eSelf Study Program 920253

The Audi 1.4l TFSI Engine

Audi Academy

Audi of America, LLC
Service Training
Created in the U.S.A.
Created 8/2015
Course Number 920253

Always check Technical Bulletins and the latest electronic service repair literature for information that may supersede any information included in this booklet.

eMedia

This eSSP contains video links which you can use to access interactive media.

Revision 1:8/2015

This eSelf Study Program teaches a basic knowledge of the design and functions of new models, new automotive components or technologies.
It is not a Repair Manual! All values given are intended as a guideline only.
For maintenance and repair work, always refer to the current technical literature.

! **Note**

Reference

Introduction

The 1.4l TFSI engine used in the A3 Sportback e-tron is from the EA211 series of 4-cylinder engines used by Audi worldwide. This is the first use of this engine in the North American market.

It is derived from the EA111 series of 4-cylinder engines but has been further refined to be lighter, more fuel efficient, and reduce emissions. It is compactly dimensioned for vehicles using the cross-platform modular component set (MQB).

In some markets, a selective cylinder shut-down capability that enables two of the four cylinders to be shut down when driving situations allow is employed. However, in the North American market this feature will not be used.

The 1.4l TFSI engine develops 147 hp (110 kw) and is coupled to the e-machine (Electro-drive Drive Motor V141) and six-speed DSG transmission 0DD.

1.4l TFSI engine

616_015a

Learning objectives of this self-study program

Upon completion of this Self-Study Program, you be able to answer the following questions:

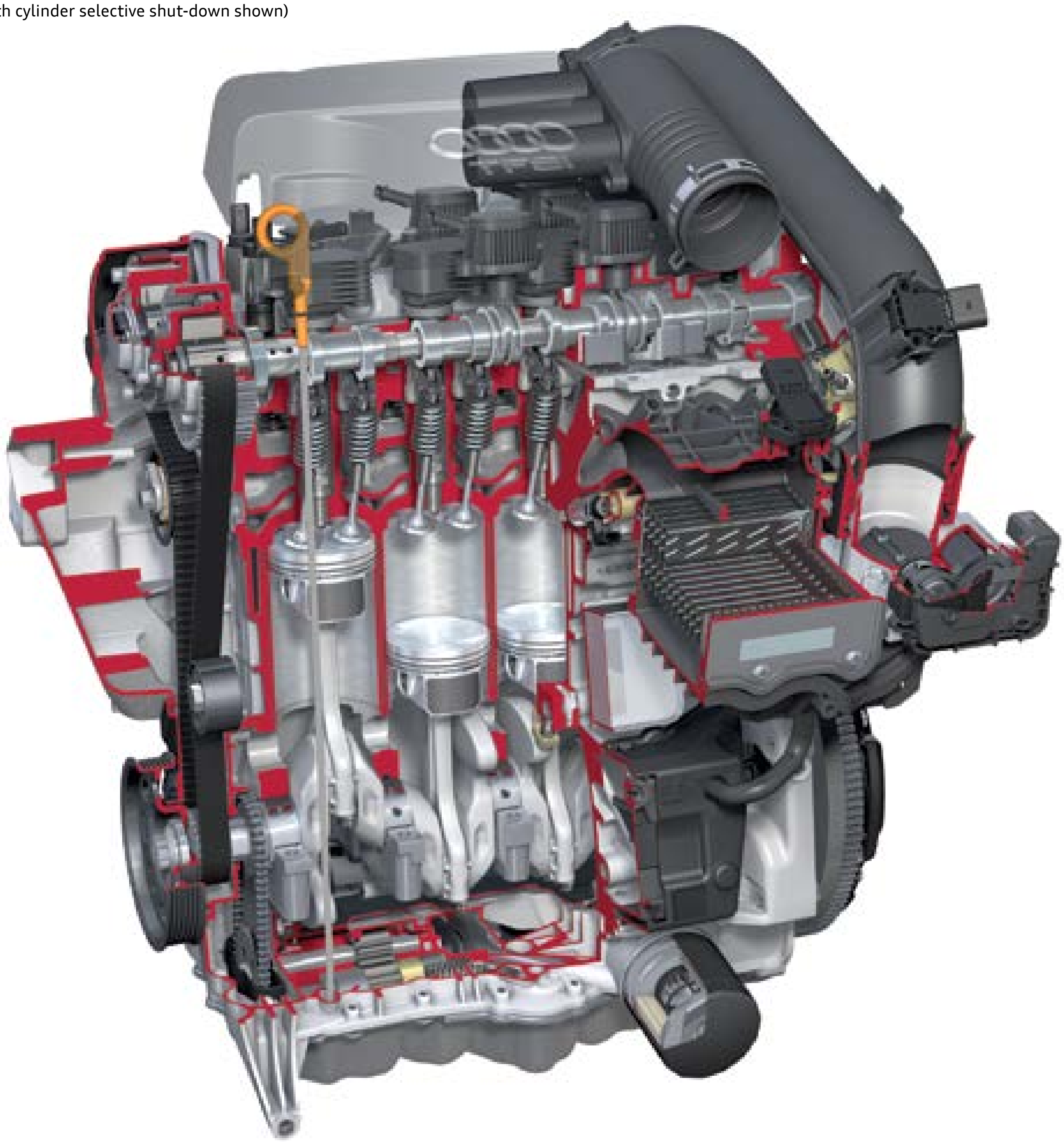
- How is the engine constructed?
- How does the engine cooling system function?
- How does the intake air and turbocharger system function?

Brief technical description

- Four-cylinder in-line engine.
- Four valves per cylinder, double overhead camshafts (DOHC).
- FSI direct injection.
- Cast aluminium cylinder block.
- Turbocharger with indirect intercooler.
- Intercooler integrated in intake manifold (air/coolant heat exchanger).
- Belt driven camshafts.
- Emission control system with ceramic catalytic converter and converter heating function using two-stage injection (homogeneity split).
- Energy recovery system in over-run mode.

1.4l TFSI engine

(Engine with cylinder selective shut-down shown)



616_014

Internal combustion engine and e-machine with transmission

627_107

Features	Specifications
Engine code	CUKB
Type	Four-cylinder in-line engine
Internal combustion engine output	150 hp (110 kW) at 5000 - 6000 rpm
Electric motor output	102 hp (75 kW) at 2000 - 2300 rpm
System output	150 kW
Torque of internal combustion engine	184 lb ft (250 Nm) at 1600 - 3500 rpm
Electric motor torque	243 lb ft (330 Nm) at 2200 rpm
System torque	258 lb ft (350 Nm)
Displacement in cm^3	1395
Stroke	3.1 in (80 mm)
Bore	2.9 in (74.5 mm)
Number of valves per cylinder	4
Firing order	1–3–4–2
Compression ratio	10 : 1
Fuel type	Premium 91 AKI
Turbocharging	Exhaust turbocharger
Engine management system	Bosch MED 17.01.21
Powertrain type	6-speed dual clutch transmission (S tronic)
Oxygen sensor control	1 sensor upstream of catalytic converter and 1 sensor downstream of catalytic converter
Mixture formation	Direct injection
Emission standard	SULEV

Power and torque specifications

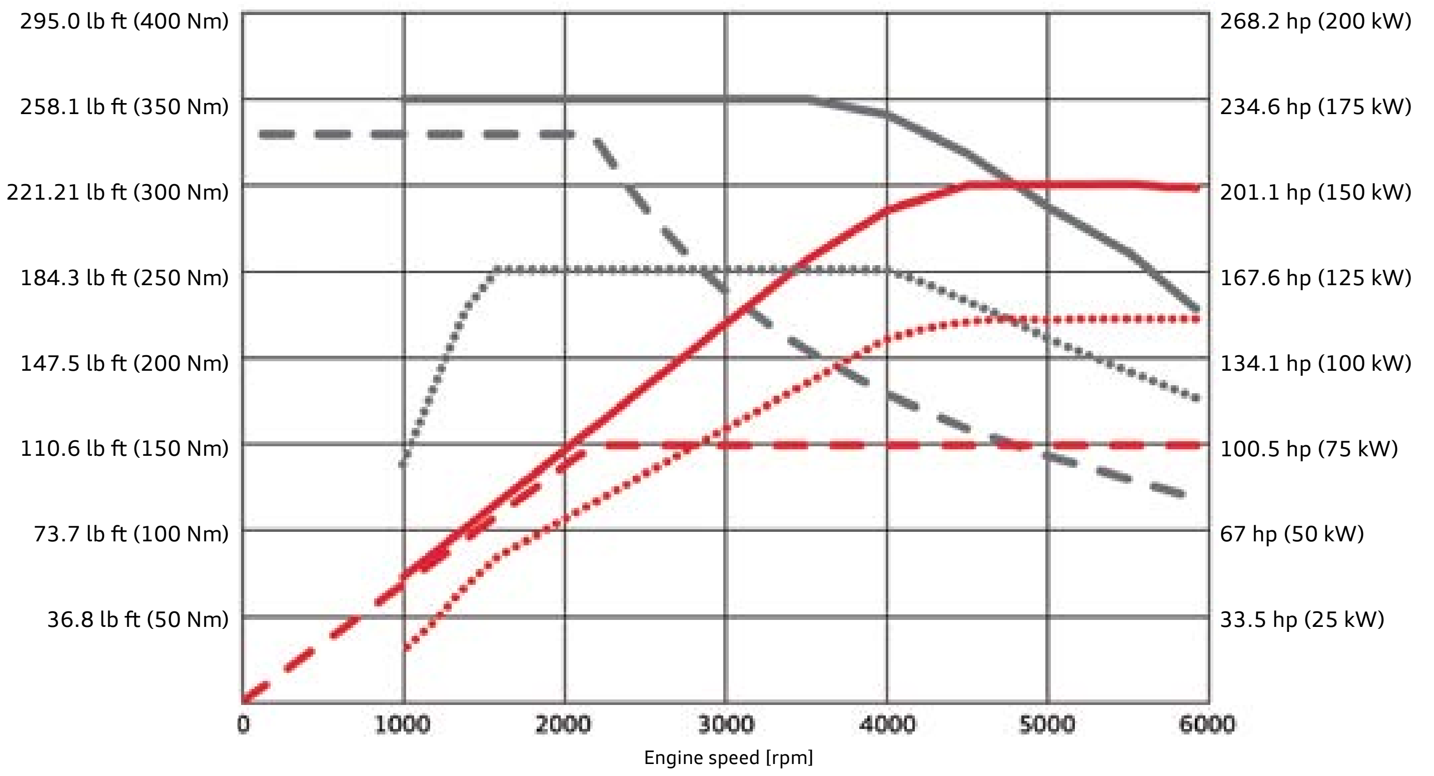
EA211 series 1.4l TFSI engine CUKB and Electro-drive Drive Motor V141 as used in the 2016 A3 Sportback e-tron

Torque in Nm

- Internal combustion engine (dotted)
- Electric motor (dashed)
- System (15 seconds) (solid)

Power in hp

- Internal combustion engine (dotted)
- Electric motor (dashed)
- System (15 seconds) (solid)



627_093

Notes

Engine mechanicals

Cylinder block

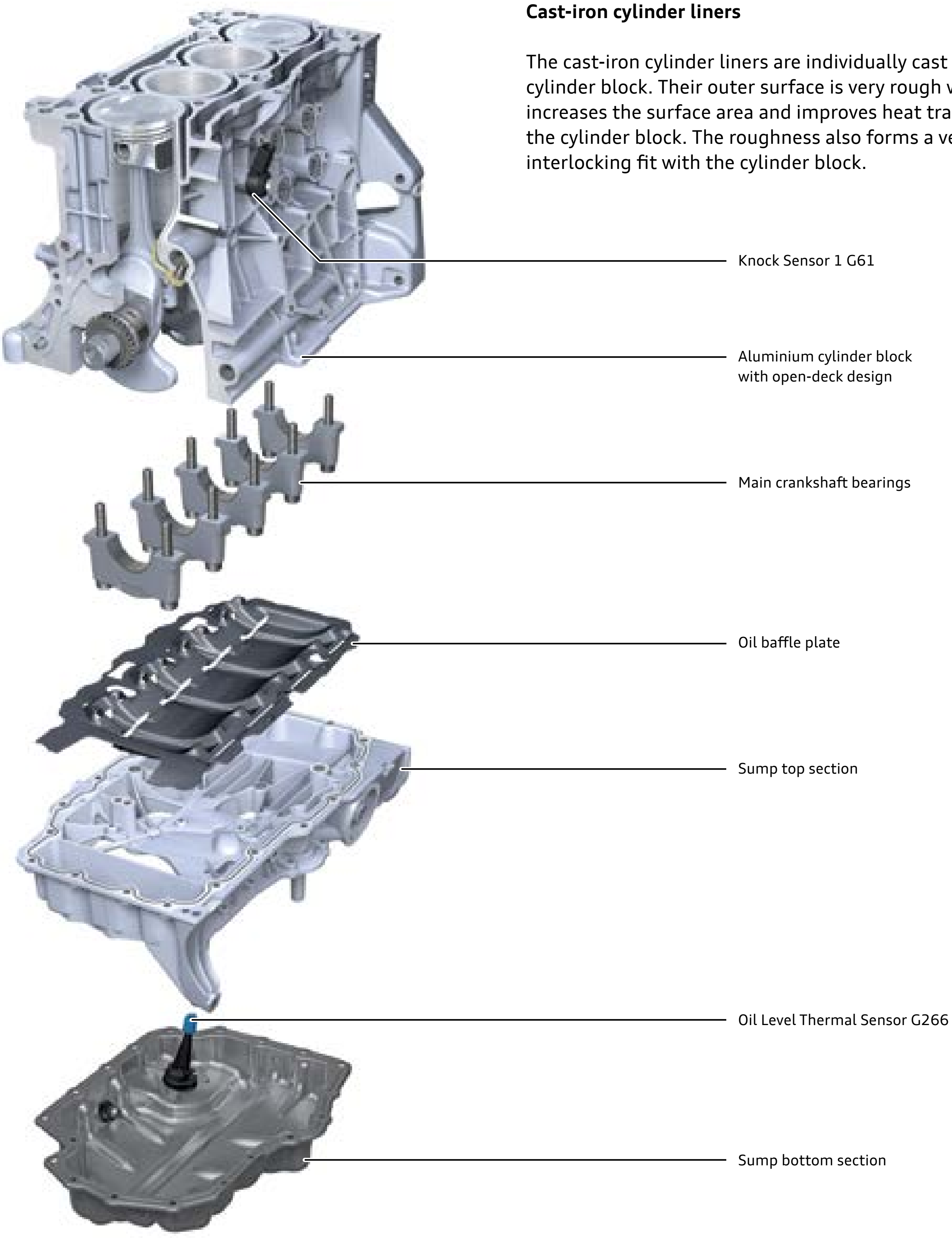
The cylinder block is made of die-cast aluminum and is an open-deck design. The advantages and disadvantages of an open-deck design are:

- It is easier and more economical to manufacture from the point of view of casting technology.
- More efficient cooling of the upper, (and hotter) part of the cylinders compared with a closed-deck design
- It is less rigid when compared to a closed-deck design. This is compensated by the use of a metal cylinder head gasket.
- There is deformation of the cylinder liner when the cylinder head and cylinder block are bolted together.
- The slight cylinder liner deformation is easily compensated by the piston rings (oil consumption is also lower).

The engine oil galleries (both pressure and return) and those for crankcase venting are cast integral with the crankcase. This reduces the number of additional components and manufacturing complexity.

Cast-iron cylinder liners

The cast-iron cylinder liners are individually cast inside the cylinder block. Their outer surface is very rough which increases the surface area and improves heat transfer to the cylinder block. The roughness also forms a very good interlocking fit with the cylinder block.



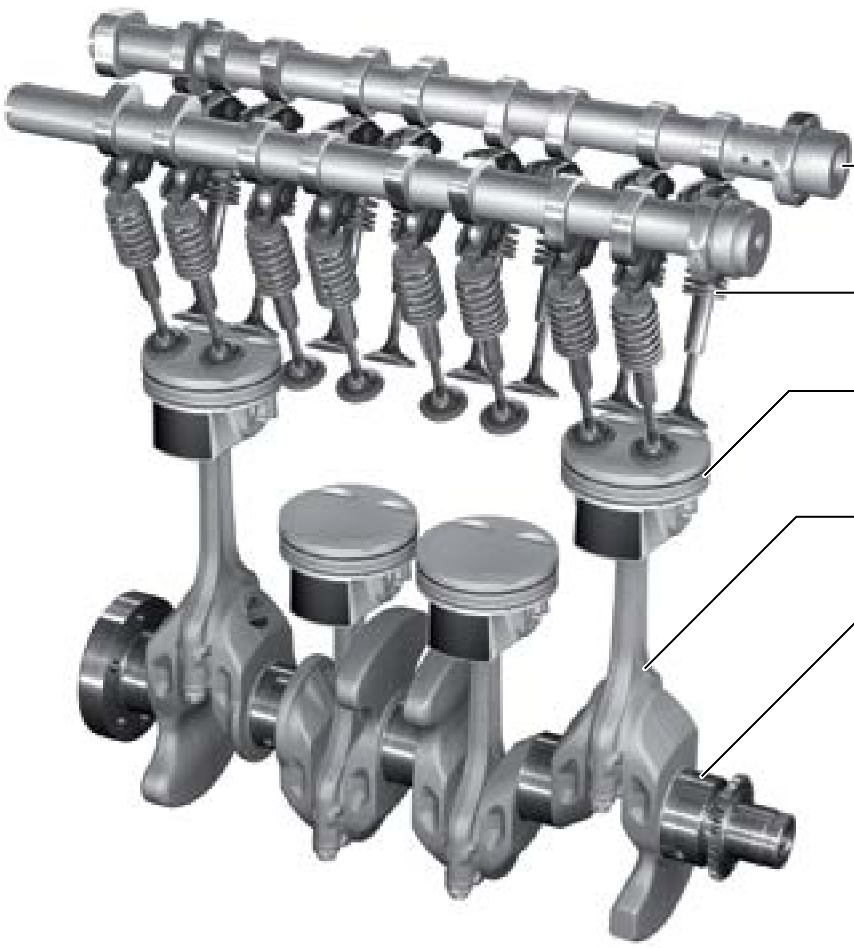
616_006

Crankshaft drive system and valve gear

The crankshaft drive components have been designed with small moving masses and low friction as a priority. The connecting rods and pistons have been optimized for weight.

The lightweight crankshaft with four counterweights, runs in five main bearings. The use of only four counterweights reduces the internal crankshaft forces and therefore the stress on the main bearings.

Crankshaft drive and valve gear on 1.4l TFSI engine



616_019

Pistons and connecting rods

The pistons are made of die-cast aluminum. To reduce the thermal stresses, oil injectors spray engine oil onto the piston crown from underneath.

The lightweight forged connecting rods have cracked big ends. The small end has a trapazoidal profile but does not have a pressurized oil supply.

The aluminum pistons have a flat crown and have optimized for weight. The wrist pins are hollow.

616_039

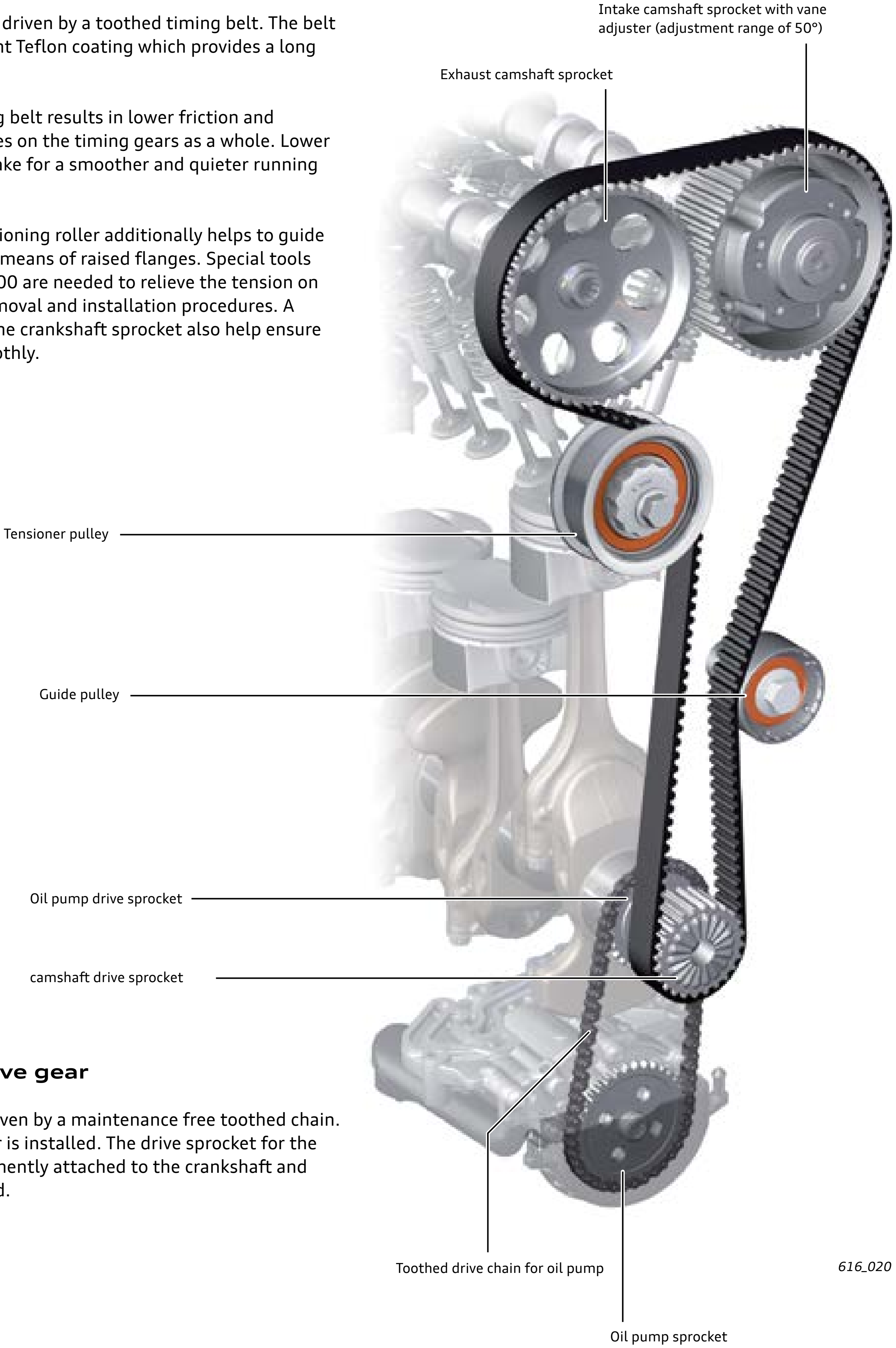
Note
The crankshaft must not be removed. For more information, please refer to ElsaPro.

Camshaft drive

The camshafts are driven by a toothed timing belt. The belt has a wear resistant Teflon coating which provides a long service life.

The use of a timing belt results in lower friction and mechanical stresses on the timing gears as a whole. Lower vibration levels make for a smoother and quieter running engine.

An automatic tensioning roller additionally helps to guide the timing belt by means of raised flanges. Special tools T10499 and T10500 are needed to relieve the tension on the belt during removal and installation procedures. A guide pulley and the crankshaft sprocket also help ensure the belt runs smoothly.



616_020

Oil pump drive gear

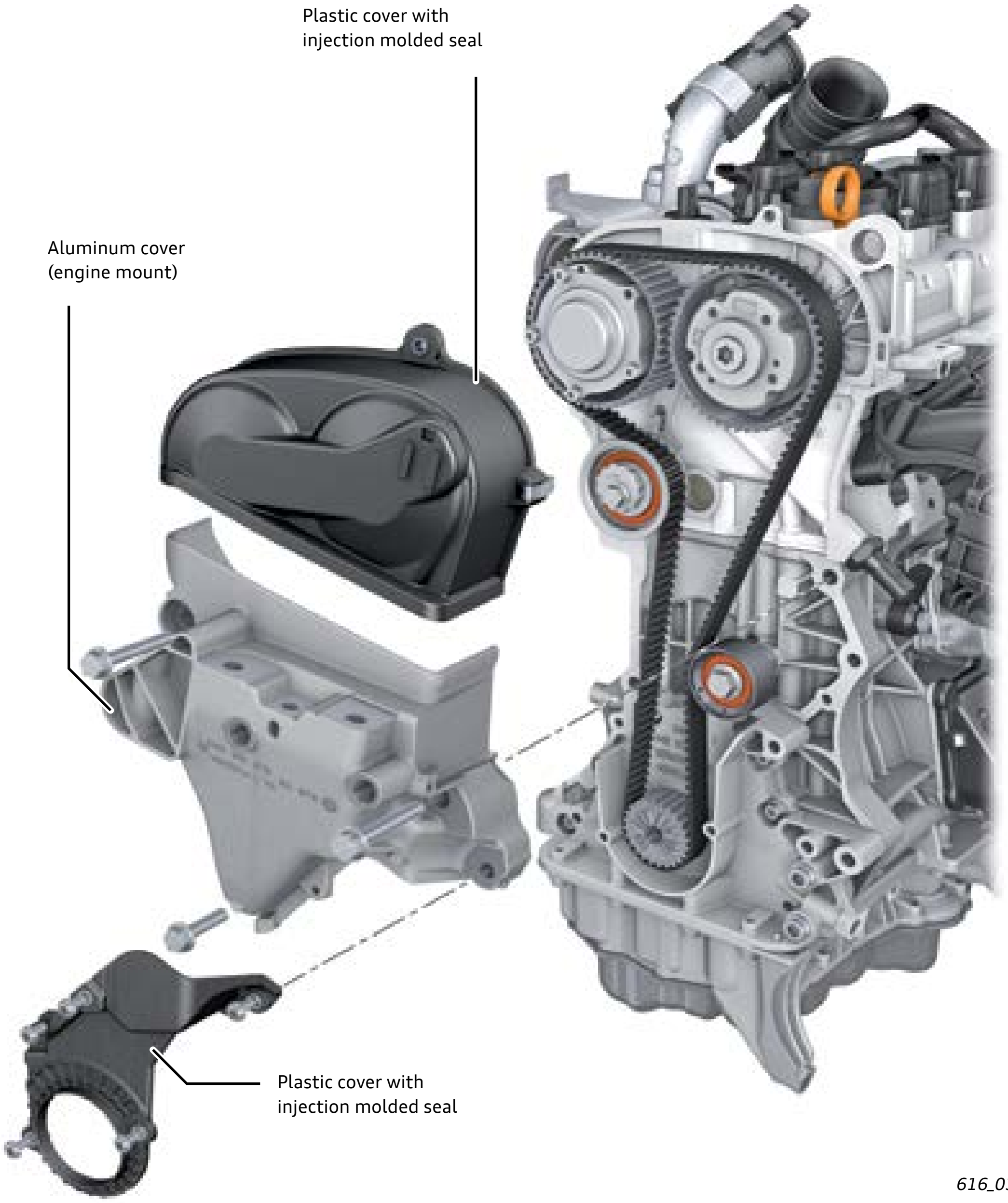
The oil pump is driven by a maintenance free toothed chain. No chain tensioner is installed. The drive sprocket for the oil pump is permanently attached to the crankshaft and cannot be removed.

Timing belt cover

The timing belt is protected from dust and dirt by a three-piece timing belt cover.

The aluminum center section of the timing belt cover also serves as an engine mounting point.

During repairs that require the removal of the timing belt from the cylinder head, the center section of the cover can remain in place. There is sufficient room to tension the belt.



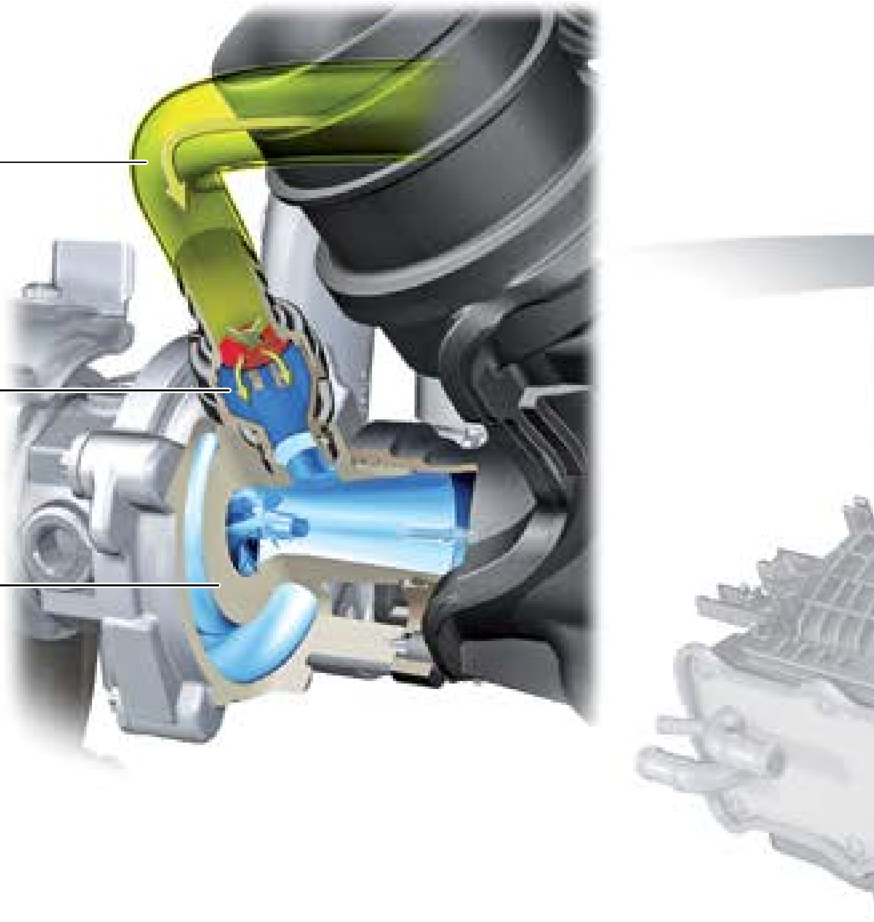
616_032

Crankcase ventilation

Cleaned blow-by gases flow through channels in the cylinder block to the intake pipe upstream of the turbocharger or into the intake manifold downstream of the turbocharger.

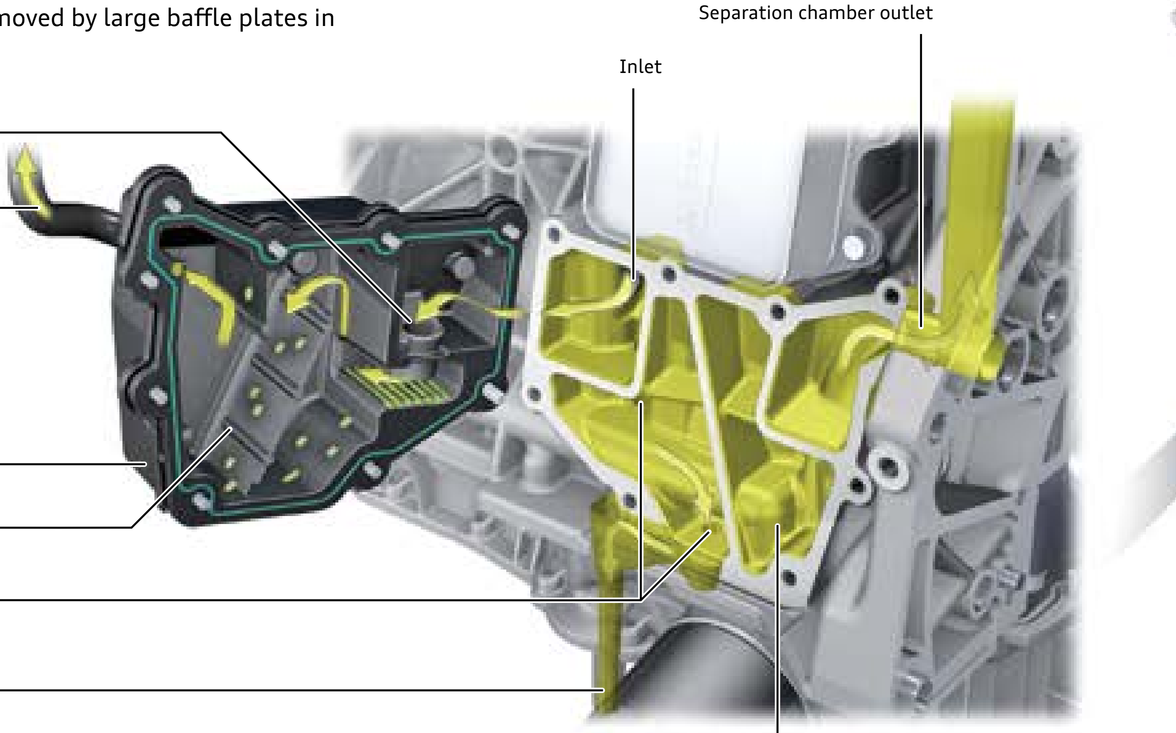
The oil vapors are removed by the plastic oil separator bolted to the cylinder block.

Inlet of blow-by gases on intake side of turbocharger (at high engine speeds)



Oil separator

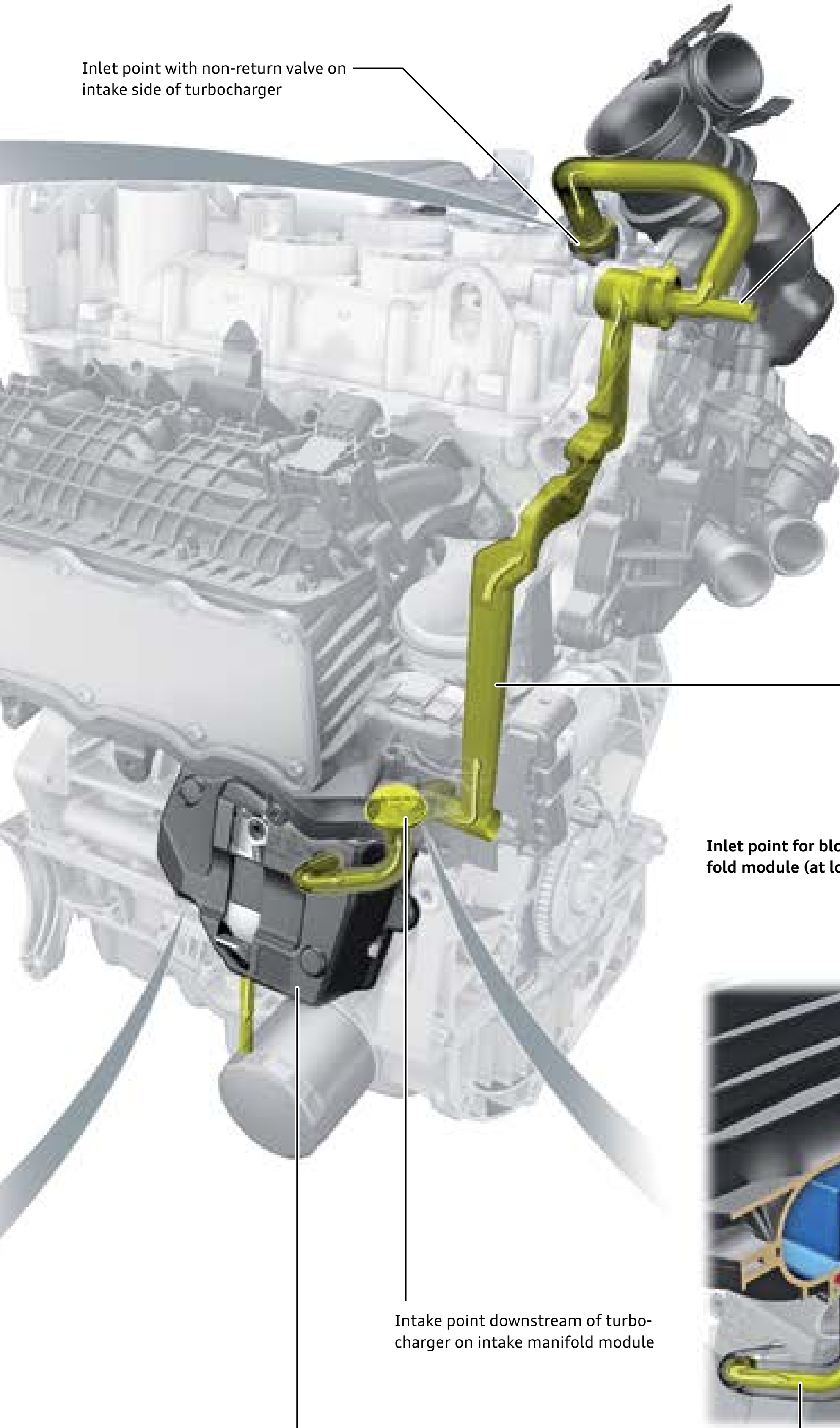
The gases flow from the crankcase into the oil separator. There, the large droplets of oil are separated by means of baffle plates and swirl channels in the coarse separator. Then the fine droplets are removed by large baffle plates in the fine separator.



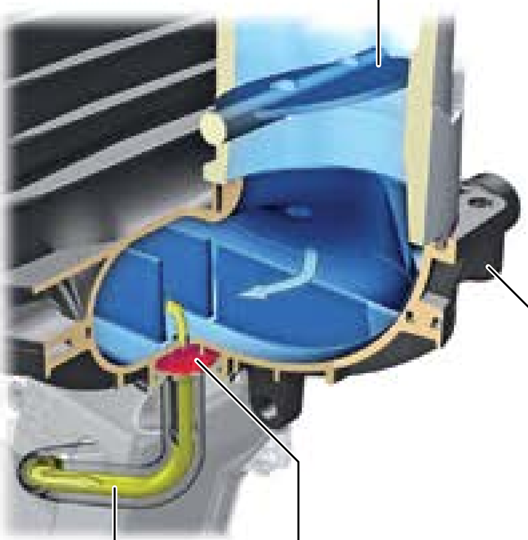
Non-return valves

The non-return valves control recirculation of the cleaned blow-by gases based on the pressure conditions in the air intake system. If there is negative pressure in the intake manifold at idling or higher engine speeds, the vacuum effect opens the valve in the intake manifold module and closes the valve on the intake side of the turbocharger.

If there is positive pressure in the intake manifold when the turbocharger is working, that pressure closes the valve in the intake manifold module. At the same time, the valve on the intake side of the turbocharger is opened by the pressure differential present. That means that the pressure on the intake side of the turbocharger is lower than the pressure inside the crankcase.



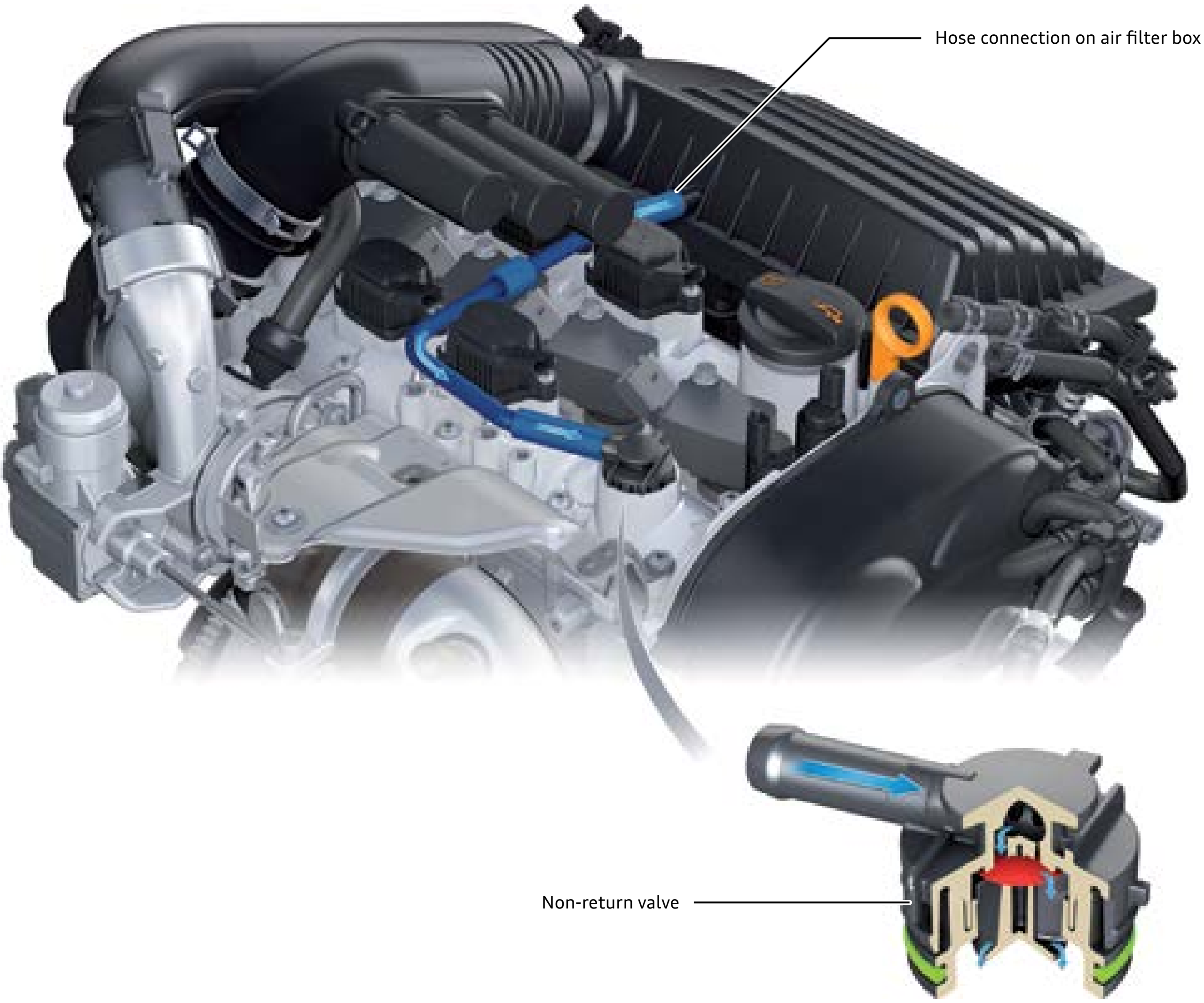
Inlet point for blow-by gases downstream of turbocharger on intake manifold module (at low engine speeds)



616_017

A non-return valve is located in the crankcase ventilation system. It allows fresh air to circulate and carry harmful condensation and fuel constituents from the cylinder block and oil sump. If there is sufficient negative pressure inside the engine, fresh air is passed from the clean side of the air filter into the engine and is subsequently fed back into the cylinders together with the blow-by gas.

To achieve that, the non-return valve must open at the slightest degree of depression inside the engine. The routing of the hose may vary depending on the engine variant. The non-return valve in the cylinder head cover prevents the oil or unfiltered blow-by gas from entering the air filter and contaminating it.



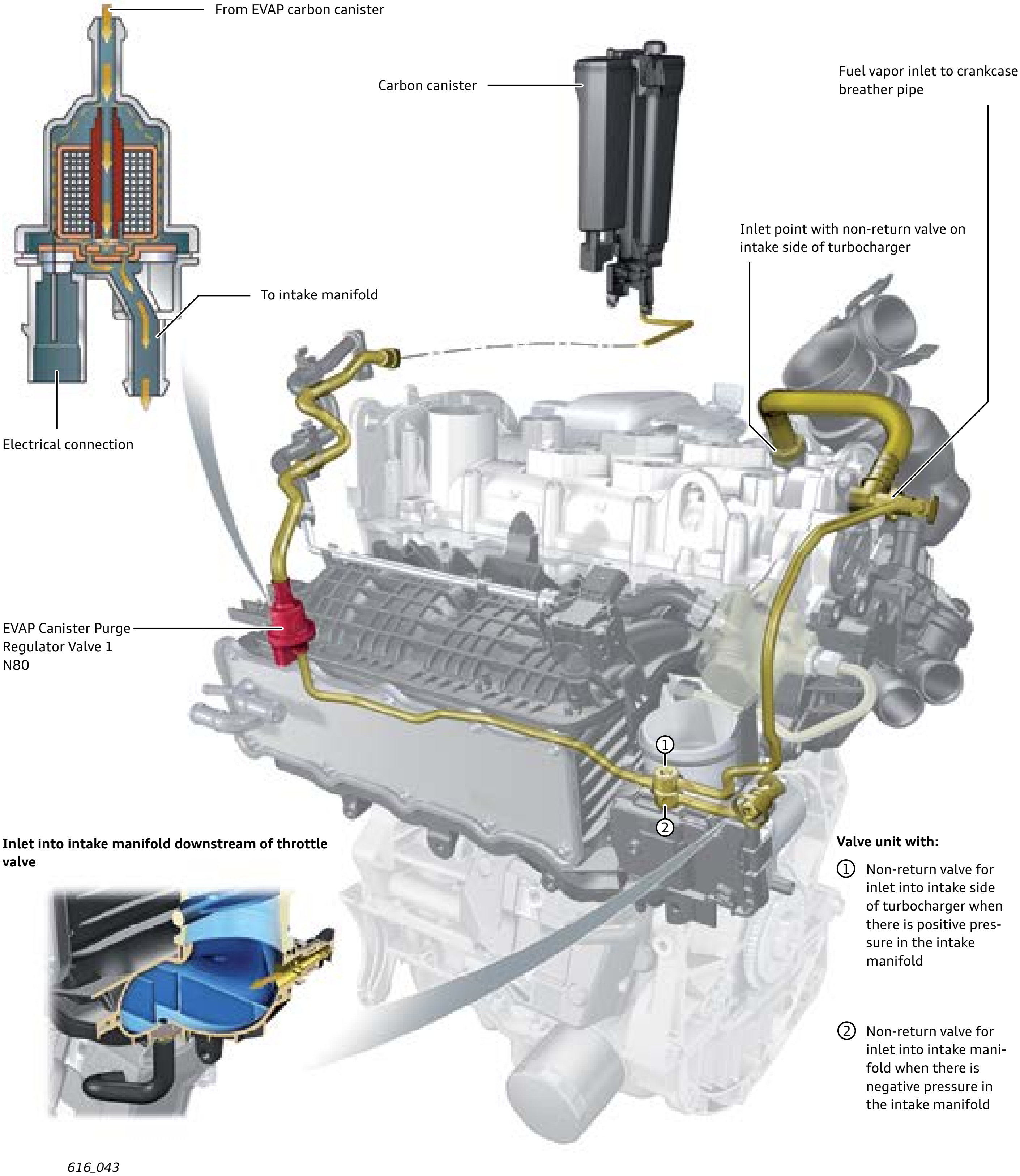
616_042

Evaporative emission system

The evaporative emission system of the 1.4l TFSI engine is similar to those used on other turbocharged gasoline engines. The carbon canister is located on the fuel filler neck at the right rear of the vehicle.

Fuel vapors are supplied to the intake manifold at two different points depending on the engine speed. EVAP Canister Purge Regulating Valve 1 N80 is controlled by the ECM and meters the amount of fuel vapor taken in by the engine.

At idling speed and at low to medium engine loads, fuel vapors are fed into the intake manifold downstream of the throttle valve because of the lower pressure in the intake system. When the engine is running under boost conditions, vapors are fed into the system upstream of the turbocharger. Two non-return valves prevent fuel vapors from returning to the carbon canister.



616_043

Cylinder head

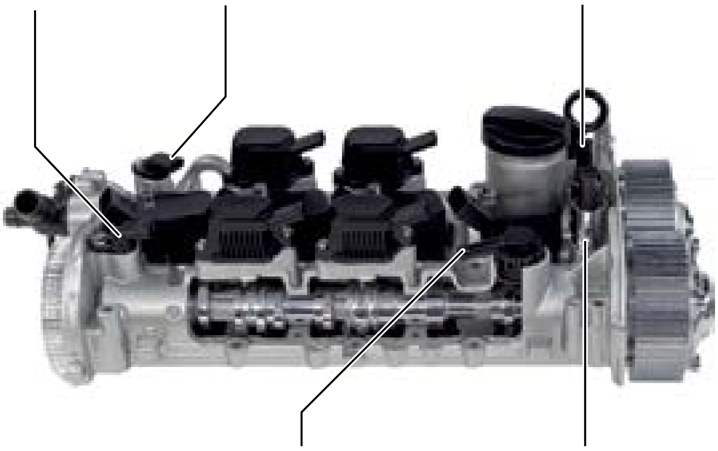
Technical features

- Aluminum cylinder head with twin composite camshafts.
- Four valves per cylinder.
- Modular-design cylinder-head cover.
- Variable inlet camshaft timing on all models, adjustment range 50°, lockable in retarded position.
- Variable exhaust camshaft timing, adjustment range 40°, lockable in advanced position.
- Central positioning of spark-plugs (at center of valve star).
- High-pressure fuel pump driven by intake camshaft (four-lobe cams).
- Integral exhaust manifold.
- Cross-flow cooling, see "Cylinder head cooling" on page 24.

Modular-design cylinder-head cover

The cylinder head cover is made of die-cast aluminum and forms a single, non-separable unit with the two camshafts. This means that the four-bearing camshafts cannot be removed.

To reduce friction, the first bearing of each camshaft, which is subject to the greatest loads from the belt-drive timing gear, is a deep groove ball bearing.



616_040

Integral exhaust manifold

In the integral exhaust manifold, the four exhaust ports are routed inside the cylinder head to a central flange. The catalytic converter is mounted directly on that flange.

As well as increasing fuel efficiency and thermal advantages, this design saves approximately 4.4 lb (2.0 kg) in weight compared to a conventional exhaust manifold.

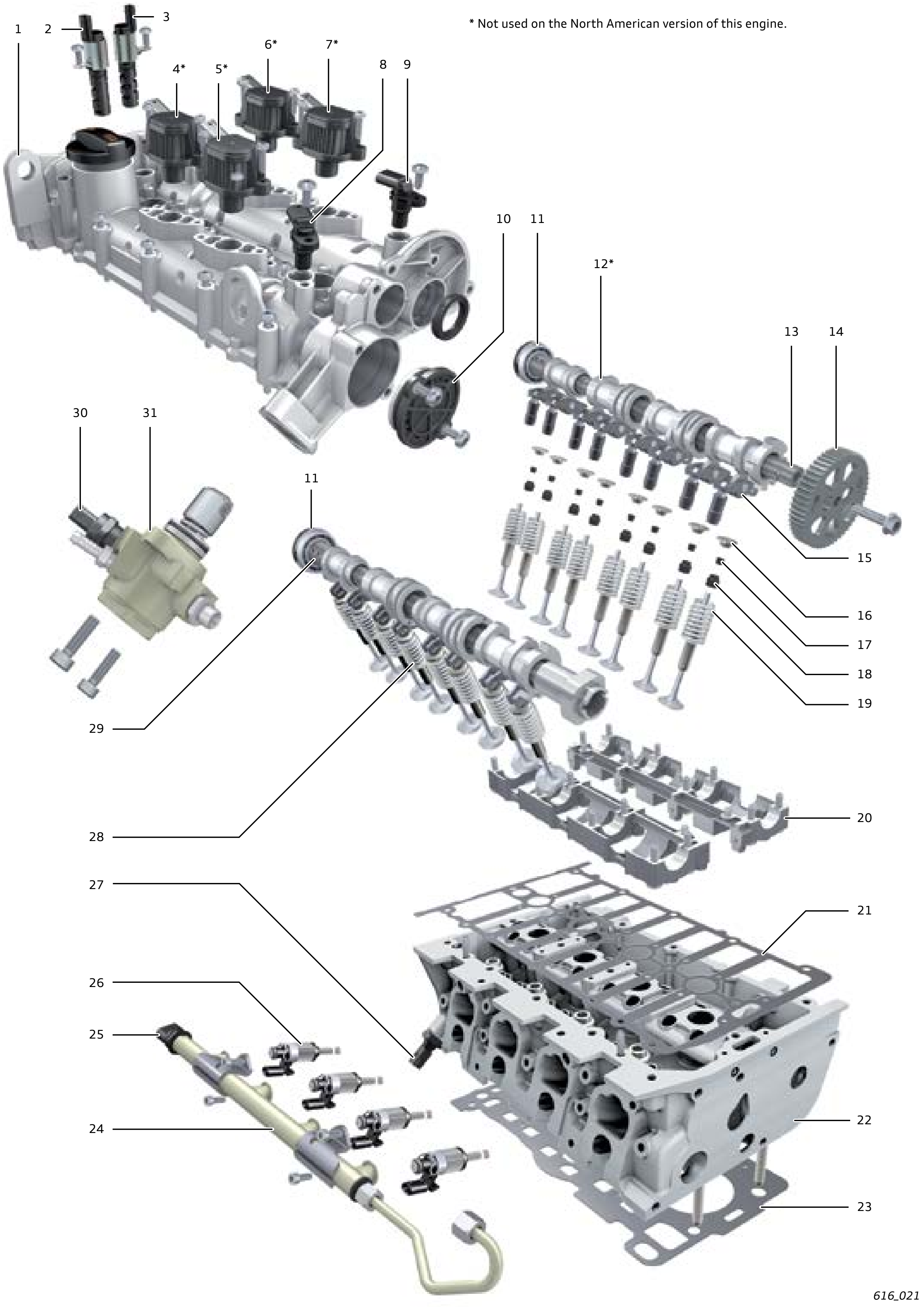

616_034

Key to illustration on Page 15

1 Cylinder head cover
2 Camshaft Adjustment Valve 1 N205
3 Exhaust Camshaft Adjustment Valve 1 N318
4 Cylinder 2 Intake Camshaft Adjuster N583*
5 Cylinder 3 Intake Camshaft Adjuster N591*
6 Cylinder 2 Exhaust Camshaft Adjuster N587*
7 Cylinder 3 Exhaust Camshaft Adjuster N595*
8 Camshaft Position Sensor G40
9 Camshaft Position Sensor 2 G163
10 Camshaft cover
11 Deep-groove ball bearing
12 Sliding cam sleeve*
13 Exhaust camshaft
14 Coolant pump drive sprocket
15 Roller-lever cam follower with support
16 Valve spring retainer
17 Valve stem oil seal
18 Valve collets
19 Valve spring
20 Camshaft bearing cap
21 Cylinder head cover gasket (metal gasket)
22 Cylinder head
23 Cylinder head gasket
24 Fuel rail
25 Fuel Pressure Sensor G47
26 Fuel Injectors 1- 4 (N30 - N33)
27 Oil Pressure Switch F1
28 Intake valve
29 Intake camshaft
30 Fuel Pressure Regulator Valve N276
31 High-pressure fuel pump

* Not used on the North American version of this engine.

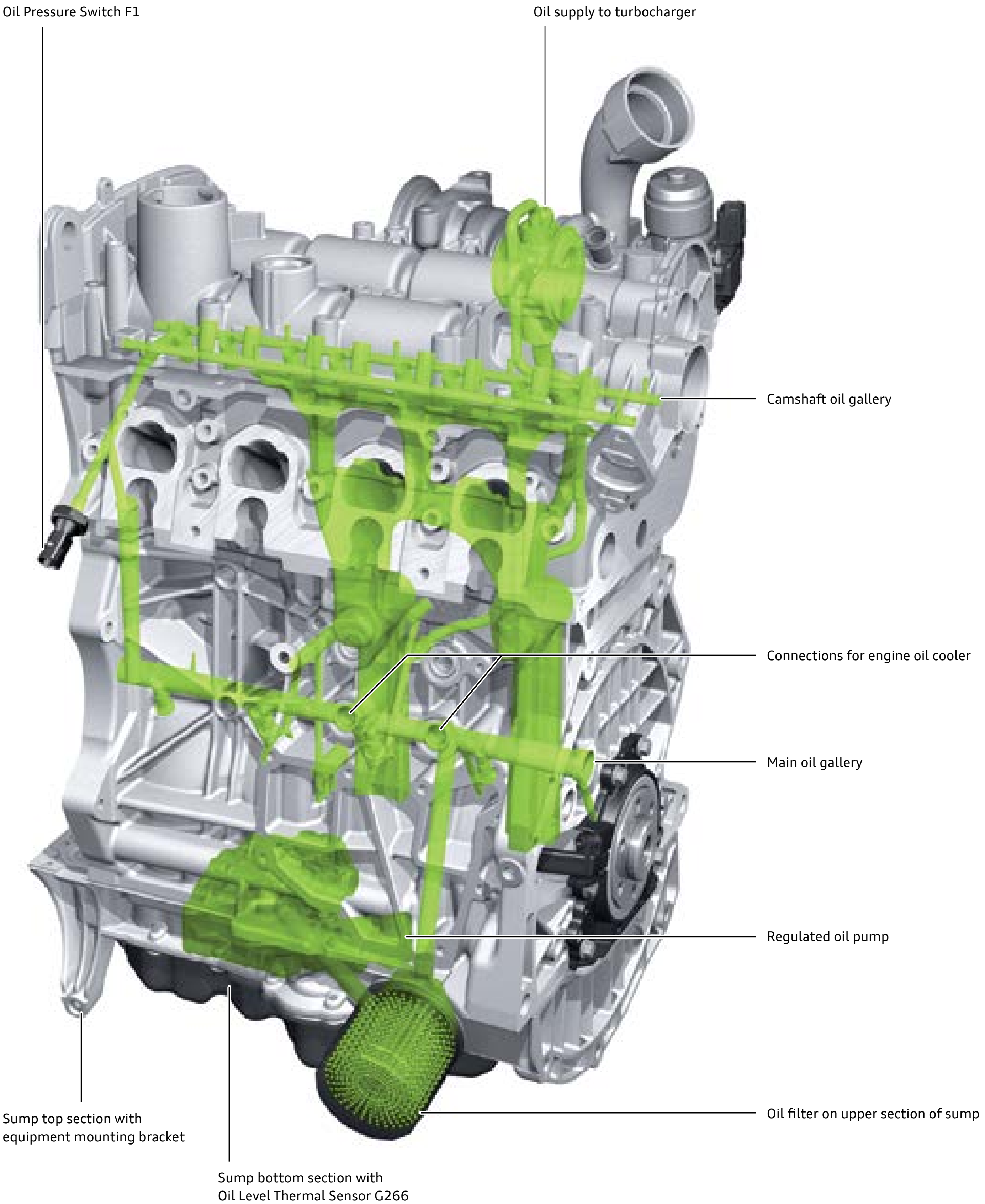
Layout on 1.4l TFSI with cylinder shut-down feature



Oil supply

Oil circulation system

The oil system supplies all bearings, the piston cooling jets, the variable valve timing system, the valve gear and the turbocharger with sufficient oil for lubrication.

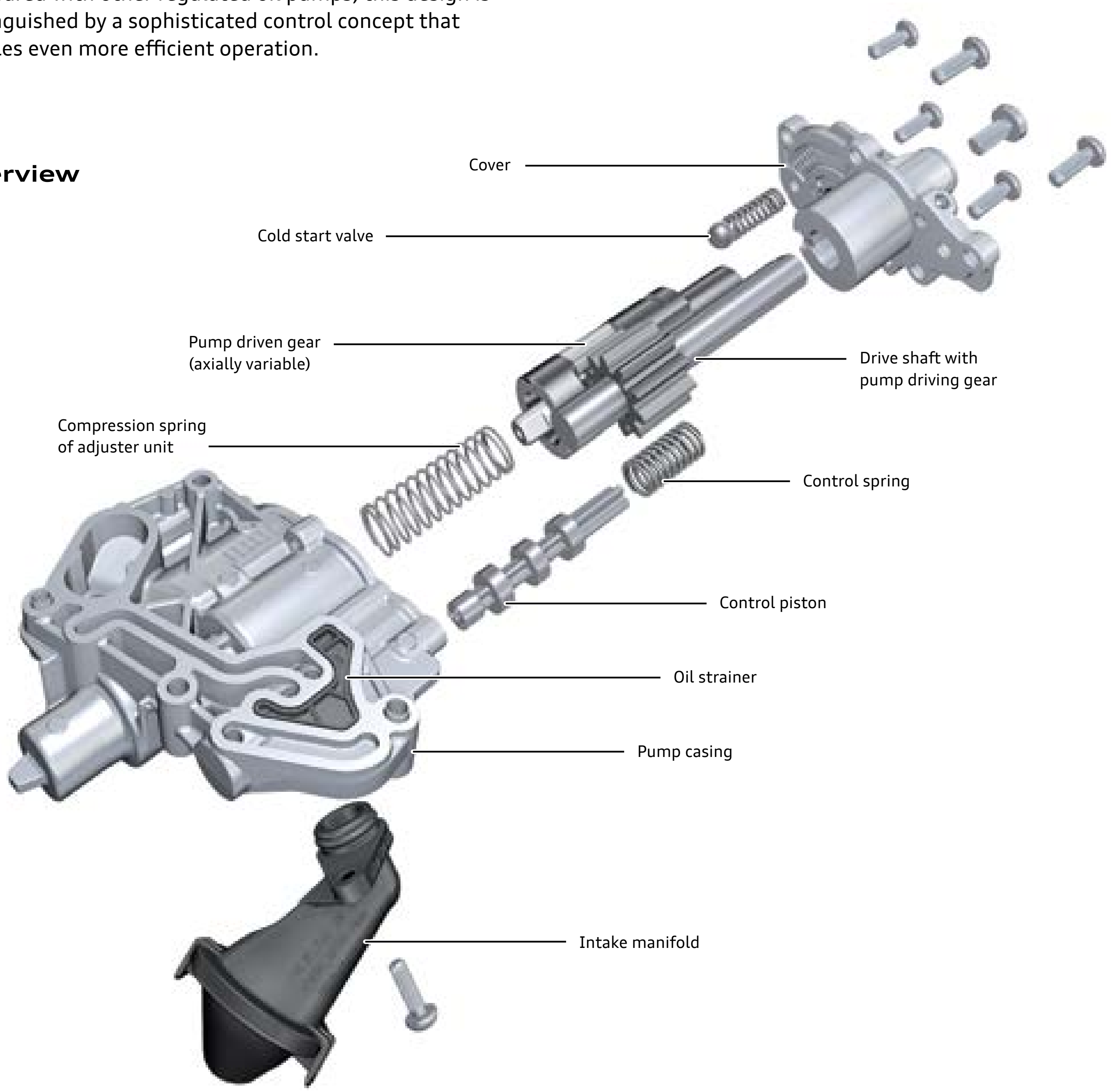


616_002

Regulated oil pump

Compared with other regulated oil pumps, this design is distinguished by a sophisticated control concept that enables even more efficient operation.

Overview



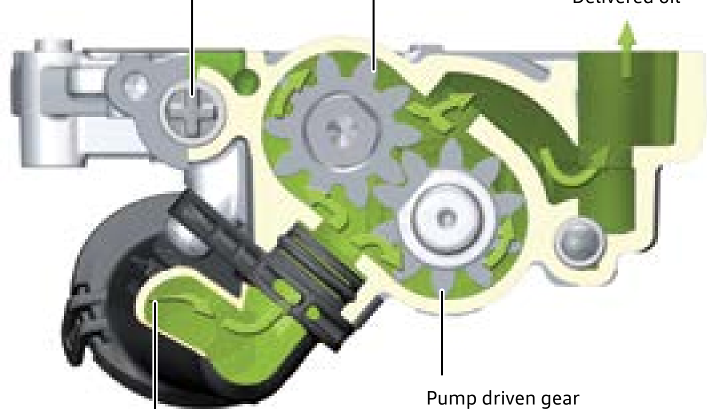
616_003

Design

In terms of its basic design, the oil pump is a spur-gear pump.

One of the pump gears is axially variable (pump driven gear). By varying the axial position of the gear, the delivery rate and pressure can be regulated in a controlled manner.

Control of the oil supply for operating the regulating piston is performed by Oil Pressure Regulation Valve N428.



616_022

Reference
More information on the regulated oil pump can be found in eSelf-Study Program 922903 Audi 2.0L TFSI Engine with AVS.

Oil Pressure Regulation Valve N428

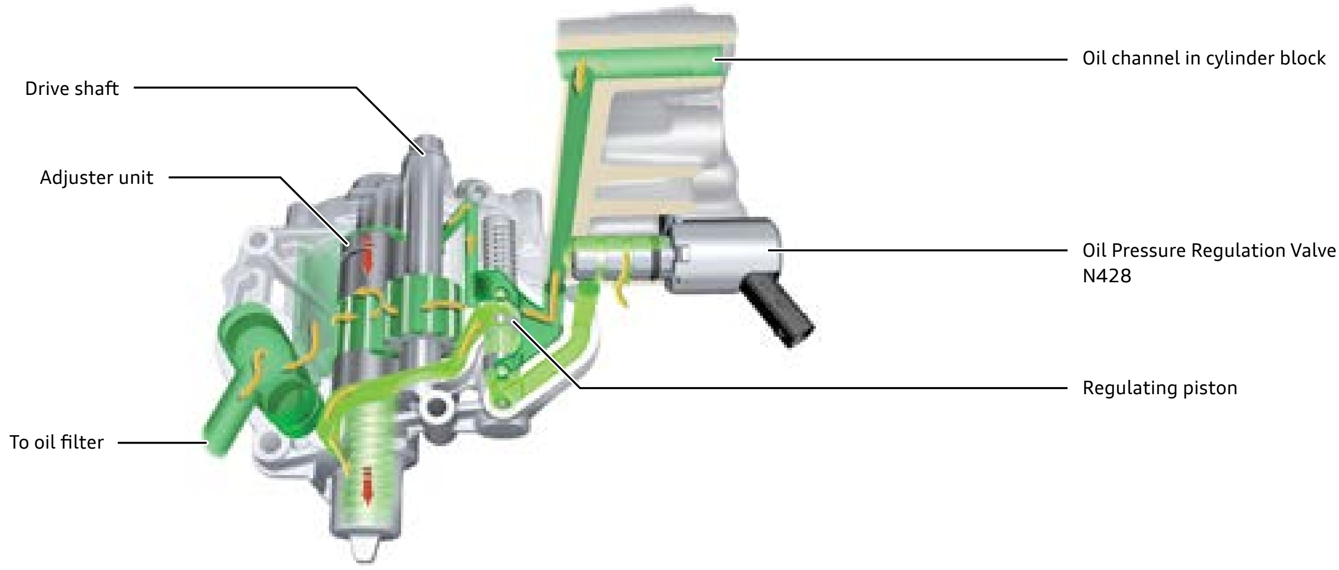
Oil Pressure Regulation Valve N428 is responsible for supplying the oil pressure for the regulation piston of the oil pump. It is located on the rear of the cylinder block and is controlled by the ECM.

During low engine speed operation, N428 is connected to ground by the ECM which switches the oil pump to its lower pressure setting.

The lower pump pressure is selected according to engine load, engine speed, oil temperature and other operating parameters.

In that setting, the power required to drive the oil pump is reduced, which lowers fuel consumption.

During high speed operation or under high engine loads (acceleration at full power), N428 is disconnected from ground by the ECM. This switches the oil pump to its higher pressure setting. In both pressure settings, the pump delivery is varied by an adjuster unit to suit variations in the engine's oil requirements.



616_046

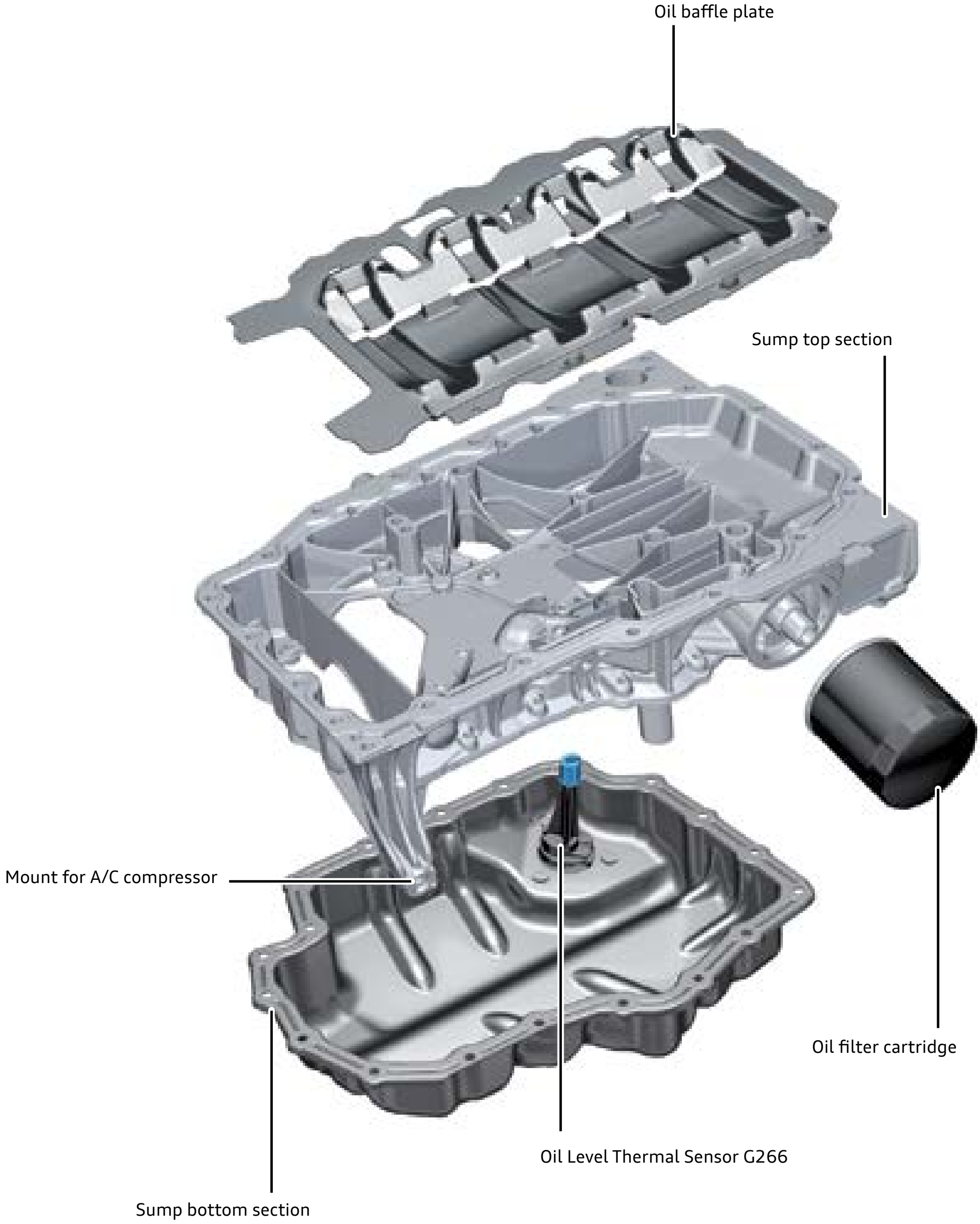
Sump

1.4l TFSI engine

The oil filter is mounted to the cast aluminum sump top section. The sheet steel sump bottom section is bolted to the bottom of the upper oil sump.

A diaphragm valve in the filter prevents oil from draining out when the engine is not running.

Underneath the crankshaft is the oil baffle plate which separates the crankshaft drive gear from the sump.

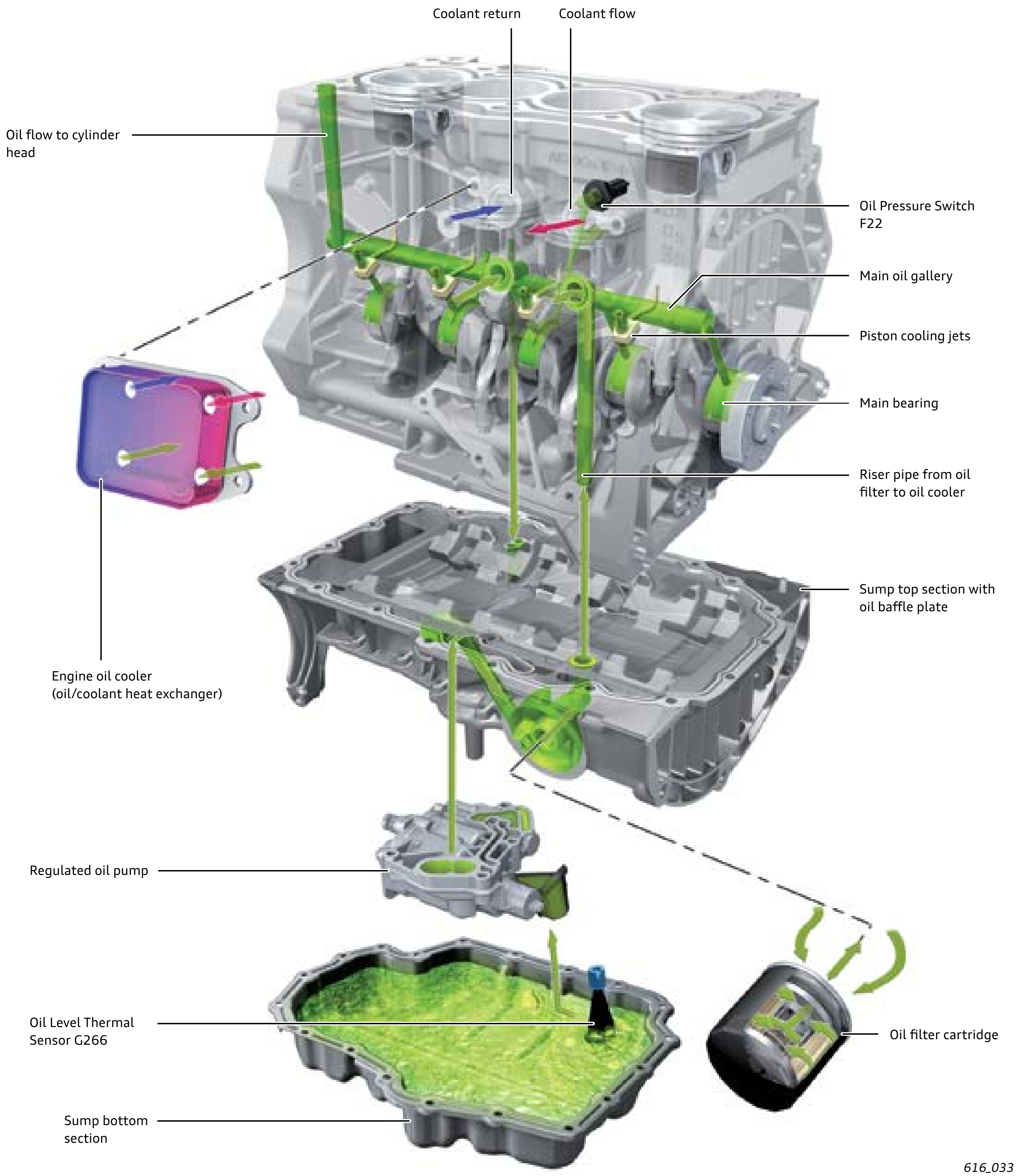


616_011

Oil cooling

The engine oil cooler is mounted directly on the cylinder block underneath the intake manifold. It is an oil/coolant heat exchanger and, therefore, incorporated in the engine's coolant circulation system.

After passing through the engine oil cooler, the oil flows into the main oil gallery and on to other lubrication points in the engine.



616_033

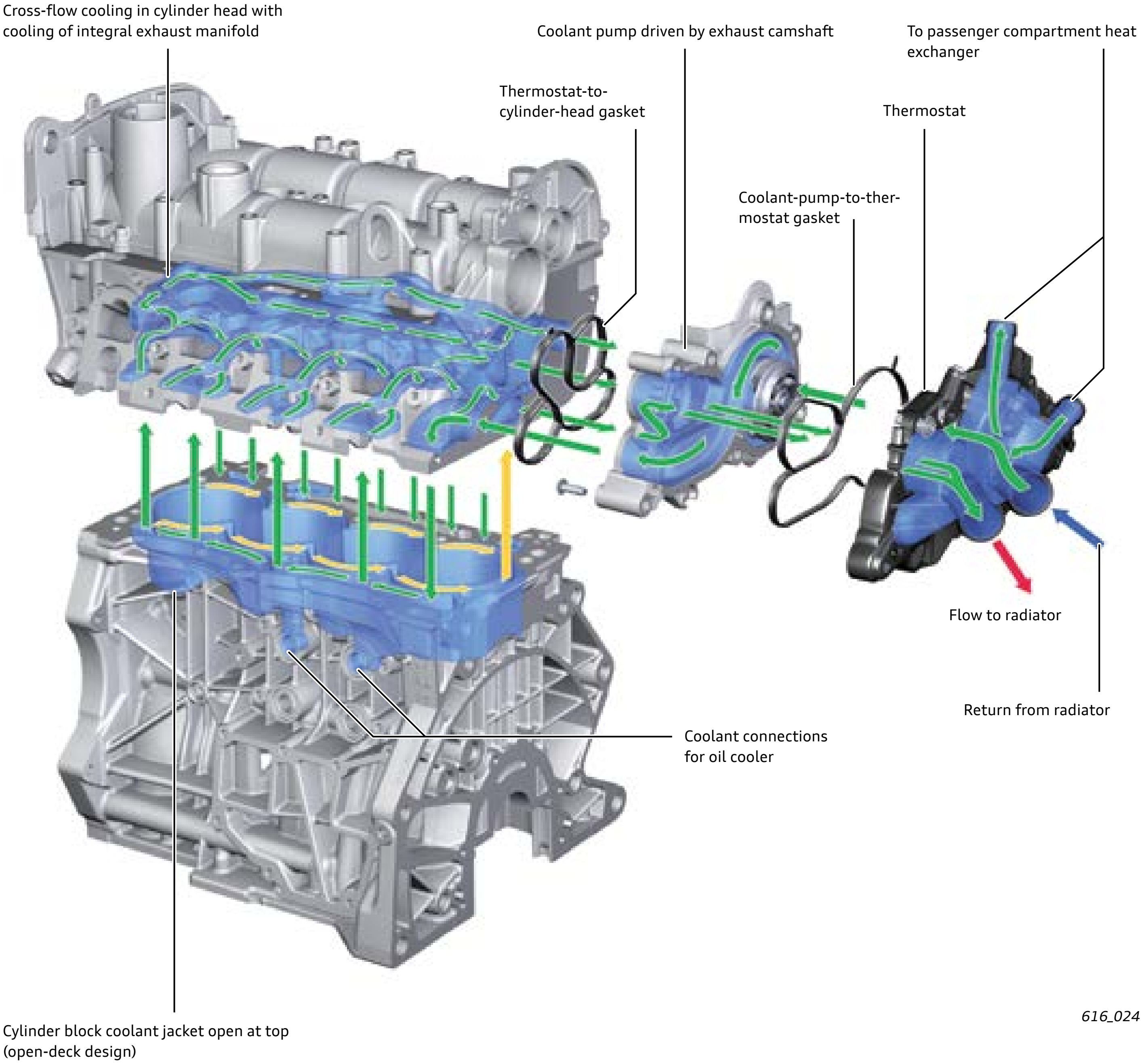
Cooling system

Introduction

The system is a twin-circuit cooling system which enables different coolant temperatures to be achieved in the cylinder head and the cylinder block. In the cylinder head, the cross-flow cooling system (from intake side to exhaust side) achieves more even temperature distribution.

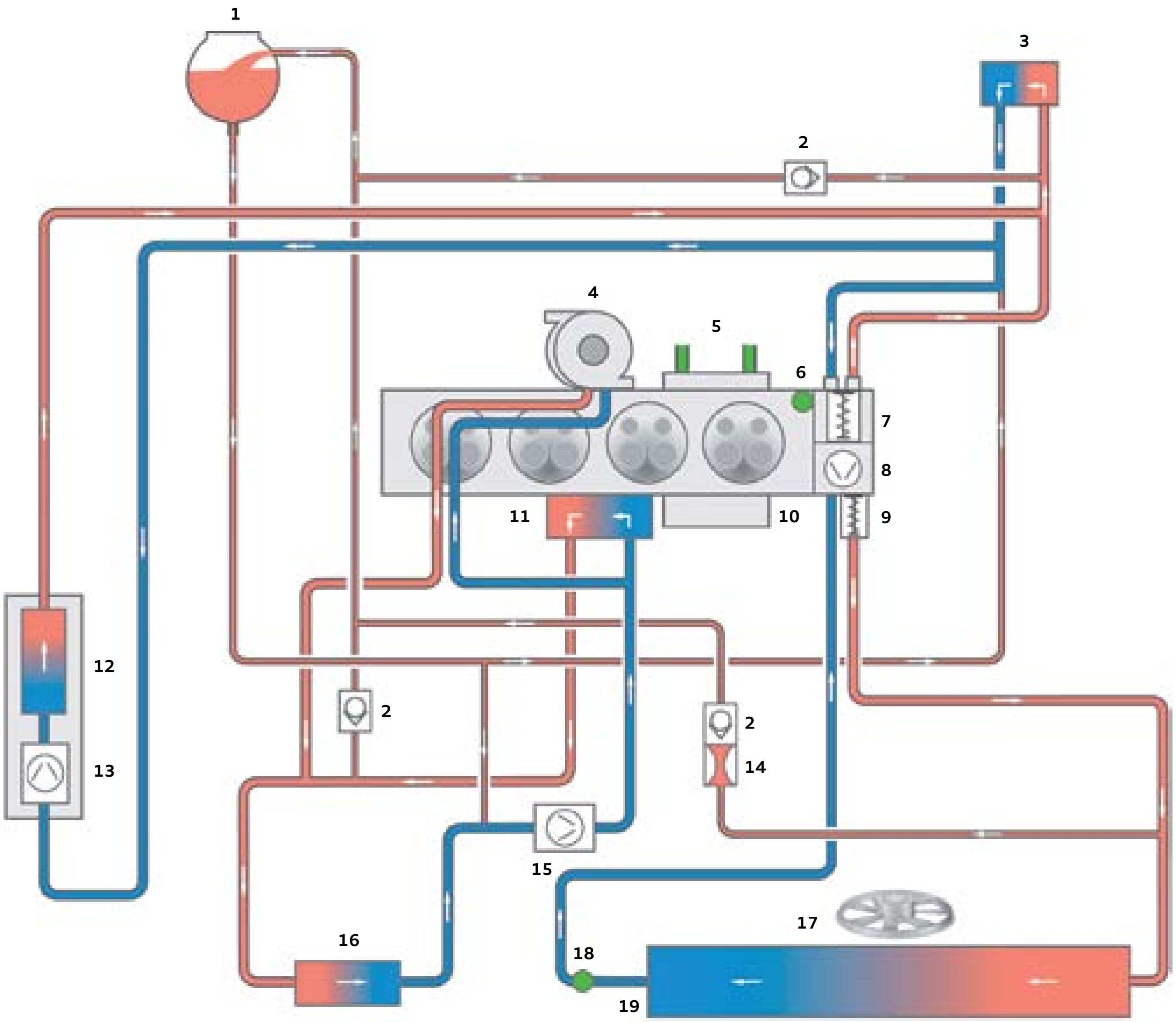
In addition, the coolant channels in the cylinder head have been dimensioned to adequately cool the integral exhaust manifold.

Mounted directly on the cylinder head is the thermostat housing and integral coolant pump. The coolant pump is driven by a toothed belt running off the exhaust camshaft.



616_024

System overview



616_005

Key:

1 Coolant expansion tank
2 Non-return valve
3 Passenger compartment heat exchanger
4 Turbocharger
5 Transmission oil cooler (ATF heat exchanger)
6 Engine Coolant Temperature Sensor G62
7 Thermostat 1
8 Coolant pump
9 Thermostat 2
10 Engine oil cooler
11 Intercooler integrated in intake manifold
12 Auxiliary heater
13 Recirculation Pump V55
14 Flow restrictor
15 After-run Coolant Pump V51
16 Intercooler
17 Radiator fan V7
18 Engine Coolant Temperature Sensor on Radiator Outlet G83
19 Radiator

Cooled coolant

Heated coolant

ATF

Thermostat

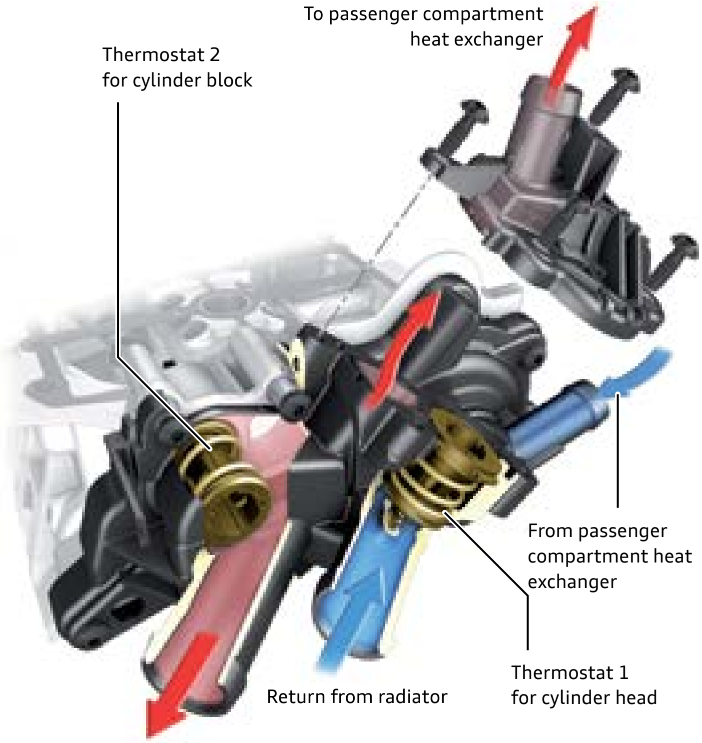
The thermostat is integrated in the thermostat housing, which is mounted directly on the cylinder head. Inside the thermostat housing there are two thermostats for the twin-circuit cooling system.

Thermostat 1

Opens from approximately 188 °F (87 °C) and allows coolant to flow from the radiator to the coolant pump.

Thermostat 2

Opens from approximately 217 °F (103 °C) and allows heated coolant to flow from the cylinder block to the radiator. The entire coolant circulation system is open.

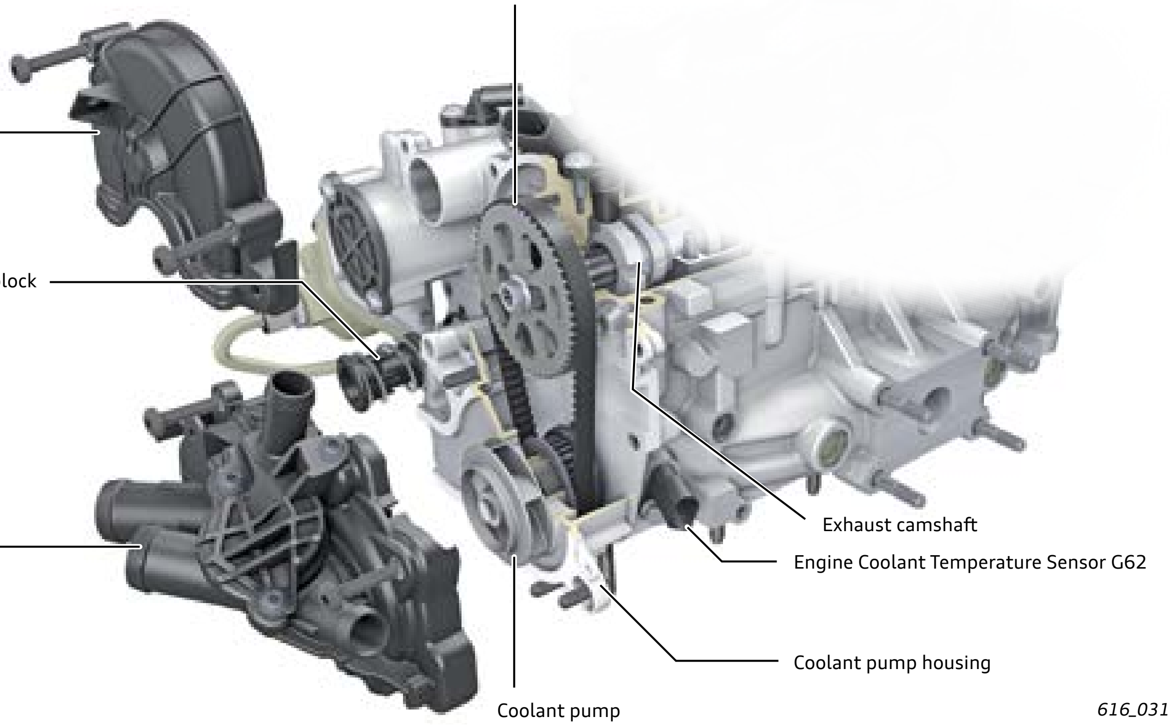


616_047

Coolant pump

The coolant pump is integrated in the thermostat housing. The complete module is bolted onto the cylinder head. It is sealed from the coolant channels by EPDM (**e**thylene **p**ropylene **d**iene **m**onomer) rubber gaskets. One gasket sits between the coolant pump housing and the cylinder head, and the other between the coolant pump and the thermostat housing.

The coolant pump is driven by a separate toothed drive belt running off the exhaust camshaft. That belt-drive system is on the flywheel end of the engine and is maintenance free. However, it does have to be replaced if the coolant pump is replaced.



616_031

Note

Before removing and when tensioning the coolant pump drive belt, always refer to the instructions in ElsaPro.

Cylinder head cooling

In the cross-flow cylinder head, the coolant flows from the intake side around the combustion chambers to the exhaust side. There it splits into two areas, above and below the exhaust manifold.

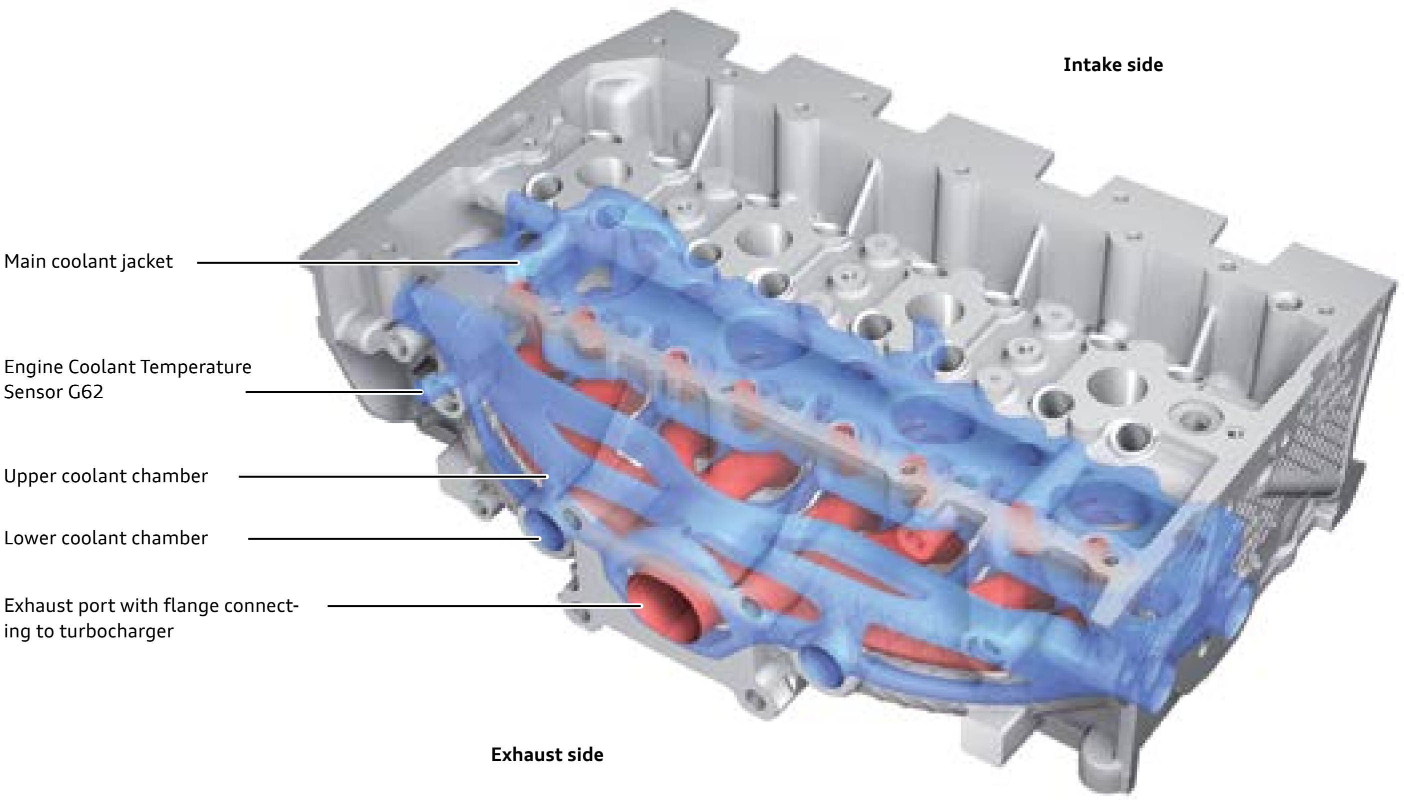
It flows through multiple channels, absorbing heat. From the cylinder head it flows into the thermostat housing where it mixes with the remaining coolant.

This design has a number of advantages:

- The coolant is heated by the exhaust while the engine is warming up. The engine reaches normal operating temperature more quickly. That reduces fuel consumption and the vehicle interior can be heated sooner.
- Because of the smaller exhaust surface area before it reaches the catalytic converter, the exhaust loses little heat when the engine is warming up and the catalytic converter heats up to its normal operating temperature more quickly despite the cooling effect of the coolant.
- When the engine is under maximum load, the coolant is cooled to a greater degree and the engine can be run fuel and emission-efficiently. That lowers fuel consumption at full power by as much as 20% compared with turbocharged engines with external exhaust manifolds. In this case the components are protected by the cooling effect with an over-rich mixture.

Coolant jacket and integral exhaust manifold

To protect the engine and especially the cylinder head against overheating, Engine Coolant Temperature Sensor G62 has been placed at the hottest point in the coolant flow, close to the exhaust manifold.



616_023

Intercooler

After the intake air has passed through the turbocharger, it is very hot. It is heated up to temperatures as high as 392 °F (200 °C)., mainly due to the compression process, but also because the turbocharger itself is very hot.

As a result, the air has a lower density, and less oxygen would enter the cylinders. Cooling it to a little above ambient temperature increases its density again and more oxygen is supplied to the cylinders. Furthermore, cooling the air reduces engine tendency to knock and reduces the production of Oxides of Nitrogen (NO_x).

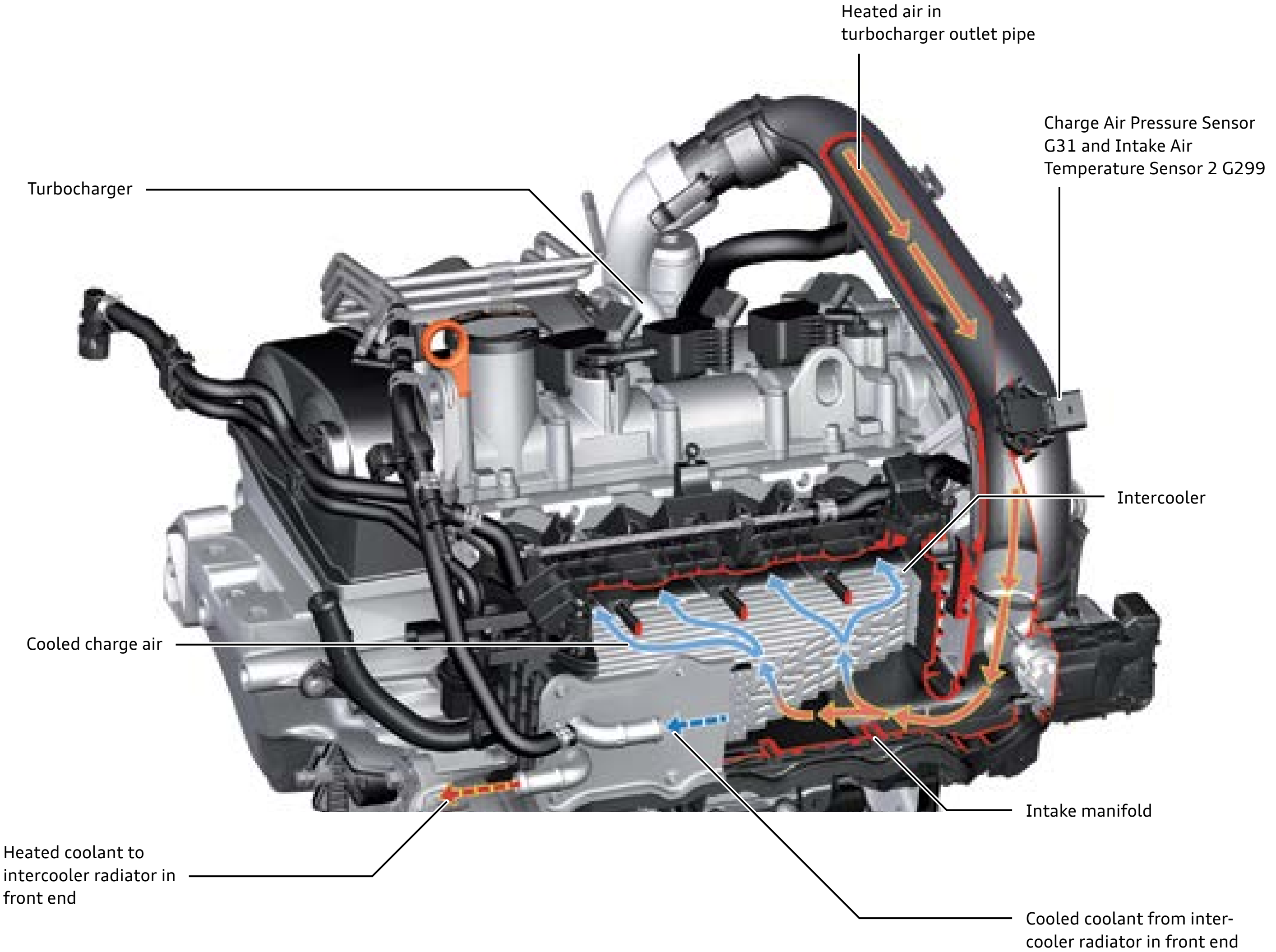
To cool the air from the turbocharger, it is passed through an intercooler, which is integrated in the intake manifold module.

The intercooler is an air/coolant heat exchanger and incorporated in the engine's coolant circulation system.

The design and function of the intercooler in the intake manifold module are similar to that of a normal liquid cooler or radiator.

A pipe carrying the coolant passes through a matrix of aluminum fins.

The hot air flows over the fins and the heat of the air is passed to the fins. The fins transfer the heat to the coolant. The heated coolant is pumped to the intercooler system's auxiliary radiator where it is cooled down again.



616_025

Intercooler coolant circulation system

The coolant circulation system for the intercooler is driven by After-run Coolant Pump V51. The turbocharger is also incorporated in that "low temperature" coolant circulation system. This coolant circulation system should be seen as independent.

It is only connected to the expansion tank, see “System overview“ on page 22. Isolation is by way of flow restrictors and a non-return valve.

Because of that separation, temperature differences of up to 212 °F (100 °C) from the main cooling system can occur. The pump is operated by means of a PWM signal from the ECM. The pump is always run at 100%. The times at which it is switched on and off are calculated using a data map. The most important variables used are the engine load and the charge air temperature upstream and downstream of the turbocharger when the engine is running.

Run-on function

After the engine is switched off, after-heating effects can cause the coolant to boil under certain circumstances (if the car has been driven at top speed and/or up a long climb in high outside temperatures). After the engine is switched off, the pump therefore runs on for a certain time according to a data map stored on the engine management ECU. The data map is computed using a model which calculates the exhaust temperatures. That then serves as a measure for the turbocharger housing temperature. While the pump V51 is running, the electric radiator fan is operated at the same time.

After-run Coolant Pump V51

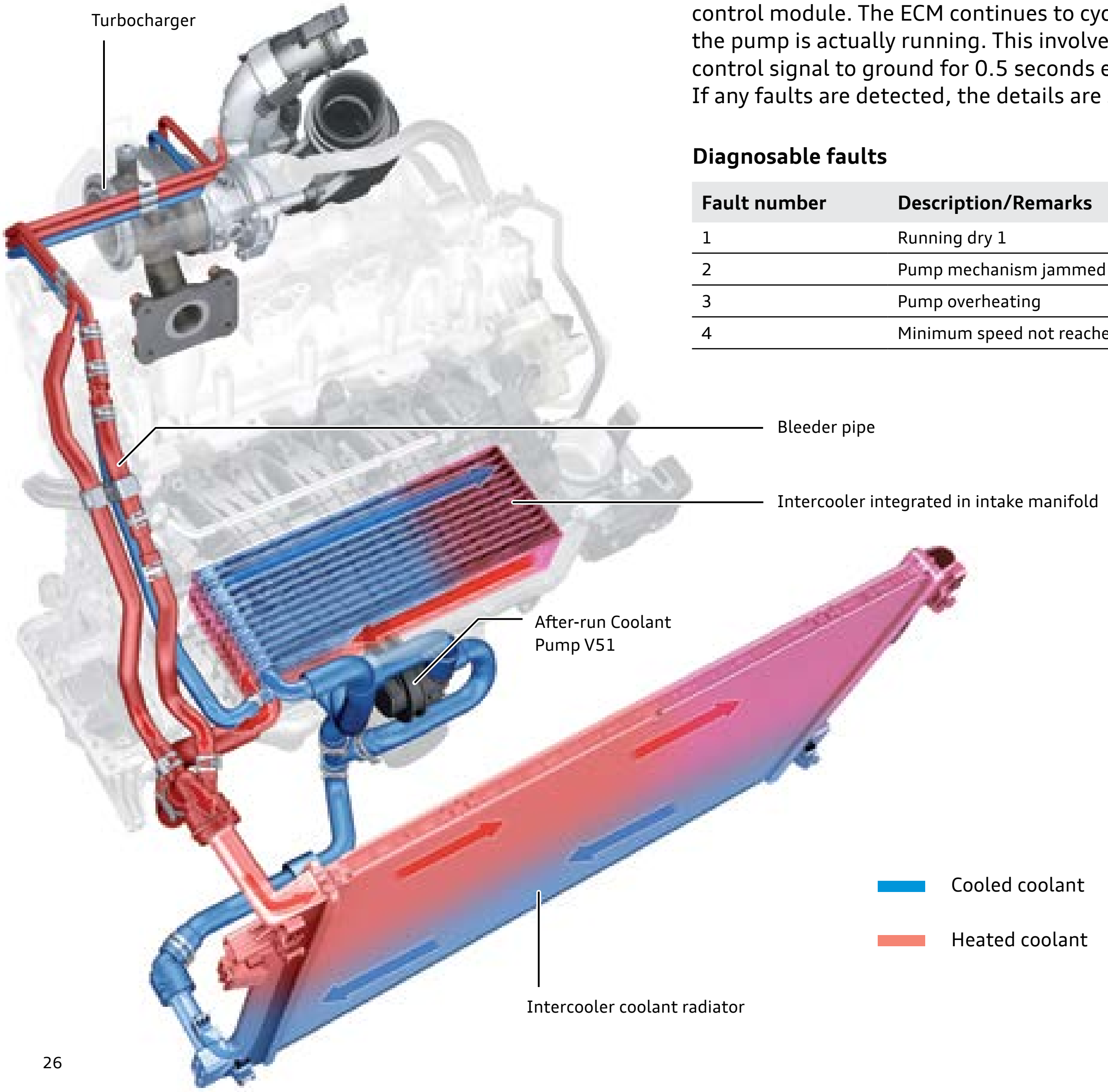
V51 is bolted onto the cylinder block below the intake manifold. Integrated in the pump is an electronic control circuit. It analyzes the PWM signal from the ECM. The pump is also fully diagnosis-compatible. Communication with the ECM for diagnostic purposes takes place via the PWM signal lead.

The pump carries out a self-diagnosis routine when in operation.

If a fault is detected, the details are stored on the pump's control module. The ECM continues to cyclically check that the pump is actually running. This involves connecting the control signal to ground for 0.5 seconds every 10 seconds. If any faults are detected, the details are sent to the ECM.

Diagnosable faults

Fault number	Description/Remarks
1	Running dry 1
2	Pump mechanism jammed
3	Pump overheating
4	Minimum speed not reached



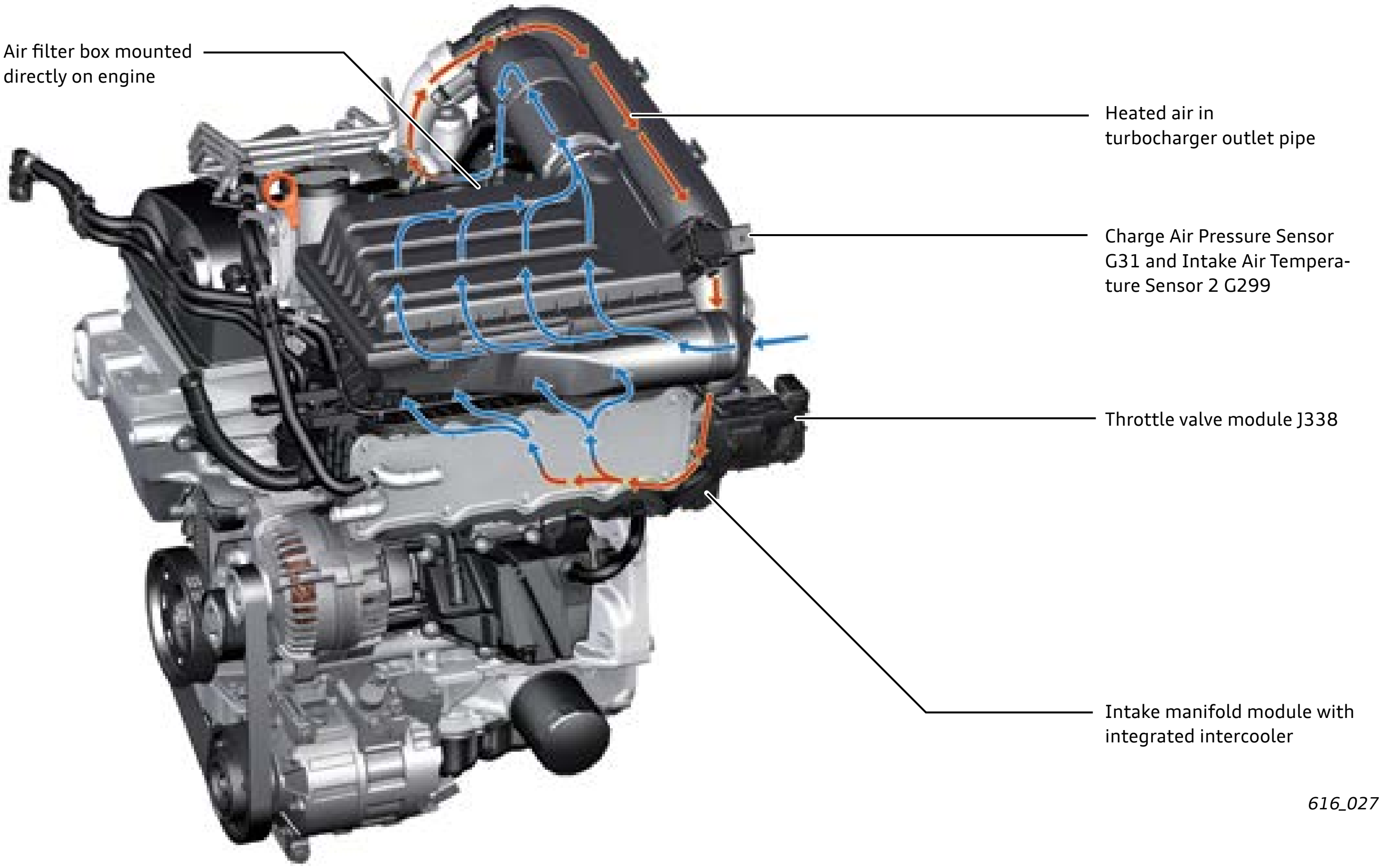
616_050

Air intake and turbocharger systems

Overview

The air intake system is on the forward facing side of the engine. The air filter box is mounted directly on the engine. This has a favorable effect on the length of the air intake system and the preheating of the intake air.

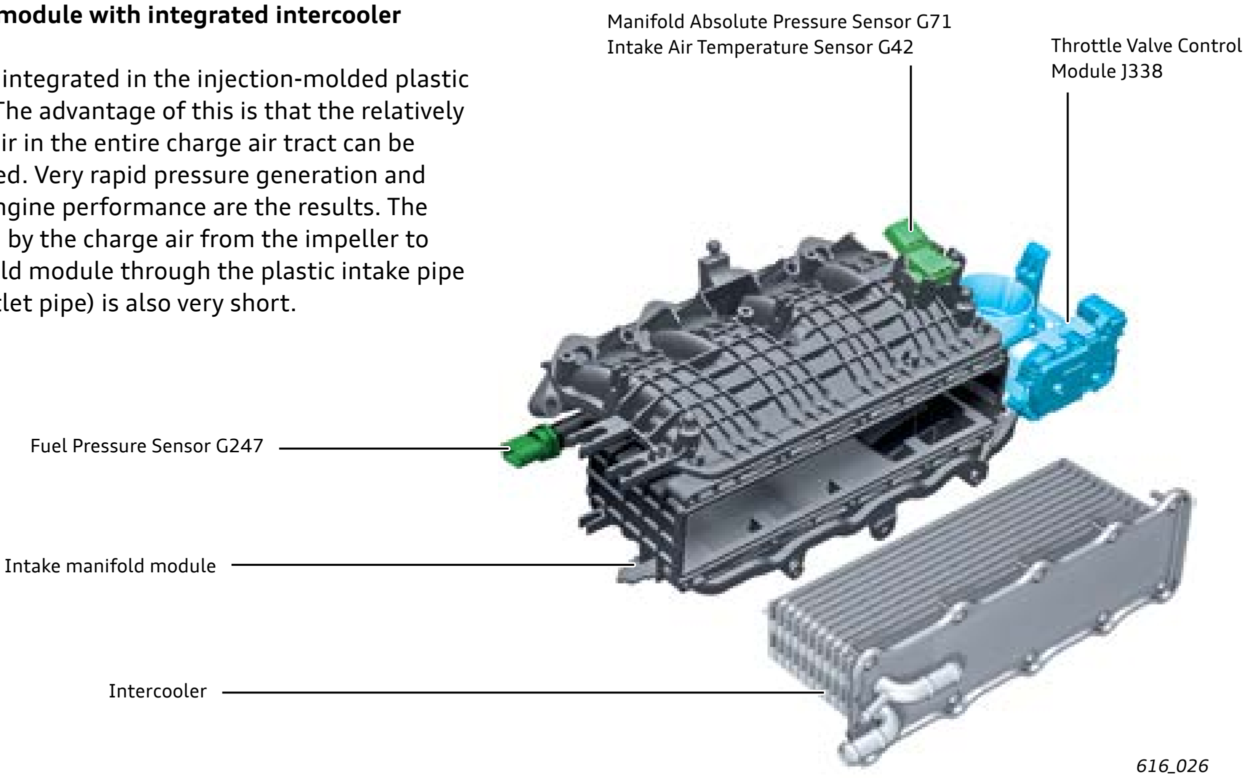
An air/coolant heat exchanger integrated in the intake manifold module cools the heated intake air.



616_027

Intake manifold module with integrated intercooler

The intercooler is integrated in the injection-molded plastic intake manifold. The advantage of this is that the relatively small volume of air in the entire charge air tract can be quickly compressed. Very rapid pressure generation and very responsive engine performance are the results. The distance travelled by the charge air from the impeller to the intake manifold module through the plastic intake pipe (turbocharger outlet pipe) is also very short.

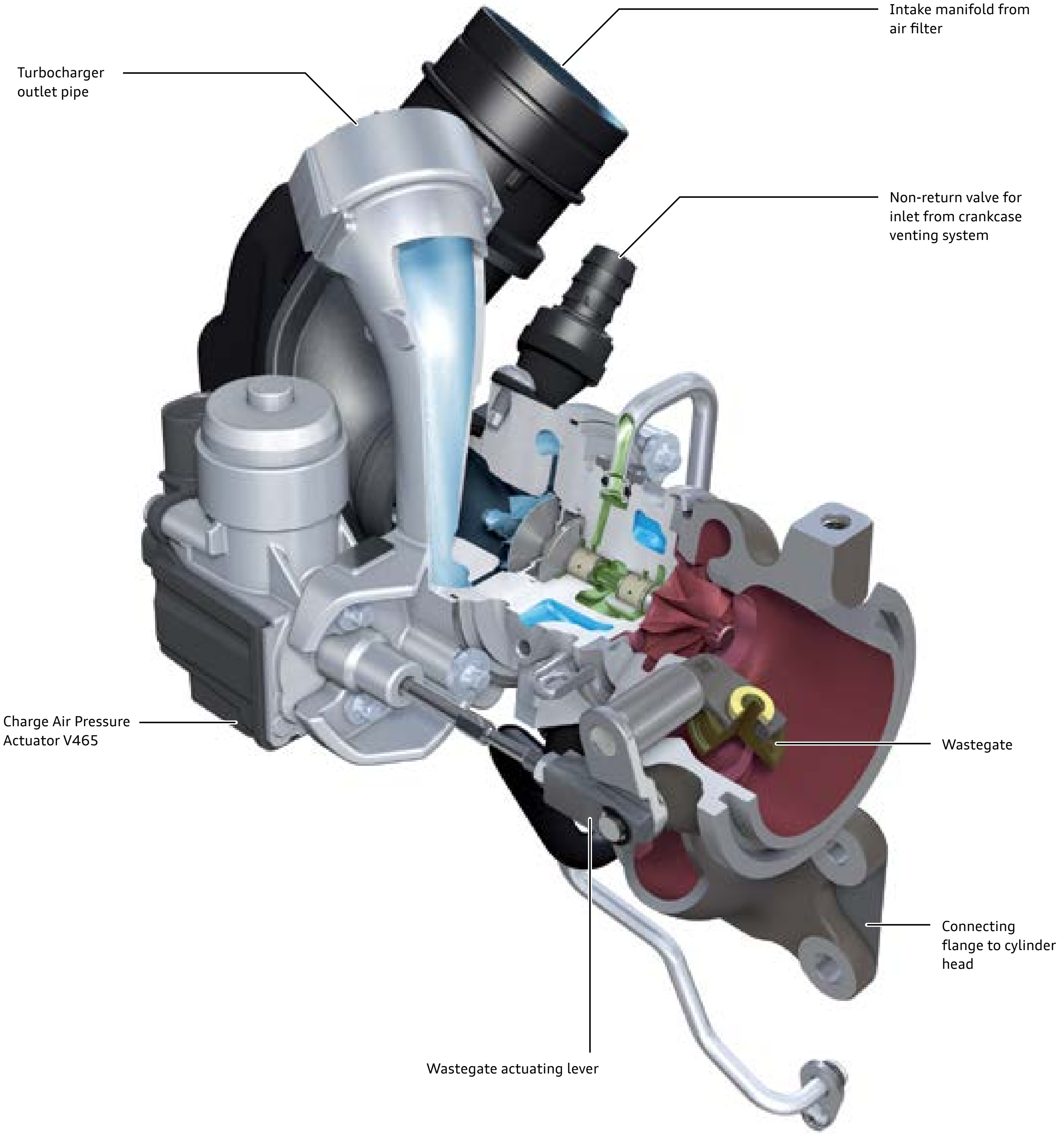


616_026

Turbocharger

Because the exhaust manifold is integrated in the cylinder head and has its own coolant jacket, it is possible to use a very lightweight mono-scroll turbocharger.

Mono-scroll turbochargers have only one inlet helix which directs the exhaust to the turbine rotor. The significant advantage is their simplicity of design, which makes mono-scroll turbochargers especially light and economical.



616_041

Reference

For more information on the design and function of Charge Air Pressure Actuator V465, refer to [eSelf-Study Program 920243, The Audi 1.8l and 2.0l Third Generation EA888 Engines.]

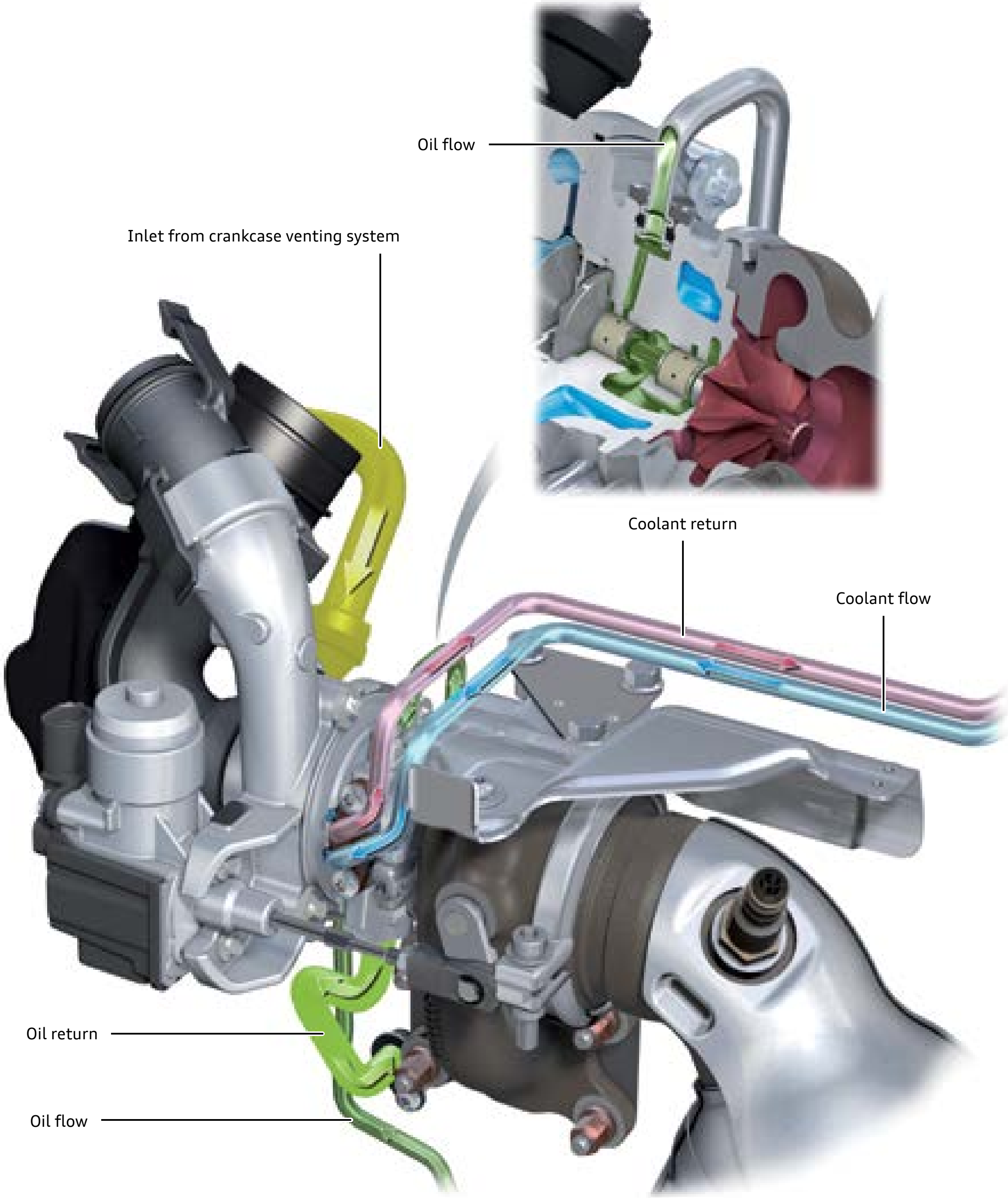
Oil supply and cooling

The turbocharger is lubricated by the engine oil circulation system.

At high engine speeds, the blow-by gas from the crankcase venting system is fed back into the intake system upstream of the impeller.

The connection for this is on the turbocharger.

To provide for adequate cooling, the turbocharger is connected to the coolant circulation system. After-run Coolant Pump V51 pumps the coolant for both the intercooler and the turbocharger to the coolant radiator in the front end.



616_049

Notes

Fuel system

Overview

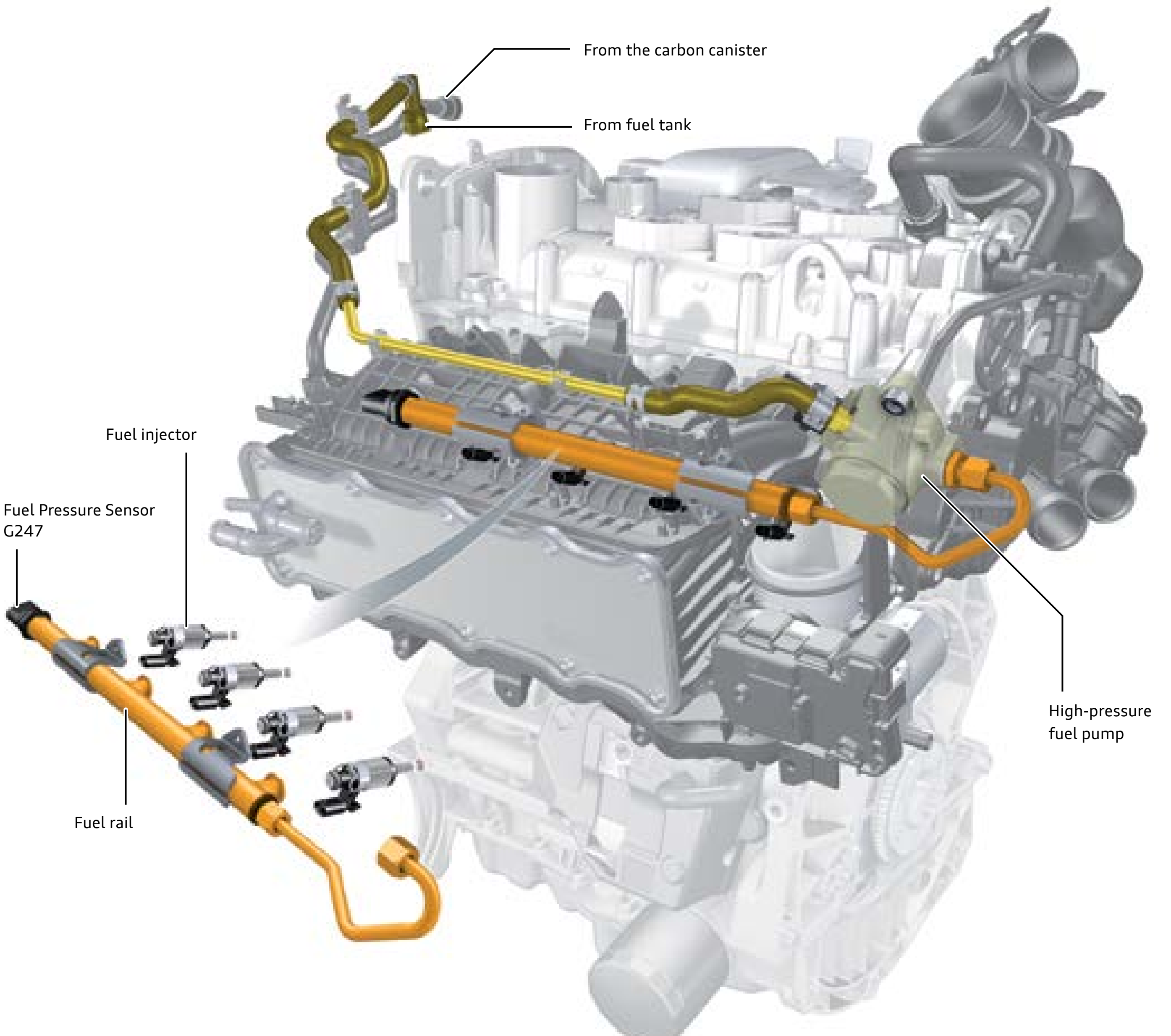
The high pressure fuel injection system is made by Hitachi. It's operating pressure is between a minimum of approximately 1450 psi (100 bar) when the engine is idling and 2900 psi (200 bar) when the engine is running at 6000 rpm.

A pressure limiting valve is designed to open at pressure peaks of over 3335 psi (230 bar) and directs the fuel back to the intake side of the pump. This control concept is the same as found on the third generation EA888 engine series.

If the power supply to N276 is cut off, no fuel is delivered to the high pressure system and the engine cuts out.

High-pressure injectors

State-of-the-art, 5-jet fuel injectors are supplied with fuel by a stainless-steel fuel rail. This enables extremely precise fuel injection with up to three separate injection phases per power stroke.

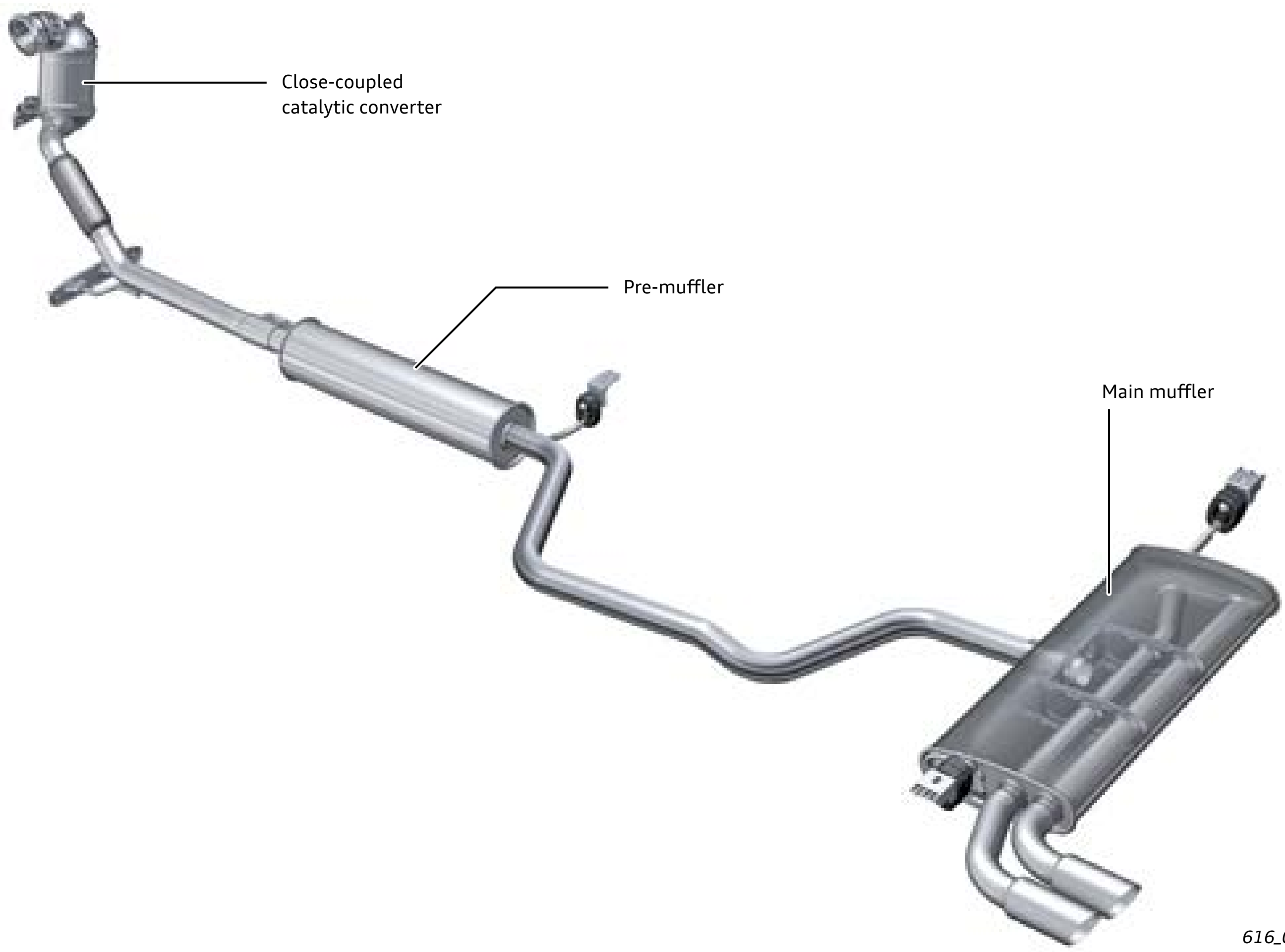


616_051

Exhaust system

Overview

1.4l TFSI engine without cylinder shut-down



616_012

Catalytic converter

Directly downstream of the turbocharger, the exhaust passes through the catalytic converter. The catalytic converter is on the rear-facing side of the engine.

Because the catalytic converter is mounted close to the engine, oxygen sensor control can start very quickly.

616_057

Engine management system

Sensors and actuators

Sensors

Transmission Neutral Position Sensor G701

Oil Pressure Switches F1, F22

Knock Sensor 1 G61

Accelerator Pedal Position Sensor G79
Accelerator Pedal Position Sensor 2 G185

Brake Light Switch F

Oil Level Thermal Sensor G266

Engine Speed Sensor G28

Charge Air Pressure Sensor G31
Intake Air Temperature Sensor 2 G299

Brake Booster Pressure Sensor G294

Intake Air Temperature Sensor 1 G42
Manifold Absolute Pressure Sensor G71

Fuel Pressure Sensor G247

Camshaft Position Sensor G40
Camshaft Position Sensor 2 G163

Throttle Valve Control Module J338
EPC Throttle Drive Angle Sensors 1 & 2
G187 & G188

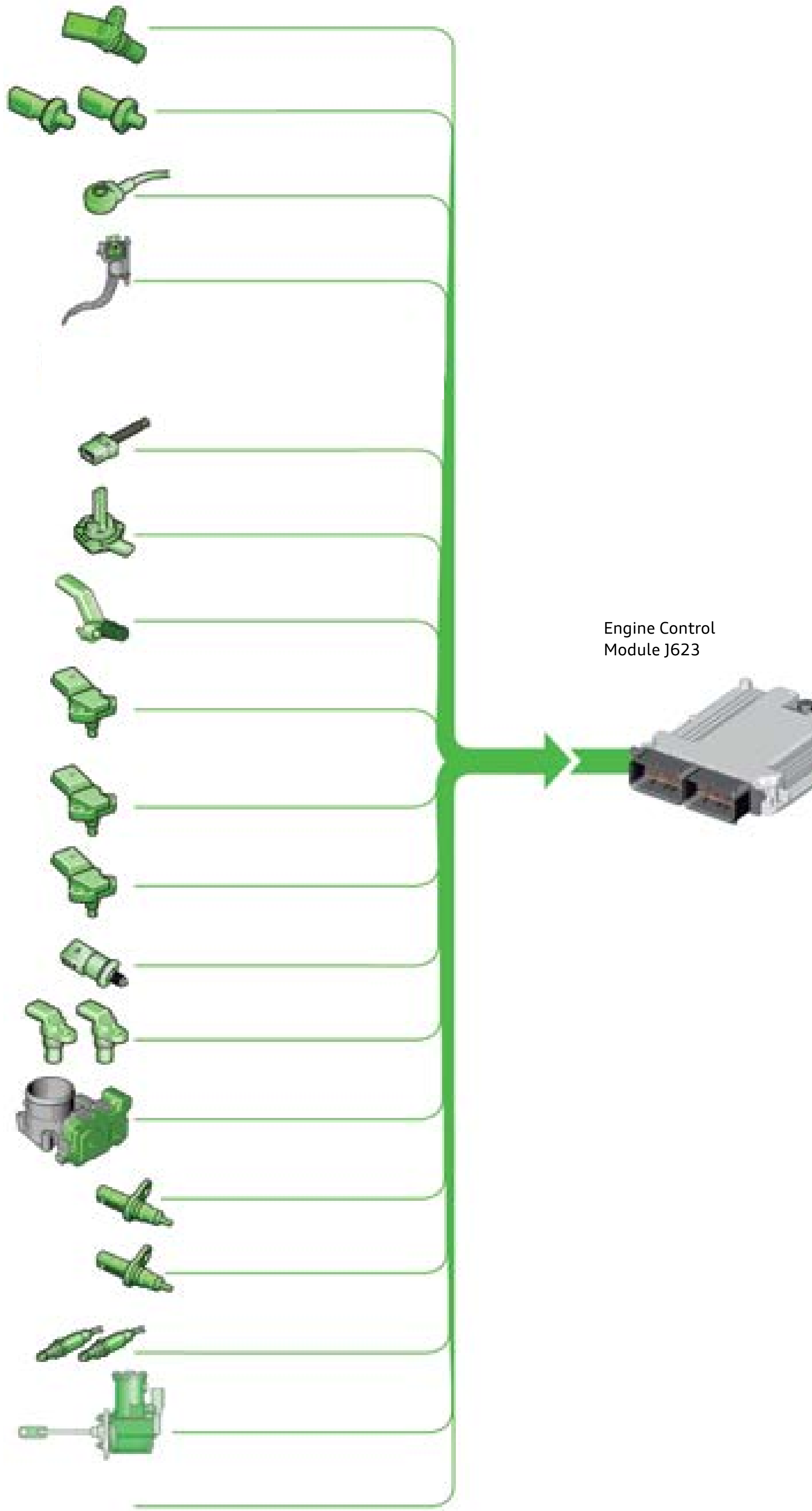
Engine Coolant Temperature Sensor G62

Engine Coolant Temperature Sensor on Radiator Outlet G83

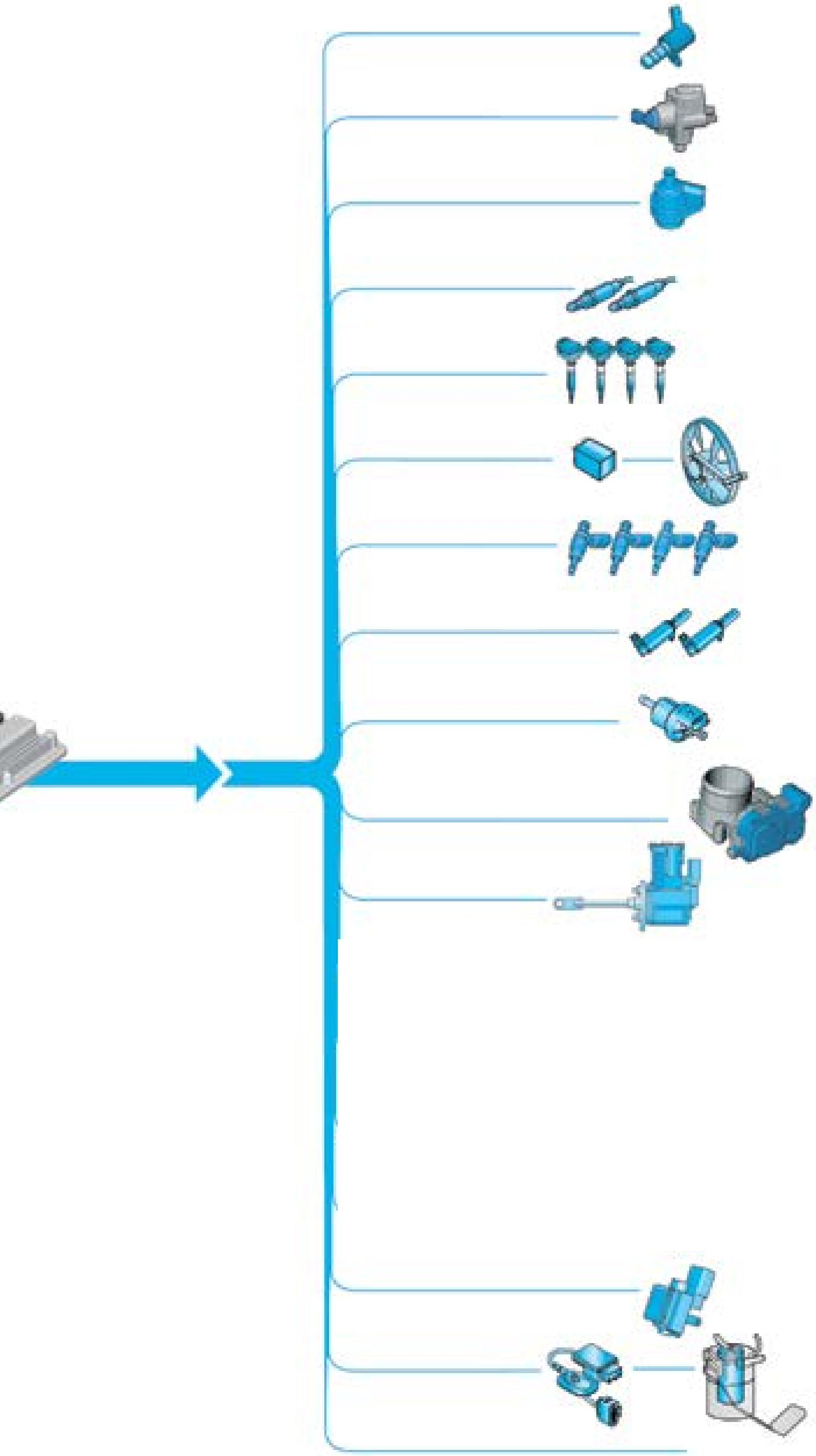
Heated Oxygen Sensor G39
Oxygen Sensor after Catalytic Converter G130

Charge Pressure Actuator Position Sensor G581

Auxiliary signals:
- Cruise control system
- Speed signal
- Start request to ECM (keyless start 1 + 2)
- Terminal 50
- Crash signal from Airbag Control Module



Actuators



Oil Pressure Regulation Valve N428

Fuel Pressure Regulator Valve N276

Continued coolant circulation pump V51

Oxygen Sensor Heater Z19
Heater for Oxygen Sensor 1 after Catalytic Converter Z29

Ignition Coils 1- 4 with Output Stage
N70, N127, N291, N292

Coolant Fan Control Module J293
Coolant Fan V7

Injector, cylinders 1 – 4 N30 – N33

Camshaft Adjustment Valve 1 N205
Exhaust Camshaft Adjustment Valve 1 N318

Carbon Canister Purge Regulator Valve N80

EPC Throttle Drive G186

Charge Pressure Actuator V465

Cooling Circuit Solenoid Valve N492

Fuel Pump Control Module J538
Transfer Fuel Pump G6
Fuel Gauge Sensor G

Auxiliary signals:
– Transmission Control Module/engine speed
– ABS Control Module
– A/C compressor

616_007

Engine speed sensor G28

Engine Speed Sensor G28 is integrated with the transmission sealing flange that is bolted to the cylinder block. It scans a 60-2 reluctor ring in the crankshaft seal flange. From those signals, the ECM detects the engine speed, its direction of rotation and, in conjunction with Camshaft Position Sensor G40, the position of the crankshaft relative to the camshaft.

616_053

Detection of direction of rotation

When an engine is switched off, it does not immediately come to a standstill but continues turning for a couple more revolutions. If a piston is just approaching TDC on the compression stroke when the engine is switched off, it is then forced backwards by the compression pressure. At that point the engine momentarily rotates counterclockwise. That cannot be detected by a conventional engine speed sensor.

Signal utilization

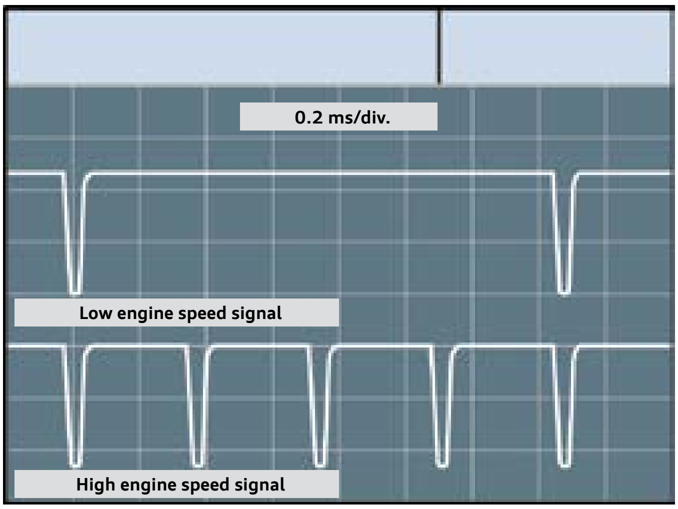
The signal is used to determine the computed injection timing, injection period and ignition timing. It is also used for the variable valve timing.

Method of operation

The two outer Hall-effect plates of the sensor simultaneously detect a rising and a falling edge on the reluctor ring. The third plate positioned off-center between the two outer plates is decisive for detecting direction of rotation.

Loss of signal

If there is a short circuit or one or more circuit breaks, the signal from G40 is used as a substitute regardless if the engine is running or not. The maximum engine speed is limited to approximately 3000 rpm and the EPC MIL is switched on. In addition, a DTC is stored in the ECM.



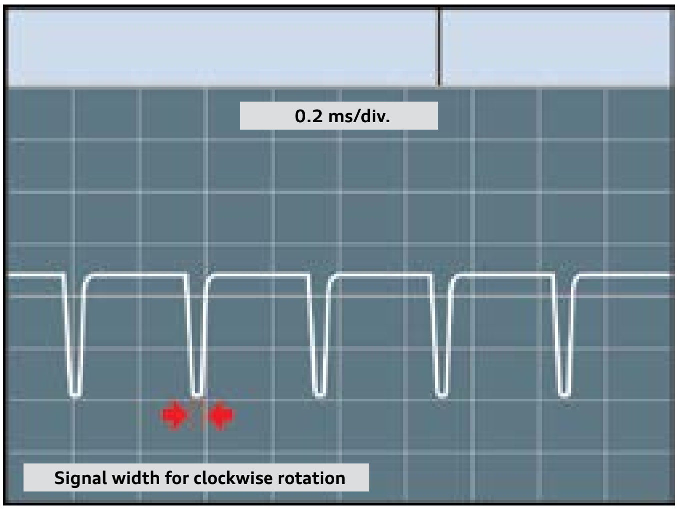
616_058

Detection of direction of rotation

The time sequence of the signals from the three Hall-effect plates when detecting a rising edge is decisive in detecting whether the engine is rotating clockwise or counterclockwise.

▶ Engine clockwise rotation

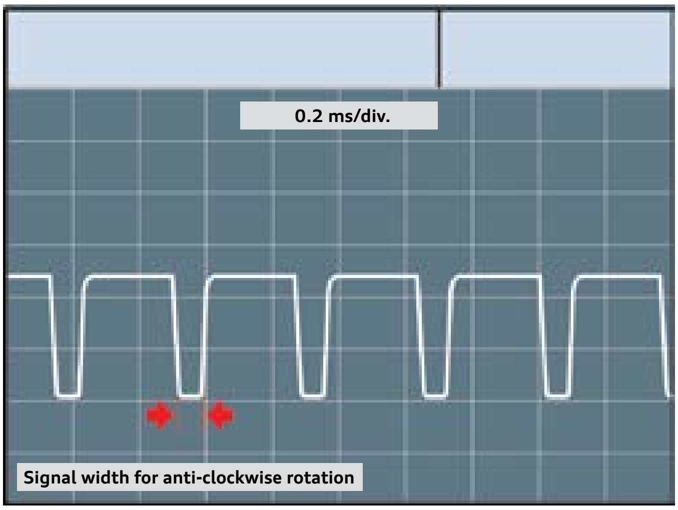
If the engine is rotating clockwise, the rising edge is detected by Hall-effect plate 1 first. A moment later the rising edge is detected by Hall-effect plate 3 and then Hall-effect plate 2. Because the time gap between Hall-effect plate 1 and Hall-effect plate 3 is shorter than between Hall-effect plate 3 and Hall-effect plate 2, it is evident that the engine is rotating clockwise. An electronic circuit in the sensor conditions the signal and sends a specific low width signal to the ECM.



616_059

▶ Engine counterclockwise rotation

If the engine is rotating counterclockwise, the rising edge is detected by Hall-effect plate 2 first. A moment later the rising edge is detected by Hall-effect plate 3 and then Hall-effect plate 1. As the time sequence of the signals is now reversed, the sensor detects that the engine is rotating counterclockwise. The electronic circuit in the sensor conditions the signal and sends a double low width signal to the ECM.



616_060

Appendix

Special tools and workshop equipment

T10133/19 Puller

616_062

For removing the high pressure injectors

T10359/3 Adapter

616_063

For removing and installing engine in conjunction with engine support T10359 and engine and transmission jack V.A.G 1383 A

T10478/5 Hexagon head screw M10x1, 25x45
T10479/4 Hexagon head screw M8x45

616_064

For replacing shaft seal for camshaft, timing side and/or transmission side

T10487 Assembly tool

616_082

For pressing down toothed belt to install the camshaft locking tool T10494 in the camshafts

T10494 Camshaft locking tool

616_066

For locking camshaft in position when checking and adjusting timing

T10497 Engine support

616_067

For removing and installing engine in conjunction with engine and transmission jack V.A.G 1383 A

T10498 Removal tool

616_068

For removing O-ring on camshaft belt pulley

T10499 Ring spanner, 30 mm

616_069

For operating toothed belt tensioning pulley

T10500 Insert tool, 13 mm

616_070

For operating toothed belt tensioning pulley

T10505 Thrust piece

616_071

For installing O-ring on camshaft belt pulley

T10504 Camshaft locking tool

616_079

For locking camshaft in position when checking and adjusting timing
- With testing pin T10504/2: checking camshaft installation
- With locking pin T10504/1: adjusting camshaft installation

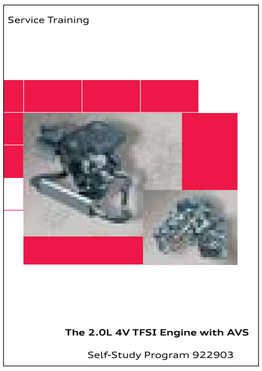
T10508 Special wrench

616_080

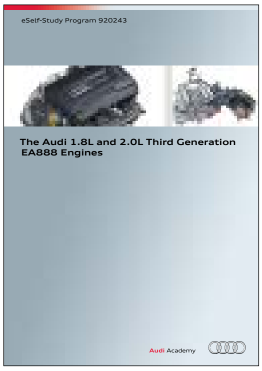
For removing and installing coolant pump thermostat

Self-study programs

For more information about the technology of the Audi 1.4l TFSI Engine, please refer to the following Self-Study Programs.



[922903 Audi 2.0L TFSI Engine with AVS]



[920243 The Audi 1.8L and 2.0L Third Generation EA888 Engines]

Knowledge assessment

An On-Line Knowledge Assessment (exam) is Available for this eSelf-Study Program.

The Knowledge Assessment is required for Certification credit.

You can find this Knowledge Assessment at:
www.accessaudi.com

From the accessaudi.com Homepage:

- Click on the "ACADEMY" tab
- Click on the "Academy site" link
- Click on the Course Catalog Search and select "920253 The Audi 1.4l TFSI Engine"

Please submit any questions or inquiries via the Academy CRC Online Support Form which is located under the "Support" tab or the "Contact Us" tab of the Academy CRC.

Thank you for reading this eSelf-Study Program and taking the assessment.

Audi
Truth in Engineering

920253

Audi of America, LLC
2200 Ferdinand Porsche Drive
Herndon, VA 20171