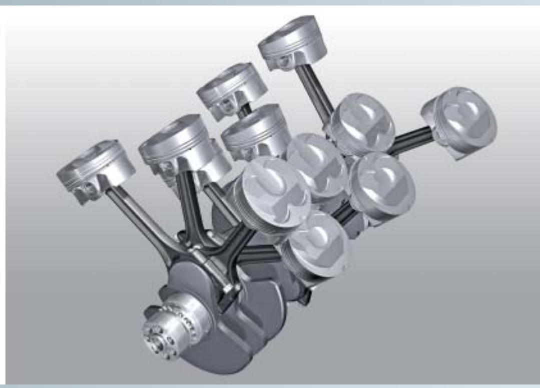
Self Study Programme 490



Audi
6.3l W12 FSI engine

Audi
Service Training

A twelve cylinder is the pinnacle of engine design, and traditionally a hallmark of luxury class cars in particular. The first-generation A8 was available with an engine of this type from 2001 onwards, and a more advanced version could be obtained from 2004 onwards in the following model series.
Audi's engineers have now thoroughly revised the W12, increasing its displacement to 6.3 litres and equipping it with petrol direct injection for higher power and efficiency.

The 6.3l W12 FSI engine gives the long-wheelbase Audi A8 ’10 sportscar-like performance: it sprints from zero to 100 kph in just 4.9 seconds; the electronically governed top speed of 250 kph is a mere formality.

The engine runs exceptionally smoothly, and only at high engine loads and speeds do the car's occupants sense any of this supreme power at work.

For use in the long-wheelbase A8 ’10, Audi's engineers have converted the W12 engine to FSI petrol direct injection. This involved extensive modification of the cylinder heads.

The high fuel economy of the 6.3l W12 FSI engine compared with its competitors is mainly a result of technologies from Audi's modular efficiency platform – which is used throughout the A8 model line.

490_002

Learning objectives of this Self Study Programme:

In this Self Study Programme you will learn about the technology of the 6.3l W12 FSI engine.
When you have worked your way through this Self Study Programme, you will be able to answer the following questions:

- Which adaptations have been made for the use of petrol direct injection?
- How does the crankcase breather work?
- How is the oil circuit designed?
- What are the special features of the fuel system?
- What modifications have been made to the engine management system?
- What are the points to note when servicing the vehicle?

Contents

- The Self Study Programme teaches a basic knowledge of the design and functions 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.

For maintenance and repair work, always refer to the current technical literature.

Terms written in italics or indicated by an asterisk are explained in the glossary at the back of this Self Study Programme.

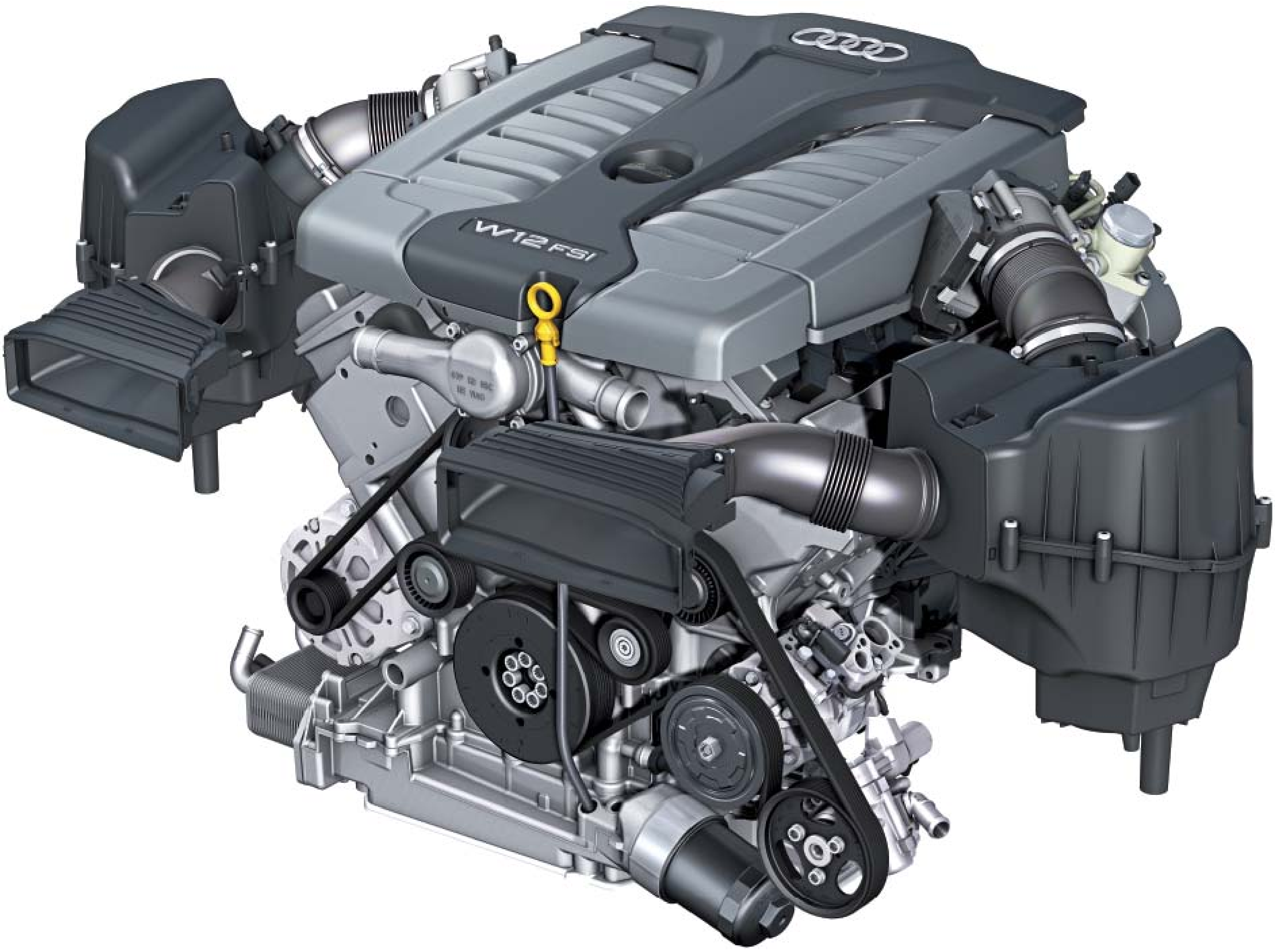
Note

Reference

Introduction

Brief technical description

- Twelve-cylinder petrol engine with four rows of three cylinders arranged in a W configuration
- More compact dimensions than a comparable V8 engine
  - Length / width / height: approx. 50 cm / 70 cm / 70 cm
- Two cylinder heads with four valves per cylinder and two camshafts per bank including hydraulic camshaft adjusters
- The engine is controlled by a multi-element chain drive (optimised for low friction)
- FSI petrol direct injection with twin high-pressure fuel pumps, twin fuel rails and six-port high-pressure injectors
- *Recuperation system** for energy recovery during deceleration phases



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Reference
For further information about the basic design of the W12 engine, refer to Self Study Programmes 267 "The Audi 6.0l W12 engine in the Audi A8 – Part 1" and 268 "The Audi 6.0l W12 engine in the Audi A8 – Part 2".

Specifications

Torque/power curves

6.3l W12 FSI engine

Power in kW

Torque in Nm

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Engine code	CEJA
Type	Twelve-cylinder W type engine with a V angle of 15° and a bank angle of 72°
Displacement in cm^3	6299
Stroke in mm	90,4
Bore in mm	86,0
Number of valves per cylinder	4
Firing order	1-7-5-11-3-9-6-12-2-8-4-10
Compression ratio	11,8 : 1
Power output in kW at rpm	368 at 6200
Torque in Nm at rpm	625 at 4750
Fuel	Sulphur free premium unleaded to DIN EN 228 / 95 RON[1)]
Mixture formation	FSI direct injection, with 130 bar max. system pressure and six-port injectors
Engine weight in kg	247
Engine management	Bosch MED 17.1.6
Emissions standard	EU5 / ULEV II
CO_2 emission in g/km	290
Exhaust gas aftertreatment	Four air-gap insulated manifold CAT modules, each with a close-coupled ceramic catalytic converter and twin oxygen sensors
Vehicle use	A8 L

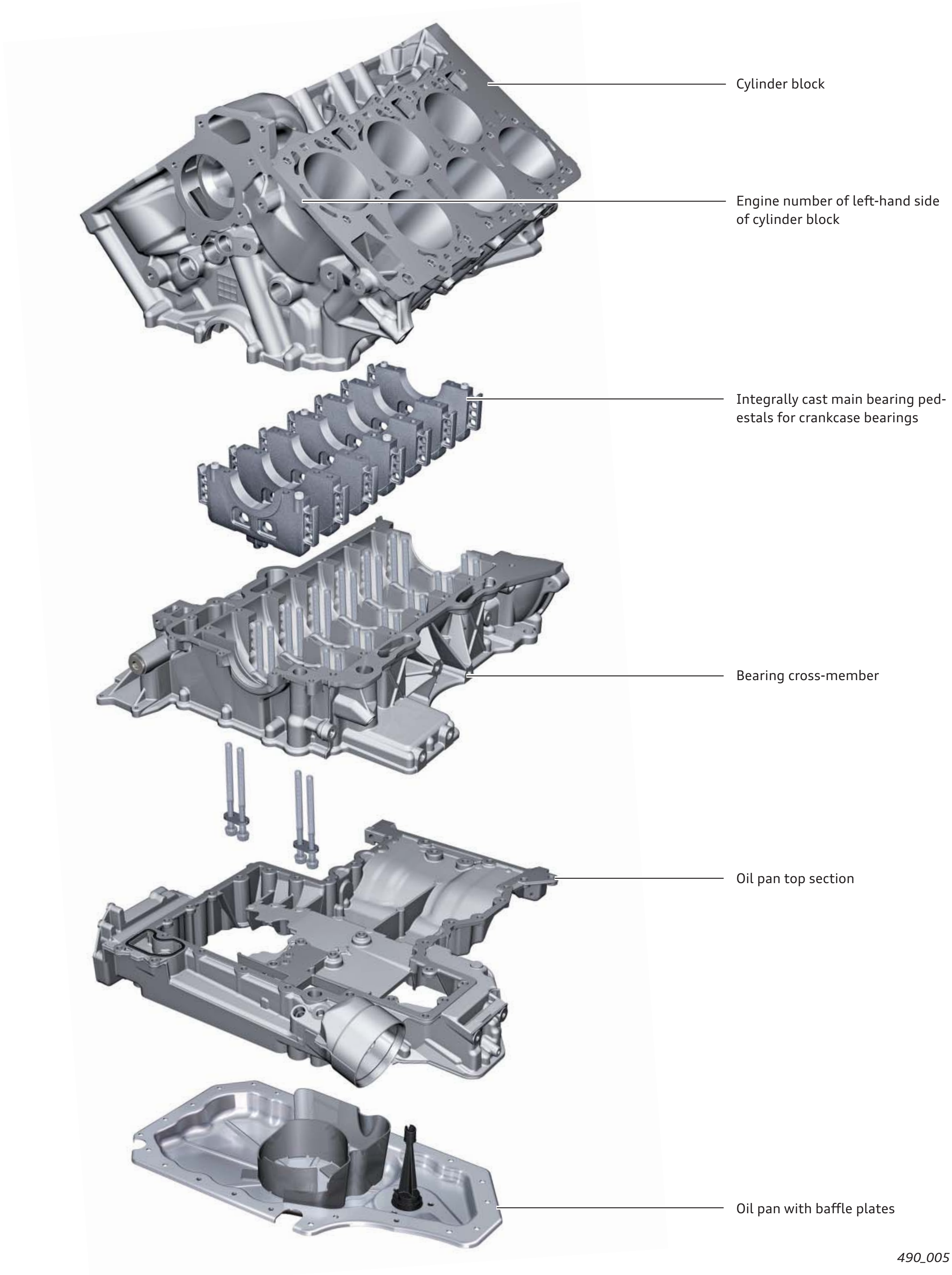
[1)] Unleaded regular 91 RON petrol can also be used, with slight loss of power.

Engine mechanicals

Cylinder block

Compared with the 6.0l W12 engine, the engineers have enlarged the cylinder bore from 84 to 86 millimetres.

The cylinder block is cast from a lightweight, high-strength aluminum-silicon alloy. The bottom section comprises a cast iron cross-member with embedded main bearing pedestals.



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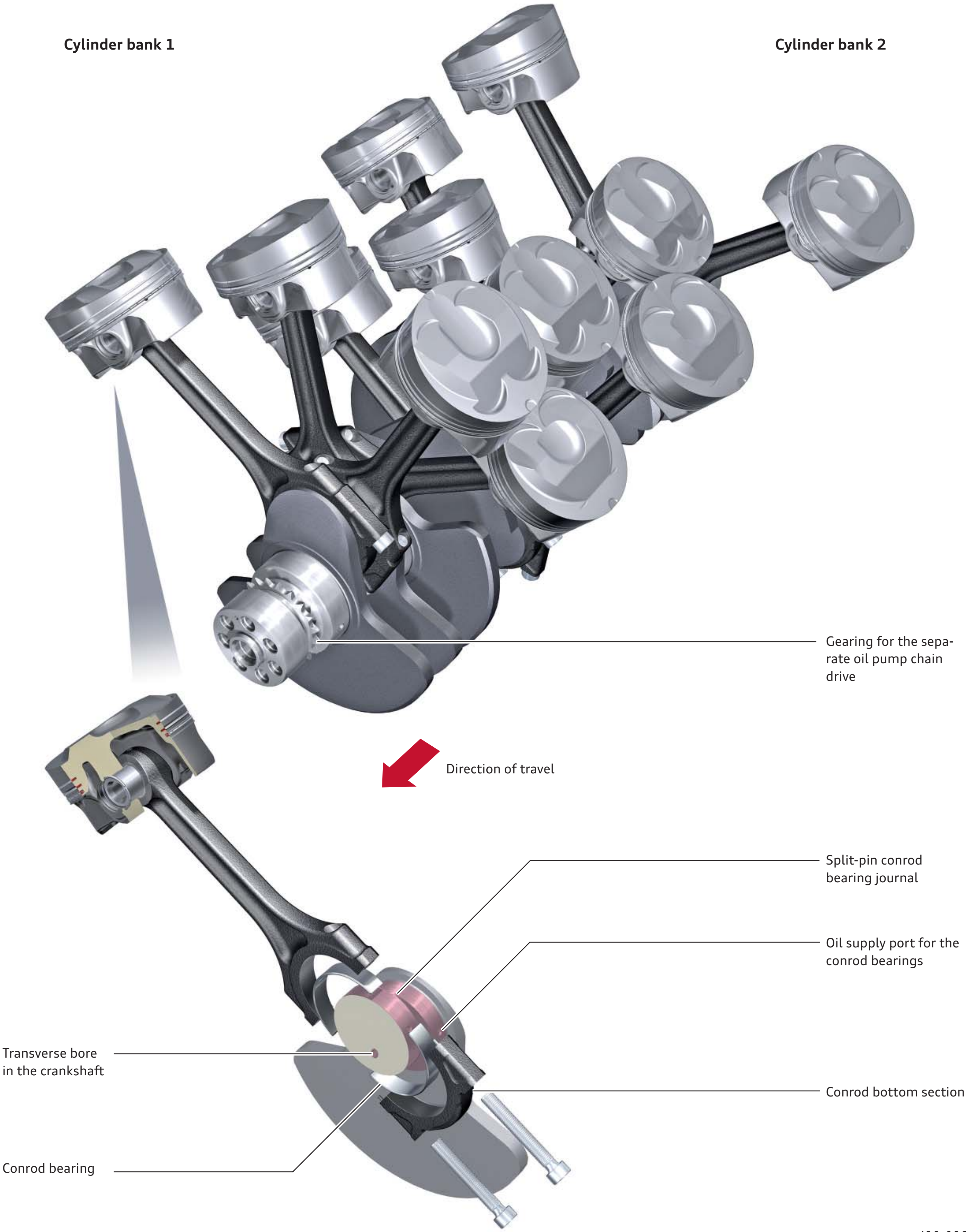
Crank mechanism

The forged crankshaft has a 12-degree angle of crankpin offset, so that the air-fuel mixture in all 12 cylinders is ignited at the ideal interval of 60 degrees.



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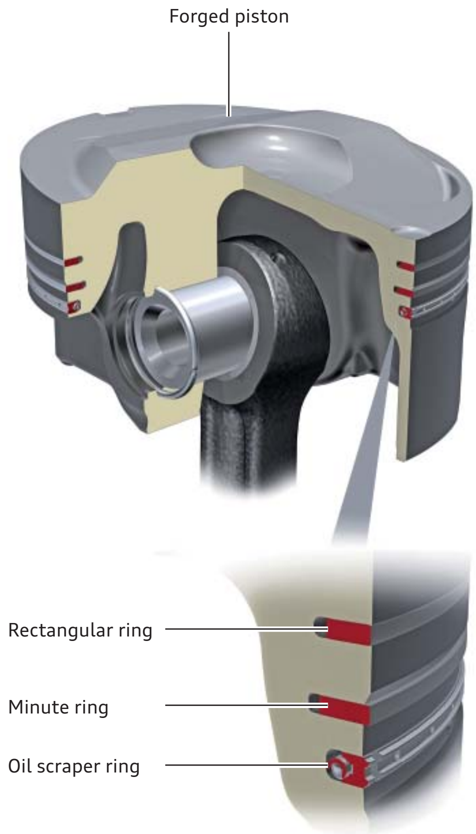
Pistons and conrods

The pistons are forged from a high-strength light alloy and have angled crowns to compensate for the cylinder bank angle. The shape of the piston crowns has been adapted for the use of FSI petrol direct injection.
The design of the W12 engine necessitated the use of different high-pressure injectors with different placement angles in the cylinder head (see "Fuel system" on page 26). For this reason, the "outer" cylinders (1, 3, 5, 8, 10 and 12) have different pistons to the "inner" cylinders (2, 4, 6, 7, 9 and 11).



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Design

Pistons of cylinders 2, 4, 6, 7, 9 and 11

490_007

Pistons of cylinders 1, 3, 5, 8, 10 and 12

490_008

Conrods

Extra-narrow trapezoidal conrods are used.

490_009

Chain drive

The timing gear is located on the gearbox side of the engine. It is subdivided into primary and secondary drives.

All components of the chain drive are designed to last the lifetime of the engine (300,000 km). No provision has been made for adjustment by service personnel

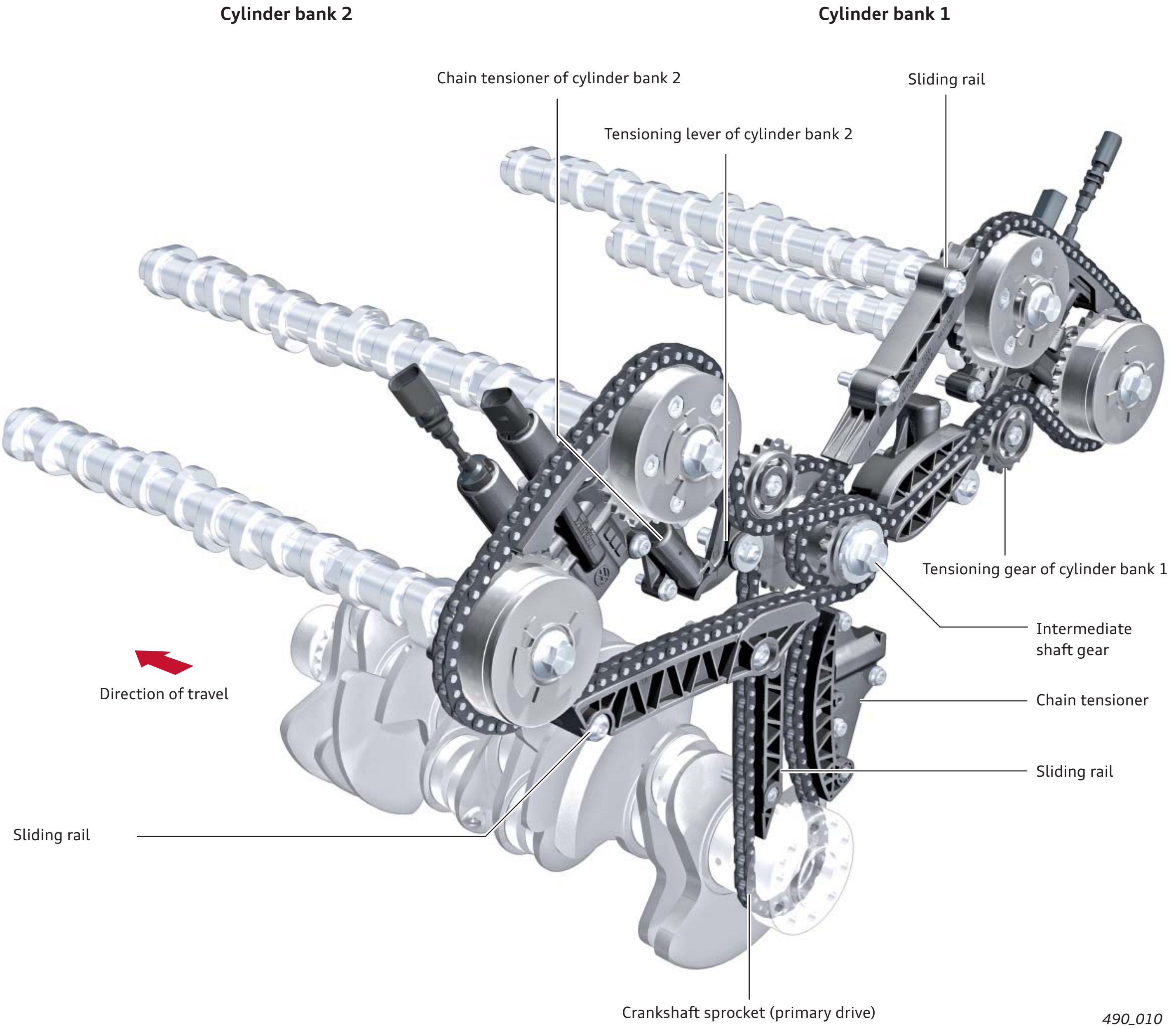
Primary drive

The primary drive is driven by a sprocket on the crankshaft. A simplex roller chain drives an intermediate gear. The intermediate gear provides speed reduction and drives the secondary drives.

The chain is guided by means of a sliding rail. Chain tensioning is provided by a spring-loaded chain tensioner, which is assisted and damped by engine oil from the oil circuit.

Secondary drives

The two secondary drives are driven by the intermediate gear. The two camshafts are driven by a single chain per cylinder bank. Bush chains are used. In this case too, the chains are guided by sliding rails. The chain tensioners work on the same principle as in the primary drive. In this case, however, the tensioning force of the chain tensioner does not act on the tensioning rail, rather on a rotatably mounted tensioning lever. At the end of the tensioning lever, a sprocket running on ball bearings engages the secondary chain. The chains of the secondary drives have to be removed in order to take off the cylinder heads.



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Crankcase breather

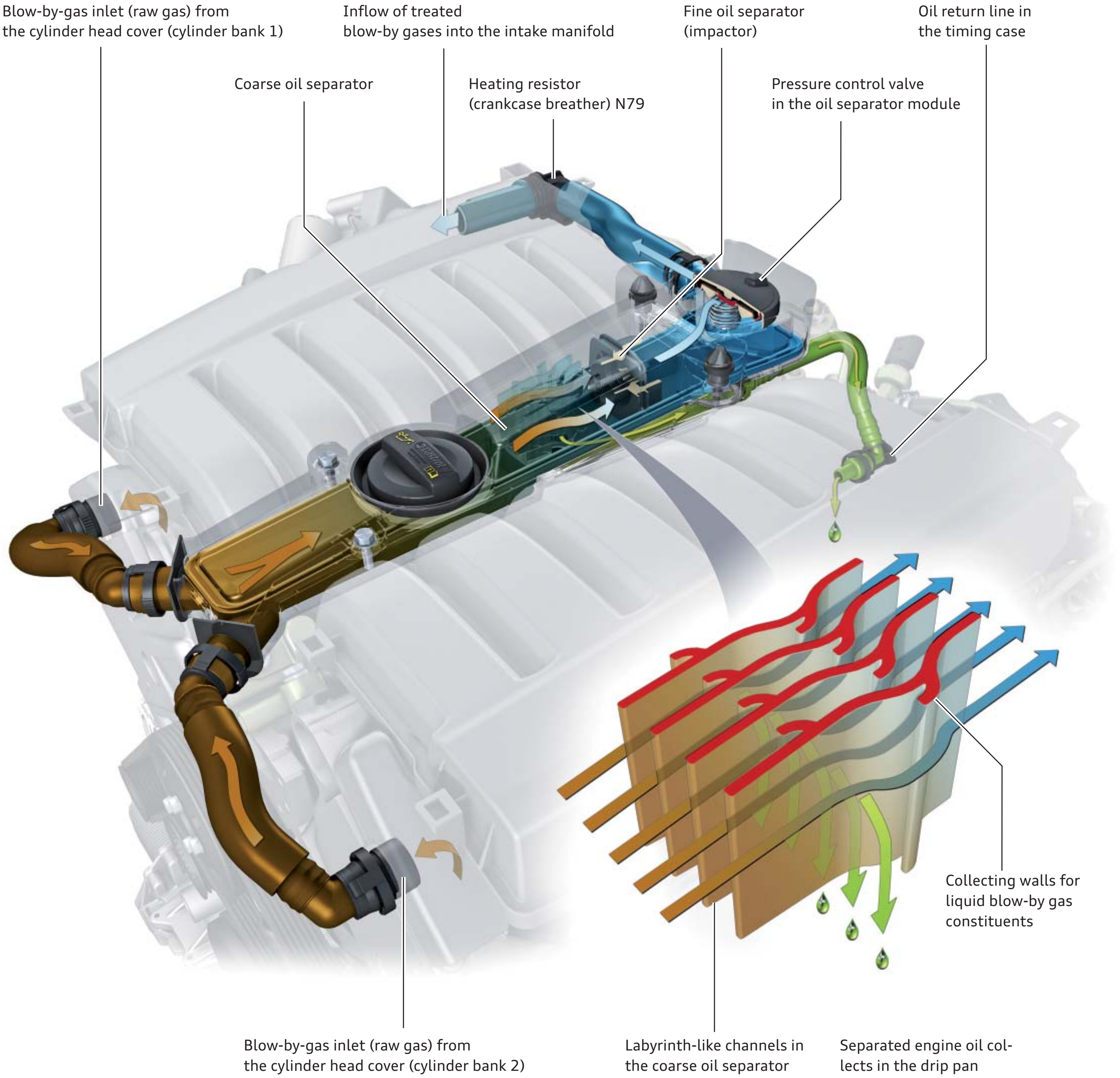
*Blow-by gases** are introduced directly into the cylinder heads. For this purpose, vent lines are connected directly to the cylinder head covers on the belt side of the engine. The blow-by gases flow through these vent lines into the oil separator module of the crankcase breather which is located at the top end of the engine between the two intake modules.

The port with cover for filling the engine oil is located on the oil separator module. The filled engine oil flows through the vent lines into the engine.
The blow-by gases are channelled through the coarse oil separator in the oil separator module. The coarse oil separator comprises multiple labyrinth-like channels with collecting walls which retain most of the oil droplets due to their inertia.

The separated engine oil drips from the walls and is collected in a pan in the oil separator module. From here, the oil runs along a return line and drains into the timing case at the back of the engine.
The pre-treated blow-by gases then flow through a fine oil separator, continuing through the pressure control valve.

The blow-by gases are introduced directly into the intake manifold of cylinder bank 1 through a plastic pipe connected to the intake manifold of cylinder bank 1. If the vacuum inside the intake manifold is too high, the pressure control valve in the oil separator module closes. This prevents an excessively high vacuum from building up inside the crankcase and damaging the crankshaft oil seals.

Design and operation



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Fine oil separation

After the blow-by gases have passed the coarse oil separator, they flow through a fine oil separator.

In terms of its working principle, the fine oil separator is a so-called *impactor**.

Functional principle

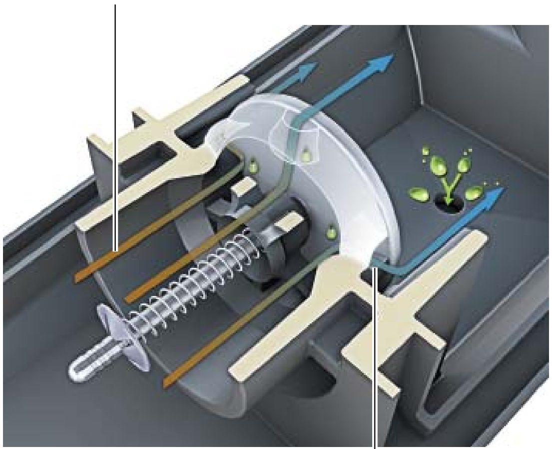
The functional principle is the same as that of an inertial separator. The blow-by gas flow is deflected "sharply", which means that the oil droplets cannot follow the air flow due to their higher mass inertia. They collide with the housing wall and, as a result, are separated. This effect is intensified in the impactor, where the mass flow is directed through nozzles.

The flow is accelerated inside the nozzle and deflected 90° straight after leaving the nozzle. Even very small oil droplets (< 1 µm) have little chance of following the air flow and collide with the wall.

A valve opens a gap acting as a bypass to the nozzles at high blow-by gas flow rates. This allows the nozzles to be designed for lower volumetric flow rates, which in turn results in higher separation efficiency.

The opening gap on the overflow valve acts like a nozzle, speeding up the gas flow. Thus, a constantly high level of separation efficiency is maintained even when the overflow valve is open.

Low blow-by gas flow rate



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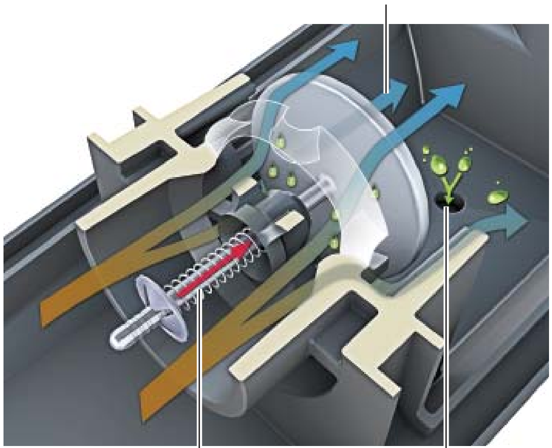
High blow-by gas flow rate



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Oil return to timing case

No internal crankcase pressure must ever be allowed into the oil separator module via the oil return line. This is prevented by a syphon downstream of the port in the timing case cover.
In this way, the oil return inlet is always below the oil level in the oil collection chamber, with the result that no exchange of gases can take place.

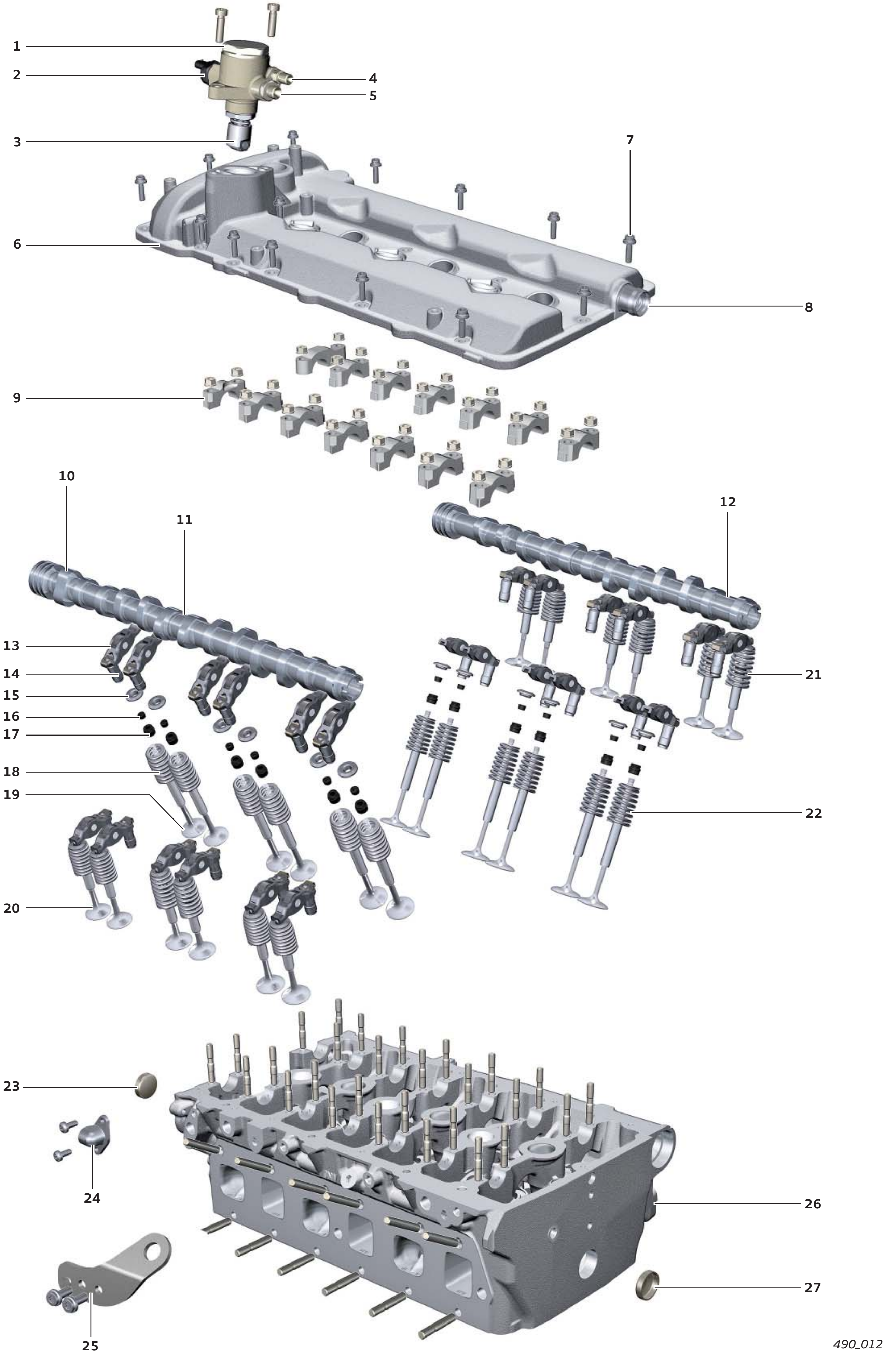
490_038

Heating

To prevent the crankcase breather from freezing up in cold weather conditions, an electrical heater at the inlet to the intake manifold is activated. To this end, the engine control unit 2 J624 activates the heating resistor (crankcase breather) N79 at ambient temperatures below 0 °C. The heating resistor is deactivated when an ambient temperature of 3 °C is exceeded. The engine control unit receives the ambient temperature signal from the control unit in the dash panel insert J285.

Cylinder head

Overview (using cylinder bank 1 as an example)



Legend of figure on page 12:

1 High-pressure fuel pump

2 Fuel metering valve N290

3 Roller tappet

4 Low-pressure connection (supply)

5 High-pressure connection

6 Cylinder head cover

7 Cylinder flange screws (steel screws / aluminium screws for the cover)

8 Crankcase breather connecting port

9 Camshaft bearing cover

10 Drive cam for high-pressure fuel pump

11 Exhaust camshaft

12 Intake camshaft

13 Roller cam follower (exhaust)

14 Support element (exhaust)

15 Valve spring plate (exhaust)

16 Valve cotters (exhaust)

17 Valve stem seal (exhaust)

18 Valve spring (exhaust)

19 Exhaust valve (long)

20 Exhaust valve assembly (short)

21 Intake valve assembly (short)

22 Intake valve assembly (long)

23 Anti-freeze plug

24 Secondary air inlet

25 Suspension eye

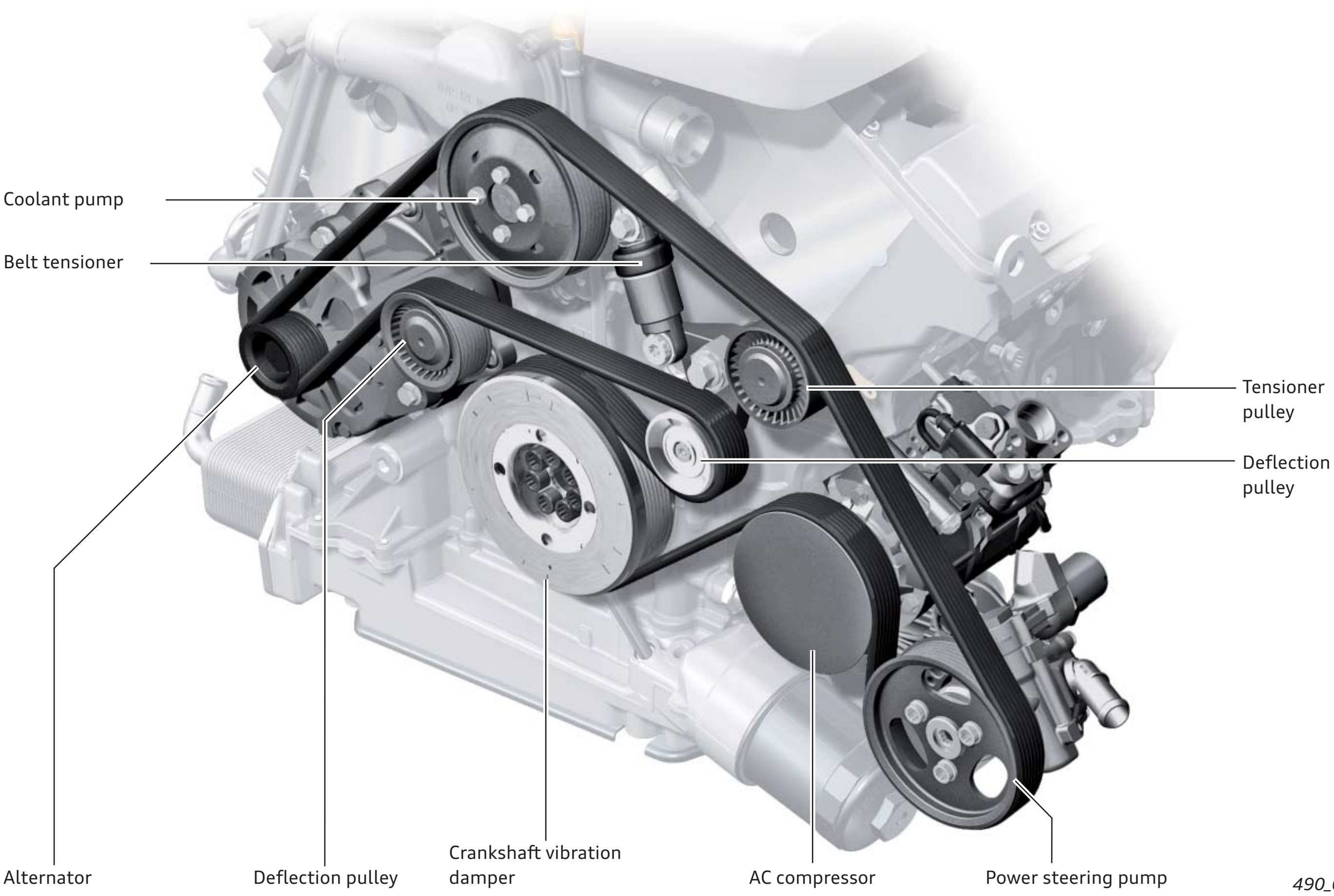
26 Oil pressure switch F1

27 Anti-freeze plug

Belt drive

The auxiliary units are driven by one-piece belt drive on the front end of the 6.3l W12 FSI engine. Key differences compared to the 6.0l W12 engine are, in particular, the belt routing and the way the alternator and AC compressor are connected directly to the cylinder block by a threaded fitting.

Depending on whether servotronic or dynamic steering is fitted, different belt drives with different ratios are used for the power steering pump.



490_011

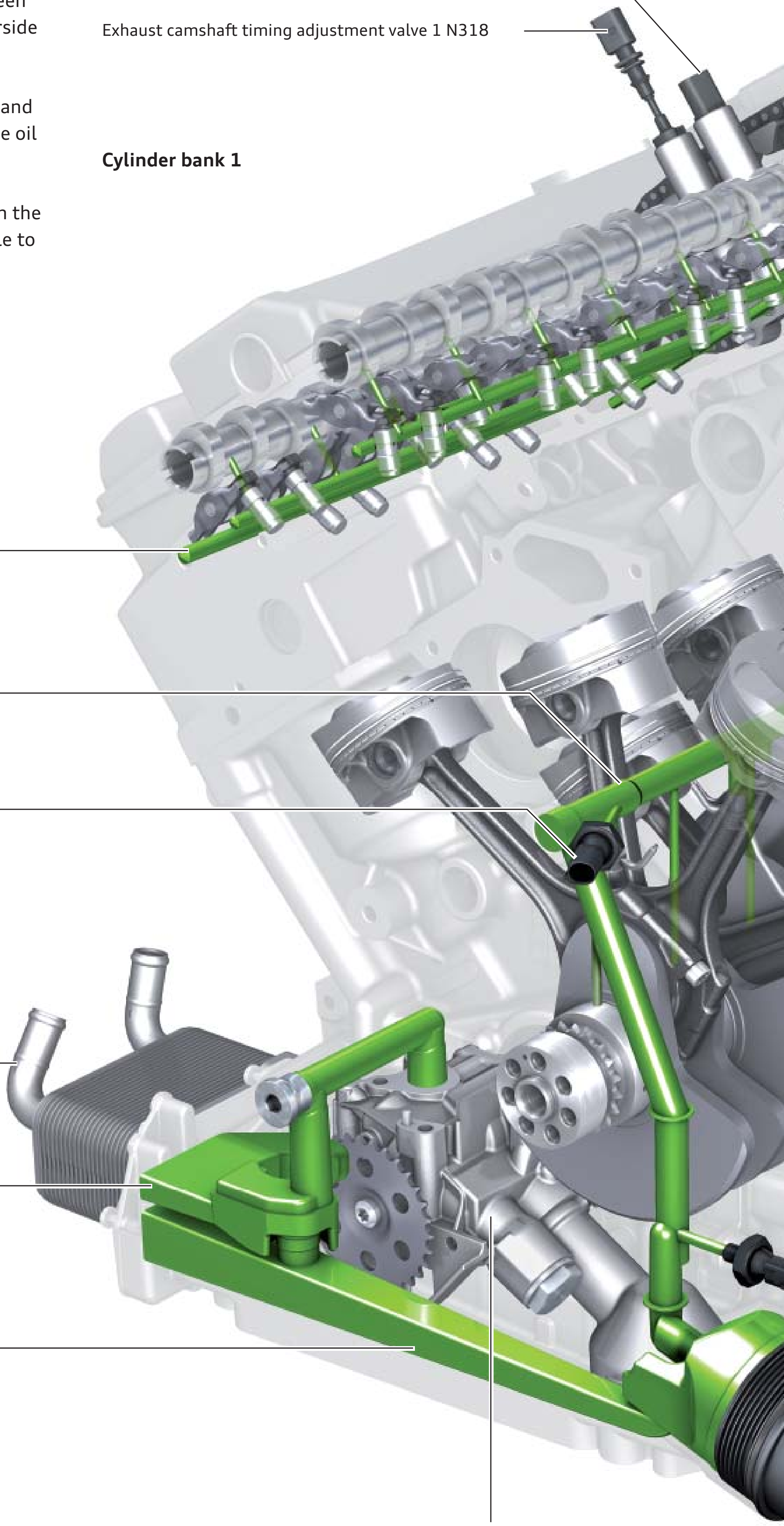
Oil supply

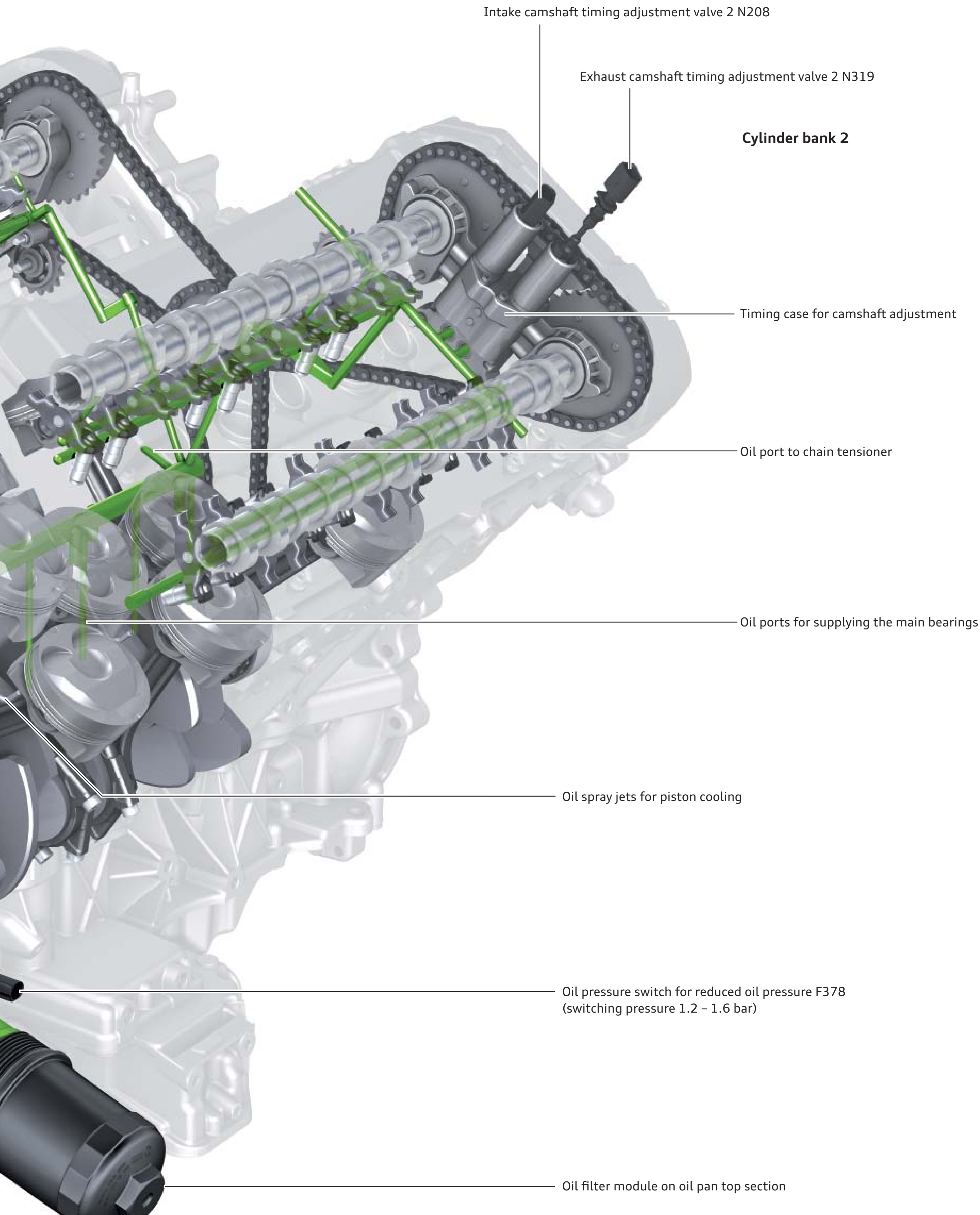
Overview

The 6.3l W12 FSI engine employs a lubrication system with conventional oil intake from an oil pan. As is the case with the 6.0l W12 engine on the Audi A8 ’01, *dry sump lubrication** has been dispensed with. An aluminium oil pan is located on the underside of the engine.

To ensure a reliable supply of oil even during high transverse and longitudinal acceleration, baffle plates have been fitted at the oil pan intake (see figure in page 16).

By eliminating dry-sump lubrication, it was possible to design the overall oil circulation system more simply. It was also possible to employ a single-stage oil pump (see page 17).




Intake camshaft timing adjustment valve 2 N208
Exhaust camshaft timing adjustment valve 2 N319
Cylinder bank 2
Timing case for camshaft adjustment
Oil port to chain tensioner
Oil ports for supplying the main bearings
Oil spray jets for piston cooling
Oil pressure switch for reduced oil pressure F378
(switching pressure 1.2 – 1.6 bar)
Oil filter module on oil pan top section

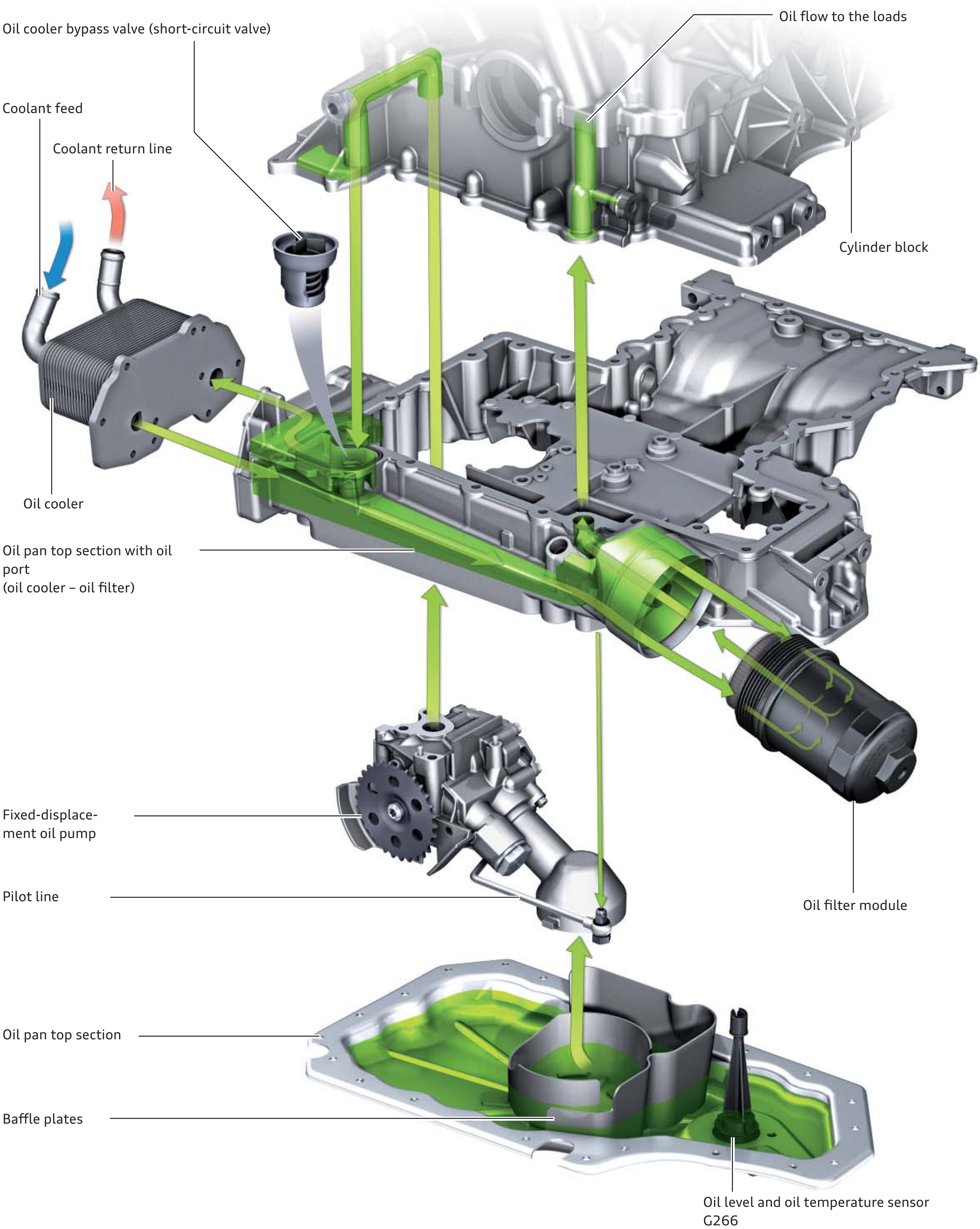
490_021

Oil circuit

The oil pressure (raw oil) produced by the oil pump initially passes through the oil cooler and then through the oil filter module. An oil cooler bypass valve ensures a reliable flow of oil in the event that the oil cooler becomes clogged.

The oil (raw oil) flows from the oil cooler through ports in the oil pan top section on to the oil filter. The clean oil then flows through corresponding oil ports in the cylinder block and the cylinder heads to the lubrication points (loads).

Oil flow in the lower section of the engine



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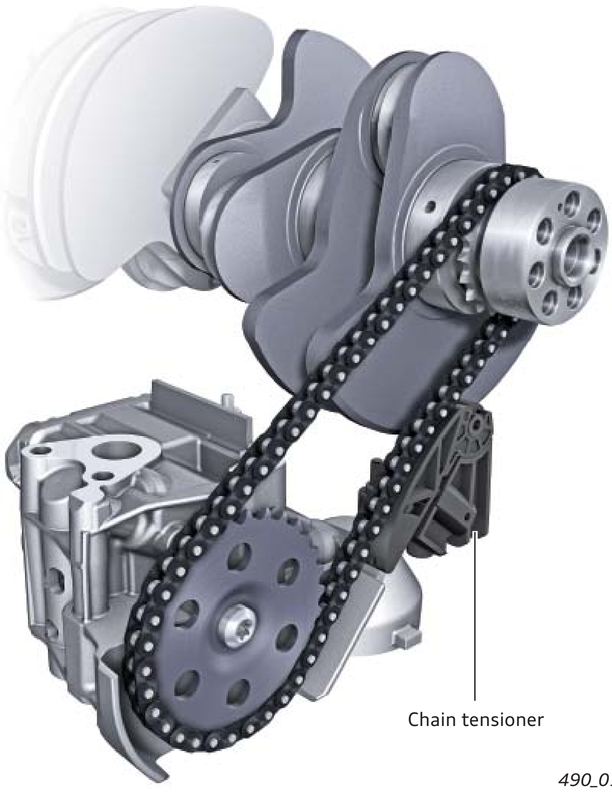
Oil pump

The oil pump is a gear pump configured for fixed displacement. Since the 6.3l W12 FSI engine does not, like the previous engine on the A8 '01, have dry-sump lubrication, the oil pump draws the oil directly from the oil pan.
The oil pump is driven by a separate chain drive which connects directly to crankshaft. This chain drive is located on the opposite side of the timing gear on the engine and has a chain tensioner. The chosen gear ratio is such that the pump rotates more slowly than the crankshaft (i = 0.633).
It is envisaged that the fixed-displacement oil pump will be replaced by a volume-controlled oil pump at a future date.

Pressure control

A control piston inside the oil pump controls oil pressure and diverts any surplus oil. Oil pressure is present in a pilot line running from the oil port in the oil pan top section to the control piston in the oil pump. The control piston inside the oil pump diverts surplus oil to the suction side.
During pump operation, the oil pressure is kept constant at approx. 5 bar at any engine speed (upwards of elevated idle speed). A pressure relief valve (cold start valve) opens to protect the engine at approx 10 bar. This can occur at very low engine oil temperatures, for instance.



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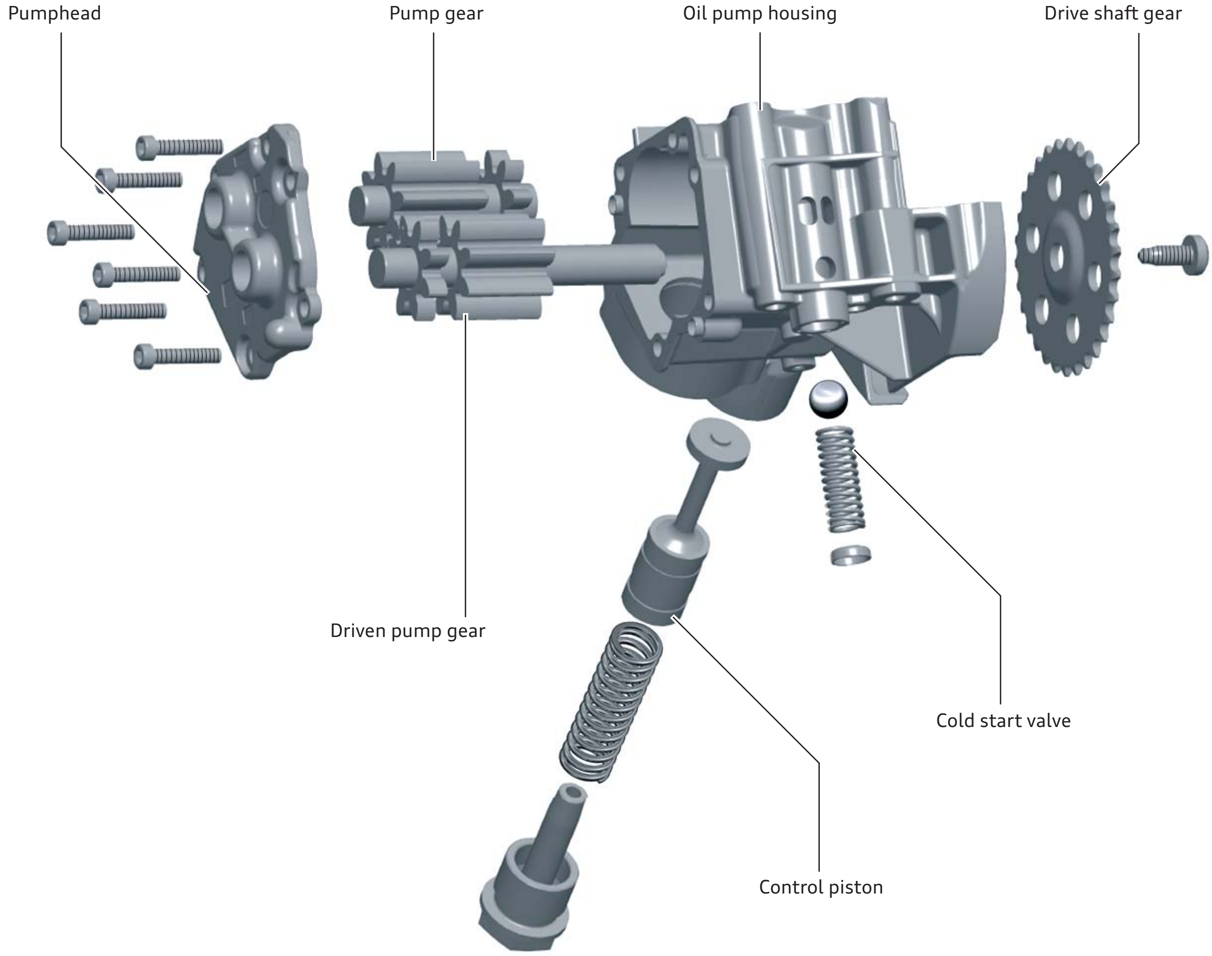
Design



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Reference
For further information about the design and function of the fixed-displacement oil pump, refer to Self-Study Programme 451 "Audi 2.5l TFSI Engine".

Air supply

Intake airflow system

Cylinder bank 1

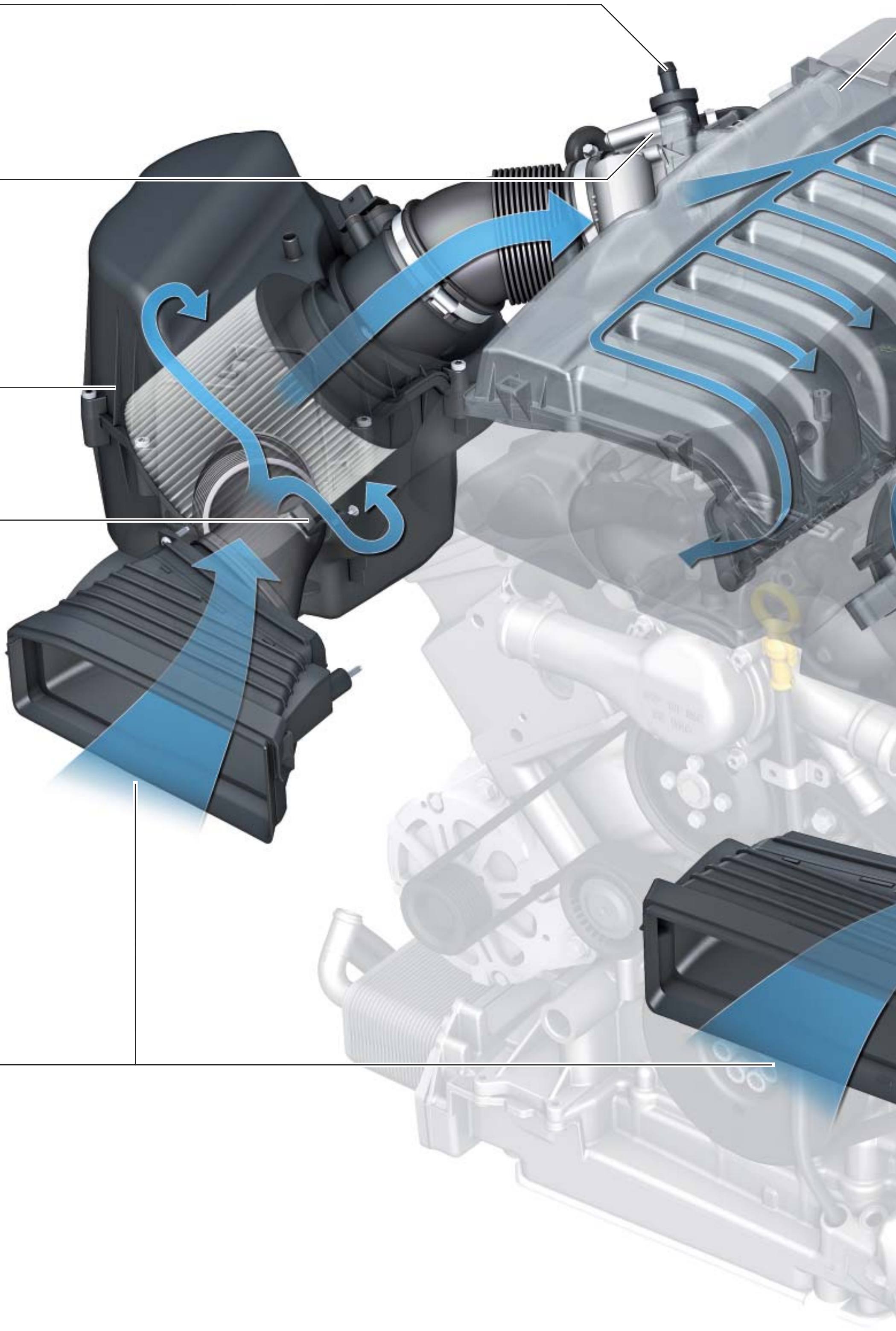
Suction jet pump to assist vacuum supply (on cylinder bank 1 only)

Throttle valve control unit 1 J338 with throttle valve drive 1 angle senders 1+2 G187, G188
Throttle valve drive G186

Air filter housing of cylinder bank 1

Intake manifold pressure sender G70 with intake air temperature sender G42

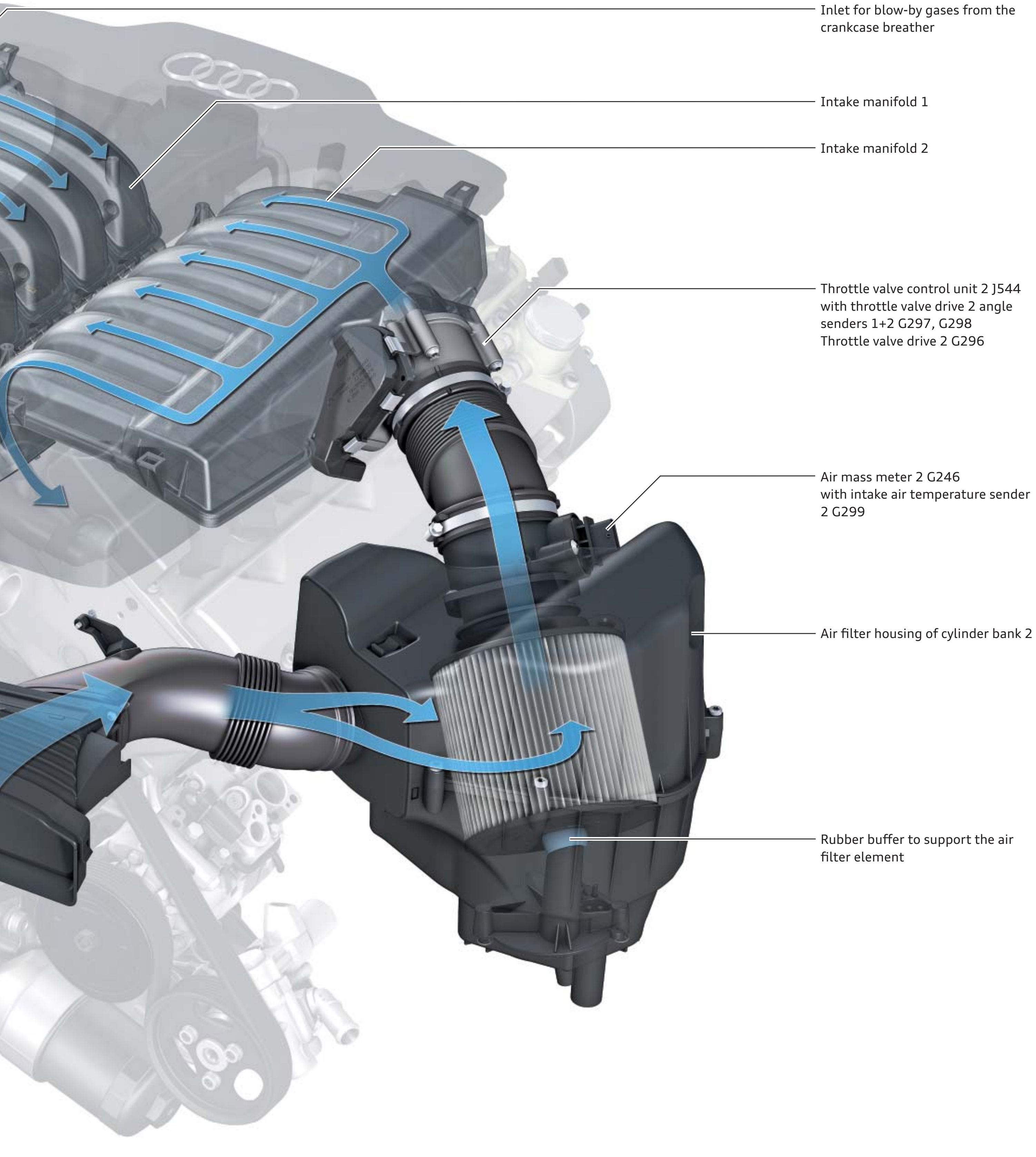
Air intake from the front end



Compared to the intake system of the 6.0l W12 engine, the system on the 6.3l W12 FSI engine has undergone several major modifications. For example, the entire secondary air system is located at the back of the engine directly on the gearbox (see page 20).

A suction jet pump located on the throttle valve control unit of cylinder bank 1 is used to produce the vacuum required for braking and actuating the exhaust flaps (see page 23).
The air ducting system has also been modified compared to the 6.0l W12 engine. The air for the right-hand cylinder bank is taken in by the right-hand air duct and the air for the left-hand cylinder bank by the left-hand air duct.

Cylinder bank 2



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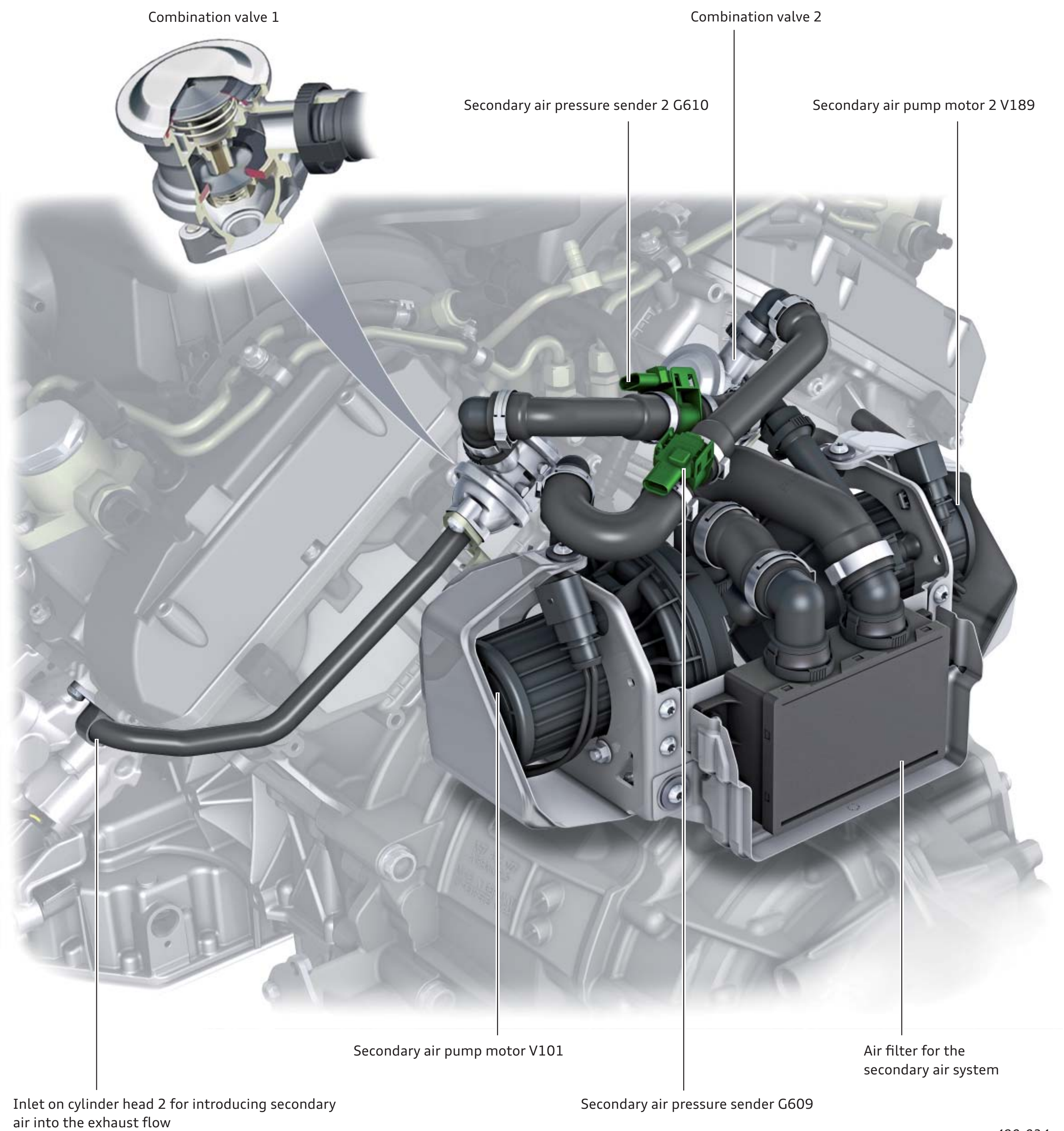
Secondary air system

The secondary air system ensures that the catalytic converters heat up more quickly and are available sooner after a cold start.
Unlike the 6.0l W12 engine, the secondary air pumps are no longer connected to the air filter housings.

For reasons of space, the secondary air pumps, as is the entire secondary air system, are installed at the back of the engine on the gearbox. The secondary air system therefore also has a separate air filter.

Overview



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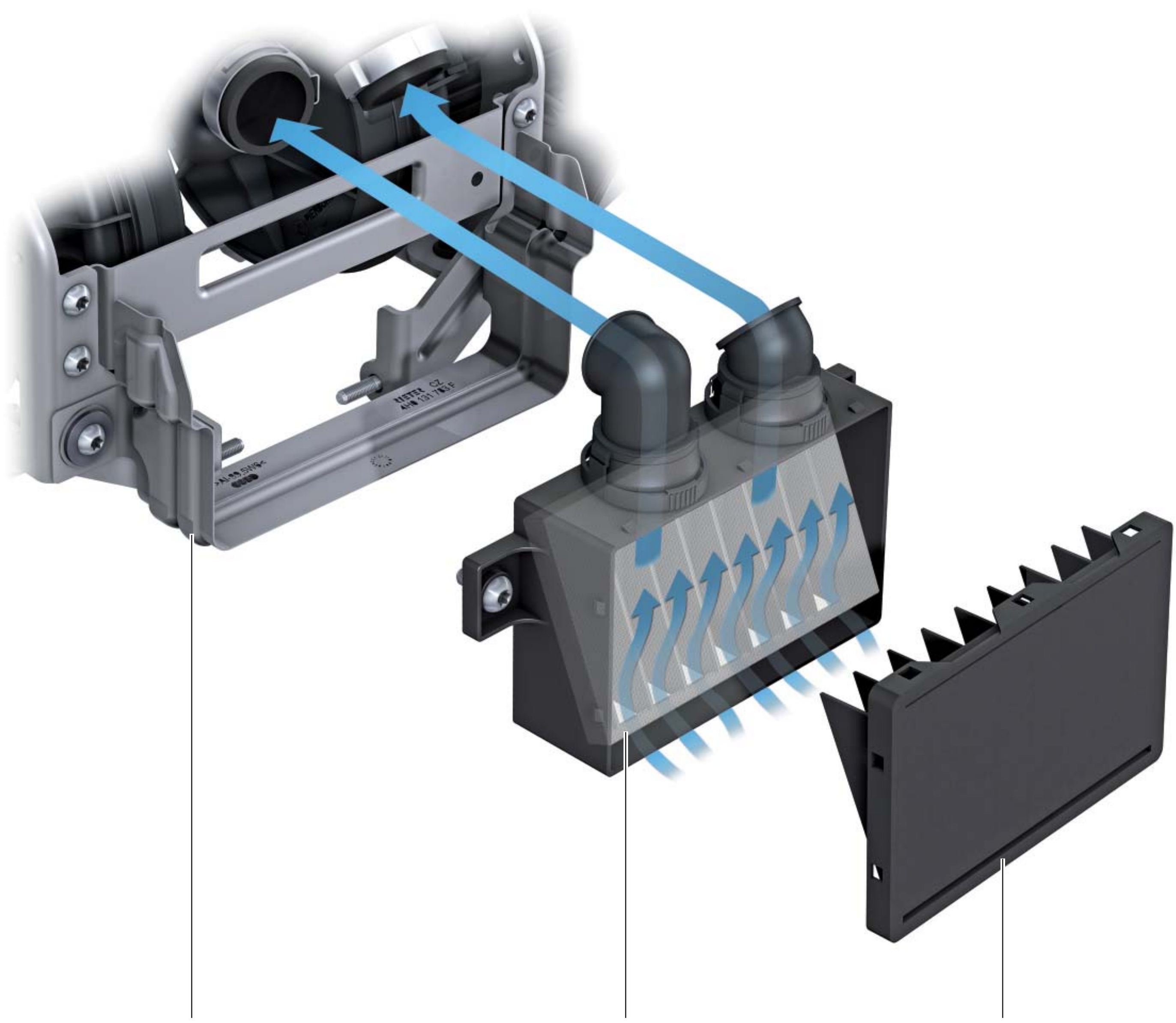
Function

Air is drawn in by the two secondary air pumps (secondary air pump motors 1 and 2 V101 or V189) via the air filter of the secondary air system. For this purpose, both of the secondary air pumps are activated by engine control units 1 and 2 via secondary air pump relays J299 and J545.

The air flows through combination valves 1 and 2 (self-opening) to both cylinder heads, where it is mixed with the exhaust gas flow. The secondary air pumps distribute air in a crossover fashion, i.e. secondary air pump 2 is connected to combination valve 1 and secondary air pump 1 is connected to combination valve 2.

Air filter of the secondary air system

Both secondary air pumps drawn in air through a common air filter. No replacement interval is specified for the air filter element.



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Vacuum supply

490_031

Suction jet pump

The conventional method of supplying vacuum to the brake servo and the engine components is problematic in the case of petrol engines, particulary in combination with automatic transmission. This means that installing a vacuum line after the throttle valve would not be sufficient to produce the vacuum required by the various subsystems

because, in many engine operating conditions, the wide open throttle valve would result in low mass flow rates and, consequently, insufficient vacuum in the intake manifold.

In the 6.3l W12 FSI engine, therefore, the requisite vacuum is produced by a suction jet pump. The suction jet pump is connected in parallel with the throttle valve contol unit J338 before and after the throttle valve (right-hand cylinder bank). The diverted air flow passes through the suction jet pump, thereby producing a vacuum (Venturi principle).

490_032

Brake vacuum pump V192

If required, an electrical vacuum pump (brake vacuum pump V192) is activated to assist with vacuum delivery.

One such application is cold starting For example, when the catalytic converter is heating up, the throttle valve is wide open. In this case, the vacuum produced by the suction jet pump is not enough to sufficiently evacuate the brake servo.

The brake servo pressure sensor G294 is connected to the line to the brake servo and sends its readings to the engine control unit J623.

The brake vacuum pump V192 is activated (in a map-controlled manner) by the engine control unit until the requisite vacuum is present.

Legend of figure on page 22:

A Brake vacuum pump V192

B Brake servo

C Brake servo pressure sensor G294

D Left secondary air combination valve

E Secondary air pressure sender 1 G609

F Secondary air pump motor V101

G Right secondary air combination valve

H Secondary air pressure sender 2 G610

I Secondary air pump motor 2 V189

J Air filter of the secondary air system

K Nonreturn valve

L T-piece with flow restrictor

M Activated charcoal canister solenoid valve 1 N80

N Activated charcoal canister

O Vacuum reservoir

P Exhaust flap valve 2 N322

Q Left exhaust flap

R Vacuum reservoir

S Exhaust flap valve 1 N321

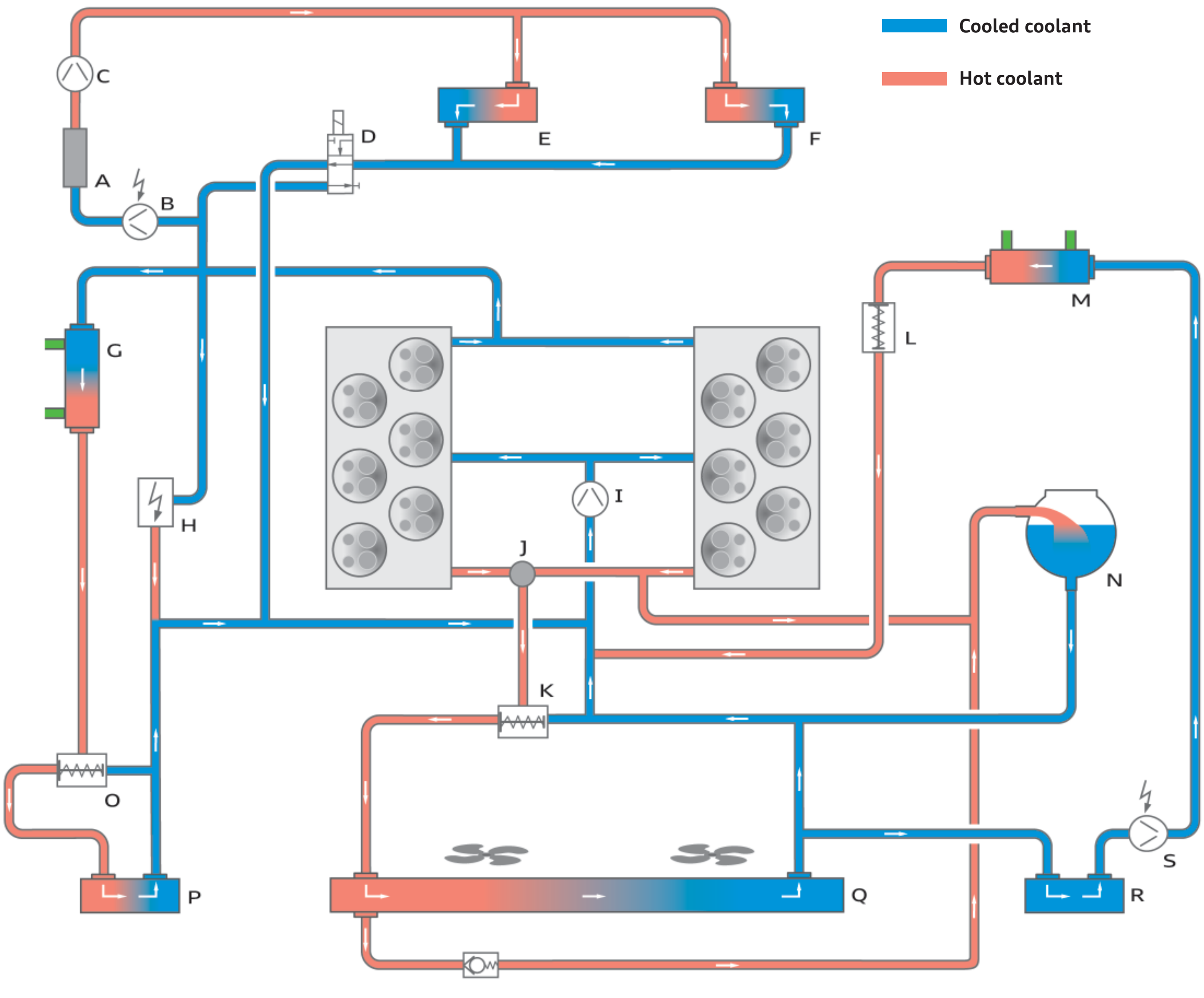
T Right exhaust flap

U Suction jet pump

Cooling system

Overview

(vehicle with auxiliary heater)



Legend:

A Auxiliary heater (optional equipment)

B Recirculation pump V55

C Coolant circulation pump V50

D Heater coolant shut-off valve N279

E Front heater heat exchanger

F Rear heater heat exchanger

G Engine oil cooler

H Alternator

I Coolant pump

J Coolant temperature sender G62

K Coolant thermostat (initial opening temperature: 97 °C)

L Coolant circuit thermostat for ATF cooling (initial opening temperature: 75 °C)

M ATF cooler

N Coolant expansion reservoir

O Coolant thermostat for right-hand additional radiator (hot climate version 8Z6, 8Z9 or higher)

O Right-hand additional radiator (hot climate version 8Z6, 8Z9 or higher)

Q Coolant radiator

R Left-hand additional radiator

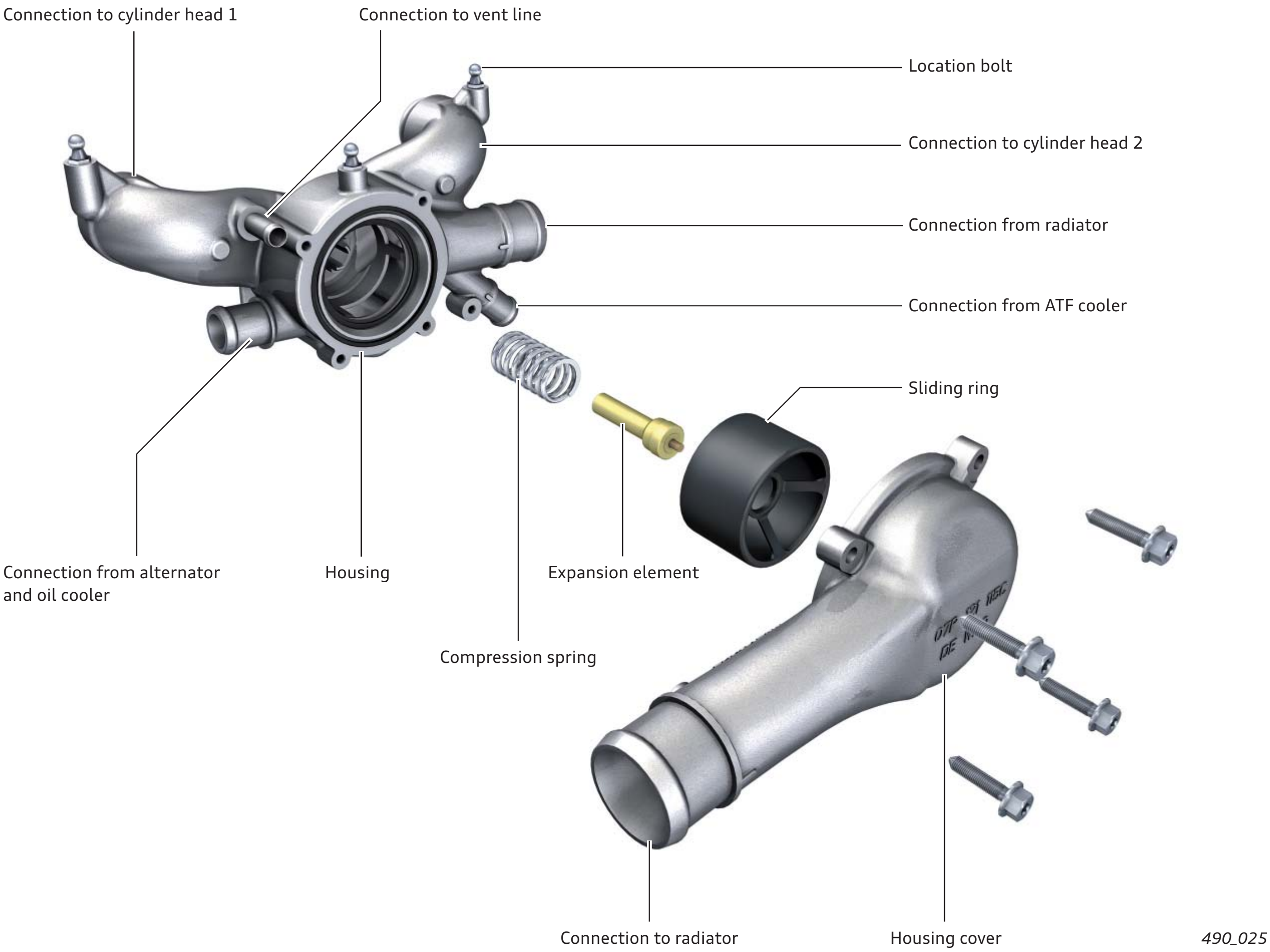
S Coolant run-on pump V51

Coolant thermostat

The coolant thermostat is located at the front end of the engine. The coolant flows to both cylinder heads converge inside the coolant thermostat housing.
The coolant thermostat for the primary cooling circuit opens at a temperature of 97 °C.

The plunger of the expansion element rests on the housing cover. The sliding ring moves with the expansion element and, depending on its position, disconnects the secondary cooling circuit from the primary cooling circuit.
The coolant thermostat housing has three location bolts into which the engine cover clips.

Design



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Note
The cooling system may only be refilled using cooling system charge unit VAS 6096. Otherwise, malfunctioning of the automatic gearbox may occur. Refer to the Workshop Manual.

Fuel system

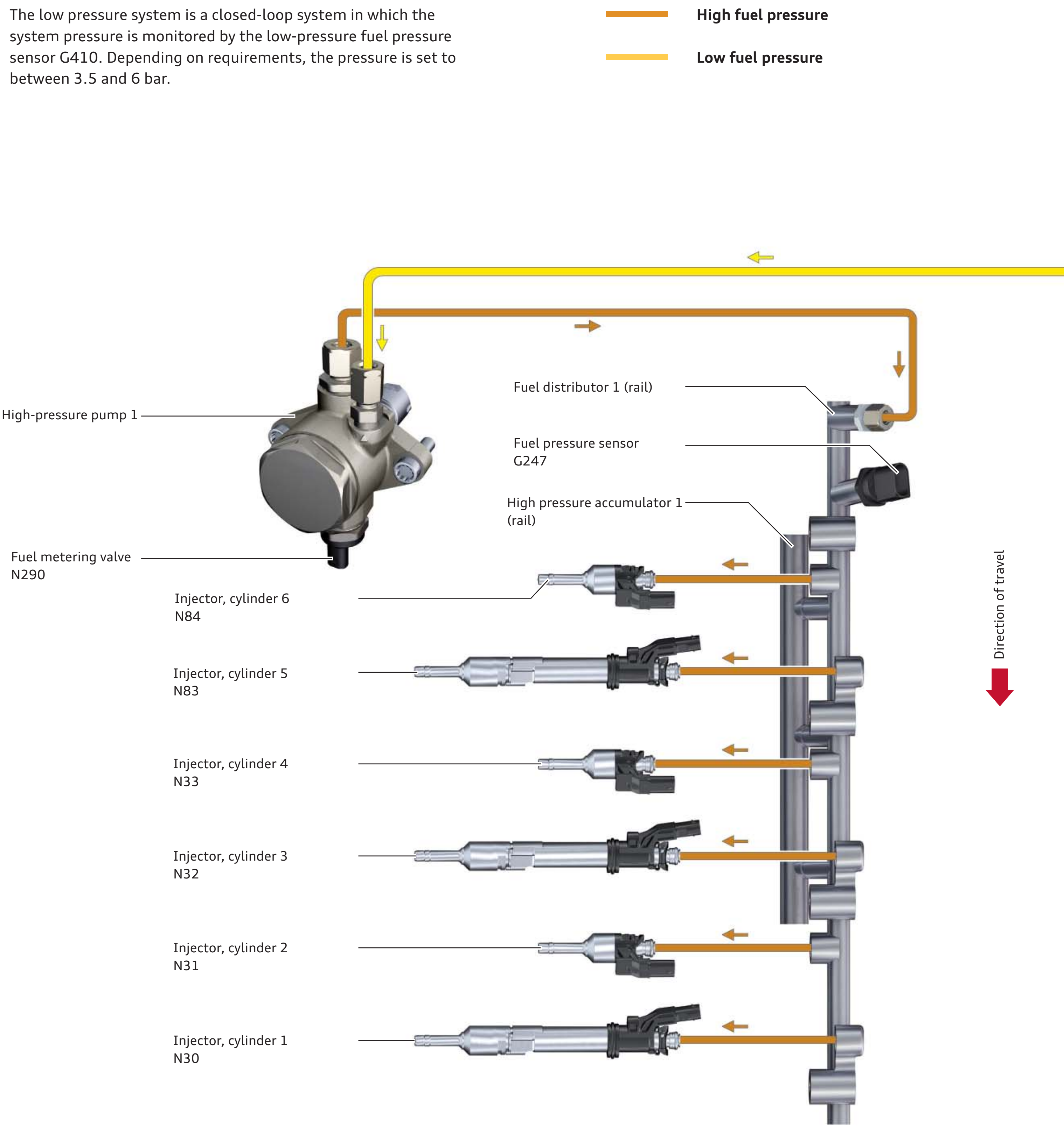
System overview

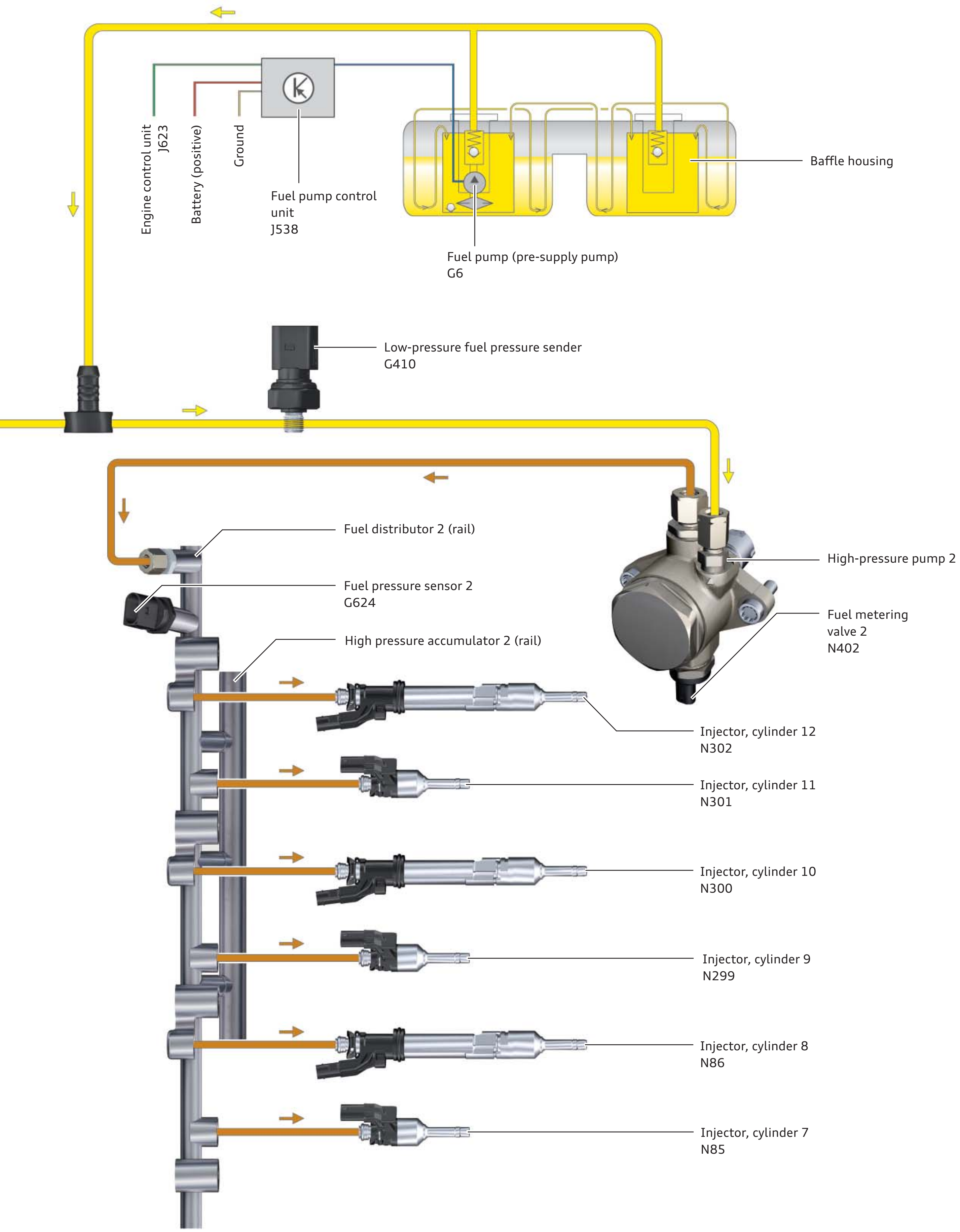
As in previous FSI engines, the fuel system is divided into a low pressure and high-pressure fuel systems.

Both systems operate in a demand responsive fashion, and neither system has a return line.

Low pressure system

The low pressure system is a closed-loop system in which the system pressure is monitored by the low-pressure fuel pressure sensor G410. Depending on requirements, the pressure is set to between 3.5 and 6 bar.




Engine control unit
J623
Battery (positive)
Ground
Fuel pump control
unit
J538
Baffle housing
Fuel pump (pre-supply pump)
G6
Low-pressure fuel pressure sender
G410
Fuel distributor 2 (rail)
High-pressure pump 2
Fuel pressure sensor 2
G624
Fuel metering
valve 2
N402
High pressure accumulator 2 (rail)
Injector, cylinder 12
N302
Injector, cylinder 11
N301
Injector, cylinder 10
N300
Injector, cylinder 9
N299
Injector, cylinder 8
N86
Injector, cylinder 7
N85

490_023

Fuel rails

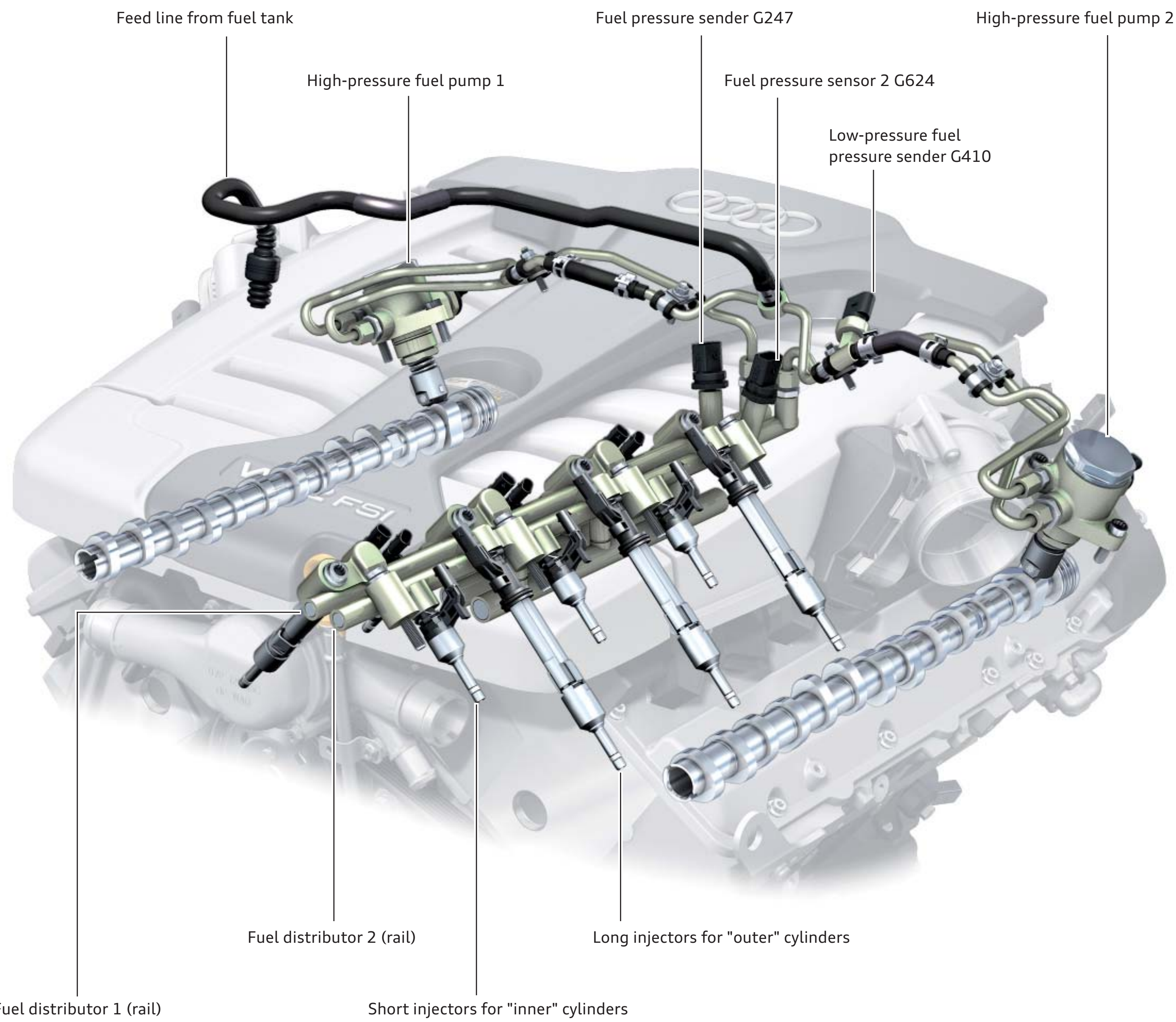
High pressure system

Due to the engine's design, the high fuel pressure is distributed to the high pressure injectors through twin fuel rails.

A single high-pressure fuel pump is responsible for supplying each cylinder bank. The electrical control unit is configured in such a way that the engine control unit J623 (master) controls cylinder bank 1 and engine control unit 2 J624 (slave). The low-pressure fuel pressure sender G410 is read in by the engine control unit J623.

Both high pressure sides are therefore hydraulically independent of each other. For this reason, a separate fuel pressure sender is required for each cylinder bank.

The high-pressure pumps are integrated in the cylinder head covers and driven by a three-lobe cam on the exhaust camshafts. They operate at pressures of between 40 and 120 bar. Hitachi pumps are fitted.



490_016

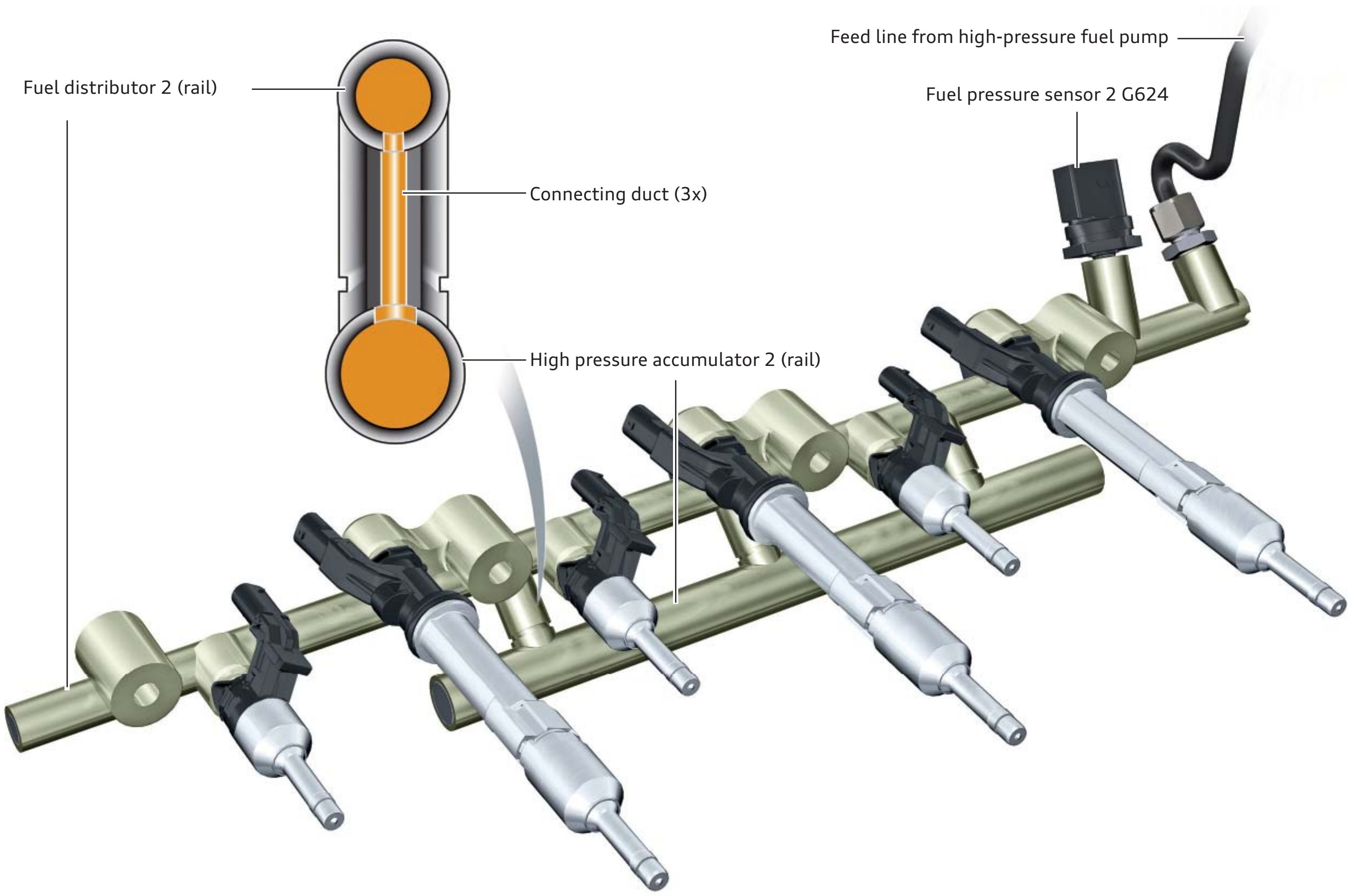
Reference
For further information about the function and control concept of the high-pressure fuel pumps, refer to Self-Study Programme 432 "Audi 1.4l TFSI Engine".

Additional volume on the fuel rails

Both fuel rails have additional volume in the form a tube. This additional volume is required to compensate for pressure peaks and pressure fluctuation.
The greater the volume, the lesser the effect of the pressure drop due to loss of volume during injection.

The diameters of the rails could theoretically have easily been made slightly larger. However, this was not possible due to the constraints on installation space. The additional volume solution was chosen for this reason.

Fuel rail on cylinder bank 2



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Note
Caution: injury hazard Very high pressures may exist inside the fuel system. To open the high-pressure side, please follow the directions given in the Workshop Manual.

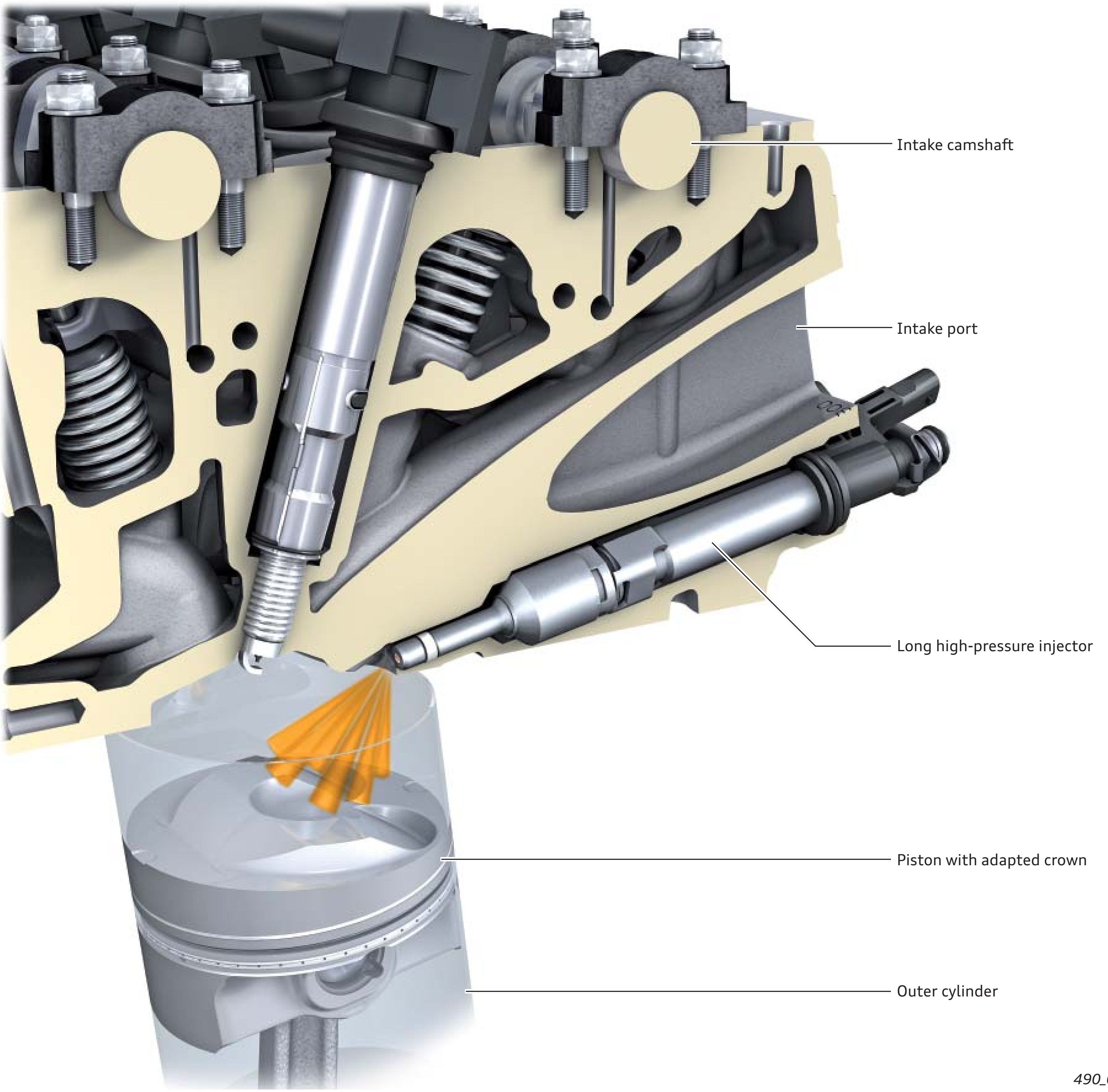
High-pressure injectors

The fuel is injected into the combustion chambers at a pressure of up to 120 bar. This task is performed by high-pressure injectors, of which there are two types on the 6.3l W12 FSI engine. The six individual jets of each high-pressure injector are arranged in such a way as to provide an optimal spatial alignment.

Different pistons with correspondingly shaped crowns are used on account of the different installation angles of the injectors (see page 8).

Cylinders 1, 3, 5, 8, 10, 12 – long high-pressure injectors

In the case of "outer" cylinders 1, 3, 5, 8, 10 and 12, longer injectors are used to deliver the fuel from each of the fuel rails between the cylinder heads to the cylinders.



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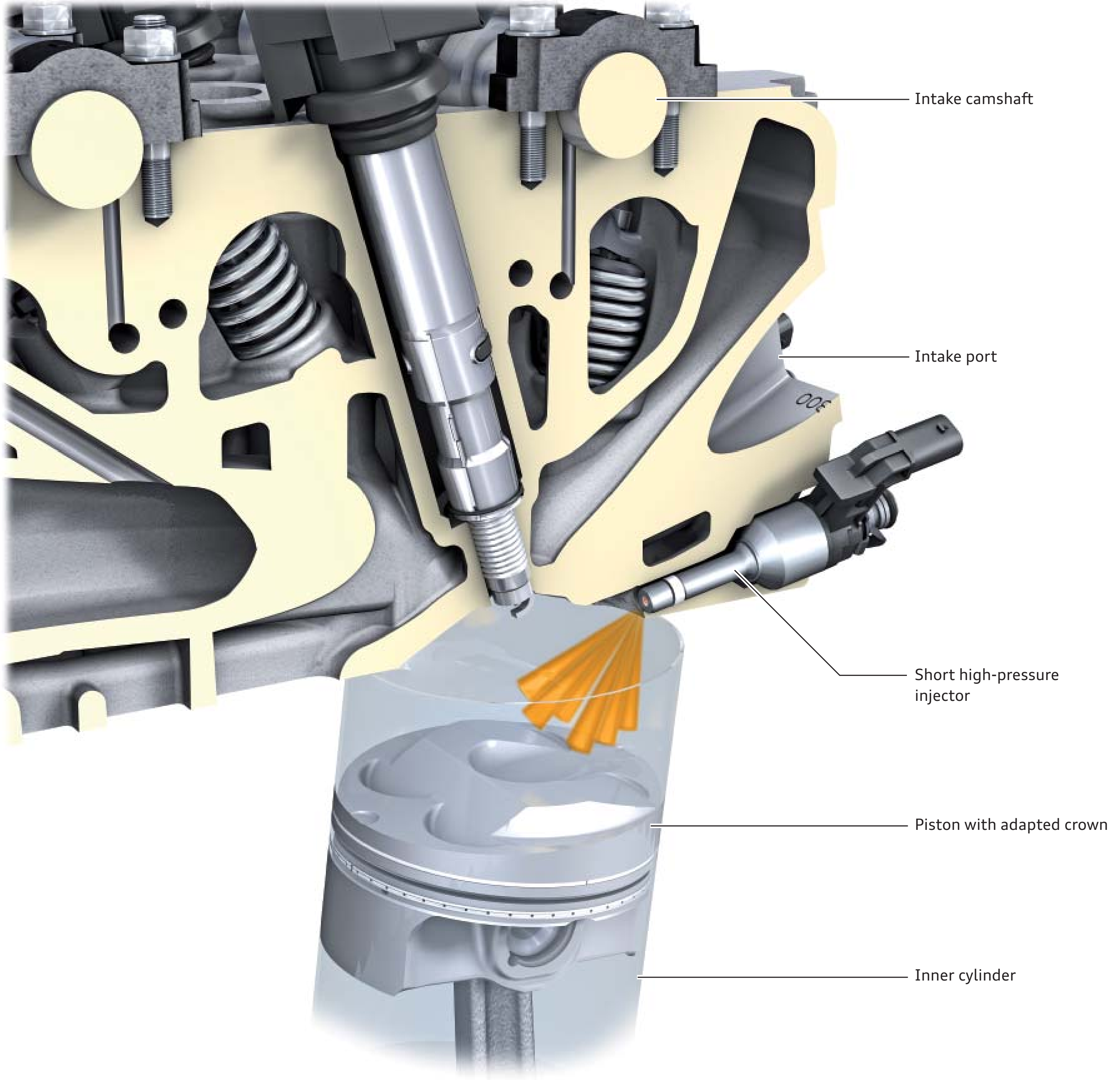
Cylinders 2, 4, 6, 7, 9, 11 – short high-pressure injectors

The high-pressure injectors of "inner" cylinders 2, 4, 6, 7, 9 and 11 are very similar in design to those of other Audi FSI and *TFSI** engines.



490_018

Engine management

System overview

Low-pressure fuel pressure sender G410

Coolant temperature sender G62

Secondary air pressure sender 1 G609

Air mass meter G70
Intake air temperature sender G42

Accelerator pedal position sensor G79
Accelerator pedal position sensor 2 G185

Engine speed sender G28

Knock sensors 1+2 G61, G66

Fuel pressure sender G247

Hall sender G40
Hall sender 3 G300

Throttle valve control unit J338
Throttle valve drive angle senders 1+2
for electronic power control G187, G188

Oil pressure switch for reduced oil pressure F378

Oil level/oil temperature sensor G266

Brake light switch F

Oxygen sensors 1+2 G39, G108
Oxygen sensors 1+2 after catalytic converter G130, G131

Auxiliary signals:
- Cruise control on/off switch E45
- Convenience sys. central control unit (wake-up door contact) J393
- Vacuum sensor in brake servo G483

Fuel pressure sensor 2 G624

Hall sender 2 G163
Hall sender 4 G301

Throttle valve control unit 2 J544
Throttle valve drive 2 angle sensors 1+2
G297, G298

Knock sensors 3+4 G198, G199

Oxygen sensor 3+4 G285, G286
Oxygen sensors 3+4 after catalytic converter G287, G288

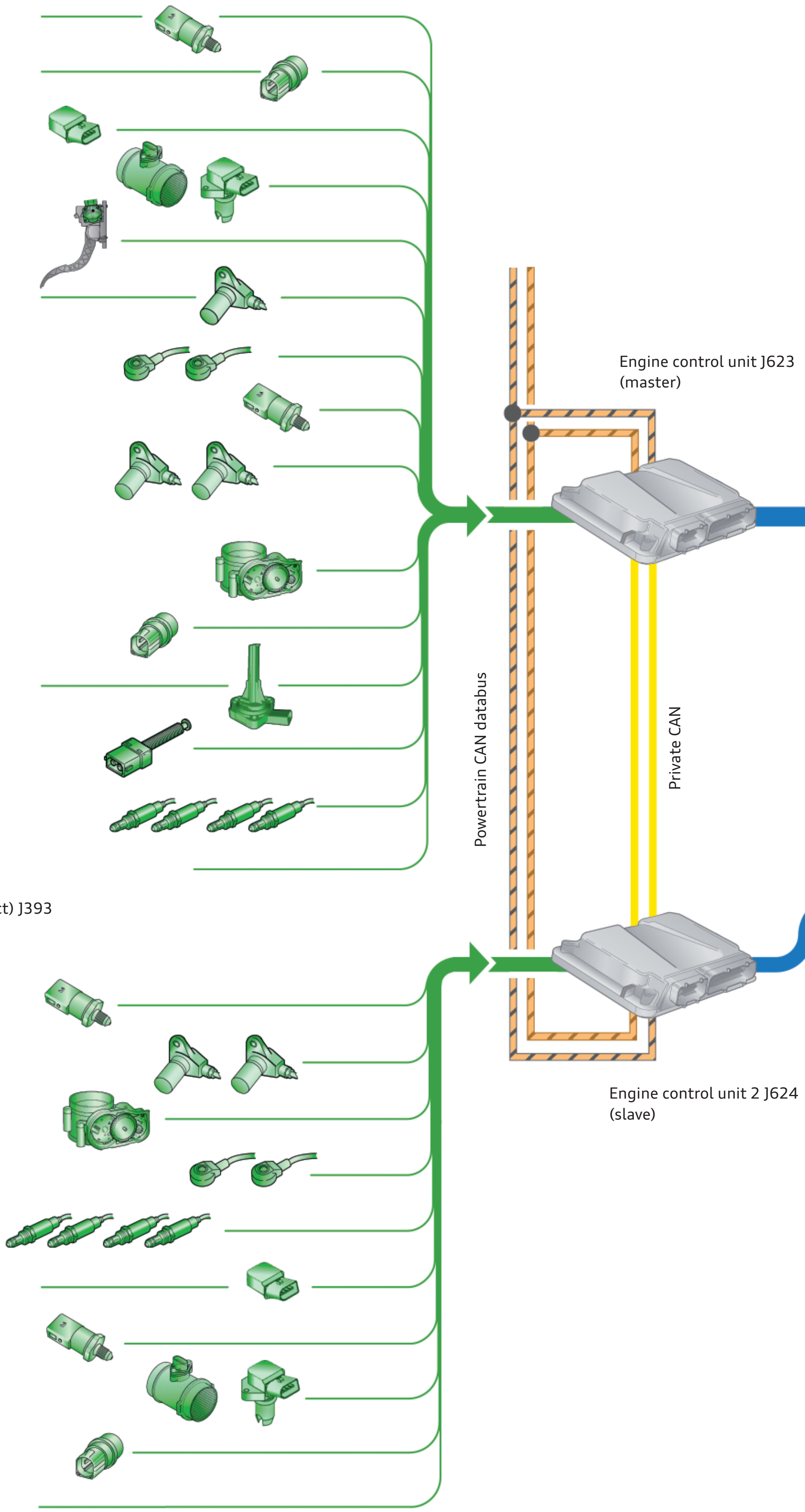
Secondary air pressure sender 2 G610

Fuel tank pressure sensor G400[1)]

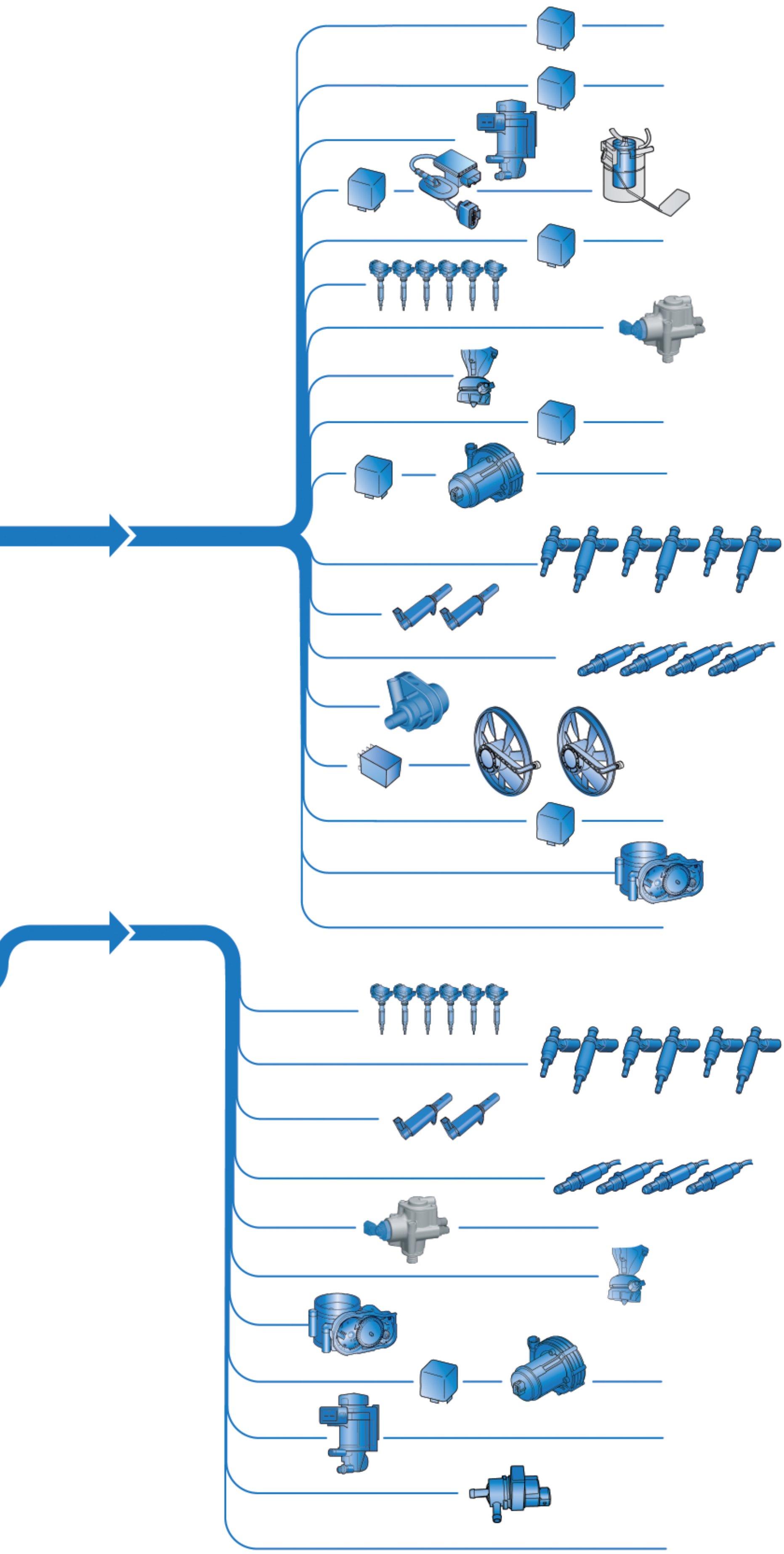
Air mass meter 2 G246
Intake air temperature sender 2 G299

Oil pressure switch F22

Auxiliary signals:
- Automatic gearbox control unit
  (selector lever position P/N) J217



[1)] American markets only



490_020

Starter motor relay J53
Starter motor relay 2 J695

Brake servo relay J569
Brake vacuum pump V192

Exhaust flap valve 1 N321

Fuel pump relay J17
Fuel pump control unit J538
Fuel predelivery pump G6

Terminal 15 voltage supply relay J329

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

Fuel metering valve N290

Electro/hydraulic engine mounting sol. valve, right N145

Power supply relay for engine components J757

Secondary air pump relay J299
Secondary air pump motor V101

Injectors, cylinders 1 – 6
N30 – N33, N83, N84

Intake camshaft timing adjustment valve -1- N205
Exhaust camshaft timing adjustment valve 1 N318

Lambda probes 1+2 heater Z19, Z28
Lambda probes 1+2 heater, after catalytic converter Z29, Z30

Coolant circulation pump V50

Radiator fan control unit J293, radiator fan V7
Radiator fan control unit J671, radiator fan 2 V177

Motronic power supply relay J271

Throttle valve drive (electronic power control) G186

Auxiliary signals:
– Gearbox mounting valve 1 N262

Ignition coils with power output stages 7 – 12 N325 – N330

Injectors, cylinders 7 – 12
N85, N86, N299 – N302

Intake camshaft timing adjustment valve 2 N208
Exhaust camshaft timing adjustment valve 2 N319

Lamdba probes 3+4 heater Z62, Z63
Lamdba probes 3+4 heater after catalytic converter Z64, Z65

Fuel metering valve 2 N402

Electro/hydraulic engine mounting solenoid valve, left N144

Throttle valve drive 2 G296

Secondary air pump solenoid valve 2 J545
Secondary air pump motor 2 V189

Exhaust flap valve 2 N322

Activated charcoal canister solenoid valve 1 N80

Auxiliary signals:
– Gearbox mounting valve 2 N263
– Heating resistor (crankcase breather) N79
– Tank leakage diagnostics control unit J909[1)]

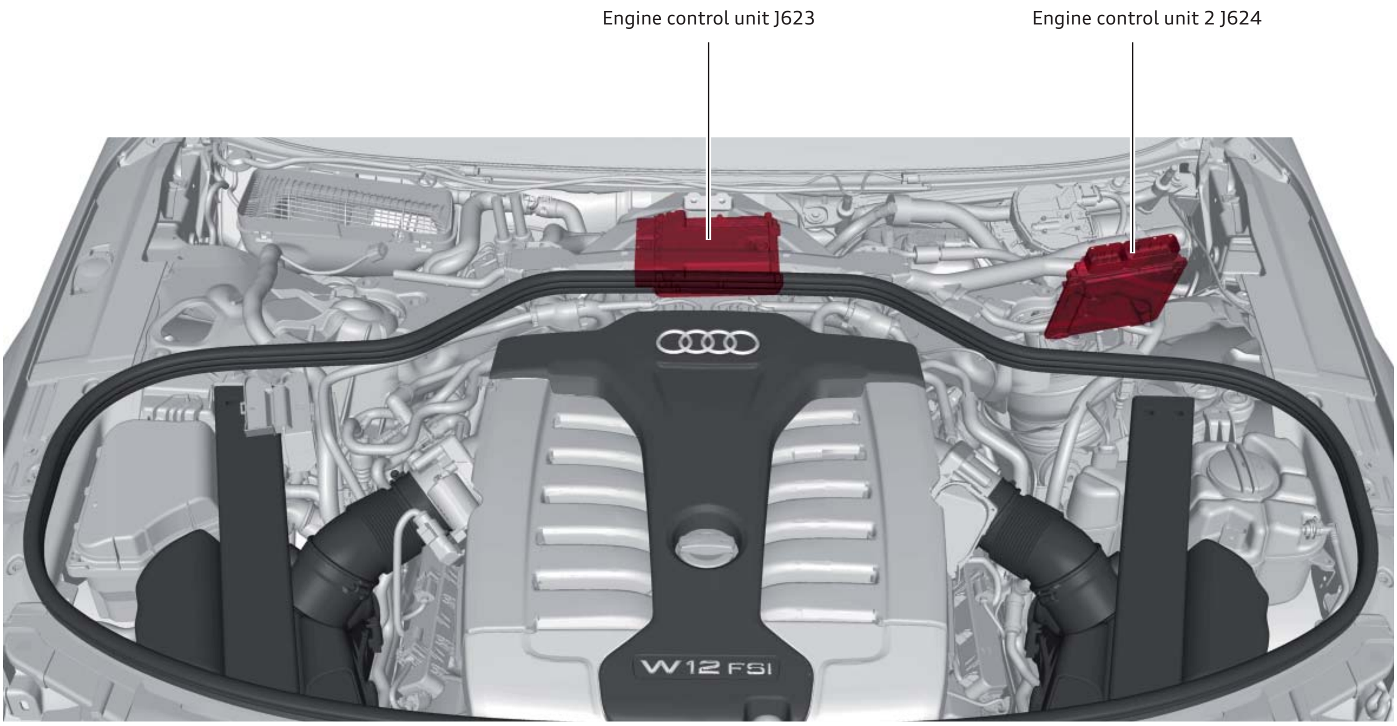
Engine control unit J623 and engine control unit 2 J624

The engine control units operate according to the dual control unit concept. The Bosch MED 17.1.6 engine management system is used.

Both engine control units are housed in the plenum chamber and are of identical design. The control units are assigned to the cylinder banks by the "PIN coding" in the wiring harness.

Both control units must always have the following features:

- Same software version
- CCS and ACC must be adapted
- Both must be treated separately in the self diagnostics
- Same coding



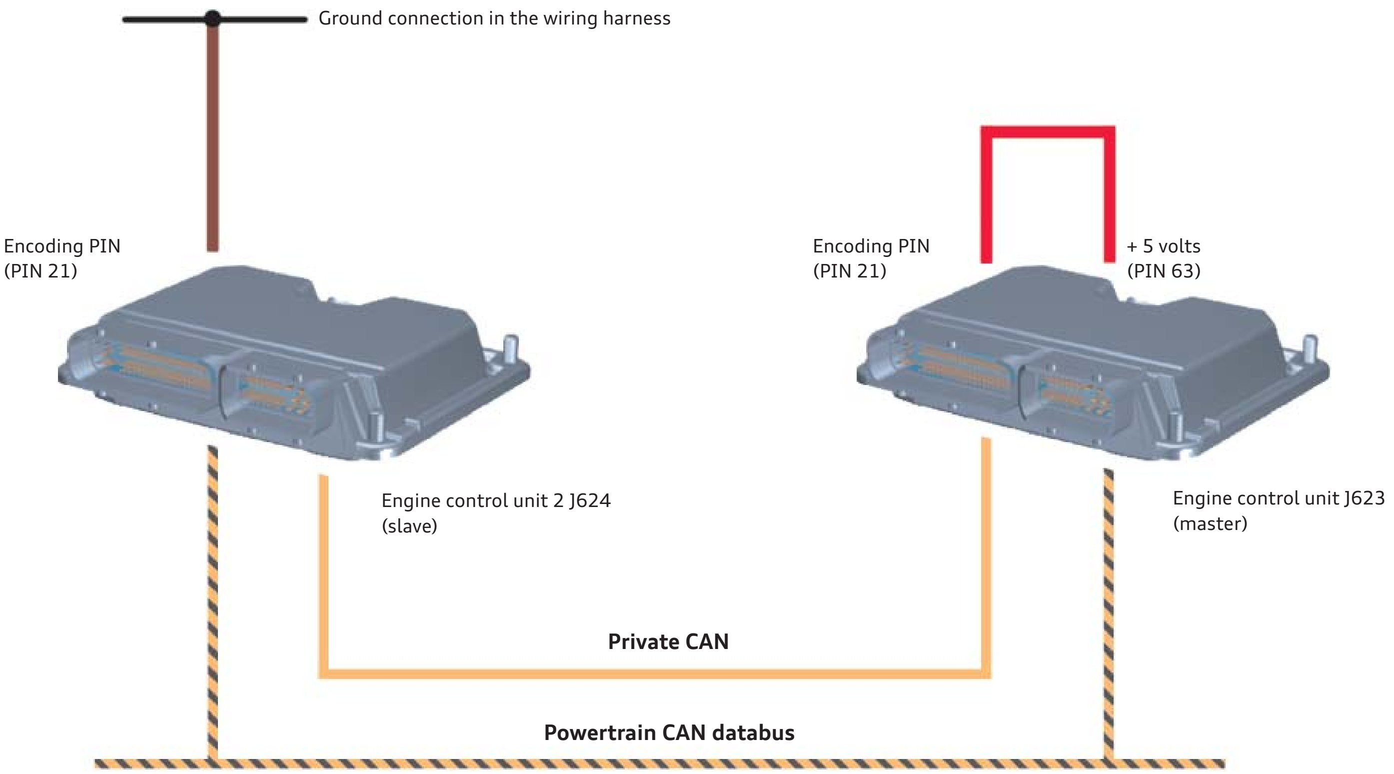
490_050

Communication between control units

Both control units are powertrain CAN data bus users They have an internal private CAN for communicating with one another. It primarily serves the exchange of engine-specific data. It works in the same way as the powertrain CAN data bus.

PIN coding

Each engine control unit is assigned to a cylinder bank by the PIN coding within the wiring harness.



490_044

Important messages which are used by the engine control units

- **ACC control units J428 / J850**
  - System states
  - Torque request
  - Start-stop information

- **Airbag control unit J234**
  - Crash intensity
  - Seat belt status, driver side

- **Trailer detector control unit J345**
  - Brake light status
  - Trailer detection
  - Brake light monitoring

- **Battery monitor control unit J367**
  - Alternator output
  - Radiator fan request
  - Stop enable

- **Automatic gearbox control unit J217**
  - All relevant signals for engine torque adaptation

- **Electromechanical park and handbrake control unit J540**
  - Deceleration request
  - Status of the EPB actuators

- **ABS control unit J104**
  - All signals relevant to the ESP

- **Entry and start authorisation switch E415**
  - Stop enable
  - Start request

- **Climatronic control unit J255**
  - Engine speed increase requested before compressor activation
  - Rear window defroster
  - Windscreen defroster
  - Air conditioning sys. on/off
  - Start-stop signals

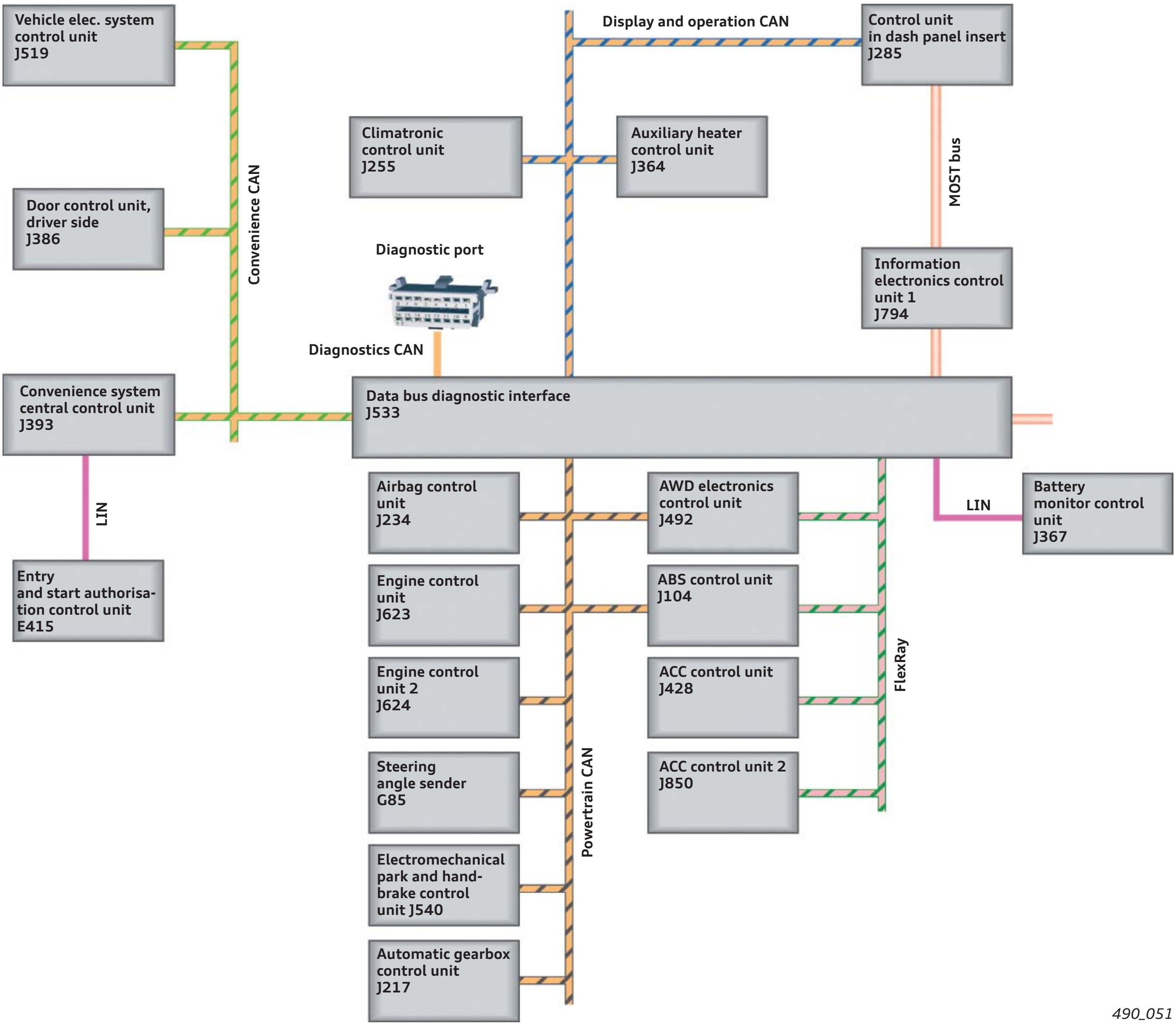
- **Control unit in dash panel insert J285**
  - Inoperative time
  - Fuel tank filling status
  - Ambient temperature
  - Vehicle speed

- **Steering column electronics control unit J527**
  - Information from CCS and ACC switches
  - Steer angle

Signals transmitted by the engine control unit J623

- Engine torque
- Kick-down
- Fault memory
- Cylinder cutout
- Gearbox status
- Start-stop status
- Accelerator pedal values
- Engine speed
- ESP signals
- Oil level, min oil pressure warning
- Oil temperature
- Fuel consumption
- Radiator fan activation
- Vacuum
- OBD
- Recuperation enable signal
- AC adjustment
- Status of Audi drive select
- Radiator fan activation
- Information on replacement interval
- Activation of fault lamps
- Intake air temperature, intake manifold pressure
- Coolant temperature
- Altitude information
- Fault
- All information from the auxiliary heater
- System states of the engine, e.g. overrun
- Shut-down cylinders

Control units communicating with the engine control units

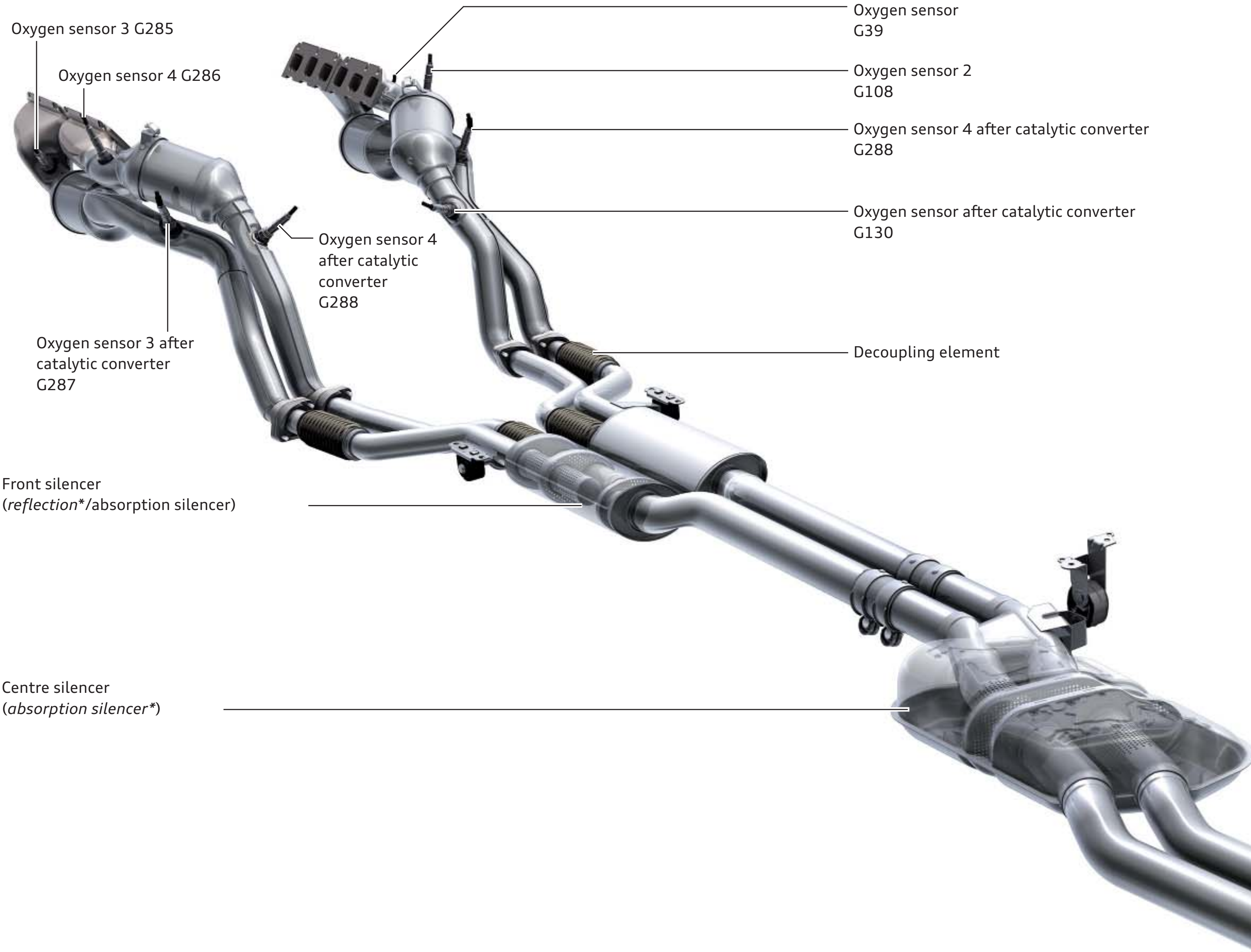


490_051

Reference
The figure shows a section of the topology of the Audi A8 ’10. For further information about the topology of the Audi A8 ’10, refer to Self Study Programme 459 "Audi A8 ’10 Onboard power supply and networking".

Exhaust system

Overview



Working on the exhaust system

The rear silencer, centre silencer and tailpipe are supplied ex works as a unit (OEM equipment).

If repair work is needed, however, the centre silencer and rear silencer can be replaced separately.

Note
For information on the interface between the centre and rear silencers, as well as assembly work, please refer to the Workshop Manual.

Exhaust flaps

A single exhaust flap is located on the tailpipes of the rear silencers on each side of the vehicle. The exhaust flaps are fitted to give the engine a sporty sound. The exhaust flaps are operated in such a way as to meet the statutory limits for vehicle exterior noise.

Low-frequency droning noise at low engine speeds is prevented. At high engine speeds and high exhaust gas flow rates, flow noise and exhaust backpressure are reduced by opening the additional cross-section. The exhaust gas flaps are closed at idle, low engine load and low engine speeds.

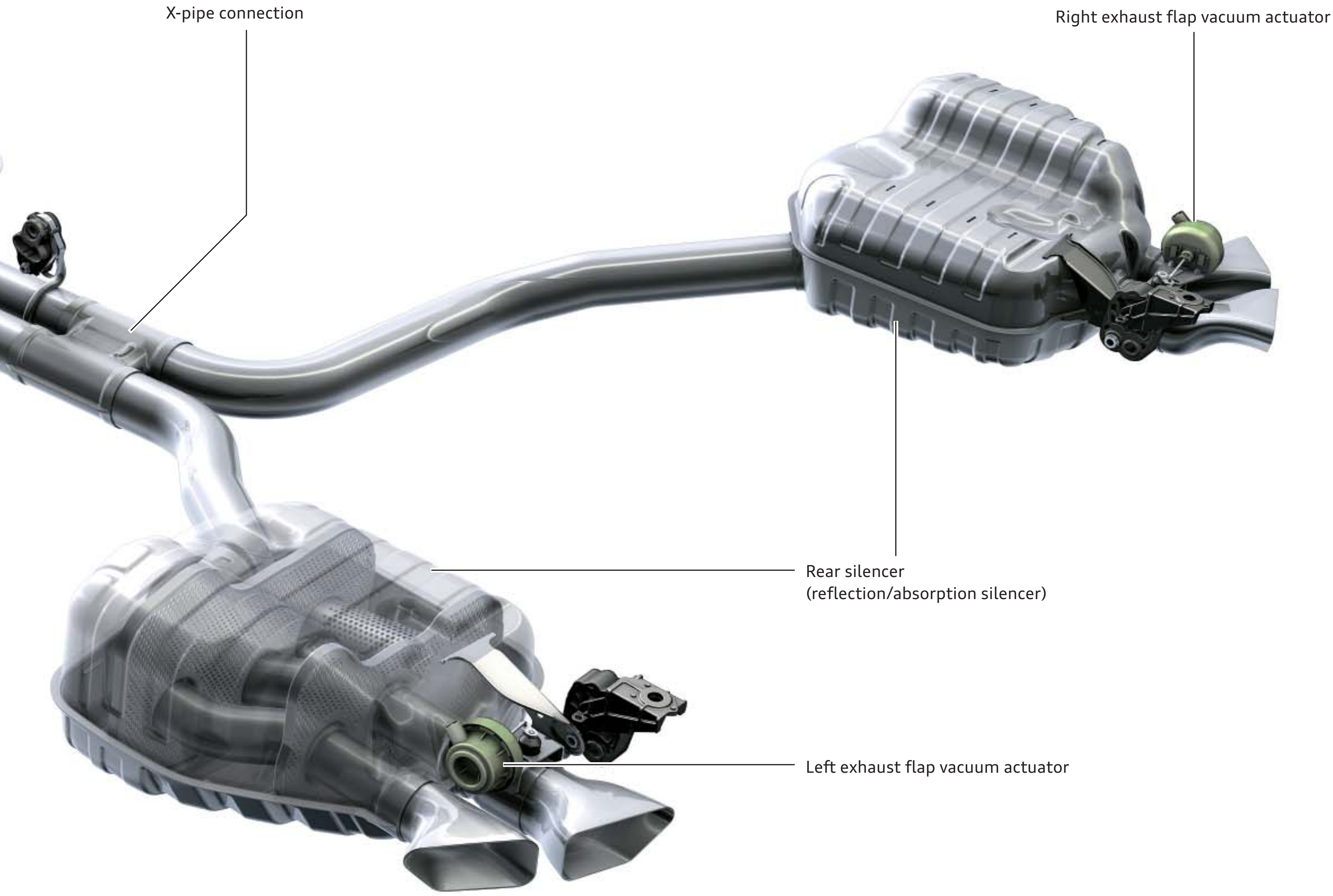
Function

The exhaust flaps are switched by a vacuum actuator. To ensure rapid switching of the exhaust flaps, each vacuum actuator has an additional vacuum reservoir (see overview of vacuum supply on page 22).
Both vacuum units are switched by an electrically activated solenoid valve:

- left: exhaust flap valve 1 N321
- right: exhaust flap valve 2 N322

The exhaust flaps are switched according to a characteristic map. The engine control units uses the following factors to plot the characteristic map:

- Engine load
- Engine speed
- Selected gear



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Service

Special tools

Assembly tool T40251

490_045

Assembling the crankshaft oil seal on the pulley side

Oil seal extractor T40249

490_046

Disassembling the crankshaft oil seal on the pulley side

Thrust piece T40250

490_047

Assembling the cylinder head cover oil seal

Thrust piece T10122/4

490_048

Assembling the PTFE crankshaft oil seal on the power output side

Engine and gearbox mounting VAS 6095/01-12

490_049

Maintenance operations

Maintenance work	Interval
Engine oil change interval with LongLife oil	Up to 30,000 km or 24 months depending on SID1) (change interval is dependent on driving style) Engine oil to VW standard 50400
Engine oil change interval without LongLife oil	Fixed interval of 15,000 km or 12 months (whichever occurs first) Engine oil to VW standard 50200 or 50400
Engine oil filter change interval	During every oil change
Engine oil change quantity (customer service)	11.5 litres (including oil filter)
Engine oil extraction / drainage	Extraction of the engine oil is not permitted.
The engine still has no electronic oil gauge - a dipstick is provided for checking the oil level.	
Air filter change interval	90,000 km
Fuel filter change interval	Lifetime
Spark plug replacement interval	60,000 km

[1] SID = Service Interval Display

Maintenance work	Interval
Poly V belt replacement interval	Lifetime
Poly V belt tensioning system	Lifetime (automatic tensioner pulley)
Timing gear chain replacement interval	Lifetime
Timing gear chain tensioning systems	Lifetime

Annex

Glossary

Absorption silencer

An absorption silencer contains porous material, normally rock wool, glass wool or glass fibre, which partially absorbs the sound energy by converting it to heat. The sound absorption effect is intensified by multiple reflection. A 50 dB(A) reduction in exhaust noise is possible, corresponding to a factor 300 reduction in sound pressure. Absorption principally attenuates high-band frequencies in the silencer.

Blow-by gases

Blow-by gases are also known as leakage gases. When the engine is running, blow-by gases flow from the combustion chamber and past the piston into the crankcase. This is due to the high pressure inside the combustion chamber and the absolutely normal leakage that occurs around the piston rings. Blow-by gases are extracted from the crankcase by the positive crankcase ventilation system and re-introduced into the combustion chamber.

Impactor

A system for separating liquid from a gas-fluid mixture. The gases are channelled in such a way that their direction of flow changes sharply several times. Due to their inertia, the liquid components collide with the walls and drip down into a collection chamber.

Reflection silencer

The reflection silencer comprises multiple (typically four) chambers designed to utilise the principle of sound reflection. The sound pressure amplitude is averaged during multiple passes through the inner chambers, thus reducing the sound pressure peaks.
Reflections are produced in a silencer by baffles, as well as cross-sectional widenings and narrowings. However, the exhaust gas backpressure increases depending on the design. Reflection principally attenuates low-band frequencies in the silencer.

Brake energy recuperation

Recuperation (Latin: "recuperare" = to recover, regain) is generally understood to describe the use of kinetic energy during deceleration phases of the vehicle. This means that the "free" energy produced during braking and overrun phases is recovered and stored in the vehicle battery.

TFSI

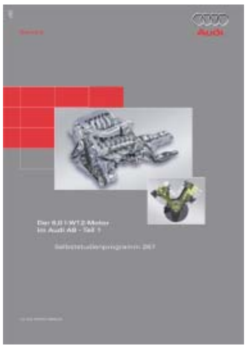
This stands for Turbo Fuel Stratified Injection - a technology used by Audi on turbocharged petrol engines for the purpose of injecting fuel directly into the combustion chamber. Fuel is injected at pressures of more than 100 bar.

Dry-sump lubrication

Dry-sump lubrication is a special type of forced-feed lubrication, where the oil pump supplies the engine lubrication points with fresh oil from a separate oil tank. This principle is applied to ensure an absolutely reliable oil supply even during extreme driving manoeuvres (longitudinal and transverse acceleration).

Self Study Programmes

This Self-Study Programme summarises all the key information you need to know about the 6.3l W12 FSI engine. You will find further information about the subsystems mentioned in this document in other Self-Study Programmes.



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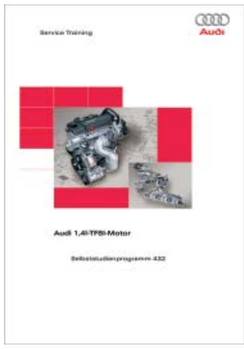

490_042

SSP 267 The 6.0l W12 engine on the Audi A8 - Part 1, order number: 140.2810.86.20
- Engine mechanicals
- W engine concept

SSP 268 The 6.0l W12 engine on the Audi A8 - Part 2, order number: 140.2810.87.20
- Water-cooled alternator
- Variable camshaft timing

SSP 432 The Audi 1.4l TFSI engine, order number: A08.5S00.48.20
- Operating principle of the high-pressure fuel pumps

490_043

490_052

SSP 451 Audi TT RS with 2.5l R5 TFSI engine, order number: A10.5S00.67.20
- Operating principle of the oil pump

SSP 459 Audi A8 '10 Onboard power supply and networking,order number: A10.5S00.63.20
- Topology

I/VK-35
service.training@audi.de

AUDI AG
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