

Introduction of the New Inline Engine Generation 4-Cylinder M 270

Introduction into Service Manual



Mercedes-Benz

Introduction of the New Inline Engine Generation 4-Cylinder M 270

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Dear Reader,

This Introduction into Service Manual presents the new 4-cylinder gasoline engine 270 in combination with vehicle model series 246.

The purpose of this brochure is to acquaint you with the technical highlights of this new engine generation in advance of its market launch. This brochure is intended to provide information for people employed in service or maintenance/repair as well as for after-sales staff. It is assumed here that the reader is already familiar with the Mercedes-Benz engines currently on the market.

This Introduction into Service Manual is not intended as an aid for repairs or for the diagnosis of technical problems. For such needs, more extensive information is available in the Workshop Information System (WIS) and Xentry Diagnostics.

WIS is updated continuously. Therefore, the information available there reflects the latest technical status of our vehicles.

This Introduction into Service manual presents initial information relating to the new engine generation and, as such, is not stored in WIS. The contents of this brochure are not updated. No provision is made for supplements.

We will publicize modifications and new features in the relevant WIS documents. The information presented in this Introduction into Service Manual may therefore differ from the more up-to-date information found in WIS.

All information relating to technical data is valid as of the copy deadline in September 2011 and may therefore differ from the current production configuration.

Daimler AG

Technical Information
and Workshop Equipment (GSP/OI)

Brief description

The M 270 will be installed as of November 2011 in the BlueEFFICIENCY models for the market launch of the new B-Class (model 246).

Engine model series M 270 has a 1.6l displacement and has been developed for transverse mounting.

There are two power variants: 90kW and 115kW.

This new engine family replaces the very successful major assemblies of engine model series M 266.

The new direct injection system combines an extremely fast and accurate injector with a new, spray-guided combustion system.

The new M 270 engine model series fulfills the increasingly strict CO₂ limits while also providing high torque, engine power and particularly comfortable noise characteristics and vibration response.

The use of flexible technology modules has made it possible to reduce consumption and untreated emissions. They allow varying worldwide market-specific and legal requirements to be fulfilled as well as ensuring the future of the engine family.

Supplementing the technology portfolio is a coolant thermal management system to regulate the coolant circuit during the warm-up phase.

The regulated vane-type oil pump with map-controlled two-stage control pressure allows the lubrication and cooling points in the engine to be supplied with a significantly lower operating energy input than would be possible with an unregulated pump.

The low engine weight compared to other 4-cylinder gasoline engines in this segment, low friction, demand-controlled ancillary equipment and the standard ECO start/stop function all make a contribution to energy efficiency.

An overview of the special features of the M 270:

- Fulfillment of EURO 5 emissions standard with potential to fulfill future standards
- Gasoline direct injection with piezo injectors of the latest generation for the spray-guided Mercedes-Benz combustion system
- Fast action piezo injectors for multiple fuel injection
- Combination of direct injection with charging by a turbocharger
- Boost pressure control via vacuum
- Advanced camshaft adjusters for optimized engine timing
- Further developed regulation and optimization of oil and cooling circuit with a regulated coolant pump and a regulated engine oil pump
- ECO start/stop function based on starter-assisted direct starting
- Demand-controlled multi-spark ignition
- Crankcase made of diecast aluminium

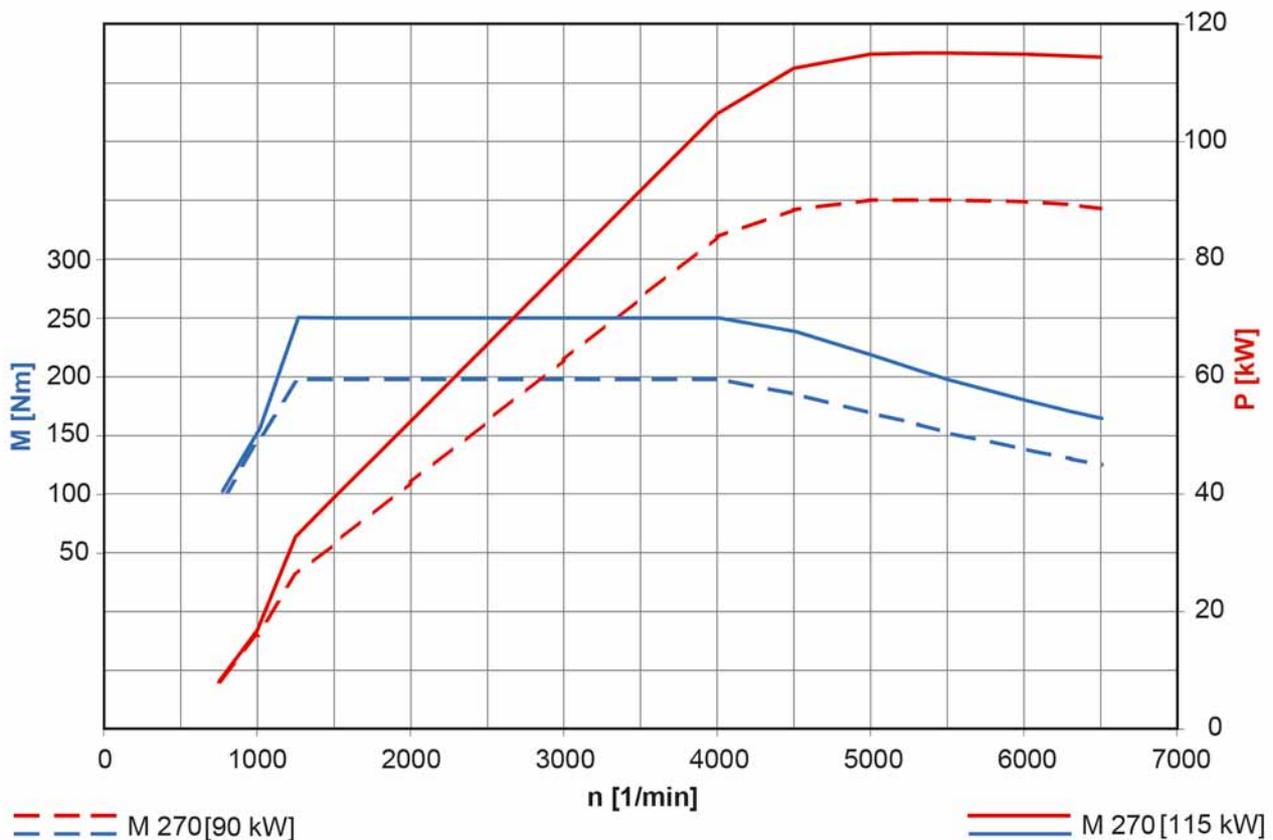


M 270 with 1.6 l displacement, transverse mounted in BR 246

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Brief description

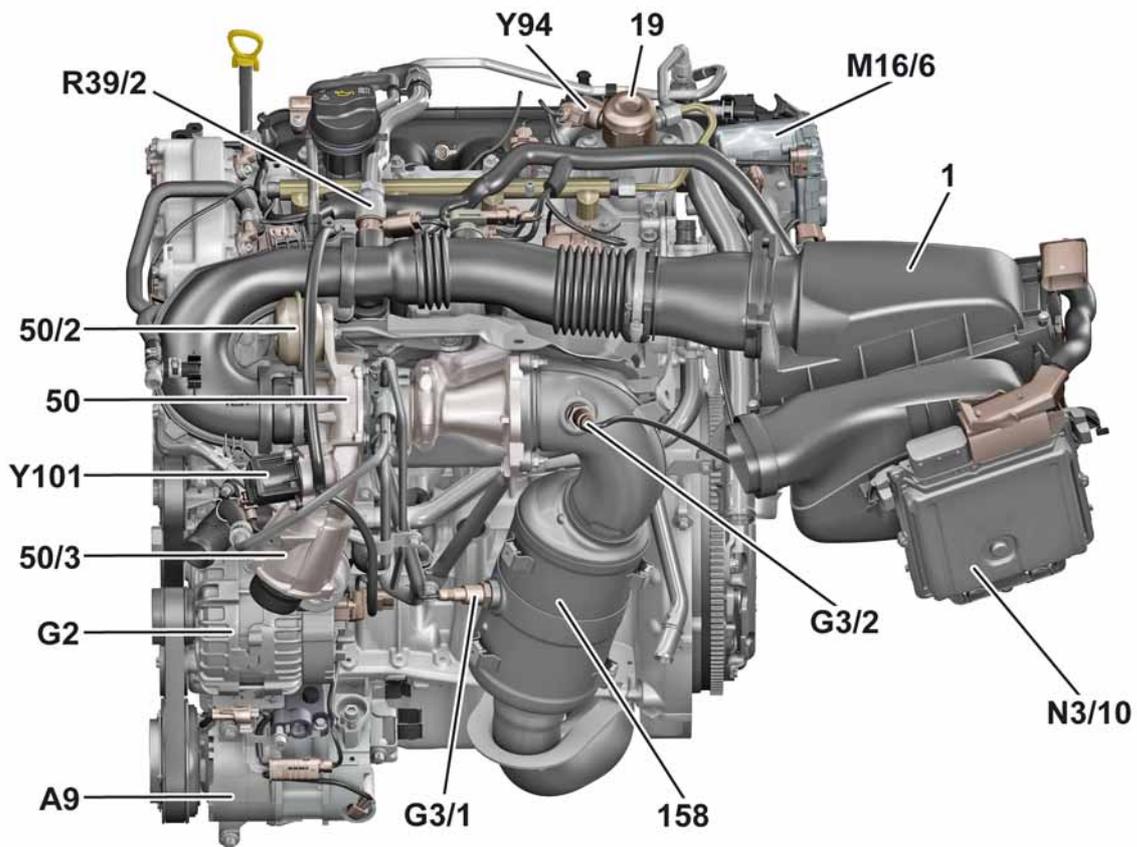
M 270 DEH16LA		B 180	B 200
Displacement	cm ³	1595	1595
Rated output	kW at rpm	90 5000	115 5300
Rated torque	Nm at rpm	200 1250...4000	250 1250...4000
Compression ratio	ϵ	10.3 : 1	10.3 : 1



Torque and power curve of M 270

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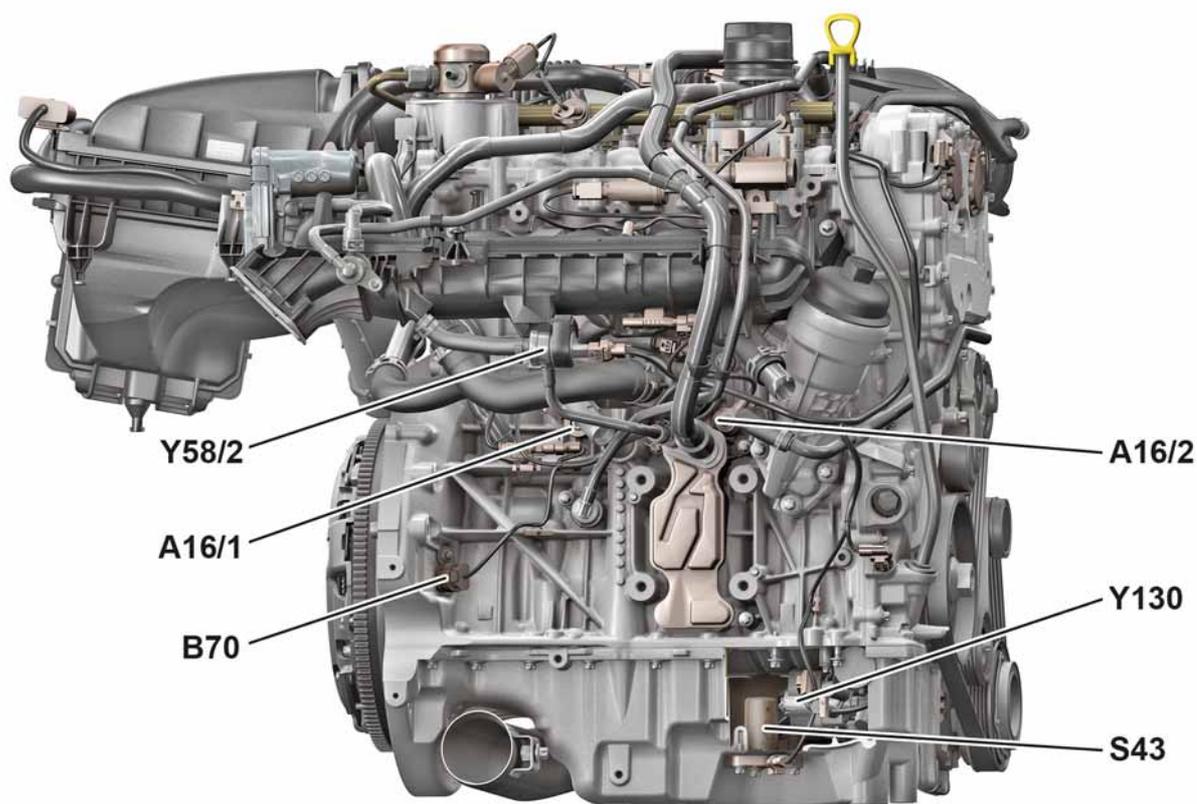


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View of engine from front

1	Air filter housing	A9	Refrigerant compressor
19	High-pressure pump	G2	Alternator
50	Turbocharger	G3/1	Oxygen sensor downstream of catalytic converter
50/2	Boost pressure control flap vacuum cell	G3/2	Oxygen sensor upstream of catalytic converter
50/3	Noise damper	M16/6	Throttle valve actuator
158	Catalytic converter	N3/10	ME-SFI [ME] control unit
		R39/2	Wide open throttle operation vent line heater element
		Y94	Quantity control valve
		Y101	Bypass air switchover valve

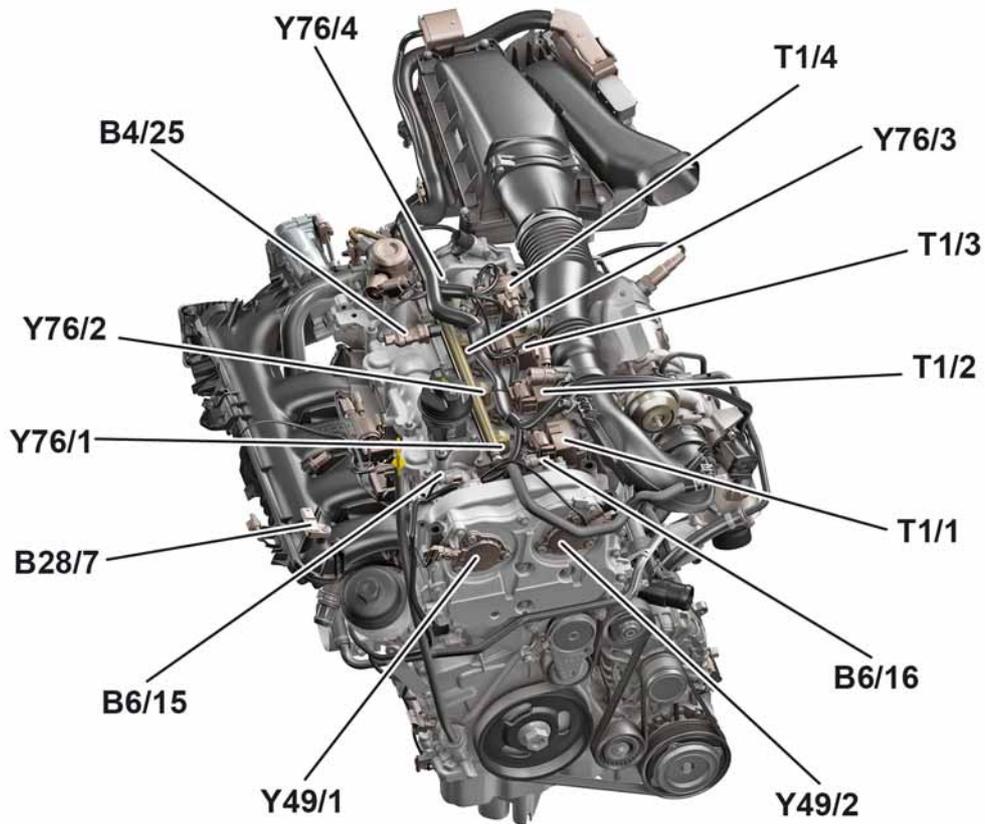
Engine views



View of engine from rear

P01.10-3072-00

A16/1	Knock sensor 1
A16/2	Knock sensor 2
B70	Crankshaft Hall sensor (with rotation direction detection)
S43	Oil level check switch
Y58/2	Partial load operation crankcase ventilation system valve
Y130	Engine oil pump valve

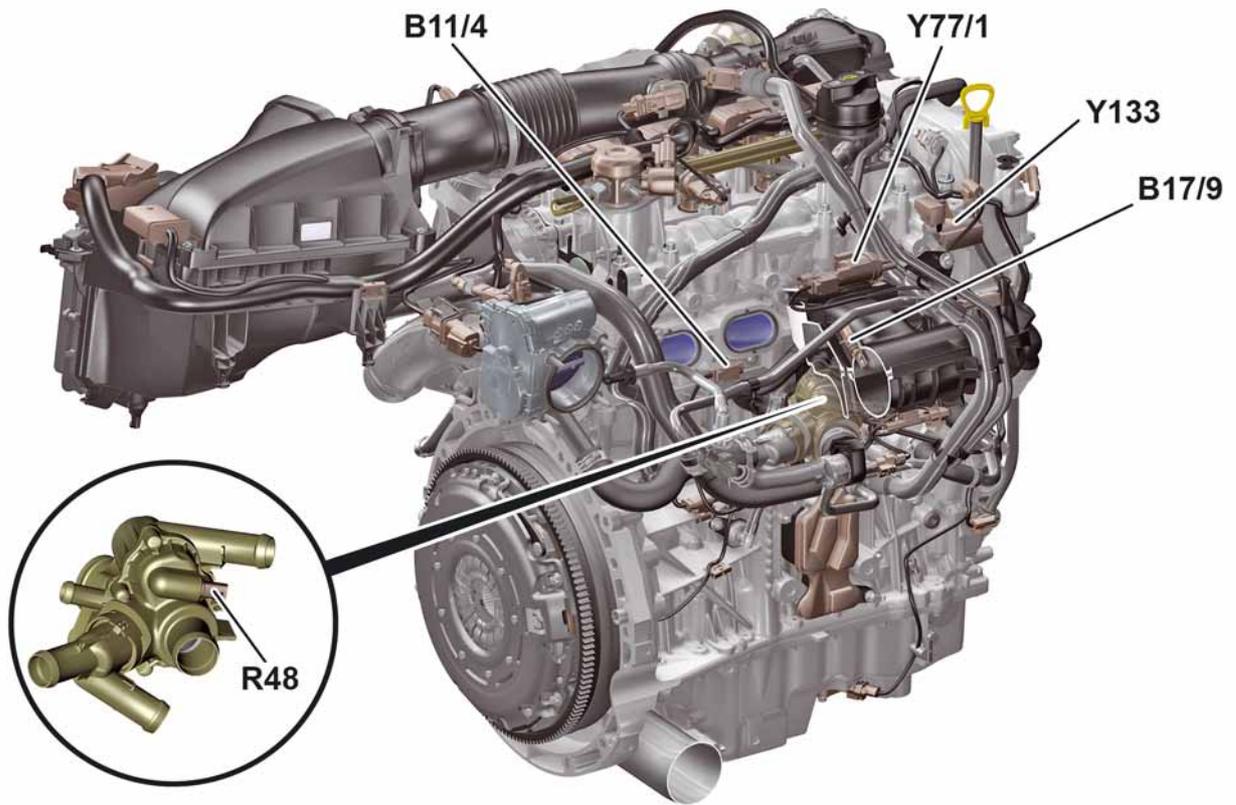


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View of engine from right

B4/25	Fuel pressure and temperature sensor	Y49/1	Intake camshaft solenoid
B6/15	Intake camshaft Hall sensor	Y49/2	Exhaust camshaft solenoid
B6/16	Exhaust camshaft Hall sensor	Y76/1	Cylinder 1 fuel injector
B28/7	Pressure sensor downstream of throttle valve	Y76/2	Cylinder 2 fuel injector
T1/1	Cylinder 1 ignition coil	Y76/3	Cylinder 3 fuel injector
T1/2	Cylinder 2 ignition coil	Y76/4	Cylinder 4 fuel injector
T1/3	Cylinder 3 ignition coil		
T1/4	Cylinder 4 ignition coil		

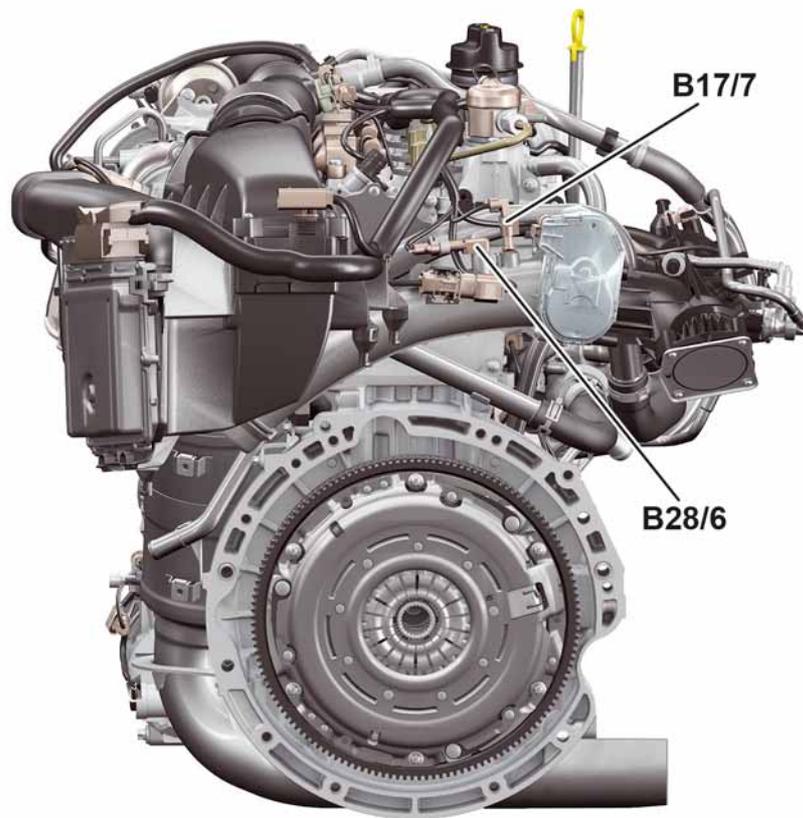
Engine views



View of engine from left rear

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- B11/4* *Coolant temperature sensor*
- B17/9* *Charge air temperature sensor downstream of throttle valve*
- R48* *Coolant thermostat heating element*
- Y77/1* *Boost pressure control pressure transducer*
- Y133* *Coolant pump switchover valve*



View of engine from left

P01.10-3078-00

- B17/7* *Charge air temperature sensor upstream of throttle valve*
- B28/6* *Pressure sensor upstream of throttle valve*

Engine data comparison with predecessor engines

BR 245		B 160	B 180	B 200	B 200 TURBO
Engine model designation		266.920	266.940	266.960	266.980
Engine designation		M266			
Rated output	kW at rpm	70 5200	85 5500	100 5500	142 4850
Rated torque	Nm at rpm	140 3500...4000	155 3500...4000	185 3500...4000	280 1800...4850
Emissions standard		EU 4			
Engine configuration/ no. of cylinders		Inline 4			
Valves		2			
Displacement	cm ³	1498	1699	2034	
Air supply		Variable intake manifold			Turbocharger with charge air cooling
Boost pressure control		-	-	-	Via boost pressure
Boost pressure	bar	-	-	-	0.7
Bore	mm	83.0			
Stroke	mm	69.2	78.5	94.0	
Cylinder spacing	mm	90.0			
Connecting rod length	mm	156.0	152.0	142.5	
Injection		Port injection (KE)			



Engine data comparison with predecessor engines

BR 246		B 180	B 200
Engine model designation		270.910	
Engine designation		M 270	
Rated output	kW at rpm	90 5000	115 5300
Rated torque	Nm at rpm	200 1250...4000	250 1250...4000
Emissions standard		EU 5	
Engine configuration/ no. of cylinders		Inline 4	
Valves		4	
Displacement	cm ³	1595	
Air supply		Turbocharger with charge air cooling	
Boost pressure control		Via vacuum	
Boost pressure	bar	0.7	
Bore	mm	83.0	
Stroke	mm	73.7	
Cylinder spacing	mm	90.0	
Connecting rod length	mm	152.2	
Injection		Direct injection (DI)	

CO2 measures

Thermal management

The thermal management function controlled by the ME-SFI [ME] control unit regulates the coolant temperature in the engine. It allows the operating temperature to be reached more quickly, which reduces exhaust emissions and improves heating comfort.

Post-start phase

In the post-start phase, the ME-SFI [ME] control unit transmits a signal to the coolant pump switchover valve. The coolant pump is then switched off.

By interrupting the coolant circulation, the engine heats up more quickly, which reduces exhaust emissions.

Coolant thermostat heating

The temperature of the coolant in the engine can be varied via the heated coolant thermostat. The coolant thermostat contains a coolant thermostat heating element and an expanding wax element. The heating element is actuated by the ME-SFI [ME] control unit via a ground signal and adjusts the positions of a rotary ball valve as required via the expanding wax element.

Fan control

The ME-SFI [ME] control units actuates the fan motor. The target fan speed is specified by the ME-SFI [ME] control unit by means of a pulse width modulated signal (PWM signal).

The on/off ratio of the PWM signal is between 10% and 90%.

For example:

- 10% fan motor "OFF"
- 20% fan motor "ON", minimum rpm
- 90% fan motor "ON", maximum rpm

If the actuation is faulty, the fan motor turns at the maximum speed (fan limp-home mode).

The automatic air conditioning control and operating unit transmits the status of the air conditioning to the ME-SFI [ME] control unit via the interior CAN and chassis CAN.

Delayed fan switch-off

After "ignition OFF" the fan motor runs on for up to 5 min if the coolant temperature or the engine oil temperature have exceeded the specified maximum values.

The on/off ratio of the PWM signal during run-on is max. 40%. If the battery voltage drops too much during this time, the delayed fan switch-off is suppressed.

Radiator shutters

In combination with engine 270, the new B-Class features adjustable radiator shutters which allow the air flow through the cooling module and engine compartment to be controlled.

The radial slats of the radiator shutters are located in front of the fan wheel across its circumference and are integrated in the fan shroud. The slats are opened and closed by an actuator attached to the cooling module.

The radiator shutters are closed in order to lower fuel consumption (due to lower aerodynamic drag). In addition, this prevents the engine compartment from cooling down and dampens the external noise produced by the engine.

The radiator shutters actuator is actuated by the ME-SFI [ME] control unit after the engine is started by means of a ground signal. A vacuum is thus built up in the vacuum cell and the radiator shutters are closed by the actuator and associated linkage.

When a coolant temperature of 111 °C is reached, the radiator shutters are opened and they are closed again at 99 °C.

One particular advantage of adjustable radiator shutters is the positive influence they have on aerodynamics and the associated potential to reduce fuel consumption.

Furthermore, when the adjustable radiator shutters are closed they allow

- The operating temperature to be reached more quickly,
- An increase in heating comfort and
- A further reduction in engine noise.

Overheating protection

The overheating protection function protects against engine damage due to thermal overload and against damage to the catalytic converter caused by overheating.

If the coolant temperature or charge air temperature is too high, the ignition timing is adjusted in direction "Retarded" depending on the engine speed and load. The correction in direction "Retarded" is controlled by the ME-SFI [ME] control unit based on a performance map.

Adjustment of the ignition timing starts at a coolant temperature of approx. 90 °C and a charge air temperature of approx. 20 °C.

The adjustment of the ignition timing in direction "Retarded" corresponds to e.g.:

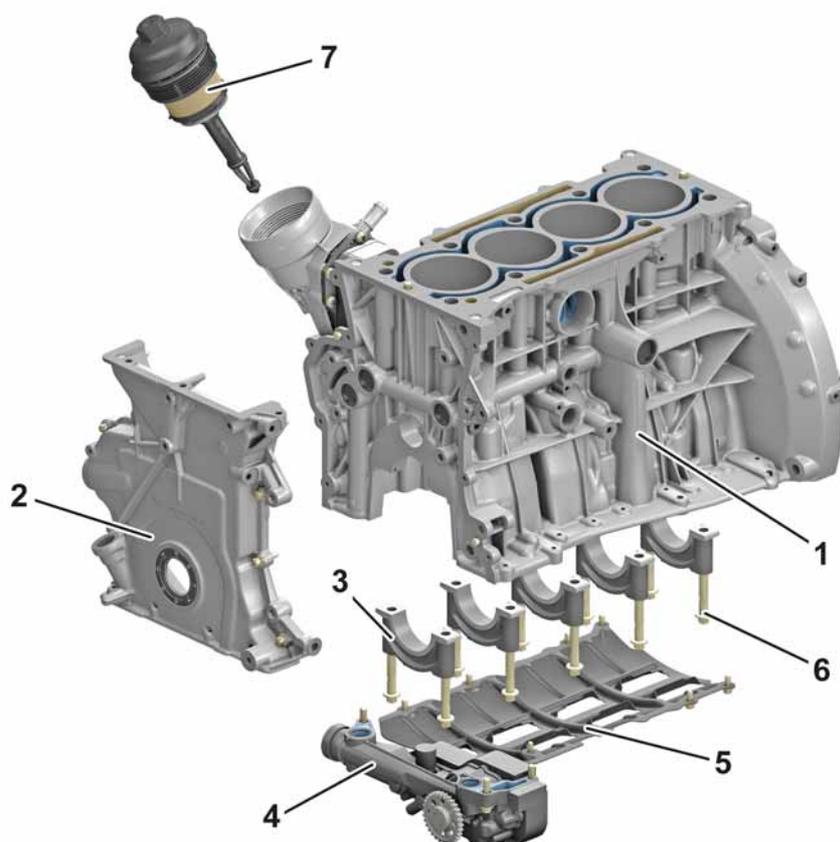
- 2 °CKA at 100 °C coolant, 20 °C charge air and wide open throttle
- 8 °CKA at 100 °C coolant, 60 °C charge air and wide open throttle
- 11 °CKA at 125 °C coolant, 60 °C charge air and wide open throttle

In addition, the ME-SFI [ME] control unit actuates the coolant thermostat heating element to fully open the thermostat so that all the coolant is cooled via the radiator.

Crankcase

The crankcase of engine 270 is made of diecast aluminium and is manufactured with an open deck design. It is highly rigid due to multiple cross struts and longitudinal struts.

The crankshaft bearing caps and cylinder liners are made of cast iron.



P01.40-2280-00

- 1 Crankcase
- 2 Timing case cover
- 3 Crankshaft bearing cap
- 4 Engine oil pump
- 5 Baffle
- 6 Crankshaft bearing cap bolts
- 7 Oil filter

Ventilation

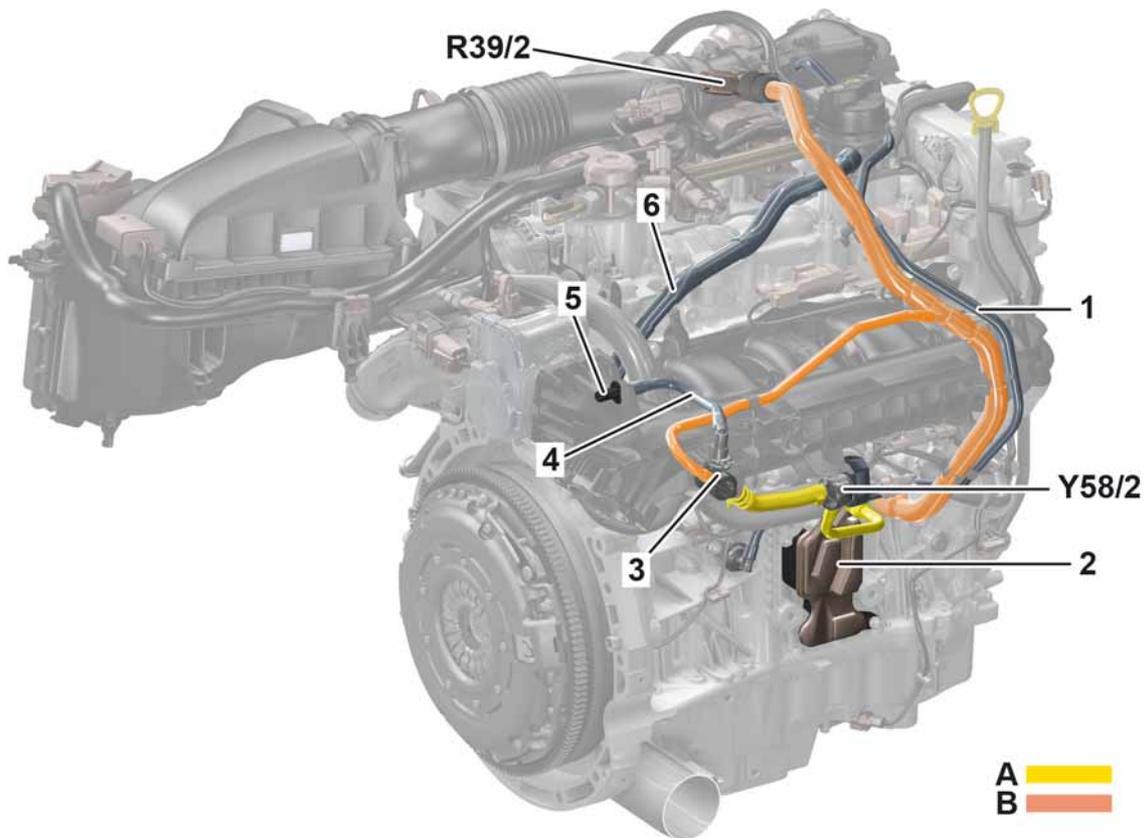
Ventilation of engine 270 is carried out by an oil separator, a partial load ventilation system and a wide open throttle ventilation system.

The crankcase is vented via the line from the air intake pipe.

During partial load operation, ventilation takes place from the oil separator to the charge air distributor.

During wide open throttle operation, ventilation takes place from the oil separator to the air intake pipe. There is a heater element in the wide open throttle vent line which prevents the crankcase ventilation system from freezing up.

The blow-by gases are removed via the oil separator vent line from the oil filler neck to the oil separator. The vent line is connected to the oil separator via a port in the crankcase.



P01.20-2277-00

- 1 Engine vent line
- 2 Oil separator
- 3 Vent valve
- 4 Purge line
- 5 Tank ventilation connection
- 6 Oil separator vent line

- R39/2 Wide open throttle operation vent line heater element
- Y58/2 Partial load operation crankcase ventilation system valve
- A Partial load vent line
- B Wide open throttle vent line

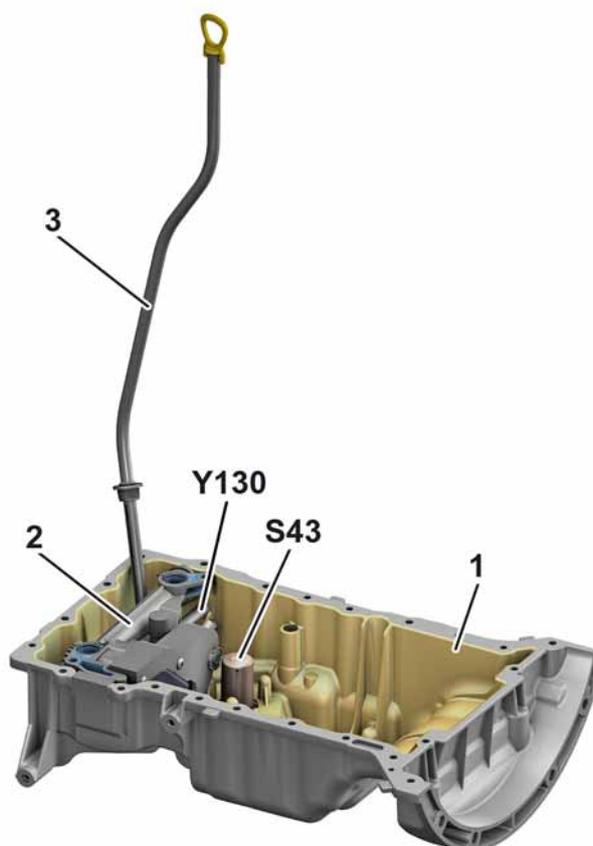
Oil pan

The oil pan is made of diecast aluminium and is highly rigid. The ribbing on the oil pan is designed to reduce noise emissions.

On engine 270, the oil dipstick guide tube is located at the rear on the right.

The oil level check switch is located on the engine.

The engine is supplied with oil by a new regulated engine oil pump, which is driven by the crankshaft via a toothed chain. The engine oil pressure is regulated via the engine oil pump valve. This is switched by the ME-SFI [ME] control unit based on a characteristics map and according to demand.



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Oil pan

- | | | | |
|---|-------------------------|------|------------------------|
| 1 | Oil pan | S43 | Oil level check switch |
| 2 | Engine oil pump | Y130 | Engine oil pump valve |
| 3 | Oil dipstick guide tube | | |

The depressions on the cast pistons are adapted to the combustion system and the location of the injectors.

The crankshaft is hollow-cast to reduce its weight and is equipped with four counterweights.



Crank assembly

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Cylinder head

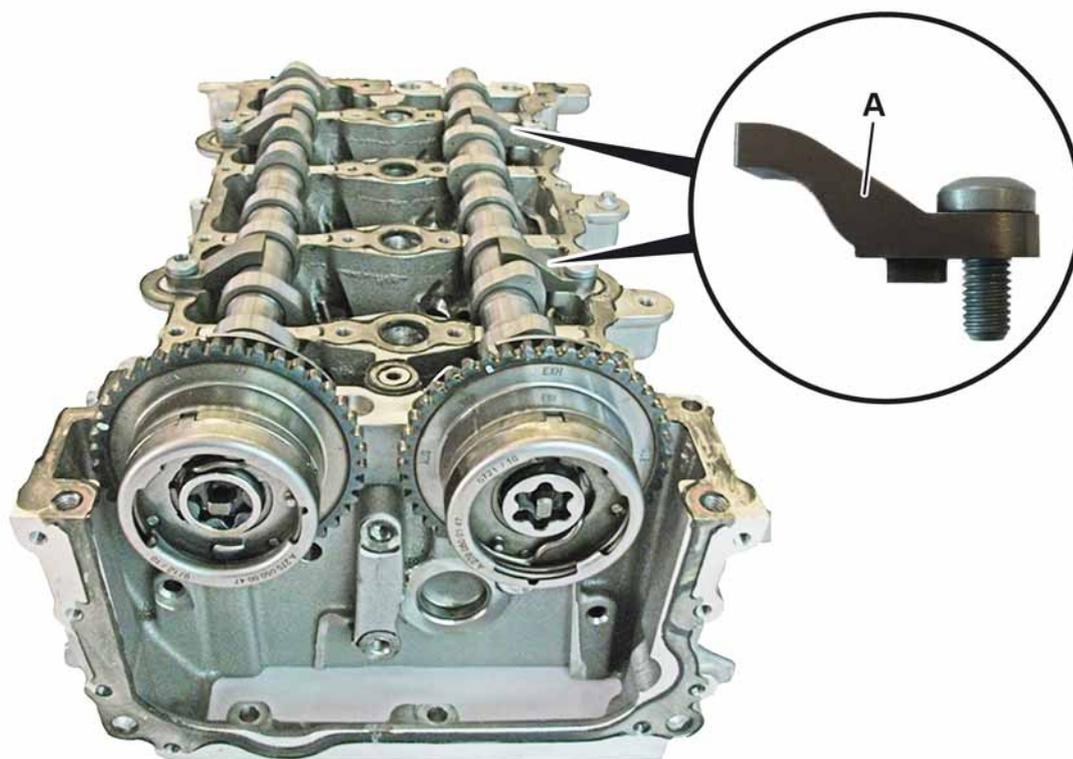
The cylinder head consists of a high-strength aluminium alloy. The specially designed intake ports create the charge movement required in the combustion chamber of a direct injection engine.

Each cylinder has four valves. The valves are controlled via two camshafts. Two hold-down devices are installed for each camshaft.

The design of the gas cycle and the charge movement of engine 270 have the following effects

- High torque over a wide rpm range,
- Low fuel consumption and
- Low exhaust emissions.

Furthermore, the cylinder head is designed in such a way as to generate sufficiently high turbulence, which further improves the combustion process.



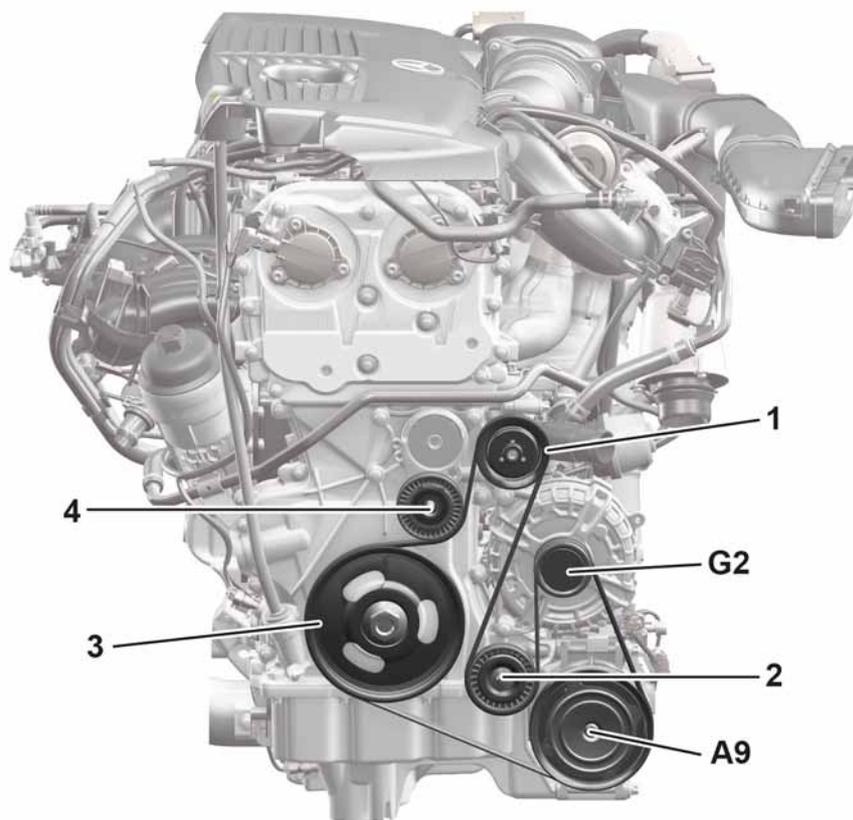
Cylinder head

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A Camshaft hold-down device with stem

The coolant pump, the alternator and the refrigerant compressor are driven by the belt drive via the crankshaft belt pulley.

The drive system consists of a low-maintenance poly-V-belt which is tensioned via an automatic belt tensioner with tensioner pulley.



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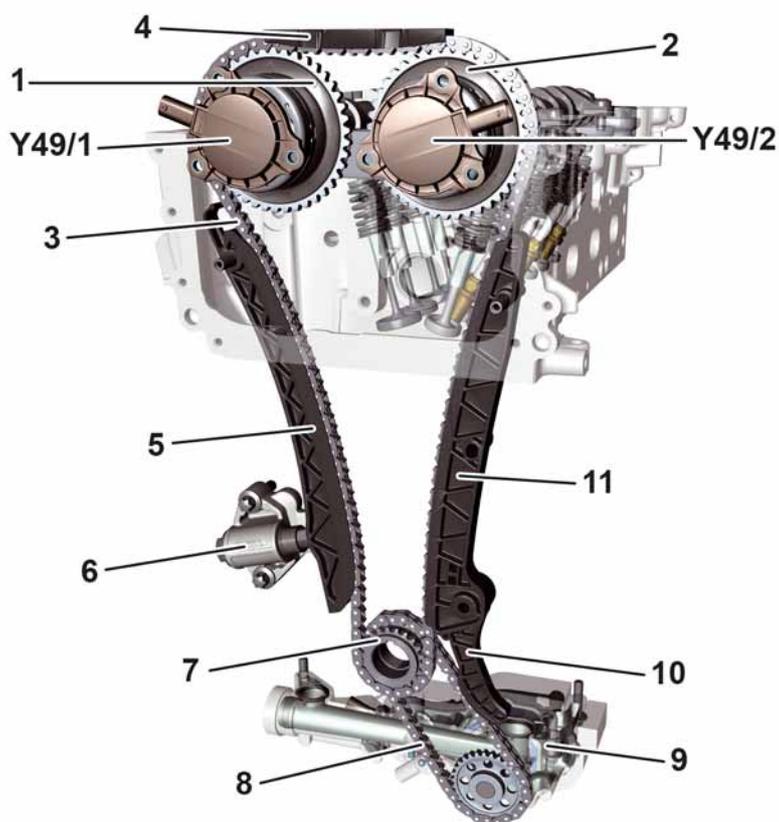
Belt drive

- | | | | |
|---|------------------------|----|------------------------|
| 1 | Coolant pump | A9 | Refrigerant compressor |
| 2 | Guide pulley | G2 | Alternator |
| 3 | Crankshaft belt pulley | | |
| 4 | Belt tensioner | | |

Chain drive and camshaft adjustment

The camshafts are driven by the crankshaft via a toothed chain. The guide rails and tensioning rail are mounted so that they do not contact the timing case cover at all. This significantly reduces noise.

The engine oil pump is driven by the crankshaft via a toothed chain.



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Chain drive

- | | | | |
|---|--------------------------------|-------|--|
| 1 | Intake camshaft gear | 8 | Engine oil pump toothed chain |
| 2 | Exhaust camshaft gear | 9 | Engine oil pump |
| 3 | Camshaft toothed chain | 10 | Engine oil pump toothed chain guide rail |
| 4 | Upper toothed chain guide rail | 11 | Toothed chain guide rail |
| 5 | Tensioning rail | Y49/1 | Intake camshaft solenoid |
| 6 | Hydraulic chain tensioner | Y49/2 | Exhaust camshaft solenoid |
| 7 | Crankshaft gear | | |

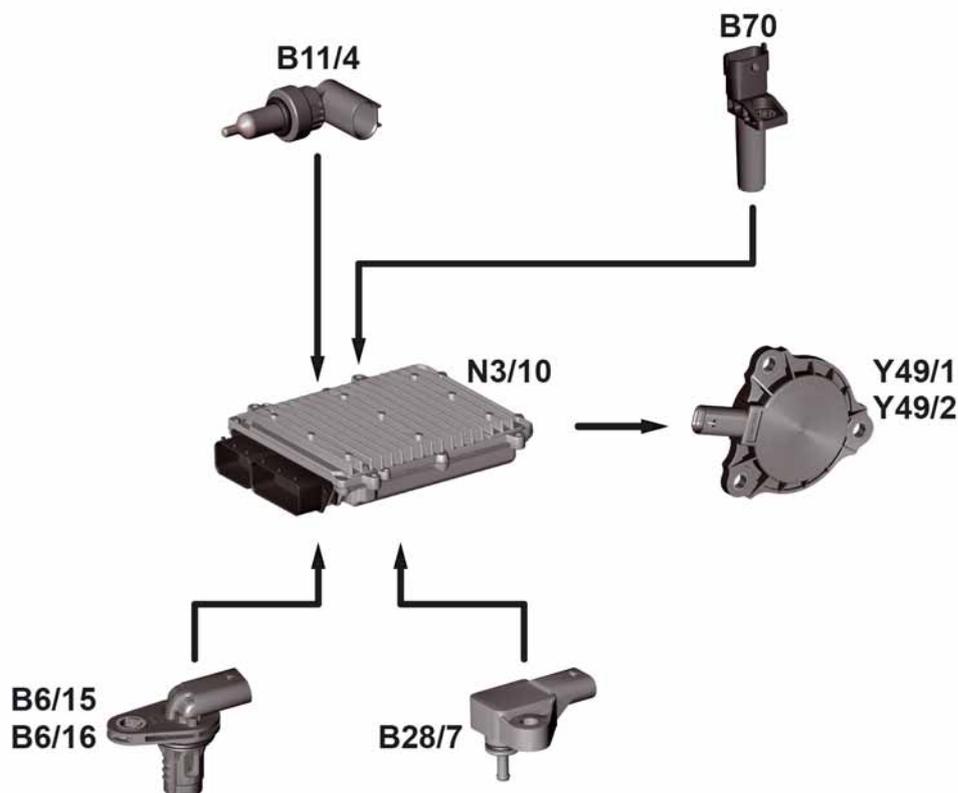
Chain drive and camshaft adjustment

The camshaft adjustment system can adjust the intake camshaft up to 30°CKA (crankshaft angle) towards "Advanced" and the exhaust camshaft up to 40°CKA towards "Retarded". In this way the valve overlap in the gas cycle can be varied within broad limits. This optimizes the engine torque curve, reduces fuel consumption and improves exhaust characteristics.

To adjust the camshaft, the intake camshaft solenoid and exhaust camshaft solenoid are actuated by the ME-SFI [ME] control unit with a pulse-width modulated signal at 150 Hz.

The actuation is dependent on a characteristics map in the partial load and wide open throttle range and allows continuous adjustment of the camshafts according to the duty cycle of the PWM signals.

The position of the intake camshaft is recorded by the intake camshaft Hall sensor and the position of the exhaust camshaft is recorded by the exhaust camshaft Hall sensor and this information is supplied to the ME-SFI [ME] control unit in the form of a voltage signal.



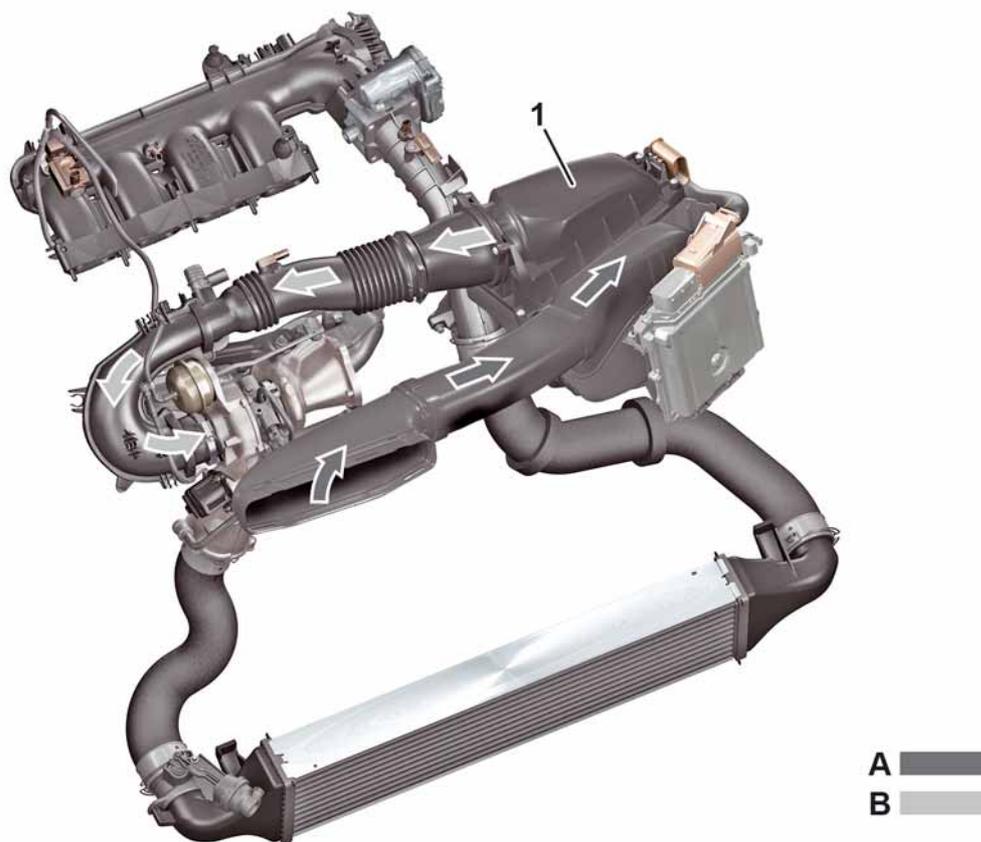
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Function schematic of camshaft adjustment

B6/15	Intake camshaft Hall sensor	N3/10	ME-SFI [ME] control unit
B6/16	Exhaust camshaft Hall sensor	Y49/1	Intake camshaft solenoid
B11/4	Coolant temperature sensor	Y49/2	Exhaust camshaft solenoid
B28/7	Pressure sensor downstream of throttle valve		
B70	Crankshaft Hall sensor (with rotation direction detection)		

Air supply

One of the main aims of the air supply system is to keep the resistance of the flow paths as low as possible and to provide favorable flow conditions under all possible circumstances.



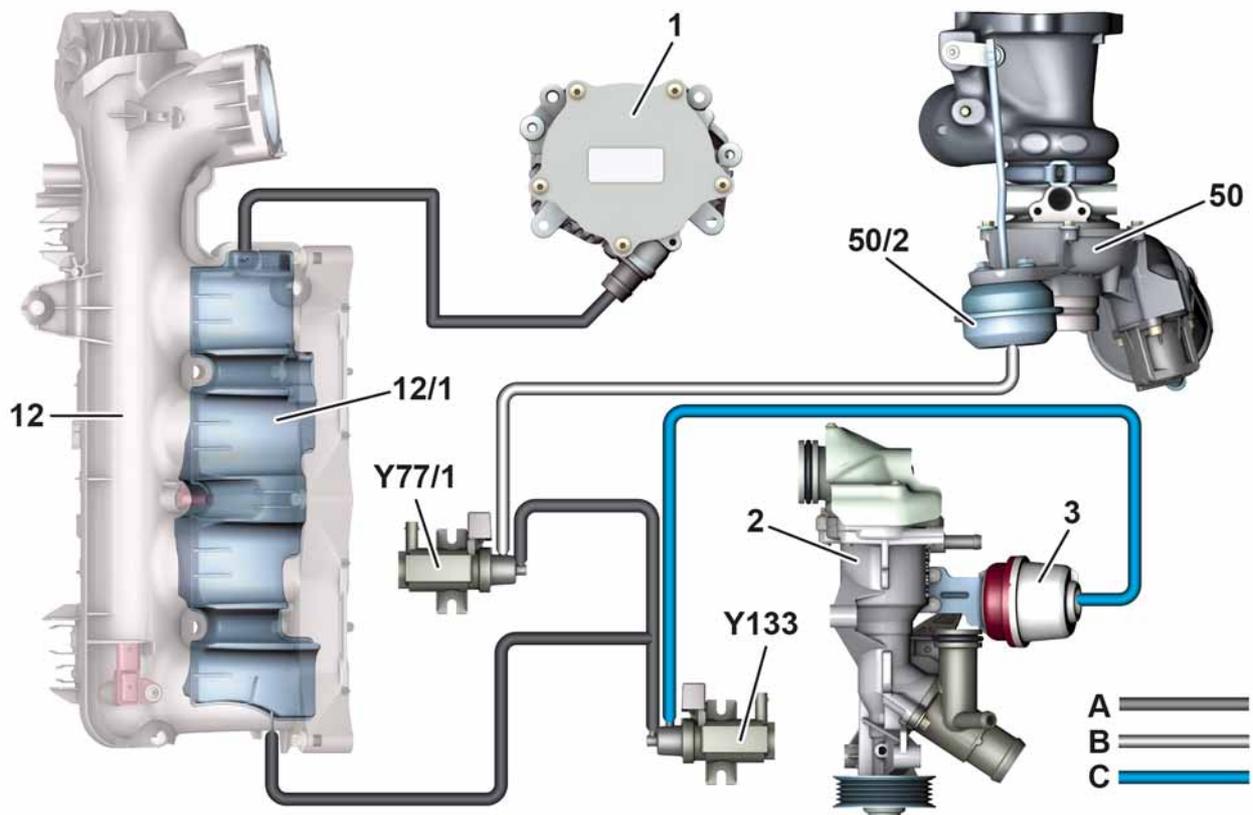
Intake air ducting

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1 Air filter housing

A Unfiltered intake air
B Filtered intake air

The vacuum pump supplies the vacuum reservoir with vacuum. The coolant pump and boost pressure control flap vacuum cells are supplied with vacuum by the vacuum reservoir.



P07.09-2041-00

Vacuum system, schematic illustration

1	Vacuum pump	Y77/1	Boost pressure control pressure transducer
2	Coolant pump	Y133	Coolant pump switchover valve
3	Coolant pump vacuum cell		
12	Charge air manifold	A	Vacuum supply
12/1	Vacuum reservoir	B	Vacuum for controlling boost pressure control flap
50	Turbocharger	C	Vacuum for controlling coolant pump
50/2	Boost pressure control flap vacuum cell		

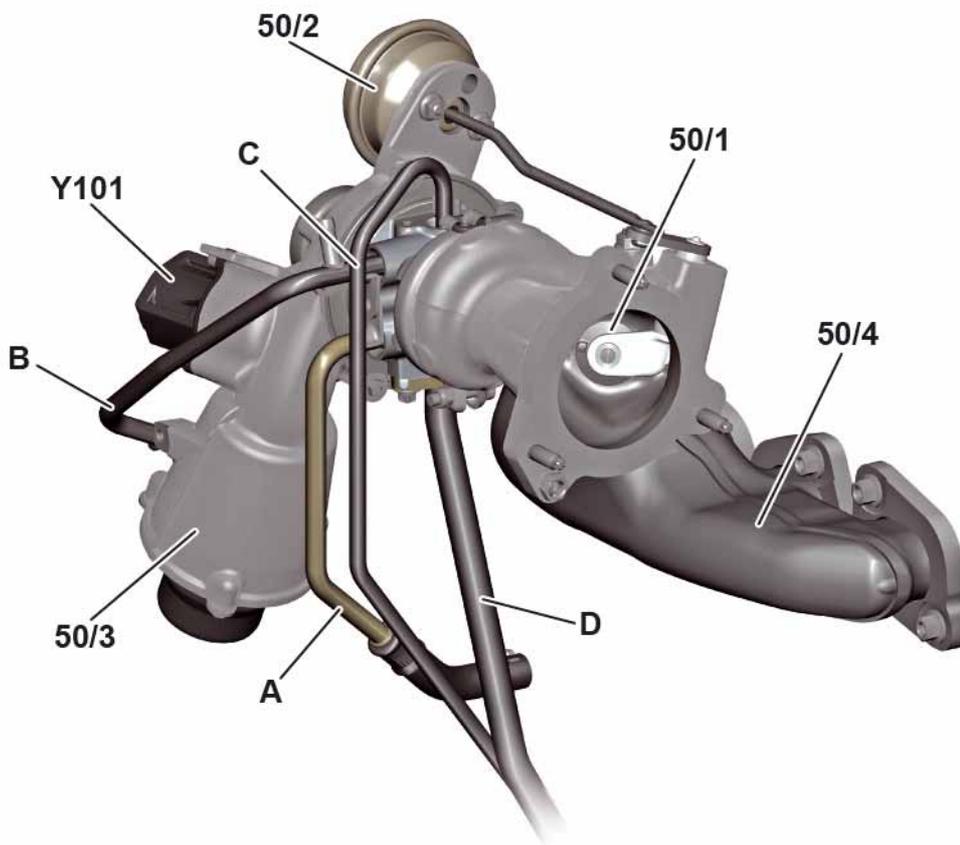
Charging

The volumetric efficiency of the cylinders is improved as a result of charging. This increases engine torque and engine power. The fuel quantity appropriate for the increased air mass is metered by the ME-SFI [ME] control unit.

The main component of the charging system is a single-stage turbocharger which can withstand temperatures of up to 1050 °C. The different engine power variants of 90 kW and 115 kW are realized through software programming of the ME-SFI [ME] control unit.

The turbocharger is welded to the exhaust manifold at the exhaust side of the engine in the form of a module.

The pressure in the turbocharger is controlled via a boost pressure control flap and an air recirculation function.



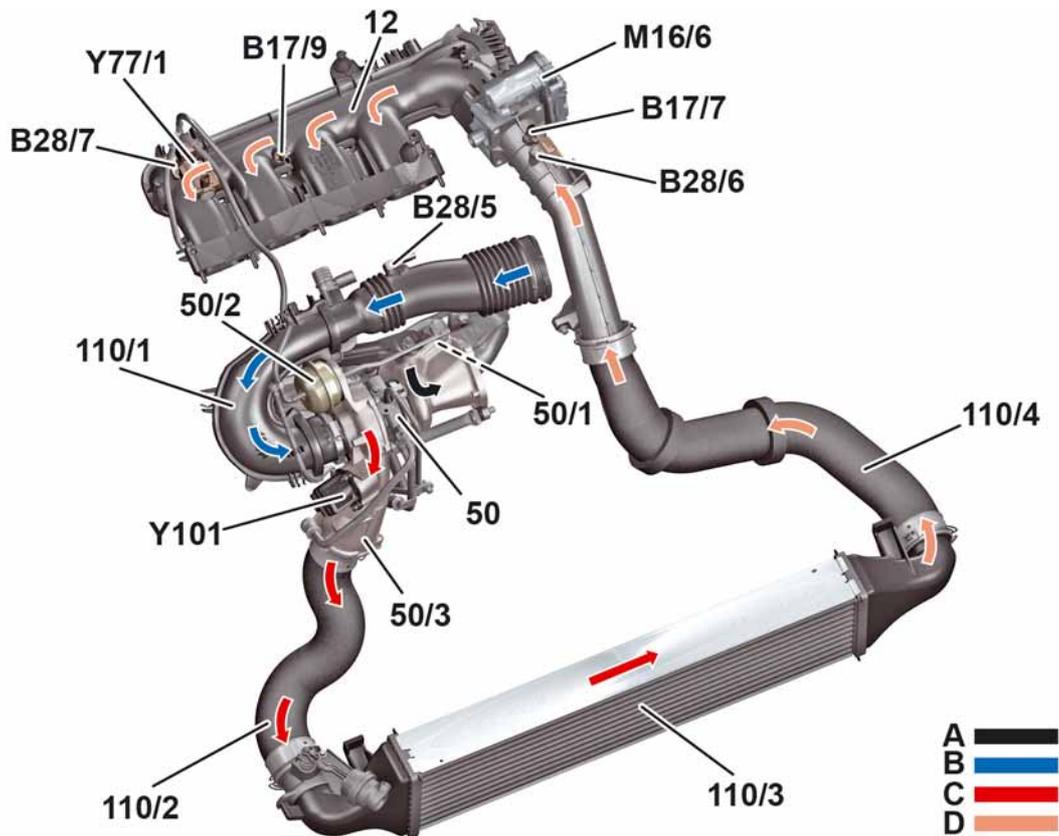
Turbocharger

50/1	Boost pressure control flap	A	Coolant feed line
50/2	Boost pressure control flap vacuum cell	B	Coolant return line
50/3	Noise damper	C	Engine oil feed line
50/4	Exhaust manifold	D	Engine oil return line
Y101	Bypass air switchover valve		

P09.40-2401-00

The turbocharger draws in fresh air via the air filter at the compressor inlet and guides it via the compressor outlet into the charge air pipe upstream of the charge air cooler. Due to the high rotational speed of the compressor wheel and the resulting high volumetric flow rate, the air in the charge air pipe is compressed to a boost pressure of max. 0.7 bar. A noise damper

dampens the boost pressure fluctuations and pulsing noises. The charge air flows to the charge air cooler via a charge air line. This then cools the compressed, heated charge air and guides it via a charge air line to the charge air manifold.



P09.00-2119-00

Flow pattern of intake air/charge air

12	Charge air manifold	B28/5	Pressure sensor downstream of air filter
50	Turbocharger	B28/6	Pressure sensor upstream of throttle valve
50/1	Boost pressure control flap	B28/7	Pressure sensor downstream of throttle valve
50/2	Boost pressure control flap vacuum cell	M16/6	Throttle valve actuator
50/3	Noise damper	Y77/1	Boost pressure control pressure transducer
110/1	Intake line	Y101	Bypass air switchover valve
110/2	Charge air line to charge air cooler	A	Exhaust
110/3	Charge air cooler	B	Intake air
110/4	Charge air line to throttle valve	C	Charge air (uncooled)
B17/7	Charge air temperature sensor upstream of throttle valve	D	Charge air (cooled)
B17/9	Charge air temperature sensor downstream of throttle valve		

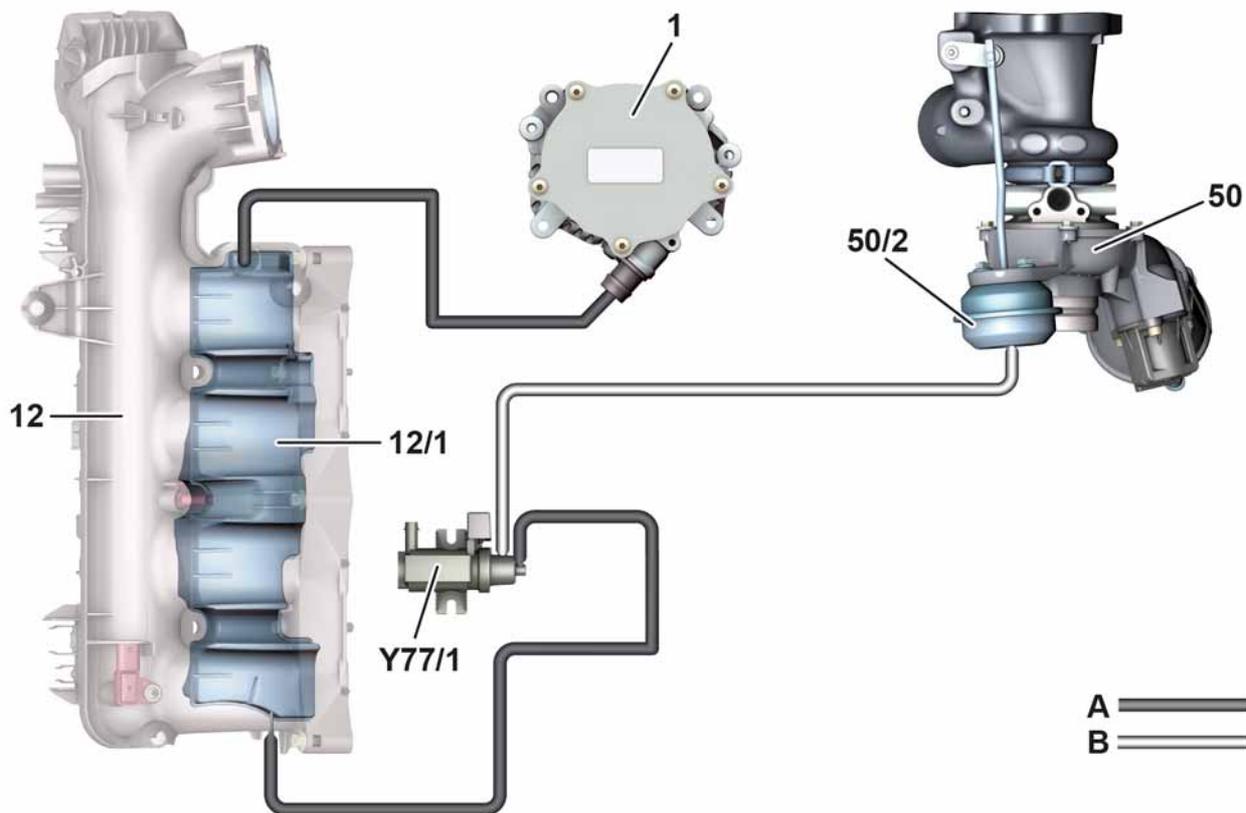
Charging

Boost pressure control

On engine 270, the boost pressure is controlled electropneumatically by the boost pressure control pressure transducer. The vacuum is generated by the mechanical vacuum pump mounted on the engine.

To control the boost pressure, the pressure transducer is actuated by the ME-SFI [ME] control unit according to a performance map and according to load. To do this, the ME-SFI [ME] control unit evaluates the following variables from the engine control system:

- Charge air temperature sensor downstream of throttle valve
- Pressure sensor upstream of throttle valve, boost pressure
- Pressure sensor downstream of throttle valve, boost pressure
- Pressure sensor downstream of air filter
- Accelerator pedal sensor, load request from driver
- Crankshaft Hall sensor (with rotation direction detection), engine speed
- Transmission overload protection, overheating protection



P07.09-2043-00

Boost pressure control vacuum system

1	Vacuum pump	Y77/1	Boost pressure control pressure transducer
12	Charge air manifold	A	Vacuum supply
12/1	Vacuum reservoir	B	Vacuum for controlling boost pressure control flap
50	Turbocharger		
50/2	Boost pressure control flap vacuum cell		

In the wide open throttle range the maximum boost pressure is built up. In order to reduce the boost pressure, the exhaust flow for driving the turbocharger turbine is diverted through a bypass by opening the boost pressure control flap. The vacuum reservoir supplies the boost pressure control valve with vacuum. In turn, the boost pressure control valve actuates the boost pressure control flap vacuum cell. The vacuum cell then opens the boost pressure control flap via a linkage, which closes the bypass. The boost pressure control flap allows the exhaust flow to bypass the turbine wheel, thus regulating the boost pressure and limiting the turbine speed. In this way the boost pressure of max. 0.7 bar can be matched to the current load requirement of the engine. To monitor the current boost pressure, the pressure sensor upstream of the throttle valve transmits an appropriate voltage signal to the ME-SFI [ME] control unit. The pressure sensor downstream of the air filter, which is located in the intake line upstream of the turbocharger, is used by the ME-SFI [ME] control unit to monitor the charging process.

The charge air temperature is registered in the charge air manifold by the charge air temperature sensor downstream of the throttle valve and sent to the ME-SFI [ME] control unit in the form of a voltage signal.

Bypass air

Due to the inertia of the shaft, compressor wheel and turbine wheel, the turbocharger continues to operate for a while after the vehicle enters deceleration mode. When the throttle valve actuator is closed quickly, a wave of boost pressure thus flows back to the turbocharger. This wave of boost pressure would cause a situation at the compressor wheel with low flow rates and high pressures, resulting in "turbo flutter" (brief howling noise and mechanical stress). Opening the bypass air switchover valve prevents this through rapid pressure release in the intake line.

If the ME-SFI [ME] control unit detects a transition from load to deceleration mode, the bypass air switchover valve is actuated. The bypass air switchover valve then opens the bypass, which runs past the compressor wheel, and allows release of the boost pressure.

Under load, the bypass air switchover valve closes the bypass with an integrated spring.

Injection system

Direct injection

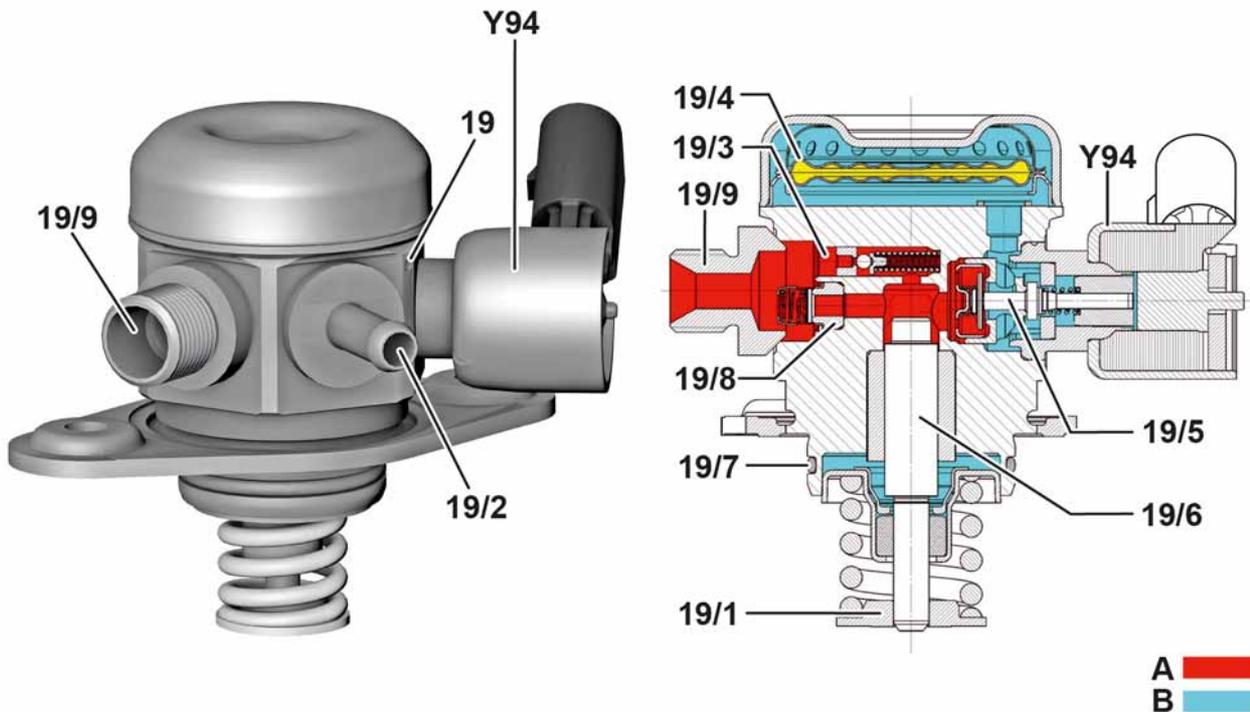
In order to generate high pressures, a high-pressure pump (single-piston pump) with a quantity control valve integrated in the pump module is used.

The fuel is transported via a high-pressure rail to the fuel injectors, which are centrally located and lead into the combustion chamber. The newly developed high-pressure injectors with piezo actuators are capable of delivering up to five highly accurate injections per cycle.

High-pressure pump

The high-pressure pump is located on the top of the cylinder head. The maximum delivery pressure of the high-pressure pump is 200 bar.

The high-pressure pump is driven mechanically by the intake camshaft via a driver. This means that the delivery rate of the high-pressure pump is rpm-dependent. During the upward stroke of the pump unit, the volume of fuel in the pump cylinder is compressed. When the system pressure is reached, the exhaust valve opens and the fuel is transported to the rail via the high-pressure line. A pressure limiting valve protects the high-pressure pump from excessive pressure buildup.



P07.02-2143-00

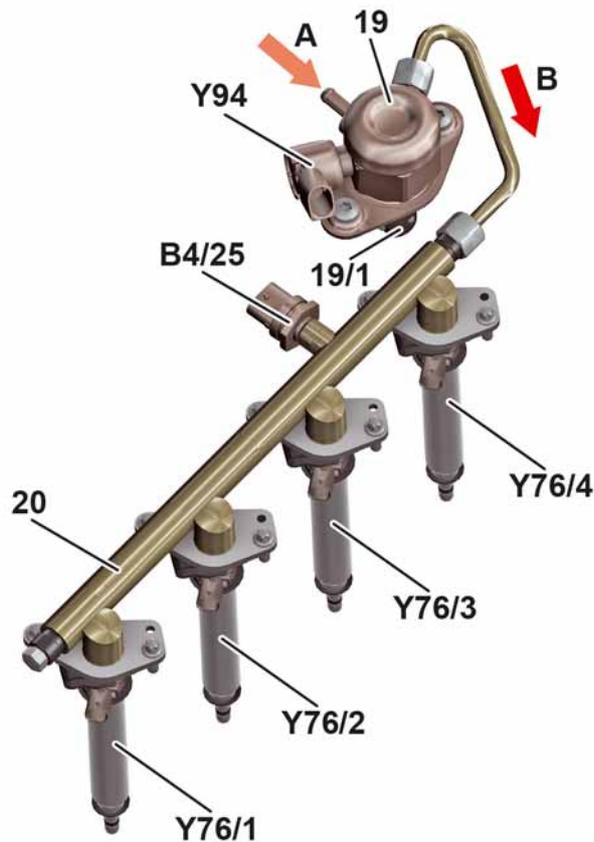
High-pressure pump

- | | | | |
|------|----------------------------------|-----|-------------------------|
| 19 | High-pressure pump | Y94 | Quantity control valve |
| 19/1 | Driver (drive) | A | Area with high pressure |
| 19/2 | Low-pressure connection fitting | B | Area with low pressure |
| 19/3 | Pressure limiting valve | | |
| 19/4 | Low-pressure pulsation damper | | |
| 19/5 | Valve needle | | |
| 19/6 | Piston | | |
| 19/7 | O-ring | | |
| 19/8 | High-pressure exhaust valve | | |
| 19/9 | High-pressure connection fitting | | |

Injection system

Rail

On engine 270, a soldered rail made of stainless steel is installed. This serves as a high-pressure reservoir for the fuel. The storage function of the rail dampens vibrations resulting from the injection process.



Fuel high-pressure system

P07.02-2142-00

19	High-pressure pump	A	Fuel low pressure (from fuel tank)
19/1	Driver (drive)	B	Fuel high pressure (to rail)
20	Rail		
B4/25	Fuel pressure and temperature sensor		
Y76/1	Cylinder 1 fuel injector		
Y76/2	Cylinder 2 fuel injector		
Y76/3	Cylinder 3 fuel injector		
Y76/4	Cylinder 4 fuel injector		
Y94	Quantity control valve		

Rail pressure regulation

The quantity control valve is located on the high-pressure pump and is actuated by the ME-SFI [ME] control unit with a PWM signal according to demand. This allows the fuel quantity which reaches the pump unit to be controlled and the high-pressure pump only compresses the fuel which is required by the engine. The rail pressure is thus regulated from 130 bar to 200 bar depending on the operating condition of the engine.

The current rail pressure and the fuel temperature are recorded by the fuel pressure and temperature sensor and forwarded to the ME-SFI [ME] control unit as voltage signals. When the engine is switched off the quantity control valve is no longer energized, which means that pressure can no longer be built up in the high-pressure chamber of the pump. The existing rail pressure is maintained for a very long period of time even after the engine is switched off.

Injection system

Fuel injectors

The fuel injectors spray a calculated quantity of finely atomized fuel into the combustion chamber of the associated cylinder at a certain point in time.

A coupler module inside the fuel injector ensures that the nozzle module and the piezo actuator module have zero clearance in the longitudinal direction. The fuel injectors are designed without a fuel return.

The fuel feed is sealed on the high-pressure side with an O-ring at the rail.

The seal between the fuel injector and the cylinder head is provided by a teflon ring.

The fuel injectors operate extremely rapidly and can inject even the smallest fuel quantities. Due to the high fuel pressure of 130 bar to 200 bar, the externally opening nozzle provides a stable hollow cone-shaped jet under all operating conditions.

The ME-SFI [ME] control unit generates the operating voltage of 125 to 160 V for the fuel injectors via an integrated output stage and actuates the fuel injectors with a ground signal. The lift of the nozzle needle is approx. 35 µm.

The piezo actuator module acts as a capacitive load for the ME-SFI [ME] control unit. When opening, a current of approx. 8 A flows for a few microseconds. To open and close, the ME-SFI [ME] control unit reverses the polarity.

The short switching times of the piezo injectors allow multiple injections with short pauses during a single combustion cycle.

Note on diagnosis

A 220 kΩ discharge resistor is connected in parallel with the piezo actuator module. This value is measurable at the electrical connections of the fuel injectors.

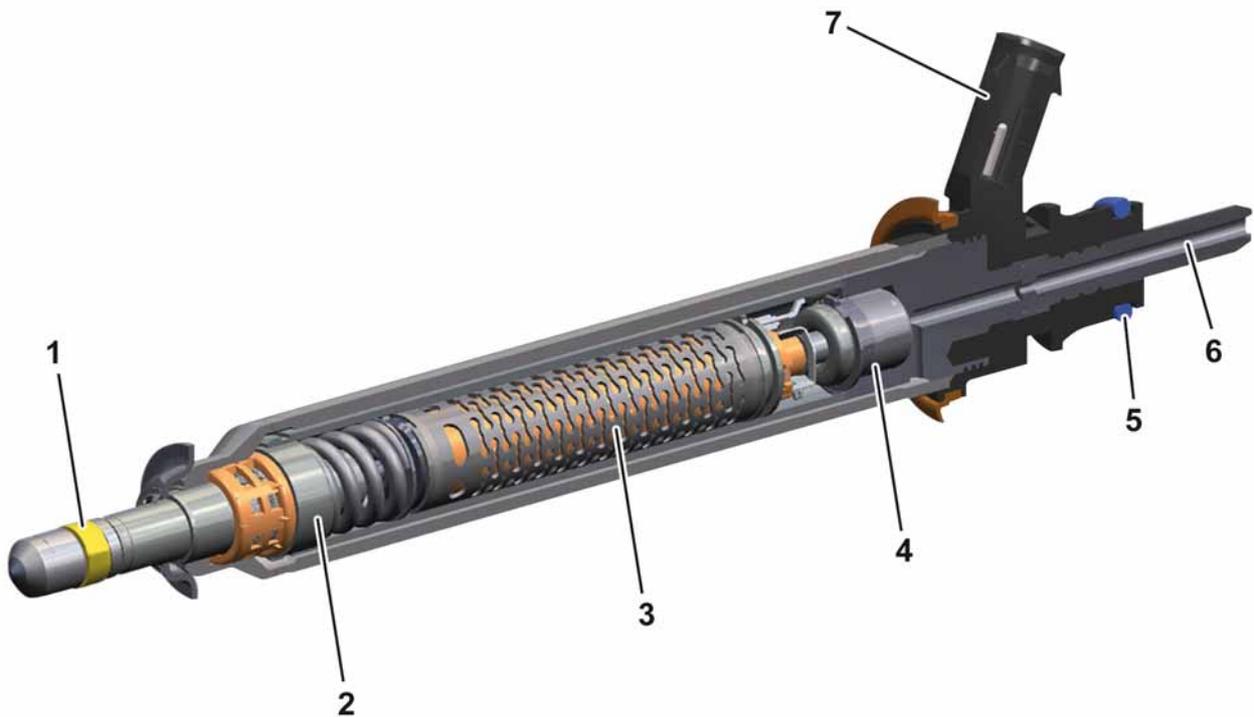
From each fuel injector, two lines lead directly to the ME-SFI [ME] control unit. Current and voltage measurements on these lines should only be performed using clamp-on probes (potential-free).

Warning

If the polarity of the lines from the fuel injector to the ME-SFI [ME] control unit is reversed, the fuel injector will be damaged!

If the lines have a short circuit to ground, the ME-SFI [ME] control unit will be damaged!

Before every removal, both ends of the fuel injector must be fitted with clean protective caps because touching the injector tip installed in the combustion chamber with other components can cause damage.



Fuel injector design (sectional view)

P07.03-2282-00

- | | |
|---|--|
| <ul style="list-style-type: none"> 1 Teflon ring 2 Valve group 3 Piezo actuator module | <ul style="list-style-type: none"> 4 Coupler 5 O-ring 6 Fuel high pressure 7 Electrical connection |
|---|--|

i Note

Whenever the fuel injectors are removed, all the seals on the fuel injector and in the rail, and the holddown springs must be renewed before re-installing.

The appropriate special tool (W278 589 00 33 00) must be used to install and remove the fuel injectors.

Do not use a slide hammer puller, as the rail is soldered!

i Note on cleanliness

The area around the fuel line to be opened must be cleaned thoroughly. Do not allow any dirt to enter the injection system, as this will lead to failure.

Fuel system

Fuel supply

The fuel supply system provides sufficient quantities of filtered fuel at sufficient pressure from the fuel tank to the high-pressure pump under all operating conditions. The high-pressure pump then pumps the fuel to the fuel injectors.

Fuel low-pressure system

The fuel pump is switched on when the signal "Fuel pump ON" is received by the fuel system control unit. This signal is transmitted redundantly both by the ME-SFI [ME] control unit as a CAN signal over the drive train CAN and directly. In addition, the fuel system control unit receives the CAN signal "Specified fuel pressure" from the ME-SFI [ME] control unit.

The fuel system control unit records the current fuel pressure via a voltage signal from the fuel pressure sensor and transmits this information via the drive train CAN to the ME-SFI [ME] control unit.

The fuel system control unit evaluates the current fuel pressure, compares it with the specified fuel pressure and actuates the fuel pump accordingly with a PWM signal so that the actual value matches the specified value.

In order to determine the specified fuel pressure (fuel requirement), the ME-SFI [ME] control unit evaluates the fuel pressure and load requirement. Depending on the fuel requirement, the fuel delivery rate is regulated up to a maximum of 130 l/h at a fuel pressure of 4.0 bar to 6.7 bar.

When actuated, the fuel pump draws the fuel out of the fuel feed module and pumps it to the high-pressure pump (single-line system, without return line). The fuel pressure is limited by the fuel pressure regulator to a pressure of 4.0 bar to 6.7 bar. The fuel filter is also located in the fuel feed module in the tank. In order to replace the fuel filter, the fuel tank must be removed.

There is a check valve at the feed point of the fuel filter which prevents reduction of the fuel pressure when the fuel pump is switched off.

Fuel high-pressure system

In the high-pressure fuel circuit, the high fuel pressure of up to 200 bar necessary for direct injection is generated, regulated and stored in the rails. There is a fuel pressure and temperature sensor mounted on the rail, which records the fuel pressure and monitors the fuel temperature.

To regulate the fuel high pressure, the ME-SFI [ME] control unit reads in the signals from the fuel pressure and temperature sensor.

There is a quantity control valve on the high-pressure pump. This regulates the quantity of fuel fed to the pump element for compression depending on the specified fuel pressure.

The high-pressure pump compresses the fuel up to max. 200 bar and pumps it via a high-pressure line into the rail. Pressure cannot be released actively in the high-pressure system. For this reason, in deceleration mode and after the engine is shut off, a pressure of up to 270 bar can build up due to heating of the high-pressure system. Fuel pressure pulses are dampened by the fuel pressure damper (e.g. during very low or very high acceleration). The fuel is stored in the rail and injected into the respective combustion chamber by the fuel injectors as a finely atomized spray.

Note

The stainless steel high-pressure fuel lines can be reused.

A relevant test specification can be found in WIS.

Fuel system

Safety fuel shutoff

In order to ensure road safety and passenger safety, a safety fuel shutoff takes place under certain conditions.

The ME-SFI [ME] control unit controls the safety fuel shutoff on the basis of the following sensors and signals:

- Crankshaft Hall sensor (with rotation direction detection)
- Engine speed
- Throttle valve actuator, throttle valve position
- Supplemental restraint system control unit, direct crash signal and indirect crash signal via chassis CAN

The safety fuel shutoff is activated by the ME-SFI [ME] control unit in the event of mechanical faults in the throttle valve actuator, if the engine speed signal is missing and in the event of a crash signal.

Mechanical faults in the throttle valve actuator

If by evaluating the throttle valve position the ME-SFI [ME] control unit detects a mechanical fault in the throttle valve actuator, the fuel injectors are partially shut off in order to restrict the engine speed to approx. 1400 rpm at idle and to approx. 1800 rpm during driving operation.

Absence of the engine speed signal

If the engine speed signal generated by the ME-SFI [ME] control unit is missing, the fuel pump is shut off by the fuel system control unit.

Crash signal

If the ME-SFI [ME] control unit receives a crash signal indirectly via the chassis CAN or directly from the supplemental restraint system control unit, it shuts off the fuel pump via the fuel system control unit (directly and via drive train CAN) as well as the quantity control valve and briefly actuates the fuel injectors in order to depressurize the fuel system.

Purging

Fuel vapors must not be allowed to escape into the atmosphere when the fuel tank is vented.

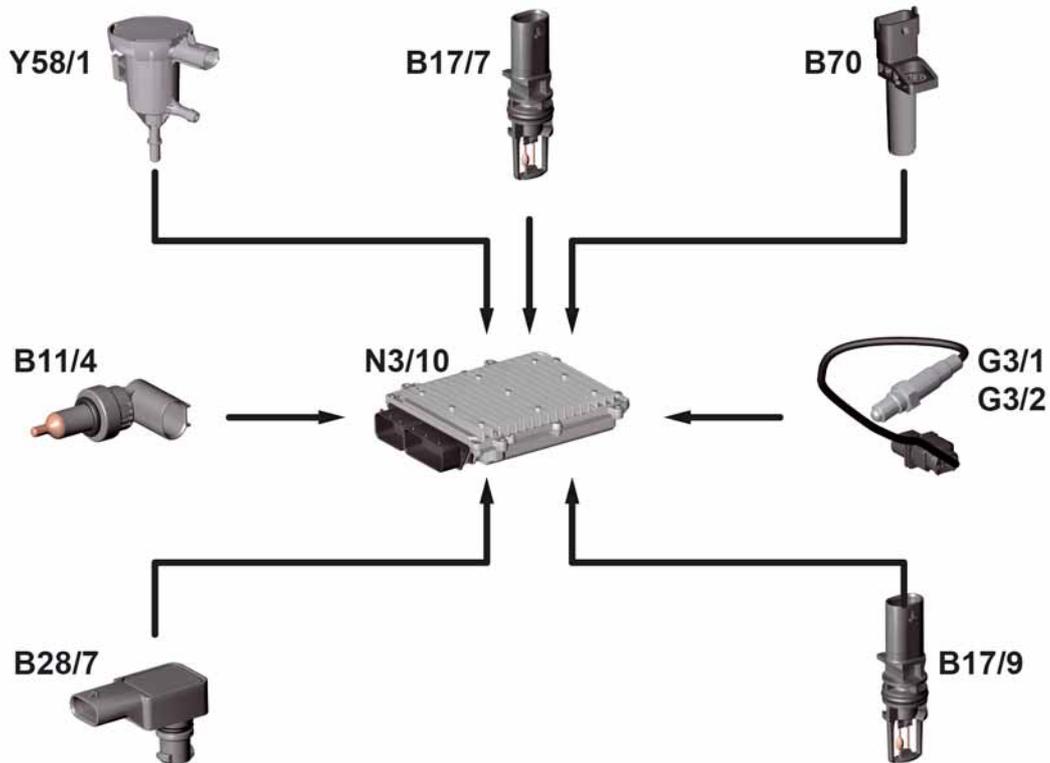
When the engine is running, the fuel vapors stored in the activated charcoal canister are drawn off via the purge switchover valve and burned in the engine.

To regulate the purge quantity, the purge switchover valve is actuated by the ME-SFI [ME] control unit at the ground end by means of a PWM signal with a frequency of 10 Hz to 30 Hz.

The constant opening and closing of the purge switchover valve with on/off cycles of varying lengths determine the purge quantity.

Note

The idle speed control prevents the purging process from causing changes to the engine speed at idle. The fuel/air mixture is leaned out accordingly depending on the amount of fuel vapor in the activated charcoal canister.



P47.30-2243-00

Function schematic of purging

- | | | | |
|--------------|---|--------------|--|
| <i>B11/4</i> | <i>Coolant temperature sensor</i> | <i>G3/1</i> | <i>Oxygen sensor downstream of catalytic converter</i> |
| <i>B17/7</i> | <i>Charge air temperature sensor upstream of throttle valve</i> | <i>G3/2</i> | <i>Oxygen sensor upstream of catalytic converter</i> |
| <i>B17/9</i> | <i>Charge air temperature sensor downstream of throttle valve</i> | <i>N3/10</i> | <i>ME-SFI [ME] control unit</i> |
| <i>B28/7</i> | <i>Pressure sensor downstream of throttle valve</i> | <i>Y58/1</i> | <i>Purge switchover valve</i> |
| <i>B70</i> | <i>Crankshaft Hall sensor (with rotation direction detection)</i> | | |

Exhaust system

Exhaust treatment

The task of the exhaust treatment system is to reduce exhaust emissions:

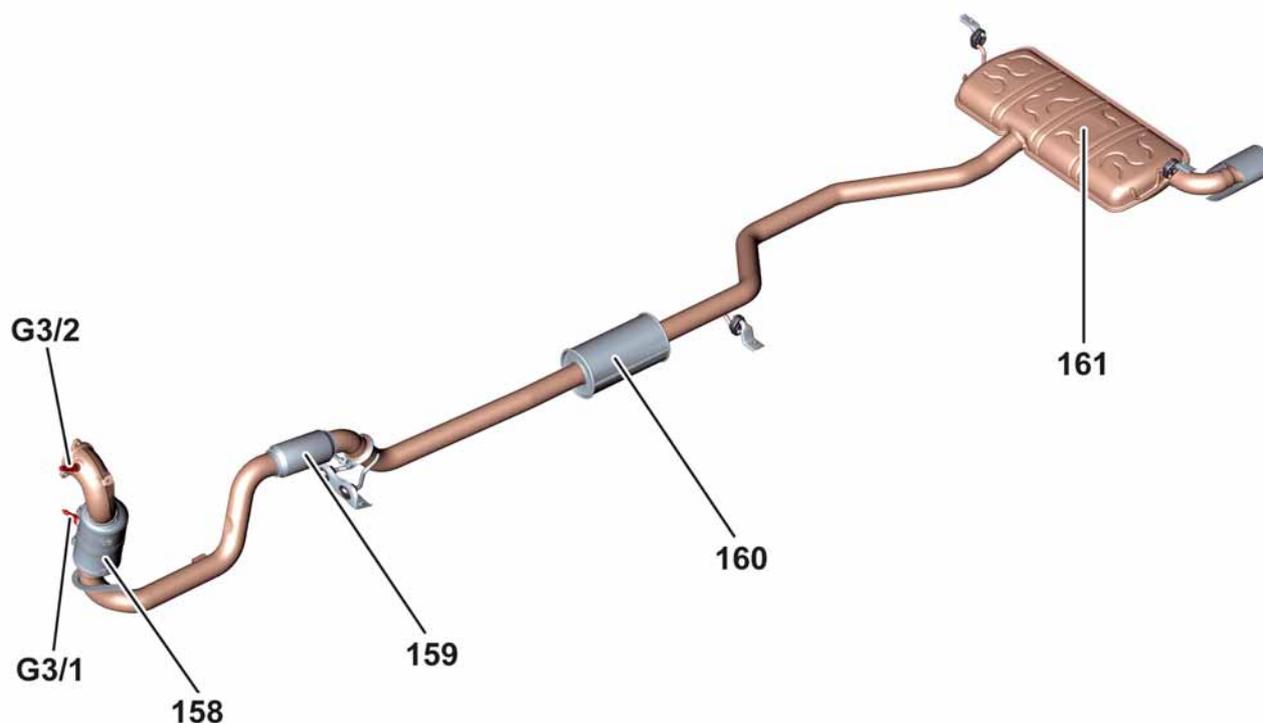
- Nitrogen oxides (NOx)
- Hydrocarbon (HC)
- Carbon monoxide (CO)

To do so, the catalytic converter, for example, must be quickly brought up to operating temperature so that exhaust emissions during cold starting are reduced.

The exhaust system consists of:

- Catalytic converter
- Decoupling element
- Front muffler
- Rear muffler

With the help of this newly developed exhaust system, the EURO 5 emissions standard required for the start of series production is fulfilled. The design takes into account the possibility of fulfilling the EURO 6 emissions standard.



P49.00-2148-00

Exhaust system

- 158 Catalytic converter
- 159 Decoupling element
- 160 Front muffler
- 161 Rear muffler

- G3/1 Oxygen sensor downstream of catalytic converter
- G3/2 Oxygen sensor upstream of catalytic converter

The following subsystems are involved in exhaust treatment:

- Catalytic converter
- Transmission shift delay (with dual clutch transmission)
- Monitoring of catalytic converter efficiency

Catalytic converter

The pollutants emitted by the engine in the exhaust are converted by the catalytic converter (three-way catalytic converter).

Through oxidation, carbon monoxide is converted into carbon dioxide (CO₂) and hydrocarbons are converted into water (H₂O) + carbon dioxide.

Through reduction, nitrogen oxides are converted into nitrogen (N₂) + carbon dioxide.

Transmission shift delay (with dual clutch transmission)

The transmission shift delay function brings the catalytic converter up to operating temperature more quickly after an engine start. The ME-SFI [ME] control unit controls the transmission shift delay by requesting the dual clutch transmission fully integrated transmission control unit to offset the shift characteristics via the drive train CAN.

The transmission shift delay is active for a maximum of 160s and takes place on a solely electronic basis.

Monitoring of catalytic converter efficiency

According to legal requirements, hydrocarbon emissions (HC emissions) may not exceed a specified limit.

The task of the catalytic converter efficiency monitoring function is to make an assessment about the aging of the catalytic converter and thus its HC conversion rate based on its ability to store oxygen.

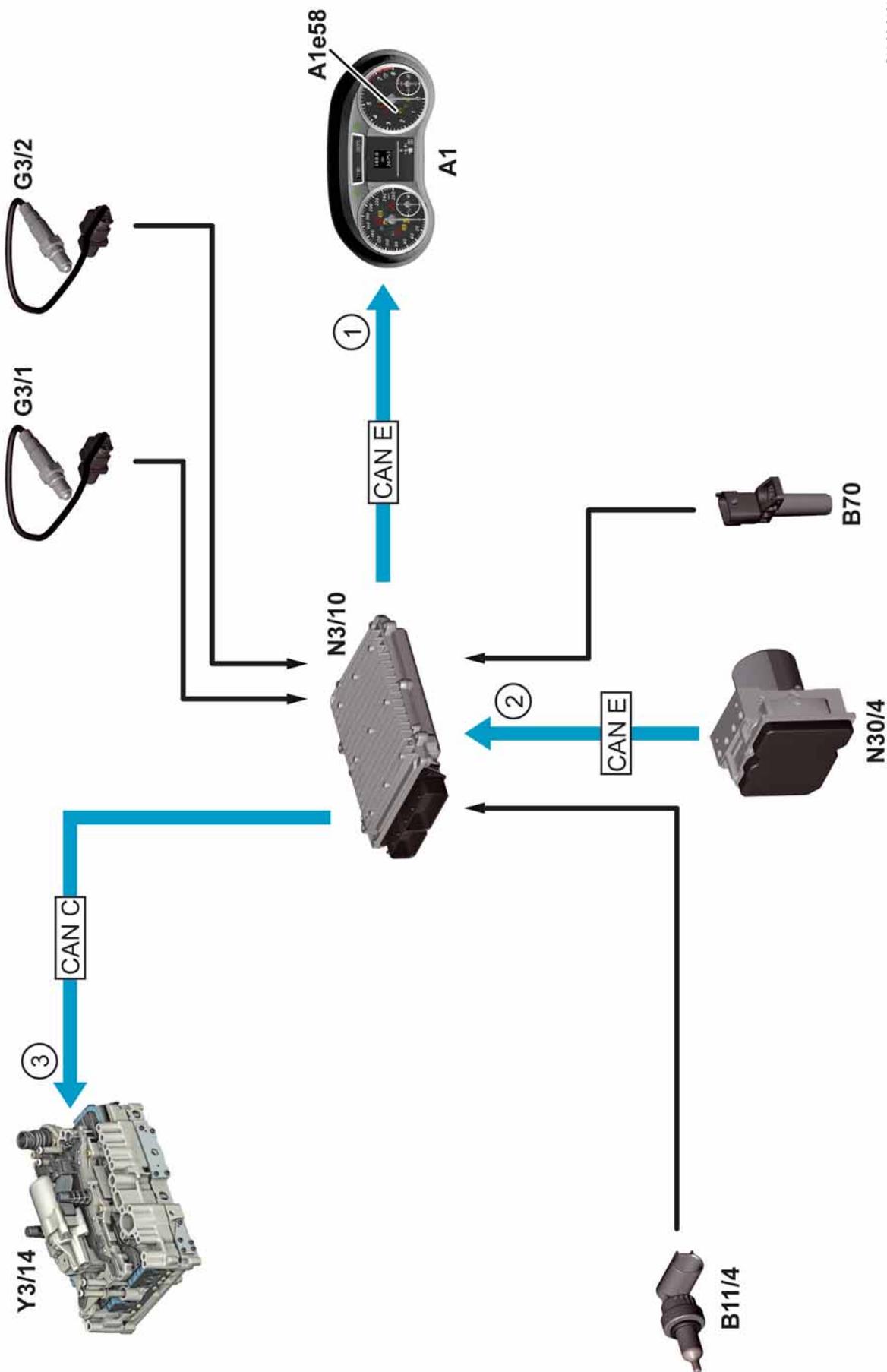
The oxygen stored in a lean operating phase is released fully or partially during a rich operating phase. Aging reduces the oxygen storage capability and HC conversion rate of the catalytic converter.

The high oxygen storage capability of the catalytic converter almost fully buffers the change in oxygen content downstream of the catalytic converter. As a consequence, the oxygen sensor signal downstream of the catalytic converter has a small amplitude and is almost constant.

When the catalytic converter is at operating temperature and lambda control is enabled, the amplitudes of the oxygen sensor signals downstream and upstream of the catalytic converter are compared. If the catalytic converter is no longer operational, the signals of the oxygen sensor upstream and downstream of the catalytic converter will be equal.

In the specified engine rpm range, multiple measurements are carried out in the lower partial-load range. The results are compared against a characteristics map in the ME-SFI [ME] control unit. When a fault is detected, the ME-SFI [ME] control unit actuates the engine diagnosis indicator lamp in the instrument cluster via the chassis CAN.

Exhaust system



P14.00-2121-00

Function schematic of exhaust treatment

A1	Instrument cluster
A1e58	Engine diagnosis indicator lamp
B11/4	Coolant temperature sensor
B70	Crankshaft Hall sensor (with rotation direction detection)
G3/1	Oxygen sensor downstream of catalytic converter
G3/2	Oxygen sensor upstream of catalytic converter

N3/10	ME-SFI [ME] control unit
N30/4	Electronic Stability Program control unit
Y3/14	Dual clutch transmission fully integrated transmission controller unit (with code (429) Dual clutch transmission)
CAN C	Drive train CAN
CAN E	Chassis CAN

- 1 Engine diagnosis indicator lamp, actuation
- 2 Wheel speed, signal
- 3 Shift point, increase request

Engine cooling

Cooling circuit

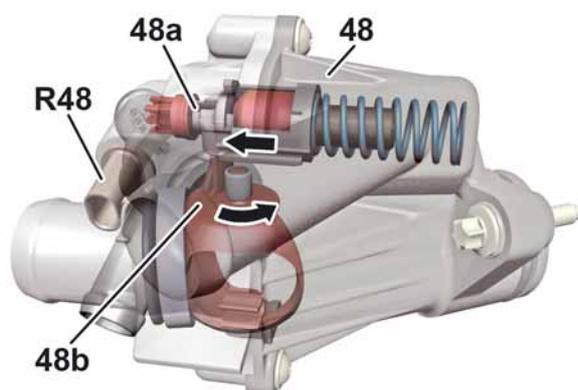
Engine cooling takes place via a crossflow cooling system. An electronically controlled thermostat enables a map-controlled warm-up process. This control system makes rapid warming of the combustion chambers possible during the warm-up phase. The coolant temperatures can be adjusted depending on driving style and ambient conditions.

The coolant pump control system is designed to allow the vehicle interior to be heated up as early as possible.

Coolant thermostat

The coolant thermostat regulates the coolant temperature in a range of 98 °C to 108 °C for the thermal management system depending on the engine load. The heating element is actuated at the ground end by the ME-SFI [ME] control unit. As of approx. 108 °C, the coolant thermostat is always fully open irrespective of the control settings.

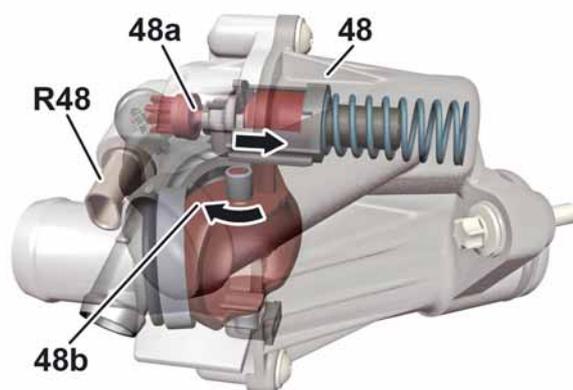
In order to minimize pressure losses, the coolant thermostat is equipped with a rotary ball valve to control the volumetric flow rates.



Coolant thermostat closed

P20.10-2316-00

- 48 Coolant thermostat housing
- 48a Expanding wax element
- 48b Rotary ball valve
- R48 Coolant thermostat heating element



Coolant thermostat open

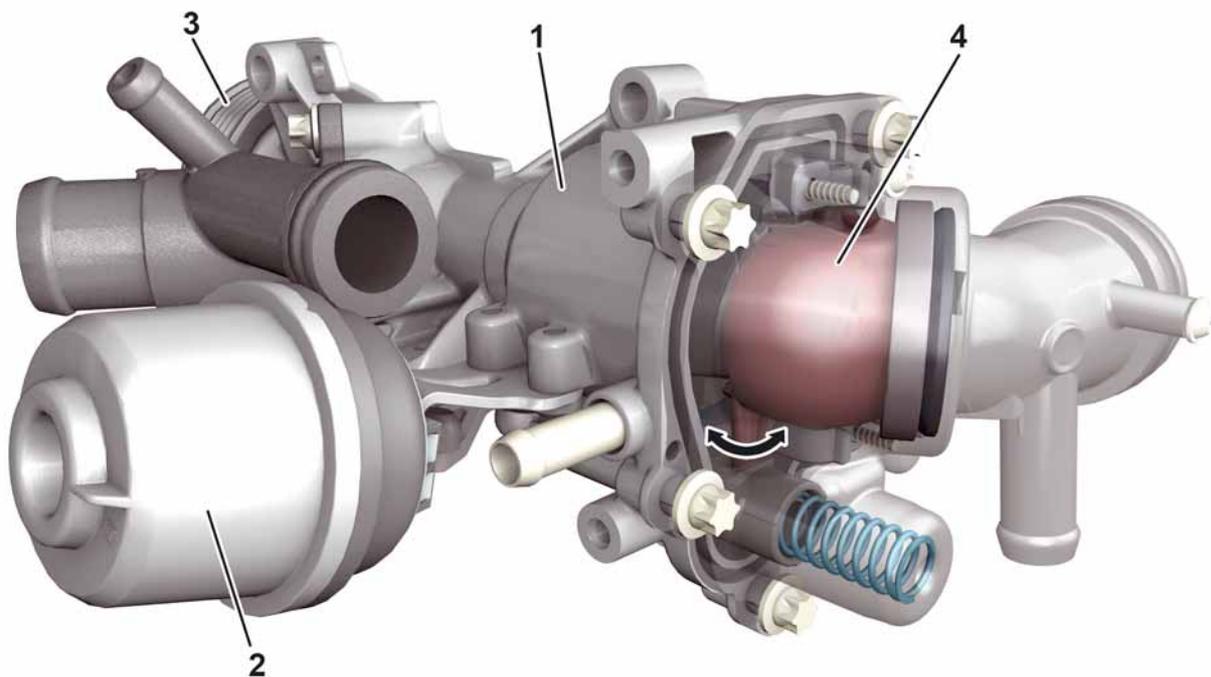
P20.10-2321-00

- 48 Coolant thermostat housing
- 48a Expanding wax element
- 48b Rotary ball valve
- R48 Coolant thermostat heating element

Coolant pump

During the warm-up phase, the coolant pump is shut off by a vacuum-operated rotary ball valve so that the coolant stays in the engine. This accelerates the warming of the engine and allows energy-saving operating strategies (e.g. ECO start/stop system) to be activated more quickly.

If heating or climate control requests are made, the coolant pump is activated according to demand.

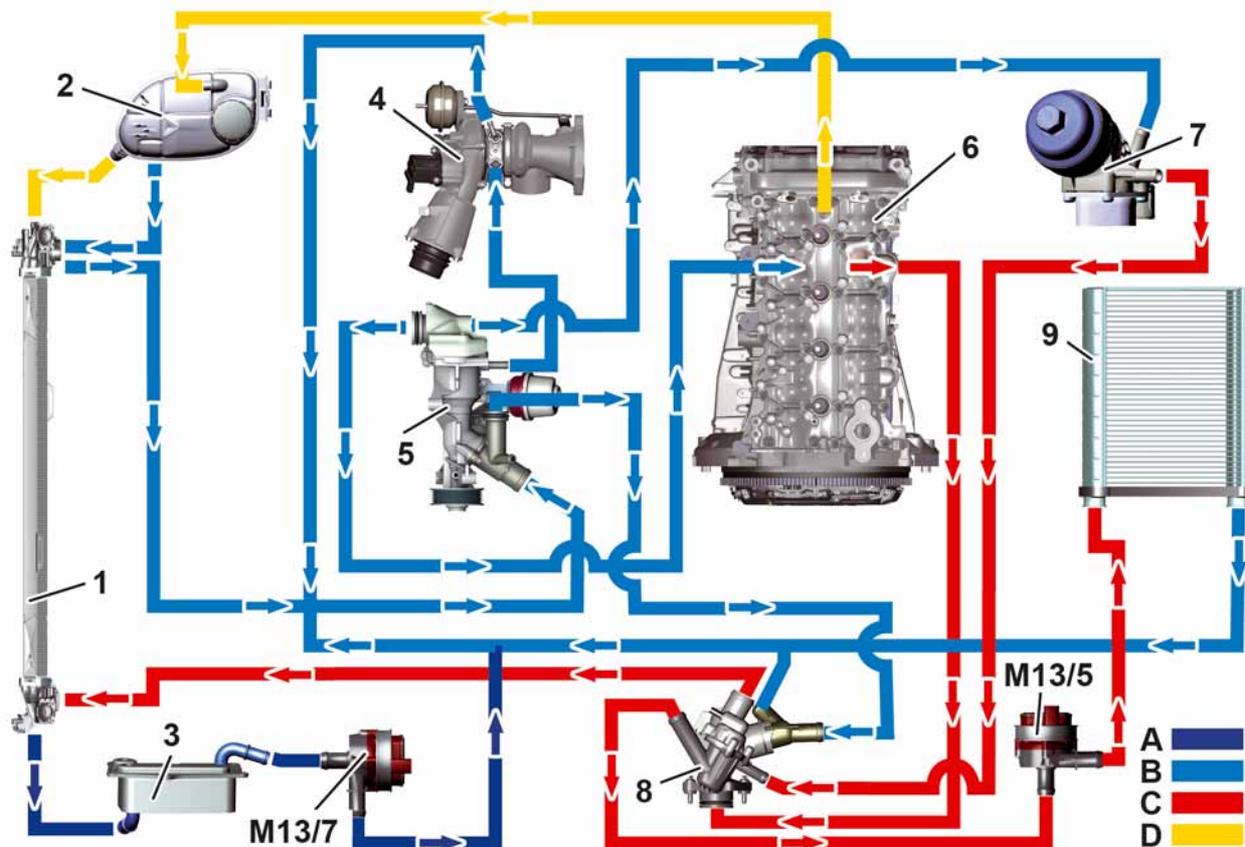


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Coolant pump

- 1 Coolant pump housing
- 2 Coolant pump vacuum cell
- 3 Belt pulley
- 4 Rotary ball valve

Engine cooling

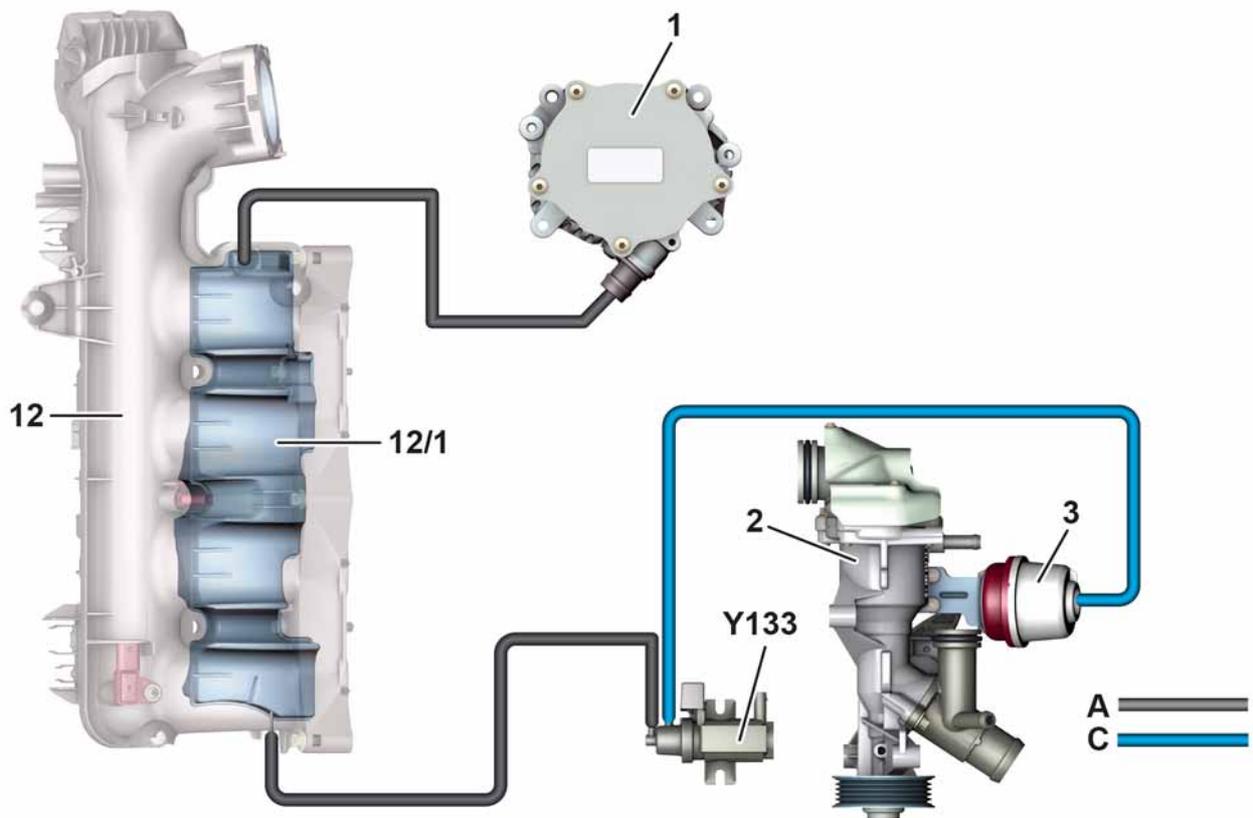


P20.00-2427-00

Coolant circuit, schematic illustration

- | | | | |
|---|---|-------|---|
| 1 | Radiator | M13/5 | Coolant circulation pump
with code (581) Comfort automatic air conditioning) |
| 2 | Coolant expansion reservoir | M13/7 | Transmission cooling coolant circulation pump
(with code (429) Dual clutch transmission) |
| 3 | Coolant/transmission oil cooler
(with code (429) Dual clutch transmission) | A | Low-temperature cooling circuit coolant return |
| 4 | Turbocharger | B | Coolant return to engine |
| 5 | Coolant pump | C | Coolant feed |
| 6 | Engine 270 | D | Coolant circuit ventilation |
| 7 | Engine oil/coolant heat exchanger | | |
| 8 | Thermostat | | |
| 9 | Heater heat exchanger | | |



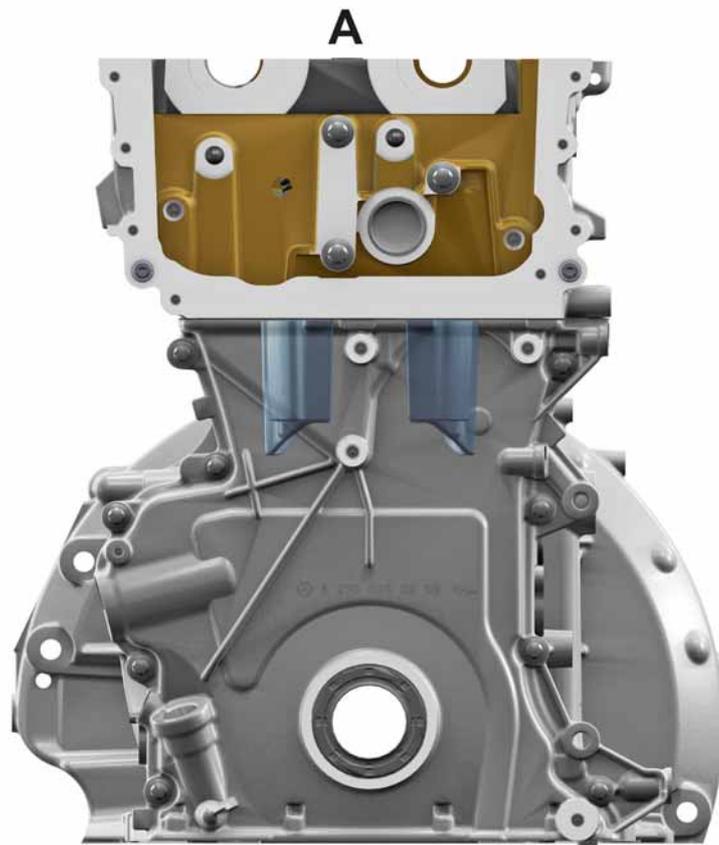


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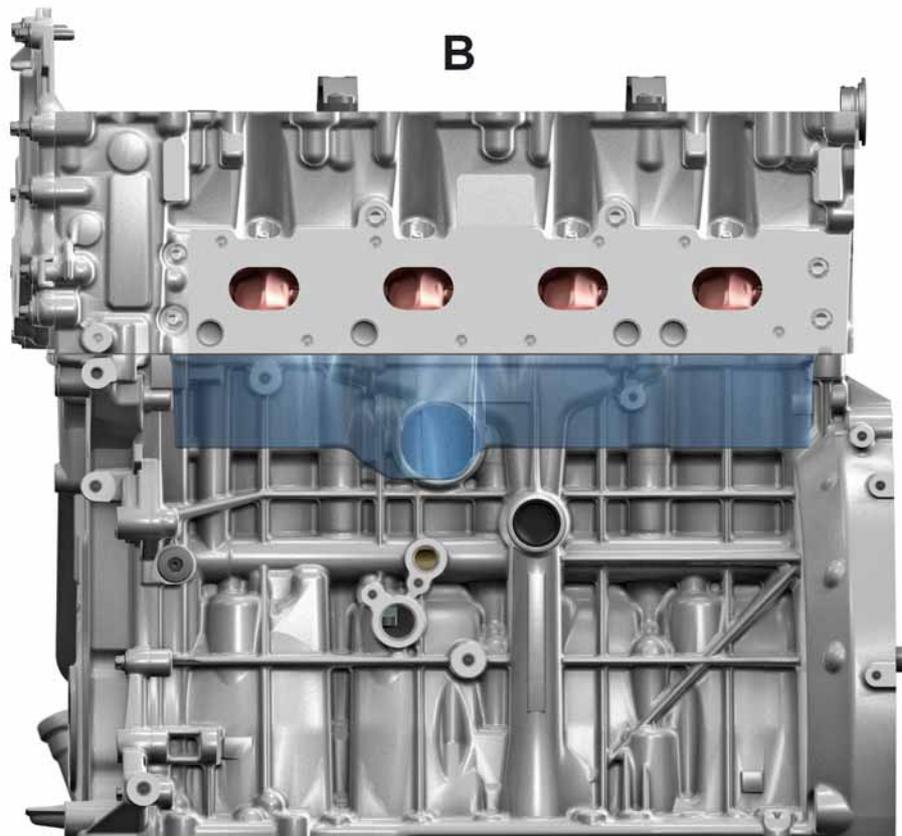
Vacuum system for coolant pump control

- | | | | |
|------|--------------------------|------|-------------------------------------|
| 1 | Vacuum pump | Y133 | Coolant pump switchover valve |
| 2 | Coolant pump | A | Vacuum supply |
| 3 | Coolant pump vacuum cell | C | Vacuum for controlling coolant pump |
| 12 | Charge air manifold | | |
| 12/1 | Vacuum reservoir | | |

Engine cooling



P20.00-2425-00

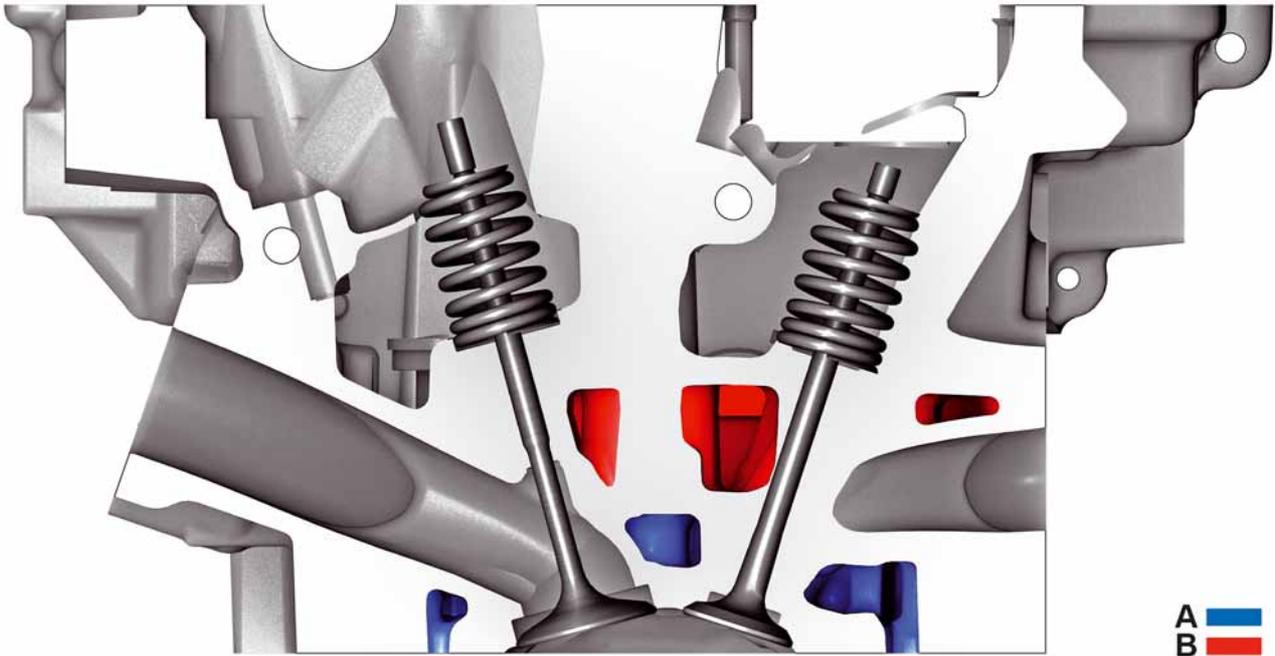


P20.00-2426-00

Coolant distribution

A Left crankcase

B Rear crankcase



A 
 B 

P20.00-2430-00

Cylinder head coolant flow

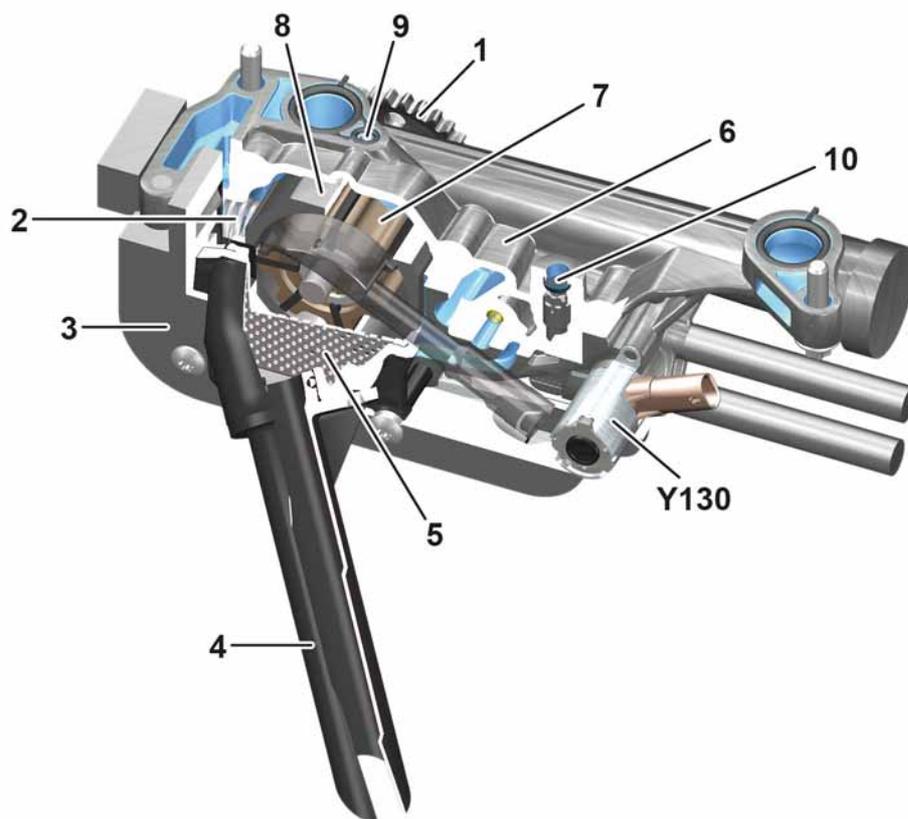
- A Rapid flow (cold)
- B Slow flow (warm)

Engine lubrication

Regulated engine oil pump

The engine oil pressure is regulated via the engine oil pump valve on the engine oil pump. The ME-SFI [ME] control unit actuates the engine oil pump valve. This allows the oil pressure to be adjusted according to demand from 3.9 bar to 1.7 bar. The engine oil supply in the oil circuit of the engine is thus optimally matched to the respective requirements. This also reduces the power loss of the engine oil pump and, as a consequence, the power loss of the engine. As soon as the minimum engine oil level is reached, this is recorded by the oil level check switch in the oil pan and transmitted to the ME-SFI [ME] control unit.

The engine oil pressure reported back via the control channel is modulated at the pilot control valve and acts on the set collar against the force of the control spring opposite. The position of the set collar produces eccentricity relative to the rotational axis of the rotor, whereby the delivery rate increases as the eccentricity increases.



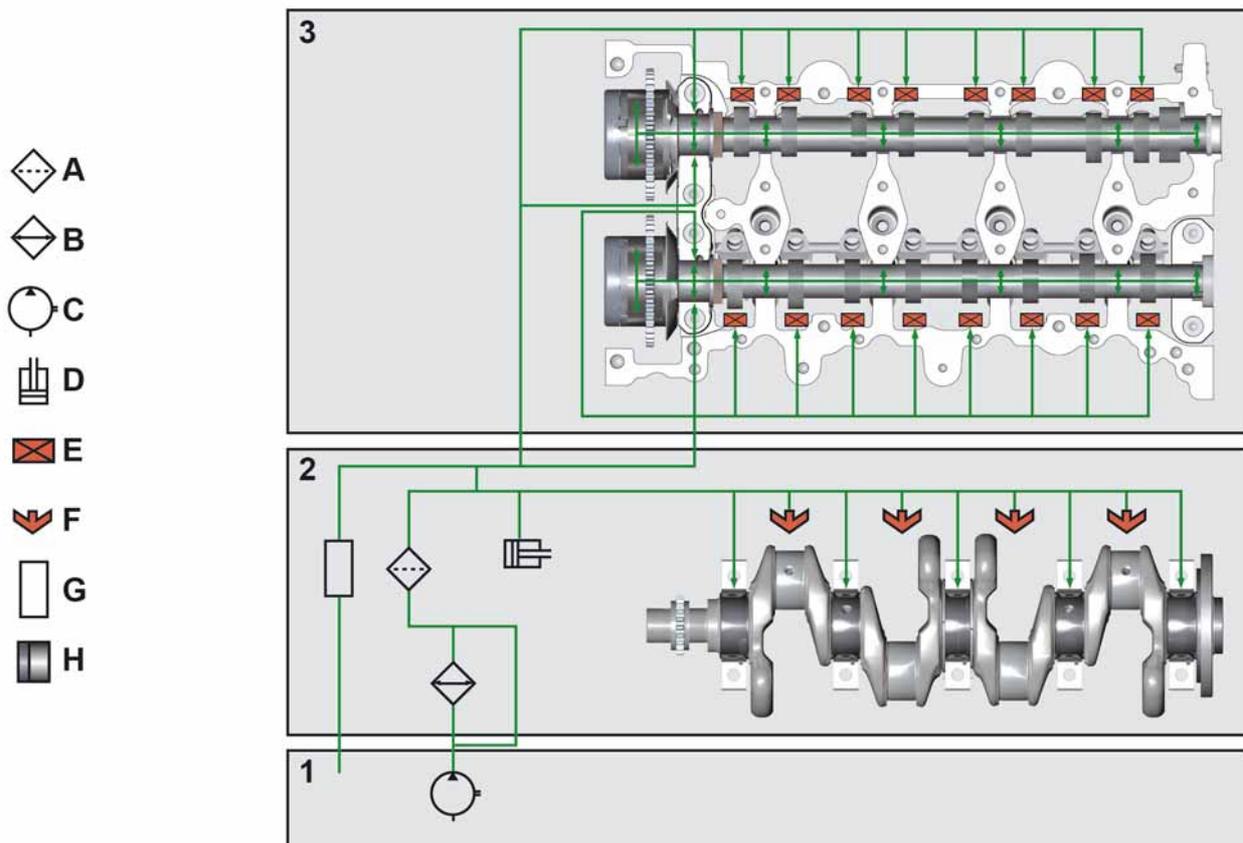
Engine oil pump

- 1 Drive gear
- 2 Control spring
- 3 Oil pump cover
- 4 Oil intake tube
- 5 Oil screen

- 6 Oil pump housing
- 7 Rotor with vane
- 8 Set collar
- 9 Control channel
- 10 Pilot control valve

Y130 Engine oil pump valve

P18.10-2195-00



P18.00-2312-00

Oil circuit diagram, M 270

- 1 Oil pan
- 2 Crankcase
- 3 Cylinder head

- A Oil filter
- B Engine oil/coolant heat exchanger
- C Engine oil pump
- D Chain tensioner
- E Hydraulic valve clearance compensator
- F Oil spray nozzle
- G Turbocharger
- H Camshaft adjuster

Engine control

Motor electronics (ME-SFI [ME]) control unit

The engine is equipped with a newly developed ME-SFI [ME] control unit. The ME-SFI [ME] control unit is attached to the intake side of the air filter housing in order to make use of the cooling effect of the intake air.

The entire engine control system is contained in the ME-SFI [ME] control unit. The ME-SFI [ME] control unit combines electrically with the sensors and actuators of engine 270 to form the engine control system.

The engine control system reads in sensor data directly and, via the CAN network, indirectly and actuates the respective actuators.

The engine control system is based on a single-processor concept with a separate control monitor and operates at a clock frequency of 150 MHz.

The most important features of the engine control system are:

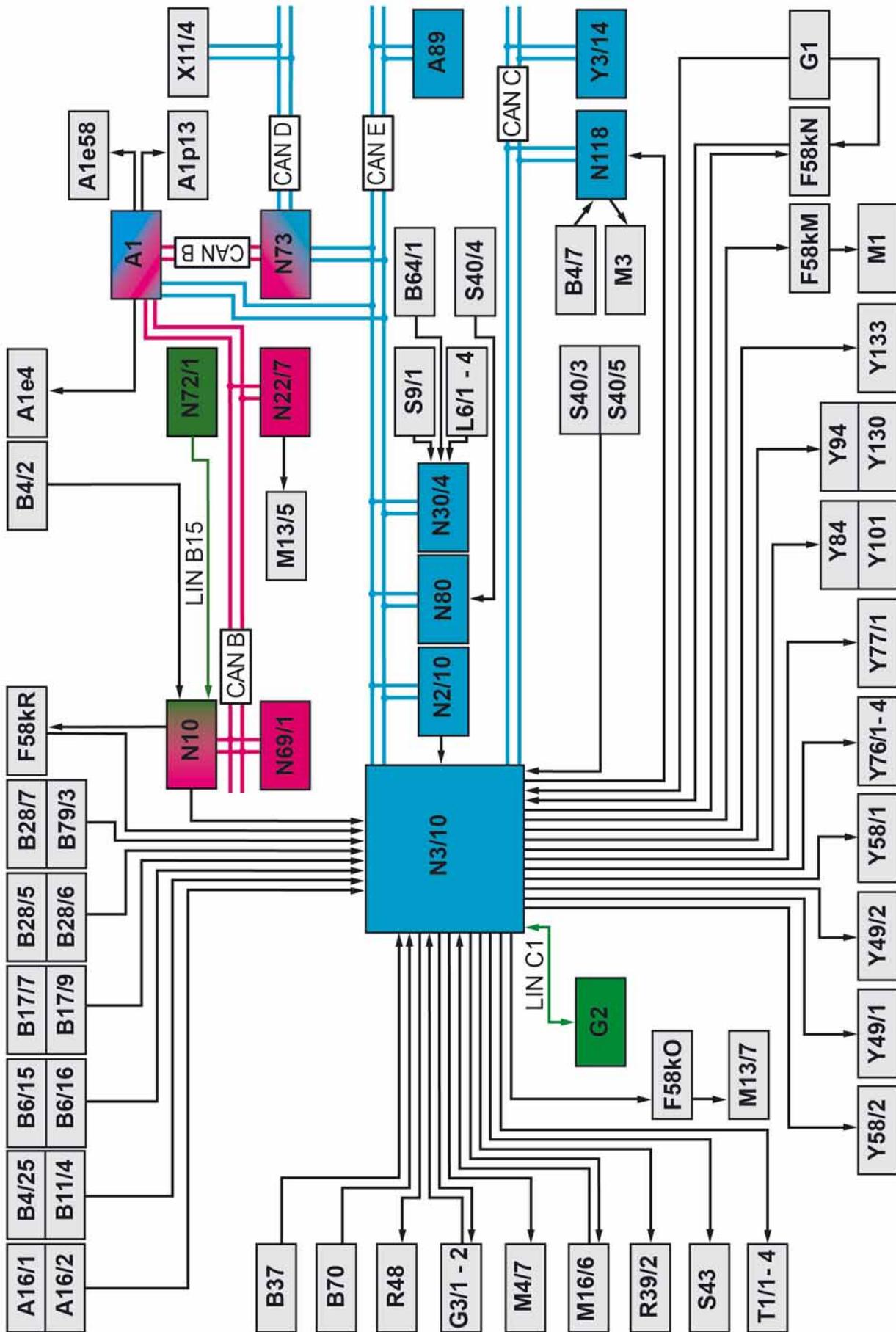
- Cylinder-selective, adaptive knock control
- Torque control
- Lambda control
- Control of direct injection fuel injectors
- Control of throttle valve actuator
- Crankshaft sensor with rotation direction detection

The following systems and functions are controlled and coordinated by the ME-SFI [ME] control unit according to the input signals:

- Ignition system
- Fuel supply
- High-pressure gasoline injection
- Electronic accelerator
- Diagnosis and fault storage
- Engine control start/stop function
- Drive authorization system and immobilizer
- Stepless camshaft adjustment for intake and exhaust
- Boost pressure control
- Torque interface to ESP, transmission and air conditioning
- Alternator interface
- Thermal management for shortening warm-up phase
- Exhaust treatment
- Control of engine oil pump

Note

Any faults detected are stored in the fault memory of the ME-SFI [ME] control unit. These can be read out using Xentry Diagnostics.



P07.70.2299.00

Engine control

Block diagram

A1 Instrument cluster
 A1e4 Fuel reserve warning lamp
 A1e58 Engine diagnosis indicator lamp
 A1p13 Multifunction display
 A16/1 Knock sensor 1
 A16/2 Knock sensor 2
 A89 DISTRONIC electric controller unit (with code (239) DISTRONIC PLUS and BAS PRO)

B4/2 Fuel tank fill level sensor, right
 B4/7 Fuel pressure sensor
 B4/25 Fuel pressure and temperature sensor
 B6/15 Intake camshaft Hall sensor
 B6/16 Exhaust camshaft Hall sensor
 B11/4 Coolant temperature sensor
 B17/7 Charge air temperature sensor upstream of throttle valve
 B17/9 Charge air temperature sensor downstream of throttle valve
 B28/5 Pressure sensor downstream of air filter
 B28/6 Pressure sensor upstream of throttle valve
 B28/7 Pressure sensor downstream of throttle valve
 B37 Accelerator pedal sensor
 B64/1 Brake vacuum sensor (with code (B03) ECO start/stop function)
 B70 Crankshaft Hall sensor (with rotation direction detection)
 B79/3 Manual transmission main shifter shaft position sensor (with manual transmission and code (B03) ECO start/stop function)

CAN B Interior CAN
 CAN C Drive train CAN
 CAN D Diagnostic CAN
 CAN E Chassis CAN
 F58kM Starter circuit 50 relay
 F58kN Circuit 87M relay
 F58kR Circuit 15 relay
 F58kO Transmission cooling coolant circulation pump relay (with code (429) Dual clutch transmission)
 G1 On-board electrical system battery
 G2 Alternator
 G3/1 Oxygen sensor downstream of catalytic converter
 G3/2 Oxygen sensor upstream of catalytic converter
 L6/1 Left front axle rpm sensor
 L6/2 Right front axle rpm sensor
 L6/3 Left rear axle rpm sensor
 L6/4 Right rear axle rpm sensor
 LIN B15 Battery sensor LIN
 LIN C1 Drive train LIN



M1	Starter
M3	Fuel pump
M4/7	Fan motor
M13/5	Coolant circulation pump (with code (581) Comfort automatic air conditioning)
M13/7	Transmission cooling coolant circulation pump (with code (429) Dual clutch transmission)
M16/6	Throttle valve actuator
N2/10	Supplemental restraint system control unit
N3/10	ME-SFI [ME] control unit
N10	SAM control unit
N22/7	Automatic air conditioning control and operating unit
N30/4	Electronic Stability Program control unit
N69/1	Left front door control unit
N72/1	Upper control panel control unit
N73	Electronic ignition lock control unit
N80	Steering column tube module control unit
N118	Fuel system control unit

R39/2	Wide open throttle operation vent line heater element
R48	Coolant thermostat heating element
S9/1	Brake light switch
S40/3	Clutch pedal switch (with manual transmission)
S40/4	Cruise control lever
S40/5	Start enable clutch pedal switch (with manual transmission)
S43	Oil level check switch
T1/1	Cylinder 1 ignition coil
T1/2	Cylinder 2 ignition coil
T1/3	Cylinder 3 ignition coil
T1/4	Cylinder 4 ignition coil
X11/4	Diagnostic connector

Y3/14	Dual clutch transmission fully integrated transmission controller unit (with code (429) Dual clutch transmission)
Y49/1	Intake camshaft solenoid
Y49/2	Exhaust camshaft solenoid
Y58/1	Purge switchover valve
Y58/2	Partial load operation crankcase ventilation system valve
Y76/1	Cylinder 1 fuel injector
Y76/2	Cylinder 2 fuel injector
Y76/3	Cylinder 3 fuel injector
Y76/4	Cylinder 4 fuel injector
Y77/1	Boost pressure control pressure transducer
Y84	Radiator shutters actuator
Y94	Quantity control valve
Y101	Bypass air switchover valve
Y130	Engine oil pump valve
Y133	Coolant pump switchover valve

Ignition system

The ignition coils are designed as single spark ignition coils and plug directly onto the spark plugs via short ignition lines ("boots"). The ignition coils provide sufficient ignition energy for the respective cylinder in all operating conditions.

The ME-SFI [ME] control unit actuates the ignition coil with a 5 V signal. At the firing point, the ignition coil interrupts the primary circuit at the ground end. The ignition voltage flows from the ignition coil to the spark plug and causes arcing in the air gap between the central electrode and ground electrode. The ignition angles are determined by the ME-SFI [ME] control unit according to a characteristics map on the basis of the input signals.

Operating modes of the ignition coil

Single-spark ignition

In this operating mode the ignition coil is charged and an ignition spark is generated once in each ignition cycle.

New combustion methods increase the demands on the ignition system. In supercharged engines the ignition coil must deliver a higher secondary voltage so that an ignition spark can be produced. In order to reliably ignite the mixture, high-energy ignition coils are used which provide a long spark duration. It is also possible to use several sparks per ignition cycle instead of just one. This system is referred to as multi-spark ignition.

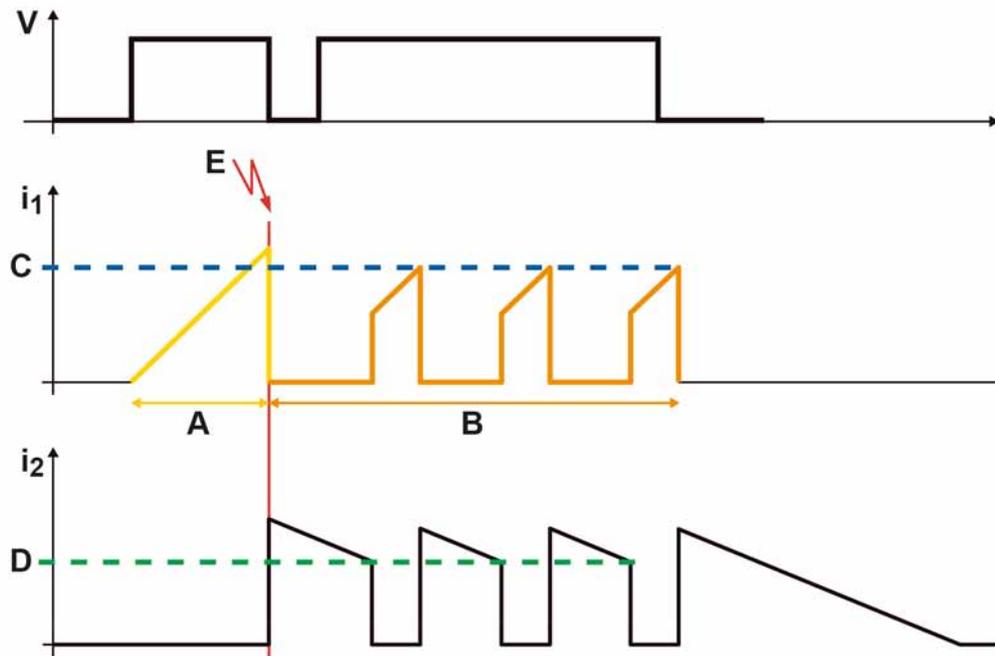
Multi-spark ignition

In contrast to the single-spark mode, several sparks are used in multi-spark operation. A multi-spark ignition cycle begins in the same way as a single-spark cycle. The ignition coil is initially charged to a desired target primary current. At the firing point the charging current is shut off, producing an ignition spark. In multi-spark mode, the ignition coil is not fully discharged, but is recharged in the interim so that it can again provide enough energy for the sparks.

The secondary current, which is directly dependent on the charge level of the ignition coil, is measured in the ignition coil. If it drops below the secondary current threshold, the ignition coil's electronic control reopens the power amplifier allowing the charging current to flow again. The level of the primary current is also monitored. When the primary current threshold is reached, the power amplifier closes the primary circuit and high voltage is generated once more. This causes another ignition spark to be produced. Subsequent sparks are generated in the same way.

Note

The ignition angles can only be checked using Xentry Diagnostics.



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Ideal primary and secondary current curve in a multi-spark ignition system

- | | | | |
|---|---------------------|-------|--------------------------|
| A | Dwell time | i_1 | Primary charging current |
| B | Spark duration | i_2 | Secondary current |
| C | Recharge threshold | V | Operating voltage |
| D | Discharge threshold | | |
| E | Firing point | | |

On-Board Diagnosis (OBD)

Engine 270 uses an on-board diagnosis system of the second generation (OBD II). In Europe the OBD II system is referred to as European On-Board Diagnosis (EOBD) with appropriate modifications for the European market.

The OBD system is integrated in the ME-SFI [ME] control unit and constantly monitors all the emissions-relevant components and systems in the vehicle.

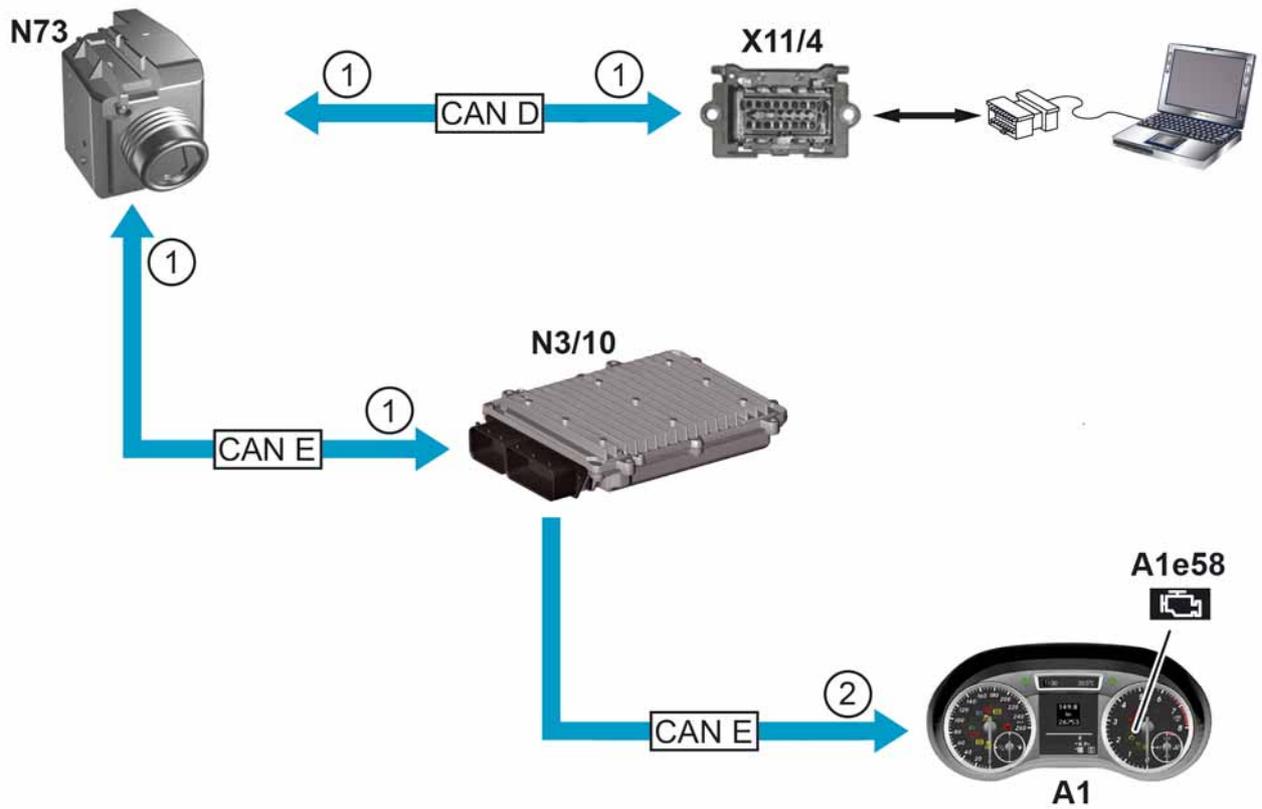
The tasks of the OBD are as follows:

- Monitoring emissions-relevant components and systems while driving
- Detecting and storing malfunctions
- Showing malfunctions via the engine diagnosis indicator lamp
- Transmitting detected faults over a standard interface (diagnostic connector) to a diagnostic unit (e.g. Xentry Diagnostics)

The aim of OBD is to guarantee consistently low exhaust emissions and to protect components at risk (such as catalytic converters) against backfires.

The following components and systems are monitored:

- Oxygen sensors
- Efficiency of catalytic converter (catalytic converter operation)
- Catalytic converter heating
- Purging
- Smooth running analysis (detection of combustion misfiring)
- Other emissions-relevant components or components the failure of which would prevent diagnosis of another component



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Function schematic of on-board diagnosis (OBD)

A1 Instrument cluster
A1e58 Engine diagnosis indicator lamp
N3/10 ME-SFI [ME] control unit
N73 Electronic ignition lock control unit
X11/4 Diagnostic connector

CAN D Diagnostic CAN
CAN E Chassis CAN

1 Engine control diagnosis, communication
2 Engine diagnosis indicator lamp, actuation

ECO start/stop system

The new engine 270 is equipped with a starter-assisted in-engine direct starting function. This function combines with the engine stop function to form a start/stop function.

The effect of the direct starting function is to ensure that, for the selected fuel injector, the very first compression stroke of a cylinder can be used for controlled combustion.

When the engine is shut off on vehicles with dual clutch transmission in ECO start/stop mode, the oil supply by the primary pump stops along with the engine. With this, all the control elements and actuators change to a basic state under no load and the dual clutch transmission power flow stops. The electric auxiliary oil pump is actuated via the dual clutch transmission fully integrated transmission control unit when the engine is switched on and off. When the engine is switched off, the electric auxiliary oil pump takes over the oil supply of the control elements and actuators of the dual clutch transmission. In addition, it minimizes the time loss between the start-off request and actual start-off time.

A 12 Ah additional battery for the ECO start/stop function cushions the voltage drop during engine start. The additional battery supplies power to all active consumers while the on-board electrical system battery is decoupled from the on-board electrical system and is made available solely to the starter.

The ME-SFI [ME] control unit continuously performs system diagnosis and evaluates the system states for the ECO start/stop function.

All systems involved in the ECO start/stop function continuously check their status and transmit it to the ME-SFI [ME] control unit via chassis CAN or drive train CAN.

The availability of the start/stop function is indicated to the driver by means of an "ECO" symbol on the multifunction display of the instrument cluster.

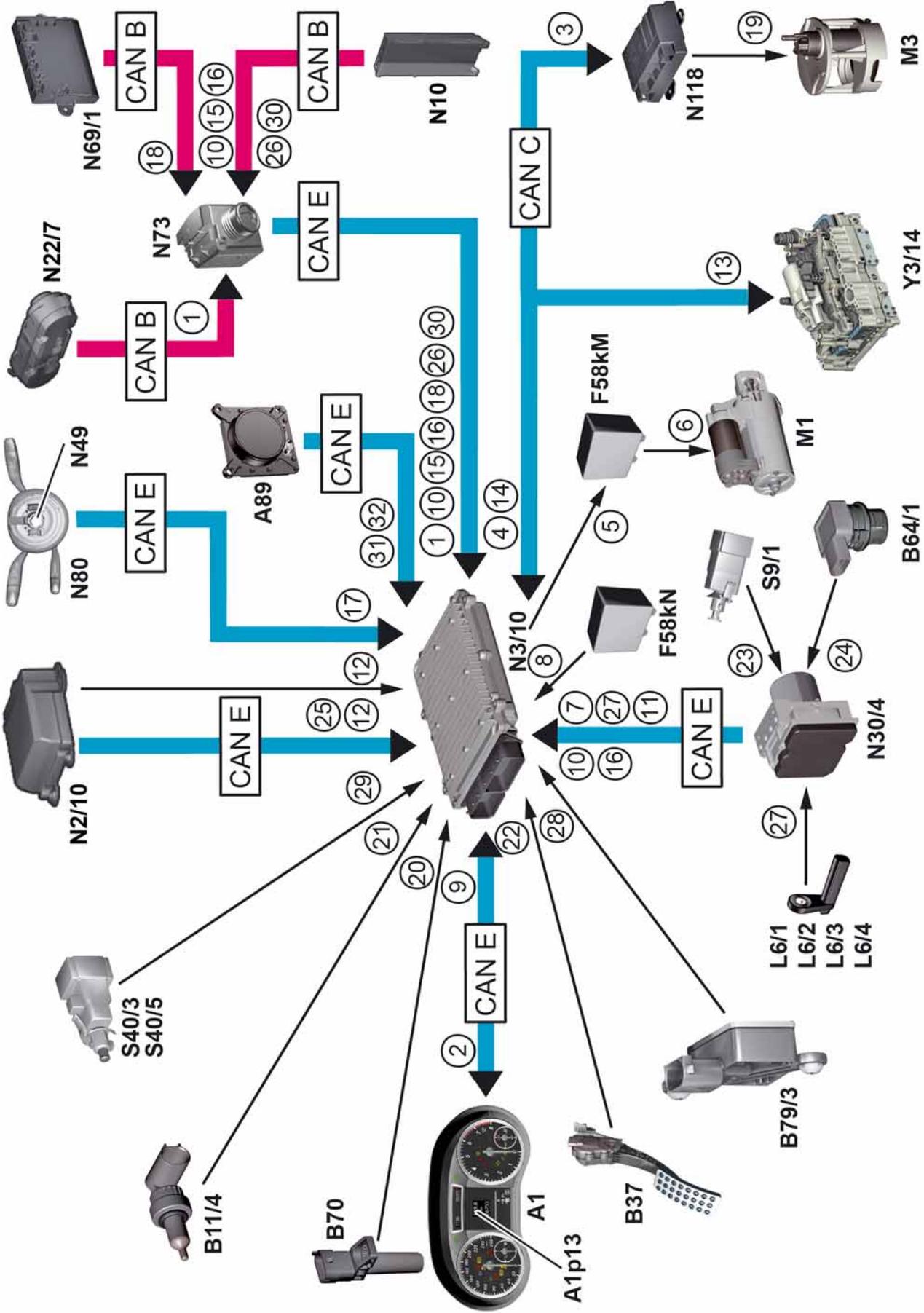
When the vehicle is stationary, the start/stop function automatically switches the engine off and restarts it as soon as the driver is ready to move off. Switching off the engine while the vehicle is at a standstill improves fuel economy and therefore reduces exhaust emissions.

It is still possible to switch off and start the engine conventionally using the transmitter key or the KEYLESS-GO start/stop button (in vehicles with code (889) Keyless-Go).

A crankshaft Hall sensor with rotation direction detection is installed on engine 270. The Hall sensor performs non-contact measurement of the position and rpm of the crankshaft via the increment wheel (perforated plate) on the starter ring gear and transmits the signals to the ME-SFI [ME] control unit.

Together with the signal from the intake camshaft Hall sensor, the signal from the crankshaft Hall sensor is used to determine cylinder 1. If the signal from the crankshaft Hall sensor is not available to the ME-SFI [ME] control unit, the ME-SFI [ME] control unit uses the signal from the intake camshaft Hall sensor as a substitute value for engine starting.

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ECO start/stop system

ECO start/stop system function schematic

A1	Instrument cluster
A1p13	Multifunction display
A89	DISTRONIC electric controller unit
B11/4	Coolant temperature sensor
B37	Accelerator pedal sensor
B64/1	Brake vacuum sensor
B70	Crankshaft Hall sensor
B79/3	Manual transmission main shifter shaft position sensor (with manual transmission)
F58kM	Starter circuit 50 relay
F58kN	Circuit 87M relay
L6/1	Left front axle rpm sensor
L6/2	Right front axle rpm sensor
L6/3	Left rear axle rpm sensor
L6/4	Right rear axle rpm sensor
M1	Starter
M3	Fuel pump
N2/10	Supplemental restraint system control unit
N3/10	ME-SFI [ME] control unit
N10	SAM control unit
N22/7	Automatic air conditioning control and operating unit
N30/4	Electronic Stability Program control unit
N49	Steering wheel angle sensor

N69/1	Left front door control unit
N73	Electronic ignition lock control unit
N80	Steering column tube module control unit
N118	Fuel system control unit
S9/1	Brake light switch
S40/3	Clutch pedal switch (with manual transmission)
S40/5	Start enable clutch pedal switch (with manual transmission)
Y3/14	Dual clutch transmission fully integrated transmission controller unit (with code (429) Dual clutch transmission)
CAN B	Interior CAN
CAN C	Drive train CAN
CAN E	Chassis CAN
1	Air conditioning, status
2	Instrument cluster, message
3	Fuel pump, specified pressure request
4	Fuel pressure, status
5	Starter circuit 50 relay, actuation
6	Starter, actuation
7	Brake light switch, status
8	Circuit 87, status
9	Vehicle speed, signal

10	Engine start, request
11	Engine stop enable, status
12	Crash, signal
13	Gear range, request
14	Gear range, status
15	ECO start/stop function button, status
16	Engine stop inhibit, request
17	Steering wheel angle sensor, signal
18	Door rotary tumbler switch, status
19	Fuel pump, actuation
20	Engine speed, signal
21	Coolant temperature sensor, signal
22	Accelerator pedal sensor, signal
23	Brake light switch, signal
24	Brake vacuum sensor, signal
25	Seat belt buckle restraint system switch, status
26	Engine hood anti-theft alarm system switch, status
27	Wheel speed, signal
28	Manual transmission main shifter shaft position sensor, signal
29	Clutch pedal switch, status
30	Engine hood contact switch, status
31	Engine torque, increase request
32	Engine torque, reduction request



Assembly lever

Use	For tensioning and releasing the tensioning device of the belt drive.
MB number	W270 589 00 07 00
FG	13
Set	B
Category	Mercedes-Benz Passenger Car Basic Operations – Mandatory/No Exemptions



P58.20-2369-00

Retaining lock

Use	For locking the flywheel or drive plate in place.
MB number	W270 589 00 40 00
FG	01, 03, 05
Set	B
Category	Mercedes-Benz Passenger Car Basic Operations – Mandatory/No Exemptions

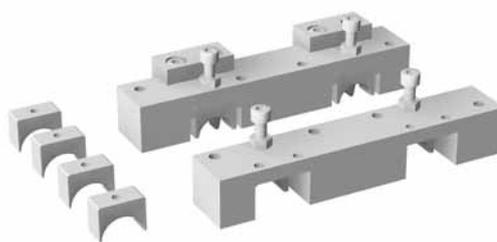


P58.20-2370-00

Mechanical components

Holding device

Use	The holding device allows the camshafts to be held down and fixed in the assembly position. This allows the mounting bolts on the camshaft sprockets to be loosened and tightened.
MB number	W270 589 00 61 00
FG	05
Set	C
Category	Mercedes-Benz Passenger Car Special Operations



P58.20-2371-00

Tester cap

Use	For checking the oil pressure at the oil filter element. Only in combination with test equipment W103 589 00 21 00.
MB number	W270 589 00 63 00
FG	18
Set	B
Category	Mercedes-Benz Passenger Car Basic Operations – Mandatory/No Exemptions



P58.20-2372-00



Socket wrench bit

Use	For turning the camshafts.
MB number	W270 589 01 07 00
FG	05
Set	C
Category	Mercedes-Benz Passenger Car Special Operations



P58.20-2374-00

Connection adapter

Use	For leak testing the charge air system. Only in combination with leak tester W611 589 02 21 00.
MB number	W270 589 00 91 00
FG	09
Set	B
Category	Mercedes-Benz Passenger Car Basic Operations – Mandatory/Approved for Cooperation



P58.20-2373-00

Abbreviations

ATL	LIN
Turbocharger	Local Interconnect Network
CAN	ME
Controller Area Network	Motor electronics (ME-SFI)
DE	NOx
Direct Injection (DI)	Nitrogen Oxide
EDW	OBD
Anti-theft alarm system (ATA)	On-Board Diagnosis
EOBD	PWM
European On-Board-Diagnosis	Pulse Width Modulated
ESP	ROZ
Electronic Stability Program	Research octane number (RON)
EURO 5	SAM
Euro 5 standard (emissions standard)	Signal acquisition and actuation module
EZS	VGS
Electronic ignition switch	Fully integrated transmission control
KE	WIS
Port injection	Workshop Information System
KLA	
Automatic Air Conditioning (AAC)	



B		
Boost pressure control	30	
C		
Charge air cooler	29	
Coolant distribution	50	
Coolant pump	16, 47	
Coolant thermostat	16, 46	
Cooling circuit	7, 46	
D		
Direct injection	7	
E		
Engine oil pump	52	
F		
Fuel injector	36, 38	
H		
High-pressure pump	32, 35, 38	
O		
Oil circuit diagram	53	
Oil level check	52	
Oil pan	52	
Oil pump	6, 52	
P		
Piezo injectors	7, 36	
Purging	60	

