

# Introduction of the New Inline Engine Generation 4-Cylinder M 274

Introduction into Service Manual



Mercedes-Benz

# Introduction of the New Inline Engine Generation 4-Cylinder M 274

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Dear Reader,

This Introduction into Service Manual presents the new 4-cylinder gasoline engine 274 in model series 204.

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 and major assemblies.

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 January 2012 and may therefore differ from the current production configuration.

Daimler AG

Technical Information  
and Workshop Equipment (GSP/OI)

## Brief description

In June 2012, the new M 274 4-cylinder gasoline engine with direct injection and turbocharging will be introduced for the first time with the modification year of model series 204.

The M 274 forms an engine family together with the transverse-mounted M 270 engine model series installed in model series 246.

It is available in model series 204 as a 1.6 l displacement variant with 115 kW.

This new engine family replaces the very successful major assemblies of engine model series M 271 EVO.

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

The M 274 engine model series fulfills the increasingly strict CO<sub>2</sub> limits while also providing high torque, engine power and particularly comfortable noise and vibration characteristics.

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.

Compared to the predecessor M 271 EVO, a lower engine weight and lower friction power contribute to energy efficiency. This is supplemented by controlled ancillaries and the standard ECO start/stop function.

### An overview of the special features of the M 274:

- 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 turbocharging
- 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 engine oil pump and coolant pump
- ECO start/stop function with starter-assisted direct starting
- Demand-controlled multi-spark ignition
- Crankcase made of diecast aluminium
- Fulfillment of EU 5 emissions standard with potential to fulfill future standards



***M 274 in model series 204 with 115 kW from 1.6 l displacement***

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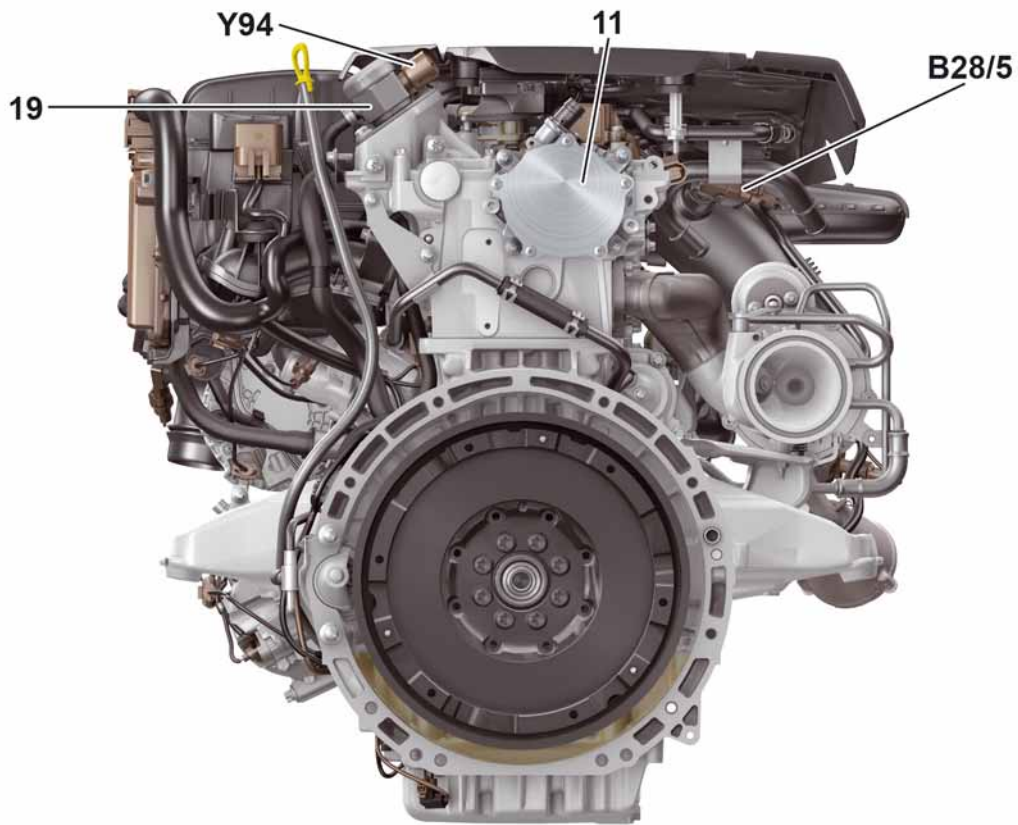
## Engine views



P01.10-3102-00

### View of engine from front

1	Air filter housing	B28/6	Pressure sensor upstream of throttle valve
50/3	Noise damper	G2	Alternator
A9	Refrigerant compressor	R39/2	Wide open throttle operation vent line heater element
B17/12	Charge air temperature sensor upstream of throttle valve	Y101	Bypass air switchover valve



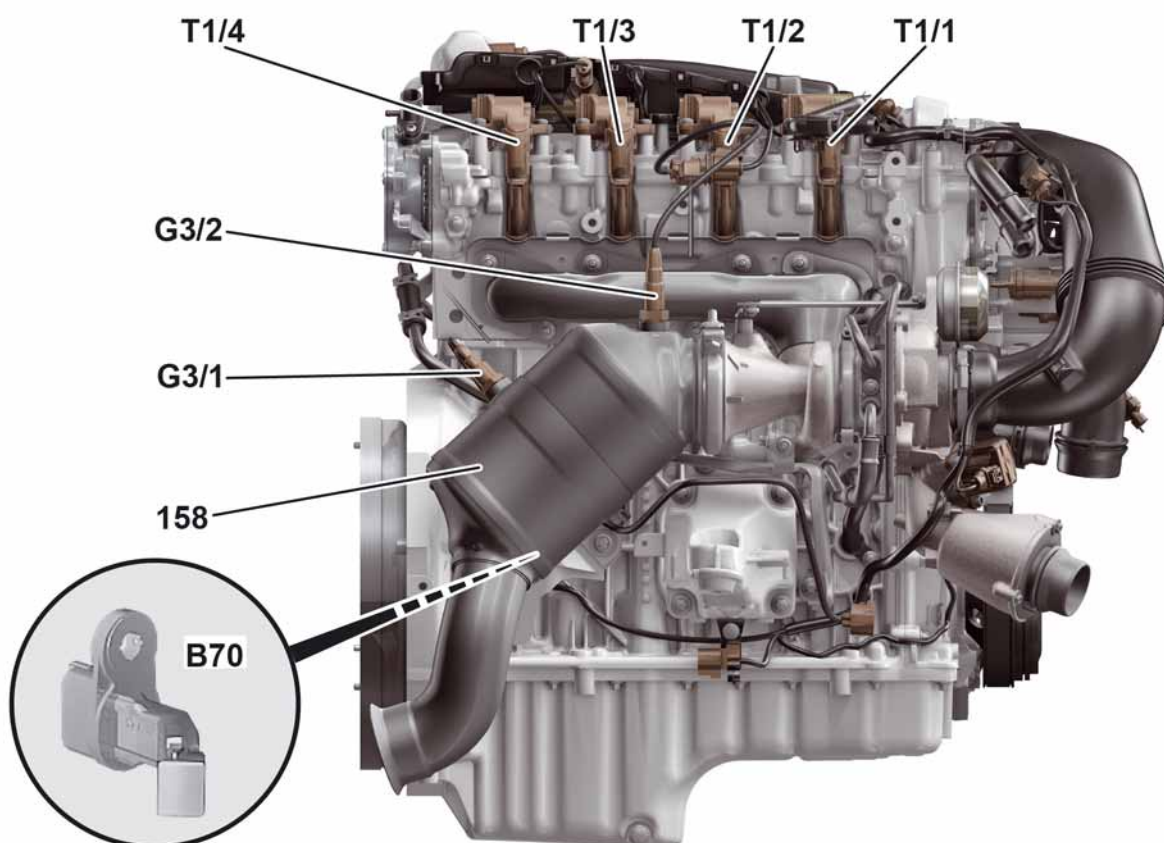
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**View of engine from rear**

- 11 Vacuum pump
- 19 High-pressure pump

- B28/5 Pressure sensor downstream of air filter
- Y94 Quantity control valve

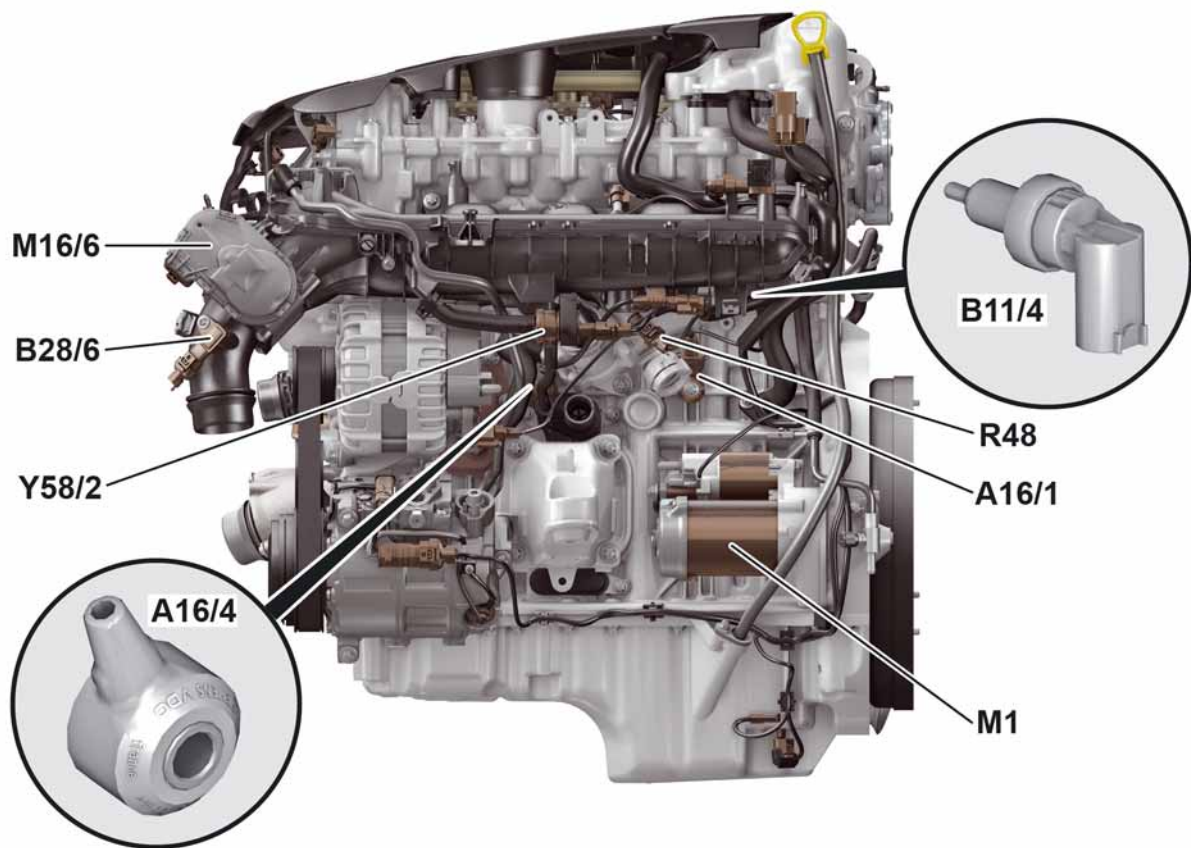
## Engine views



**View of engine from right**

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158	Three-way catalytic converter	T1/1	Cylinder 1 ignition coil
B70	Crankshaft Hall sensor (with rotation direction detection)	T1/2	Cylinder 2 ignition coil
G3/1	Oxygen sensor downstream of catalytic converter	T1/3	Cylinder 3 ignition coil
G3/2	Oxygen sensor upstream of catalytic converter	T1/4	Cylinder 4 ignition coil



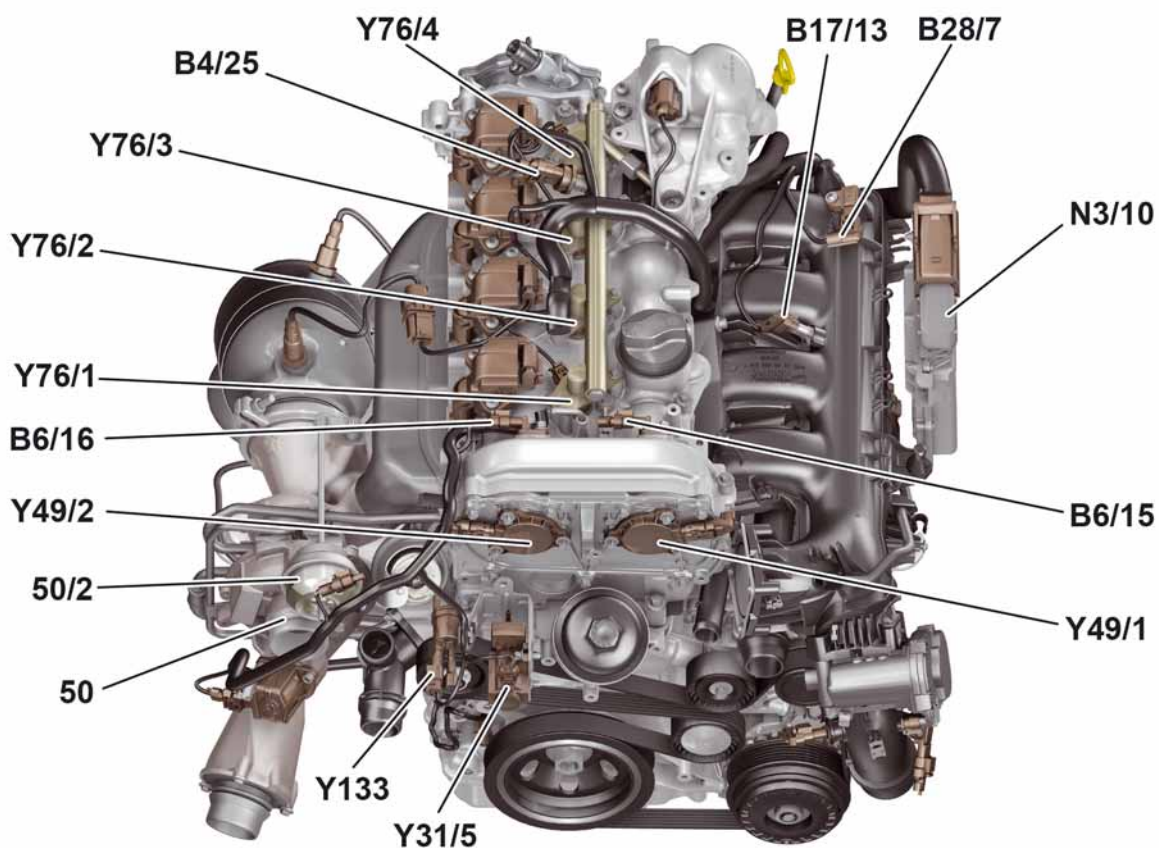
**View of engine from left**

P01.10-3105-00

- |       |  |       |   |
|-------|--|-------|---|
| A16/1 | Rear knock sensor                          | M1    | Starter   |
| A16/4 | Front knock sensor                         | M16/6 | Throttle valve actuator                                   |
| B11/4 | Coolant temperature sensor                 | R48   | Coolant thermostat heating element                        |
| B28/6 | Pressure sensor upstream of throttle valve | Y58/2 | Partial load operation crankcase ventilation system valve |



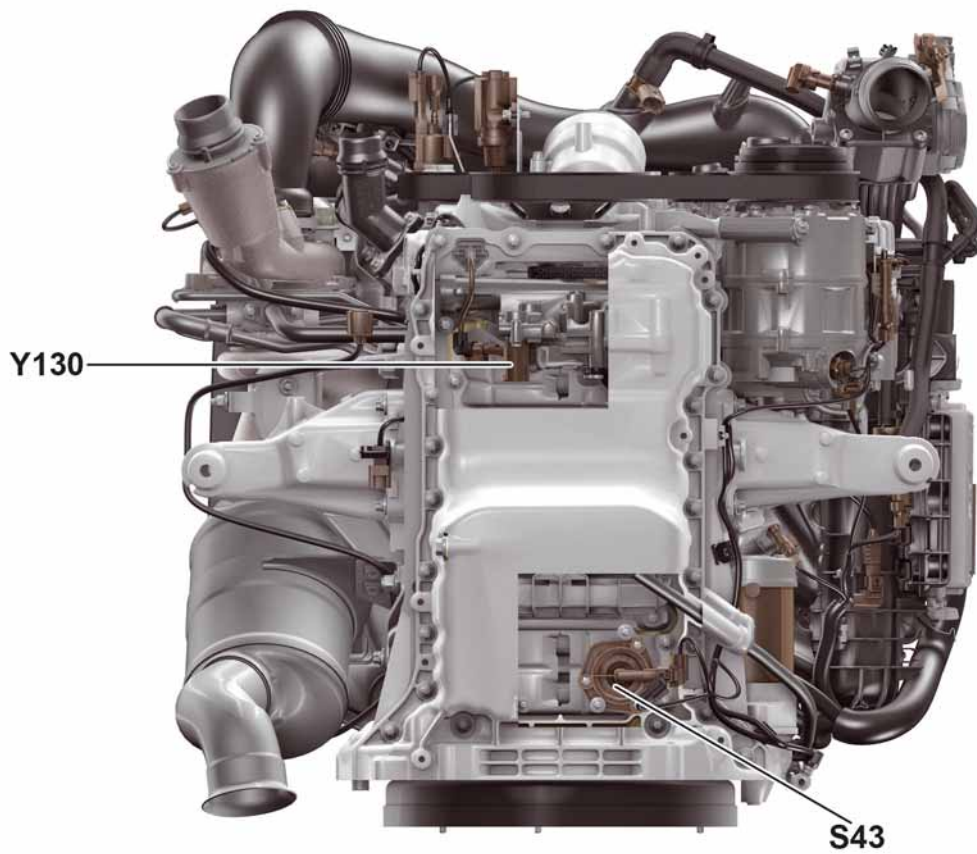
## Engine views



P01.10-3106-00

### View of engine from above

50	Turbocharger	Y31/5	Boost pressure control pressure transducer
50/2	Boost pressure control flap vacuum unit	Y49/1	Intake camshaft solenoid
B4/25	Fuel pressure and temperature sensor	Y49/2	Exhaust camshaft solenoid
B6/15	Intake camshaft Hall sensor	Y76/1	Cylinder 1 fuel injector
B6/16	Exhaust camshaft Hall sensor	Y76/2	Cylinder 2 fuel injector
B17/13	Charge air temperature sensor downstream of throttle valve	Y76/3	Cylinder 3 fuel injector
B28/7	Pressure sensor downstream of throttle valve	Y76/4	Cylinder 4 fuel injector
N3/10	ME-SFI [ME] control unit (motor electronics)	Y133	Coolant pump switchover valve



**Engine view from below**

P01.10-3107-00

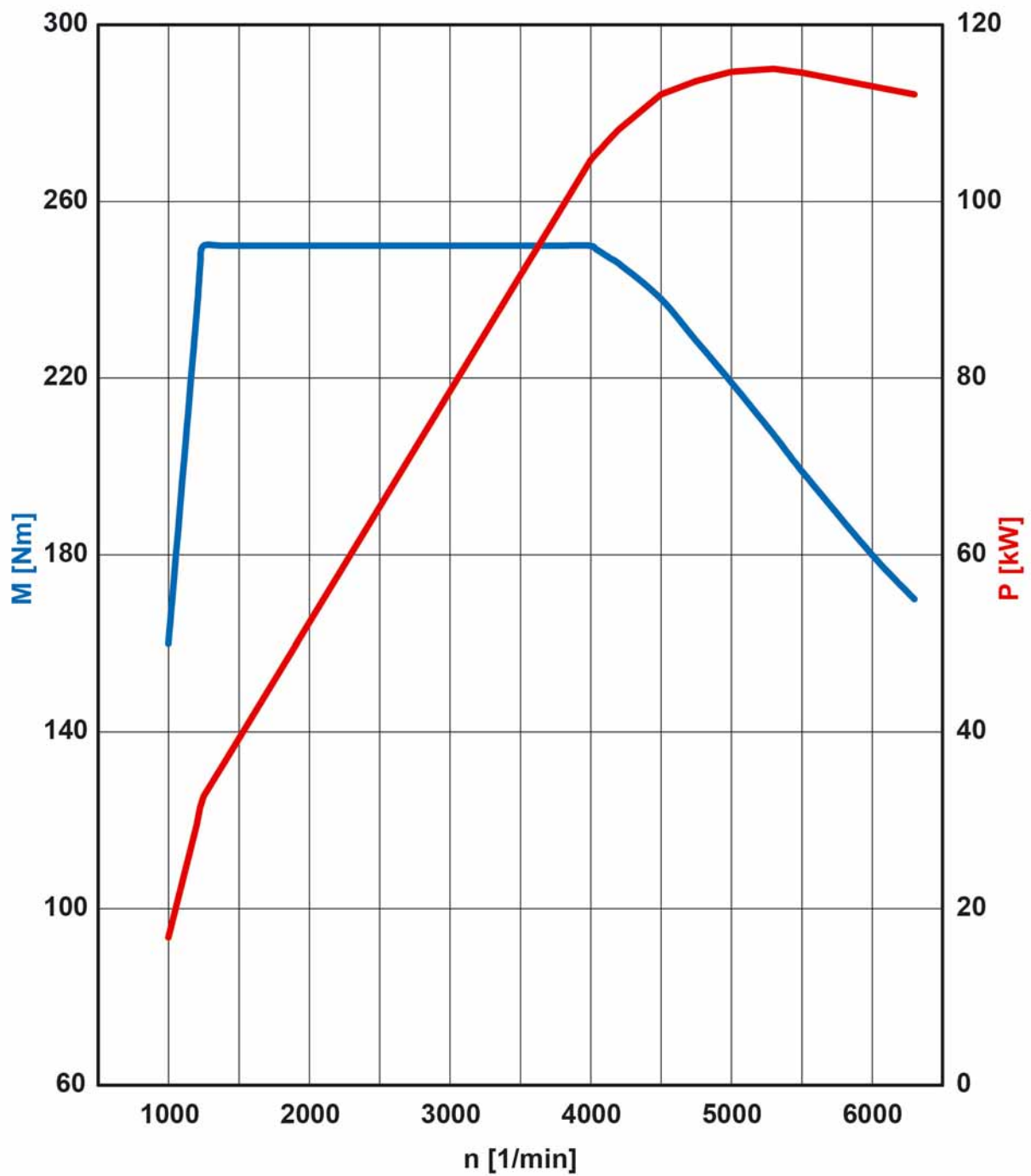
S43 Oil level check switch

Y130 Engine oil pump valve

## Engine data comparison with predecessor engine

BR 204		C 180 CGI As of 09/2009	C 180 As of 06/2012
Engine designation		M 271 EVO	M 274
Engine model designation		271.820	274.910
Displacement	cm <sup>3</sup>	1796	1595
Rated output	kW at rpm	115 5000	115 5300
Rated torque	Nm at rpm	250 1600 – 4300	250 1250 – 4000
Compression ratio	ε	9.8 : 1	10.3 : 1
Emissions standard		EU 5	
Engine configuration/ no. of cylinders		Inline 4	
Valves		4	
Air supply		Turbocharger with charge air cooling	
Boost pressure control		Via boost pressure	Via vacuum
Boost pressure	bar	1.2	1.1
Bore	mm	82.0	83.0
Stroke	mm	85.0	73.7
Cylinder spacing	mm	90.0	
Connecting rod length	mm	143.5	152.2
Injection		Direct injection (DI)	





Torque and power curve of M 274

P01.00-3356-00



## 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. This is then shut 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 thermostat. There is a heating element in the thermostat.

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 unit 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 274, the C-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.

Closing the radiator shutters reduces aerodynamic drag and thus fuel consumption. 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 unit and the radiator shutters are closed by the actuator and associated linkage.

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
- 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.:

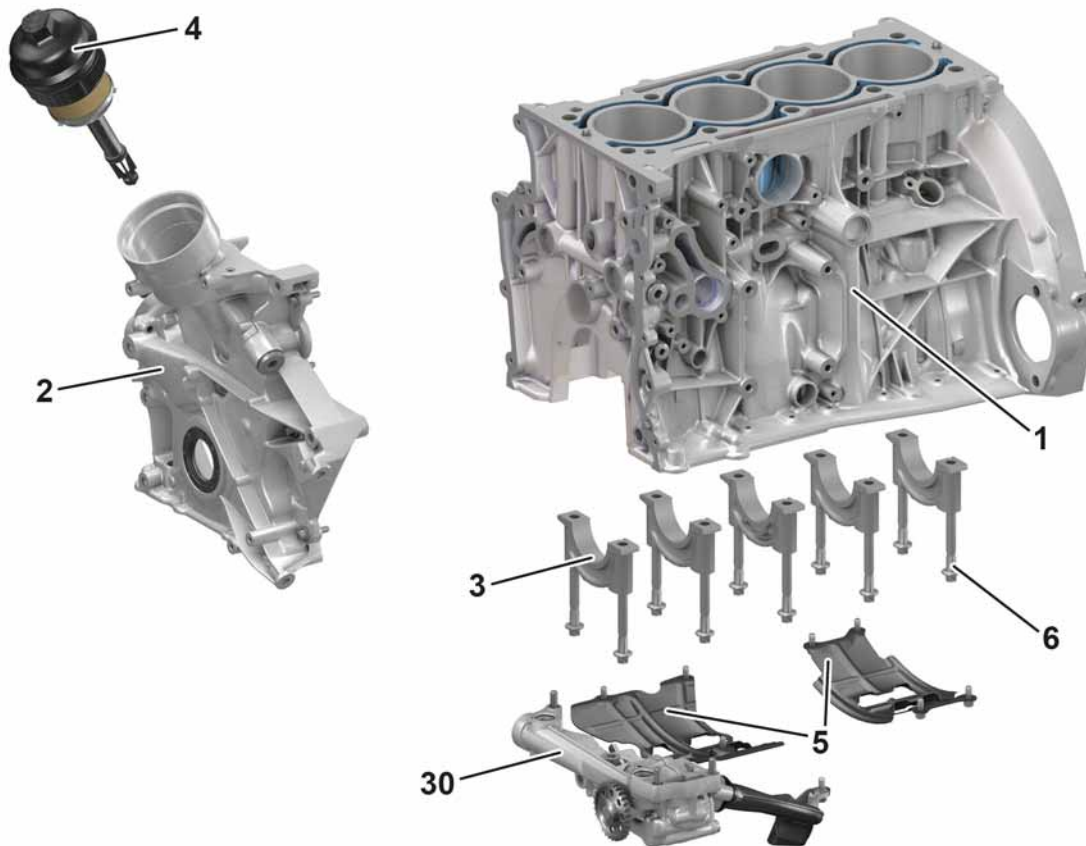
- 2 °CKA at 100 °C coolant, 20 °C charge air and wide open throttle
- 8 °CKA at 100 °C coolant, 60 °C charge air and wide open throttle
- 11 °CKA at 125 °C coolant, 60 °C charge air and wide open throttle

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 274 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.



- 1 Crankcase
- 2 Timing case cover
- 3 Crankshaft bearing cap

- 4 Oil filter
- 5 Baffle
- 6 Crankshaft bearing cap bolts
- 30 Engine oil pump

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## Ventilation

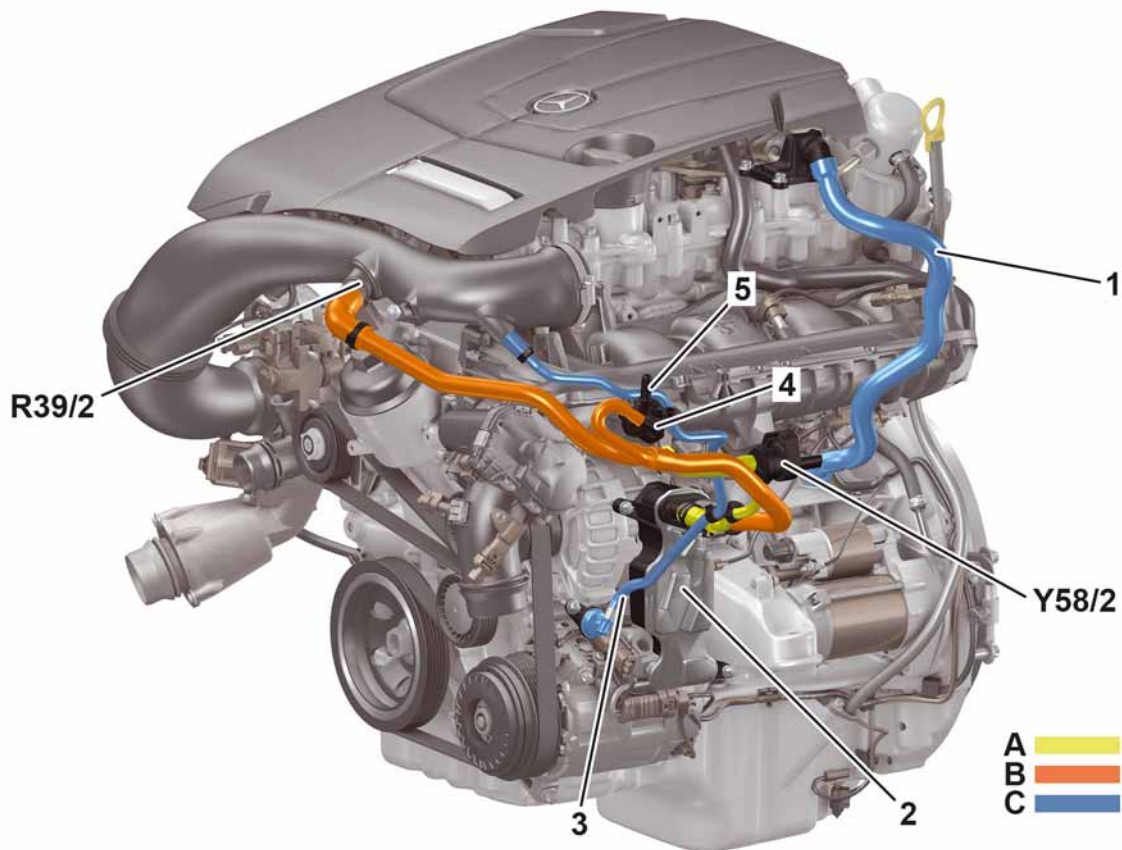
Ventilation of engine 274 is carried out by an oil separator, a partial load ventilation system and a wide open throttle ventilation system.

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.



P01.20-2291-00

- 1 Oil separator ventilation
- 2 Oil separator
- 3 Engine ventilation
- 4 Purge valve
- 5 Tank ventilation connection

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

## Oil pan

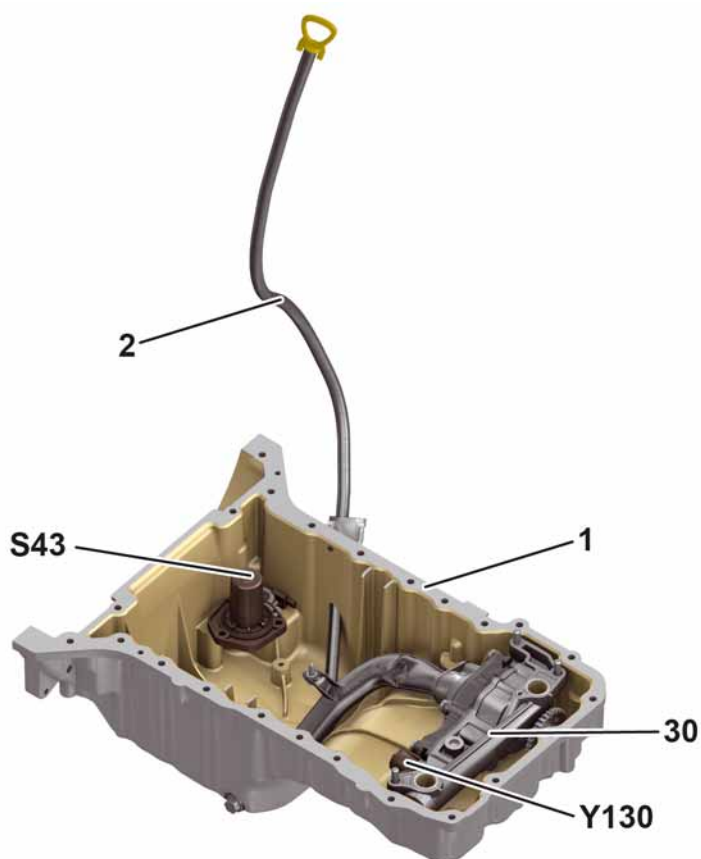
The oil pan is made of diecast aluminium, which gives it a high level of rigidity.

The ribbing on the oil pan is designed to reduce noise emissions.

On engine 274, the oil dipstick guide tube is located at the rear on the left.

The oil level check switch is located at the rear of the oil pan.

The engine is supplied with oil by a 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.



### Oil pan

- 1 Oil pan
- 2 Oil dipstick guide tube
- 30 Engine oil pump

- S43 Oil level check switch
- Y130 Engine oil pump valve

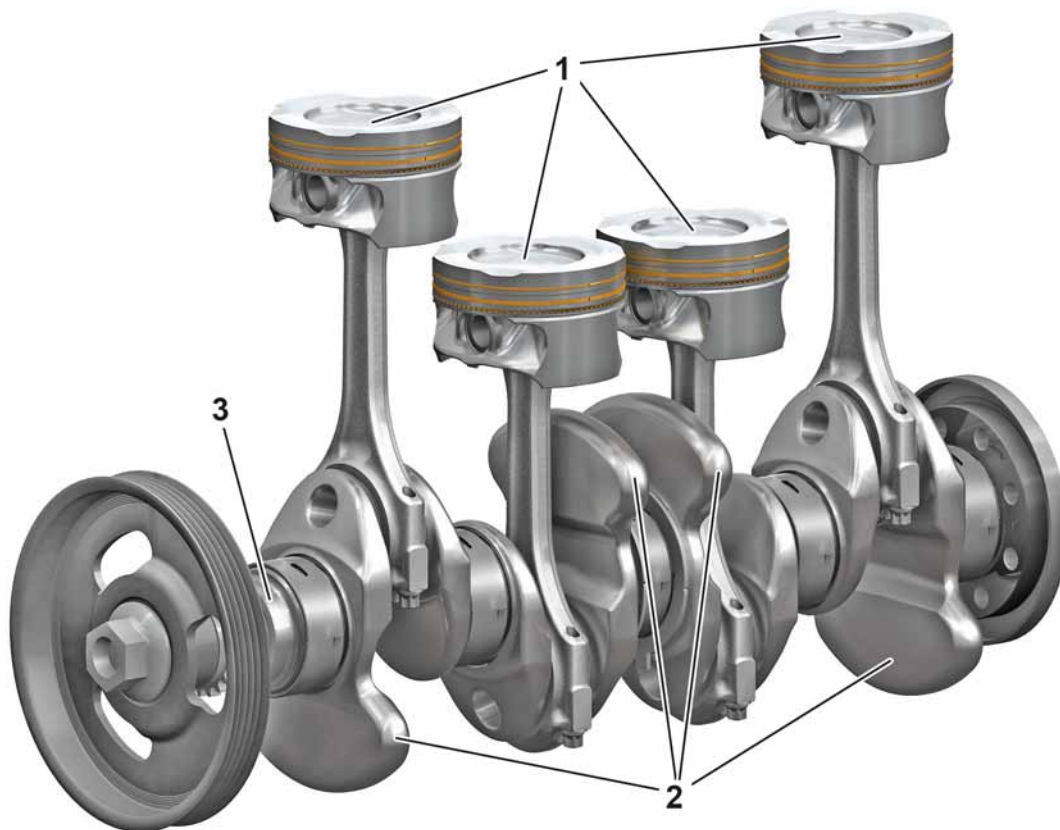
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The depressions on the cast pistons are adapted to the combustion system and the location of the fuel injectors.

In comparison to the predecessor engine M 271 EVO, the stroke has been shortened from 85 mm to 73.7 mm and the connecting rod length has thus been increased by 8.7 mm.

The diameter of the pistons has been increased by 1 mm. Thanks to a new piston design, the weight has been maintained despite the larger pistons.

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



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### **Crank assembly**

- 1 *Pistons*
- 2 *Counterweights*

- 3 *Crankshaft*



## Cylinder head

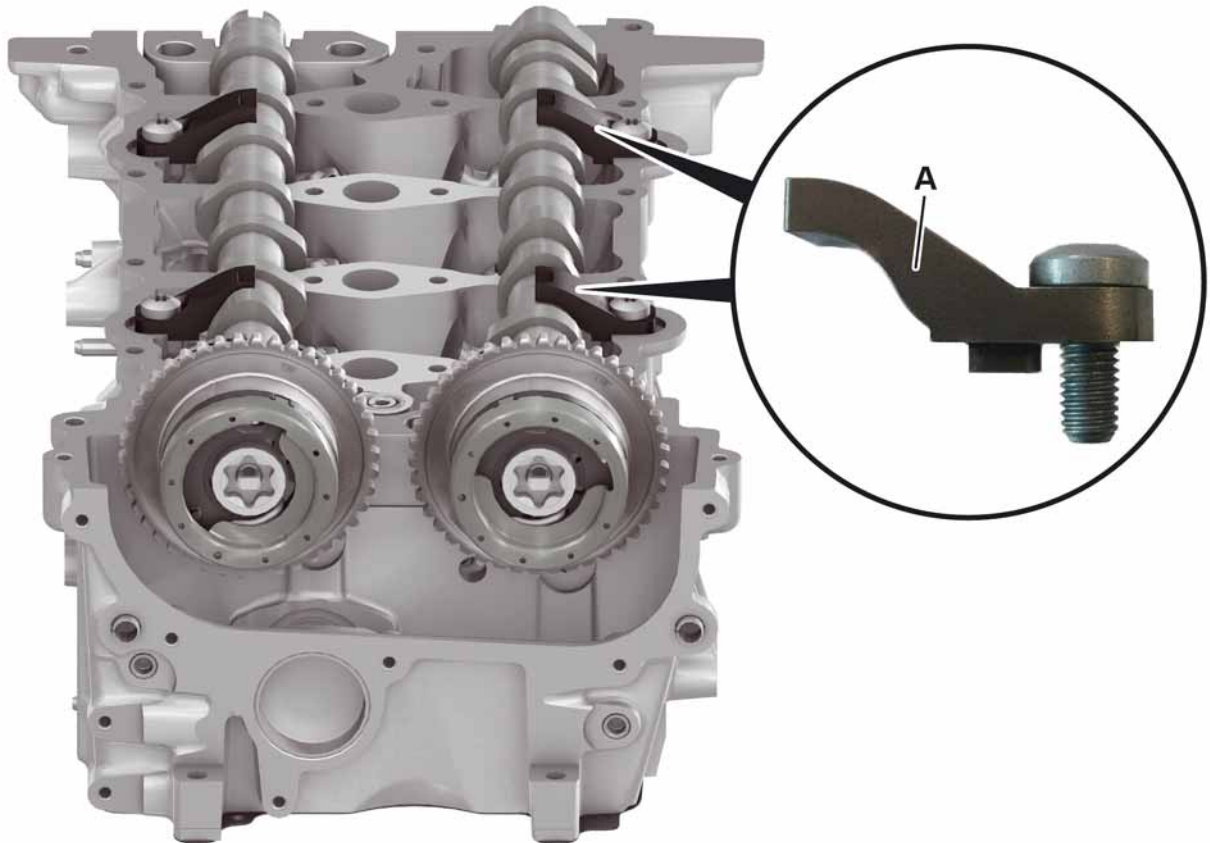
The cylinder head consists of a high-strength aluminium alloy. The specially designed intake ports generate the required charge movement in the combustion chamber.

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 274 have the following effects:

- High torque over a wide rpm range
- Low fuel consumption
- 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**

P01.30-2407-00

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**

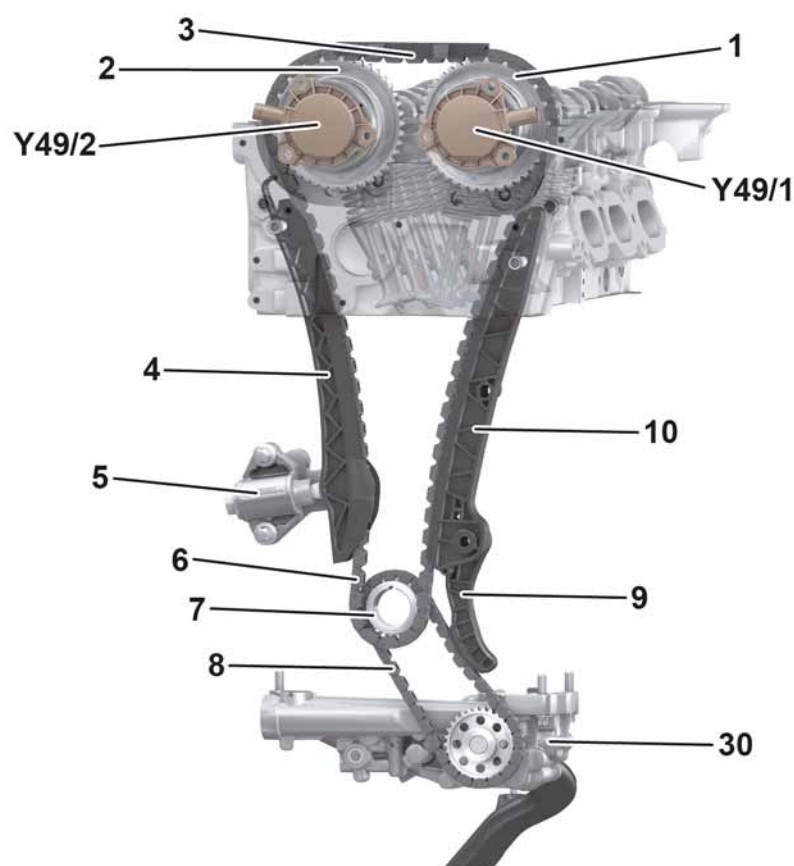
- |    |                        |    |                        |
|----|------------------------|----|------------------------|
| 1  | Guide pulley           | A9 | Refrigerant compressor |
| 2  | Belt tensioner         | G2 | Alternator             |
| 3  | Crankshaft belt pulley |    |                        |
| 40 | Coolant pump           |    |                        |



## Chain drive and camshaft adjustment

The camshafts are driven by the crankshaft via a toothed chain. The chain drive includes two guide rails and one tensioning rail. The rails have a fully non-contact mounting on the timing case cover. This significantly reduces noise.

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



P05.10-2456-00

### Chain drive

- |   |                                |       |  |
|---|--------------------------------|-------|--|
| 1 | Intake camshaft gear           | 8     | Engine oil pump toothed chain            |
| 2 | Exhaust camshaft gear          | 9     | Engine oil pump toothed chain guide rail |
| 3 | Upper toothed chain guide rail | 10    | Toothed chain guide rail                 |
| 4 | Tensioning rail                | 30    | Engine oil pump                          |
| 5 | Hydraulic chain tensioner      | Y49/1 | Intake camshaft solenoid                 |
| 6 | Camshaft toothed chain         | Y49/2 | Exhaust camshaft solenoid                |
| 7 | Crankshaft gear                |       |  |

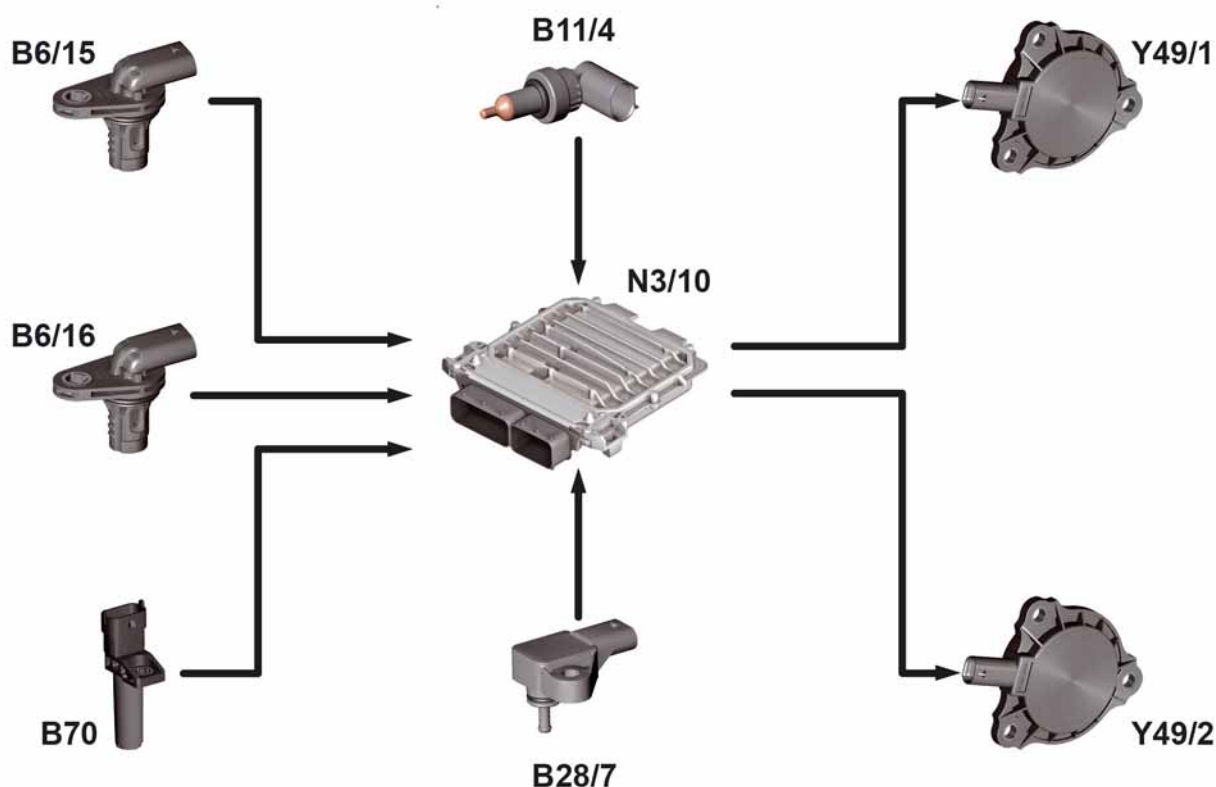
## Chain drive and camshaft adjustment

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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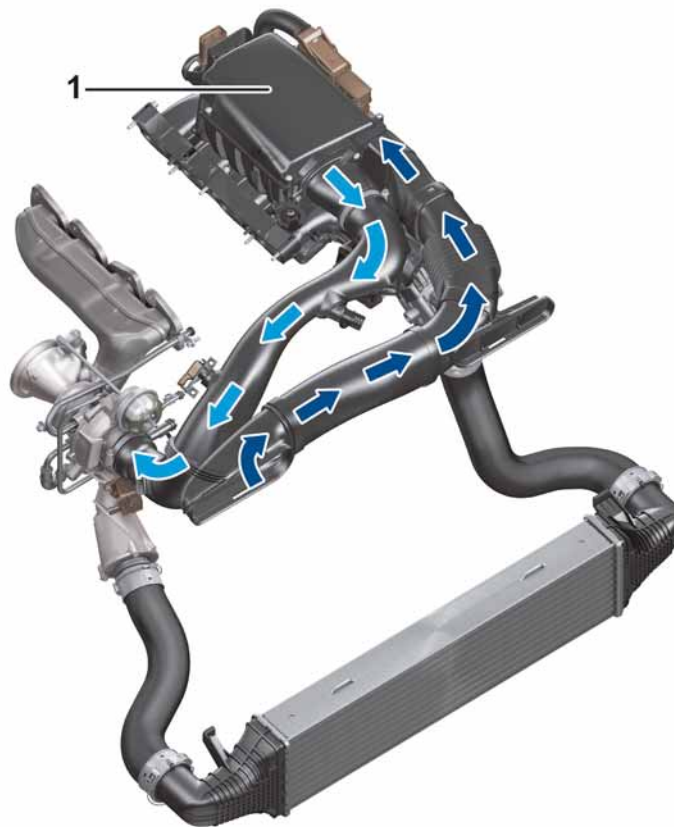
### Function schematic of camshaft adjustment

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

## 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.

The air ducting in the air filter housing has been designed to keep the flow resistances to a minimum. The intake manifold has a double shell design.



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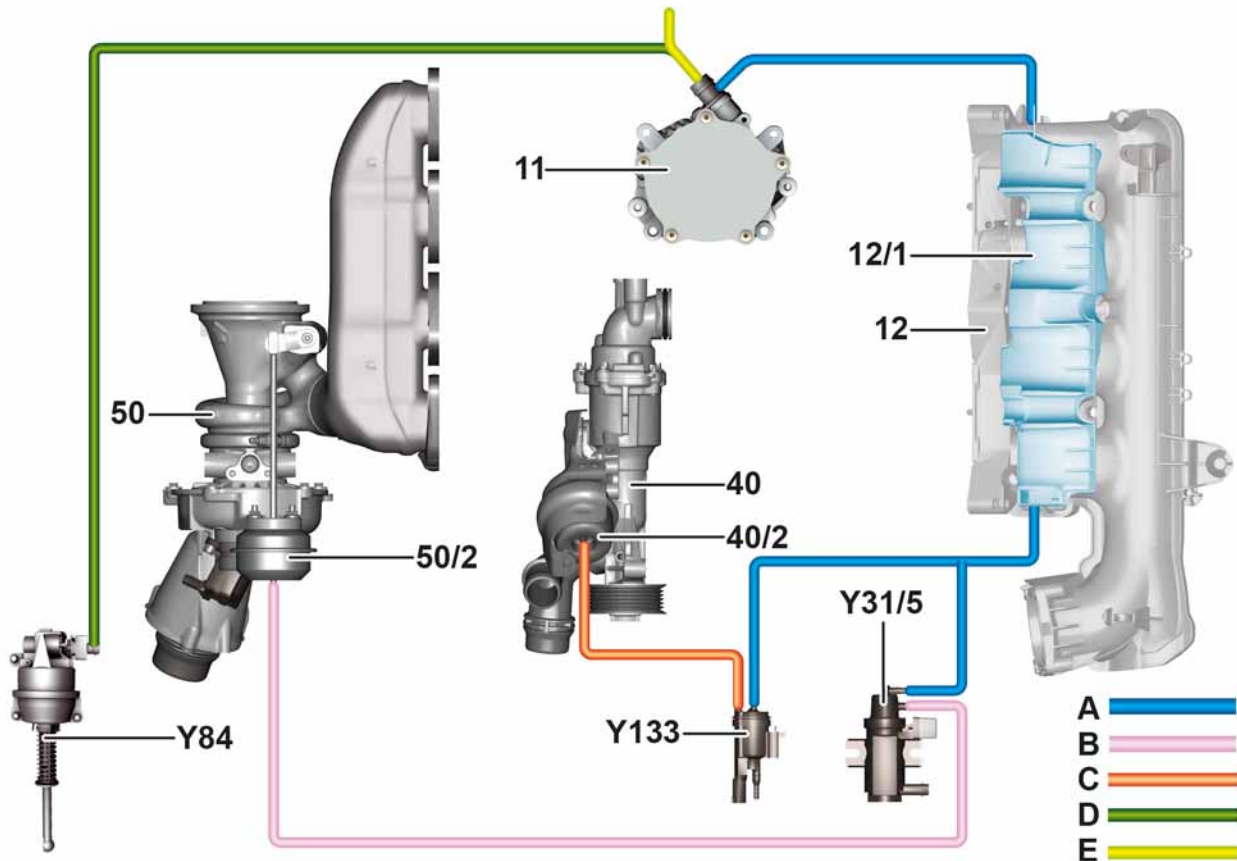
### Intake air ducting

1 Air filter housing

A Unfiltered intake air  
B Filtered intake air

The vacuum pump produces a vacuum to supply the vacuum system. This is stored in the vacuum reservoir and is used to supply all connected consumers.

The corresponding vacuum units are actuated electropneumatically to control the boost pressure and the coolant pump. The radiator shutters actuator is connected to the vacuum pump by a distribution system.



P07.09-2044-00

### Vacuum system, schematic illustration

11	Vacuum pump	A	Vacuum supply via vacuum reservoir
12	Charge air manifold	B	Vacuum for controlling boost pressure control flap
12/1	Vacuum reservoir	C	Vacuum for controlling coolant pump
40	Coolant pump	D	Vacuum for controlling radiator shutters actuator
40/2	Coolant pump vacuum unit	E	Vacuum to brake booster
50	Turbocharger		
50/2	Boost pressure control flap vacuum unit		
Y31/5	Boost pressure control pressure transducer		
Y84	Radiator shutters actuator		
Y133	Coolant pump switchover valve		

## Charging

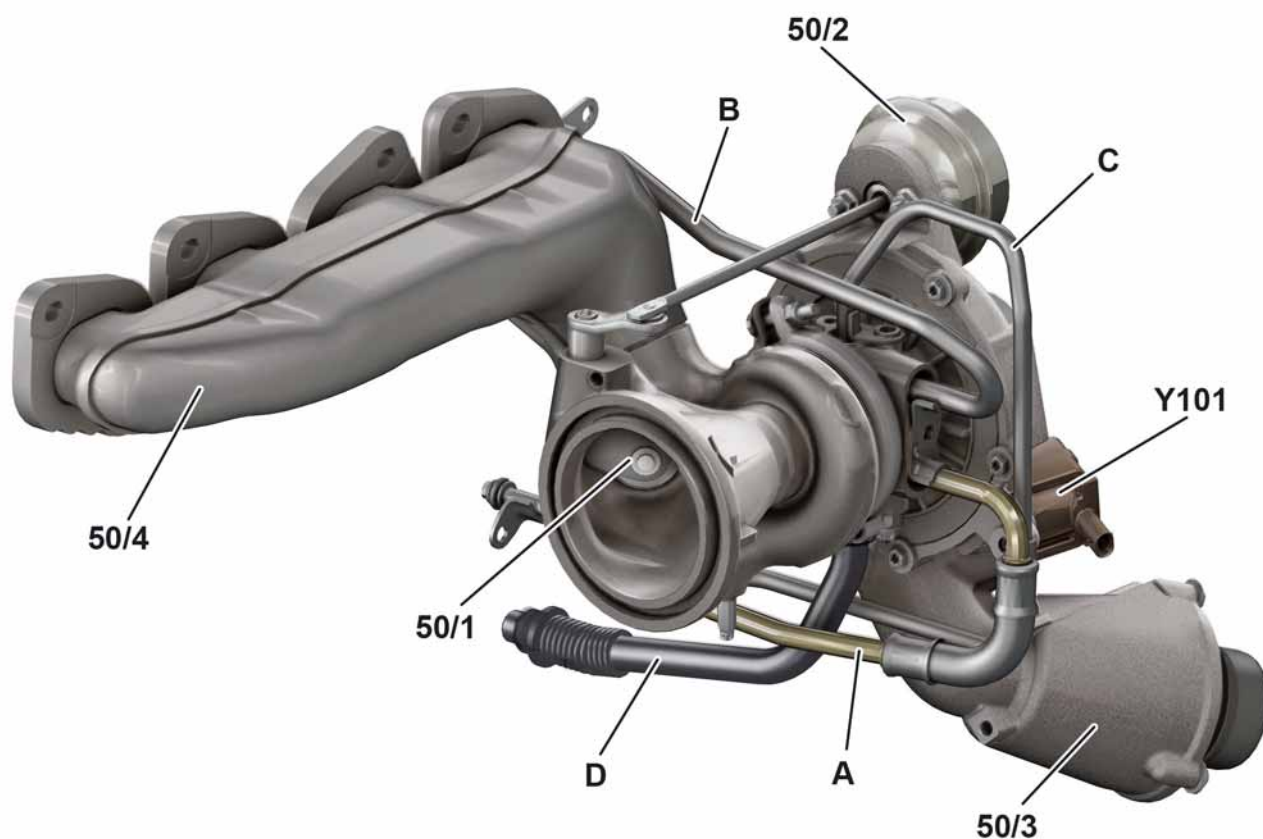
The volumetric efficiency of the cylinders is improved as a result of charging. This increases engine torque and engine power.

The ME-SFI [ME] control unit calculates the corresponding fuel quantity for the increased air mass.

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

A noise damper reduces the boost pressure fluctuations and pulsing noises.

The main component of the charging system is a single-stage turbocharger which can withstand temperatures of 1050 °C. This is welded to the exhaust manifold at the exhaust side of the engine in the form of a module.



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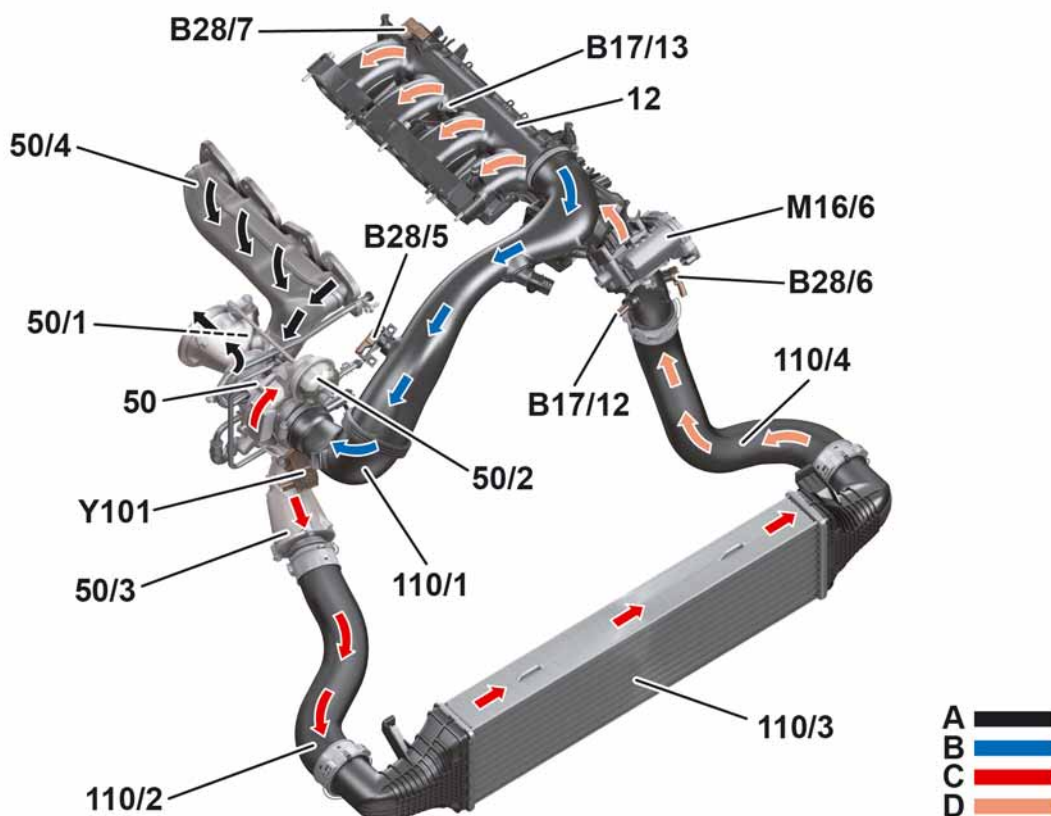
### Turbocharger

50/1 Boost pressure control flap  
 50/2 Boost pressure control flap vacuum unit  
 50/3 Noise damper  
 50/4 Exhaust manifold  
 Y101 Bypass air switchover valve

A Coolant feed line  
 B Coolant return line  
 C Engine oil feed line  
 D Engine oil return line

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. 1.1 bar.

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.



P09,00-2124-00

### Flow pattern of intake air/charge air

12	Charge air manifold	B17/13	Charge air temperature sensor downstream of throttle valve
50	Turbocharger	B28/5	Pressure sensor downstream of air filter
50/1	Boost pressure control flap	B28/6	Pressure sensor upstream of throttle valve
50/2	Boost pressure control flap vacuum unit	B28/7	Pressure sensor downstream of throttle valve
50/3	Noise damper	M16/6	Throttle valve actuator
50/4	Exhaust manifold	Y101	Bypass air switchover valve
110/1	Intake line	A	Exhaust
110/2	Charge air line to charge air cooler	B	Intake air
110/3	Charge air cooler	C	Charge air (uncooled)
110/4	Charge air line to throttle valve	D	Charge air (cooled)
B17/12	Charge air temperature sensor upstream of throttle valve		



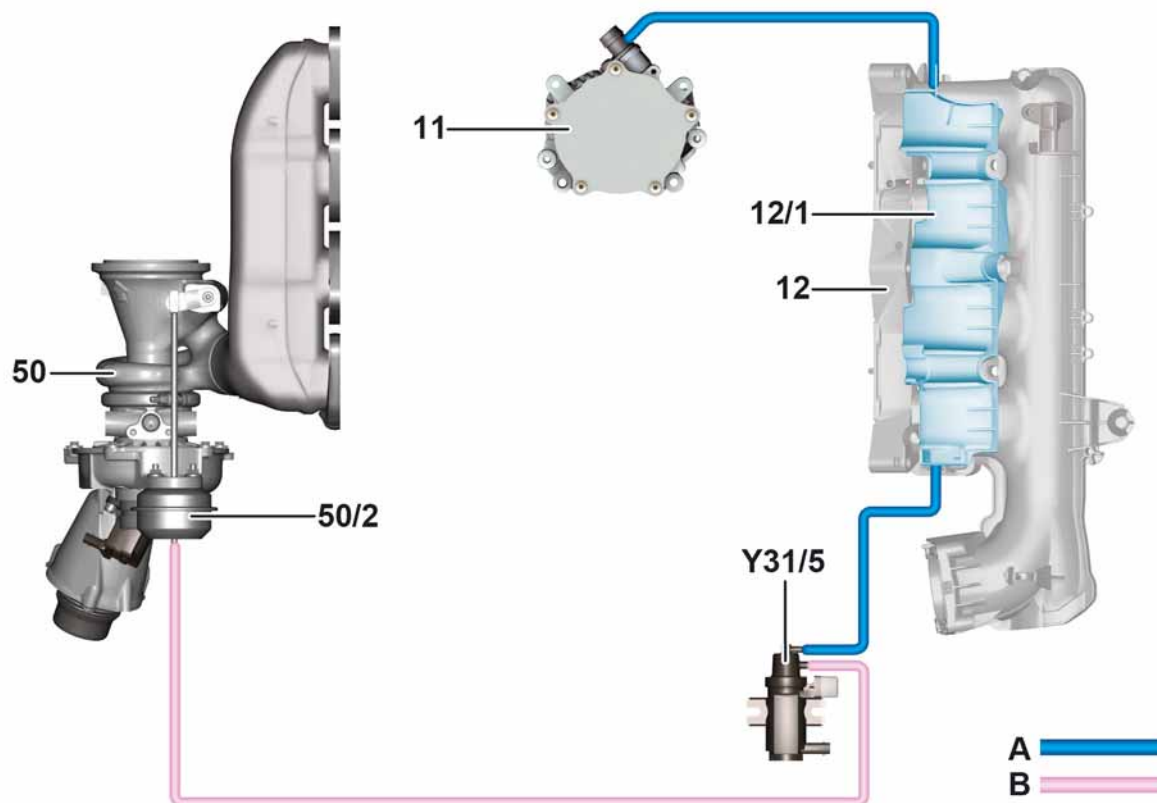
## Charging

### Boost pressure control

On engine 274, 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 sensors of 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



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### Boost pressure control vacuum system

- |      |   |       |  |
|------|---|-------|--|
| 11   | Vacuum pump                             | Y31/5 | Boost pressure control pressure transducer         |
| 12   | Charge air manifold                     | A     | Vacuum supply via vacuum reservoir                 |
| 12/1 | Vacuum reservoir                        | B     | Vacuum for controlling boost pressure control flap |
| 50   | Turbocharger                            |       |  |
| 50/2 | Boost pressure control flap vacuum unit |       |  |

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 pressure transducer with vacuum. This actuates the boost pressure control flap vacuum unit. The vacuum unit 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 (bypass duct), thus regulating the boost pressure and limiting the turbine speed. In this way the boost pressure of max. 1.1 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 rapidly, a charge air pressure wave runs back to the turbocharger. This pressure fluctuation 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 reduction via a bypass duct into the intake side of the turbocharger.

If the ME-SFI [ME] control unit detects a transition from engine load to deceleration mode, the bypass air switchover valve is actuated. A diaphragm integrated in the bypass air switchover valve then opens the bypass duct, which bypasses the compressor wheel and the boost pressure is reduced.

When the engine is under load, the bypass duct is closed by the diaphragm, which is pressurized by boost pressure.



## Injection system

### High-pressure pump

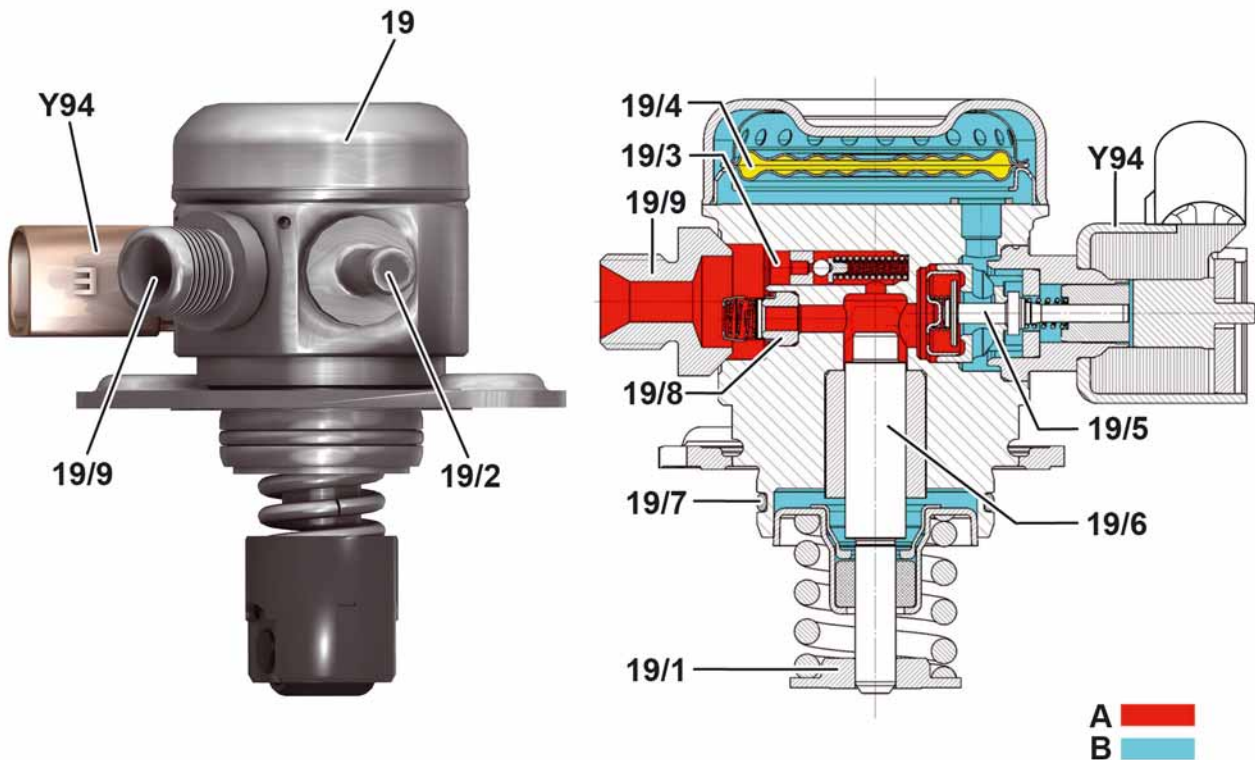
The high-pressure pump is located on the top of the cylinder head. The maximum delivery pressure of the high-pressure pump is 200 bar.

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. When the pump piston moves upwards, the fuel volume in the pump cylinder is pressurized. 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.

### Direct injection

A high-pressure pump (simplex plunger pump) with integrated quantity control valve is used to generate the high pressure.

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



P07.02-2146-00

### High-pressure pump

- |      |                                  |     |                        |
|------|----------------------------------|-----|------------------------|
| 19   | High-pressure pump               | Y94 | Quantity control valve |
| 19/1 | Cup tappet                       | A   | High-pressure area     |
| 19/2 | Low-pressure connection fitting  | B   | Low-pressure area      |
| 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 274, 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.

### 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.

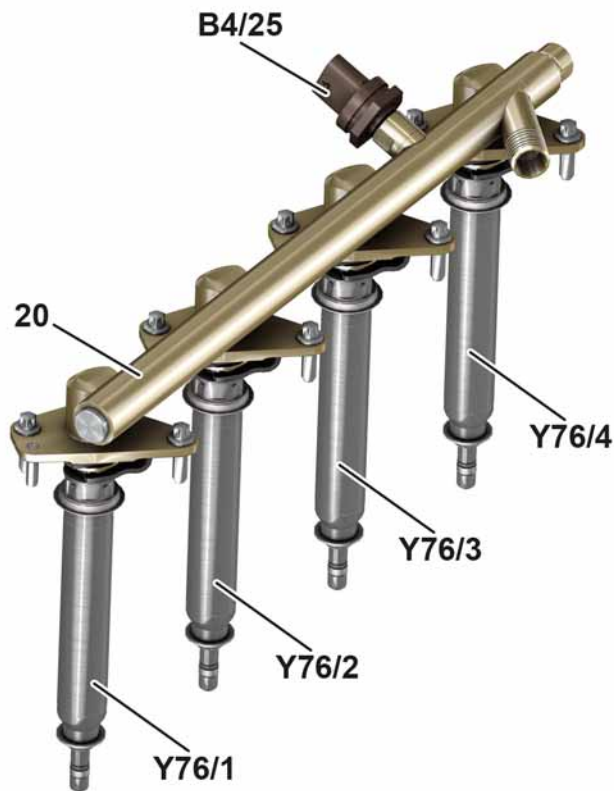
The pumped fuel quantity is limited during every delivery stroke by the variable closing point of the quantity control valve and thus regulated in this manner. The high-pressure pump only delivers the fuel which is required by the engine. The rail pressure is thus regulated from 130 bar to 200 bar depending 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.

### Note!

The stainless steel high-pressure fuel lines can be reused in the event of a repair.

A relevant test specification can be found in WIS.



### Rail with fuel injectors

P07.03-2308-00

20	Rail	Y76/2	Cylinder 2 fuel injector
B4/25	Fuel pressure and temperature sensor	Y76/3	Cylinder 3 fuel injector
Y76/1	Cylinder 1 fuel injector	Y76/4	Cylinder 4 fuel injector

## 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 line is sealed at the high-pressure end in the rail by a sealing unit consisting of an O ring and anti-extrusion rings.

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 140 V to 210 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 provides a capacitive load for the ME-SFI [ME] control unit. When opened, 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!

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.

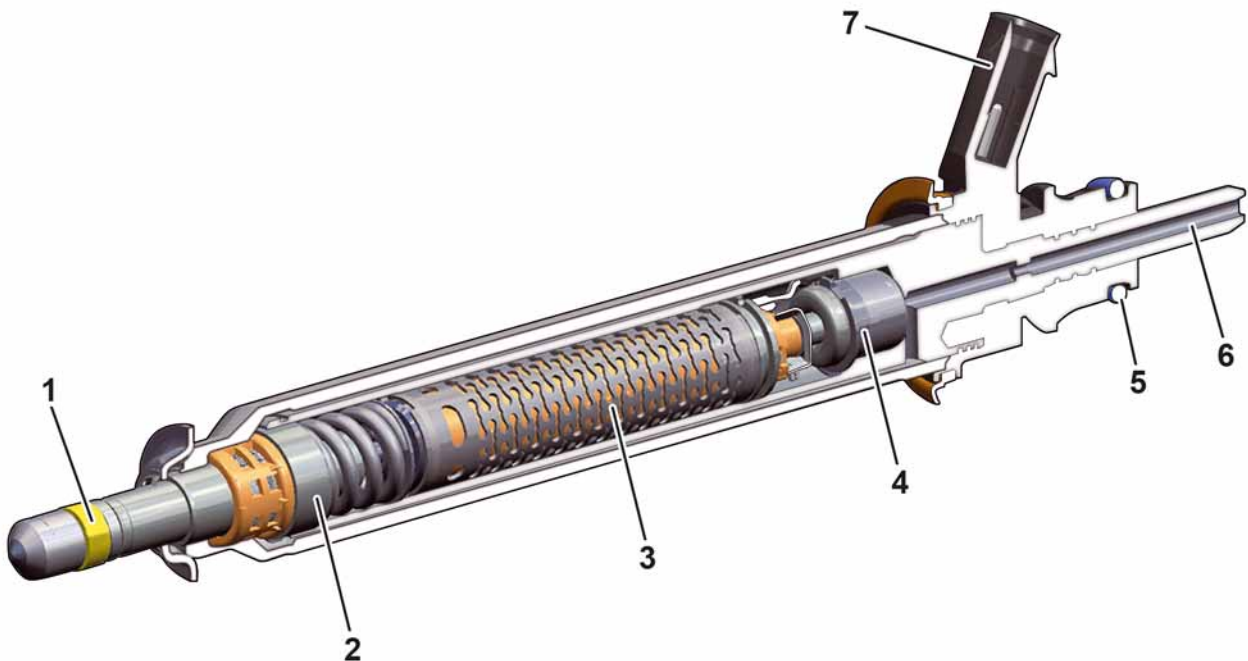
Current and voltage measurements on these lines must only be performed with potential-free current clamps.

#### Important!

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 if they come into any contact with other components they may be damaged.



**Fuel injector design (sectional view)**

P07.03-2309-00

- |   |                       |   |                       |
|---|-----------------------|---|-----------------------|
| 1 | Teflon ring           | 5 | O-ring                |
| 2 | Valve group           | 6 | Fuel high pressure    |
| 3 | Piezo actuator module | 7 | Electrical connection |
| 4 | Coupler               |   |                       |

**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!**

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 to the high-pressure pump under all operating conditions. The high-pressure pump then pumps the fuel to the fuel injectors.

### Low-pressure fuel 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 pressure (fuel requirement), the ME-SFI [ME] control unit evaluates the fuel pressure and load requirement. Depending on the requirement, the 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 suctions the fuel from the feed module and pumps it through the fuel filter to the high-pressure pump (single line system without return line).

The overflow valve in the fuel filter opens at a pressure of approx. 7 bar to approx. 9 bar. Fuel is taken from a T-piece upstream of the fuel filter. The fuel is pumped here at a rate of 20 to 40 l/h by the suction jet pump. This suction jet pump pumps the fuel from the left fuel tank chamber into the fuel feed module (in the right fuel tank chamber), thus preventing the fuel tank from being emptied on one side only.

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

### High-pressure fuel system

In the high-pressure 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 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.

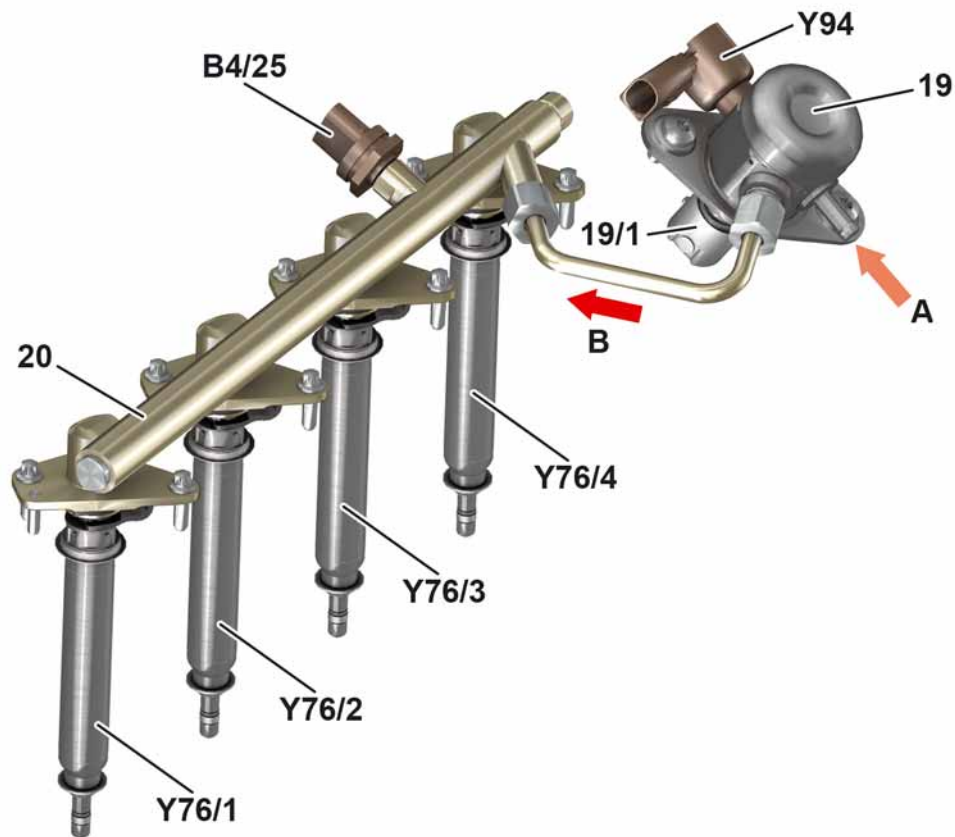
There is a quantity control valve on the high-pressure pump. This regulates the quantity of fuel fed to the pump element for compression depending on the specified pressure.

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.

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 high-pressure pump. The existing rail pressure is maintained for a very long period of time even after the engine is switched off.



P07.02-2147-00

### Fuel high-pressure system

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



## 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 direction of rotation 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 switches off the fuel pump directly via the fuel system control unit and via the drivetrain CAN along with the quantity control valve. The ME-SFI [ME] control unit actuates the fuel injectors briefly 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.

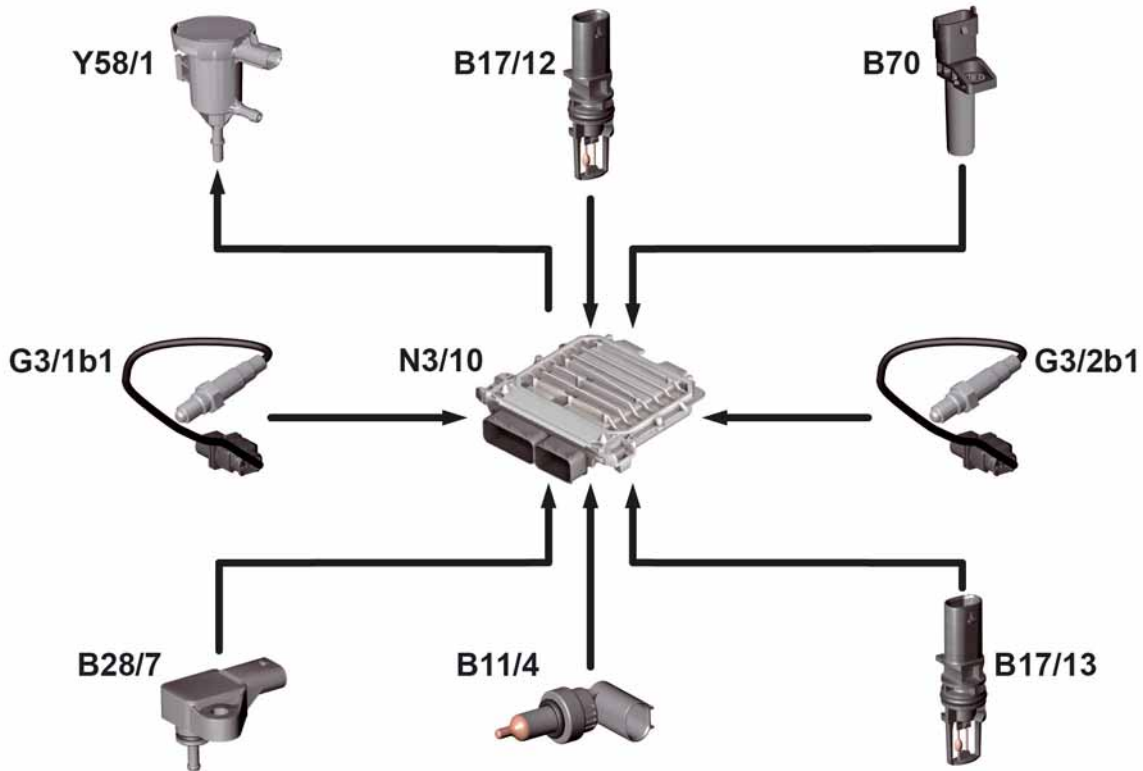
When the engine is running, the fuel vapors stored in the activated charcoal canister are drawn off via the purge switchover valve and burned in the engine.

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 function 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.



P47.30-2252-00

**Function schematic of purging**

- |        |  |        |   |
|--------|--|--------|---|
| B11/4  | Coolant temperature sensor                                 | G3/1b1 | Sensor element of oxygen sensor downstream of catalytic converter |
| B17/12 | Charge air temperature sensor upstream of throttle valve   | G3/2b1 | Sensor element of oxygen sensor upstream of catalytic converter   |
| B17/13 | Charge air temperature sensor downstream of throttle valve | N3/10  | ME-SFI [ME] control unit  |
| B28/7  | Pressure sensor downstream of throttle valve               | Y58/1  | Purge switchover valve  |
| B70    | Crankshaft Hall sensor (with rotation direction detection) |        |   |

## Exhaust system

### Exhaust treatment

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

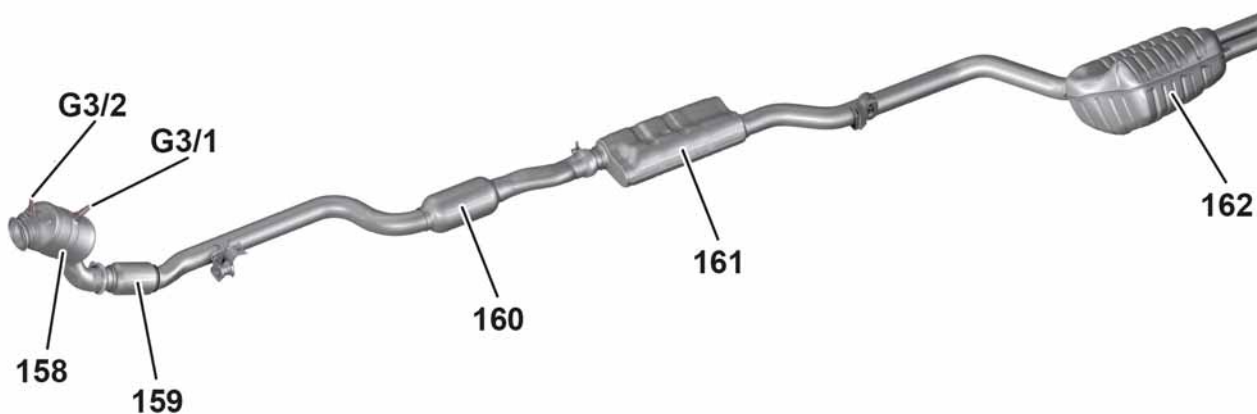
- Nitrogen oxides (NOx)
- Hydrocarbon (HC)
- Carbon monoxide (CO)

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
- Center muffler
- Rear muffler

With the help of this exhaust system, the EU 5 emissions standard required for the start of series production is fulfilled. The design takes into account the possibility of fulfilling the EU 6 emissions standard. The decoupling element reduces the transmission of vibrations from the engine to the exhaust system.



### Exhaust system

P49.00-2159-00

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

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



## Exhaust system

The following subsystems are involved in exhaust treatment:

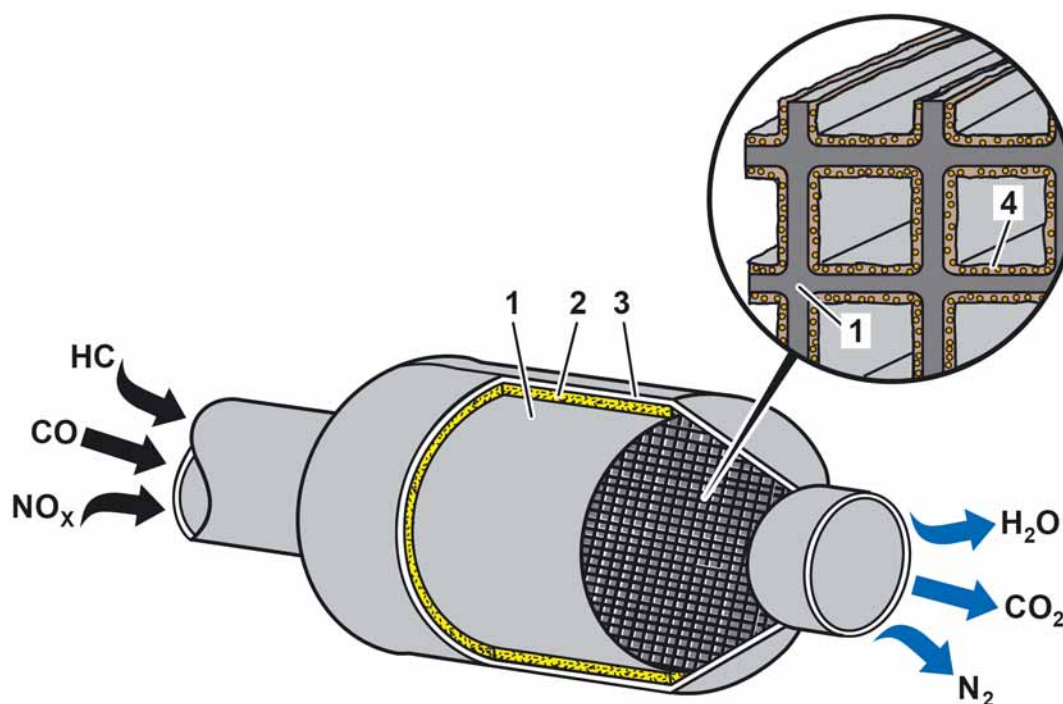
- Catalytic converter
- Transmission shift delay (with automatic transmission)
- Monitoring of catalytic converter efficiency

Through oxidation, carbon monoxide (CO) is converted into carbon dioxide (CO<sub>2</sub>) and hydrocarbons (HC) are converted into water (H<sub>2</sub>O) + carbon dioxide (CO<sub>2</sub>).

Through reduction, nitrogen oxides (NO<sub>x</sub>) are converted into nitrogen (N<sub>2</sub>) + carbon dioxide (CO<sub>2</sub>).

### Catalytic converter

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



P49.10-2998-00

#### Catalytic converter operation, schematic illustration

- 1 Ceramic body
- 2 Retaining mat
- 3 Housing
- 4 Substrate coating
- CO Carbon monoxide

- CO<sub>2</sub> Carbon dioxide
- HC Hydrocarbon
- H<sub>2</sub>O Water
- N<sub>2</sub> Nitrogen
- NO<sub>x</sub> Nitrogen oxides

## Exhaust system

### Transmission shift delay (with automatic 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 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.

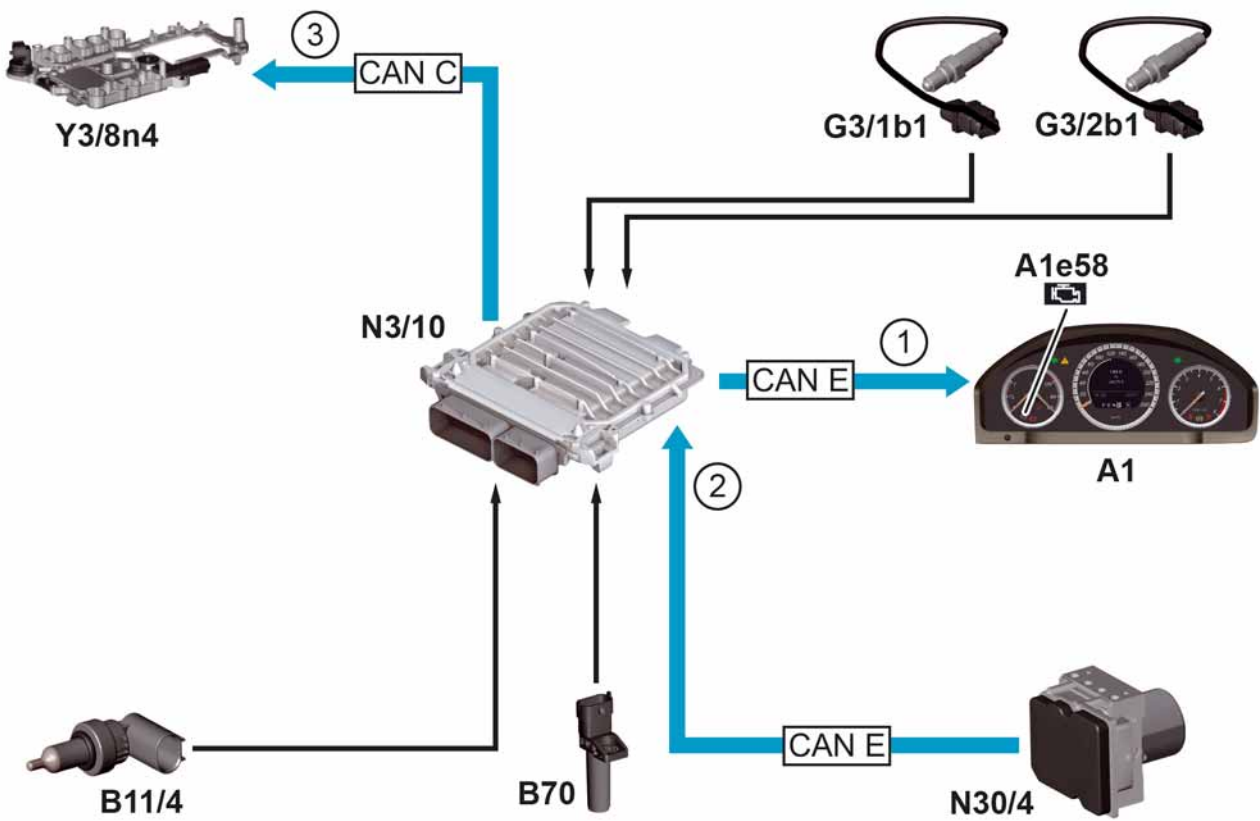
The task of the catalytic converter efficiency monitoring function is to make an assessment about the aging of the catalytic converter and thus its HC conversion rate based on its ability to store oxygen.

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 upstream and downstream 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.



P14.00-2126-00

### Function schematic of exhaust treatment

A1	Instrument cluster	N3/10	ME-SFI [ME] control unit
A1e58	Engine diagnosis indicator lamp	N30/4	Electronic Stability Program control unit
B11/4	Coolant temperature sensor	Y3/8n4	Fully integrated transmission control unit (with automatic transmission)
B70	Crankshaft Hall sensor (with rotation direction detection)	CAN C	Drive train CAN
G3/1b1	Sensor element of oxygen sensor downstream of catalytic converter	CAN E	Chassis CAN
G3/2b1	Sensor element of oxygen sensor upstream of catalytic converter	1	Engine diagnosis indicator lamp, actuation
		2	Wheel speed, signal
		3	Shift point, increase request

## Engine cooling

### Cooling circuit

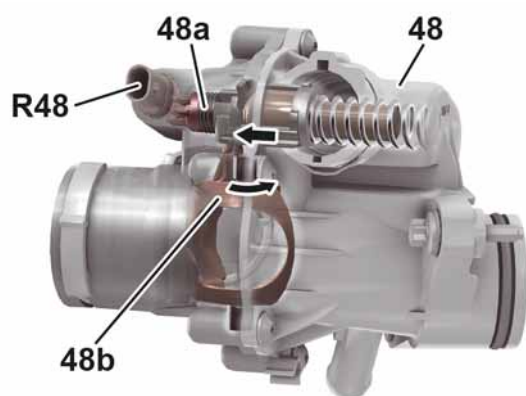
Engine cooling takes place via a crossflow cooling system. This ensures that each cylinder is supplied uniformly with coolant. In contrast to longitudinal flow cooling, this prevents a temperature gradient between the cylinders under high loads.

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. In the process, the coolant temperatures are actively influenced by the ME-SFI [ME] control unit depending on the driving style and ambient conditions (e.g. outside temperature).

### 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.

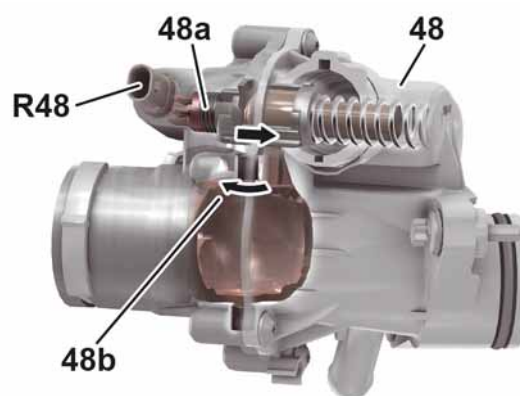
In order to minimize pressure losses, the coolant thermostat is equipped with a rotary ball valve to control the volumetric flow rates.



**Coolant thermostat closed**

P20.10-2343-00

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



**Coolant thermostat open**

P20.10-2344-00

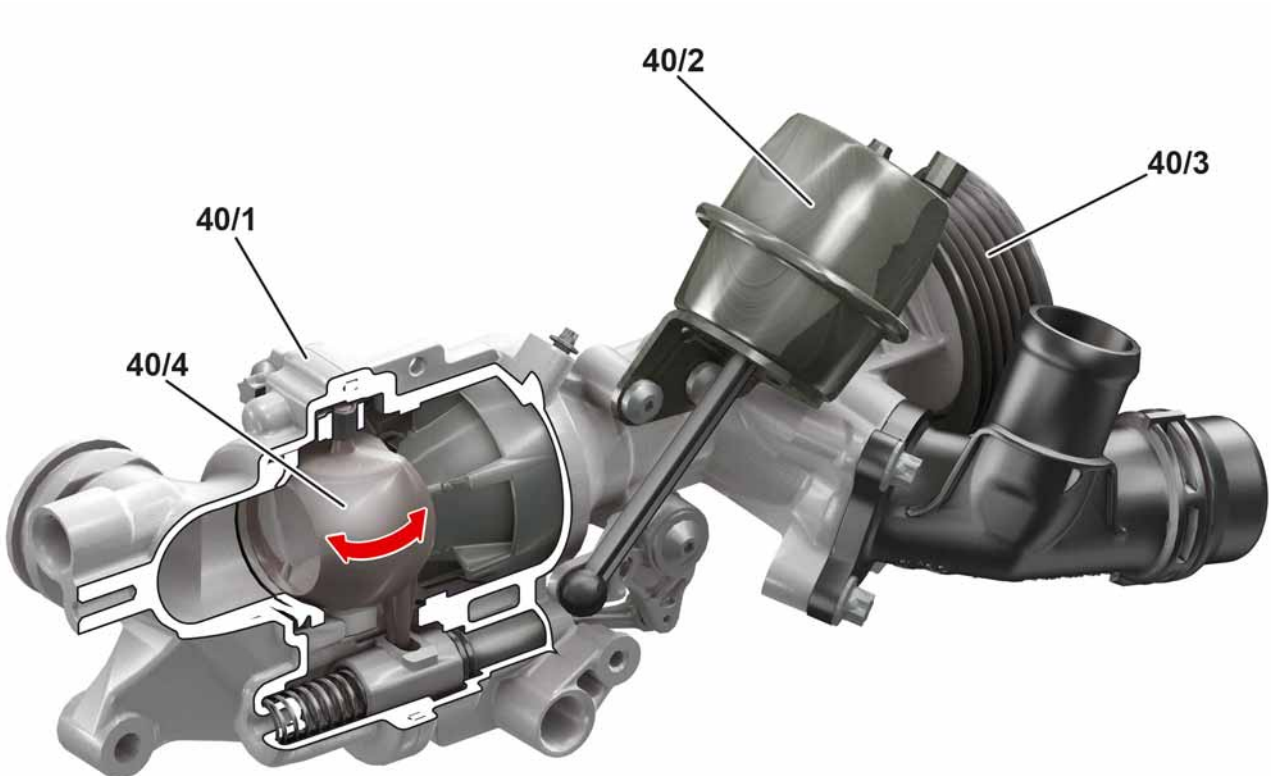
- 48 Coolant thermostat housing
- 48a Expanding wax element
- 48b Rotary ball valve
- R48 Coolant thermostat heating element



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



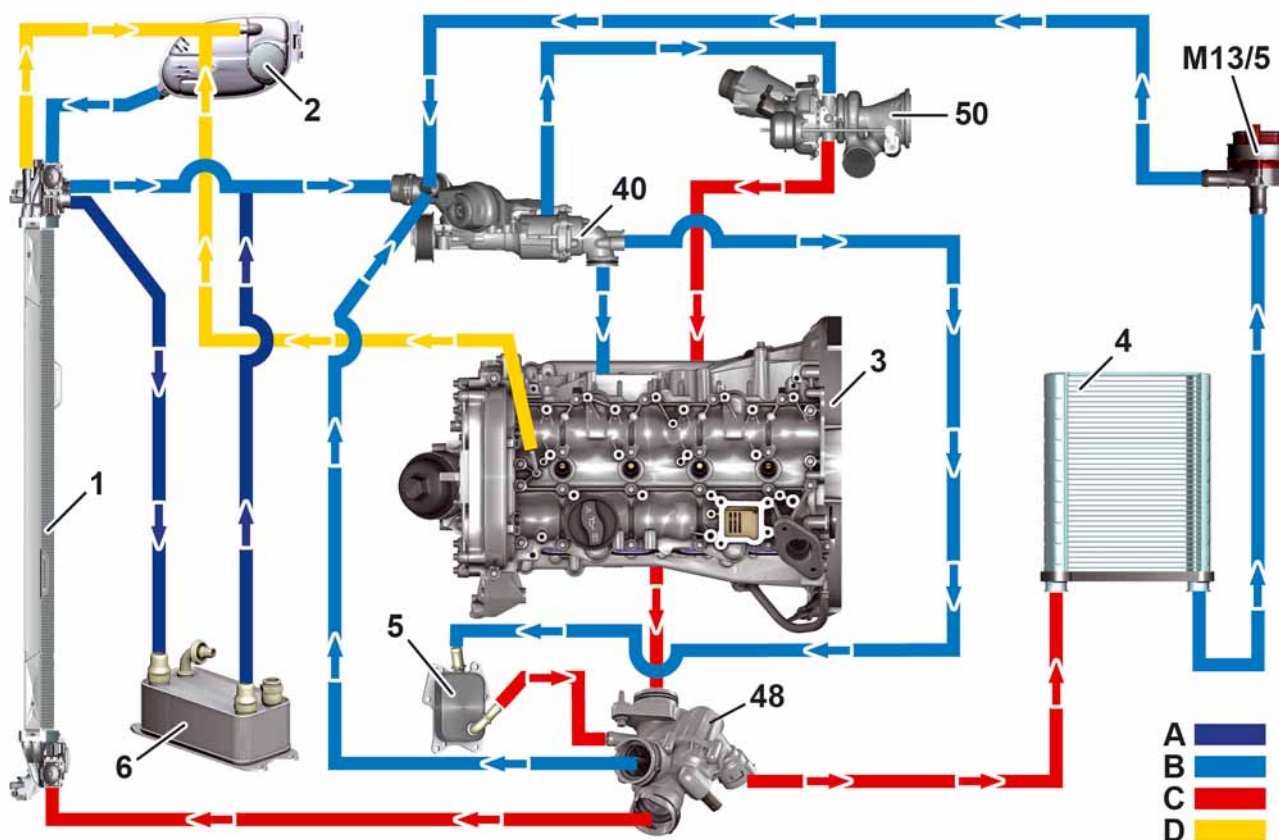
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## Coolant pump

- 40/1 Coolant pump housing
- 40/2 Coolant pump vacuum unit

- 40/3 Belt pulley
- 40/4 Rotary ball valve

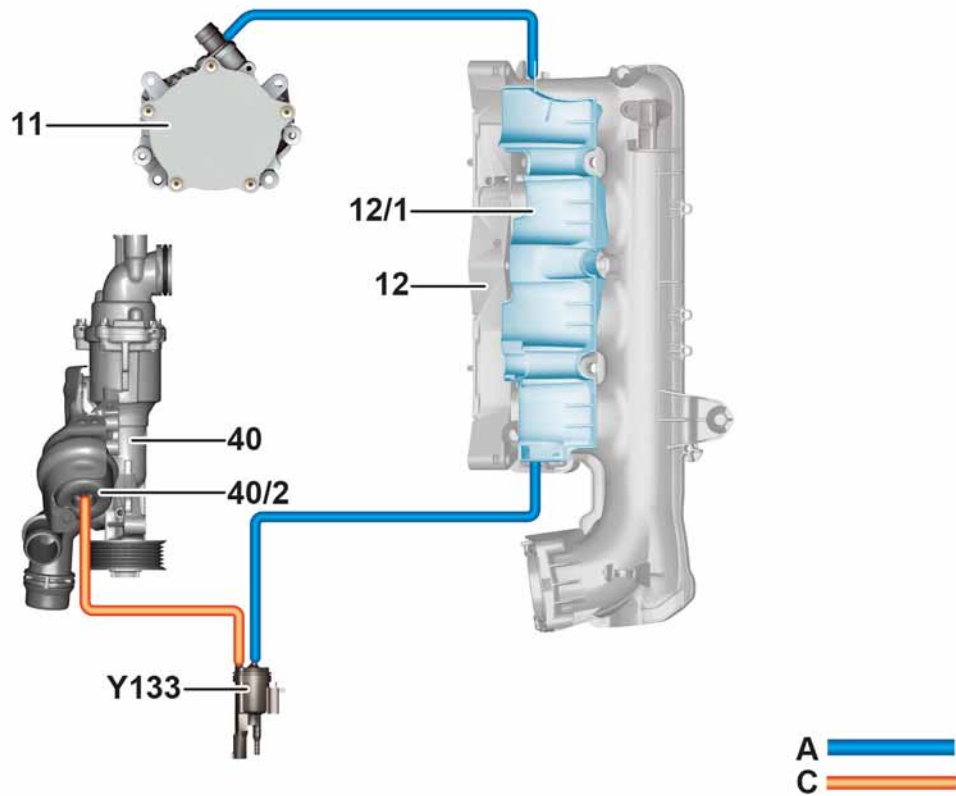
## Engine cooling



P20.00-2438-00

### Coolant circuit, schematic illustration

- |    |   |       |  |
|----|---|-------|--|
| 1  | Radiator  | 48    | Coolant thermostat                             |
| 2  | Coolant expansion reservoir                                   | 50    | Turbocharger                                   |
| 3  | Engine 274  | M13/5 | Coolant circulation pump                       |
| 4  | Heater heat exchanger   | A     | Low-temperature cooling circuit coolant return |
| 5  | Engine oil/coolant heat exchanger                             | B     | Coolant return to engine                       |
| 6  | Coolant/transmission oil cooler (with automatic transmission) | C     | Coolant feed                                   |
| 40 | Coolant pump  | D     | Coolant circuit ventilation                    |

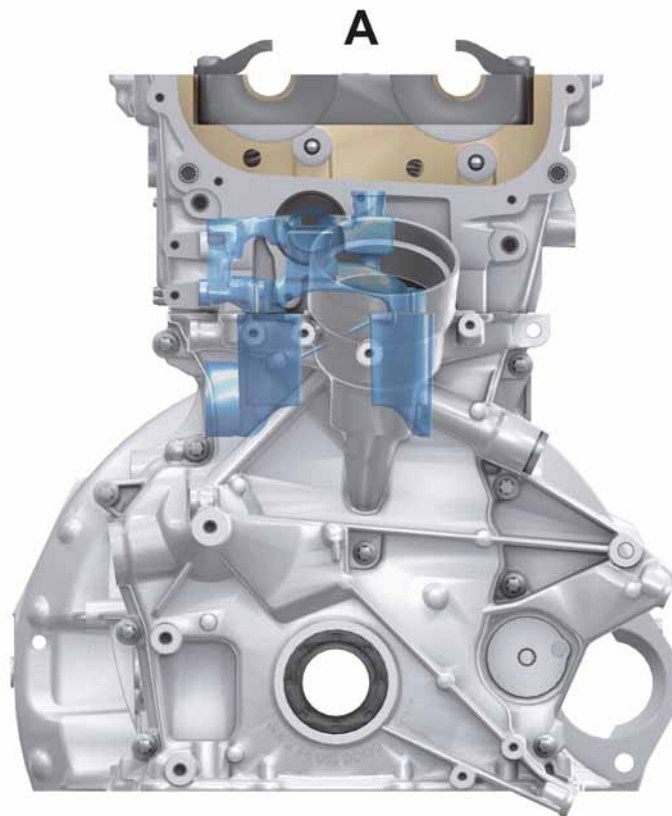


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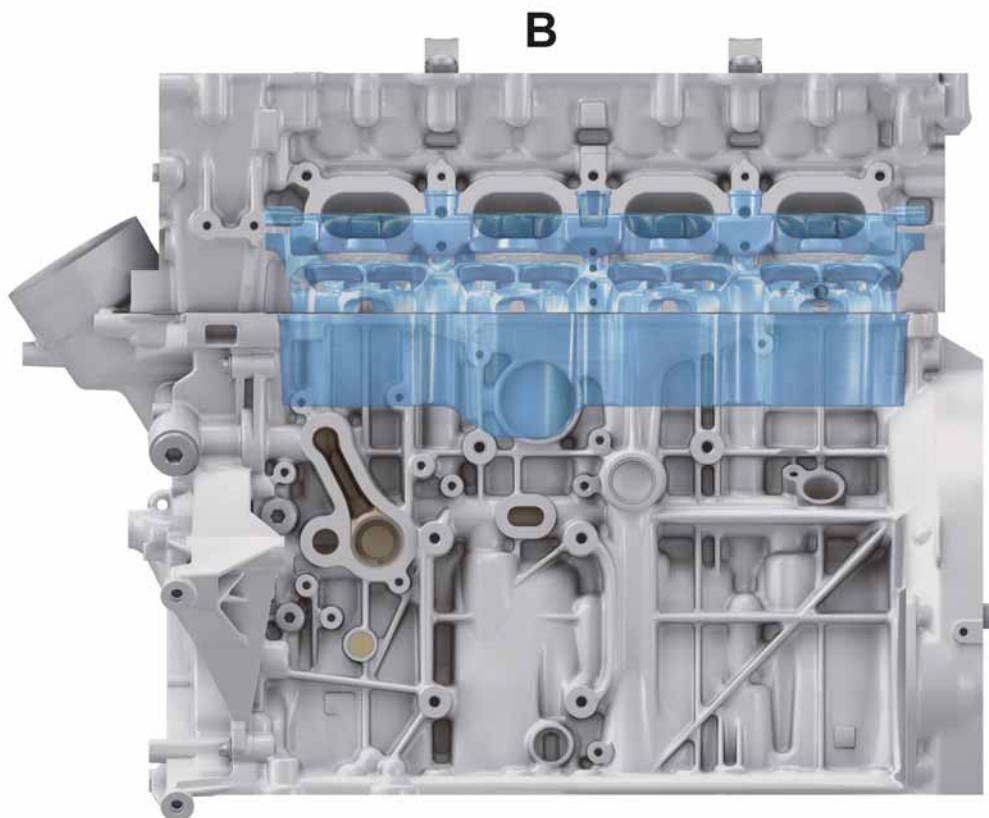
### Vacuum system for coolant pump control

11	Vacuum pump	40/2	Coolant pump vacuum unit
12	Charge air manifold	Y133	Coolant pump switchover valve
12/1	Vacuum reservoir	A	Vacuum supply via vacuum reservoir
40	Coolant pump	C	Vacuum for controlling coolant pump

# Engine cooling



P20.00-2435-00



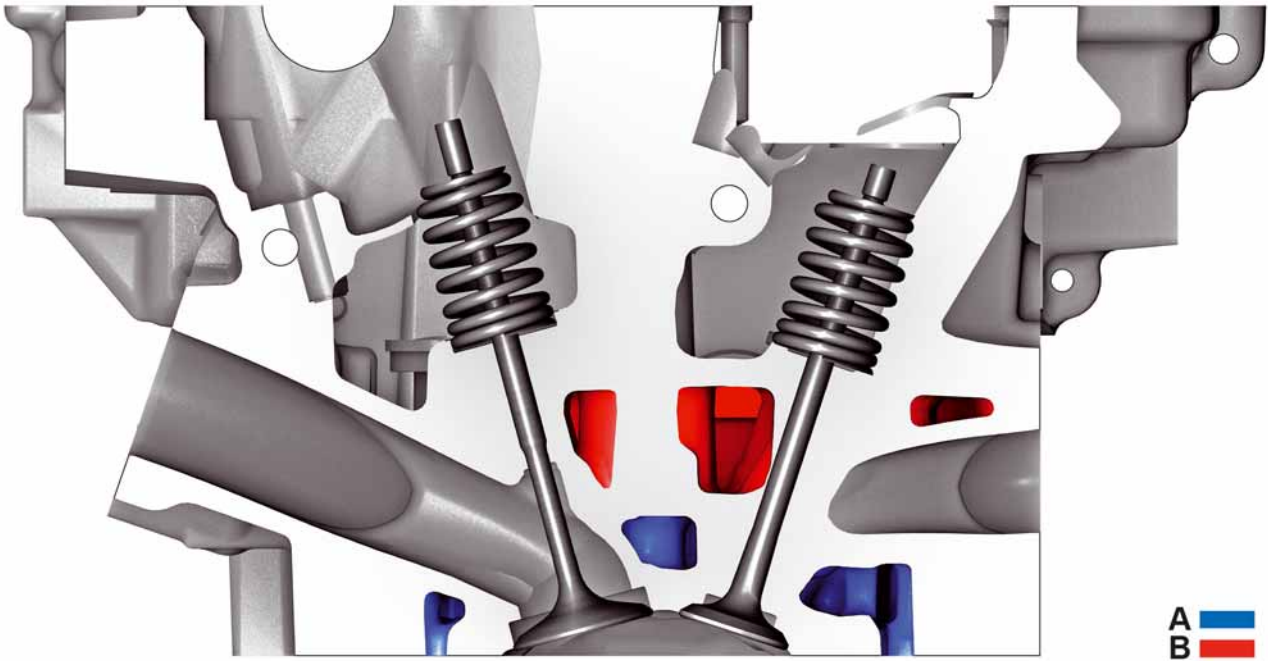
P20.00-2436-00

### Coolant distribution

A Front of crankcase

B Left of crankcase





A   
B 

**Cylinder head coolant flow**

P20.00-2430-00

A Rapid flow (cold)

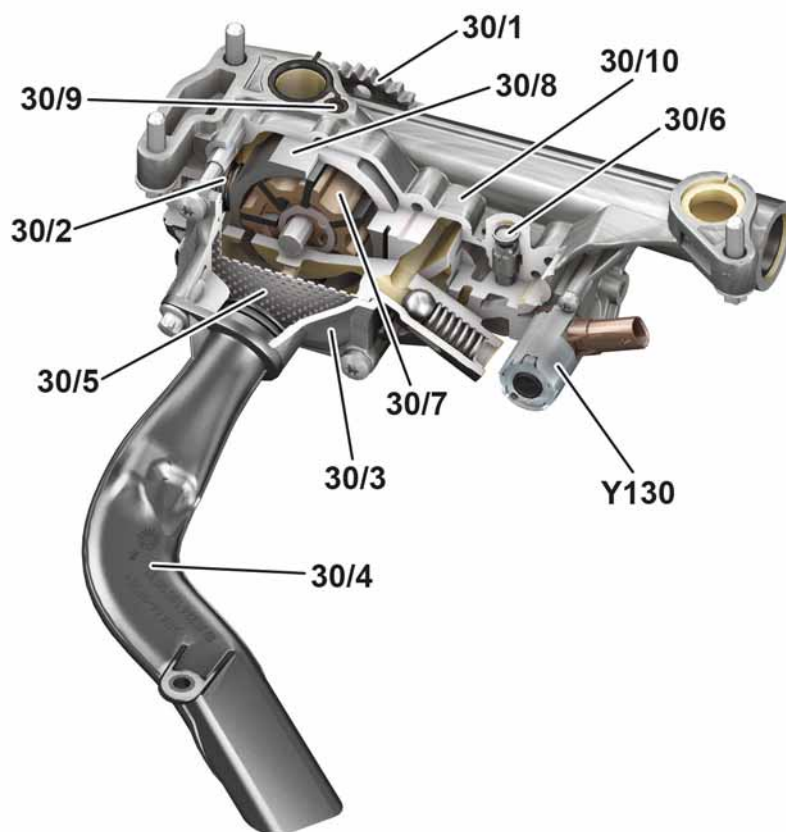
B Slow flow (warm)

## Engine lubrication

### Regulated engine oil pump

The engine oil pressure is regulated via the 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 operating energy input 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.



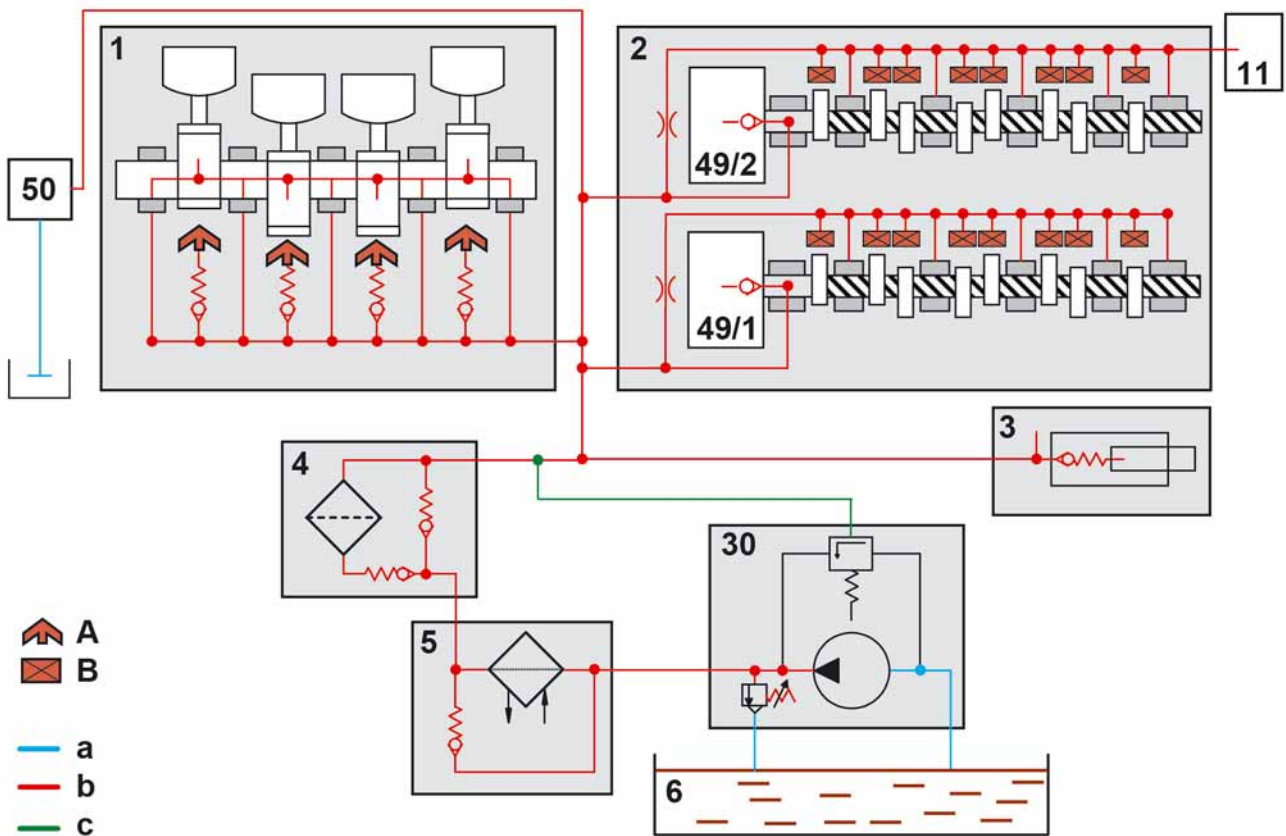
### Engine oil pump

30/1 Drive gear  
30/2 Control spring  
30/3 Oil pump cover  
30/4 Oil intake tube  
30/5 Oil screen

30/6 Pilot control valve  
30/7 Rotor with vane  
30/8 Set collar  
30/9 Control channel  
30/10 Oil pump housing  
Y130 Engine oil pump valve

P18.10-2201-00





**Oil circuit diagram, M 274**

P18.00-2322-00

- |    |  |      |  |
|----|--|------|--|
| 1  | Crankcase  | 49/1 | Intake camshaft adjuster               |
| 2  | Cylinder head  | 49/2 | Exhaust camshaft adjuster              |
| 3  | Chain tensioner with oil spray nozzle                              | 50   | Turbocharger                           |
| 4  | Oil filter module with return stop and pressure differential valve | a    | Engine oil return line                 |
| 5  | Engine oil/coolant heat exchanger with thermostatic valve          | b    | Engine oil pressure line               |
| 6  | Oil sump   | c    | Control pressure for engine oil pump   |
| 11 | Vacuum pump  | A    | Oil spray nozzle                       |
| 30 | Engine oil pump with 2 pressure stages (1.7 bar and 3.9 bar)       | B    | Hydraulic valve clearance compensation |



## Engine control

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

The engine is equipped with a newly developed ME-SFI [ME] control unit. This 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 ME-SFI [ME] control unit combines electrically with the sensors and actuators of engine 274 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
- Oil temperature model
- 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:

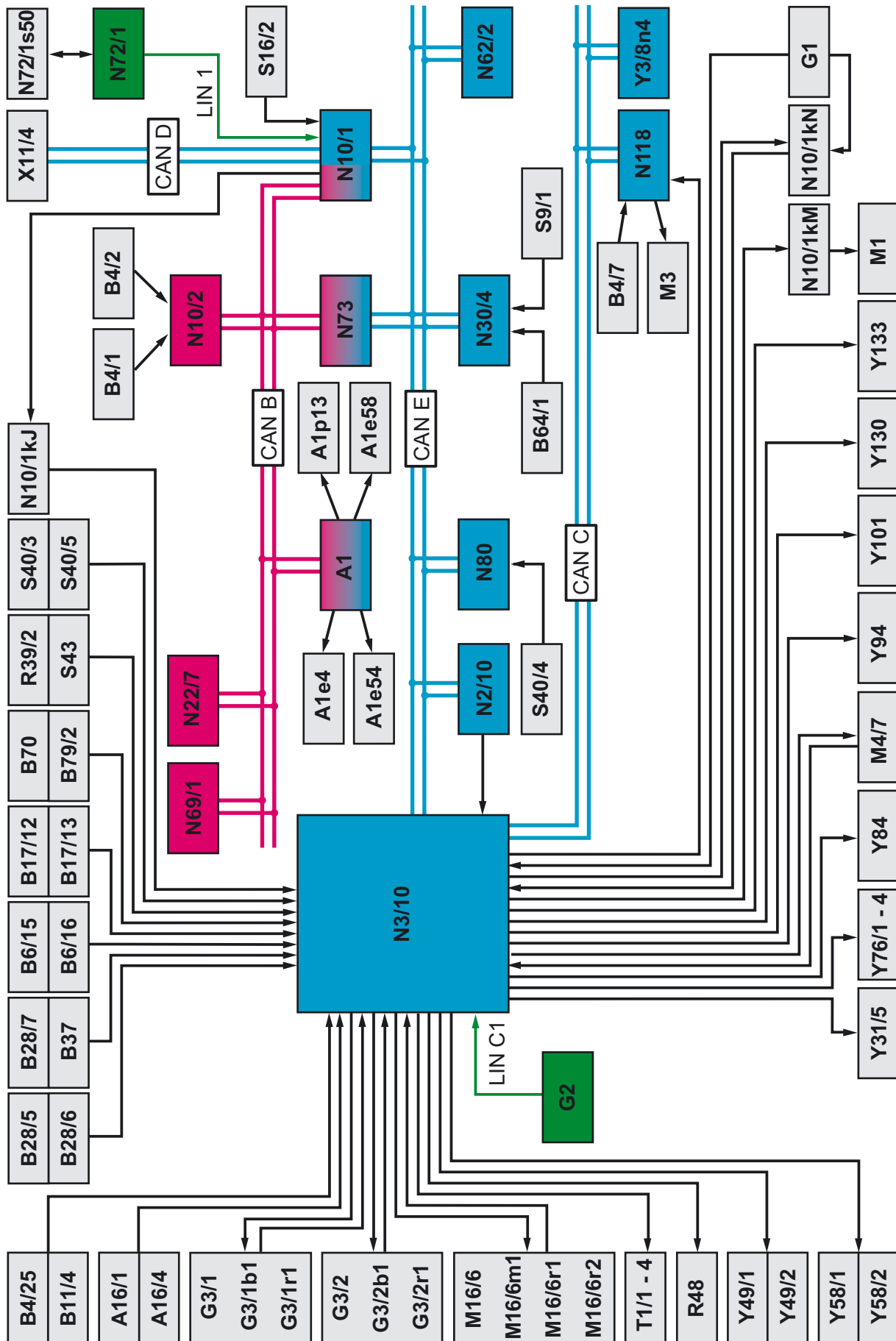
- Ignition system
- Fuel supply
- High-pressure gasoline injection
- Electronic accelerator
- Diagnosis and fault storage
- ECO start/stop function engine control system
- Drive authorization system and immobilizer
- Stepless camshaft adjustment for intake and exhaust
- Boost pressure control
- Torque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

#### Note!

Further details on this and other electrical systems (e.g. function descriptions and the locations of electrical components) are available in the Workshop Information System (WIS) under the "Basic knowledge/functions" (GF) information type.

#### 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.



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## Engine control

### Block diagram

A1	Instrument cluster
A1e4	Fuel reserve warning lamp
A1e54	Coolant temperature warning lamp
A1e58	Engine diagnosis indicator lamp
A1p13	Multifunction display
A16/1	Rear knock sensor
A16/4	Front knock sensor
B4/1	Fuel level indicator sensor, left
B4/2	Fuel level indicator 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
B17/12	Charge air temperature sensor upstream of throttle valve

B17/13	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
B70	Crankshaft Hall sensor (with rotation direction detection)
B79/2	Transmission neutral position sensor (with manual transmission)
CAN B	Interior CAN
CAN C	Drive train CAN
CAN D	Diagnostic CAN
CAN E	Chassis CAN

G1	On-board electrical system battery
G2	Alternator
G3/1	Oxygen sensor downstream of catalytic converter
G3/1b1	Sensor element of oxygen sensor downstream of catalytic converter
G3/1r1	Heater of oxygen sensor downstream of catalytic converter
G3/2	Oxygen sensor upstream of catalytic converter
G3/2b1	Sensor element of oxygen sensor upstream of catalytic converter
G3/2r1	Heater of oxygen sensor upstream of catalytic converter
LIN 1	Instrument panel LIN
LIN C1	Drive train LIN



M1	Starter
M3	Fuel pump
M4/7	Combustion engine and air conditioning fan motor with integrated control
M16/6	Throttle valve actuator
M16/6m1	Actuator motor
M16/6r1	Actual value potentiometer 1
M16/6r2	Actual value potentiometer 2
N2/10	Supplemental restraint system control unit
N3/10	ME-SFI [ME] control unit
N10/1	Front SAM control unit with fuse and relay module
N10/1k1	Circuit 15 relay
N10/1kM	Starter circuit 50 relay
N10/1kN	Engine circuit 87 relay
N10/2	Rear SAM control unit with fuse and relay module
N22/7	Automatic air conditioning control and operating unit
N30/4	Electronic Stability Program control unit
N69/1	Left front door control unit

N62/2	Video and radar sensor system control unit (with code (233) <i>DISTRONIC PLUS</i> , with code (237) <i>Active Blind Spot Assist</i> , with code (238) <i>Active Lane Keeping Assist</i> )
N72/1	Upper control panel control unit
N72/1s50	ECO start/stop function button
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
S16/2	Backup lamp switch (with manual transmission)
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
Y3/8n4	Fully integrated transmission control unit (with automatic transmission)
Y31/5	Boost pressure control pressure transducer
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
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 plugged directly onto the spark plugs with short ignition lines known as "boots". They 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, this interrupts the primary circuit at the ground end. This creates arcing in the air gap between the center and ground electrode of the spark plug. 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

#### Singlespark – 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.

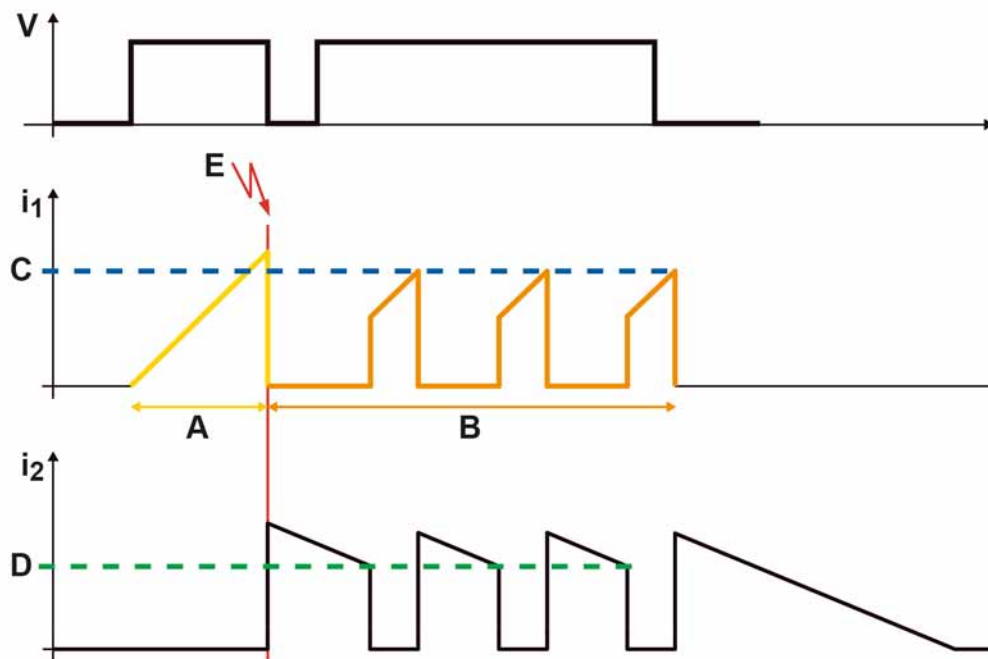
#### Multispark – Multiple spark ignition

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 electronics reopen the output stage allowing the charging current to flow again. The level of the primary current is also monitored. When the primary current threshold is reached, the output stage closes the primary circuit and high voltage is generated once more. This causes another ignition spark to be produced. Subsequent sparks are also 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

Engine 274 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:

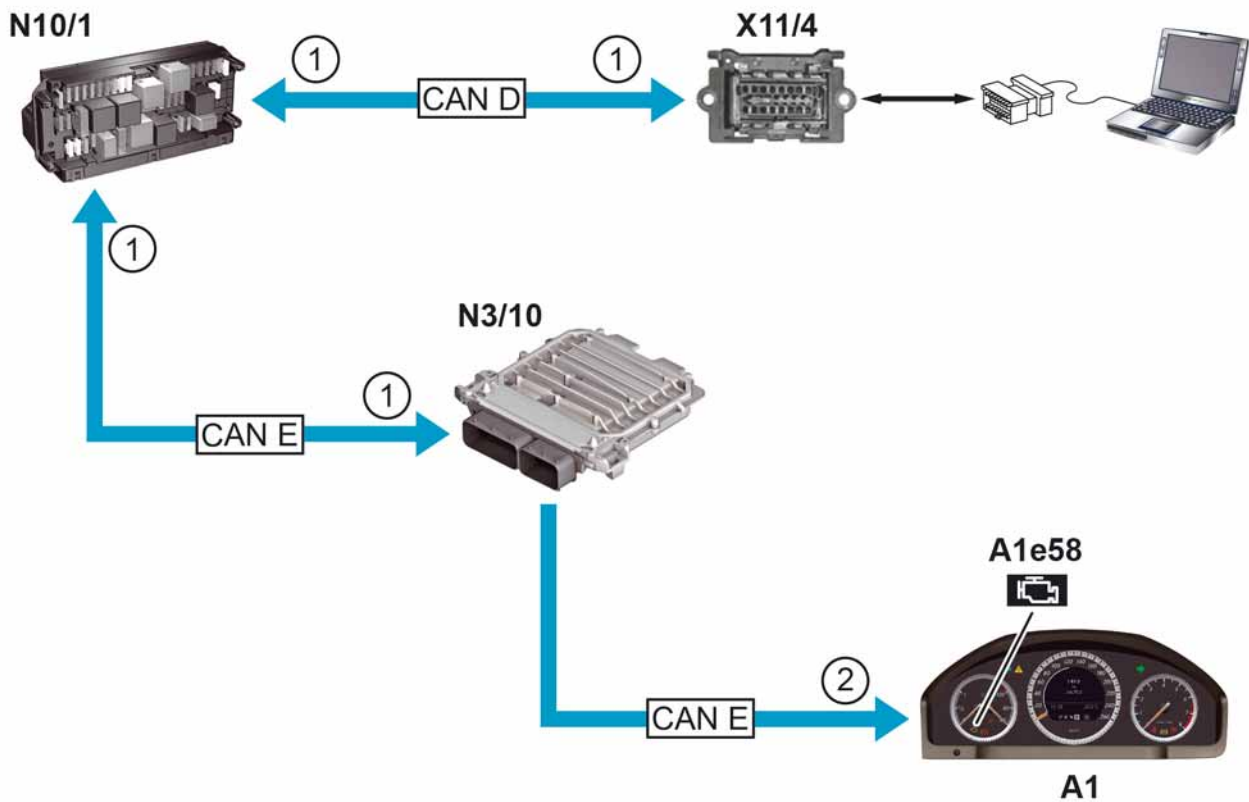
- Monitoring emissions-relevant components and systems while driving
- Detecting and storing malfunctions
- Showing malfunctions via the engine diagnosis indicator lamp
- Transmitting detected faults over a standard interface (diagnostic connector) to a diagnostic unit (e.g. Xentry Diagnostics)

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





**On-Board Diagnosis function schematic**

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- A1 Instrument cluster
- A1e58 Engine diagnosis indicator lamp
- N3/10 ME-SFI [ME] control unit
- N10/1 Front SAM control unit with fuse and relay module

- X11/4 Diagnostic connector
- CAN D Diagnostic CAN
- CAN E Chassis CAN
- 1 Engine control diagnosis, communication
- 2 Engine diagnosis indicator lamp, actuation

## Abbreviations

<b>CAN</b>	<b>H<sub>2</sub>O</b>
Controller Area Network	Water
<b>CO</b>	<b>KW</b>
Carbon monoxide	Crank angle (CKA)
<b>CO<sub>2</sub></b>	<b>LIN</b>
Carbon dioxide	Local Interconnect Network
<b>DE</b>	<b>ME</b>
Direct Injection (DI)	Motor Electronics (ME-SFI)
<b>EOBD</b>	<b>N<sub>2</sub></b>
European On-Board-Diagnosis	Nitrogen
<b>ESP</b>	<b>NO<sub>x</sub></b>
Electronic Stability Program	Nitrogen Oxide
<b>EU 5</b>	<b>OBD</b>
Euro 5 standard (emissions standard)	On-Board Diagnosis
<b>EU 6</b>	<b>PWM</b>
Euro 6 standard (emissions standard)	Pulse Width Modulated
<b>HC</b>	<b>SAM</b>
Hydrocarbon	Signal acquisition and actuation module
	<b>WIS</b>
	Workshop Information System

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