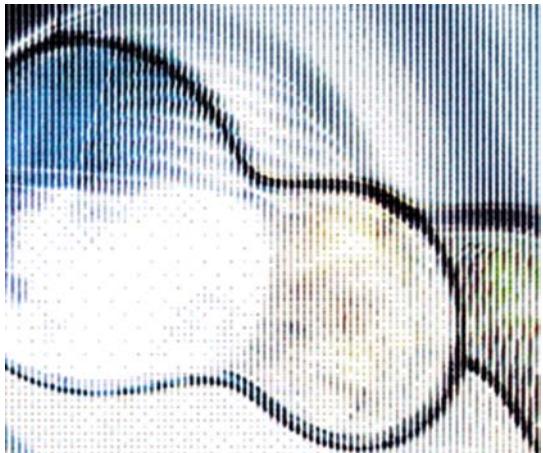


# DAIMLERCHRYSLER



**Powersystems • Industrial Engines  
Maintenance and Repair  
Series 457, 500 and 900**

**Advanced Training**



As at 04/03



**Global Training.**

The finest automotive learning

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Printed in Germany

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Note:

The term "employee" always refers to both male and female staff.

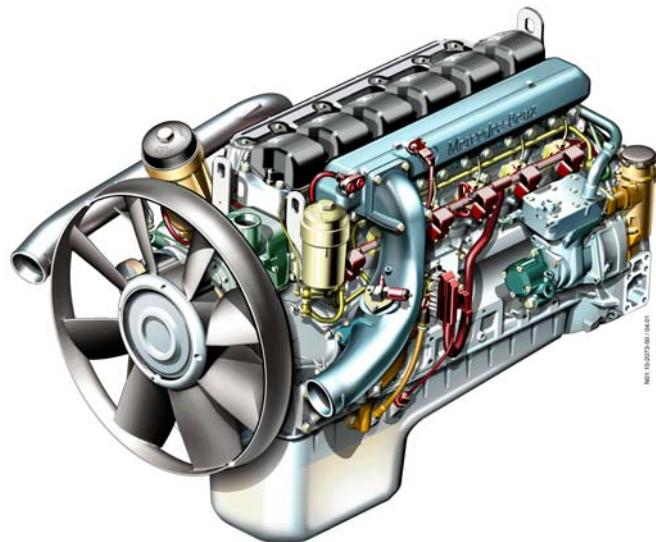
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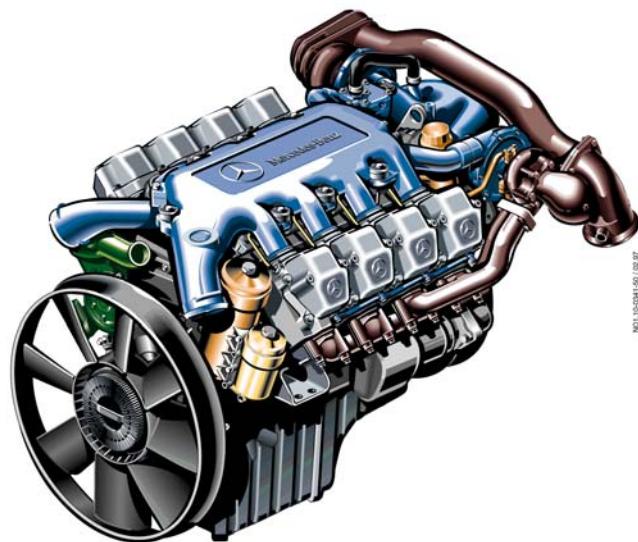
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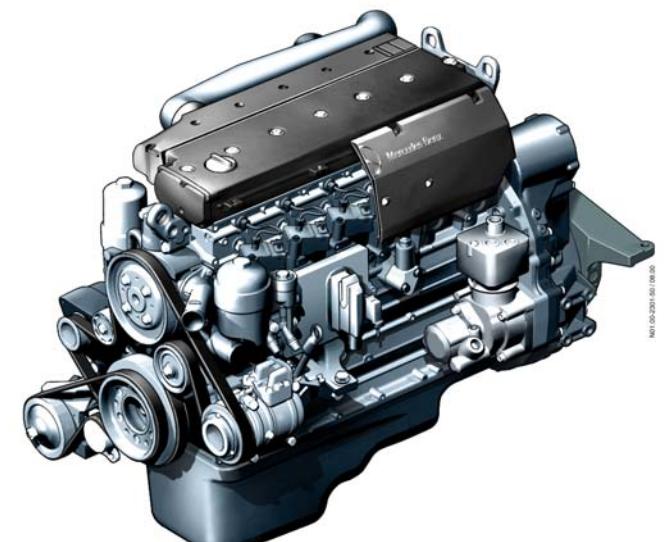
OM 457 LA



OM 502 LA



OM 906 LA



N01.10-2073-50

N01.10-0341-50

N01.00-2301-50

The 500 engine model series is future-ready, and comes in V6 and V8 cylinder variants with 2 litre swept volume per cylinder.

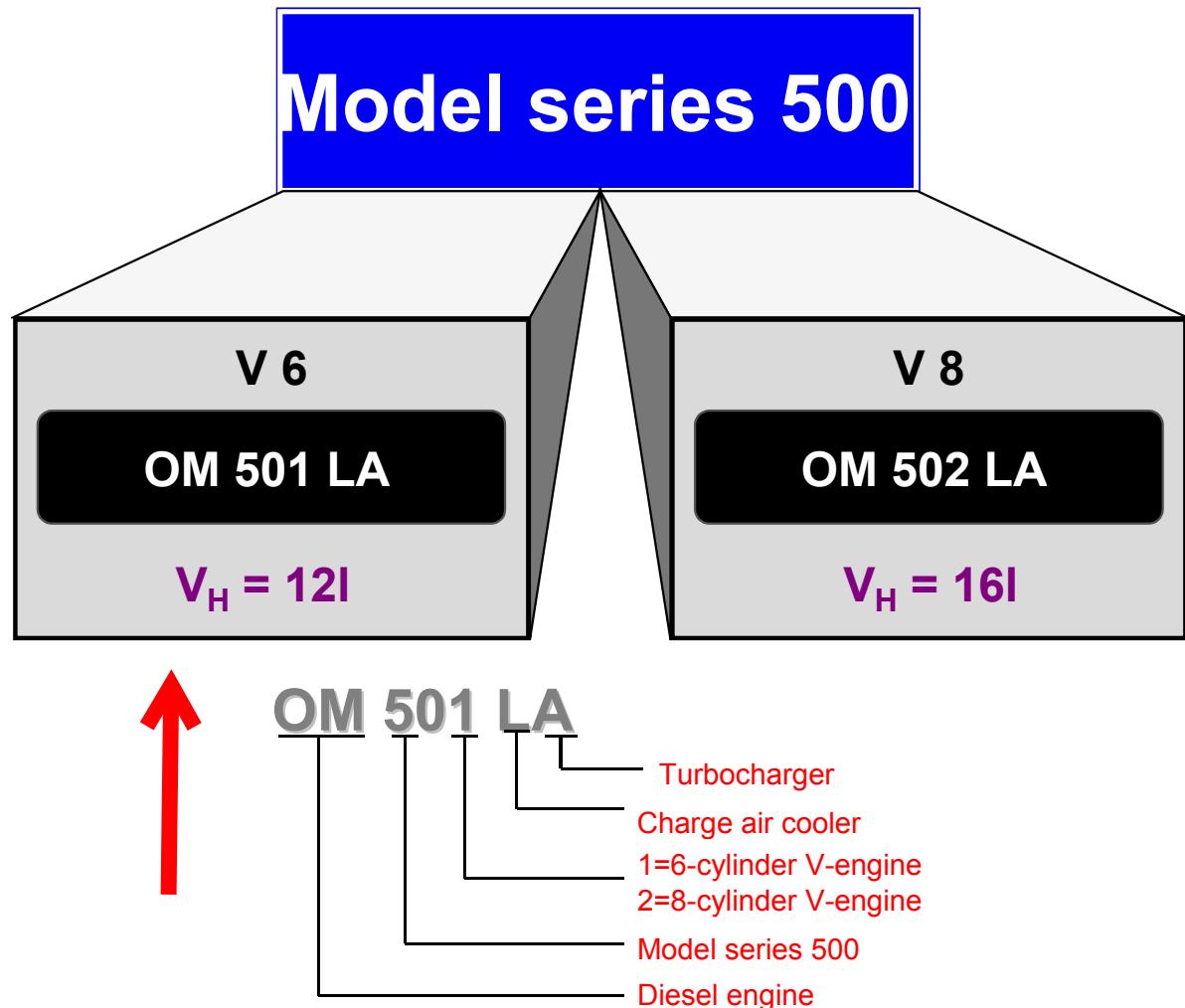
The sales designation is formed in the same way as the 400 model series:

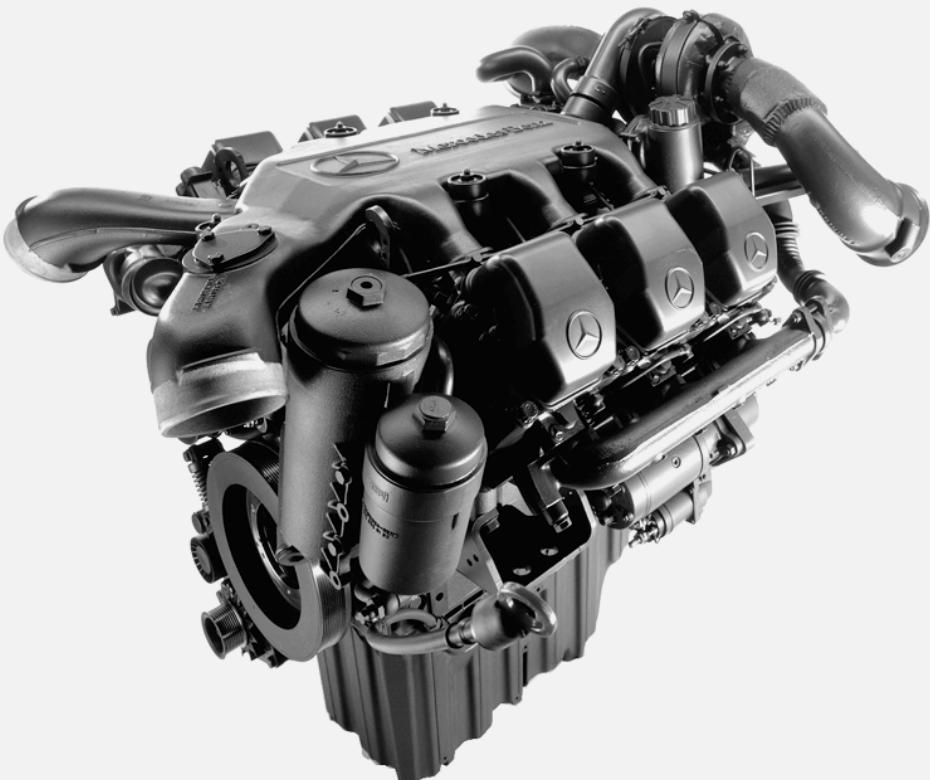
6-cylinder engine: OM 501 LA

8-cylinder engine: OM 502 LA

At the same time, the OM 457 LA engine was developed with the same basic design as the V-engines.

The Series 2000 V12 and V16 MTU engines are derived from the BR 500, and are intended for industrial applications.





N01.10-2026-11



N01.10-2028-11

The development of the 500 series encapsulates all the knowledge and experience gained from the 1 million V-engines manufactured since 1969, when production of the OM 403 V10 engine began.

- ⇒ Outstanding **power output and torque characteristics** over the whole rpm range
- ⇒ Dynamic start-off characteristics and pulling power
- ⇒ Attractive power/weight ratio
- ⇒ Low **fuel consumption**
- ⇒ Enormous **potential**: the V6 engines meet the requirements of the highly popular 400 HP Class
- ⇒ High-pressure direct injection, **pump-line-nozzle system** with peak pressures up to 1,800 bar.
- ⇒ **Electronic engine control (MR)** with electronic system fixed to the engine, and extensive engine protection functions
- ⇒ Direct injection with centrally positioned **6-hole injection nozzle**.
- ⇒ **4-valve technology**
- ⇒ Useful engine brake rpm well over rated rpm, up to **2400 rpm**
- ⇒ Meets the emission legislation of **EURO 3 and EUROMOT/EPA Level 2**
- ⇒ Turbocharger with charge air cooling
- ⇒ V8 with 2 turbochargers
- ⇒ **Viscous fan clutch, electromagnetic fan clutch and high-speed fan drive** on the most powerful engines
- ⇒ Rated engine speed **1,800 rpm or 2000 rpm**
- ⇒ Low maintenance requirement
- ⇒ Long maintenance intervals
- ⇒ Engine oil and fuel filter located at the front, for easy maintenance
- ⇒ Maintenance-free belt drive
- ⇒ Can run on FAME / RME (rape methyl ester) or biodiesel, and engine oil changes are halved
- ⇒ High reliability and long runtime
- ⇒ Low number of component variants, as many parts are the same on both 6 and 8 cylinder engines
- ⇒ Rear engine power take-off ex works



## Overview of BR 500 engines with EURO 3 certification

Engine model	No. of cylinders/ layout	Output (rpm) [kW/HP (at rpm)]	Torque (rpm) [Nm (at rpm)]	Cylinder bore [mm]	Cylinder stroke [mm]	Displacement [l]	Dimensions L x W x H [mm]	Weight [kg]	Power/weight ratio [kg/kW]
--------------	-----------------------------	----------------------------------	-------------------------------	-----------------------	-------------------------	---------------------	------------------------------	----------------	-------------------------------

OM 501 LA	6 Cyl./V	230/313 (1800)	1530 (1080)	130	150	11.95	1190x1020x1130	885	3.85
OM 501 LA	6 Cyl./V	260/354 (1800)	1730 (1080)	130	150	11.95	1190x1020x1130	885	3.40
OM 501 LA	6 Cyl./V	290/394 (1800)	1850 (1080)	130	150	11.95	1190x1020x1130	885	3.05
OM 501 LA	6 Cyl./V	300/408 (2000)	1900 (1080)	130	150	11.95	1190x1020x1130	885	2.95
OM 501 LA	6 Cyl./V	315/428 (1800)	2000 (1080)	130	150	11.95	1190x1020x1130	885	2.81

OM 502 LA	8 Cyl./V	320/435 (2000)	1900 (1080)	130	150	15.93	1530x1195x1080	1125	3.52
OM 502 LA	8 Cyl./V	350/476 (2000)	2100 (1080)	130	150	15.93	1530x1195x1080	1125	3.21
OM 502 LA	8 Cyl./V	350/476 (1800)	2300 (1080)	130	150	15.93	1530x1195x1080	1125	3.21
OM 502 LA	8 Cyl./V	370/503 (2000)	2300 (1080)	130	150	15.93	1530x1195x1080	1125	3.04
OM 502 LA	8 Cyl./V	390/530 (1800)	2400 (1080)	130	150	15.93	1530x1195x1080	1125	2.88
OM 502 LA	8 Cyl./V	420/571 (1800)	2700 (1080)	130	150	15.93	1530x1195x1080	1125	2.68

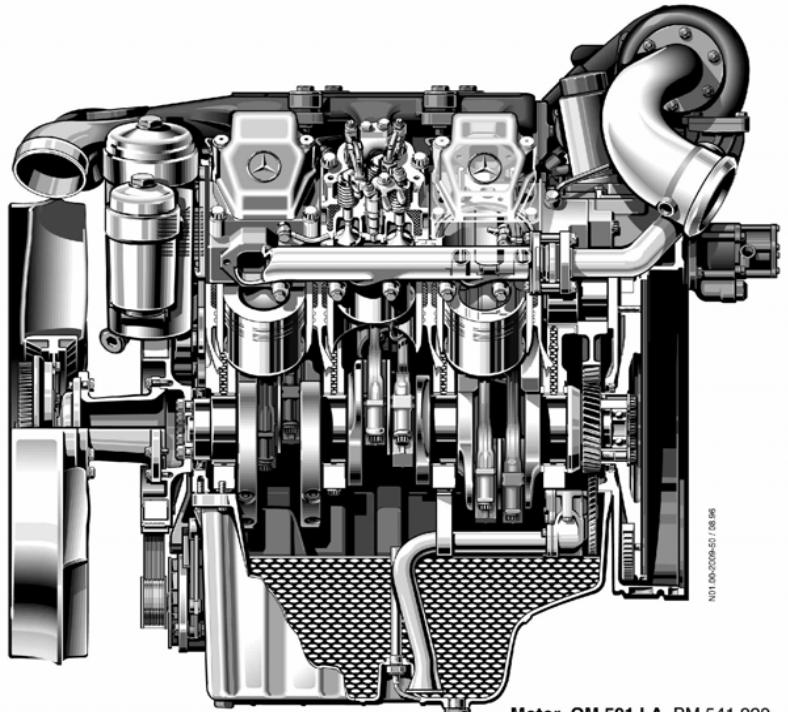
## Overview of BR 500 engines with EUROMOT/EPA Level 2 certification

Engine model	No. of cylinders/ layout	Output (rpm) [kW/HP (at rpm)]	Torque (rpm) [Nm (at rpm)]	Cylinder bore [mm]	Cylinder stroke [mm]	Displacement [l]	Dimensions L x W x H [mm]	Weight [kg]	Power/weight ratio [kg/kW]
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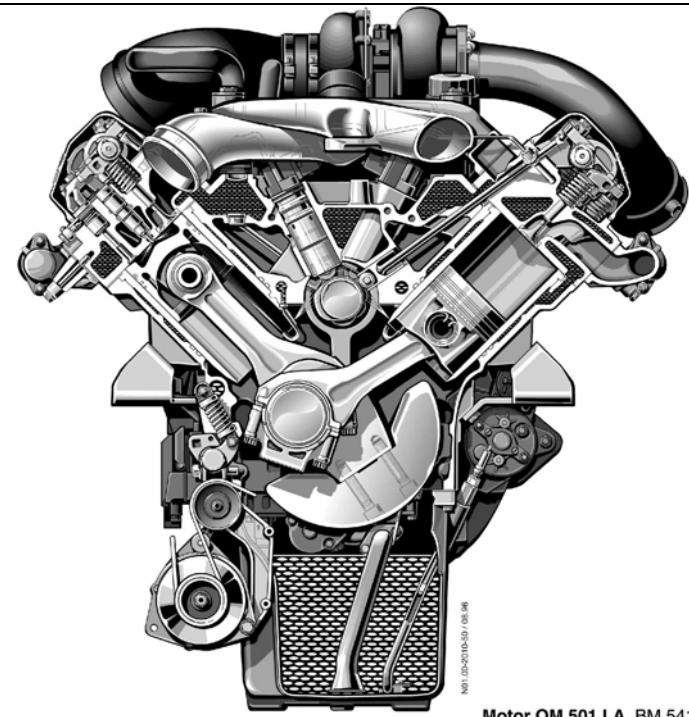
OM 501 LA	6 Cyl./V	230/313 (1800)	1530 (1080)	130	150	11.95	1190x1020x1130	885	3.85
OM 501 LA	6 Cyl./V	260/354 (1800)	1730 (1080)	130	150	11.95	1190x1020x1130	885	3.40
OM 501 LA	6 Cyl./V	290/394 (1800)	1850 (1080)	130	150	11.95	1190x1020x1130	885	3.05
OM 501 LA	6 Cyl./V	315/428 (1800)	2000 (1080)	130	150	11.95	1190x1020x1130	885	2.81

OM 502 LA	8 Cyl./V	330/449 (1800)	2150 (1200)	130	150	15.93	1530x1195x1080	1125	3.40
OM 502 LA	8 Cyl./V	350/476 (1800)	2300 (1200)	130	150	15.93	1530x1195x1080	1125	3.21
OM 502 LA	8 Cyl./V	350/476 (2000)	2100 (1200)	130	150	15.93	1530x1195x1080	1125	3.21
OM 502 LA	8 Cyl./V	380/517 (1800)	2400 (1200)	130	150	15.93	1530x1195x1080	1125	2.96
OM 502 LA	8 Cyl./V	420/571 (1800)	2700 (1200)	130	150	15.93	1530x1195x1080	1125	2.68
OM 502 LA	8 Cyl./V	448/609 (1800)	2700 (1200)	130	150	15.93	1530x1195x1080	1125	2.51

## Engine OM 501 LA in cross section

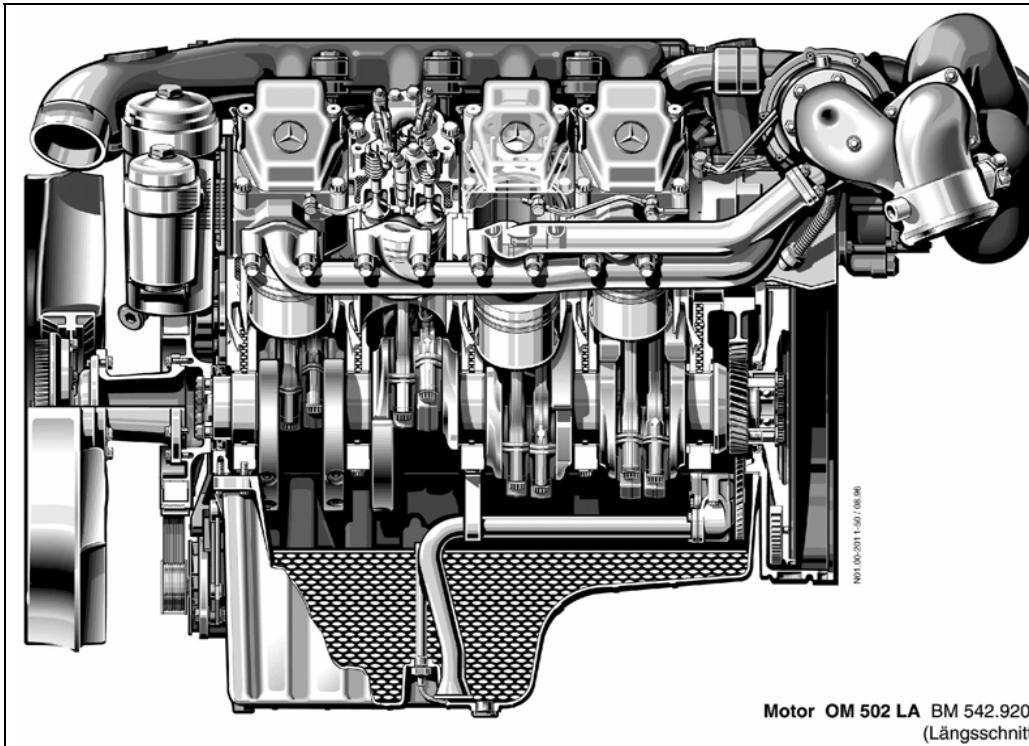


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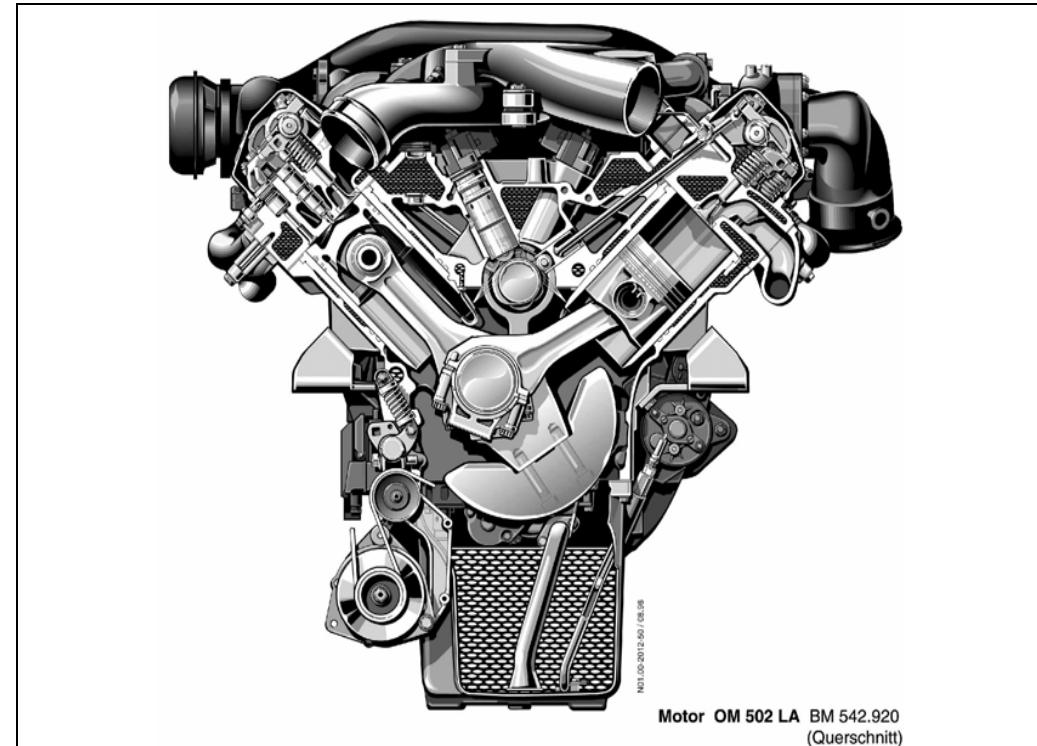


N01.00-2010-50

## Engine OM 502 LA in cross section



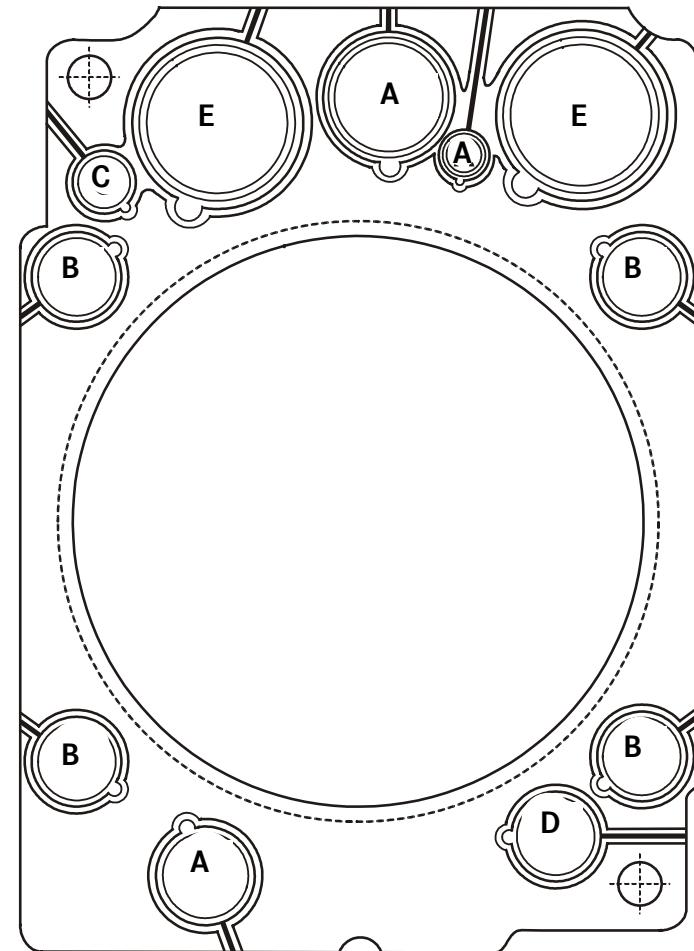
N01.00-2011-50



N01.00-2012-50

Port assignment

- A Coolant
- B Bolts
- C Pressure oil
- D Oil return
- E Plunger, oil return



N01.30-2024-12

The individual cylinder heads are made of high-quality molybdenum/cast iron alloy. Each has four stretch-thread bolts (M18x2), with which it is bolted to the crankcase.

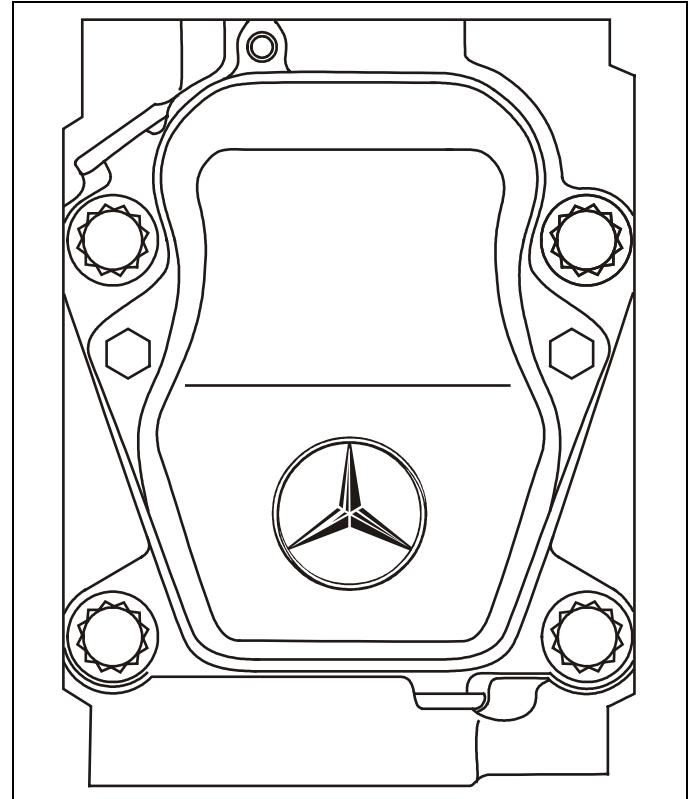
The optimal position for the injection nozzle is the vertical position at the center of the combustion chamber.

This ideal arrangement can only be achieved by using multi-valve technology.

This consists in arranging the valves in pairs (2 intake, 2 exhaust) around the injection nozzle.

A fifth valve is required for the constant throttle or the decompression valve/engine brake.

In both cases, these are linked to the exhaust port through an exactly adjusted hole.

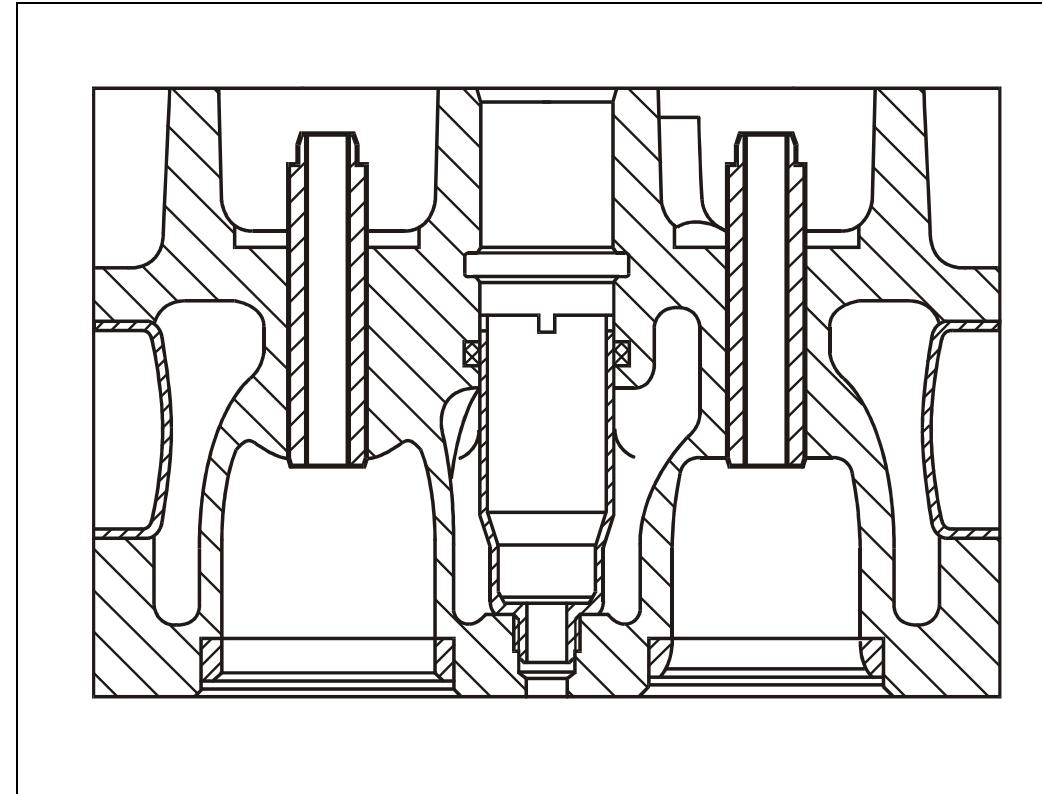


N01.30-2025-02

The high-temperature, wear-resistant valve seat rings are inserted deep-frozen into the floor panel.

The nozzle holder is inserted in a protective sleeve, which is washed around by coolant and thus individually cooled.

The nozzle protective sleeve is sealed by an O-ring against coolant escape, and by the thread and face against gas escape.



N07.03-2035-11

The cylinder head is tightened in 6 stages.

The cylinder head bolts do not require retightening.

Step 1      10      Nm

Step 2      50      Nm

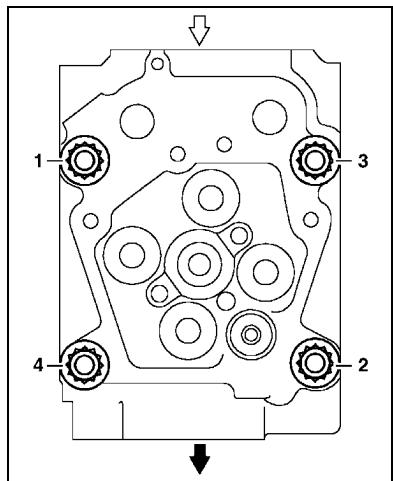
Step 3      100      Nm

Step 4      200      Nm

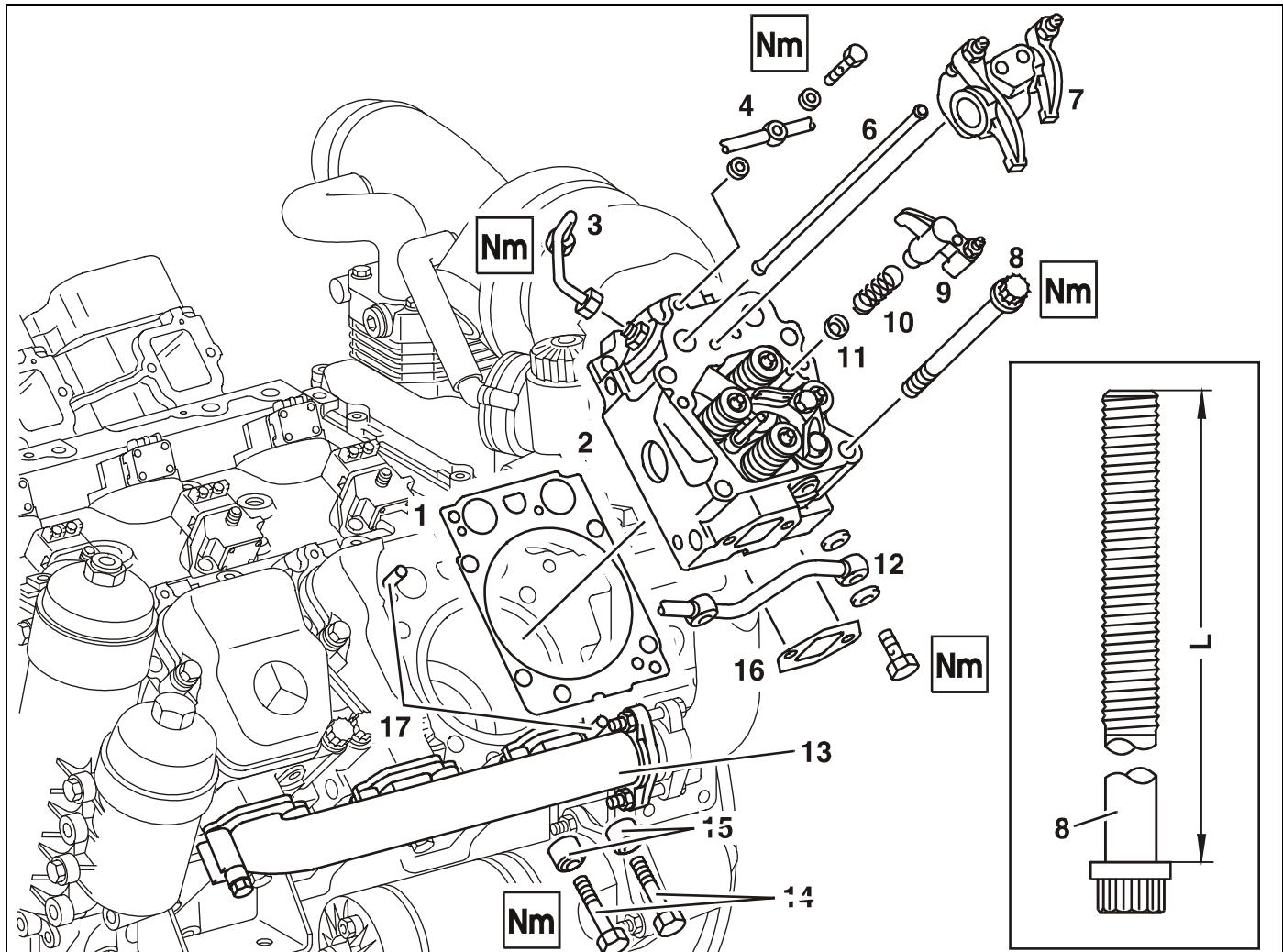
Step 5      90      °

Step 6      90      °

**1      L ≤ 212 mm**

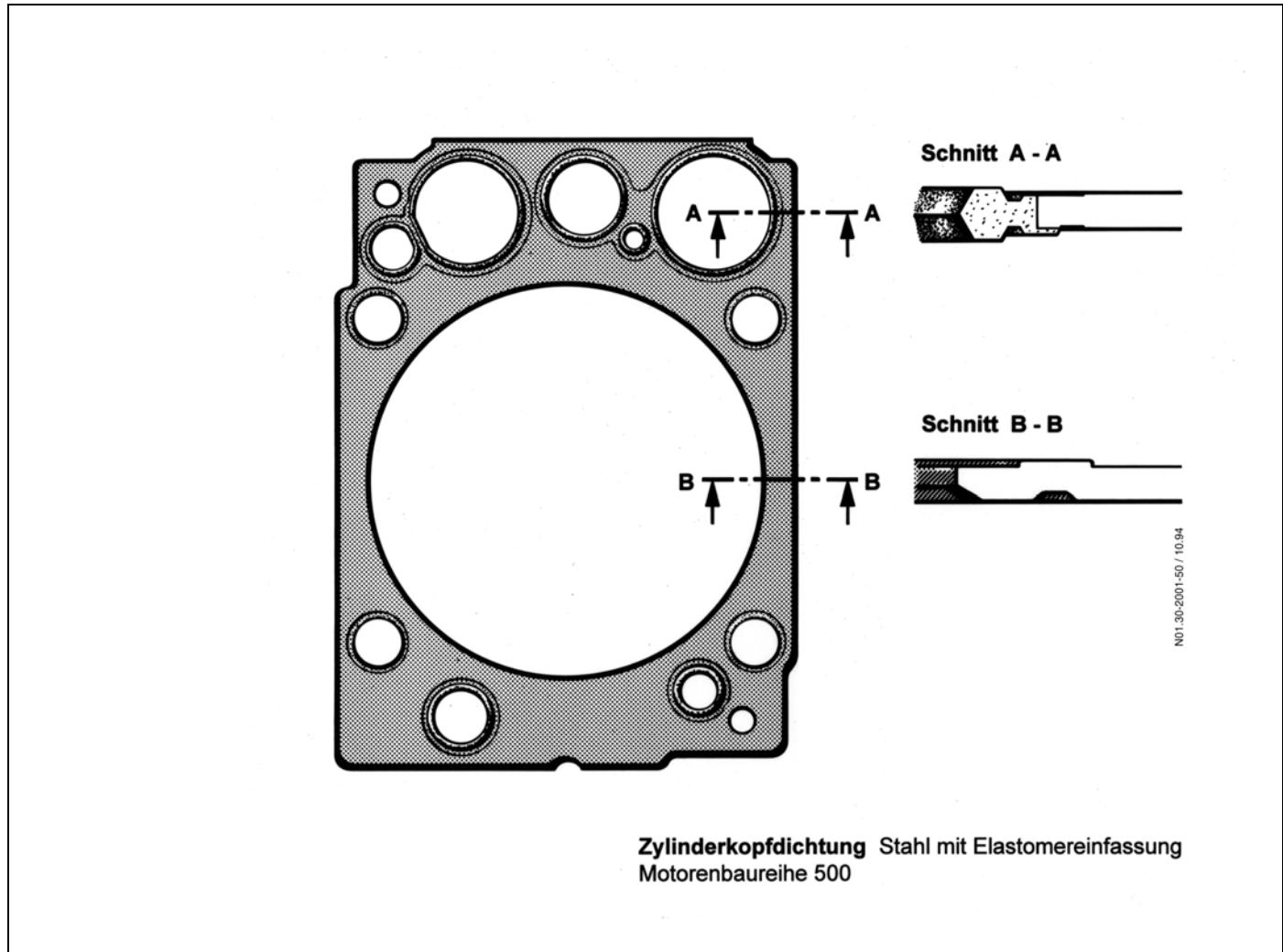


W01.30-0009-02



W01.30-0010-06

Each cylinder head has a stainless steel insert gasket with scorched elastomer binding, which does not require retightening.

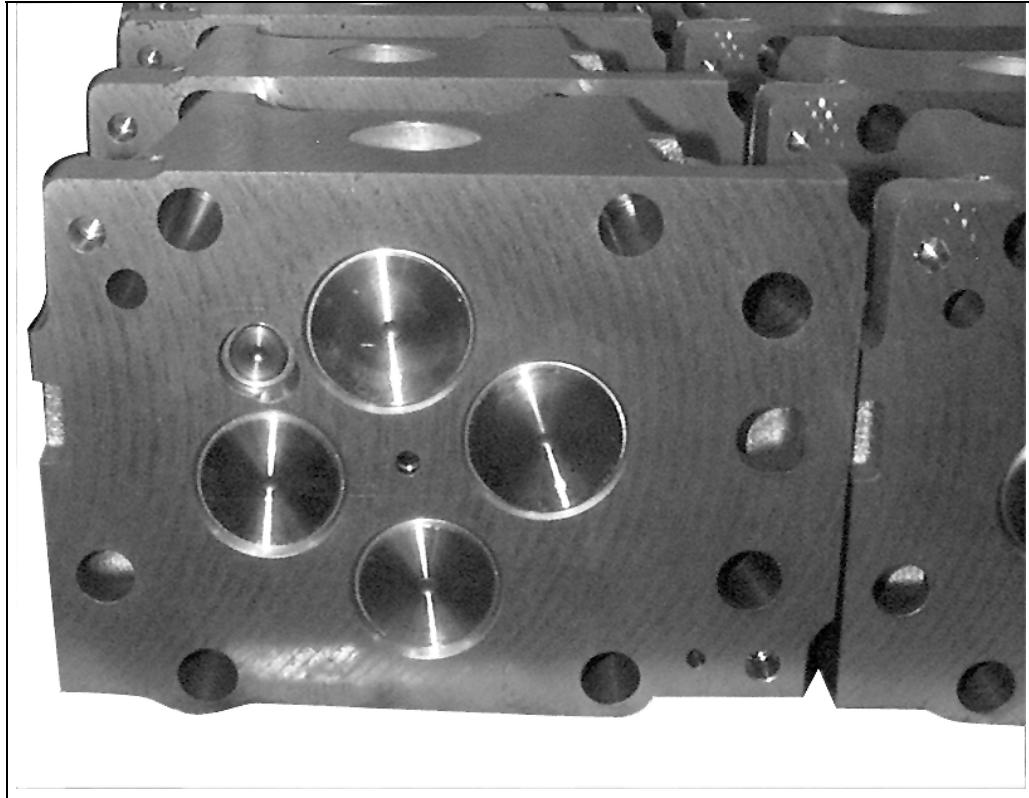


N01.30-2001-50 / 10.94

N01.30-2001-50

## Series 500<>EURO 2 and EURO 3 cylinder heads compared

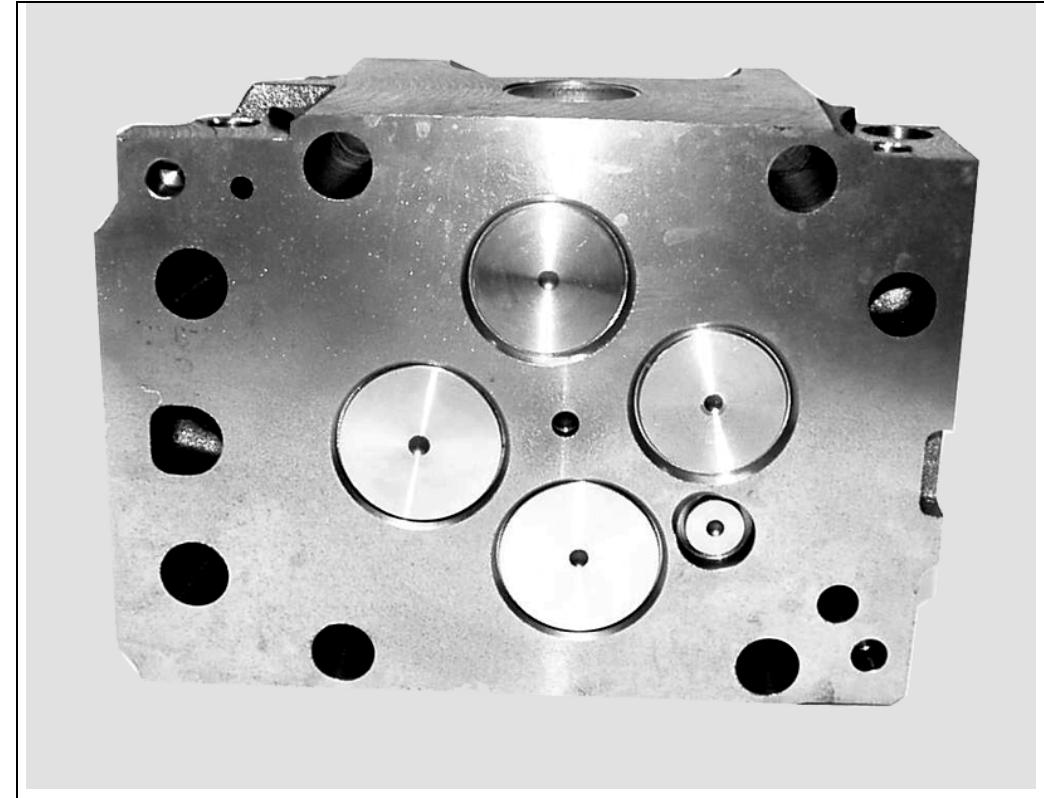
07.05.2003



Cylinder head old version, as of 04/99

N01.30-2065-11

In the previous Euro 2 version, the cover surfaces were milled. Since 2000, as part of the "Euro 3" package of measures, the cylinder head surfaces are turned, to a specific surface quality. Since 06/2000, this also applies to all Euro 2 V8 and 315 kW V6 engines, and from January 2001 to all other V6 engines.



Cylinder head, Euro 3 version

N01.30-2064-11

The new cylinder heads should be ground to a minimum height of 113.5 mm, by face grinding only. The surface quality (peak-to-valley height and corrugation depth) is to be observed in all cases.

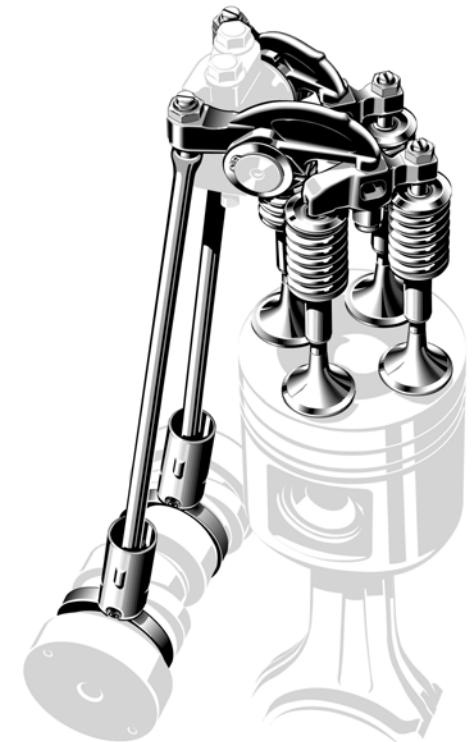


Gas exchange is improved by 4-valve technology, thus contributing considerably to lower fuel consumption with lower emissions.

The intake and exhaust valves are controlled by means of roller tappets, push rods and intake and exhaust rocker arms which are set in a groove in the crankcase with a sliding block, and which operate the intake/exhaust valve pairs through a valve bridge.

The rocker arm spindle complete with preassembled rocker arms and rocker arm bearing bracket is bolted to the cylinder head.

To keep wear in the whole valve assembly to a minimum throughout its lifetime, the contact surfaces of the valve, valve bridge, the rocker arm thumb, the upset ball socket of the push rod, and the ball head of the adjusting screw, are induction hardened. This is to allow them to support the actuation forces of the high-temperature valve springs, and the effects of inertial forces and cylinder pressures.



Ventiltrieb (Motorenbaureihe 500)

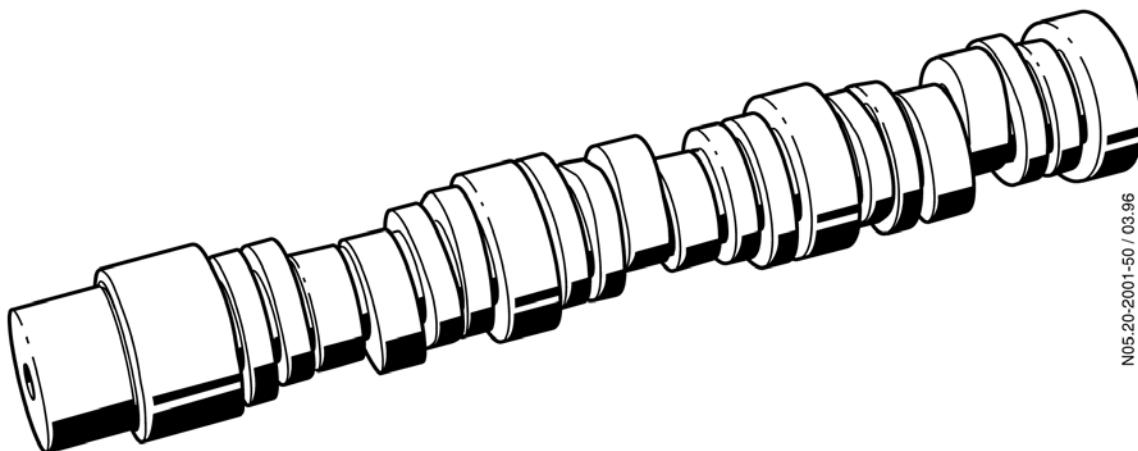
N05.30-2001-50

## Camshaft

The camshaft is made of high-strength material, with induction-hardened running surfaces, and has 4 bearings in the OM 501 LA, 5 bearings in the OM 502 LA.

Between the bearings are 4 valve timing cams and 2 injection cams for each opposing cylinder pair.

The slide ways of the timing cams for the valve and injection roller tappets are supplied with lube oil through additional oil holes in the piston jet pipe.



N05.20-2001-50 / 03.96

**Nockenwelle Motor OM 501 LA**

N05.20-2001-50

## Adjusting the valve play

The valve play checking and setting procedure is the same as for the BR 400, and there are two methods.

### Method 1

Set the intake and exhaust valves for each cylinder, according to the injection sequence.

The cylinder to be set must be at ignition TDC, the parallel cylinder at valve overlap TDC.

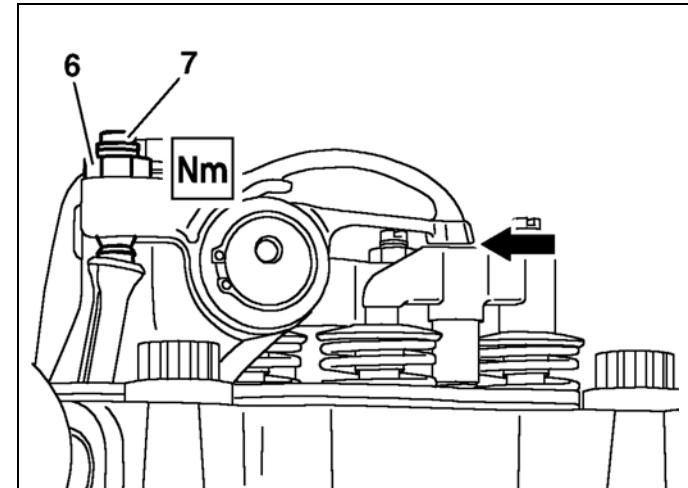
With this method, the crankshaft must be turned six times in the 6-cylinder engine, and eight times in the 8-cylinder engine.

### Method 2

Set the intake and exhaust valves in two crankshaft positions.

Adjust when cylinder 1 is at ignition TDC.

Adjust when cylinder 1 is at overlap TDC.



N05.30-0302-01 P

Valve	Play	Tolerance
Intake	0.40	+ 0.20 / - 0.10
Exhaust	0.60	+ 0.20 / - 0.10

The valve play test tolerance applies only for checking valve play.

If valve play is outside the tolerance range, the specified value must be set.

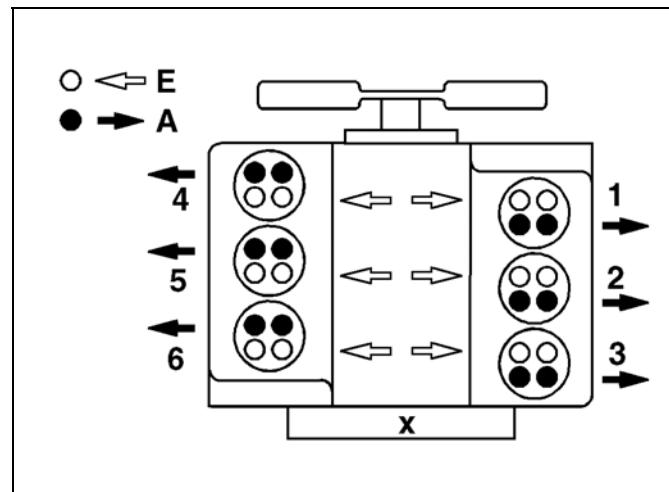
## General notes on valve adjustment

### Method 1

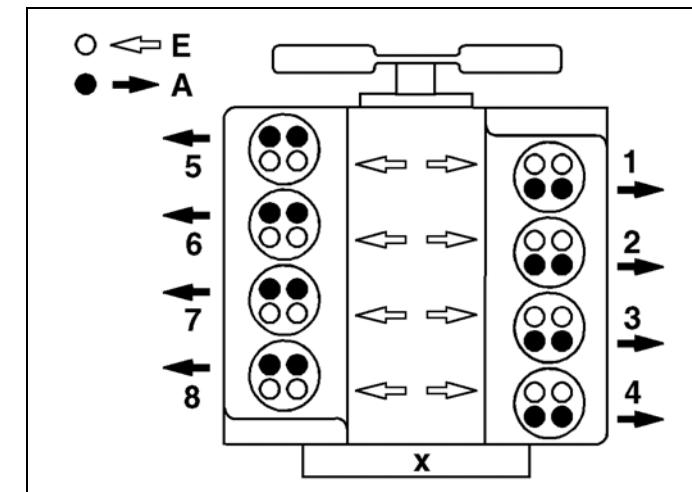
Set the intake and exhaust valves for each cylinder, according to the injection sequence.

The cylinder to be set must be at ignition TDC, and the parallel cylinder at valve overlap TDC.

A      Exhaust valve  
E      Intake valve  
X      Flywheel side



N01.00-0200-01



N01.00-0201-01

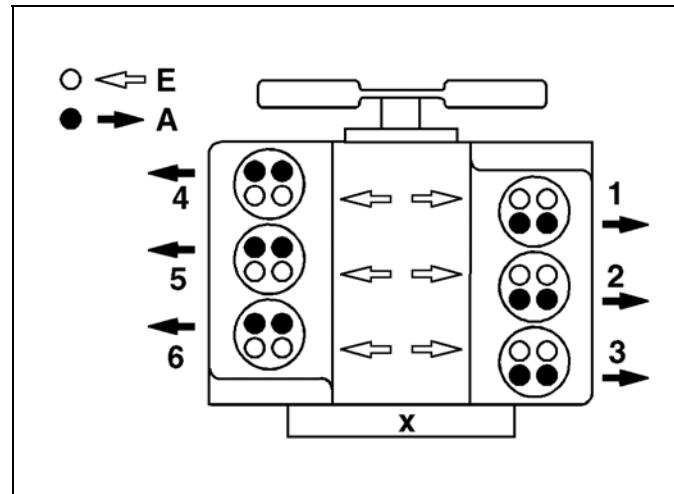
Engine	Crankshaft position	Cylinder/injection sequence						
6-cylinder	Ignition TDC	1	4	2	5	3	6	
	Valve overlap	5	3	6	1	4	2	
8-cylinder	Ignition TDC	1	5	7	2	6	3	4
	Valve overlap	6	3	4	8	1	5	7

## General notes on valve adjustment

### Method 2

Set the intake and exhaust valves at two crankshaft positions, as shown in the table.

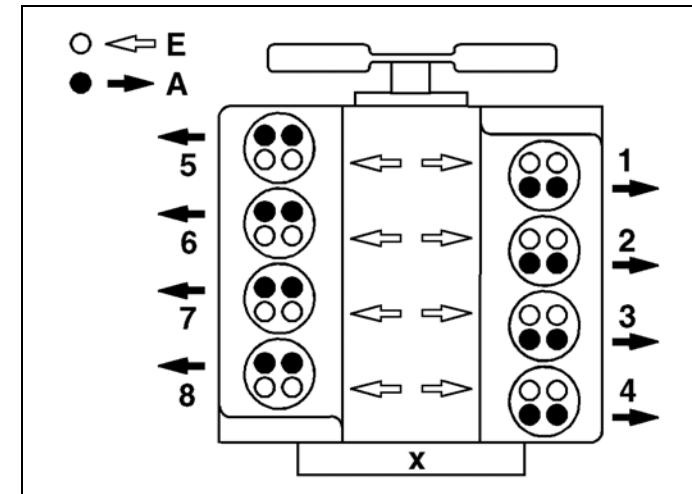
A Exhaust valve  
E Intake valve  
X Flywheel side



N01.00-0200-01

#### 6-cylinder

First set cylinder 5 at valve overlap TDC (cylinder 1 at ignition TDC), then cylinder 1 at valve overlap TDC (cylinder 5 at ignition TDC).



N01.00-0201-01

#### 8-cylinder

First set cylinder 6 at valve overlap TDC (cylinder 1 at ignition TDC), then cylinder 1 at valve overlap TDC (cylinder 6 at ignition TDC).

Engine	Crankshaft position	Cylinder/injection sequence							
		1	2	3	4	5	6	7	8
6-cylinder	Cylinder 5 valve overlap	I / E	E	I	E	-	I		
	Cylinder 1 valve overlap	-	I	E	I	I / E	E		

8-cylinder	Cylinder 6 valve overlap	I / E	E	I	I	E	-	E	I
	Cylinder 1 valve overlap	-	I	E	E	I	I / E	I	E



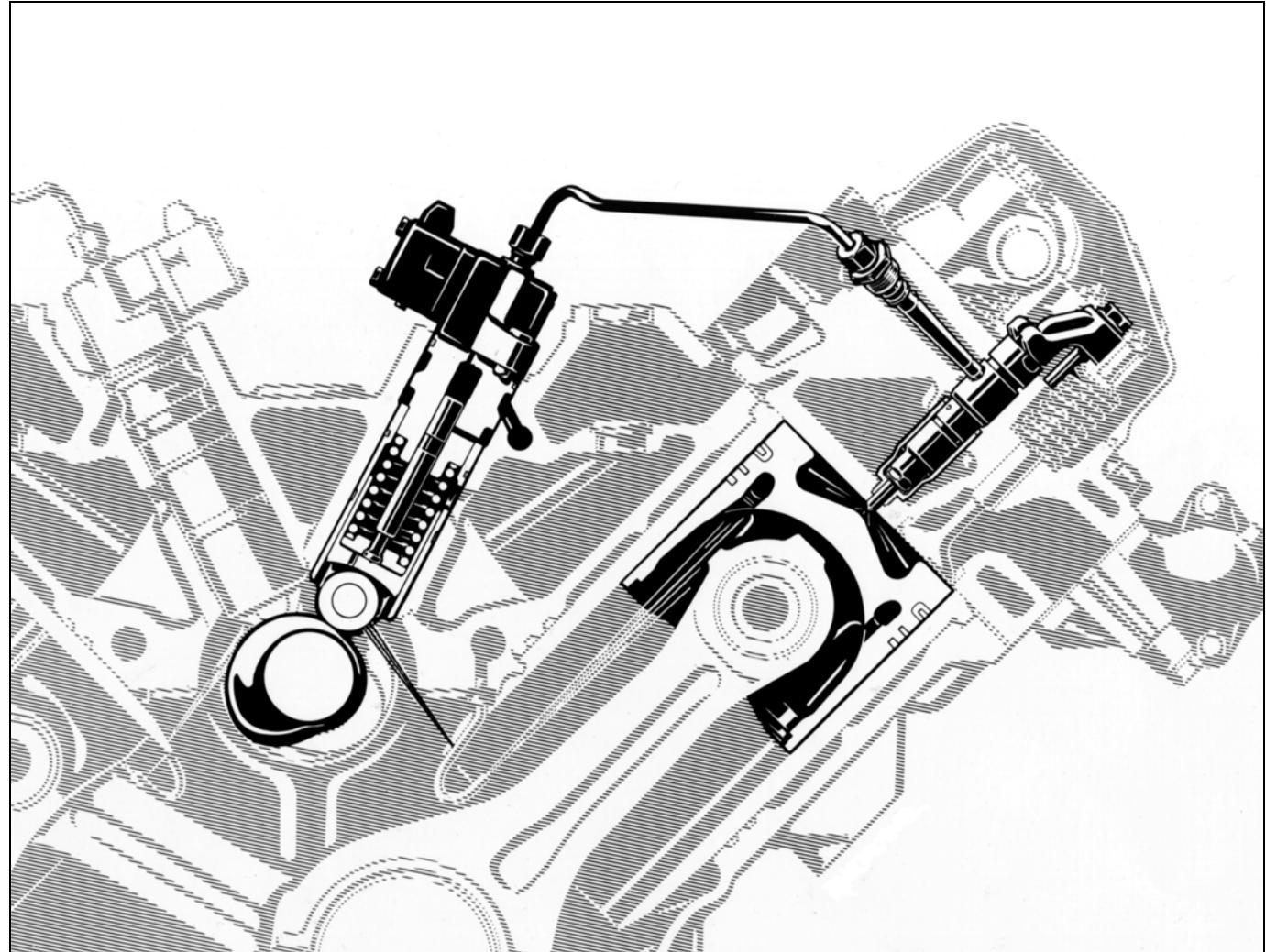
Engines of the OM 500 model series use the direct fuel injection process.

The injection process is performed by the newly developed pump-line-nozzle (PLD) system, controlled by an electronic engine management system that has also been newly developed.

In the PLD system, fuel is delivered to the injection nozzle by individual unit pumps over short, rigid high-pressure injection lines, and through the pressure pipe connection screwed into the cylinder head.

The connection to the nozzle and nozzle holder is located centrally at the cylinder, and is integrated with, and removable from, the cylinder head.

A unit pump fitted for each cylinder is located directly on the crankcase.



N07.02-2018-50

The electronic engine management system controls the injection timing point and quantity injected individually per cylinder, by means of solenoid valves.

Separation of the high pressure pump and injection nozzle made it necessary to develop a high pressure injection line of special tube material with a surface hardened by internal high pressure forming, able to support continuous injection pressures over 2000 bar.

With high pressure injection (peak pressures up to 1800 bar) together with the central, vertically positioned nozzle with 8 or 6 injection orifices and flat combustion chamber cavity in the piston, outstanding particulate values are achieved.

### **Advantages over the Pump-Nozzle system**

- No overhead camshaft
  - therefore lower space requirement and reduced engine height
  - lower noise emission
- On the V-engine, only one camshaft needed, which controls both cylinder banks.
  - Weight saving
- Locating the camshaft in the center of the crankcase means there is optimal power absorption. With an overhead camshaft, measures would be necessary for strengthening the cylinder head.
- Easy to repair
  - Individual cylinder heads, which are all identical
  - Compact unit pumps, which are simple to replace
  - Inexpensive replacement due to separate pump and nozzle

## Pressure pipe connection and nozzle holder location

Connection to the nozzle holder and injection nozzle (positioned vertically at the center of the cylinder), is through a fixed, preassembled pressure pipe connection with integral pin-type filter.

The nozzle holder with 8 or 6-hole injection nozzle is held in a protective sleeve by means of a clamping claw supported on the nozzle holder and constant throttle cap, and attached with a central screw.

The seal at the nozzle protective sleeve consists of a copper spacer or sealing sleeve.

For nozzle holder positioning, the clamping claw grips a locating pin fixed into the nozzle holder cap.

The pressure pipe connection is attached with a press-in ball fastening.

1 Injection line, 30 [Nm]

3 Pressure screw, 40 [Nm]

4 O-ring

5.1 Pressure pipe connection with anti-twist lock (press-in ball fastening)

5.2 Pressure pipe connection without anti-twist lock

6 Nozzle holder combination

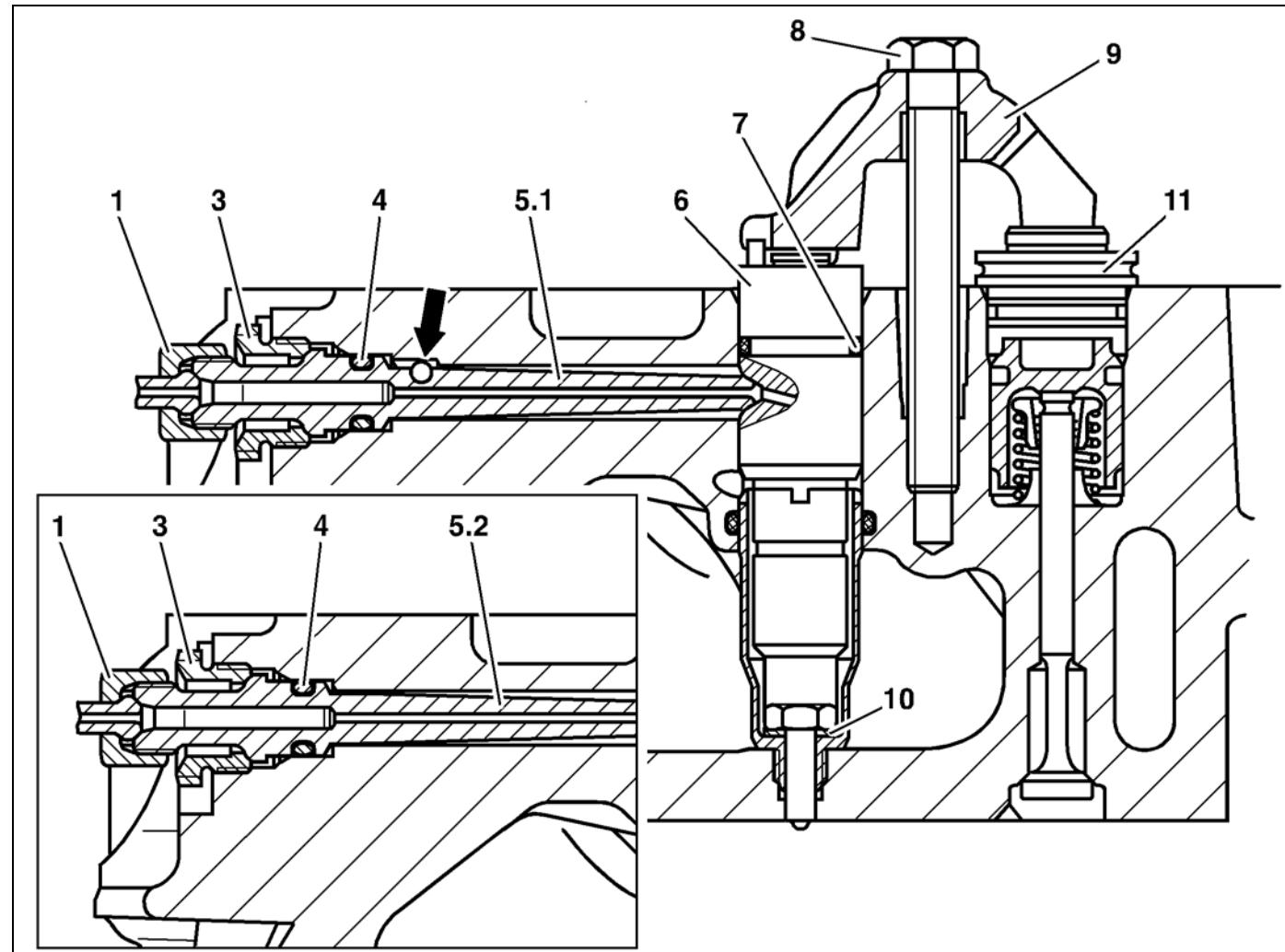
7 O-ring

8 Screw, 50 Nm,  $\leq$  91 mm

9 Retaining clip

10 Sealing ring

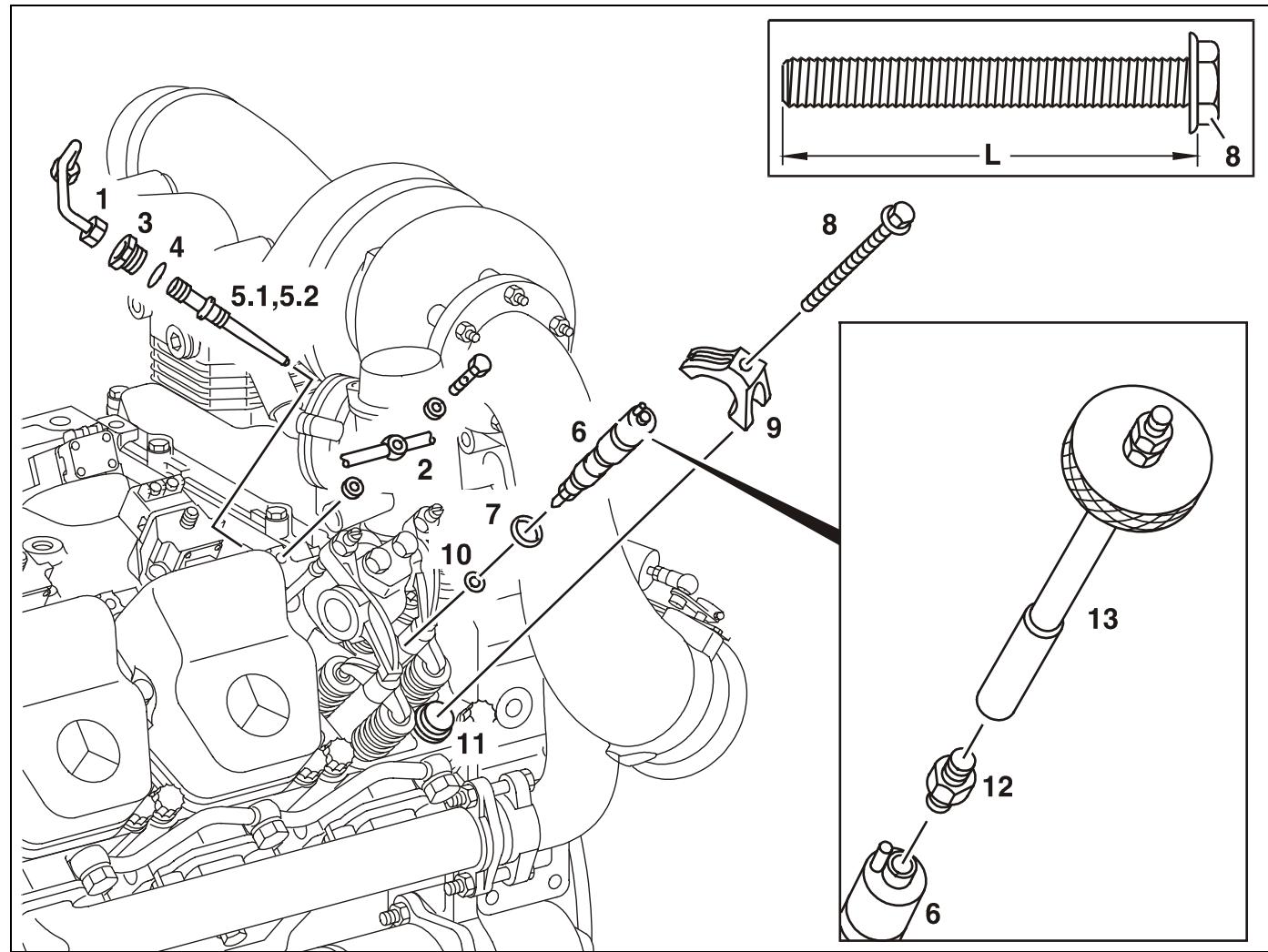
11 Constant throttle cap



W07.03-1006-06

## Removing/installing the nozzle holder combination

- 1 Injection line, 30 Nm
- 2 Leak fuel line, 15 Nm
- 3 Pressure screw, 40 Nm
- 4 O-ring
- 5.1 Pressure pipe connection with anti-twist lock (press-in ball)
- 5.2 Pressure pipe connection without anti-twist lock
- 6 Nozzle holder combination
- 7 O-ring
- 8 Screw, 50 Nm
- 9 Retaining clip
- 10 Sealing ring or sealing sleeve
- 11 Constant throttle cap
- 12 Adapter 904 589 00 63 00
- 13 Extractor 355 589 01 63 00
- L Shank length of screw (8), ≤ 91 mm

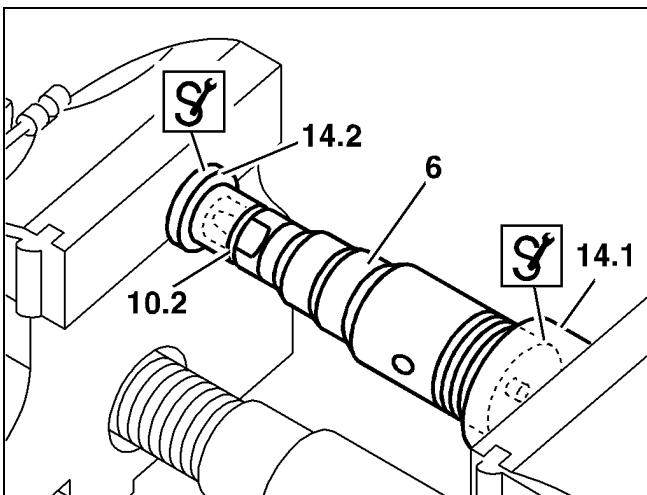


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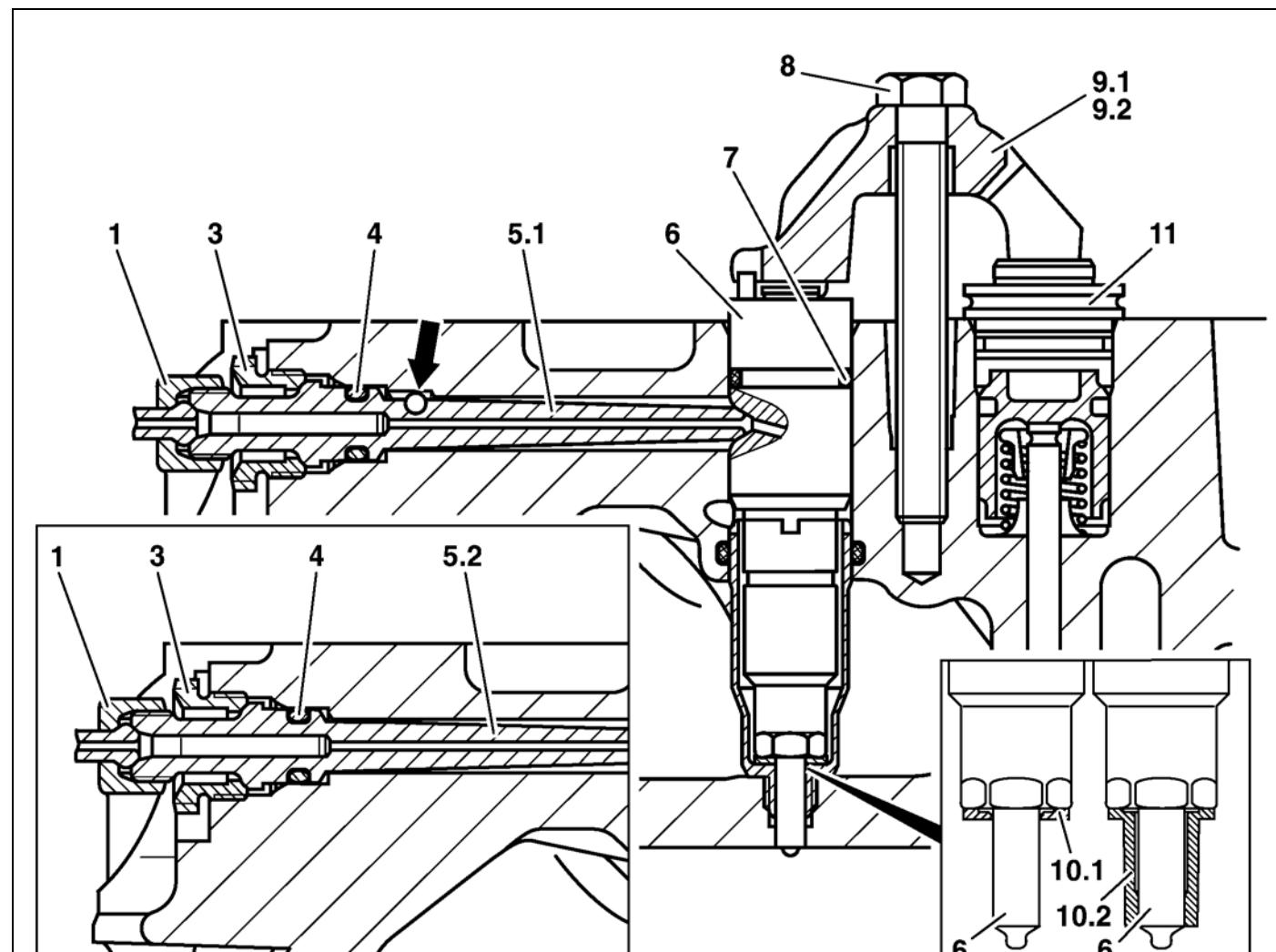
	<b>To remove</b>	
1.	Risk of explosion due to gas ignition, risk of poisoning by inhaling or absorbing fuel, or risk of injury to skin and eyes through contact with fuel.	Fire, sparks, naked flames, smoking are forbidden. Only store fuel in suitable and appropriately marked containers. Wear protective clothing if handling fuel.
2.	Remove the cylinder head cover	
3.	Remove leak fuel line (2) from cylinder head	
4.	Remove injection line (1)	
5.	Unscrew pressure screw (3) and remove pressure pipe connection (5).	
6.	Remove retaining clip (9)	
7.	Fit the adapter (12) and extractor (13) to the inside thread (M 8) of nozzle holder combination (6)	Adapter: 904 589 00 63 00 Extractor: 355 589 01 63 00
8.	Take out the nozzle holder combination (6)	The nozzle holder combination should not be disassembled. If worn or faulty, the nozzle holder combination must be replaced.
9.	Remove the adapter (12) and extractor (13) from nozzle holder combination (6)	
10.	Take out the sealing ring (10)	

	<b>To install</b>	
1.	Measure the shank length of screw (8).	<b>i</b> If the maximum shank length is exceeded, replace the screw. MB Standard 10105 screws are generally to be replaced by screws with an MB Part No. on the screw head.
2.	Insert a new O-ring (7) at nozzle holder combination (6)	<b>i</b> Grease the O-ring.
3.1	Place the new O-ring (10.1) at nozzle holder combination (6)	<b>i</b> Up to engine End Number 197928 Note the installation location and thickness of the sealing ring: the smaller ring surface should point towards the nozzle holder combination.  Grease the sealing ring.

3.2	Press new sealing sleeve (10.2) onto nozzle holder combination (6)	<p><b>i</b> From engine End Number 197928 Before pressing on the new sealing sleeve, the contact surface of the sealing sleeve should be cleaned to remove combustion residues (using a wire brush or ultrasonic equipment, for example).</p> <p>↓ Clean the nozzle holder combination.</p> <p><b>i</b> Grease the sealing sleeve.</p> <p></p>
4.	Install nozzle holder combination (6)	<p><b>i</b> Note installation location of nozzle holder combination at the pressure pipe connection hole. Twist the nozzle holder combination with retaining clip (9) into the cylinder head until the retaining clip (9.1 or 9.2) clips onto the locating pin on the cap of constant throttle (11).</p>
5.	Mount the retaining clip (9.1 or 9.2), 50 Nm	
6.	Place the new O-ring (4) at pressure pipe connection (5).	<p><b>i</b> Grease the O-ring.</p>
7.	Fit the pressure pipe connection (5.1 or 5.2) and tighten pressure screw (3), 40 Nm	<p><b>i</b> Pressure pipe connections <b>with</b> anti-twist lock (5.1, press-in ball) should not be fitted to cylinder heads without a groove (arrowed). The ball (arrowed) must be inserted in the groove (arrowed). Damaged pressure pipe connections with an anti-twist lock can be replaced by the modified pressure pipe connection without anti-twist lock (5.2).</p> <p><b>i</b> Moisten the pressure pipe connection around the taper seal with engine oil.</p> <p></p>
8.	Install the injection line (1)	
9.	Fit the leak fuel line (2), 15 Nm	
10.	Fit the cylinder head cover	

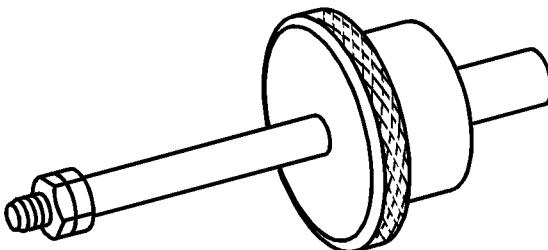


W07.03-1020-01

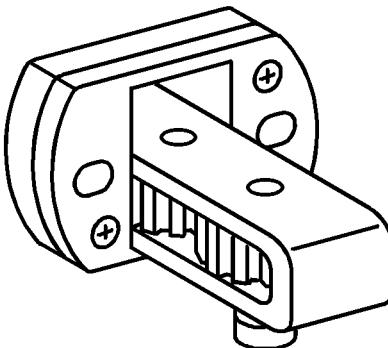


W07.03-1019-06

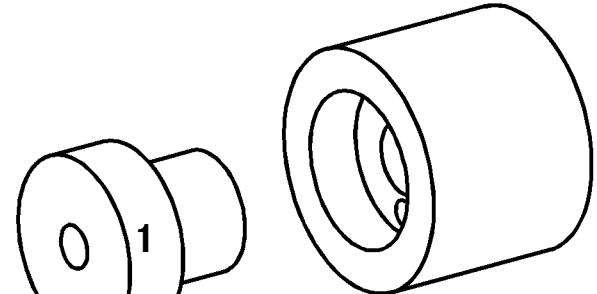
## Special tools



355\_589\_01\_63\_00



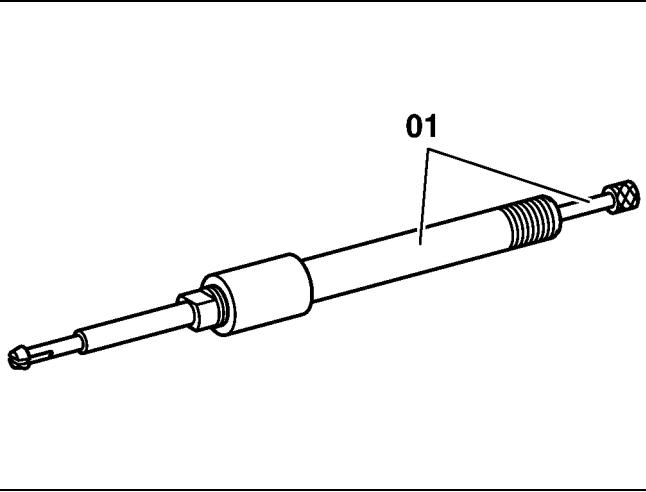
904\_589\_00\_63\_00



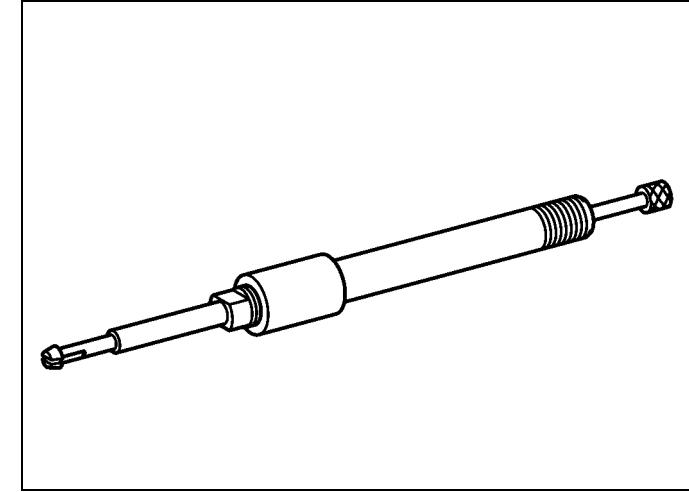
906\_589\_00\_63\_00

### Remarks:

- 3.) Extracting tool 906 589 02 63 00 is now usually supplied together with the extension.
- 4.) From April 2003, for new orders under the existing number, special tool 906 589 00 63 00 is supplied with modification to Part 1. To extend existing tools, the modified Part 1 can also be ordered separately under number 906 589 00 63 01.

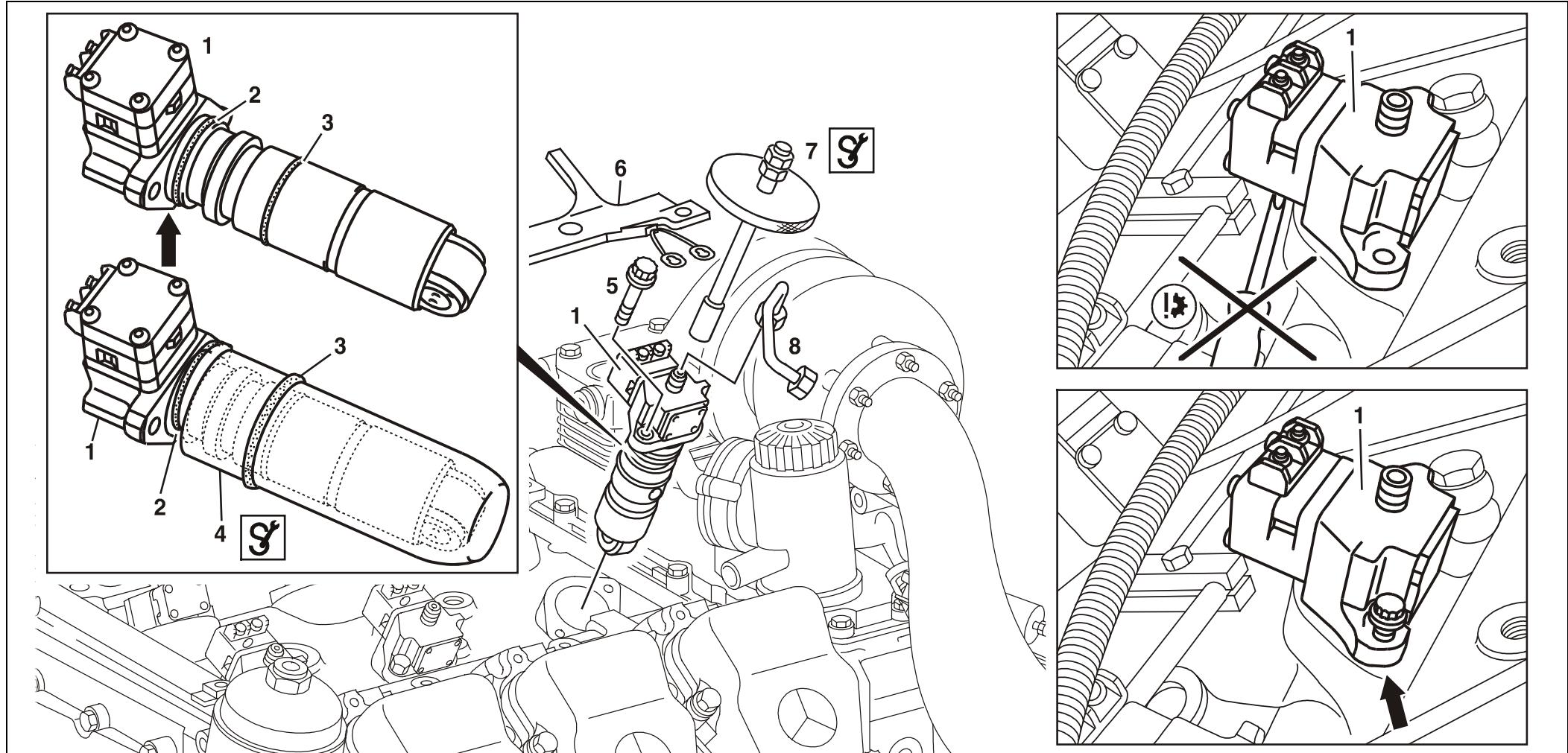


906\_589\_02\_63\_00



Extracting tool extension

906\_589\_02\_63\_01



W07.15-1057-09

1 MR/PLD unit pump  
2 O-ring (black)

3 O-ring (brown)  
4 Protective sleeve 541 589 01 14 00

5 Splined bolt, 65 Nm  
6 Cable duct with engine wiring harness

7 Extractor 355 589 01 63 00  
8 Injection line, M16x1.5, 50Nm

	<b>Removing/installing</b>	
1.	Risk of explosion due to gas ignition, risk of poisoning by inhaling or absorbing fuel, or risk of injury to skin and eyes through contact with fuel.	Fire, sparks, naked flames, smoking are forbidden. Only store fuel in suitable and appropriately marked containers. Wear protective clothing if handling fuel.
2.	Remove the charge air pipe	
3.	Remove injection line (8)	Stop up the orifices in the nozzle holder combination and MR/PLD unit pump (1).
4.	Clean the crankcase around the MR/PLD unit pumps (1).	Cover the intake orifices in the cylinder heads.
5.	Remove engine wiring harness (6) at all MR/PLD unit pumps (1) on left or right.	To do this, loosen the screws on the solenoid valve and detach both clip fasteners.
6.	Identify the MR/PLD unit pump (1) for the cylinder concerned	Only if removing more than one or all MR/PLD unit pumps
7.	Loosen the splined bolts (5)	For reasons of safety, the splined bolts should be unscrewed by only about 4 to 5 mm; the MR/PLD unit pump is under spring load. <b>Installation:</b> Press the MR/PLD unit pump into the crankcase with the splined bolts, tightening slowly and alternating between bolts. Tighten the splined bolts to 65 Nm
8.	Fit the extractor (7) to MR/PLD unit pump (1)	Extractor: 355 589 01 63 00

9.	Pull out the MR/PLD unit pump (1) with the extractor (355 589 01 63 00) up to the bolt heads	<p>Remove the fuel lines or fuel overflow valve on the crankcase if necessary. Banjo bolt of fuel line to port in crankcase, 50Nm. Banjo bolt of fuel line to fuel overflow valve, 50 Nm. If stuck, the MR/PLD unit pump should not be pressed out at the solenoid valve and housing flange. Carefully press out the MR/PLD unit pump at the cutout (arrowed) in the unit pump housing.</p> <p><b>Installation:</b> Lightly oil the unit pump body, O-ring surfaces (2, 3), and hole in the crankcase with engine oil. Do not tilt the MR/PLD unit pump when inserting in the crankcase. Carefully press in the MR/PLD unit pump by hand, to a depth of about 4 mm. If the unit pump cam on the camshaft is at the top, turn the engine by a half-revolution (in direction of rotation).</p>
10.	Unscrew the splined bolts (5) and pull out the MR/PLD unit pump (1)	<b>Installation:</b> Carefully remove dirt and paint residues from the sealing surface (arrowed) of the MR/PLD unit pump and crankcase.
11.	Check the MR/PLD unit pump	Check the roller on roller tappet; if there is only slight scoring or scratching, the MR/PLD unit pump can be used again. If there is deep scoring, scratching, or sanding spots: Install a new MR/PLD unit pump
12.	Remove O-rings (2, 3) from the MR/PLD unit pump (1)	Installation: Clean the radial groove in the unit pump body. Push protective sleeve (541 589 01 14 00) over the unit pump body, coat the new O-rings with engine oil; slip the black O-ring, (2) over the protective sleeve into the top groove, then the brown O-ring (3) into the lower groove. Avoid twisting the O-rings when fitting into the grooves.
13.	Install in the reverse order	

## Unit pump classification

The BR 457, 500 and 900 unit pumps are classified at manufacture.

When each pump is installed in the engine on the assembly line at Mannheim, its classification is registered and stored in the MR electronic system.

To ensure smooth engine running, the classification values are taken into account when distributing the fuel quantity (injection timing).

To ensure that smooth engine running continues after unit pumps are replaced or modified for diagnostic purposes, the unit pump classification must be assigned to the cylinder.

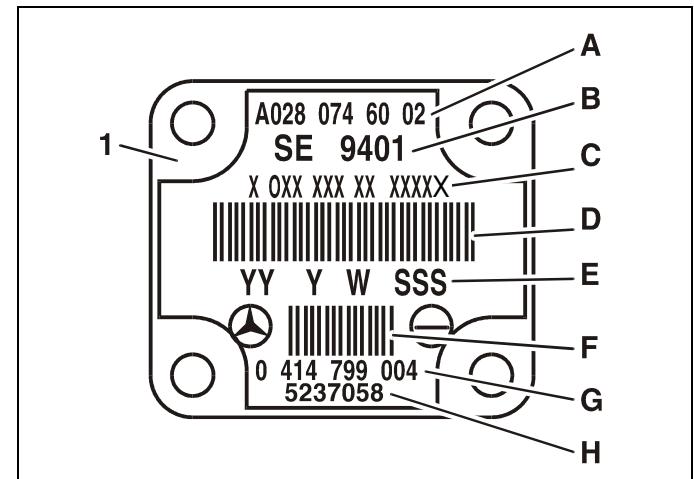
**An input error may lead to rough engine running and overloading of individual cylinders.**

**Then reset the individual cylinder torque control to "0".**

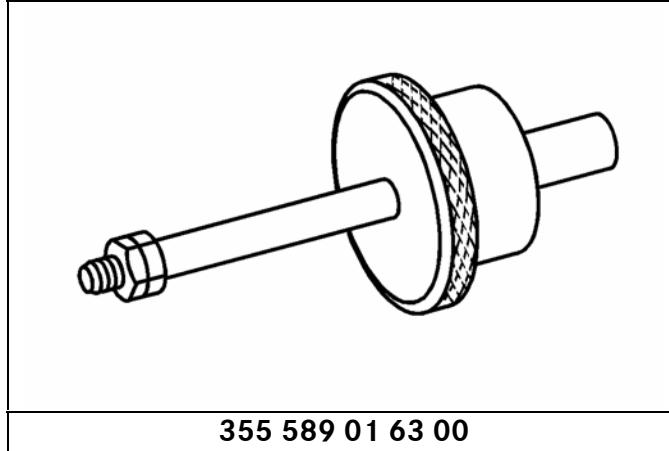
AXOR	MR
Replace unit pump	
Cylinder	Code
1 Cylinder 1	X-XXX-XXX-XX-XXXXXX
2 Cylinder 2	X-XXX-XXX-XX-XXXXXX
3 Cylinder 3	X-XXX-XXX-XX-XXXXXX
4 Cylinder 4	X-XXX-XXX-XX-XXXXXX
5 Cylinder 5	X-XXX-XXX-XX-XXXXXX
6 Cylinder 6	X-XXX-XXX-XX-XXXXXX
Note:	
The user must read off the unit pump number on the unit pump, and enter it for the corresponding cylinder. Only enter the unit pump number for pumps being replaced.	
To confirm, press F3.	

The classification is coded as a 14-digit number (**C**) on the unit pump model plate. The code is entered through the "Replace Unit Pump" menu in DAS.

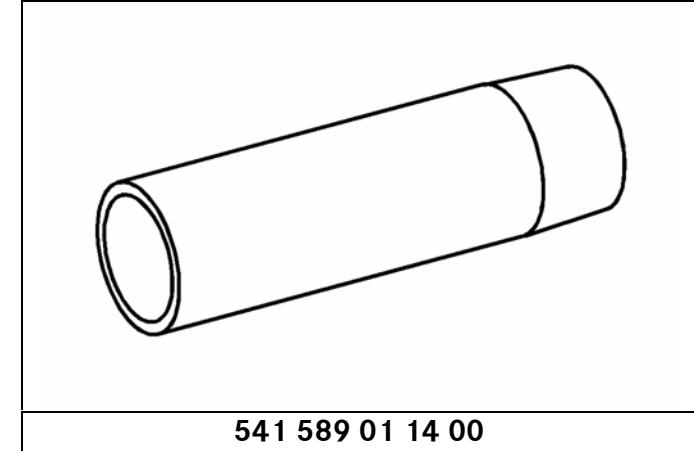
- A = MB number
- B = Certification number
- C = Unit pump number (classification)
- D = Bar code
- E, G, H = Manufacturer information
- F = Manufacturer bar code



N07.02-2028-01

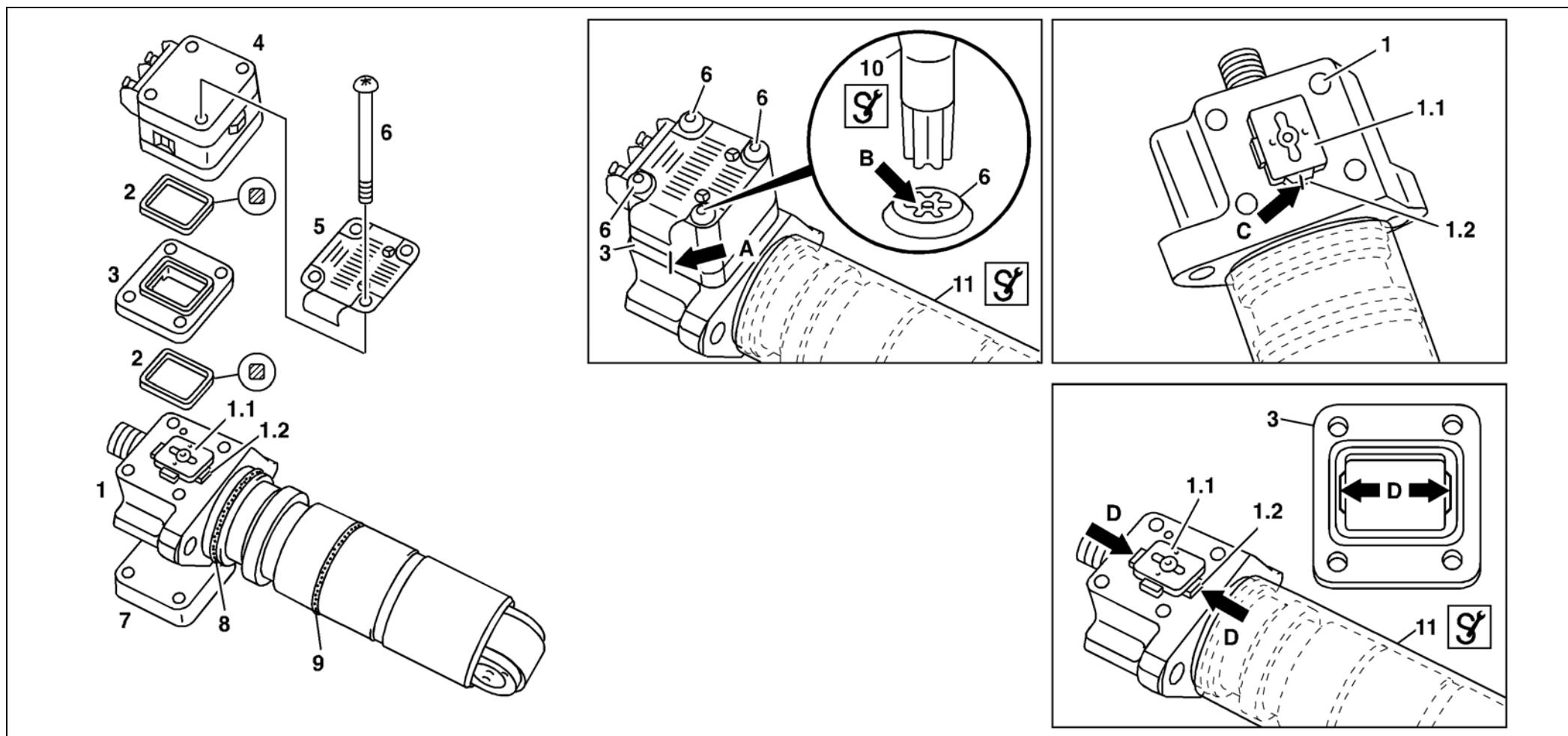


355 589 01 63 00



541 589 01 14 00

## Sealing the intermediate plate of the unit pump



W07.15-1058-09

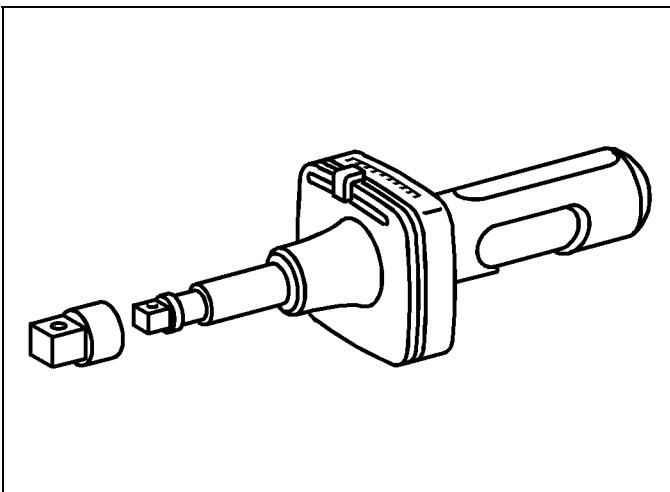
1	Pump body	2	Seal	5	Model plate	8	O-ring	10	Screwdriver bit
1.1	Anchor plate	3	Intermediate plate	6	Screw	9	O-ring	11	Sleeve
1.2	Crosspiece	4	Solenoid	7	Stop plate				

	<b>To remove</b>	
	Utmost cleanliness should be ensured whenever working on the unit pumps.	
1	Remove the MR/PLD unit pump	
2	Remove O-rings (8,9,) from the unit pump (1)	First clean the bottom part of the pump body (1).
3	Push the sleeve (11) onto unit pump (1)	So that dirt will not get into the orifices. 
4	Clean the upper part of the MR/PLD unit pump.	Carefully remove paint residues on the sealing surfaces of the MR/PLD unit pump. The high pressure orifice must be closed off. No dirt or cleaning agent should be allowed to penetrate into the pump body (1).
5	Identify the intermediate plate (3) (arrow A) for the pump body (1) and place the MR/PLD unit pump at the stop plate.	Use a scribe or touch-up pencil, never a stamping tool.
6	Loosen the screws (6), and remove solenoid (4) together with intermediate plate (3) and model plate.	First remove paint residues from the screw heads with a scribe (arrow B). 
7	Remove intermediate plate (3) and model plate (5) from solenoid (4).	Clean the sealing surface of the solenoid.
8	Take out sealing rings (2) and clean intermediate plate (3)	Do not damage the sealing surfaces.
9	Identify the crosspiece (1.2) and anchor plate (1.1) for pump body (1) (arrow C).	Use a touch-up pencil, never a scribe or stamping tool. The crosspiece should not be moved or turned.
10	Apply cleaning spray to the sealing surfaces of pump body (1), crosspiece (1.2) and anchor plate (1.1).	Clean the parts carefully. Do not remove paint residues from the pump body (1), these will be needed for locating the intermediate plate (3).

11	Take off stop plate (7)	 Remove paint residues around the contact surface of the screw heads. Do not remove the protective foil on the model plate.
12	Clean the model plate (5)	
	To install	
13	Place new stop plate (7) under the pump body (1).	
14	Insert new seals (2) in the intermediate plate (3).	 Protect the seals with grease
15	Place intermediate plate (3) on pump body (1).	 Pay attention to the identification marks on the crosspiece (1.2) and anchor plate (1.1) for pump body (1). The cutouts (arrows D) at the opening in the intermediate plate must point towards the crosspiece (1,2).  The paint residues are used to locate intermediate plate (3) on pump body (1).
16	Insert the solenoid (4) on intermediate plate (3).	
17	Assemble the model plate (5), solenoid(4), intermediate plate (3), pump body (1) and stop plate (7) and fasten with new screws (6).	  Tighten the screws crosswise.  904 589 02 10 00  001 589 80 21 00
18	Take off sleeve (11)	 541 589 01 14 00
19	Install MR/PLD unit pumps	 Fit new O-rings (8,9), following the installation specification.

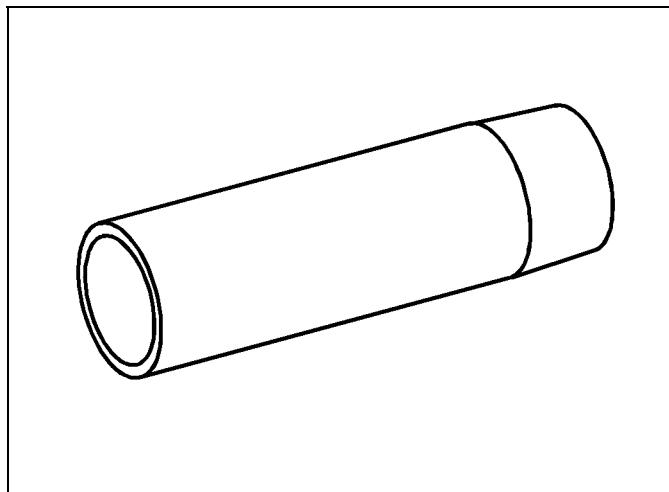
<b>Nm</b> MR/PLD unit pump		<b>Engine 541.9, 542.9</b>
Screw, solenoid valve to MR/PLD unit pump	Step 1 [Nm]	2
	Step 2 [Nm]	4

### Special tools



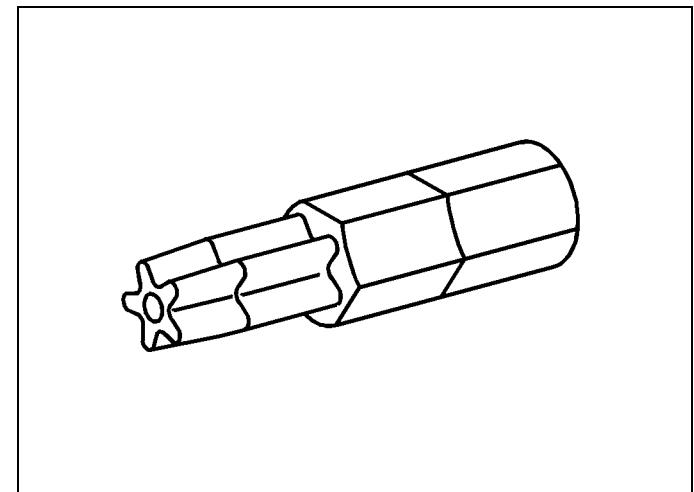
Torque screwdriver

001\_589\_80\_21\_00



Sleeve

541\_589\_01\_14\_00



Screwdriver bit

904\_589\_02\_10\_00



Euro 2 piston

N03.10-2051-11

From 02/00, quality improved by reduced ring wear and oil consumption and optimized bore profile for longer service life.



Euro 3 piston

N03.10-2052-11

From 03/00 for Euro 3 engines: Modified combustion chamber, use of hub liner to prevent strain cracks and improve cylinder properties. The radial grooves and piston rings have also been modified to further reduce oil consumption.

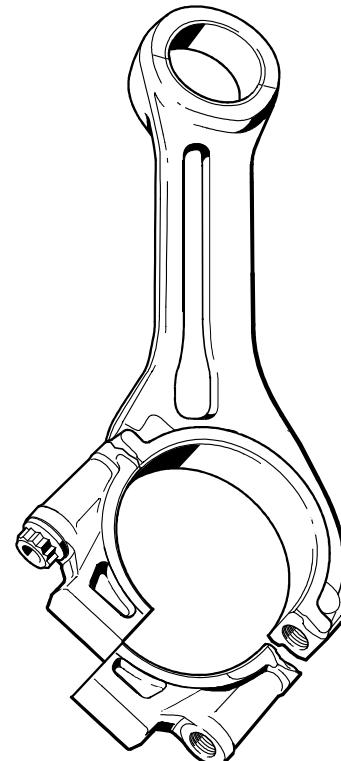
The steel connecting rod is partially forged. The separation of connecting rod from bearing cap is made by 'cracking'.

Compared with the conventional, costly separating process, 'cracking' brings high dimensional stability to the large connecting rod eye.

The separation point at the large connecting rod eye is set obliquely.

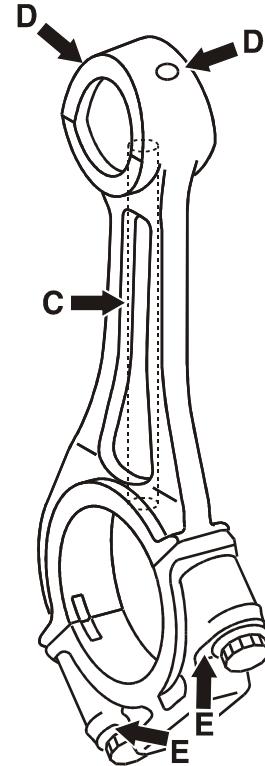
Connecting rod and bearing cap are linked positively and frictionally with each other by two stretch-thread bolts.

The ignition power is absorbed evenly at the small, trapezoidal connecting rod eye by a solid bronze bushing, which is supplied with sufficient lube oil from the large connecting rod eye through a pressure oil hole.



N03.10-2002-03

Due to the intermediate flange needed on the crankshaft in the V6 engines, the width of the connecting rod at the connecting rod eye is fixed at 34 mm. In the V8 engines, the width is 37 mm.

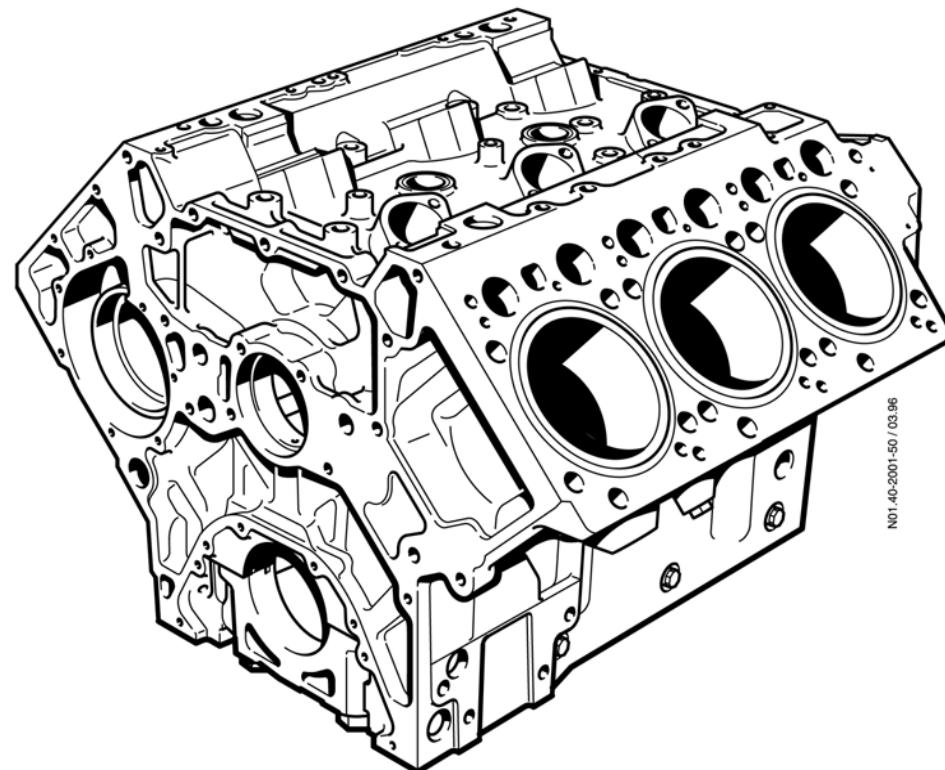


N03.10-2021-02

From about 06/98, there has been a modification to the oil feed at the small end bearing. Two oil holes (D) have been made in the connecting rod eye for the oil supply to the small end bearing. The long oil hole (C) for the pressure oil supply to the small end bearing has been removed.

**Design features:**

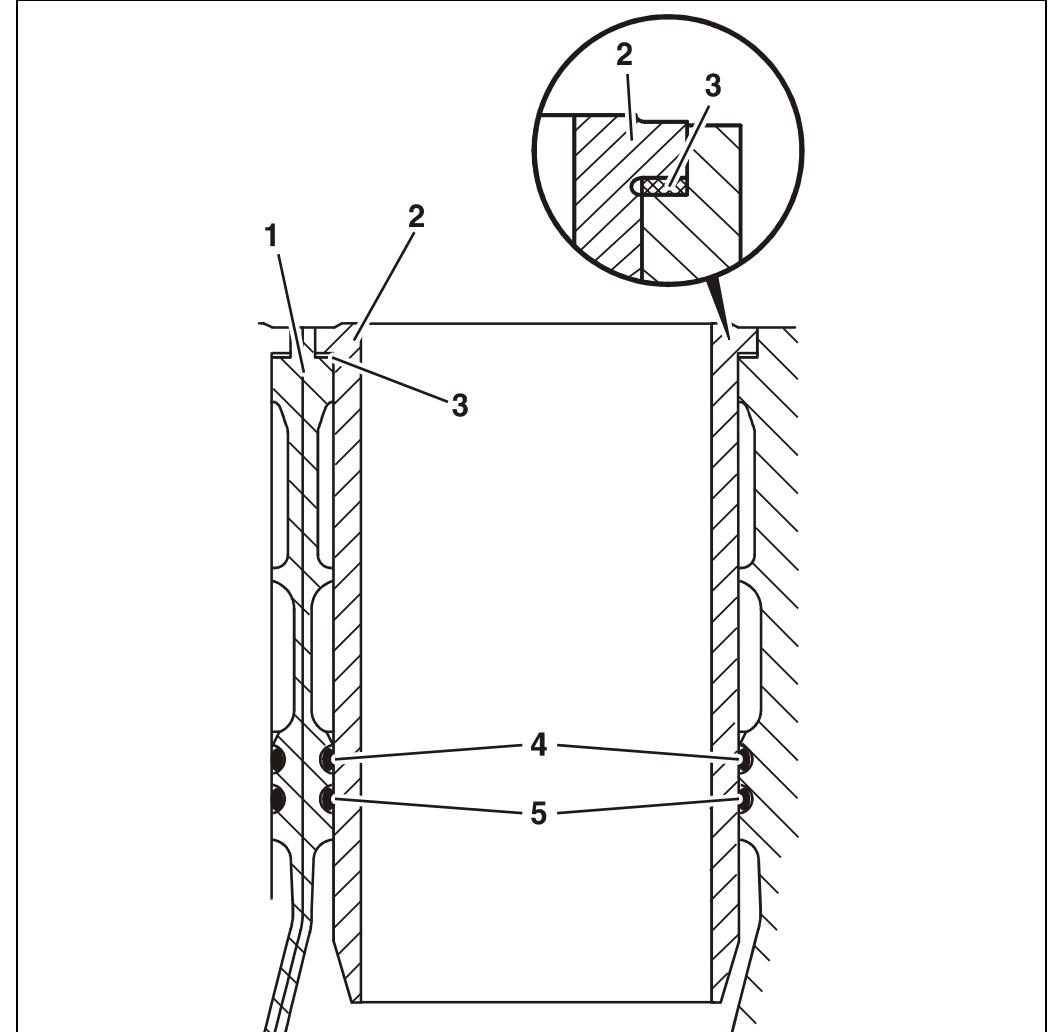
- \* Compact design, by integrating the oil cooler, coolant pump coil, unit pumps, and the coolant, fuel and oil ducts.
- \* Highly rigid alloy cast iron.
- \* Rigid crankcase deck and stable liner bottom collar support, with low-set threads on the cylinder head bolts. This results in low-warp absorption of the thread connection and ignition forces by the rigid collar of the wet cylinder liner.
- \* Rigid side walls extending well below the center of the crankshaft, and bolted together with the crankshaft bearing caps.

**Kurbelgehäuse Motor OM 501 LA**

N01.40-2001-50

A tombac ring (0.15 mm) is placed under the upper cylinder liner collar support where the thermal load is high, and forms the seal on the water side. The lower end is sealed by two high-temperature, oval Viton rings, on both the water and oil side.

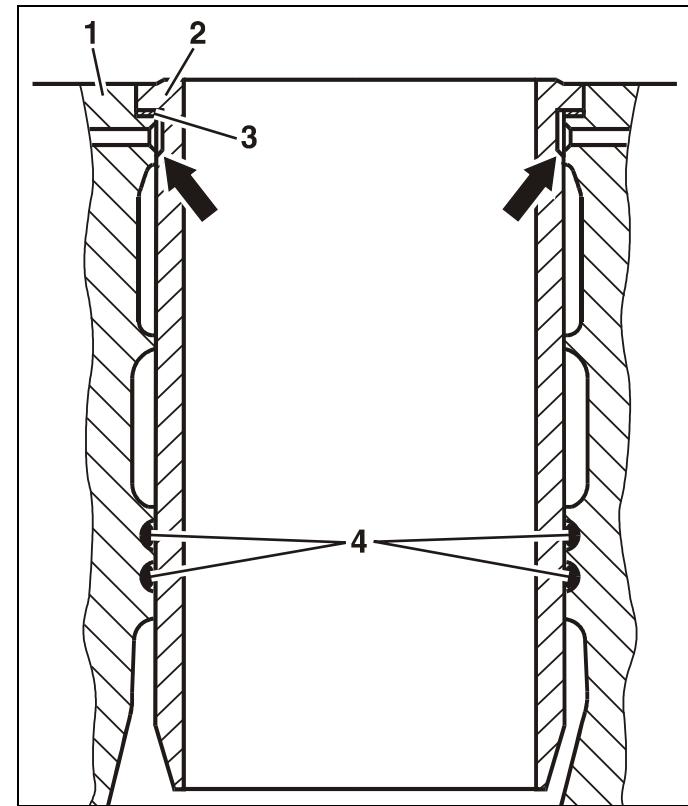
- 1 Crankcase
- 2 Cylinder liner
- 3 Tombac ring
- 4,5 Oval Viton ring



N01.40-2019-03

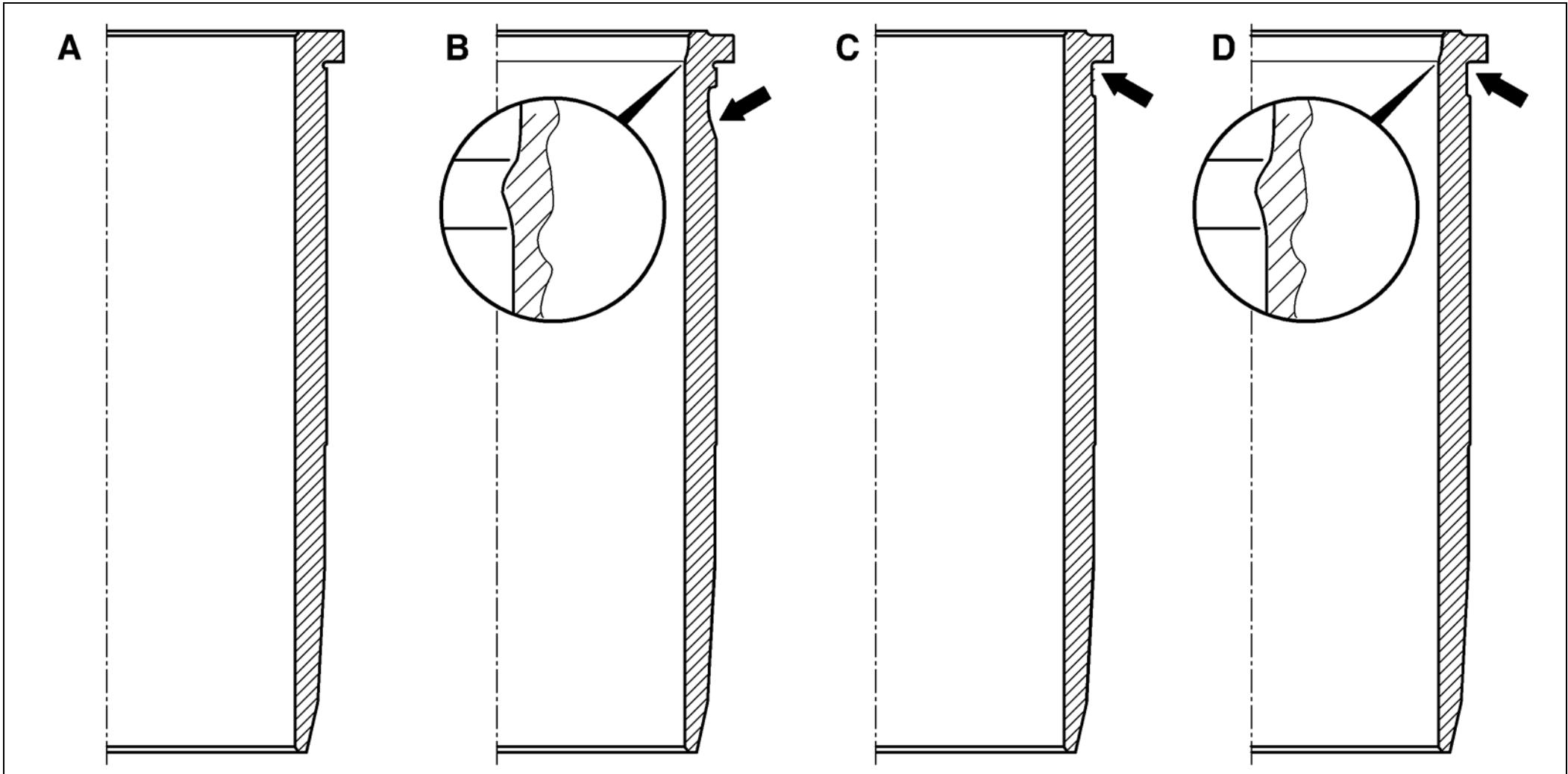
## Modifications

From about 04/99, a new cylinder liner has been installed, in conjunction with a modified crankcase. The new cylinder liners have a groove (arrowed) under the collar. Two holes have also been made in the crankcase (arrowed) under the cylinder liner seat. This improves the cooling around the piston top land and the first piston ring



N01.40-2020-02

## Comparison of cylinder liners



N01.40-2061-09

A Standard production up to around 04/99 in conjunction with crankcase without cooling holes

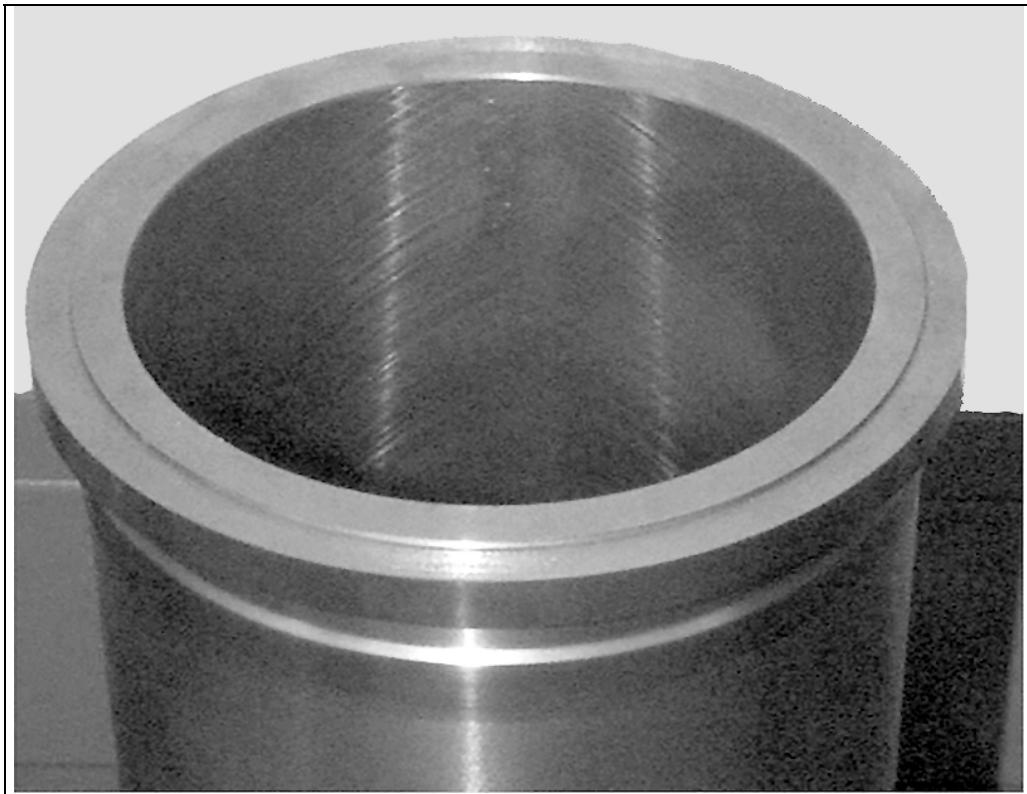
B Repair in conjunction with crankcase without cooling holes

C Standard production up to around 04/99 in conjunction with crankcase with cooling holes

D EURO 3 standard

## Series 500<>EURO 2 and EURO 3 cylinder liners compared

07.05.2003



Euro 2 cylinder liner

N01.10-2070-11



Euro 3 cylinder liner

N01.30-2071-11

### Modification to Euro 3 standard

As part of "Quality offensive 2000", the crankcase in engine model series BR 500 has been modified starting from 07/00. Partially hardened raised bead liners are now used, as in Euro 3.

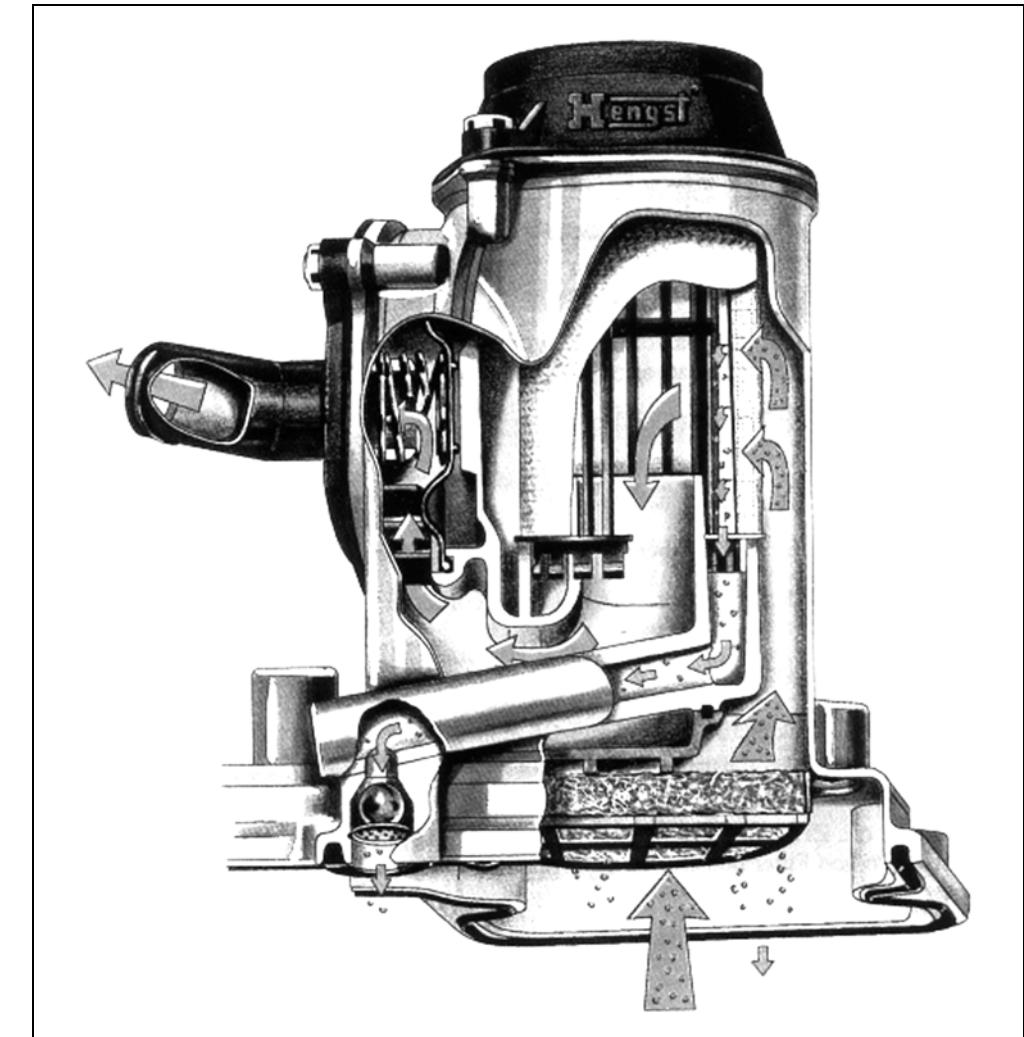
The overall length of the cylinder liner was also shortened in order to adapt the pre-worked dimensions to the finished part.

An oil breather is fitted to the timing case cover, as part of the general plan to cut exhaust gas emissions and help reduce engine oil consumption.

Blow-by gases pass from the combustion chamber over the piston rings into the crankcase, where they are mixed with tiny oil droplets in the oil vapor. To stop oil vapor escaping into the atmosphere, the vapor is drawn off, cleaned and recycled back to the engine intake side.

A vacuum diaphragm controls the pressure in the engine oil gallery.

A filter element keeps the proportion of oil vapor to a reduced level. The oil filtered out is passed back into the oil gallery through a return element integrated with the ventilation system.



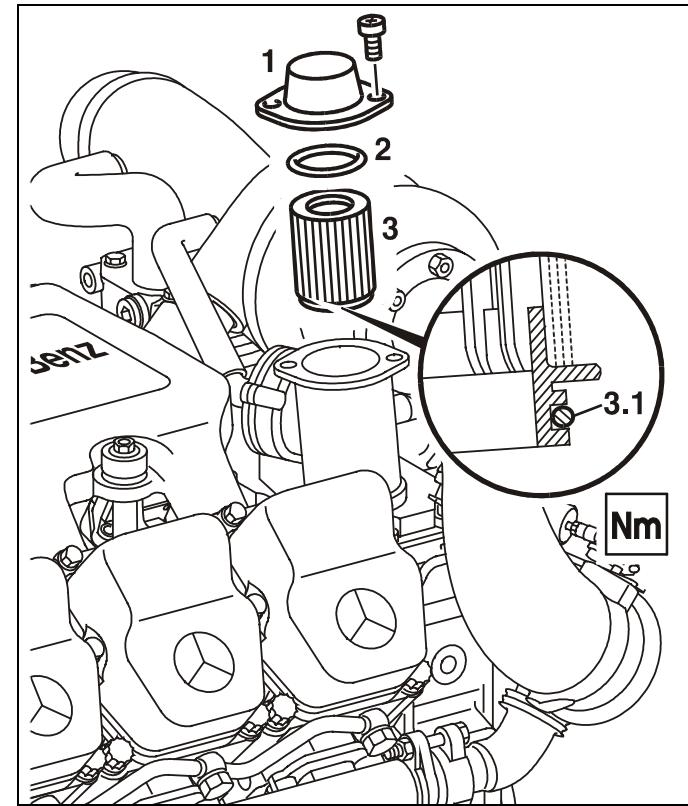
N01.20-2009-12

The oil separator insert is exchangeable.

*Note on repairs:*

If an oil separator insert (3) without sealing ring is removed, the modified insert with sealing ring (3.1) must be installed.

- |     |                      |
|-----|----------------------|
| 1   | Cap                  |
| 2   | Seal                 |
| 3   | Oil separator insert |
| 3.1 | Seal                 |



W01.20-1004-02

*Note on diagnosis:*

If there is repeated oil leakage from the engine, the de-oiling element must be checked to ensure that it is functioning properly, i.e. the filter insert must be examined for contamination or damage.

**Important!**

**Whenever the oil filter is changed, the oil separator insert of the engine ventilation system must be replaced as well!**

## Defective vacuum diaphragm



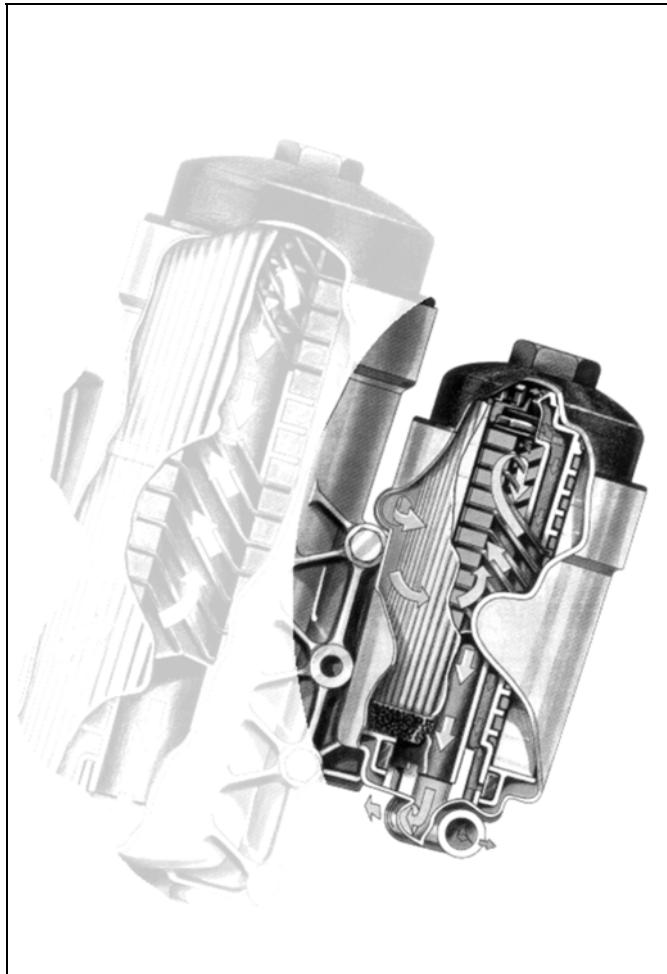
GT\_01\_40\_00\_0003



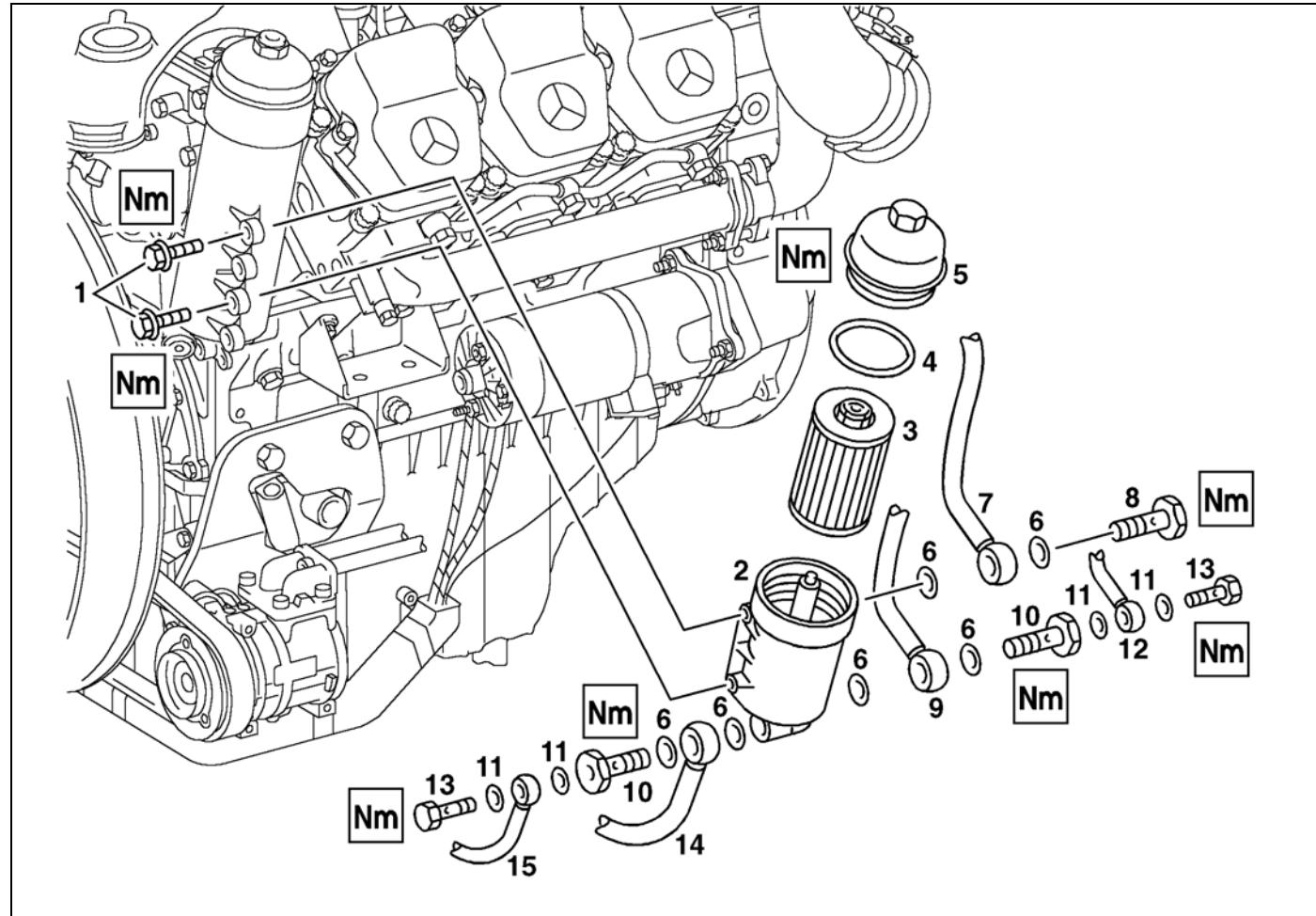
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## Location of the fuel filter bowl



N47.20-2033-02



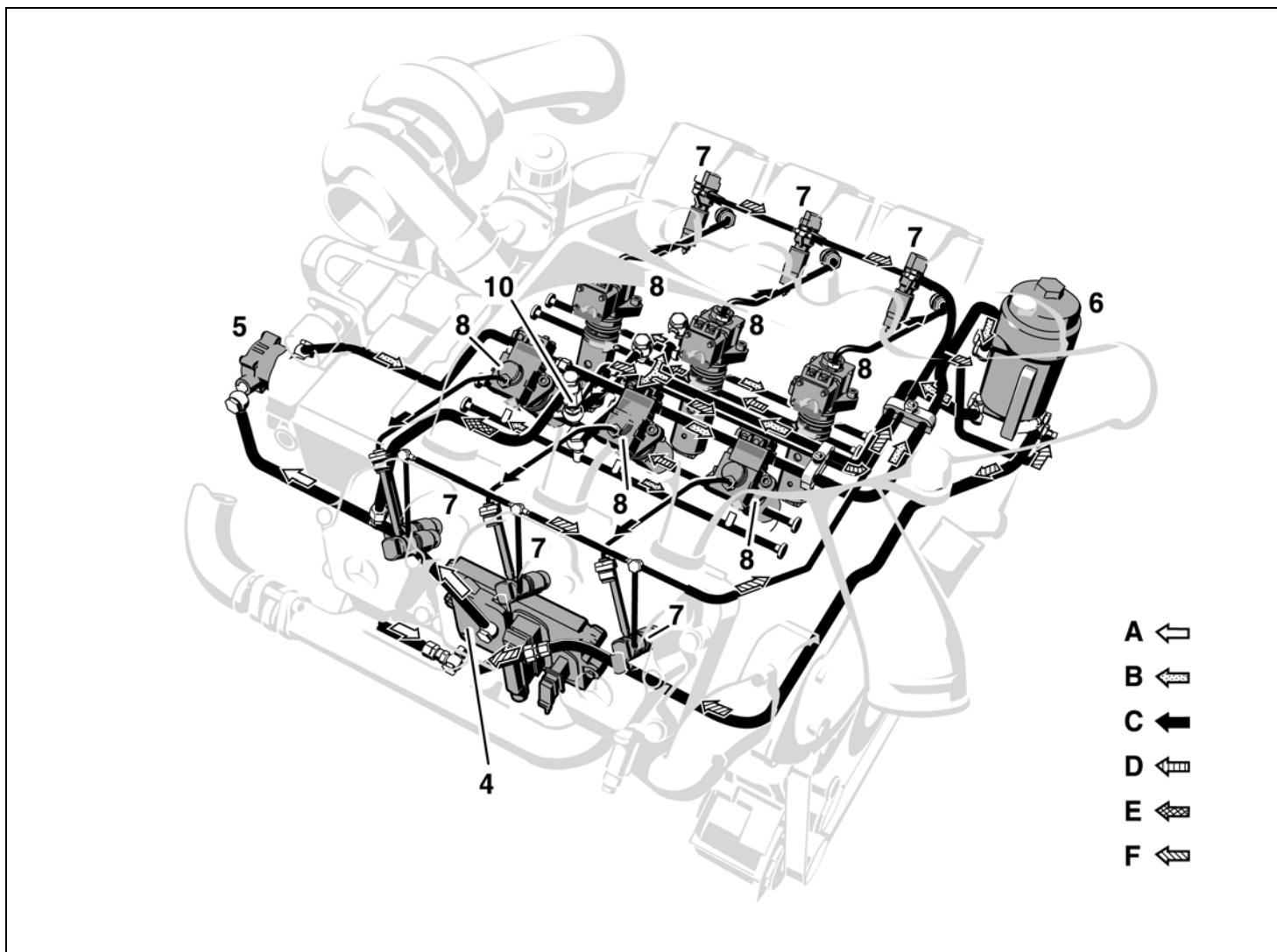
W07.57-0002-06

The fuel filter bowl is fixed to the oil filter oil filter housing, but has its own feed lines that can be removed separately.

## Fuel system - real

- 4 Fuel heat exchanger
- 5 Fuel pump (KFP)
- 6 Fuel filter
- 7 Nozzle holder combination
- 8 PLD unit pumps (Y6 to Y13)
- 10 Overflow valve

- A Fuel feed/suction side
- B Fuel feed/pressure side
- C Fuel high pressure side  
(injection line) after PLD unit pumps
- D Fuel return after unit pump
- E Fuel flush quantity  
(fuel short circuit)
- F Fuel return/ leak fuel



W07.00-1001-06

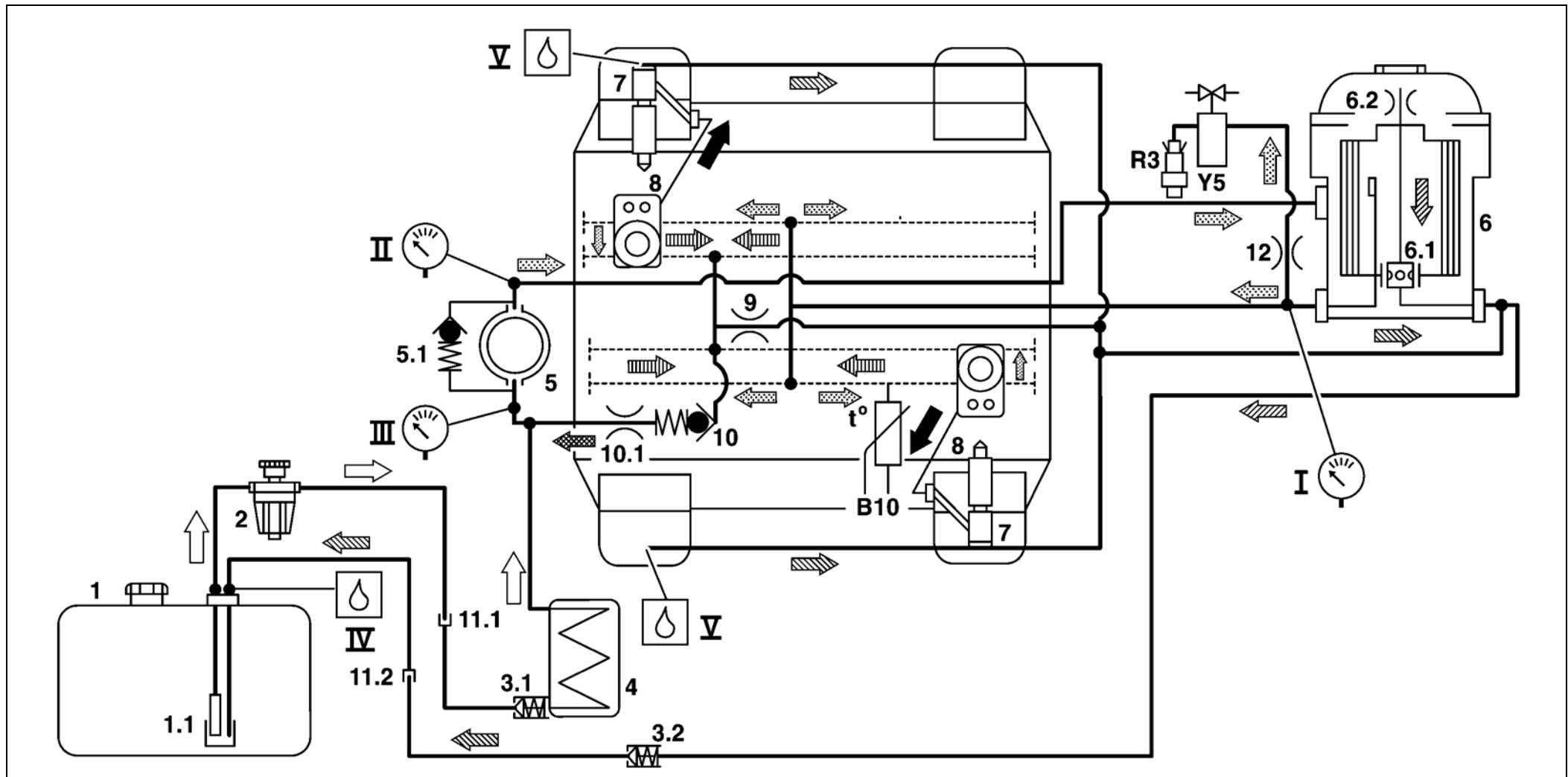
## Fuel system - symbolic

The low-pressure fuel system has been specially designed to meet the requirements of the high-pressure injection system with individual unit pumps on V-engines. Unlike on conventional injection systems, to ensure stable injection, a high pre-pressure is necessary in the low-pressure system and a large flush volume for cooling the control valve solenoids in the unit pumps.

- 1 Fuel tank
- 1.1 Fuel strainer (800 µm)
- 2 Fuel prefilter (KVF 300 µm) with manual fuel feed pump
- 3.1 Plug-on valve in fuel feed (locked open)
- 3.2 Plug-on valve in fuel return (locked open)
- 4. Fuel heat exchanger
- 5. Fuel pump (KFP)
- 5.1 Pressure relief valve (9.0 – 12.0 bar)
- 6. Fuel filter (5 µm)
- 6.1 Fuel filter drain valve
- 6.2 Constant vent in fuel filter (0.7 mm)
- 7. Nozzle holder combination
- 8. PLD unit pumps (Y6 to Y13)
- 9. Banjo union with constant vent (0.7 mm)
- 10. Overflow valve (2.0 bar up to engine No. 092 407, 2.65 bar from engine No. 092 408)
- 10.1 Throttle (3.1 mm) in overflow valve
- 11.1 Fuel feed connector (in frame)
- 11.2 Fuel return connector (in frame)
- 12 Throttle (0.5 mm) in flame starting system fuel line
  
- B10 Fuel temperature sensor (**no longer installed**).
- R3 Flame glow plug
- Y5 Flame starting system solenoid valve

### Test points

- I Fuel pressure after fuel filter  
Idle speed: 1.8 - 2.8 bar up to engine No. 092407, 2.2 – 3.2 bar from engine No. 092 408  
Cutoff speed: 4.5 – 5.5 bar
- II Fuel pressure after fuel pump  
Idle speed: 2.1 – 3.0 bar  
Cutoff speed: 5.0 – 6.0 bar (limit value ≈ 6,5 bar)
- III Fuel intake pressure before fuel pump  
Cutoff speed: 0.35 to 0.25 bar
- IV Fuel return quantity at fuel tank  
Idle speed: 0.6 – 1.0 l/min  
Cutoff speed: 1.0 -1.6 l/min  
Low pressure-fuel system leaktightness  
Test pressure 5.5 bar/test period 5 minutes: no pressure drop
- V Fuel return quantity at nozzle holder combination  
Idle speed: oil-damp  
Cutoff speed: drops only at most.



W07.15-1077-09

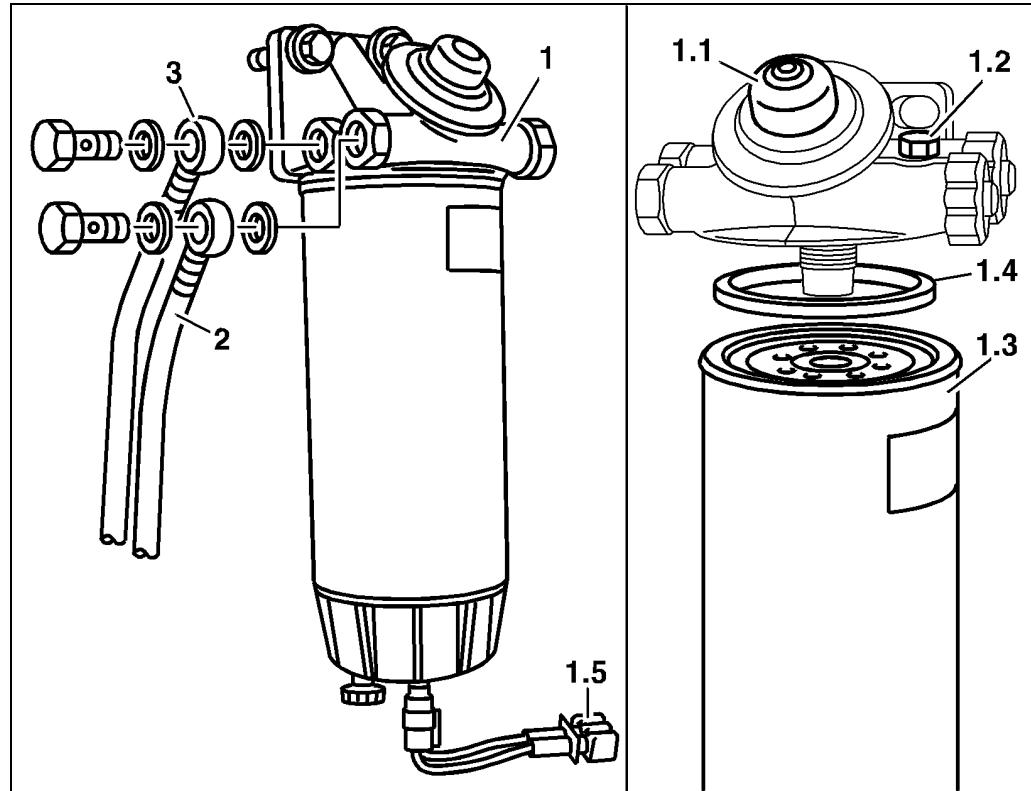
## Fuel prefilter with heated water separator

In countries where the fuel is considered heavily contaminated and with high water content, an additional fuel filter with integrated water separator (including manual feed pump) is highly recommended.

**Vehicles that are operated in countries of Eastern Europe, or filled with fuel from those countries, must be fitted with a prefilter.**

### Advantages to the customer:

- Increased durability of the injection system
- Long maintenance intervals despite difficult operating conditions
- Greater economy through shorter vehicle downtimes.



W47.20-1006-11

## Checking the low pressure fuel system

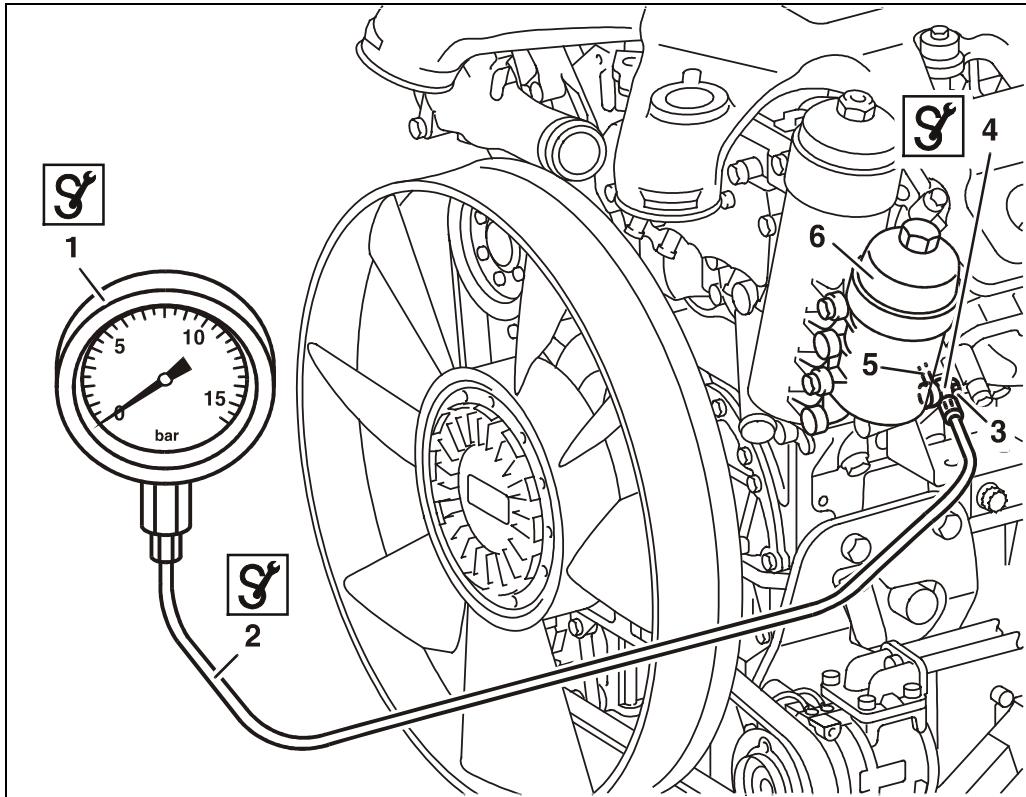
	<b>Removing/installing</b>	
1.	Risk of explosion due to gas ignition, risk of poisoning by inhaling or absorbing fuel, or risk of injury to skin and eyes through contact with fuel.	Fire, sparks, naked flames, smoking are forbidden. Only store fuel in suitable and appropriately marked containers. Wear protective clothing if handling fuel.
2.	Carry out a visual inspection of all fuel lines, threaded connections and components	If components are soiled, clean them and dry off. Let the engine run for about 2-3 minutes at cutoff speed. If damaged or leaky, install new components, or retighten to the tightening torque.
3.	Check the fuel prefilter insert	Clean the fuel prefilter if necessary.
4.	Check the fuel filter insert	Replace fuel filter insert if necessary.
5.	Open the cap on the fuel tank	
6.	If stationary rpm limitation is parameterized, set a high value	Connect diagnostic test equipment. Only on engines with stationary rpm limitation, set this up to 4000 rpm. Note down the rpm limitation value entered. <b>Installation:</b> Set the rpm limitation parameter back to the original value with the test equipment.

	<b>Testing</b>	
1.	Test conditions	If a Racor fuel prefilter is installed, detach the fuel lines to the prefilter and put the fuel system in the standard production configuration. The engine must be at operating temperature. Fuel temperature in the fuel tank $\leq 40^{\circ}\text{C}$ . Collect any escaping fuel. When testing, the flowing fuel must be free of bubbles.

## Testing fuel pressure

Attach pressure gauge (1) with high pressure hose (2) and fuel line (5) to the fuel filter housing bowl (6). When testing, do not connect the fuel line to the flame starting system.

1. Tester 541 589 02 21 00
2. High pressure hose 123 589 04 21 18
3. Double banjo bolt M16 x 1.5, 50 Nm
4. Banjo union with external thread
5. Fuel line
6. Fuel filter bowl



W07.15-0127-11

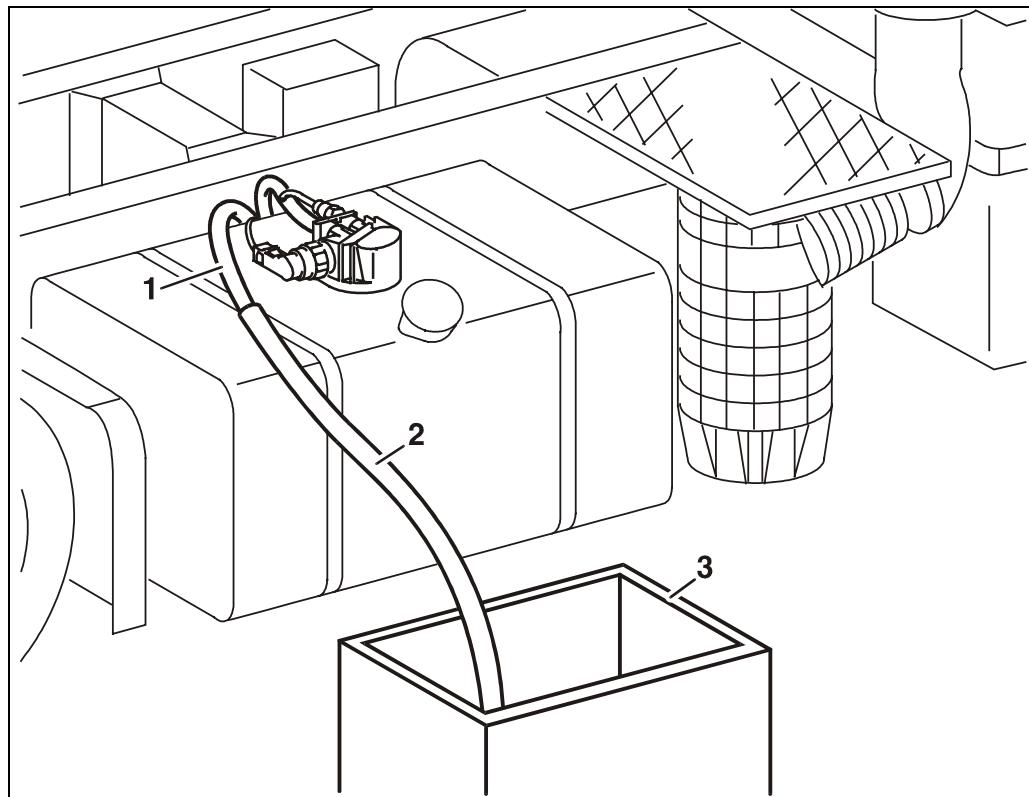
	Testing	
2.	Connect the tester/gauge to the low pressure fuel system	Fuel pressure test at the outlet of the fuel filter bowl (clean fuel side)

## Testing the fuel return quantity

- Detach the fuel return line (1) at the sensor of the fuel level gauge and remove the O-ring from the plug socket.
- Do not damage the O-ring.
- Connect the fuel return line (1) with the see-thru fuel line (2).
- With the engine running, check the see-thru fuel line (2) for air bubbles.
- If there are air bubbles, check the fuel system for leaks.
- Check the fuel return quantity

## Testing the fuel system for leak points:

- Detach both lines from the tank.
- Stop up the return line
- Fit a shutoff cock to the intake line
- Connect an external air supply.
- Set a test pressure of 5.5 bar (read off the pressure on fuel pressure gauge)
- No pressure loss over the test period (5 min).



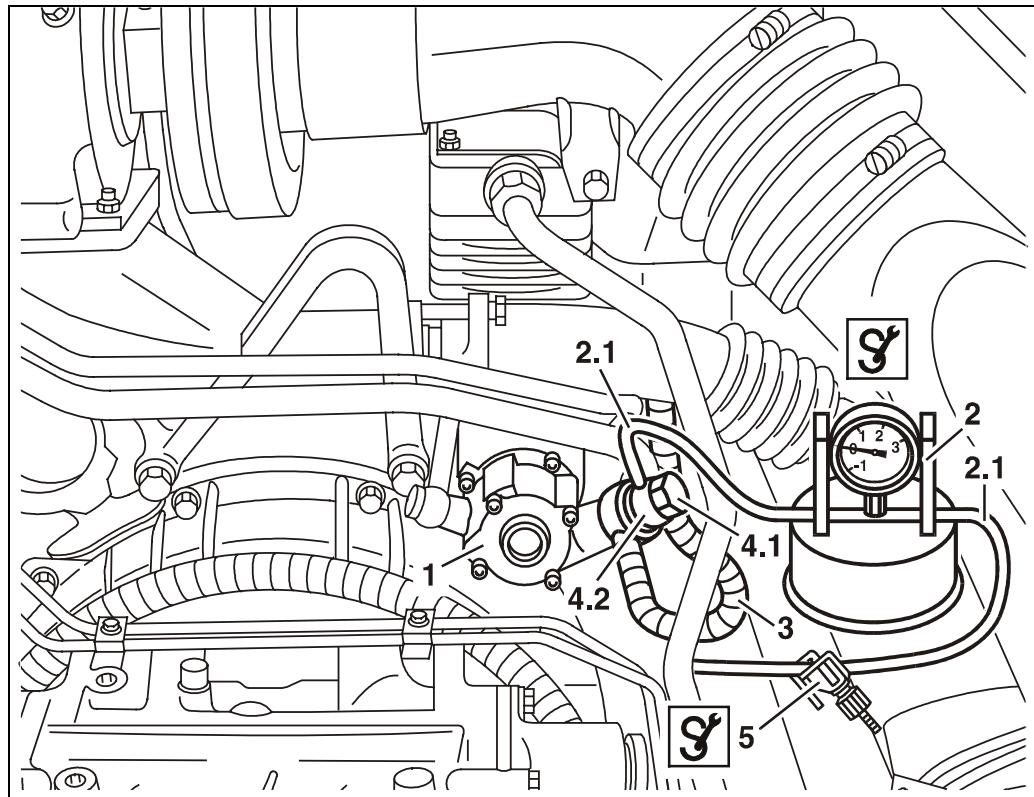
W07.15-0126-11

	<b>Testing</b>	
3.	Connect the tester/gauge to the low pressure fuel system	Measurement of fuel return quantity at the fuel tank

## Testing the fuel intake pressure at the fuel feed pump

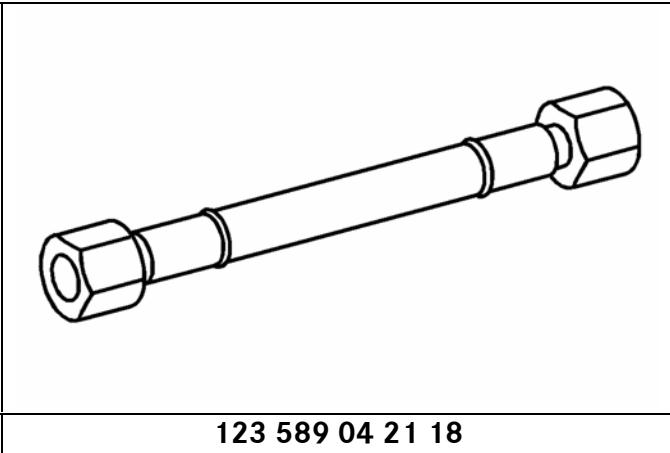
- Attach the tester (2) with test line (2.1) and fuel feed line (3) to fuel feed pump (1).
- Unclip the free test line (2.1) with clamp (5). Put the tester (2) at the frame and fasten.

- |     |                                    |
|-----|------------------------------------|
| 1   | Fuel feed pump                     |
| 2   | Tester 617 589 04 21 00            |
| 2.1 | Test lines                         |
| 3   | Fuel feed line                     |
| 4.1 | Double banjo bolt M16 x 1.5, 50 Nm |
| 4.2 | Banjo union                        |
| 5   | Clamp 000 589 40 37 00             |

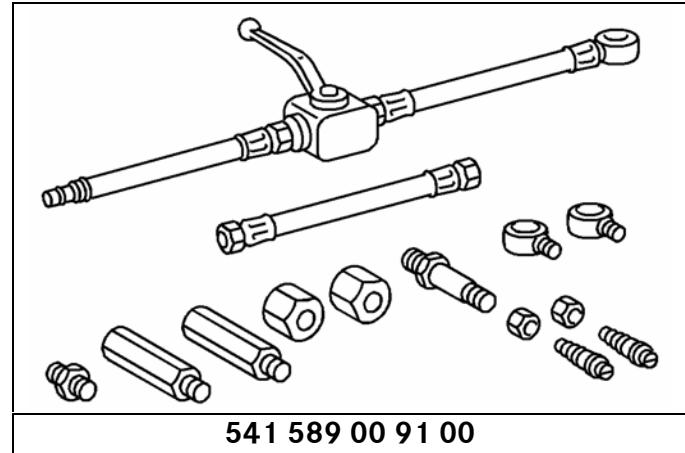


W07.15-0123-11

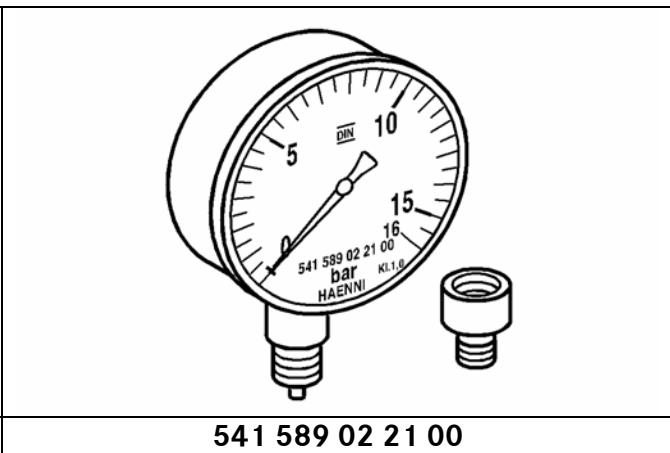
	Testing	
4.	Connect the tester/gauge to the low pressure fuel system	Fuel intake pressure before the fuel feed pump



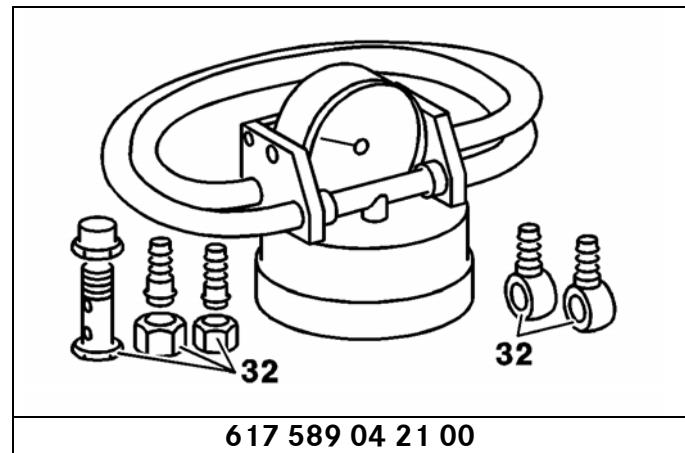
123 589 04 21 18



541 589 00 91 00



541 589 02 21 00



617 589 04 21 00

## **Checking the fuel system**

### **In what circumstances must the fuel pressure be checked?**

Poor startup, poor performance

### **What can cause the fuel pressure to be too low?**

Dirty prefilter, dirty fuel filter, faulty overflow valve, fuel system is drawing in air,  
kink in feed line from tank, intake line at fuel tank sensor, check valve in fuel feed,  
leak in filter bowl at the return flow, faulty feed pump

### **What can cause the fuel pressure to be too high?**

Faulty overflow valve, kink in return flow line, check valve in the fuel return line,  
fuel tank sensor clogged

### **What other operations should be carried out?**

Check the fuel system at and in the engine for leaktightness, check the fuel intake pressure, measure the fuel return quantity  
and check for air bubbles.

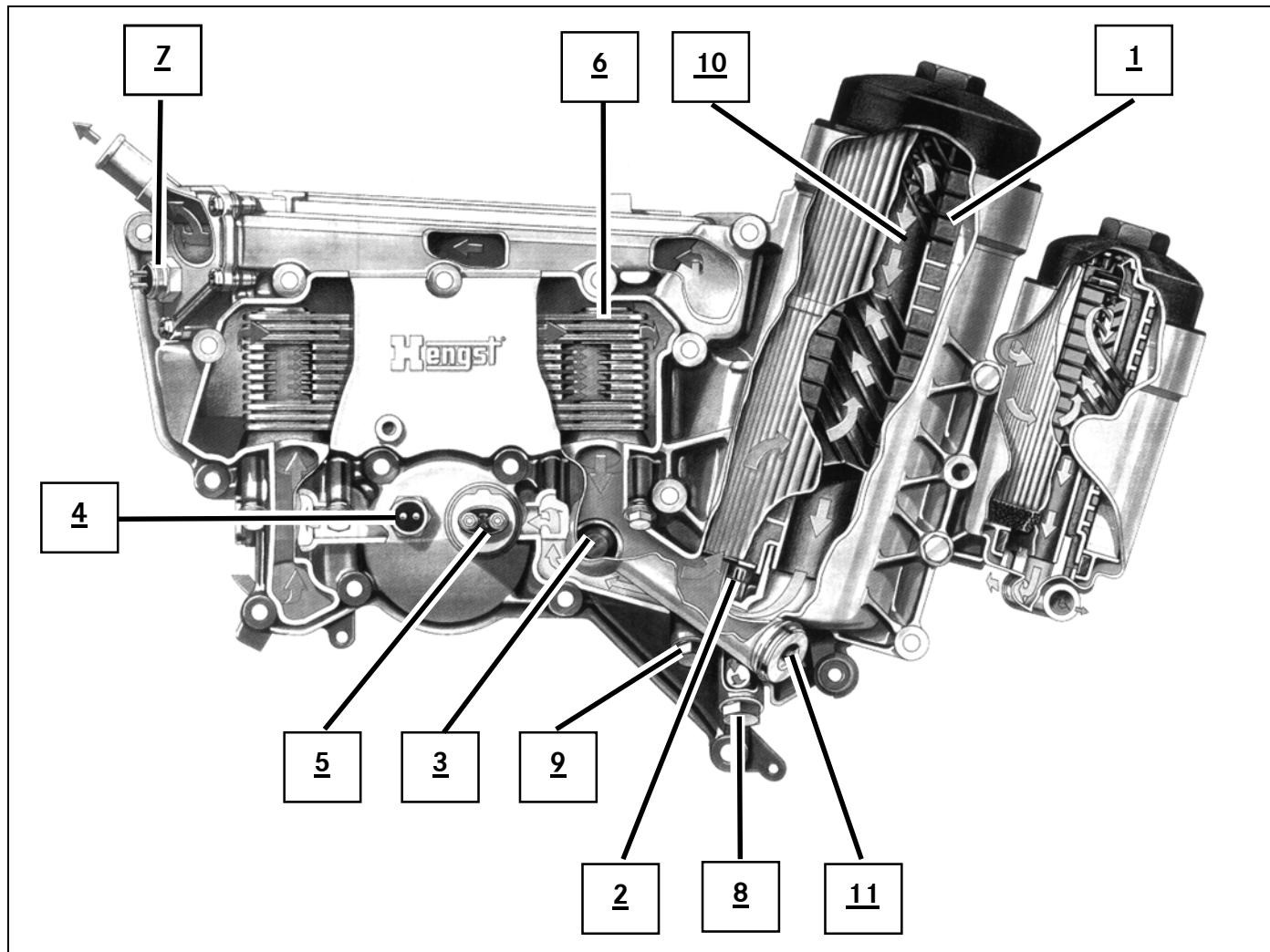


**Task 1**

Assign the correct numbers to the components in the diagram.  
Refer to the existing workshop documentation.

The following components are integrated in the aluminum die-cast housing of this assembly:

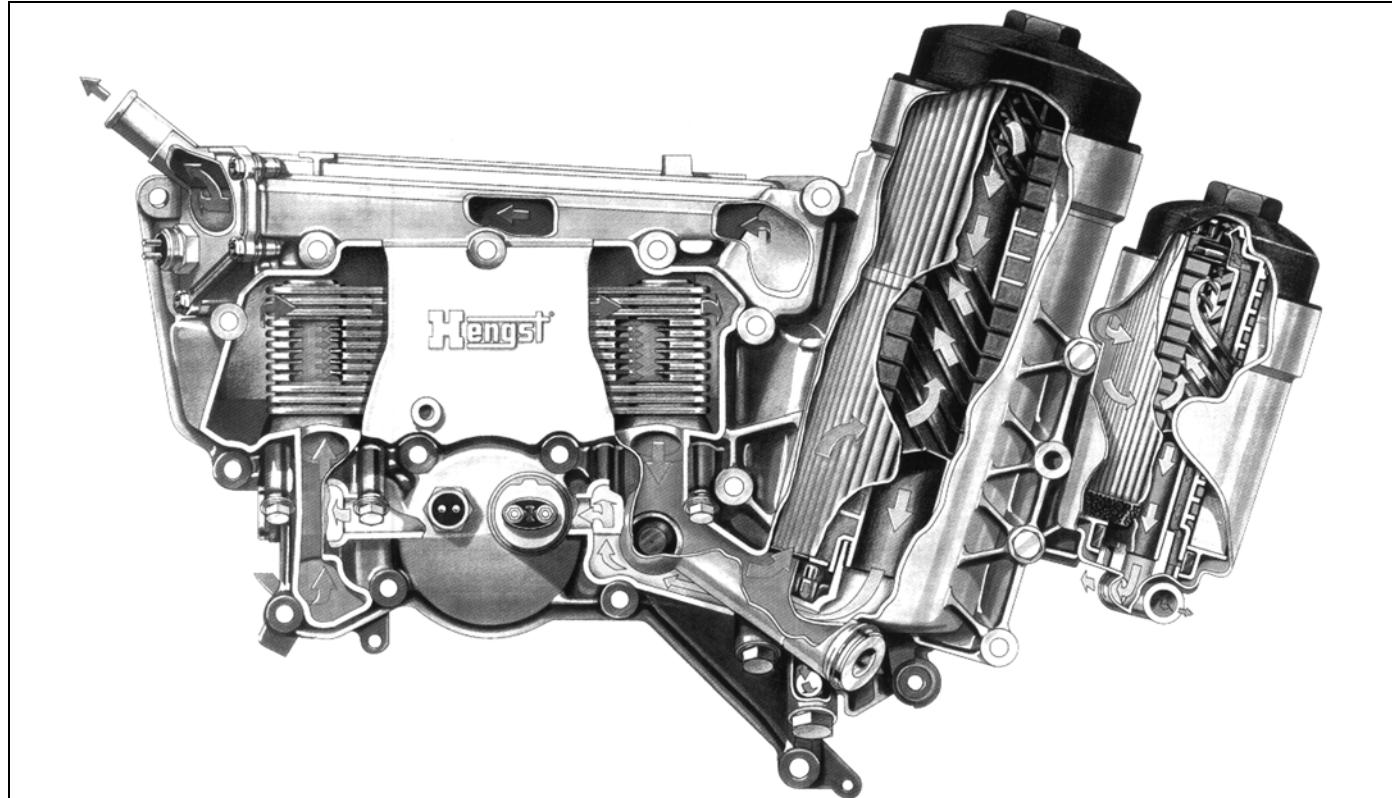
- 1 Full-flow oil filter
- 2 Filter drain valve
- 3 Filter bypass valve
- 4 Oil temperature sensor
- 5 Oil pressure sensor
- 6 Oil/water heat exchanger (flat pipe)
- 7 Coolant temperature sensor
- 8 Connection for bypass filter (outlet)
- 9 Connection for bypass filter (inlet)
- 10 Riser
- 11 Connection for oil filling



Oil filter housing with oil filter, drain valve, filter bypass valve, oil/water heat exchanger with fuel filter installed.

**The most important components of the engine lubrication / cooling system are:**

- Oil pan
- Oil pump with pressure relief valve
- Oil retention valve (return flow check valve)
- Oil/water heat exchanger
- Oil filter with drain valve and filling valve
- Filter bypass valve
- Main oil duct, oil ducts and oil lines
- Oil spray nozzles
- Oil temperature sensor and oil pressure sensor
- Oil level sensor
- Rocker arm spindle, rocker arm with oil hole



N18.20-2020-05

Engine lubrication reduces the mechanical wear on moving parts and makes their work easier. At the same time, the parts are cooled and impacts absorbed.

**Oil pump**

The oil pump is in the form of a gear type oil pump, with a gear width of 43 mm on the 541.9 engine and 49 mm on the 542.9 engine.

The gear type oil pump is located at the rear of the crankcase. The oil pump is driven by the crankshaft. It delivers the engine oil from the oil pan through an oil duct to the oil retention valve, then to the lateral main oil duct and the oil/water heat exchanger.

### **Pressure relief valve**

The pressure relief valve is located under the oil pump and maintains constant oil pressure.

If too much oil is delivered at high engine speeds, the pressure relief valve opens and allows the engine oil to flow directly from the oil pump back to the oil pan.

### **Oil retention valve (return flow check valve)**

The return flow check valve is placed at the right rear in the crankcase and is intended to prevent engine oil flowing back into the oil pan when the engine is stopped. The oil ducts are therefore always filled with oil. When the engine is restarted, this ensures that components always receive optimal lubrication from the beginning.

### **Oil/water heat exchanger**

The oil/water heat exchanger is located in a housing assembly on the front of the crankcase, with integral oil/water heat exchanger and oil filter.

The engine oil flows through the plates (12 elements) in the oil/water heat exchanger, and these are washed around by the engine coolant. Since the engine coolant is at a considerably lower temperature than the engine oil, the coolant absorbs the heat from the engine oil and cools it down to engine operating temperature. During cold starts, the engine oil is warmed up by the surrounding coolant through of the oil/water heat exchanger.

### **Oil ducts and oil lines**

Oil ducts are integrated into the crankcase and cylinder heads. The oil pressure and oil return lines to the turbocharger (or both turbochargers) and long-life oil filter housing (special equipment) are located externally.

The oil retention valve is located at the start of the lateral main oil duct, which is placed on the right of the crankcase.

From two further oil ducts located centrally at camshaft level in the crankcase, other oil ducts (Y and cross-drillings) go to the individual oil spray nozzles, camshaft bearing, crankshaft main bearing, MR/PLD unit pumps and the individual cylinder heads.

Engine oil is fed from the main oil duct, through an oil duct system in the rear wall of the crankcase, to the turbocharger oil pressure line and both compressor bearings. This oil duct system also supplies engine oil to the oil spray nozzle for the power take-off (special equipment). On engines without power take-off, a screw plug is fitted in place of the oil spray nozzle. The oil ducts in the crankcase are partly closed with screw plugs or balls.

The connecting rod bearing is supplied with engine oil through oil ducts integrated into the crankshaft. Engine oil is delivered to the bearing brackets of the individual rocker arm spindles through holes in the cylinder head gasket and the oil duct in the cylinder head.

From the rocker arm spindle bearing bracket, oil is supplied to the rocker arm spindle and all the rocker arms. It then passes through the oil holes in the rocker arms and also supplies the valve assembly.

The oil then flows back to the oil pan through oil return holes in the cylinder head and crankcase.

## **Oil filter**

The oil filter housing is fitted to the left front of the crankcase. It contains an oil filter insert, made of paper.

The oil filter insert is clipped into the oil filter cover and is replaced from the top. When the filter cover is unscrewed, engine oil in the filter housing flows through the drain valve back into the oil pan.

## **Drain valve**

The drain valve is located in the oil filter housing under the filter insert, and opens when the filter cover is unscrewed. This ensures a cleaner filter change and less environmental pollution by reducing the amount of residual oil in the old filter.

## **Filter bypass valve**

The filter bypass valve (release pressure 2.3 - 3.0 bar) is located in the housing assembly under the oil/water heat exchanger and connected with the oil filter through an oil duct. The normal position of the filter bypass valve is closed.

If the oil filter insert is clogged, the pressure increase in the filter housing opens the filter bypass valve. This ensures that the engine is lubricated, although the engine oil passing through the bypass valve is unfiltered.

## **Filling valve**

The filling valve is placed at the bottom of oil filter housing and is closed with a screw plug (M33x2). Through this valve, engine oil can be poured into the engine assembly, and after repairs to the engine oil system before starting the engine.

## **Oil spray nozzles**

The oil spray nozzles are located in the crankcase, one per cylinder. Oil is supplied to the oil spray nozzles through both oil ducts. The nozzles spray engine oil continuously under the piston crowns, thus cooling them, while at the same time the piston crowns are lubricated by engine oil dripping through an opening in the top of the connecting rod. The oil spray nozzles also spray engine oil through another hole onto the valve and unit pump cams on the camshaft.

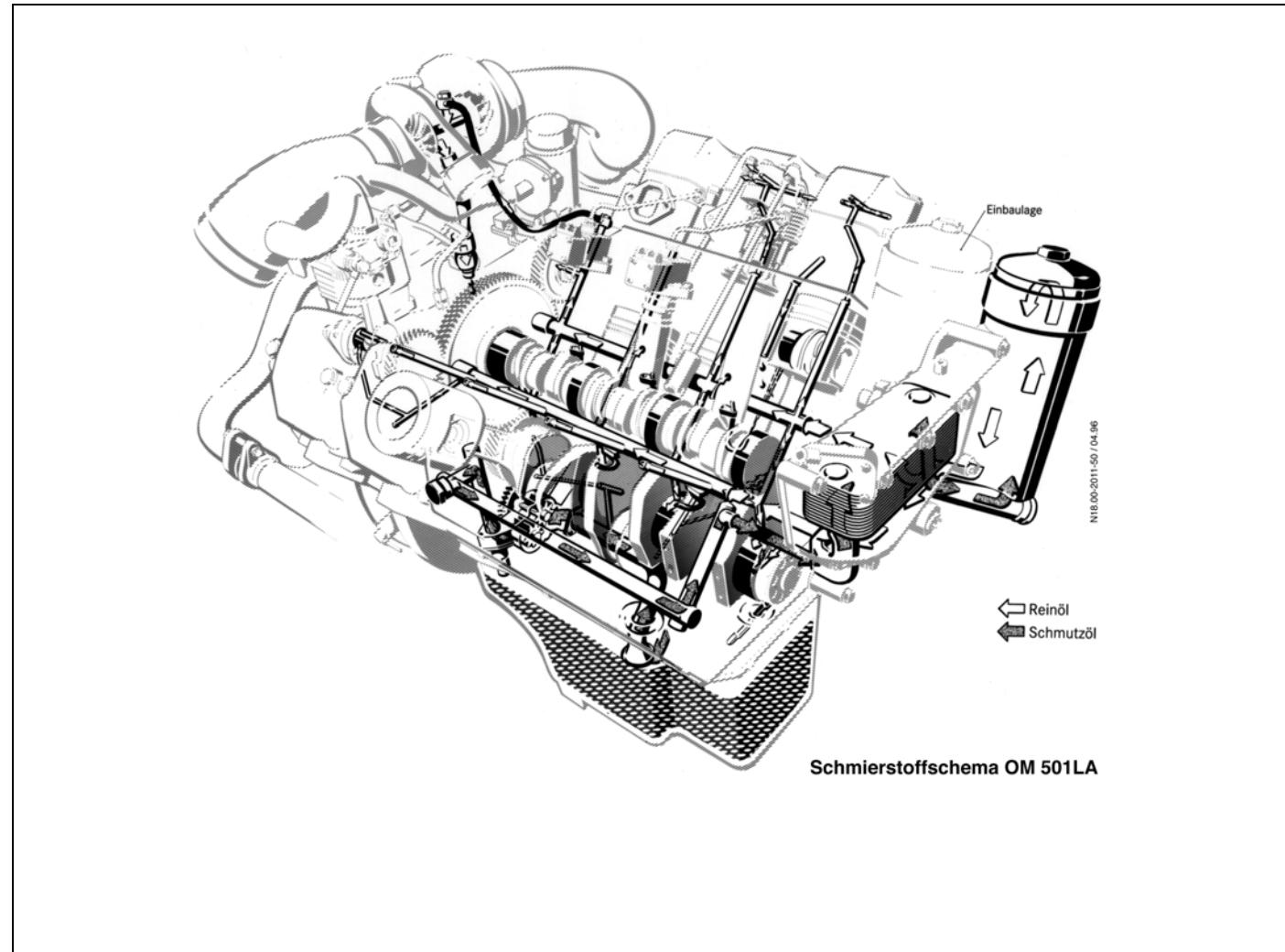
## **Oil temperature sensor and oil pressure sensor**

The oil temperature and oil pressure sensor is screwed from the front into the housing assembly under the oil/water heat exchanger, and connected with the oil filter through an oil return duct.

Engine lubrication reduces the mechanical wear on moving parts and makes their work easier. At the same time, the parts are cooled and impacts absorbed.

The most important components of the engine lubrication / cooling system are:

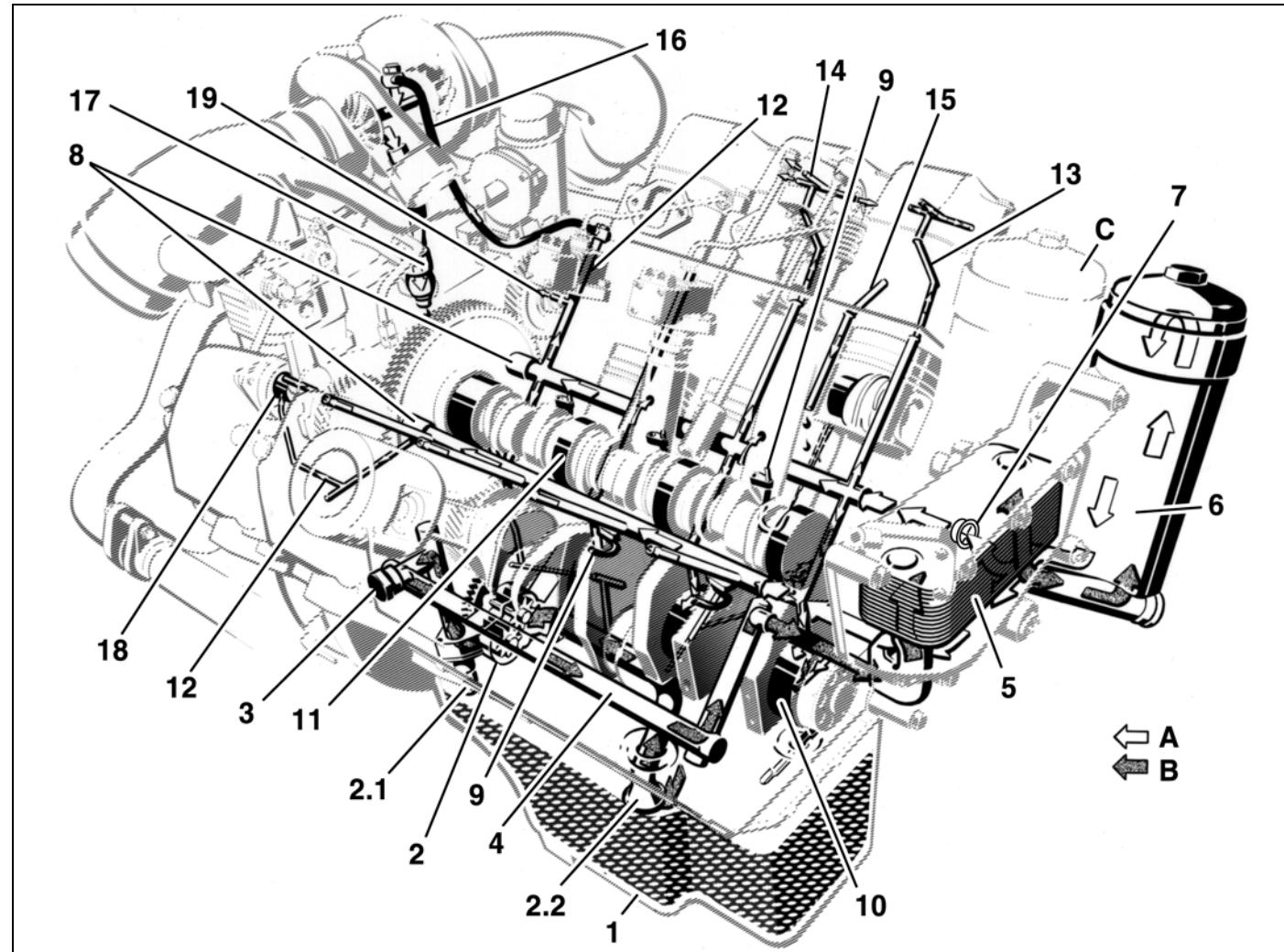
- Oil pan
- Oil pump with pressure relief valve
- Oil retention valve (return flow check valve)
- Oil/water heat exchanger
- Oil filter with drain valve and filling valve
- Filter bypass valve
- Main oil duct, oil ducts and oil lines
- Oil spray nozzles
- Oil temperature sensor and oil pressure sensor
- Oil level sensor
- Rocker arm spindle, rocker arm with oil hole



N18.00-2011-50

Shown on 541.9 engine

- A Engine oil cleaned
- B Engine oil dirty
- C Oil filter bowl installation location
- 1 Oil pan
- 2 Oil pump
- 2.1 Pressure limiting valve
- 2.2 Oil pump strainer with oil intake tube
- 3 Oil retention valve
- 4 Main oil duct
- 5 Oil/water heat exchanger
- 6 Oil filter housing
- 7 Oil filter bypass valve
- 8 Oil duct
- 9 Oil spray nozzle
- 10 Main con-rod bearing on crankshaft
- 11 Camshaft bearing
- 12 Rear oil duct
- 13 Oil duct in cylinder head
- 14 Rocker arm spindle, rocker arm with oil hole
- 15 Oil return flow duct from cylinder head
- 16 Oil pressure line to turbocharger
- 17 Oil return line from turbocharger
- 18 Crankshaft in compressor
- 19 Oil spray nozzle for power take-off special equipment



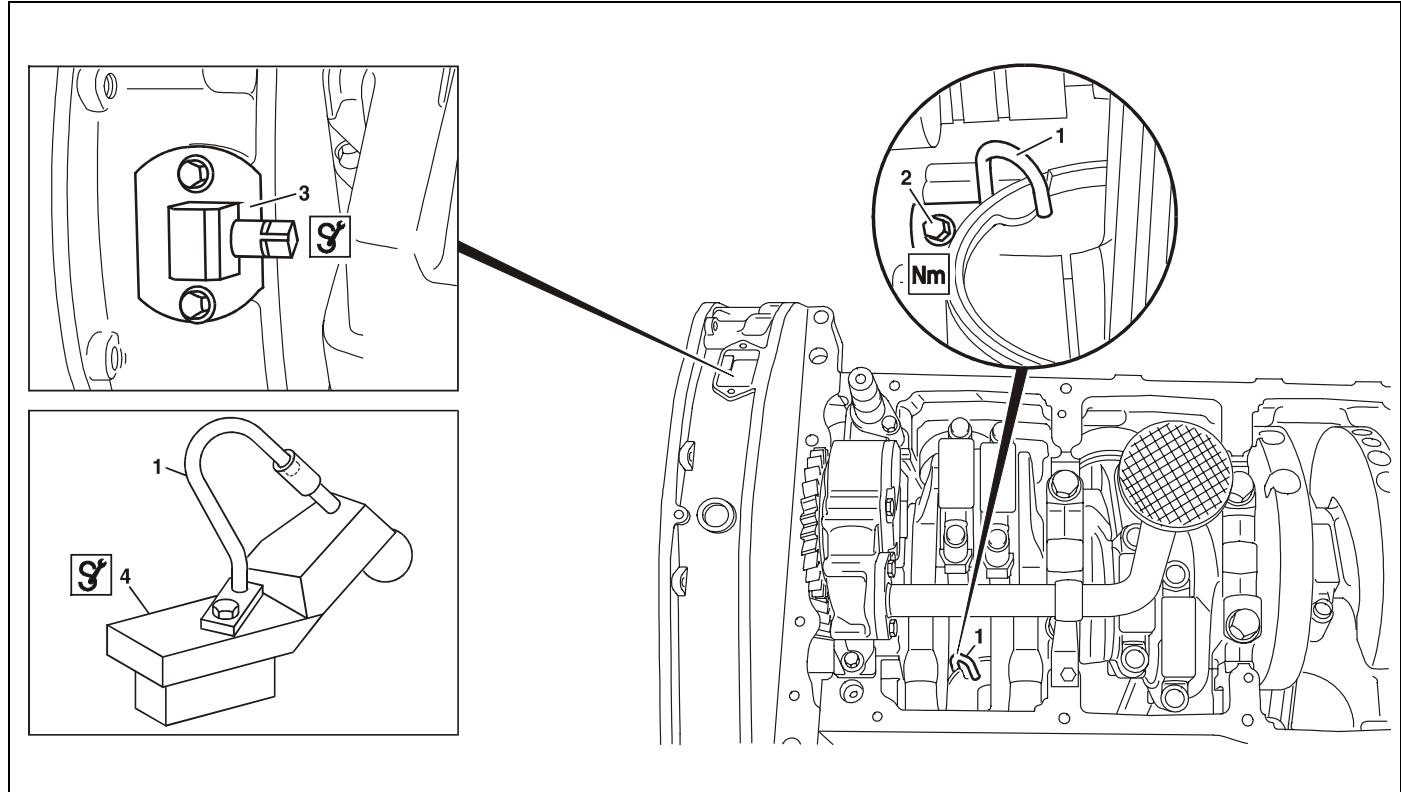
W18.00-1006-06

If an oil spray nozzle is damaged or incorrectly adjusted, the piston is no longer cooled correctly. This can cause piston seizure.

**Note:**

It is no longer permitted to adjust the oil spray nozzle.

The oil splash pipe is soldered in, and the adjustment process could cause initial damage.

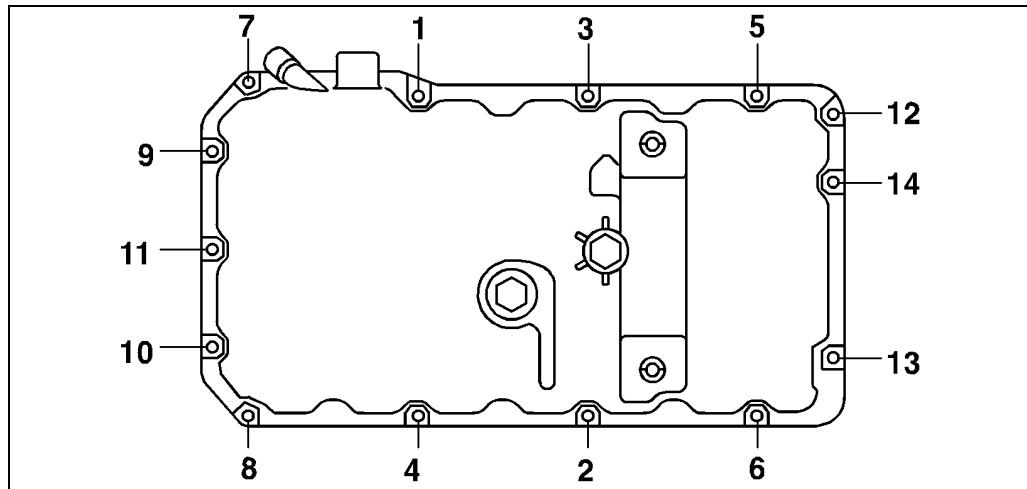


W18.00-0004-09

## Tightening pattern for the oil pan bolts

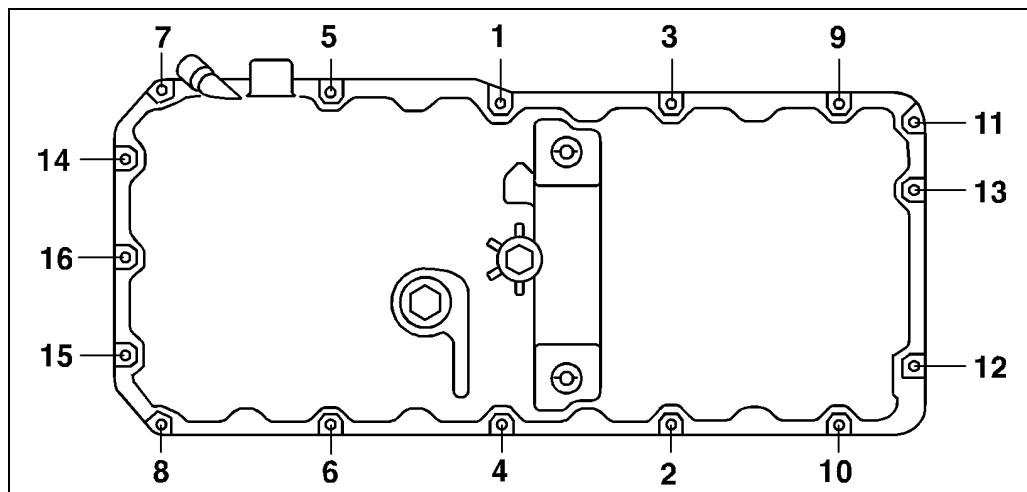
Observe the tightening torque and sequence for the oil pan bolts, always starting from position No. 1 (see tightening pattern).

 To ensure even contact (no turning of the oil pan gasket), all tightening stages must be observed.



Engine 541 tightening pattern

W01.45-1008-10



Engine 542 tightening pattern

W01.45-1009-10

<b>Nm</b> Oil pan			<b>Engine 541.9, 542.9</b>
Oil pan bolt to crankcase	Light alloy	[Nm]	55
	Plastic	Stage 1	[Nm] 0.5
	Plastic	Stage 2	[Nm] 10
	Plastic	Stage 3	[Nm] 35



### Internal water guide

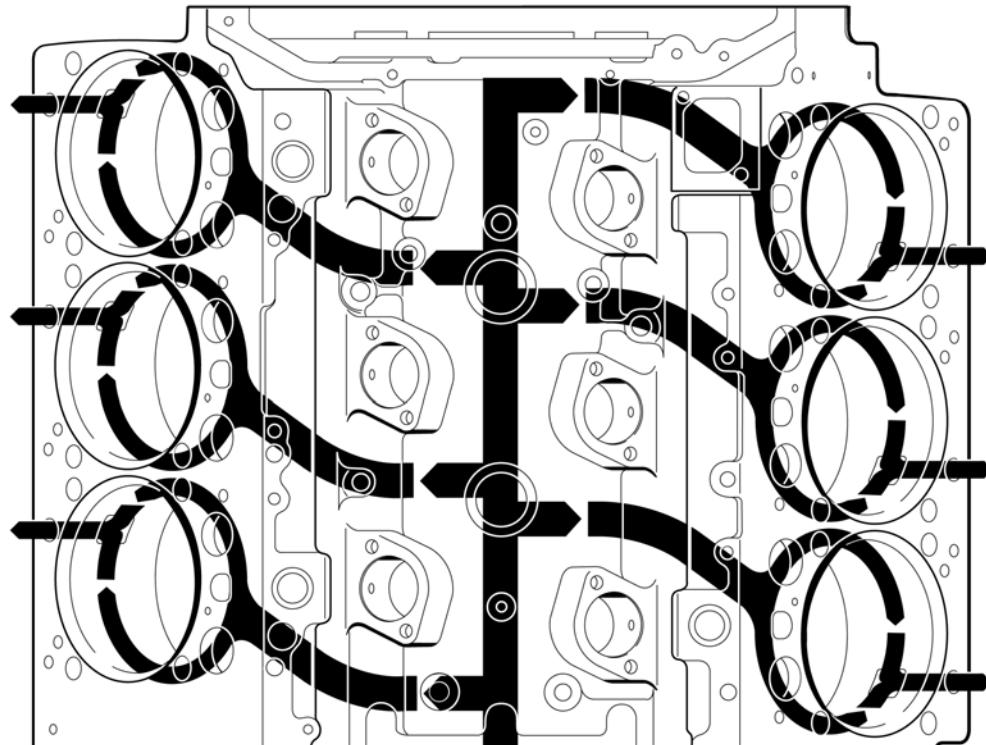
Coolant is delivered from the water pump coil integrated into the front of the crankcase, and flows through the plate-type oil cooler in the oil filter housing, which projects into the central water channel.

From the central water channel in the crankcase, each cylinder is supplied with water uniformly through individual, tangential water channels.

The water flow around the cylinder liners is divided in two by a fin. This ensures the coolant flow in the lower cylinder area and an even main flow in the upper area, for intensive cooling of the piston TDC areas where the thermal load is high.

Coolant flows through the drillings in the crankcase into the cylinder head.

Particularly intensive cooling of the valve lands and nozzle area is achieved by special forming of the water jacket in the cylinder head.



N20.00-2002-50 / 03.96

Wasserführung Motor OM 501 LA (BR 500)

N20.00-2002-50

Coolant flows back through openings in the crankcase into two return channels cast into the crankcase, one per cylinder bank. The return channels are connected to a cross-duct integrated in the oil filter/oil cooler housing assembly, through which coolant flows back into the double thermostat housing joined to the coolant pump.

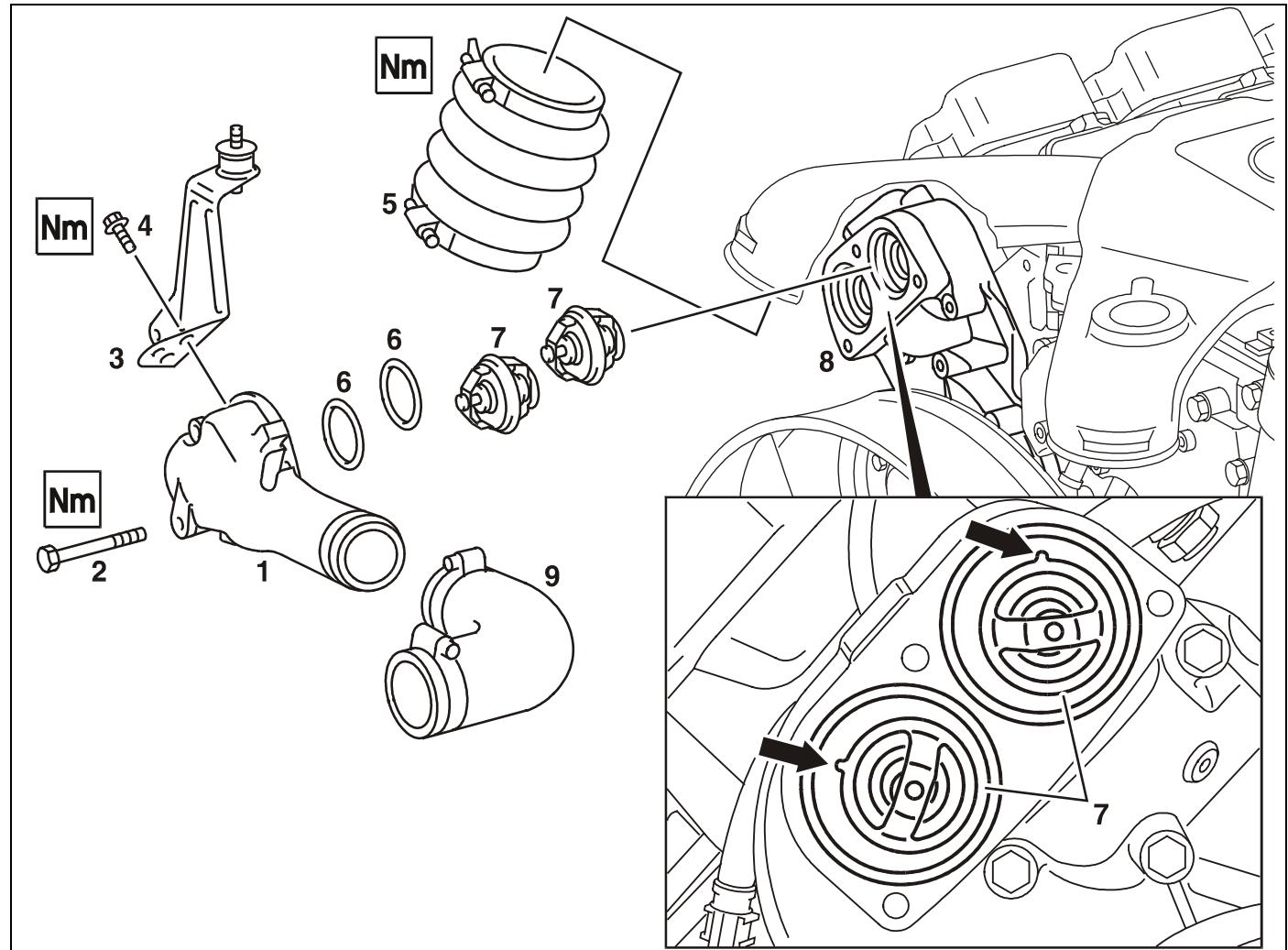
If a retarder is fitted, the coolant for the retarder heat exchanger at the rear of the crankcase is taken from the left return channel. A special water pump is provided for this purpose, so that all the coolant is also circulated to the retarder heat exchanger after the engine circuit. From the retarder, coolant is fed back into the thermostat compartment of the water pump through a separate coolant line. A separate temperature gauge is integrated into the coolant circuit.

The connection for vehicle heating and coolant bleeding is through the transfer duct in the oil filter and oil cooler assembly.

The standard thermostat starts to open at 83°C.

The installation location of the thermostats is shown on the right of the illustration.

The arrows point to the bleed tabs.  
These tabs must point upwards.



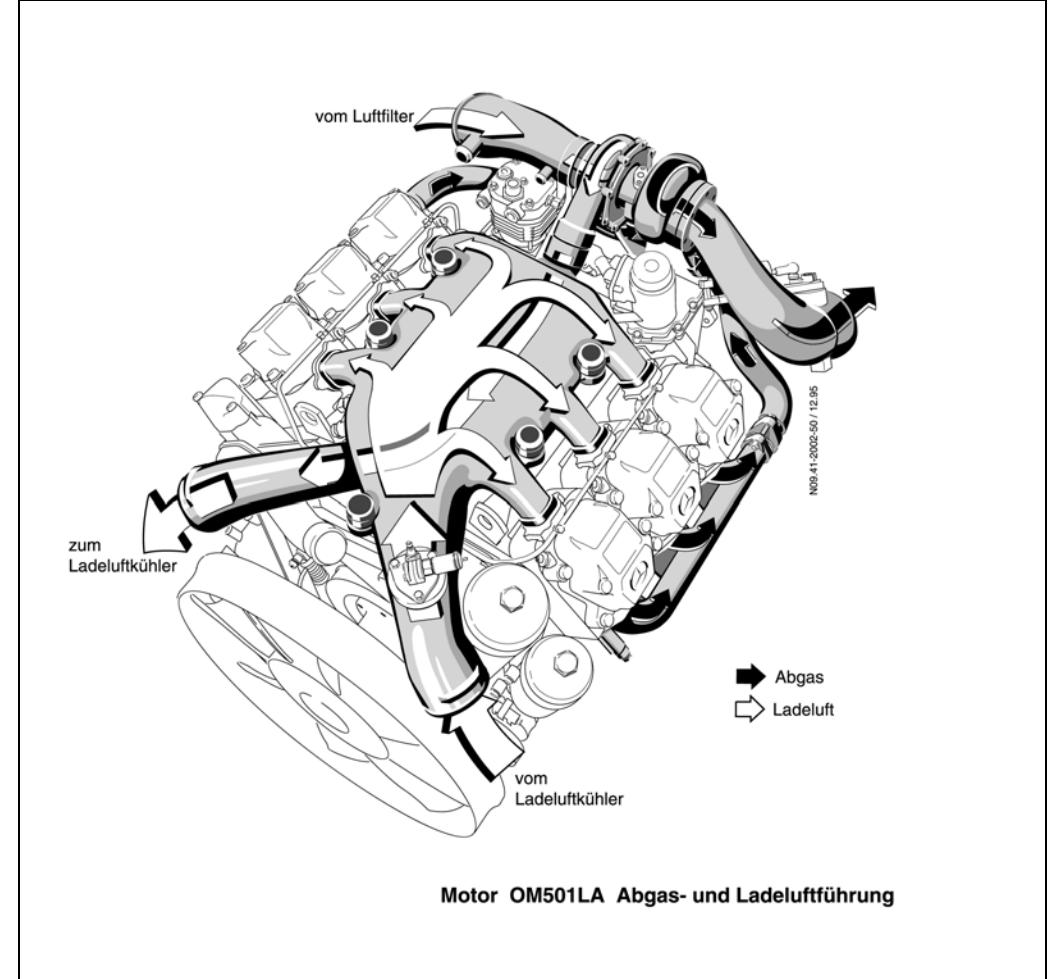
W20.10-0010-06

A completely new design has been developed for the charge air ducting in the BR 500.

The charge air housing is decoupled elastically from the individual cylinder heads by means of elastomer sealing elements, which ensure noise reduction and the balancing of tolerances and different thermal expansion rates.

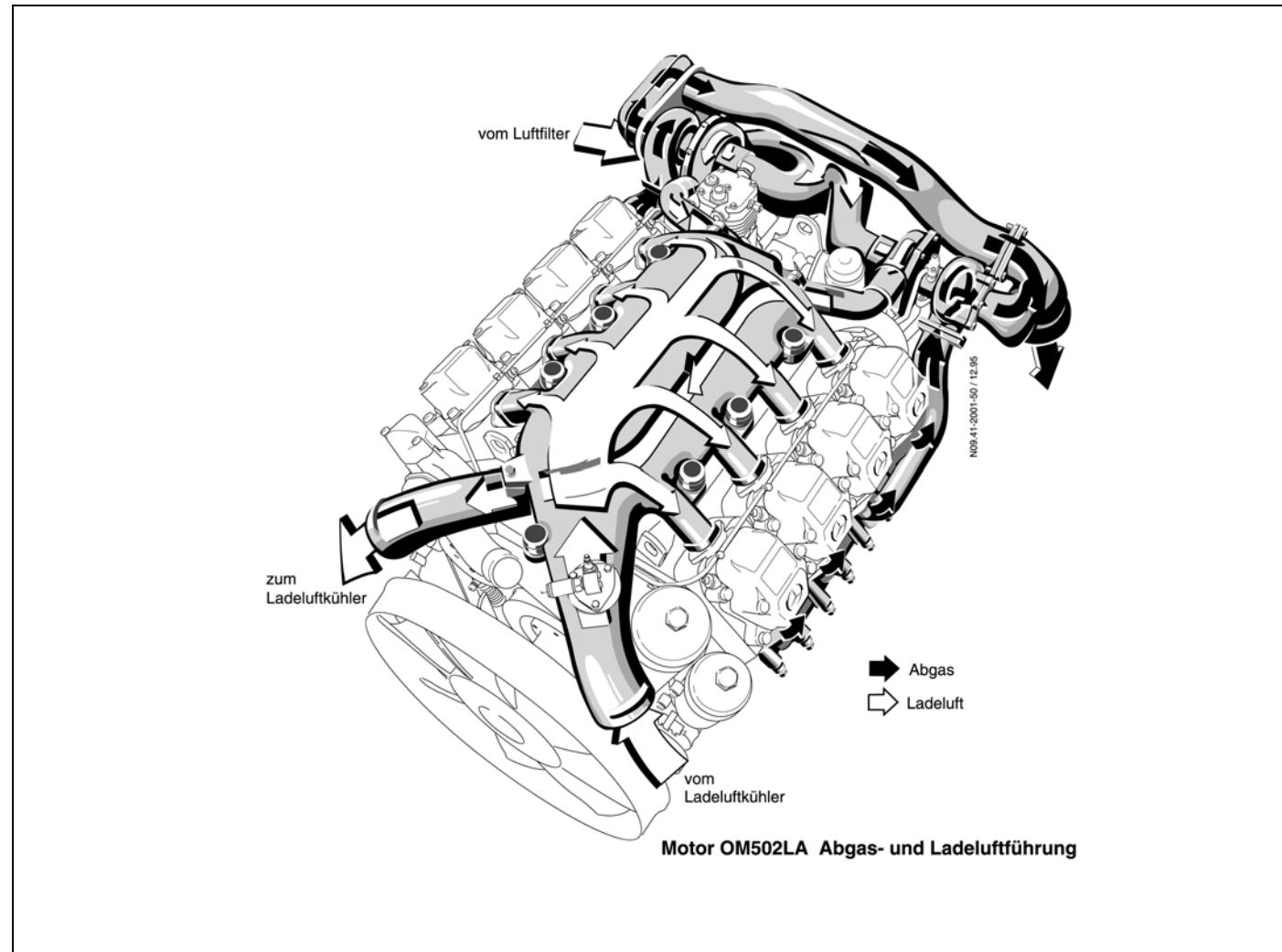
The V6 engines have one turbocharger, and the V8 engines have two. The turbine and compressor are designed for rapid, dynamic torque build-up even at low engine speeds, and a full torque curve between 1000 rpm and 1500 rpm.

**The charge air housing should be tightened to 40 Nm only!**

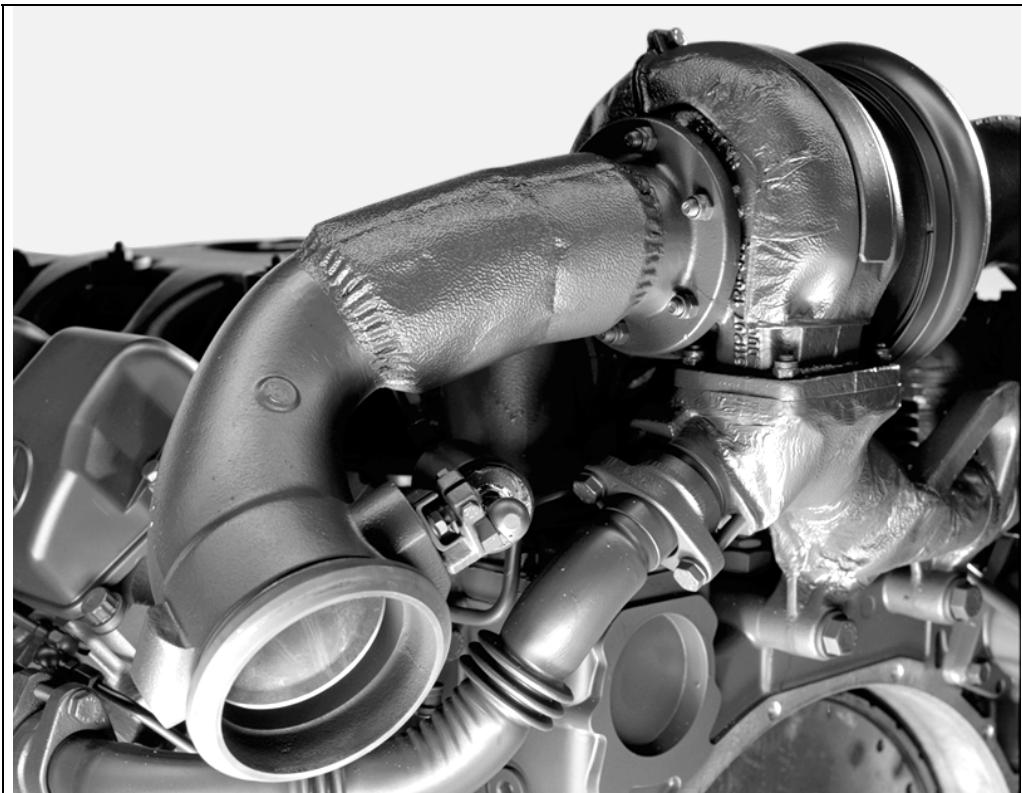


N09.41-2002-50

Despite the two turbochargers on V8 engines, the exhaust gas is collected in a flap fitting on the left. A two-shell transverse exhaust pipe connects the right turbocharger with the flap fitting. This allows the exhaust gas guide to take the same form in vehicles with V6 and V8 engines. Depending on the installation location of the engine (high/low), or for vertical exhaust systems, different flap fittings with integral single-piece engine brake valve are used.



N09.41-2001-50

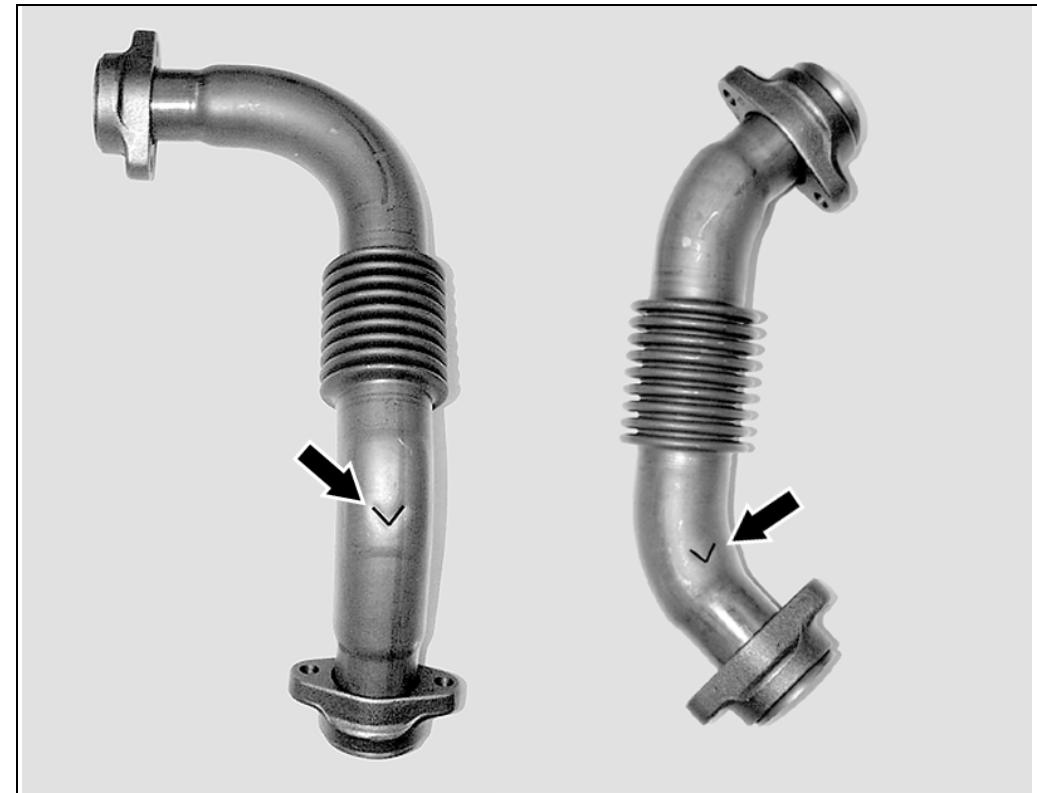


#### Previous version

N09.41-2011-11

To reduce heat dissipation at the rear of the cab, two two-shell sheet metal pipes with air gap insulation are fitted between the exhaust manifold and the turbocharger. Because of possible vibration fractures, modified pipes have been installed since March 2000.

The arrow imprint must point towards the turbocharger support! A tightening torque of 50 Nm must be applied, and parts assembled free of tension.



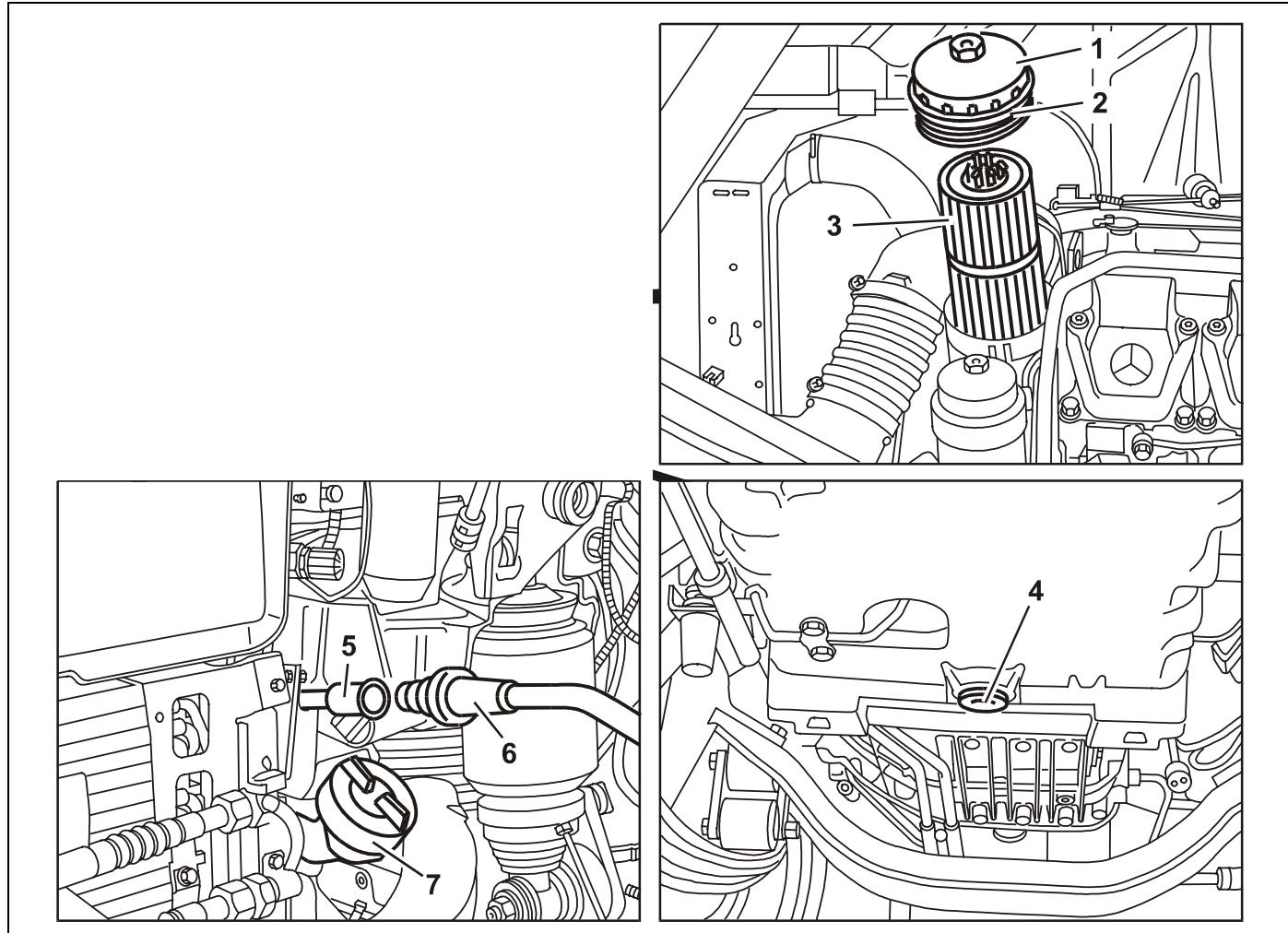
#### Modified version (from 03/2000)

N14.10-2033-11

	Used previously:	Replaced by:
to engine	left 541 140 1203	left 541 140 2103
End No. 089 130	right 541 140 1303	right 541 140 2203
from engine	left 541 140 1503	left 541 140 1903
End No. 089 132	right 541 140 1603	right 541 140 2003
The modified exhaust pipes ... 1903/... 2003 fitted as standard from engine End No. 160 569.		

Engine oil and filter change

- 1 Screw cap
- 2 Sealing ring
- 3 Oil filter element
- 4 Oil pan drain plug
- 5 Oil dipstick-guide tube
- 6 Engine oil suction unit
- 7 Oil filler plug



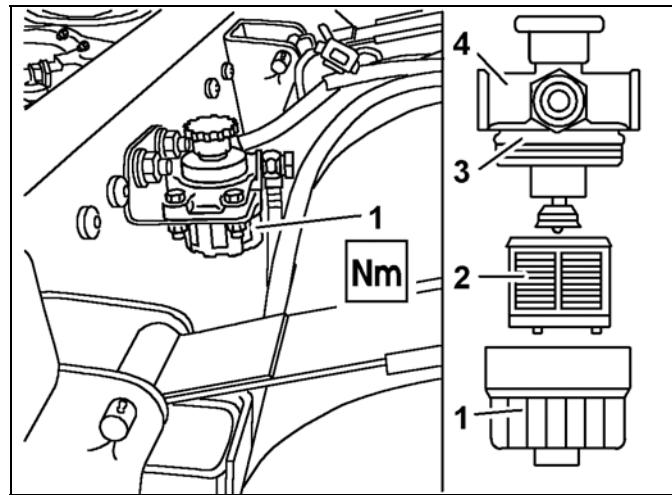
N18.00-0277-06

<b>i</b> 1	<b>Only change the engine oil with the engine warm</b>  Install new oil filter element (3)	<b>Nm</b> Oil filter cover to oil filter housing, Nm
2.1	Suction off the engine oil through the dipstick guide tube (5) or	<b>L</b> <b>i</b> Follow the manufacturer's operating instructions for the engine oil suction unit
2.2	drain off the engine oil at the oil drain plug (4) on the oil pan.	<b>i</b> Fit new sealing ring to the oil drain plug.
2.2.1	Screw in the oil drain plug (5) and tighten	<b>Nm</b> <b>i</b> Plastic oil pan: the specified tightening torque must be applied.
<b>i</b>	Notes on engine oil	
3   <b>Danger!</b>	Pour in the specified quantity of engine oil at the oil filler plug (7). <b>Testing</b> <b>Risk of accident</b> due to vehicle starting off while engine is running. <b>Risk of injury</b> due to crushing or burns if components are touched during the starting procedure or while the engine is running	Secure the vehicle to prevent it starting off automatically. Wear closed and snug-fitting work clothes. Do not touch hot or rotating parts.
4	Start engine	<b>Watch the engine oil pressure gauge!</b> It should indicate pressure after several seconds.  Do not rev the engine until oil pressure is indicated.
5	Allow the engine to run for 1 - 2 min at idle speed, once the oil pressure is indicated.	
6	Wait for about 5 minutes, then check the oil level and adjust if necessary.	<b>i</b> The waiting time must be observed.
7	Check the oil filter, the oil pan drain plug if necessary, and the long-life oil filter for leaktightness.	

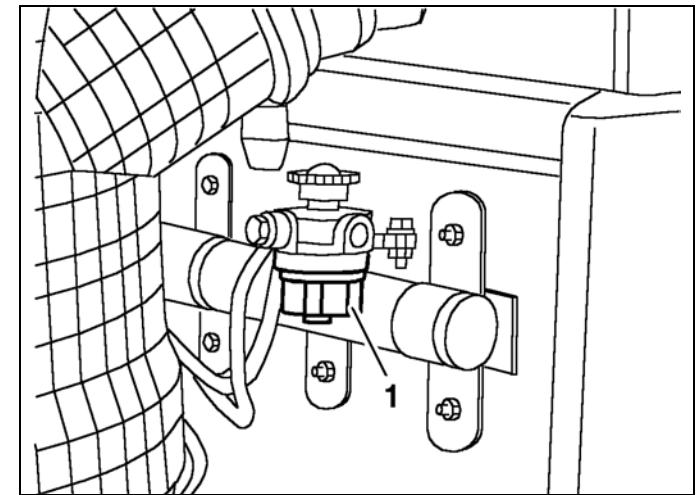
<b>Nm</b> Oil filter			<b>Engine 541.9, 542.9</b>
Oil filter cover to oil filter housing		[Nm]	40



- 1 Filter bowl  
2 Filter insert  
3 Sealing ring  
4 Filter housing



N07.57-0206-01



N07.57-0220-01

1.	Clean the outside of the fuel prefilter if dirty	
2.	Unscrew the filter bowl (1) with filter insert (2)	
3.	Clean the filter bowl (1) and filter insert (2)	<span style="color: blue;">i</span> If badly soiled or damaged, replace the filter insert
4.	Check the sealing ring (3) and replace if necessary	<span style="color: blue;">i</span> Lightly grease or oil the new sealing ring (3).
5.	Place filter insert (2) in filter bowl (1) and screw into filter housing (4)	<span style="border: 1px solid black; padding: 2px;">Nm</span>

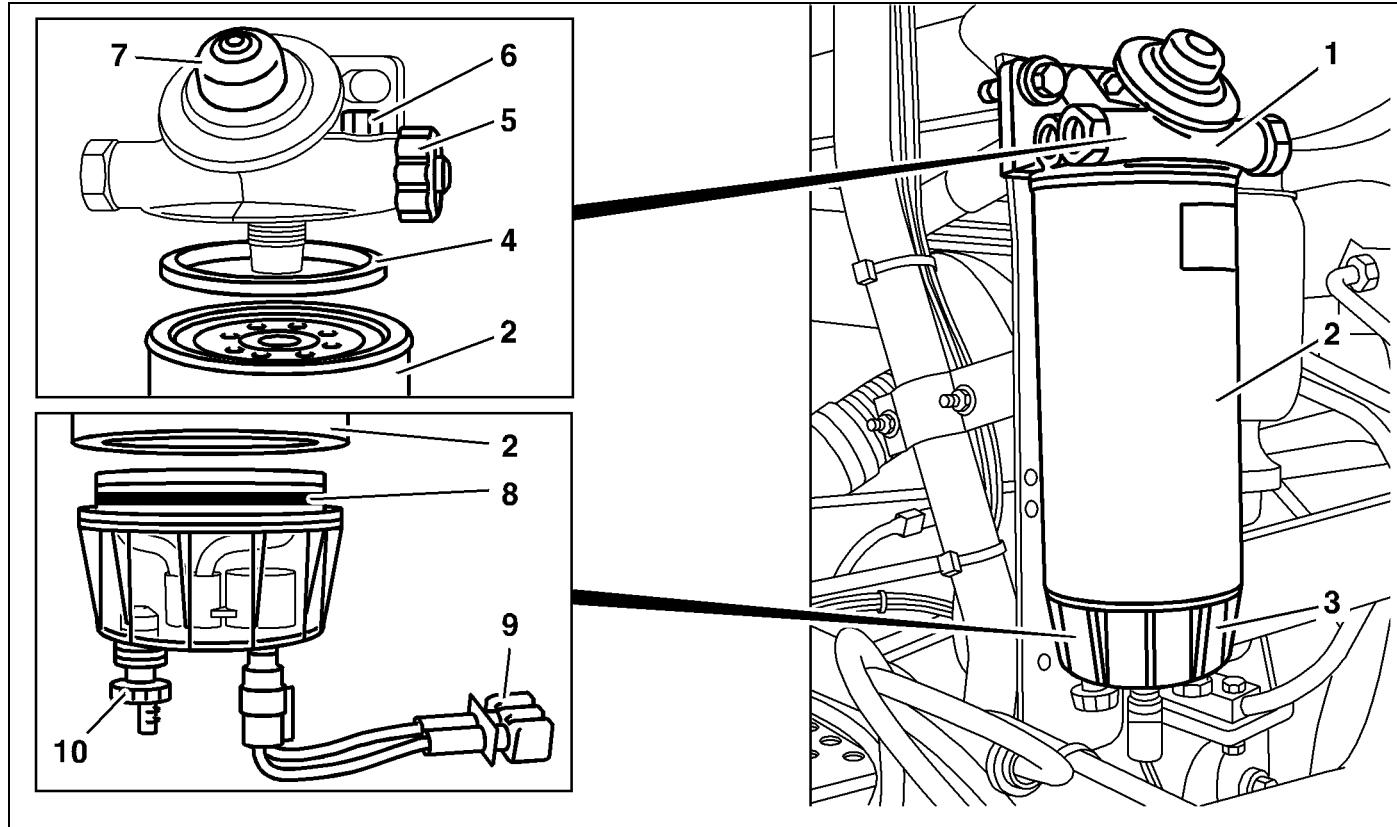
<b>⚠ Danger!</b>	<b>Risk of accident</b> due to vehicle starting off while engine is running. <b>Risk of injury</b> due to crushing or burns if components are touched during the start-up procedure or when the engine is running.	Wear closed and snug-fitting work clothes. Do not touch hot or rotating parts.
6.	Start the engine and bleed the fuel system.	<b>i</b> Let the engine run for about 1 minute. The fuel system is bled automatically. If the engine remains off or will not start ↓ bleed the fuel system manually
7.	Check the prefilter for leaktightness	

<b>Nm</b> Fuel filter		<b>Engine 541.9, 542.9</b>
Filter bowl to fuel prefilter housing	[Nm]	10

## Series 500->-Fuel prefilter with water separator - replacing the filter element

07.05.2003

- 1 Filter head
- 2 Filter element
- 3 Separator
- 4 Sealing ring
- 5 Shutoff valve
- 6 Bleed screw
- 7 Fuel pump
- 8 Sealing ring
- 9 Heater plug
- 10 Drain valve

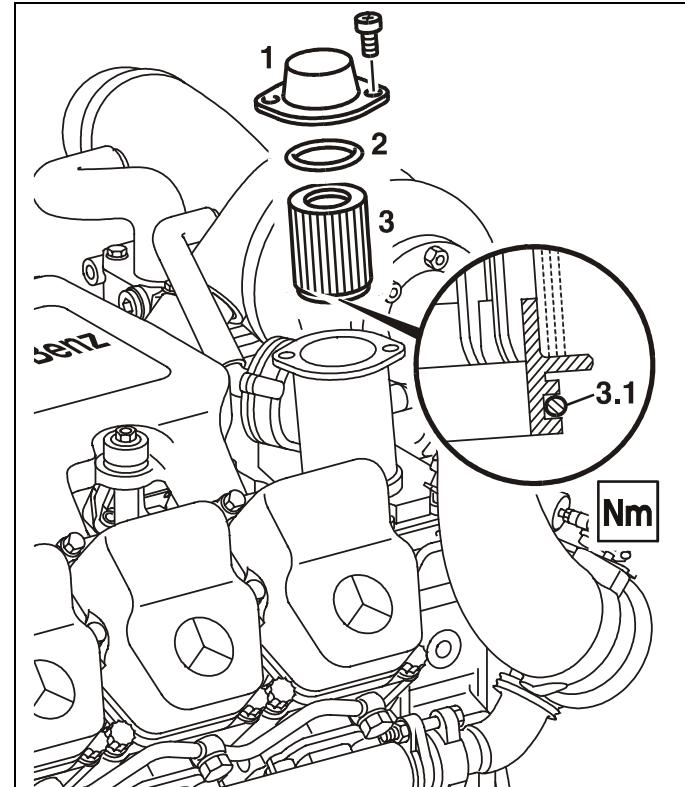


N47.20-2032-05

	To remove	
1.	Place the separator under the prefilter	
2.	Open the drain valve (10) and bleed screw (6)	Let the filter element (2) run dry Dispose of the water/fuel mixture in env. acceptable manner.
3.	Pull out the heater plug (9)	

4.	Unscrew filter element (2)	<b>i</b> Dispose of the filter element in an environmentally acceptable manner.
5.	Unscrew the separator (3) from the filter element (2)	If damaged, replace the separator
6.	Clean the separator (3)	Ensure that the sealing ring groove is clean!

<b>☒</b>	<b>To install</b>	
7.	Moisten the new sealing rings (4 and 8) with engine oil.	
8.	Screw the separator (3) with new sealing ring (8) onto the filter element (2) and finger-tighten.	
9.	Screw the filter element (2) with new sealing ring (4) onto filter head (1) and finger-tighten.	<b>i</b> Do not use tools to tighten!
10.	Close drain valve (10).	
11.	Fill the prefilter with a manual fuel feed pump (7).	
12.	Close the bleed screw (6).	
<b>⚠ Danger!</b>	<b>Risk of accident</b> due to vehicle starting off while engine is running. <b>Risk of injury</b> due to crushing or burns if components are touched during the start-up procedure or when the engine is running.	Wear closed and snug-fitting work clothes. Do not touch hot or rotating parts.
13.	Start the engine and bleed the fuel system.	<b>i</b> Let the engine run for about 1 minute. The fuel system is bled automatically.
14.	Check the prefilter for leaktightness.	



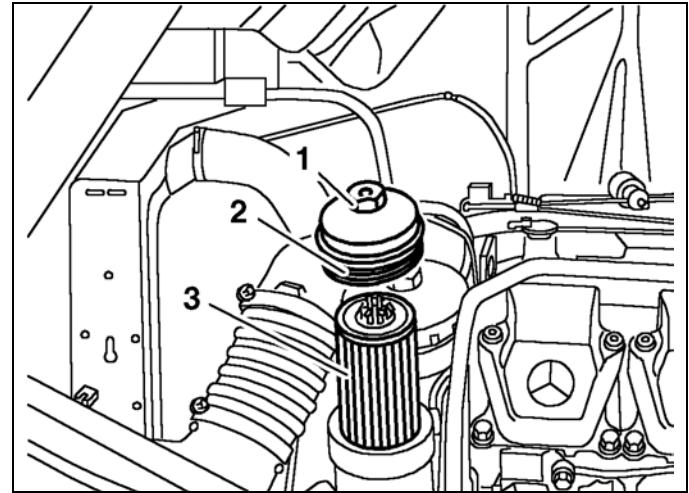
- 1 Cap
- 2 Sealing ring
- 3 Oil separator insert
- 3.1 Sealing ring

W01.20-1004-02

1.	Remove cap (1) from oil separator	
2.	Remove sealing ring (2) from cap (1)	<b>Installation:</b> Replace sealing ring.

3.	Take out the oil separator insert (3).	<b>i</b> If an oil separator insert without sealing ring is being removed, the modified insert with sealing ring (3.1) must be installed.
4.	Install in the reverse order	

<b>Nm</b> Crankcase ventilation, cylinder head cover		<b>Engine 541.9, 542.9</b>
Screw, cap to oil separator	[Nm]	6



1 Screw cap  
2 Sealing ring  
3 Filter insert

N07.57-0207-01

	To remove	
1.	Unscrew the fuel filter screw cap (1) using a socket wrench bit (SW 36)	Only remove screw cap(1) with filter insert (3) after the fuel has run out of the filter housing; if necessary, open the filler cap or close the fuel cock
2.	Remove screw cap (1) of filter insert (3) and unclip the filter insert by pressing at the side	Take care not to let any foreign matter into the filter housing. Do not in any circumstances wipe the filter bowl.

	To install	
3.	Replace the sealing ring (2)	Lightly grease the sealing ring.
4.	Insert new filter element (3) in screw cap (1)	
5.	Screw on the screw cap (1) with filter element (3), and tighten.	Engine 541, 542

 <b>Danger!</b>	<b>Risk of accident</b> due to vehicle starting off while engine is running. <b>Risk of injury</b> due to crushing or burns if components are touched during the start-up procedure or when the engine is running.	Wear closed and snug-fitting work clothes. Do not touch hot or rotating parts.
6.	Start the engine and bleed the fuel system.	 Let the engine run for about 1 minute. The fuel system is bled automatically. If the engine remains off or will not start ↓ bleed the fuel system manually
7.	Check the filter for leaktightness with the engine running	

 Fuel filter		Engine 541	Engine 542
Cap to fuel filter housing	[Nm]	25	25

#### Maintaining the air cleaner

Remove the air cleaner and check for dirt and damage. Clean the inside of the air cleaner housing if necessary.

The air cleaner cartridge must not be cleaned with compressed air cleaning equipment.

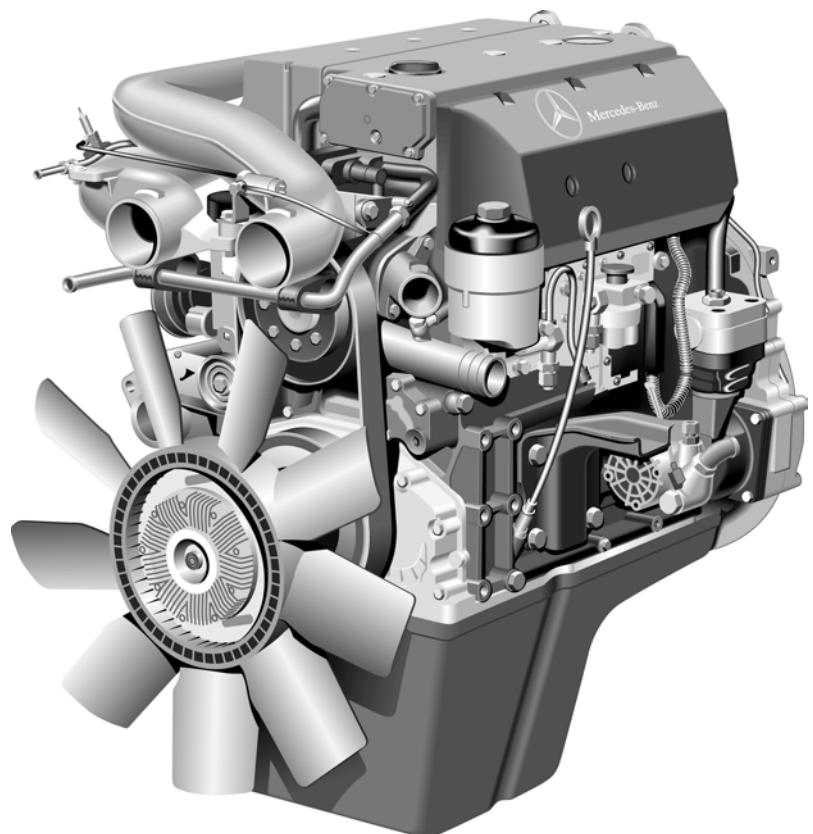
**Air cleaner cartridges must be replaced every 3 years at least.**

#### Engine coolant

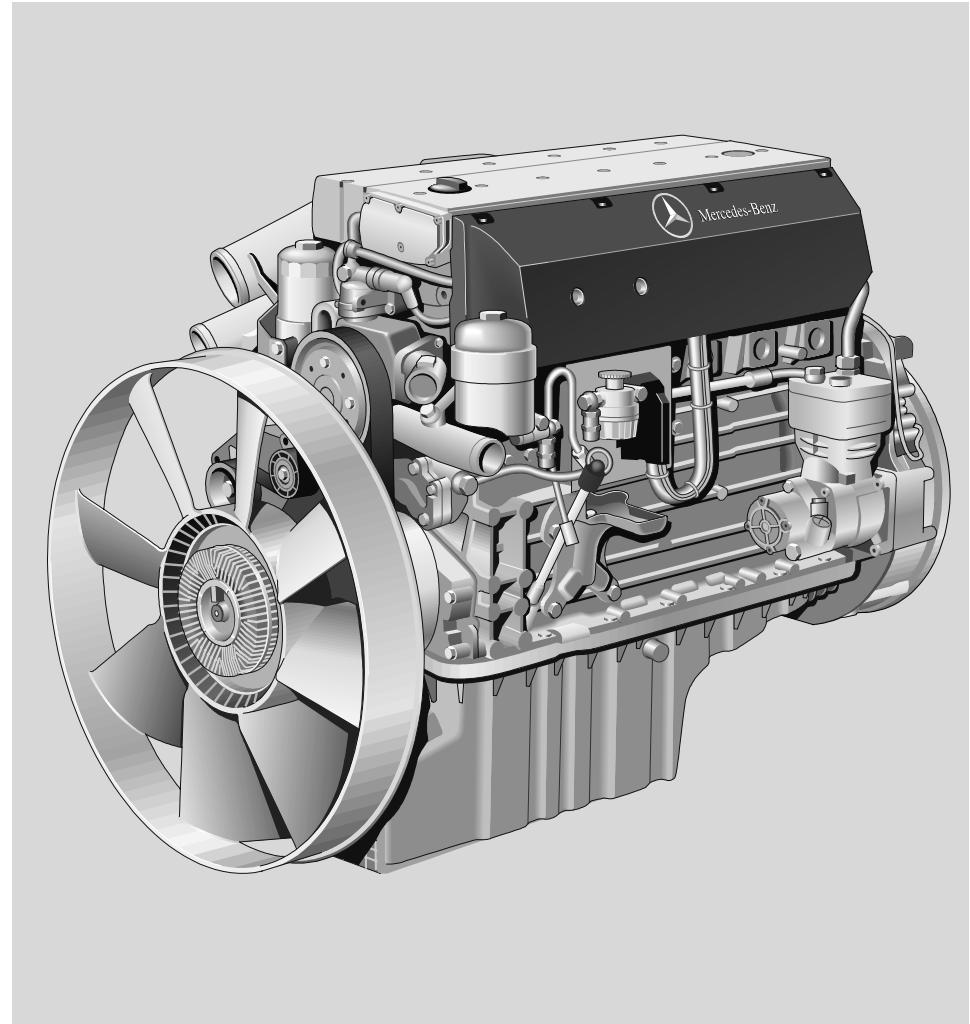
**The engine coolant must be changed every 3 years at least.**

## Engines OM 904 and 906

07.05.2003



N01.00-0392-00



N01.00-2138-00

Engine model series 900 is a series of in-line engines that has been completely re-designed. Its introduction at the beginning of 1996 marked the start of final replacement of the proven 300 model series, which had been renewed and modernized again and again over a period of 25 years.

## Model series 900

4-cylinder in-line engine

**904 LA**

$V_H = 4.25 / 4.8 \text{ l}$

6-cylinder in-line engine

**906 LA**

$V_H = 6.37 / 7.2 \text{ l}$

The sales designation is formed in the same way as the 300 model series:

**4-cylinder engine: OM 904 LA**

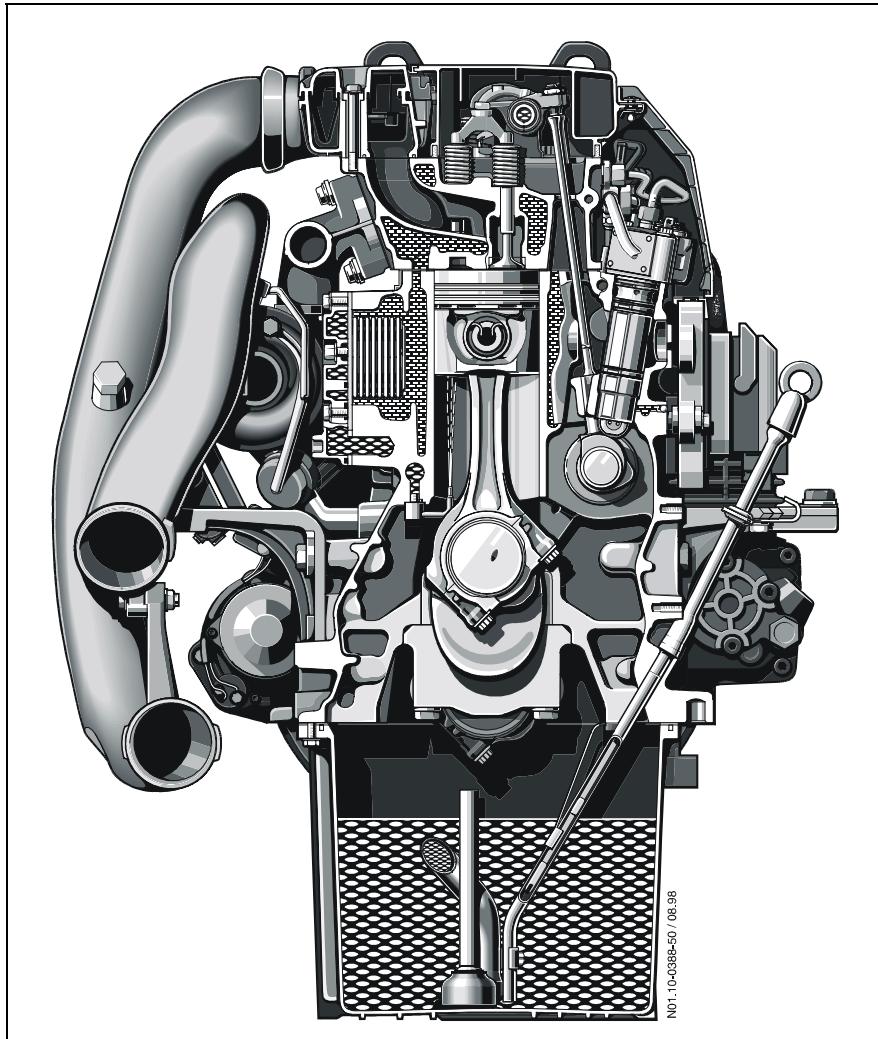
**6-cylinder engine: OM 906 LA**



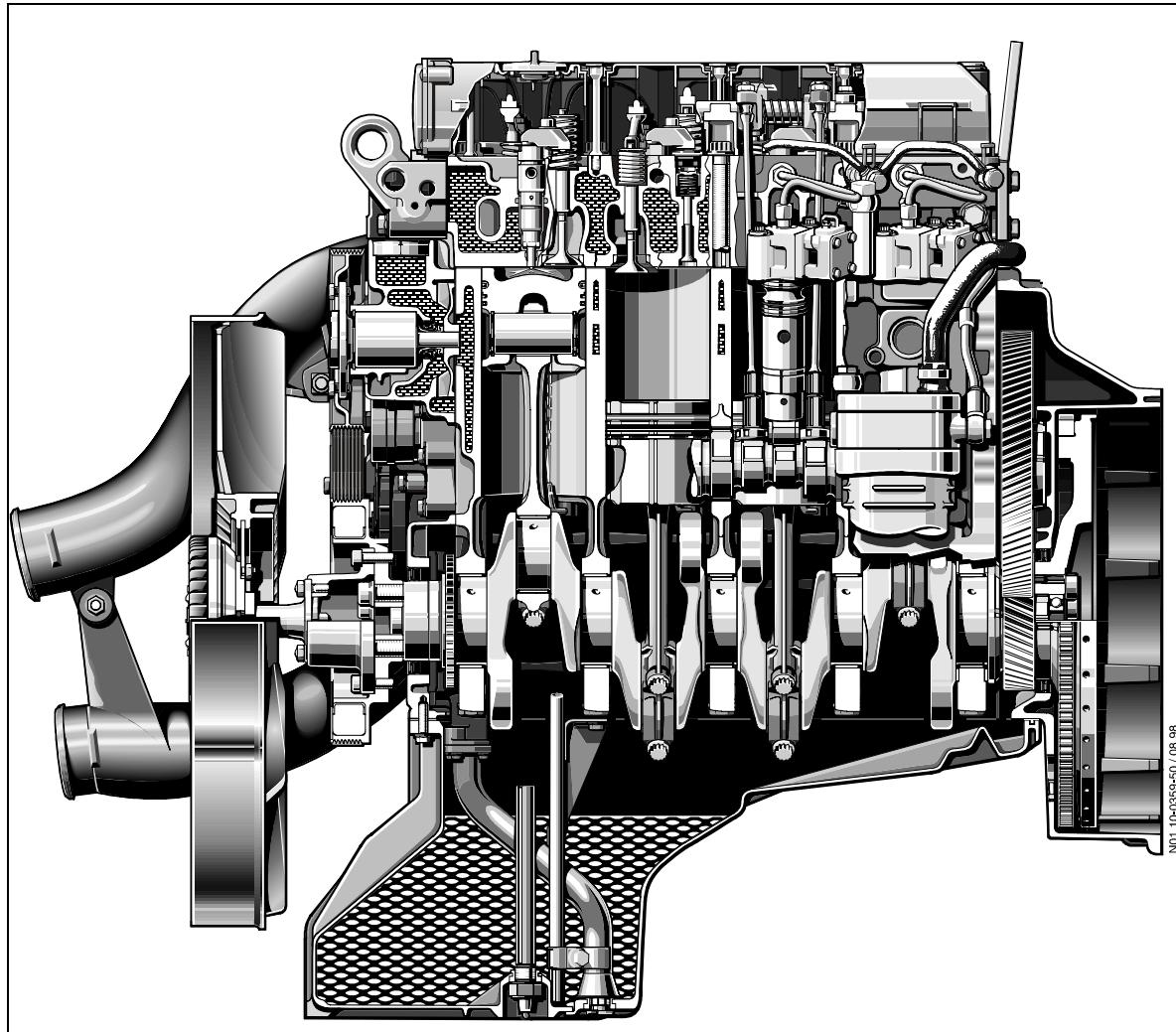
**OM 904 LA**

- Turbocharger
- Charge air cooler
- 4 = 4-cylinder in-line
- 6 = 6-cylinder in-line
- Model series 900
- Diesel engine

## OM 904 LA - section

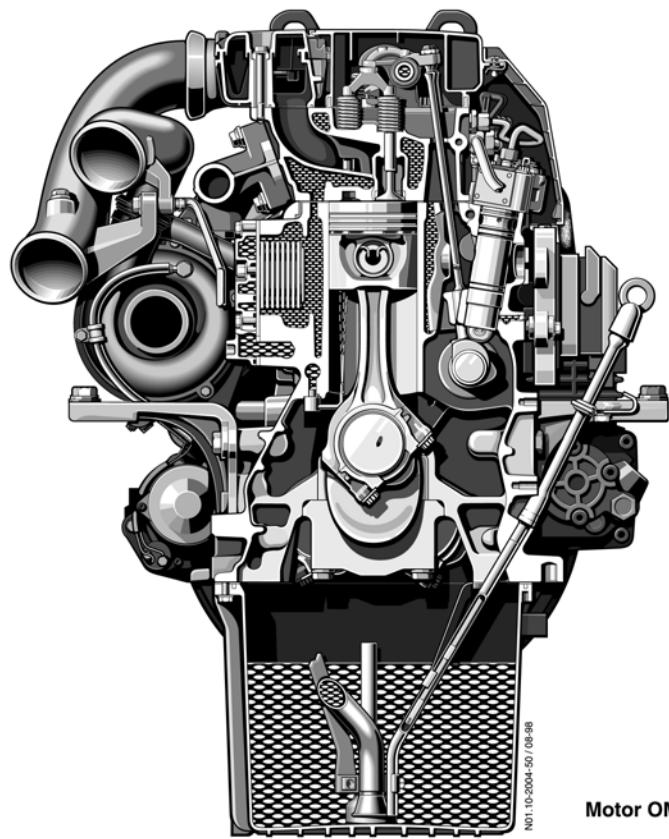


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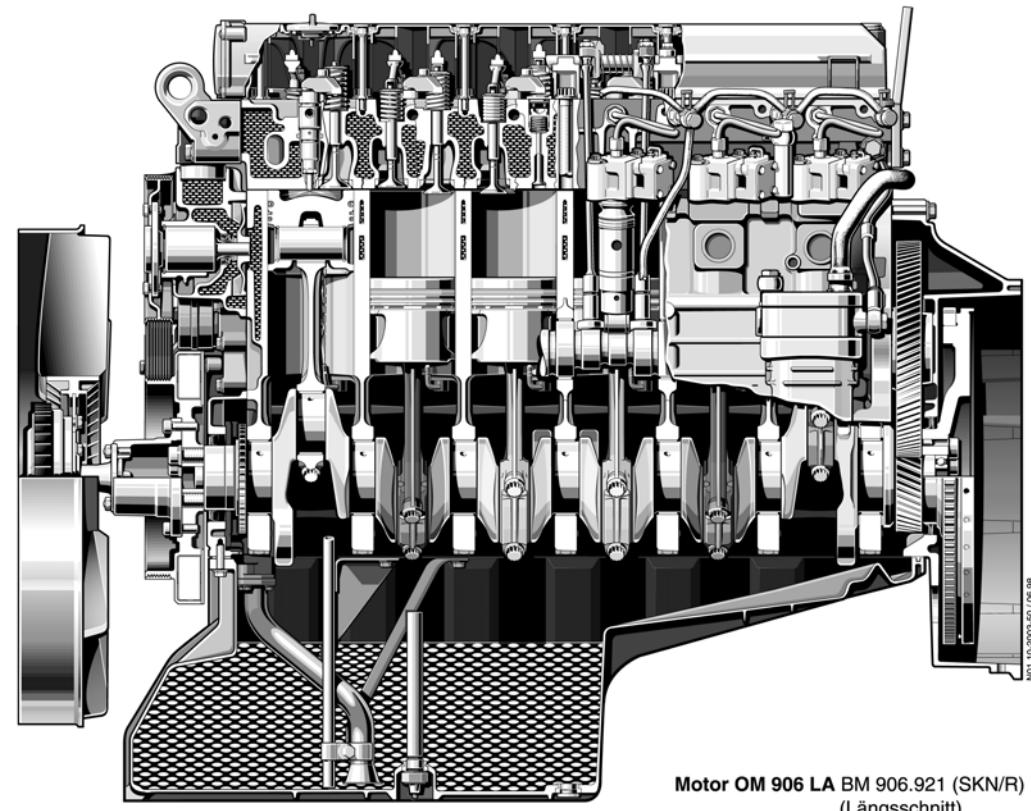


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## OM 906 LA - section



N01.10-2004-50



N01.10-2003-50

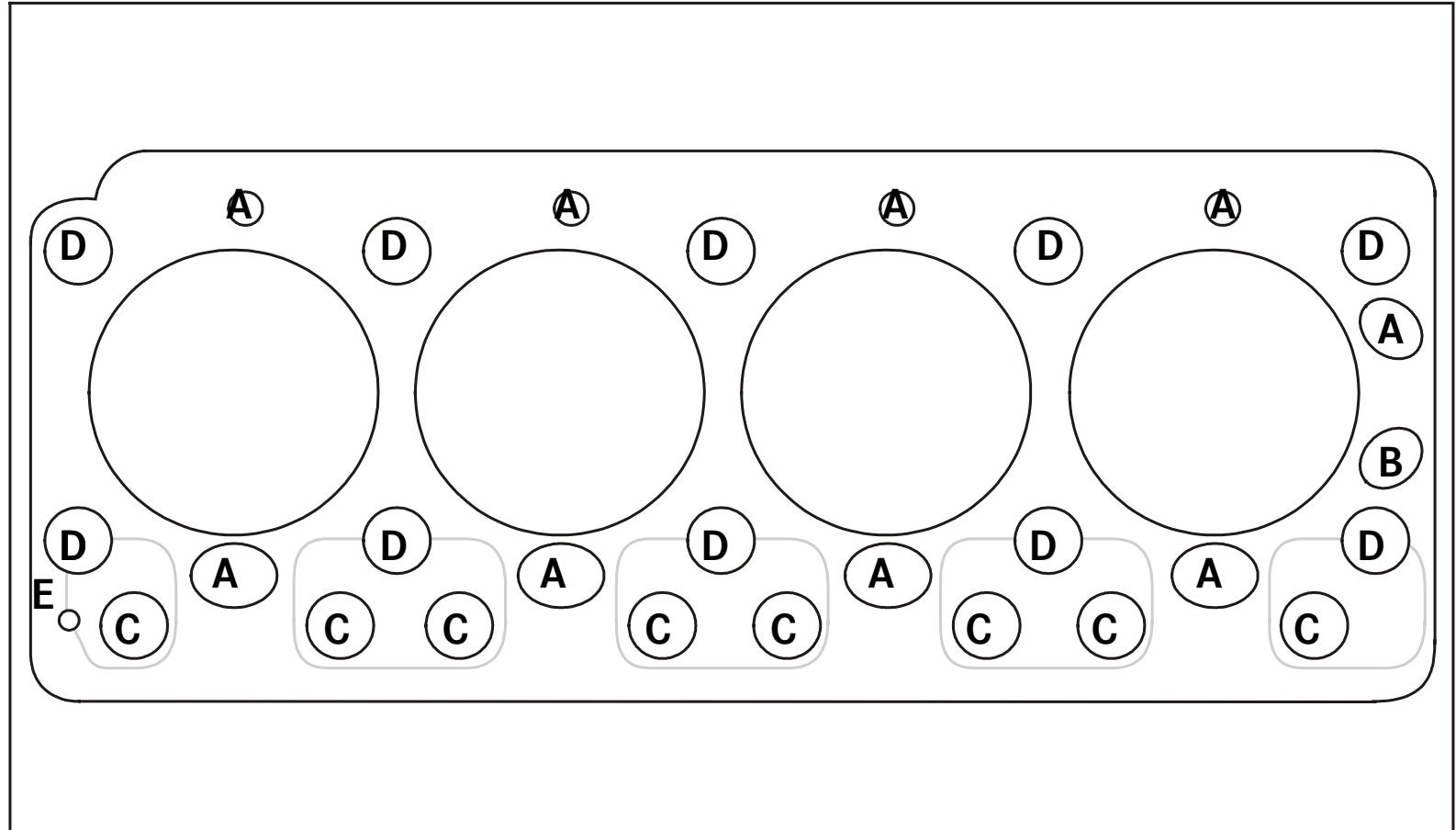
- ⇒ Outstanding **power output and torque characteristics** over the whole rpm range
- ⇒ Dynamic start-off characteristics and pulling power
- ⇒ Attractive power/weight ratio
- ⇒ Low **fuel consumption**
- ⇒ High-pressure direct injection with unit pump, *pump-line-nozzle* system with peak pressures up to 1 800 bar.
- ⇒ **Electronic engine control (MR)** with electronic system fixed to the engine, and extensive engine protection functions
- ⇒ Direct injection with centrally positioned **6-hole injection nozzle**.
- ⇒ **3-valve technology** with 2 intake valves and one exhaust valve
- ⇒ Pneumatically or hydraulically controlled **constant throttle**
- ⇒ Useful engine brake rpm well over rated rpm, up to **2700 rpm**
- ⇒ Meets the emission legislation of **EURO 3** and **EUROMOT/EPA Level 2**
- ⇒ Turbocharger with charge air cooling
- ⇒ Turbocharger with wastegate valve, depending on engine model
- ⇒ Rated engine speed **2200 rpm or 2300 rpm**
- ⇒ Low service requirements
  - long maintenance intervals
  - engine oil and fuel filter located at front for easy maintenance
  - maintenance-free belt drive
- ⇒ Can run on FAME / RME (rape methyl ester) or biodiesel, and engine oil changes are halved
- ⇒ High reliability and long runtime
- ⇒ Low number of parts variants - many parts are the same on both 4 and 6 cylinder engines
- ⇒ Rear engine power take-off ex works

## Overview of BR 900 engines with EURO 3 certification

Engine model	No. of cylinders/ layout	Output (rpm) [kW/HP (at rpm)]	Torque (rpm) [Nm (at rpm)]	Cylinder bore [mm]	Cylinder stroke [mm]	Displacement [l]	Dimensions L x W x H [mm]	Weight [kg]	Power/weight ratio [kg/kW]
OM 904 LA	4 Cyl./in-line	90/122 (2200)	470 (1200-1600)	102	130	4.25			
OM 904 LA	4 Cyl./in-line	100/136 (2200)	520 (1200-1600)	102	130	4.25			
OM 904 LA	4 Cyl./in-line	110/150 (2200)	580 (1200-1600)	102	130	4.25			
OM 904 LA	4 Cyl./in-line	130/177 (2200)	675 (1200-1600)	102	130	4.25			
OM 906 LA	6 Cyl./in-line	170/231 (2200)	810 (1200-1600)	102	130	4.25			
OM 906 LA	6 Cyl./in-line	180/245 (2200)	900 (1200-1600)	102	130	4.25			
OM 906 LA	6 Cyl./in-line	205/279 (2200)	1100 (1200-1600)	102	130	4.25			
OM 906 hLA	6 Cyl./horiz.	180/245 (2200)	900 (1200-1600)	102	130	4.25			
OM 906 hLA	6 Cyl./horiz.	205/279 (2200)	1100 (1200-1600)	102	130	4.25			

## Overview of BR 900 engines with EUROMOT/EPA Level 2 certification

Engine model	No. of cyl./layout	Output (rpm) [kW/HP (at rpm)]	Torque (rpm) [Nm (at rpm)]	Cylinder bore [mm]	Cylinder stroke [mm]	Displacement [l]	Dimensions L x W x H [mm]	Weight [kg]	Power/weight ratio [kg/kW]
OM 904 LA	4 Cyl./in-line	75/102 (2200)	400 (1200-1600)	102	130	4.25			
OM 904 LA	4 Cyl./in-line	90/122 (2200)	470 (1200-1600)	102	130	4.25			
OM 904 LA	4 Cyl./in-line	100/136 (2200)	520 (1200-1600)	102	130	4.25			
OM 904 LA	4 Cyl./in-line	110/150 (2200)	580 (1200-1600)	102	130	4.25			
OM 904 LA	4 Cyl./in-line	130/177 (2200)	675 (1200-1600)	102	130	4.25			
OM 906 LA	6 Cyl./in-line	150/204 (2200)	810 (1200-1600)	102	130	6.37			
OM 906 LA	6 Cyl./in-line	170/231 (2200)	900 (1200-1600)	102	130	6.37			
OM 906 LA	6 Cyl./in-line	180/245 (2200)	1100 (1200-1600)	102	130	6.37			
OM 906 LA	6 Cyl./horiz.	190/258 (2200)	900 (1200-1600)	102	130	6.37			
OM 906 LA	6 Cyl./horiz.	205/279 (2200)	1100 (1200-1600)	102	130	6.37			
OM 926 LA	6 Cyl./horiz.	240/325 (2300)	1300 (1200-1500)	106	136	7.20			



- A Coolant
  - B Pressure oil
  - C Push rod/ oil return
  - D Cylinder head bolts
  - E Oil return
- Crankcase ventilation

N01.30-2039-05

## **Series 900<>Tightening instructions for cylinder head bolts**

**07.05.2003**

### **Cylinder head bolt test values**

<b>Designation</b>		<b>Engine 904.9, 906.9</b>
Cylinder head bolt M 16 x 2	Shank length in new state [mm]	149
	Shank length [mm]	≤ 151

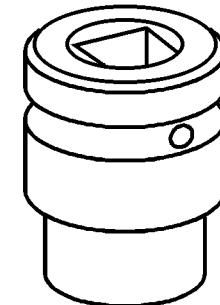
### **Cylinder head bolt tightening torques**

<b>Designation</b>		<b>Engine 904.9, 906.9</b>
Cylinder head bolt to crankcase	Step 1 [Nm]	20
	Step 2 [Nm]	70
	Step 3 [Nm]	170
	Step 4 [Nm]	280
	Step 5 ↗	90°
	Step 6 ↗	90°

- Screw in the cylinder head bolts and, following the above tightening sequence (1 to 6), tighten to the indicated torque **Nm** and tightening angle.

**!** To ensure even contact pressure around the cylinder head gasket, follow all the tightening steps and sequence (see tightening pattern).

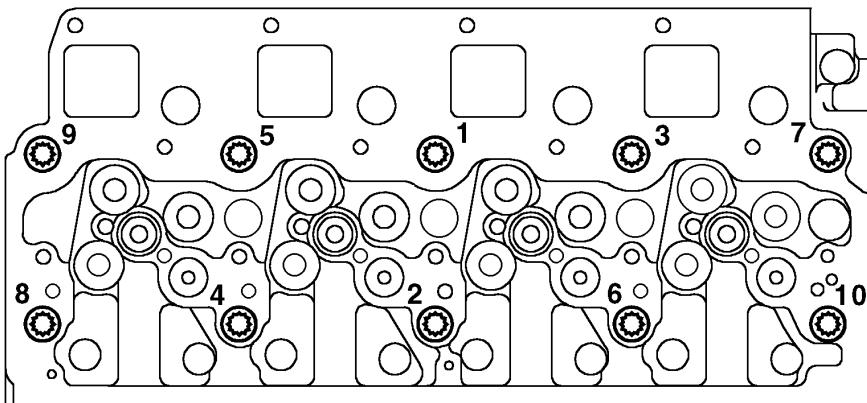
**!** If a bolt has been over-tightened when assembling, then all four bolts should be removed from the cylinder head and examined for elongation, then tightened again starting from Step 1.



Socket wrench bit

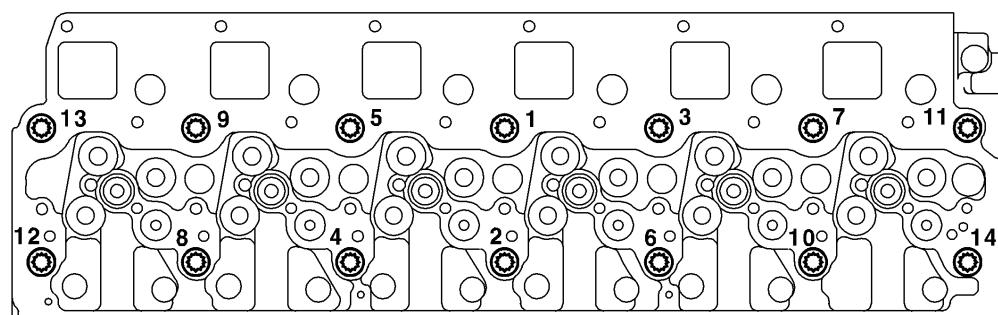
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**i** The cylinder head bolts do not require retightening.



Engine 904

W01.30-0005-10



Engine 906

W01.30-0020-04

The 900 model series has two intake valves and one exhaust valve per cylinder. It is therefore referred to as a "3-valve" engine.

The steel camshaft (which has 5 bearings on the 4-cylinder and 7 bearings on the 6-cylinder engine) has one intake and one exhaust cam per cylinder, plus one cam for driving the unit pump.

All valves are driven by the camshaft, by means of mushroom tappets and short push rods. A floating valve bridge links and actuates both intake valves.

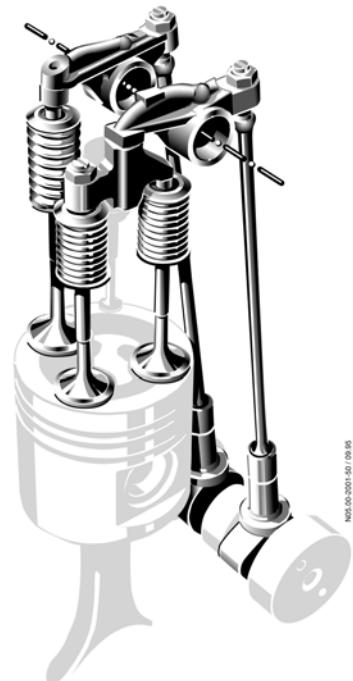
The complete valve actuation system with rocker arm bearing brackets is bolted to the cylinder head as a preassembled unit.

*Left view:*

First generation with pin-guided adjustable valve bridge, exhaust valve rocker arm with link.

*Right view:*

Next generation with floating, adjustment-free valve bridge, exhaust valve with valve cap.



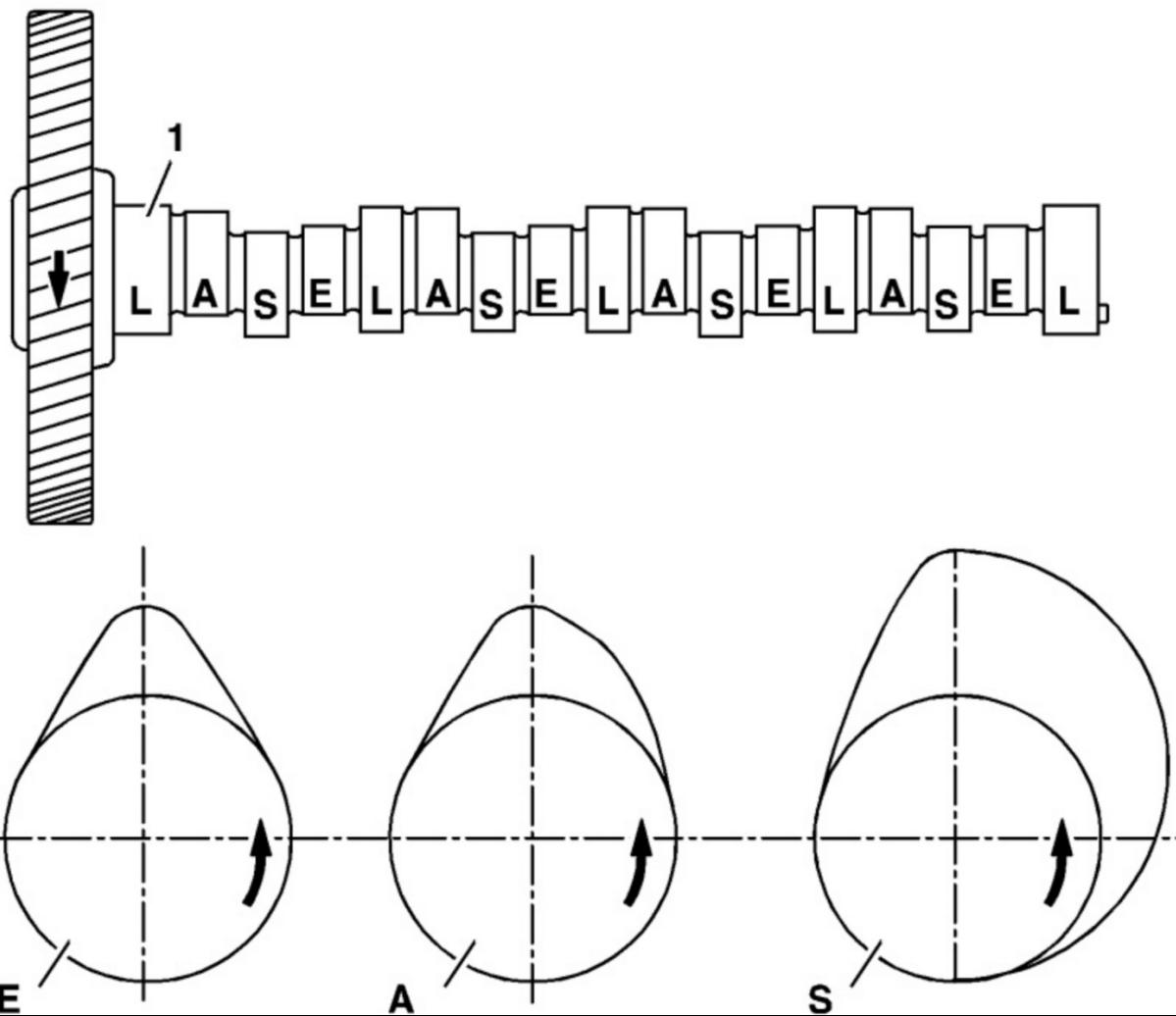
Ventiltrieb (Motorenbaureihe 900)



Ventiltrieb Motorenbaureihe 900 ( LKN, SKN/R )

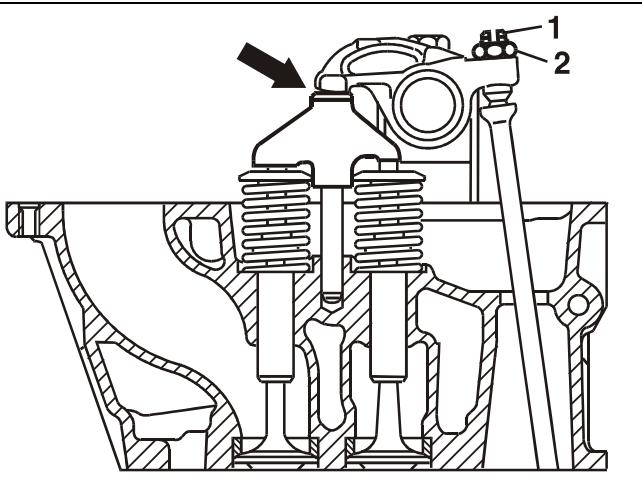
N05.00-2001-50

N05.00-2002-50



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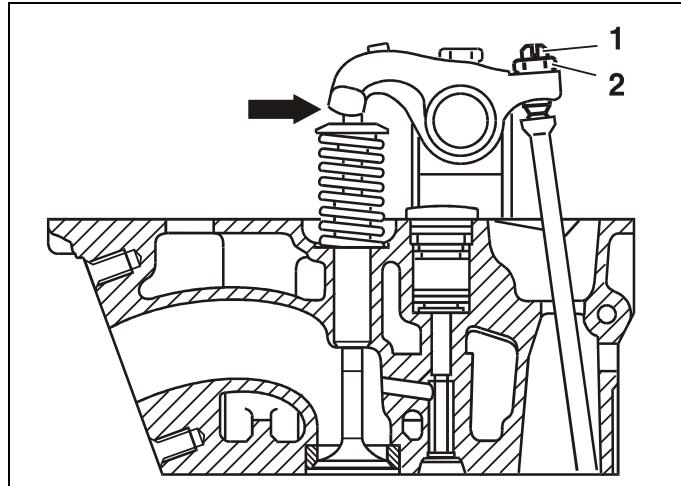
- L Bearing
- A Exhaust valve cam
- S Unit pump cam
- E Intake valve cam



Intake valve

N05.30-0372-01

1 Adjusting screw  
2 Locknut



Exhaust valve

W05.30-1006-01

### Procedure for setting valve play

<b>i</b>	Check or set the valve play with the engine cold; at least 30 minutes after stopping the engine, even after running for a short period, so that the engine is warmed up evenly. Remove the cylinder head cover	
1	Select the valve setting method	<ul style="list-style-type: none"> <li><b>i</b> Setting according to injection sequence Method 1</li> <li><b>i</b> Setting in two crankshaft positions Method 2</li> </ul>
2	Install turning device (4) at the inspection hole in the timing case and turn the engine to the crankshaft position for the selected setting method.	

4	Check and set valve play (as indicated by arrows).	<b>i</b> The valve play test tolerance applies only for checking, not setting.
5	Remove turning device (4) and fit the cap to the inspection hole in the crankcase.	
6	Fit the cylinder head covers.	

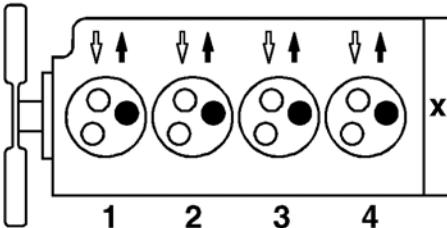
#### Valve test values

Designation		Engine 904.9, 906.9
Valve play	Intake [mm]	0.40
	Exhaust [mm]	0.60
Test tolerance	[mm]	-0.10/+0.20

**The valve play test tolerance applies only for checking valve play.**

**If valve play is outside the tolerance range, the specified value must be set.**

## Valve play setting methods



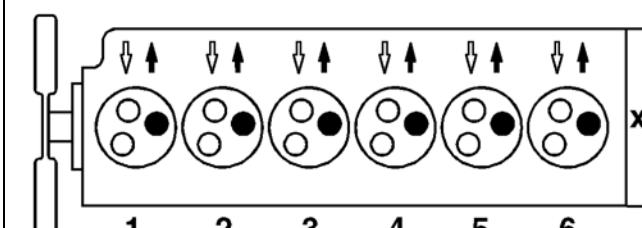
○ ← E  
● → A

Engine OM 904 LA

N01.00-0347-01

**Firing order**  
4-cylinder: 1 - 3 - 4 - 2  
6-cylinder: 1 - 5 - 3 - 6 - 2 - 4

A...Exhaust valve  
E...Intake valve  
X...Flywheel side



○ ← E  
● → A

Engine OM 906 LA

N01.00-0348-01

### Method 1:

Set intake and exhaust valves for each cylinder, according to the injection sequence. The cylinder to be set must be at ignition TDC, the parallel cylinder at valve overlap TDC. With this method, the crankshaft must be turned four times in the 4-cylinder engine, and six times in the 6-cylinder engine.

### Method 2:

Set intake and exhaust valves in two crankshaft positions, as shown in the table.

- Adjust when cylinder 1 is at ignition TDC. with 4th or 6th cylinder at valve overlap.
- Adjust when cylinder 1 is at valve overlap and the 4th or 6th cylinder is at ignition TDC.

Engine	Crankshaft position	Cylinder/values to be set					
		1	2	3	4	5	6
OM 904 LA	Cyl. 4 valve overlap	I / E	I	E	-	-	-
	Cyl. 1 valve overlap	-	E	I	I / E	-	-
OM 906 LA	Cyl. 6 valve overlap	I / E	I	E	I	E	-
	Cyl. 1 valve overlap	-	E	I	E	I	I / E

**Location of the unit pump**

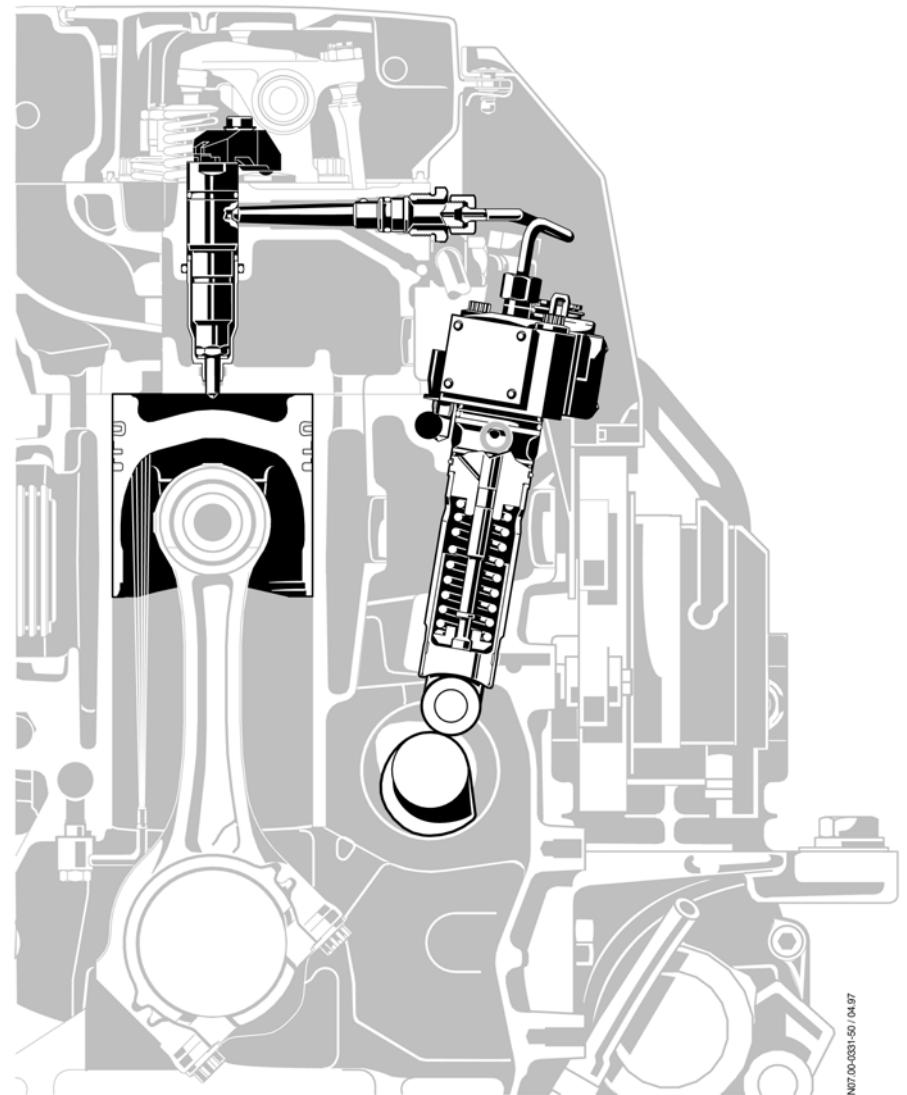
The injection process is performed by the newly developed pump-line-nozzle system, controlled by the Telligent® electronic engine management system.

In the MR system, fuel is delivered to the injection nozzle by individual unit pumps over short, relatively rigid high-pressure injection lines, and through the pressure pipe connection screwed into the cylinder head.

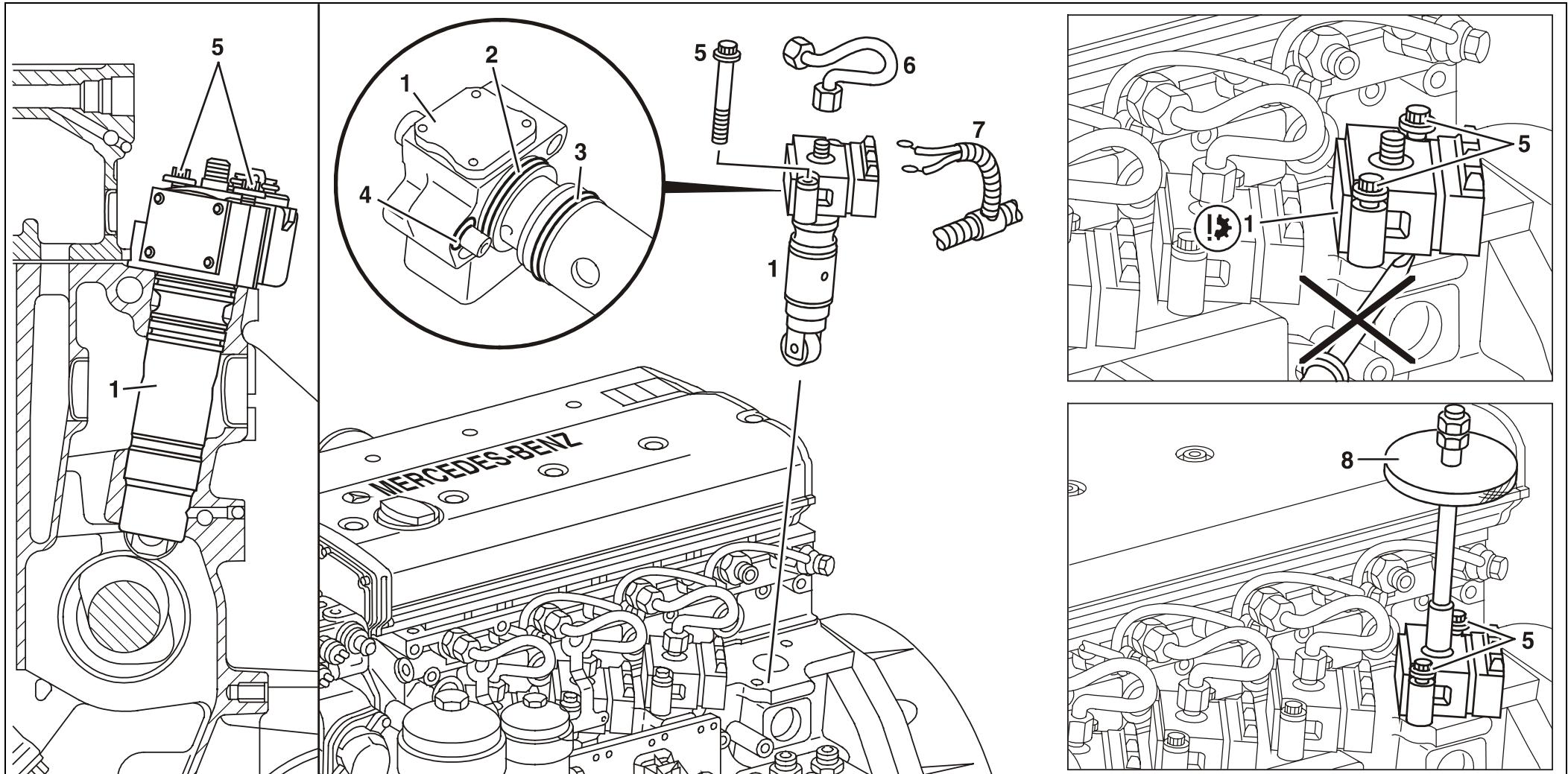
A unit pump fitted to the crankcase is assigned to each cylinder. The pump is driven by another timing cam on the camshaft. The camshaft therefore also has the task of driving the unit pumps, besides the traditional function of driving the intake and exhaust valves.

The operating principle of the unit pump is based on the same principle as the piston pump, as in the in-line injection pumps used till now, but without control edges at the pump plunger.

The quantity injected is determined individually per cylinder by solenoid valves, which control the start and end of injection.



## Removing/installing the MR/PLD unit pumps



1 MR/PLD unit pump  
2 O-ring

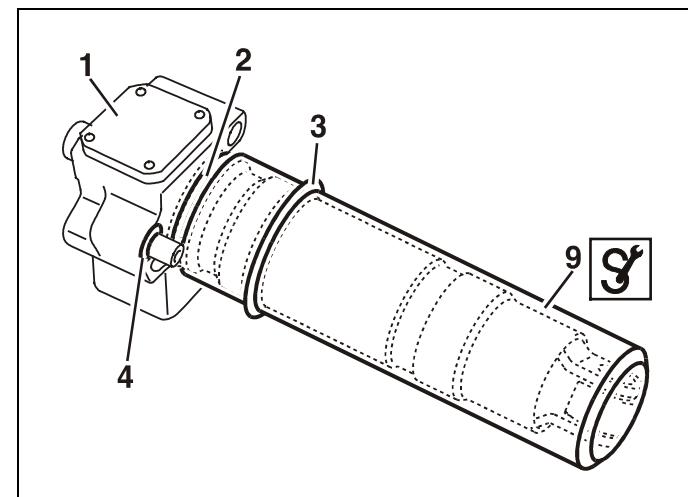
3 O-ring  
4 O-ring

5 Splined bolt, 65 Nm  
6 Injection line

7 Engine wiring harness  
8 Extractor 355 589 01 63 00

W07.15-0082-09

- 1 MR/PLD unit pump  
 2 O-ring  
 3 O-ring  
 4 O-ring  
 9 Protective sleeve 904 589 00 14 00

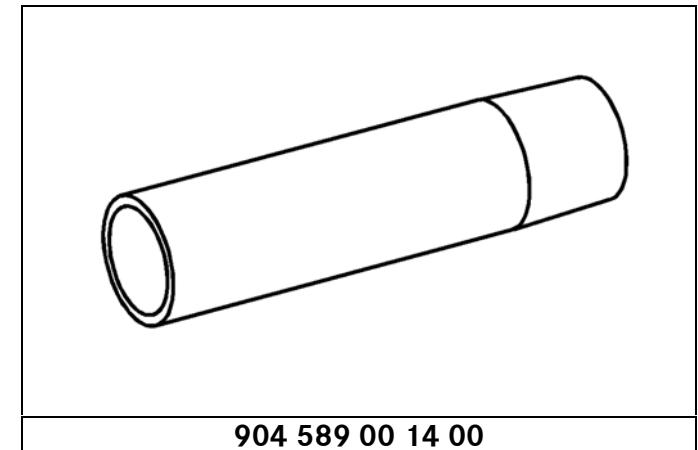
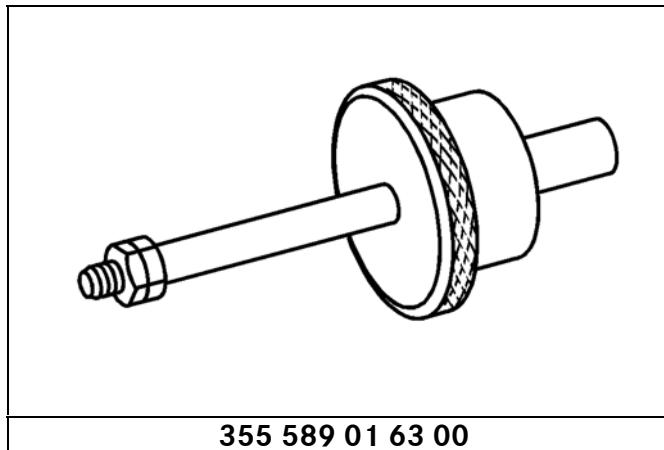


W07.15-1060-01

	<b>Removing/installing</b>	
1.	Risk of explosion due to gas ignition, risk of poisoning by inhaling or absorbing fuel, or risk of injury to skin and eyes through contact with fuel.	Fire, sparks, naked flames, smoking are forbidden. Only store fuel in suitable and appropriately marked containers. Wear protective clothing if handling fuel.
2.	Remove injection line (6)	Stop up the orifices in the nozzle holder combination and MR/PLD unit pump (1).
3.	Clean the engine around the MR/PLD unit pump (1).	
4.	Remove the engine wiring harness fastening strip with start/stop switch from the crankcase.	Only if removing the MR/PLD unit pump for cylinder 1 or 2
5.	Remove engine wiring harness (7) at MR unit pump (1)	To do this, loosen the screws on the solenoid valve and detach both clip fasteners.
6.	Identify the MR/PLD unit pump (1) for the cylinder concerned	Only if removing more than one or all MR/PLD unit pumps.

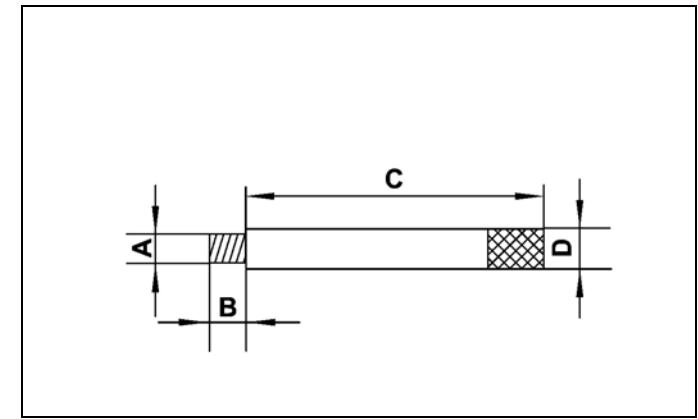
	<b>Removing/installing</b>	
6.	Loosen the splined bolts (5)	For reasons of safety, the splined bolts should be unscrewed by only about 4 to 5 mm; the MR/PLD unit pump is under spring load.
7.	Fit the extractor (8) to MR/PLD unit pump (1)	Extractor: 355 589 01 63 00
8.	Pull out the MR/PLD unit pump (1) with the extractor (8) up to the bolt heads.	If stuck, the MR/PLD unit pump should not be pressed out at the solenoid valve or at the housing flange. <b>Installation:</b> Lightly oil the unit pump body, O-ring surfaces (2, 3), and hole in the crankcase with engine oil. Insert the unit pump in the crankcase using the mounting pins. Before pressing in the MR/PLD, check that the fuel feed pipe and transfer hole are aligned with each other. Carefully press in the MR/PLD unit pump by hand, to a depth of about 4 mm. If the unit pump cam on the camshaft is at the top, turn the engine by about a half-revolution (in direction of rotation). Insert the MR/PLD unit pump into the crankcase with the splined bolts, tightening slowly and alternating between bolts. Tighten the splined bolts (.....Nm)
9.	Unscrew the splined bolts (5) and pull out the MR/PLD unit pump (1)	Installation: Carefully remove dirt and paint residues from the sealing surface of the MR/PLD unit pump and from the crankcase.
10.	Check the MR/PLD unit pump	Check the roller on roller tappet; if there is only slight scoring or scratching, the MR/PLD unit pump can be used again. If there is deep scoring, scratching, or sanding spots: Install a new MR/PLD unit pump The unit pump body should not be disassembled.

	<b>Removing/installing</b>	
11.	Remove O-rings (2, 3, 4) from MR/PLD unit pump (1)	<b>Installation:</b> Clean the radial groove in the unit pump body. Coat the new o-rings with engine oil. Push protective sleeve (9, 904 589 00 14 00) over the unit pump body. First slide O-ring (2) over protective sleeve (9) into the groove, then O-ring (3). Avoid twisting the O-rings (2, 3, 4) when fitting into the grooves.
12.	Install in the reverse order	



The assembling pins (two) are shop-made from round material (St 37), to the specified dimensions.

A = M10x1.5  
 B = 10.0 mm ± 0.5 mm  
 C = 80.0 mm ± 1.0 mm  
 D = 10.6 mm ± 0.1 mm



## Unit pump classification

The BR 457, 500 and 900 unit pumps are classified at manufacture.

When each pump is installed in the engine on the assembly line at Mannheim, its classification is registered and stored in the MR electronic system.

To ensure smooth engine running, the classification values are taken into account when distributing the fuel quantity (injection timing).

To ensure that smooth engine running continues after unit pumps are replaced or modified for diagnostic purposes, the unit pump classification must be assigned to the cylinder.

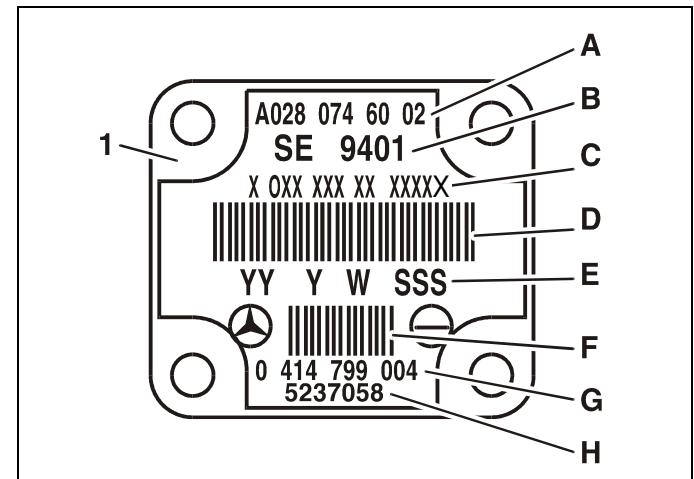
**An input error may lead to rough engine running and overloading of individual cylinders.**

**Then reset the individual cylinder torque control to "0".**

AXOR	MR
Replace the unit pump	
Cylinder	Code
1 Cylinder 1	X-XXX-XXX-XX-XXXXXX
2 Cylinder 2	X-XXX-XXX-XX-XXXXXX
3 Cylinder 3	X-XXX-XXX-XX-XXXXXX
4 Cylinder 4	X-XXX-XXX-XX-XXXXXX
5 Cylinder 5	X-XXX-XXX-XX-XXXXXX
6 Cylinder 6	X-XXX-XXX-XX-XXXXXX
Note:	
The user must read off the unit pump number on the unit pump and enter it for the corresponding cylinder. Only enter the number for unit pumps being replaced.	
Press F3 to confirm.	

The classification is coded as a 14-digit number (**C**) on the unit pump model plate. The code is entered through the "Replace Unit Pump" menu in DAS.

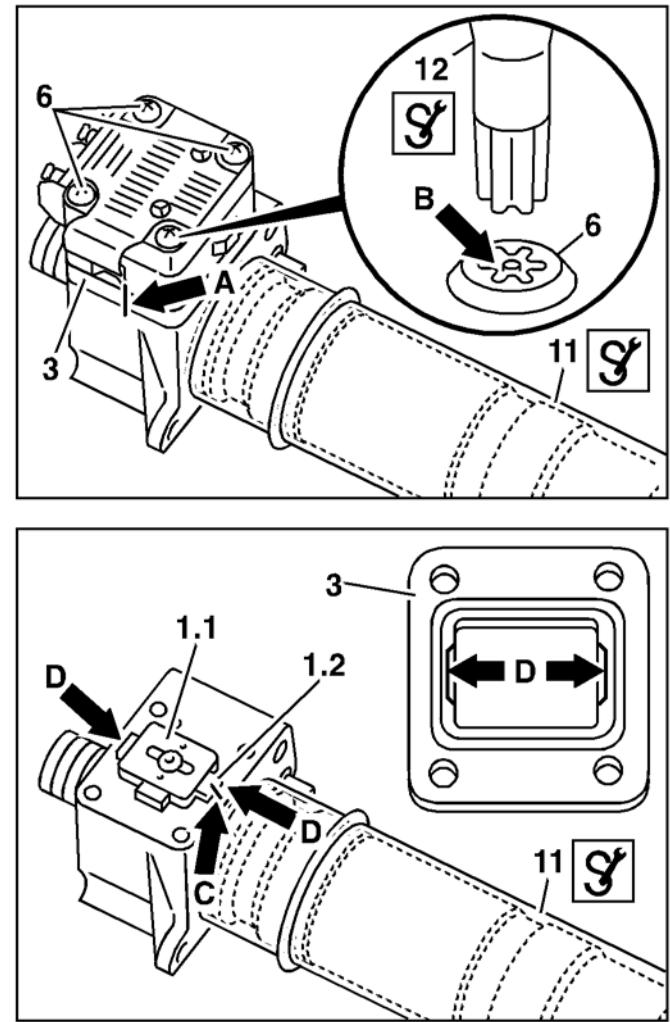
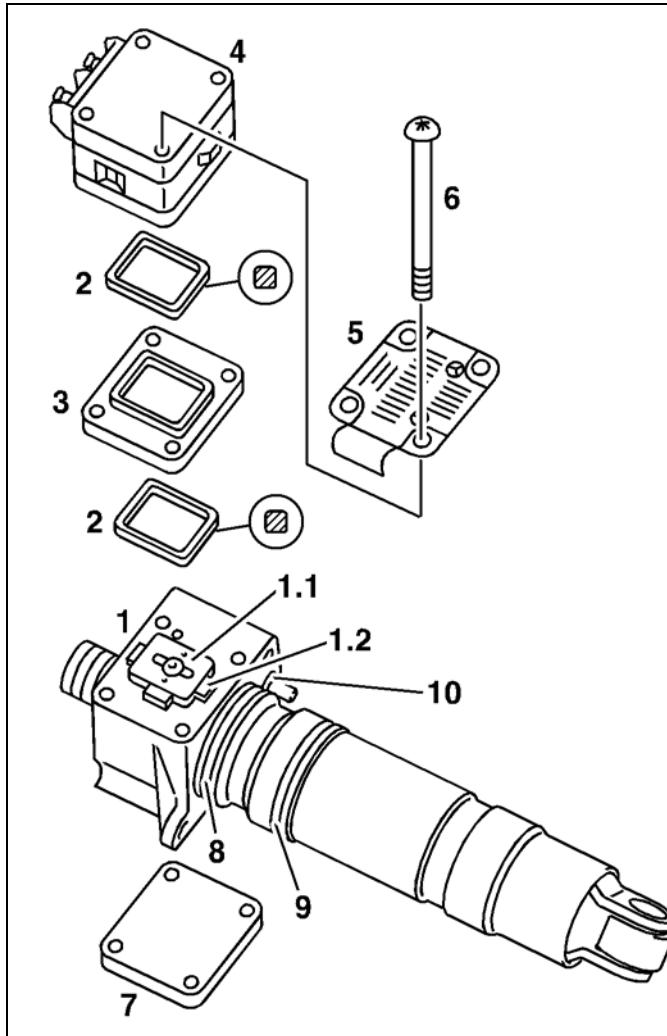
- A = MB number
- B = Certification number
- C = Unit pump number (classification)
- D = Bar code
- E, G, H = Manufacturer information
- F = Manufacturer bar code



N07.02-2028-01

## Sealing the intermediate plate of the unit pump - BR 900

- 1 Pump body
- 1.1 Anchor plate
- 1.2 Crosspiece
- 2 Seal
- 3 Intermediate plate
- 4 Solenoid
- 5 Model plate
- 6 Screw
- 7 Stop plate
- 8 O-ring
- 9 O-ring
- 10 O-ring
- 11 Sleeve
- 12 Screwdriver bit

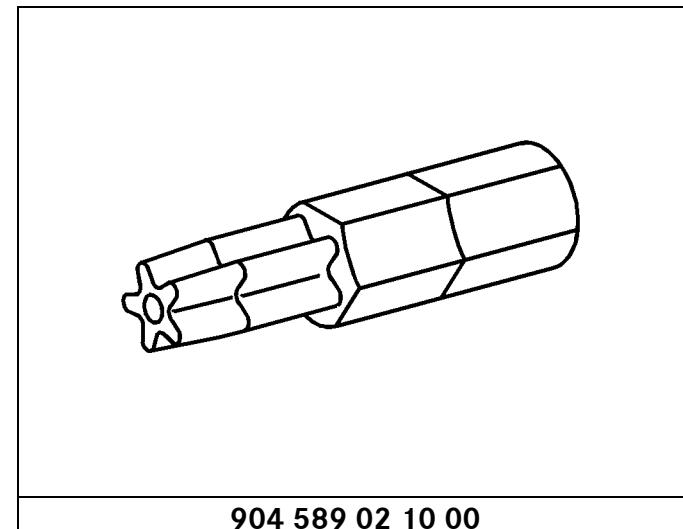
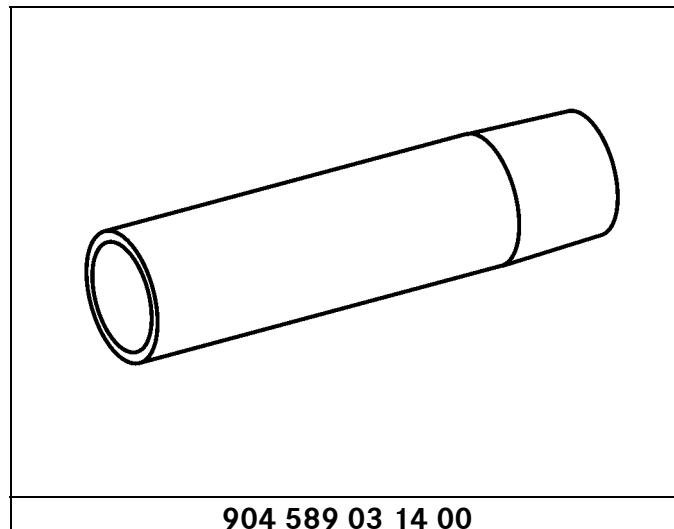
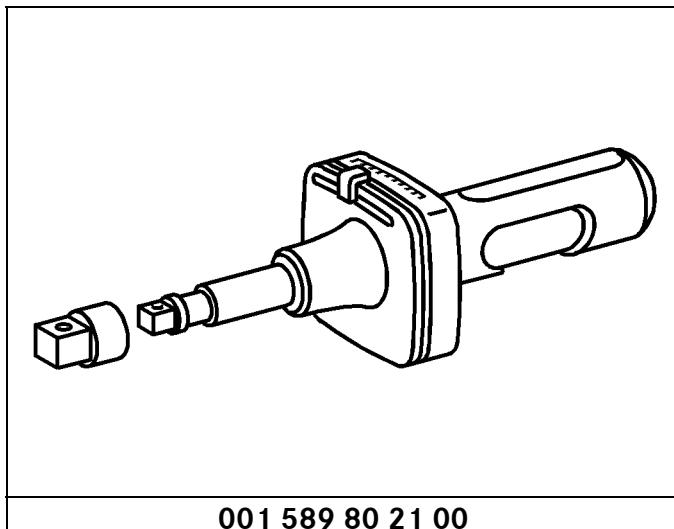


W07.15-1061-06

	To remove	
	Utmost cleanliness should be ensured whenever working on the unit pumps.	
1.	Remove the MR/PLD unit pump	
2.	Remove O-rings (8, 9, 10) from unit pump (1)	First clean the bottom part of the pump body (1).
3.	Push the sleeve (11) onto unit pump (1)	So that dirt will not get into the orifices.
4.	Clean the upper part of the MR/PLD unit pump.	Carefully remove paint residues on the sealing surfaces of the MR/PLD unit pump. The high pressure orifice must be closed off. No dirt or cleaning agent should be allowed to penetrate into the pump body (1).
5.	Identify the intermediate plate (3) (arrow A) for the pump body (1) and place the MR/PLD unit pump at stop plate (7).	Use a scribe or touch-up pencil, never a stamping tool.
6.	Loosen the screws (6), and remove solenoid (4) together with intermediate plate (3) and model plate (5).	First remove paint residues from the screw heads with a scribe (arrow B). 
7.	Remove intermediate plate (3) and model plate (5) from solenoid (4).	Clean the sealing surface of the solenoid.
8.	Take out seal (2) and clean intermediate plate (3)	Do not damage the sealing surfaces.
9.	Identify the crosspiece (1.2) and anchor plate (1.1) for pump body (1) (arrow C).	Use a touch-up pencil, never a scribe or stamping tool. The crosspiece should not be moved or turned.
10.	Apply cleaning spray to the sealing surfaces of pump body (1), crosspiece (1.2) and anchor plate (1.1).	Clean the parts carefully. Do not remove paint residues from the pump body (1), these will be needed for locating the intermediate plate (3).
11.	Take off stop plate (7)	
12.	Clean the model plate (5)	Remove paint residues around the contact surface of the screw heads. Do not remove the protective foil on the model plate.

	To install	
13.	Place new stop plate (7) under pump body (1).	
14.	Insert new seals (2) in intermediate plate (3).	 Protect the seals with grease
15.	Place intermediate plate (3) on pump body (1).	 Pay attention to the identification marks on the crosspiece (1.2) and anchor plate (1.1) for pump body (1). The cutouts (arrows D) at the opening in the intermediate plate must point towards the crosspiece (1, 2).   The paint residues are used to locate intermediate plate (3) on pump body (1).
16.	Place solenoid (4) on intermediate plate (3).	
17.	Assemble the model plate (5), solenoid(4), intermediate plate (3), pump body (1) and stop plate (7), and fasten with new screws (6).	  Tighten the screws crosswise.  904 589 021 000  001 589 021 100
18.	Take off sleeve (11)	 904 589 031 400
19.	Install MR/PLD unit pumps	 Fit O-rings (8, 9 and 10), following the installation specification.

<b>Nm</b> Diesel injection system with unit pumps		Engine 904.9, 906.9
Screw, solenoid valve to MR/PLD unit pump	Step 1 [Nm]	2
	Step 2 [Nm]	4



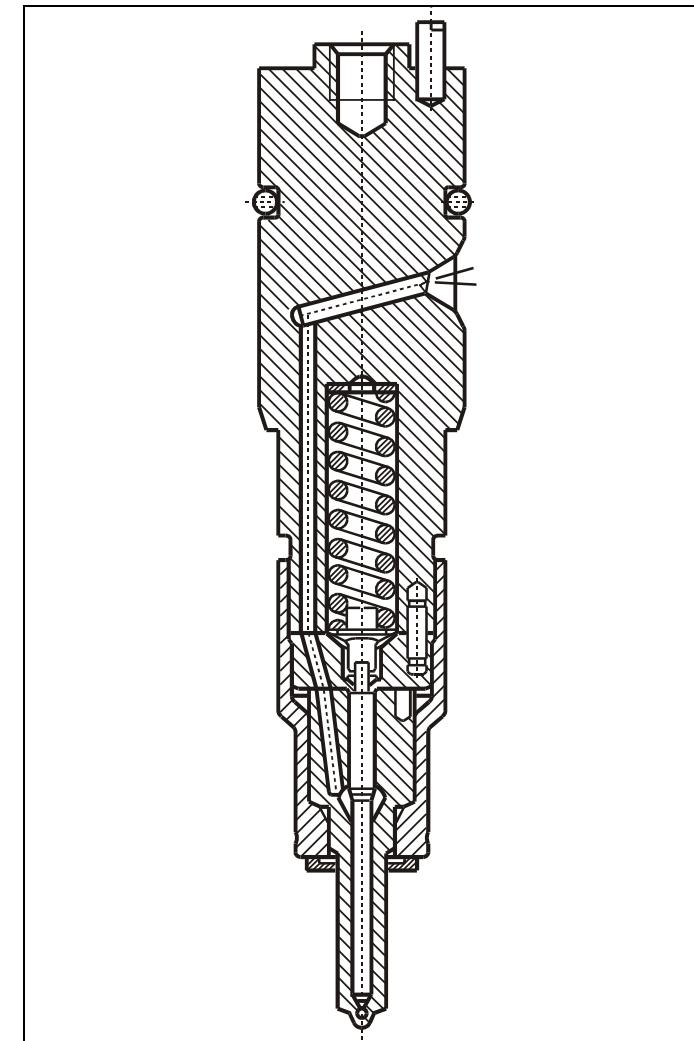
## Injection nozzle - BR 900

The injection nozzle does not have a leak oil hole. This causes pressure to build up in the spring chamber. This pressure acts like a hydraulic spring, and takes on the function of a second coil spring.

The injection characteristics are similar to those with a 2-spring retainer. The spring chamber pressure depends on load and rpm, and can reach a maximum of 180 bar. The spring chamber pressure has little effect at low engine speeds and loads, but has a strong effect at high engines speeds and loads.

This gives an injection nozzle opening pressure varying from about 250 to 500 bar.

**Note:** this nozzle cannot be checked or adjusted by Bosch Diesel services.



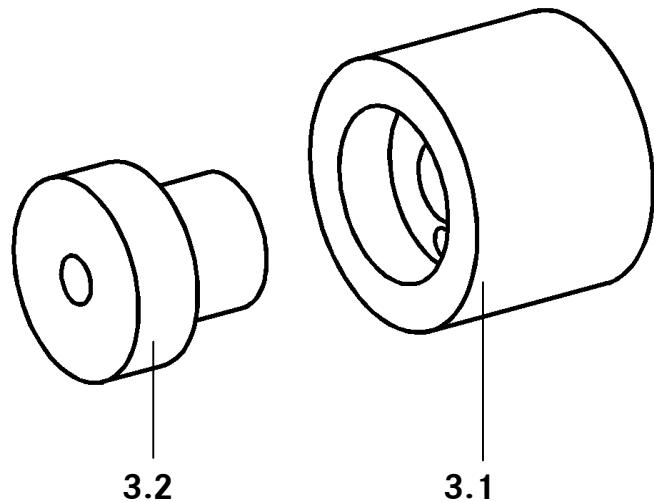
N07.03-2018-03

## Injection nozzle OM 906 LA

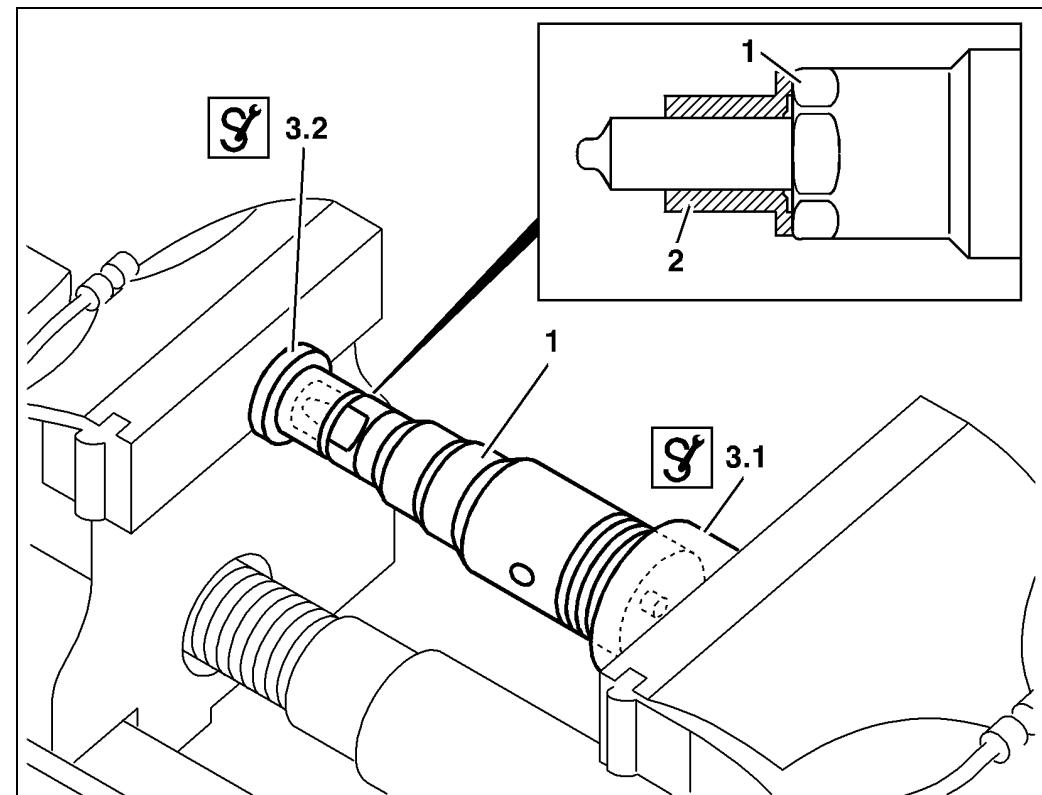
For the introduction of the OM 906 LA engines, the new injection nozzle with sealing sleeve was used for thermal reasons. If an injection nozzle is removed during repairs, the sealing sleeve must always be replaced as well. A special tool must always be used to fit the sealing sleeve.

### Pressing the sealing sleeve onto the injection nozzle

- 1 Nozzle holder combination
- 2 Sealing sleeve
- 3.1 Mounting socket (for nozzle holder head)
- 3.2 Assembly sleeve (for sealing sleeve)



906 589 00 63 00



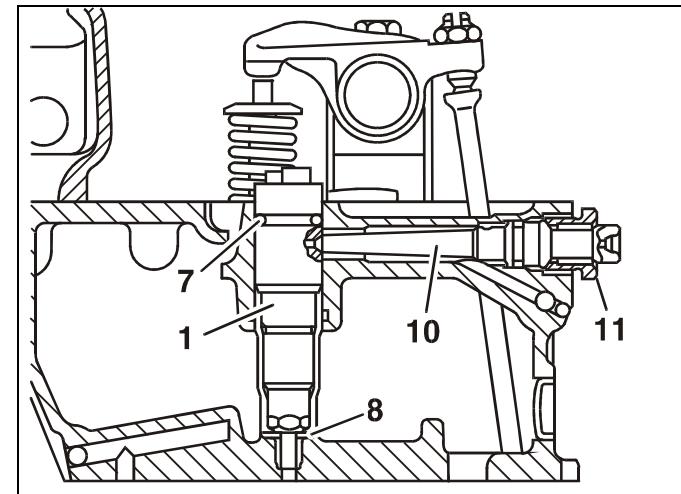
W07.03-1003-11

## Location of pressure pipe connection, nozzle holder combination, and nozzle protective sleeve

The pressure pipe with integral pin-type filter forms the connection from the high-pressure injection line to the vertical, centrally positioned nozzle holder combination with the injection nozzle.

The nozzle holder combination is placed inside a protective sleeve and is attached to the cylinder head by means of a clamping claw. The combustion gas seal consists of a copper ring or sealing sleeve.

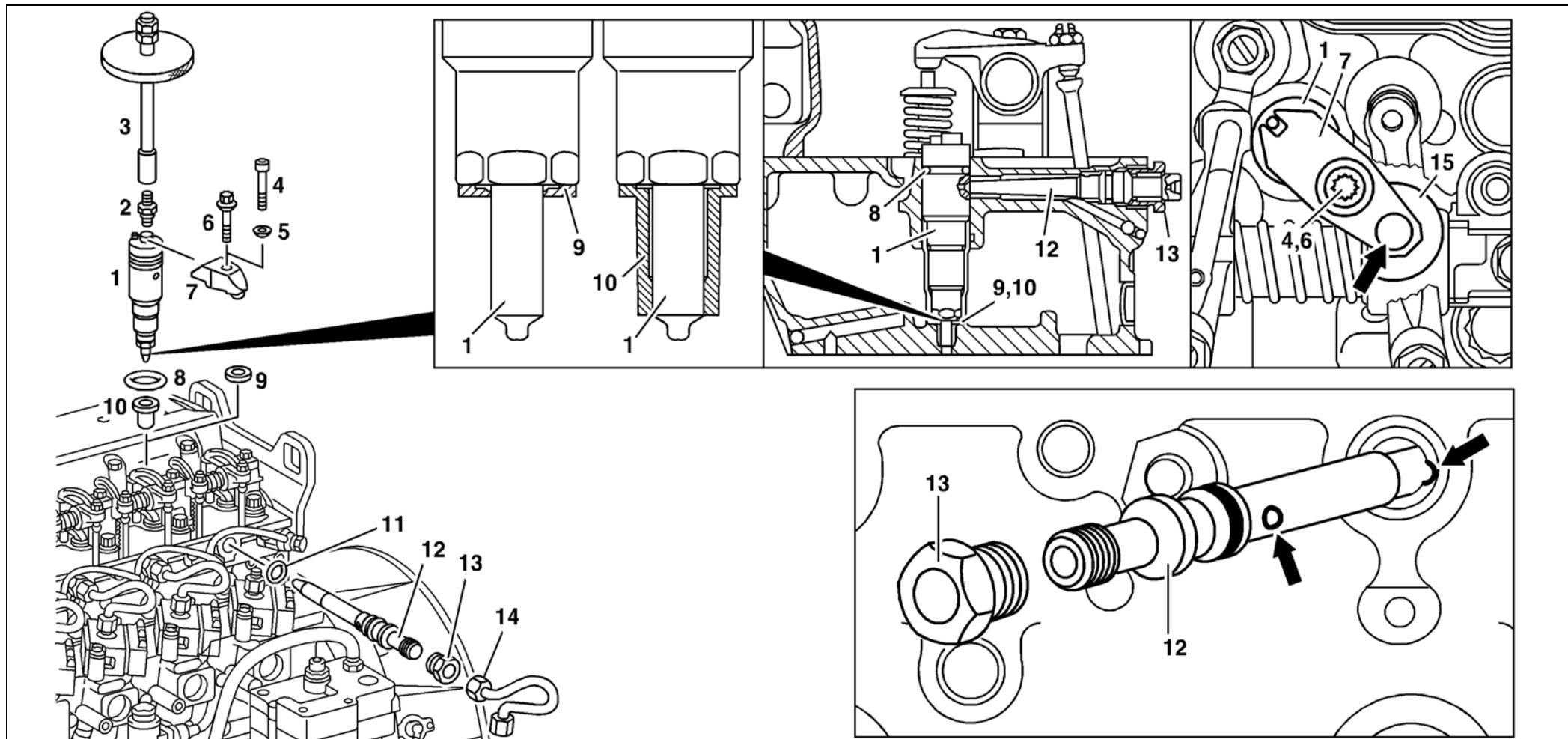
The protective sleeve itself is protected from the coolant by an O-ring, and on the pressure side by the thread and the contact surface.



N07.03-2038-01

- 1 Nozzle holder combination
- 7 O-ring
- 8 Copper sealing ring
- 10 Pressure pipe connection
- 11 Pressure screw

## Removing/installing the nozzle holder combination



- 1 Nozzle holder combination  
 2 Adapter 904 589 00 63 00  
 3 Extractor 355 589 01 63 00  
 4 Screw (up to End No. 046892), 30 Nm  
 5 Spherical washer (up to End No. 046892)

- 6 Spherical collar bolt (from End No. 046893), 35 Nm  
 7 Retaining clip  
 8 O-ring  
 9 Sealing ring (906 engine up to End No. 056812)  
 10 Sealing sleeve (906 engine from End No. 056813)

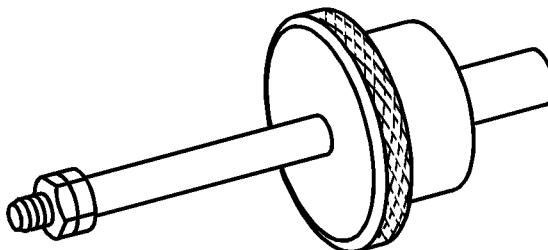
- 11 O-ring  
 12 Pressure pipe connection  
 13 Pressure screw, 40 Nm  
 14 Injection line  
 15 Constant throttle cap

W07.03-1008-09

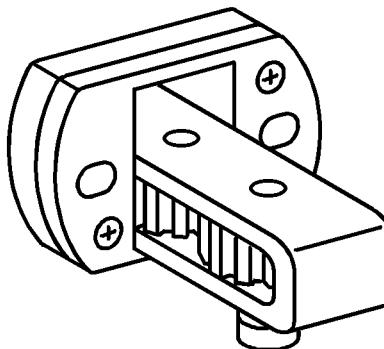
	<b>To remove</b>	
1.	Remove the cylinder head cover.	
2.	Risk of explosion due to gas ignition, risk of poisoning by inhaling or absorbing fuel, or risk of injury to skin and eyes through contact with fuel.	Fire, sparks, naked flames, smoking are forbidden. Only store fuel in suitable and appropriately marked containers. Wear protective clothing if handling fuel.
3.	Remove injection line (14)	
4.	Remove pressure pipe connection (12)	
5.	Remove retaining clip (7)	
6.	Fit the adapter (2) and extractor (3) to the inside thread (M 8) of nozzle holder combination (1)	Adapter: 904 589 00 63 00 Extractor: 355 589 01 63 00
7.	Take out nozzle holder combination (1)	The nozzle holder combination should not be disassembled. If worn or faulty, install new nozzle holder combination.
8.	Remove the adapter (2) and extractor (3) from nozzle holder combination (1)	
9.	Take out sealing ring (9).	All 904 engines and 906 engine up to End No. 056812 Note the thickness of the removed sealing ring (gives nozzle projection at the cylinder head separating surface).
10.	Pull sealing sleeve (10) out of nozzle holder (1)	906 engine from End No. 056813 If sealing sleeve (10) remains stuck: pull sealing sleeve (10) out of cylinder head Extracting tool 906 589 02 63 00 Adapter 904 589 00 63 00 Extractor 355 589 01 63 00

<b>To install</b>	
11.	Replace O-ring (8) on nozzle holder combination (1)
12.	Place sealing ring (9) at nozzle holder combination (1)
13.	Press new sealing sleeve (10) onto nozzle holder combination (1)
14.	Install nozzle holder combination (1)
15.	Tighten the retaining clip (7) and spherical washer (5) with the bolt (4)
16.	Tighten the retaining clip (7) and spherical collar bolt (6)
17.	Replace O-ring (11) on pressure pipe connection (12)
18.	Install the pressure pipe connection (12) and tighten the pressure screw, 40 Nm.
19.	Install the injection line (14)
20.	Fit the cylinder head cover

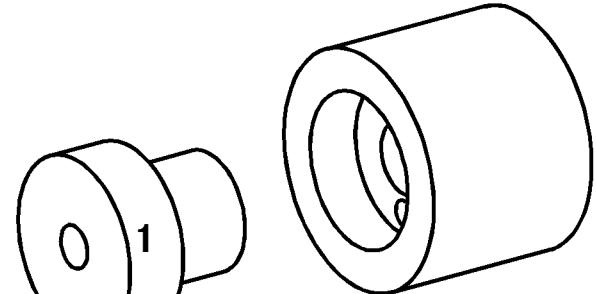
## Special tools



355\_589\_01\_63\_00



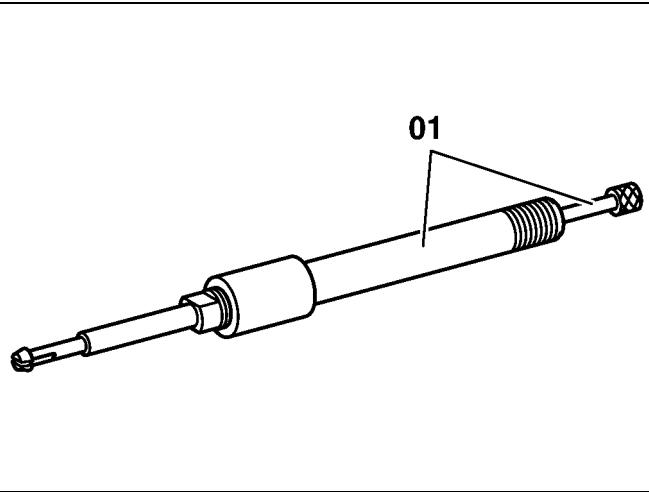
904\_589\_00\_63\_00



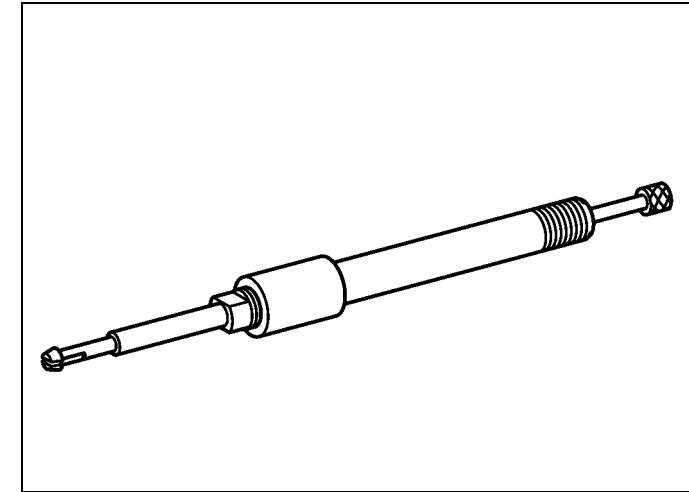
906\_589\_00\_63\_00

### Remarks:

- 5.) Extracting tool 906 589 02 63 00 is now usually supplied together with the extension.
- 6.) From April 2003, for new orders under the existing number, special tool 906 589 00 63 00 is supplied with modification to Part 1. To extend existing tools, the modified Part 1 can also be ordered separately under number 906 589 00 63 01.



906\_589\_02\_63\_00



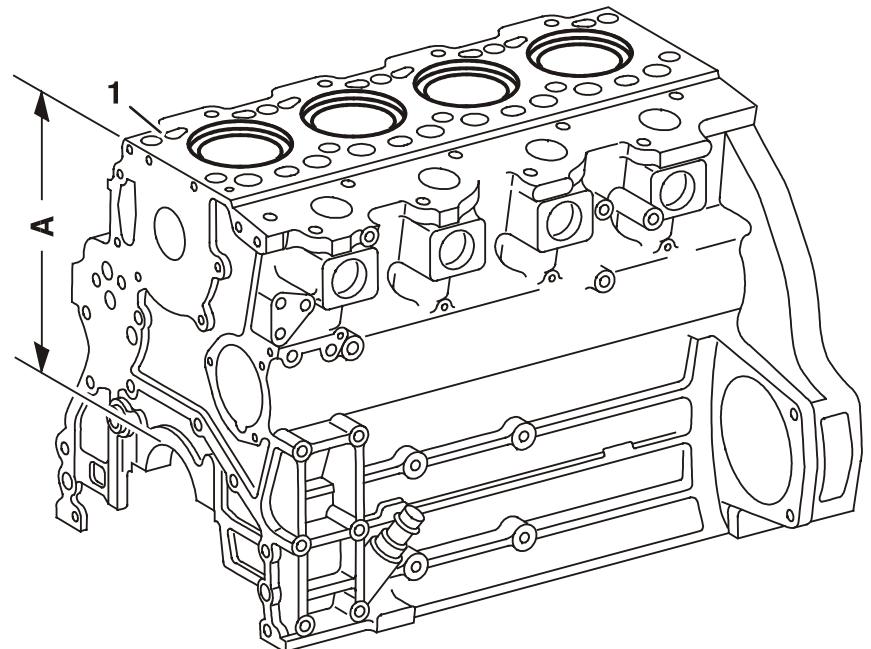
Extracting tool extension

906\_589\_02\_63\_01

All engines are based on the particularly stable, noise-optimized crankcase, which is made of a high-carbon / cast iron alloy.

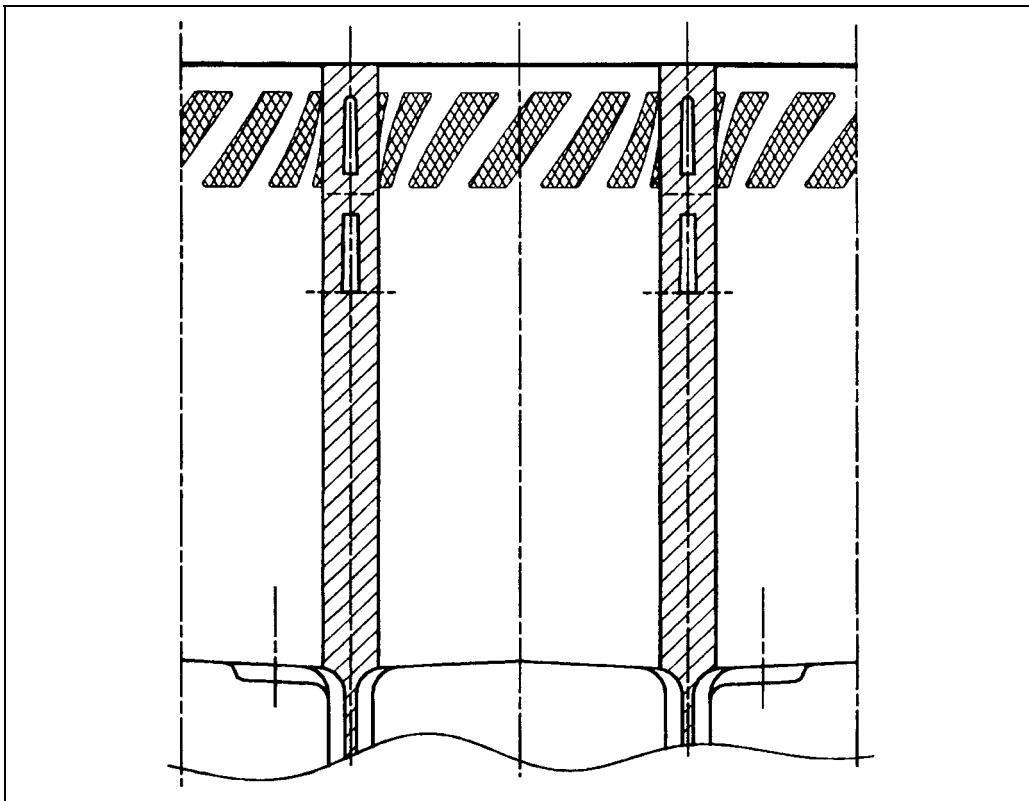
#### Design features:

- Both the 4 and the 6-cylinder engine have only one variant.
- Compact design through integration of the oil cooler, the unit pumps, and the coolant, fuel and oil ports.
- Highly rigid, high carbon /cast iron alloy.
- Rigid sidewalls, extending well past the center of the crankshaft.  
This means that the separating surface of the oil pan is located lower than the level of the crankshaft center.
- The front engine mount is located at cylinder 2.
- Induction-hardened cylinder contact surfaces.
- Dry cylinder liners can be inserted.
- On the left on the flywheel side, an assembling lug is provided for attaching the compressor with power steering pump.



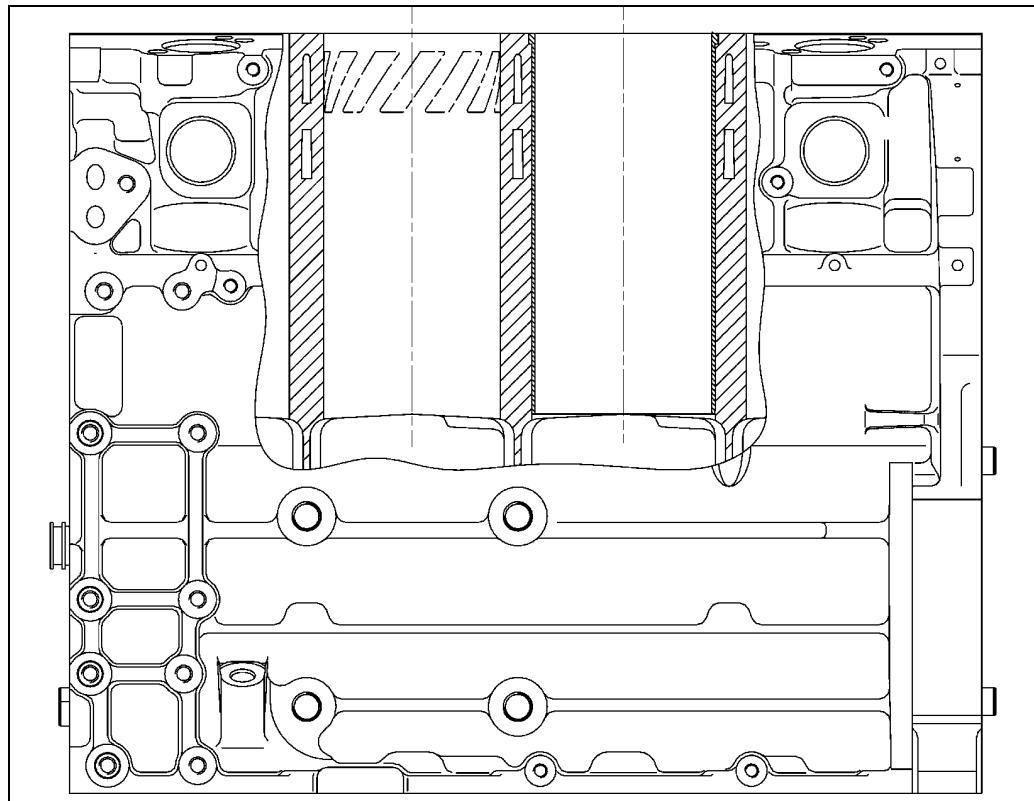
W01.40-1017-11

## Induction-hardened cylinder contact surfaces and liners



N01.40-2033-11

Cylinder contact surfaces with induction-hardened strips are provided at the upper piston return point, around the rings, to increase engine life.



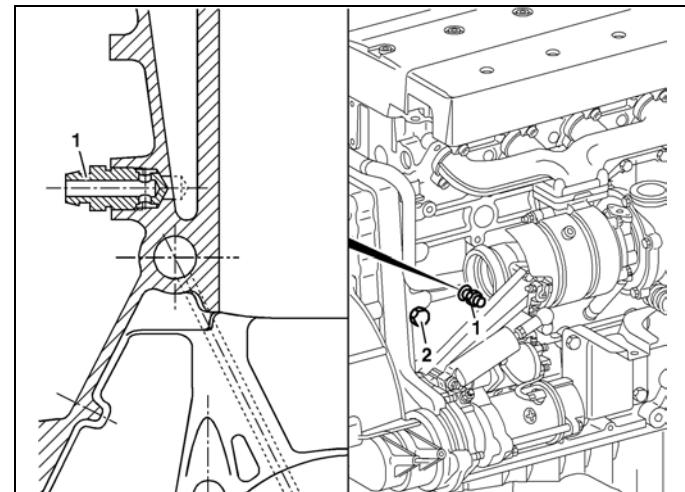
N01.40-2032-11

Cylinder liners can be inserted for repairs. Drillings are provided in the crankcase for this purpose.

## Coolant drain plug

A coolant drain plug (1) is fitted to the crankcase, to allow easier draining of the coolant circuit.

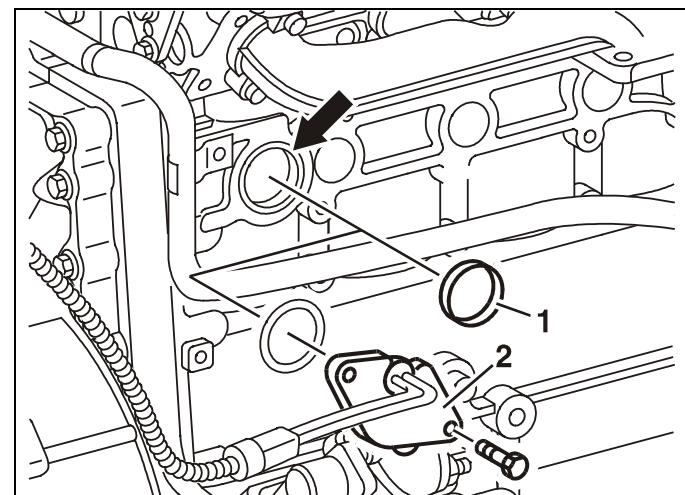
The screw plug (2) in the main engine oil duct is mounted with Loctite 221.



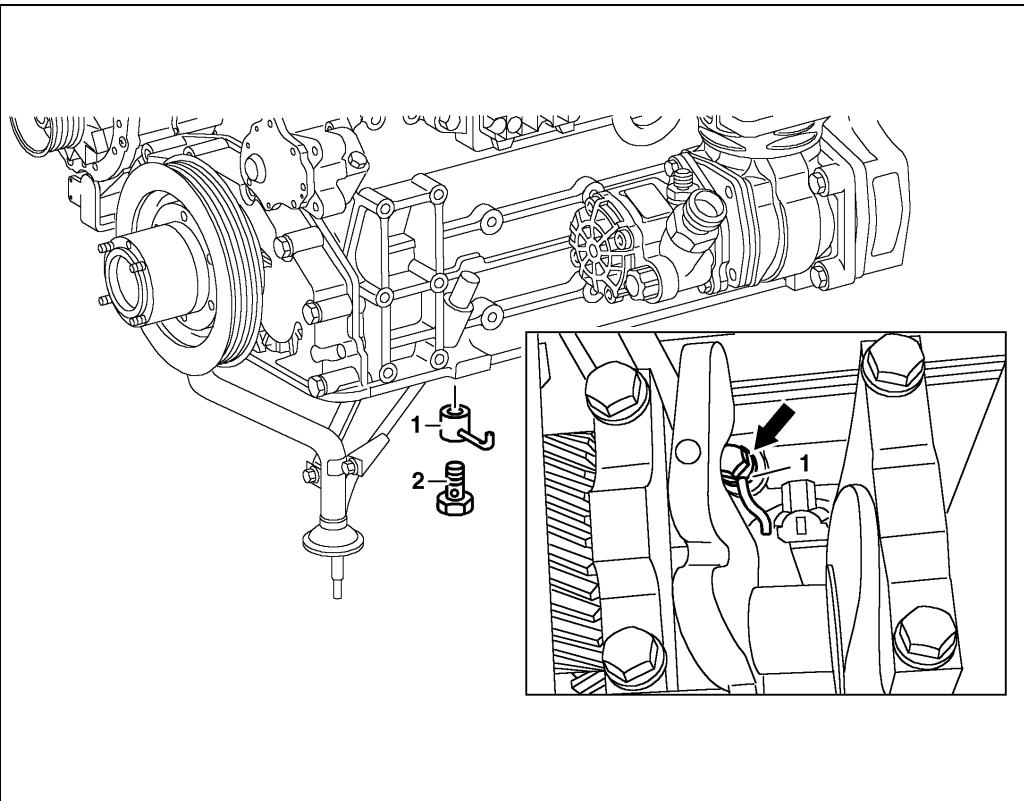
N01.40-2051-11

## Engine block heater connection

From about 03/99, an additional hole  $\varnothing$  60 mm is provided at the right rear (arrowed) of the crankcase. This hole is fitted with a cap (1) as standard. The cap is removed if installing an engine block heater (special equipment) (2).

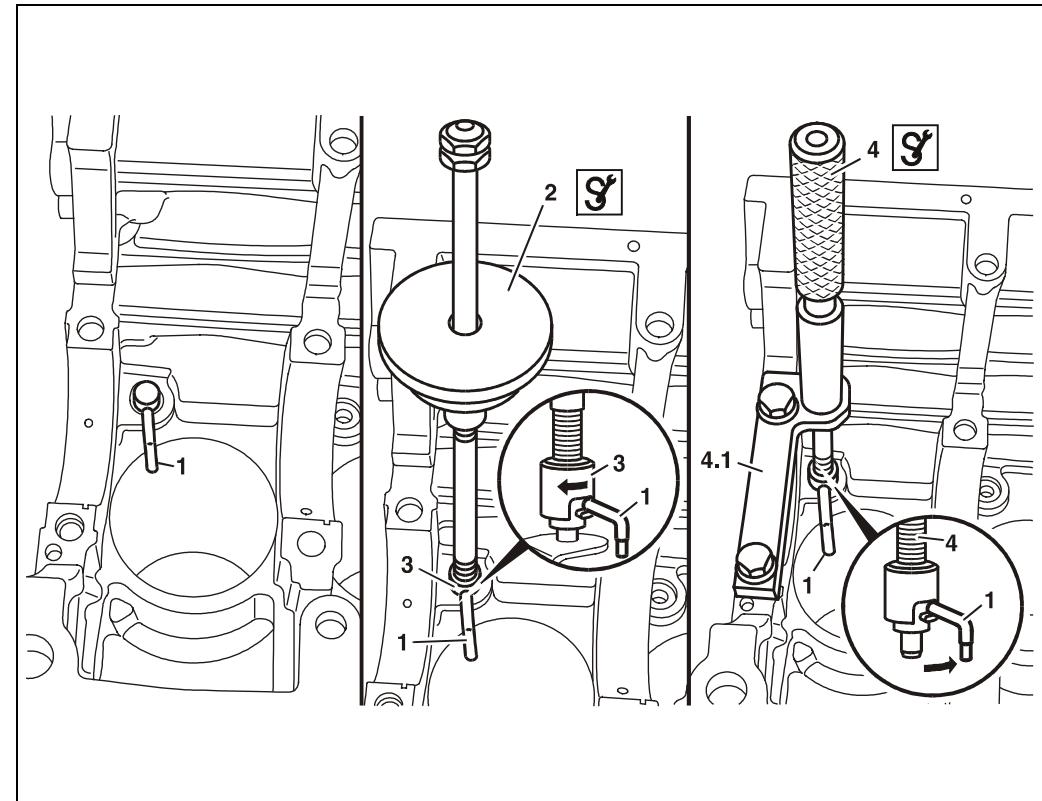


N01.40-2058-01



W18.00-0002-05

Version 1: Screw-in oil spray nozzle



W18.00-1004-05

Version 2: Press-in oil spray nozzle

The crankcase must be removed to install/remove the oil spray nozzle. To ensure the correct spray direction for the piston cooling, the press-in oil spray nozzles (1) must only be removed/installed with the correct special tools.

Pistons and piston rings are among the most highly stressed engine components. Pistons are therefore constructed of high-temperature aluminum alloy. The piston top land and stem are graphite-coated to increase running-in and limp-home capability.

There is a cast-in, reinforced ring groove for the first piston ring.

The piston pin support is trapezoidal in shape, to increase the pressure-load surfaces on the piston and connecting rod.

Features of the piston rings:

Groove 1: Compression ring

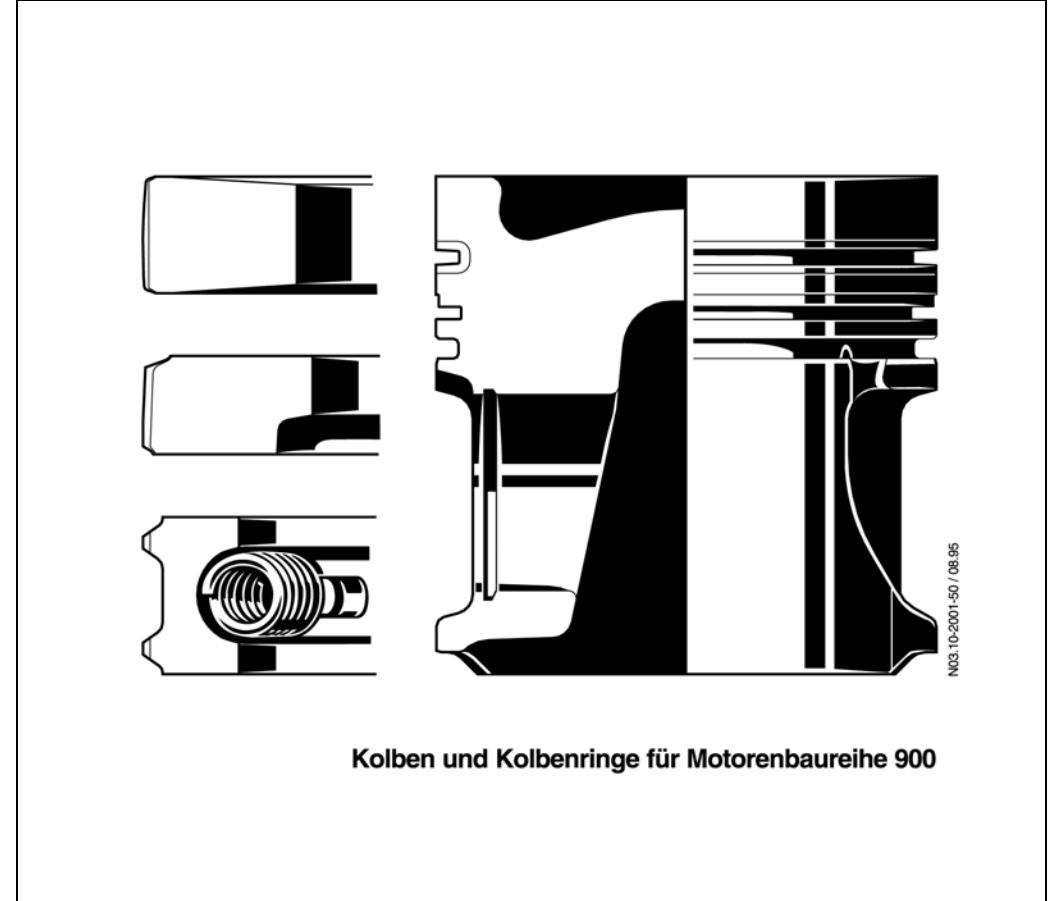
Cast-iron keystone ring with plasma spray layer of chrome-ceramic, spherical-lapped.

Groove 2: Compression ring with oil-scraper action.

Chrome-plated taper-faced ring with internal angle underneath.

Groove 3: Oil scraper ring

Roof bevel ring with chrome-plated, lapped lands and garter springs.



A particular feature of the manufacturing technology used to produce the forged steel connecting rod is the 'cracking' process used to separate the rod from the bearing cap.

With this process, the connecting rod (produced in one piece up to now) is split at the big connecting rod eye at an exactly pre-determined fracture line. The separated parts are then bolted together to form a precise, exact-fitting attachment for the bearing.

**Note:**

Because of the 'cracked' surface structure, special care and cleanliness is required when performing repairs.



N03.10-2025-10

From about 11/99, because of the new piston pins for Euro 2 engines (2), with 42.0 mm diameter (previously 40.0 mm) and 80.0 mm length (previously 78.0 mm), the pistons (1) and connecting rods (3) had to be modified also.

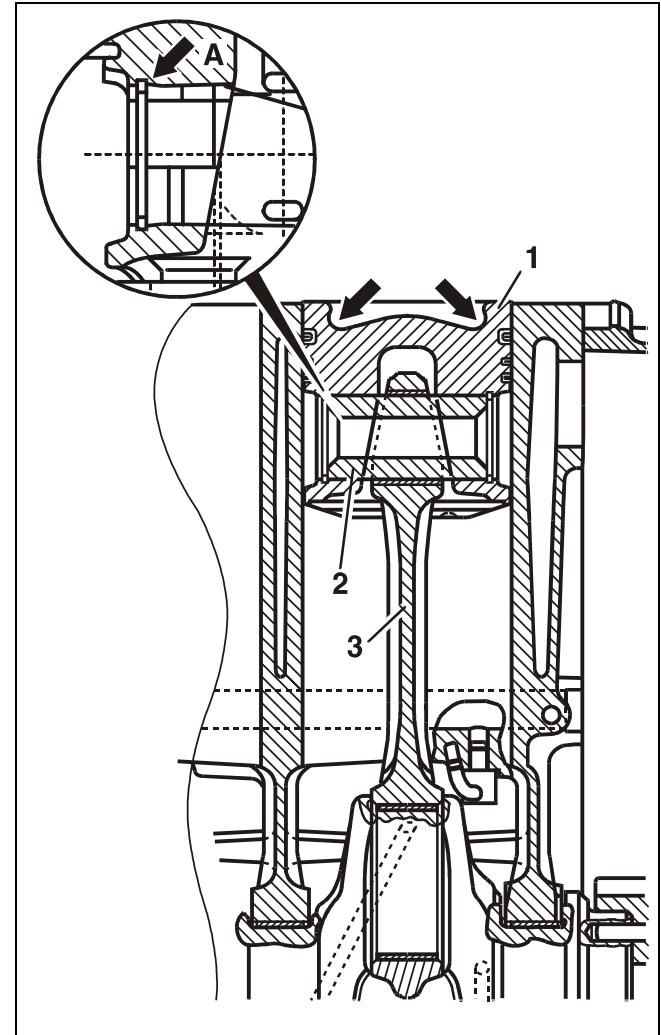
As standard for Euro 3 engines with  $\varnothing$  102 mm cylinders

Pistons of  $\varnothing$  102 mm with combustion chamber recess diameter of 73.08 mm and depth of 13.57 mm, giving a chamber recess volume of  $46.96 \pm 0.6 \text{ cm}^3$

(Euro 2 pistons of  $\varnothing$  102 mm with combustion chamber recess diameter of 75.0 mm and depth of 13.0 mm, giving a chamber recess volume of  $50.36 \pm 0.6 \text{ cm}^3$ )

As standard for Euro 2 engines with  $\varnothing$  106 mm cylinders

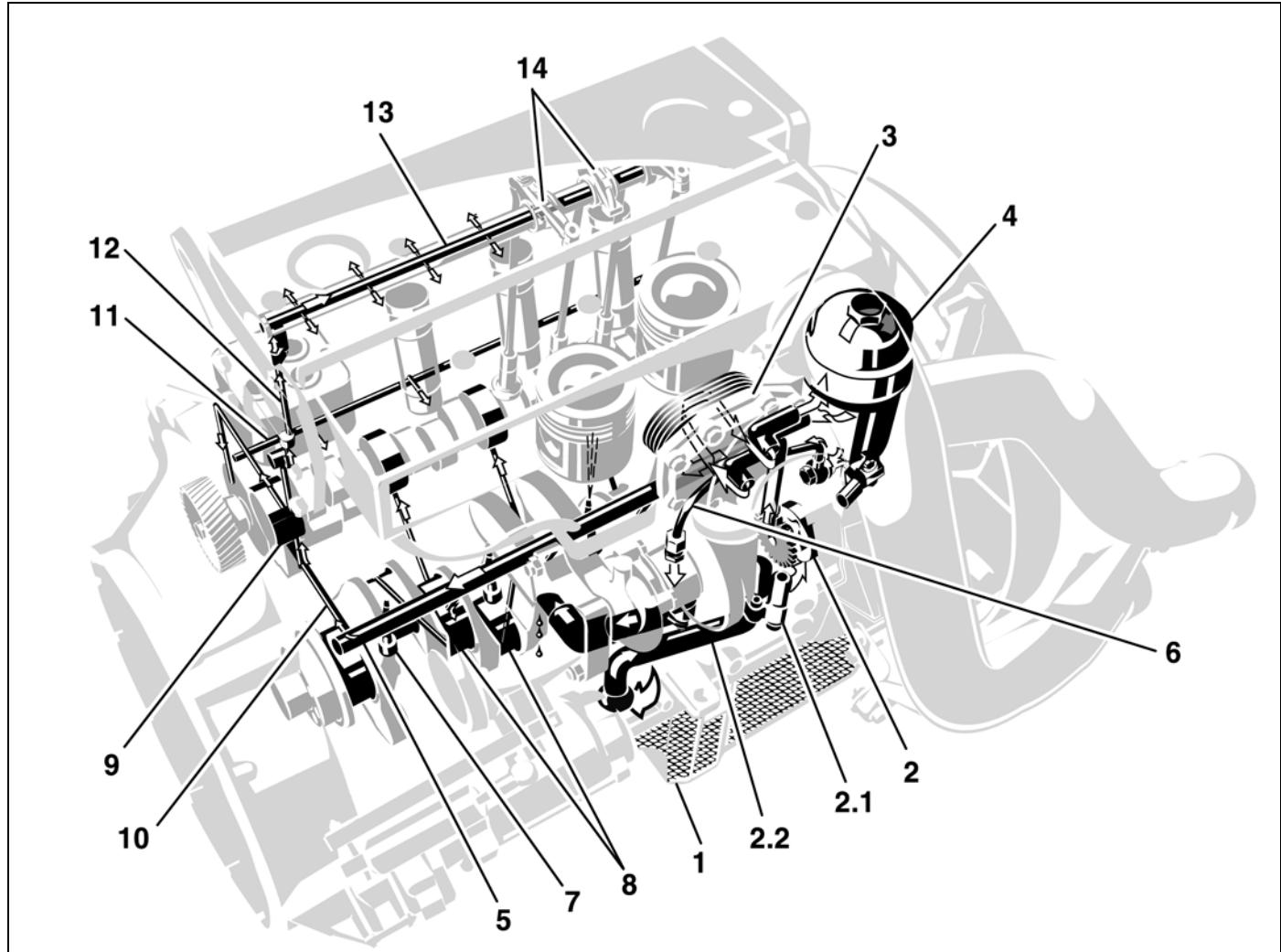
Pistons of  $\varnothing$  106 mm (Euro 2) with combustion chamber recess diameter of 78.0 mm and depth of 13.4 mm, giving a chamber recess volume of  $58.25 \pm 0.6 \text{ cm}^3$



N03.10-2047-03

Shown on 904.9 engine

- 1 Oil pan
- 2 Oil pump
- 2.1 Pressure limiting valve
- 2.2 Oil pump strainer with oil intake tube
- 3 Oil/water heat exchanger
- 4 Oil filter housing
- 5 Main oil duct
- 6 Oil pressure line to turbocharger
- 7 Oil spray nozzle
- 8 Main con-rod bearing on crankshaft
- 9 Camshaft bearing
- 10 Oil rear cross duct
- 11 Oil duct to unit pumps
- 12 Oil duct to cylinder head
- 13 Rocker arm spindle
- 14 Rocker arm with oil hole



W18.00-1005-06

Engine lubrication reduces the mechanical wear on moving parts and makes their work easier. At the same time, the parts are cooled and impacts absorbed.

**The most important components of the engine lubrication / cooling system are:**

Oil pan

Oil pump with pressure limiting valve

Oil/water heat exchanger

Oil filter housing with oil filter, drain valve, filter bypass valve, and oil retention valve (return flow check valve)

Oil spray nozzles

Main oil duct, oil cross duct. oil ducts (cylinder head unit pumps) with oil lines

Rocker arm spindle

**Oil pump**

The oil pump consists of a gear type pump and is located in the front end cover. It is driven by the crankshaft. It delivers the engine oil from the oil pan through an oil duct to the oil/water heat exchanger.

**Pressure relief valve**

The pressure relief valve is located under the oil pump and maintains the oil pressure at 3 to 4 bar. If too much oil is delivered at high engine speeds, the pressure relief valve opens and allows the engine oil to flow directly from the oil pump back to the oil pan.

**Oil/water heat exchanger**

The oil/water heat exchanger is located on the right side of the crankcase.

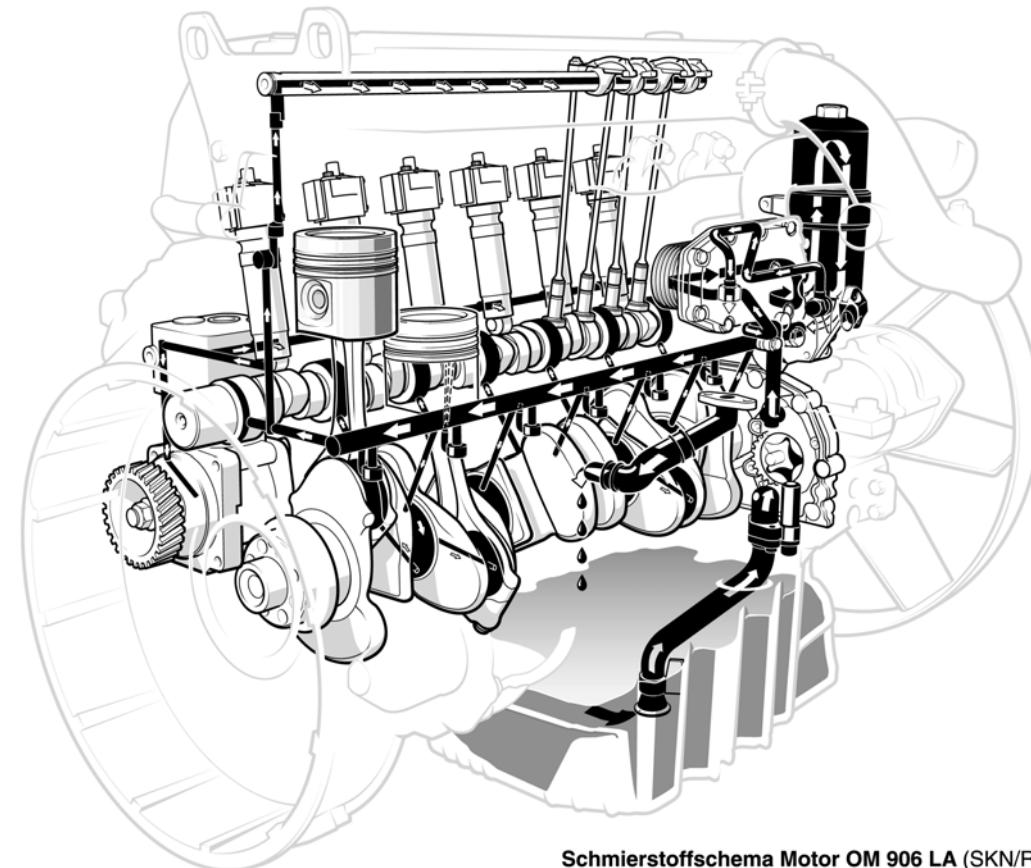
The engine oil flows through the plates (8 elements) in the oil/water heat exchanger, and these are washed around by the engine coolant. Since the engine coolant is at a considerably lower temperature than the engine oil, the coolant absorbs the heat from the engine oil and cools it down to engine operating temperature. During cold starts, the engine oil is heated by the surrounding coolant through the oil/water heat exchanger.

## **Oil ducts and oil lines**

Oil ducts are integrated into the crankcase and cylinder head. The oil pressure lines to the turbocharger and power take-off (special equipment, fitted to the crankcase) are located externally.

The other oil ducts to the crankshaft bearings and oil spray nozzles are supplied with engine oil through the main oil duct, located on the right side of the crankcase. Other oil ducts lead in the crankcase from the individual crankshaft bearings and to the camshaft bearings. The connecting rod bearing is supplied with engine oil through oil ducts integrated into the crankshaft.

Engine oil is fed from the main oil duct to the compressor and cylinder head through an oil duct system in the rear wall of the crankcase. A further longitudinal oil duct on the left side of the crankcase supplies engine oil to the MR/PLD unit pumps. Engine oil is delivered to the last rocker arm bearing bracket through holes in the cylinder head gasket and the oil duct in the rear of the cylinder head. From the rocker arm spindle bearing bracket, oil then passes to the rocker arm spindle and all the rocker arms.



N18.00-2004-50

It then passes through the oil holes in the rocker arms and also supplies the valve assembly. The oil ducts in the crankcase are partly closed with screw plugs or balls. The oil then flows back to the oil pan through oil return holes in the cylinder head and crankcase.

## **Oil filter**

The oil filter housing is fitted to the right front of the crankcase. It contains an oil filter insert, made of paper. The oil filter insert is clipped into the oil filter cover. The oil filter insert is replaced from the top. When the filter cover is unscrewed, engine oil in the filter housing flows through the drain valve back into the oil pan.

## **Drain valve**

The drain valve is located in the oil filter housing under the filter insert, and opens when the filter cover is unscrewed. This ensures a cleaner filter change and less environmental pollution by reducing the amount of residual oil in the old filter.

## **Filter bypass valve (opening pressure 1. 8 - 2. 6 bar)**

The filter bypass valve is located in the top dome (filter housing) of the oil filter insert. The normal position of the filter bypass valve is closed. If the oil filter insert is clogged, the pressure increase in the filter housing opens the filter bypass valve. This ensures that the engine is lubricated, although the engine oil passing through the bypass valve is unfiltered.

## **Oil retention valve (return flow check valve)**

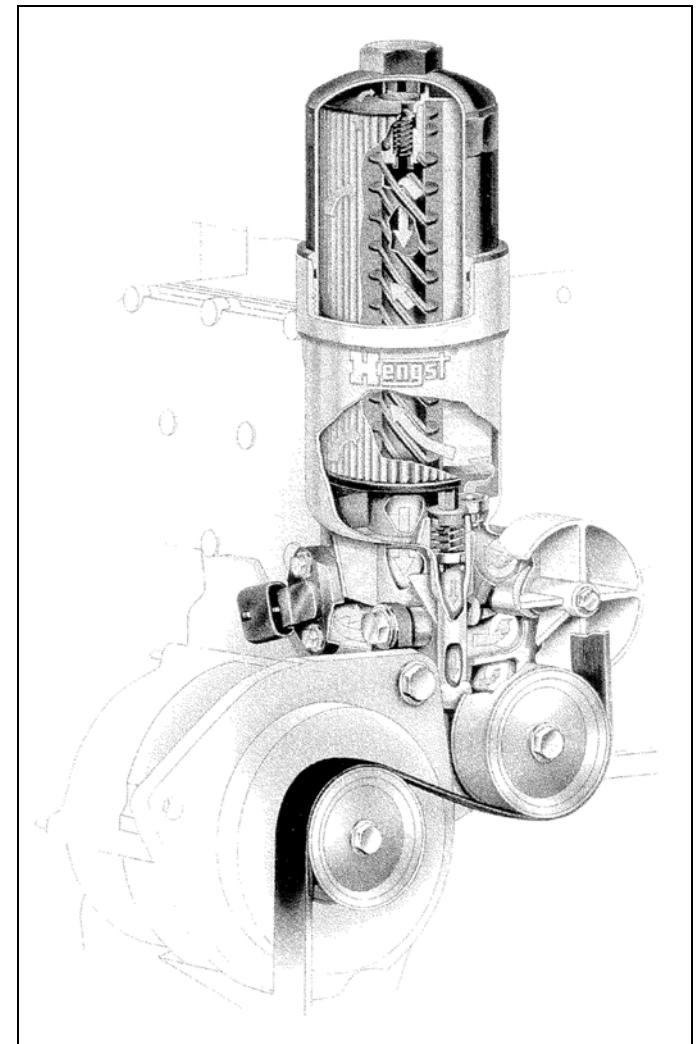
The oil retention valve (opening pressure 0. 03 - 0. 07 bar) is placed in the oil filter housing and is intended to prevent the engine oil in the oil ducts from flowing back into the oil pan when the engine is stopped. The oil ducts are therefore always filled with oil. When the engine is restarted, this ensures that components always receive optimal lubrication immediately.

## **Oil spray nozzles**

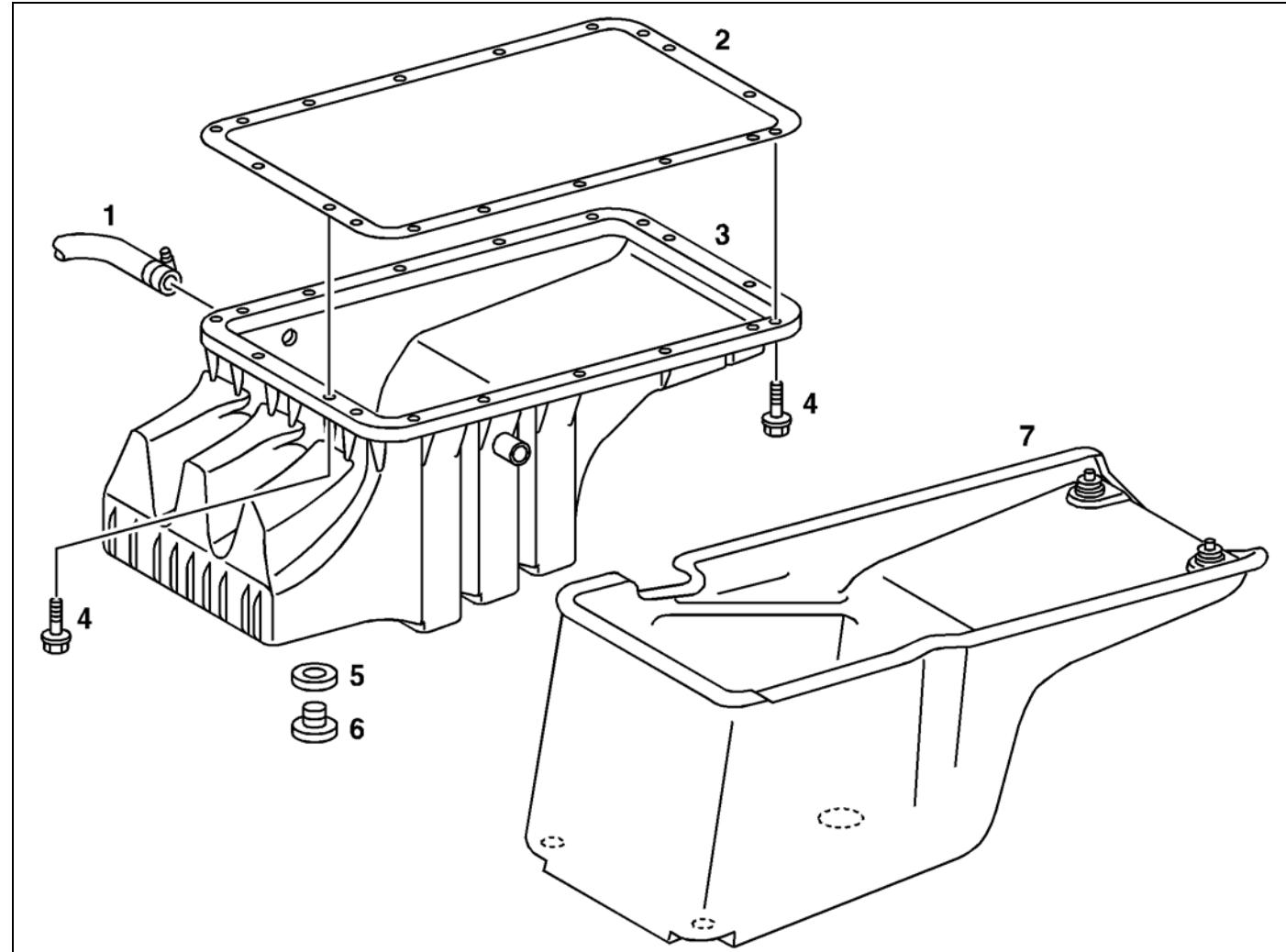
The oil spray nozzles are located in the crankcase. There is one oil spray nozzle per cylinder. The oil spray nozzles spray engine oil continuously under the piston crowns to cool them down. Oil is supplied to the oil spray nozzles through the main oil duct.

## **Combination oil temperature sensor/ pressure sensor**

The oil temperature sensor and oil pressure sensor are located on side of the oil filter housing.



N18.20-2021-03



W01.45-0004-06

## Procedure for removal/installation of the oil pan

1	Suction off the engine	
2	Remove oil filler line (1) from the oil pan	
3	Remove oil pan (3)	<p><b>i</b> <b>Installation:</b> Clean the oil pan and separating surface on the crankcase. Replace the sealing ring (2); note the installation location.  OM 904 only: From engine End No. 004 313 to End No. 004 449, one bolt is shortened; note the location at left rear of the oil pan (compressor side).</p> <p><b>Nm</b> Oil pan bolt to crankcase</p> <p><b>i</b> <b>Installation:</b> Replace the sealing ring (5)</p> <p><b>Nm</b> Oil drain plug</p>
4	Install in the reverse order	
5  <b>Danger!</b>	Check the oil level with the oil dipstick <b>Risk of accident</b> due to vehicle starting off while engine is running. <b>Risk of injury</b> due to crushing or burns if components are touched during the start-up procedure or when the engine is running	Secure the vehicle to prevent it starting off automatically. Wear closed and snug-fitting work clothes. Do not touch hot or rotating parts.
6	Start the engine and watch the oil pressure display at idle speed	 Start the engine with the starter for 90 seconds maximum. Repeat the starting procedure after waiting about 2 minutes. Do not rev the engine until oil pressure is indicated. <p><b>i</b> The oil pressure gauge must show the oil pressure after about 10 seconds.</p>
7	Stop the engine and check for leaktightness	

### Engine oil pressure test values

Designation		Engine 904.9, 906.9
Engine oil pressure at	Idle speed [bar]	≥ 0.5
	Maximum rpm [bar]	≥ 2.5

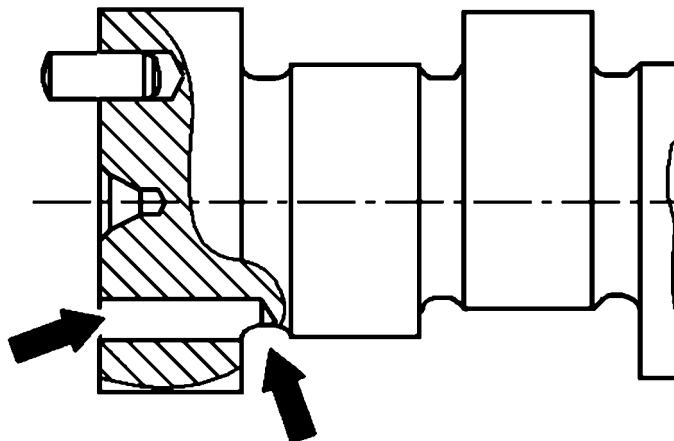
### Oil pan bolt tightening torques

Nm Oil pan		Engine 904.9, 906.9
Oil pan bolt to crankcase	[Nm]	25
	M 20x1.5 [Nm]	65
	M 26x1.5 [Nm]	85



**Camshaft**

Fuel pump drive



N05.20-2013-10

Arrow indicates oil hole for  
lubrication of the fuel pump drive

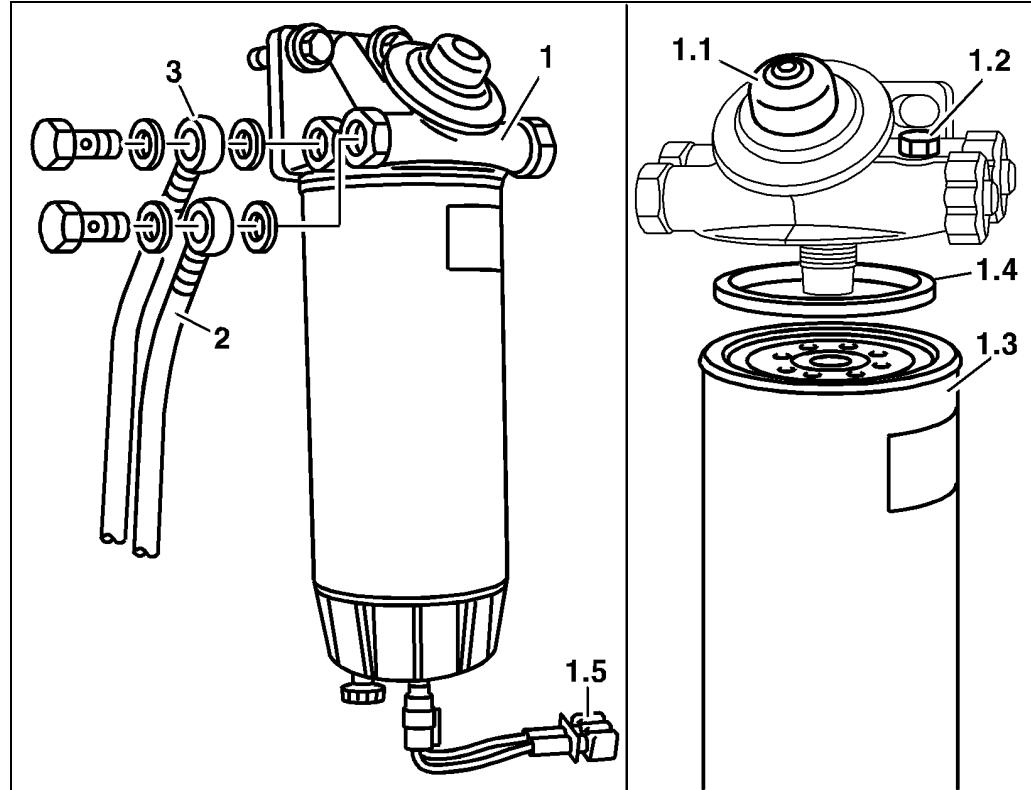
## Fuel prefilter with heated water separator

In countries where the fuel is considered to be heavily contaminated and to have high water content, an additional fuel filter with integrated water separator (including manual feed pump) is **highly recommended**.

**Vehicles that are run in countries of Eastern Europe, or filled with fuel from those countries, must be fitted with a prefilter.**

### Advantages to the customer:

- Increased durability of the injection system
- Long maintenance intervals despite difficult operating conditions
- Greater economy through shorter vehicle downtimes.

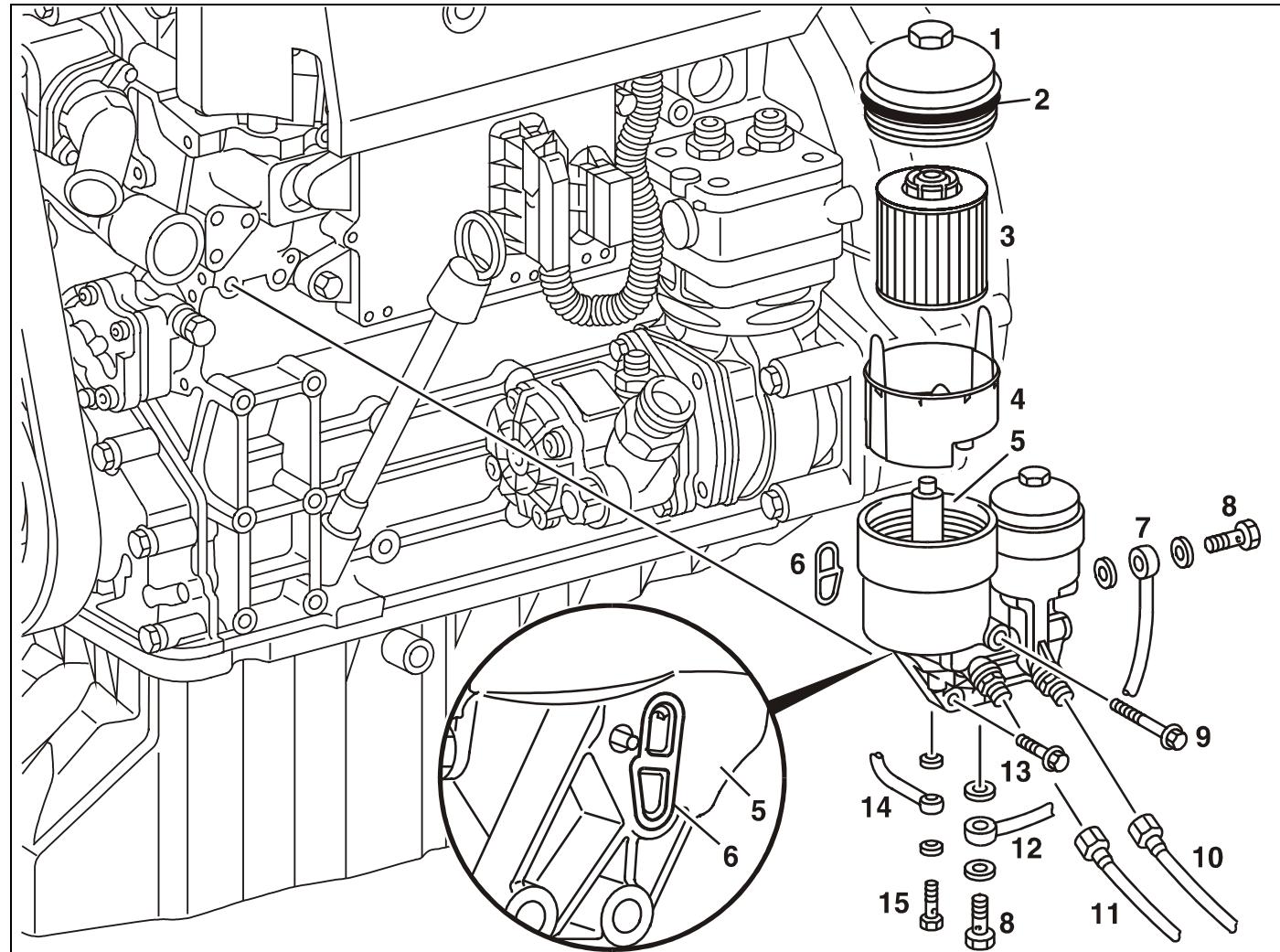


W47.20-1006-11

## Location of the fuel filter bowl



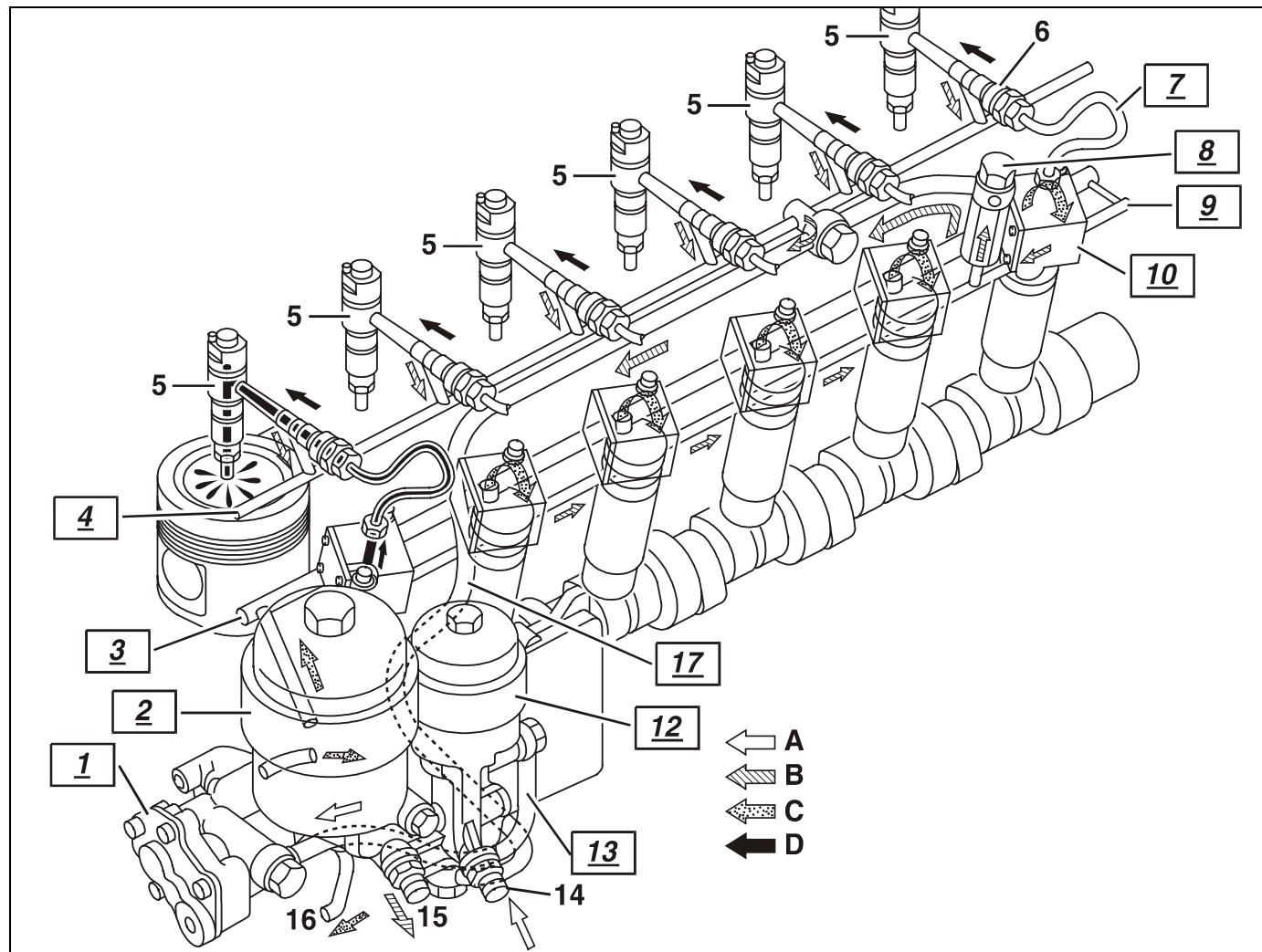
N47.20-2034-02



W47.20-0003-06

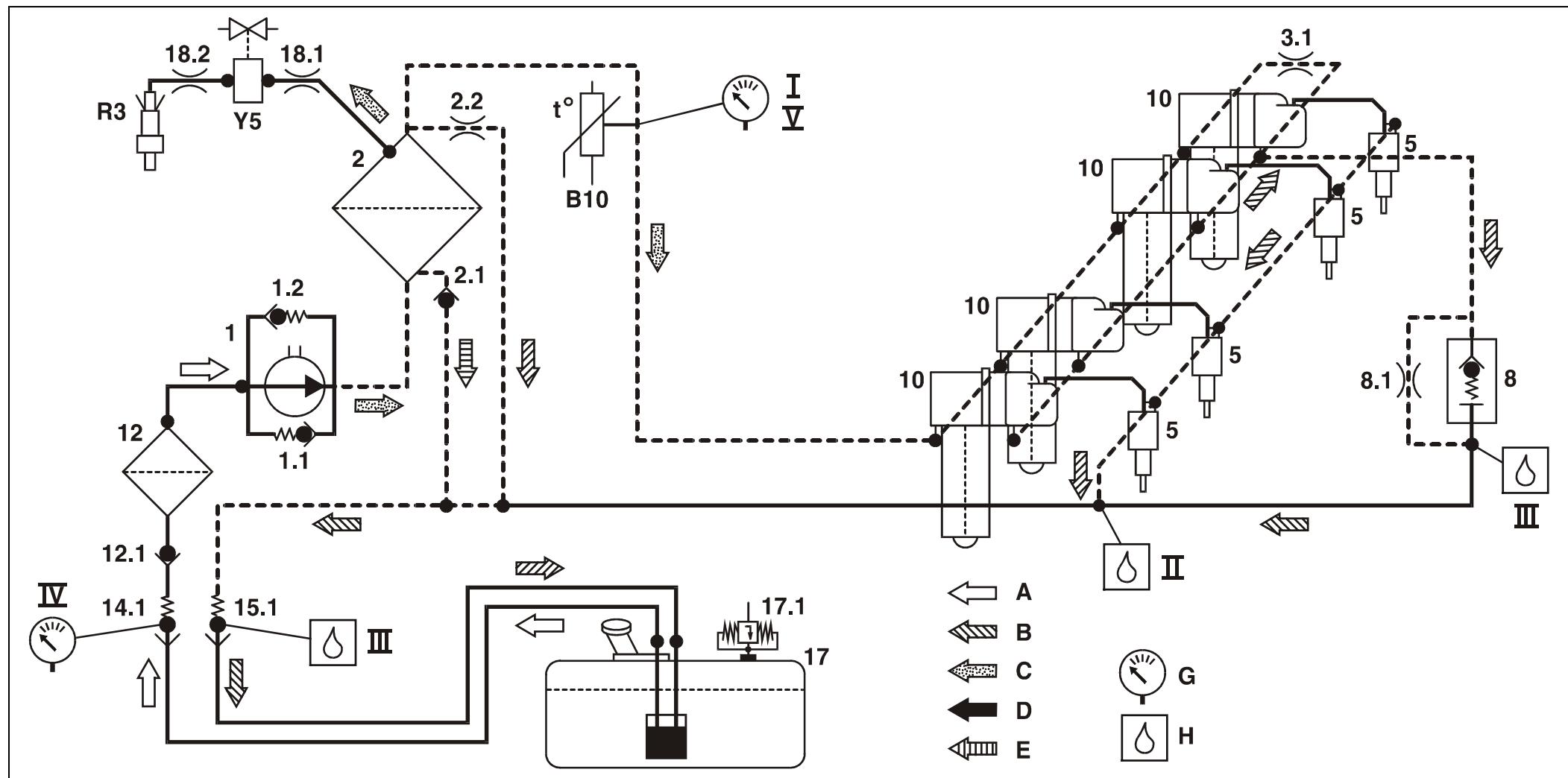
## Fuel system - real-life representation

- 1 Fuel feed pump (KFP)
- 2 Fuel filter (KF)
- 3 Fuel feed duct in crankcase
- 5 Nozzle holder combination
- 6 Pressure pipe connection
- 7 Injection line
- 8 Overflow valve (4.5 bar)
- 9 Fuel return flow duct in crankcase
- 10 Unit pump (Y6 to Y11)
- 12 Fuel prefilter
- 13 Fuel line (prefilter - feed pump), suction side
- 14 Fuel feed from tank
- 15 Fuel return to tank
- 16 Fuel feed to flame starting system
- 17 Fuel return flow duct from cylinder head
- A Fuel feed/suction side
- B Fuel return/ leak fuel
- C Fuel feed/pressure side
- D Fuel high pressure



N07.00-2027-06

## Fuel system - symbolic representation



W07.15-1015-09

	<b>Fuel circuit schematic diagram</b>	
1	Fuel feed pump (KFP)	D Fuel high pressure side (after PLD unit pumps)
1.1	Pressure limiting valve in KFP pump (9.2 bar)	E Fuel return (fuel drain)
1.2	Check valve in KFP pump (0.2 bar)	----- Fuel ducts in crankcase
2	Fuel filter (KF)	— Fuel lines
2.1	Fuel drain valve	
2.2	Constant vent in fuel filter (KF)	
3.1	Bypass from fuel feed duct to fuel return duct	
5	Nozzle holder combination	<b>Test points, inspection data</b>
8	Overflow valve (4.5 bar)	G Pressure gauge testing
8.1	Constant vent (0.5 mm)	H Fuel return quantity testing
10	PLD unit pumps (Y6 to Y11)	
12	Fuel prefilter (KVF)	I Fuel pressure after fuel filter
12.1	Check valve in prefilter (KVF)	Idle speed: $\geq$ 4.3 bar
14.1	Plug-on valve in fuel feed (locked open)	Cutoff speed: 4.0 - 6.5 bar
15.1	Plug-on valve in fuel return (locked open)	II Fuel return quantity at nozzle holder combination
17	Fuel tank	Test period: 5 min
17.1	Air intake valve	no fuel
18.1	Throttle (0.5 mm) in flame start fuel line	III Fuel return quantity at fuel filter bowl outlet
18.2	Throttle (threaded orifice) in flame start fuel line	Idle and cutoff speed: $\leq$ 0.3 l/min
B10	Fuel temperature sensor	Fuel return quantity at overflow valve
R3	Flame start glow plugs	Idle speed: 0.9 - 1.7 l/min
Y5	Solenoid valve	Cutoff speed: 2.7 - 7.5 l/min
	<b>Fuel system</b>	IV Fuel intake pressure before fuel pump
A	Fuel feed (intake/vacuum side)	Idle speed: -0.09 to -0.12 bar
B	Fuel return (leak fuel)	Cutoff speed: -0.4 to -0.5 bar
C	Fuel feed (pressure side)	V Low pressure-fuel system leaktightness
		Test pressure: 5.0 bar
		Test period: 5 min
		Pressure drop: $\leq$ 0.25 bar

## **Checking the fuel system**

### **In what circumstances must the fuel pressure be checked?**

Poor startup, poor performance

### **What can cause the fuel pressure to be too low?**

Dirty prefilter, dirty fuel filter, faulty overflow valve, fuel system is drawing in air,  
Kink in feed line from tank, intake line at fuel tank sensor, check valve at prefilter inlet,  
leak in filter bowl at the return flow, faulty feed pump

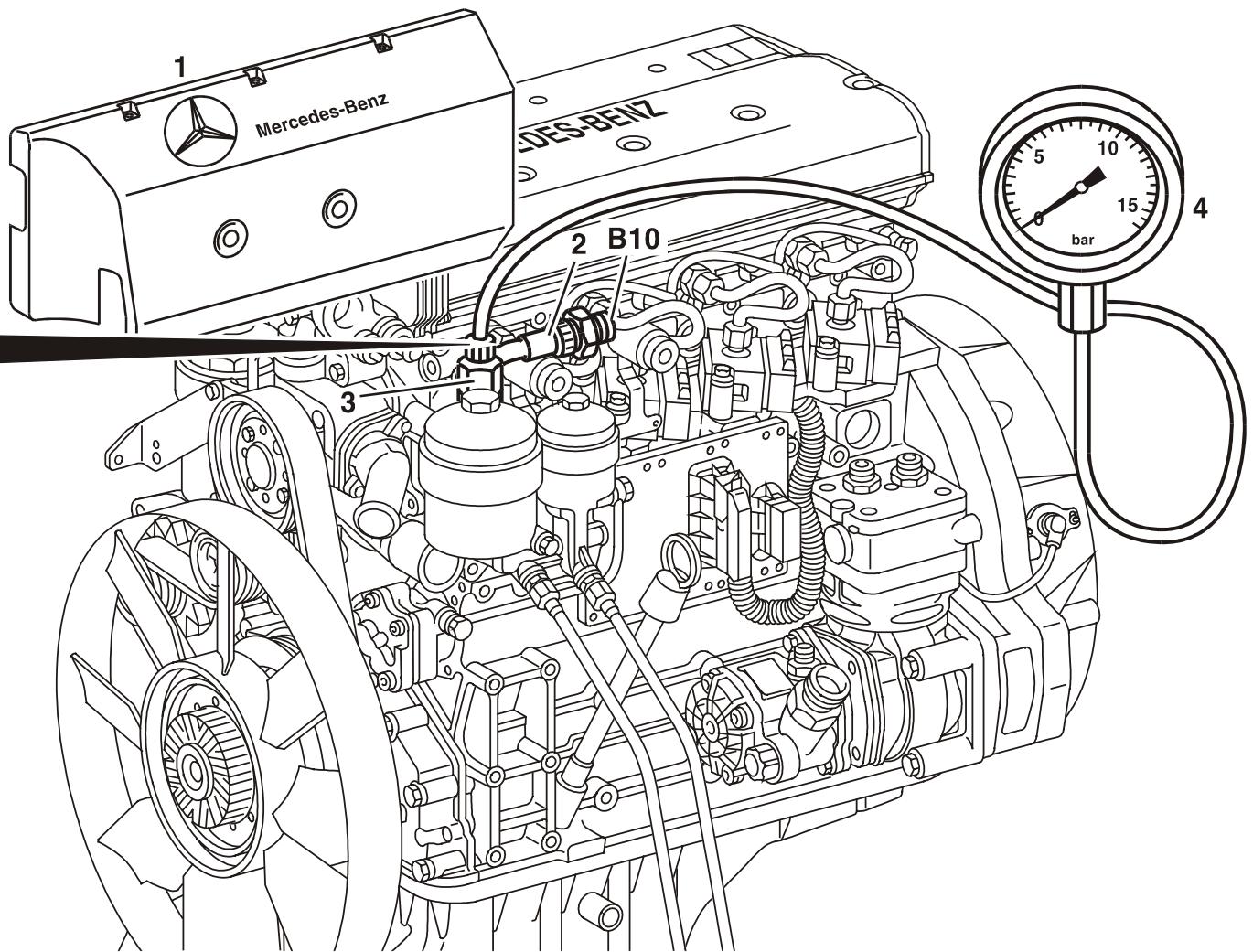
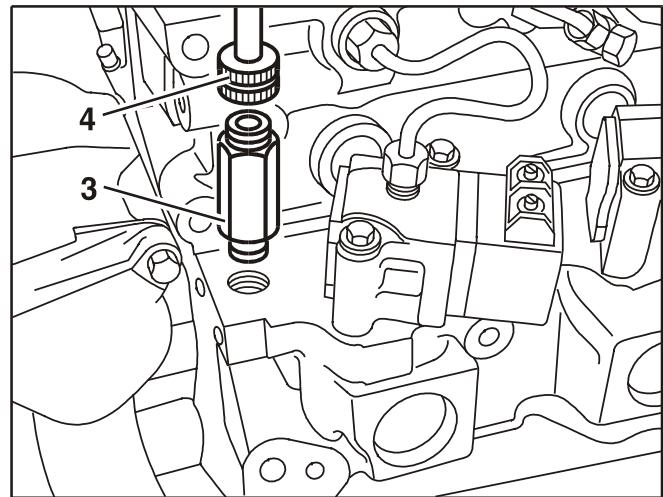
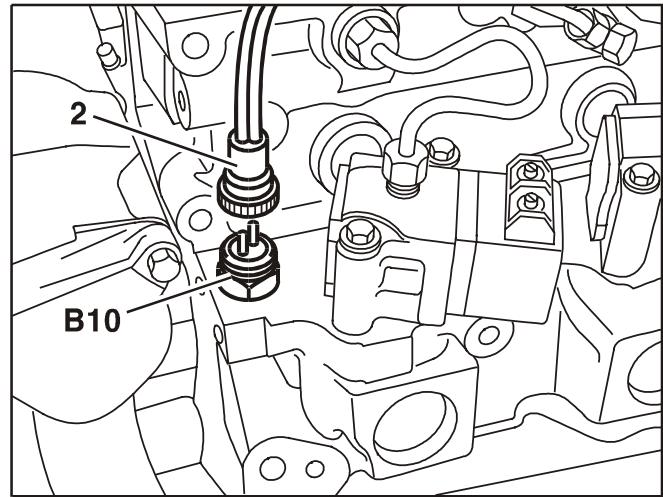
### **What can cause the fuel pressure to be too high?**

Faulty overflow valve, kink in return flow line, check valve at return line connection to filter bowl,  
fuel tank sensor clogged

### **What other operations should be carried out?**

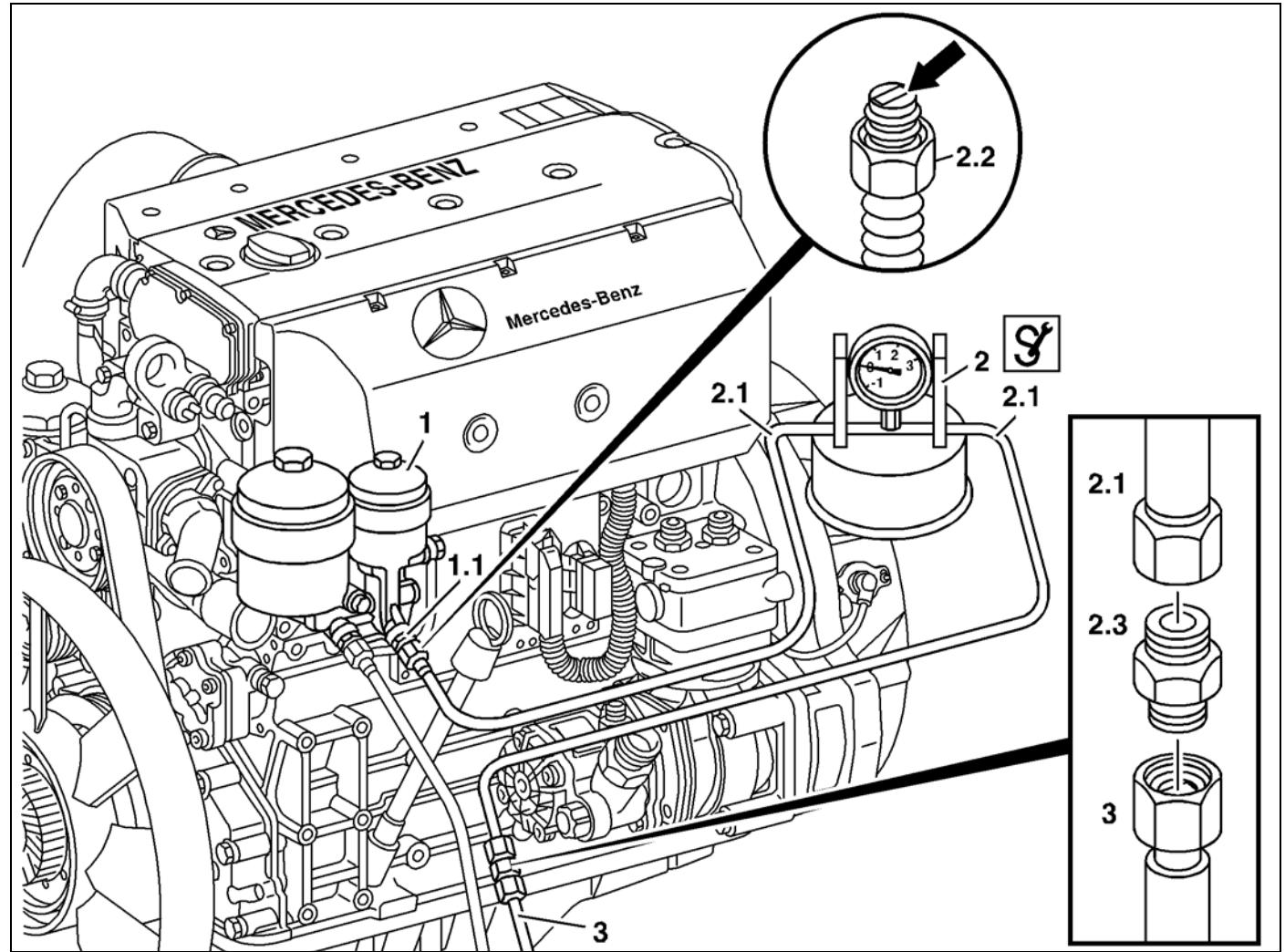
Check the fuel system at and in the engine for leaktightness, check the fuel intake pressure, measure the fuel return quantity,  
measure fuel return quantity at nozzle holder combination.

## Checking the fuel pressure



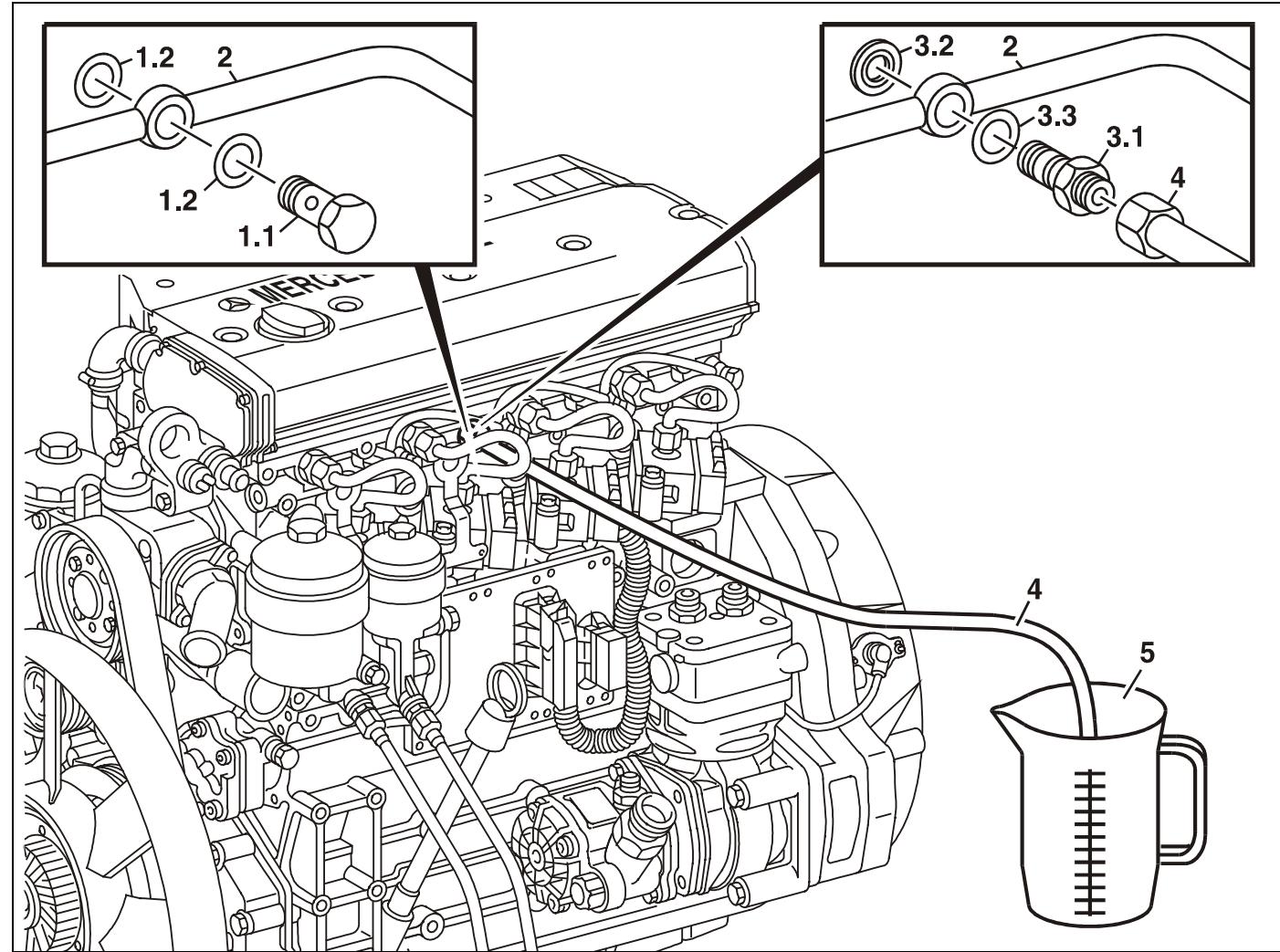
N07.15-2019-09

## Checking the fuel intake pressure



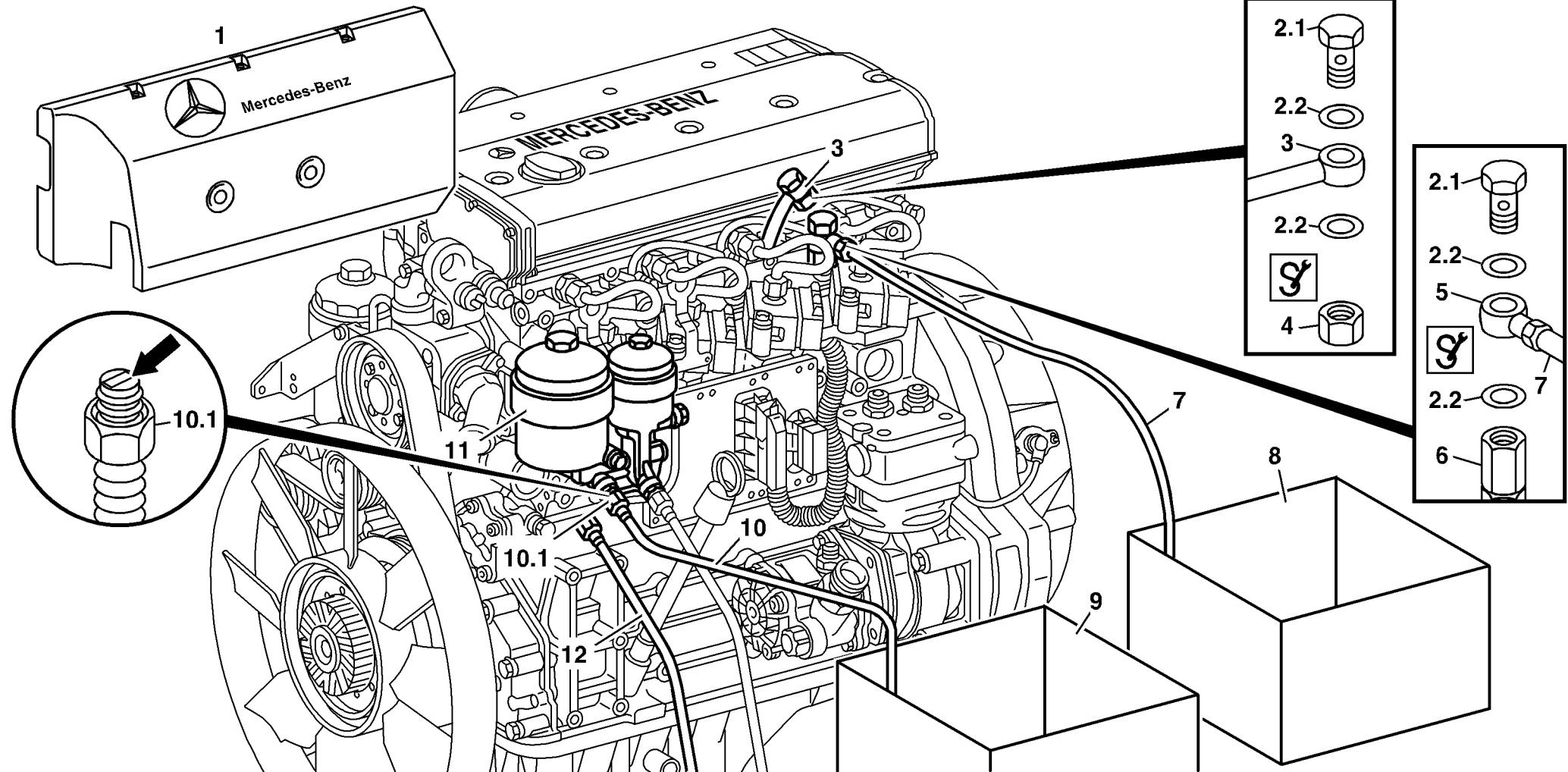
W07.15-1008-06

## Measuring fuel return quantity at the nozzle holder combination



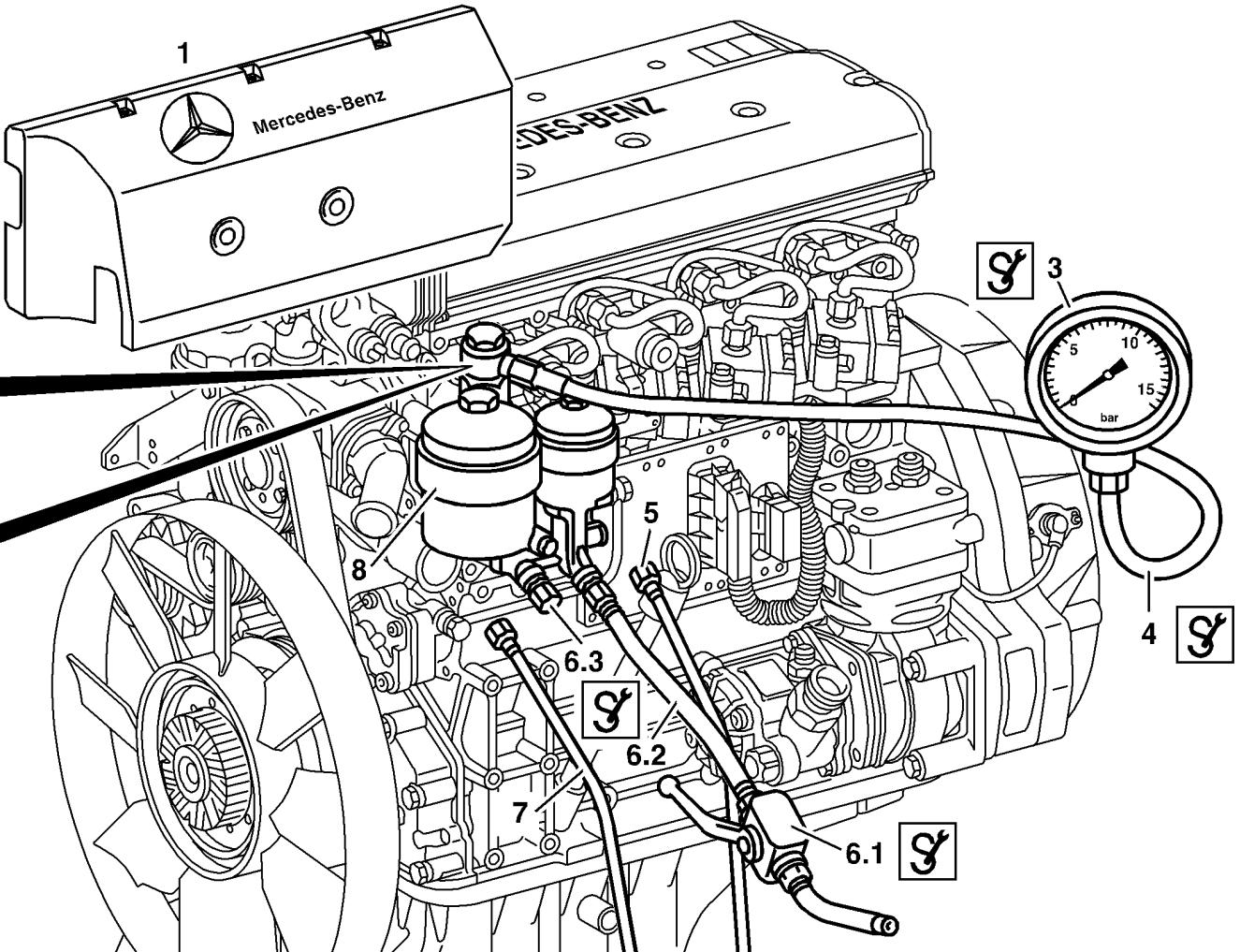
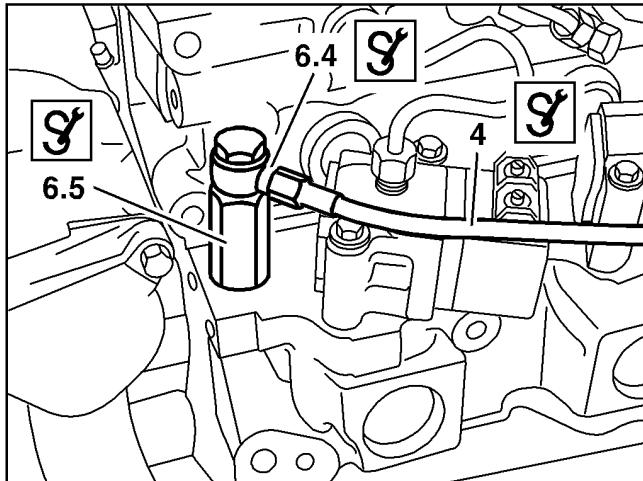
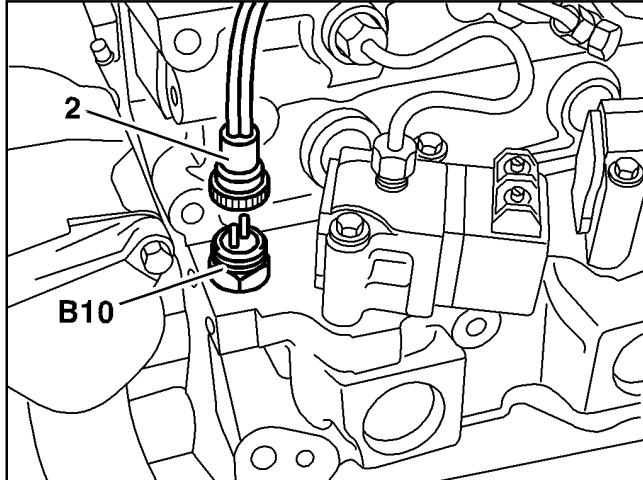
N07.15-2020-06

## Measuring the fuel return quantity



W07.15-1012-09

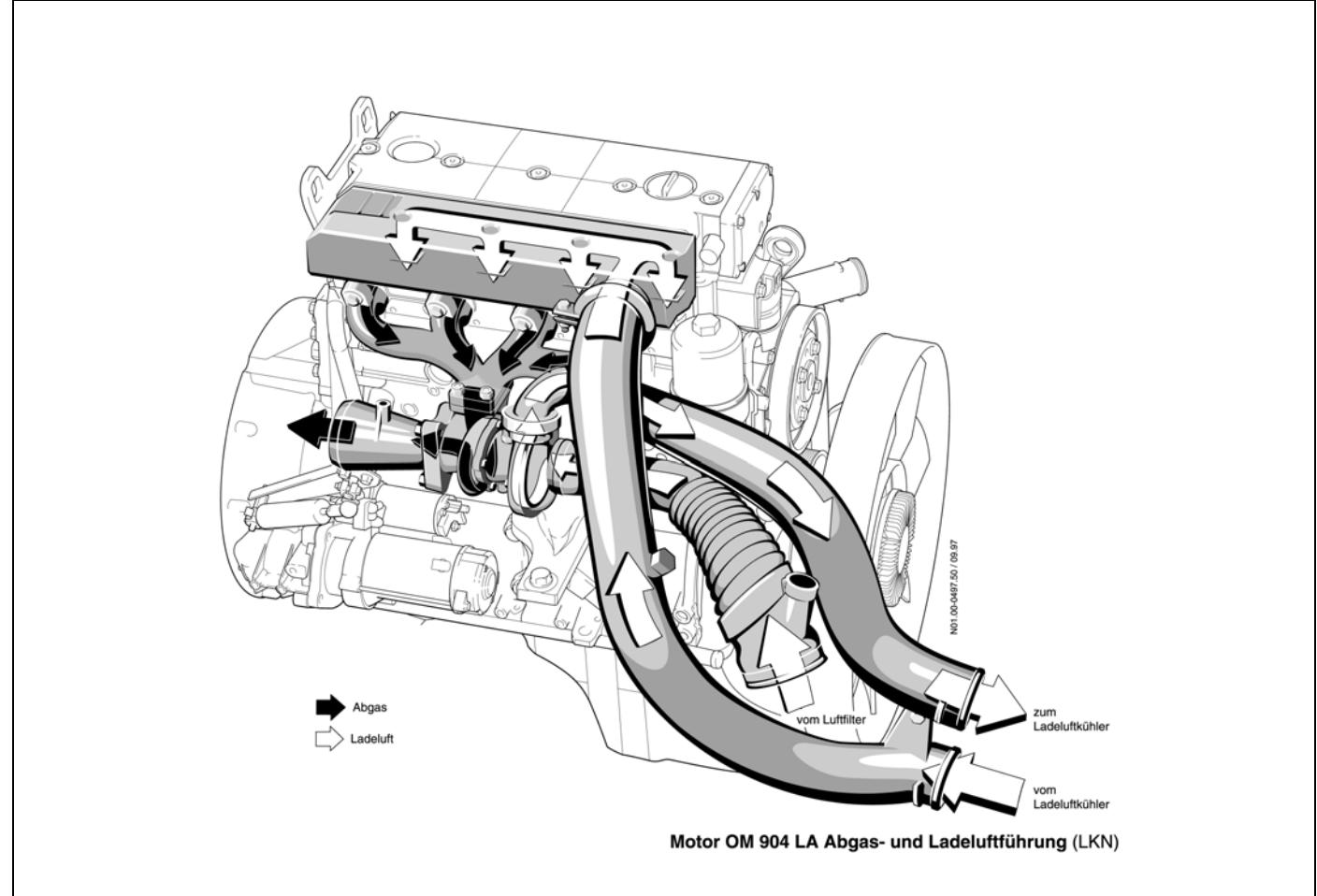
## Checking the engine fuel circuit for leaktightness



W07.15-1010-09

The fuel system should only be pressurized to 5 bar, to avoid damage to any fuel cooler installed in the electronic system.

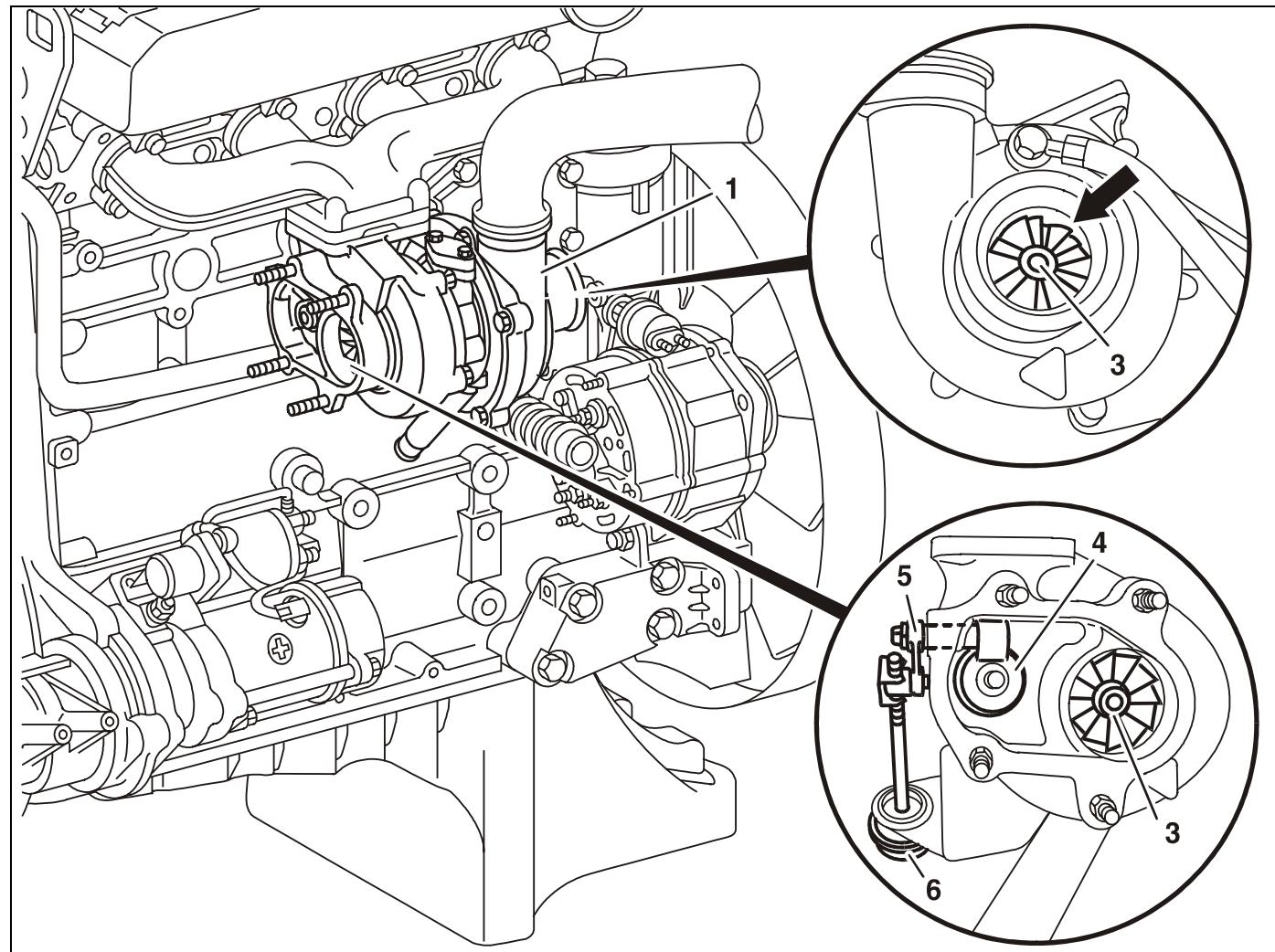
The charge air is drawn from the air cleaner through the compressor turbine wheel of the turbocharger, through the on-board charge air cooler, then fed into the combustion chamber. The charge air is re-cooled to below 50°C. The hot exhaust gases leave the combustion chamber through the exhaust manifold and pass into the turbocharger. A heat shield over the turbocharger prevents heat dissipation into the engine compartment.



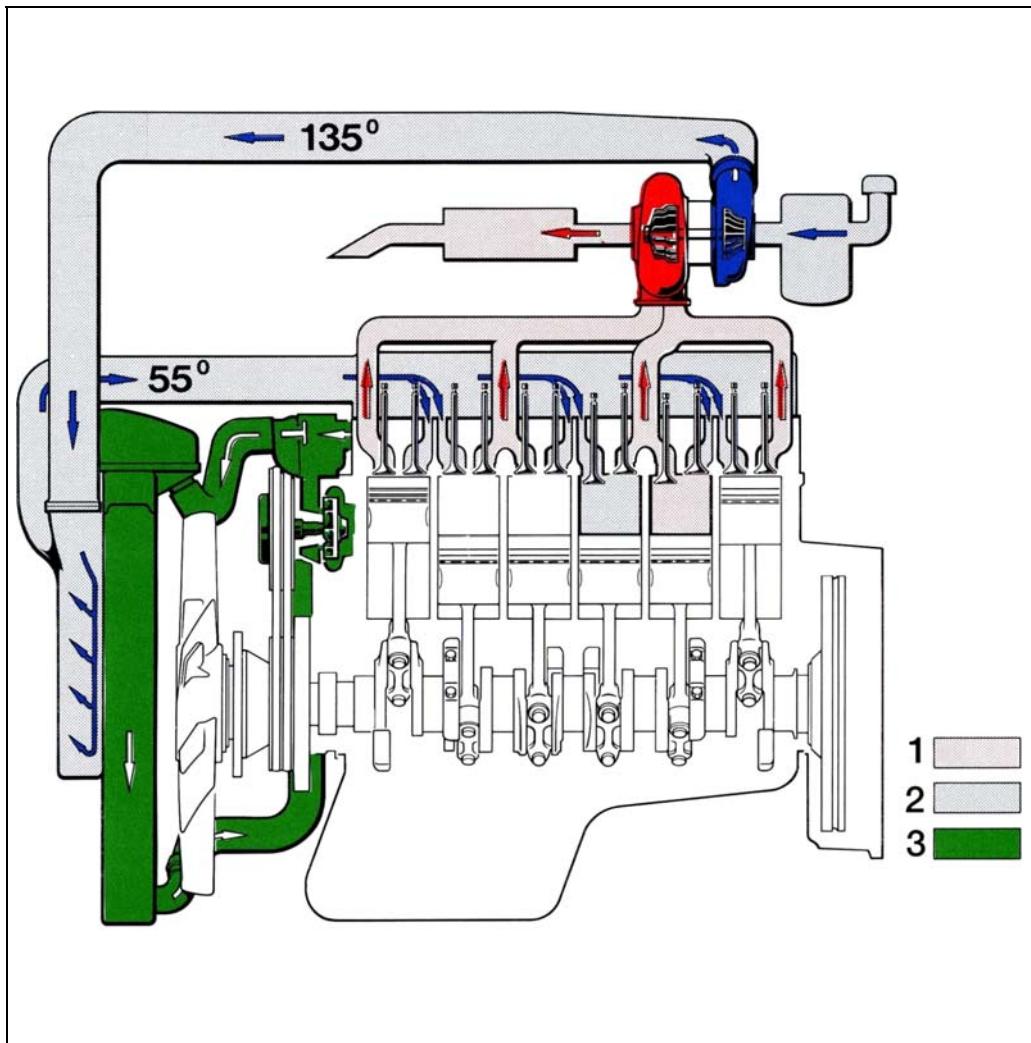
N01.00-0497-50

The turbocharger is surge-proof and is designed for rapid, dynamic pressure build-up even at low engine speeds. This ensures prompt start-off characteristics and acceleration.

In engines of the upper power category, this function is performed by the wastegate valve. In the medium and lower engine speed range, the turbocharger can be designed for high boost pressure and increased torque. At the higher engine speeds, the boost pressure is then limited by the opening of the valve, which causes part of the exhaust flow to bypass the turbocharger and pass directly into the exhaust system.

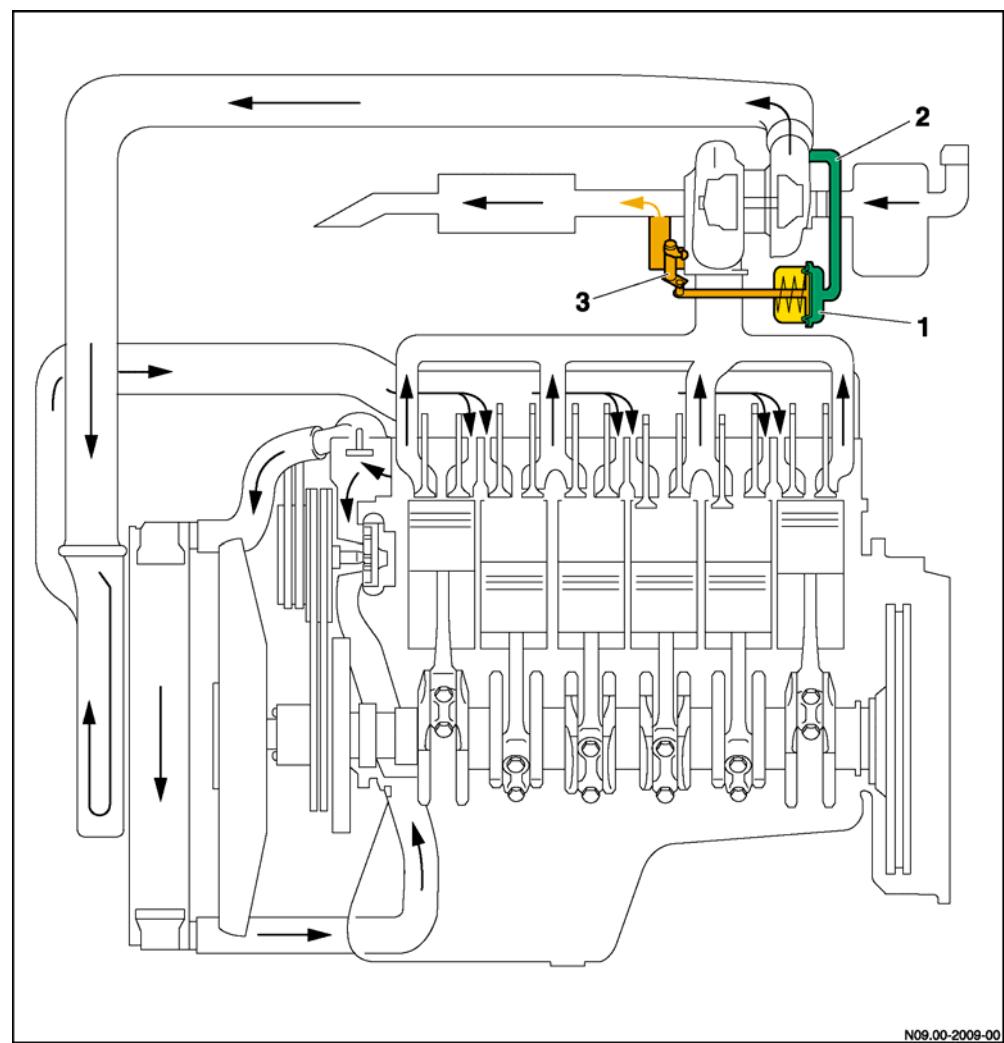


W09.40-0012-06



N09.41-2011-82

Charge air circuit without wastegate valve

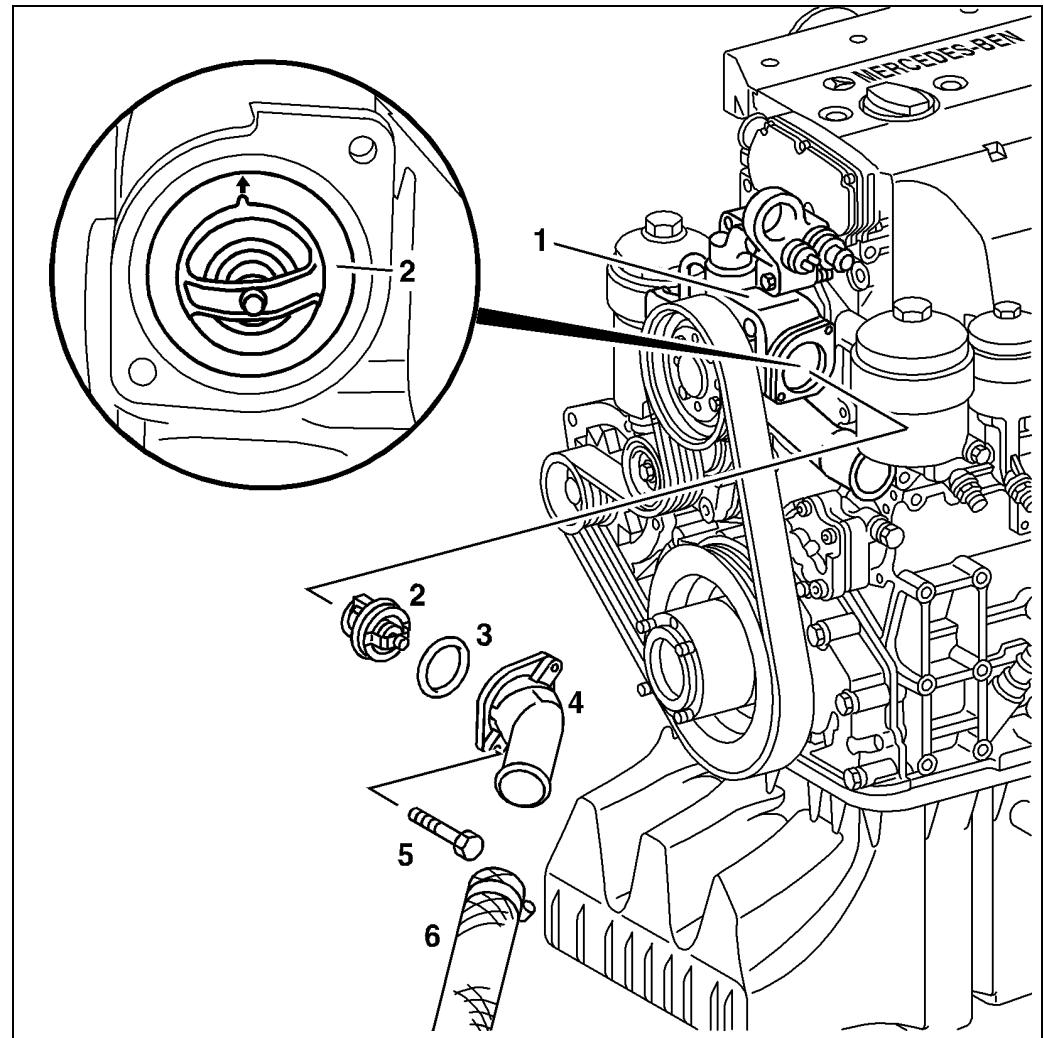


N09.00-2009-00

Charge air circuit with wastegate valve



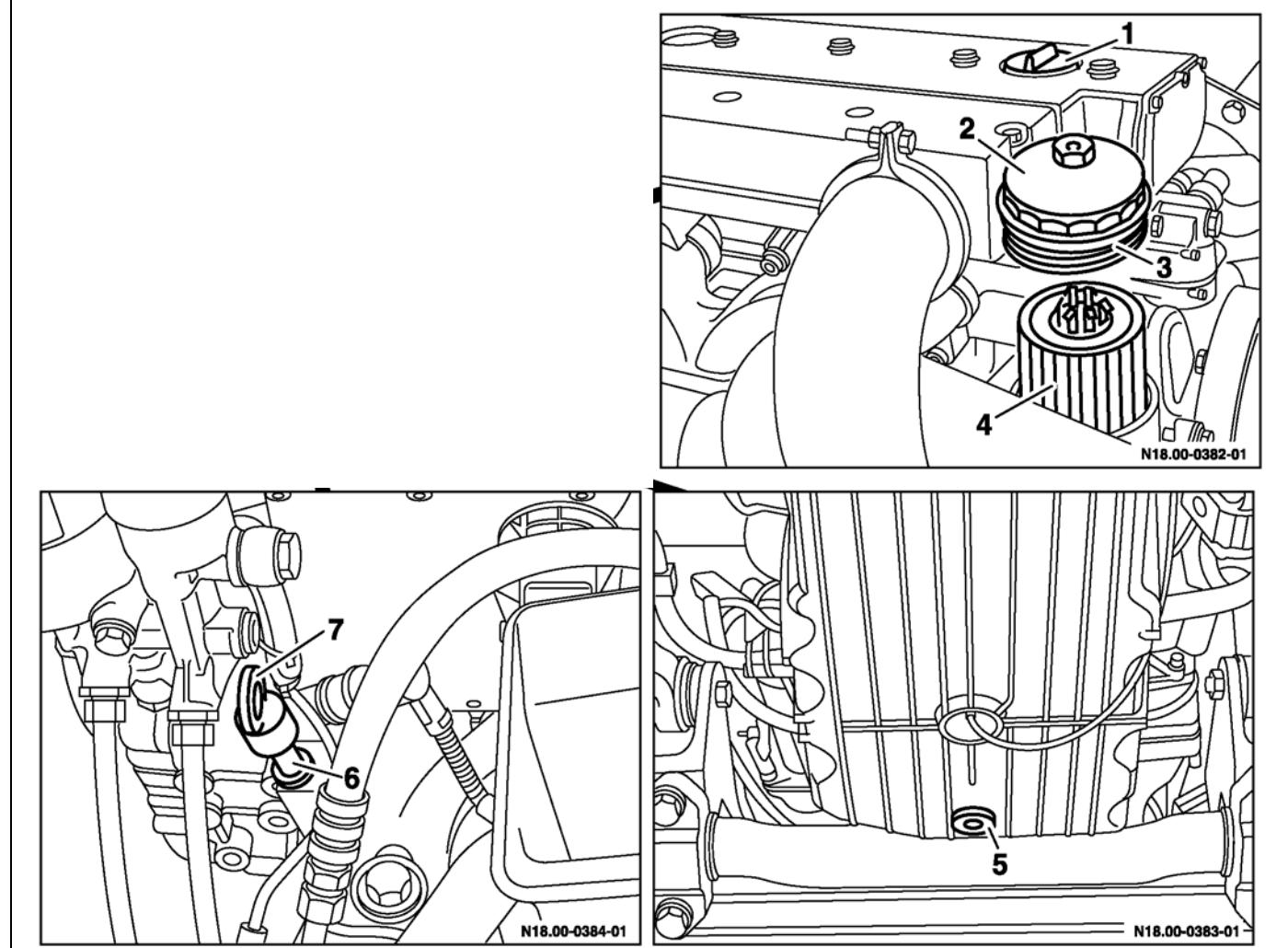
- 1 Coolant pump
- 2 Coolant thermostatic control
- 3 O-ring
- 4 Coolant line
- 5 Screw
- 6 Coolant hose



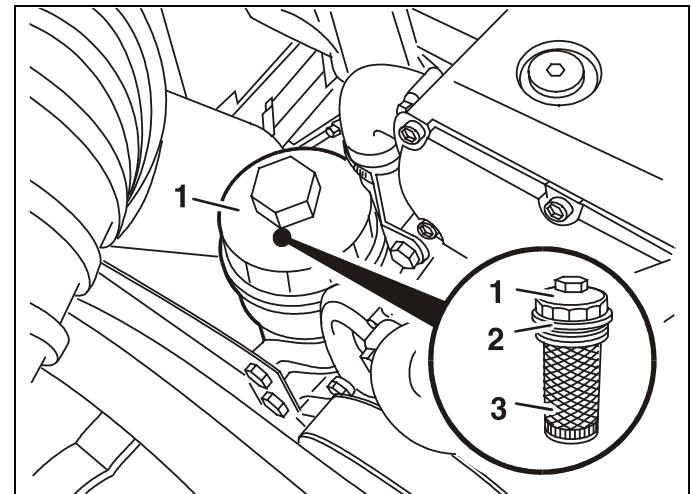
W20.10-0015-12

	<b>Removing/installing</b>	
	<b>Risk of injury</b> to skin and eyes due to scalding, as hot coolant may spurt out. <b>Risk of poisoning</b> if coolant is swallowed.	Only open the cooling system at coolant temperatures under 90 °C. Open the cap slowly and release the pressure. Do not store the coolant in drink containers. Wear protective gloves, protective clothing and safety glasses.
1 	Drain the coolant Notes on coolant	
2	Remove the coolant line (4)	Collect the escaping coolant 
3	Remove the coolant thermostatic control (4)	Installation: Replace the O-ring (3). Note the installation location of the coolant thermostatic control. The blow hole (arrowed) must always point upwards.
4	Install in the reverse order	

- 1 Cap (oil replenishment)
- 2 Screw cap
- 3 Sealing ring
- 4 Oil filter
- 5 Oil pan drain plug
- 6 Oil dipstick-guide tube
- 7 Oil dipstick



<b>i</b>	<b>Only change the engine oil with the engine warm</b> Install new oil filter element (4)	
2. 1	Suction off engine oil through the dipstick guide tube (6)	 <b>i</b> Follow the manufacturer's operating instructions for the engine oil suction unit.
2.2 2.2.1	Drain off the engine oil at the oil drain plug (5) on the oil pan. Screw in the oil drain plug (5) and tighten	 <b>i</b> Remove the bottom parts of the noise encapsulation <b>i</b> Fit new sealing ring to the drain plug <b>Nm</b>
<b>i</b>	Notes on engine oil	
<b>Danger!</b>	Pour in the specified quantity of engine oil at the filler hole (1) <b>Risk of accident</b> due to vehicle starting off while engine is running. <b>Risk of injury</b> due to crushing or burns if components are touched during the start-up procedure or when the engine is running	 Secure the vehicle to prevent it starting off automatically. Wear closed and snug-fitting work clothes. Do not touch hot or rotating parts.
4.	Start engine	<b>Watch the engine oil pressure gauge!</b> It must indicate the pressure after several seconds  <b>Do not rev the engine</b> until oil pressure is indicated.
5.	Stop the engine after oil pressure is indicated.	
6.	Wait at least 5 minutes, then check the oil level and adjust if necessary	<b>i</b> The waiting time must be observed.
7.	The waiting time must be observed.	

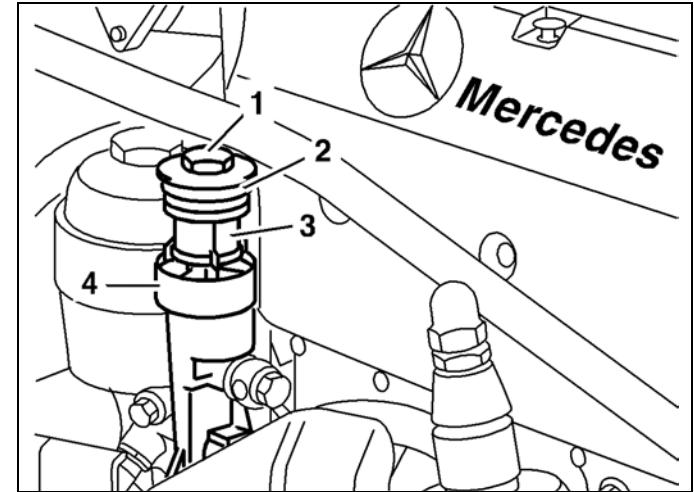


N18.20-0252-01

1.	Unscrew the oil filter screw cap (1) using a socket wrench bit (SW36). Allow the oil to run out of the filter bowl.	
2.	Remove screw cap (1) with oil filter insert (3), and unclip filter insert (3) by pressing at the side.	<b>i</b> Take care not to let any foreign matter into the filter bowl. Do not in any circumstances wipe the filter bowl.
3.	Replace the sealing ring (2)	<b>i</b> Lightly grease the sealing ring.
4.	Insert new oil filter element (3) in screw cap (1)	
5.	Screw on the screw cap (1) with oil filter element (3), and tighten.	[Nm]

<b>Nm</b> Oil filter		<b>Engine 904.9, 906.9</b>
Oil filter cover to oil filter housing	[Nm]	25

- 1 Screw cap  
2 Sealing ring  
3 Filter insert  
4 Filter housing



N07.57-0224-01

1.	Open the cap on the fuel tank; allow pressure to escape, or close the fuel cock.	
2.	Clean the outside of the fuel prefilter if dirty	
3.	Unscrew screw cap (1) with filter insert (3), and take out of filter bowl (4).	<p><b>i</b> Take care not to let any foreign matter into the filter bowl. Do not in any circumstances wipe the filter bowl.</p>
4.	Clean the screw cap (1) and filter insert (3)	<p><b>i</b> If badly soiled or damaged, replace filter insert (3)</p>
5.	Check the sealing ring (2) and replace if necessary	<p><b>i</b> Lightly grease or oil the new sealing ring (3).</p>
6.	Screw on the screw cap (1) with filter element (3), and tighten.	<b>Nm</b>

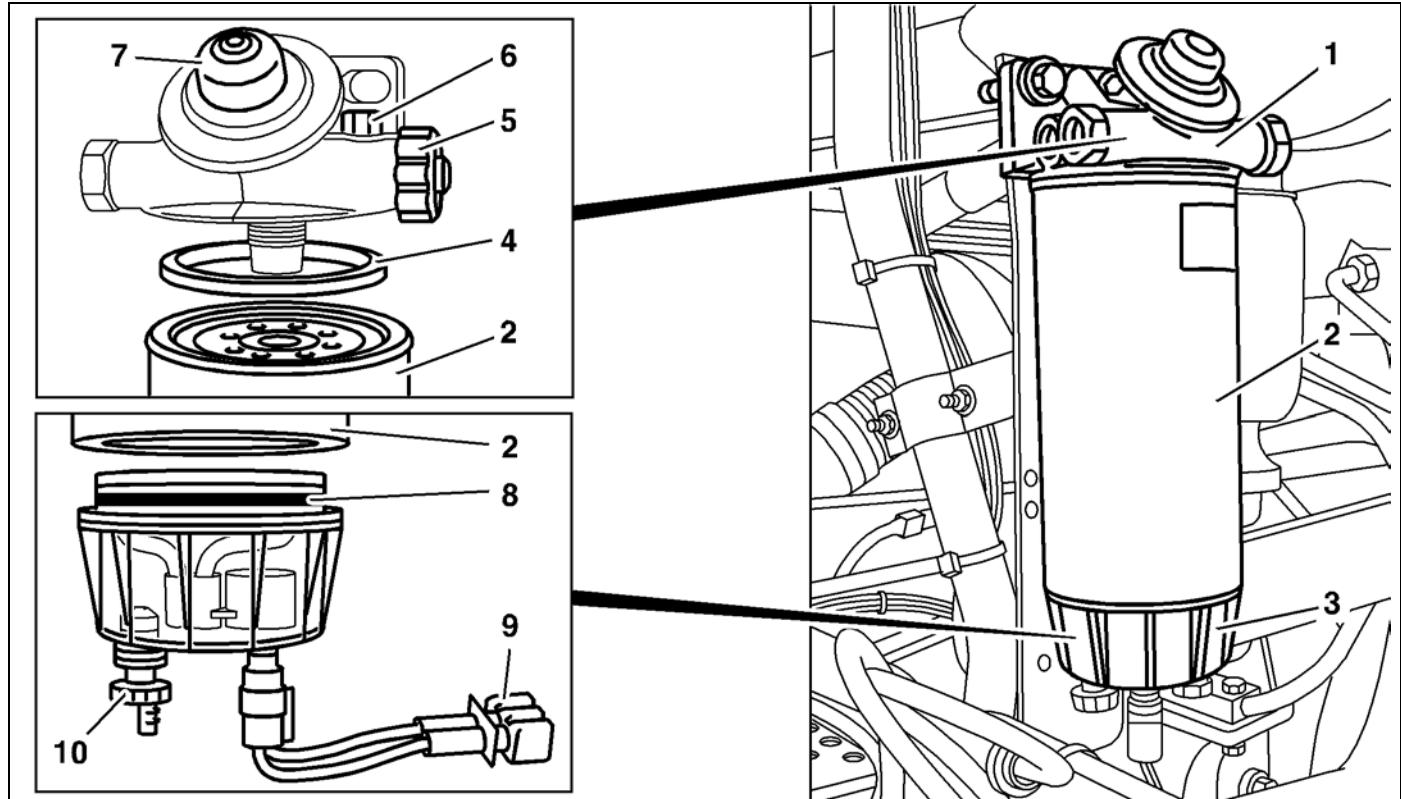
<b>⚠ Danger!</b>	<b>Risk of accident</b> due to vehicle starting off while engine is running. <b>Risk of injury</b> due to crushing or burns if components are touched during the start-up procedure or when the engine is running.	Wear closed and snug-fitting work clothes. Do not touch hot or rotating parts.
6.	Start the engine and bleed the fuel system.	<b>i</b> Let the engine run for about 1 minute. The fuel system is bled automatically.
7.	Check the prefilter for leaktightness	

<b>Nm</b> Fuel filter		<b>Engine 904.9, 906.9</b>
Cap to fuel prefilter housing	[Nm]	25

## Series 900<>Fuel prefilter with water separator - replacing the filter element

07.05.2003

- 1 Filter head
- 2 Filter element
- 3 Separator
- 4 Sealing ring
- 5 Shutoff valve
- 6 Bleed screw
- 7 Fuel pump
- 8 Sealing ring
- 9 Heater plug
- 10 Drain valve



N47.20-2032-05

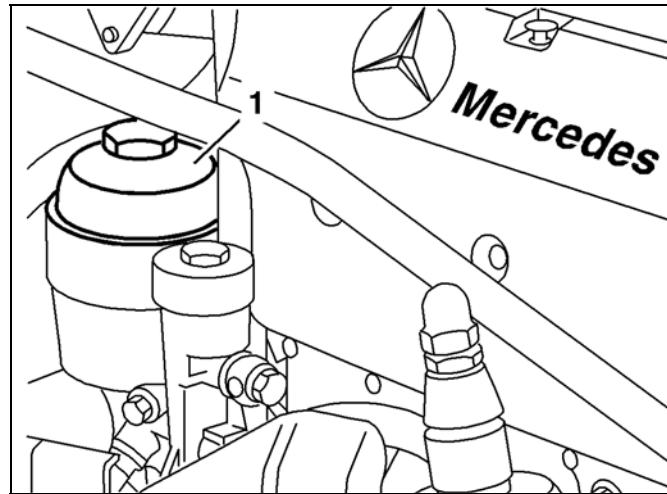
	To remove	
1.	Place the separator under the prefilter	
2.	Open the drain valve (10) and bleed screw (6)	<p>Let the filter element (2) run dry</p> <p> Dispose of the water/fuel mixture in an environmentally acceptable manner.</p>

3.	Pull out heater plug (9)	
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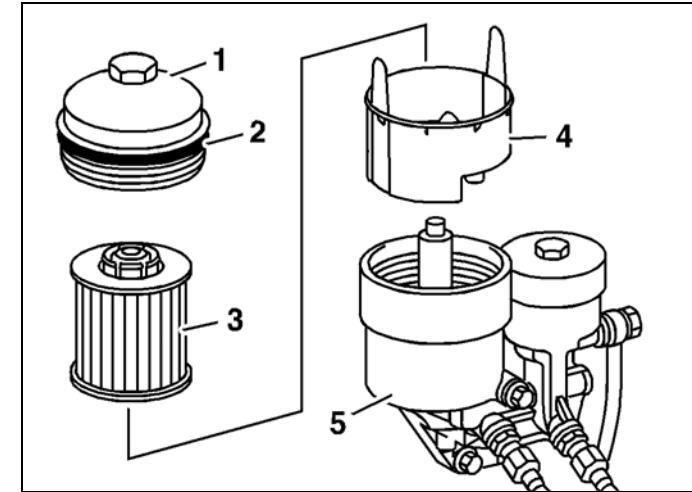
4.	Unscrew filter element (2)	<b>i</b> Dispose of the filter element in an environmentally acceptable manner.
5.	Unscrew separator (3) from filter element (2)	If damaged, replace the separator
6.	Clean the separator (3)	Ensure that the sealing ring groove is clean!

<b>☒</b>	<b>To install</b>	
7.	Moisten the new sealing rings (4 and 8) with engine oil.	
8.	Screw the separator (3) with new sealing ring (8) onto the filter element (2) and finger-tighten.	
9.	Screw the filter element (2) with new sealing ring (4) onto filter head (1) and finger-tighten.	<b>i</b> Do not use tools to tighten!
10.	Close drain valve (10).	
11.	Fill the prefilter with a manual fuel feed pump (7).	
12.	Close the bleed screw (6).	
<b>⚠ Danger!</b>	<b>Risk of accident</b> due to vehicle starting off while engine is running. <b>Risk of injury</b> due to crushing or burns if components are touched during the start-up procedure or when the engine is running.	Wear closed and snug-fitting work clothes. Do not touch hot or rotating parts.
13.	Start the engine and bleed the fuel system.	<b>i</b> Let the engine run for about 1 minute. The fuel system is bled automatically.
14.	Check the prefilter for leaktightness.	

- 1 Screw cap
- 2 Sealing ring
- 3 Filter insert
- 4 Sludge collector
- 5 Filter bowl



N07.57-0226-01



N07.57-0225-01

	To remove	
1.	Open the cap on the fuel tank; allow pressure to escape, or close the fuel cock.	
2.	Unscrew the fuel filter screw cap (1) using a socket wrench bit (SW 36)	Only remove screw cap (1) with filter insert (3) after the fuel has run out of the filter bowl
3.	Remove screw cap (1) with filter insert (3) and unclip the filter insert by pressing at the side	
4.	Pull the sludge collector (5) by the straps out of filter bowl (5).	Take care not to let any of the collected sludge into the filter bowl. Do not empty the sludge collector into the filter bowl! Do not in any circumstances wipe the filter bowl.
5.	Clean the screw cap (1) and sludge collector (4)	

	<b>To install</b>	
6.	Replace the sealing ring (2)	Lightly grease the sealing ring.
7.	Insert new filter element (3) in screw cap (1)	
8.	Insert the sludge collector (4) into filter bowl (5)	Place at the correct installation location!
9.	Screw on the screw cap (1) with filter element (3), and tighten.	
<b>Danger!</b>	<b>Risk of accident</b> due to vehicle starting off while engine is running. <b>Risk of injury</b> due to crushing or burns if components are touched during the start-up procedure or when the engine is running Start the engine and bleed the fuel system.	Secure the vehicle to prevent it starting off automatically. Wear closed and snug-fitting work clothes. Do not touch hot or rotating parts. Let the engine run for about 1 minute. The fuel system is bled automatically.
11.	Check the filter for leaktightness with the engine running	

<b>Fuel filter</b>		<b>Engine 904.9, 906.9</b>
Cap to fuel filter housing	[Nm]	25

### Maintaining the air cleaner

Remove the air cleaner and check for dirt and damage. Clean the inside of the air cleaner housing if necessary.

The air cleaner cartridge must not be cleaned with compressed air cleaning equipment.

**Air cleaner cartridges must be replaced every 3 years at least.**

### Engine coolant

**The engine coolant must be changed every 3 years at least.**

» ... 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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