

**03–320 Refitting crankshaft bearings**
**Data**

Crankshaft, normal size and repair stages	Crankshaft journal dia.	Width of thrust bearing journal		Crankpin dia.	Crankpin dia.
Normal size	<u>69.96</u>	<u>34.00</u> <sup>1)</sup>	<u>34.00</u> <sup>2)</sup>	<u>51.96</u>	<u>32.00</u>
	69.95	34.03	34.03	51.95	32.10
			<u>34.10</u> <sup>2)</sup>		
			34.13		
1st repair stage	<u>69.71</u>	up to 34.60 <sup>1)</sup>	<u>34.20</u> <sup>2)</sup>	<u>51.71</u>	up to 32.30
	69.70		34.23	51.70	
2nd repair stage	<u>69.46</u>		or	<u>51.46</u>	
	69.45		<u>34.40</u> <sup>2)</sup>	51.45	
3rd repair stage	<u>69.21</u>		34.43	<u>51.21</u>	
	69.20		or	<u>51.20</u>	
4th repair stage	<u>68.96</u>		<u>34.50</u> <sup>2)</sup>	<u>50.96</u>	
	68.95		34.53	50.95	

1) Dimensions for flanged thrust shell bearings.

2) Dimensions for thrust bearings with thrust washers.

Basic bore and bearing play	Crankshaft bearings	Big-end bearings
Basic bore dia.	<u>74.50</u>	<u>55.60</u>
	74.52	55.62
Basic bore width at thrust bearing	<u>29.48</u>	—
	29.50	
Big-end width	—	<u>31.84</u>
		31.88
Permissible ovality of basic bore	0.005	
Permissible conicity of basic bore	0.01	
Bearing play radial	as new	0.031–0.073 <sup>1)</sup>
	tolerance limit	0.08
Bearing play axial	as new	0.10–0.25
	tolerance limit	0.30
		0.12–0.26
		0.50

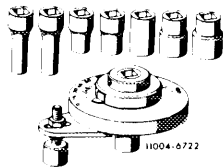
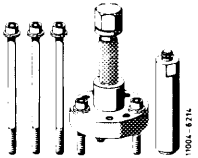
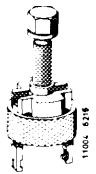

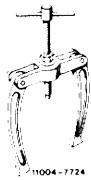

1) Aim at mean value for radial play.

Shell bearings	Wall thickness crankshaft bearings	Width of flanged thrust shell bearings	Thickness of thrust bearing thrust washers	Thickness of big- end bearings
Normal size	2.25	33.80–33.90	2.15 or 2.20	1.80
1st repair stage	2.37	34.40–34.60 <sup>1)</sup>	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	

<sup>1)</sup> The thrust shell bearings for the 1st to 4th repair stages are available in oversize widths and must be machined to match ground crankshaft journals.

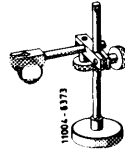
Tightening torques	Nm	(kpm)
Crankshaft bearing bolts	90	(9)
Clamp nuts	Initial torque	40–50 (4–5)
	Final torquing angle	90–100°
Bolt M 18 x 1.5 x 45 to crankshaft	270–330	(27–33)
Waisted bolts for flywheel and driven plate	Initial torque	30–40 (3–4)
	Final torquing angle	90–100°

### Special tools

Torquing angle set		116 589 01 13 00
Puller for balance plate		116 589 10 33 00
Puller for crankshaft sprocket		615 589 01 33 00
Supporting lock		110 589 00 40 00
Counter-support for internal extractor		000 589 33 33 00
Internal extractor 14.5–18.5 mm for deep-groove ball bearing		000 589 25 33 00

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Dial gauge holder for measuring axial play



116 589 12 21 00

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### Note

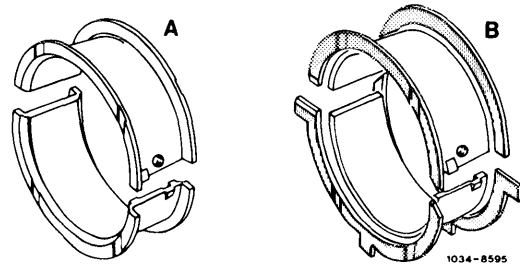
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Engine removed and disassembled.

Main oil galleries in crankcase open (for removal of steel balls see 03—030). Oil passages in crankcase and crankshaft cleaned carefully.

Crankshaft checked for cracks, truth, hardness and eccentricity (03—318).

To increase the service life, the flanged thrust shell bearings (A) of the 3rd crankshaft bearing (thrust bearing) have been replaced by shell bearings with thrust washers (B).



The thrust washers take up crankshaft thrust.

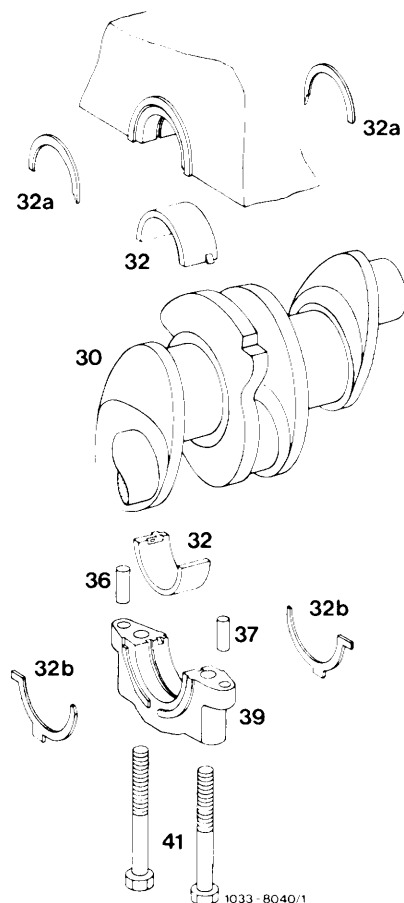
The thrust washers (32a and 32b) fitted at both ends of the crankcase and at both sides of the bearing caps are identical.

To avoid reversal and prevent assembly errors, the thrust washers for the bearing caps have two retaining lugs each, the lower ones being off-center. Besides, all thrust washers are chamfered at one end.

For reconditioning crankshafts, be sure to regrind thrust bearing journals to one of the widths indicated in the table (section entitled "Data").

Note the corresponding journal widths for the thrust washers (table).

32	Shell bearings	36	Straight pin 10 m 6 x 16
32a	Thrust washers in crankcase	37	Straight pin 8 m 6 x 16
32b	Thrust washers in bearing cap	39	Bearing cap
		41	Bolts M 12 x 75



Be sure to fit thrust washers of identical thickness at both ends and sides.

Thrust washer regrinding is not permissible.

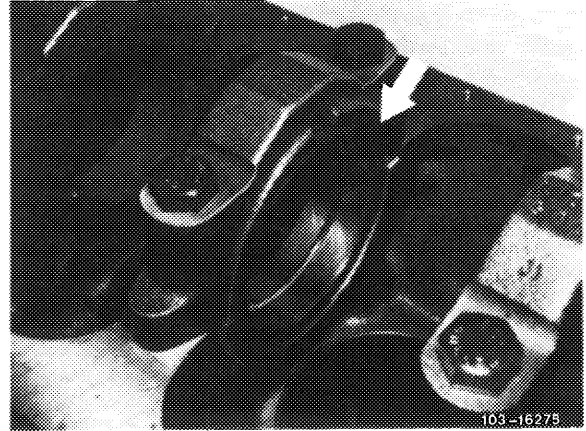
Spare thrust washers are available in sets only. A set consists of a top and a bottom thrust washer (32a and 32b).

#### Thrust washer sets

Thickness in mm	Set part No.
2.15	617 586 19 03
2.20	617 586 20 03
2.25	617 586 21 03
2.35	617 586 22 03
2.40	617 586 31 03

Crankcases bored for thrust washers must not be fitted with flanged thrust shell bearings (arrow).

Since the spares service is only able to supply the crankcase bored for thrust washers, it is necessary to find the shell bearing set that matches the corresponding crankshaft and crankcase.



The part Nos. of the normal size shell bearing sets are given in the bearing diagrams.

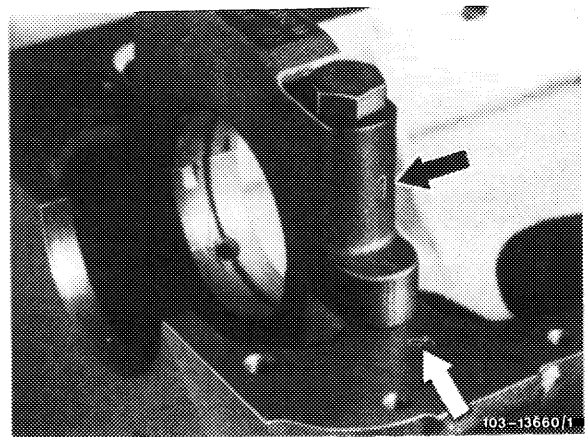
#### Allocation of crankshaft bearings, installation of crankshaft

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1 Fit crankshaft bearing caps with reference to code No. (1 at front).

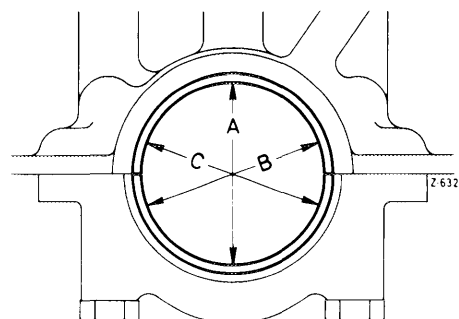
Crankshaft bearing caps must not be crossed.

2 Tighten bolts to 90 Nm (9 kpm).

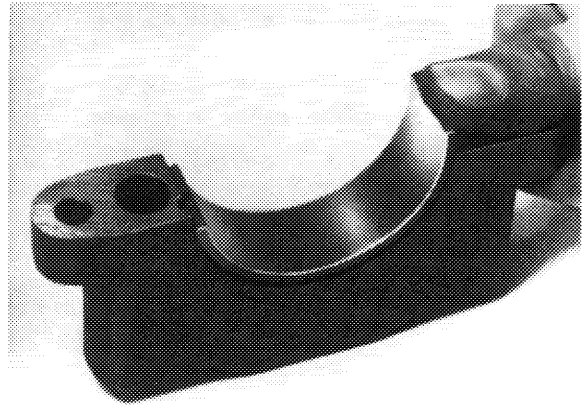


3 Measure basic bore in directions A, B and C on two levels (conicity).

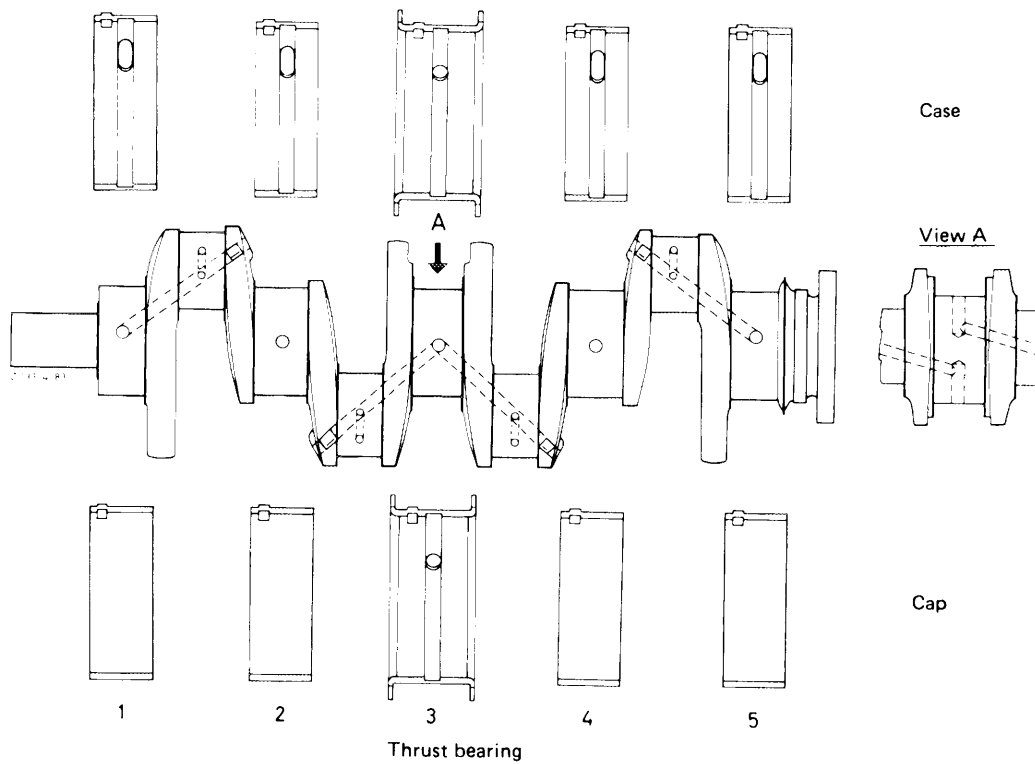
If any basic bore exceeds specification or is tapered, dress supporting surface of bearing cap by max. 0.02 mm, using a surface plate for reference.



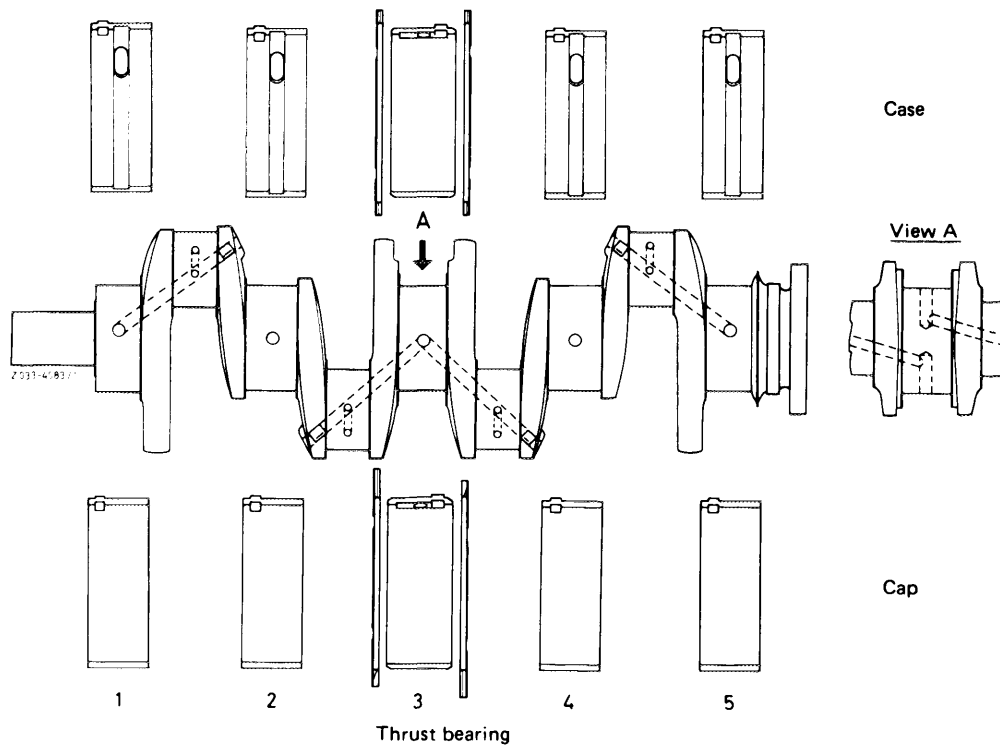
4 Insert crankshaft shell bearings and fit bearing caps. Tighten bolts to 90 Nm (9 kpm).



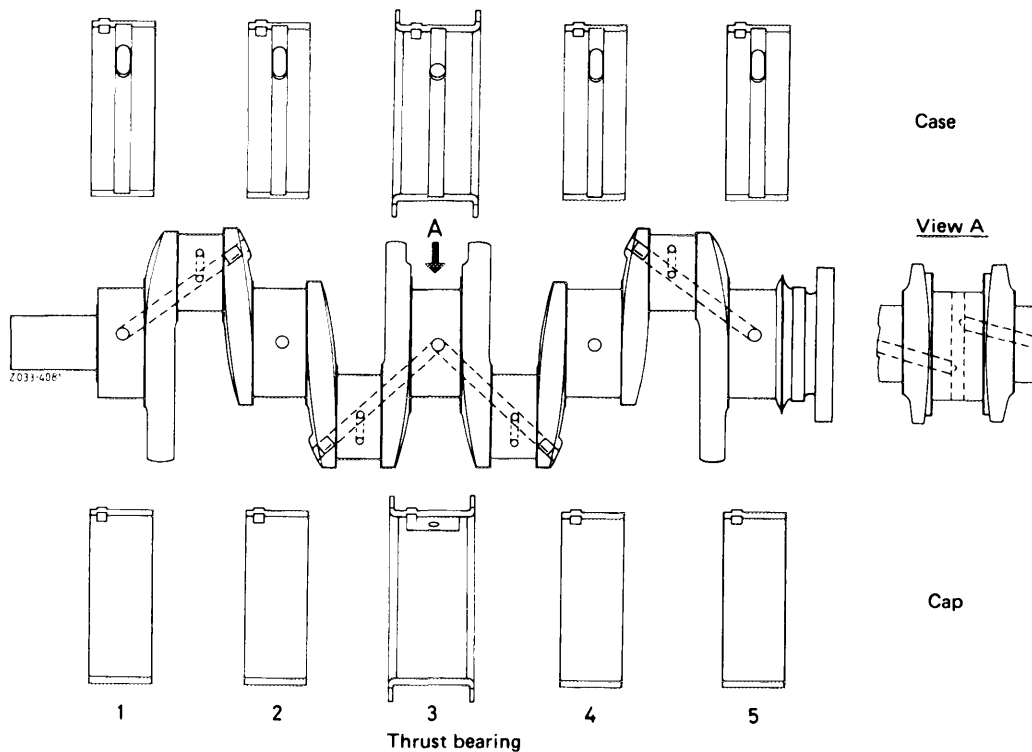
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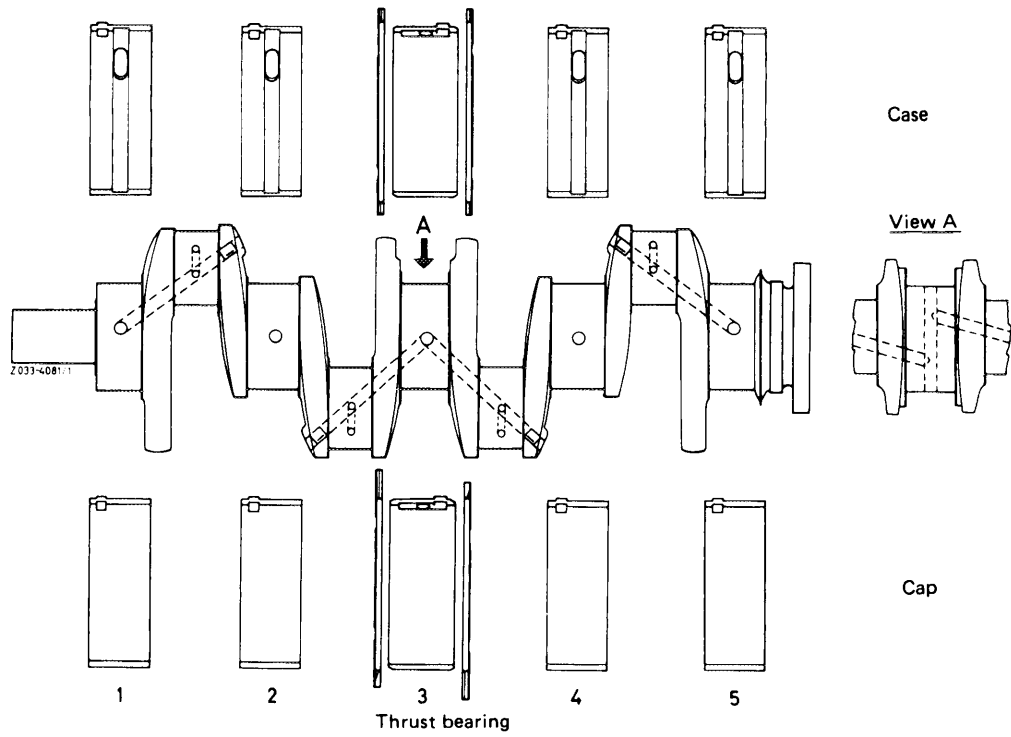
Engine 615, 1st version  
Flanged thrust shell bearings  
Shell bearing set part No. 115 586 07 03



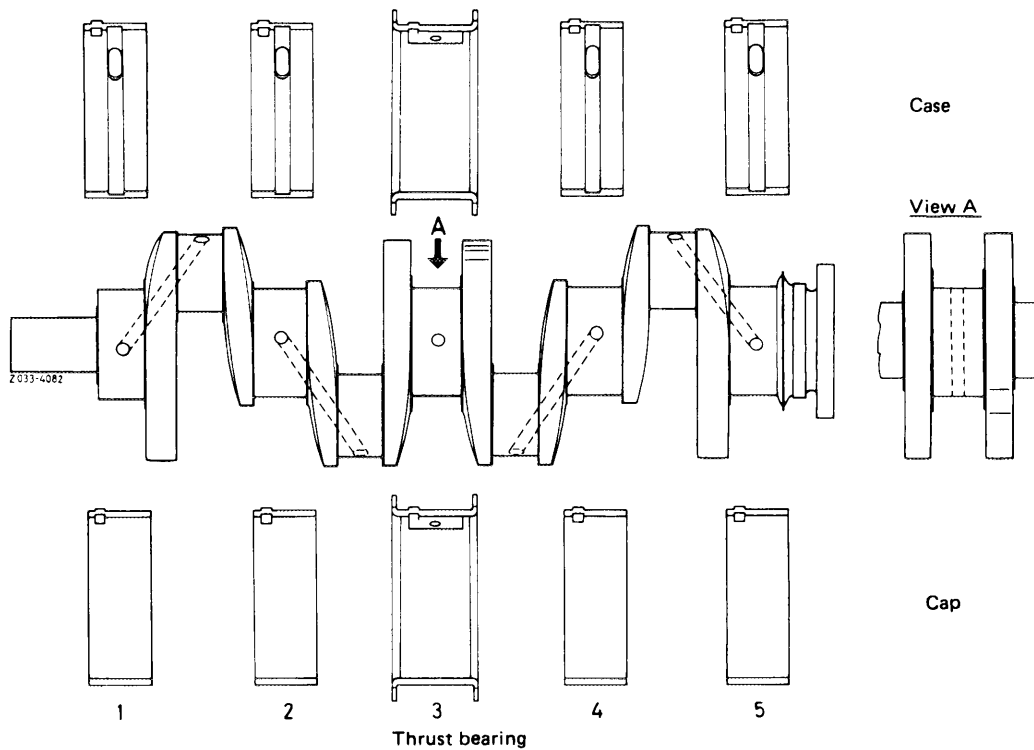
Engine 615, 1st version  
 Thrust bearings: Shell bearings with thrust washers  
 Shell bearing set part No. 615 586 39 03  
 Thrust washer set part No. 617 586 19 03 (two)



Engine 615, 2nd version  
 Flanged thrust shell bearings  
 Shell bearing set part No. 615 586 00 03

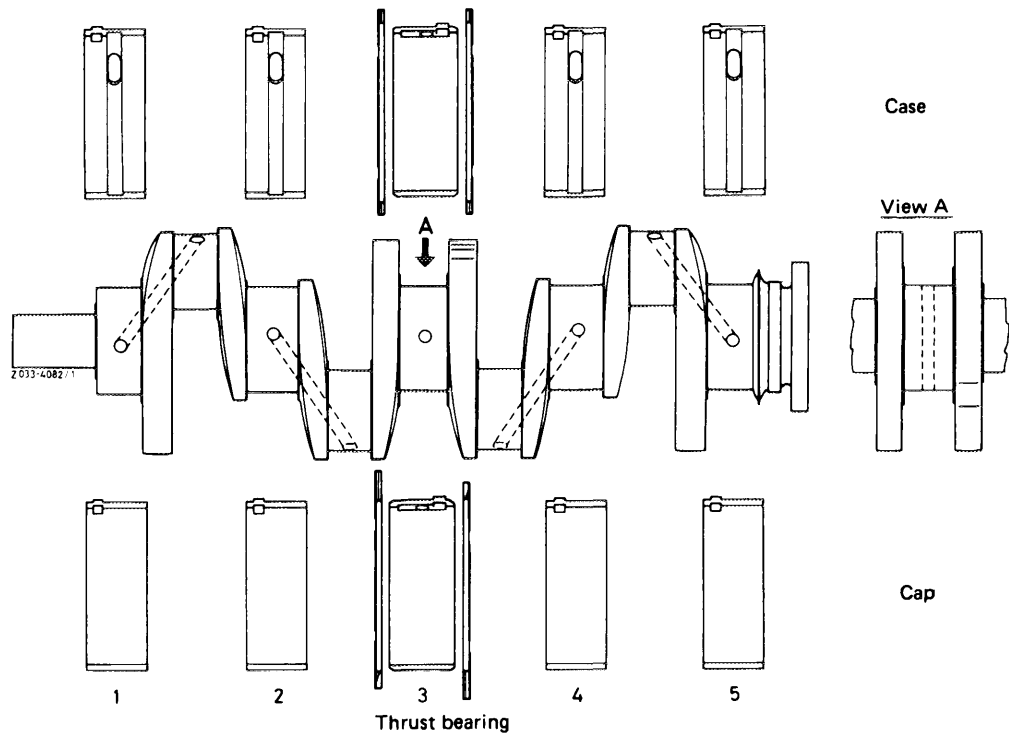


Engine 615, 2nd version  
 Thrust bearings, shell bearings with thrust washers  
 Shell bearing set part No. 615 589 39 03  
 Thrust washer set part No. 617 586 19 03 (two)

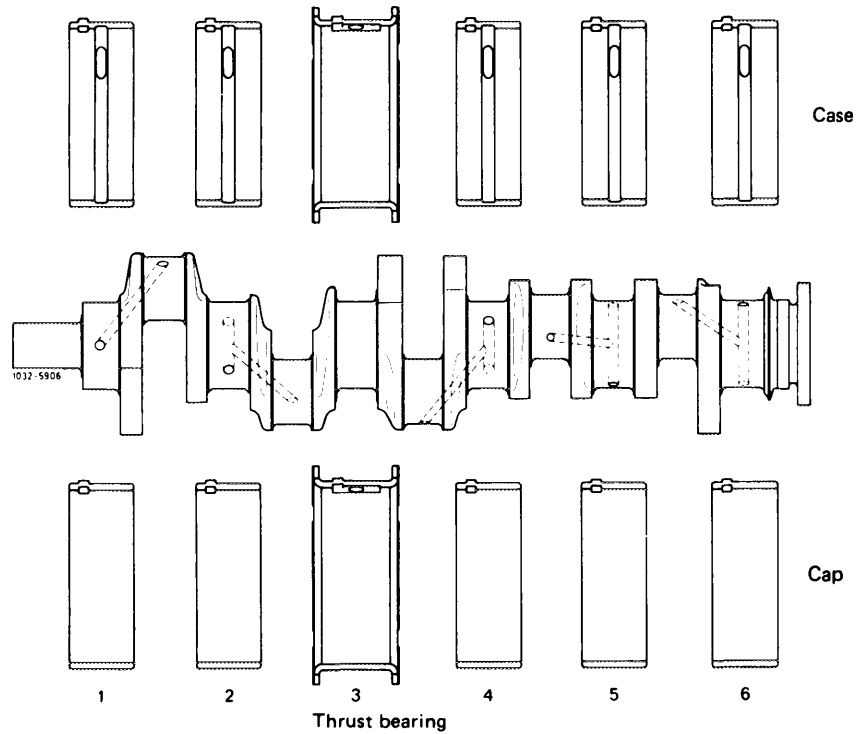


Engine 615, 3rd version and engine 616  
 Flanged thrust shell bearings  
 Shell bearing set part No. 616 586 00 03

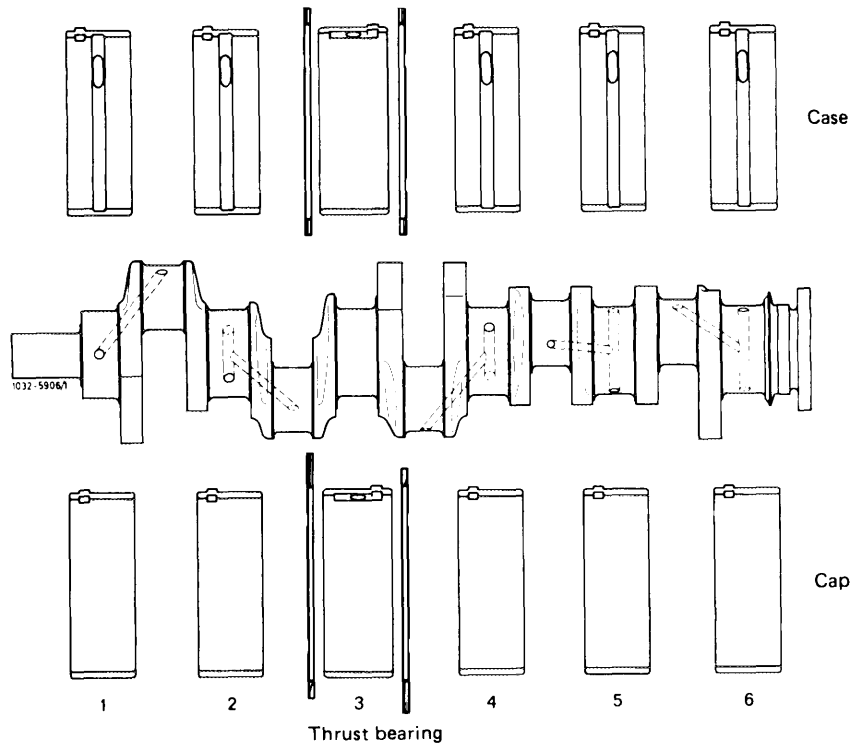




Engine 615, 3rd version and engine 616  
 Thrust bearings: Shell bearings with thrust washers  
 Shell bearing set part No. 617 586 34 03  
 Thrust washer set part No. 617 586 19 03 (two)

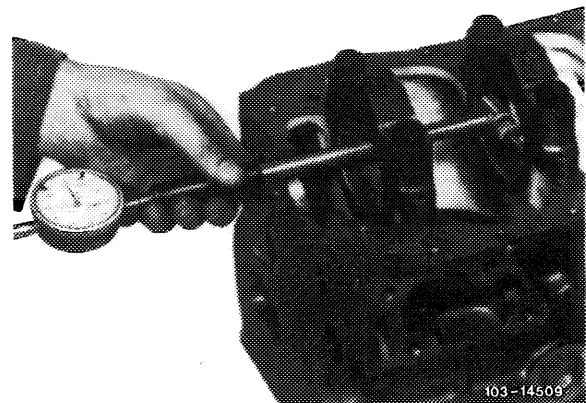


Engine 617  
 Flanged thrust shell bearings  
 Shell bearing set part No. 617 586 00 03



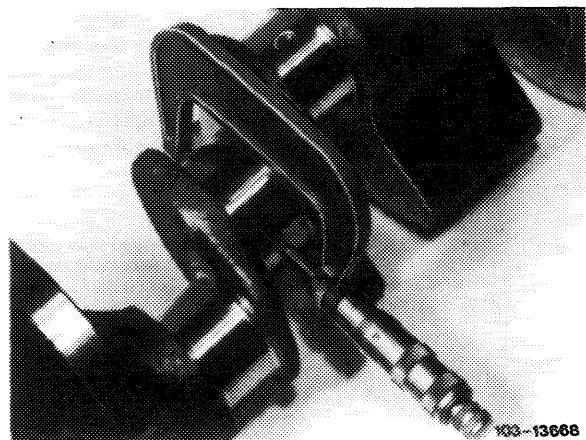
Engine 617  
 Thrust bearings: Shell bearings with thrust washers  
 Shell bearing set part No. 617 586 14 03 (two)  
 Thrust washer set part No. 617 586 19 03 (two)

5 Measure and note bearing diameter.



6 Measure crankshaft journal and ascertain radial play of crankshaft bearings.

**Note:** Bearing play can be corrected by exchanging shell bearings. Try and obtain mean value of bearing play specification. Crankshaft shell bearings without color coding are thicker than those with blue marking. But please remember that wall thicknesses of types with or without color coding may overlap.

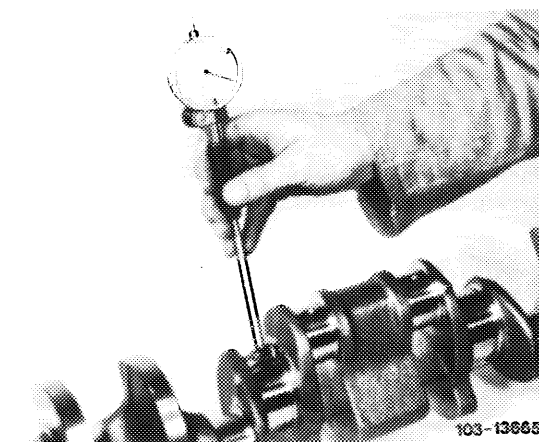


7 Measure width of thrust bearing journal and flanged thrust bearing, selecting appropriate thrust washers (see "Data").

Ascertain axial play of crankshaft bearings.

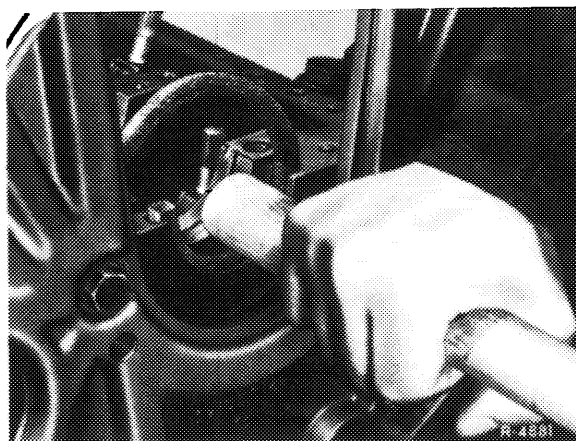
**Note:** The flanged thrust shell bearings of the repair stages are available in oversizes.

Both flanged thrust shell bearings must be dressed together at both sides to the width of the thrust bearing journal, minus the axial play. Aim at lower value of 0.10 mm.



8 Replace aft radial seal on crankshaft (03-327).

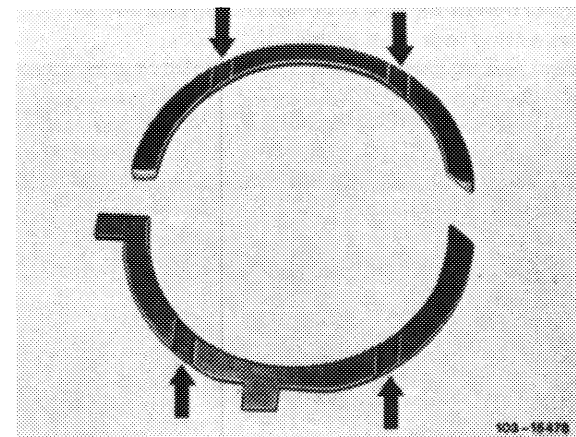
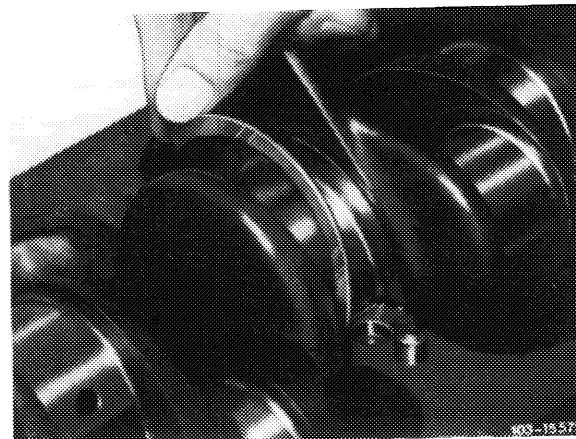
9 Apply engine oil to shell bearings, crankshaft and radial seal, finally inserting crankshaft.



10 For engines with thrust washers, first apply engine oil to washers and then slip washers into grooves on thrust bearing.

**Caution:**

The two oil grooves (arrows) in the thrust washers must point toward crankshaft webs.

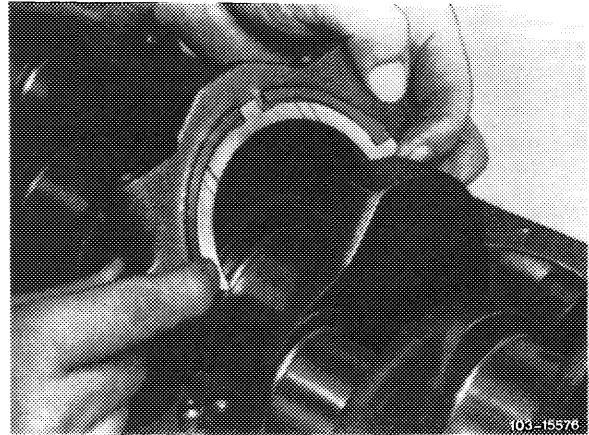


11 Fit thrust bearing cap.

**Caution:**

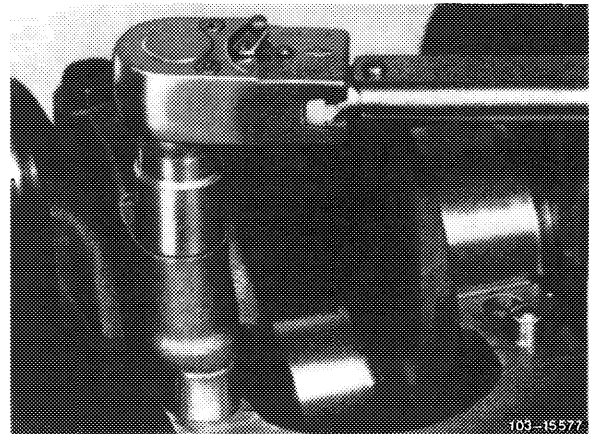
Apply engine oil to thrust washers and slip washers into grooves on thrust bearing cap. The two oil grooves (arrows) in the thrust washers must point toward crankshaft webs.

Securely hold both thrust washers and fit thrust bearing cap.



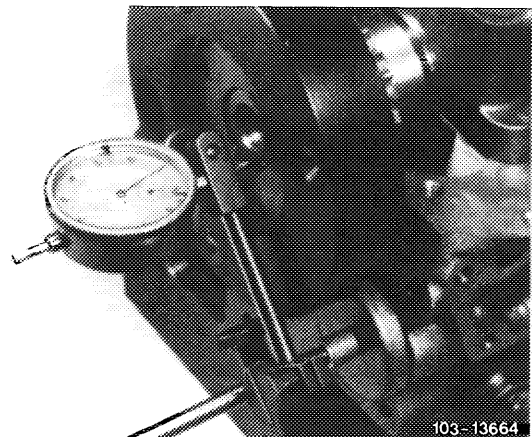
12 Fit crankshaft bearing cap.

13 Torque all bearing caps to 90 Nm (9 kpm).



14 Measure axial play of crankshaft bearings.

15 Turn crankshaft by hand and check whether it moves freely.

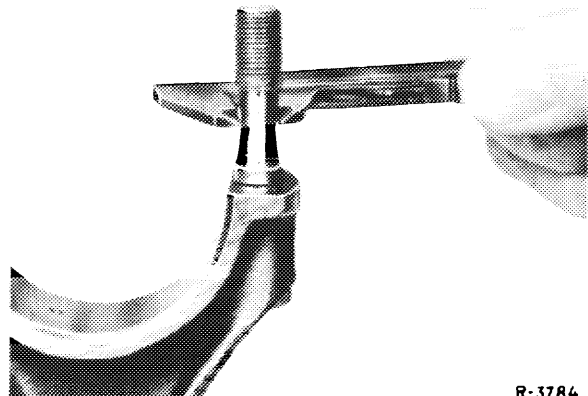


**Allocation of big-end bearings and installation of connecting rods**

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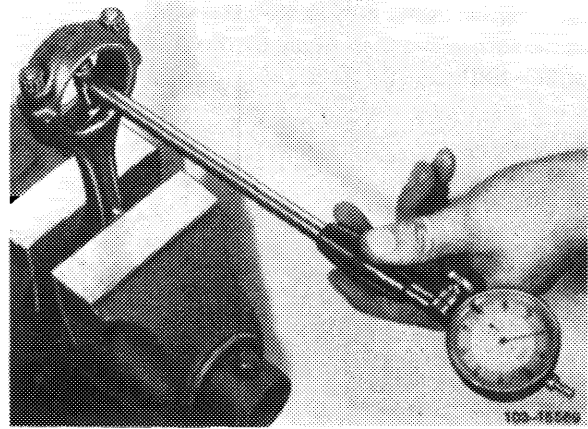
16 Check big-end clamp bolts (03-310).

17 Recondition and square connecting rod (03-313).

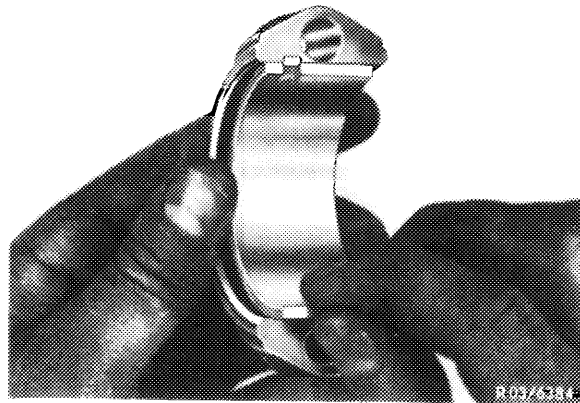


18 Fit big-end bearing cap, noting the marks.  
Torque clamp nuts to 40–50 Nm (4–5 kpm).

19 Measure basic bore in two directions. If any basic bore exceeds specification or is tapered, dress supporting surface of bearing cap by max. 0.02 mm, using a surface plate for reference.



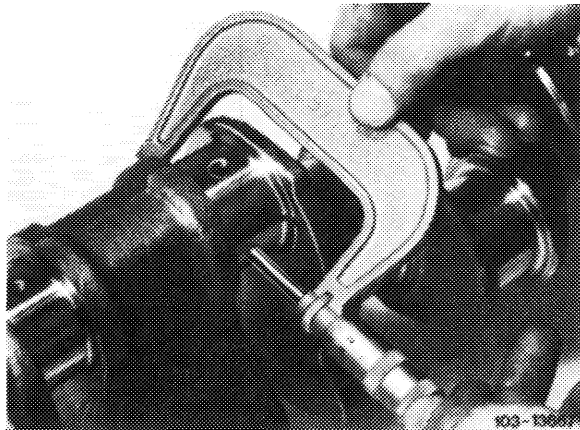
20 Insert big-end shell bearings, fit bearing cap with shell bearings and torque clamp nuts to 40–50 Nm (4–5 kpm).



21 Measure and note bearing diameter.

22 Measure crankpins and ascertain radial play of big-end bearings.

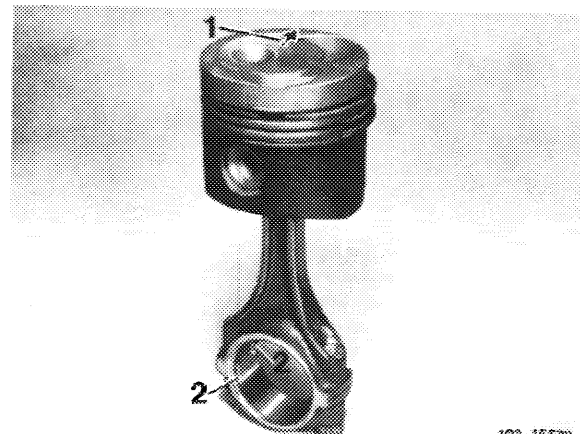
**Note:** Bearing play can be corrected by exchanging shell bearings. Try and obtain mean value of bearing play specification. Crankshaft shell bearings without color coding are thicker than those with blue marking. But please remember that wall thicknesses of types with or without color coding may overlap.



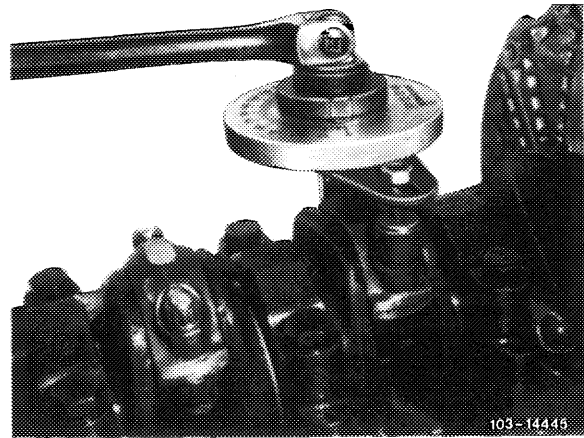
23 Attach piston to connecting rod (03–316);

24 Apply engine oil to shell bearings, crankshaft, pistons and cylinder walls, installing connecting rods with pistons (03–316).

Note marking.



25 Tighten clamp nuts to 40–50 Nm (4–5 kpm) **initial torque** and then secure by **final torquing angle** of 90–100°.

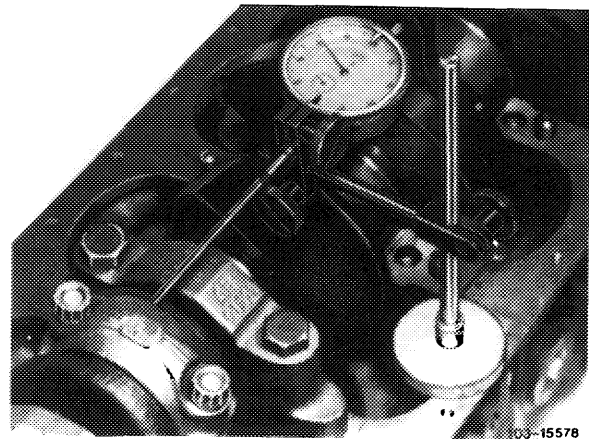


26 Measure axial play of big-end bearings, making sure that connecting rods move freely in pistons.

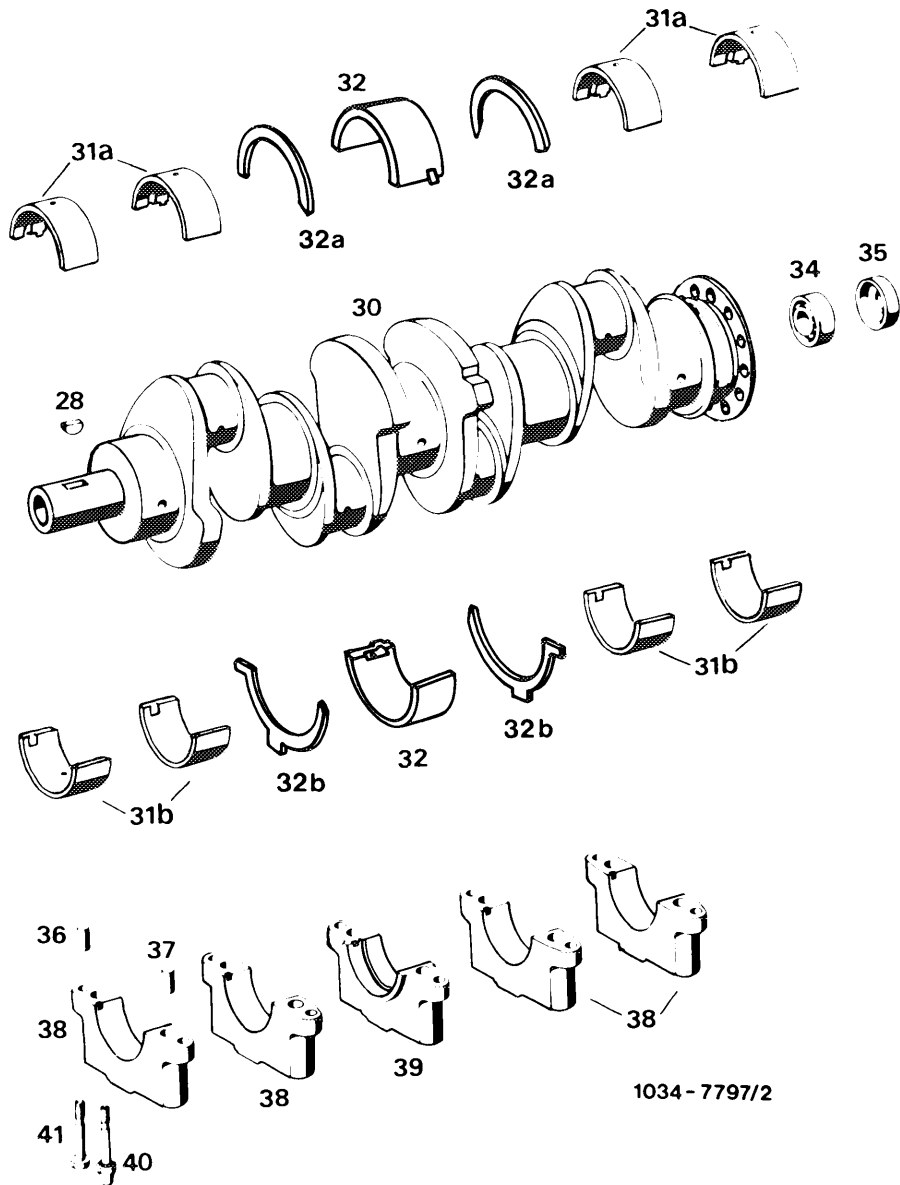
**Caution:**

Disassemble and clean oil pump, replacing if necessary; replace oil pressure relief valve. Disassemble and clean oil filter. Carefully clean air-cooled oil cooler. Clean oil spray nozzles (18-040).

Fit oil filter element for running in. Exchange engine oil and oil filter element after 500–1000 km.

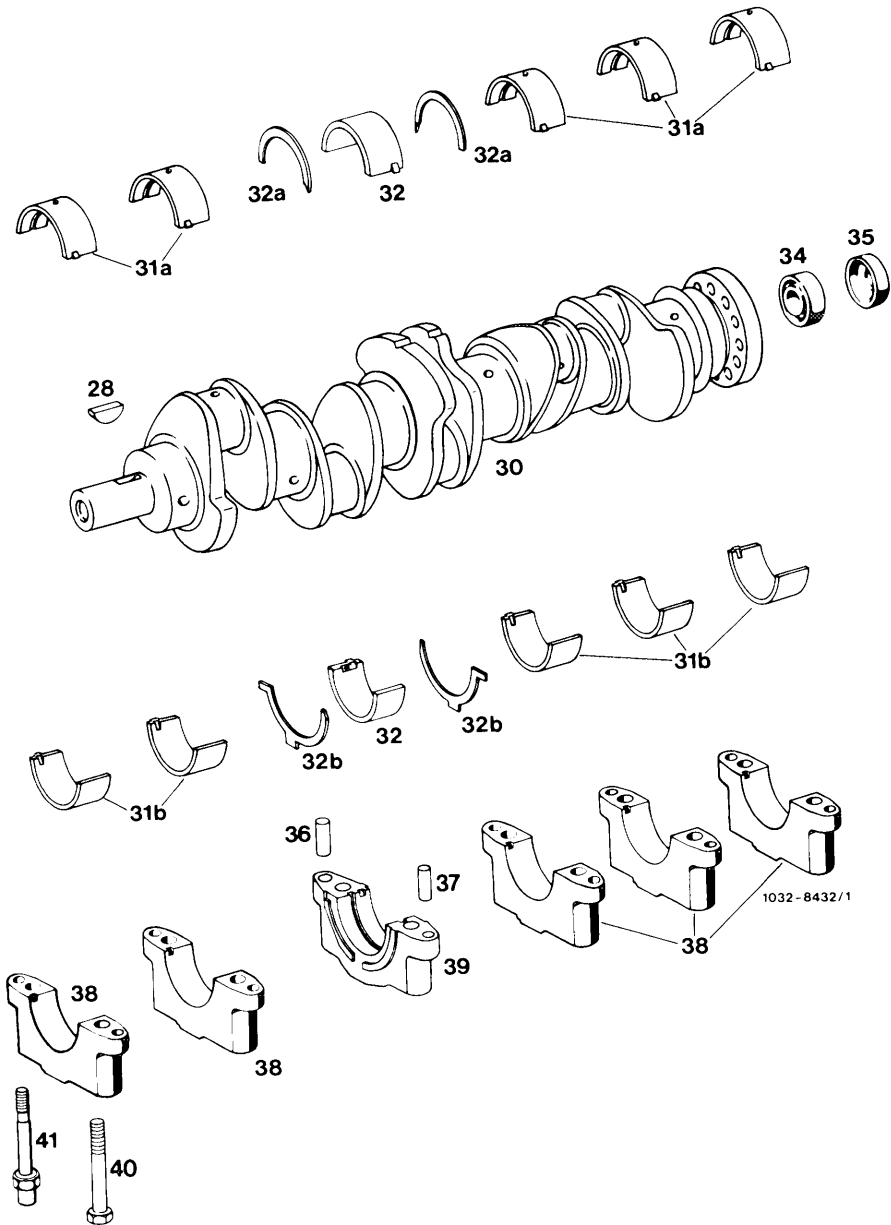


Crankshaft and shell bearings, engines 615 and 616



- |     |                              |    |   |
|-----|------------------------------|----|---|
| 28  | Woodruff key                 | 34 | Ball bearing 6202                       |
| 30  | Crankshaft                   | 35 | Locking ring                            |
| 31a | Shell bearings, upper halves | 36 | 5 straight pins 10 m 6 x 16             |
| 31b | Shell bearings, lower halves | 37 | 5 straight pins 8 m 5 x 16              |
| 32  | Shell bearings, thrust       | 38 | Crankshaft bearing cap                  |
| 32a | Thrust washers, upper halves | 39 | Crankshaft bearing cap (thrust bearing) |
| 32b | Thrust washers, lower halves | 40 | 9 bolts M 12 x 75                       |
|     |                              | 41 | Bolt M 12 x 75 with female thread       |

# Crankshaft and shell bearings, engine 617



- |     |                              |    |   |
|-----|------------------------------|----|---|
| 28  | Woodruff key                 | 35 | Locking ring                            |
| 30  | Crankshaft                   | 36 | 6 straight pins 10 m 6 x 16             |
| 31a | Shell bearings, upper halves | 37 | 6 straight pins 8 m 6 x 16              |
| 31b | Shell bearings, lower halves | 38 | Crankshaft bearing cap                  |
| 32  | Shell bearings, (thrust)     | 39 | Crankshaft bearing cap (thrust bearing) |
| 32a | Thrust washers, upper halves | 40 | 12 bolts M 12 x 75                      |
| 32b | Thrust washers, lower halves | 41 | Bolt M 12 x 75 with female thread       |
| 34  | Ball bearing 6202            |    |   |