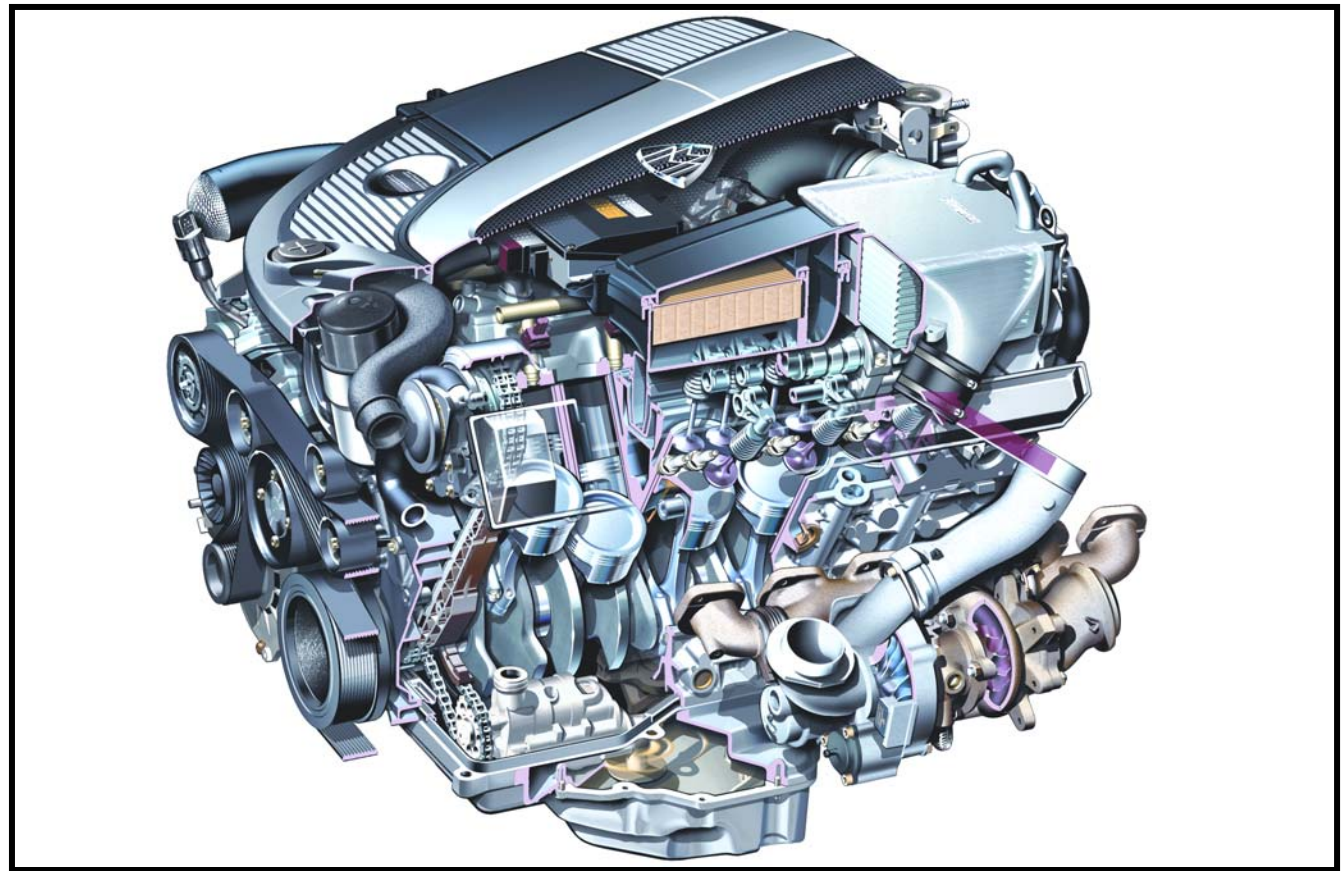


MAYBACH



Maybach Engine – M285



512 HO M285 Engine
(FrechW)
08-06-03

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WIS document numbers shown apply to WIS Version USA/CDN at date of writing.

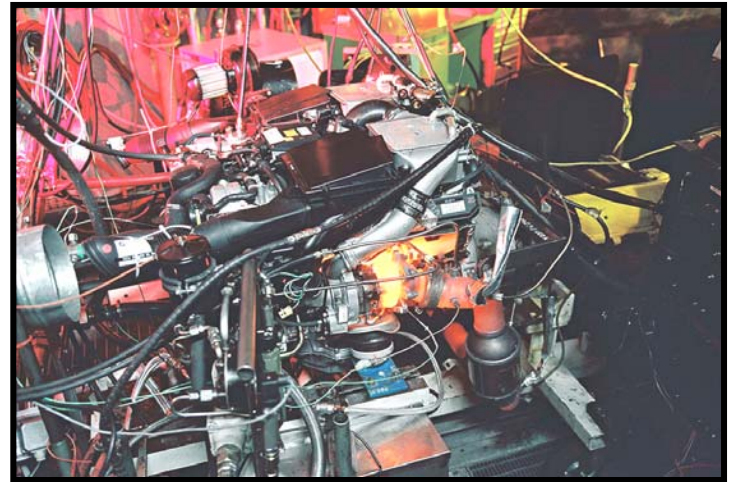
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Printed in U. S.A.

What is the M285?

- M275 / M285 is the next generation of engine development from Mercedes-Benz
- Replaces the M137
- Newly developed twelve-cylinder bi-turbocharged engine sets new standards in terms of horsepower and torque in all driving situations
- M285 engine is only available in the Maybach



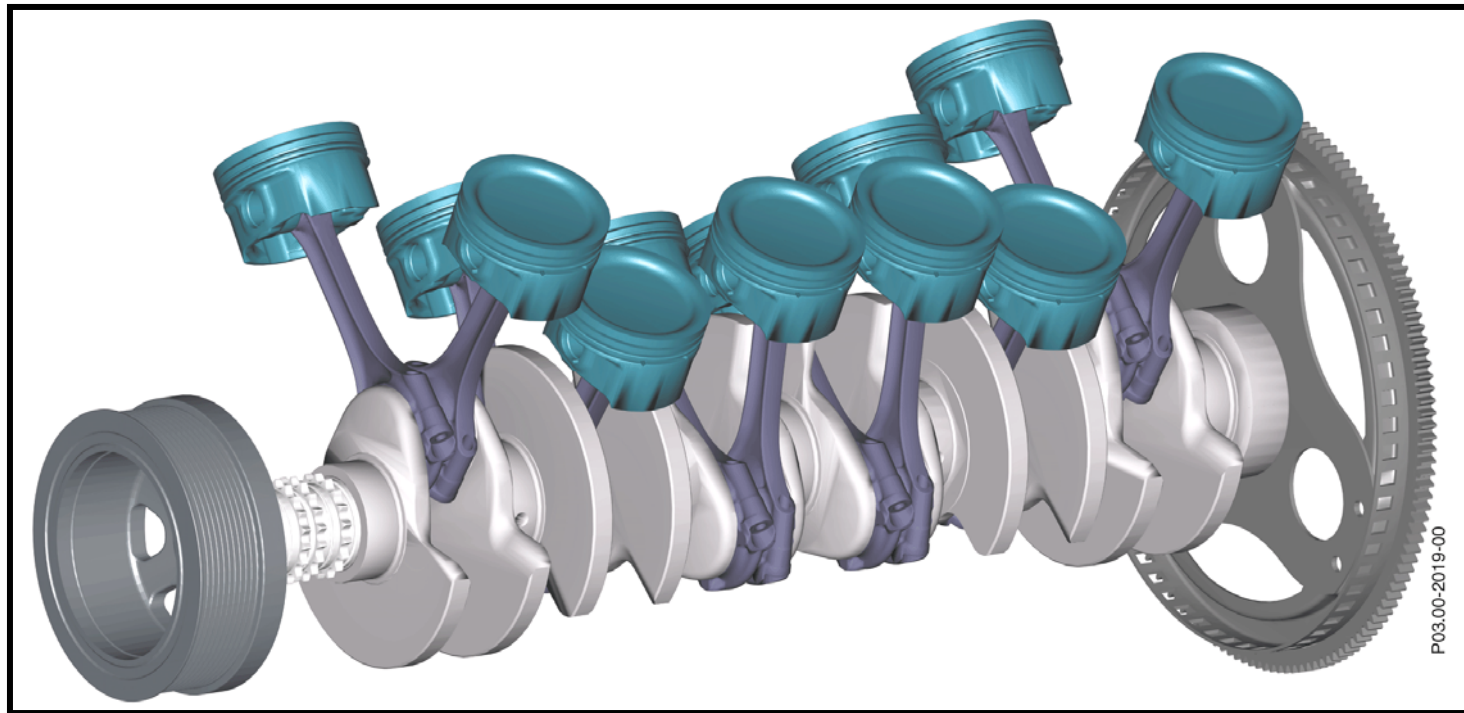
Engine Advantages

- Higher power output for a smaller engine displacement
- Larger torque output generated at low speeds
- Reduced engine noise

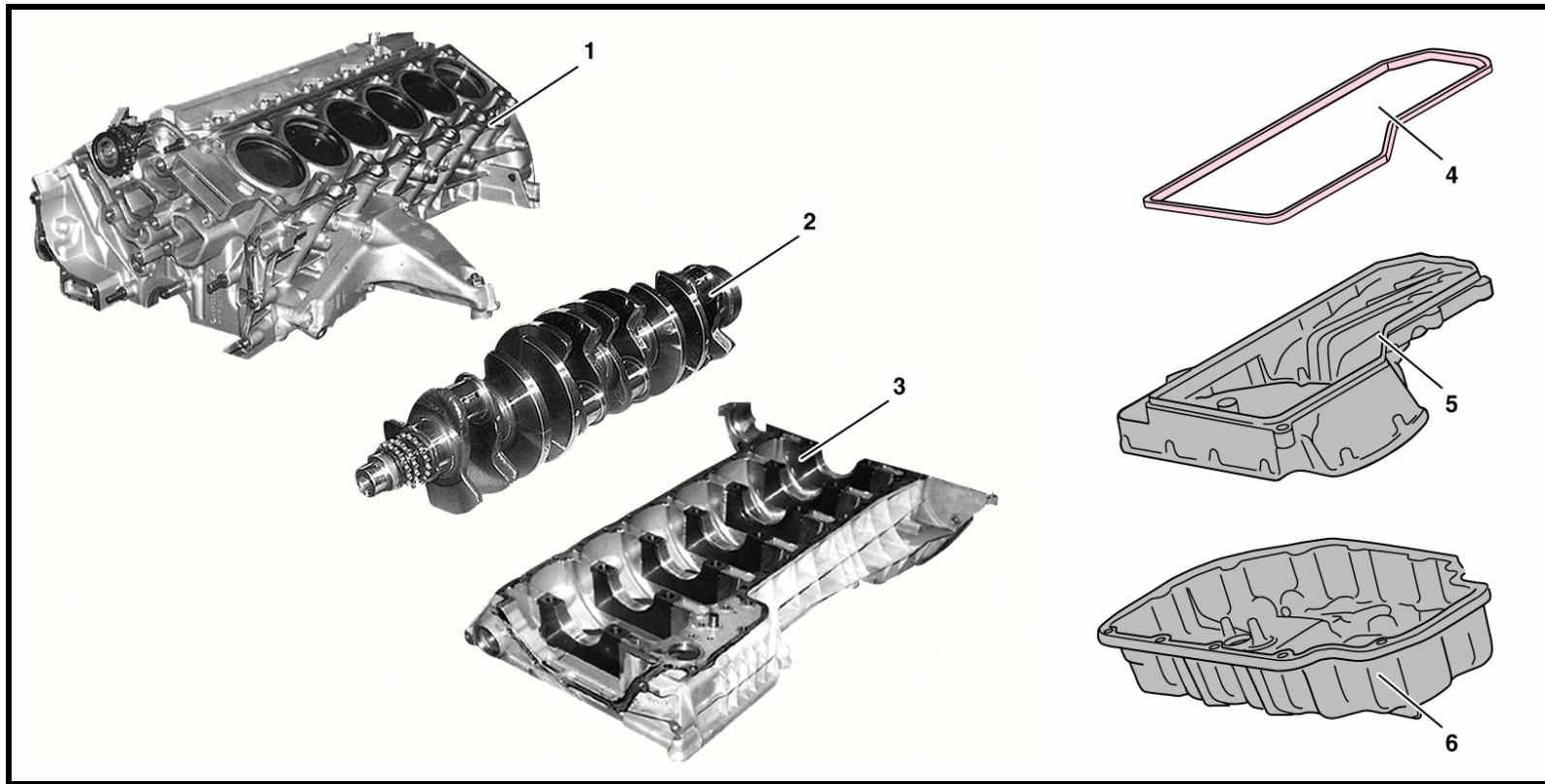
M137 vs. M285 Comparison

M137 5.8l (naturally aspirated)	M285 5.5l (bi-turbo charged)
362 hp @ 5000 rpm	550 hp @ 5000 rpm
391 ft-lb torque @ 4100 rpm	663 ft-lb torque @ 2300-3000 rpm
ECI used for knock detection	Four sensors used for knock detection
ECI used for misfire detection	ECI and CKP used for misfire detection
Constant delivery fuel pump	On-demand fuel pump
Fuel filter with pressure regulator	Fuel filter with overflow valve
Eight oxygen sensors	Four oxygen sensors
Six catalytic converters	Two catalytic converters
Cylinder shutoff	No cylinder shutoff
Hot film air mass sensor	Pressure sensors and charge air temperature sensor
One air filter	Two air filters
Camshaft adjustment	No camshaft adjustment
Oil to water cooler in "V"	Air to oil cooler behind bumper
Oil orifice separator PCV	Centrifugal oil separator PCV
10 to 1 compression ratio	9 to 1 compression ratio

M285 Engine Mechanics



Crankcase Components



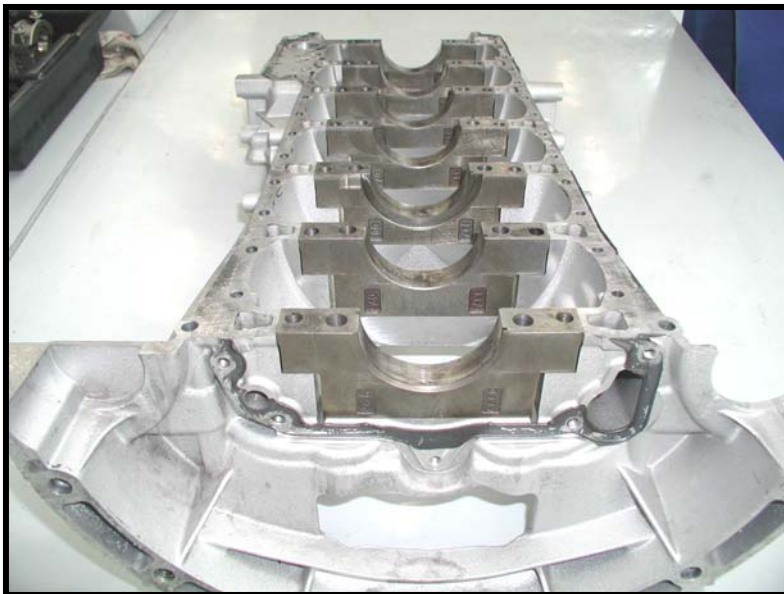
- 1 Upper portion of crankcase is cast aluminum
- 3 Lower portion of the crankcase is cast aluminum
- 5 Upper portion of oil pan is aluminum

- 2 Crankshaft with counterweight system
- 4 Rubber seal between lower crankcase and oil pan
- 6 Lower portion of oil pan is aluminum

Note: The rubber seal between lower crankcase and oil pan (4) is used for noise reduction.

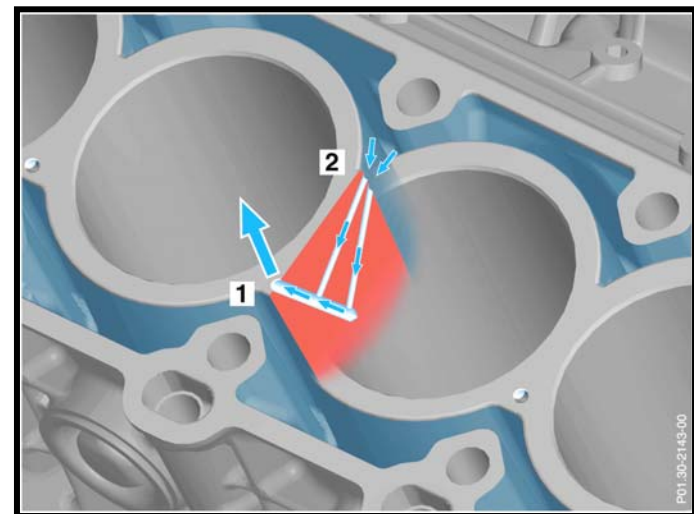
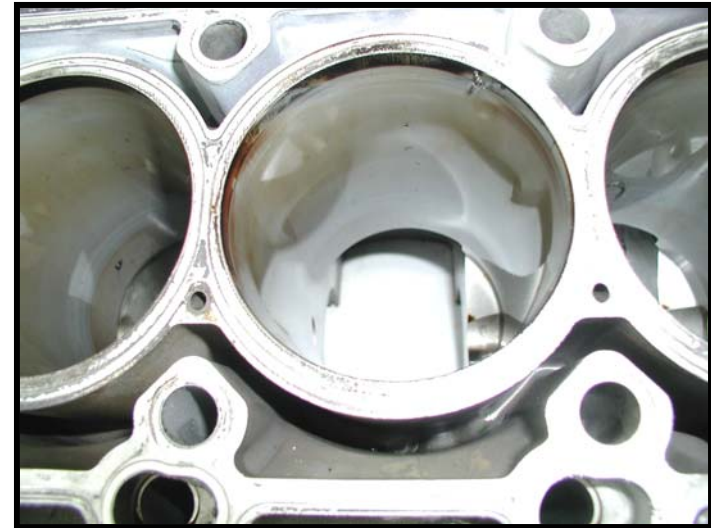
Crankcase Design

- Two piece bedplate design
- Cast iron inserts for main bearings
- only lower portion



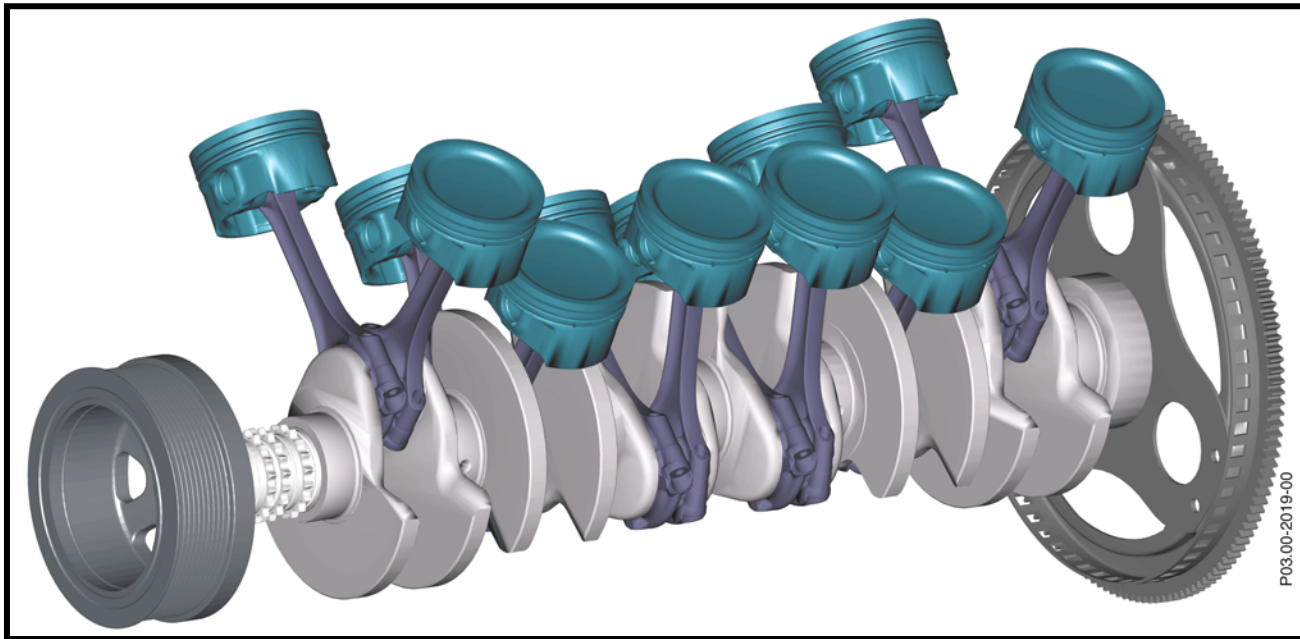
Cylinder Liners

- Cylinders made of alloy of aluminum-silicon (silitec) 2.5 mm thickness
- Due to higher heat and pressure loads the land bores (wall between cylinders) has been widened by 2mm
- Cylinder bore has been reduced from 84.0mm to 82.0mm
- Equipped with (2) two feed bores which supply the land with coolant and (1) one drain bore



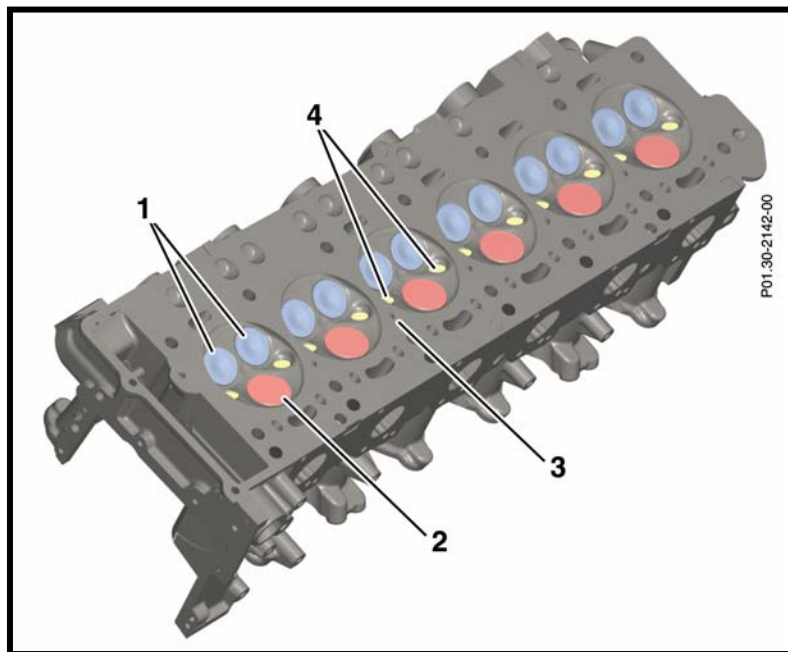
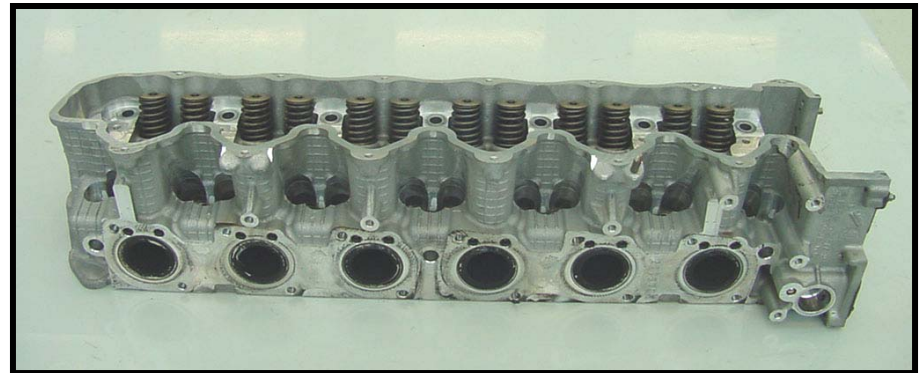
Crankshaft Assembly

- Pistons accommodate extremely high temperatures & pressures
 - oil nozzles for piston cooling
- Connecting rods made of high-strength forged steel

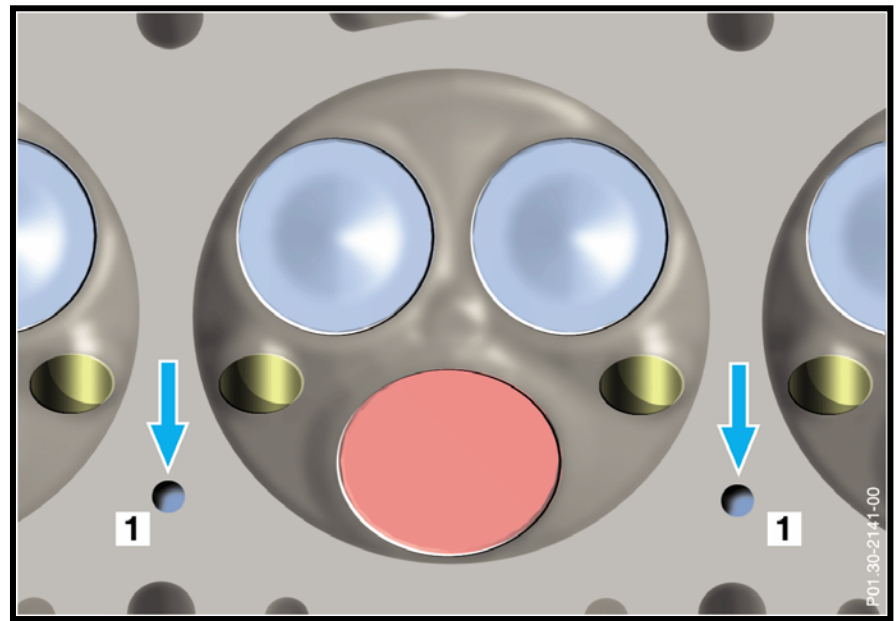


Cylinder Heads

- Made of aluminum
- Incorporating three valve per cylinder technology
- Land bores for cooling



- 1 Intake valves 2 Exhaust valves
3 Land cooling bores 4 Spark plug bores



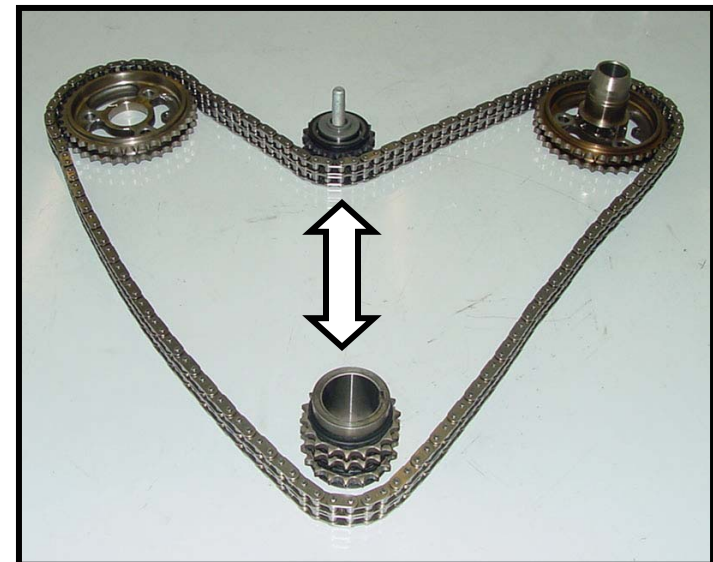
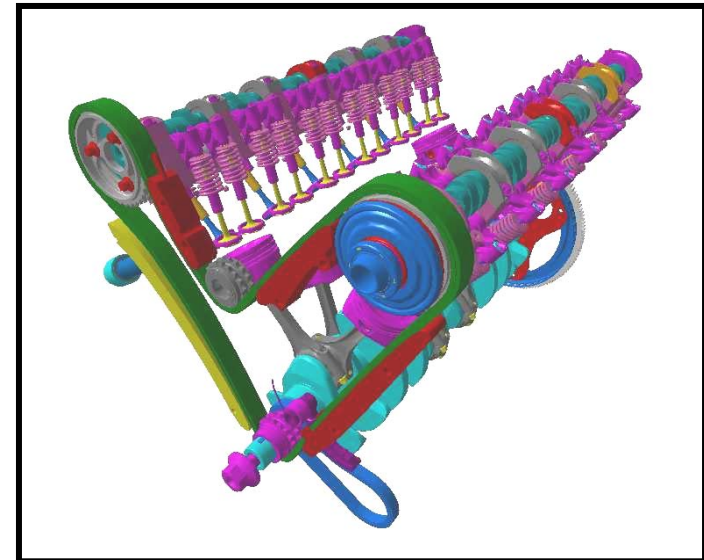
- 1 Coolant feed bore in cylinder head

Valve Gears

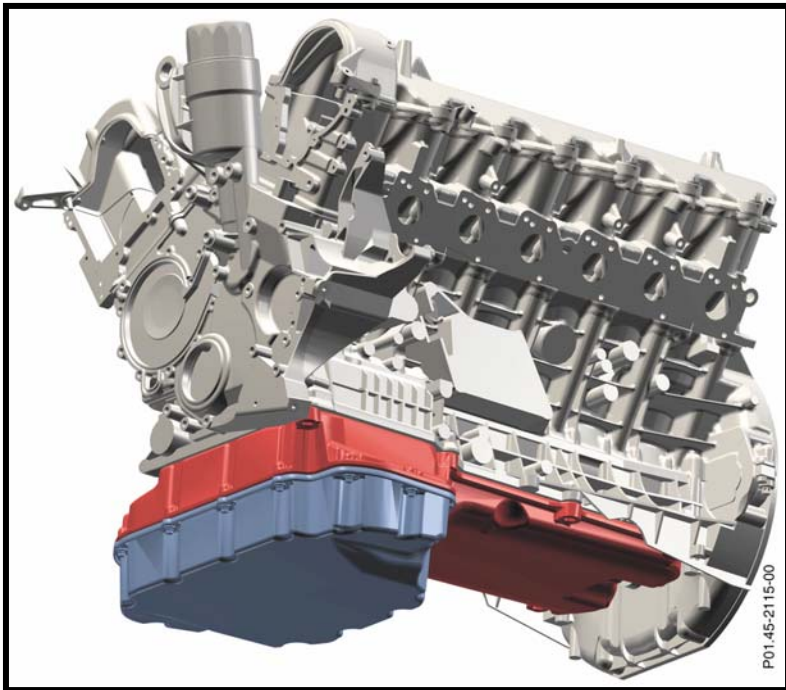
- Camshaft driven by crankshaft by means of a twin roller chain
- A guide wheel is used in the center of the V for deflection
- Chain tensioning is done using a tensioning rail and hydraulic chain tensioner



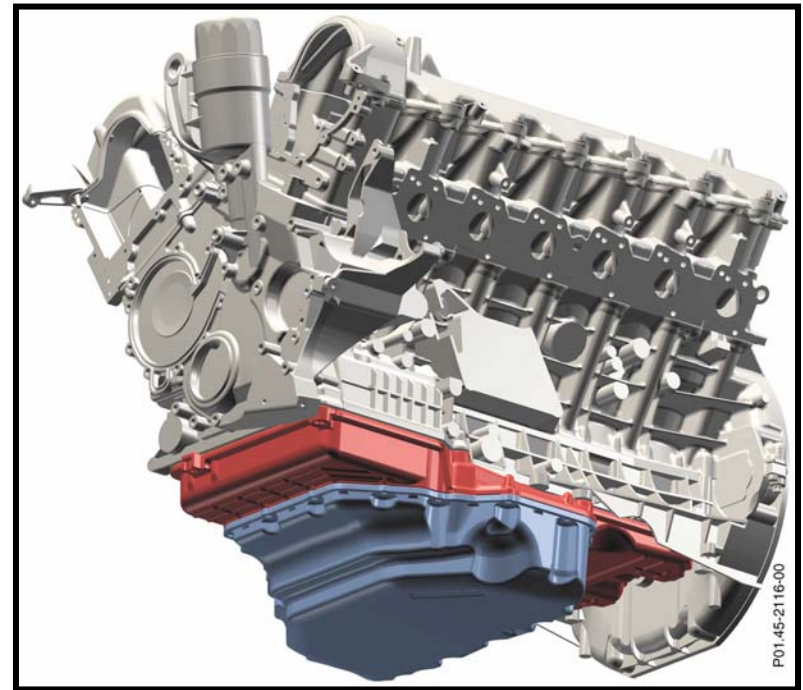
- Small rollers incorporate vulcanized rubber, but camshaft sprockets do not



Oil Pan Configurations



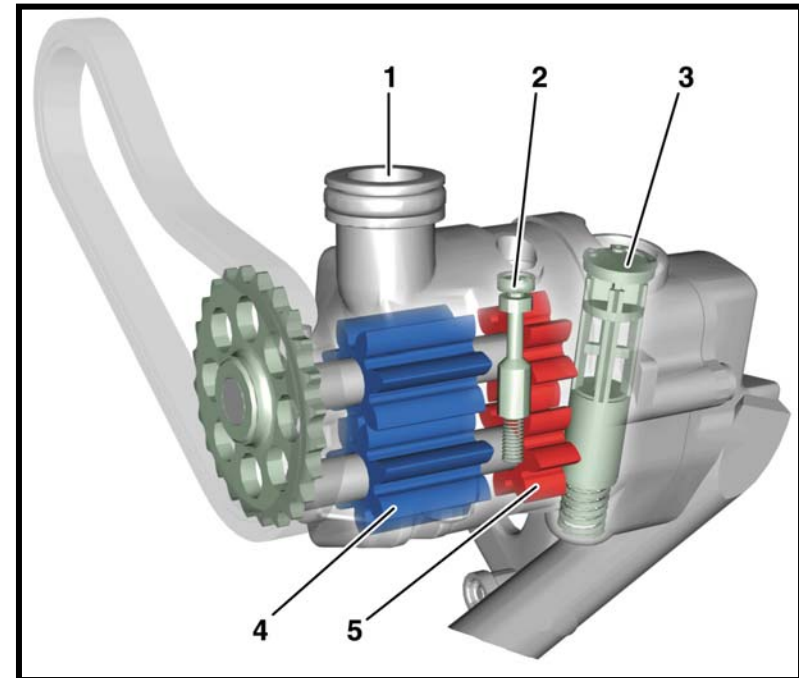
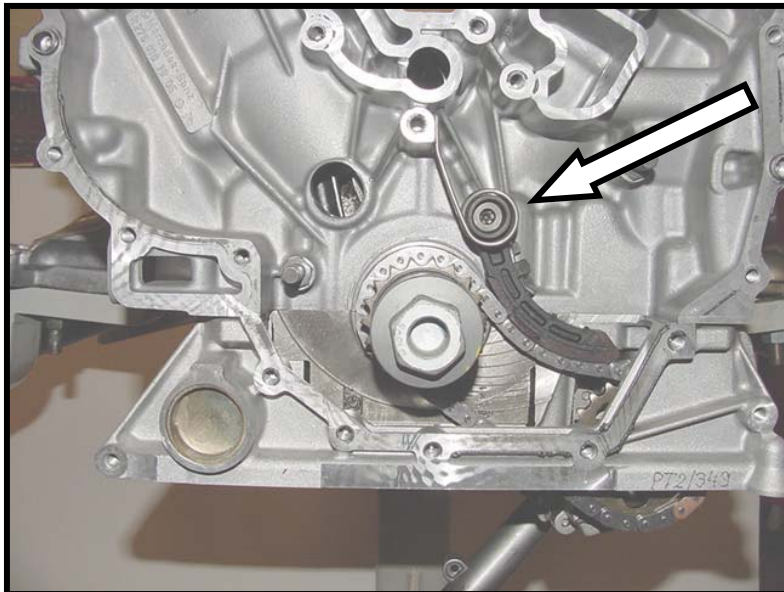
M275 in model 220



M285 in model 240

Oil Pump

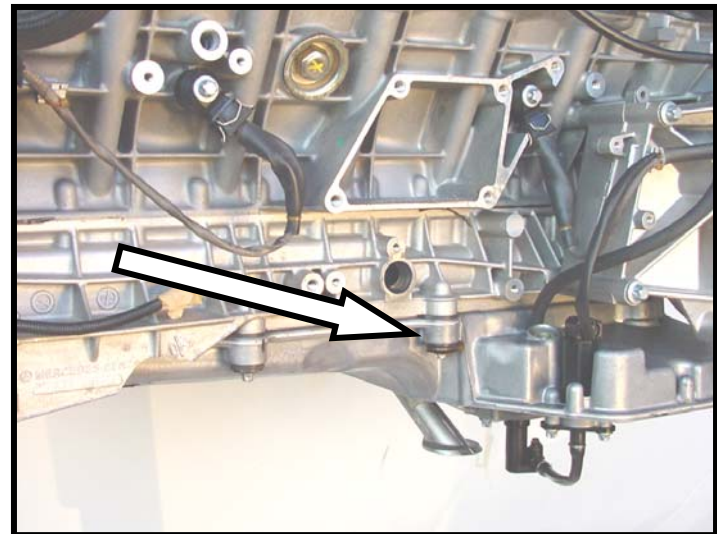
- Two-stage gear pump design
- One control plunger in each delivery stage which controls the pressure and delivery rate
- Spring loaded chain tensioner



- 1 Pressure connection
- 2 Stage 2 control plunger
- 3 Stage 1 control plunger
- 4 Delivery stage 1
- 5 Delivery stage 2

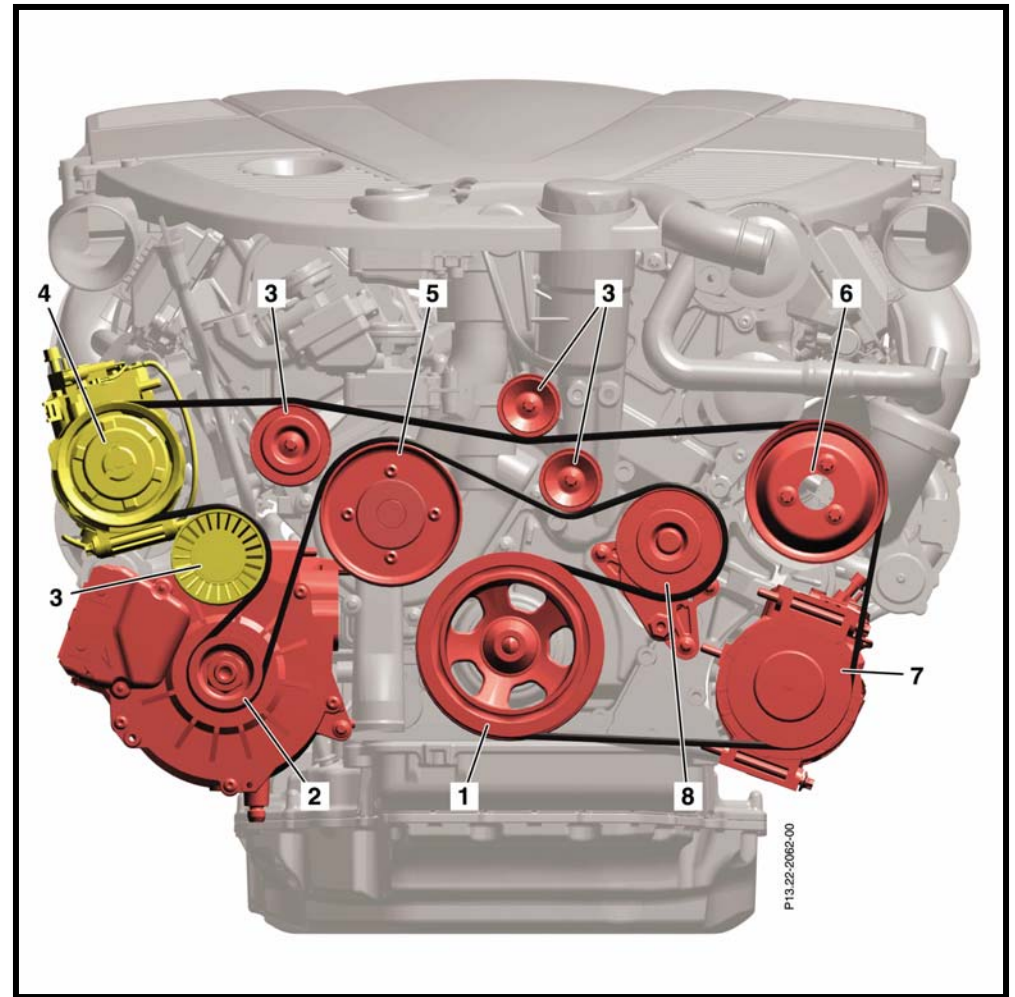
Oil Pan Removal Service Tip

- When removing / reinstalling the upper portion of the oil pan be sure to reinstall the copper tab
- This tab creates a ground between the oil sensor and the crankcase which is required due to the thick rubber gasket



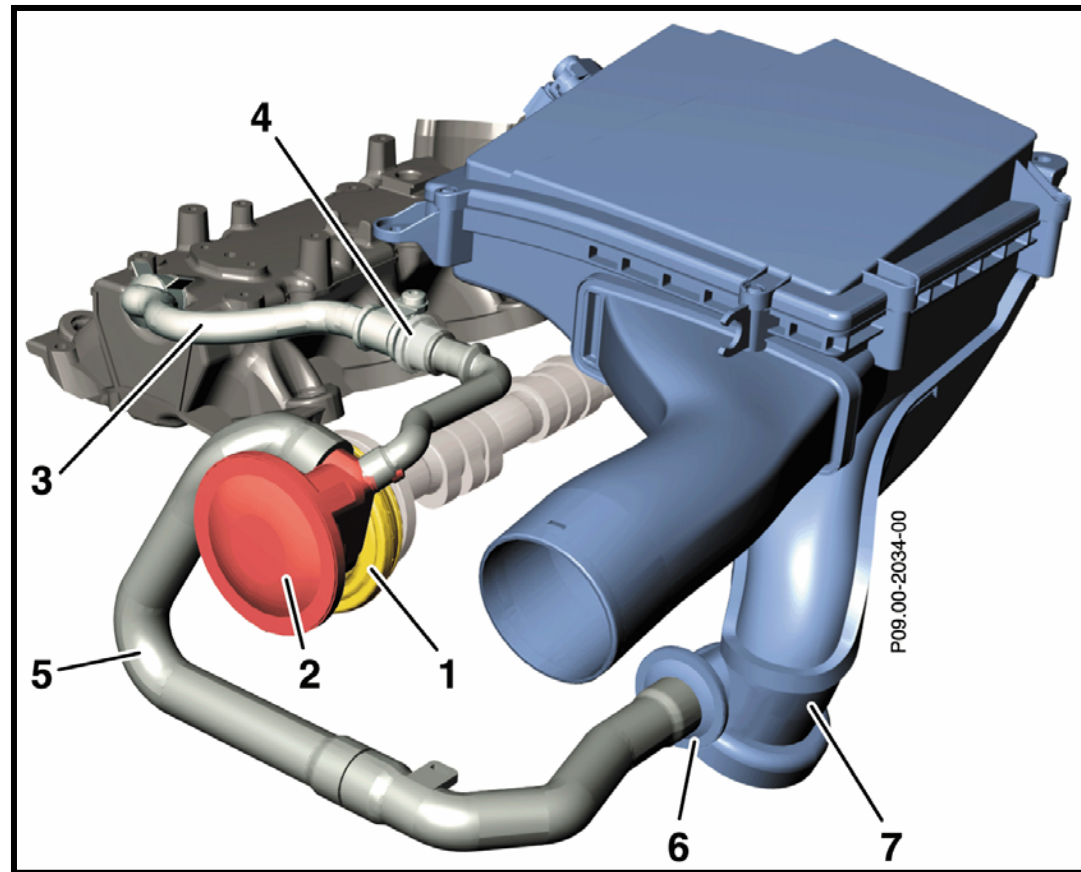
Belt Drive

- 1 Crankshaft belt pulley
- 2 Alternator
- 3 Pulleys and guide rollers
- 4 A/C compressor (rear system)
- 5 Coolant pump
- 6 Power steering pump
- 7 A/C compressor (front system)
- 8 Tensioning pulley



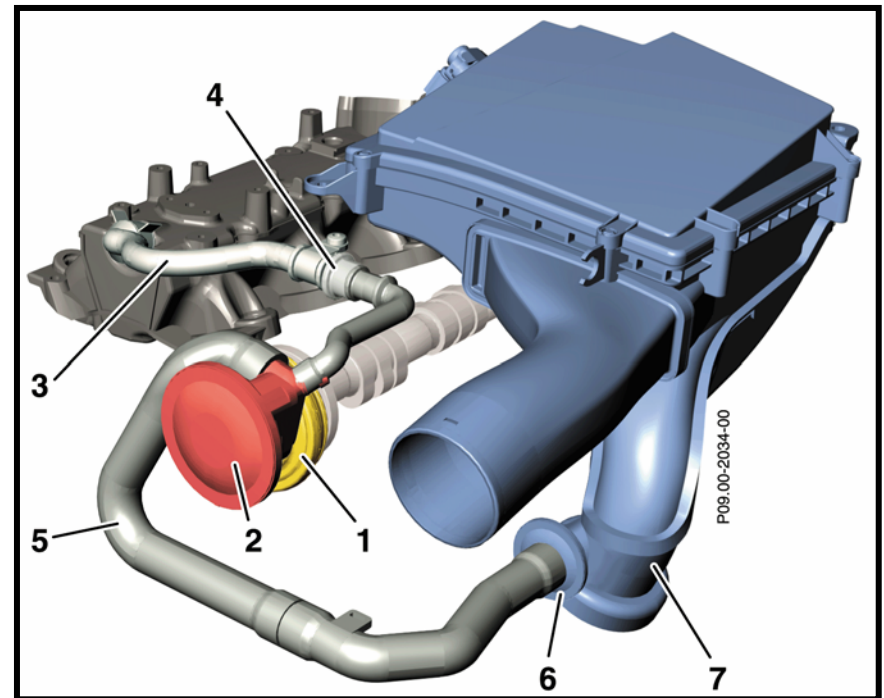
Note: Tensioner and serpentine belt should be replaced at 37,500 miles

Crankcase Ventilation



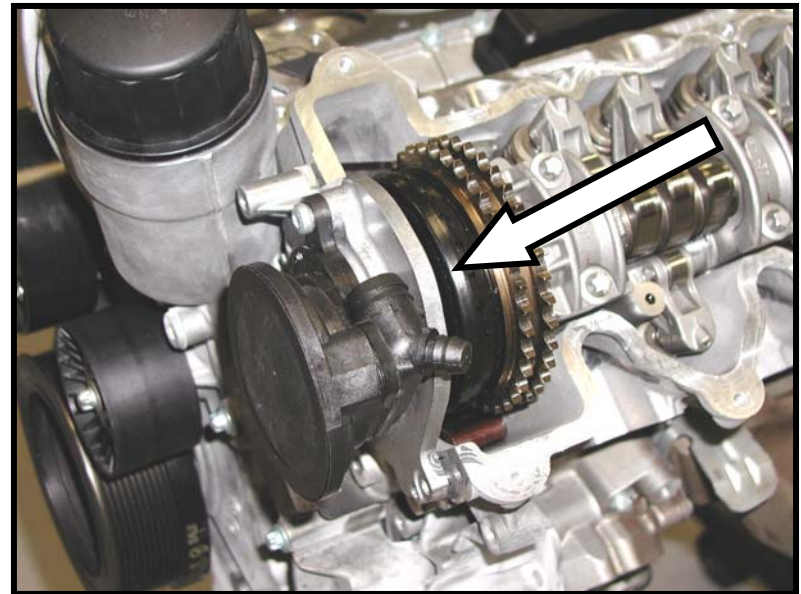
Crankcase Ventilation Components

- 1 Centrifugal oil separator
(driven by camshaft)
- 2 Pressure regulator valve
- 3 Partial load vent line
- 4 Partial load ventilation check valve
- 5 Full load vent line
- 6 Full load ventilation check valve
- 7 Intake line for left turbocharger



Centrifugal Oil Separator

- Driven by the left camshaft
- Integrated into the ventilation system to remove oil under all operating conditions



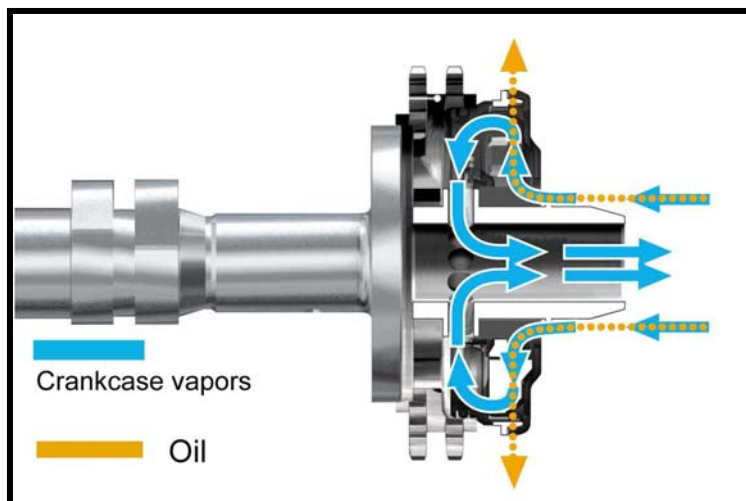
Pressure Regulating Valve

- Located on the left cylinder head
- Ensures adequate evacuation of crankcase vapors during partial and full load conditions
- At >50 mbar the connection between the intake line of the turbocharger is sealed using a diagram in the valve



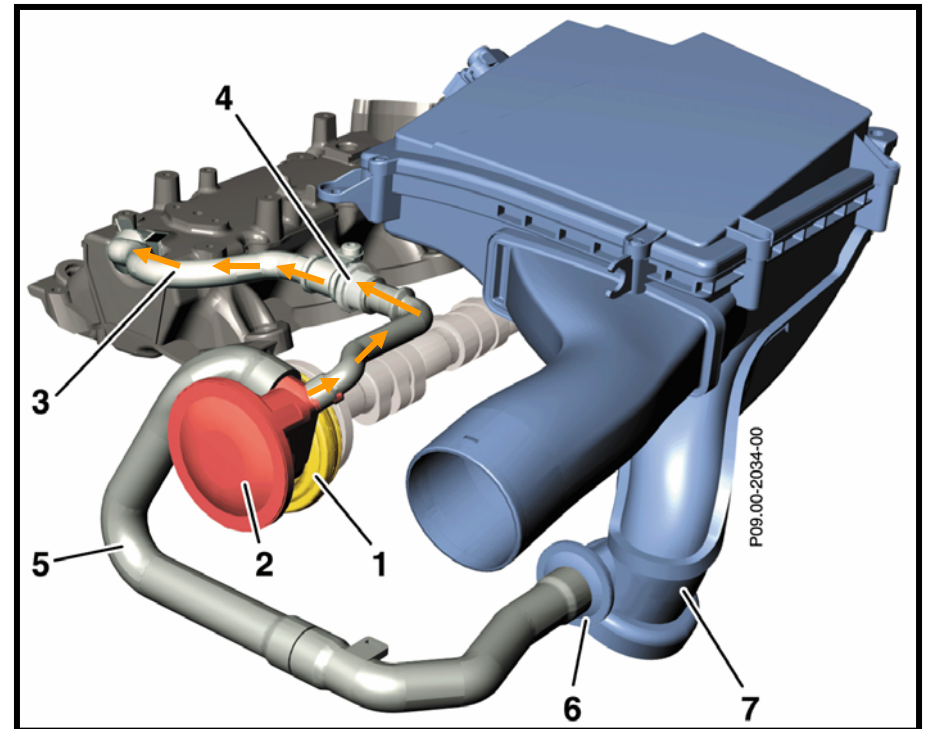
Crankcase Ventilation Function

- The oil-air-fuel vapor is aspirated by the intake manifold
- It's routed from the crankcase to the centrifugal oil separator where oil is separated
- The separated oil is fed back to the oil pan through the timing chain compartment



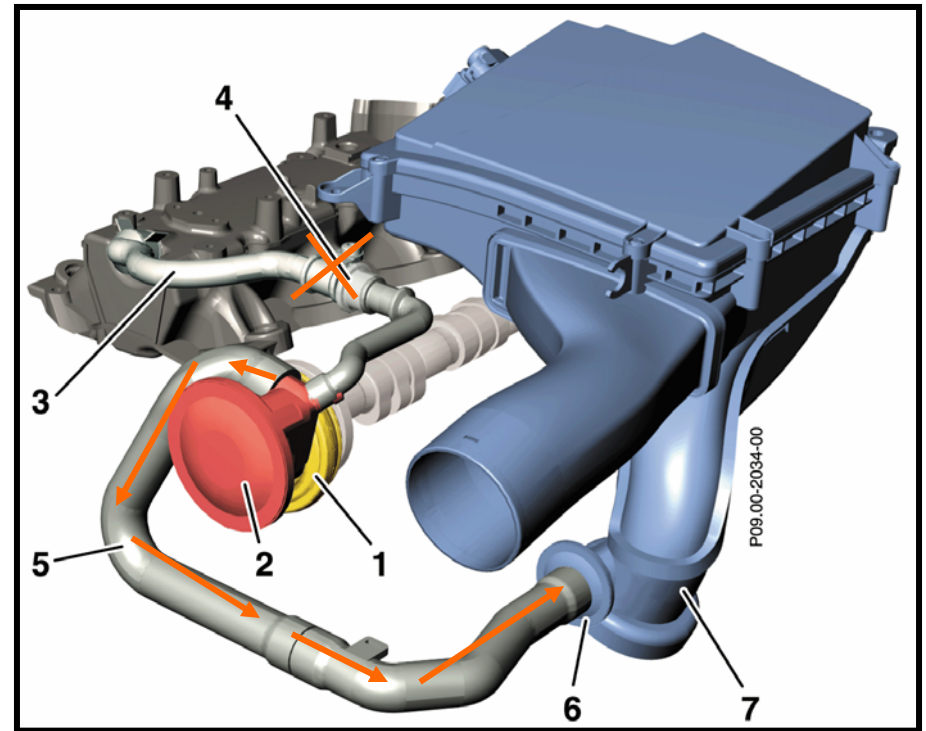
Partial Load Ventilation

- During partial load ventilation the crankcase vapors are routed through the check valve (4) into the intake manifold
 - vacuum at intake manifold



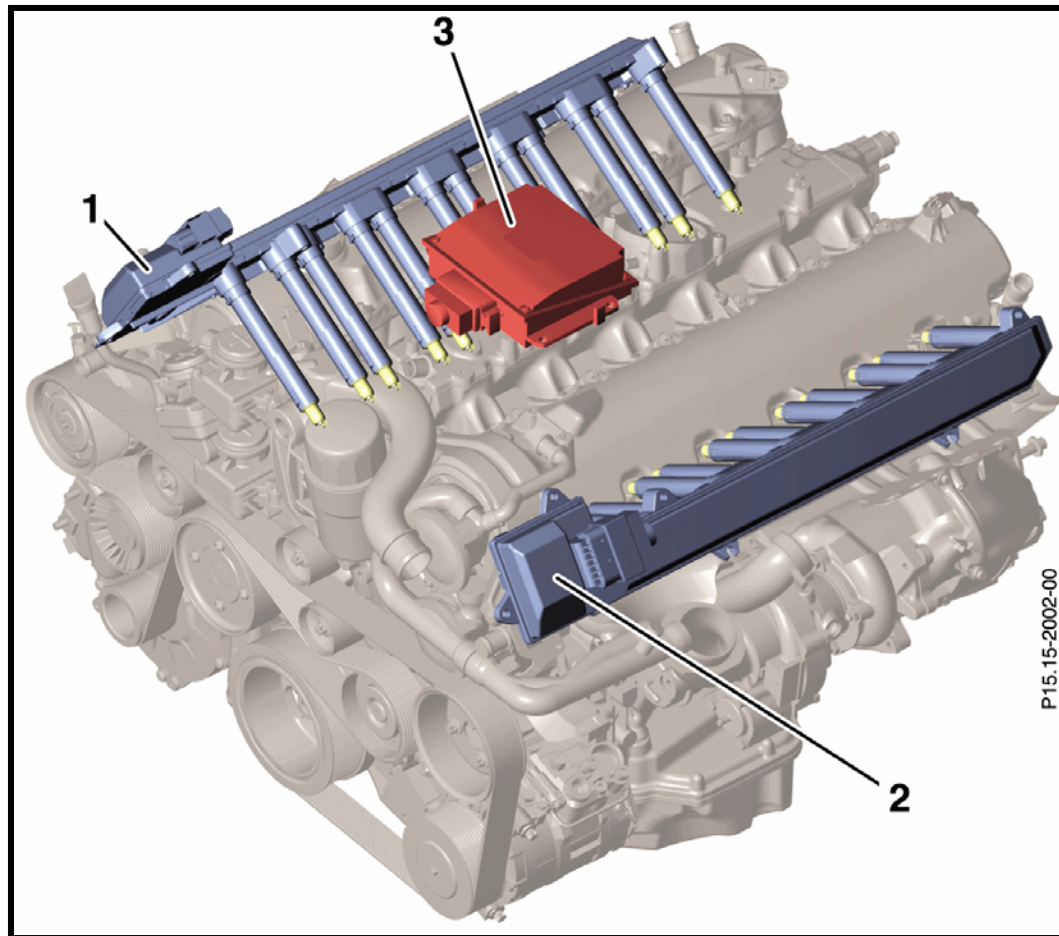
Full Load Ventilation

- Partial load ventilation line is closed by the boost pressure applied to the check valve (4)
- The vapor is routed to the intake line for the turbocharger downstream of the air cleaner via check valve (6)



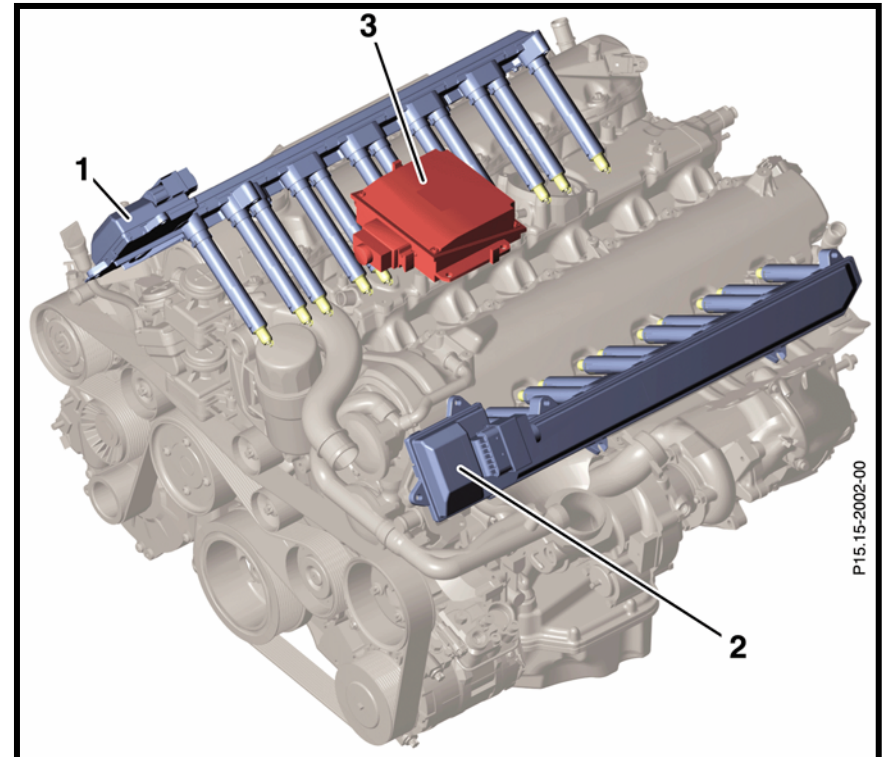
Note: The left turbocharger may appear darker internally as compared to the right. This is due to the crankcase ventilation operation during full load applications.

ECI Ignition System



Ignition System Overview

- Energy Controlled Ignition (ECI) is used on the M285 engine
- System functions are based on the M137 engine



P15.15-2002-00

- 1 Ignition module, right cylinder bank
- 2 Ignition module, left cylinder bank
- 3 ECI power supply unit

Power Supply Unit (N91)

- Generates 180 volts DC (VDC) for ignition
- Generates 23 VDC for ionic current measurement voltage
- Supplies 12 VDC to ignition modules



CAUTION: Do not disconnect N91 until after the ignition has been off for at least 4 minutes.

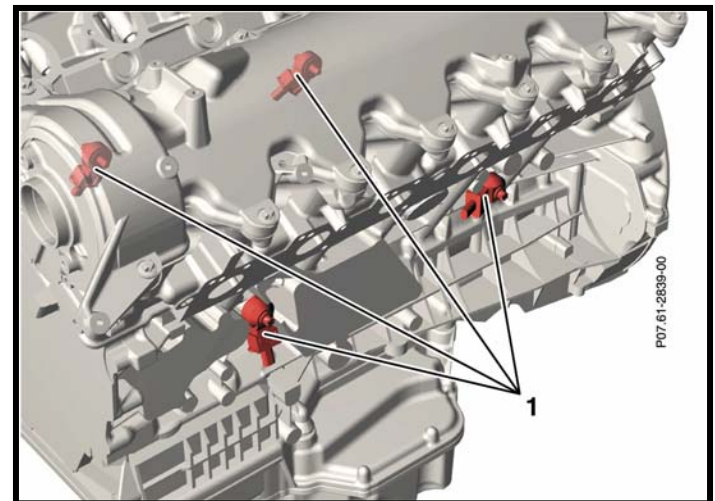
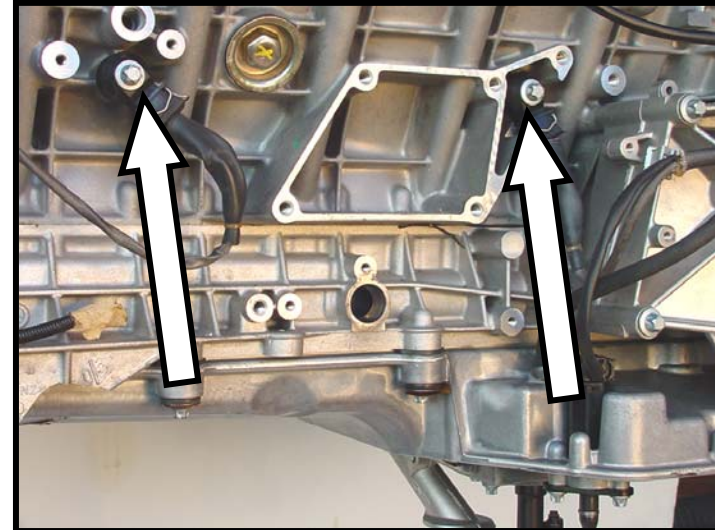
Ignition Modules (N92/1 & N92/2)

- There are 12 individual ignition coils per ignition module
- Ignition modules convert 180 VDC to 32kv AC voltage
- 23 VDC is used to generate voltage for ionic current measurement
- This current is utilized along with crankshaft position information (L5) for misfire detection



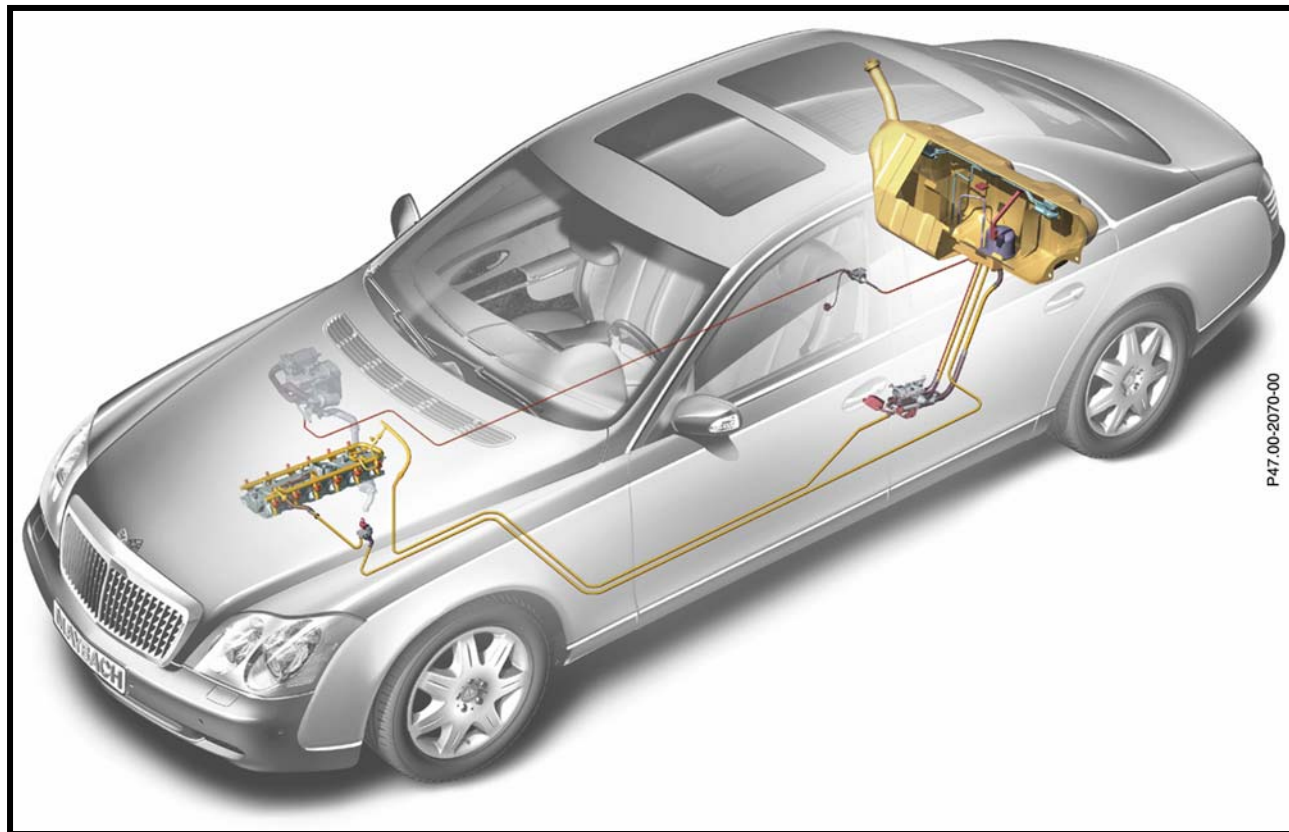
Knock Detection

- Knock detection is performed using the following sensors
 - Left (A29/1 & A29/2)
 - Right (A30/1 & A30/2)
- Engine knocking is detected by the sensors and converted into electrical signals
- Signals are sent to the ME control module and evaluated to regulate ignition timing

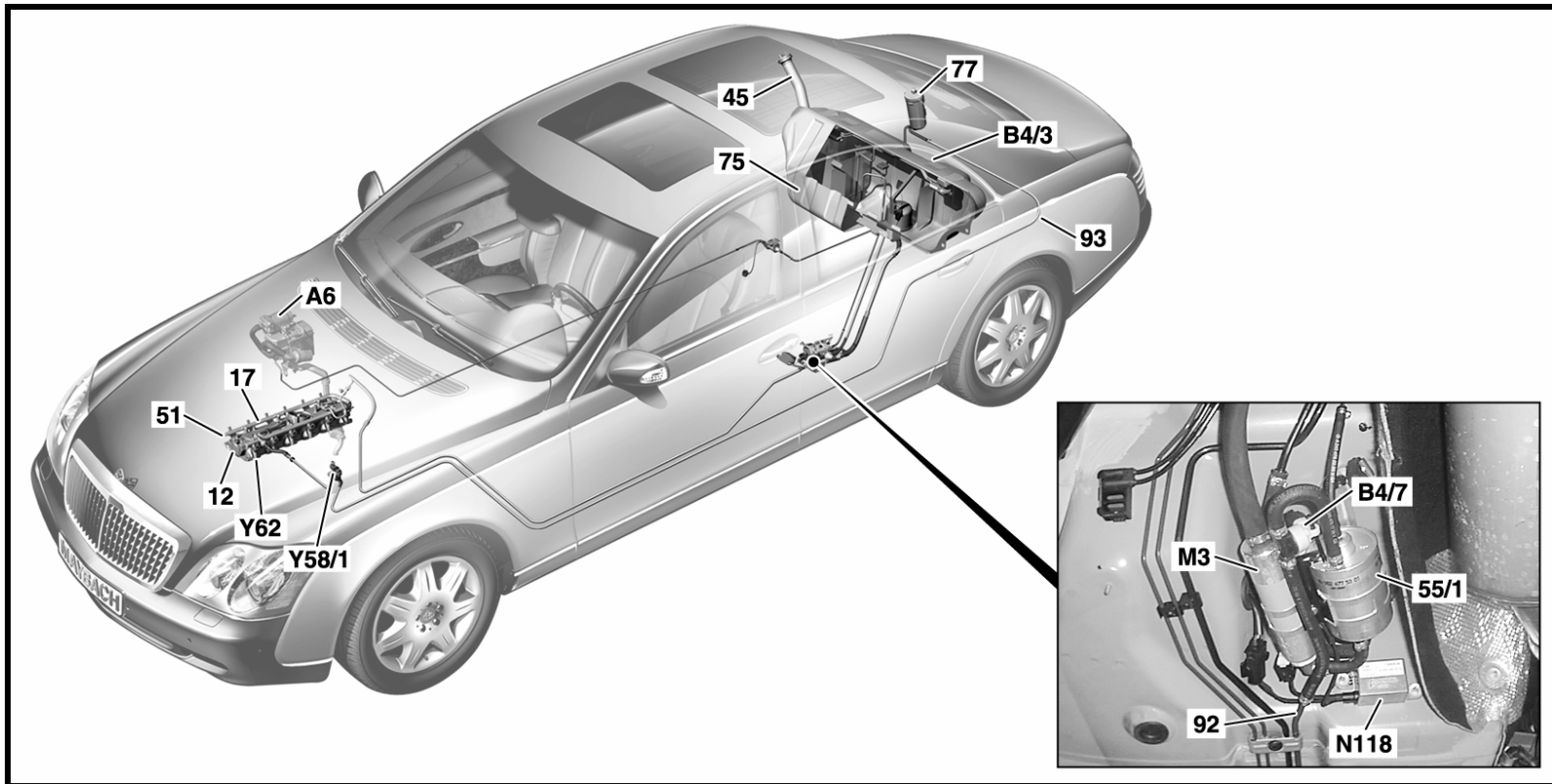


1 Knock sensors

Fuel Delivery System



Fuel Delivery System Components



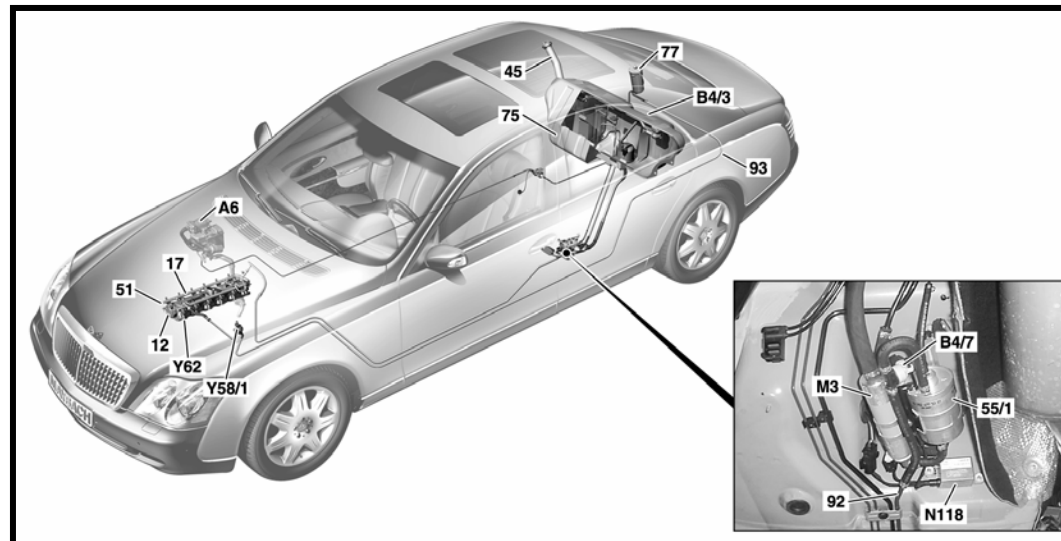
Y58/1	System tank ventilation	Y62	Injection valves	12	Intake manifold
51	Pressure gauge connection	17	Fuel distribution pipe	A6	NOT USA
75	Fuel tank	45	Fuel filler tube	77	Activated charcoal filter
B4/3	Pressure sensor (in tank)	93 & 92	Fuel lines	M3	Fuel pump
B4/7	Pressure sensor	55/1	Fuel filter	N118	Fuel pump control module

Fuel Delivery System Overview

- The M285 uses an on-demand fuel pump that delivers exactly the amount of fuel the engine requires
- This system is regulated by a dedicated control module N118
- Screw spindle type pump is used to handle increased fuel consumption
- A pressure sensor provides control module (N118) with actual fuel pressure
- System pressure is held at a constant 3.8 bar by adjusting the rotational speed of the pump (rpm)

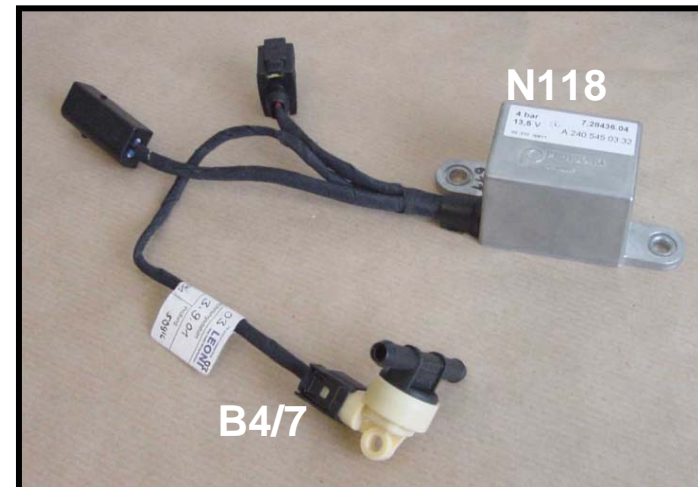
Fuel Delivery Function

- Fuel pump (M3) pulls fuel from the fuel tank and delivers it through the fuel filter (55/1) with integrated overflow valve
 - fuel filter looks similar to other engines
- The return from the overflow valve leads back to the tank to refill the splash pot
 - controlled leakage valve that opens at 3.5 bar
- Fuel flows from the fuel filter via a single line to the fuel rail to the injection valves

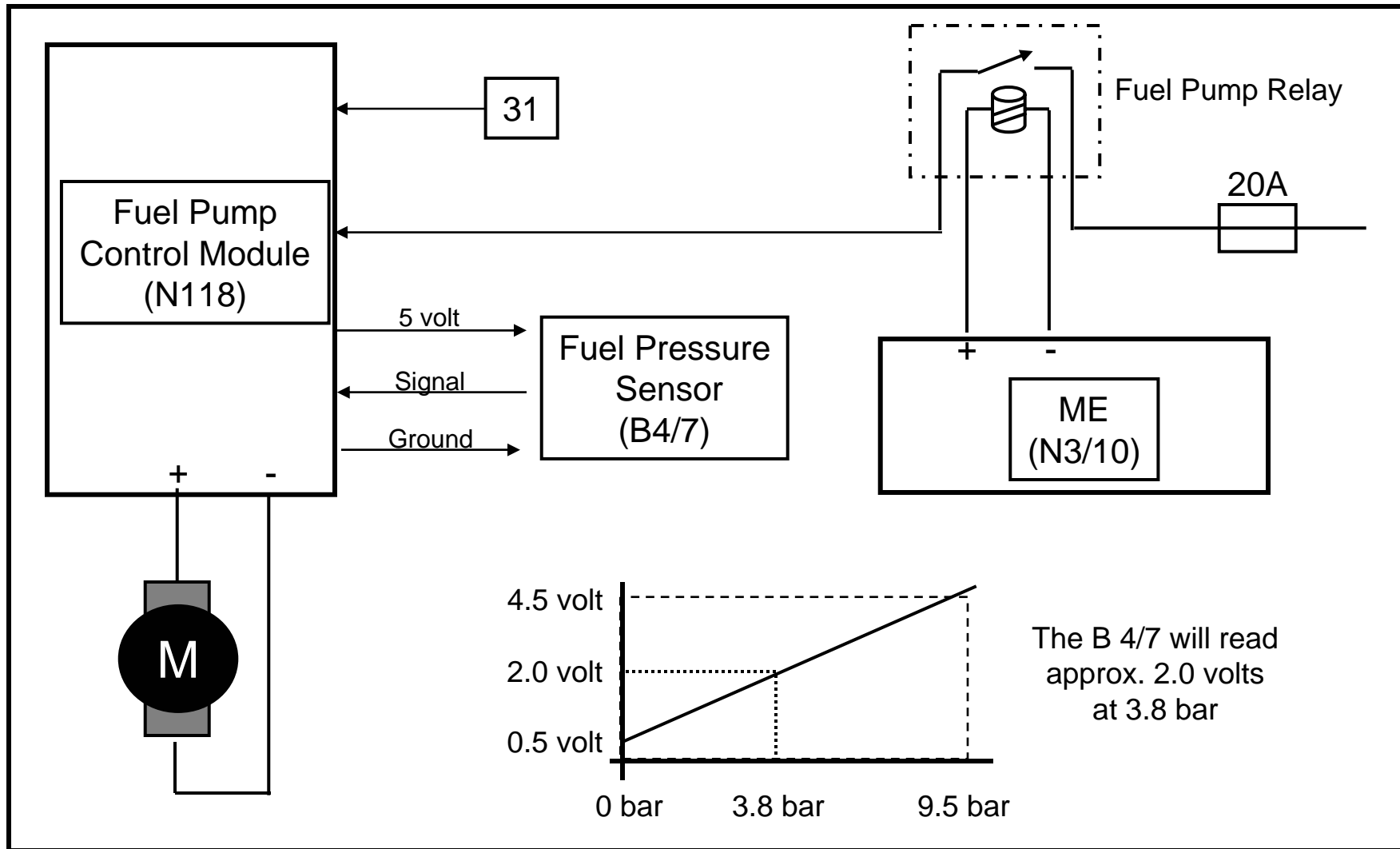


Fuel Pump Control Module (N118)

- Located underneath the vehicle in front of the left rear axle
- Control module (N118) controls fuel pump rotational speed using a pulse width modulating (PWM) the ground
- If pressure sensor (B4/7) drops below approx. 3.8 bar the ON time of the PWM signal is increased

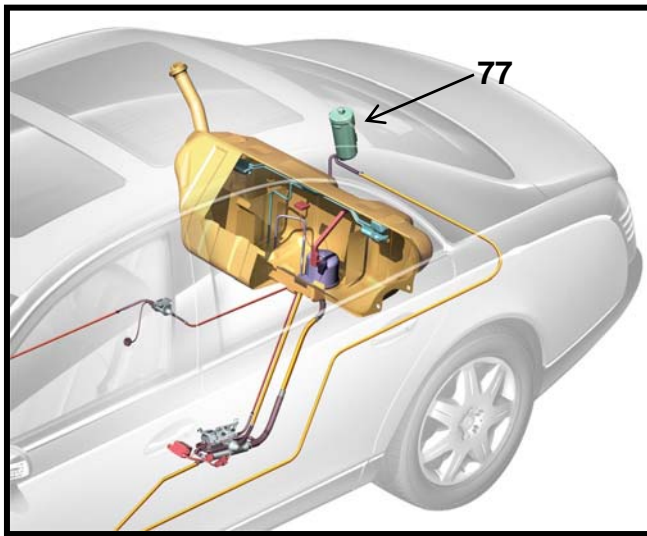


Fuel Pump Control Circuit

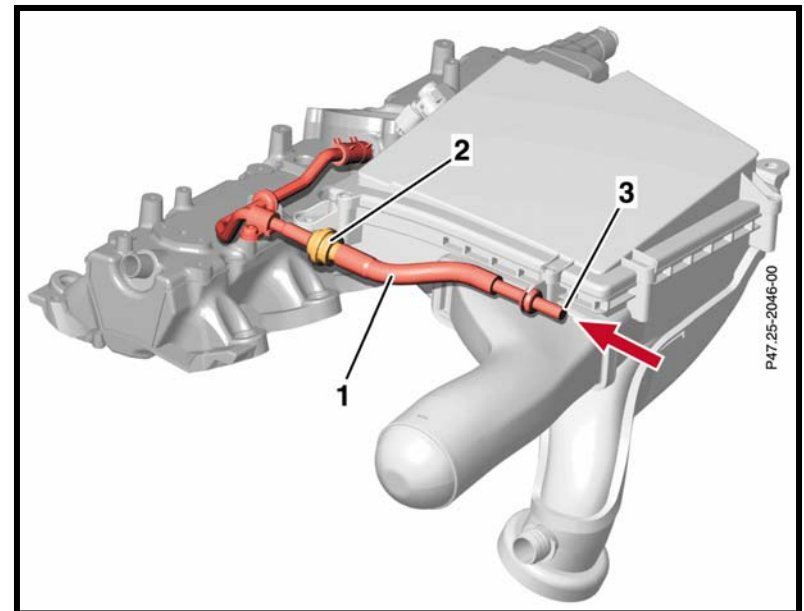


EVAP Purge Line

- Activated charcoal canister (77) located near fuel tank stores fuel vapors
- Check valve (2) prevents boost pressure from entering purge system

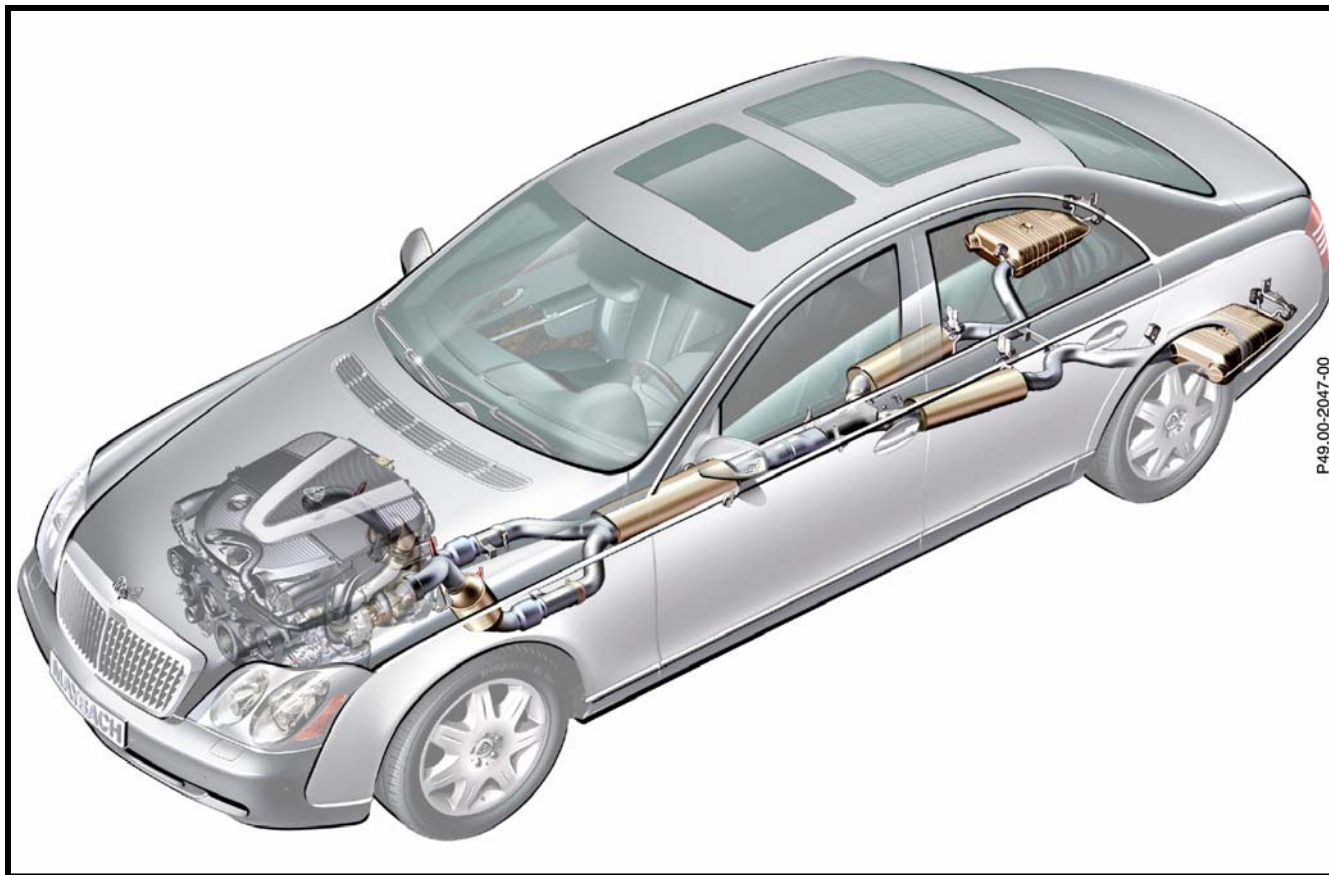


77 Activated charcoal filter

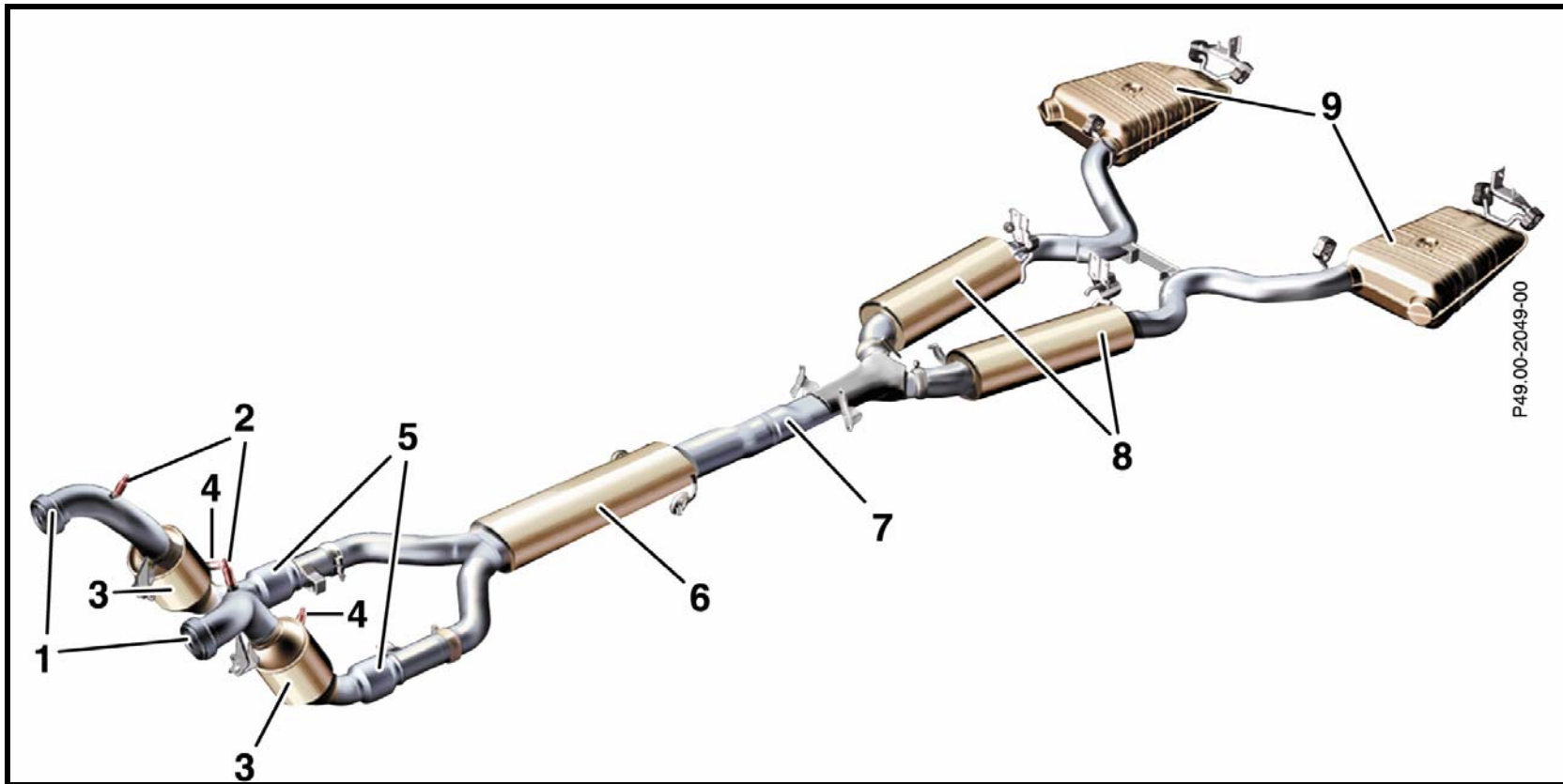


- 1 Purge line to intake manifold
- 2 Check valve for activated charcoal filter
- 3 From purge control valve

Exhaust System



Exhaust System Components



1 Lead pipe

2 O2 control sensor

3 Catalytic converter

4 O2 diagnostic sensor

5 Decoupling element

6 Front muffler

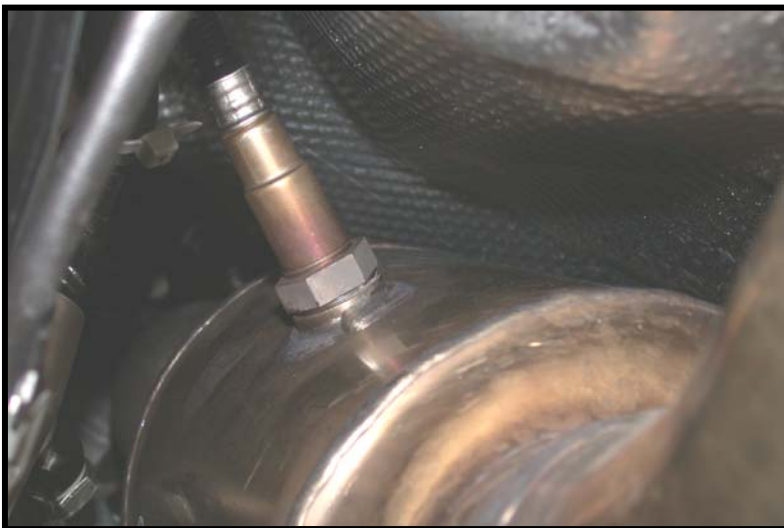
7 Mixing area

8 Center muffler

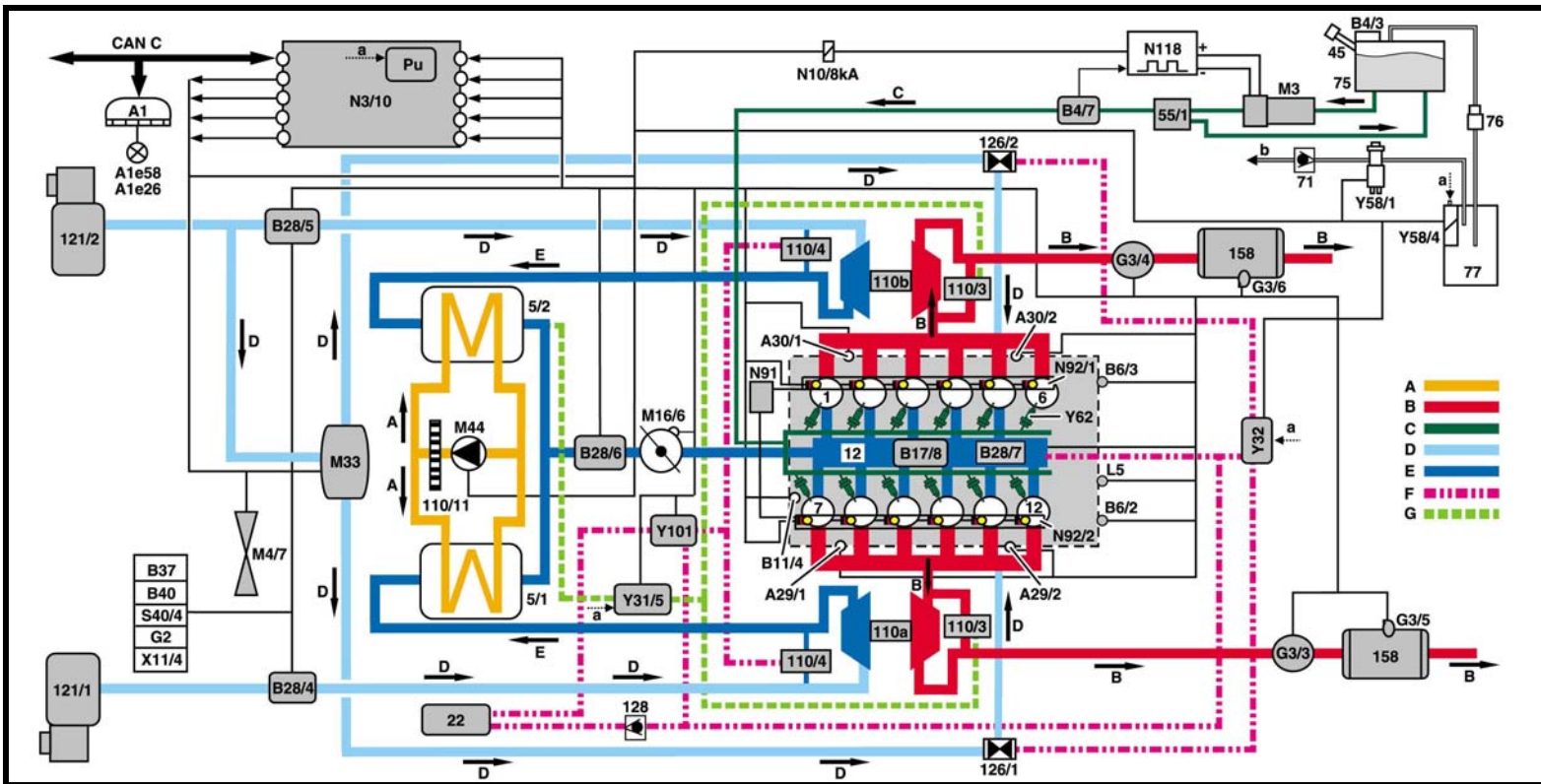
9 Rear muffler

Oxygen Sensors

- Four oxygen sensors used to monitor emissions
- Two sensors located before the catalyts (G3/3 & G3/4)
- Two sensors located in the catalyts (G3/5 & G3/6)

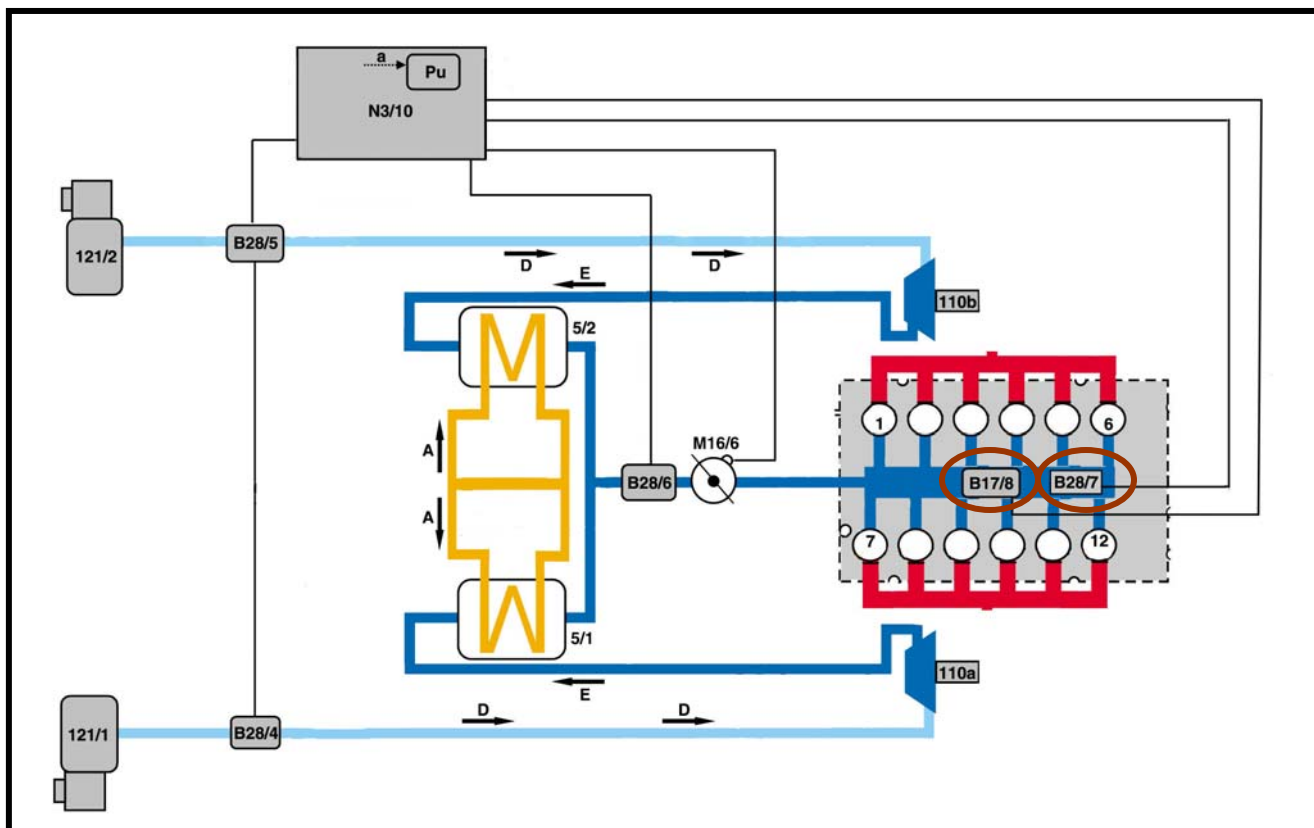


M285 Engine Control



Fuel Mixture Control

Fuel injector duration is calculated using a speed density system using inputs from pressure sensor (B28/7) and the charge air temp sensor (B17/8)



5/1 & 5/2 Charge air coolers

B17/8 Charge air temperature sensor

110a & 110b Turbochargers

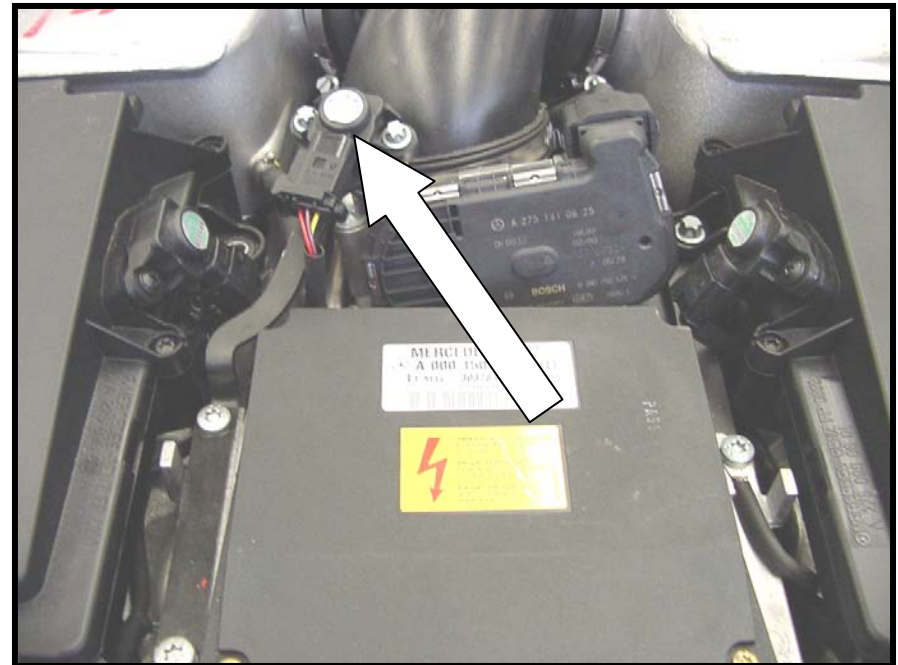
121/1 & 121/2 Air filters

B28/4,5,6,7 Pressure sensors

M16/6 Throttle valve actuator

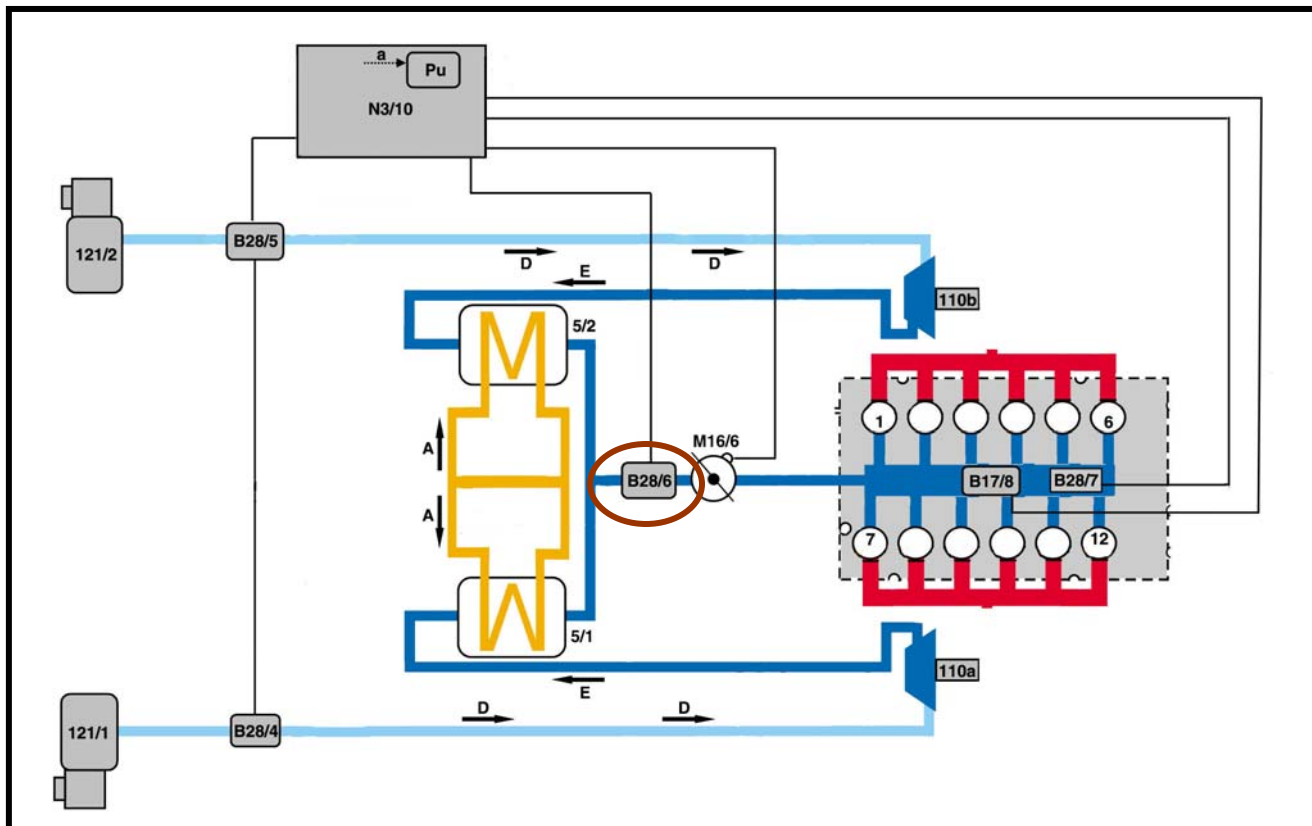
Pressure Sensor Upstream of Throttle Valve Actuator (B28/6) Location

- Black colored sensor with a blue text sticker
- Located at the throttle valve actuator



B28/6 Function

- Detects current boost pressure upstream of the throttle valve actuator
- Signal used for boost pressure control



5/1 & 5/2 Charge air coolers

B17/8 Charge air temperature sensor

110a & 110b Turbochargers

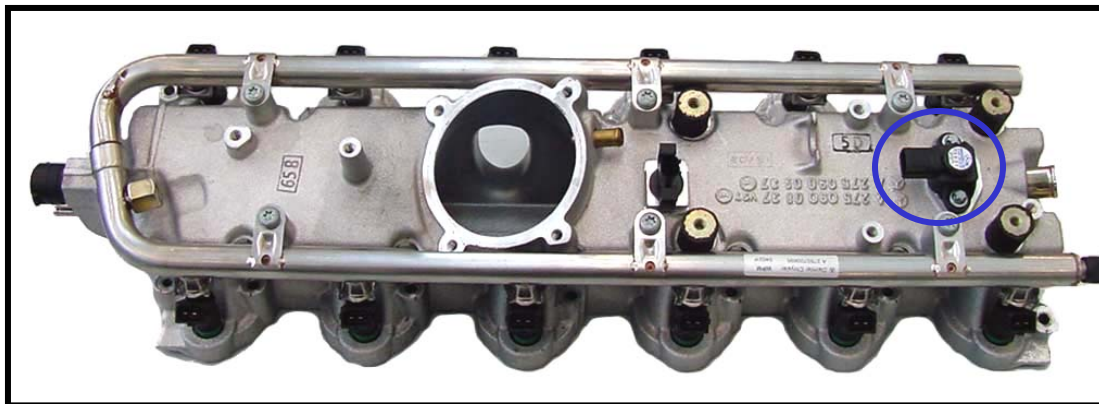
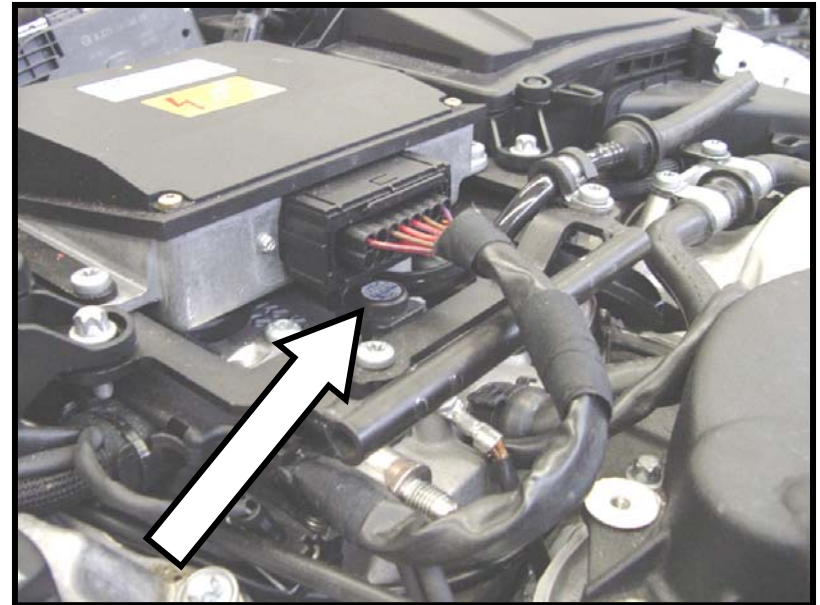
121/1 & 121/2 Air filters

B28/4,5,6,7 Pressure sensors

M16/6 Throttle valve actuator

Pressure Sensor Downstream of Throttle Valve Actuator (B28/7) Location

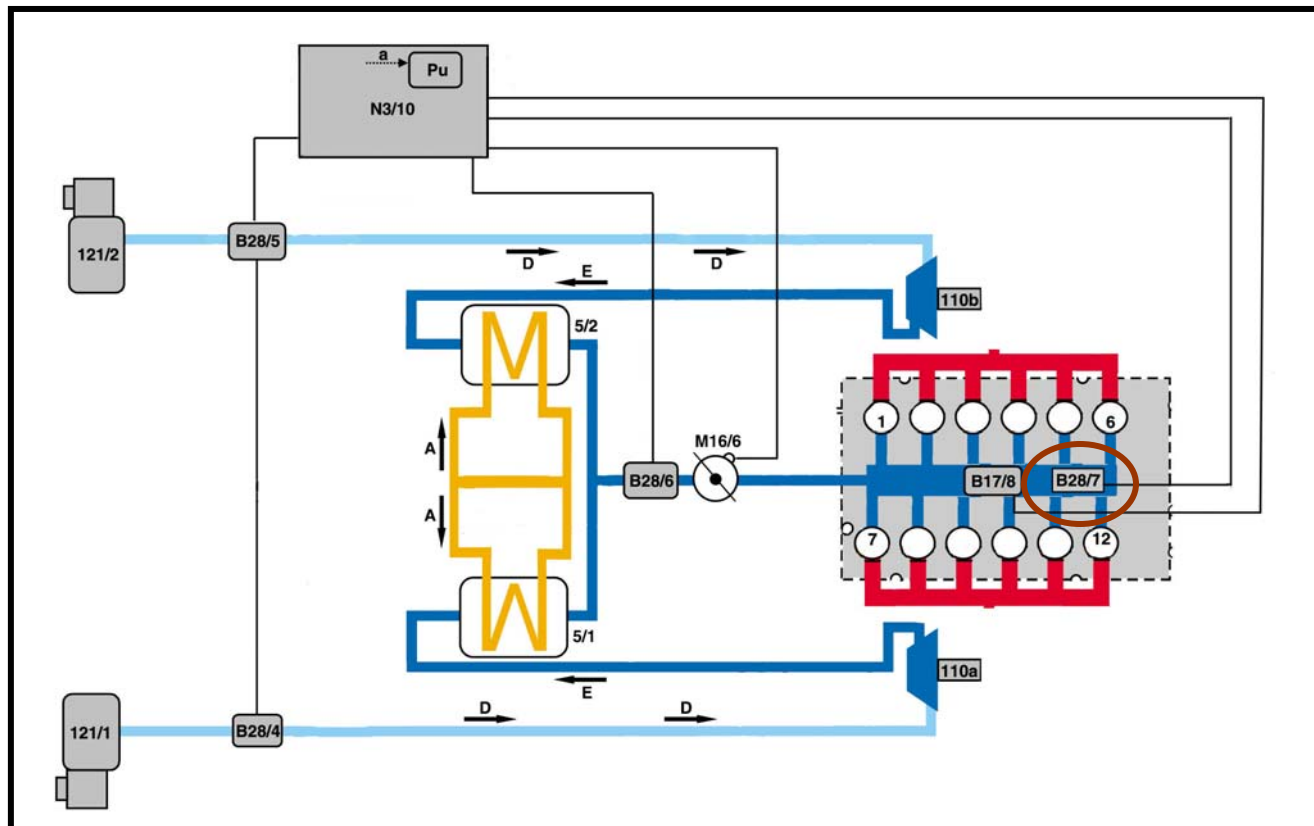
- Black colored sensor with a blue text sticker
- Located on the intake manifold beneath the ECI ignition system power supply



Front of engine 

B28/7 Function

- Records current boost pressure downstream of the throttle valve
- Signal is used to calculate engine load in conjunction with B17/8



5/1 & 5/2 Charge air coolers

B17/8 Charge air temperature sensor

110a & 110b Turbochargers

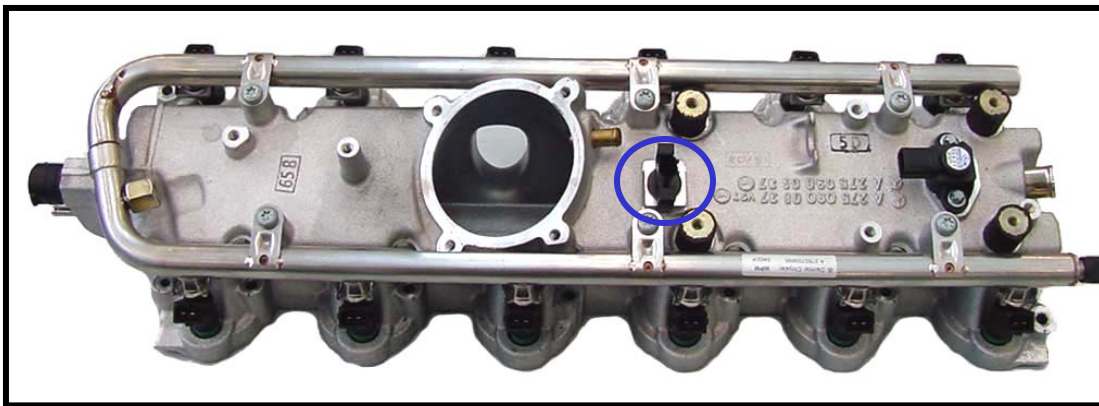
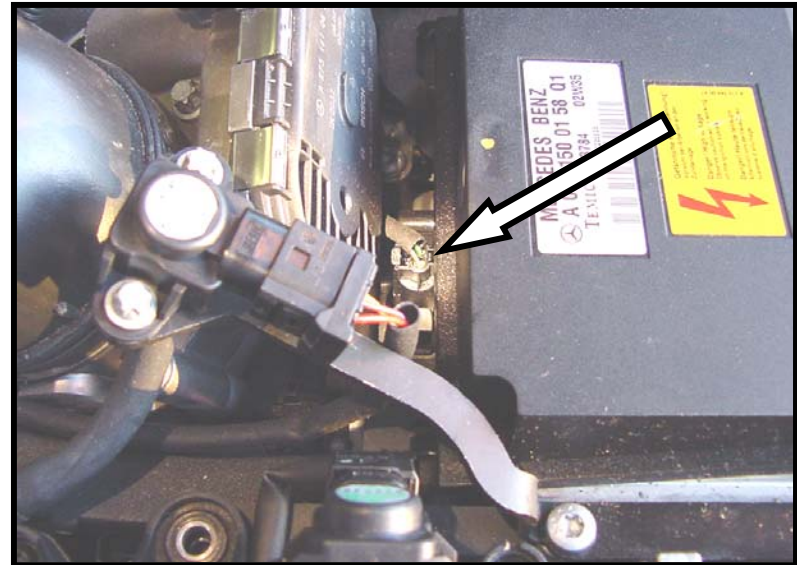
121/1 & 121/2 Air filters

B28/4,5,6,7 Pressure sensors

M16/6 Throttle valve actuator

Charge Air Temperature Sensor (B17/8) Location

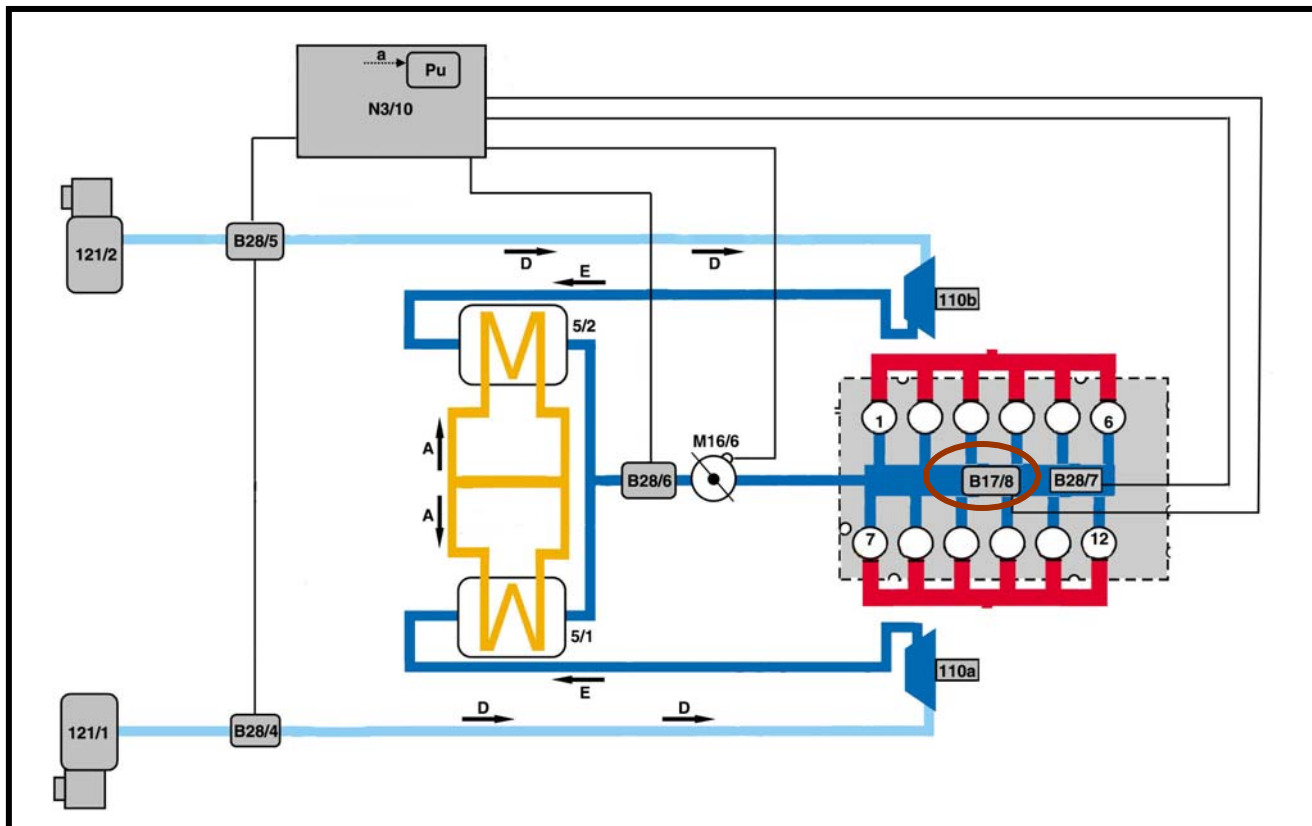
Located in the intake manifold



Front of engine 

B17/8 Function

- Records current charge air temp. (may limit max boost if temp is $>149^{\circ}\text{C}$)
- Signal is used to calculate air mass (along with B28/7) as well as for monitoring boost pressure
- Also monitors the operation of the charge air cooling system



5/1 & 5/2 Charge air coolers

121/1 & 121/2 Air filters

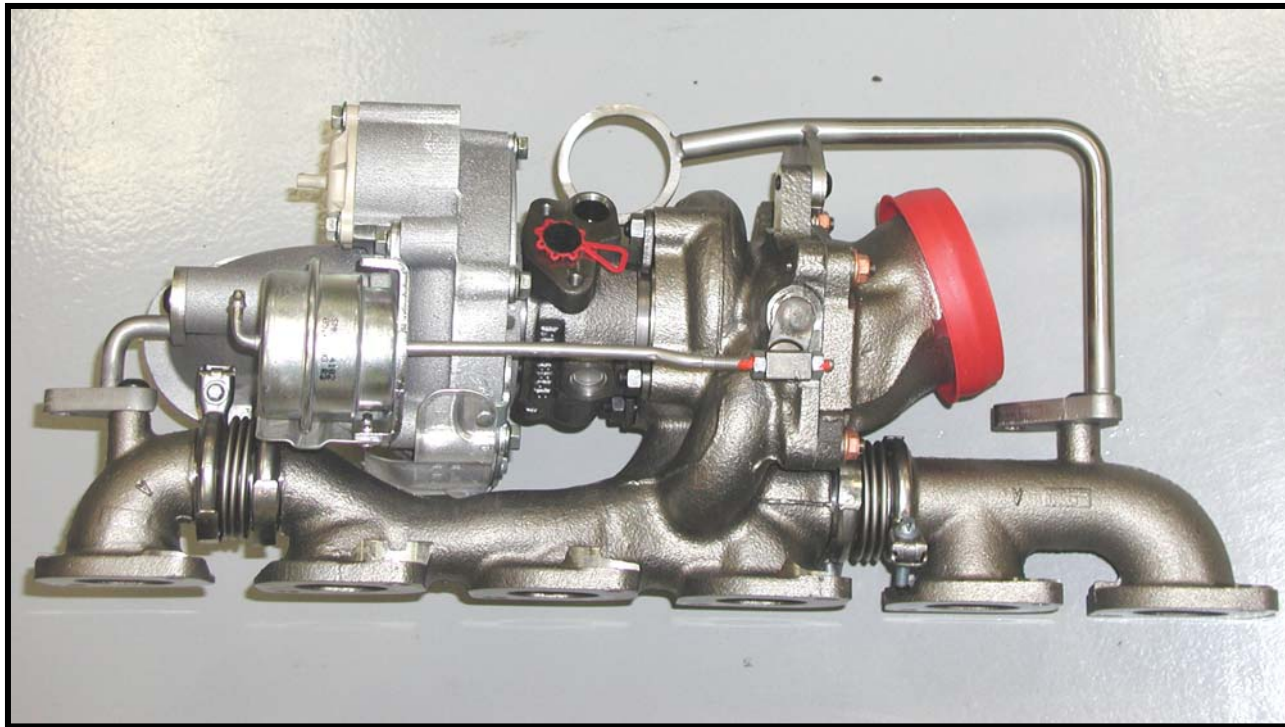
B17/8 Charge air temperature sensor

B28/4,5,6,7 Pressure sensors

110a & 110b Turbochargers

M16/6 Throttle valve actuator

Turbocharger



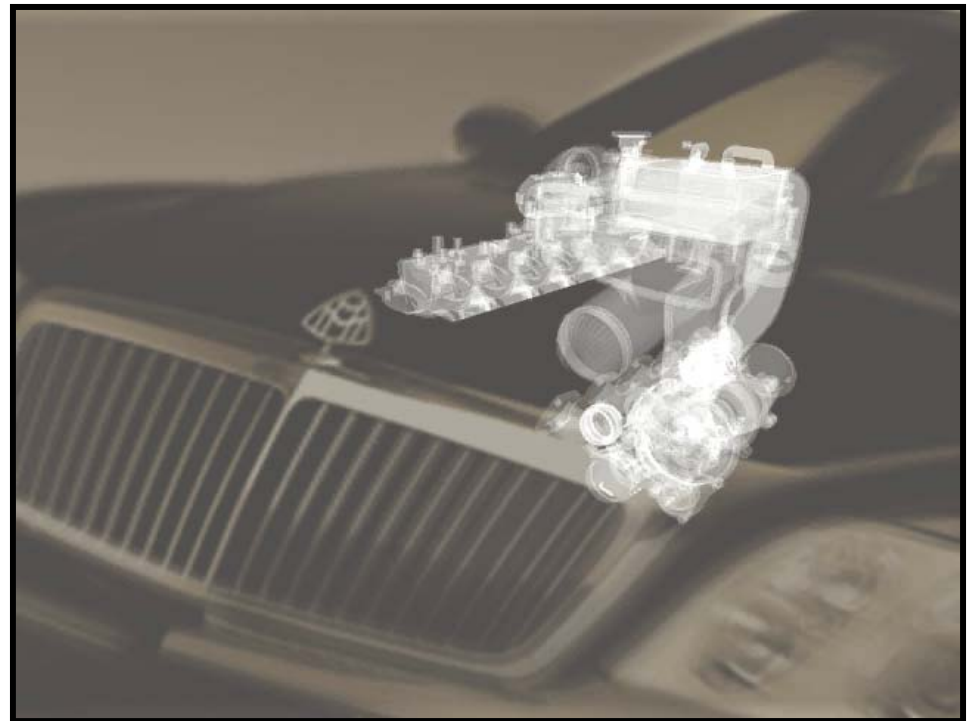
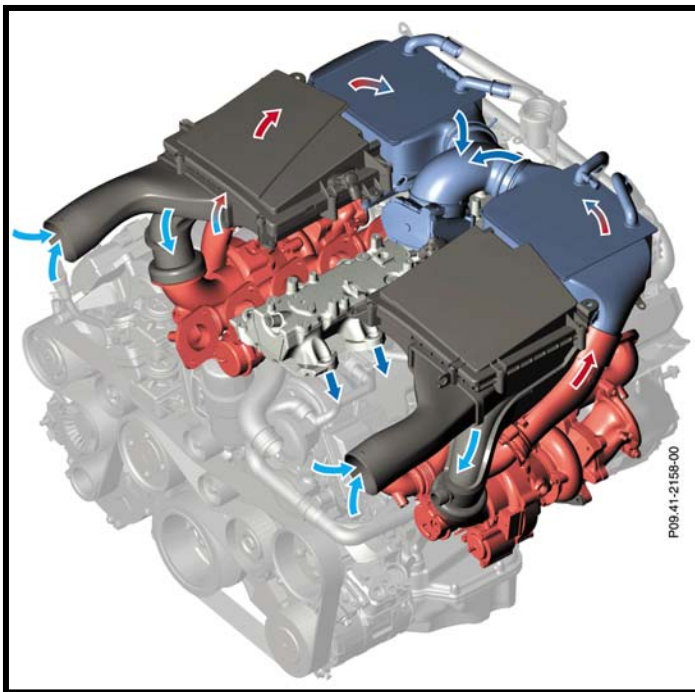
Note: Two installation / removal bars should always be used when removing or installing a turbocharger

Advantages of Turbocharging

- Higher power output for smaller engine displacement
- Smaller size of engine for small engine compartment
- Larger torques generated at low engine speeds
- Lower noise levels
- Favorable fuel consumption characteristics
- Ecologically friendly exhaust / emission output

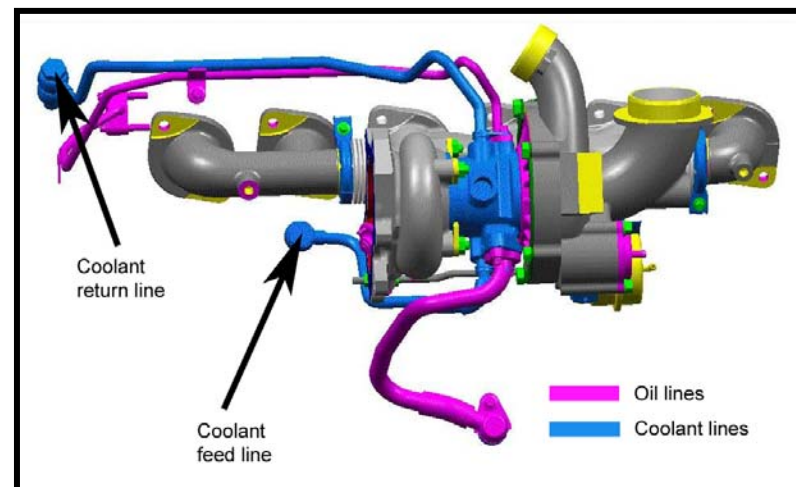
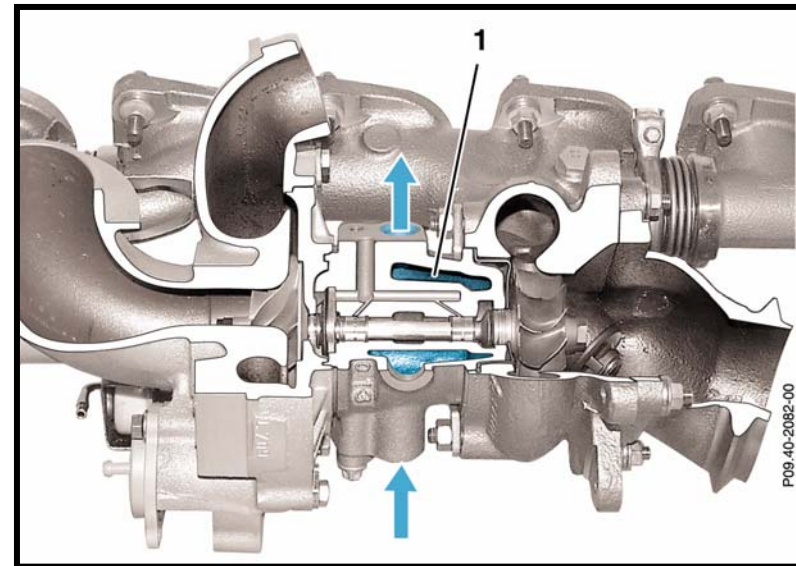
Air Flow

- Two separate air filters route
- The air is compressed in the turbochargers then travels through the charge air pipes into the charge air coolers
- A “Y” pipe from the intercoolers feeds the intake manifold through the throttle valve actuator



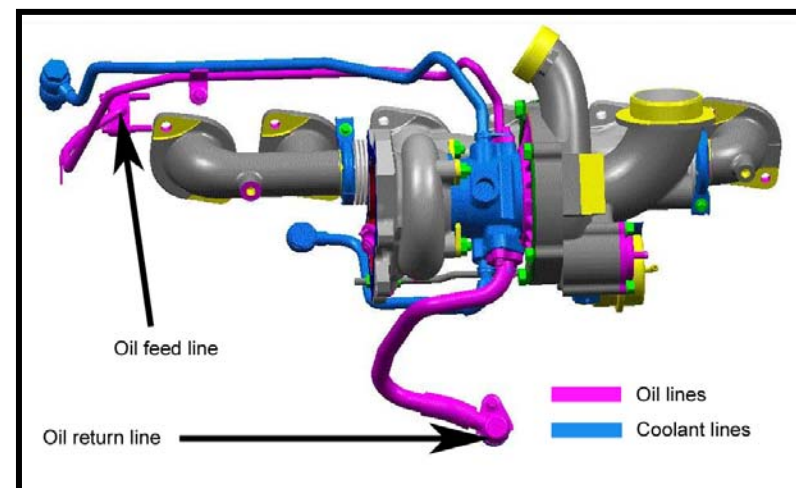
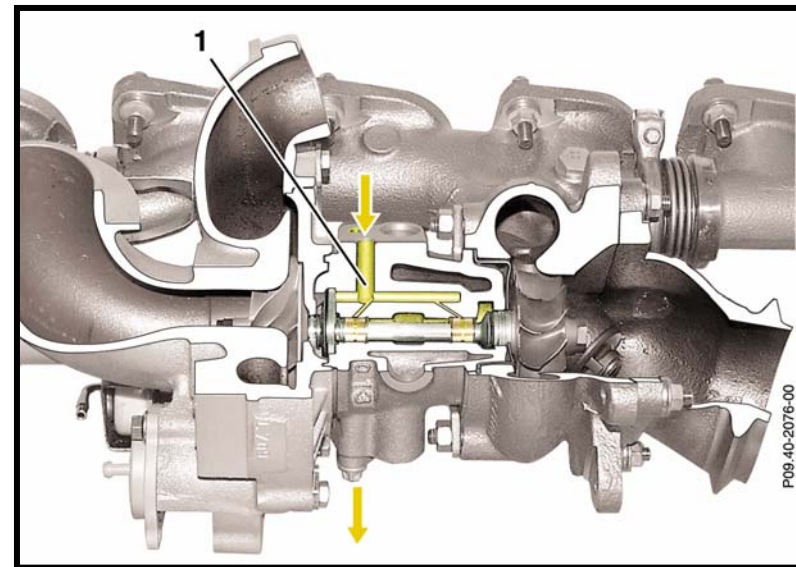
Turbocharger Cooling (coolant)

- The bearing housings of the turbochargers are cooled with coolant
- Coolant flows through connections in the crankcase to each of the turbochargers and passes through bearing housings from bottom to top
- The coolant exits the bearing housings and is directed back into the main cooling circuit at the cylinder heads
- Coolant lines are rearward



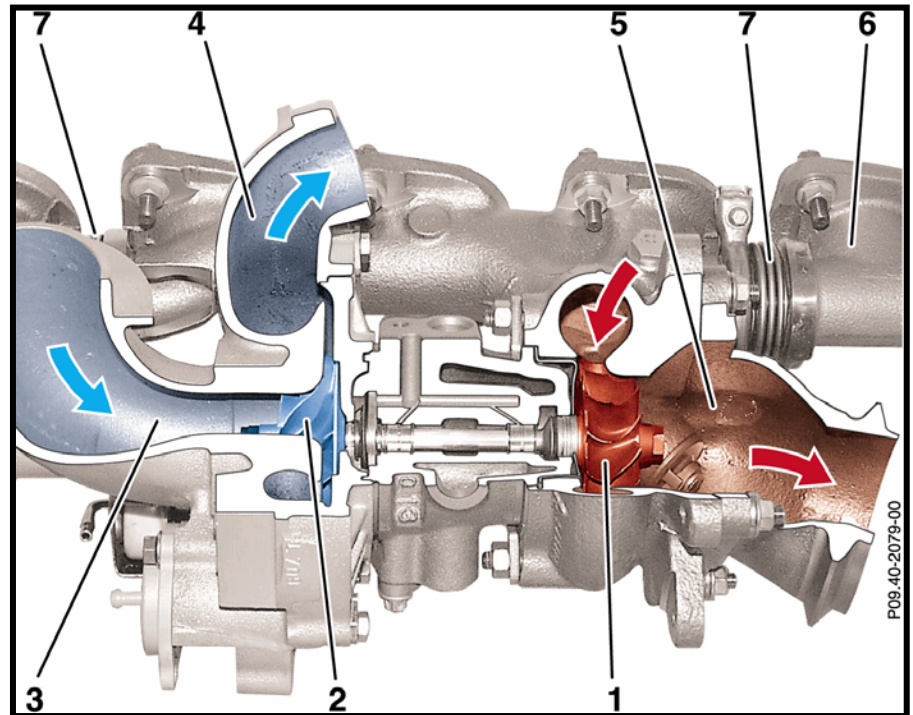
Turbocharger Cooling / Lubrication (oil)

- The shaft with the turbine and compressor wheels is connected to the engine's lubricating oil circuit
- The oil flow direction is opposite to the flow of coolant
- The oil is taken from the main oil galley in the V of the crankcase and flows through the bearing housing and is directed back to the bottom section of the crankcase
- Oil lines are forward



Turbocharger Operation

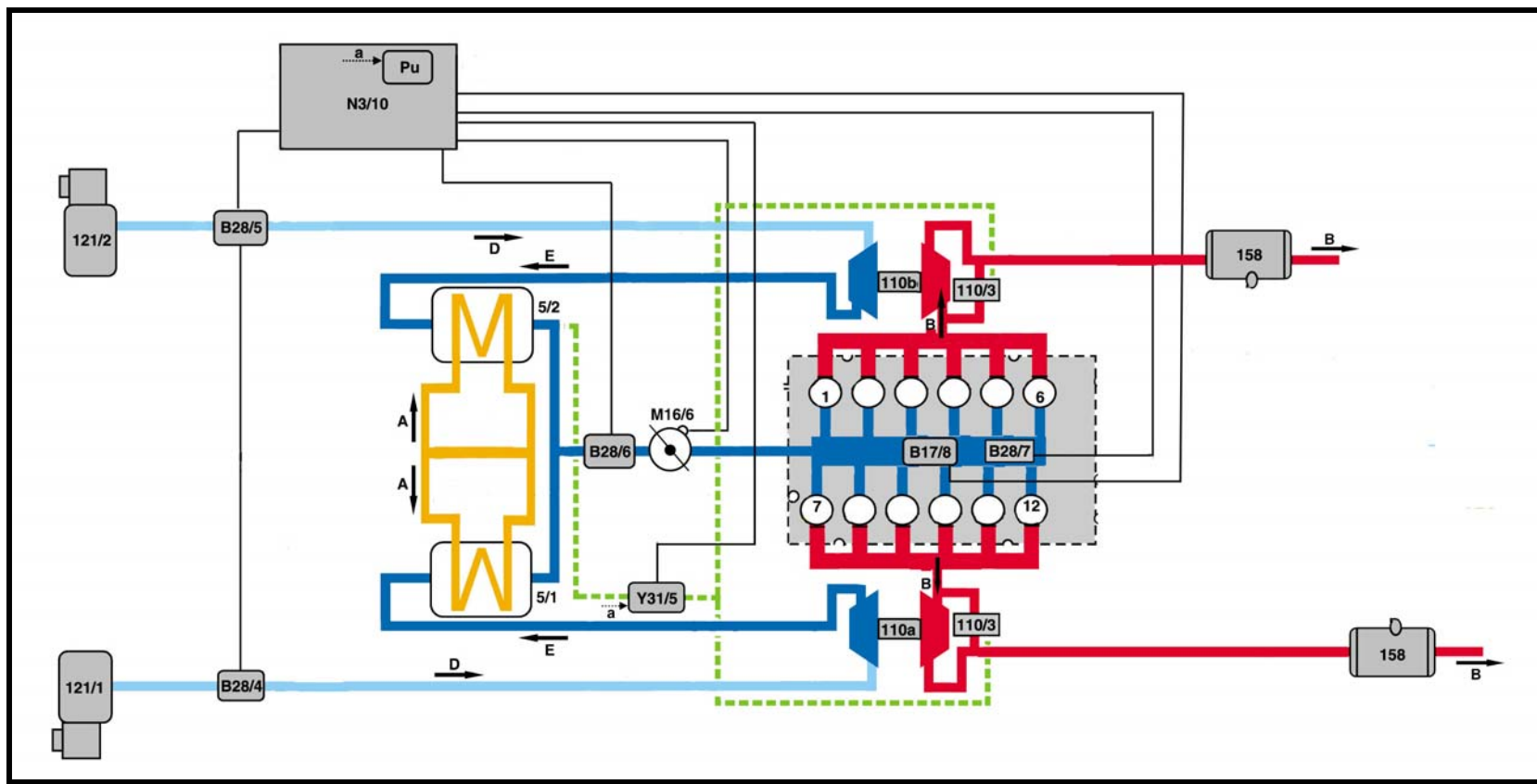
- At the turbine end exhaust gas causes the turbine wheel to rotate
 - rotational speeds in excess of 120,000 rpm
- At the compressor end, clean air is drawn in through the air cleaner and is directed under pressure to the combustion chambers
 - maximum boost pressure 1.3 bar (atmospheric)
- SDS / DAS displays absolute pressure not atmospheric pressure



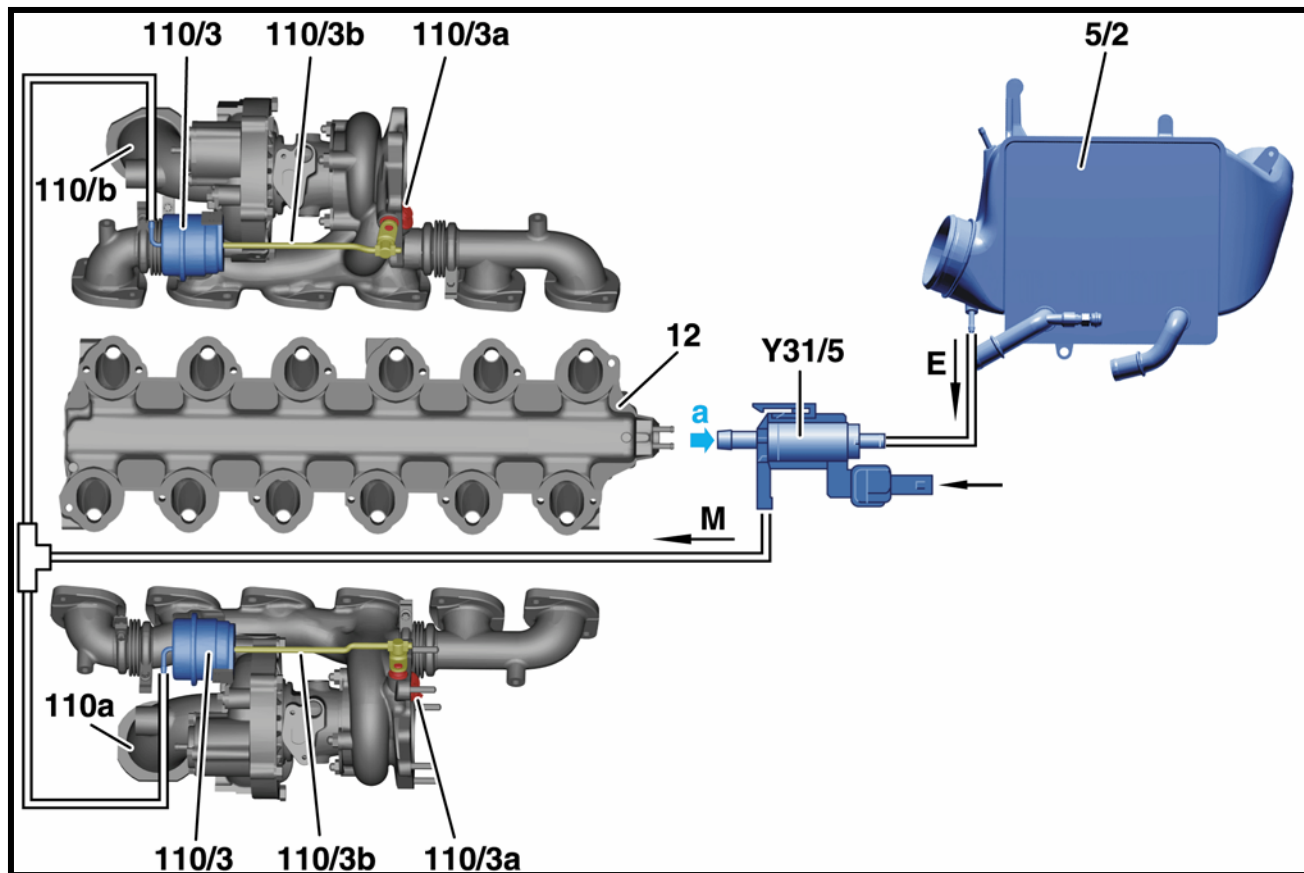
- | | |
|----------------------|--------------------|
| 1 Turbine wheel | 2 Compressor wheel |
| 3 Clean air | 4 Charge air |
| 5 Exhaust gas | 6 Exhaust manifold |
| 7 Expansion elements | |

Boost Pressure Control

- Boost pressure is map dependant on engine load and throttle valve angle
- Uses B25/6 for control input



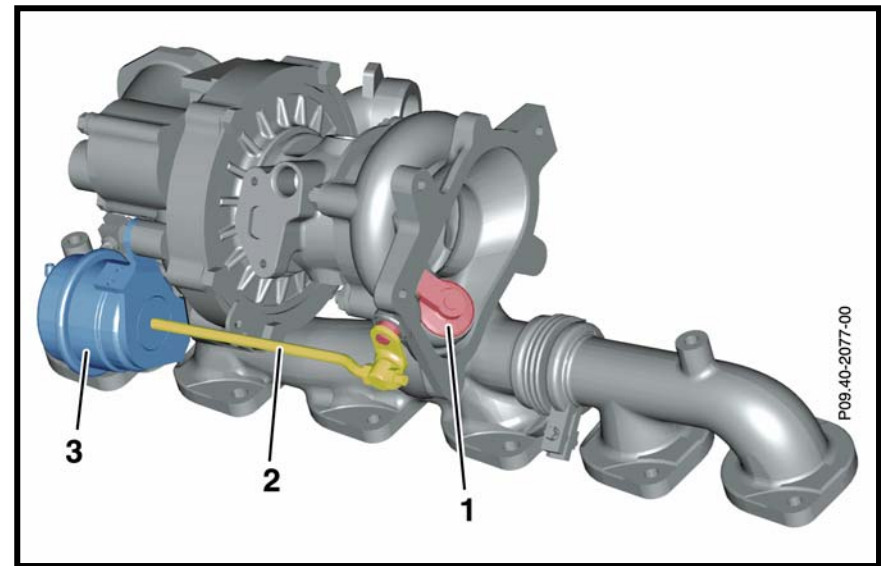
Boost Pressure Control Components



5/2	Charge air cooler	E	Boost pressure	Y31/5	Charge pressure vacuum transducer
12	Intake manifold	M	Modulated boost	110/3a	Boost pressure control valve
110/3b	Control rod	110/3	Waste gate diaphragm	110a	Left turbocharger
110b	Right turbo charger	a	Ambient pressure		

Boost Pressure Control Elements

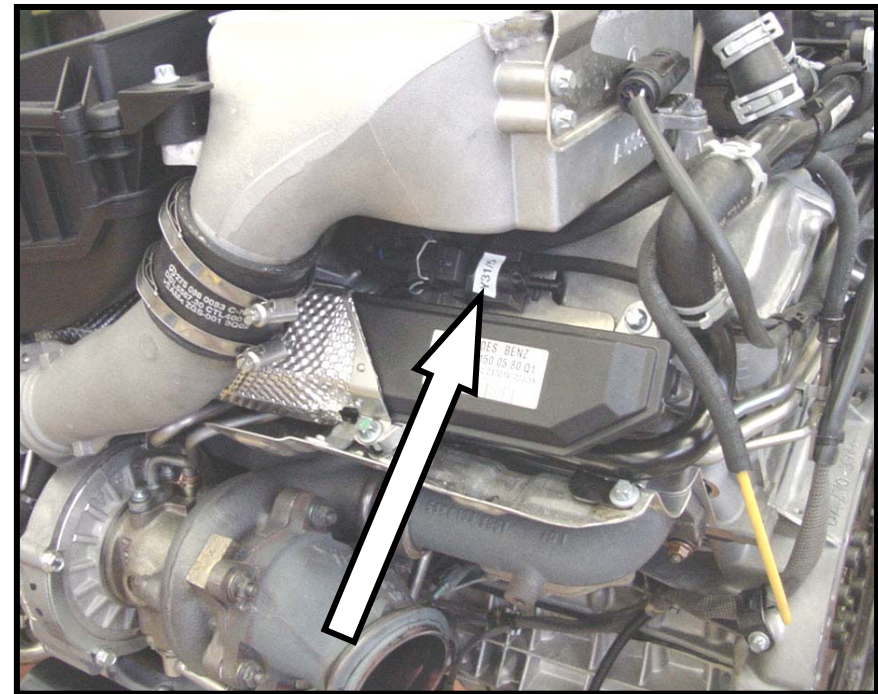
- Turbochargers each feature a waste gate to regulate boost pressure
- Exhaust stream bypasses the turbine
- Pneumatic cell actuates the waste gate valve via the control rod (adjustable



- 1 Boost pressure control valve
- 2 Control rod
- 3 Pneumatic cell (waste gate diaphragm)

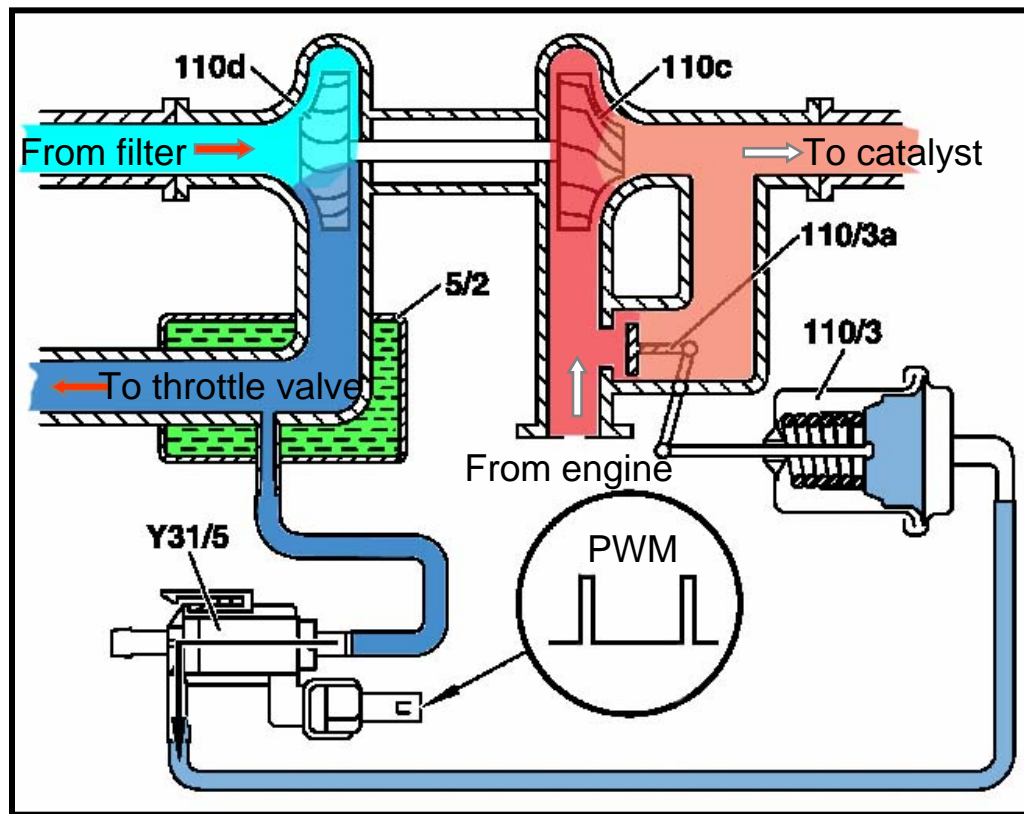
Charge Pressure Control Vacuum Transducer (Y31/5)

- Located downstream of the charge air cooler on the left side of engine
- Actuated by ME by a PWM signal with a frequency of 30Hz
- Uses a 5% to 95% ON / OFF duty cycle



Boost Pressure Control Circuit

- Duty cycle less than 5%
- Pressure regulating valves open, boost pressure low



5/2 Charge air cooler

110c Exhaust turbine wheel

110d Compressor turbine wheel

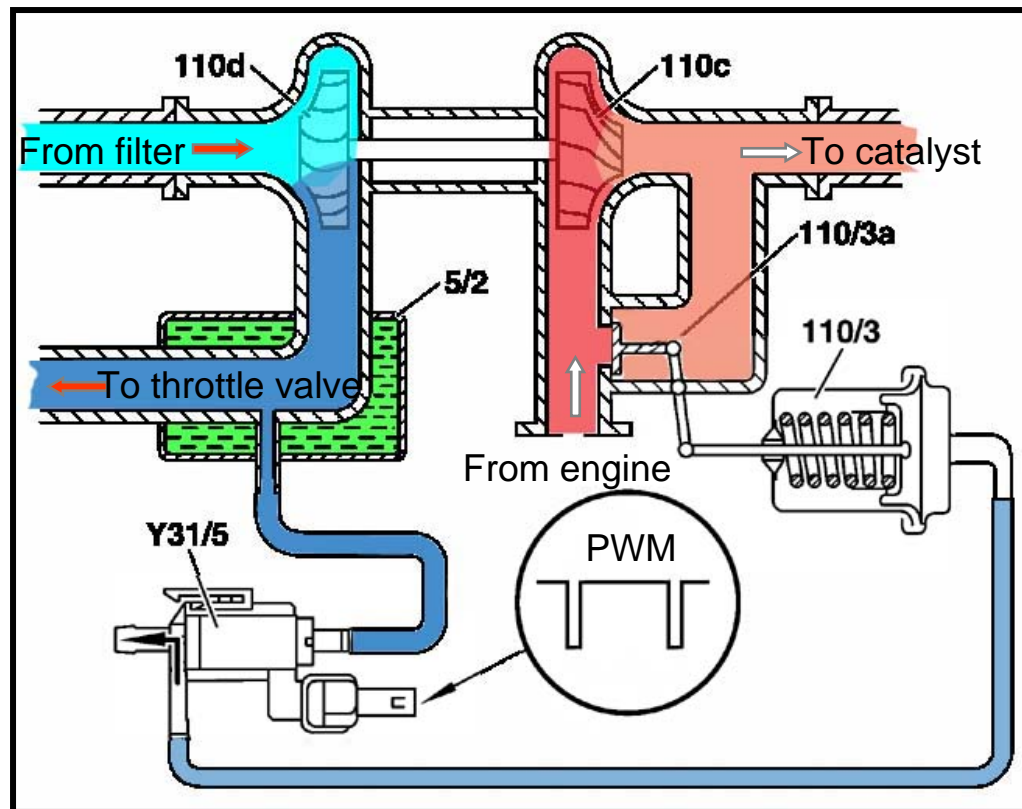
110/3 Waste gate

110/3a Boost pressure control valve

Y31/5 Charge pressure control vacuum transducer

Boost Pressure Control Circuit

- Duty cycle greater than 95%
- Pressure regulating valves closed, boost pressure high



5/2 Charge air cooler

110c Exhaust turbine wheel

110d Compressor turbine wheel

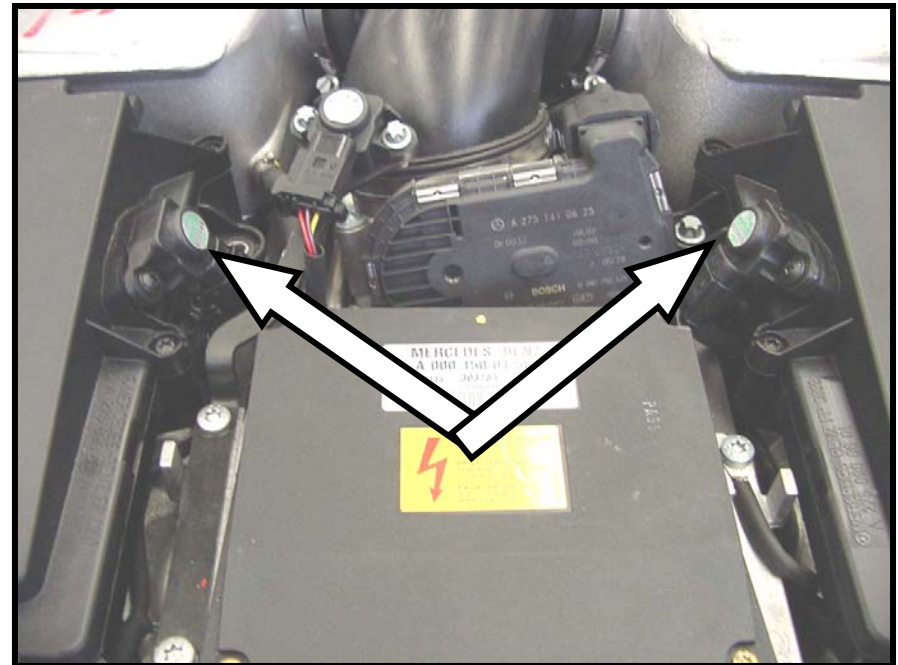
110/3 Waste gate

110/3a Boost pressure control valve

Y31/5 Charge pressure control vacuum transducer

Pressure Sensors Downstream of Air Cleaner (B28/4 & B28/5)

- Located on the air filter housing between the air filter insert and the turbocharger
- Black sensors with green text label
- Left (B28/4) - right (B28/5)
- Records current air passage pressures on the right and left side of the engine
- Used to detect an air passage obstruction which could result in turbocharger over speed
- If pressure differential is detected ME control module will open the waste gate to limit power



Boost Pressure Service Tips

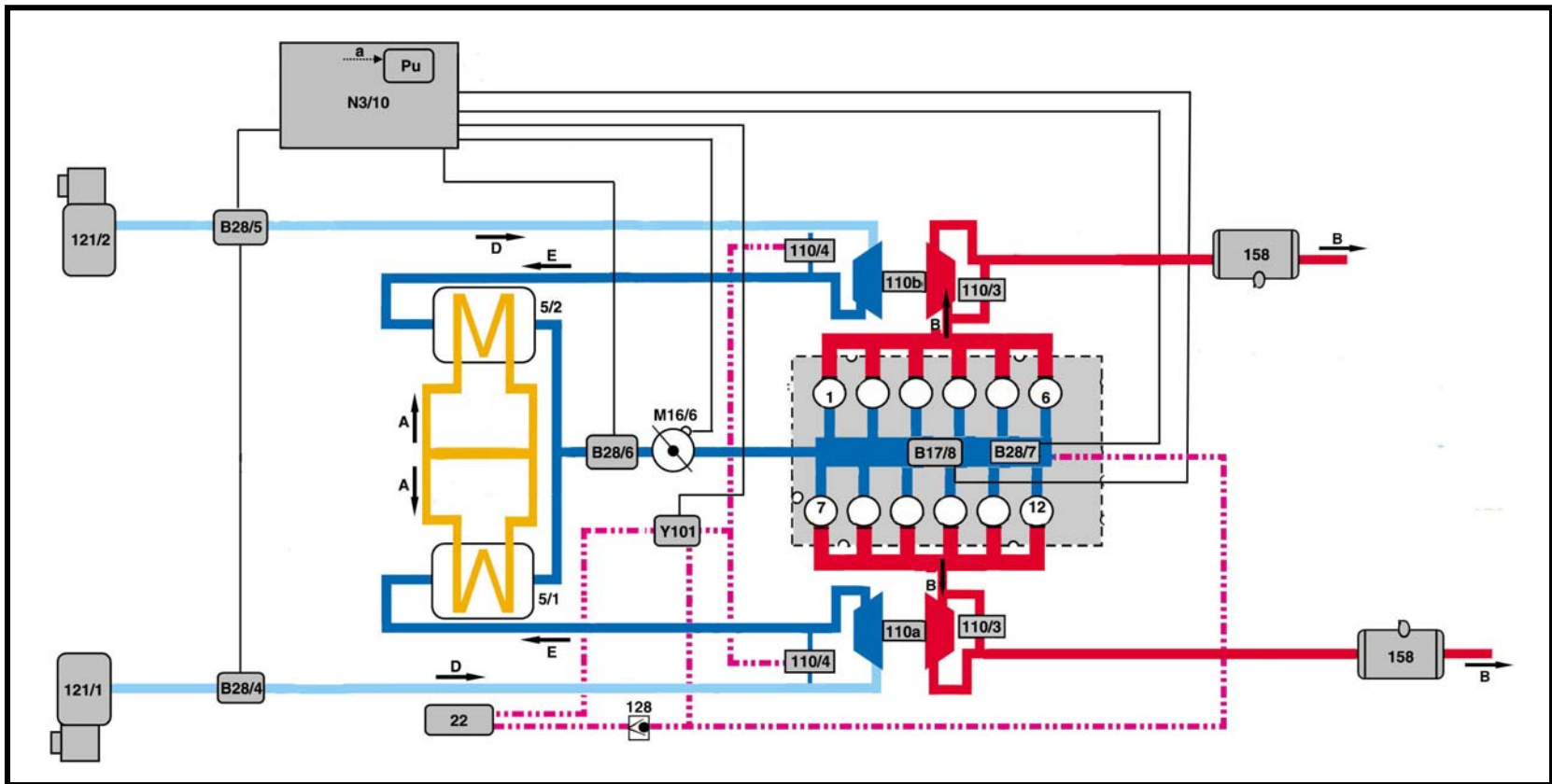
When boost pressure is not available for troubleshooting, proceed as follows:

- Check for leaks at boost pressure pipes
- Check function of boost pressure control with boost pressure control pressure transducer (Y31/5)
- Check for leaks and actuation of deceleration air valves
- Check turning capability of both turbochargers when removed

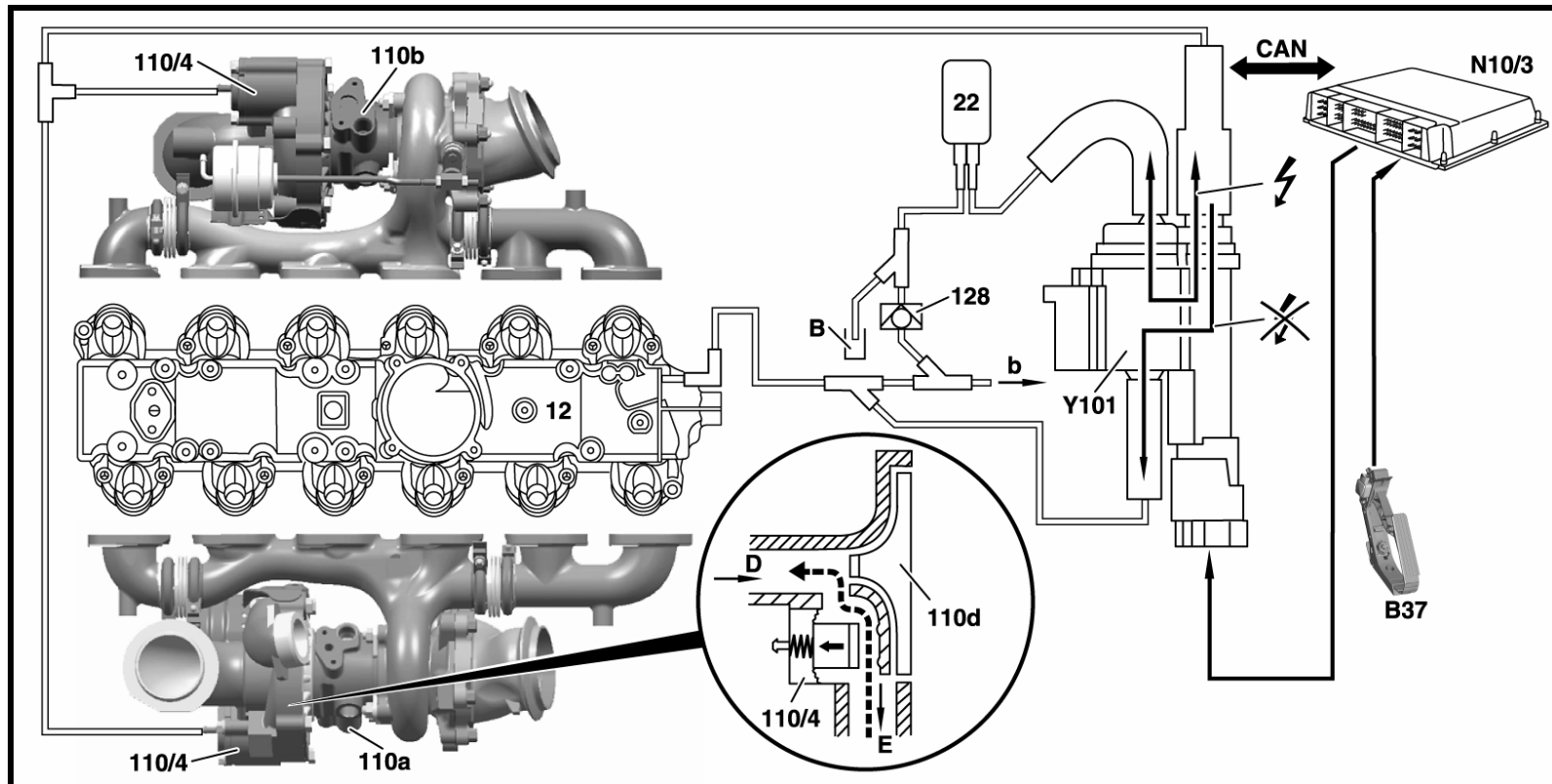
Note: The left turbocharger may appear darker internally as compared to the right.
This is due to the crankcase ventilation operation during full load applications.

Divert Air Control

Uses inputs from ME to control divert air operation



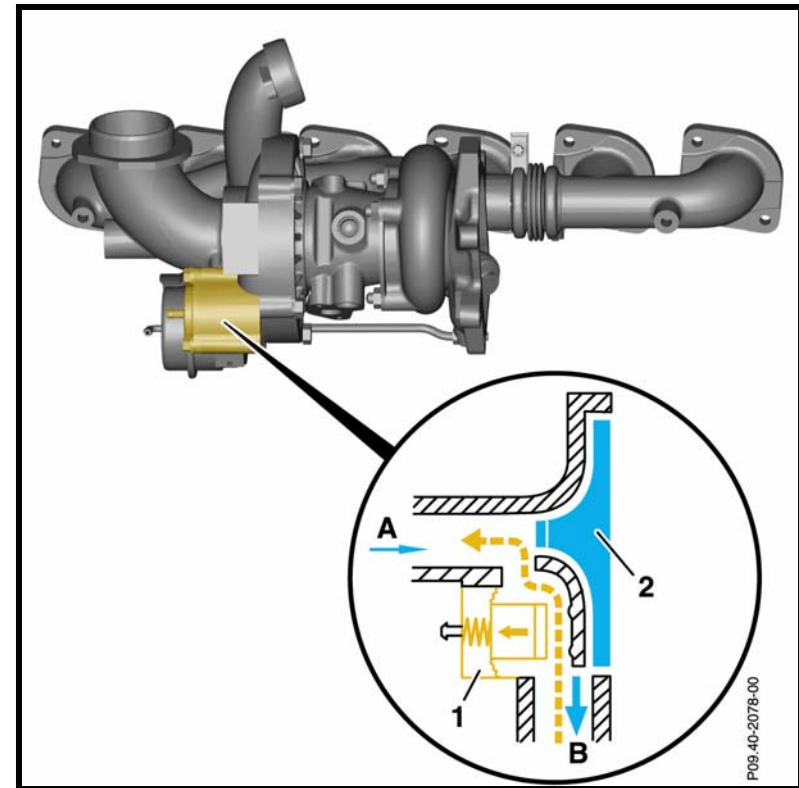
Divert Air Control Components



- | | | | | | |
|------|--------------------------|-------|---------------------------------|---|-----------------------------------|
| 12 | Intake manifold | 128 | Check valve (vacuum) | b | to switchover valve air injection |
| 22 | Vacuum tank | B37 | Accelerator pedal sensor | B | Test connection divert air |
| 110a | Left turbocharger | N3/10 | ME control module | D | Clean air (toward air cleaner) |
| 110b | Right turbocharger | Y101 | Divert air switchover valve | E | Charge air |
| 110d | Compressor turbine wheel | 110/4 | Deceleration (divert) air valve | | |

Divert Air Valve (110/4) Location

- Prevents deceleration whistling caused by compressor wheel operating at limits when the throttle valve closes abruptly
- Spring loaded, held closed by boost pressure opened by vacuum



Blue Activated

Yellow Not activated

1 Deceleration (divert) air valve

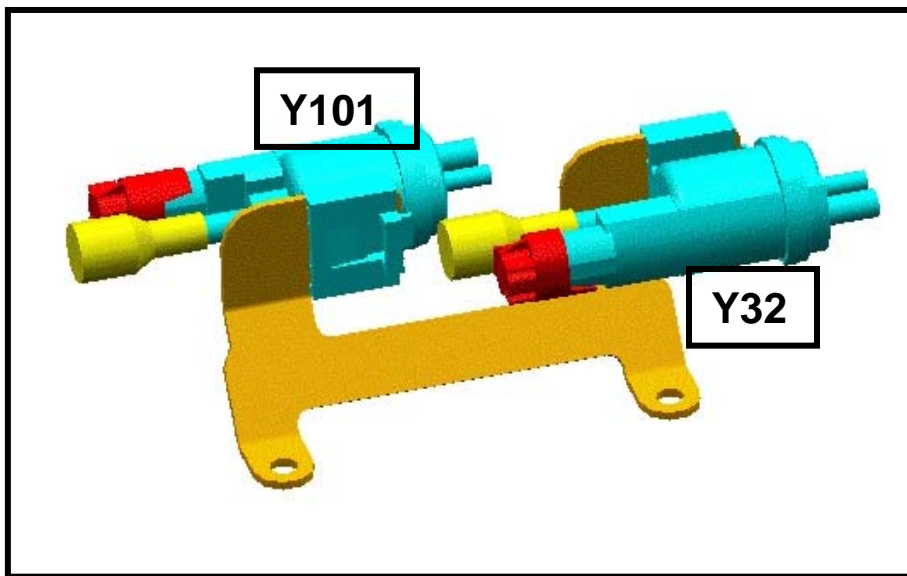
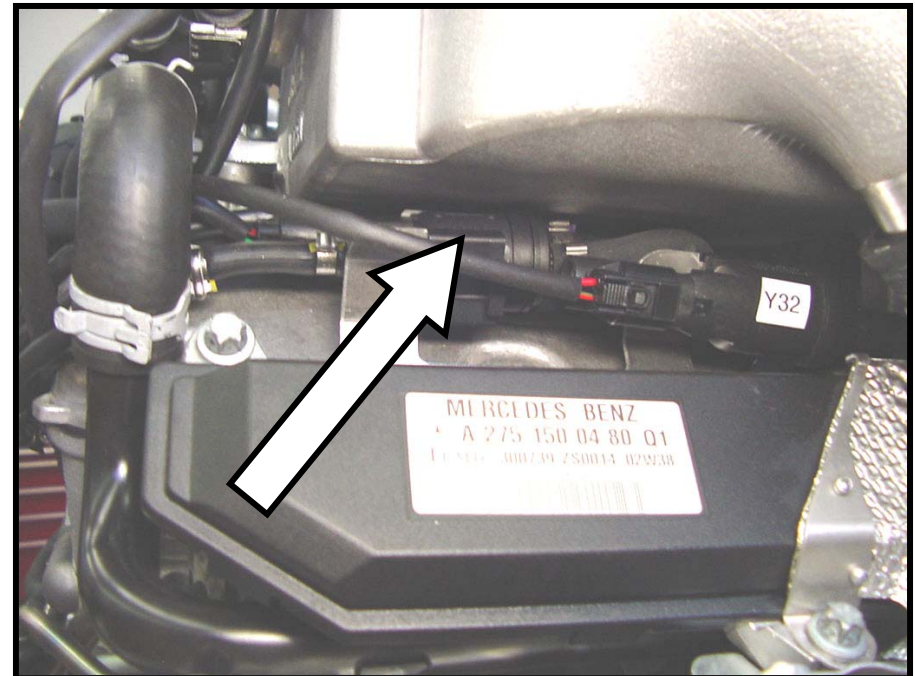
2 Compressor wheel

A Clean air from air cleaner

B Charge air to charge air cooler

Divert Air Switchover Valve (Y101) Location

- Located beneath the charge air cooler (right side)
- Actuated by ME control module during deceleration



Y101 Divert air switchover valve

Y32 Air injection switchover valve

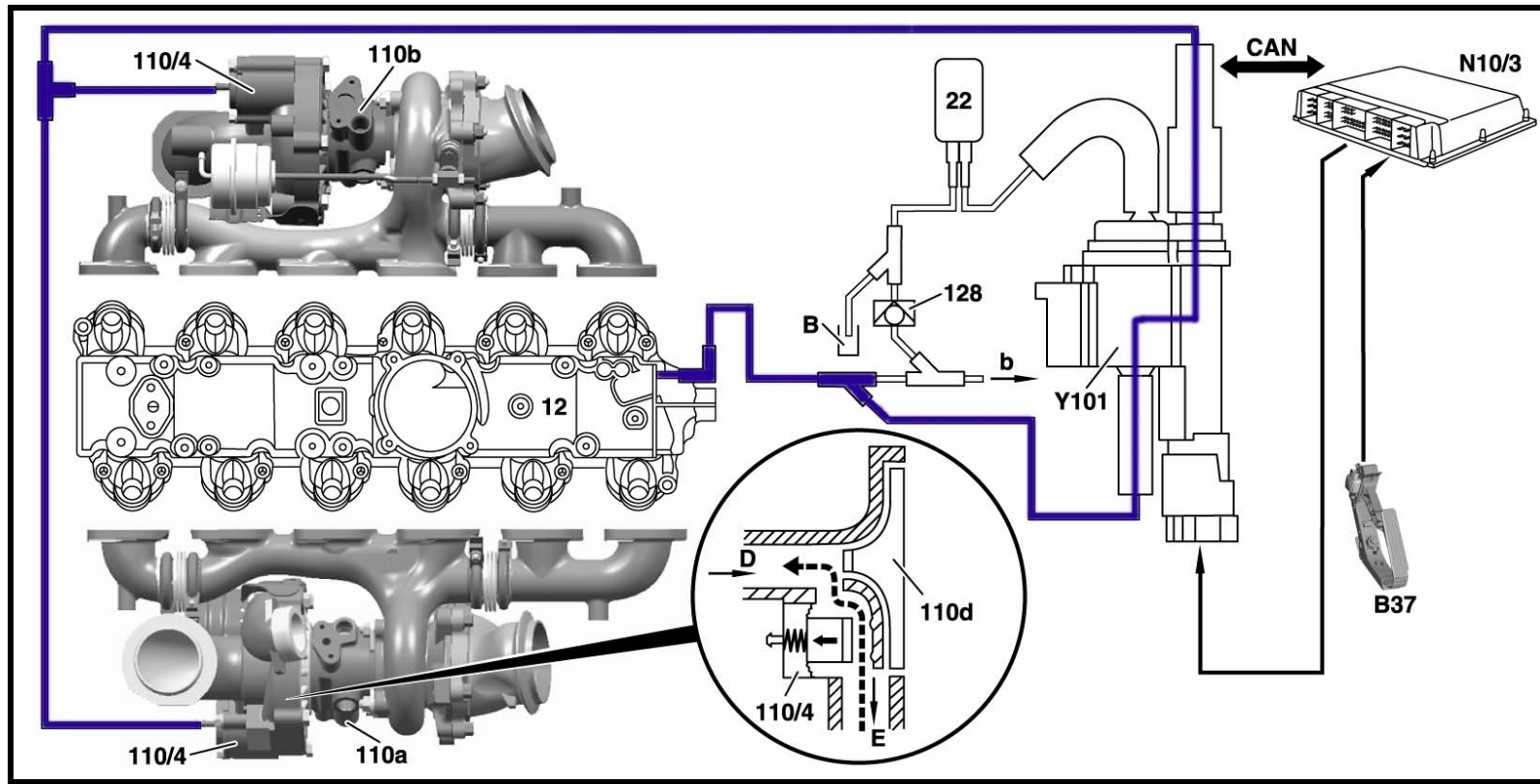
Vacuum Tank (22)

- Divert air switchover valve (Y101) receives vacuum from the vacuum tank that is located in the V of the engine
- The deceleration air valves reduce boost pressure immediately by opening a bypass around each compressor turbine wheel



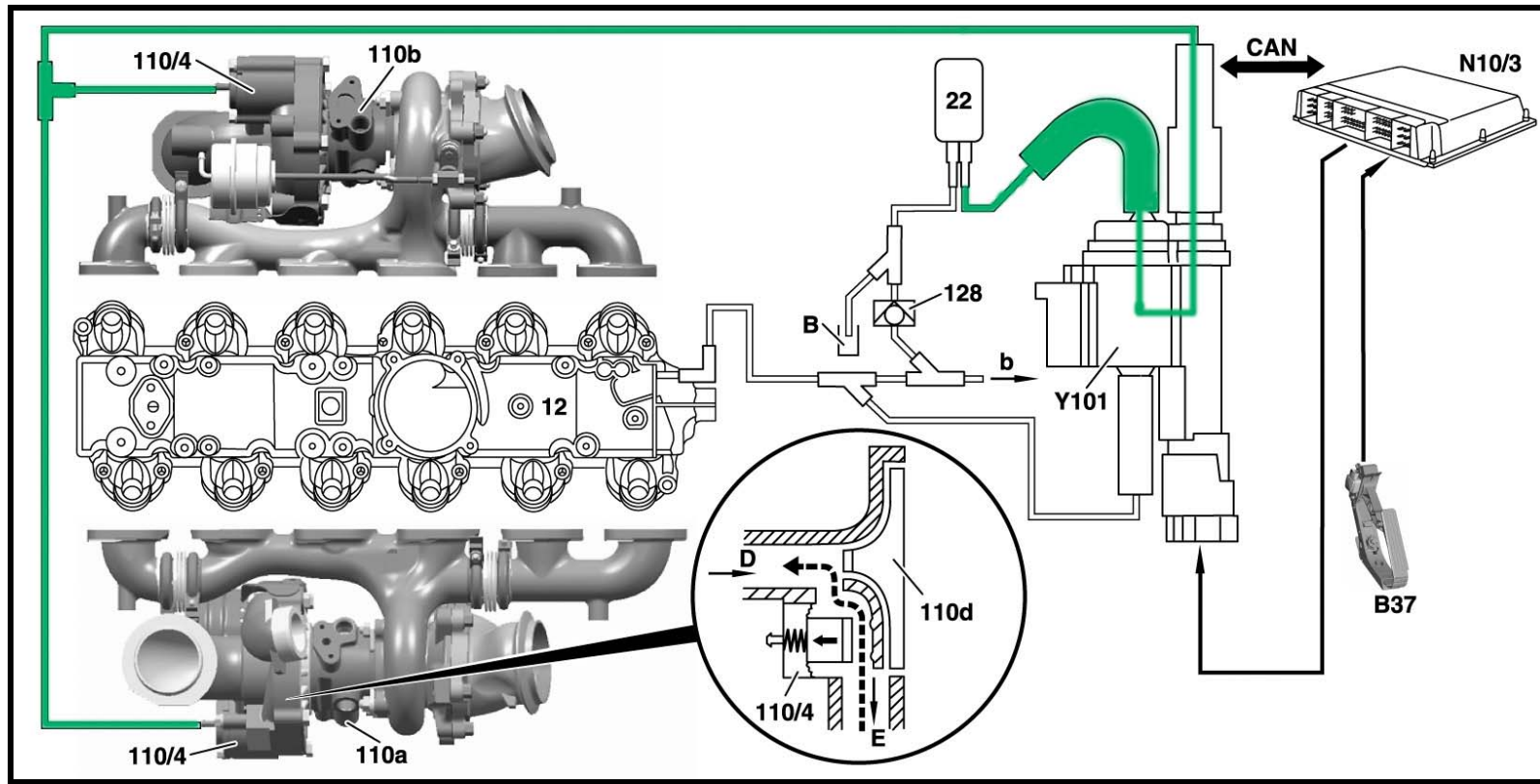
Divert Air Operation

- Y101 is de-energized during acceleration
- Divert air valves held closed by boost pressure



Divert Air Operation

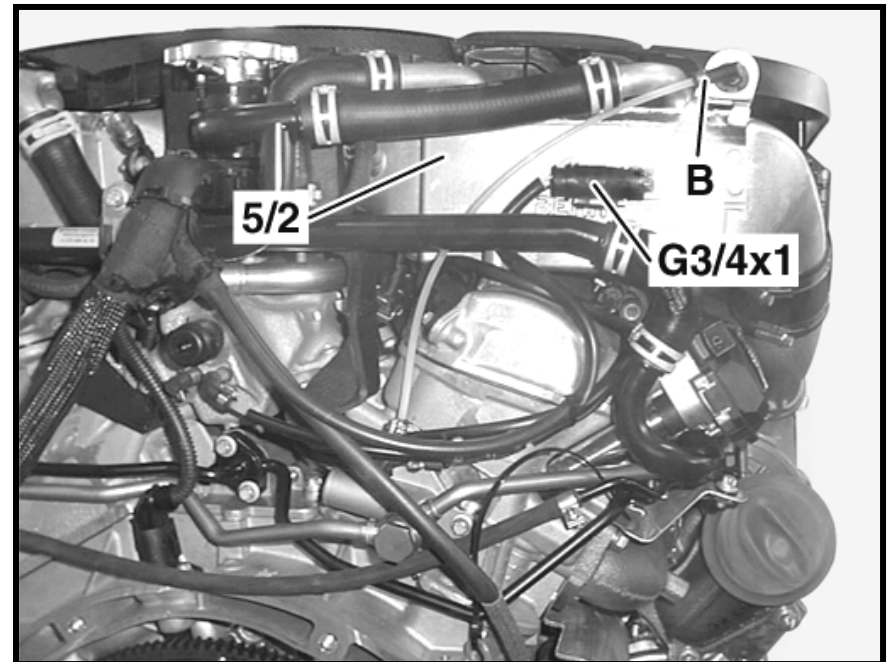
- Y101 is energized during deceleration
- Divert air valves opened by vacuum



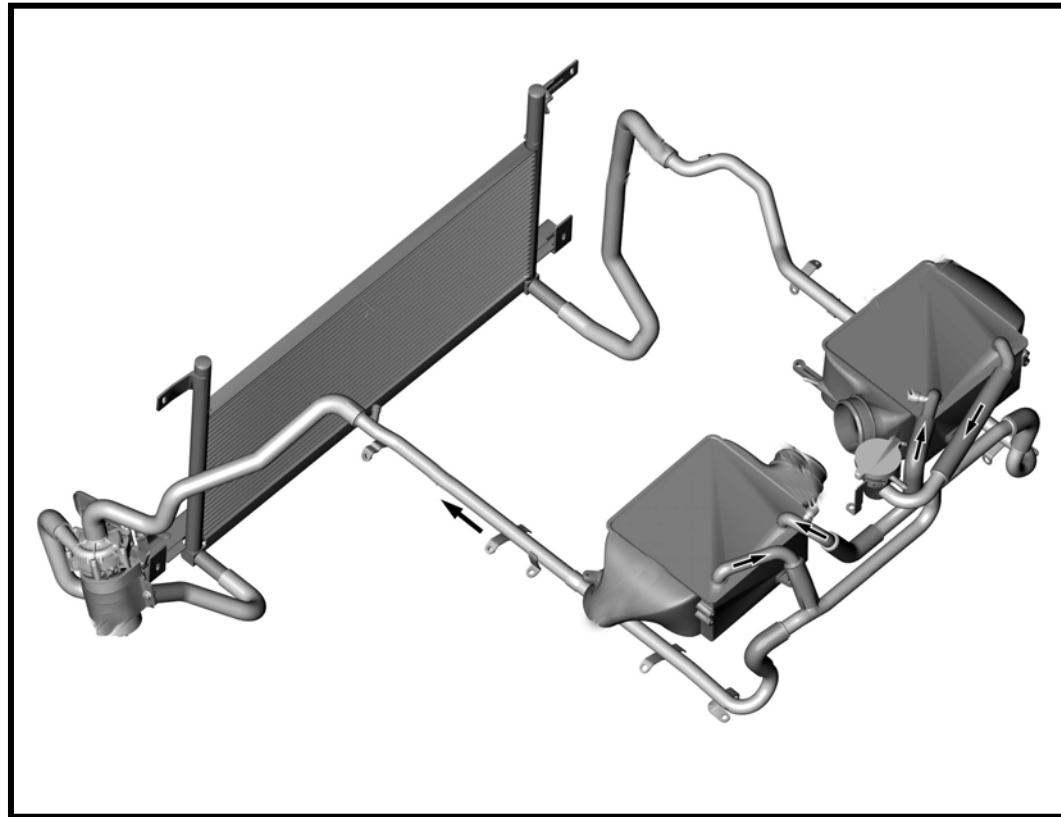
Divert Air Service Tips

Test port to for divert air integrity:

- Located on the right charge air cooler (5/2) is a connection point (B) to test the divert air function

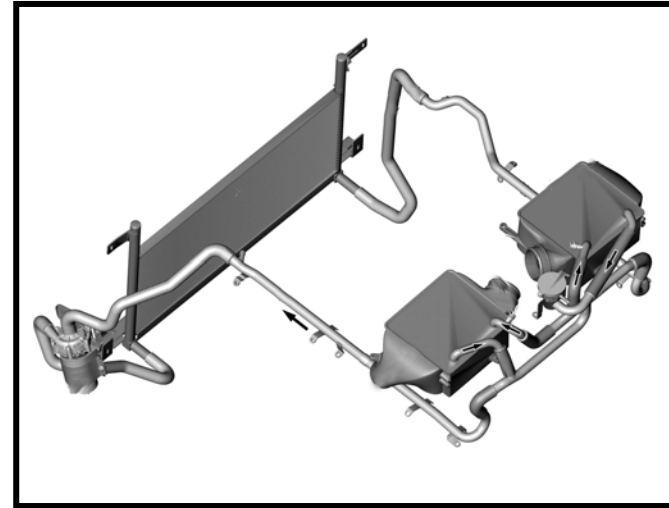


Low Temperature Cooling Circuit (LTCC)



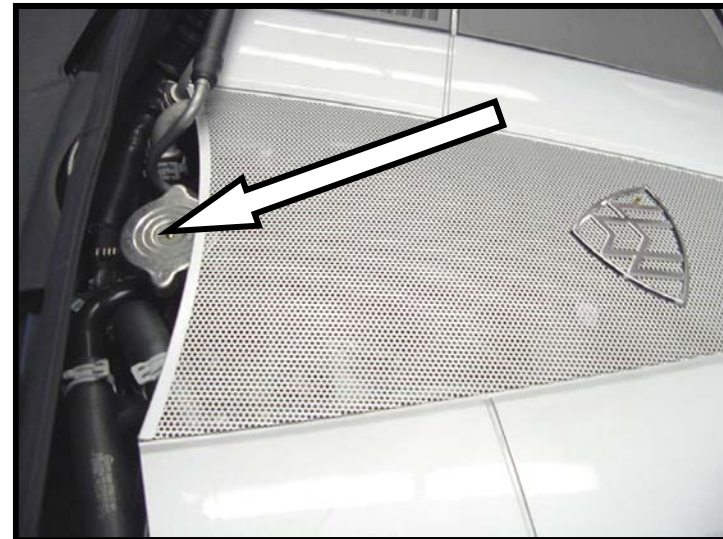
Charge Air Cooling Advantages

- Increased performance
- Increased production of torque
- Reduction of emissions

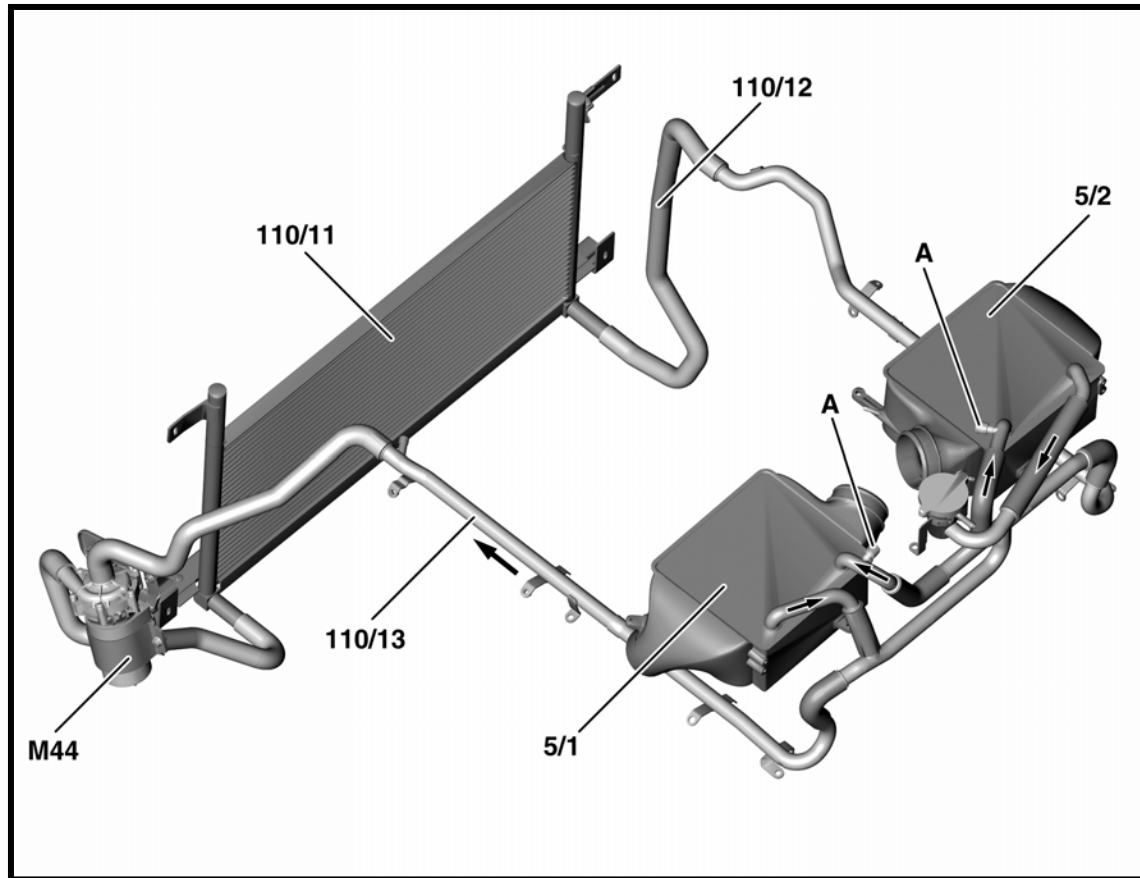


CAUTION:

- Do NOT open this cap when the engine is warm
- If this cap is removed, a special bleeding procedure will need to be performed



Low Temperature Circuit Components



110/11 Low temperature water cooler

M44 Circulation pump

110/12 Feed line to low temperature water cooler

A Service valves

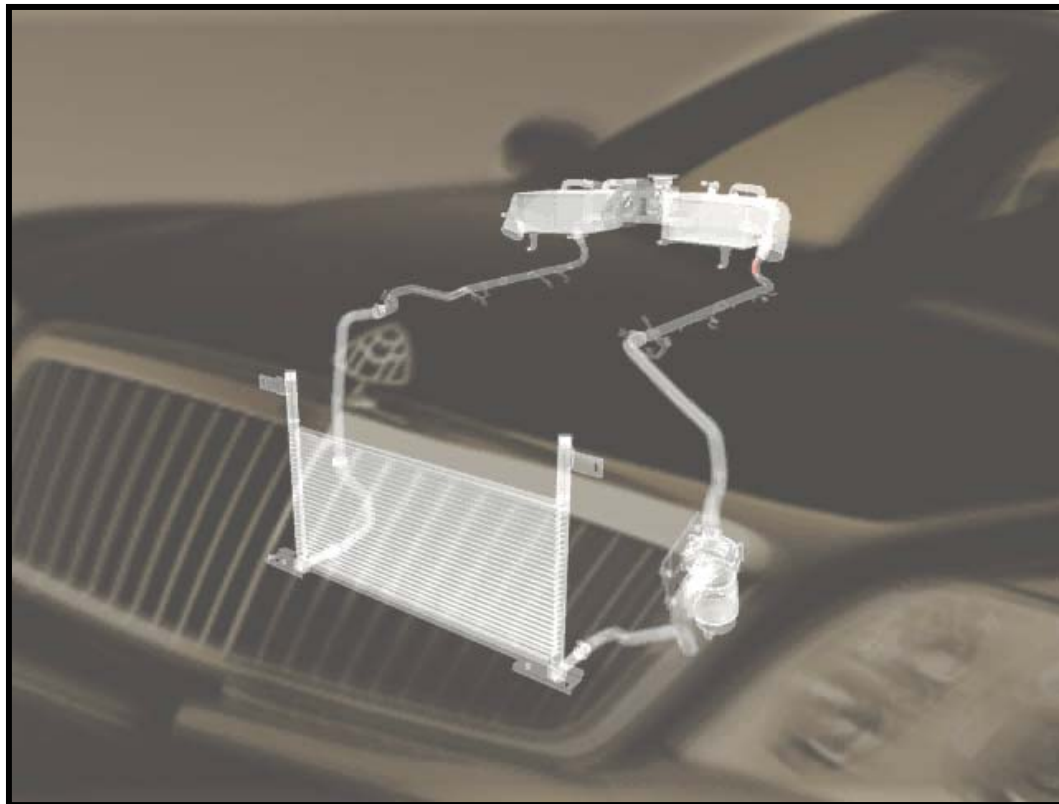
5/1 Charge air cooler on the left row of cylinders

5/2 Charge air cooler on the right row of cylinders

110/13 Return line from low temperature water cooler

Circuit Overview

- Coolant circulated using electric pump
- Coolant circulated through charge air coolers to lower charge air temperature
- Capable of lowering charge air temperature approx. 100°C
- Contains 2.4 liters of coolant



Cooling Circuit Pump (M44) Function

- Located under the left front of the vehicle
- Pump is controlled by ME control module
- Pump is activated via relay N10/9kO located at right front SAM
- Circulation pump is switched ON when the charge air temperature is over approx. 47°C
- Circulation pump is switched OFF when the charge air temperature under approx. 35°C

