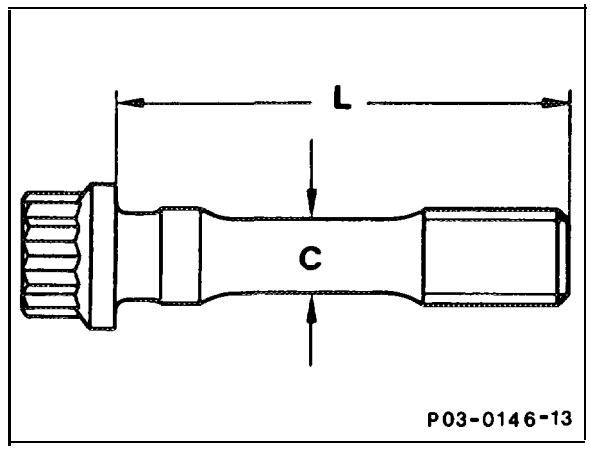
Job No.

03-310 Checking, replacing and torquing conrod bolts



Conrod bolts	before reuse, measure the smallest bolt shaft dia. If the dia. reaches or is less than the minimum shaft dia. of 7.1 mm, replace the conrod bolt.
Thread and bolt head contact surface	oil before installing.
Conrod bolt initial and angle of rotation torque	initial torque 30 Nm. Angle of rotation torque 90 – 100°, use special tool 001 589 66 21 00. Pay **attention** to note.

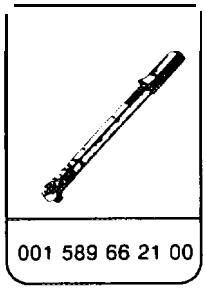
Dimensions of conrod bolts

Part No.	Thread dia.	Stretch shaft dia. when new	Minimum stretch shaft dia. "c"
102 038 00 71	M9 × 1	7.4 – 0.1	7.1

Torque of conrod bolt

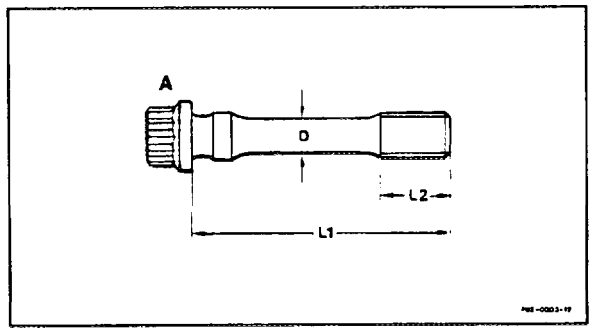
Initial tightening torque	30 Nm
Angle of rotation torque	90" – 100"

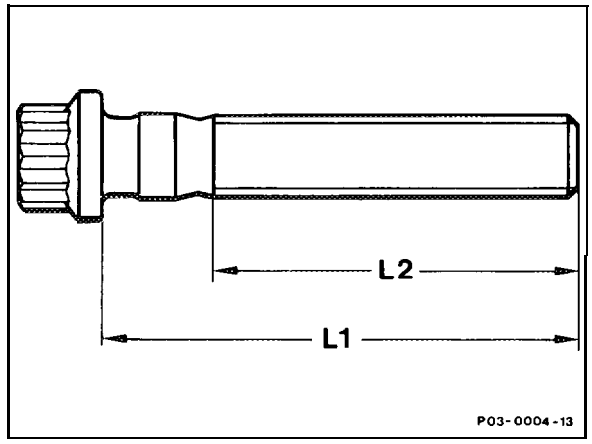
Special tool



Note

In September 1988 conrod bolts with a longer thread were installed.
These conrod bolts are not supplied as replacement parts.



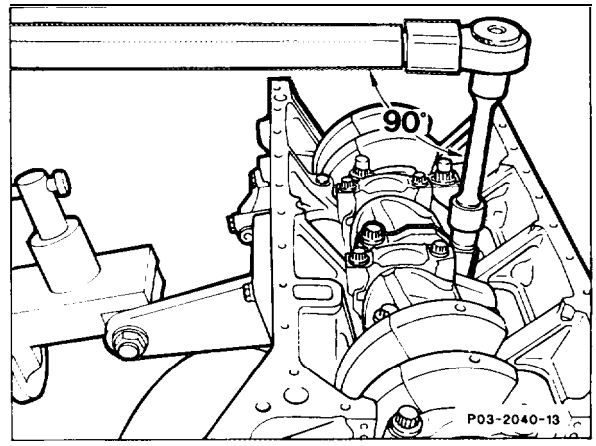


A 1st version
B 2nd version

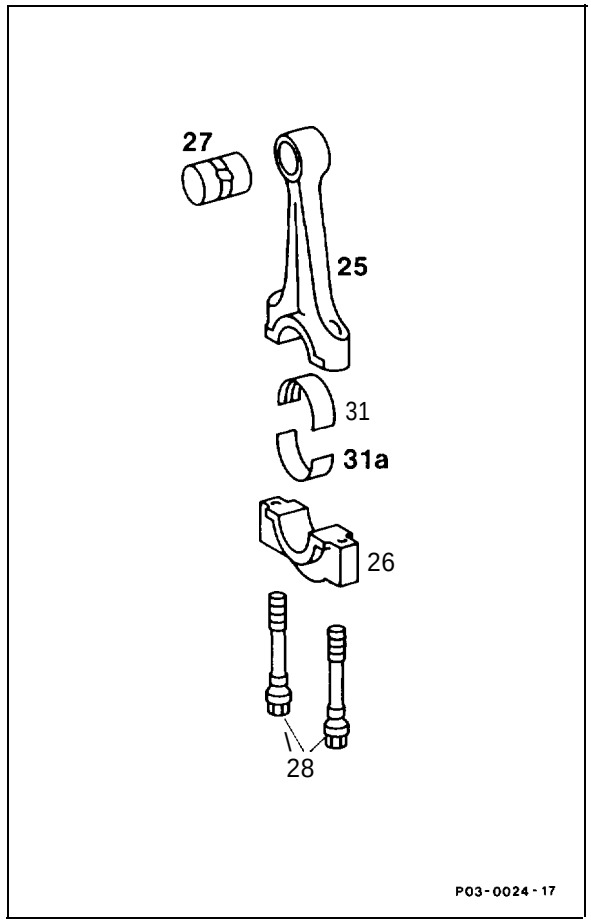
Standard **implementation:** 09/86

Model	Engine	Engine End No.	
		Manual transmission	Automatic transmission
201.028	102.985	027063 – 028449	076715 – 077418

If no torque wrench is available, the conrod bolt can be tightened according to the specified torquing angle with a socket wrench in a single operation. To prevent any angular errors, do not use a bending rod torque wrench for tightening according to angle degrees.



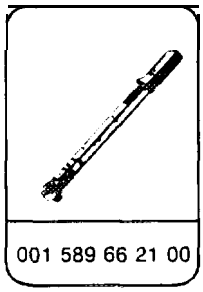
03-313 Reconditlonlng and checking angles of bearing bores



Conrod bolt (28)	check (03-310).
Conrod bearing cover (26)	install without bearing shells (31 and 31a), oil thread and bolt head contact surface, 30 Nm.
Basic bore	measure; if the value of 51.619 mm is exceeded, or if it is conical, dress bearing cover up to max. 0.02 mm (step 3).
Conrod bushing (27)	press in, pay attention to oil holes. Insertion pressure approx. 2500 N. Hollow out conrod bushing by turning or reaming. Dress side contact surfaces on dressing plate (steps 4 to 6).

Conrod (25)	check angles of bearing bores with conrod tester. Align conrod bearing bore to small end bushing bore (steps 7 and 8).
Axial twist	to small end bushing bore, check (step 9).

Special tool



Commercial tool

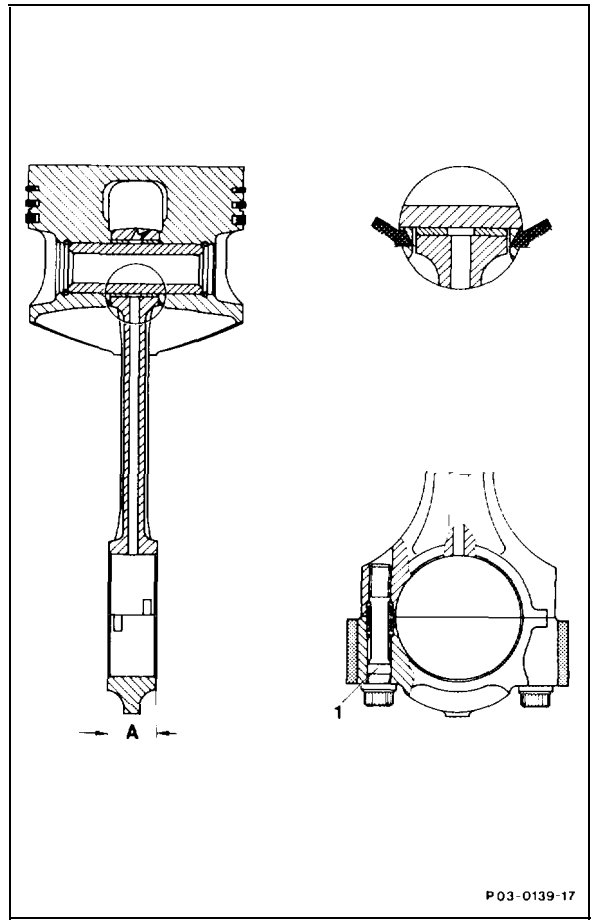
Conrod aligning tool	e. g.	Hahn & Kolb D-7000 Stuttgart Model BC 503

Data

Centre of conrod bearing bore to center of small end bushing bore (L, Fig. para 4)	144 95 145.05
Width of conrod at conrod bearing bore and at small end bushing bore (B, Fig. para 4)	22 000 21.948
Basic bore for conrod bearing shells	51 600 51.619
Basic bore for small end bushing (D1, Fig. para 4)	24 521 24.500
Small end bushing OD	24 590 24.550
Small end bushing ID (D2, Fig. para 4)	22.007 22.013
Peak-to-valley height of small end bushing on inside	0.005
Permissible axial twist of conrod bearing bore to small end bushing bore related to 100 mm length	0.1
Permissible variation of axial parallelism: conrod bearing bore to small end bushing bore related to 100 mm length	0.045
Permissible variation of conrod bearing bore from roughness	0.02
Permissible difference in weight of complete conrod within an engine	5 grams

Note

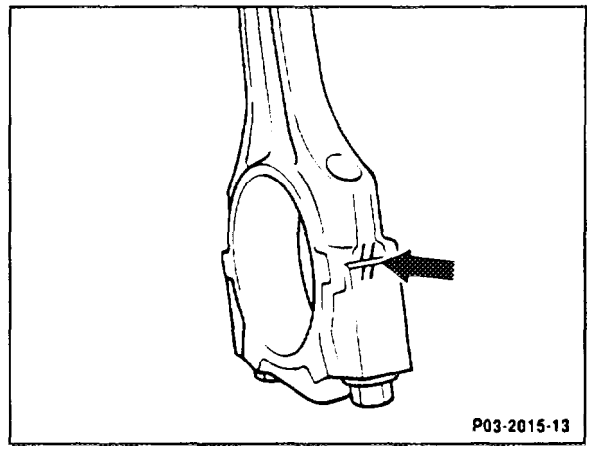
The end play of the conrod is limited not at the crankshaft journals but at the piston pin bosses (piston-guided conrod, arrows).



Conrods which have been overheated as a result of a bearing damage (blue discolouration), must not be reused.

Conrod and conrod bearing cover are marked together. The conrod shaft must not show any cross scoring and notches.

Conrods are supplied as replacement parts with a machined small end bushing.



To reduce the distortion tendency, conrods with a modified material were installed from June through September 1985 and are installed effective February 1987.

Standard implementation: June through September 1985

Model	Engine	Engine End No.		Vehicle Ident End No.	
		Manual transmission	Automatic transmission	A	F
201.024	102.961	–	056261 – 056430		124773 – 135776
201.024 (USA)	102.985	002118 – 002665	018026 – 023402	–	120052 – 153013

" not covered

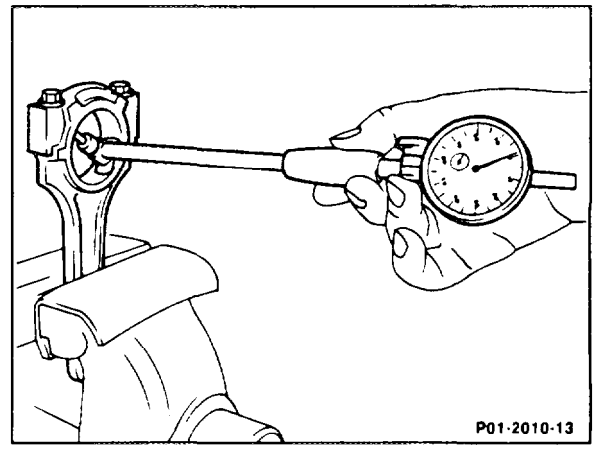
Effective 09/89 all conrods are subject to additonal heat treatment to prevent conrod distortion resulting in noises when the engine is operating at normal temperature.

Reconditioning

1 Check conrod bolts, replace if necessary (03-310).

2 Install conrod bearing cover. To perform the step, oil thread and bolt head contact surface and tighten to 30 + 5 Nm.

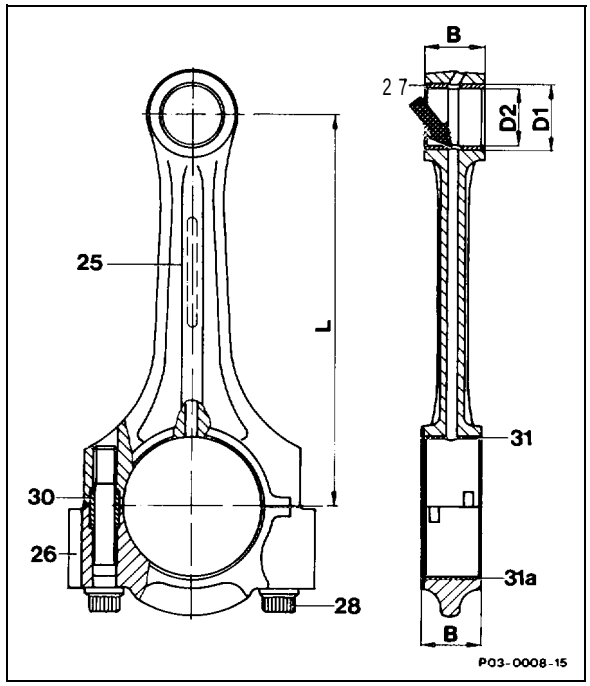
3 Measure conrod bearing basic bore. If the basic bore exceeds the value of 51.619 mm or is conical, dress contact face of bearing cover on a surface plate to max. 0.02 mm.



4 Press in new small end bushing so that the oil bores are aligned (arrow).
Press-fitting pressure 2500 N.

5 Hollow out small end bushing by turning or reaming.

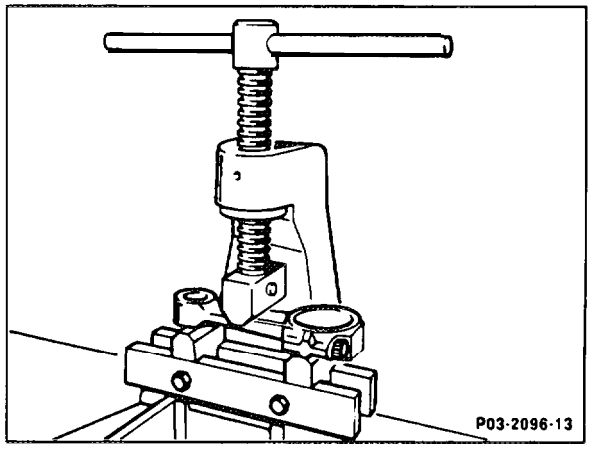
6 Dress side contact faces of conrod on the surface plate.



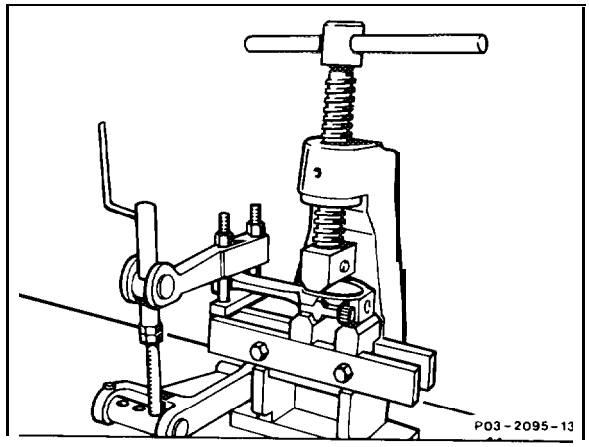
Checking angles

7 Check angles of bearing bores with a conrod tester.

8 Align conrod bearing bore to small end bushing bore (parallelism).

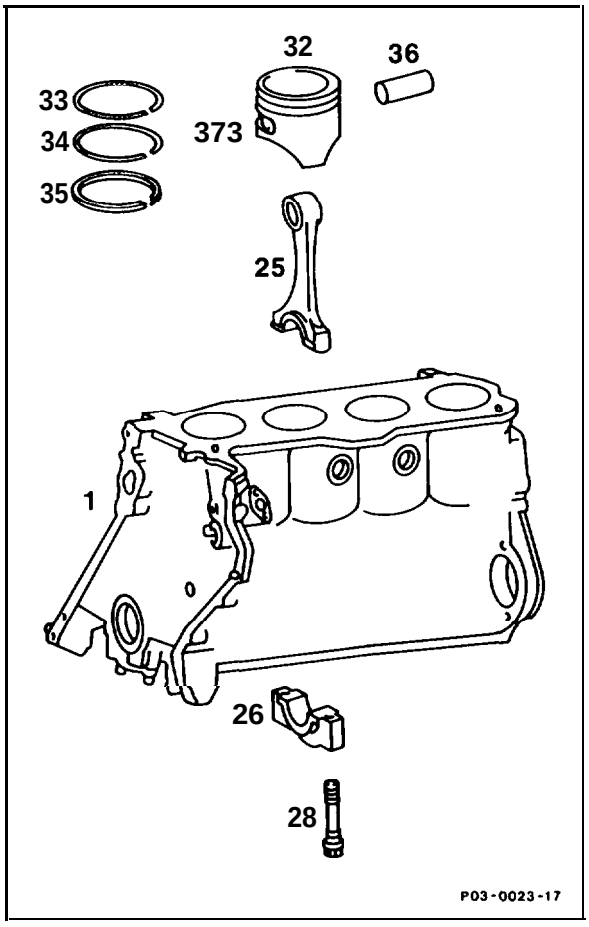


9 Check axial twist of conrod bearing bore relative to small end bushing bore and correct, if necessary.



03-316 Removal and installation of pistons

Preceding work:
Removal of engine (01-030).
Removal of cylinder head (01-415).
Removal of oil pan (01-310).



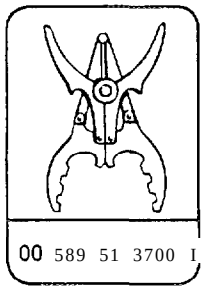
Conrod bearing cover (26)	unbolt, bolt on, 30 Nm and 90” angle of rotation torque. Do not mix up top and bottom bearing shells. Pay attention to matching of conrod and bearing cap (step 12).
Conrod bolt (28)	check (03-310).
Piston (32) and conrod (25)	push out of crankcase upwards.
Locking ring (37)	remove (step 3) and insert (step 9).
Piston pin (36)	press out and press in by hand (step 8).

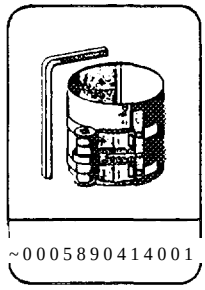
Installation Instructlon

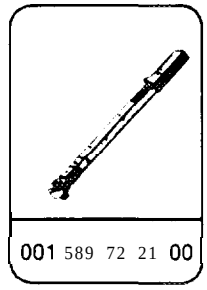
Insert conrod into piston so that the chamfered splash bore in the small end bearing with the arrow in the piston crown are pointing in direction of travel; **do not** heat piston.

Piston (32)	check condition, pay attention to installation position.
Piston rings (33, 34 and 35) ..	check condition, pay attention to installation position, “Top” must face upwards. Position ring gaps evenly around circumference of piston.
Piston (32) with conrod (25) ...	install with tensioning strap 000 589 04 14 00, oil piston beforehand and clean cylinder bores (steps 10 and 11).
Piston projection	check in TDC position (step 14).

Special tools







Matching pistons and cylinders

Engine	Group No.	Piston dia.	Cylinder dia.	Group code letter	Piston dia.	Cylinder dia.
102.922/924 102.962963 Standard (normal size)	0	88.968 88.982	88.998 89.008	A	88.973 88.979	89.000 89.006
	1	88.978 88.992	89.009 89.018	X	88.978 88.986	89.007 89.012
	2	88.988 89.002	89.019 89.028	B	88.985 88.991	89.013 89.018
Repair size 1 (+0.5)	0	89.468 89.482	89.498 89.508	A	89.473 89.479	89.500 89.506
	1	89 478 89.492	89.509 89.518	X	89.478 89.486	89.507 89.512
	2	89.488 89.502	89 519 89.528	B	89.485 89.491	89.513 89.518

Engine	Group No.	Piston dia.	Cylinder dia.	Group code letter	Piston dia.	Cylinder dia.
Repair size 2 (+ 1.0)	0	89.968 89.982	89.998 90.008	A	89.973 89.979	90.000 90.006
	1	89.978 89.992	90.009 90.018	X	89.978 89.986	90.007 90.012
	2	89.988 90.002	90.019 90.028	B	89.985 89.991	90.013 90.018
102.982/985 Standard (normal size)	0	95.469 95.481	95.498 95.508	A	95.473 95.479	95.500 95.506
	1	95.479 95.491	95.509 95.518	X	95.478 95.486	95.507 95.512
	2	95.489 95.501	95.519 95.528	B	95.485 95.491	95.513 95.518
Repair size 1 (+0.5)	0	95.969 95.981	95.998 96.008	A	95.973 95.979	96.000 96.006
	1	95979 95.991	9696.018 009	X	95.978 95.986	96.007 96.012
	2	95.989 96.001	96.019 96.028	B	95.985 95.991	96.013 96.018
Repair size 2 (+1.0)	0	96.469 96.481	96.498 96.508	A	96.473 96.479	96.500 96.506
	1	96.479 96.491	96.509 96.518	X	95.478 96.486	96.507 96.512
	2	96.489 96.501	96.519 96.528	B	96.485 96.491	96.513 96.518

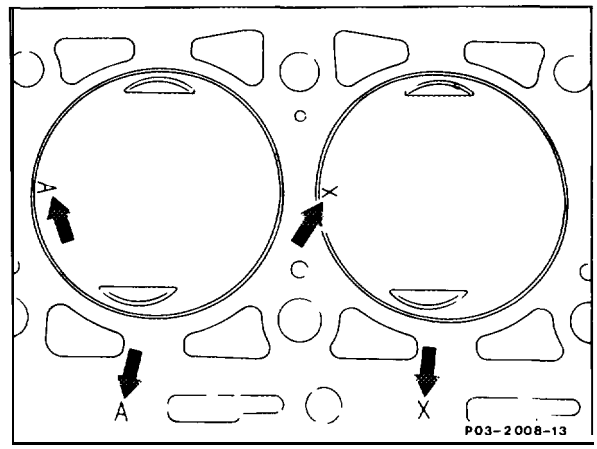
Test data

		When new	Wear limit
Piston play	with Group No. 0, 1 or 2	0.016 – 0.040	–
	with Group code letter A, X or B	0.020 – 0.034	–
Difference in weight of pistons in an engine			10 g
Piston pin dia.		21.995 – 22.000	–
Piston pin play	in small end bush	0.007 – 0.018	–
	in piston	0.002 – 0.012	–
End gap of piston rings	groove 1	0.30 – 0.55	1.0
	groove 2	0.30 – 0.55	0.8
	groove 3	0.25 – 0.50	0.8
Vertical play of piston rings	groove 1	0.050 – 0.085	0.15
	groove 2	0.010 – 0.030	0.1
	groove 3	0.010 – 0.045	0.1
Conrod in piston (end play)		0.050 – 0.450	–
Piston projection		0.60 – 1.0	–

Note

The pistons and cylinder bores are arranged into three diameter groups within the tolerance and were previously identified with the figures 0, 1 and 2.

As of April 1988 the tolerance stages are identified with the Group code letters A, X and B. The identification is given as before in the mating face of the crankcase and in the piston crown.

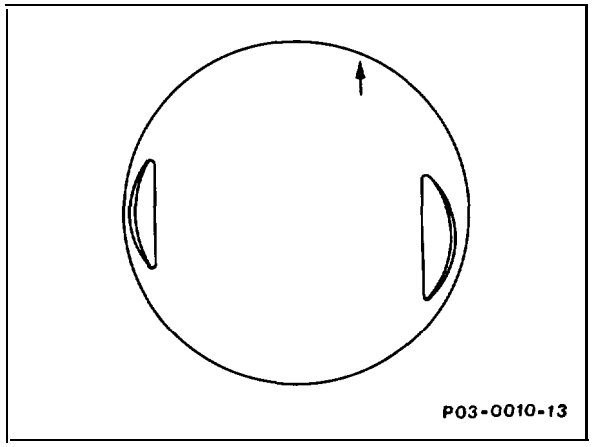


previously	now
0	A
1	X
2	B

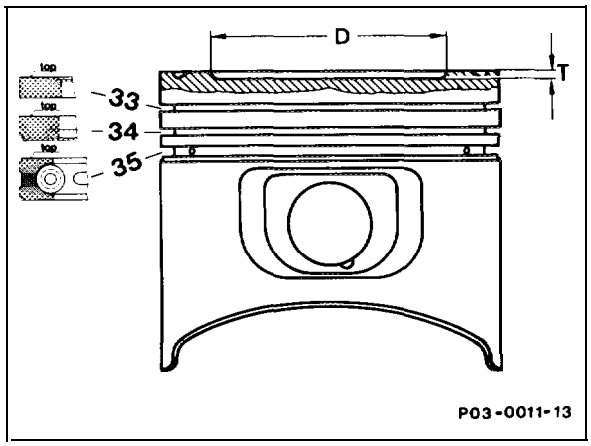
Only pistons with the Group code letter “X” are supplied for repair purposes. These pistons should also be installed in the cylinder bores with the Group code letters “A” or "B".
Only pistons with Group code letters are also supplied for the previous engines with Group numbers 0, 1 and 2, namely piston "X" for Group No. 0 and 1. Piston “B” for Group No. 2.
When performing repairs, the cylinder bores should be honed according to the dimensions of the existing pistons plus piston play.

The piston crown is designed differently in the individual engines. The piston crown of normal compression engines is either smooth or provided with a recess. In addition, there are two valve niches each in the piston crown.

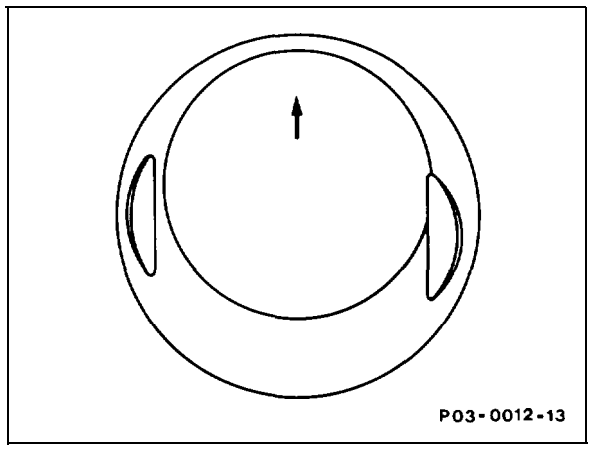
Caution!
A recess with a diameter of 50 mm appears on the piston crown of pistons in repair size version.



Piston crown smooth, two valve niches

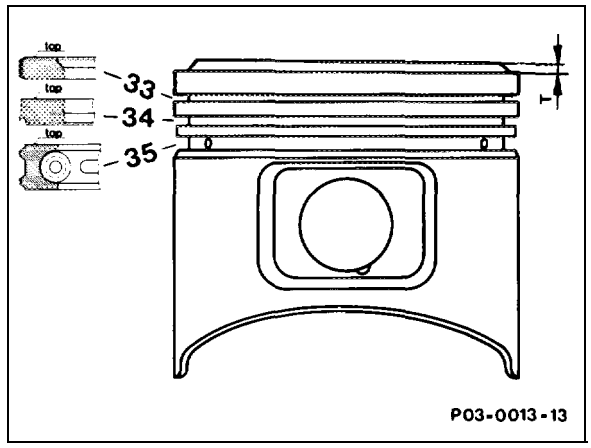


Engine 102.985

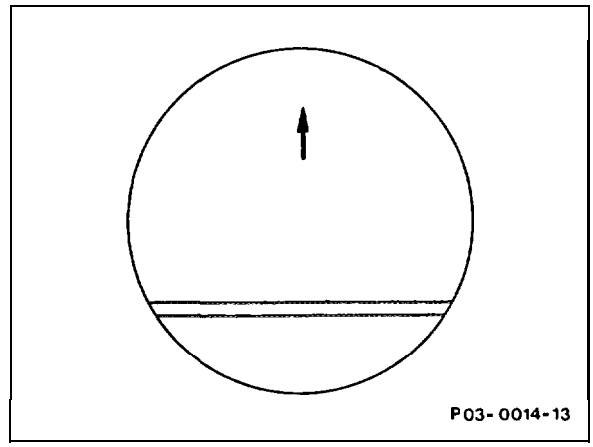


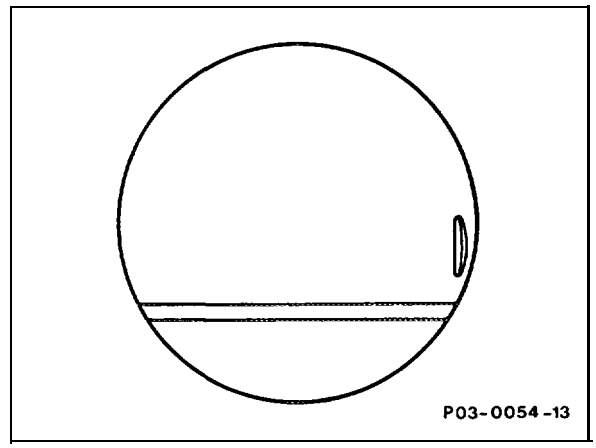
Recess in piston crown, two valve niches
D 70 mm dia.
T vanes according to piston (normal size, repair sizes)

All low compression engines have a step on the piston crown (except 102.985 (USA), 1985 additionally one valve niche).



33 Rectangular ring with Internal chamfer, running surface chrome-plated
34 Taper face oil scraper ring, running surface precision-turned
35 Chamferred oil control ring with garter spring, running surfaces chrome-plated
T Height of size 2.0 mm





Engine 102.985 (USA)

As the design of the piston crown (flat, recess or step) has an influence on the compression, the pistons are not interchangeable.
Two repair sizes (each step + 0.5 mm dia.) are approved for the pistons of all engines.

The shape of the piston and the roughness of the grinding pattern of the pistons has been modified from 0.8 mm to 1.2 mm on Engine 102.982 as a noise-reducing measure.

On engine 102.985 (USA) the rectangular ring manufactured by Götze is installed in groove I of the piston manufactured by Mahle and KS. The running surface of this piston ring is chrome-plated, asymmetrically crowned and sharp-edged at the bottom to reduce oil consumption.

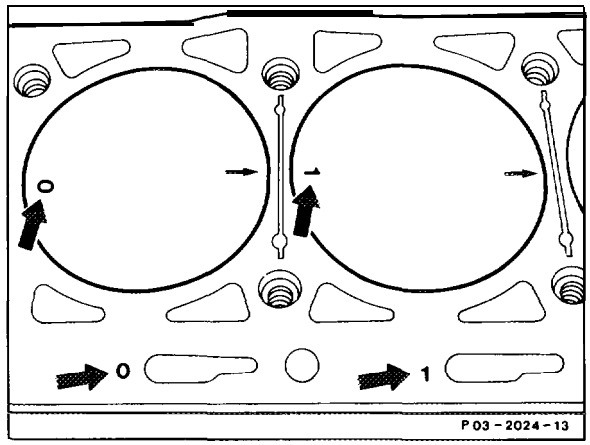
Standard Implementation: 03/88 (Mahle)

Model	Engine	Engine End No.		Vehicle Ident End No.	
		Manual transmission	Automatic transmission	A	F
201.028 (USA)	1102.985	023341	069631		484718

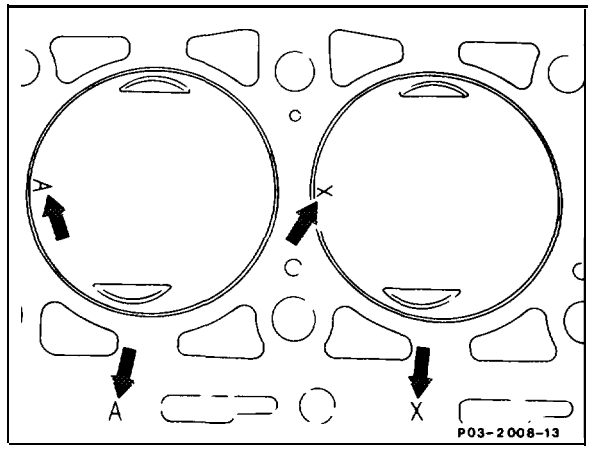
Standard Implementation: 03/88 (KS)

Model	Engine	Engine End No.		Vehicle Ident End No.	
		Manual transmission	Automatic transmission	A	F
201.028 (USA)	102.985	023788	070989		492527

The Group code numbers on the pistons and on the mating face of the crankcase have been replaced by Group code letters.
As a result, the cylinder diameters and matching of pistons and cylinders have also been modified (refer to data).



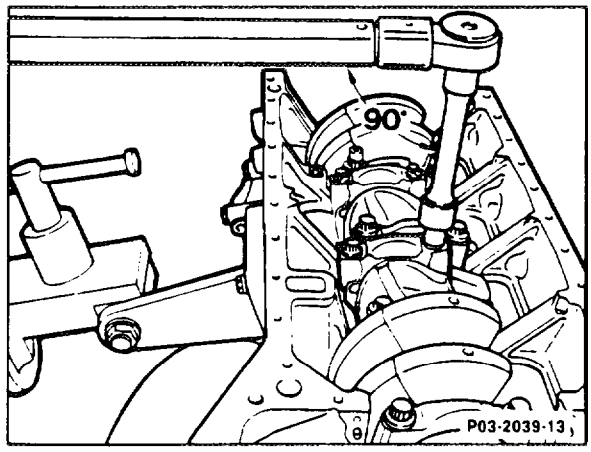
Crankcase with Group numbers



Crankcase with Group code letters

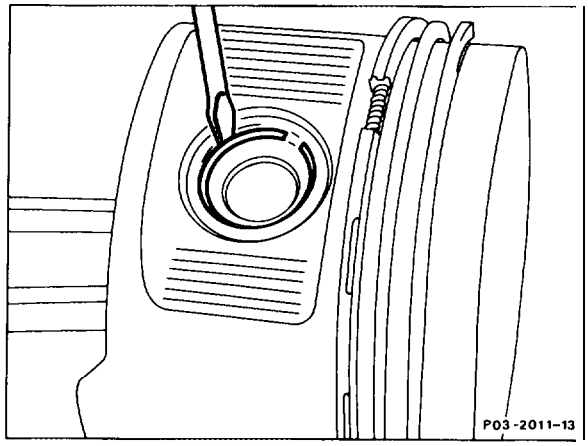
Removal and installation

1 Unbolt conrod bearing cover and remove conrod together with piston upwards.



2 Check conrod bolts (03310).

3 Remove piston pin locking element with screwdriver and press out piston pin.

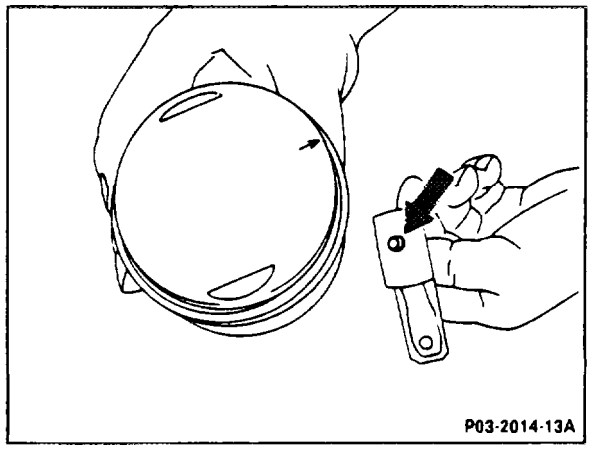


4 Recondition conrod and check angles of bearing bores, if necessary (03-313).

5 If the pistons are worn, check the gap clearance and end play of the piston rings (refer to table). Check that the piston rings move easily. Pay attention to installation position: “Top” must be facing upwards. Distribute the ring gaps evenly around the circumference of the piston.

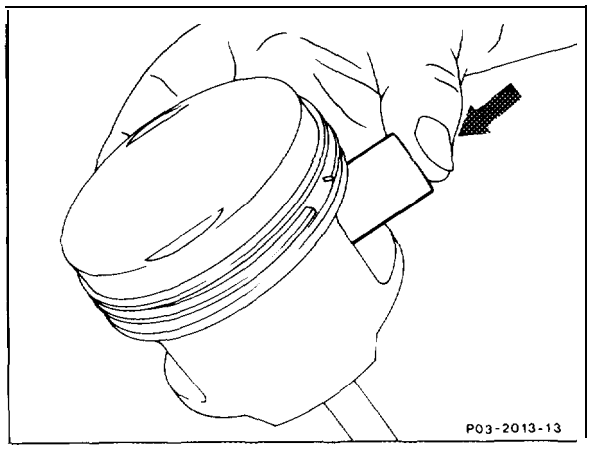
6 Oil piston pin and small end bushes.

7 Install piston so that the chamfered splash bore in the small end bearing (arrow) and the arrow in the piston crown are facing in direction of travel.



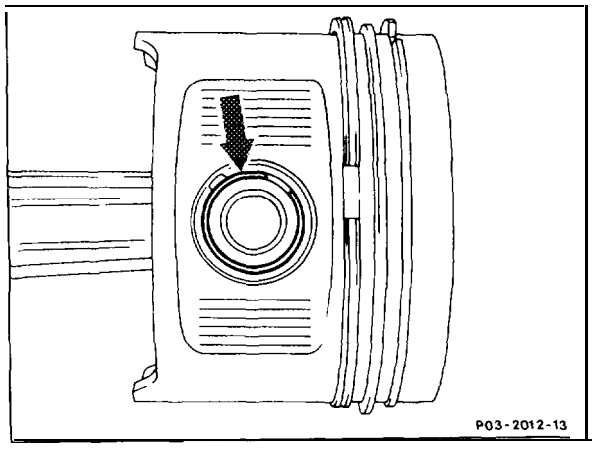
Caution!
Do not heat piston.

8 Press in piston pin by hand.

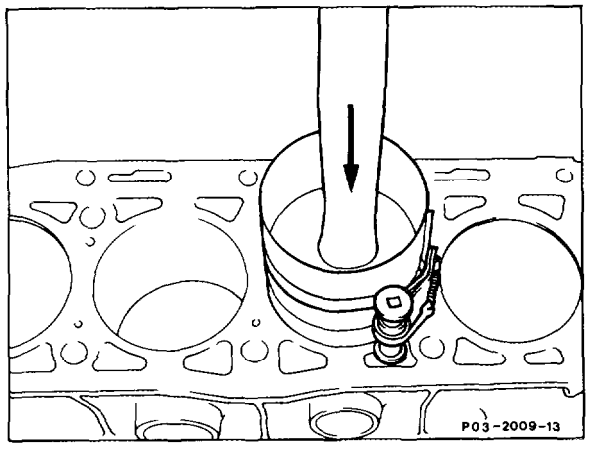


9 Insert piston pin locking element into the groove.

10 Oil cleaned cylinder bores, conrod bearing journals, conrod bearing shells and pistons.

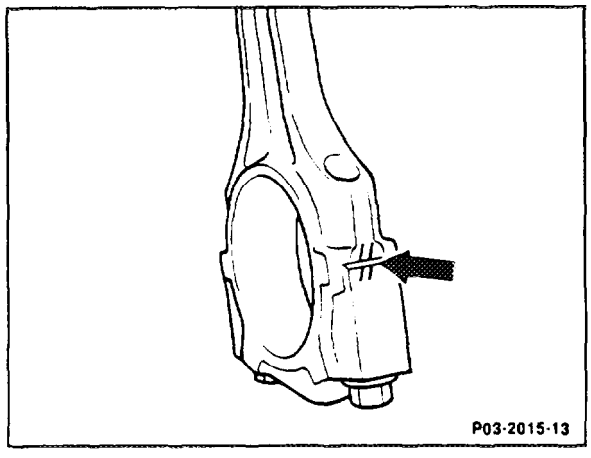


11 Install tensioning strap for piston rings and install piston into cylinder bore with arrow facing in direction of travel.

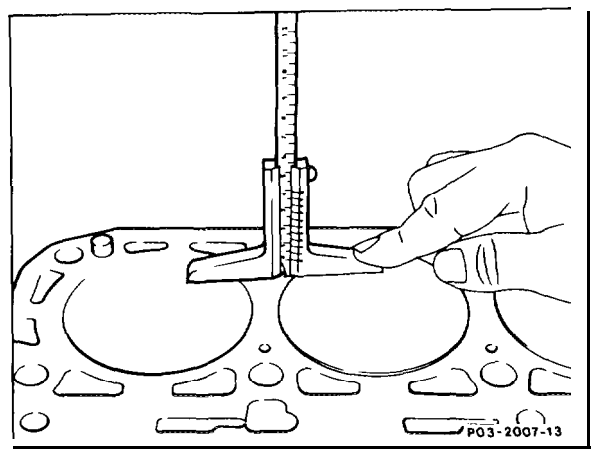


12 Mount conrod bearing cover onto the conrod with the code marks (arrows) aligned with each other and torque conrod bolts to an initial torque of 30 Nm and angle of rotation torque of 90".

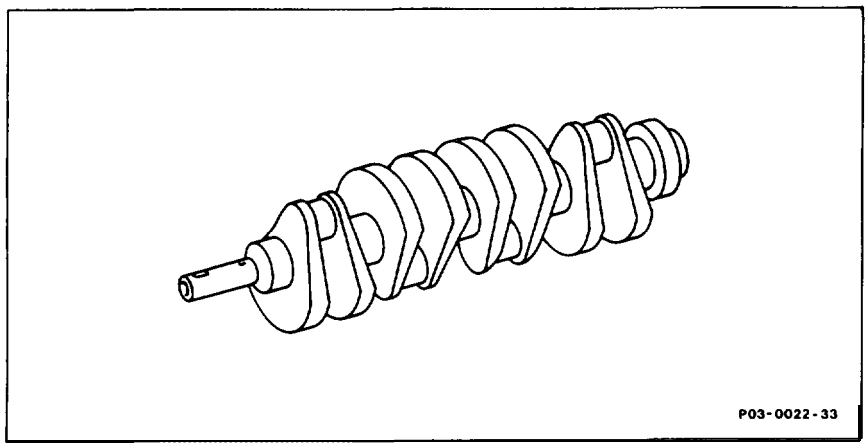
13 Turn crankshaft and check clearance between piston pin boss and conrod.



14 Measure the distance between piston crown and crankcase mating face with the pistons in the TDC postion (refer to table).



03-318 Checking and reconditioning crankshaft



Data

Crankshaft normal size and repair sizes	Crankshaft journal dia.	Crankshaft journal width at thrust bearing	Crankpin dia.	Crankpin width
Normal size	57.950 57.965	28.500 28.533 or 28.600 28.633	47.955 47.965	28 000 28.084
Normal size II	57.935 57.950			
1st repair size	57.705 57.715	28.700 28.721 or 28.900 28.921 or 29.000 29.021	47.705 47.715	up to 28.30
2nd repair size	57.455 57.465		47.455 47.465	
3rd repair size	57.205 57.215		47.205 47.215	
4th repair size	56.955 56.965		46.955 46.965	

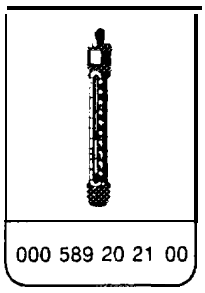
Permissible out-of-roundness of crankshaft journals and crankpins		0.0025
Permissible conicity	crankpins	0.010
	crankshaft journals	0.010
Permissible axial runout of fit bearing		0.02
Fillet radii at the	crankshaft bearing journals	2.0 – 2.2
	crankpins	2.8 – 3.0
Bearing journals ground and fine-lapped, max peak-to-valley height R_z (pm)		0.15
Crankshaft journall dia. front		29.987 – 30.000
Permissible variation of front crankshaft journal from concentricity [1)] [2)]		0.030
Running surface dia. for rear radial seal		92.874 – 92.928
Permissible variation of rear crankshaft flange	from concentricity [1)]	0.02
	from axial runout [1)]	0.012
Permissible variation of crankshaft journals from concentricity [1)]	journal II, IV	0.07
	journal III	0.10
Scleroscopic hardness of crankshaft journals and crankpins	when new	74 – 82
	limit value	60 [3)]
Permissible unbalance of crankshaft		14.5 cmg

1) When crankshaft mounted on outer crankshaft journals I and V and one full rotation.
2) If measurement performed when crankshaft installed, eliminate radial bearing play by pressing against crankshaft journal.
3) The limit value must exist at least at 2/3 of the circumference of the journal.

Note

Maximum wear limit of crankshaft journals and crankpins 0.02 mmm. The repair sizes listed in the table must be strictly adhered to. In addition, it is essential to adhere to the fillet radii at the crankshaft journals and crankpins when regrinding.

Special tool



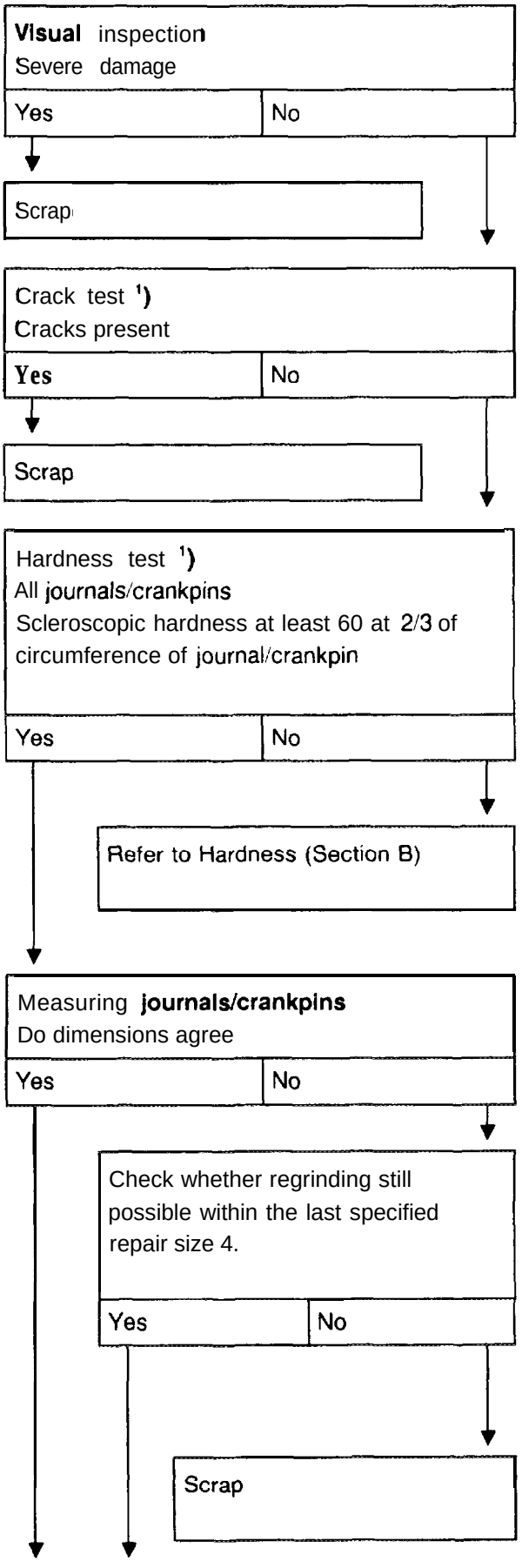
Note

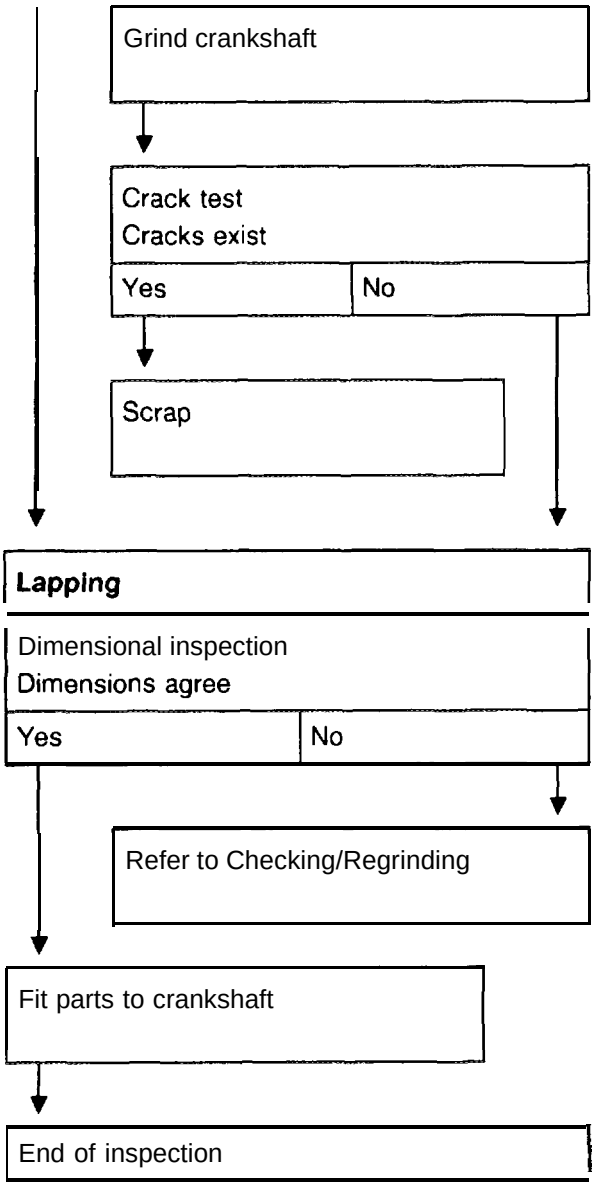
Adhere to the sequence of operations of the diagram below when checking and reconditioning crankshafts.

Dianram

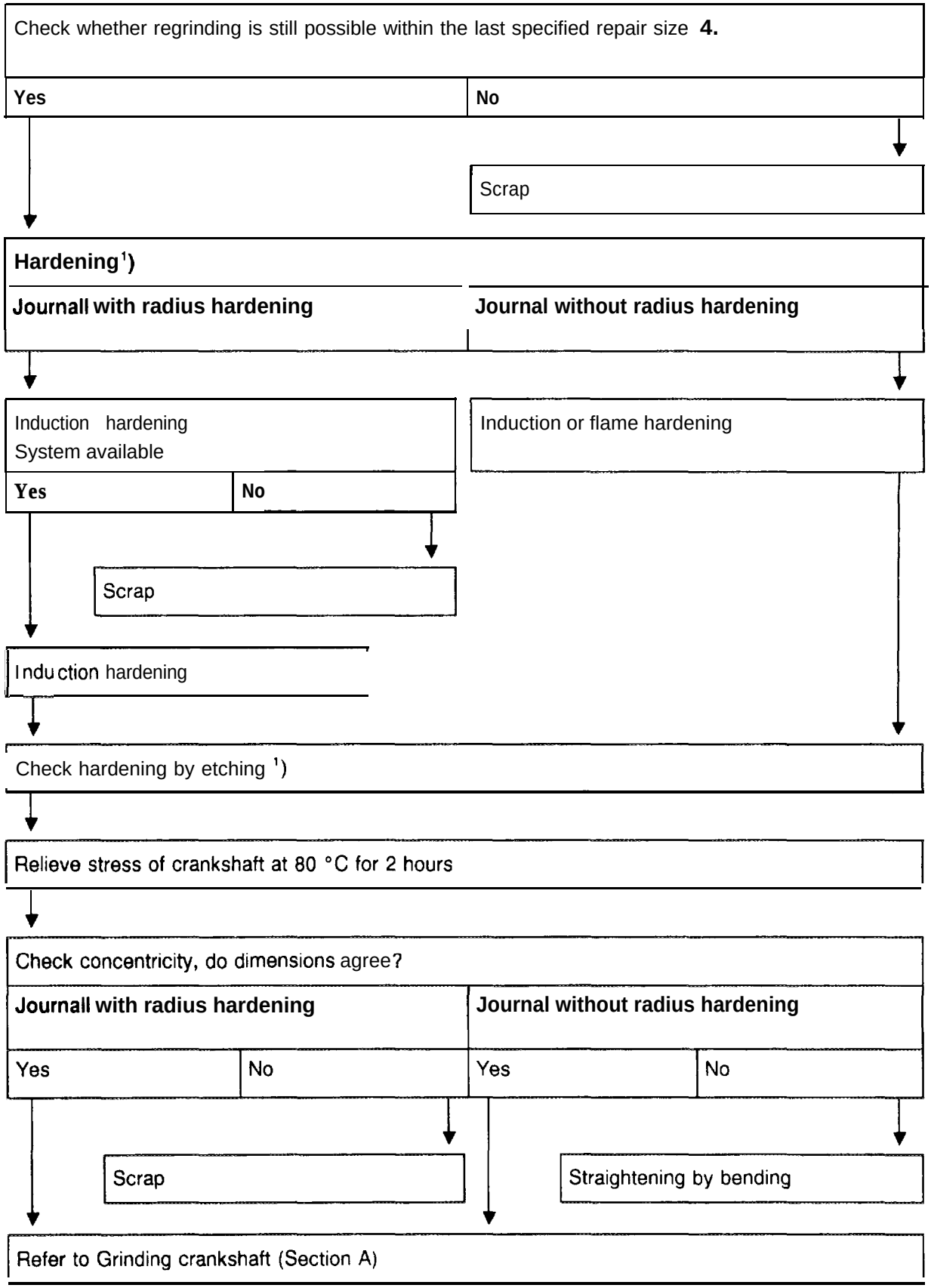
[1]) Refer to Section “Explanatory notes regarding diagram”.

A. Checking, grinding




Grind crankshaft
Crack test
Cracks exist
Yes
No
Scrap
Lapping
Dimensional inspection
Dimensions agree
Yes
No
Refer to Checking/Regrinding
Fit parts to crankshaft
End of inspection

B. Hardening


Check whether regrinding is still possible within the last specified repair size 4.
Yes
No
Scrap
Hardening 1)
Journall with radius hardening
Journal without radius hardening
Induction hardening System available
Yes
No
Scrap
Induction or flame hardening
Induction hardening
Check hardening by etching 1)
Relieve stress of crankshaft at 80 °C for 2 hours
Check concentricity, do dimensions agree?
Journall with radius hardening
Journal without radius hardening
Yes
No
Yes
No
Scrap
Straightening by bending
Refer to Grinding crankshaft (Section A)

Explanatory notes regarding diagram

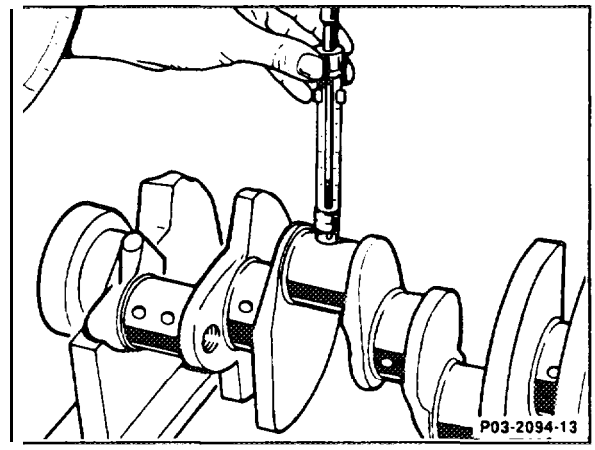
Crack test

Clean crankshaft. The bearing journals must be free of oil and grease.
Magnetize crankshaft and apply fluorescent powder (flux).
A dye penetration method (immersing in bath or with spray can) may also be used.

Helpful tools: die, UV oil or fluorescent powder,
cleaning agent,
developer

Hardness test

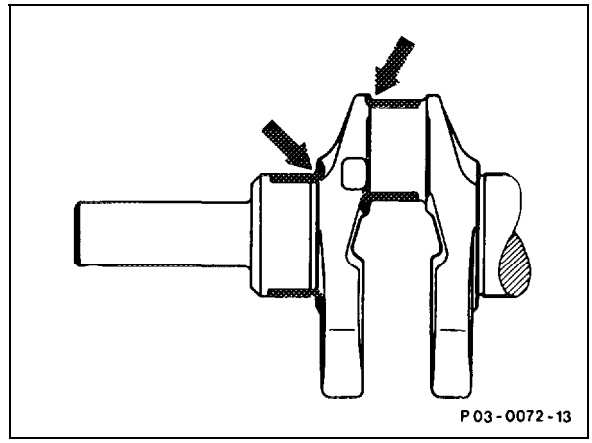
Test hardness with the drop hardness tester (scleroscopic hardness).
The minimum hardness of 60 must exist at 2/3 of the circumference of the journal.



Hardening

The journals without hardened radii may be hardened inductively or with a flame. By contrast, the journals with hardened radii (arrows) must always be hardened inductively. If this is not possible, scrap crankshaft.

When hardening the journals without hardened radii, it is important to adhere to the distance A between hardening runout and radius (4 – 5 mm).



Inspection of hardening

To achieve proper hardening, check the setting of the hardening system by metallographic ground surfaces.

These can be removed from test hardening operations on scrapped crankshafts.

Check hardening by etching the surface of the journal with a 2 % alcoholic nitric acid (HNO_3).

No dark spots should appear on the surface of the journal.

Non-hardened radii change to a dark colour.

By contrast, the hardened radii must be just as bright as the surface of the journal.

As a comparison, it is recommended to perform etching on a metallographically tested journal.

Following this, carefully wash off the nitric acid with alcohol.

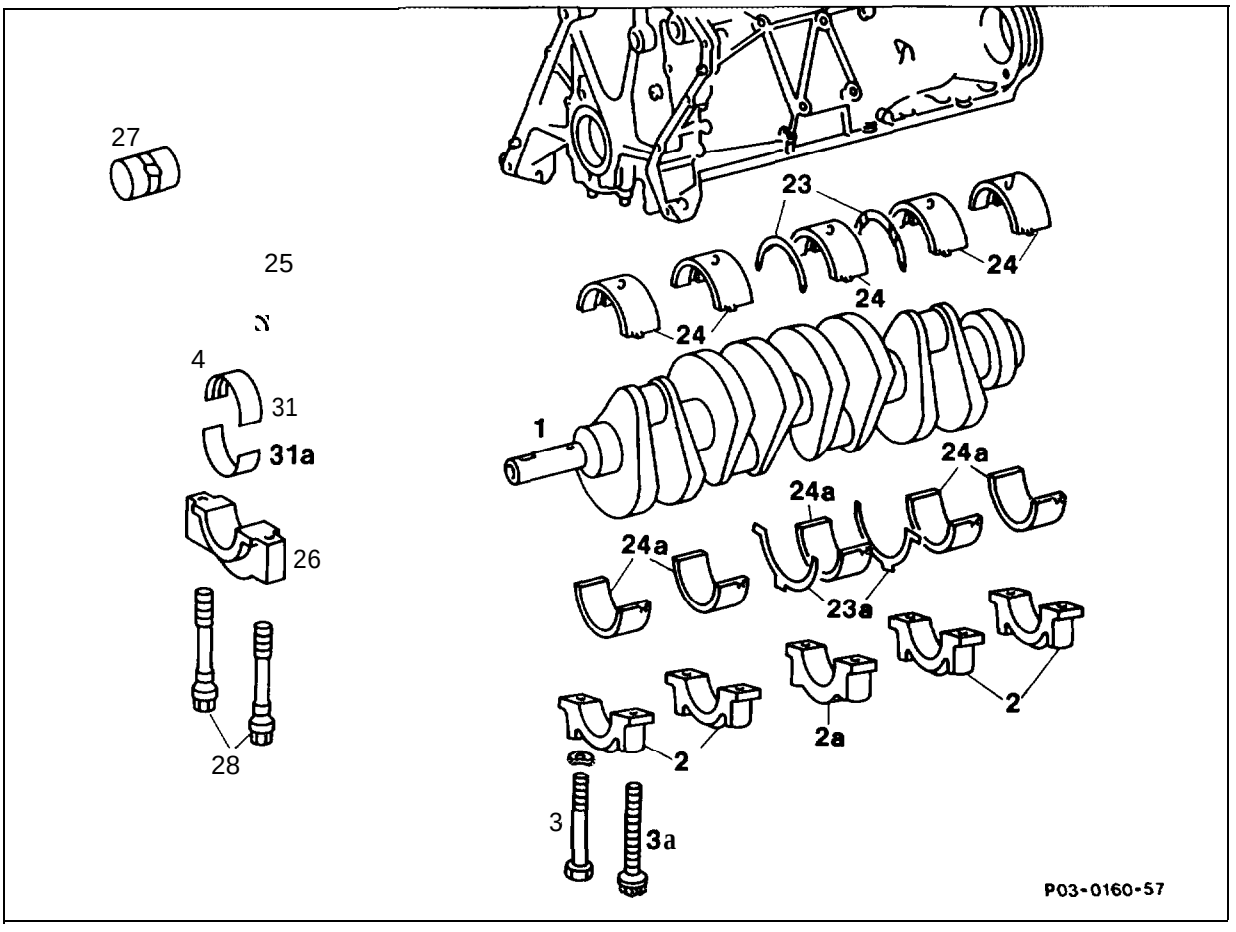
Corrosion protection

Crankshafts which are not immediately re-installed, must be oiled with initial operation engine oil (SAE 30).

EXIT

03-320 Installation of crankshafts bearings

Preceding work:
Engine removed and disassembled.
Main oil passage in crankcase open (01-130).
Clean oil passages in crankcase and in crankshaft.
Check crankshaft for cracks, dimensional tolerance, hardness and concentricity (03-318).



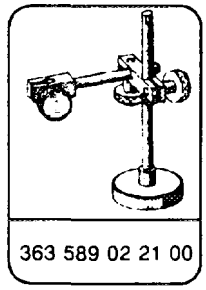
Crankshaft bearing covers (2 and 2 a)	.....	install without bearing shells, pay attention to markings, tighten. Hex. bolt 90 Nm, stretch bolt, initial torque 55 Nm, angle of rotation torque 90” (steps 1 and 2).
Basic bore	.....	measure conicity in direction A, B and C (step 3).

Crankshaft bearing shells (24 and 24 a)	insert, adhere to tightening torques (step 4).
Bearing diameters	measure and note values (step 5).
Crankshaft (1)	measure crankshaft bearing journals, determine bearing play (step 6).
Thrust bearing journals	measure width and match appropriate thrust washers (step 7).
Bearing shells (24)	oil with engine oil and insert crankshaft (step 8).
Thrust washers (23)	oil and fit into grooves of thrust bearings, pay attention to oil grooves (step 9).
Thrust bearing cover (2a)	oil together with thrust washers (23 a) and install (step 10).
Crankshaft bearing cover (2)	install, hexagon bolt, 90 Nm, stretch bolt (3 a), initial torque 55 Nm, angle of rotation torque 90° (steps 11 and 12).
Crankshaft bearing end play	measure. Check ease of movement of crankshaft (steps 13 and 14).
Conrod	recondition and check angles (03-313).
Conrod bearing shells (31 and 31 a)	insert, initial torque 30 Nm, angle of rotation torque 90” (step 16).
Bearing diameter	measure and note value (step 17).
Wrist pins	measure, determine bearing play (step 18).
Piston	install on conrod (pay attention to installation position and install (03-316).
Conrod bearing cover (26)	install, initial torque 30 Nm, angle of rotation torque 90” (step 20). **Caution!** Note step 20.

Special tools


001 589 72 21 00


001 589 66 21 00


363 589 02 21 00

Commercial tools

Quick caliper for internal measurements, dia. 40 – 60 mm	e. g. Hahn und Kolb Borsigstraße 50 D-7000 Stuttgart 30 Order No. G 222 K
Quick caliper for internal measurements, dia. 60 – 80 mm	Order No. G 322 K
Bow-type measuring bolt 25 – 50 mm	Order No. 31346 025
Bow-type measuring bolt 50 – 75 mm	Order No. 31346 050

EXIT

Data

Crankshaft normal size and repair sizes	Crankshaft bearing journal dia.	Thrust bearings Matched thickness of thrust washers	Crankshaft journal width at thrust bearing	Wrist pin dia.	Wrist pin width
Normal size	57.960 [1] 57.965 57.955 57.960 57.950 [1] 57.955	4.15 or 4.20	28 500 28.521 or 28.600 28.621	47 955 47.965	28 000 28.084
Normal size I	57.945 [1] 57.950 57.940 57.945 57.935 [1] 57.940				
1st repair size	57.705 57.715	4.25 or 4.35 or 4.40	28. 700 28.721 or 28.900 28.921 or 29.000 29.021	47 705 47.715	up to 28.30
2nd repair size	57.455 57.465			47.455 47.465	
3rd repair size	57 205 57.215			47 205 47.215	
4th repair size	56.955 56.965			46 955 46.965	

[1]) Colored dots on the crank webs or counterweights next to the crankshaft journals: blue, yellow, red.

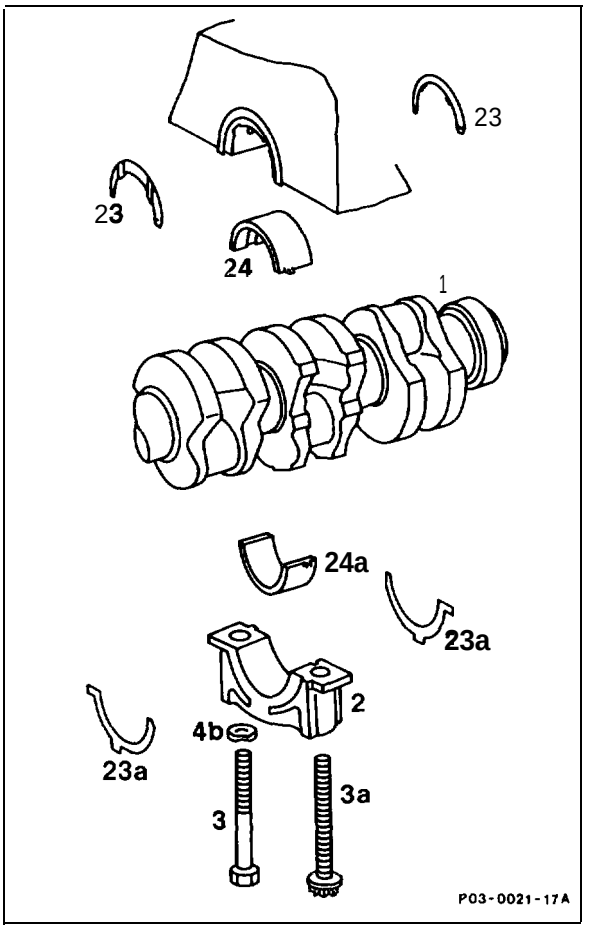
Basic bore and bearing play

		Crankshaft bearings	Conrod bearings
Basic bore dia.		62.500 62.519	62.500 62.519
Basic bore width at thrust bearing		23.979 24.000	–
Conrod width		–	22.000 21.948
Permissible out-of-roundness and conicity of basic bore		0.02	0.02
Radial bearing play	when new	0.025 – 0.045	0.030 – 0.050
	wear limit	0.070	0.070
Axial bearing play	when new	0.06 – 0.22	–
	wear limit	0.30	–

Notes

Engine removed and disassembled.
Main oil passage in crankcase open (01-130).
Oil passages in crankcase and in crankshaft carefully cleaned.
Crankshaft checked for cracks, hardness, dimensional tolerance and concentricity (03-318).
Normal bearing shells and **thrust washers** are installed on the 3rd crankshaft bearing (thrust bearing).
The thrust washers absorb the axial forces of the crankshaft.

The thrust washers (23 and 23a) inserted in the crankcase and in the bearing cover on both sides are each identical.
The thrust washers each have two retaining lugs in the bearing cover as an anti-twist lock and to avoid assembly errors, the bottom lugs being fitted off-center. In addition, all the thrust washers are chamfered at one end.
When repairing crankshafts, the thrust bearing journals must be reground in the width to one of the dimensions stated in the table (Section "Data").



1 Crankshaft
2 Bearing cover
3 M 12 x 60 bolts (1 S version)
3a Ml 1 x 62 collar bolts (2nd version)
4b Washer
23 Thrust washer in crankcase
23a Thrust washer in bearing cover
24 Bearing shell in crankcase
24a Bearing shell in bearing cover

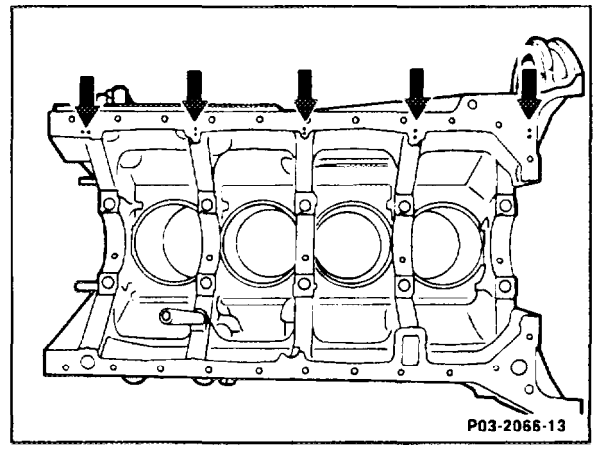
Thrust washers of the same thickness must always be installed on both sides.
It is not permitted to regrind thrust washers.
The thrust washers are available only as sets as replacement parts. A set consists of one top and one bottom thrust washer (23 and 23a).

Matching crankshaft bearing shells to crankcase

Crankshaft journal bearing [1]	Basic bores in crankcase		
	1 chisel marks	2 chisel marks	3 chisel marks [2]
	Matching bearing shells with color coding		
blue	blue	yellow	yellow
yellow	blue	yellow	red
red	yellow	yellow	red

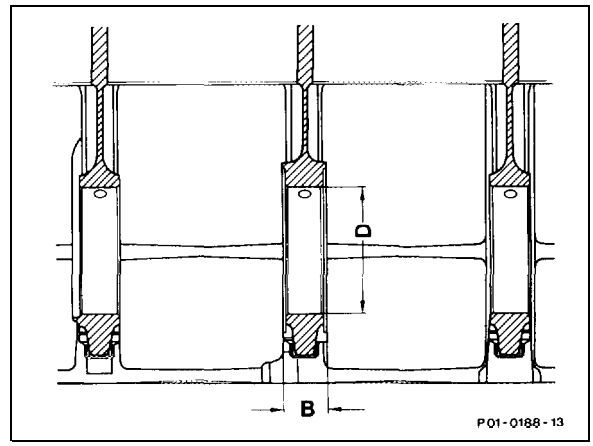
[1] Colored dots on the crank webs or counterweights next to the crankshaft journals.
[2] Chisel marks in mating face of crankcase at oil sump end next to basic bore.

The normal size crankshaft bearing shells with the color coding blue, yellow and red are supplied as replacement parts.
They should be matched according to the table.
The bearing plays do not therefore need to be measured.

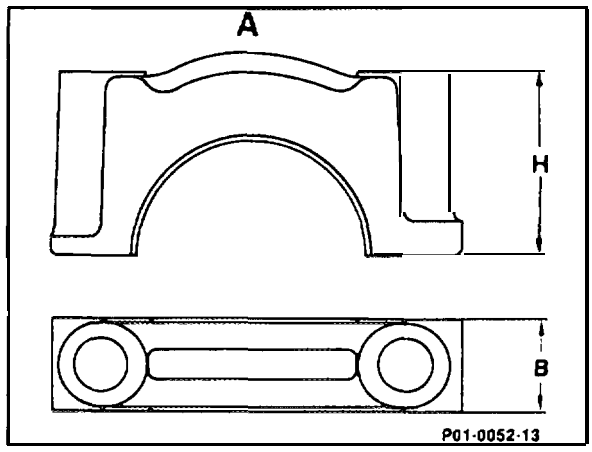


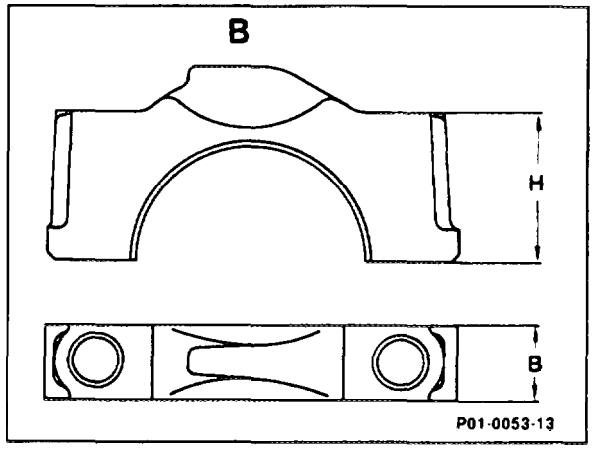
Chisel marks for matching crankshaft bearing shells

In June 1986 the crankshaft bearings were modified from 24 mm to 20 mm (size "B").



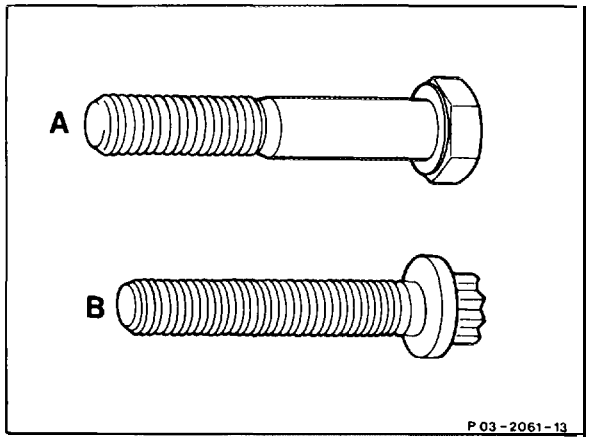
At the same time, the crankshaft bearing covers were reduced in height by 8 mm (H = 40 mm).





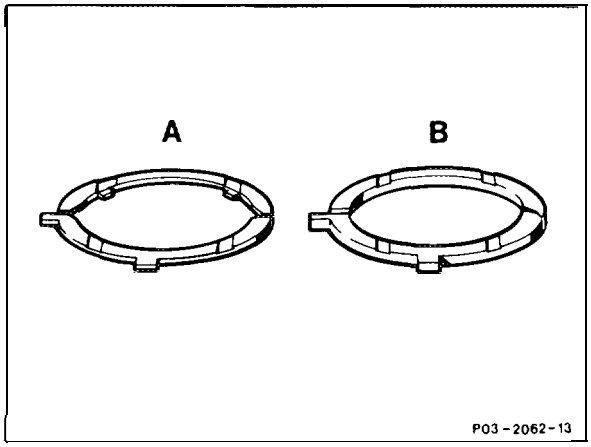
A 1 st version H 48 mm
B 24 mm
B 2nd version H 40 mm
B 20 mm

Likewise, the bolts of the crankshaft bearing covers were converted to M 11 × 62 twelve-sided stretch bolts with collar.
Previously, Ml 2 × 70 hexagon bolts.



A Ml 2 x 70 hexagon bolts
B M11 x62 twelve-sided stretch bolt

In view of the narrower crankshaft bearings, 4.15 mm thick thrust washers are installed on crankshaft bearing 3 (thrust bearing).

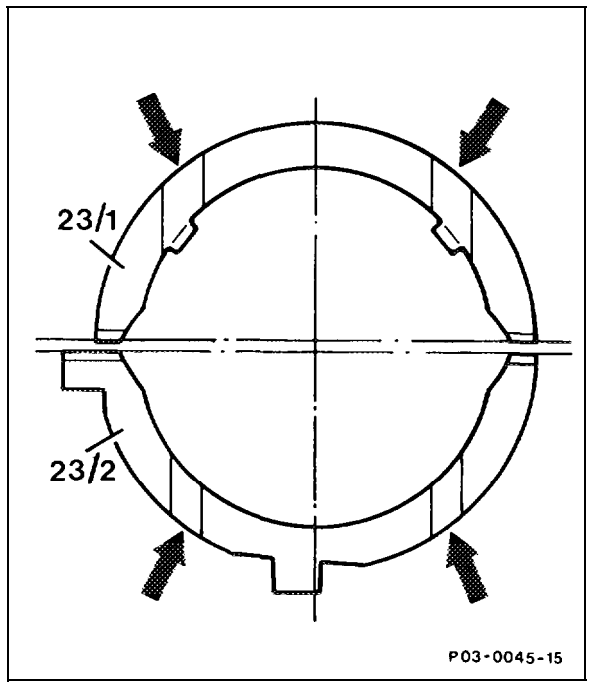


A 2.15 mm thick thrust washers
B 4.15 mm thick thrust washers

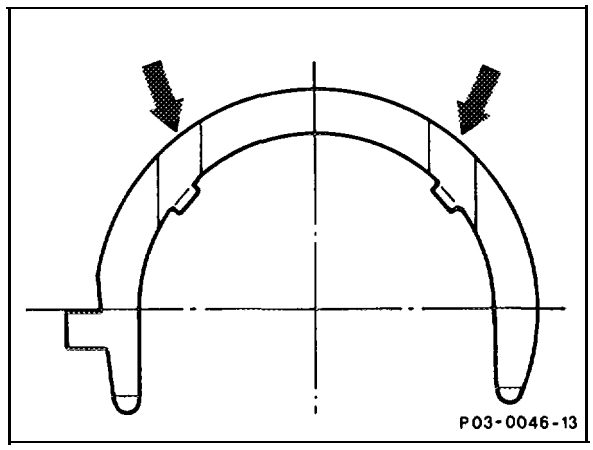
Standard implementation: 06186

Model	Engine	Engine End No.		Vehicle Ident End No.	
		Manual transmission	Automatic transmission	A	F
201.024 (USA)	102.985	003938	036445		246820

During the period November through December 1987 and December 1987 through January 1988, single-section thrust washers from two different suppliers were installed.



A Two-section thrust washers



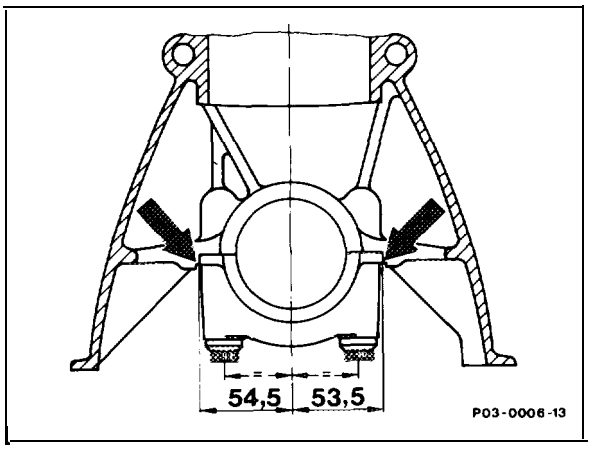
B Single-section thrust washers

Matching crankshaft bearings, installing crankshaft

Note

These operations should be performed if the dimensions of the crankshaft journals or of the basic bearing bores in the crankcase and at the conrod are not known, e.g. if the crankshafts have been remachined.

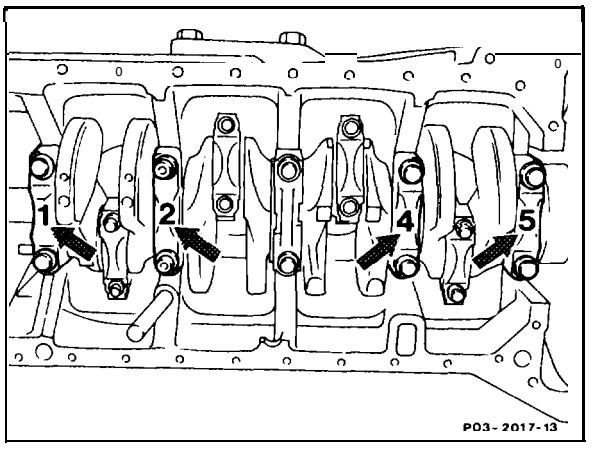
All the bearing covers fit into the side of the crankcase (arrows) and are attached each with 2 bolts.
The fit (arrows) is offset from the center so that the bearing covers can only be installed in one position.



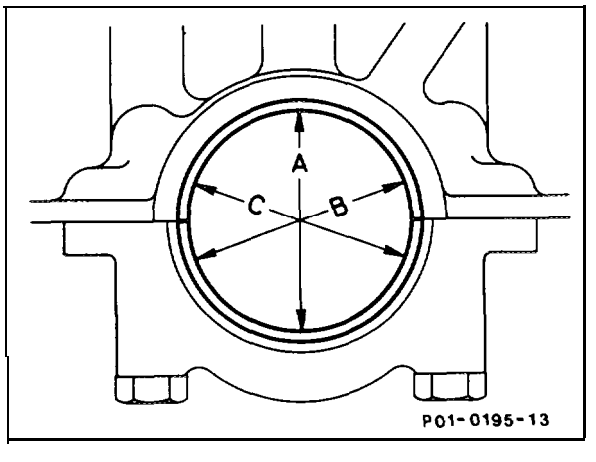
In addition, they are marked from front to rear with the code numbers 1, 2, 4 and 5 (arrows), with the exception of the thrust bearing covers,, and must not be interchanged or replaced.

1 Install crankshaft bearing covers without bearing shells.

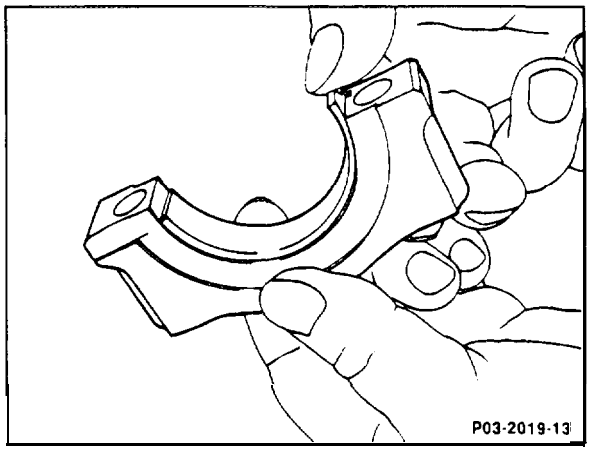
2 Oil fastening bolts for crankshaft bearing covers and tighten to 90 Nm (hexagon bolts) or 55 Nm initial torque and 90° angle of rotation torque (stretch bolts), respectively.

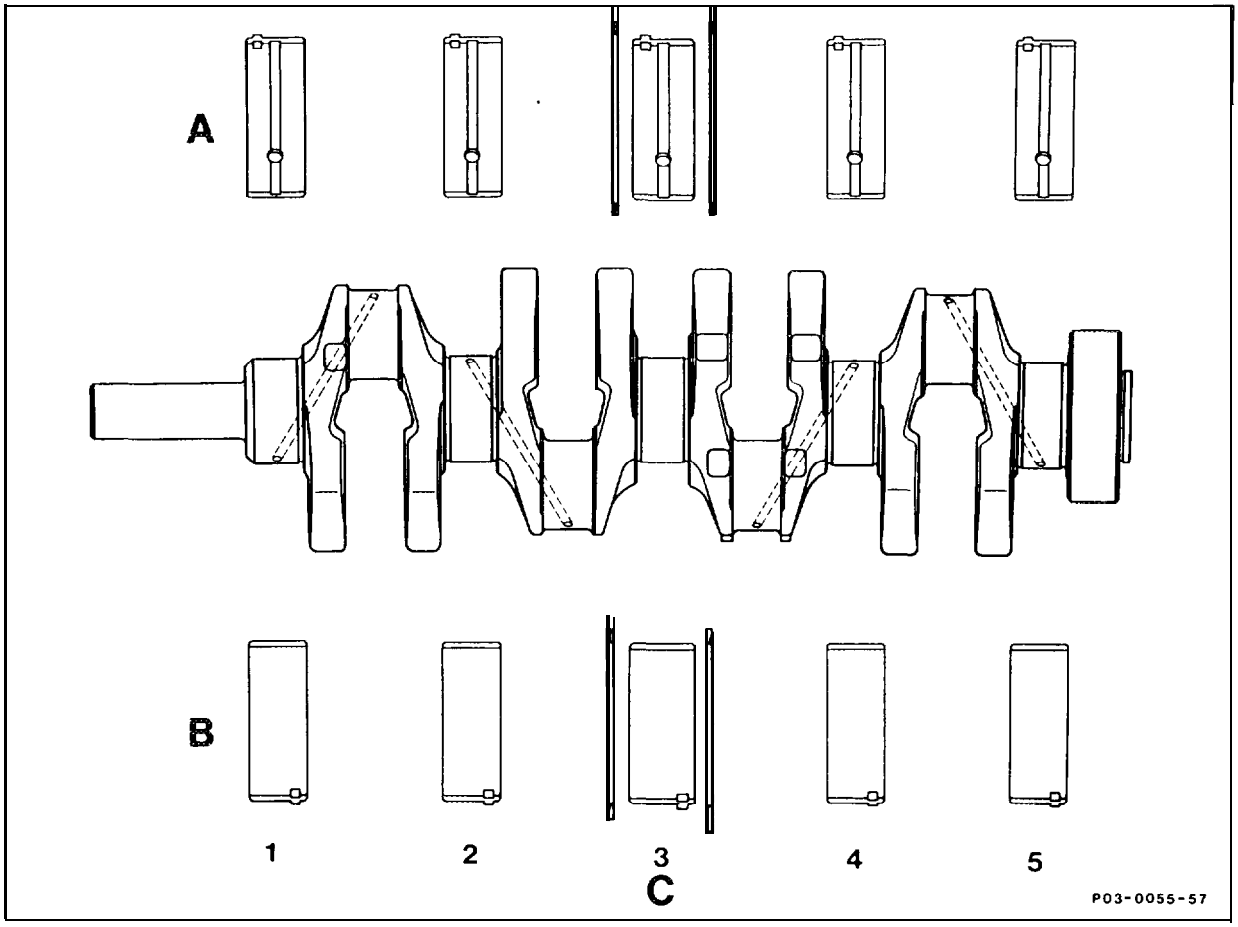


3 Measure basic bore in two planes in the direction A, B and C (conicity).
If a basic bore exceeds the specified value or is conical, dress the mating face of the bearing cover on a surface plate to max. 0.02 mm.



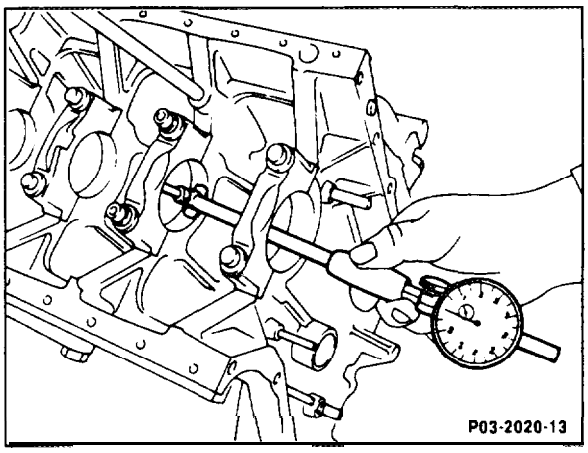
4 Insert crankshaft bearing shells, install bearing covers, screw in fastening bolts and tighten to 90 Nm (hexagon bolts) or 55 Nm initial torque and 90” angle of rotation torque (stretch bolts), respectively.



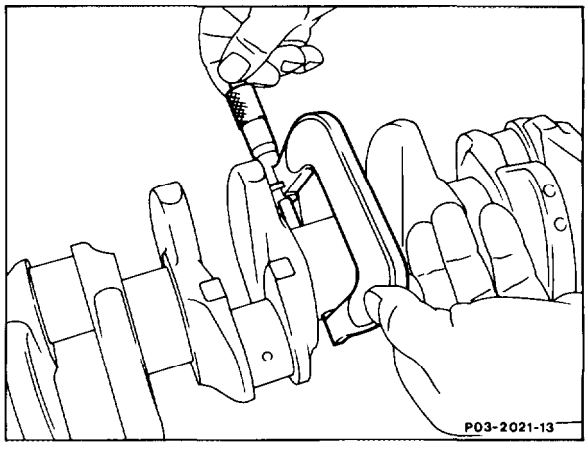


A Bearing shells in crankcase
B Bearing shells in bearing covers
C Thrust bearings with thrust washers

5 Measure and note bearing diameters.

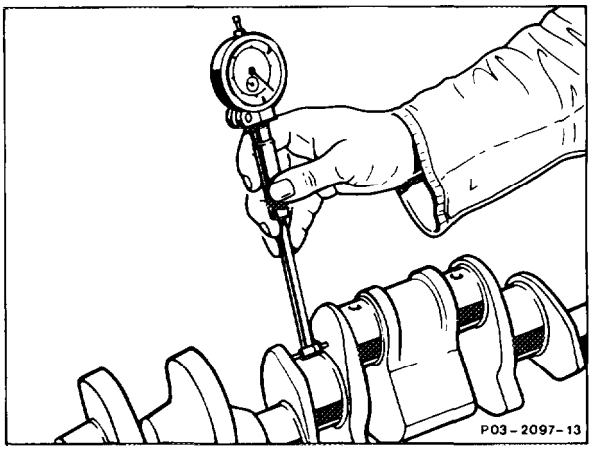


6 Measure crankshaft bearing journals, determine radial play of crankshaft bearings.
Note
Bearing play can be corrected by replacing the bearing shells (refer to table for matching crankshaft bearing shells to crankcase).

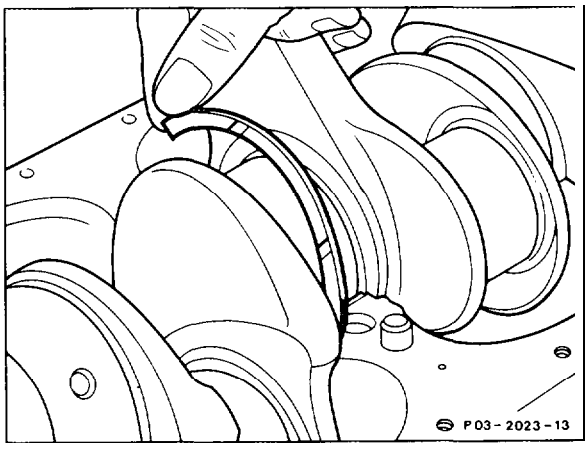


7 Measure width of thrust bearing journal and match appropriate thrust washers (refer to table, Section " Data").

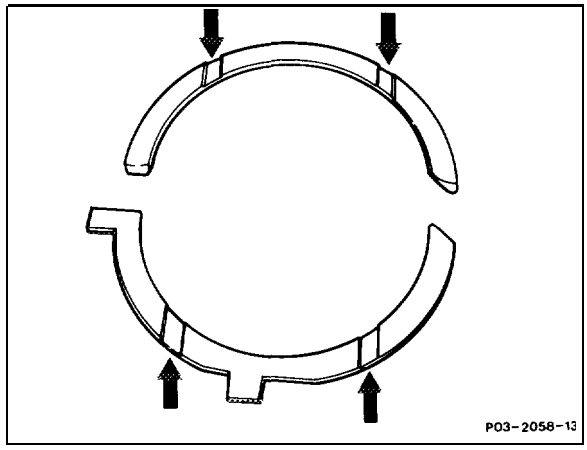
8 Oil bearing shells and crankshaft with engine oil and insert crankshaft.



9 Oil thrust washers with engine oil and fit the grooves on the thrust bearing (crankcase).

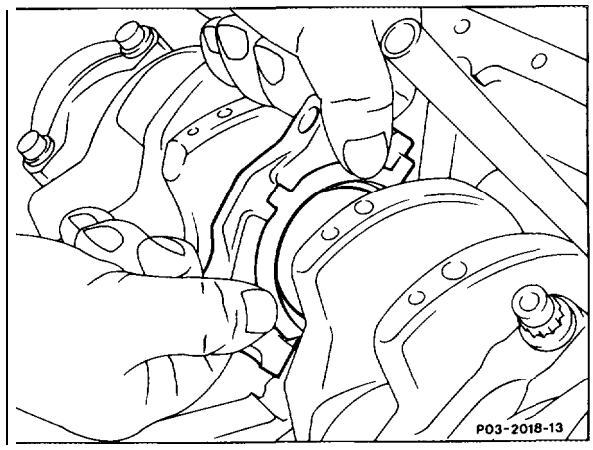


Caution!
The two oil grooves (arrows) in the thrust washers must be facing the crankshaft webs.



10 Install thrust bearing cover.

Caution!
Oil thrust washers with engine oil and place into the grooves on the thrust bearing cover. The two oil grooves in the thrust washers must be facing the crankshaft webs.
When installing the thrust bearing cover, hold both thrust washers tight.

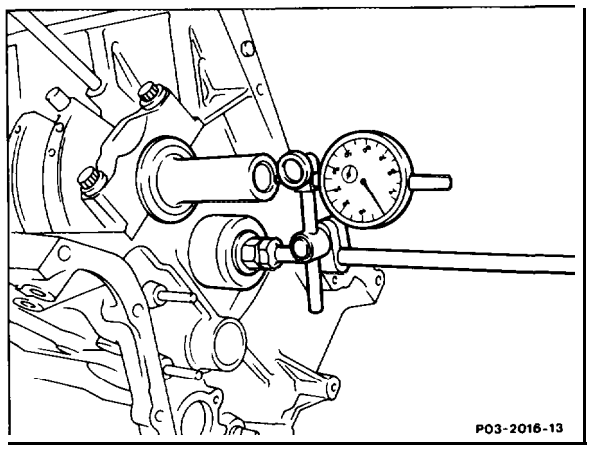


11 Install crankshaft bearing cover.

12 Tighten fastening bolts of bearing covers to 90 Nm (hexagon bolts) or 55 Nm initial torque and 90° angle of rotation torque (stretch bolts), respectively.

13 Measure end play of crankshaft bearings.

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



Matching conrod bearings and installing conrod

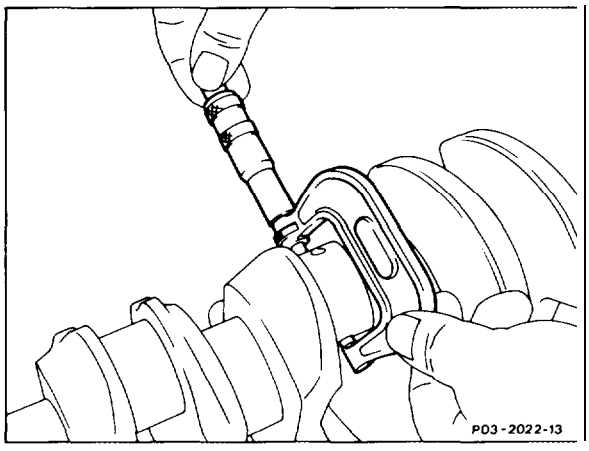
15 Recondition conrod and check angles of bearing bores relative to each other (03-313).

16 Insert conrod bearing shells. Install conrod bearing cover with bearing shell and tighten conrod bolts to an initial torque of 30 Nm and angle of rotation torque of 90".

Note

Conrod bearing shells are supplied only in the yellow version.

17 Measure bearing diameter and note.



18 Measure wrist pins, determine radial play of conrod bearings.

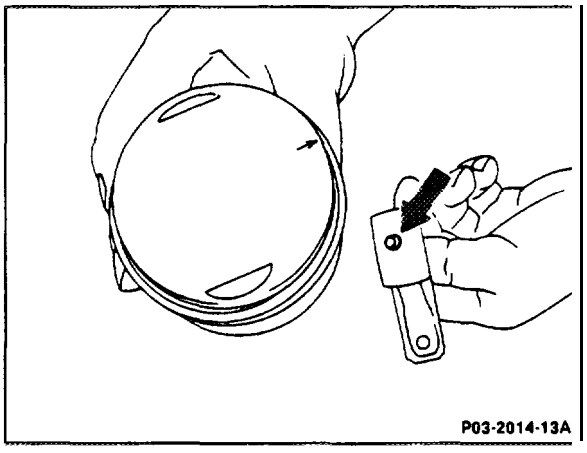
Note

If the conrod bearing play exceeds the specified value, dress mating face of conrod bearing cover on a surface plate to max. 0.02 mm.

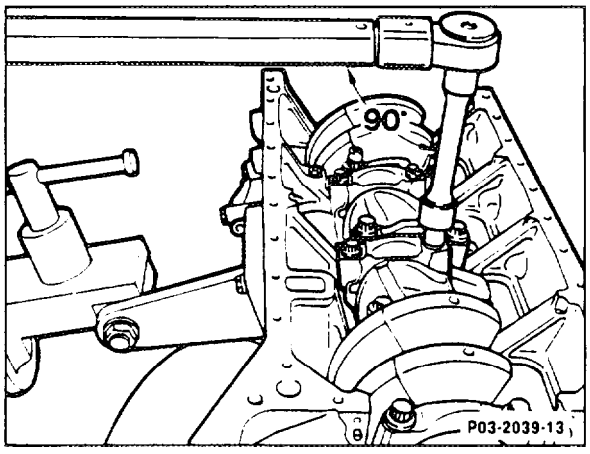
19 Fit pistons to conrod and install (03-316).

Note

The conrod must be installed on the pistons so that the **chamfered** splash bore in the small end bearing (arrow) and the arrow in the piston crown are facing the direction of travel.



20 Tighten conrod bolts to an initial torque of 30 Nm and angle of rotation torque of 90”.

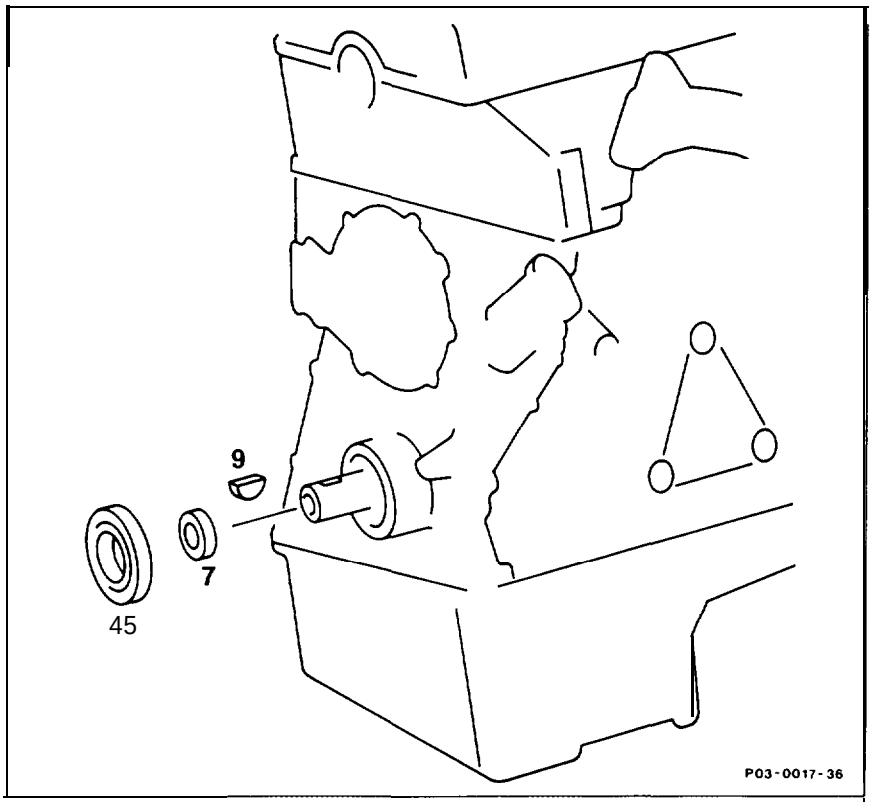


Caution!
Remove oil pump, clean, replace, if necessary, oil pump gears and drive sleeve (18-210). Remove oil pressure relief valve and check ease of movement of pistons (18-215). Remove oil filter (18-l 10), disassemble and clean.

Install initial operation oil filter element. After 1000 – 1500 km, change engine oil and oil filter element.

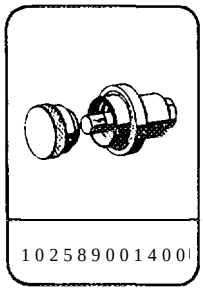
03-324 Replacing front crankshaft radial seal

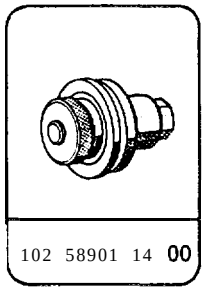
Preceding work:
Drain coolant (20-010).
Remove radiator (20-420).
Remove poly V-Belt (13-342).
Remove belt pulley and vibration damper (03342).

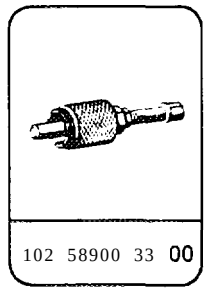


Radial seal (45)	. . . . .	remove, replace and install (steps 1, 3 and 4)
Spacer ring (7)	. . . . .	check, replace if necessary (step 2).
Mounting hole	. . . . .	clean, check.

Special tools

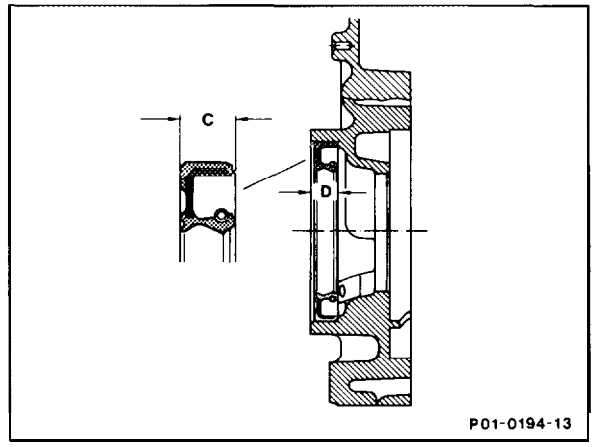






Notes

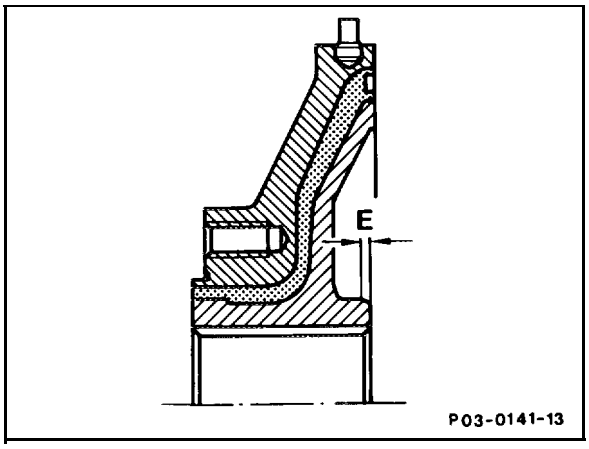
Since August 1986 (implementation of use of double roller chain) a 4 mm narrower radial seal has been installed.
Size "C" 8 mm (previously 12 mm).
For the same reason, the mounting in the timing case cover (D) was made 3.4 mm flatter.
Size "D" 9.8 mm (previously 13.2 mm).



Standard implementation: 08/86 radial seal

Model	Engine	Engine End No.		Vehicle Ident End No.	
		Manual transmission	Automatic transmission	A	F
201.024 (USA)	102.985	004069	038196		261571

As a result of the modified installation position of the dust lip on the narrower radial seal, the chamfer on the vibration damper is shorter. Size "E" 0.8 mm (previously 2 mm).



Standard implementation: 08/86 vibration damper

Model	Engine	Engine End No.		Vehicle Ident End No.	
		Manual transmission	Automatic transmission	A	F
201.024 (USA)	102.985	004202	039381		267452

A radial seal of a further manufacturer was installed for a certain period.

Identification: outer ring black
inner ring red

Removal and installation

Note

Before replacing the front crankshaft radial seal, it is necessary to determine whether the leak is occurring at the timing case cover itself (shrink holes, cracks).

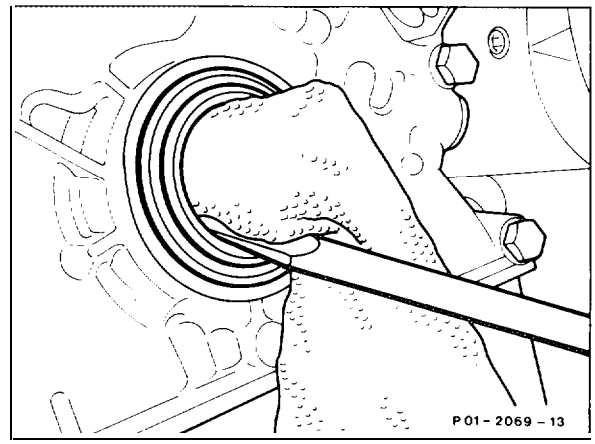
This is done by cleaning the bottom area of the timing case cover free of oil, drying and spraying it with “MB contrast spray white”,

Part No. 009 989 03 59. Run engine and pinpoint oil leak after 2 – 5 minutes.

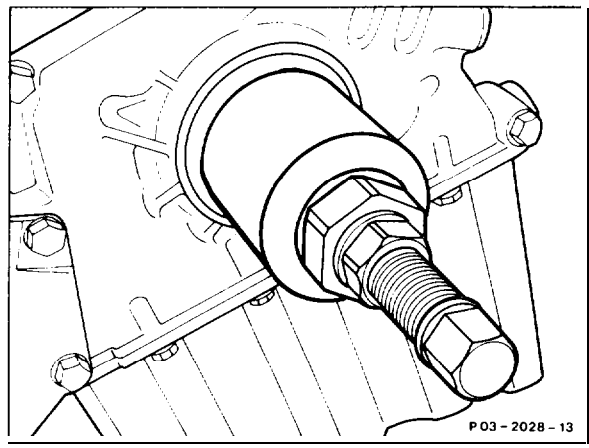
1 Pry radial seal (45) out of the timing case cover with a screwdriver.

When performing the step, ensure that the crankshaft journal and the mounting hole in the timing case are not damaged. Cover over crankshaft journal with a rag.

Deburr mounting hole, if necessary.



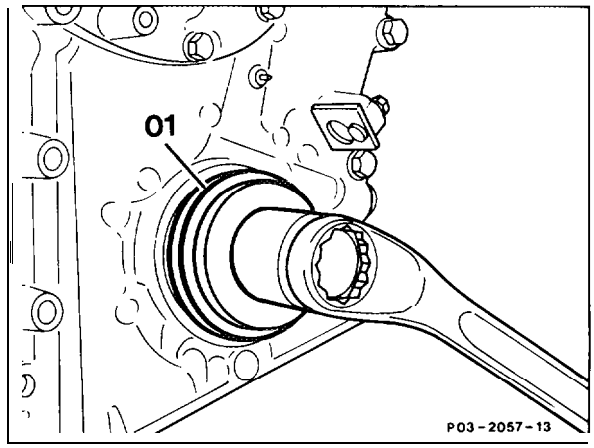
2 Check whether the sealing lip of the radial seal has worn at the spacer ring (7) (groove). If necessary, remove spacer ring with the puller 102 589 00 33 00.
If necessary, install new spacer ring.



3 Oil the sealing lip of radial seal (45).

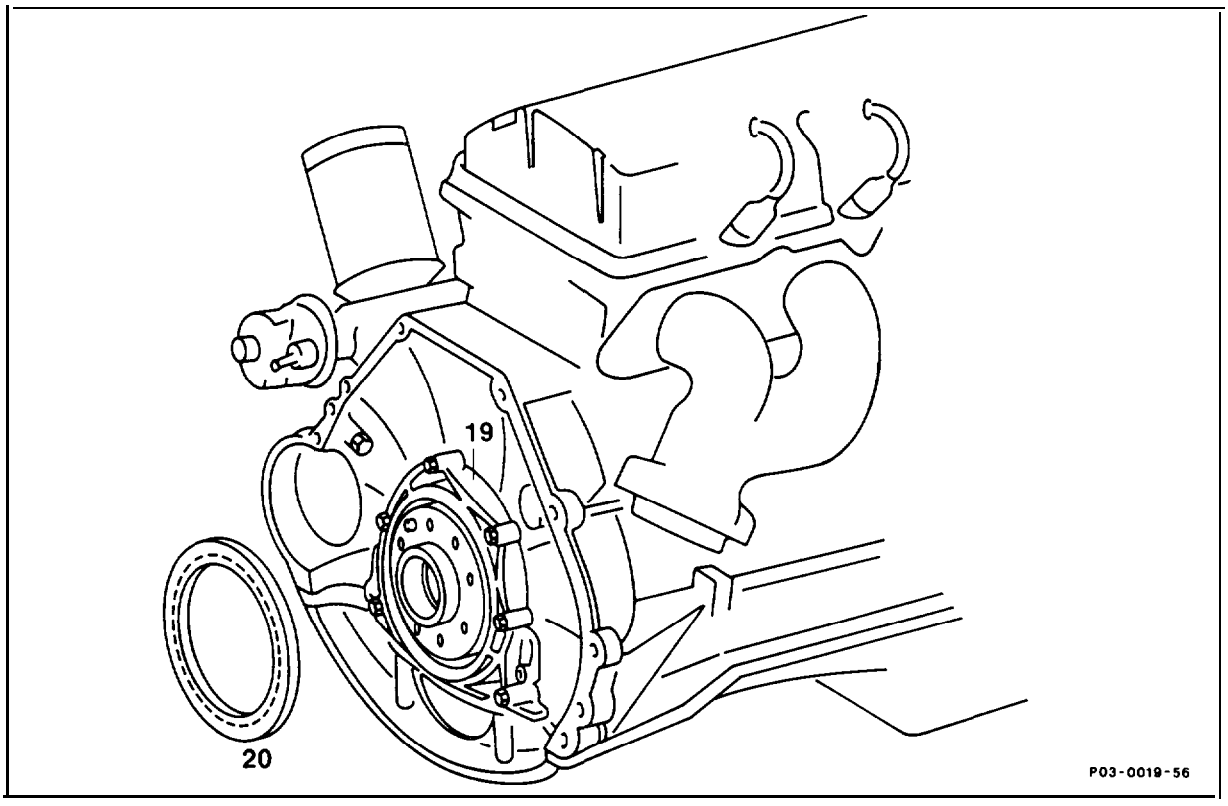
Caution!
Do not use any grease. Grease prevents the inclined webs on the sealing lip from positioning.

4 Pull in radial seal with an installation tool.
Installation instruction
Use **special** tool 102 589 00 14 00 on engines with single roller chain, use additionally the 'spacer ring 102 589 01 14 00 (01) on engines with double roller chain.



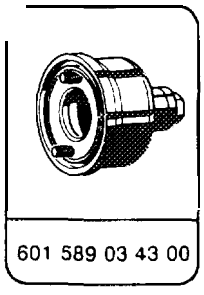
03-327 Replacing rear crankshaft radial seal

Preceding work:
Removing transmission (26-020 or 27-600).
Removing flywheel or driven member (03-410).



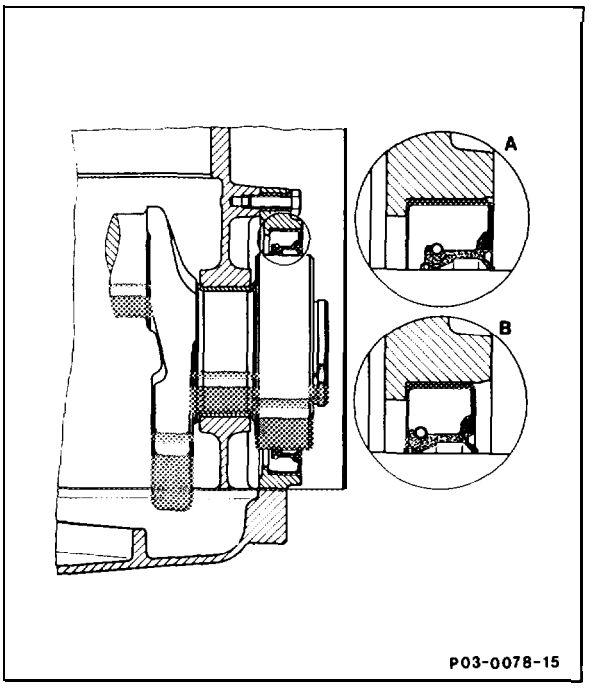
Radial seal (20)	remove, replace and install.
Mounting hole	clean, check.
Sealing lip	oil.
Leaks when engine running	check.

Special tool



Notes

The sealing lip of the replacement radial seal is offset to the inside by 3 mm so that it does not run in a groove which may have been produced on the running surface on the crankshaft by the standard radial seal.



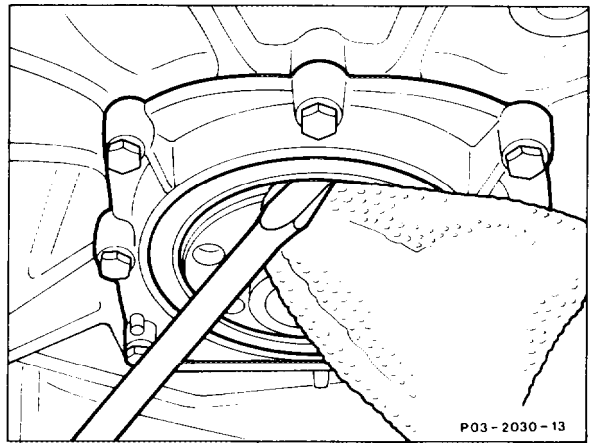
A Standard radial seal
B Repair radial seal

The radial seall is installed into the end cover flush without any sealant.

Oil leaks can be determined after spraying the cleaned and dried surrounding area with Mercedes-Benz contrast spray white, Part No. 000 989 03 59.

Removal and installation

1 Press radial seal out of the end cover with a screwdriver.
When performing this step, ensure that the crankshaft flange and the mounting hole in the end cover are not damaged. Cover over crankshaft flange with a rag.



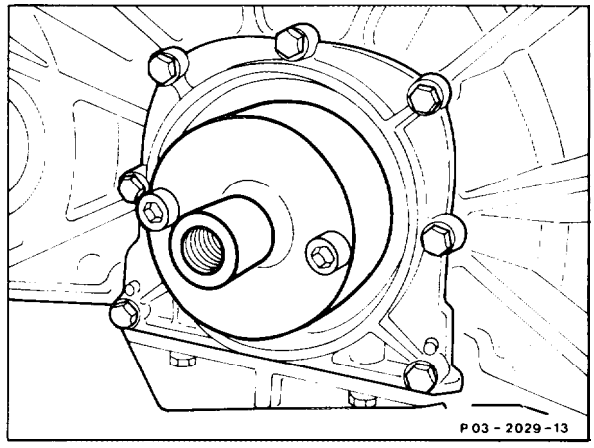
2 Check running surface for radial seal on the crankshaft for signs of damage.

3 Clean mounting hole in the end cover for the radial seal, deburr if necessary.

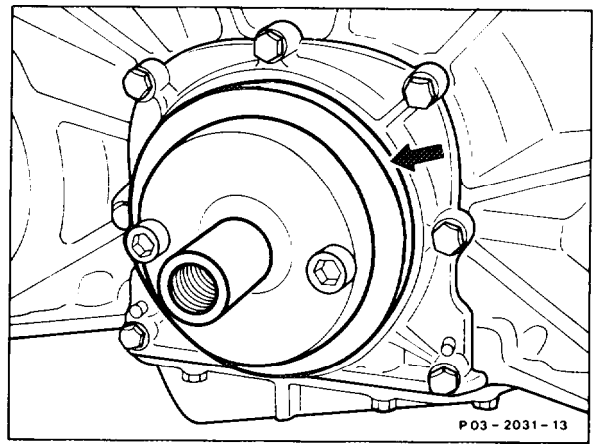
4 Screw inner part of installation tool onto crankshaft flange.

5 Oil sealing lip of radial seal.

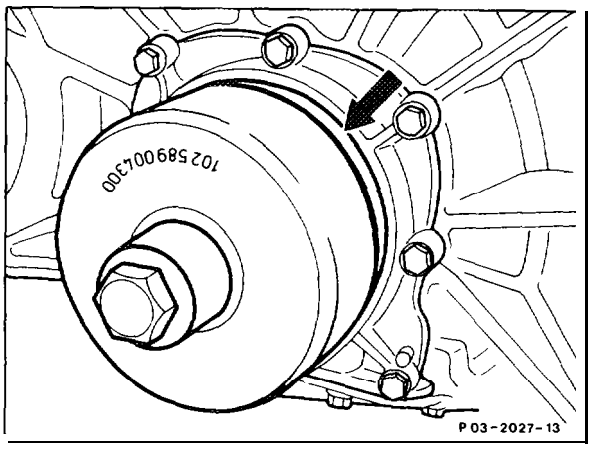
Caution!
Do not use any grease. Grease prevents the inclined webs on the sealing lip from repositioning.



6 Install radial seal (arrow) over the inner part of the Installation tool.



7 Press the radial seal (arrow) into the end cover as far as the stop with the outer part of the installation tool.

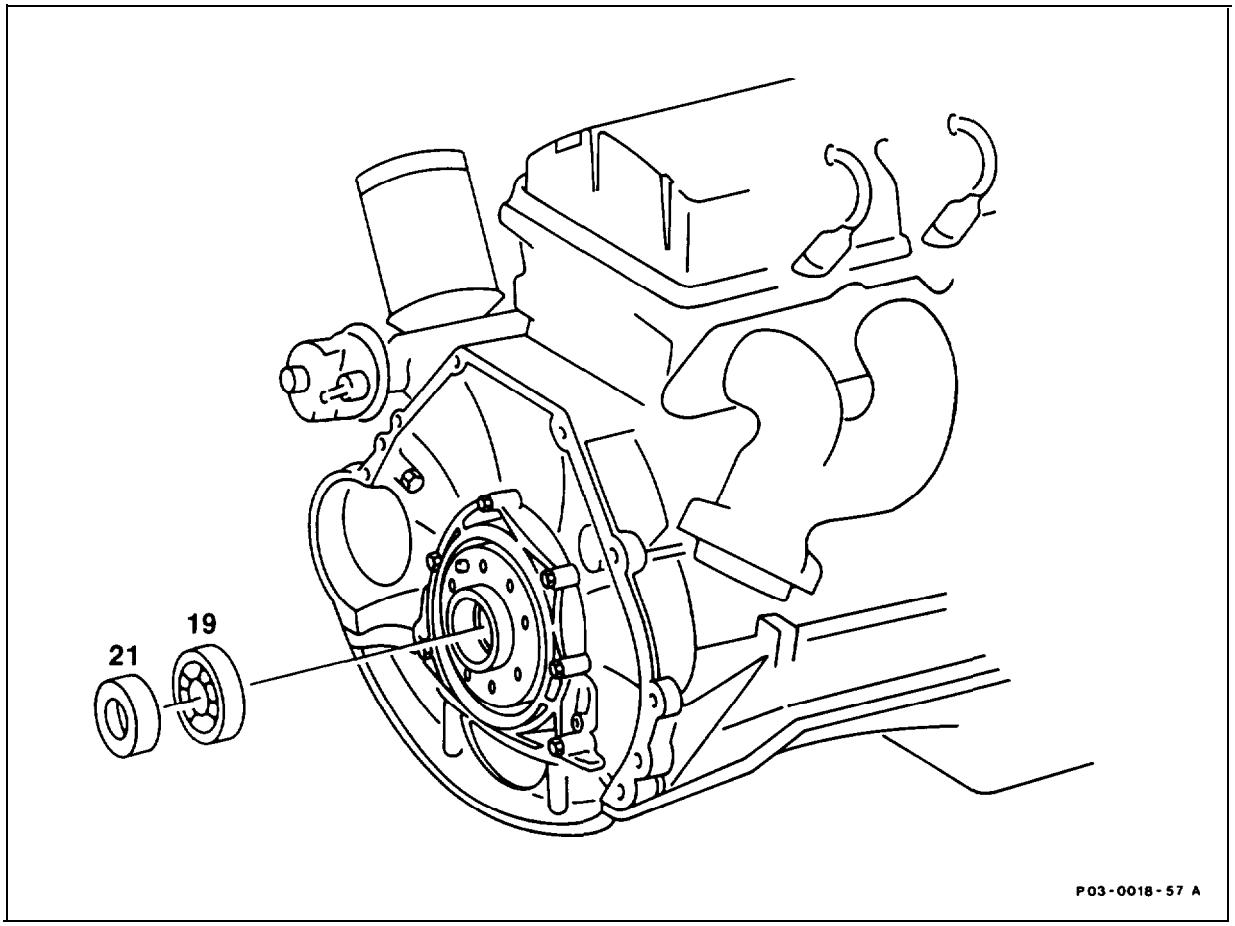


Caution!
The radial seal must be positioned exactly at right angles to the crankshaft flange or inner part of the installation tool to ensure that it provides a proper seal.

8 Check for leaks with engine running.

03-330 Removal and installation of grooved ball bearlng in crankshaft

Preceding work:
Removing transmission (26-020 or 27-600).
Removing clutch (25050).

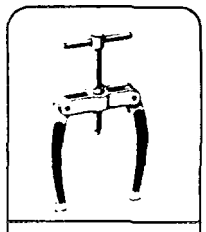


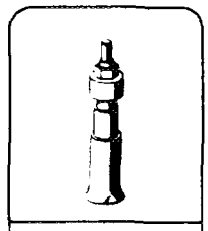
Grooved ball bearing (19) and locking ring (21) . . withdraw, special tool 000 589 33 33 00 and 000 589 25 33 00.

Before installation, coat outer race of grooved ball bearing with adhesive 002 989 94 71.

Knock in grooved ball bearing as far as the stop, outer race flush.

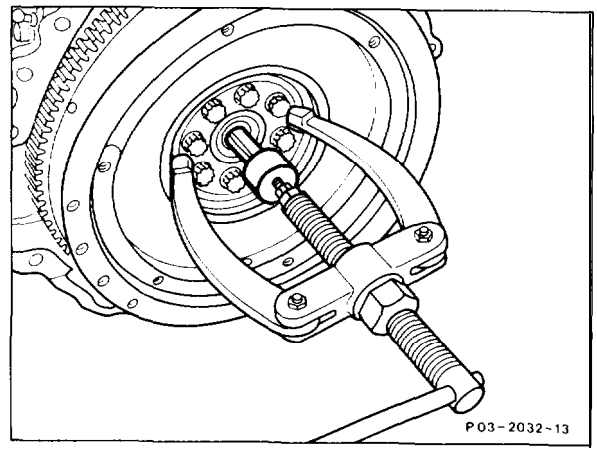
Special tools





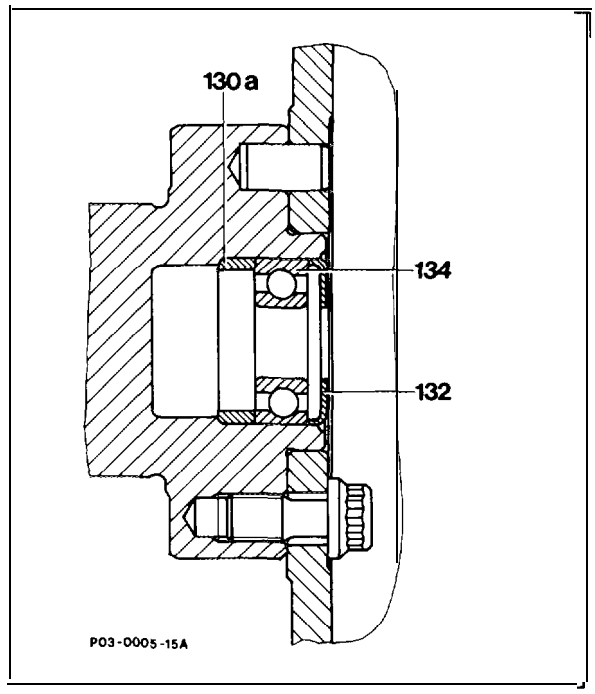
Removal and installation

1 Withdraw grooved ball bearing with locking ring from the crankshaft, special tool 000 589 33 33 00 and 000 589 25 33 00.



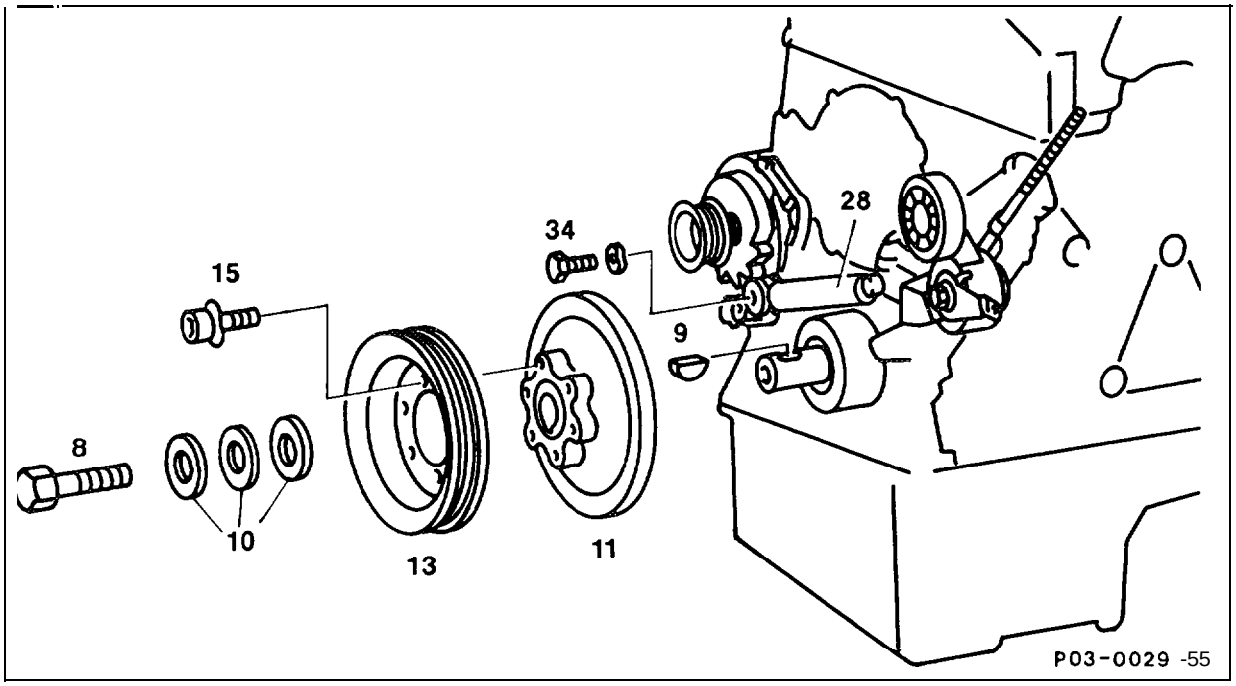
2 Coat the new grooved ball bearing with the adhesive 002 989 94 71 and knock the outer race with a suitable drift to insert it into the crankshaft as far as the stop.

3 Knock in locking ring (132) flush.



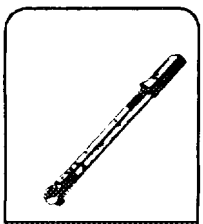
03-342 Removal and installation of vibration damper or hub and belt pulley

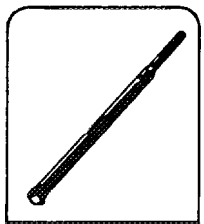
Preceding work:
Draining coolant (20-010).
Removing radiator (20-420).
Removing poly V-belt (13-340).

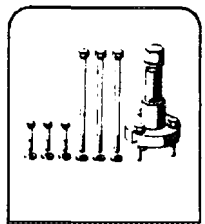


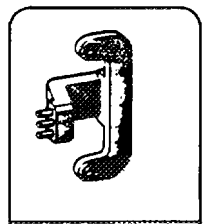
Retaining lock on starter ring gear	remove and install, special tool 601 589 02 40 00.
Belt pulley (13)	unbolt, bolt on, 25 Nm.
Hexagon bolt (8)	unscrew, bolt on, 300 Nm.
Shock absorber (28)	Unbolt at bottom, bolt on (step 4) and press up, 25 Nm.
Vibration damper (11)	pull off, special tool 601 589 08 33 00, fit on.

Special tools


001 589 72 21 00


001 589 74 21 00


103 589 00 33 00

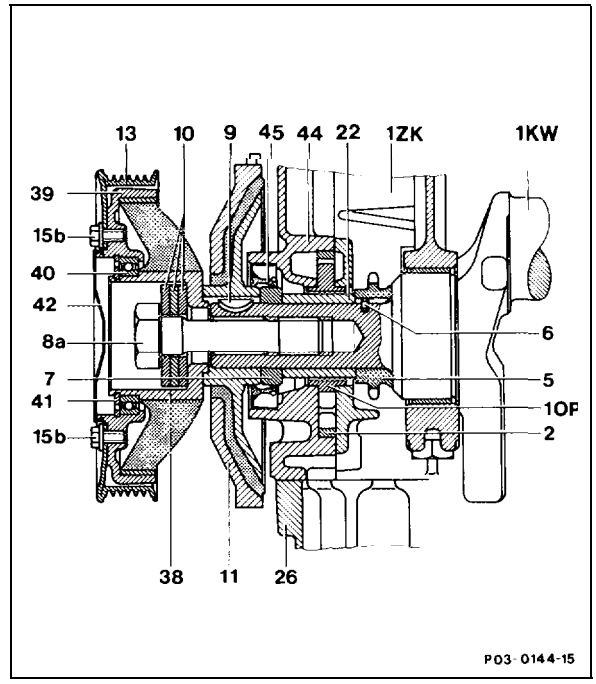

601 589 02 40 00

Commercial tool

3/4" square socket to 1/2" square driver coupler	e. g. Hazet D-5630 Remscheid Order No. 1058 R-I

On vehicles with air conditioning/automatic climate control, the belt pulley (13) was installed with a hub with rubber part (38, damping part) with ball bearing (40) up to December 1984.

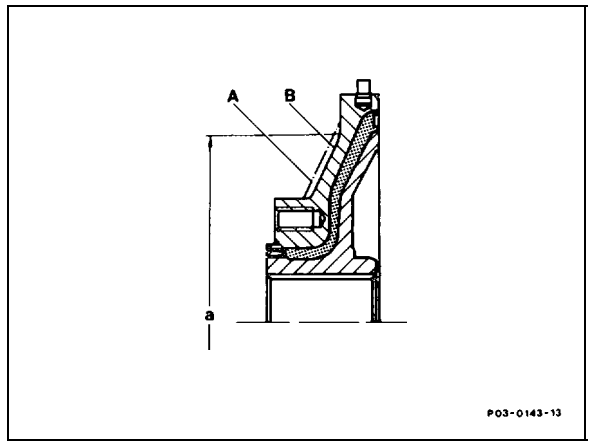
The uneven running of the crankshaft, particularly at low engine speeds and during cutin surges of the A/C compressor, are damped by the coupling so that the V-belt runs practically slip-free on the belt pulley.



1 KW Crankshaft
1ZK Crankcase
2 Oil pump outer gear
5 Crankshaft gear
6 Straight pin 3 × 5 mm
7 Spacer ring
8a M18 x 1.5 x 75 stretch bolt
9 Woodruff key
10 Belleville spring washer
10P Oil pump inner gear
11 Vibration damper
13 Belt pulley
15b M6 × 13 bolts
22 Oil pump drive sleeve
26 Oil sump
38 Hub with rubber part and steel ring
39 Flange
40 Ball bearing
41 Locking ring
42 End cover
44 Timing case cover
45 Radial seal

In order to provide greater clearance for the top shock absorber of the poly V-belt tensioning device, the shape of the vibration damper has been modified.

Size "a" = 133.1 **mm dia., previously** 145 mm dia.



A 1st version
B 2nd version

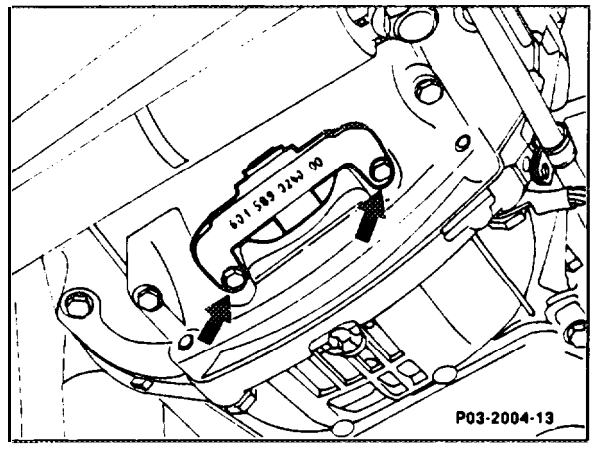
Standard implementation: 10/87

Model	Engine	Engine End No.	
		Manual transmission	Automatic transmission
201.028	102.985	018810	061766

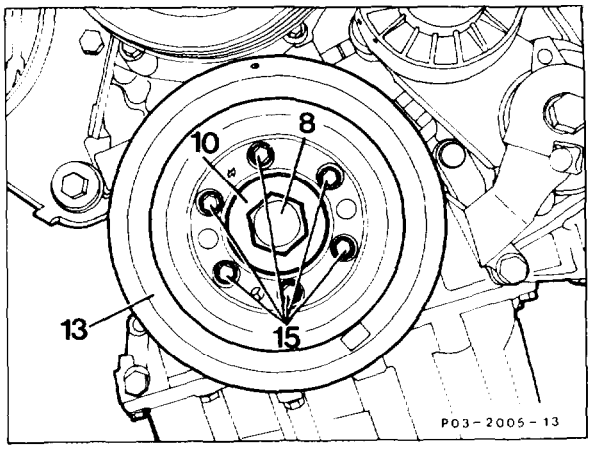
The spacer ring on the crankshaft was made 3.65 mm narrower with implementation of the double roller chain.

Removal and installation

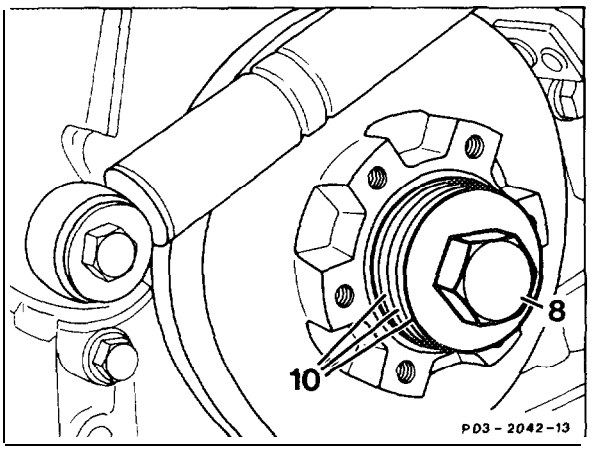
1 Attach retaining lock 601 589 02 40 00 with two bolts to the oil pan (arrows).



2 Remove bolts (15) and take off belt pulley (13). Tightening torque 25 Nm.

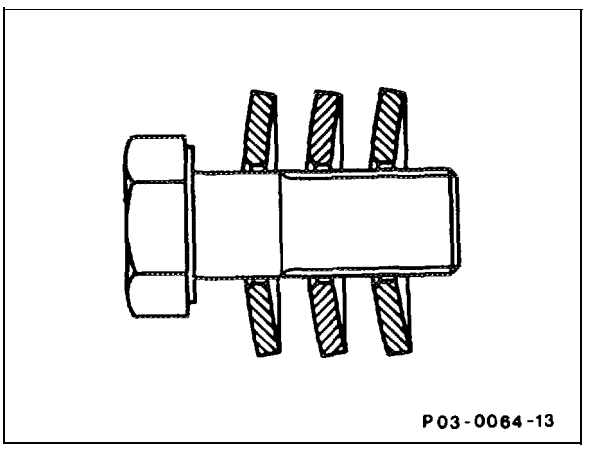


3 Remove bolt (8) and take off Belleville spring washers (10).

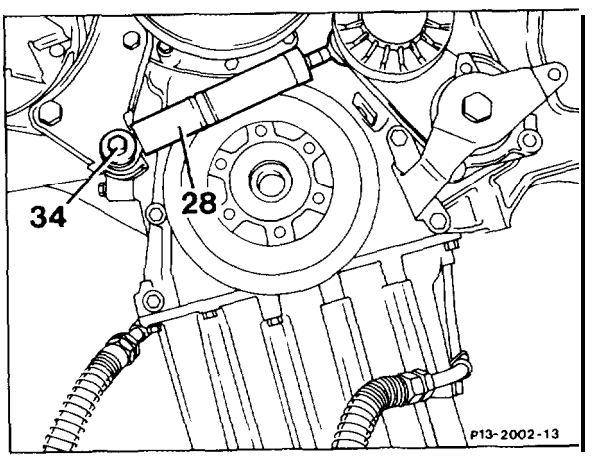


Installation Instruction

Oil bolt threads and Belleville spring washers. Install Belleville spring washers with curved side facing bolt head.



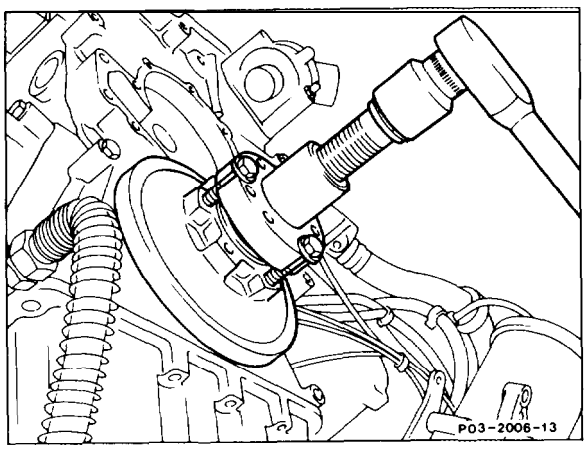
4 Remove bolt (34) for bottom shock absorber mounting and swing shock abosrber (28) upwards. Tightening torque 25 Nm.



5 Pull off vibration damper (11) with the puller 103 589 00 33 00.

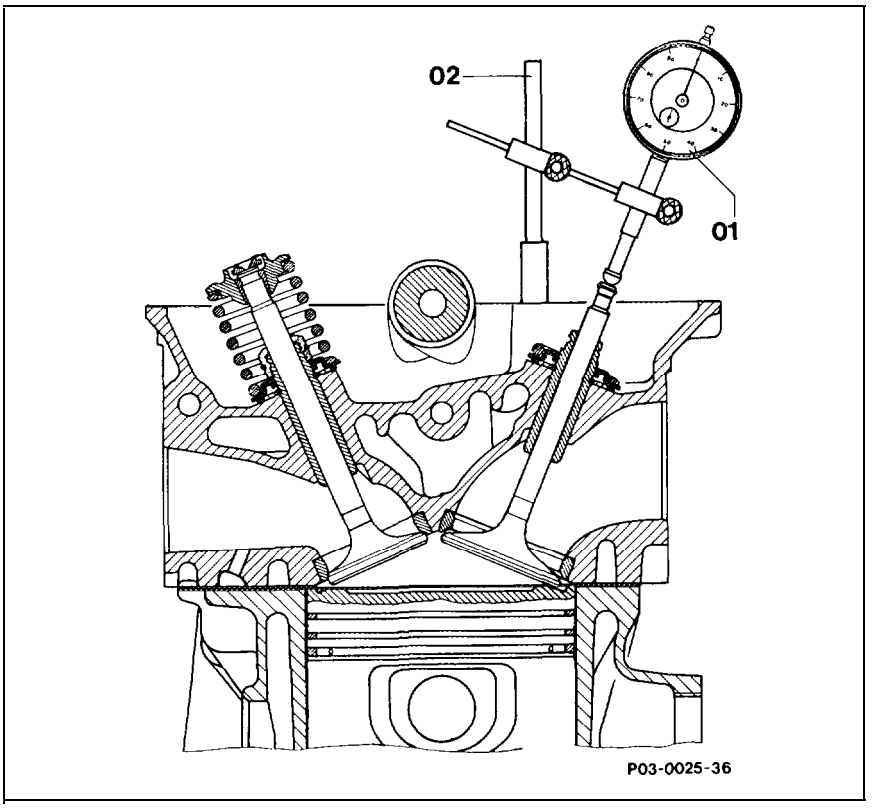
Installation instruction

When installing the vibration damper, check whether the groove in the hub is aligned with the Belleville spring washer in the crankshaft.



03-345 Checking and correcting setting of TDC pulse generator

Preceding work:
Removing poly V-belt (13-342).
Removing cylinder head cover (01-406).
Removing spark plugs (15-018).



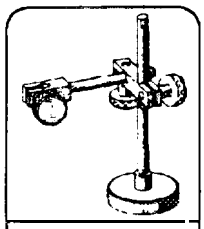
Fan and fan coupling	remove and install (step 1).
No. 1 cylinder piston	set to ignition TDC (step 2).
No. 1 cylinder rocker arm bearing bracket	remove and install, 20 Nm (step 3).
Valve spring	remove from 1st intake valve, install (05-250).
Valve stem seal	remove from 1st intake valve, install (step 5 and 05-270).

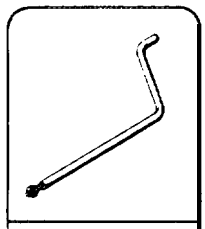
TDC setting	measure by attaching dial gauge holder 363 589 02 21 00 to cylinder head. Mount valve on piston crown. Turn back crankshaft to approx. 10° before TDC of No 1 cylinder. Inset-t dial gauge in holder. Fit tracer pin of dial gauge onto valve stem with preload of 2 mm. Slowly turn crankshaft in direction of rotation of engine until the large pointer stops (TDC setting, steps 6 through 11).
Hexagon nut	unbolt at TDC pulse generator, withdraw TDC pulse generator (step 12).
Dial gauge	loosen and set preload of 5 mm, position scale of gauge to "0" (step 13).
Turn crankshaft	until dial gauge has moved back by 2.85 mm or 3.07 mm, respectively (step 14).
Fixing device	Insert special tool 119 589 00 21 00 into setting slide. The pin in the vibration damper must engage in the groove of the fixing device; correct setting slide, if necessary (steps 14 through 19).

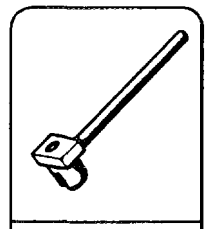
Data

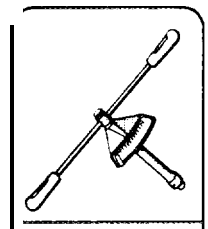
Piston travel at crankshaft setting 20° after TDC	measured over intake valve	2.85 mm
	measured directly at piston crown	3.07 mm

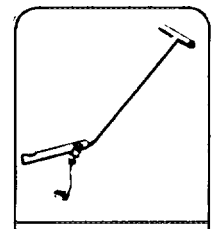
Special tools

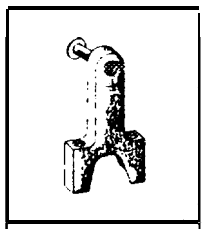

363 589 02 21 00

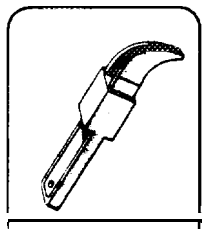

123 589 09 63 00

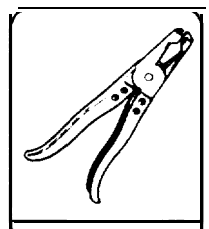

119 589 00 21 00


001 589 51 21 00


102 589 00 61 00


1102589 01 61 00


116 589 06 63 00

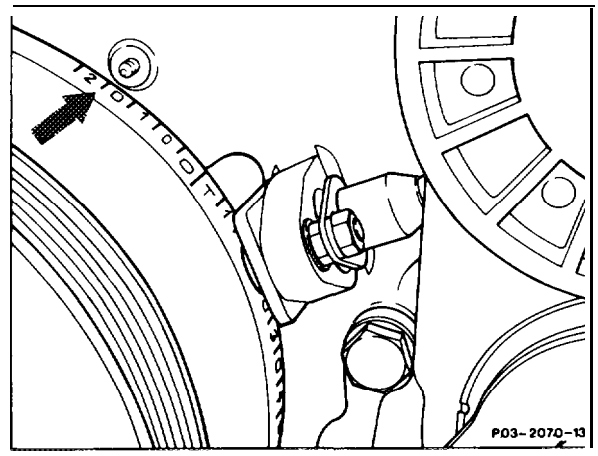

104 58900 3700

Commercial tool

Dial gauge A 1 DIN 878	e. g.	Mahr D-7300 Esslingen Order No. 311000

Notes

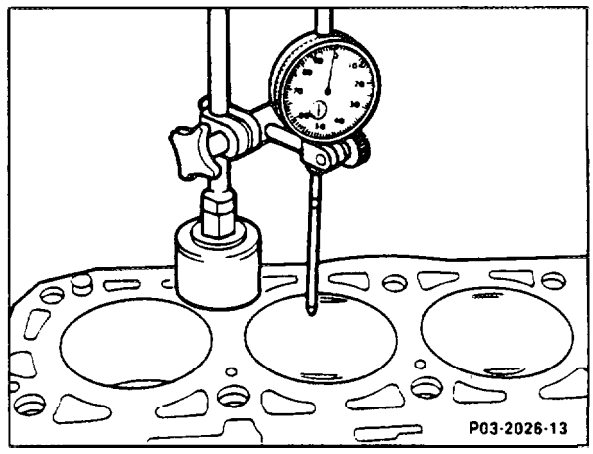
The TDS pulse generator with holder (1) is attached to the timing case cover.
The pin in the vibration damper or on the belt pulley must be positioned exactly below the TDC pulse generator at a crankshaft setting of 20” after TDC.



The adjustment of the TDC pulse generator must be checked or corrected:

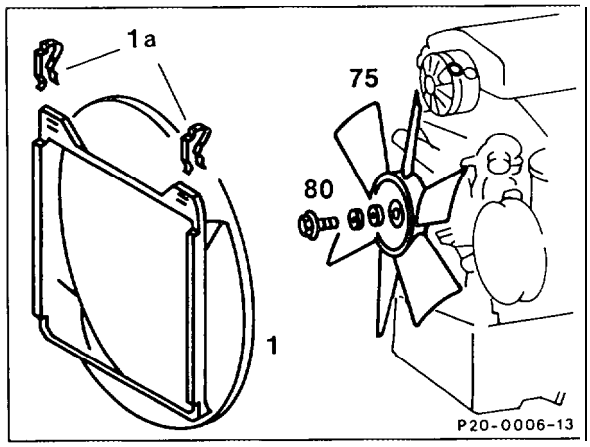
- When replacing the crankshaft or the vibration damper.
- When replacing the timing case cover.
- When installing parts to reconditioned engines.

The crankshaft setting 20” after TDC is determined from the piston travel, starting from ignition TDC of No. 1 piston.
The piston travel is measured either with the intake valve of No. 1 cylinder mounted on the piston crown and dial gauge or, if the cylinder head is removed, directly by mounting the dial gauge pin on the piston crown.

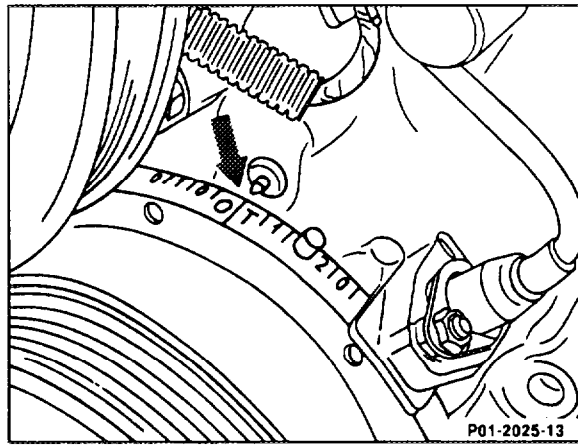


Checking

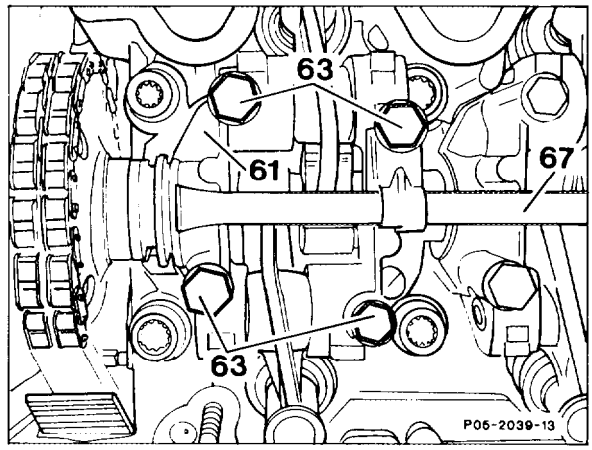
1 Remove and install fan shroud (1) and fan (75), tightening torque of bolt (80), 25 Nm.



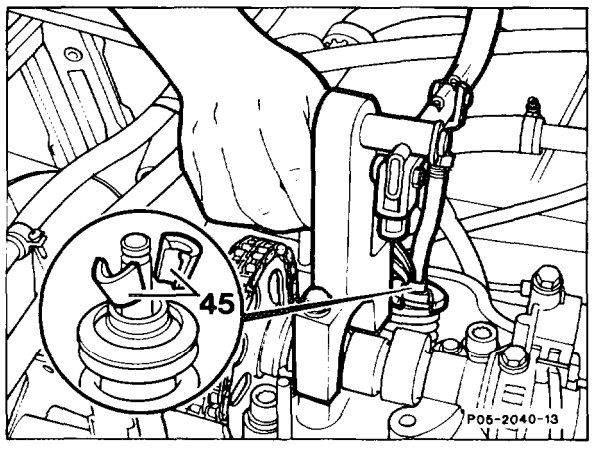
2 Set engine to ignition TDC of No. 1 cylinder.



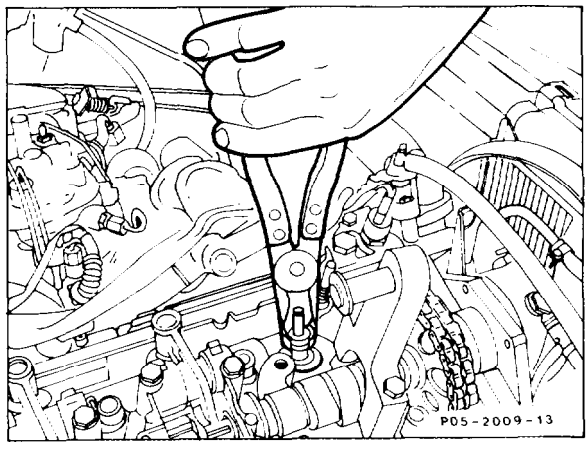
3 Remove and install rocker arm bearing bracket (61) by unscrewing oil pipe. Tightening torque of bolts (63), 21 Nm.



4 Remove and install valve spring at No. 1 intake valve (05-250).



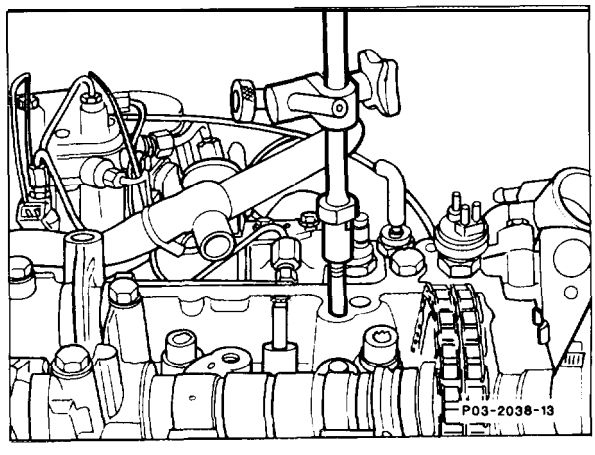
5 Remove and install valve stem seal of No. 1 intake valve. Oil new valve stem seal and press on by hand. Mount assembly sleeve on the valve stem for performing this step (05-270).



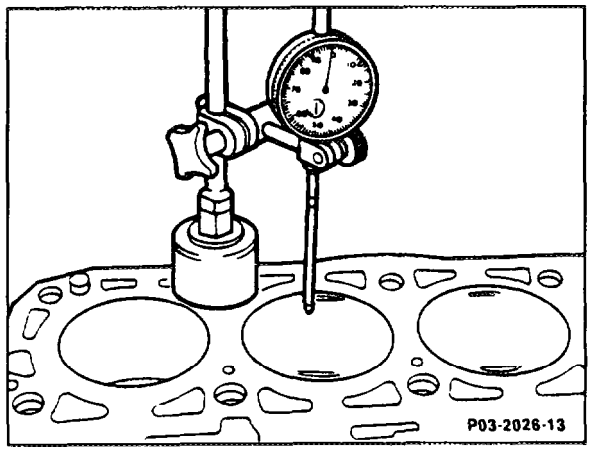
6 Mount valve on piston crown.

7 Turn back crankshaft to approx. 10° before TDC of No. 1 cylinder.

8 Bolt dial gauge holder 363 589 02 21 00 with threaded sleeve onto cylinder head set bolt at front left.



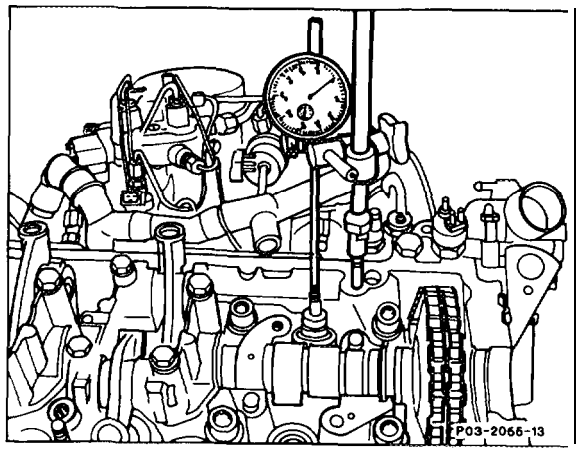
Note
With cylinder head removed, mount a magnetic dial gauge holder onto the mating face of the crankcase.



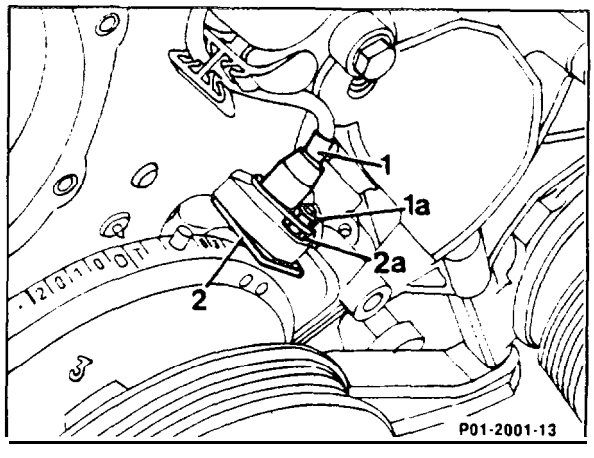
9 Insert dial gauge with extension.

10 Mount dial gauge with 2 mm preload onto the valve stem or piston crown.

11 Slowly turn crankshaft in direction of rotattion of *engine* until the larger pointer of the dial gauge stops (TDC setting).

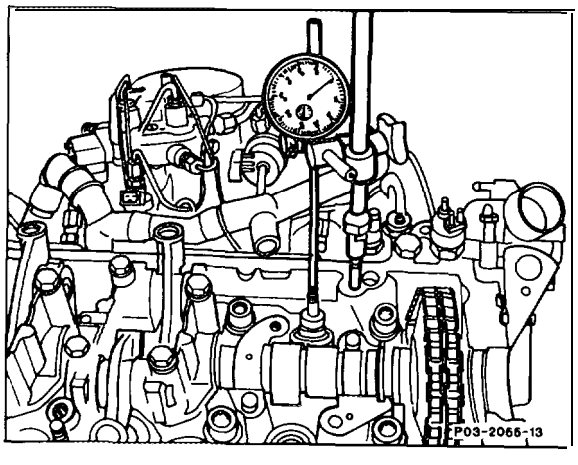


12 Unscrew hexagon nut (la) and withdraw TDC pulse generator (1).



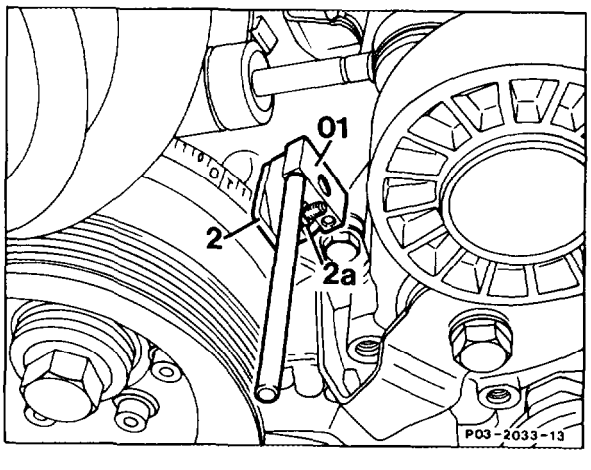
13 Loosen dial gauge and mount extension with 5 mm preload onto the valve stem or piston crown. Turn scale of gauge until the large pointer is at zero.

14 Turn on crankshaft in direction of rotation until the dial gauge has moved back by the appropriate value (data in table).



15 Position fixing device 119 589 00 21 00 into the setting slide (2).
The pin on the vibration damper must engage in the groove of the fixing device (1).

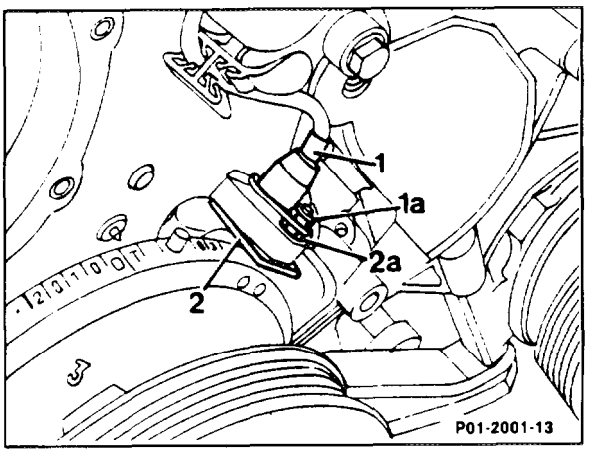
If the pin does not engage, adjust position of setting slide.



Adjustment

16 Loosen nut (2a) and move setting slide (2) far enough for the pin on the vibration damper to engage in the groove of the fixing device.

17 Tighten nut (2a) and withdraw fixina device.

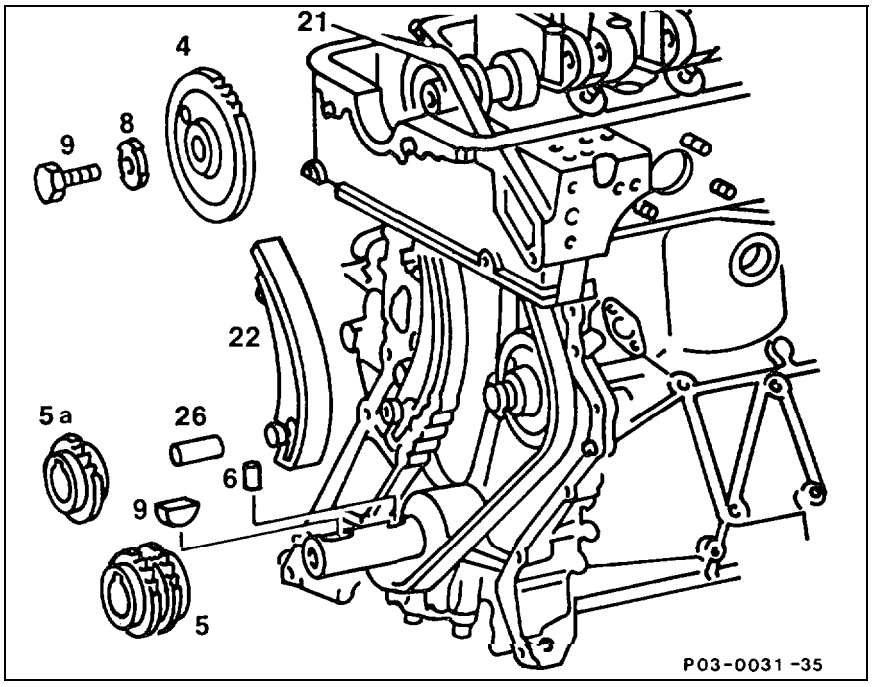


18 Insert TDC pulse generator and bolt on.

19 Remove dial gauge and dial gauge holder.

03-350 Removal and installation of crankshaft gear

Preceding work:
Removing liming case cover (01-210).
Removing chain tensioner (05-310).



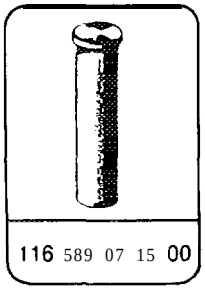
Timing chain (21), camshaft gear (4) and crankshaft gear (5 or 5a)	mark relative to each other (steps 1 and 2).
Camshaft gear (4)	remove and place timing chain in chain box (step 3). Install (step 10), 80 Nm.
Tensioning rail (22)	pull off and insert.

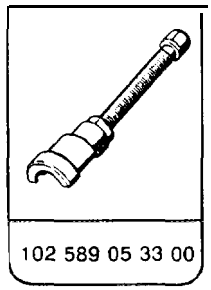
Note

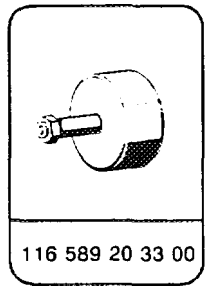
Drill bearing pin (26) of engines with double roller chain, tap M6 thread and knock out with impact extractor 115 589 12 33 00 and extension 100 589 00 43 00.
When installing tensioning rail, insert new bearing pin together with tensioning rail (steps 4 and 9).

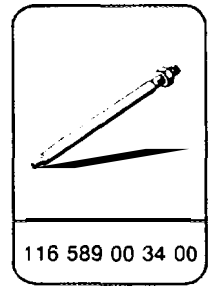
Crankshaft gear (5 or 5a)	. . . . .	pull off with puller 102 589 05 33 00 together with oil pump drive sleeve. Transfer colour marking to new crankshaft gear. Knock in crankshaft gear, if necessary, with drift 116 589 07 15 00, pay attention to straight pin (6) (steps 5 through 8).

Special tools







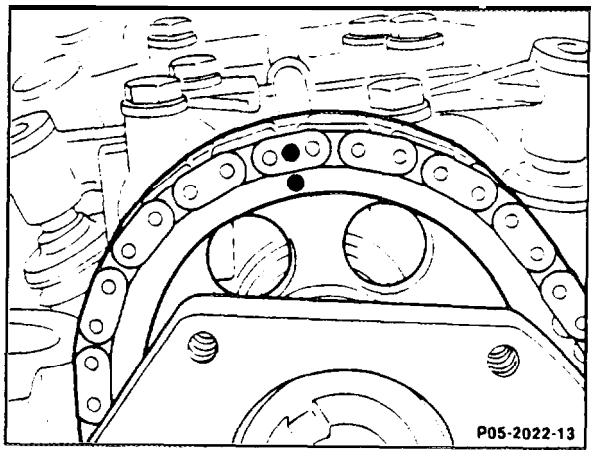


Note

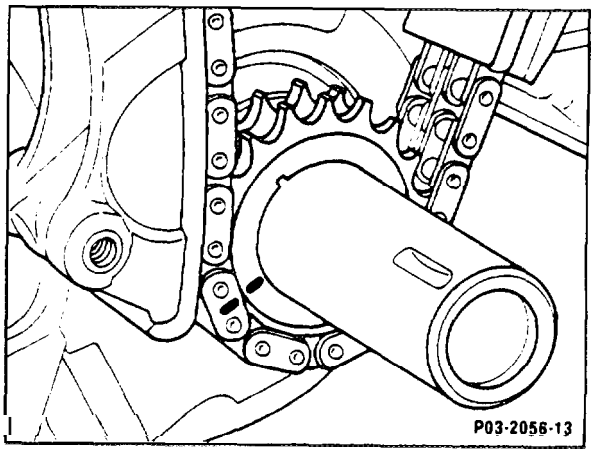
As of January 1988 a double roller timing chain has been installed.

Removal and installation

1 Mark timing chain and camshaft gear rerlative to each other.

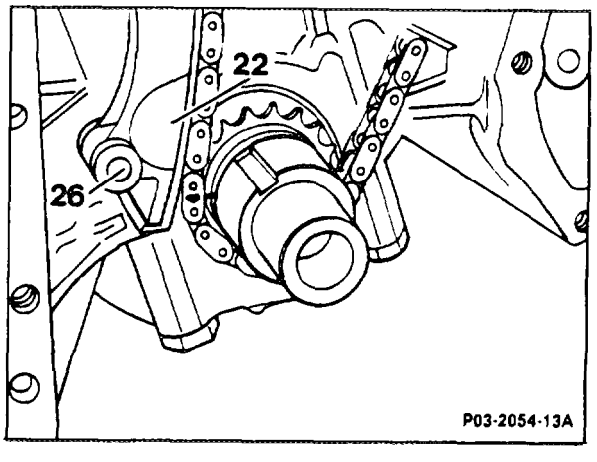


2 Mark timing chain and crankshaft gear relative to each other.



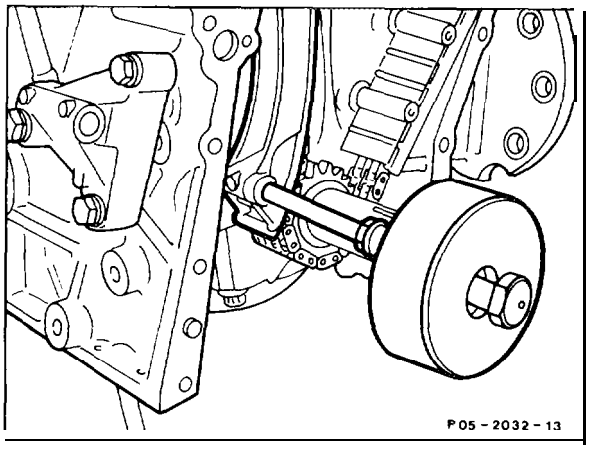
3 Unbolt camshaft gear and place timing chain in chain box.

4 Pull tensioning rail (22) off bearing pin (26) .

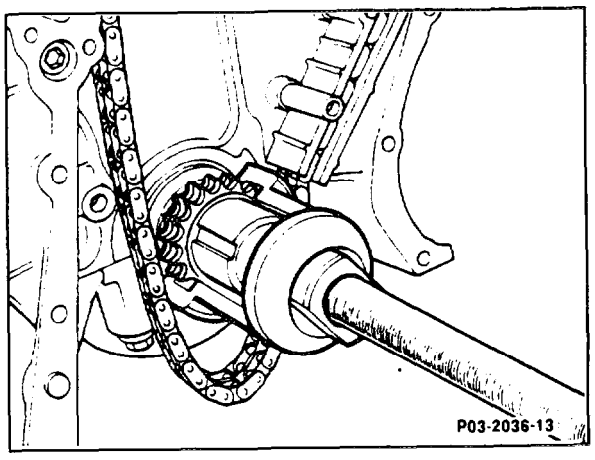


Note

On engines with double roller chain, knock out bearing pin of tensioning rail with the impact extractor 115 589 12 33 00 and the extension 100 589 00 43 00.
To perform the step, tap an M6 thread approx. 10 mm deep into the bearing pin.



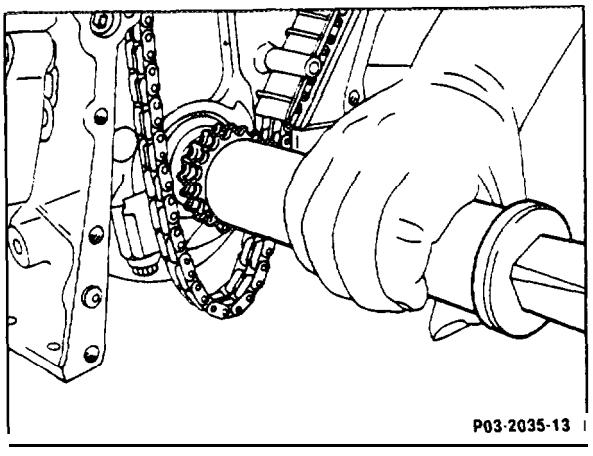
5 Pull off crankshaft gear and oil pump drive sleeve with the puller 102 589 05 33 00.



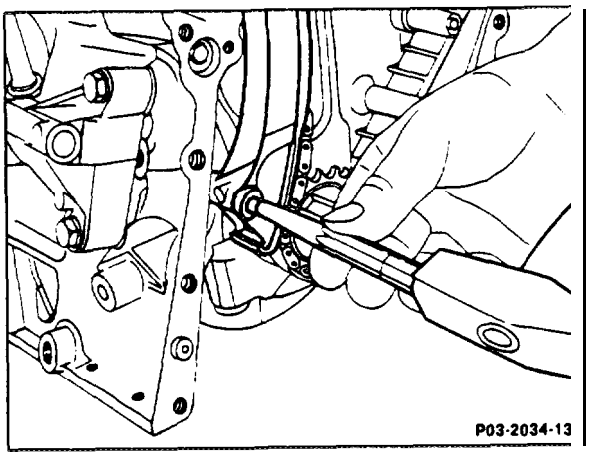
6 If the crankshaft gear is replaced, transfer color marking from the old to the new crankshaft gear.

7 Install crankshaft gear onto crankshaft. If this proves difficult, knock in with the impact drift 116 589 07 15 00.
Pay attention to the straight pin for locating, when performing this step.

8 Insert drive sleeve.

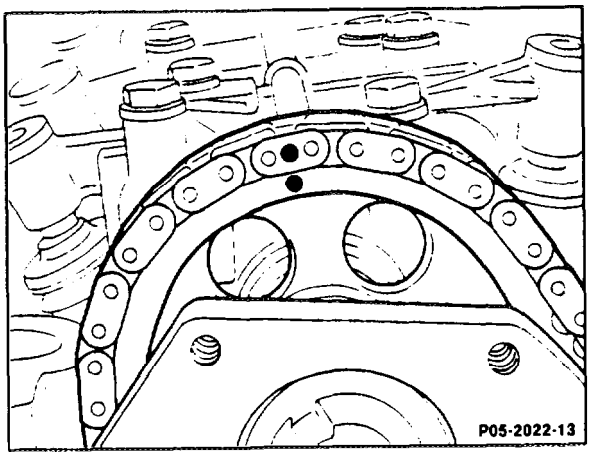


9 Insert tensioning rail.
On engines with double roller chain, insert tensioning rail and knock in new bearing pin as far as the stop.



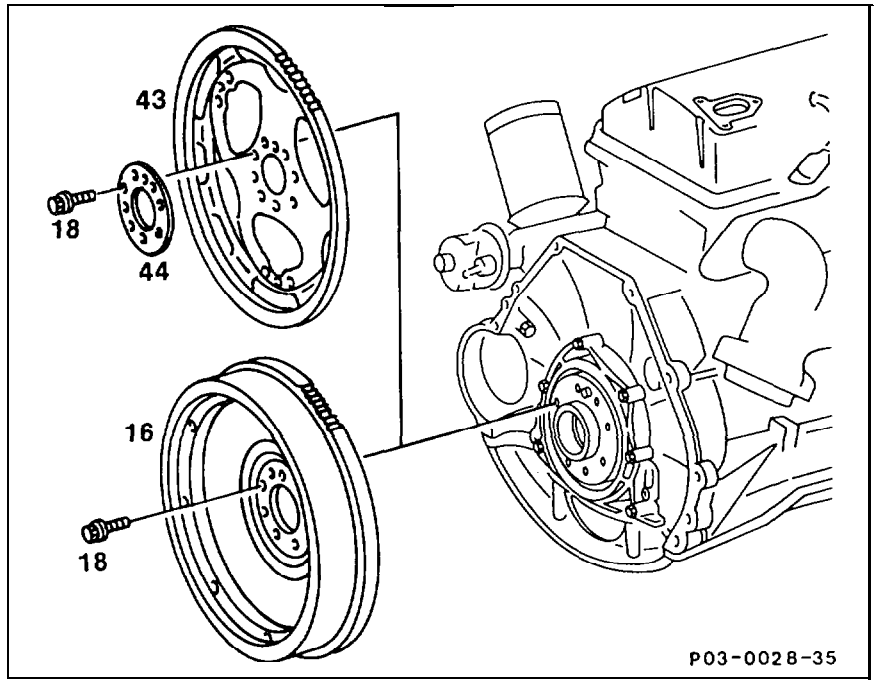
10 Install camshaft gear (pay attention to color marking), tightening torque 80 Nm.

11 Check for leaks with engine running.



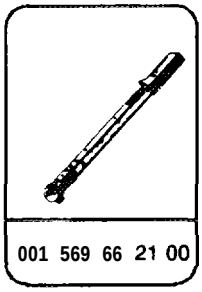
03-410 Removal and Installation of flywheel or flex plate

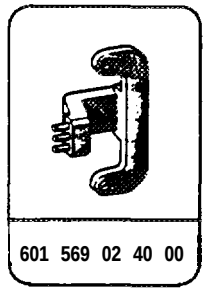
Preceding work:
Removing transmission (26-020 or 27-600).
Removing clutch (25-050).



Retaining lock on starter ring gear	remove and install, special tool 601 589 02 40 00 (step 2).
Stretch bolt (18)	unbolt, bolt in, check length/stretch shaft dia., initial torque 30 Nm, angle of rotation torque 90°, with two-mass flywheel 50 Nm, angle of rotation torque 90° (steps 6 and 7).
Flywheel (16) or flex plate (43) with spacer disc (44)	detach, attach (step 5).

Special tools

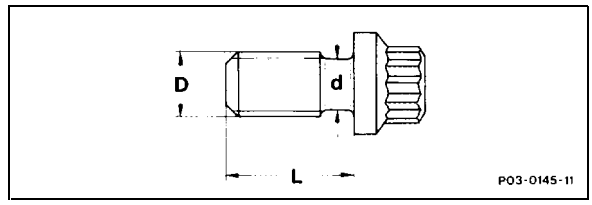

001 569 66 21 00


601 569 02 40 00

Stretch bolt

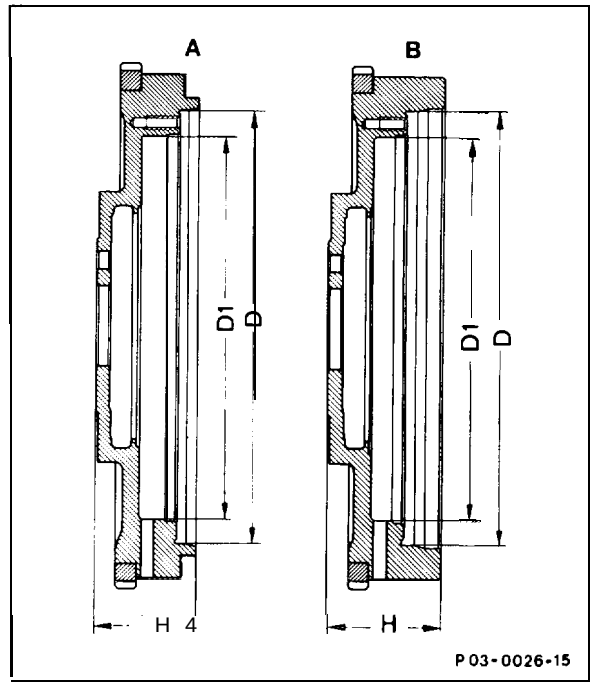
Part No.		102 **032 00** 71	103 032 00 71 [1])
Thread dia. D		M10 × 1	M10 × 1
Thread shaft dia. d	when new	8.5 -0.2	8.5 -0.2
	minimum dia.	8.0	8.1
Length L	when new	22 ±0.2	57 ±0.2
	maximum length	22.5	

[1]) Stretch bolt with two-mass flywheel



Notes

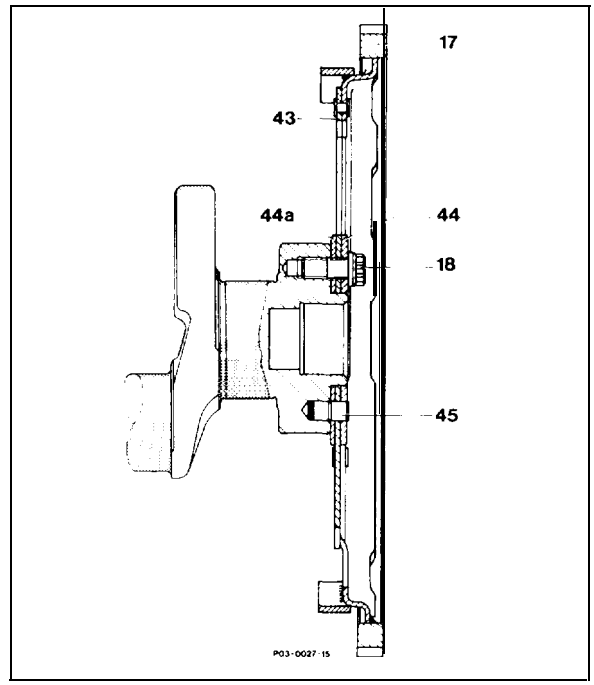
The engines 102.922/924/962/963 have the same flywheels (standard flywheel). Compared to this standard flywheel, the flywheel of engine 102.985 is lighter and the hole circle for the tapped holes for mounting the clutch are larger. The flywheels must not be interchanged and can be replaced without the need for static or dynamic balancing.



A Engines **102.922/924/962/963**
D 253 mm
D1 223 mm
H 58.6 mm

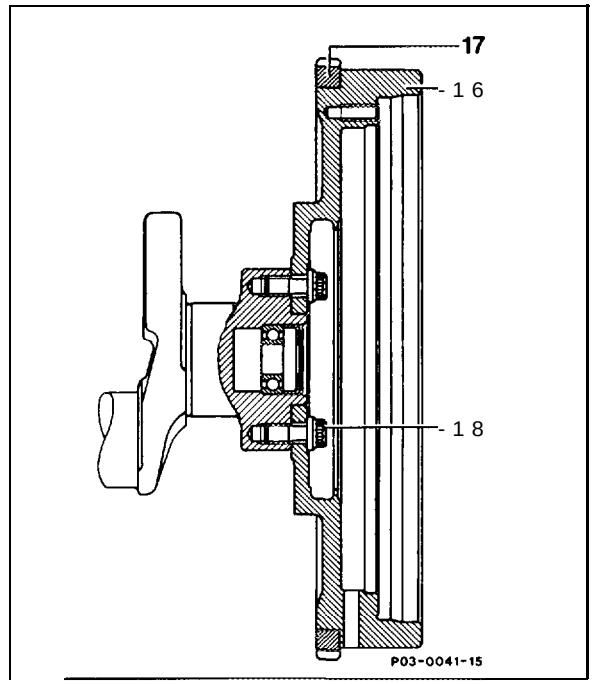
B Engine 102.985
D 265 mm
D1 237 m m
H **57** mm

The flex plate of the engines with automatic transmission is identical on all engines. Flywheel and flex plate with ring gear can be replaced without the need for static or dynamic balancing.



Arrangement of flex plate on crankshaft of engines with automatic transmission.

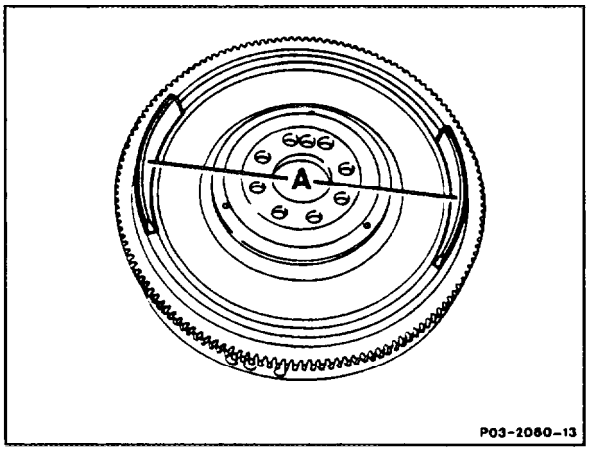
17 Ring gear
18 Ml0 x 1 x22 stretch bolt
43 Flex plate
44 Spacer disc
44a Spacer disc (bonded on)



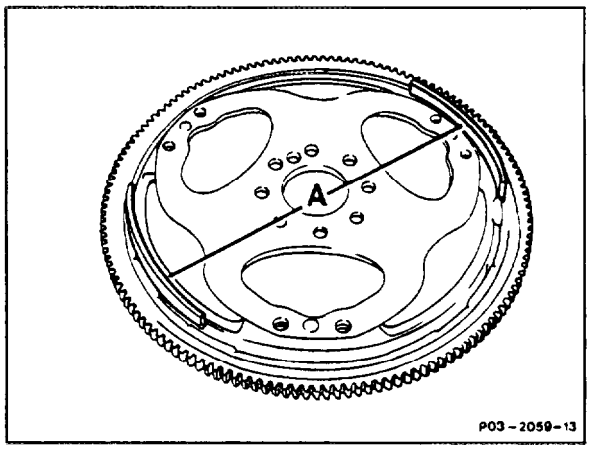
Arrangement of flywheel on crankshaft of engines with manual transmission.

16 Flywheel
17 Ring gear
1a M10×1 x22 stretch bolt

With the distributor ignition (DI - formerly EZL), the flywheel or the flex plate was provided with two segments (A) offset by 180“.
As the segments rotate past the position sensor this produces an alternating voltage as a result of induction.
If the segments are damaged, replace the flywheel or the flex plate.



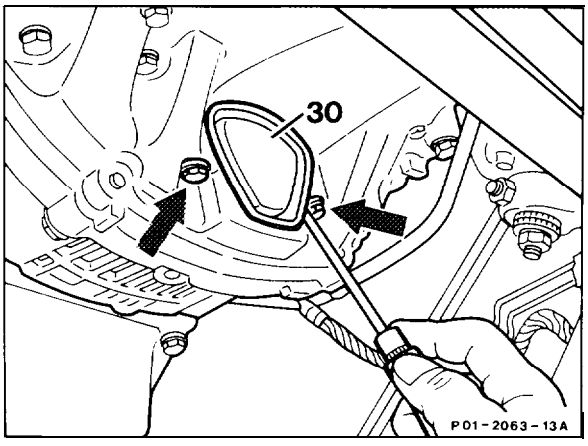
Flywheel of manual transmission



Flex plate of automatic transmission

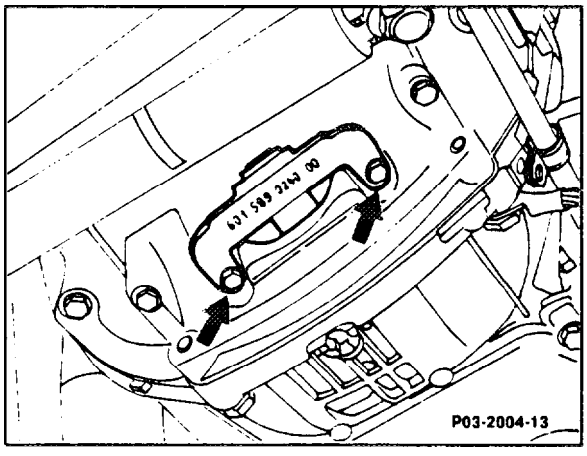
Removal and installation

1 Remove end cover (30) from the rear of the oil pan. Remove bolts (arrows), bolt in, tightening torque 10 Nm.
Press off end cover with screwdriver, fit on.



2 Attach retaining lock 601 589 02 40 00 with both bolts (arrows). The pins on the retaining lock must mesh into the ring gear teeth.

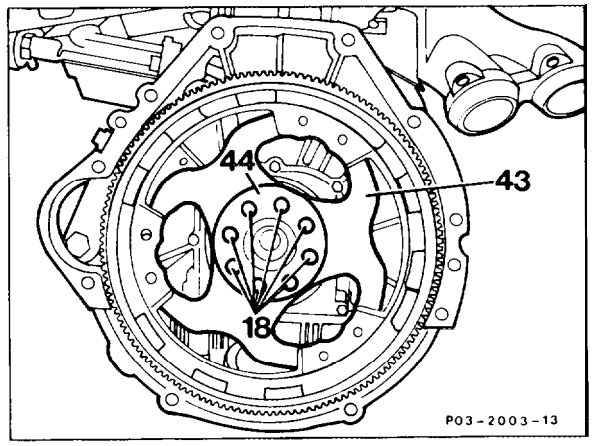
3 Unscrew stretch bolts (18).
Take off flywheel or driven member with bonded spacer disc (44a) and spacer disc (44).



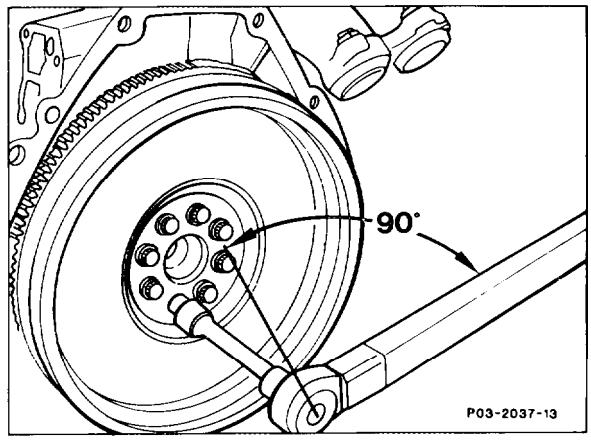
4 Check stretch bolts (see table).

5 install flywheel or flex plate (43) with bonded disc and disc (44), pay attention to centering of installation pin.

6 Bolt in stretch bolts (18) and tighten to an initial torque of 30 Nm or 50 Nm, respectively, for the two-mass flywheel.

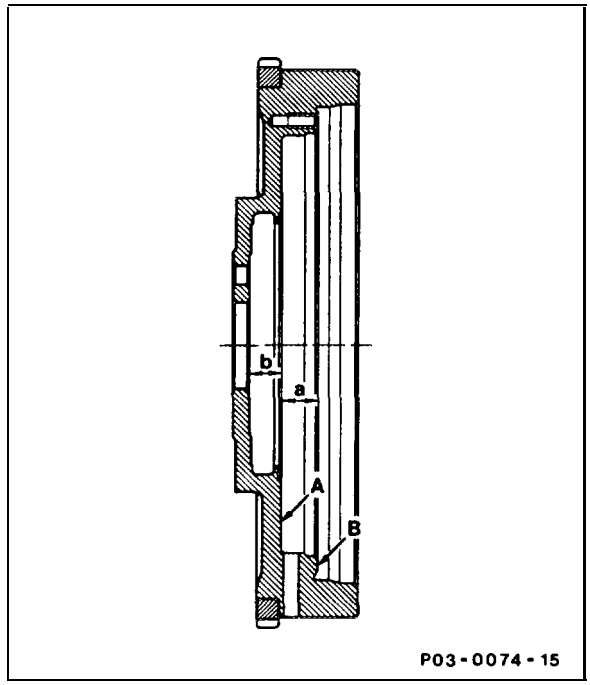


7 Torque stretch bolts (18) in a single operation by the specified angle of rotation torque of 90”.



03-420 Remachining flywheel

Preceding work:
Removing flywheel (03410).



Data

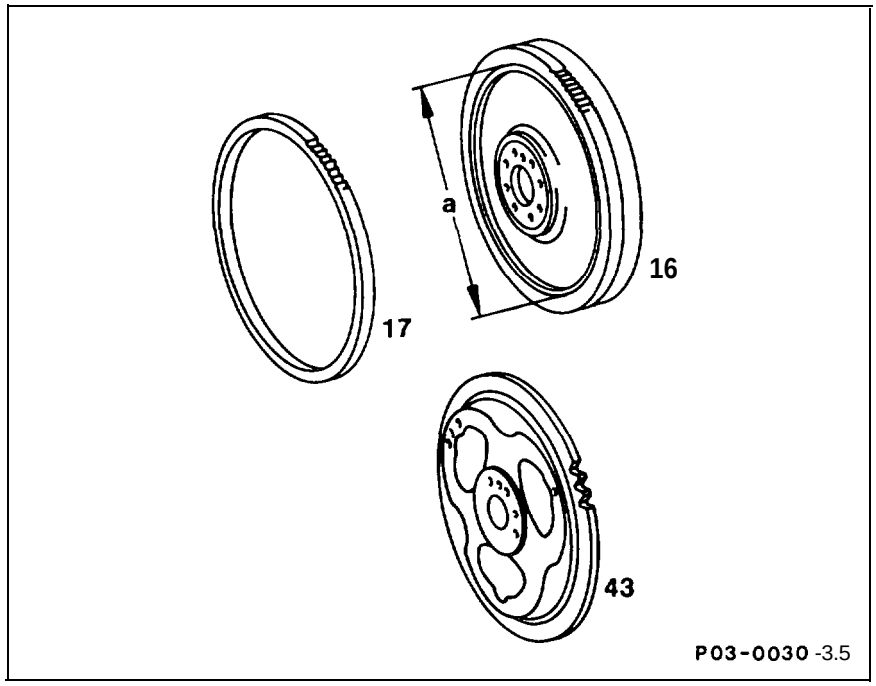
Engine		102.985
Distance a		19.4 – 19.5 mm
Distance b	when new	16.6 mm
	up to for repairs	15.5 mm
Permissible axial runout at clutch face or clutch flange face		0.05 mm

Notes
The two-mass flywheel cannot be machined and is only available as a complete replacement part.
Flywheels for manual transmissions which have scorch marks, scoring or cracks in the clutch face, should be machined by precision turning.

If grooves or cracks are deeper than the maximum permissible material removal, the flywheel must be replaced.
If the clutch face A is machined, the mounting face B must be machined by the same amount in order to maintain the distance a.
The size b must be maintained as a minimum when performing repairs.
The flywheel must be properly clamped for machining to ensure that the permissible axial runout of 0.05 mm is not exceeded.
After machining, the clutch face must not show any shrink holes or chatter marks.

03-430 Replacing ring gear on flywheel

Preceding work:
Removing flywheel (03-410).



Ring gear (17)	Drill old ring gear and snap open with a chisel or heat rapidly and then remove immediately. Heat new ring gear to 220 °C and fit onto the flywheel immediately. Pay attention to instruction. Lateral runout at ring gear max. 0.4 mm.
Flywheel (16)	Centering collar dia. (a) for ring gear 275,31–275,39 mm. Clean contact surface of ring gear at flywheel before installation on ring gear.
Flex plate (43)	This ring gear is welded on and cannot be replaced. Replace driven member complete.

Commercial accessories

Temperature measuring chalk Colour No. 2815/220 (white) Thermochrom	e. g. AW Faber-Castell D-8504 Stein bei Nürnberg

Notes

The ring gear is hardened. For this reason, do not exceed a temperature of 220 °C (yellow annealing colour) at any point when heating. This is only reliably possible by using a heating plate or heating oven.
Use a temperature measuring chalk corresponding to the instructions if possible.
Only use a flame in exceptional cases.
Coat only the inside of the ring gear for this purpose.
After replacing a ring gear, the flywheel does not need to be balanced.

To avoid damage to the ring gear, a ring gear with axially chamferred teeth was installed for a brief period to vehicles with automatic transmission.

Standard implementation: April – July 1986 standard

Model	Engine	Engine End No.	
		Manual transmission	Automatic transmission
201.028	102.985		033406 – 038268