
Crankshaft assembly 03



03 Crankshaft assembly

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03-3 10 Checking, renewing and tightening connecting rod bolts

Dimensions of connecting rod bolt

Part no.	Thread dia.	Necked-down shank dia. c when new (Fig. item 1)	Minimum necked-down shank dia. c
601 038 01 71	M 9 x 1	7.4-o. 1	7.1

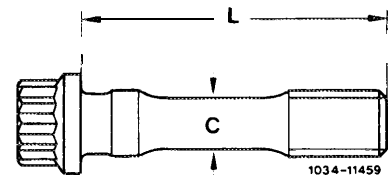
Tightening connecting rod bolt

Initial torque	30 + 5 Nm
Angle of rotation torque	90-1 00"

Checking

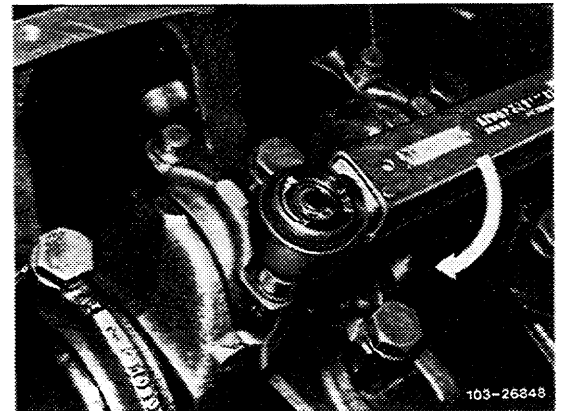
- 1 Measure minimum necked-down shank dia. prior to re-use.

Note: If the minimum necked-down shank dia. of 7.1 mm is attained or less, renew connecting rod bolt.



Tightening

- 2 Lubricate threads and screw head contact area.
- 3 Tighten connecting rod bolt to 30 Nm initial torque and 90–100° angle of rotation torque.



Note: Estimate angle of rotation. For this purpose, place adjustable torque wrench **in release position** (locked) into plug-in ratchet. Position adjustable torque wrench with plug-in ratchet lengthwise in relation to engine and keep turning until it is transverse in relation to engine.

03-313 Reconditioning and squaring connecting rods

Data

Center of connecting rod bearing bore to center of connecting rod bushing bore	engine 601.911	<u>148.97</u> 149.03
	engine 60 1.92 1	<u>144.97</u> 145.03
Width of connecting rod (B) at connecting rod bearing bore and connecting rod bushing bore		<u>23.835</u> 24.165
		<u>5 1.600</u> 51.619
Basic bore for connecting rod bushing	standard dimension	<u>29.500</u> 29.521
	repair stage	_____
Connecting rod bushing OD	standard dimension	<u>29.560</u> 29.600
	repair stage	_____
Connecting rod bushing ID		<u>27.018</u> 27.024
		0.004
Roughness of connecting rod bushing, inside		0.004
Permissible offset of connecting rod bearing bore in relation to connecting rod bushing bore with reference to 100 mm length		0.1
Permissible deviation of parallel axle alignment: Connecting rod bearing bore in relation to connecting rod bushing bore with reference to 100 mm length		0.045
Permissible difference in weight of complete connecting rods within one engine		5 g
Tightening torque		
Connecting rod bolts	initial torque	30 + 5 Nm
	angle of rotation	90-1 00"

Special tool

Torque wrench, single-arm, emitting signal, with plug-in ratchet, 1/2" square, 25-130 Nm



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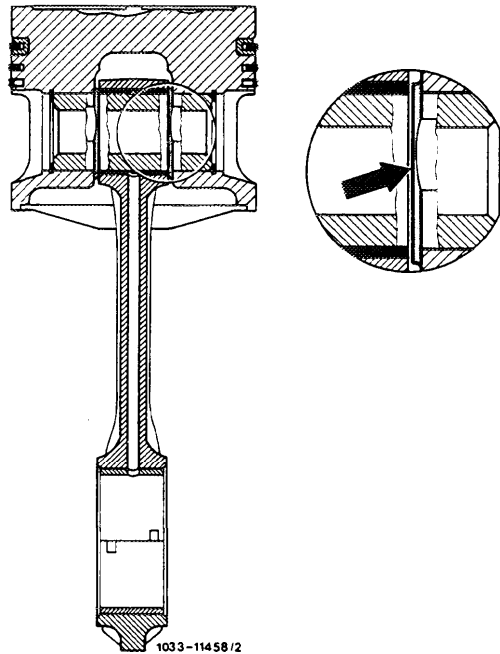
Conventional tool

Connecting rod straightener

e.g. Hahn & Kolb, D-7000 Stuttgart model BC 503

Note

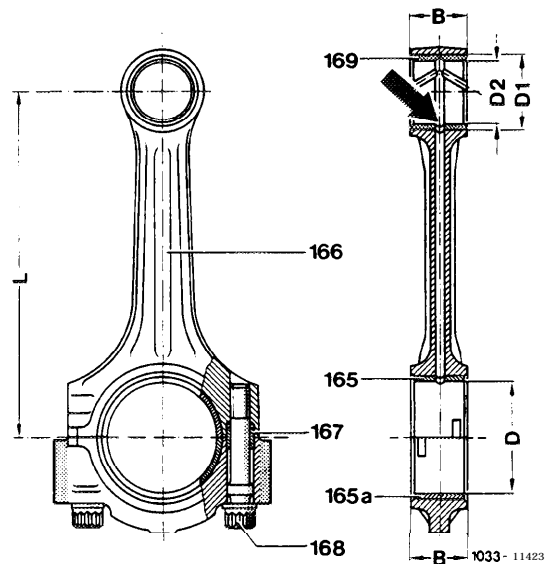
End play of connecting rods is not limited at crankshaft journals, but at piston pin eyes (piston-guided connecting rods). For this purpose, thrust surfaces (arrow) are cast onto piston pin eyes.



Connecting rod bearing and connecting rod bushing bores (**B**) are of similar width.

A weight compensation is attached at left and right on connecting rod bearing cap.

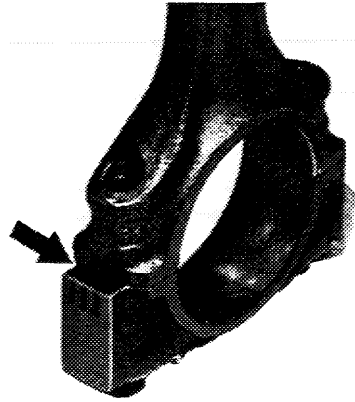
Only connecting rods of similar weight may be installed in one engine.



Connecting rods, which have become overheated as a result of bearing damage (blue coloring), may no longer be used.

Connecting rod and connecting rod bearing cap are marked together. There should be no transverse score marks and notches on connecting rod shaft.

As a spare part, connecting rods with machined connecting rod bushing are available.

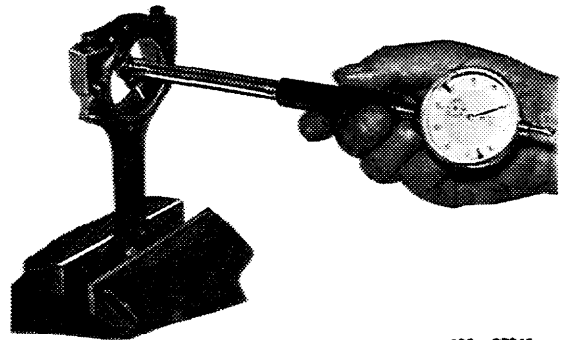


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Reconditioning

- 1 Check connecting rod screws and renew, if required (03-310).
- 2 Mount connecting rod bearing caps. For this purpose, lubricate threads and screw head contact surface and tighten to $30 + 5$ Nm.

- 3 Measure connecting rod bearing basic bore. At a basic bore which exceeds the value of 51.619 mm or is conical, touch up bearing cap at its contact surface on a surface plate up to max. 0.02 mm.

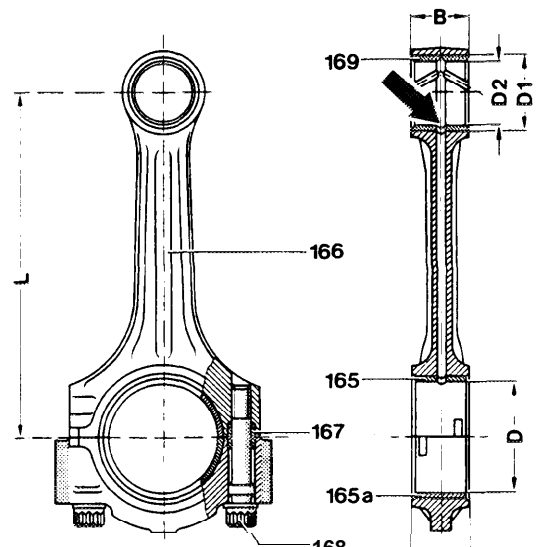


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- 4 Press in new connecting rod bushing in such a manner that the oil bores are in alignment (arrow).

Pressing-in pressure 2450 N.

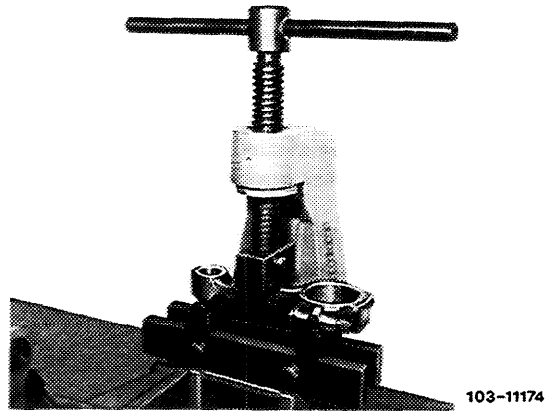
- 5 Machine or ream connecting rod bushing.
- 6 Touch up lateral thrust surfaces of connecting rod on surface plate.



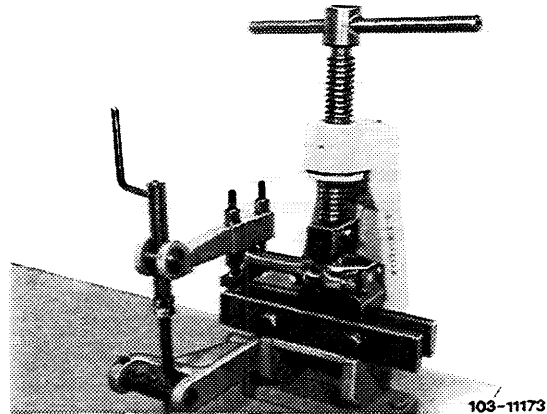
Squaring

7 Square connecting rod with a connecting rod tester.

8 Align connecting rod bearing bore in relation to connecting rod bushing bore (parallel alignment).



9 Check offset of connecting rod bearing bore in relation to connecting rod bushing bore and correct, if required.



Association piston – cylinder

Engine	Piston code number	Group code letter	Normal dimension std (standard)	
			piston dia.	cylinder dia.
601.911	01	A	86.970-86.976	87.000-87.006
		X	above 86.975-86.983	above 87.006-87.012
601.921	04	B	above 86.982-86.988	above 87.012-87.018

Piston stand out

Distance between piston crown and cylinder crankcase parting surface	standout max. 0.96 standout min. 0.73
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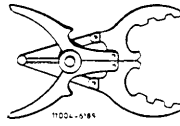
Test values	when new	wear limit	
Piston clearance	0.017-0.043	0.12	
Difference in weight of pistons in one engine	6 g	10 g	
Piston pin dia.	26.995-27.000		
Piston pin clearance	in connecting rod bushing	0.018-0.029	
	in piston	0.004-0.015	
Connecting rod in piston (end play)	0.083-0.314		
Gap clearance of piston rings	groove 1	0.20-0.40	1.5
	groove 2	0.20-0.40	1.0
	groove 3	0.20-0.40	1.0
Side clearance of piston rings	groove 1	0.090-0.120	0.20
	groove 2	0.050-0.080	0.15
	groove 3	0.030-0.065	0.1

Tightening torque

Connecting rod screws	initial torque	30 + 5 Nm
	angle of rotation torque	90-1 00"

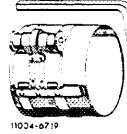
Special tools

Spreaders for piston rings



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Clamping strap for piston rings

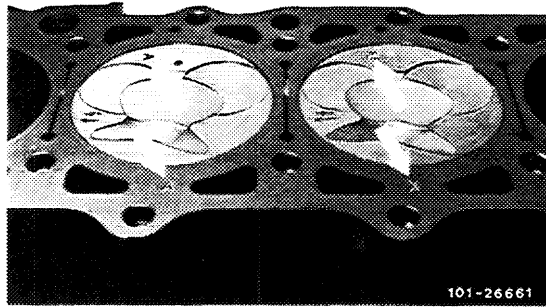


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Note

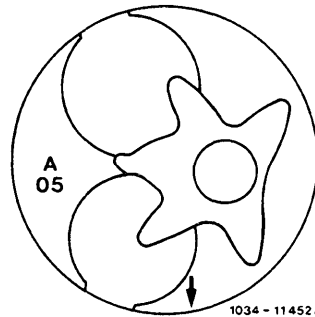
The group code letter A, X or B, the piston code number 05 or 06 and the driving direction arrow are punched into piston crown.

The group code letter is also punched into cylinder crankcase parting surface.

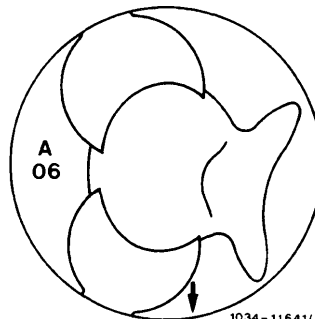


For repairs, only pistons with group code letters "X" are available. These pistons are also for installation in cylinder bores with group code letters "A" or "B".

In the event of repairs, hone cylinder bores according to dimensions of available pistons "X" plus piston clearance.



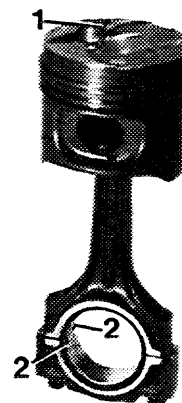
Engine 601.911



Engine 601.921

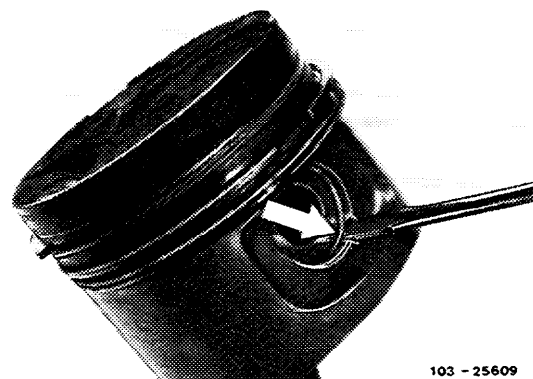
Removal

- 1 Remove connecting rod with piston in upward direction.



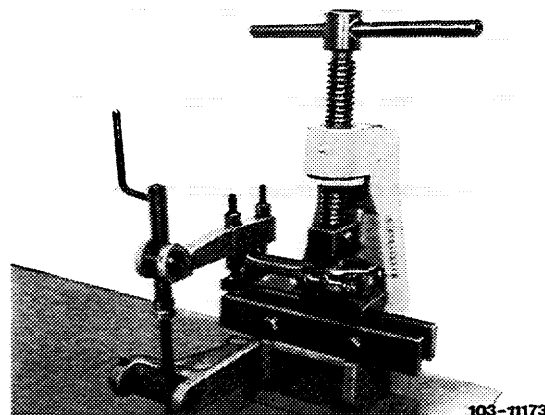
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- 2 Remove piston pin circlip and push out piston pin.



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



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Installation

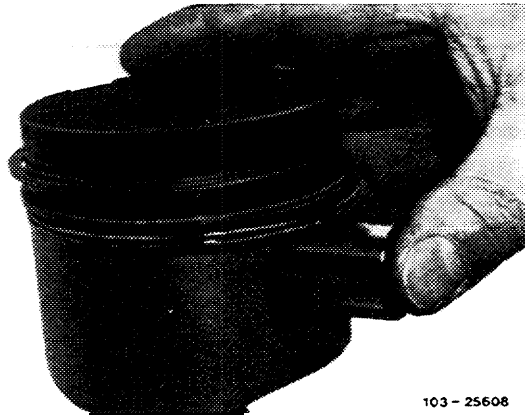
- 4 Place piston on connecting rod in such a manner that arrow (1) points in driving direction and locking grooves (2) in connecting rod to lefthand engine side.

Attention!
Do not heat pistons.



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5 Push in piston pins provided with engine oil manually.

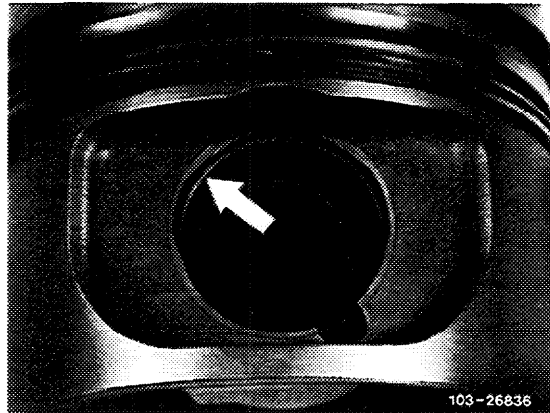


6 Insert piston pin circlip into groove.

Check piston rings for easy operation.

When installing used pistons, check piston rings for gap and side clearance.

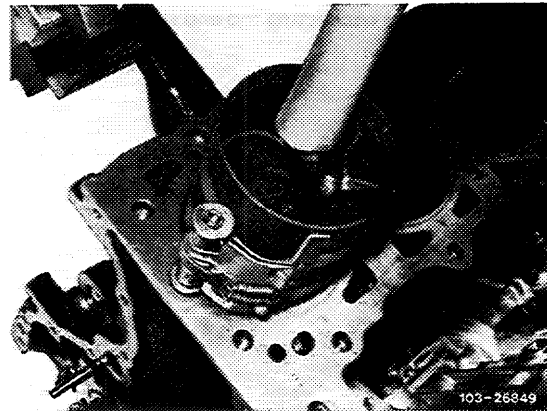
7 Lubricate cleaned cylinder bores, connecting rod bearing journals, connecting rod bearing shells and pistons.



8 Distribute gaps of piston rings uniformly along piston circumference.

9 Mount piston ring clamping strap and introduce pistons.

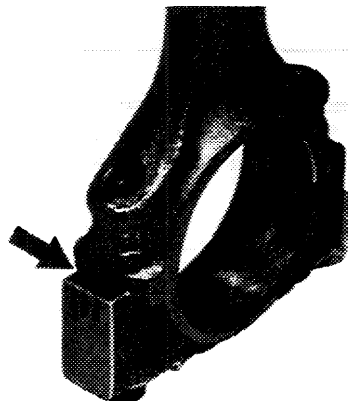
Arrow in piston crown should point in driving direction.



10 Mount connecting rod bearing caps with code numbers (arrow) in relation to each other on connecting rod. Lubricate threads and screw head contact surface of connecting rod screws and tighten to 30 Nm and $90-100^\circ$ angle of rotation torque.

11 Rotate crankshaft and check clearance between connecting rod and crankshaft.

12 Measure distance between piston crown and cylinder crankcase parting surface in TDC position of pistons (refer to Table).



03-318 Checking and reconditioning of crankshaft

Data

Crankshaft normal dimension and repair stages	Crankshaft bearing journal dia.	Fitted bearing Associated thickness of thrust washers	Width of journal	Crankpin dia.	Crankpin width
Standard dimension	<u>57.950</u> 57.965	2,15	<u>26.52</u> 26.50	47.950 47.965	<u>27.96</u> 28.04
			2.20		<u>26.62</u> 26.60
1st repair stage	<u>57.700</u> 57.715	2.25 or 2.35 or 2.40	<u>26.72</u> 26.70	<u>47.700</u> 47.715	up to 28.30
2nd repair stage	<u>57.450</u> 57.465		or	<u>47.450</u> 47.650	
3rd repair stage	<u>57.200</u> 57.215		or	<u>47.200</u> 47.215	
4th repair stage	<u>56.950</u> 56.965		or	<u>46.950</u> 46.965	
Permissible deviation of crankshaft journals and crankpins from true				0.005	
Permissible conicity of crankshaft journals and crankpins				0.01	
Permissible deviation of flywheel flange from true				0.02	
Permissible axial runout of fitted bearing				0.02	
Fillets	on crankshaft bearing journals			2.5 to 3.0	
	on crankpins			3.0 to 3.5	
Permissible deviation of crankshaft bearing journals from true when mounted in outer crankshaft bearing journals			journal II, IV	0.07	
			journal III	0.10	
Scleroscope hardness of crankshaft journals and crankpins				55-74	
Permissible unbalance of crankshaft				15cmg	

Special tool

Impact hardness tester



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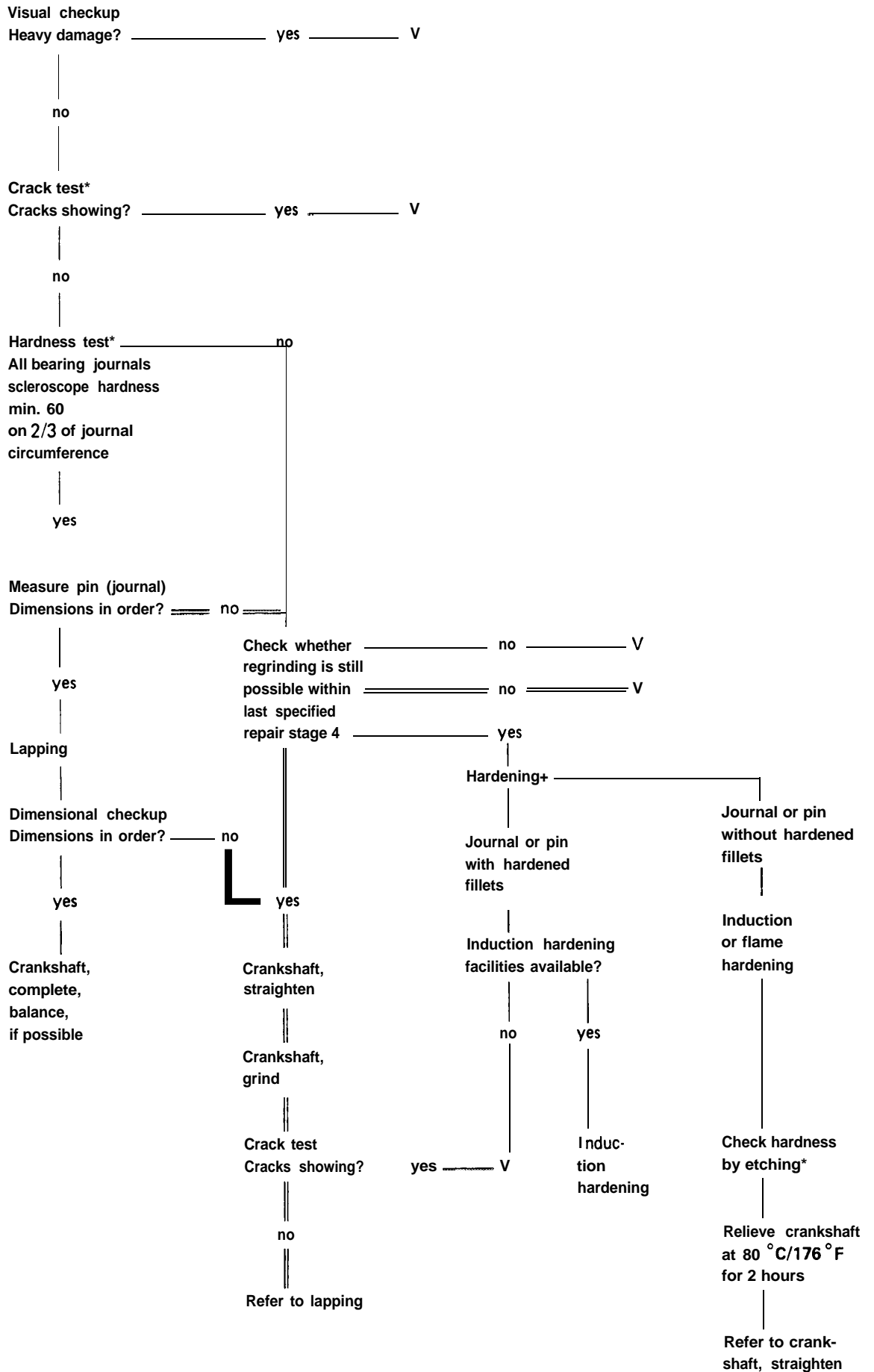
Note

When testing and reconditioning crankshafts, proceed in sequence of diagram shown below.

Diagram

* Refer to section "Explanations concerning diagram".

V = scrap.



Explanations concerning diagram

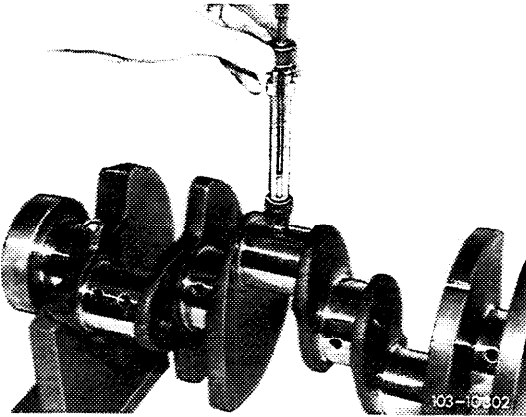
Crack test

Clean crankshaft. Bearing journals should be free of oil and grease.

Magnetize crankshaft and apply fluorescent powder (fluxing).

A color penetration method may also be used (immersion in bath or using spray can).

Agent: Paint or fluorescent powder,
cleaning agent,
developer



Hardness test

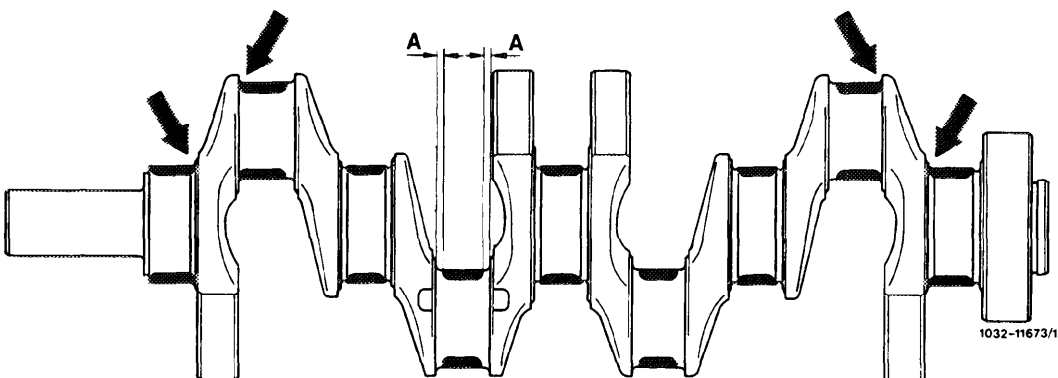
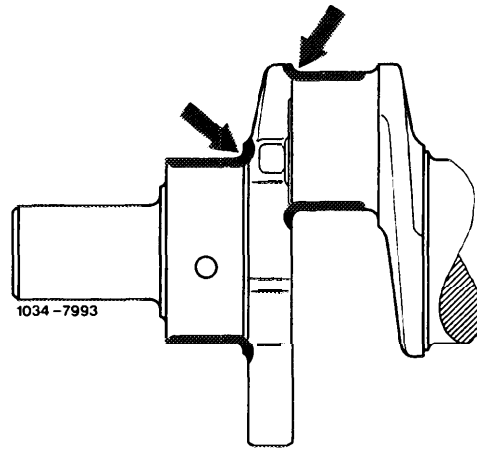
Test hardness with impact hardness tester (scleroscope hardness).

Minimum hardness of 55 should be available on 2/3 of journal (pin) circumference.

Hardening

Pins without hardened fillets can be inductance-hardened or flame-hardened. On the other hand, journals and pins with hardened fillets (arrows) should be inductance-hardened on principle. If this cannot be done, scrap crankshaft.

When hardening journals and pins without hardened fillets, the distance A between hardened runout and fillets radius (5-6 mm) must be maintained.



Checking the hardening results

For perfect hardening, check adjustment of hardening equipment by means of metallographic etching (grinding).

These tests can be made with test hardenings on scrapped crankshafts.

Check hardening by etching surface of journals or pins with a 2 % solution of alcoholic nitric acid (HNO_3).

No dark spots should appear on journal or pin surface.

Unhardened fillets will become dark.

Hardened fillets, on the other hand, should be as bright as the surface of pin or journal.

A journal or pin which has already passed metallographic inspection may be used for comparison.

Then carefully wash off nitric acid with alcohol.

Protection against corrosion

Crankshafts which are not immediately installed again should be lubricated with engine initial operation oil (SAE 30).

03-320 Mounting of crankshaft

Data

Crankshaft standard dimension and repair stages	Crankshaft bearing journal dia.	Fitted bearing Associated thickness of thrust washers	Crankshaft journal widths	Crankpin dia.	Crankpin width
Normal dimension	<u>57.950</u> 57.965	2.15	<u>26.52</u> 26.50	<u>47.950</u> 47.965	<u>27.96</u> 28.04
		2.20	<u>26.62</u> 26.60		
1st repair stage	<u>57.700</u> 57.715	2.25	<u>26.72</u> 26.70	<u>47.700</u> 47.715	up to 28.30
2nd repair stage	<u>57.450</u> 57.465	or	or	<u>47.450</u> 47.650	
3rd repair stage	<u>57.200</u> 57.215	2.35	<u>26.92</u> 26.90	<u>47.200</u> 47.215	
4th repair stage	<u>56.950</u> 56.965	or	or	<u>46.950</u> 46.965	

Basic bore and bearing play	Crankshaft bearings	Connecting rod bearings
Basic bore dia.	<u>62.500</u> 62.519	<u>51.600</u> 51.619
Basic bore width on fitted bearing	<u>22.00</u> 21.97	—
Connecting rod width	—	<u>23.835</u> 24.165
Permissible out-of-true of basic bore	0.01	
Permissible conicity of basic bore	0.01	
Bearing play, radial	when new	0.03 I-0.073 ¹⁾
	wear limit	0.08
Bearing play, axial	when new	0.10-0.25
	wear limit	0.30
		0.12-O-26
		0.50

1) For radial clearance, try for mean value.

Bearing shells	Wall thickness crankshaft bearings	Width of bearing shells	Thickness of fitted bearing thrust washers	Wall thickness connecting rod bearings
Normal dimension	2.25	17.30-17.60	2.15 or 2.20	1.80
1st repair stage	2.37		2.25	1.92
2nd repair stage	2.50		or	2.05
3rd repair stage	2.62		2.35	2.17
4th repair stage	2.75		or	2.30
			2.40	

Tightening torques		Nm
Crankshaft bearing bolts		90
Connecting rod screws	initial torque	30 + 5
	angle of rotation torque	90–100°
Screw M 18 x 1.5 x 50 on crankshaft		370 + 40
Necked-down screws for flywheel or driven plate	Initial torque	30-40
	angle of rotation torque	90-l 00"

Special tools

Torque wrench, single-arm, with ratchet,
3/4" square, 150-800 Nm



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Torque wrench, single-arm, emitting signal,
with plug-in ratchet, 1/2" square, 25-130 Nm



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Puller for crankshaft timing gear



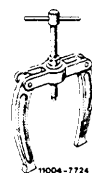
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Detent



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Countersupport for internal puller



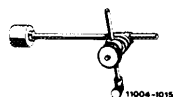
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Internal puller 14.5-18.5 mm
for radial ball bearings



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Dial gauge holder for measuring
end play



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Note

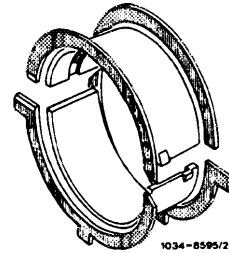
Engine removed and disassembled.

Main oil duct in cylinder crankcase open (01-130).
Oil ducts in cylinder crankcase and in crankshaft
carefully cleaned.

Check crankshaft for cracks, dimensional accuracy
hardness and concentricity (93-318).

The 3rd crankshaft bearing is provided with thrust
washers.

These thrust washers absorb the axial forces of crank-
shaft.

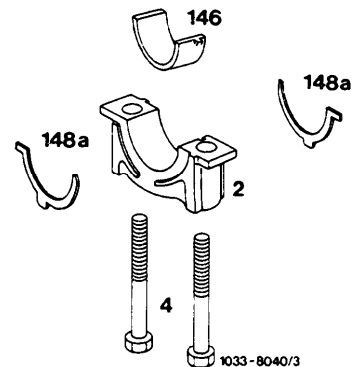
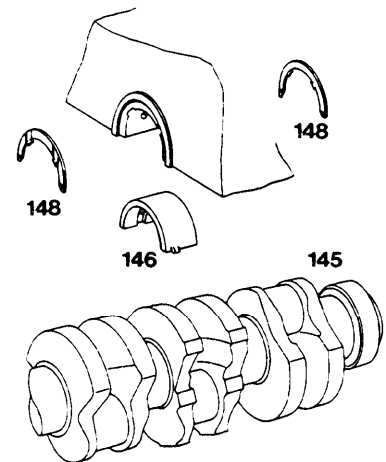


The thrust washers (148 and 148a) installed in
cylinder crankcase and in bearing cap on both sides
are of different shape.

As a torsion lock and to prevent assembly faults, the
thrust washers in bearing cap are provided with two
holding lugs, of which the outer one is installed off
center.

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

Associate thrust washers to respective journal or pin
widths (Table).



- 2 Bearing cap
- 4 Screws M 12 x 6 0
- 145 Crankshaft
- 146 Bearing shell
- 148 Upper thrust washer
- 148a Lower thrust washer

Install thrust washers of the same thickness on both sides on principle.

Regrinding of thrust washers is not permitted.

As replacement parts, thrust washers are available in sets only. One set comprises an upper and a lower thrust washer (148 and 148a).

Thrust washer sets

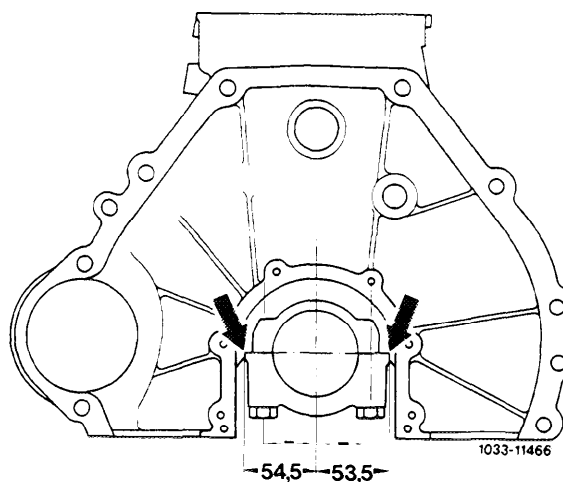
Thickness in mm	Set part no.
2.15	601 030 00 62
2.20	601 030 01 62
2.25	601 0300262
2.35	6010300362
2.40	601 030 04 62

Association of crankshaft bearings, installation of crankshaft

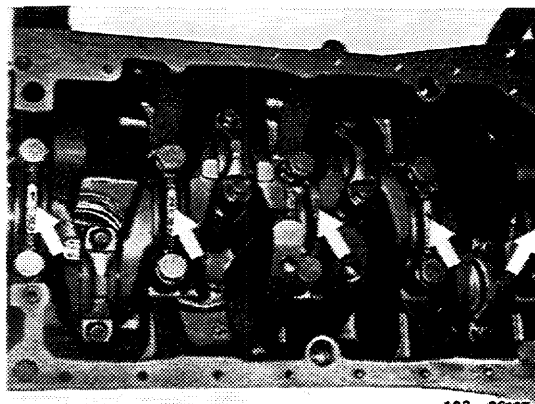
1 Install crankshaft bearing cap.

Note: All bearing caps are fitted laterally into crankcase (arrows) and are fastened with 2 screws M 12 x 60 each.

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



The bearing caps are additionally identified from the front to the rear with the code numbers 1, 2, 3, 4 and 5 (arrows), and should not be mixed up.

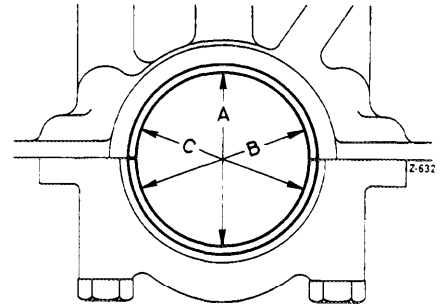


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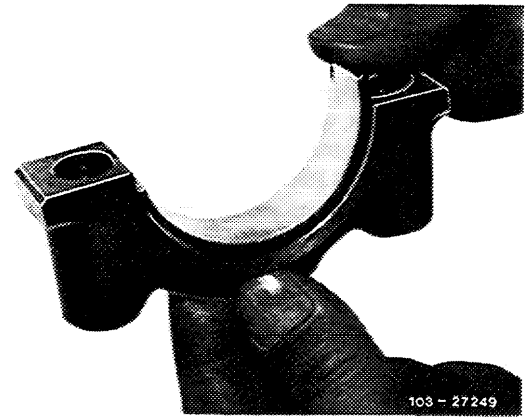
2 Lubricate screws for crankshaft bearing caps and tighten to 90 Nm.

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

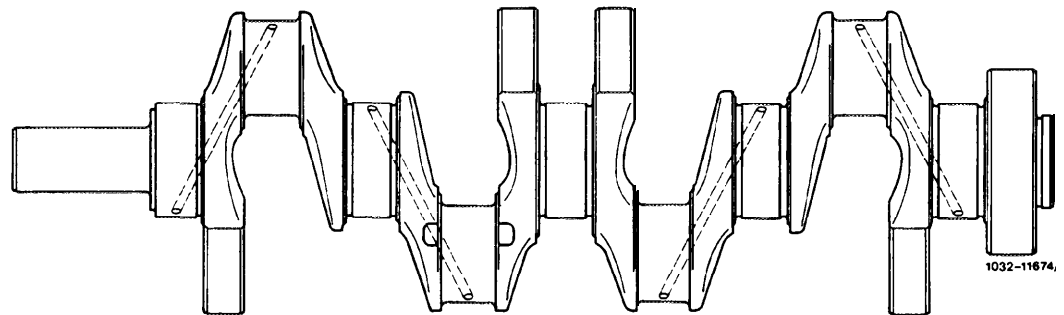
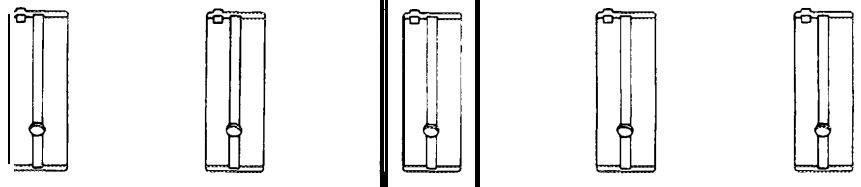
If the specified value of a basic bore is exceeded, touch up bearing cap at its parting surface on a surface plate up to max. 0.02 mm.



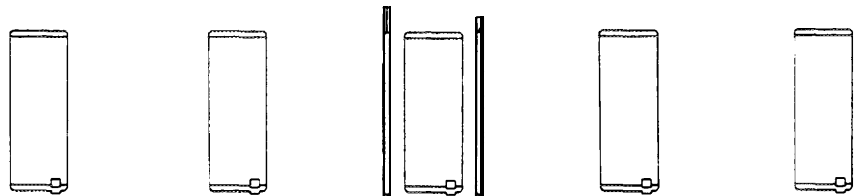
4 Insert crankshaft bearing shells, mount bearing caps, tighten screws to 90 Nm.



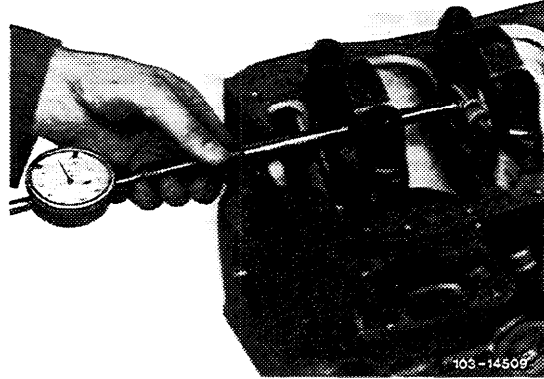
Housings



Caps

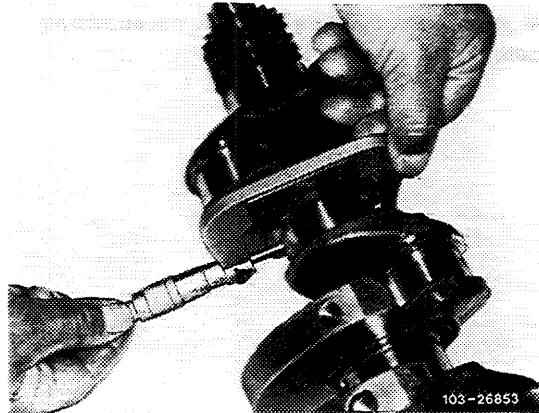


5 Measure bearing dia. and write down.

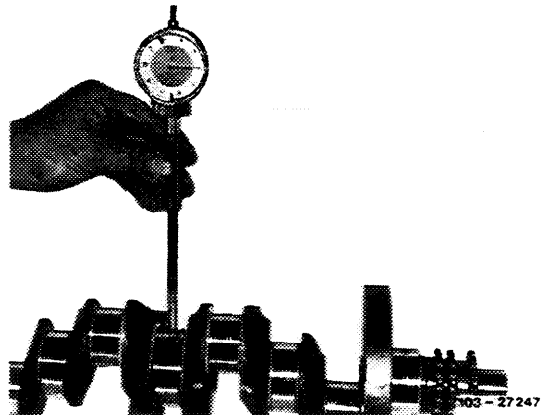


6 Measure crankshaft bearing journals, find crankshaft bearing radial play.

Note: The bearing play can be corrected by exchanging bearing shells, while trying for mean value of specified bearing play. Crankshaft bearing shells without color code are thicker than those with blue color code, while taking into account that the thickness of walls without and with color code may overlap.



7 Measure width of fitted bearing journal and associate pertinent thrust washers (refer to Table, section Data).

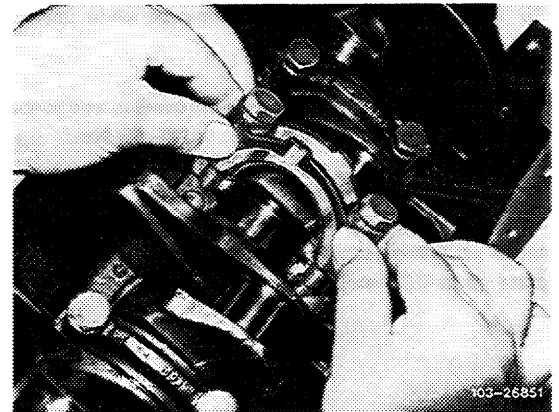
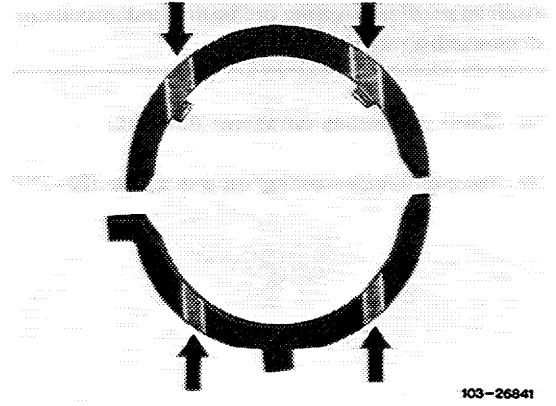


8 Lubricate bearing shells and crankshaft with engine oil and install crankshaft.

9 Provide thrust washers with oil and slip into grooves on fitted bearing (crankcase).

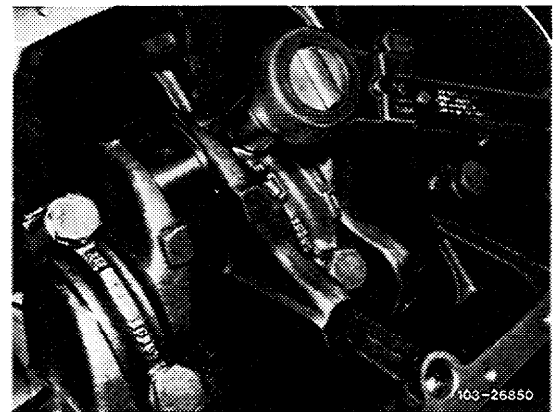
Attention!

Make sure that the two oil grooves (arrows) in thrust washers are pointing toward crankshaft webs.



10 Mount crankshaft bearing caps.

11 Tighten bearing caps to 90 Nm.



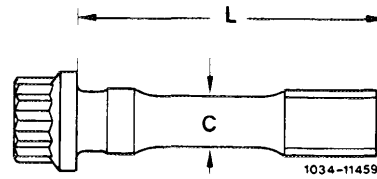
12 Measure crankshaft end play.

13 Rotate crankshaft manually and check for easy running.

Association of connecting rod bearing and installation of connecting rod

14 Check connecting rod screws (03-310).

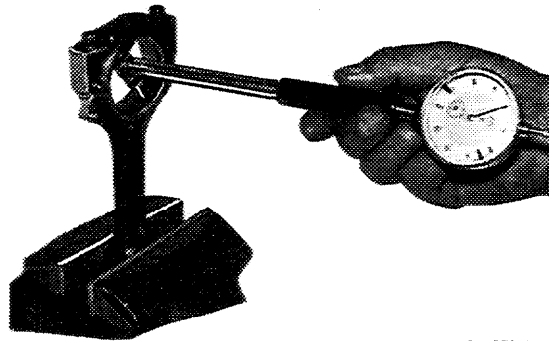
15 Recondition connecting rod and square (03-313).



16 Mount connecting rod bearing caps, while paying attention to identification.

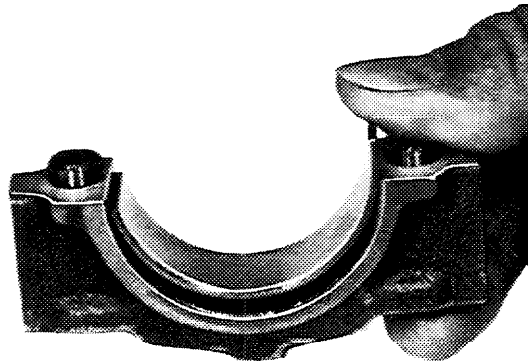
Lubricate connecting rod screws on threads and screw head contact surface and tighten to 30-40 Nm.

17 Measure basic bore in two directions. If one basic bore exceeds the specified value or if it is conical, touch up bearing cap at its parting surface on a surface plate up to 0.02 mm.



103 - 27245

18 Insert connecting rod bearing shells, mount connecting rod bearing caps together with bearing shells and tighten connecting rod nuts to 30-35 Nm.

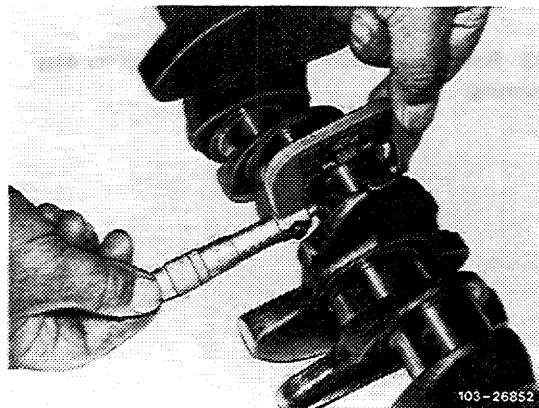


103 - 26742

19 Measure bearing dia. and write down.

20 Measure crankpins, find connecting rod bearing radial play.

Note: The bearing play can be corrected by changing bearing shells, trying for medium value of specified bearing play. Crankshaft bearing shells without color coding are thicker than those with blue color coding, while taking into account that the thickness of walls without and with color coding may overlap.

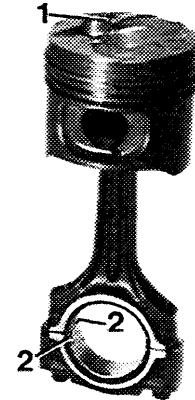


103-26852

21 Attach piston to connecting rod (03–316).

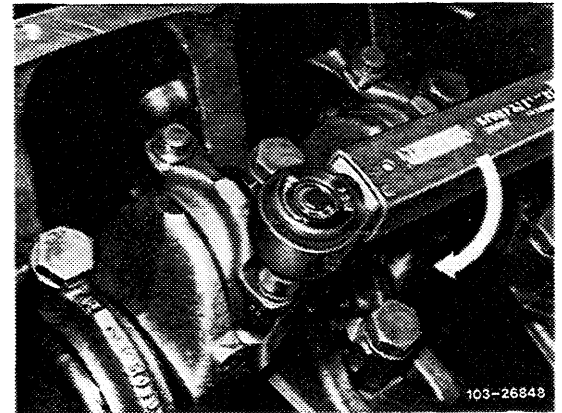
22 Provide bearing shells, crankshaft, pistons and cylinder walls with engine oil, install connecting rod with piston (03–316).

Pay attention to identification.



103–26983

23 Tighten connecting rod screws to 30 + 5 Nm initial torque and 90–100° angle of rotation torque.



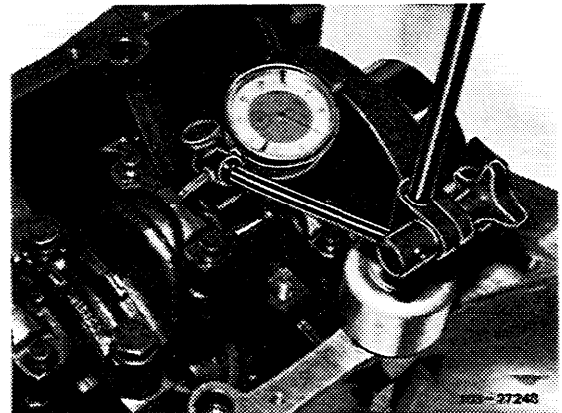
103–26848

24 Measure connecting rod bearing end play, while displacing connecting rod directly at piston pin. Check clearance of connecting rods in relation to crankshaft.

Attention!

Disassemble oil pump and clean, renew, if required. Renew oil pressure relief valve. Disassemble oil filter and clean.

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



103–27248

03-324 Replacing front crankshaft radial sealing ring

Tightening torques	Nm
Screw M 18 x 1.5 x 50 on crankshaft	370 + 40
Screws M 8 x 12 pulley to hub	25

Special tools

Torque wrench, single-arm, with ratchet, 3/4" square, 150-800 Nm		001 5897421 00
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Puller for hub		601 589 08 33 00
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Detent		601589024000
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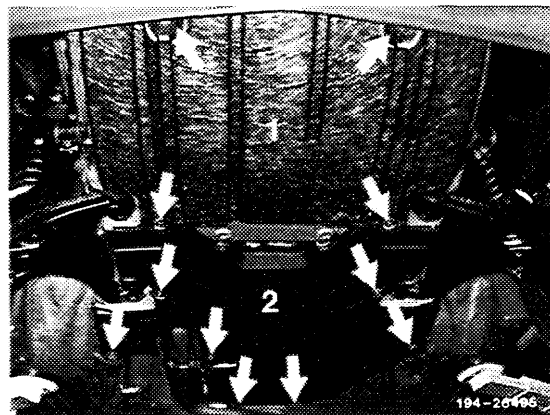
Sleeve for pushing in radial sealing ring, front		601 589031400
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Conventional tool

Adapter 3/4" square socket to 1/2" square head	e.g. Hazet, D-5630 Remscheid order no. 1058 R-I
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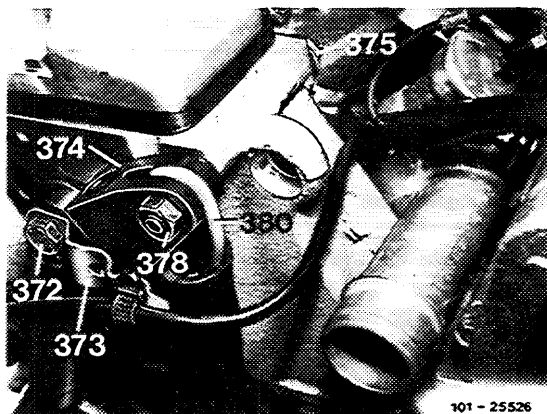
Removal

- 1 Remove noise capsule.
- 2 Remove radiator (20-420).



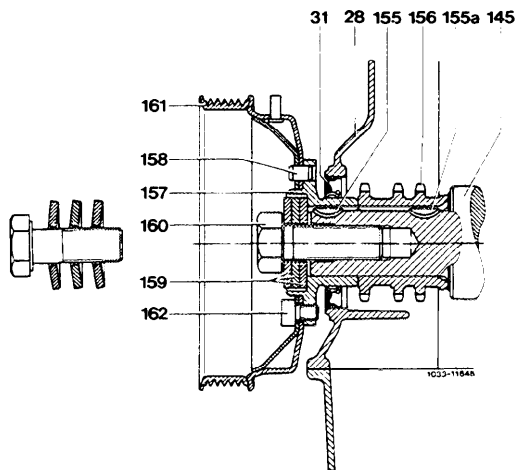
3 Slacken V-belt and remove. Unscrew flange nut (378) for this purpose. Insert a mandrel into spring tensioning lever (374) and relieve hex. screw (375) in relation to draw spring (380) until spring can be pushed back in direction of intake manifold.

Release spring tensioning lever and remove V-belt.



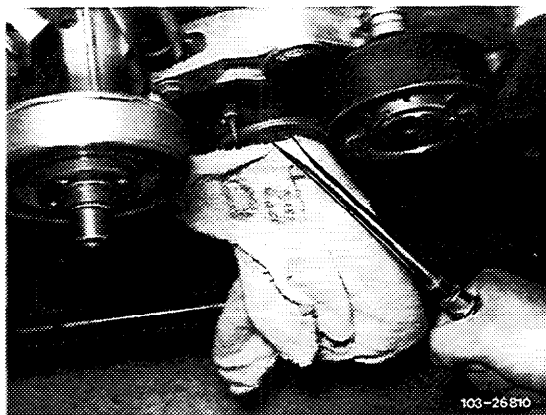
4 Unscrew pulley (161) and pull off flange (157) (03-341).

- | | |
|-----------------------------|-----------------------------------|
| 28 Timing housing cover | 159 Cup spring |
| 31 Radial sealing ring | 160 Screw
M 18 x 1.5 x 50 |
| 145 Crankshaft | 161 Pulley |
| 155 Woodruff key, hub | 162 Combination
screw M 8 x 12 |
| 155a Woodruff key, sprocket | |
| 156 Sprocket | |
| 157 Hub | |
| 158 Cylindrical pin | |



5 Push out radial sealing ring by means of a screwdriver. Make sure that crankshaft journal and mounting bore are not damaged.

6 Check hub (157) for score marks of radial sealing ring, renew hub, if required.



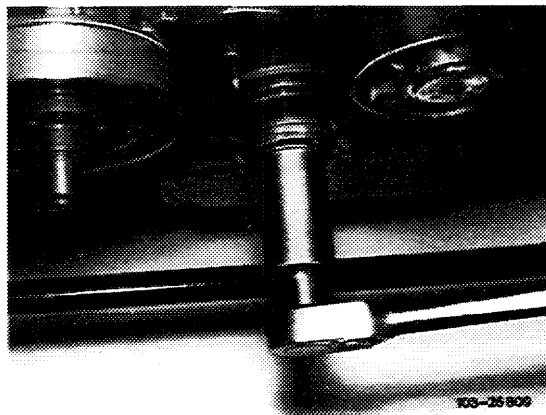
Installation

7 Deburr mounting bore for radial sealing ring and clean.

8 Moisten new radial sealing ring on sealing lip with oil and insert with inserting tool.

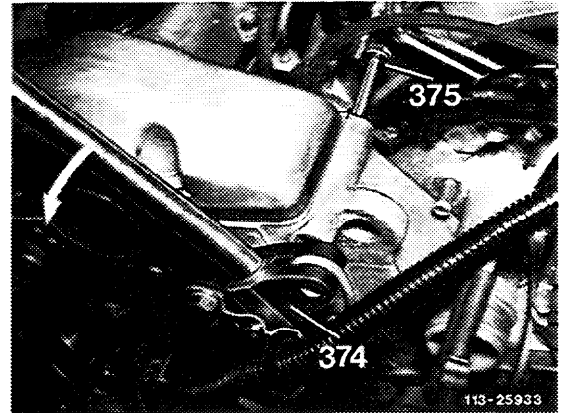
Attention!

The radial sealing ring should be accurately square in relation to crankshaft journal, since otherwise no perfect sealing will be obtained.



9 Install hub and pulley (03-341).

10 Mount V-belt and engage spring tensioning lever. For this purpose, swivel spring tensioning lever (374) with a mandrel against draw spring to the left until screw (375) can be slipped through spring tensioning lever. Position collar nut and tighten.



11 Install radiator (20-420).

12 Install noise capsule.

03-327 Replacing rear crankshaft radial sealing ring

Tightening torques

Nm

Necked-down screw for flywheel or driven plate

initial torque

30 + 10

angle of rotation torque

90-1 00"

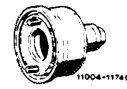
Special tools

Detent



601589024000

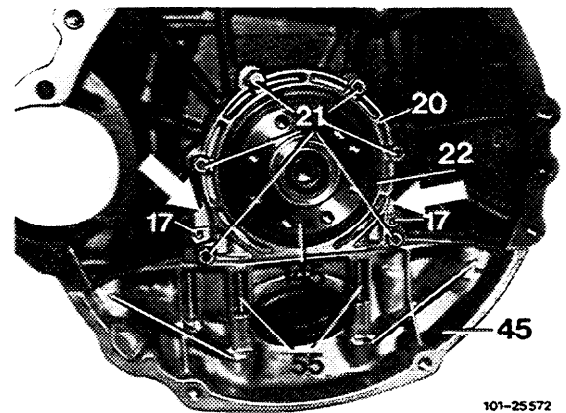
Installation tool for rear crankshaft radial sealing ring



601589034300

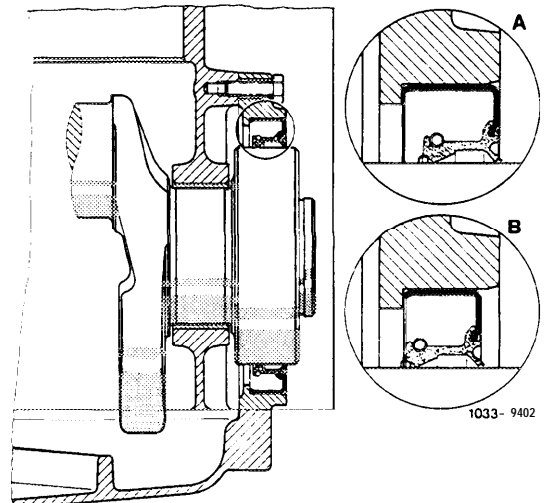
Note

The radial sealing ring (22) is seated in an end cover screwed to cylinder crankcase and oil pan and located by means of 2 clamping sleeves (17).



101-25572

The sealing lip of repair radial sealing ring is offset by 3 mm in inward direction, so that it cannot run in a groove which may have been generated by series-radial sealing ring on crankshaft flange.



1033-9402

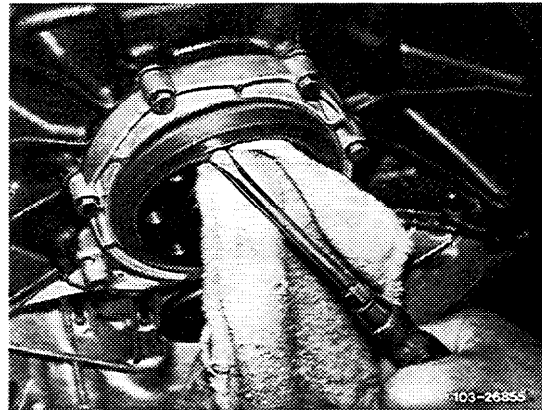
**A Radial sealing ring (series)
B Repair radial sealing ring**

Renewing

- 1 Remove transmission (26-020 or 27-600).
- 2 Remove flywheel or driven plate (03-410).

- 3 Push radial sealing ring out of end cover by means of a screwdriver.

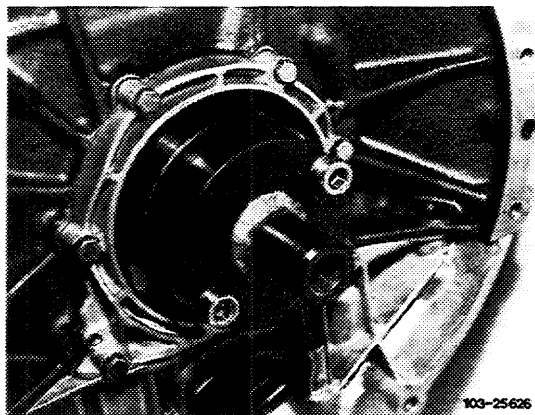
Make sure that the crankshaft flange and the end cover are not damaged. Cover crankshaft flange with a rag.



- 4 Check running surface for radial sealing ring on crankshaft flange for damage.

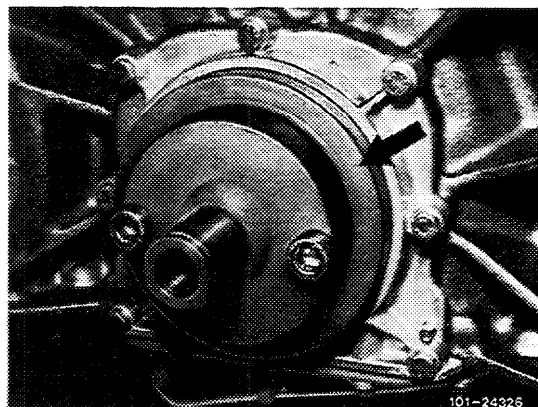
- 5 Clean mounting bore for radial sealing ring and deburr, if required.

- 6 Screw inner part of installation tool to crankshaft flange.



- 7 Fill new radial sealing ring between sealing and dust lip with 1 g or 1 cc longterm grease. Do not fill in more oil, since otherwise the presence of leaks might be simulated.

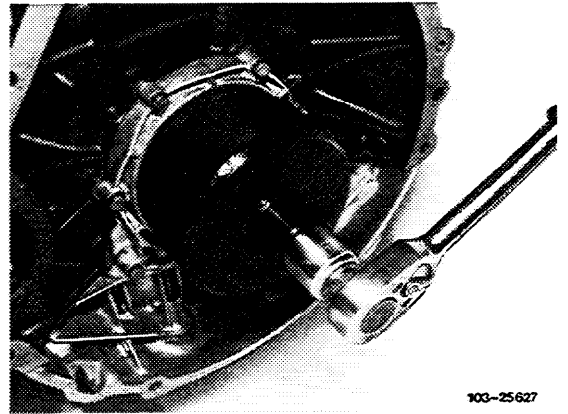
- 8 Slip radial sealing ring (arrow) over inner part of installation tool.



9 Push radial sealing ring up to stop into end cover by means of outer part of installation tool.

Attention!

Radial sealing ring should be seated accurately square in end cover for perfect sealing.



103-25627

10 install flywheel or driven plate (03-410).

11 Check for leaks with engine running.

12 install transmission (26-020 or 27-600).

03-330 Removal and installation of radial ball bearing in crankshaft

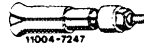
Special tools

Countersupport for internal puller



000589333300

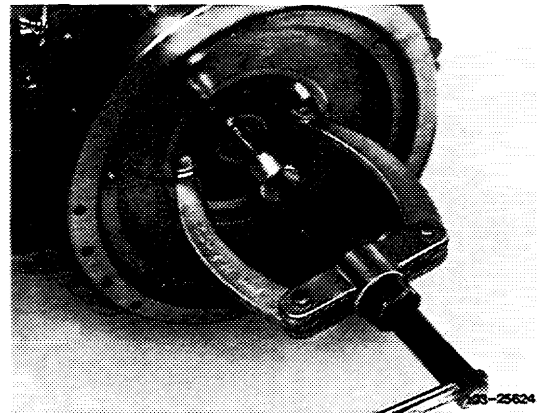
Internal puller 14.5-18.5 mm



000589253300

Removal

- 1 Remove transmission (26-020 or 27-600).
- 2 Pull ball bearing out of crankshaft together with countersupport and internal puller.



Installation

- 3 Coat new ball bearing with glue "Loctite 241", part no. 002 989 94 71 and knock into crankshaft on outer race by means of a suitable mandrel.
- 4 Install transmission (26-020 or 27-600).

03-341 Removal and installation of crankshaft pulley and hub

Tightening torques	Nm
Screw M 18 x 1.5 x 50 to crankshaft	370 + 40
Screws M 8 x 12 crankshaft pulley to hub	25

Special tools

Torque wrench, single-arm, with ratchet, 3/4" square, 150-800 Nm		001 5897421 00
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Detent		601 589 02 40 00
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Puller for hub		601589083300
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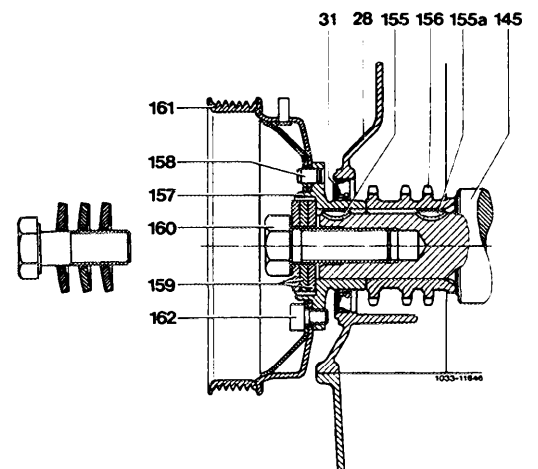
Conventional tool

Adapter 3/4" square socket to 1/2" square head	e.g. Hazet, D-5630 Remscheid order no. 1058 R-I
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Note

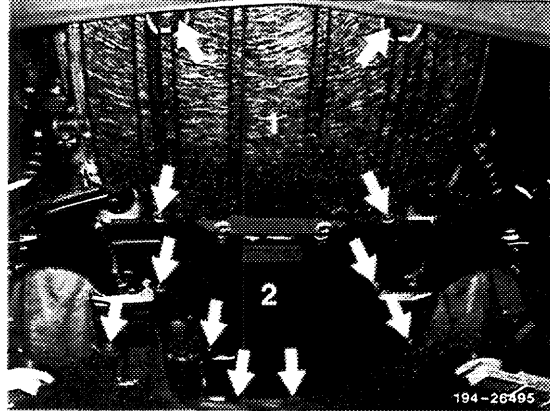
Engines 601 have no vibration damper and no balancing disk.

28 Timing housing cover	158 Cylindrical pin
31 Radial sealing ring	159 Cup spring
145 Crankshaft	160 Screw
155 Woodruff key for hub	M 18 x 1.5 x 50
155a Woodruff key for sprocket	161 Crankshaft pulley
156 Sprocket	162 Combination screw M 8 x 12
157 Hub	



Removal

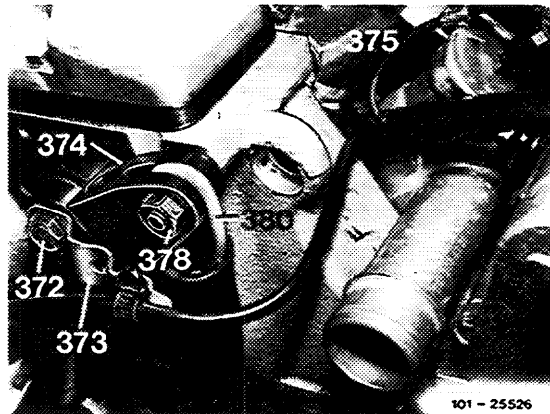
Remove noise capsule below.



2 Remove radiator (20-420).

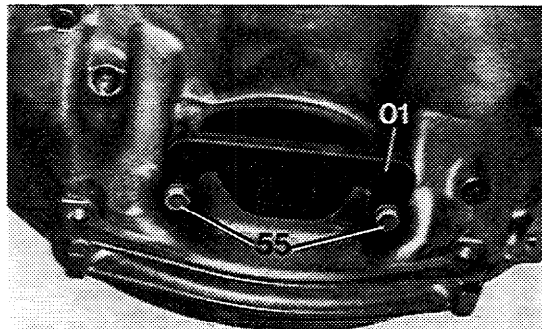
3 Slacken V-belt and remove. For this purpose, unscrew collar nut (378). Insert a mandrel into spring tensioning lever (374) and release hex. screw (375) opposite to draw spring (380) until spring can be pushed back in direction of intake manifold.

Release spring tensioning lever and remove V-belt.



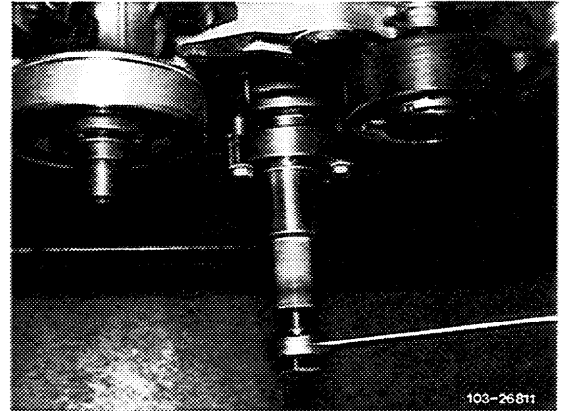
4 Remove crankshaft pulley.

5 Unscrew screw (160) on crankshaft. For this purpose, fasten detent, part no. 601 589 02 40 00, to oil pan.



6 Pull hub (157) from crankshaft journal.

Pull off hard-to-move hubs with puller.

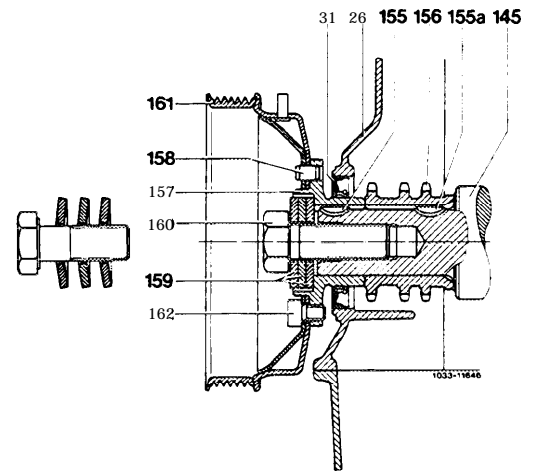


Installation

7 Slip hub (157) on crankshaft journal and tighten screw (160) to 370 + 40 Nm.

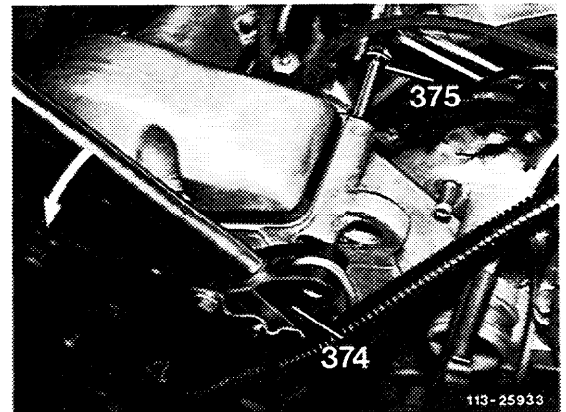
Make sure that woodruff key (155) and groove are in alignment.

Note: Install the three cup springs (159) with crown toward screw head.



8 Mount V-belt pulley, while paying attention to centering by means of cylindrical pin (158).




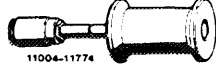
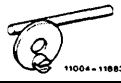

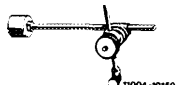
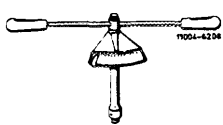
9 Mount V-belt and engage spring tensioning lever. For this purpose, swivel spring tensioning lever (374) with a mandrel against draw spring to the left until screw (375) can be slipped through spring tensioning lever. Position collar nut and tighten.



10 Install radiator (20-420).

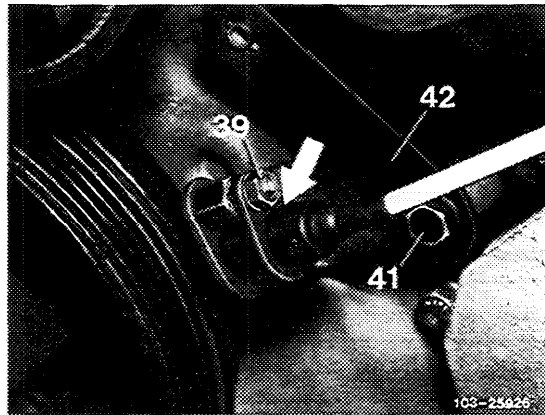
11 Install noise capsule.

03–345 Checking and correcting adjustment of TDC transmitter

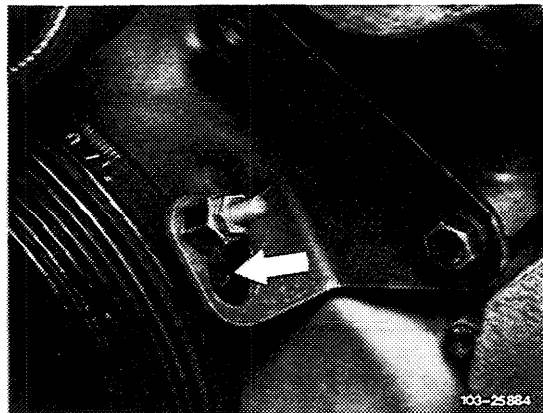
Tightening torques		Nm
Screws for cylinder head cover		10
Coupling nuts for injection lines (reference value)		1 0-20
Prechamber in cylinder head (threaded ring)		100 ± 10
Nozzle holder in prechamber		70 + 10
Special tools		
Box end wrench element, open, 14 mm, 1/4" drive, for coupling nut of injection line		000 589 77 03 00
Wrench element for threaded ring of prechamber		615589000700
Socket wrench element 27 mm, 1/2" square		001 589 65 09 00
Impact puller for prechamber		601 589 06 33 00
Locating device for holder of TDC transmitter		601 589 06 21 00
Measuring instrument for TDC and 20° after TDC		601 589 07 21 00
Dial gauge holder		3635890221 00
Torque wrench, double-arm, 3/8" square, 8-32 Nm		001 589 51 21 00
Conventional tool		
Dial gauge A 1 DIN 878	e.g. Mahr, D-7300 Esslingen order no. 810	

Note

The TDC-transmitter with holder is fastened to timing housing cover (arrow).



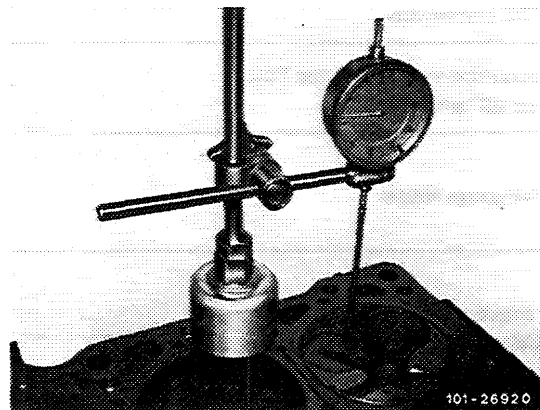
The pin in crankshaft pulley must be accurately under TDC transmitter (arrow) in crankshaft position 20° after TDC.



Adjustment of adjusting slide must be checked and corrected, if required:

- a) When renewing adjusting slide.
- b) When renewing crankshaft with hub or crankshaft pulley.
- c) When completing partial engines.

With cylinder head removed, the measuring pin of the dial gauge can be set directly on piston crown. For this purpose, place magnetic dial gauge holder on cylinder crankcase parting surface.

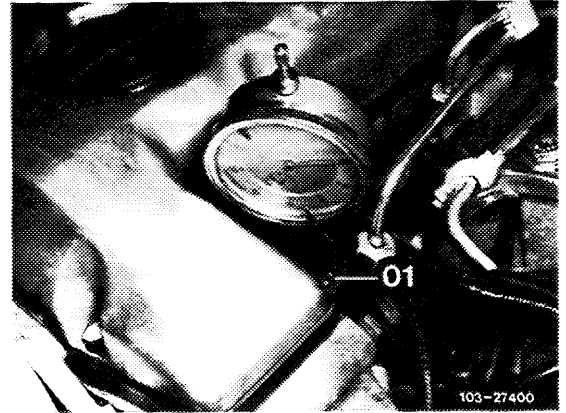


Checking

- 1 Remove radiator (20-420).
- 2 Remove cylinder head cover.
- 3 Set piston of 1st cylinder to ignition TDC of 1st cylinder.



- 4 Remove prechamber of 1st cylinder (01-417).
- 5 Screw measuring instrument into prechamber duct.
- 6 Place dial gauge at 2 mm preload on test mandrel.



- 7 Slowly rotate crankshaft in direction of rotation of engine until large needle of dial gauge stops (TDC position).

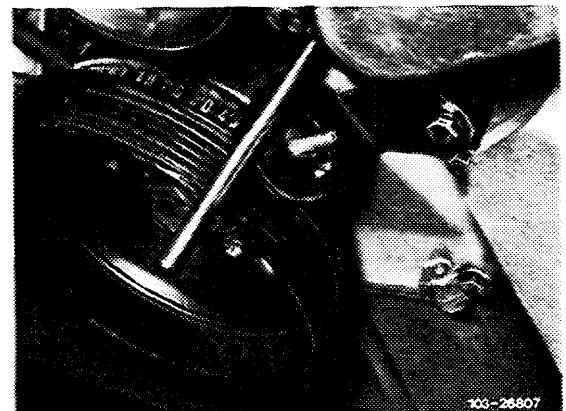
- 8 Loosen dial gauge and place measuring arm under 5 mm preload into test mandrel. Turn dial gauge scale until large needle points to zero.

- 9 Slowly turn crankshaft in direction of rotation of engine until on engine 601.911 the dial gauge has moved back by 3.22 mm and on engine 601.921 by 3.65 mm.

- 10 Place locating device into adjusting slide.

Pin in crankshaft pulley must engage in groove of locating device.

If pin is not engaging, correct position of adjusting slide.

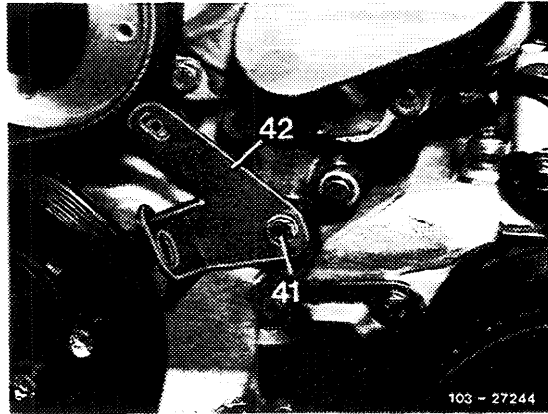


Correcting

11 Loosen adjusting slide (42) on screw (41) and displace until pin in pulley engages in groove of locating device.

12 Screw down adjusting slide.

13 Remove dial gauge and measuring instrument.



14 Install prechamber (01-417).

15 Install valve cover.

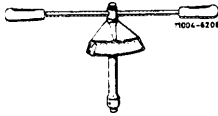


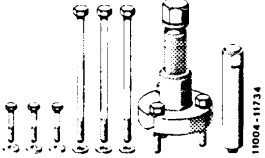
16 Install radiator.

17 Run engine, check for leaks.

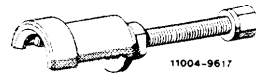
03-350 Removal and installation of crankshaft timing gear

Tightening torques		Nm
Screw M 18 x 1.5 x 50 to crankshaft		370 + 40
Screws for cylinder head cover		10
Screws M 8 x 12 for crankshaft pulley to hub		25
Oil drain plug to oil pan		30
Oil pan to cylinder crankcase	M 6	10
	M 8	25
Central screw for fan on coolant pump		25
Adjusting screw for front engine stop		130
Screws for engine carrier to engine mount		35 + 10
Cylinder head bolts M 8		25
Screws for timing housing cover	M 6	10
	M 8	25

Special tools

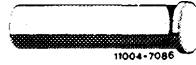
Torque wrench, double-arm, 1/4" square, 8-32 Nm		001 589 51 21 00
Torque wrench, single-arm, emitting signal, with plug-in ratchet, 1/2" square, 40-200 Nm		001 589 67 21 00
Torque wrench, single-arm, with ratchet, 3/4" square, 150-800 Nm		001 589 74 21 00
Puller for hub		601 589 08 33 00

Puller for crankshaft timing gear



601 589 07 33 00

Knocking-in mandrel for crankshaft timing gear



116589071500

Screwdriver with tommy handle for hex. socket screws 6 mm, 440 mm long



116589030700

Conventional tool

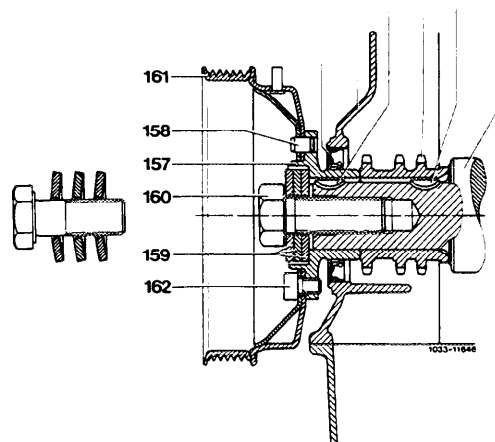
Adapter $3/4''$ square socket to $1/2''$ square head

e.g. Hazet, D-5630 Remscheid
order no. 1058 R-I

Layout crankshaft front

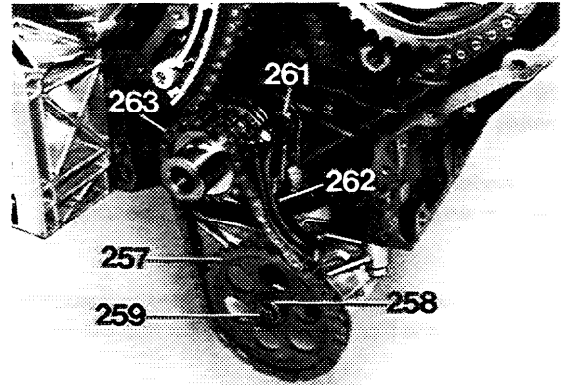
31 28 155 156 155a 145

- | | |
|-----------------------------|-----------------------|
| 28 Timing housing cover | 158 Cylindrical pin |
| 31 Radial sealing ring | 159 Cup spring |
| 145 Crankshaft | 160 Screw |
| 155 Woodruff key, hub | M 18x 1.5 x 50 |
| 155a Woodruff key, sprocket | 161 Crankshaft pulley |
| 156 Sprocket | 162 Combination screw |
| 157 Hub | M 8 x 12 |



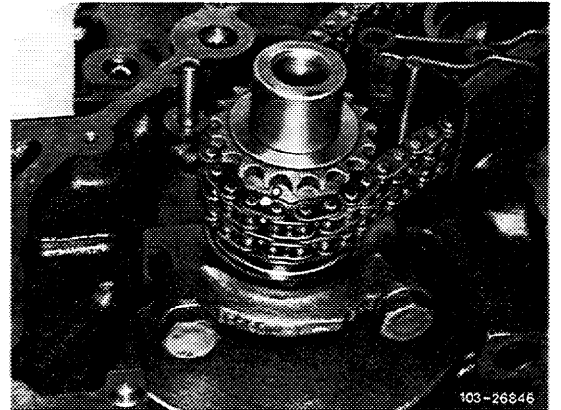
Removal

- 1 Remove timing housing cover (01-210).
- 2 Pull off clamp (262) and torsion spring (261).
- 3 Unscrew fastening screw (259) and remove oil pump sprocket (257).
- 4 Remove chain for oil pump drive.



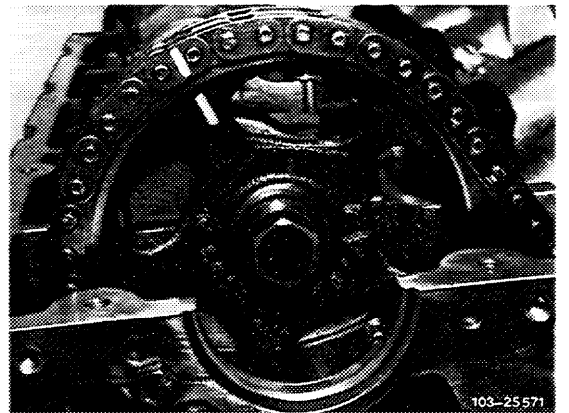
18-25635

- 5 Mark timing chain and crankshaft timing gear in relation to each other.



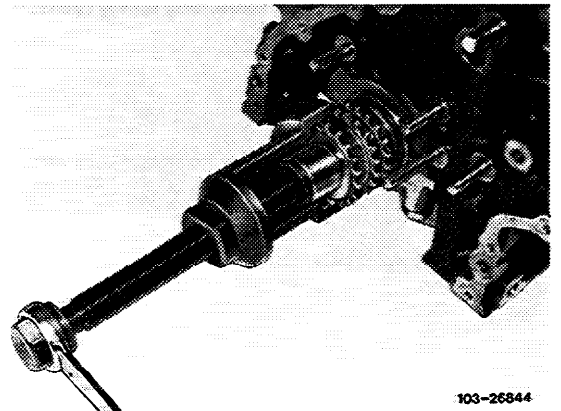
- 6 Mark timing chain and camshaft timing gear in relation to each other

- 7 Remove camshaft timing gear and let timing chain sag.



- 8 Pull off crankshaft timing gear with puller.

- 9 Check woodruff key in crankshaft for condition and renew, if required.



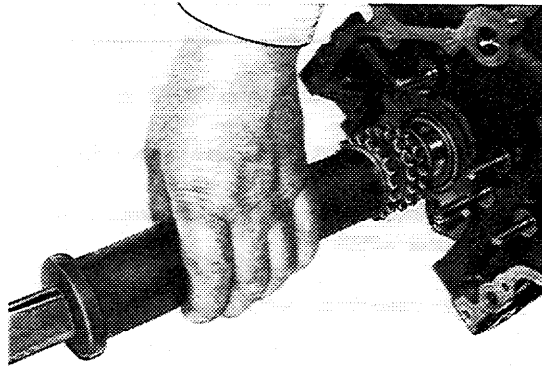
103-26844

Installation

10 Transfer color mark from old to new crankshaft timing gear.

11 Knock crankshaft timing gear with knocking-in mandrel on crankshaft. Pay attention to woodruff key.

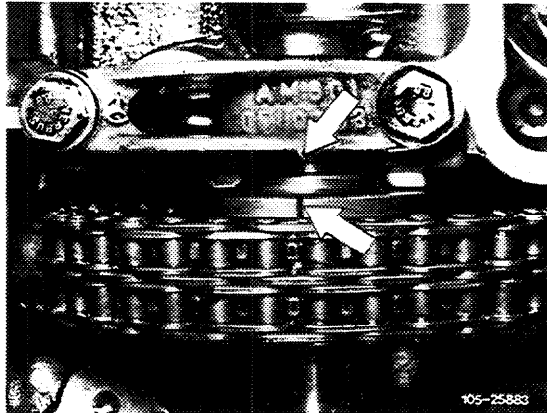
Note: For better location when knocking in crankshaft timing gear, the front woodruff key for hub can be inserted.



103-26843

12 Mount camshaft timing gear and timing chain, paying attention to marks.

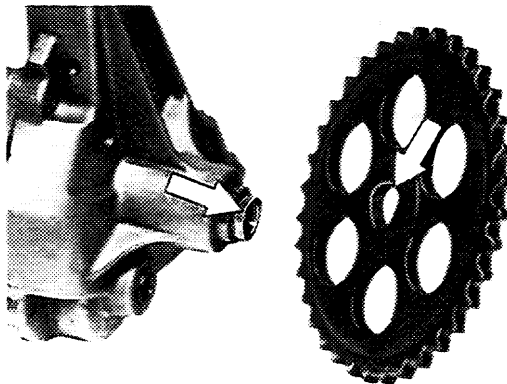
13 Keep turning crankshaft and check adjusting marks at TDC position of engine (arrows).



105-25883

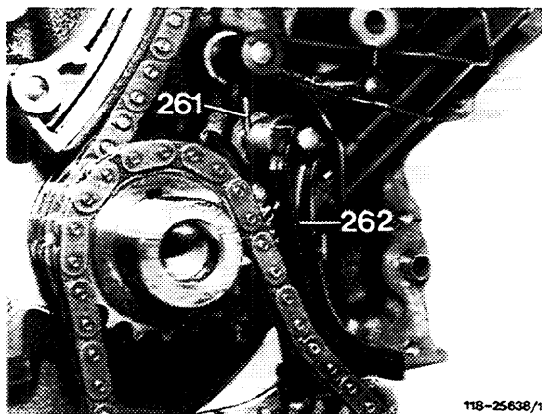
14 Mount chain for oil pump drive together with oil pump sprocket.

Note: Mount sprocket in such a manner that its crown is pointing toward oil pump and the three contact surfaces on the oil pump shaft coincide with those on the sprocket (arrows).



118-26004

15 Install clamp (262) and tensioning spring (261).



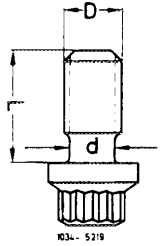
118-25638/1

-
- 16 Install timing housing cover (01–210).
 - 17 For further installation proceed vice versa.
 - 18 Run engine and check for leaks.

03-410 Removal and installation of flywheel and driven plate

Necked-down screw

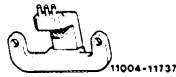

		manual transmission	automatic transmission
Part no.		1020320071	601 03201 71
Thread dia. D		M 10 x 1	
Necked-down dia. d	when new	8.5–0.2	
	min. dia.	8.1	
Length L	when new	22 ± 0.2	26 ± 0.2
	max. length	22.5	26.5



Tightening torque

Initial torque	30 + 10 Nm
Angle of rotation torque	90–100°

Special tools

Detent		601 589 02 40 00
Torque wrench, single-arm, emitting signal, with plug-in ratchet, 1/2" square, 25-l 30 Nm		001 589 66 21 00

Note

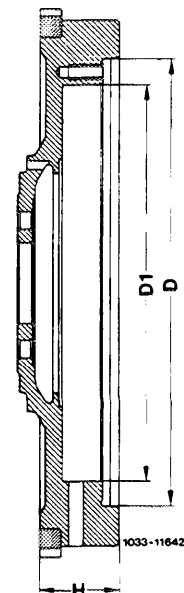
Weight and dimensions of flywheels of engines with manual transmission are similar.

Flywheels and driven plates of engines with automatic transmissions are identical on all engines.

Flywheels can be replaced without static or dynamic balancing.

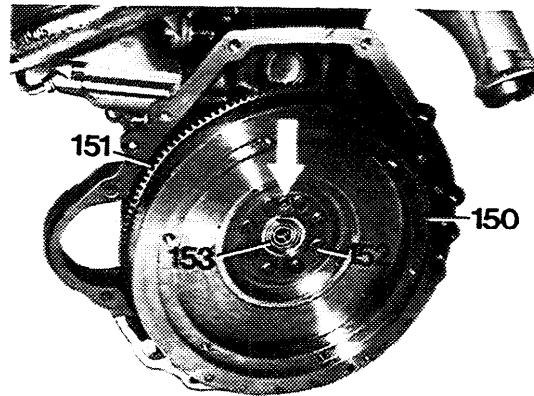
Engine 601

D 254.5 mm
D1 223 mm
H 57 mm



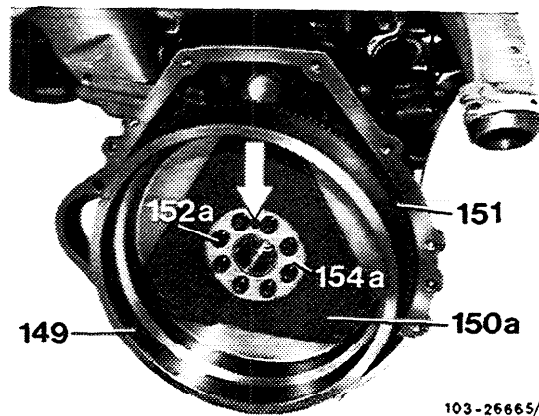
Fasten flywheel and driven plate to crankshaft in such a manner that the unused bores (arrow) on flywheel or on driven plate and spacing washer are in alignment with unused bore on crankshaft flange.

Vehicles with manual transmission



103-26328

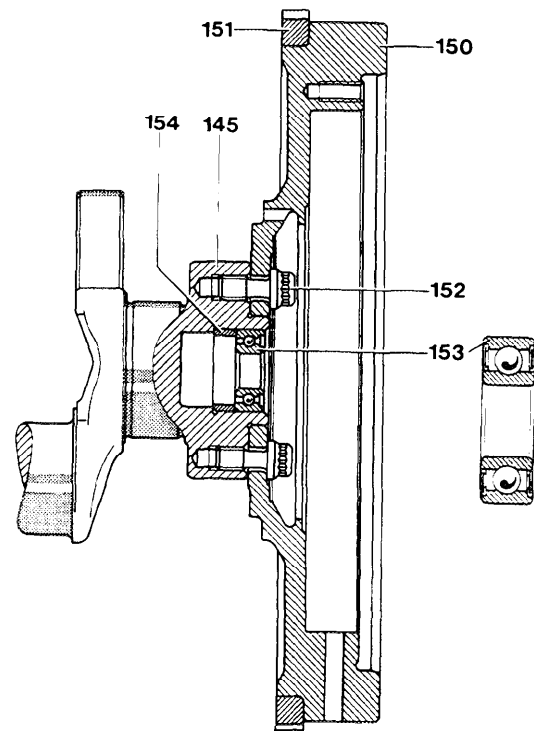
Vehicles with automatic transmission



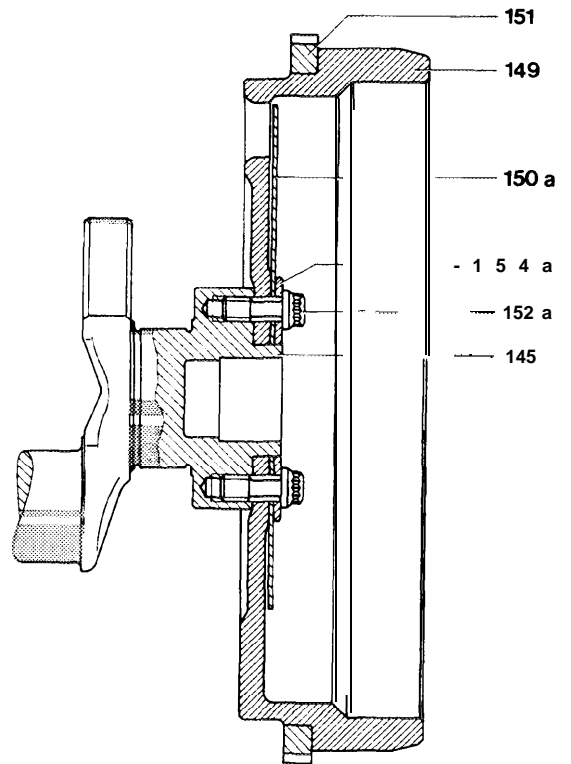
103-26665/2

Layout of flywheel for manual transmission

- 145 Crankshaft
- 150 Flywheel
- 151 Ring gear
- 152 Necked-down-screw
- 153 Ball bearing
- 154 Spacing ring



1033-11671/1



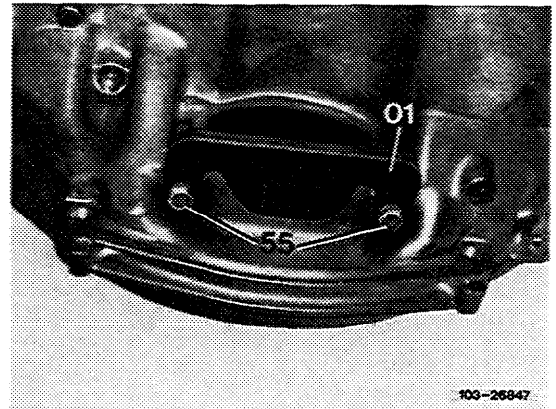
1033-11799/1

Layout of flywheel and driven plate for automatic transmission

- 145 Crankshaft
- 150a Driven plate
- 152a Necked-down screw
- 154a Spacing washer

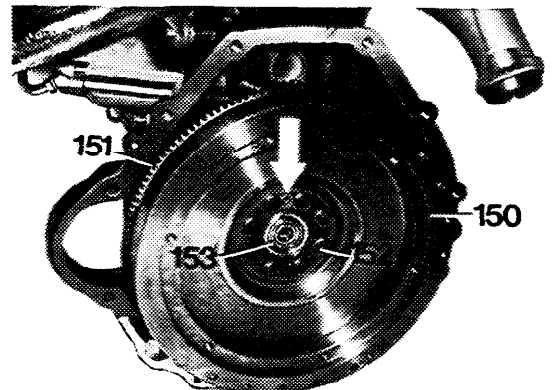
Removal

- 1 Remove transmission (26-020 or 27-600).
- 2 Fasten detent (arrow) to oil pan below.



103-26847

- 3 Unscrew necked-down screws (152) and remove flywheel, driven plate and spacing washer.



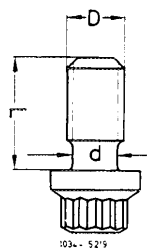
103-26328

Flywheel manual transmission

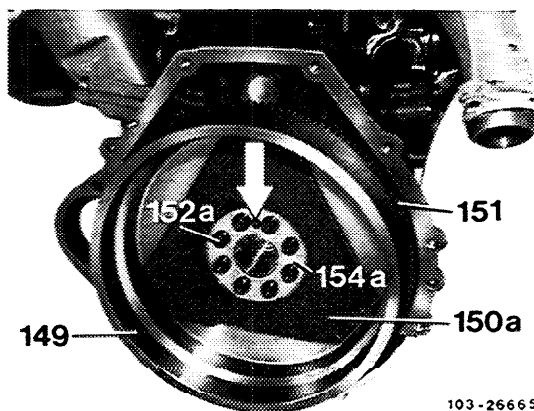
Installation

4 Measure necked-down dia. of necked-down screws.

If minimum dia. is attained, install new necked-down screws.



5 Position flywheel, driven plate and spacing washer on crankshaft journal in such a manner that the bores (arrow) are in alignment.



6 Screw in necked-down screws and tighten to 30 Nm initial torque and $90-100^\circ$ angle of rotation torque.

03-420 Refinishing of flywheel

Data

Engine	601	
Distance a	22.4-22.6	
Distance b	when new	16.6
	during repairs	up to
Permissible deviation from axial runout on clutch surface or clutch flange-on surface	0.05 mm	

Note

Flywheels for manual transmissions which are showing burnt spots, score marks or cracks on clutch surface, must be refinished by precision turning.

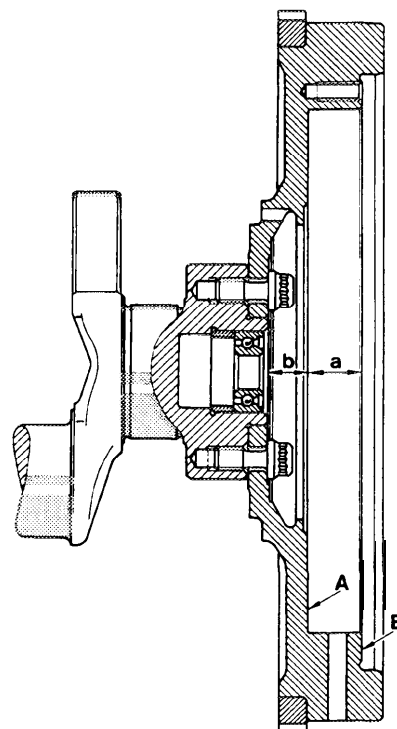
If score marks or cracks are deeper than the max. permissible material allowance, replace flywheel.

If the clutch surface A is refinished, also refinish fastening surface B by the same dimension to maintain distance a.

In the event of repairs, do not machine below dimension b.

For refinishing, clamp flywheel well, so that the permissible axial runout of 0.05 mm is not exceeded.

No cavities and chatter marks should be seen on clutch surface after refinishing.



1033-11688

03-430 Renewing ring gear of flywheel

Data

Axial runout on ring gear	max. 0.4
Centering flange dia. for ring gear	275.00-275.05
Shrinking-on temperature	220 °C
Annealing color	yellow

Conventional accessory

Temperature measuring chalk color no. 2815/220 (white) Thermochrom	e.g. AW Faber-Castell, D-8504 Stein bei Nürnberg
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Note

The ring gear is hardened. To protect hardness, the temperature for heating up ring gear should not exceed 220 °C at any point. This can be done reliably **only by means of a hot plate or a heating oven.**

An open flame may be used as an exception only. The flame should touch only the inside of the ring gear.

Following renewal of ring gear, the flywheel need not be balanced.

Renewal

- 1 Drill into old ring gear and break up with a chisel, or heat quickly and immediately remove.
- 2 Clean mounting surface of ring gear on flywheel.
- 3 Uniformly heat new ring gear on a hot plate or in a heating oven. For this purpose, use temperature measuring chalk in accordance with instructions whenever possible.
- 4 Mount heated ring gear immediately on flywheel.