



# Introduction of the New Generation of V-Engines 8-cylinder M 157 AMG

Introduction into Service Manual



Mercedes-Benz

# Introduction of the New Generation of V-Engines 8-cylinder M 157 AMG

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Dear reader,

This Introduction into Service Manual presents the new 8-cylinder V-engine M 157 from Mercedes-AMG in combination with the vehicle model series 216/221.

The purpose of this brochure is to acquaint you with the technical highlights of this new engine in advance of its market launch. This brochure is intended to provide information for people employed in service or maintenance/repair as well as for aftersales staff. It is assumed that the reader is already familiar with the engines in the various Mercedes-Benz and Mercedes-AMG 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 in Xentry Diagnostics.

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

This Introduction into Service manual presents initial information relating to the new engine 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 August 2010, actual production vehicles may incorporate revisions and design changes based on differing technical specifications.

Daimler AG

Technical Information  
and Workshop Equipment (GSP/OI)

## Highlights

From autumn 2010 onwards Mercedes-AMG will be gradually introducing the new generation of V-engines starting with the S-Class (model 221) and the CL-Class (model 216).

This new engine with the model designation M 157 is uncompromisingly based on modularization and technological development. It replaces the successful engine model M 156 in the S-Class and CL-Class.

The new AMG 5.5-liter biturbo engine combines performance with efficiency. This is made possible by the combination of high-tech systems such as gasoline direct injection, biturbocharging with air/water charge air cooler and the Controlled Efficiency stop/start system in conjunction with the alternator management system and the AMG MCT 7-speed sport transmission at close intervals.

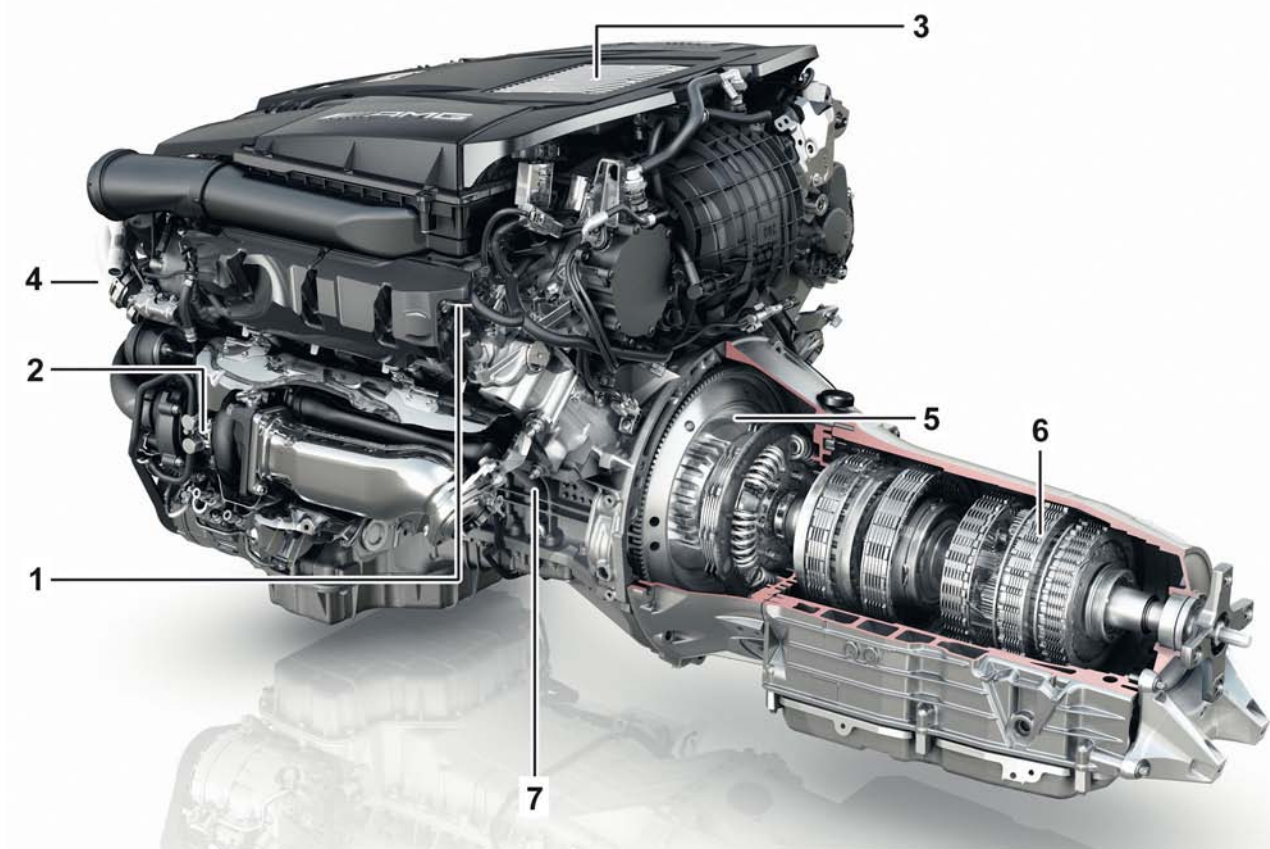
The new direct injection system combines an extremely fast and accurate piezo injector with a new, jet-guided combustion system. The short switching times of the piezo injector allow multiple injections with short pauses during a single combustion cycle.

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 prominent features of the AMG V8 biturbo engine M157 at a glance:

- Gasoline direct injection with piezo injectors and jet-guided combustion
- Fully variable injection pressure from 100 to 200 bar
- Biturbocharging with air/water charge air cooling
- Turbocharger with wastegate valve
- Reduced-vibration belt drive with dual-chamber viscous damper
- Motor electronics with Controlled Efficiency stop/start function and alternator management
- Full aluminum crankcase with pulsation bores
- Three-piece chain drive
- Forged crankshaft made of high-quality alloy steel
- Innovative cast pistons
- Continuous camshaft adjustment on the intake and exhaust sides
- Two exhaust valves and two intake valves per cylinder
- Roller cam followers
- Hollow stem exhaust valves with sodium filling
- On-demand control of the oil and cooling circuits





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### AMG V8 biturbo engine M 157

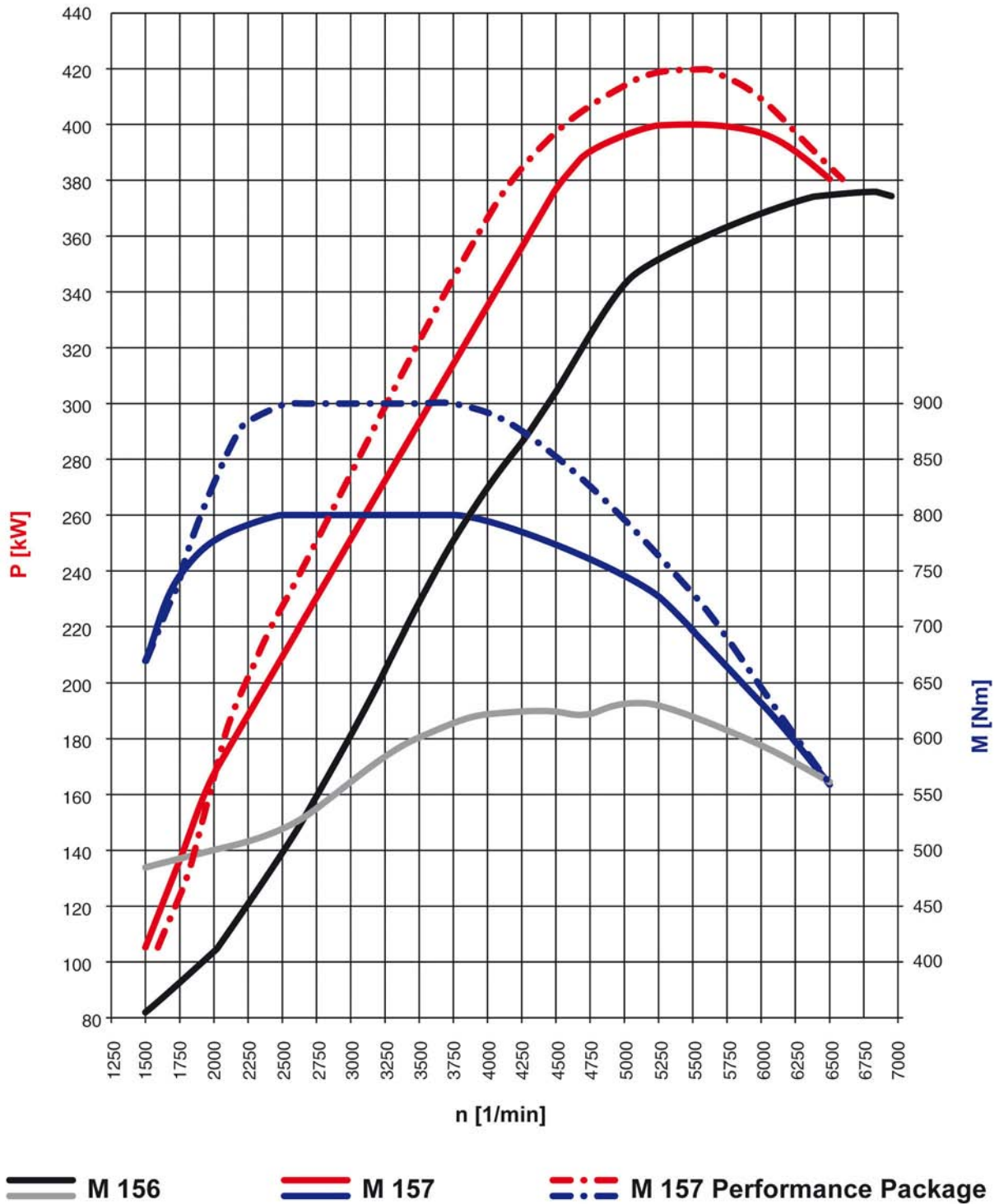
- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>1 Jet-guided gasoline direct injection with piezo injectors</li> <li>2 Biturbocharging with air/water charge air cooling</li> <li>3 High-performance motor electronics with stop/start function and alternator management</li> <li>4 Continuous camshaft adjustment on the intake and exhaust sides</li> </ul> | <ul style="list-style-type: none"> <li>5 Wet start-up clutch</li> <li>6 AMG SPEEDSHIFT MCT 7-speed sport transmission</li> <li>7 Full aluminum crankcase with ventilation bores to reduce friction</li> </ul> |
|---|---|



## Engine data comparison M 156 - M 157

		M 156	M 157
Cylinder configuration/angle		V8/90°	V8/90°
Rated output at engine speed	kW rpm	386 6800	400/420 <sup>1)</sup> 5500
Rated torque at engine speed	Nm rpm	630 5200	800/900 <sup>1)</sup> 2500-3750
Displacement	cm <sup>3</sup>	6208	5461
Bore	mm	102.2	98
Stroke	mm	94.6	90.5
Cylinder spacing	mm	109	106
Compression ratio $\epsilon$		11.3	10.0
Connecting rod length	mm	145.6	146.5
Piston compression height	mm	29.5	30.1
Forced induction		–	2 turbochargers
Turbocharger control		–	Wastegate
Boost pressure (absolute)	bar	–	1.0/1.3 <sup>1)</sup>
Oil change quantity (with filter)	l	9.0	8.5
Fuel type		Super Plus 98 RON	
Engine weight DIN 70020 GZ	kg	223	220
Emissions regulation ECE/USA		Euro 4/LEV 2	Euro 5/ULEV II
<sup>1)</sup> Performance Package			





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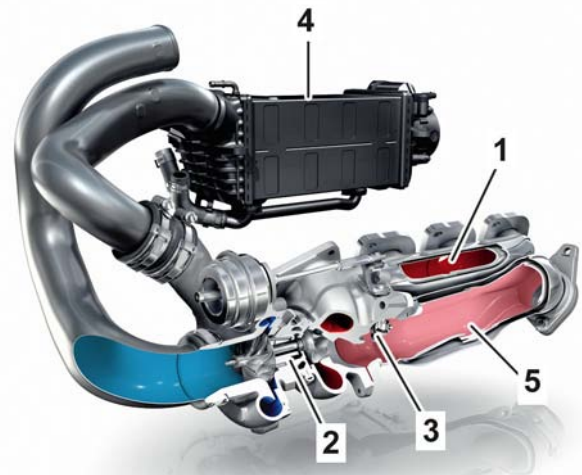
Torque and power curve, M 156 and M 157

## CO2 measures

The principal measures aimed at reducing CO<sub>2</sub> emissions are the turbocharging, which enables a significant power and torque increase with a reduced displacement, the piezo direct injection system and the stop/start function coupled with the second-generation Controlled Efficiency system including alternator management.

The components of the systems are described in detail in subsequent chapters.

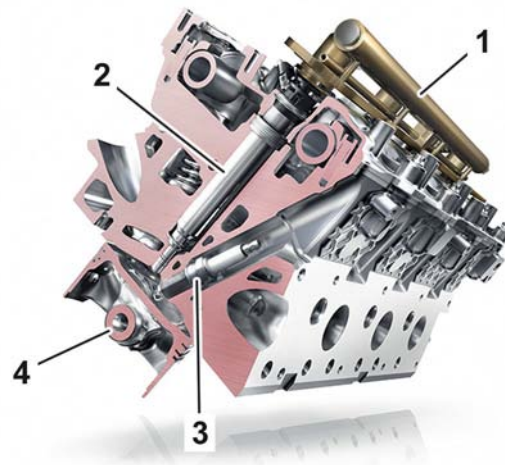
Measures have also been implemented for thermal management and on-demand oil pressure regulation by means of a controllable oil pressure pump.



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### **Turbocharging**

- 1 Exhaust manifold
- 2 Turbocharger
- 3 Wastegate
- 4 Air/water charge air cooler
- 5 Exhaust pipe



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### **Piezo direct injection**

- 1 Fuel rail
- 2 Fuel injector
- 3 Spark plug
- 4 Piston

**M 157**

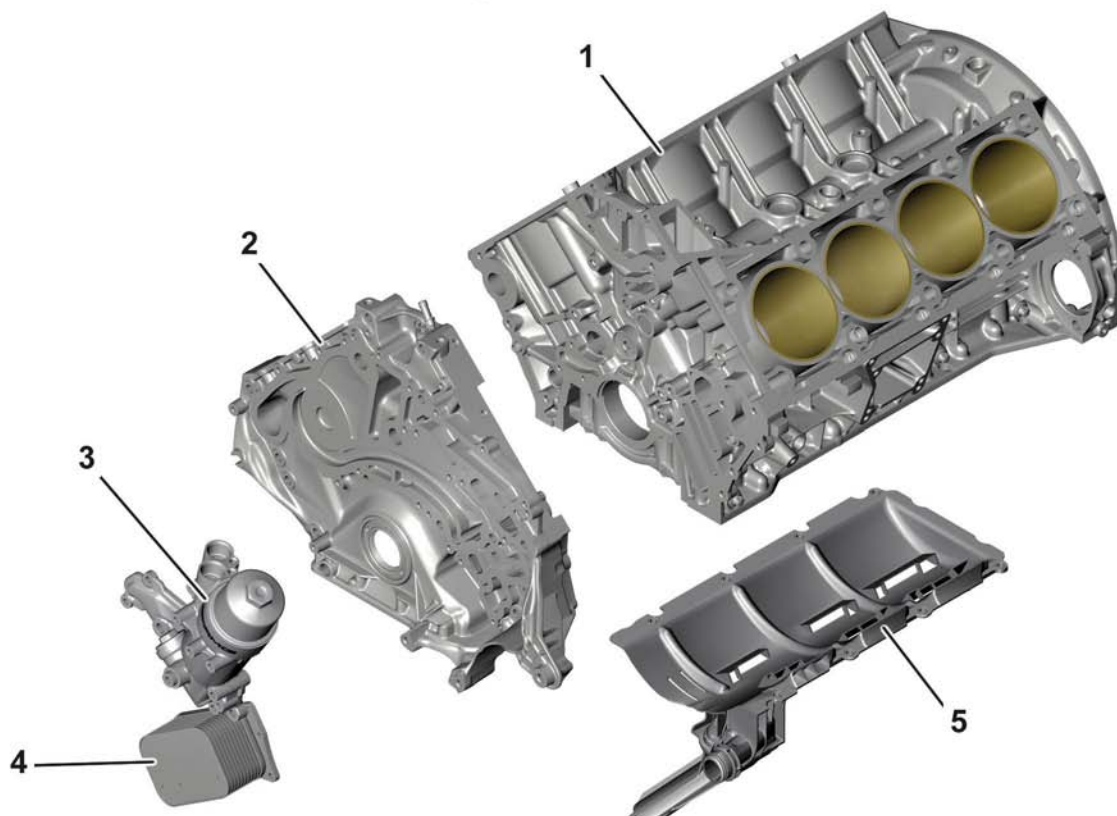
A die-cast aluminum crankcase with Silitec cylinder liners is used in the new AMG engine.

In comparison with the M 156 the bore has been changed from 102.2 to 98.0 mm and the cylinder spacing shortened from 109 to 106 mm. The compression ratio  $\epsilon$  is 10.0.

A variety of media-carrying ducts and lines (pressurized oil, coolant, air, oil return) is integrated in the crankcase and the timing case. The crankcase is a long-skirt design, with individually mountable main bearing caps made of cast steel.

**Note**

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



- 1 Crankcase
- 2 Timing case cover
- 3 Oil filter housing with oil filter

- 4 Oil-water heat exchanger
- 5 Oil suction pipe with oil deflector

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# Crankcase

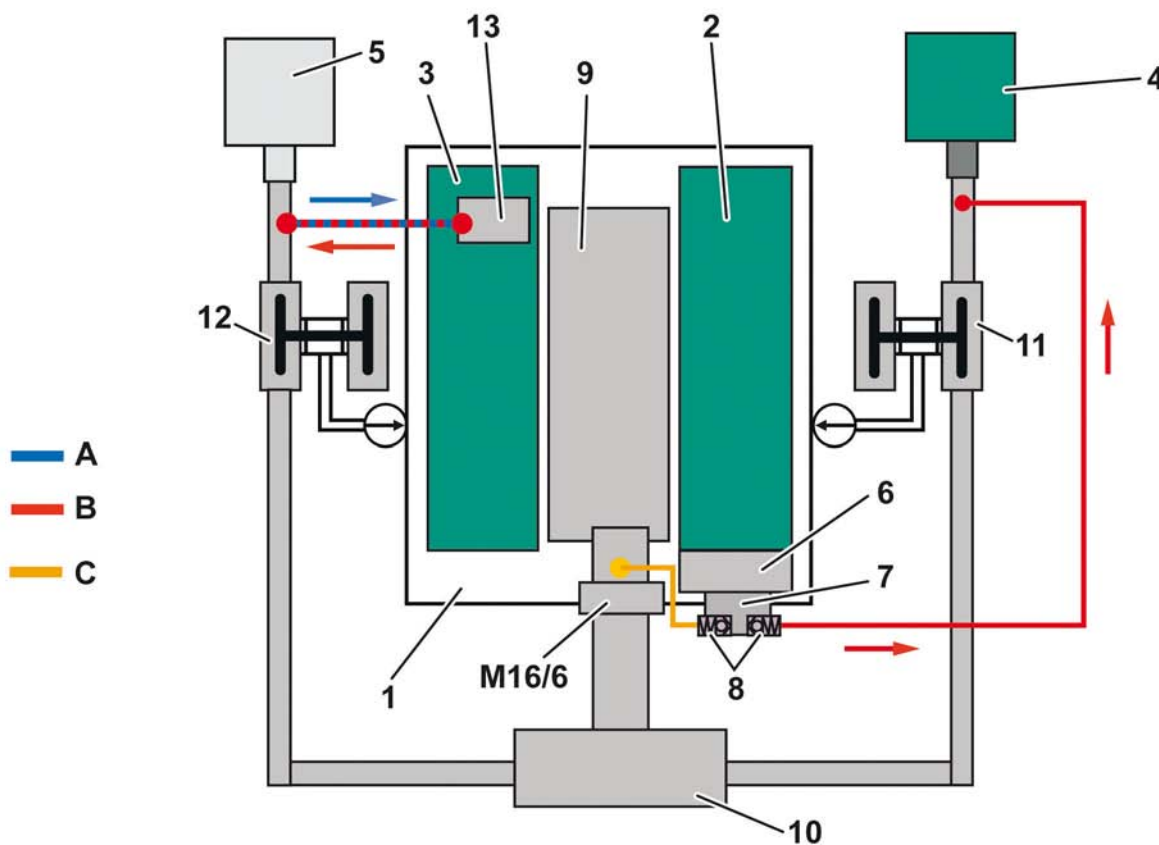
## Engine ventilation, M 157

The ventilation and venting systems of engine M 157 consist of 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 M 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.



- 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

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The oil pan is designed as a front or rear sump, depending on the model series. The top and bottom sections of the oil pan are made of die-cast aluminum.

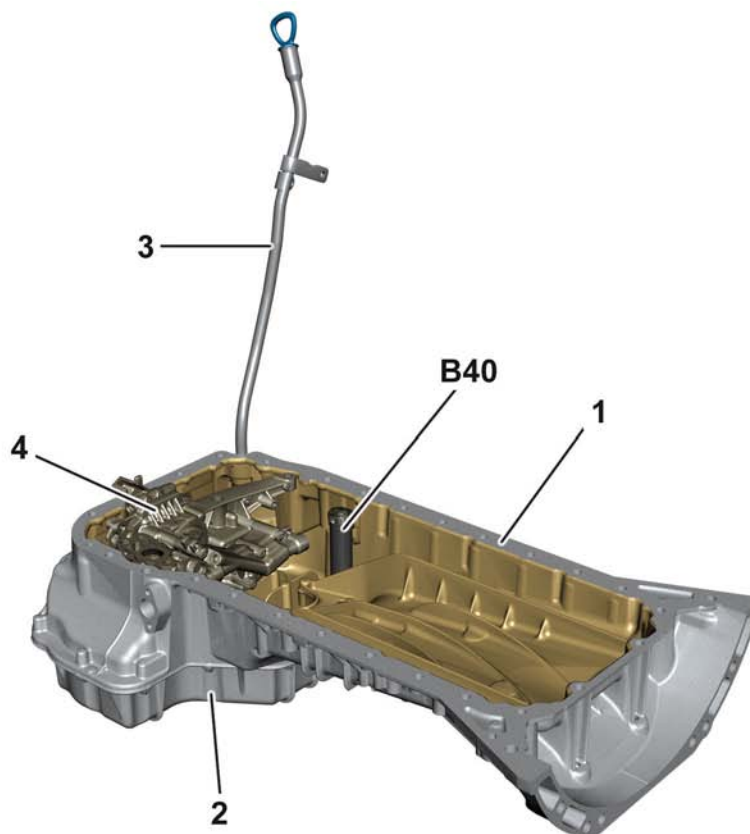
### Oil sensor

A new-generation oil sensor is used, which is installed in the oil pan bottom section. The oil sensor senses the oil level (capacitive) and the oil temperature (by means of a temperature sensor). The measured values are digitally conditioned and transmitted to the engine control unit.

In the internal electronics the measured values are conditioned and are then forwarded via a serial digital LIN interface to the engine control unit. The transmitted values can be used by the engine control directly.

The advantages of the sensor are:

- Oil level and oil temperature are registered
- On-demand oil change intervals (optional)
- Detection of gradual and rapid oil loss



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### Oil pan

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

B40 Oil sensor

## Crank assembly

Engine M 157 features a new piston designed to withstand extremely high loads.

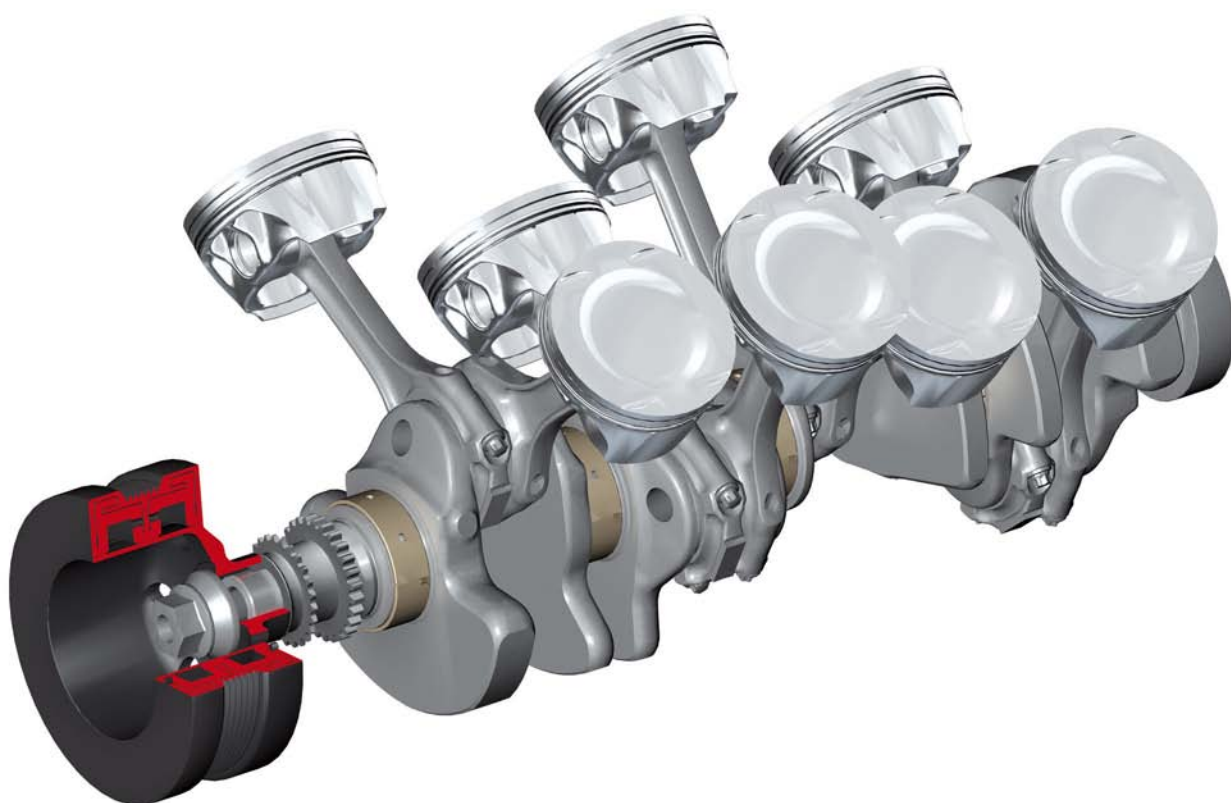
Its special feature is that, despite the very high lateral forces acting on the pistons (resulting from the peak pressure and optimum combustion center of gravity), the stem area is extremely narrow, which provides an additional weight benefit. This is achieved through the use of closely arranged, oblique box walls.

The advantage of this design is that it reduces friction losses. The piston rings have also been adapted to cope with the high loads.

The 1st ring features a DLC coating (DLC= diamond-like carbon) as is used in motor racing. The 2nd ring is a high-grade casting with an additional thin chrome plating. The oil scraper ring is a two-piece casting with chrome-plated lands and convex lapping.

The rings selected guarantee optimum wear behavior and significant reductions in friction.

The piston rings have been optimized to keep the blow-by gases and oil consumption at low levels at high peak and mean pressures.



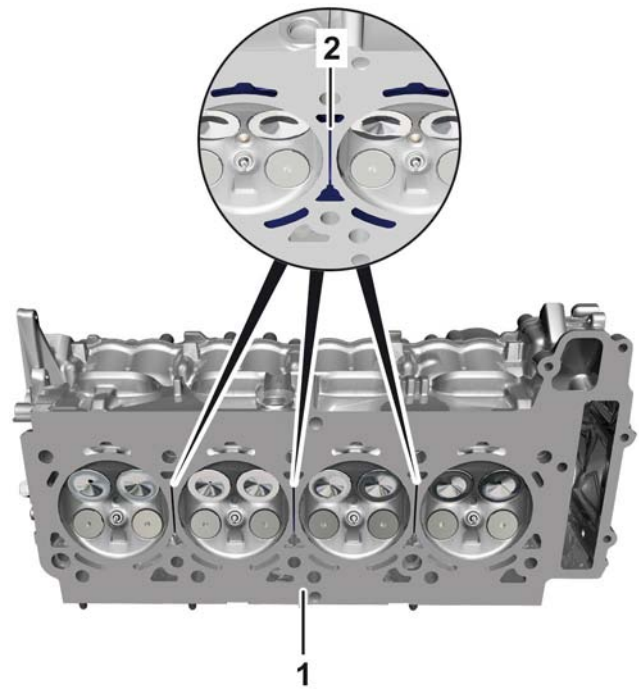
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*Crank assembly with vibration damper*

The cylinder head houses the double overhead camshafts (DOHC). The camshafts are constructed, i.e. they consist of an IHPF-formed steel tube with joined cams, and are extremely light (IHPF = internal high-pressure forming).

Each cylinder has four valves. The valves are controlled by roller cam followers with hydraulic valve clearance compensation.

Due to the extreme thermal parameters of the combustion chamber, the heat transfer at the roof of the chamber has been optimized. The flow was optimized by designing the water jacket in two parts and a cooling slot has been added between the cylinders in the cylinder head.



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### Left cylinder head

- 1 Cylinder head
- 2 Cooling slot

### **i** Note

In the M 157 **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

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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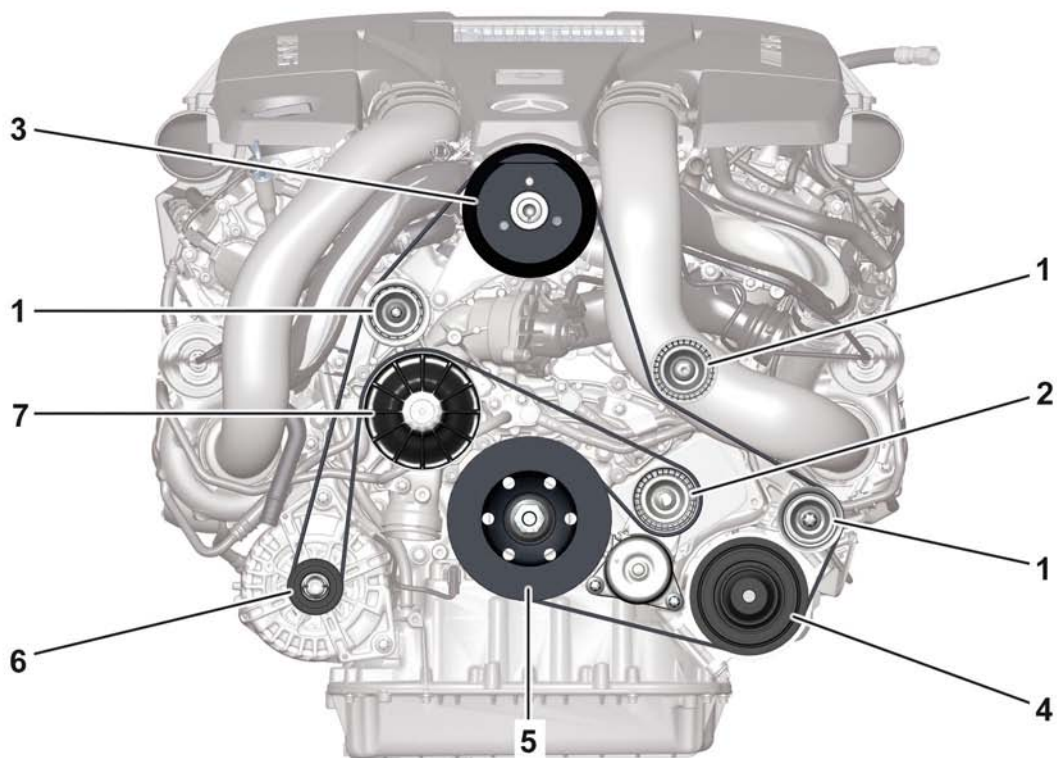
### Cylinder heads

- 3 Roller cam follower



## Belt drive

The belt drive system drives the ancillary assemblies of coolant pump, alternator, ABC pump and refrigerant compressor. Because of the high dynamic requirements of the AMG MCT 7-speed sport transmission with its very short shift times, the belt pulley of the alternator is equipped with a freewheel. The use of the dual-chamber viscous damper as a torsional vibration damper has made it possible to reduce the combustion-induced torsional vibrations towards the transmission input end to a minimum.



### Overview of belt drive

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- |                                       |   |
|---------------------------------------|---|
| 1 Guide pulley                        | 5 Belt pulley, crankshaft with vibration damper |
| 2 Belt tensioner                      | 6 Belt pulley, alternator with freewheel        |
| 3 Belt pulley, ABC pump               | 7 Belt pulley, coolant pump                     |
| 4 Belt pulley, refrigerant compressor |   |

### Chain drive

The M 157 features an entirely new two-stage chain drive system with three gear chains. The design of the chain drive therefore fulfills the goals of good acoustics, low chain friction and a long service life coupled with very compact construction.

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

**Primary drive:** Crankshaft intermediate gear

Gear ratio: 1:1.33

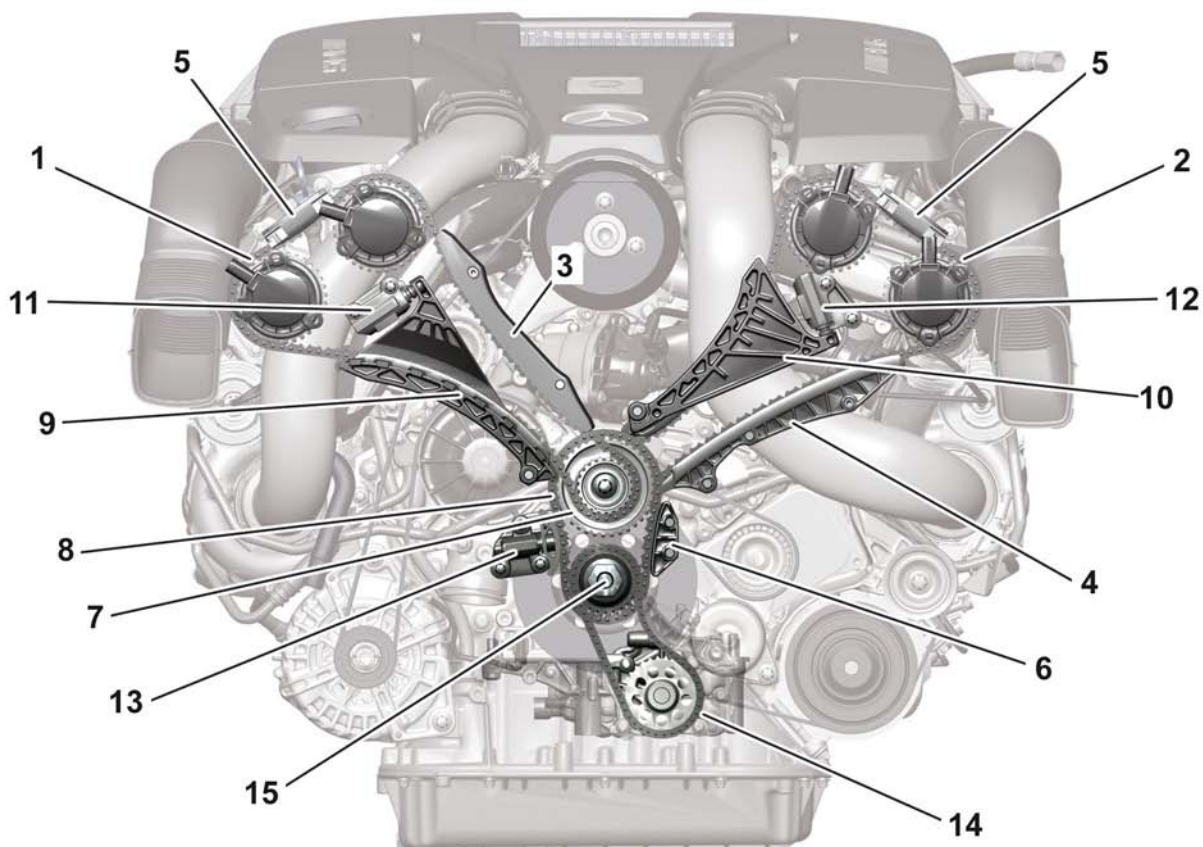
**Secondary drive:** Camshaft intermediate gear

Gear ratio: 1:1.5

The chain slide and tensioning rails are lightweight aluminum structures optimally designed for the available 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 minimizing friction power.

## Chain drive and camshaft adjustment



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### Chain drive

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

## Camshaft adjustment

A major consideration in terms of space requirements and also of weight optimization is the use 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 features are:

- Very fast adjustment rate
- Ready to operate at minimal oil pressure
- Optimized in terms of weight and package

A steel design was selected 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. The camshaft adjustment therefore meets the demands of combustion control to achieve an optimum engine torque curve and the required exhaust characteristics.

### Adjustment range

Exhaust closes at 25° CKA before TDC (top dead center) to 15° CKA after TDC

Intake opens at 4° CKA before TDC to 36° CKA after TDC

### Start position

Exhaust closes at 25° CKA before TDC

Intake opens at 36° CKA after 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.

To adjust the camshafts, the engine control unit reads the values of the following sensors:

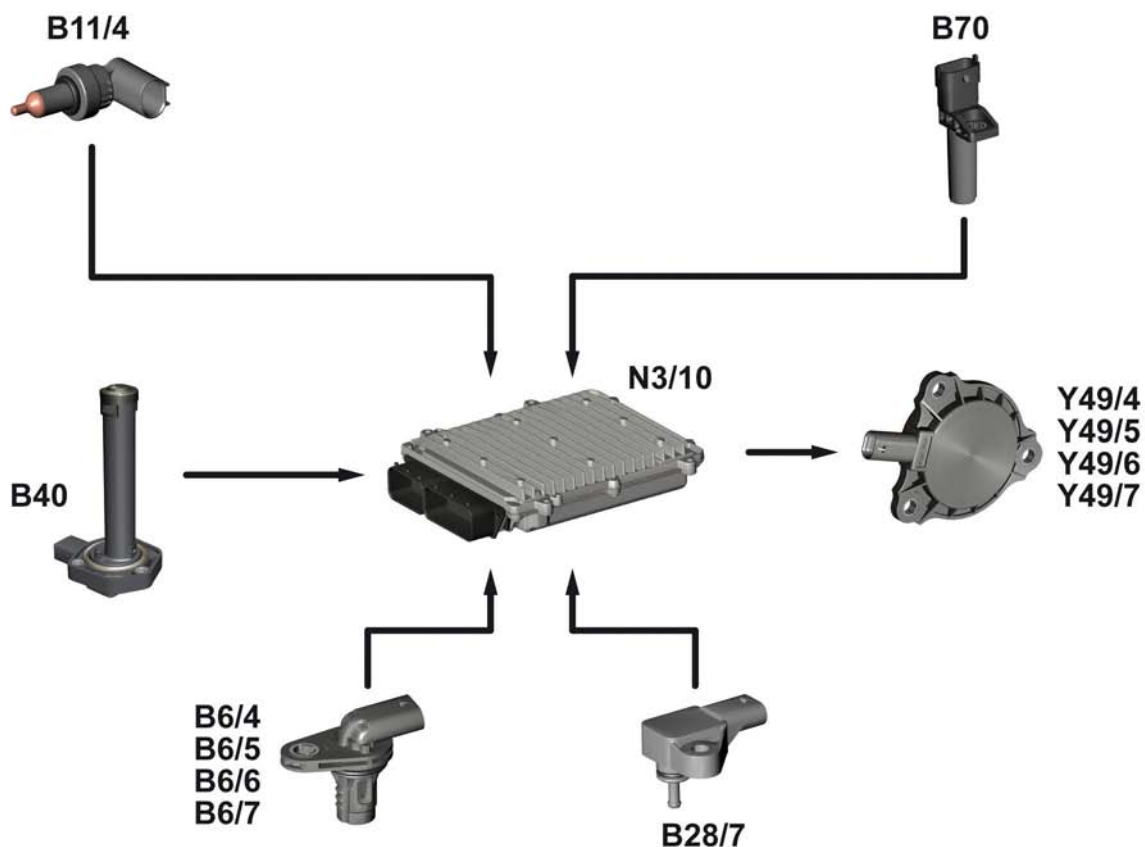
- Intake camshaft Hall sensors, left and right, intake camshaft positions
- Exhaust camshaft Hall sensors, left and right, exhaust camshaft positions
- Coolant temperature sensor
- Pressure sensor downstream of throttle valve actuator, engine load
- Crankshaft Hall sensor, engine rpm

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

In addition to the measurement provided by the oil sensor, the engine oil temperature is redundantly calculated by the engine control unit 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.

## Chain drive and camshaft adjustment



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### Function schematic of camshaft adjustment

- |              |  |              |   |
|--------------|--|--------------|---|
| <i>B6/4</i>  | <i>Intake camshaft Hall sensor, left</i>                     | <i>B70</i>   | <i>Crankshaft Hall sensor</i>           |
| <i>B6/5</i>  | <i>Intake camshaft Hall sensor, right</i>                    | <i>N3/10</i> | <i>ME-SFI [ME] control unit</i>         |
| <i>B6/6</i>  | <i>Exhaust camshaft Hall sensor, left</i>                    | <i>Y49/4</i> | <i>Intake camshaft solenoid, left</i>   |
| <i>B6/7</i>  | <i>Exhaust camshaft Hall sensor, right</i>                   | <i>Y49/5</i> | <i>Intake camshaft solenoid, right</i>  |
| <i>B11/4</i> | <i>Coolant temperature sensor</i>                            | <i>Y49/6</i> | <i>Exhaust camshaft solenoid, left</i>  |
| <i>B28/7</i> | <i>Pressure sensor downstream of throttle valve actuator</i> | <i>Y49/7</i> | <i>Exhaust camshaft solenoid, right</i> |
| <i>B40</i>   | <i>Oil sensor</i>  |              |   |

## Turbocharging

Engine M 157 is turbocharged. Each of the two exhaust manifolds is fitted with a turbocharger, which is driven by the thermal and kinetic energy contained in the exhaust gas from the associated cylinder bank.

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 in an air gap-insulated, welded exhaust manifold and an exhaust pipe downstream of the turbocharger. The low thermal losses guarantee the rapid response of the catalytic converters.

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 M 157 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 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 directly into the exhaust pipe by opening the wastegates.

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 engine control unit according to a performance map and according to load. To do this, the engine control unit evaluates the signals of 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 contrast to the pressurized systems frequently 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.

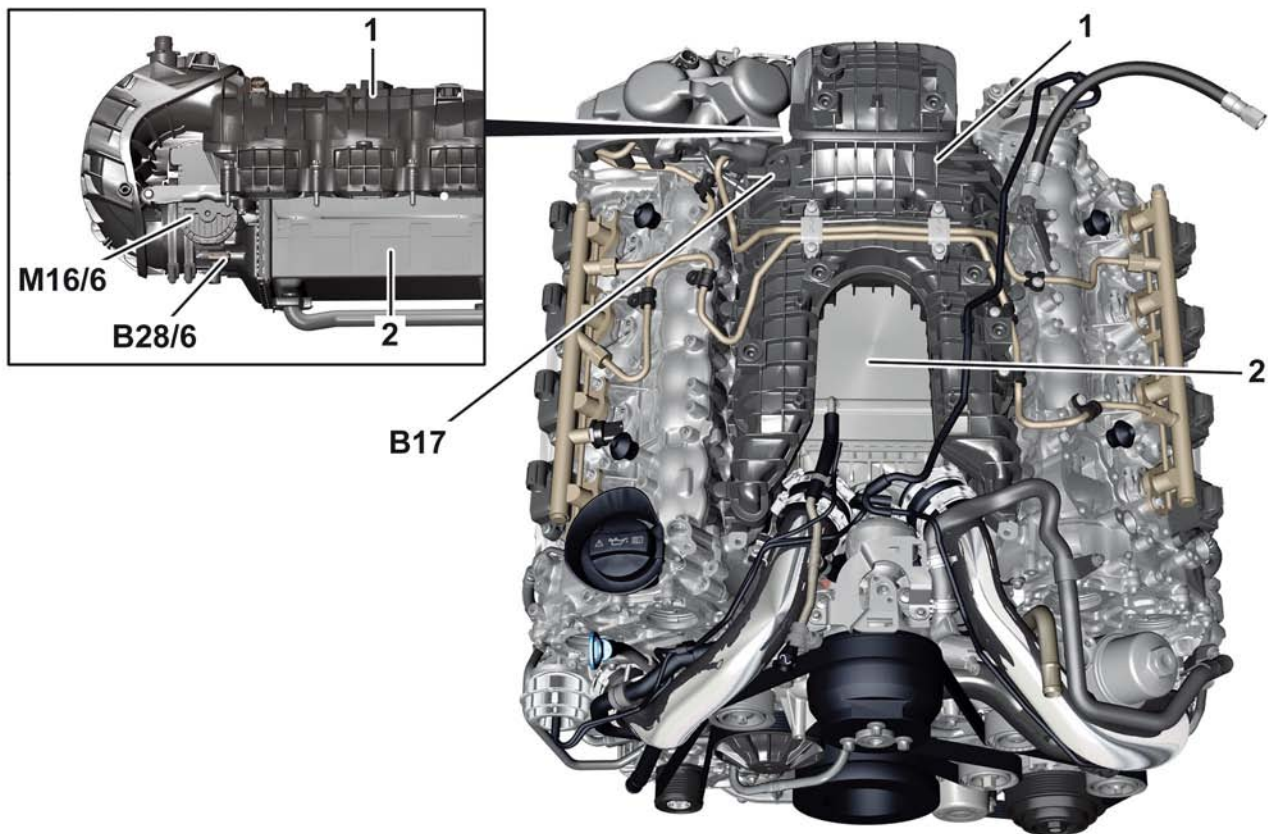
## Forced induction

In this way the boost pressure of max. 1.0 bar (1.3 bar in engines with Performance Package) relative to the environment 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 engine control unit.

The pressure sensors downstream of the air filter are used by the engine 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 engine control unit in the form of a voltage signal.



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### Charge air cooler and charge air distributor

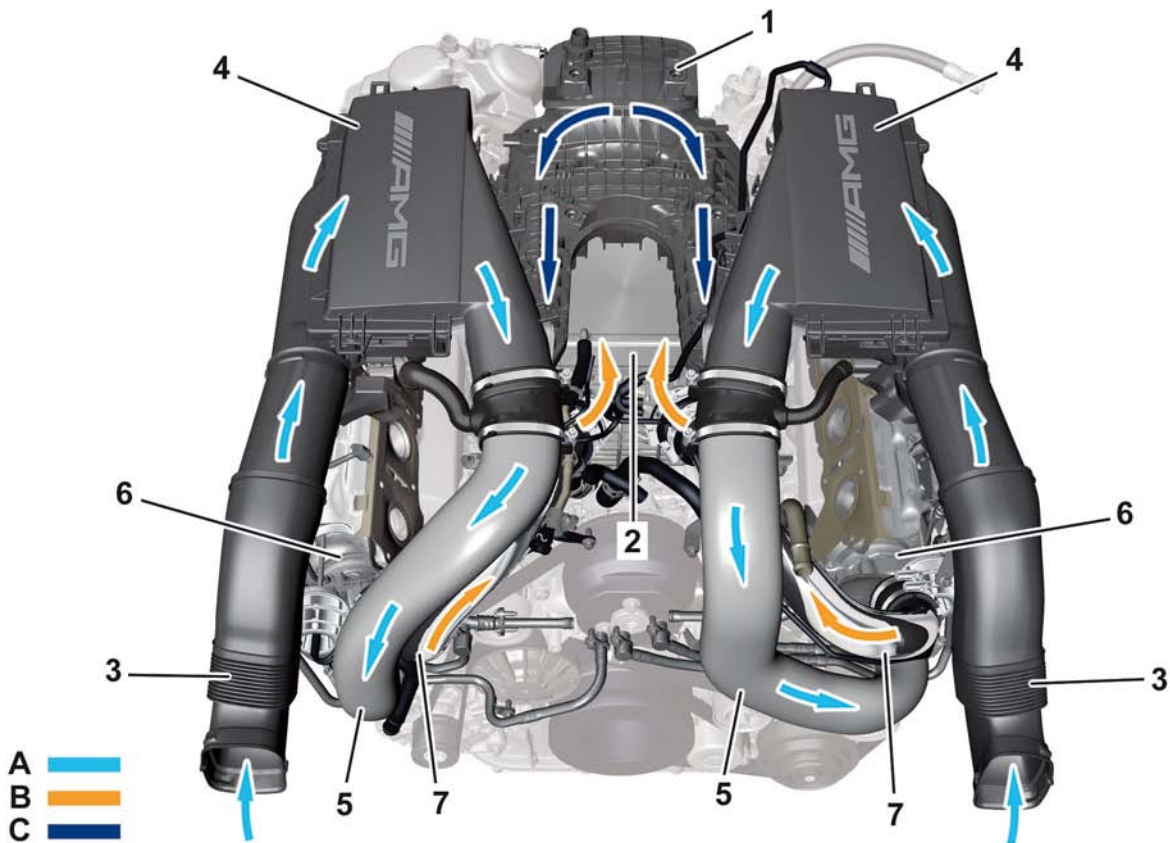
*B17 Intake air temperature sensor*

*B28/6 Pressure sensor upstream of throttle valve actuator*

*M16/6 Throttle valve actuator*

*1 Charge air distributor*

*2 Charge air cooler*



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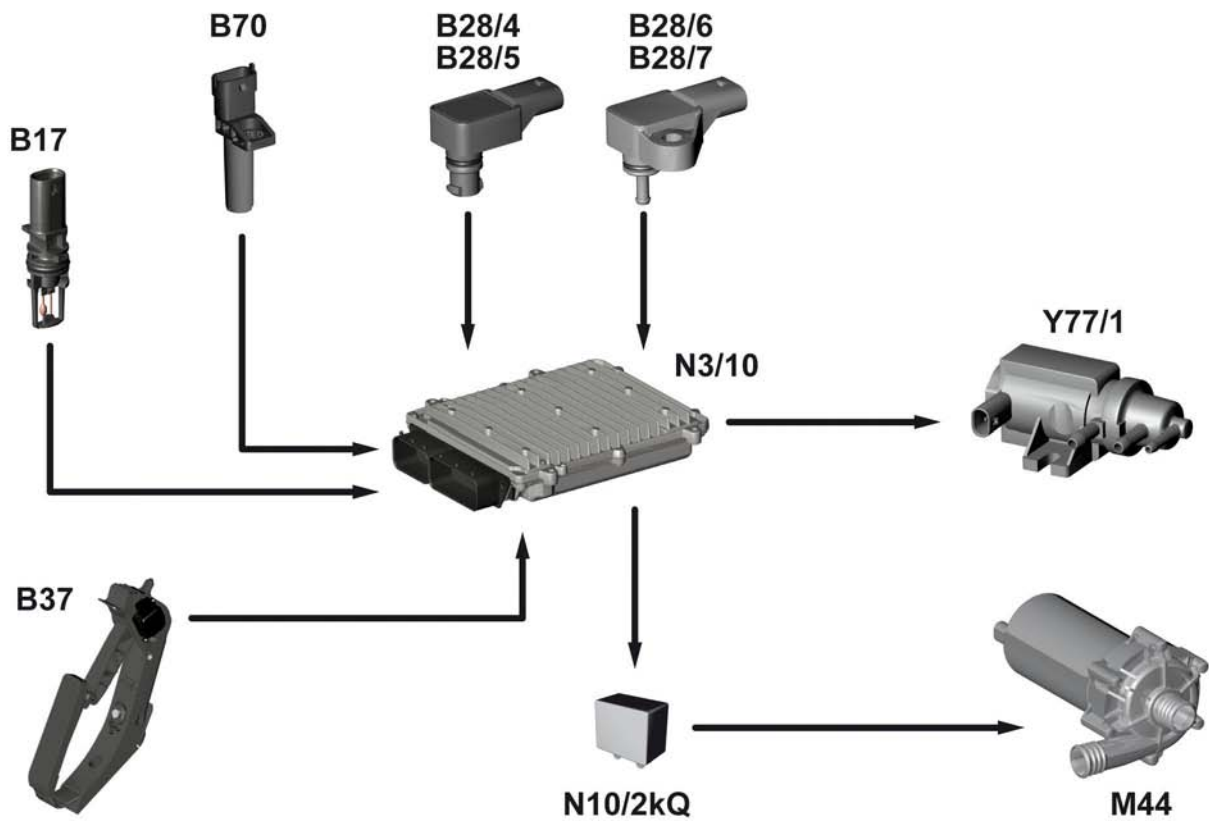
**Flow pattern of intake air/charge air**

- 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



P09.00-2109-00

### Function schematic of forced induction

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

## Charge air cooling

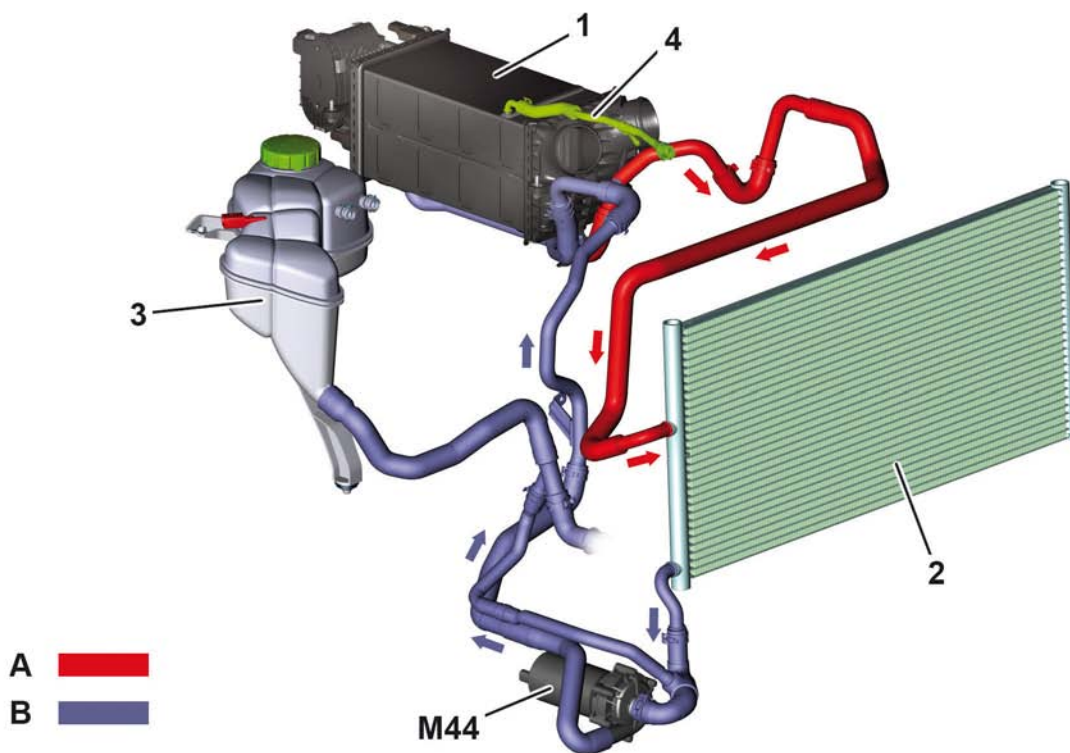
The charge air cooling system keeps the charge air temperature at  $<70\text{ }^{\circ}\text{C}$ . The air cooled in the charge air coolers has a higher density. This increases the cylinder charge and thus the engine power. The tendency to knock is decreased. In addition, the lower exhaust temperatures 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  $> 45\text{ }^{\circ}\text{C}$ , the charge air cooler circulation pump is actuated by the engine control unit via the circulation pump relay.

When the charge air temperature drops below  $40\text{ }^{\circ}\text{C}$ , 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 engine control unit via a voltage signal.



P09.41-2590-00

### 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

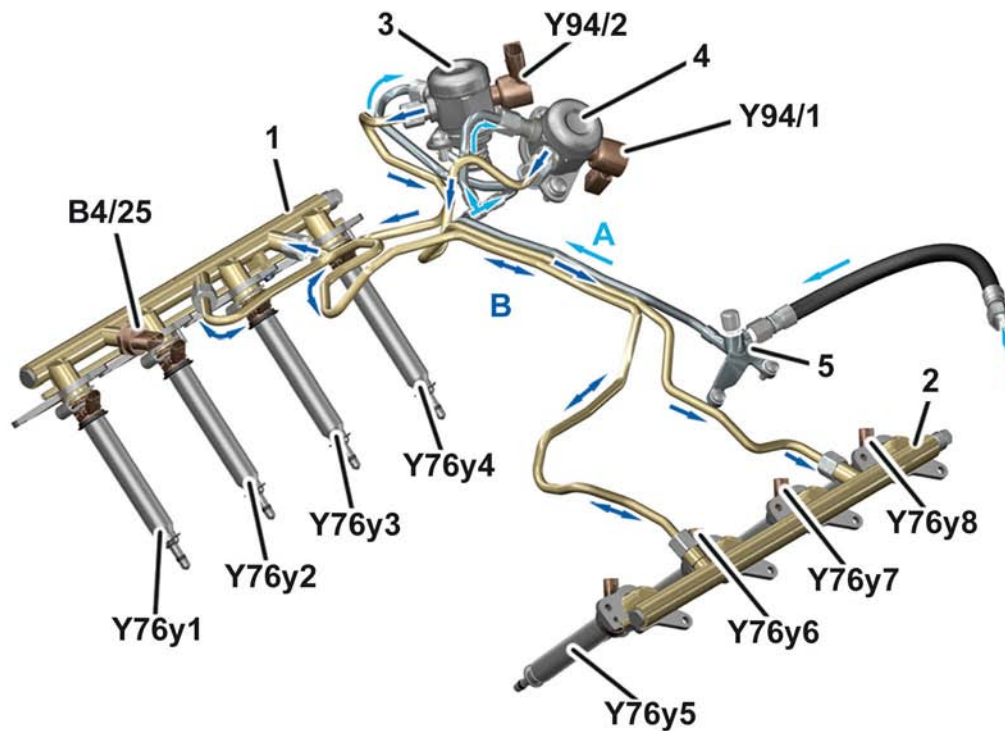
## Direct injection

Engine M 157 features the third generation of direct injection (jet-guided).

The system is now a non-return high-pressure supply with two separate rails. The high pressure is supplied by two separate pumps. The high-pressure pumps are located at the rear end of the right intake camshaft and are actuated by four cams.

The supply pressure can be regulated according to the operating mode and lies between 100 and 200 bar.

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



P07.00-2151-00

### Injection system

- 1 Right rail
- 2 Left rail
- 3 Right high-pressure pump
- 4 Left high-pressure pump
- 5 Pressure gauge connection with service valve
- A Fuel low pressure
- B 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
- Y94/1 Left quantity control valve
- Y94/2 Right quantity control valve



## Fuel injectors

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

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

The fuel feed is sealed on the high-pressure side with an O-ring at the rail. 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. Even under high fuel pressure, the outwardly opening nozzle forms a hollow cone jet that is stable under all operating conditions.

The engine 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 engine control unit. When opening, a current of approx. 8 A flows for a few microseconds. To open and close, the engine control unit reverses the polarity.

### Note on diagnosis

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

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

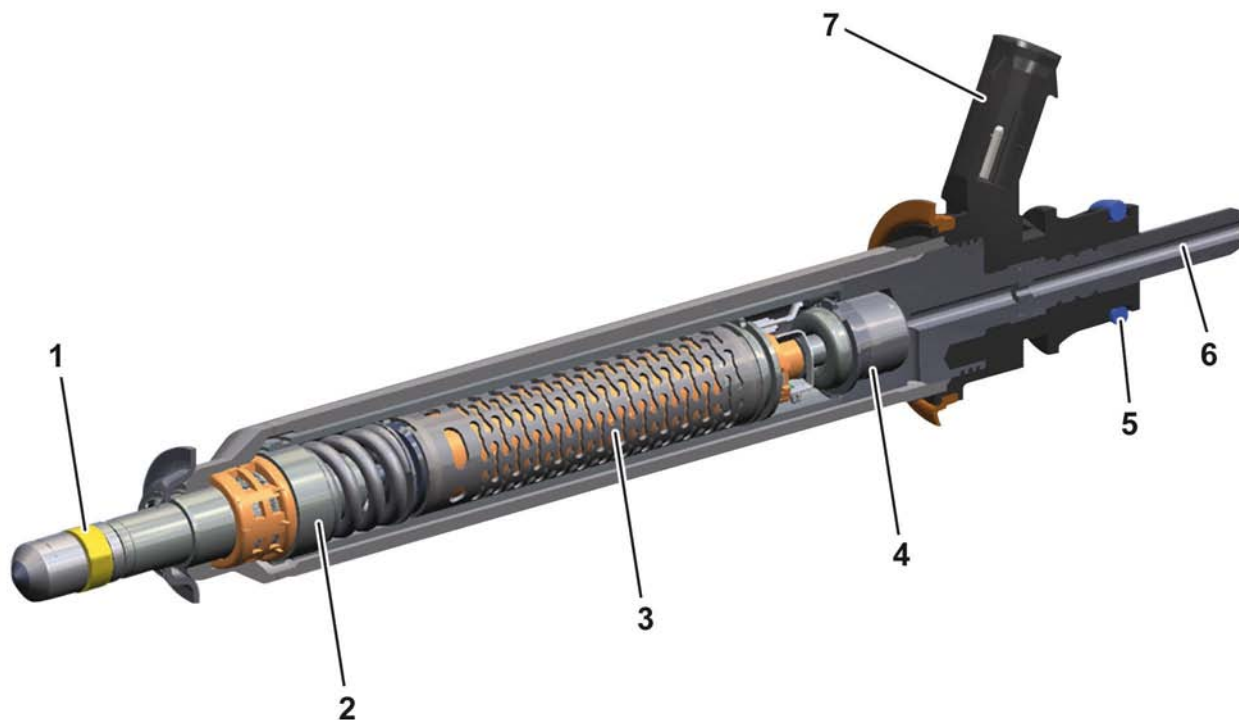
### Warning

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

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

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

## Injection system



P07.03-2282-00

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

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

#### **i** 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 157 is soldered!

#### **i** Note on cleanliness

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

## Fuel 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 engine 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 engine 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 two high-pressure pumps.

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

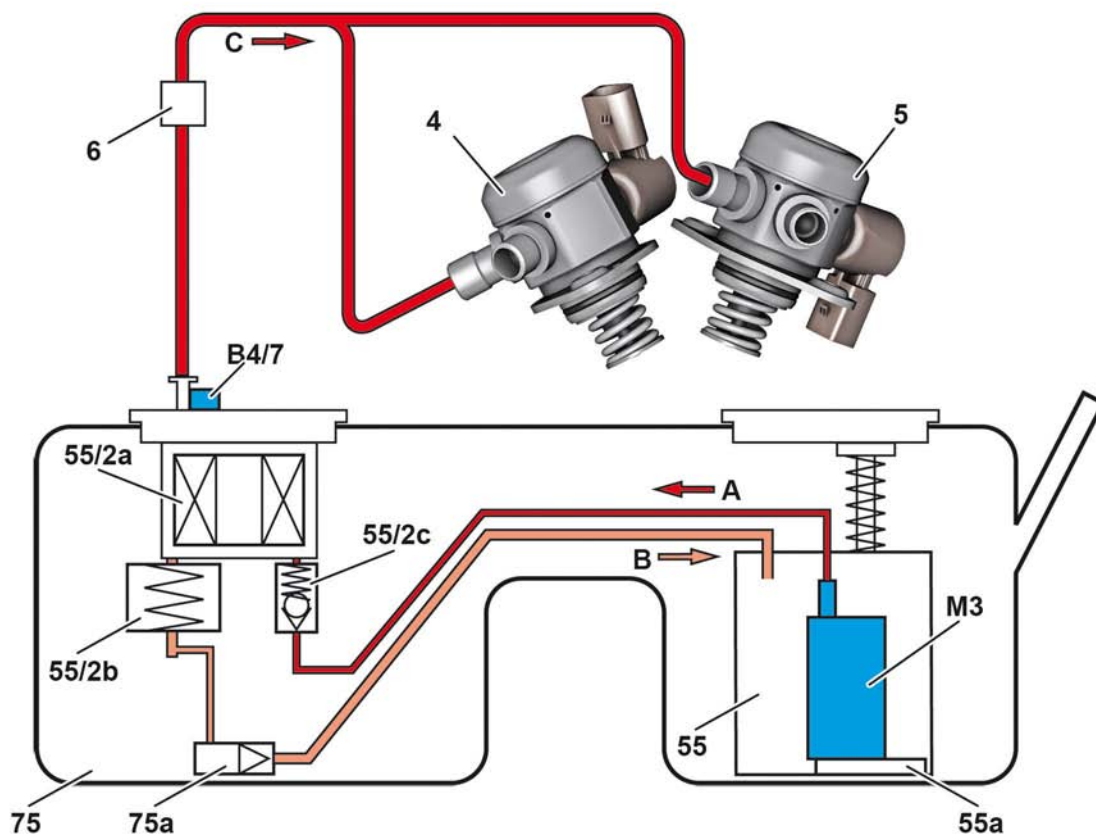
In the fuel high-pressure system the high fuel pressure necessary for the spray-guided direct injection is generated, regulated and held in the rails.

To regulate the fuel high pressure, the control unit scans the signals of 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 increases the fuel pressure 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



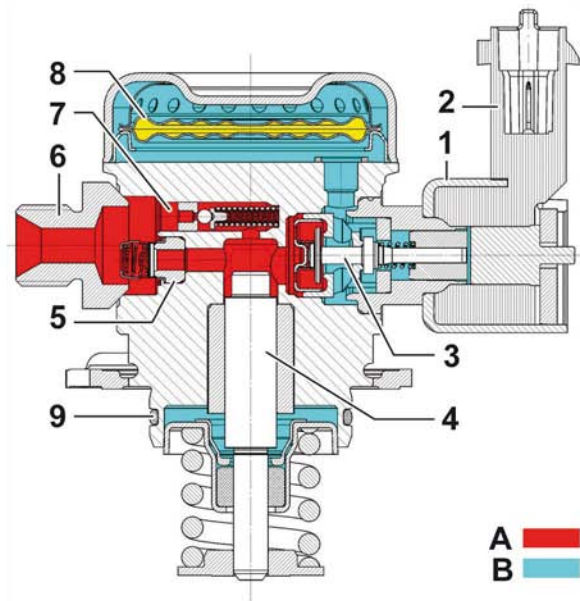
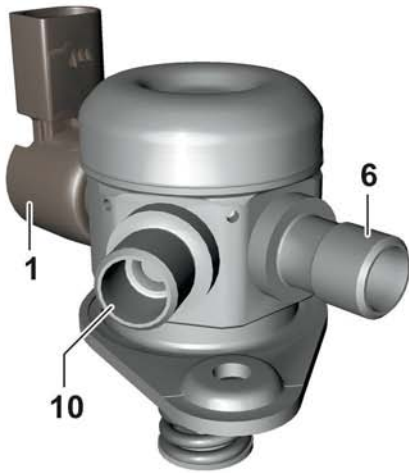
P07.70-2240-00

### Hydraulic diagram of fuel low-pressure system

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



P07.02-2134-00

**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 system

Each high-pressure pump has a quantity control valve which regulates the fuel quantity supplied to the pump element 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 right rail. The operating pressure varies according to load and engine speed between 100 and 200 bar. When the vehicle is stationary and the selector lever is at position "N" or "P", the pressure is lowered to 100 bar in order to reduce the noise emissions of the high-pressure pumps. If the vehicle is parked with the engine hot, the fuel pressure can rise to up to 250 bar in the high-pressure circuit. When this threshold is reached, a valve in the high-pressure pump opens and the pressure is dissipated. The minimum fuel pressure at idle is 100 bar. It rises as the engine load increases up to the maximum fuel pressure.

The maximum fuel pressure is 200 bar. It is achieved between the medium load range and the wide open throttle range.

The rail pressure is regulated by the engine 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 4.5 to 6.7 bar.

### Normal mode

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

The fuel pump pressure is regulated 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
- 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 engine 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 engine 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 engine 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 engine 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.

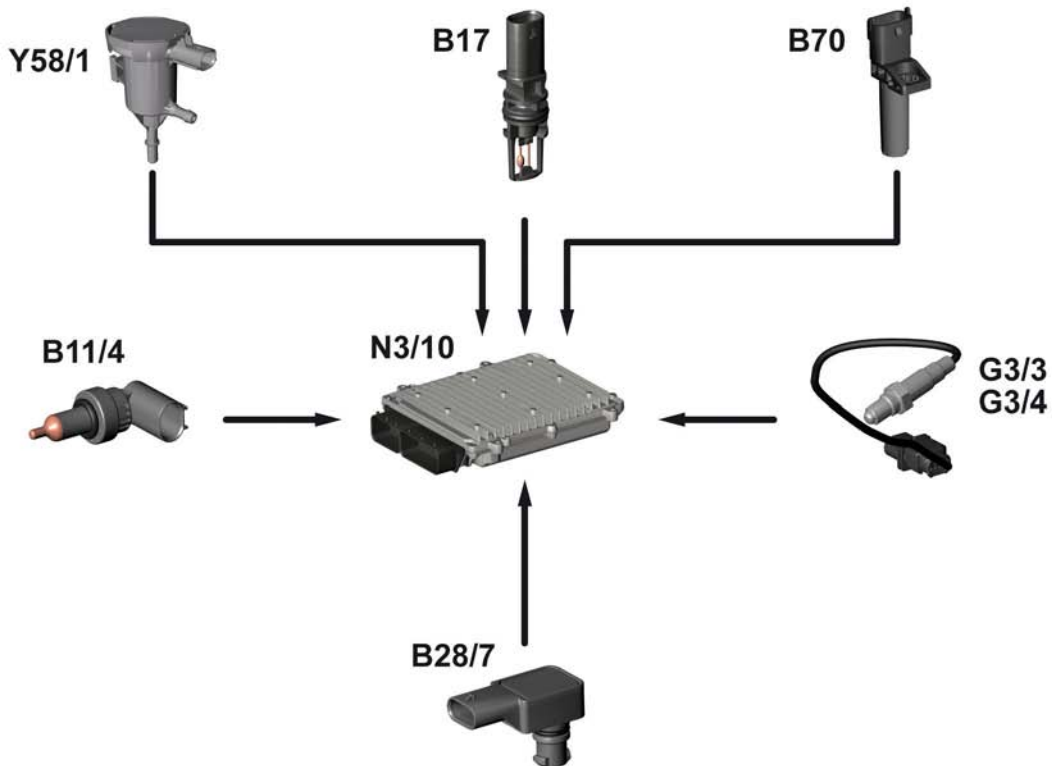
When the engine is running, the fuel vapors stored in the activated charcoal canister are drawn off via the purge switchover valve and burned in the engine.

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

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

### Note

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



P47.30-2224-00

**Function schematic of purging**

- B11/4* Coolant temperature sensor
- B17* Intake air temperature sensor
- 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)

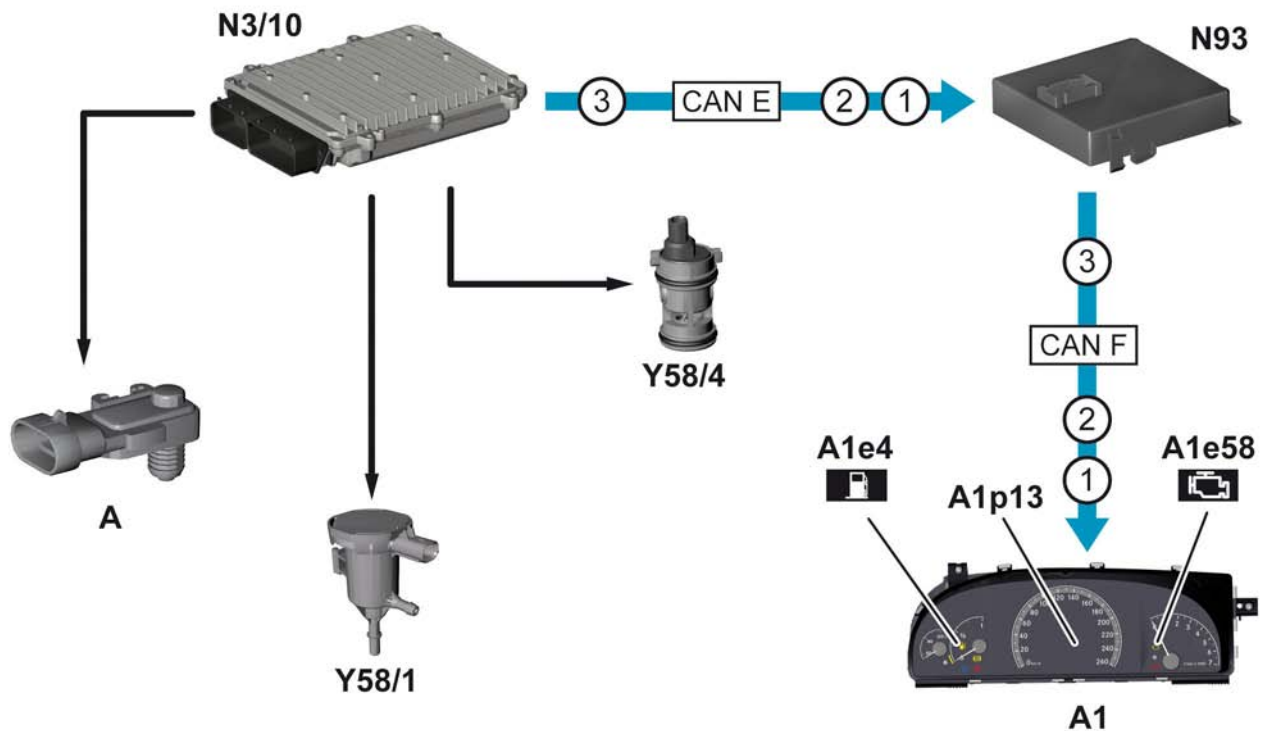
#### Activated charcoal canister shutoff valve

The activated charcoal canister shutoff valve is actuated by the engine 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.



P47.30-2225-00

#### 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  
 N93 Central gateway 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

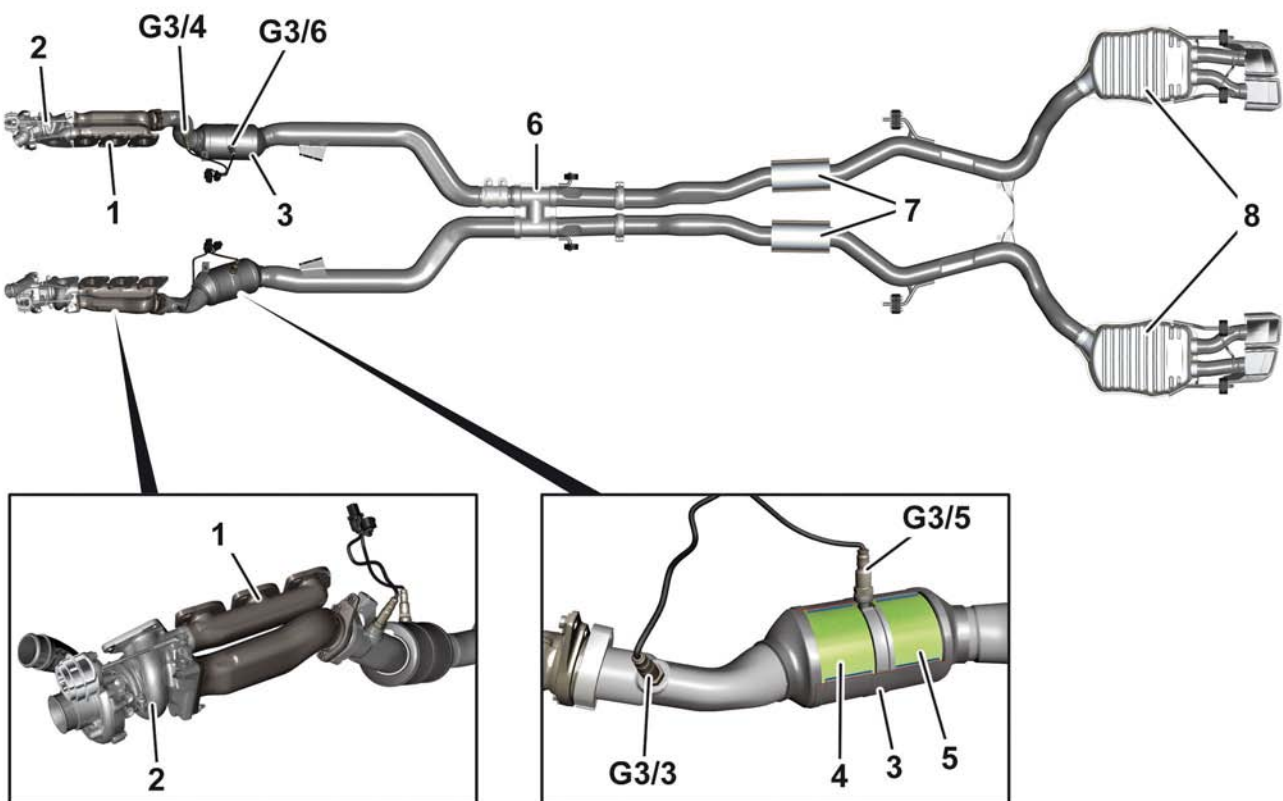
The task of the exhaust treatment system is to reduce exhaust emissions:

- 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:

- Near-engine mounted catalytic converter with two "monoliths"
- System designed as tandem catalytic converter box
- O<sub>2</sub> sensors upstream and downstream of first "monolith"

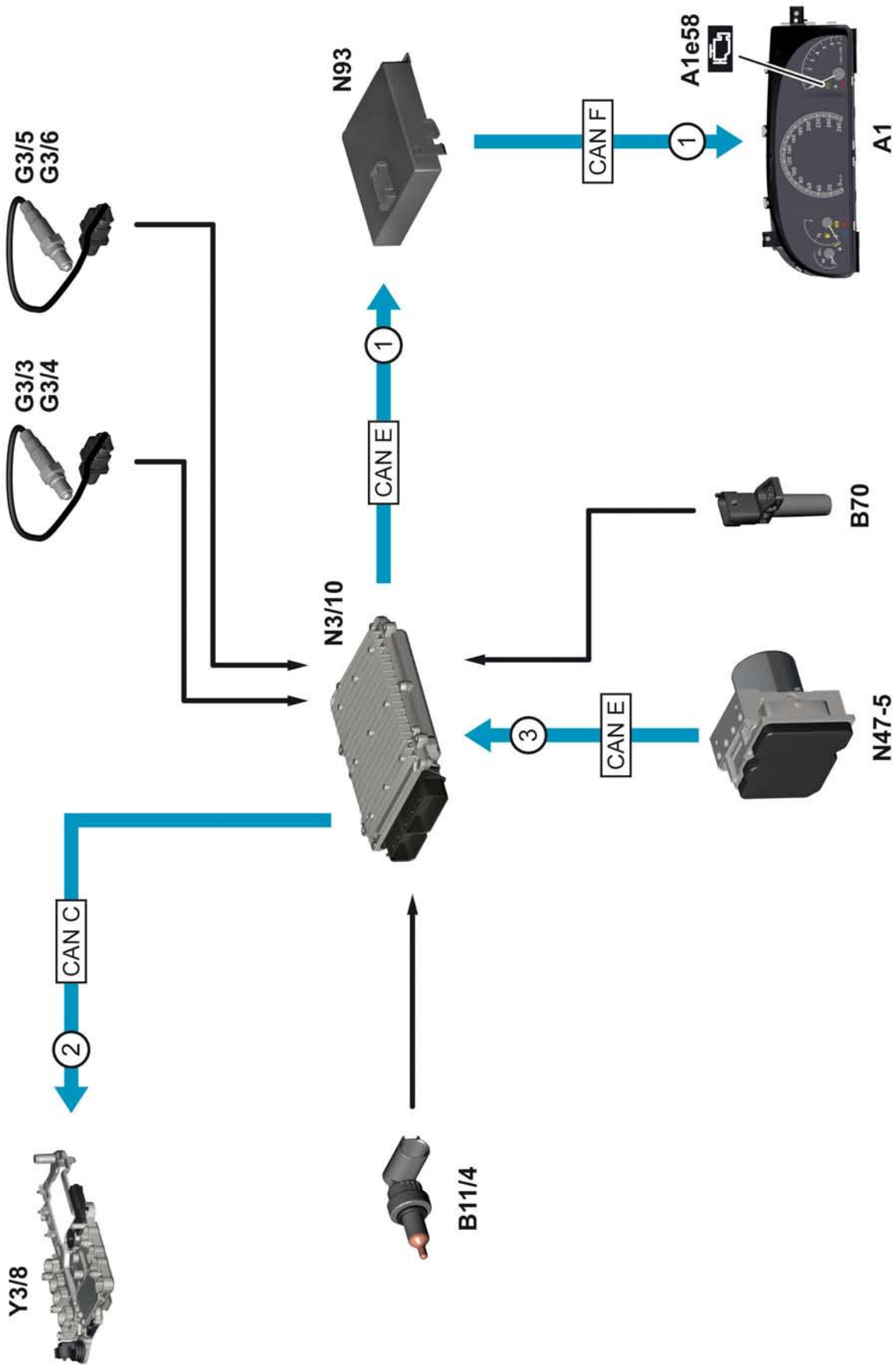


P49.10-2929-00

## Exhaust system

- |   |                              |      |   |
|---|------------------------------|------|---|
| 1 | Exhaust manifold             | G3/3 | Left O <sub>2</sub> sensor upstream of catalytic converter    |
| 2 | Turbocharger                 | G3/4 | Right O <sub>2</sub> sensor upstream of catalytic converter   |
| 3 | Firewall catalytic converter | G3/5 | Left O <sub>2</sub> sensor downstream of catalytic converter  |
| 4 | Intake monolith              | G3/6 | Right O <sub>2</sub> sensor downstream of catalytic converter |
| 5 | Exhaust monolith             |      |   |
| 6 | Switchover valve             |      |   |
| 7 | Center muffler               |      |   |
| 8 | Rear muffler                 |      |   |

Exhaust system



P14.00-2116-00

Function schematic of exhaust treatment

- 1 Engine diagnosis indicator lamp, actuation
- 2 Switch point, increase request
- 3 Vehicle speed, signal

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

- |       |   |
|-------|---|
| A1    | Instrument cluster                                |
| A1e58 | Engine diagnosis indicator lamp                   |
| B11/4 | Coolant temperature sensor                        |
| 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                          |
| N47-5 | ESP control unit                                  |
| N93   | Central gateway control unit                      |
| Y3/8  | Electric controller unit (VGS)                    |

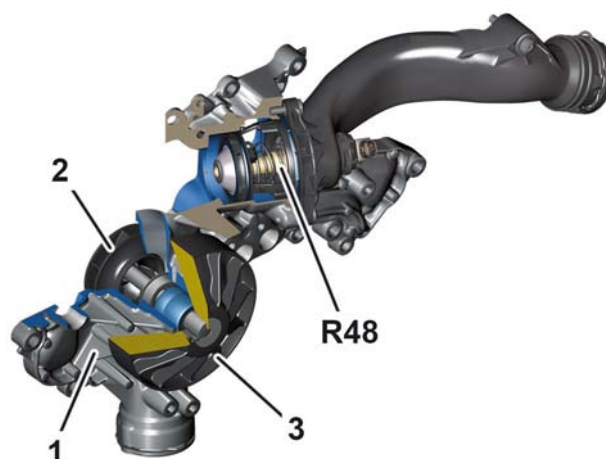


## Engine cooling

### Cooling circuit, M 157

Optimum cooling of the engine and turbocharger is necessary to ensure maximum engine performance. It has been possible to minimize the operating energy input of the coolant pump by specifically reducing the hydraulic pressure losses and making other minor improvements to the cooling system. At the same time, its variability has been optimized.

Low component weights have resulted from the consistent replacement of aluminum and steel with plastic parts, e.g. in the thermostat, belt pulley, rotor, heater valve and hydraulic lines.



P20.10-2277-00

#### Coolant pump

- 1 Housing
- 2 Rotor
- 3 Belt pulley

R48 Two-disk thermostat heating element

### Thermal management

The thermal management function controlled by the engine control unit regulates the coolant temperature in the engine. It allows the operating temperature to be reached more quickly, which reduces exhaust emissions, improves heating comfort and lowers fuel consumption by 4%.

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

- 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 engine 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 warm-up phase, shutoff of the heating system, heating of the two-disk thermostat, fan control, delayed fan switch-off and overheating protection.

#### Warm-up phase

During the warm-up phase the coolant circuit is regulated in three stages:

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), the temperature is reduced to 90 °C or 80 °C in the outlet. The actuator for this is a heated thermostat cartridge.

### Shutoff of the heating system

In order to ensure that the optimum engine operating temperature is reached as quickly as possible, the engine 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. An integrated heating element adjusts the positions of the thermostat disks according to requirements. To do this, it is actuated by a ground signal from the engine control unit.

### Fan control

The engine control unit actuates the engine and air conditioning electric suction fan with integrated control. The target fan speed is specified by the engine 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 engine control unit.

### 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.

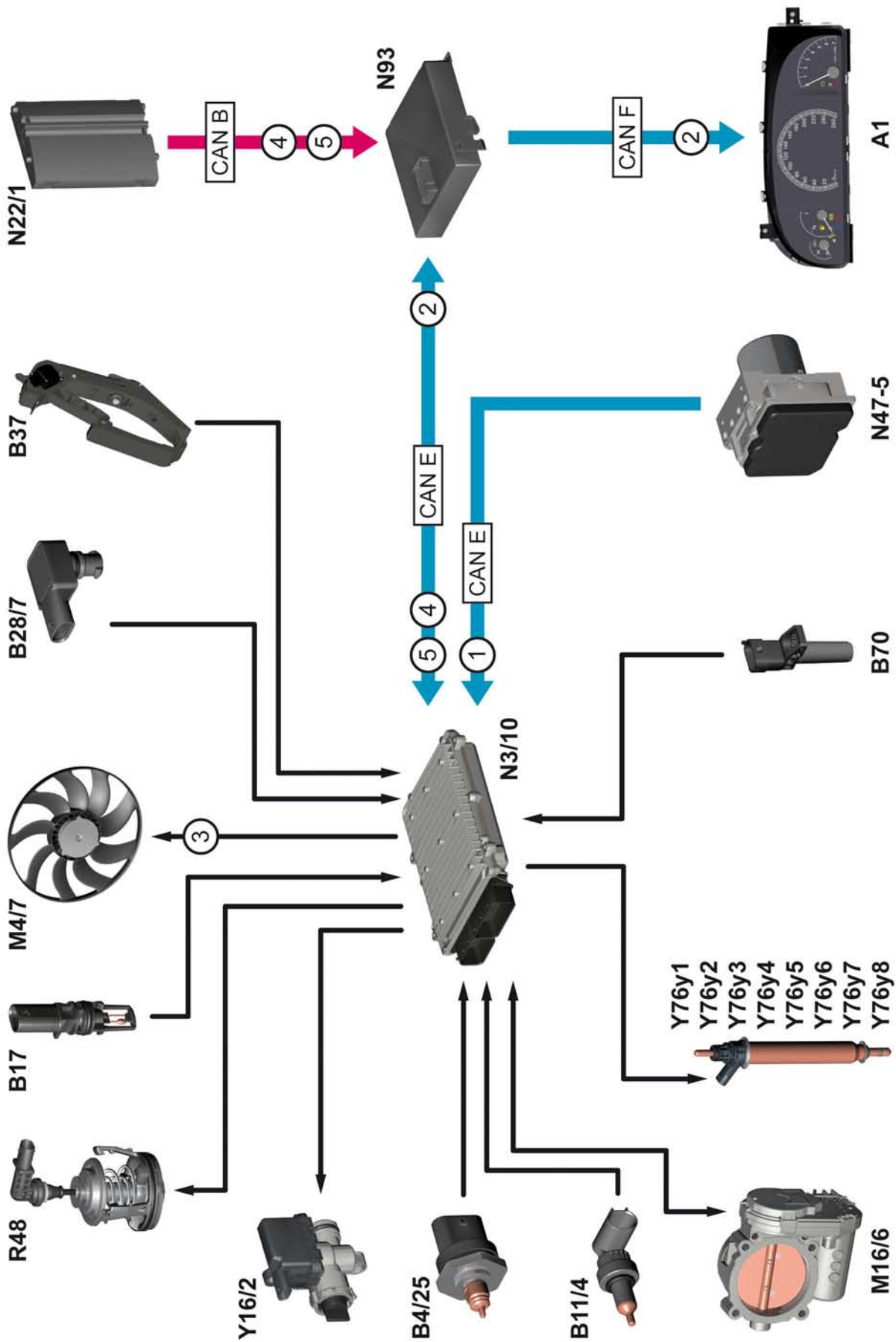
### Overheating protection

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 engine control unit no longer closes the wastegate completely, depending on the engine speed and load. Also, the throttle valve actuator may no longer be fully opened. The injection time of the fuel injectors is shortened by the engine control unit according to the reduced air mass.

In addition, the engine 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.

Engine cooling



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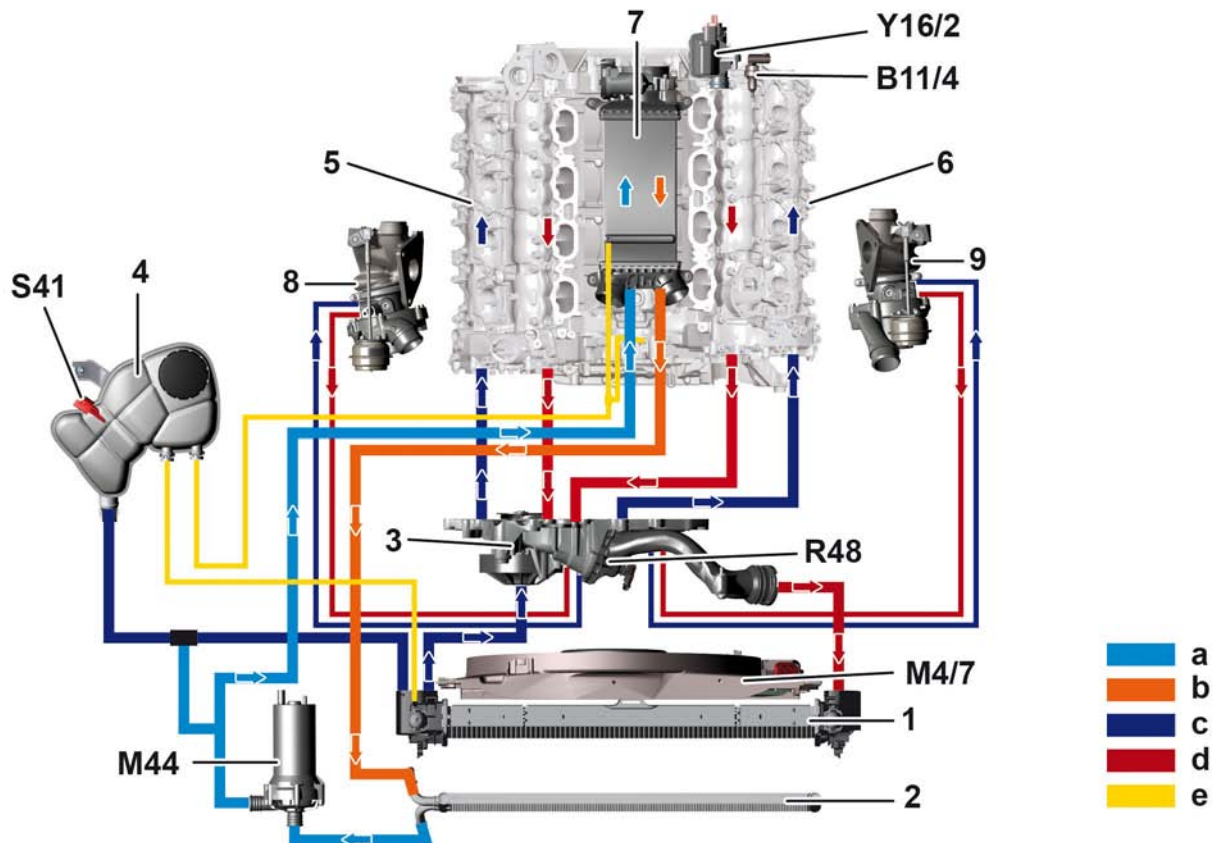
Function schematic of thermal management (shown on model 221)

A1 Instrument cluster  
 B4/25 Fuel pressure and temperature sensor  
 B11/4 Coolant temperature sensor  
 B17 Intake air temperature sensor  
 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  
 Y76y8 Fuel injector, cylinder 8

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

## Engine cooling



P18.00-2298-00

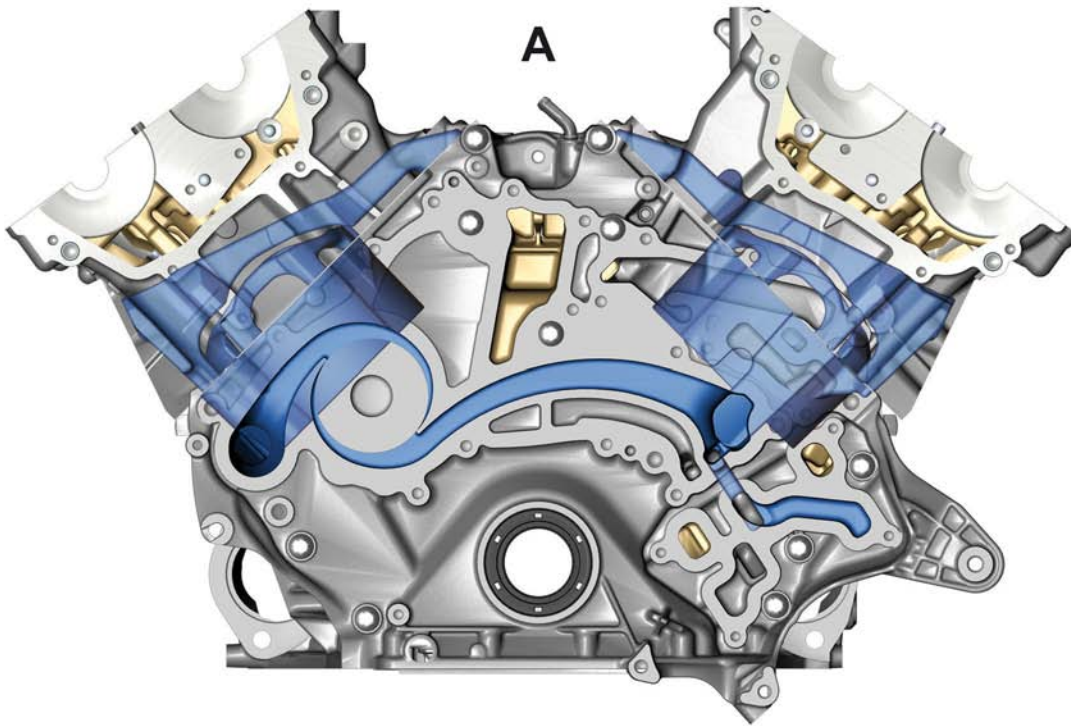
### Coolant circuit

- 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
- 9 Left turbocharger

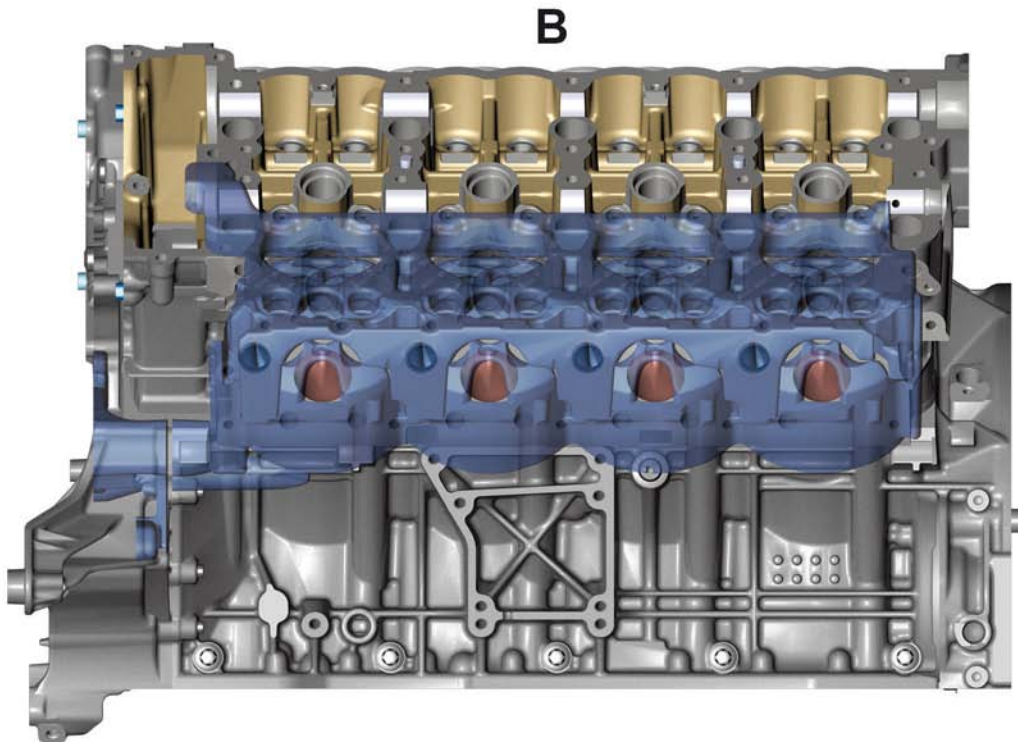
- B11/4 Coolant temperature sensor
- M4/7 Engine and air conditioning electric suction fan with integrated control
- M44 Charge air cooler circulation pump
- R48 Two-disk thermostat heating element
- S41 Coolant level indicator switch
- Y16/2 Heating system shutoff valve

- 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





P20.20-2391-00



P20.20-2394-00

**Coolant distribution**

*A View from front*

*B View from left*

## Engine lubrication

### Regulated engine oil pump

Engine M 157 features 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 spray nozzles 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 157 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.

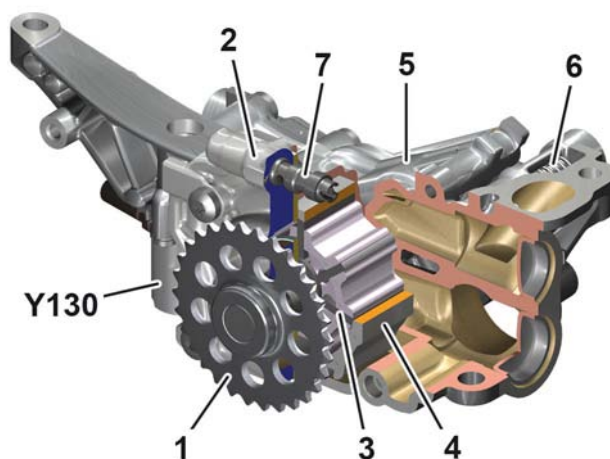
The oil sensor is located on the bottom section of the oil pan. It senses the oil level and the oil temperature.

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 engine control unit depending on a characteristics map. It switches between the 2 bar and 4 bar pressure levels according to requirements.

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

- Temperature
- Engine speed
- Engine load

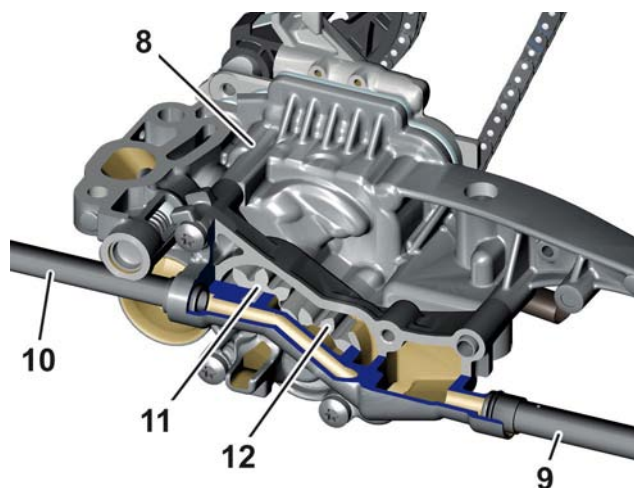


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**Engine oil pump, front view**

- 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

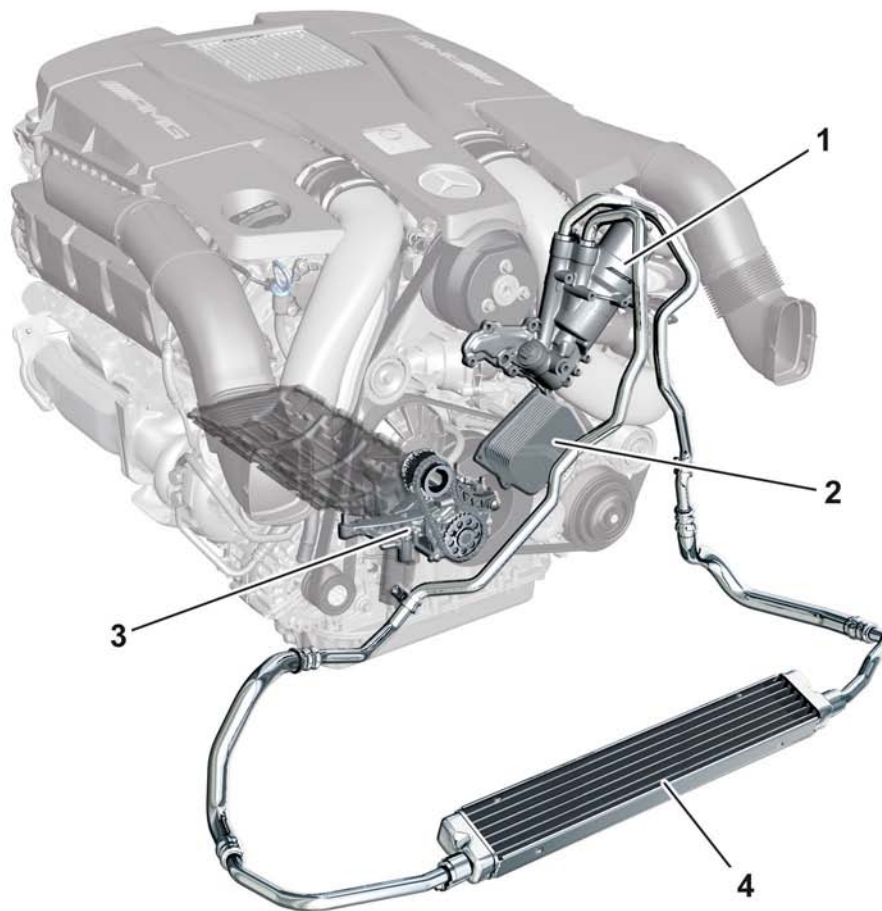


P18.30-2143-00

**Engine oil pump with external gear pump, 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





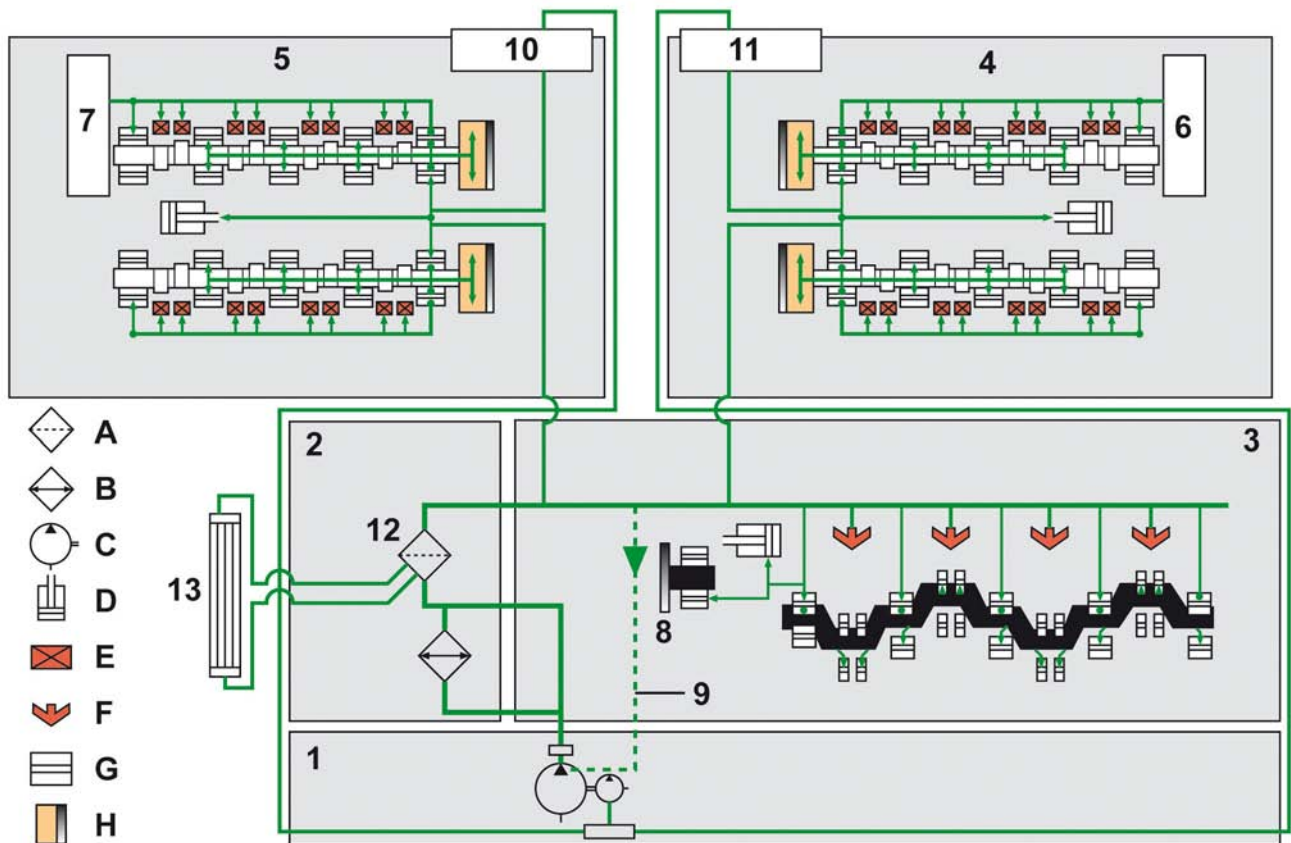
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### **Engine oil cooling**

- 1 Oil filter
- 2 Oil-water heat exchanger
- 3 Oil pump
- 4 Engine oil cooler



## Engine lubrication



P18.00-2299-00

### Oil circuit diagram, M 157

- |  |   |
|--|---|
| 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                    |   |
| 10 Left turbocharger                         |   |
| 11 Right turbocharger                        |   |
| 12 Oil filter with integrated oil thermostat |   |
| 13 Engine oil cooler                         |   |



### ME (motor electronics) control unit

The MED 17.7.1 engine control builds on experiences with the MED 9 of previous engines. The following features have been implemented in this new engine control MED 17.7.1 in an identical modular housing:

- Modular design as a standardized control unit for all new 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



P54.21-3171-00

### Engine M 157

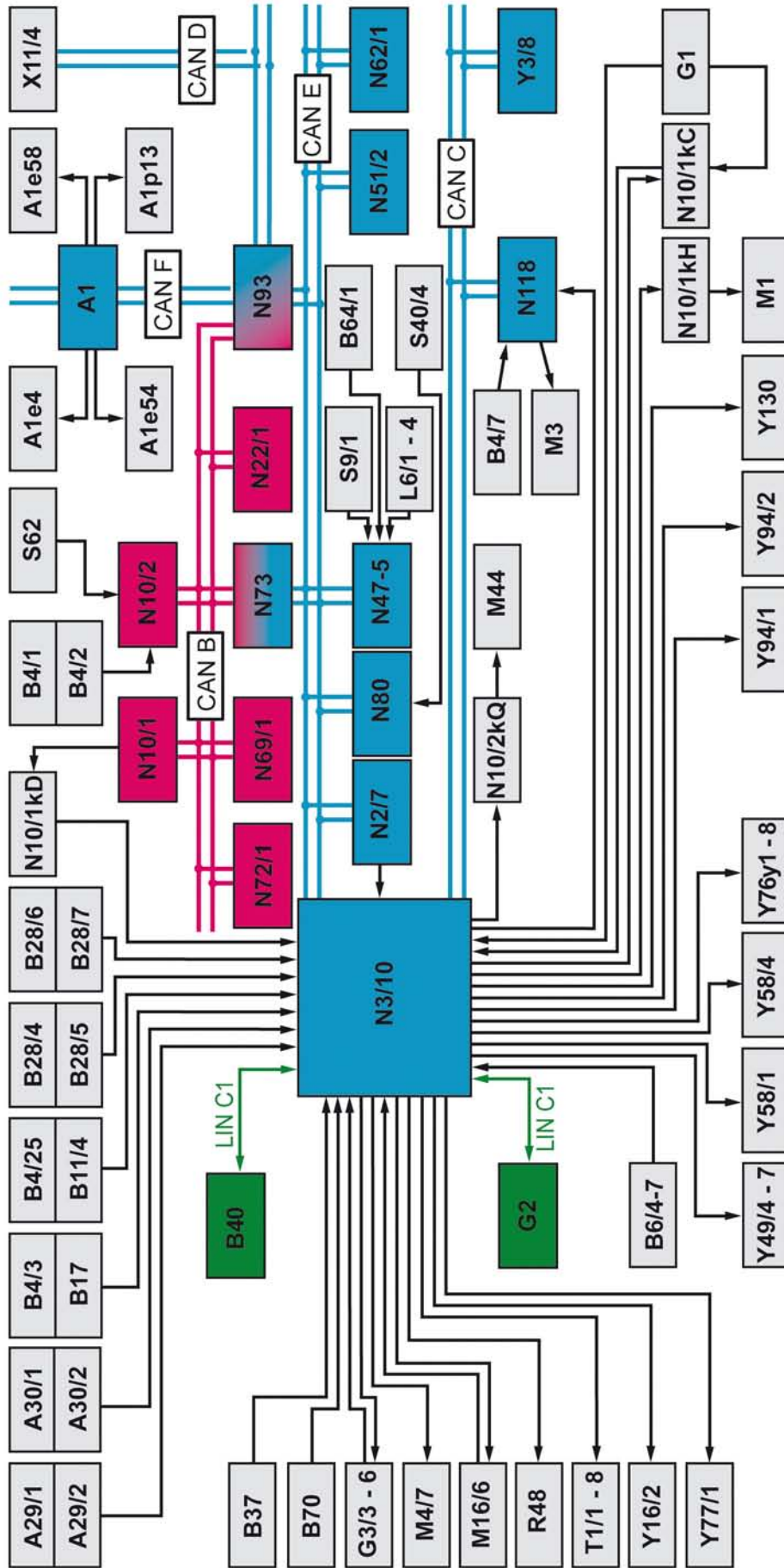
N3/10 ME-SFI [ME] control unit

### Task

The engine control unit combines with the sensors and actuators of engine M 157 to form the engine control system. The following systems and functions are controlled and coordinated by the engine control unit according to the input signals:

- Ignition system
- Fuel supply
- Injection control
- Electronic accelerator
- Diagnosis and fault storage
- Engine start/stop function
- Drive authorization system and immobilizer
- Controlled camshaft adjustment
- Thermal management
- Torque interface
- Alternator interface
- Oil pressure control
- Lambda control
- Tank diagnosis
- Purging

Engine control



P07.70-2239-00

Block diagram of engine M 157 (shown on model 221)

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
M44	Charge air cooler circulation pump
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
N22/1	AAC [KLA] control unit
N47-5	ESP control unit
N51/2	ABC control unit

B11/4	Coolant temperature sensor
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
B40	Oil sensor (oil level, temperature and quality)
B64/1	Brake vacuum sensor
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

A1	Instrument cluster
A1e4	Fuel reserve warning lamp
A1e54	Coolant temperature warning lamp
A1e58	Engine diagnosis indicator lamp
A1p13	Multifunction display
A29/1	Front knock sensor (left side of engine)
A29/2	Rear knock sensor (left side of engine)
A30/1	Front knock sensor (right side of engine)
A30/2	Rear knock sensor (right side of engine)
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

## Engine control

CAN B Interior CAN  
 CAN C Drive train CAN  
 CAN D Diagnostic CAN  
 CAN E Chassis CAN  
 CAN F Central CAN  
 LIN C1 Drive train LIN

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  
 Y76y8 Fuel injector, cylinder 8  
 Y77/1 Boost pressure actuator  
 Y94/1 Left quantity control valve  
 Y94/2 Right quantity control valve  
 Y130 Engine oil pump valve

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  
 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  
 T1/8 Cylinder 8 ignition coil  
 X11/4 Data link connector

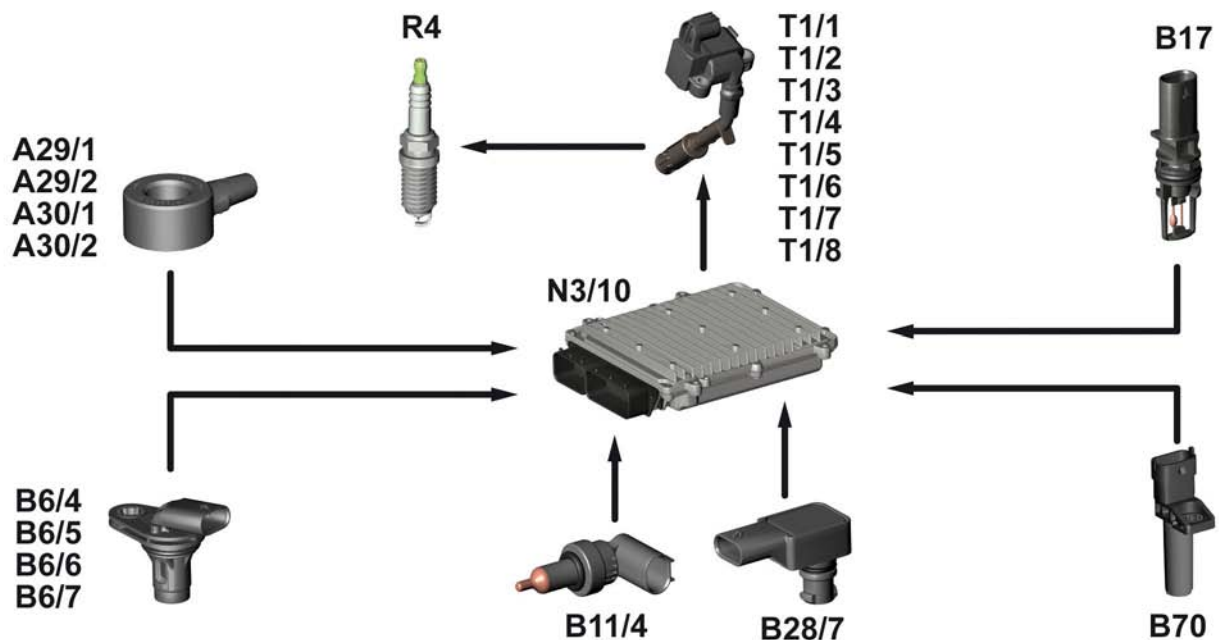


The engine control unit transmits the signal for the dwell time of the relevant operating point to the ignition coil via the actuation line (circuit 4). The relevant ignition coil interrupts the primary circuit by means of an integrated magneto when the dwell time has elapsed. From the ignition coil 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 engine control unit according to a characteristics map on the basis of the input signals.

**i Note**

The ignition angles can only be checked using Xentry Diagnostics.



P07.10-2006-00

**Function schematic of ignition system**

- A29/1 Front knock sensor (left side of engine)
- A29/2 Rear knock sensor (left side of engine)
- A30/1 Front knock sensor (right side of engine)
- A30/2 Rear knock sensor (right side of engine)
- 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
- 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
- T1/8 Cylinder 8 ignition coil

## On-board diagnosis

The new engine M 157 features 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 engine control unit and constantly monitors all the emissions-relevant components and systems in the vehicle.

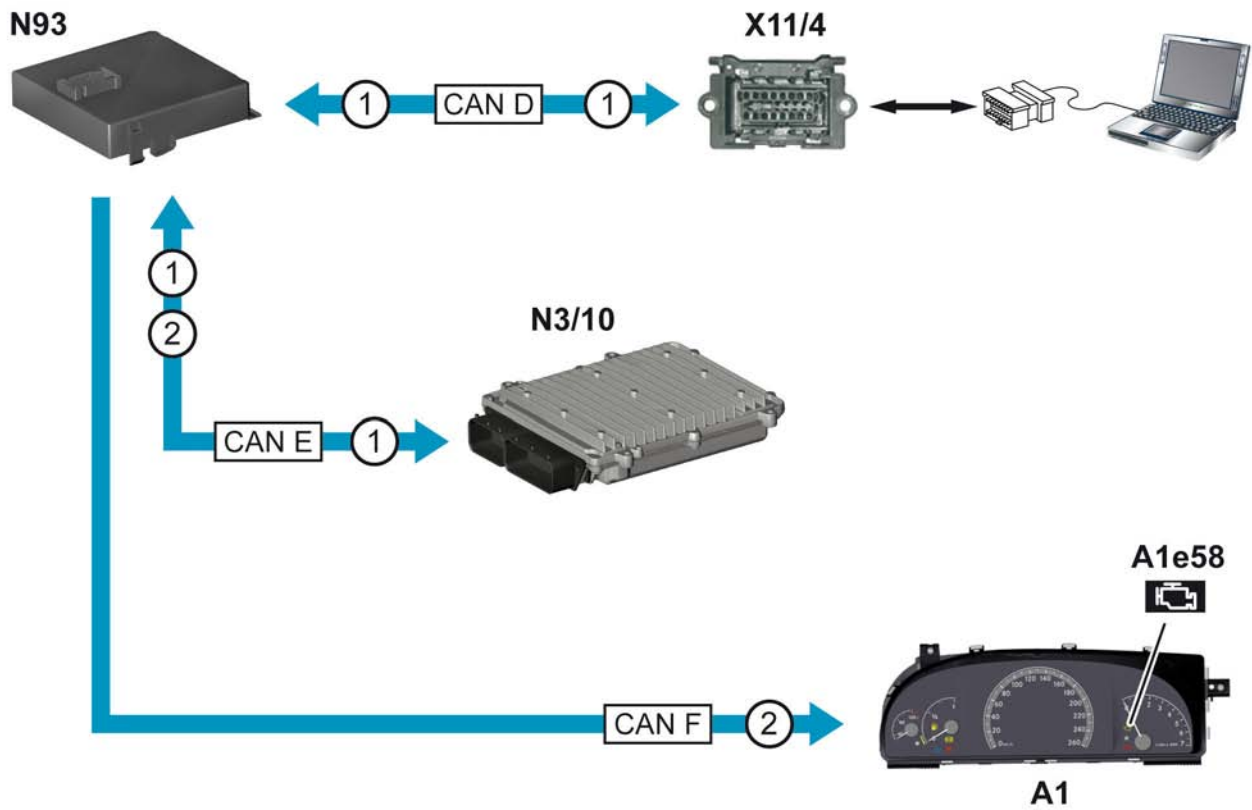
The tasks of the OBD are as follows:

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

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

The following components and systems are monitored:

- O<sub>2</sub> sensors
- Efficiency of catalytic converters (catalyst function)
- Catalytic converter heating
- Purging
- Smooth running analysis (detection of combustion misfiring)
- Other emissions-relevant components or components the failure of which would prevent diagnosis of another component



P07.10-2008-00

### Function schematic of on-board diagnosis (OBD)

- A1 Instrument cluster
- A1e58 Engine diagnosis indicator lamp
- N3/10 ME-SFI [ME] control unit
- N93 Central gateway control unit
- X11/4 Data link connector

- CAN D Diagnostic CAN
- CAN E Chassis CAN
- CAN F Central CAN

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



## Controlled Efficiency start/stop function

The new engine M 157 is 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 fuel injector 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 157 the start/stop function is always combined with the AMG SPEEDSHIFT MCT 7-speed sport transmission.

The availability of the start/stop function is indicated to the driver by 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 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 engine control unit performs a system diagnosis and evaluates the operational capability of the start/stop function.

### **i** Note

The start/stop function is only active in transmission mode "C". In the transmission modes "S" and "M" the function cannot be activated, and it is automatically deactivated when changing from "C" to "S" or "M".

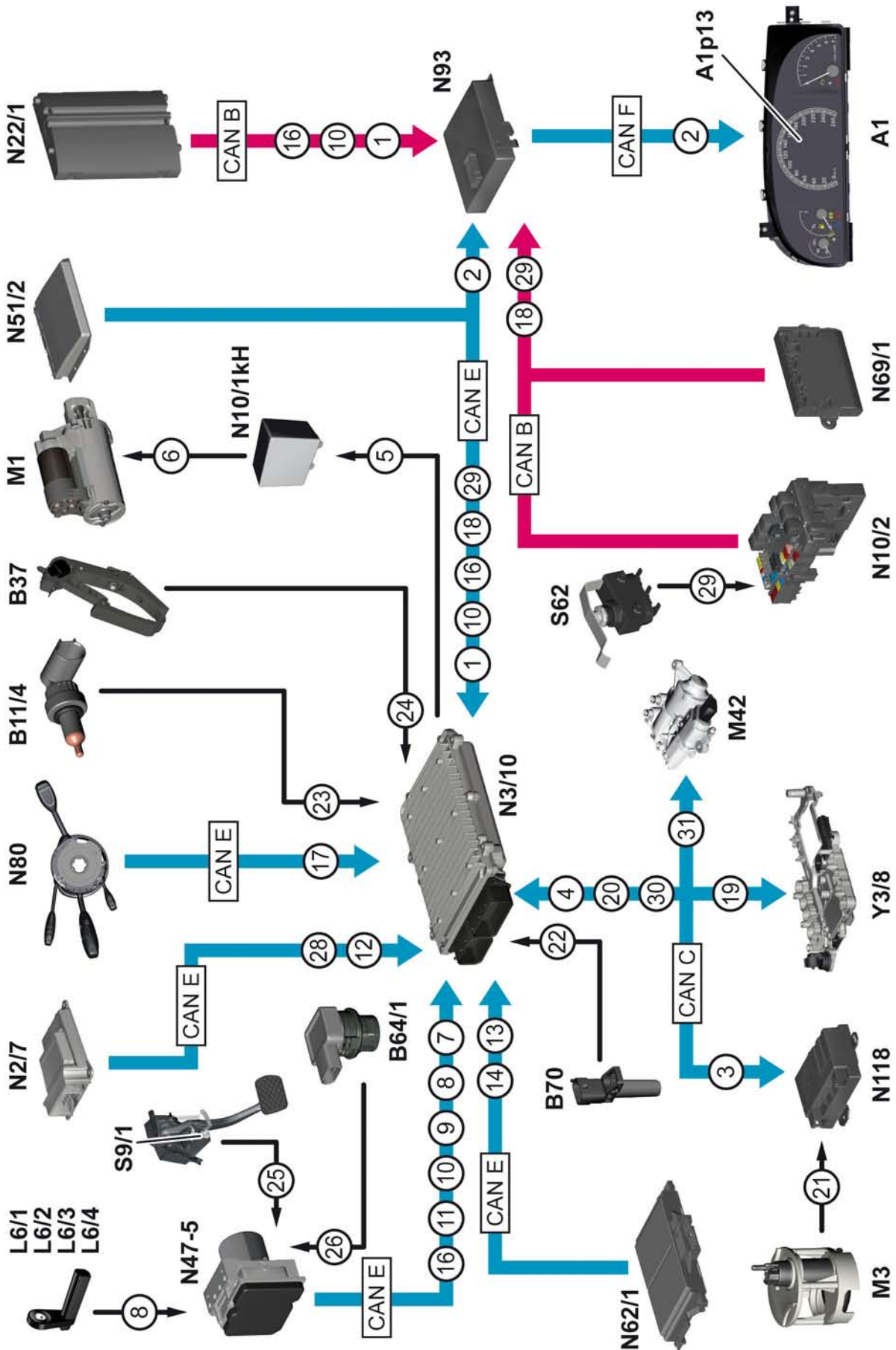


P54.32-8897-00

1 Start/stop function indicator lamp



# Controlled Efficiency start/stop function



P07.10-2007-00

Function schematic of start/stop function

## Controlled Efficiency start/stop function

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

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

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
N51/2	ABC control unit
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



## Hold-down device

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



P58.20-2295-00

## Lifting eye

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



P58.20-2294-00

## Mechanical components

### Assembly insert

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



P58.20-2301-00

## Connection line

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



P58.20-2298-00

## Plug

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



P58.20-2299-00

## Fuel system

### Drift

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



P58.20-2292-00

### Extractor

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



P58.20-2293-00

## 4-pin adapter cable

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



P58.20-2296-00

## Spark plug wrench

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



P58.20-2291-00



## Air supply

### Adapter

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



P58.20-2300-00



**ABC**

Active Body Control

**CAN**

Controller Area Network

**CO**

Carbon monoxide

**CO<sub>2</sub>**

Carbon dioxide

**DLC**

Diamond-like-carbon

**DOHC**

Double overhead camshaft

**EDW**

Anti-theft alarm system (ATA)

**EOBD**

European On-Board-Diagnosis

**ESP**

Electronic Stability Program

**EZS**

Electronic ignition lock

**HC**

Hydrocarbon

**IHU**

Internal high-pressure forming (IHPF)

**KLA**

Automatic air conditioning (AAC)

**LEV**

Low Emission Vehicle

**LIN**

Local interconnect network

**MCT**

Multi-Clutch Technology

**ME**

Motor electronics (ME-SFI)

**NO<sub>x</sub>**

Nitrogen oxide

**OBD**

On-board diagnosis

**PWM**

Pulse width modulated

**RAM**

Random access memory

**ROZ**

Research octane number (RON)

**SAM**

Signal acquisition and actuation module

**SGR**

Radar sensors control unit

**TPM**

Cruise control (CC)

**ULEV**

Ultra Low Emission Vehicle

**VGS**

Fully integrated transmission control

**WIS**

Workshop Information System

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