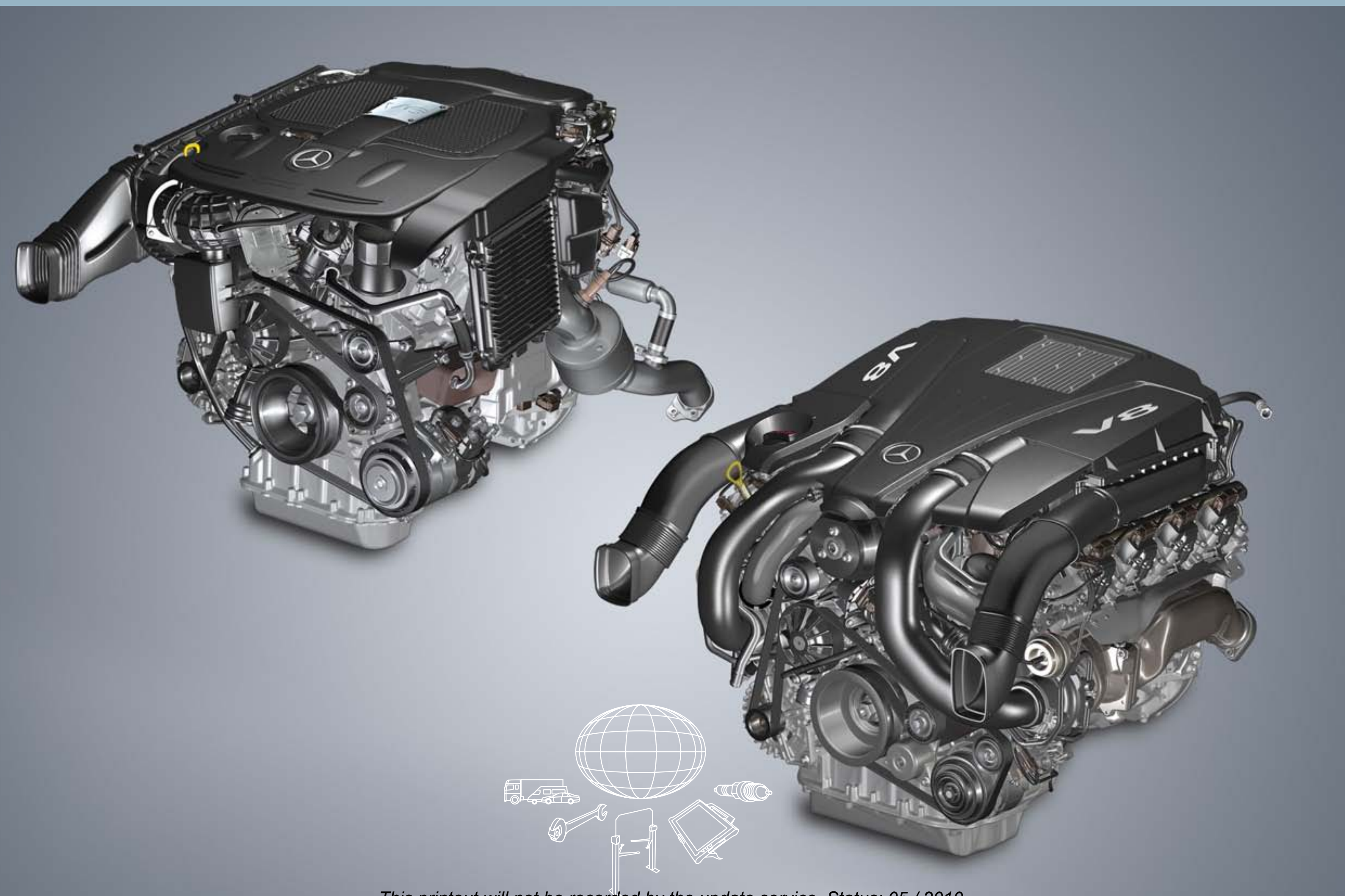
Introduction of the New Generation of V-Engines 6 and 8-cylinder M 276/M 278

Introduction into Service Manual

Mercedes-Benz



Introduction of the New Generation of V-Engines 6 and 8-cylinder M 276/M 278

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Dear reader,

This Introduction into Service Manual presents the new 6 and 8-cylinder spark-ignition engines 276 and 278 in combination with the vehicle model series 216/221.

The purpose of this brochure is to acquaint you with the technical highlights of these new engines in advance of their 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 that the reader is already familiar with the engines in the various Mercedes-Benz models 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 engines 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.

While this brochure's technical content is valid as of our publication date in April 2010, actual production vehicles may incorporate revisions and design changes based on differing technical specifications.

Daimler AG

Technical Information
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Highlights

From autumn 2010 onwards a new generation of gasoline V-engines will be gradually introduced in Mercedes-Benz vehicles starting with the S-Class (model 221) and the S-Class Coupé (model 216).

This new engine family, with the model designations M 276 for the V6 engine and M 278 for the V8 engine, has a deliberate focus on downsizing, modularization and technological development. It replaces the highly successful powerplants of engine models M 272 and M 273.

The use of versatile technology modules makes it possible to satisfy the varying global market and legal requirements as well as future-proofing the engine family.

The new third-generation direct injection system combines an extremely fast and accurate injector with a new, jet-guided combustion system. The short switching times of the piezo injectors allow multiple injections with short pauses during a single combustion cycle.

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 special features of the new V-engines at a glance:

- High-power engines successfully combining exclusive performance and demanding fuel consumption goals
- ECO start/stop function with starter-assisted direct start in combination with the 7-speed automatic transmission
- Improved comfort in terms of acoustics and vibrations
- Compliance with the currently applicable exhaust emissions legislation with potential for future conformity
- Modular concept for integration of forced induction systems and hybridization, and for compatibility with fuels with an ethanol content of up to 25%, and as an add-on module for an ethanol content of up to 85%
- Full aluminum crankcase
- Gasoline direct injection with the latest generation of piezo injectors and jet-guided combustion
- Advanced camshaft adjusters for optimized engine timing
- Advanced control and optimization of the oil and cooling circuits

Brief description

Engine 276

Features:

- V6/60° cylinder angle
- Balance shaft omitted
- Increased power and torque
- Extended lean burn (stratified combustion)
- New combustion system operating modes
- Resonance intake manifold
- Multi-spark ignition

Homogeneous and stratified combustion

The new 6-cylinder engine is available in two operating variants:

- Homogeneous combustion M 276 DEH (USA)
- Stratified combustion M 276 DES (ECE)

Homogeneous combustion (M 276 DEH)

In homogeneous operation a homogeneous combustible air/fuel mixture (λ=1) is produced throughout the combustion chamber. This system requires no additional exhaust aftertreatment measures as the normal 3-way catalytic converter can adequately convert the pollutants.

Stratified combustion (M 276 DES)

In stratified operation there is a combustible mixture ($\lambda \approx 1$) only in the vicinity of the spark plug. The lambda values in the rest of the combustion chamber vary. These values extend from pure intake air through to exhaust gases from the exhaust gas recirculation system. The fuel consumption in stratified operation is therefore lower than in homogeneous operation. Due to the excess air, which consists of approx. 75% nitrogen by volume, the formation of NOx is significantly higher in stratified combustion than in homogeneous combustion. This necessitates the use of an NOx storage catalytic converter.

Engine 276, V6-cylinder with 3.5 l displacement P01.10-3010-00

Homogeneous stratified combustion (HOS)

In the predecessor engines there was a relatively clearly defined boundary between stratified combustion and homogeneous combustion at a mean pressure of approx. 5-6 bar.

The new HOS mode shows that it provides more favorable values in the range above 4 bar than pure stratified combustion. At the same time it allows homogeneous combustion to be used to pressures in excess of 7 bar, which results in considerable fuel savings.

HOS is a combination of the homogeneous lean-burn and classic stratified combustion processes. In an unthrottled engine, the first injection is sprayed in during the intake stroke, and the actual "stratified" injection occurs before ignition.

Different components in engine 276 with homogeneous combustion (DEH) and stratified combustion (DES)

Components	M 276 DEH	M 276 DES
Hot film mass air flow sensor (B2/5)	–	X
Intake air temperature sensor (B17) (between air filter and throttle valve actuator)	X	–
Temperature sensor upstream of NOx storage catalytic converter, left (B16/1) and right (B16)	–	X
NOx (nitrogen oxides) control unit, left (N37/5) and right (N37/6)	–	X
NOx (nitrogen oxides) sensor, left (N37/5b1) and right (N37/6b1)	–	X
Exhaust gas recirculation actuator motor, left (M16/45m2) and right (M16/45m1)	–	X
Exhaust gas recirculation valve	–	X
Exhaust gas recirculation line, left and right	–	X

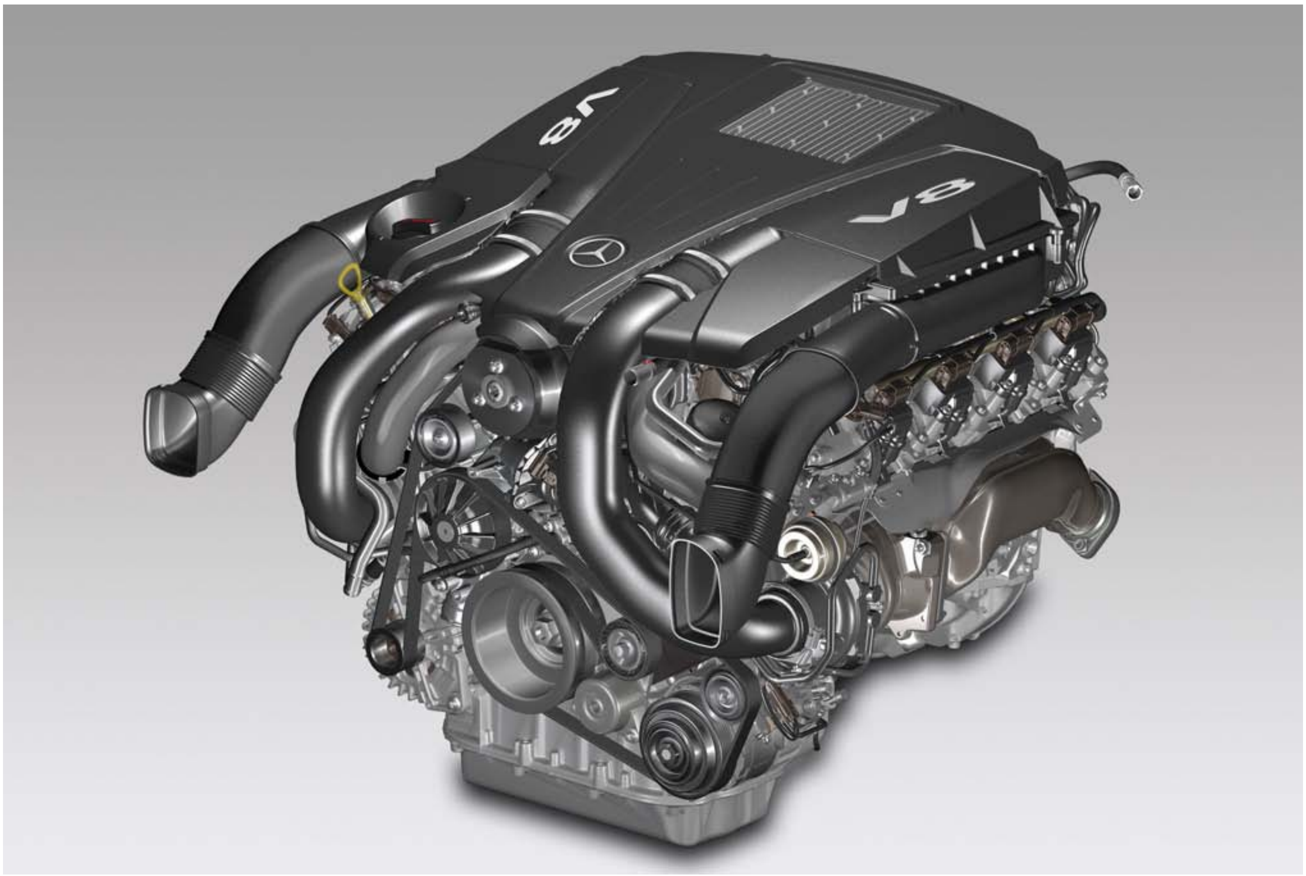
Brief description

M 278

Compared with the predecessor engine M 273 KE 55, the displacement has been reduced to 4.6 liters. Nevertheless, thanks to the use of one turbocharger for each cylinder bank, it has been possible to significantly increase the engine power and torque.

Features:

- V8/90° cylinder angle
- Biturbocharging with charge air cooling



Engine 278, V8-cylinder with 4.6 l displacement and forced induction

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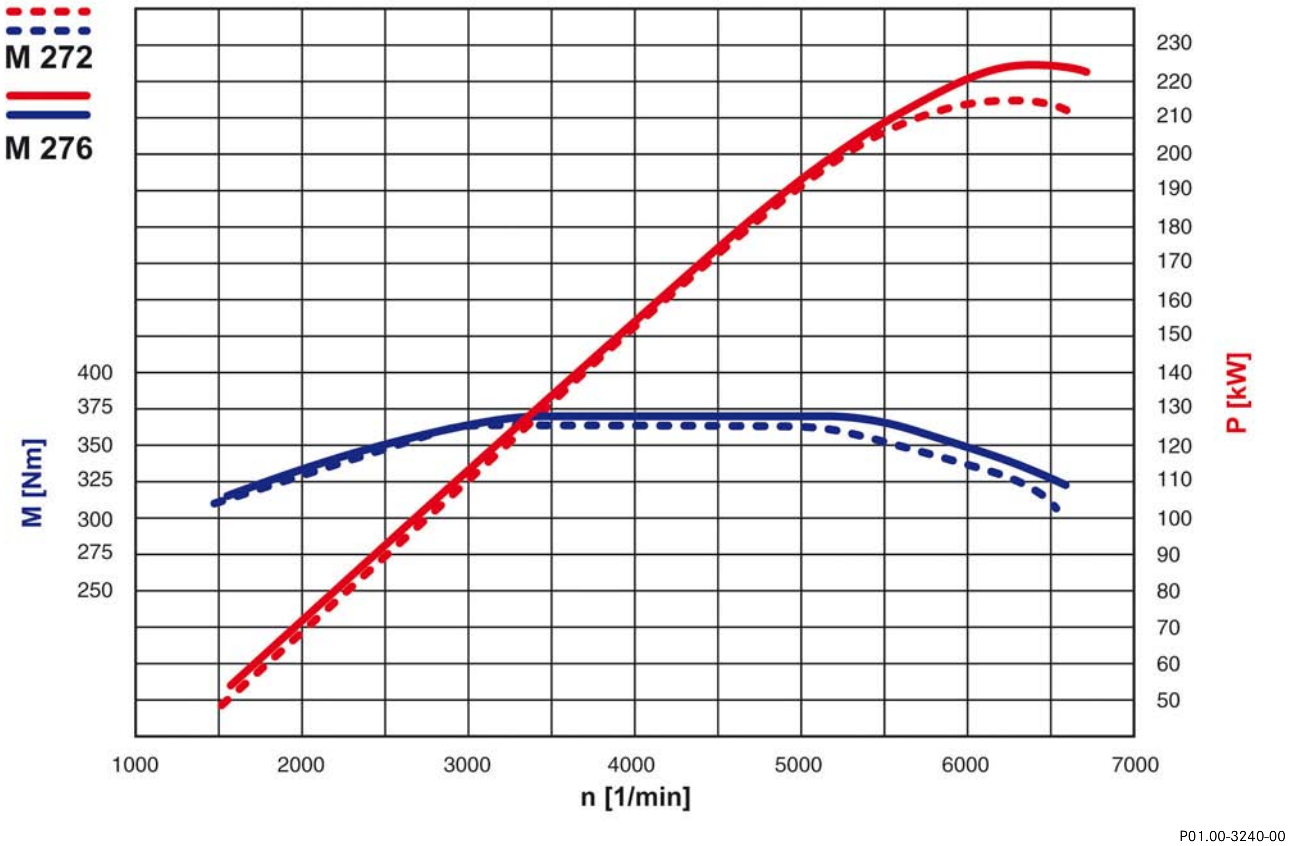
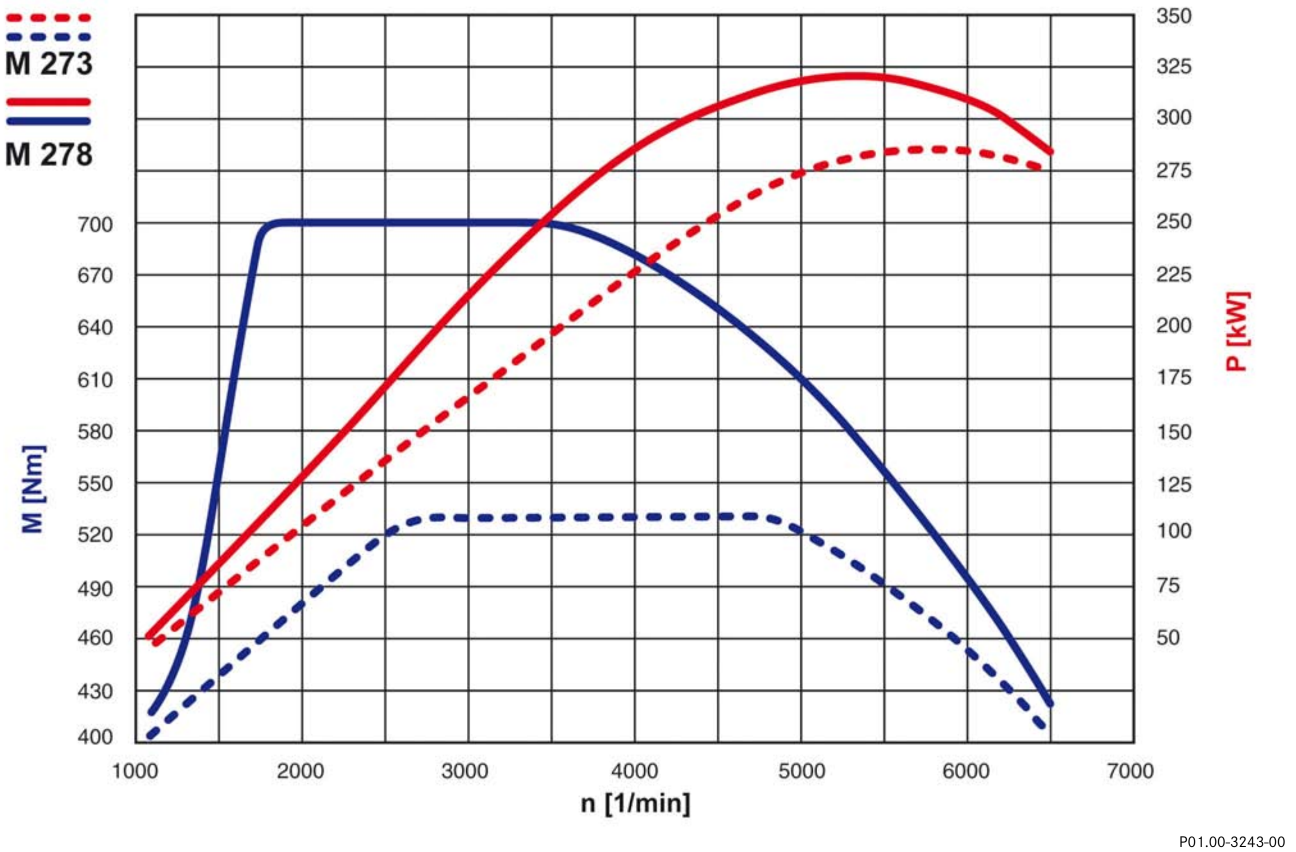
Engine data comparison with predecessor engines

		Comparison of 6-cylinder engines		Comparison of 8-cylinder engines	
		M 276 DE 35 S 350 CGI	**M 272 KE 35 S 350**	**M 278 DELA 46 S 500 CGI**	**M 273 KE 55 S 500**
Configuration/angle		V6/60°	V6/90°	V8/90°	
Rated output at engine speed	kW rpm	225 6500	200 6000	320 5250	285 6000
Rated torque at engine speed	Nm rpm	370 3500-5250	350 2400-5000	700 1800-3500	530 2800-4800
Displacement	cm^3	3498		4663	5461
Bore	mm	92.9		92.9	98
Stroke	mm	86.0			90.5
Compression ratio ε		12.2	10.7	10.5	
Connecting rod length	mm	146.5	148.5	146.5	148.5
Piston compression height	mm	32.35	28.1	32.35	28.1
Forced induction		–	–	2 turbochargers	–
Turbocharger control		–	–	Wastegate	–
Boost pressure (max.)	mbar	–	–	900	–
Oil change quantity (with filter) with 4MATIC	l l	6.5 6.5	8.0 7.0	8.0 8.0	8.5 8.5
Coolant filling capacity (with heating circuit)	l	10.2	11.0	13.7	11.5
Fuel type		Premium 95 RON			
Engine weight DIN 70020 GZ	kg	166.3	181	220	
Emissions regulation ECE/USA		EU5/ULEV	EU5/LEV2	EU5/ULEV	EU4/LEV2

Engine data comparison with predecessor engines



Torque and power curve, M 272 and M 276



Torque and power curve, M 273 and M 278

Thermal management

The thermal management function controlled by the ME-SFI 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. It also results in fuel savings of up to approx. 4%.

The thermal management function is controlled in relation to the following sensors and signals:

- Hot film mass air flow sensor, engine load (M 276 DES)
- Intake air temperature sensor
  Fuel pressure and temperature sensor
- Coolant temperature sensor
- Intake manifold intake air temperature sensor
- Pressure sensor downstream of throttle valve actuator, engine load
- Accelerator pedal sensor, accelerator pedal position
- Crankshaft Hall sensor, engine rpm
- Temperature sensor in ME-SFI control unit
- AAC control unit, status of air conditioning and outside air temperature via interior CAN and chassis CAN
- ESP control unit, vehicle speed via chassis CAN

Function of thermal management

The thermal management is described in the sections on shutoff of the heating system, heating of the two-disk thermostat, fan control, delayed fan switch-off and overheating protection.

Shutoff of the heating system

In order to ensure that the optimum engine operating temperature is reached as quickly as possible, the ME-SFI control unit shuts off the coolant circuit of the heating system by means of the heating system shutoff valve.

Heating of the two-disk thermostat

The temperature of the coolant in the engine can be varied by the heated two-disk thermostat. This contains the two-disk thermostat heating element, which sets the positions of the thermostat disks according to requirements when actuated by a ground signal from the ME-SFI control unit.

Fan control

The ME-SFI control unit actuates the engine and air conditioning electric suction fan with integrated control. The target fan speed is specified by the ME-SFI 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 speed
90% fan motor "ON", maximum speed

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

The AAC control unit transmits the status of the air conditioning over the interior CAN and the chassis CAN to the ME-SFI control unit.

CO2 measures

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.

Overheating protection

The overheating protection function provides protection against engine damage in the event of thermal overload and prevents overheating damage to the firewall catalytic converters.

If the coolant or intake air temperature is too high, the ME-SFI control unit no longer opens the throttle valve actuator completely, depending on the engine speed and load. The injection time of the fuel injectors is shortened by the ME-SFI control unit according to the reduced air mass.

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

Variable oil pump

The engines M 276 and M 278 each operate with a variable-flow oil pump. This enables the oil flow to be regulated via a hydraulic control circuit, in contrast to the predecessor engines.

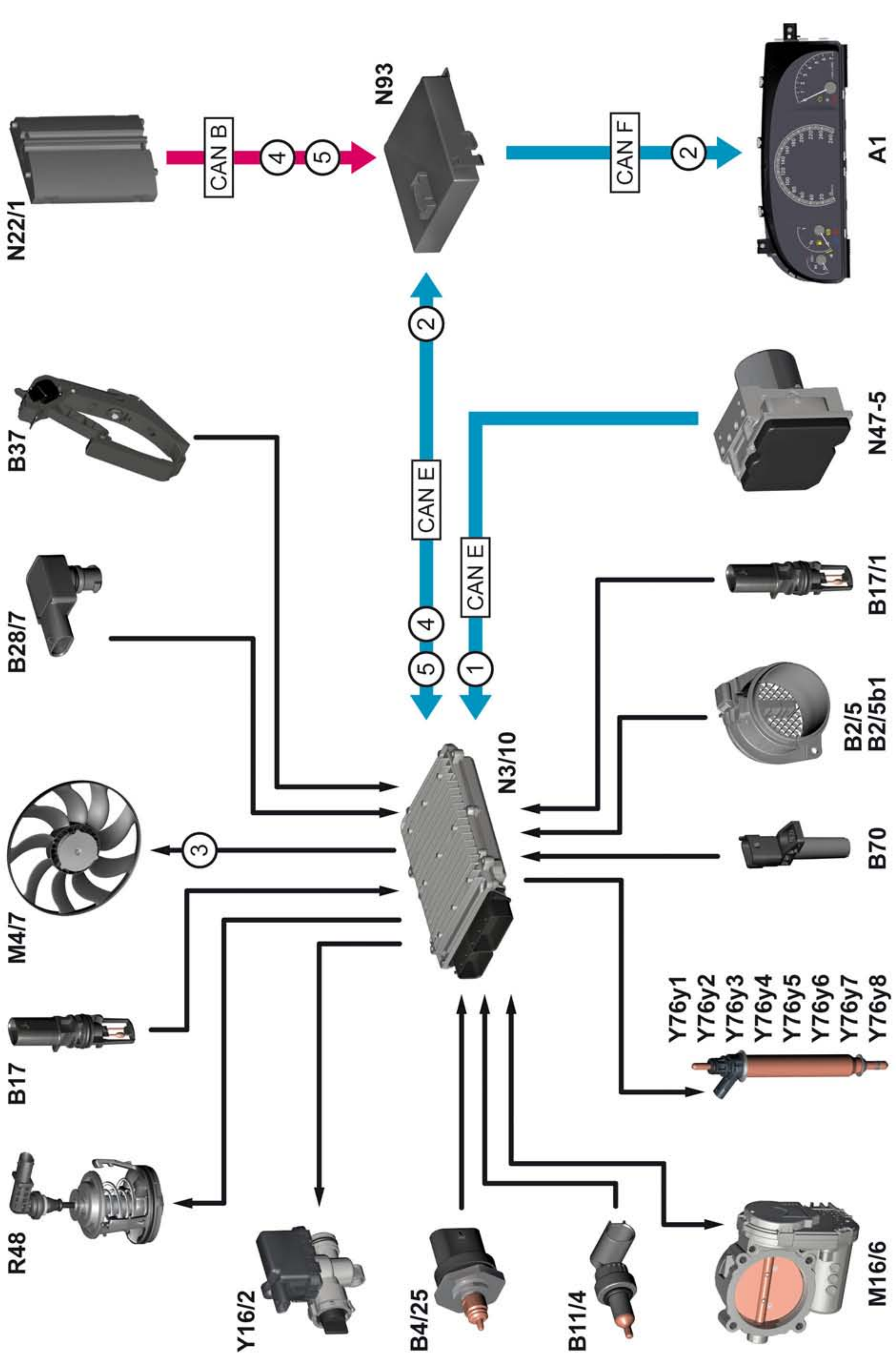
Furthermore, the oil pump has two pressure settings, which are switched via the ME-SFI control unit. When operating at the low pressure setting, the piston cooling nozzles are deactivated because they feature a valve that only opens at a pressure above the low pressure setting of the oil pump.

This makes it possible to intervene in the thermal management as well as to significantly reduce the oil throughput.

The pump is generally controlled in relation to the following signals and sensors:

- Temperature
- Engine speed
- Engine load

CO_2 savings of approx. 2-2.5% in total can be achieved here.



Function schematic of thermal management *(shown on model 221)*

CO2 measures

A1	Instrument cluster
B2/5	Hot film mass air flow sensor (M 276 DES)
B2/5b1	Intake air temperature sensor (M 276 DES)
B4/25	Fuel pressure and temperature sensor
B11/4	Coolant temperature sensor
B17	Intake air temperature sensor (M 276 DEH and M 278)
B17/1	Intake manifold intake air temperature sensor (M 276 DEH and M 276 DES)
B28/7	Pressure sensor downstream of throttle valve actuator
B37	Accelerator pedal sensor
B70	Crankshaft Hall sensor
M4/7	Engine and air conditioning electric suction fan with integrated control
M16/6	Throttle valve actuator
N3/10	ME-SFI [ME] control unit
N22/1	AAC [KLA] control unit
N47-5	ESP control unit
N93	Central gateway control unit
R48	Two-disk thermostat heating element

Y16/2	Heating system shutoff valve
Y76y1	Fuel injector, cylinder 1
Y76y2	Fuel injector, cylinder 2
Y76y3	Fuel injector, cylinder 3
Y76y4	Fuel injector, cylinder 4
Y76y5	Fuel injector, cylinder 5
Y76y6	Fuel injector, cylinder 6
Y76y7	Fuel injector, cylinder 7 (M 278)
Y76y8	Fuel injector, cylinder 8 (M 278)

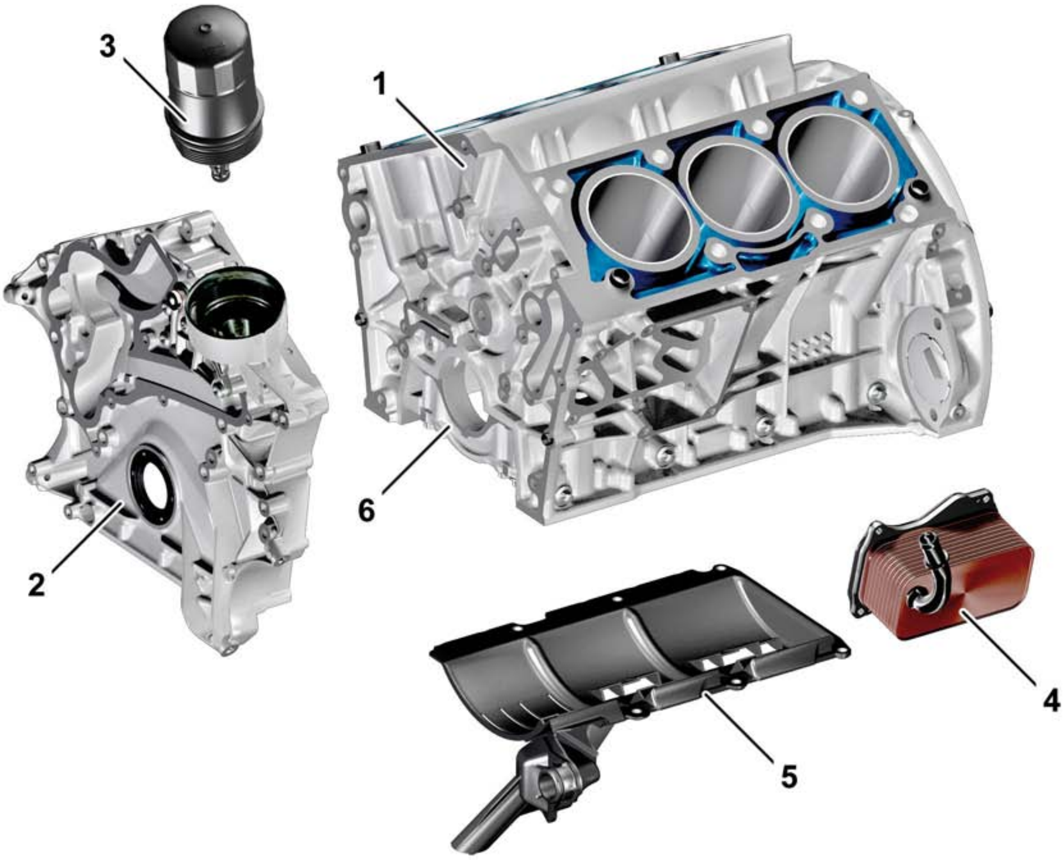
CAN B	Interior CAN
CAN E	Chassis CAN
CAN F	Central CAN
1	Vehicle speed, signal
2	Instrument cluster, message
3	Fan motor, specified rpm request
4	Air conditioning, status
5	Outside temperature, signal

M 276

The most obvious change from the predecessor engine M 272 is the reduction of the V angle from 90° to 60°. This reduces vibrations to such an extent that a balance shaft is no longer necessary. The result is less in-engine friction, lower fuel consumption and reduced CO_2 emissions.

The aluminum alloy crankcase is die-cast. The cylinder liners are made of cast iron.

> **i Note**
>
> The engine number is stamped on the bottom of the torque converter housing on the left side.



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1 Crankcase
2 Timing case cover
3 Oil filter
4 Oil-water heat exchanger
5 Oil suction pipe with baffle
6 Crankshaft bearing cap

Crankcase

Lightweight design of oil circuit in M 276 (example)

Compared with the predecessor engine M 272, the oil change quantity has been reduced from 8.0 l to 6.5 l. A completely new oil pan was developed for this which, despite its reduced volume, satisfies all the requirements in terms of vehicle dynamics. The significant reduction in the oil volume made it possible to downsize the oil pan and manufacture it as an optimized thin casting so that here alone about 2.5 kg in weight could be saved.

Furthermore, the functions of the oil filter module and oil cooler module have been separated. The oil cooler is now located under the left engine support to save space and the thread for the oil filter is integrated in the timing case, which is also manufactured as a weight-optimized thin casting. The oil filter housing itself is made completely of plastic. This means that the entire module casting and its threaded connection could be omitted.

The lightweight design is rounded off by a newly developed oil windage tray/suction pipe module made of plastic, which combines the oil windage tray (formerly made of sheet steel) and oil suction pipe components in a single part. Not only is this component lighter, it also simplifies the assembly process.

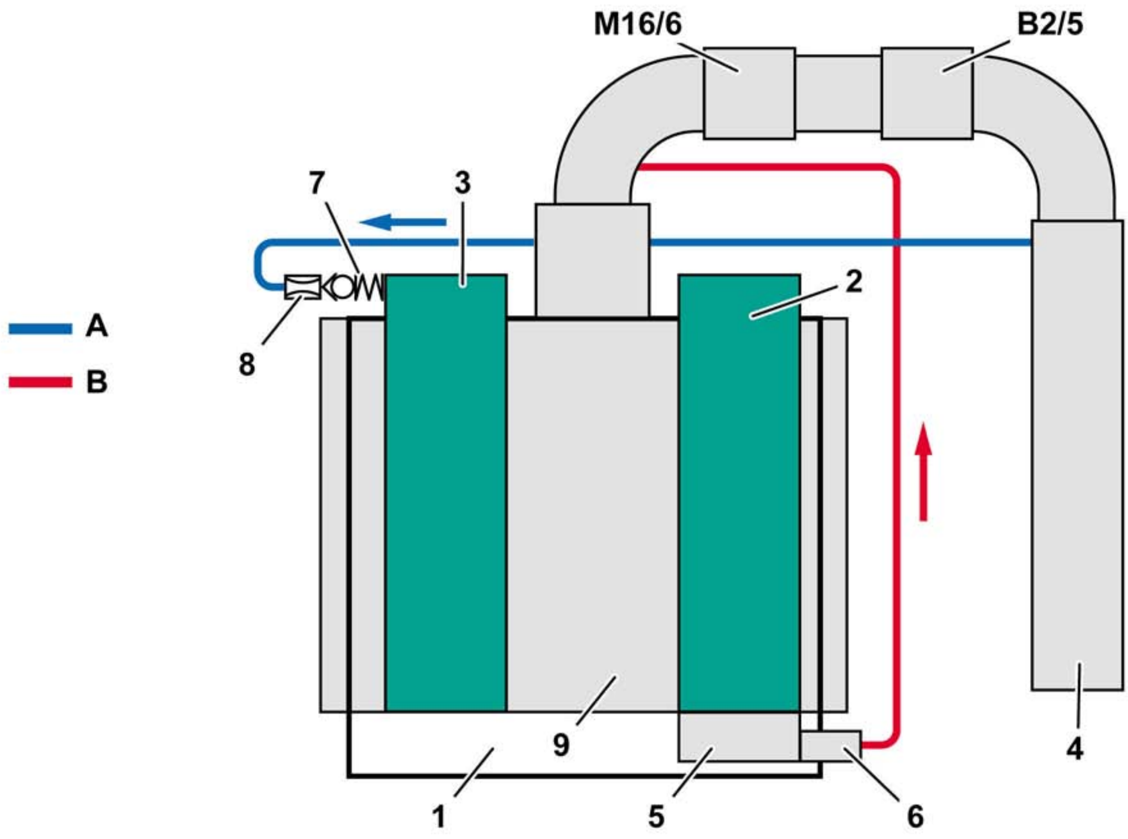
In total, therefore, the oil circuit alone contributes around 4.5 kg towards the weight reduction compared to the M 272.

Engine ventilation, M 276

A ventilation line with restrictor and check valve has been integrated between the air filter and the left cylinder head to ventilate the crankcase.

In contrast to the predecessor engine M 272, there is now only one oil separator in the vent line. The centrifuge at the rear of the right cylinder head is the same as before.

In all load states the engine is vented via the pressure regulating valve starting at the centrifuge. For this purpose a vent line leads from the pressure regulating valve to the intake manifold downstream of the throttle valve actuator.



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1 Crankcase
2 Right cylinder head
3 Left cylinder head
4 Air filter
5 Centrifuge
6 Pressure regulating valve
7 Check valve
8 Restrictor
9 Intake manifold

A Ventilation
B Venting

B2/5 Hot film mass air flow sensor (engine 276 DES only)
M16/6 Throttle valve actuator

Crankcase

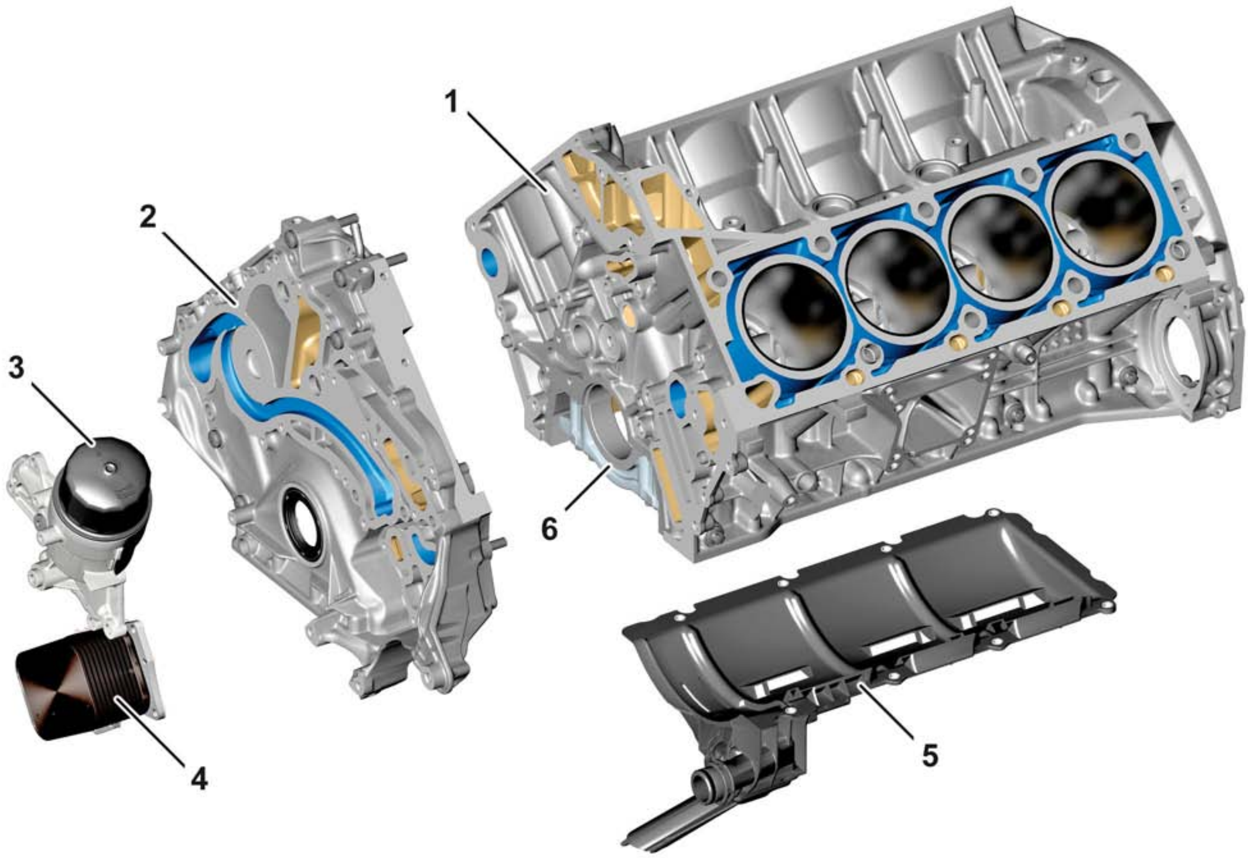
M 278

Despite the significantly higher loads on the crank assembly, the 8-cylinder engine also features a die-cast full aluminum crankcase, although with Silitec cylinder liners. The basic and conrod crank pin diameters are the same as in the predecessor engine M 273.
The piston compression height has been increased by 2 mm due to the loads. The connecting rods are 2 mm shorter in order to preserve the height of the crankcase.

The compression ratio of the M 273 naturally aspirated engine of $\varepsilon = 10.5$ has been preserved in spite of the forced induction.

Note

The engine number is stamped on the bottom of the torque converter housing on the left side.



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1 Crankcase
2 Timing case cover
3 Oil filter
4 Oil-water heat exchanger
5 Oil suction pipe with baffle
6 Crankshaft bearing cap

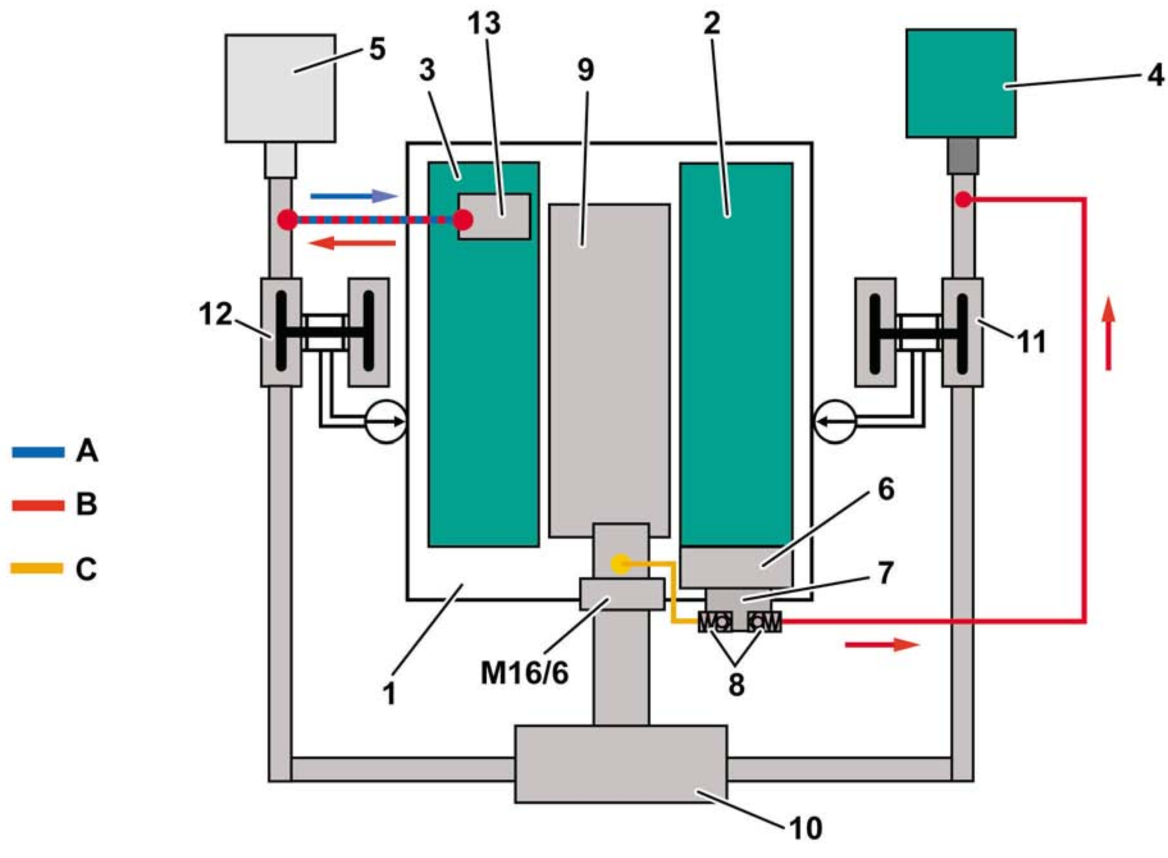
Engine ventilation, M 278

The ventilation and venting systems of engine 278 feature two oil separators, an impactor on the left cylinder head cover at the front and a centrifuge at the rear of the right cylinder head. The impactor is a development of the volume separator of engine 273. The centrifuge is unchanged.

In partial-load operation the engine is vented starting at the centrifuge via the pressure regulating valve and the check valve, as well as via the partial-load branch to the charge air distributor. The crankcase is ventilated via the line between the left air filter and the impactor.

In full-load operation the engine is vented starting at the centrifuge via the pressure regulating valve and the check valve to the right air filter upstream of the turbocharger.

In addition, venting occurs via the line between the left air filter and the oil separator to the left air filter upstream of the turbocharger.



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1 *Crankcase*
2 *Right cylinder head*
3 *Left cylinder head*
4 *Right air filter*
5 *Left air filter*
6 *Centrifuge*
7 *Pressure regulating valve*
8 *Check valve*
9 *Charge air distributor*

10 *Charge air cooler*
11 *Right turbocharger*
12 *Left turbocharger*
13 *Oil separator*

A *Ventilation*
B *Venting*
C *Partial-load vent line branch*

M16/6 *Throttle valve actuator*

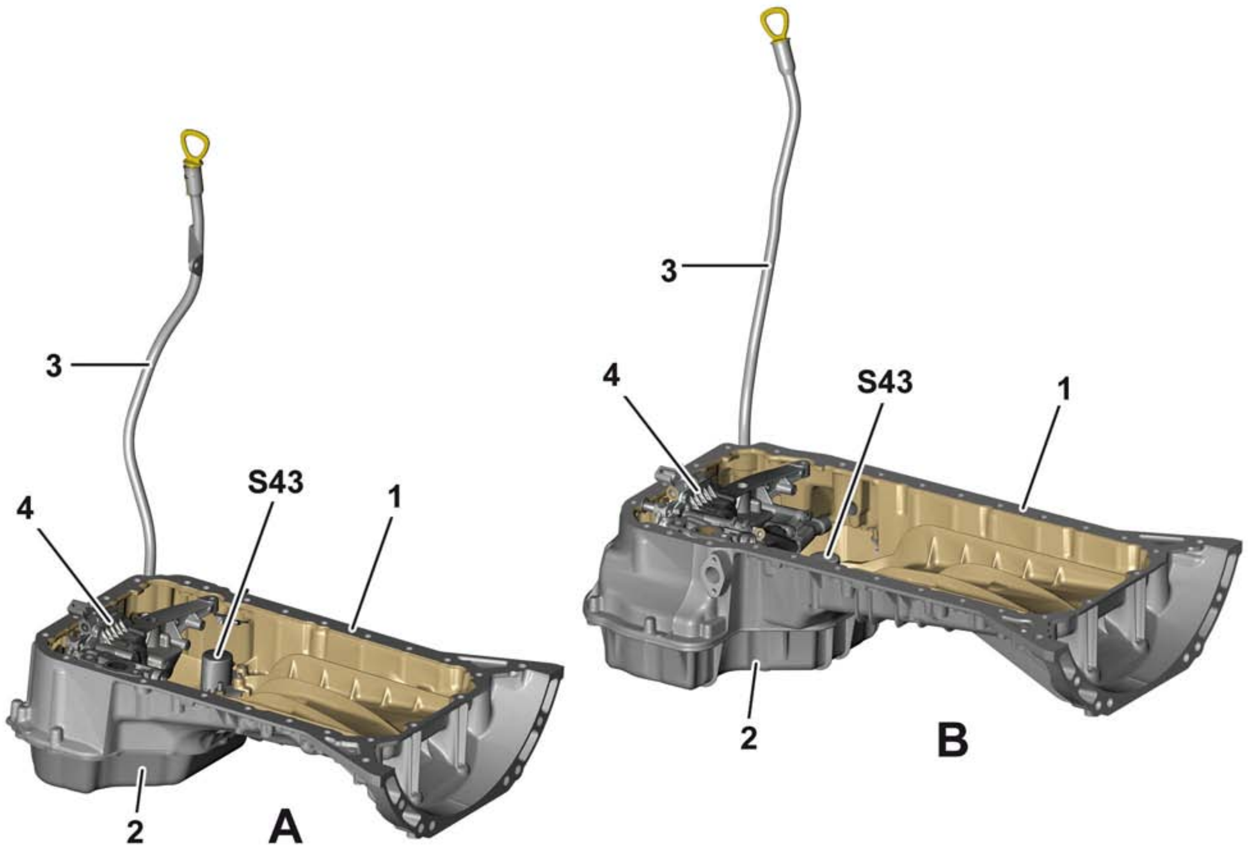
Oil pan

The oil pan top section is made of die-cast aluminum. The bottom section of the oil pan is sealed with silicone and is made of sheet metal on the M 276 and die-cast aluminum on the M 278.

On both engines the oil dipstick guide tube is located at the front on the right.

The oil level check switch is in the front of the oil sump.

The engine is supplied with oil by a new regulated vane-type oil pump, which is driven by the crank-shaft via a simplex bush roller chain.



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Oil pan

1 Oil pan top section
2 Oil pan bottom section
3 Oil dipstick guide tube
4 Oil pump

S43 Oil level check switch
A M 276
B M 278

Crank assembly

The crank assembly differs from the predecessor engines in the following respects:

The connecting rods have been shortened by 2 mm. The width of the connecting rod bearings in engine 276 has been reduced from 19 mm to 17 mm. The reason for this is the necessity for additional intermediate webs on the crankshaft between adjacent crank pins.

The piston rings have been optimized to keep the blow-by gases and oil consumption at good levels and also to further reduce friction at the high peak pressures and mean pressure.

The piston height has been decreased by 2 mm to reduce weight. The diameter of the piston pins has been reduced by 2 mm in engine 276, and has been increased by 2 mm in engine 278 due to loads.

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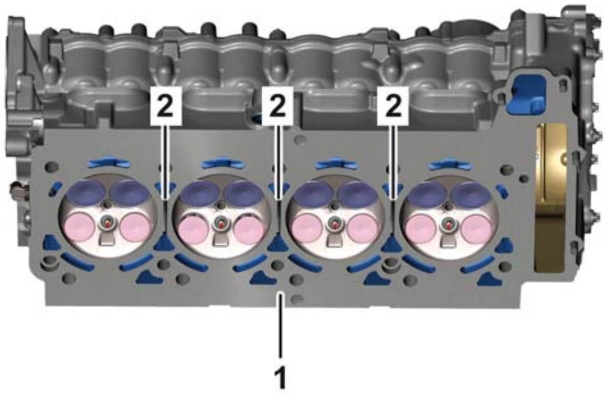
Crank assembly *(shown on the 8-cylinder engine)*

Cylinder head

The tried-and-tested basic concept of the cylinder head with roller cam follower valve timing is largely identical to the predecessor engine. Heat transfer in the roof of the combustion chamber has been significantly improved because of the higher chamber loads. The flow has been optimized by designing the water jacket in two parts and a cooling slot has been added between the cylinders in the cylinder head.

In the new V-engines 276 and 278 **aluminum bolts** are used at three locations:

- On the front left of the cylinder head cover
- On the front right of the cylinder head cover
- On the oil dipstick guide tube



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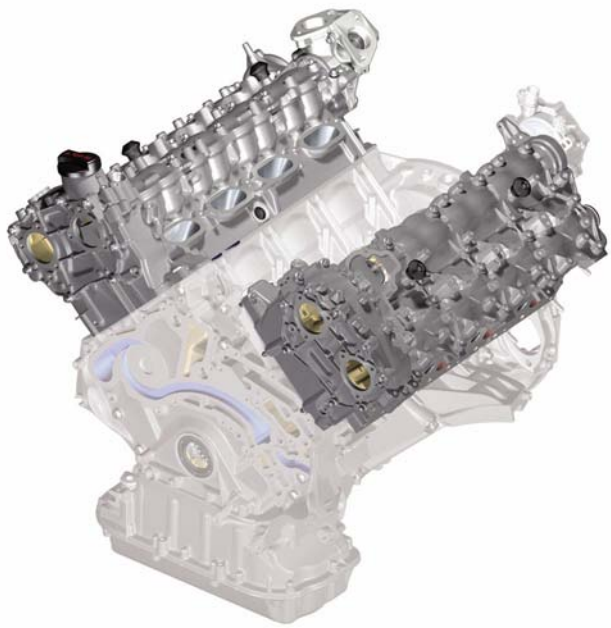
Left cylinder head *(shown on the 8-cylinder engine)*

1 Cylinder head
2 Cooling slot

Note

New aluminum bolts must be used when installing the cylinder head and the oil dipstick guide tube! The tightening torque of the aluminum bolts is listed in the relevant AR document in the Workshop Information System (WIS).



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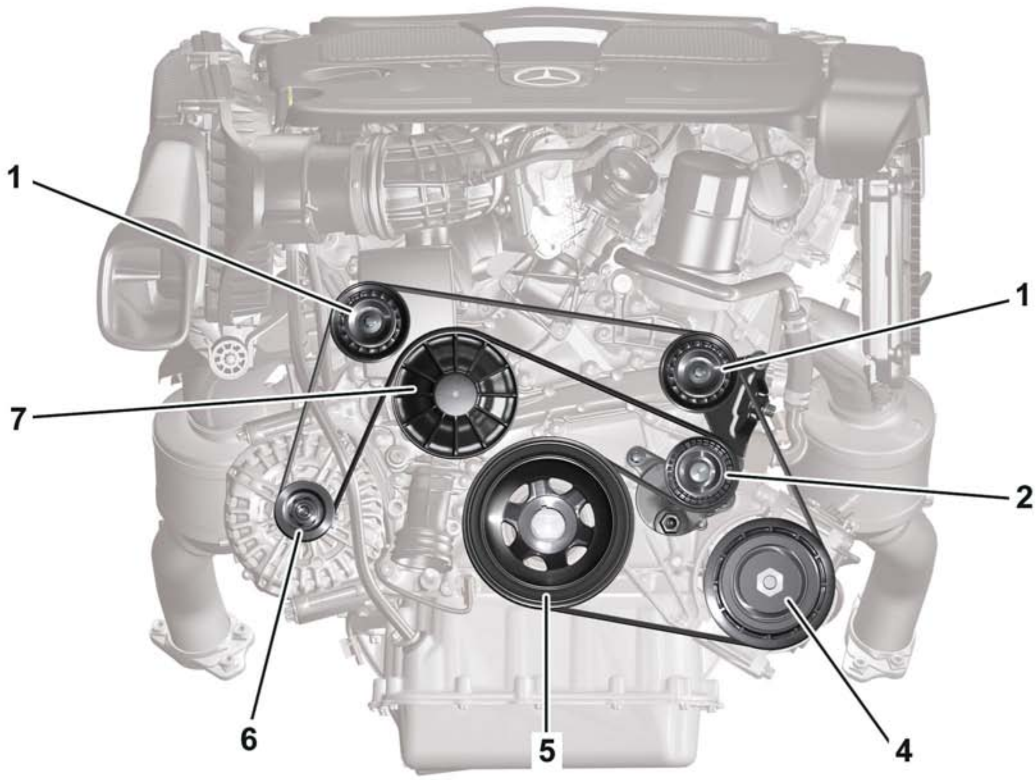
Cylinder heads *(shown on the 8-cylinder engine)*



Belt drive, 6-cylinder engine

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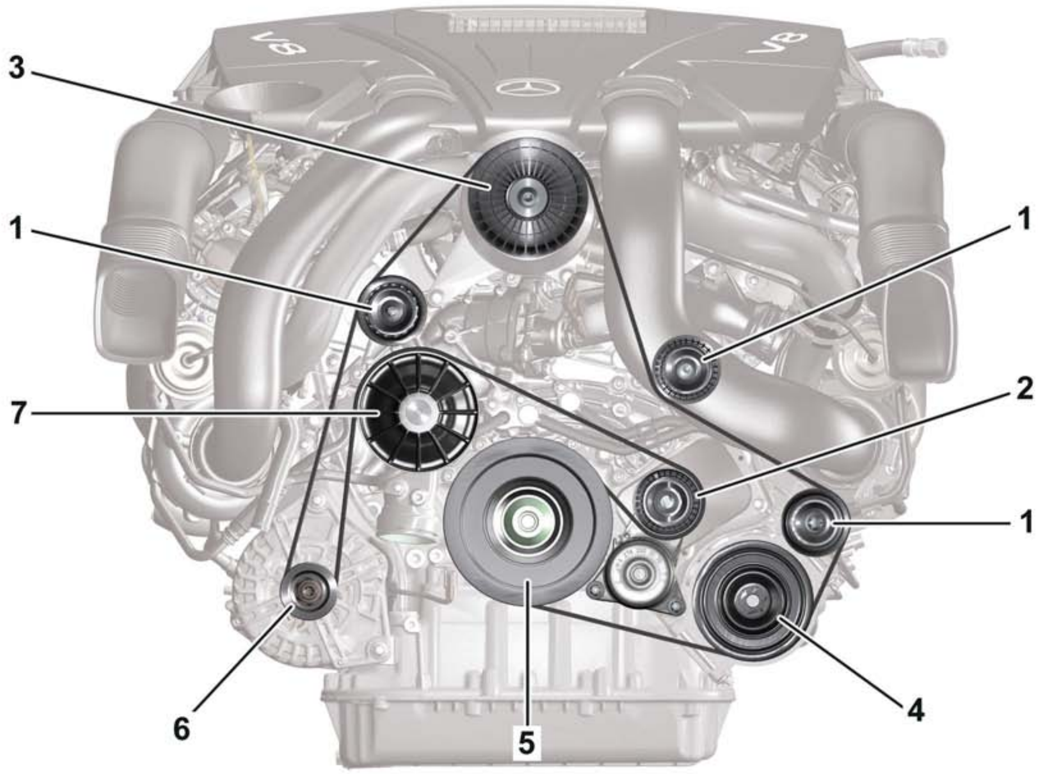


Belt drive, 8-cylinder engine

P13.20-2076-00

1 *Guide pulley*
2 *Belt tensioner*
3 *ABC pump (with code (487) Active Body Control (ABC)) or guide pulley*
4 *Refrigerant compressor*
5 *Belt pulley*
6 *Alternator*
7 *Coolant pump*

Chain drive and camshaft adjustment

Chain drive

The new V-engines M 276 and M 278 feature an entirely new 2-stage chain drive system with three gear chains. One aim of this was to achieve a compact design in order to further reduce the crash-relevant overall height of the engine in particular. Another goal was to further optimize the proven acoustic and endurance properties and the friction characteristics of the chains.

The chain drive is a two-stage system with primary and secondary drives.

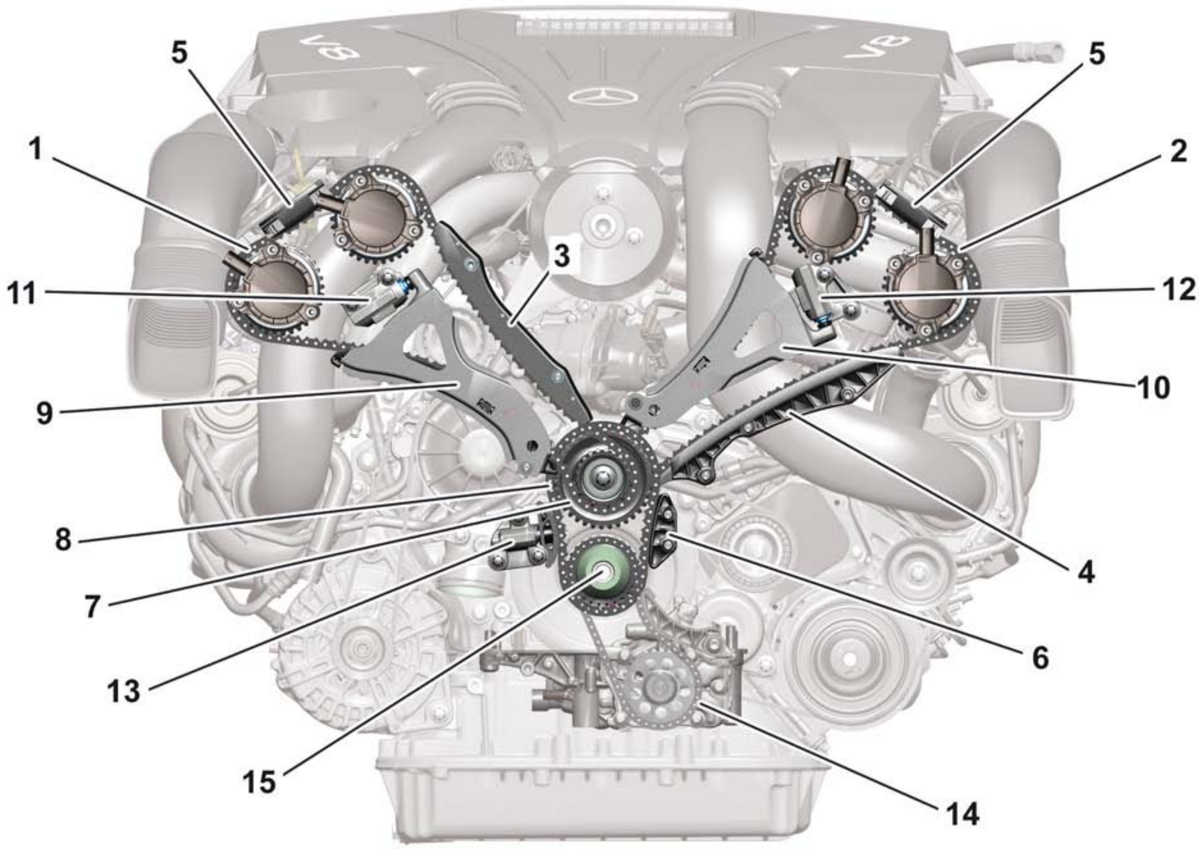
Primary drive: Crankshaft intermediate gear
Gear ratio: 1:1.33

Secondary drive: Camshaft intermediate gear
Gear ratio: 1:1.5

The chain slide and tensioning rails are compact and occupy only a little installation space.

Each of the three gear chains is tensioned by a hydraulic chain tensioner. Low tensioning forces and chain dynamics ensure stable engine timing and outstanding acoustic properties while reducing friction power compared with the predecessor engines.

Chain drive and camshaft adjustment



Chain drive (shown on the 8-cylinder engine)

1 Right secondary drive chain
2 Left secondary drive chain
3 Right guide rail
4 Left guide rail
5 Upper guide rail
6 Lower guide rail
7 Chain drive intermediate gear
8 Primary drive chain
9 Right tensioning rail
10 Left tensioning rail
11 Right secondary drive chain tensioner
12 Left secondary drive chain tensioner
13 Primary drive chain tensioner
14 Oil pump chain
15 Crankshaft

Chain drive and camshaft adjustment

Camshaft adjustment

A major consideration in terms of space requirements and also of weight optimization was the development of the hydraulic vane-cell camshaft adjuster.

Part of this compact design is the integrated control valve, which guarantees rapid and stepless setting of the optimum engine timing.

The most important new features are:

- 35% faster adjustment rate
- Ready to operate at 0.4 bar lower oil pressure
- Weight reduction by approx. 50%
- Dimensions (including solenoid and control valve) reduced by 15 mm in the longitudinal and vertical engine axes

A steel design was preserved in order to keep wear and leakage behavior at the best possible levels.

The camshaft adjuster is capable of adjusting all four camshafts steplessly by up to 40° CKA (crank angle). In this way the valve overlap in the gas cycle can be varied within broad limits. This optimizes the engine torque curve and improves exhaust characteristics.

Adjustment range

Intake opens at 4° CKA before TDC (top dead center) to 36° CKA after TDC

Exhaust closes at 25° CKA before TDC to 15° CKA after TDC

Start position

Intake opens at 36° CKA after TDC

Exhaust closes at 25° CKA before TDC

For engine start, the camshafts are locked in a fixed position by means of a catch bolt. This start position is unlocked hydraulically the first time the intake camshaft and exhaust camshaft solenoids are actuated.

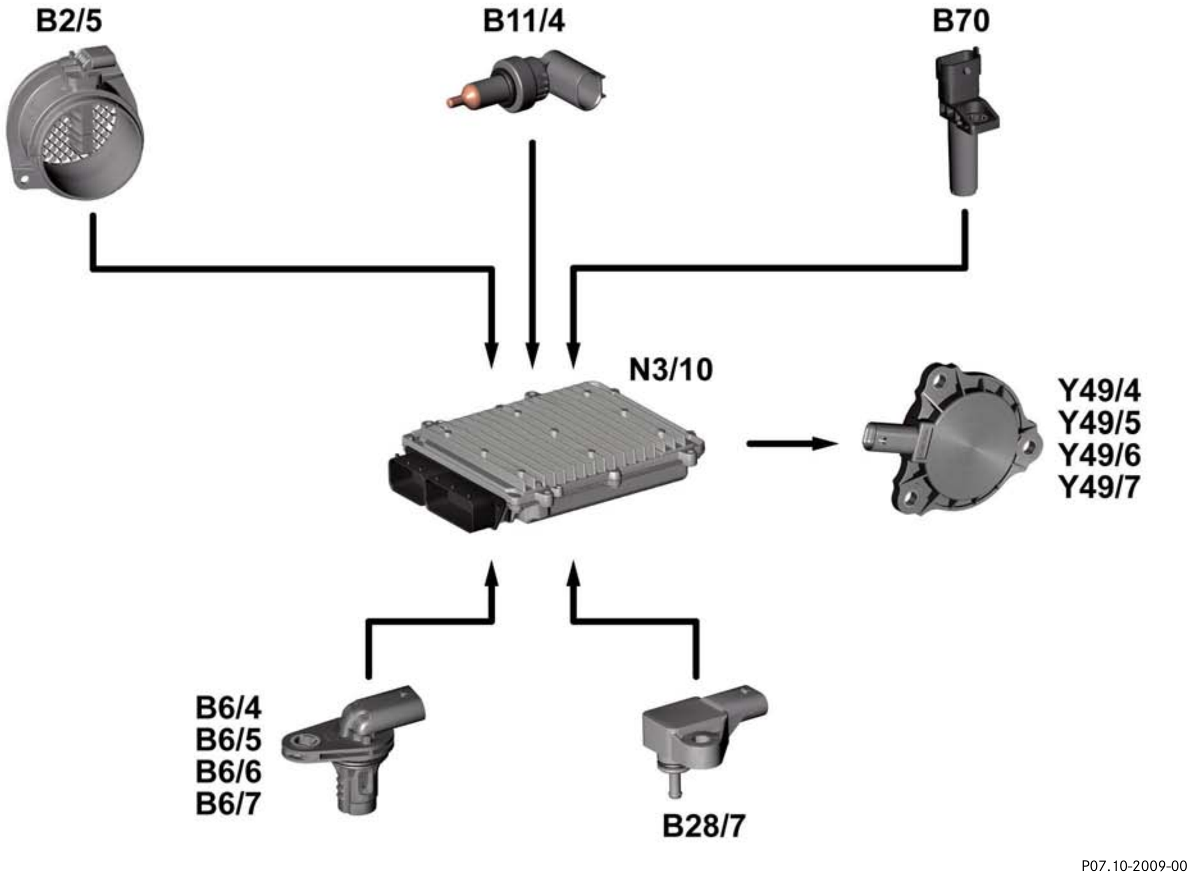
For camshaft adjustment the ME-SFI control unit scans the following sensors:

- Intake camshaft Hall sensors, left and right, intake camshaft positions
- Exhaust camshaft Hall sensors, left and right, exhaust camshaft positions
- Coolant temperature sensor
- Pressure sensor downstream of throttle valve actuator, engine load
- Crankshaft Hall sensor, engine rpm

Camshaft adjustment is enabled by the ME-SFI control unit depending on the engine speed and the engine oil temperature.

The ME-SFI control unit determines the engine oil temperature from various operating data (e.g. coolant temperature, time, engine load) and a stored temperature model.

Adjustment of the exhaust camshafts is enabled at a higher engine speed than for the intake camshafts. This ensures that the lock position is still reached on the exhaust stroke against the retarded reaction moments of the camshaft even when the oil pressure is low.



Function schematic of camshaft adjustment

B2/5 Hot film mass air flow sensor (M 276 DES only)
B6/4 Intake camshaft Hall sensor, left
B6/5 Intake camshaft Hall sensor, right
B6/6 Exhaust camshaft Hall sensor, left
B6/7 Exhaust camshaft Hall sensor, right
B11/4 Coolant temperature sensor
B28/7 Pressure sensor downstream of throttle valve actuator

B70 Crankshaft Hall sensor
N3/10 ME-SFI [ME] control unit
Y49/4 Intake camshaft solenoid, left
Y49/5 Intake camshaft solenoid, right
Y49/6 Exhaust camshaft solenoid, left
Y49/7 Exhaust camshaft solenoid, right

Intake manifold switchover, M 276

The air ducting and the length of the intake tracts has changed due to the intake manifold switchover function with selector drum and the two resonance flaps. In addition, the right and left sides of the intake manifold are connected with each other via a resonance chamber. These measures serve to optimize the engine torque curve by what is known as "internal charging". This utilizes the kinetic energy of the air moving in the intake tract and of the oscillations of the air column.

By changing the length of the intake manifold, forced induction can be achieved in a wider engine speed range. The length is changed by means of flaps (variable intake manifold). In the lower rpm range the air flows through the long intake tract. The short intake tracts are closed by the flaps and the selector drum. At high engine speeds the flaps and the selector drum are opened. The length of the intake tract is thus adjusted to suit the higher gas exchange frequency and the shorter intake tracts permit a greater gas throughput.

The ME-SFI control unit controls the intake manifold switchover on the basis of the following sensors:

- Pressure sensor downstream of throttle valve actuator, engine load
- Crankshaft Hall sensor, engine rpm

Note

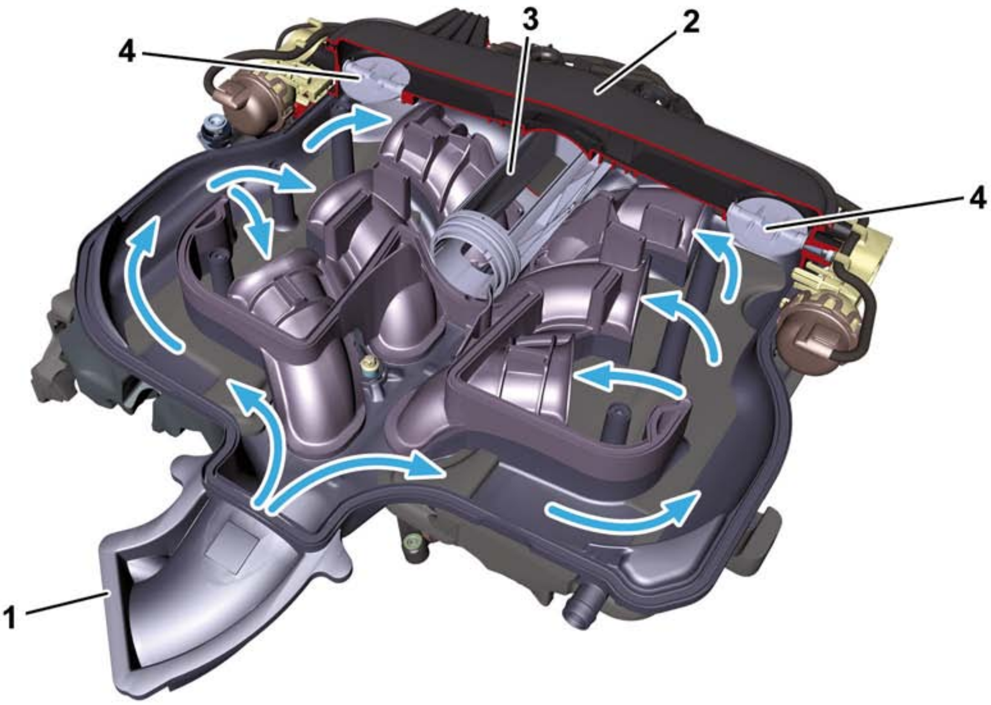
In the failure mode, the resonance flaps are closed and the selector drum is open across the entire rpm range.

Intake manifold switchover, M 276

Switching positions of resonance flaps and selector drum

Low rpm range:

- Engine load >50%
- Engine speed <3200 rpm
- Resonance flaps closed
- Selector drum closed



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Torque position in low rpm range

1 Intake manifold
2 Resonance chamber
3 Selector drum
4 Resonance flap

Intake manifold switchover, M 276

Medium rpm range

To open the resonance flaps, the ME-SFI control unit actuates the resonance flap switchover valves in parallel with a ground signal according to the engine load and engine speed.

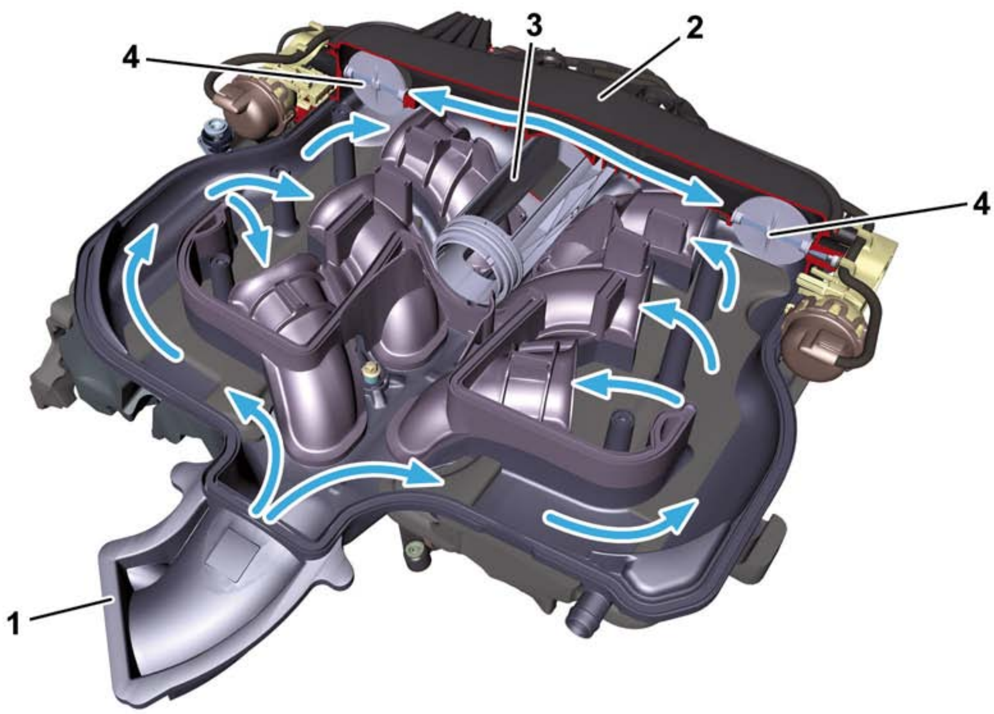
The resonance flap vacuum units are connected with the switchover valves via hose lines.

When the switchover valves are not actuated, the vacuum units are pressurized and the resonance flaps are kept closed by spring force. The resonance chamber is closed.

When the switchover valves are actuated, the resonance flap vacuum units are subjected to a vacuum from the vacuum pump and the resonance flaps are opened. The intake air can flow via the resonance chamber between the right and left intake tracts of the intake manifold.

Medium rpm range:

- Engine load >50%
- Engine speed >3200 rpm to 4250 rpm
- Resonance flaps open
- Selector drum closed



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Torque position in medium rpm range

1 Intake manifold
2 Resonance chamber
3 Selector drum
4 Resonance flap

High rpm range

To switch over the selector drum, the ME-SFI control unit actuates the intake manifold selector drum switchover valve with a ground signal according to the engine load and engine speed.

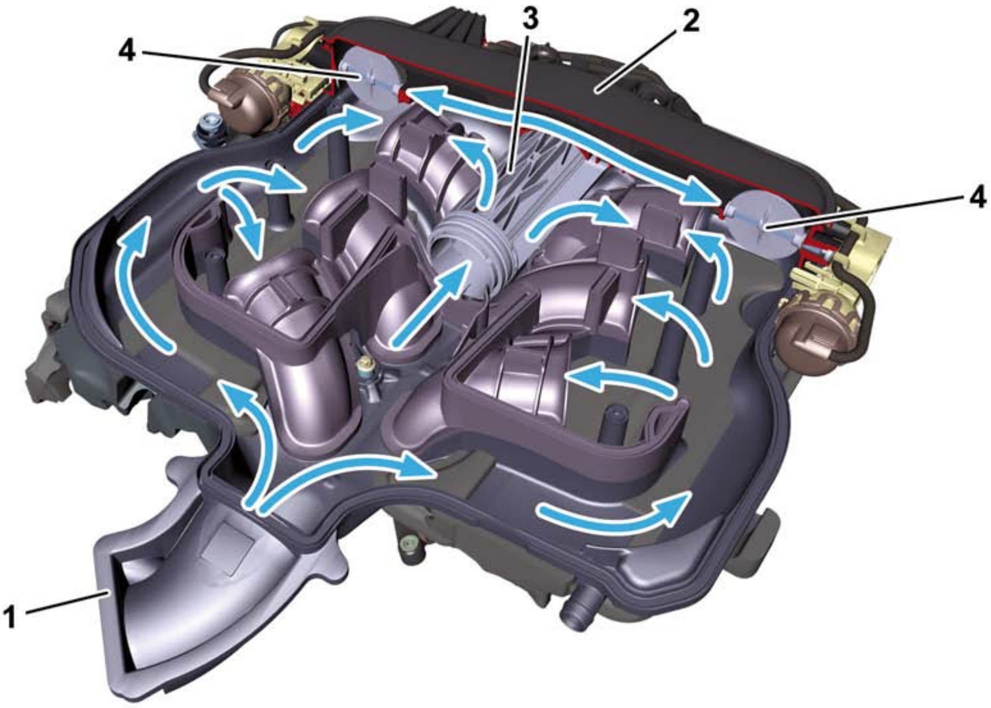
The selector drum vacuum unit is connected with the intake manifold selector drum switchover valve via a hose line. When the intake manifold selector drum switchover valve is not actuated, the vacuum unit is pressurized and the selector drum is rotated to the open position by spring force.

The intake air can flow through the selector drum to the rear into the right and left intake tracts of the intake manifold.

When the intake manifold selector drum switchover valve is actuated, the vacuum unit is subjected to a vacuum from the vacuum pump. This rotates the selector drum through approx. 90° and the rear intake tracts of the intake manifold are closed. The air now enters the intake manifold through the front intake tracts only.

High rpm range:

- Engine load >50%
- Engine speed >4250 rpm
- Resonance flaps open
- Selector drum open



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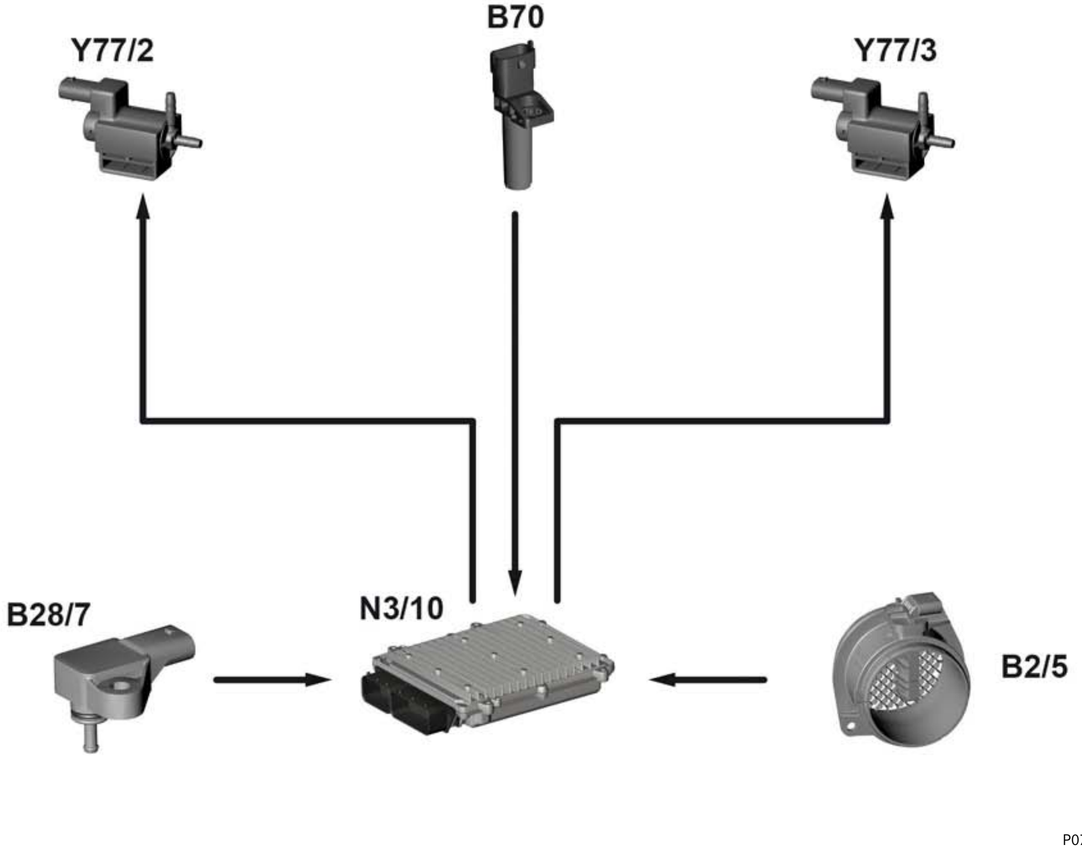
Power position in high rpm range

1 Intake manifold
2 Resonance chamber
3 Selector drum
4 Resonance flap

Intake manifold switchover, M 276



Function schematic of intake manifold switchover

B2/5 Hot film mass air flow sensor (M 276 DES)
B28/7 Pressure sensor downstream of throttle valve actuator
B70 Crankshaft Hall sensor
N3/10 ME-SFI [ME] control unit
Y77/2 Intake manifold resonance flap switchover valve
Y77/3 Intake manifold selector drum switchover valve

Turbocharging

Engine 278 is turbocharged. Each of the two cylinder banks is supplied by one turbocharger with wastegate control.

A compact charge air cooler ensures optimum cooling of the charge air and a high thermodynamic efficiency. Short flow paths ensure low flow resistances and contribute towards the high efficiency of the engine.

The exhaust gas is carried by a double-walled exhaust manifold made of sheet steel. The low thermal losses guarantee the rapid response of the catalytic converters in spite of the turbocharger.

The two turbochargers are protected by means of pressure limiting at the compressor. The two pressure sensors upstream of the compressor also serve to monitor the fouling of the air filter.

Boost pressure control

The wastegate in engine 278 is controlled by vacuum from the mechanical vacuum pump mounted on the engine. This means that the wastegate can also be opened in the partial-load range, which reduces fuel consumption. To build up the boost pressure, the wastegate is closed by a vacuum from the vacuum unit. In contrast to the pressurized systems previously used, it is not possible to build up the boost pressure if there is a leak in the line between the vacuum pump and the vacuum units.

The boost pressure is controlled electropneumatically by the boost pressure actuator (boost pressure control pressure transducer). To control the boost pressure, the boost pressure actuator is actuated by the ME-SFI control unit according to a performance map and according to load. To do this, the ME-SFI control unit evaluates the following sensors and functions of the engine control:

- Intake air temperature sensor
- Pressure sensor downstream of air filter, left cylinder bank
- Pressure sensor downstream of air filter, right cylinder bank
- Pressure sensor upstream of throttle valve actuator, boost pressure
- Pressure sensor downstream of throttle valve actuator, charge air distributor pressure
- Accelerator pedal sensor, load request from driver
- Crankshaft Hall sensor, engine rpm
- Knock control, transmission overload protection, overheating protection

In the wide open throttle range the maximum boost pressure is built up. To reduce the boost pressure, the exhaust streams for driving the turbocharger turbines are diverted via different bypasses by opening the boost pressure control flaps.
The boost pressure actuator actuates the relevant vacuum unit of the boost pressure control flaps with vacuum from the vacuum pump. When the vacuum is applied, the boost pressure control flaps are closed via a linkage. When there is no vacuum at the vacuum units, the boost pressure control flaps and thus the bypasses are opened.

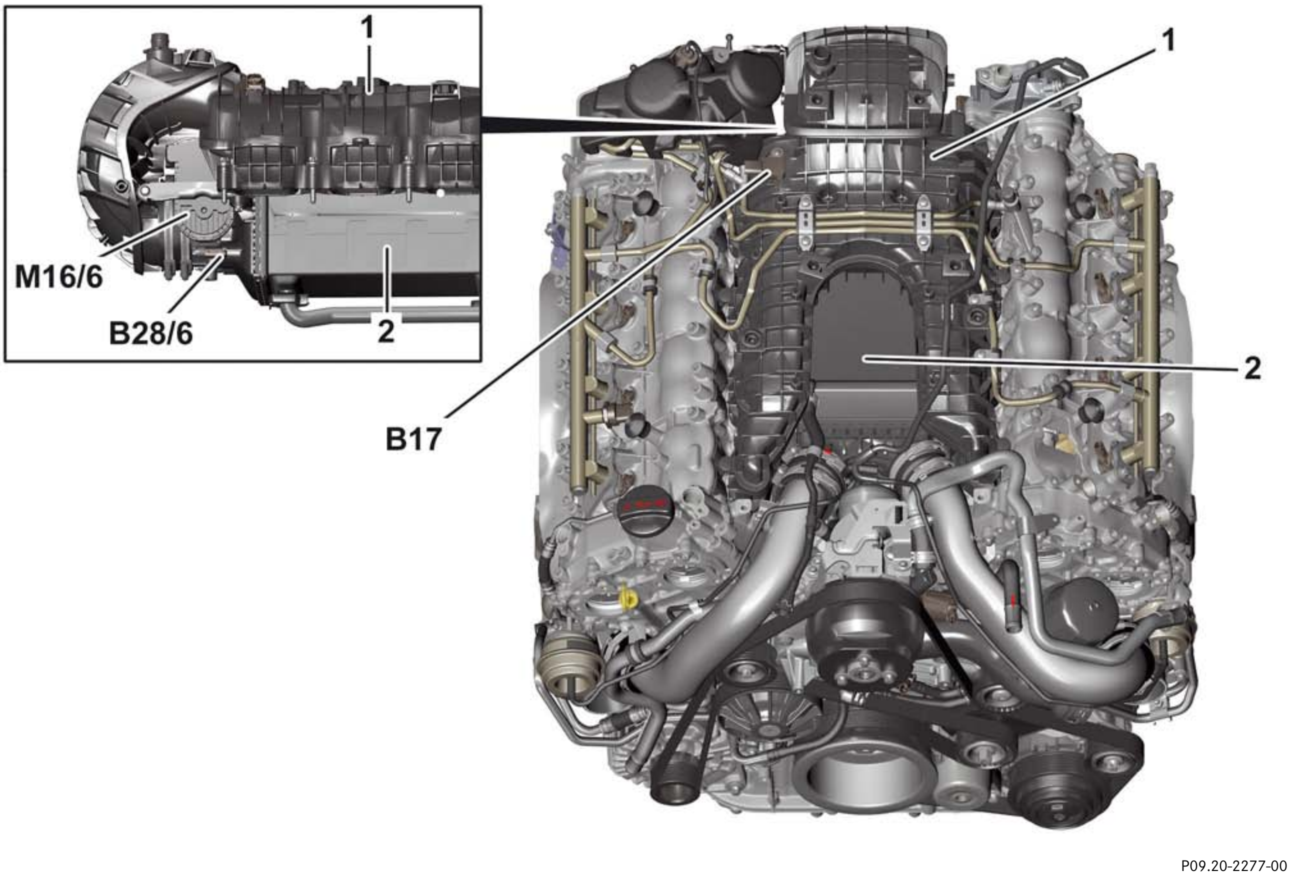
Forced induction, M 278

In this way the boost pressure of max. 0.9 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 actuator transmits an appropriate voltage signal to the ME-SFI control unit.

The pressure sensors downstream of the air filter are used by the ME-SFI control unit to monitor the forced induction.

The charge air temperature is registered in the charge air distributor by the intake air temperature sensor and sent to the ME-SFI control unit in the form of a voltage signal.

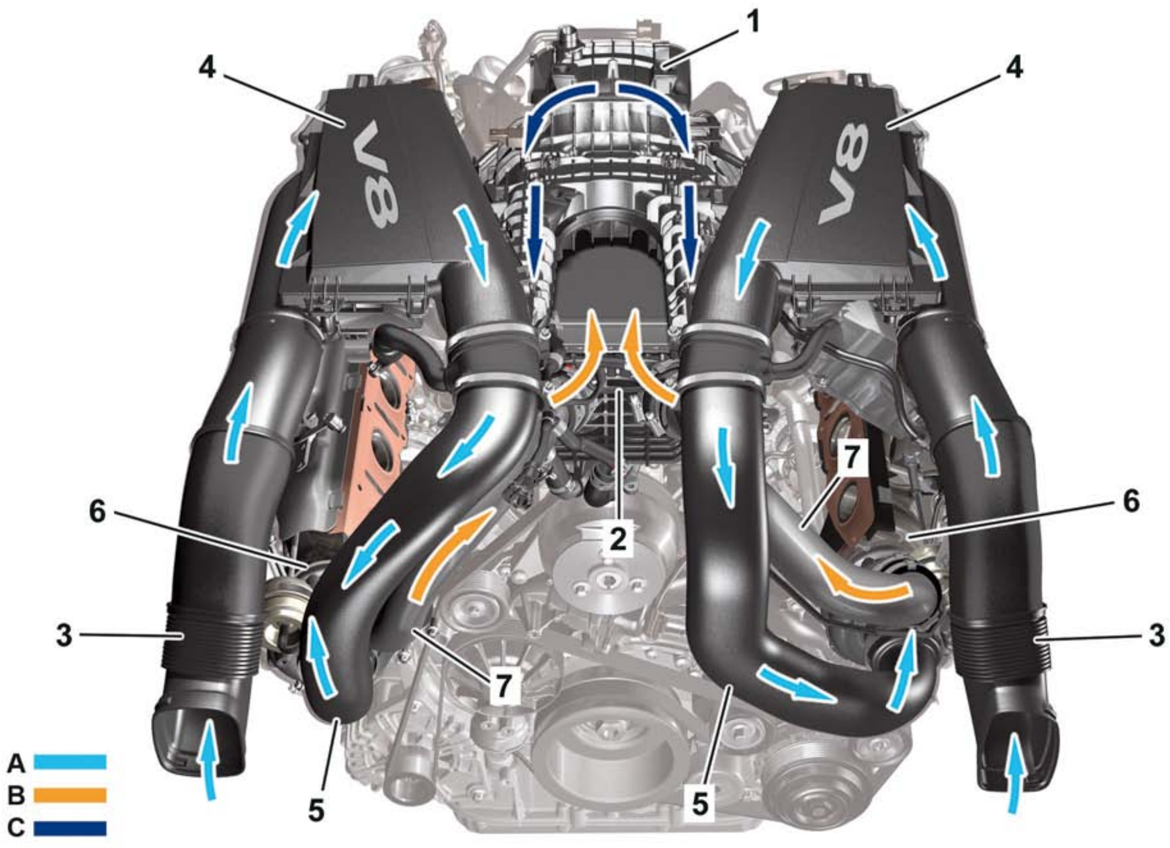


Charge air cooler and charge air distributor

B17 Intake air temperature sensor
B28/6 Pressure sensor upstream of throttle valve actuator
M16/6 Throttle valve actuator

1 Charge air distributor
2 Charge air cooler

Forced induction, M 278



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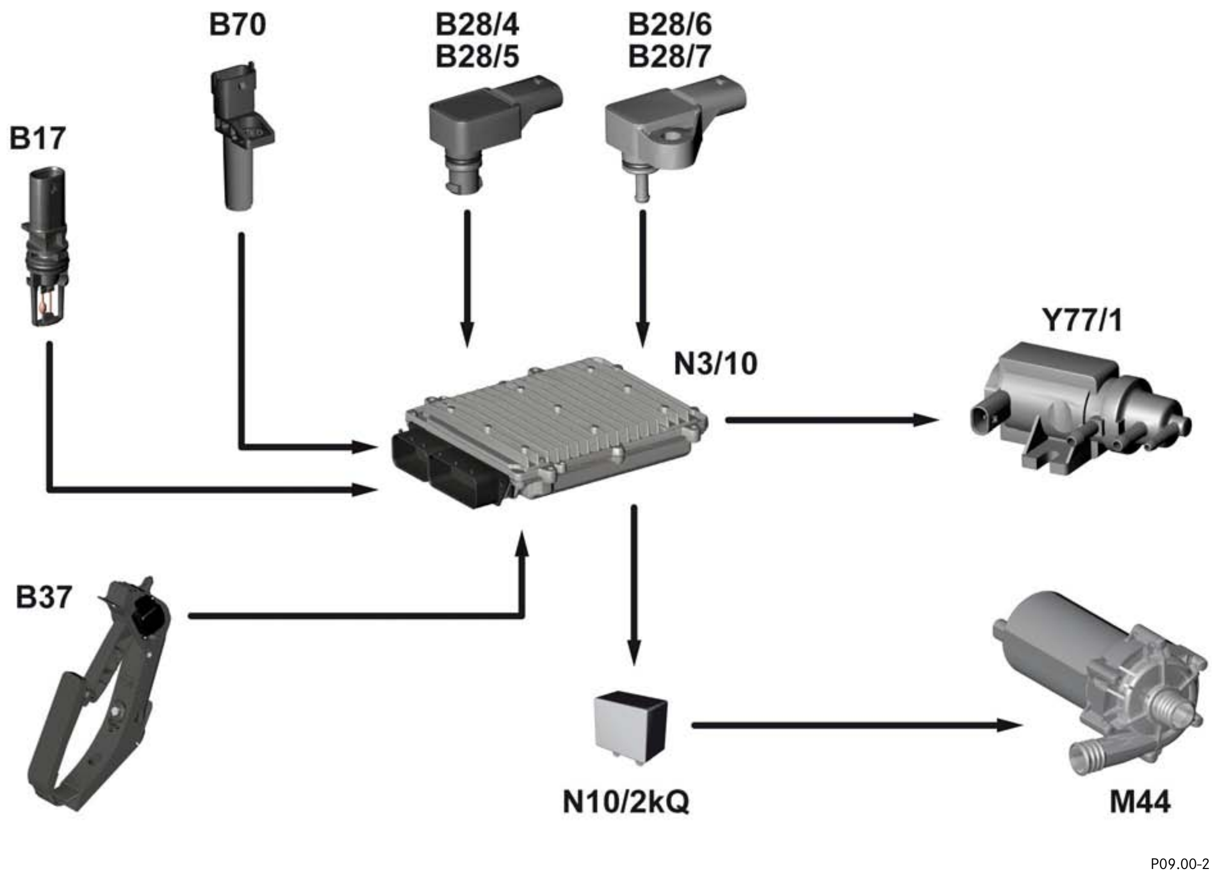
Flow pattern of intake air/charge air

1 Charge air distributor
2 Charge air cooler
3 Air intake hose
4 Air filter (damper filter)
5 Clean air line
6 Turbocharger
7 Charge air manifold

A Intake air
B Heated charge air
C Cooled charge air

Forced induction, M 278



Function schematic of forced induction

B17	*Intake air temperature sensor*
B28/4	*Pressure sensor downstream of air filter, left cylinder bank*
B28/5	*Pressure sensor downstream of air filter, right cylinder bank*
B28/6	*Pressure sensor upstream of throttle valve actuator*
B28/7	*Pressure sensor downstream of throttle valve actuator*
B37	*Accelerator pedal sensor*
B70	*Crankshaft Hall sensor*
M44	*Charge air cooler circulation pump*
N3/10	*ME-SFI [ME] control unit*
N10/2kQ	*Circulation pump relay*
Y77/1	*Boost pressure actuator*

Charge air cooling

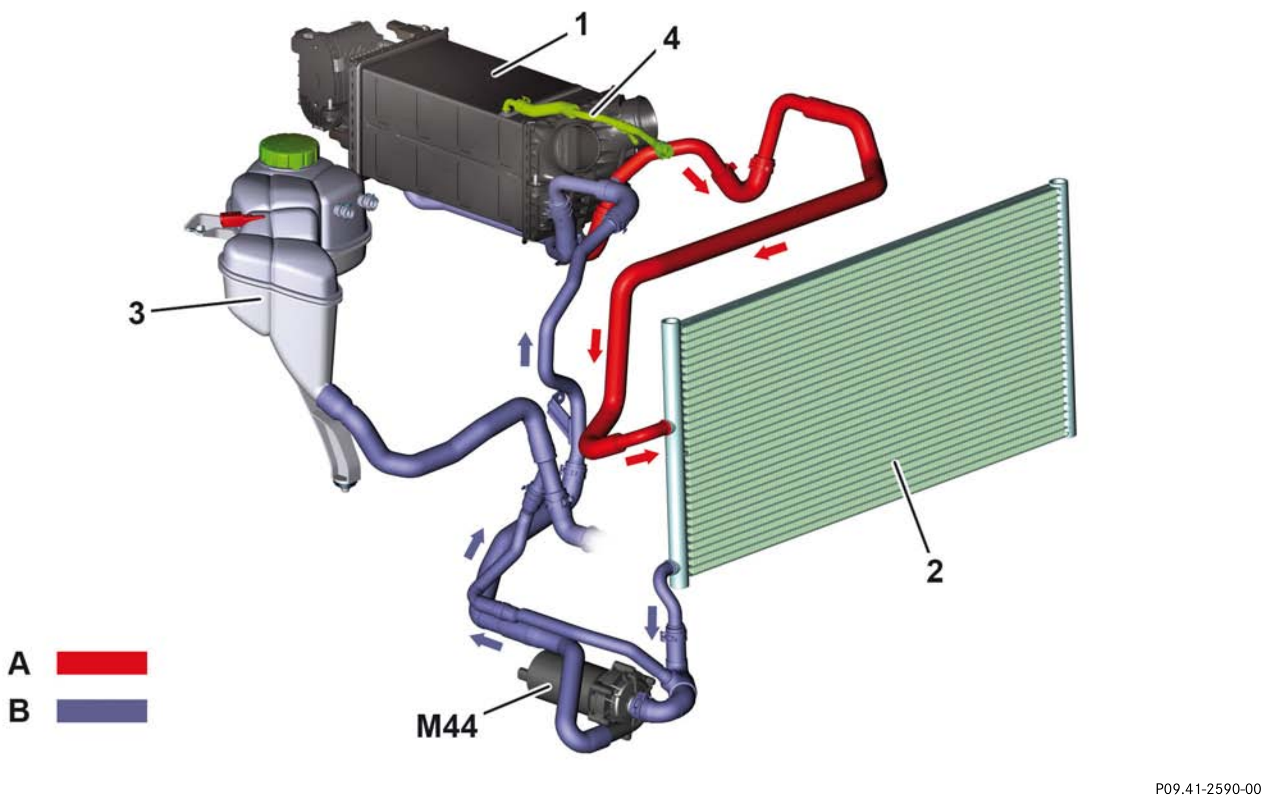
The charge air cooling system keeps the charge air temperature at <70 °C. The air cooled in the charge air coolers has a higher density. This increases the cylinder charge and thus the engine power. In addition, the tendency to knock is decreased and the lower exhaust temperatures reduce the formation of nitrogen oxides (NOx).

The two cylinder banks have a common water/charge air cooler. The water/charge air cooler is connected to the low-temperature cooling circuit with low-temperature cooler and charge air cooler circulation pump.

If the charge air temperature is >35 °C, the charge air cooler circulation pump is actuated by the ME-SFI control unit via the circulation pump relay.

When the charge air temperature drops below 25 °C, the charge air cooler circulation pump is switched off again.

The charge air temperature is registered in the charge air distributor by the intake air temperature sensor and sent to the ME-SFI control unit via a voltage signal.



Coolant circuit of charge air cooler

1 Charge air cooler
2 Low-temperature cooler
3 Expansion reservoir
4 Vent line

M44 Charge air cooler circulation pump

A Coolant feed
B Coolant return

Injection system

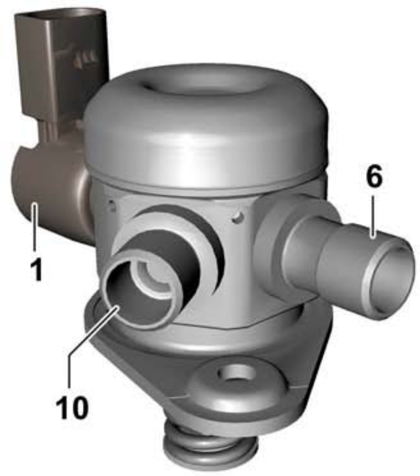
Direct injection

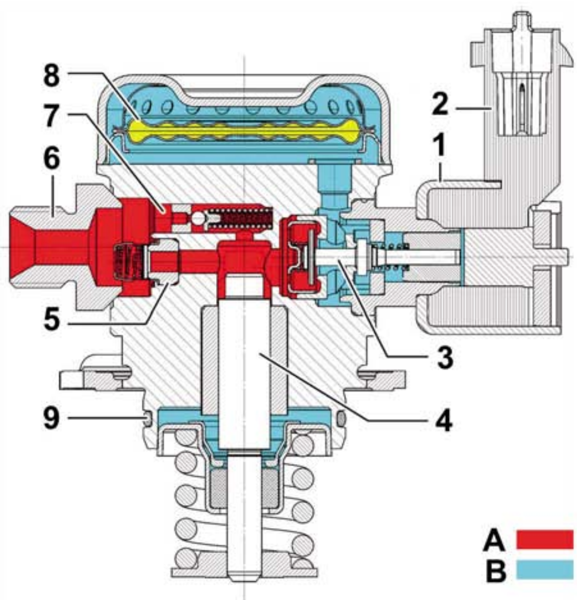
The direct injection system has been developed to the Third Generation for the new engines 276 and 278.

The system is now a non-return high-pressure supply with two separate rails. The high pressure is supplied by one high-pressure pump in engine M 276 and by two in engine M 278. The high-pressure pumps are located at the rear end of the right intake shaft and are actuated by three cams on the M 276 and by four cams on the M 278.

The supply pressure can be regulated according to the operating mode and lies between 120 and 200 bar.

The newly developed high-pressure injectors with piezo actuators are capable of delivering up to five highly accurate injections per cycle.





High-pressure pump *(general and sectional views)*

1 Quantity control valve
2 Solenoid
3 Valve needle
4 Piston
5 High-pressure outlet valve
6 High-pressure connection fitting
7 Pressure limiting valve
8 Low-pressure pulsation damper
9 O-ring
10 Low-pressure connection fitting

A Area with high pressure
B Area with low pressure

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 and are designed without a fuel return.

The fuel feed is sealed on the high-pressure side with an O-ring at the rail. Another O-ring at the fuel injector seals the leak line.

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 approx. 200 bar, the outward-opening nozzle forms a hollow cone of spray that remains stable under all operating conditions, which is one of the main prerequisites for stratified combustion with no misfiring.

The ME-SFI control unit generates the operating voltage of 125 to 160 V for the fuel injectors 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 control unit. When opening, a current of approx. 8 A flows for a few microseconds. To open and close, the ME-SFI control unit reverses the polarity.

Note on diagnosis

A 220 k 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 injector, two lines lead directly to the ME-SFI control unit. Current and voltage measurements on these lines should only be performed using clamp-on probes (potential-free).

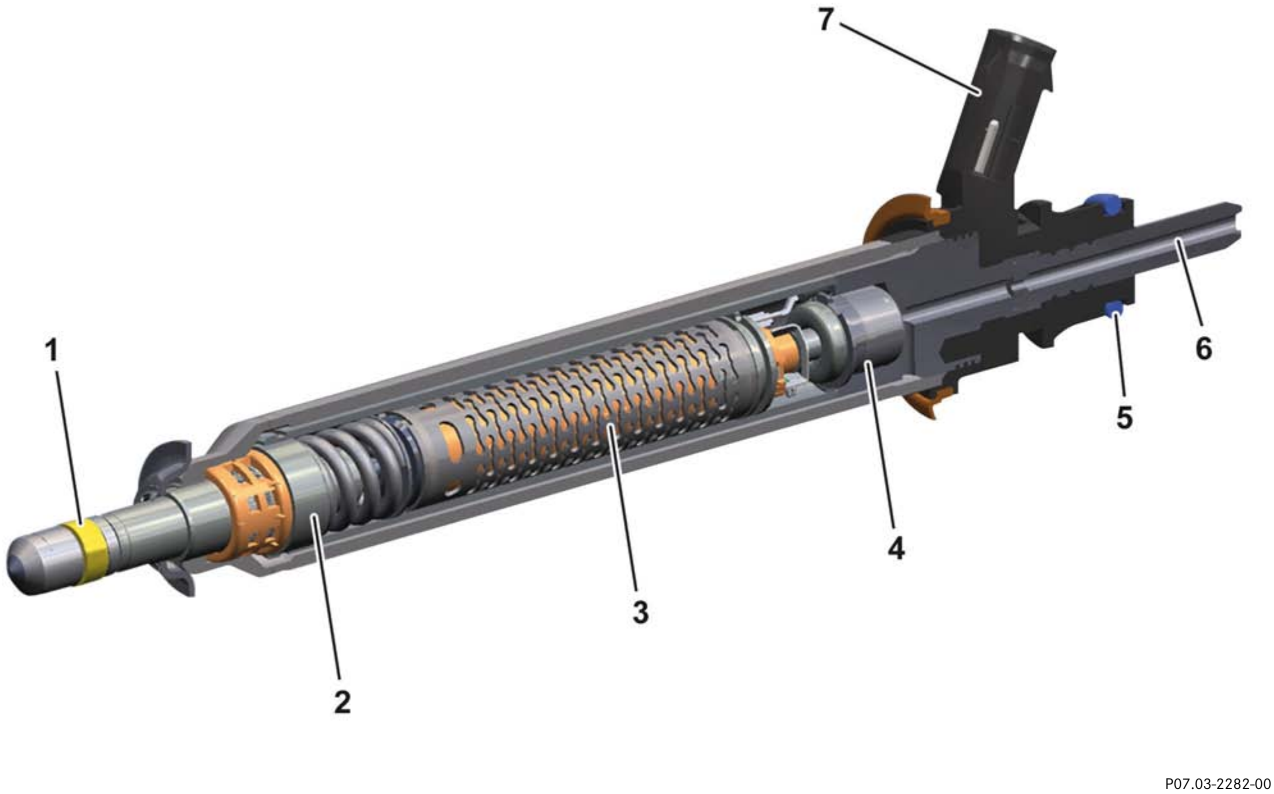
Warning

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

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

Whenever an injector is removed, both ends must be fitted with clean protective caps. Any contact of the injector tip installed in the combustion chamber with other components can lead to damage.

Injection system



Design of fuel injector (Y76) *(sectional view)*

1 Teflon ring
2 Valve group
3 Piezo actuator module
4 Coupler
5 O-ring (leak line)
6 Fuel feed (high pressure)
7 Electrical connection

Note

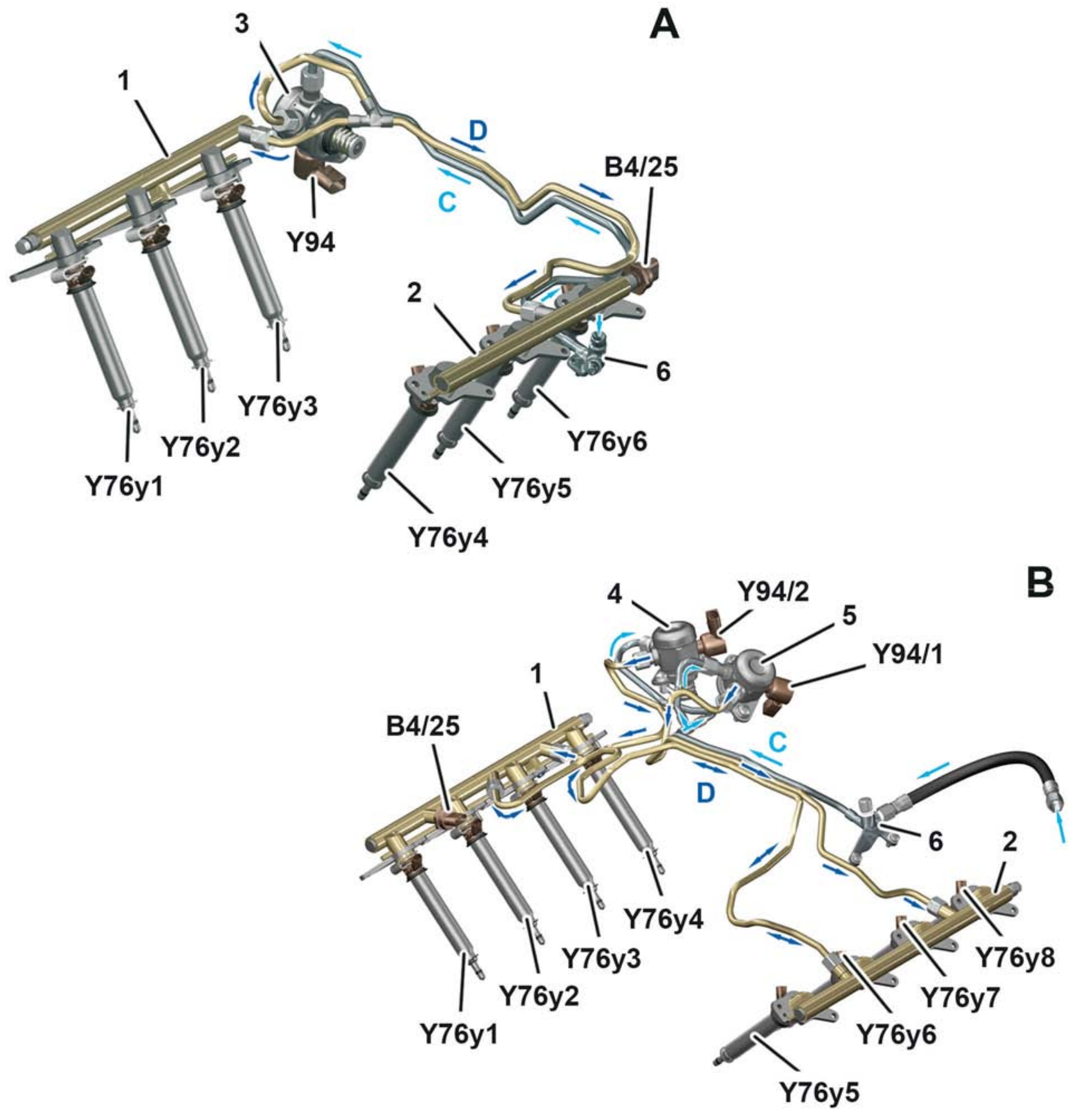
Whenever the injectors are removed, all the seals on the injector and in the rail, and the holddown springs must be renewed before reinstalling.

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 on the M 276/278 is soldered!

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.



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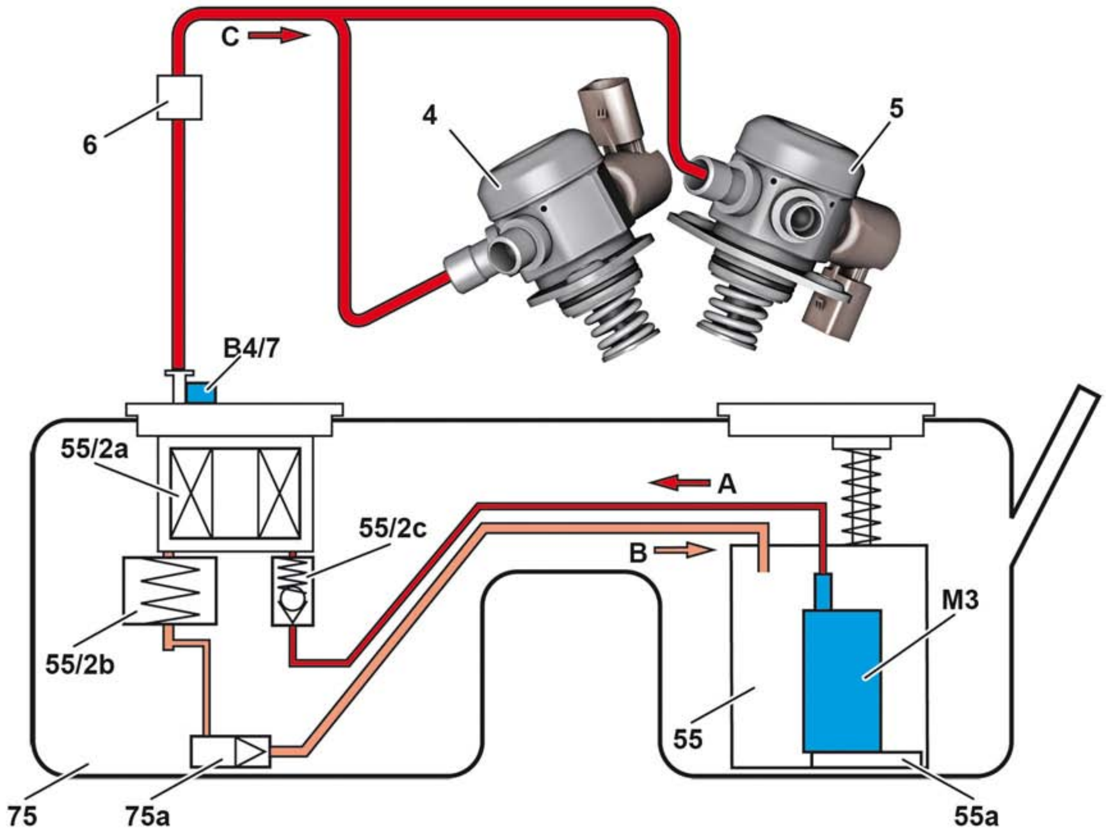
Injection system fuel high-pressure system

1 Right rail
2 Left rail
3 High-pressure pump
4 Right high-pressure pump
5 Left high-pressure pump
6 Pressure gauge connection with service valve

A M 276
B M 278
C Fuel low pressure
D Fuel high pressure

B4/25 Fuel pressure and temperature sensor
Y76y1 Fuel injector, cylinder 1
Y76y2 Fuel injector, cylinder 2
Y76y3 Fuel injector, cylinder 3
Y76y4 Fuel injector, cylinder 4
Y76y5 Fuel injector, cylinder 5
Y76y6 Fuel injector, cylinder 6
Y76y7 Fuel injector, cylinder 7
Y76y8 Fuel injector, cylinder 8
Y94 Quantity control valve
Y94/1 Left quantity control valve
Y94/2 Right quantity control valve

Injection system



Hydraulic diagram of fuel low-pressure system

4	*Left high-pressure pump*
5	*Right high-pressure pump*
6	*Pressure gauge connection with service valve*
55	*Fuel feed module*
55a	*Right suction jet pump*
55/2a	*Fuel filter*
55/2b	*Overflow valve*
55/2c	*Check valve*
75	*Fuel tank*
75a	*Left suction jet pump*
B4/7	*Fuel pressure sensor*
M3	*Fuel pump*
A	*Fuel feed to fuel filter*
B	*Fuel return from overflow valve*
C	*Fuel to high-pressure pump*

The service valve dissipates the fuel pressure in the low-pressure line when the rail is removed. To do this, a pressure hose (special tool W119 589 04 63 00) is connected to the service valve.

Fuel supply

The fuel supply system provides the injection system with a sufficient quantity of fuel at a sufficient pressure in all operating conditions of the engine.

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 by the ME-SFI control unit as a CAN signal over the drive train CAN and as a ground signal.

The fuel system control unit registers the current fuel pressure by means of a voltage signal from the fuel pressure sensor. In addition, the fuel system control unit receives the CAN signal "Specified fuel pressure" from the ME-SFI control unit. After comparing the current fuel pressure with the specified fuel pressure, the fuel pump is actuated with a pulse width modulated signal (PWM signal) until the actual value matches the specified value.

Depending on the fuel requirement, the fuel pressure is thus varied from approx. 4.5 to 6.7 bar. When actuated, the fuel pump draws the fuel from the fuel feed module and pumps it through the fuel filter to the high-pressure pump (M 276) or to the two high-pressure pumps (M 278).

The overflow valve in the fuel filter opens at a fuel pressure of 7 to 9 bar. Before the filter, fuel is removed via a T-piece to drive the suction jet pump at 20 to 40 l/h. This suction jet pump conveys the fuel from the left tank chamber to the right. From here the fuel is pumped to the rails by the fuel pump. In the filter feed line there is a check valve which prevents the fuel pressure from dissipating when the fuel pump is shut off.

Fuel high-pressure system

In the fuel high-pressure system the high fuel pressure necessary for the spray-guided direct injection is generated, regulated and stored in the rails.

To regulate the fuel high pressure, the ME-SFI control unit scans the fuel pressure and temperature sensor.

The fuel from the fuel tank flows from the low-pressure fuel distributor to the high-pressure pump. This compresses the fuel to up to 200 bar (depending on the operating state) and directs it through the high-pressure line and the rails to the fuel injectors.

The fuel injectors in each cylinder bank are supplied with fuel directly from the corresponding rail. There are no return lines on the rails.

Fuel system

Each high-pressure pump has a quantity control valve which regulates the fuel quantity supplied to the pump element for compression according to the specified fuel pressure.

The fuel pressure and temperature sensor registers the current fuel high pressure (rail pressure) and the fuel temperature in the left rail (in the M 276) or in the right rail (M 278). At wide open throttle the rail pressure in the M 276 is approx. 200 bar (M 278: 170 bar) and at very low temperatures (e.g. -30 °C) it is temporarily reduced to approx. 50 bar. At idle with a hot engine the rail pressure in the M 276 can rise to at least 150 bar (M 278: 120 bar). When the engine is shut off, the rail pressure can reach up to 270 bar.

The rail pressure is regulated by the ME-SFI control unit actuating the quantity control valve with a PWM signal until the specified pressure is obtained in the rail.

Control of the fuel high-pressure system breaks down into the following operating states:

- Startup
- Normal mode
- Low-pressure limp-home mode
- Shutoff

Startup

The quantity control valve is energized and closed, guaranteeing full delivery by the high-pressure pump and rapid pressure buildup.

The fuel pump pressure is approx. 4.5 to 6.7 bar.

Normal mode

The quantity control valve regulates the fuel high pressure via its on/off ratio.

The fuel pump pressure is regulated between approx. 3.0 and 5.5 bar depending on the fuel temperature.

The fuel prefeed pressure is varied between approx. 4.5 and 6.7 bar (absolute) depending on the engine speed and the fuel temperature.

Low-pressure limp-home mode (fuel high pressure is not reached)

- Quantity control valve is deenergized and therefore open
- Fuel pump pressure approx. 4.5 to 6.7 bar, fuel flows via the open quantity control valve into the rails
- Actuation of fuel injectors extended
- Stratified combustion disabled (M 276 DES)
- Power reduction, max. speed approx. 70 km/h.

Shutoff

The quantity control valve is deenergized and open, and the fuel pump is not actuated.

Note

The stainless steel high-pressure fuel lines can be reused.
A relevant test specification can be found in WIS.

Safety fuel shutoff

A safety fuel shutoff function guarantees road safety and the safety of the occupants.

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

- Crankshaft Hall sensor, engine rpm
- Throttle valve actuator, throttle valve position
- Restraint systems control unit, direct crash signal
- Restraint systems control unit, indirect crash signal via chassis CAN

The safety fuel shutoff is activated by the ME-SFI control unit in the event of mechanical faults in the throttle valve actuator, on the absence of the engine speed signal or after receipt of a crash signal.

Mechanical faults in the throttle valve actuator

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

Absence of the engine speed signal

If the engine speed signal generated by the crankshaft Hall sensor is absent, the fuel pump is shut off by the fuel system control unit.

Crash signal

If the ME-SFI control unit receives a crash signal either indirectly via the chassis CAN or directly from the restraint systems control unit, it shuts off the fuel pump and the quantity control valves indirectly via the fuel system control unit in order to depressurize the fuel system.

Fuel system

Purging

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

The fuel vapors are stored in the activated charcoal canister and later burned in the engine.

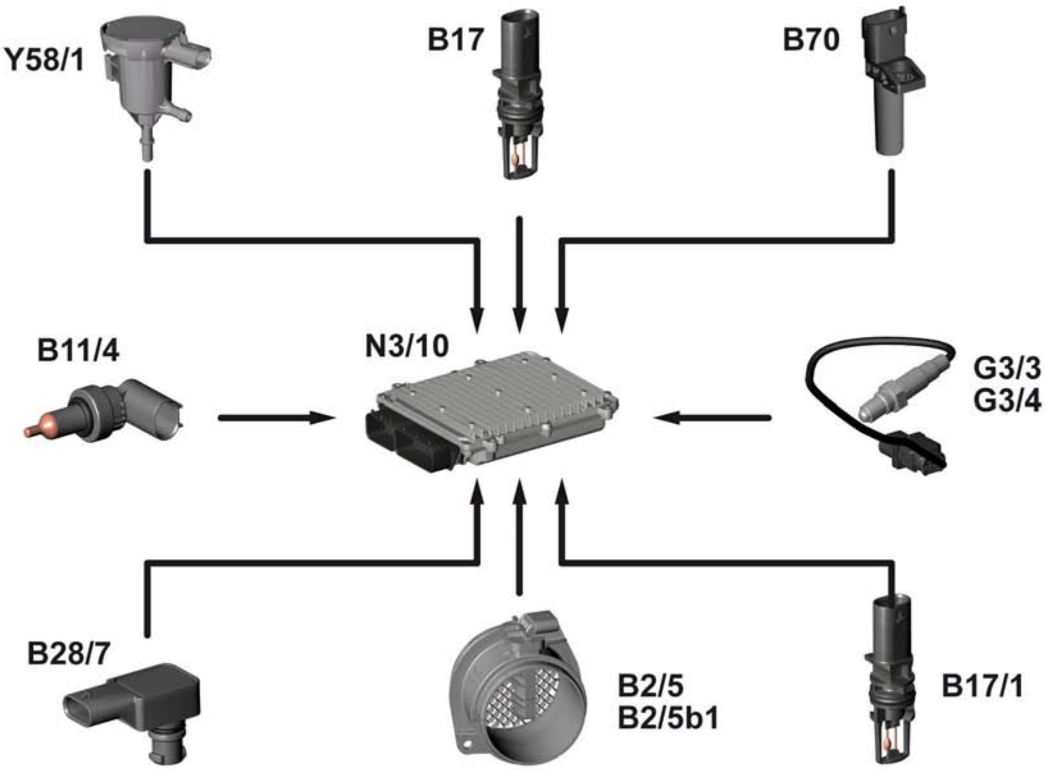
When the engine is running, the fuel vapors stored in the activated charcoal canister are drawn off via the purge switchover valve and burned in the engine.

To regulate the purge quantity, the switchover valve is actuated by the ME-SFI 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.



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Function schematic of purging

B2/5 Hot film mass air flow sensor (M 276 DES)
B2/5b1 Intake air temperature sensor (M 276 DES)
B11/4 Coolant temperature sensor
B17 Intake air temperature sensor (M 276 DEH and M 278)
B17/1 Intake manifold intake air temperature sensor (M 276 DEH and M 276 DES)
B28/7 Pressure sensor downstream of throttle valve actuator
B70 Crankshaft Hall sensor
G3/3 Left O2 sensor upstream of catalytic converter
G3/4 Right O2 sensor upstream of catalytic converter
N3/10 ME-SFI [ME] control unit
Y58/1 Purge switchover valve

Fuel system

Purging (with code (494) USA version)

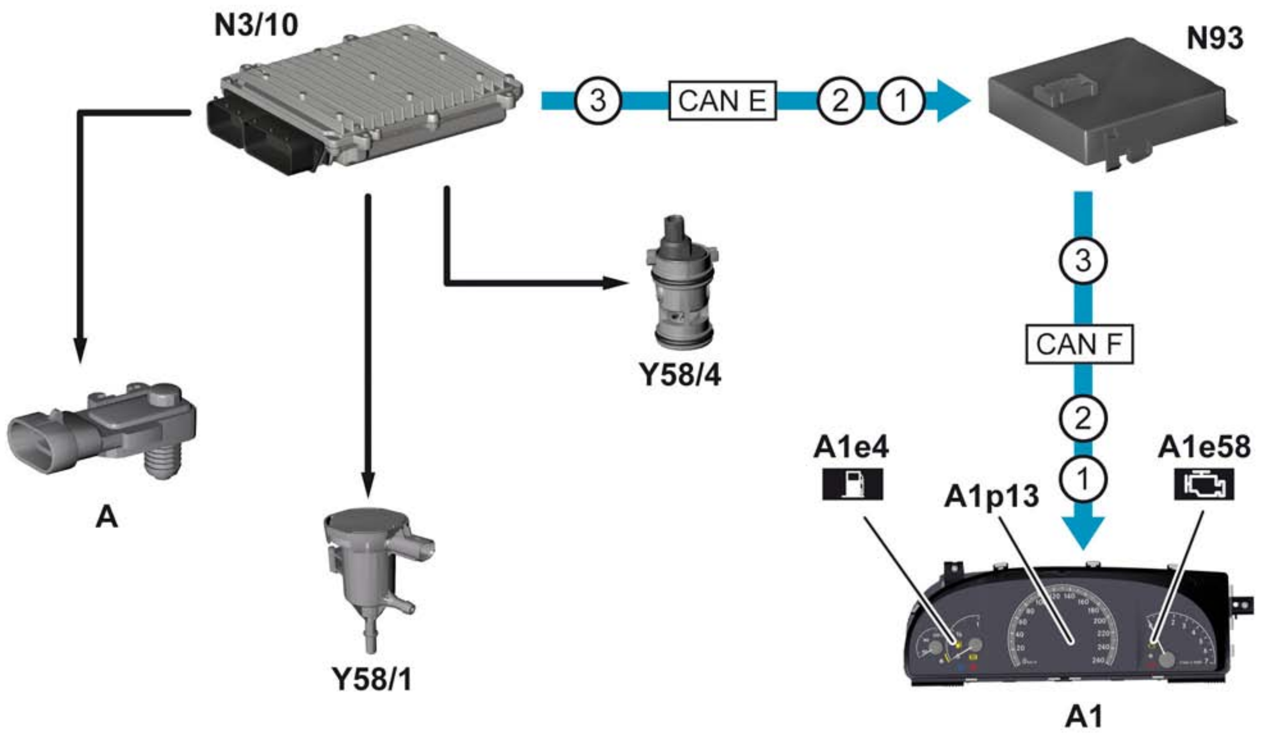
Activated charcoal canister shutoff valve

The activated charcoal canister shutoff valve is actuated by the ME-SFI control unit to close the ventilation connections of the activated charcoal filter. This is necessary in order to perform the leak test of the purging system that is required by law.

When the activated charcoal canister shutoff valve is closed, the mechanical safety valve is responsible for ventilating the activated charcoal filter.

OBD pressure sensor

The OBD pressure sensor registers the internal pressure in the fuel tank for the leak test. The OBD pressure sensor is located on the purge line below the filler neck.



Function schematic of purging with leak test

A1	*Instrument cluster*
A1e4	*Fuel reserve warning lamp*
A1e58	*Engine diagnosis indicator lamp*
A1p13	*Multifunction display*
N3/10	*ME-SFI [ME] control unit*
Y58/1	*Purge switchover valve*
Y58/4	*Activated charcoal canister shutoff valve*
A	*OBD pressure sensor*
CAN E	*Chassis CAN*
CAN F	*Central CAN*
1	*Engine diagnosis indicator lamp, actuation*
2	*Instrument cluster, message*
3	*Fuel reserve warning lamp, actuation*

Exhaust treatment

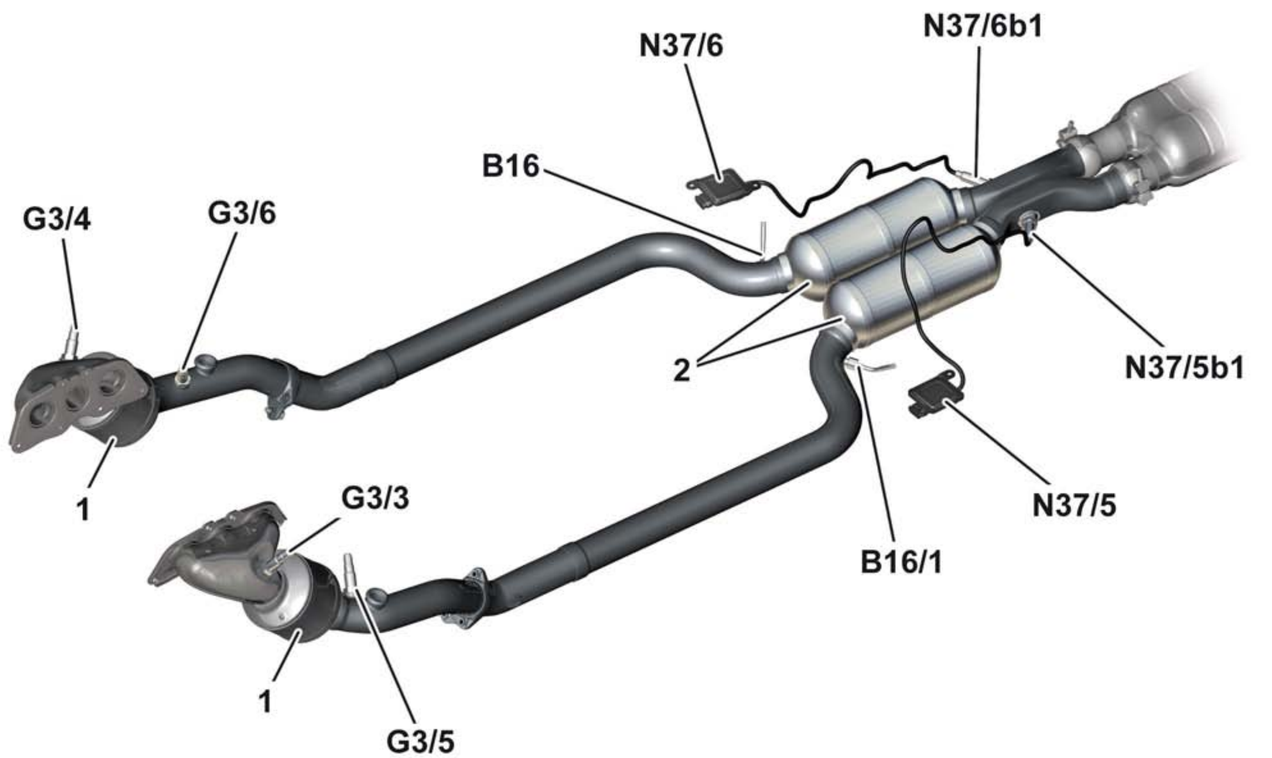
The task of the exhaust treatment system is to reduce exhaust emissions:

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

The near-engine location of the firewall catalytic converters ensures that operating temperature necessary for optimum emissions reduction is reached as quickly as possible.

The following components and subsystems are involved in exhaust treatment:

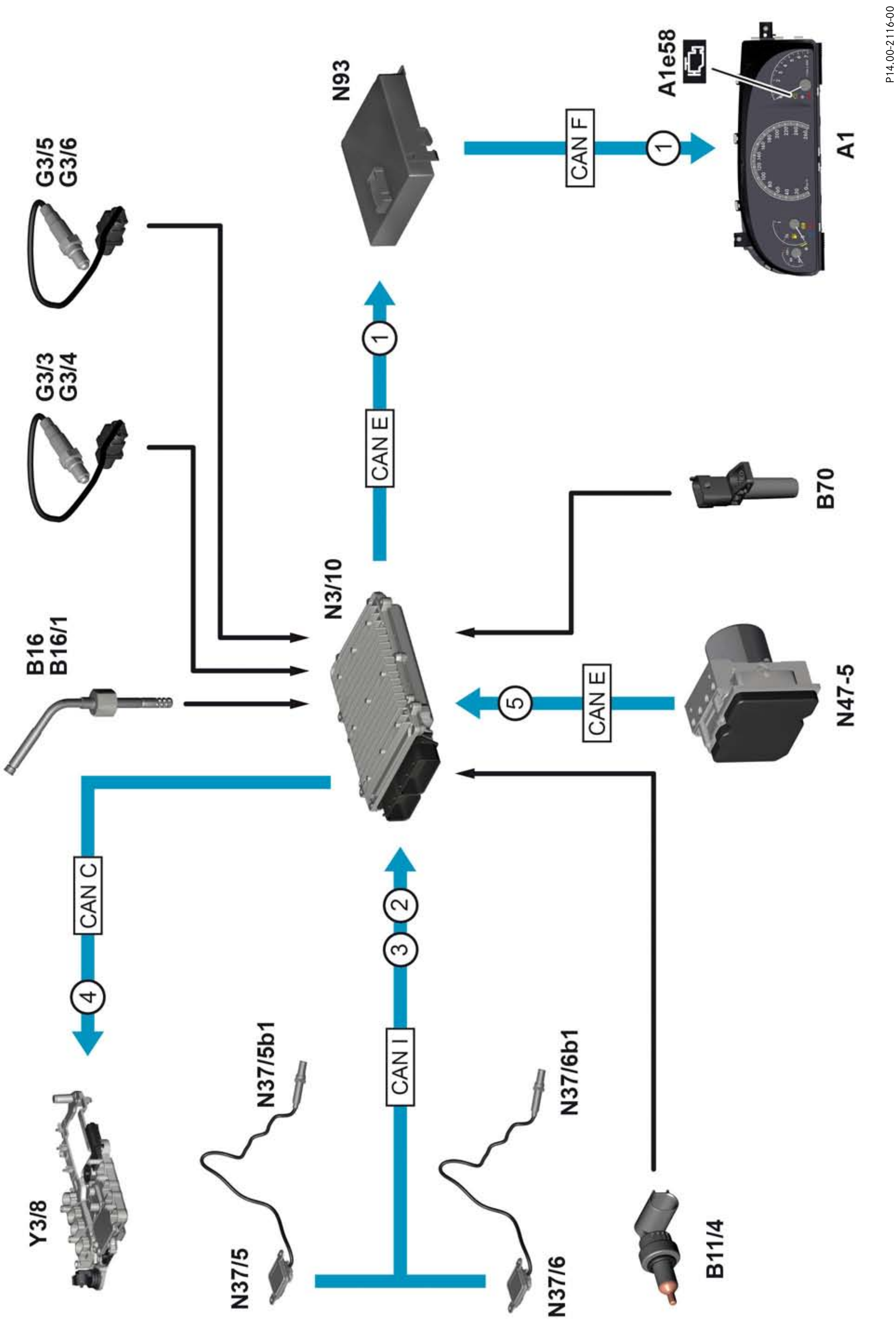
- Firewall catalytic converters
- NOx storage catalytic converters (M 276 DES)
- O_2 sensors upstream and downstream of firewall catalytic converter
- Temperature sensor upstream of NOx storage catalytic converter
- NOx sensor downstream of NOx storage catalytic converter



Exhaust system with NOx storage catalytic converter, 6-cylinder engine with stratified combustion

1	*Firewall CAT*
2	*NOx storage CAT*
G3/3	*Left O2 sensor upstream of CAT*
G3/4	*Right O2 sensor upstream of CAT*
G3/5	*Left O2 sensor downstream of CAT*
G3/6	*Right O2 sensor downstream of CAT*
B16	*Temperature sensor upstream of right NOx storage CAT*
B16/1	*Temperature sensor upstream of left NOx storage CAT*
N37/5	*Left NOX (nitrogen oxides) control unit*
N37/5b1	*Left NOX (nitrogen oxides) sensor*
N37/6	*Right NOX (nitrogen oxides) control unit*
N37/6b1	*Right NOX (nitrogen oxides) sensor*

Exhaust system



Function schematic of exhaust treatment

A1	Instrument cluster
A1e58	Engine diagnosis indicator lamp
B11/4	Coolant temperature sensor
B16	Temperature sensor upstream of right NOx storage catalytic converter (engine 276 DES)
B16/1	Temperature sensor upstream of left NOx storage catalytic converter (engine 276 DES)
B70	Crankshaft Hall sensor
G3/3	Left O2 sensor upstream of catalytic converter
G3/4	Right O2 sensor upstream of catalytic converter
G3/5	Left O2 sensor downstream of catalytic converter
G3/6	Right O2 sensor downstream of catalytic converter
N3/10	ME-SFI [ME] control unit
N37/5	Left NOX (nitrogen oxides) control unit (M 276 DES)
N37/5b1	Left NOX (nitrogen oxides) sensor (M 276 DES)
N37/6	Right NOX (nitrogen oxides) control unit (M 276 DES)
N37/6b1	Right NOX (nitrogen oxides) sensor (M 276 DES)
N47-5	ESP control unit
N93	Central gateway control unit
Y3/8	Electric controller unit (VGS)

CAN C	Drive train CAN
CAN E	Chassis CAN
CAN F	Central CAN
CAN I	Drive train sensor CAN

1	Engine diagnosis indicator lamp, actuation
2	Nitrogen oxide content, status
3	Oxygen content, status
4	Switch point, increase request
5	Vehicle speed, signal

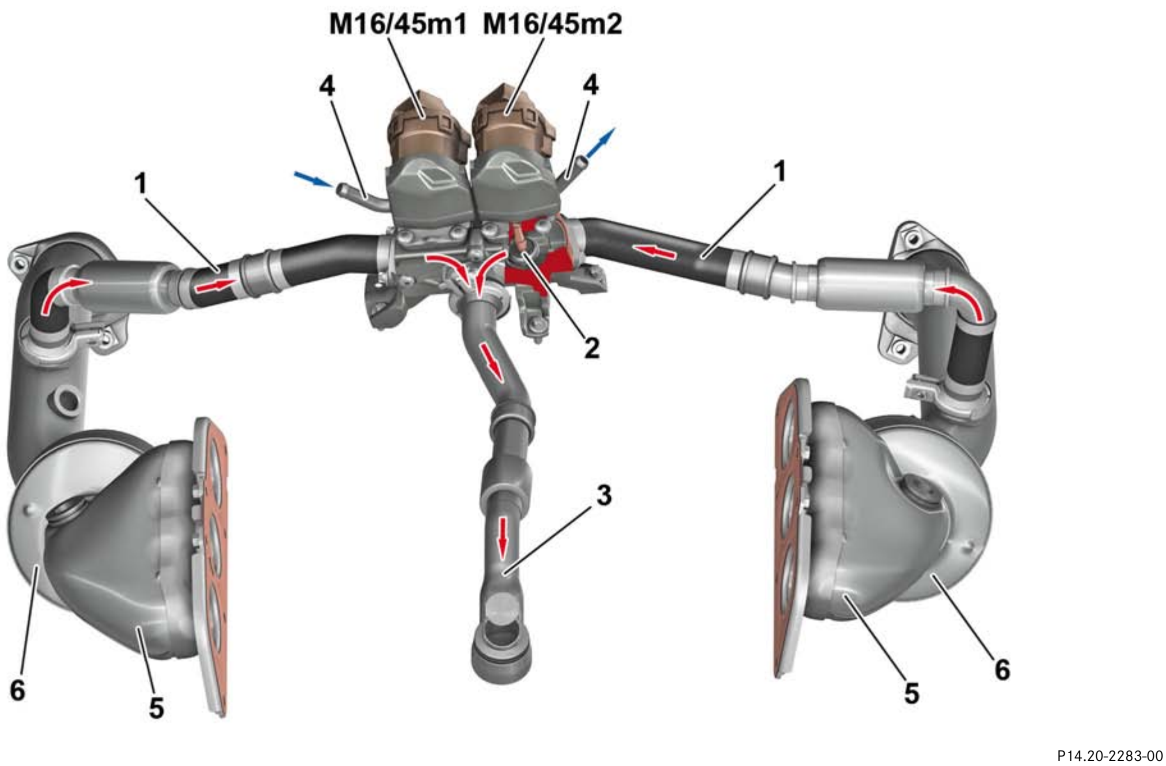
Exhaust system

Exhaust gas recirculation in the M 276 with stratified combustion

The exhaust gas recirculation system enriches the intake air with low-oxygen exhaust gas to reduce the combustion temperature in stratified combustion mode. This reduces the formation of NOx. Because of this, the NOx storage catalytic converters fill with NOx more slowly and stratified combustion is active for longer.

The ME-SFI control unit controls the exhaust gas recirculation on the basis of the following sensors and signals:

- Hot film mass air flow sensor, engine load
- Pressure sensor downstream of throttle valve actuator, intake manifold air pressure
- Right and left Hall sensors, positions of exhaust gas recirculation actuator motors



Exhaust gas recirculation, 6-cylinder engine with stratified combustion

1 Exhaust sampling pipe
2 Recirculation valve
3 Connecting pipe to intake manifold
4 Coolant connection
5 Exhaust manifold
6 Firewall catalytic converter

M16/45m1 Right exhaust gas recirculation actuator motor (with right Hall sensor (M16/45b1))
M16/45m2 Left exhaust gas recirculation actuator motor (with left Hall sensor (M16/45b2))

Cooling circuit, M 276

Although the engine power has increased, it has been possible to almost halve the operating energy input of the coolant pump compared to the predecessor engine M 272. Crucial in this was the consistent reduction of power losses in the coolant circuit as a whole. In addition, the flow to the coolant pump now comes from the rear via the plastic cover for optimum efficiency. Its length has been reduced by 12.5 mm.

A thermal management system allows standing water in the warm-up phase and operating temperatures of 80 to 105 °C, whereby the heating system supply can be shut off independently. This means that the heating system can be fully supplied during warm-up with the radiator circuit shut off.

For weight reasons the thermostat, coolant pump pulley, rotor and lines are made of plastic.

Cooling circuit, M 278

The greater engine power and the two turbochargers have higher coolant requirements than the predecessor engine 273. In spite of this, the consistent reduction of hydraulic pressure losses and detail improvements in the cooling system made it possible to reduce the operating energy input of the coolant pump. At the same time, its variability has been improved.

Component weights have been reduced by consistently replacing aluminum and steel with plastic parts, e.g. in the thermostat, belt pulley, rotor, heater valve and hydraulic lines.

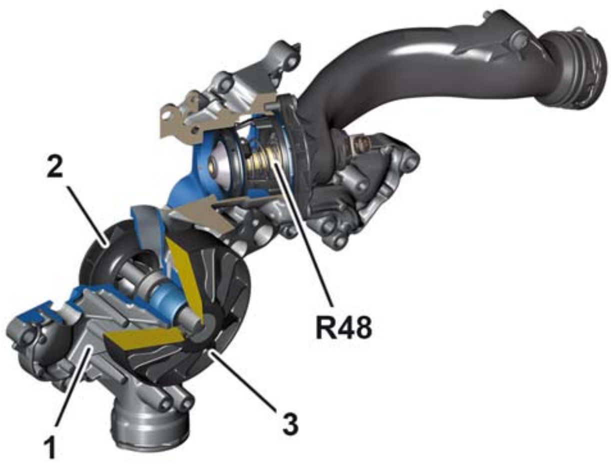
Thermal management

The thermal management system regulates the coolant circuit in three stages during the warm-up phase:

In the "standing water" phase in the engine the delivery of the coolant pump is suppressed entirely by a closed thermostat and a closed heating system shutoff valve.

In the "engine circuit without radiator" phase the cooling circuit is operated on a shortened circuit. The coolant circulates inside the engine only. The feed and return lines to the radiator are closed.

In the "radiator circuit" phase a coolant temperature of up to 105 °C (default) is permitted initially in order to encourage rapid warm-up. When the threshold values of several input factors are exceeded (e.g. engine rpm, torque etc.), the temperature is reduced to 90 °C or 80 °C in the outlet. The actuator for this is a heated thermostat cartridge.



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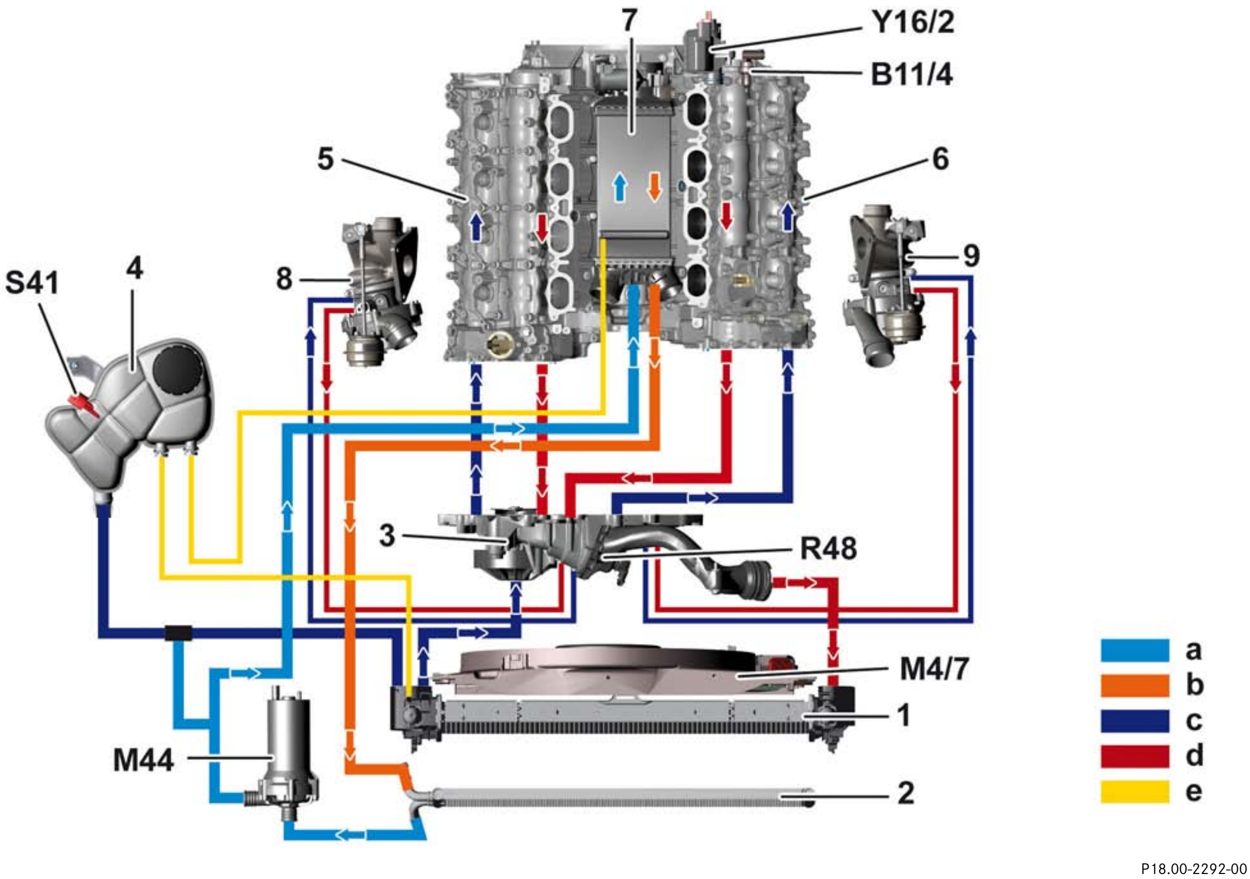
Coolant pump

1 Housing
2 Rotor
3 Belt pulley

R48 Two-disk thermostat heating element

Engine cooling

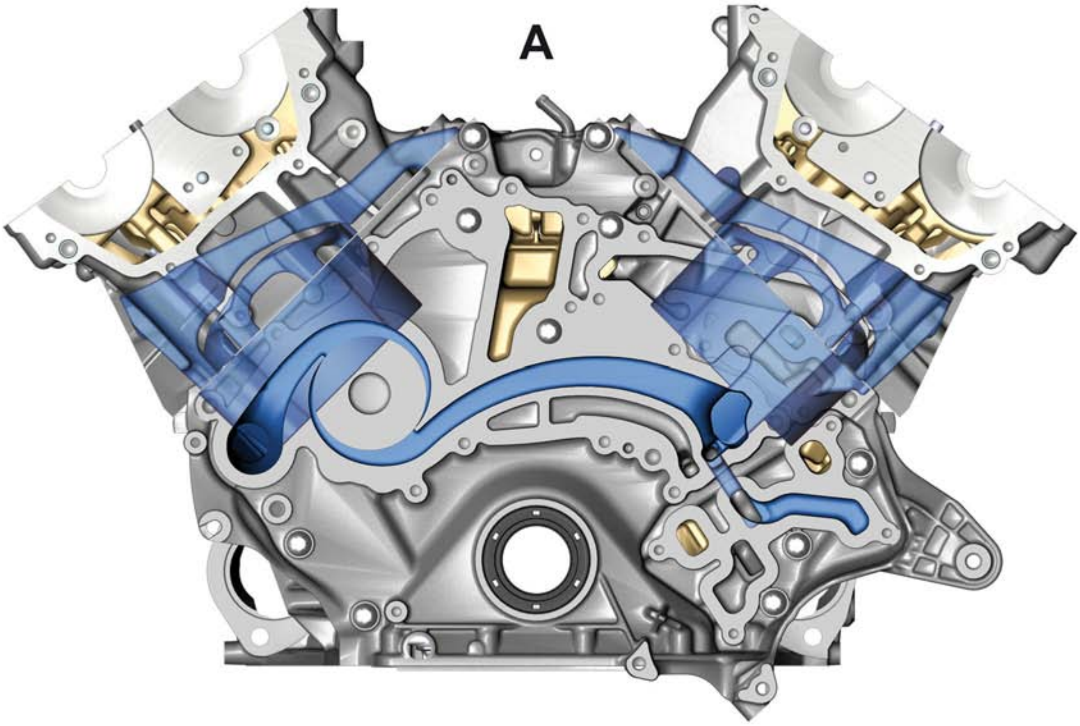


***Coolant circuit** (schematic, shown on the 8-cylinder engine)*

1	*Radiator*
2	*Low-temperature cooler*
3	*Coolant pump*
4	*Expansion reservoir*
5	*Right cylinder bank*
6	*Left cylinder bank*
7	*Charge air cooler*
8	*Right turbocharger (M 278 only)*
9	*Left turbocharger (M 278 only)*

B11/4	*Coolant temperature sensor*
M4/7	*Engine and air conditioning electric suction fan with integrated control*
M44	*Charge air cooler circulation pump*
R48	*Two-disk thermostat heating element*
S41	*Coolant level indicator switch*
Y16/2	*Heating system shutoff valve*

a	*Charge air cooler coolant feed*
b	*Charge air cooler coolant return*
c	*Engine and turbocharger coolant feed*
d	*Engine and turbocharger coolant return*
e	*Vent*



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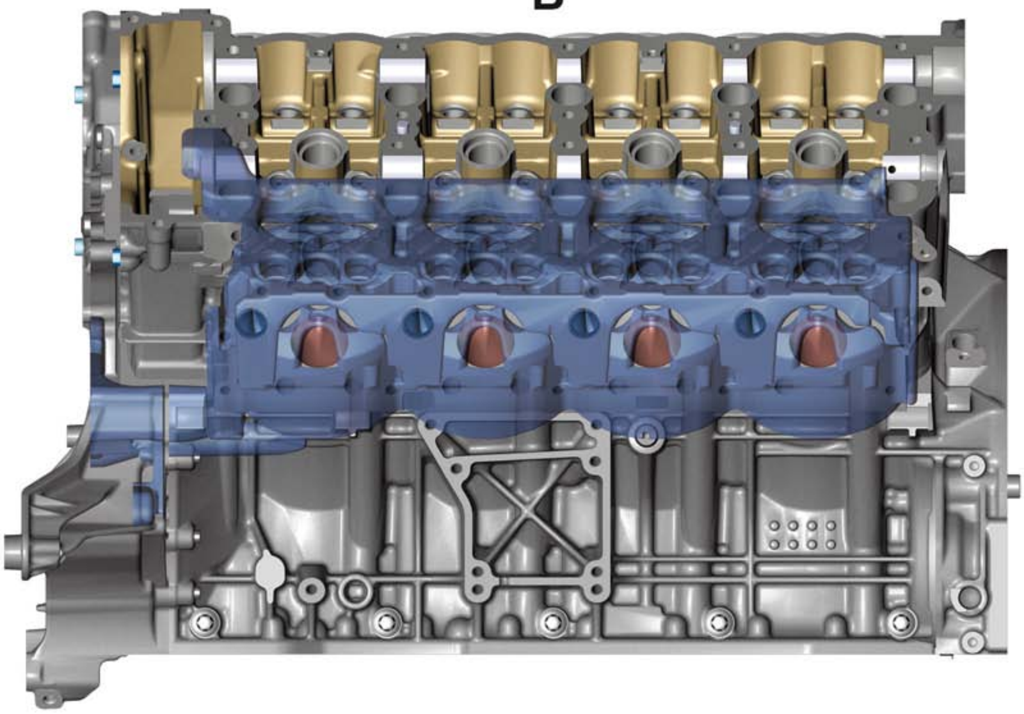

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Coolant distribution *(shown on the 8-cylinder engine)*

A View of cylinder head from front

B View of crankcase from left

Engine lubrication

Regulated engine oil pump

Engines 276 and 278 feature a newly developed vane-type oil pump with on-demand quantity control and two map-controlled, switched pressure levels.

With this control concept the lubrication and cooling points in the engine can, depending on the engine load and absolute engine speed, and especially in the partial-load range, be supplied with a significantly lower operating energy input than would be possible with an unregulated pump.

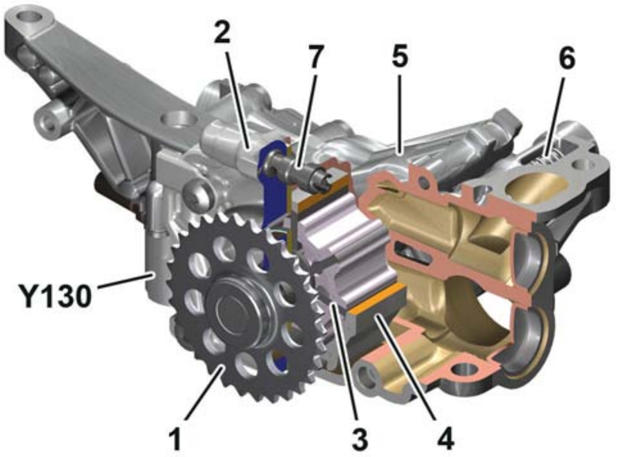
The engine oil pump operates with two pressure levels according to a characteristics map. At the high pressure level, the lubrication and cooling points in the engine are supplied with the maximum quantity of oil at 4 bar, while at the low level the flow rate is reduced to 2 bar. At the same time the oil sprayers for cooling the piston undersides are shut off.

Special features are the anodized aluminum oil pump housing and the aluminum intermediate flange for lasting wear resistance and low leakage clearances. In the M 278 an external gear pump is responsible for the oil return from the turbochargers. This is intended to prevent oil from being forced into the intake or exhaust tract. The external gear pump is located on the rear of the engine oil pump.

The oil level is registered by the oil level check switch in the oil pan and is transmitted to the ME-SFI control unit.

The engine oil pump valve is an electromagnetic valve with three hydraulic connections and two operating positions (open and closed).

The valve is actuated by a ground signal direct from the ME-SFI control unit depending on a characteristics map. It switches between the 2 bar and 4 bar pressure levels according to requirements.



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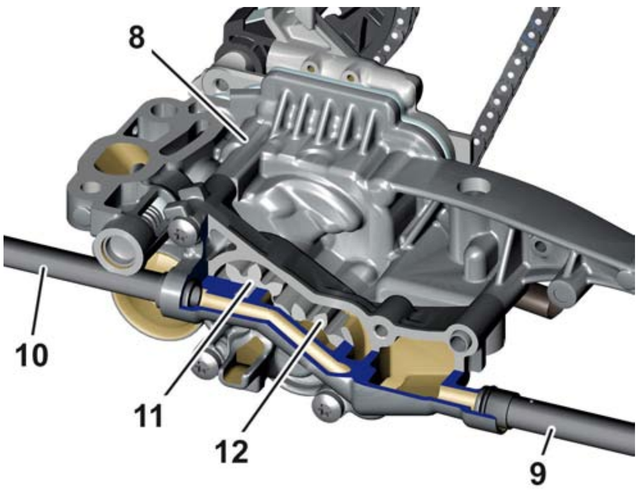
Engine oil pump, front view

1 Drive gear
2 Oil pump cover
3 Rotor with vane
4 Set collar
5 Oil pump housing
6 Cold start protection valve
7 Control plunger

Y130 Engine oil pump valve



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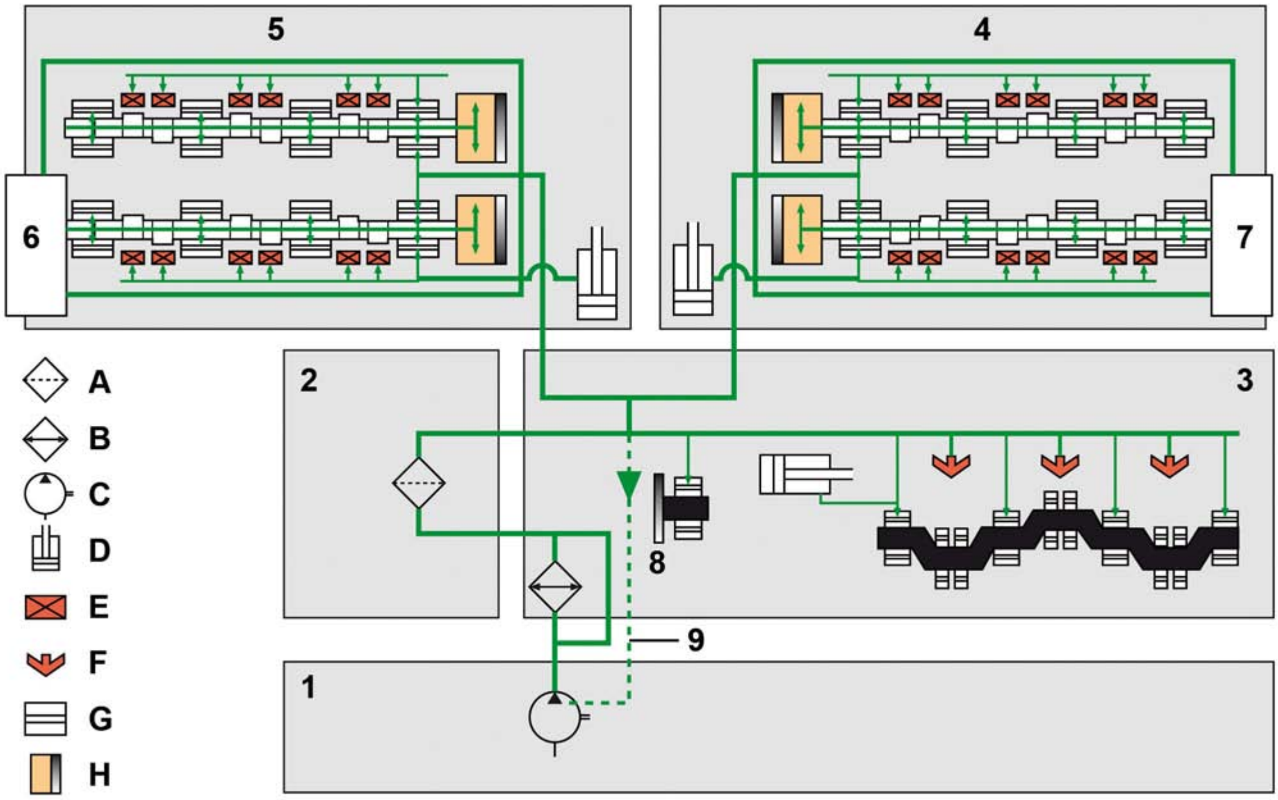
Engine oil pump with external gear pump on M 278, rear view

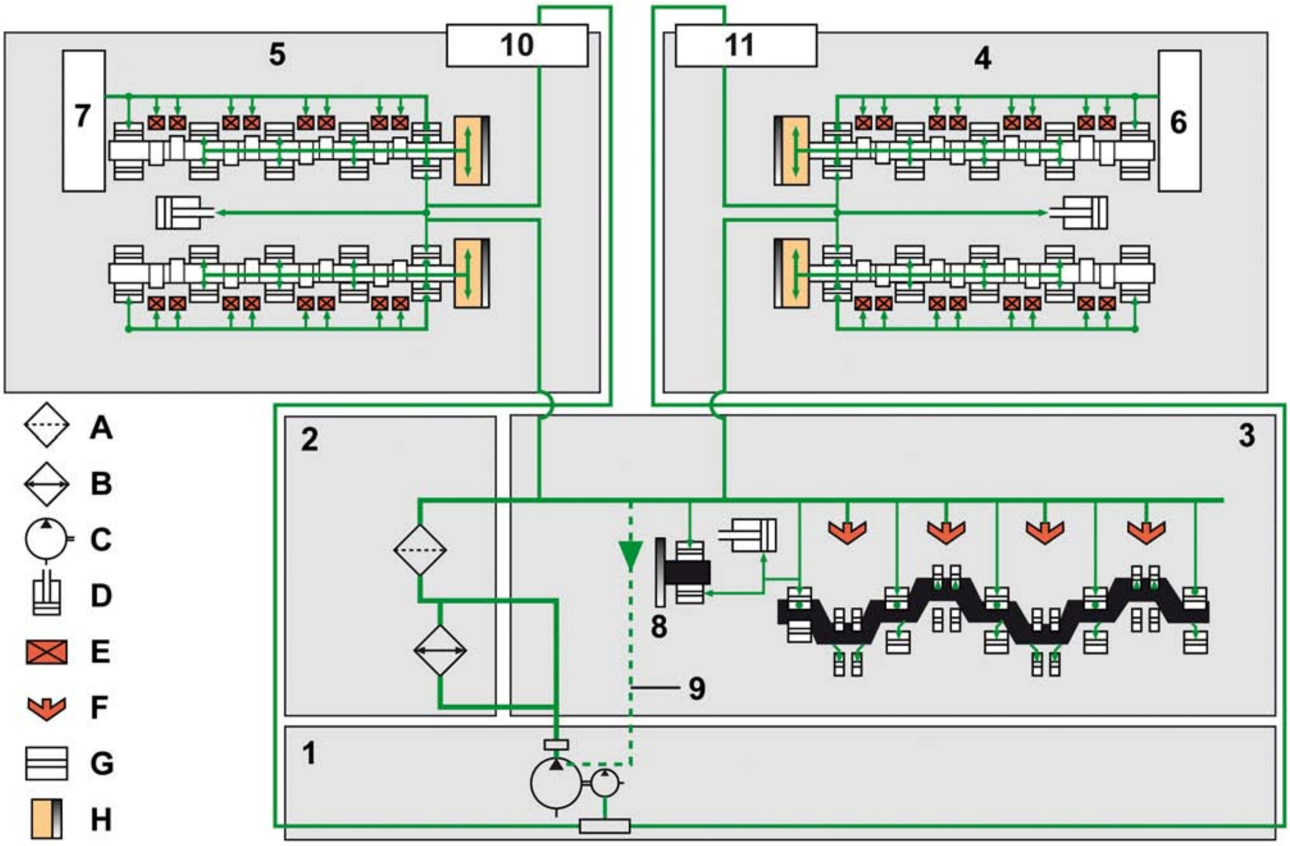
8 Engine oil pump housing
9 Right turbocharger oil return line
10 Left turbocharger oil return line
11 Drive shaft gear
12 Oil pump gear



Oil circuit diagram, M 276

1	*Oil pan*	*A*	*Oil filter*
2	*Timing case*	*B*	*Oil-water heat exchanger*
3	*Crankcase*	*C*	*Oil pump*
4	*Right cylinder head*	*D*	*Chain tensioner*
5	*Left cylinder head*	*E*	*Hydraulic valve clearance compensator*
6	*High-pressure pump (bearing lubrication)*	*F*	*Oil spray nozzle*
7	*Vacuum pump (bearing lubrication)*	*G*	*Plain bearing*
8	*Chain drive intermediate gear*	*H*	*Camshaft adjuster*
9	*Control pressure return*		

Engine lubrication



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Oil circuit diagram, M 278

1 Oil pan
2 Timing case
3 Crankcase
4 Right cylinder head
5 Left cylinder head
6 High-pressure pump (bearing lubrication)
7 Vacuum pump (bearing lubrication)
8 Chain drive intermediate gear
9 Control pressure return
10 Left turbocharger
11 Right turbocharger

A Oil filter
B Oil-water heat exchanger
C Oil pump
D Chain tensioner
E Hydraulic valve clearance compensator
F Oil spray nozzle
G Plain bearing
H Camshaft adjuster

ME-SFI control unit

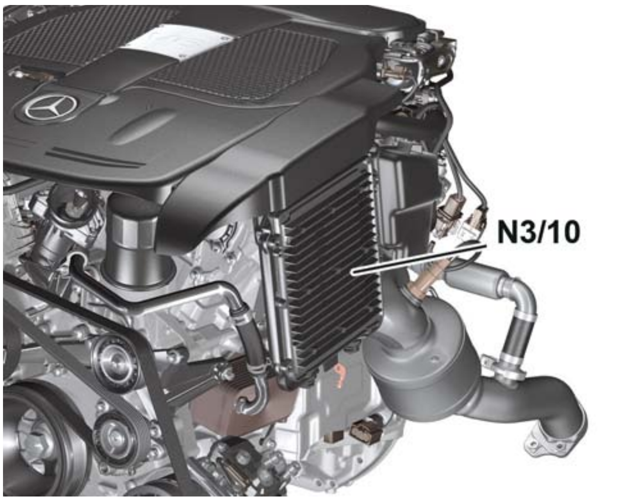
The MED 17.7 engine control builds on experiences with the MED9 of the predecessor engines. The following features have been implemented for this new engine control MED 17 in an identical modular housing:

- Modular design as a standardized unit for all new V6 and V8 engines with direct injection
- In contrast to the predecessor unit, no separate water cooling of the injector power amplifiers but air convection via cooling fins instead
- No additional component carriers in the control unit for the injector power amplifiers
- Single-processor concept with 150 MHz clock frequency instead of dual-core concept with 66 MHz each
- Significantly increased flash and RAM memory capacities
- Weight reduction by 0.2 kg

Task

The ME-SFI control unit combines with the sensors and actuators of engine 276 or 278 to form the engine control system. The following systems and functions are controlled and coordinated by the ME-SFI control unit according to the input signals:

- Ignition system
- Fuel supply
- Injection control
- Electronic accelerator
- Diagnosis and fault storage
- Engine start/stop function (with code (B03) ECO start/stop function)
- Drive authorization system and immobilizer
- Controlled camshaft adjustment
- Intake manifold switchover (M 276)
- Thermal management
- Torque interface
- Alternator interface
- Exhaust gas recirculation and exhaust treatment (with NOx catalytic converter) (M 276 DES)
- Boost pressure control (M 278)
- Oil pressure control
- Lambda control
- Tank diagnosis
- Purging



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Engine 276

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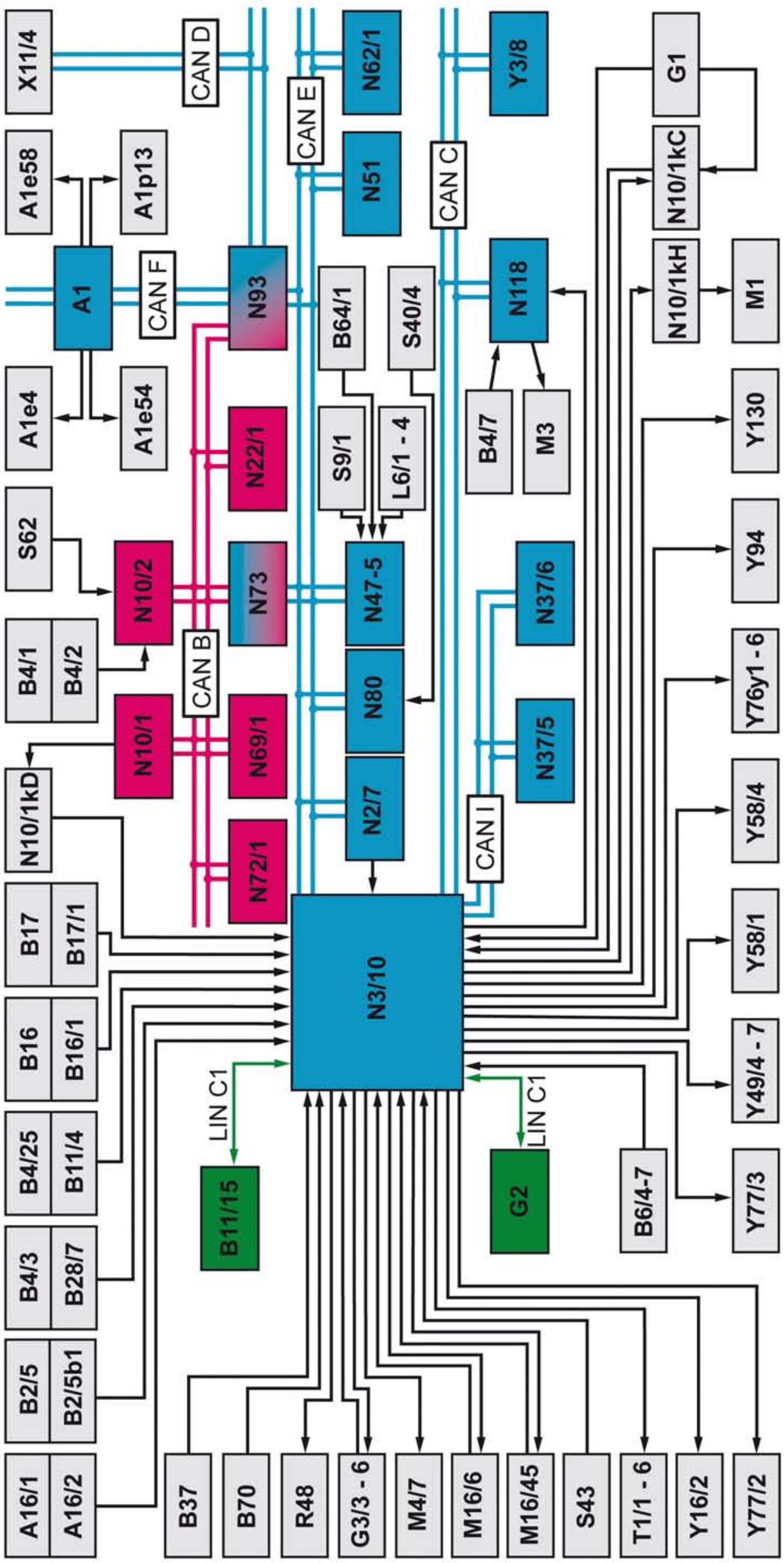
Engine 278

N3/10 ME-SFI [ME] control unit

Engine control



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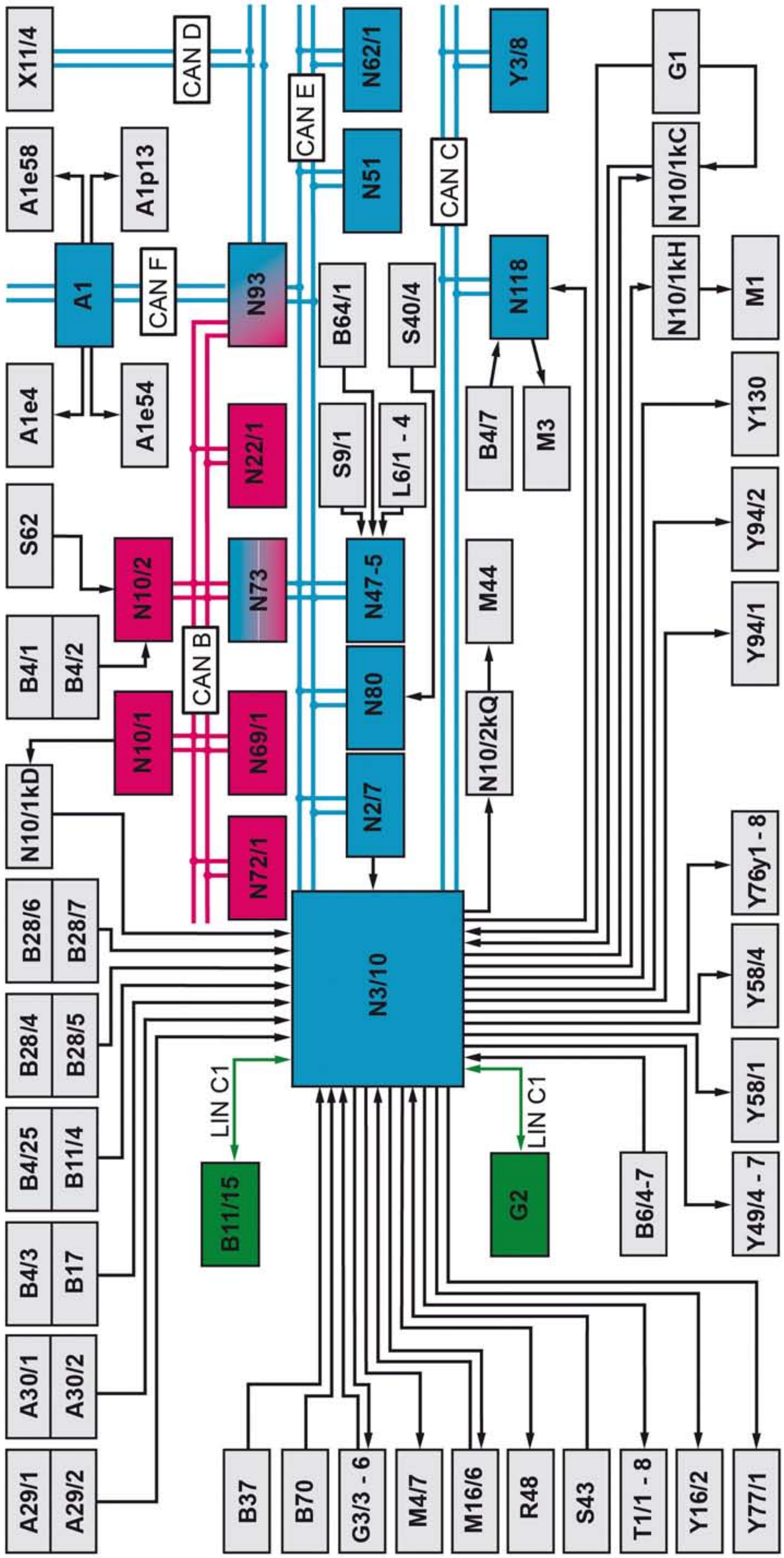
Block diagram of engine 276 *(shown on model 221)*



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Block diagram of engine 278 *(shown on model 221)*

Engine control

A1	Instrument cluster
A1e4	Fuel reserve warning lamp
A1e54	Coolant temperature warning lamp
A1e58	Engine diagnosis indicator lamp
A1p13	Multifunction display
A16/1	Knock sensor 1, right (M 276)
A16/2	Knock sensor 2, left (M 276)
A29/1	Front knock sensor (left side of engine) (M 278)
A29/2	Rear knock sensor (left side of engine) (M 278)
A30/1	Front knock sensor (right side of engine) (M 278)
A30/2	Rear knock sensor (right side of engine) (M 278)
B2/5	Hot film mass air flow sensor (M 276 DES)
B2/5b1	Intake air temperature sensor (M 276 DES)
B4/1	Fuel level indicator sensor, left tank half
B4/2	Fuel level indicator sensor, right tank half
B4/3	Tank pressure sensor (with code (494) USA version)
B4/7	Fuel pressure sensor
B4/25	Fuel pressure and temperature sensor
B6/4	Intake camshaft Hall sensor, left
B6/5	Intake camshaft Hall sensor, right
B6/6	Exhaust camshaft Hall sensor, left
B6/7	Exhaust camshaft Hall sensor, right
B11/4	Coolant temperature sensor
B11/15	Radiator sensor for engine diagnosis (with code (494) USA version)
B16	Temperature sensor upstream of right NOx storage catalytic converter (M 276 DES)
B16/1	Temperature sensor upstream of left NOx storage catalytic converter (M 276 DES)
B17	Intake air temperature sensor (except M 276 DES)
B17/1	Intake manifold intake air temperature sensor (M 276)
B28/4	Pressure sensor downstream of air filter, left cylinder bank (M 278)
B28/5	Pressure sensor downstream of air filter, right cylinder bank (M 278)
B28/6	Pressure sensor upstream of throttle valve actuator (M 278)
B28/7	Pressure sensor downstream of throttle valve actuator
B37	Accelerator pedal sensor
B64/1	Brake vacuum sensor (with code (B03) ECO start/stop function)
B70	Crankshaft Hall sensor
G1	On-board electrical system battery
G2	Alternator
G3/3	Left O2 sensor upstream of catalytic converter
G3/4	Right O2 sensor upstream of catalytic converter
G3/5	Left O2 sensor downstream of catalytic converter
G3/6	Right O2 sensor downstream of catalytic converter
L6/1	Left front rpm sensor
L6/2	Right front rpm sensor
L6/3	Left rear rpm sensor
L6/4	Right rear rpm sensor
M1	Starter
M3	Fuel pump
M4/7	Engine and air conditioning electric suction fan with integrated control
M16/6	Throttle valve actuator
M16/45	Exhaust gas recirculation actuator motors (M 276 DES)
N2/7	Restraint systems control unit
N3/10	ME-SFI [ME] control unit
N10/1	Front SAM control unit with fuse and relay module
N10/1kC	Circuit 87 relay, engine
N10/1kD	Circuit 15 relay
N10/1kH	Circuit 50 relay, starter
N10/2	Rear SAM control unit with fuse and relay module
N10/2kQ	Circulation pump relay (M 278)
N22/1	AAC [KLA] control unit
N37/5	Left NOX (nitrogen oxides) control unit (M 276 DES)
N37/6	Right NOX (nitrogen oxides) control unit (M 276 DES)
N47-5	ESP control unit

N51	AIRMATIC with ADS control unit (with code (489) AIRMATIC (air suspension with continuously adjustable damping))
N62/1	Radar sensors control unit (SGR) (with code (233) DISTRONIC PLUS)
N69/1	Left front door control unit
N72/1	Upper control panel control unit
N73	EZS control unit
N80	Steering column tube module
N93	Central gateway control unit
N118	Fuel system control unit
R48	Two-disk thermostat heating element
S9/1	Brake light switch
S40/4	Cruise control switch
S43	Oil level check switch
S62	Engine hood ATA switch (with code (551) Anti-theft alarm system (ATA))
T1/1	Cylinder 1 ignition coil
T1/2	Cylinder 2 ignition coil
T1/3	Cylinder 3 ignition coil
T1/4	Cylinder 4 ignition coil
T1/5	Cylinder 5 ignition coil
T1/6	Cylinder 6 ignition coil
T1/7	Cylinder 7 ignition coil (M 278)
T1/8	Cylinder 8 ignition coil (M 278)
X11/4	Data link connector

Y3/8	Electric controller unit (VGS)
Y16/2	Heating system shutoff valve
Y49/4	Intake camshaft solenoid, left
Y49/5	Intake camshaft solenoid, right
Y49/6	Exhaust camshaft solenoid, left
Y49/7	Exhaust camshaft solenoid, right
Y58/1	Purge switchover valve
Y58/4	Activated charcoal canister shutoff valve (with code (494) USA version)
Y76y1	Fuel injector, cylinder 1
Y76y2	Fuel injector, cylinder 2
Y76y3	Fuel injector, cylinder 3
Y76y4	Fuel injector, cylinder 4
Y76y5	Fuel injector, cylinder 5
Y76y6	Fuel injector, cylinder 6
Y76y7	Fuel injector, cylinder 7 (M 278)
Y76y8	Fuel injector, cylinder 8 (M 278)
Y77/1	Boost pressure actuator (M 278)
Y77/2	Intake manifold resonance flap switchover valve (M 276)
Y77/3	Intake manifold selector drum switchover valve (M 276)
Y94	Quantity control valve (M 276)
Y94/1	Left quantity control valve (M 278)
Y94/2	Right quantity control valve (M 278)
Y130	Engine oil pump valve

CAN B	Interior CAN
CAN C	Drive train CAN
CAN D	Diagnostic CAN
CAN E	Chassis CAN
CAN F	Central CAN
CAN I	Drive train sensor CAN (engine 276 DES))
LIN C1	Drive train LIN

Ignition system

At the instant of the firing point, the ME-SFI control unit interrupts the primary circuit (circuit 1) at the ground end of the relevant ignition coil. From the ignition coil the ignition voltage reaches the spark plug and causes arcing in the gap between the center electrode and the ground electrode.

The ignition angles are determined by the ME-SFI control unit according to a characteristics map on the basis of the input signals.

Note

The ignition angles can only be checked using Xentry Diagnostics.

Operating modes of the ignition coil

Single-spark ignition

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

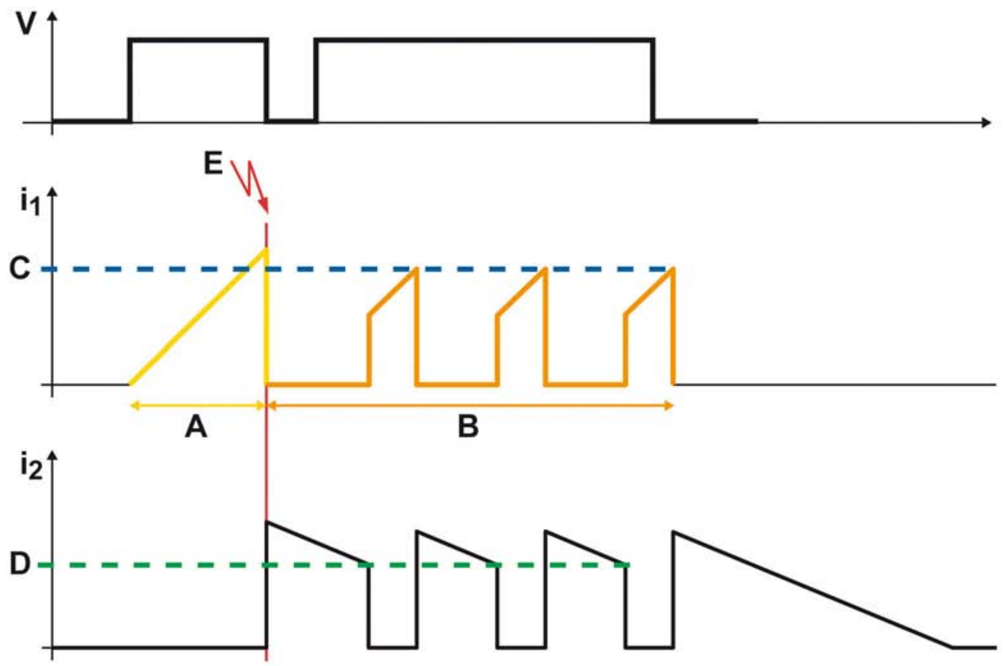
New combustion methods increase the demands on the ignition system. In supercharged engines the ignition coil must deliver a higher secondary voltage so that an ignition spark can be produced. In stratified combustion mode the firing point fluctuates slightly. In order to reliably ignite the mixture, 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. Rather than producing a succession of sparks by the single-spark method, the coil is recharged in the meantime in order to provide sufficient energy for more sparks.

A multi-spark ignition cycle begins in the same way as a single-spark cycle. The coil is initially charged to a desired target primary current. At the firing point the charging current is shut off, producing an ignition spark. However, in multi-spark mode the coil is not discharged completely. The secondary current, which is directly dependent on the charge level of the coil, is measured in the coil. If it drops below the secondary current threshold, the 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 spark to be produced. Subsequent sparks are generated in the same way.

In multi-spark ignition mode it is possible to drive with a much leaner mixture with stratified combustion. The advantage of this is lower fuel consumption.



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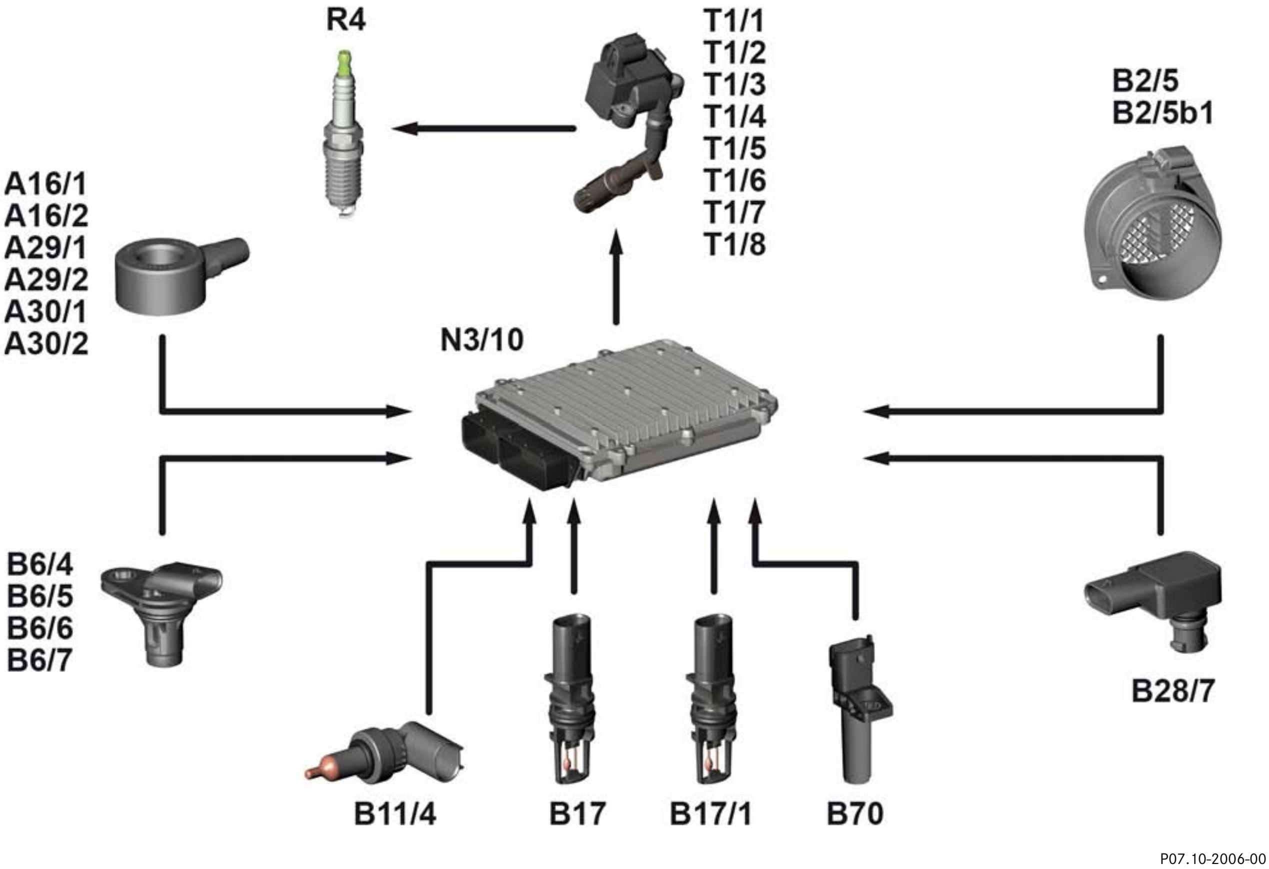
Ideal primary and secondary current curve in a multi-spark ignition system

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

Ignition system



Function schematic of ignition system

A16/1	*Knock sensor 1, right (M 276)*
A16/2	*Knock sensor 2, left (M 276)*
A29/1	*Front knock sensor (left side of engine) (M 278)*
A29/2	*Rear knock sensor (left side of engine) (M 278)*
A30/1	*Front knock sensor (right side of engine) (M 278)*
A30/2	*Rear knock sensor (right side of engine) (M 278)*
B2/5	*Hot film mass air flow sensor (M 276 DES)*
B2/5b1	*Intake air temperature sensor (M 276 DES)*
B6/4	*Intake camshaft Hall sensor, left*
B6/5	*Intake camshaft Hall sensor, right*
B6/6	*Exhaust camshaft Hall sensor, left*
B6/7	*Exhaust camshaft Hall sensor, right*
B11/4	*Coolant temperature sensor*
B17	*Intake air temperature sensor (M 276 DEH and M 278)*
B17/1	*Intake manifold intake air temperature sensor (M 276)*
B28/7	*Pressure sensor downstream of throttle valve actuator*
B70	*Crankshaft Hall sensor*
N3/10	*ME-SFI [ME] control unit*
R4	*Spark plugs*
T1/1	*Cylinder 1 ignition coil*
T1/2	*Cylinder 2 ignition coil*
T1/3	*Cylinder 3 ignition coil*
T1/4	*Cylinder 4 ignition coil*
T1/5	*Cylinder 5 ignition coil*
T1/6	*Cylinder 6 ignition coil*
T1/7	*Cylinder 7 ignition coil (M 278)*
T1/8	*Cylinder 8 ignition coil (M 278)*

On-board diagnosis

The new engines 276 and 278 feature a second-generation on-board diagnosis system (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 control unit and constantly monitors all the emissions-relevant components and systems in the vehicle.

The tasks of the OBD are as follows:

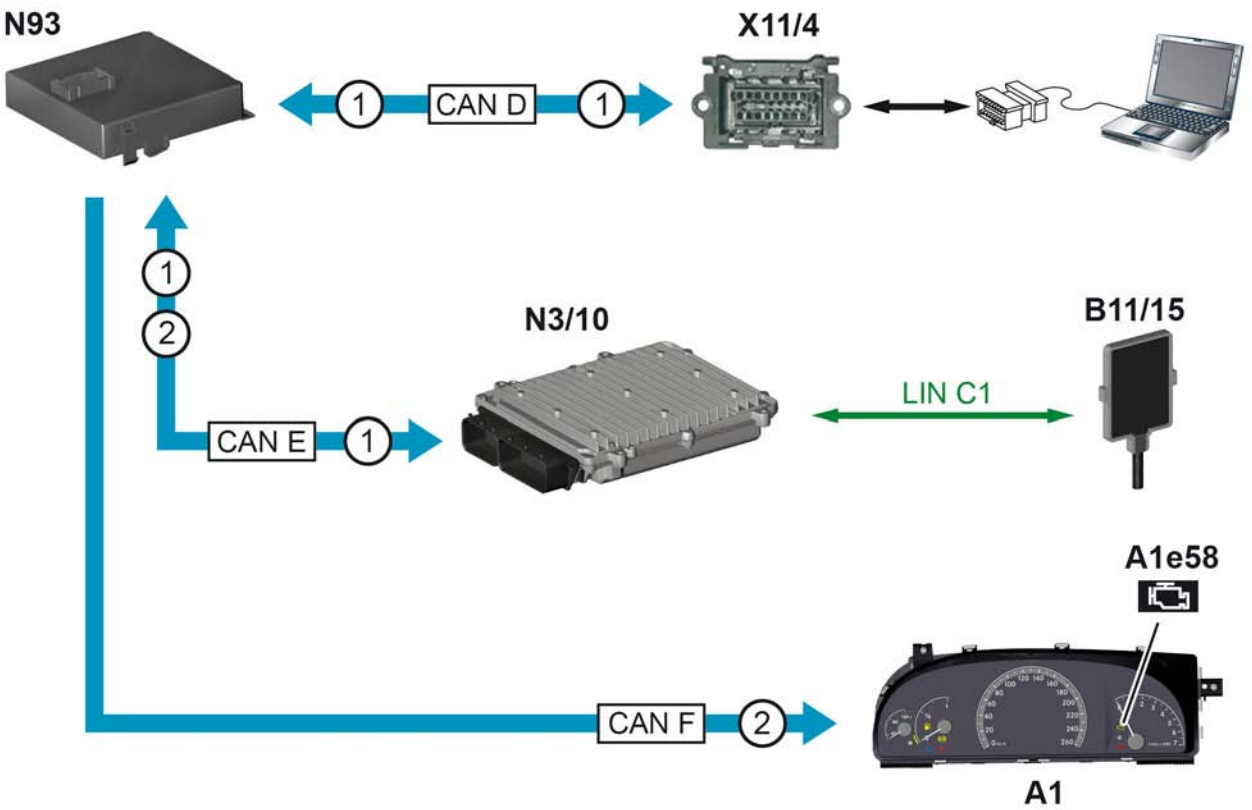
- Monitoring emissions-relevant components and systems while driving
- Detecting and storing malfunctions
- Displaying malfunctions by means of a warning lamp (engine diagnosis indicator lamp)
- Transmitting detected faults over a standard interface (diagnostic connector) to a diagnostic unit (e.g. Xentry 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:

- O2 sensors
- NOx sensors (engine 276 DES)
- Radiator sensor for engine diagnosis (with code (494) USA version)
- Efficiency of catalytic converters (catalyst function)
- Catalytic converter heating
- Purging
- Smooth running analysis (detection of combustion misfiring)
- Exhaust gas recirculation (engine 276 DES)
- Other emissions-relevant components or components the failure of which would prevent diagnosis of another component

On-board diagnosis



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Function schematic of on-board diagnosis (OBD)

A1	*Instrument cluster*	*CAN D*	*Diagnostic CAN*
A1e58	*Engine diagnosis indicator lamp*	*CAN E*	*Chassis CAN*
B11/15	*Radiator sensor for engine diagnosis (with code (494) USA version)*	*CAN F*	*Central CAN*
		LIN C1	*Drive train LIN*
N3/10	*ME-SFI [ME] control unit*		
N93	*Central gateway control unit*	*1*	*Engine control diagnosis, communication*
X11/4	*Data link connector*	*2*	*Engine diagnosis indicator lamp, actuation*

The new V-engines are equipped with a starter-assisted in-engine direct start function. This function combines with the engine stop function to form a start/stop function.

The direct start function makes use of the fact that, with the selected piezo injection valve coupled with the correct injection timing, the very first compression stroke of a cylinder can be utilized for a controlled combustion.

To be able to drive off immediately after a direct start of the engine, the oil supply to the transmission hydraulics must be guaranteed while the engine is off and while it is being restarted in order to avoid losing time between the start-off command and the start-off time due to a delayed oil supply. For this reason, the additional electric transmission oil pump supplies oil to the transmission control system when the internal transmission pump is off.

On engine M 278 the start/stop function is always combined with a revised 7G-TRONIC automatic transmission.

The availability of the start/stop function is indicated to the driver be means of a green ECO symbol in 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 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.

Directly after the engine is cold started, the ME-SFI control unit performs a system diagnosis and evaluates the operational capability of the start/stop function.

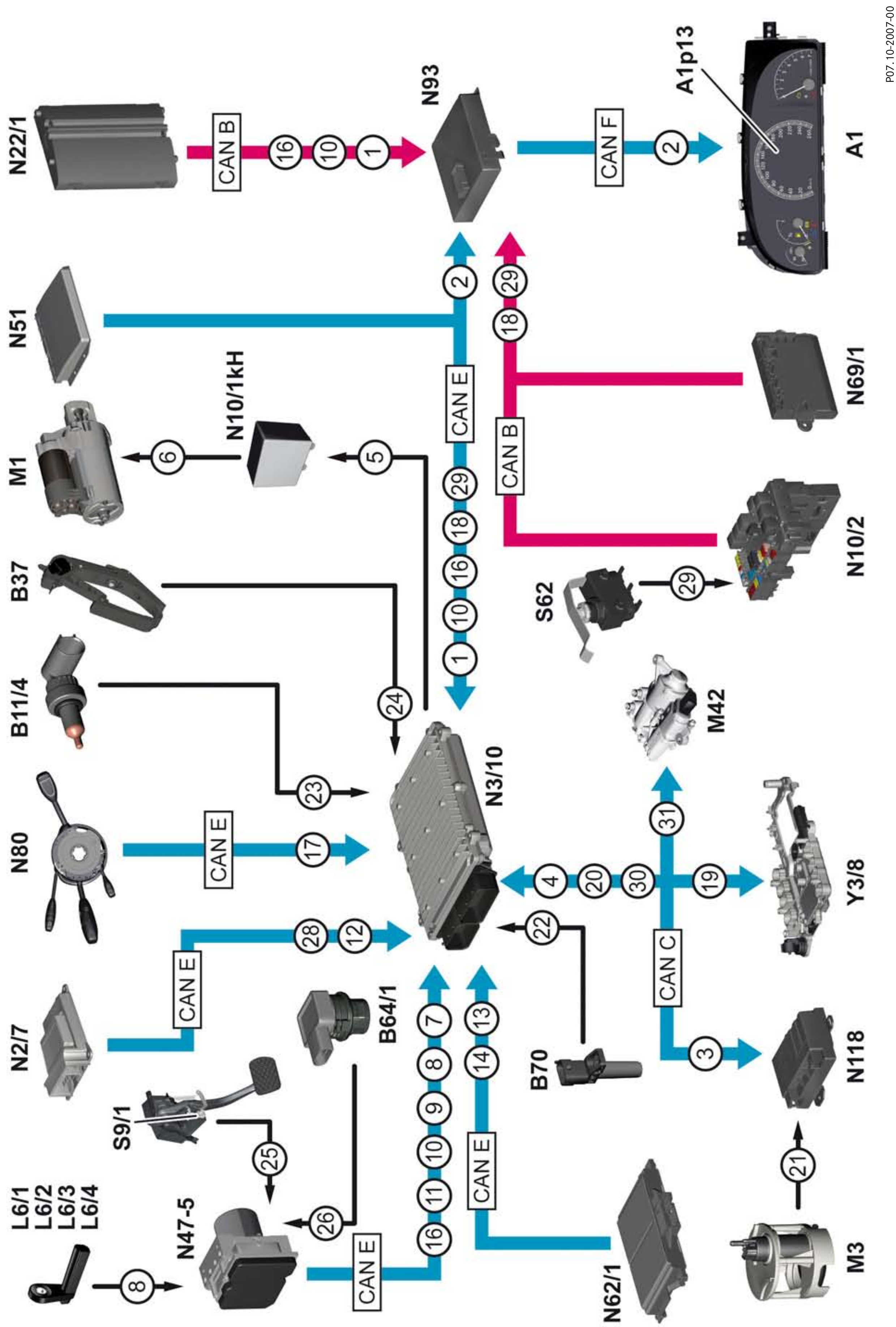
Note

In the S-Class and CL-Class the start/stop function is deactivated in the gear ranges S and M.

P54.32-8502-31

1 ECO start/stop function indicator lamp

ECO start/stop function



Function schematic of start/stop function

A1	Instrument cluster
A1p13	Multifunction display
B11/4	Coolant temperature sensor
B37	Accelerator pedal sensor
B64/1	Brake vacuum sensor
B70	Crankshaft Hall sensor
L6/1	Left front rpm sensor
L6/2	Right front rpm sensor
L6/3	Left rear rpm sensor
L6/4	Right rear rpm sensor
M1	Starter
M3	Fuel pump
M42	Electric transmission oil pump
N2/7	Restraint systems control unit
N3/10	ME-SFI [ME] control unit
N10/1kH	Circuit 50 relay, starter
N10/2	Rear SAM control unit with fuse and relay module
N22/1	AAC [KLA] control unit
N47-5	ESP control unit
N51	AIRMATIC with ADS control unit (with code (489) AIRMATIC (air suspension with continuously adjustable damping))
N62/1	Radar sensors control unit (SGR) (with code (233) DISTRONIC PLUS)
N69/1	Left front door control unit
N80	Steering column tube module
N93	Central gateway control unit
N118	Fuel system control unit

S9/1	Brake light switch
S62	ATA engine hood switch (with code (882) Interior protection)
Y3/8	Electric controller unit (VGS)
CAN B	Interior CAN
CAN C	Drive train CAN
CAN E	Chassis CAN
CAN F	Central 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	Wheel speed, signal
9	Vehicle speed, signal
10	Engine start, request
11	Engine stop enable, status
12	Crash, signal
13	Engine torque, increase request
14	Engine torque, reduction request

16	Engine stop inhibit, request
17	Steering angle sensor, signal
18	Door rotary tumbler switch, status
19	Gear range, request
20	Gear range, status
21	Fuel pump, actuation
22	Engine speed, signal
23	Coolant temperature sensor, signal
24	Accelerator pedal sensor, signal
25	Brake light switch, signal
26	Vacuum sensor, signal
28	Seat belt buckle switch, status
29	ATA engine hood switch, status
30	Stop inhibit, start request
31	Electric transmission oil pump, actuation

Brief description

General

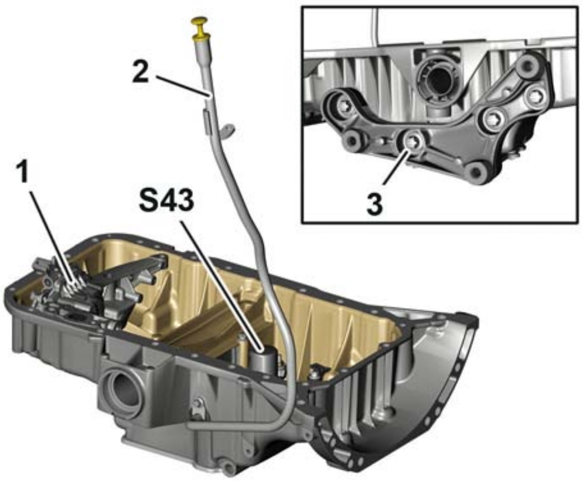
The oil pan, exhaust manifold and engine supports have been modified in order to allow the new V-engines to be used as powerplants of the 4MATIC all-wheel system.

Oil pan

The oil pan on both engines has been adapted to the demands of all-wheel drive.

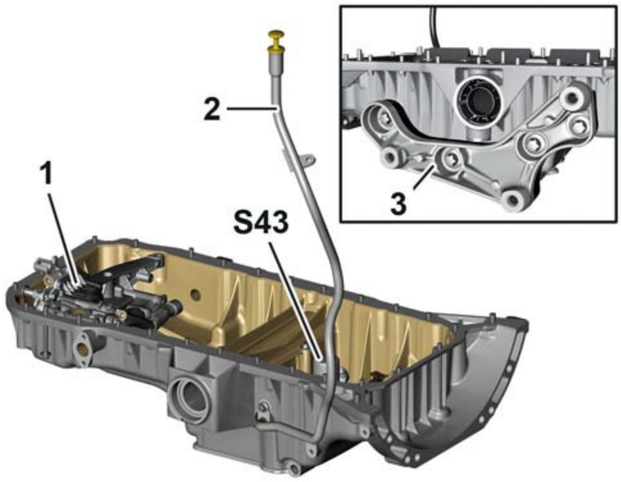
The oil sump has been relocated towards the center of the engine, and the oil level check switch and oil windage tray module with intake pipe adapted accordingly.

The upper section of the oil pan has a passage for the front left drive shaft.
A transmission support brace is located on the left side of the oil pan.



P01.45-2345-00

Oil pan, M 276 4MATIC



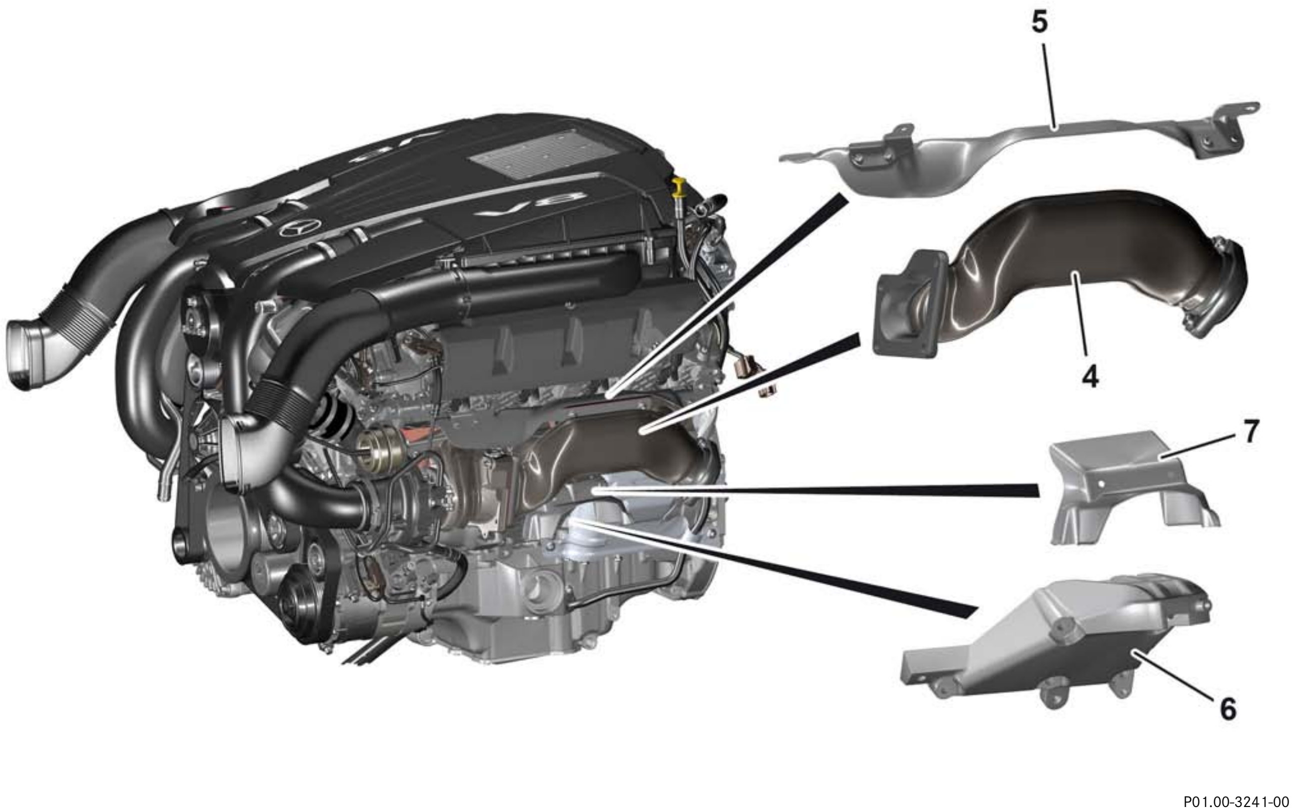
P01.45-2346-00

Oil pan, M 278 4MATIC

1 Oil pump
2 Oil dipstick
3 Transmission support brace

S43 Oil level check switch

The design of the engine supports and exhaust manifold as well as the associated shields have been adapted to suit the demands of the 4MATIC all-wheel system.



Modifications for 4MATIC *(shown on left side of 8-cylinder engine)*

4 Exhaust manifold
5 Shield
6 Engine support
7 Shield

Mechanical components

Hold-down device

Use	For holding down the camshafts when working on the engine.
MB number	W276 589 00 40 00
FG	05
Set	B
Category	Passenger Car Special Operation

P58.20-2295-00

Adapter for engine hoist

Use	For receiving the rear lifting eyes on the engine hoist.
MB number	W276 589 00 62 00
FG	01
Set	B
Category	Passenger Car Basic Operation Mandatory – approved alternative
Note	Alternatively, engine M 276 can also be removed "downwards" by using the lifting platform. To do this, the suspension subframe must be removed, which necessarily entails a wheel alignment check meaning that more time is required altogether.

P58.20-2289-00

Lifting eye

Use	For lifting the engine.
MB number	W278 589 00 40 00
FG	01
Set	B
Category	Passenger Car Basic Operation Mandatory – without exception ruling

P58.20-2294-00

Chain tensioner retainer

Use	For securing the chain tensioner pin when removing the chain tensioner.
MB number	W276 589 01 63 00
FG	05
Set	C
Category	Passenger Car Special Operation

P58.20-2290-00

Mechanical components

Assembly insert

Use	D15 and F14 assembly inserts for riveting the timing chain.
MB number	W278 589 01 63 00
FG	05
Set	C
Category	Passenger Car Special Operation

P58.20-2301-00

Connection line

Use	For high-pressure and leak testing of the fuel system.
MB number	W276 589 01 91 00
FG	07
Set	B
Category	Passenger Car Basic Operation Mandatory – without exception ruling

P58.20-2298-00

Plug

Use	For plugging the high-pressure system.
MB number	W276 589 02 91 00
FG	07
Set	B
Category	Passenger Car Basic Operation Mandatory – without exception ruling

P58.20-2299-00

Fuel system

Drift

Use	For pressing in the seal assembly of the rail.
MB number	W278 589 00 15 00
FG	07
Set	B
Category	Passenger Car Basic Operation Mandatory – without exception ruling

P58.20-2292-00

Extractor

Use	For extracting the individual injectors.
MB number	W278 589 00 33 00
FG	07
Set	B
Category	Passenger Car Basic Operation Mandatory – without exception ruling
Note	Use only in combination with impact extractor/W602 589 00 33 00.

P58.20-2293-00

4-pin adapter cable

Use	For checking the ignition coil module.
MB number	W276 589 00 63 00
FG	07
Set	B
Category	Passenger Car Basic Operation Mandatory – without exception ruling

P58.20-2296-00

Spark plug wrench

Use	For installing and removing bihex size 14 spark plugs.
MB number	W278 589 00 09 00
FG	15
Set	B
Category	Passenger Car Basic Operation Mandatory – without exception ruling

P58.20-2291-00

Air supply

Adapter

Use	For leak testing of the intake air system on engine 278.
MB number	W278 589 00 91 00
FG	09
Set	B
Category	Passenger Car Basic Operation Mandatory – approved for cooperation
Note	Use only in combination with leak tester/ W611 589 02 21 00.

P58.20-2300-00

Adapter

Use	For leak testing of the intake air system on engine 276.
MB number	W276 589 00 91 00
FG	09
Set	B
Category	Passenger Car Basic Operation Mandatory – approved for cooperation
Note	Use only in combination with leak tester/ W611 589 02 21 00.

P58.20-2297-00

Abbreviations

ABC

Active Body Control

ADS

Adaptive damping system

ATL

Turbocharger

CAN

Controller Area Network

DE

Direct injection (DI)

DEH

Direct injection, homogeneous combustion

DES

Direct injection, stratified combustion

EDW

Anti-theft alarm system (ATA)

EOBD

European On-Board-Diagnosis

ESP

Electronic Stability Program

EU 4

Euro 4 standard (exhaust emission regulation)

EU 5

Euro 5 standard (exhaust emission regulation)

EZS

Electronic ignition switch

HOS

Homogeneous stratified combustion

KE

Port injection

KLA

Automatic air conditioning (AAC)

LEV

Low Emission Vehicle

LIN

Local interconnect network

ME

Motor electronics (ME-SFI)

NOx

Nitrogen oxide

OBD

On-board diagnosis

PWM

Pulse width modulated

ROZ

Research octane number (RON)

SAM

Signal acquisition and actuation module

SGR

Radar sensors control unit

ULEV

Ultra Low Emission Vehicle

VGS

Fully integrated transmission control

WIS

Workshop Information System

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