation of the line of EA888 engines, achieving exhaust limit values recommended by the Euro 6 standard and suitability for use in modular platforms were the main items on the agenda .

When optimizing the basic engine, reduction of weight and the friction must be taken into account.

Adaptation to the modular platform

To use the third generation of the line of EA888 engines as "global engine" in the longitudinal modular platform (MLB) and the transverse modular platform (MQB), we had to revisit its ratings and its attachment and connection.

When the engine is operated in a transverse position, a call is made to an engine support and an oil gauge. When the engine is mounted longitudinally mounted, it uses the engine and support for a sealing cap in place of the oil dipstick.

CO₂ reduction

To meet the limit values of exhaust gases set by the Euro 6 standard and reduce CO₂ we had to make the following enhancements and changes.

Downsizing / Downspeeding

- Drive camshafts of intake and exhaust
- Audi valvelift system (AVS)

friction and weight reduction

- balancer shafts with friction bearings in part
- Diameters smaller crankshaft bearing
- reduced oil pressure level
- Reduction of tension strength in the secondary control

Cylinder head

- Cylinder head with integrated exhaust manifold
- Carter eased turbocharger
- electric wastegate actuator

Injection

- ISPs and MPI injectors

thermal management

- Control via rotary valve

Reducing friction

The chain adjusters are optimized for low oil pressure. The clamping force has also been reduced. A reduction in consumption by friction has been possible.

Furthermore, the crankshafts were executed with smaller bearing diameters, generate less friction.

The design of the belt drive is identical in the case of the longitudinal position as transverse. Alternators and air conditioning compressors, however, remain dedicated to the vehicle.



return

You can find more information about the design and operation as well as the stages of development in the self-study program 384 "engine TFSI 4-cylinder 1.8l Audi chain control" and the self-study program 436 "Changes to the engine TFSI 4 chain drive cylinders ".

brief technical description

Engine Type

- petrol inline four-cylinder direct injection engine
- Turbocharging with cooling of the charge air

- Chain drive
- balancer shafts

Valvetrain

- Four valves per cylinder, two overhead camshafts (DOHC)
- continuously variable timing camshaft intake and exhaust
- Audi valvelift system (AVS)
- Engine management Simos 12 (sté Continental)
- start-stop system and recuperation

Packaging mixture

- Management of full electronic engine with electric throttle
- direct injection and injection in the intake pipe combined
- lambda adaptive control
- Mapping static ignition distribution of high voltage
- selective adaptive knock detection



e-media



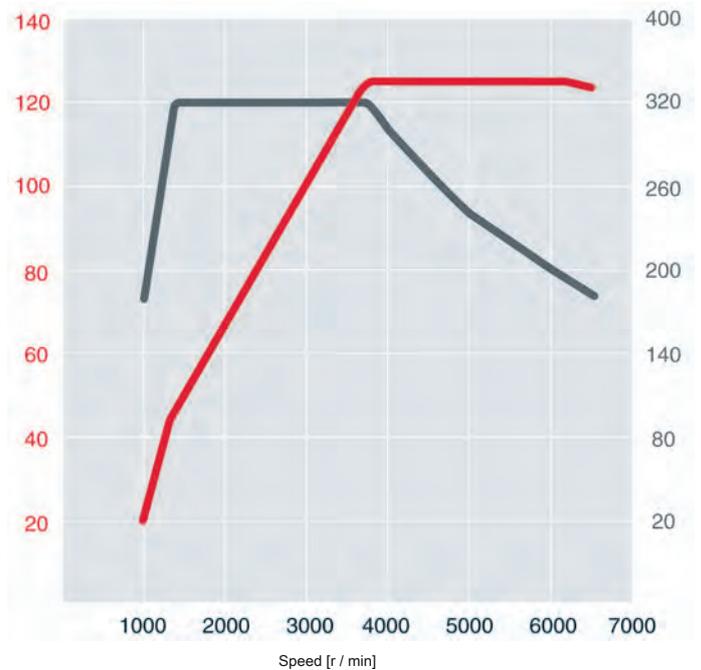
Animation for the entire engine.

1.8l TFSI engine

Torque curve and power

Motor with letters benchmark engine CJEB

- Power in kW
- Torque Nm



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technical features

1.8l TFSI engine

Motor letters benchmark	CJEB	CJSA	CJSB
Mounting position	longitudinal	transversal	transversal
Displacement in cm ³	1798	1798	1798
Power kW to rev / min	125-3800 - 6200	132-5100 - 6200	132-4500 - 6200
Couple in Nm r / min	320-1400 - 3700	250-1250 - 5000	280-1350 - 4500
bore in mm	82.5	82.5	82.5
Race in mm	84.1	84.1	84.1
Compression	9.6: 1	9.6: 1	9.6: 1
crank shaft			
crankshaft bearing diameter in mm	48	48	48
Engine management			
Fuel RON	95 ^{1), 2)}	95 ^{1), 2)}	95 ²⁾
maximum injection pressure bar			
CO ₂ in g / km			
emissions standard	Euro5	Euro5 more	Euro5 more
Ignition order	1-3-4-2	1-3-4-2	1-3-4-2
Knock control	Yes	Yes	Yes
overeating	Yes	Yes	Yes
Recirculation of exhaust gas	internal (variable valve timing system)	internal (variable valve timing system)	internal (variable valve timing system)
Intake manifold flaps	Yes	Yes	Yes
Change the setting of the inlet side distribution	Yes	Yes	Yes
Change the setting of the exhaust side distribution	Yes	Yes	Yes
High-pressure injectors (ISP)	Yes	Yes	Yes
Injectors in the intake manifold (MPI)	Yes	Yes	Yes
secondary air system	no	no	no
Audi valvelift system (AVS) in the exhaust	Yes	Yes	Yes
rotary vane	Yes	Yes	Yes
Oil pump control	Yes	Yes	Yes
Tumble	Yes	Yes	Yes
Drumbe ⁴⁾	no	no	no

¹⁾ Unleaded petrol RON 91 permitted, but however with loss of power

²⁾ E25-compatible (from the date of manufacture wk. 40/2012)

³⁾ Super unleaded 95 RON authorized, but however with loss of power

⁴⁾ Drumbe see page 59

2.0l TFSI engine

Motor letters benchmark	CNCB	CNCD	CJXC
Mounting position	longitudinal	longitudinal	transversal
Displacement in cm ³	1984	1984	1984
Power kW to rev / min	132-4000 - 6000	165-4500 - 6250	221-5500 - 6200
Couple in Nm r / min	320-1500 - 3800	350-1500 - 4500	380 to 1800 - 5500
bore in mm	82.5	82.5	82.5
Race in mm	92.8	92.8	92.8
Compression	9.6: 1	9.6: 1	9.3: 1
crank shaft			
crankshaft bearing diameter in mm	52	52	52
Engine management			
Fuel RON	95 ^{1), 2)}	95 ^{1), 2)}	98 ^{2), 3)}
maximum injection pressure bar			
CO ₂ in g / km			
emissions standard	Euro5	Euro5	Euro6
Ignition order	1-3-4-2	1-3-4-2	1-3-4-2
Knock control	Yes	Yes	Yes
overeating	Yes	Yes	Yes
Recirculation of exhaust gas	internal (variable valve timing system)	internal (variable valve timing system)	internal (variable valve timing system)
Intake manifold flaps	Yes	Yes	Yes
Change the setting of the inlet side distribution	Yes	Yes	Yes
Change the setting of the exhaust side distribution	Yes	Yes	Yes
High-pressure injectors (ISP)	Yes	Yes	Yes
Injectors in the intake manifold (MPI)	Yes	Yes	Yes
secondary air system	no	no	no
Audi valvelift system (AVS) in the exhaust	Yes	Yes	Yes
rotary vane	Yes	Yes	Yes
Oil pump control	Yes	Yes	Yes
Tumble	no	no	no
Drumble ⁴⁾	Yes	Yes	Yes

engine mechanics

Overview

At the cylinder block, not only the weight has been significantly reduced, but a second pressurized oil gallery was developed the "cold side" for piston cooling nozzles to electrical switching. Changes were made to the sections of the coolant and oil return and position of the knock sensors has also been optimized.

For the balance shafts are sufficiently robust for the implementation of a start-stop system, they are partly executed with anti-friction bearings. They thus feature in a point of a smooth bearing and two points of antifriction bearings. Simultaneously, the friction, the weight and inertia of the balance shafts were reduced. The oil return of the "hot" side of the engine has been completely overhauled.

weight reduction measures (1.8l TFSI engine)

In the case of the third generation of the line of EA888 engines, a reduction in the total weight of about 7.8 kg was performed. To achieve this, the following components have been optimized or are used for the first time:

- Cylinder Block with thin walls and removal of coarse oil separator
- Cylinder head and turbocharger
- Crankshaft (with diameters smaller crankshaft bearings and four counterweight)
- Upper oil pan in cast aluminum (aluminum with screw)
- Bottom plastic oil sump
- Aluminum Screw
- balancer shafts (with friction bearings in part)

Cylinder Block

The cylinder block has been fundamentally redesigned. The main objective was to reduce weight. The wall thickness is increased from approx. 3.5 mm to 3.0 mm. In addition, the function of crude oil separator has been integrated into the cylinder block. In total, it was possible to gain 2.4 kg at the cylinder block to the motor of the 2nd generation. Consumption by internal friction was also reduced. The main measures taken for this are reducing crankshaft bearing diameters and improved fixation of the balance shafts.

Other modifications to the engine of the second generation:

- second oil gallery pressure in the region of the "cold side" for the piston cooling nozzles electrically commutated
- Modifications sections of coolant and oil return
- shirt optimized long coolant
- supply of the oil cooler via the cylinder head coolant return
- Optimized position of knock sensors
- fixing improved bearings of the balance shafts

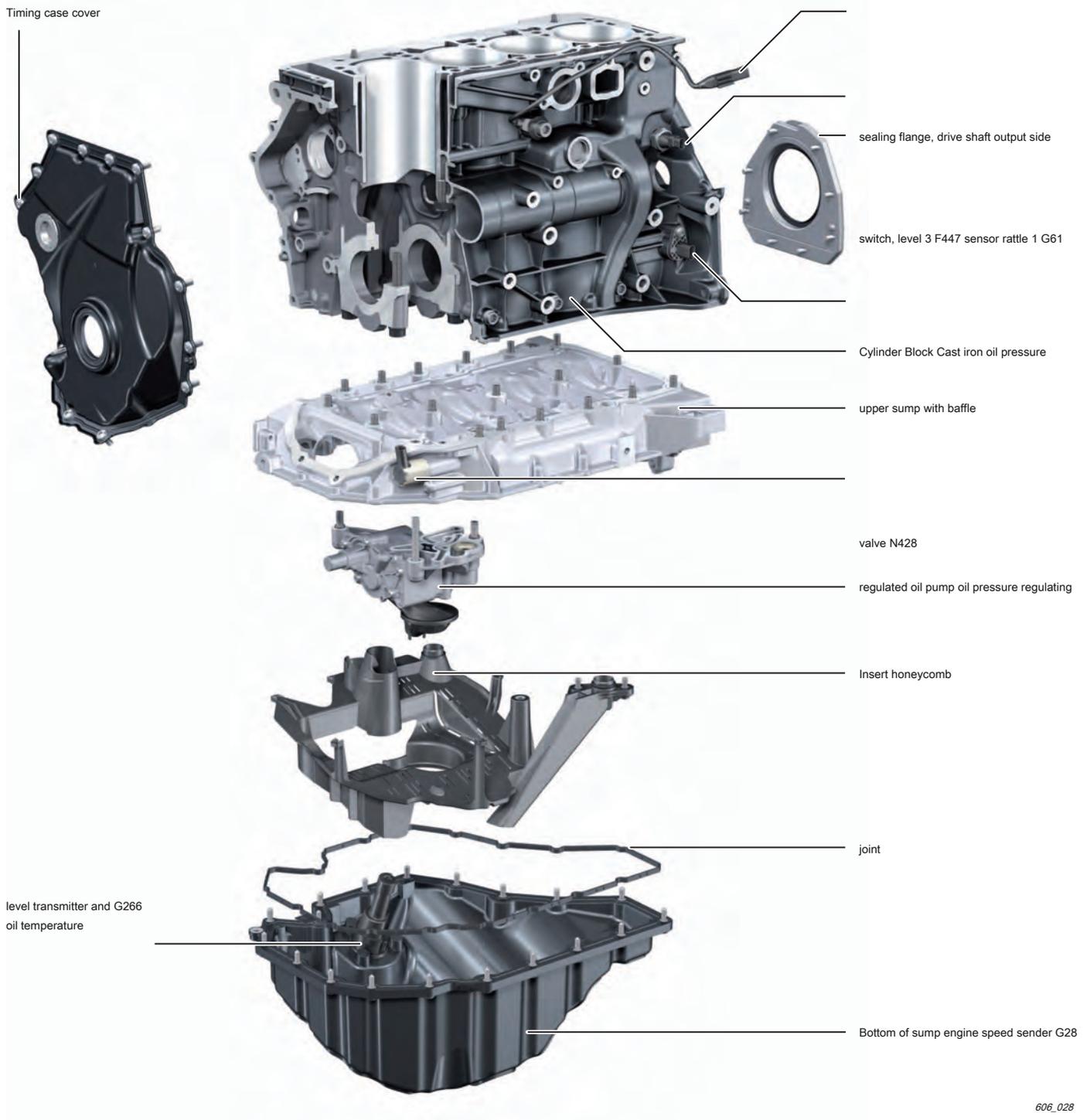
Weatherization

The drive shaft output side sealing is achieved by a sealing flange. The latter has a liquid sealant and screwed onto the cylinder block with aluminum screws.

The timing case cover is sealed with liquid sealant.

Overview

Timing case cover



oil pan

upper part of the oil pan

It is made of die-cast aluminum. The oil pump and insert Honeycomb for suction and return oil are screwed there. Pressurized oil channels and the control valve of the oil pump at two levels are also housed in the upper part of the oil pan.

Sealing to the cylinder block is made with liquid sealant. Aluminum screws are used for screwing.

To further improve the acoustic properties of the engine, the bearing caps are screwed onto the upper part of the oil sump.

Bottom of the oil pan

The bottom of the oil sump is made of plastic. This has saved about 1.0 kg. Sealing is provided by a molded rubber seal. The screwing is carried out with steel screws.

The level transmitter of oil and G266 oil temperature is mounted in the bottom of the oil sump. The oil drain plug is made of plastic (bayonet).

606_028

moving equipment (1.8l TFSI engine)

In the area of the crankshaft, the main objectives of development were reducing the weight and the friction.



Piston

Here, the piston clearance was increased to reduce friction during the action phase. It is also used a material resistant to the wear of the piston skirt.

piston ring upper segment conical = / on

2,0l engines

Segment rectangular section, asymmetrical convex

central piston ring

= Shouldered conical Segment

Segment = lower piston oil ring (in two parts,

spiral spring wiper)

Crankshaft (1.8l TFSI engine)

Relative to the engine of the second generation, the diameters of the crankshaft bearings have been reduced from 52 to 48 mm and the number of counterweights reduced from eight to four. This has saved 1.6 kg. Bearing caps, superiors as inferiors, are lead-free bearings bilayer. The ability to start-stop mode is ensured.

lower half range of crankshaft bearing

The crankshaft bearing caps are screwed with the upper oil pan. This measure improves engine comfort properties in terms of vibration behavior and acoustics.

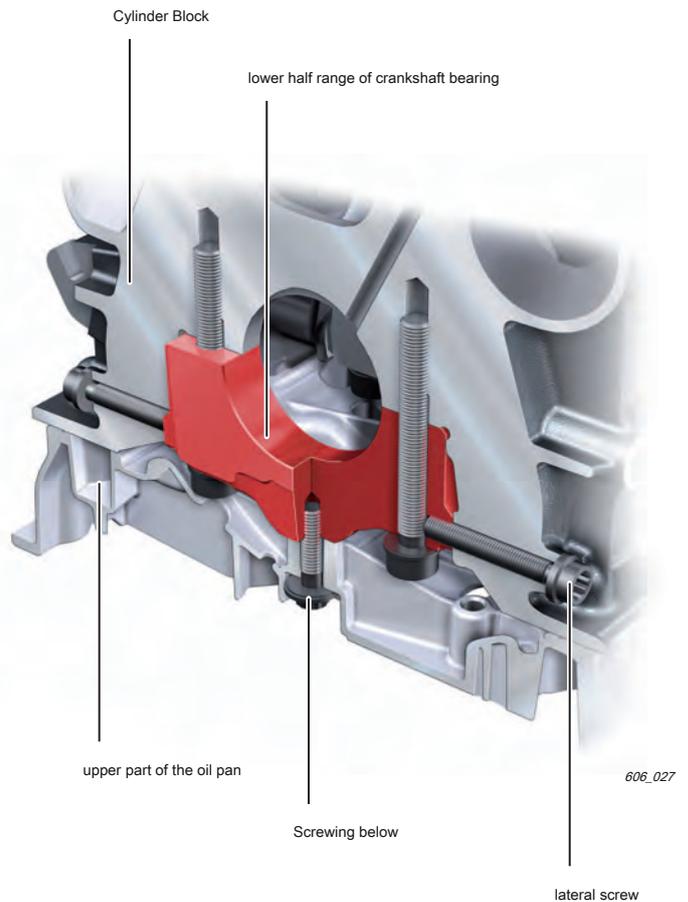
Rod / piston pin

The connecting rods are kind of broken. In the lower foot rod, a call is made, as in the case of main bearings, with two-material bearings.

A key new feature is the removal of the bronze ring in the side of upper rod.

The entire motor is equipped with bearings lead-free. Fixing without gudgeon ring is used for the first time on the VL engines. This is a process patented by Audi. The piston pin is connected directly to the steel in the rod and to the aluminum alloy in the piston.

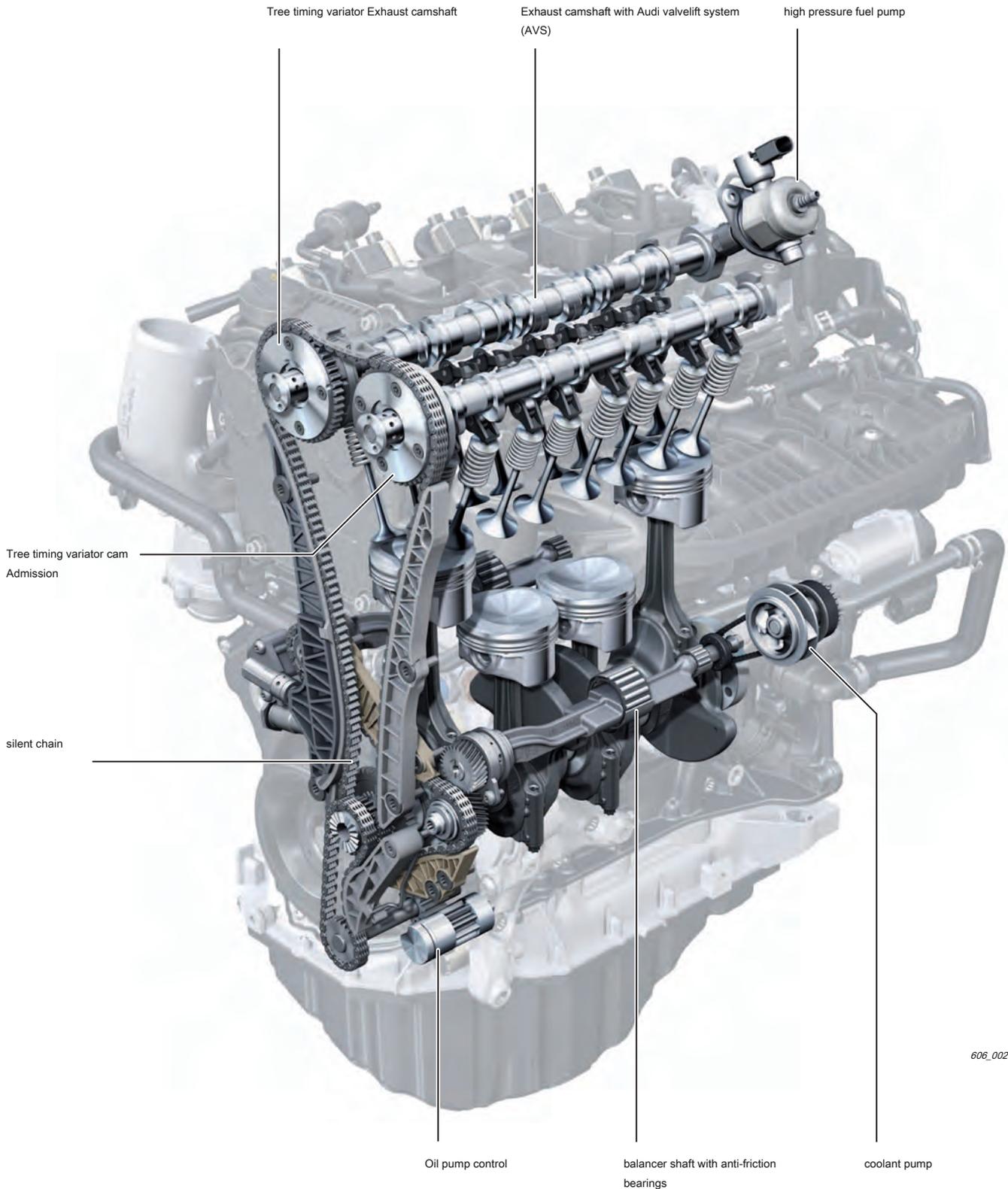
The piston pin is why with a special surface coating. This is a coating DLC*.



Chain drive

The basic architecture of the chain drive is widely resumption of the 2nd generation. It has also been consistently improved. Due to the reduction in consumption by friction and reduced need for oil, the drive power in the chain drive is also reduced. Therefore an adjustment was made at the chain tensioners. They have been adapted to the lower oil pressure.

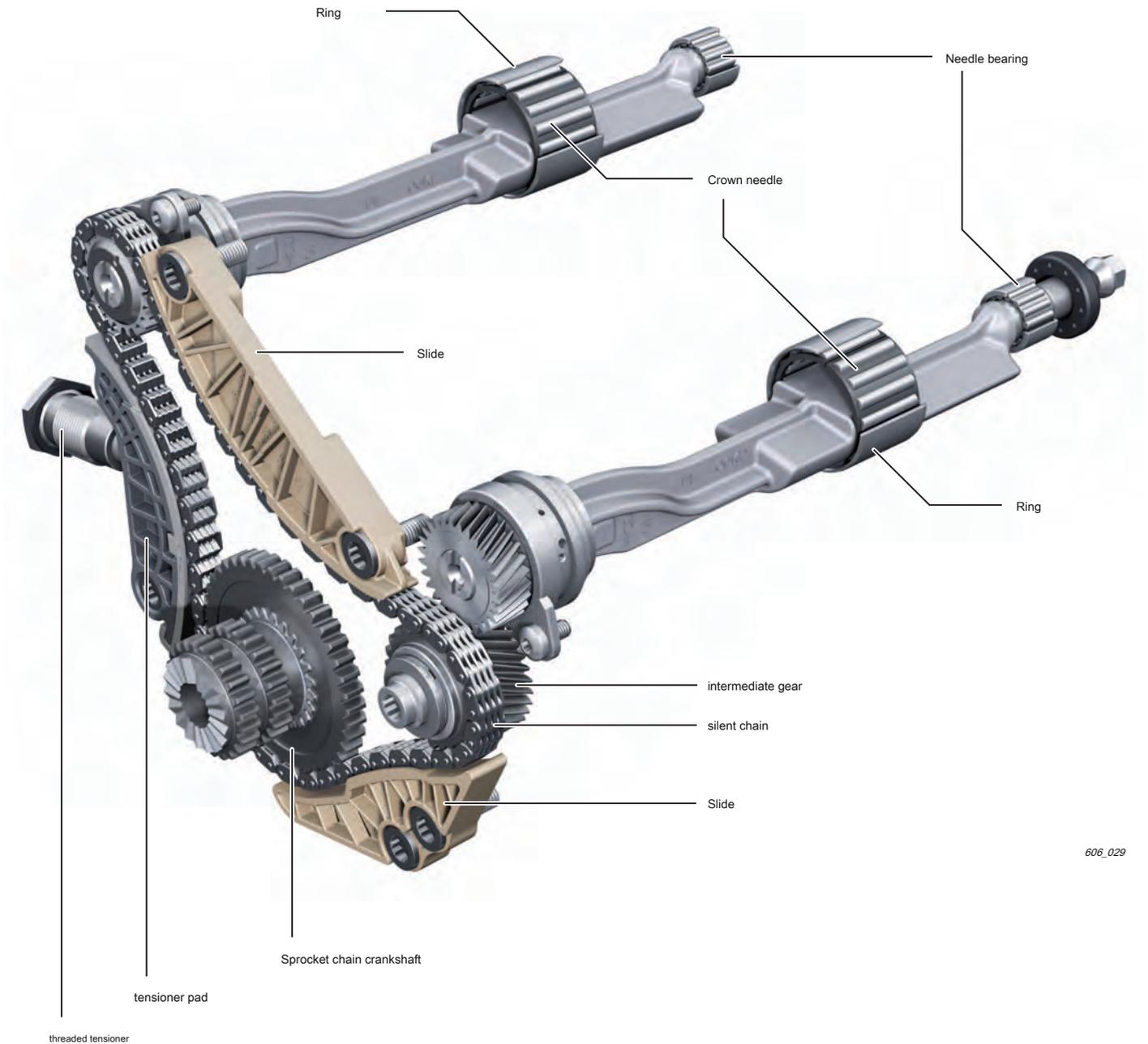
Although this is not noticeable at first glance, a number of things changed for the After-Sales Service. This concerns the operations of mounting of the chain on the one hand and, on the other, a new set of tools is implemented. In addition, it is necessary, after operations on the chain drive, carry out an adjustment with the vehicle diagnostic tester. For diagnostic reasons, the tolerances of the components of the chain drive are recorded and taken into account.



606_002

balancer shafts

In addition to a reduction in mass, the balance shafts are partially equipped with antifriction bearings. The result is a net reduction in consumption by friction. It is particularly sensitive in the case of low oil temperatures. This measure also has a positive effect on robustness in start-stop and hybrid mode.



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Note

In case of damage, there is a repair kit consisting of two balancer shafts with needle crowns proposed in ETKA catalog. Small needle bearings are currently not replaceable with auxiliary service.

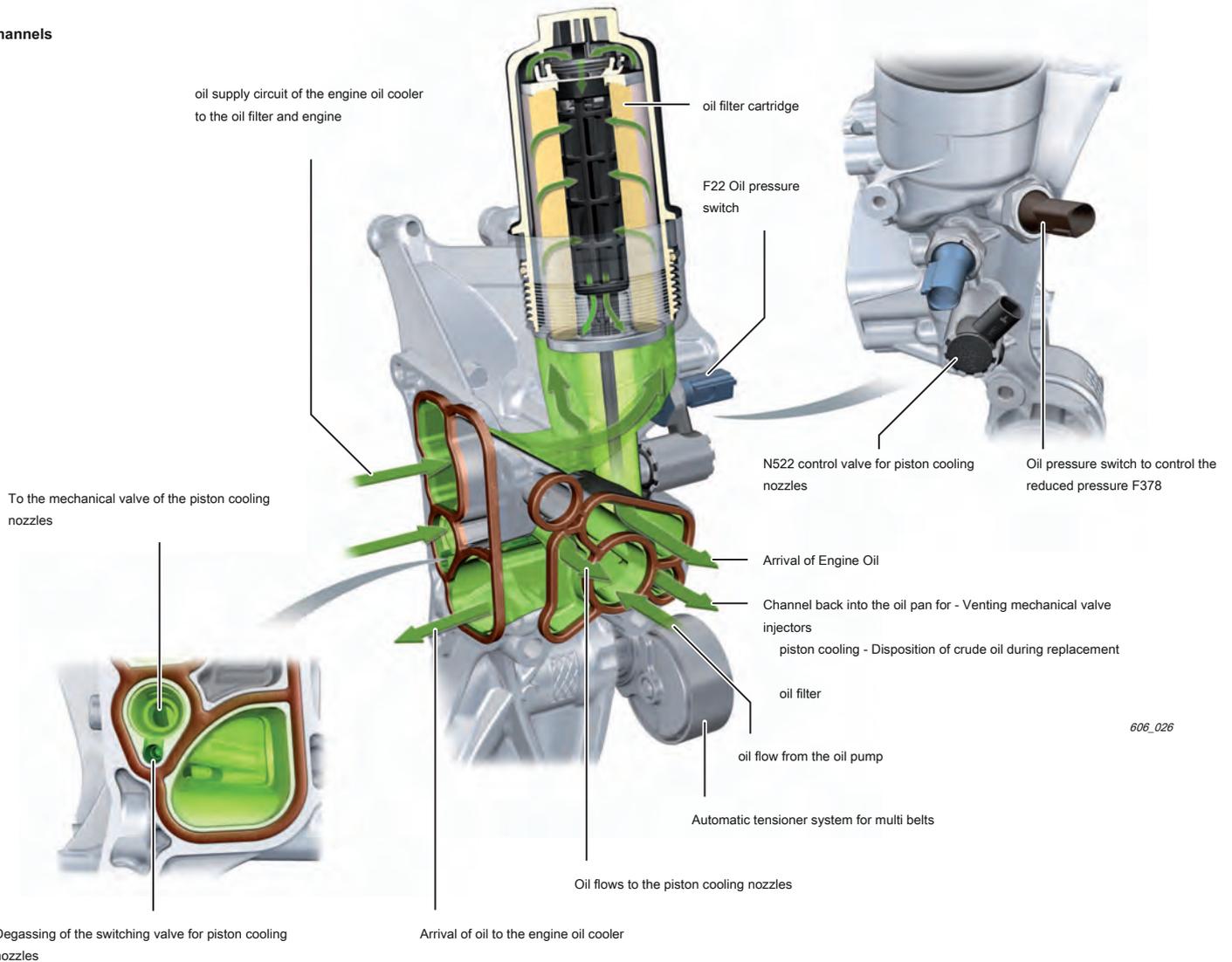
Support of secondary units

The supports of oil and oil cooler filter are integrated in the support auxiliary elements. It contains the oil channels and the coolant channels up to the oil cooler. The contactors of oil pressure, the electric switching valve for piston cooling nozzles and the tensioning device of the multi-belt there are also mounted.

The oil filter cartridge is accessible from the top, which facilitates service work. For it does not flow oil when replacing the filter, a shutter pin is open when loosening, so that the oil can return to the oil pan.

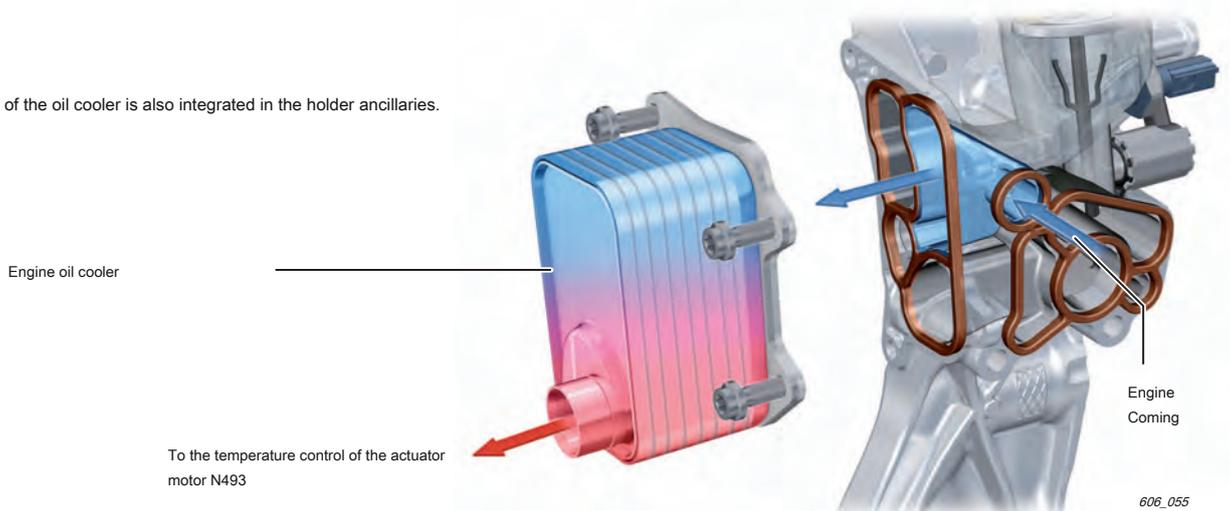
Architecture using the example of the 1.8l TFSI engine in a transverse position

oil channels



coolant channels

The coolant supply circuit of the oil cooler is also integrated in the holder ancillaries.



Cylinder head

The new engine component that is most amazing is the head. This is a completely new development. Cooling of integrated exhaust gas in the cylinder head and an exhaust gas recirculation (IAGK) are implemented for the first time on turbocharged engines.

Tree variable valve timing cam
actuators 1-8 F366 - F373

Ignition Coils 1-4 with output stage N70 power, N127,
N291, N292

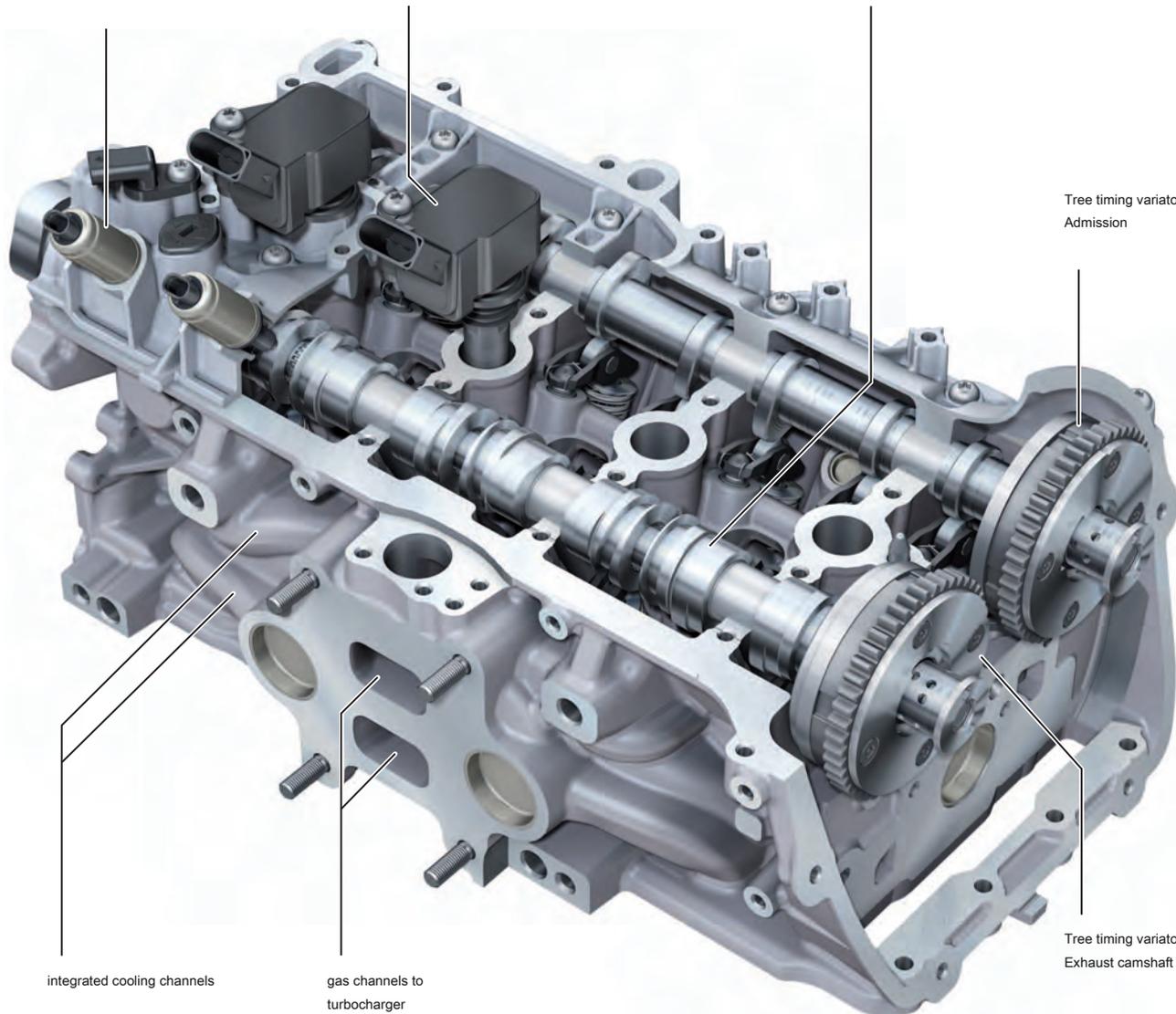
Exhaust camshaft with Audi valvelift system

Tree timing variator cam
Admission

Tree timing variator
Exhaust camshaft

integrated cooling channels

gas channels to
turbocharger



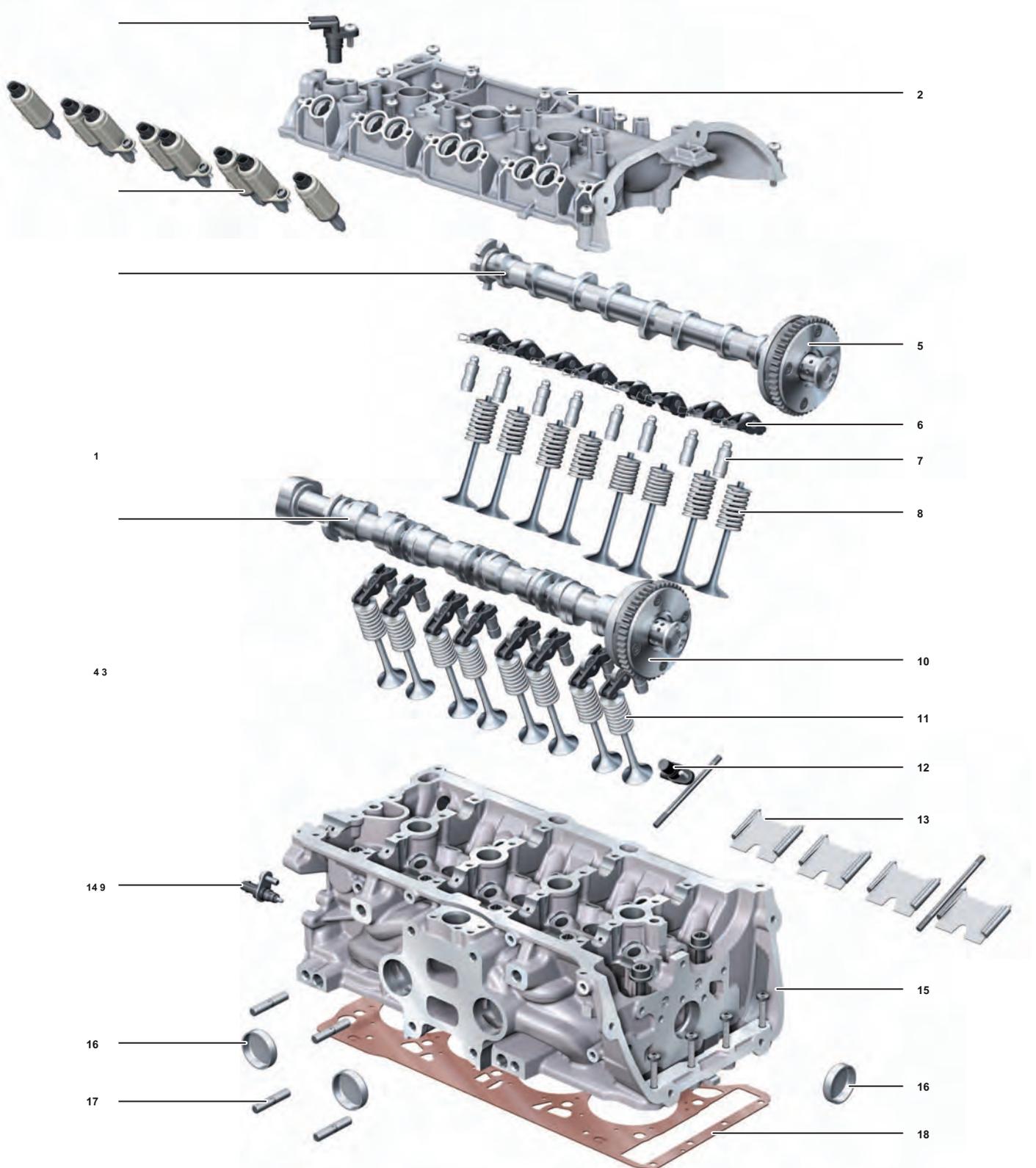
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return

You will find more information about how the tree variable valve timing cam in the self-study program 255 "Engines 4-cylinder in line 2.0 liter V6 and 3.0 l".

Architecture



606_031

legend:

- | | | | |
|---|--|----|----------------------------------|
| 1 | Transmitter Hall 3 G300 | 10 | Shaft drive exhaust camshaft |
| 2 | Cylinder head cover | 11 | Exhaust valve |
| 3 | Actuators 1-8 of shaft variable valve timing cam F366 - F373 | 12 | Transmitter Hall G40 |
| 4 | Intake camshaft | 13 | Partitions sheet channel |
| 5 | Shaft drive intake cam | 14 | coolant temperature sender G62 |
| 6 | Roller rocker arm | 15 | Cylinder head |
| 7 | support element | 16 | antifreeze plug |
| 8 | Valve admission according | 17 | Stud integrated exhaust manifold |
| 9 | Exhaust camshaft | 18 | gasket |

Weatherization

Steel screws are used for screwing the cylinder head cover. Sealing to the cylinder head cover is performed with a liquid sealant.

The sealing between the cylinder block and cylinder head is ensured by a three-layer metal head gasket. control side, the sealing is provided by a plastic chain case cover. The oil filler cap is now built.

Audi valvelift system (AVS)

The Audi valvelift system has been developed to optimize the renewal of gas. This system was implemented for the first time on the 2.8L FSI V6 engine of the Audi A6 05 in late 2006.

To improve the torque characteristic, the proven Audi valvelift AVS system (switching valves on two levels) was taken from the 2.0l TFSI engine of the 2nd generation (predecessor engine) - 436 Self-Study program.

Tree variable valve timing cam

Another important innovation is the implementation of a shaft drive cam on the camshaft exhaust. This helped to achieve maximum degrees of freedom to control the renewal of gas. The AVS system and the drive of exhaust cam shaft timing can adapt the needs of the renewal of the various gases in the full load range and partial load.

The result is a faster establishment of the couple. Due to the high torque up to 320 Nm in a broad band system, the gear box can be adapted differently (downspeeding). This reduces fuel consumption.

Other changes:

- of long spark plug thread
- New pencil coils
- camshafts optimized weight
- Roller rocker arms optimized (reducing friction)
- Decrease spring forces in the valve train
- New oil filler cap positioned in the upper chain guard
- coolant temperature sensor G62 positioned in the cylinder head (GTI)
- New position of the high pressure pump
- oil separator improved end
- The turbocharger turbine casing is screwed directly to the cylinder head
- Optimization of inlet channels
- Development of injection components including an acoustic decoupling



return

You can find more information on the functions of the Audi valvelift system in the self-study program 411 "FSI engines of 2.8 l and 3.2 l with Audi Audi valvelift system."



Note

Some modifications were made to the assembly work at the head also. For example, it is necessary, when removing the cylinder head, before dismantling the cylinder head cover. For accurate approach, see the relevant Workshop Manual.

integrated exhaust manifold (IAGK)

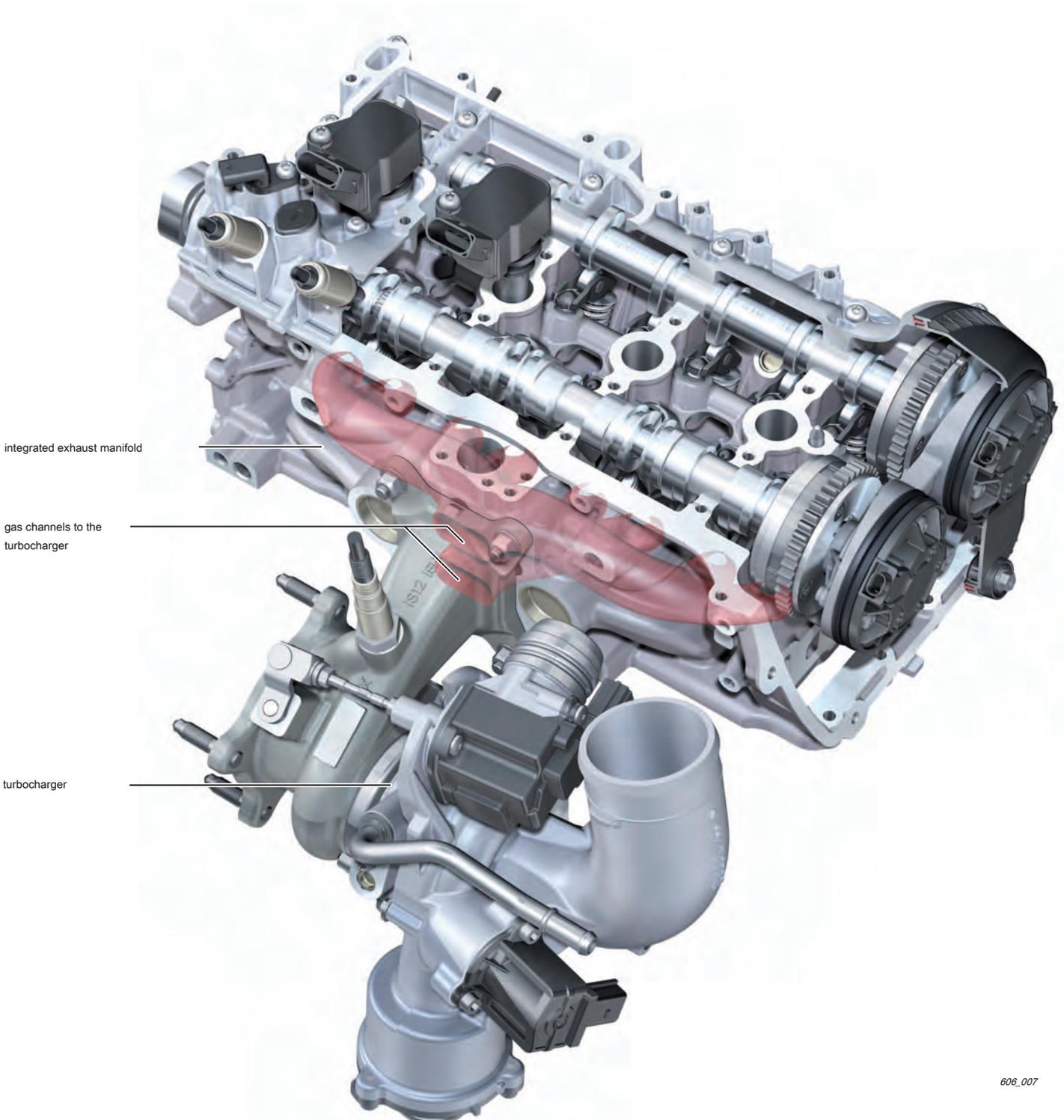
One of the main novelties is the exhaust manifold cooled with dissociation of the ignition timing, which is now integrated directly into the cylinder head. Due to the implementation of an integrated exhaust manifold is obtained, compared to a conventional collector, a net reduction of the temperature of the exhaust upstream of the turbine. It is also used a turbocharger resistant to high temperatures.

With this combination, it is possible, especially at high speeds, to give up a large part in enrichment at full load in order to protect the turbine. Thus, consumption can be significantly reduced in normal driving mode as in the case of a sporty drive. In addition, the integrated exhaust manifold supports the rapid warming of the coolant and thus an essential component of thermal management

exhaust channels

The exhaust channel are positioned such that the flow of exhaust gas from the cylinder occurs where the exhaust has no disturbing influence on the scanning of another cylinder.

The full energy of the flow is thus available for driving the turbocharger turbine. exhaust gas channels of the rolls 1 and 4 and the cylinders 2 and 3 converge respectively at the transition point to the turbocharger.

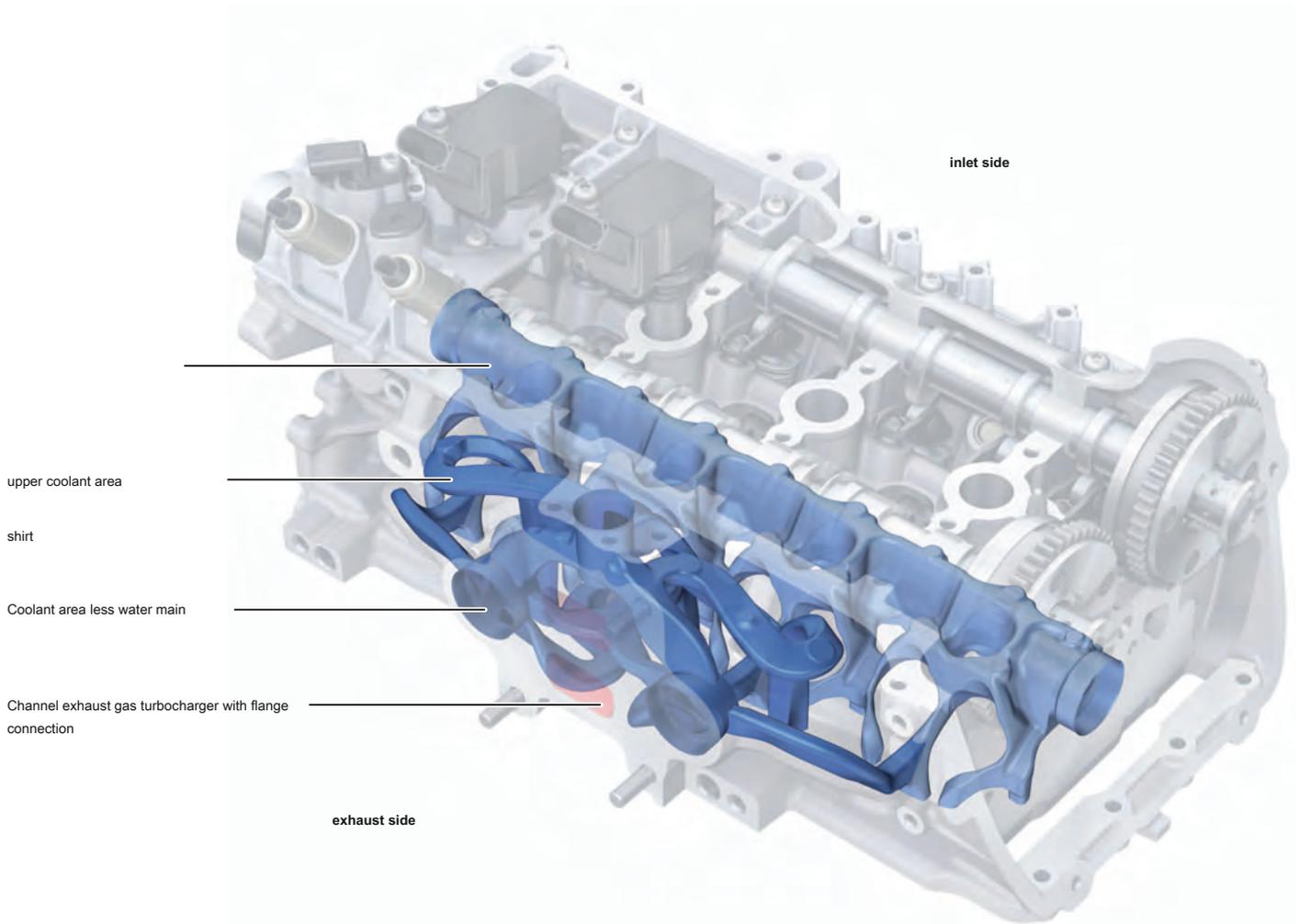


Cooling the integrated exhaust manifold

The integrated exhaust manifold supports the rapid warming of the coolant and thus constitutes an essential element of thermal management.

Phase actuation, heat is induced at the end of a very short time in the cooling liquid. This heat is used immediately for engine warm-up as well as heating the passenger compartment. Because of the lower heat loss and short strokes, the downstream components (Lambda sensor, turbocharger and catalyst) can more quickly reach their operating temperature.

There passage cooling mode after a short actuation phase. This is necessary because the coolant is quickly brought to boiling in the integrated exhaust manifold area. It is for this reason that the coolant temperature sender G62 is mounted on the hottest place in the cylinder head.



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e-media



Animation for the cylinder head and the integrated exhaust manifold.

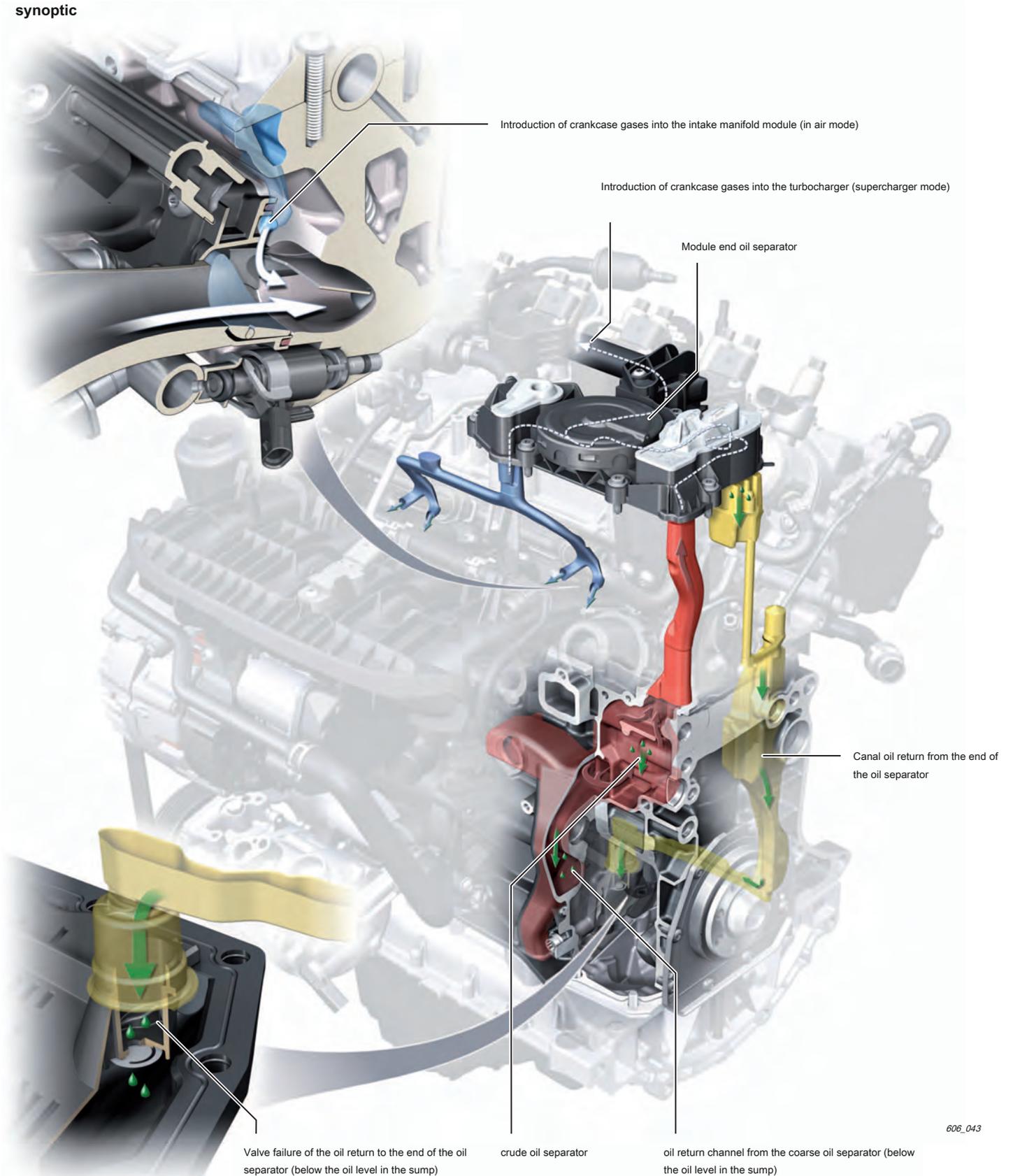
Degassing of the housing and crankcase gases

The crankcase ventilation system and crankcase gases has also been a systematic development. The pressure ratio of the cylinder block and the ambient air is set to a larger pressure difference. This has a positive impact on the engine's oil consumption. More attention was also paid to the reduction of components. Thus, there are outside of the motor more than a conduit for discharging the cleaned crankcase gases.

The system includes the following elements:

- crude oil separator in the cylinder block
- oil separator module end screwed into the cylinder head cover
- Pipe for discharging the cleaned crankcase gases
- Back of oil in the cylinder block with shut-off valve in the insert in the oil sump of the honeycomb.

synoptic



606_043

crude oil separation

The crude oil separator function is integrated in the cylinder block. A part of the oil is discharged by change of direction in a labyrinth.

The decanted oil is redirected to the oil sump via the return channel in the cylinder block. The channel ends below the oil level.

fine oil separation

The roughly purified crankcase gases reach the cylinder block via a channel in the cylinder head into the oil separator end module. There, they are first cleaned in the cyclone separator. decanted oil cyclone oil separator is returned to the oil sump via a separate channel in the cylinder block. The channel ends below the oil level. A cutoff valve avoids here that in case of unfavorable pressure conditions, oil is sucked into the crankcase. If sporty driving (high transverse acceleration), the oil return may no longer be in the oil, because of the cross fluctuations of oil in the crankcase. Here too, the shut-off valve maintains the closed oil return. It is the valve anti-rotation guy.

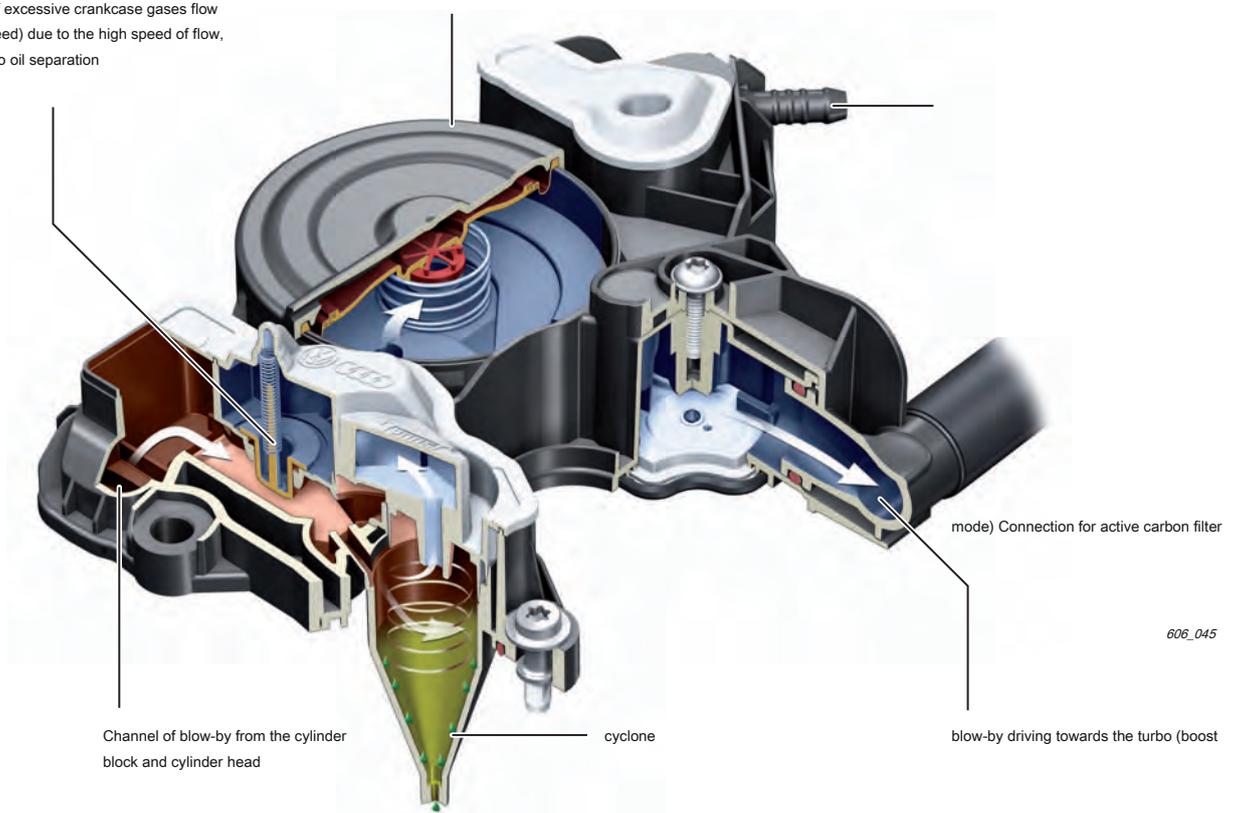
cleaned crankcase gases are conveyed to the combustion by the pressure regulating valve to a level. The pressure regulating valve is set to a pressure difference

- 100 mbar compared to the outside air. The point at which occurs the introduction is defined by the pressure ratio of the air supply system.

Bypass Valve

opens in case of excessive crankcase gases flow (high engine speed) due to the high speed of flow, there is here also oil separation

pressure regulating valve



606_045

Conveying the cleaned crankcase gases to the combustion

After the fine separation and transfer by the pressure regulating valve, cleaned crankcase gas is passed to combustion. The steering valve is automatically ensured by the automatic check valves integrated in the oil separator end module.

The check valves come back to the basic position to stop the engine. The check valve in the direction of the turbocharger is opened. The check valve in the direction of the intake manifold is closed.

Incorrect installation of detection

In some markets, such as North America, the legislation requires keying components that affect the exhaust.

If the return line on the crankcase gas recycling module is not mounted or incorrectly mounted, the incorrect installation of the sensor fitting is open.

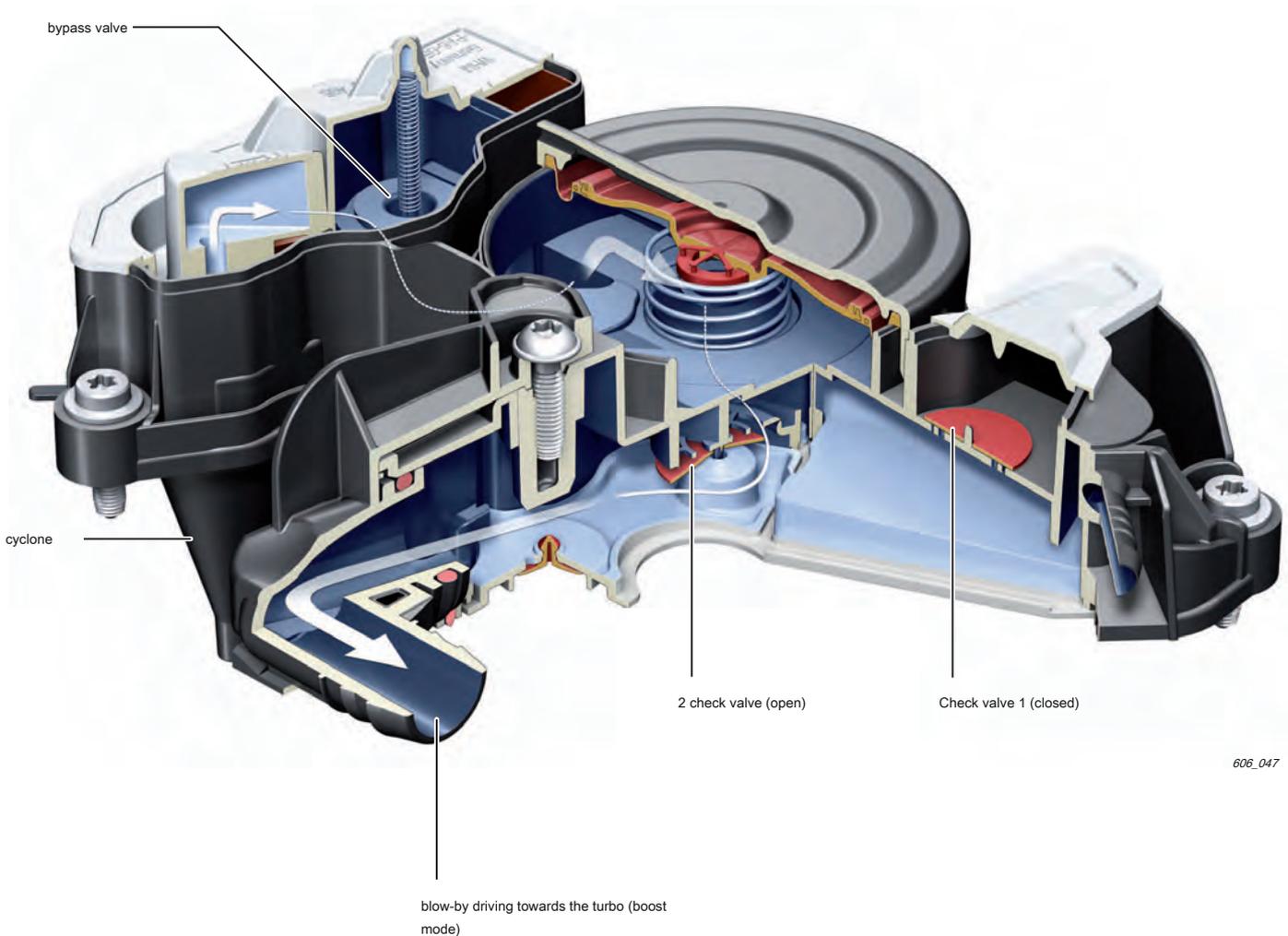
As this connection is directly connected to the side air intake of the cylinder head, the engine immediately draws in unmeasured disturbance air. It is detected by the lambda control.

full charge (boost mode) Mode

As pressure prevails throughout the charge air system, the check valve 1 closes.

cleaned crankcase gases are sucked by the compressor.

Under the effect of the pressure difference between the internal pressure of the crankcase and the intake side of the turbocharger, the check valve 2 is opened.

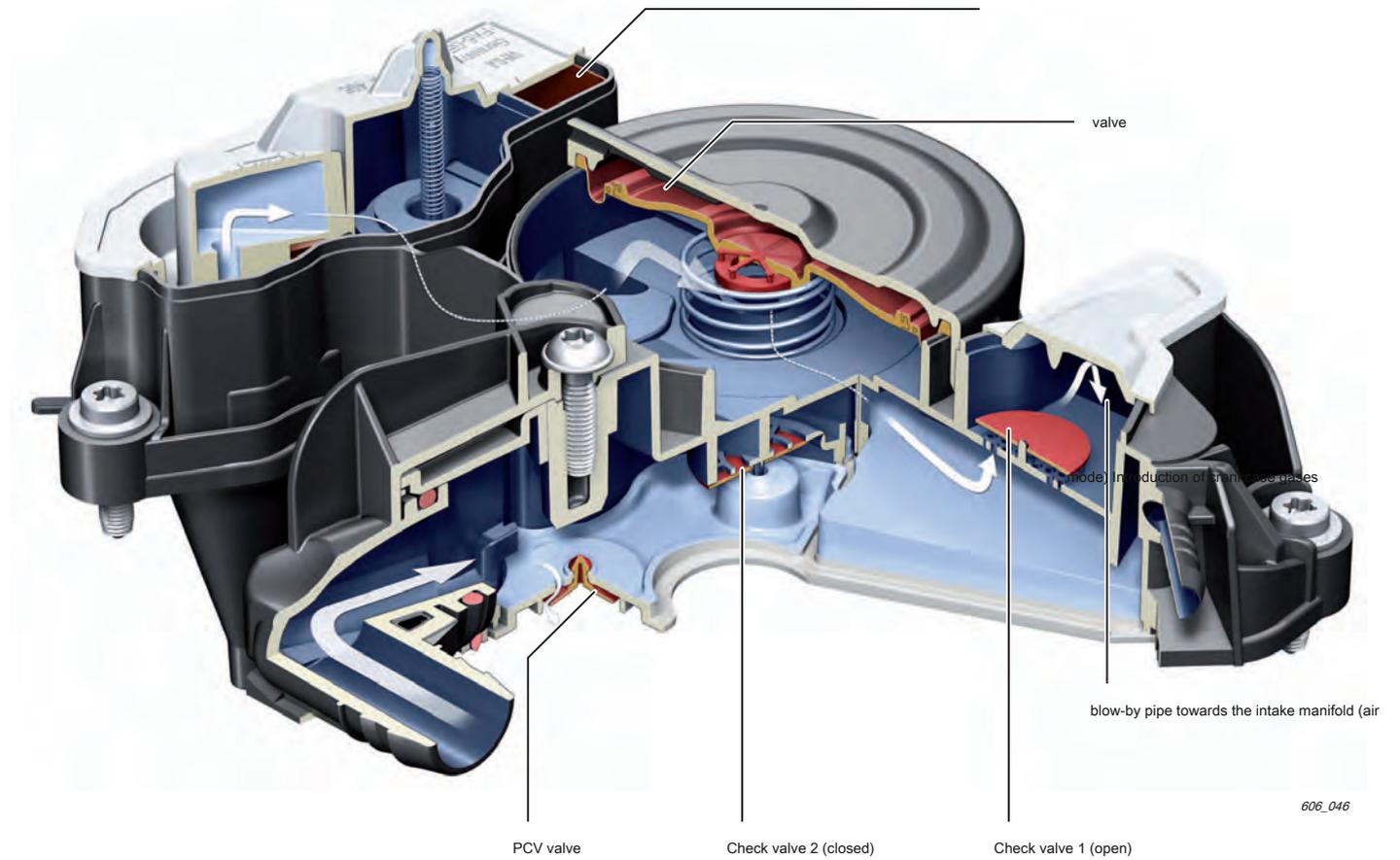


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Slow and partial load lower range (air mode)

In air mode, the check valve 1 in the intake manifold is opened and the check valve 2 closed under the effect of depression.

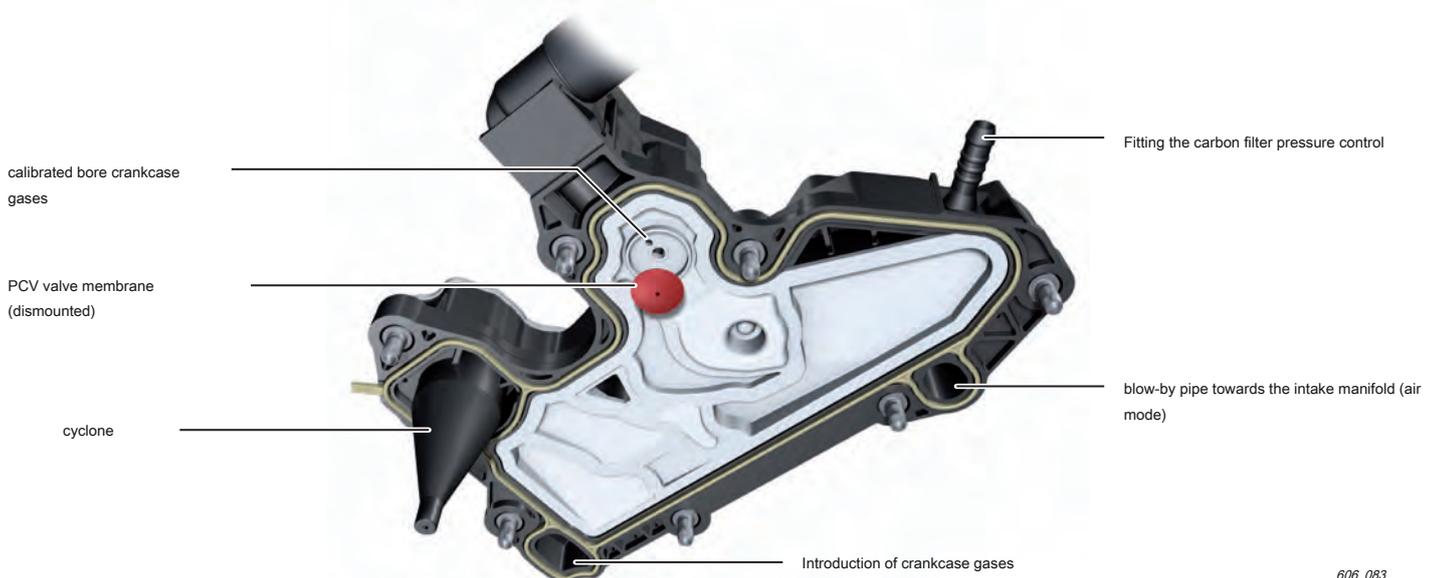
cleaned crankcase gases are conveyed directly to the combustion via the intake manifold.



Crankcase gases (PCV *)

The crankcase gas, with oil separator and fine pressure control, mounted in a module on couvreculasse.

A crankcase gas is via the vent line connected upstream of the turbine and a gauged hole in the ventilation flap of the crankcase. The system is designed so that the aeration takes place in atmospheric mode.



Oil supply

System overview

legend:

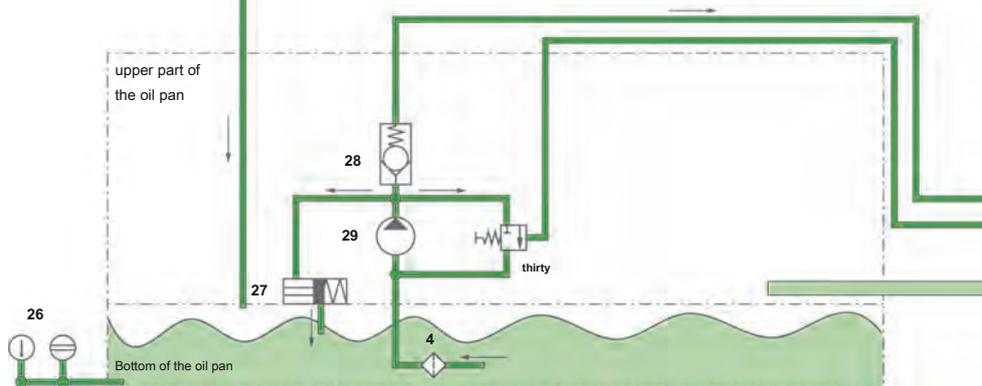
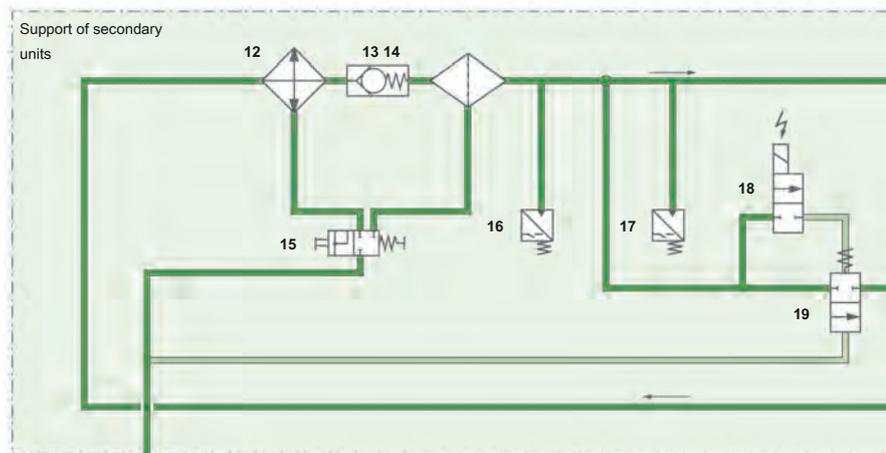
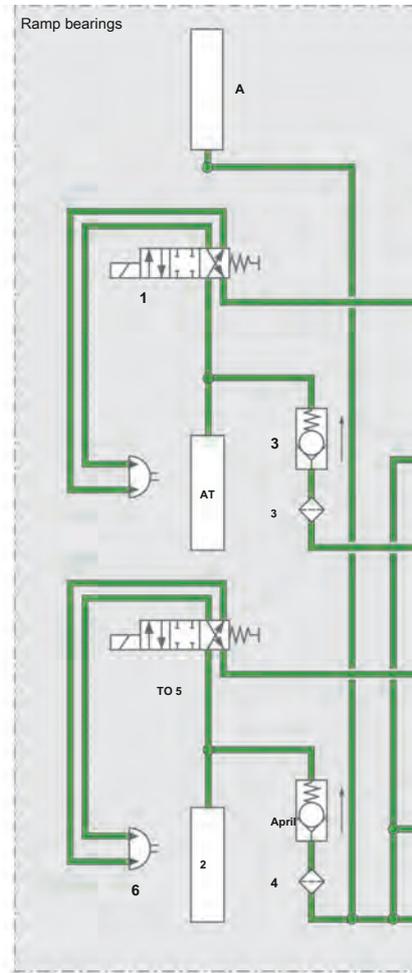
- AT shaft bearing cam
- B support element
- C balance shaft bearing
- D exhaust balancer shaft, bearing 1
- E rod
- F crankshaft bearings 1-5

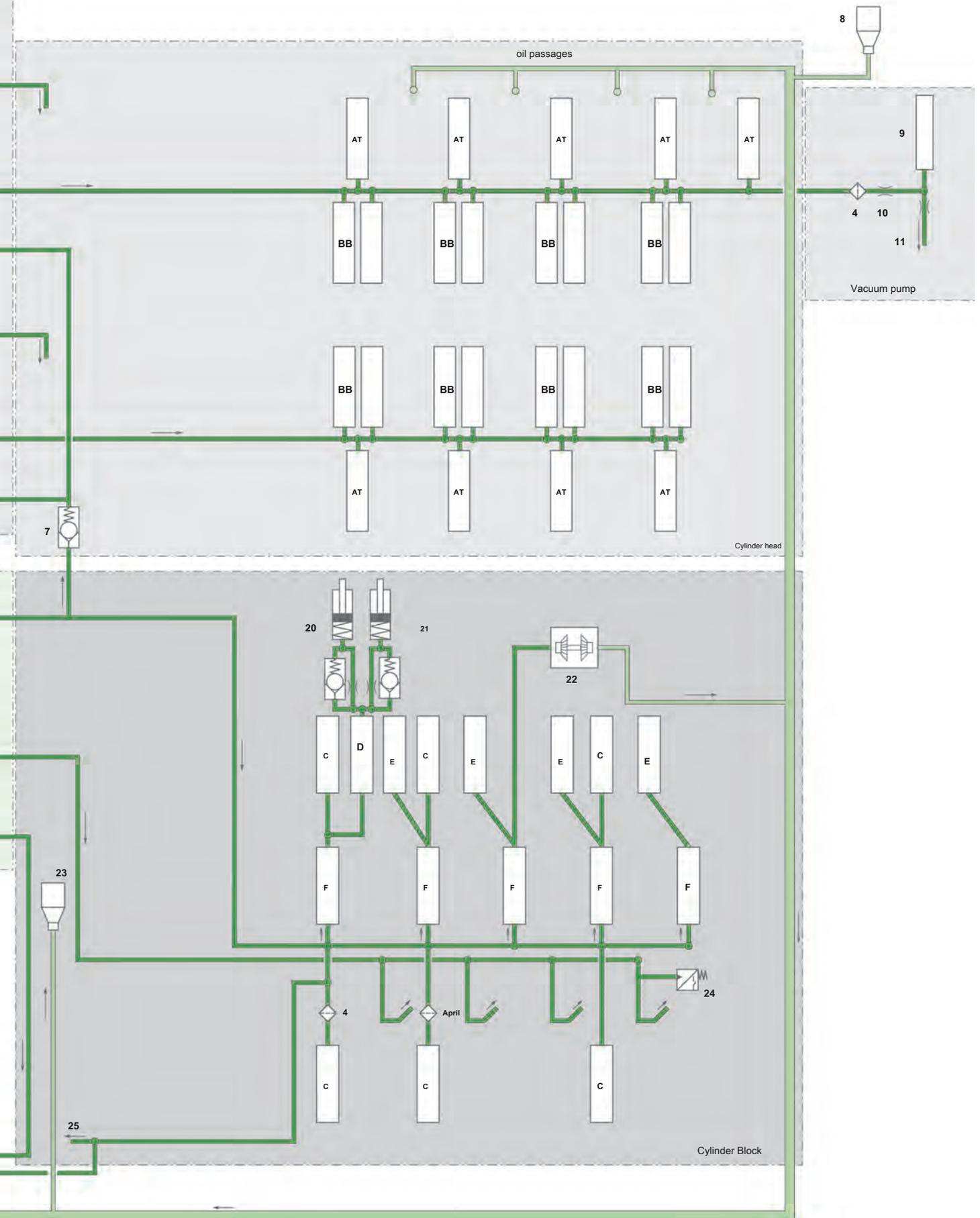
- 1 1 solenoid valve variable valve in the exhaust N318
- 2 Hydraulic pallet inverter (exhaust)
- 3 Check valve, integrated into the bearing ramp
- 4 Oil strainer
- 5 1 solenoid valve variable valve N205
- 6 Drive hydraulic pallet (admission)
- 7 Check valve integrated in the cylinder head
- 8 oil separator end
- 9 Vacuum pump
- 10 strangulation
- 11 Lubricating the cam for high-pressure fuel pump

- 12 Oil Cooler
- 13 Check valve, integrated into the oil filter
- 14 Oil Filter
- 15 oil drain valve
- 16 Oil pressure switch F22 (2.3 to 3.0 bar)
- 17 Oil pressure switch for control
F378 reduced pressure (0.5 to 0.8 bar)

- 18 control valve for injectors
piston cooling N522
- 19 mechanical switching valve
- 20 chain tensioner, balancing shafts
- 21 chain tensioner, chain drive
- 22 turbocharger
- 23 crude oil separator
- 24 Oil pressure switch, level 3 F447
- 25 Lubricating gear stage
- 26 level transmitter and G266 oil temperature
- 27 cold start injector
- 28 Check valve, built-in oil pump
- 29 Oil pump control
- thirty Oil pressure regulating valve N428

- high pressure circuit low
- pressure circuit



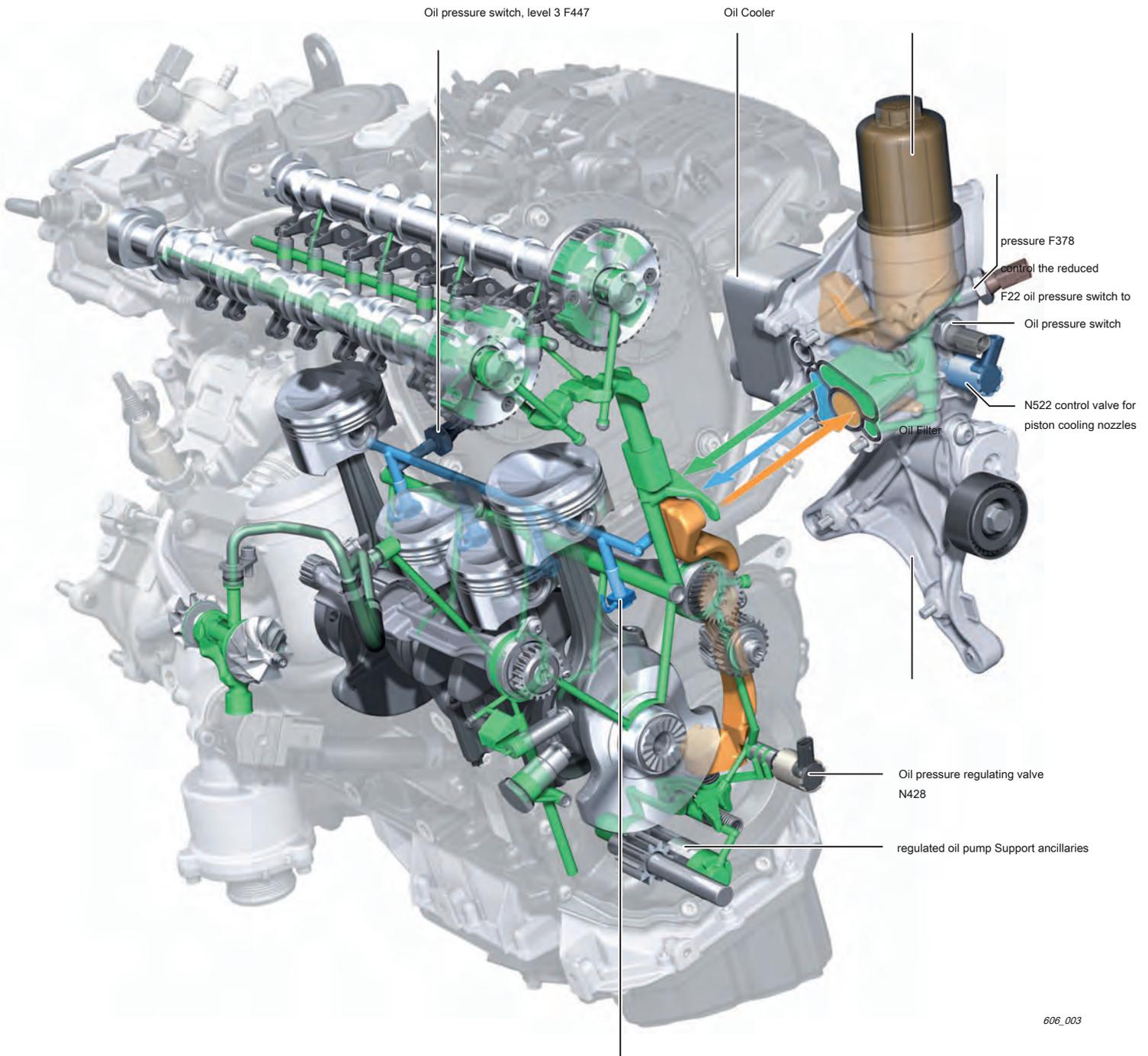


Oil supply

Optimizations and systematic improvements have also been made at the pressurized oil circuit. The main objectives were:

- Optimization of pressure channels in the oil circuit, hence reducing pressure losses coupled with an increase in volume
- Reducing pressure losses in the oil pressure circuit
- Expansion of the rev range at low pressure
- Decrease the oil pressure level low pressure
- Switchable piston cooling nozzles

Overall, these measures have achieved a significant reduction in engine friction. It was thus possible to achieve a further reduction of fuel consumption.



606_003

- Crude oil
- refined oil
- Switchable piston cooling nozzles

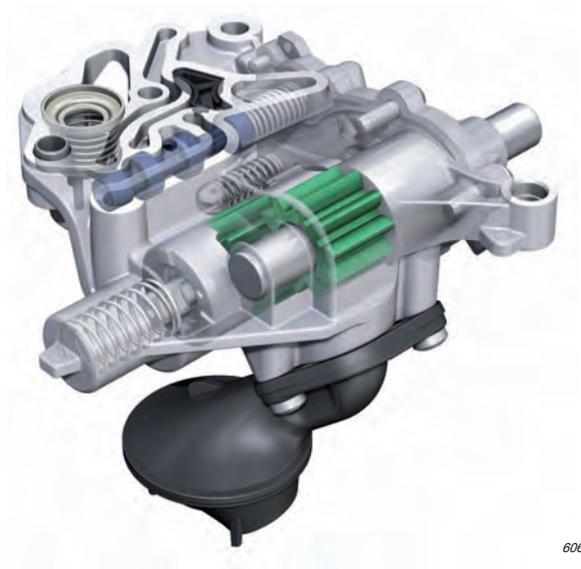
Changes to the oil pump:

- Pressure levels changed
- Increased yield
- Changes in hydraulic control of the piston cooling nozzle

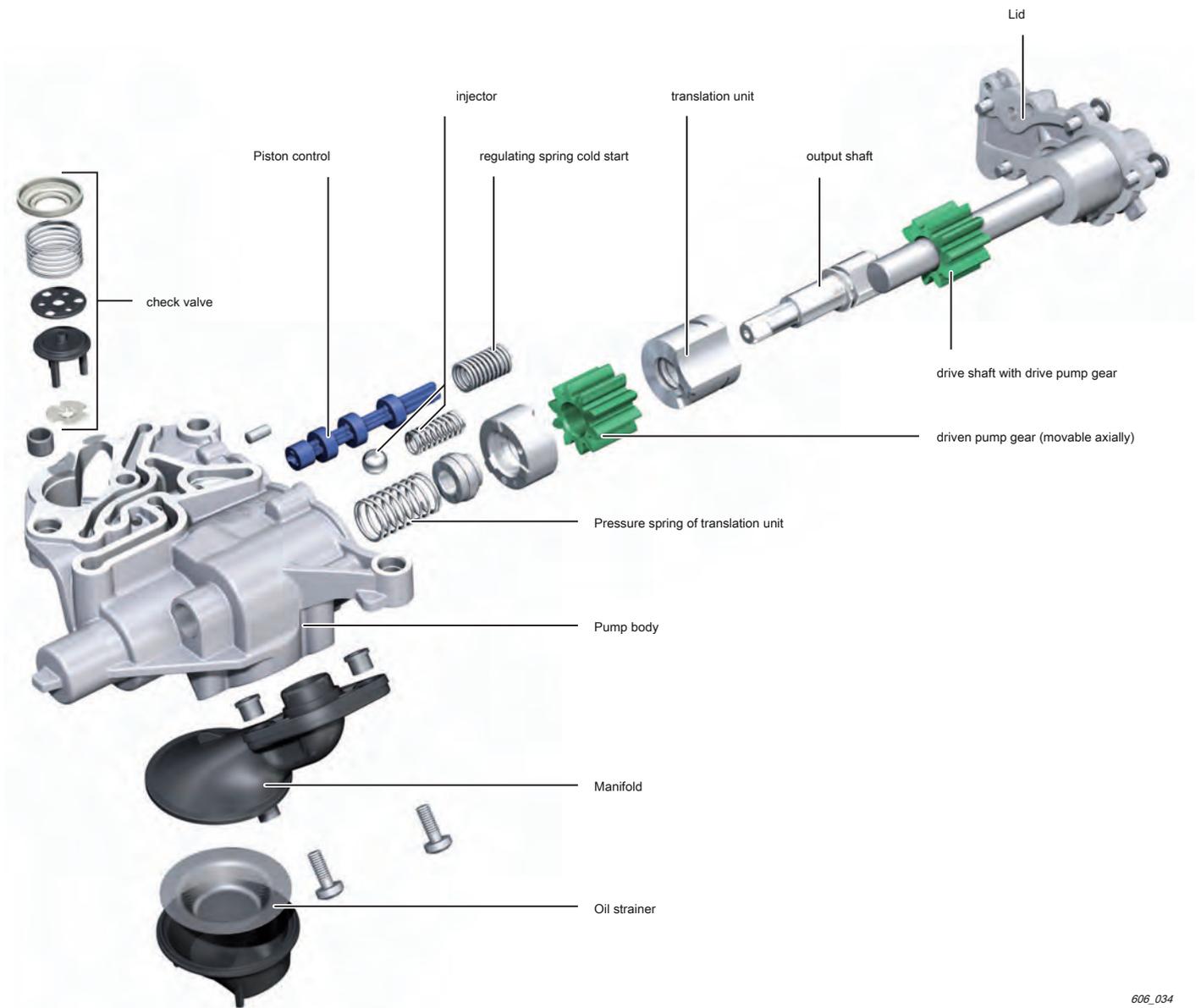
Oil pump control

The basic function of the oil pump is derived from the pump motor of the 2nd generation. There are the following differences:

- The hydraulic regulation within the pump has been perfected. The pump can then proceed to more precise control.
- The gear driving the pump has been modified so that the pump now rotates slower, $i = 0.96$.



606_033



606_034



return

You can find more information about the architecture and operation and to control oil pump in the self-study program 436 "Changes TFSI engine chain drive 4-cylinder".

oil filler cap

The lid is located in the chain cover. The cover is characterized by its opening and closing-off as well as safe and tight sealing water from the engine compartment relative to the environment.

Compared to the old building, a functional separation occurs between the seal and the bayonet. The sealing surface of the elastomer seal is rectangular smaller. In addition, there is no relative movement of the seal relative to the cover of the housing when mounting the cover on the engine. With the new construction, the actuation forces were reduced to a minimum. The bayonet positions undetachably cover all 90 °.



606_082

Switchable piston cooling nozzles

A cooling plunger heads is not required in each operating situation.

A targeted cut of piston cooling nozzles allows a new fuel economy improvement. Another reason for the removal of spring calibrated piston cooling nozzles is the oil level in overall lower pressure.

- oil channel additional pressure in the cylinder block
- New piston cooling nozzles without spring valves; there are injectors of two different internal diameters (injectors TFSI engines 1,8l have the smallest diameter)
- Oil pressure switch, level 3 F447 (closes at 0.3 to 0.6 bar)
- N522 control valve for piston cooling nozzles
- mechanical switching valve

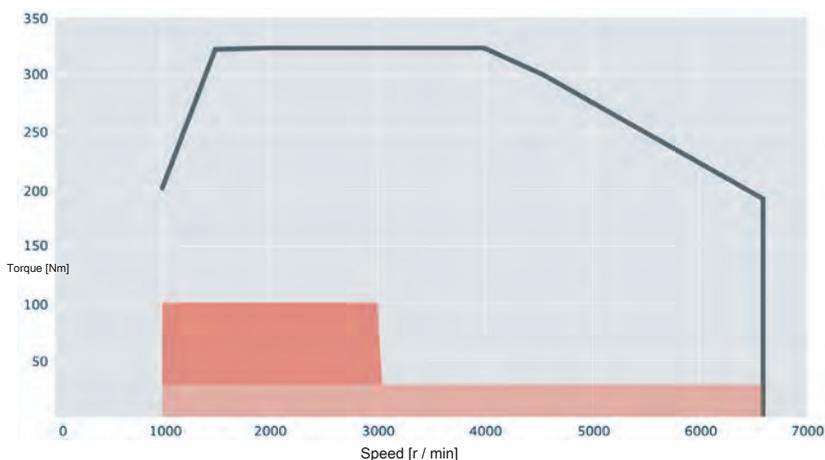
Mapping of piston cooling nozzles

piston cooling the injectors are activated as needed. This is calculated in a special mapping in the engine control unit.

piston cooling injectors can be activated at low or high pressure.

The main factors of the calculation are:

- Engine load
- Engine speed
- Cooling nozzles calculate the following components:



606_019

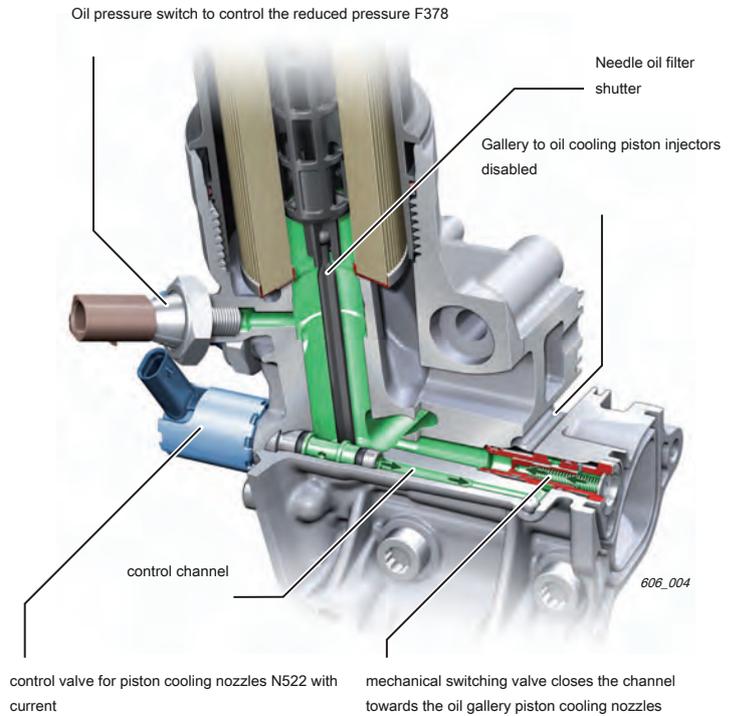
Cooling the deactivated piston (oil temperature <50 ° C)

Cooling off piston (oil temperature > 50 ° C) The system of switchable piston

disabled piston cooling nozzles

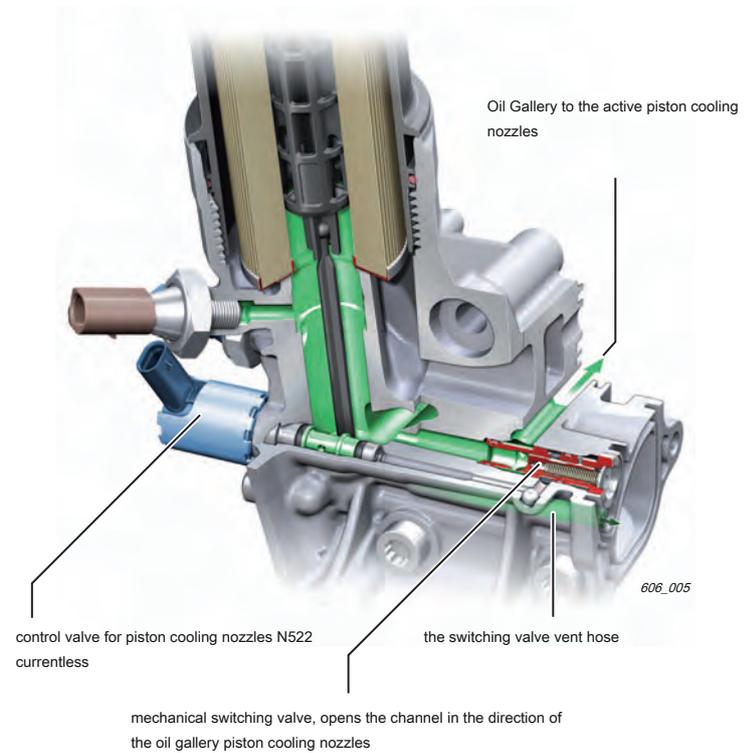
The control valve for piston cooling N522 injectors is supplied with power by the engine control unit. The control valve for piston cooling N522 injectors is then supplied with power by the terminal 87. The engine control unit provides the grounding and hence the closure of the electrical circuit.

N522 the valve and releases the control channel of the mechanical switching valve. The oil under pressure is now applied to the control piston of the mechanical switching valve from both sides. The spring pushes the mechanical switching valve and thus closes the channel going to the oil gallery of the piston cooling nozzles.



activated piston cooling nozzles

The circuiting of the piston cooling nozzles is carried out by keeping N522 off. The control channel to the mechanical switching valve then closes. As the oil pressure acts only on one side of the switching valve, it moves and opens the channel to the oil gallery of the piston cooling nozzles. The spring in the switching valve is then prestressed. The spring force in the switching valve allows the opening of the oil gallery in the direction of the piston cooling nozzles from an oil pressure of 0.9 bar. So that the switching valve comes, after switching off the control valve for piston cooling nozzles N522 without delay in the initial position, the oil must s' quickly flow from the control piston. For this there are a separate channel, which ensures the flow of oil without pressure in the engine oil sump. This is the same channel in which flows the oil when replacing the oil filter.



Monitoring the function

When the piston cooling nozzles are activated, the contact in the oil pressure switch, level 3 F447, closes. The switch is at the end of the oil gallery for piston cooling nozzles (see page 26, figure 606_003).

The oil pressure switch can detect the following defects:

- No oil pressure on the piston cooling nozzles despite request
- Faulty oil pressure switch
- oil pressure in spite of the deactivation of the piston cooling nozzles

The control valve for piston cooling nozzles, the following electrical faults can be detected:

- cable cut, piston cooling nozzles always enabled
- Short circuit to ground; cooling off piston
- Short circuit to +; piston cooling always on

In case of faults causing the piston cooling does not occur, the following backup reactions are triggered:

- torque limiting and speed by the engine control unit
- No level of low oil pressure in the control oil pump
- There in the instrument cluster display a message that the plan is limited to 4000 rev / min, a beep, EPC warning light

Cooling system

System overview

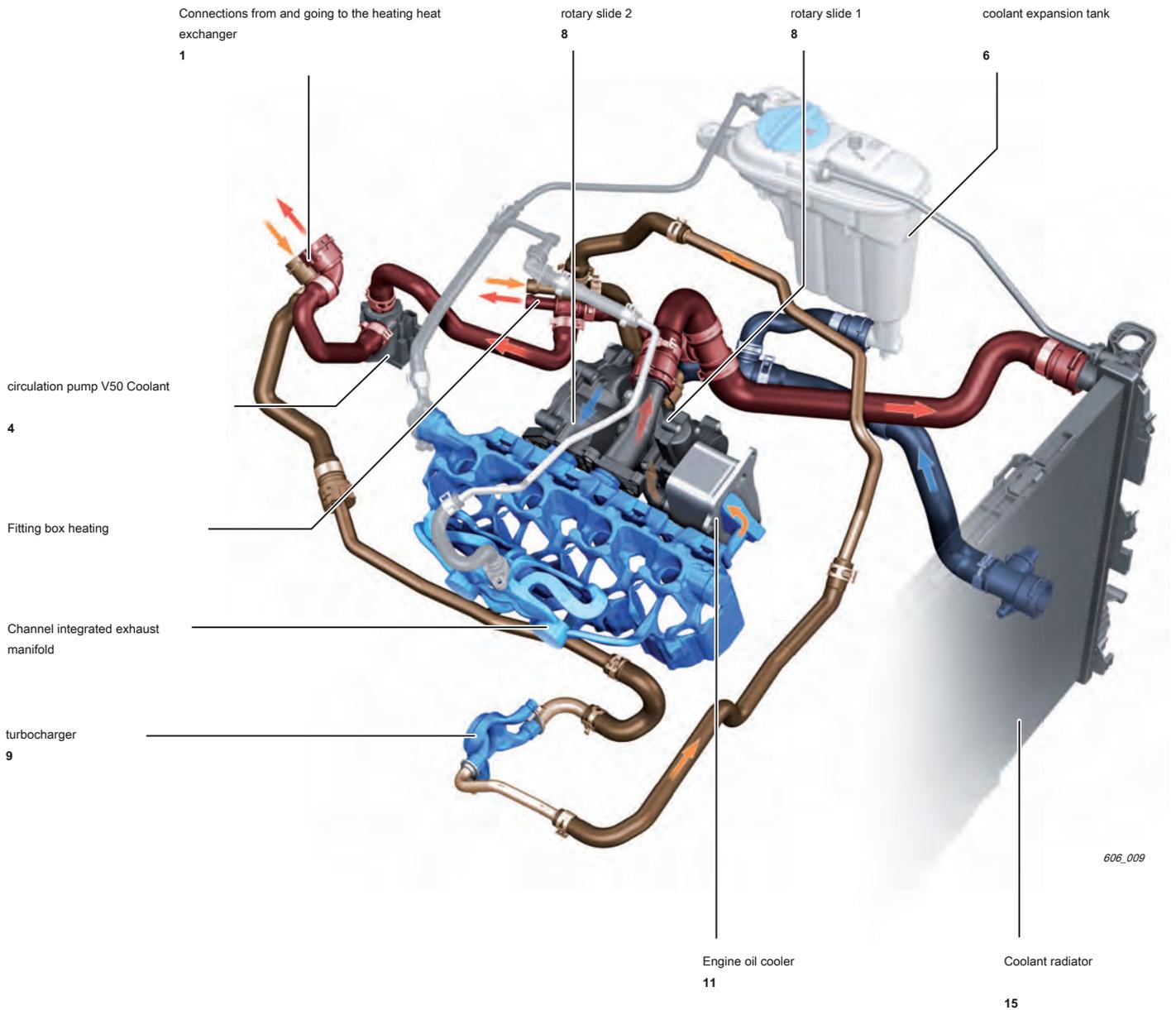
The cooling system is adapted to the vehicle equipment, as well as its engine.

It is thus the difference between longitudinal and transverse mounting, engine, gearbox version and if the vehicle is equipped with a stationary heating.

Circulation of the cooling liquid

We took here for example the TFSI version 1.8l longitudinal position with manual transmission and without stationary heating.

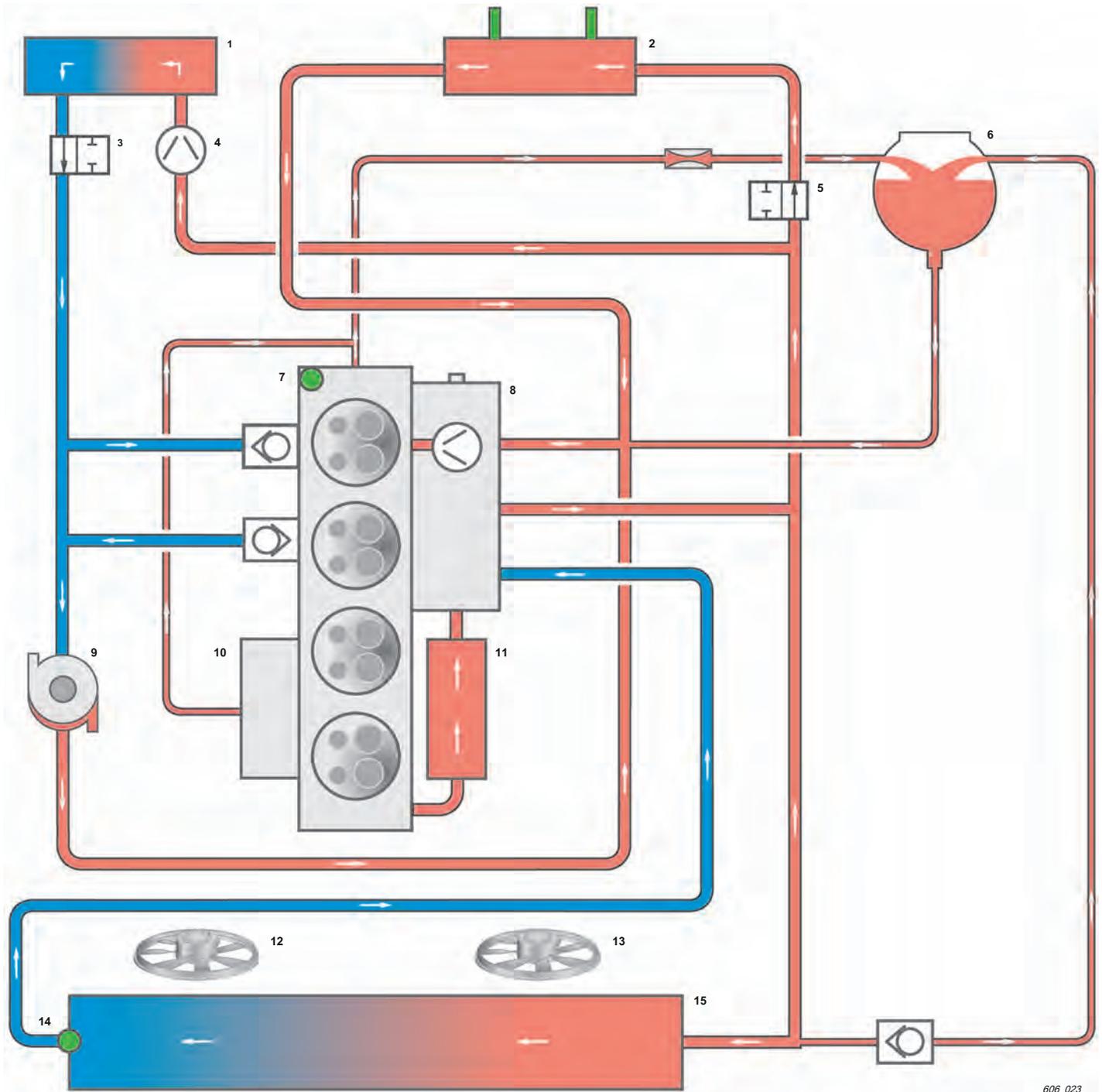
The identification of the chart also includes the numbers of the legend on page 31.



Note

For specific connection diagrams to the vehicle, consult the relevant Repair Manual.

1.8I TFSI engine longitudinally mounted, with manual transmission and without stationary heating



606_023

- █ Liquid cooled cooling
- █ Heated liquid cooling
- █ ATF

legend:

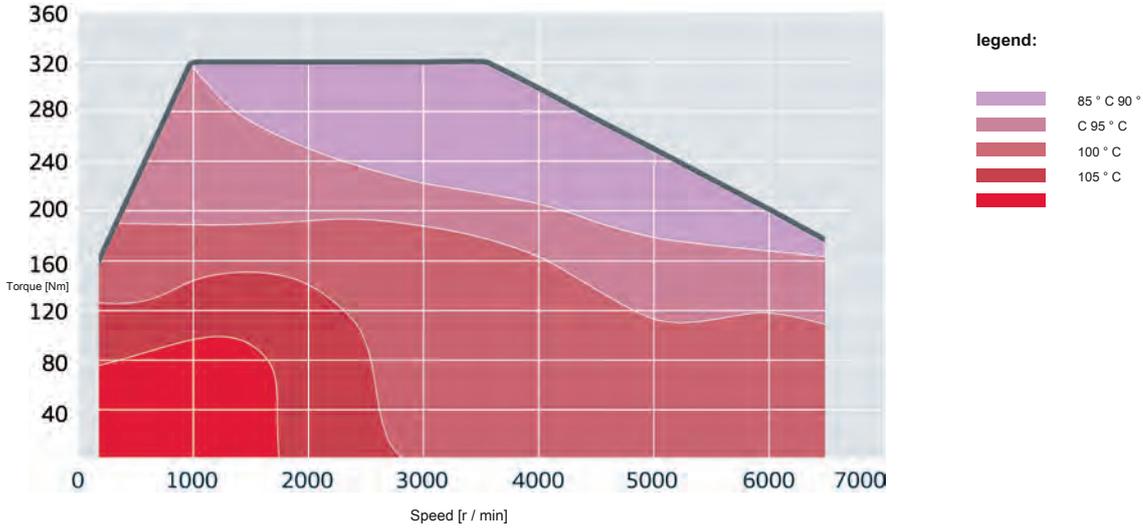
- | | | | |
|---|---|----|---|
| 1 | Heat exchanger of the heating | 9 | turbocharger |
| 2 | Radiator transmission oil | 10 | integrated exhaust manifold (IACV) |
| 3 | Coolant shutoff valve N422 of the Climatronic | 11 | Engine oil cooler |
| 4 | circulation pump V50 Coolant | 12 | Radiator fan V7 |
| 5 | coolant valve for box N488 speeds | 13 | radiator fan V177 2 |
| 6 | coolant expansion tank | 14 | coolant temperature transmitter radiator outlet G83 |
| 7 | coolant temperature sender G62 | 15 | Coolant radiator |
| 8 | coolant pump with engine temperature control actuator N493 (rotary valve 1 and 2) | | |

Innovative Thermal Management (ITM)

During engine development, the complete coolant circuit has been revamped. The rapid heating of the engine, a reduction in consumption as well as regulating the temperature of the rapid and optimal engine thermodynamically and, if necessary, the heating systems were the main targets.

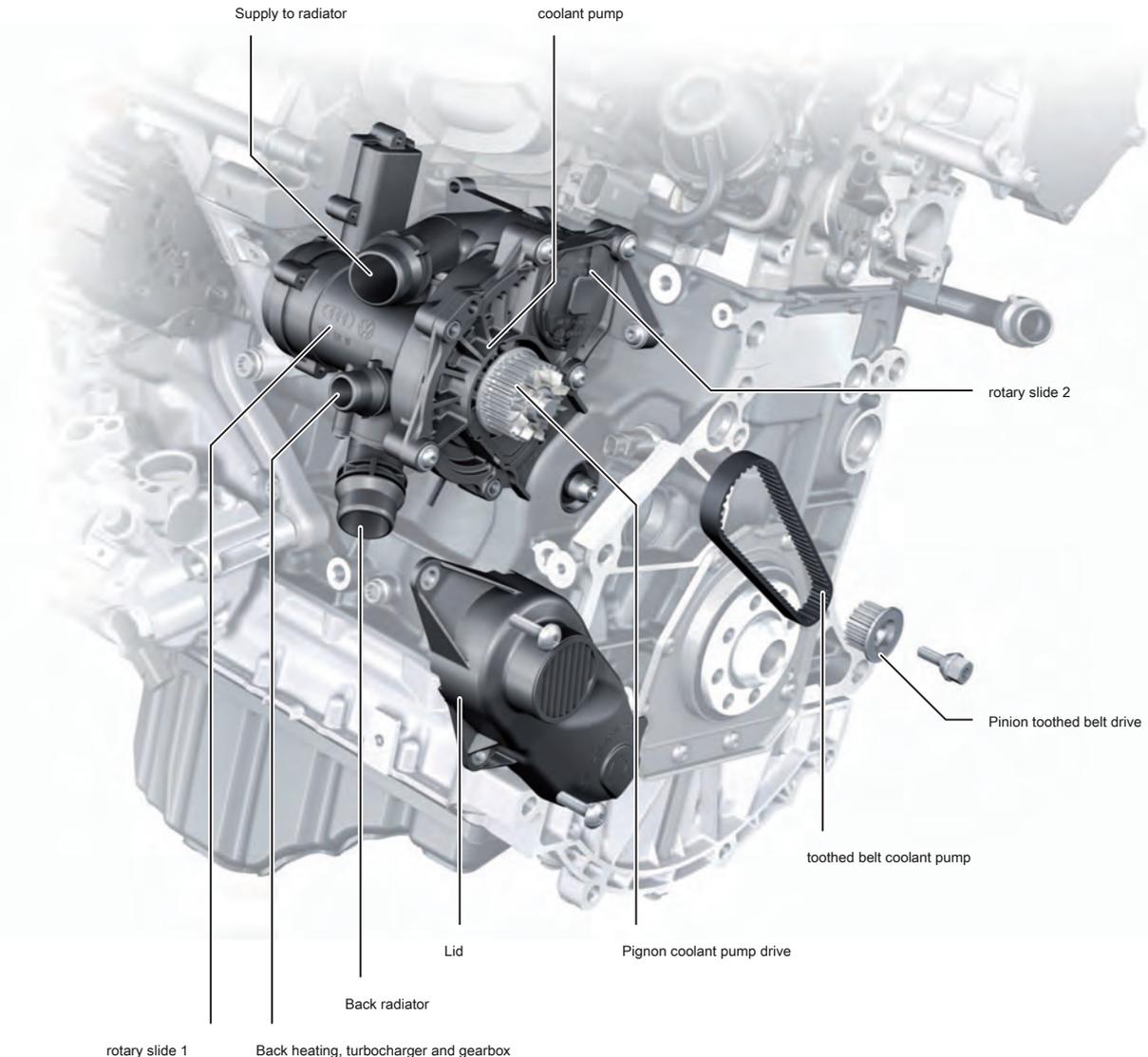
The two main essential components of the innovative thermal management are integrated exhaust manifold into the cylinder head (see section A cylinder head) and described below, the N493 engine temperature control actuator. It is mounted as a module with the coolant pump, the cold side of the engine.

Temperature of the cooling liquid at room temperature of 20 ° C.



606_040

Module of rotary and coolant pump

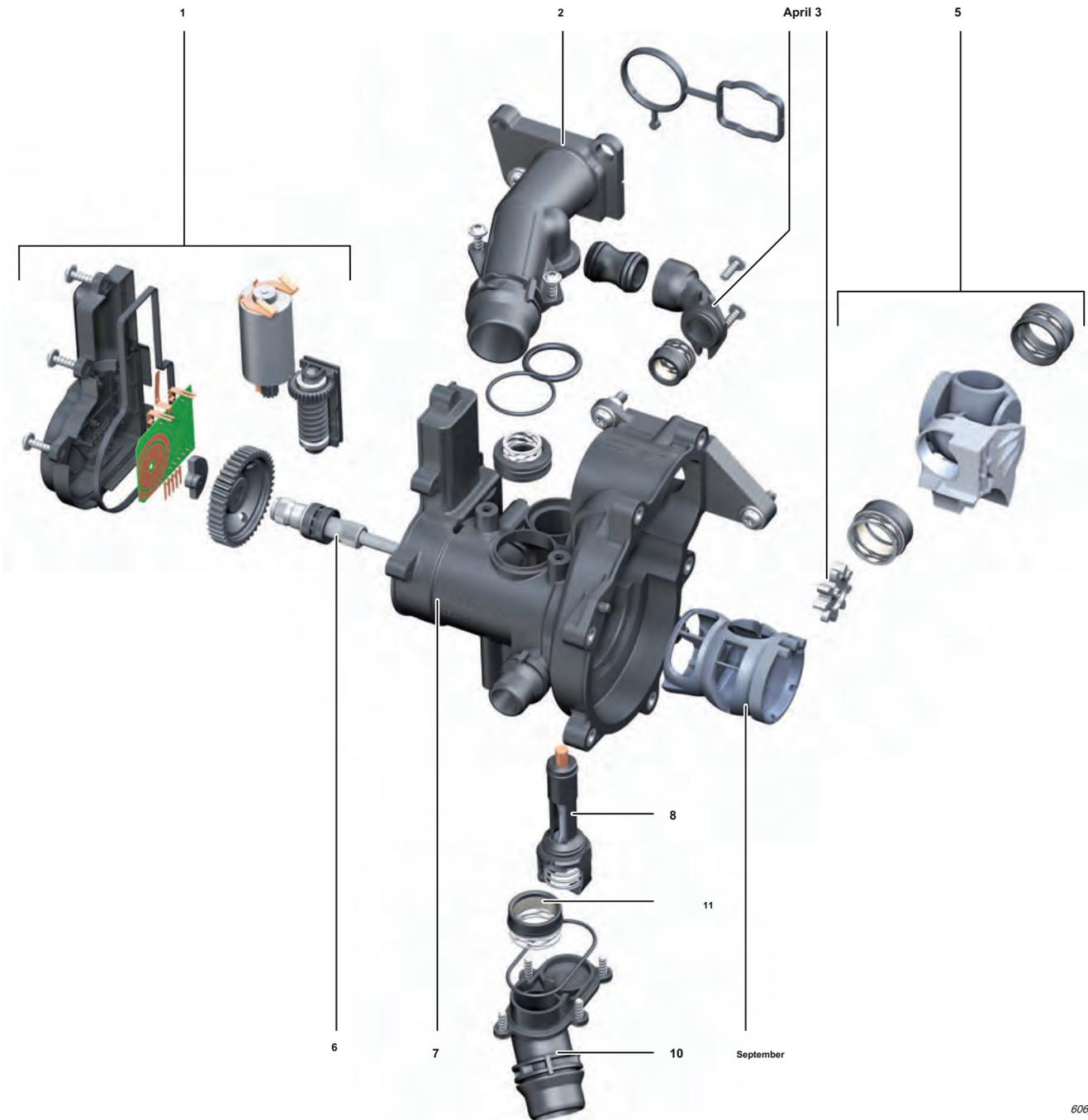


606_035

engine temperature control actuator N493 (rotary valve)

The N493 engine temperature control actuator is identical to the engines of 1.8 l and 2.0 l, longitudinal position as cross. It regulates the coolant flow via two rotary slide valves mechanically coupled. Regulation of the angular position of the rotary slide valve takes place according to the instructions of different maps in the engine control unit.

By corresponding positioning of the rotary valve, it is possible to realize different switching positions. This enables rapid heating of the engine, which results in a reduction in friction and hence the fuel consumption. Furthermore, engine temperatures varying between 85 °C and 107 °C are achievable.



legend:

- | | | | |
|---|--|----|--|
| 1 | Training the N493 motor temperature control actuator with sensor | 6 | rotary valve shaft 1 |
| 2 | Nozzle for supply to radiator | 7 | Rotary slide housing |
| 3 | Nozzle connection to the engine oil cooler | 8 | Thermostat wax capsule (thermostat FS) |
| 4 | intermediate gear | 9 | Stacking joints |
| 5 | rotary slide 2 | 10 | Nozzle for return of the radiator |
| | | 11 | rotary slide 1 |

606_036

Depending on the temperature control of the actuator motor N493

A DC electric motor drives the rotary slide valve. The engine management is ensured via the engine control unit by a PWM signal (12 V). The drive frequency is 1000 Hz.

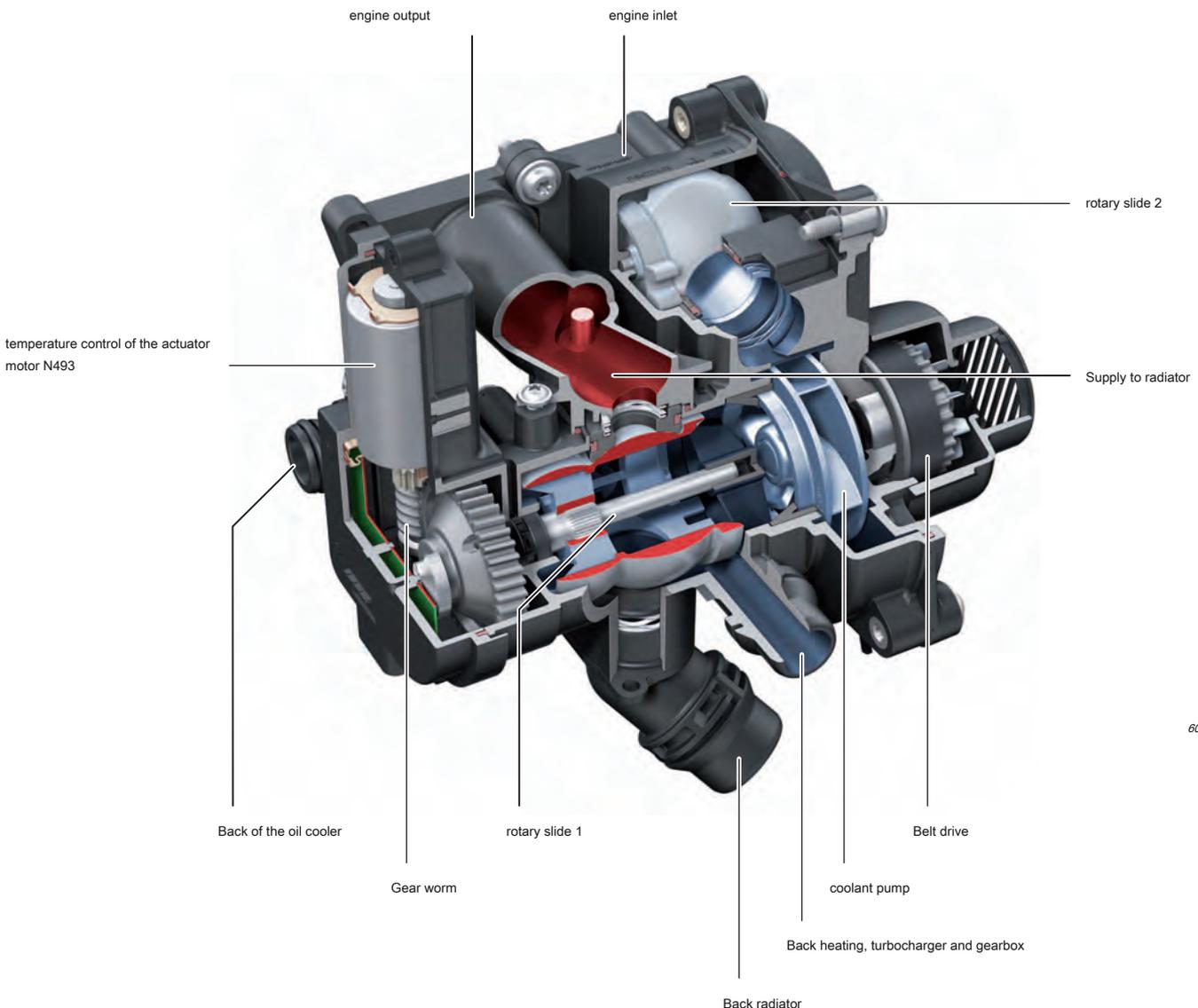
The control signal is new. This is a digital signal, whose architecture is similar to a CAN signal. The control takes place until the position determined by the engine control unit is reached. A positive control (measured value in the vehicle diagnostic tester) means that the rotary slide moves toward the opening.

The electric motor drives the rotary slide 1 by means of a worm gear screw sharp reduction. It controls the coolant flow of the oil cooler, the cylinder head and the main water heater. (The oil cooler box, the turbocharger and the return of heating are not regulated.)

Over the engine warms, the greater the rotary valve is rotated. Different rates are then opened in the variable area.

The rotary valve 2 is connected via a toothed spindles to the rotatable tray 1. The toothing is designed so that the rotary slide valve 2 is coupled and decoupled in different angular positions of the rotary valve 1. The rotary movement of the rotary valve 2 (opening of coolant flow through the cylinder block) begins at a rotational angle position of the rotary valve 1 of approx. 145°. In a rotational angle position of the rotary valve 1 of approx. 85°, there is again decoupling. Here, the rotary valve 2 has reached its maximum rotational movement and fully open the coolant circuit of the cylinder block. The movements of rotary slide valves are limited by mechanical stops.

For detecting the exact position of the rotary and recognize malfunctions, a rotational angle sensor is mounted on the control board of the rotary valve. It delivers a digital voltage signal (*SENT*) the engine control unit. The position of the rotary valve 1 can be read in the measured values with the vehicle diagnostic tester.



606_010

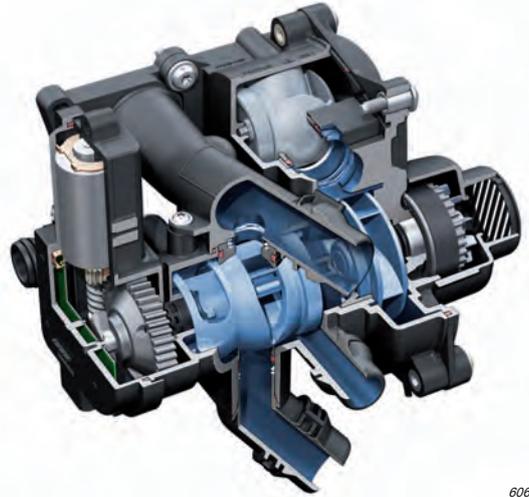
control strategy

The present description relates to the operation of the entire cooling liquid circuit during the engine warm-up phase. The description for the engines of the Audi A4 12.

Warming

For the engine actuation, the rotary slide 1 is moved into position 160°. In this position, the connections of the engine oil cooler and the main water radiator return are closed on the rotary slide 1.

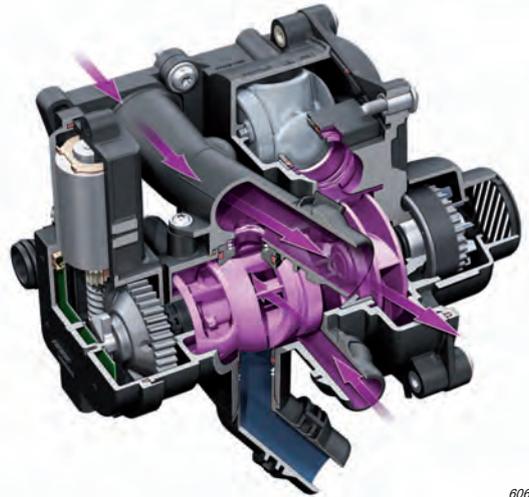
The rotary slide valve 2 closes the connection from the cylinder block. Coolant cutoff valve climatronic N422 and the coolant valve for N488 gearbox are, at first, closed. The recirculation pump coolant V51 is not driven. The circulation of the coolant through the cylinder block is thus not possible. Coolant stagnation is performed, depending on the load and speed, until a maximum temperature of 90 °C.



606_062

independent heating

In case of heating application, the coolant shutoff valve climatronic N422 and V51 coolant recirculation pump are activated. The coolant flow then passes through the cylinder head, the turbocharger and heat exchanger of the heating.

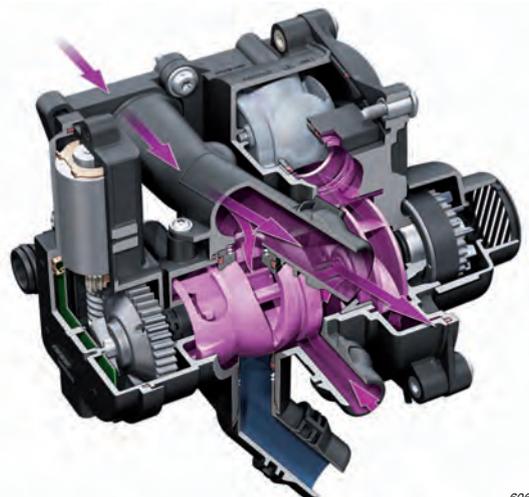


606_063

Mini volume flow

This function serves to protect against overheating of the cylinder head (integrated exhaust manifold) and the turbocharger, when the stagnation of coolant is formed in the cylinder block. For this, the rotary disc 1 is brought into a position of approx. 145°. From this position, the teeth in time enters the rotary slide 2 and begins to open. A small portion of the coolant is now discharged from the cylinder block in the cylinder head, passes through the turbocharger and is returned through the module of rotary valve to the coolant pump.

The second partial flow flows, if necessary, via the coolant shutoff valve N82 in the direction of the heat exchanger of the heating. The recirculation pump coolant V51 is then driven in case of "heat demand". The engine friction during actuation can be further reduced through the rapid warming of the coolant.

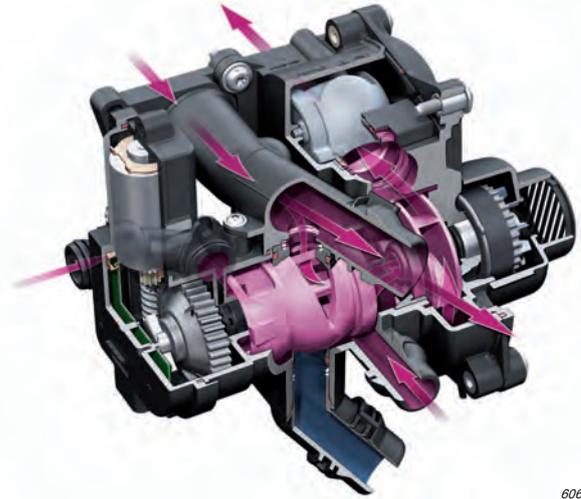


606_064

Enabling the engine oil cooler to put into action

During the further course of the heating phase, the engine oil cooler is activated in turn. The opening of the connection of the engine oil cooler starts from a position of the rotary valve 1 to 120 °.

Meanwhile, the rotary disc 2 continues to open and the coolant flow through the cylinder block increases. engine oil is also heated by the targeted activation of the engine oil cooler.

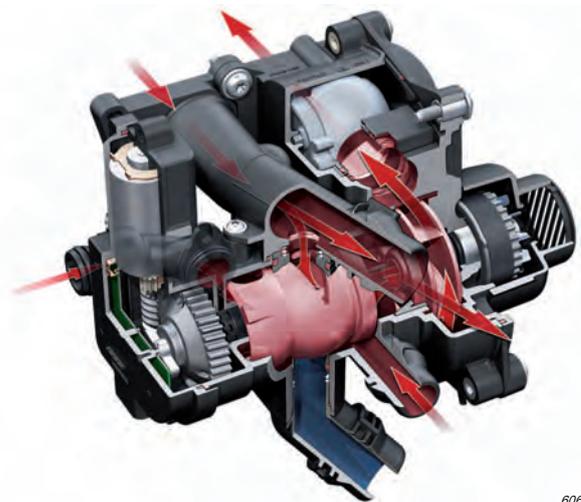


606_065

Heating of the transmission oil

After sufficient heating of the combustion engine, the coolant valve for gearbox N488 is open, to also heat the gear oil with excess heat.

The activation of the heating function of the transmission oil takes place at a temperature of the coolant of 80 ° C without heating and 97 ° C with heating.



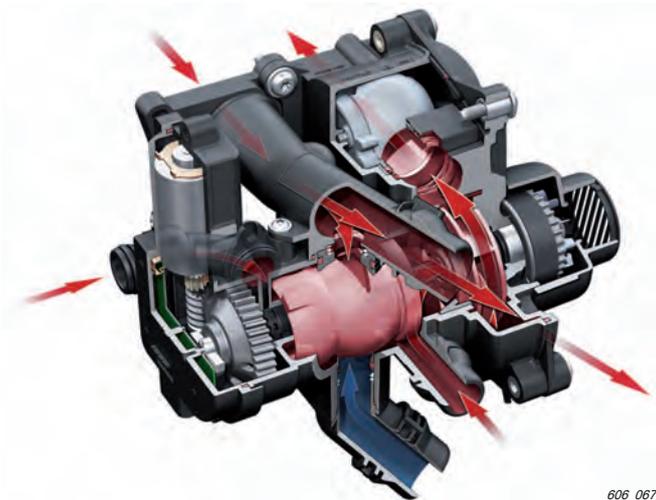
606_066

Temperature control via the main water radiator

In the case of low speeds and loads, the cooling liquid is controlled to a minimum friction of the engine, at 107 ° C. When the load and speed increase, the coolant temperature is lowered to 85 ° C.

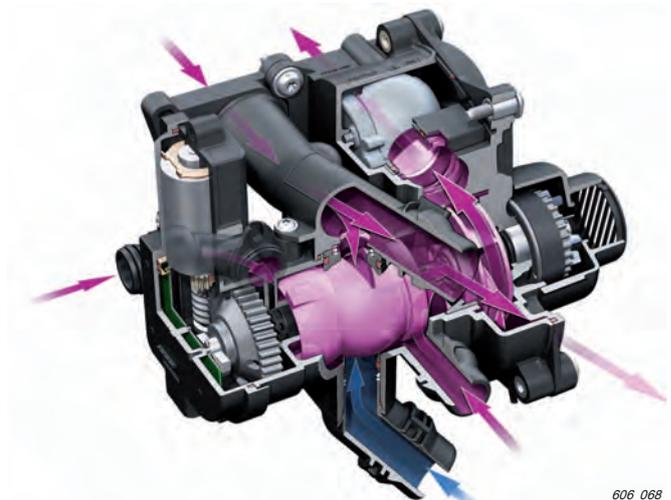
For this, the rotary valve 1 is adjusted according to the need of cooling between 85 ° and 0 °. 0 ° position of the rotary valve, the connector main water radiator return is fully open.

partial load range



606_067

Beach full load



606_068

recirculation function after engine shutdown

To prevent boiling coolant in the cylinder head and turbocharger after the engine failure or to avoid unnecessary cooling of the engine, the recirculation function is started on demand mapping. It is activated for 15 minutes maximum after switching off the engine. For this, the rotary slide valve is brought into "position recirculation" (160-255 °). Regulating the coolant temperature was also performed in the recirculation. In the case of an application for maximum recirculation (255 °) and a corresponding low temperature coolant, the coupling main water radiator return is open, the connection from the cylinder block being closed however via rotary slide 2. In addition,

The coolant then flows into two partial flows. On the one hand via the cylinder head to V51, the second partial stream flows through the turbocharger via the rotary slide, and then via the main water heater to return to the recirculation pump of the V51 engine coolant.

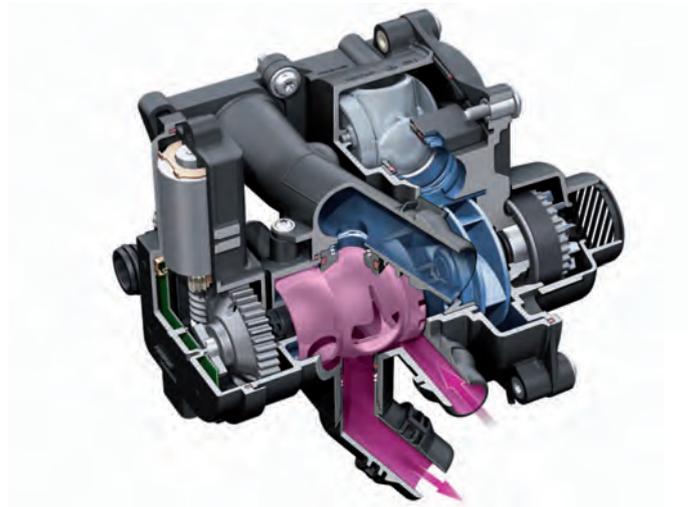
In recirculation position, the crankcase is not crossed. This function has significantly reduced the time of the recirculation function without generating excessive heat loss.

Default

In case of failure of the rotation angle sensor, the rotary slide valve is fully controlled (maximum cooling of the engine). If the DC motor is defective, if the rotary valve is jammed, a limitation on the speed and torque is enabled depending on the position of the rotary valve.

Other reactions:

- There in the instrument cluster display a message that the plan is limited to 4000 rev / min, a beep, EPC warning light
- Display of the actual temperature of the coolant in the instrument cluster
- Opening of the coolant shutoff valve N82
- Activation of the recirculation pump V51 coolant to ensure the cooling of the cylinder head.



606_077

If the temperature in the rotary valve exceeds 113 ° C, a wax capsule thermostat opens in the rotary valve by-pass towards the main water heater, so that the coolant can flow through the radiator main water (see page 33, figure 606_036). This will continue the trip in case of default.

e-media

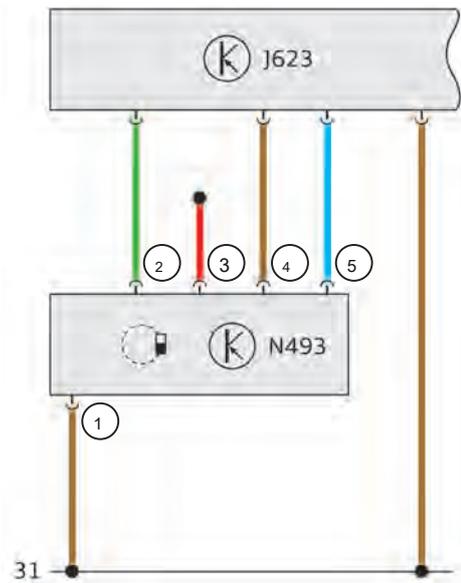


Animation on the innovative thermal management and operation of the rotary valve.

Block diagram of the temperature control actuator motor N493

Connectors on the control actuator of the N493 engine temperature:

- Sensor - (mass connection of the sensor, engine wiring)
- ② Sensor signal
- ③ Sensor + (5 V in fitting the motor wiring)
- ④ actuator -
- ⑤ Actuator + 1

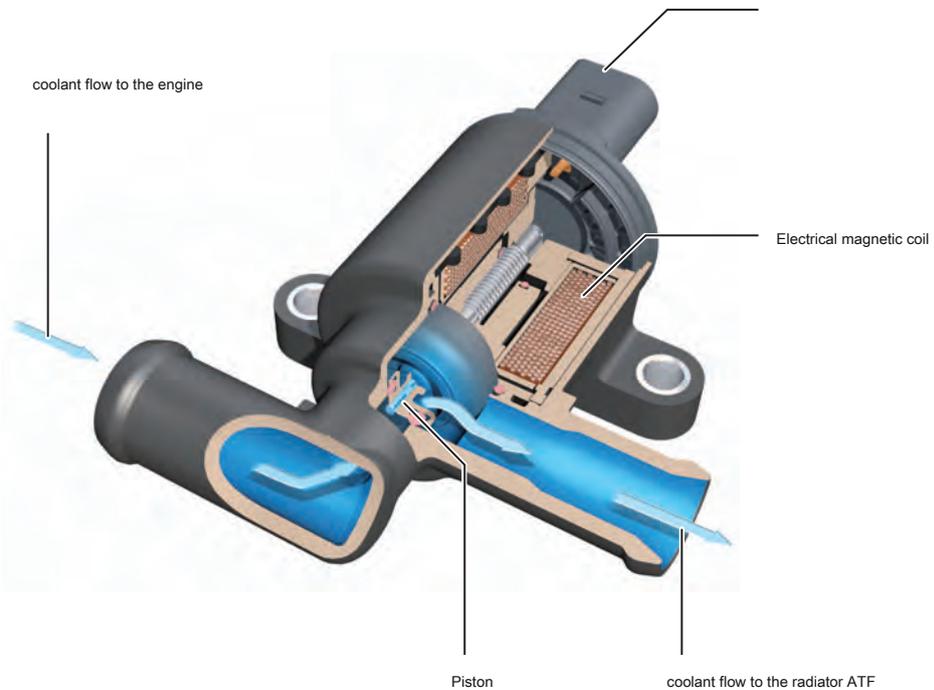


606_021

coolant valve for box N488 speeds

The coolant valve for pilot gearbox arrivals hot coolant flow to the radiator transmission oil. It is for example mounted on the Audi A5 12 with manual gearbox. The solenoid valve is driven when required by the engine control unit with the on-board voltage. If it is not controlled, it is open by mechanical force of the spring.

When starting the engine, it is closed. The coolant flows to the box is open at a temperature of the coolant of 80 ° C and closed at 90 ° C. This assists the mechanical box to reach its optimum temperature in terms of friction.



606_022

circulation pump V50 Coolant

This pump is used on vehicles with engines in longitudinal position, recirculation pump for the heat exchanger heating. It is controlled by the computer Climatronic J255 via a PWM signal. It is diagnosable via the calculator Climatronic J255.

Operation

When the recirculating pump V50 coolant running, the coolant is sucked via the flexible engine coolant through the heat exchanger of the cooling block and the cooling liquid shutoff valve and forwarded to the motor via the coolant hose.

The circulation pump V50 Coolant is with the ignition set, controlled depending on the temperature of the coolant and the setting on the control unit and the air conditioner display.

The vehicle equipment version is selected in coding and adaptation (eg. Stationary mounted heating).

Coolant shutoff valve N422 of the Climatronic

Coolant cutoff valve is mounted on the engine in the longitudinal position and without stationary heating.

Operation

It is identical to the coolant valve for the gearbox N488 (see page 38).

If it is not controlled, it is open (the coolant flows). When driving, it is closed. The opening is provided by the mechanical force of the spring.

recirculating pump V51 Coolant

The pump is mounted on vehicles with engine in a transverse position. It is identical to the V50 pump fitted to engines in longitudinal position. The control of the engine control unit is provided by the computer by means of a PWM signal. The pump recirculation V51 coolant is controlled by the engine control unit on request of the control unit (ECU heating J65) or Climatronic J255 calculator.

cutoff valve N82 coolant

The cutoff valve N82 coolant is controlled by the engine control unit.

It is among others mounted on the Audi A3 with 13 stationary heating.



circulation pump V50 Coolant

606_056

The valve opens and closes the coolant flows from the heat exchanger of the vehicle heating, cf. page 31, figure 606_023.

After engine startup, it is closed. It is open if desired heating, cooling and recirculating start-stop demand.

The steering "black and white" is provided by the computer Climatronic J255.

N422 Climatronic coolant shut-off valve must be properly adjusted in the computer.

It is also responsible for the assistance of the pump engine coolant to improve cooling fluid flow rate through the heat exchanger of the heating at given engine speeds, with a view to improving the power heating.

In addition, the temperature in the turbocharger can be reduced more rapidly. This improves the lifetime of the engine oil.

It cuts in the case of a cold engine, depending on the setting on the control unit (ECU heating J65) or Climatronic J255 calculator coolant flow through the heat exchanger of the heating, ex. to speed up the engine warm.

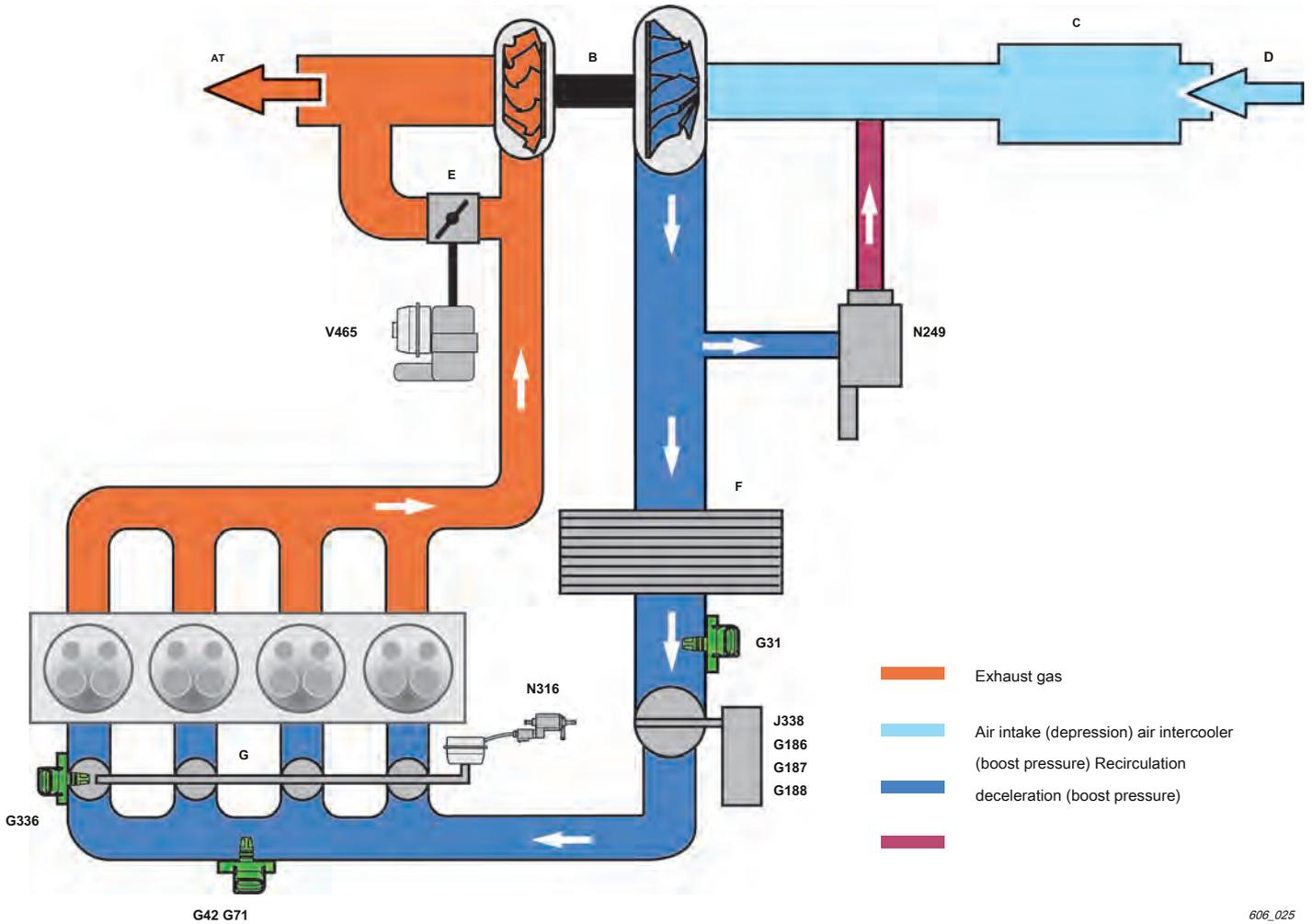


return

You will find more information on the operation of the recirculation pump coolant V50 / V51 in the self-study program 616 "1.2l TFSI and 1.4l engines of the Audi EA211 line."

air and boost supply

System overview



legend:

- AT Flow of exhaust gas
- B turbocharger
- C Air filter
- D flow of fresh air
- E wastegate flap
- F charge air radiator
- G Intake manifold flaps

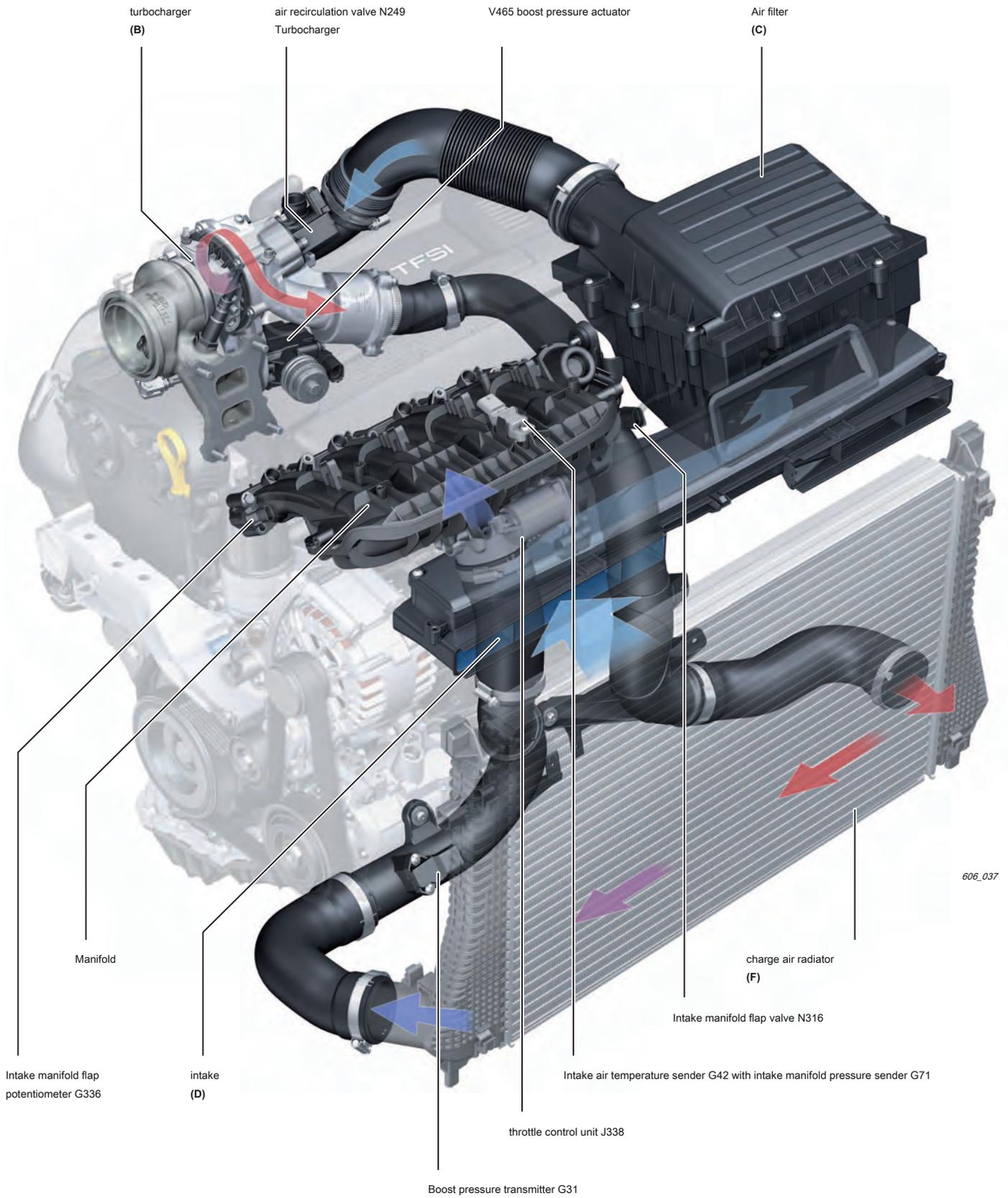
- G31 Boost pressure transmitter
- G42 Intake air temperature sender
- G71 intake manifold pressure transmitter
- G186 throttle drive
(Electric throttle control)
- G187 angle transmitter 1 of the throttle drive
(Electric throttle control)
- G188 Angle transmitter 2 of the throttle drive
(Electric throttle control)
- G336 Potentiometer intake manifold flap
- J338 throttle control unit
- N249 air recirculation valve Turbocharger
- N316 intake manifold flap valve
- V465 Boost pressure actuator



Note

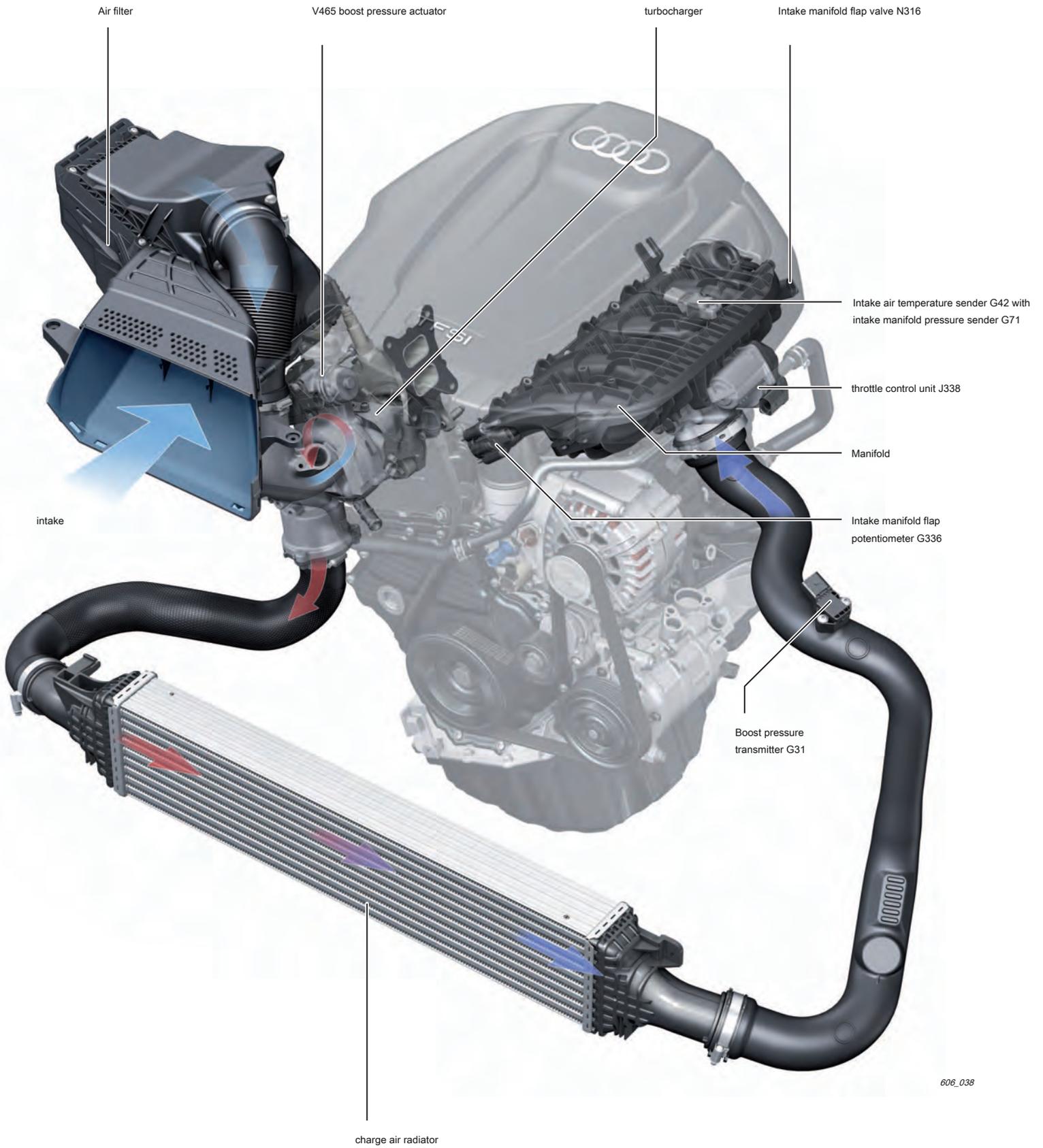
The V465 boost pressure actuator must be replaced after loosening the nuts against the rod. After replacement, the boost pressure actuator must be adjusted with the vehicle diagnostic tester.

air guide on the motor in a transverse position



606_037

air guide on the motor in the longitudinal position

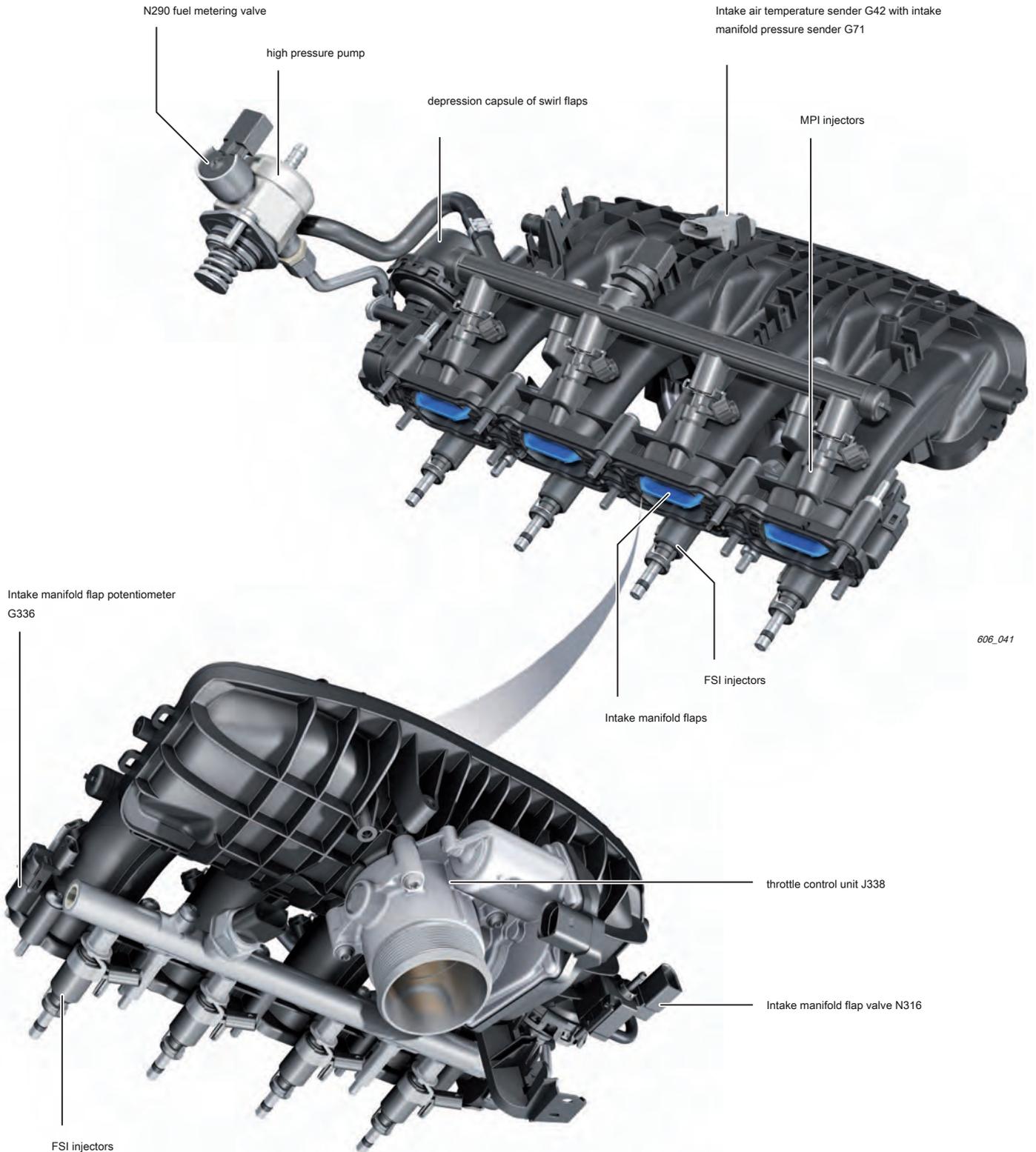


606_038

Manifold

Because higher boost pressures, the integrated intake manifold flap system in the intake manifold has been completely overhauled. The stainless steel shaft in a portion, angled, ensures a resistance to the maximum torque for the trough-shaped flaps in the intake channel. Detecting the positioning of the flaps is ensured by the intake manifold flap potentiometer G336 (rotation angle sensor without contact).

through the flaps are in the open state, biased in the base body, so as to minimize the excitations by the air flow. The shaft is switched electropneumatically with a capsule controlled by depression (two-position control) by the computer via the N316 intake manifold flap valve.



606_041

606_042

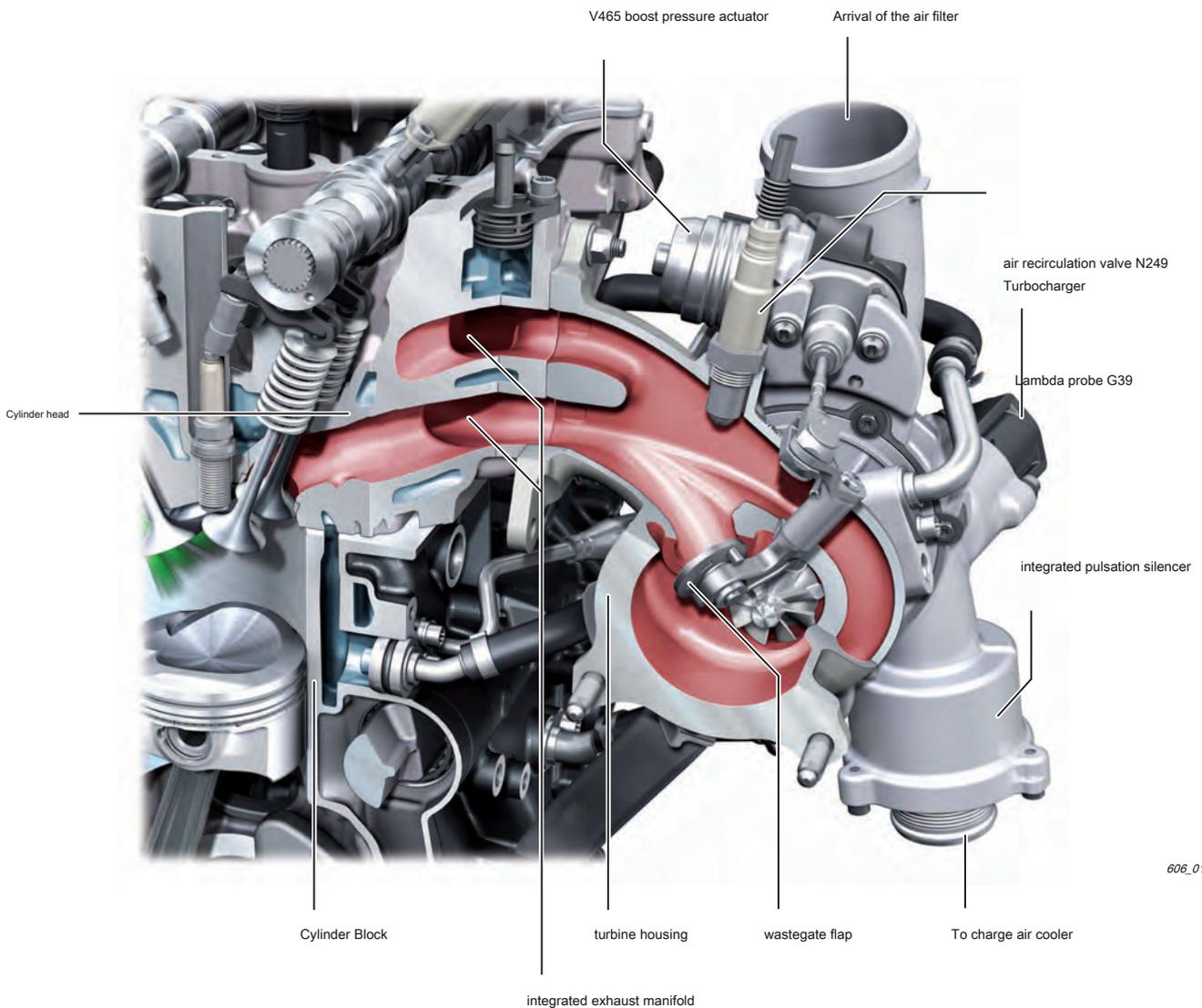
turbocharger

The supercharging system is a turbocharger *MonoScroll* *completely new design.

Overeating using the Mono-scroll turbocharger improves the behavior at full load, especially in the upper rev range. Guiding the double-channel flow of exhaust gas at the outlet of the cylinder head is continued in the turbocharger up to a little before the turbine. This results in optimum separation of the ignition timing (four in two in one).

The turbocharger is characterized by the following properties:

- Wastegate actuator power (boost pressure actuator V465 with transmitter position of the boost pressure actuator G581)
- Lambda sensor upstream of the turbine (lambda probe G39)
- compact turbine housing with double cast steel input stream, directly flanged to the cylinder head
- Carter silent compressor with integrated pulsation and air recirculation valve in overrun (air recirculation valve N249 Turbocharger)
- Turbine wheel (*Inconel **) heat resistant, designed for temperatures up to 980 ° C
- Carter bearing with compression fittings for oil and coolant
- compressor wheel milled for better driving stability at all speeds and improved acoustics
- turbine wheel carried out as *Mixed Flow Turbine **Inconel 713 ° C



606_013

Sensors for recording the air mass and the temperature of the air:

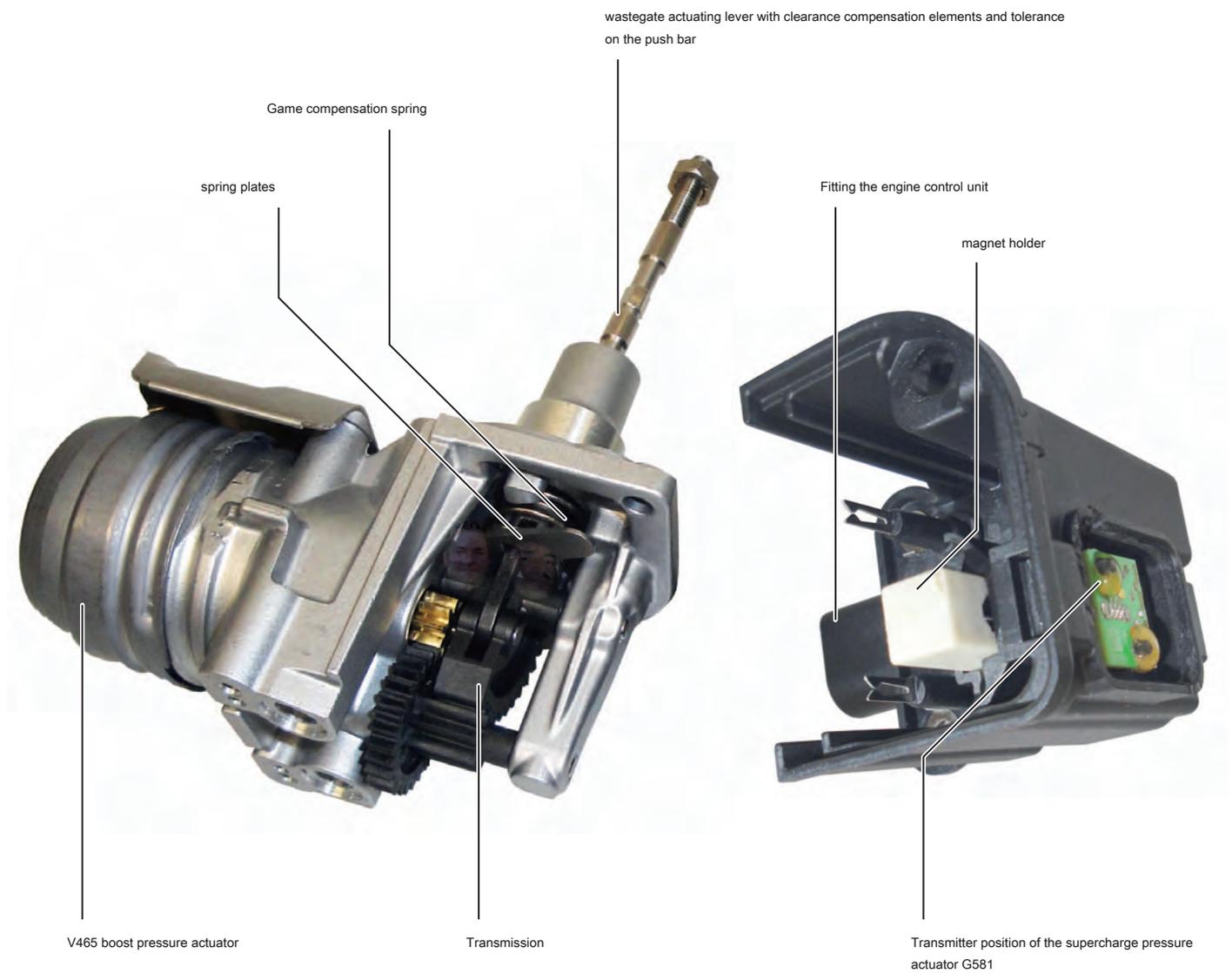
- Boost pressure transmitter G31 (position 3) fitted in the air line between the charge air cooler and the butterfly. Its signal is used to control the boost pressure.
- Intake air temperature sender G42 with pressure transmitter of the G71 intake manifold, the air mass is recorded with the pressure and temperature signals.

V465 boost pressure actuator

An electric wastegate actuator is implemented for the first time on an engine supercharged four-cylinder Audi. This technology offers the following advantages over vacuum capsules used previously:

- faster and more accurate response
- Can be controlled independently of the applied boost pressure
- Because of the higher closing force, the maximum torque of 320 Nm engine is reached at a low engine speed of 1500 rev / min.

- The base boost pressure can be lowered with an active opening of the part-load wastegate. This allows approx fuel economy. 1.2 g CO₂/ km in the MVEG cycle.
- Due to the active aperture of the wastegate during heating of the catalyst, there is obtained an increased temperature of the exhaust gas of 10 ° C upstream of the catalyst, leading to lower cold-start emissions.
- Due to the high operating speed of the actuator of the wastegate, immediate elimination of boost pressure when negative stress cycles (deceleration) is possible, which has a positive impact, particularly in behavior acoustic turbocharger (whistle blowing).



Components of the supercharging pressure of the actuator system

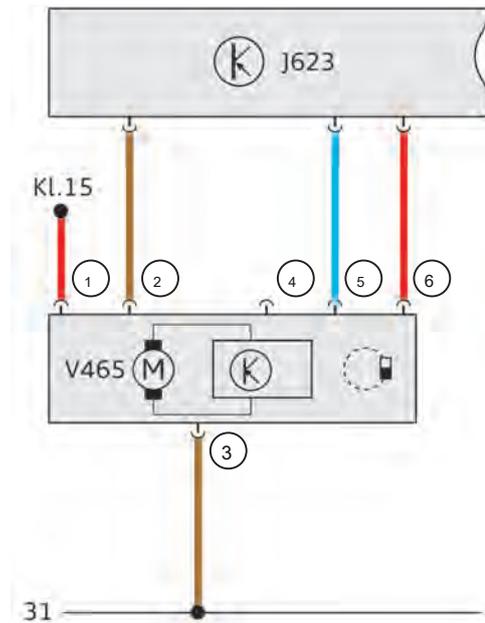
Full positioning mechanism consists of the following:

- Housing
- DC motor (boost pressure actuator V465)
- Transmission
- integrated position sensor without contact (position transmitter to boost pressure actuator G581)
- upper and lower mechanical stops transmission
- Game compensation elements and tolerance on the push bar

Functional scheme

Connections on the boost pressure transmitter V465:

- Sensor + (5 V in fitting the motor wiring)
- ② actuator -
- ③ Mass
- ④ not occupied
- ⑤ Sensor signal
- ⑥ Actuator + 1



606_020

Operation

The DC motor moves the wastegate flap via the transmission unit and the thrust rod. The limitation of the movement is performed in the case of the mechanical stop by the bottom external abutment wastegate flap in its seat and, in the case of the upper mechanical stop, by the inner boundary of the transmission on the housing.

The DC motor drive frequency takes place in a frequency range of 1000 Hz via the engine control unit. The length of the push bar is adjustable. A setting wastegate flap is possible after replacement of the actuator.

Transmitter position of the supercharge pressure actuator G581

The boost pressure actuator G581 position transmitter is mounted in the housing cover of the transmission of the boost pressure actuator. In the housing cover there is also a magnet holder with two permanent magnets. The magnet holder is engaged in the housing cover and is based on the transmission spring plate. It therefore carries the same movement as the push bar. When the push rod moves, the magnets are moved along the Hall sensor, which is also located in the housing cover, and the actual value of the displacement path is recorded. The movement path is supplied as a linear analog voltage signal.

Turbine housing and turbine wheel

As the turbine casing has very compact dimensions, the concept of screwing with the bolt used is a standard screw-bolt and nut. The turbine wheel is designed as Mixed Flow turbine (semi-radial turbine).

housing configuration. To achieve optimal separation of the ignition sequence, the housing is formed, unlike the second generation, in a new cast aluminum material in the compressor casing and the compressor wheel. In the housing, the turbine meet the temperature requirements of the higher exhaust gas of the order of 980 °C and point for the gas from the degassing of the crankcase and the reservoir are integrated. To the muffler pulsation, the air recirculation valve N249 turbocharger and the introduction boost pressure actuator. It is made of cast aluminum. Furthermore, the compressor wheel. The compressor casing has been enhanced due to the high actuation forces of the V465

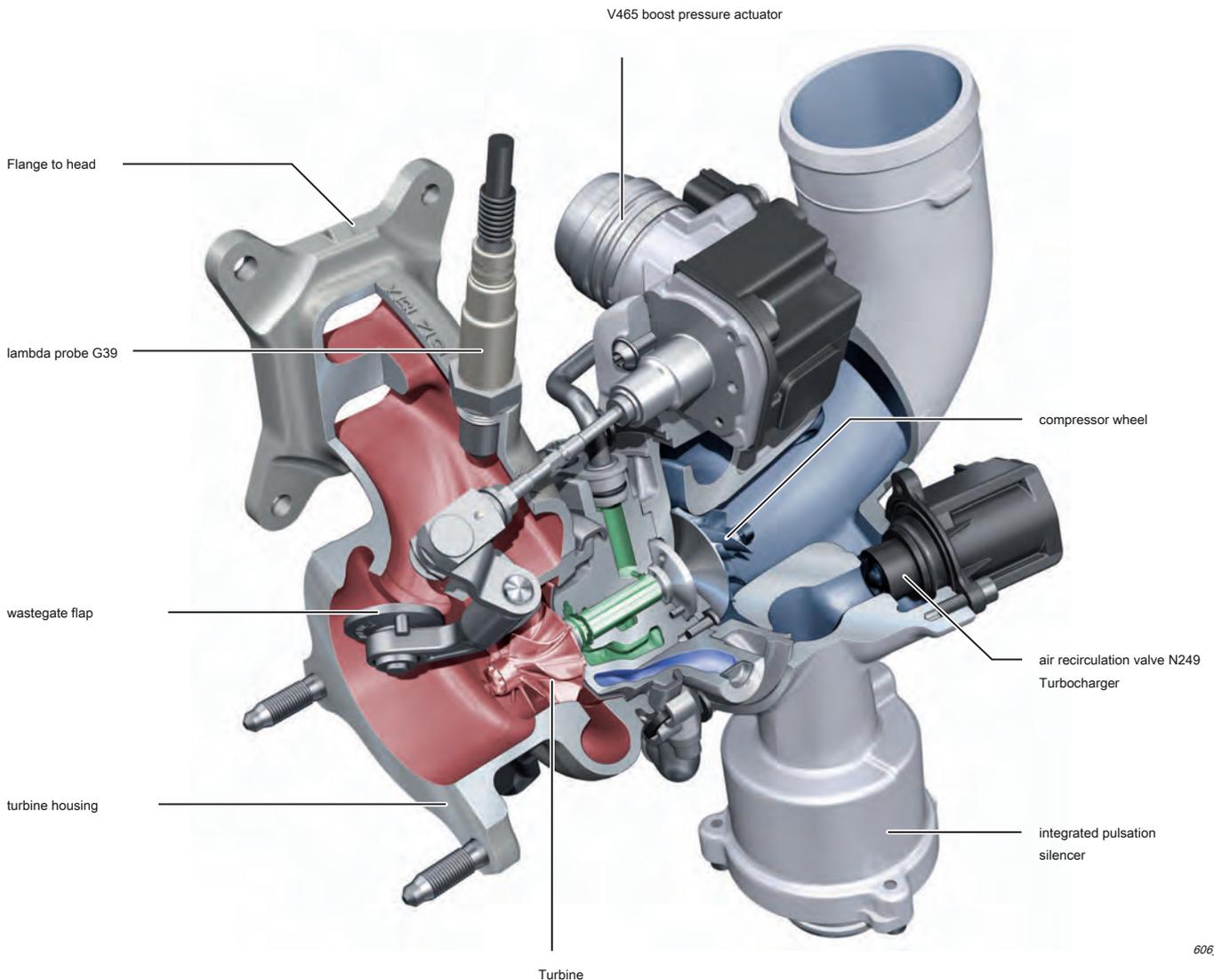
The compressor wheel is countersunk in one portion. This allows for better driving stability at all speeds and improved acoustics.

lambda probe G39

The lambda sensor (upstream of the catalyst) is positioned at a strategic point where the exhaust gases of each cylinder are pushed to the turbine housing, and temperatures are still not too high.

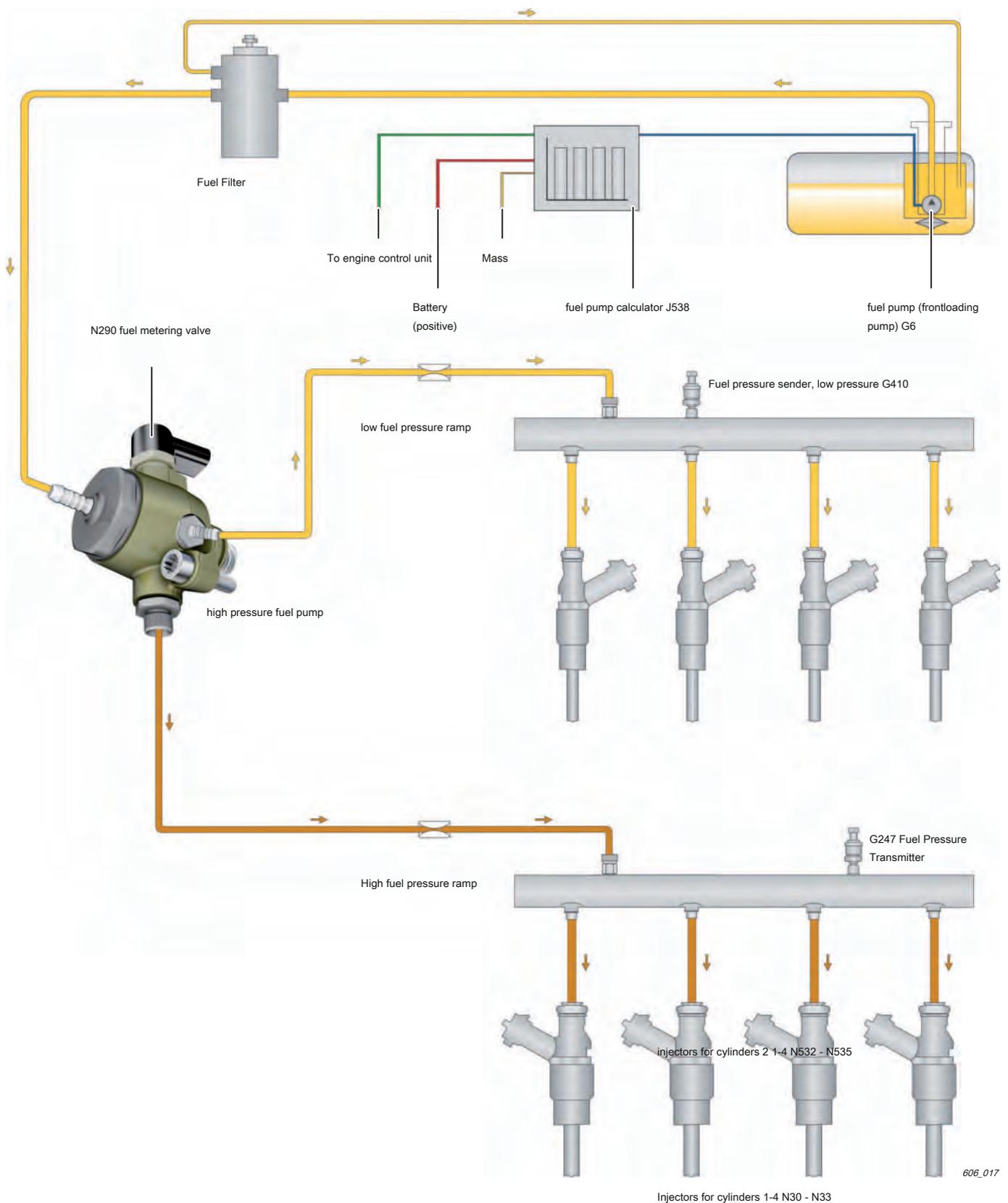
This allows a much earlier end of the dew point and thus a rapid validation of the lambda control (six seconds) after engine start and a good detection of the individual cylinders.

The lambda probe G39 is a lambda probe LSU 4.2 broadband.



fuel supply system

System overview



606_017

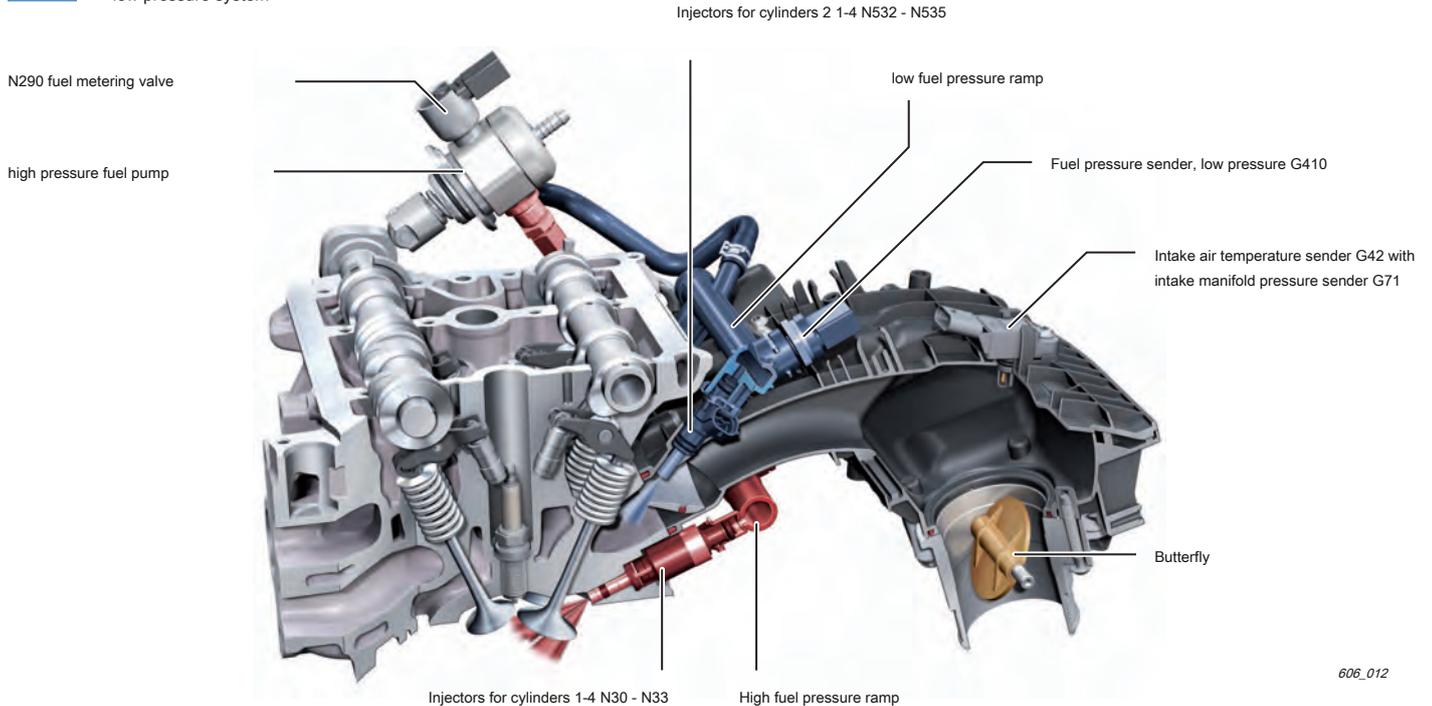
Packaging mixing / dual injection system

Critics increasingly frequent at gasoline engines with direct injection, whereby rejection of very fine soot particles is almost ten times higher than existing diesel engines has led to the development of dual injection system.

The following objectives were achieved:

- Raising the system pressure of 150 to 200 bar.
- Improved acoustics
- Achievement of limit values for Euro6 mass and amount of particles (net reduction of soot emissions, factor 10)
- Reducing emissions, including CO₂ satisfaction and compliance with current and future emission standards
- Adoption of an injection system for additional intake manifold
- Reduction in partial load consumption, the advantage held by the use of injection MPI

 high pressure system
 low pressure system



MPI injection system

The MPI system power is supplied via the scanning coupling of the high pressure pump. The high pressure pump continues to be traversed automatically by the fuel during the MPI mode and is cooled.

To reduce pulsation that the high pressure pump induced into the manifold, a throttle is integrated in the scanning coupling of the high pressure pump.

The MPI system has its own pressure sensor, fuel pressure sender, low pressure G410. The pressure supply as required is provided by the prefeed pump G6 in the fuel tank. Frontloading G6 pump is controlled by the pump calculator J538 fuel via the engine control unit. MPI ramp is made of plastic. MPI injectors (N532 - N535) are mounted in the intake manifold in plastic and optimally arranged for guidance of the jet.

high pressure injection system

For the system pressure up to 200 bar, all parts of the high pressure part have been adapted. The injectors were acoustically decoupled from the cylinder head via elastic steel washers. The high pressure common rail was also decoupled from the intake manifold is screwed to the cylinder head. The position of the high-pressure injectors is slightly recessed.

This helped to improve the homogenization of the mixture and reduce the thermal stress of the valves. For the future a concept similar regulation for all engines, it has been redesigned. The following rule of thumb applies to the concept of regulation: With the profile of the pressure regulating valve N276 Fuel disconnected, there is no establishment of pressure in the high pressure range.



return

You will find more information on the concept of regulation of the high pressure injection system in Self-Study Programme 384 "engine TFSI 4-cylinder 1.8l Audi chain drive."

Operating modes

It is routinely calculated in mapping if the engine operates in MPI or ISP mode.

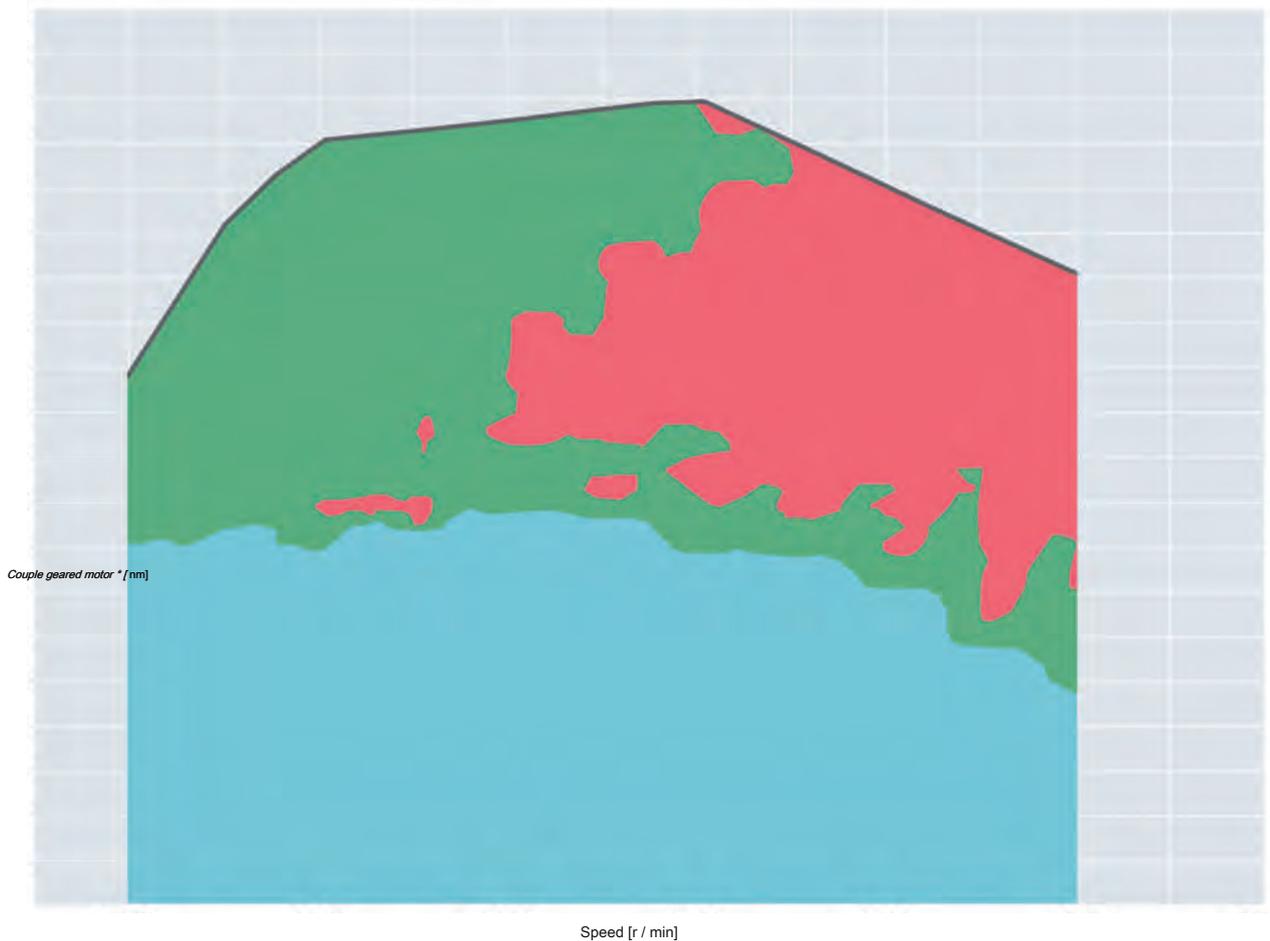
To achieve minimal soot emissions, low oil dilution and low tendency to knock, the number and type of injection (MPI or ISPs) are optimized thermodynamically. The conditioning of the mixture is modified. Here we must adapt the timing and duration of injection.

In the widest possible range of operation, the preferred lambda 1. This is also possible thanks to the implementation of the integrated exhaust manifold.

In cold engine (coolant below approx. 45 ° C and depending on the oil temperature) it is always uses direct injection. Similarly, direct injection is used for each engine start.

For the fuel in the high-pressure injectors can not coked during prolonged operation, it is used a scanning function. The ISP mode is activated briefly.

Mapping type of injection



606_061

- MPI
- Single injection FSI
(High-pressure direct injection)
- FSI injection Double
(Homogeneous strata, direct injection into the intake time and another in)

cranking

A triple injection takes place during the compression stroke.

Actuation / heating of the catalyst

Here, a double injection occurs during the intake stroke and compression. The ignition point is shifted towards the "delay". intake manifold flaps are closed.

Engine hot (> 45 ° C) partial load

Here, there commutation in MPI mode. The intake manifold flaps are closed in the partial load range, but not 1: 1 with the MPI mode (depending on the mapping parameters).

Advantage in consumption

In hot engine, an optimal homogenisation of the mixture is carried out by storage upstream of the mixture. There is a conditioning time of longer mixing. This results in a rapid combustion, optimized in terms of performance. In addition, it is not necessary to supply power for driving the high pressure pump.

higher load

Here, a double direct injection is performed. Direct injection into the intake time and another in the compression stroke.

degraded mode operation

In case of failure of one system, the other is in charge of the operation in degraded mode. This ensures that the vehicle remains operational.



Calculator J623 engine

606_089

e-media



Animation on MPI and ISP modes.

Engine management

Synoptic TFSI engine system 1.8I CJEB (Audi A5 12)

sensors

angle transmitters 1 + 2 of the throttle drive (electric throttle control) G187, G188

Clutch pedal switch for engine start switch F194 F stop lights position G185 clutch position transmitter G476 clutch pedal switch of the accelerator position sensor G79 transmitter 2 of throttle

Sensor 1 rattling G61

G410

coolant temperature sender G62

coolant temperature transmitter radiator outlet G83

Level Transmitter and oil temperature G266 engine speed sender G28

Intake manifold flap potentiometer G336 Fuel pressure sender, low pressure

intake air temperature sender G42 Intake manifold pressure sender G71

Fuel pressure transmitter G247 Hall sender G40

Boost pressure transmitter G31

sensor

pressure sensor brake booster G294

lambda probe G39

lambda sensor downstream of the catalyst G130

Oil pressure switch to control the reduced pressure F378

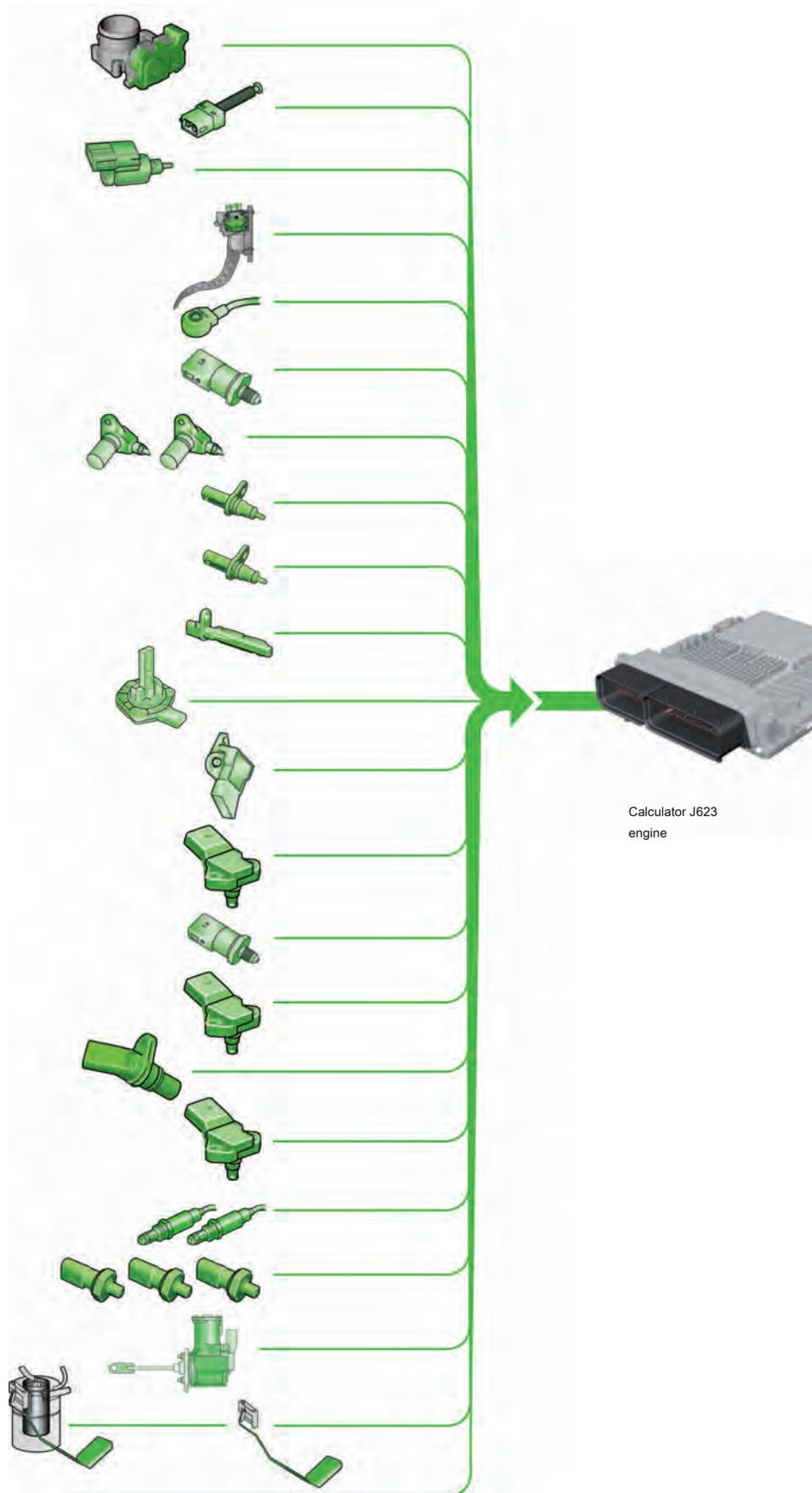
Oil pressure switch, level 3 F447 G604 ratio detection pressure switch F22 Transmitter position of the supercharge pressure actuator G581

fuel level indicator G Transmitter 2 Transmitter fuel level G169 Oil

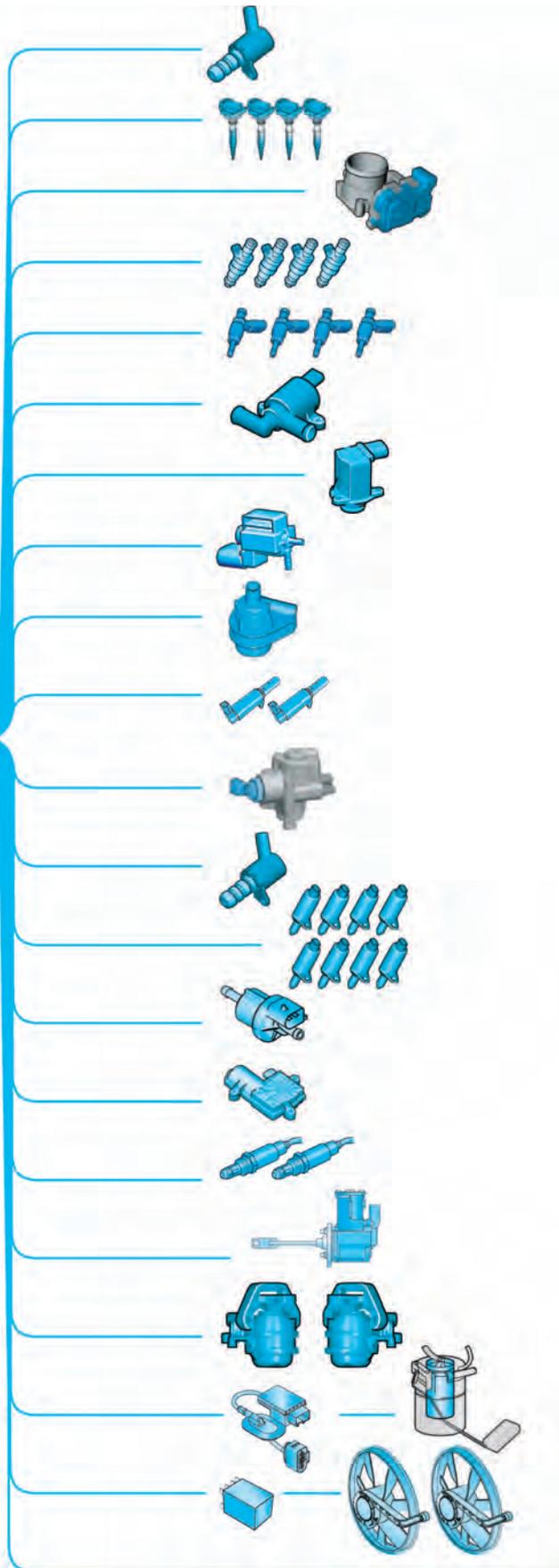
Additional signals: - Cruise control - Speed signal

- Start request to the engine controller (Keyless Start 1 and 2) - Terminal 50

- Signal collision airbag computer throttle control unit J338



Calculator J623 engine



actuators

N522 control valve for piston cooling nozzles

Injectors for cylinders 1-4 N30-N33

2 1-4 N532 - N535

circulation pump V50 Coolant

converter Z29 air recirculation valve N249 Turbocharger Injectors for cylinders
oil pressure regulating valve N428 coolant valve for gearbox N488

Actuators 1-8 of shaft variable valve timing cam F366 - F373

Solenoid 1 activated charcoal filter N80 butterfly Training (electric throttle control)

Steering Coils 1-4 with output stage N70 power, N127, N291, N292

bearing N145 engine temperature control actuator N493 fuel metering valve N290
lambda probe heater Z19 heating Lambda probe 1 downstream of catalytic
N205 Solenoid 1 variable valve in the exhaust N318

Boost pressure actuator valve V465 Intake manifold flap N316

Solenoid left electrohydraulic engine bearing N144 solenoid right electrohydraulic engine
calculator ABS / clutch position - Air conditioner compressor - starter

fuel pump calculator J538 Fuel pump (pre-feed pump) G6 1 Solenoid variable valve

radiator fan calculator J293 Radiator fan V7 Radiator Fan
2 V177

Additional signals: - Calculator automatic gearbox / engine speed -

Differentiation Engine Versions

Differences between 1.8 l / 2.0 l and between longitudinal and transverse position

Depending on the engine (1.8 l and 2.0 l) and position, longitudinal or transverse, the engines have differences in power classes, components and the combustion process.

These differences are presented in the following pages.

Overview of power classes

	longitudinal position	transverse position
Power Class 1	12 Audi A4, Audi A5 12 1.8 l 125 kilowatts, 320 Nm	Audi A3 13 1.8 l 132 kilowatts, 280 Nm
power class 2	Audi Q5 13 2.0 l 165 kilowatts, 350 Nm	
power class 3		Audi A3 13 2.0 l 221 kilowatts, 380 Nm

Overview of different pieces

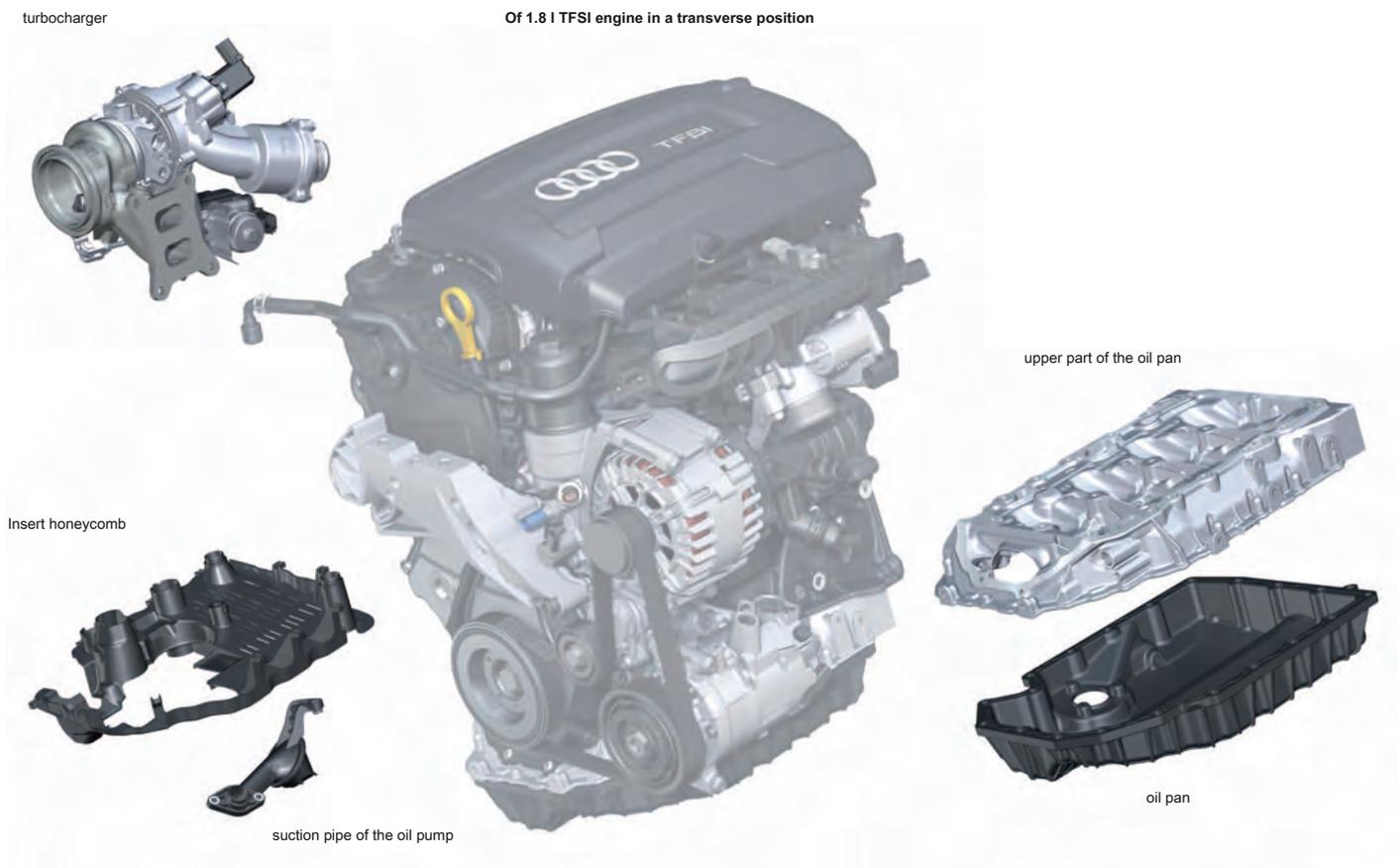
	longitudinal position	transverse position
Power Class 1		
power class 2		
power class 3		

Differences between the components longitudinal and transverse position

The following components have been adapted:

- upper part of the oil pan
- Insert honeycomb
- suction pipe of the oil pump
- oil pan
- turbocharger

The components top and bottom of the oil pan, honeycomb insert and suction of the oil pump has been modified to keep the same oil capacity (5.4 l) and answer the operating criteria required of the oil circuit, such as oil pressure, oil foaming, transverse and longitudinal dynamics, driving uphill and downhill.



606_071

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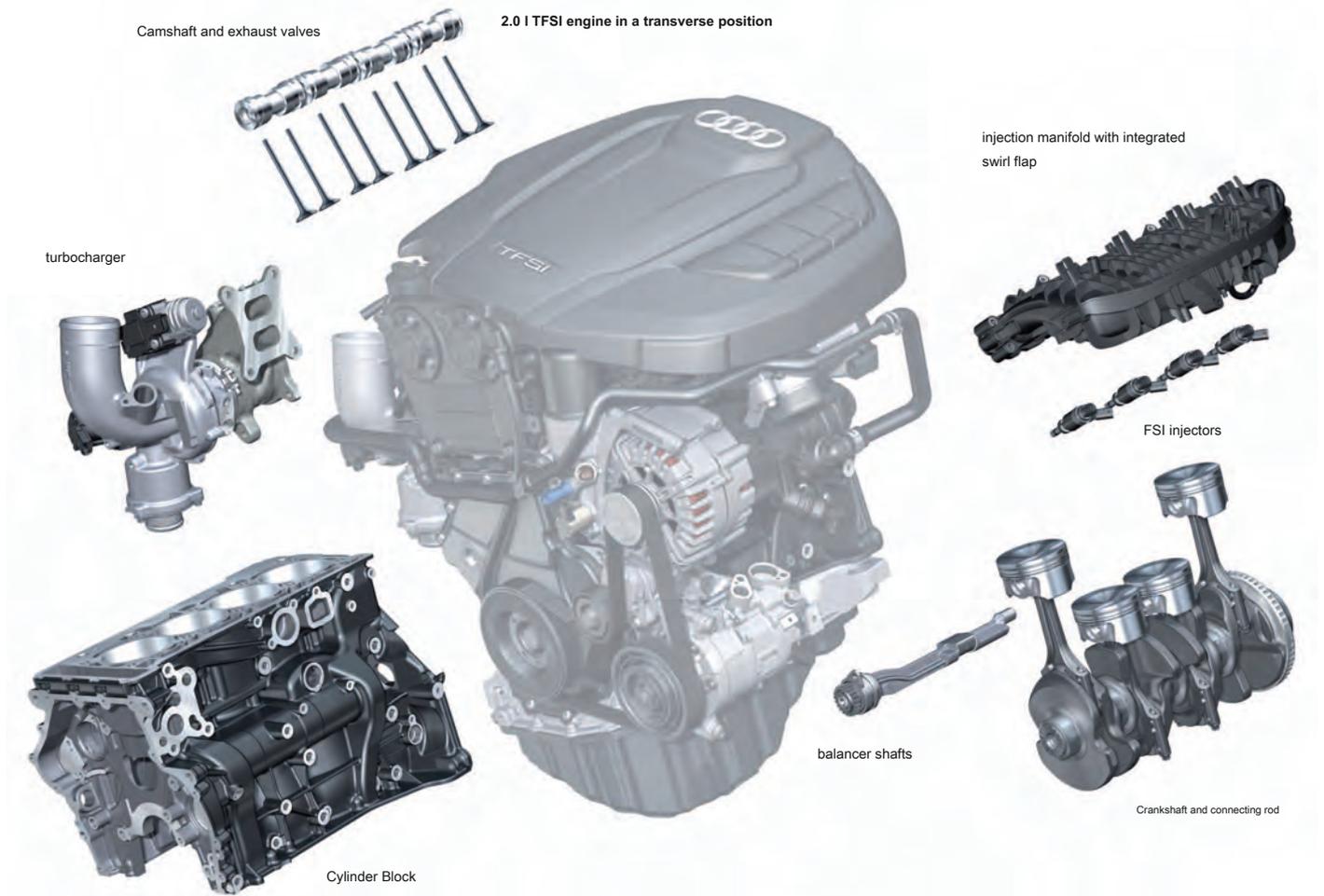


Animation on the differences between longitudinal and transverse position, taking for example the TFSI engine 1,8l.

Differences between the components displacement of 1.8 l and 2.0 l

different parts:

- Cylinder Block (crankshaft bearing diameter 52 mm)
- Crankshaft (92.8 mm stroke crankshaft bearing diameter 52 mm, eight counterweights)
- Rod with suitable caliber
- crankshaft bearing (52 mm, using a two-material bearing throughout the modular platform)
- balancer shafts
- Exhaust camshaft (10 mm valve lift, timing of distribution adapted)
- exhaust valves (hollow, bimetal)
- High-pressure injectors (increased speed)
- intake manifold with integrated swirl flap (Drumble pane)
- Turbocharger



606_072

e-media



Animation on the differences between the displacements of 1.8 liters and 2.0 liters, taking for example the engine longitudinally mounted.

components on the Audi S3 13

The following components have been adapted:

- Cylinder head with another alloy than other engines of this group, due to the higher thermal stress
- exhaust valves (hollow Ni content higher, nitrided)
- Rings exhaust valve seat (temperature resistance and improved wear)
- Exhaust camshaft (setting of the appropriate distribution)
- Compression ratio 9.3: 1
- piston cooling nozzles (increased speed)
- High-pressure injectors (further increased speed)
- Turbocharger
- boost pressure up to 1.2 bar
- main water radiator high performance with 1 to 2 additional water heaters (depending on national version)
- Additional acoustic measurements for a sporty sound with a sound actuator (for the passenger) and components of exhaust gases in the exhaust system

e-media



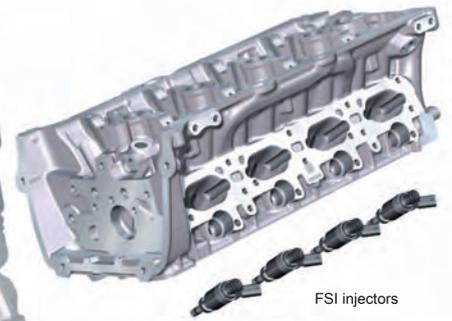
Animation on the Audi S3 13.

2.0l TFSI engine from the Audi S3 13

camshaft and exhaust valve seat rings



turbocharger



FSJ injectors



piston cooling nozzles Piston Cylinder

606_073

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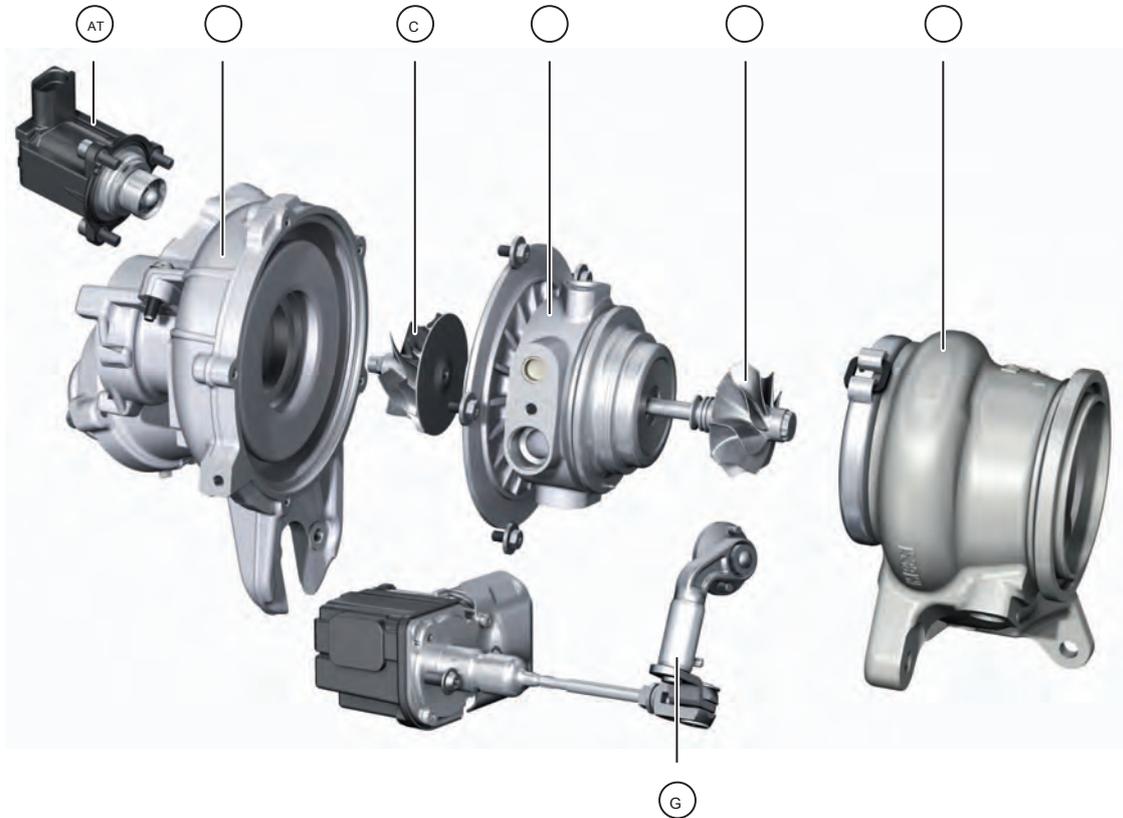


Animation on the modified engine components from the Audi S3 13.

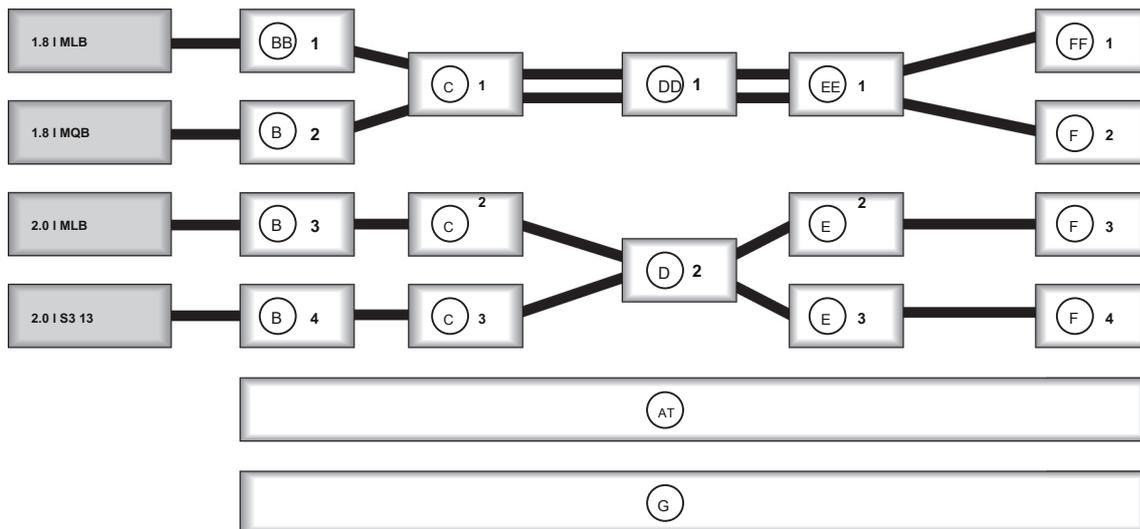
Differences in turbochargers

For the Audi S3 13 of the compressor wheel and even higher turbine are used and the housing components have been adapted accordingly. To achieve high mass flow of exhaust gas S3 13, is made use of more sophisticated materials for the turbine housing as well as the turbine wheel.

One of the features of the turbocharger 13 is Audi S3 technology "abradeable seal" (ICSI GmbH) in the compressor. A plastic insert is autorodant ensures a considerably small gap between the impeller and the compressor casing. This increases the compressor output level until additional 2%.



606_074



606_078

legend:

- (AT) air bypass valve during deceleration
- (B) Compressor housing
- (C) compressor wheel
- (D) bearings
- (E) Turbine
- (F) turbine housing
- (G) wastegate system

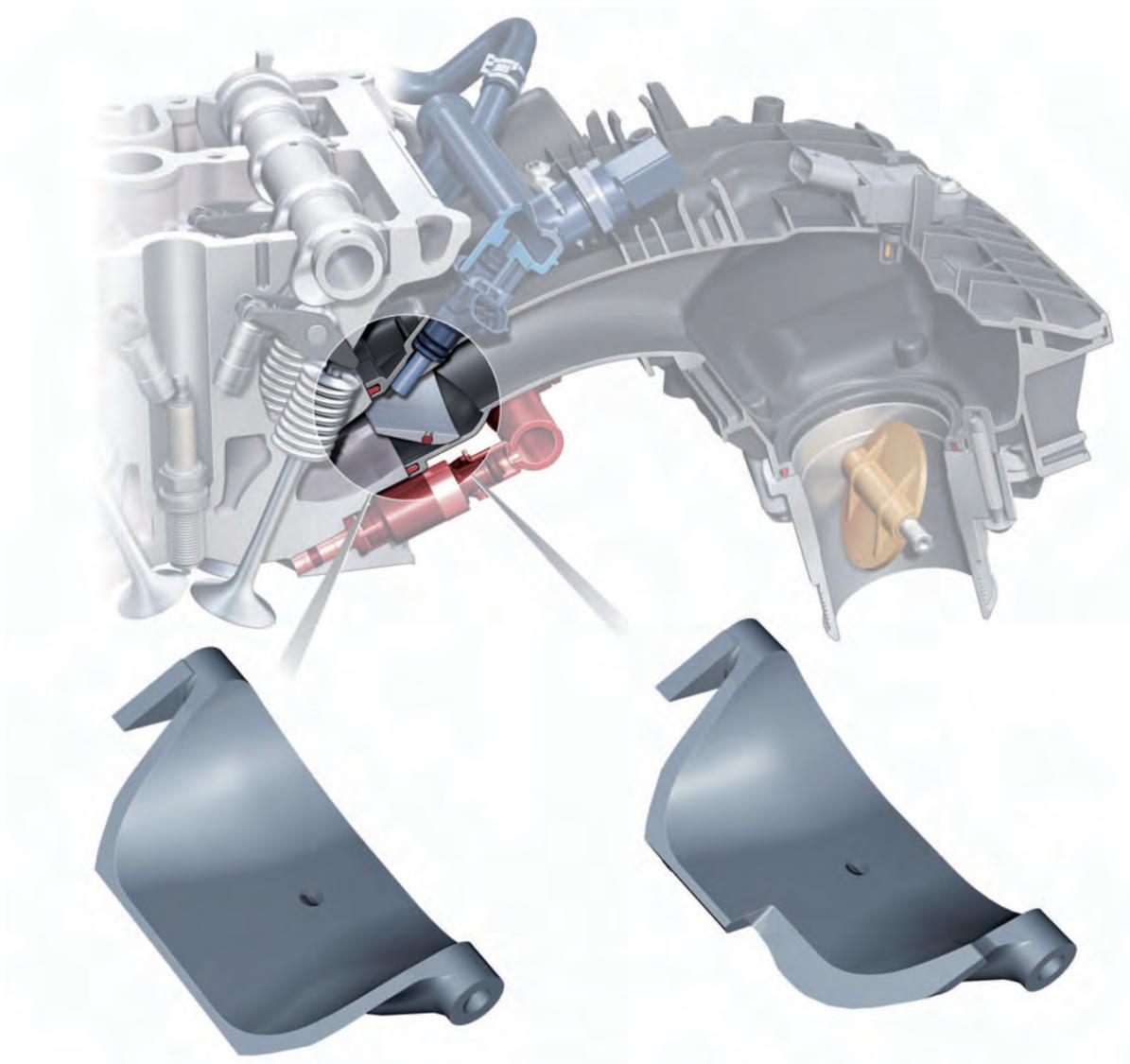
combustion process differences

	1.8 l	2.0 l	2.0 l S3 13
Flow rate of the high pressure injector	15 cm ³ /s	17.5 cm ³ /s	20 cm ³ /s
MPI injector	same room	same room	same room
inlet channels	Canal Tumble	Canal Tumble	Canal Tumble
flap system	Tumble	Drumble	Drumble
Compression ratio	9.6: 1	9.6: 1	9.3: 1
A timing variator shaft intake cam	Yes	Yes	Yes
A timing variator shaft exhaust camshaft	Yes	Yes	Yes
Exhaust - Audi valvelift system (AVS)	Yes	Yes	Yes
integrated exhaust manifold	Yes	Yes	Yes

Drumble flap

The level of movement of the load with closed intake pipe differs depending on the displacement (1.8 l compared to 2.0 l). To obtain an equivalent result we should also use different intake manifolds for different cars. To avoid this, it uses different swirl flaps.

Therefore TFSI engines 2.0l feature Drumble shutters. In the case of this design, there is asymmetrical closure Tumble channel. This results in an overlap of the charge movement "Drall" (turbulent), and "Tumble" (drum).



Tumble flap with 1.8l TFSI engine

Component Drumble TFSI engine with 2.0 l

Annex

Service

Special tools / workshop facilities

T10133 / 16 A Removal Tool



606_048

Dismantling of high-pressure injectors
Special tool T10133 / 16 A replaces the old removal tool T10133 / 16.

(Equipment Group: A1)

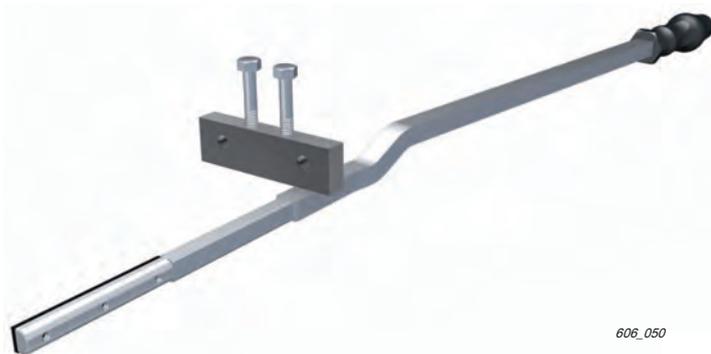
T10133 / 18 Sleeve



606_049

Dismantling of high pressure injectors (Equipment Group: A1)

T40243 lever



606_050

To set up the crankshaft tensioner (Equipment Group: A1)

T40267 wedging tool



606_051

Lock the tensioner (Equipment Group: A1)

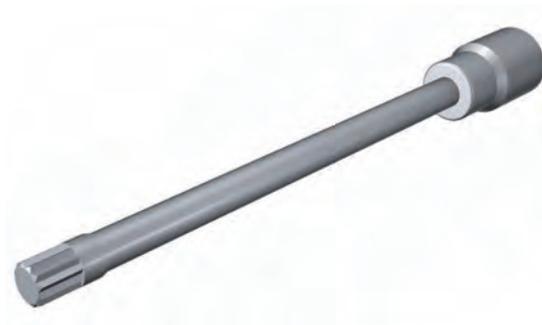
T40274 extraction Hook



606_054

Removing the crankshaft attached ring (Equipment Group: A1)

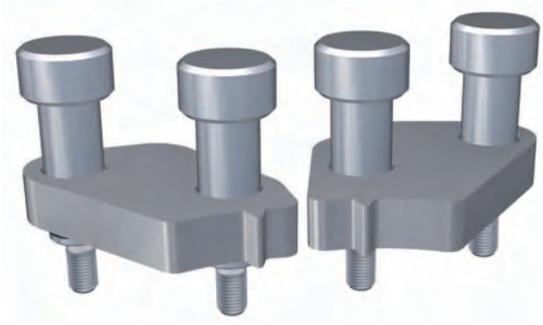
T40270 Socket XZN 12



606_052

Removing and installing mechanical bearing assembly (Equipment Group: A1)

Fixing T40271



606_053

sprockets attachment (Equipment Group: A1)

T40290 adjustment template



606_081

wastegate flap fixation during adjustment work of the turbocharger boost pressure actuator. (Equipment Group: A1)

maintenance using the example of the 1.8l TFSI engine in the Audi A5 12 (motor letters benchmark CJEB)

intermediary service intervals with LongLife Service	max. 30,000 km / 2 years as the maintenance display engine oil specification VW 504 00
intermediary service interval without LongLife Service	every 15 000 km / after 1 year (whichever comes first) engine oil specification VW 504 00 or 502 00
Changing the oil filter	at each intermediate maintenance
drain capacity of the engine oil	4.7 liters (with filter)
Suction / discharge of engine oil	Both are possible
Scale values of the electronic indicator controller oil level (when removing the dipstick)	Set for the adjusting ring (upper scale value): 32 set for the range of oil level min. max. (Lower scale value): 0-27
Replacing the air filter	90 000 km / 6 years
Sparkplugs	90 000 km / 6 years
Fuel Filter	for life
Distribution Chain	for life
Tensioner system of the distribution chain	for life
multitrack belt	for life
System multitrack belt tensioner	for life
toothed belt coolant pump	for life



Note

The indications of Service news documentation always apply.

Glossary

indexed engine torque

indexed engine torque called torque than the combustion engine could deliver if it were free of losses.

DLC

Diamond like carbon, this is an amorphous carbon, resembling the diamond. These layers are characterized by very high levels of hardness and very low dry friction coefficients. They are recognizable by their shiny dark gray surface.

downspeeding

generally referred to by "downspeeding" the reduction in engine speed by changing the gear box total. A gear optimized propulsion eating plan allows for consumption improvements comparable to those obtained by engine downsizing. Due to the level of power and average pressure higher supercharged engines, it is possible to achieve an operating point shift towards lower and higher loads regimes. This means that the motor can operate in a more favorable mapping range for consumption. downspeeding concepts are generally linked to a concept of downsizing, this combination is particularly suitable for gasoline engines with direct injection and turbocharging.

Inconel

Inconel is a trademark of the Special Metals Corporation, designating a series of alloys corrosion-resistant nickel. They are mainly used for high temperature applications

Mixed Flow Turbine (semi-radial turbine)

A "Mixed Flow" turbine is an intermediate solution between radial and axial turbine turbine. The radial turbine wheel is driven radially (inlet edge parallel to the axis of rotation). It is therefore well suited for small flow rates, as in the case of the VL. The attack of the axial turbine wheel has for its location in the axial direction (direction of 90 ° from the inlet edge relative to the axis of rotation) and more suitable for high flow rates for large engines for example.

Mixed Flow turbine exhibit oblique inlet edge. As there is added an axial rotor element, ideal for high flow rates, it is also possible to use a smaller rotor. The advantage of the best behavior in the radial turbine combined response to the advantage of the better performance of the axial rotor element in the upper rev range.

Mono-Scroll

Mono-scroll turbines have only a rotary input that sends exhaust gas to the rotor. Their architecture is simpler than that of twin-scroll turbines, they are lighter and cost less.

The twin-scroll turbines have two rotary inputs arranged in parallel. The flow of exhaust gas cylinders connected to the turbine rotor is entirely dissociated. The mode of operation is better, because the gas pulses are completely separated and so have no disturbing influences.

PCV

The abbreviation stands for "positive crankcase ventilation," which means crankcase gases.

In the case of this system, fresh air is mixed with the blowby gas in the crankcase. Fuel vapor and water contained in the blowby gas are absorbed by the fresh air and evacuated by the outgassing of the crankcase.

SENT

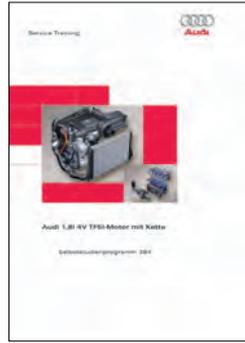
SENT data protocol (Single Edge Nibble Transmission), in combination with suitable sensors, the switch from analog interfaces and digital data transmission.

self-study programs (SSP)

You will find more information on the line of EA888 engines in the following self-study programs.



606_088



606_084



606_085

Progr. autodidact. 255

Engines 4-cylinder in line 2.0 liter V6 and 3.0-liter, Reference: 040.2810.74.40

Progr. autodidact. 384

Audi 1.8l TFSI engine of 4 valves per cylinder, with chain drive, Reference: A06.5S00.29.40

Progr. autodidact. 411

FSI engines of 2.8L and 3.2L Audi with Audi valvelift system Reference: A07.5S00.42.40



606_086



606_087

Progr. autodidact. 436

Changes to the engine TFSI 4 chain drive cylinders, Reference: A08.5S00.52.40

Progr. autodidact. 616

TFSI engines 1,2l and 1,4l of Audi EA211 online Reference: A12.5S01.00.40

Information on QR codes

This self-study program was endowed with electronic media (animations, video and mini-WBTs) which illustrate the content. References to electronic media hide behind QR codes are barcodes in two dimensions formed by a set of small black squares on white background. You can scan these codes with a tablet or smartphone to get an Internet address. An Internet connection is required.

Please install on your mobile device QR scanner suitable selected from the public App Stores Apple® or Google®. For some media, other readers may possibly be required.

On PCs and notebooks, it is possible to click on the e-media in the PDF version of the self-study program and call them online - after connection GTO.

All e-media are managed on the didactic platform Group Training Online (GTO). You require GTO to a user account and must, after scanning the QR code and before the first media call, connect to GTO. On the iPhone, iPad and many Android devices, you can store your access data in the mobile browser. This facilitates the next connection. Protect your phone from unauthorized use by a PIN.

Remember that use of electronic media via wireless phone networks can generate substantial costs, especially in the case of data roaming abroad. You are personally responsible. The ideal is to use wifi.

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AUDI AG

I / VK-35

service.training@audi.de

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