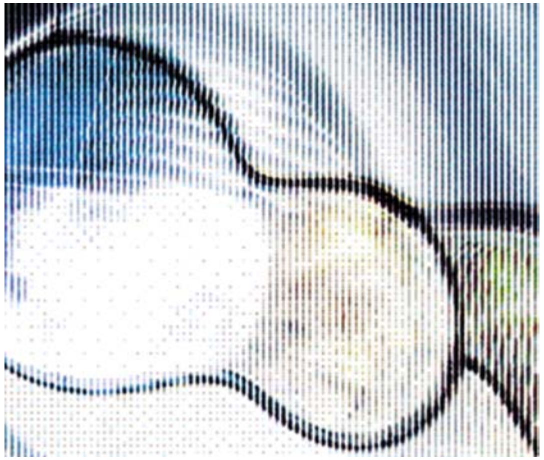
DaimlerChrysler



Cars • Engine
Petrol Engine M275
Initial Training
Information module

As at 03/04

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Note:
The term »employees« does not imply any preference of gender and incorporated male and refers to maler and female employees alike.

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Dear participant!

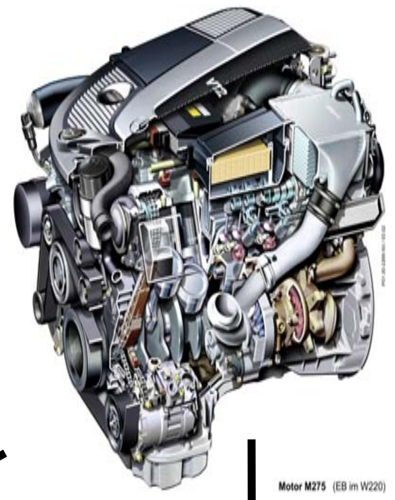
A warm welcome to the **Car <> gasoline engine M275** initial training course.
These training documents contain information sheets which will help you to familiarize yourself with the M275 gasoline engine. Apart from this we will also provide you with useful service tips and additional technical information.

It goes without saying that the information compiled here reflects current state-of-the-art technology. Advance developments or modifications will not be followed up on after this training course, as the information hereto is available in the training documents.

Our intention is to work our way through this training course together with you - step-by-step.

All the best

Engine team



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Press release

Precision through manual work

* Made at DaimlerChrysler's Berlin-based engine plant
* Approximately 750 engine parts mounted by hand
* Stringent tests for each engine

On the new high-end V12 gasoline engine, which is made in the production area at the engine plant situated in Berlin-Marienfelde, DaimlerChrysler relies mainly on highly-qualified manual work.
Thanks to manual work, the twelve-cylinder engine excels on account of its outstanding precision and quality. Both factors belong to the most important preconditions for long service life, exemplary smooth operation and the commanding engine-output characteristics of the 368 kW (500 hp) power unit.

The assembly lines for the high-tech engine are similar to a clean-room laboratory: the general picture in Hall 25 at the Berlin plant is marked by bright light, meticulous cleanliness and conscientious tidiness. Seven places with two fitting racks each are located next to each other.

Assembly with a sure instinct

Assembly starts off with the crankshaft housing made of die-cast aluminum, into which the specialists carefully insert the bearings for the crankshaft. Each operation is followed by a visual inspection, and a sensitive touch of the fingertips. Finally, the shaft is located; its axial play may not exceed one tenth of a millimeter.
Pistons and connecting rods are inserted by the specialists with the aid of a guide cone into the cylinder liners, without tilting them to even the slightest degree. Prior to this the conrods are selected according to the most stringent of criteria, as only components with minimum weight tolerances are mounted into an engine, in order to ensure smooth running characteristics. In some operations the fitters wear white glazed cotton gloves. These serve to prevent any contamination and skin grease from contacting the metal surfaces.

The maximum in precision, for example also applies to the assembly of the ignition block of the AC dual ignition, which contains a separate ignition coil for each of the 24 spark plugs and which is equipped with state-of-the-art ionic current measurement, that is capable of reliably detecting any combustion misfiring.

Electronics augment manual work

All in all the Berlin-based twelve-cylinder engine specialists assemble approximately 750 parts - and almost all of them by hand. Technical aids are only deployed, if their use will bring about an even greater degree of precision than could be achieved by manual work. Thus the fitters carefully insert the bolts for mounting the cylinder head by hand, but they then use an electric nutsetter to tighten the bolts exactly to the specified torque value.
Here the electronics simply cannot be beaten in terms of accuracy.

Berlin engine plant chalks up 100 years

The Berlin-based DaimlerChrysler engine plant will celebrate on the 2^{nd} of October 2002 its 100^{th} anniversary. All in all the operation which covers an area of 463,000 square meters currently employs a workforce of 3,000. They are also responsible for building the state-of-the-art V8 diesel engine for the Mercedes-Benz E-, G-, M- and S-Class cars as well as the twelve-cylinder engine for the S-, SL- and CL-Classes, which since its market launch has been made more than 21,000 times. This in turn means that DaimlerChrysler is the world's largest manufacturer of car twelve-cylinder engines.

Highlights M275

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The new V12 with bi-turbo charging

High-tech perfection is promised by the new 12-cylinder engine, which will be available as of autumn 2002 in the model refined S-Class. This V12-cylinder bi-turbo comes with commanding performance values: the engine develops a rated output of 368 kW at 5,000 rpm and a rated torque of 800 Nm at 1,800-3,500 rpm.
This power unit has a generously rated surplus in output and, in particular, torque and this is available at constantly harmonious output and torque development. In keeping with the character of a luxury sedan the new motorization comes with a perfectly smooth operation and an harmonic noise design.

Taking all viewpoints into consideration the technical realization of the goals set called for a V12-concept with 5.5 l displacement, 60 degree cylinder bank angle and bi-turbo charging.
Engine breathing is supported by a turbocharger with "wastegate-control system" for each cylinder bank. Exhaust gas turbocharging development mainly focuses on the finest response characteristics in combination with the achievement of maximum torque at as low as possible engine speed. Apart from this special emphasis was placed on the acoustic characteristic.

Output and torque in abundance

In comparison to the predecessor engine the rated output and rated torque for the new engine have been increased by approx. 30 % or 50 %. Because a corresponding increase in displacement was ruled out due to the wish to keep to a moderate fuel consumption and a compact design, a slightly reduced displacement with two exhaust gas turbochargers and charge air cooling was selected. The model refined S-Class achieves thus outstanding performance with excellent acoustics, a superb degree of vibrational comfort and, in view of the performance data, adequate fuel consumption.

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Smooth operation and noise emission

On a 12-cylinder engine with a cylinder angle of 60 degrees, all forces and torques of the 2^{nd} order are completely balanced as a matter of principle. Thus the greatest possible degree of smooth operation without additional balance shafts is a given factor.

All engine parts are designed using ultramodern calculation and testing methods in terms of rigidity and vibrational characteristics. The improvement in vibrational characteristics is contributed to in particular by a bedplate design with gray cast iron inserts on the crankshaft main bearings. The oil pan is completely decoupled from the crankcase in terms of vibrations. Combustion noise is dampened by the installed dual ignition, which serves to keep the pressure gradients in the combustion chamber at a low level and which minimizes cycle scatter for each individual combustion procedure. Noise reduction was also achieved by the damping through the exhaust gas turbochargers on the air and exhaust-gas sides as well as the water jacket of the water-cooled generator.

Weight

Despite the additional exhaust gas turbocharger, engine-side charge air cooler and the reinforced belt drive the M275 only weighs 270 kg and thus achieves an excellent power/weight ratio of 0.65 kg/kW.

The following lightweight components are used:

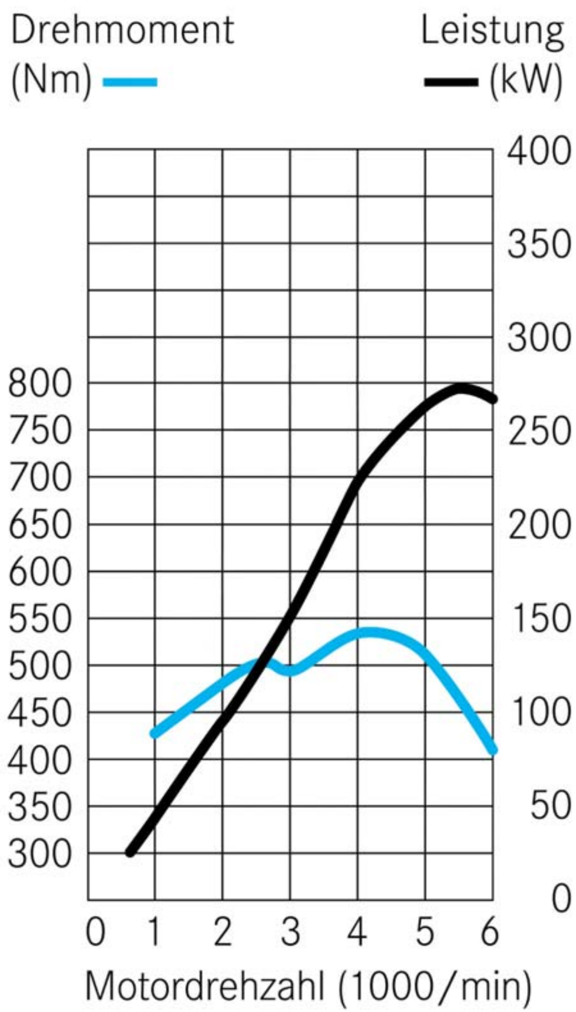
* cylinder head cover made of die-cast magnesium
* weight-optimized cracked, forged steel conrod
* die-cast aluminum for upper and lower section of crankcase
* lightweight silitec cylinder liner
* weight-optimized elastoval piston
* a 3-valve design with one camshaft per cylinder bank
* weight-optimized crankshaft and dynamic balancer
* an oil pan made of die-cast aluminum

Technical data comparison

Sales designation	CL 600	CL 600	S 600	SL 600 *
Vehicle model	215.378	215.376	220.176	230.476
Engine model	137.970	275.950		
Cylinder arrangement / number / angle	V12 / 60°			
Valves / spark plugs per cylinder	3 / 2			
Continuous fuel-injection and ignition system	ME 2.7	ME 2.7.1		
Air supply	Naturally aspirated engine	Turbo charging with charge air cooler		
Total displacement cm³	5,786	5,513		
Rated output kW (hp) at rpm	270 (367) at 5,500	368 (500) at 5,000		
Rated torque Nm at rpm	530 at 4,100	800 at 1,800 - 3,500		
Fuel consumption (New European Driving Cycle) Super Plus l/100 km/h	13.4	14.7		
Acceleration 0 - 100 km/h s	6.3	4.8		

* Market launch 04/2003

Performance graph M137



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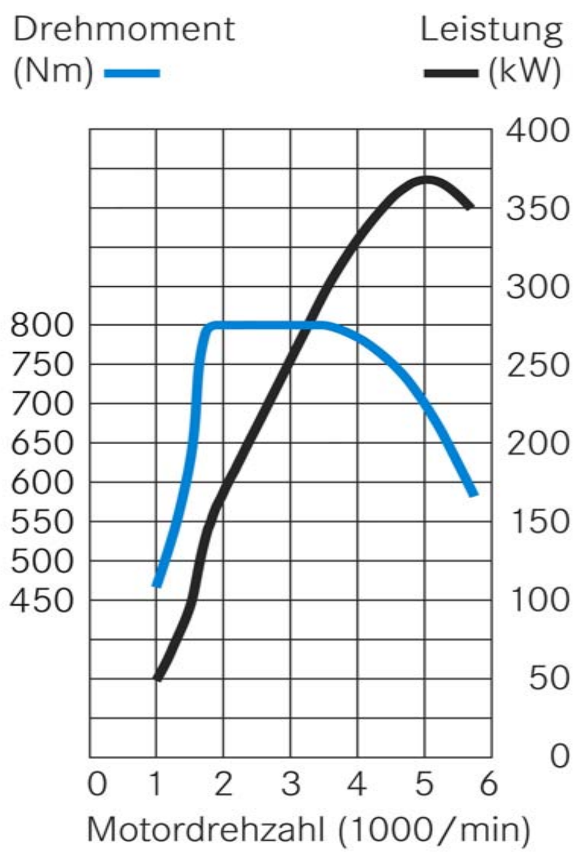
Performance graph M275



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Comparison of M275 / M285 with M137

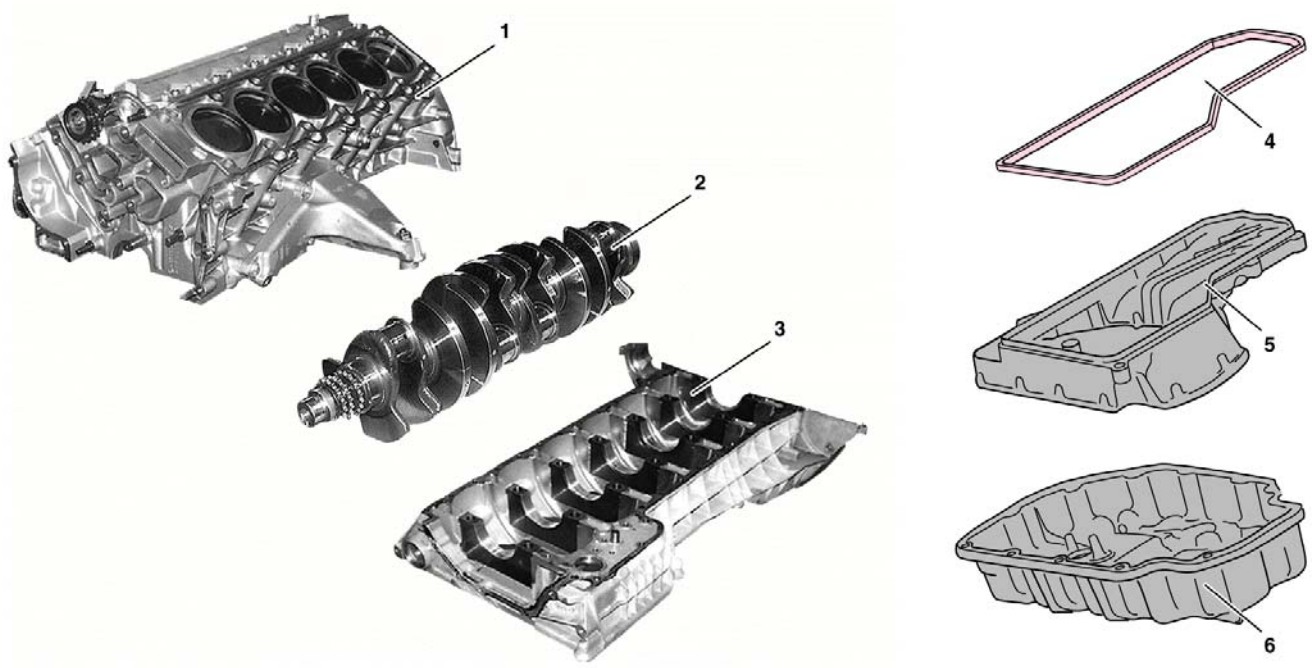
Engine 275 / Engine 285	Engine 137
Continuous fuel-injection and ignition system ME 2.7.1	Continuous fuel-injection and ignition system ME 2.7
Detection of boost pressure through signal from pressure sensor upstream of throttle valve actuator (B28/6). Detection of load through signal from pressure sensor downstream of throttle valve actuator (B28/7). Hot film mass air flow sensor no longer applicable.	One hot film mass air flow sensor with integrated intake air temperature sensor
One exhaust gas turbocharger (bi-turbo) made of steel casting for each cylinder bank. Turbine housing integrated into exhaust manifold, shaft housing coolant cooled.	Naturally aspirated engine
Boost pressure control via the boost pressure control pressure transducer (Y31 /5) and the vacuum cell actuated pressure regulator valves (wastgate-valves) in the turbine housings.	–
Actuation of deceleration air valves via divert air switchover valve (Y101). The rapid reduction in charge air pressure during the transition from full load to deceleration serves to prevent charging noise.	–
For each exhaust gas turbocharger a water/charge air cooler. For both water/charge air coolers a separate low-temperature cooling circulation with low temperature cooler and electric circulation pump (M44). Engine 285: actuation of electric circulation pump (M44) from motor electronics control module via relay (N10/9 kO) cannot be verified, because the relay is actuated by its own output stage in the passenger-side signal acquisition and actuation module (N1 0/9).	–

Engine 275 / Engine 285	Engine 137
One air cleaner for each cylinder bank. Downstream of each air cleaner in the air cleaner housing a pressure sensor (B28/4, B28/5) is installed, in order to recognize the pressure drop across the air cleaner. To limit the maximum charger speed the pressure ratio downstream/upstream of the compressor (pressure value of B28/6 to B28/4 and B28/5) is calculated and regulated by the map-dependent boost pressure control.	One air cleaner
One three-way catalytic converter per cylinder bank. A total of 4 O_2 sensors, each upstream and at the side of the two three way catalytic converters.	A firewall three way catalytic converter for 3 cylinders each. A total of 8 O_2 sensors, each upstream and downstream of each of the 4 firewall three way catalytic converters.
No camshaft adjustment	Camshaft adjustment with engine oil pressure, 2 valve camshaft adjustment (Y49/1, Y49/2)
No cylinder shutoff	Cylinder shutoff for left-hand cylinder bank
–	Oil pressure sensor downstream of secondary oil pump for cylinder shutoff
–	Exhaust flap in exhaust pipe for cylinder shutoff
ECI ignition system (AC voltage ignition system with integrated ionic current measurement), ignition voltage **32 kV**, two spark plugs per cylinder (dual ignition).	ECI ignition system (AC voltage ignition system with integrated ionic current measurement), ignition voltage **30 kV**, two spark plugs per cylinder (dual ignition).
Detection of combustion misfires through ionic current signals and through smooth operation evaluation using the crankshaft position sensor.	Detection of combustion misfires through ionic current signals.
Knock identification through 4 knock sensors	Knock identification through ionic current signals (no knock sensors)
Pressure sensor for ambient pressure in motor electronics control module (N3/10)	–
Air injection with electric air pump (M33), air injection actuated over an air pump switchover valve (Y32), Combination valve air injection designed for suction and charging.	Air injection with electric air pump (M33) Air injection for each cylinder bank can be individually actuated, two air pump switchover valves (Y32/1, Y32/2) Air injection combination valve for suction operation

Engine 275 / Engine 285	**Engine 137**
Purge line with check valve, so that boost pressure cannot get to the activated charcoal canister.	Purge line for naturally aspirated engine without check valve.
The fuel system is designed as an induction system, the fuel filter with integrated diaphragm pressure regulator, and the fuel supply is demand controlled. The fuel pump (maximum delivery rate approx. 245 l/h) is actuated by the fuel pump control module (N118) using a pulse width modulated signal, in accordance with the signals from the fuel pressure sensor (B4/7).	The fuel system is designed as an induction system, the fuel filter with integrated diaphragm pressure regulator, and the fuel pump unregulated.
Exhaust manifold 3-piece with integrated turbine housing	Air-gap insulated sheet metal exhaust manifold
Crankcase ventilation with centrifugal separator and pressure regulator valve. Check valve in the partial and full load vent line on the air cleaner.	Crankcase ventilation

Crankcase

The crankcase and oil pan for the M137, M275 and M285 engines are designed as follows.



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Legend:

1 Upper crankcase section made of die-cast aluminum
2 Weight-optimized crankshaft and dynamic balancer
3 Upper crankcase section made of die-cast aluminum
4 Rubber gasket between crankcase bottom section and upper section of oil pan
5 Upper section of oil pan made of die-cast

The upper section of the oil pan in the S-Class is designed as shown. The front axle design of the various vehicle models (S-, SL-Class and Maybach) means that the oil sumps have to be located in different places.

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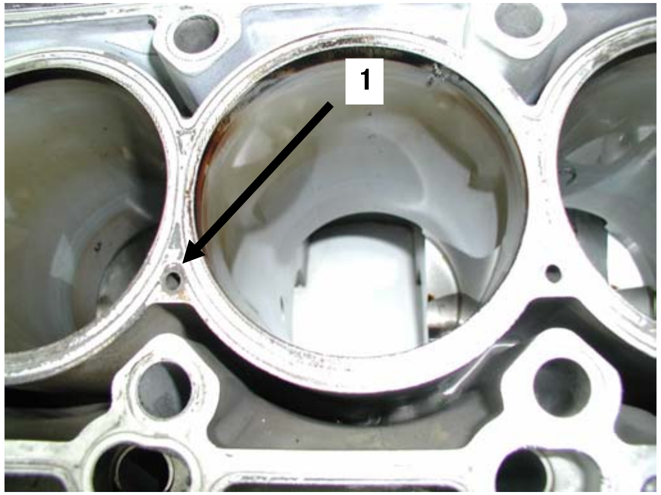
Aluminum crankcase with gray cast-iron insert

A genuine highlight is the particularly innovative design of the crankcase.
The crankcase is of a two piece bedplate design. Massive gray cast iron inserts in the area of the lower crankcase section's main bearing serve to enhance the noise characteristic.

All in all the very compact design, in spite of the charging, did not result in any significant increase in engine size compared with the predecessor model. In combination with the applied lightweight technologies an engine weight of only 270 kg is registered, which corresponds to a weight increase of only roughly 50 kg compared with the base engine M137.



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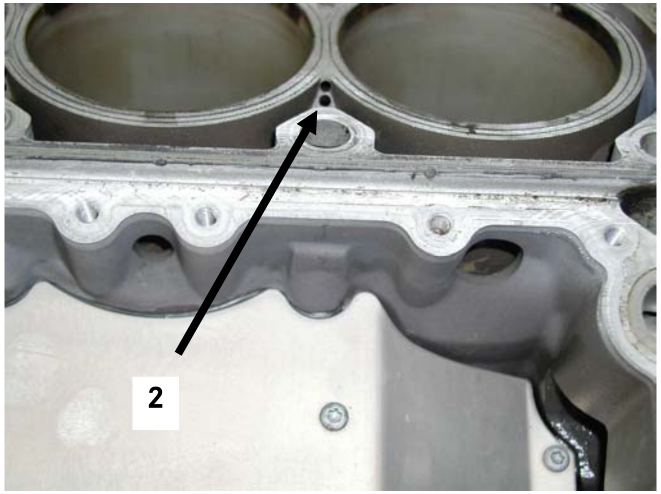
In order to do justice to the higher heat and pressure loads, the wall between the cylinders of the upper crankcase section have been widened compared with the M137 by 2 mm to 8 mm and in each case 3 water cooling bores (1 and 2) have been integrated into the walls.
The cylinder bore has been reduced compared with the M137 from 84.0 mm to 82.0 mm. By contrast the cylinder spacing of 90 mm and the stroke of 87 mm have not been altered.



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The cylinder liners are made up of an alloy of aluminum-silicon (silitec). They have a wall thickness of 2.5 mm.
Advantage: lower cylinder thermal offset, lower noise and less pollutant emissions, as well as lower weight and greater stability.

Water-cooling bores (1 and 2) for cooling walls

Piston

The cast pistons of the M275 and M285 are designed to cope with the extremely high pressures and temperatures. For the realization of the smallest, noise-relevant plays and for the purpose of improving the emergency running characteristics, the gravity die-cast pistons have been galvanically coated with iron.

The piston pins have been optimized in accordance with the acting loads both in terms of outer diameter and wall thickness.

Piston cooling is supported by oil spray nozzles.

The piston and piston ring package of the M275 and M285 also excel on account of being designed to handle extremely high pressure and temperature loads.

Connecting rod

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Forged steel conrods made of crack-capable forged steel are used. To protect the extremely high loads DaimlerChrysler is using a high-strength forged material for the first time.

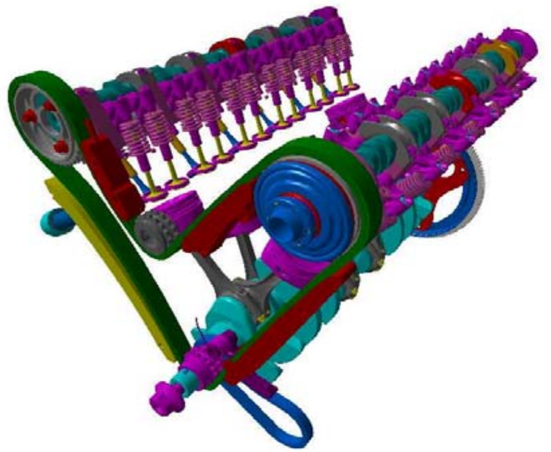
As previously with the 137 engine für reasons of higher dimensional accuracy in the M275 and M285 engines the lower connecting rod eye is cracked (broken) and bolted to the crankshaft's main bearing.

Cylinder head

The aluminum cylinder heads come with the 3-valves-per-cylinder technology familiar from the M137. Each cylinder bank contains a camshaft, which actuates both the inlet and exhaust valves by means of cam followers.

The M275 and M285 engines do not need camshaft adjustment, as their torque increasing function in combination with turbo charging is rendered superfluous.

Chain drive



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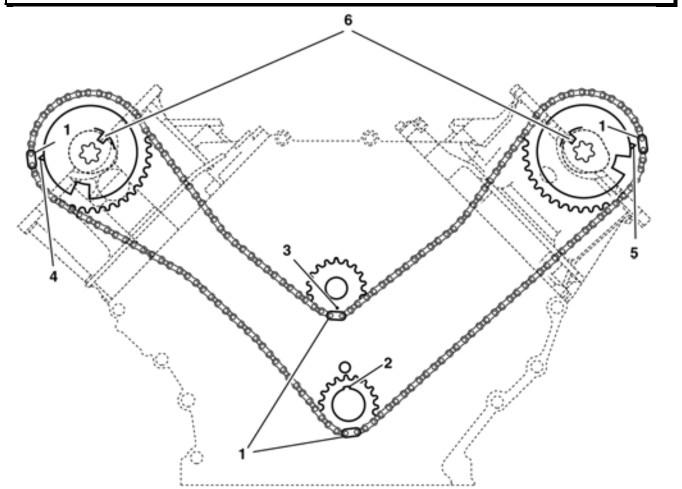
Camshaft drive ensues from the crankshaft by means of a twin roller chain. A sprocket wheel is used in the V-center for deflection purposes. Otherwise the chain is routed through slightly bent slide rails.
The chain tensioning force is achieved over a tensioning rail by means of a hydraulic chain tensioner.

In order to improve the noise characteristic of the chain drive, the sprocket wheel of the crankshaft, the guide wheel and the camshaft are rubberized.

To optimize the overall length the oil pump drive has been located downstream of the timing chain. The oil pump chain drive is designed as a single roller chain.

Engine control



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How is the engine control's basic adjustment made?

The basic adjustment is 30° ATDC. At 30° ATDC the groove (6) of the camshaft at left and right is centered relative to the separating surface for the cylinder head cover towards the inner-V. To fasten the camshafts, the special tool familiar from the M137 can be used. The groove on the crankshaft gear (2) points to the mark on the crankcase. The guide wheel (3) without a mark need not be considered.

1	Copper plated connecting link, two each for camshaft sprocket adjustment	
2	Groove in crankshaft	
3	Guide wheel without mark	
4	Mark on camshaft sprocket at right	R
5	Mark on camshaft sprocket at left	L
6	Groove in camshaft	

Service tip

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The following must be noted when removing and installing the upper oil pan:

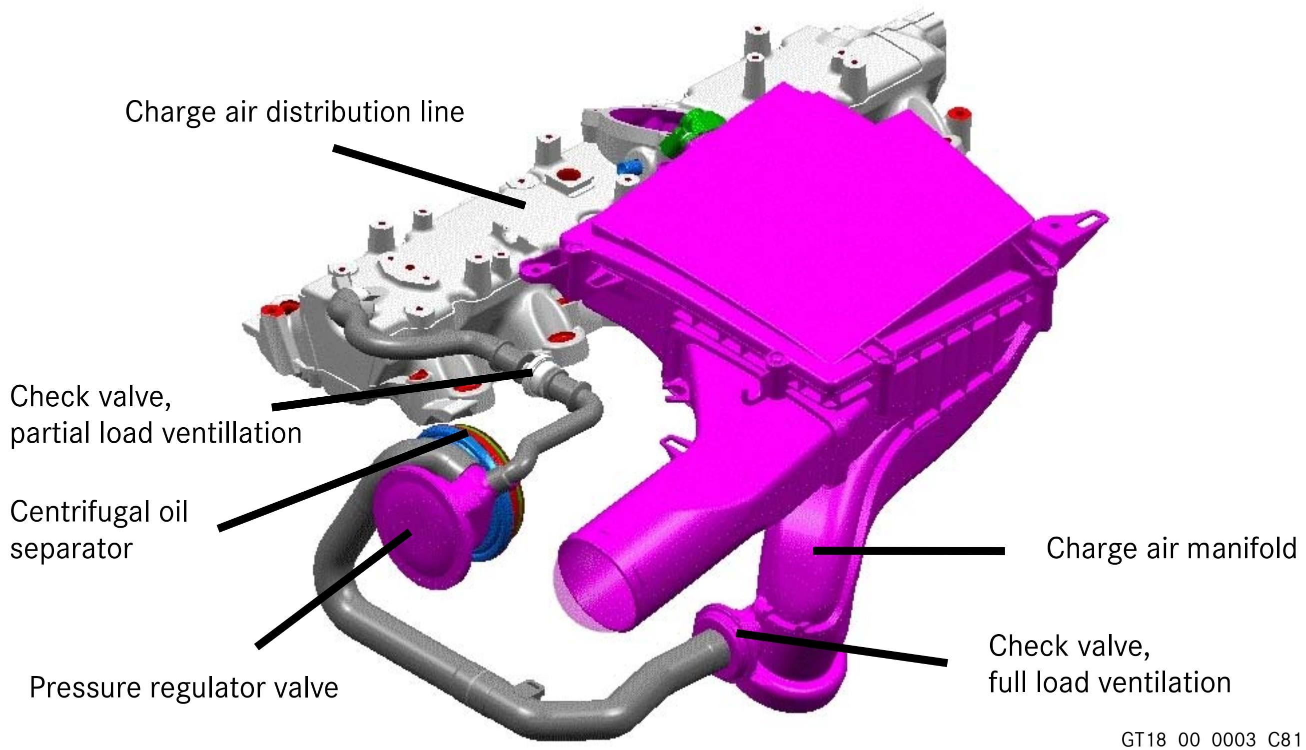
A copper connecting link is located at one of the screws, which serves to set up the ground connection between the oil sensor and the crankcase.
Never forget this when assembling!

Oil separator

The oil-air-fuel mixture is aspirated by the vacuum in the charge air distribution line, or charge air manifold.
It is routed from the timing-chain compartment to the centrifugal oil separator where the oil is separated from the air-fuel mixture.
Following this, the air-fuel mixture is routed to the pressure regulator valve. The separated oil is fed back to the oil pan over the timing-chain compartment.

Partial load ventilation
During partial load ventilation the air is routed across the check valve into the charge air distribution line.

Full load ventilation
During full load ventilation the partial load ventilation line is closed by the boost pressure applied to the check valve. The air separated from the oil is then routed to the charge air manifold downstream of the air cleaner.



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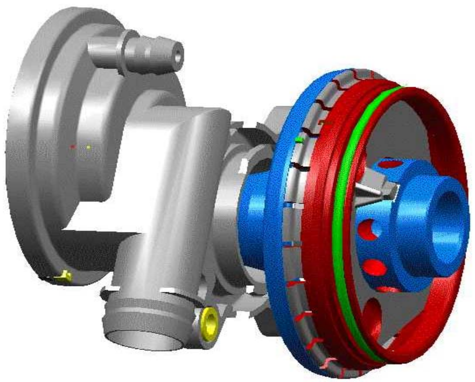
Pressure regulator valve



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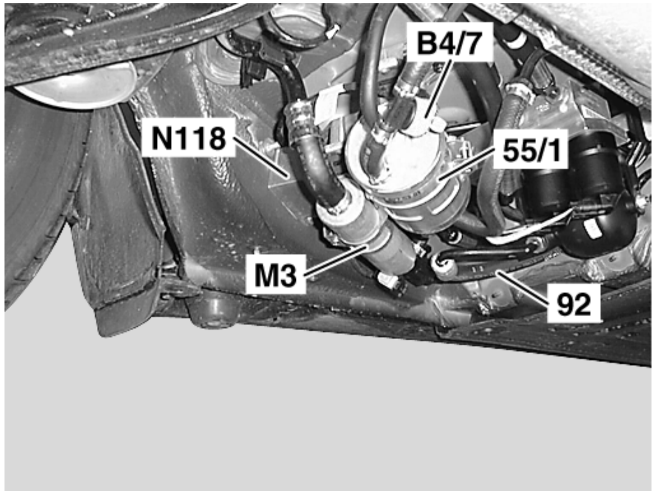
At a specific vacuum (> 50 mbar) in the charge air manifold the connection to the crankcase is sealed by means of a diaphragm in the pressure regulator valve.
If the pressure in the crankcase rises above a specific value, the diaphragm is opened and thus the connection to the charge air manifold set up again.

General



In order to prevent any increase in temperature in the fuel tank caused by the heated-up fuel return flow, vehicles with the 275 and M285 engines also have the fuel system designed as an induction system.

The fuel pump (M3) draws in the fuel from the fuel tank and pumps it through the modified fuel filter (55/1) with integrated overflow valve to the injection valves on the fuel distribution tube.

The fuel supply is assumed by the tried-and-tested helical spindle pump, which had to be modified however, because of the higher fuel requirements of the engines at full load.
New is the electronic control of the fuel pump (M3), which regulates the delivery volume depending on the engine's instantaneous fuel requirements. This in turn serves to enhance the pump's noise and wear characteristics.

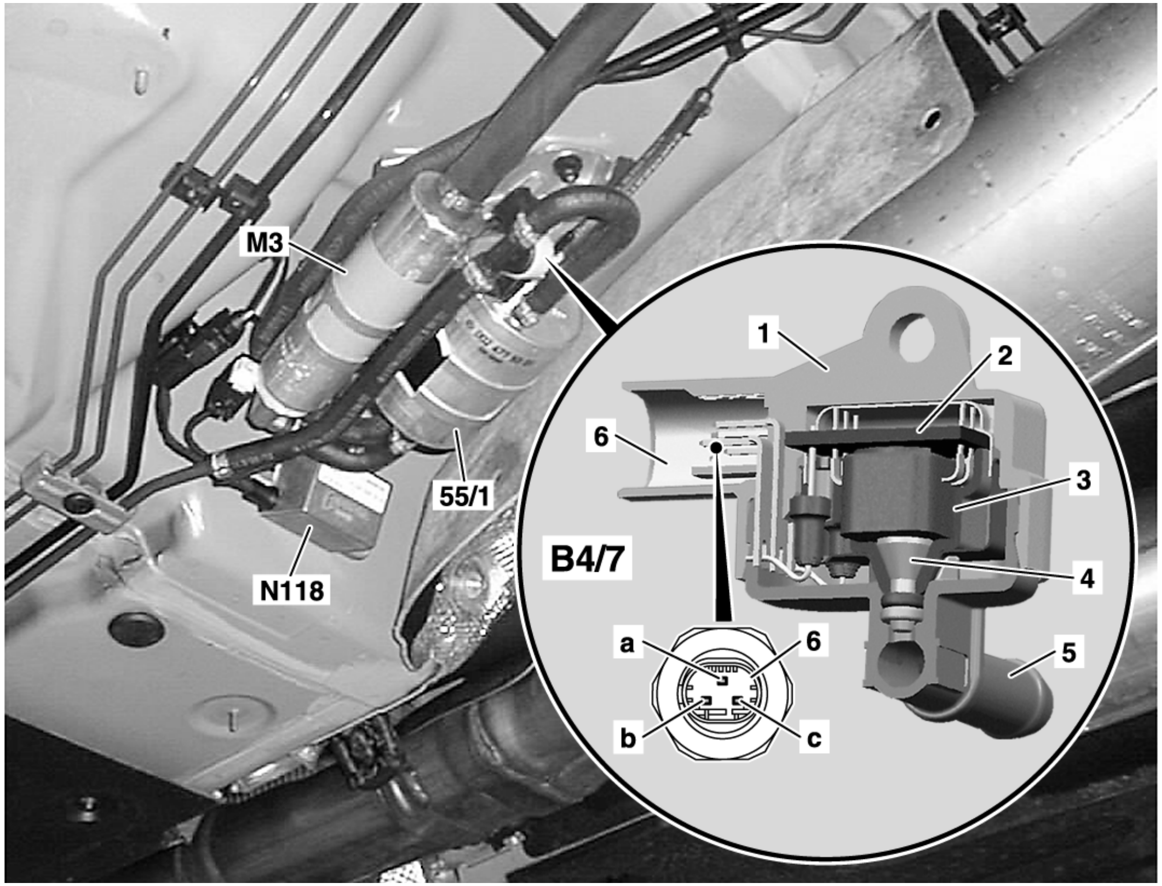
Pressure control

Pressure control is set up via the fuel pressure sensor (B4/7), which is installed in the admission line downstream of the fuel filter (55/1) and which converts the fuel pressure into a voltage signal. This voltage signal is evaluated in the fuel pump control module (N118). A pulse width modulated signal (operating voltage) is used to regulate the speed of the fuel pump (M3) such that the system pressure of approx. 3.8 bar is held constant.
If the system pressure drops, e.g. below approx. 3.7 bar, the delivery volume (rotational speed) of the fuel pump is increased until such time as the system pressure is reached again.

At the maximum power consumption of the fuel pump of approx. 16 A (coupling on fuel pressure sensor (B4/7) detached), a fuel pressure of approx. 9 bar is reached.

Fuel pressure sensor

55/1	Fuel filter (55/1) with integrated overflow valve
B4/7	Fuel pressure sensor
M3	Fuel pump
N118	Fuel pump control module



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Cross section of fuel pressure sensor
1 Housing upper part
2 Electronic board
3 Coil
4 Armature
5 Housing lower part with hose connections
6 Electrical connection
 a Ground
 b Signal
 c Voltage supply (5 V)

Design and function

The fuel pressure sensor (B4/7) consists of a coil (3), a movable armature (4) and an electronic system (2).
As fuel pressure increases,the armature in the coil is moved, the inductivity (magnetic field) alters. This is registered by the electronic system and sent as a signal to the fuel pump control module (N118) (approx. 0.5 V at 0 bar; approx. 4.5 V at 9 bar).
The voltage supply for the fuel pressure sensor is set up by way of the fuel pump control module.

Fuel filter

The fuel filter (55/1) with integrated overflow valve is designed for the new pressure control for the engines. In other words, the overflow valve opens slightly at a system pressure of approx. 3.8 bar (release pressure for overflow valve approx. 3.5 bar). The throttled return flow of the overflow valve leads back to the fuel tank (75) and supplies the suction jet pump for the purpose of charging the swirl pot in the fuel tank.
After switching off the engine, the overflow valve assumes the task of a check valve and closes the admission line to the fuel tank and thus holds the system at a specific pressure (holding pressure).

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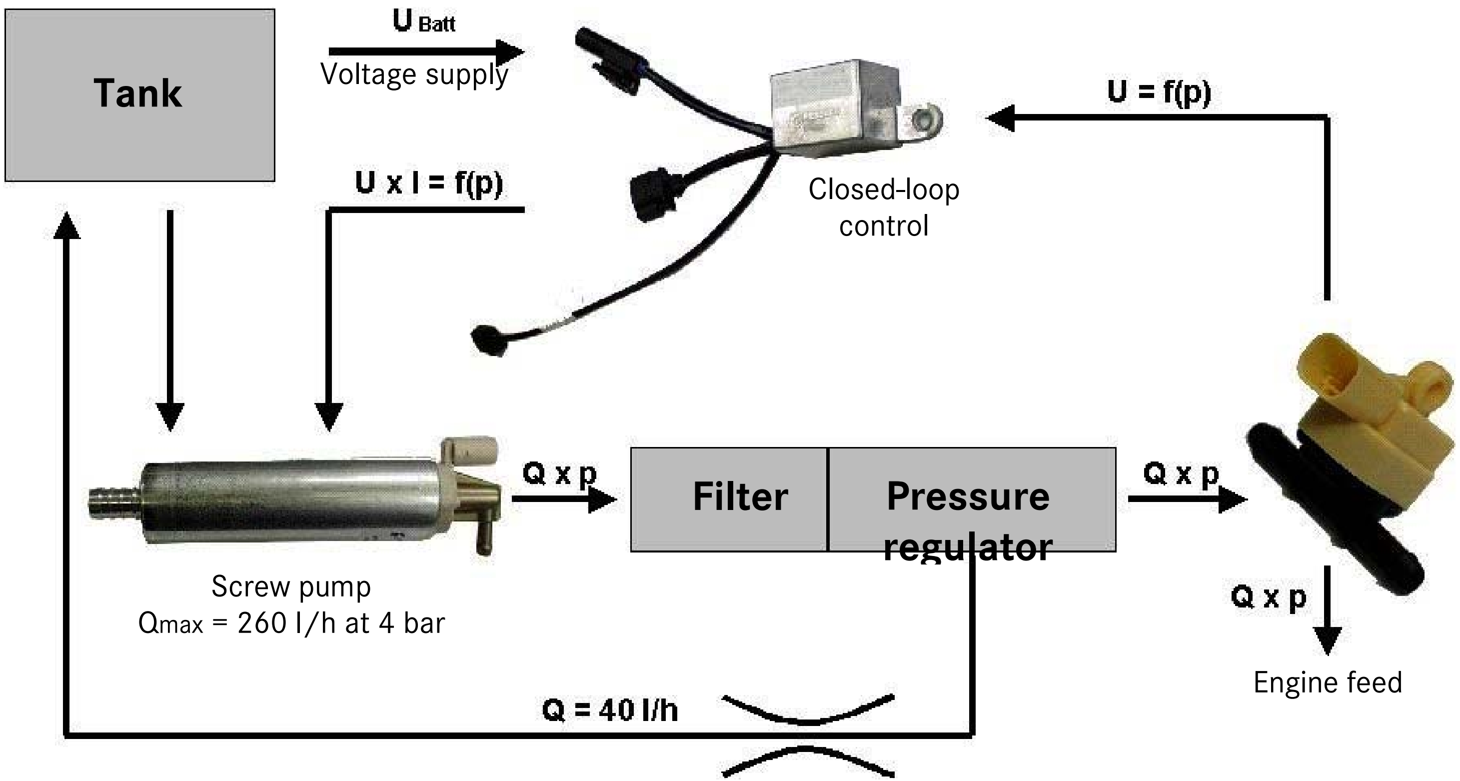
Fuel pump control module

The fuel pump control module (N118) consists of the control system, electronic circuit and a wiring harness, which leads to the fuel pressure sensor (B4/7) and the fuse and relay module.

The voltage supply of the fuel pump control module is set up by way of the fuel pump relay.

Advantages of electronically regulated fuel supply

* Temperature reduction of fuel return
* Lower noise emission
* Relay function can be implemented.
* Relief to on-board electrical system of up to 40 %
* Extended fuel pump service life
* Pressure and volume flows can be regulated according to a desired performance map.
* Starting pressure and volumetric flow can be regulated (start-time optimization)
* Fuel saving up to 0.15 l/100 km
* Constant supply of ancillary assemblies (e.g. suction jet pumps)
* Pollutant reduction
* Extended change interval for fuel filter (lifetime)



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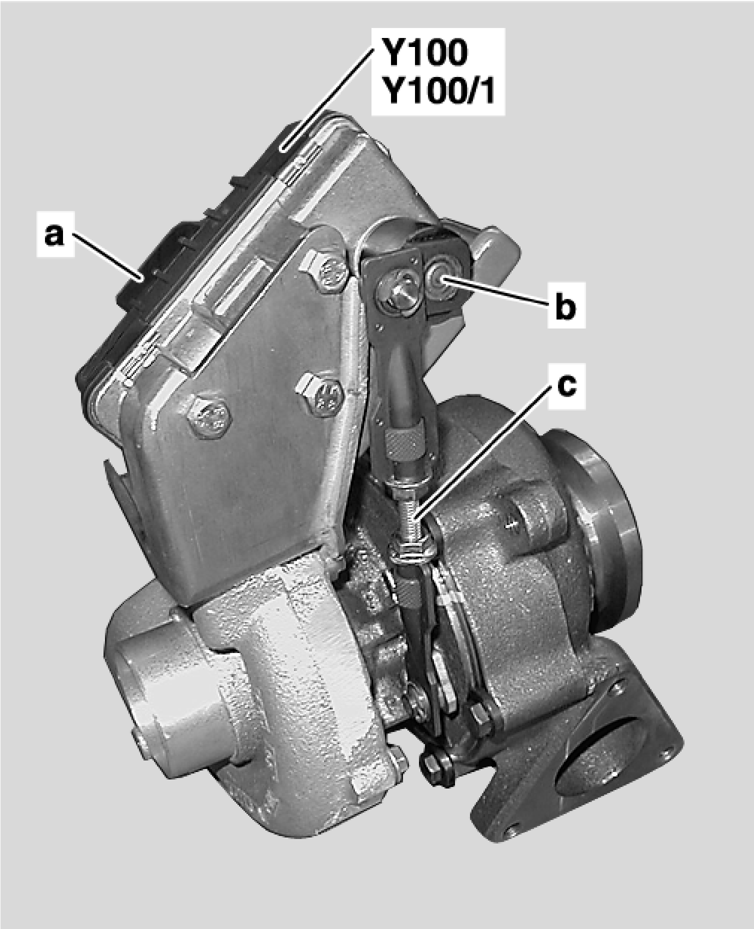
Exhaust gas turbocharger

Advantages	Disadvantages
↳ No additional drive required, and in turn almost loss-free operation possible. ↳ The lower exhaust-gas temperatures for diesel engines result in inexpensive material outlay for exhaust-gas routing parts. ↳ Lower noise development ↳ Low weight ↳ Inexpensive ↳ Matured technology ↳ On account of high supercharger speeds (speeds approx. 10x greater than mechanical supercharger), and thus high power density, the exhaust gas turbocharger can be better deployed with large-displacement engines	↳ The exhaust gas turbocharger must be fastened close to the exhaust manifold for efficiency reasons; this in turn means that high thermal loads are generated for adjacent parts (e.g. heating up of suction and charge air), resulting in extensive sealing measures being necessary. ↳ Without variable turbine geometry (VTG) a high boost pressure is not reached until at medium to high speeds. ↳ Responds with delay only to fast changes in accelerator pedal position, as the inertia of mass of the exhaust gases prevents them from following any fast load changes ("turbo lag"). ↳ In the lower speed range the exhaust gas turbocharger fails to reach the required speed (lower rate of air flow), and thus a high turbine speed is not reached, resulting in a low engine output only. ↳ Separate secondary air injection pump required. ↳ The upper speed range records extremely high turbine speeds (higher boost pressure), thus a boost pressure control is required. ↳ Connection to cooling and oil circuit required

Exhaust gas turbocharger with variable turbine geometry for diesel engines with CDI 2, CDI 3 and CDI V1



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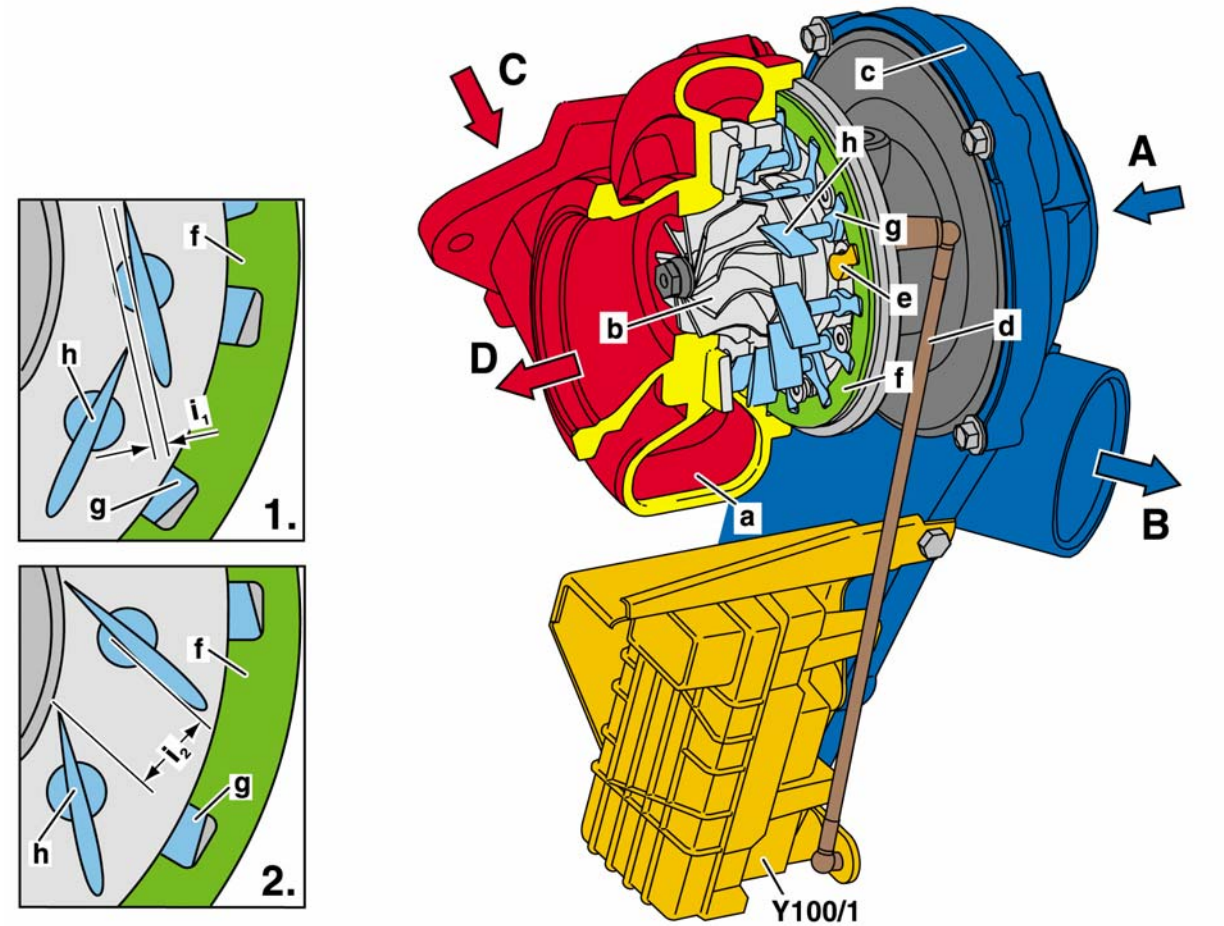

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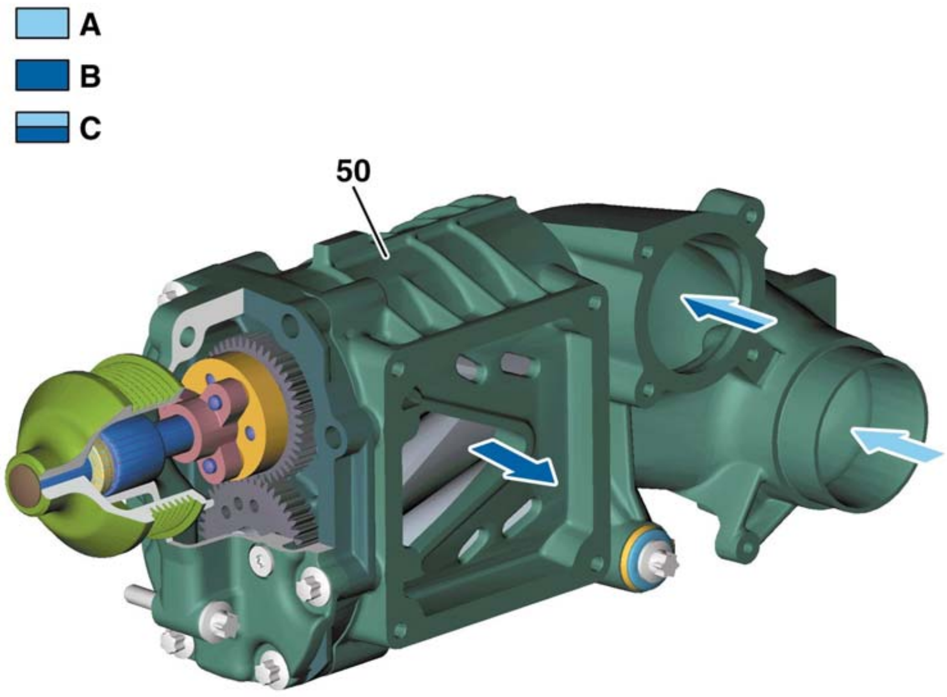
Mechanical supercharger

Advantages	Disadvantages
↳ Faster build up of boost pressure, fast engine response characteristics, no "turbo lag". ↳ No intervention in engine's exhaust-gas system required, this in turn means that simple and versatile design of exhaust routing possible. ↳ Connection to oil circuit not necessary. ↳ Boost pressure control not necessary (helical spindle compressor). ↳ Secondary air injection possible via compressor. ↳ Air routing components can be arranged at a sufficiently large distance away from the exhaust-gas system, thus avoiding any overheating of the suction and charge air. ↳ No heat loss following cold start in exhaust-gas system, which results in faster three way catalytic converter heating up.	↳ The supercharger requires additional engine output for drive (on average approx. 15-20 kW, for the M112.960 approx. 42 kW at full load). ↳ High noise development ↳ Extensive manufacturing process ↳ High extra weight for overall engine ↳ Separate cooling circulation required

Roots blower M111 (EVO)



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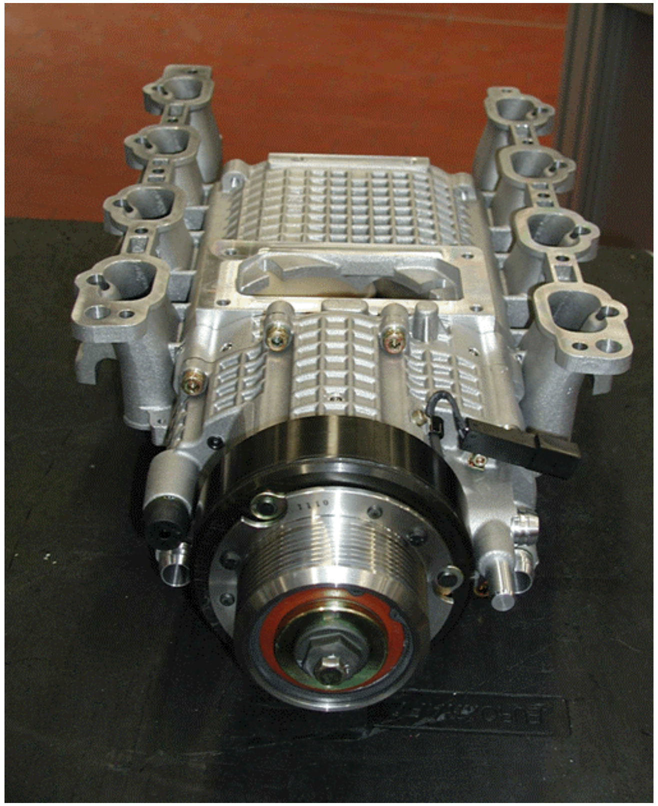
Screw-type compressor M113



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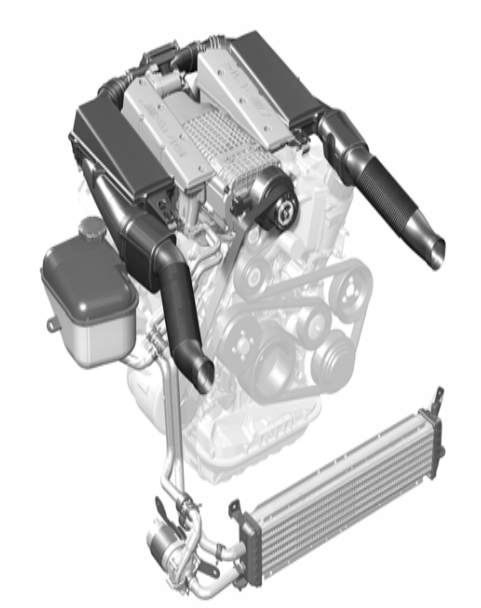

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P09.10-2053-76

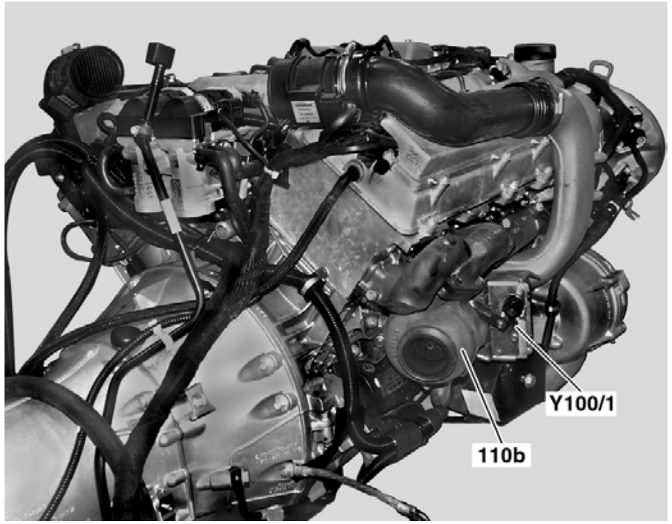
Why do the 112/113 engines have a mechanical supercharger and not an exhaust gas turbocharger?

- The mechanical supercharger enjoys an excellent image which in turn makes it easier to sell (solid history).

- An exhaust gas turbocharger has to be considered right at the start of a new engine's development because of its high space requirement (for this reason V-engines with turbocharger always have a smaller V-angle, 70° ±5°, than V-engines with mechanical supercharger). This in turn rules out any subsequent "add-on solution".

- The mechanical supercharger as an "add-on solution" is easier to design, particularly for V-engines M112/113, the supercharger and charge air cooler can be accommodated more easily.

- On the M112 an exhaust gas turbocharger could not be fitted because of the V-angle of 90° (lack of installation space).



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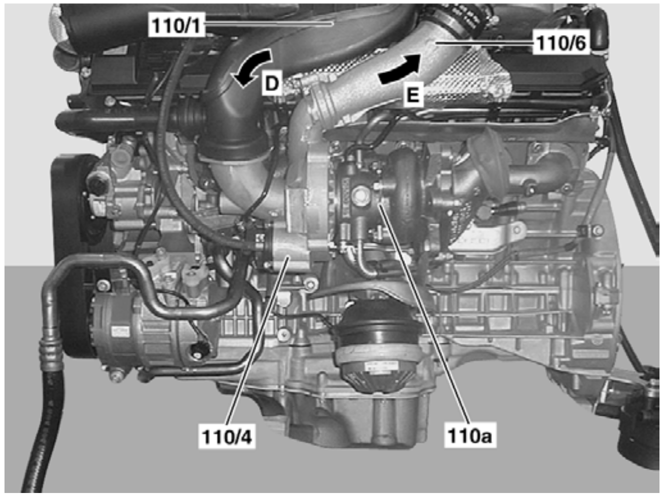


P09.40-2056-11

Why use exhaust gas turbochargers for the 628 and 275 engines?

- These engines are large-displacement V-engines, in which the exhaust gas turbocharger offers advantages over the mechanical supercharger.

- The V-angle on these engines is 60 or 70°, as a consequence the exhaust gas turbocharger variant is preferred for these engines.

In comparison to the predecessor engine M137, the rated output and rated torque for the new engine 275 have been increased by approx. 30 % or 50 %.

Because a corresponding increase in displacement was ruled out due to the wish to keep to a moderate fuel consumption, a compact design and due to expected impairments in comfort, a slightly reduced displacement with charging with two exhaust gas turbochargers and charge air cooling was selected.

The usual camshaft adjustment as found in the other engines, which in particular serves to boost the pulling power in the lower speed range has been dispensed with. The bi-turbo charging aspirates the twelve-cylinder engine so effectively that the driver can call up the tremendous power reserves even at very low speed.

In figures:
At 1,000 rpm there are already 500 Newton meters of torque on call, at 1,500 rpm the 600 Newton meter barrier is broken through and as from 1,800 rpm the engine achieves its maximum torque which is for car production engines of 800 Newton meters, which remains constant at 3,500 rpm.

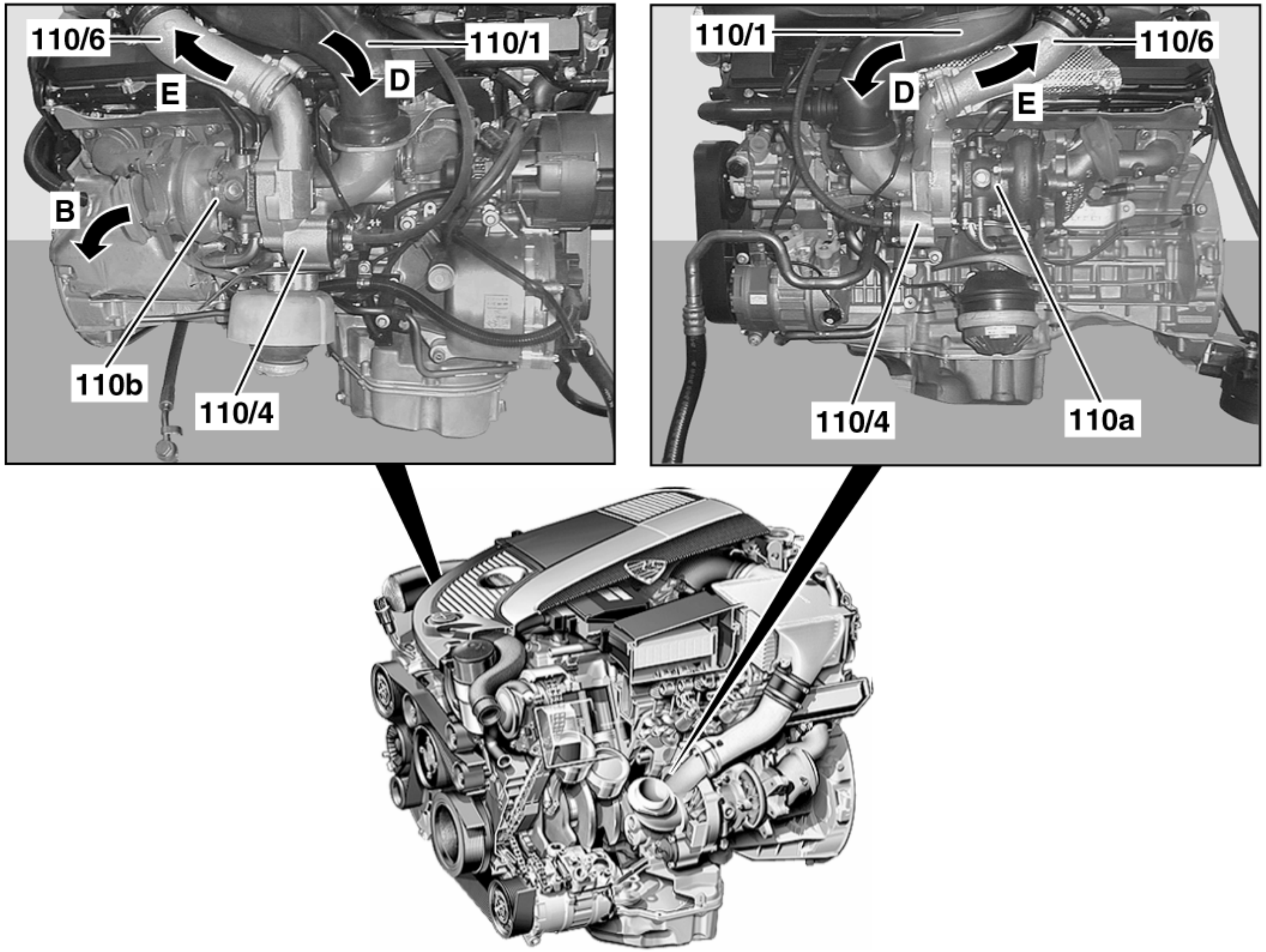
The peak performance of the V12 engine of 368 kW (500 hp) is available at 5,000 rpm.

One exhaust gas turbocharger each (110a, 110b) with wastegate control per cylinder bank supports the engine's fresh air supply.

In doing so the turbine wheel in the exhaust gas turbocharger is driven by the exhaust flow (B). Fresh air (D) is routed over the suction line (110/1) to the intake side of the exhaust gas turbocharger. The compressor turbine wheel, which is permanently mounted by means of a shaft to the turbine wheel, compresses the fresh air. The charge air (E) is routed via the charge air pipe (110/6) to the engine.

The deceleration air valve (110/4), which is mounted straight onto the turbocharger, serves to minimize charger noise.

Exhaust-gas turbocharging development mainly focused on the response characteristic in combination with the achievement of maximum torque at as low as possible engine speed. Apart from this special emphasis is placed on the acoustic characteristics.



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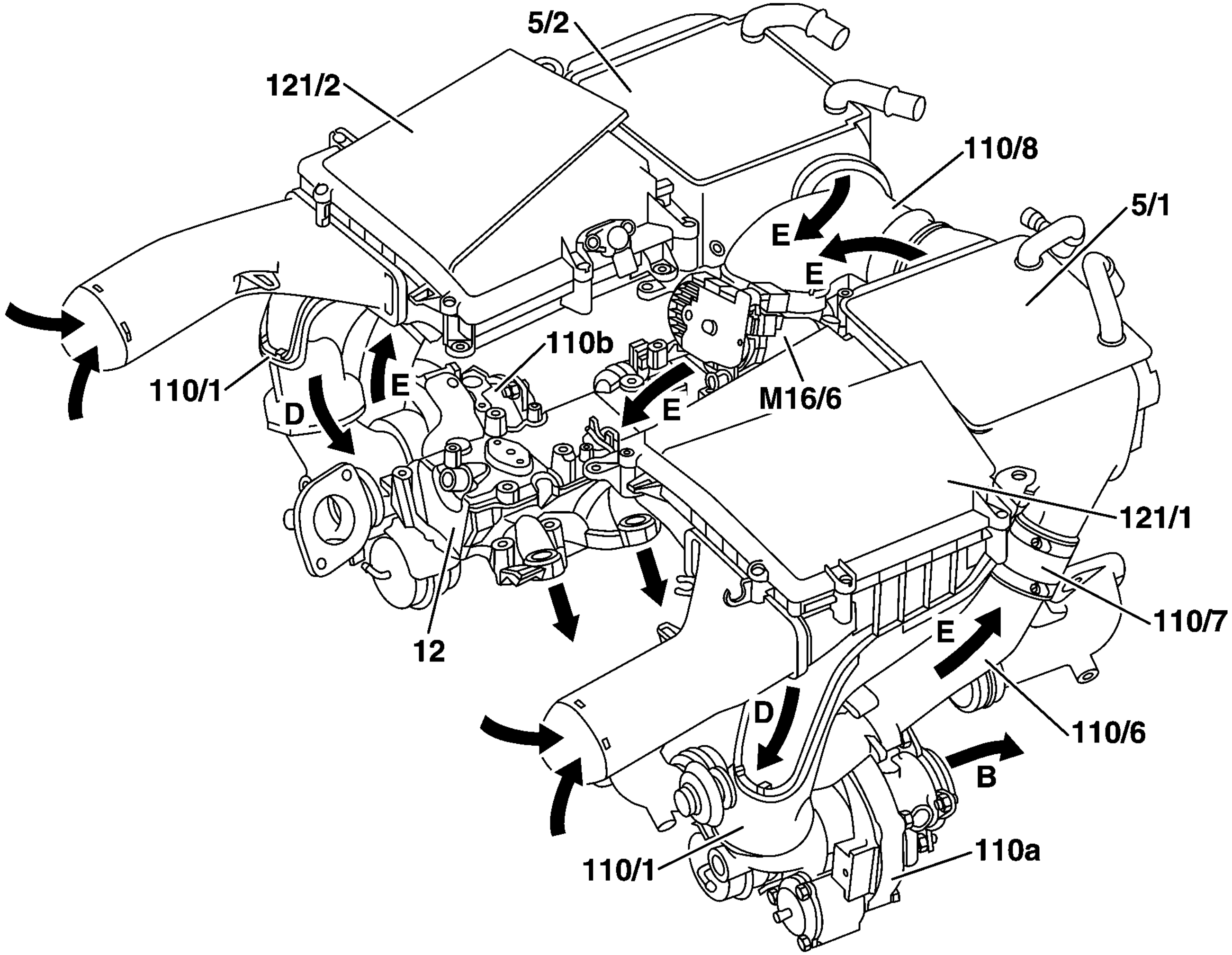
Function



5/1	Charge air cooler for left cylinder bank
5/2	Charge air cooler for right cylinder bank
12	Intake manifold
110a	Left exhaust gas turbocharger
110b	Right exhaust gas turbocharger
110/1	Intake line/air cleaner housing
110/6	Boost pressure pipe
110/7	Hose piece with hose clamp
110/8	Y-connecting piece
121/1	Air cleaner for left cylinder bank
121/2	Air cleaner for right cylinder bank
M16/6	Throttle valve actuator
B	Exhaust
D	Clean air (downstream of air cleaner)
E	Charge air

P09.40-2063-06

For exhaust-gas turbocharging the flow energy of the exhaust gases (B) from each cylinder bank is used to drive the turbocharger (110a, 110b). The exhaust gas turbochargers draw in the clean air (D) downstream of the air cleaners (121/1, 121/2) via the suction line (110/1). The compressed air is cooled in the charge air cooler (5/1, 5/2). The charge air (E) flows from the right and left exhaust gas turbochargers through the boost pressure pipe (110/6), a hose coupling (110/7) and Y-connecting piece (110/8) jointly over the throttle valve actuator (M16/6) to the intake manifold (12).

For each cylinder bank a coolant cooled exhaust gas turbocharger (bi-turbo) made of cast steel is installed. The location on the exhaust manifold itself ensures an optimum response and thus higher boost pressure even at low speeds. Short exhaust gas channels serve to ensure a fast heating up and an excellent degree of efficiency for the three way catalytic converters.

The exhaust gas turbochargers generate boost pressure as from approx. 1,500 rpm. The maximum boost pressure of 1.9 bar is reached at approx. 2,000 rpm. In accordance with the load the quantity injected and ignition timing are issued by the engine control module.
The boost pressure is recorded by the signal from the pressure sensor upstream of the throttle valve actuator (B28/6) and the load by the signal from the pressure sensor downstream of the throttle valve actuator (B28/7).

A boost pressure control is performed for both exhaust gas turbochargers by the boost pressure control pressure transducer (Y31/5) and the vacuum cell actuated pressure regulator valves (wastegate valves) in the turbine housings. This is additionally followed by fast interventions and load settings below the basic charge pressure over the throttle valve actuator.

The cooled air downstream of the charge air coolers has a higher density. As a result the cylinder charge is increased and thus engine output. Furthermore, the tendency to knock is also reduced. At a charge air temperature less than 70 °C the maximum boost pressure is released. The charge air temperature sensor (B17/8) is located on the intake manifold.

At too high charge air temperature, air bubbles in the low-temperature cooling circuit may be the cause.

During the transition from load to deceleration a deceleration air valve is opened at each compressor housing. This in turn serves to cut back the boost pressure quickly and prevent any charging noise.
Downstream of each air cleaner in the air cleaner housing a pressure sensor (B28/4, B28/5) is installed, in order to recognize the pressure drop across the air cleaner. To limit the maximum charger speed, the pressure ratio downstream/upstream of the compressor (pressure value of B28/6 to B28/4 and B28/5) is calculated and regulated by the map-dependent boost pressure control.
At high altitudes the maximum boost pressure is limited.

Exhaust gas turbocharger

The exhaust gas turbochargers (110a, 110b) are steel cast and their integration into the exhaust manifold (14) of cylinders 2-4 on the right side, as well as cylinders 8-10 on the left side of the engine takes up little space.

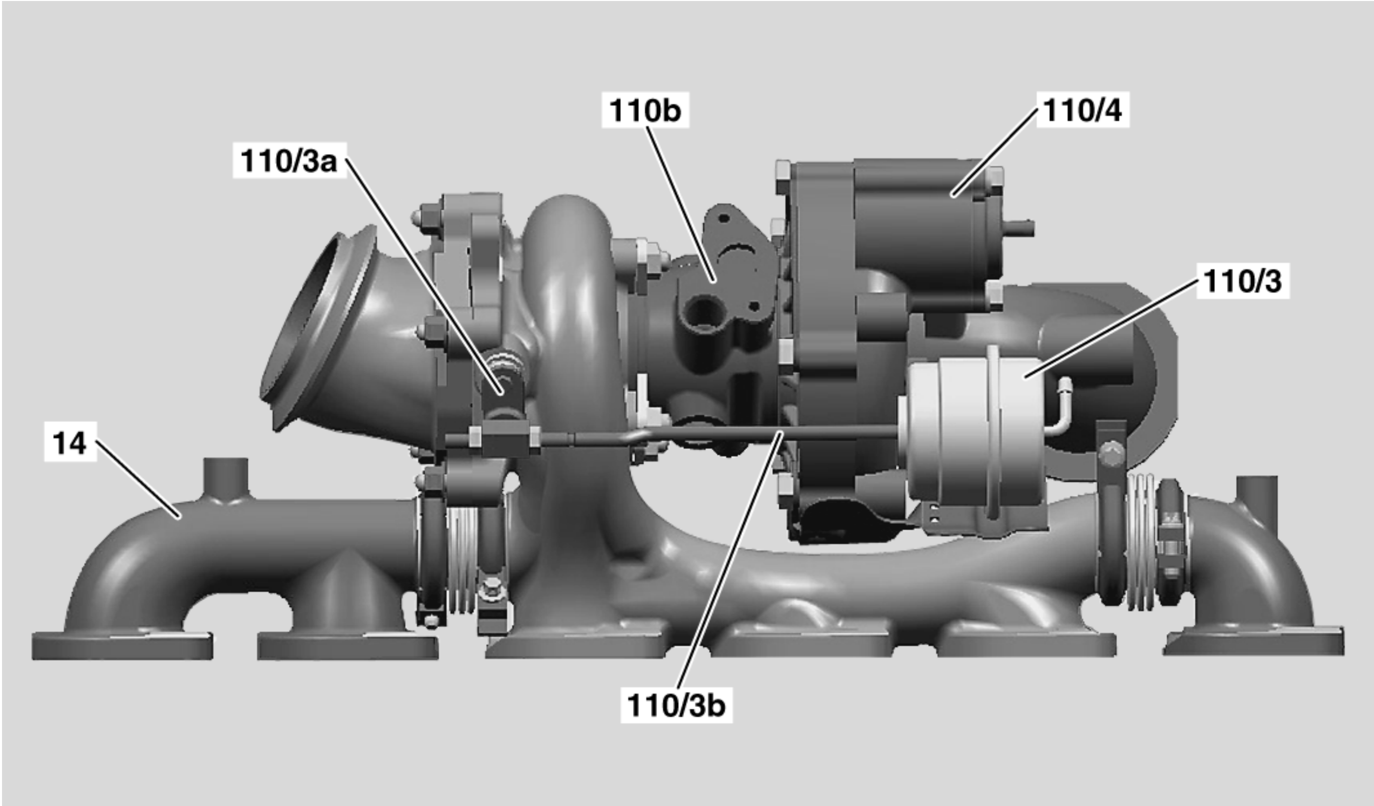
In addition to this, the compact layout and design enables faster response of the three way catalytic converters during a cold start.

The exhaust gas turbochargers are made by the 3K-Warner company. They bear the designation K24.2-2472 DXB 6.81.

The delivery specification for the exhaust gas turbocharger contains the following components:

* vacuum cell (110/3)
* boost pressure control valve (110/3a)
* control rod (110/3b)
* deceleration air valve (110/4)

Maximum supercharger speed can be up to 160,000 rpm.



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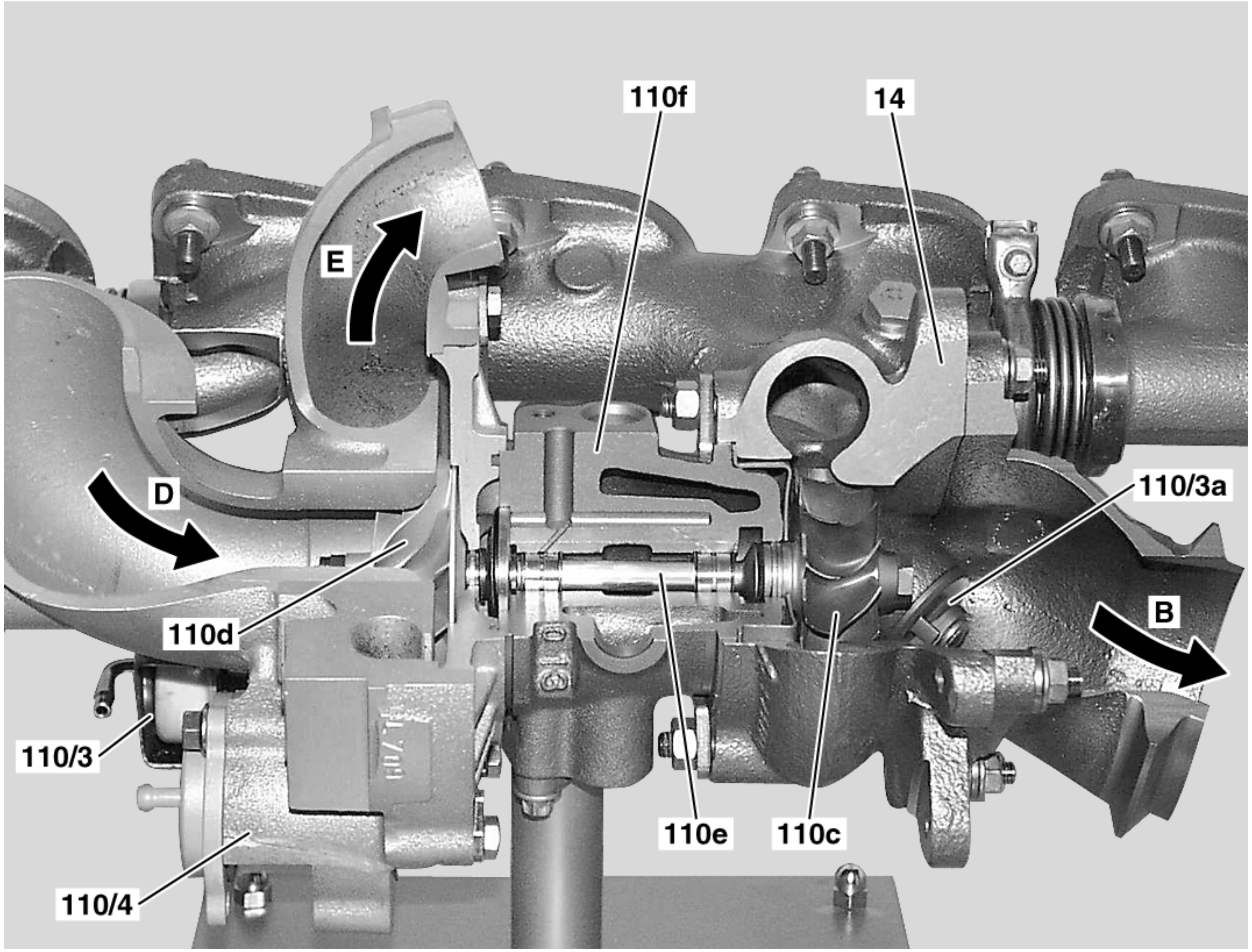
14	Exhaust manifold
110b	Right exhaust gas turbocharger (from below)
110/3	Vacuum cell
110/3a	Boost pressure control valve
110/3b	Control rod
110/4	Deceleration air valve

Cross section of left exhaust gas turbocharger model



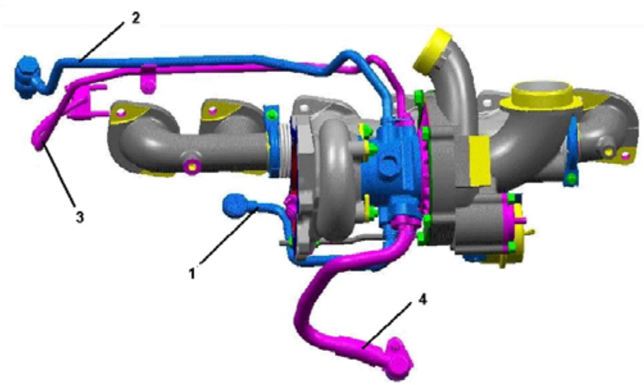
P09.40-2055-06

14	Exhaust manifold
110c	Turbine wheel
110d	Compressor turbine wheel
110e	Shaft
110f	Shaft housing
110/3	Vacuum cell
110/3a	Boost pressure control valve
110/4	Deceleration air valve
B	Exhaust
D	Clean air (downstream of air cleaner)
E	Charge air

Design and function

The exhaust gases of each cylinder bank are routed over the exhaust manifold (14) into the turbine housing onto the turbine wheel (110c). The exhaust gas flow energy (B) induces the turbine wheel to turn. As a result the compressor turbine wheel (110d), which is connected by means of a shaft (110e) mounted in the shaft housing (110f) to the turbine wheel, is driven at the same speed. The clean air (D) draw in by compressor turbine wheel is compressed (E) and routed to the engine.
Boost pressure control ensues by way opening and closing the boost pressure control valve (110/3a), which releases a bypass around the turbine wheel. The boost pressure control valve is actuated via a vacuum cell (110/3) using a control rod.
The controlled range on the control rod is approx. 5 to 13 mm. The vacuum cells (110/3) of both exhaust gas turbochargers jointly have pressure applied to them from the boost pressure control pressure transducer (Y31 /5).

Each exhaust gas turbocharger has a deceleration air valve (110/4), which during the transition from full load to deceleration releases a bypass around the compressor turbine wheel. The rapid drop in pressure serves to prevent any charging noise.



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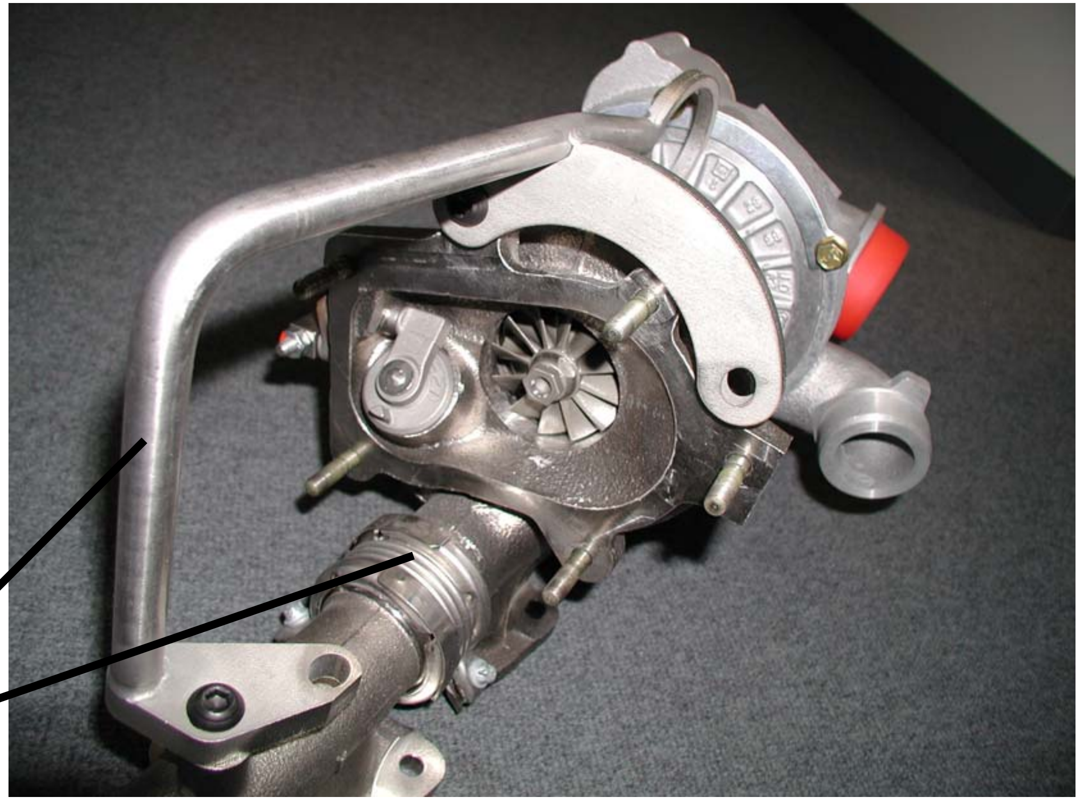
The shaft housings for both exhaust gas turbochargers are coolant cooled and connected to the engine's cooling circuit. Similarly, the exhaust gas turbocharger is connected to the oil circuit to safeguard lubrication of the rotating parts.

The oil-water heat exchanger in the "V" of the engine is no longer applicable.
The compressor turbine wheel on the left exhaust gas turbocharger may have a slight covering of oil caused by vapors from the crankcase ventilation.

1 Coolant from crankcase (feed)
2 Coolant to cylinder head (return flow)
3 Engine oil from main oil duct (feed)
4 Engine oil to crankcase (return flow)

Assembly note

* The new exhaust gas turbochargers are delivered with an assembly tool.
  This may not be removed until after assembly has been completed. In addition to easing the assembly task it also serves to protect the expansion element during transport.
* The deceleration air valve on the exhaust gas turbocharger can be replaced separately.



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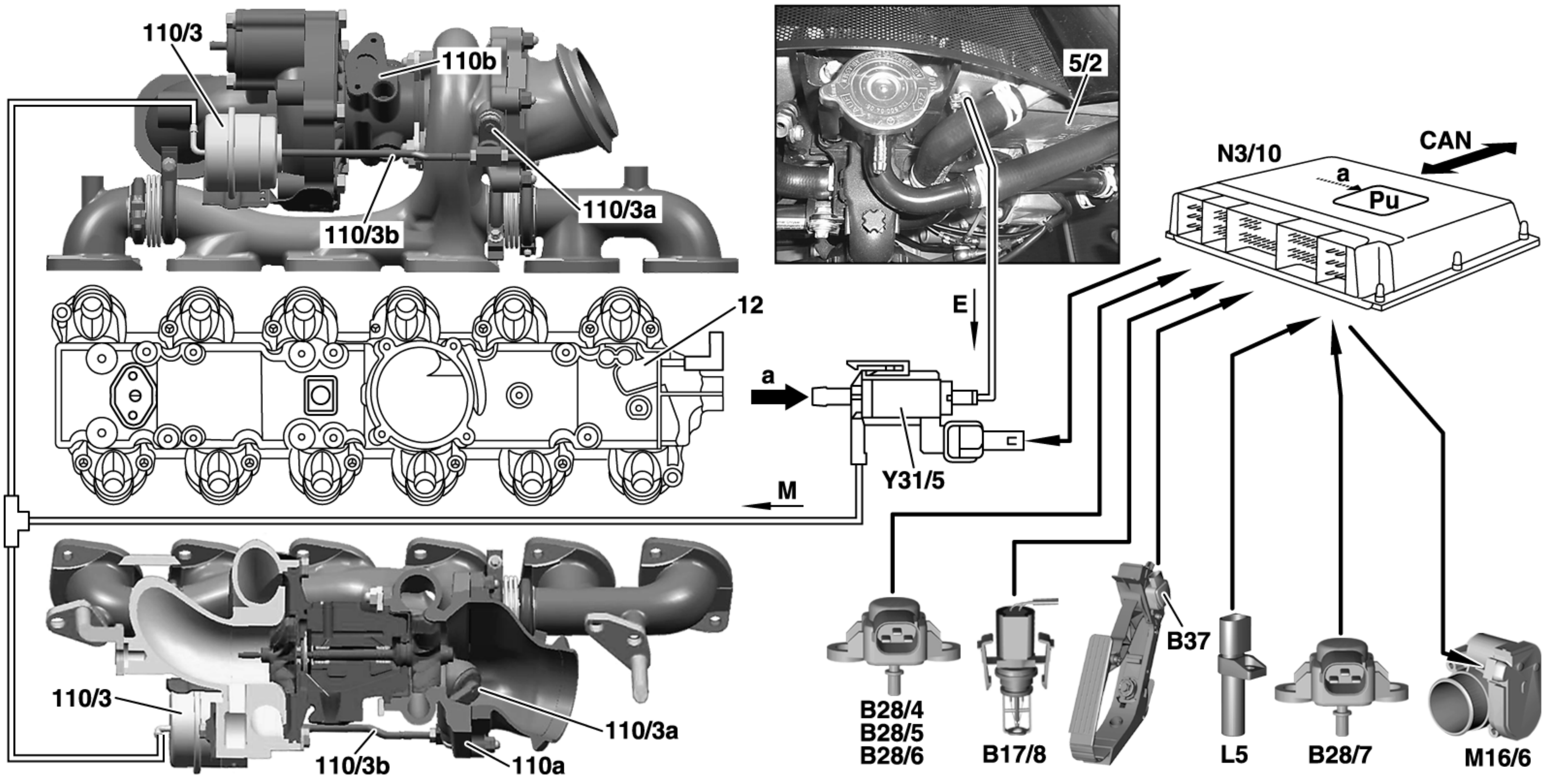
Boost pressure control



P07.61-2726-09

5/2	Charge air cooler for right cylinder bank
12	Intake manifold
110a	Left exhaust gas turbocharger
110b	Right exhaust gas turbocharger
110/3	Vacuum cell
110/3a	Boost pressure control valve
110/3b	Control rod
B17/8	Charge air temperature sensor
B28/4	Pressure sensor downstream of air cleaner on left cylinder bank
B28/5	Pressure sensor downstream of air cleaner on right cylinder bank
B28/6	Pressure sensor upstream of throttle valve actuator
B28/7	Pressure sensor downstream of throttle valve actuator
B37	Pedal value sensor
L5	Crankshaft position sensor
M16/6	Throttle valve actuator
N3/10	Motor electronics control module (integrated pressure sensor ambient pressure)
Pu	Pressure sensor, ambient pressure
Y31/5	Boost pressure control pressure transducer
CAN	Data bus
a	Ambient pressure
E	Boost pressure
M	Modulated boost pressure

Function

For boost pressure control, the engine control module (N3/10) actuates the boost pressure control pressure transducer (Y31/5) using a pulse width modulated signal at a frequency of 30 Hz. In accordance with the duty cycle of 5 - 95 % the modulated boost pressure (M) is routed to the vacuum cells (110/3) of both exhaust gas turbocharger (110a/110b).

The control rods (110/3b) are used to increasingly open the boost pressure control valves (110/3a) to limit the boost pressure. A part of the exhaust is thus routed past the turbine wheel.

To limit the boost pressure, the pressure ratio downstream/upstream of the compressor (pressure value of B28/6 to B28/4 and B28/5) is calculated and regulated by the map-dependent boost pressure control.
Detection of load ensues through a signal from the pressure sensor downstream of throttle valve actuator (B28/7).

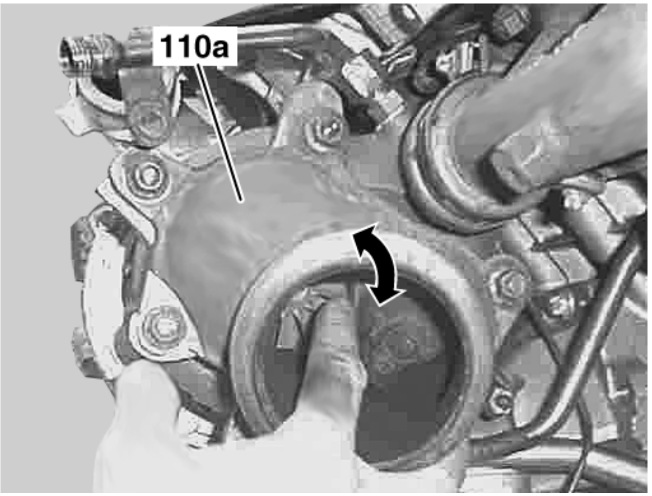
The input parameters for boost pressure control are:

* Boost pressure from pressure sensor upstream of throttle valve actuator (B28/6)
* Load recognition from pressure sensor downstream of throttle valve actuator (B28/7)
* Charge air temperature through charge air temperature sensor (B17/8)
* Ambient pressure (altitude correction), signal from pressure sensor in engine control module
* Engine speed
* Coolant temperature
* Engaged drive position
* Engine oil temperature
* Pressure drop in air cleaner, recognition through pressure sensor downstream of air cleaner (B28/4 and B28/5)
* Exhaust-gas temperature (from model calculation/performance map)
* Active anti-knock control (maximum boost pressure with RON 98 only)
* TWC-damaging combustion misfiring detected

The signal from the charge air temperature sensor (B17/8) is used to release the maximum boost pressure, only when the charge air temperature is less than 70 °C.

In order to protect exhaust gas turbochargers against excess speeds at high altitude operation and with contaminated air cleaners, the maximum boost pressure is restricted through the pressure ratio downstream/upstream of the compressor (pressure values B28/6 to B28/4 and B28/5).

In addition to boost pressure control, under certain conditions (e.g. at excessive boost pressure caused by leaking lines to vacuum cells) a load restriction can also be made by closing the throttle valve.



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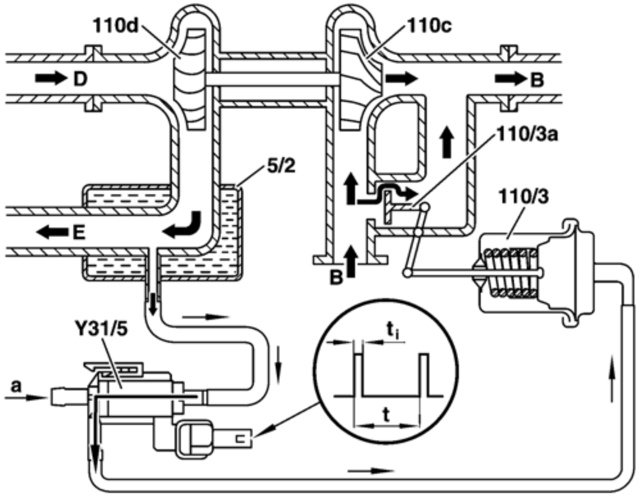
When boost pressure is not available for troubleshooting, proceed as follows:

1. Check leaktightness of boost pressure pipes (check seals and hose clamps between compressor housing and intake manifold)
2. Check function of boost pressure control with boost pressure control pressure transducer (Y31/5)
3. Check leaktightness and actuation of deceleration air valves
4. Check turning capability of both exhaust gas turbochargers (exhaust system removed).



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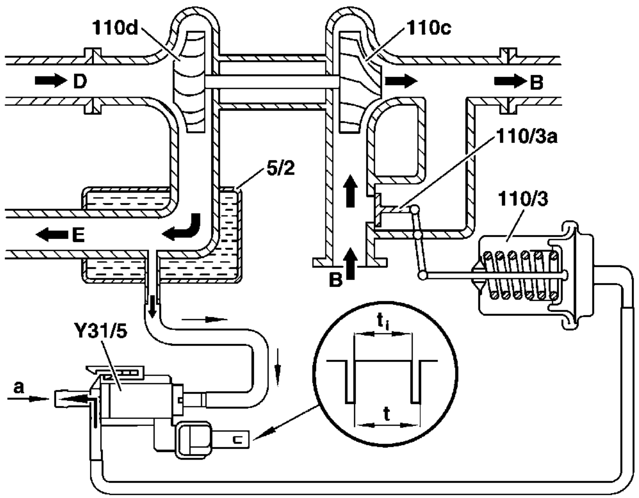
Duty cycle less than 5 %
Without actuation the entire boost pressure in the vacuum cell (110/3) is active. Using the control rod it opens, against spring load, the boost pressure control valve (110/3a) even at low boost pressure (mechanical basic boost pressure approx. 300 mbar). This results in a drop in performance.



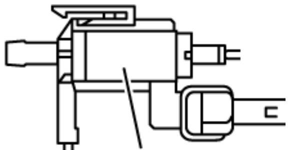
P07.61-2742-11

Duty cycle greater than 95 %
The vacuum cell is vented to the atmosphere (a) so that boost pressure is no longer effective in the vacuum cell. When unpressurized, a spring in the vacuum cell keeps the boost pressure control valve closed. The entire exhaust (B) impels the compressor turbine wheel (110d) via the turbine wheel (110c). A maximum boost pressure is generated. The clean air (D) is turned into charge air (E).

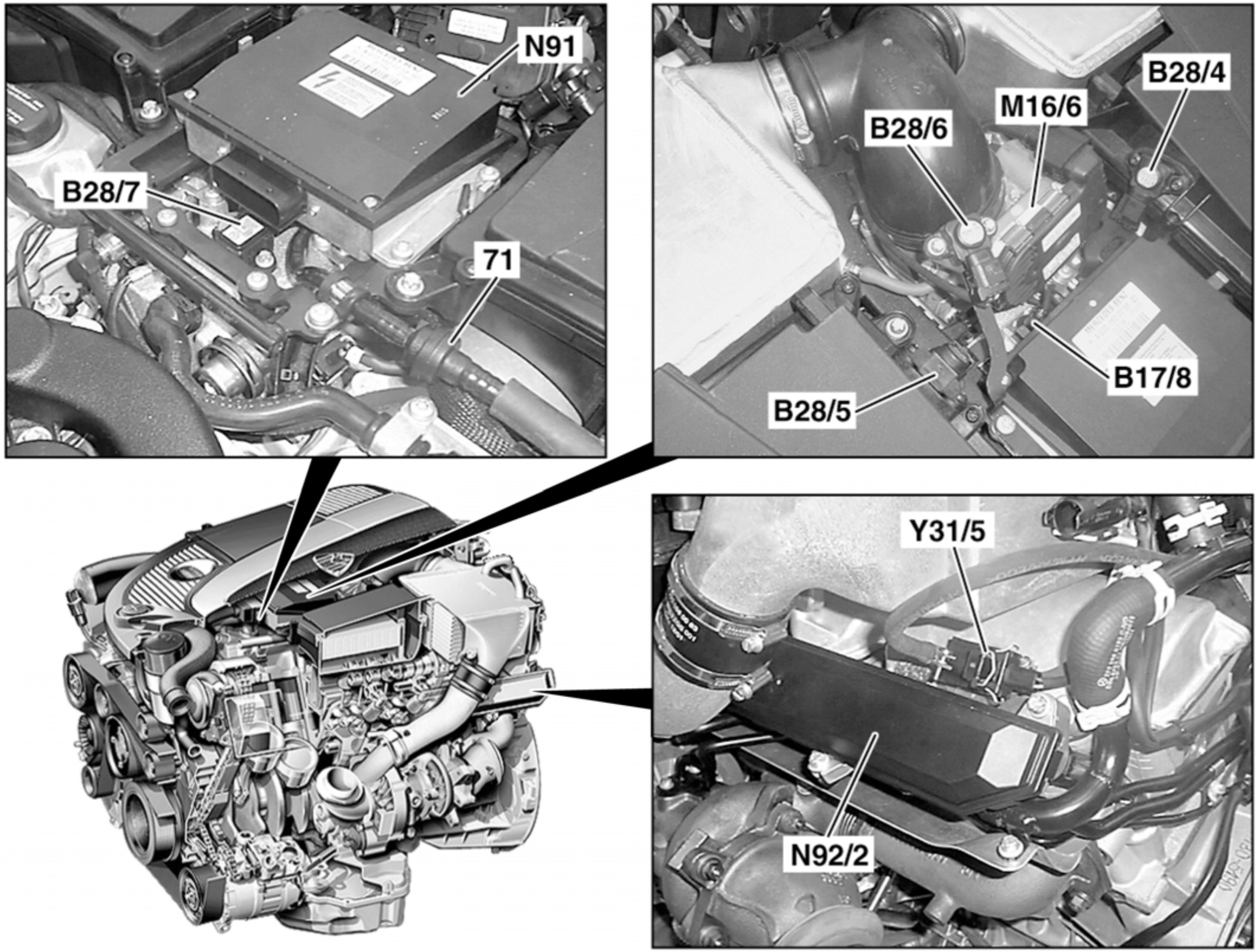
The function of the boost pressure control can only be analyzed, if using STAR Diagnosis the message "Boost pressure control adapted" is read out. After replacement of, e.g. the engine control module or an exhaust gas turbocharger, a longer journey under specific operating conditions is required, in order to perform the adaptation.

If the hose lines between the vacuum cells (110/3), vacuum transducer (Y31/5) and charge air cooler on the right cylinder bank (5/2) are leaking, the error "Boost pressure too high" is stored in the engine control module.

Component overview

Component	Designation	Location	Task	Effect
 Y31/5	Boost pressure control pressure transducer	Downstream of charge air cooler on left engine side	Depending on actuation it routes modulated boost pressure to the vacuum cells (110/3)	Vacuum cell slides control rod, this results in regulation of boost pressure
 B28/4 B28/5 B28/6 B28/7	Pressure sensor downstream of air cleaner on left cylinder bank (B28/4)	On air cleaner housing between air cleaner and exhaust gas turbocharger on left side of engine	Records current intake manifold pressure on left side of engine	Signal compared with boost pressure for boost pressure control (supercharger protection) of charger
	Pressure sensor downstream of air cleaner on right cylinder bank (B28/5)	On air cleaner housing between air cleaner and exhaust gas turbocharger on right side of engine	Records current intake manifold pressure on right side of engine	Signal compared with boost pressure for boost pressure control (supercharger protection) of charger
	Pressure sensor upstream of throttle valve actuator (B28/6)	On throttle valve actuator	Records current boost pressure upstream of throttle valve actuator	Signal compared with intake manifold pressure for boost pressure control (supercharger protection)
	Pressure sensor downstream of throttle valve actuator (B28/7)	In intake manifold upstream of power supply unit ECI	Records current boost pressure downstream of throttle valve actuator	Signal required for calculation of engine load
 B17/8	Charge air temperature sensor (B17/8)	In intake manifold upstream of throttle valve actuator	Records current charge air temperature	Signal required for calculation of air mass (in combination with B28/7), as well as for monitoring the boost pressure system

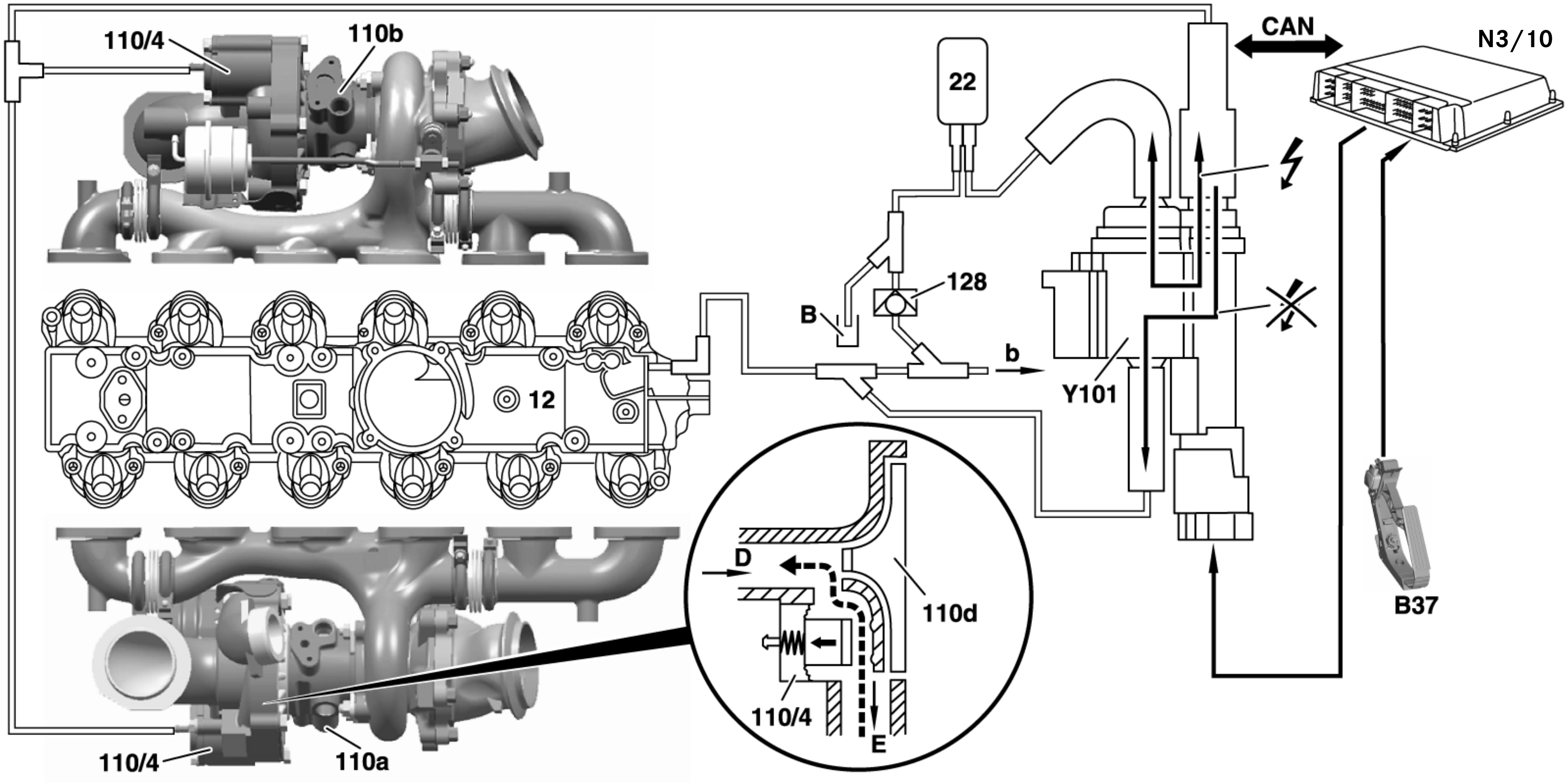
Location of components



P07.61-2828-06

71	Check valve
B17/8	Charge air temperature sensor
B28/4	Pressure sensor downstream of air cleaner left side of engine
B28/5	Pressure sensor downstream of air cleaner right side of engine
B28/6	Pressure sensor upstream of throttle valve actuator
B28/7	Pressure sensor downstream of throttle valve actuator
M16/6	Throttle valve actuator
N91	Power supply unit ECI
N92/2	Ignition module left side of engine
Y31/5	Boost pressure control pressure transducer

Divert air

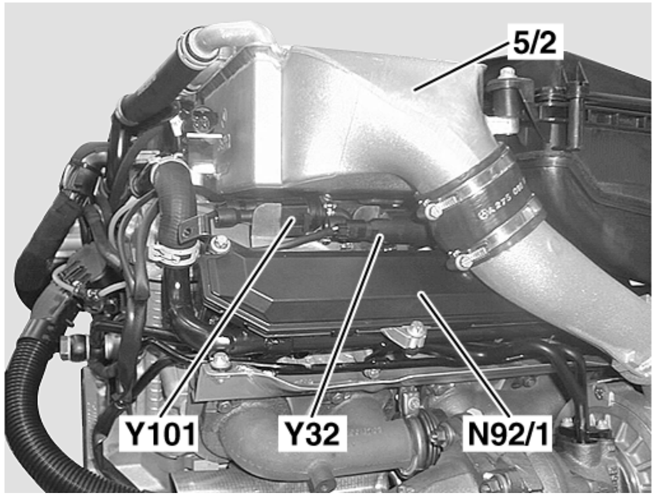


P07.61-2727-09

12	Intake manifold	110/4	Deceleration air valve	B	Divert air test connection
22	Vacuum tank	128	Check valve (vacuum)	b	To air injection switchover valve
110a	Left exhaust gas turbocharger	B37	Pedal value sensor	CAN	Control Area Network
110b	Right exhaust gas turbocharger	N3/10	Motor electronics control module	D	Clean air (downstream of air cleaner)
110d	Compressor turbine wheel	Y101	Divert air switchover valve	E	Charge air

Function

In trailing-throttle condition, or when the accelerator is suddenly released,the engine control module (N3/10) actuates the divert air switchover valve (Y101). This means that both deceleration air valves (110/4) at the exhaust gas turbochargers (110a, 110b) have vacuum pressure applied to them. The vacuum pressure is taken from the vacuum tank (22).
The deceleration air valves reduce the boost pressure immediately, by opening a bypass around each compressor turbine wheel. Whining charger noise (deceleration whine), which is normally generated during transition into the trailing-throttle condition, is thus immediately prevented.



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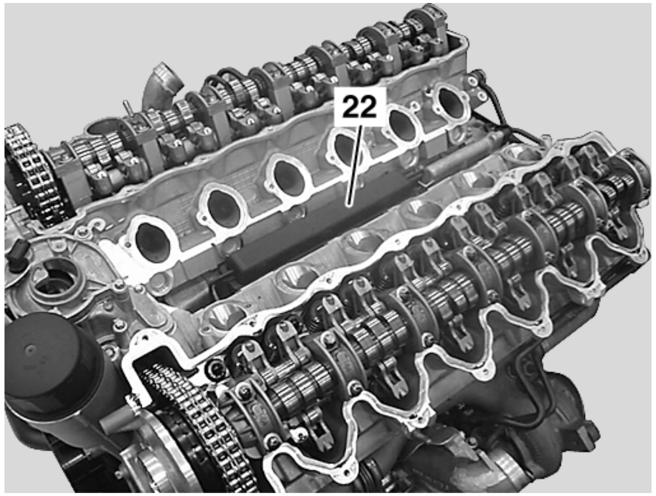
What is meant by deceleration whine?

The exhaust gas turbochargers are rotated slightly through inertia of the shaft, compressor and turbine wheel following start of deceleration and thus continue, for a brief period, to generate boost pressure against the closed throttle valve. This pressure is quickly reduced by the deceleration air valves.

Without any actuation on the divert air switchover valve (Y101) the diaphragm chambers of the deceleration air valves are connected to the intake manifold (12). The deceleration air valves in charging mode are closed by boost pressure and spring load. If a deceleration air valve fails to close, then less boost pressure is built up.

The divert air switchover valve is located on the right-hand side of the engine between the ignition module (N92/1) and charge air cooler (5/2). The air pump switchover valve (Y32) is also located here.



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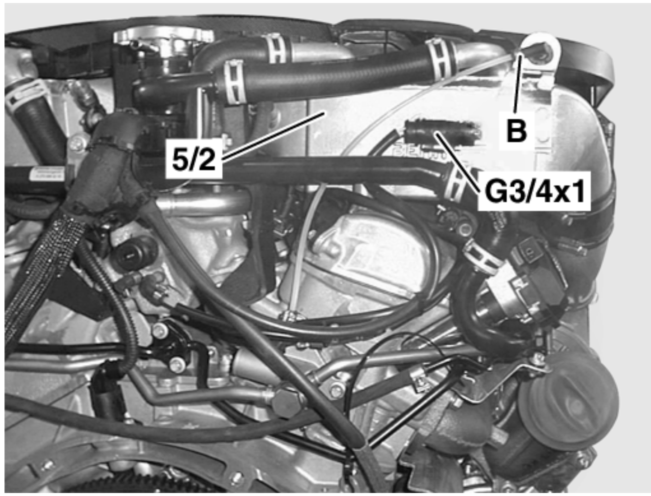
The vacuum pressure required for actuation is provided from a vacuum tank (22), which is located in the "V" of the crankcase instead of the oil-water heat exchanger.

Vacuum pressure is generated in the vacuum tank during the engine's aspiration and trailing-throttle modes. The check valve only opens at vacuum.



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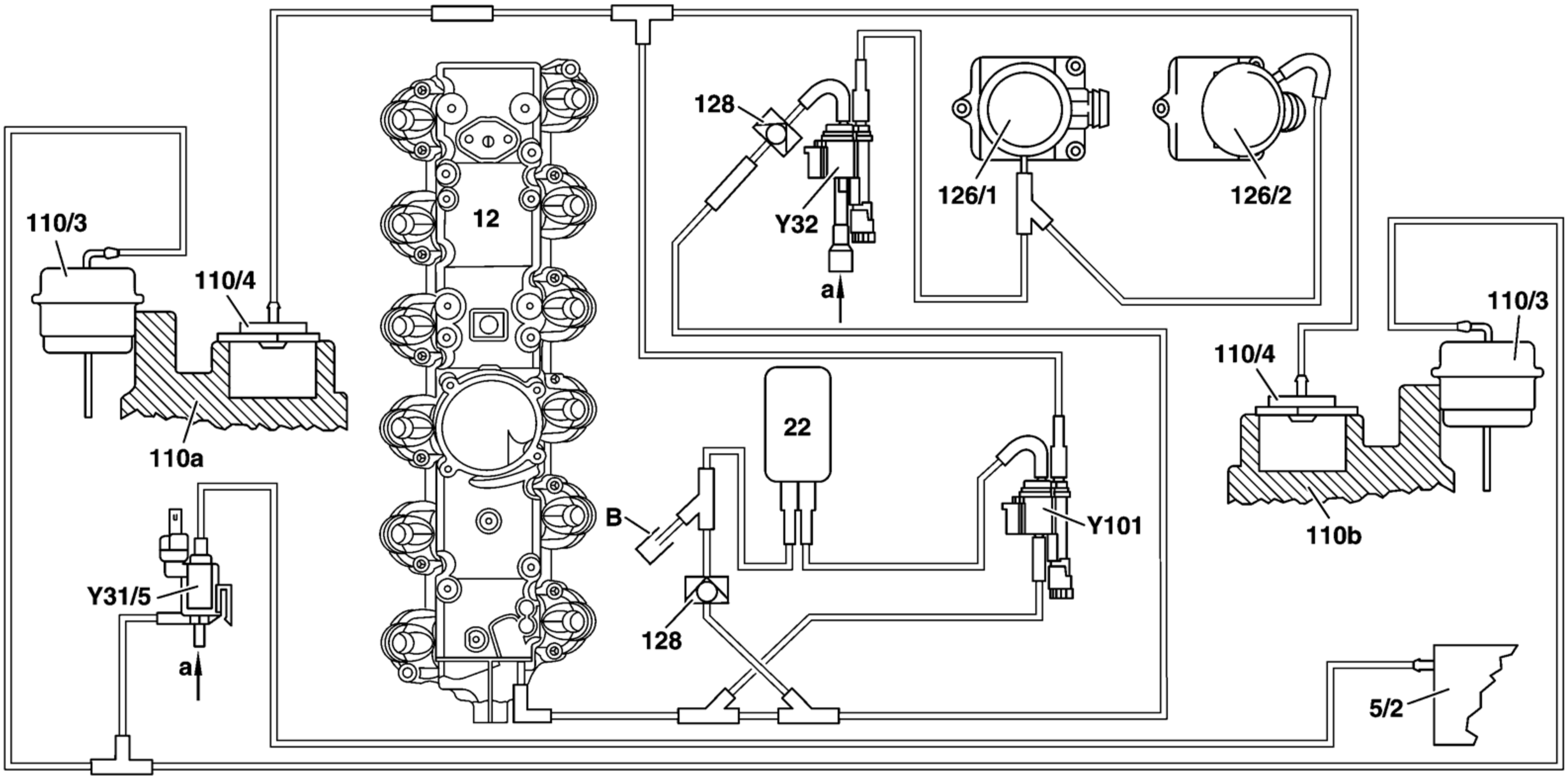
To test the "divert air" function a test connection (B) has been provided on the charge air cooler on the right-hand side of the engine (5/2), in the area of the O_2 sensor connection at the right upstream of the TWC (G3/4x1).

General overview of pneumatics system



P07.61-2728-09

5/2	Charge air cooler for right cylinder bank		128	Check valve (vacuum)
12	Intake manifold		Y31/5	Boost pressure control pressure transducer
22	Vacuum tank		Y32	Air pump switchover valve
110a	Left exhaust gas turbocharger		Y101	Divert air switchover valve
110b	Right exhaust gas turbocharger		a	Ambient pressure
110/3	Vacuum cell		B	Test connection for divert air control
110/4	Deceleration air valve			
126/1	Left air injection shutoff valve (combination valve: check valve integrated)			
126/2	Right air injection shutoff valve (combination valve: check valve integrated)			

Please note the following when working on the pneumatics system:

* Tthe hose lines must be secured using clamps.
* All hose couplings that are to be released are to be carefully and clearly marked.
* Only isopropanol or palationol may be used as assembly aids for hose lines.
* On no account should grease or oil be used.
* Lines carrying vacuum pressure could slip off.
* Llubricant residue will clog up check valves and boreholes.
* Check hose lines and connecting pieces for signs of fractures.

Low-temperature cooling circuit

In order to ensure a high cooling-down rate of the charge air, a separate low-temperature cooling circuit is used for water-air charge air cooling.

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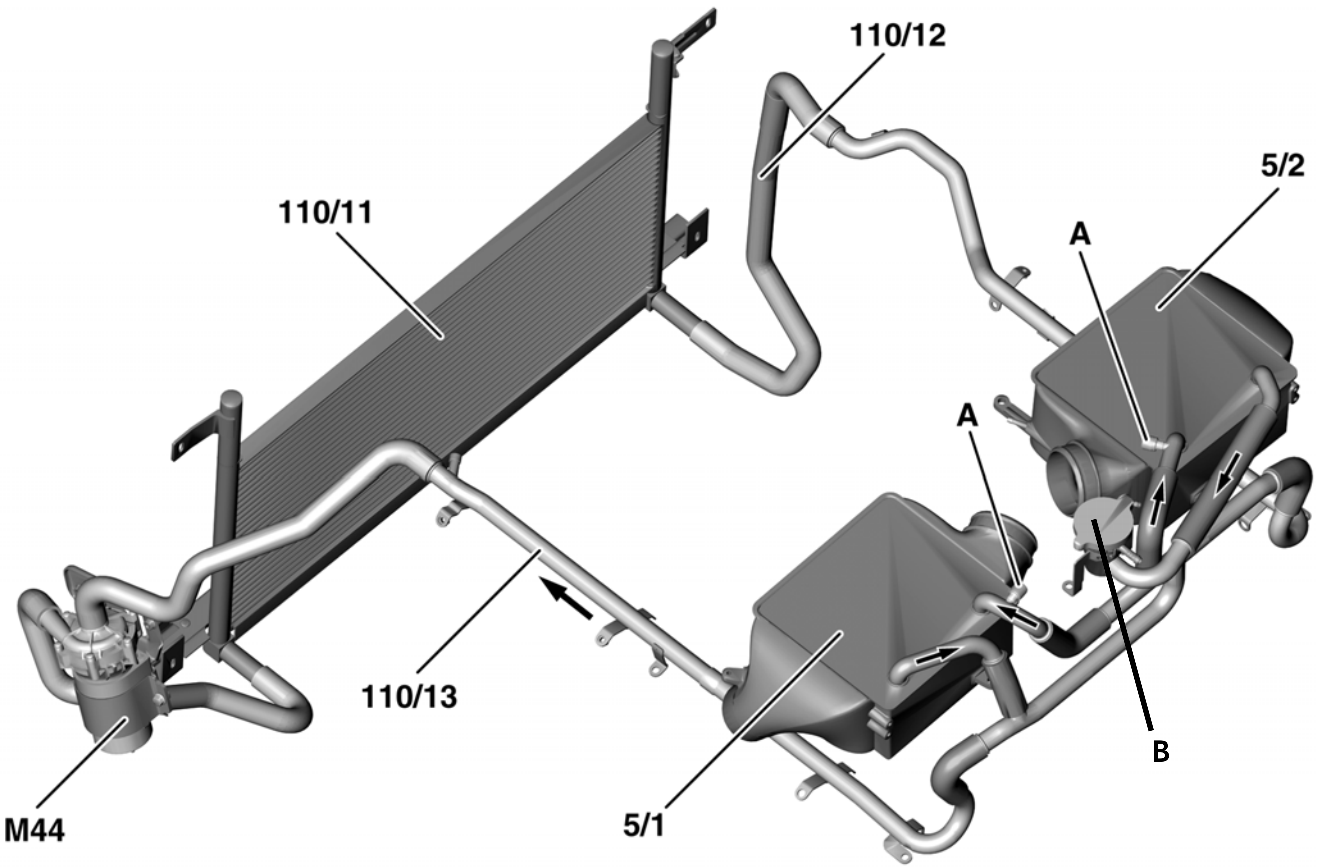

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5/1	Charge air cooler for left cylinder bank
5/2	Charge air cooler for right cylinder bank
110/11	Low-temperature radiator
110/12	Admission line from low-temperature radiator
110/13	Return line to low-temperature radiator
M44	Charge air cooler circulation pump (for models 215, 220 located in feed line 110/12)
A	Service valves
B	Filler neck

⚠ **The filler neck may not be opened, as otherwise the system has to be ventilated!**

Task

In order to cool down the air compressed and heated by the exhaust gas turbocharger, each cylinder bank has a separate charge air cooler.
The charge air coolers are designed as air-water heat exchanger. The water cooling enables a higher degree of efficiency to be achieved than that for air-cooled charge air coolers.

In order to lower the temperature of the coolant, this is routed to the low-temperature radiator located on the cooling module.

Function

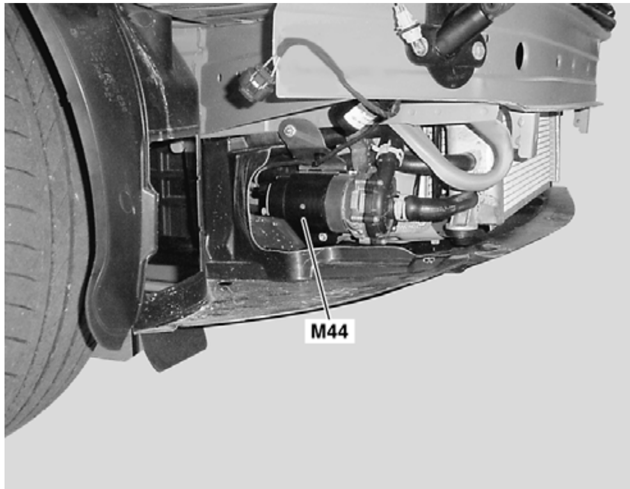
The charge air coolers (5/1, 5/2) are connected to a separate coolant circuit with low-temperature radiator and electric circulation pump (M44). The air heated up during the charging process dissipates the heat to the coolant which has been routed through the charge air cooler. In the event that the charge air temperature, which is measured by the charge air temperature sensor (B17/8), exceeds 47 °C, then the circulation pump (M44) is actuated via a relay from the engine control module (N3/10). At a charge air temperature of less than 35 °C the circulation pump is switched off again.

The cooled air downstream of the charge air coolers has a higher density. As a result the cylinder charge is increased and thus engine output. In addition to this the engine's tendency to knock is also reduced.

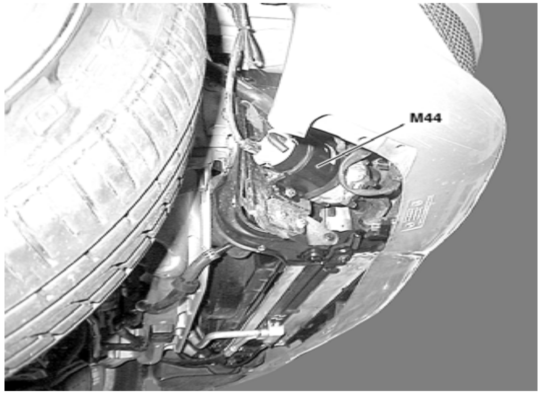
Note:

The low-temperature cooling Due to the restricted installation space there was no room for an expansion reservoir for separate ventilation, which is why particular specifications apply to ventilation, which must be adhered to.

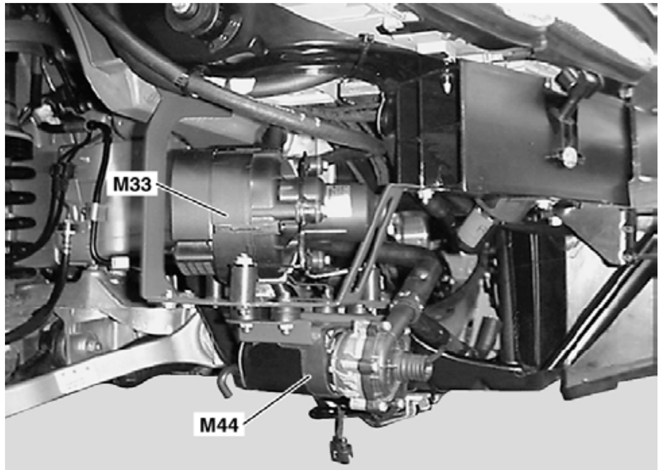
Pump arrangement on different model series



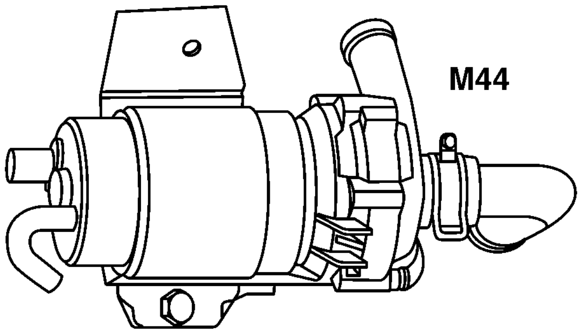
C215 P09.41-2055-11



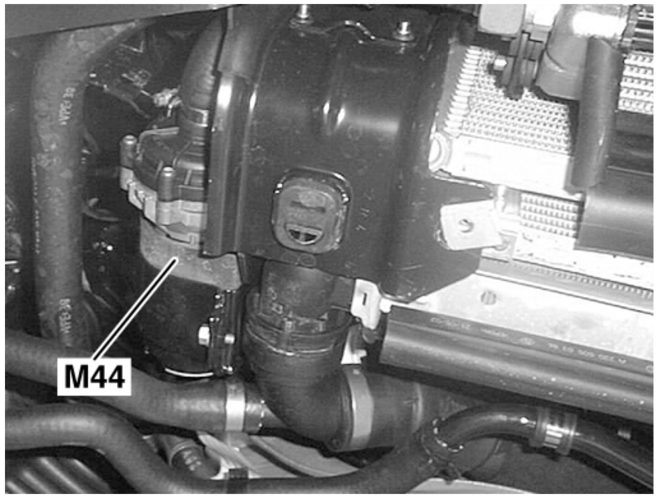
W220 P09.41-2062-12



R230 P07.61-2582-11



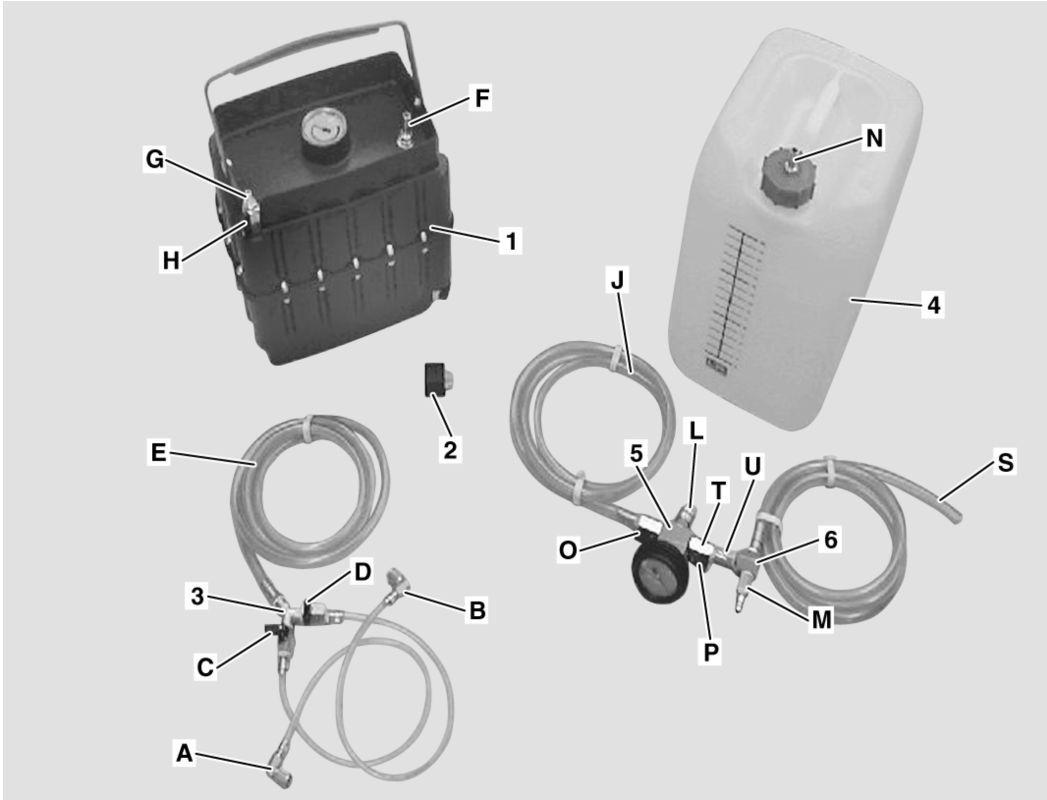
P09.41-2058-01



W240 P07.61-2804-01

Ventilation low-temperature cooling circuit M275 / M285

1 Vacuum box
2 Switch
3 Y-fitting
4 Coolant tank
5 Control unit
6 Venturi nozzle
A Connection
B Connection
C Valve
D Valve
E End of hose
F Connection
G Connection
H Valve
J End of hose
L Connection
M Connection
N Connection
O Valve
P Valve
S End of hose
T Connection
U Connection



P20.00-2093-06

Supplier
Autotestgeräte Leitenberger GmbH
72138 Kirchentellinsfurt
Bahnhofstrasse

Mr. Helmuth Ramp
Tel: +49 (0) 7121/908121
Price: € 400

Delivery specification
1 Vacuum box VB 01
2 Water pump control
3 Y-fitting
4 20 liter container
5 Control unit
6 Venturi nozzle

Ventilation process

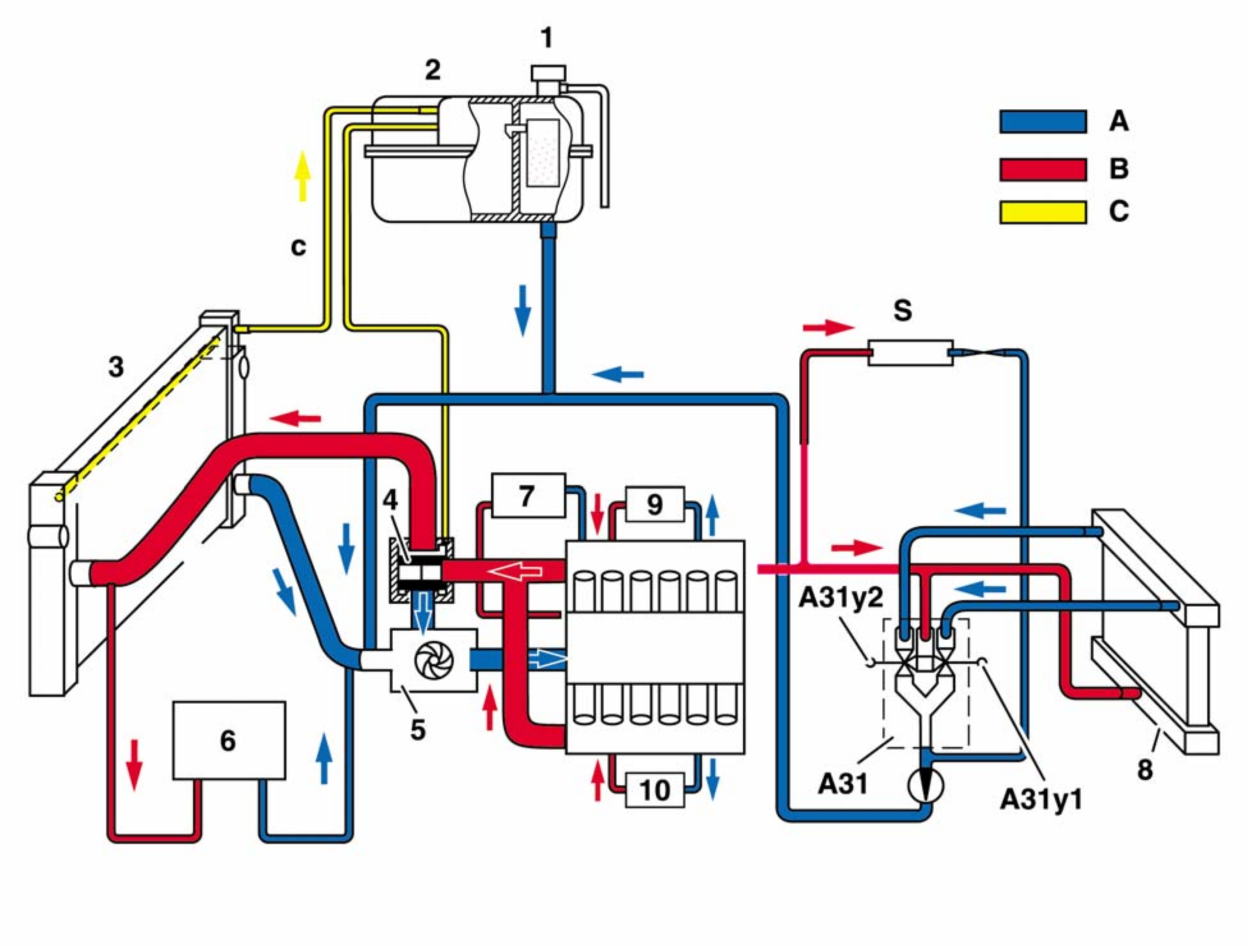
Ventilation only to be performed when the engine is cold	
Fill coolant bottle (4) with coolant	20 liters
Drain coolant from vacuum box (1)	Only if coolant is from previous ventilation process.
Close valves (C, D, H, O, P)	90° to flow direction
Open test connections on filler neck of low-temperature cooling circuit	
Plug ends of hose (J) onto connection (N)	
Connect Venturi nozzle (6) using control unit (5); to do so couple connection (U) to connection (T)	Under certain circumstances the hose end (S) may dissipate water drops, if necessary collect with suitable container.
Connect compressed air to connection (M) of Venturi nozzle (6)	8 to 12 bar A hissing noise is heard.
Vent low-temperature circuit	
Open valve (P)	Vacuum pressure is generated in the control unit (5).
Open valve (O) until coolant reaches the control unit (5), then close valve (O)	Coolant flows out of coolant bottle (4) to control unit (5).
Close valve (P)	
Disconnect Venturi nozzle (6) from control unit (5); to do so uncouple connection (U) from connection (T)	
Couple connection (L) to test connection	
Couple connections (A) and (B) to low-temperature cooling circuit	
Plug hose end (E) onto connection (F)	
Prepare actuation of circulation pump of low-temperature cooling circuit Model 220: AR20.00-P-1145-01M	Switch (2) set to Off, lamp on switch (2) does not illuminate.
Couple connection (U) of Venturi nozzle (6) with connection (G) of vacuum box (1)	
Connect compressed air to connection (M) of Venturi nozzle (6)	8 to 12 bar A hissing noise is heard.

Open valve (H)	Vacuum pressure of -0.85 bar displayed.
Actuate circulation pump of low-temperature cooling circuit; to do so switch on switch (2)	Lamp on switch (2) lights up.
Open valves (C, D) and wait for approx. 15 seconds	
Open valve (O)	Coolant flows from the coolant bottle (4) over the control unit (5) and Y-fitting (3) into the vacuum box (1).
Observe flow of coolant on Y-fitting (3)	Perform ventilation process for at least 5 minutes. If the low-temperature cooling circuit is intact, coolant will flow - free of bubbles - after 5 minutes, and the low-temperature cooling circuit has been successfully vented.
Close valves (C) and (D)	
Switch off switch (2)	
Close valve (O)	
Disconnect compressed air to connection (M) of Venturi nozzle (6)	
Uncouple connection (L) from test connection	
Disconnect cooler vacuum filling device from vehicle	Seal diagnostic socket of low-temperature coolant circuit.
Replace switch (2) with charge air relay	

On the 275 engine the coolant circuit has been adapted to suit the requirements of a turbocharged engine and the exhaust-gas turbochargers have been incorporated into the cooling circuit.

1 2-stage screw cap
2 Coolant expansion tank with silica gel container
3 Cooler
4 Coolant thermostat (hot engine position)
5 Coolant pump
6 Additional coolant radiator in right wheelhouse
7 Coolant cooled generator
8 Heat exchanger
9 Coolant cooled exhaust-gas turbocharger on right of engine
10 Coolant cooled exhaust-gas turbocharger on left of engine

A31 Heating system delivery unit
A31y2 Left duovalve
A31y1 Right duovalve
A Coolant return
B Coolant feed
C Vent line
S Heated windshield washer system container
M Engine



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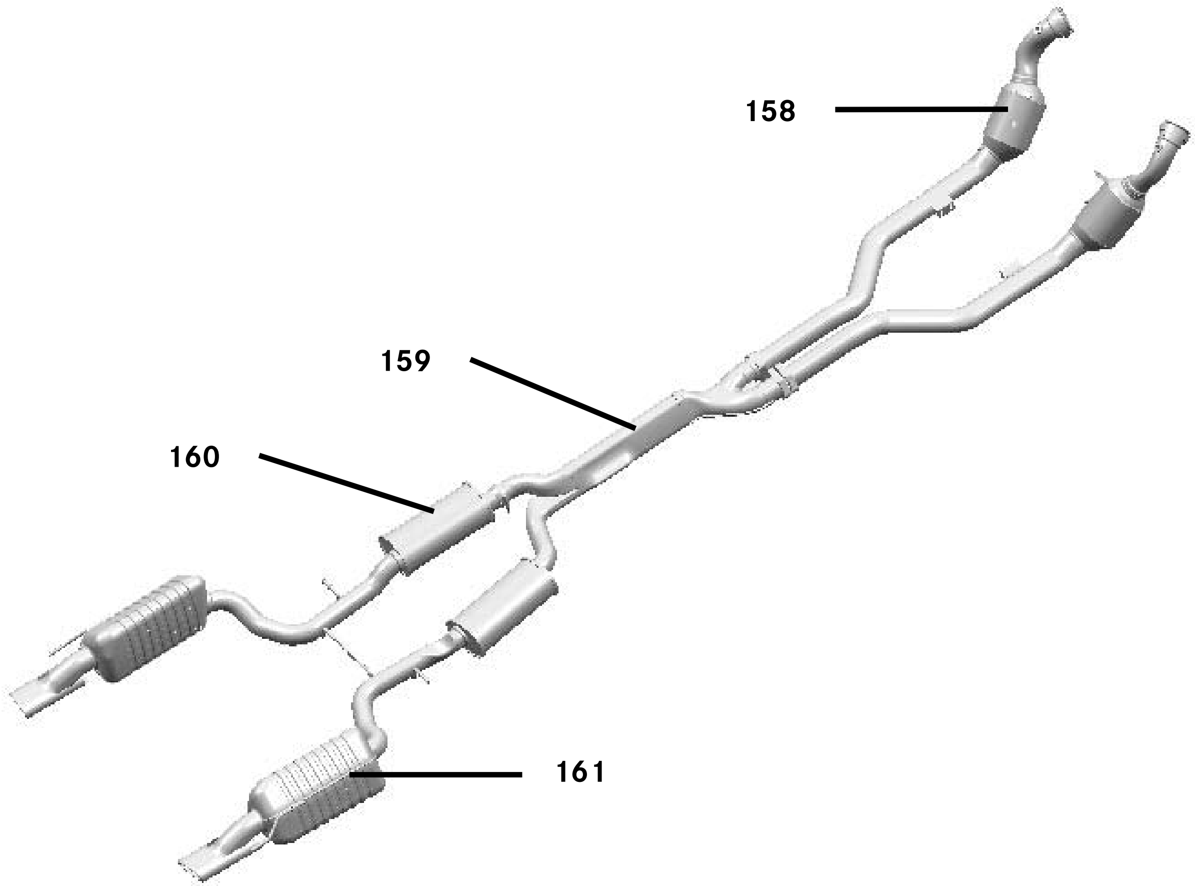
Models 215, 220 and 230 are equipped with ultramodern technologies for emission control, with the result that the exhaust emission standards as under EURO 4 and LEV can be complied with.

The system essentially encompasses two near-engine mounted firewall catalytic converters, one mixing tube, two center and two rear mufflers in order to impart a sporty and powerful sound.

The system is equipped with a control sensor and a diagnostic sensor for each exhaust branch. The control sensor is located in the front pipe of the firewall catalytic converter. The diagnostic sensor is mounted in the three way catalytic converter, which consists of two monoliths.



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158 Three way catalytic converter
160 Center muffler
161 Rear muffler with tailpipe

159 Mixing tube

Exhaust gas emission

Special requirements apply to the exhaust cleaning system. The use of exhaust-gas turbochargers and the cast design exhaust manifold version on the M275 impair for principle-related reasons the response characteristics (heating up) of the exhaust-gas catalytic converters. Through the exhaust manifold version and turbine housing as a composite part in cast steel and thus the doing away with the need for a flange connection however, enabled this model-related disadvantage to be significantly reduced.

The target with regard to emission qualities was the fulfillment of EU 4 as well as LEV I. Potential is also available for LEV II.

The following technologies for reduction of the engine's untreated emissions are displayed:

* 3-valves per cylinder technology to support a faster heating up of the three-way catalytic converter on the basis of reduced heat transfers to material surfaces and thus also
* an AC-dual ignition for improvement of ignition and an increase in combustion quality.

The twin-pipe exhaust cleaning system is marked by the following attributes:

* two large-displacement, near-engine mounted catalytic converters with extremely high heat-storage capacity
* a version with high cell, thin-walled ceramic monoliths for increasing the catalytic surface while simultaneously minimizing mass
* a non-metallic coating in double-layer technology for optimum conversion rates
* for each cylinder bank a control and diagnostic sensor each
* optimized secondary air injection with focus on uniform distribution into the two cylinder banks.

The exhaust-gas system has been adapted to suit the high mass flows. On the engine control side the more stringent requirements with regard to long-term stability have been encountered by means of diverse functional adaptations.

Terminology

ECI is an abbreviation for..

Energy
Controlled
Ignition

... the German equivalent is: Energie gesteuerte Zündanlage

General

The ignition system of engine 275 has essentially been adopted from that in engine 137 and matched to the requirements of a supercharged engine. It has the following subfunctions:

* generation of ignition voltage
* ionic current measurement

The parts required for these subfunctions are described below.

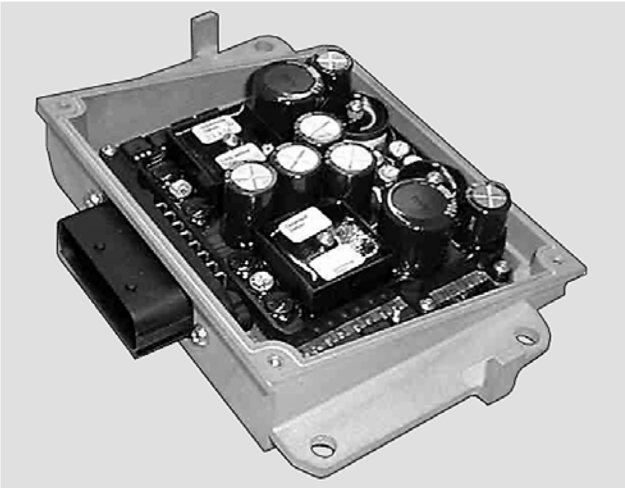
Power supply unit (N91)

GT_15_00_0003_C76

The power supply unit operates as a DC voltage supplier, the function of which could be compared to that of a power station.

The power supply unit is a type of control module for the ECI ignition system with a 16-pin plug socket.
The power supply unit designation is N91.
The power supply unit is mounted between the two cylinder banks on the charge air distribution pipe.

On-board electrical system



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The power supply unit consists of a housing made of light alloy, in which several electronic components are accommodated. These electronic elements are available in duplicate for each cylinder bank.

They serve to ensure that two different voltages are generated by the on-board electrical system:

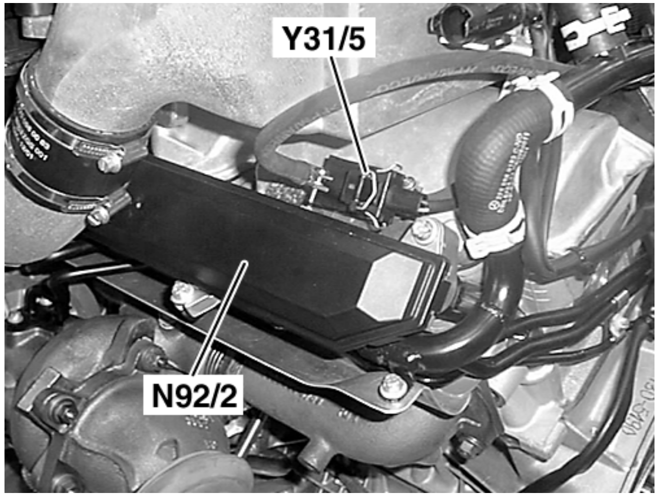
1. **180 V** for generation of the **ignition** voltage.
2. **23 V** for generation of an **auxiliary** voltage (test voltage).

The power supply unit is fitted with an electronic overload protection for the 180 V and 23 V voltages. In the event of a short circuit or overload, the outputs are blocked until the ignition is switched on again.

Apart from this following ignition "OFF" the plug on the power supply unit and the ignition module may only be detached after waiting for the **4** min. run-on time to expire!

In order to avoid damage to the ECI power supply unit (N91), the ignition must not be switched on without ground supply. The ground supply takes place via the power supply unit's housing.

Voltage generation



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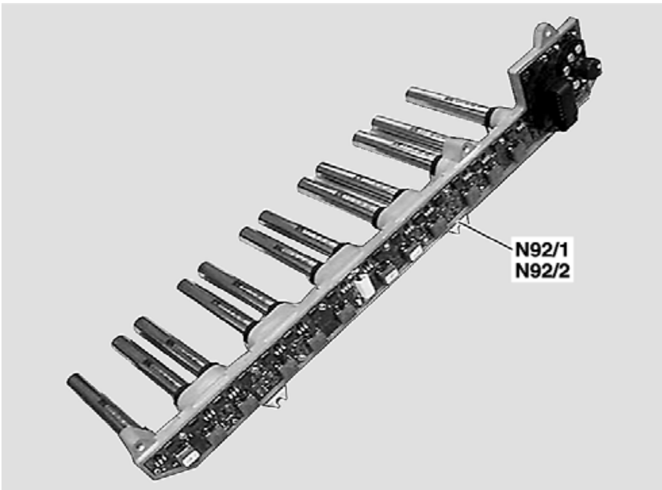
Now we move on to ignition voltage generation!

The 180 V direct current voltage, coming from the power supply unit, is applied to the ignition module (N92/1, N92/2).
As soon as ignition takes place the direct current voltage is converted with a frequency of 25 kHz into an AC voltage.

This means that the ignition coil's magnetic field is set up and removed at **each** pending ignition up to 25,000 times/s. This in turn means that the ignition spark (burning life) is maintained.



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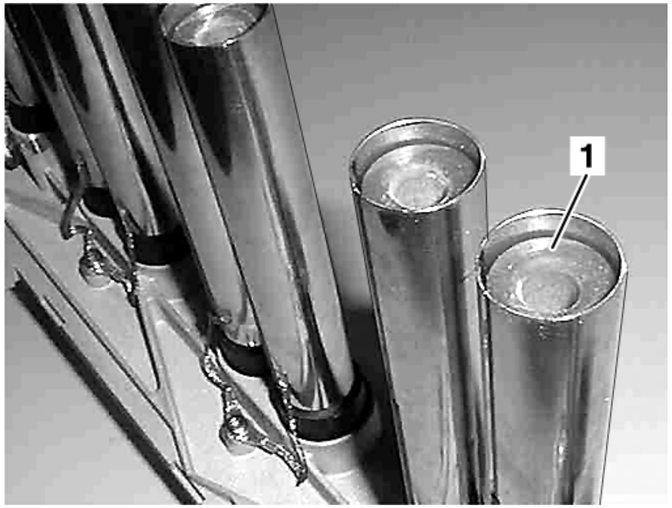
The required ignition voltage is built up significantly faster using the ECI ignition system.
Here a pilot control of the ignition coil (building up and removing the magnetic field) is no longer required.

The burning life is set by the motor electronics control module (N3/10) to 5° crankshaft angle, and irrespective of the required ignition voltage. This corresponds to approx. 1.5 to 2 ms when idling und approx. 0.15 ms at full load.

The ignition voltage is max. 32 kV.

Ignition module



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The ignition coils of the M275 and M285 are located in the upper section of each spark plug connector. This means that this engine has a total of **24** ignition circuits.

Service tip:
The ignition coils and spark plug connectors cannot be replaced individually!

Each time the ignition module is dismantled, the sealing rings (1) in the lower section of the spark plug connector have to be replaced.

Order number of sealing rings: 000 159 00 80 (1 set 25 pcs.).

As for engines M112/113 the ignition spark control system for engine M275 is phase-shifted and alternating.

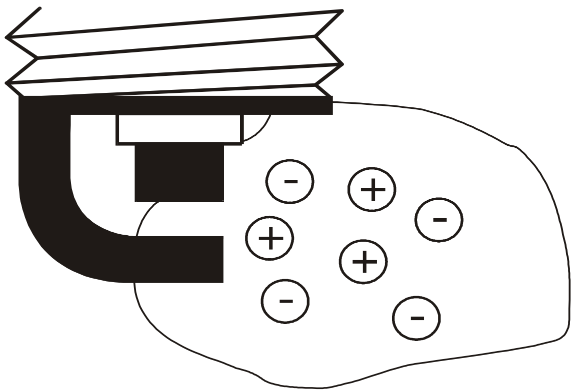
Ionic current measurement

Fundamentals

Following ignition of the fuel-air mixture by the ignition sparks the fuel is then chemically converted. In doing so both positively and negatively charged electric particles are generated. These particles are known as ions. One property associated with the ions is their electrical conductivity.

The degree of electrical conductivity is dependent on the density of the ions in the burnt mixture.

⚠ **The higher the pressure in the combustion chamber, the greater the number of ions and the greater the conductivity.**



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After end of sparking, a test voltage of 1 kV (resulting from 23 V auxiliary voltage) is applied to the spark plugs between the center and ground electrodes.
Ions are located in the air gap, which then transport this test current depending on how it is composed (high conductivity/low conductivity).
The electronics in the ignition module evaluate the resulting ionic current signal and forward this to the motor electronics control module (N3/10).
The ME engine control module (N3/10) is now capable of detecting any resulting combustion misfires and responding to them.

Background information on ionic current measurement

Electric charge carrier

Each atom consists of an atomic nucleus and an atomic shell. The atomic nucleus represents the atom's main mass.
Located in the atomic nucleus are positive electric particles, which are known as **protons**. The number of protons determines the atom's **electronic charge**.
Each atom contains an electronic charge.
In the atomic nucleus,in additions to the protons there are also **neutrons**. These are electrically neutral.

The atomic shell contains negative electric particles. However, they are of an entirely different type.
Their mass is significantly less and only accounts for roughly 1/1800 of a proton's mass.
These almost mass-free electric particles are called **electrons**.

For the purpose of differentiation one calls ...
... the proton's electric charge as a **positive electric charge**.
... the electron's electric charge as a **negative electric charge**.
... the neutrons as a **neutral electric charge.**

The electrons spin around the nucleus in specific distances in a circular or elliptical orbit.
The orbital paths are designated from inwards to the outside using letters. The smallest distance is known as the K-shell, the next largest as the L-shell, then the M-shell and so on.
Each shell is equivalent to a specific energy level, i.e. the more shells the greater the level of energy.

For example, the smallest and lightest atom hydrogen (H) contains one proton and one electron.
An iron atom (Fe) is approx. 52 times heavier than hydrogen. It is made up of 26 protons, neutrons and electrons.
The heaviest known element Ununbium (Uub) contains 112 protons, neutrons and electrons and is 277 times heavier than hydrogen (H).

Ions

Electric charge carriers (protons and electrons) exist in pairs, in other words, each positive electric charge carrier should be coupled to a negative electric charge carrier.
Outwards the atom should be **electrically neutral.** The number of protons and electrons in this case are the same.

If an electron is now taken away from the atom, the positive charge then prevails in the atomic nucleus. One then speaks of a **positive ion.**

If one can induce the atom to accept an extra electron in its shell, a negative charge then prevails in the atomic nucleus. In this case one speaks of a **negative ion.**

If two or more atoms combine to form a molecule, then this can also have more or less electrons than it should have, and thus also be designated as a **positive or negative ion**.

Notes

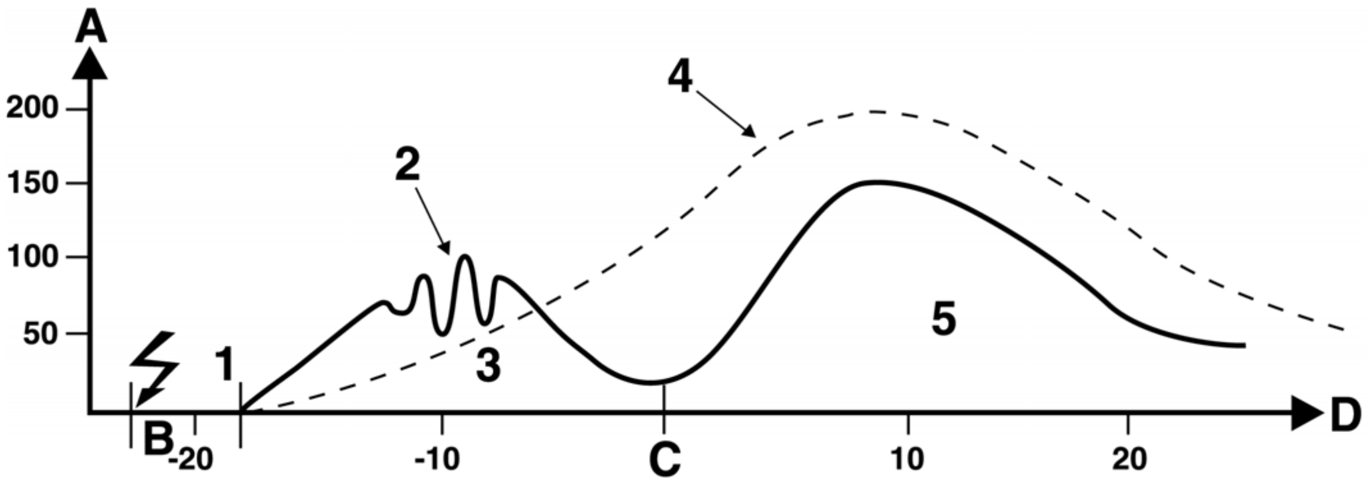
Ionic current measurement

Standard combustion

After the end of sparking (1) an auxiliary voltage is applied to the spark plug and an ionic current signal (2) generated.
The first peak created in the diagram represents the propagation of the flame front (vibrations).
The second peak provides information with regard to the combustion cycle.
If a "standard" combustion is given, then the signal uniformly weakens.

1 End of sparking
2 Ionic current signal
3 Chemical ionization
4 Combustion chamber pressure
5 Thermal ionization
ϟ Ignition timing

A Ionic current in µA
B Spark duration
C Ignition TDC
D Crankshaft position °KW



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Knocking combustion

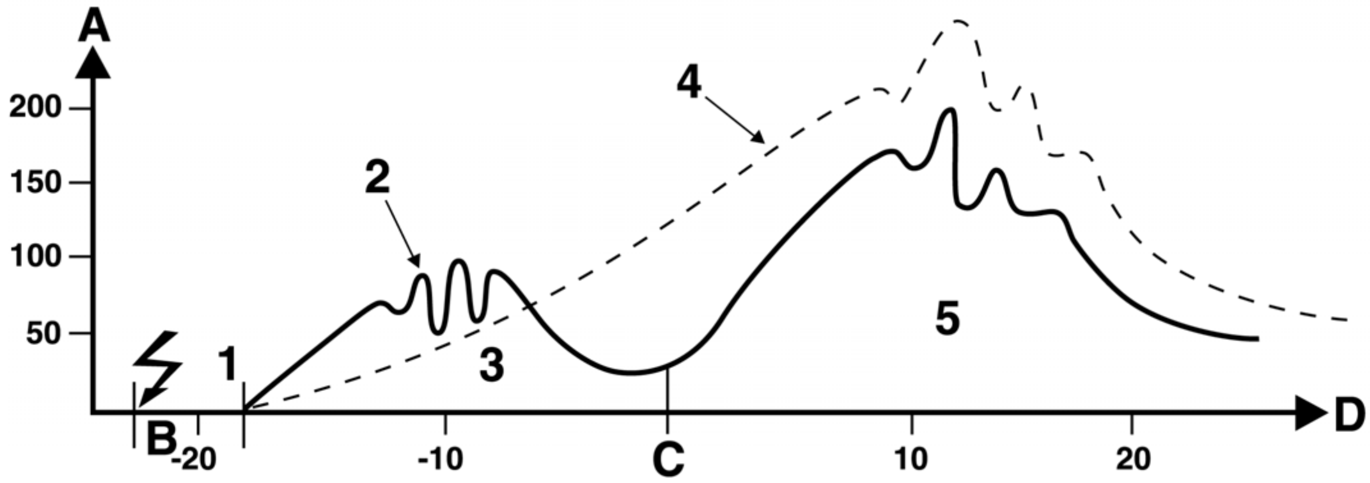
If knocking combustion is given, then additional knocking vibrations are displayed in the signal. These are caused by erratic, additional combustions.

The resulting knocking combustions are **only** used **for ignition systems in 137 engines** for the detection of a knocking combustion.

For ignition systems in 275 engines a knocking combustion is detected by way of the existing knock sensors.

1 End of sparking
2 Ionic current signal
3 Chemical ionization
4 Combustion chamber pressure
5 Thermal ionization
ϟ Ignition timing

A Ionic current in µA
B Spark duration
C ignition TDC
D Crankshaft position °KW



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Background information on misfire detection

Initial situation

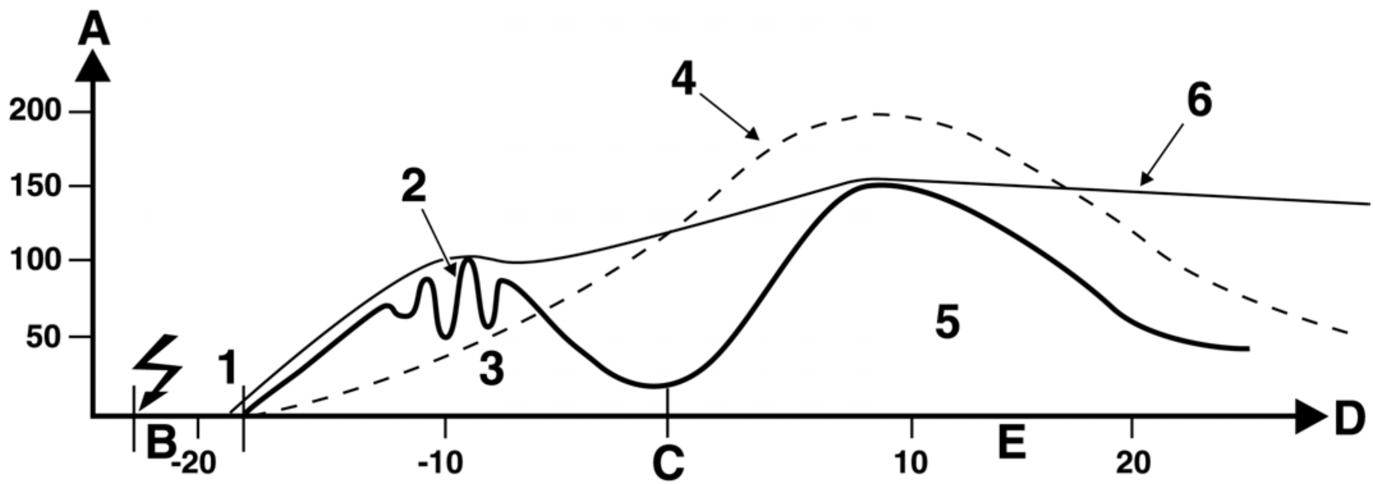
With the launch of the European On-Board Diagnosis EOBD,legislators demanded a combustion misfire detection feature, in order to detect any threatened damage to the three way catalytic converter or the O_2 sensor, and to prevent such damage by switching off the fuel injectors.

Function

Combustion misfire detection is performed without any significant outlay in the engine control module (N3/10).
For the purpose of analysis the first thing to do is to determine the integral value (7) from the ionic current signal (2).
The integral value is used to filter the ionic current signal and to display it very simply.

1 End of sparking
2 Ionic current signal
3 Chemical ionization
4 Combustion chamber pressure
5 Thermal ionization
6 Integral value

A Ionic current in mA
B Spark duration
C Ignition TDC
D Crankshaft position °KW
E Measurement window for anti-knock control (M137 only)



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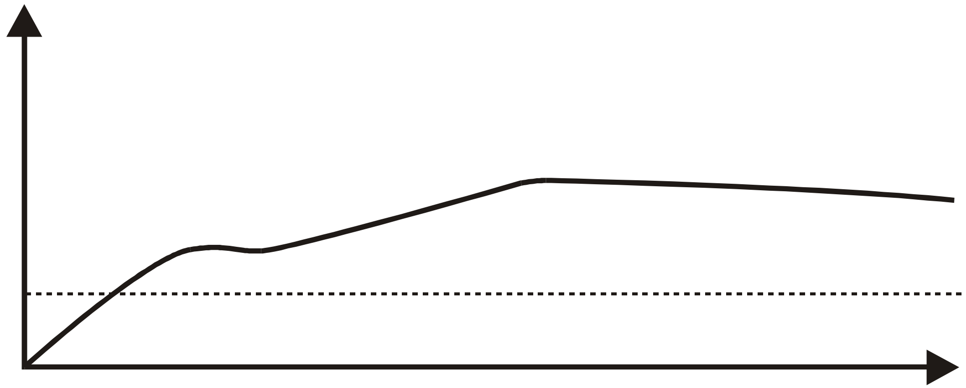
Note: The 275 engine no longer has a measurement window, as the anti-knock control is detected over knock sensors.

Background information on integral value



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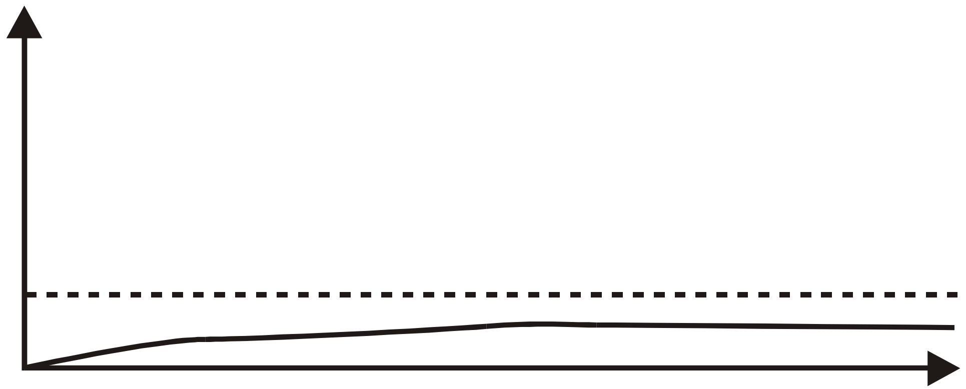
No combustion misfires

The threshold value (cutoff wave) is then formed by the motor electronics control module (N3/10) depending on engine speed and engine load.
If the integral value of the ionic current signal stays above the specified threshold value, then combustion has taken place. A misfire is thus not detected.



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Combustion misfiring

If the integral value of the ionic current signal lies below the specified threshold value, then a misfire has been detected.
The error counter in the engine control module (N3/10) then increments the relevant cylinders by a figure of 1 upwards.

Summary

Following switch off of the ignition spark an auxiliary voltage of 23 Volts is transformed from the primary side in approx. 1 kV to the secondary side. This is then applied to the spark plug electrodes.

During combustion of the fuel-air mixture a chemical reaction is stimulated. This releases positively and negatively charged particles (ions), which permit current flow (conductivity) between the electrodes. The strength of the current flow is a measure of good or poor combustion.

After a brief period the ions "disintegrate", and the current flow decreases. The pressure rise in the combustion chamber induces ions to be generated in the same ratio to the combustion pressure (thermal ionization), which in turn then allows the auxiliary current (measuring current) to flow again. This evaluation is drawn on for the recognition of uncontrolled pressure rises (combustion misfires).

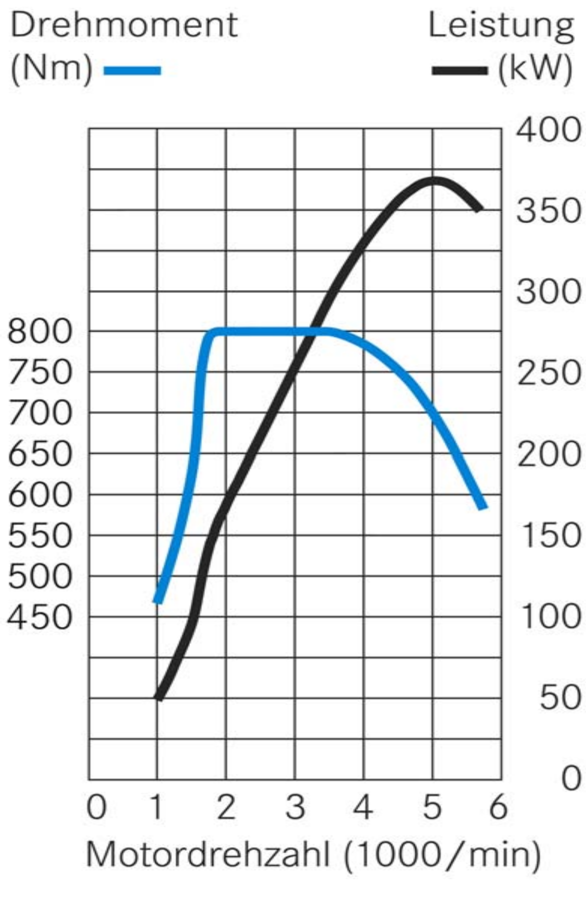
The electronics in the ignition module evaluate the ionic current measurement and forward an electronic signal to the motor electronics control module (N3/10). The engine control module is able to use the ionic current measurement to recognize **combustion misfires** and to respond to them.

Technical data comparison

Sales designation		S 600	Maybach
Vehicle model		220.176	240.078/178
Engine model		275.950	285.950
Cylinder arrangement / number / angle		V12 / 60°	
Valves / spark plugs per cylinder		3 / 2	
Continuous fuel-injection and ignition system		ME 2.7.1	
Air supply		Turbo charging with charge air cooler	
Total displacement	cm^3	5513	
Rated output	kW (hp) at rpm	368 (500) at 5,000	405 (550) at 5,250
Rated torque	Nm at rpm	800 at 1,800 - 3,500	900 at 2,300 - 3,000
Fuel consumption (New European Driving Cycle) Super Plus	l/100 km/h	14.8	16.6
Acceleration 0 - 100 km/h	s	4.8	5.4/5.5

The higher output of 37 (50) kW (hp) as well as the torque increase of 100 Nm on the 285 engine is achieved using the motor electronics control module (change of performance map). The engine variants are reserved for the Maybach W240 (240.078) and V240 (240.178).

Performance graph M275



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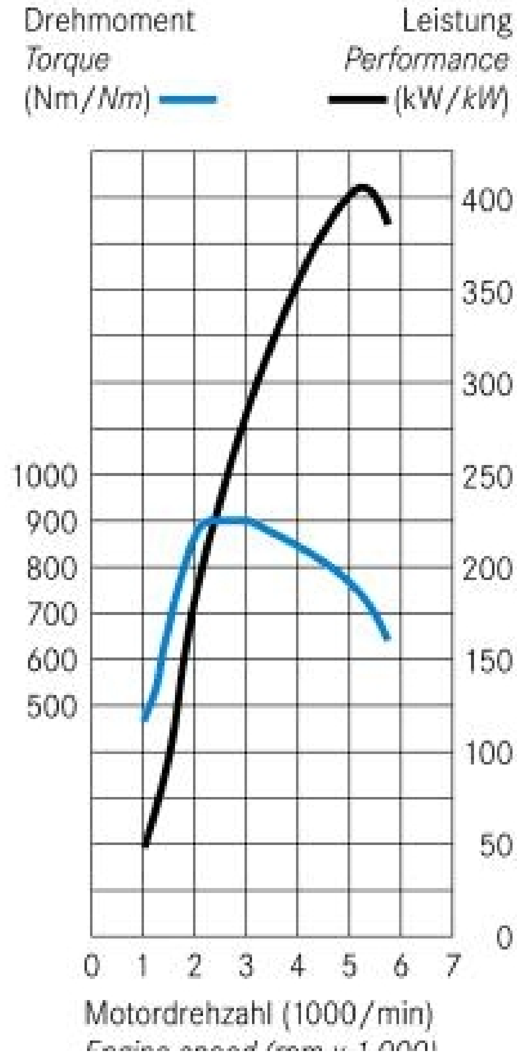
Performance graph M285



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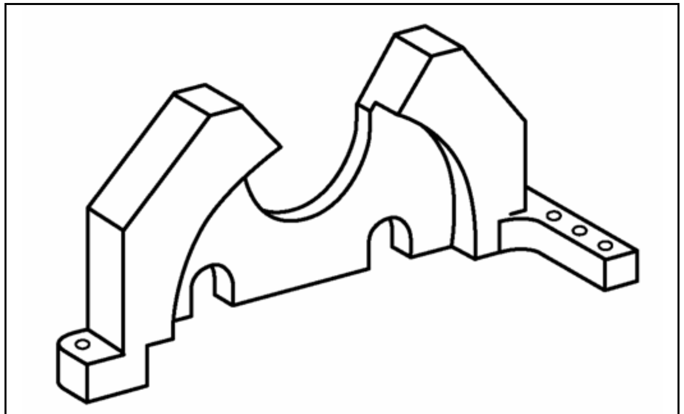
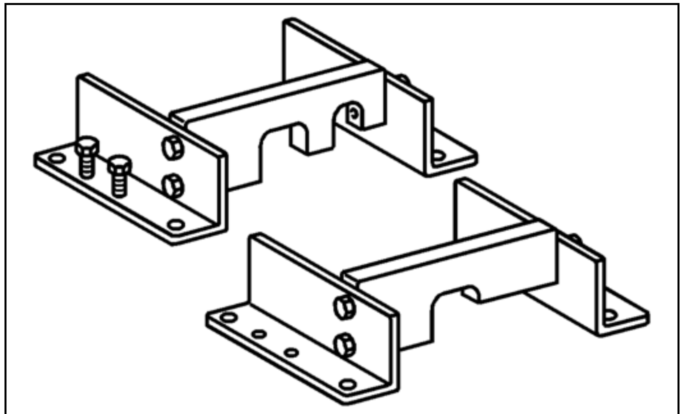
For professional diagnosis and maintenance of the engine 275 a series of test cables and special tools are required.
Although some of these have already been mentioned in the respective chapter, we will display them again here as part of a summary.



285 589 01 40 00

Retainer

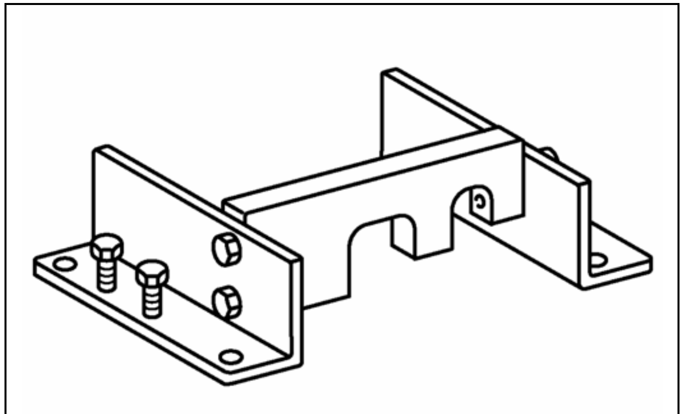
Retainer device for changing timing chain.



137 589 01 40 00

Retainer

For right cylinder bank only.
The retainer device serves to position the camshaft in the 30 degree ATDC position.

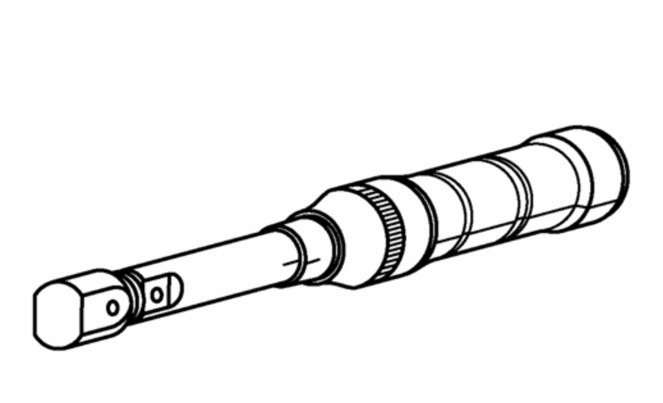


285 589 00 40 00

Retainer

For left cylinder bank only. The retainer device serves to position the camshaft in the 30 degree ATDC position.

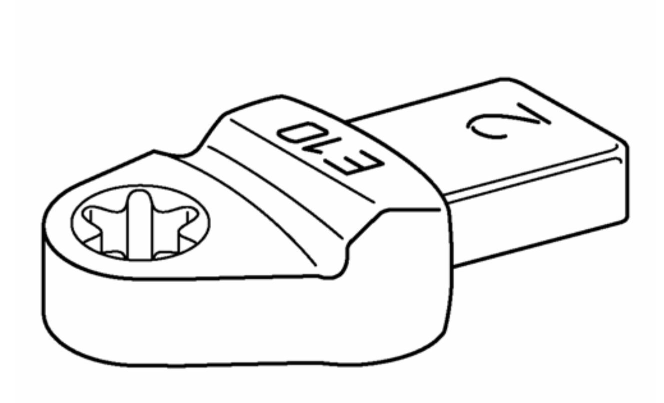
Note:
For the right cylinder bank W137 589 01 40 00 should be used.



001 589 87 21 00

Torque wrench

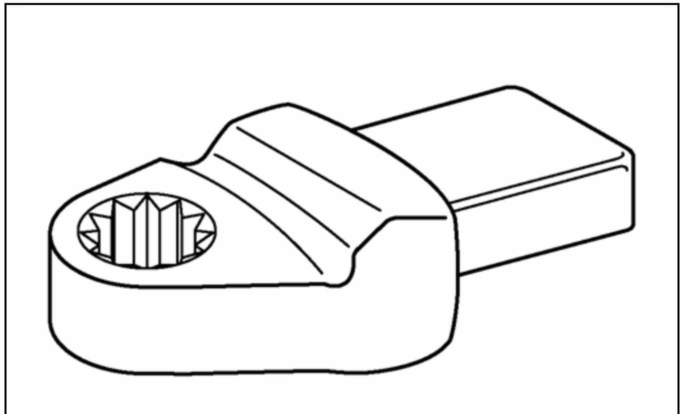
For releasing and tightening of V-clamps on connection for exhaust gas system - turbocharger.



285 589 01 03 00

Box wrench bit

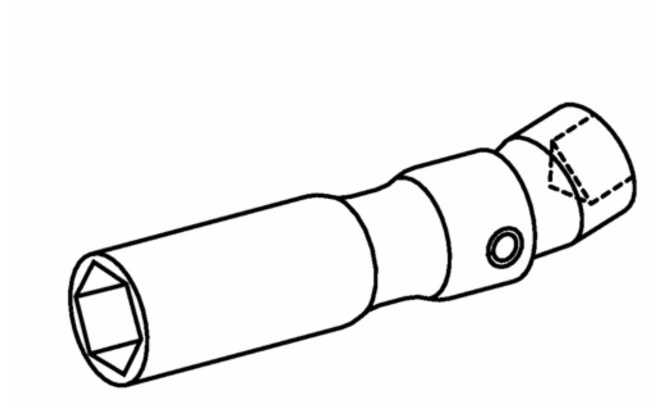
Box wrench bit E 10, Hazet company with male square wrench 12x9 mm.
For releasing and tightening of threaded connections of V-clamps on turbocharger.



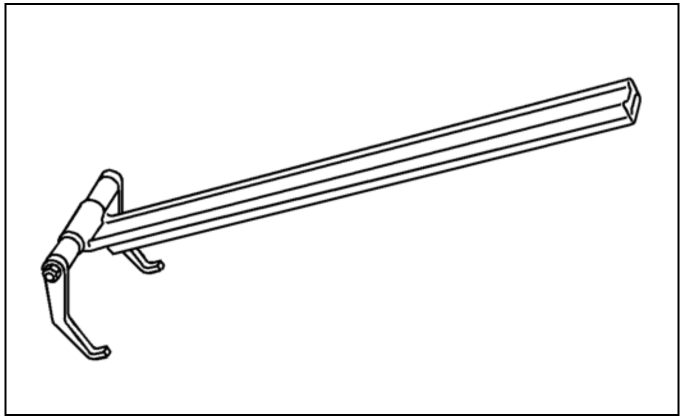
285 589 00 03 00

Box wrench bit

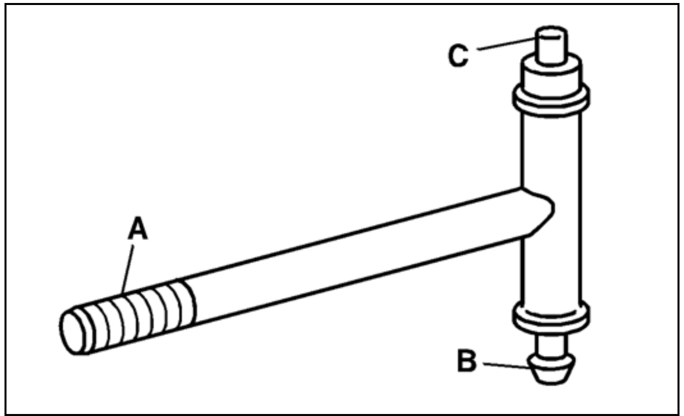
Box wrench bit WAF 11, Hazet company with male square wrench 12x9 mm.
For releasing and tightening of threaded connections on exhaust manifold.



112 589 01 09 00



137 589 00 33 00



137 589 01 33 00

Spark plug wrench

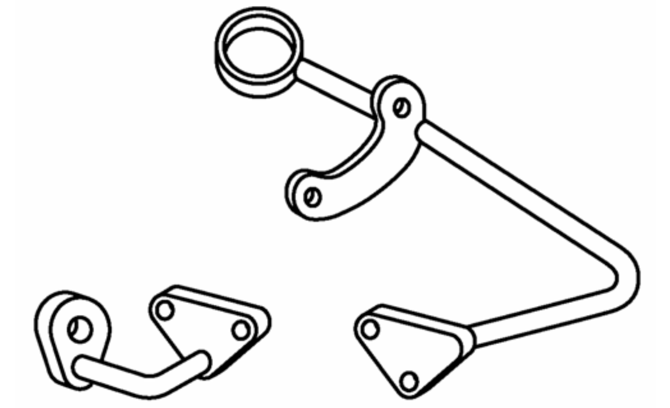
Spark plug wrench 5/8" (15.8 mm) with retaining spring and joint, 3/8" square traction, outside diameter 21.4 mm; Length 97 mm
Additionally required for M112/113 commercially available extension 3/8" length 74 mm e.g. Hazet 8821-3.

Puller

Puller device for extracting ignition module (spark plug change).

Puller

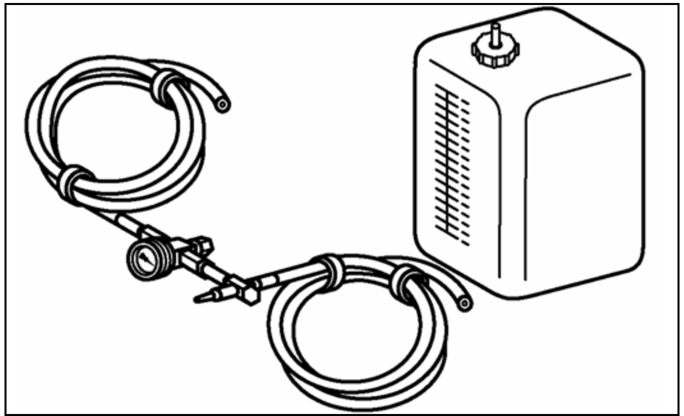
Puller device for extracting sealing rubbers from the spark plugs (A) or for pulling out the ignition block (B) and for mounting sealing rubbers into the ignition block (C).



285 589 00 61 00

Assembly tool

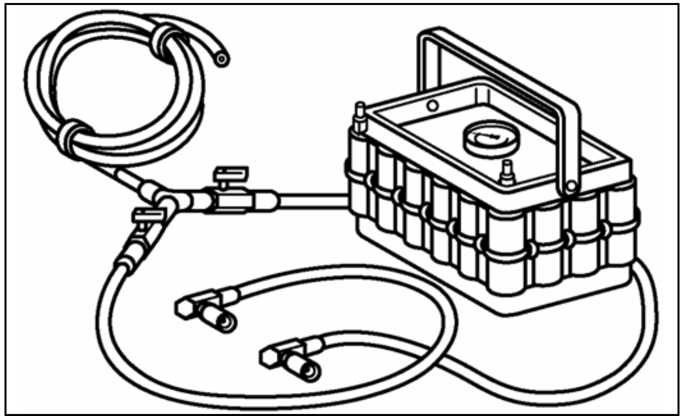
Assembly tool for removal and installation of exhaust manifold in combination with the turbocharger (set condition).



285 589 00 21 00

Cooler-vacuum- illing device

Filling device for low-temperature cooling circuit, with integrated leakage test.

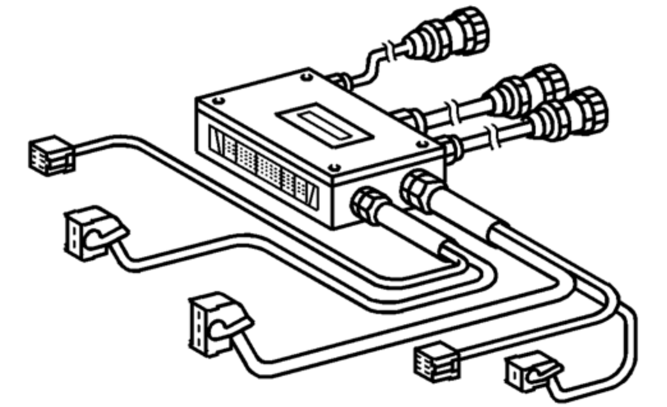


285 589 01 21 00

Low-temperature cooling circuit adaptation

For filling and bleeding the low-temperature cooling circuit.

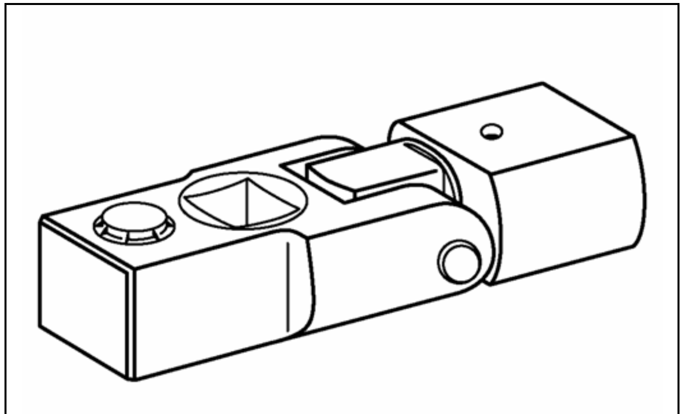
Note:
Use only in combination with W285 589 00 21 00.



137 589 00 63 00

Test cable 134-pin

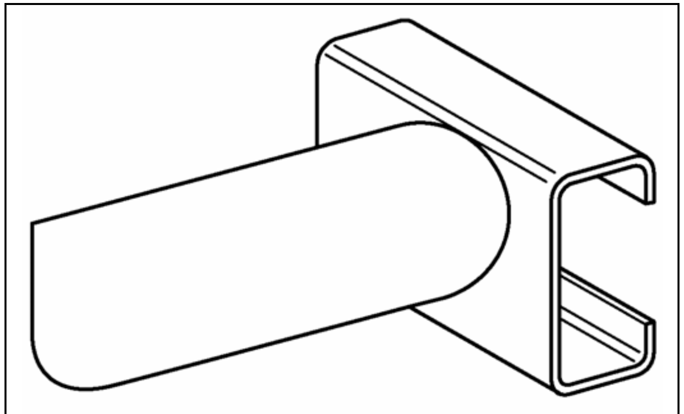
Test cable 134-pin for testing ME continuous fuel injection and ignition system, ME 2.7 and ME2.8 in combination with socket boxes W129 589 00 21 00 and W124 589 00 21 00.



001 589 00 16 00

Insertion hinge adapter

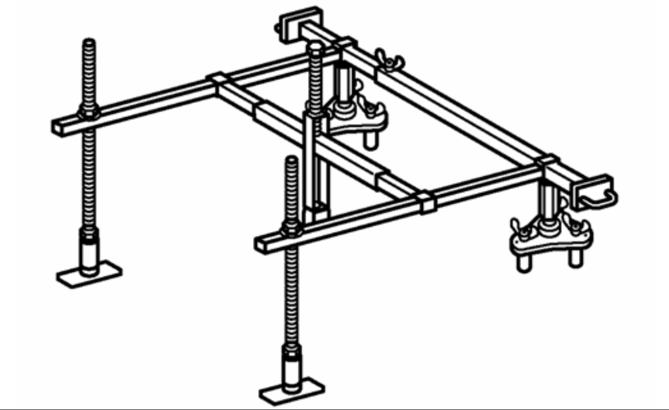
For releasing and tightening of V-clamps on connection for exhaust gas system - turbocharger.



285 589 00 34 00

Support

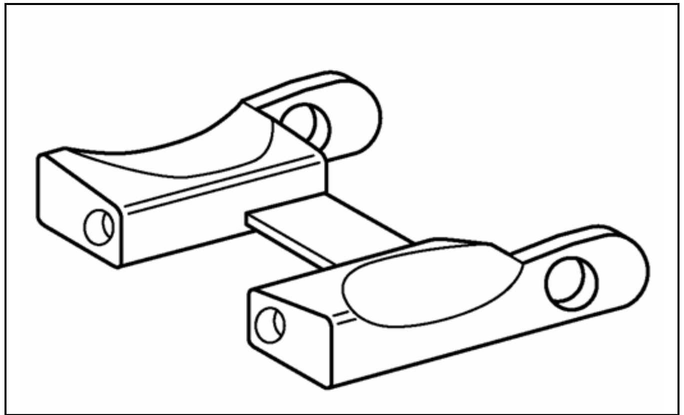
Support device for removing ignition module to be used in combination with W137 589 00 33 00.



240 589 00 61 00

Engine hoisting device

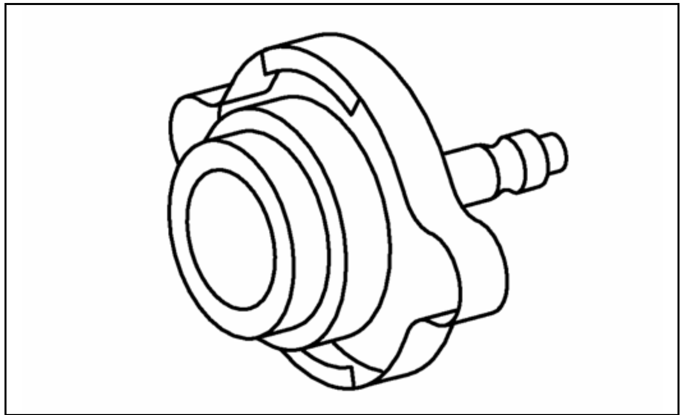
For hoisting major asssembly.



285 589 01 61 00

Lifting eye

Lifting eye for removal/installation of engine.



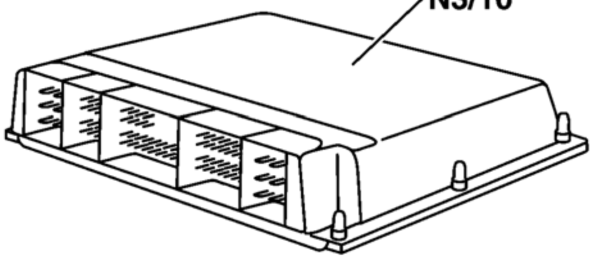
124 589 00 91 00

Test closure

For filling/bleeding the low-temperature cooling circuit.

Pliers

For releasing and fastening CLIC-type hose clamps.
Hazet 798-2
EAN 4000896 051397



P07.08-2017-01

Motor electronics control module 2.7.1
The electronic engine management is an advanced development of the ME 2.7 of the M137, which had to be adapted to suit the new conditions and functions of the M275 and M285 engines.
It contains all engine control functions as well as the diagnosis.
As was previously the case it is integrated into the network of the vehicle's other electronic control modules via the databus CAN-class C and transmits or receives data, which is vital for the most varied of functions.

New is the communication of the motor electronics control module with the generator via a bi-serial communication interface.

The engine control function has been adapted to the bi-turbo engine:

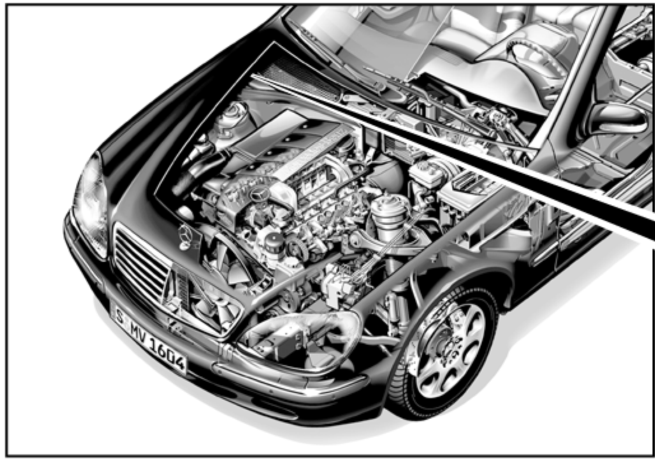
* The pressure in the charge air distribution pipe and the corresponding temperature are recorded for calculation of the aspirated air mass using separate pressure and temperature sensors.
* Boost pressure is regulated by the wastegate valve in the exhaust gas turbocharger.
* The boost pressure is recorded by a second pressure sensor upstream of the throttle valve and serves the boost pressure control.
* Instantaneous coordination and the engine's limp-home function have been adapted to the country-specific requirements.
* The diagnosis has been extended by the charger protection feature, which serves to prevent any impermissibly high turbine wheel speed.
* The signals from four knock sensors are evaluated for knock identification.
* In order to safeguard the exhaust gas turbocharger and the local three way catalytic converters against too high exhaust gas temperatures, a model-based exhaust gas temperature control has been introduced.

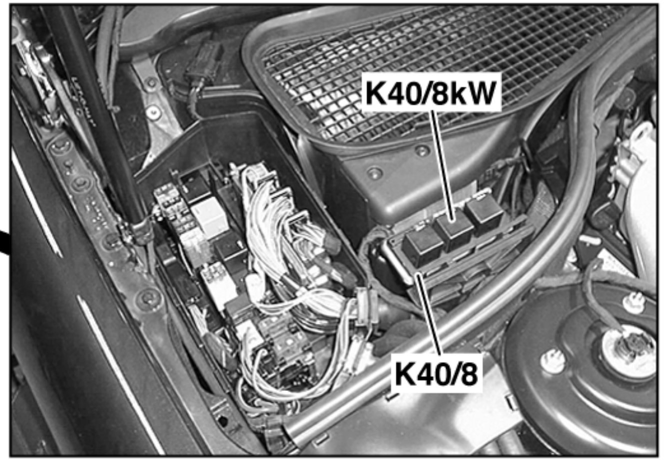
The ionic current misfiring detection familiar from the 137 engine has been adapted to suit the requirements of a highly-supercharged engine. The detection quality was able to be improved by continuously comparing it with a speed uniformity analysis on the crankshaft.

Engine fuse and relay box (K40/8)

In the engine compartment the S and CL 600 models have had an additional relay box installed. The following components are contained in this relay box:

K40/8kW	charge air relay
K40/8kV	Motronic relay
K40/8kX	intank fuel pump relay (only for S 55 AMG, CL 55 AMG)
Fuse 87	Motronic 1
Fuse 88	Motronic 2
Fuse 89	reserve
Fuse 90	charge air pump
Fuse 91	reserve





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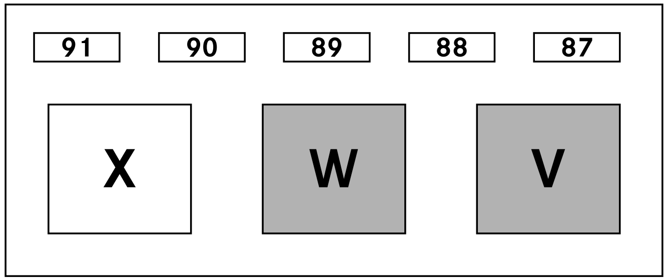


K40/8

Pin assignment: Plug connector for ME engine control module 2.7 1

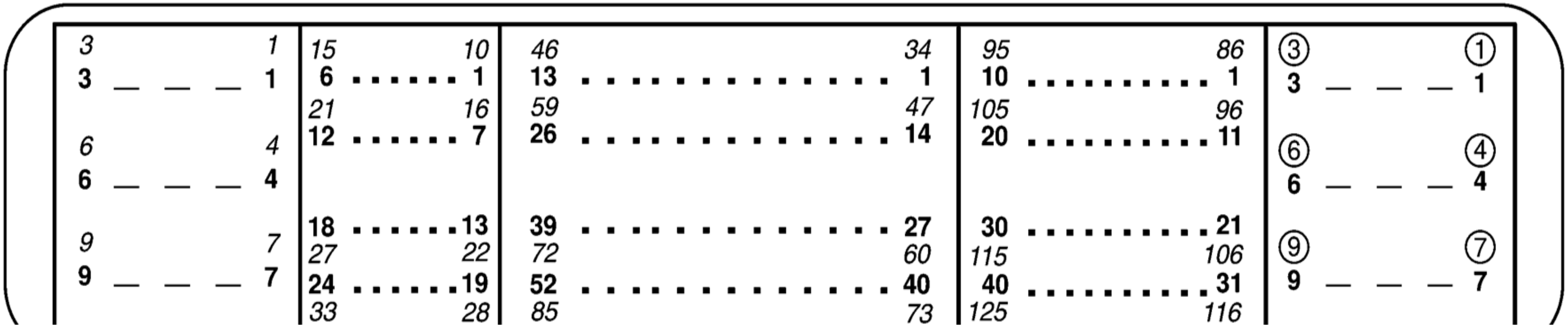
Plug 1
Ignition

Plug 2
(not populated for M111)

Plug 3
Engine side

Plug 4
Vehicle side

Plug 5
Supply



P07.08-2042-09

Large
Socket box

Small
Socket box (Plug 1 - 4)

129 589 00 21 00

Socket box (Plug 5)

124 589 00 21 00

Italic ⇒ *Socket assignment*

Bold ⇒ **Pin assignment on control module**

Pin assignment ME engine control module 2.7.1

Plug 1 **Ignition**	**Plug 2** **(not for M111 EVO)**	**Plug 3** **Engine side**		**Plug 4** **Vehicle side**		**Plug 5** **Supply**
1.1 ⇒ 1	2.1 ⇒ 10	3.1 ⇒ 34	3.27 ⇒ 60	4.1 ⇒ 86	4.27 ⇒ 112	5.1 ⇒ 1
1.2 ⇒ 2	2.2 ⇒ 11	3.2 ⇒ 35	3.28 ⇒ 61	4.2 ⇒ 87	4.28 ⇒ 113	5.2 ⇒ 2
1.3 ⇒ 3	2.3 ⇒ 12	3.3 ⇒ 36	3.29 ⇒ 62	4.3 ⇒ 88	4.29 ⇒ 114	5.3 ⇒ 3
1.4 ⇒ 4	2.4 ⇒ 13	3.4 ⇒ 37	3.30 ⇒ 63	4.4 ⇒ 89	4.30 ⇒ 115	5.4 ⇒ 4
1.5 ⇒ 5	2.5 ⇒ 14	3.5 ⇒ 38	3.31 ⇒ 64	4.5 ⇒ 90	4.31 ⇒ 116	5.5 ⇒ 5
1.6 ⇒ 6	2.6 ⇒ 15	3.6 ⇒ 39	3.32 ⇒ 65	4.6 ⇒ 91	4.32 ⇒ 117	5.6 ⇒ 6
1.7 ⇒ 7	2.7 ⇒ 16	3.7 ⇒ 40	3.33 ⇒ 66	4.7 ⇒ 92	4.33 ⇒ 118	5.7 ⇒ 7
1.8 ⇒ 8	2.8 ⇒ 17	3.8 ⇒ 41	3.34 ⇒ 67	4.8 ⇒ 93	4.34 ⇒ 119	5.8 ⇒ 8
1.9 ⇒ 9	2.9 ⇒ 18	3.9 ⇒ 42	3.35 ⇒ 68	4.9 ⇒ 94	4.35 ⇒ 120	5.9 ⇒ 9
	2.10 ⇒ 19	3.10 ⇒ 43	3.36 ⇒ 69	4.10 ⇒ 95	4.36 ⇒ 121	
	2.11 ⇒ 20	3.11 ⇒ 44	3.37 ⇒ 70	4.11 ⇒ 96	4.37 ⇒ 122	
	2.12 ⇒ 21	3.12 ⇒ 45	3.38 ⇒ 71	4.12 ⇒ 97	4.38 ⇒ 123	
	2.13 ⇒ 22	3.13 ⇒ 46	3.39 ⇒ 72	4.13 ⇒ 98	4.39 ⇒ 124	
	2.14 ⇒ 23	3.14 ⇒ 47	3.40 ⇒ 73	4.14 ⇒ 99	4.40 ⇒ 125	
	2.15 ⇒ 24	3.15 ⇒ 48	3.41 ⇒ 74	4.15 ⇒ 100		
	2.16 ⇒ 25	3.16 ⇒ 49	3.42 ⇒ 75	4.16 ⇒ 101		
	2.17 ⇒ 26	3.17 ⇒ 50	3.43 ⇒ 76	4.17 ⇒ 102		
	2.18 ⇒ 27	3.18 ⇒ 51	3.44 ⇒ 77	4.18 ⇒ 103		
	2.19 ⇒ 28	3.19 ⇒ 52	3.45 ⇒ 78	4.19 ⇒ 104		
	2.20 ⇒ 29	3.20 ⇒ 53	3.46 ⇒ 79	4.20 ⇒ 105		
	2.21 ⇒ 30	3.21 ⇒ 54	3.47 ⇒ 80	4.21 ⇒ 106		
	2.22 ⇒ 31	3.22 ⇒ 55	3.48 ⇒ 81	4.22 ⇒ 107		
	2.23 ⇒ 32	3.23 ⇒ 56	3.49 ⇒ 82	4.23 ⇒ 108		
	2.24 ⇒ 33	3.24 ⇒ 57	3.50 ⇒ 83	4.24 ⇒ 109		
		3.25 ⇒ 58	3.51 ⇒ 84	4.25 ⇒ 110		
		3.26 ⇒ 59	3.52 ⇒ 85	4.26 ⇒ 111		

Continuous fuel injection system (overview)

BOSCH	ME 1.0	M119 M120	* Control through hot film mass air flow sensor
	ME 2.0	M112 M113	* Control through hot film mass air flow sensor
	ME 2.1	M111	* Control through hot film mass air flow sensor
	ME 2.7	M137	* Control through hot film mass air flow sensor
	ME 2.7.1	M285	* Pressure motor control
	ME 2.7.1	M275	* Pressure motor control
	ME 2.8	M112 M113	* Control through hot film mass air flow sensor Manifold air pressure sensor for monitoring
	ME 2.8.1	M112 ML M113 ML	* Pressure motor control
VDO	MSM	M166	* To 08/2001 control through hot film mass air flow sensor * As of 09/2001 pressure motor control
Siemens	SIM4	M111 EVO	* To speed 2,000 rpm control through hot film mass air flow sensor * As of speed 2,000 rpm manifold air pressure control

» ... Die Mitarbeiter werden zukünftig in die Rolle persönlicher Wissensmanager hineinwachsen müssen, die aktiv die Verantwortung für ihre Qualifizierung übernehmen ... « Jürgen E. Schrempp

» ... Staff must in future assume the role of personal knowledge managers, who actively take responsibility for their own qualification ... « Jürgen E. Schrempp

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