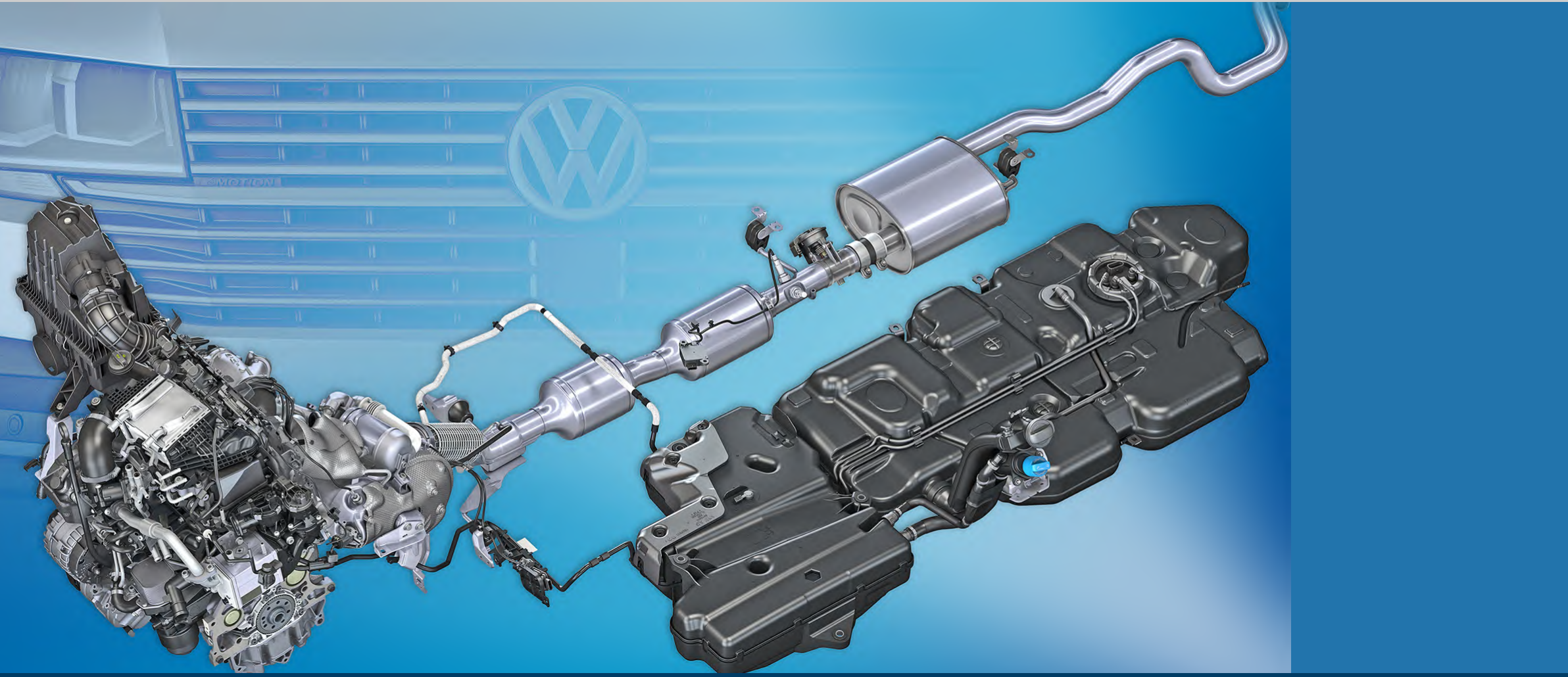
SSP 722 The 2.0 l TDI engine with close-coupled emission control (MAR) in the T6.1 2021

Design and function

Commercial Vehicles



Introduction

Notes on use

You will find an explanation of how to use the new online Self-study Programmes under the heading “Help” in the menu.

Notes on content

Self-study Programmes are used to teach users about the design and function of new developments. Please use the respective workshop information for up-to-date test, adjustment and repair instructions.
The contents will not be updated.

Legal note

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Introduction

The 2.0 l TDI EA288 Nutz engines with close-coupled emission control (MAR) developed by Volkswagen belong to the EA288 Nutz diesel engine series. Compared to the EA288 predecessor engine family, a wide range of aspects of the new EA288 Nutz engine family have been improved.

The EA288 Nutz engine family achieves a significant increase in efficiency combined with optimised power delivery and improved acoustics. The SCR system with twin dosing technology enables a significant reduction in nitrogen oxide emissions.

The new EA288 Nutz engine family is based exclusively on a 4-cylinder engine with 1968 cm^3 displacement.

The range of power outputs starts at 66 kW and extends up to 150 kW.

This Self-Study Programme describes the design and components of the new EA288 Nutz engine generation and how individual subsystems of the engine work.



Important notes on using the SSP

Technical characteristics and torque/power diagrams

Technical features

The raw emissions have been significantly reduced by optimising combustion in order to achieve the development goals, particularly with regard to compliance with emissions legislation. At the same time, it was necessary to use exhaust gas aftertreatment technology that is considerably more powerful than that of the predecessor engine. For this purpose, the following technology modules have been integrated into the EA288 Nutz of the latest generation:

Technical features

- Injection system with up to 2500 bar for the biturbo
- More advanced, cooled high-pressure exhaust gas recirculation system
- Cooled low-pressure exhaust gas recirculation
- More advanced turbocharging group as biturbo and monoturbo
- Thermal management with more advanced functions
- Close-coupled emission control
- Double SCR system (twin dosing)



The torque/power diagrams for the various engine codes are illustrated at the top of the following tabs.

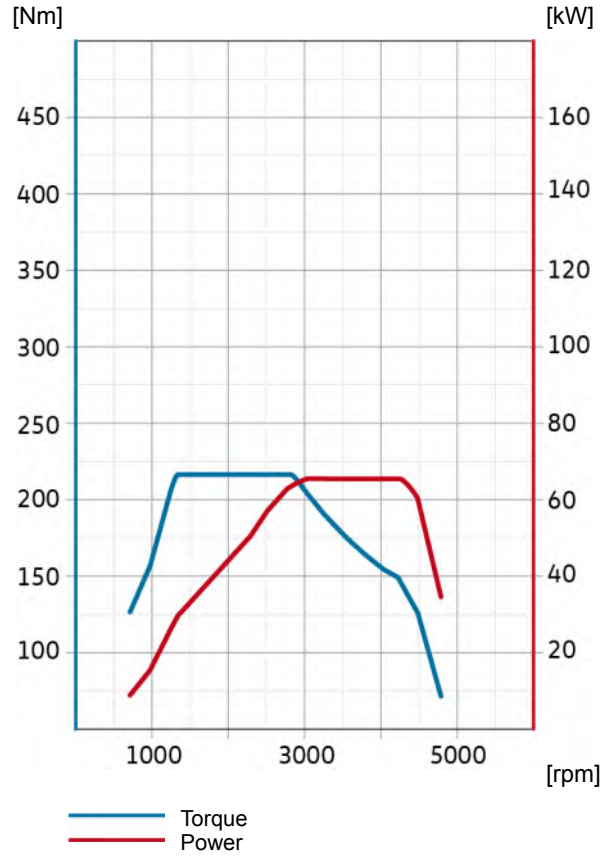


If you hold down the left mouse button, you will get an enlarged image.

Technical characteristics and torque/power diagrams

DNAC

Engine code	DNAC
Type	4-cylinder in-line engine
Capacity	1968 cm³
Bore	81 mm
Stroke	95.5 mm
Valves per cylinder	4
Compression ratio	15.5 : 1
Maximum power	66 kW at 3000 – 4250 rpm
Maximum torque	220 Nm at 1350 – 2750 rpm
Engine management system	Bosch MD1 CS
Fuel	Diesel, in accordance with DIN EN 590
Exhaust post-treatment	High-pressure and low-pressure exhaust gas recirculation, oxidising catalytic converter, diesel particulate filter, SCR system (twin dosing technology)
Emission code	EU6 *)

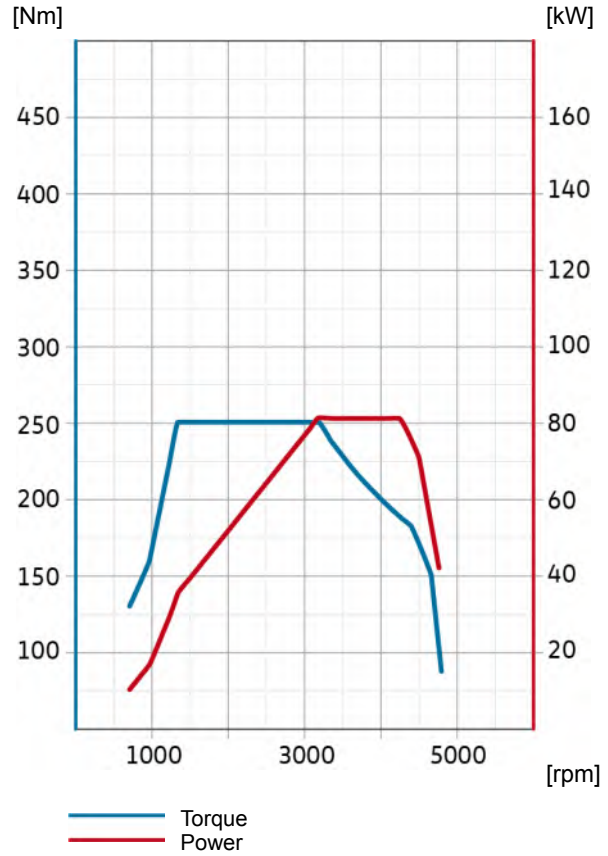


*) Exhaust emission standard in country and equipment-related specification.

Technical characteristics and torque/power diagrams

DNAB

Engine code	DNAB
Type	4-cylinder in-line engine
Capacity	1968 cm³
Bore	81 mm
Stroke	95.5 mm
Valves per cylinder	4
Compression ratio	15.5 : 1
Maximum power	81 kW at 3100 – 4250 rpm
Maximum torque	250 Nm at 1350 – 3100 rpm
Engine management system	Bosch MD1 CS
Fuel	Diesel, in accordance with DIN EN 590
Exhaust post-treatment	High-pressure and low-pressure exhaust gas recirculation, oxidising catalytic converter, diesel particulate filter, SCR system (twin dosing technology)
Emission code	EU6 *)

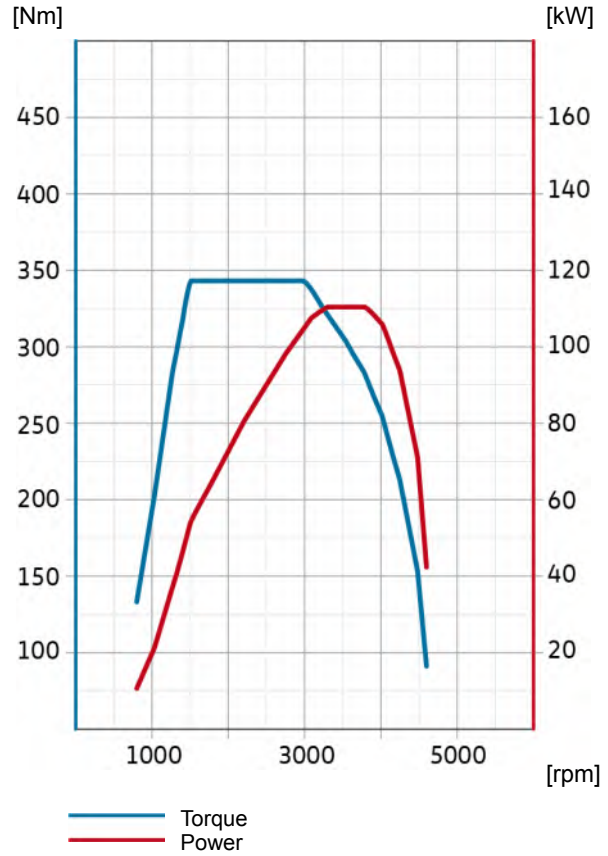


*) Exhaust emission standard in country and equipment-related specification.

Technical characteristics and torque/power diagrams

DNAA

Engine code	DNAA
Type	4-cylinder in-line engine
Capacity	1968 cm³
Bore	81 mm
Stroke	95.5 mm
Valves per cylinder	4
Compression ratio	15.5 : 1
Maximum power	110 kW at 3250 – 3750 rpm
Maximum torque	340 Nm at 1500 – 3000 rpm
Engine management system	Bosch MD1 CS
Fuel	Diesel, in accordance with DIN EN 590
Exhaust post-treatment	High-pressure and low-pressure exhaust gas recirculation, oxidising catalytic converter, diesel particulate filter, SCR system (twin dosing technology)
Emission code	EU6 *)

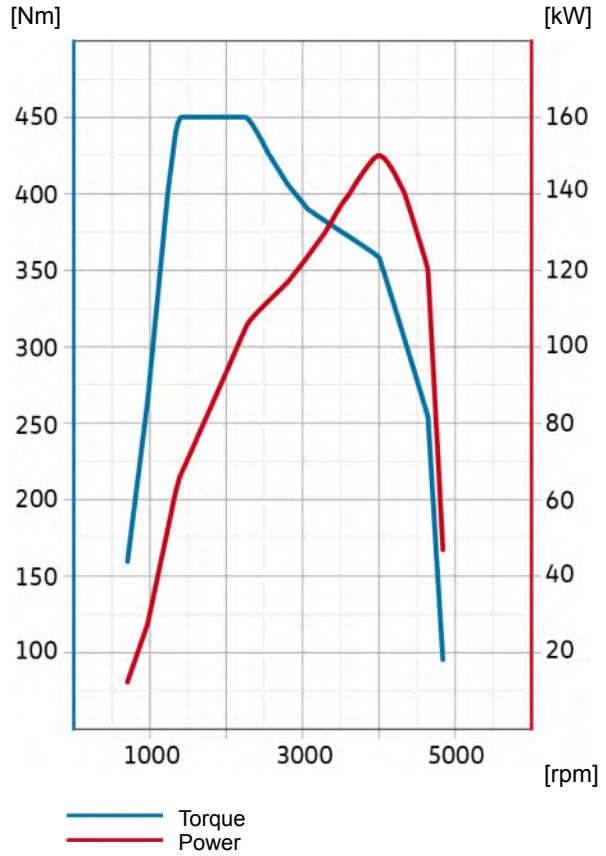


*) Exhaust emission standard in country and equipment-related specification.

Technical characteristics and torque/power diagrams

DMZA

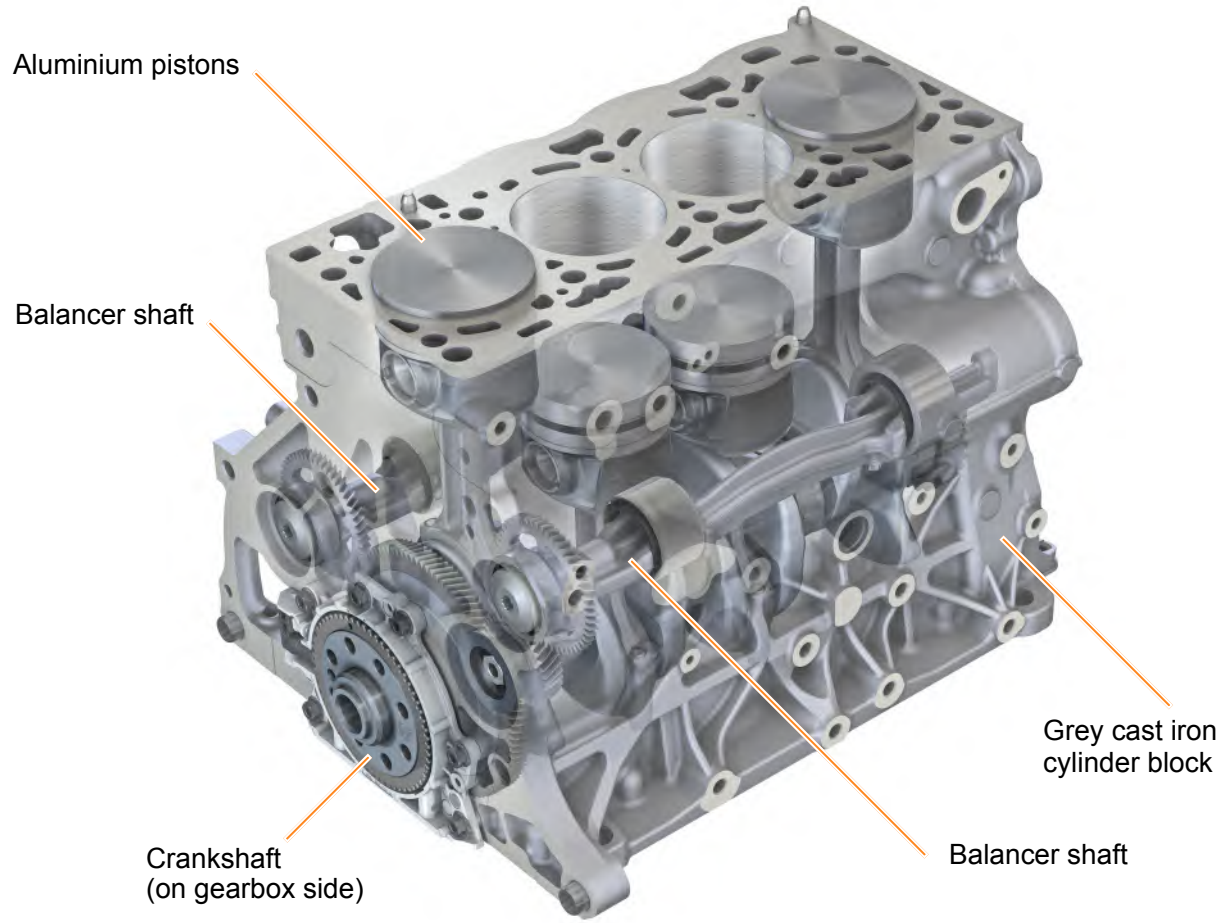
Engine code	DMZA
Type	4-cylinder in-line engine
Capacity	1968 cm³
Bore	81 mm
Stroke	95.5 mm
Valves per cylinder	4
Compression ratio	15.5 : 1
Maximum power	150 kW at 4000 rpm
Maximum torque	450 Nm at 1400 – 2250 rpm
Engine management system	Bosch MD1 CS
Fuel	Diesel, in accordance with DIN EN 590
Exhaust post-treatment	High-pressure and low-pressure exhaust gas recirculation, oxidising catalytic converter, diesel particulate filter, SCR system (twin dosing technology)
Emission code	EU6 *)



*) Exhaust emission standard in country and equipment-related specification.

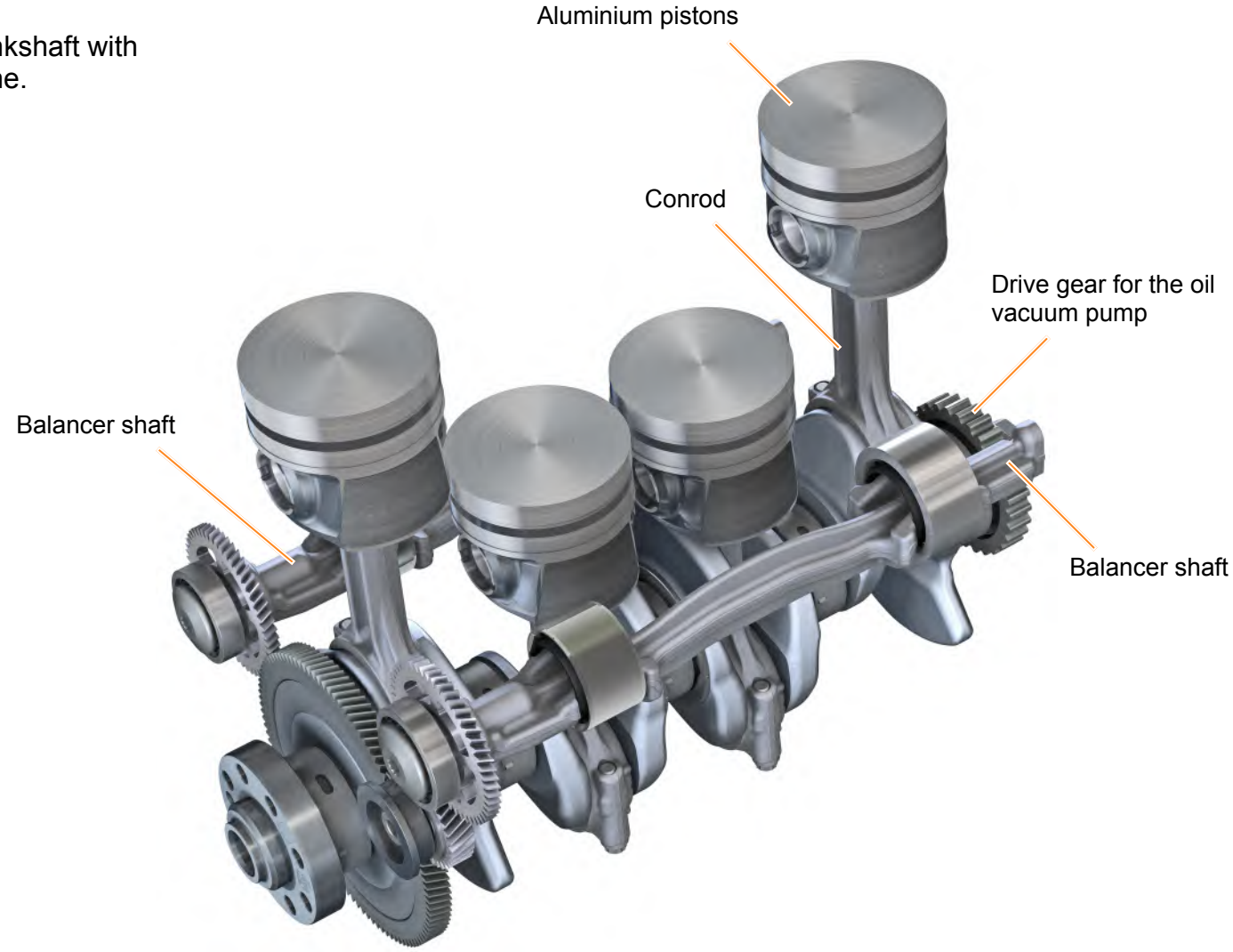
Cylinder block

The cylinder block of the 2.0 l TDI engine with close coupled emission control (MAR) is made of grey cast iron. This is an alloy of cast iron and lamellar graphite.
The engine has balancer shafts integrated in the block in every power class and vehicle equipment.



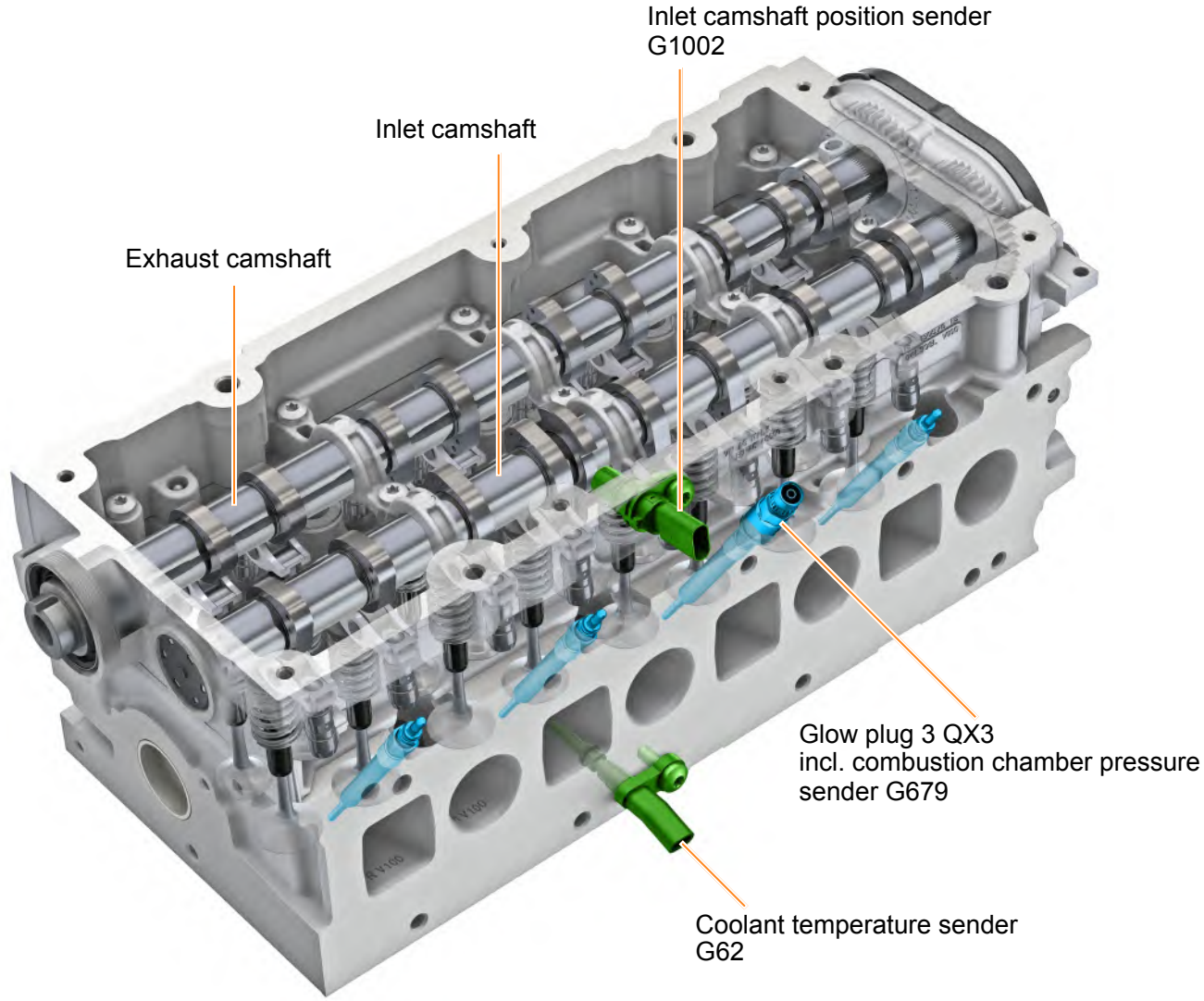
Crankshaft group

Due to the high mechanical load, a forged crankshaft with five-way bearings is used in the 2.0 l TDI engine.



The cylinder head with camshaft housing

The cylinder head with 4-valve technology is manufactured from an aluminium alloy for all power versions.
The valves are actuated by roller rocker fingers with hydraulic compensation elements. The inlet valves are located on the inlet side and the exhaust valves on the exhaust side.
The inlet and exhaust camshafts are integrated into a retaining frame.
A toothed belt drive is used to drive the exhaust camshaft. The exhaust camshaft then drives the inlet camshaft via spur gears.
The sender wheel for the inlet camshaft position sender G1002 is installed on the inlet camshaft. The position sender is pushed into the side of the camshaft housing and bolted in place.



Oil circuit



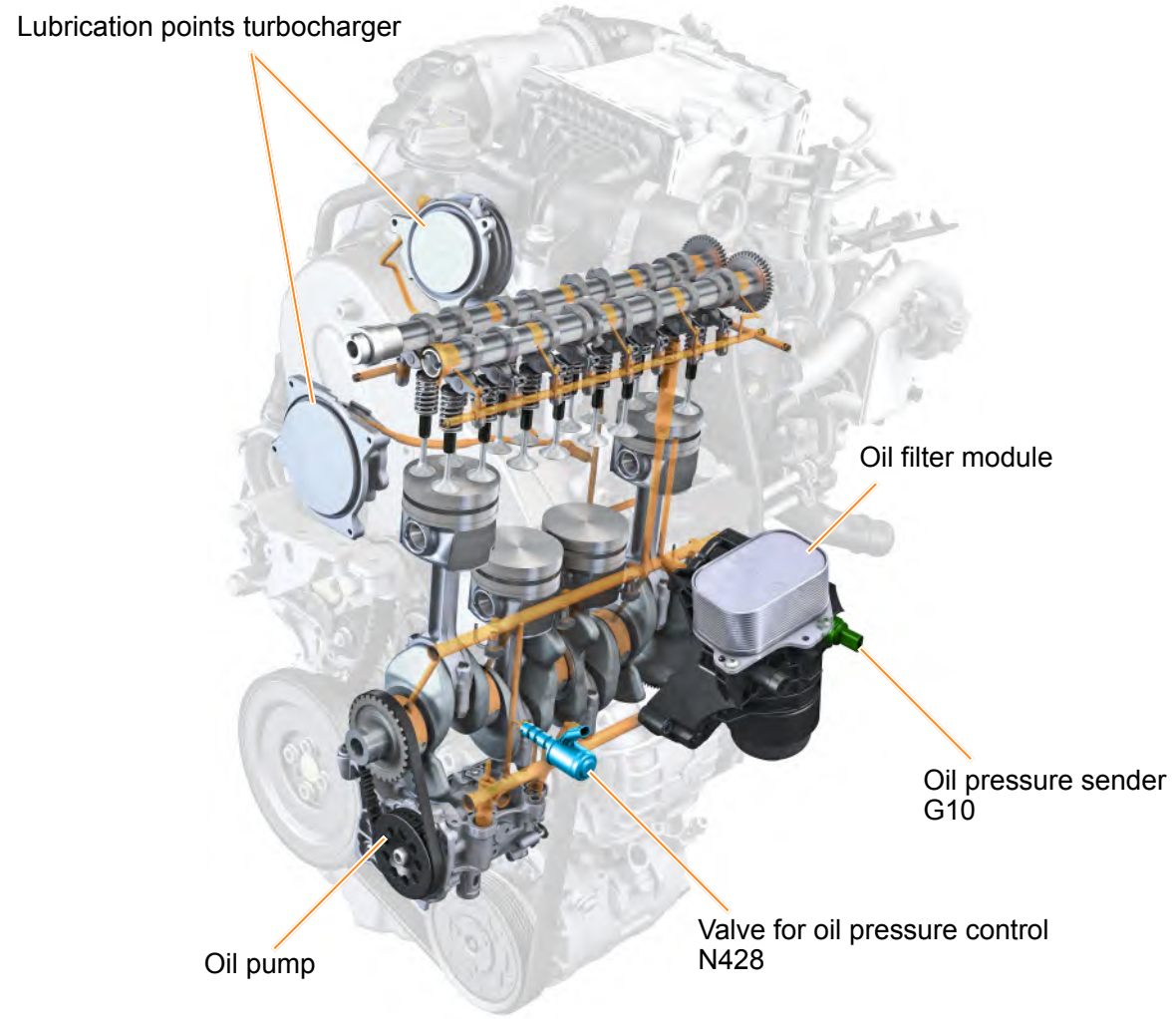
If the engine/short engine, the cylinder head, the camshaft housing and/or the turbocharger are replaced, the vehicle diagnostic tester must be used to activate the inflow function (high oil pressure) of the oil pump.
Observe the information in the Workshop Manual.

Note

Oil circuit

Features of the oil system

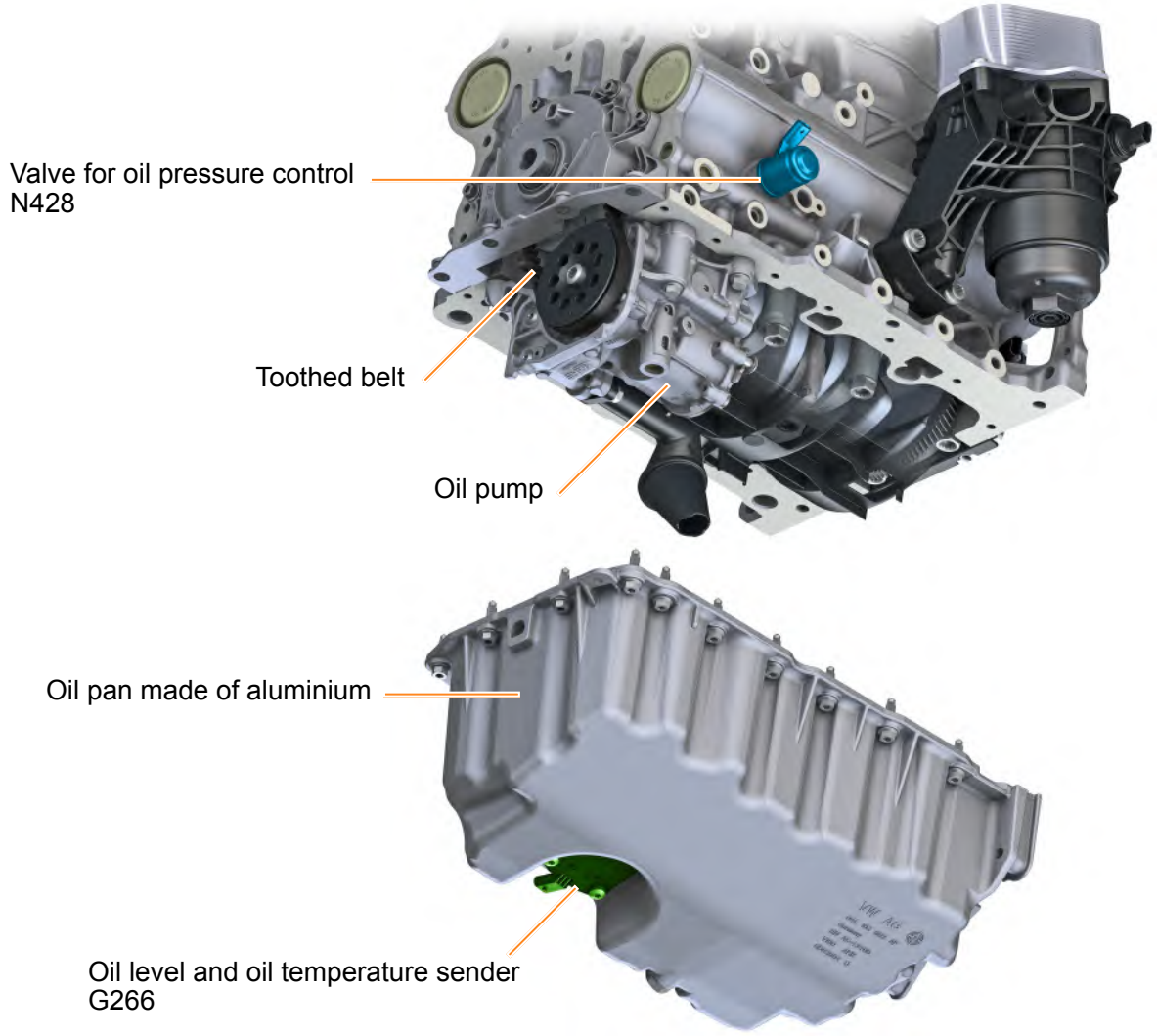
- Two-stage oil pressure control
- Piston cooling (depending on oil pressure)
- Engine oil 0W-30 according to engine oil standard VW 507 00



Press and hold the left mouse button to obtain an enlarged view.

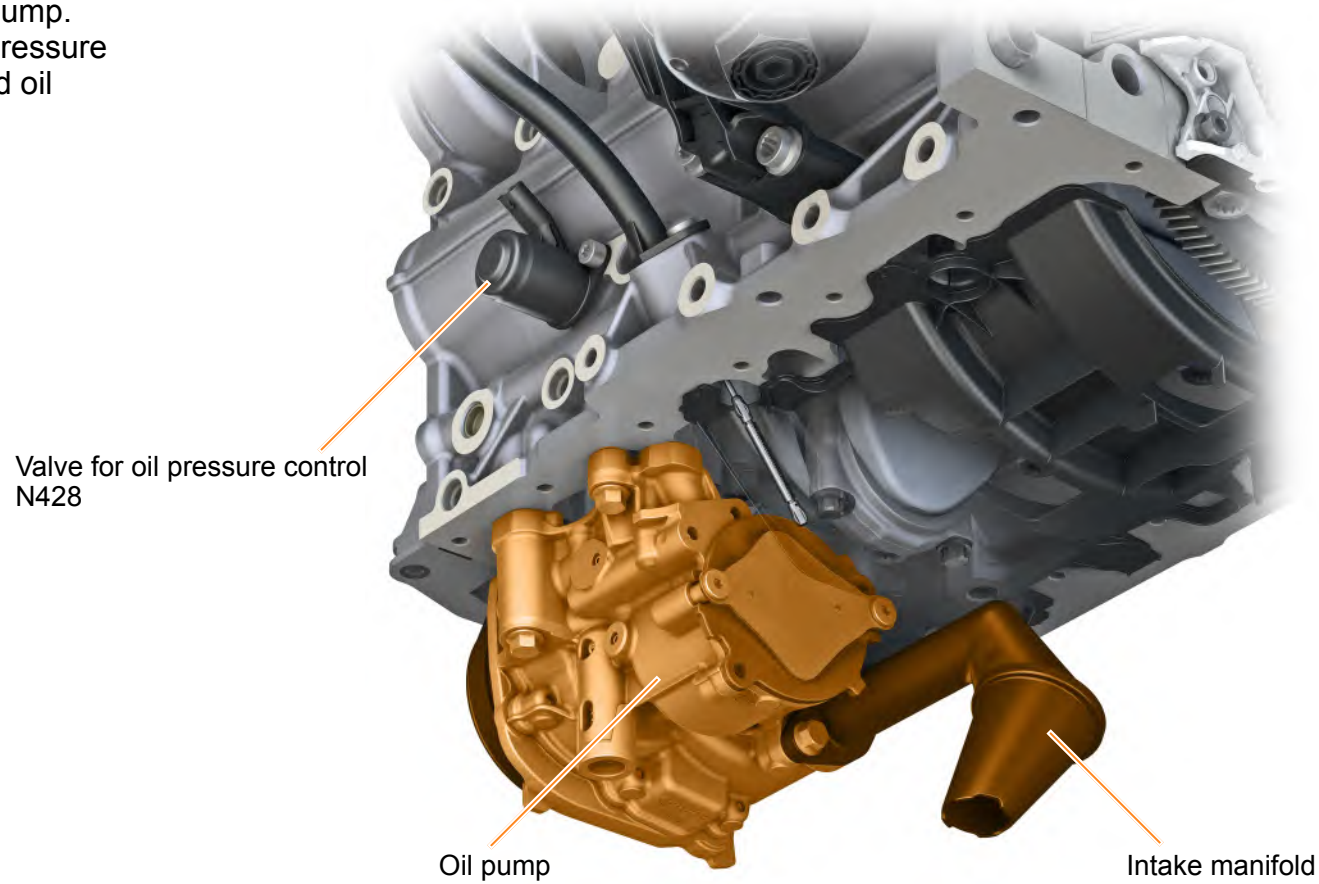
The sump

The oil pan is made of one piece of aluminium.
The oil volume is 7.4 litres in all power classes.
Oil grade 0W-30 according to engine oil standard VW 507 00



Oil pump

The oil pump and vacuum pump have a common housing. They are driven by the crankshaft via a toothed belt.
The oil pump is a flow rate-controlled vane pump. The pump can be switched to two different pressure stages depending on engine load, speed and oil temperature.

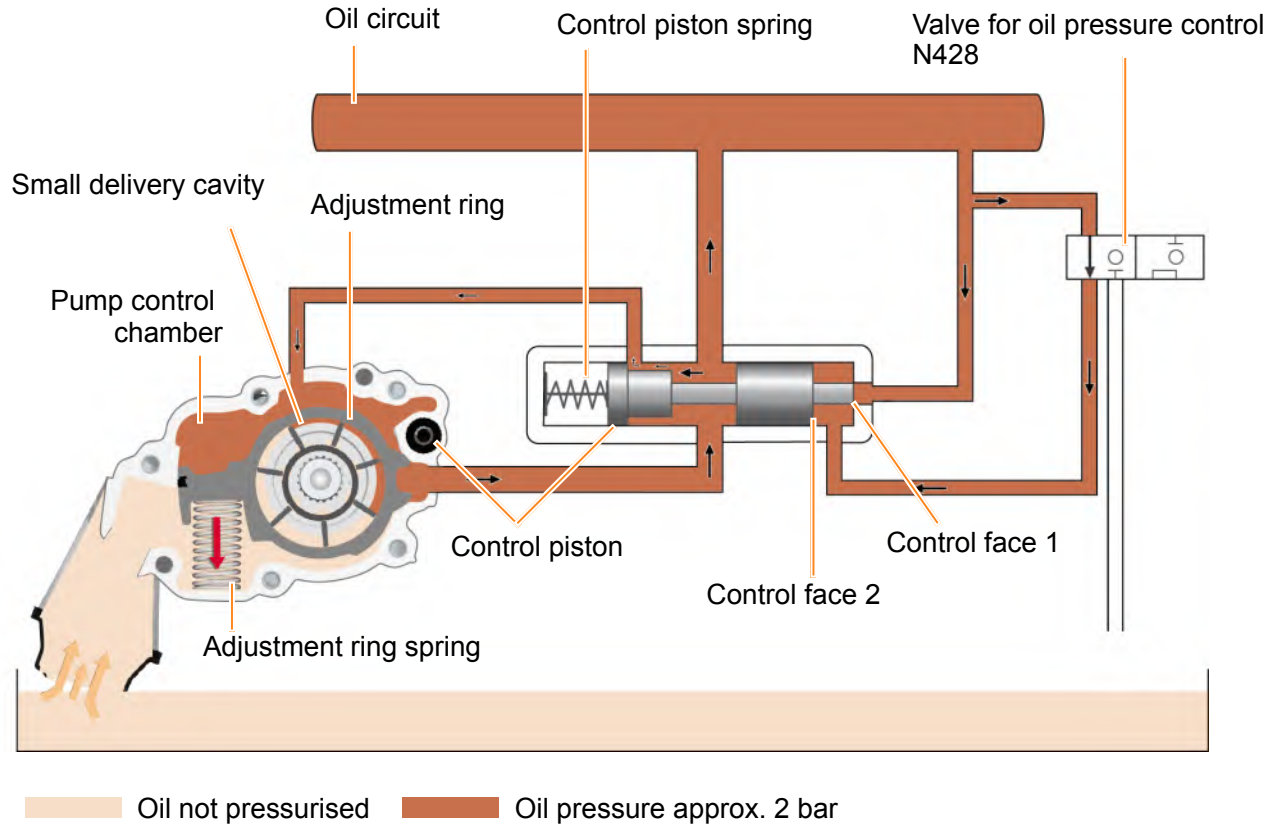


Oil pressure control

Low pressure stage

The engine control unit switches the valve for oil pressure control N428 by applying earth to the valve currently under voltage (terminal 15).

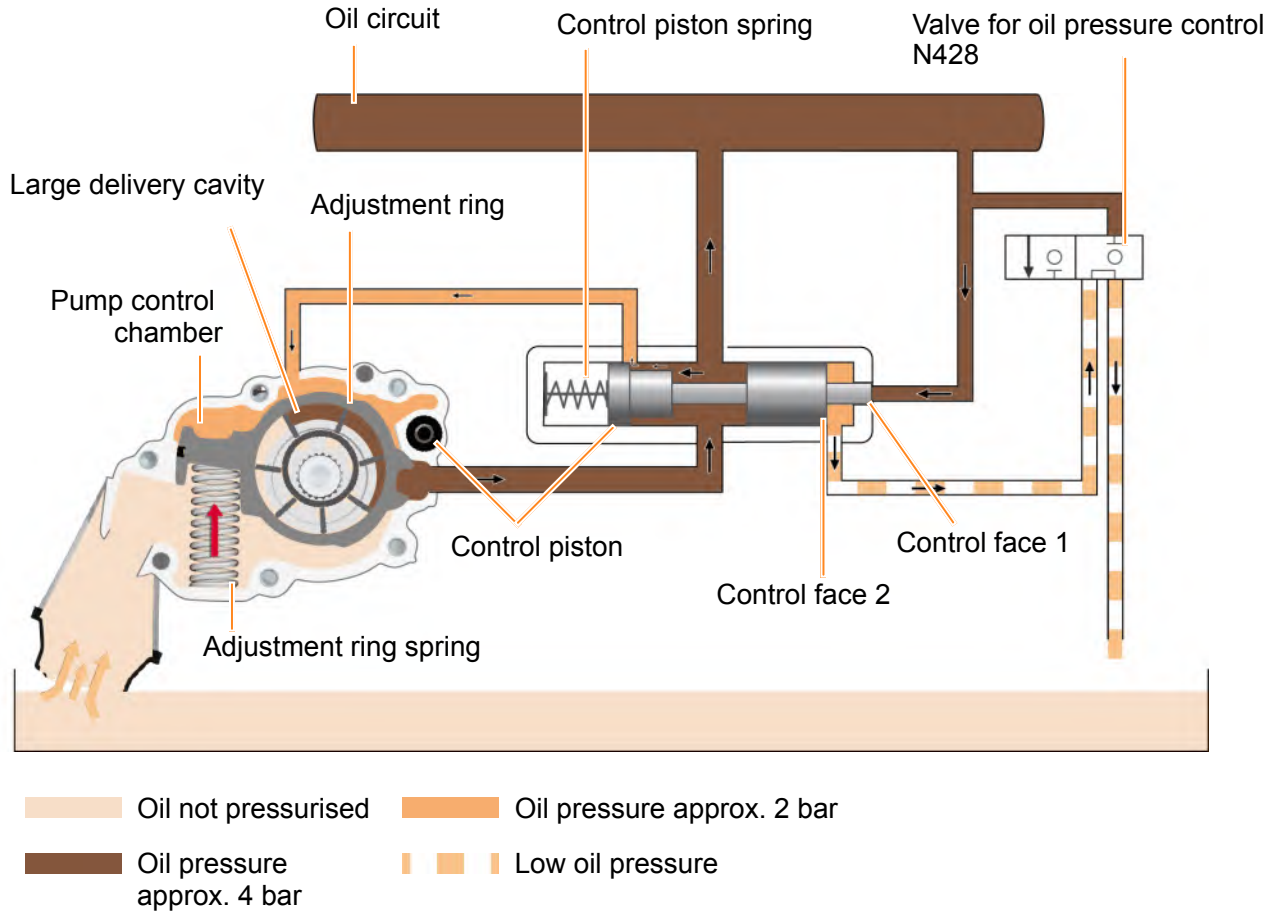
This allows the valve to open the control port from the oil circuit to control face 2 of the control piston. The oil pressure now acts on both faces of the control piston, thereby increasing the force with which the control piston moves against the control piston spring. The control edge of the piston leaves a larger cross section free, guiding a large quantity of oil to the pump control chamber. As soon as the oil pressure in the pump control chamber is greater than the force of the adjustment ring spring, the adjustment ring swivels anti-clockwise. This reduces the delivery space between the vanes, and less oil is pumped into the oil circuit.



Oil pressure control

High pressure stage

The valve for oil pressure control N428 is not actuated by the engine control unit. The oil pressure of the oil circuit only acts on control face 1 of the control piston. The force which the control piston exerts against the control piston spring is lower. This means the control edge of the piston only leaves a small cross section to the pump control chamber free, and only a small amount of oil enters the pump control chamber. The oil pressure acting on the control face of the adjustment ring is lower than the force of the adjustment ring spring.
The adjustment ring swivels clockwise and thereby increases the delivery space between the vane cells. The larger delivery space means that more oil is pumped in the oil circuit.
Leaking oil from control chamber 2 of the control piston is guided to the sump via the control port and the valve for oil pressure control.



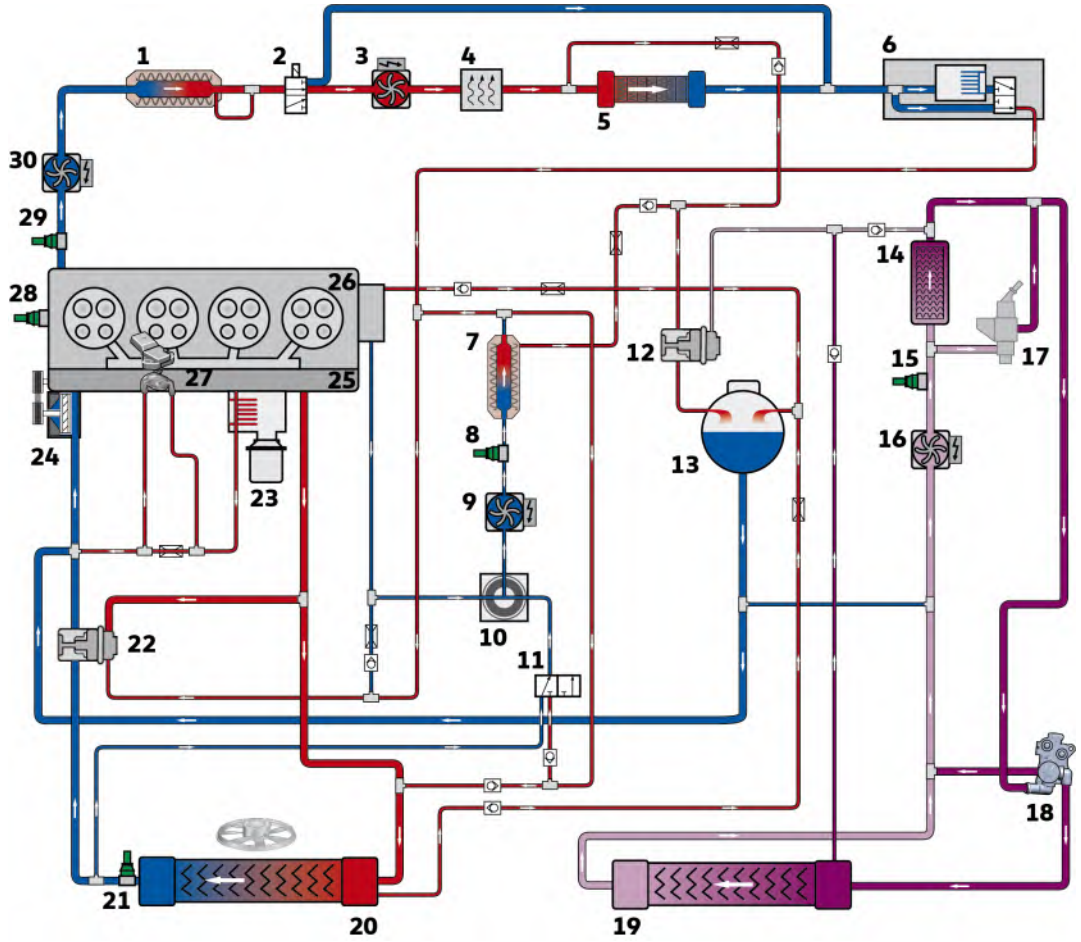
Overview of the thermal management system

1 Cooler for low pressure exhaust gas recirculation
2 Changeover valve for heating coolant
3 Circulating pump V55 for coolant circulation
4 Front supplementary heater
5 Heat exchanger for heater
6 Gear oil cooler with valve for gear oil cooling N509
7 Cooler for high-pressure exhaust gas recirculation
8 Coolant temperature sender 3 G812
9 Pump for exhaust gas recirculation cooler V400
10 Solenoid valve for coolant circuit N492
11 Changeover valve for high-pressure exhaust gas recirculation cooler
12 Thermostat for charge air cooling circuit
13 Coolant expansion tank
14 Charge air cooler
15 Sender for coolant temperature of the charge air cooler G1130
16 Charge air cooling pump V188
17 Injector for reducing agent N474
18 Mixing valve for coolant control GX40
19 Water radiator for charge air cooling circuit
20 Radiator for engine coolant
21 Radiator outlet coolant temperature sender G83
22 Thermostat for engine temperature control
23 Engine oil cooler
24 Coolant pump
25 Cylinder block
26 Cylinder head
27 Charge pressure sender G31
28 Coolant temperature sender G62
29 Coolant temperature sender 2 G802
30 Heating booster pump V488

Key

Overview of the thermal management system

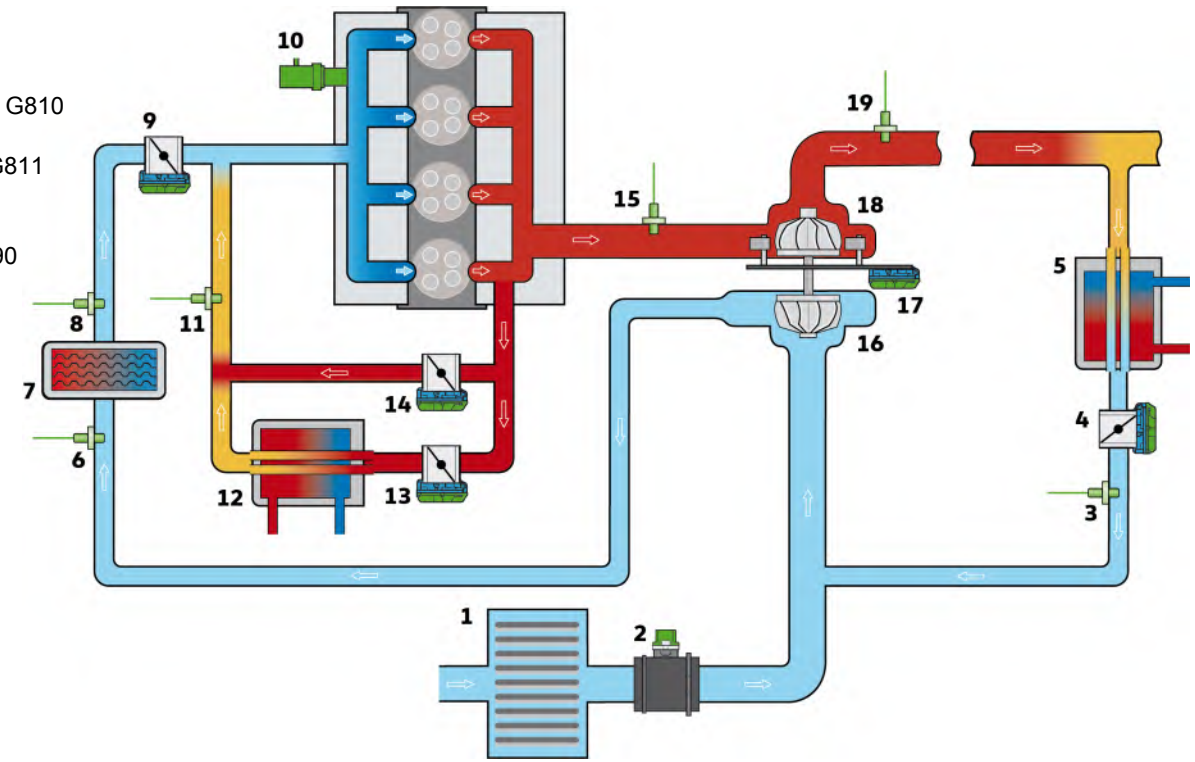
The cooling system consists of a high temperature and a low temperature circuit.
The high temperature circuit is separated into a large and small cooling circuit via the thermostat for engine temperature control.
In the low-temperature circuit, the flow in the water radiator for charge air cooling circuit can be controlled.
When the operating temperature is reached, the venting of the low-temperature circuit is thermostatically switched off so that the circuit cannot draw hot coolant from the expansion tank.
G12evo coolant is used.
The system can only be filled with electric filling device VAS 6096/2.
After filling, a venting routine must be performed via ODIS.



Air duct system with mono turbocharger

Key

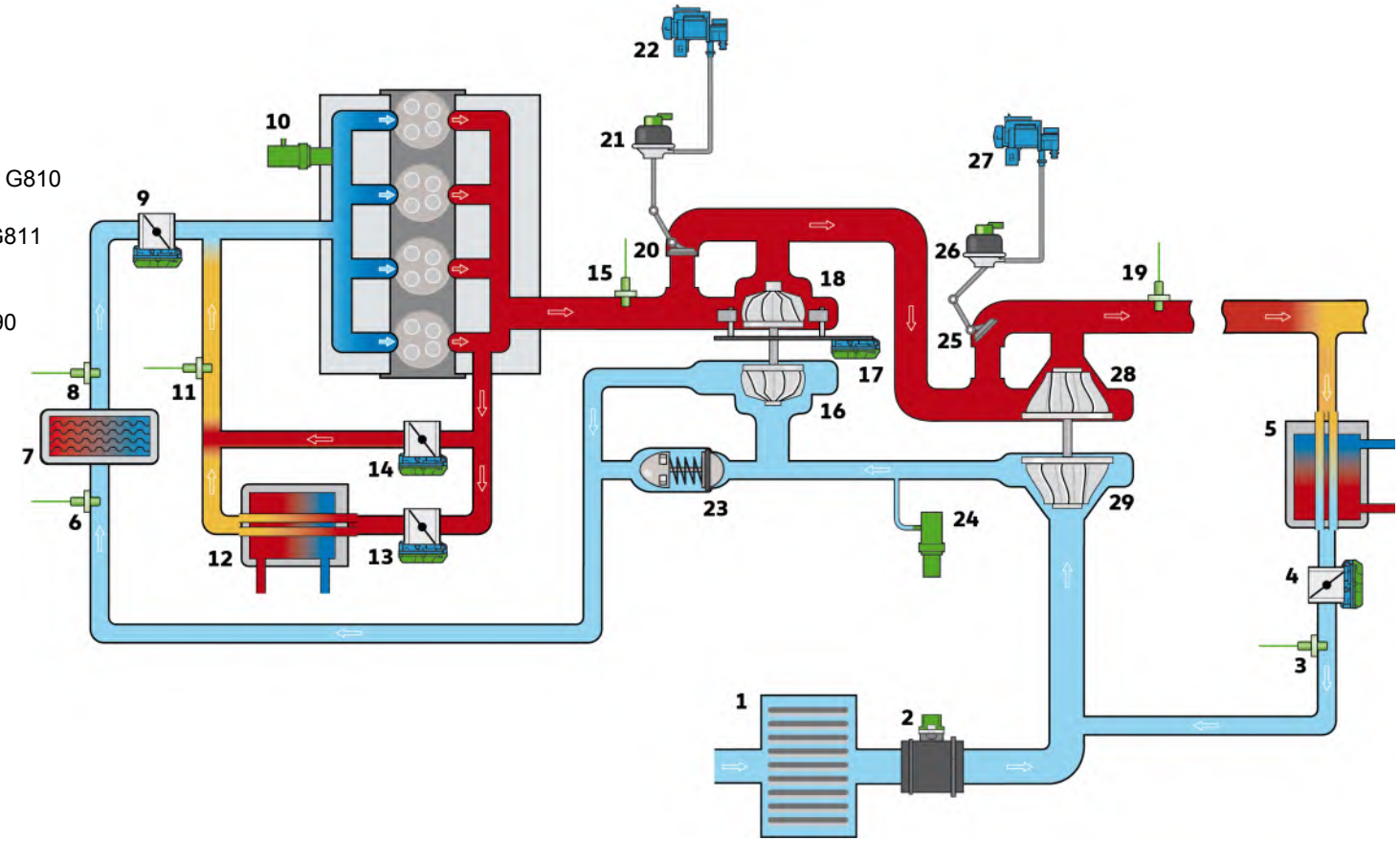
1 Air filter
2 Module for air mass measurement GX35
3 Temperature sensor for exhaust gas recirculation G98
4 Exhaust gas recirculation valve 2 GX6
5 Low pressure exhaust gas recirculation cooler
6 Charge air temperature sensor before charge air cooler G810
7 Charge air cooler
8 Charge air temperature sensor after charge air cooler G811
9 Throttle valve control unit GX3
10 Charge pressure sensor G31
11 Temperature sensor 2 for exhaust gas recirculation G690
12 High-pressure exhaust gas recirculation cooler
13 Exhaust gas recirculation valve 3 GX48
14 Exhaust gas recirculation valve 1 GX5
15 Exhaust gas temperature sensor 1 G235
16 Exhaust gas turbocharger compressor wheel
17 Module for charge pressure control GX34
18 Turbine wheel of exhaust gas turbocharger
19 Exhaust gas temperature sensor 2 G448



Air duct system with bi-turbocharger

Key

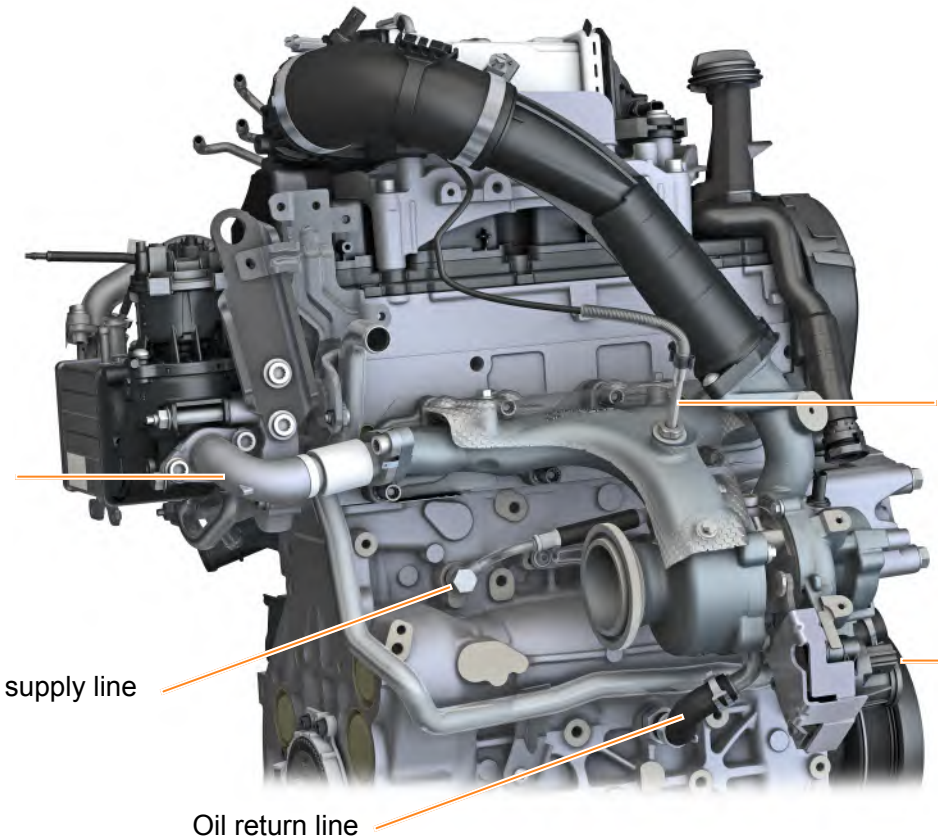
1 Air filter
2 Module for air mass measurement GX35
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4 Exhaust gas recirculation valve 2 GX6
5 Low-pressure exhaust gas recirculation cooler
6 Charge air temperature sensor before charge air cooler G810
7 Charge air cooler
8 Charge air temperature sensor after charge air cooler G811
9 Throttle valve control unit GX3
10 Charge pressure sensor G31
11 Temperature sensor 2 for exhaust gas recirculation G690
12 High-pressure exhaust gas recirculation cooler
13 Exhaust gas recirculation valve 3 GX48
14 Exhaust gas recirculation valve 1 GX5
15 Exhaust gas temperature sensor 1 G235
16 Compressor wheel of high-pressure turbocharger
17 Charge pressure control module GX34
18 Turbine of the high-pressure turbocharger
19 Exhaust gas temperature sensor 2 G448
20 Turbine bypass flap
21 Vacuum unit for exhaust flap with position sender 2 for charge pressure positioner G580
22 Valve for turbine changeover N529
23 Compressor bypass valve
24 Charge pressure sensor 2 G447
25 Wastegate flap
26 Vacuum unit for wastegate flap
27 Charge pressure control solenoid valve 2 N274
28 Turbine of the low-pressure turbocharger
29 Compressor wheel of the low-pressure turbocharger



The mono turbocharger

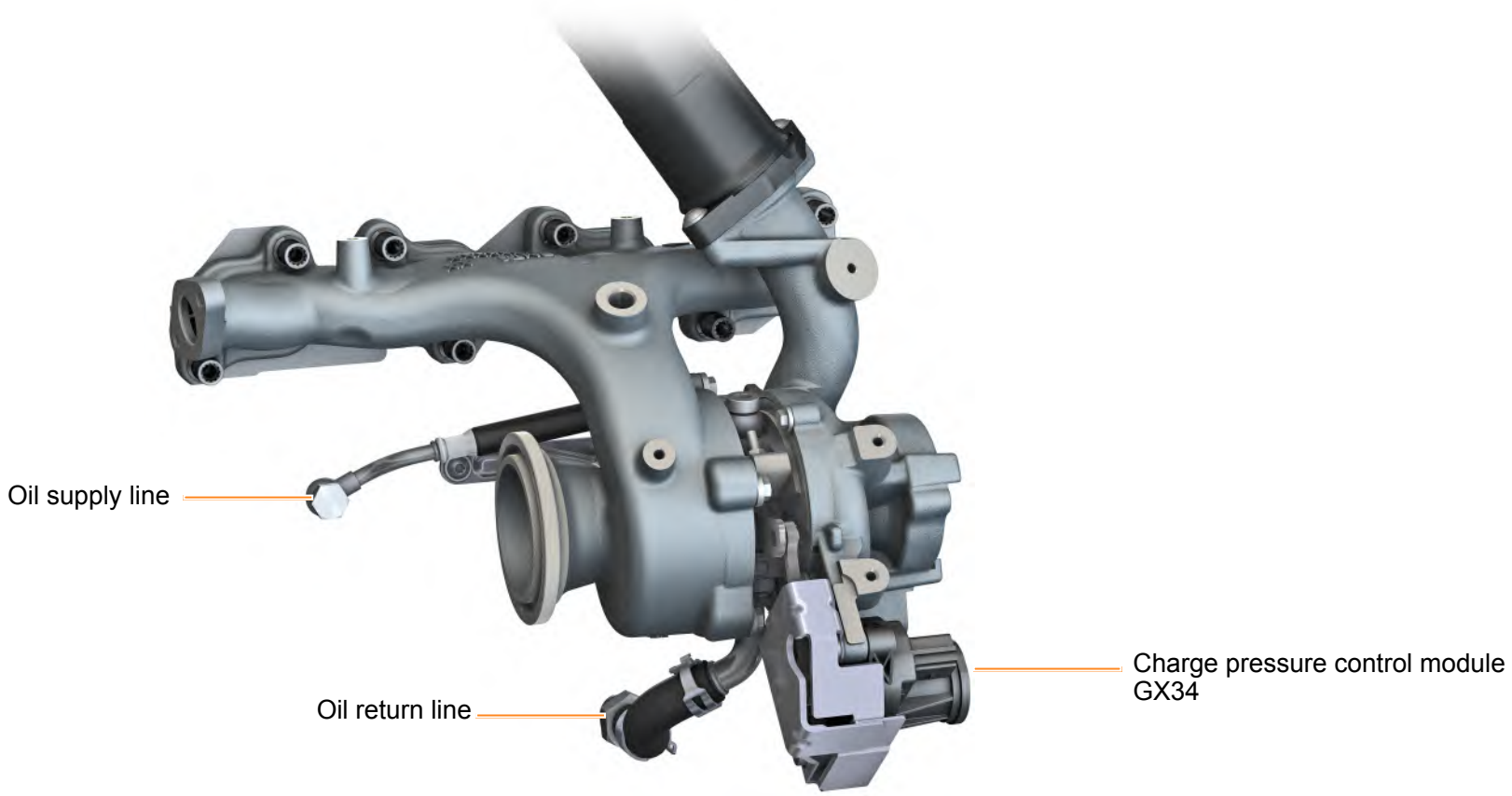
Monoturbo

The mono turbo is used in the 66 kW, 81 kW and 110 kW variants.
The charge pressure is controlled by adjusting the guide vanes (VTG adjustment).
The adjustment is made via the module for charge pressure control GX34.
The maximum charge pressure is 2.2 bar.



The mono turbocharger

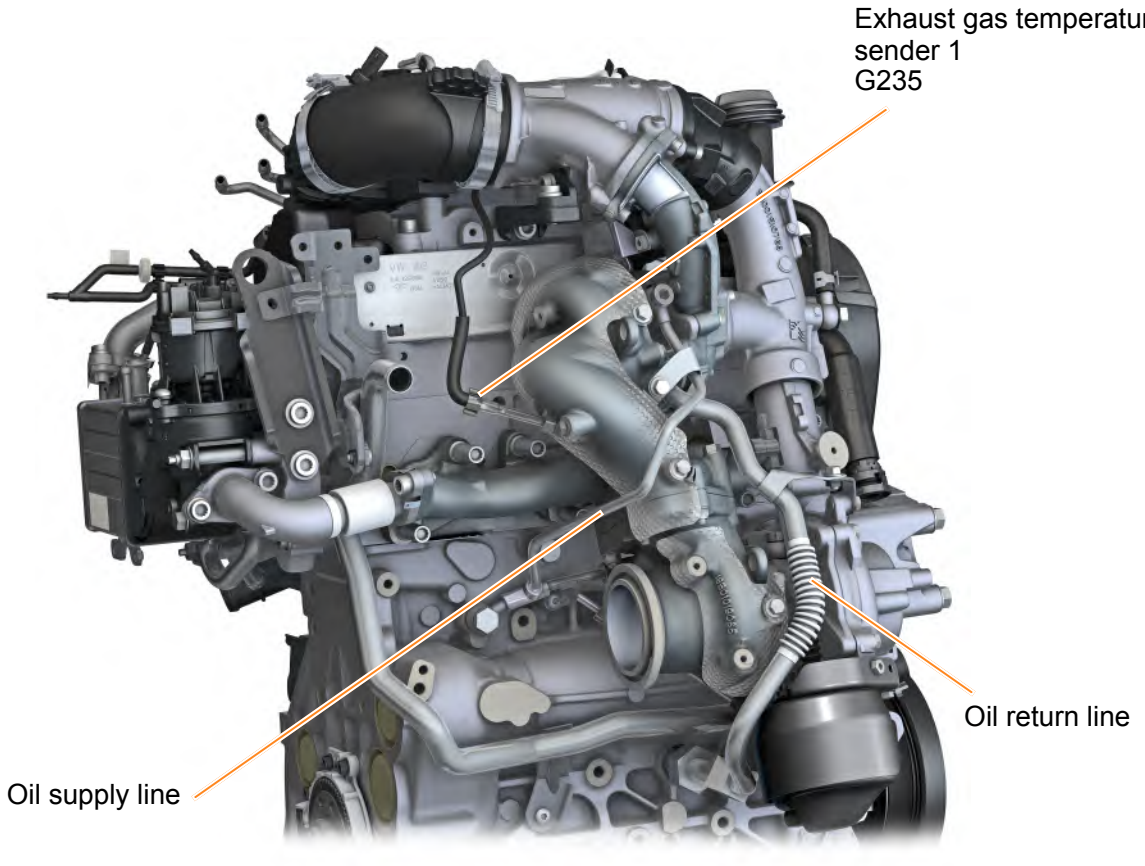
Detail



The bi-turbocharger

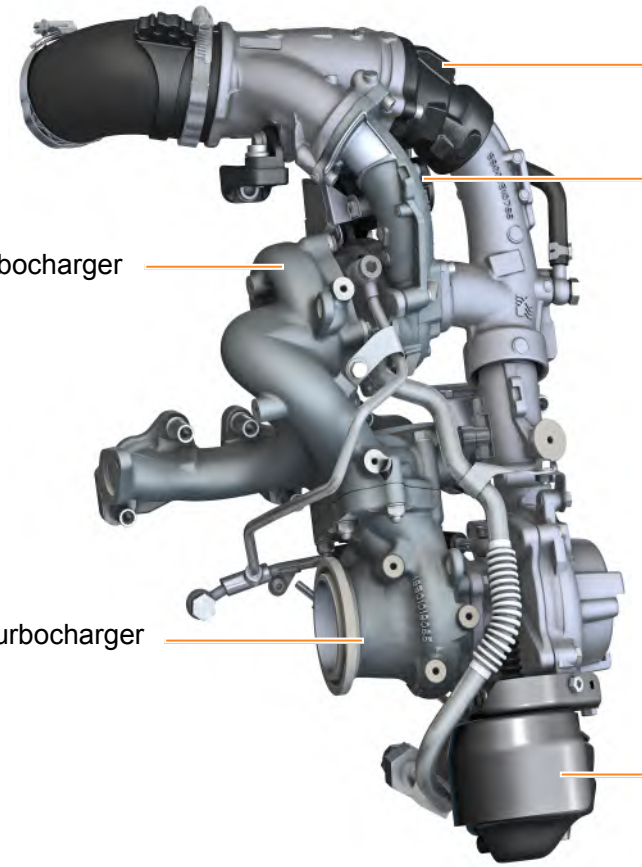
Biturbo

Due to the special power and torque requirements of light commercial vehicles, a two-stage turbocharger connected in series on the turbine and compressor side, including bypass, is used in the new EA288 Nutz for the variants with 130 kW or more, as in the predecessor engine.
Compared to the turbocharging group of the predecessor powerplant, the variable turbine geometry (VTG) of the high-pressure turbocharger is no longer controlled pneumatically, but via an electric control element, which enables faster and more precise control. The low-pressure stage is controlled by vacuum for both the wastegate and the turbine bypass flap.
The maximum charge pressure is 2.6 bar.



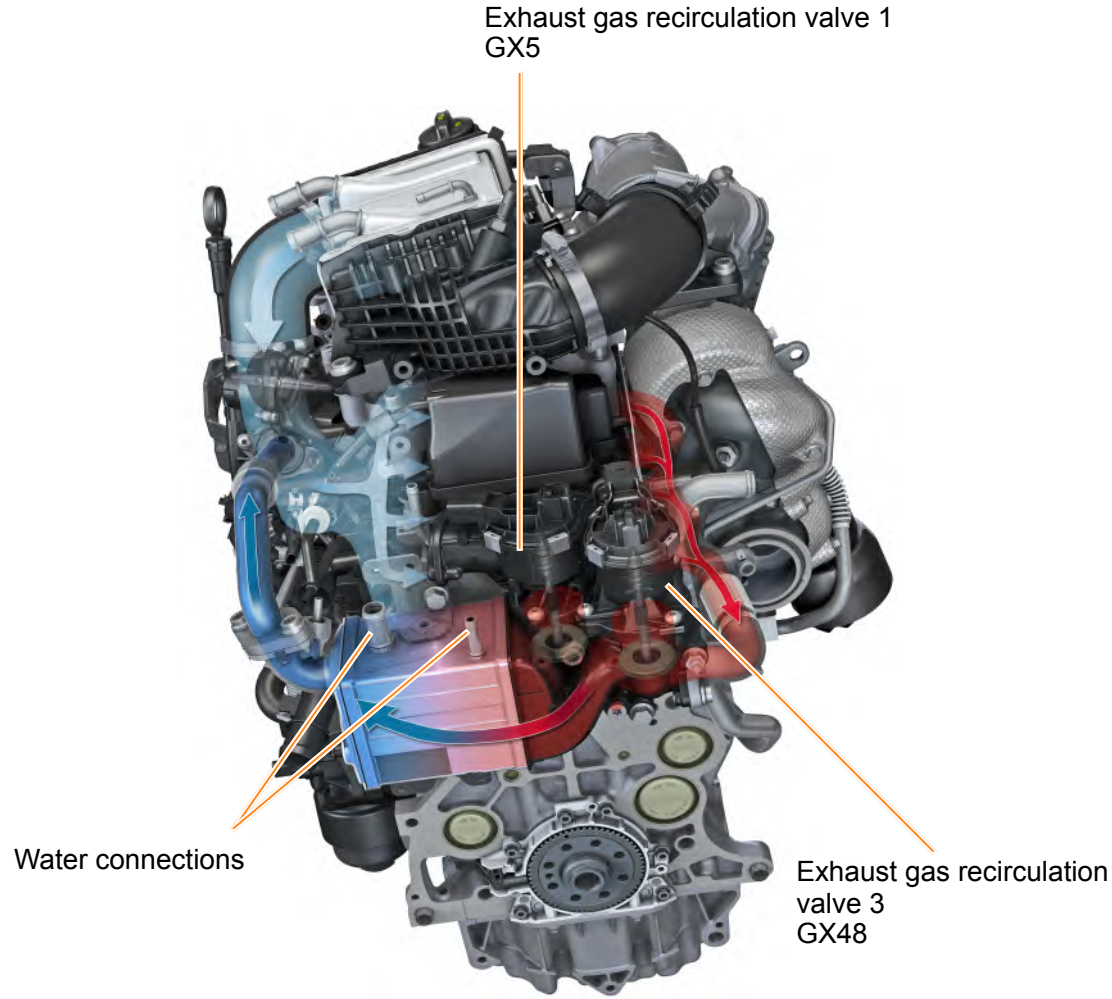
The bi-turbocharger

Detail



High-pressure exhaust gas recirculation

In order to reduce raw nitrogen oxide emissions, the new EA288 Nutz engine generation is equipped with a high-pressure exhaust gas recirculation system (HP-EGR), which can be used cooled or uncooled, and also has a cooled low-pressure exhaust gas recirculation system (LP-EGR). The uncooled HP-EGR is used when the LP-EGR or the cooled HP-EGR are not available due to restrictive operating conditions. The determining parameters for this are, among others, cooling water temperature, sooting tendency and combustion quality.
The high-pressure exhaust gas recirculation module consists of a co-current cooler with S-flow and integrated bypass.
The cooled or uncooled operating mode control as well as the respective volume flow control are carried out via two electrical actuators arranged in parallel, which open and control the cooled or uncooled EGR path respectively.



Press and hold the left mouse button to obtain an enlarged view.

Low-pressure exhaust gas recirculation

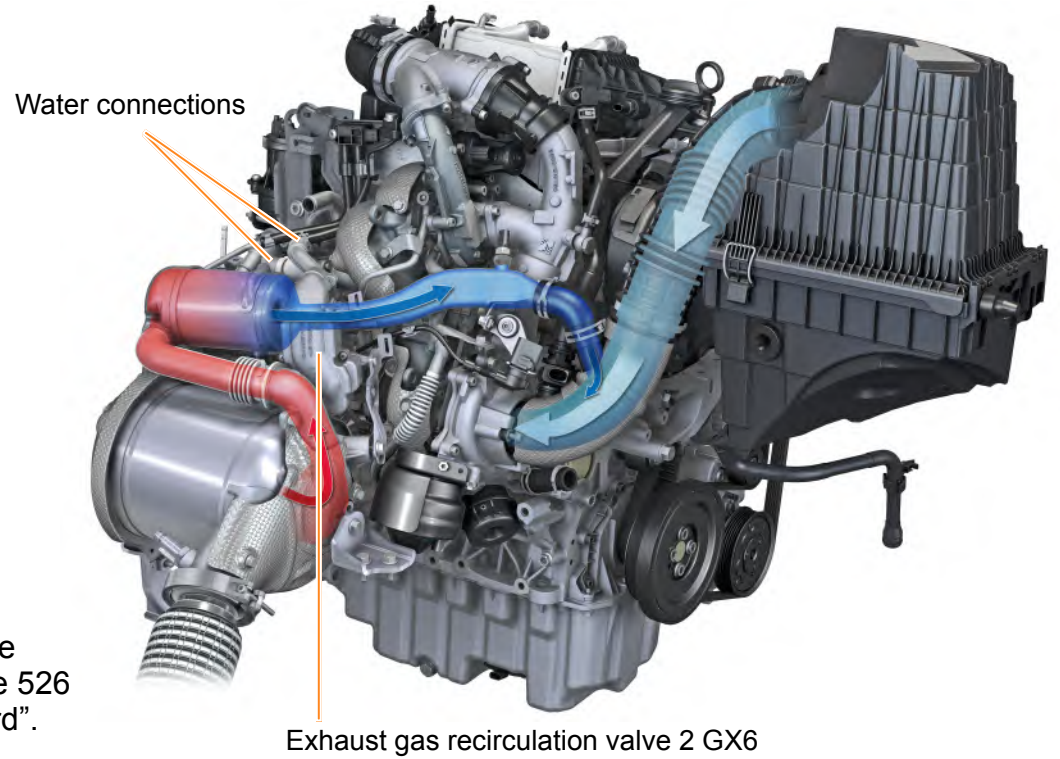
The close-coupled arrangement and the resulting short line lengths result in the following advantages:

- Faster warm-up and operational readiness
- Reduced condensate formation
- Reduced formation of deposition products.

The low-pressure EGR cooler is designed as a parallel-flow cooler. It is configured for high exhaust gas mass flows up to 80 kg/h at maximum exhaust temperatures of up to 500 °C and a cooling capacity of 8.5 kW. This allows it to be used in the entire engine characteristic map.

The low-pressure EGR module is decoupled from the exhaust system by means of a bellows and a holder structure with tolerance compensation in order to be able to compensate for the tolerances of the exhaust system and the different thermal expansions.

The cooled EGR flap valve of the low-pressure EGR system is connected in series to the radiator.





More information about the function of the high and low-pressure exhaust gas recirculation can be found in Self-study Programme 526 “The diesel engine family EA288 with the EU6 emission standard”.



Press and hold the left mouse button to obtain an enlarged view.

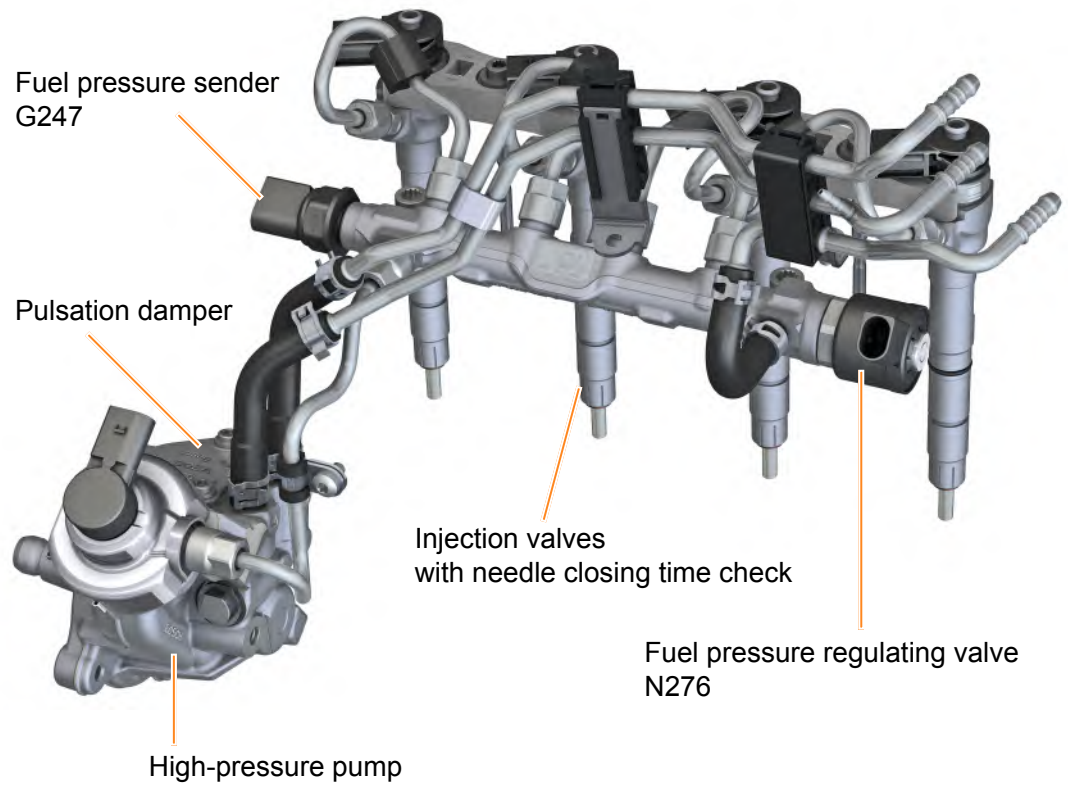
Common rail injection system

Due to the requirement for high injection pressures and multiple injections, a more advanced solenoid valve technology is used in the injector, which allows up to 9 injections depending on the operating point. This provides maximum degrees of freedom for optimizing the burn function.

The injectors allow the needle closing time to be controlled and have integrated piezo sensors for this purpose. With the help of the sensor signal, the engine control unit can determine the closing time of the nozzle needle.

The engine control unit can correct production-related tolerances and changes in behaviour due to wear over the runtime on the basis of the sensor signal, thus ensuring injection accuracy over the entire lifetime of the engine.

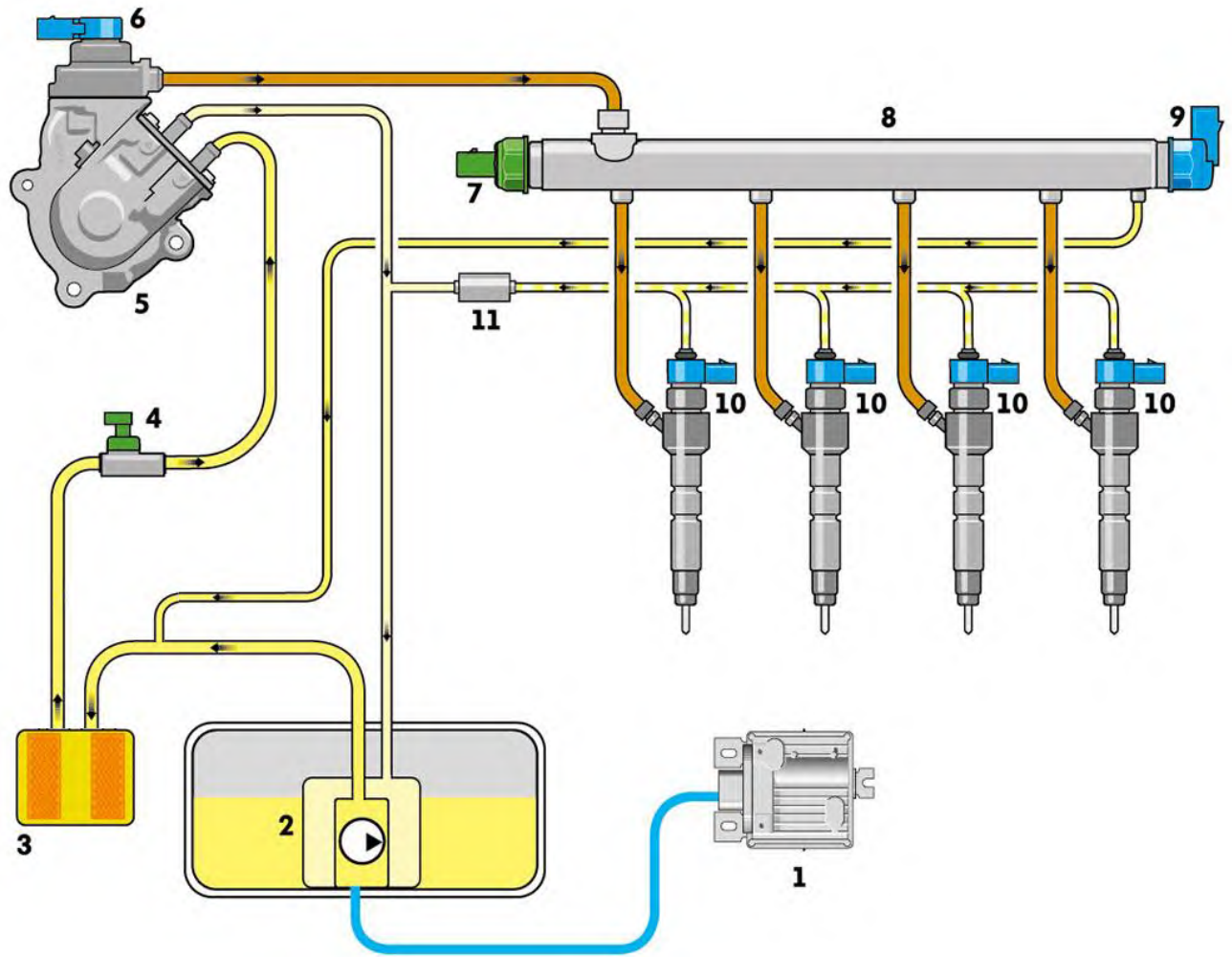
The electric suction valve in the high-pressure pump ensures optimum fuel metering to the system. The closing time determines the amount of fuel to be compressed for the engine load depending on the pump piston position. The gas-filled metal diaphragm damper in the low-pressure area of the fuel pump reduces pressure pulsations and relieves stress peaks.



Overview of the components of the common rail injection system

Key

1 Fuel pump control unit J538
2 Fuel system pressurisation pump G6
3 Fuel filter
4 Temperature and pressure sender for low-pressure fuel system GX20
5 High-pressure fuel pump
6 Fuel metering valve N290
7 Fuel pressure sender G247
8 Fuel rail (high-pressure accumulator)
9 Fuel pressure regulating valve N276
10 Injectors N30, N31, N32, N33
11 Non-return valve

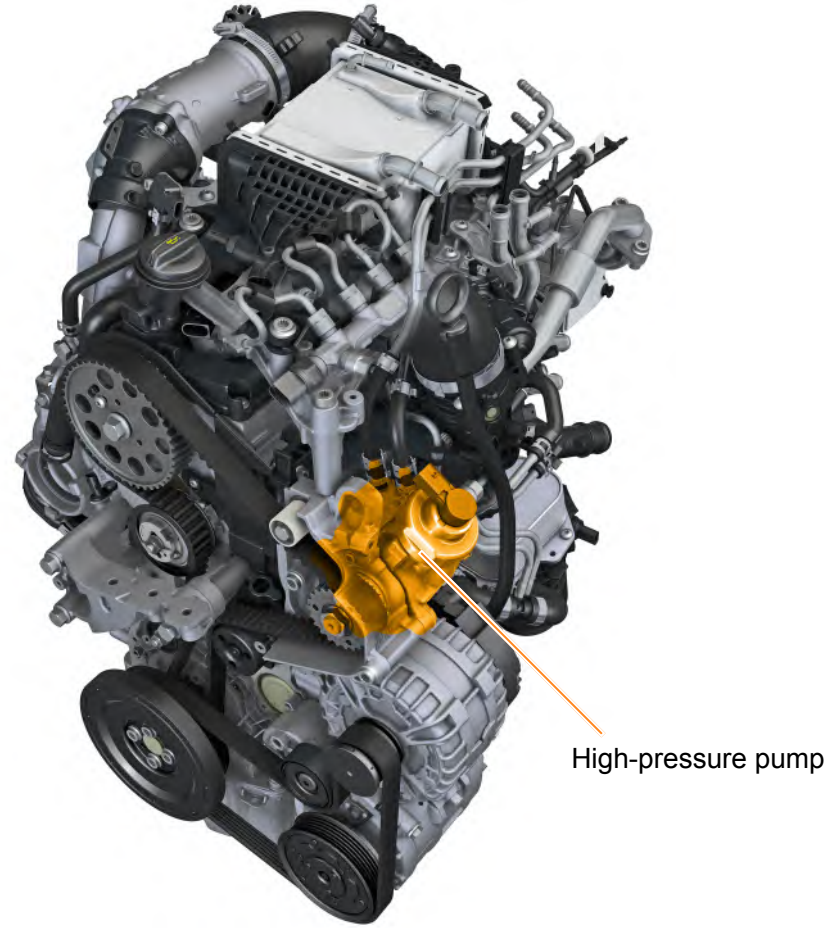


Fuel high pressure max. 2200/2500 bar
Fuel return line 0 – 1.0 bar (relative)
Fuel supply pressure 3.6 – 6.6 bar (relative)
Fuel return from the injectors 0.5 – 1 bar (relative)

The high-pressure pump

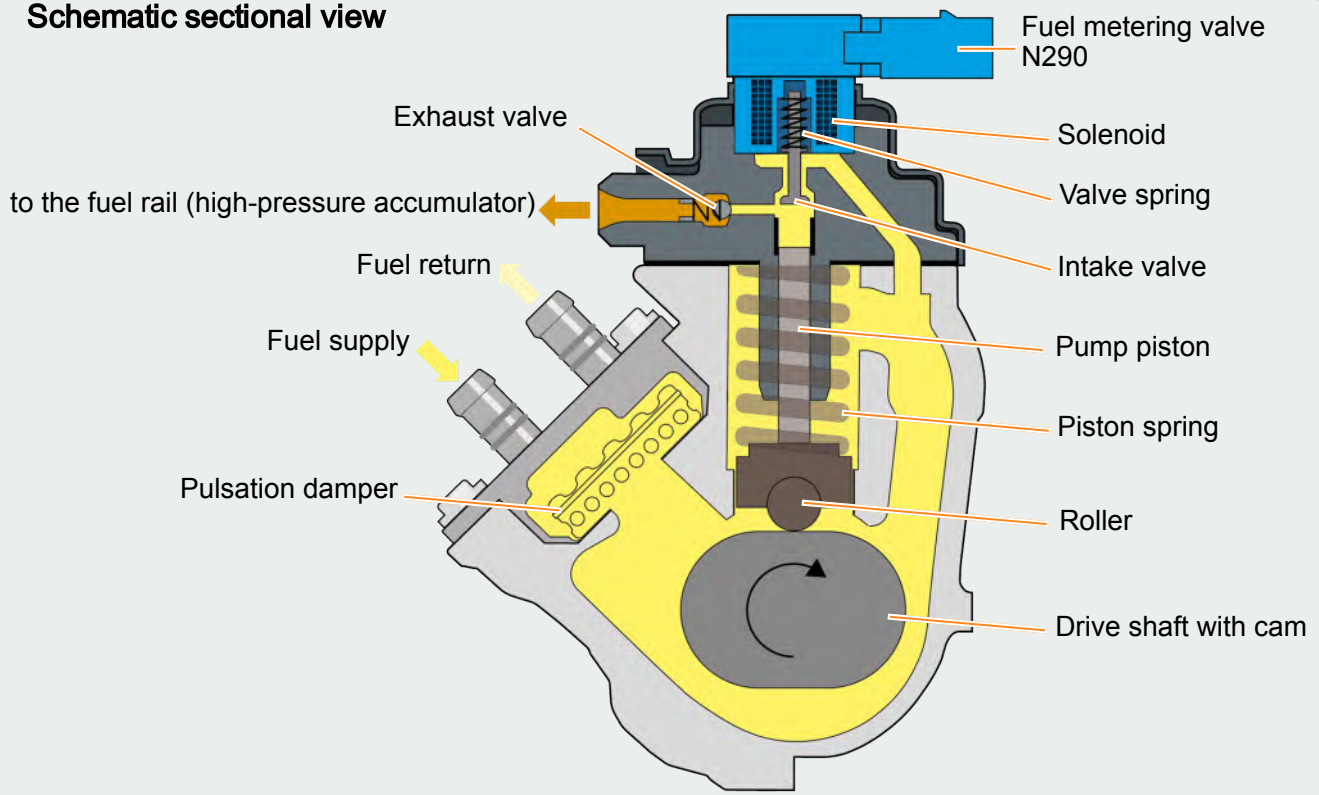
Characteristics

The high-pressure pump made by Bosch is a single piston pump. The crankshaft uses the toothed belt to drive it at engine speed.
Using two cams offset by 180° on the drive shaft, the pressure is generated in sync with injection in the operating cycle of the respective cylinder. In this way, the pump drive is subject to an equal load and pressure fluctuations in the high-pressure system are kept at a minimum.



Design

Schematic sectional view

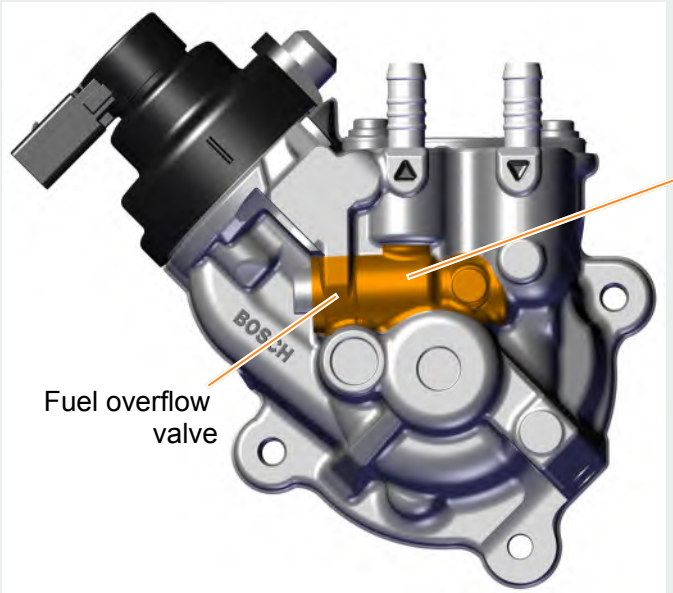


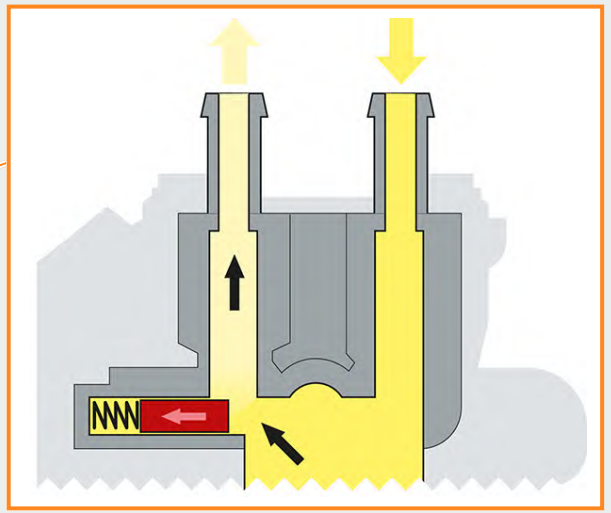
Schematic sectional view

Design

The fuel overflow valve in the high-pressure pump

A spring-loaded piston valve limits the fuel pressure in the low-pressure range of the high-pressure pump to approx. 4.3 bar. If the pressure increases and exceeds this value, the fuel overflow valve opens and excess fuel enters the fuel return line.





Fuel overflow valve

Design



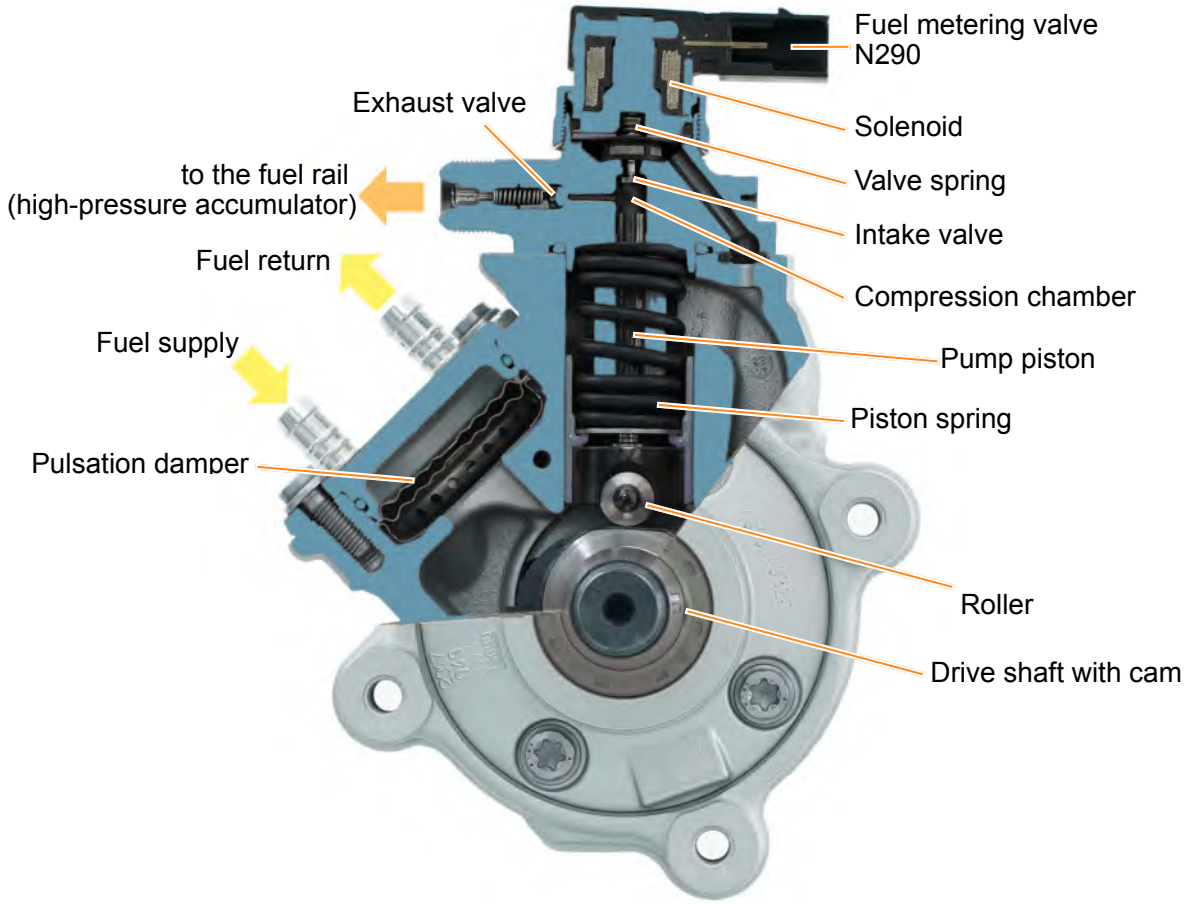
When the engine valve timing is adjusted, the position of the drive shaft of the high-pressure pump must be adjusted. Please note the information in the Workshop Manual.
Without electric activation of the fuel metering valve N290, no high fuel pressure can be built up.
Engine operation is not possible.

Additional notes

The high-pressure pump

Design

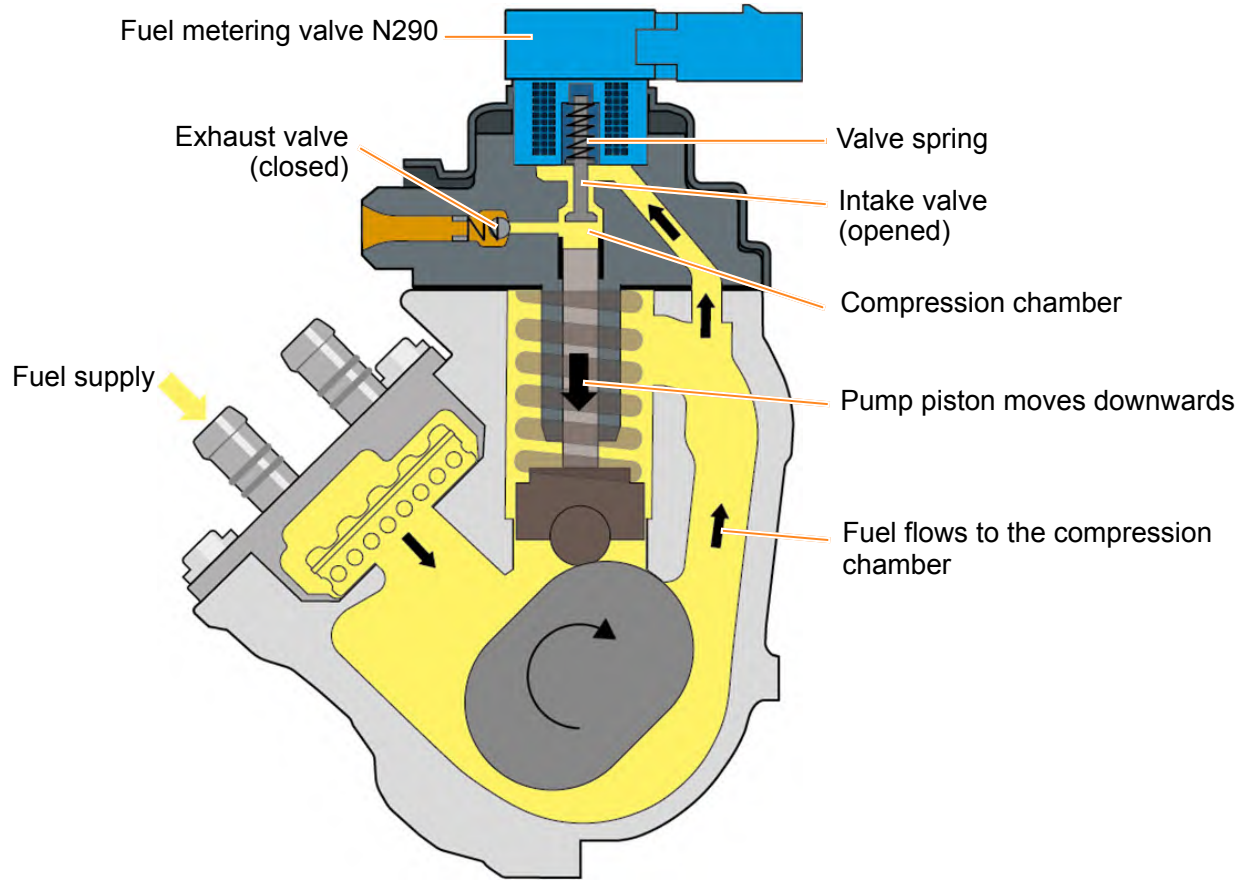
The fuel metering valve N290 has been designed as an electric intake valve.
The use of the electrical intake valve dethrottles the fuel supply to the compression chamber and reduces pressure fluctuations in the high-pressure pump. This allows precise metering of the fuel quantity for building up high pressure.
An integrated metal diaphragm damper is used as a pulsation damper and reduces any pressure spikes in the low-pressure range of the high-pressure pump.



The high-pressure pump

How it works
Phase 1

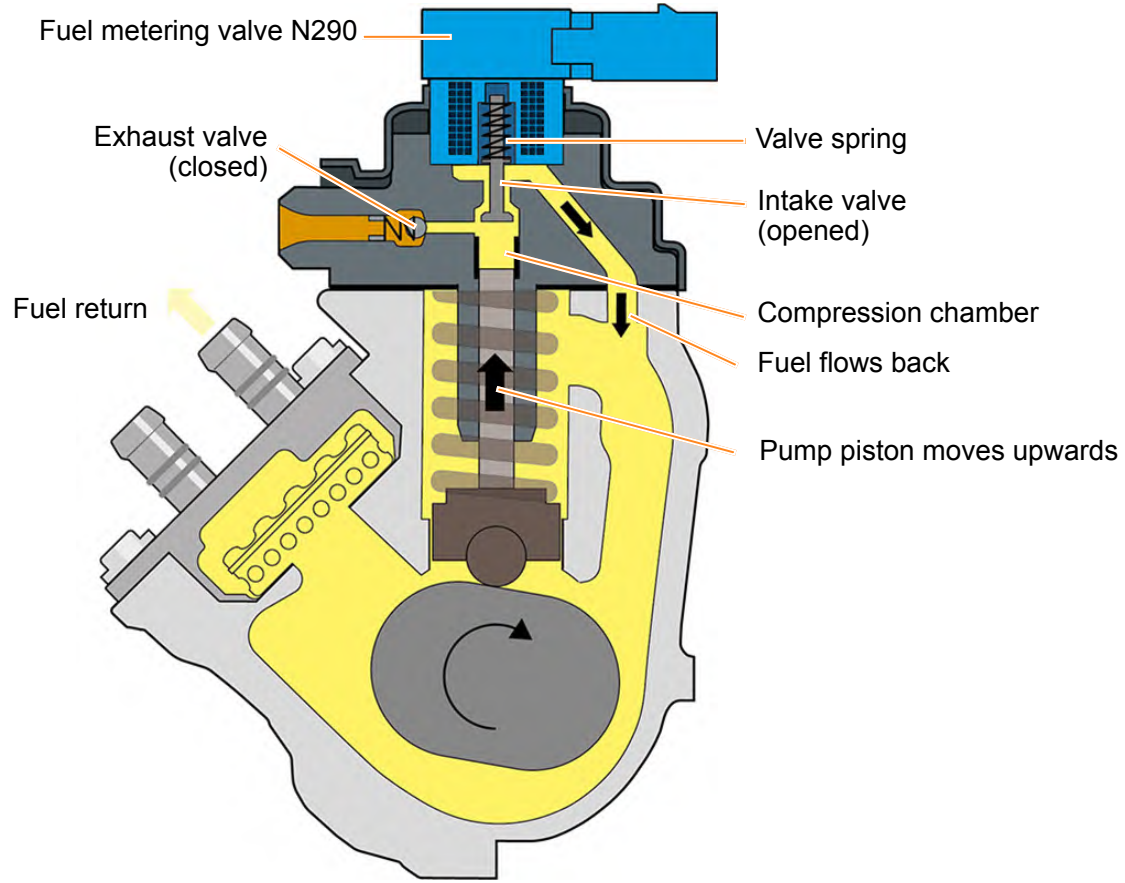
The downward motion by the pump piston increases the volume of the compression chamber.The intake valve is opened by the force of the valve spring, and fuel flows into the compression chamber.



The high-pressure pump

How it works
Phase 2

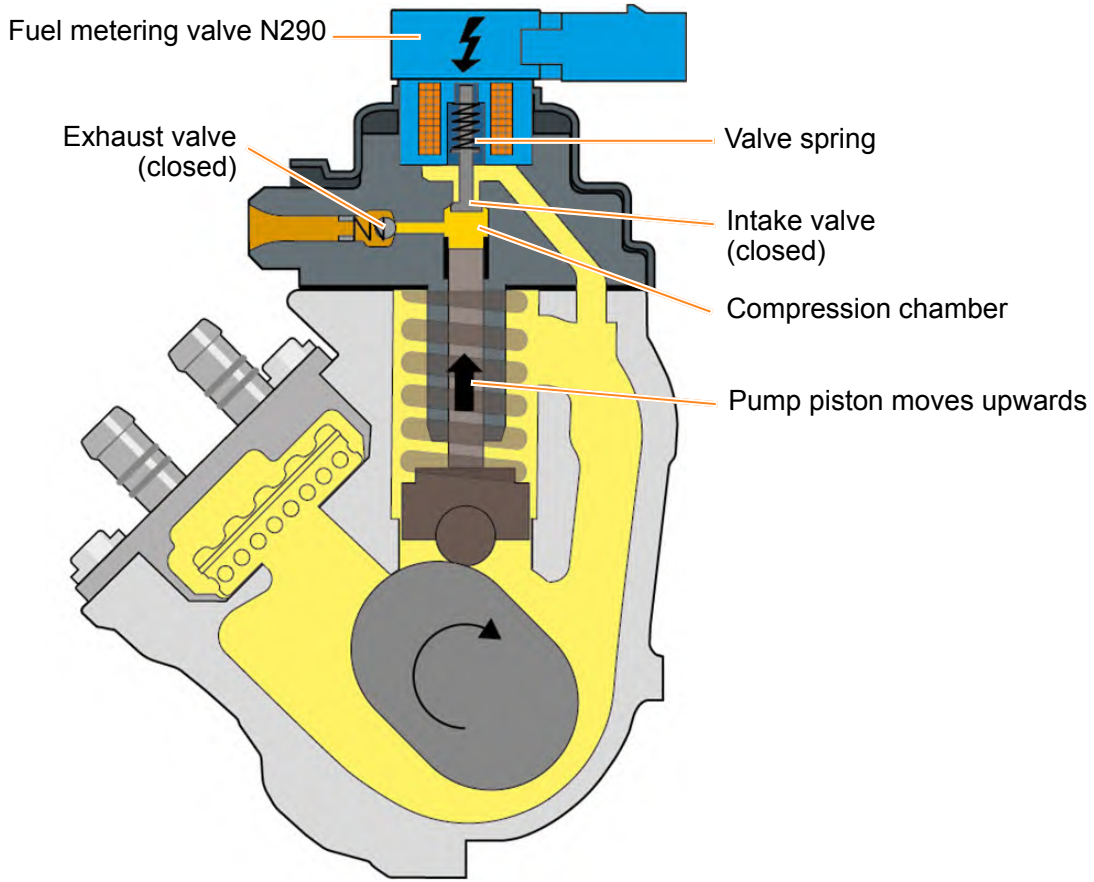
After reaching bottom dead centre, the piston is moved upwards by the cam.
The intake valve remains open due to the force of the valve spring.
Excess fuel is pushed out of the compression chamber and back into the pump chamber by the movement of the piston, and is conducted through the fuel overflow valve into the fuel return line.



The high-pressure pump

How it works
Phase 3

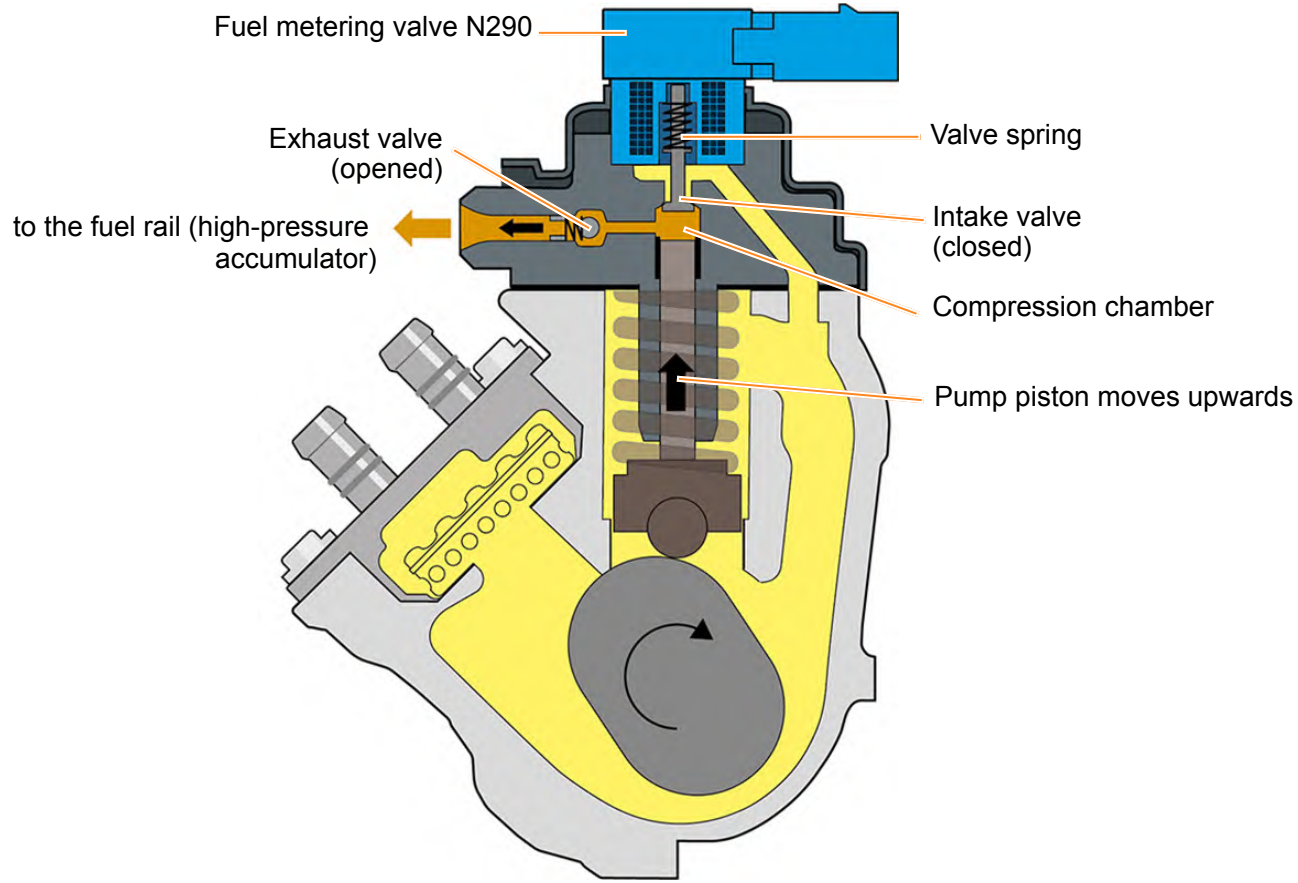
The fuel quantity required for injection is determined by the closing time of the intake valve and the position of the pump piston. To do this, the engine/motor control unit activates the solenoid of the fuel metering valve.
As soon as the intake valve closes, high fuel pressure begins to build up.



The high-pressure pump

How it works
Phase 4

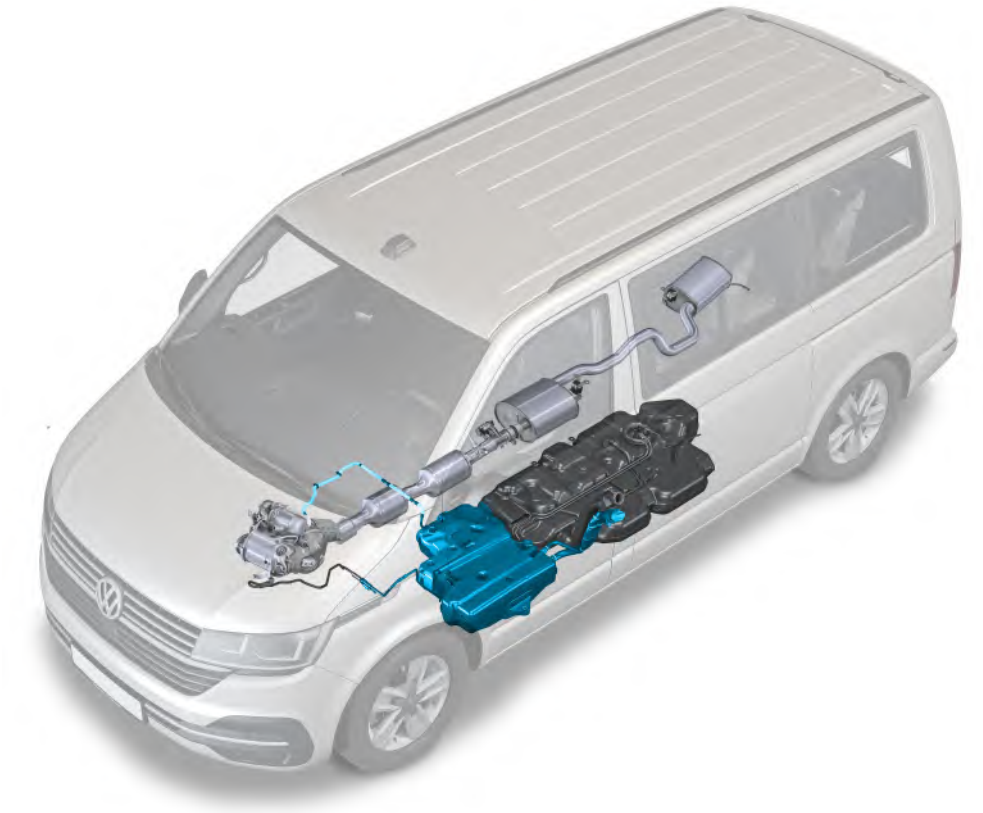
After the intake valve has closed, the fuel metering valve is not activated by the engine/motor control unit again.
The high fuel pressure in the compression chamber keeps the intake valve closed against the force of the valve spring.
When the pump piston is moving upwards in the compression chamber, high fuel pressure is built up and pumped through the exhaust valve into the fuel rail. After upper dead centre of the piston has been reached, the intake valve is opened by the force of the valve spring.



The SCR system

General overview

For the first time, the new commercial vehicle diesel engine uses close-coupled emission control (MAR), consisting of a diesel oxidation catalyst (DOC) and a combined SCR diesel particulate filter (S-DPF), similar to the EA288evo engines in the passenger car segment. This arrangement allows both rapid heating and slower cooling of the close-coupled emission control. The particulate filter is also regenerated more efficiently and quickly due to the close-coupled arrangement. The close-coupled arrangement of the S-DPF is also advantageous during regeneration, as the shorter distance between DOC and S-DPF reduces temperature losses. This means that regeneration takes place more quickly and thus provides additional safety against any deterioration in the oil quality of the engine. In addition, close-coupled emission control is a prerequisite for use of an optimised controllable LP-EGR section with short line lengths.
In addition, a non-close-coupled SCR catalytic converter system is installed in the underbody. This is accompanied by the introduction of what is called twin dosing, which allows AdBlue to be injected precisely and as required at two points in the exhaust tract. AdBlue is injected both upstream of the S-DPF of the close-coupled emission control and upstream of the SCR catalytic converter in the underbody. The AdBlue can thus be optimally used for reducing nitrogen oxides.
If the entire system fails, the OBD threshold values are exceeded due to the commercial vehicle-specific load profiles and the associated high NOx raw emission values. Using a twin dosing system allows both SCR catalytic converters to be monitored independently for failure.



SCR twin dosing system

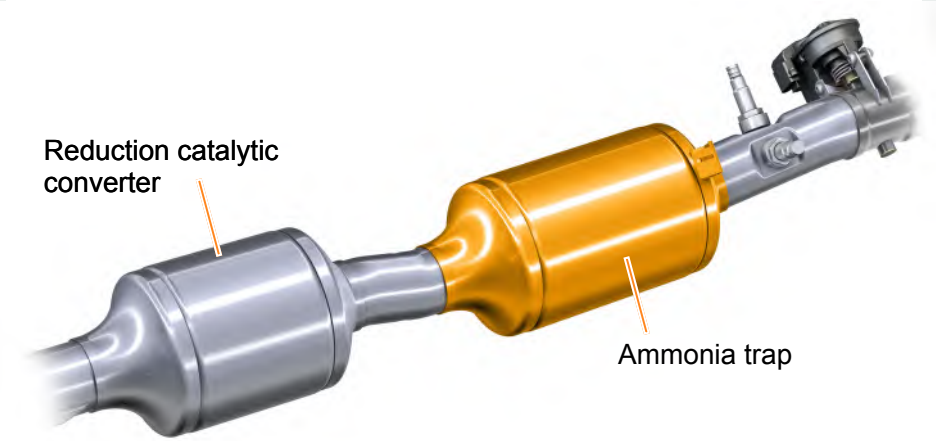
The NO_x senders G295, G687 and G932

The engine/motor control unit uses the signals from the NO_x senders to calculate the metering quantity and monitor the efficiency of selective catalytic reduction.

The NO_x senders

SCR twin dosing system

Ammonia trap



The ammonia trap converts excess ammonia formed during selective catalytic reduction into nitrogen and water. Moreover, it oxidises the carbon monoxide produced during diesel particulate filter regeneration to form carbon dioxide.

Ammonia trap

SCR twin dosing system

Reducing agent tank system



The pump for reducing agent in reducing agent tank pumps AdBlue® reducing agent to the two injectors for reducing agent.



The design and functional principle of the reducing agent tank system can be found in Self-study Programme 540, “The selective catalytic reduction exhaust gas treatment system in the Passat 2015”.

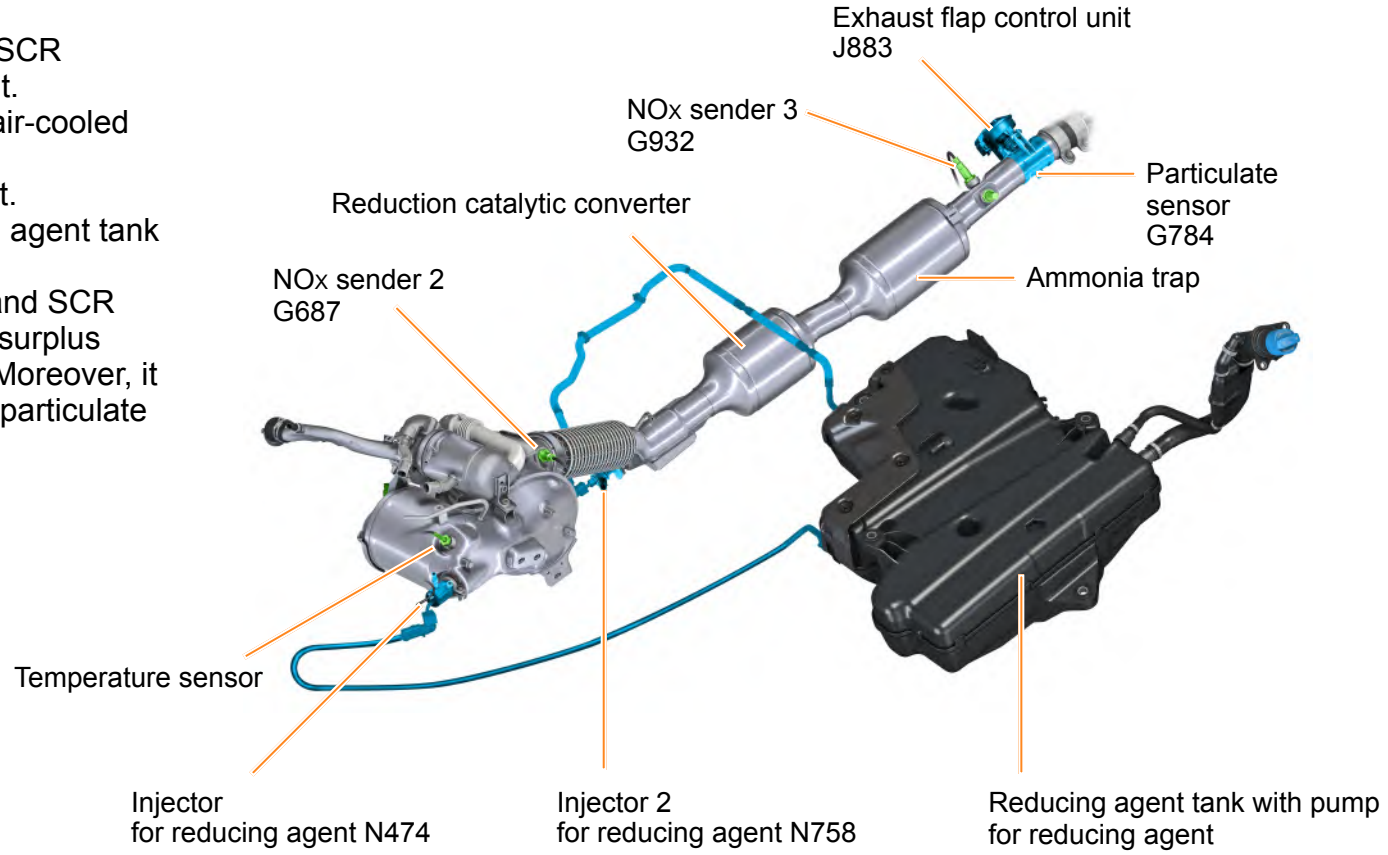
Reducing agent tank system

The SCR system

SCR twin dosing system

The main components of the SCR system with the “twin dosing” concept are:

- A close-coupled diesel particulate filter coated for the SCR function with a water-cooled injector for reducing agent.
- A non-close-coupled SCR catalytic converter with an air-cooled injector for reducing agent.
- A reducing agent tank with welded-on fuel delivery unit.
- A heated reducing agent supply line from the reducing agent tank to the injectors for reducing agent.
- An ammonia trap with combined coating of oxidation and SCR catalytic converter and the following tasks: it converts surplus ammonia in the SCR system into nitrogen and water. Moreover, it oxidises the carbon monoxide produced during diesel particulate filter regeneration to form carbon dioxide.

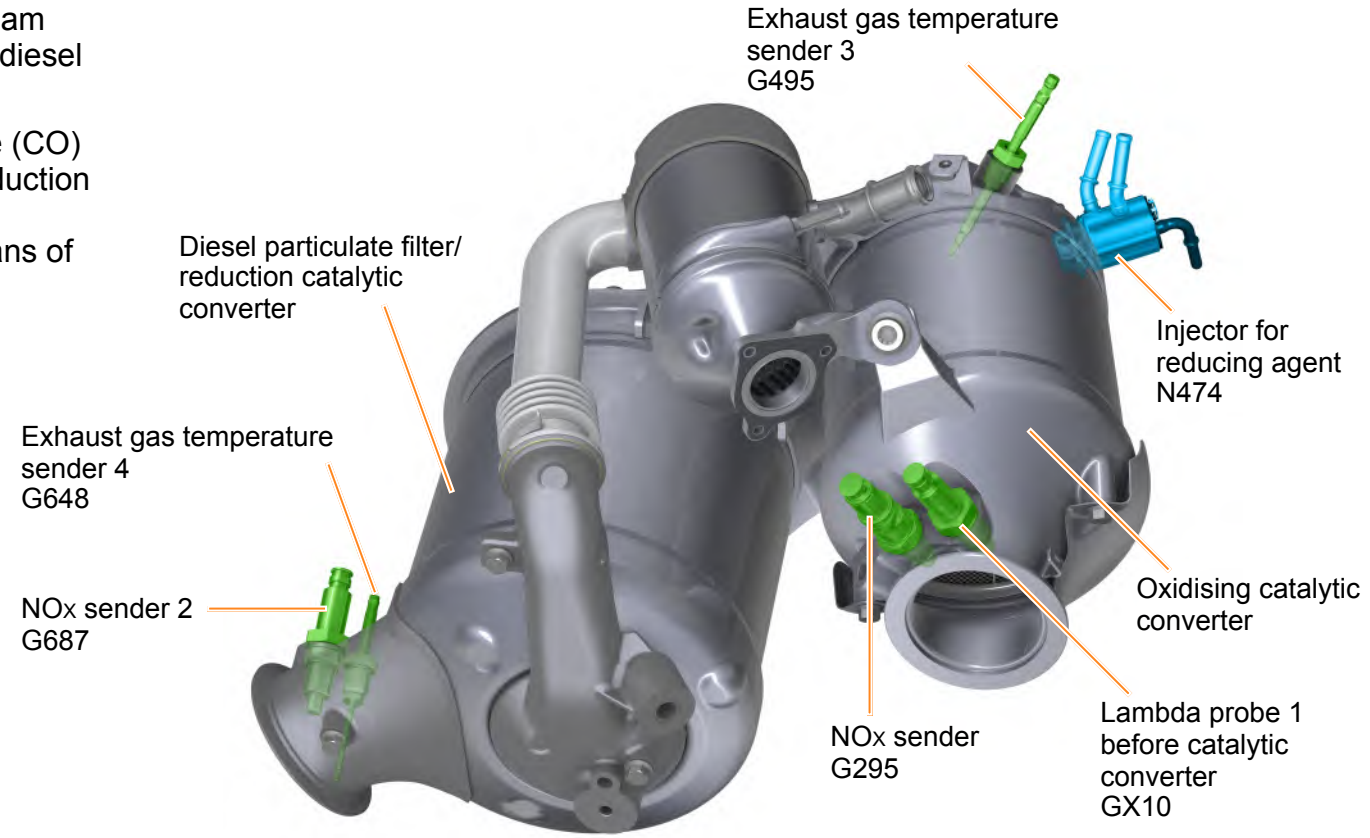


Selective catalytic reduction with twin dosing technology

Emission control module

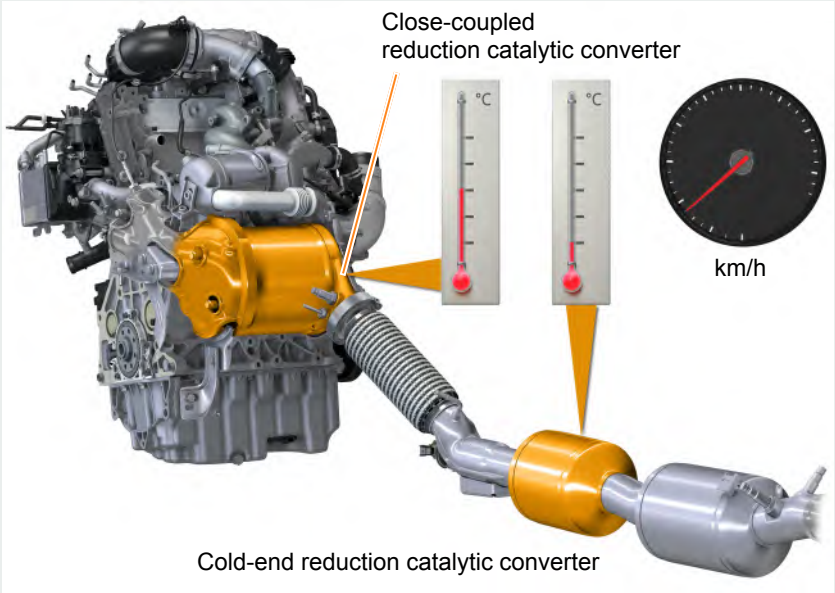
The close-coupled emission control module consists of two units: oxidising catalytic converter with downstream injector for reducing agent and the combined unit of diesel particulate filter with reduction catalytic converter.

In the oxidising catalytic converter, carbon monoxide (CO) is converted into carbon dioxide (CO_2) and in the reduction catalytic converter the nitrogen oxides (NO_X) are converted into nitrogen (N_2) and water (H_2O) by means of Adblue® reducing agent.



How it works

Temperature curve at low vehicle speed

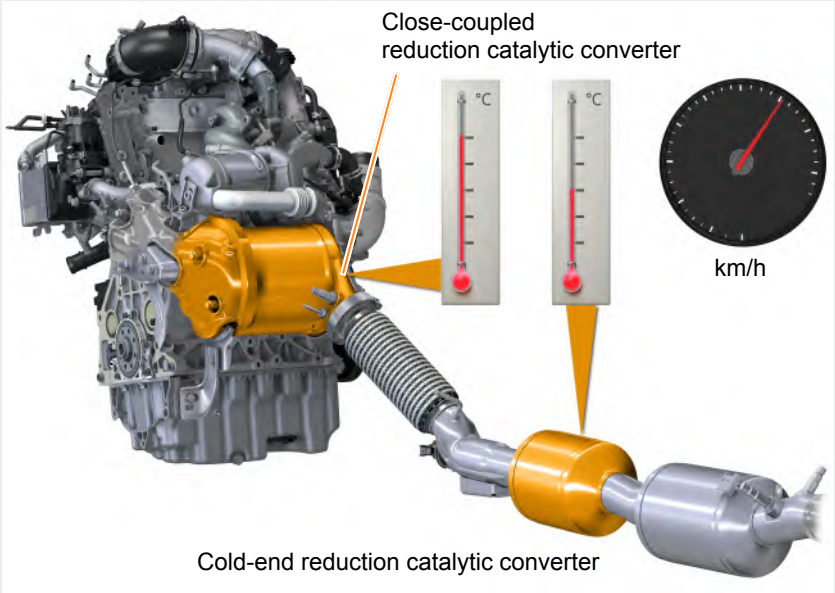


The close-coupled reduction catalytic converter reaches its operating temperature quickly after a cold start. Even when the engine load is low, for example during a slow drive through the city, the close-coupled reduction catalytic converter still allows an effective reduction in nitrogen oxide to be achieved.

Temperature curve at low vehicle speed

How it works

Temperature curve at high vehicle speed



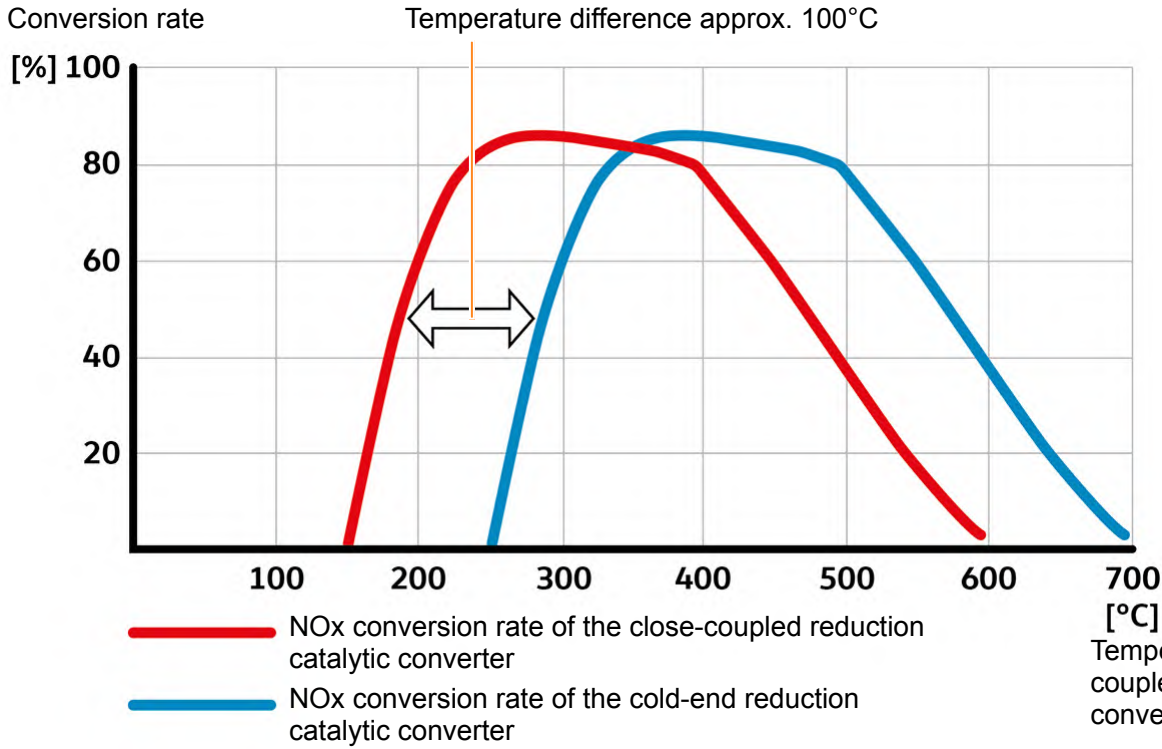
When the engine load is high, for example when driving on a motorway, the temperatures in the close-coupled reduction catalytic converter increase over the range most conducive to operation.
At high exhaust gas temperatures, the non-close-coupled reduction catalytic converter allows the SCR system to maintain a high NOx conversion rate.This is because the exhaust gas temperature in the non-close-coupled reduction catalytic converter is approximately 100 °C lower than it is in the close-coupled reduction catalytic converter.

Temperature curve at high vehicle speed

Selective catalytic reduction with twin dosing technology

How it works

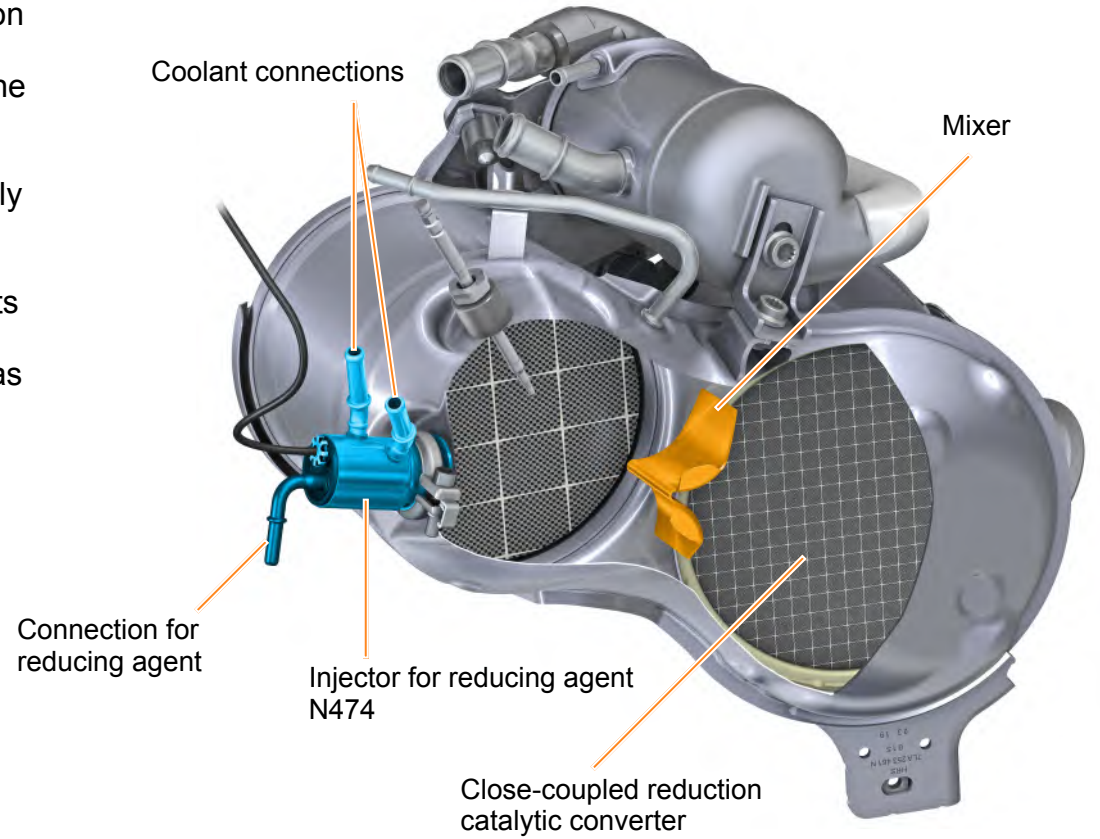
Selective catalytic reduction works most effectively when temperatures in the reduction catalytic converter total between 220 °C and 400 °C. The highest conversion rates are achieved to reduce the nitrogen oxides in the exhaust gas in this temperature range. Because there is a temperature difference of around 100 °C between the close-coupled and cold-end reduction catalytic converter, selective catalytic reduction can operate within the optimum temperature range with high conversion rates in almost all operating states.



Selective catalytic reduction with twin dosing technology

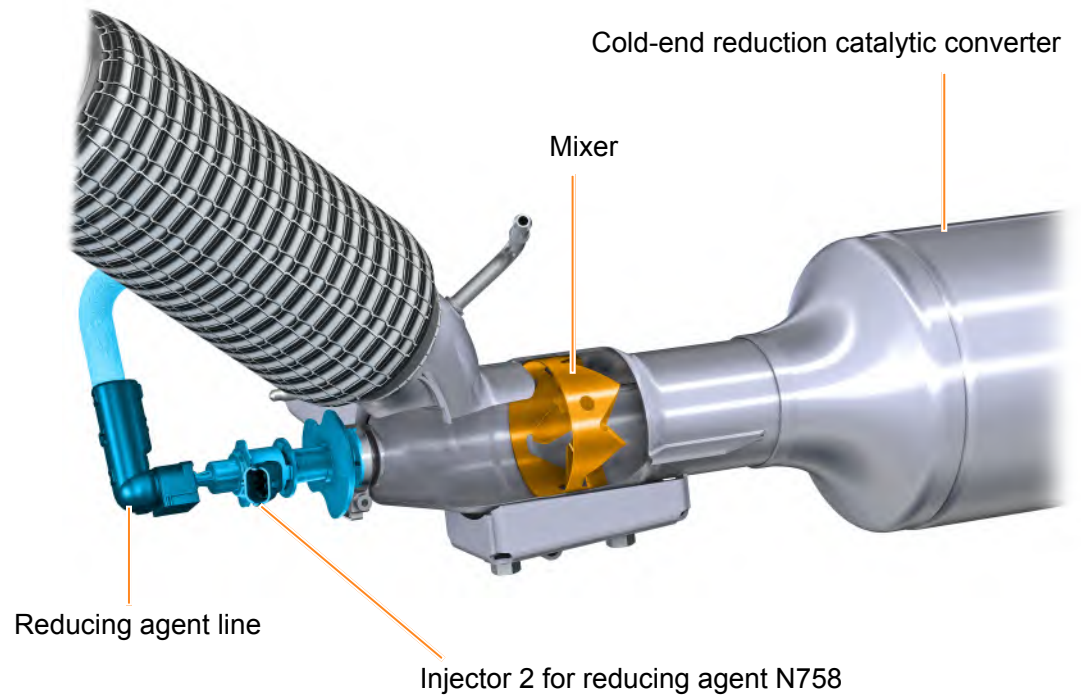
Injector for reducing agent N474

The injector for reducing agent N474 injects the reducing agent into the exhaust gas stream before the reduction catalytic converter in the emission control module by injecting it through three injector holes.
The spray droplets are reduced in size when they hit the baffle plates in the mixer. This leads to faster evaporation of the injected reducing agent, which then becomes gaseous.
This ensures that the reducing agent that is injected is distributed uniformly in the exhaust gas.
The injector has a cooling jacket due to the close-coupled installation position and the resulting high thermal loading. This cooling jacket protects the electrical connection for the injector in addition to the mechanical components against overheating. The injector for reducing agent N474 has been incorporated into the low-temperature circuit in the map-controlled engine cooling.



Injector 2 for reducing agent N758

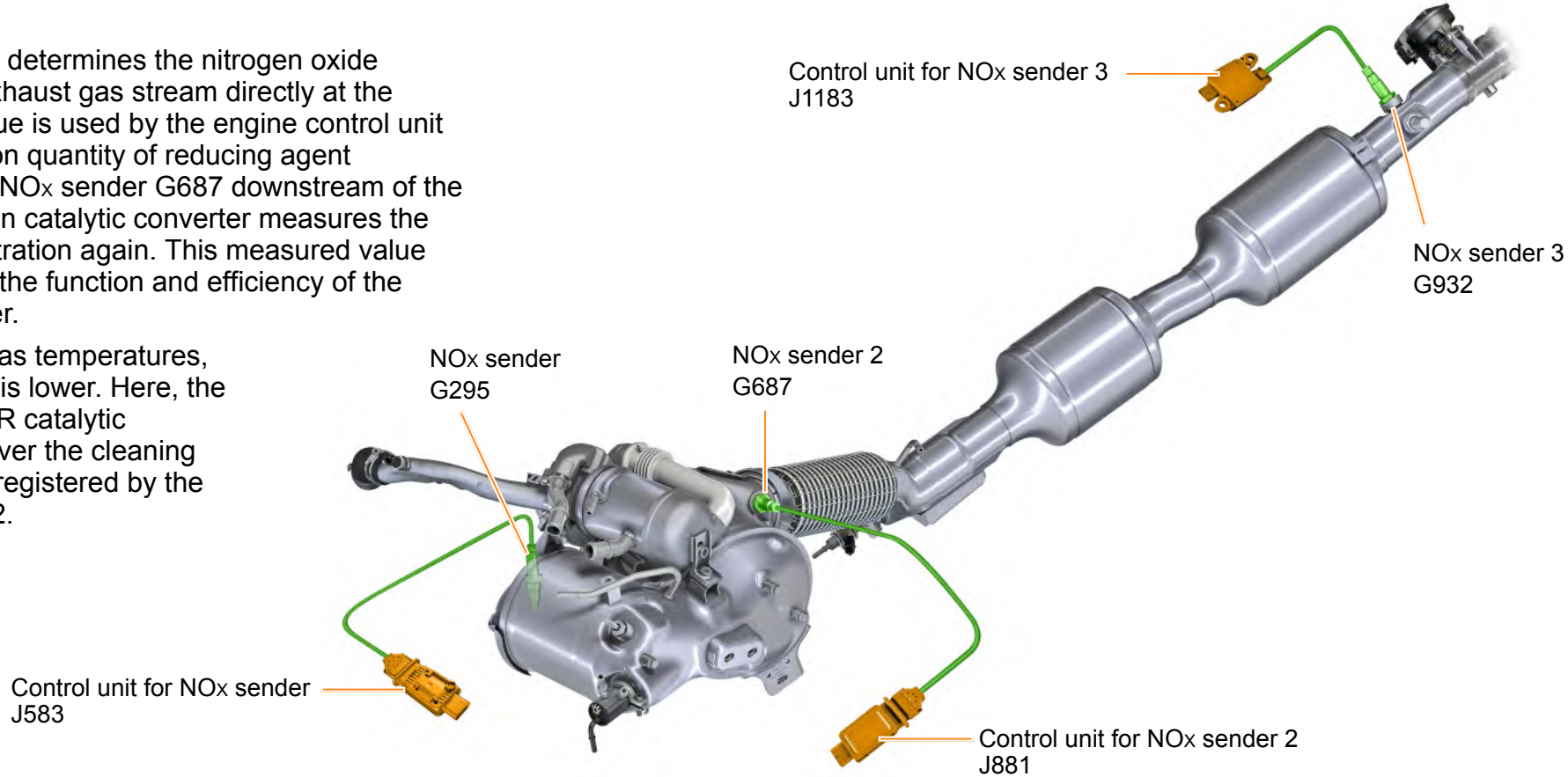
Injector 2 for reducing agent N758 injects the reducing agent into the exhaust gas stream before the reduction catalytic converter by injecting it through three injector holes.
The spray droplets are reduced in size when they hit the baffle plates in the mixer. This leads to faster evaporation of the injected reducing agent, which then becomes gaseous. In addition, the geometry of the mixer causes the exhaust gas stream to swirl. This results in an improved mixture and uniform distribution of the spray droplets in the exhaust gas stream.
The injector is cooled by ambient air using cooling fins and protected against overheating.



The NOx sender

The NOx sender G295 determines the nitrogen oxide concentration in the exhaust gas stream directly at the engine outlet. This value is used by the engine control unit to calculate the injection quantity of reducing agent (AdBlue). The second NOx sender G687 downstream of the close-coupled reduction catalytic converter measures the nitrogen oxide concentration again. This measured value can be used to record the function and efficiency of the SCR catalytic converter.

At very high exhaust gas temperatures, the reduction capacity is lower. Here, the non-close-coupled SCR catalytic converter then takes over the cleaning function. The result is registered by the third NOx sender G932.



The design and function of the NOx sender is described in Self-Study Programme 424 “The selective catalytic reduction exhaust post-treatment system”.

Selective catalytic reduction warning indicators

AdBlue® tank level warning indicators

The warning indicators for the tank level of the reducing agent are issued three stages.



Tank level warning level 1
The first prompt to refill reducing agent appears when the AdBlue® still available allows a remaining range of 2000 km to be driven.
The engine/motor control unit calculates the remaining range on the basis of the quantity of reducing agent in the tank and the reducing agent consumption.



Tank level warning level 2
When the remaining range is only 1000 km, the warning is intensified. The warning symbol is therefore displayed in yellow. You can only drive for the displayed remaining range. If you do not refill a sufficient quantity of reducing agent, you will no longer be able to restart the engine after the remaining range has been used up and the ignition is switched off.



Tank level warning level 3
If there is no more AdBlue® left in reducing agent tank, then the warning symbol is displayed in red.
Reducing agent needs to be refilled in order to override the engine start inhibitor.

Selective catalytic reduction warning indicators

Display of the remaining range

When none of the warnings are active, there is the option of calling up the current remaining range for the AdBlue® reducing agent by using the multifunction display or infotainment system menu.



Minimum refill quantity
The figure indicating the minimum refill quantity provides information about the minimum amount of AdBlue® to add to the tank to make the remaining range display change after refilling.

Maximum refill quantity
The figure indicating the maximum refill quantity provides information to help with selection of the suitable refill container, when relevant.

Selective catalytic reduction warning indicators

Warning display in the event of faults affecting selective catalytic reduction



When warning stages 2 and 3 are reached, only the vehicle diagnostic tester can be used to rectify selective catalytic reduction faults and reset the warning display. In this case, refilling AdBlue® will not make the display disappear from the dash panel insert.

Note for the warning levels 2 and 3

Selective catalytic reduction warning indicators

Warning display in the event of faults affecting selective catalytic reduction

If the engine control unit detects a fault in the SCR system or insufficient efficiency, a warning display will appear in the dash panel insert that indicates a malfunction in the SCR system. A spanner symbol will also be displayed as a visual indicator of a system error.



System fault warning level 1
If the system fault was caused by a poor reducing agent quality, a prompt to check the reducing agent appears as the first warning level. This gives the driver the option of rectifying the system fault themselves within a distance of 50 km.



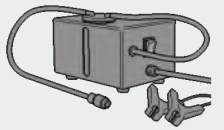
System fault warning level 2
After covering a distance of 50 km, the warning symbol is shown in yellow. The display text indicates that there is a system error and an engine start inhibitor may be activated. The remaining range is 1000 km. The remaining range is not based on the reducing agent tank level nor the consumption of reducing agent.



System fault warning level 3
If the fault affecting selective catalytic reduction is not rectified within the remaining range, then the engine cannot be started again after switching off the ignition.

Special tools

Tool	Designation	Purpose
	**V.A.G 1331/10** Open ring spanner	for removing and installing the exhaust gas temperature sensor
	**T10395 A** Tool set	for removing and installing the turbocharger
	**T10385** Bit XZN 10	for removing and installing the turbocharger

Tool	Designation	Purpose
	**T10545** Bit	for removing and installing the piston cooling oil spray jets
	**VAS 6096/2** Cooling system charge unit	Vacuum filling device for cooling system
	**VAS 541 001** Reamer	Cleaning device for glow plug bores

Thank you very much for your interest.

