

03-320 Installation of crankshaft and connecting rod bearings

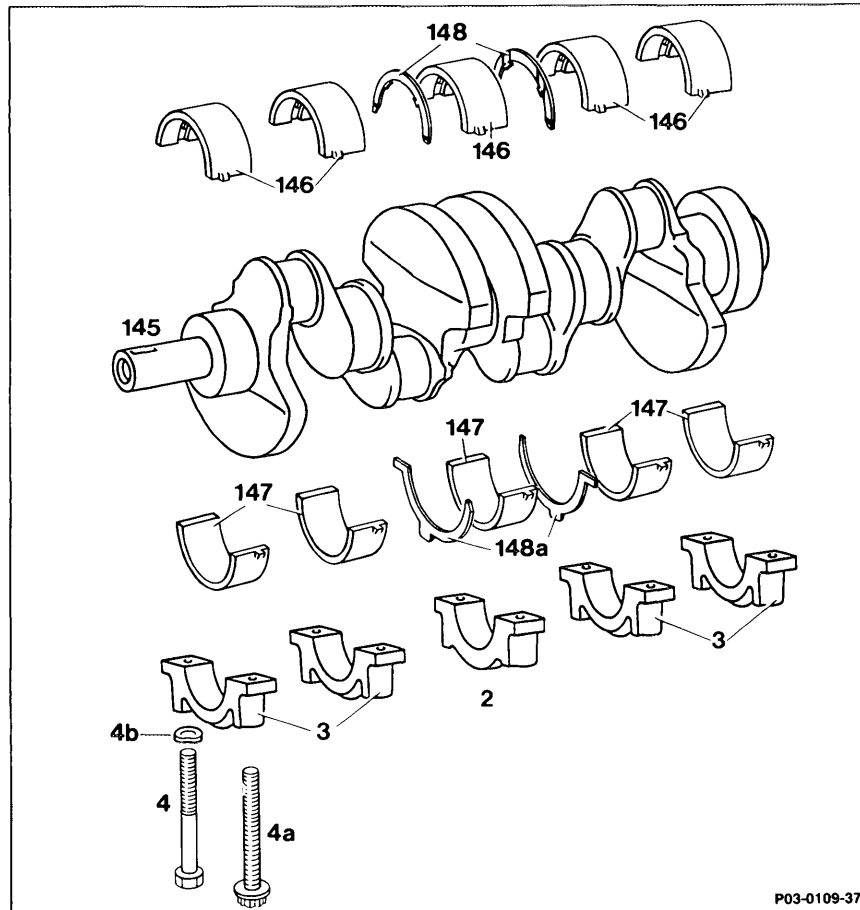
Preliminary jobs:

Main oil passage in crankcase open (01-130).

Oil passages in crankcase and crankshaft cleaned.

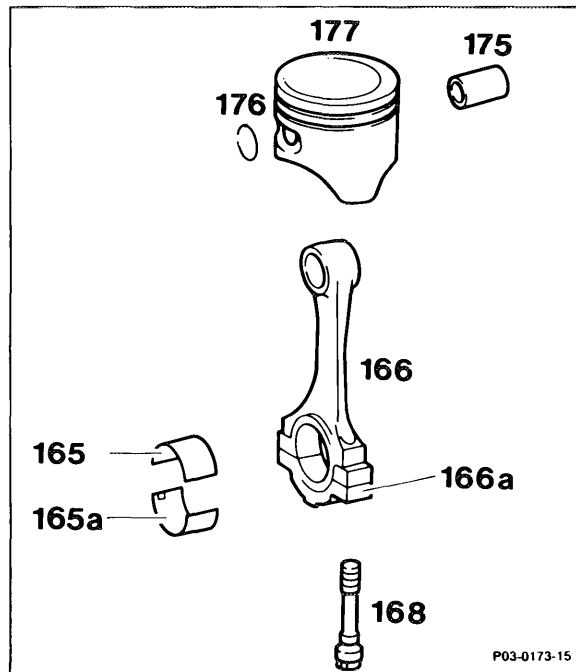
Crankshaft tested (03-318).

Connecting rods reconditioned (03-313).



Crankshaft bearing caps (2, 3) install without bearing shells, observe markings, tighten.
 Tightening torque or rotation angle:
 Crankshaft bearing bolt M 12 (4) 90 Nm
 Crankshaft bolt M 11 (4 a) 55 Nm, 90 - 100°.

Basic bores	measure conicity in directions A, B and C, min. 62.500 mm, max. 62.519 mm (item 3).
Crankshaft bearing caps (2, 3)	remove (item 4).
Crankshaft bearing shells (146, 147)	insert (item 4).
	Caution! Do not mix up upper and lower crankshaft bearing shells.
Crankshaft bearing caps (2, 3)	position in proper order, position washers (4 b) and tighten crankshaft bearing bolts (4 and 4a) (item 4). Tightening torque and tightening rotation angle crankshaft bearing bolts M 12 (4) 90 Nm crankshaft bearing bolts M 11 (4a) 55 Nm, 90 - 100° (item 4).
Crankshaft	measure bearing journals, determine bearing clearance (item 5).
Fitted bearing journal	measure width and match appropriate thrust washers (item 7).
Crankshaft bearing caps (2, 3)	remove crankshaft bearing bolts (4 and 4a), remove caps, remove lower bearing shells (147) and insert crankshaft (145) with thrust washers (148, 148a), position lower bearing shells (147) (items 8, 9). The oil grooves must point toward the crankshaft. Oil crankshaft, bearing shells and thrust washers.
Crankshaft bearing caps (2, 3)	position in correct order and tighten crankshaft bearing bolts (4 and 4 a) (items 10, 11). Tightening torque and tightening rotation angle crankshaft bearing bolts M 12 (4) 90 Nm, crankshaft bearing bolts M 11 (4a) 55 Nm, 90 - 100°.
Crankshaft (145)	measure end play, new value 0.100 - 0.254 mm; wear limit 0.30 mm.



- | | |
|---|---|
| Connecting rod bearing caps (166 a) | install without bearing shells and tighten, 30 Nm. Observe marking. |
| Basic bore for rod bearing | measure (03-313). |
| Rod bearing shells (165, 165 a) | insert, install rod bearing cap and tighten, rod bearing bolts (168) 30 Nm. |

Caution!

Do not mix up upper and lower rod bearing shells.

- | | |
|---|---|
| Connecting rod bearing diameter | measure and note value (item 15). |
| Connecting rod bearing journals | measure, new value 47.950 mm, determine bearing clearance, wear limit 47.965 mm (item 16). |
| Connecting rod radial clearance | measure, new value 0.030 to 0.055 mm; wear limit 0.08 mm (item 16). |
| Pistons (177) | attach to connecting rod (166) together with piston pins (175) and piston pin retainers (176) and install (observe installation position) (03-316). |

Pistons (177) and connecting rods (166) install (arrow on piston crown toward front of vehicle) (03-316).

Connecting rod bearing end play measure, new value 0.12 to 0.26 mm; wear limit 0.50 mm (item 20).

Oil pump and oil filter disassemble and clean, renew oil pressure valve and install initial operation oil filter cartridge.

Data

Crankshaft standard dimensions and repair stages	Crankshaft bearing journal dia.	Fitted bearing Associated thickness of thrust washers		Width of journal	Connecting rod bearing journal dia.	Connecting rod bearing journal width
Standard dimension	57.950	2.15	26.52 ¹⁾	24.53 ²⁾	47.950	27.96
	57.965		26.50	24.50		
1st repair stage	57.700	2.20	26.62 ¹⁾	24.63 ²⁾	47.965	28.04
	57.715		26.60	24.60		
2nd repair stage	57.450	2.25	26.72 ¹⁾	24.73 ²⁾	47.700	- 28.30
	57.465		26.70	24.70		
3rd repair stage	57.200	or	or		47.715	- 28.30
	57.215		26.92 ¹⁾	24.93 ²⁾	47.450	
4th repair stage	56.950	2.35	26.90	24.90	47.650	- 28.30
	56.965		or	or		
	56.950	2.40	27.02 ¹⁾	25.03 ²⁾	47.215	- 28.30
	56.965		27.00	25.00	46.950	
					46.965	

1) Up to 06/84
2) Starting 07/84

Basic bore and bearing play in mm		Crankshaft bearing	Connecting rod bearing
Basic bore dia.		62.500	51.600
		62.519	51.619
Basic bore width on fitted bearing	Engines 602 and 603	20.000	-
		19.979	
Connecting rod width	Engines 602 and 603	21.948	-
		22.000	
Permissible out-of-round of basic bore		0.01	
Permissible conicity of basic bore		0.01	
Bearing play, radial	New value	0.030 – 0.055 ¹⁾	
	Wear limit	0.08	
Bearing play, axial	New value	0.100 – 0.254	0.12 – 0.26
	Wear limit	0.30	0.50

1) For radial play, set to medium value.

Bearing shells

	Wall thickness Crankshaft bearing in mm	Width of bearing shells in mm	Thickness of fitted bearing thrust washers in mm	Wall thickness Connecting rod bearing in mm
Standard dimension	2.25	17.30 – 17.50	2.15 or 2.20	1.80
1st repair stage	2.37		2.25	1.92
2nd repair stage	2.50		or	2.05
3rd repair stage	2.62		2.35	2.17
4th repair stage	2.75		or	2.30
			2.40	

Engine 602.91

The tolerance range for the wall thicknesses of the connecting rod bearings was replaced starting 08/85 with three stages. The stages are indicated by a color code.

Only connecting rod bearing shells with the color code yellow are available as replacement parts.

Color code	Dimension
Red	1.804 to 1.808 mm
Yellow	1.808 to 1.812
Blue	1.812 to 1.816

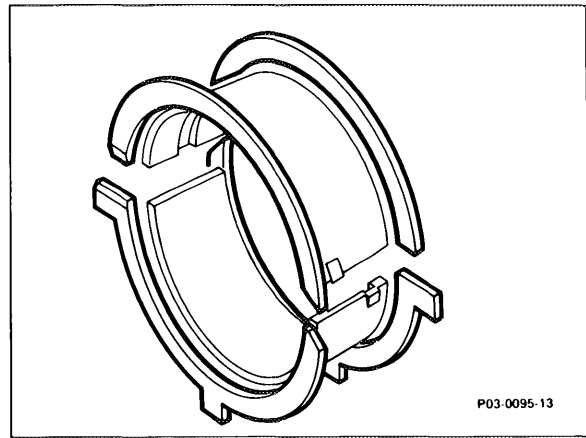
Engines 602.96, 603.96 and 603.96/97

Upper connecting rod bearing shells from Glyco with improved coating (cathode dust coating method).

Engines 602.96, 603.96/97

The groove for fixing the connecting rod bearing was modified to assure correct installation position.

Dimension A: 3.2 mm for all engines
 Dimension B: 2.5 mm 602.96, 603.96/97
 3.5 mm 602.91

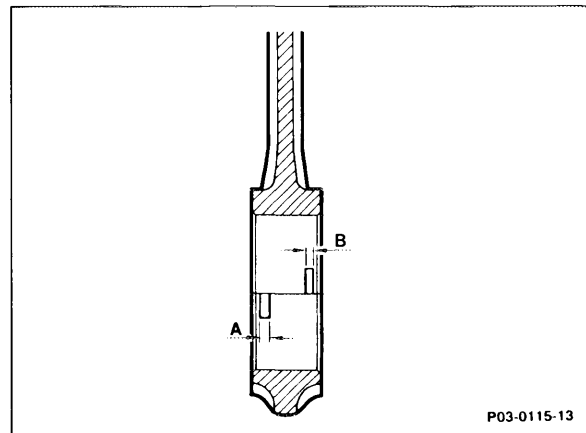
**Production breakpoint: 05/86**

Model	Engine	Engine end No.		Vehicle ident end No.	
		manual transmission	automatic transmission	A	F
124.133 124.193	603.960 603.960		001032	266393	013772
126.125	603.961		002508	260197	-

1) Engines 602.96 and 603.97 from start of production

Note

The axial forces of the crankshaft are taken up by the thrust washers.



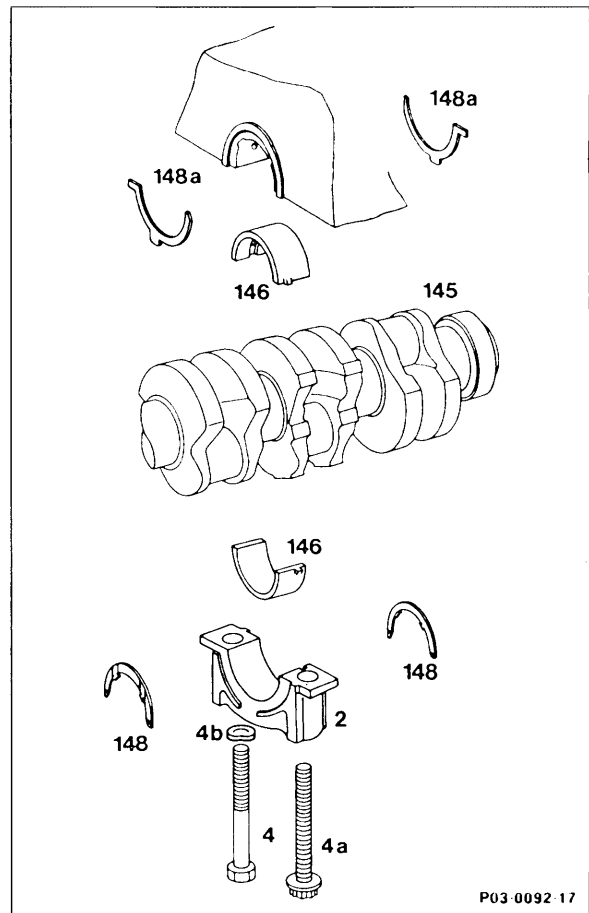
The thrust washers (148 and 148a) installed in the crankcase and in the bearing caps have a different shape.

The thrust washers in the crankshaft bearing caps each have two retaining lugs to prevent rotation and installation errors, whereby the lower retaining lugs are off-center.

When reconditioning crankshafts, regrind width of fitted bearing journals to one of the dimensions shown in the table (section "Data").

Match thrust washers to respective journal width (table).

2	Bearing cap
4	Crankshaft bearing bolt M 12 x 60
4a	Crankshaft bearing bolt M 11 x 62
4b	Washer
145	Crankshaft
146	Bearing shell
148	Upper thrust washer
148a	Lower thrust washer



P03-0092-17

Thrust washers of the same thickness must always be installed on both sides.

Do not regrind thrust washers.

Thrust washers are available for replacement in sets only. One set consists of one upper and one lower thrust washer (148 and 148a).

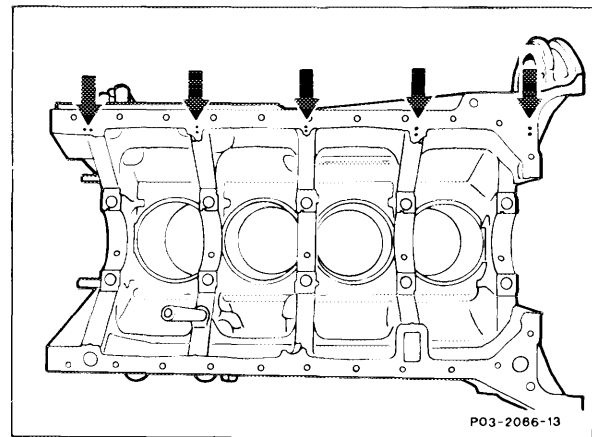
Association of crankshaft bearing shells and crankcases

Crankshaft bearing shell ¹⁾	Basic bores in crankcase		
	1 punch mark	2 punch marks	3 punch marks ²⁾
	Bearing shell association with color code		
Blue	Blue	Yellow	Yellow
Yellow	Blue	Yellow	Red
Red	Yellow	Yellow	Red

¹⁾ Color dots on crankshaft cheeks or counterweights next to crankshaft journals.

²⁾ Punch marks on parting surface of crankcase on oil pan side next to basic bore.

The standard dimension crankshaft bearing shells with color codes blue, yellow and red are available as parts. They must be matched according to the table. This eliminates the necessity of measuring the bearing clearance.



Punch marks for matching crankshaft bearing shells

When ordering crankshaft bearing shells the code
 52 for blue
 54 for yellow
 und 56 for red
 must be indicated in addition to the part No.

Only the yellow version bearing shells are available for the connecting rod bearing shells.

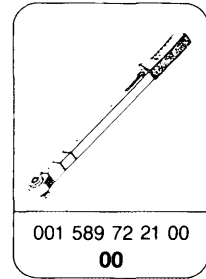
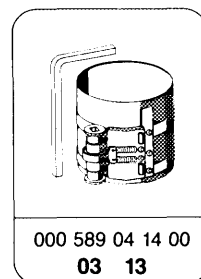
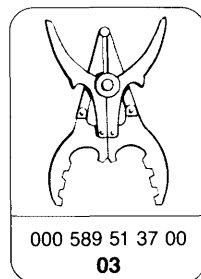
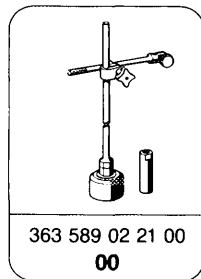
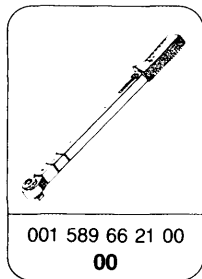
Thrust washer sets

Thickness in mm	Set Part No.
2.15	601 030 00 62
2.20	601 030 01 62
2.25	601 030 02 62
2.35	601 030 03 62
2.40	601 030 04 62

Tightening torques and rotation angle

Crankshaft bearing bolts	M 12	90 Nm
	M 11	Initial tightening torque Rotation angle
Connecting rod bolts		55 Nm 90 – 100°
		Initial tightening torque Rotation angle
		30 Nm 90 – 100°
M 18 x 1.5 x 50 bolts on crankshaft		320 Nm

Special tools



Commercially available tools

Connecting rod straightener	e.g.	Hahn & Kolb, D-7000 Stuttgart Model BC 503
Internal gauge	e.g.	Carl Mahr, D-7300 Esslingen Model 844 N
Micrometer screw	e.g.	Carl Mahr, D-7300 Esslingen
Dial gauge A1 DIN 878	e.g.	Carl Mahr, D-7300 Esslingen Model 810

Installation of crankshaft and connecting rod bearings

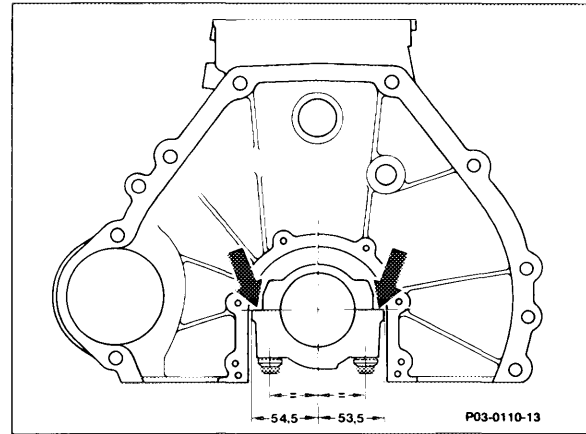
- 1 Attach crankshaft bearing cap.

Note

All bearing caps are fitted laterally into crankcase (arrows) and are fastened with two M 12 x 60 or M 11 x 60 bolts each.

The pilot fit (arrows) is offset 0.5 mm from the center so that the bearing caps can be mounted in one position only.

The bearing caps are also identified from front to rear with the code numbers 1, 2, 3, 4 etc. and must not be mixed up.



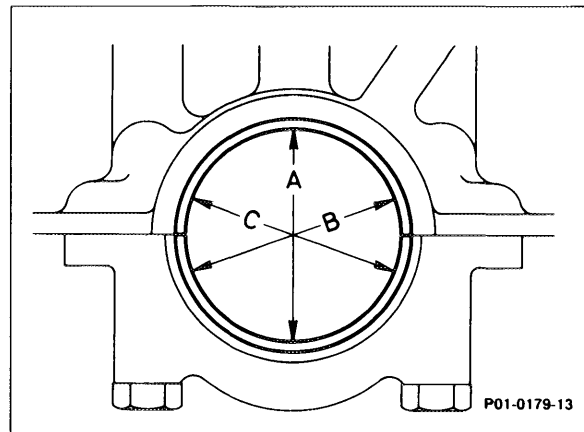
- 2 Lubricate crankshaft bearing bolts for crankshaft bearing caps and tighten.

Tightening torque and rotation angle:

Crankshaft bearing bolts	M 12	90 Nm,
crankshaft bearing bolts	M 11	55 Nm,
		90 – 100°.

- 3 Measure basic bore in directions A, B and C at two levels (conicity).

If specified value for one basic bore is exceeded or conical, touch up bearing cap at parting surface on surface plate up to max. 0.02 mm.



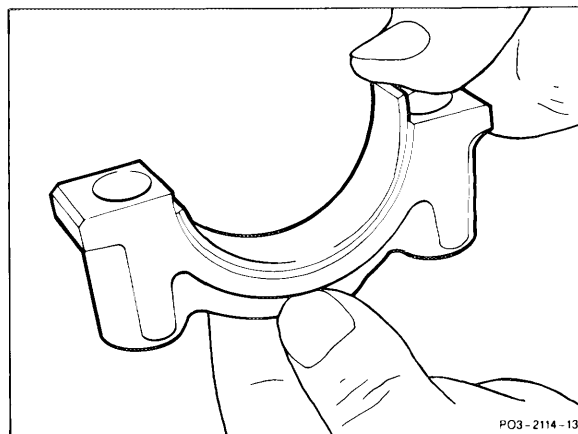
4 Remove crankshaft bearing bolts, insert crankshaft bearing shells, install crankshaft bearing caps and tighten.

Tightening torque and rotation angle:

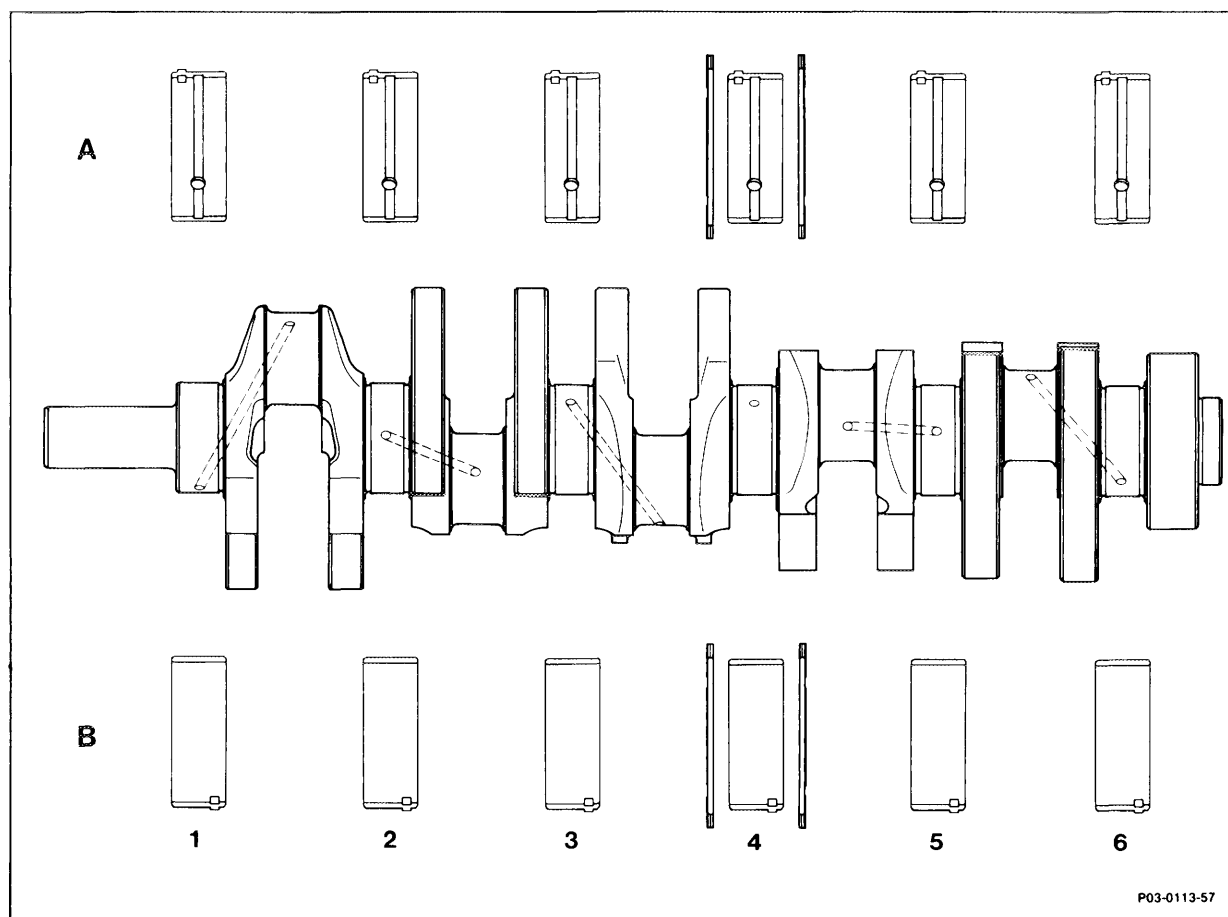
Crankshaft bearing bolts M 12 90 Nm
 Crankshaft bearing bolts M 11 55 Nm,
 90 – 100°.

Caution!

Observe order of crankshaft bearing caps. Do not interchange upper and lower crankshaft bearing shells.



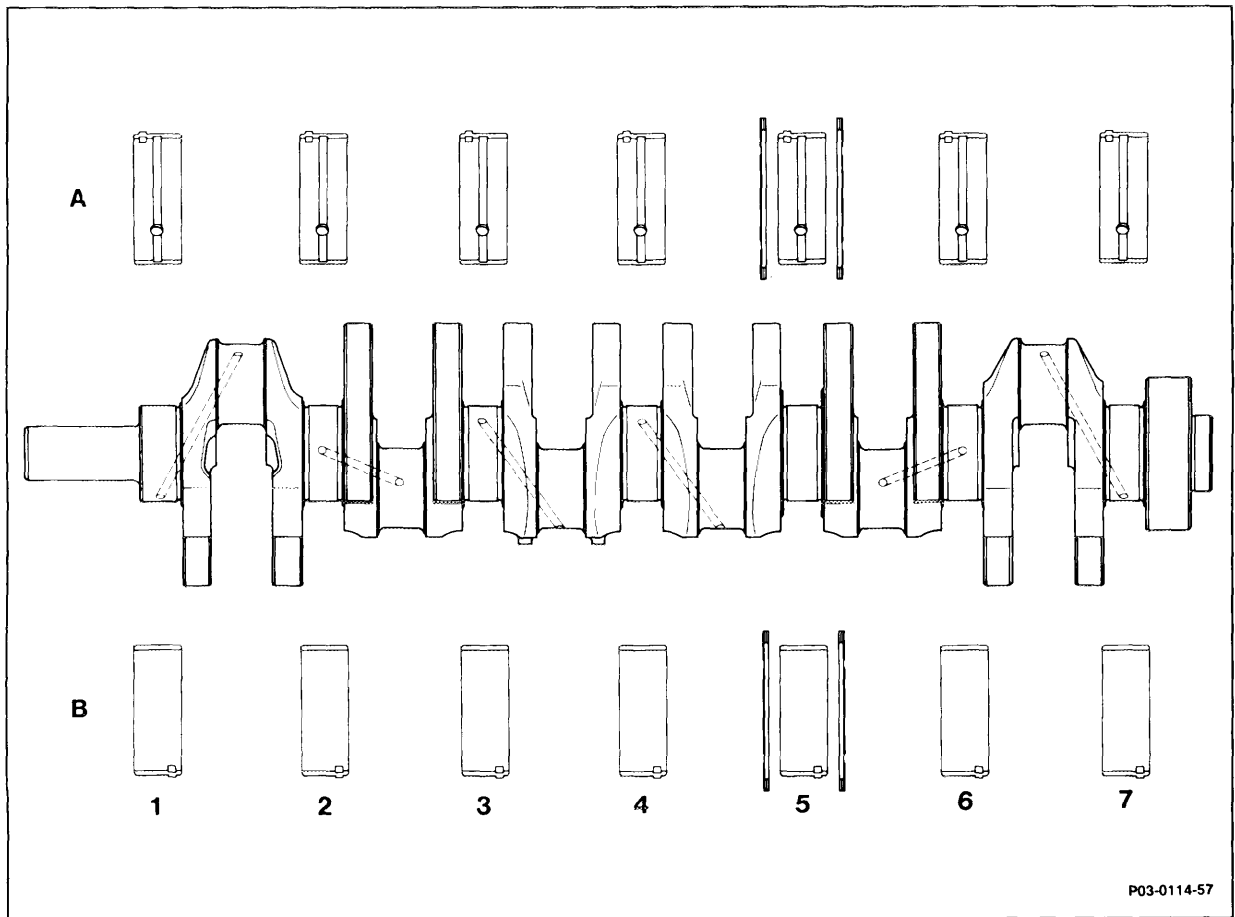
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P03-0113-57

Engine 602

Fitted bearing: bearing 4



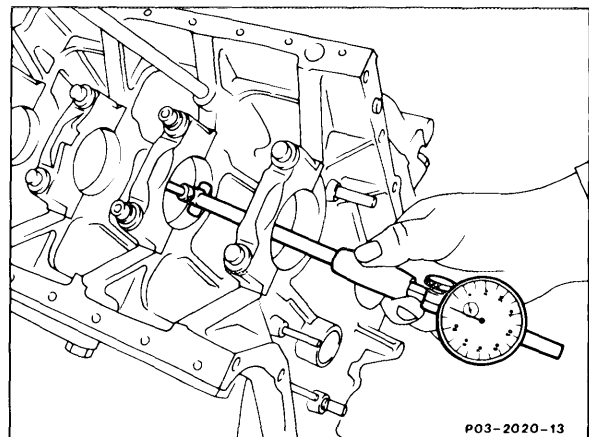
Engine 603

Fitted bearing: bearing 5

A Upper bearing shells, crankcase

B Lower bearing shells (cap shells)

5 Measure crankshaft bearings and note values.



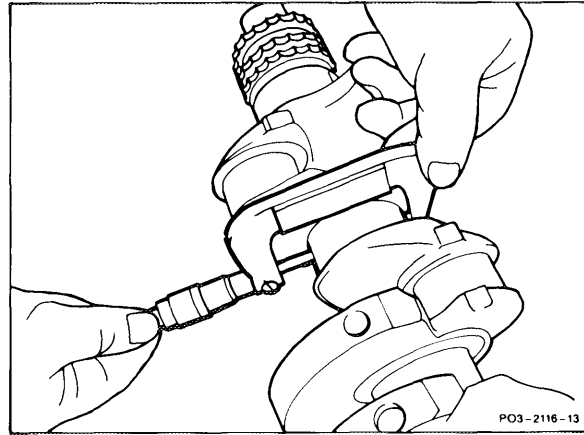
6 Measure crankshaft bearing journals, determine crankshaft bearing radial clearance.

Note

The bearing clearance can be corrected by exchanging bearing shells. Attempt to achieve the mean value of the specified bearing clearance.

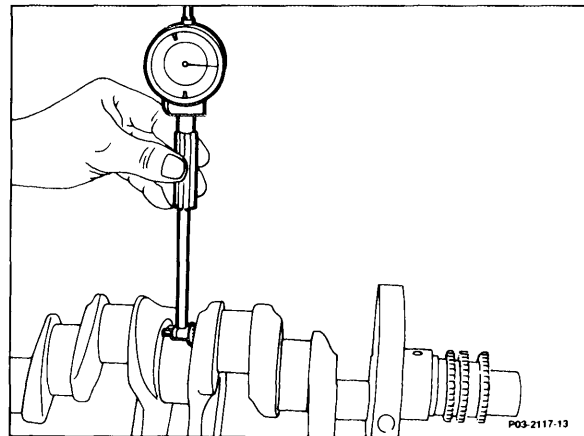
Caution!

Observe different wall thicknesses.



7 Measure width of fitted bearing journal and find proper thrust washers (see table, section Data).

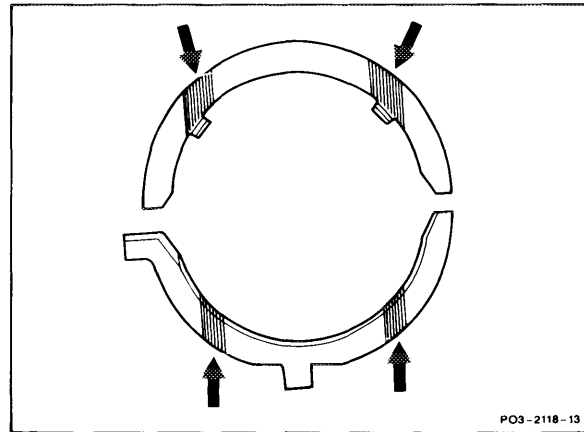
8 Remove crankshaft bearing bolts, remove lower crankshaft bearing shell, oil crankshaft, position in crankcase and oil lower crankshaft bearing shell and reposition.



Caution!

The two oil grooves (arrows) in the thrust washers should point toward the crankshaft cheeks.

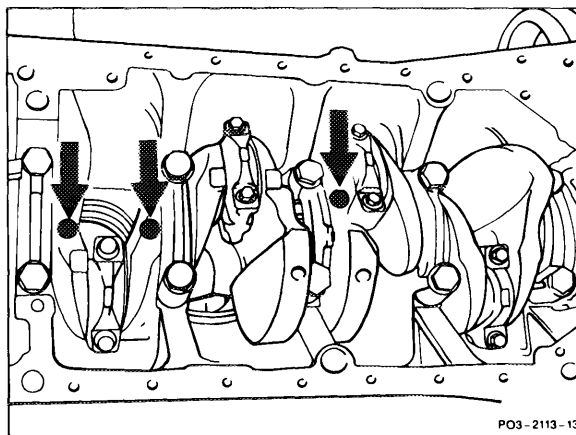
9 Oil thrust washers and slide into grooves at fitted bearing (crankcase).



10 Position crankshaft bearing caps in proper order.

Note

The crankshaft bearing caps are marked with code numbers at the marking points (arrows).



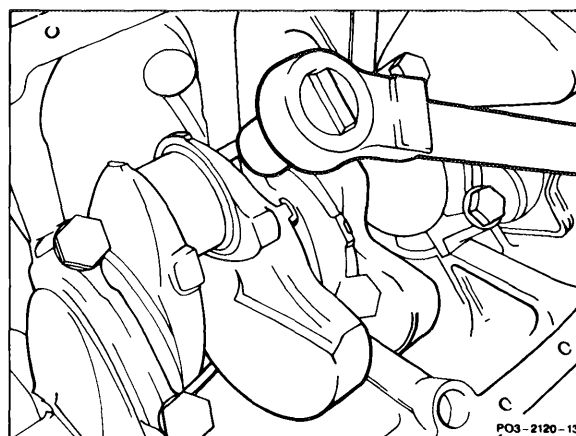
11 Tighten crankshaft bearing caps.

Tightening torque and rotation angle:

Crankshaft bearing bolts M 12	90 Nm
Crankshaft bearing bolts M 11	55 Nm, 90 – 100°.

12 Measure crankshaft end play.

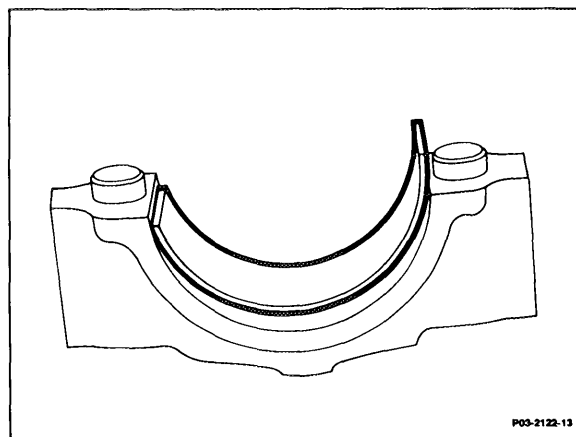
13 Turn crankshaft by hand and assure that it runs free.



Installation of connecting rod bearings and connecting rods

14 Insert connecting rod bearing shells, install connecting rod bearing caps with bearing shells and tighten connecting rod bolts to 30 Nm.

Connecting rod bearing shells are available only in the yellow version.



Note

The upper connecting rod bearing shells for engines 603.96 are made using a different material starting 05/86 due to the higher load.

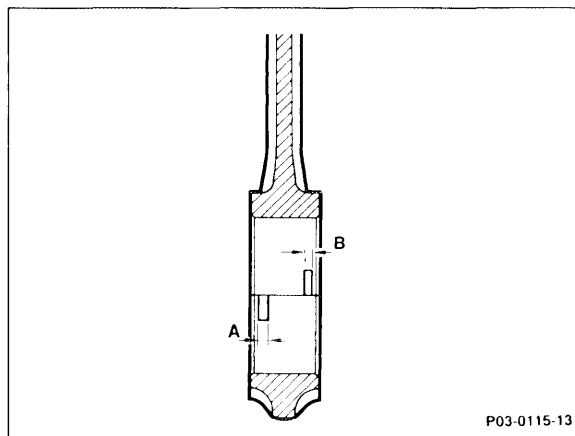
Caution!

Do not mix the upper and lower bearing shells. They can be recognized by the stamped-in part number.

Upper bearing shells 603 08 10
 or 603 15 10
Lower bearing shells 601 04 11
 or 601 08 11

The bore for lubrication of the piston pin has been eliminated.

Due to higher loads in engine 603.970, the upper connecting rod bearing shells are made of a different material than the lower shells. To prevent misassembly, the upper locating groove is 0.7 mm narrower.



A 3.2 mm all engines
B 2.5 mm engines 603.96, 603.97
 3.2 mm engine 602

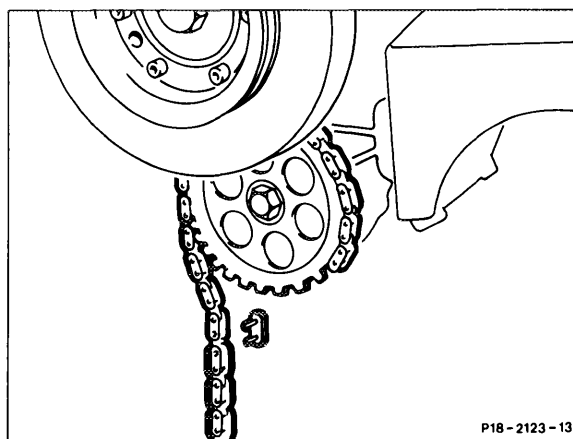
15 Measure connecting rod bearing diameters and note.

16 Measure connecting rod bearing journals. Determine connecting rod bearing radial clearance.

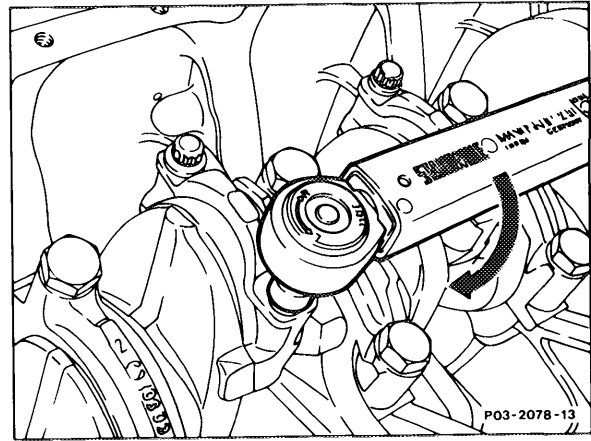
The bearing clearance can be corrected by changing the bearing shells, whereby it should be attempted to achieve the mean value of the specified bearing clearance. Observe different wall thicknesses.

17 Install pistons on connecting rods (03-316).

18 Coat bearing shells, crankshaft, pistons and cylinder walls with engine oil, install connecting rods with pistons (03-316).



19 Tighten connecting rod bolts to initial torque of 30 Nm and then turn 90 - 100°.



20 Measure connecting rod bearing end play while moving connecting rod directly at piston pin. Assure that connecting rod moves freely in relation to crankshaft. Use dial gauge holder 363 589 02 21 00.

Caution!

Disassemble oil pump and clean, replace if required. Replace oil pressure valve. Disassemble oil filter and clean.

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

