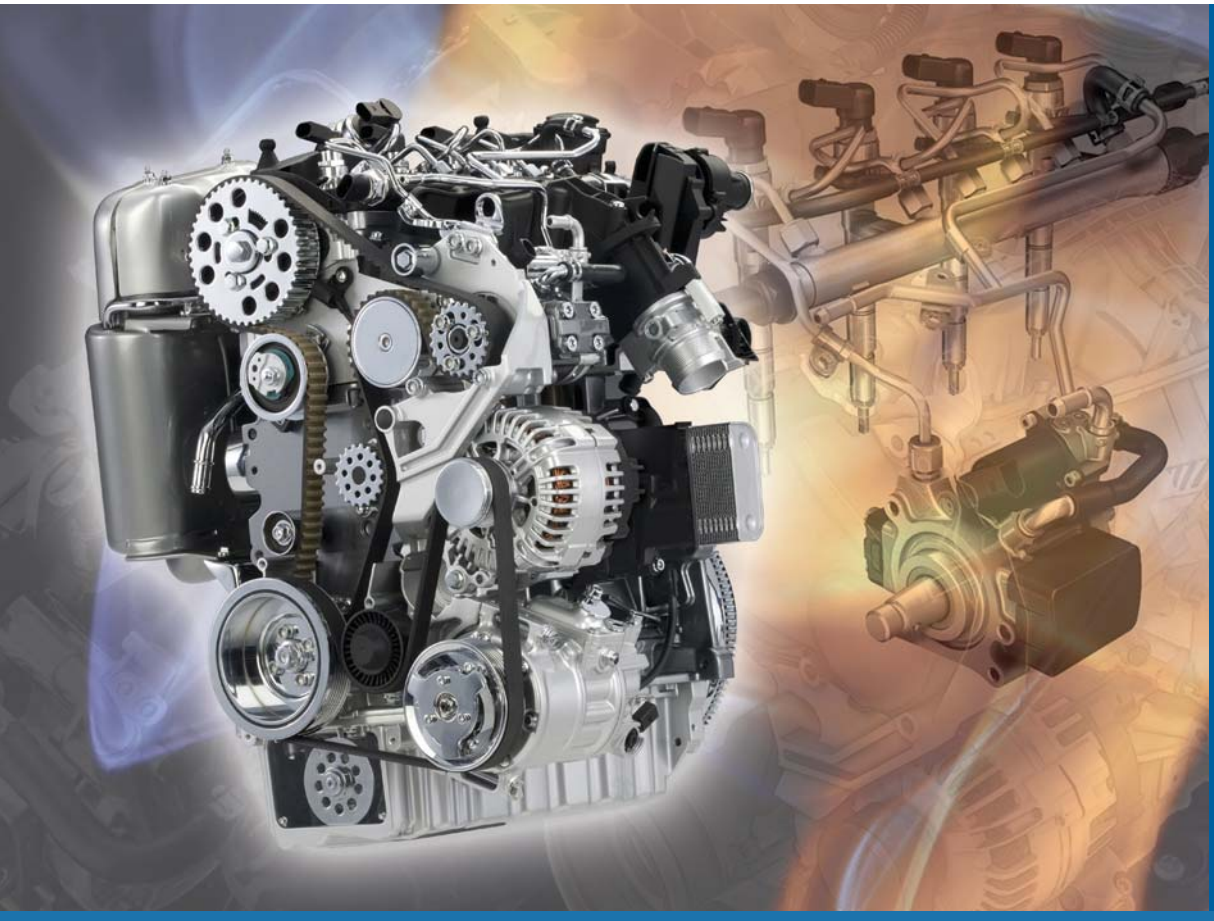
Service Training

Self-study Programme 442

The 1.6ltr. TDI Engine with Common Rail Injection System

Design and Function



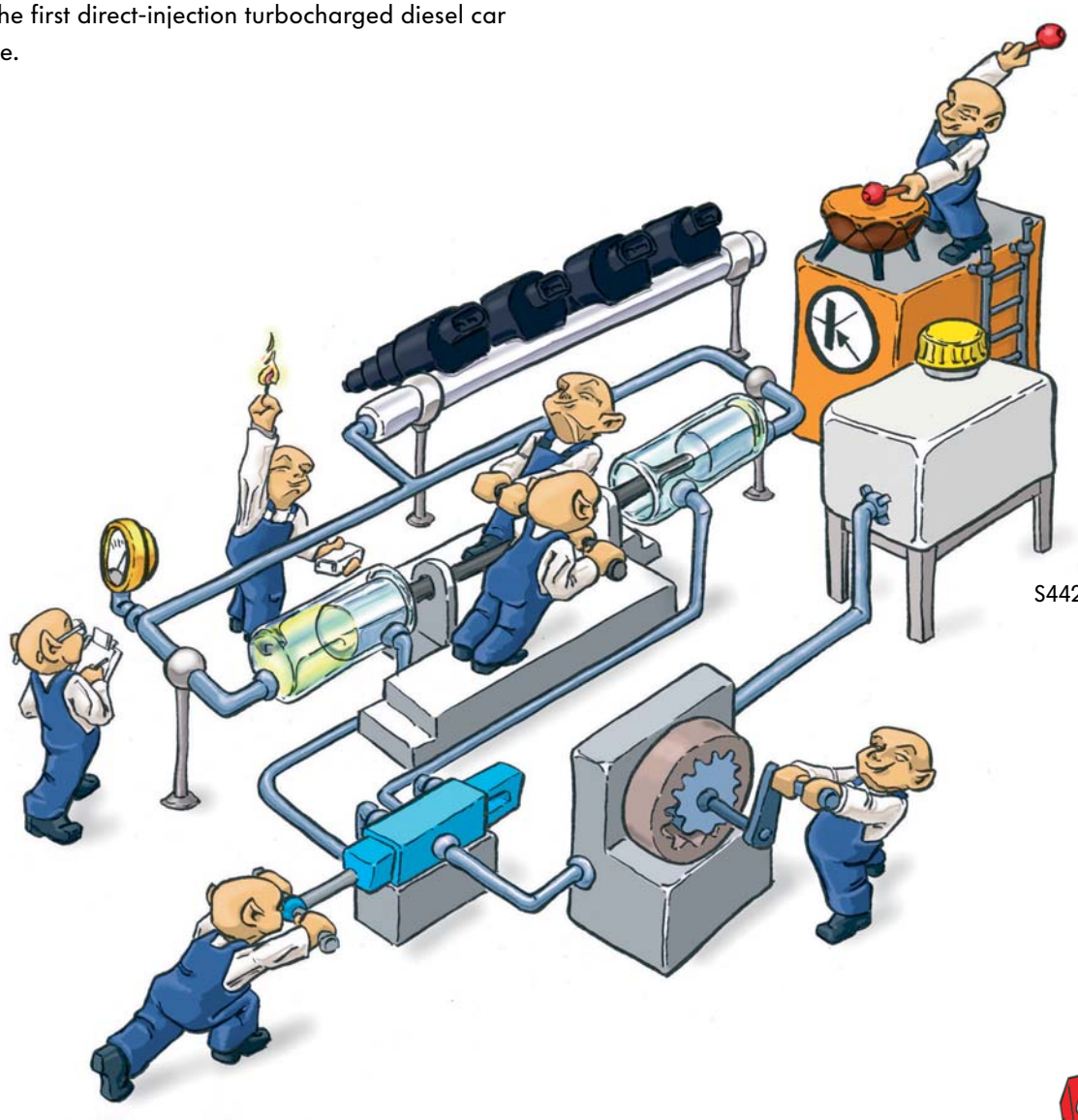
The 1.6l TDI engine with common rail injection system will form the basis for all future four-cylinder diesel engines. This engine represents a new generation of efficient, economical and dynamic diesel engines from Volkswagen.

Following the 2.0l 103kW TDI engine with common rail injection system, the 1.6l TDI engine is now being launched in different output levels.

The 1.6l TDI engine sees Volkswagen continue a success story in the diesel segment that began in 1993 with the first direct-injection turbocharged diesel car engine.

The engine sets standards in terms of dynamics, driving fun, consumption and reliability.
In addition, the use of common rail technology allows a clear improvement in comfort and noise.

Volkswagen is very well prepared with this engine when it comes to future emissions standards. It fulfils the EU5 emissions standard.



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The self-study programme portrays the design and function of new developments.
The contents will not be updated.

For current testing, adjustment and repair instructions, refer to the relevant service literature.

Important Note

Contents

1.6l TDI engine with 4-valve technology

The 1.6l TDI engine with 4-valve technology is based on the 2.0l 103kW TDI engine with common rail injection system. The engine comes in three power versions — 55kW, 66kW and 77kW. Thanks to continued further development of tried and tested technology and the new common rail injection system from Continental (PCR 2), these engines fulfil the EU5 emissions standard. The engine is used in the Polo, Golf and Passat.

Crankcase

Cylinder head cover

Exhaust gas recirculation

S442_220

Piston

Oil pump

Oil filter module

In some countries, the engine will be available with emissions standard EU3.

The following self-study programme looks at the new features compared with the 2.0l 103kW TDI engine with common rail injection system.

Common rail fuel injection system

Cylinder head

Exhaust gas recirculation module

S442_218

Engine mounting

Drive for ancillary units

Toothed belt drive

You will find further information on the 2.0l 103kW TDI engine in self-study programme no. 403 “The 2.0-ltr. TDI Engine with Common Rail Injection System”.

Introduction

Technical features

- Common rail injection system with piezo injectors and maximum injection pressure of 1600 bar
- Adjustable turbocharger
- Exhaust gas recirculation module comprising exhaust gas recirculation system with exhaust gas recirculation valve and exhaust gas recirculation cooler
- Diesel particulate filter with oxidation catalytic converter
- Plastic intake manifold

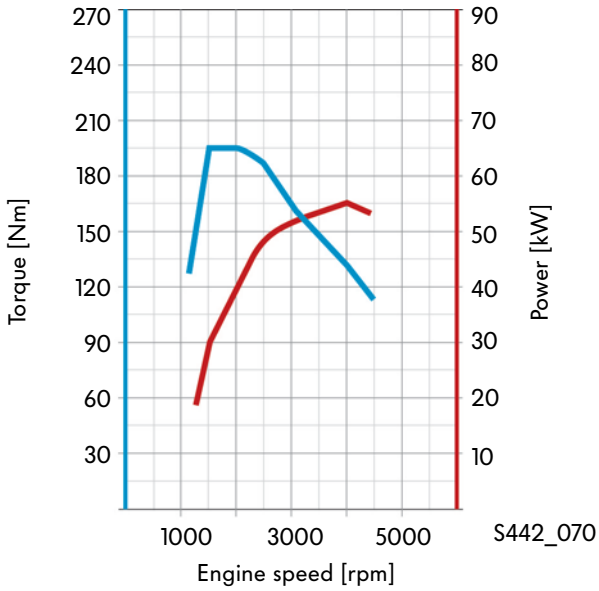
S442_057

Technical data

1.6l 55kW TDI engine

Engine code	CAYA
Type	4-cylinder in-line engine
Displacement	1598 cm^3
Bore	79.5 mm
Stroke	80.5 mm
Valves per cylinder	4
Compression ratio	16.5:1
Maximum output	55 kW at 4000 rpm
Maximum torque	195 Nm at 1500-2000 rpm
Engine management	Simos PCR2
Fuel	Diesel complying with DIN EN590
Exhaust gas treatment	Exhaust gas recirculation, oxidation catalytic converter and diesel particulate filter
Emissions standard	EU5
CO2 emissions	109 g/km (Polo 2010)

Torque and output diagram



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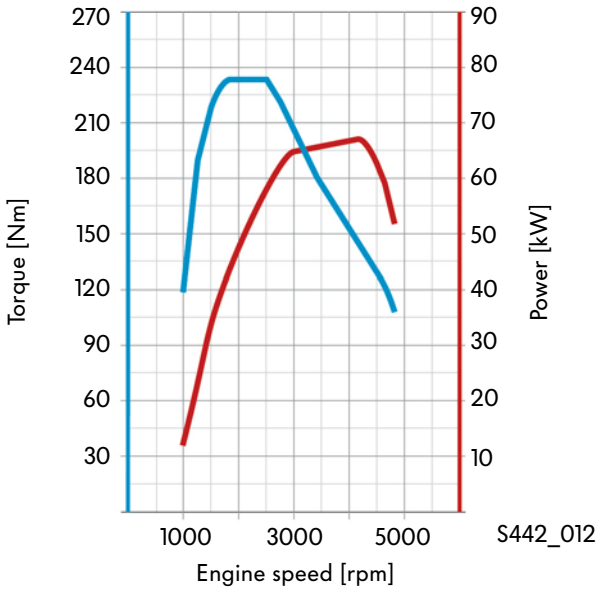
1.6l 66kW TDI engine

Engine code	CAYB
Type	4-cylinder in-line engine
Displacement	1598cm^3
Bore	79.5mm
Stroke	80.5mm
Valves per cylinder	4
Compression ratio	16.5:1
Maximum output	66kW at 4200 rpm
Maximum torque	230Nm at 1750-2500 rpm
Engine management	Simos PCR2
Fuel	Diesel complying with DIN EN590
Exhaust gas treatment	Exhaust gas recirculation, oxidation catalytic converter and diesel particulate filter
Emissions standard	EU5
CO2 emissions	118g/km (Golf 2009)

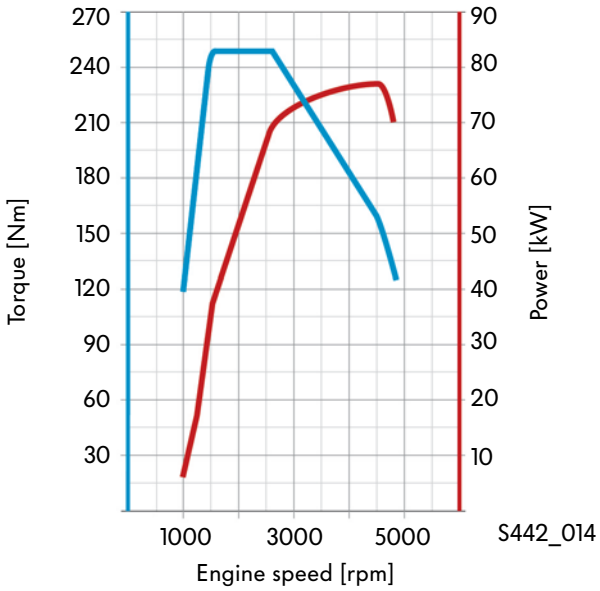
Torque and output diagram



1.6l 77kW TDI engine

Engine code	CAYC
Type	4-cylinder in-line engine
Displacement	1598cm^3
Bore	79.5mm
Stroke	80.5mm
Valves per cylinder	4
Compression ratio	16.5:1
Maximum output	77kW at 4400 rpm
Maximum torque	250Nm at 1900-2500 rpm
Engine management	Simos PCR2
Fuel	Diesel complying with DIN EN590
Exhaust gas treatment	Exhaust gas recirculation, oxidation catalytic converter and diesel particulate filter
Emissions standard	EU5
CO2 emissions	118g/km (Golf 2009)

Torque and output diagram

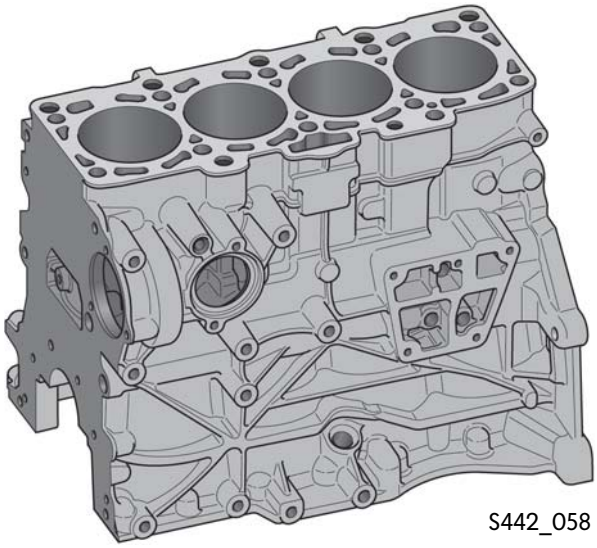


Cylinder block

The weight of the cylinder block has been reduced by approx. 6kg compared with the 2.0l 103kW TDI engine thanks to various measures.
This includes the omission of:

- Bolting points,
- ribs and
- various unnecessary mounts.

The reduced displacement has been achieved with a smaller cylinder diameter and a shorter stroke.
The cylinder diameter is 79.5mm. The stroke of 80.5mm is achieved with smaller diameter crank pins on the crank shaft.



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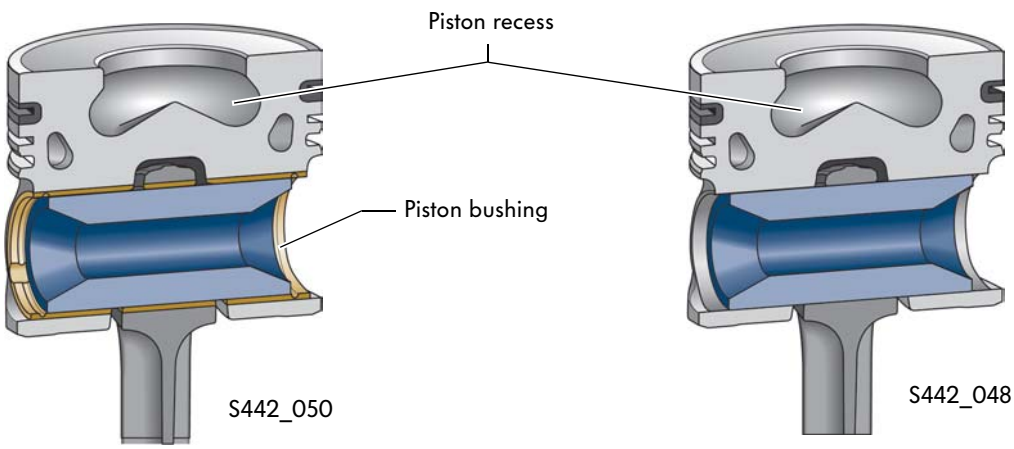
Piston

The piston is a die-cast part made from aluminium. The shape of the piston recess allows good fuel swirl generation and improves the mixture formation.
The piston bushing could be omitted due to the lower thermal loading.

2.0l TDI engine **1.6l TDI engine**



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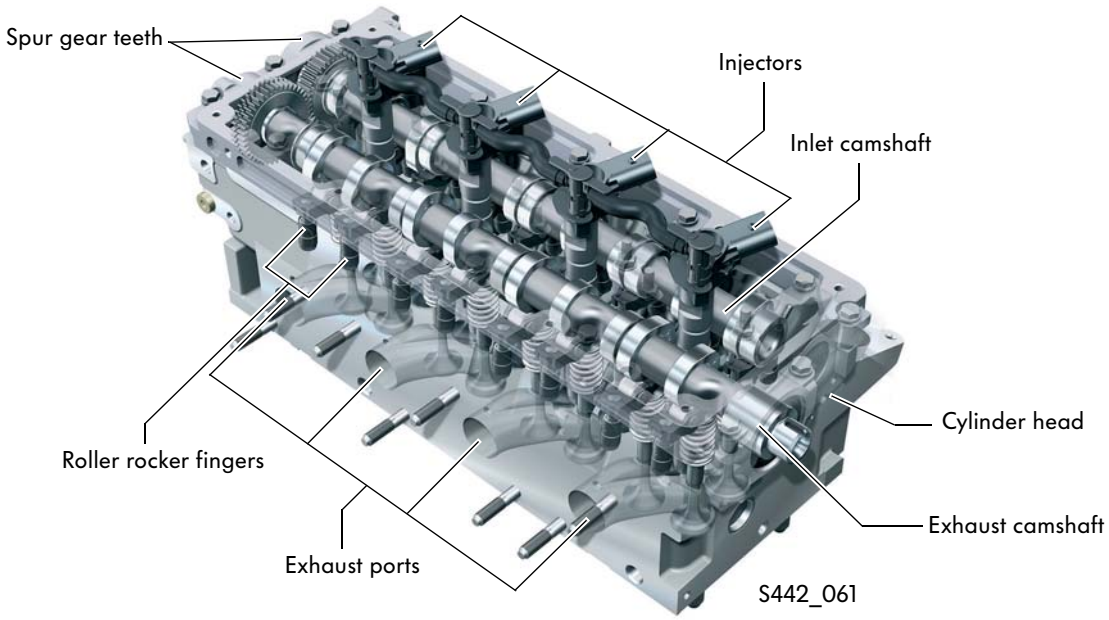
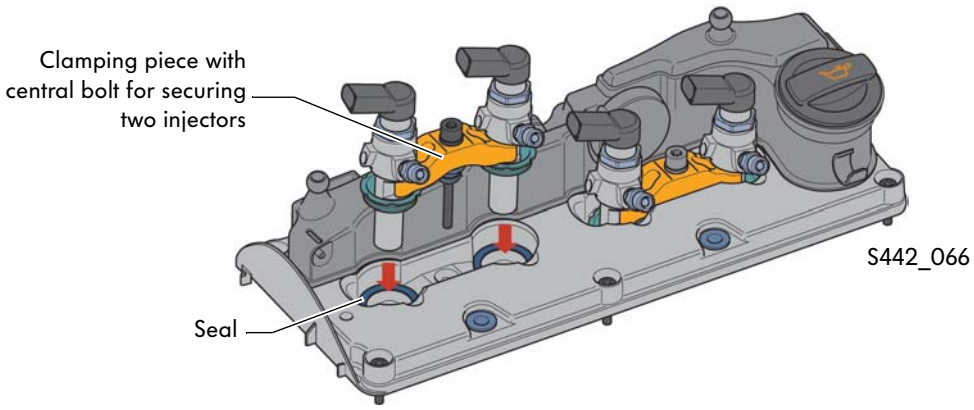
Cylinder head

The cylinder head on the 1.6l TDI engine with common rail injection system has two inlet valves and two exhaust valves for each cylinder. The camshafts are driven by the crankshaft via a toothed belt and the spur gear teeth. An oval exhaust gas port and a spiral-shaped intake port allows a faster gas flow. This contributes to a better mixture formation. The valves are actuated by roller rocker fingers with hydraulic valve play compensation.



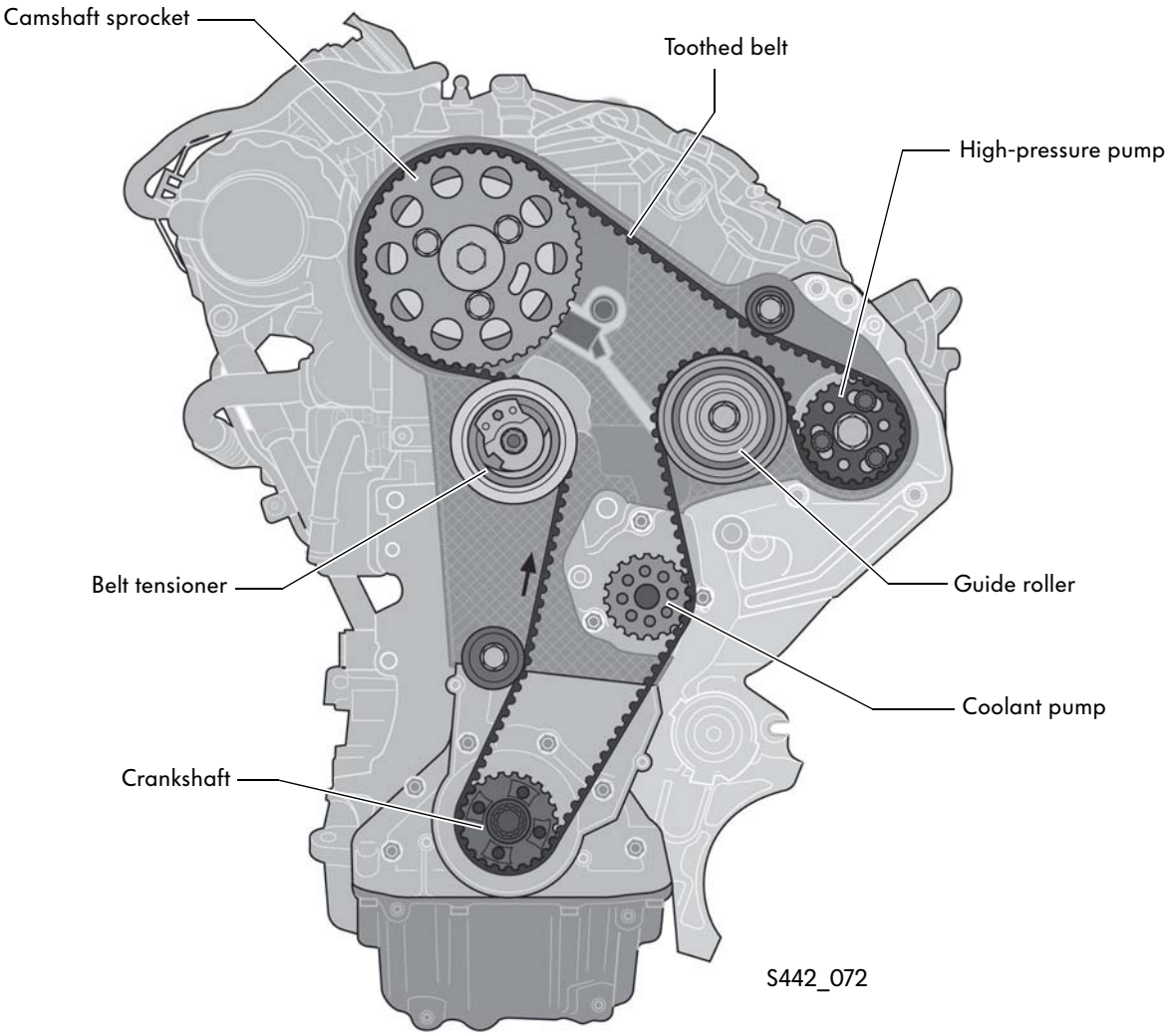
Cylinder head cover

The cylinder head cover has two outer clamping pieces for securing the injectors.
The seals for the injectors are in the cylinder head cover.



Toothed belt drive

The camshaft, the high-pressure pump for the common rail system and the coolant pump are driven by the toothed belt. The width of the toothed belt has been reduced by 5mm to 25mm and all sprockets, belt tensioners and guide rollers have been modified accordingly.

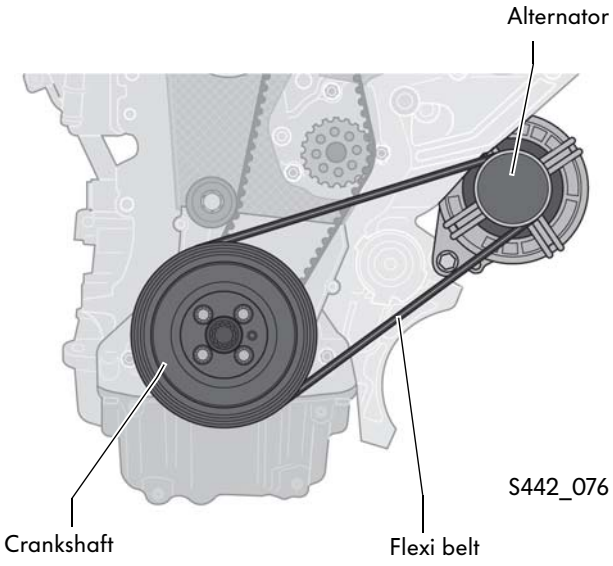


Ancillary component drive

The ancillary components are driven via a flexible, stretchable poly V-belt, called a flexi belt.
The belt tensioner is not required due to the use of the flexi belt. There are two different versions:

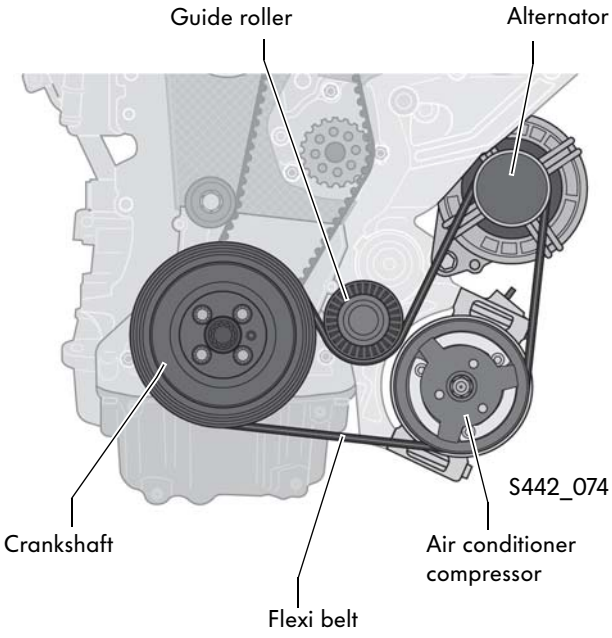
1. **Poly V-belt drive for vehicles without air-conditioning compressor.**

   Only the alternator is driven by the poly V-belt in this case.



2. **Poly V-belt drive for vehicles with air-conditioning compressor.**

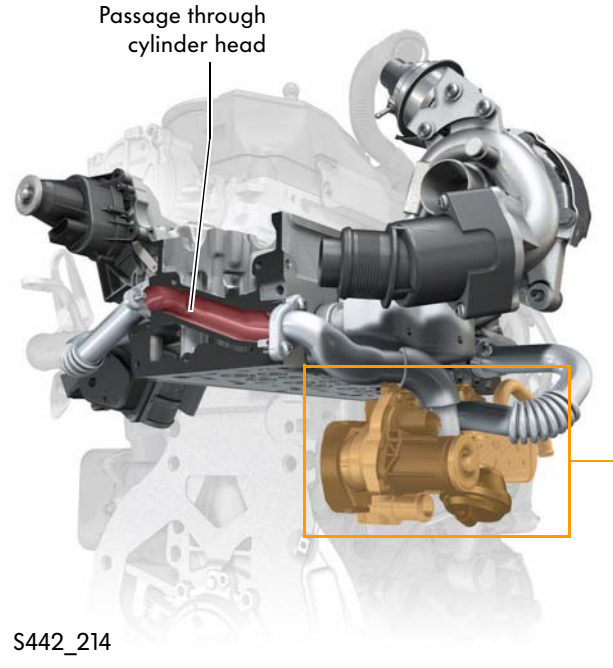
   All ancillary units are driven by a poly V-belt with guide roller.



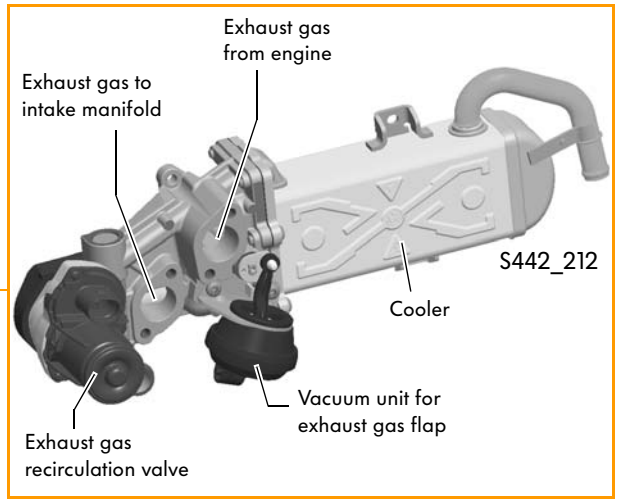
The guide roller has a fixed mounting position and should not be confused with a belt tensioner.
Please refer to the assembly instructions in the repair guide.

Exhaust gas recirculation system

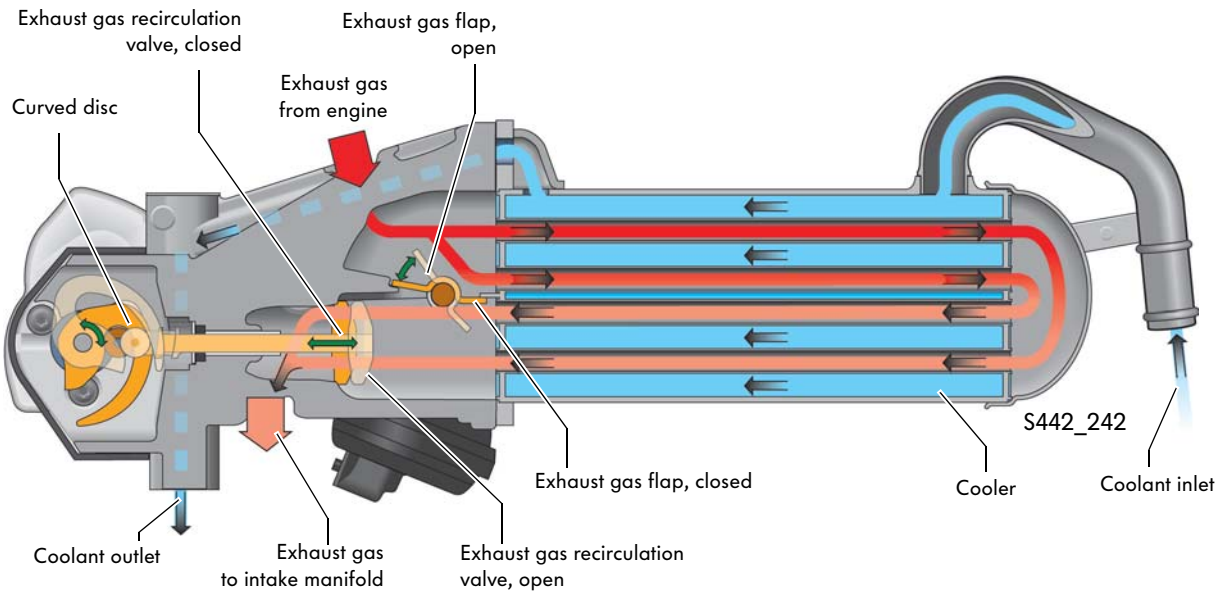
On the 1.6l TDI engine, the exhaust gas recirculation valve and the exhaust gas cooler with exhaust gas flap have been combined into a single module. The advantages of the modular design are a compact space requirement and, at the same time, a shorter control path. The exhaust gas recirculation module is bolted to the exhaust side of the cylinder head and the exhaust manifold. The module is connected to the intake manifold directly through the cylinder head. This allows additional cooling of the recirculated exhaust gases.



Exhaust gas recirculation module

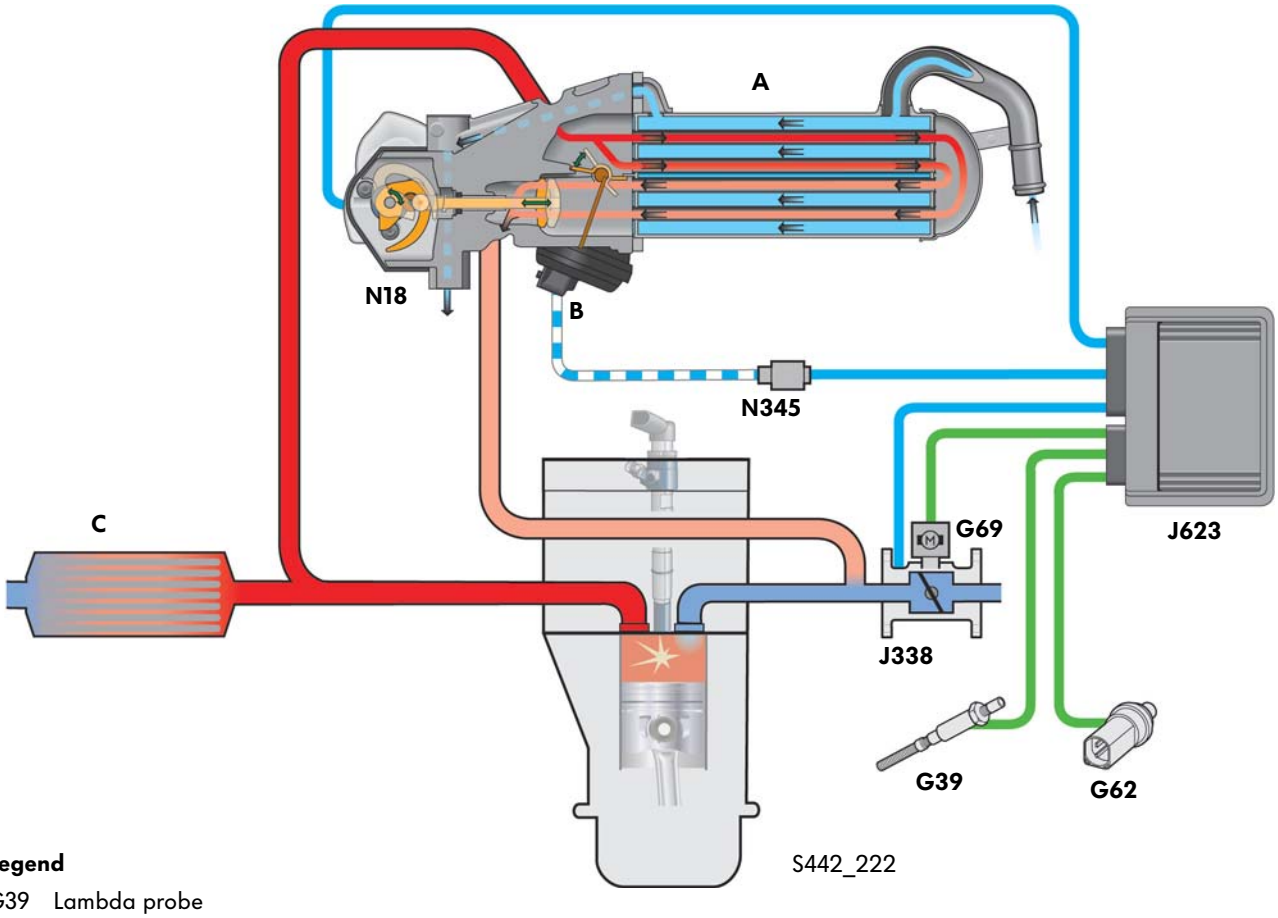


Design



Function

The exhaust gas recirculation helps reduce nitrogen oxide emissions. Part of the exhaust gases are returned to the combustion process. The recirculation quantity is regulated by the engine control unit taking the engine speed, intake air quantity, intake air temperature, injection quantity and air pressure into account.



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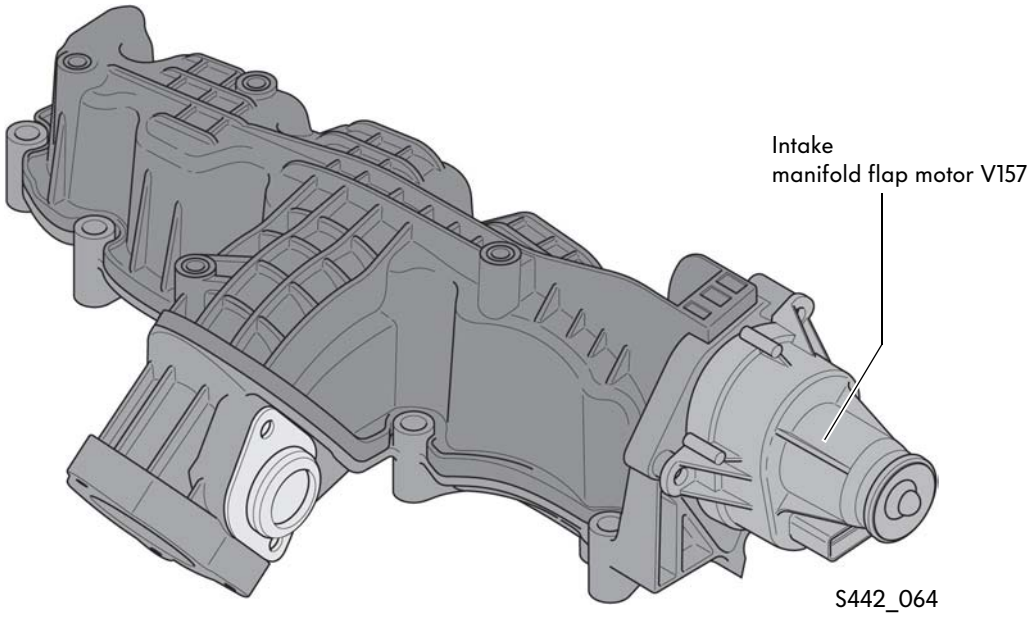
Legend

G39 Lambda probe
G62 Coolant temperature sender
G69 Throttle valve potentiometer
J338 Throttle valve module
J623 Engine control unit
N18 Exhaust gas recirculation valve
N345 Exhaust gas recirculation cooler change-over valve
A Exhaust gas recirculation module
B Vacuum unit
C Catalytic converter

You will find more information on how the exhaust gas recirculation system works in self-study programme no. 316 “The 2.0l TDI Engine”.

Intake manifold

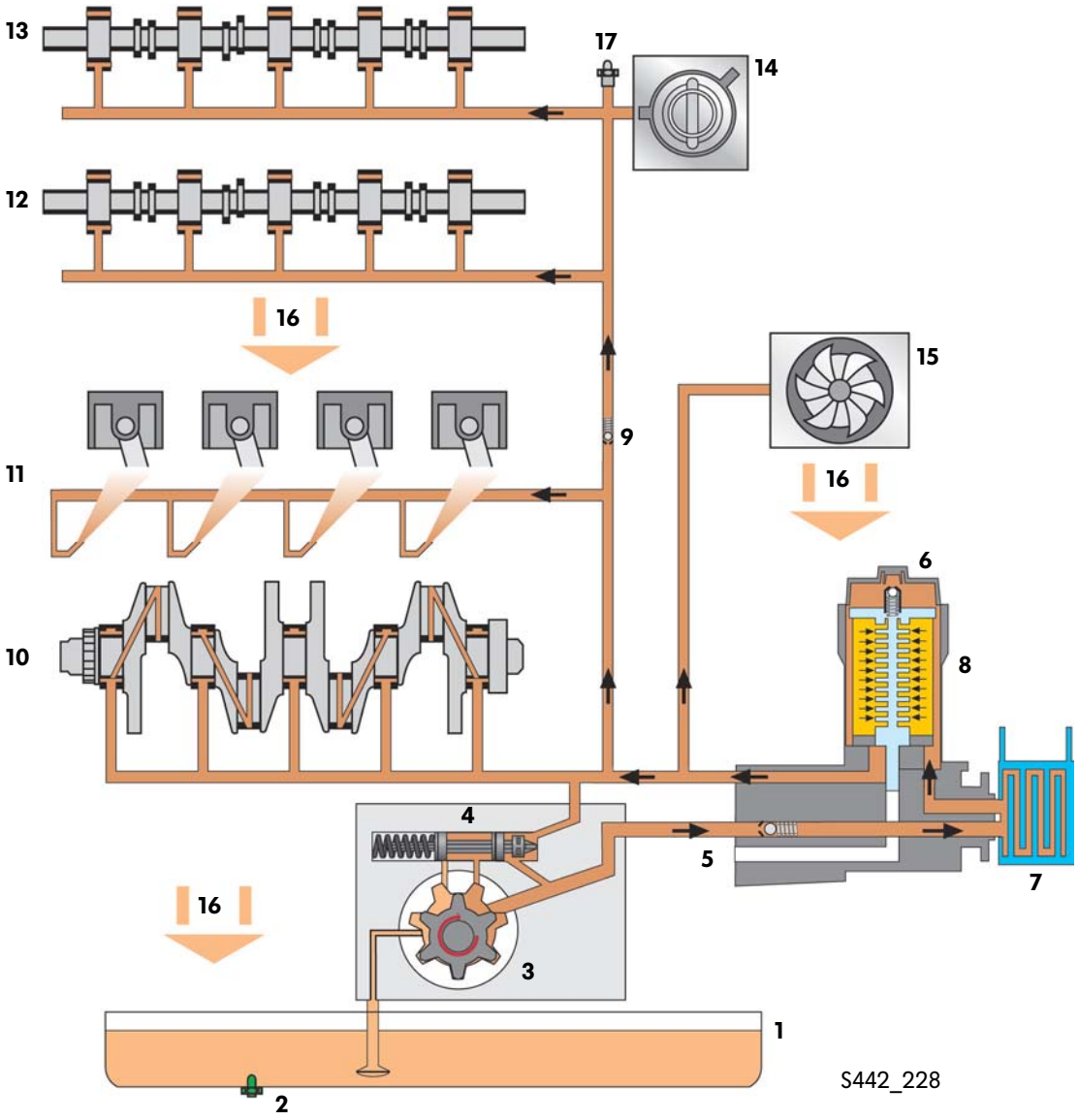
The intake manifold is made from plastic. The combination of all exhaust gas recirculation components in the new exhaust gas recirculation module on the exhaust side means there is no separate exhaust gas recirculation valve on the intake manifold. As a result, an aluminium intake manifold is not required.



The intake manifold flap motor V157 and the swirl flap adjustment, which it is linked to, currently do not have a function. The intake manifold flap motor V157 and the intake manifold flap potentiometer G336 are currently not included in the self-diagnosis.

Oil system

The oil pump generates the oil pressure required to lubricate the engine. It is driven by the crankshaft via a separate toothed belt. The filter bypass valve opens when the filter is clogged up to ensure lubrication of the engine.

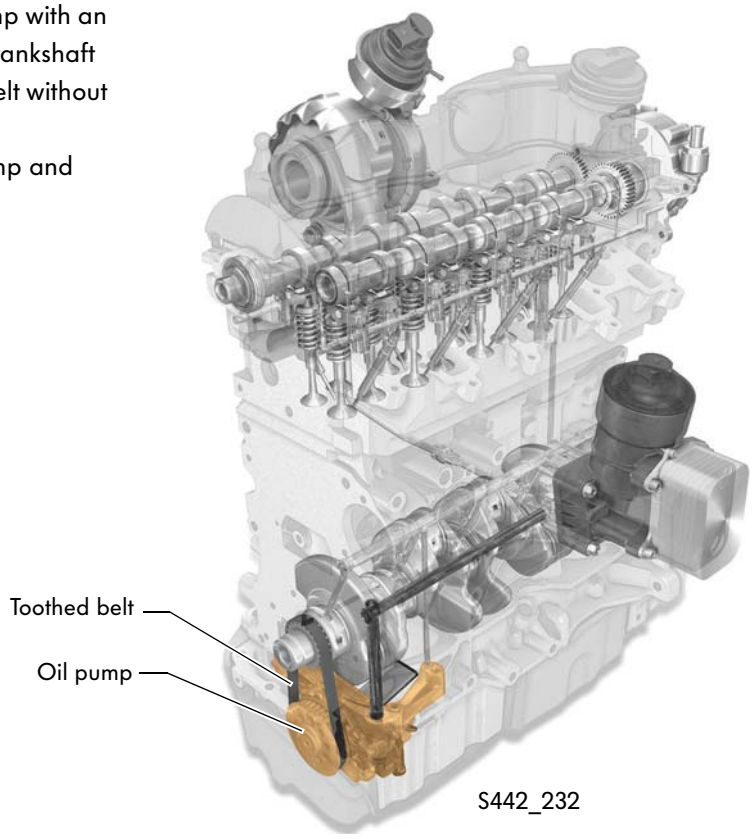


Legend

1 - Oil sump
2 - Oil level and oil temperature sender G266
3 - Oil pump
4 - Control plunger
5 - Oil non-return valve
6 - Filter bypass valve
7 - Oil cooler
8 - Oil filter
9 - Oil pressure retention valve
10 - Crankshaft
11 - Jets for piston cooling
12 - Inlet camshaft bearing
13 - Exhaust camshaft bearing
14 - Vacuum pump
15 - Turbocharger
16 - Oil return
17 - Oil pressure switch F1

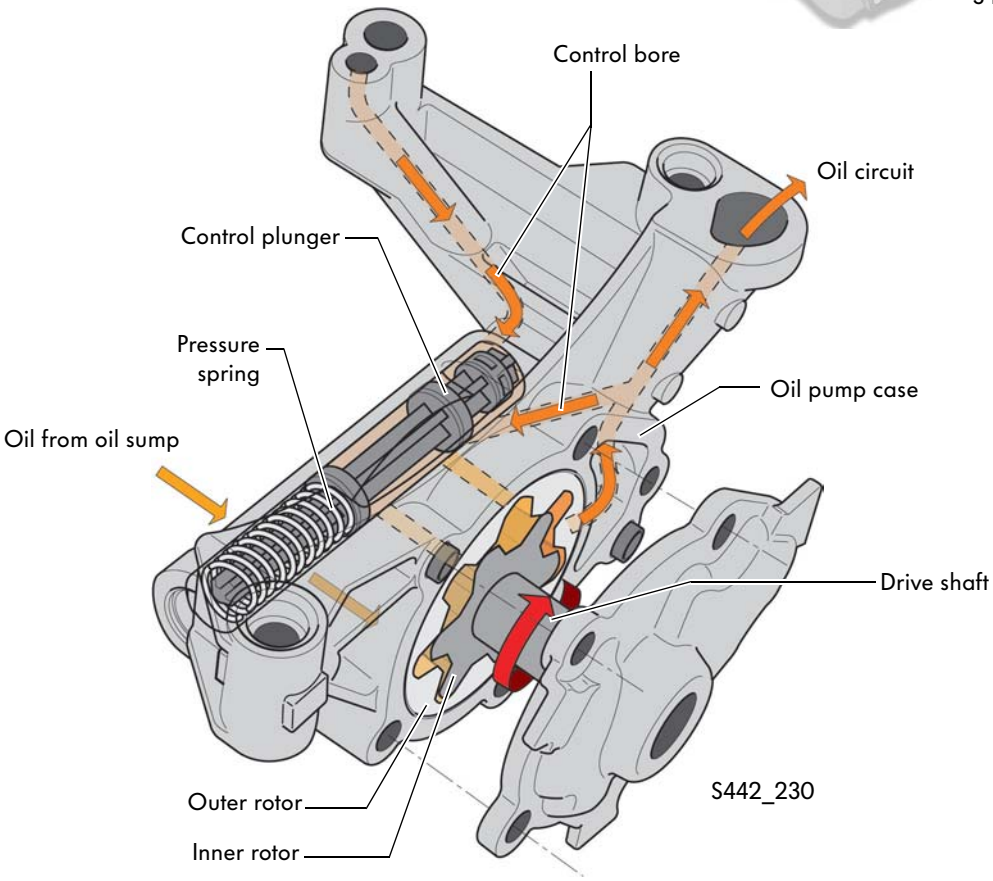
Oil pump

The oil pump is a regulated duo-centric pump with an internal limiter. The pump is driven by the crankshaft via a separate, maintenance-free toothed belt without tensioner.
The oil pump draws the oil out of the oil sump and pumps it into the oil circuit.



S442_232

Design



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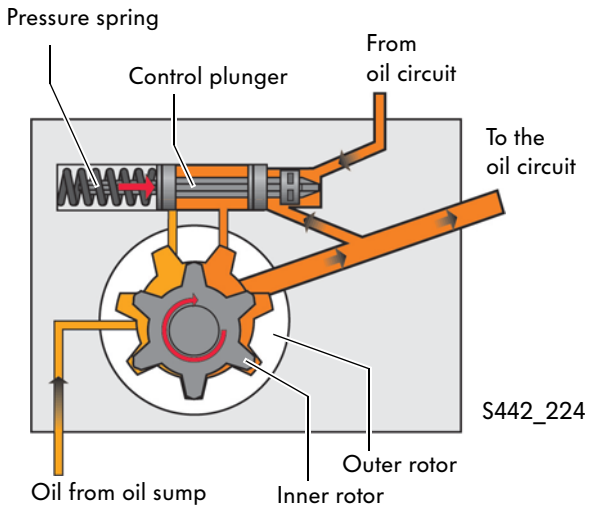
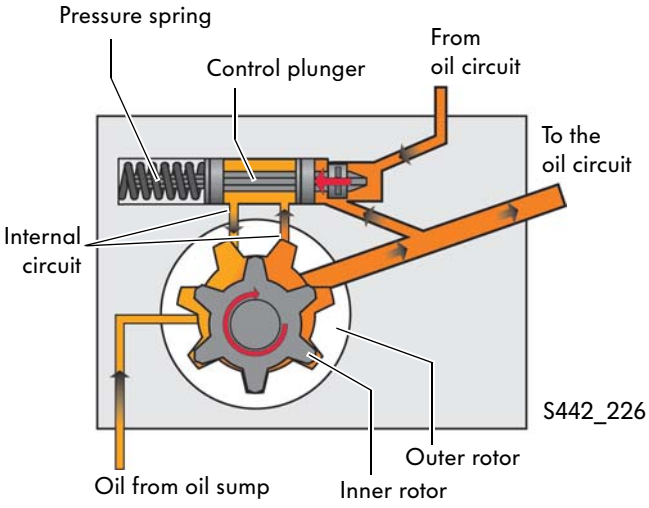
Function

Control circuit closed:



The oil pump contains a control plunger. This spring-loaded control plunger closes the circuit inside the pump. The spring force acts on the control plunger and pushes it forwards.
The oil is delivered to the oil circuit.

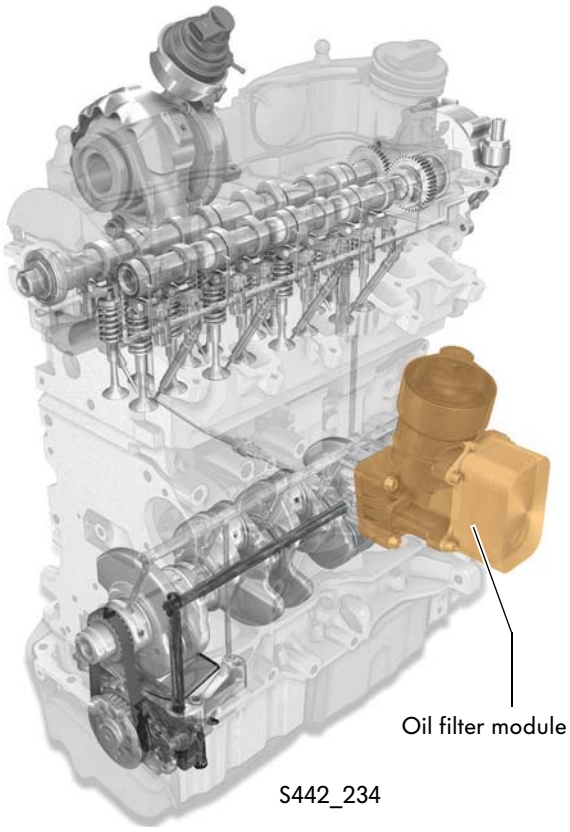
Control circuit open:



The control plunger is connected to the oil circuit via control bores. If the oil pressure rises in the oil circuit, the control plunger is pressed back against the spring. This opens the circuit inside the pump. The oil is delivered to the pump chamber and the pump conveys the oil inside the pump housing. As soon as the pressure in the oil circuit falls, the control plunger closes the internal circuit and the oil can be pumped into the oil circuit again. No additional safety valve is required for pressure limitation due to the way the control plunger works.

Oil filter module

The plastic casing of the oil filter and the oil cooler made from aluminium are combined in the oil filter module. The module is bolted directly to the crankcase. Coolant is supplied directly from the crankcase.



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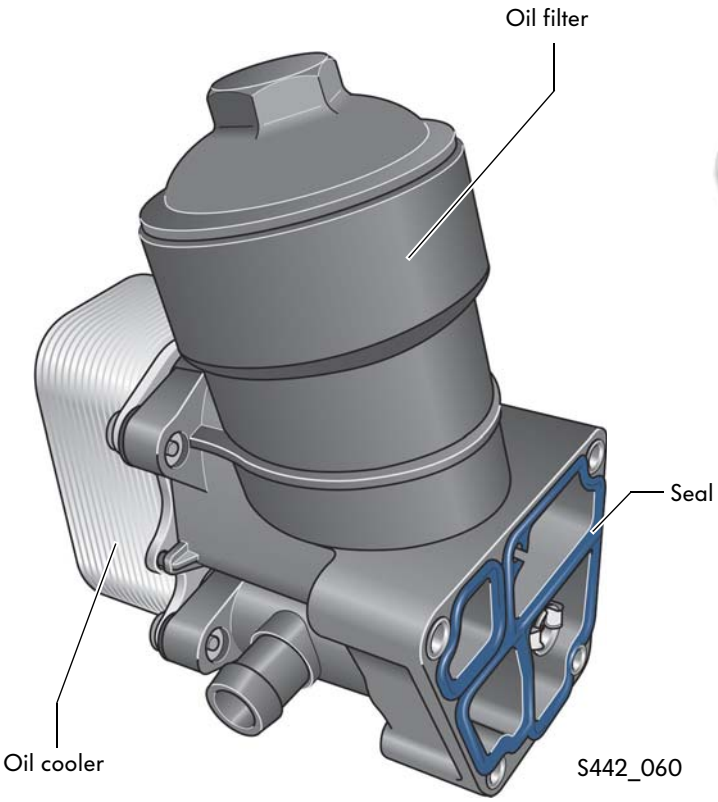

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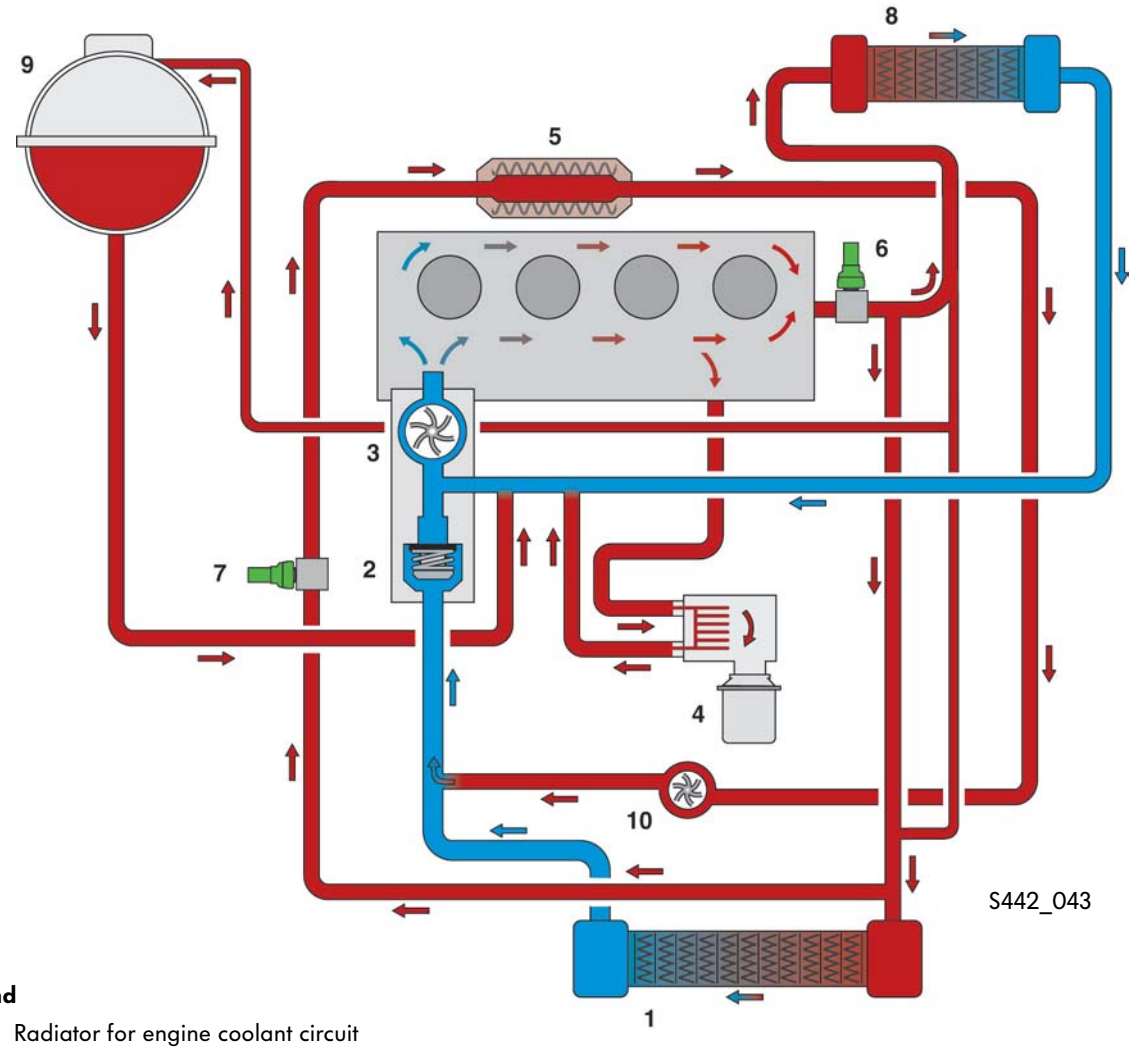
Coolant circuit

The coolant is circulated around the coolant circuit by a mechanical coolant pump. The pump is driven by the toothed belt. The system is controlled by an expansion-type thermostat.
The engine is equipped with a low-temperature exhaust gas recirculation system to reduce nitrogen oxide emissions.



Legend

1 - Radiator for engine coolant circuit
2 - Thermostat
3 - Coolant pump
4 - Oil cooler
5 - Cooler for exhaust gas recirculation
6 - Coolant temperature sender G62
7 - Radiator outlet coolant temperature sender G83
8 - Heat exchanger for heating system
9 - Expansion tank
10 - Coolant circulation pump 2 V178

You will find further information on the low-temperature exhaust gas recirculation system in self-study programme no. 403 “The 2.0ltr. TDI Engine with Common Rail Injection System”.

Improved engine mount

The 1.6l TDI engine does not have a balancer shaft. The new engine mount reduces vibrations that are felt by occupants.

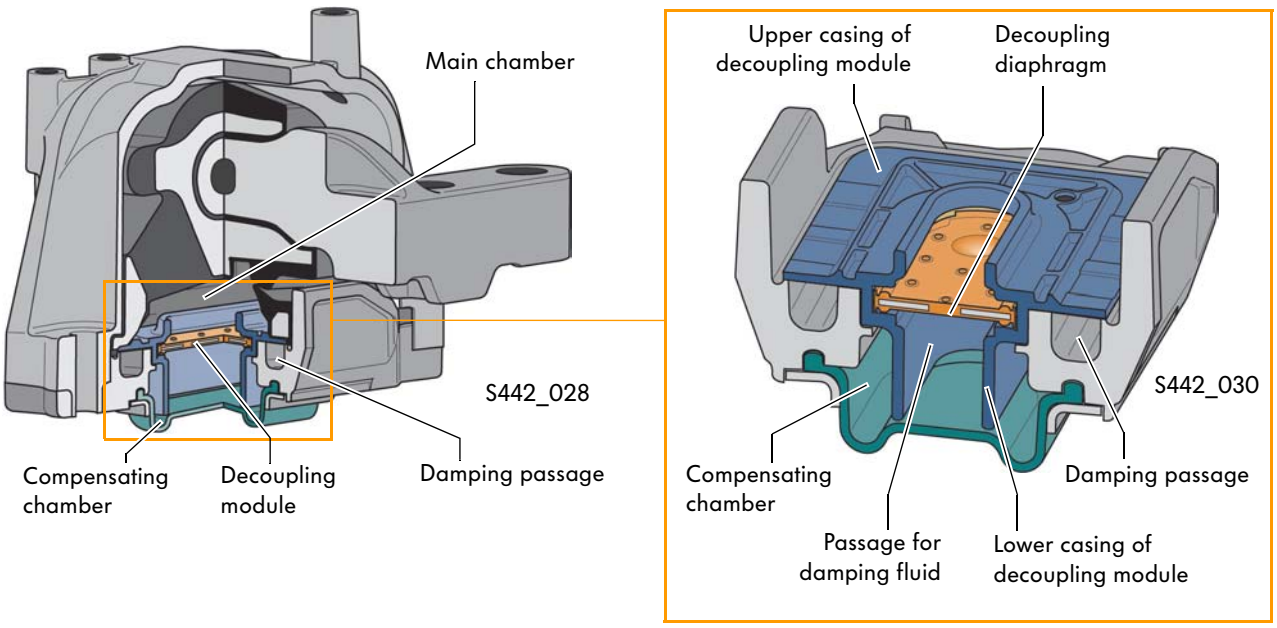
Tasks of an engine mount:

- Securing the engine in the engine compartment; statically (when stationary) and dynamically (on the road)
- Bearing the static engine load
- Reducing the vibrations from uneven road surfaces (shaking)
- Reducing the vibrations transferred from the engine to the body

Engine mounts are used in vehicles to prevent the transfer of vibrations from the engine to the body and to dampen the resonance vibration of the engine.
Extremely hard and highly stiff mounts are required to bear the engine load and secure the engine in the engine compartment. Soft bearings are required for good acoustics in the vehicle interior. These ensure a low dynamic stiffness across a broad frequency range.
In order to find a compromise for all tasks, engine mounts filled with hydraulic fluid, called hydro-mounts, are fitted.

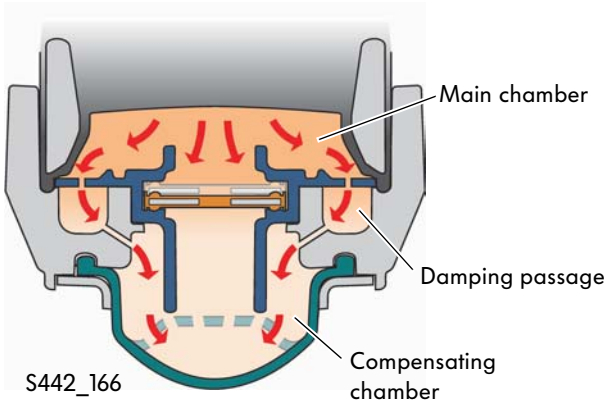
New engine mount

The efficiency of the new engine mount has been improved by modifying the design of its hydraulic system. Careful configuration of the geometry has made it possible to use the fluid in hydraulic mounts as an “internal damper”.



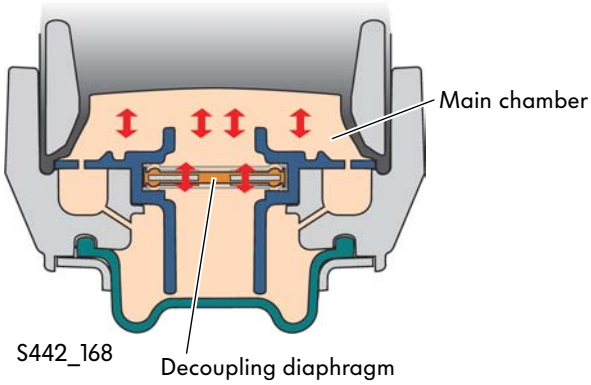
Function

Large vibration amplitude



When a greater vibration amplitude acts on the mount, for example, due to an uneven road surface, the vibration energy is reduced by the damping system inside the hydro mount. This is achieved by the hydraulic fluid being pressed out of the main chamber into the compensating chamber via the damping passage. The damping reduces the shaking to a comfortable level.

Small vibration amplitude



If a small vibration amplitude acts on the mount, for example, from engine vibrations, the damping will be deactivated by the decoupling diaphragm mounted on floating bearings.
In the new engine mount, the decoupling diaphragm vibrates within a certain speed/frequency range together with the hydraulic fluid against the vibrations produced by the engine.
The decoupling diaphragm mounted on floating bearings prevents premature hardening of the mount. This decreases the vibrations transferred to the body. The humming/droning noises are reduced to a comfortable level so there is no need for a balancer shaft.

The fluid in the engine mount is made from dihydric alcohol (propylene glycol); commonly known as anti-freeze.

Damage to the area around the engine mount diaphragm will cause a loss of hydraulic fluid in the mount and incorrect functioning.

Fuel system (Golf 2009)

1 - Fuel system pressurisation pump G6

The fuel system pressurisation pump constantly delivers fuel to the supply line.

2 - Fuel filter with pre-heater valve

The pre-heater valve prevents the filter becoming clogged with crystallising paraffin crystals at low outside temperatures.
(The pre-heater valve is mounted separately in the Polo 2010.)

3 - Pre-supply pump

The pre-supply pump is part of the high-pressure pump and delivers the fuel from the supply line to the high-pressure pump unit.

4 - Fuel temperature sender G81

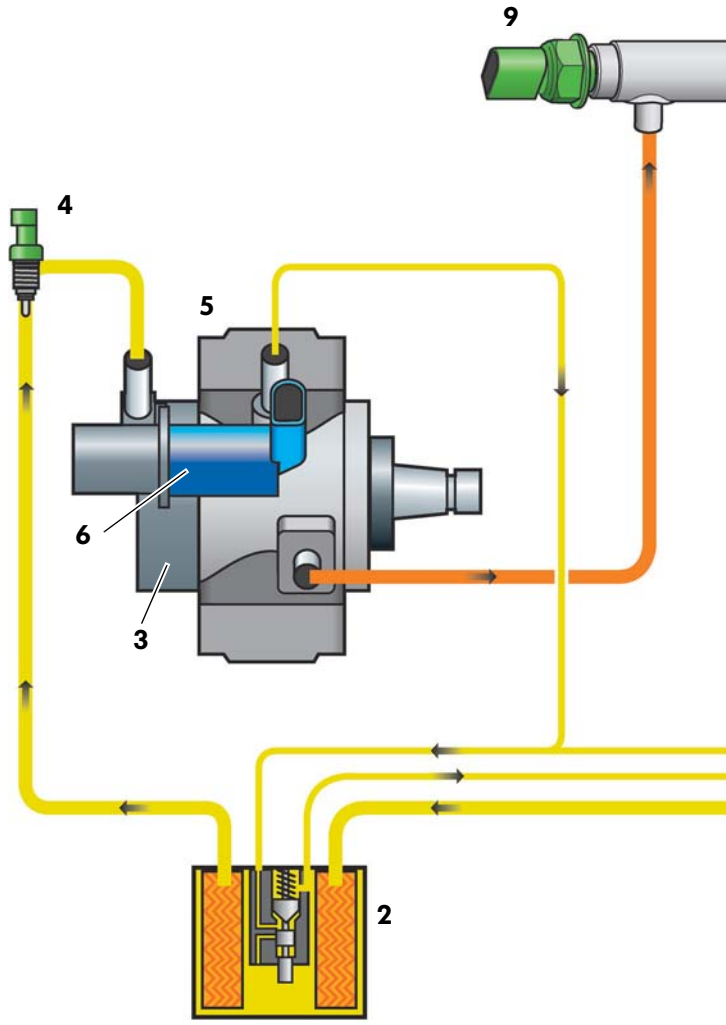
The fuel temperature sender measures the current fuel temperature.

5 - High-pressure pump

The high-pressure pump generates the high fuel pressure required for injection.

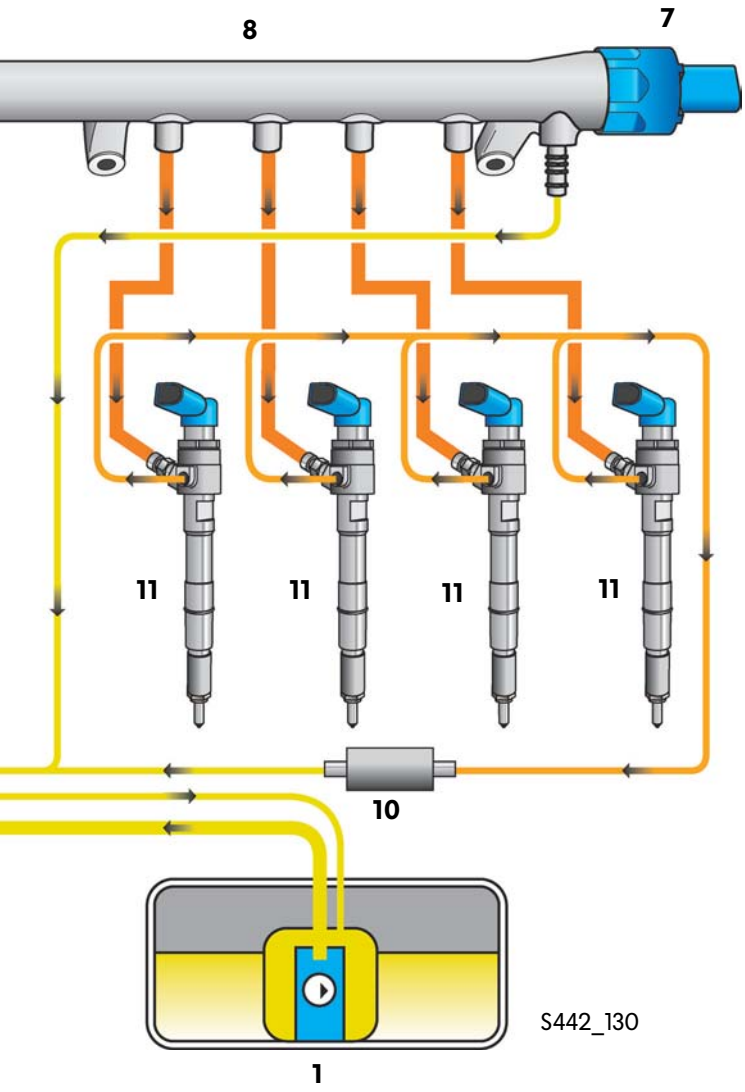
6 - Fuel metering valve N290

The fuel metering valve controls on demand the quantity of fuel to be compressed.



Colour code/legend

- High pressure 230 – 1600bar
- Return pressure from the injectors 1bar
- Supply pressure/return pressure



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The fuel system components are explained over the following pages.

7 - Fuel pressure regulating valve N276

The fuel pressure regulating valve adjusts the fuel pressure in the high-pressure area.

8 - High-pressure accumulator (rail)

The high-pressure accumulator stores the fuel required for injection into all cylinders under high pressure.

9 - Fuel pressure sender G247

The fuel pressure sender measures the current fuel pressure in the high-pressure area.

10 - Pressure retention valve

The pressure retention valve is used to stabilise the pressure in the return line to avoid fluctuations at the injectors and ensure the function of the piezo injectors. It keeps the pressure in the return line almost constant.

11 - Injectors N30, N31, N32, N33

The injectors inject the fuel into the combustion chambers.

Common rail fuel injection system

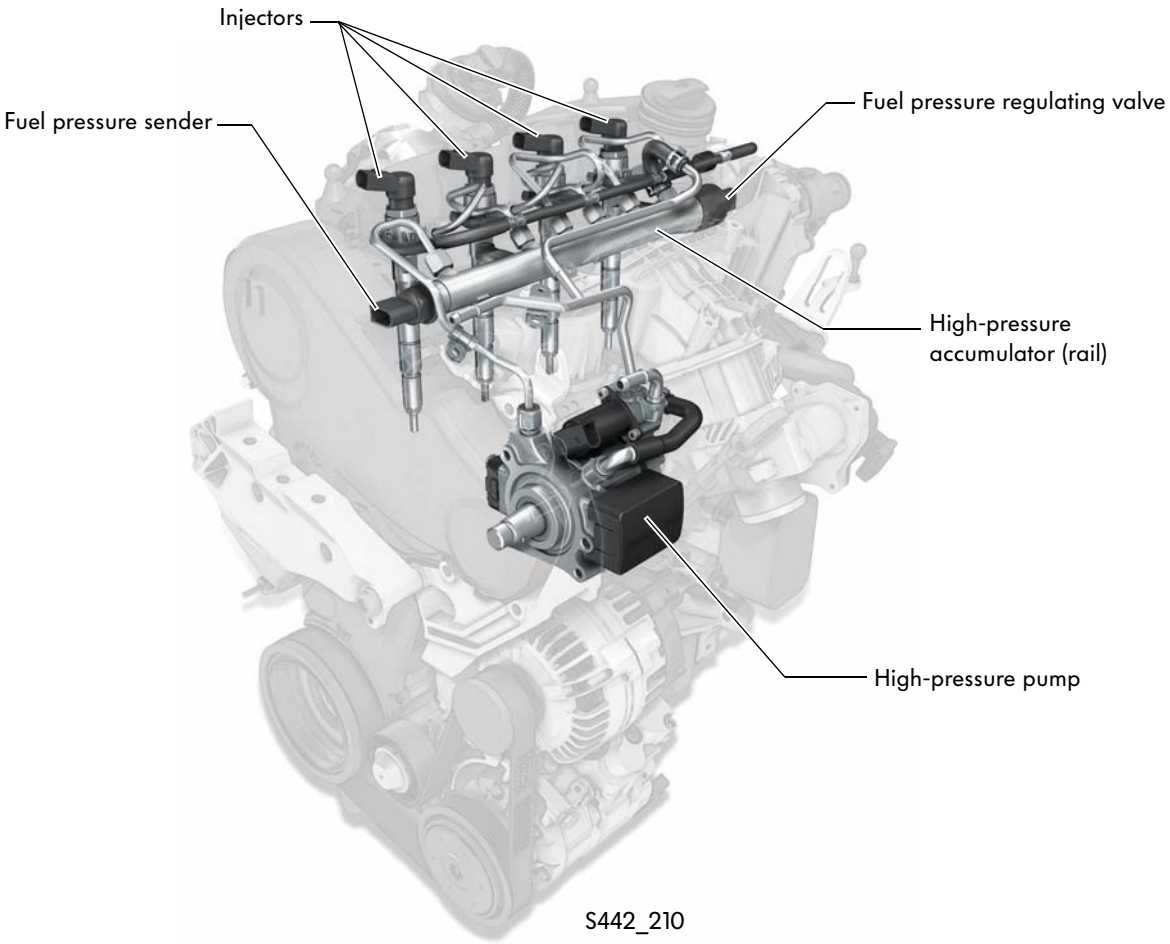
The common rail fuel injection system was developed by Volkswagen and Continental.
It is made up of:

- The engine control unit
- The injectors
- The high-pressure accumulator (rail)
- The fuel pressure sender
- The fuel pressure regulating valve
- The high-pressure pipes
- The high-pressure pump

The high-pressure pump consists of:

- The mechanical pre-supply pump
- The fuel metering valve
- The high-pressure pump unit

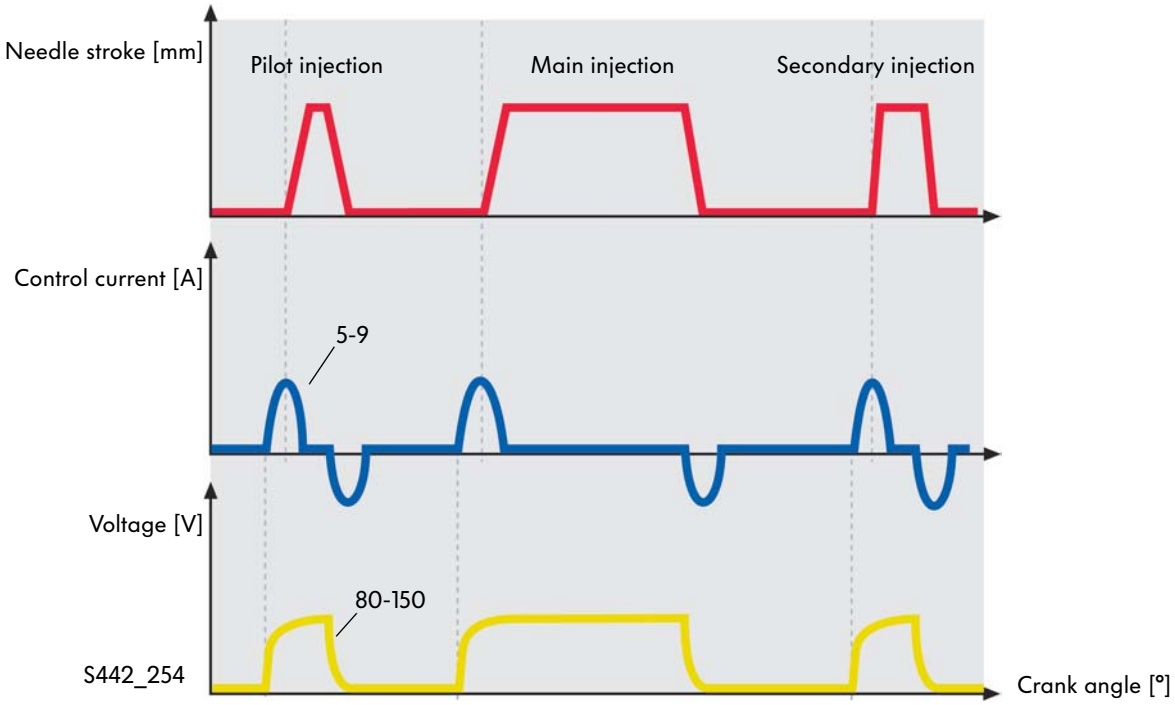
The common rail injection system allows optimum and efficient mixture formation and combustion. The following always applies: The higher the injection pressure, the smaller the droplets of fuel and the better the mixture formation.
The basic feature of the common rail system is that the injection pressure (max. 1600 bar) can be generated regardless of the engine speed and the injection quantity.



S442_210

The pressure generation and fuel injection are separated with the aid of the storage volume in the high-pressure accumulator (rail). The pressure is generated by a radial-piston type, high-pressure pump that conveys the fuel to the high-pressure accumulator (rail).

The injectors are connected to the high-pressure accumulator by short high-pressure pipes. Being the centrepiece of the system, the injectors have the task of injecting the fuel into the combustion chamber.



A pulse sent to the injector by the engine control unit at the right time initiates the injection process.
The opening duration and system pressure determine the injection quantity. In addition, the fuel can be divided into several individual injections per combustion cycle:

Very small quantities of fuel in the pilot injections are followed by the main injection and then several secondary injections for active regeneration.

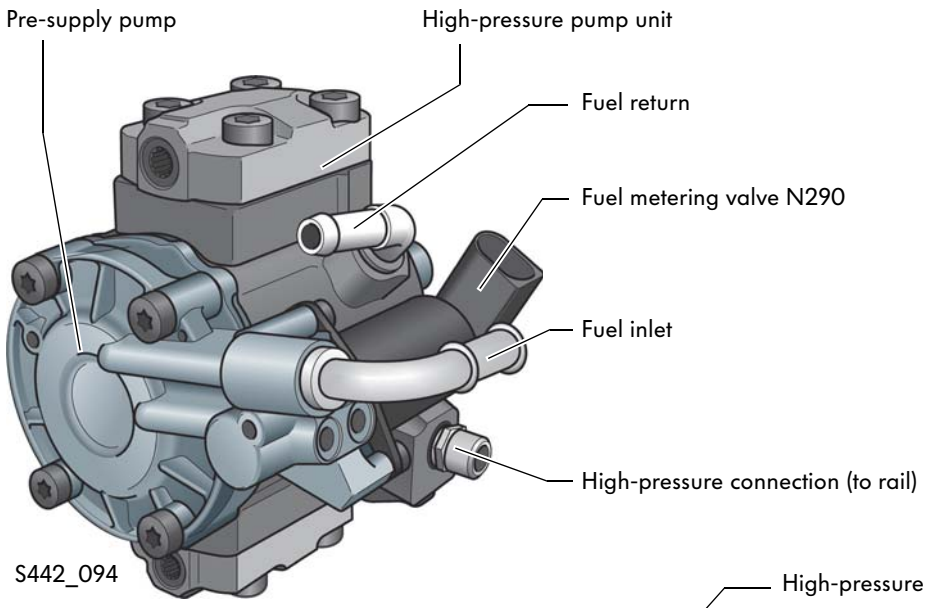
While the pilot injections make the rise in pressure in the combustion chamber more constant and thus reduce the combustion noise, the secondary injections are intended for exhaust gas treatment. Together with the powerful control unit and the injectors with small tolerances, the common rail injection system clearly reduces consumption and emissions. At the same time, it increases the engine power and allows quieter running.

High-pressure pump

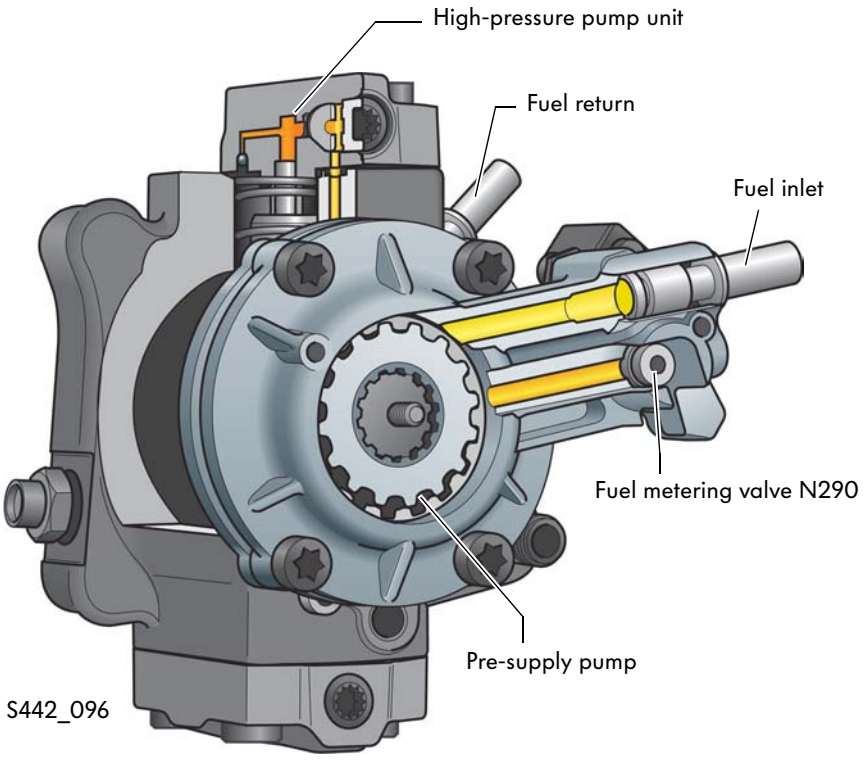
The high-pressure pump comprises the following components:

- Pre-supply pump
- Fuel metering valve
- High-pressure pump unit

All parts are combined in a single housing.



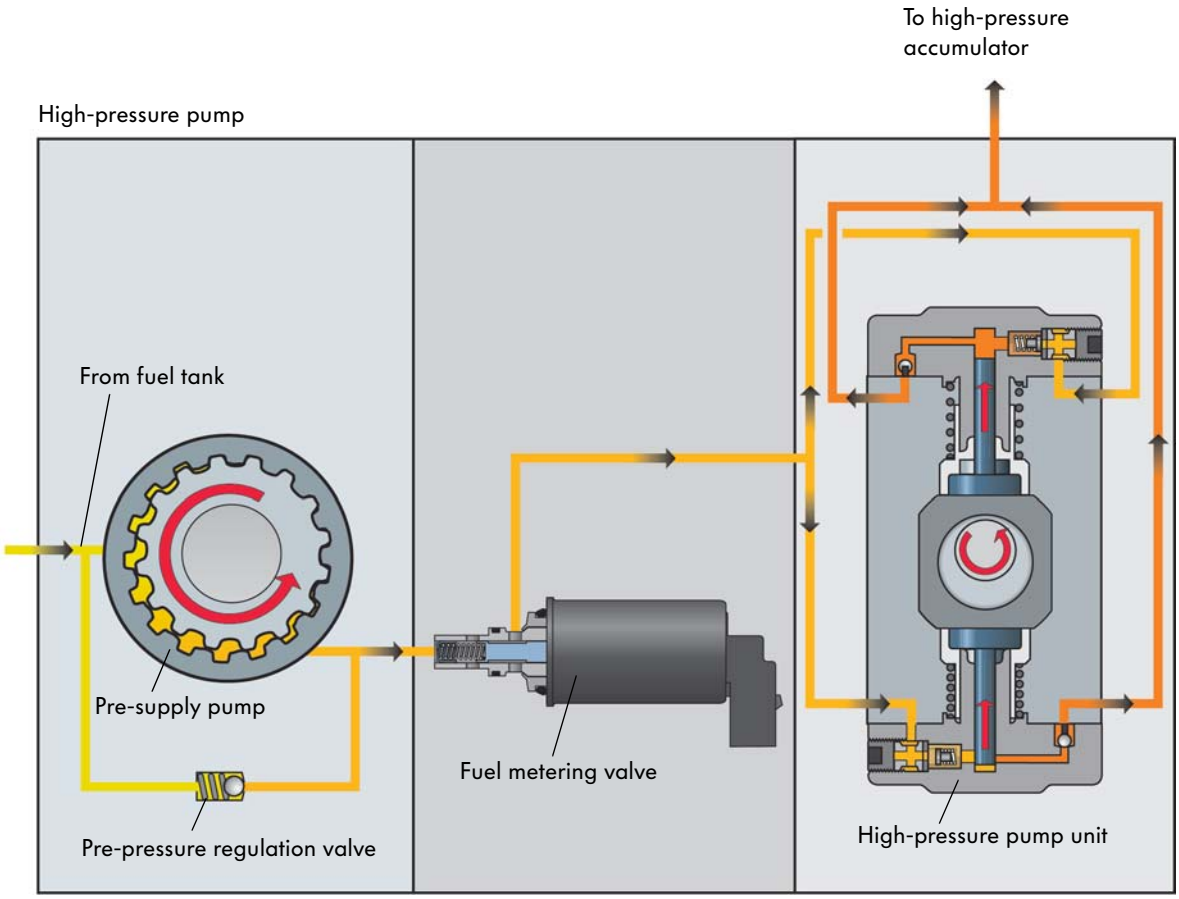
S442_094



S442_096

Fuel system within high-pressure pump

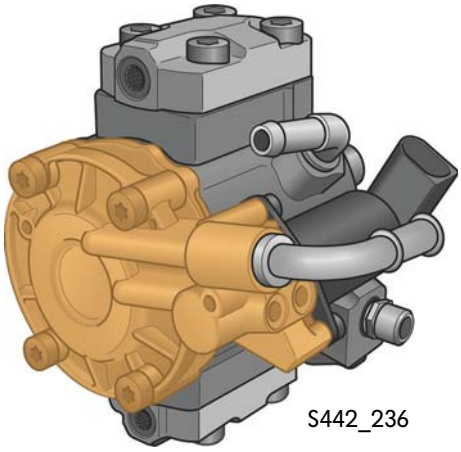
The electric fuel pump pumps diesel fuel out of the fuel tank through the fuel filter to the pre-supply pump.
The pre-pressure regulation valve controls the fuel pressure in the pre-supply pump.
It opens at 5bar and returns the fuel to the intake side of the pre-supply pump. The pre-supply pump delivers the fuel to the high-pressure pump via the actuated fuel metering valve. From the high-pressure pump, the fuel passes through the fuel pressure regulating valve to the high-pressure accumulator (rail) and then via high-pressure pipes to the injectors.



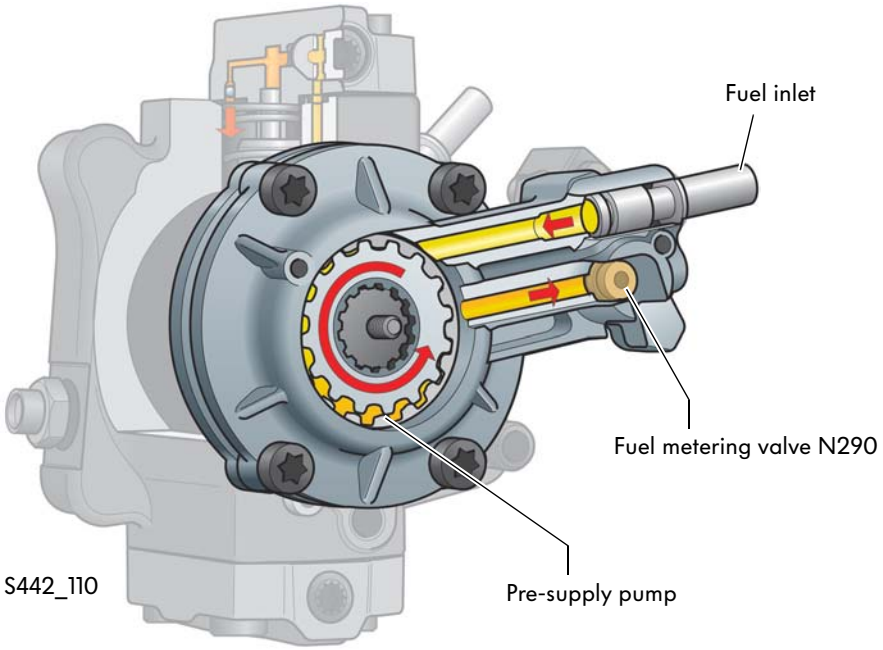
S442_156

Pre-supply pump

The pre-supply pump is a mechanically-operated gear wheel pump and is part of the high-pressure pump. It has the task of delivering the fuel supplied from the fuel tank to the high-pressure pump via the fuel metering valve. The fuel pressure is increased to approx. 5bar. This guarantees a constant supply of fuel to the high-pressure pump in all engine operating modes.



S442_236



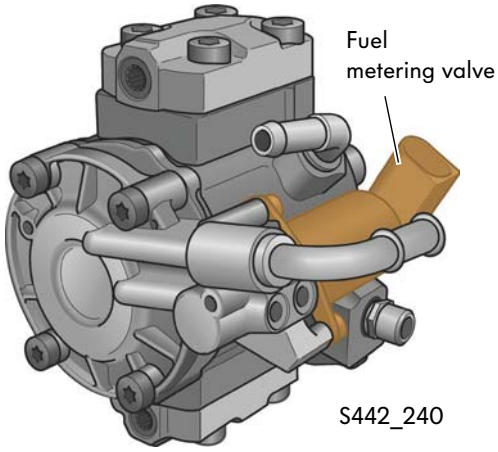
S442_110

Effects upon failure

If the high-pressure pump unit is not supplied with fuel. You cannot start the engine.

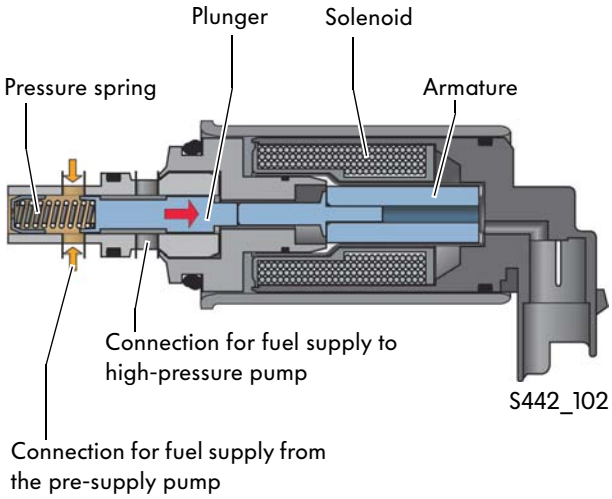
Fuel metering valve N290

The fuel metering valve controls the fuel supply to the high-pressure pump unit and ensures that fuel is supplied to the high-pressure pump.
This allows the delivery quantity of the high-pressure pump to be adjusted to the engine requirements on the low-pressure side. The advantage of this is that the high-pressure pump only has to generate the pressure which is required for the current operating situation.



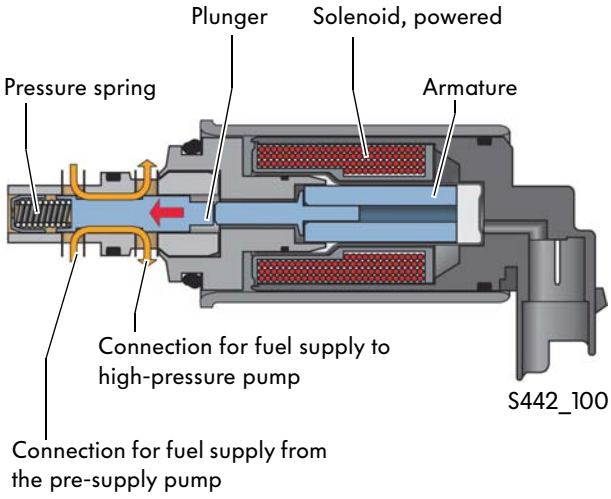
Function

Valve not activated



The fuel metering valve is not powered. The spring force moves the plunger to close the passage to the high-pressure pump. The fuel supply to the high-pressure pump is interrupted.

Valve activated



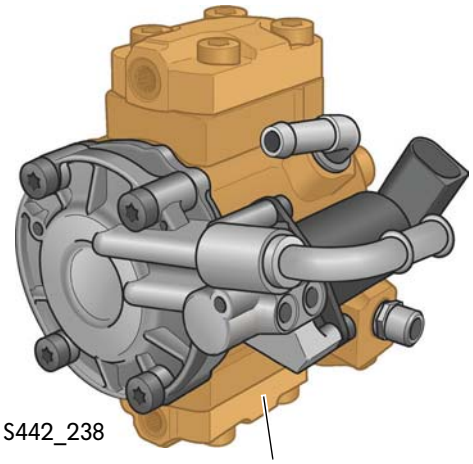
The fuel metering valve is powered and the solenoid generates a magnetic field.
The plunger is pressed against the spring force by the valve armature. The fuel supply to the high-pressure pump is opened and fuel reaches the high-pressure pump.

Effects upon failure

The valve is closed if the voltage supply fails. Fuel is not delivered to the high-pressure pump. You can no longer start the engine.

High-pressure pump unit

The high-pressure pump unit has the task of generating the high fuel pressure of up to 1600 bar, which is required for fuel injection. It is an on-demand radial piston pump with two high-pressure units arranged at 180 ° that are operated by a cam.

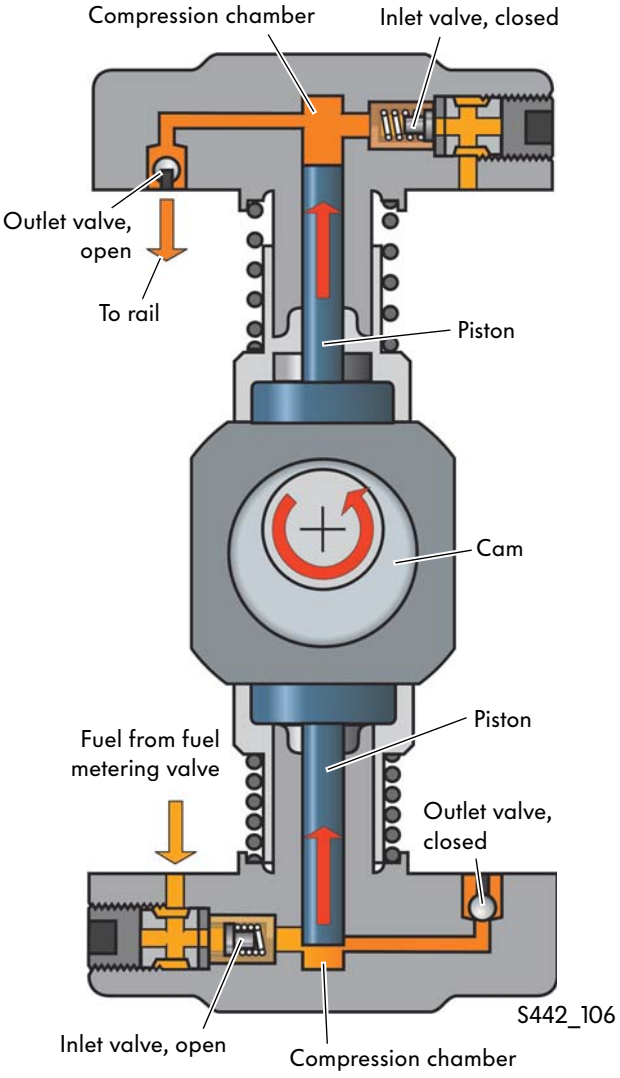


Delivery stroke

The cam pushes the piston upwards. The inlet valve is closed by the spring force and the pressure builds up in the compression chamber. The outlet valve opens when the pressure inside the compression chamber is greater than the fuel pressure in the high-pressure accumulator.

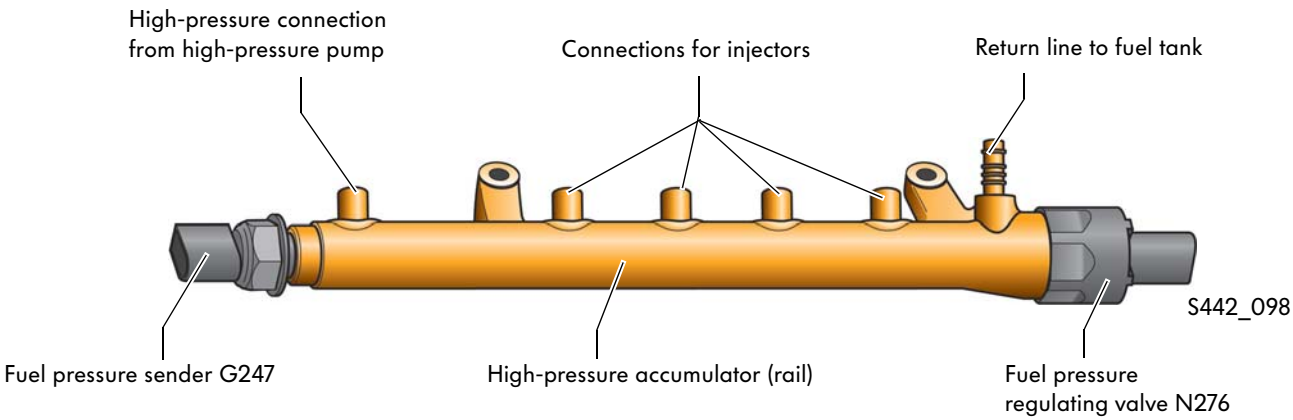
Suction stroke

The downwards movement of the piston creates a vacuum in the compression chamber that opens the inlet valve against the spring force.
The fuel coming from the fuel metering valve is drawn in. At the same time, the outlet valve is closed due to the difference in pressure between the compression chamber and the fuel pressure in the high-pressure accumulator.

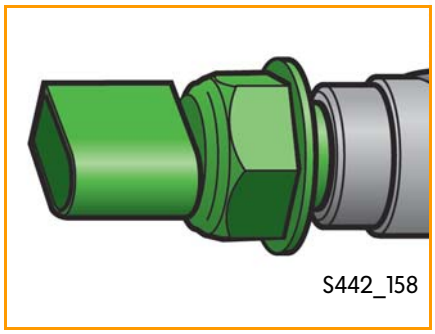


High-pressure accumulator (rail)

The rail is a high-pressure accumulator for the fuel that is delivered by the high-pressure pump. It supplies the injectors with the quantity of fuel required for all operating modes.



Fuel pressure sender G247



The fuel pressure sender G247 measures the fuel pressure in the rail. The pressure is converted into a voltage signal that is evaluated by the engine control unit.

Based on the maps stored in the engine control unit, the pressure signal is used to calculate the activation period of the injectors and the high-pressure regulation by the fuel metering valve.

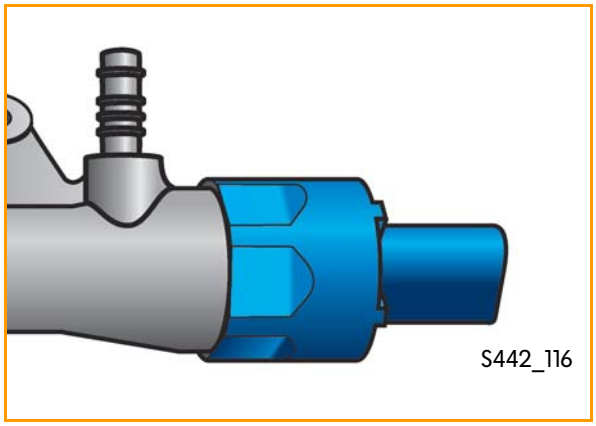
The fuel pressure sender is bolted directly onto the high-pressure accumulator.

Effects upon failure

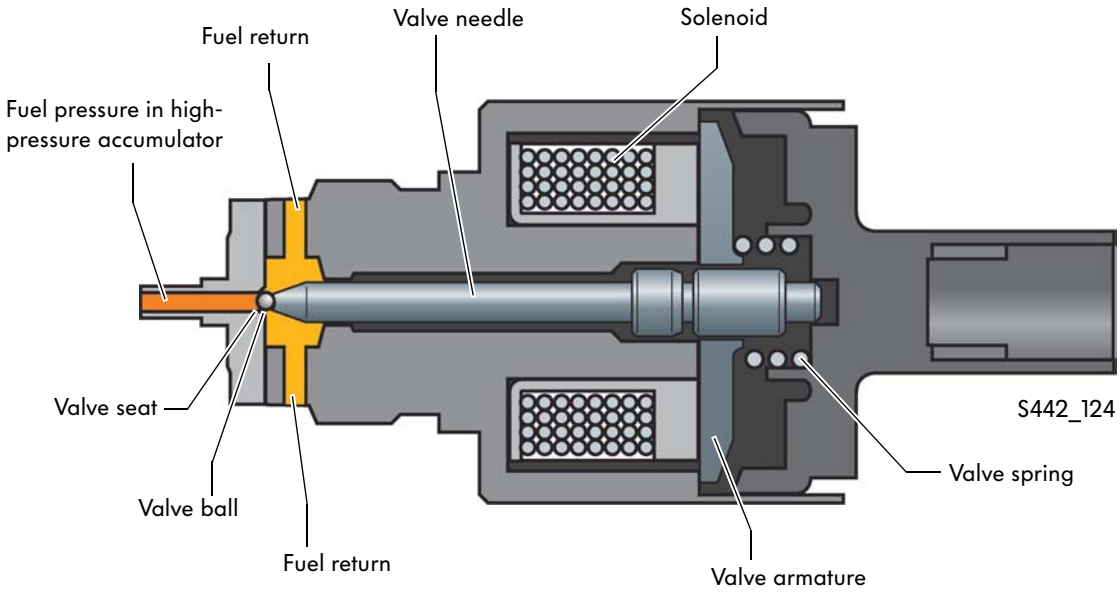
If the signal fails or there is an implausible signal from the sender, the engine control unit switches to emergency-running mode. The engine power is reduced and the maximum engine speed limited to 3000 rpm.

Fuel pressure regulating valve N276

The fuel pressure regulating valve is located on the high-pressure accumulator (rail). It regulates the fuel pressure in the high-pressure accumulator. The engine control unit uses a pulse-width modulated signal to operate the valve.

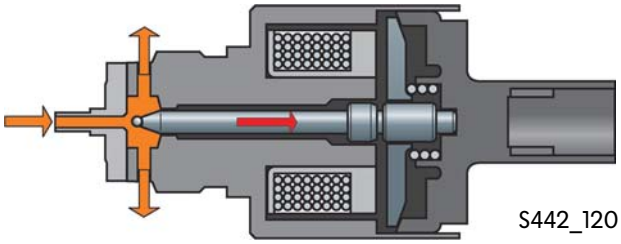


Design



Function

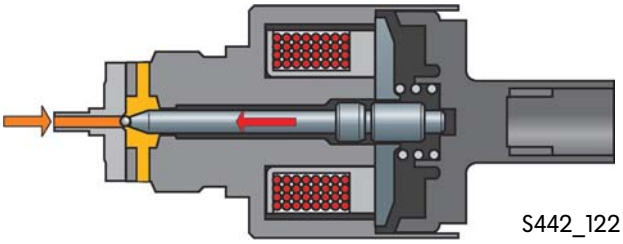
Regulating valve not activated



S442_120

Upon “Engine OFF”, the valve ball is pressed into the valve seat only by the spring force. This maintains a low fuel pressure.
If the fuel pressure in the high-pressure accumulator is greater than the spring force, the valve opens and fuel flows to the fuel tank via the fuel return.

Regulating valve activated



S442_122

The engine control unit adjusts the operating pressure in the high-pressure accumulator by operating the solenoid with a pulse-width modulated signal. The valve armature is energised and presses the valve needle into its seat.
The quantity flowing into the fuel return line is varied in relation to the duty cycle.

Effects upon failure

The engine will not run if the fuel pressure regulating valve fails. The fuel pressure required for injection cannot be built up.

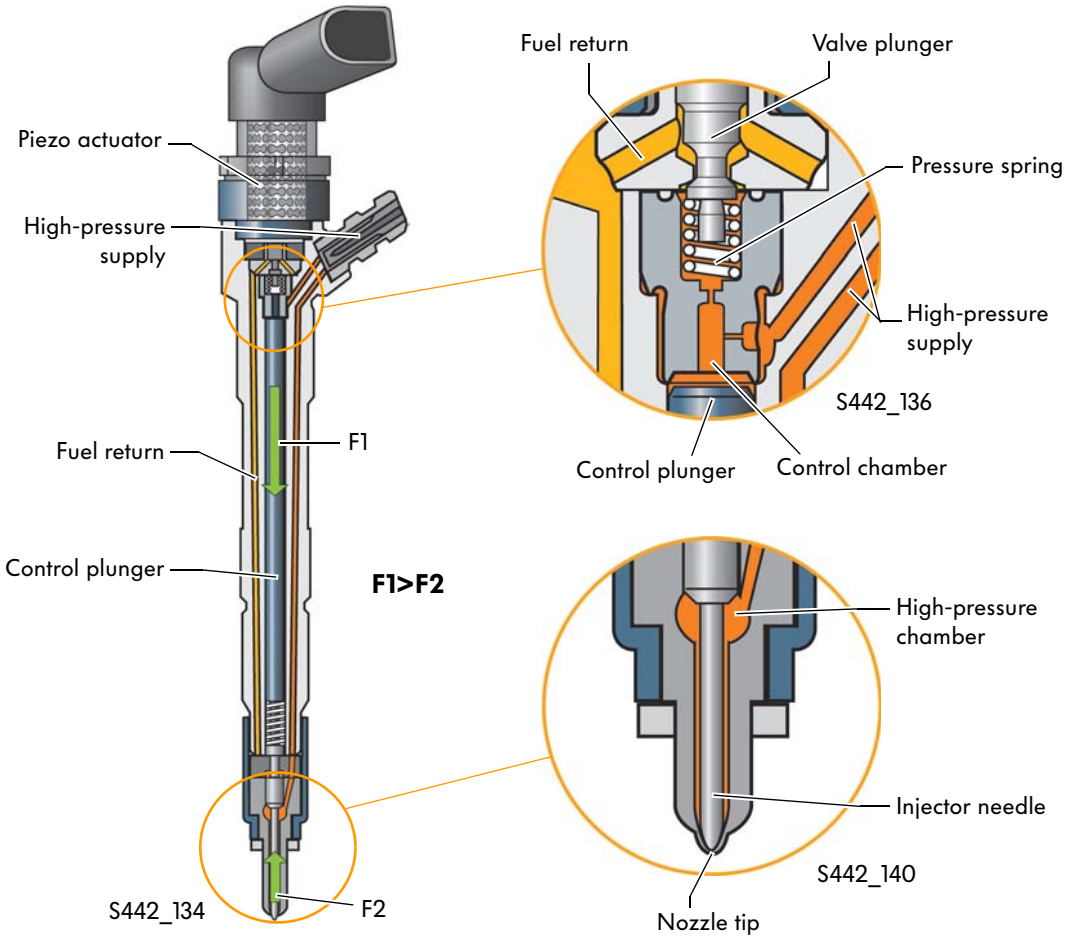
Injectors

The (piezo) injectors, which are connected to the rail via a high-pressure line, inject the quantity of fuel required for all engine operating modes into the combustion chambers. The respective injection quantity is made up of a pilot injection quantity, a main injection quantity and a secondary injection quantity. The injectors are controlled by a piezo actuator. This results in very short switching times, map-controlled injection quantities and a “smoother” combustion process.

Injector (piezo actuator) not activated

The fuel reaches the control chamber and the high-pressure chamber of the injector via the high-pressure supply line. The force (F1) acting on the control plunger is greater than the force (F2) acting on the nozzle needle.

The nozzle is closed. The pressure spring closes the return with the valve plunger to prevent the fuel flowing out when the engine is not turning over.

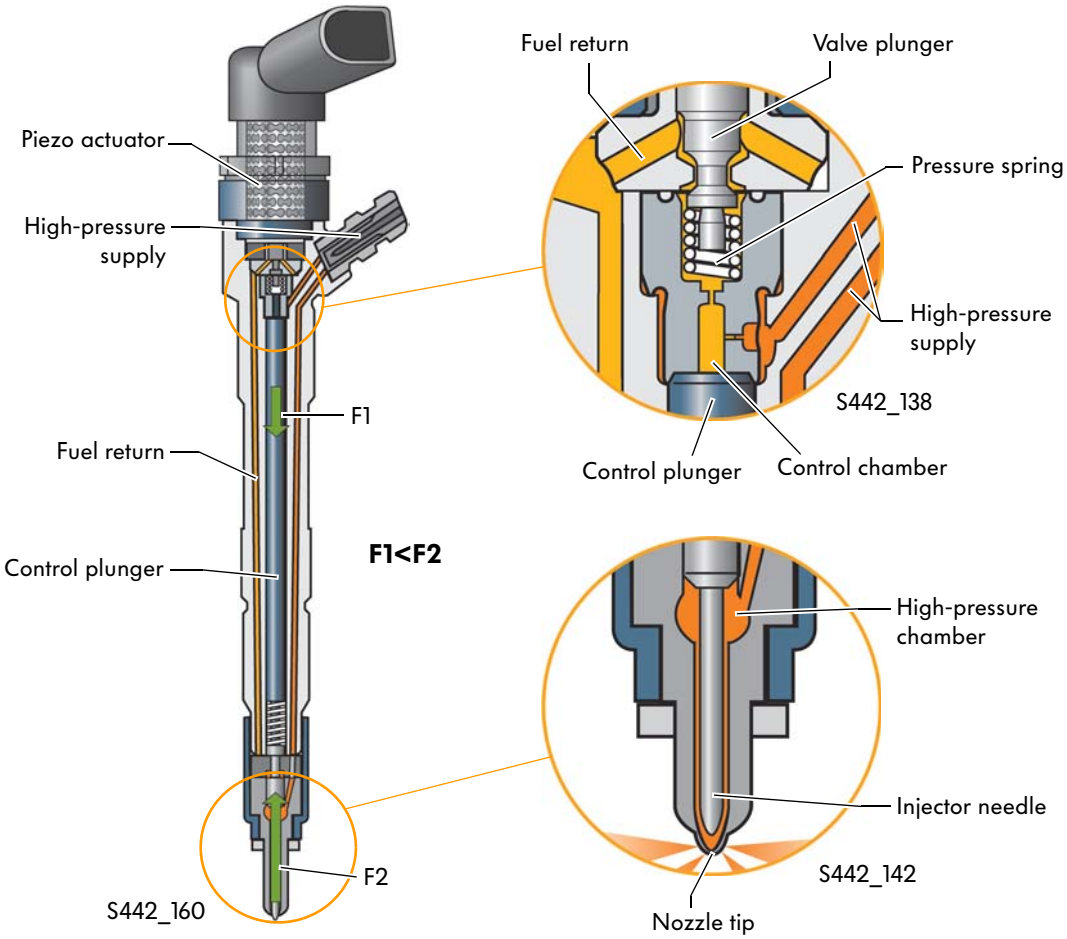


The design and function of the piezo actuator is described in self-study programme no. 351 “The common rail fuel injection system fitted in the 3.0l V6 TDI engine”.

Injector (piezo actuator) activated

The piezo actuator in the injector is activated and expands. The valve plunger is pushed against the spring force and connects the control chamber to the fuel return. This reduces the pressure in the control chamber.

The hydraulic force (F2) at the nozzle needle is now greater than the force (F1) applied by the control plunger.
The nozzle needle moves upwards and the fuel is injected into the combustion chamber.

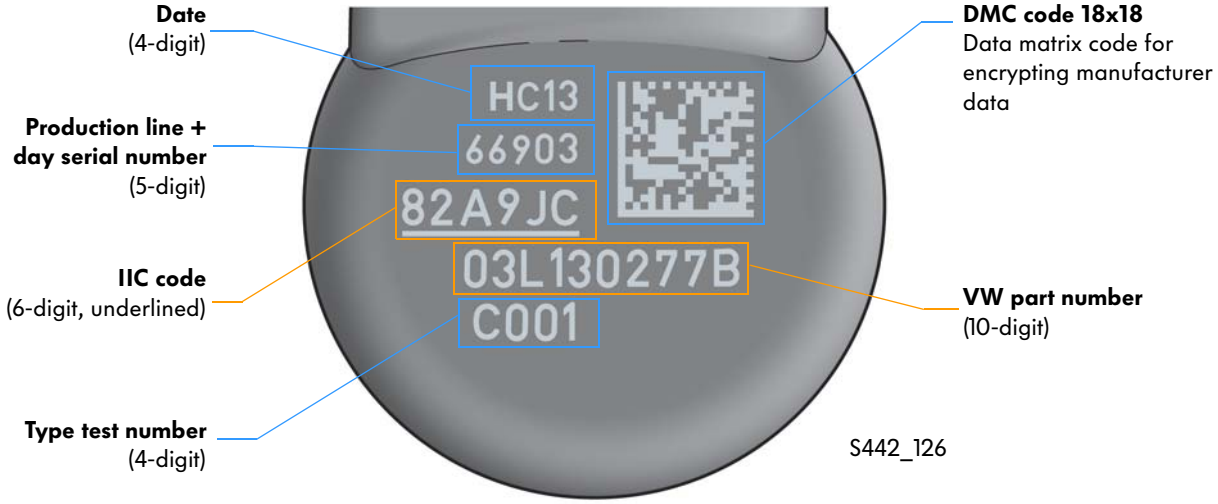


Engine Components

Identification of injectors

There is a data carrier on the top of the injectors. In addition to the VW parts number, date and type test number, the 6-digit IIC code (Injector Individual Correction) is stamped there.

The IIC code needs to be entered in the Guided Function “Read/adapt correction values for injectors” when the injectors are replaced.

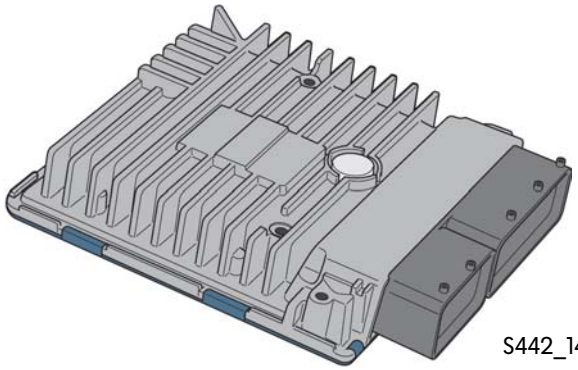


S442_126

Engine control unit

The engine control unit checks all processes that are required to regulate the engine system.

The engine control unit regulates the engine output data, like fuel injection quantity, fuel injection time etc. using the vehicle data it receives (engine speed, coolant temperature, accelerator pedal position etc.).



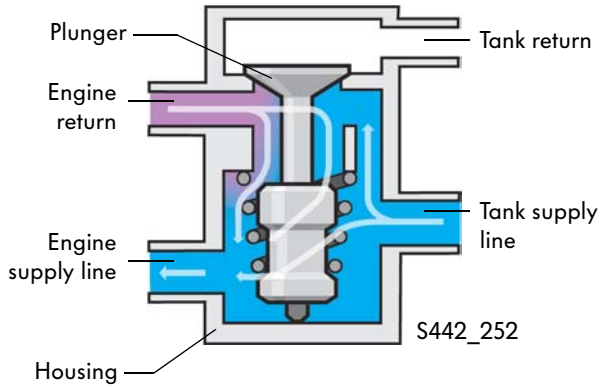
S442_144

Combination valve

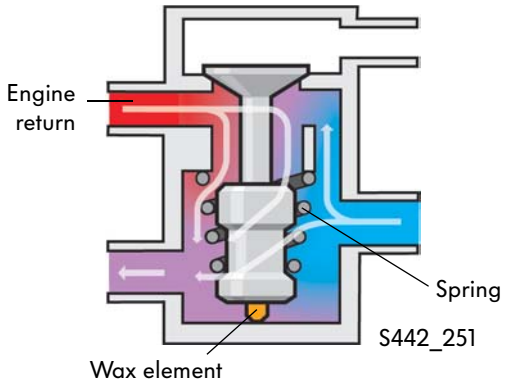
In the Polo 2010, the combination valve is mounted near the fuel filter. The combination valve has the task of preheating the fuel.

Function

Combination valve closed

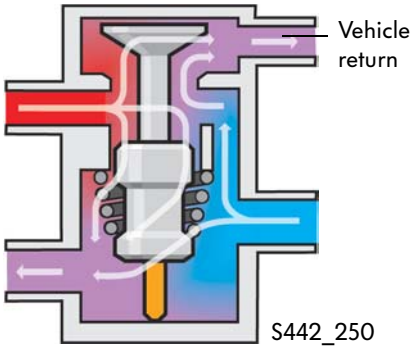


When cold starting, the return to the tank is closed by the plunger in the combination valve.
Warm fuel from the engine return is mixed with cold fuel from the tank in the combination valve and is delivered to the engine again.
Preheating the fuel in this way prevents the separation of paraffin and thus fuel filter blockages.



As the engine temperature rises, the fuel temperature in the engine return line also rises. As a result, the plunger heats up together with the wax thermostatic element in the combination valve. The wax thermostatic element expands and presses the plunger upwards against the spring force.

Combination valve open



Once the operating temperature has been reached, the combination valve opens the return line to the tank. Cold fuel from the tank mixes with warm fuel from the engine return line and flows back into the fuel tank. This allows the fuel in the fuel tank to warm up at low temperatures.

Warm fuel

Cold fuel

System Overview

Sensors

G28 Engine speed sender

G40 Hall sender

G79 Accelerator position sender
G185 Accelerator position sender 2

G70 Air mass meter

G62 Coolant temperature sender
G83 Radiator outlet coolant temperature sender

G31 Charge air pressure sender
G42 Intake air temperature sender

G81 Fuel temperature sender

G247 Fuel pressure sender

G212 Exhaust gas recirculation potentiometer

G39 Lambda probe

G450 Exhaust gas pressure sensor 1

G235 Exhaust gas temperature sender 1

G495 Exhaust gas temperature sender 3

G648 Exhaust gas temperature sender 4

F Brake light switch

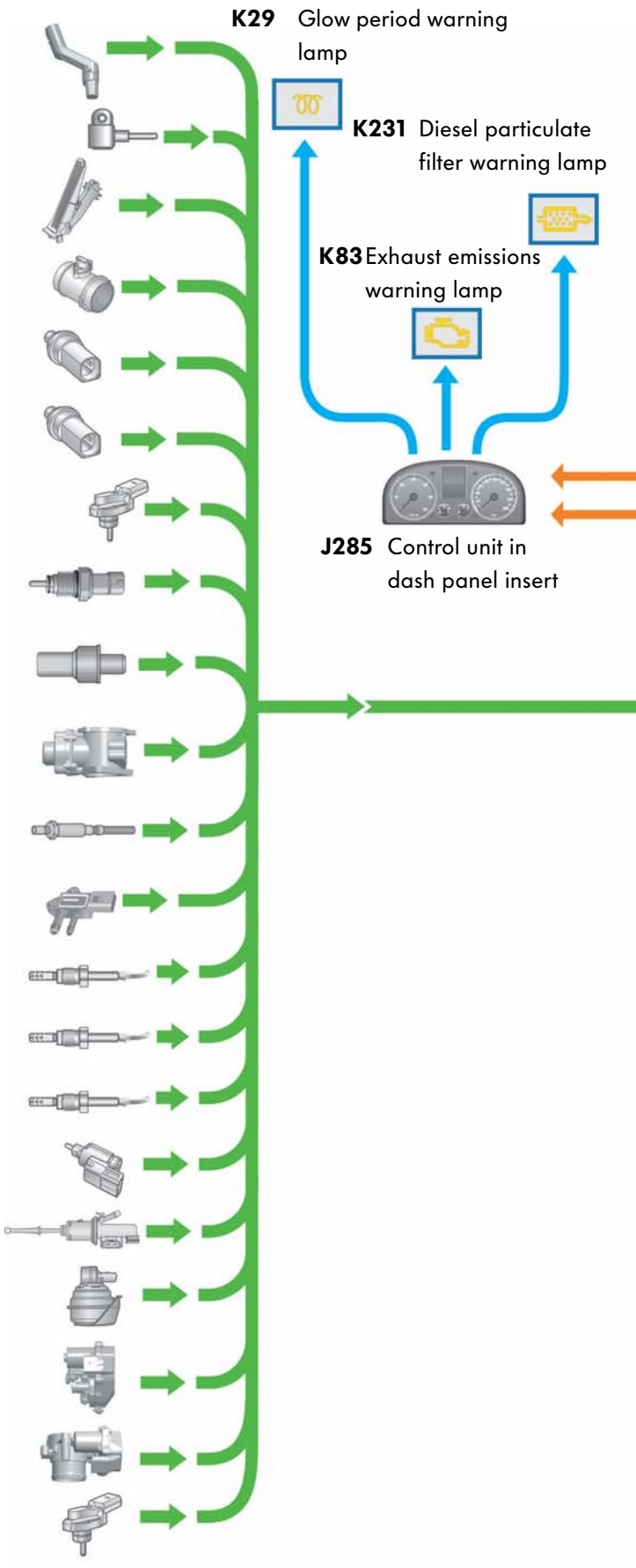
G476 Clutch position sender

G581 Position sender for charge pressure positioner

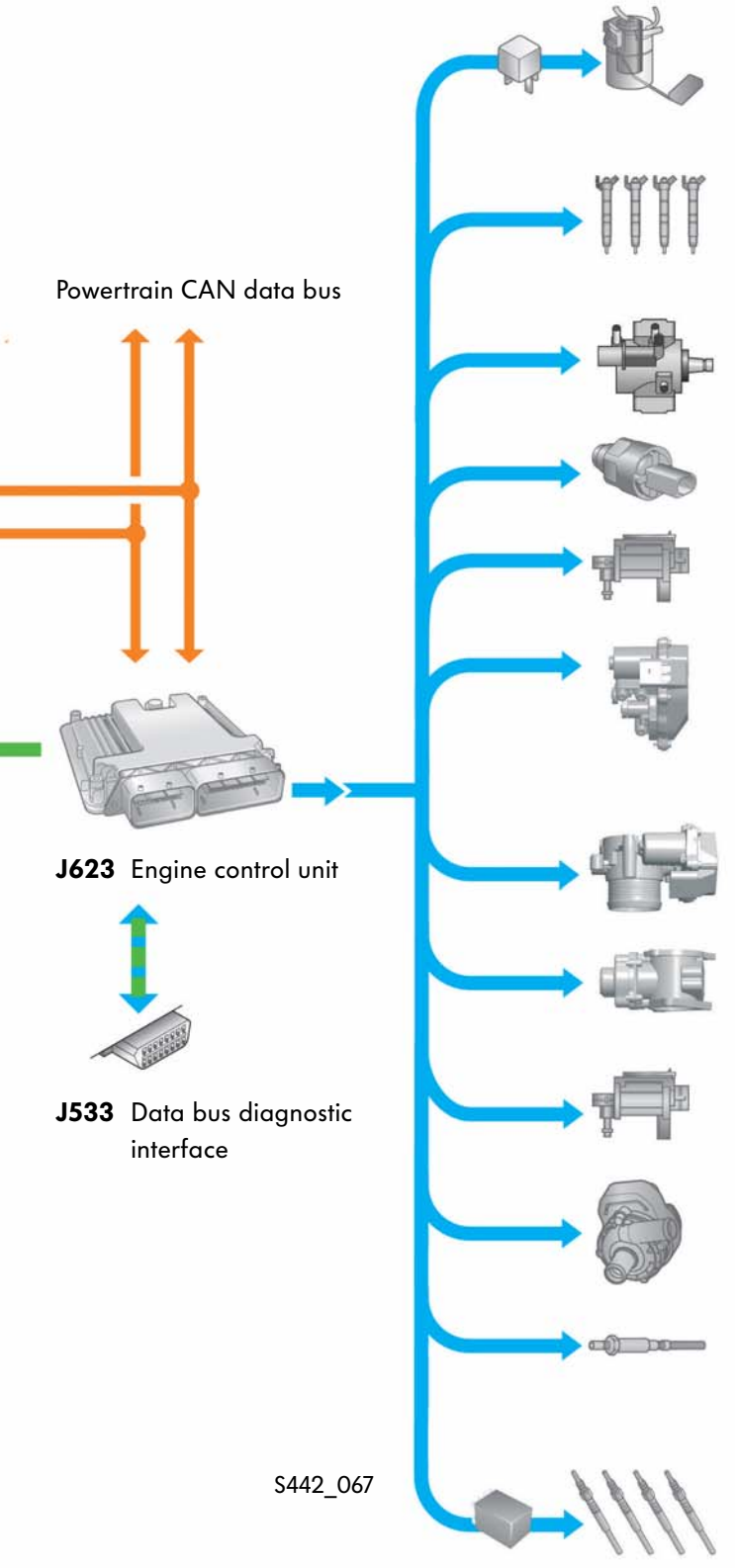
G336 Intake manifold flap potentiometer*

G69 Throttle valve potentiometer

G266 Oil level and oil temperature sender



Actuators



J17 Fuel pump relay
G6 Fuel system pressurisation pump

N30 Injector, cylinder 1
N31 Injector, cylinder 2
N32 Injector, cylinder 3
N33 Injector, cylinder 4

N290 Fuel metering valve

N276 Fuel pressure regulating valve

N75 Charge pressure control solenoid valve

V157 Intake manifold flap motor*

J338 Throttle valve module

N18 Exhaust gas recirculation valve

N345 Exhaust gas recirculation cooler change-over valve

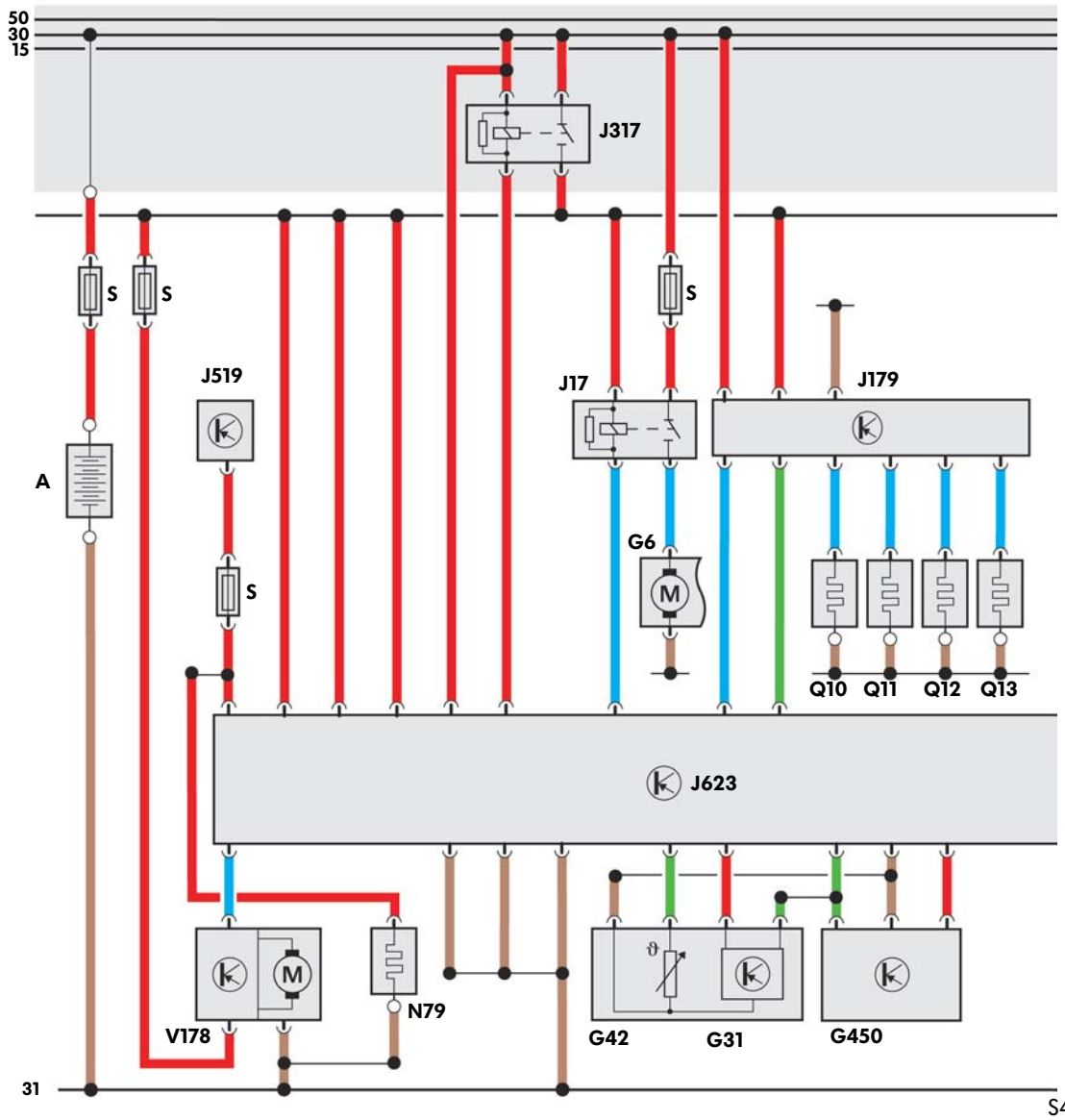
V178 Coolant circulation pump 2

Z19 Lambda probe heater

J179 Automatic glow period control unit
Q10 Glow plug 1
Q11 Glow plug 2
Q12 Glow plug 3
Q13 Glow plug 4

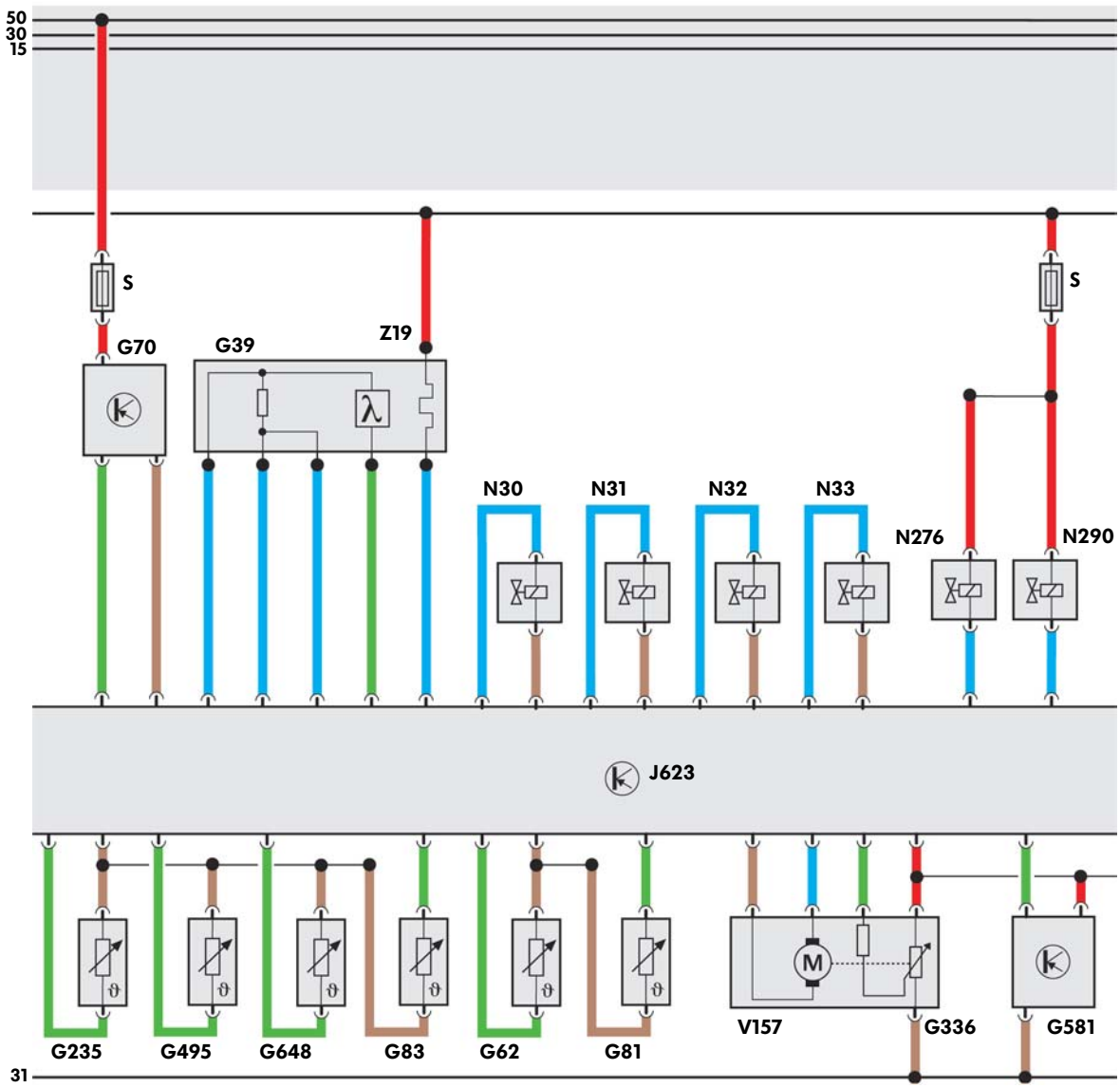
* No function at present

Functional Diagram



S442_200

A	Battery
G6	Fuel system pressurisation pump
G31	Charge air pressure sender
G39	Lambda probe
G42	Intake air temperature sender
G62	Coolant temperature sender
G70	Air mass meter
G81	Fuel temperature sender
G83	Radiator outlet coolant temperature sender
G235	Exhaust gas temperature sender 1
G336	Intake manifold flap potentiometer*
G450	Exhaust gas pressure sensor 1
G495	Exhaust gas temperature sender 3
G581	Position sender for charge pressure positioner
G648	Exhaust gas temperature sender 4
J17	Fuel pump relay
J179	Automatic glow period control unit
J317	Voltage supply relay
J519	Onboard supply control unit
J623	Engine control unit
N30	Injector, cylinder 1
N31	Injector, cylinder 2
N32	Injector, cylinder 3
N33	Injector, cylinder 4
N276	Fuel pressure regulating valve
N290	Fuel metering valve



S442_202

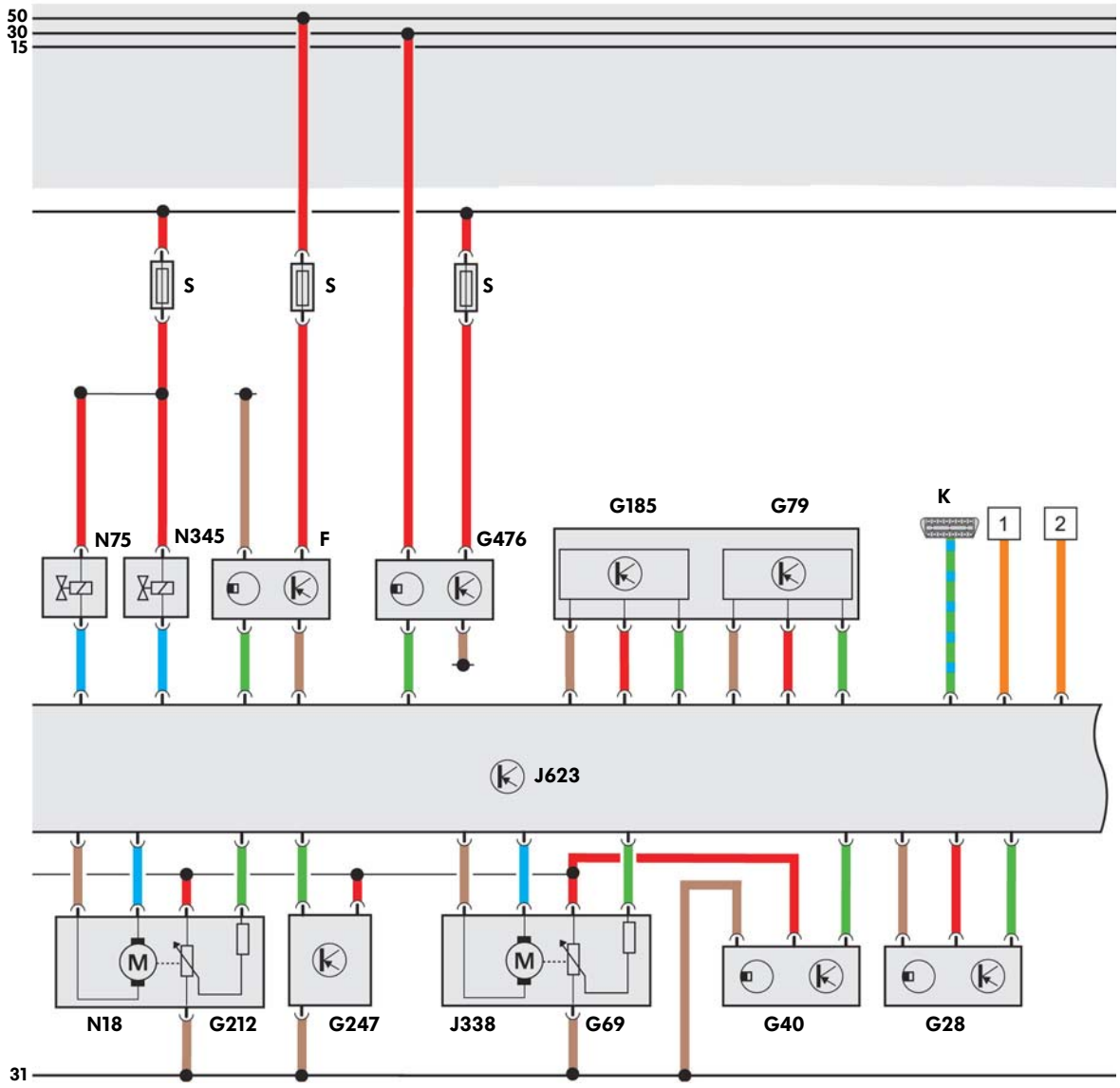
Q10 Glow plug 1
Q11 Glow plug 2
Q12 Glow plug 3
Q13 Glow plug 4
S Fuse
V157 Intake manifold flap motor*
V178 Coolant circulation pump 2
Z19 Lambda probe heater

* No function at present

Colour code/legend

= input signal
= output signal
= positive
= earth
= powertrain CAN data bus

Functional Diagram



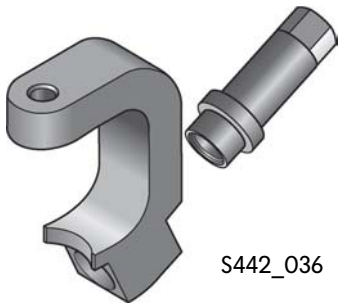
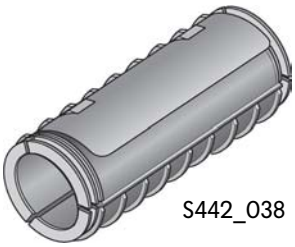
S442_204

F	Brake light switch
G28	Engine speed sender
G40	Hall sender
G69	Throttle valve potentiometer
G79	Accelerator position sender
G185	Accelerator position sender 2
G212	Exhaust gas recirculation potentiometer
G247	Fuel pressure sender
G476	Clutch position sender
J338	Throttle valve module
J623	Engine control unit
N18	Exhaust gas recirculation valve
N75	Charge pressure control solenoid valve
N345	Exhaust gas recirculation cooler change-over valve
K	Diagnostic connection
S	Fuse
1	CAN data bus
2	CAN data bus

Colour code/legend

= input signal
= output signal
= positive
= earth
= powertrain CAN data bus

Special tools

Description	Tool	Application
T10402 Puller	 S442_036	For removal of injectors (piezo injectors)
T10403 Transportation lock	 S442_038	For locking decoupling element of exhaust system

Test Yourself

Which answers are correct?

One or several of the answers could be correct.

1. What output versions of the 1.6l TDI engine are available?

- [ ] a) 44kW, 55kW, 81kW
- [ ] b) 50kW, 70kW, 90kW
- [ ] c) 55kW, 66kW, 77kW

2. What is a flexi belt?

- [ ] a) A flexible, stretchable poly V-belt
- [ ] b) A tensioned poly V-belt
- [ ] c) A poly V-belt stretched with a tensioner

3. Where is the exhaust gas recirculation module fitted?

- [ ] a) On the intake side, on the intake manifold
- [ ] b) On the exhaust side, on the cylinder head
- [ ] c) On the underbody, near to the fuel tank

4. What components belong to the high-pressure pump?

☐ a) Pre-supply pump, high-pressure pump unit, rail

☐ b) Pre-supply pump, fuel metering valve, high pressure pump unit

☐ c) High-pressure pump unit, rail, injector

5. What is the task of the fuel pressure sender G247?

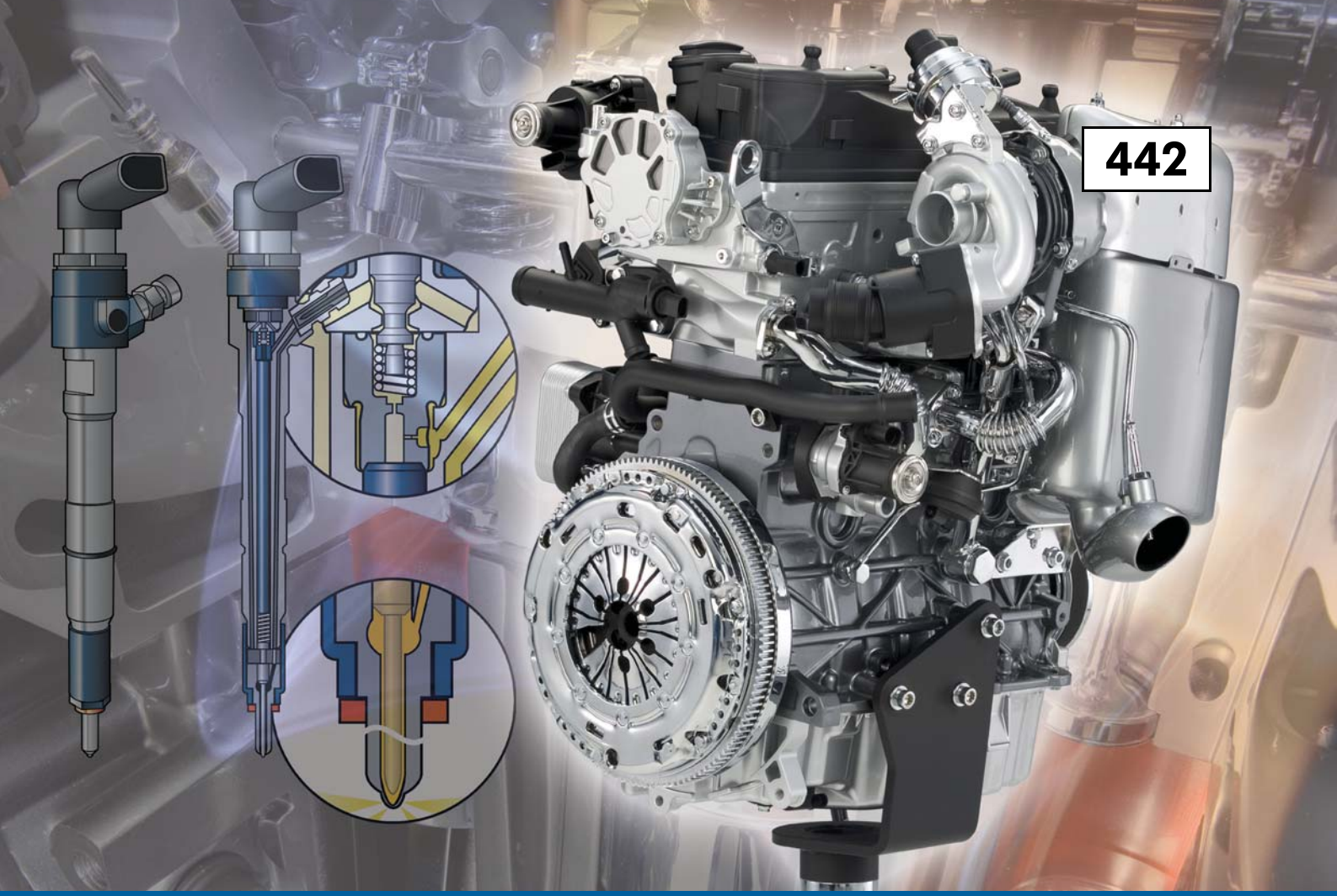
☐ a) The fuel pressure sender measures the fuel pressure in the rail.

☐ b) The fuel pressure sender measures the fuel pressure in the pre-supply pump.

☐ c) The fuel pressure sender measures the fuel pressure in the fuel return line.

Answers
1. c); 2. a); 3. b); 4. b); 5. a)

Notes



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