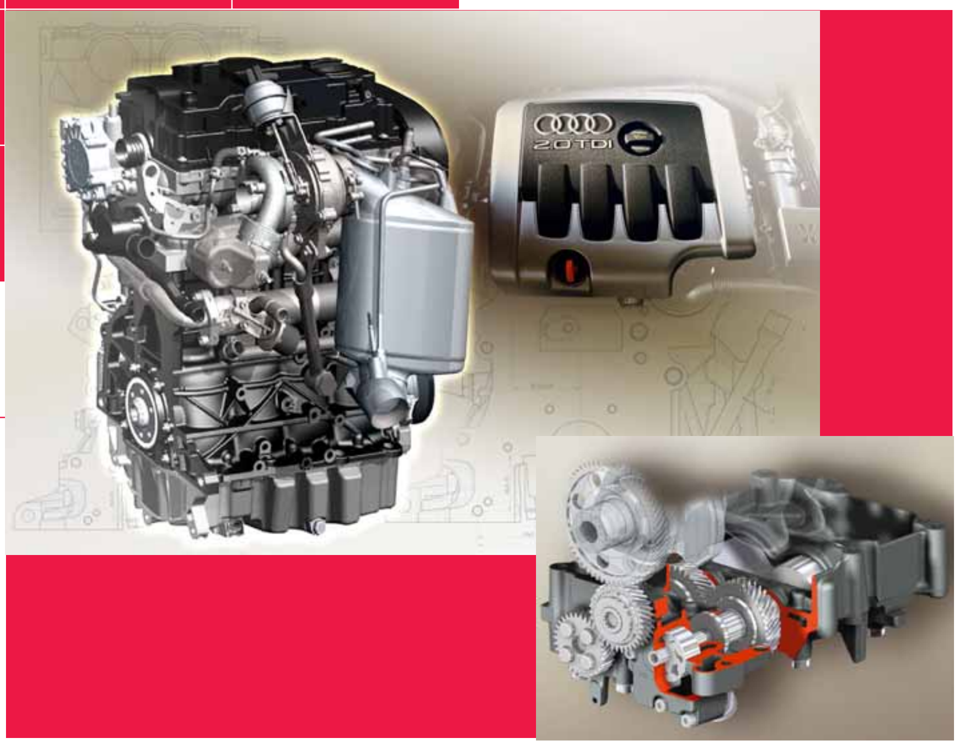
Service Training



Audi 2.0l 125 kW TDI Engine with Pump Injection System

Self-Study Programme 412

In this booklet we explain to you the design and function of the 2.0 l 125 kW four-valve TDI engine, focussing on the differences between it and the 103 kW version.

412_009

Reference

For information about the 2.0 l 103 kW four-valve TDI engine, please refer to SSP 316 "The 2.0 l TDI Engine".

Contents

Introduction

Engine mechanicals

Exhaust system

Engine management

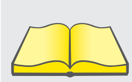
Service

The Self-Study Programme explains the design and function of new vehicle models,
new automotive components or new technologies.

The Self-Study Programme is not a Repair Manual!
Please note that all data and values given are for purposes of easier comprehension only and refer to the software version valid at the time of publication of the SSP.

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

Reference



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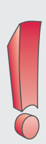


2.0l 125 kW TDI engine with pump injection system

The 2.0l 125 kW TDI engine is based on the 2.0l 103 kW TDI engine. In terms of power output, the 125 kW TDI engine is the market leader in the 2-litre diesel engine class.

This gain in power was accomplished whilst reducing fuel consumption and pollutant exhaust emissions through systematic development of proven TDI technology.

412_002

2.0l TDI

Technical features

– New pump-injector unit with piezo valve and injection pressures up to 2200 bar
– Balancer shaft module*
– Pistons without valve pockets
– Ceramic or steel glow plugs (depending on engine code)
– CTC toothed belt sprocket on the crankshaft
– Improved oil separation
– Exhaust gas turbocharger with positional feedback
– Maintenance-free diesel particulate filter

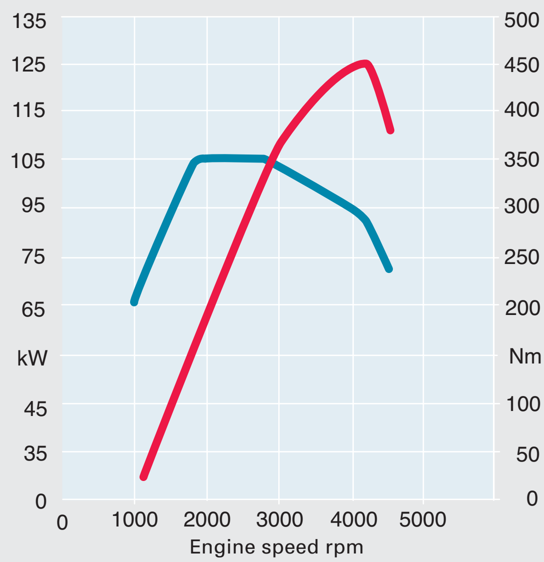
* for longitudinally mounted engines

412_001

Torque/power curve

Max. torque in Nm

Max. power in kW



Specifications

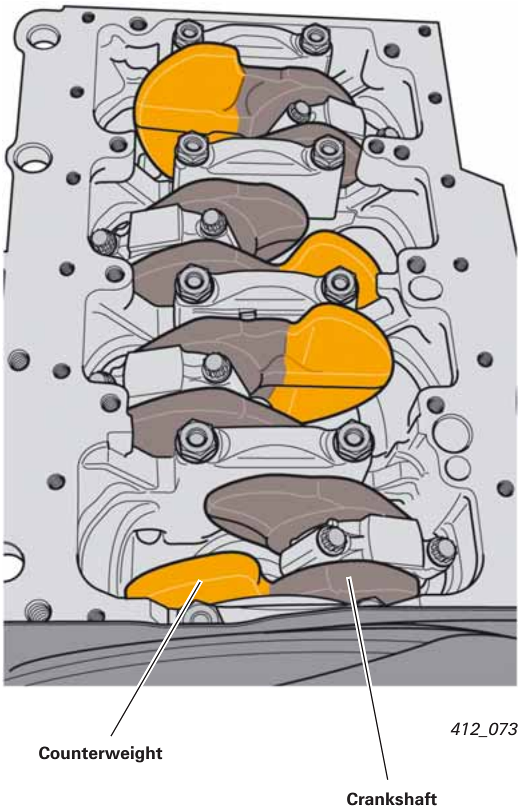
Engine codes	BMN, BRE, BRD
Type of engine	In-line four-cylinder diesel with VTG exhaust gas turbocharger, DOHC, TDI direct injection
Displacement in cm^3	1968
Max. power output in kW (bhp)	125 (170) at 4200 rpm
Max. torque in Nm	350 from 1750 to 2500 rpm
Bore in mm	81
Stroke in mm	95.5
Compression ratio	18 : 1
Cylinder spacing in mm	88
Firing order	1 - 3 - 4 - 2
Engine management	Bosch EDC 16
Exhaust emission control	Coated oxidising catalytic converter integrated in the diesel particulate filter
Exhaust emission standard	EU 4

Crankshaft drive

Crankshaft

The increase in power to 125 kW places a higher load on the crankshaft. For this reason, a reinforced forged crankshaft is used.

The crankshaft now has only four counterweights, as opposed to eight in the previous engine, with the result that it is correspondingly lighter.
These modifications in crankshaft design help to reduce the peak loads acting on the crankshaft bearings. There is less noise emission due to natural movement and vibration of the engine.



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Piston

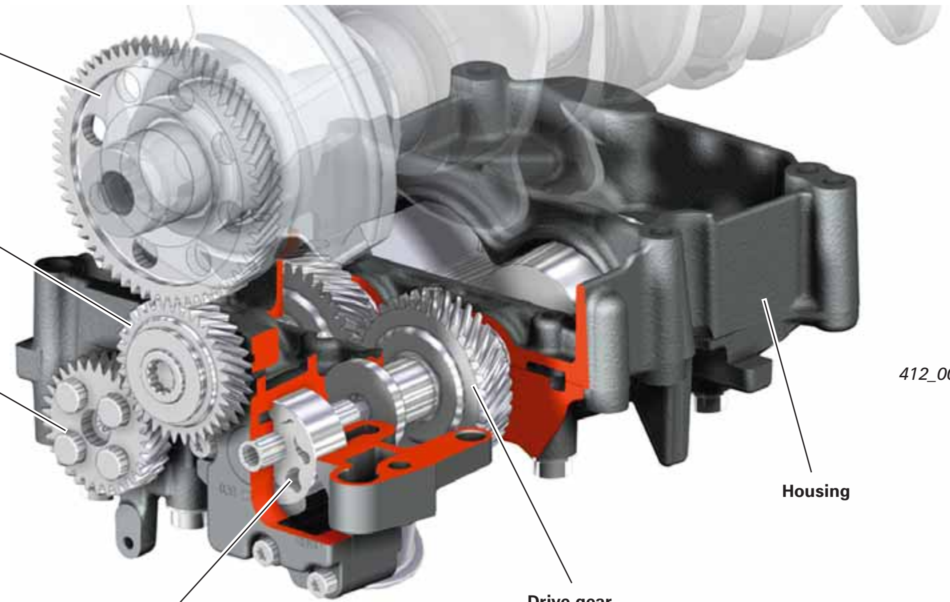
By dispensing with valve pockets on the piston crown it was possible to reduce the crevice volume between the piston base and oil scraper ring and to improve swirl formation inside the cylinder.
Swirl is a term used to describe the circular flowing motion about the vertical axis of a cylinder.
Swirl is a major factor influencing the quality of the air-fuel mixture.

Valve pockets were eliminated through the use of flatter valve discs and modified valve seats in the cylinder head.

412_078

Balancer shaft module

The longitudinally mounted 2.0l 125 kW TDI engine has a balancer shaft module, which is integrated in the oil pan below the crankshaft.
The balancer shaft module is driven by the crankshaft via a gear drive. The Duocentric oil pump is integrated in the balancer shaft module.



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Design

The balancer shaft module is comprised of a cast iron housing, two counter-rotating balancer shafts, a helical-cut gear drive and an integrated Duocentric oil pump.
The rotational movement of the crankshaft is transmitted to the idler gear on the outside of the housing. The idler gear drives balancer shaft I. This balancer shaft subsequently transmits the movement via a gear pair within the housing to balancer shaft II and the Duocentric oil pump.

The gear drive is designed in such a way that the balancer shafts rotate at double the speed of the crankshaft.

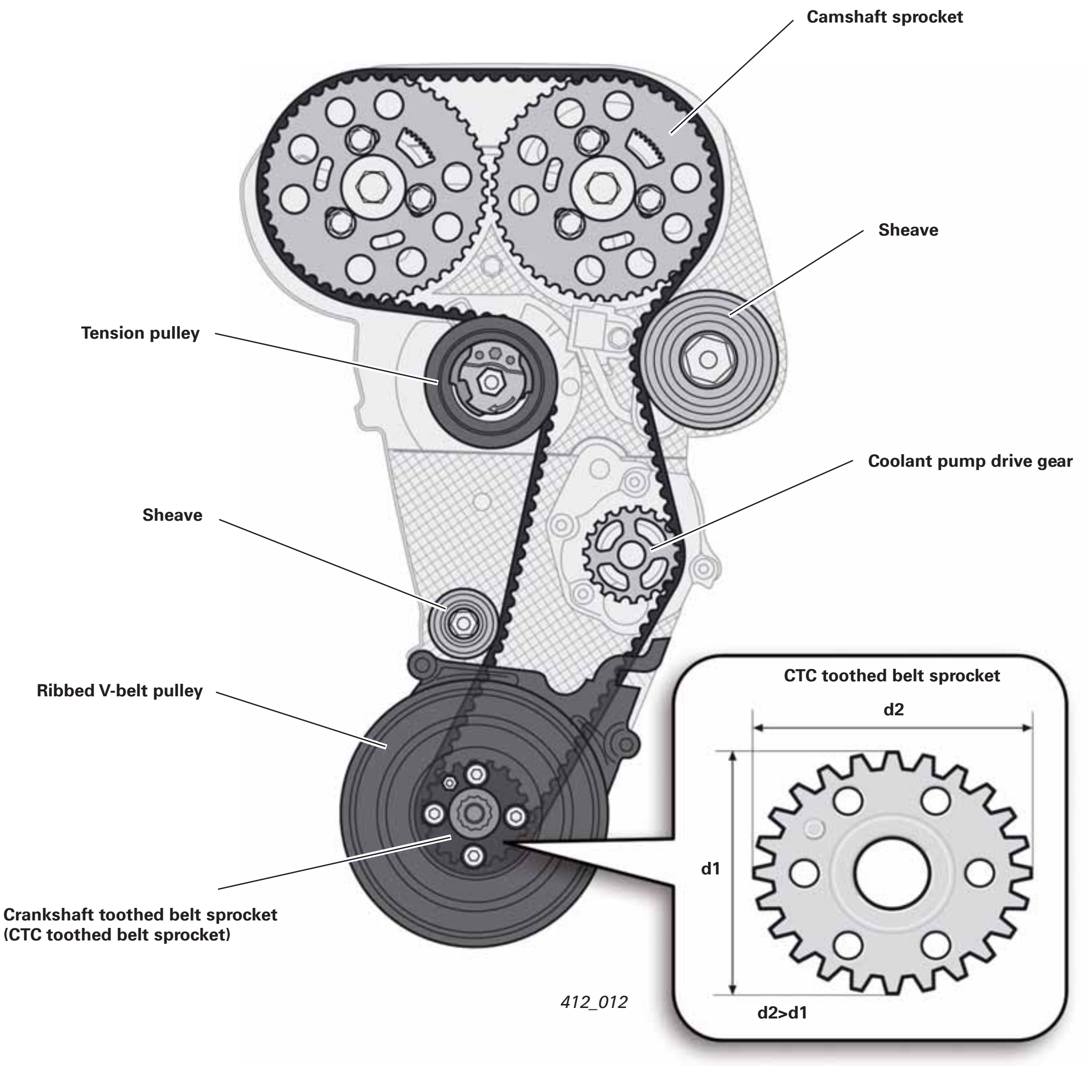
Gear drive backlash is adjusted by means of a coating on the idler gear. This coating wears off when the engine is put into operation, producing a defined amount of backlash.

Note

The idler gear must be replaced whenever the idler gear or the drive gear of balancer shaft I is removed.

Timing gear

The timing gear train is configured as a toothed belt drive comprising the crankshaft's toothed belt sprocket, two camshafts, a coolant pump, two sheaves and a tension pulley.



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A CTC toothed belt sprocket is used to drive the timing gear train. CTC is an abbreviation which stands for Crankshaft Torsional Cancellation.
The CTC sprocket reduces torsional vibration of the camshaft and minimises the tensile forces acting upon the toothed belt.

The narrow end of the toothed belt sprocket the timing gear train to be slackened slightly during the combustion process. This reduces the tensile forces and torsional vibration of the timing gear train, making it possible to dispense with a camshaft balancer.

Cylinder head

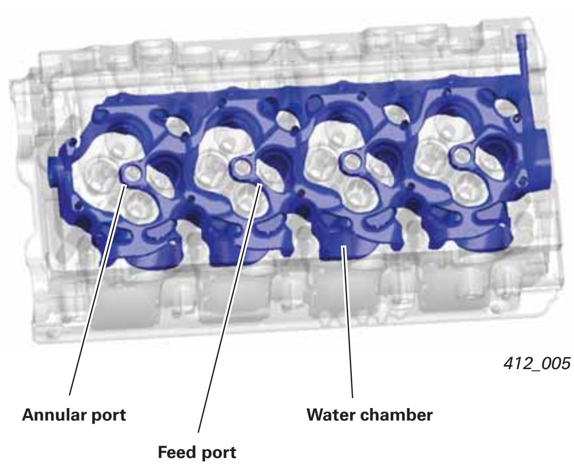
The cylinder head is made of an aluminium silicon copper alloy and has been adapted to the engine's power output of 125 kW.

412_059

Cylinder head cooling system

The water chamber inside the cylinder head has been completely revised to provide better heat dissipation.
A new feature are the annular ports arranged around the injection nozzle port. Coolant is fed into the annular ports via feed ports between the valves. This counteracts the higher thermal stresses acting on the region around the injectors and the exhaust ports due to the power increase in 125 kW.

The layout of the valves, pump injector units and glow plugs is identical to that in the 103 kW TDI engine.



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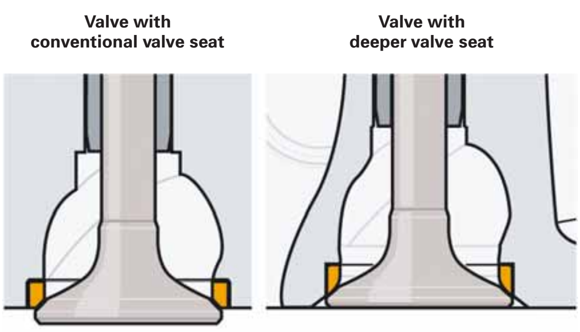
Valve seats in the cylinder head

To eliminate valve pockets, the valve seats are recessed more deeply into the cylinder head than on a cylinder head designed for pistons with valve pockets. Crevice volume has been reduced in combination with flatter valve discs.



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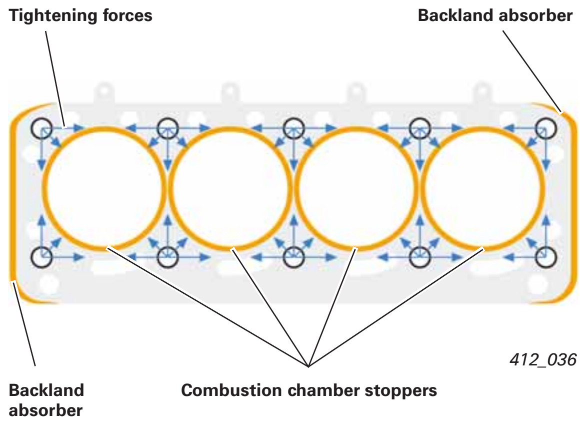
Cylinder head gasket

A new cylinder head gasket design reduces the distortion of the cylinder head and cylinder bores. This provides improved sealing of the combustion chambers.

The head gasket has a five-ply design and two special features:

– Height-profiled combustion chamber stoppers
– Backland absorption



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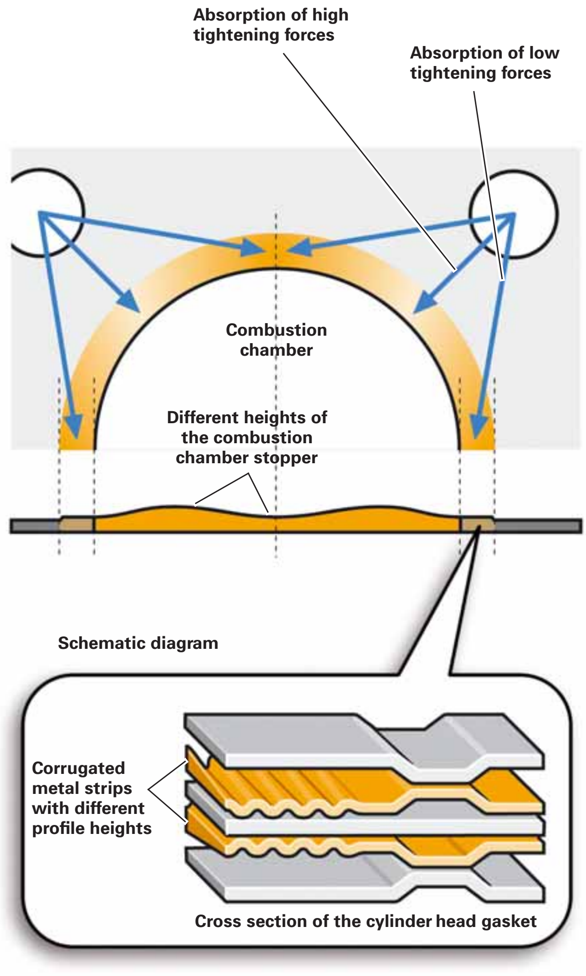
Height-profiled combustion chamber stopper

The "combustion chamber stopper" is the term used to describe the sealing edge on the cylinder bore. It has different heights along the edge of the combustion chamber.
This special design ensures a more uniform distribution of tightening forces to the combustion chambers after the cylinder head bolts have been tightened. As a result, sealing gap oscillation and distortion of the cylinder bores are reduced.

The reason for this improvement in cylinder head sealing is the differences in distance between the cylinder head bolt and the cylinder bores. This means that parts of the combustion chamber stopper are located close to a cylinder head bolt and therefore are subject to high tightening forces. Other sections are located at a greater distance to a cylinder head bolt and therefore are subject to less tightening force.
These differences are compensated by an elevated combustion chamber stopper in areas subject to low tightening forces and a flat combustion chamber stopper in areas subject to higher tightening forces.



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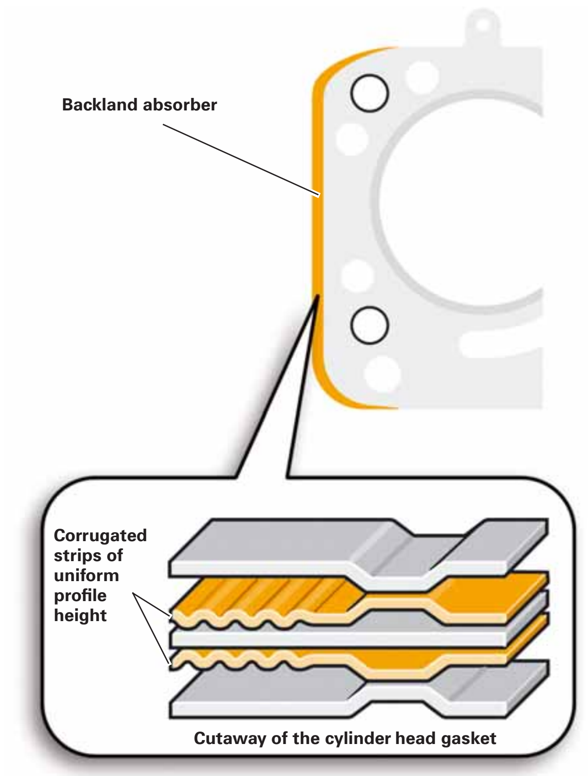
Backland absorbers

Backland absorbers are built into the cylinder head gasket in the region of the two outer cylinders. They provide a more uniform distribution of tightening forces to the outer cylinder head bolts. This counteracts cylinder head flexure and reduces distortion of the outer cylinder bores.



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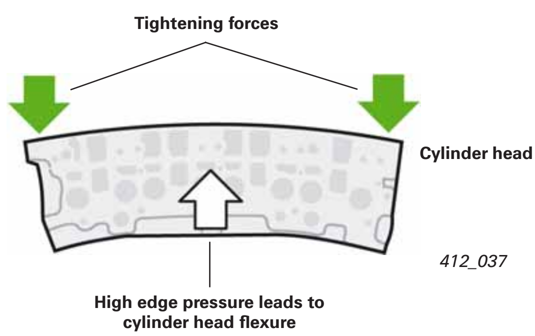
The outer cylinder head bolts produce higher tightening forces due to the fact that the contact cylinder head has a smaller contact area in the region of the outer cylinders. This results in an increased pressure on the cylinder head gasket, resulting in the flexure of the cylinder head. This flexure in turn produces distortion of the outer cylinder bores.

The backland absorber absorbs the higher edge pressure on the cylinder head gasket, thereby reducing the flexure of the cylinder head. As a result of this improvement, the distribution of tightening forces at the outer combustion chamber stoppers has been optimised. In addition, the total amount of movement of the cylinder head during engine operation has been reduced.

without backland absorber



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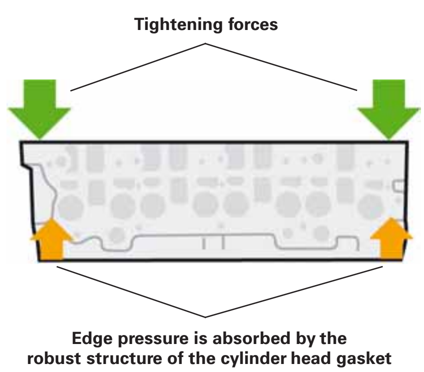
with backland absorber



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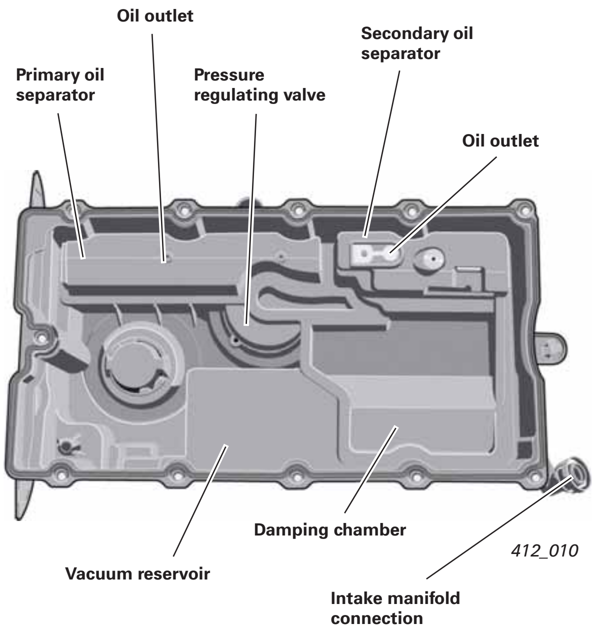
Cylinder head cover

It is made of plastic and houses the oil separating members of the crankcase breather. The oil separation system is integrated in the cylinder head cover and cannot be opened or removed.

The oil separation system is comprised of three sections:

– Primary oil separator
– Secondary oil separator
– Damping chamber

The multistage design of the oil separation system reduces oil entrainment from the crankcase breather.



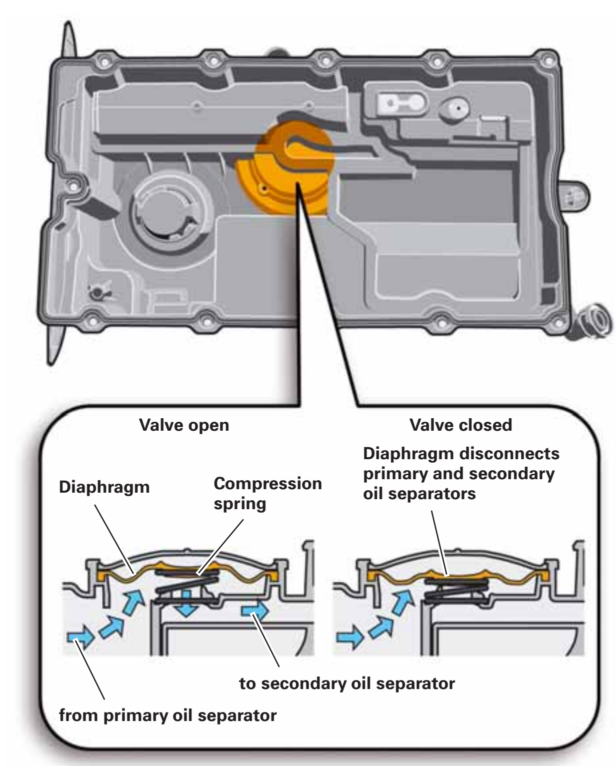
412_010

Pressure regulating valve

The pressure control valve is positioned between the primary and secondary oil separators, and as such limits the amount of vacuum inside the crankcase. An excessively high vacuum can damage the engine gaskets.

The valve is comprised of a diaphragm and a compression spring.
When a low vacuum level is present in the intake port, the valve opens under the force exerted by the compression spring.
When a high vacuum level is present in the intake port, the pressure control valve closes and disconnects the primary and secondary oil separators.

Inside view of cylinder head cover



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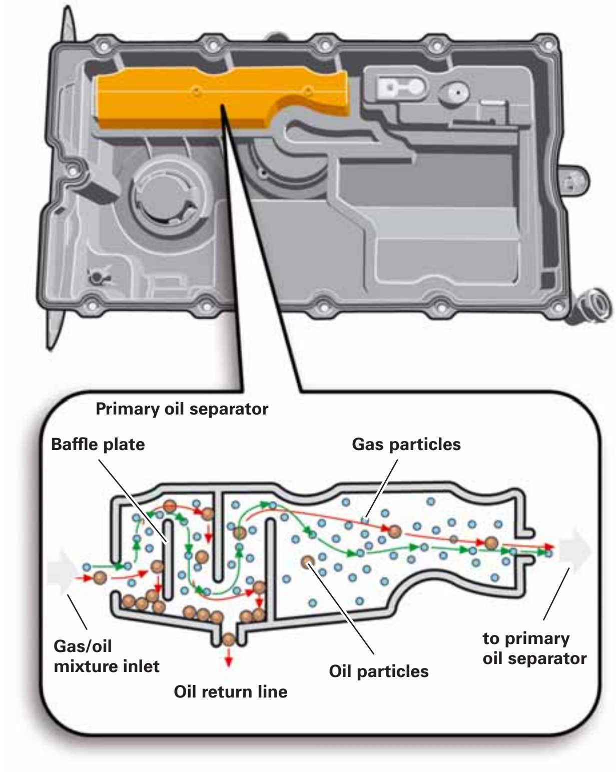
Primary oil separator

The primary oil separator is comprised of a baffle plate separator.
The larger oil droplets carried away from the crankcase by the gas flow are separated at the baffle plates and collect on the bottom of the primary oil separator.
The oil is able to drip into the cylinder head through small holes in the plastic housing.

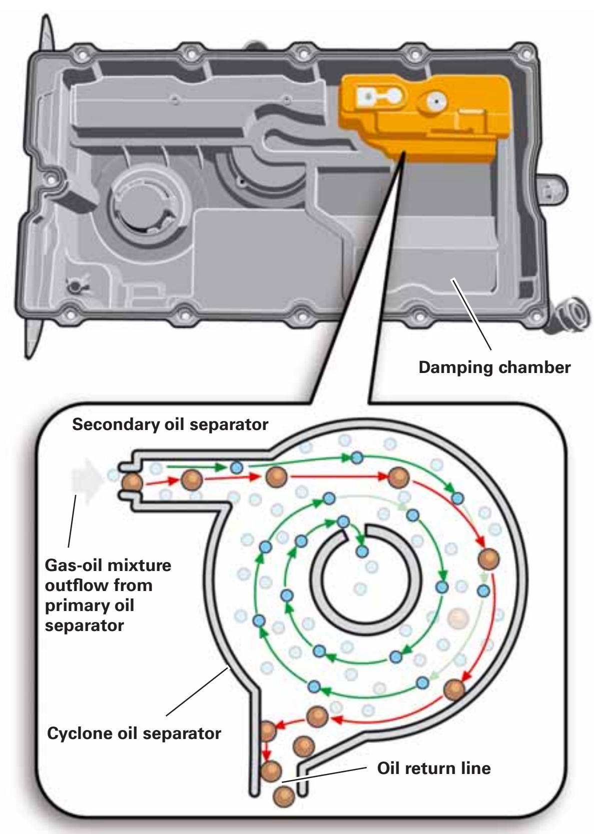


412_011

Secondary oil separator

Secondary oil separation is provided by a cyclone oil separator with a pressure regulating valve.
Cyclone oil separators are also known as centrifugal oil separators. Their functional principle is based on the induction of rotational movement in an oil-gas mixture by channelling the flow.
The centrifugal force accelerates outwards the oil droplets, which are heavier than the gas. The oil droplets deposit on the wall of the cyclone oil separator and drip through a drain hole into the cylinder head. The cyclone oil separator has the capability to separate very fine oil droplets.

A damping chamber adjoining the cyclone oil separator prevents unwanted turbulence when the gas flows into the intake manifold. The damping chamber reduces the kinetic energy of the gas.
A residual amount of oil also precipitates out inside the damping chamber.



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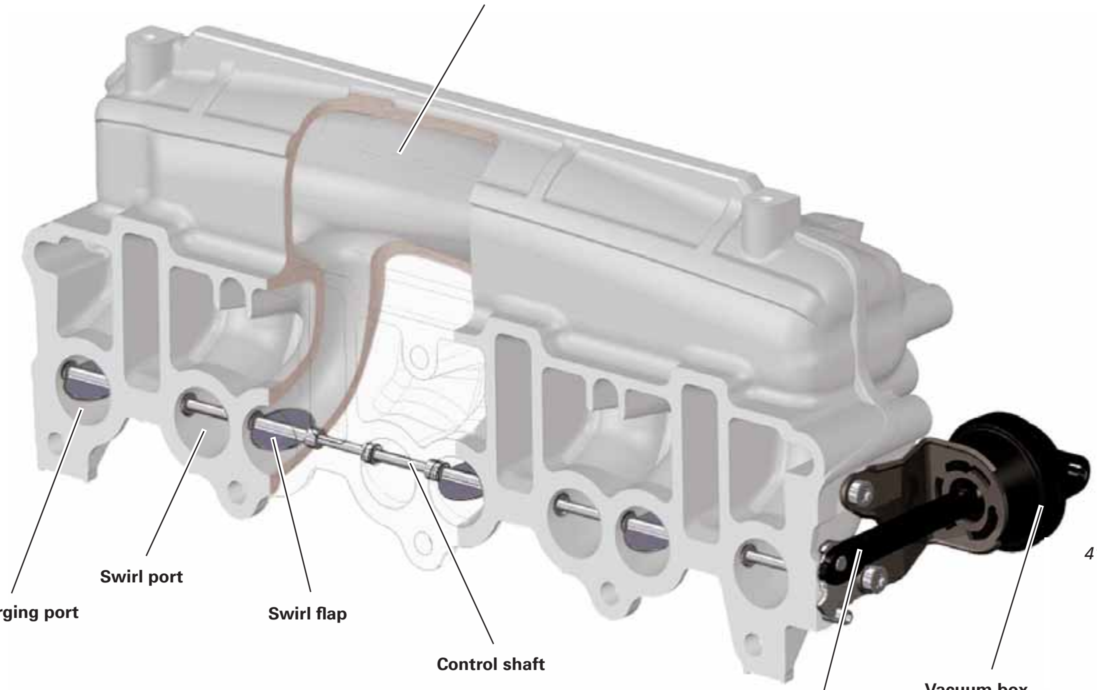
Intake manifold

The 125 kW TDI engine has an aluminium intake manifold with swirl flaps. By closing the swirl flaps, carbon monoxide (CO) and hydrocarbon (HC) emissions are significantly reduced.



Design

A steel control shaft inside the intake manifold is actuated by a vacuum box via a selector gate.
The vacuum box is supplied with vacuum by an electric control valve (intake manifold flap valve N316). The required amount of vacuum is produced by the tandem pump.

The special feature of the intake manifold is that the intake port on each cylinder branches into a charging port and a swirl port but the control shaft closes only the charging port with one swirl flap. When the swirl flap is closed, air is induced via the swirl port only, thereby increasing the rate of flow through this port.

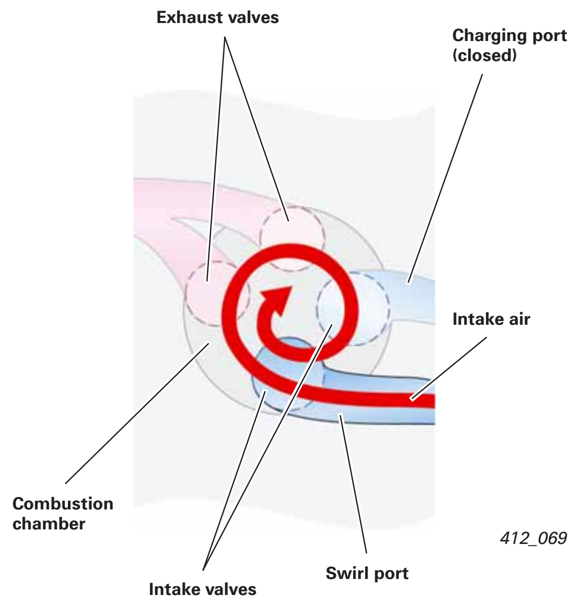
The swirl flaps can adopt only the "open" or "closed" position. When no vacuum is present at the vacuum box, the swirl flaps are in the "open" position (emergency running position).

Function

The increased flow rate within the swirl port when the swirl flap is closed as well as the design and layout of the swirl port increase intake swirl within the cylinder at low intake air flow rates.
This (desirable) effect causes the intake air to rotate faster. This rotation and a higher flow rate are necessary to ensure better carburetion, particularly at low engine speeds and torque. Better fuel economy and lower pollutant emissions are achieved.

The swirl flaps are kept closed in the engine speed range of 950 rpm to 2200 rpm depending on the engine torque. The swirl flaps are always open when starting the engine and when coasting.

Swirl flaps in "closed" position



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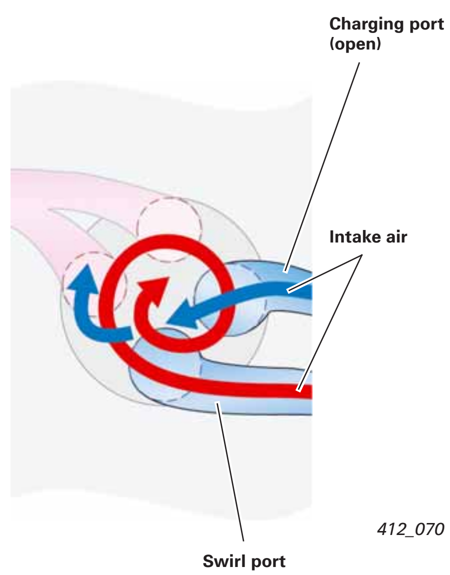
At higher engine speeds and torque, the swirl flap is opened in order to provide better volumetric efficiency. Intake air can now flow into the cylinders through both intake ports. The intake swirl required for carburetion is accomplished through the higher flow rate at high engine speeds.

The intake manifold flap valve N316 is map-controlled by the engine control unit.

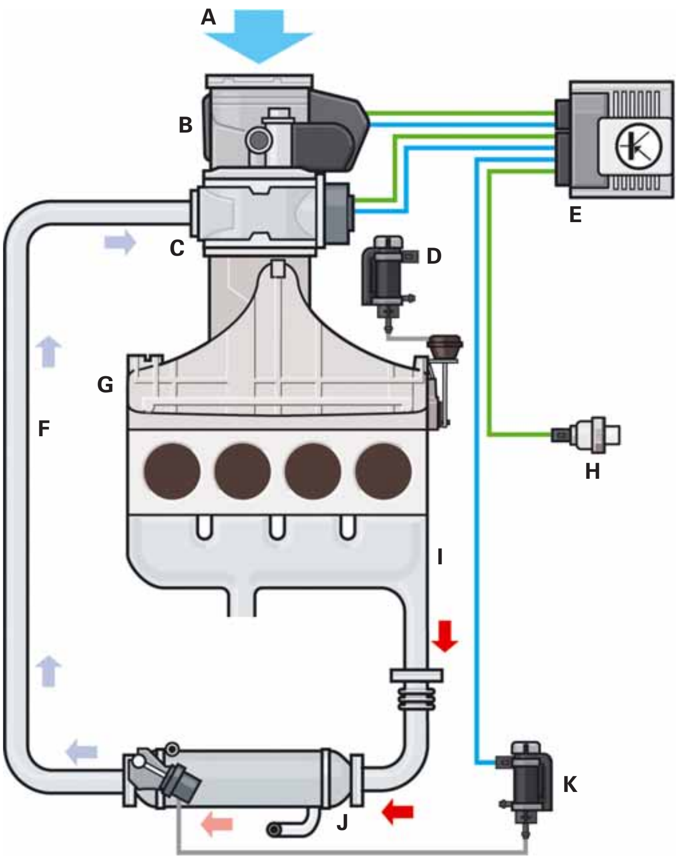
Swirl flaps in "open" position



412_070

Exhaust gas recirculation

The 125 kW TDI engine has a revised exhaust gas recirculation system. The exhaust gas recirculation had to be adapted to accommodate the additional diesel particulate filter, the new position of the exhaust gas turbocharger above the intake manifold and the increased engine power.



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Legend

A Intake air

B Intake manifold flap with intake manifold flap position sender and intake manifold flap motor V157

C Exhaust gas recirculation valve N18 with exhaust gas recirculation potentiometer G212

D Intake manifold flap valve N316

E Engine control unit J623

F Exhaust-gas supply pipe

G Intake manifold

H Coolant temperature sender G62

I Exhaust manifold

J Exhaust gas cooler

K Exhaust gas recirculation cooler change-over valve N345

Design and function

The exhaust gas is extracted from the exhaust manifold on the exhaust end of the engine and channelled to the exhaust gas cooler with control valve. From here, the exhaust gas flows along a pipe and into the exhaust gas recirculation valve.
The exhaust gas recirculation valve is situated in the direction of flow downstream of the electrically actuated intake manifold flap.

Task

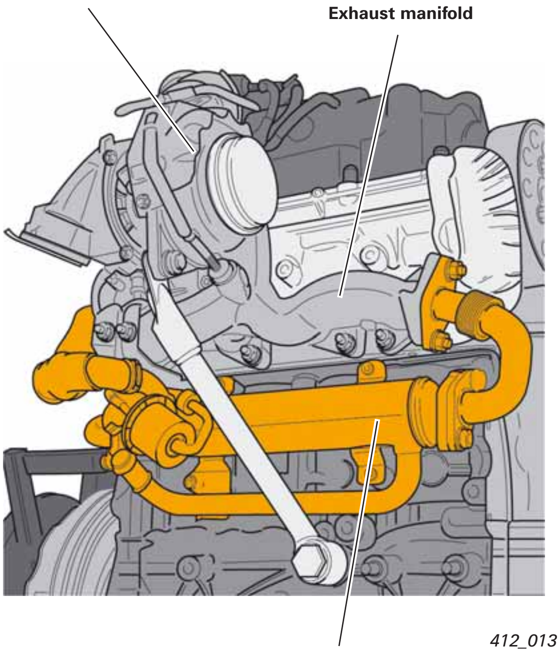
The purpose of exhaust gas recirculation is to reduce nitrous oxide emissions. An exhaust gas recirculation system reduces nitrous oxide emissions because:

– less oxygen is available for combustion due to the recirculated exhaust gas,

– the rate of combustion, and hence the increase in temperature, is reduced by the inflowing exhaust gas.

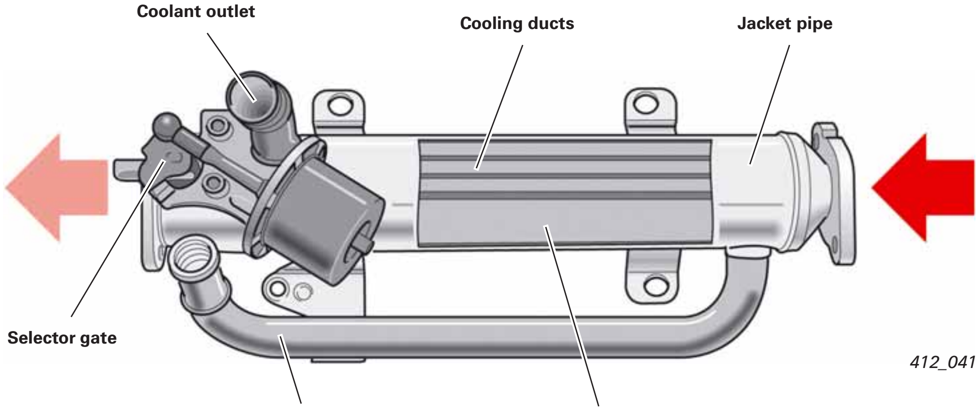
Exhaust gas cooler

The 125 kW TDI engine has a larger exhaust gas cooler on account of its higher power output.
The exhaust gas cooler is bolted to the crankcase below the exhaust gas turbocharger.



412_013

Design



412_041

Design

The new exhaust gas cooler is, unlike the cooler on the predecessor model, housed inside a smooth jacket pipe, which is split into two channels on the inside.
Thin exhaust gas cooling ducts which are swept by coolant are integrated in the top section.
In the bottom section there is a single, thicker pipe which, as a bypass, channels the exhaust gas past the cooler and can be closed or opened by a flap.

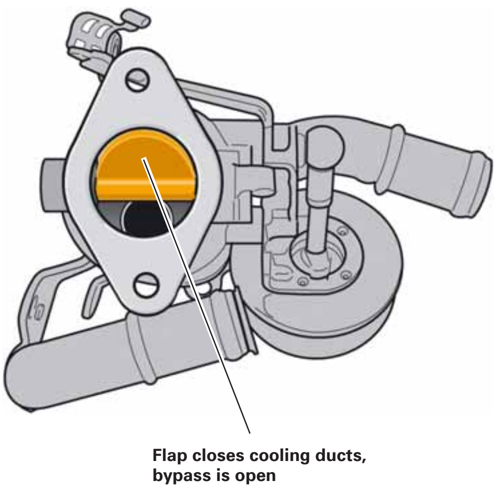
The flap is actuated via a vacuum box with selector gate. When no vacuum is present, the flap closes the bypass.
The vacuum box is placed under vacuum via an electrical control valve (exhaust gas recirculation cooler change-over valve N345).

Function

The exhaust gas cooling system is active at coolant temperatures of less than 34 °C. The flap closes the cooling tube, and the bypass is opened. The uncooled exhaust gas is admitted into the intake manifold.

When the engine is cold started, the inflow of uncooled exhaust gases allows the engine and catalytic converter to reach their respective operating temperatures more quickly.
For this reason, the cooler is closed until the switching conditions are met.

Exhaust gas cooling system inactive



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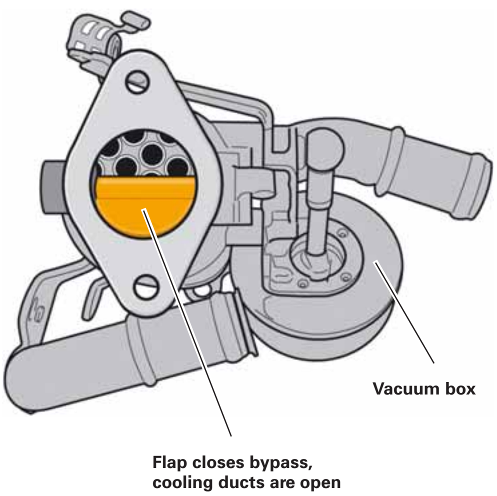
At coolant temperatures of 35 °C or higher, the exhaust gas cooler is activated by closing the flap in the bypass tube. To this end, the engine control unit activates the exhaust gas recirculation cooler change-over valve N345.
The recirculated exhaust gas now flows through the cooling ducts.

The inflow of cooled exhaust gas reduces nitrous oxide emissions particularly at high combustion temperatures.

Exhaust gas cooling system active



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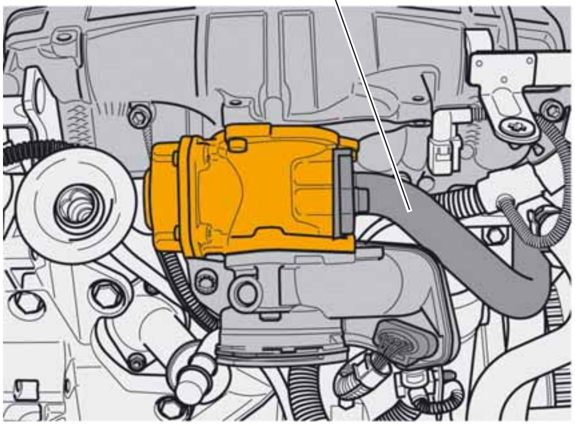
Exhaust gas recirculation valve

A new exhaust gas recirculation valve is used in the 125 kW TDI engine.
It is seated directly on the intake manifold inlet and is electrically actuated.



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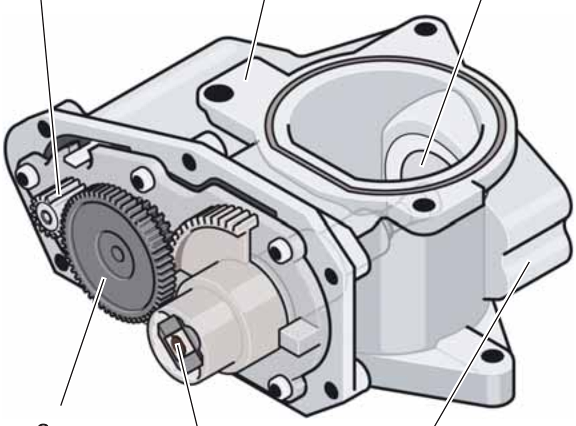
Design

The exhaust gas recirculation valve has a lateral flange which connects to the exhaust gas feed pipe from the exhaust gas cooler.
A valve disc actuated by an electric motor (exhaust gas recirculation valve N18) opens or closes the connection to the exhaust gas feed pipe.
The valve disc has a variable stroke which can be adjusted via a worm gear. This allows the inflowing quantity of exhaust gas to be regulated.
The position of the valve disc is measured by an integral contactless sensor (exhaust gas recirculation potentiometer G212). A return spring ensures that the valve disc is closed if the exhaust gas recirculation valve fails.



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Function

The engine control unit uses a characteristic map to activate the valve disc drive and thereby determines, depending on operating state, how much exhaust gas is admitted into the variable intake manifold.
The amount of exhaust gas recirculated is determined from the air mass meter signal.

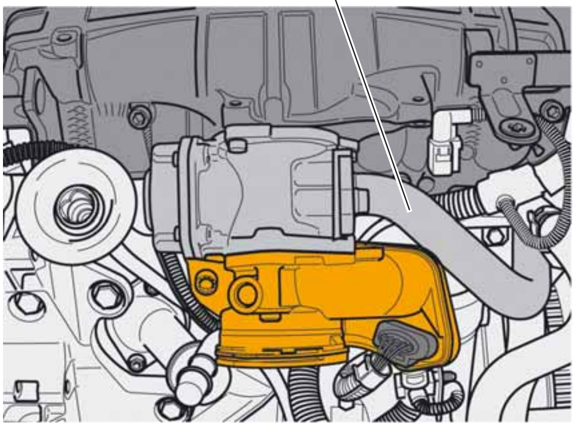
Reference

For information about the exhaust gas recirculation potentiometer G212, refer to page 27 of this Self-Study Programme.

Intake manifold flap

The 125 kW TDI engine has an electrically actuated intake manifold flap, which is mounted in the direction of flow upstream of the exhaust gas recirculation valve.
The task of the intake manifold flap is to assist exhaust gas inflow into the intake port by building up a vacuum downstream of the control flap.

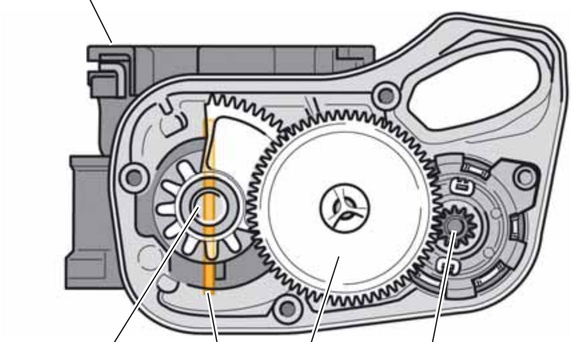
The inflow rate is continuously variable and, therefore, can be adapted to engine load and speed. When the engine is shut off, the control flap is closed to prevent shudder.



412_031

Design

The intake manifold flap is comprised of a housing, a control flap and a drive with an integrated, contactless sensor for determining the flap position.
The drive is comprised of an electric motor (intake manifold flap motor V157) with an easy-locking gear. A return spring ensures that the control flap is in the "open" position (emergency running position) in a deenergised condition. Air intake is not adversely affected when the control flap is in this position.



412_085

Function

The intake manifold flap motor is activated directly by the engine control unit by the application of a DC voltage. The integrated sensor (intake manifold flap position sender) indicates the actual flap position to the engine control unit.

Note

The intake manifold flap position sender is integrated in the housing of the intake manifold flap motor V157. For this reason, the sender is not listed in the "Guided Fault Finding" program.

For further information about the intake manifold flap position sender, refer to page 28 of this Self-Study Programme.

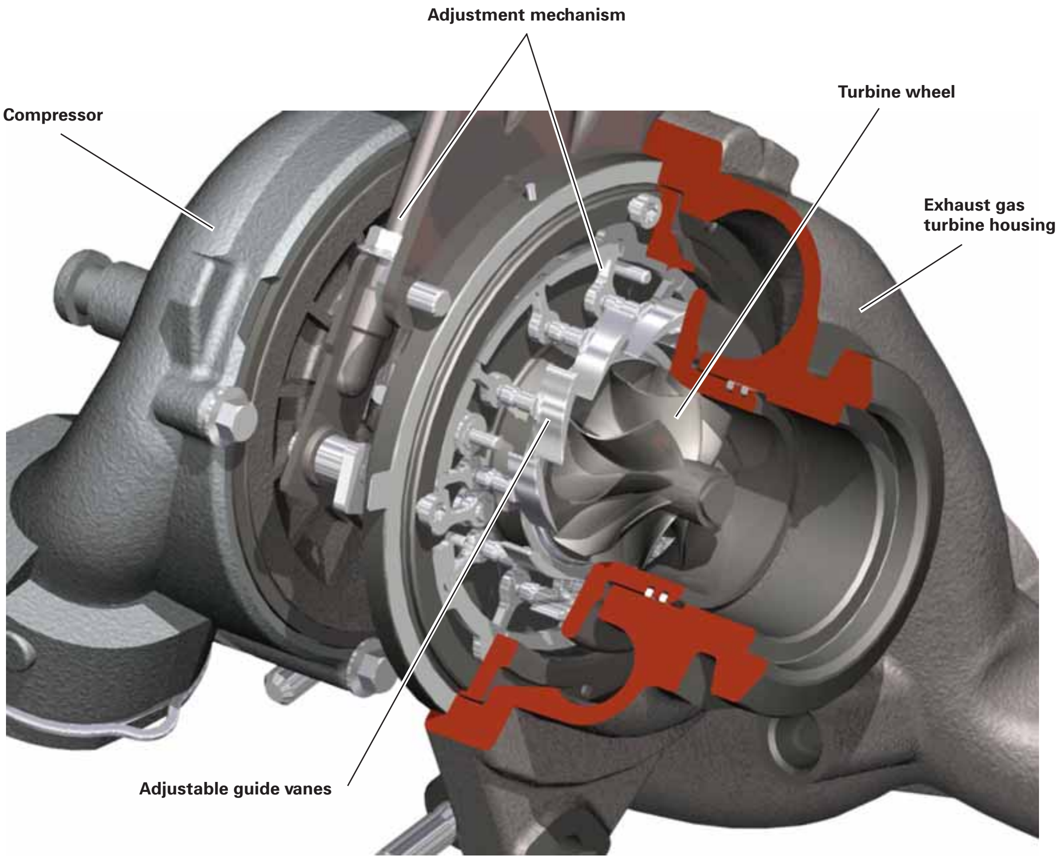
Exhaust gas turbocharger with positional feedback

The 125 kW TDI engine has a revised turbocharger. The exhaust gas turbocharger is integrated in the exhaust manifold together with the turbine housing. The compressor and the turbine wheel have been optimised thermo-dynamically and with respect to flow mechanics, resulting in faster boost pressure build-up, faster gas flow despite the turbocharger having the same size and higher efficiency.

Thanks to the introduction of a close-coupled particulate filter, the exhaust gas turbocharger is now positioned above the exhaust manifold and is supported by the crankcase by means of a tubular element.

Function

The function of the turbocharger adjustment mechanism is unchanged.
The charge-pressure actuator position sender G581 indicates the momentary position of the adjustment mechanism to the engine control unit (positional feedback).



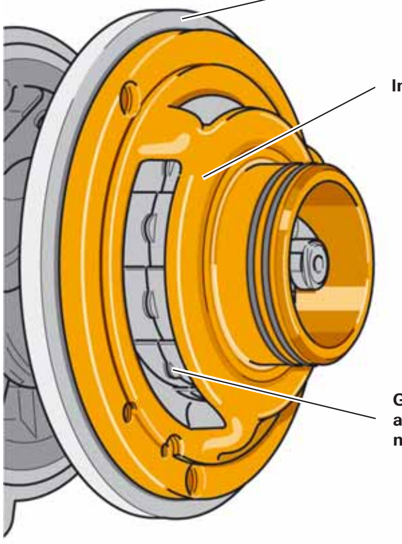
412_076

Reference

For further information about the turbocharger adjustment mechanism, refer to SSP 190 "The Adjustable Turbocharger".

Design and function

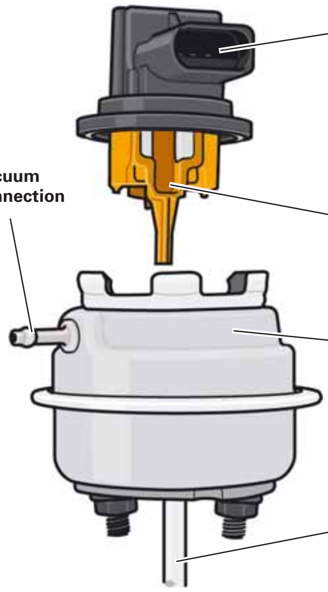
The means by which the adjustment mechanism is attached to the turbocharger has been modified. Previously the adjustment mechanism was connected to the turbine housing. With this turbocharger, the adjustment mechanism is held in place by a cage structure or so-called insert, which is bolted to the bearing housing.
This has the advantage that the adjustment mechanism is isolated from the turbine housing and, as a result, is less affected by vibration caused by the turbine.
The guide vane adjustment mechanism by means of an adjusting ring has been adopted unchanged.



412_066

Charge pressure actuator position sender

The turbocharger has a charge pressure actuator actuator position sender G581. The sensor is integrated in the turbocharger vacuum box.
It measures contactlessly the distance which the diaphragm travels inside the vacuum box when the guide vanes are actuated.
The position of the diaphragm is therefore a direct indication of the inclination angle of the guide vanes.



412_049

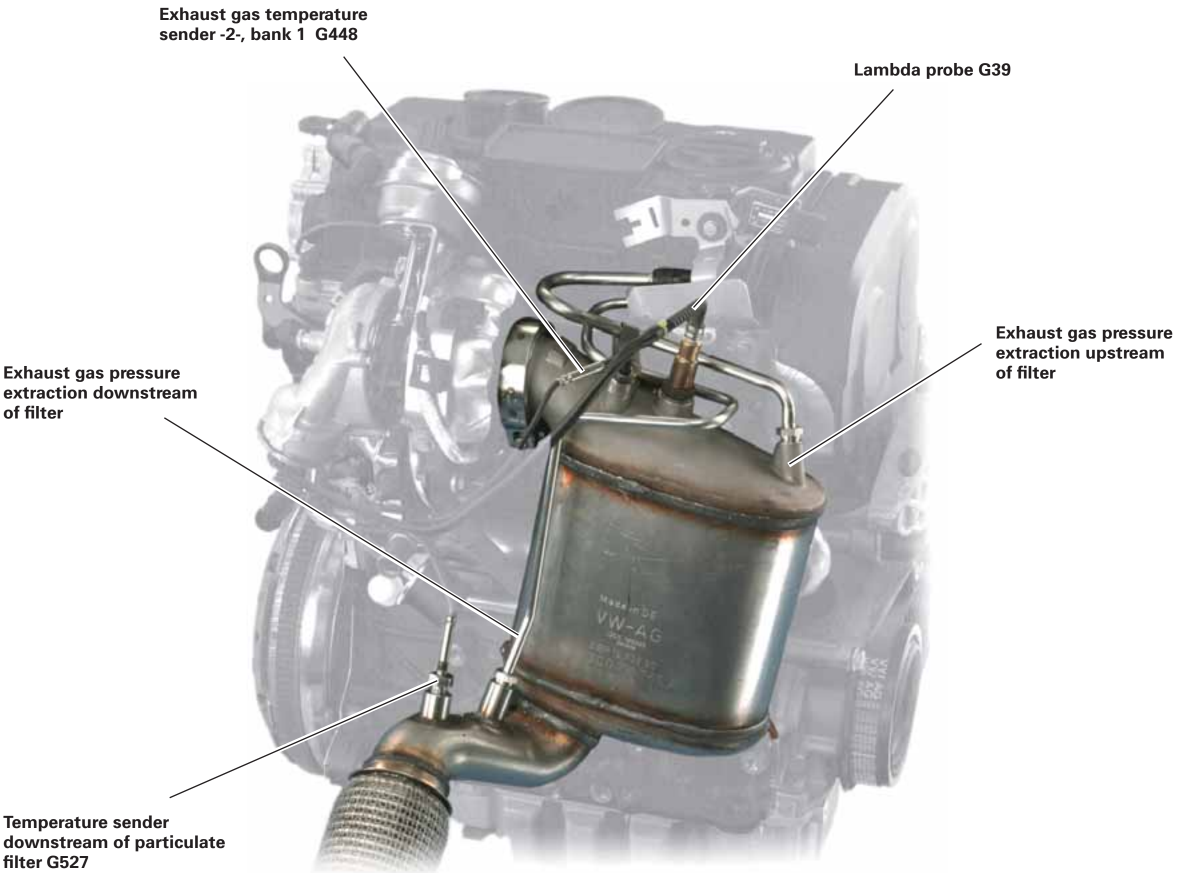
Reference

For further information about the charge pressure actuator position sender, refer to page 26 of this Self-Study Programme.

Diesel particulate filter

The diesel particulate filter is combined with an oxidising catalytic converter to create a unit.
Due to the close-coupled position of the diesel particulate filter and the fact that the oxidising catalytic converter and particulate filter are combined, no additives are required. Continuous passive regeneration of the diesel particulate filter is possible because it reaches its operating temperature quickly.

In addition to passive regeneration, the particulate filter can be actively regenerated. Active regeneration is carried out by the engine control unit when the particulate filter is loaded with particulate matter, e.g. during short trips at partial engine load. In this case, the temperature necessary for complete passive regeneration is not reached inside the particulate filter.



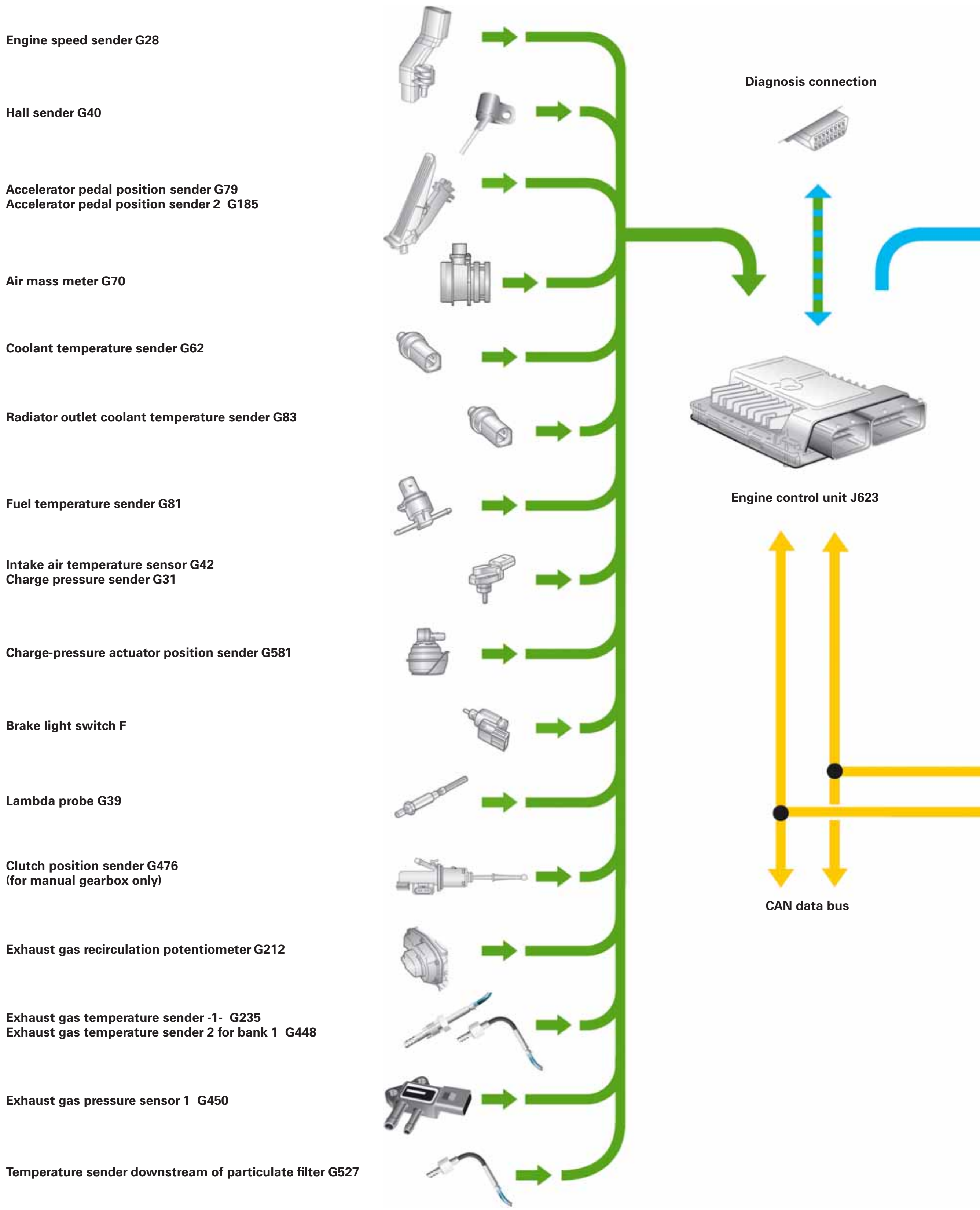
412_007

Reference

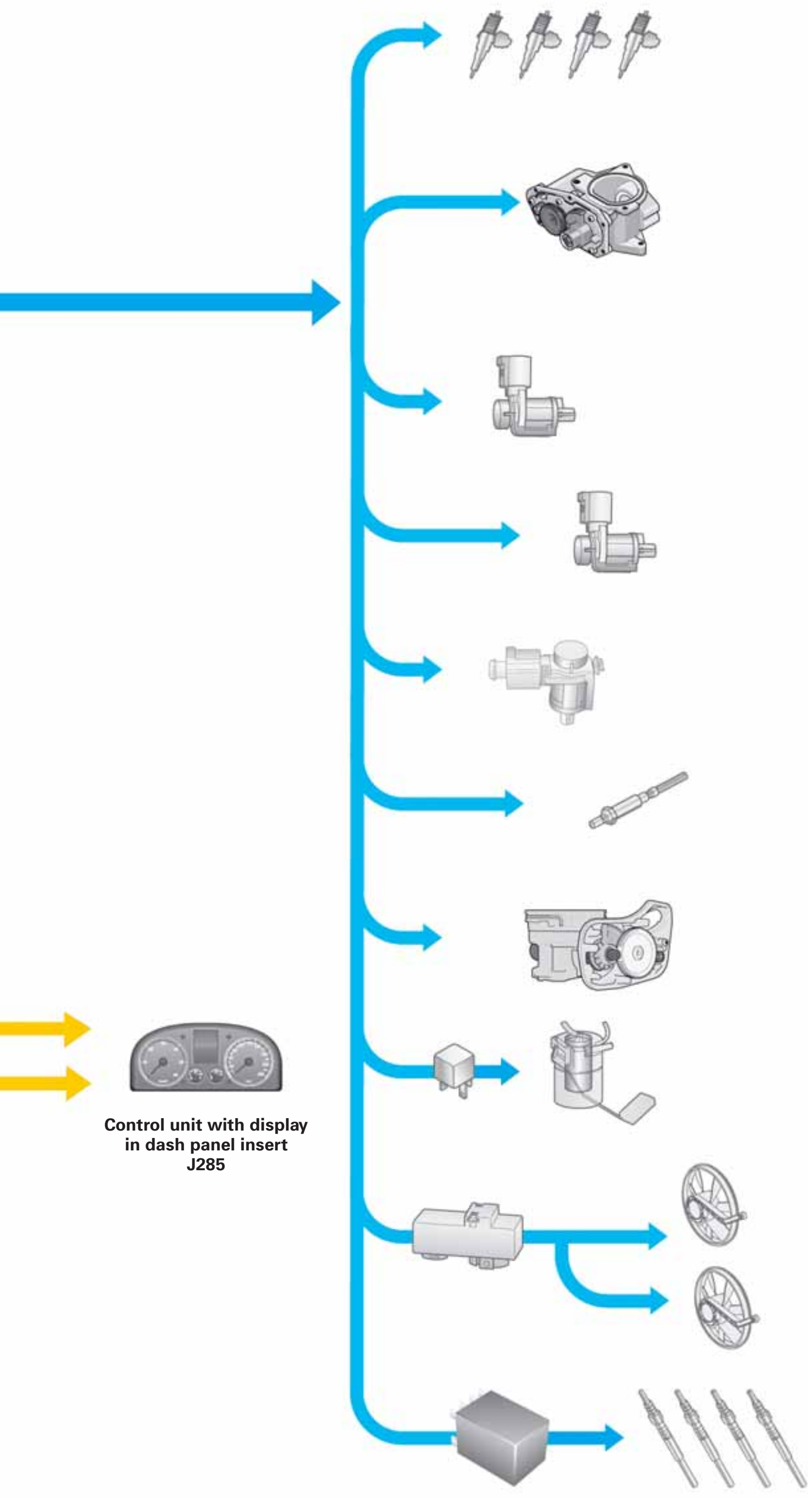
For further information about the catalysed soot diesel particulate filter, refer to SSP 336 "The Catalysed Soot Diesel Particulate Filter".

System overview

Sensors



Actuators



Pump injection valve, cylinders 1 to 4
N240, N241, N242, N243

Exhaust gas recirculation valve N18

Charge pressure control solenoid valve N75

Exhaust gas recirculation cooler change-over valve N345

Intake manifold flap valve N316

Lambda probe heater Z19

Intake manifold flap motor V157

Fuel pump relay J17
Fuel pump (pre-supply pump) G6

Radiator fan control unit J293
Radiator fan V7
Radiator fan 2 V177

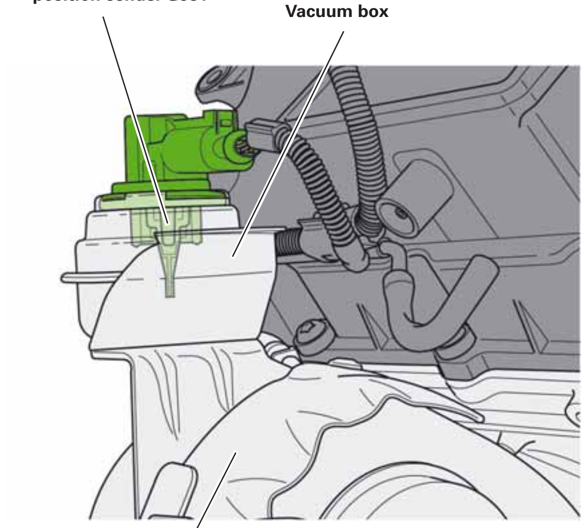
Automatic glow period control unit J179
Glow plugs 1 to 4 Q10, Q11, Q12, Q13

412_072

Sensors

Charge-pressure actuator position sender G581

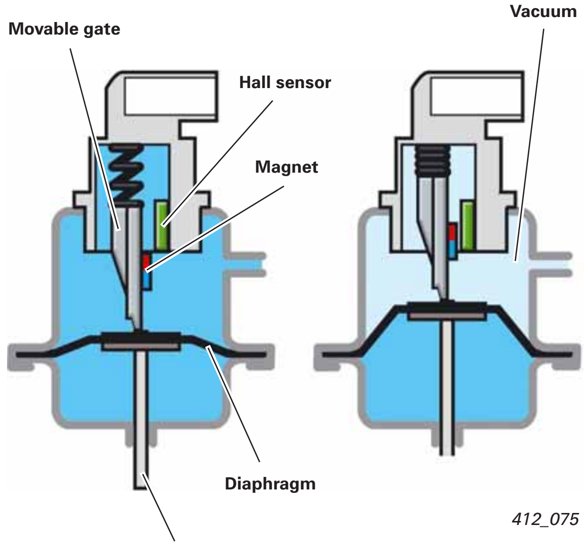
The charge-pressure actuator position sender G581 is integrated in the turbocharger vacuum box. Being a displacement sensor, it allows the engine control unit J623 to determine the position of the turbocharger guide vanes.



412_074

Design and function

The position sender senses the distance travelled by the diaphragm in the vacuum box via a movable gate carrying a magnet.
If the diaphragm becomes displaced during vane adjustment, the magnet is guided past a Hall sensor. The change in the magnetic field strength enables the sensor electronics to determine the position of the diaphragm and hence the position of the guide vanes.



412_075

Signal utilisation

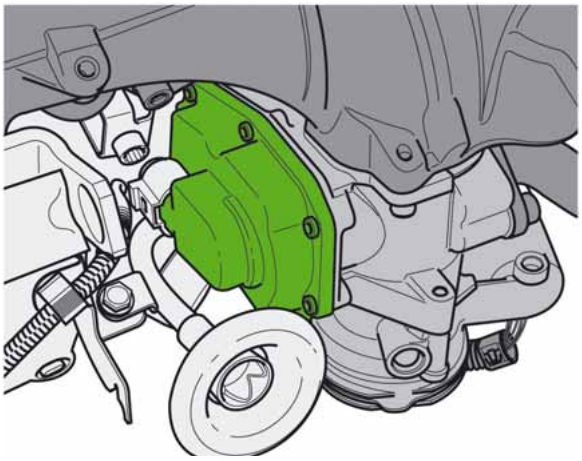
The signal from the sensor is used by the engine control unit J623 to determine the momentary position of the turbocharger guide vanes.
This signal, together with the signal from the charge pressure sender G31, gives an indication of the status of the charge pressure control system.

Effects of failure

In the event of failure of the sensor, the signal from the charge pressure sender G31 and the engine speed are utilised to determine the position of the guide vanes. The exhaust emissions warning lamp K83 is activated.

Exhaust gas recirculation potentiometer G212

The exhaust gas recirculation potentiometer G212 determines the position of the valve disc in the EGR valve (exhaust gas recirculation valve). The stroke of the valve disc controls the inflow of recirculated exhaust gas into the intake manifold.

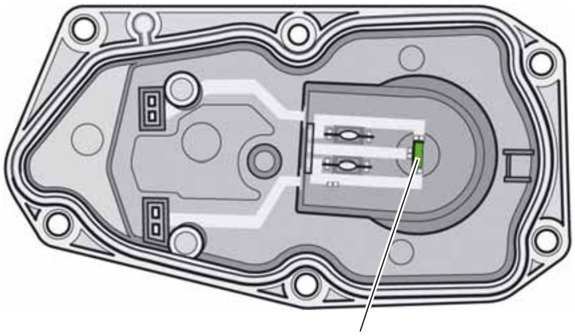


412_017

Design and function

The sender is integrated in the plastic cover of the exhaust gas recirculation valve N18. It is a Hall sender which contactlessly monitors a permanent magnet on the input shaft and, depending on the change in field strength, supplies a signal that can be used to compute the opening stroke of the valve disc.

Exhaust gas recirculation valve cover



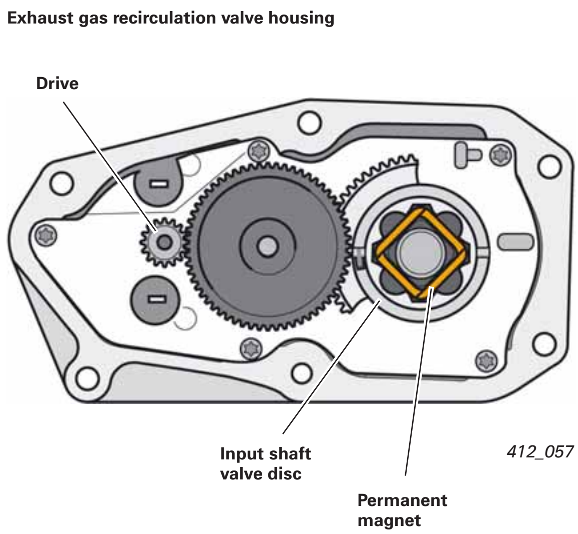
412_056

Signal utilisation

The signal signifies to the engine control unit J623 the momentary position of the valve disc. This information is required, among other things, to control the recirculated exhaust gas flow rate and hence the nitrous oxide concentration in the exhaust gas.

Effects of failure

In the event of failure of the sensor, the exhaust gas recirculation system is switched off.
The drive of exhaust gas recirculation valve N18 is simultaneously deenergised and, as a result, the valve disc is drawn into the "closed" position by the resetting spring.



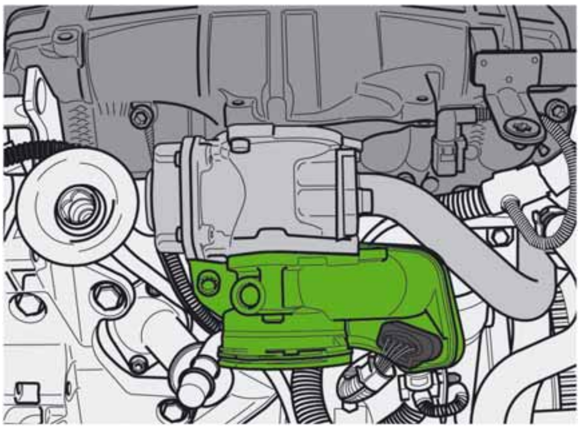
412_057

Intake manifold flap position sender

Design and function

The sensor element is integrated in the intake manifold flap drive (intake manifold flap motor V157). It determines the momentary position of the intake manifold flap.

The sender is located on a PCB under the plastic cover of the intake manifold flap module.
It is a magneto-resistive sensor which contactlessly monitors a permanent magnet on the control flap shaft.

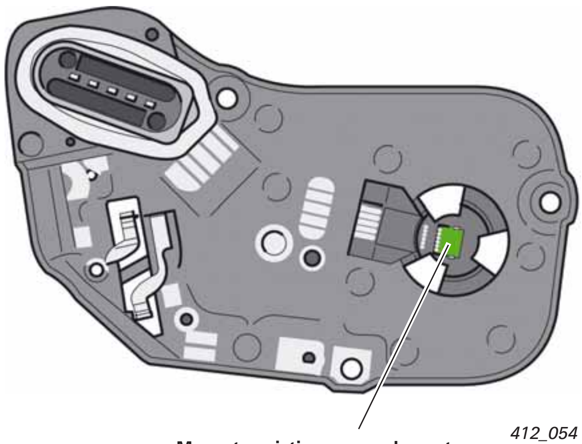


412_018

Signal utilisation

The signal tells the engine control unit J623 the momentary position of the intake manifold flap. The control unit requires the position, among other things, in order to control exhaust gas recirculation and particulate filter regeneration.

PCB

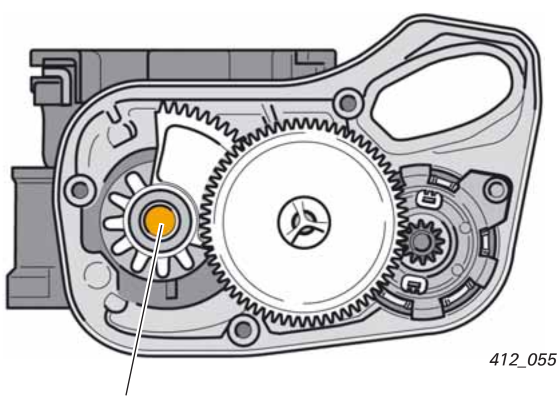


412_054

Effects of failure

In the event of failure of the sensor, the exhaust gas recirculation system is switched off. The exhaust gas recirculation valve drive is simultaneously deenergised and, as a result, the valve disc is drawn into the "closed" position by the resetting spring. A fault is registered in the fault memory under the associated intake manifold flap motor V157.

Intake manifold flap housing



412_055

Actuators

Pump injection valve, cylinders 1 to 4 N240, N241, N242, N243

Design and function

The pump-injector valves are piezoelectric valves. They are an integral part of the pump injector units and are connected directly to the engine control unit J623. The engine control unit J623 controls the individual injection phases of the pump-injector units.

The advantages of piezoelectric valves over a pump-injector unit with solenoid valve are:

- Lower noise emissions
- A broader range of injection pressures (130 - 2200 bar)
- More flexible control of the pre-injection, main injection and post-injection phases
- Higher efficiency
- Lower fuel consumption
- Lower pollutant emissions
- Higher engine power

412_021

Effects of failure

If a pump-injector valve fails, fuel injection into the cylinder in question is suppressed.
If a slight deviation from the control limit occurs, the pump-injector valve is still activated. In any case, a fault will be registered in the fault memory.

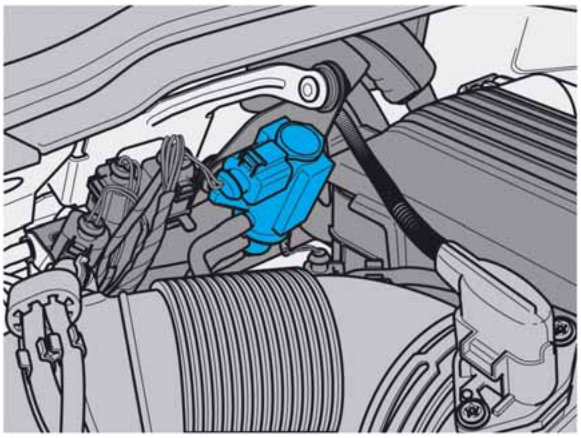
Reference

For detailed information, please refer to SSP 352 "The Pump Injector Unit with Piezo Valve".

Charge pressure control solenoid valve N75

Design and function

This valve supplies the exhaust gas turbocharger vacuum box with the vacuum required to adjust the guide vanes.



412_052

Effects of failure

In the deenergised state, the valve disconnects the vacuum box from the vacuum system.
A spring in the vacuum box displaces the adjustment mechanism linkage in such a way that the turbocharger guide vanes are adjusted to a steep inclination angle (emergency running position).
At low engine speeds, i.e. low exhaust gas pressure, only a low charge pressure is available.

Legend

A Vacuum system

B Engine control unit J623

C Intake air

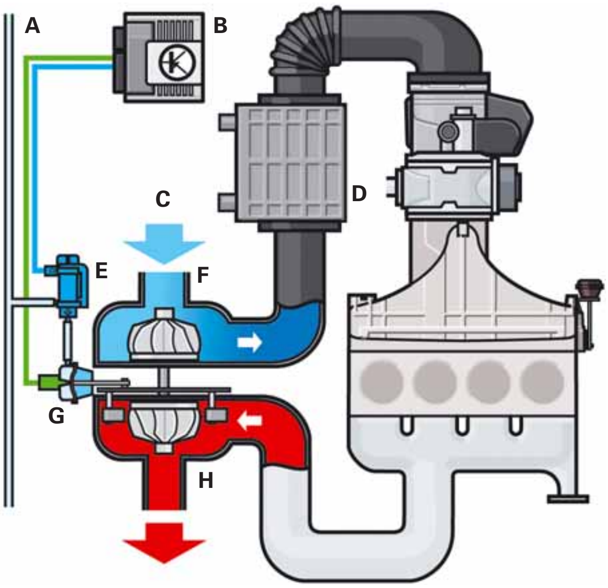
D Charge-air cooler

E Charge pressure control solenoid valve N75

F Compressor

G Vacuum box with charge-pressure actuator position sender G581

H Exhaust gas turbine with vane adjustment

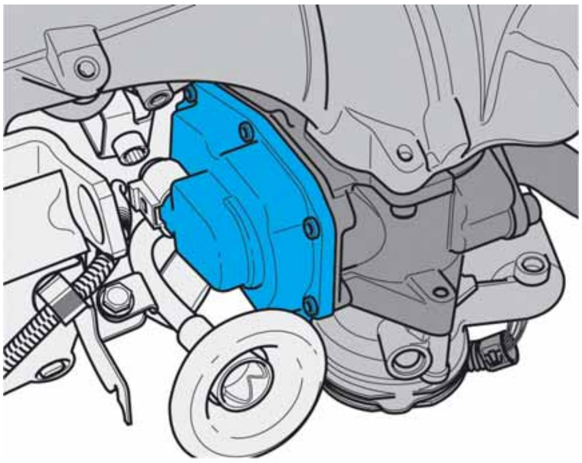


412_094

Exhaust gas recirculation valve N18

Design and function

An electric motor produces a lifting movement of the valve disc of exhaust gas recirculation valve N18 via a gear mechanism.
To this end, the motor is activated by the engine control unit J623 via an analogue signal.



412_053

Effects of failure

In the deenergised state, the valve is drawn into an emergency running position (closed) by a resetting spring. In this position the exhaust gas recirculation system is switched off.

Legend

A Intake air

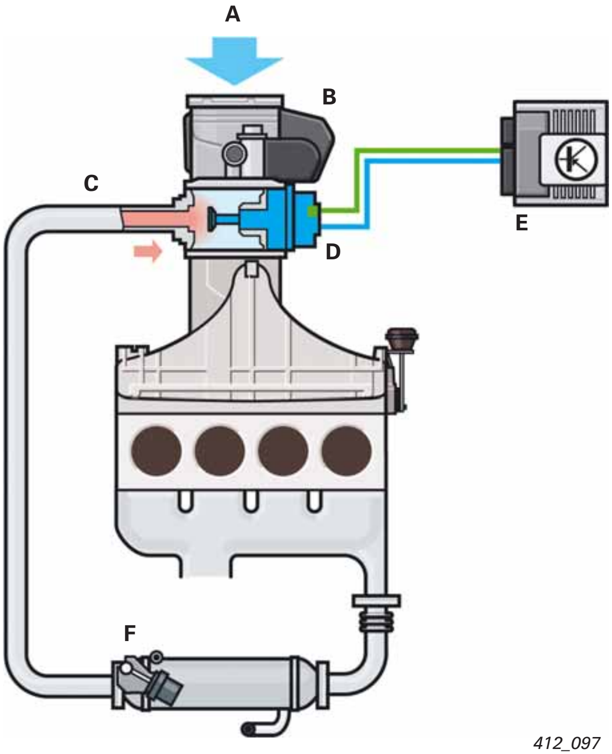
B Intake manifold flap

C Exhaust gas feed pipe

D Exhaust gas recirculation valve N18 with exhaust gas recirculation potentiometer G212

E Engine control unit J623

F Exhaust gas cooler



412_097

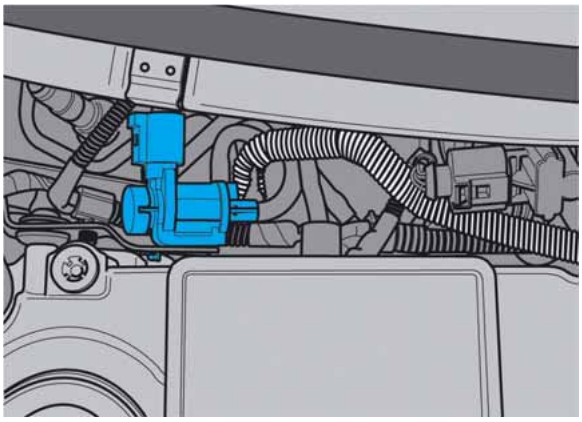
Exhaust gas recirculation cooler change-over valve N345

Design and function

This valve supplies the exhaust gas cooler vacuum box with the amount of vacuum needed to actuate the bypass flap.

Effects of failure

In the deenergised state, the valve disconnects the vacuum box from the vacuum system. As a result, the exhaust gas cooler bypass valve remains closed, and no exhaust gas is able to flow through the cooler.



412_051

Legend

A Intake air

B Intake manifold flap

C Exhaust gas recirculation valve N18

D Engine control unit J623

E Cooled exhaust gas

F Coolant outlet

G Exhaust gas cooler

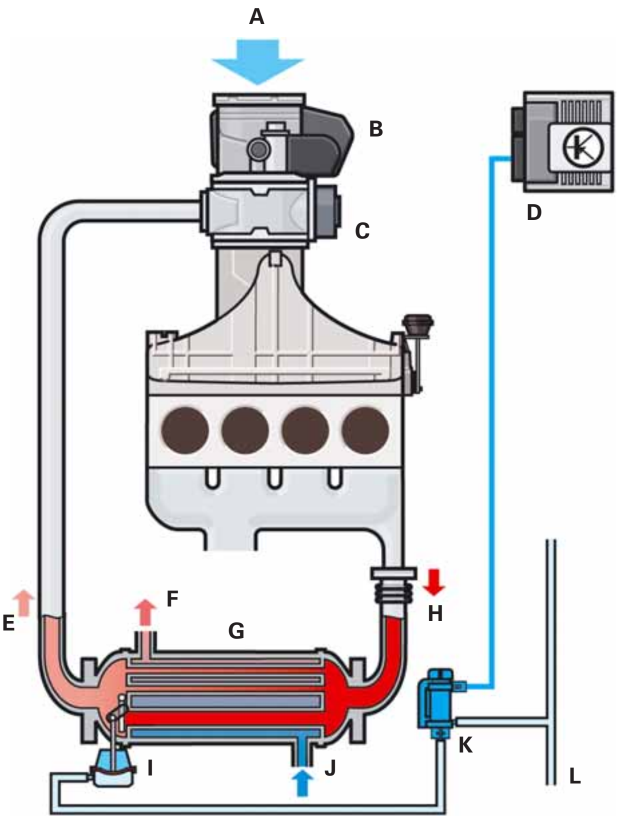
H Hot exhaust gas

I Vacuum box

J Coolant inlet

K Exhaust gas recirculation cooler change-over valve N345

L Vacuum system



412_096

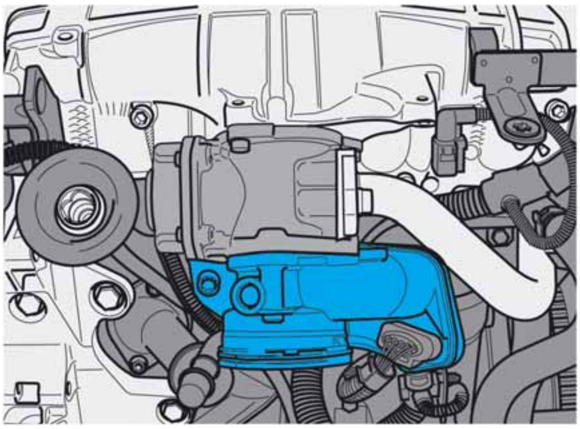
Intake manifold flap motor V157

Design and function

A control flap driven by an electric motor is integrated in the intake manifold flap. The control flap regulates the intake air flow and is adjusted in a continuously variable manner by the engine control unit J623.

Effects of failure

In the deenergised state, the control flap is drawn into an emergency running position (open) by a resetting spring. In this position air induction is not adversely affected by failure of the control flap.



412_058

Legend

A Intake air

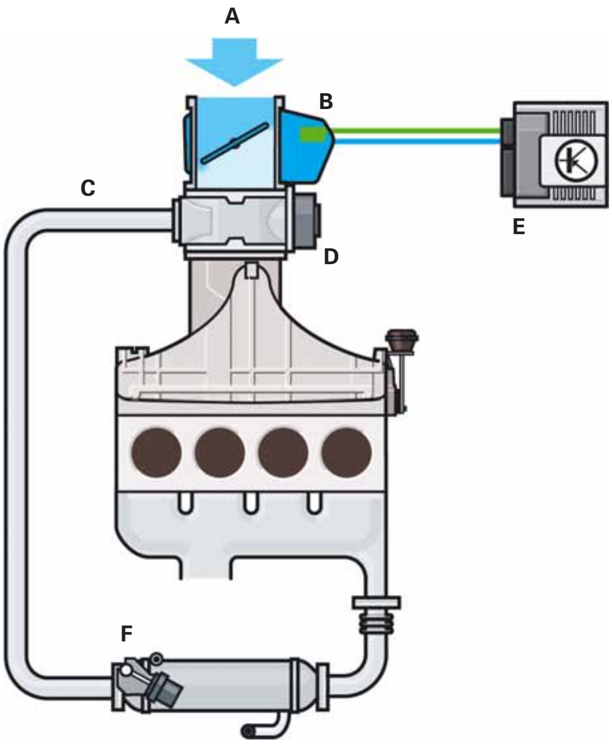
B Intake manifold flap with intake manifold flap position sender and intake manifold flap motor V157

C Exhaust gas feed pipe

D Exhaust gas recirculation valve N18

E Engine control unit J623

F Exhaust gas cooler

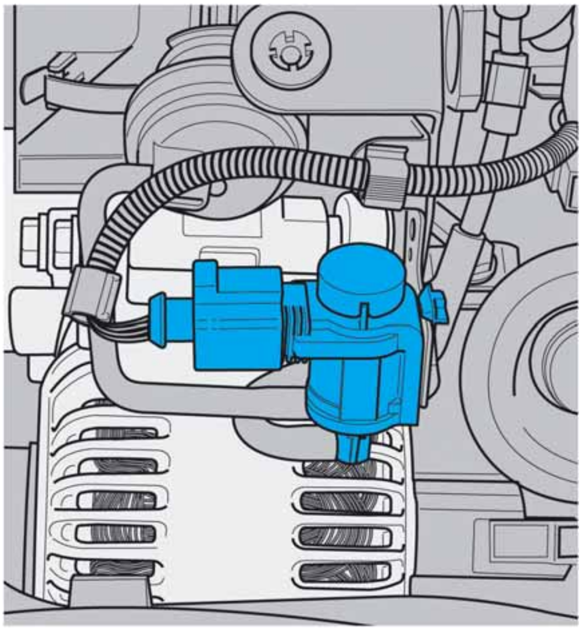


412_098

Intake manifold flap valve N316

Design and function

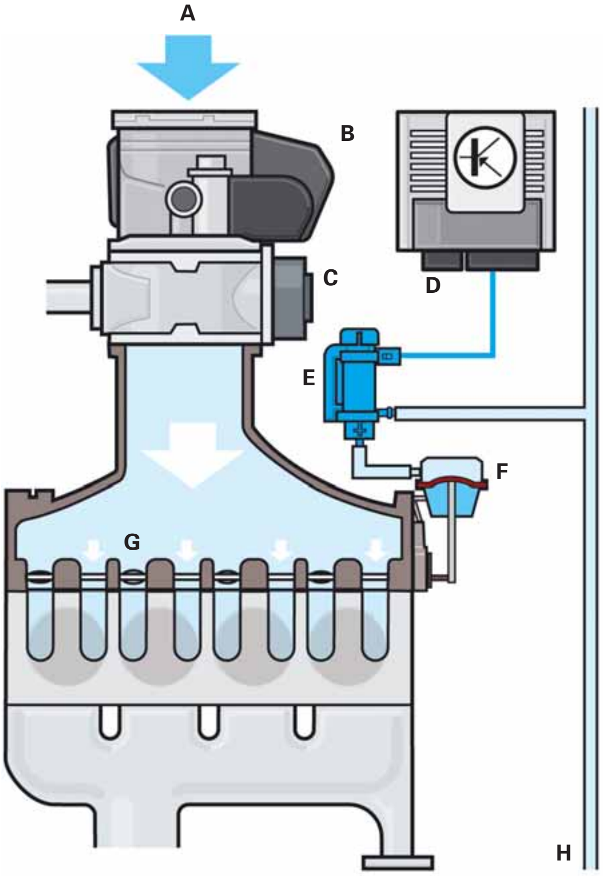
The intake manifold flap valve N316 is a solenoid valve. It supplies the vacuum box of the intake manifold with the vacuum required to open and close the swirl flaps. It is activated by engine control unit J623 according to a characteristic map.



412_050

Effects of failure

If the intake manifold flap valve fails, the swirl flaps in the intake manifold cannot be closed. The intake manifold swirl flaps are fixed in the "open" position.



412_095

Legend

A Intake air

B Intake manifold flap

C Exhaust gas recirculation valve N18

D Engine control unit J623

E Intake manifold flap valve N316

F Vacuum box

G Variable intake manifold with control shaft

H Vacuum system

Glow plugs 1 to 4 Q10, Q11, Q12, Q13

The new NGK ceramic glow plugs are a special feature of the glow plug system.
They exhibit minimum ageing effects and thereby have a long useful life.
Further advantages are improved cold starting performance and exhaust emissions.

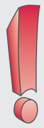
412_020

Design and function

The ceramic glow plug is comprised of a plug element, a terminal stud and a heating element made of ceramic materials. The heating element is comprised of an insulating protective ceramic sleeve and an inner heat-conductive ceramic material. The heat-conductive ceramic material replaces the regulating and heating coil of the metallic glow plug.

Effects of failure

If the automatic glow period control unit J179 detects an excessively high power consumption or resistance when a glow plug is connected, the corresponding glow plugs are no longer activated.



Note

Please note that ceramic glow plugs should only be installed in suitable engines.
Use of ceramic glow plugs in an engine for which they are not intended will inevitably lead to cold-starting problems because the engine management system cannot utilise the full potential of the ceramic glow plugs.

Ceramic glow plugs are sensitive to impact and bending. For further information, refer to the Workshop Manual.

Function

Pre-heating

The ceramic glow plugs are sequentially activated by the engine control unit J623 via the automatic glow period control unit J179 using a pulse-width modulated signal (PWM).
At the same time, the voltage at the individual glow plugs is adjusted by changing the frequency of the PWM pulses.
For quick starting at an ambient temperature of less than 14 °C, the maximum voltage of 11.5 V is applied. This ensures that the glow plug heats up to a temperature of over 1000 °C within an extremely short space of time (no more than two seconds). Engine pre-heating time is reduced as a result.

Post-heating

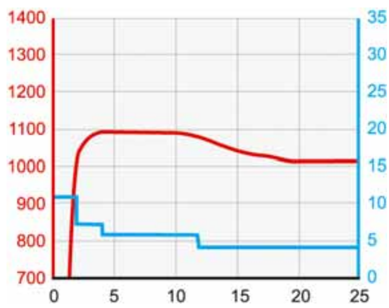
Post-heating voltage is adjusted to the nominal value of 7 V by continuously reducing the control frequency of the PWM signal.
During the post-heating phase, the ceramic glow plug reaches a temperature of approx. 1350 °C. Post-heating is active for max. 5 minutes after starting the engine until a coolant temperature of 20 °C is reached.
The high glow temperature helps to reduce hydrocarbon emissions and combustion noise in the warm-up phase.

Intermediate heating phase

To regenerate the particulate filter, the engine control unit J623 activates the glow plugs for an intermediate heating phase. Intermediate heating improves combustion conditions during the regeneration cycle.
Intermediate heating for purposes of particulate filter regeneration does not put special demands on ceramic glow plugs due to their low ageing rate.

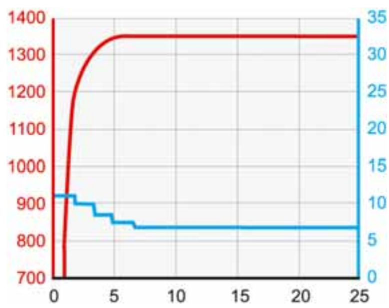
In comparison with the metallic glow plug, the ceramic glow plug achieves significantly higher glow temperatures, but has a similar power demand.

Metallic glow plug



412_024

Ceramic glow plug



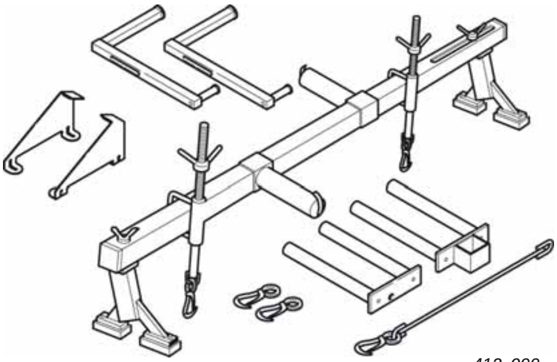
412_023

Legend

Voltage [V]
Glow temperature [°C]

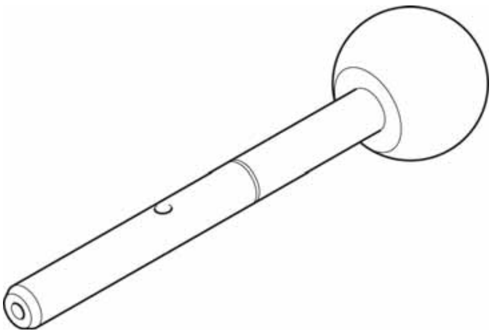
Special tools

Here you are shown the special tools for the 2.0l 125 kW TDI engine with pump injection system.



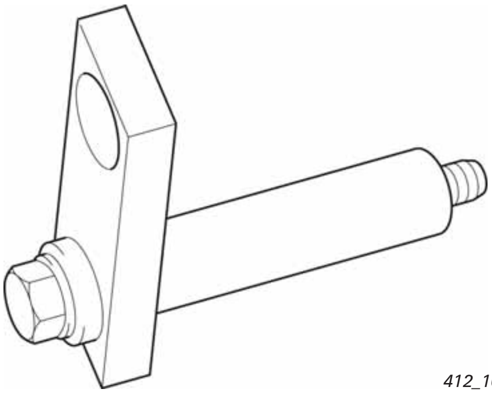
412_099

10-222A
Support device



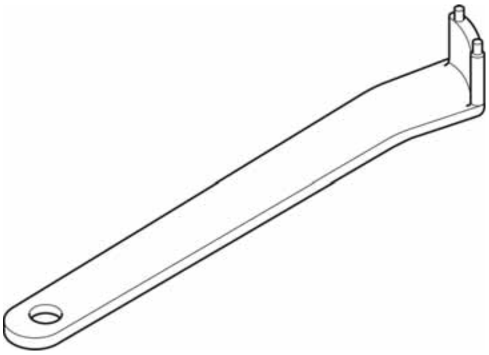
412_100

3359
Rig pin



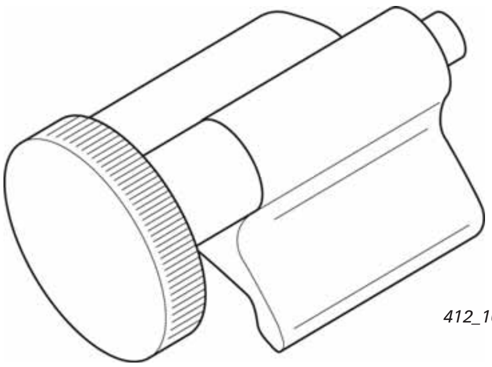
412_101

T10014
Holder



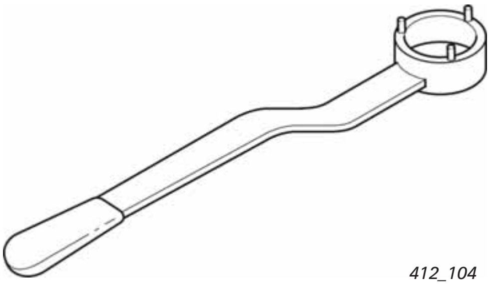
412_102

T10020
Pin wrench



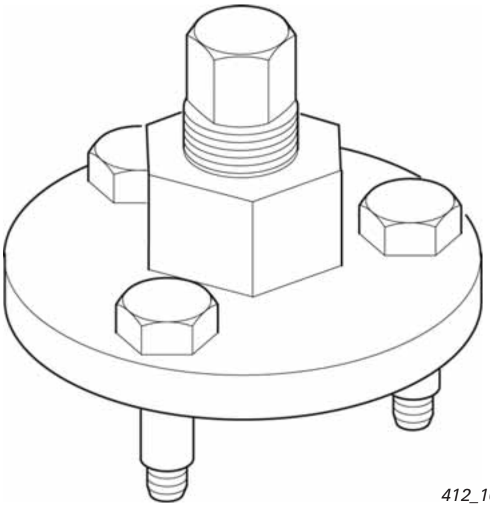
412_103

T10050
Crankshaft locking tool



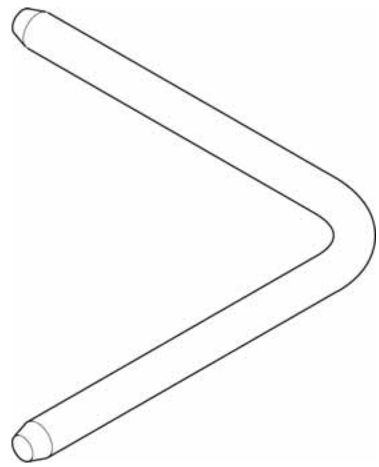
412_104

T10051
Counter-holder



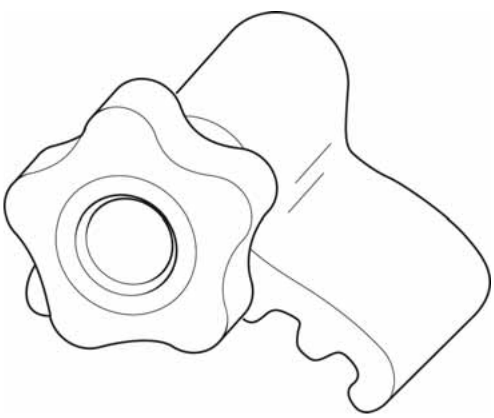
412_105

T10052
Puller



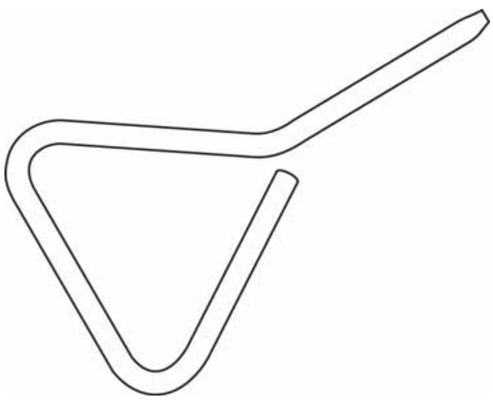
412_106

T10060A
Drift



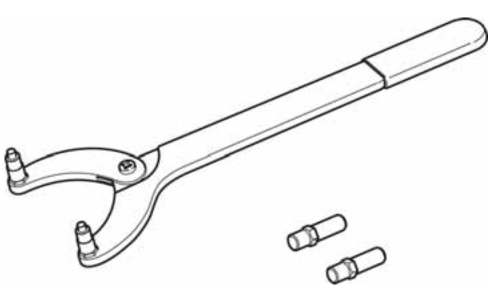
412_107

T10100
Crankshaft locking tool



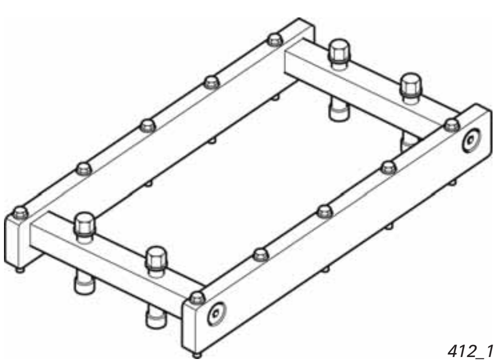
412_108

T10115
Rig pin



412_109

T10172
Counter-holder



412_110

T10262
Frame

412

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