



**Data in mm**

Crankshaft standard size and repair sizes	Crankshaft bearing journal Ø	Color coding	Crankshaft journal width at fit bearing <sup>2)</sup>	Crankshaft bearing journal Ø	Crankshaft bearing journal width
Standard size	<u>63.960</u> <sup>1)</sup> →	blue	max. 27.50	47.965 47.955	50.000 50.100
	63.965				
	<u>63.955</u> <sup>1)</sup> →	yellow			
63.960					
<u>63.950</u> <sup>1)</sup> →	red				
63.955					
1st repair size	<u>63.715</u> 63.700				
2nd repair size	<u>63.465</u> 63.450		47.465 47.455		
3rd repair size	<u>63.215</u> 63.200		47.215 47.205		
4th repair size	<u>62.965</u> 62.950		46.965 46.955		

1) Tolerance division for bottom bearing cap, colored dots on crank webs or counterweights next to crankshaft bearing journals

2) Crankshaft main bearings with fit bearing as of engine no. 119.96 as of start of production  
up to engine no. 119.970 12 036277  
119.971 12 017447  
119.972 12 004797  
119.974 12 008072  
119.975 12 010516

**Crankshaft bearing bore, conrod bearing bore and bearing play in mm**

	Crankcase <sup>4)</sup>	Color coding	Conrod
Crankshaft bearing bore	<u>68.480</u> <sup>3)</sup> →	blue	-
	68.486		
	<u>68.486</u> <sup>3)</sup> →	yellow	
	68.492		
	<u>68.492</u> <sup>3)</sup> →	red	
	68.500		
Conrod bearing bore	-	-	<u>51.600</u> 51.619
Permissible out-of-roundness and conicity of bores	0.01		0.01
Radial bearing play	when new		0.021–0.045 <sup>5)</sup>
	wear limit		0.090
Axial bearing play	when new		0.10–0.22
	wear limit		0.30

3) Tolerance division for top bearing cap, chisel punch points in contact surface of crankcase at oil sump end.

4) Machined together with crankshaft bearing cap.

5) Aimed for average value of radial bearing play.

## Matching crankshaft bearing shells to crankcase

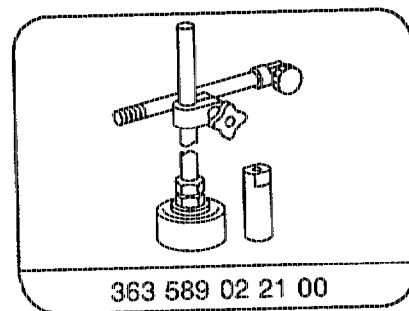
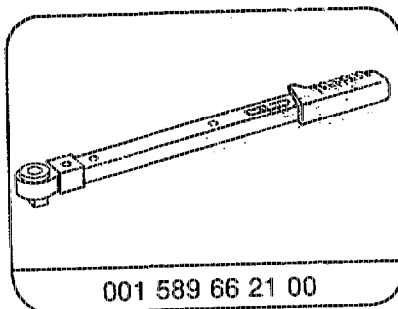
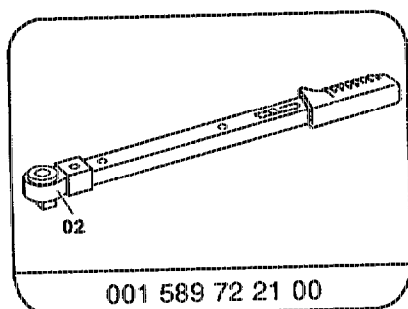
Chisel punch points on crankcase	Matching top bearing shell with color coding		
	1 punch point	2 punch points	3 punch points
Colored dots on crankshaft bearing cap	blue	yellow	red
Color of top bearing shell	blue	yellow	red
Color coding on crankshaft	Matching bottom bearing shell with color coding		
	blue	yellow	red
Color of bottom bearing shell	blue	yellow	red

## Tightening torques in Nm

	Stud bolt in crankcase 1)	30
Crankshaft bearing stud bolt	M10×1 nut	50
	M10×40 side bolts (10.9)	50

1) The stud bolts lose their locking effect after being unscrewed and must therefore only be used once.

## Special tools



## Commercially available tools

Quick-callipers for internal measurements,  
dia. 40 – 60 mm

e.g. Hahn und Kolb  
Borsigstraße 50  
D-7000 Stuttgart 30  
Order no. G 222 K

Quick-callipers for internal measurements,  
dia. 60 – 80 mm

Order no. G 322 K

Micrometer 25 – 50 mm

Order no. 31346 025

Micrometer 50 – 75 mm

Order no. 31346 050

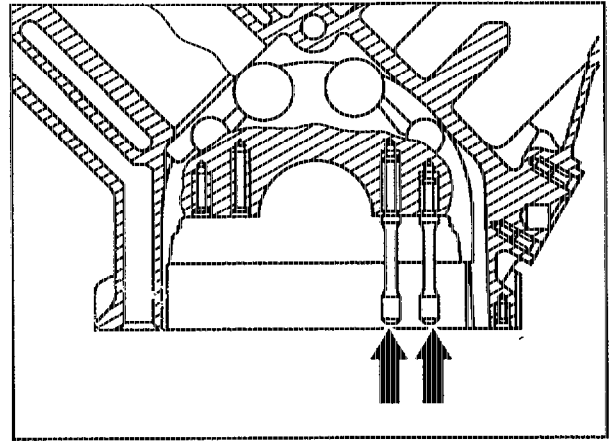
**Note**

Self-locking stud bolts are screwed into the crankcase for securing the crankshaft bearing caps. These stud bolts may only be used once as the locking adhesive applied over approx. 8 mm length of the thread is no longer effective when they are removed.

Pay attention to the different insertion depth and collar dia. when replacing the stud bolts.



When performing repairs, no HELI-COIL inserts may be used for the self-locking stud bolts of the crankshaft bearing caps.



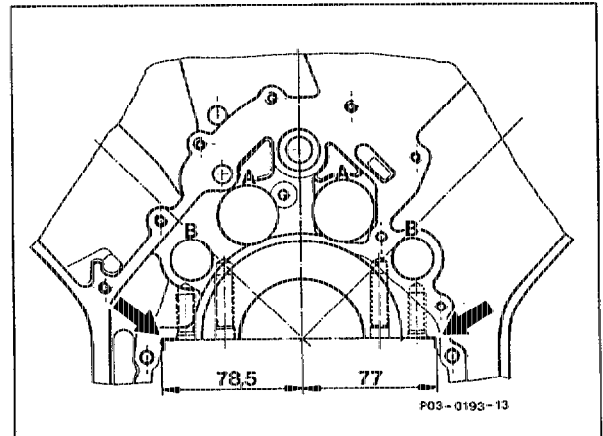
P03-5337-13

The 5 crankshaft bearing caps manufactured from malleable cast iron are fitted into the side in the crankcase (arrows).

The fitting face (arrows) is positioned off-centre so that the bearing caps can only be installed in one position.

The three centre bearing caps are additionally bolted to the housing side walls.

The crankshaft bearing caps are machined together with the crankcase and are not available as a replacement part.



P03-0193-13

If bearing damage has occurred, the conrods must be removed and any swarf removed from the conrod bores and the oil passages of the crankshaft.

Carefully clean the oil passages in the crankcase, crankshaft, timing case cover, oil filter housing, closing cover, oil pump etc.

Examine crankshaft for cracks, dimensional tolerance and hardness (03-3180).

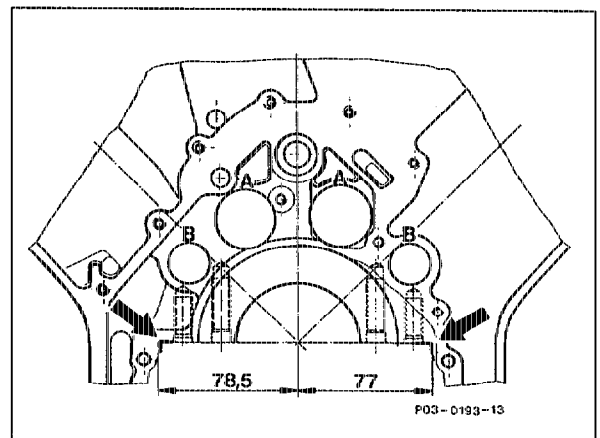
### Matching crankshaft bearings, installing crankshaft

1 Install crankshaft bearing caps, pay attention to marking, 1 is to the front.

The fit face is asymmetrical (arrows); the crankshaft bearing caps can thus only be installed in one position.

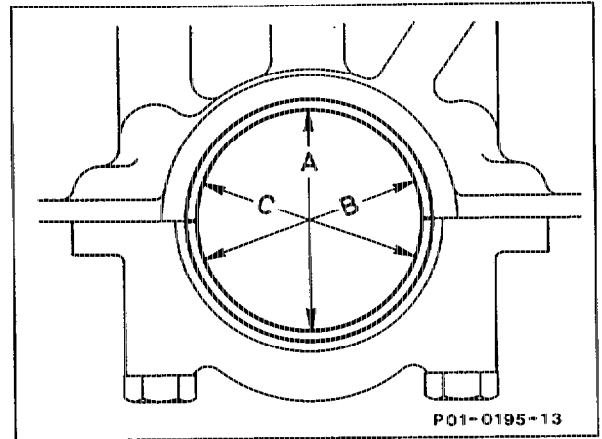
2 Oil thread and contact surface of nuts, tighten nuts to 50 Nm.

3 Oil thread and head contact surface of side bolts (M10×40), install with the washers and tighten to 50 Nm.



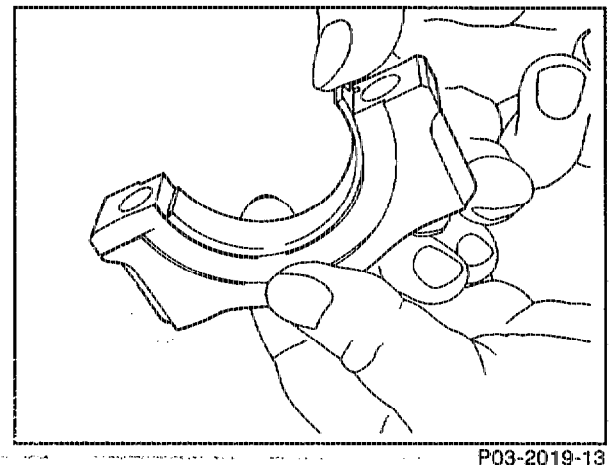
4 Measure crankshaft bearing bore in direction A, B and C at two levels (conicity); note measured values.

If a crankshaft bearing bore exceeds the specified value or is conical, dress bearing cap at its mating surface on a dressing plate up to max. 0.02 mm.

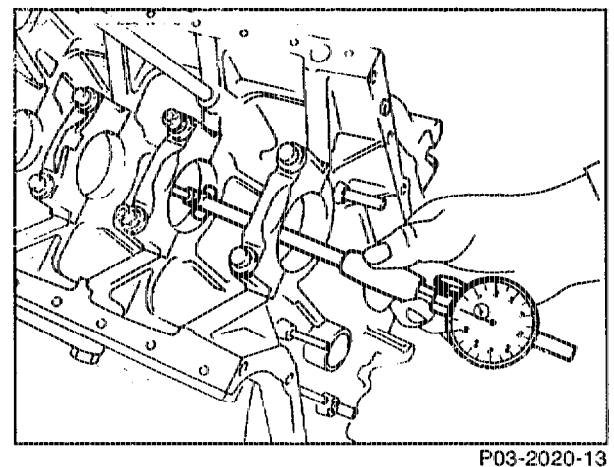


5 Insert bearing shells, install crankshaft bearing cap.

Tighten nuts and side bolts to 50 Nm.



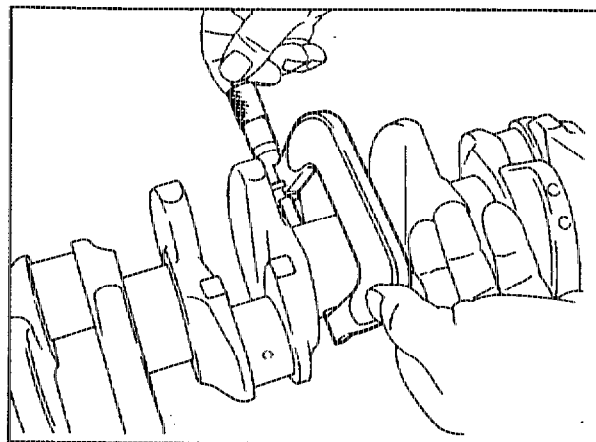
6 Measure bearing diameter and note.



7 Measure crankshaft bearing journals, determine radial play of crankshaft bearing.

**Note**

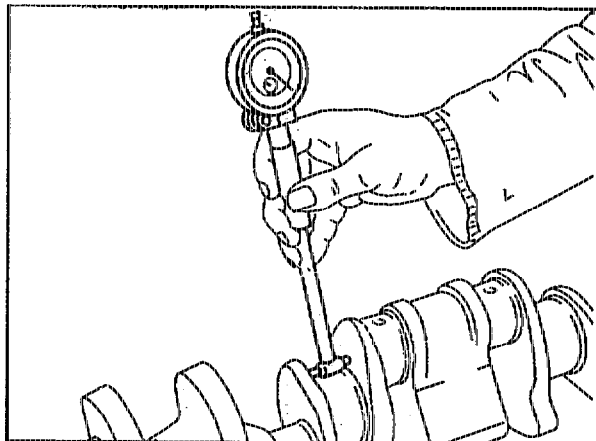
The bearing play can be corrected by replacing the bearing shells (see table Matching crankshaft bearing shells to crankcase); in this case, aim for the average value of the bearing play stated.



P03-2021-13

8 Measure width of fit bearing journal and of fit bearing. Determine axial play of crankshaft.

The fit bearing shells of the repair sizes are supplied oversized.

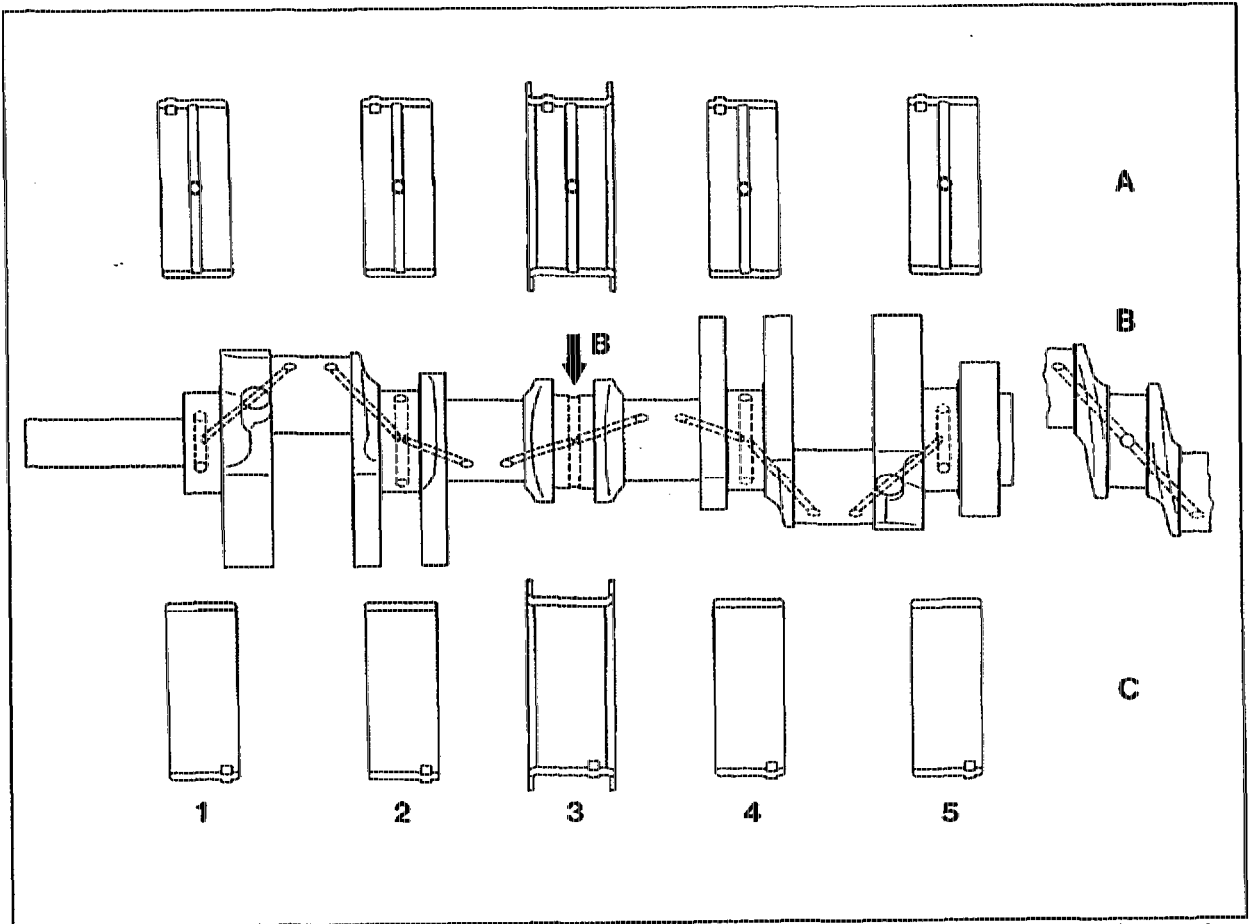


P03-2097-13

9 Moisten bearing shells and crankshaft with SAE 30 engine oil and insert crankshaft.



Install bearing shells with oil drilling into the crankcase.



P03-0192-57

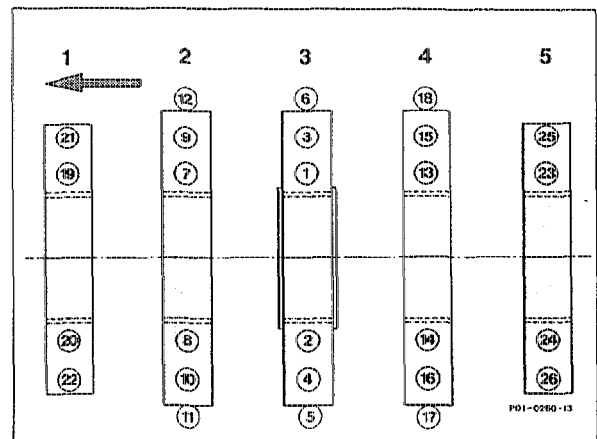
- A Crankcase
- B Fit bearing
- C Crankshaft

10 Tighten crankshaft bearing caps to the specified torque in the order of the tightening diagram. Oil the thread and the bolt head or nut contact surface for this step.

Nuts 50 Nm.  
Side bolts 50 Nm

**Note**

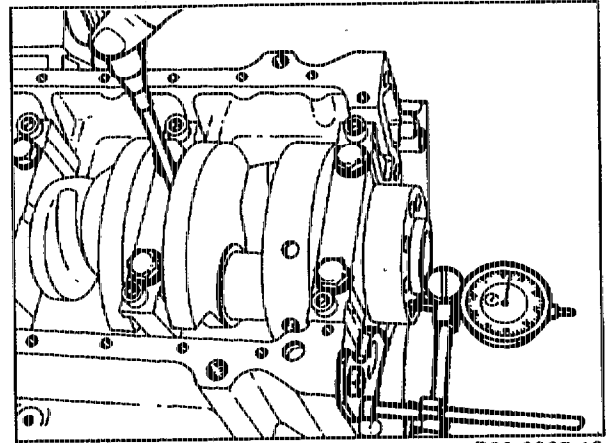
Bolts of quality 10.9 should be used for the side bearing cap fixture.





11 Measure axial play of crankshaft.

12 Rotate crankshaft by hand and check whether it runs freely.

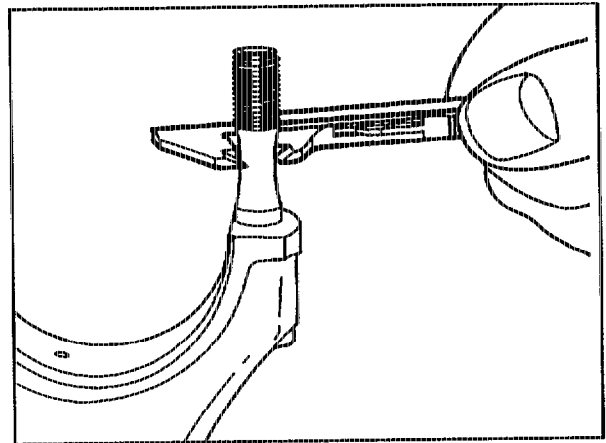


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### Matching conrod bearings and installing

13 Examine conrod bolts (03-3100).

14 Repair and align conrod (03-3130).

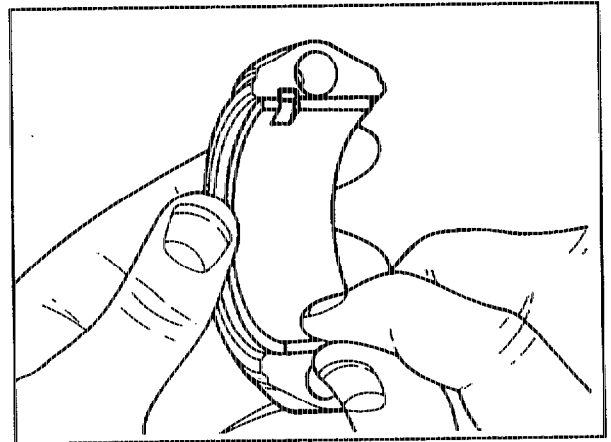


P03-2220-13

15 Insert conrod bearing shells, install conrod bearing caps with conrod bearing shells and tighten conrod nuts or bolts to 35 Nm.

16 Measure bearing diameter and note.

17 Measure conrod bearing journal. Determine radial play of conrod bearing.



P03-2222-13

### Note

The bearing play can be corrected by replacing the conrod bearing shells; if this step is performed, aim for the average value of the specified bearing play.

Crankshaft bearing shells without colour coding are thicker than those with blue colour coding, although it should be noted that the wall thicknesses without and with colour coding may overlap.

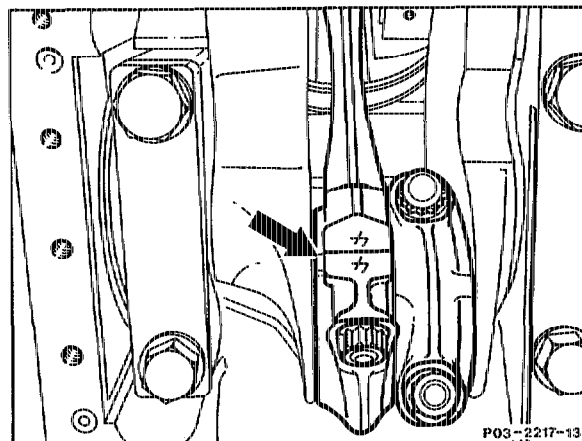
18 Install pistons and conrod (03-3160).

19 Moisten bearing shells, crankshafts, pistons and cylinders with SAE 30 engine oil. Install conrod with pistons (03-3160).

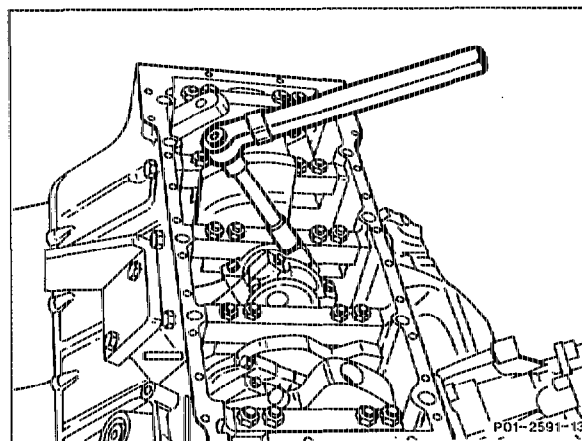


Pay attention to marking.

Install the bearing shells with the oil drilling in the conrod otherwise the conrod bushes will not be lubricated.



20 Tighten conrod nuts and conrod bolts (03-3100).

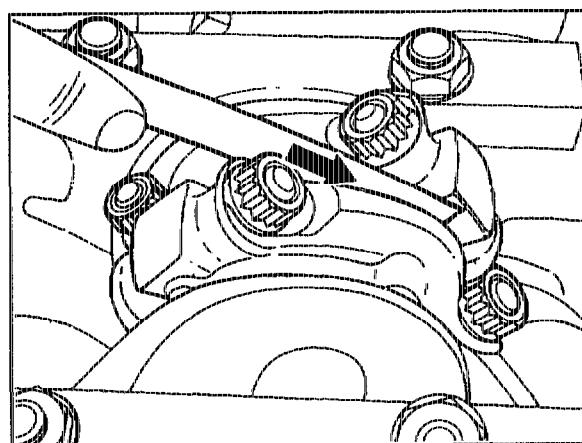


21 Measure axial play of conrod bearings. Examine clearance of conrod in the piston.

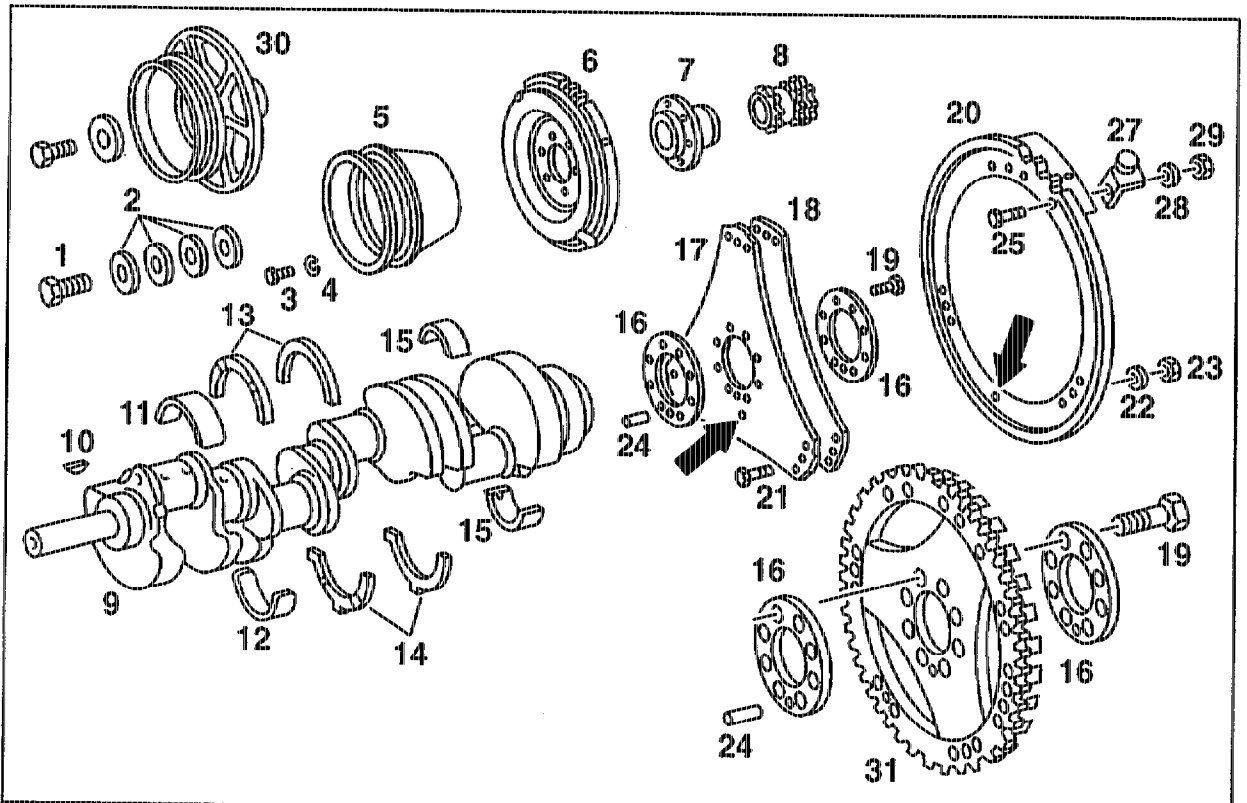


Disassemble oil pump, clean, renew if necessary. Replace oil delivery valve. Clean oil filter, carefully clean air-to-oil cooler or replace.

Install initial operation oil filter element. Change engine oil and oil filter element after 1000 – 1500 km.



## B. Engine 119.97/98 with thrust washers



P03.30-0253-56

1	Bolt M 18×1.5×45 mm	16	Discs 4.5 mm thick
2	Belleville spring washers (4 ea.)	17	Driven plate 1.5 mm thick, 296 mm dia.
3	Bolt M 8×22 (6 ea.)	18	Driven plate 1 mm thick, 287 mm dia.
4	Spring lock washer A8	19	Stretch bolt for driven plates M 12×1.5×23 (8 ea.)
5	Belt pulley	20	Ring gear with segments
6	Vibration damper	21	Fit bolts M 6×12 mm
7	Hub	22	Spring washer B 6
8	Crankshaft gear	23	Nut M 6
9	Crankshaft	24	Locating pin
10	Woodruff key	25	Bolt M5×10
11	Crankshaft bearing shell in crankcase	26	Bracket
12	Crankshaft bearing shell in bearing cap	27	Magnet
13	Fit bearing shell in crankcase with oil groove and drilling	28	Washer A 5.3
14	Fit bearing shell in bearing cap	29	Nut M5
15	Conrod bearing shells	30	Integrated vibration damper with belt pulley
		31	Starter ring gear increment (as of Motronic)

**Data M119.971/975/981/985**

Crankshaft standard size and repair sizes	Crankshaft bearing journal Ø	Color coding	Thickness of thrust washers at fit bearing	Crankshaft journal width at fit bearing	Crankshaft bearing journal Ø	Crankshaft bearing journal width
Standard size	<u>63.960</u> <sup>1)</sup> 63.965	→ blue	2.20 <sup>2)</sup> or 2.25 <sup>2)</sup> or 2.30 <sup>2)</sup>	<u>27.000</u> 27.033	<u>47.955</u> 47.965	<u>50.000</u> 50.100
	<u>63.955</u> <sup>1)</sup> 63.960	→ yellow				
	<u>63.950</u> <sup>1)</sup> 63.955	→ red				
Standard size I	<u>63.945</u> 63.950					
	<u>63.940</u> 63.945					
	<u>63.935</u> 63.940					

<sup>1)</sup> Tolerance division for bottom bearing cap, colored dots on crank webs or counterweights next to crankshaft bearing journals.

<sup>2)</sup> Crankshaft main bearing with thrust washers as of engine no. 119.970 12 036277  
119.971 12 017447  
119.972 12 004797  
119.974 12 008072  
119.975 12 010516  
119.98 as of start of production

**Crankshaft bearing bore, conrod bearing bore and bearing play in mm**

	Crankcase	Color coding	Conrod
Crankshaft bearing bore	<u>68.480</u> <sup>3)</sup> 68.486	→ blue	--
	<u>68.486</u> <sup>3)</sup> 68.492	→ yellow	
	<u>68.492</u> <sup>3)</sup> 68.500	→ red	
Conrod bearing bore	--	--	<u>51.600</u> 51.619
Permissible out-of-roundness and conicity of bores	0.01		0.01
Radial bearing play	when new	0.021–0.045 <sup>4)</sup>	0.030–0.055 <sup>4)</sup>
	wear limit	0.090	0.080
Axial bearing play	when new	0.10–0.22	0.22–0.38
	wear limit	0.30	0.50

<sup>3)</sup> Tolerance division for top bearing cap, chisel punch points in contact surface of crankcase at oil sump end.

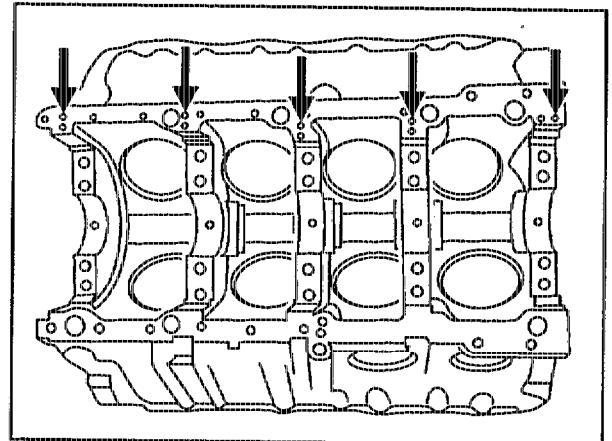
<sup>4)</sup> Aim for the average value of radial bearing play.

### Matching crankshaft bearing shells to crankcase

				Matching top bearing shell with color coding		
				1 chisel point	2 chisel points	3 chisel points
Chisel punch points on crankcase				1 chisel point	2 chisel points	3 chisel points
Colored dots on crankshaft bearing cap				blue	yellow	red
Color of top bearing shell				blue	yellow	red
				Matching bottom bearing shell with color coding		
Color coding on crankshaft				blue	yellow	red
Color of bottom bearing shell				blue	yellow	red

The top and bottom standard size crankshaft bearing shells are supplied as replacement parts with the color codings blue, yellow and red. They should be matched according to the table. It is then no longer necessary to gage the bearing clearances.

Chisel punch points for matching crankshaft bearing shells



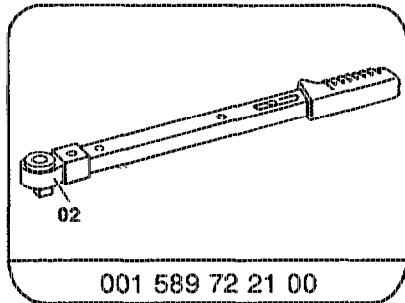
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### Tightening torques in Nm

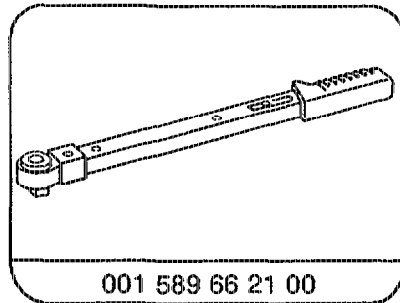
	Stud bolt in crankcase <sup>5)</sup>	30
Crankshaft bearing stud bolt	M10×1 nut	50
	M10×40 side bolts (10.9)	50

5) The stud bolts lose their locking effect after being unscrewed and should therefore be used only once.

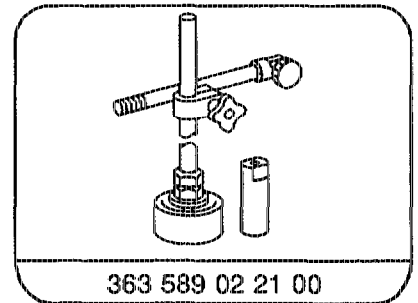
## Special tools



001 589 72 21 00



001 589 66 21 00



363 589 02 21 00

## Commercially available tools

Quick calipers for internal measurements,  $\varnothing$  40 – 60 mm e.g. Hahn und Kolb  
Borsigstraße 50  
D-7000 Stuttgart 30  
Order no. G 222 K

Quick calipers for internal measurements,  $\varnothing$  60 – 80 mm Order no. G 322 K

Micrometer 25 – 50 mm Order no. 31346 025

Micrometer 50 – 75 mm Order no. 31346 050

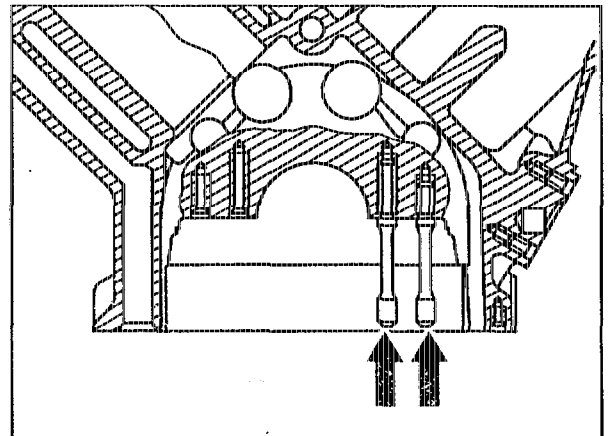
## Note

Self-locking stud bolts are inserted into the crankcase for attaching the crankshaft bearing caps. The stud bolts should only be used once as the locking fluid applied over a length of about 8 mm of the thread is rendered ineffective when the bolts are unscrewed.

Pay attention to different insertion depth and collar  $\varnothing$  when replacing the stud bolts.



When performing repairs, do not use HELI-COIL inserts for the self-locking stud bolts of the crankshaft bearing caps.

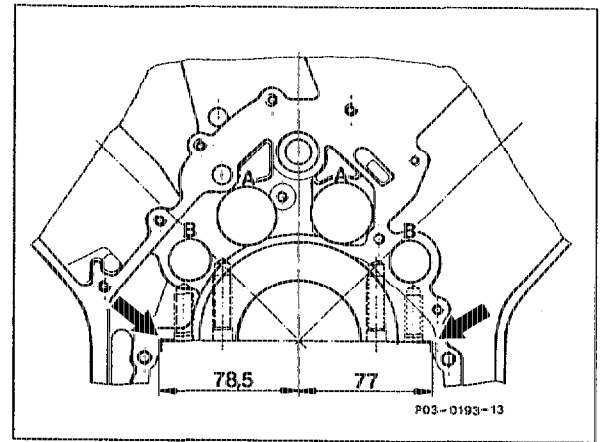


P03-5337-13

The 5 crankshaft bearing caps are manufactured from malleable cast iron and are interference-fitted in the side of the crankcase (arrows). The fit (arrows) is off-centered with the result that the bearing caps can only be installed in one position.

The three center bearing caps are additionally bolted to the side walls of the housing.

The crankshaft bearing caps are machined together with the crankcase and are not available as a replacement part.



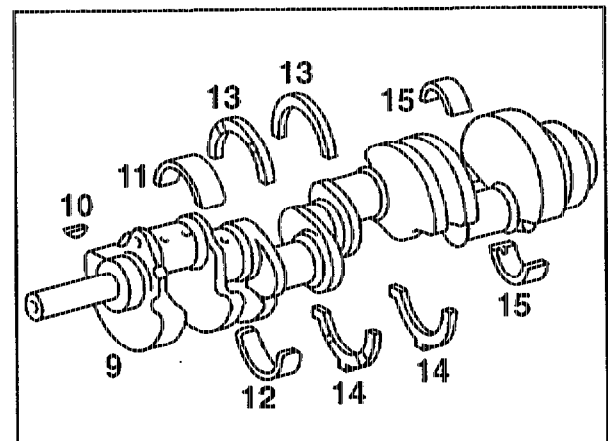
Standard bearing shells and thrust washers are installed at the 3rd crankshaft bearing (fit bearing).

The thrust washers absorb the axial forces of the crankshaft.

The thrust washers (13 and 14) inserted on both sides of the crankcase and the bearing cap, are identical.

The thrust washers in the bearing cap each have two retaining lugs, the bottom lugs being positioned off-center, as an anti-twist lock and to avoid incorrect installation. In addition, all the thrust washers are chamfered at one end. The two oil grooves in the thrust washers must face towards the crank webs.

When repairing crankshafts, the fit bearing journals should be re-ground in width to one of the dimensions stated in the table (section "Data").



After bearing damage has occurred, the conrod should be taken out and any swarf present in the conrod bores and in the crankshaft oil galleries, removed.

Carefully clean oil galleries in crankcase, crankshaft, timing case cover, oil filter housing, end cover, oil pump etc.

Inspect crankshafts for cracks, dimensional tolerance and hardness.

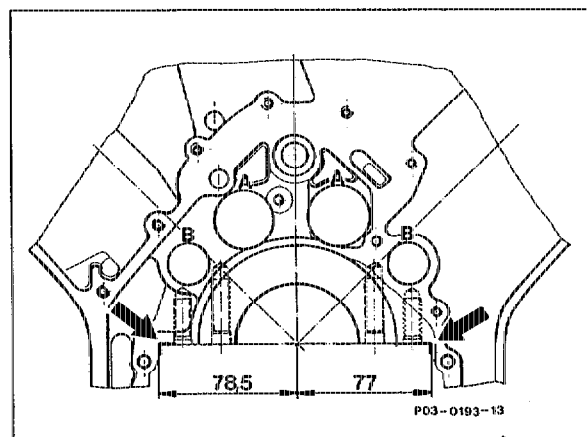
## Matching crankshaft bearings, installing crankshaft

1 Install crankshaft bearing caps; pay attention to marking, 1 is at the front.

The fit is asymmetrical (arrows) with the result that the crankshaft bearing caps can only be installed in one position.

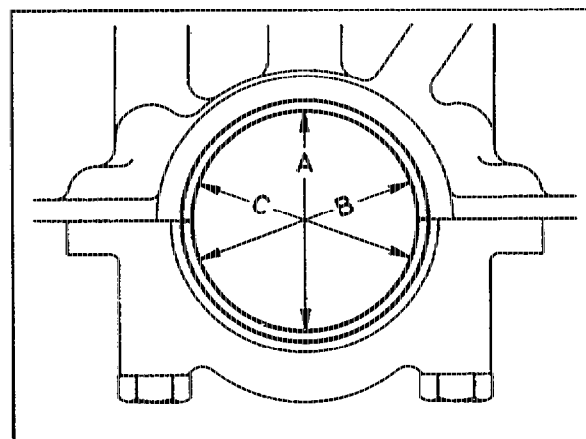
2 Oil contact surface of nut and thread and tighten nuts to 50 Nm.

3 Oil the thread and the bolt head contact surface of the side bolts (M10 × 40), install with the washers and tighten to 50 Nm.



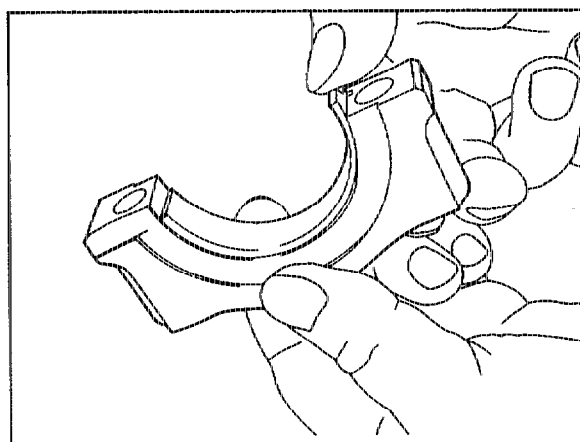
4 Measure crankshaft bearing bore in the direction A, B and C at two planes (conicity) and note the measurements obtained.

If a crankshaft bearing bore exceeds the specified data or is conical in shape, dress the contact surface of the bearing cap on a dressing plate to not more than 0.02 mm.



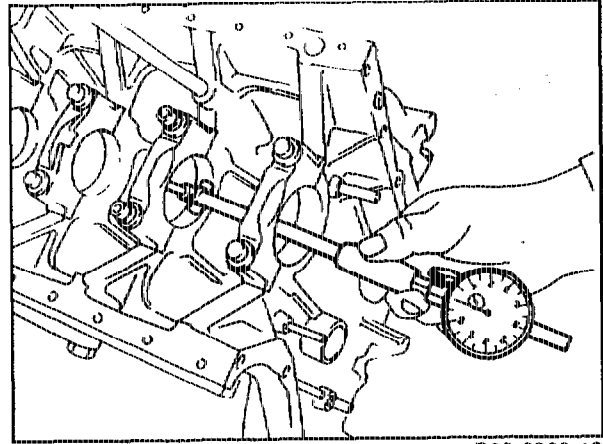
5 Insert bearing shells and install crankshaft bearing cap.

Tighten nuts and side bolts to 50 Nm.





6 Measure bearing diameter and note.

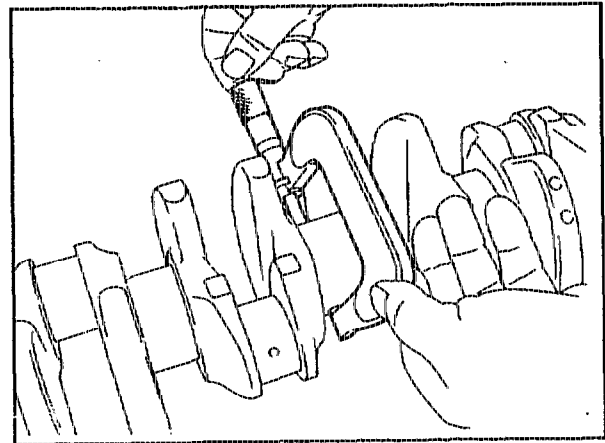


P03-2020-13

7 Measure crankshaft bearing journal and determine radial crankshaft bearing play.

**Note**

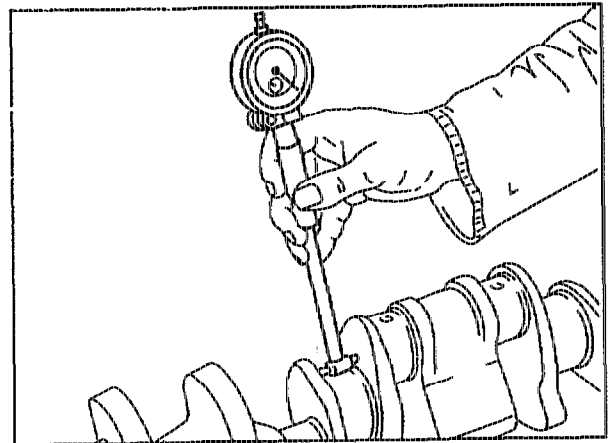
The bearing play can be corrected by replacing the bearing shells (see table Matching crankshaft bearing shells to crankcase).



P03-2021-13

8 Measure width of fit bearing journal and of fit bearing and determine axial crankshaft bearing play.  
(See table of Data)

The repair size fit bearing shells are supplied oversized.



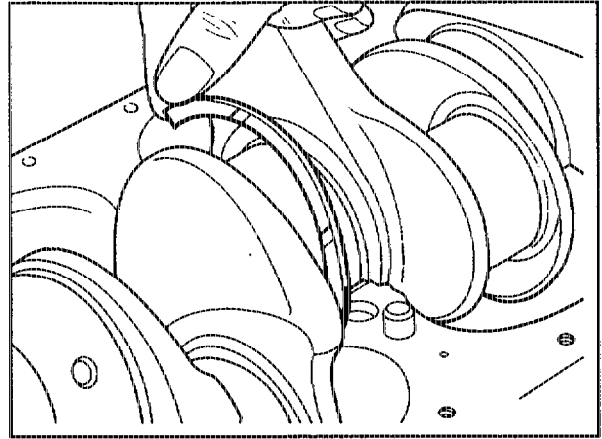
P03-2097-13

9 Moisten bearing shells and crankshaft with SAE 30 engine oil and insert crankshaft.



Install bearing shells with oil drilling in the crankcase.

10 Oil thrust washers with engine oil and push into the grooves at the fit bearing (crankcase).

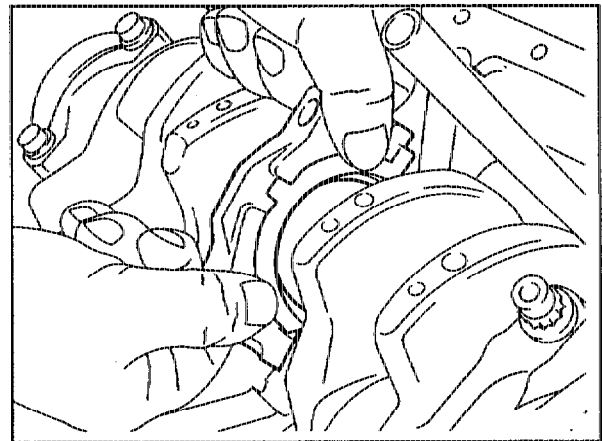


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11 Install fit bearing cap.



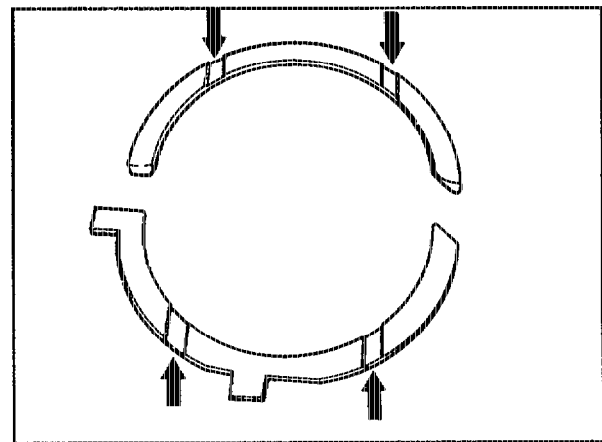
Hold both thrust washers tight when installing the fit bearing cap.



P03-2018-13



The two oil grooves (arrows) in the thrust washers must face toward the crank webs.



P03-2058-13

12 Install crankshaft bearing caps.

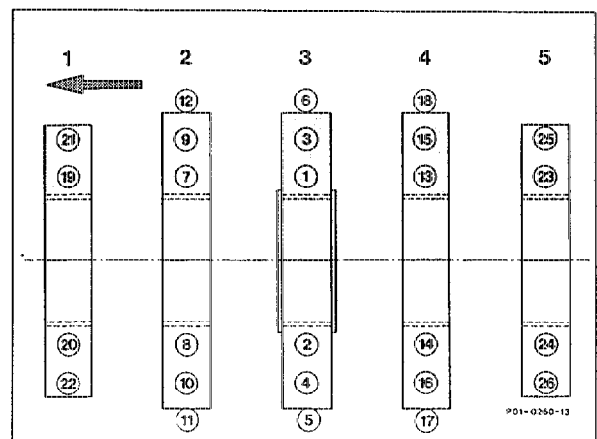
13 Tighten crankshaft bearing caps to the specified torque in the order of the tightening diagram. Oil the thread and the bolt head and nut contact surface for this step.

Nuts 50 Nm.

Side bolts 50 Nm

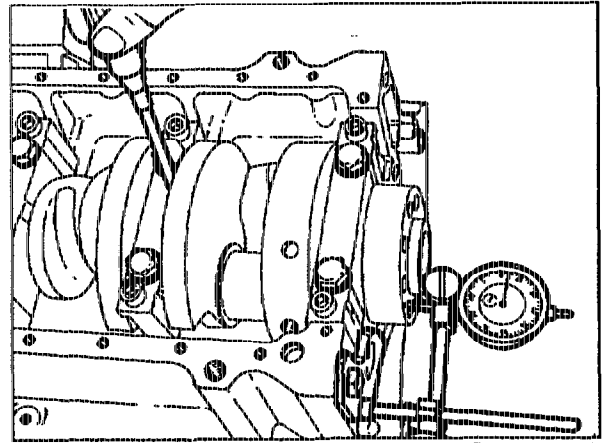
**Note**

Bolts of quality 10.9 should be used for the side bearing cap connection.



14 Measure crankshaft bearing axial play.

15 Rotate crankshaft by hand and check whether it rotates freely.

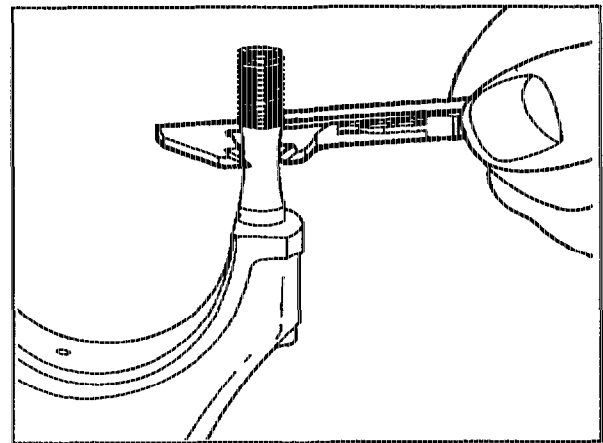


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### Matching conrod bearings and installing

16 Inspect conrod bolts (03-3100).

17 Repair conrod and align (03-3130).

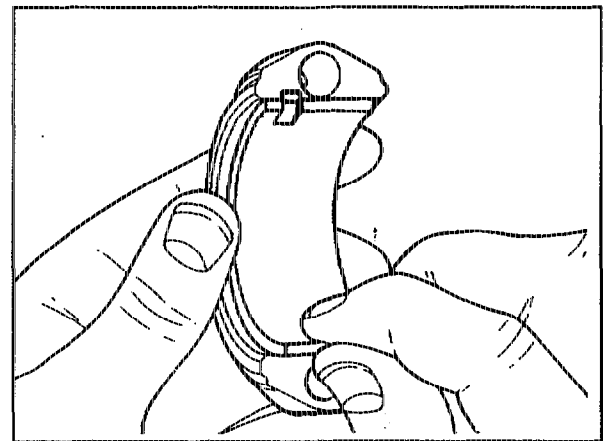


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18 Insert conrod bearing shells, install conrod bearing caps with conrod bearing shells and tighten conrod nuts and bolts to 35 Nm.

19 Measure bearing diameter and note.

20 Measure conrod bearing journals and determine conrod bearing radial play.



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### Note

The bearing play can be corrected by replacing the conrod bearing shells. Aim for the average value of the bearing play stated.

Conrod bearing shells without color coding are thicker than those with blue color coding; note, however, that the wall thicknesses with and without color coding may overlap.

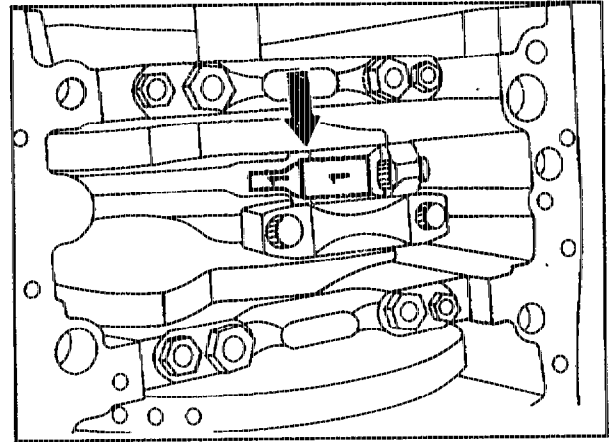
21 Assemble pistons and conrod (03-3160).

22 Moisten bearing shells, crankshafts, pistons and cylinders with SAE 30 engine oil. Install conrod with pistons (03-3160).



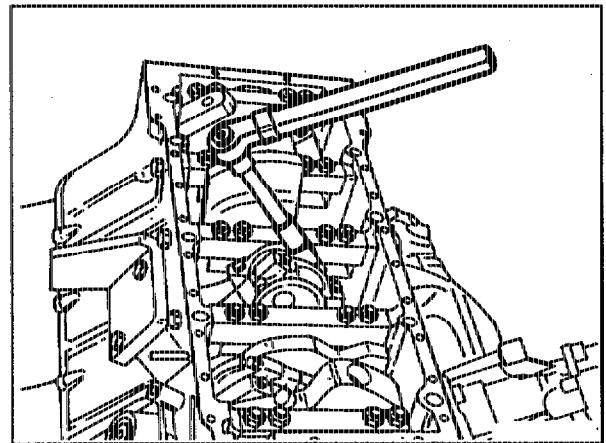
Pay attention to identification.

Install the bearing shells with the oil drilling in the conrod otherwise the conrod bushes will not be lubricated.



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23 Tighten conrod bolts (03-3100).



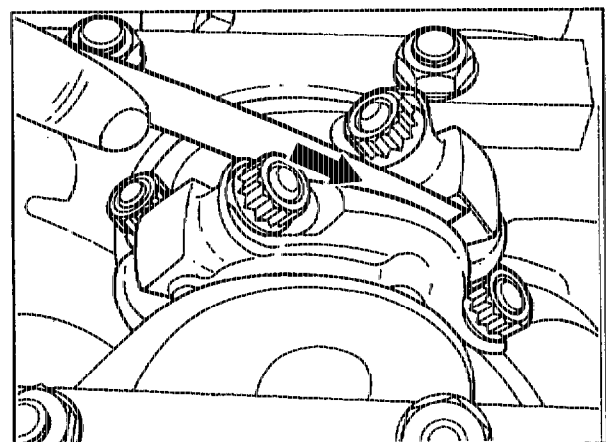
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21 Measure conrod bearing axial play. Inspect clearance of conrods in piston.



Disassemble oil pump, clean, replace if necessary. Replace oil delivery valve. Clean oil filter, carefully clean air-oil cooler or replace.

Install initial operation oil filter element.  
Change engine oil and oil filter element after 1000-1500 km.



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