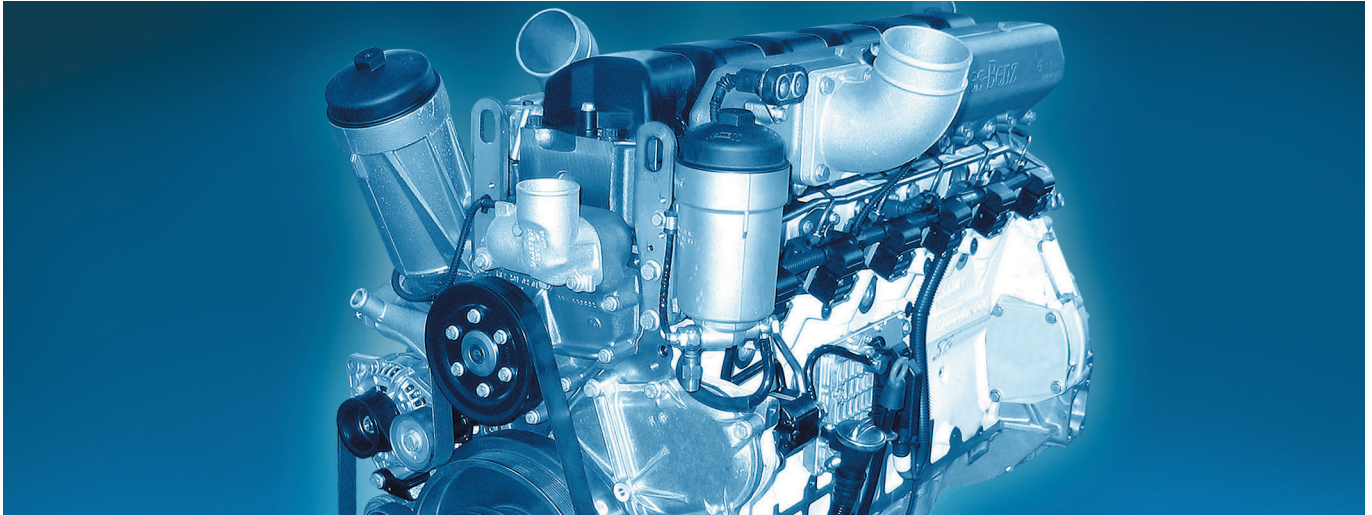


Mercedes-Benz Diesel Engines



# **OM 460 LA**

**6-Cylinder In-line Diesel Engine**

**Workshop Manual**



Mercedes-Benz

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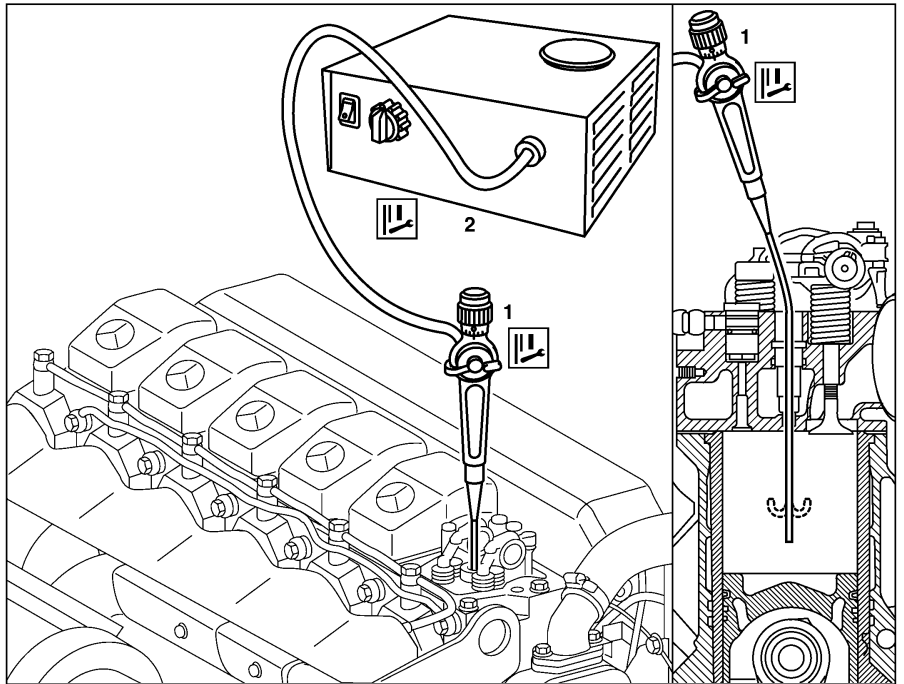
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











AR01.00-G-0200CH	Inspect cylinders with light probe	26.5.04
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

MODEL 000.001 with ENGINE 457.960

- 1  Inspection probe
- 2  Light projector



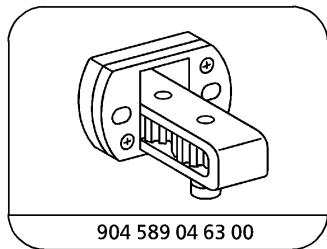
G01.00-3160-06

	Check		
1	Attach cranking/blocking device for engine	 	<b>Page 5</b> BA01.60-N-1001-01K 904 589 04 63 00
2	Remove nozzle holder combination	 Remove any sealing sleeve remaining in the cylinder head.	<b>Page 127</b>
3	Position piston of cylinder to be inspected to bottom dead center	 Turn crankshaft with cranking/blocking device.	
4	Connect inspection probe (1) to light projector (2)	 The tip of the inspection probe is very sensitive and must not be damaged.  For connecting, refer to manufacturer's operating instructions. Use dia. ≤ 8.5 mm test probe.    	WH58.30-Z-1009-05A WH58.30-Z-1010-05A WH58.30-Z-1027-05A WH58.30-Z-1028-05A
5	Insert inspection probe (1) through the protective sleeve hole into the cylinder	 Ambient temperature ≤ 80 °C. Ensure that the test probe (1) does not make contact or hit, otherwise the tip of the probe can be damaged.  It is possible to inspect all the cylinders with 3 crankshaft positions: Cylinders 1/6, 2/5 and 3/4.	

<p>6</p> <p></p>	<p>Inspect condition of cylinder wall, piston crown, compression chamber and valves at cylinder head</p> <p>Notes for assessing wear to cylinder barrel in the case of dust damage</p>	<p> If the cylinder head or valves are damaged:</p> <p style="text-align: center;">↓</p> <p>Remove cylinder head, replace damaged parts as required</p> <p> The piston crown should not be damaged, if necessary: ↓</p> <p>Replace piston</p> <p>If the cylinder barrel is worn:</p> <p style="text-align: center;">↓</p> <p>Install new cylinder liner.</p> <p>Engine 401.9, 402.9, 441.9, 442.9, 446.9, 447, 457.9, 489, 541.9, 542.9, 900.9, 902.9, 904.9, 906.9, 924.9, 926.9</p>	<p><b>Page 23</b></p> <p><b>Page 69</b></p> <p><b>Page 6</b></p>
<p>7</p>	<p>Install in the reverse order</p>		

 **Timing case**

Number	Designation	Engine 457.960
BA01.60-N-1001-01K	Bolt of end cover of inspection hole to timing case	Nm 25



904 589 04 63 00

Cranking device

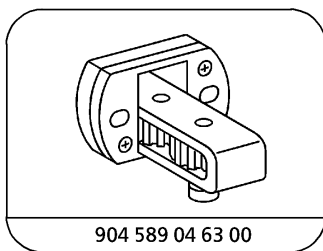
Commercially available tools (see Workshop Equipment Manual)

Number	Designation	Make (e. g.)	Order number
WH58.30-Z-1009-05A	Flexible inspection light Scope of supply 1 (complete unit): -glass fiber optical fiber -light projector -230 V, storage case -operating instructions -graphics protocol	Richard Wolf GmbH Pforzheimerstr. 32 D-75438 Knittlingen Karl Storz GmbH Mittelstr. 8 D-78532 Tuttlingen	1.00565.00  80902
WH58.30-Z-1010-05A	Flexible inspection light Scope of supply (for workshops which already have an approved Wolf or Storz inspection light): -storage case -operating instructions -pictures protocol	Richard Wolf GmbH Pforzheimerstr. 32 D-75438 Knittlingen Karl Storz GmbH Mittelstr. 8 D-78532 Tuttlingen	7.05065.00  K03506AJ
WH58.30-Z-1027-05A	Cylinder inspection equipment Motoskop MB (cold light) with 560 mm and 200 mm lens probes	Karl Storz GmbH D-78512 Tuttlingen	80 900
WH58.30-Z-1028-05A	Cylinder inspection equipment Motoskop TW (cold light) with lens probes 103 26 CW (570 mm) and 103 26 CT (210 mm)	Karl Storz GmbH D-78532 Tuttlingen	

AR03.30-G-1600-03CH	Attach, detach cranking/blocking device for engine		
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**Nm** Timing case







Number	Designation	Engine 457.960
BA01.60-N-1001-01K	Bolt of end cover of inspection hole to timing case	Nm 25

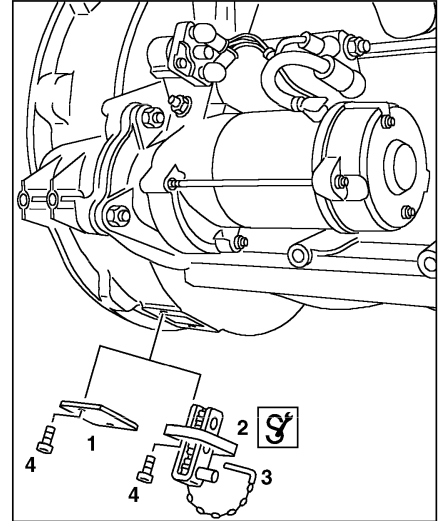


904 589 04 63 00

Cranking device



Attach


- 1 Remove cover (1) on flywheel housing.
- 2  Attach cranking/blocking device (2) with bolts (4) to flywheel housing.  
  The cranking/blocking device (2) must be removed before starting engine, otherwise the flywheel or the  cranking/blocking device (2) is damaged.  
  The cranking/blocking device (2) can be blocked by plugging in pin (3).



W03.30-0001-02

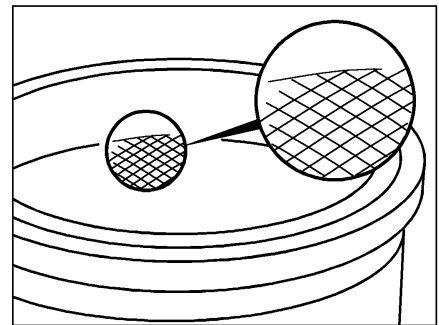
Detach

- 3  Remove cranking/blocking device (2) from the flywheel housing.
- 4  Attach cover (1) with bolts (4) to the flywheel housing.

AH01.40-N-0001-01A	Notes for assessing wear to cylinder wall in the case of dust damage	Engines 401.9, 402.9, 441.9, 442.9, 446.9, 447, 457.9, 489, 541.9, 542.9, 900.9, 902.9, 904.9, 906.9, 924.9, 926.9	
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Cylinder contact surfaces or cylinder liners without dust damage


The honing pattern is more or less clearly recognizable over the entire running surface. The hone marks may be partially worn away at the travel limit of the first piston ring.

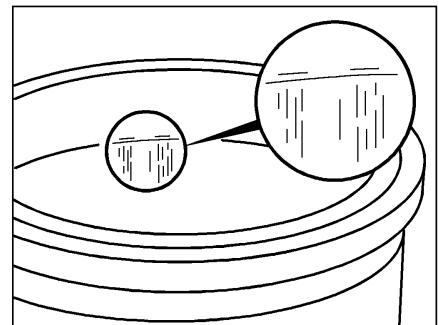


W03.10-0014-01

Cylinder contact surfaces or cylinder liners with dust damage

The traces of processing by honing are only just visible or are no longer visible. If the wear is substantial, a ridge can be felt at the travel limit of the first piston ring.




-  Dust and particulate damage are caused by poor sealing, cracks and abrasion in the intake tract's collars, ducts and hoses. Carefully inspect all intake ducts, collars and hoses, even in areas where access is difficult, when performing service and maintenance operations.



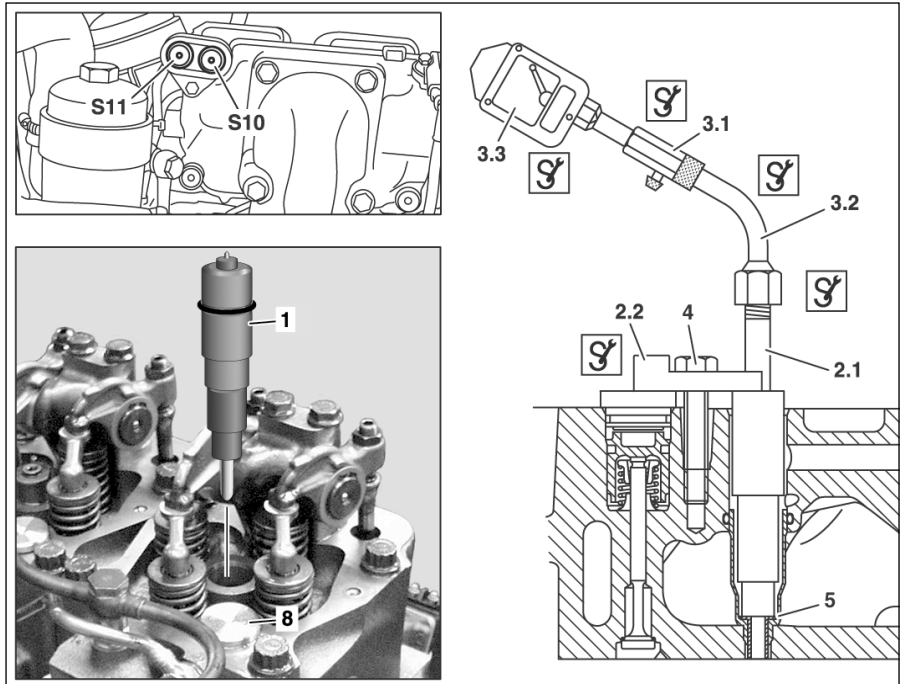
W03.10-0015-01

AR01.00-G-1200CH	Testing compression pressure	26.5.04
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






MODEL 000.001 with ENGINE 457.960

- 1 Nozzle holder combination
- 2.1  Connection piece
- 2.2  Retaining clip
- 3.1  Compression tester
- 3.2  Angled connection
- 3.3  Diagram chart
- 4 Bolt
- 5 Sealing sleeve
- 8 Constant throttle










S10 Engine start pushbutton switch  
 S11 Engine stop pushbutton switch



G01.00-3159-06


	<b>Remove</b>		
 <b>Danger!</b>	Risk of accident caused by vehicle starting off by itself when engine is running. Risk of injury caused by contusions and burns when working in engine during starting procedure	Secure vehicle to prevent it from moving. Wear closed and snug-fitting work clothes. Do not grasp hot or rotating parts.	<b>Page 9</b>
1	Check valve clearance, set if necessary	 Perform setting only when engine is cold, at the earliest, 30 min after shutting off the engine.	
 <b>AP</b>	Set valve clearance		<b>Page 121</b>
2	Warm engine up to operating temperature	 Coolant temperature 70 °C to 95 °C.	
3	Remove all nozzle holder combinations (1) for cylinders one through six		<b>Page 127</b>
4	Crank engine several times with the starter	 Press engine stop pushbutton switch (S11) and hold down, then also press engine start pushbutton switch (S10). The engine does not start if both pushbutton switches (S10, S11) are pressed simultaneously.	
5	Install connection piece (2.1) with sealing sleeve (5)	 Start preparation for test with cylinder one.	
6	Clamp connection piece (2.1) with retaining clip (2.2)	 Screw retaining clip (2.2) tight with a suitable bolt (4). The retaining clip (2.2) should be supported on the constant throttle (8). Pull out tight sealing sleeve (5) with pulling tool.	
			BA07.15-N-1007-01F



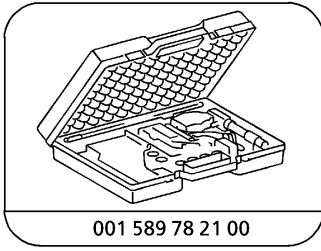
			904 589 01 21 00
			906 589 02 63 00
7	Attach compression tester (3.1) and angled connection (3.2) to connection piece (2.1) and insert diagram sheet (3.3)		001 589 78 21 00
	<b>Check</b>		
8	Crank engine with starter at least 8 revolutions and check compression pressure	 Press engine stop pushbutton switch (S11) and hold down, then also press engine start pushbutton switch (S10). The engine does not start if both pushbutton switches (S10, S11) are pressed simultaneously.	
9	Inspect the remaining cylinders in the same way	 Check cylinders two through six in the same manner with Steps 5 to 8.	
10	Compare readings on diagram sheet (3.3) with permissible specified values	 If the pressure measured is below the minimum compression pressure or if the permissible difference between cylinders is exceeded, determine the cause and rectify: ↓ Remove cylinder head	BE01.00-N-1001-01K  BE01.00-N-1002-01K  <b>Page 23</b>
	<b>Install</b>		
11	Remove connection piece (2.1) with sealing sleeve (5)		
12	Reinstall all nozzle holder combinations (1) for cylinders one through six	 Install new sealing sleeves (5).	<b>Page 127</b>

**Test data of compression pressure**

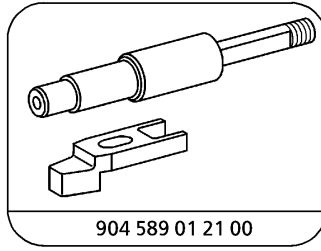
Number	Designation	Engine 457.960
BE01.00-N-1001-01K	Compression pressure service limit or limit value at cranking speed	bar 28
BE01.00-N-1002-01K	Compression pressure permissible difference between individual cylinders	bar ≤4

 **Diesel injection system with unit pumps (MR/PLD)**

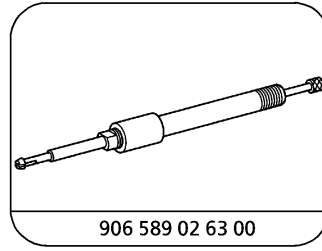
Number	Designation	Engine 457.960
BA07.15-N-1007-01F	Bolt of tensioning arm, nozzle holder combination and constant throttle to cylinder head	Nm 50



001 589 78 21 00  
Compression recorder



904 589 01 21 00  
Connection piece



906 589 02 63 00  
Extraction tool

AS00.00-Z-0005-01A	<p><b>Risk of accident</b> as vehicle may start off by itself with the engine running. <b>Risk of injury</b> as working around the engine during start-up or while running may result in contusions and burns</p>	<p>Secure vehicle to prevent it from moving off by itself. Wear closed and close-fitting work clothes. Do not grasp hot or rotating parts.</p>	<p><b>⚠ Danger!</b></p>
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**Possible hazards**

**Risk of accident**

from vehicle starting off during starting operation (e.g. when testing compression pressure) as a result of gear engaged or when engine running, or vehicles with automatic transmission as a result of selector lever position "P" or "N" not engaged (exception: some vehicles do not have a selector lever position "P").

**Injury hazard**

Severe injuries may be caused by unshielded rotating parts in the area of the running engine. The heat produced by the running engine can result in severe burns if contact is made with individual, unshielded parts.

**First aid measures in the event of burns**

- Do not rub the skin areas affected; flush with plenty of cold water and cover skin with sterile bandages.
- Consult a doctor without delay.


**Procedural guidelines and safety precautions**

- As a general rule, carry out work on the running engine only if this is absolutely necessary.
- Before starting the engine, apply parking brake.
- On models with manual transmission move gearshift lever into Neutral position.
- On vehicles with automatic transmission move selector lever into position "P" or "N" (exception: some vehicles do not have a selector lever position "P").
- On models which do not have selector lever position "P", secure selector lever to prevent it from being operated unintentionally.
- Wear closed and close-fitting work clothes.
- All items of jewelry like chains or rings must be taken off.
- Restrain long hair by wearing an appropriate head cover.
- Before commencing any work on the running engine, familiarize yourself with the location of potentially hot parts.
- When carrying out work when starting the engine or when engine is running do not touch any hot and rotating parts.



AR01.10-G-0002CH	Check engine parts for wear and damage	26.5.04
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**MODEL 000.001 with ENGINE 457.960**

	Check		
1	Check cylinder head and cylinder head gasket for wear and damage		<b>Page 19</b>
2	Check cylinder barrel for wear and damage		<b>Page 33</b>
3	Check piston and connecting rod for wear and damage		<b>Page 61</b>
4	During engine repair additional test work at piston/connecting rod and at cylinder contact surface		<b>Page 67</b>
5	Additional tests when carrying out a repair to the crankshaft, main bearing or connecting rod bearing		<b>Page 77</b>



AR01.10-G-0003CH	During engine repair additional test work at cylinder head and cylinder head gasket	26.5.04
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MODEL 000.001 with ENGINE 457.960

	Check		
1  AP	Remove oil filter element and check for outer metal abrasion or swollen condition of the oil filter element disks  Replace oil filter element	<b>i</b> Only if damage is severe at cylinder head and at cylinder head gasket.  <b>Nm</b>	<b>Page 13</b>  BA18.20-N-1006-01N
2  AP	Replace engine oil and oil filter element  Engine - oil and filter change	<b>i</b> Only if there is metal grit or a swollen oil filter element (coolant in the engine oil circuit).	<b>Page 185</b>

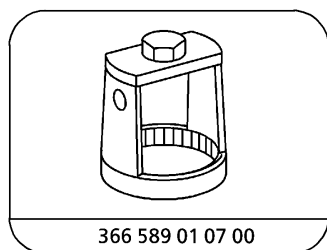
**Nm** Oil filter

Number	Designation	Engine 457.960
BA18.20-N-1006-01N	Oil filter cap to oil filter housing	Nm 40






AP18.20-G-0100-04C	Replace oil filter element		
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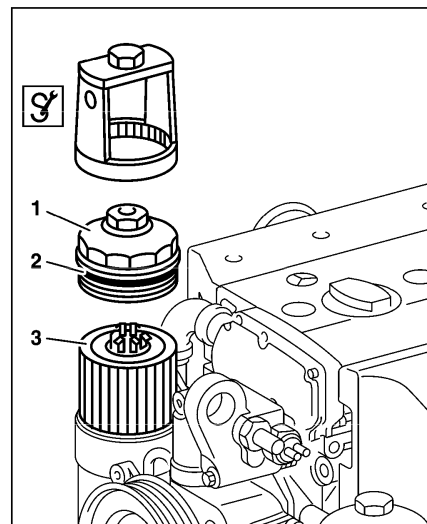
**Nm** Oil filter

Number	Designation	Engines 904.927/928/952/953	Engine 924.916
		Engine 906.935/936/955/967	
BA18.20-N-1003-01M	Oil filter cap to oil filter housing	Nm 25	25



Socket wrench insert waf 94 mm (14-point)

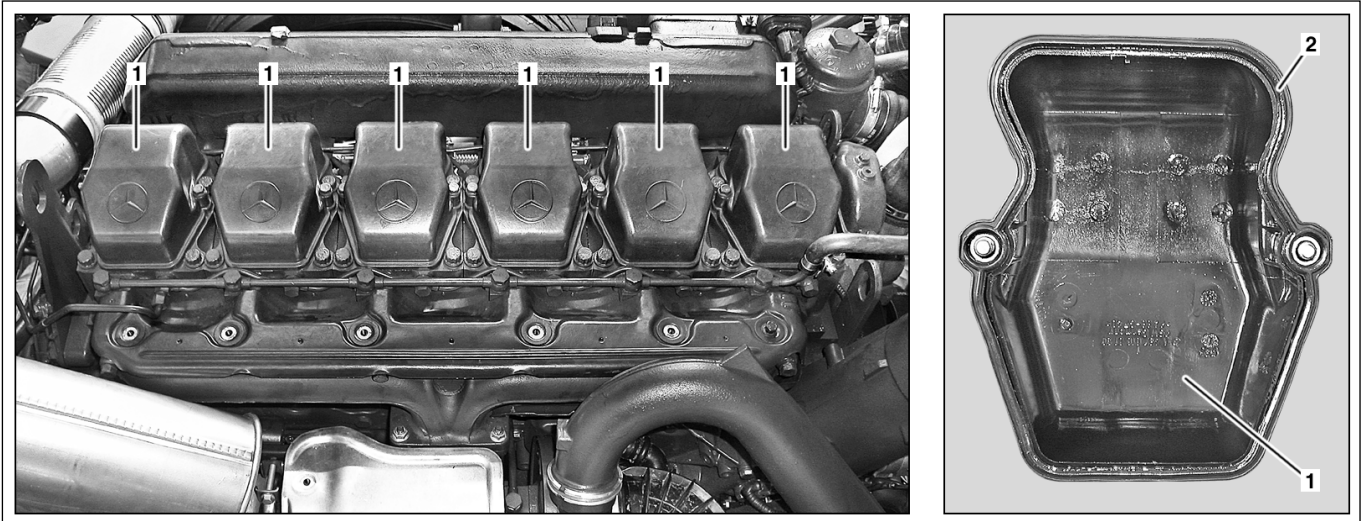
- 1 Unscrew the screw cap (1) of the oil filter with a socket wrench bit (width across flats 36) or  a socket wrench bit (width across flats 94) and let the oil escape from the oil filter housing.
- 2 Take off the screw cap (1) with the oil filter element (3) and unclip the oil filter element (3) by pressing on the side.  
 Ensure that no foreign objects enter into the oil filter housing.  
Never wipe out the oil filter housing.
- 3 Replace the sealing ring (2) and insert a new oil filter element (3) in the screw cap (1).  
 Grease the sealing ring (2) slightly.
- 4  Insert the screw cap (1) with the oil filter element (3) into the oil filter housing and screw on tightly with a socket wrench insert (waf 36) or a  socket wrench insert (waf 94).



G18.20-3120-02

AR01.20-G-5014CH	Remove/install cylinder head cover	12.7.04
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MODEL 000.001 with ENGINE 457.960



W01.20-1016-08

1 Cylinder head cover

2 Gasket

	<b>Remove/Install</b>		
1	Take off cylinder head cover (1)	Installation: Install new gasket (2).  	BA01.20-N-1001-01L BA01.20-N-1002-01L
2	Clean sealing surfaces at cylinder head cover (1) and cylinder head	Only scraper tools may be used for removing sealing residues. Do not use grinding material.	<b>Page 16</b>
	Information on working sealing surfaces when carrying out engine repairs	Engine 457.9, 541.9, 542.9, 900.9, 902.9, 904.9, 906.9, 924.9, 926.9	
3	Install in the reverse order		

Crankcase ventilation, cylinder head cover

Number	Designation	Engine 457.960	
BA01.20-N-1001-01L	Bolt of light alloy cylinder head cover to cylinder head	Nm	25
BA01.20-N-1002-01L	Bolt of plastic cylinder head cover to cylinder head	Nm	20



AH01.10-N-0002-01A	Information on machining sealing surfaces when carrying out engine repairs	Engines 457.9, 541.9, 542.9, 900.9, 902.9, 904.9, 906.9, 924.9, 926.9	ⓘ
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When machining the sealing surfaces on oil and fuel carrying components or interior compartments, grinding materials (emery cloth etc.) must not be used, otherwise the loose particles (e.g. corundum) can lead to impurities and damage on the connecting rod and main bearings.

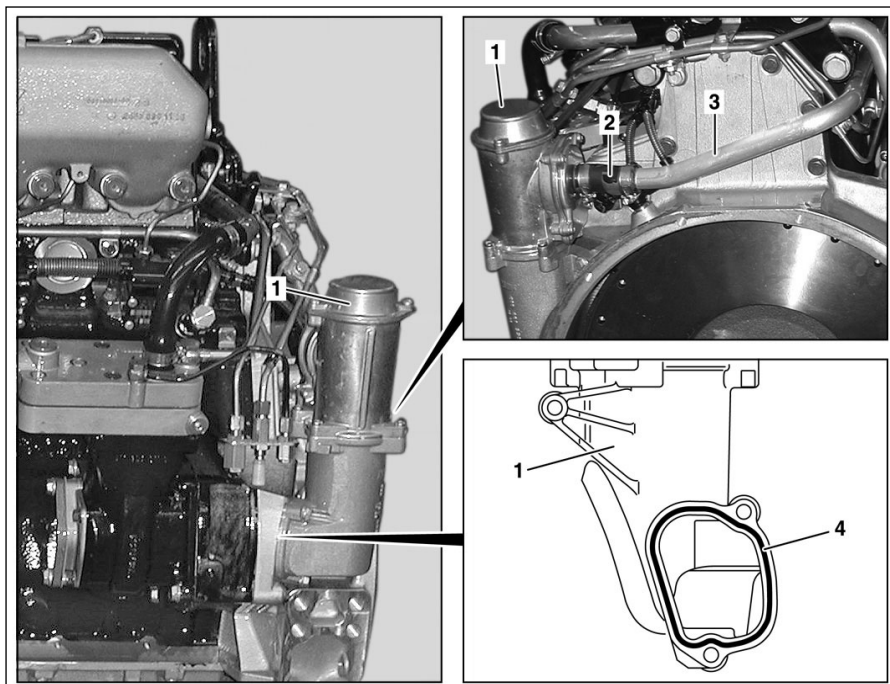
For this reason, scraper tools must always be used for removing sealing residues, rust, lime and combustion residues.

All oil and coolant bores and drillings should be carefully sealed before commencing work.

AR01.20-G-9750CH	Remove/install oil separator	26.5.04
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MODEL 000.001 with ENGINE 457.960

- 1 Oil separator
- 2 Bleed hose
- 3 Vent line
- 4 Sealing ring



W01.20-1010-06

	<b>Remove/install</b>		
1	Disconnect bleed hose (2) on oil separator (1) and vent line (3); move bleed hose on vent line	Check vent line (3) for deposits, clean or replace as required.	
2	Remove oil separator (1) on timing case	Collect engine oil which flows out. Installation: Replace sealing ring (4) on oil separator (1). 	BA01.20-N-1003-01L
3	Install in the reverse order		
<b>Danger!</b>	<b>Risk of accident</b> caused by vehicle starting off by itself when engine is running. <b>Risk of injury</b> caused by contusions and burns when working in engine during starting procedure	Secure vehicle to prevent it from moving. Wear closed and snug-fitting work clothes. Do not grasp hot or rotating parts.	<b>Page 9</b>
4	Start engine and allow to idle		
5	Shut off engine and check oil separator (1) for leaks	Visual inspection	

Crankcase ventilation, cylinder head cover

Number	Designation	Engine 457.960
BA01.20-N-1003-01L	Bolt of crankcase ventilation to timing case	Nm 25



AR01.30-G-0001CH	Check cylinder head and cylinder head gasket for wear and damage	26.5.04
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MODEL 000.001 with ENGINE 457.960

	Check		
1	Remove cylinder head		Page 23
2	Clean crankcase sealing surface		Page 16
	Information on working sealing surfaces when carrying out engine repairs	Engine 457.9, 541.9, 542.9, 900.9, 902.9, 904.9, 906.9, 924.9, 926.9	
3	Check crankcase sealing surface and cylinder head gasket	 If wear or damage is severe, exchange cylinder head. If light gap is visible at straightedge in the area of the cylinder head separating surface ↓ Check/face-grind cylinder head contact surfaces	Page 19  BE01.30-N-1001-02N WH58.30-Z-1025-12A  Page 29
4	Install cylinder head		Page 23

Test values for cylinder head

Number	Designation	Engine 457.960
BE01.30-N-1001-02N	Height of cylinder head	when new mm 113.85...114.15
		after stock removal mm ≥ 113,5

Commercially available tools (see Workshop Equipment Manual)

Number	Designation	Make (e. g.)	Order number
WH58.30-Z-1025-12A	Straightedge, 500 mm	Hahn und Kolb Borsigstr. 50 D-70469 Stuttgart www.hahn-kolb.de	37 550 050

AR01.30-G-5800-15CH	Check crankcase sealing surface and cylinder head gasket		
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Test values for cylinder head

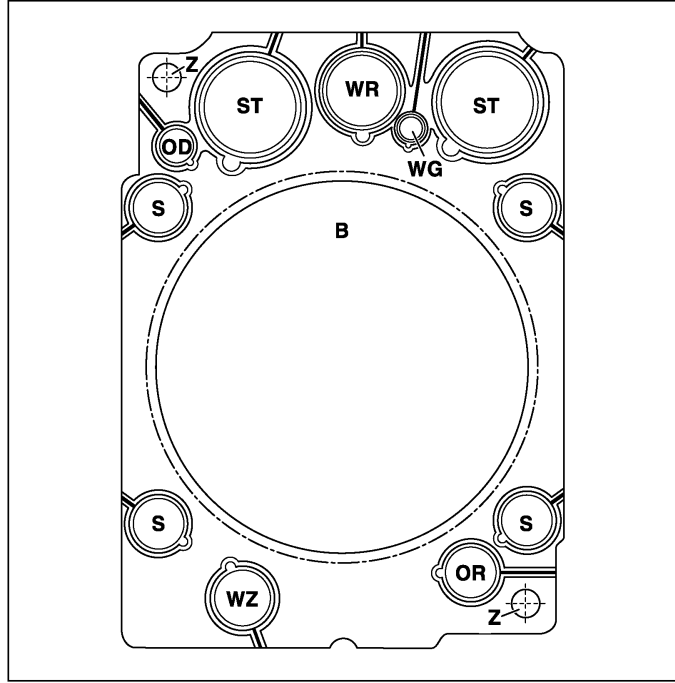
Number	Designation	Engine 457.960
BE01.30-N-1001-02N	Height of cylinder head	when new mm 113.85...114.15
		after stock removal mm ≥ 113.5

Commercially available tools (see Workshop Equipment Manual)

Number	Designation	Make (e. g.)	Order number
WH58.30-Z-1025-12A	Straightedge, 500 mm	Hahn und Kolb Borsigstr. 50 D-70469 Stuttgart www.hahn-kolb.de	37 550 050

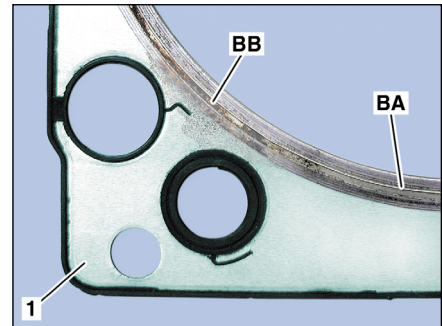
**Assignment of bores in the cylinder head gasket**

- B Combustion chamber bore
- OD Engine oil bore (pressure oil)
- OR Engine oil bore (oil return)
- S Cylinder head bolt bore
- ST Push rod bore
- WG Coolant bore (gas escape)
- WR Coolant bore (return)
- WZ Coolant bore (feed)
- Z Bore for fitted pins or centering sleeves



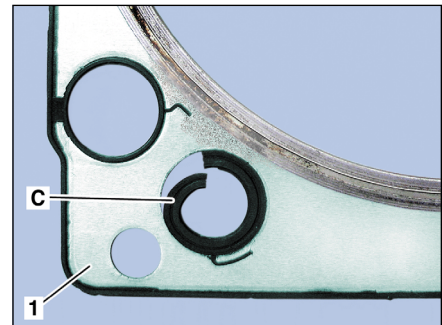
W01.30-1034-12

- 1 Check cylinder head gasket (1) at combustion chamber.  
 ⓘ Sealing surface (BA) at combustion chamber bore, the cylinder head gasket (1) was gas-tight. Sealing surface (BB) at combustion chamber bore, the cylinder head gasket (1) was not gas-tight.



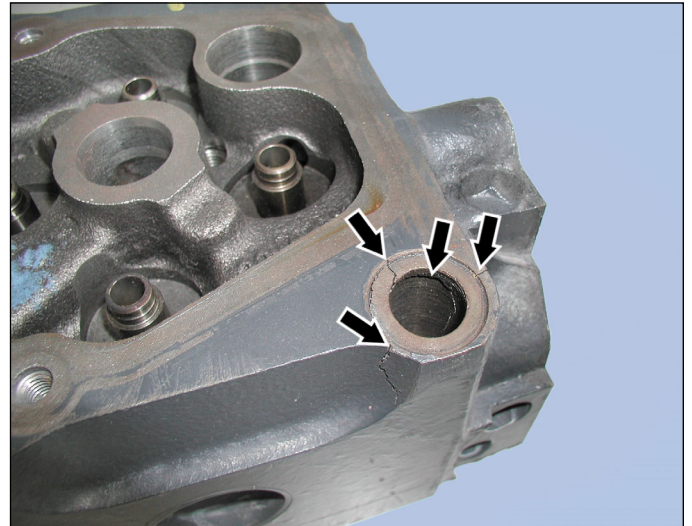
W01.30-1039-71

- 2 Check cylinder head gasket (1) at sealing rings.  
 ⓘ A damaged sealing ring (elastomer) (C) in the engine oil bore or in the coolant bore is a result of a cylinder head gasket (1) that is not gas-tight. If the cylinder head gasket (1) is leaky, it is necessary to also consider the cylinder head and crankcase sealing surfaces.



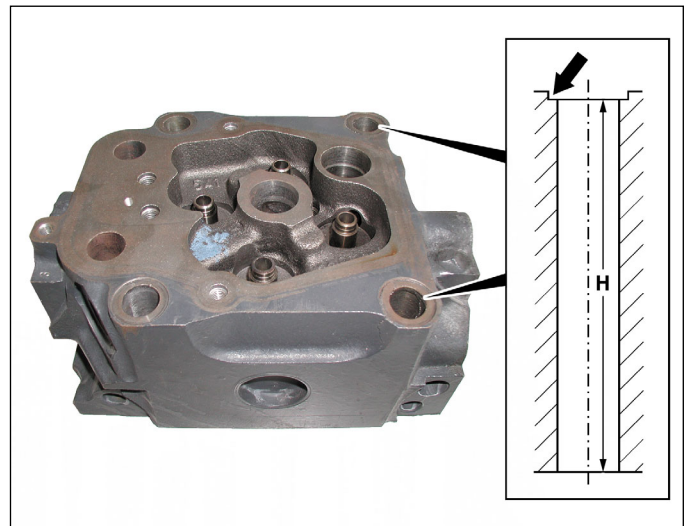
W01.30-1040-71

- 3 Clean cylinder head sealing surface.
- 4 Check cylinder head in the area of the bores and contact surfaces of the cylinder head bolts for cracks (arrows).  
 ⓘ Visible cracks always occur in combination with diggings around the bores for the cylinder head bolts and frequently only on the exhaust manifold side. If cracks are present, the cylinder head must be exchanged.



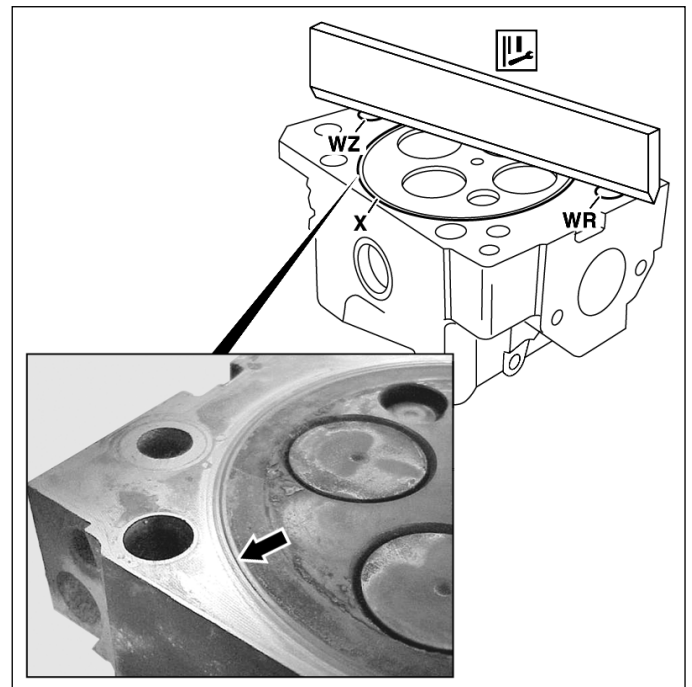
W01.30-1041-81

- 5 Check contact surfaces around the bores of the cylinder head bolts for diggings (arrow).  
 ⓘ If diggings are present, the height (H) of the cylinder head must be measured. If the dimension after a stock removal is below the limit, the cylinder head must be exchanged.  
 The cylinder head bolts must always be replaced. Oil cylinder head bolts on collar surface, thread and stem with engine oil.



W01.30-1042-81

- 6 Check cylinder head sealing surface according to cylinder head gasket.
- 7 Check cylinder head surface through visual inspection for flatness. ⓘ Place straightedge above both coolant bores (RC, WZ) onto the cylinder head sealing surface. Only check flatness within the sealing ring area (X) of the cylinder head gasket.  
 ⓘ If a light gap appears below the ⓘ straightedge due to diggings (arrow) of the cylinder head gasket (crimped part or bead) at the cylinder head sealing surface, then the cylinder head surface must be face-ground or the cylinder head exchanged.  
 When face-grinding, observe the following instructions:
  - The material removed from the cylinder head should not be less than the permissible overall cylinder head "minimum height".
  - Only face-grind the cylinder head sealing surface through face grinding.
 The surface quality of the cylinder head sealing surface must be maintained.

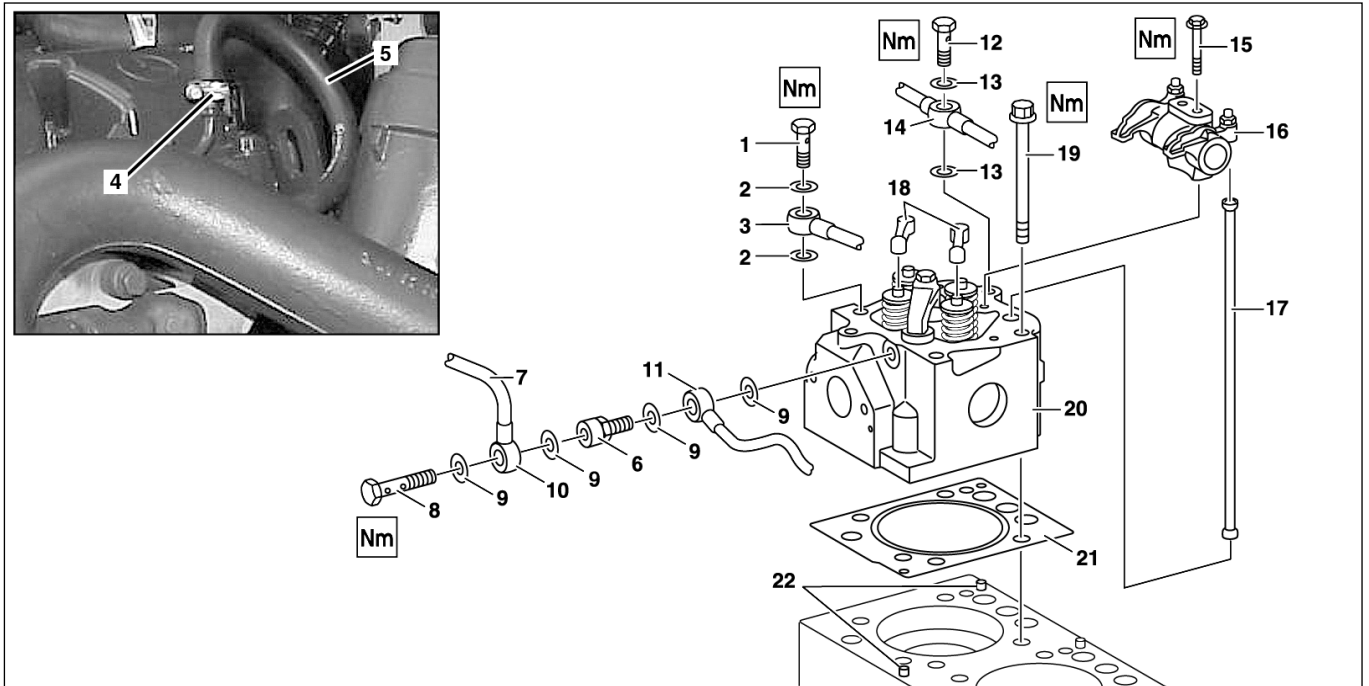


G01.30-3109-12



AR01.30-G-5800CH	Remove/install cylinder head	8.6.04
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MODEL 000.001 with ENGINE 457.960






















G01.30-3110-09

- |                       |                                    |                         |
|-----------------------|------------------------------------|-------------------------|
| 1 Banjo bolt          | 9 Sealing ring                     | 16 Rocker arm assembly  |
| 2 Sealing ring        | 10 Connection                      | 17 Tappet rod           |
| 3 Coolant vent line   | 11 Constant throttle pressure line | 18 Valve bridge         |
| 4 Clip                | 12 Banjo bolt                      | 19 Cylinder head bolt   |
| 5 Coolant hose        | 13 Sealing ring                    | 20 Cylinder head        |
| 6 Connection          | 14 Fuel leak oil line              | 21 Cylinder head gasket |
| 7 Compressed-air line | 15 Bolt                            | 22 Centering sleeve     |
| 8 Banjo bolt          |                                    |                         |

	Remove/Install		
<b>Danger!</b>	<b>Risk of injury</b> to skin and eyes suffering scalding from contact with hot coolant spray. <b>Risk of poisoning</b> from swallowing coolant.	Do not open cooling system unless coolant temperature is below 90 °C. Open cap slowly and release the pressure. Do not pour coolant into beverage bottles. Wear protective gloves, protective clothing and eye protection.	<b>Page 26</b>
<b>Danger!</b>	<b>Risk of explosion</b> caused by ignition of flammable products, <b>risk of poisoning</b> caused by inhaling fuel vapors or swallowing fuel as well as <b>risk of injury</b> to skin and eyes exposed to fuel.	No fire, sparks, open flames or smoking. Pour fuels only into suitable and appropriately marked containers. Wear protective clothing when handling fuel.	<b>Page 27</b>
	Information on working sealing surfaces when carrying out engine repairs	Engine 457.9, 541.9, 542.9, 900.9, 902.9, 904.9, 906.9, 924.9, 926.9	<b>Page 16</b>
1	Drain and collect coolant	<b>Installation:</b> Use only corrosion/antifreeze approved in the coolant specifications to prevent damage to the engine. Observe following, see: ↓	



 <b>BB</b>	Coolant specifications	Sheet 310.1	BB00.40-P-0310-01A
 <b>BB</b>	Anticorrosion/antifreeze agent	Sheet 325.2	BB00.40-P-0325-02A
2	Remove exhaust manifold		<b>Page 171</b>
3	Remove charge air manifold		<b>Page 153</b>
4	Remove injection lines	 Do not bend injection lines.	<b>Page 139</b>
5	Remove fuel leak oil line (14)	 <b>Installation:</b> Install new sealing rings (13). 	BA01.30-N-1005-01O
6	Remove coolant vent line (3) on cylinder head (20)	 <b>Installation:</b> Replace sealing rings (2). 	BA01.30-N-1003-01O
7	Remove constant throttle pressure lines (11) on cylinder head (20)	 <b>Installation:</b> Install new sealing rings (9). 	BA01.30-N-1004-01O
8	Remove cylinder head cover		<b>Page 15</b>
9	Remove rocker arm assembly (16)		<b>Page 105</b>
10	Remove valve bridges (18)		
11	Remove push rods (17)	 Turn push rods (17) when pulling out so that they separate from the roller tappet and the roller tappet is not pulled into the crankcase.  <b>Installation:</b> Oil push rods (17) with engine oil and ensure that they are properly seated in the roller tappet.	
12	Unscrew cylinder head bolts (19) and remove cylinder head (20)	 Put cylinder head (20) down to side so that built-in nozzle holder combinations are not damaged.  <b>Installation:</b> To achieve uniform compression of the cylinder head gasket (21) it is necessary to observe all tightening torque stages.  <b>Installation</b> Fit cylinder head (20) over the centering sleeves (22). Oil cylinder head bolts (19) with engine oil. Pay attention to tightening instruction for cylinder head bolts (19).  	<b>Page 27</b>  BE01.30-N-1001-01M BA01.30-N-1001-01O 422 589 01 09 00
13	Remove cylinder head gasket (21)	 <b>Installation:</b> Put new cylinder head gasket (21) over the centering sleeves (22) onto the face of the crankcase. Pay attention to installation position of cylinder head gasket (21).	
14	Clean threaded holes and oil and coolant drillings in crankcase	 Seal holes with plugs. No impurities must get into the crankcase during cleaning.	
	<b>Check</b>		
15	Measure shank length of cylinder head bolts (19)	If the maximum shank length (L) is exceeded, replace cylinder head bolt (19).	BE01.30-N-1001-01M

16	Clean cylinder head (20) and inspect for cracks and damage	⚠ When cleaning separating surfaces, scrape only, do not rub with emery cloth, otherwise engine damage can occur later. If a problem exists, replace cylinder head (20).	
17	Inspect contact surface of cylinder head (20) for distortion	ℹ If the separating surface of the cylinder (20) is distorted, face-grind only.	
18	Clean crankcase contact surface and inspect.	⚠ No impurities must get into the cylinder bores or oil and coolant drillings. Remove gasket and paint residues on crankcase separating surface by scraping only, do not rub with emery cloth, otherwise engine damage can occur later. ℹ Plug cylinder, oil and coolant bores.	
19	Inspect seat of roller tappets in crankcase		
20	Install in the reverse order		
21	Set valve clearance AP		Page 121
22	Perform testing work on cylinder head (20) and cylinder head gasket (21) when repairing engine		Page 13
23	Check engine oil level, correct as indicated AP	Engine - oil and filter change	Page 185
24	Pour in coolant BB	⚠ Use only coolant approved in the coolant specifications to prevent damage to the engine, see: ↓ Sheet 310.1	BB00.40-P-0310-01A
25	Start engine and observe oil pressure gauge with the engine idling	⚠ Crank engine with starter for no more than 20 seconds. Repeat starting procedure only after waiting for at least approx. 1 min. Do not increase engine speed until oil pressure is indicated to prevent engine damage. ℹ The oil pressure display should indicate oil pressure after approx. 10 s.	BE18.00-N-1001-01L

Test values of cylinder head bolts

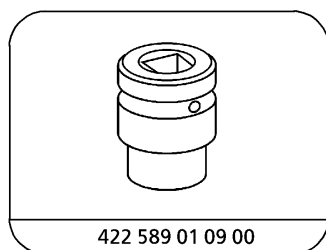
Number	Designation	Engine 457.960	
BE01.30-N-1001-01M	Cylinder head bolts M15×2	Shank length when new	mm 210
		Shank length	mm ≤ 212

Engine oil pressure test data

Number	Designation	Engine 457.960	
BE18.00-N-1001-01L	Engine oil pressure at	Idling speed	bar ≥ 0.5
		Maximum speed	bar ≥ 2.5

**Nm** Cylinder head

Number	Designation	Engine 457.960	
BA01.30-N-1001-01O	Cylinder head bolt to crankcase	1st stage	Nm 10
		2nd stage	Nm 50
		3rd stage	Nm 100
		4th stage	Nm 200
		5th stage	Δ° 90
		6th stage	Δ° 90
		For picture, see	-
BA01.30-N-1003-01O	Banjo bolt of coolant vent line to connection	Nm	35
BA01.30-N-1004-01O	Banjo bolt of constant throttle pressure line to cylinder head	Nm	45
BA01.30-N-1005-01O	Banjo bolt of fuel leak line to cylinder head	Nm	15



Socket wrench bit

AS20.00-Z-0001-01A	<b>Risk of injury</b> to skin and eyes suffering scalding from contact with hot coolant spray. <b>Risk of poisoning</b> from swallowing coolant.	Do not open cooling system unless coolant temperature is below 90 °C. Open cap slowly and release the pressure. Do not pour coolant into beverage bottles. Wear protective gloves, protective clothing and eye protection.	<b>⚠ Danger!</b>
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**Possible hazards**

**Risk of injury**

When the engine is warm, the cooling system is pressurized. If the cooling system is opened suddenly, there is a risk of scalding from hot coolant which splashes out.

**Danger of poisoning**

If coolant is swallowed, this can result in manifestations of poisoning such as headaches, dizziness, stomach pain, respiratory paralysis, unconsciousness, vomiting and cramps.

**Safety precautions/instructions**

- Allow cooling system to cool down to a coolant temperature of less than 90 °C.
- Open cap of cooling system slowly; turn a conventional coolant cap as far as the first detent and turn a screwed coolant cap approx. 1/2 turn and release the pressure. Wear protective gloves, protective clothing and eye protection. Do not pour coolant into beverage bottles.

**First aid measures**

- Rinse affected skin with large quantities of cold water and cover with sterile bandages.
- Allow the person affected to drink plenty of water with the addition of medicinal charcoal.
- If the person has suffered severe burns or has swallowed coolant, contact a doctor.

AS47.00-Z-0001-01A	Risk of explosion caused by fuel igniting, risk of poisoning caused by inhaling and swallowing fuel as well as risk of injury to eyes and skin caused by contact with fuel.	No fire, sparks, open flames or smoking. Pour fuels only into suitable and appropriately marked containers. Wear protective clothing when handling fuel.	⚠ Danger!
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Potential risks

Risk of explosion, poisoning and injury

Fuels are highly inflammable and toxic if inhaled. Fuel may cause damage to skin. For example, skin is degreased when it comes into contact with gasoline fuel. Fuel vapors are explosive, invisible and spread out at floor level. This vapor is poisonous when inhaled and has an anesthetizing effect in high concentrations.

- Store drained fuel in a suitable and sealed vessel.
- Immediately eliminate any fuel which has flowed out.

Conducting work on a vehicle with open flames (e.g. welding etc.)

- Before carrying out this work, remove relevant parts of fuel system and seal open fuel lines with plugs.

Safety precautions/instructions

- Observe the national safety precautions and regulations.
- No fire, sparks, open flames or smoking.
- Ensure the work place is adequately ventilated.
- Never drain or pour in fuels over assembly pits.

First aid measures

- Clean affected skin areas with water and soap.
- Change affected clothing as quickly as possible.
- If fuel gets into the eyes, rinse eyes with water immediately and call a doctor if necessary.

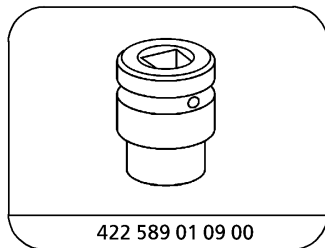
AR01.30-G-5800-07CH	Tightening specification of cylinder head bolts		
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Test values of cylinder head bolts

Number	Designation	Engine 457.960	
BE01.30-N-1001-01M	Cylinder head bolts M15×2	Shank length when new	mm 210
		Shank length	mm ≤212




 Cylinder head


Number	Designation	Engine 457.960		
BA01.30-N-1001-01O	Cylinder head bolt to crankcase	1st stage	Nm	10
		2nd stage	Nm	50
		3rd step	Nm	100
		4th stage	Nm	200
		5th stage	Δ°	90
		6th stage	Δ°	90
		For picture, see		



422 589 01 09 00

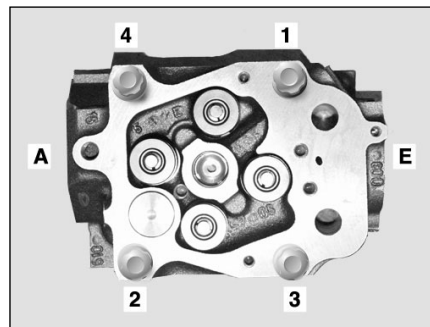
Socket wrench bit

- 1  Oil cylinder head bolts with engine oil, screw in with  socket wrench bit and tighten in specified sequence (1 to 4) to specified torque and rotation angle.  
 If one of the bolts is tightened too tightly during assembly, remove all 4 bolts on cylinder head in question and check permissible shank length. In addition, it is also necessary to use a new cylinder head gasket. Failure to observe can lead to leakage at the cylinder head gasket.

 The cylinder head bolts are no longer retightened.

*E* Inlet side



*A* Exhaust side



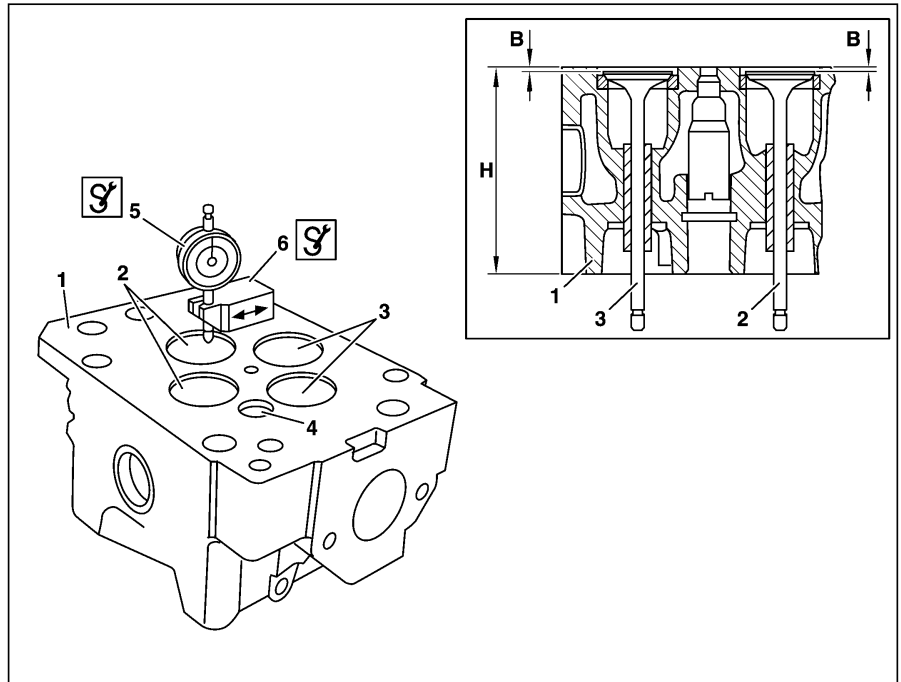
A01.30-0003-01

AR01.30-G-7162CH	Check/face grind cylinder head contact surfaces	26.5.04
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








MODEL 000.001 with ENGINE 457.960








- 1 Cylinder head
- 2 Inlet valve
- 3 Outlet valve
- 4 Constant throttle valve
- 5  dial indicator
- 6  dial indicator holder

- H Height of cylinder head
- B Amount by which valve stands back



A01.30-0005-06

	<b>Remove</b>		
1	Remove cylinder head (1)		<b>Page 23</b>
2	Remove nozzle holder combination		<b>Page 127</b>
3	Remove valves (2, 3)	 Mark valves (2, 3).	<b>Page 117</b>
4	Remove constant throttle valve (4)		<b>Page 53</b>
5	Clean cylinder head (1)		
	<b>Check</b>		
6	Check sealing surface of cylinder head (1) for porous or damaged points	 If porous and/or damaged points are present: Machine cylinder head contact surface	
7	Inspect cylinder head (1) for flatness	 	<b>Page 31</b> BE01.30-N-1002-02N WH58.30-Z-1025-12A WH58.30-Z-1026-12A
8	Measure parallelism of upper contact surface to lower surface in longitudinal direction	 If value deviates from specified value: Face-grind cylinder head separation surface.	BE01.30-N-1004-02N
9	Measure overall height of cylinder head (H)	 If value deviates from specified value: Replace cylinder head (1). 	BE01.30-N-1001-02N WH58.30-Z-1027-12A
10	Face-machine cylinder head contact surface (combustion chamber side)	 After stock removal: - the cylinder head overall height (H) must not be less than the permissible height.	BE01.30-N-1001-02N

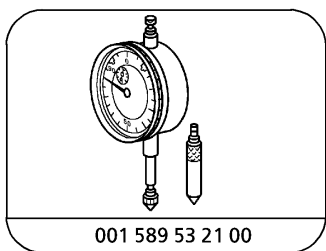
		- the surface finish (peak-to-valley height $R_z$ ) of cylinder head contact surface must be maintained. - the permissible variation of the parallelism of the top contact surface to bottom surface must not be exceeded. 	BE01.30-N-1003-02N  BE01.30-N-1004-02N  WH58.30-Z-1027-12A
11	Clean cylinder head (1)		
	<b>Measure</b>		
12	Install valves (2, 3) in cylinder head (1)	 Observe marking on valves (2,3).	
13	Measure valve setback (B) in relation to cylinder head (1) with dial indicator (5) and dial indicator holder (6)	 If measurement differs from specification:  ↓ Replace cylinder head (1) and install new valves (2, 3).  	<b>Page 32</b>  BE05.30-N-1003-01M  001 589 53 21 00 343 589 00 40 00
	<b>Install</b>		
14	Install constant throttle valve (4)		<b>Page 53</b>
15	Install valves (2, 3)		<b>Page 117</b>
16	Install nozzle holder combination		<b>Page 127</b>
17	Install cylinder head (1)		<b>Page 23</b>

Test values for cylinder head

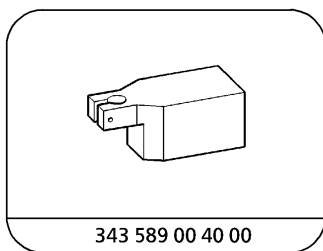
Number	Designation	Engine 457.960
BE01.30-N-1001-02N	Height of cylinder head	when new mm 113.85...114.15
		after stock removal mm $\geq 113,5$
BE01.30-N-1002-02N	Permissible variation of flatness of bottom contact surface in longitudinal direction Over a length of 150 mm mm 0.015	
BE01.30-N-1003-02N	Peak-to-valley height ( $R_z$ ) of cylinder head contact surface mm 0.008...0.016	
BE01.30-N-1004-02N	Variation of parallelism of top to bottom contact surface mm 0.1	

Test values for valves

Number	Designation	Engine 457.960
BE05.30-N-1003-01M	Valve setback to cylinder head contact surface	when new mm 0.7...1.1
		permissible value mm -



Dial indicator



Dial indicator holder

Commercially available tools (see Workshop Equipment Manual)

Number	Designation	Make (e. g.)	Order number
WH58.30-Z-1025-12A	Straightedge, 500 mm	Hahn und Kolb Borsigstr. 50 D-70469 Stuttgart www.hahn-kolb.de	37 550 050
WH58.30-Z-1026-12A	Feeler gage 0.04 - 0.15 mm	Hahn und Kolb Borsigstr. 50 D-70469 Stuttgart www.hahn-kolb.de	36 180 010
WH58.30-Z-1027-12A	External micrometer 100-125 mm (included in set 31414 150)	Hahn und Kolb Borsigstr. 50 D-70469 Stuttgart www.hahn-kolb.de	31366 100

AR01.30-G-5800-12CH	Inspect flatness of cylinder head		
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Test values for cylinder head

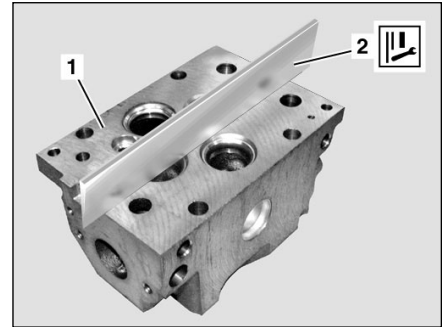
Number	Designation	Engine 457.960
BE01.30-N-1002-02N	Permissible variation of flatness of bottom contact surface in longitudinal direction	Over a length of 150 mm mm 0.015

Commercially available tools (see Workshop Equipment Manual)

Number	Designation	Make (e. g.)	Order number
WH58.30-Z-1025-12A	Straightedge, 500 mm	Hahn und Kolb Borsigstr. 50 D-70469 Stuttgart www.hahn-kolb.de	37 550 050
WH58.30-Z-1026-12A	Feeler gage 0.04 - 0.15 mm	Hahn und Kolb Borsigstr. 50 D-70469 Stuttgart www.hahn-kolb.de	36 180 010



- 1 Check cylinder head separation surface (1) with  straightedge (2) over entire length and diagonals for flatness.
  -  If a gap is present, check the permissible deviation with a  feeler gauge. When checking in the transverse direction, the permissible tolerance specified serves only as a flat rate and is not measurable.

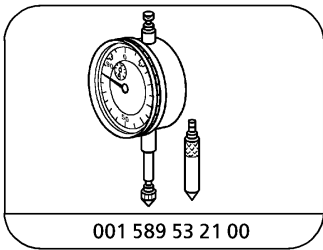


A01.30-0004-01

AR05.30-G-4100-01CH	Measure valve setback in relation to cylinder head		
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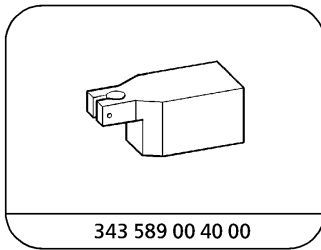
Test values for valves

Number	Designation	Engine 457.960	
BE05.30-N-1003-01M	Valve setback in relation to cylinder head separating surfaces	New condition	mm 0.7...1.1
		Permissible value	mm -










001 589 53 21 00

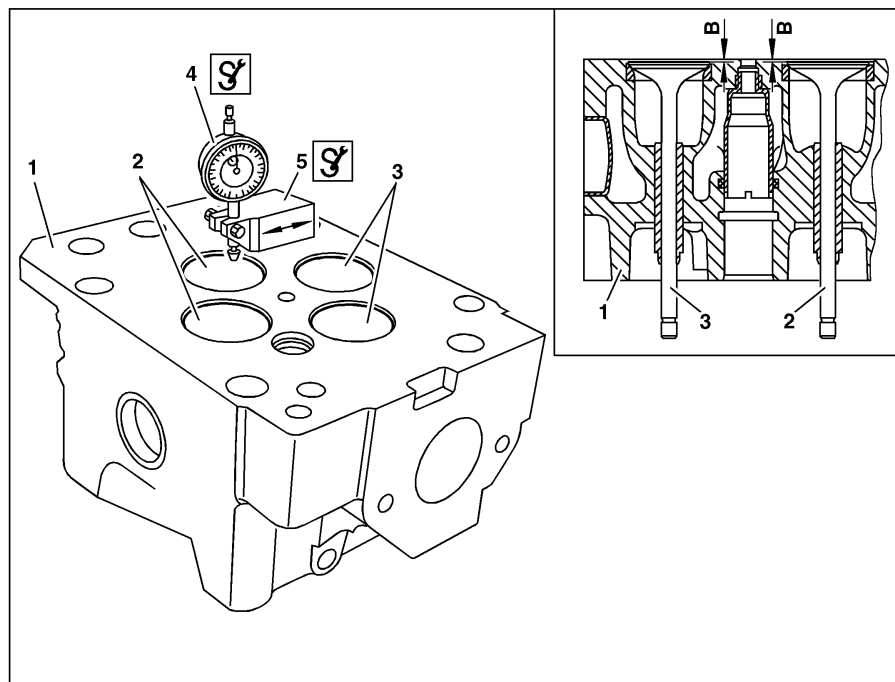
Dial indicator



343 589 00 40 00

Dial indicator holder

- 1 Install  dial indicator (4) on  dial indicator holder (5)
- 2 Install  dial indicator (4) on level surface of cylinder head (1) under tension
- 3 Adjust scale on  dial indicator (4) to "0"
- 4 Move  dial indicator (4) with  dial indicator holder (5) until tracer pin is positioned on valve plate of intake valve (2) or exhaust valve (3).
  -  Measure valve setback (B) on both intake (2) and exhaust valves (3). The valve setback (B) for one valve pair should be within the permissible tolerance range



W05.30-0042-06

AR01.40-G-0003CH	Check cylinder barrel for wear and damage	26.5.04
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MODEL 000.001 with ENGINE 457.960

	Check		
1	Remove cylinder head		Page 23
2	Clean crankcase sealing surface		
	Information on working sealing surfaces when carrying out engine repairs	Engine 457.9, 541.9, 542.9, 900.9, 902.9, 904.9, 906.9, 924.9, 926.9	Page 16
3	Rotate crankshaft until the piston of the cylinder to be checked is positioned on BDC, then assess the cylinder barrel by means of a visual inspection		
	Notes for evaluation of cylinder contact surface	Engine 457.9, 541.9, 542.9, 902.9, 904.9, 906.9, 924.9, 926.9	Page 34
		If wear or a damage is determined on the piston crown or on the cylinder barrel: ↓ Check piston and cylinder liner matchup Cylinder liner inner dia. Piston dia.	Page 37
		If wear, damage or variation of the specified values was determined: ↓ Install new piston Install new cylinder liner.	Page 69
			BE01.40-N-1001-03K BE03.10-N-1001-02N
4	Install cylinder head		Page 23

Test values of cylinder liner

Number	Designation	Engine 457.960	
BE01.40-N-1001-03K	Cylinder liner inner dia.	Code letter A	mm 127.990...127.995
		Code letter B	mm 127.995...128.005
		Code letter C	mm 128.005...128.010

Test values for pistons

Number	Designation	Engine 457.960	
BE03.10-N-1001-02N	Piston dia.	Group identification BA	mm 127.743...127.751
		BC	mm 127.749...127.757

AH01.40-N-0001-03A	Information on assessment of cylinder contact surface	Engines 457.9, 541.9, 542.9, 902.9, 904.9, 906.9, 924.9, 926.9	<b>i</b>
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The following information should be of help in the assessment of the cylinder contact surface, in order to make an expert decision regarding the condition and the further use of the crankcase or the cylinder liner.

On a new engine the cylinder contact surface is cylindrical and wear occurs as the period of operation increases.

The cylinder contact surface is not used evenly so a beveled shape occurs during normal wear.

Wear or a damage can also be recognized on the honing pattern of the cylinder contact surface

The following illustrated damage patterns are only one series of examples of possible damage forms on the cylinder contact surface. When assessing the types of damage one must always include the surface quality of the piston and the piston rings in the damage diagnosis.

**Normal condition**

Matt gray surface, visible honing pattern, dried cylinder contact surface, without oil residues, without gloss marks or reflective smoothings. The cylinder walls or the cylinder liners must not have any scorch streaks. Individual slight drawing scores are not critical. The honing pattern is clearly more or less recognizable on the total cylinder contact surface. The honing pattern may be partially worn away at the reversal point of the first piston ring.

**i** The cylinder liner or the crankcase can be reused.

Wear or damage on the cylinder contact surface is often caused by:

- leaky air intake ducts downstream air cleaner,
- faults in the fuel injection system,
- a too small or a too large piston axial play between piston skirt and cylinder contact surface,
- poor engine oil quality (oil viscosity) or engine oil thinning through fuel,
- soiled or damaged engine oil filter,
- fault in engine oil circuit e.g. engine oil pressure too low,
- bent or damaged oil spray nozzles for the piston cooling.

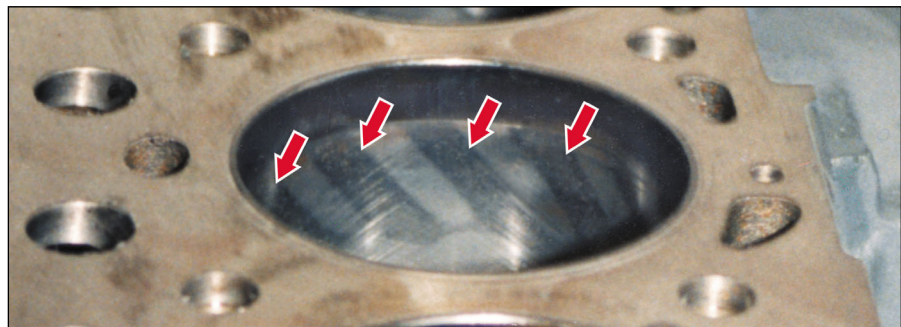
**i** After an engine repair, the engine oil circuit must be filled externally with released engine oil before starting the engine. Afterwards crank the engine several times by simultaneously pressing the engine start button and engine stop button with the starter until the engine oil pressure is present.



W01.40-1044-81

Only for engines 902.9, 904.9, 906.9, 924.9, 926.9

**i** The streaky pattern (arrows) in the high range of the cylinder contact surface results from the induction hardening when manufacturing the crankcase and is to be regarded as a normal condition. The longer the runtime of the engine, the less visible the streaky pattern (arrows).

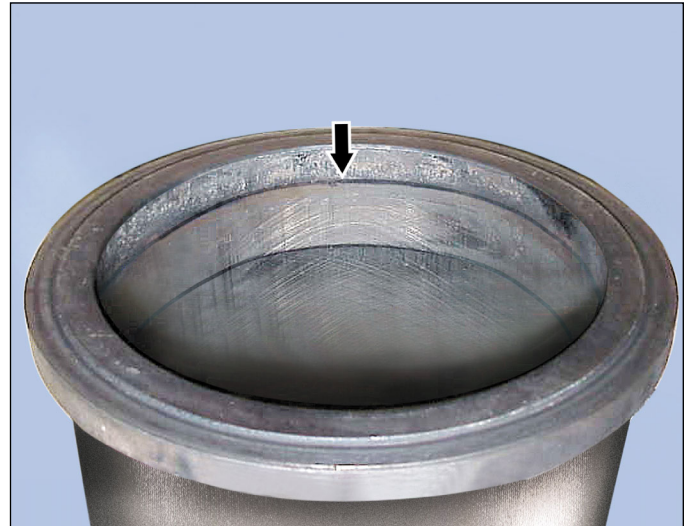


W01.40-1042-74

**Carbon deposits on the cylinder contact surface**

Check the top land area of the cylinder liner or the crankcase for carbon (arrow).

- i** For oil carbon (arrow) on the top land unit:
  - clean top land area and reuse the cylinder liner or the crankcase.
  - additionally remove the piston and assess the piston rings.

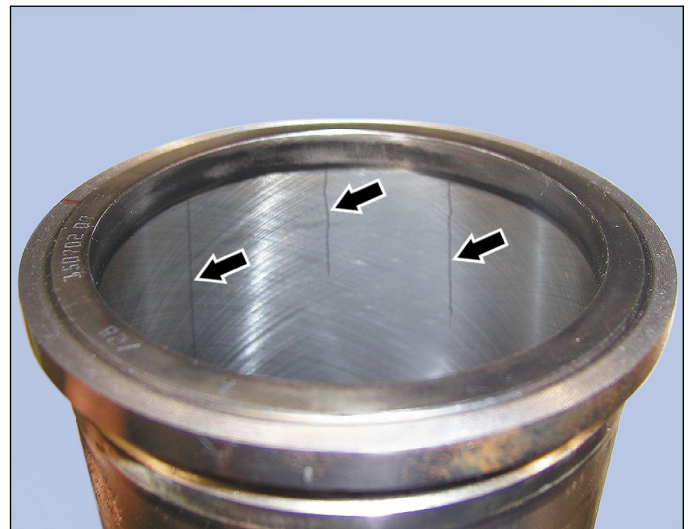


W01.40-1051-81

**Individual continuous traces of scratches or score marks**

Check area of the contact surface in the cylinder liner or the crankcase for traces of scratching (arrows).

- i** The cylinder liner or the crankcase can be reused when there are only slight traces of scratches (arrows) or score marks.



W01.40-1052-81

**Ring shaped imprints**

Color shadow markings (arrow) are visible in the upper and lower piston ring reversal point and the honing pattern is still recognizable.

- i** The cylinder liner or the crankcase can be reused.



W01.40-1053-81

**Pressure gloss marks, smoothings**

Individual blank places, for example in the middle (arrow) of the cylinder barrel or all-round an imprint on the piston ring reversal point above and below.

Can be caused by poor engine oil quality (oil viscosity).



Engines 457.9, 541.9, 542.9:

The cylinder liner is unusable and must be replaced.

Engines 902.9, 904.9, 906.9, 924.9, 926.9:

The crankcase can be reused if the engine has no in-engine complaints such as noises or increased engine oil consumption.



W01.40-1055-81

**Visual streaks, traces of friction**

Imperceptible dried traces of friction or deposits (arrow) on cylinder contact surface feathers out as of the second or third piston ring to the bottom.

Caused by soot particles and fuel ablations of engine oil film. Even damaged piston rings could be the cause.



Engines 457.9, 541.9, 542.9:

The cylinder liner is unusable and must be replaced. Additionally the piston has to be replaced.

Engines 902.9, 904.9, 906.9, 924.9, 926.9:

The crankcase can be reused if the engine has no in-engine complaints such as noises or increased engine oil consumption.



W01.40-1035-81

**Dust damage**

The traces of processing by honing are only just visible or are no longer visible. If the wear is substantial, a stage of wear is perceptible at the reversal point of the first piston ring (arrow).

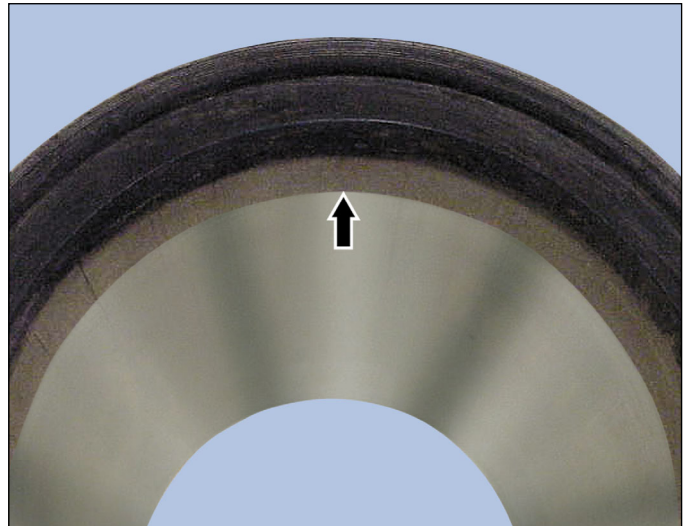


Engines 457.9, 541.9, 542.9:

The cylinder liner is unusable and must be replaced. Additionally check the piston and piston rings, replace if necessary.

Engines 902.9, 904.9, 906.9, 924.9, 926.9:

The crankcase can be reused if the engine has no in-engine complaints such as noises or increased engine oil consumption.

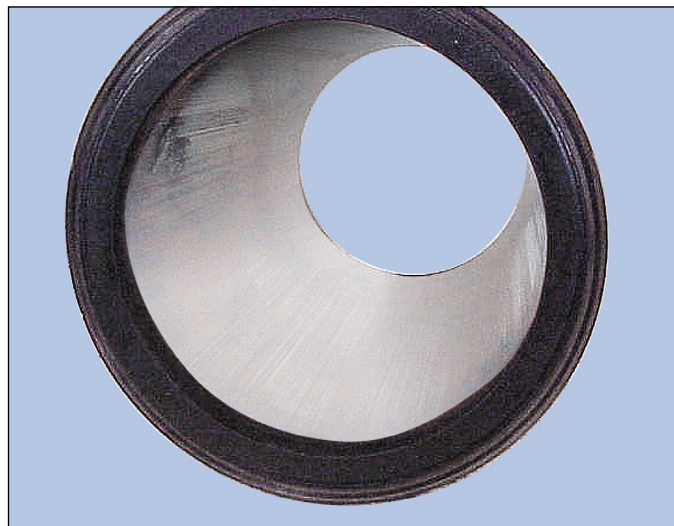


W01.40-1041-81

**Piston seizure or roughened streaks, friction seizure**

The cylinder contact surface is mostly perceptibly roughened over the total length. Material applications and perceptible traces of seizure at the cylinder contact surface and also on the piston skirt.

**i** The cylinder liner or the crankcase is unusable and must be replaced or machined. Additionally check the piston and piston rings, replace if necessary.



W01.40-1036-81

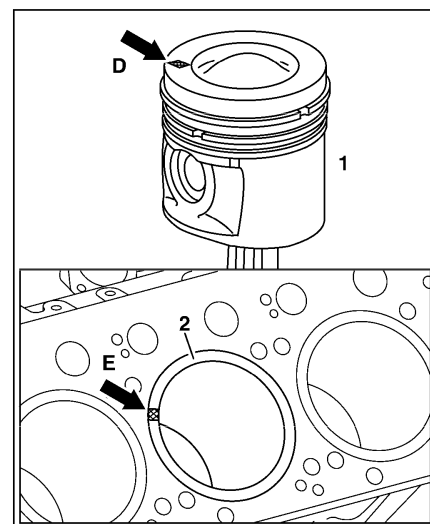
AR03.10-G-7021-02CH	Assign standard size piston to cylinder bore		
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**Test values of cylinder liner**

Number	Designation	Engine 457.960		
BE01.40-N-1001-03K	Cylinder liner inner dia.	Code letter A	mm	127.990...127.995
		Code letter B	mm	127.995...128.005
		Code letter C	mm	128.005...128.010

- Read off tolerance group marking on piston crown (arrow D) on piston (1) and match up with cylinder liner markings on edge of liner (arrow E) on cylinder liner (2).  
**i** The piston (1) is marked with a group of letters (BA or BC) and the cylinder liner (2) is marked with one letter (A, B or C).  
 In each case, a piston (1) and cylinder liner (2) with the following markings match in terms of dimensions:

Piston (1)		Cylinder liners (2)
BA	→	A or B
BC	→	B or C



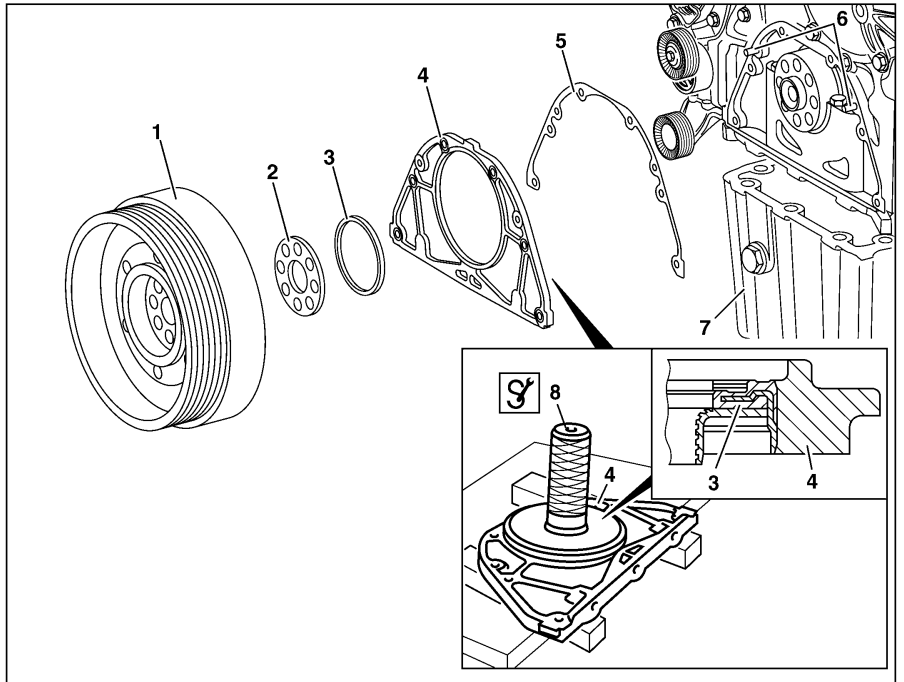
G03.10-3105-02













AR01.40-G-8800CH	Remove/install housing cover at front	26.5.04
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MODEL 000.001 with ENGINE 457.960



- 1 Belt pulley / vibration damper
- 2 Splash ring
- 3 Crankshaft radial seal
- 4 Housing cover
- 5 Gasket
- 6 Dowel pin
- 7 Oil pan
- 8  Drift




W01.40-1068-06

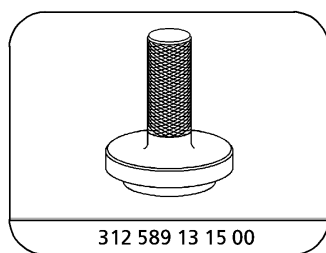
	<b>Remove</b>		
1	Remove belt pulley / vibration damper (1)		<b>Page 89</b>
2	Remove the slinger (2)	 Mark installed position.	
3	Remove oil pan (7)		<b>Page 51</b>
4	Housing cover (4) together with crankshaft radial sealing ring (3)		
5	Remove gasket (5)		
6	Remove crankshaft radial sealing ring (3) from housing cover (4)	 For this purpose, place housing cover (4) flat on two wooden strips and press out crankshaft radial sealing ring (3) with drift (8). 	312 589 13 15 00
	<b>Check</b>		
7	Check running surface of crankshaft radial sealing ring (3) on race or crankshaft flange	 If galling is present on the race or crankshaft flange, replace race: ↓ Install race on crankshaft flange	<b>Page 79</b>
	<b>Install</b>		
8	Install new gasket (5)	 Clean sealing surfaces.	
9	Install housing cover (4)	 Place the housing cover (4) over the dowel pins (6) on the crankcase and push it in. 	BA01.40-N-1001-01P
10	Install oil pan (7)		<b>Page 51</b>
11	Install the crankshaft radial sealing ring (3)	When installing crankshaft radial sealing ring (3) without race	<b>Page 40</b>



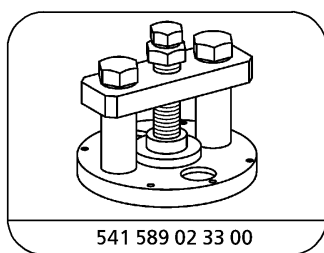
		When installing crankshaft radial sealing ring (3) with race 	<b>Page 42</b>
12	Fit a slinger (2)	 Pay attention to the installation position of the slinger (2).	541 589 02 33 00
13	Install belt pulley/vibration damper (1)		<b>Page 89</b>

 Crankcase, timing case cover, end cover

Number	Designation	Engine
BA01.40-N-1001-01P	Bolt of housing cover to crankcase M8×25 -10.9	Nm 457.960 30

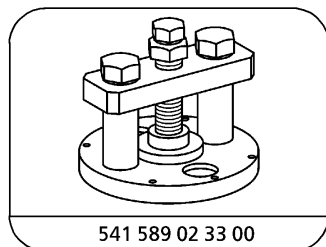


Drift



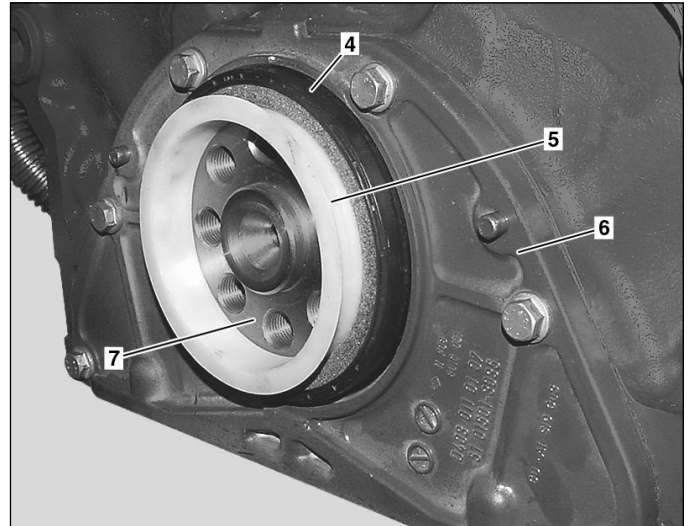
Removal and insertion device

AR03.20-G-3000-01CH	Install front crankshaft radial seal		
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






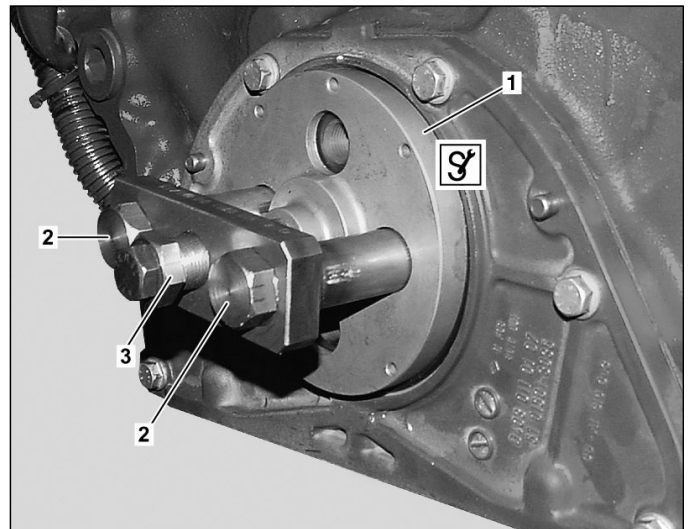
Removal and insertion device

- 1 Moisten crankshaft flange (7) with engine oil.
- 2 Position crankshaft radial sealing ring (4) on crankshaft flange (7) with installation aid (5).
- 3 Press crankshaft radial sealing ring (4) into front housing cover (6) and remove installation aid (5).



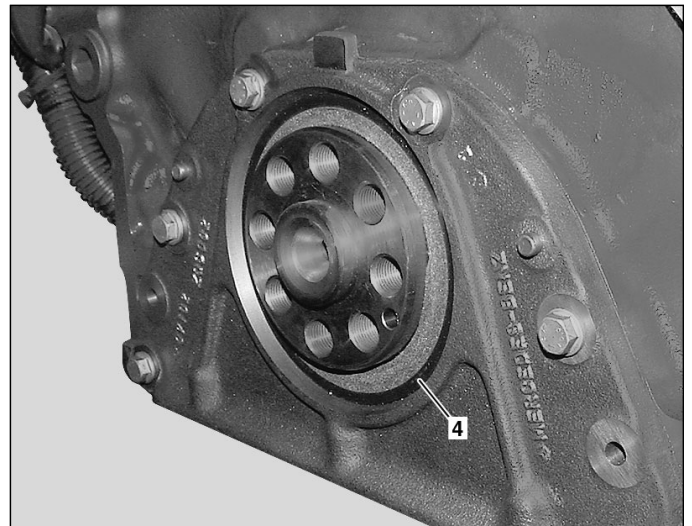
G03.20-3111-11

- 4 Attach  removal and insertion device (1) to crankshaft flange with bolts (2).  
 When tightening bolts (2) ensure that the  removal and insertion device (1) does not make contact with the crankshaft radial sealing ring (4), if necessary, unscrew bolt (3).
- 5 Press crankshaft radial sealing ring (4) down to perceptible stop with  removal and insertion device (1) by screwing in bolt (3).
- 6  Remove removal and insertion device (1).



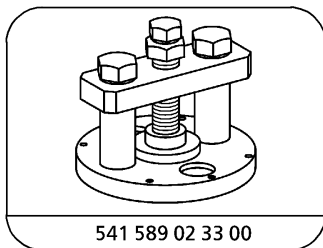
G03.20-3108-11

- 7 Check installation position of the crankshaft radial sealing ring (4).



G03.20-3110-11

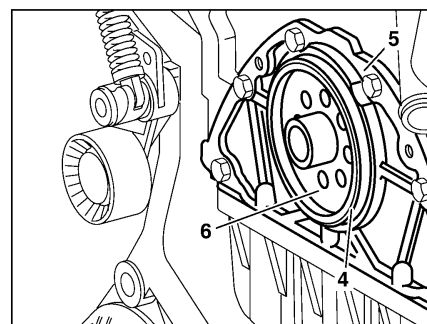
AR03.20-G-3000-01CHA	Install front crankshaft radial sealing ring		
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541 589 02 33 00

Removal and insertion device

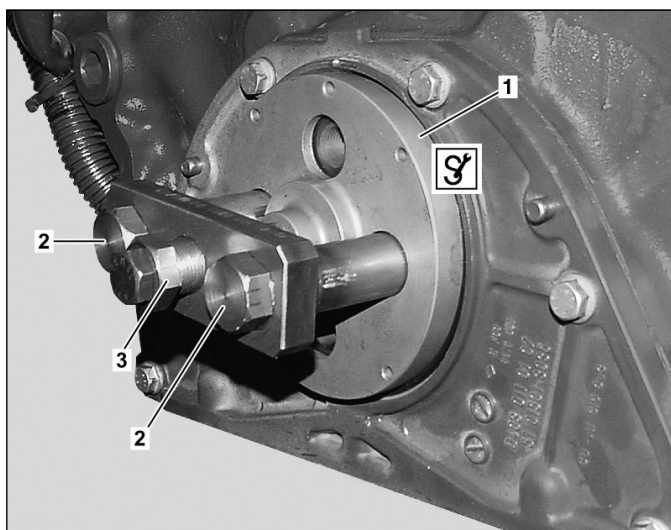
- 1 Moisten lip from crankshaft radial sealing ring (4) and race on crankshaft flange (6) by engine oil.
- 2 Slide crankshaft radial sealing ring (4) on crankshaft flange (6).
- 3 Press crankshaft radial sealing ring (4) into front housing cover (5) by hand.



G03.20-3106-01

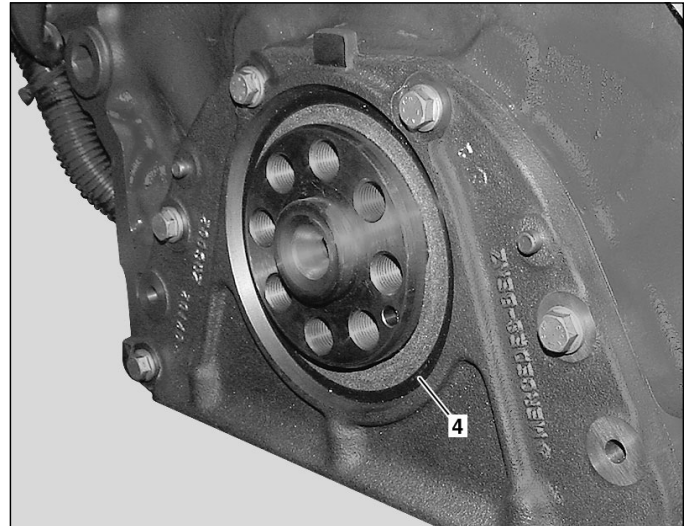
**i** Press in crankshaft radial sealing ring (4) only to the point that it no longer falls out.

- 4 Attach **S** removal and insertion device (1) to crankshaft flange with bolts (2).
- i** When tightening bolts (2) ensure that the **S** removal and insertion device (1) does not make contact with the crankshaft radial sealing ring (4), if necessary, unscrew bolt (3).
- 5 Press crankshaft radial sealing ring (4) down to perceptible stop with **S** removal and insertion device (1) by screwing in bolt (3).
- 6 **S** Remove removal and insertion device (1).



G03.20-3108-11

- 7 Check installation position of the crankshaft radial sealing ring (4).

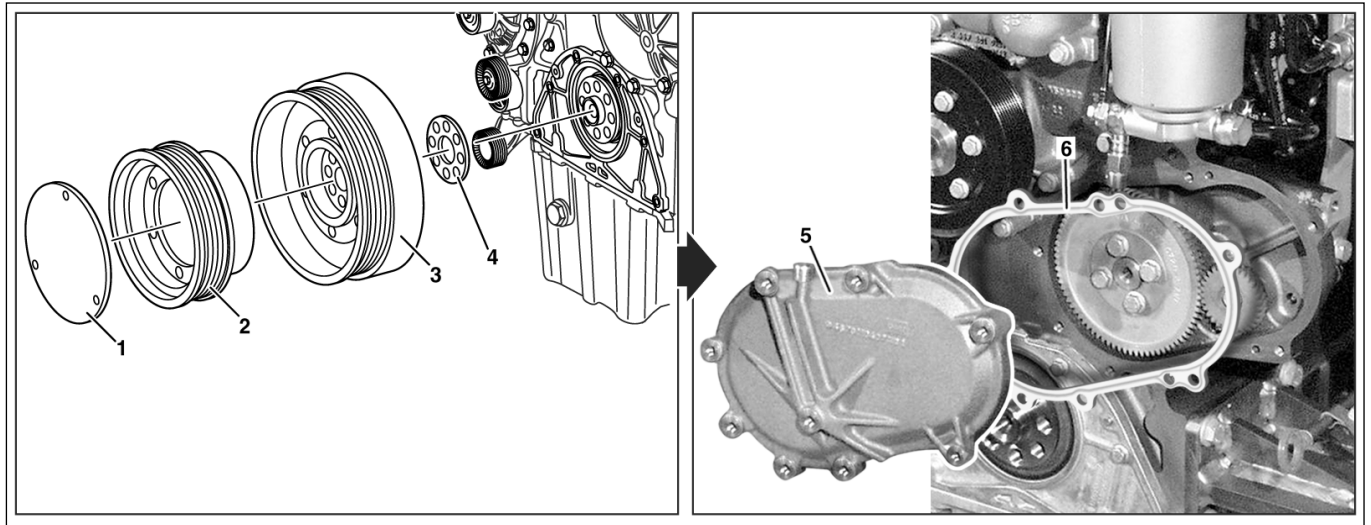


G03.20-3110-11



AR01.40-G-8921CH	Remove/install cover of camshaft sprocket	26.5.04
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MODEL 000.001 with ENGINE 457.960



W01.40-1067-08

- |   |                       |   |                                |   |                            |
|---|-----------------------|---|--------------------------------|---|----------------------------|
| 1 | Cover                 | 3 | Belt pulley / vibration damper | 5 | Cover of camshaft sprocket |
| 2 | Belt pulley fan drive | 4 | Splash ring                    | 6 | Gasket                     |

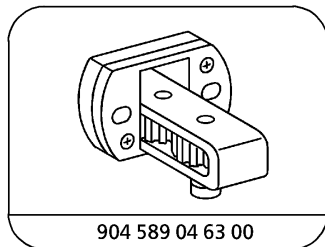
	Remove/Install		
1	Remove holder for Visco fan		<b>Page 215</b>
2	Remove belt pulley/vibration damper (3)	Check cover (1), fan drive belt pulley (2), belt pulley/vibration damper (3) as well as slinger (4) for condition and replace if required.	<b>Page 89</b>
3	Attach cranking/blocking device for engine	 	<b>Page 5</b> BA01.60-N-1001-01K 904 589 04 63 00
4	Remove bracket for fuel lines on camshaft sprocket cover (5)		BA01.40-N-1002-01P
5	Remove cover of camshaft sprocket (5)	Loosen camshaft sprocket cover (5) with plastic mallet and ensure that sealing surface is not damaged. <b>Installation:</b> Clean sealing surface on camshaft sprocket cover (5) and on crankcase. 	BA01.40-N-1002-01P
6	Remove gasket (6)	<b>Installation:</b> Replace gasket (6).	
7	Install in the reverse order		

Crankcase, timing case cover, end cover

Number	Designation	Engine 457.960
BA01.40-N-1002-01P	Bolt, camshaft sprocket cover to crankcase	Nm 50

**Nm** Timing case

Number	Designation	Engine 457.960
BA01.60-N-1001-01K	Bolt of end cover of inspection hole to timing case	Nm 25






904 589 04 63 00

Cranking device

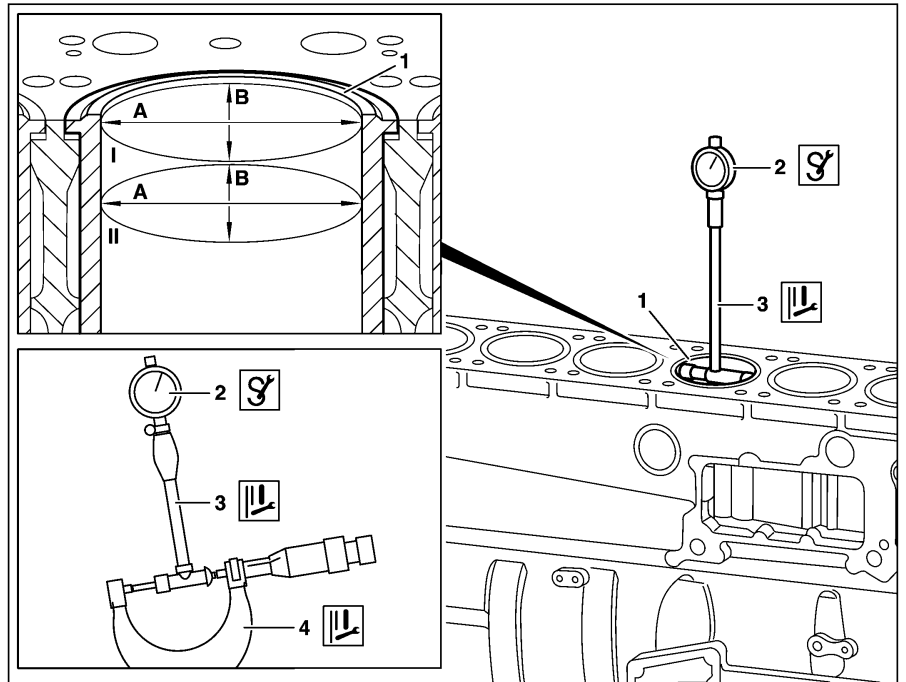
AR01.40-G-9202CH	Measure cylinder bores	7.6.04
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MODEL 000.001 with ENGINE 457.960












- 1 Cylinder liner
- 2  Dial indicator
- 3  Quick calipers for internal measurements
- 4  Micrometer

A, B Measuring direction in crankcase

- I Measuring points at intervals of 15 mm or beginning with top of cylinder liners (area without wear)
- II Measuring point at bottom reversal point for first piston ring (area with maximum wear)



A01.40-0003-06

	<b>Remove</b>		
1	Remove cylinder head		<b>Page 23</b>
2	Thoroughly clean cylinder liner (1)		
3	Attach cranking/blocking device for engine	 	<b>Page 5</b> BA01.60-N-1001-01K 904 589 04 63 00
4	Turn crankshaft with cranking/blocking device	 Move piston in cylinder liner (1) to be tested to bottom dead center. All cylinder liners (1) can be tested and measured in 3 crankshaft positions: Cylinder liners 1/6, 2/5 and 3/4.	
5	Inspect cylinder liners (1)	 The cylinder liners (1) should not show any signs of burning. Individual slight drawing scores are not critical.	<b>Page 6</b>
	Notes for assessing wear to cylinder wall in the case of dust damage	Engine 401.9, 402.9, 441.9, 442.9, 446.9, 447, 457.9, 489, 541.9, 542.9, 900.9, 902.9, 904.9, 906.9, 924.9, 926.9	
	<b>Measure</b>		
6	Set dial indicator (2) and quick release holder (3) to inner diameter of cylinder liner with measuring screw (4)	 Pretension 5 mm.    	BE01.40-N-1001-03K  001 589 53 21 00 WH58.30-Z-1019-12A WH58.30-Z-1028-12A



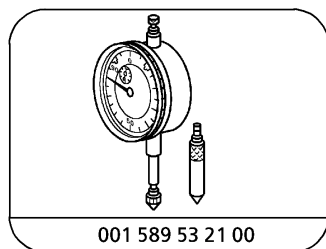
7	Measure inner diameter of cylinder liner at measuring points (I) and set scale on dial indicator (2) to "0"	Perform measurement at distance of 15 mm (area without wear) from top of cylinder liner (1). Conduct measurements in direction of travel (A) and in transverse direction (B).	
8	Measure wear and difference in diameter in cylinder line (1) at measuring point (II) at upper reversal point of first piston ring	Conduct measurements in the area with the greatest wear, in direction of travel (A) and in transverse direction (B). If measurement differs from specification: ↓ Install new cylinder liner (1).	BE01.40-N-1002-03K
	<b>Install</b>		
9	Take off cranking/blocking device for engine	 	<b>Page 5</b> BA01.60-N-1001-01K 904 589 04 63 00
10	Install cylinder head		<b>Page 23</b>

Test values of cylinder liner

Number	Designation	Engine 457.960
BE01.40-N-1001-03K	Cylinder liner inner dia.	Code letter A mm 127.990...127.995
		Code letter B mm 127.995...128.005
		Code letter C mm 128.005...128.010
BE01.40-N-1002-03K	Wear of cylinder liner	Top reversal point of first piston ring mm ≤0.08

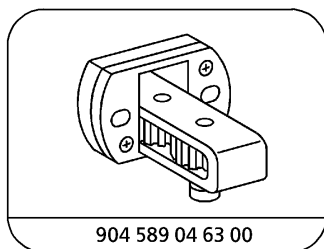
Timing case

Number	Designation	Engine 457.960
BA01.60-N-1001-01K	Bolt of end cover of inspection hole to timing case	Nm 25



001 589 53 21 00

Dial indicator



904 589 04 63 00

Cranking device

## Commercially available tools (see Workshop Equipment Manual)

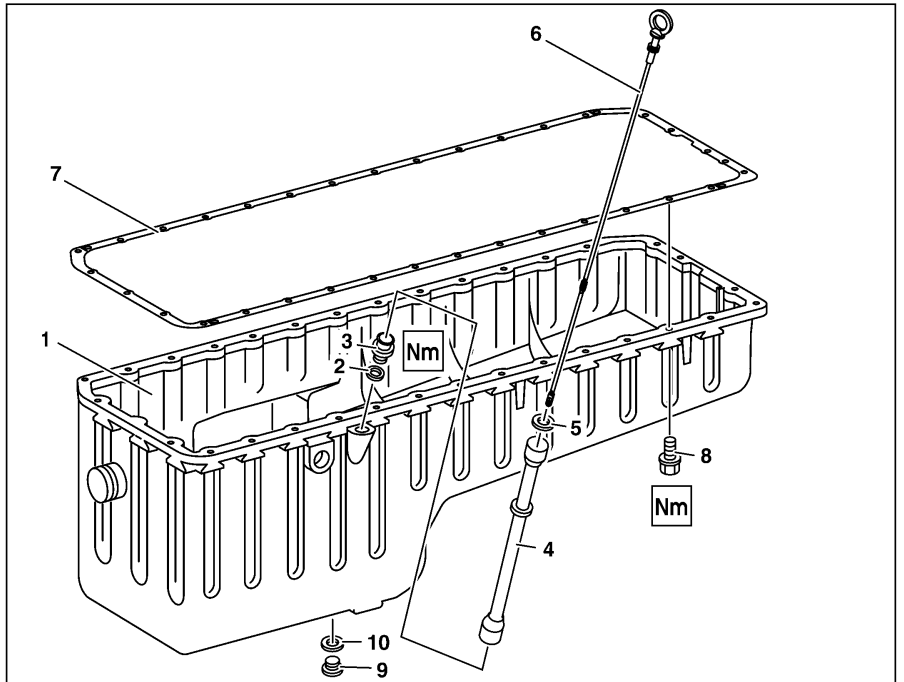
Number	Designation	Make (e. g.)	Order number
WH58.30-Z-1019-12A	Quick calipers for internal measurements, $\varnothing$ 120-140 mm	Hahn und Kolb Borsigstr. 50 D-70469 Stuttgart www.hahn-kolb.de	
WH58.30-Z-1028-12A	Micrometer 125-150 mm (contained in set 31414 150)	Hahn und Kolb Borsigstr. 50 D-70469 Stuttgart www.hahn-kolb.de	31366 125



AR01.45-G-7500CH	Remove/install oil pan	7.6.04
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MODEL 000.001 with ENGINE 457.960

- 1 Oil pan
- 2 Sealing ring
- 3 Fitting
- 4 Guide tube (oil dipstick)
- 5 Sealing ring
- 6 Dipstick
- 7 Oil pan gasket (full face gasket)
- 8 Bolt
- 9 Oil drain screw
- 10 Sealing ring



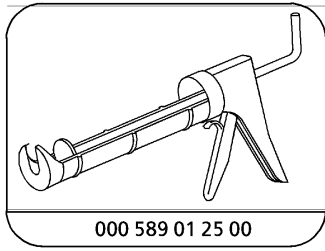
G01.45-3111-06

Remove/Install			
	<b>Remove/Install</b>		
1 	Evacuate engine oil or drain through oil drain screw (9) Engine - oil and filter change	ⓘ Installation: Replace sealing ring (10).	Page 185
2	Pull out dipstick (6) at oil pan (1)	ⓘ Installation: Check sealing ring (5).	
3	Remove guide tube (4) with fitting (3) from oil pan (1)	ⓘ Installation: Install new sealing ring (2). Nm	BA01.45-N-1005-01N
4	Take off oil pan (1)	ⓘ Installation: To achieve uniform pressure (without turning over oil pan gasket), it is necessary to tighten new microencapsulated bolts (8) in a number of stages according to the specified tightening pattern: ↓ Tightening pattern for oil pan bolts Nm	Page 52 BA01.45-N-1003-01N
5	Remove oil pan gasket (7)	ⓘ Installation: Install new oil pan gasket (7), observe installation position.	
6	Clean thread in crankcase housing for microencapsulated bolts (8) with tap		
7	Clean sealing surface for oil pan (1) on timing case, crankcase and front housing cover	ⓘ Installation: Apply sealant at the gaps between the gaskets for the timing case and front housing cover. 	000 589 01 25 00 BR00.45-Z-1026-01A

8	Install in the reverse order		
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**Nm** Oil pan

Number	Designation	Engine 457.960		
BA01.45-N-1003-01N	Bolt, oil pan to crankcase	1st stage	Nm	10
		2nd stage	Nm	35
BA01.45-N-1005-01N	Screw connection of guide tube to oil pan	M18×1.5	Nm	50



Hand pressure gun

**Auxiliary repair materials**

Number	Designation	Order number
BR00.45-Z-1026-01A	Sealant	001 989 29 20

AR01.45-G-7500-01CH	Tightening pattern for oil pan bolts		
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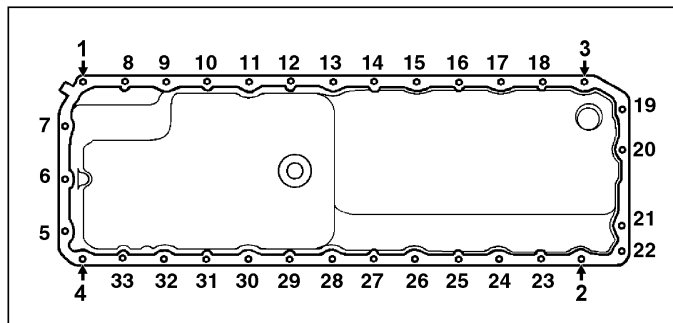
**Nm** Oil pan

Number	Designation	Engine 457.960		
BA01.45-N-1003-01N	Bolt, oil pan to crankcase	1st stage	Nm	10
		2nd stage	Nm	35

**Tightening pattern**

ⓘ To achieve uniform pressure (without turning over oil pan gasket), it is necessary to observe both tightening torque stages.

- 1 Tighten oil pan bolts.
  - ⓘ Observe tightening torque stages and sequence for oil pan bolts. Always start tightening with position No. 1.



W01.45-1014-10

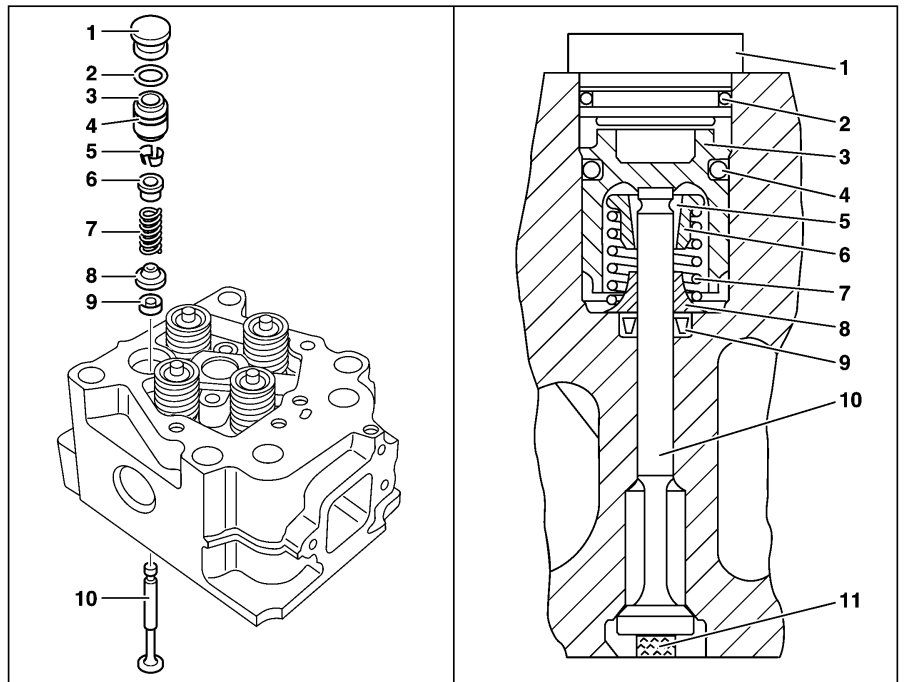
AR01.50-G-1000CH

Remove/install constant-speed throttle




7.6.04

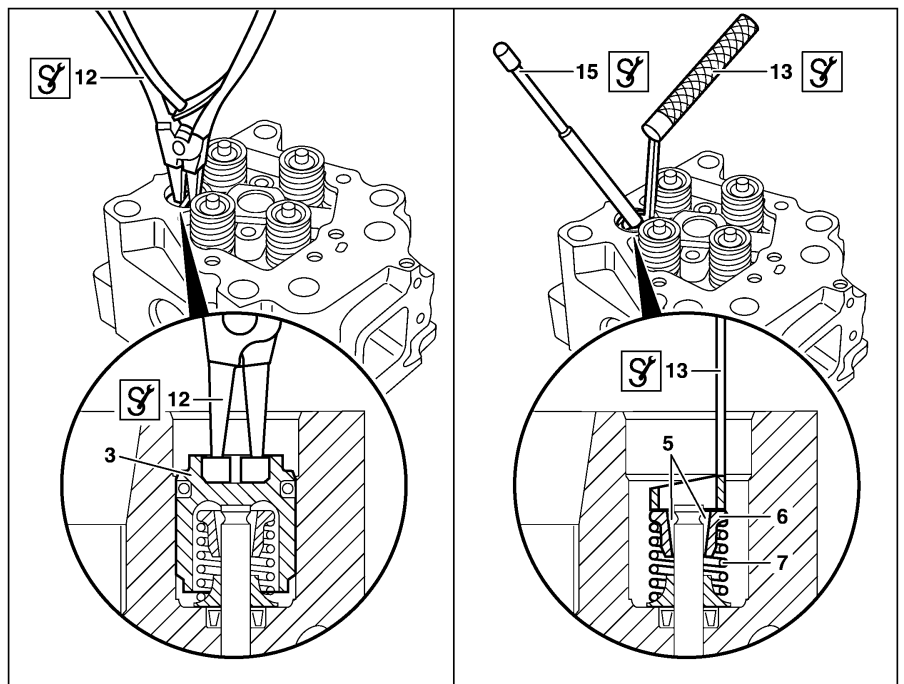
MODEL 000.001 with ENGINE 457.960

- 1 Cap
- 2 O-ring
- 3 Pistons
- 4 Piston sealing ring
- 5 Locking wedge
- 6 Spring cup
- 7 Spring
- 8 Spring guide
- 9 Gasket
- 10 Valve
- 11 Spacer



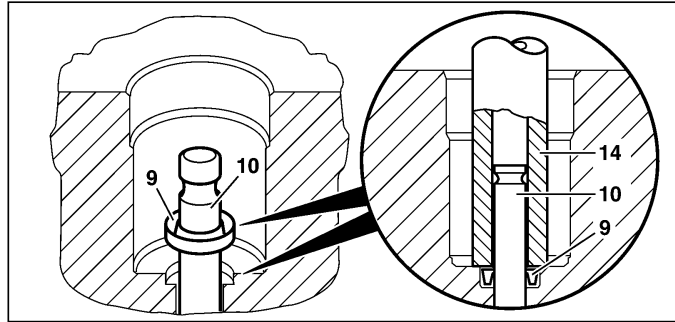
A01.50-0001-06

- 3 Pistons
- 5 Locking wedge
- 6 Spring cup
- 7 Spring
- 12  Pliers
- 13  Spring disk compressor
- 15  Magnetic pin



A01.50-0002-06

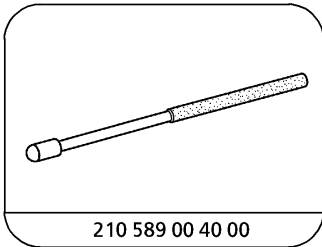
- 9 Gasket
- 10 Valve
- 14 Drift



A01.50-0003-10

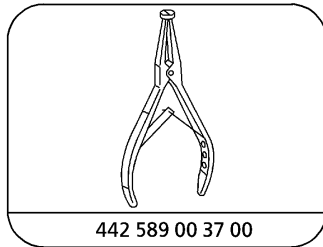
	<b>Remove</b>		
1	Remove cylinder head		<b>Page 23</b>
2	Remove nozzle holder combination		<b>Page 127</b>
3	Remove end cover (1)		
4	Insert a suitable spacer (11) between valve disk and base	Height of spacer approx. 6.0 mm.	
5	Use pliers (12) to remove piston (3)	Check pistons (3) and piston seal (4) for wear and damage, replace piston (3) and piston seal (4) if required. 	442 589 00 37 00
6	Remove locking wedges (5)	Press spring plate (6) down with spring plate compressor (13) and remove retainer lock (5) with magnetic pin (15).  	210 589 00 40 00 442 589 05 63 00
7	Relieve pressure on spring plate compressor (13) and take out spring plate (6), spring (7) and spring guide (8)		
8	Turn cylinder head and pull out valve (10)	Mark valve (10) in relation to corresponding cylinder head.	
9	Remove gasket (9)		906 589 02 63 00
	<b>Install</b>		
10	Insert valve (10) into the cylinder head	Observe marking on valve (10). Oil valve stem on valve (10) and position spacer (11) below valve disk.	
11	Install new gasket (9)	Observe installation position of gasket (9) and do not damage gasket (9), otherwise leakages can occur. Push gasket (9) over groove in valve stem by hand and then press in with drift (14).	
<b>WF</b>	Drift for pressing in engine brake sealing		WF58.50-A-0150-01A
12	Install spring (7)	Do not mix up spring guide (8) and spring plate (6), otherwise, it is not possible to install the retainer locks (5) and damage can occur to the engine.	

		<p><b>i</b> Press spring (7) together with spring plate compressor (13) and install retainer locks (5) in groove in valve stem. Ensure that retainer locks (5) latch properly. Slowly relieve pressure on spring (7).</p> <p><b>S</b></p>	442 589 05 63 00
13	Install piston (3) together with piston seal (4)	<p><b>!</b> Do not damage piston seal (4), otherwise leakage can occur.</p> <p><b>i</b> Oil piston (3) and piston seal (4).</p>	
14	Install end cover (1)	<b>i</b> Install new O-ring (2).	
15	Install nozzle holder combination		<b>Page 127</b>
16	Install cylinder head		<b>Page 23</b>



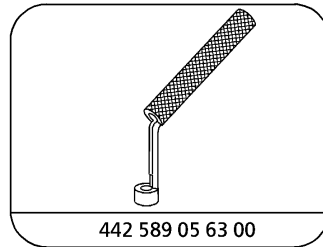
210 589 00 40 00

Magnet pin



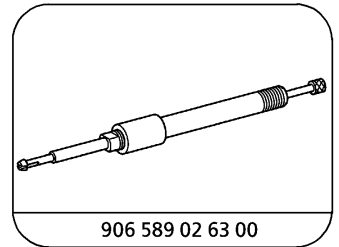
442 589 00 37 00

Pliers



442 589 05 63 00

Spring disk compressor



906 589 02 63 00

Extraction tool

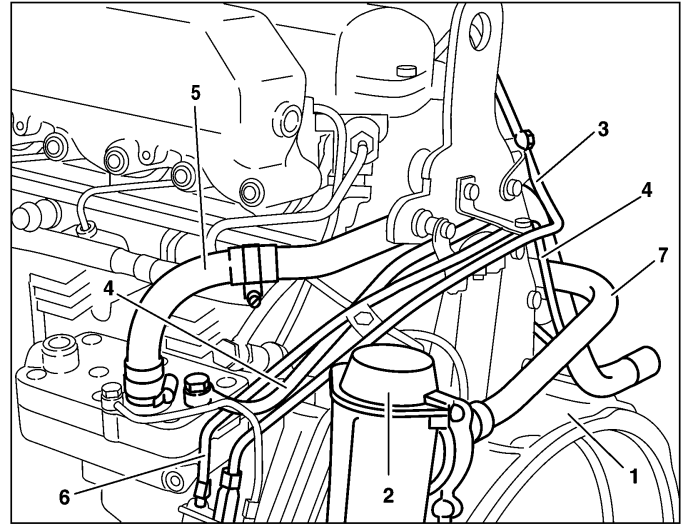




AR01.60-G-8200CH	Remove/install timing case	8.6.04
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**MODEL 000.001 with ENGINE 457.960**

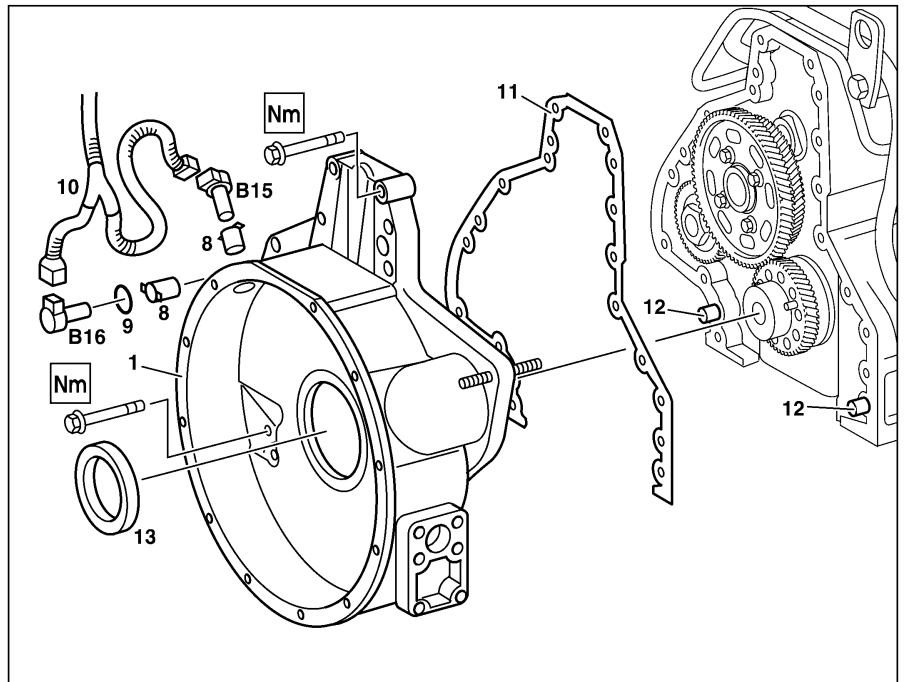
- 1 Timing case
- 2 Oil separator
- 3 Compressed-air line (constant throttle)
- 4 Coolant line (compressor)
- 5 Air intake pipe (compressor)
- 6 Compressed air line (engine brake)
- 7 Vent tube (crankcase ventilation)



W01.60-1004-11

- 1 Timing case
- 8 Locking bush
- 9 O-ring
- 10 Engine wiring harness
- 11 Gasket
- 12 Dowel pins
- 13 Radial seal ring

B15 Crankshaft angle position sensor  
 B16 Cylinder 1 TDC sensor



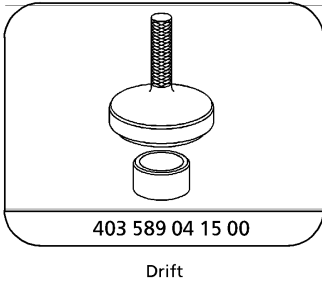
G01.60-3104-06

	Remove/Install		
	Notes on self-locking nuts and bolts	All models	<b>Page 59</b>
	Drain engine oil Engine - oil and filter change		<b>Page 185</b>
2	Remove engine		
3	Attach engine to engine repair stand		WE58.40-Z-1001-11A WE58.40-Z-1015-11A
4	Remove starter		<b>Page 177</b>

5	Mark crankshaft angle position sensor (B15) and TDC sensor of cylinder 1 (B16) relative to engine wiring harness in timing case (1)		
6	Pull out crankshaft angle position sensor (B15)	<b>i</b> Installation: Press in retaining bushing (8) and crankshaft angle position sensor (B15) to stop.	
7	Pull out TDC sensor of cylinder 1 (B16)	<b>i</b> Installation: Oil and install new O-rings (9). Press in retaining bushing (8) and TDC sensor for cylinder 1 (B16) to stop.	
8	Remove flywheel		<b>Page 95</b>
9	Remove oil pan		<b>Page 51</b>
10	Remove vent tube (7) on timing case (1)		
11	Remove oil separator (2)		<b>Page 17</b>
12	Remove air intake pipe (5) on timing case (1)		
13	Remove compressed air line (3), compressed air line (6) and coolant line (4) from rear motor suspension lug		
14	Remove side holder with connectors for compressed air line for engine brake, constant throttle and control line for compressor on timing case (1)		
15	Remove timing case (1)	<b>i</b> If necessary, loosen timing case (1) by tapping with plastic mallet. Check timing case (1) for damage, if necessary: ↓  Replace timing case (1), transfer oil guide section of oil separator (2) and all detachable body components. <b>i</b> Installation: When installing a new timing case (1), transfer all detachable parts. Position timing case (1) on fitted pins (12). <b>Nm</b>	BA01.60-N-1002-01K
16	Remove gasket (11)	<b>i</b> Clean sealing surfaces <b>i</b> Installation: Replace gasket (11), cut off extending ends of gasket (bottom) exactly after attaching timing case (1). apply sealant at separation point between gaskets for timing case (1) and front housing cover.	BR00.45-Z-1010-01A
17	Remove radial seal (13) in timing case (1)	<b>S</b>	<b>Page 59</b> 403 589 04 15 00
18	Install in the reverse order		

**Nm** Timing case

Number	Designation	Engine 457.960
BA01.60-N-1002-01K	Bolt of timing case to crankcase	Nm 70



**Workshop equipment/MB testers (see Workshop Equipment Manual)**

WE58.40-Z-1001-11A	Engine repair stand
WE58.40-Z-1015-11A	Engine support, Messrs. Erwin Schairer GmbH, Apparatebau; Keltenstrasse 9 D-72469 Meßstetten; MSW / R6 457

**Auxiliary repair materials**

Number	Designation	Order number
BR00.45-Z-1010-01A	Loctite sealing compound 574	001 989 89 20

AH00.00-N-0001-01A	Notes on self-locking nuts and bolts	All models	
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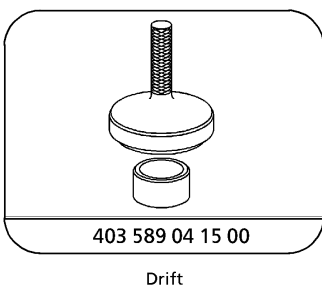
**Important repair information**

Bolts with locking splines, micro-encapsulated bolts and self-locking nuts must always be replaced after being used once.

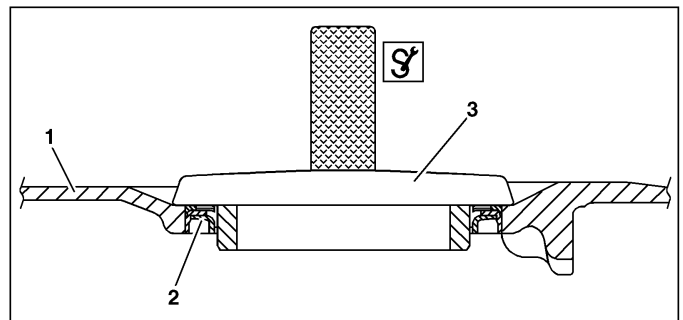
Before new micro-encapsulated bolts are screwed in, the mating thread must be re-cut in order to remove all the residue of the old bolt locking compound.

There is an increased risk of injury when unscrewing micro-encapsulated bolts due to the sudden breakaway torque.

AR01.60-G-8200-01CH	Replace seal in timing case		
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- 1 Place timing case (1) down flat.
- 2 Use a suitable drift to remove radial seal (2).
- 3 Press new radial sealing ring (2) into timing case (1) flush with drift (3).  
 Press in radial sealing ring (2) dry, axially parallel and evenly around the entire circumference. Observe the installation position of radial sealing ring (2).



W01.60-0004-10



AR03.10-G-0001CH	Check piston and conrod for wear and damage	8.6.04
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**MODEL 000.001 with ENGINE 457.960**

	Check		
1	Remove cylinder head		Page 23
2	Check piston crown through a visual inspection for damage		
	Information for assessment of piston and piston rings	ENGINE 457.9, 541.9, 542.9, 902.9, 904.9, 906.9, 924.9, 926.9	Page 61
3	Check cylinder contact surface for wear, damage		Page 33
4	Remove pistons	Only if wear or damage was found on the piston crown or cylinder contact surface:	Page 69
5	Check piston skirt and piston ring through visual inspection for damage and wear		
	Information for assessment of piston and piston rings	ENGINE 457.9, 541.9, 542.9, 902.9, 904.9, 906.9, 924.9, 926.9	Page 61
6	Remove connecting rod and check connecting rod bushing (connecting rod eye) through visual inspection for wear, damage or angular movement of the oil holes	If wear, damage or angular movement of the connecting rod bushing was determined: ↓  replace connecting rod.	
	Notes on assessing wear on connecting rod bearing and connecting rod journal	Engine 457.9, 541.9, 542.9, 900.9, 902.9, 904.9, 906.9, 924.9, 926.9	Page 63
7	Installing pistons	If wear or damage is present, replace piston.	Page 69
8	Install cylinder head		Page 23

AH03.10-N-0001-04A	Notes on assessing pistons and piston rings	ENGINE 457.9, 541.9, 542.9, 902.9, 904.9, 906.9, 924.9, 926.9	
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The following information should be helpful in assessing the piston, in order to evaluate the condition of the piston correctly, and decide whether it is still usable.

Possible damage can also be identified on the contact pattern of the piston skirt.

The following damage patterns are only some examples of the possible damage types to pistons and piston rings. The surface quality of the cylinder barrel must always be taken into account in diagnosing the type of damage.

Piston damage is caused by:

- leaky air intake ducts downstream of the air cleaner,
- fault in the fuel injection system,
- too little or too much clearance between piston skirt and cylinder barrel,
- poor engine oil quality (viscosity) or thinning of the engine oil by fuel,
- soiled or damaged engine oil filter,
- fault in engine oil circuit e.g. engine oil pressure too low,
- twisted or damaged oil spray nozzles for the piston cooling.

**Piston undamaged**

Carbon deposits on the piston crown and in the combustion chamber recess are normal, as are sinkage of the spray pattern of the combination nozzle holder on the piston crown and in the combustion chamber recess.

- i** The combustion is OK.  
The piston can be cleaned and re-used.



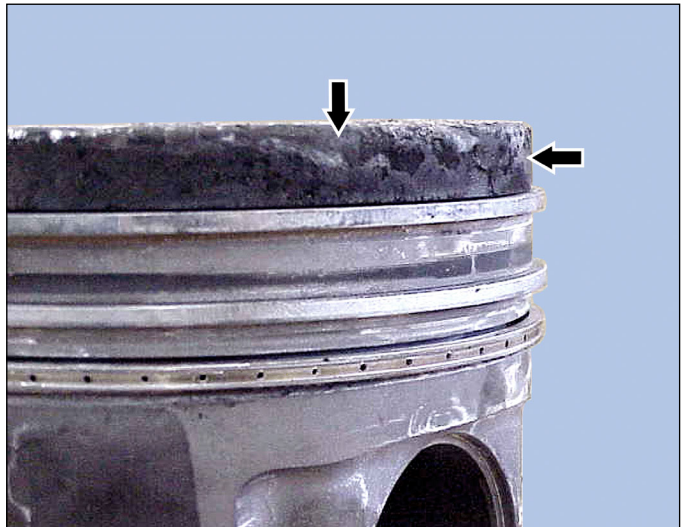
W03.10-1022-81

**Piston undamaged**

Carbon deposits on the piston crown, on the top land (arrowed) and in the combustion chamber recess, are normal.

Score marks in the carbon deposits are due to moving pieces of carbon deposit.

- i** The piston can be cleaned and re-used.



W03.10-1008-81

**Pistons with dust damage**

The contact pattern on the skirt is matt in appearance, and the machined grooves in the bearing surface are completely worn away. In the advanced stage, there are already light score marks on the piston skirt, and the piston rings are sharp-edged.

- i** Replace the piston.



W03.10-1009-81

**Score marks on the piston skirt**

The piston has score marks of the same type around the piston skirt. The surfaces of the score marks vary from highly glossy pressure marks to dark-colored areas that have been rubbed relatively smooth.

The piston clearance between piston skirt and cylinder barrel was too narrow, the cylinder bore is warped, or there was a fault in the cooling system.



W03.10-1010-81

There are score marks in the contact area of the piston skirt, which extend partly into the piston ring area.

The corresponding score marks appear on the opposite side of the piston skirt. The surface of the score marks is metallically clean, rough, and with no glossy transition points.

There has been insufficient lubrication between the piston contact surface and the cylinder barrel (engine oil thinned by fuel).

- i** Replace the piston, and
- check the cylinder barrel and measure the cylinder bore; replace if necessary,
- observe the classifications of piston and cylinder bore,
- observe the engine oil quality (oil viscosity),
- check the engine oil filter and engine oil circuit,
- check the oil spray nozzles for piston cooling.



W03.10-1011-81

AH03.10-N-0001-03A	Notes on assessing wear on conrod bearings and conrod bearing journals	Engine 457.9, 541.9, 542.9, 900.9, 902.9, 904.9, 906.9, 924.9, 926.9	<b>i</b>
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The following notes should be helpful in assessing the condition of the connecting rod bearings and journals, and deciding whether they are still usable.

The following illustrated damage patterns are only an example of the types of damage to the connecting rod bearing and connecting rod journal. The surface quality of the main bearing must always be taken into account in diagnosing the type of damage.

Wear or damage to the connecting rod bearings and journals are often caused by:

- too little engine oil, poor engine oil quality (viscosity) or thinning of the oil by fuel,
- soiled or damaged engine oil filter,
- fault in the engine oil circuit e.g. engine oil pressure too low,
- too little or too much clearance between the connecting rod bearings and connecting rod journals
- insufficient cleaning after an engine repair.

**i** After an engine repair, fill the oil circuit with an approved engine oil. Then crank the engine with the starter several times by pressing the engine start button and engine stop button at the same time, till oil pressure is established.



**Connecting rod bearing undamaged**

The entire surface of the connecting rod bearing is smooth and even, without visible score marks or wear to the contact surface.

**i** The connecting rod bearing is still usable. The measuring marks on the connecting rod bearing surface are normal, and are caused by the measuring process carried out during production.

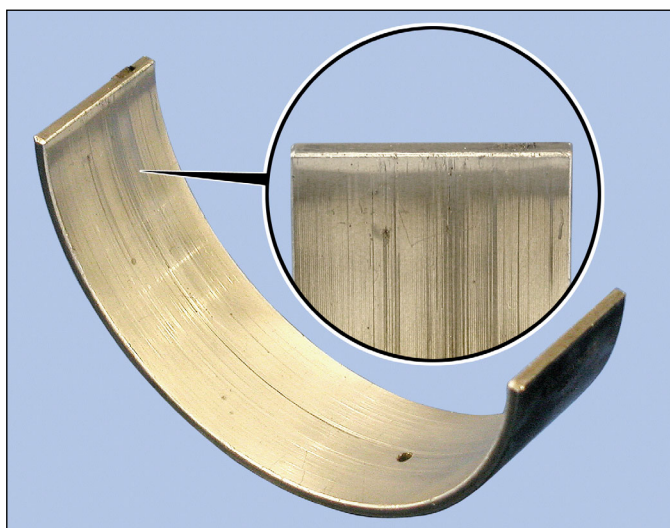


W03.10-1012-81

**Connecting rod bearing with faint scoring and scratches**

Faint score marks and scratches are visible on the connecting rod bearing surface, and noticeable to the touch.

**i** The connecting rod bearing is still usable. Individual dirt scoring and scratches are not critical, and are due to fine dirt particles in the engine oil circuit. During maintenance and repair operations, check the engine oil and engine oil filter for contamination, and replace if necessary.



W03.10-1013-81

**Connecting rod bearing with heavy scoring**

Score marks are evident on the connecting rod bearing surface, and very noticeable to the touch.

These are due to:

- dirt and foreign matter in the engine oil circuit, for example due to a faulty engine oil filter, use of grinding materials, or insufficient cleaning after an engine repair
- oil pressure too low (insufficient lubrication).

**i** The connecting rod bearing is no longer usable, and must be replaced.

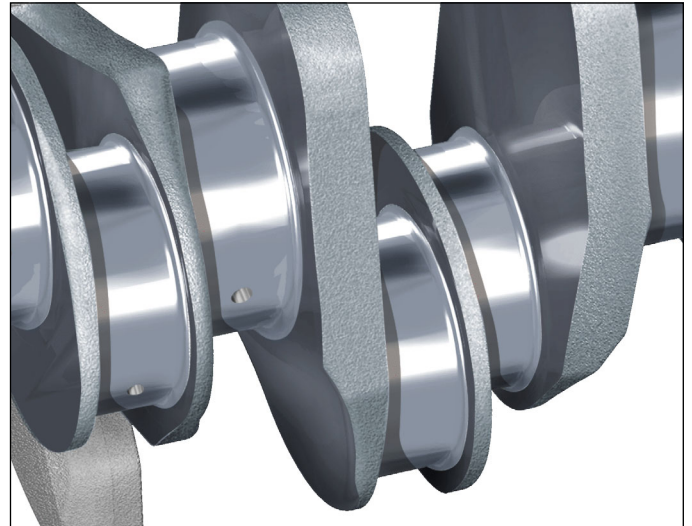


W03.10-1014-81

**Contact surfaces on the crankshaft connecting rod journal undamaged**

The entire contact surface of the connecting rod journal is smooth and even, and without visible scoring.

**i** The crankshaft is still usable, if all the contact surfaces of the crankshaft are OK.

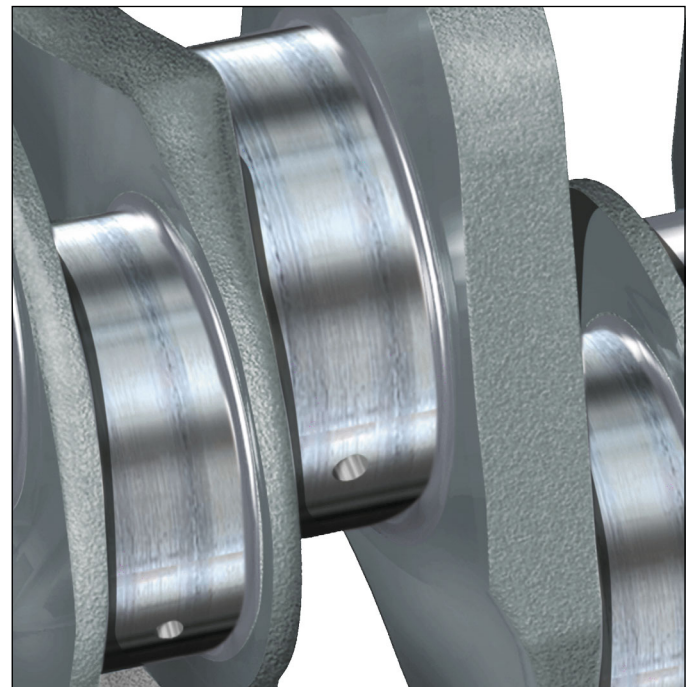


W03.20-1030-81

**Normal marks on the contact surface of the crankshaft at the connecting rod journal**

The entire contact surface of the connecting rod journal is smooth and even, and without visible scoring.

**i** The crankshaft is still usable, if all other contact surfaces of the crankshaft are OK.

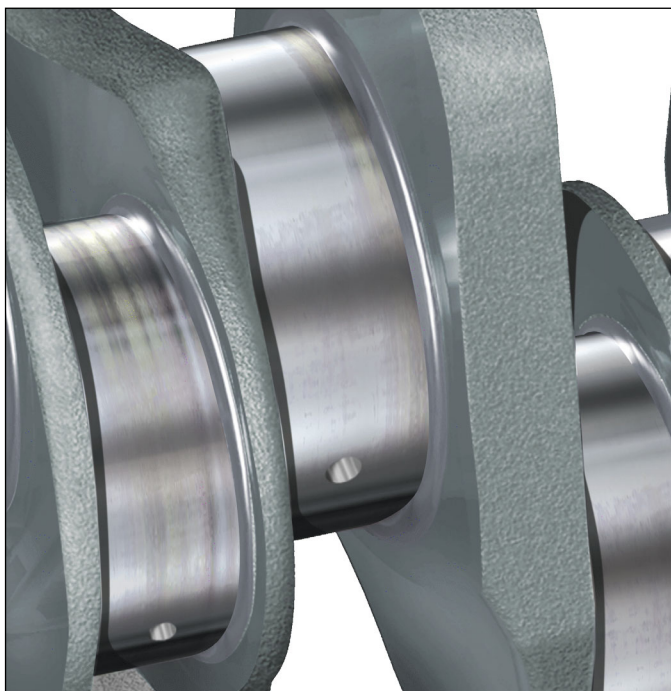


W03.20-1031-82

**Faint scoring and scratches on the contact surface of the crankshaft at the connecting rod journal**

Faint scoring and scratches are visible on the contact surface, and noticeable to the touch.

**i** The connecting rod journal is still usable, if all other contact surfaces of the crankshaft are OK and the diameter of the connecting rod journal is still within the tolerance (check this by measuring the connecting rod journal). Individual dirt score marks and scratches are not critical. Metal marks on the contact surface of the connecting rod journal can be polished off with a cleaning agent, for example Sidolin hot plate cleaner. During maintenance and repair operations, check the engine oil and engine oil filter for contamination, and replace if necessary.



W03.20-1032-82

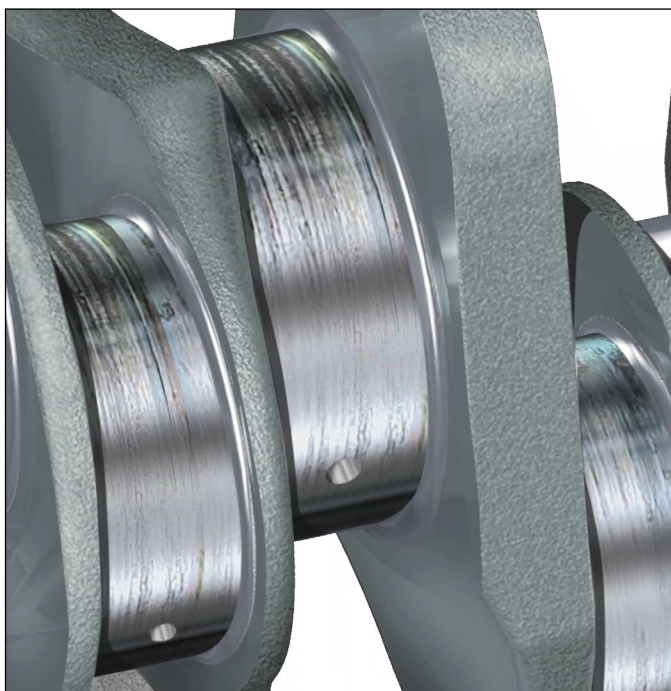
**Heavy scoring on the contact surface of the crankshaft connecting rod journal**

Score marks are evident on the connecting rod bearing surface, and very noticeable to the touch.

These are due to:

- dirt and foreign matter in the engine oil circuit, for example due to a faulty engine oil filter, use of grinding materials, or insufficient cleaning after an engine repair
- oil pressure too low (insufficient lubrication).









**i** Measure the crankshaft, and machine to the next size if necessary. If machining is no longer possible, the crankshaft must be renewed.



W03.20-1033-82

AR03.10-G-0002CH	During engine repair additional test work at piston/conrod and at cylinder contact surface	8.6.04
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MODEL 000.001 with ENGINE 457.960

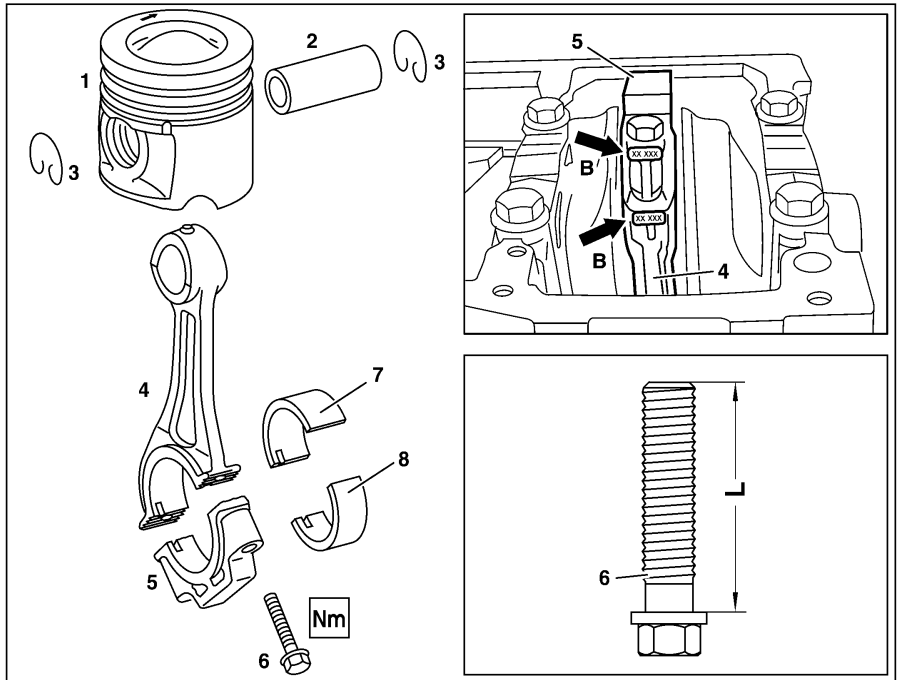
	Check		
1  	Remove oil filter element and check for outer metal abrasion or swollen condition of the oil filter element disks  Engine - oil and filter change	 Only if there is advanced wear or damage to engine components.	<b>Page 185</b>
2	Replace oil/water heat exchanger	 Only in the event of metal abrasion on lamellas in oil filter element or in engine oil circuit.	<b>Page 205</b>
3	Remove, check and replace if necessary oil spray nozzles (piston)	 Only if damage is found on the piston.	<b>Page 193</b>
4	Remove, disassemble and check oil pump through a visual inspection for wear	 Only remove if reinforced metal abrasion was found at oil filter element. If wear is present, replace oil pump if necessary.	<b>Page 199</b>
5  	Replace engine oil and oil filter element.  Engine - oil and filter change	 Only if there is metal grit or a swollen oil filter element (coolant in the engine oil circuit).	<b>Page 185</b>



AR03.10-G-7021CH	Remove/install piston	8.6.04
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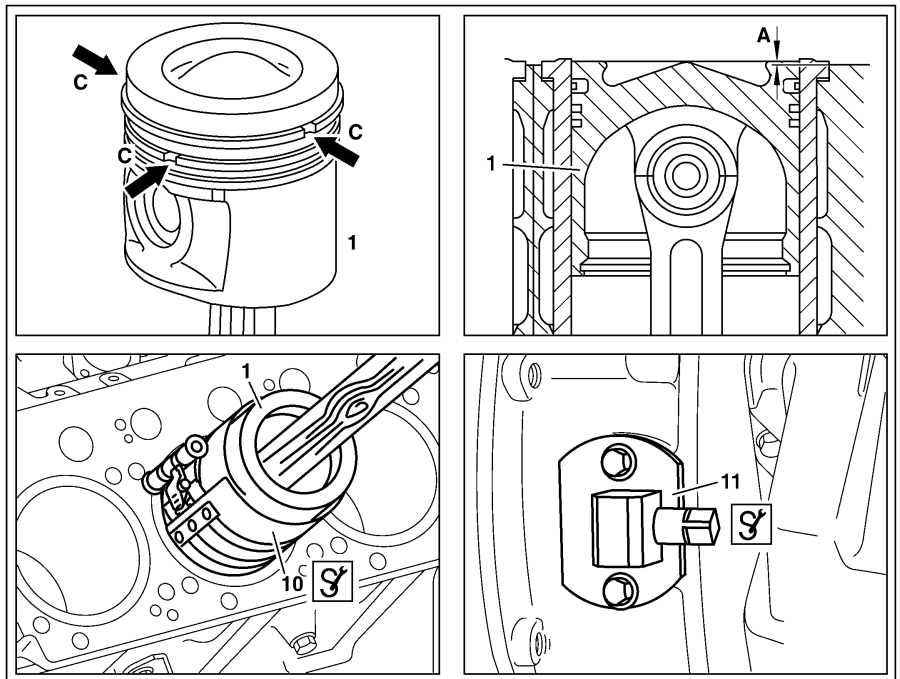
**MODEL 000.001 with ENGINE 457.960**

- 1 Pistons
- 2 Piston pin
- 3 Circlip
- 4 Conrods
- 5 Connecting rod bearing cap
- 6 Connecting rod bolt
- 7 Connecting rod bearing shell
- 8 Connecting rod bearing shell
  
- L Shank length of the connecting rod bolt















G03.10-3103-06













- 1 Pistons
- 10 Tensioning strap
- 11 Cranking device
  
- A Piston projection








G03.10-3104-06

	<b>Remove</b>		
	Information on working sealing surfaces when carrying out engine repairs	Engine 457.9, 541.9, 542.9, 900.9, 902.9, 904.9, 906.9, 924.9, 926.9	<b>Page 16</b>
	Notes for assessing piston wear from dust/particulate damage	Engine 401.9, 402.9, 441.9, 442.9, 446.9, 447, 457.9, 489, 541.9, 542.9, 900.9, 902.9, 904.9, 906.9, 924.9, 926.9	<b>Page 73</b>

	Notes on assessing wear on conrod bearings and conrod bearing journals	Engine 457.9, 541.9, 542.9, 900.9, 902.9, 904.9, 906.9, 924.9, 926.9	<b>Page 63</b>
1	Remove cylinder head		<b>Page 23</b>
2	Remove oil pan		<b>Page 51</b>
3	Attach cranking/blocking device for engine	 	<b>Page 5</b> BA01.60-N-1001-01K 904 589 04 63 00
4	Use a scraper to carefully remove combustion residues above the top land zone in the cylinder wall.	 This avoids any damage to the piston rings when the pistons (1) are removed.	
5	Remove oil spray nozzles and inspect		<b>Page 193</b>
6	Unscrew connecting rod bolts (6)		
7	Detach connecting rod bearing caps (5)	 Ensure that the matching connecting rod bearing cap (5) and conrod (4) are marked (arrows B).	
8	Remove connecting rod bearing shells (7, 8) and mark matching connecting rod bearing cap (5) and conrod (4)	 The connecting rod bearing cap (5) should be installed on the conrod (4) only with the connecting rod bearing shells (7, 8) installed; otherwise, they can be damaged resulting in engine damage.	
9	Mark piston (1) with direction arrows and numbers for matching cylinder		
10	Remove piston (1) together with conrod (4) from the crankcase	 Press out piston of cylinder liner with wooden or plastic handle on connection rod bearing seat, otherwise, damage can occur, which result in engine damage later.  Secure cylinder liner to prevent it being pushed out.	
11	Clamp conrod (4) together with piston (1) in a vice	 Use protective jaws for clamping.	
12	Remove circlip (3)		
13	Press out piston pin (2) and remove piston (1) from conrod (4)		
	<b>Check</b>		
14	Inspect pistons (1) for dust damage and other signs of damage		
15	Inspect cylinder walls for dust damage		
16	Measure cylinder bores		<b>Page 47</b>
17	Carry out a visual inspection of piston rings for spalling of coating		
18	Inspect conrod bearing shells (7, 8) and conrod bearing journals of crankshaft for wear		
19	Measure conrod bolt (6)		BE03.10-N-1002-01O
	<b>Install</b>		
20	Match piston (1) to cylinder liner	 Only when new pistons (1) or cylinder liners are to be installed.	<b>Page 37</b> BE01.40-N-1001-03K
21	Install circlip (3) in piston eye on piston (1)		

22	Clamp conrod (4) in a vice	 Use protective jaws for clamping.	
23	Assemble piston (1) and conrod (4)	 Install conrod in piston so that direction arrow and marking on the piston crown point forward and the longer side of the angularly divided conrod is located on the left side.	
24	Oil piston pin (2) and introduce by hand into the piston (1) and conrod (4)	 Press piston pin in the direction of the installed circlip (3).	
25	Install circlip (3) in piston eye on piston (1)		
26	Oil piston (1) and alternate piston ring end gaps (arrows C) 120° in sequence		
27	Install tensioning strap (10) over piston rings and tighten to outer diameter of piston	 It should still be possible to move the boot on the Tensioning strap (10) slightly. 	000 589 38 31 00
28	Insert piston (1) into crankcase until the tensioning strap (10) touches the crankcase	 The direction arrow on the piston crown must be pointing forward (in opposite direction of power output side). Rotate crankshaft so that the conrod bearing journal of the piston to be installed is positioned at TDC. All pistons can be installed in 3 crankshaft positions: Cylinders 1/6, 2/5, 3/4.	
29	Insert connecting rod bearing shell (7) into the conrod (4) and oil contact surface	 Different connecting rod bearing shells (7, 8) are installed in the connecting rod bearing cap (5) and conrod (4). The lug on the connecting rod bearing shell (7) must be located in the groove in the conrod (4), otherwise, engine damage is possible due to improper installation.	
30	Press piston (1) into the crankcase until the conrod bearing shell (7) is touching the conrod journal of the crankshaft		
31	Insert conrod bearing shell (8) into the conrod bearing cap (5) and oil contact surface	 The lug on the connecting rod bearing shell (8) must be located in the groove in the connecting rod bearing cap (5).	
32	Attach conrod (4) and connecting rod bearing cap (5) to crankshaft	 The numbers (arrow B) on the conrod (4) and on the connecting rod bearing cap (5) must coincide and be located on the same side. The conrod (4) and connecting rod bearing cap (5) must fit precisely on the crankshaft journal.	
33	Lightly oil thread of conrod bolt (6) with engine oil and screw tight	 When screwing in the connecting rod bolt (6), press the conrod (4) and connecting rod bearing cap (5) against the crankshaft journal by hand. 	BA03.10-N-1001-01M
34	Install oil spray nozzles		<b>Page 193</b>
35	Rotate crankshaft and ensure proper clearance	 Pay attention to axial play of conrod bearings.	BE03.10-N-1001-01O
36	Measure piston projection at all pistons		<b>Page 73</b> BE03.10-N-1005-02N



		  	001 589 53 21 00 541 589 01 21 00 904 589 04 63 00
37	Installing oil pan		<b>Page 51</b>
38	Install cylinder head		<b>Page 23</b>
39	Take off cranking/blocking device for engine	 	<b>Page 5</b>  BA01.60-N-1001-01K 904 589 04 63 00
40	Fill engine oil circuit		<b>Page 191</b>

## Test values of cylinder liner

Number	Designation	Engine 457.960		
BE01.40-N-1001-03K	Cylinder liner inner dia.	Code letter A	mm	127.990...127.995
		Code letter B	mm	127.995...128.005
		Code letter C	mm	128.005...128.010

## Test values of connecting rod

Number	Designation	Engine 457.960		
BE03.10-N-1001-01O	Connecting rod bearing play	radial	mm	-
		axial	mm	0.130...0.292
BE03.10-N-1002-01O	Connecting rod bolt	Thread dia.	M	16×1.5
		Shank length (L) when new	mm	67.0...67.5
		Permissible shank length (L)	mm	≤ 68,5

## Test values for pistons

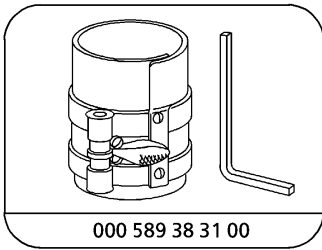
Number	Designation	Engine 457.960	
BE03.10-N-1005-02N	Piston projection at TDC relative to contact face of crankcase	mm	0.,224...0.715

 Timing case

Number	Designation	Engine 457.960	
BA01.60-N-1001-01K	Bolt of end cover of inspection hole to timing case	Nm	25

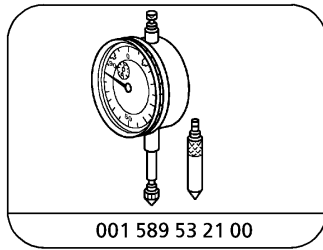
 Connecting rod

Number	Designation	Engine 457.960		
BA03.10-N-1001-01M	Bolt of connecting rod bearing cap to connecting rod	1st stage	Nm	110
		2nd stage	∠°	90



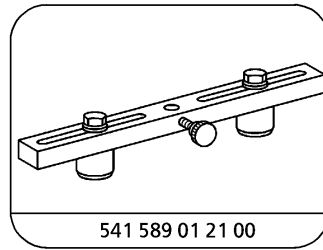
000 589 38 31 00

Retaining strap



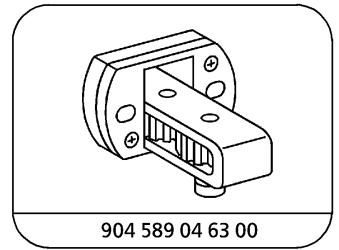
001 589 53 21 00

Dial indicator



541 589 01 21 00

Measuring bridge



904 589 04 63 00

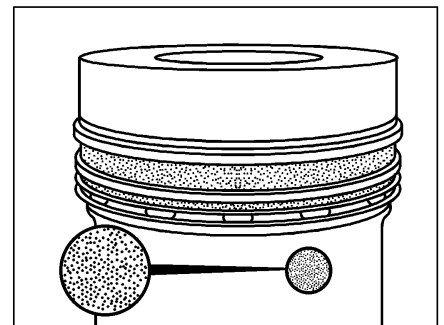
Cranking device

AH03.10-N-0001-01A	Notes for assessing wear on pistons in the case of dust damage	Engines 401.9, 402.9, 441.9, 442.9, 446.9, 447, 457.9, 489, 541.9, 542.9, 900.9, 902.9, 904.9, 906.9, 924.9, 926.9	i
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**Pistons without dust damage**

The piston skirt contact pattern is deeply contoured over a wide area and the machined grooves are still clearly visible.

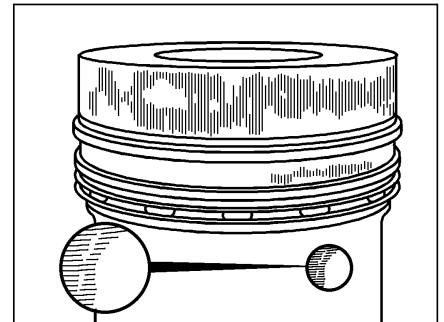
**i** The grooves around the circumference have been machined there intentionally, in order to retain oil and improve lubrication.



W03.10-0012-01

**Pistons with dust damage**

The contact surfaces on the skirt have a matt (scuffed) appearance, and the machined grooves within the contact area have been completely worn away. In the advanced stages, the skirt shows slight scoring and the piston rings have sharp edges.

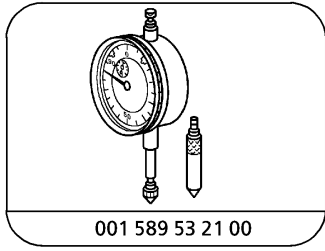


W03.10-0013-01

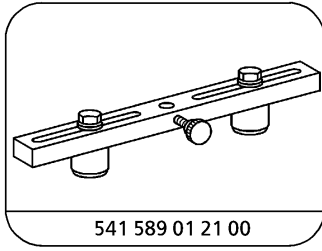
AR03.10-G-7041-01CH	Measure piston projection		
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**Test values for pistons**

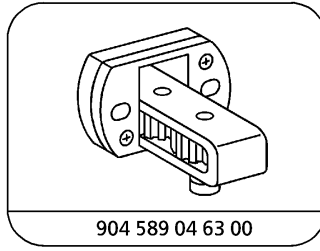
Number	Designation	Engine 457.960
BE03.10-N-1005-02N	Piston projection at TDC relative to contact face of crankcase	mm 0.224...0.715



Dial indicator

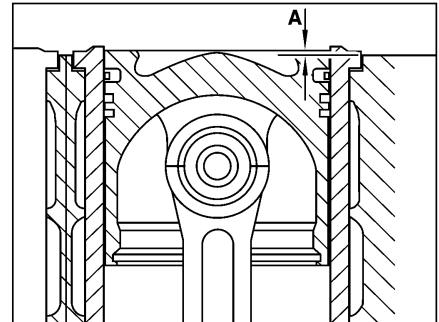


Measuring bridge



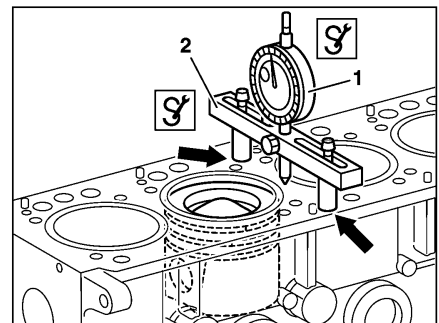
Cranking device

**i** Measure piston projection (A) between piston crown and cylinder head contact surface without the cylinder head gasket fitted. There must not be any deposits present on the piston crown and on the contact surface of the crankcase. The measurement must be carried out in the direction of the piston pin in order to eliminate piston rock.



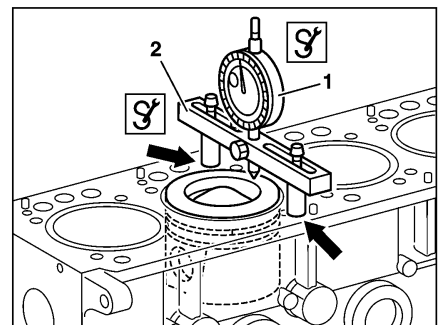
W03.10-1006-01

- 1 Rotate crankshaft until the piston to be measured is positioned about 10 mm before TDC.
- 2 Fasten **i** dial indicator (1) in **i** measuring bridge (2) with pretension.
- 3 Position **i** measuring bridge (2) on separating surface of crankcase (arrows) and set scale on dial indicator (2) to "0".



G03.10-3101-01


- 4 Move **i** measuring bridge (2) from separating surface of crankcase over cylinder bore. **i** Pull back tracer pin on **i** dial indicator (1) when moving.
- 5 Rotate crankshaft until the piston to be measured is positioned at TDC.
- 6 Tracer pin of **i** dial indicator (1) is pushed back by the piston crown, the measurement read off is the piston projection. **i** During measurement, the **i** measuring bridge (2) must be supported on the separating surface of the crankcase (arrows).

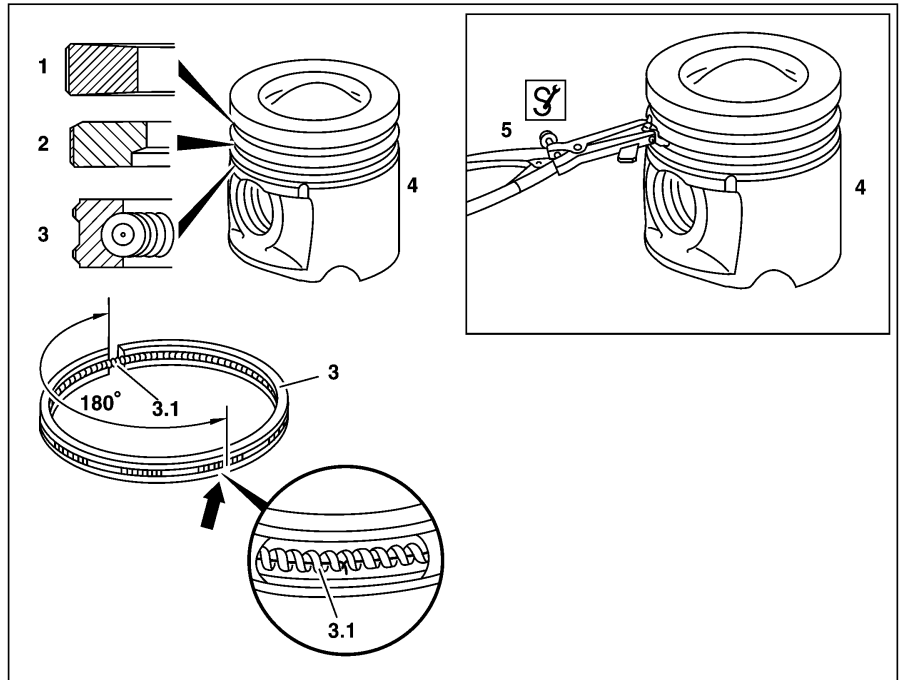


G03.10-3102-01


AR03.10-G-7311CH	Remove/install piston rings	8.6.04
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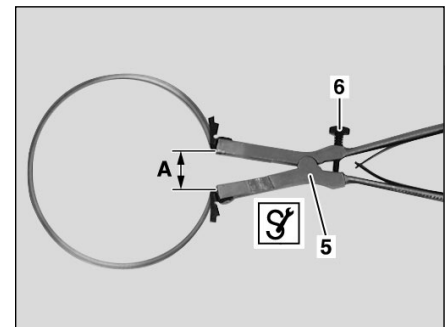
MODEL 000.001 with ENGINE 457.960

- 1 Piston ring (groove I)  
keystone ring
- 2 Piston ring (groove II)  
taper faced ring with internal angle
- 3 Piston ring (groove III)  
bevel-edged ring with spring expander
- 3.1 Spring expander
- 4 Pistons
- 5  Pliers







W03.10-1007-06

- 5  Pliers
- 6 Knurled screw
- A = Spread 43 mm



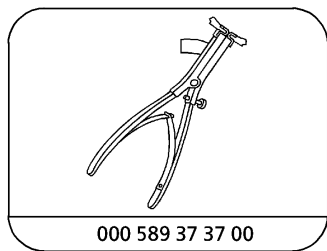
G03.10-3100-01

	Remove/Install		
1	Remove pistons (4)		<b>Page 69</b>
2	Clamp conrod and piston (4) in a vise	 Use protective jaws for clamping.	
3	Remove the piston rings (1, 2, 3) starting from the top	<p> Before assembly or disassembly of the piston rings (1, 2, 3), adjust the maximum permissible spreading dimension (A) for the pliers (5) with the knurled screw (6).</p> <p> Installation: Before reinstallation and after installation, always visually check piston rings (1, 2, 3) for chipping in the non-metallic coating; if necessary, replace piston rings (1, 2, 3). Observe installation position: The word "TOP" should point toward the piston crown. The gap (arrow) in the spring expander (3.1) in the bevel-edged ring with spring expander (3) must be offset 180° to the gap in the piston ring.</p>	BE03.10-N-1001-05L

		☒	000 589 37 37 00
4	Install in the reverse order		

Test values of piston rings

Number	Designation	Engine 457.960
BE03.10-N-1001-05L	Expanding value of piston ring max. mm	43











000 589 37 37 00

Pliers

AR03.20-G-0002CH	Additional tests when carrying out a repair to the crankshaft, main bearing or connecting rod bearing	16.6.04
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

**MODEL 000.001 with ENGINE 457.960**

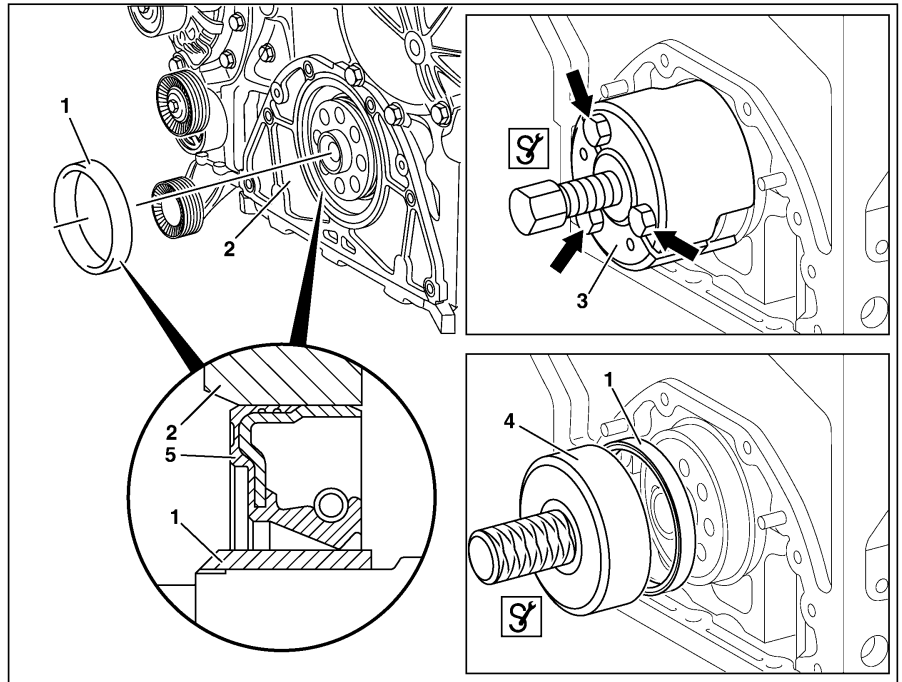
	Check		
1  	Remove oil filter element and check for outer metal abrasion or swollen condition of the oil filter element disks  Engine - oil and filter change	 Only if there is advanced wear or damage to engine components.	<b>Page 185</b>
2	Replace oil/water heat exchanger	 Only if metal abrasion is present at oil filter element disks or in the engine oil circuit.	<b>Page 205</b>
3	Remove, disassemble and check oil pump through a visual inspection for wear	 Only remove if reinforced metal abrasion was found at oil filter element. If wear is present, replace oil pump if necessary.	<b>Page 199</b>
4	Fill engine oil circuit	 Only if engine was repaired because of crankshaft bearing damage.	<b>Page 191</b>
5  	Replace engine oil and oil filter element.  Engine - oil and filter change	 If metal abrasion or swollen condition of oil filter element (coolant in engine oil circuit):	<b>Page 185</b>















AR03.20-G-2570CH	Remove/install race on crankshaft	16.6.04
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MODEL 000.001 with ENGINE 457.960



- 1 Race
- 2 Housing cover
- 3  Puller
- 4  Drift
- 5 Crankshaft radial seal

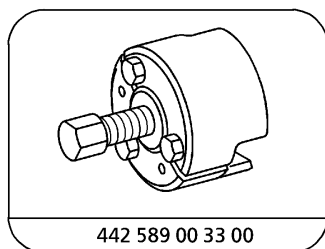


W03.20-1080-06

	<b>Remove</b>		
 <b>Danger!</b>	<b>Risk of injury</b> to skin and eyes caused by handling hot or glowing objects.	Wear safety gloves, protective clothing and safety glasses, if necessary.	<b>Page 80</b>
1	Remove the front crankshaft radial sealing ring (5)		<b>Page 81</b>
2	Remove housing cover (2)	Only when race (1) is present.	<b>Page 39</b>
3	Pull off the race (1) with the puller (3) at the crankshaft flange	Only when race (1) is present.   Position the two halves of the puller (3) over the race (1) and tighten the bolts (arrows). 	442 589 00 33 00
	<b>Install</b>		
4	Heat the new race (1) and drift (4)	 Heat the drift (4) to a temperature of maximum 60 °C. Heat the race (1) to a temperature of maximum 150 °C. The race (1) must not have any temper color; replace the race (1) if required.    	447 589 01 15 00 WH58.30-Z-1007-08A WH58.30-Z-1010-08A WH58.30-Z-1002-28A
5	Insert the new race (1) in the drift (4)	 The chamfered edge of the race (1) must point to the drift (4). 	447 589 01 15 00

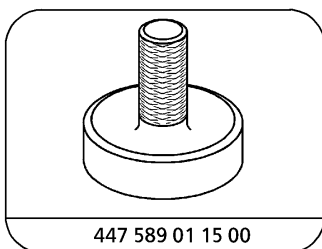


6	Install race (1) on crankshaft	<p><b>i</b> The race (1) must be flush mounted to the front edge of the crankshaft flange.</p> <p></p>	447 589 01 15 00
7	Fit a new front crankshaft radial sealing ring (5)	<p><b>i</b> After installing a race (1) on the crankshaft, it is necessary to install a crankshaft radial sealing ring (5) with greater inner diameter (with spring expander).</p> <p></p>	<p align="right"><b>Page 42</b></p> <p>541 589 02 33 00</p>



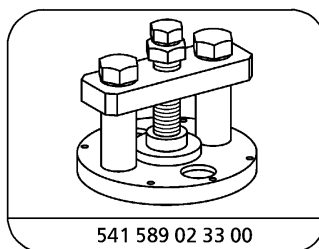
442 589 00 33 00

Puller



447 589 01 15 00

Drift




541 589 02 33 00

Removal and insertion device

Commercially available tools (see Workshop Equipment Manual)

Number	Designation	Make (e. g.)	Order number
WH58.30-Z-1007-08A	Temperature measuring instrument ALMEMO 2020-1 (measuring range -200 °C to + 1000 °C)	Ahlborn www.ahlborn.com	MA20201
WH58.30-Z-1010-08A	Measuring sensor, type TK 121 (measuring probe offset 45°) for temperature measuring instrument ALMEMO 2020-1	Ahlborn www.ahlborn.com	FTA2211
WH58.30-Z-1002-28A	Heating plate	Helios GmbH Postfach 1160 D-58803 Neuenrade Tel. 02392/69080 Fax. 02392/61005	801 0041

AS00.00-Z-0002-01A	<b>Risk of injury.</b> Skin or eye injuries may result when handling hot or glowing objects.	Wear protective gloves, protective clothing and (where necessary) safety glasses.	 <b>Danger!</b>
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**Risk of injury**

Unprotected contact with hot or glowing objects may cause severe burns to the skin and eyes.  
 If glowing objects come into contact with water, hot steam or hot splashing water may result in severe skin and eye burns.  
 Severe and possibly permanent injuries may result if hot or glowing objects come into contact with unprotected skin or eyes.

**i** Fire may result if glowing objects come into contact with flammable materials or substances.

**Safety precautions/instructions**

- Wear protective clothing, safety glasses and heat-resistant gloves.
- Transport hot or glowing objects using approved equipment only.
- When handling glowing objects, avoid sparks and keep objects away from flammable materials and substances.

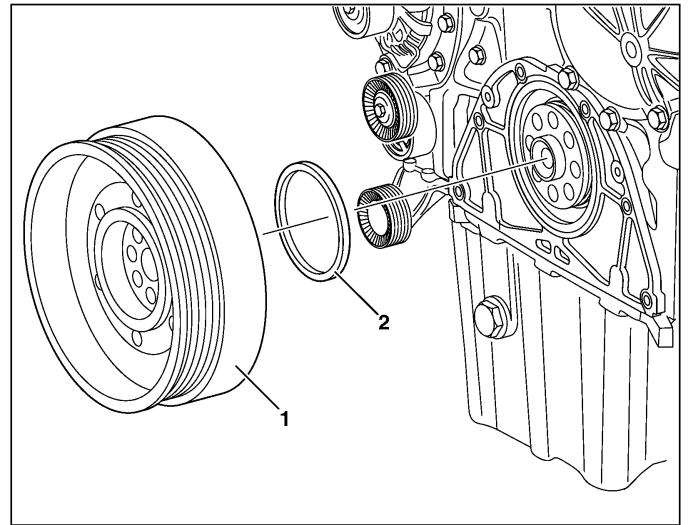
**First aid measures**

- Flush the affected skin areas with plenty of cold water and dress with sterile bandages.
- Consult a doctor without delay.

AR03.20-G-3000CH	Replace front crankshaft radial seal	16.6.04
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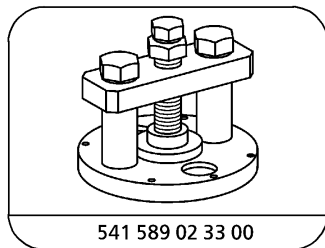
**MODEL 000.001 with ENGINE 457.960**

- 1 Belt pulley / vibration damper
- 2 Crankshaft radial seal



W03.20-1079-11

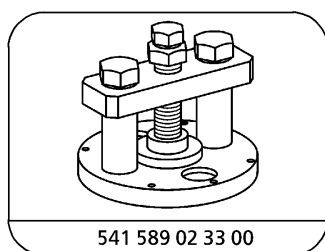
	<b>Remove</b>		
1	Remove belt pulley / vibration damper (1)		<b>Page 89</b>
2	Remove the front crankshaft radial sealing ring (2)		<b>Page 82</b> 541 589 02 33 00
	<b>Check</b>		
3	Check tread of crankshaft radial sealing ring (2) on race or crankshaft flange	If galling on the race or the crankshaft are present: ↓ Install new race on crankshaft flange	<b>Page 79</b>
	<b>Install</b>		
4	Install front crankshaft radial sealing ring (2)	Crankshaft radial sealing ring (2) without race  Crankshaft radial sealing ring (2) with race 	<b>Page 40</b> 541 589 02 33 00 <b>Page 42</b> 541 589 02 33 00
5	Install belt pulley/vibration damper (1)		<b>Page 89</b>
<b>Danger!</b>	<b>Risk of accident</b> caused by vehicle starting off by itself when engine is running. <b>Risk of injury</b> caused by contusions and burns when working in engine during starting procedure	Secure vehicle to prevent it from moving. Wear closed and snug-fitting work clothes. Do not grasp hot or rotating parts.	<b>Page 9</b>
6	Crank the engine and check the front crankshaft radial sealing ring (2) for leaks		



541 589 02 33 00





Removal and insertion device

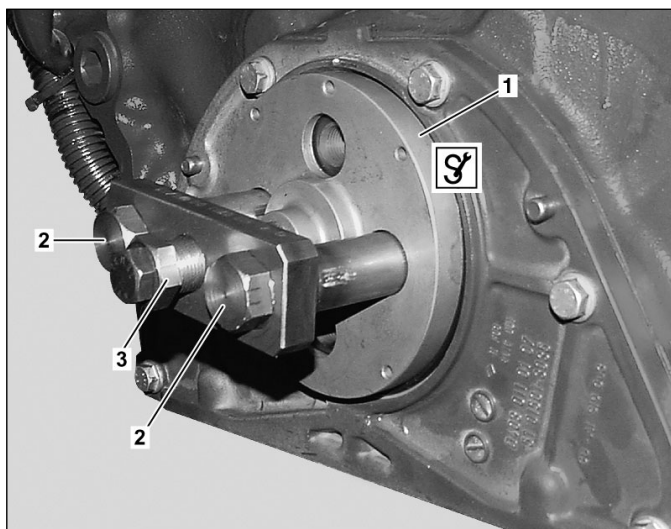
AR03.20-G-3000-02CH	Remove front crankshaft radial sealing ring		
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
541 589 02 33 00

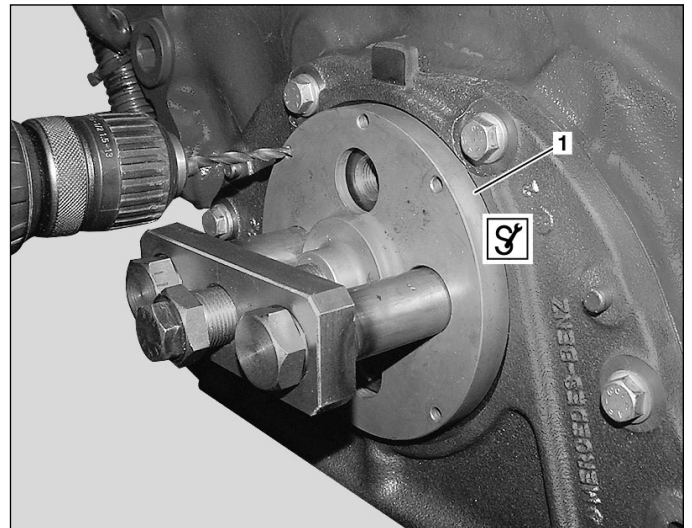
Removal and insertion device

- 1 Attach  removal and insertion device (1) to crankshaft flange with bolts (2).  
 When tightening the bolts (2), ensure that the removal and insertion device  (1) is not resting against the crankshaft radial sealing ring; if necessary, unscrew bolt (3).
- 2 Screw in bolt (3)  until the removal and insertion device (1) is resting against the crankshaft radial sealing ring.






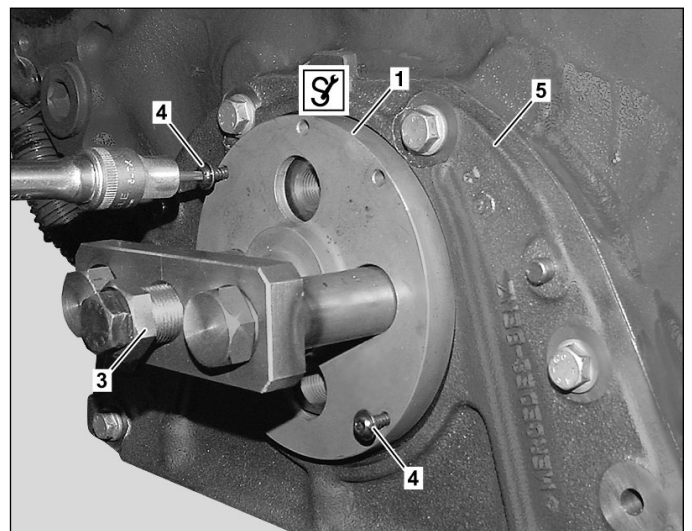
G03.20-3108-11

- 3 Drill two holes (dia. 3.5 mm) in the crankshaft radial sealing ring by drilling through the holes present in the  removal and insertion device.  
 Drill holes so that oppose one another diagonally.



G03.20-3107-11

- 4 Tighten crankshaft radial sealing ring with two sheet metal screws (4)  to the removal and insertion device (1).  
 Use M4.8X25 sheet metal screws.
- 5 Unscrew bolt (3) so far, until the crankshaft radial sealing ring is pulled out of the front housing cover (5).
- 6 Remove  removal and insertion device (1) with crankshaft radial sealing ring from crankshaft flange.
- 7 Unscrew sheet metal screws (4).





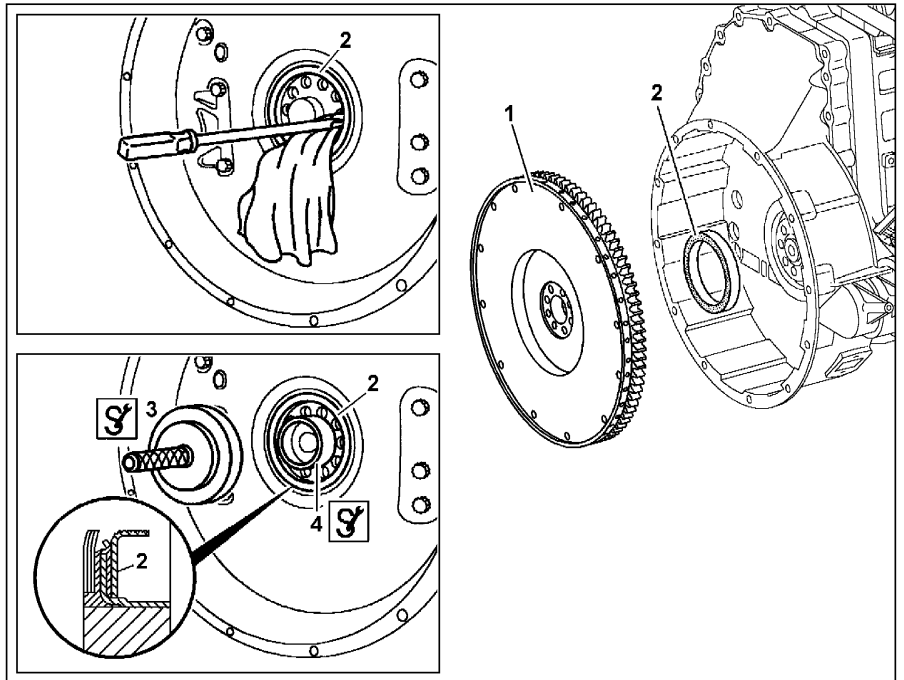
G03.20-3109-11











AR03.20-G-3063CH	Replace rear crankshaft radial seal	16.6.04
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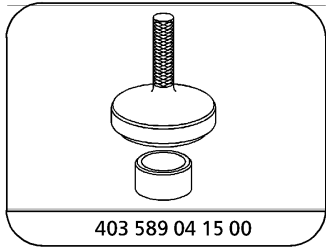
MODEL 000.001 with ENGINE 457.960

- 1 Flywheel
- 2 Crankshaft radial seal
- 3  Drift
- 4  Spacer sleeve



W03.20-1018-06

	<b>Remove</b>		
1	Remove flywheel (1)		<b>Page 95</b>
2	Remove crankshaft radial sealing ring (2)	 Cover over crankshaft with a cloth as a protection.	
	<b>Install</b>		
3	Fit spacer sleeve (4) onto the crankshaft		403 589 04 15 00
4	Position crankshaft radial sealing ring (2) on timing case and press in with drift (3) until drift (3) makes contact with spacer sleeve (4)	 Install crankshaft radial sealing ring (2) dry.  	403 589 04 15 00
5	Remove drift (3) and spacer sleeve (4)	 After removing drift (3) and spacer sleeve (4), check to ensure that crankshaft radial sealing ring (2) is properly seated on timing case.  	403 589 04 15 00
6	Install flywheel (1)		<b>Page 95</b>

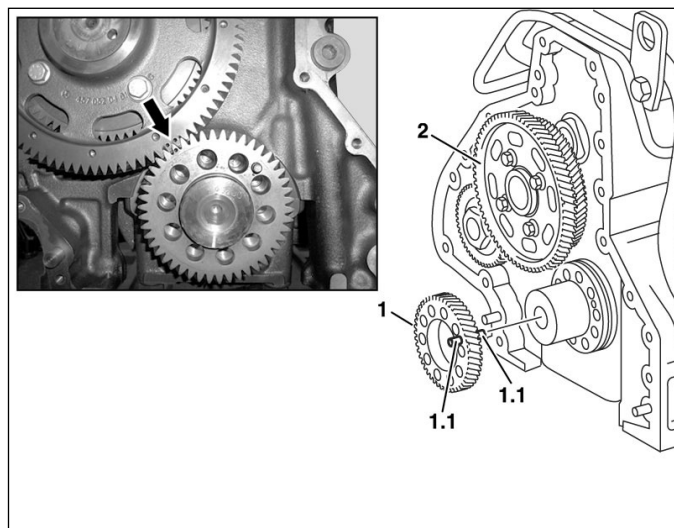


Drift

AR03.20-G-4803CH	Remove/install crankshaft gear	17.6.04
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**MODEL 000.001 with ENGINE 457.960**

- 1 Crankshaft gear
- 1.1 Dowel pin
- 2 Camshaft sprocket



W03.20-1021-11

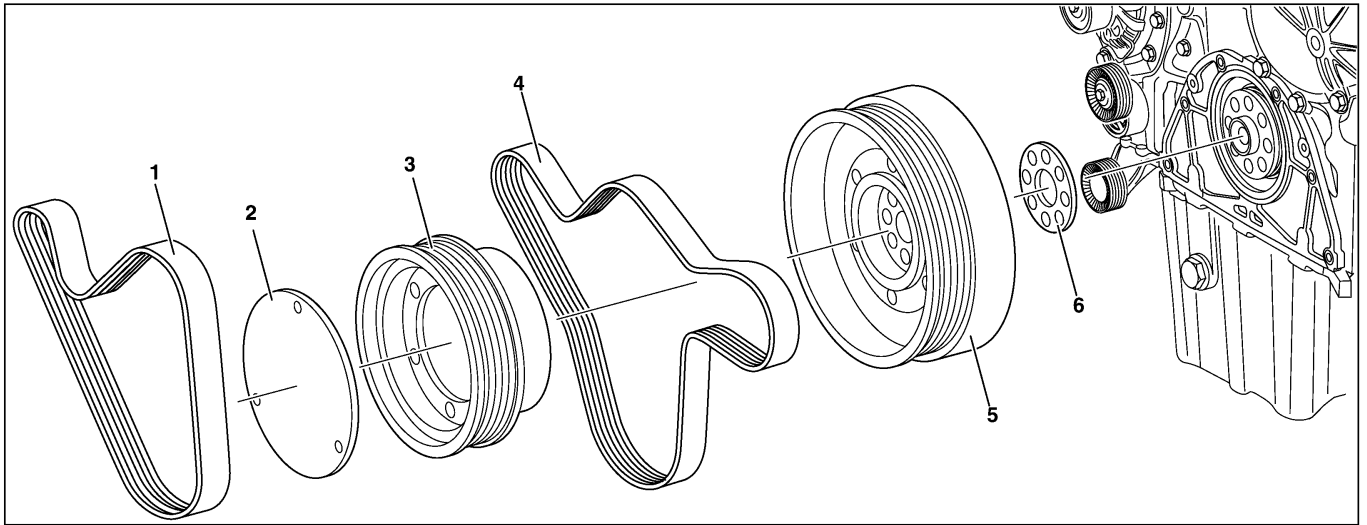
	<b>Remove/Install</b>		
1	Remove timing case		<b>Page 57</b>
2	Pull crankshaft gear (1) off the crankshaft	<p>⚠ Before pulling, ensure that the marking point on the crankshaft gear (1) is located between the marking points (arrow) on the camshaft sprocket (2), otherwise the engine can be damaged as a result of incorrect timing.</p> <p><b>i</b> Installation: Observe installation position of fitted pin (1.1).</p>	
3	Install in the reverse order		





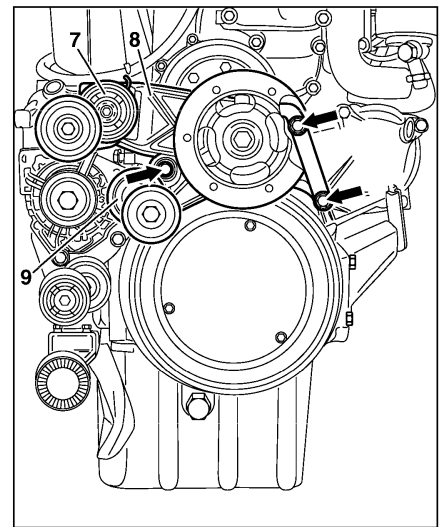
AR03.30-G-1600CH	Remove/install belt pulley/vibration damper	17.6.04
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MODEL 000.001 with ENGINE 457.960












W03.30-1025-08

- 1 Poly-V-belt of the fan
- 2 Cover
- 3 Belt pulley fan drive
- 4 Poly-V-belt of generator
- 5 Belt pulley / vibration damper
- 6 Splash ring
- 7 Poly-V-belt tensioning device of the fan
- 8 Bracket
- 9 Guide pulley



W03.30-1024-02

	<b>Remove/Install</b>		
<b>Danger!</b>	<b>Risk of injury</b> caused by pinching or jamming when working on loaded springs or spring bodies	Use only approved clamping devices; shield off hazard area if necessary. Inspect special tools for damage and proper operation (visual inspection). Wear protective gloves.	<b>Page 91</b>
	Notes on self-locking nuts and bolts	All models	<b>Page 59</b>
1	Release tension on fan poly-V-belt (1) and remove tensioning pulley on tensioning device for fan poly-V-belt (7)	<b>Installation:</b> Observe running diagram and damage pictures for fan poly-V-belt (1), replace fan poly-V-belt (1) if worn: ↓ Running diagram of poly V-belt	<b>Page 157</b>  <b>Page 91</b>


 AP		Damage patterns of poly V-belt	<b>Page 92</b>
2	Release tension on generator poly-V-belt (4) and remove generator poly-V-belt and guide pulley (9)	 <b>Installation:</b> Observe running diagram and damage pictures for generator poly-V-belt (4), replace generator poly-V-belt (4) if worn:  ↓ Running diagram of poly V-belt Damage patterns of poly V-belt	<b>Page 155</b>  <b>Page 91</b> <b>Page 92</b>
 AP			
3	Unscrew bolts (arrow) on bracket (8) for fan drive		BA20.40-N-1004-01M
4	Press the fan wheel with the bracket (8) upwards in the direction of the engine and attach with tie strap to the front lifting eye on the engine		
5	Remove the cover (2) of the belt pulley of the fan drive (3)		
6	Attach cranking/blocking device for engine	 	<b>Page 5</b> BA01.60-N-1001-01K 904 589 04 63 00
7	Detach the belt pulley of the fan drive (3) from the belt pulley/vibration damper (5)		BA03.30-N-1005-01R
8	Take off belt pulley / vibration damper (5)		BA03.30-N-1002-01R
9	Check belt pulley/vibration damper (5) and the belt pulleys of the remaining driven components for damage and smooth operation, replace if necessary		
10	Remove the slinger (6)	 <b>Installation:</b> Observe the installation position of the slinger (6).	
11	Install in the reverse order		

 **Timing case**

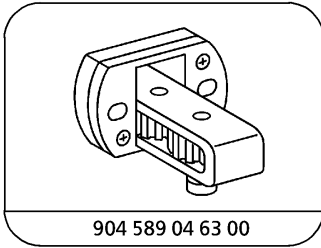
Number	Designation	Engine 457.960	
BA01.60-N-1001-01K	Bolt of end cover of inspection hole to timing case	Nm	25

 **Flywheel, driven plate, vibration damper, starter ring gear**

Number	Designation	Engine 457.960	
BA03.30-N-1002-01R	Bolt of vibration damper to crankshaft	Nm	200
BA03.30-N-1005-01R	Bolt of the belt pulley of the fan drive to vibration damper	Nm	30

 **Fan, fan clutch**

Number	Designation	Engine 457.960	
BA20.40-N-1004-01M	Bracket of the fan drive at crankcase	Nm	60



904 589 04 63 00  
Cranking device

AS00.00-Z-0001-01A	<b>Risk of injury caused by pinching or jamming when working on loaded springs or spring bodies</b>	Use only approved clamping devices; shield off hazard area if necessary. Inspect special tools for damage and proper operation (visual inspection). Wear protective gloves.	<b>⚠ Danger!</b>
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**Risk of pinching and jamming body parts when working on pre-loaded components.**

When loosening or removing components that are under significant load, there is a risk of **serious injury** if **non-approved clamping devices** are used.

**Safety instructions/precautions**

When conducting repair work on springs, spring bodies, spring-type actuators and other components under tension use **approved clamping devices only**.

**Spring compressor**

The spring compressor should **never** be clamped or released using an impact wrench.

**Check clamping devices**

- The spindle must be undamaged and allow ease of movement.
- The clamping plates must not be deformed.
- Note arrangement of clamping plates to springs.
- If the device is damaged or malfunctioning, it must be returned to the manufacturer.

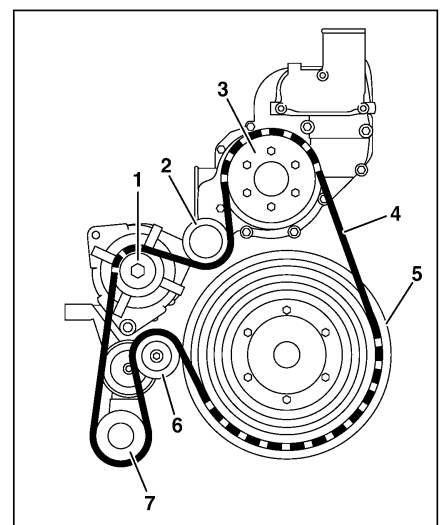
**i** The coil diameter of the spring should match the groove in the clamping plate.

Wear protective gloves during all operations.

AR13.22-G-3902-02CH	Poly-V-belt route		
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**Belt drive for alternator and coolant pump  
(Vehicles without code (H03) Air conditioning in front end)**

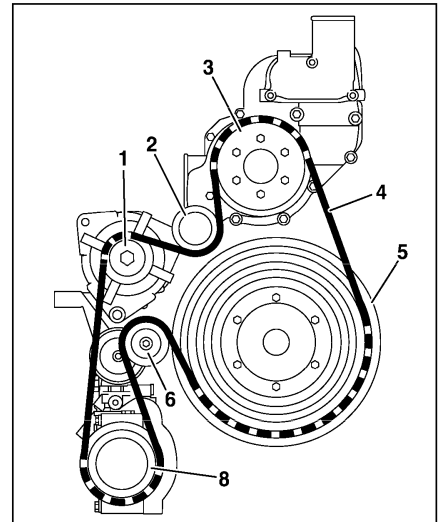
- 1 Belt pulley alternator
- 2 Guide pulley
- 3 Belt pulley coolant pump
- 4 Poly-V-belt
- 5 Belt pulley/vibration damper
- 6 Tensioning device with tensioning pulley
- 7 Guide pulley



W13.20-1001-02

**Belt drive for alternator, coolant pump and AC compressor  
(Vehicles with code (H03) Air conditioning in front end)**

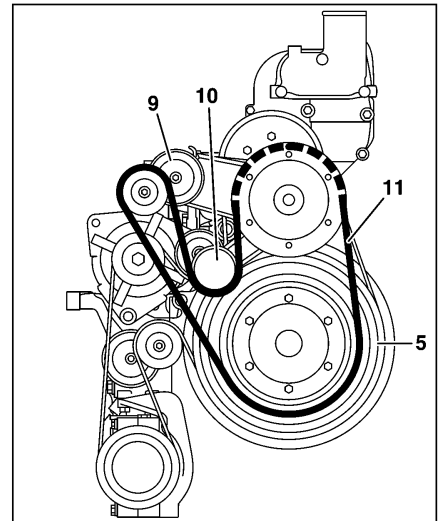
- 1 Belt pulley alternator
- 2 Guide pulley
- 3 Belt pulley coolant pump
- 4 Poly-V-belt
- 5 Belt pulley/vibration damper
- 6 Tensioning device with tensioning pulley
- 8 Belt pulley AC compressor



W13.20-1002-02

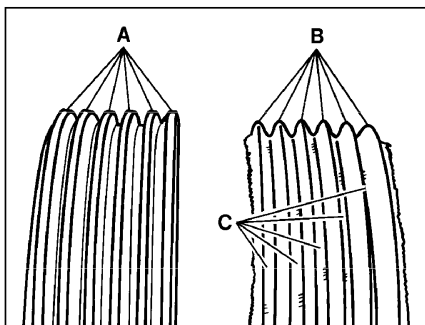
**Belt drive for fan**

- 5 Belt pulley/vibration damper
- 9 Tensioning device with tensioning pulley for poly-V-belt for fan
- 10 Guide pulley for poly-V-belt for fan
- 11 Poly-V-belt for fan



W13.20-1003-02

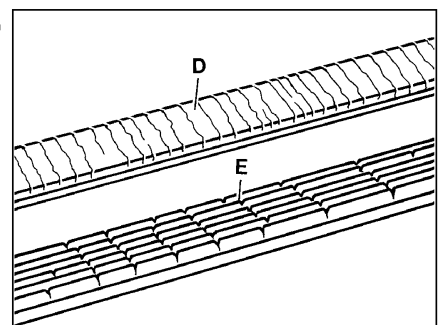
AP13.22-D-1351-01A	Damage patterns for poly V-belt		
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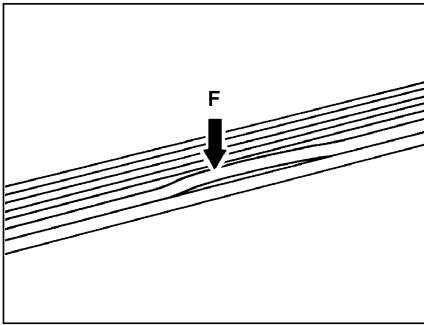
N13.22-2068-01

Wear to flank - ribs wedge-shaped (B) and cord visible in base of rib (C), condition of ribs when new is trapezoidal in shape (A)

Splits across the back (D)  
Splits across several ribs (E)



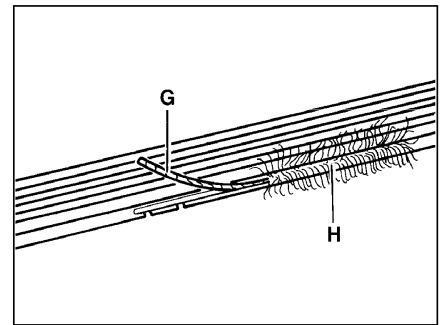
N13.22-2066-01



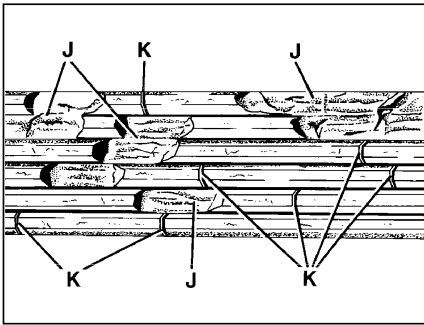
N13.22-2071-01

Rib detached from base of belt (F)

Strand torn out at the side (G), fraying (H) of outer strands



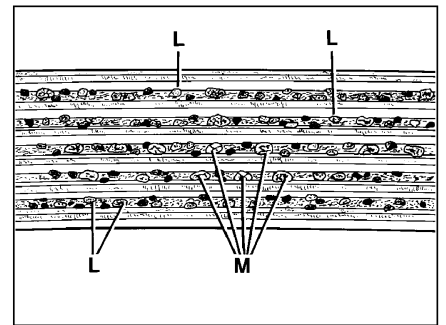
N13.22-2067-01



N13.22-2069-01

Sections of ribs broken out (J)  
Splits across ribs (K),

Rubber lumps in base of rib (L)  
Dirt or grit embedded (M)





N13.22-2070-01

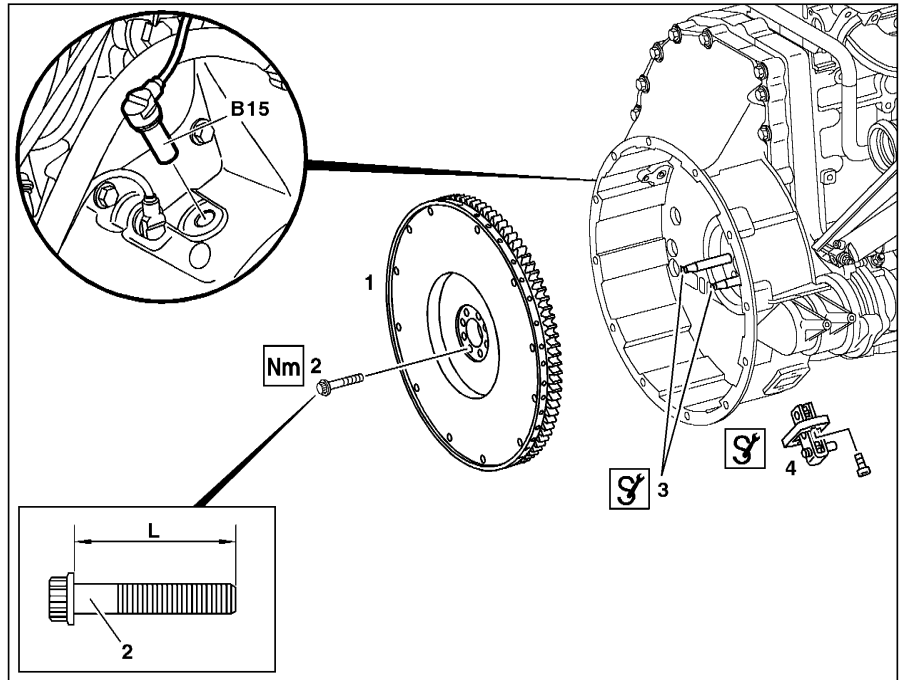


AR03.30-G-8002CH	Remove/install flywheel	17.6.04
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











MODEL 000.001 with ENGINE 457.960

- 1 Flywheel
- 2 Flywheel bolt
- 3  Drift
- 4  Cranking/blocking device

B15 Crankshaft angle position sensor  
 L Shank length of flywheel bolt



W03.30-1008-06

	Remove/Install		
1	Remove clutch		AR25.10-G-0050CH
2	Pull crankshaft angle position sensor (B15) out of the timing case	 Installation: Press crankshaft angle position sensor (B15) into timing case up to the stop.	
3	Attach cranking/blocking device for engine	 	<b>Page 5</b> BA01.60-N-1001-01K 904 589 04 63 00
4	Arrest flywheel (1) with cranking/blocking device on ring gear		904 589 04 63 00
5	Unscrew flywheel bolts (2) at flywheel (1)	 Installation: Oil flywheel bolts (2) lightly.  	BA03.30-N-1001-01R 422 589 02 09 00
6	Screw drifts (3) into two opposite threaded holes		403 589 02 63 00
7	Remove flywheel (1)	 If flywheel is stuck, screw two matching bolts into tapped holes and press off flywheel.  Installation: Grease ring gear with long-life grease.	BR00.45-Z-1001-06A
	Check		
8	Measure flywheel bolts (2)	 If the max. shank length (L) is exceeded, replace flywheel bolts (2).	BE03.30-N-1004-03J



9	Inspect clutch surface at flywheel (1)	<b>i</b> If scorch marks, scores or cracks are visible in the clutch surface: ↓ Check flywheel (1), machine if required	<b>Page 97</b>
10	Inspect ring gear for wear	<b>i</b> If worn: ↓ Replace gear ring on flywheel (1)	<b>Page 99</b>
11	Install in the reverse order		

## Test values of flywheel

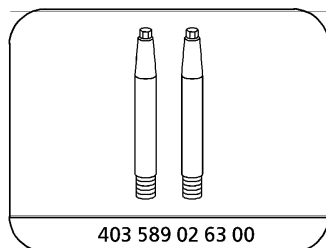
Number	Designation	Engine 457.960	
BE03.30-N-1004-03J	Flywheel bolt	Thread dia.	M 16×1.5
		Shank length when new	mm 74,0
		Shank length	mm ≤75,0

**Nm** Timing case

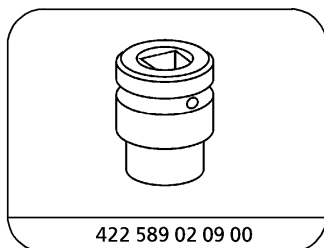
Number	Designation	Engine 457.960	
BA01.60-N-1001-01K	Bolt of end cover of inspection hole to timing case	Nm	25

**Nm** Flywheel, driven plate, vibration damper, starter ring gear

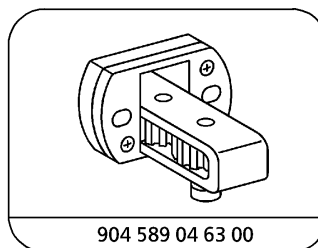
Number	Designation	Engine 457.960	
BA03.30-N-1001-01R	Bolt of flywheel to crankshaft	1st stage	Nm 210
		2nd stage	∠° 90



Drift



Socket wrench bit



Cranking device

## Auxiliary repair materials

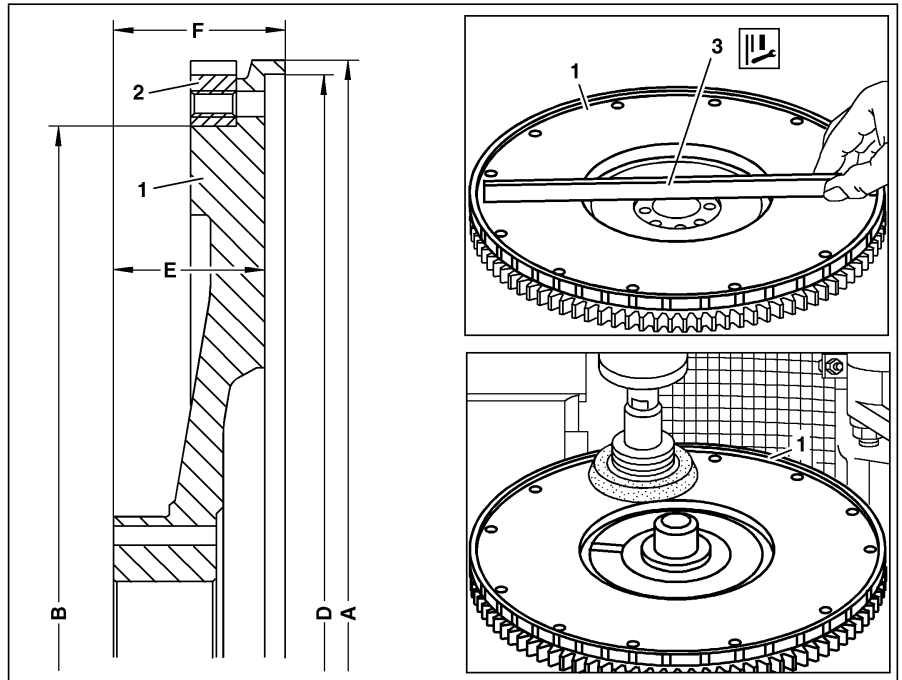
Number	Designation	Order number
BR00.45-Z-1001-06A	MB long-life grease	000 989 63 51

AR03.30-G-8022CH	Check flywheel, re-machine	17.6.04
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



MODEL 000.001 with ENGINE 457.960

- 1 Flywheel
- 2 Ring gear
- 3  Straightedge

- A Outer diameter of flywheel
- B Flywheel dia. for ring gear surface
- D Flywheel dia. for clutch mounting
- E Flywheel minimum width between friction surface and support flange for repairs
- F Flywheel overall width



W03.30-0013-06

	<b>Remove</b>		
1	Remove flywheel (1)		<b>Page 95</b>
	<b>Check</b>		
2	Clean flywheel (1) and inspect clutch surface (friction surface) for scorch marks, scores and cracks, and also check flatness with a straightedge (3)	<p> Before machining flywheel (1), check whether it is still possible to remove material.</p> <p>If scoring or cracks on the clutch surface (friction surface) are deeper than the maximum permissible quantity of material which can be removed, replace flywheel (1).</p> <p></p>	<p>BE03.30-N-1003-03J</p> <p>WH58.30-Z-1025-12A</p>
3	Machine flywheel (1)	<p>Only when complaint is received.</p> <p> If a problem exists, the clutch surface (friction surface) must be machined only by grinding.</p> <p>After machining, there must not be any shrink holes or chatter marks present.</p>	<p>BE03.30-N-1001-03J</p> <p>BE03.30-N-1002-03J</p> <p>BE03.30-N-1003-03J</p>
	<b>Install</b>		
4	Install flywheel (1)		<b>Page 95</b>

## Test values of flywheel

Number	Designation		Engine 457.960
BE03.30-N-1001-03J	Flywheel dia.	Outer (A)	mm 486.600...487.400
		For mounting	Standard mm 432.490...432.645
		starter ring gear (B)	Dimensions 0.5 mm 431.990...432.145
		For mounting	mm 475.000...475.063
		clutch (D)	
		For picture, see	-
BE03.30-N-1002-03J	Clutch friction surface	Peak-to-valley height (R <sub>z</sub> )	µm 16
		Flatness	mm ≤0,03
BE03.30-N-1003-03J	Flywheel	Overall width (F)	mm 70
		Minimum width between friction surface and mounting flange for repairs (E)	mm 60
		For picture, see	mm -

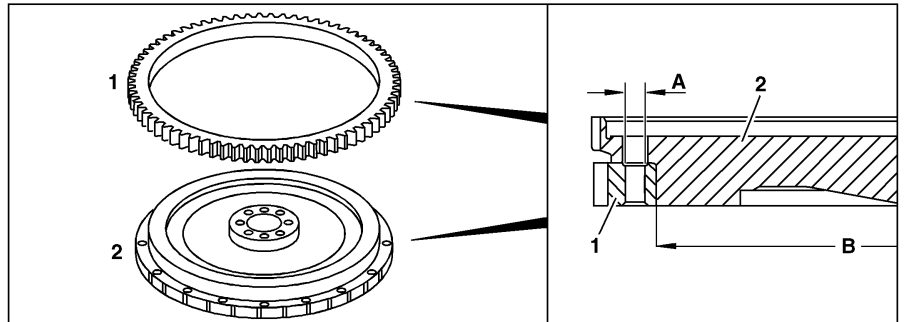
## Commercially available tools (see Workshop Equipment Manual)

Number	Designation	Make (e. g.)	Order number
WH58.30-Z-1025-12A	Straightedge, 500 mm	Hahn und Kolb Borsigstr. 50 D-70469 Stuttgart www.hahn-kolb.de	37 550 050

AR03.30-G-8312CH	Replace ring gear of flywheel	17.6.04
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MODEL 000.001 with ENGINE 457.960

- 1 Ring gear
- 2 Flywheel
  
- A Bore dia. for mounting clutch pressure plate (M10×1,5)
- B Flywheel dia. for mounting the starter ring gear



W03.30-0014-04

	<b>Remove</b>		
1	Remove flywheel (2)		<b>Page 95</b>
	<b>Disassemble</b>		
	<b>Danger!</b>	Risk of injury to skin and eyes caused by handling hot or glowing objects.	<b>Page 80</b>
2	Use a welding flashlight to rapidly heat up ring gear (1) and press it off the flywheel (2)	Wear safety gloves, protective clothing and safety glasses, if necessary.	BE03.30-N-1001-04J
	<b>Measure</b>		
3	Measure flywheel dia. (B) for mounting ring gear (1)	If the standard dia. is exceeded, it is necessary to machine the flywheel dia. to the repair dia. for mounting the ring gear.	BE03.30-N-1001-03J
	<b>Assemble</b>		
4	Select and heat new ring gear (1) according to flywheel dia.	The correct temperature is reached when the ring gear (1) has a light yellow color.  	BE03.30-N-1001-04J WH58.30-Z-1007-08A WH58.30-Z-1010-08A
5	Press ring gear (1) onto the flywheel (2) as far as the contact surface		BE03.30-N-1001-04J
6	Drill holes (A) for mounting the clutch pressure plate in the ring gear (1) and tap thread (M10×1.5)		
	<b>Install</b>		
7	Install flywheel (2)		<b>Page 95</b>

Test values of flywheel

Number	Designation	Engine 457.960
BE03.30-N-1001-03J	Flywheel dia.	Outer (A) mm 486.600...487.400
		For mounting starter ring gear (B) Standard mm 432.490...432.645
		Dimensions 0.5 mm 431.990...432.145
		For mounting clutch (D) mm 475.000...475.063
		For picture, see -

## Inspection and adjustment data: starter ring gear, flywheel



Number	Designation	Engine 457.960
BE03.30-N-1001-04J	Ring gear inner dia.	Standard mm 432,000...432,155
		Dimensions 0.5 mm 431.500...431.655
	Spec. max. radial runout at ring gear seat mm $\leq 0,5$	
	Width mm 18.25...18.75	
	Fitting temperature °C 200...230	
BE03.30-N-1002-04J	Overlap between starter ring gear and flywheel mm 0.335...0.645	

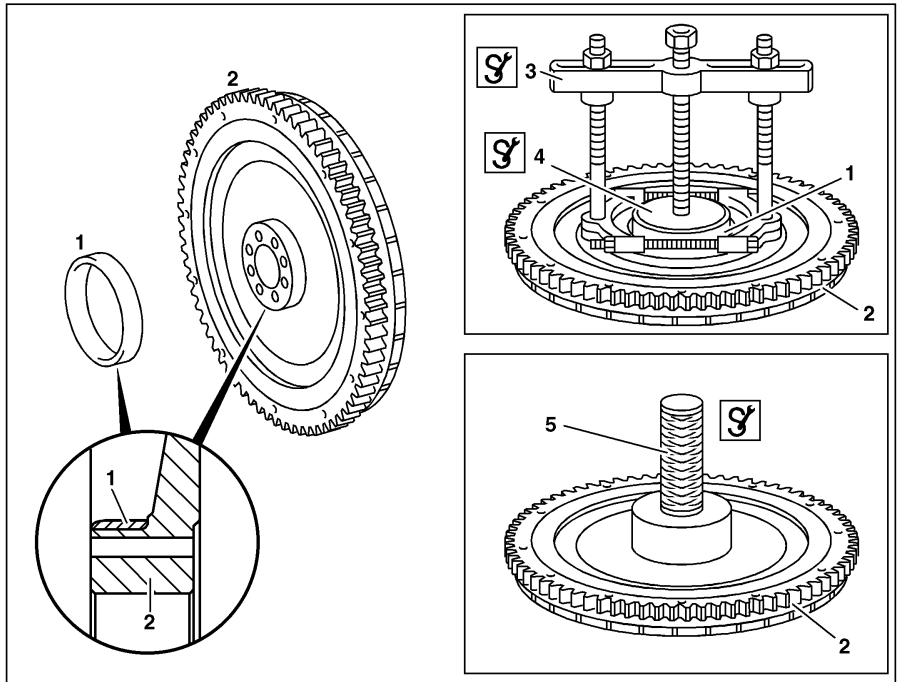
## Commercially available tools (see Workshop Equipment Manual)

Number	Designation	Make (e. g.)	Order number
WH58.30-Z-1007-08A	Temperature measuring instrument ALMEMO 2020-1 (measuring range -200 °C to + 1000 °C)	Ahlborn www.ahlborn.com	MA20201
WH58.30-Z-1010-08A	Measuring sensor, type TK 121 (measuring probe offset 45°) for temperature measuring instrument ALMEMO 2020-1	Ahlborn www.ahlborn.com	FTA2211













AR03.30-G-8350CH	Remove/install race on flywheel	13.7.04
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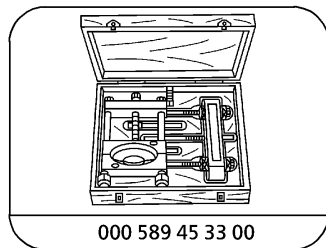
MODEL 000.001 with ENGINE 457.960

- 1 Race
- 2 Flywheel
- 3  Puller
- 4  Thrust piece
- 5  Drift

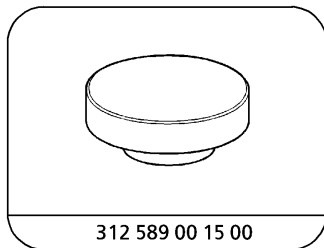


W03.30-0016-06

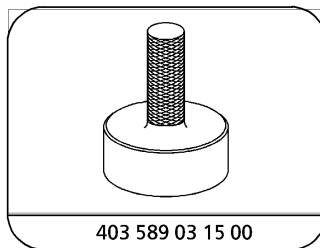
	<b>Remove</b>		
1	Remove flywheel (2)		<b>Page 95</b>
2	Pull off race (1) at flywheel (2)	 	000 589 45 33 00 312 589 00 15 00
	<b>Install</b>		
 <b>Danger!</b>	<b>Risk of injury to skin and eyes caused by handling hot or glowing objects.</b>	Wear safety gloves, protective clothing and safety glasses, if necessary.	<b>Page 80</b>
3	Heat new race (1) and insert into the drift (5)	 Max. temperature 200 °C. The rounded edge of the race (1) should point toward the drift (5).    	403 589 03 15 00 WH58.30-Z-1007-08A WH58.30-Z-1010-08A WH58.30-Z-1002-28A
4	Install race (1) at flywheel (2)		403 589 03 15 00
5	Install new crankshaft radial sealing ring with spring expander in timing case	 The inner diameter of the crankshaft radial sealing ring with spring expander is larger than that of the crankshaft radial sealing ring without spring expander.	<b>Page 85</b>
6	Install flywheel (2)		<b>Page 95</b>



Puller



Thrust piece



Drift

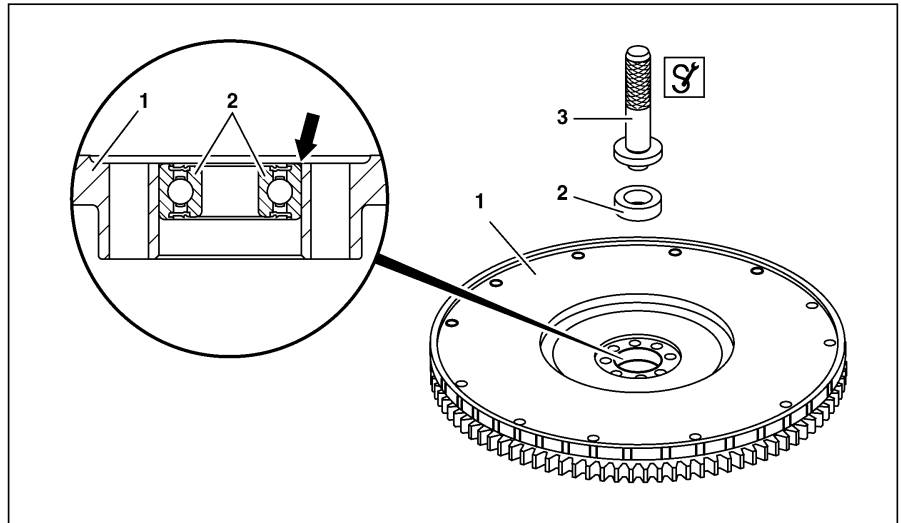
## Commercially available tools (see Workshop Equipment Manual)

Number	Designation	Make (e. g.)	Order number
WH58.30-Z-1007-08A	Temperature measuring instrument ALMEMO 2020-1 (measuring range -200 °C to + 1000 °C)	Ahlborn www.ahlborn.com	MA20201
WH58.30-Z-1010-08A	Measuring sensor, type TK 121 (measuring probe offset 45°) for temperature measuring instrument ALMEMO 2020-1	Ahlborn www.ahlborn.com	FTA2211
WH58.30-Z-1002-28A	Heating plate	Helios GmbH Postfach 1160 D-58803 Neuenrade Tel. 02392/69080 Fax. 02392/61005	801 0041





AR03.30-G-8401CH	Remove/install guide bearing in flywheel	18.6.04
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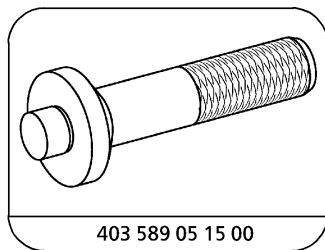
MODEL 000.001 with ENGINE 457.960

- 1 Flywheel
- 2 Guide bearing
- 3  Drift



G03.30-3131-05

 	<b>Remove/Install</b>		
1	Remove flywheel (1)		<b>Page 95</b>
2	Use drift (3) to remove guide bearing (2) from flywheel (1)	<p> <b>Installation:</b> Press in new guide bearing (2) with drift (3) flush with contact surface on screw head (arrow), ensure that guide bearing (2) does not extend. Grease guide bearing (2).</p> <p></p>	<p>403 589 05 15 00</p> <p>BR00.45-Z-1001-06A</p>
3	Install in the reverse order		



403 589 05 15 00

Drift

Auxiliary repair materials

Number	Designation	Order number
BR00.45-Z-1001-06A	MB long-life grease	000 989 63 51

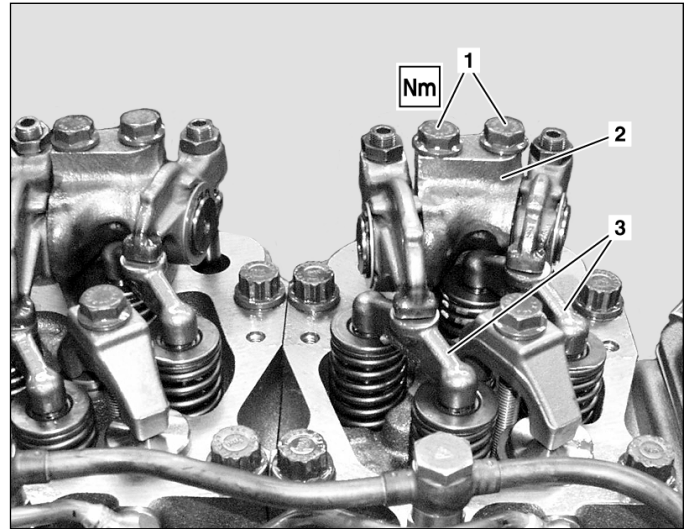




AR05.00-G-5521CH	Remove/install rocker arms assembly	18.6.04
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**MODEL 000.001 with ENGINE 457.960**

- 1 Bolt
- 2 Rocker arms assembly
- 3 Valve bridge



G05.00-3110-11

	<b>Removal</b>		
1	Remove cylinder head cover		<b>Page 15</b>
2	Unscrew bolts (1) and remove rocker arms assembly (2)	Check rocker arms assembly (2) for wear, if necessary: ↓ Disassemble rocker arms assembly (2) and replace worn parts	<b>Page 107</b>
3	Remove valve bridges (2)	Mark installation position. Check valve bridges (3) for wear, replace if necessary: ↓ Replace valve bridges (3)	
	<b>Installation</b>		
4	Install valve bridges (3)	Observe installation position	
5	Install rocker arms assembly (2)	Check whether push rods are seated properly in tappets Oil valve push rod sockets with engine oil	
6	Screw in bolts (1)		BA05.00-N-1001-01K
	<b>Test</b>		
7	Adjust valve play Adjust valve play		<b>Page 121</b>
8	Install cylinder head cover		<b>Page 15</b>

Engine control, general

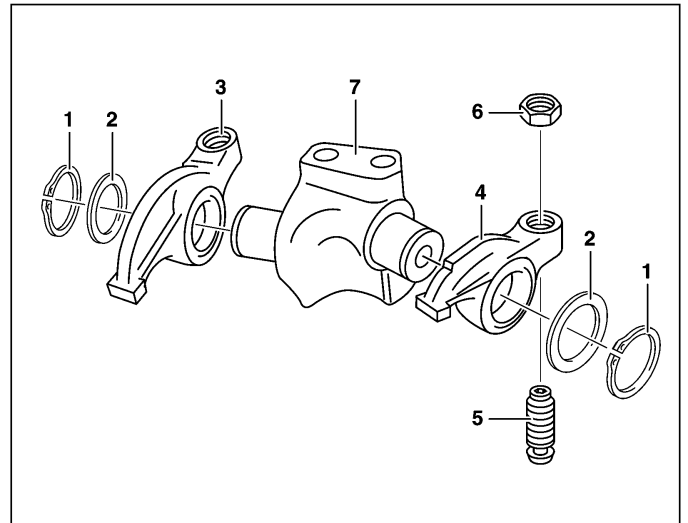
Number	Designation	Engine 457.960		
BA05.00-N-1001-01K	Bolt, rocker arm bracket to cylinder head	1st stage	Nm	60
		2nd stage	Δ°	90



AR05.00-G-5541CH	Assemble/disassemble rocker arms assembly	18.6.04
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**MODEL 000.001 with ENGINE 457.960**

- 1 Circlip
- 2 Washers
- 3 Rocker arms (exhaust)
- 4 Rocker arms (intake)
- 5 Adjustment screw
- 6 Counter nut
- 7 Rocker arm bracket



W05.00-1007-11

	<b>Removal</b>		
1	Remove rocker arms assembly		<b>Page 105</b>
	<b>Disassemble</b>		
2	Remove circlips (1)		
3	Remove washers (2) and rocker arms (3, 4)	Mark installation position of rocker arms (3, 4).	
	<b>Test</b>		
4	Check circlips (1), washers (2), rocker arms (3, 4), adjustment screw (5) and counternut (6) for wear and damage	Replace defective parts	BE05.30-N-1002-04J BE05.30-N-1003-04J
	<b>Assemble</b>		
5	Install washers (2) and rocker arms (3, 4)	Oil washers (2), rocker arms (3, 4) and shafts on rocker arms brackets (7) with engine oil Mark installation position of rocker arms (3, 4)	
6	Install circlips (1)		
	<b>Installation</b>		
7	Install rocker arms assembly		<b>Page 105</b>

**Test values for valve control**

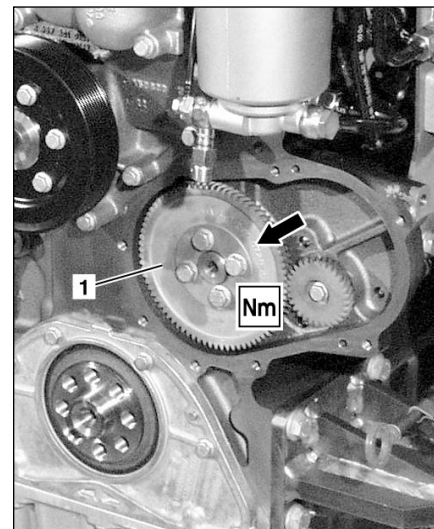
Number	Designation	Engine 457.960
BE05.30-N-1002-04J	Inner diameter of rocker arms bearing bushing in installed state	mm 25,005...25,021
BE05.30-N-1003-04J	Rocker arm spindle dia.	mm 24.967...24.980



AR05.20-G-6040CH	Remove/install camshaft sprocket	18.6.04
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MODEL 000.001 with ENGINE 457.960

1 Camshaft sprocket



G05.20-3107-02

	Removal, installation		
1	Remove camshaft sprocket cover		<b>Page 45</b>
2	Remove camshaft sprocket (1)	Installation: The labeling (arrow) on the camshaft sprocket (1) should point toward outside 	BA05.20-N-1001-01J
3	Reinstall in opposite order		

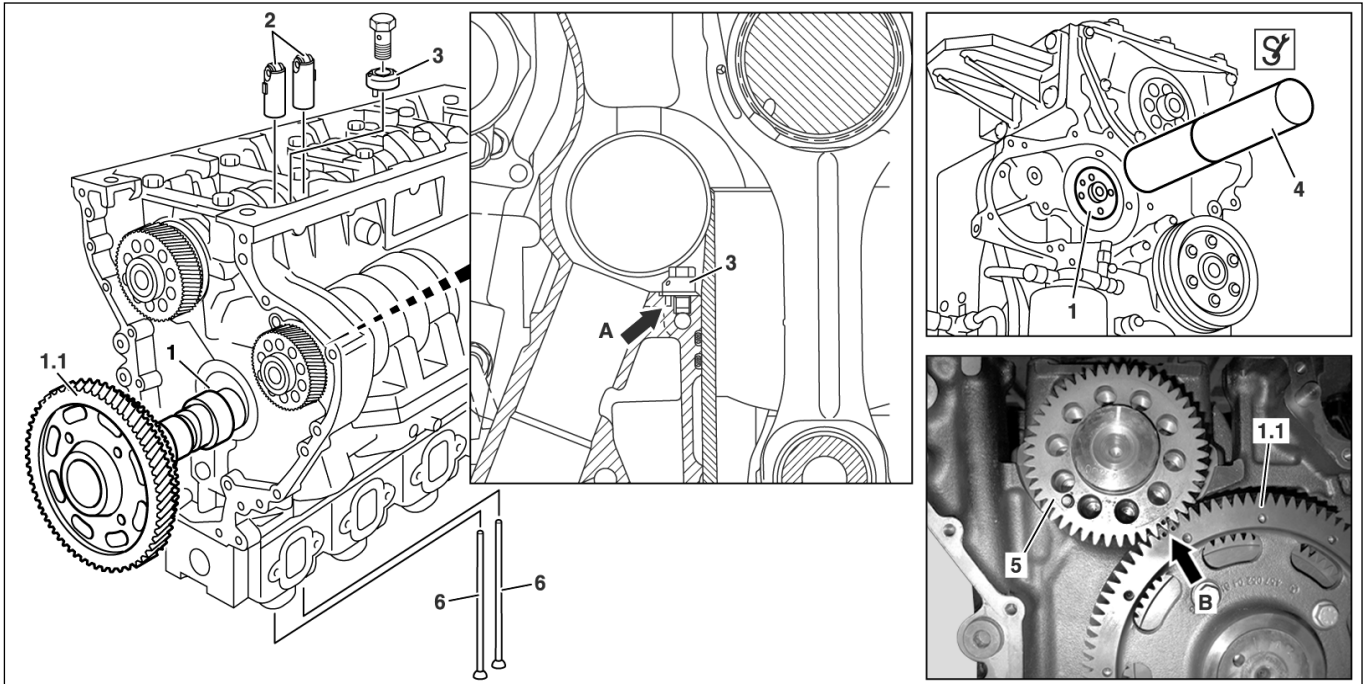
Camshaft

Number	Designation	Engine 457.960
BA05.20-N-1001-01J	Bolt, camshaft sprocket to camshaft	Nm 60



AR05.20-G-6292CH	Remove/install camshaft	21.7.04
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MODEL 000.001 with ENGINE 457.960



G05.20-3108-09

- |     |                   |   |                 |
|-----|-------------------|---|-----------------|
| 1   | Camshaft          | 4 | Guide sleeve    |
| 1.1 | Camshaft sprocket | 5 | Crankshaft gear |
| 2   | Roller tappet     | 6 | Push rod        |
| 3   | Oil spray nozzle  |   |                 |

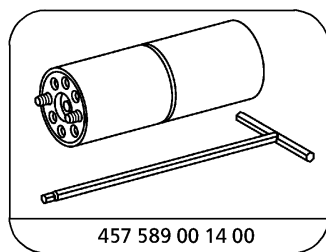
	Removal, installation		
1	Attach engine to engine assembly bracket	 	WE58.40-Z-1001-11A WE58.40-Z-1015-11A
2	Remove camshaft sprocket (1.1)		<b>Page 109</b>
3	Remove timing case		AR01.60-G-8200C
4	Remove MR/PLD unit pumps		<b>Page 135</b>
5	Remove rocker arms assembly		<b>Page 105</b>
6	Pull out push rods (6)	Installation: Oil push rods (6) with engine oil and check whether roller tappets (2) are seated correctly	
7	Turn engine in engine assembly support	Turn engine approx. 180° so that roller tappets (2) loosen from camshaft (1)  	WE58.40-Z-1001-11A WE58.40-Z-1015-11A
8	Tighten guide sleeve (4) to camshaft (1) at front		457 589 00 14 00
9	Pull out camshaft (1)	Carefully pull camshaft (1) out of crankcase to prevent damaging camshaft bearing	



		<p>ⓘ Installation: Carefully slide camshaft (1) into crankcase with guide sleeve (4) to prevent damaging camshaft bearing The marked tooth on the crankshaft gear (5) should be located between the teeth also marked (arrow B) on the camshaft sprockets (1.1), otherwise the engine can be damaged</p>	
10	Press roller tappets (2) out of crankcase with push rod (6)	<p>ⓘ Mark roller tappets (2) to crankcase</p> <p>ⓘ Installation: Oil roller tappets (2) with engine oil and slide in. While doing this observe groove in crankcase.</p>	
◀	<b>Test</b>		
11	Remove and check oil spray nozzles (3) for camshaft lubrication	<p>ⓘ If necessary replace oil spray nozzles (3) if damaged</p> <p>ⓘ Installation: Observe installation of dowel pin (arrow) on oil spray nozzles (3)</p> <p>Nm</p>	BA18.00-N-1002-011
12	Check roller tappets (2)	<p>ⓘ If damaged or worn: ↓ Replace roller tappets (2)</p>	
13	Check camshaft (1)	<p>ⓘ If damaged or worn: ↓ Replace camshaft (1)</p>	
14	Check push rods (5)	<p>ⓘ For this purpose roll off push rods (5) on even subsurface if bent or damaged: ↓ Replace push rods (5)</p>	
15	Reinstall in opposite order		

**Nm** Engine lubrication, engine oil cooling, general

Number	Designation	Engine 457.960
BA18.00-N-1002-011	Banjo bolt for oil spray nozzle (camshaft lubrication) on crankcase	Nm 20




Guide sleeve

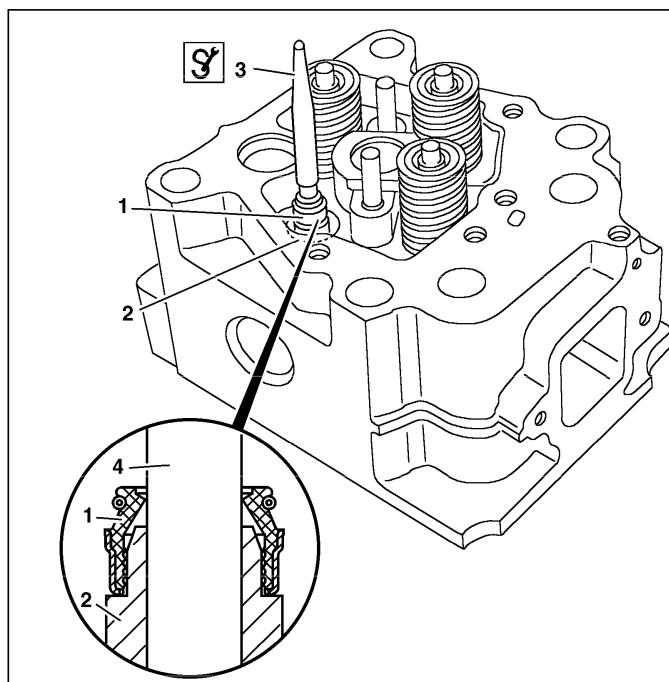
**Workshop equipment/MB testers (see workshop equipment manual)**

WE58.40-Z-1001-11A	Engine assembly bracket
WE58.40-Z-1015-11A	Engine support, Erwin Schairer GmbH, Apparatebau; Keltenstrasse 9 D-72469 Meßstetten; MSW / R6 457









AR05.30-G-3510CH	Replace valve stem seals	18.6.04
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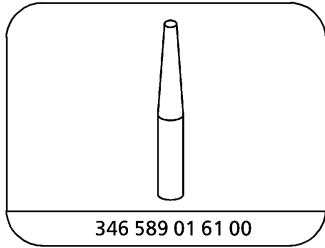
MODEL 000.001 with ENGINE 457.960

- 1 Valve stem seals
- 2 Valve guide
- 3  Sleeve
- 4 Valve stem

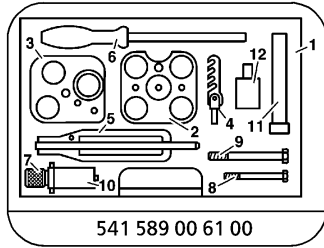


W05.30-0041-12

	<b>Removal</b>		
1	Remove cylinder head		<b>Page 23</b>
2	Remove valve spring		<b>Page 114</b> 541 589 00 61 00
3	Pull valves out of cylinder head	 Mark valves	
4	Remove valve stem seals (1)		
5	Check whether valves can be reused		
	<b>Installation</b>		
6	Oil valve stems (4) with engine oil		
7	Insert valves into cylinder head	 Observe marking on valves	
8	Slide sleeve (3) over valve stem (4) to stop on valve guide (2)		346 589 01 61 00
9	Press new valve stem seal (1) over sleeve (3) onto valve guide (2)		
10	Remove sleeve (3)		346 589 01 61 00
11	Install valve springs		<b>Page 114</b> 541 589 00 61 00
12	Install cylinder head		<b>Page 23</b>

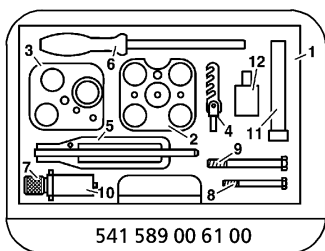


Sleeve



Valve tool kit

AR05.30-G-3510-03CH	Remove/install valve springs		
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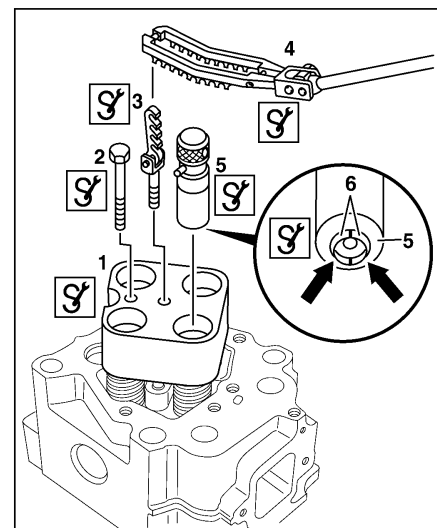


Valve tool kit






Removal

**i** Repeat steps 1 to 12 for all valve springs









- 1 Lay cylinder head down on even subsurface
- 2 Position assembly cartridge guide (1) over valve spring assembly and screw onto cylinder head with bolt (2)
- 3 Screw grid element (3) into assembly cartridge guide (1)
- 4 Fold out lever handle on thrust fork (4) and secure with bolts
- 5 Insert assembly cartridge (5) into guide bushing for assembly cartridge guide (1), hook thrust fork (4) into screen section (3) and position on support bolt on assembly cartridge
- 6 Apply slight pressure to thrust fork (4) and assembly cartridge (5), simultaneously slowly turn knurled bolt for assembly cartridge (5) to right until inner gap tips arrest perceptively between cone elements
- 7 Press thrust fork (4) down to stop (if necessary use extension) and simultaneously press down knurled bolt for assembly cartridge (5) The cone elements are removed automatically  
**i** During this procedure the cone elements are pressed into the assembly cartridge (5) and are held by the latter (arrows)

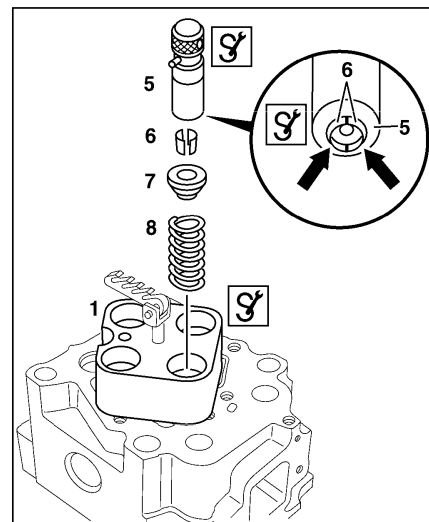


G05.30-3111-02

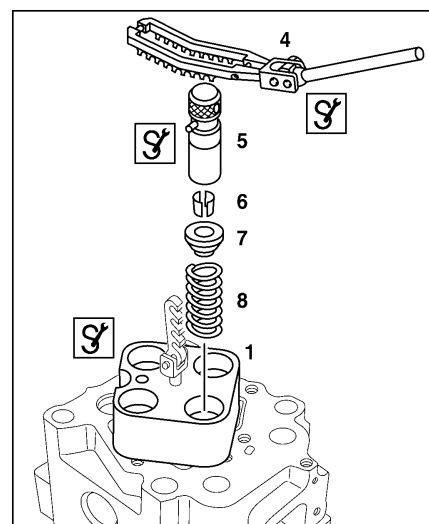
- 8 Carefully release tension on valve spring with  thrust fork (4) and remove  thrust fork (4)
- 9  Remove assembly cartridge (5) with removed cone elements (6) from  assembly cartridge guide
- 10 Pull knurled bolt out of  assembly cartridge (5) and remove cone elements (6)
- 11 Remove valve spring plate (7) and valve spring (8)
- 12 Check valve spring plate (7) and cone elements (6) for wear, replace if necessary

Installation

- 13 Pull knurled bolt out of assembly cartridge (5) and insert cone elements (6) into guide Slowly relieve tension on knurled bolt
  -  Observe installation position of cone elements (6) in relation to inner gap tips (arrows)
- 14 Insert valve spring (8) and valve spring plate (7) into  assembly cartridge guide
- 15  Position assembly cartridge (5) on valve spring plate (7) with cone elements (6) installed and press valve spring (8) together with  thrust fork (4), simultaneously pull up knurled bolt on  assembly cartridge until cone elements (6) fall downward and catch in the groove in the valve stem.
- 16 Slowly release tension on valve spring (8) and remove  assembly cartridge (5) upward from  assembly cartridge guide
-  Repeat steps 13 to 16 on all valve springs
- 17 Check whether cone elements (6) arrest securely, if necessary repeat steps 5 to 8 and 14 to 16



G05.30-3112-02








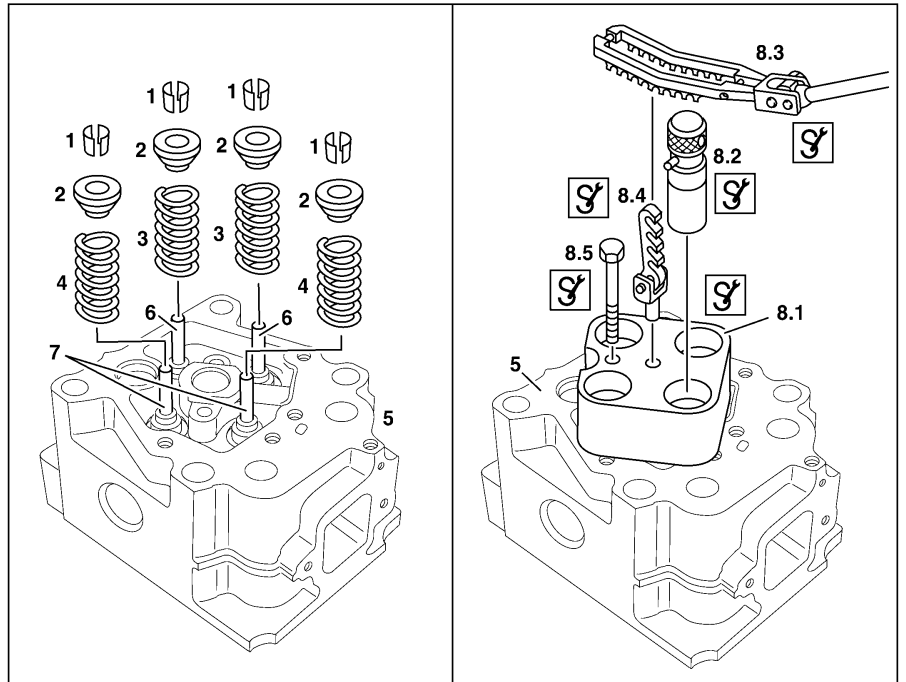
G05.30-3113-02






AR05.30-G-3511CH	Remove/install valves	18.6.04
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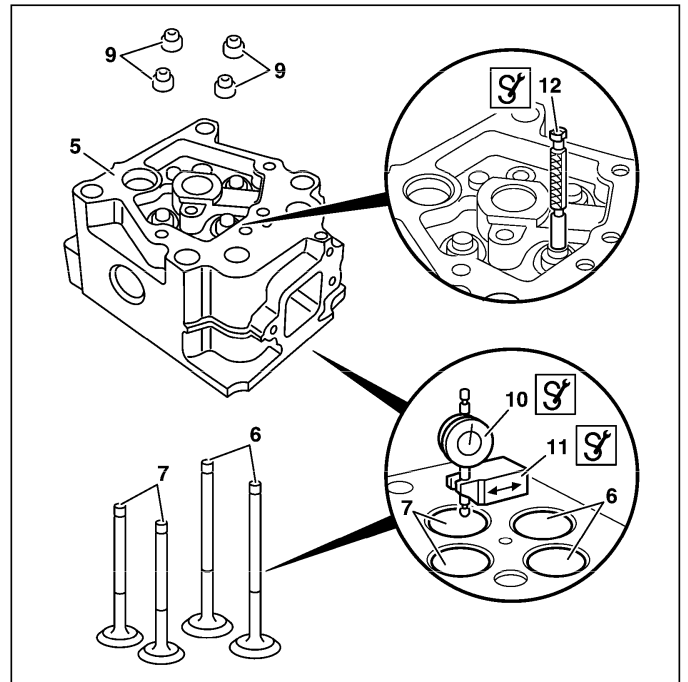
MODEL 000.001 with ENGINE 457.960

- 1 Cone element
- 2 Valve spring plate
- 3 Valve spring intake
- 4 Valve spring exhaust
- 5 Cylinder head
- 6 Intake valves
- 7 Exhaust valves
- 8.1  Assembly cartridge guide
- 8.2  Assembly cartridge
- 8.3  Thrust fork
- 8.4  Screen section
- 8.5  Bolt




G05.30-3110-06

- 5 Cylinder head
- 6 Intake valves
- 7 Exhaust valves
- 9 Valve stem seals
- 10  Dial indicator
- 11  Dial indicator holder
- 12  Measuring punch



A05.30-0003-12

	<b>Removal, installation</b>		
1	Remove cylinder head (5)		<b>Page 23</b>
2	Remove nozzle holder combination		<b>Page 127</b>
3	Measure valve setback in relation to cylinder head separating surface with dial indicator (10) and dial indicator holder (11)	<b>i</b> If the reading is not within the permissible tolerance, replace cylinder head (5).	<b>Page 32</b>

BE05.30-N-1003-01M

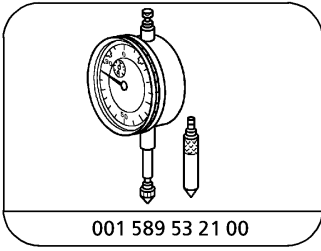
			001 589 53 21 00
			343 589 00 40 00
4	Remove cone element elements (1), valve spring plate (2) and valve springs (3, 4)		<b>Page 114</b> 541 589 00 61 00
5	Remove valve stem seals (9)	<b>Installation:</b> Install new valve stem seals (9)	<b>Page 113</b>
6	Remove valves (6, 7) from cylinder head (5)	Mark valves (6, 7) <b>Installation:</b> Oil valve stem with engine oil	
	<b>Test</b>		
7	Check valve guides for wear		BE05.30-N-1003-02M 117 589 03 23 00
8	Check whether valves (6, 7) can be used continuously	The valve stem ends should not be damaged on the surface The valve wedge grooves should not be worn out and the chrome-plating on the valve stem should not be damaged The valve seats should not be burned. It is not permissible to grind the intake valves with abrasive paste. If complaint is present, replace intake valves (6)	
9	Check intake and exhaust valve seat rings	If intake and exhaust valve seat rings are worn, replace cylinder head (5).	
10	Check valve springs (3 or 4)		
11	Reinstall in opposite order		

Test values for valves

Number	Designation	Engine 457.960	
BE05.30-N-1003-01M	Valve setback in relation to cylinder head separating surfaces	New condition	mm 0.7...1.1
		Permissible value	mm -

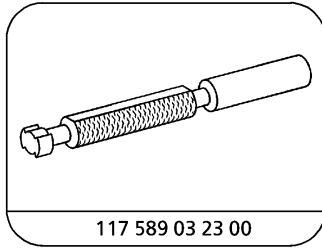
Test values for valve guides

Number	Designation	Engine 457.960	
BE05.30-N-1003-02M	Inner diameter (B) pressed in	Standard	mm 9.000...9.022
		Wear limit	mm 9.050



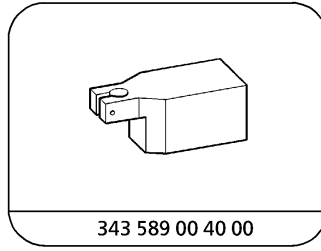
001 589 53 21 00

Dial indicator



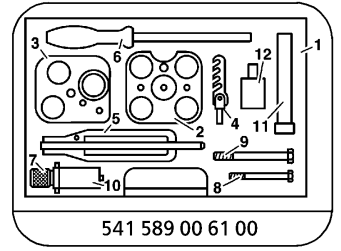
117 589 03 23 00

Punch



343 589 00 40 00

Dial indicator holder



541 589 00 61 00

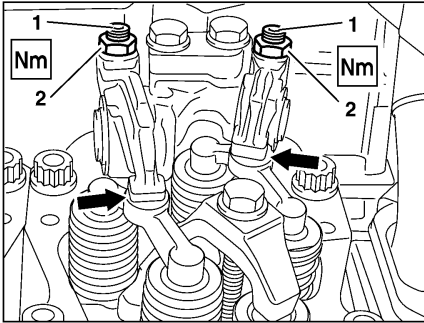
Valve tool kit



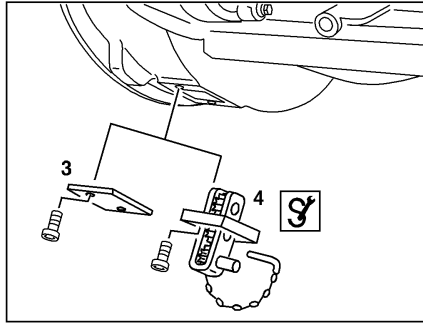


AP05.30-G-0560CH	Set valve clearance	12.7.04
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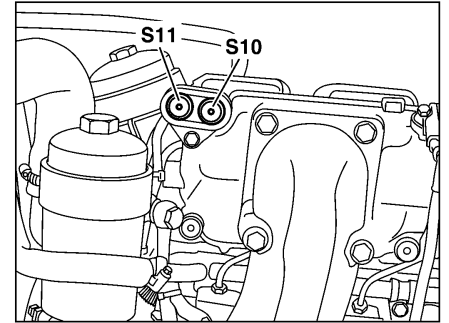
ENGINE 457.960 in MODEL 000.001



G05.30-3114-01



N03.30-0313-01








N01.00-2325-01

- 1 Adjustment screw
- 2 Lock nut

- 3 Cap
- 4 Cranking/blocking device

- S10 Engine start pushbutton switch
- S11 Engine stop pushbutton switch

1	Remove cylinder head covers	<b>i</b> Check and adjust valve clearance with engine cold, wait at least 30 min after shutting off engine, even after short operation, to ensure uniform heatup in the parts	
<b>AR</b>	Remove cylinder head cover		<b>Page 15</b>
2	Select method for adjusting valve clearance	<b>i</b> Adjust according to injection sequence: ↓ Engine 457, 900, 902, 904, 906, 924, 926 Method 1	<b>Page 123</b>
<b>i</b>	General information on adjusting valve clearance	<b>i</b> Setting in two positions of crankshaft: ↓ Engine 457, 900, 902, 904, 906, 924, 926 Method 2	<b>Page 124</b>
<b>i</b>	General information on adjusting valve clearance		
3		Only with mechanical valve clearance adjustment using Method 2 or when cranking engine with cranking device (4).	
4.1	Remove cap (3) and attach cranking/blocking device (4) for observation hole in timing case	Only when cranking the engine with the cranking/blocking device (4).	
<b>AR</b>	Attach, detach cranking/blocking device for engine		<b>Page 5</b>
		<b>Nm</b> <b>S</b>	BA01.60-N-1001-01K 904 589 04 63 00
4.2	Press engine stop pushbutton switch (S11) and hold down, then press engine start pushbutton switch (S10) in addition and move engine to crankshaft position for selected adjustment method	Only when cranking engine with starter.	
		<b>i</b> The engine does not start when the start engine pushbutton switch and stop engine pushbutton switch are (S10) pressed at the same time (S11).	
5	Move engine into the crankshaft position of the selected setting method		

6	Inspect valve clearance (arrows) and set	 The inspection tolerance of the valve clearance applies only to the inspection, not to the setting  	<p style="text-align: right;"><b>Page 124</b></p> BE05.30-N-1001-01M BE05.30-N-1002-01M BA05.00-N-1002-01K WH58.30-Z-1046-12B
7	Remove cranking/blocking device (4) and attach cap (3) for observation hole in timing case  Attach, detach cranking/blocking device for engine	Only with mechanical valve clearance adjustment using Method 2, or when cranking engine with cranking/blocking device (4).   	<p style="text-align: right;"><b>Page 5</b></p> BA01.60-N-1001-01K 904 589 04 63 00
8	Install cylinder head covers Install cylinder head cover		<p style="text-align: right;"><b>Page 15</b></p>

Test values for valves

Number	Designation	Engine 457.960	
BE05.30-N-1001-01M	Valve clearance	Inlet	mm 0.40
		Outlet	mm 0.60
BE05.30-N-1002-01M	Inspection tolerance of valve clearance	mm	-0.10/ + 0.20

 Crankcase ventilation, cylinder head cover

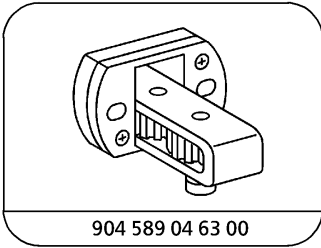
Number	Designation	Engine 457.960	
BA01.20-N-1001-01L	Bolt of light alloy cylinder head cover to cylinder head	Nm	25
BA01.20-N-1002-01L	Bolt of plastic cylinder head cover to cylinder head	Nm	20

 Timing case

Number	Designation	Engine 457.960	
BA01.60-N-1001-01K	Bolt of end cover of inspection hole to timing case	Nm	25

 Engine control - general

Number	Designation	Engine 457.960	
BA05.00-N-1002-01K	Locknut at adjusting bolt of rocker arm	Nm	50



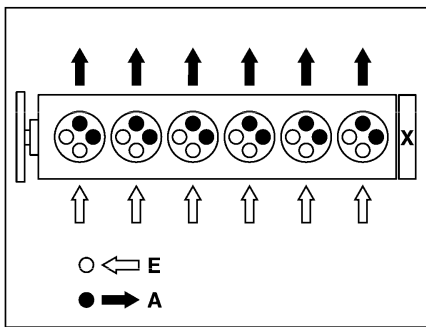
904 589 04 63 00

Cranking device

Commercially available tools (see Workshop Equipment Manual)

Number	Designation	Make (e. g.)	Order number
WH58.30-Z-1046-12B	Feeler gauge	Boos GmbH Industrie- und Werkstattausrüstung Im Lippfeld 9a D-46047 Oberhausen	804.P

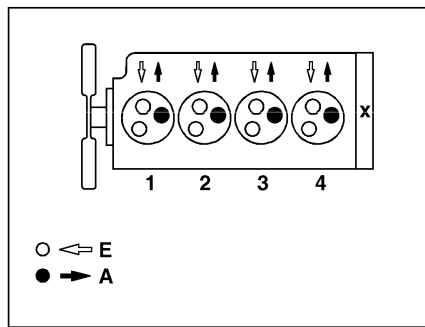
AH05.30-N-1000-01C	General information on adjusting valve clearance	Engine 457.9, 900.9, 902.9, 904.9, 906.9, 924.9, 926.9 Method 1	
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A01.00-0001-01

**Engine 457.9**

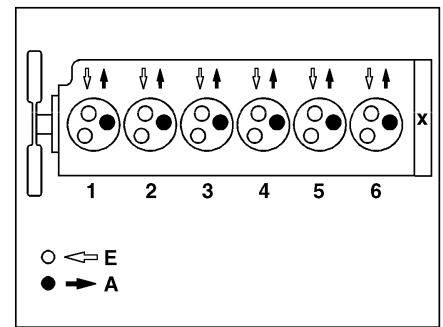
- A Outlet valve
- E Inlet valve
- X Flywheel side



N01.00-0347-01

**Engines 900.9, 904.9, 924.9**

- A Outlet valve
- E Inlet valve
- X Flywheel side



N01.00-0348-01

**Engines 902.9, 906.9, 926.9**

- A Outlet valve
- E Inlet valve
- X Flywheel side

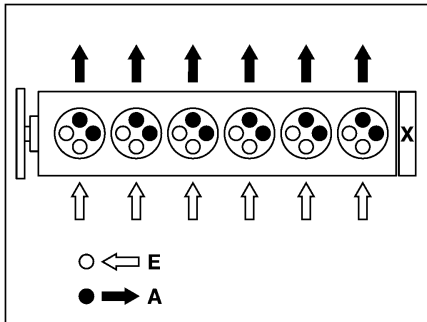
**Method 1:**

Set inlet and exhaust valves for each cylinder, according to firing order.

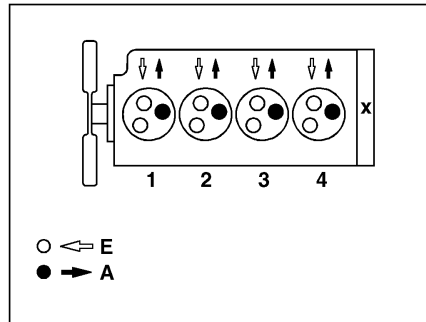
The cylinder to be set must be at ignition TDC, the synchronized cylinder at overlap TDC.

Motor	Crankshaft position	Cylinder/injection order
4-cylinder	Ignition TDC	1 3 4 2
	Overlap TDC	4 2 1 3
6-cylinder	Ignition TDC	1 5 3 6 2 4
	Overlap TDC	6 2 4 1 5 3

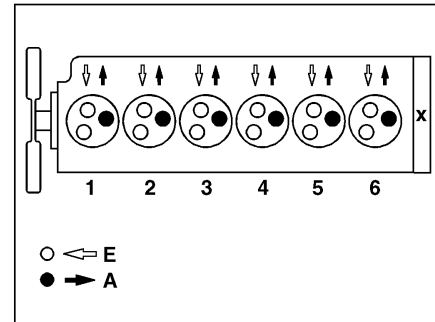
AH05.30-N-1000-01D	General information on adjusting valve clearance	Engine 457.9, 900.9, 902.9, 904.9, 906.9, 924.9, 926.9 Method 2	
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A01.00-0001-01



N01.00-0347-01



N01.00-0348-01

**Engine 457.9**

- A Outlet valve
- E Inlet valve
- X Flywheel side

**Engines 900.9, 904.9, 924.9**

- A Outlet valve
- E Inlet valve
- X Flywheel side

**Engines 902.9, 906.9, 926.9**

- A Outlet valve
- E Inlet valve
- X Flywheel side

**Method 2:**

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

**4-cylinder**

Position cylinder 4 in the valve overlap TDC (cylinder 1 in ignition TDC), then position cylinder 1 in valve overlap TDC (cylinder 4 in ignition TDC).

**6-cylinder**

Position cylinder 6 in the valve overlap TDC (cylinder 1 in ignition TDC), then position cylinder 1 in valve overlap TDC (cylinder 6 in ignition TDC).

Motor	Crankshaft position	Cylinder/valves to be set					
		1	2	3	4	5	6
4-cylinder	Cyl. 4 valve overlap TDC	E/A	E	A	-		
	Cyl. 1 valve overlap TDC	-	A	E	E/A		
6-cylinder	Cyl. 6 valve overlap TDC	E/A	E	A	E	A	-
	Cyl. 1 valve overlap TDC	-	A	E	A	E	E/A

AP05.30-G-0560-01CH	Check and adjust valve clearance		
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**Test values for valves**






Number	Designation	Engine 457.960	
BE05.30-N-1001-01M	Valve clearance	Inlet	mm 0,40
		Outlet	mm 0,60
BE05.30-N-1002-01M	Inspection tolerance of valve clearance	mm	-0.10/ + 0.20

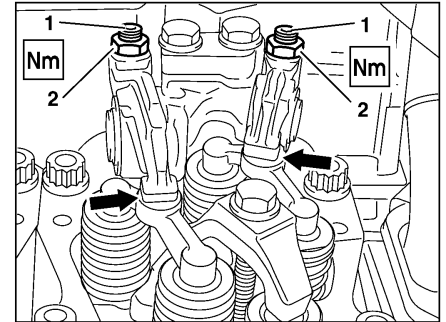
**Engine timing - general**

Number	Designation	Engine 457.960	
BA05.00-N-1002-01K	Locknut at adjusting bolt of rocker arm	Nm	50

## Commercially available tools (see Workshop Equipment Manual)

Number	Designation	Make (e. g.)	Order number
WH58.30-Z-1046-12B	Feeler gauge	Boos GmbH Industrie- und Werkstattausrüstung Im Lippfeld 9a D-46047 Oberhausen	804.P

- 1 Check valve clearance with  feeler gauge between rocker arm and valve bridge (arrows).  
 Only for maintenance: It is not necessary to adjust the valve clearance when it is within the test tolerance.
- 2 Set valve clearance.  
 For this purpose, loosen counternut (2) and adjust the valve clearance with the adjustment screw (1).  
 Counter-hold adjusting bolt (1) and tighten locknut (2) fully.  
 Recheck valve clearance and correct if necessary.  
 The valve clearance is adjusted correctly when it is possible to pull the  feeler gauge between the rocker arm and valve bridge (arrows) with slight resistance.



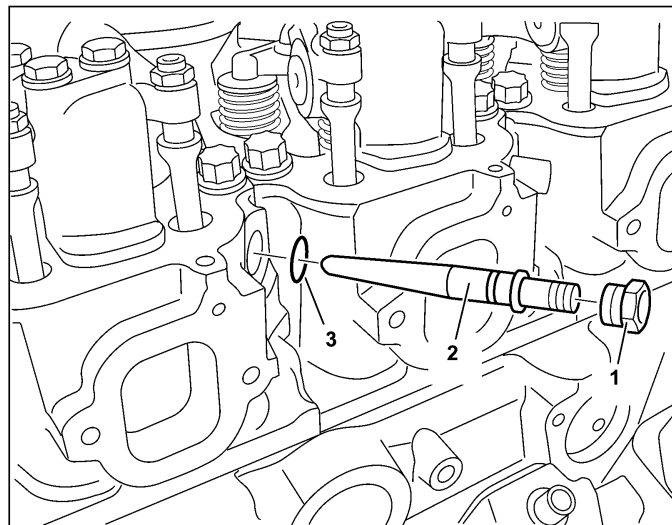
G05.30-3114-01



AR07.03-G-6831CH	Remove/install nozzle holder combination	18.6.04
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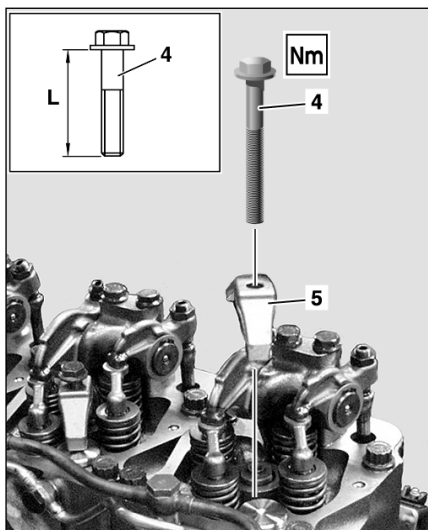
**MODEL 000.001 with ENGINE 457.960**

- 1 Pressure screw
- 2 Pressure pie connection
- 3 O-ring

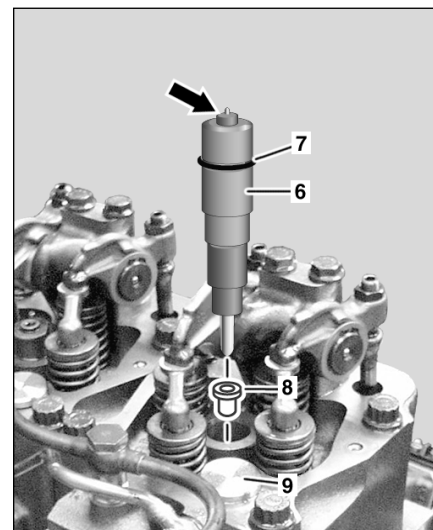


W07.03-1014-11



- 4 Bolt
  - 5 Retaining clip
  - 6 Nozzle holder assembly
  - 7 O-ring
  - 8 Sealing sleeve
  - 9 Cap
- L Shank length

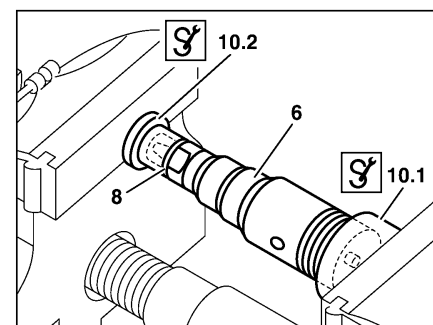


G07.03-3110-02




W07.03-1027-02




















- 6 Nozzle holder assembly
- 8 Sealing sleeve
- 10.1  Assembly tool (for nozzle holder head)
- 10.2  Assembly tool (for sealing sleeve)



W07.03-1028-01

	Removal		
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 <b>Danger!</b>	Fuel vapors present an explosion hazard. Fuel vapors are toxic when inhaled while handling open fuel. Contact with fuel can cause eye and skin injury	Fire, open lights and smoking prohibited. Avoid sparks. Fill and store fuel only in containers intended and marked for this purpose. Wear protective clothing when handling fuel.	<b>Page 27</b>
1	Remove charge air manifold		<b>Page 153</b>
2	Remove cylinder head cover		<b>Page 15</b>
3	Removal		<b>Page 139</b>
4	Unscrew pressure bolt (1) and remove pressure pipe connections (2)		
5	Remove retaining clip (5)		
6	Install threaded insert with extractor on nozzle holder assembly (6) (arrow)	 	355 589 01 63 00 904 589 00 63 00
7	Remove nozzle holder assembly (6) with extractor	 Do not disassemble nozzle holder assembly (6) 	355 589 01 63 00
8	Remove threaded insert and extractor from nozzle holder assembly (6)	 	355 589 01 63 00 904 589 00 63 00
9	Remove sealing sleeve (8) from nozzle holder assembly (6)	 Only when reinstalling used nozzle holder assembly (6).	
10	Remove sealing sleeve (8) from cylinder head	 Only when sealing sleeve (8) seized in cylinder head  	355 589 01 63 00 906 589 02 63 00
11	Clean nozzle holder assembly (6) for combustion residues and perform visual inspection	 Only when reinstalling used nozzle holder assembly (6). Clean contact surface of sealing sleeve (8) with brass brush  If complaint is present: ↓ Clean hole nozzle and contact surface for nozzle holder assembly (6) with ultrasonic nozzle cleaning equipment.  If wear is present: ↓ Always replace nozzle holder assembly (6).	<b>Page 131</b>
	<b>Installation</b>		
12	Measure shank length (L) of bolt (4)	 If max. shank length (L) is exceeded, replace bolt (4)	BE07.03-N-1002-01K
13	Insert new O-ring (7) into nozzle holder assembly (6)	 Only when reinstalling used nozzle holder assembly (6).	
14	Lightly coat O-ring (7) with high-temperature bearing grease		BR00.45-Z-1058-06A
15	Press new sealing sleeve (8) onto nozzle holder assembly (6) with assembly tool (10.1, 10.2)	 Only when reinstalling used nozzle holder assembly (6). 	906 589 03 63 00

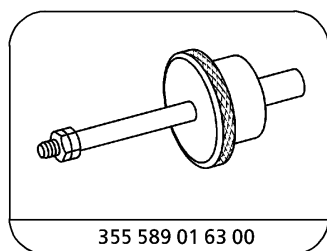
16	Install new O-ring (3) on pressure pipe connections (2)	Lightly coat O-ring (3) with high temperature bearing grease and moisten pressure pipe connections (2) in area of conical nipple with engine oil	BR00.45-Z-1058-06A
17	Install nozzle holder assembly (6) and position retaining clip (5)	Observe installation position of nozzle holder assembly (6) in relation to pressure pipe connection hole	
18	Insert pressure pipe connections (2) into cylinder head and press in until it engages in the fuel hole of the nozzle holder combination	If necessary twist nozzle holder assembly (6) under retaining clip (5) in cylinder head	
19	Tighten retaining clip (5) with bolt (4)		BA07.15-N-1006-01F
20	Install pressure pipe connections (2) and tighten with pressure bolt (1)		BA07.15-N-1004-01F
21	Install injection lines		<b>Page 139</b>
22	Install cylinder head cover		<b>Page 15</b>
23	Install charge air manifold		<b>Page 153</b>

Test and adjustment values for injection nozzles

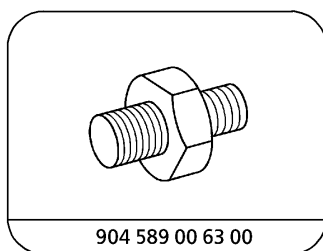
Number	Designation	Engine 457.960
BE07.03-N-1002-01K	Bolt, retaining clip on nozzle holder assembly /constant throttle to cylinder head	Shank length mm ≤91

Diesel injection system with unit pumps (MR/PLD)

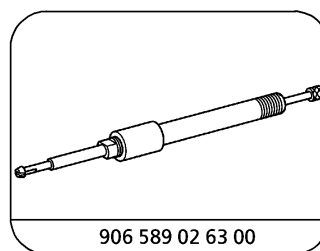
Number	Designation	Engine 457.960
BA07.15-N-1004-01F	Pressure screw, pressure pipe connections to cylinder head	Nm 40
BA07.15-N-1006-01F	Bolt, retaining clip on injection nozzle and constant throttle to cylinder head	Nm 43



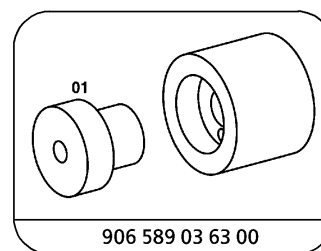
Extractor



Threaded insert



Puller tool



Assembly tool

Repair agent

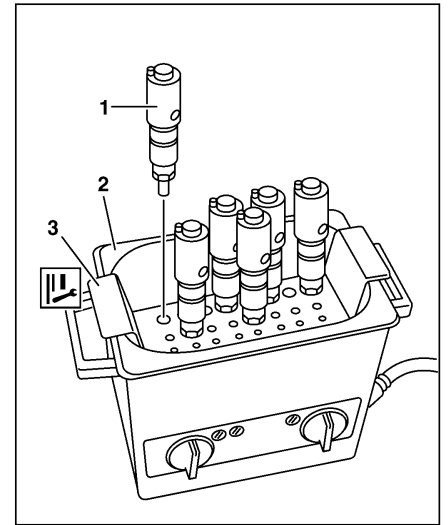
Number	Designation	Order number
BR00.45-Z-1058-06A	Hot bearing grease	A 000 989 81 51



AR07.03-G-6833CH	Clean nozzle holder combination	18.6.04
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**MODEL 000.001 with ENGINE 457.960**

- 1 Nozzle holder assembly
- 2 Ultrasonic nozzle cleaning equipment
- 3 Holed cover



G07.03-3111-02

	Cleaning		
1	Remove nozzle holder assembly (1)	<ul style="list-style-type: none"> <li>ⓘ Mark nozzle holder assembly (1) in upper area of nozzle holder to cylinder</li> </ul>	<b>Page 127</b>
2	Fill ultrasonic nozzle cleaning equipment (2) with cleaning liquid and heat up to 60 °C	<ul style="list-style-type: none"> <li>ⓘ Observe operating instructions for ultrasonic nozzle cleaning equipment (2)</li> <li>ⓘ Delude cleaning agent at a ratio of 1:2 with water (0.5 l of cleaner to 1.0 l of water). Fill tub up to marking (fill quantity approx. 1.5 l)</li> </ul>	WE58.40-Z-1001-13A BR00.45-Z-1037-04A
3	Insert holed cover (3) into ultrasonic nozzle cleaning equipment (2), position nozzle holder assembly (1) vertically in holed cover (3) and switch on ultrasonic nozzle cleaning equipment (2)	<ul style="list-style-type: none"> <li>ⓘ Install nozzle holder assembly (1) in same engine immediately (max. 3 to 4 h) following cleaning, otherwise the nozzle holder assembly (1) can be damaged by corrosion (nozzle needle sticks). This can lead to damage when starting the engine</li> <li>ⓘ Observe manufacturer's safety notes.</li> </ul>	WH58.30-Z-1017-20A WE58.40-Z-1001-13A
4	Install nozzle holder assembly (1)	<ul style="list-style-type: none"> <li>ⓘ Observe markings on nozzle holder</li> </ul>	<b>Page 127</b>
⚠ <b>Danger!</b>	<b>Accident hazard</b> resulting from vehicle starting to move by itself with engine running. <b>Injury hazard</b> resulting from pinching and burning when reaching in during the starting operation or with the engine running.	<p>Secure vehicle against starting to move unintentionally. Wear tightly fitting work clothes. Do not reach into hot or rotating parts</p>	<b>Page 9</b>
5	Crank the engine immediately after installing nozzle holder assembly (1), bleed fuel system and allow engine to run.	<ul style="list-style-type: none"> <li>ⓘ Fuel system bleeds by itself</li> </ul>	

**Commercially available tools** (see workshop equipment manual)

Number	Designation	Company (e.g.)	Order number
WH58.30-Z-1017-20A	DE 822 holed cover for ultrasonic nozzle cleaning equipment	Bandelin elektronik GmbH & Co KG D-12171 Berlin Postfach 450160	Item No. 343

**Workshop equipment/MB testers** (see workshop equipment manual)

WE58.40-Z-1001-13A	Ultrasonic nozzle cleaning equipment, SONOREX SUPER RK 100 SH
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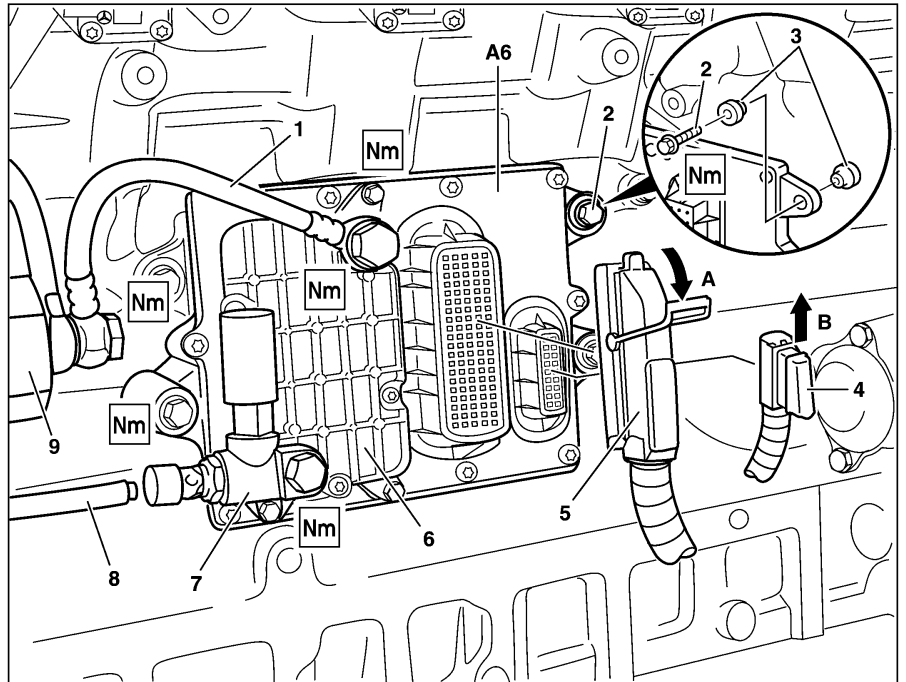
**Repair agent**

Number	Designation	Order number
BR00.45-Z-1037-04A	Cleaning agent, e.g. P3 Neuproton 5032	Bandelin elektronik GmbH & Co KG D-12171 Berlin Postfach 450160

AR07.15-G-1628CH	Remove/install MR/PLD control unit	4.11.05
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


MODEL 000.001 with ENGINE 457.960


- 1 Fuel intake line
  - 2 Bolt
  - 3 Rubber damper
  - 4 Vehicle wiring harness connector
  - 5 Engine wiring harness connector
  - 6 Fuel heat exchanger
  - 7 Manual fuel feed pump
  - 8 Fuel feed line
  - 9 Fuel pump
- A6 MR/PLD control unit



G07.15-3149-06

	Remove/install		
<b>Danger!</b>	<b>Risk of accident</b> caused by vehicle starting off by itself when engine is running. <b>Risk of injury</b> caused by contusions and burns during starting procedure or when working near the running engine	Secure vehicle to prevent it from moving by itself. Wear closed and snug-fitting work clothes. Do not grasp hot or rotating parts.	<b>Page 9</b>
<b>Danger!</b>	<b>Risk of explosion</b> caused by ignition of flammable products, <b>risk of poisoning</b> caused by inhaling fuel vapors or swallowing fuel as well as <b>risk of injury</b> to skin and eyes exposed to fuel.	No fire, sparks, open flames or smoking. Pour fuels only into suitable and appropriately marked containers. Wear protective clothing when handling fuel.	<b>Page 27</b>
1	In the "MR" menu of STAR DIAGNOSIS, read out and note the parameter data for the MR/PLD control unit (A6)	Only when replacing MR/PLD control unit (A6)  Installation: In the "MR" menu of STAR DIAGNOSIS, enter the parameter data noted into the new MR/PLD control unit (A6).	WE58.40-Z-1014-06A
2	Pull oil dipstick guide tube with grommet out of bracket		
3	Remove fuel feed line (8) from manual fuel feed pump (7)	Press clips together and pull out fuel feed line (8) Collect escaping fuel.	
4	Remove fuel intake line (1) on fuel heat exchanger (6) and on fuel pump (9)	Collect escaping fuel.  Installation: Replace sealing rings.  Nm Nm	BA47.25-N-1007-01L BA47.25-N-1009-01L

5	Remove vehicle wiring harness connector (4) from MR/PLD control unit (A6)	 For this step push the locking element upwards (arrow B) and release the connector of the vehicle wiring harness (4).	
6	Remove engine wiring harness connector (5) from MR/PLD control unit (A6)	 For this step swivel locking clamp downwards (arrow B) and release the connector of the engine wiring harness (5).	
7	Unscrew bolt (2)		BA07.15-N-1002-01F
8	Remove MR/PLD control unit (A6) with rubber dampers (3) and remove upward		
9	Remove fuel heat exchanger (6) with manual fuel feed pump (7) from the MR/PLD control unit (A6)	 Only when replacing MR/PLD control unit (A6) 	BA07.15-N-1001-01F
10	Install in the reverse order		
11	Start the engine and bleed the fuel system	 The fuel system is bled automatically.	
12	Turn off engine		

 Diesel injection system with unit pumps (MR/PLD)

Number	Designation		Engine 457.960
BA07.15-N-1001-01F	Bolt connecting fuel heat exchanger to MR/PLD control unit	Nm	8
BA07.15-N-1002-01F	Bolt connecting MR/PLD control unit to crankcase	Nm	12

 Fuel pipes/hoses

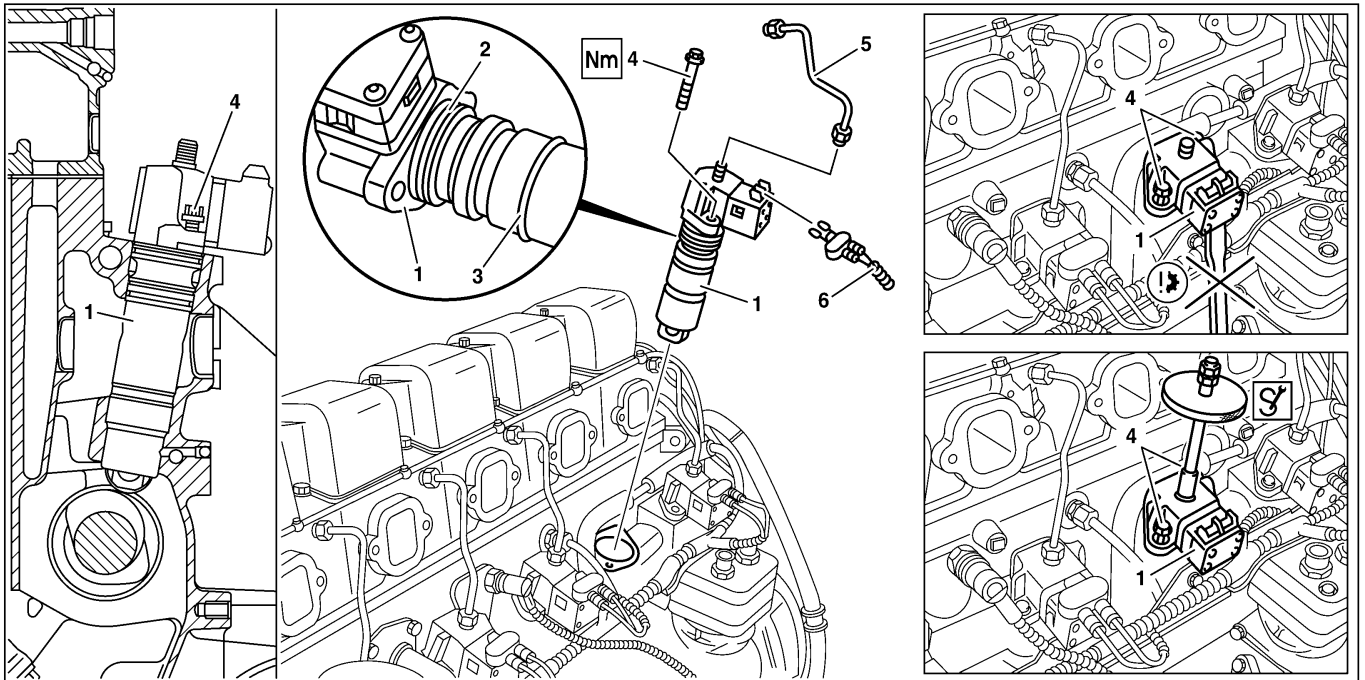
Number	Designation		Engine 457.960
BA47.25-N-1007-01L	Banjo bolt connecting fuel intake line to fuel pump	Nm	50
BA47.25-N-1009-01L	Banjo bolt connecting fuel line to fuel heat exchanger	Nm	50

## Workshop equipment/MB testers (see Workshop Equipment Manual)

WE58.40-Z-1014-06A	STAR DIAGNOSIS compact system, commercial vehicle, order number 6511 3110 00
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
AR07.15-G-8950CH	Remove MR/PLD unit pump, install	4.11.05
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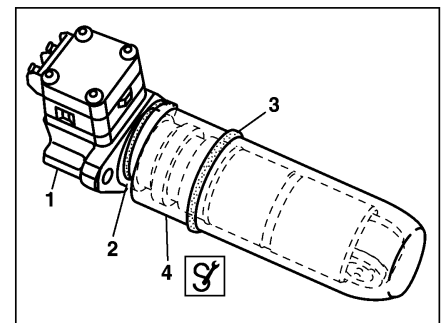
MODEL 000.001 with ENGINE 457.960



W07.15-1108-09

- |                    |                  |                         |
|--------------------|------------------|-------------------------|
| 1 MR/PLD unit pump | 3 O-ring (green) | 5 Injection line        |
| 2 O-ring (black)   | 4 Serrated bolt  | 6 Engine wiring harness |

- 1 MR/PLD unit pump
- 2 O-ring (black)
- 3 O-ring (green)
- 4  Protective sleeve




















W07.15-1107-01



- 1 MR/PLD unit pump
- Arrow: Bar code



T07.15-0007-02

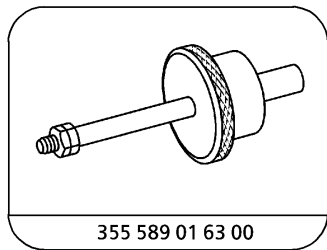


	Remove/install		
 <b>Danger!</b>	<b>Risk of injury to skin and eyes caused by scalding from contact with hot coolant spray. Risk of poisoning from swallowing coolant.</b>	Do not open cooling system unless coolant temperature is below 90°C. Open cap slowly and release the pressure. Do not pour coolant into beverage containers. Wear protective gloves, protective clothing and safety glasses.	<b>Page 26</b>
1	Drain and collect coolant	<p> Only when removing the MR/PLD unit pumps (1) from cylinders 1 to 3.</p> <p> <b>Installation:</b> In line with the coolant regulations, only approved anticorrosion/antifrost agents may be used otherwise engine damage may occur. The following should be observed:</p> <p style="text-align: center;">↓</p>	
 <b>BB</b>	Coolant specifications	Sheet 310.1	BB00.40-P-0310-01A
 <b>BB</b>	Anticorrosion/antifreeze agent	Sheet 325.2	BB00.40-P-0325-02A
2	Detach coolant pipe at crankcase	 Only when removing the MR/PLD unit pumps (1) from cylinders 1 to 3.	
3	Remove charge air manifold		<b>Page 153</b>
 <b>Danger!</b>	<b>Risk of explosion caused by fuel igniting, risk of poisoning caused by inhaling and swallowing fuel as well as risk of injury to eyes and skin caused by contact with fuel.</b>	No fire, sparks, open flames or smoking. Pour fuels only into suitable and appropriately marked containers. Wear protective clothing when handling fuel.	<b>Page 27</b>
4	Remove injection line (5)	 Seal holes at nozzle holder combination and at MR/PLD unit pump (1).	<b>Page 139</b>
5	Take off engine wiring harness (6) at MR/PLD unit pump (1)	 Loosen bolts at solenoid valve and separate both push-fit clips for this step.	
6	Mark MR/PLD unit pump (1) to the relevant cylinder	 Only when removing several or all MR/PLD unit pumps (1).	
7	Loosen bolts (4)	<p> For safety reasons, the bolts (4) must be loosened by around 4 to 5mm only and the MR/PLD unit pump unit (1) tensioned by spring force.</p> <p> <b>Installation:</b> Install MR/PLD unit pump (1) by slowly and alternately screwing bolt (4) into crankcase</p> <p></p>	BA07.15-N-1005-01F
8	Pull MR/PLD unit pump (1) with extractor to stop on bolt heads (4)	<p> Tight MR/PLD unit pumps (1) must not be pressed out at the solenoid valve or at the housing flange, otherwise damage may occur to the MR/PLD unit pumps (1).</p> <p></p>	355 589 01 63 00
9	Completely unscrew bolt (4) and pull out MR/PLD unit pump (1)	 <b>Installation:</b> Lightly grease housing of MR/PLD unit pump (1), surface of black O-rings (2), green O-ring (3) as well as holes in crankcase with high temperature bearing grease. Insert the MR/PLD unit pump (1) with the self-made assembly pins into the crankcase.	BR00.45-Z-1058-06A

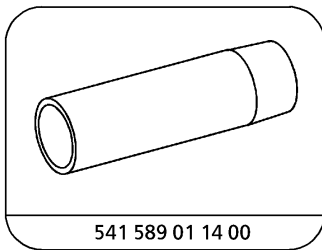
 <b>WF</b>	Assembly pins for installing unit pump	<p><b>i</b> <b>Installation:</b> Before pressing on the MR/PLD unit pump (1), ensure that the fuel feed pipe and the overflow hole are positioned one above the other. Carefully press in MR/PLD unit pump (1) against the force of the spring until a clearance of approx. 4 mm. If the unit pump cams at the camshaft are at the top and it is not possible to press in the MR/PLD unit pump (1) far enough as a result, continue to turn the crankcase by approx. half a revolution in the direction of rotation.</p>	WF58.50-W-0715-01A
10	Check the MR/PLD unit pump (1) for score marks, scratches and worn points.	<p><b>i</b> If only minimal scores or scratches are present at the roller of the roller tappet, the MR/PLD unit pump (1) can continue to be used. If deep scoring, scratches or sanding spots are present: ↓ Replace MR/PLD unit pump (1) <b>i</b> <b>Installation:</b> Carefully remove paint and paint remains from the sealing surface of the MR/PLD unit pump (1) and the crankcase.</p>	
11	Remove black O-ring (2) and green O-ring (3) from MR/PLD unit pump (1)	<p><b>⚠</b> <b>Installation:</b> Do not install black O-ring (2) and green O-ring (3) with a twist in order to prevent tearing. <b>i</b> <b>Installation:</b> Clean radial groove on housing of MR/PLD unit pump (1) Replace O-rings (2, 3,) and coat with high-temperature grease. Slide sleeve (8) over the body of the unit pump. First roll the black O-ring (2) over the sleeve (8) into the groove, then roll the green O-ring (3) into the groove. Then remove the sleeve (9). </p>	541 589 01 14 00 BR00.45-Z-1058-06A
12	Install in the reverse order	<p><b>i</b> <b>Installation:</b> At the time of installing new MR/PLD unit pumps (1), note the barcode (arrow) of the MR/PLD unit pump (1) to the respective cylinder.</p>	
13	Teach in the barcode (arrow) of the MR/PLD unit pump (1) with STAR DIAGNOSIS	<p><b>i</b> Only when installing new MR/PLD unit pumps (1).</p>	WE58.40-Z-1014-06A

**Nm** Diesel injection system with unit pumps (MR/PLD)

Number	Designation	Engine 457.960
BA07.15-N-1005-01F	Bolt connecting MR/PLD unit pump to crankcase	Nm 60



Impact extractor



Sleeve

**Workshop equipment/MB testers (see Workshop Equipment Manual)**

WE58.40-Z-1014-06A	STAR DIAGNOSIS compact system, commercial vehicle, order number 6511 3110 00
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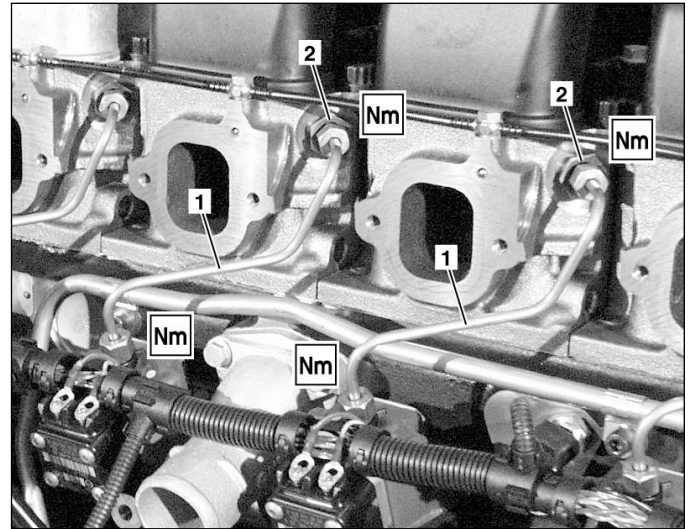
**Auxiliary repair materials**

Number	Designation	Order number
BR00.45-Z-1058-06A	Hot bearing grease	A 000 989 81 51

AR07.15-G-9235CH	Remove/install injection lines MR/PLD	30.6.04
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**MODEL 000.001 with ENGINE 457.960**

- 1 MR/PLD injection line
- 2 Pressure screw pressure pipe connections



G07.15-3148-11

☒☒	<b>Removal, installation</b>		
<p><b>⚠ Danger!</b></p> <p>Fuel vapors present an explosion hazard. Fuel vapors are toxic when inhaled while handling open fuel. Contact with fuel can cause eye and skin injury</p>	<p>Remove injection lines MR/PLD (1)</p>	<p>Fire, open lights and smoking prohibited. Avoid sparks. Fill and store fuel only in containers intended and marked for this purpose. Wear protective clothing when handling fuel.</p> <p><b>i</b> Plug holes on pressure pipe connections and MR/PLD unit pump</p> <p><b>i</b> <b>Installation:</b> Retighten pressure pipe connection pressure bolt (2) on cylinder head. Observe installation position of MR/PLD injection lines (1)</p> <p><b>Nm</b></p> <p><b>Nm</b></p>	<p><b>Page 27</b></p> <p>BA07.15-N-1003-01F</p> <p>BA07.15-N-1004-01F</p>
2	Reinstall in opposite order		

**Nm Diesel injection system with unit pumps (MR/PLD)**

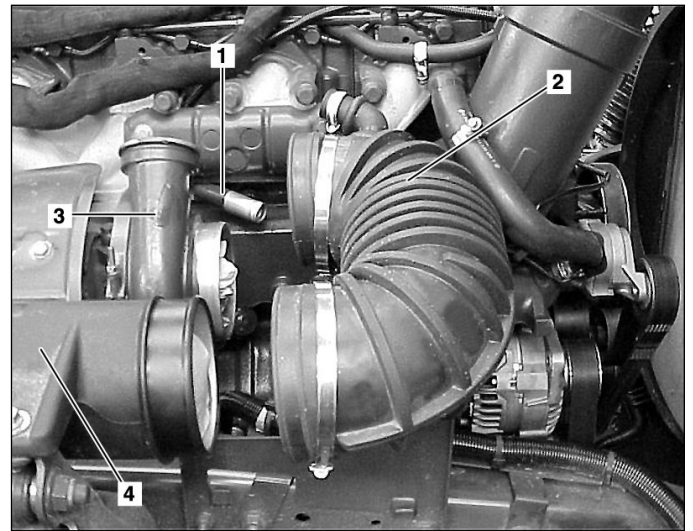
Number	Designation	Engine	457.960
BA07.15-N-1003-01F	Union nut, injection line to pressure pipe connections/unit pump	Nm	30
BA07.15-N-1004-01F	Pressure screw, pressure pipe connections to cylinder head	Nm	40






AR09.10-G-8030CH	Remove/install air intake hose	30.6.04
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**MODEL 000.001 with ENGINE 457.960**

- 1 Crankcase breather line
- 2 Air intake hose
- 3 Exhaust gas turbocharger
- 4 Air intake manifold



W09.10-1005-11

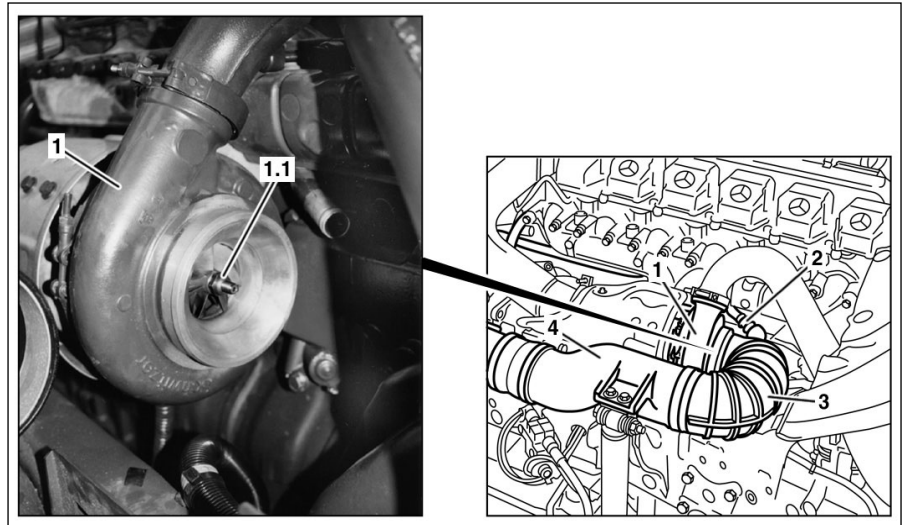
 	Removal, installation		
1	Separate crankcase breather line (1) from air intake hose (2)		
2	Remove air intake hose (2) from exhaust gas turbocharger (3) to air intake manifold (4)	 Check air intake hose (2) and hose clamps for condition, replace if necessary	
3	Reinstall in opposite order		



AR09.40-G-5910CH	Check turbocharger	5.7.04
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**MODEL 000.001 with ENGINE 457.960**

- 1 Exhaust gas turbocharger
- 1.1 Rotor shaft
- 2 Crankcase breather line
- 3 Air intake hose
- 4 Intake manifold



W09.40-1044-05

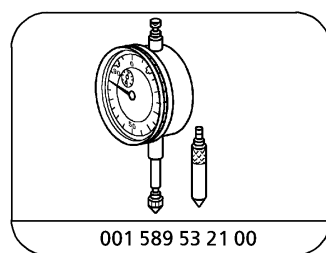
	Removal, installation		
1	Remove crankcase breather line (2) and air intake hose (3) to exhaust gas turbocharger (1)	Check air intake hose (3) and hose clamps for condition, replace if necessary	<b>Page 141</b>
2	Remove oil carbon deposits in exhaust gas turbocharger compressor housing	For this purpose, turn rotor shaft (1.1) back and forth on shaft nut or on compressor turbine wheel until carbon deposits are removed.	
	<b>Test</b>		
3	Check exhaust gas turbocharger compressor housing and compressor turbine wheel for damage	If damage is present: ↓  Replace exhaust gas turbocharger (1)	<b>Page 147</b>
4	Check intake manifold (4), air intake hose (3) and exhaust gas turbocharger compressor housing for oil deposits  Notes for evaluation of turbocharger in the event of engine blue smoke.	Engine 457.9, 541.9, 542.9	<b>Page 144</b>
5	Check rotor shaft (1.1) for easy and uniform operation	If rotor shaft is hard to move (1.1): ↓ Replace exhaust gas turbocharger (1)	<b>Page 147</b>
6	Check axial and radial play for rotor shaft (1.1)	   	<b>Page 145</b>  BE09.40-N-1001-01E BE09.40-N-1002-01E 001 589 53 21 00 363 589 02 21 00 366 589 00 21 05 WH58.30-Z-1046-12B



		<p><b>i</b> If one of the permissible values is exceeded: ↓ Replace exhaust gas turbocharger (1)</p>	<b>Page 147</b>
7	Reinstall in opposite order		

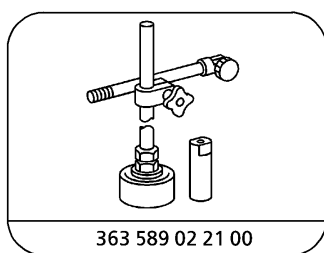
Test values for turbocharger

Number	Designation	Engine 457.960
BE09.40-N-1001-01E	Rotor shaft axial play	mm ≤ 0.1
BE09.40-N-1002-01E	Rotor shaft radial play	mm ≤ 0.9



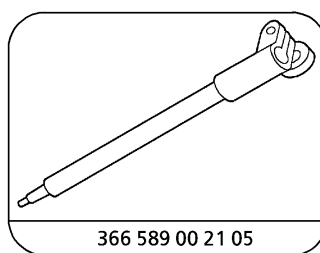
001 589 53 21 00

Dial indicator



363 589 02 21 00

Dial indicator holder



366 589 00 21 05

Extension

Commercially available tools (see workshop equipment manual)

Number	Designation	Company (e.g.)	Order number
WH58.30-Z-1046-12B	Feeler gauge	Boos GmbH Industrie- and Werkstattausrüstung Im Lippfeld 9a D-46047 Oberhausen	804.P

AH09.40-N-0001-01A	Notes on appraisal of the turbocharger in the event of blue smoke from the engine	Engine 457.9, 541.9, 542.9, 902.9, 904.9, 906.9, 926.9	<b>i</b>
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In the event of blue smoke from the engine, the following components must be inspected for oil deposits:

- Turbocharger compressor housing
- Intake manifold
- Intake hose
- Charge air cooler

● If the turbocharger compressor housing or charge air lines are coated with a little oil, no damage to the turbocharger is present as yet.

**i** The normal formation of oil misting in the charge air system does not damage the engine. A certain quantity of oil is required to lubricate the intake valves.

The exuded oil quantity is so minimal that there is no measurable influence on engine oil consumption.

A completely dry charge air system does not exist. The turbochargers used have an oil-guiding bearing housing with piston rings as a seal for the rotor shaft to the turbine and compressor housing. The function of this seal is based on the excess pressure in the compressor housing. At an increased idle speed or in overrun mode, however, a vacuum can occur, which favors oil escaping.

● If a high level of oil is found in the turbocharger-compressor housing, the charge air lines or in the charge air cooler, a full and careful inspection must be carried out:

- Inspect crankcase ventilation/oil separator for damage and flow.
- Inspect oil return line for damage and flow.

**i** If no flow is possible, the oil level in the turbocharger bearing housing increases and oil enters the turbine and compressor housing via the seals. In the case of damage or no flow present, the respective part must be repaired or replaced.

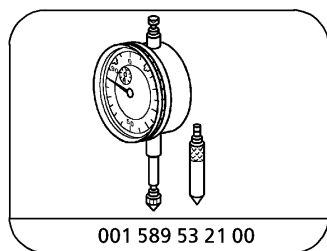
Check axial play and radial play at rotor shaft. If the test values lie outside the tolerance, the turbocharger must be replaced.

**i** It is not necessary to replace the second turbocharger along with the first turbocharger if only one turbocharger is defective. If damage has been caused by a foreign body, both turbochargers may be damaged.

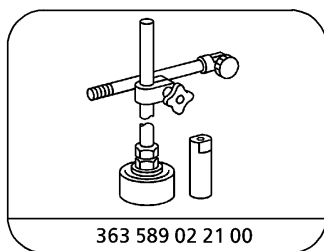
AR09.40-G-5910-01CH	Check axial play and radial play on rotor shaft		
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**Test values for turbocharger**

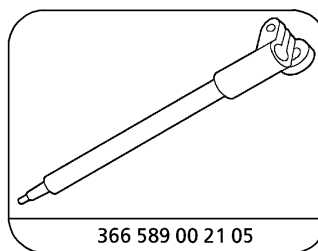
Number	Designation	Engine 457.960
BE09.40-N-1001-01E	Rotor shaft axial play	mm ≤ 0.1
BE09.40-N-1002-01E	Rotor shaft radial play	mm ≤ 0.9



Dial indicator



Dial indicator holder







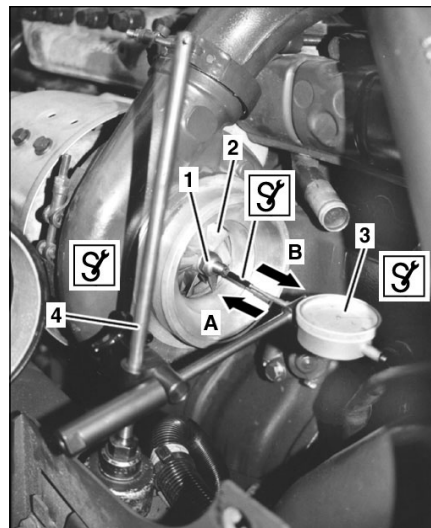
Extension

**Commercially available tools (see workshop equipment manual)**

Number	Designation	Company (e.g.)	Order number
WH58.30-Z-1046-12B	Feeler gauge	Boos GmbH Industrie- und Werkstattausrüstung Im Lippfeld 9a D-46047 Oberhausen	804.P




## Check axial play for rotor shaft:

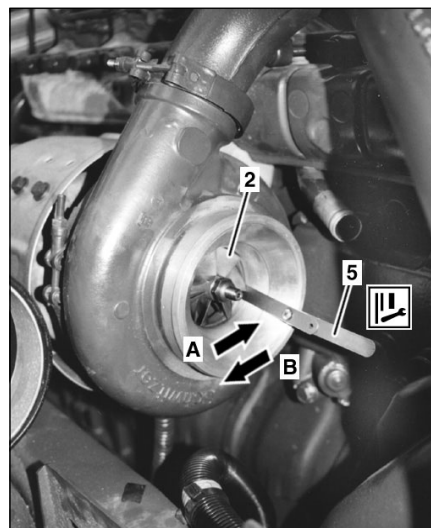
- 1  Install dial indicator (3) with  dial indicator holder (4)
- 2 Press rotor shaft (1) for exhaust gas turbocharger to stop (arrow A) and hold
- 3 Set scale for  dial indicator (3) to zero
- 4 Pull rotor shaft (1) for exhaust gas turbocharger to stop (arrow B) and hold
- 5 Read off values
  -  The reading is equal to the axial play for the rotor shaft (1).



G09.40-3113-02

## Check radial play for rotor shaft:

- 6 Press compressor turbine wheel (2) to stop (arrow A) and determine minimum play with  feeler gauge (5).
  - 7 Press compressor turbine wheel (2) to opposite side to stop (arrow B) and determine maximum play with  feeler gauge (5)
-  Perform both measurements at same point of compressor housing and on same vane of compressor turbine wheel (2)  
The difference between the two measuring results is the radial play

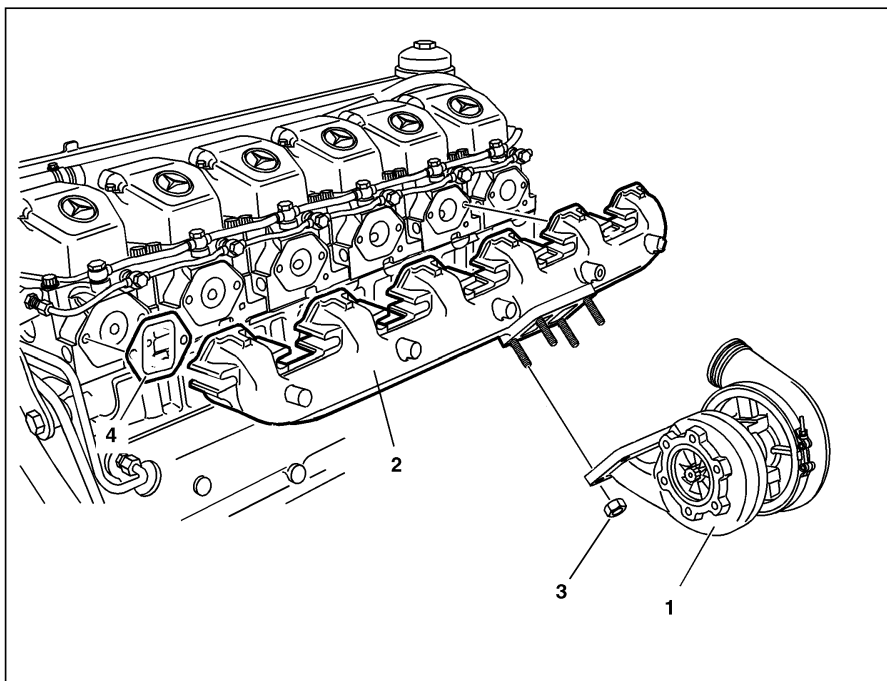


G09.40-3114-02







AR09.40-G-6020CH	Remove/install exhaust gas turbocharger	5.7.04
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**MODEL 000.001 with ENGINE 457.960**

- 1 Exhaust gas turbocharger
- 2 Exhaust manifold
- 3 Nut
- 4 Gasket



W09.40-1041-06

 	Removal, installation		
1	Remove exhaust manifold (2) with engine brake flap fittings and exhaust gas turbocharger (1)	 Installation: Replace seal (4)	<b>Page 171</b>
2	Remove engine brake flap fittings from exhaust gas turbocharger (1)		<b>Page 175</b>
3	Remove exhaust gas turbocharger (1) from exhaust manifold (2)	 Plug holes on exhaust gas turbocharger (1) with caps, otherwise dirt can damage the exhaust gas turbocharger (1).  Installation: Replace nuts (3) 	BA09.40-N-1004-01N
4	Reinstall in opposite order		

 Turbocharger

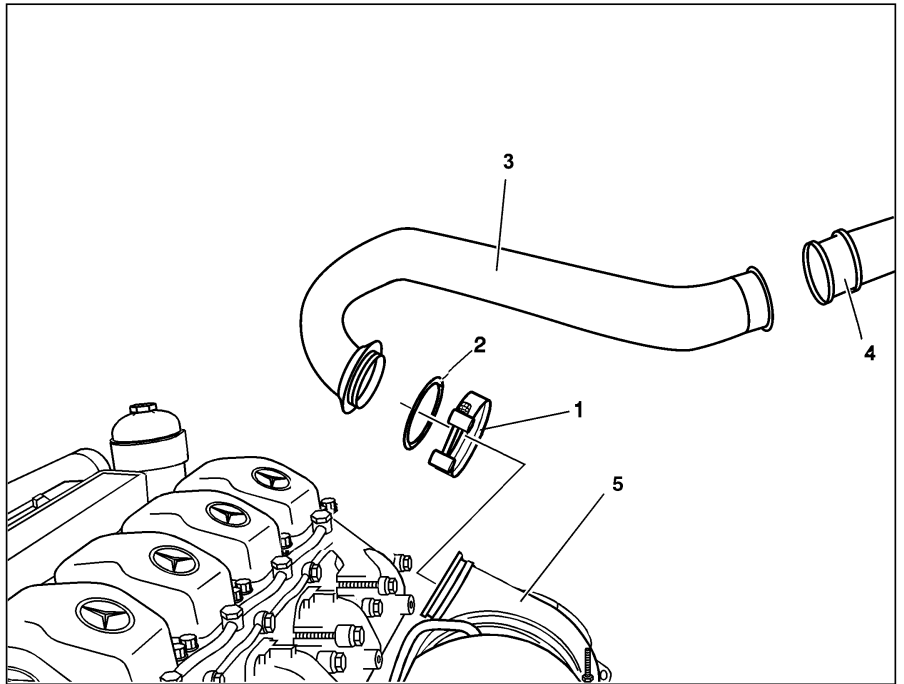
Number	Designation	Engine
		<b>457.960</b>
BA09.40-N-1004-01N	Nut for turbocharger on exhaust manifold	Nm 50



AR09.41-G-1311CH	Remove/install charge air pipe	5.7.04
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MODEL 000.001 with ENGINE 457.960

- 1 Clamp
- 2 O-ring
- 3 Charge air pipe
- 4 Charge air hose
- 5 Exhaust gas turbocharger



W09.41-1012-06

		Removal, installation	
1	Remove charge air hose (4)	Check charge air hose (4) and hose clamps for condition, replace if necessary 	BA09.41-N-1001-01L
2	Remove clamp (1) from charge air pipe (3) and exhaust gas turbocharger (5)	Plug holes on exhaust gas turbocharger (1) with caps, otherwise dirt can damage the exhaust gas turbocharger (1).. Installation: Replace O-ring (2)	
3	Remove charge air pipe (3) with bracket		
4	Reinstall in opposite order		

Charge air pipe/charge air cooler

Number	Designation	Engine
BA09.41-N-1001-01L	Clamp, charge air hose to charge air housing/charge air pipe and charge air cooler	457.960 Nm 7.5

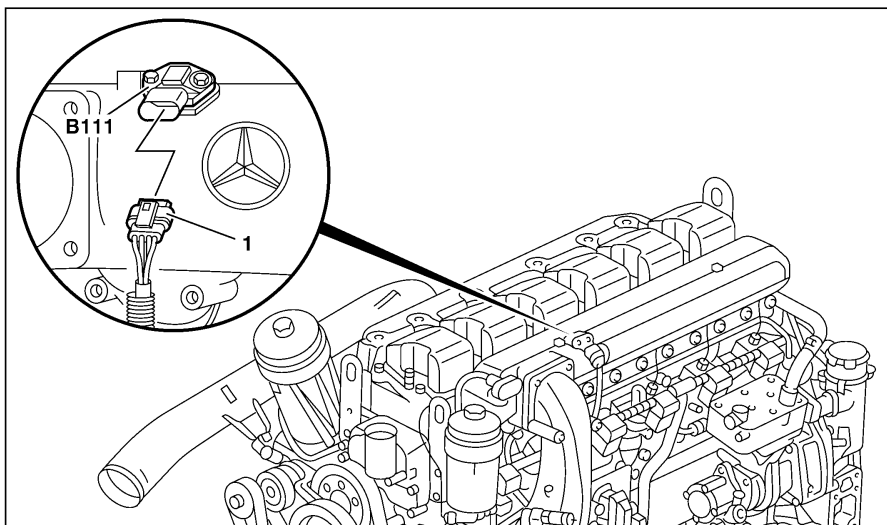


AR09.41-G-2003CH	Remove/install charge air pressure, charge air temperature sensor	5.7.04
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
**MODEL 000.001 with ENGINE 457.960**

1 Connector for engine wiring harness

B111 Charge air combination sensor (temperature and pressure)



W09.41-1014-05

 	Removal, installation		
1	Unlock engine wiring harness connector (1) from charge air combination sensor (B111) and pull off		
2	Remove charge air combination sensor (B111)	 <b>Installation:</b> Check O-ring on charge air combination sensor (B111) for damage, if necessary install new charge air combination sensor (B111). 	BA09.41-N-1004-01L
3	Reinstall in opposite order		

 **Charge air pipe/charge air cooler**

Number	Designation	Engine
		<b>457.960</b>
BA09.41-N-1004-01L	Bolt, charge air pressure, charge air temperature sensor to charge air manifold	Nm 10



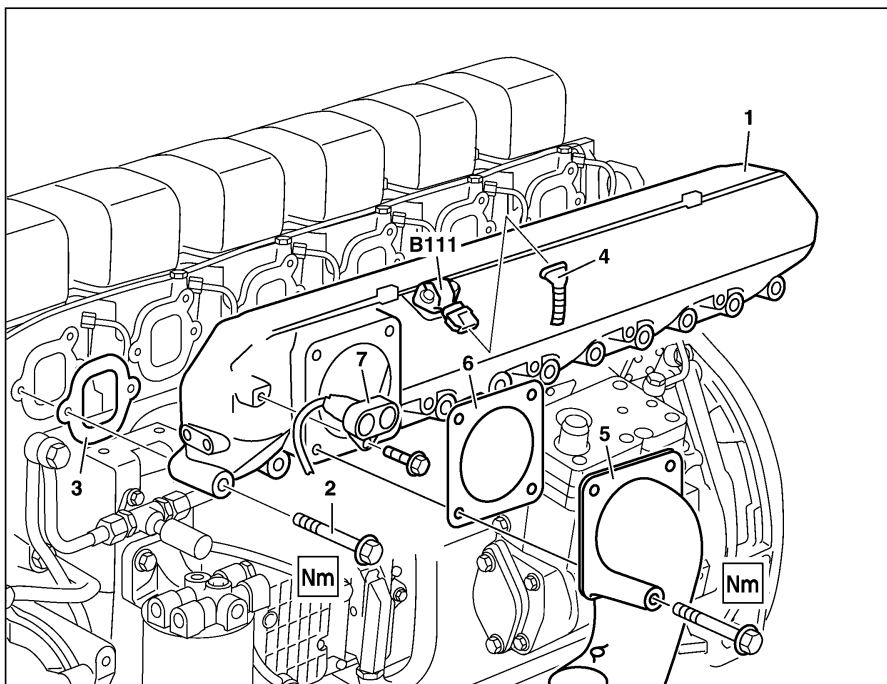


AR09.41-G-8681CH	Remove/install charge air manifold	5.7.04
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**MODEL 000.001 with ENGINE 457.960**

- 1 Charge air manifold
- 2 Bolt
- 3 Gasket
- 4 Connector
- 5 Intake manifold
- 6 Gasket
- 7 Start/stop button

**B111** Charge air combination sensor  
(temperature and pressure)



G09.41-3126-06

		Removal, installation	
1	Remove intake manifold (5) from charge air manifolds (1)	Replace seal (6) 	BA09.41-N-1002-01L
2	Remove start/stop button (7) with bracket		
3	Unlock connector (4) from charge air combination sensor (B111) and pull off		
4	Unscrew bolts (2) and remove charge air manifold (1)	Installation: Clean sealing surface, replace seals (3) 	BA09.41-N-1003-01L
5	Reinstall in opposite order		

**Charge air pipe/charge air cooler**

Number	Designation	Engine 457.960
BA09.41-N-1002-01L	Bolt, charge air pipe to charge air manifold	Nm 60
BA09.41-N-1003-01L	Bolt, charge air manifold to cylinder head	Nm 30

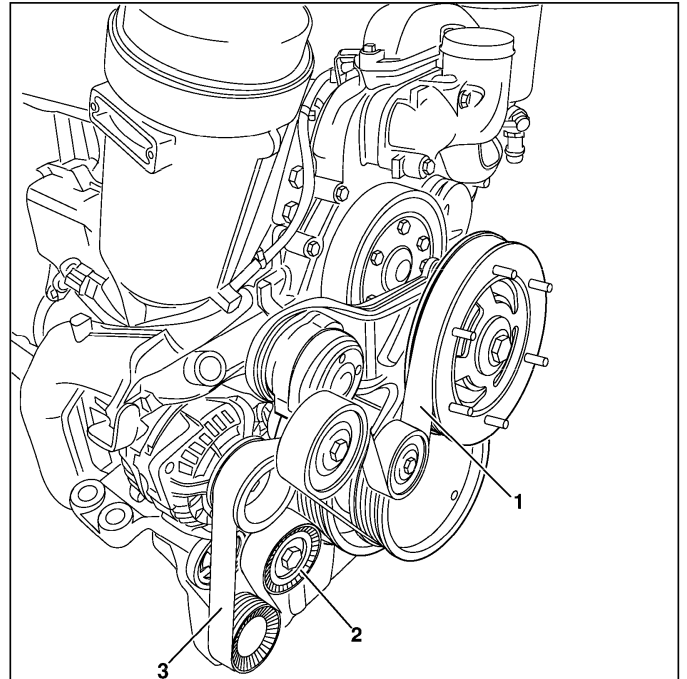


AR13.22-G-0003CH	Remove/install alternator poly-V-belt	5.7.04
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**MODEL 000.001 with ENGINE 457.960**


*Shown with fan wheel removed*

- 1 Poly-V-belt (fan)
- 2 Tensioning device (alternator poly-V-belt)
- 3 Poly-V-belt (alternator)



W20.40-1063-12

	<b>Removal</b>		
<b>Danger!</b>	Injury hazard from pinching when working on springs and spring bodies under tension	Use only approved tensioning devices, if necessary shield hazardous areas additionally Check special tools for damage and proper function (visual inspection). Wear protective gloves.	<b>Page 91</b>
1	Remove poly-V-belt (1)		<b>Page 157</b>
2	Pivot tensioning pulley for tensioning device (2) downward and hold		
3	Remove poly-V-belt (3) from belt pulleys		
4	Pivot back tensioning pulley for tensioning device (2)		
5	Press fan wheel toward front and remove poly-V-belt (3)	Do not damage poly-V-belt (3) when removing	
	<b>Test</b>		
6	Check belt pulleys and tensioning pulleys for damage and smoothness, replace if necessary.		
7	Check poly-V-belt (3) for condition, replace if necessary		
	Damage pattern for poly-V-belt		<b>Page 92</b>
	<b>Installation</b>		
8	Press fan wheel toward front and position poly-V-belt (3) on belt pulley	Observe belt route of poly-V-belt	<b>Page 91</b>
9	Pivot tensioning pulley for tensioning device (2) downward and hold		

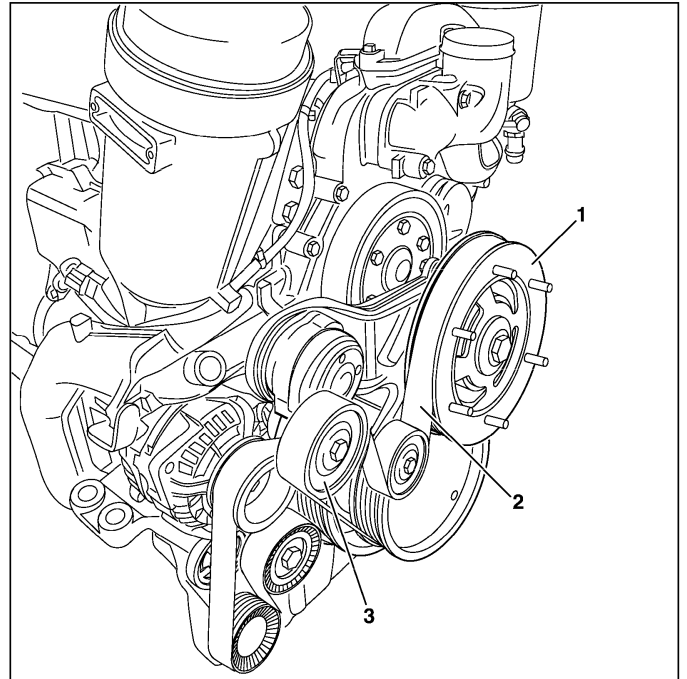
10	Position poly-V-belt (3) on tensioning pulley of tensioning device (2) and pivot back tensioning device (2)	 Ensure that poly-V-belt (3) is seated correctly.	
11	Install poly-V-belt (1)		<b>Page 157</b>

AR13.22-G-1302CH	Remove/install poly-V-belt fan	5.7.04
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MODEL 000.001 with ENGINE 457.960




Shown with fan wheel removed


- 1 Belt pulley
- 2 Poly-V-belt
- 3 Tensioning device



W20.40-1064-12

	<b>Removal</b>		
<b>Danger!</b>	Injury hazard from pinching when working on springs and spring bodies under tension	Use only approved tensioning devices, shield hazardous area additionally if necessary. Check special tools for damage and proper function (visual inspection)Wear protective gloves.	<b>Page 91</b>
	Notes on self-locking nuts and bolts	All models	<b>Page 59</b>
1	Pivot tensioning pulley for tensioning device (3) downward and hold		
2	Remove poly-V-belt (2) from belt pulley		
3	Pivot back tensioning pulley of tensioning device (3)		
4	Remove viscous fan clutch with fan wheel from belt pulley (1)	Arrest belt pulley (1) with corresponding tool	
5	Press fan wheel toward front and remove poly-V-belt (2)	Do not damage poly-V-belt (2) when removing	
	<b>Test</b>		
6	Check belt pulleys and tensioning pulleys for damage and smoothness, replace if necessary.		
7	Check poly-V-belt (2) for good condition	If necessary replace poly-V-belt (2)	
<b>AP</b>	Damage pattern for poly-V-belt		<b>Page 92</b>
	<b>Installation</b>		
8	Press fan wheel toward front and position poly-V-belt (2) on belt pulley	↓ Observe belt route of poly-V-belt	

		Poly-V-belt route	Page 91
9	Install viscous fan clutch with fan wheel on belt pulley (1)	 Arrest belt pulley (1) with corresponding tool 	BA20.40-N-1003-01M
10	Pivot tensioning pulley for tensioning device (3) downward and hold		
11	Position poly-V-belt (2) on tensioning pulley for tensioning device (3) and pivot back tensioning device (3)	 Ensure that poly-V-belts (2) is seated correctly	

 Fan, fan clutch

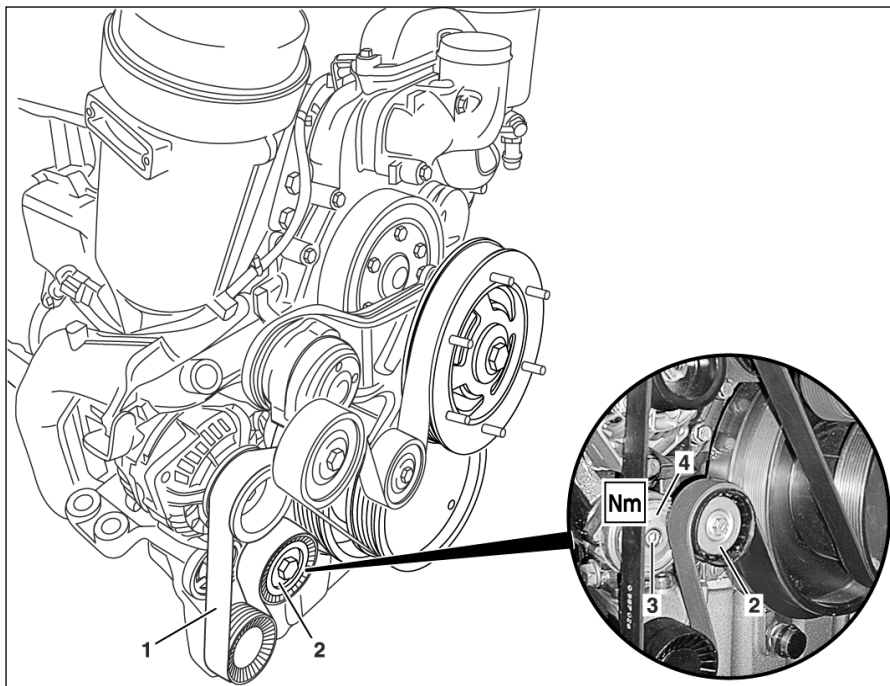
Number	Designation	Engine 457.960
BA20.40-N-1003-01M	Bolt, viscous fan clutch to belt pulley fan drive	Nm 50

AR13.25-G-3200CH	Remove/install poly-V-belt tensioning device	7.7.04
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MODEL 000.001 with ENGINE 457.960

Shown with fan wheel removed

- 1 Poly-V-belt (alternator)
- 2 Tensioning pulley
- 3 Bolt
- 4 Tensioning device (alternator poly-V-belt)



G13.25-3110-06

	<b>Removal, installation</b>		
<b>Danger!</b>	Injury hazard from pinching when working on springs and spring bodies under tension	Use only approved tensioning devices, shield hazardous area additionally if necessary. Check special tools for damage and proper function (visual inspection) Wear protective gloves.	<b>Page 91</b>
1	Release tension on poly-V-belt (1) and remove from tensioning pulley (2)	<b>Installation:</b> Observe poly-V-belt route: ↓ Poly-V-belt route	<b>Page 91</b>
2	Unscrew bolt (3) from tensioning device (4)		BA13.25-N-1002-010
3	Remove tensioning device (4)	<b>Installation:</b> First insert pin on back of tensioning device (4) into mounting holes	
	<b>Test</b>		
4	Check poly-V-belt (1) for condition, replace if necessary		
	Damage pattern for poly-V-belt		<b>Page 92</b>
5	Reinstall in opposite order		

**Belt tensioning device**

Number	Designation	Engine
BA13.25-N-1002-010	Bolt, poly-V-belt-tensioning device to engine carrier	457.960
		Nm 50



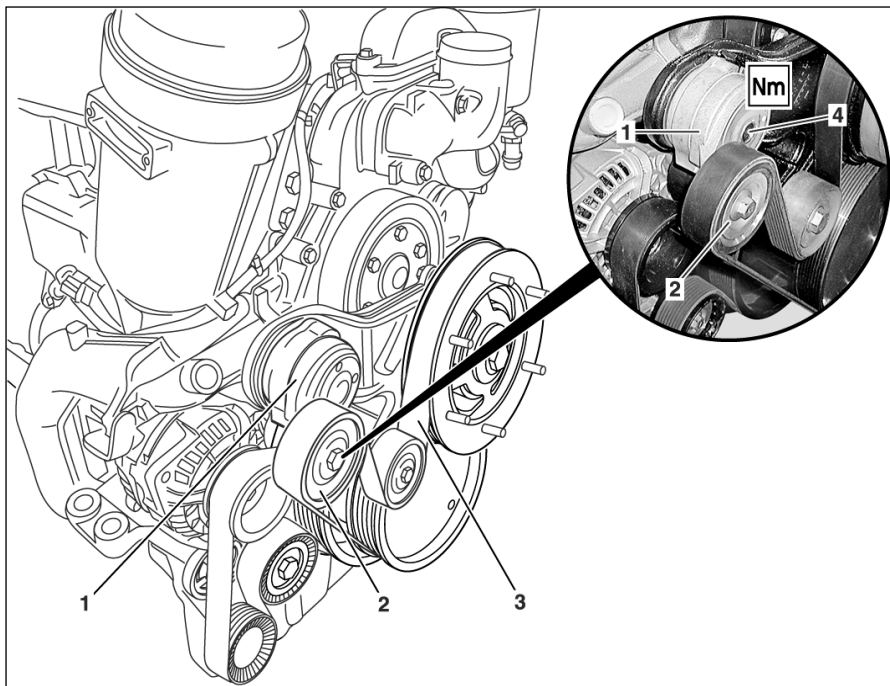


AR13.25-G-3202CH	Remove/install poly-V-Belt tensioning device for fan drive	7.7.04
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**MODEL 000.001 with ENGINE 457.960**

*Shown on engine with fan wheel removed*

- 1 Tensioning device (poly-V-belt for fan drive)
- 2 Tensioning pulley
- 3 Poly-V-belt (fan)
- 4 Bolt



G20.40-3144-06

	<b>Removal, installation</b>		
1	Release tension on poly-V-belt (3) and remove from tensioning pulley (2)	<b>Installation:</b> Observe poly-V-belt route: ↓ Poly-V-belt route	<b>Page 91</b>
2	Unscrew bolt (4) from tensioning device (1)		BA13.25-N-1001-01O
3	Remove tensioning device (1)	<b>Installation:</b> Insert pins into rear of tensioning device (1) first into mounting holes	
	<b>Test</b>		
4	Check poly-V-belt (3) for condition, replace if necessary <b>AP</b> Damage pattern for poly-V-belt		<b>Page 92</b>
5	Reinstall in opposite order		

**Belt tensioning device**

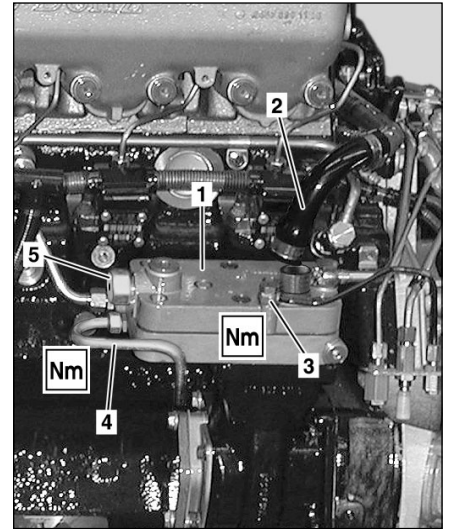
Number	Designation	Engine
BA13.25-N-1001-01O	Bolt, poly-V-belt-tensioning device to fan drive bracket	457.960 Nm 50



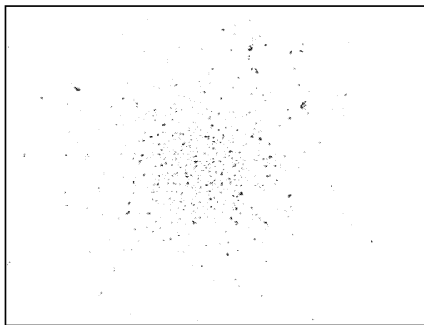
AR13.30-G-5005CH	Check compressor for oil ejection	7.7.04
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**MODEL 000.001 with ENGINE 457.960**

- 1 Compressor
- 2 Suction hose
- 3 Control line
- 4 Compressed air line
- 5 Holed cover



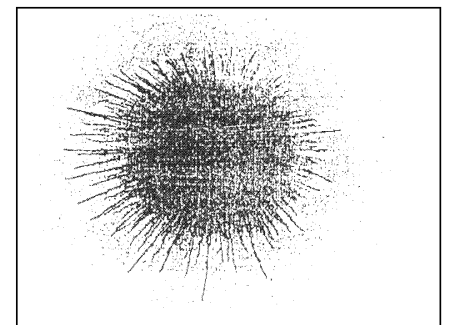
G13.30-3107-02



G13.10-3001-01

**Oil ejection on test paper**













*Normal oil ejection*



G13.10-3002-01


*Increased oil ejection*

	<b>Removal, installation</b>		
<b>⚠ Danger!</b>	<b>Accident hazard</b> resulting from vehicle starting to move by itself with engine running. <b>Injury hazard</b> resulting from pinching and burning when reaching in during the starting operation or with the engine running.	Secure vehicle against starting to move unintentionally. Wear tight and closed clothing Do not reach into hot or rotating parts	<b>Page 9</b>
1	Heat engine up to operating temperature	Coolant temperature approx. 70 to 95 °C.	
2	Remove suction hose (2)	Ensure that no foreign bodies are sucked into the intake fittings on the compressor (1) during the test run Ensure that the compressor (1) sucks in only oil-free air. <b>Installation:</b> Check suction hose (2) and hose clamps for condition, replace if necessary	
3	Remove compressed air line (4) from compressor (1) and check for coking	In the event of coking, also check compressed air line (4) between compressor (1), compressed air drier and four circuit protection valve. ↓	

	Notes on oil consumption/oil ejection on compressors	Replace coked parts  Engine 457.9, 541.9, 542.9, 900.9, 902.9, 904.9, 906.9, 924.9, 926.9	BA13.30-N-1004-01J  <b>Page 164</b>
4	Remove control line (3) from compressor (1)	 Removing the control line (3) brings the compressor (1) to rated output  Installation: Replace sealing rings. 	BA13.30-N-1006-01J
 WF	Install shop-made holed cover (5) of pressure connection on compressor (1)  Holed cover for testing oil ejection on compressor	 The test run can be performed with or without holed cover (5). The illustrations show a test run with holed cover (5).	WF58.50-W-1330-01A
	<b>Test</b>		
6	Crank the engine and perform test run	 Allow engine to run without load for 60 s after rated speed (1900 rpm) and hold a sheet of white typing paper 10 cm in front of the holed cover (5)	
7	Evaluate oil ejection on test paper	 If oil ejection is too high: ↓ Replace compressor (1)	<b>Page 167</b>
8	Reinstall in opposite order		
9	Crank the engine	 Allow to idle until service brake pressure is reached, then shut off engine	
10	Check compressed air line (4) for leakage	 Visual inspection.	

 Compressor (compressed air system)

Number	Designation	Engine 457.960
BA13.30-N-1004-01J	Fittings, compressed air line to compressor	Nm 80
BA13.30-N-1006-01J	Banjo bolt, control line to compressor	Nm 15

AH13.30-N-1000-01B	Notes on oil consumption/oil loss with compressors	Engine 457.9, 541.9, 542.9, 900.9, 902.9, 904.9, 906.9, 924.9, 926.9	
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Modification notes

8.11.04	Contents completely revised.		
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**Non-delivery mode:**

With uncontrolled compressors, the oil also delivered in the compressed air is dissipated via the breather connections into the exhaust system or into the air.

With controlled compressors, this oil is fed back to the suction side of the compressor and to the clearance pocket.

**Delivery mode:**

With controlled and uncontrolled compressors, around 50 % of the pumped oil is delivered to the compressed-air system and the rest is retained by the air drier. This oil quantity located in the air drier thus does not permit a return to the permissible oil emissions.

The permissible oil consumption amounts to maximum 2g / operating hours.

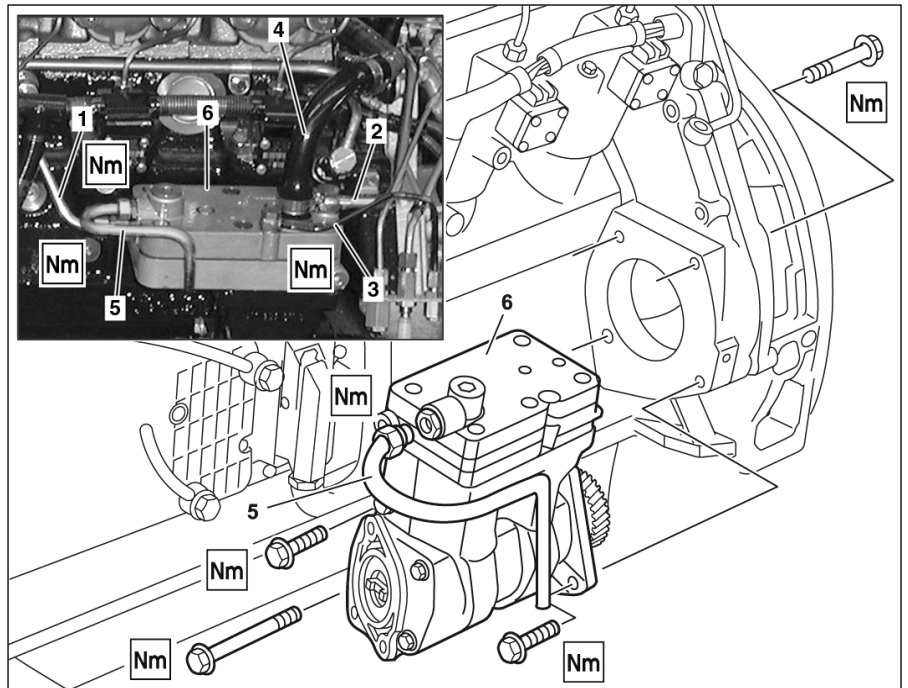
Check compressor for oil loss if enlarged oil loss or oil consumption is suspected.



AR13.30-G-5510CH	Remove/install compressor	7.7.04
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MODEL 000.001 with ENGINE 457.960

- 1 Coolant line (return)
- 2 Coolant line (feed)
- 3 Control line (energy saving circuit)
- 4 Intake line
- 5 Compressed air line
- 6 Compressor



G13.30-3109-06

	<b>Removal, installation</b>		
<b>Danger!</b>	<b>Injury hazard</b> Danger of severe burns to skin and eyes from hot coolant spewing out Coolant is toxic if swallowed	Open cooling system only at coolant temperatures below 90 °C Slowly open cover and relieve pressure Do not fill beverage containers with coolant. Wear protective gloves, protective clothing and protective goggles.	<b>Page 26</b>
	Notes on coolant	All engines	<b>Page 168</b>
1	Drain coolant and catch	<b>Installation:</b> Add only corrosion/frost protection agents approved according to coolant regulations to prevent damaging the engine. Observe the following: ↓	
<b>BB</b>	Coolant regulations	Sheet 310.1	BB00.40-P-0310-01A
<b>BB</b>	Corrosion/frost protection agent	Sheet 325.2	BB00.40-P-0325-02A
2	Remove coolant lines (1, 2) from compressor (6)	<b>Installation:</b> Replace sealing rings.  	BA13.30-N-1002-01J
3	Remove compressed air line (5) from compressor (6) and check for coking and deposits	In the event of coking or deposits also check compressed air line between compressor, compressed air drier and four circuit protection valve. Replace coked parts or parts with deposits <b>Installation:</b> Check compressed air line (5) for leakage  	BA13.30-N-1004-01J
4	Remove intake line (4) from compressor (6)		BA13.30-N-1005-01J



5	Remove control line (3)	Nm	BA13.30-N-1006-01J
6	Remove compressor (6) from timing case	Installation: Observe various bolt lengths Nm	BA13.30-N-1001-01J
7	Reinstall in opposite order		
8	Correct engine oil level AP Engine oil and filter change		Page 185
9	Check coolant level, correct is necessary		

Compressor (compressed air system)

Number	Designation	Engine 457.960
BA13.30-N-1001-01J	Bolt, compressor to crankcase	Nm 60
BA13.30-N-1002-01J	Banjo bolt, coolant line to compressor	M16x1.5 Nm 40
		M14X1.51 Nm 35
BA13.30-N-1004-01J	Fittings, compressed air line to compressor	Nm 80
BA13.30-N-1005-01J	Fittings, intake line to compressor	Nm 80
BA13.30-N-1006-01J	Banjo bolt, control line to compressor	Nm 15

AH20.00-N-2080-01A	Notes on coolant	All engines	
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**Coolant composition**

passenger car and commercial vehicle engines (normally)  
50 water in % by volume and  
50 corrosion/antifreeze agent in % by volume.

Different coolant composition for CV engines, refer to **MB Specifications for Operating Fluids**.

**Tasks of corrosion and frost protection**

- Corrosion and cavitation protection of all components in cooling system
- Antifreeze protection (frost protection)
- Increase the boiling point so that coolant does not evaporate so rapidly. Avoiding ejection of coolant at high coolant temperatures.

**Water**

Use water which is clean and not too hard. Drinking water often satisfies requirements, but not always the contents of dissolved substances in the water may be of significance for the occurrence of corrosion. If in doubt, analyze the water.

For fresh water specifications refer to **MB Specifications for Operating Fluids**.

**Period of use**

The maximum permissible period of use of the coolant can be taken from the maintenance booklet; from the applicable service/maintenance sheet or the **MB-Specifications for Operating Fluids** respectively.

For the period of use for a varying coolant composition for CV engines, refer to **MB Specifications for Operating Fluids**.

**Antifreeze protection**

50 % by volume of anticorrosion/ antifreeze agent offers antifreeze protection down to approx. -37 °C. A higher concentration is only necessary if the ambient temperatures are even lower. 55 % by volume of anticorrosion/antifreeze agent offers antifreeze protection down to approx. -45 °C.

A concentration of more than 55 % by volume of anticorrosion/ antifreeze agent should not be used as the maximum antifreeze protection is already reached. An even higher concentration once reduces antifreeze protection and impairs heat dissipation. Reduced heat dissipation can lead to damage to components in the cooling system or damage to the engine.

Before pouring in fresh coolant, flush the used coolant out of the cooling system. In the event of high pollution or oil fouling levels, clean the cooling system, otherwise damage can occur to the components of the cooling system.

**Disposing of coolants**

Pay attention to legal provisions and local wastewater regulations.

For workshops located in the Federal Republic of Germany refer to:

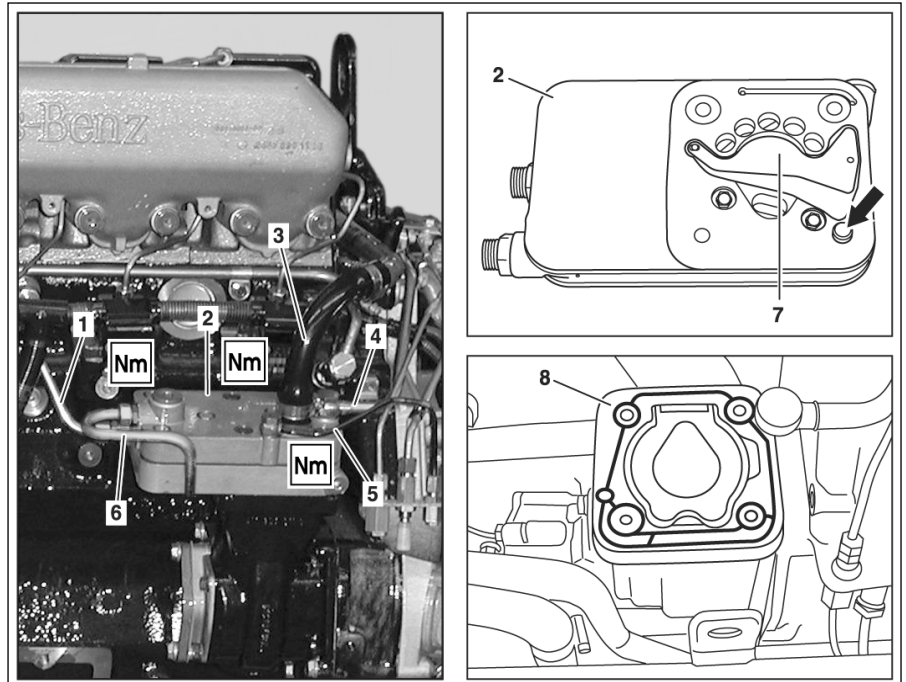
"Environmental Protection Manual for Automotive Repair Workshops"

Publisher: Association of Automotive Industry e.V. (VDA)  
60625 Frankfurt am Main, Westendstraße 61

AR13.30-G-6010CH	Remove/install cylinder head compressor	7.7.04
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MODEL 000.001 with ENGINE 457.960

- 1 Coolant line (return)
- 2 Cylinder head compressor
- 3 Suction hose
- 4 Coolant line (feed)
- 5 Control line
- 6 Compressed air line
- 7 Control slide
- 8 Inlet valve disk



G13.30-3108-06

	<b>Removal, installation</b>		
<b>Danger!</b>	Accident hazard resulting from vehicle starting to move by itself with engine running. Injury hazard resulting from pinching and burning when reaching in during the starting operation or with the engine running.	Secure vehicle against starting to move unintentionally. Wear closed and tight work clothing Do not reach into hot or rotating parts	<b>Page 9</b>
<b>Danger!</b>	Danger of severe burns to skin and eyes from hot coolant spewing out Coolant is toxic if swallowed	Open cooling system only at coolant temperatures below 90 °C Slowly open cover and relieve pressure Do not fill beverage containers with coolant. Wear protective gloves, protective clothing and protective goggles.	<b>Page 26</b>
	Notes on coolant	All engines	<b>Page 168</b>
1	Drain coolant and catch	<b>Installation:</b> Add only corrosion/frost protection agents approved according to coolant regulations to prevent damaging the engine. Observe the following: ↓ Sheet 310.1 Sheet 325.2	BB00.40-P-0310-01A BB00.40-P-0325-02A
<b>BB</b> <b>BB</b>	Coolant regulations Corrosion/frost protection agent		
2	Remove compressed air line (6) from cylinder head compressor (2) and check for coking	In the event of coking, also check compressed air line between compressor, compressed air drier and four circuit protection valve: ↓ Replace coked parts 	BA13.30-N-1004-01J

3	Remove suction hose (3) from cylinder head compressor fittings (2)	<p><b>i</b> Check suction hose (3) and hose clamps for condition, replace if necessary.</p> <p><b>Nm</b></p>	BA13.30-N-1005-01J
4	Remove control line (5)	<p><b>i</b> <b>Installation:</b> Replace sealing rings.</p> <p><b>Nm</b></p>	BA13.30-N-1006-01J
5	Remove coolant lines (4) from cylinder head compressor (2)	<p><b>i</b> Catch coolant running out.</p> <p><b>i</b> <b>Installation:</b> Replace sealing rings.</p> <p><b>Nm</b></p>	BA13.30-N-1002-01J
6	Remove coolant lines (1)	<p><b>i</b> Catch coolant running out.</p> <p><b>i</b> <b>Installation:</b> Replace sealing rings.</p> <p><b>Nm</b></p> <p><b>Nm</b></p>	BA13.30-N-1002-01J BA13.30-N-1008-01J
7	Remove cylinder head compressor (2)	<p><b>i</b> Control valve (7) can fall out when lifting the cylinder head compressors (2)</p> <p><b>i</b> <b>Installation:</b> Lift coolant lines (4) for installing cylinder head compressor (2)</p> <p><b>Nm</b></p>	BA13.30-N-1007-01J
8	Remove inlet valve disk (8)	<p><b>i</b> <b>Installation:</b> Ensure that control valve (7) does not fall out, otherwise compressor can be damaged</p> <p><b>i</b> <b>Installation:</b> Replace inlet valve disk (8). Lay inlet valve disk (8) on cylinder head compressor (2) and install cylinder head compressor (2) on compressor housing. Observe installation position of inlet valve disk (8) in relation to roll pin (arrow) in intermediate valve plate</p>	
9	Clean sealing surfaces		
10	Reinstall in opposite order		
11	Check coolant level and correct		
12	Crank the engine	<b>i</b> Allow to idle until service brake pressure is reached, then shut off engine	
13	Check compressor (2), coolant lines and compressed air line (6) for leakage	<b>i</b> Visual inspection.	

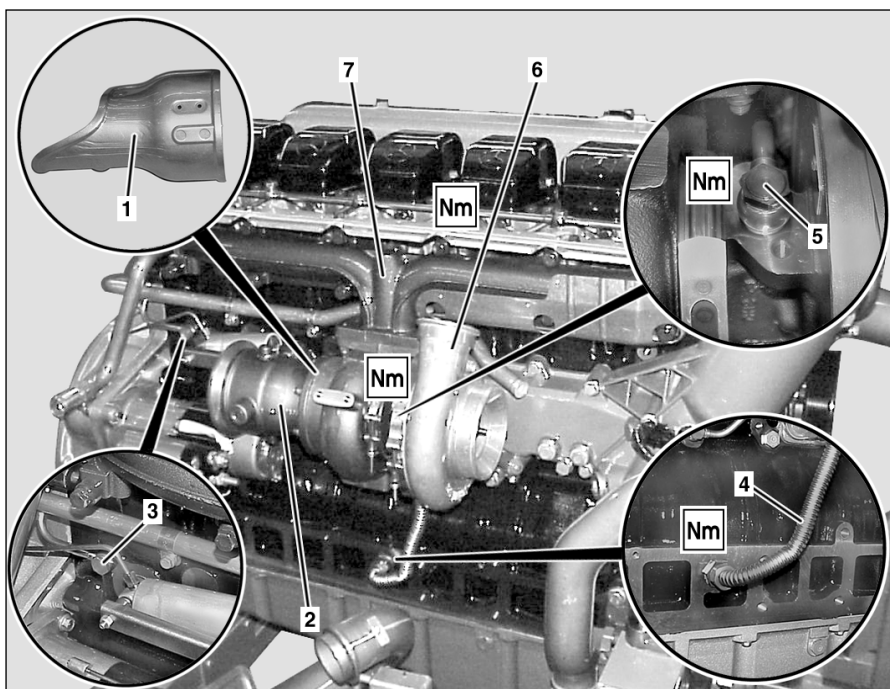
**Nm** Compressor (compressed air system)

Number	Designation	Engine 457.960
BA13.30-N-1002-01J	Banjo bolt, coolant line to compressor	M16x1.5 Nm 40
		M14X1.51 Nm 35
BA13.30-N-1004-01J	Fittings, compressed air line to compressor	Nm 80
BA13.30-N-1005-01J	Fittings, intake line to compressor	Nm 80
BA13.30-N-1006-01J	Banjo bolt, control line to compressor	Nm 15
BA13.30-N-1007-01J	Bolt, cylinder head to compressor-crankcase	1st stage Nm 25
		2nd stage $\Delta^\circ$ 90
BA13.30-N-1008-01J	Fittings, coolant lines to compressor	30

AR14.10-G-3915CH	Remove/install exhaust manifold	7.7.04
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**MODEL 000.001 with ENGINE 457.960**

- 1 Heat shield
- 2 Engine brake flap fitting
- 3 Compressed air line
- 4 Oil return line
- 5 Oil pressure line
- 6 Exhaust gas turbocharger
- 7 Exhaust manifold



G14.10-3104-06

	<b>Removal, installation</b>		
<b>⚠ Danger!</b>	<b>Explosion hazard from explosive gas. Coolant is toxic when swallowed Injury hazard from burning skin and eyes with battery acid or when handling damaged lead/acid batteries.</b>	Fire, open lights and smoking prohibited. Avoid sparks. Wear acid protective gloves, clothing and goggles. Fill battery acid only in suitable and corresponding marked vessels	<b>Page 173</b>
1	Disconnect ground line from battery		
	Notes on battery	All models	<b>Page 174</b>
2	Remove charge air pipe	Clean sealing surfaces and plug holes on exhaust gas turbocharger (6) otherwise dirt can damage the exhaust gas turbocharger (6)	<b>Page 149</b>
3	Remove air intake hose		<b>Page 141</b>
4	Remove heat shield (1) from engine brake flap fittings (2)	Nm	BA09.40-N-1005-01N
5	Remove exhaust pipe from engine brake flap fittings (2)		
6	Remove compressed air line (3) from engine brake cylinder		
7	Remove oil return line (4) from crankcase	Catch engine oil running out Nm	BA09.40-N-1006-01N
8	Remove oil pressure line (5) from exhaust gas turbocharger (6)	Plug holes on exhaust gas turbocharger (6) with caps, otherwise dirt can damage the exhaust gas turbocharger (6).	

		<p><b>i</b> Installation: Before installing the oil pressure line (5) fill bearing housing of exhaust gas turbocharger (6) with engine oil through oil inlet hole. While doing this, turn exhaust gas turbocharger shaft by hand, until the bearings are coated with a thin coating of oil.</p> <p><b>Nm</b></p>	BA09.40-N-1001-01N
9	Remove exhaust manifold (7), exhaust gas turbocharger (6) and engine brake flap fittings (2) together	<p><b>i</b> Only loosen rear exhaust manifold bolts in lower row, the exhaust manifold (7) remains hanging on these bolts for this period of time.</p> <p><b>Nm</b></p>	BA14.10-N-1001-01N
10	Remove exhaust gas turbocharger (6) with engine brake flap fittings (2) from exhaust manifold (7)	<p><b>⊗</b> Plug holes on exhaust gas turbocharger (6) with caps, otherwise dirt can damage the exhaust gas turbocharger (6).</p> <p><b>i</b> Installation: Replace nuts</p> <p><b>Nm</b></p>	BA09.40-N-1004-01N
11	Reinstall in opposite order		
12	Check engine oil level with oil dipstick, correct if necessary Engine oil and filter change		




**Nm** Turbocharger

Number	Designation	Engine 457.960
BA09.40-N-1001-01N	Bolt, oil pressure line to exhaust gas turbocharger	Nm 25
BA09.40-N-1004-01N	Nut, turbocharger to exhaust manifold	Nm 50
BA09.40-N-1005-01N	Bolt, heat shield to exhaust gas turbocharger and engine brake flap fitting	Nm 20
BA09.40-N-1006-01N	Nut, oil pressure to crankcase fittings	M26X1.51 Nm 50

**Nm** Exhaust manifold

Number	Designation	Engine 457.960
BA14.10-N-1001-01N	Bolt, exhaust manifold to cylinder head	Nm 50

AS54.10-Z-0001-01A	Risk of explosion from gas. Risk of poisoning and burns from swallowing battery electrolyte. Risk of injury to eyes and skin as result of caustic burns from battery electrolyte or from handling damaged lead-acid batteries.	No fire, sparks, naked flames or smoking. Wear acid-resistant gloves, clothing and eye protection. Pour battery electrolyte only into suitable and appropriately marked containers.	 <b>Danger!</b>
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**Possible hazards**

**Risk of explosion**

A highly explosive gas mixture is produced when charging lead-acid batteries.

**Risk of poisoning**

If battery electrolyte is swallowed, this can result in manifestations of poisoning such as headaches, dizziness, stomach pain, respiratory paralysis, unconsciousness, vomiting and cramps.

Battery electrolyte mist causes caustic burns to the eyes.

If swallowed, this can result in caustic burns to the mucous membranes and respiratory passages.

The absorption of lead in the body can cause damage to blood, nerves and kidneys; in addition, lead compounds are considered to represent a reproductive hazard.

- Keep lead-acid batteries and battery electrolyte away from unauthorized persons.  
Pour battery electrolyte only into suitable and appropriately marked containers.
- Always store lead-acid batteries horizontally.
- Ensure the gassing line is properly connected.
- Ensure the gassing line does not have any kinks and is not blocked at any point.
- Pay attention to instructions for use of the particular lead-acid battery and the operating instructions of the vehicle.
- Wear acid-resistant clothing and eye protection with side guards.

**Injury hazard**

Battery electrolyte contains sulfuric acid which can cause severe caustic burns to skin and eyes. Strict caution is required when handling damaged lead-acid batteries (removing from vehicle damaged in accident) because of the sharp edges on the fractured housing and direct contact with the lead plates.

**Protective measures/rules of conduct**

- Charge lead-acid batteries only in well ventilated areas.
- No fire, sparks, naked flames or smoking.
- Do not place any tool or other conducting objects onto the lead-acid battery (risk of short-circuit).
- Disconnect and remove lead-acid batteries for charging.
- Always disconnect negative terminal first of all; always connect positive terminal first of all.
- Do not switch on the charger until after it has been connected to the terminals; switch it off before disconnecting.

**First-aid measures**

Eye contact

- Rinse out eyes immediately with plenty of water.

Skin contact

- Take off moistened clothing.
- Immediately neutralize acid splashes on skin or clothing with acid converter or soap suds and rinse off with plenty of water.

Inhaling battery electrolyte mist

- Take the affected person out into the fresh air.

Swallowing battery electrolyte

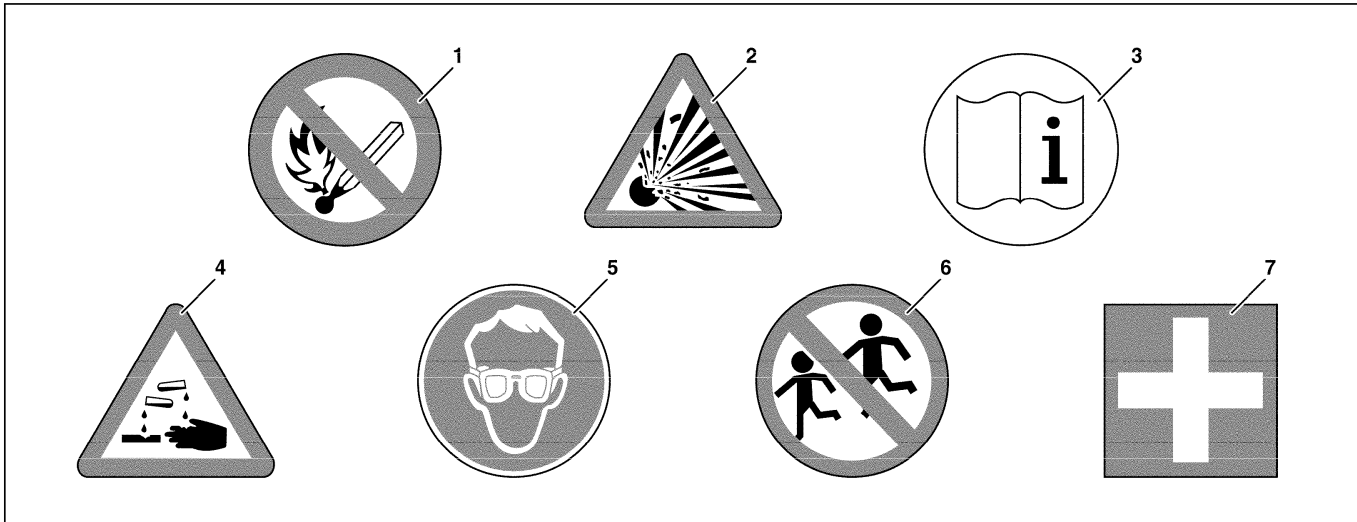
- Have the person affected drink plenty of water with the addition of activated charcoal.

As a general rule, the person affected should consult a medical service or doctor after first-aid has been rendered.

**Fire protection measures**

Suitable extinguishing agents

- CO<sub>2</sub> and dry extinguishing agent



P54.10-0270-08

**Warning instructions for lead-acid batteries**

- |  |  |   |
|--|--|---|
| <p>1 No fire, sparks, naked flames or smoking</p> <p>2 Risk of explosion</p> | <p>3 Pay attention to operating instructions</p> <p>4 Risk of caustic burns</p> <p>5 Wear eye protection</p> | <p>6 Keep away from children</p> <p>7 First-aid</p> |
|--|--|---|

AH54.10-P-0001-01A	Notes on battery	All models	
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**General information on batteries**

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>• Do not store batteries over a longer period at a storage point with direct solar radiation.</li> <li>• Discharged or defective batteries can freeze, therefore store free from frost.</li> <li>• Avoid polarity reversal and short-circuits.</li> <li>• Do not place tool or other conducting objects on the battery (risk of short-circuit).</li> <li>• Before removal and installation of batteries all switchable current consumers should be switched off, as well as the engine switched off so that inadvertent arcing is ruled out.</li> <li>• Always disconnect the <b>negative terminal first</b> and always connect the <b>positive terminal first</b>.</li> </ul> | <ul style="list-style-type: none"> <li>• Only charge batteries with DC, 10 % of the capacity is recommended as charging current for slow charging and 50 % of the capacity recommended for fast charging.</li> <li>• Only switch on the charger after connecting to the terminals and switch off before disconnecting.</li> <li>• We recommend greasing the batteries slightly with battery terminal grease.</li> <li>• If the battery is to remain in the parked vehicle for a longer time, the negative terminal should be disconnected.</li> <li>• If possible batteries should be kept clean and dry.</li> <li>• Batteries should not be stored over a longer period without recharging.</li> </ul> |
|---|---|

**Notes on lead-gel batteries (additional battery for special bodies)**

- Lead-gel batteries are free from gassing, acid does not run out of them and are completely independent of position and maintenance free.
- When fast charging ensure that the housing of the lead-gel battery does not heat up excessively otherwise a pressure relief valve will be opened and the lead-gel battery will be defective.

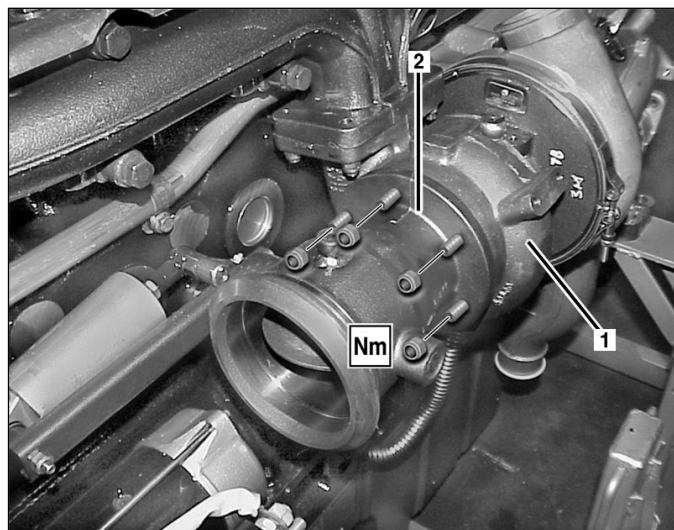
**Notes on lead acid batteries**

- Always store lead lead-acid batteries horizontally to prevent acid leaking out and do not tilt during transportation.
- When fast charging ensure that the housing of the lead-acid battery does not heat up excessively.

AR14.15-G-6302CH	Remove/install engine brake flap fittings	8.7.04
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**MODEL 000.001 with ENGINE 457.960**

- 1 Exhaust gas turbocharger
- 2 Engine brake flap fitting



W14.15-1008-11

	<b>Removal, installation</b>		
1	Remove exhaust manifold with engine brake flap fittings (2) and exhaust gas turbocharger (1)		<b>Page 171</b>
2	Remove engine brake flap fittings (2) from exhaust gas turbocharger (1)	Installation: Replace nuts 	BA09.40-N-1008-01N
3	Reinstall in opposite order		

**Turbocharger**

Number	Designation	Engine
BA09.40-N-1008-01N	Nut, engine brake flap fittings to turbocharger	457.960 Nm 50



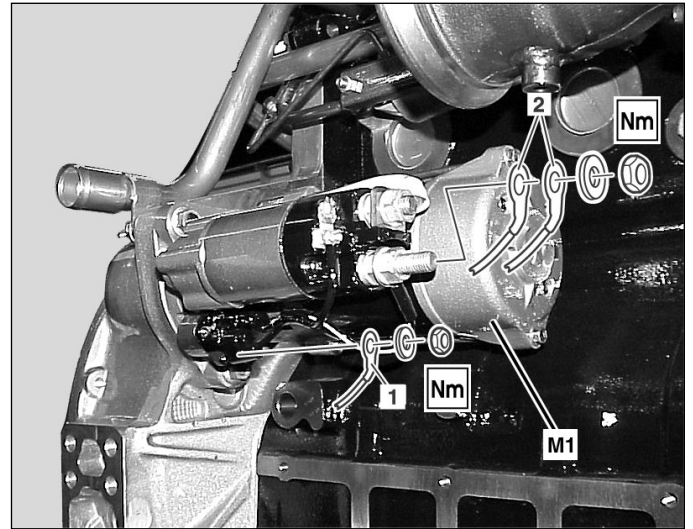


AR15.30-G-7100CH	Remove/ install starter	8.7.04
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


**MODEL 000.001 with ENGINE 457.960**

- 1 Control line
- 2 Starter line

M1 Starter



G15.30-3113-11

	Removal, installation		
 <b>Danger!</b>	Explosion hazard from explosive gas. Coolant is toxic when swallowed <b>Injury hazard</b> from burning skin and eyes with battery acid or when handling damaged lead/acid batteries	Fire, open lights and smoking prohibited. Avoid sparks. Wear acid protective gloves, clothing and goggles. Fill battery acid only in suitable and corresponding marked vessels .	<b>Page 173</b>
1 	Disconnect ground line from battery Notes on battery	All models	<b>Page 174</b>
2	Remove control line (1) and start line (2) from starter (M1)		BA15.30-N-1002-01N
3	Remove starter (M1)	 <b>Installation:</b> Lightly grease starter drive pinion and ring gear on flywheel with long-life grease 	BA15.30-N-1001-01N BR00.45-Z-1001-06A
4	Check starter drive pinion for wear	 In the event of wear replace starter (M1).	
5	Check ring gear of flywheel for wear	 If wear is present: ↓ Replace ring gear of flywheel	<b>Page 99</b>
6	Reinstall in opposite order		

 **Starter**

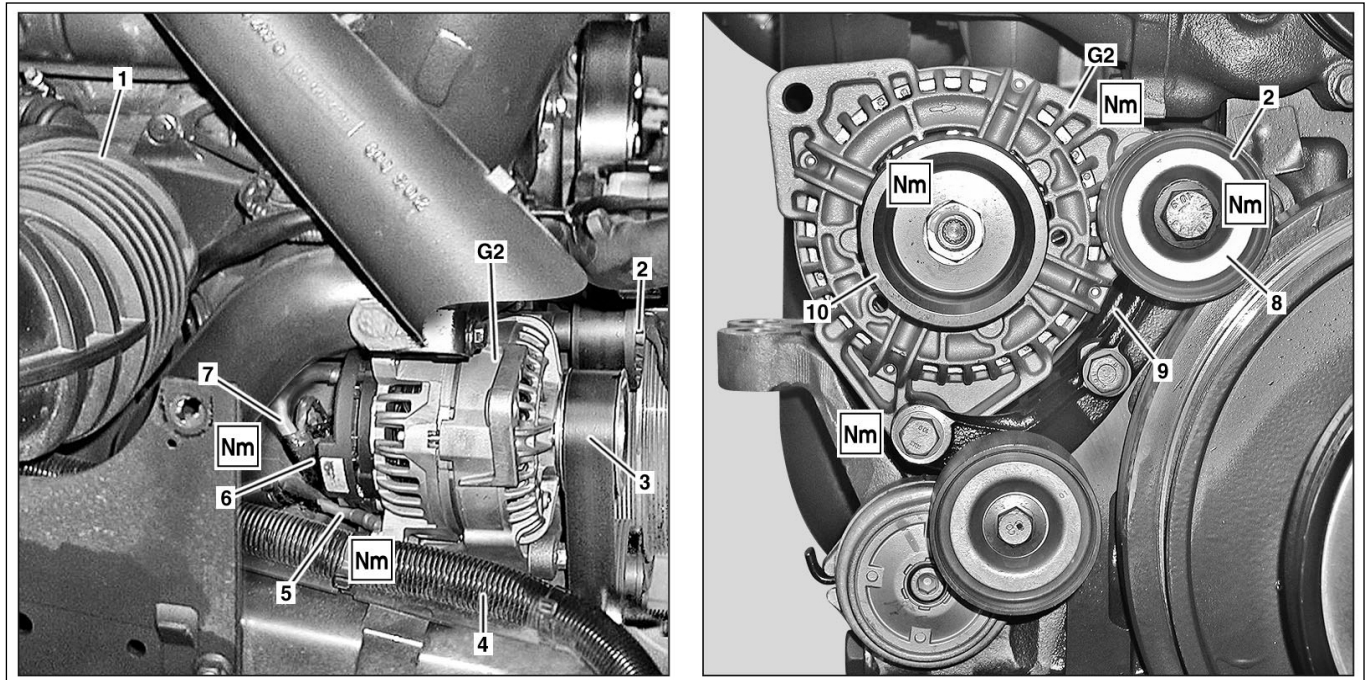
Number	Designation	Engine 457.960
BA15.30-N-1001-01N	Nut, starter to timing case	Nm 80
BA15.30-N-1002-01N	Nut, line circuit 30 to starter	Nm 30

**Repair agent**

Number	Designation	Order number
BR00.45-Z-1001-06A	MB long-life grease	000 989 63 51

AR15.40-G-5032CH	Remove/install alternator	7.7.04
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MODEL 000.001 with ENGINE 457.960



G15.40-3108-09

- |                           |                   |                |
|---------------------------|-------------------|----------------|
| 1 Air intake hose         | 5 Ground line     | 9 Carrier      |
| 2 Guide pulley            | 6 Plug            | 10 Belt pulley |
| 3 Poly-V-belt             | 7 Electrical line | G2 Alternator  |
| 4 Electric wiring harness | 8 Washer          |                |

	Removal, installation		
<p><b>⚠ Danger!</b></p> <p>1</p> <p></p>	<p><b>Explosion hazard from explosive gas. Coolant is toxic when swallowed Injury hazard from burning skin and eyes with battery acid or when handling damaged lead/acid batteries</b></p> <p>Disconnect ground line from battery</p> <p>Notes on battery</p>	<p>Fire, open lights and smoking prohibited. Avoid sparks. Wear acid protective gloves, clothing and goggles. Fill battery acid only in suitable and corresponding marked vessels .</p> <p>All models</p>	<p><b>Page 173</b></p> <p><b>Page 174</b></p>
<p>2</p>	<p><b>Injury hazard from pinching when working on springs and spring bodies under tension</b></p> <p>Release tension on poly-V-belt (3) of alternator (G2) and remove from belt pulley (10) and guide pulley (2)</p>	<p>Use only approved tensioning devices, shield hazardous area additionally if necessary. Check special tools for damage and proper function (visual inspection) Wear protective gloves.</p> <p> Remove poly-V-belt (3) only partially</p> <p> <b>Installation:</b> Observe belt route and damage pattern for poly-V-belts (3) , if necessary replace poly-V-belt (3) in the event of wear:</p> <p style="text-align: center;">↓</p> <p>Poly-V-belt route</p>	<p><b>Page 91</b></p> <p><b>Page 155</b></p> <p><b>Page 91</b></p>

AP		Damage pattern for poly-V-belt	Page 92
3	Remove guide pulley (2) and washer (8) from carrier (9)	Nm	BA13.22-N-1001-01F
4	Remove ground line (5) from alternator (G2)	Nm	BA15.40-N-1010-01O
5	Remove tie strap, unlock plug (6) with retaining bracket and pull out of alternator (G2)	<b>i</b> Installation: Additionally secure retaining bracket with tie strap	
6	Remove electrical line (7) from alternator (G2)	Nm	BA15.40-N-1002-01O
7	Remove alternator (G2) from carrier (9) and remove between charge air pipe and frame	<b>i</b> Installation: Check belt pulley (10) for alternator (G2) for damage and concentricity, if applicable: ↓ Replace belt pulley (10) For this purpose, counterhold alternator shaft with socket wrench. Nm Nm Nm	BA15.40-N-1001-01O BA15.40-N-1003-01O BA15.40-N-1004-01O
8	Reinstall in opposite order		

**Nm** Single-belt drive

Number	Designation	Engine 457.960
BA13.22-N-1001-01F	Bolt, guide pulley to carrier	Nm 50

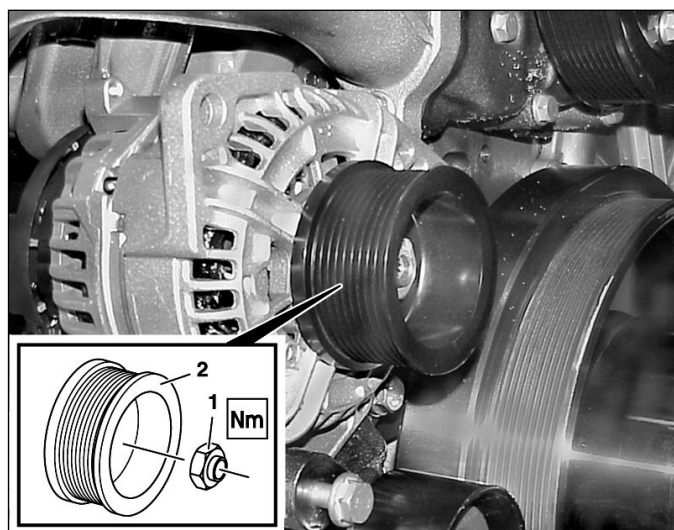
**Nm** Alternator

Number	Designation	Engine 457.960
BA15.40-N-1001-01O	Nut, belt pulley to alternator M16×1.5	Nm 70
BA15.40-N-1002-01O	Nut, electrical line to circuit B + alternator	Nm 15
BA15.40-N-1003-01O	Bolt, alternator to carrier M10	Nm 50
BA15.40-N-1004-01O	Bolt/nut, alternator to carrier M12	Nm 80
BA15.40-N-1010-01O	Bolt, ground line to alternator	Nm 12

AR15.40-G-5710CH	Remove/install belt pulley for alternator	8.7.04
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MODEL 000.001 with ENGINE 457.960

- 1 Nut
- 2 Belt pulley



G15.40-3110-11

AP	Removal, installation		
1	Release tension on poly-V-belt and remove from belt pulley (2) for alternator	<p><b>i</b> Remove poly-V-belt only partially</p> <p><b>i</b> Installation: Observe belt route and damage pattern for poly-V-belt, if necessary replace poly-V-belt if worn:</p> <p style="text-align: center;">↓</p> <p>Poly-V-belt route</p> <p>Damage pattern for poly-V-belt</p>	<p><b>Page 155</b></p> <p><b>Page 91</b></p> <p><b>Page 92</b></p>
2	Unscrew nut (1) from belt pulley (2)	<p><b>i</b> Counterhold alternator shaft with socket wrench</p> <p><b>Nm</b></p>	BA15.40-N-1001-010
3	Remove belt pulley (2) from alternator		
4	Reinstall in opposite order		

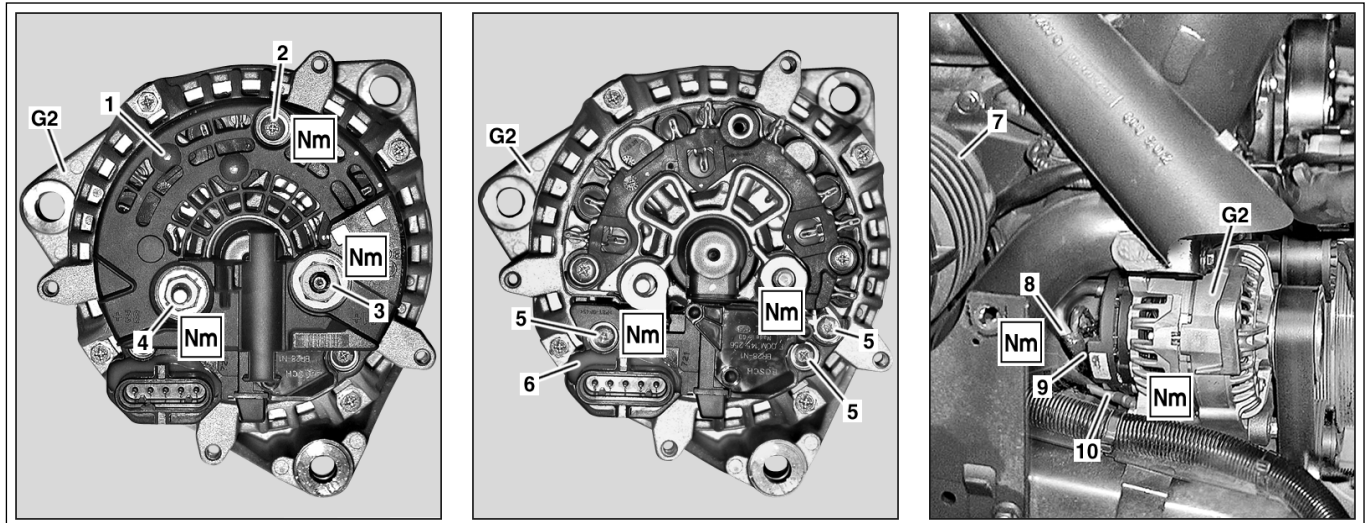
**Nm** Alternator

Number	Designation	Engine 457.960
BA15.40-N-1001-010	Nut, belt pulley to alternator M16×1.5 Nm	70



AR15.40-G-5760CH	Remove/install controller for alternator	13.7.04
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MODEL 000.001 with ENGINE 457.960



G15.40-3109-08

- |                       |                   |                |
|-----------------------|-------------------|----------------|
| 1 Cover               | 5 Bolt            | 9 Plug         |
| 2 Bolt                | 6 Controller      | 10 Ground line |
| 3 Nut for circuit B1+ | 7 Air intake hose |                |
| 4 Nut for circuit B2+ | 8 Electrical line | G2 Alternator  |

	Removal, installation		
1	Switch off ignition		
<b>Danger!</b>	<b>Explosion hazard from explosive gas.</b> When swallowed battery acid is toxic and caustic. <b>Injury hazard from burning skin and eyes with battery acid or when handling damaged lead/acid batteries.</b>	Fire, open lights and smoking prohibited. Avoid sparks. Wear acid protective gloves, clothing and goggles. Fill battery acid only in suitable and corresponding marked vessels.	<b>Page 173</b>
2 	Disconnect ground line from battery Notes on battery	All models	<b>Page 174</b>
3	Remove air intake hose (7)		<b>Page 141</b>
4	Remove ground line (10) from alternator (G2)		BA15.40-N-1010-010
5	Remove tie strap, unlock connector (9) with retaining bracket and pull out of alternator (G2)	<b>Installation:</b> Additionally secure retaining bracket with tie strap	
6	Remove electrical line (8) from alternator (G2)		BA15.40-N-1002-010
7	Unscrew bolt (2), nut for circuit B1+ (3) and nut for circuit B2+ (4) and remove cover (1) from alternator (G2)	 	BA15.40-N-1007-010 BA15.40-N-1011-010
8	Unscrew bolts (5)		BA15.40-N-1008-010
9	Remove controller (6)	Check regulator carbon brushes length (6) for wear: ↓ Check regulator carbon brushes length (6)	<b>Page 184</b>



		<p><b>i</b> Installation: Check both slip rings of alternator (G2) for scores; if necessary, replace alternator (G2):</p> <p style="text-align: center;">↓</p> <p>Replace alternator (G2)</p>	BE15.40-N-1001-02E
10	Reinstall in opposite order		<b>Page 179</b>

Test values for controller

Number	Designation	Engine 457.960
BE15.40-N-1001-02E	Carbon brushes length mm	≥ 5.0

**Nm** Alternator

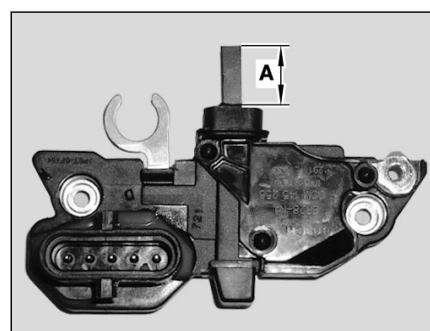
Number	Designation	Engine 457.960
BA15.40-N-1002-01O	Nut, electrical line to circuit B + alternator	Nm 15
BA15.40-N-1007-01O	Bolt, cover to alternator housing	Nm 4
BA15.40-N-1008-01O	Bolt, controller to alternator housing	Nm 2
BA15.40-N-1010-01O	Bolt, ground line to alternator	Nm 12
BA15.40-N-1011-01O	Nut, cover to circuits B1 + and B2 + alternator	Nm 15

AR15.40-G-5033-02CH	Check controller carbon brush length		
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Test values for controller

Number	Designation	Engine 457.960
BE15.40-N-1001-02E	Carbon brush length mm	≥ 5.0

- 1 Check carbon brush length (A) on controller carbon brush  
**i** If the minimum dimension of a carbon brush is not achieved, replace controller



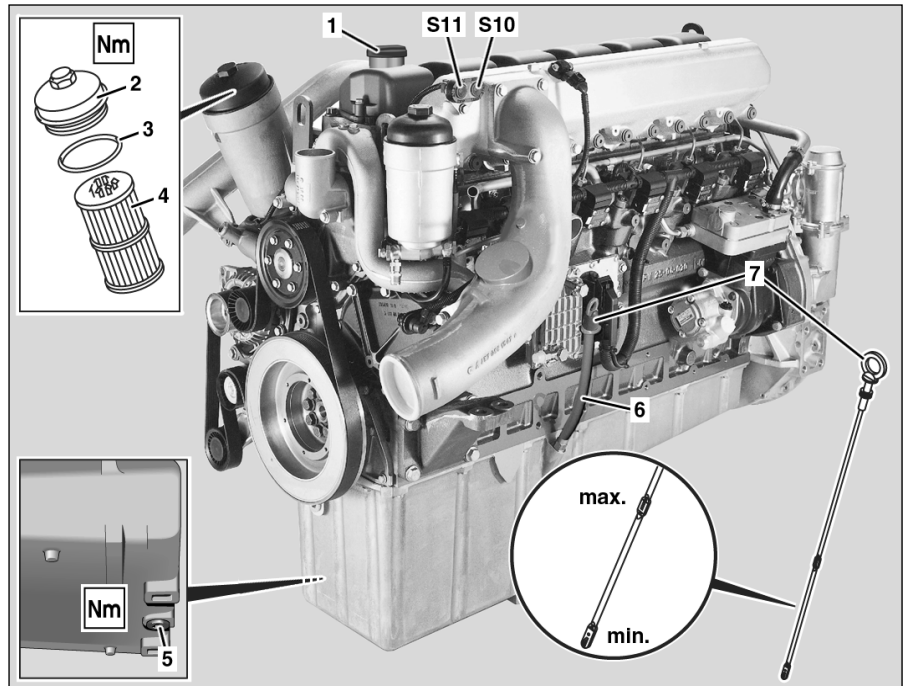
W15.40-1065-01

AP18.00-G-0101CH	Engine: change oil and replace filter	14.7.04
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**ENGINE 457.960 in MODEL 000.001**

- 1 Cap (oil replenishment)
- 2 Oil filter cover
- 3 Sealing ring
- 4 Oil filter element
- 5 Oil drain screw
- 6 Oil dipstick guide tube
- 7 Dipstick

- S10 Engine start pushbutton switch
- S11 Engine stop pushbutton switch




G18.00-3126-06

<b>Danger!</b>	Risk of accident caused by vehicle starting off by itself when engine is running. Risk of injury caused by contusions and burns when working in engine during starting procedure	Secure vehicle to prevent it from moving. Wear closed and snug-fitting work clothes. Do not grasp hot or rotating parts.	<b>Page 9</b>
	Notes on engine oil	Engine 457.960	<b>Page 187</b>
1	Allow the engine to run until normal operating temperature is reached	Change engine oil only when the engine is at normal operating temperature.	
2	Replace oil filter element (4)		<b>Page 187</b> BA18.20-N-1006-01N
3.1	Suction off engine oil via oil dipstick guide tube (6)	Observe user manual provided by manufacturer of engine oil extractor.  	WH58.30-Z-1004-16A WH58.30-Z-1007-16A
3.2.1	Unscrew the oil drain screw (5) on the oil pan and drain the engine oil	Let the engine oil drain off completely.	
3.2.2	Screw in oil drain screw (5) and tighten fully	Replace sealing ring for oil drain screw (5) 	BA01.45-N-1001-01N
4	Open the cap (1) and fill engine oil to the specified filling capacity through the filler hole		BF18.00-N-1001-01K
	<b>Check</b>		


5	Press and hold down engine stop pushbutton switch (S11), then press engine start pushbutton switch (S10) until engine reaches its oil pressure at cranking speed	<p>⚠️ Crank the engine for max. 20 s Repeat the starting procedure after about one minute so that the starter does not get damaged.</p> <p>ℹ️ The engine does not start when the start engine pushbutton switch and stop engine pushbutton switch are (S11) pressed at the same time (S10). After reaching oil pressure on oil pressure display, release engine stop button (S11)</p>	
6	Allow engine to idle for 1 minute and observe oil pressure display		BE18.00-N-1001-01L
7	Turn off engine		
8	Wait at least five minutes and then check the oil level on the oil dipstick. Correct it if necessary	<p>ℹ️ The waiting time must be maintained The oil level must be located directly under the max. marking on the oil dipstick (7).</p>	
9	Check the oil filter cover (2) and the oil drain screw (5) of the oil pan for leaks		

Engine oil pressure test data


Number	Designation	Engine 457.960
BE18.00-N-1001-01L	Engine oil pressure at	Idling speed bar $\geq 0.5$
		Maximum speed bar $\geq 2.5$

 Oil pan

Number	Designation	Engine 457.960
BA01.45-N-1001-01N	Oil drain screw to oil pan M20 × 1.5 Nm	60

 Oil filter

Number	Designation	Engine 457.960
BA18.20-N-1006-01N	Oil filter cap to oil filter housing Nm	40

 Engine lubrication

Number	Designation	Engine 457.960
BF18.00-N-1001-01K	Engine oil	
	Filling capacity without oil filter	Liters $\approx 36$
	Filling capacity with oil filter	Liters $\approx 39$
	Specifications for Operating Fluids	Sheet BB00.40-P-0228-01A
		Sheet BB00.40-P-0228-03A
	Sheet BB00.40-P-0228-05A	
	Sheet BB00.40-P-0228-51A	

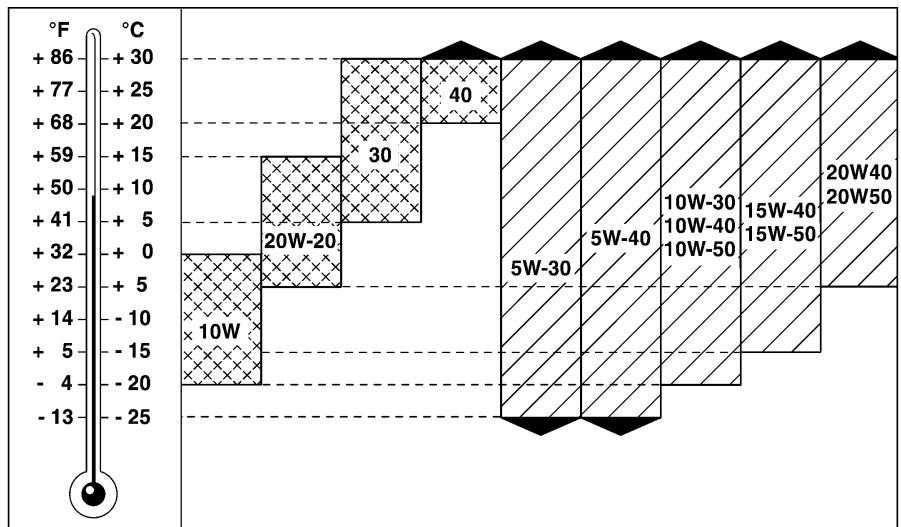
Commercially available tools (see Workshop Equipment Manual)

Number	Designation	Make (e. g.)	Order number
WH58.30-Z-1004-16A	Engine oil extractor	Flaco Geräte GmbH Isselhorsterstr. 379 D-33334 Gütersloh	40 403 200
WH58.30-Z-1007-16A	Engine oil extractor	Deutsche Tecalemit Am Metallwerk 11 33659 Bielefeld	1.386950.2

AH18.00-N-0101-01CH	Notes on engine oil	Engine 457.960	
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**SAE viscosity grades**

The SAW class (viscosity) must be selected in accordance with the average season-dependent air temperature. A precise application of the SAE classes on the basis of the ambient air temperature would require more frequent engine-oil changes. The temperature ranges for the SAE classes (viscosity) are therefore to be observed as a guideline which can be exceeded or dropped below for a short time.



N18.00-2074-05

**Specified engine oil qualities**

Engine oils which are approved in the particular valid **MB Specifications for Operating Fluids** with an indication of their brand name, are authorized for use. The oil grades of the different engine oil qualities are listed under the respective sheet number.

The intervals for the engine oil and filter change depend on the quality of the engine oil, the sulfur content of the fuel as well as on vehicle operation.

**Engine oil change intervals**

Change engine oil and filter at least once a year.

Due to the different conditions of use for the engine, it is necessary to observe different engine oil change intervals. The engine oil change intervals are given in the **Maintenance booklet**.

**Note**

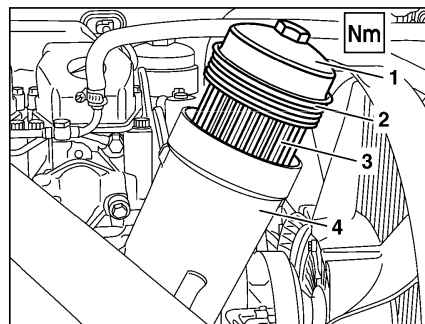
If the sulfur content in the fuel is greater than 0.3 %-by-weight, other engine oil change intervals must be observed. See **Maintenance booklet**

AP18.20-G-0100-04CH	Replace oil filter element		
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**Oil filter**

Number	Designation	Engine 457.960
BA18.20-N-1006-01N	Oil filter cap to oil filter housing	Nm 40

- 1 Oil filter cover
- 2 Sealing ring
- 3 Oil filter element
- 4 Oil filter housing

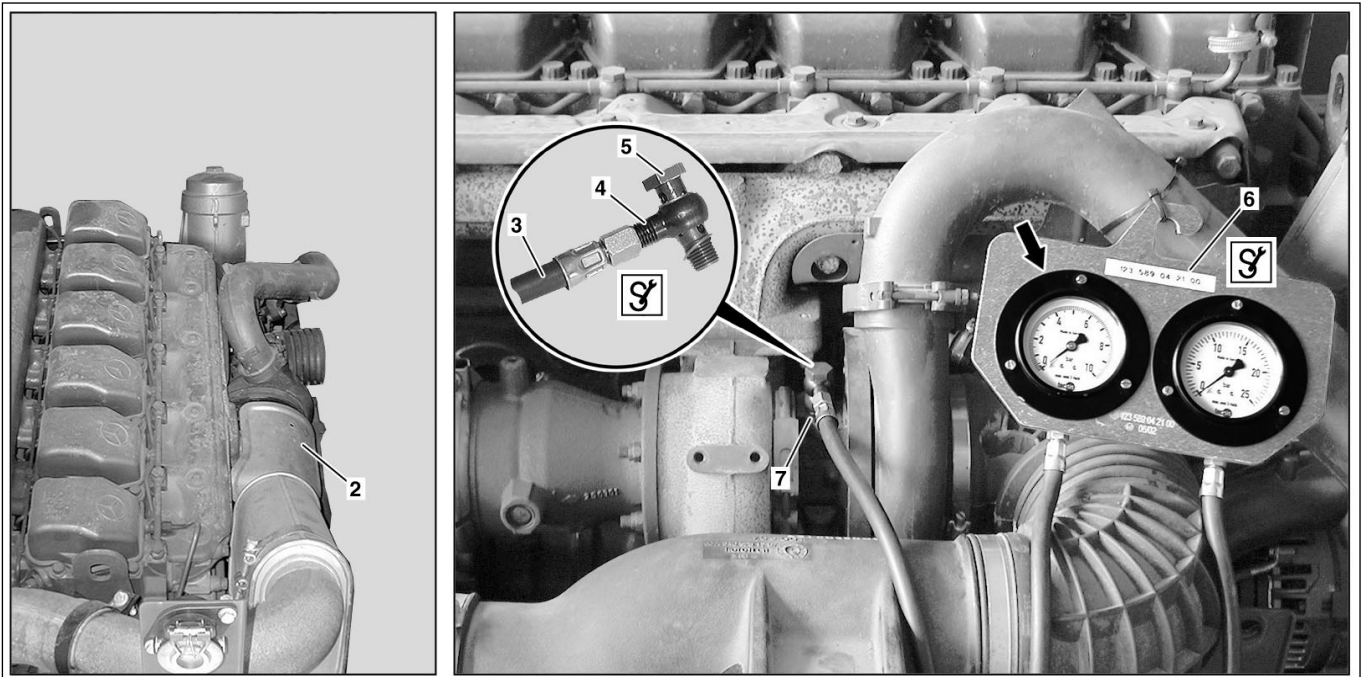


G18.20-3128-01

- 1 Unscrew oil filter cover (1) from oil filter with 36 mm socket wrench bit.  
i Allow oil to drain out of oil filter housing (4).
- 2 Remove oil filter cover (1) together with oil filter element (3) from oil filter housing (4).  
i Never wipe out oil filter housing (4). Ensure that no foreign bodies get into the oil filter housing (4).
- 3 Unclip oil filter element (3) from oil filter cover (1) by pressing on side.
- 4 Replace sealing ring (2).  
i Grease sealing ring (2) slightly.
- 5 Install new oil filter element (3) in oil filter cover (1).
- 6 Nm Screw oil filter cap (1) with oil filter element (3) into oil filter housing (4) and tighten with 36 mm socket wrench bit.

AR18.00-G-1250CH	Check oil pressure	8.7.04
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MODEL 000.001 with ENGINE 457.960



G18.00-3123-09

- 1 Soundproofing
- 2 Heat shield
- 3 Test line
- 4 Adapter
- 5 Double banjo bolt
- 6 Tester
- 7 Exhaust gas turbocharger

	<b>Removal, installation</b>		
1 	Check engine oil level, correct if necessary Engine, oil and filter change		<b>Page 185</b>
2	Remove heat shield (2) from exhaust gas turbocharger (7)		
3	Remove banjo bolt from oil pressure line on exhaust gas turbocharger (7)	Installation: Replace sealing rings.  	BA09.40-N-1001-01N
	<b>Test</b>		
4	Install adapter (4) on test line (3) of tester (6)	Use test line (3) of pressure gauge indicator (arrow) with a test pressure of max. 10 bars   	123 589 04 21 00 541 589 00 91 00
5	Install adapter (4) with double banjo bolt (5) on connector for oil pressure line on exhaust gas turbocharger (7)	Use new sealing rings   	BA09.40-N-1001-01N 541 589 00 91 00

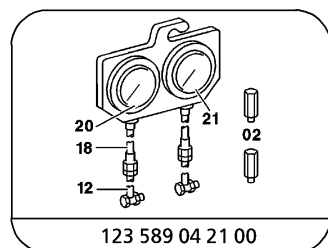
6	<b>⚠ Danger!</b>	<b>Accident hazard</b> resulting from vehicle starting to move by itself with engine running. <b>Injury hazard</b> resulting from pinching and burning when reaching in during the starting operation or with the engine running.	Secure vehicle against starting to move unintentionally. Wear closed and tight work clothing Do not reach into hot or rotating parts	<b>Page 9</b>
		Crank the engine and heat up to operating temperature	Coolant temperature approx. 70 to 95 °C.	
7		Check oil pressure		BE18.00-N-1001-01L
8		Reinstall in opposite order		

Test values for oil pressure

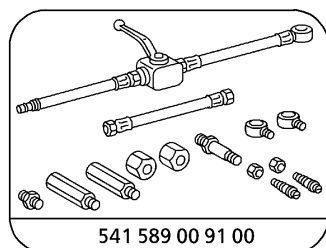
Number	Designation	Engine 457.960
BE18.00-N-1001-01L	Engine oil pressure at	Idle speed bar $\geq 0.5$
		Max. speed bar $\geq 2.5$

**Nm** Turbocharger

Number	Designation	Engine 457.960
BA09.40-N-1001-01N	Bolt, oil pressure line to exhaust gas turbocharger	Nm 25






Tester

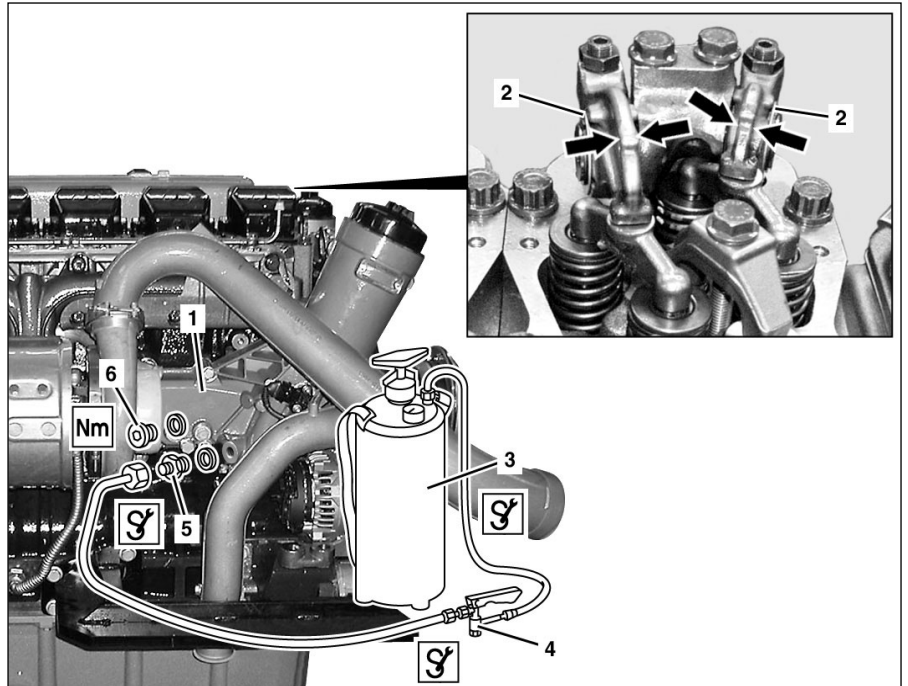


Adaptation parts














AR18.00-G-1600CH	Fill engine oil circuit	8.7.04
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MODEL 000.001 with ENGINE 457.960

- 1 Oil filter housing
- 2 Rocker arm
- 3  Oil replenishing canister
- 4  Shut-off valve
- 5  Adapter
- 6 Screw plug (M33×2)



G18.00-3125-06

 	Removal, installation		
1	Remove cylinder head cover	 Only on 1st cylinder head.	<b>Page 15</b>
2	Remove crankcase breather line from air intake hose		
3	Remove air intake hose to exhaust gas turbocharger	 Check air intake hose and hose clamps for condition, replace if necessary.	
4	Unscrew screw plug (6) from oil filter housing (1)		BA18.20-N-1005-01N
5	Tighten adapter (5) with sealing ring on oil filter housing (1)		541 589 02 63 00
6	Tighten connection hose for oil replenishing canister (3) on adapter (5)	 	352 589 11 63 00 541 589 02 63 00
	<b>Filling</b>		
7  <b>BB</b>	Fill oil replenishing canister (3) and close	 With 5 l of specified engine oil: ↓ Specified engine oils (service) - Survey 	BB00.40-P-0223-02A 352 589 11 63 00
8	Pump up to gauge pressure of approx. 3 bar with manual pump installed on oil replenishing canister (3)	 Shut-off valve (4) is closed 	352 589 11 63 00



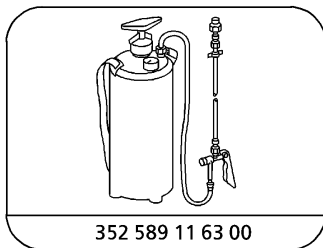
9	Open shut-off valve (4) until approx. 4.0 l of engine oil are pumped from the oil replenishing canister (3) into the oil ducts and the engine oil exits free of bubbles from the holes (arrows) in the rocker arm (2)	<p><b>i</b> Do not allow pressure gauge to drop below 1.5 bars in the oil replenishing canister (3), if necessary pump again</p> <p>Do not drain oil replenishing canister (3) completely, because otherwise air would be sucked in</p> <p><b>G</b></p>	352 589 11 63 00
10	Reinstall in opposite order		
11	Fill remaining engine oil into engine		<b>Page 185</b>
<b>AP</b>	Engine, oil and filter change		
<b>!</b> <b>Danger!</b>	<b>Accident hazard</b> resulting from vehicle starting to move by itself with engine running. <b>Injury hazard</b> resulting from pinching and burning when reaching in during the starting operation or with the engine running.	Secure vehicle against starting to move unintentionally. Wear closed and tight work clothing Do not reach into hot or rotating parts	<b>Page 9</b>
12	Crank the engine and allow to idle	<p><b>C</b> Crank the engine with starter for max. 20 s Wait approx. 1 minute before attempting to start again to prevent damage to starter.</p> <p>Do not increase engine speed as long as the oil pressure is not indicated.</p> <p><b>i</b> The oil pressure indicator should indicate the oil pressure after approx. 10 s.</p>	BE18.00-N-1001-01L
13	Shut off engine and check for leakage	<b>i</b> Visual inspection.	
14	Check engine oil level with oil dipstick		<b>Page 185</b>
<b>AP</b>	Engine, oil and filter change		

Test values for oil pressure

Number	Designation	Engine 457.960
BE18.00-N-1001-01L	Engine oil pressure at	Idle speed      bar $\geq 0.5$
		Max. speed      bar $\geq 2.5$

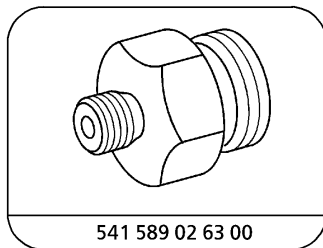
**Nm** Oil filter

Number	Designation	Engine 457.960
BA18.20-N-1005-01N	Screw plug (oil circuit filling) on oil filter housing M33×2	Nm 80



352 589 11 63 00

Oil filter reservoir



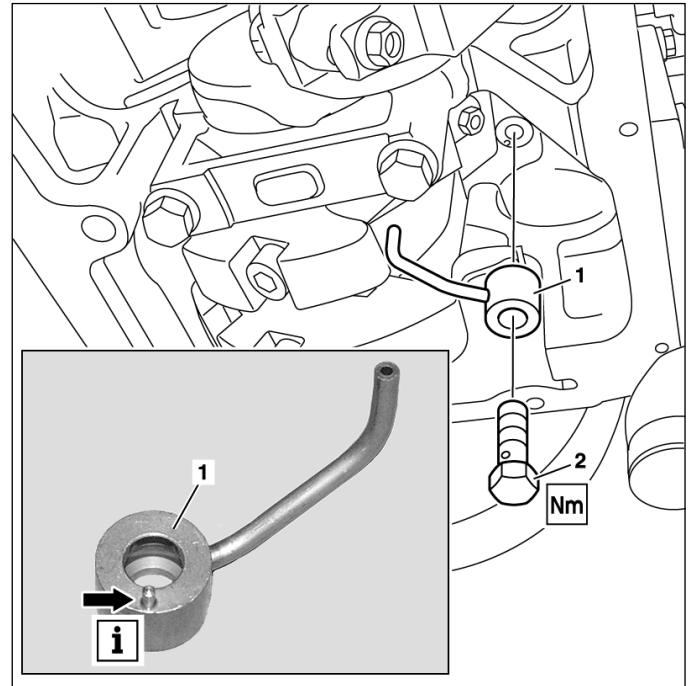
541 589 02 63 00

Adapter M33

AR18.00-G-4000CH	Remove/install oil spray nozzles (piston)	8.7.04
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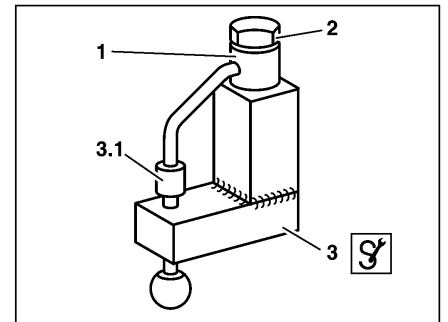
MODEL 000.001 with ENGINE 457.960

- 1 Oil spray nozzle
- 2 Banjo bolt



G18.00-3124-12

- 1 Oil spray nozzle
- 2 Banjo bolt
- 3 Gauge
- 3.1 Guide



W18.00-1010-01

	Removal, installation		
1	Remove oil pan		<b>Page 51</b>
2	Convert turning device	Only turning devices as of production date "07/2001" (see stamp) can be transferred 	<b>Page 194</b> 904 589 04 63 00
3	Install turning/blocking device for engine	 	<b>Page 195</b> BA01.60-N-1001-01K 904 589 04 63 00
4	Turn crankshaft with turning/blocking device until the oil spray nozzle (1) is accessible	All oil spray nozzles (1) can be removed with 3 crankshaft positions: Oil spray nozzles (1) for cylinders 1/6, 2/5 and 3/4.	
5	Unscrew banjo bolt (2) and remove oil spray nozzle (1)	<b>Installation:</b> The dowel pin (arrow) on the oil spray nozzle (1) should catch in the hole in the crankcase. 	BA18.00-N-1001-01I

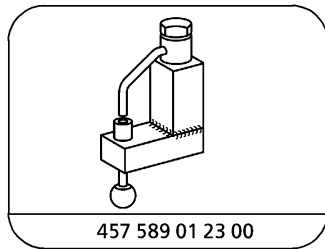
	Test		
6	Check dowel pin (arrow) on oil spray nozzle (1) for damage	If event of damage replace oil spray nozzle (1)	
7	Install oil spray nozzle (1) on gauge (3) Check oil splasher pipe with guide (3.1)	If the oil splasher pipe is bent or oil spray nozzle (1) damaged, replace oil spray nozzle (1) otherwise the pistons are not sufficiently cooled and the piston pins not correctly lubricated. 	457 589 01 23 00
8	Reinstall in opposite order		

Timing case

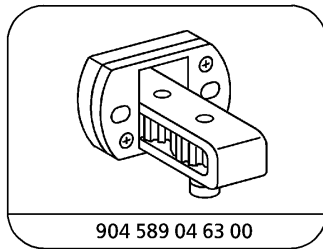
Number	Designation	Engine 457.960
BA01.60-N-1001-01K	Bolt, cap on observation hole to timing case	Nm 25

Engine lubrication, engine oil cooling, general

Number	Designation	Engine 457.960
BA18.00-N-1001-01I	Banjo bolt, oil spray nozzle (piston cooling) to crankcase	Nm 40

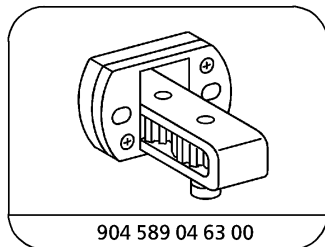


Gauge






Turning device





AR03.30-G-1600-04CH	Convert cranking device		
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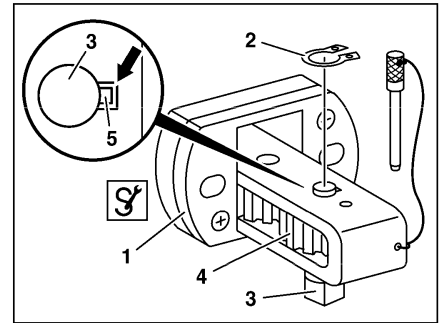


Cranking device








ⓘ Only  cranking devices (1) which have a groove (arrow) under the circlip (2) can be converted (see production date stamp as of "07/2001"). On older or other cranking devices without this groove (arrow) problems can occur when pivot bolt (3) is removed.

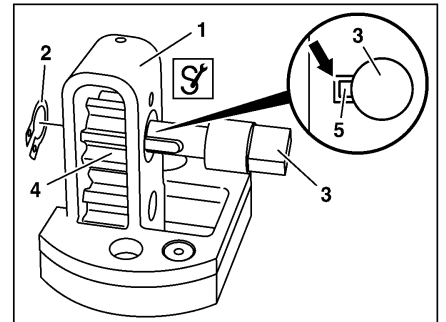
 This work sequence is illustrated with a  cranking device (1) with groove (arrow).

- 1 Remove circlip (2) from  cranking device (1).
- 2 Turn pivot bolt (3) until the Woodruff key (5) is visible in the groove (arrow).
- 3 Drive pivot bolt (3) out of  cranking device (1) with brass punch.  
 The gear (4) falls out of the  cranking device (1). Check Woodruff key (5) for damage; if necessary remachine Woodruff key (5).



G58.20-3110-01

- 4 Install gear (4) in  cranking device (1) and align through hole.  
 Ensure that the groove (arrow) in the  cranking device (1) coincides with the recess in the gear (4).
- 5 Drive pivot bolt (3) into  cranking device (1) observing the opposite installation position of the pivot bolt (3).  
 Do not damage the groove (arrow) and the Woodruff key (5).
- 6 Attach circlip (2) to  cranking device (1).
- 7 Oil moving parts of  cranking device (1).



G58.20-3109-01

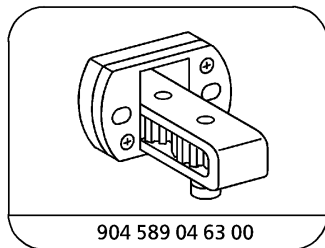
AR03.30-W-1600-03A	Attach cranking/blocking device for engine, detach		
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 Timing case

Number	Designation	Engines 900.9, 902.9, 904.9, 906.9	Engines 924.9, 926.9
BA01.60-N-1002-01A	Inspection hole closure cover to timing case	Nm 25	25

 Timing case




Number	Designation	Engine 457.9
BA01.60-N-1001-01M	Bolt, inspection hole cover to timing case	Nm 25

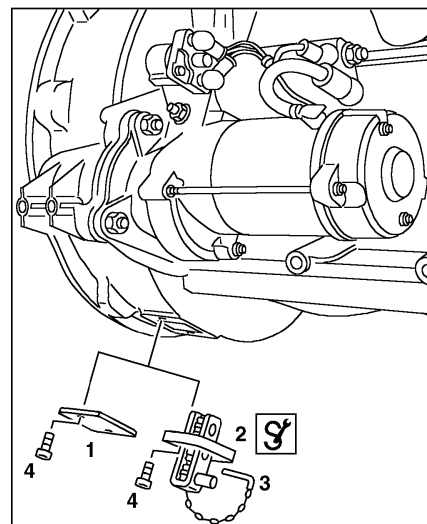


904 589 04 63 00

Cranking device

**Shown on engine 904**

- 1 Remove noise encapsulation below the timing case.
- 2 Remove cover (1) at timing case.
- 3  Use suitable bolts (4) to bolt cranking device (2) tight at timing case.
-  The cranking device (2) must be dismantled before the engine is started, otherwise it may damage the flywheel or the timing case.
-  The cranking device (2) can also be used to insert the pin (3) to lock the engine.
- 4 Remove in the reverse order.

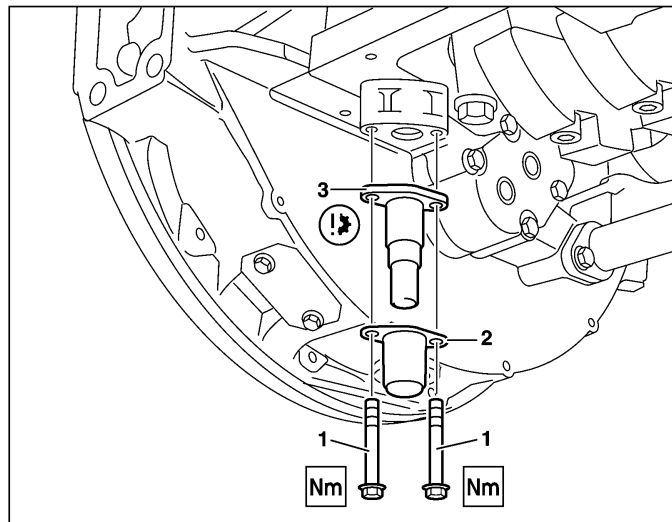


W03.30-0001-02

AR18.10-G-5031CH	Remove/install oil pressure relief valve	8.7.04
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MODEL 000.001 with ENGINE 457.960

- 1 Bolt
- 2 Cap
- 3 Oil pressure relief valve



G18.10-3107-11

⊠ ⊠	Removal, installation		
1	Remove oil pan		Page 51
2	Unscrew bolts (1) and remove protective cap (2) together with oil pressure relief valve (3)	<p>⚠ Do not disassemble oil pressure relief valve (3). In the event of complaint replace oil pressure relief valve (3).</p> <p><b>i</b> Catch engine oil running out in suitable vessel</p> <p><b>Nm</b></p>	BA18.10-N-1001-01N
3	Clean sealing surface		
4	Reinstall in opposite order		
5	Fill engine oil circuit		Page 191

**Nm** Oil pump

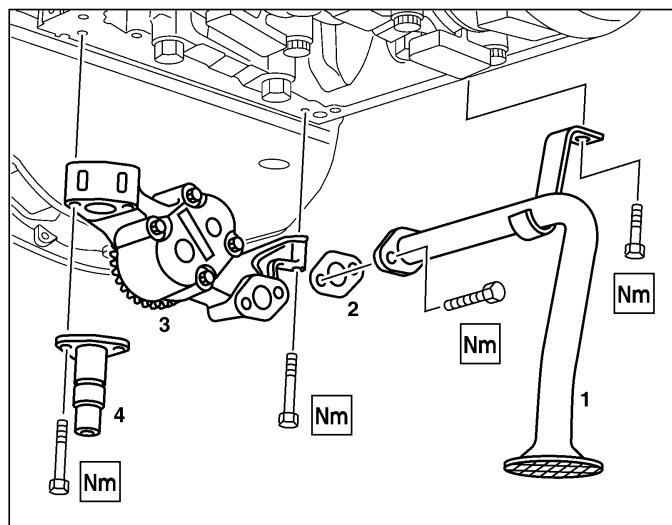
Number	Designation	Engine 457.960
BA18.10-N-1001-01N	Bolt, oil pump with pressure relief valve to crankcase	Nm 35



AR18.10-G-6020CH	Remove/install oil pump	8.7.04
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**MODEL 000.001 with ENGINE 457.960**

- 1 Oil suction pipe
- 2 Gasket
- 3 Oil pump
- 4 Oil pressure relief valve



G18.10-3106-11

	Removal, installation		
1	Remove oil pan		<b>Page 51</b>
2	Remove oil pressure relief valve (4)		<b>Page 197</b>
3	Remove mount for oil suction pipe (1) from crankcase		
4	Remove oil suction pipe (1) from oil pump (3)	Installation: Install new seal (2). 	BA18.10-N-1003-01N
5	Remove oil pump (3) from crankcase		BA18.10-N-1002-01N
6	Clean sealing surface on oil pump (3), on oil suction pipe (1) and on crankcase		
7	Reinstall in opposite order		

**Oil pump**

Number	Designation	Engine 457.960	
BA18.10-N-1002-01N	Bolt, oil pump to crankcase	Nm	35
BA18.10-N-1003-01N	Bolt, intake manifold to oil pump	Nm	25

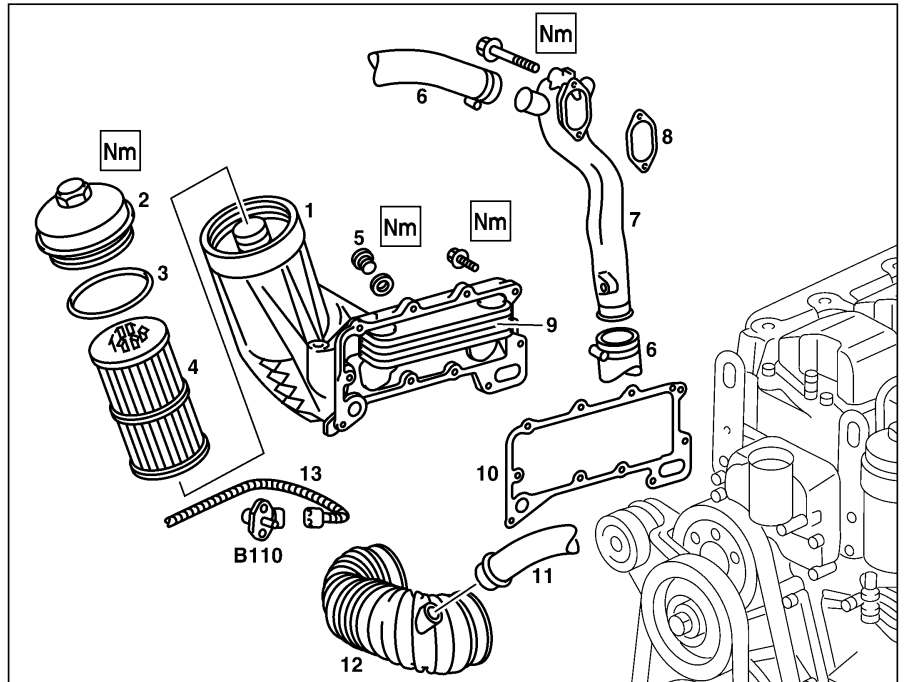




AR18.20-G-3471CH	Remove/install oil filter housing	8.7.04
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**MODEL 000.001 with ENGINE 457.960**






- 1 Oil filter housing
- 2 Oil filter cover
- 3 Sealing ring
- 4 Oil filter element
- 5 Screw plug (M14×1.5)
- 6 Coolant hose
- 7 Coolant inlet fitting
- 8 Gasket
- 9 Oil/water heat exchanger
- 10 Gasket
- 11 Crankcase breather line
- 12 Air intake hose
- 13 Engine wiring harness
  
- B110 Oil combination sensor  
(temperature, pressure)



G18.20-3127-06

	<b>Removal, installation</b>		
<b>Danger!</b>	<b>Accident hazard</b> resulting from vehicle starting to move by itself with engine running. <b>Injury hazard</b> resulting from pinching and burning when reaching in during the starting operation or with the engine running.	Secure vehicle against starting to move unintentionally. Wear closed and tight work clothing Do not reach into hot or rotating parts	<b>Page 9</b>
<b>Danger!</b>	<b>Injury hazard</b> Danger of severe burns to skin and eyes from hot coolant spewing out Coolant is toxic if swallowed	Open cooling system only at coolant temperatures below 90 °C Slowly open cover and relieve pressure Do not fill beverage containers with coolant. Wear protective gloves, protective clothing and protective goggles.	<b>Page 26</b>
	Notes on coolant	All engines	<b>Page 168</b>
1	Drain coolant and catch	<b>Installation:</b> Add only corrosion/frost protection agents approved according to coolant regulations to prevent damaging the engine. Observe the following: ↓ Sheet 310.1 Sheet 325.2	BB0.40-P-0310-01A BB0.40-P-0325-02A
<b>BB</b> <b>BB</b>	Coolant regulations Corrosion/frost protection agent		
2	Remove charge air pipe		<b>Page 149</b>
3	Remove crankcase breather line (11) and air intake hose (12) to exhaust gas turbocharger	Check air intake hose (12) and hose clamps for damage, replace if necessary	<b>Page 141</b>
4	Remove exhaust manifold with engine brake flap fittings and exhaust gas turbocharger		<b>Page 171</b>

5	Unscrew oil filter cover (2) with oil filter element (4)	<p><b>i</b> When screwing out the engine oil returns to the oil pan from the oil filter housing (1).</p> <p><b>Nm</b></p>	BA18.20-N-1006-01N
6	Detach engine wiring harness (13) from coolant inlet fitting (7)		
7	Remove alternator	<p><b>⚠</b> Do not kink or damage poly-V-belt, otherwise the engine can be damaged by poly-V-belts tearing off.</p> <p><b>i</b> Only take poly-V-belt for fan and alternator off of belt pulley, do not remove</p>	<b>Page 179</b>
8	Remove coolant inlet fitting (7) from coolant pump	<p><b>i</b> <b>Installation:</b> Replace sealing ring (8)</p> <p><b>Nm</b></p>	BA20.10-N-1002-01O
9	Disconnect engine wiring harness (13) from oil combination sensor (B110)		
10	Pull out oil filter cover (2) and oil filter element (4)	<b>i</b> <b>Installation:</b> Check sealing ring (3), replace if necessary	
11	Check whether oil filter element (4) is damaged or soiled	<p><b>i</b> If damaged or soiled replace oil filter element (4):</p> <p style="text-align: center;">↓</p> <p>Replace oil filter element</p>	<b>Page 187</b>
12	Unscrew screw plug (5) and drain remaining coolant from oil/water heat exchanger	<p><b>i</b> Catch coolant running out.</p> <p><b>Nm</b></p>	BA18.20-N-1007-01N
13	Remove oil filter housing (1) from crankcase	<p><b>i</b> Catch coolant and engine oil running out</p> <p>When replacing oil filter housing (1) transfer following parts to new oil filter housing (1):</p> <p style="text-align: center;">↓</p> <p>Oil/water heat exchanger (9)</p> <p>Remove, install oil/water heat exchanger</p> <p>Oil combination sensor (B110)</p> <p>Remove, install oil pressure, oil temperature sensor</p> <p><b>Nm</b> Screw plug (oil circuit filling) with new sealing rings</p> <p><b>Nm</b> Lock bolts on oil cooler housing with new sealing rings</p>	<p>BA18.20-N-1004-01N</p> <p><b>Page 205</b></p> <p><b>Page 207</b></p> <p>BA18.20-N-1005-01N</p> <p>BA18.20-N-1007-01N</p>
14	Drain remaining engine oil from oil filter housing (1) and catch		
15	Drain remaining engine oil from oil/water heat exchanger (9) and catch	<b>i</b> For this purpose, press oil retention valve into oil/water heat exchanger.	
16	Remove gasket (10) and clean sealing surface	<b>i</b> <b>Installation:</b> Replace gasket.	
17	Check oil/water heat exchanger (9) for outer damage	<p><b>i</b> In the event of damage:</p> <p style="text-align: center;">↓</p>	


		Replace oil/water heat exchanger (9)	Page 205
18	Reinstall in opposite order	 Install air intake hose (12) to exhaust gas turbocharger first after filling engine oil circuit.	
19	Fill engine oil circuit		Page 191
20	Check engine oil level with oil dipstick  Engine oil and filter change		Page 185
21	Crank the engine and allow to idle	Do not increase  engine speed as long as oil pressure is not indicated to prevent damaging the engine.  The oil pressure indicator should indicate the oil pressure after approx. 10 s.	BE18.00-N-1001-01L
22	Shut off engine and check for leakage	 Visual inspection.	

Test values for oil pressure

Number	Designation	Engine 457.960
BE18.00-N-1001-01L	Engine oil pressure at	Idle speed      bar      ≥ 0.5
		Max. speed      bar      ≥ 2.5

 Oil filter

Number	Designation	Engine 457.960
BA18.20-N-1004-01N	Bolt, oil filter/oil cooler housing to crankcase	Nm 50
BA18.20-N-1005-01N	Screw plug (oil circuit filling) on oil filter housing M33×2	Nm 80
BA18.20-N-1006-01N	Oil filter cover to oil filter housing	Nm 40
BA18.20-N-1007-01N	Lock bolts to oil cooler housing	M12×1.5      Nm      20
		M14×1.5      Nm      20
		M22×1.5      Nm      20
		M30×1.5      Nm      40

 Coolant pump, coolant thermostat

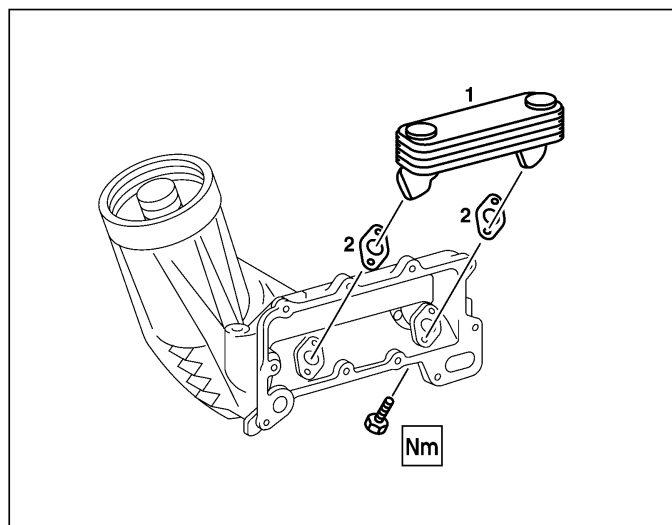
Number	Designation	Engine 457.960
BA20.10-N-1002-01O	Bolt, coolant inlet fitting to coolant pump	Nm 50



AR18.30-G-6840CH	Remove/install oil/water heat exchanger	8.7.04
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MODEL 000.001 with ENGINE 457.960

- 1 Oil/water heat exchanger
- 2 Gasket



G18.30-3109-11

	Removal, installation		
1	Remove oil filter housing		<b>Page 201</b>
2	Remove oil/water heat exchanger (1)	<p> Replace oil/water heat exchanger (1) in the event of outer damage and engine abrasion in engine oil</p> <p></p>	BA18.30-N-1001-01P
3	Remove gasket (2)	<p> <b>Installation:</b> Clean sealing surfaces and replace gasket (2). Do not use emery paper for cleaning</p>	
4	Reinstall in opposite order		

Oil cooler

Number	Designation	Engine	
BA18.30-N-1001-01P	Bolt, oil/water heat exchanger to oil cooler housing	457.960	Nm 25

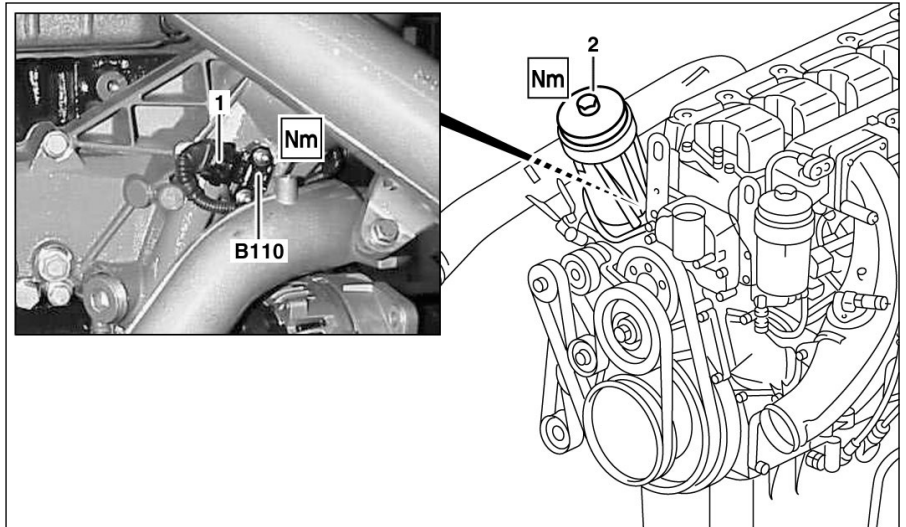


AR18.40-G-4133CH	Remove/install oil pressure, oil temperature sensor	19.7.04
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**MODEL 000.001 with ENGINE 457.960**

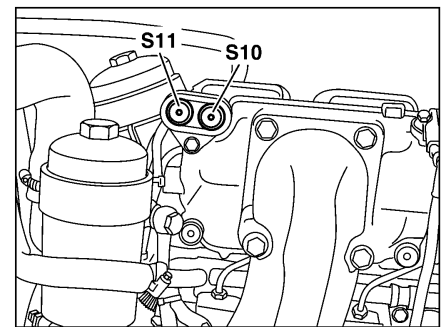
- 1 Engine wiring harness connector
- 2 Oil filter cover

B110 Oil combination sensor  
(temperature, pressure)



G18.40-3110-05

- S10 Engine start pushbutton switch
- S11 Engine stop pushbutton switch



N01.00-2325-01

	Removal, installation		
1	Unscrew oil filter cover (2) from oil filter housing	<p> Engine oil returns to the oil pan by unscrewing the oil filter covers (2)</p> <p> Installation: Check sealing ring on oil filter cover, replace if necessary</p> <p>Nm</p>	BA18.20-N-1006-01N
2	Unlock engine wiring harness connector (1) from oil combination sensor (B110) and pull off		
3	Remove oil combination sensor (B110)	<p> Catch engine oil running out</p> <p> Installation: Check O-ring on oil combination sensor (B110) for damage, replace oil combination sensor (B110) if necessary</p> <p>Nm</p>	BA18.40-N-1004-01K
4	Reinstall in opposite order		
	Test		
5	Check engine oil level with oil dipstick		
AP	Engine oil and filter change		<b>Page 185</b>



<p><b>⚠ Danger!</b></p> <p>6</p>	<p><b>Accident hazard</b> resulting from vehicle starting to move by itself with engine running. <b>Injury hazard</b> resulting from pinching and burning when reaching in during the starting operation or with the engine running.</p> <p>Press and hold down engine stop pushbutton switch (S11), then press engine start pushbutton switch (S10) until engine reaches its oil pressure at cranking speed</p>	<p>Secure vehicle against starting to move unintentionally. Wear closed and tight work clothing Do not reach into hot or rotating parts</p> <p>⌚ Crank the engine for max. 20 sRestart after a pause of approx. 1 minute to prevent damaging the starter</p> <p><b>i</b> The engine does not start when the engine stop pushbutton switch (S11) and engine start pushbutton switch (S10) are pressed simultaneously After reaching oil pressure on oil pressure display, release engine stop button (S11)</p>	<p><b>Page 9</b></p>
<p>7</p>	<p>Allow engine to idle for 1 minute and observe oil pressure display</p>		<p>BE18.00-N-1001-01L</p>
<p>8</p>	<p>Shut off engine and check for leakage</p>	<p><b>i</b> Visual inspection.</p>	

**Test values for oil pressure**

Number	Designation	Engine 457.960
BE18.00-N-1001-01L	Engine oil pressure at	Idle speed bar ≥ 0.5
		Max. speed bar ≥ 2.5

**Nm Oil filter**

Number	Designation	Engine 457.960
BA18.20-N-1006-01N	Oil filter cover to oil filter housing	Nm 40

**Nm Oil level, oil pressure sensor**

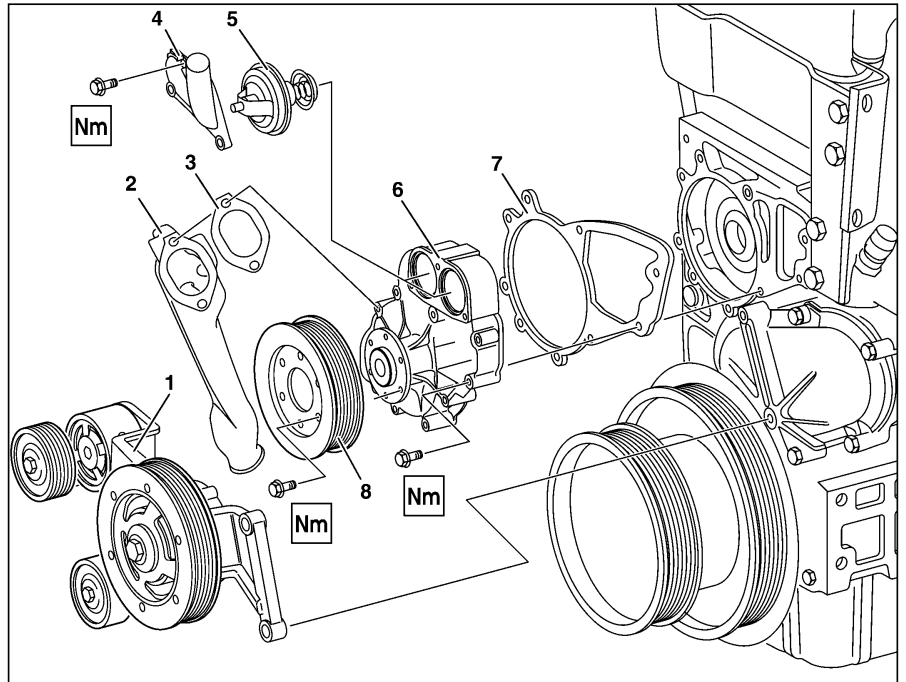
Number	Designation	Engine 457.960
BA18.40-N-1004-01K	Bolt, oil pressure temperature sensor to oil filter/oil cooler housing	Nm 10

AR20.10-G-1271CH	Remove/install coolant pump	8.7.04
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MODEL 000.001 with ENGINE 457.960






Shown with fan wheel removed


- 1 Bracket
- 2 Coolant inlet fitting
- 3 Gasket
- 4 Coolant outlet nipple
- 5 Coolant thermostat
- 6 Coolant pump
- 7 Gasket
- 8 Belt pulley (coolant pump)



G20.10-3126-06

	Removal, installation		
<b>Danger!</b>	Accident hazard resulting from vehicle starting to move by itself with engine running. Injury hazard resulting from pinching and burning when reaching in during the starting operation or with the engine running.	Secure vehicle against starting to move unintentionally. Wear closed and tight work clothing Do not reach into hot or rotating parts	<b>Page 9</b>
<b>Danger!</b>	Injury hazard Danger of severe burns to skin and eyes from hot coolant spewing out Coolant is toxic if swallowed	Open cooling system only at coolant temperatures below 90 °C Slowly open cover and relieve pressure Do not fill beverage containers with coolant. Wear protective gloves, protective clothing and protective goggles.	<b>Page 26</b>
	Notes on coolant	All engines	<b>Page 168</b>
1	Drain coolant and catch	<b>Installation:</b> Add only corrosion/frost protection agents approved according to coolant regulations to prevent damaging the engine. Observe the following: ↓	
<b>BB</b>	Coolant regulations	Sheet 310.1	BB00.40-P-0310-01A
<b>BB</b>	Corrosion/frost protection agent	Sheet 325.2	BB00.40-P-0325-02A
2	Remove bracket (1) for Viscous fan		<b>Page 215</b>
3	Remove fan		<b>Page 213</b>
4	Loosen alternator		<b>Page 179</b>
5	Remove coolant inlet fitting (2) from coolant pump (6)	<b>Installation:</b> Replace gasket (3).  	BA20.10-N-1002-010

6	Remove coolant outlet fittings (4) and coolant thermostat (5) from coolant pump (6)	 <b>Installation:</b> Replace gasket. Observe installation position of coolant thermostat (5)	<b>Page 211</b>
7	Remove belt pulley (8)		BA20.10-N-1004-01O
8	Remove coolant pump (6)	 <b>Installation:</b> Clean sealing surfaces on crankcase and on coolant pump (6). Replace gasket (7). 	BA20.10-N-1003-01O
9	Reinstall in opposite order		
10	Crank the engine and allow to idle	 Until operating temperature is reached, then shut off engine	
11	Check coolant level, correct if necessary		

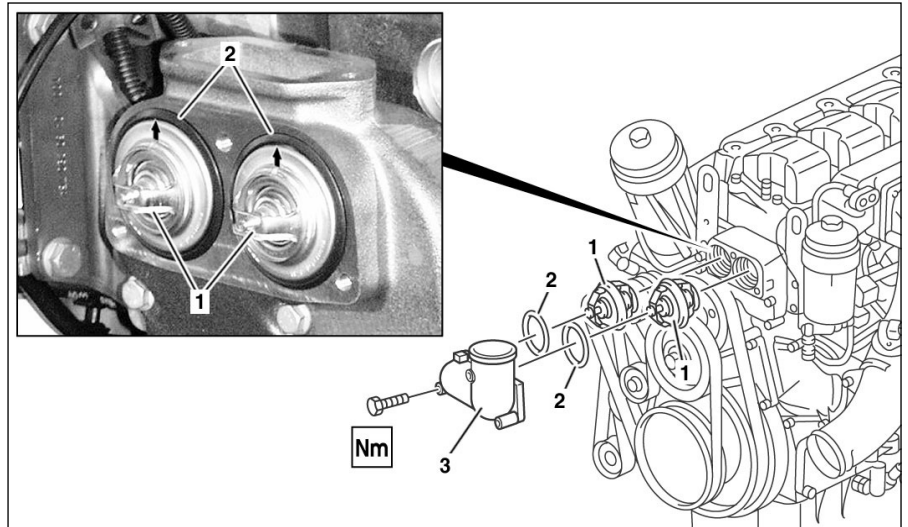
 **Coolant pump, coolant thermostat**

Number	Designation		Engine 457.960
BA20.10-N-1002-01O	Bolt, coolant inlet fitting to coolant pump	Nm	50
BA20.10-N-1003-01O	Bolt, coolant pump to crankcase	Nm	30
BA20.10-N-1004-01O	Bolt, belt pulley to coolant pump	Nm	25

AR20.10-G-2460CH	Remove/install coolant thermostat	8.7.04
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MODEL 000.001 with ENGINE 457.960

- 1 Coolant thermostat
- 2 Sealing ring
- 3 Coolant outlet nipple



G20.10-3125-05

	<b>Removal, installation</b>		
<b>Danger!</b>	Accident hazard resulting from vehicle starting to move by itself with engine running. Injury hazard resulting from pinching and burning when reaching in during the starting operation or with the engine running.	Secure vehicle against starting to move unintentionally. Wear closed and tight work clothing Do not reach into hot or rotating parts	<b>Page 9</b>
<b>Danger!</b>	Danger of severe burns to skin and eyes from hot coolant spewing out Coolant is toxic if swallowed	Open cooling system only at coolant temperatures below 90 °C Slowly open cover and relieve pressure Do not fill beverage containers with coolant. Wear protective gloves, protective clothing and protective goggles.	<b>Page 26</b>
	Notes on coolant	All engines	<b>Page 168</b>
1	Drain coolant and catch	<b>Installation:</b> Add only corrosion/frost protection agents approved according to coolant regulations to prevent damaging the engine. Observe the following: ↓	
<b>BB</b>	Coolant regulations	Sheet 310.1	BB00.40-P-0310-01A
<b>BB</b>	Corrosion/frost protection agent	Sheet 325.2	BB00.40-P-0325-02A
2	Remove coolant outlet nipple (3) from coolant pump		BA20.10-N-1001-01O
3	Remove coolant thermostat (1) together with sealing rings (2)	<b>Installation:</b> Replace sealing rings (2), grease and position on coolant thermostat (1). Observe installation position of sealing rings (2). Observe installation position of coolant thermostat (1), the blow holes (arrows) should point upward	BR00.45-Z-1018-06A
4	Reinstall in opposite order		

5	Crank the engine and allow to idle	 Until operating temperature is reached, then shut off engine	
6	Check coolant level, correct if necessary		

 Coolant pump, coolant thermostat

Number	Designation	Engine 457.960
BA20.10-N-1001-01O	Bolt, coolant outlet nipple with coolant thermostat on coolant pump	Nm 25

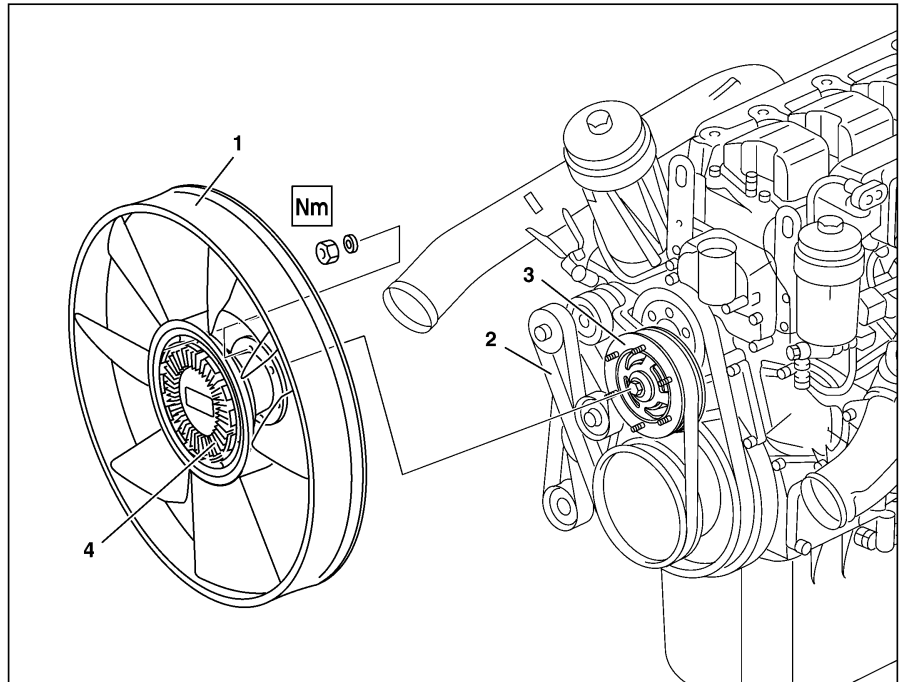
Repair agent

Number	Designation	Order number
BR00.45-Z-1018-06A	ATE grease	-

AR20.40-G-5614CH	Remove/install fan	9.7.04
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MODEL 000.001 with ENGINE 457.960

- 1 Fan wheel
- 2 Poly-V-belt (fan)
- 3 Belt pulley (fan)
- 4 Viscous fan clutch



G20.40-3145-06

	<b>Removal, installation</b>		
<b>⚠ Danger!</b>	<b>Injury hazard from pinching when working on springs and spring bodies under tension</b>	Use only approved tensioning devices, shield hazardous area additionally if necessary. Check special tools for damage and proper function (visual inspection) Wear protective gloves.	<b>Page 91</b>
1	Remove poly-V-belt (2)	<p> Remove poly-V-belt (2) only partially</p> <p> <b>Installation:</b> Observe belt route and damage pattern for poly-V-belts (2), if necessary replace poly-V-belt (2) in the event of wear:</p> <p style="text-align: center;">↓</p> <p>Poly-V-belt route</p> <p>Damage pattern for poly-V-belt</p>	<b>Page 157</b>
			<b>Page 91</b> <b>Page 92</b>
2	Remove viscous fan clutch (4) from belt pulley (3)	<p> Lock up belt pulley (3) with corresponding tool</p> <p></p>	BA20.40-N-1003-01M
3	Remove fan wheel (1) with viscous fan clutch (4)	<p> Ensure that fan wheels (1) with viscous fan clutch (4) are always stored in vertical position</p>	
4	Remove viscous fan clutch (4) from fan wheel (1)	<p> Only if viscous fan clutch (4) or fan wheel (1) is to be replaced</p> <p> <b>Installation:</b> If viscous fan clutch (4) must be replaced, store viscous fan clutch (4) in vertical position min. 1 h before installation.</p> <p></p>	BA20.40-N-1001-01M

5	Reinstall in opposite order		
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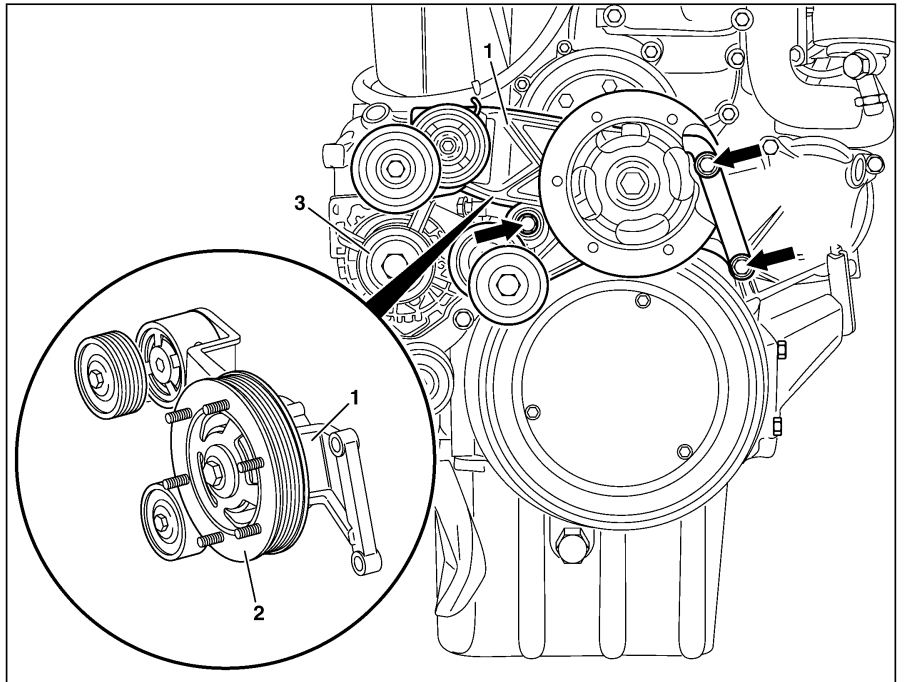
**Nm** Fan, fan clutch

Number	Designation		Engine 457.960
BA20.40-N-1001-01M	Bolt fan on viscous fan clutch	Nm	30
BA20.40-N-1003-01M	Nut, viscous fan clutch to belt pulley fan drive	Nm	50

AR20.40-G-5640CH	Remove/install bracket for viscous fan	9.7.04
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MODEL 000.001 with ENGINE 457.960

- 1 Bracket (fan drive)
- 2 Belt pulley (fan)
- 3 Belt pulley (alternator)



W20.40-1057-06

	<b>Removal, installation</b>		
<b>Danger!</b>	Injury hazard from pinching when working on springs and spring bodies under tension	Use only approved tensioning devices, shield hazardous area additionally if necessary. Check special tools for damage and proper function (visual inspection) Wear protective gloves.	<b>Page 91</b>
1	Remove fan		<b>Page 213</b>
2	Release tension on poly-V-belt and remove from belt pulley (3)	<b>Installation:</b> Observe belt route and damage pattern for poly-V-belts, if necessary replace poly-V-belt if worn: ↓ Poly-V-belt route Damage pattern for poly-V-belt	<b>Page 155</b>  <b>Page 91</b> <b>Page 92</b>
3	Remove bracket (1) for fan drive	Check belt pulley (2) for condition, replace if necessary. <b>Installation:</b> Observe various bolt lengths 	BA20.40-N-1004-01M
4	Reinstall in opposite order		

Fan, fan clutch

Number	Designation	Engine 457.960
BA20.40-N-1004-01M	Fan drive bracket to crankcase	Nm 60

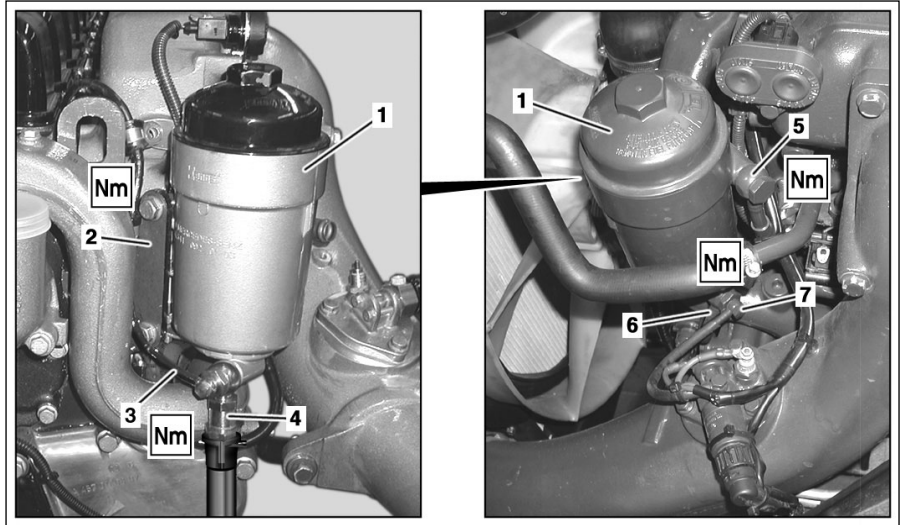




AR47.20-G-1070CH	Remove/install main fuel filter	29.6.04
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**MODEL 000.001 with ENGINE 457.960**

- 1 Main fuel filter
- 2 Bracket/lifting eye
- 3 Fuel line (from leak fuel line)
- 4 Fuel line (to fuel tank)
- 5 Fuel line (from fuel pump)
- 6 Fuel line (to unit pumps)



G47.20-3133-05

	<b>Removal, installation</b>		
<b>Danger!</b>	Accident hazard resulting from vehicle starting to move by itself with engine running. Injury hazard resulting from pinching and burning when reaching in during the starting operation or with the engine running.	Secure vehicle against starting to move unintentionally. Wear tightly fitting work clothes. Do not reach into hot or rotating parts	<b>Page 9</b>
<b>Danger!</b>	Fuel vapors present an explosion hazard. Fuel vapors are toxic when inhaled while handling open fuel. Contact with fuel can cause eye and skin injury	Fire, open lights and smoking prohibited. Avoid sparks. Fill and store fuel only in containers intended and marked for this purpose. Wear protective clothing when handling fuel.	<b>Page 27</b>
1	Remove fuel lines (3, 4) from main fuel filter (1)	<b>Installation:</b> Replace sealing rings.  	BA47.25-N-1003-01L
2	Remove fuel lines (5, 6) from main fuel filter (1)	<b>Installation:</b> Replace sealing rings.  	BA47.25-N-1004-01L
3	Remove main fuel filter (1) from bracket/lifting eye (2)	  	BA47.20-N-1005-02K BA47.20-N-1006-02K
4	Reinstall in opposite order		
5	Crank the engine and bleed fuel system, allow engine to idle	Allow engine to run for approx. 1 min. Fuel system bleeds by itself	
6	Shut off engine and check fuel lines (3, 4, 5, 6) for leakage	Visual inspection.	

**Fuel filter**

Number	Designation	Engine 457.960
BA47.20-N-1005-02K	Bolt, fuel filter to bracket	25

**Nm** Fuel filter

Number	Designation	Engine 457.960	
BA47.20-N-1006-02K	Bolt, mount fuel filter/front lifting eyes to crankcase	Nm	100

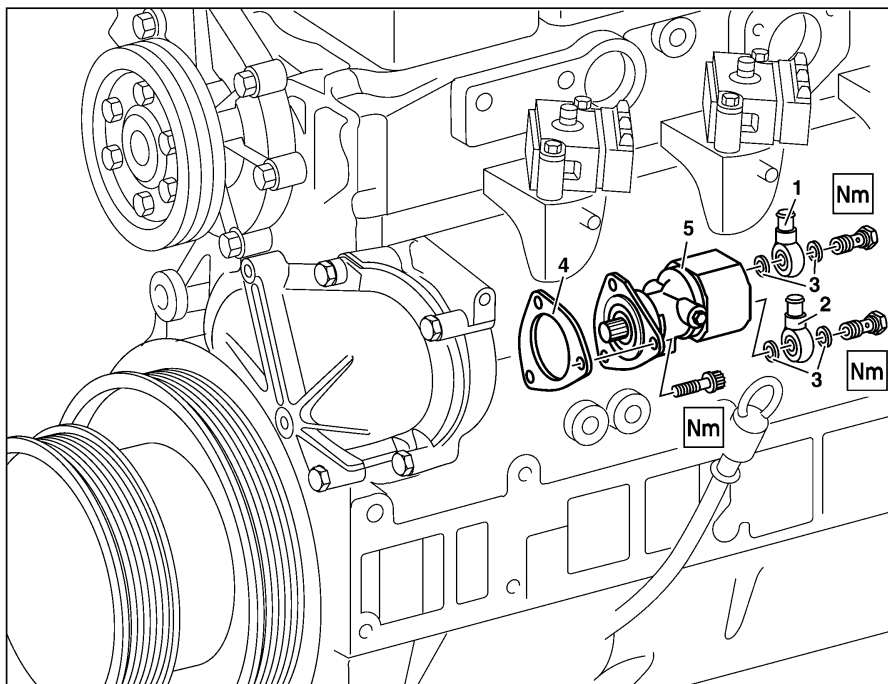
**Nm** Fuel lines/hoses

Number	Designation	Engine 457.960	
BA47.25-N-1003-01L	Banjo bolt, fuel line/leak fuel line to banjo bolt	Nm	15
BA47.25-N-1004-01L	Banjo bolt, fuel line to fuel filter housing	Nm	50

AR47.20-G-5710CH	Remove/install fuel pump	29.6.04
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**MODEL 000.001 with ENGINE 457.960**

- 1 Fuel pressure line
- 2 Fuel intake line
- 3 Sealing rings
- 4 Gasket
- 5 Fuel pump



G47.20-3134-06

	<b>Removal, installation</b>		
<b>⚠ Danger!</b>	<b>Explosion hazard from igniting. Fuel is toxic when taken orally or inhaled. Injury hazard from skin and eye contact with fuel.</b>	Fire, open lights and smoking prohibited. Avoid sparks. Fill and store fuel only in containers intended and marked for this purpose. Wear protective clothing when handling fuel.	<b>Page 27</b>
1	Remove MR/PLD control unit		<b>Page 133</b>
2	Fuel pressure line (1)	<b>Installation:</b> Replace sealing rings (3) 	BA47.25-N-1008-01L
3	Remove fuel intake line (2)	<b>Installation:</b> Replace sealing rings (3) 	BA47.25-N-1007-01L
4	Remove fuel pump (5)	<b>Installation:</b> Replace gasket (4) 	BA47.20-N-1002-02K
5	Reinstall in opposite order		

**Fuel filter**

Number	Designation	Engine 457.960
BA47.20-N-1002-02K	Bolt, fuel pump to crankcase	Nm 25

**Fuel lines/hoses**


Number	Designation	Engine 457.960
BA47.25-N-1007-01L	Banjo bolt, fuel intake line on fuel pump	Nm 50

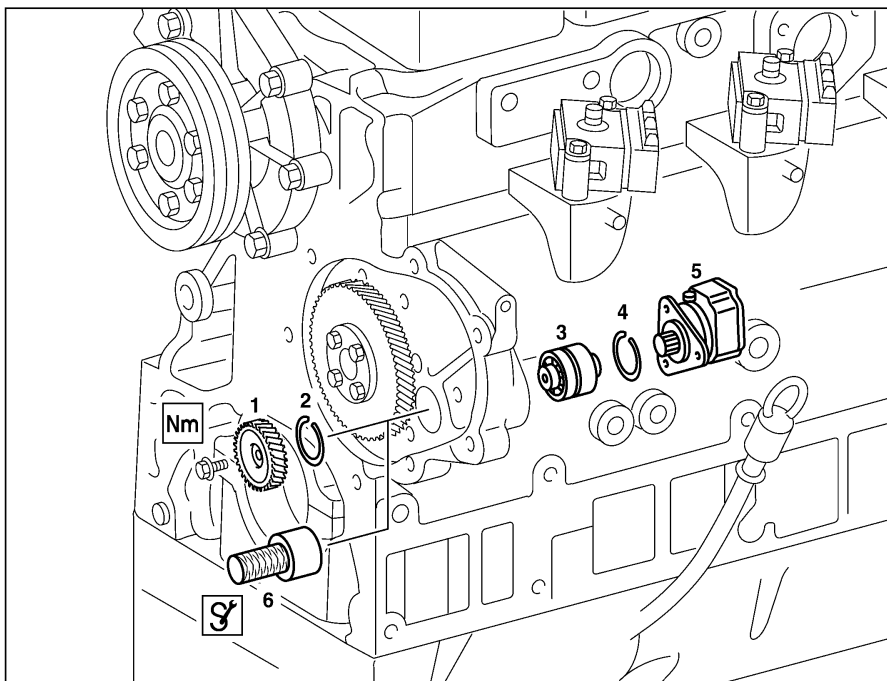
**Nm** Fuel lines/hoses

Number	Designation	Engine 457.960
BA47.25-N-1008-01L	Banjo bolt, fuel pressure line to fuel pump	Nm 50







AR47.20-G-5821CH	Remove/install bearing for fuel pump drive	29.6.04
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**MODEL 000.001 with ENGINE 457.960**

- 1 Drive wheel
- 2 Circlip
- 3 Bearing
- 4 Circlip
- 5 Fuel pump
- 6  Drift punch

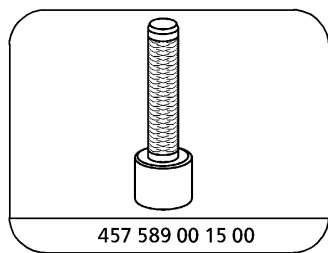


G47.20-3132-06

	Removal		
1	Remove camshaft sprocket cover		<b>Page 45</b>
2	Remove fuel pump (5)		<b>Page 219</b>
3	Remove drive gear (1) from bearing (3)		
4	Remove circlip (4)		
5	Remove circlip (2)		
6	Remove bearing (3) from crankcase with drift punch (6)		457 589 00 15 00
	Installation		
7	Install circlip (4)		
8	Install bearing (3) from crankcase with drift punch (6)	 	457 589 00 15 00
9	Install circlip (2)		
10	Install drive wheel (1) on bearing (2)		BA47.20-N-1004-02K
11	Install fuel pump (5)		<b>Page 219</b>
12	Install camshaft sprocket cover		<b>Page 45</b>

 Fuel filter

Number	Designation	Engine 457.960
BA47.20-N-1004-02K	Bolt, fuel pump drive gear to bearing	Nm 30



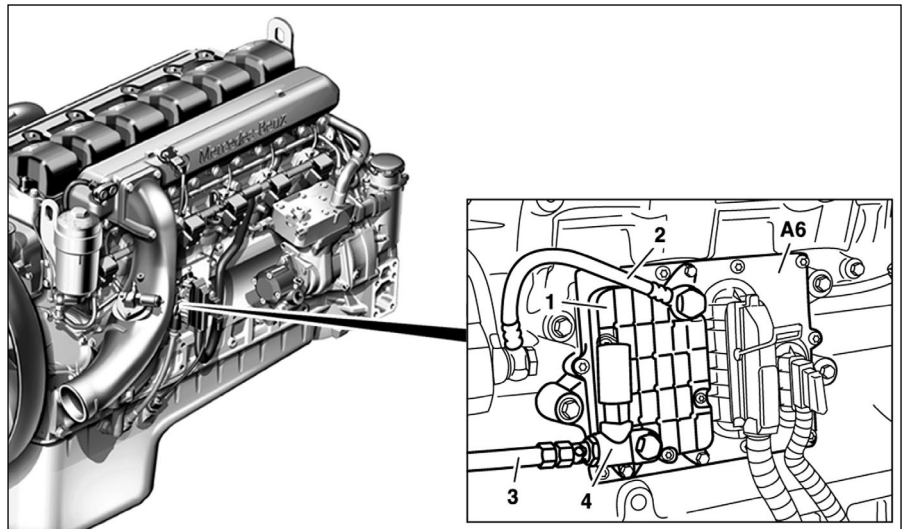
457 589 00 15 00

Drift punch

AR47.21-G-5621CH	Remove/install fuel heat exchanger	29.6.04
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**MODEL 000.001 with ENGINE 457.960**

- 1 Fuel heat exchanger
- 2 Fuel line
- 3 Fuel line
- 4 Manual fuel feed pump
  
- A6 MR/PLD control unit



W47.21-1003-05

	<b>Removal, installation</b>		
<b>Danger!</b>	Injury hazard for skin and eyes when handling hot or glowing subjects	Wear protective gloves, protective clothing and protective goggles.	<b>Page 80</b>
<b>Danger!</b>	Accident hazard resulting from vehicle starting to move by itself with engine running. Injury hazard resulting from pinching and burning when reaching in during the starting operation or with the engine running.	Secure vehicle against starting to move unintentionally. Wear closed and tight work clothing Do not reach into hot or rotating parts	<b>Page 9</b>
<b>Danger!</b>	Explosion hazard from igniting. Fuel is toxic when taken orally or inhaled. Injury hazard from skin and eye contact with fuel.	Fire, open lights and smoking prohibited. Avoid sparks. Fill and store fuel only in containers intended and marked for this purpose. Wear protective clothing when handling fuel.	<b>Page 27</b>
1	Remove fuel line (2) from fuel heat exchanger (1)	<b>Installation:</b> Replace sealing rings.  	BA47.25-N-1009-01L
2	Remove fuel line (3) together with manual fuel feed pump (4) from fuel heat exchanger (1)	<b>Installation:</b> Replace sealing rings.  	BA47.25-N-1001-01L
3	Remove fuel heat exchanger (1) from MR/PLD control unit (A6)	Do not disassemble fuel heat exchanger (1).  	BA07.15-N-1001-01F
4	Reinstall in opposite order		
5	Crank the engine and bleed fuel system, allow engine to idle	Allow engine to run for approx. 1 min. Fuel system bleeds by itself	
6	Shut off engine and check fuel lines (2, 3) for leakage	Visual inspection.	



**Nm Diesel injection system with unit pumps (MR/PLD)**

<b>Number</b>	<b>Designation</b>	<b>Engine</b>
		<b>457.960</b>
BA07.15-N-1001-01F	Bolt, fuel heat exchanger on MR/PLD control unit	Nm 8

**Nm Fuel lines/hoses**

<b>Number</b>	<b>Designation</b>	<b>Engine</b>
		<b>457.960</b>
BA47.25-N-1001-01L	Banjo bolt, fuel line to fuel/prefilter bracket	Nm 50
BA47.25-N-1009-01L	Banjo bolt, fuel line to fuel heat exchanger	Nm 50