Mercedes-Benz

Service

Service Manual
Engine 102

Mercedes-Benz of North America, Inc. · Montvale, NJ 07645

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Introduction

This service manual is the product of existing technical publications. Special care has been taken to provide accurate information on removal, disassembly, inspection, installation, and adjustment procedures, together with the necessary technical data for the particular job.

The material in this manual is divided according to the Mercedes-Benz Component Group System as outlined on the GROUP INDEX page. This page will quickly direct the reader to the Major Component Group. Each Major Component Group begins with a JOB INDEX listing all jobs within that group.

Mercedes-Benz of North America, Inc. recommends that repairs to, and maintenance of Mercedes-Benz automobiles be performed by **trained Mercedes-Benz personnel** at authorized Mercedes-Benz dealerships.

The information contained in this special publication is ordinarily issued by Mercedes-Benz of North America, Inc., in conjunction with supplementary service literature and special tools supplied **only to** its authorized dealers. The repair and maintenance procedures outlined herein are intended for use by **trained Mercedes-Benz service and dealership personnel. This** manual can also be useful for Mercedes-Benz owners in diagnosing vehicle systems and performing repairs. Supplementary service literature will not be provided with this publication, but may be contained in reprints of this service manual.

Please note that this manual has been compiled from various sources, some of which cover models other than the subject of this book. Always refer to the engine and vehicle identification table for model and component information.

Special tools required in performing certain service jobs are identified in the manual and are recommended for use. Any part numbers given are only used for identification and easier differentiation between individual components, and are not intended for ordering purposes.

If your Mercedes-Benz model differs from the specifications contained in the manual you select, consult your authorized Mercedes-Benz dealer.

Caution!

The proper performance of service and repair procedures is essential for both the safety of the mechanic and the safe and efficient operation of the vehicle. The use of incorrect service procedures and tools may greatly increase the risk of personal injury and render the vehicle unsafe. The procedures in this manual are described in such a manner that the service may be performed safely and accurately.

However, it is a general assumption that the reader is familiar with basic automotive repair procedures and Mercedes-Benz vehicles. You should not attempt to use this manual if this is not the case.

Mercedes-Benz of North America, Inc. assumes no liability for any damage to person or property caused by the utilization of this publication to effect maintenance or repair work on Mercedes-Benz automobiles.

MERCEDES-BENZ OF NORTH AMERICA, INC.
Service and Parts Literature

Complete Service Manual coverage for late model year Mercedes-Benz vehicles requires four individual manuals:

Service Manual, Engine
Service Manual, Chassis and Body
Service Manual, Automatic Climate Control
Electrical Troubleshooting Manual

Throughout these manuals, the vehicles are identified by their chassis and engine numbers. These numbers are made up of the first six digits of the respective serial number. For the actual location of chassis and engine numbers, see page 00-015/1. In cases where the repair instructions apply to all versions, only the first three digits of the respective number are referenced.

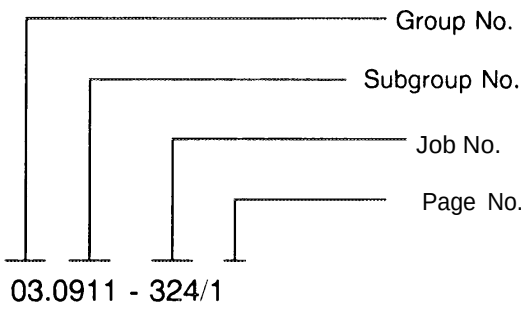
For example, chassis 124 applies to all 124 models. However, chassis 124.051 would apply only to model 300CE with engine 104.

Location of specific repair instructions

First locate the Group No. in the Group Index. Individual groups are separated by an easily visible dividing page, which is followed by the job index page. The exact job required is found in the job index. The initial page of a typical job description appears as follows:

03-324 Replacement of front crankshaft radial seal

Job Title appears on same line as Group No.



Technical data, tightening torques and tools are listed at the beginning of each job.

All dimensions are in metric units unless otherwise indicated. Any part numbers given are only used for identification and differentiation between individual components, and are not intended for ordering purposes.

Special Instructions

⚠Warning Appears throughout service instructions indicating the possiblity of personal injury if procedures are not followed.

Caution! Indicates possible equipment or vehicle damage if procedures are not followed.

Note Provides helpful information for the described procedure.

Installation note Provides detailed information during assembly.

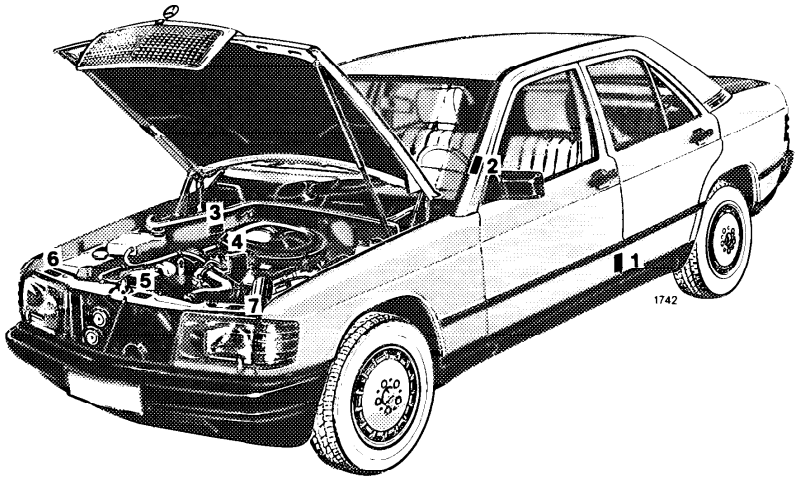
This manual applies to the following passenger cars, starting model year 1984.

Gasoline engines

Model Year	Model	Sales Designation	Engine
1984	201.024	190 E 2.3	102.961
1985	201.024	190 E 2.3	102.985
1986	201.024	190 E 2.3	102.985
1987	201.028	190 E 2.3	102.985
1988	201.028	190 E 2.3	102.985
1989	–	–	–
1990	–	–	–
1991	201.028	190 E 2.3	102.985
1992	201.028	190 E 2.3	102.985
1993	201.028	190 E 2.3	102.985

Model 201

When ordering spare parts, please specify chassis and engine numbers.



1 Certification Tag (left door pillar)
2 Identification Tag (left window post)
3 Vehicle Identification No.
4 Engine No.
5 Body No. and Paintwork No.
6 Informatron Tag
California version
Vacuum line routing for emission control system
7 Emission Control Tag
a Emission Control Tag
Catalyst Information
(from model year 1964 up to 1966)

Gasoline engines

Model	20 1.024	201.024	201.028
Sales designation	190 E 2.3 (Model year 1984)	190 E 2.3 (Model years 1985 - 86)	190 E 2.3 (Model years 1987-8, 1991-3)
Engine	102.961	102.985	102.985
Operation	4-stroke spark ignition, mechanically/electronically controlled continuous fuel injection system with airflow sensor (CIS-E)	4-stroke spark ignition, mechanically/electronically controlled continuous fuel injection system with airflow sensor (CIS-E)	4-stroke spark ignition, mechanically/electronically controlled continuous fuel injection system with airflow sensor (CIS-E)
Aspiration	Normal	Normal	Normal
Number of cylinders	4	4	4
Cylinder arrangement	In-line 15° inclination	In-line 15° inclination	In-line 15° inclination
Bore, stroke mm	95580.25	95.5/80.25	95.5/80.25
Total effective piston displacement cc	2299	2299	2299
Compression ratio	8.0 : 1	8.0 : 1	9.0 : 1
Firing order	1-3-4-2	1-3-4-2	1-3-4-2
Maximum speed rpm	5700 ± 50	6200 ± 50	6200 ± 50
Engine output (SAE) kW/rpm net bhp, rpm	84/5000 11315000	90/5000 120/5000	97/5100 130/5100
Maximum torque Nm, rpm net lb-ft./rpm	18113500 13313500	184/3500 1361'3500,	198/3500 14613500
Crankshaft bearings	5(multi-component, anti-friction bearings)	5(multi-component, anti-friction bearings)	5 (multi-component, anti-friction bearings)
Valve arrangement	Overhead, 2 per cylinder	Overhead, 2 per cylinder	Overhead, 2 per cylinder
Camshaft arrangement	1 overhead camshaft	1 overhead camshaft	1 overhead camshaft
Oil cooling	-	-	-
Cooling	Coolant circulation pump, thermostat with bypass line, fan with electromagnetic clutch, finned tube radiator	Coolant circulation pump, thermostat with bypass line, fan with electromagnetic clutch, finned tube radiator	Coolant circulation pump, thermostat with bypass line, fan with electromagnetic clutch, finned tube radiator
Lubrication	Pressure lubrication via gear type pump	Pressure lubrication via gear type pump	Pressure lubrication via gear type pump
Oil filter	Full flow filter	Full flow filter	Full flow filter
Air filter	Dry air filter with paper cartridge	Dry air filter with paper cartridge	Dry air filter with paper cartridge

Filling capacities

Model	201.024	201.024	201.028
Sales designation	190 E 2.3 (Model Year 1984)	190 E 2.3 (Model Years 1985 - 6)	190 E 2.3 (Model Years 1987-8, 1991-3)
Engine	102.961	102.985	102.985
Fuel tank/reserve approx. l	55/7.5	55/7.5	55/7.0 (6.0 l reserve from 1991)
During initial oil filling approx. l	5.0	5.0	5.0
During oil and filter change approx. l	4.5	4.8	4.5
Marks on dipstick max./min. approx. l	4.3/2.8	4.3/2.8	4.3/2.8
Cooling system with heater approx. l	8.5	8.5	8.5

Electrical system

Model	201.024	201.024	201.028
Sales designation	190 E 2.3	190 E 2.3	190 E 2.3
Engine	102.961	102.985	102.985
Battery Voltage Capacity	 12 V 55 Ah	 12 V 55 Ah	 12 V 62 Ah
Starter Bosch	12 V 1.5 kW	12 V 1.5 kW	12 V 1.4 kW
Alternator	14 V 65 A	14 V 70 A	14 V 70 A

Job No.

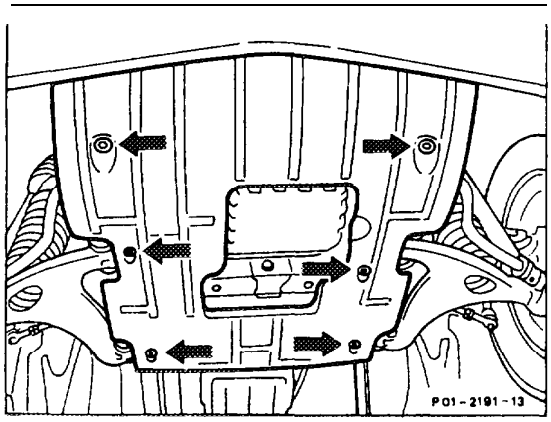
01-001 Engine and Model Survey

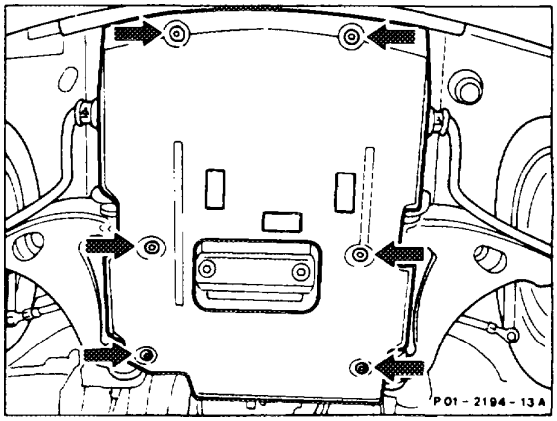
Engine	Model	Model Year	Sales designation	Power in kW at rprn	Compression ratio
102.961	201.024	1984	190 E 2.3	84/5000	8.0:1
102.985	201.024	1985 - 86	1190E2.3	90/5000	9.0:1
102.985	1201.028	1987 - 88 1991 - 93	1190E2.3	97/5100	9.0:1

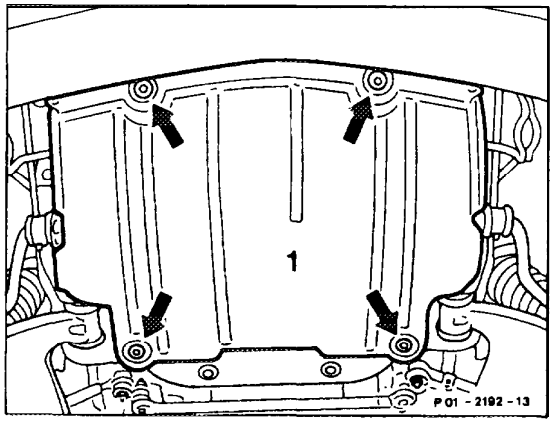
01-005 Overview – Engines, Models, Output and Compression Ratio

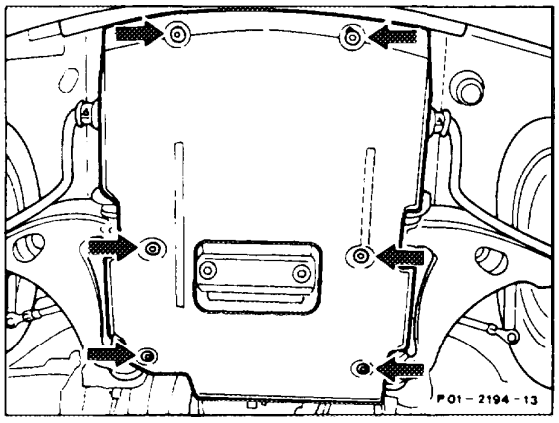
Engine	Model	Sales designation	Output in KW at rpm net bhpirpm	Compression ratio ε: 1
102.961 (USA) as of 1984	201.024	190 E 2.3	84/5000 113/5000	8.0
102.985 (USA) as of 1985	201.024	190 E 2.3	90/5000 12015000	8.0
102.985 (USA) as of 1987	201.028	190 E 2.3	97/5100 130/5100	9.0

01-006 Removal and installation of bottom engine compartment cover









Model 201

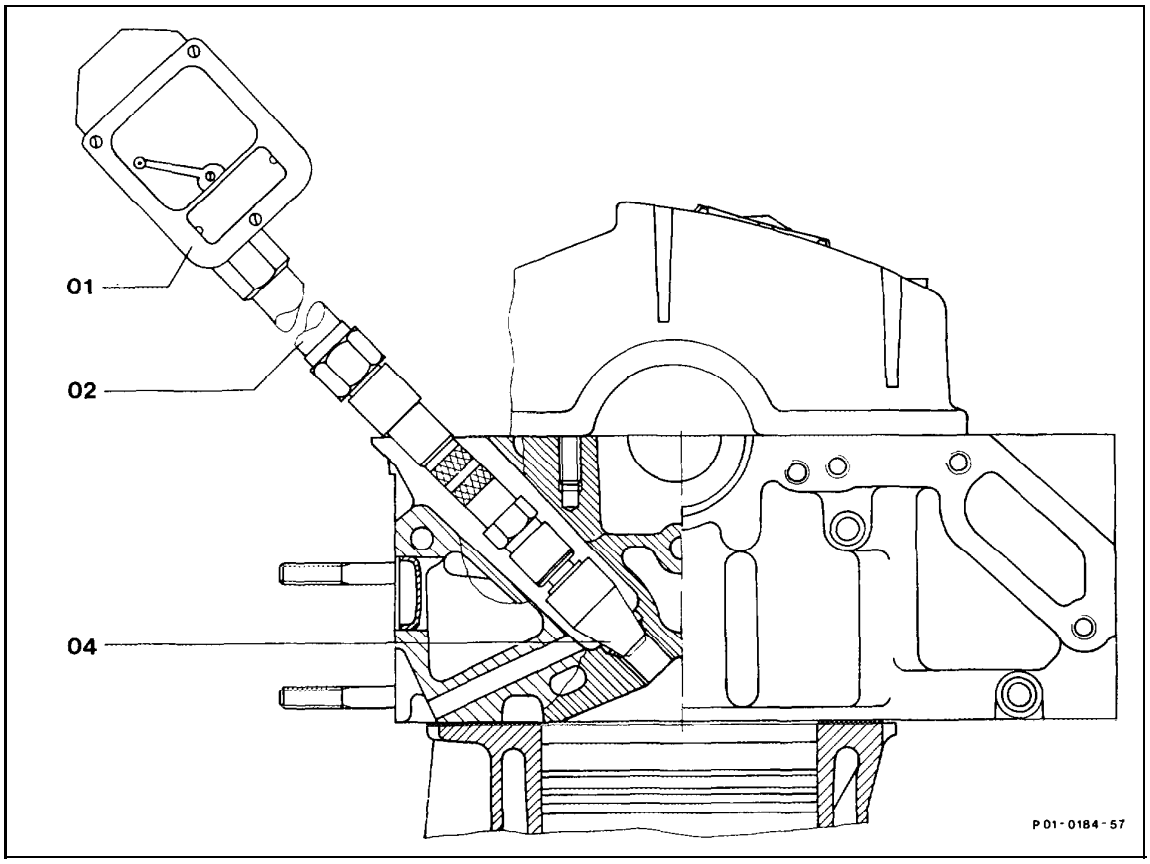
Self-tapping screws (arrows) . . . . . remove, screw in and remove, install engine compartment cover.

Note

On Model 201.028 (USA) install engine compartment cover so that the edge of the side parts grips above the bottom part.

01-010 Testing compression pressure

Preceding work:
Removing spark plug (15-018).



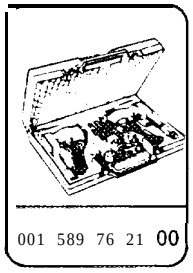
01 Compression pressure recorder, special tool 001 589 76 '21 00
02 Adapter piece
04 Sealing cone with check valve

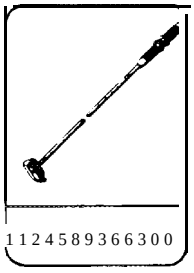
Test data with engine at normal operating temperature (80°C) in bar

Subject		When new	Limit value
Compression ratio	ε = 9.0 – 9.4	10 – 12	approx. 8.5
	ε = 10.0	13.5 – 15.5	approx. 12
	ε = 7.5 – 8.3	9 - 10	approx. 7.5
	ε = 7.2 (102.92)	8 - 9	approx. 6.5

Permissible difference between individual cylinders max. 3

Special tools


001 589 76 21 00


1124589366300

Notes

Test compression pressure at normal operating temperature.

If the minimum compression pressure is not reached, test cylinder leaktightness (01-015).

Unscrew all the spark plugs for testing.

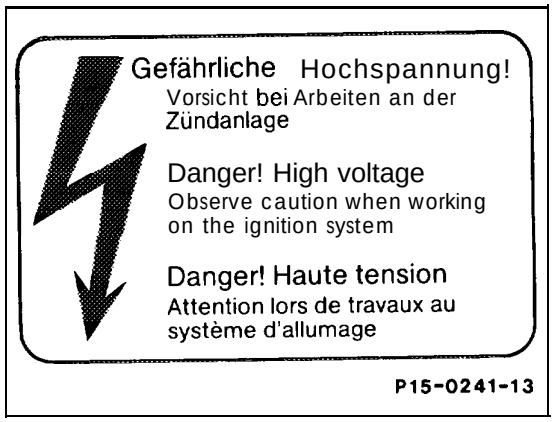
Turn crankshaft with starter and compression pressure recorder.

Warning!

The engines are equipped with an ignition system with variable ignition characteristics (EZL).

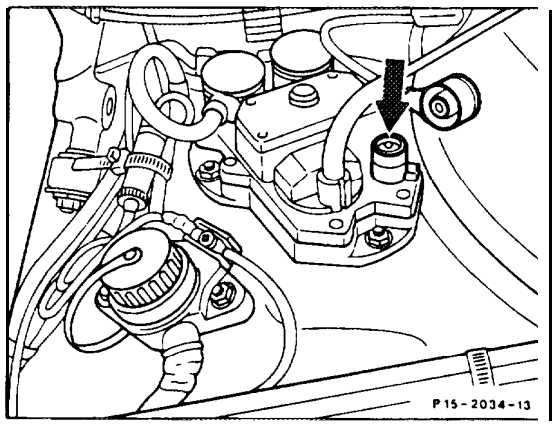
Because of high ignition voltage, it is very dangerous to touch components of the ignition system (ignition coil, ignition cables, spark plug connector, plug-on unit) when

- the engine is running,
- the engine is started,
- the key in the steering lock is in position 2 and the engine is cranked by hand.

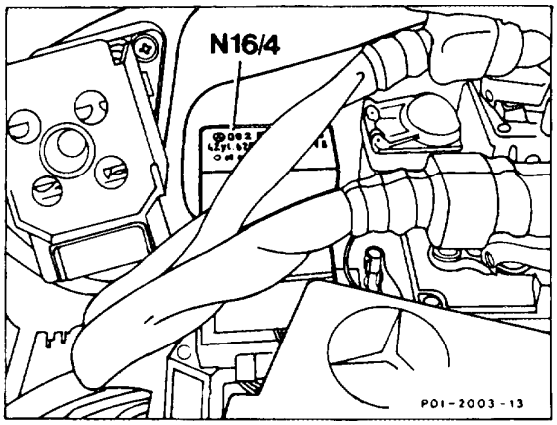


Testing

1 Switch off ignition. Detach connector from ignition distributor pickup (green cable on control module) (arrow).

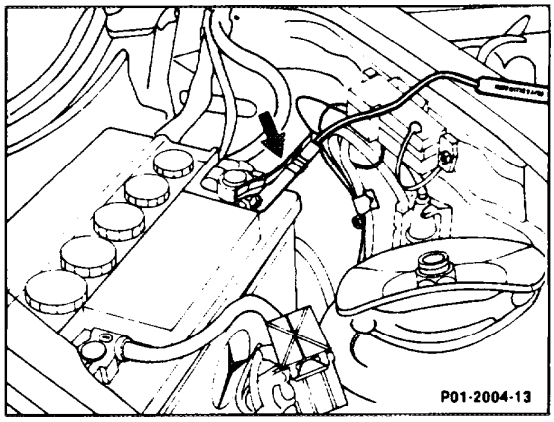


Caution!
On injection engines, detach the fuel pump relay module (N1614) before turning the crankshaft to ensure that no fuel is injected.



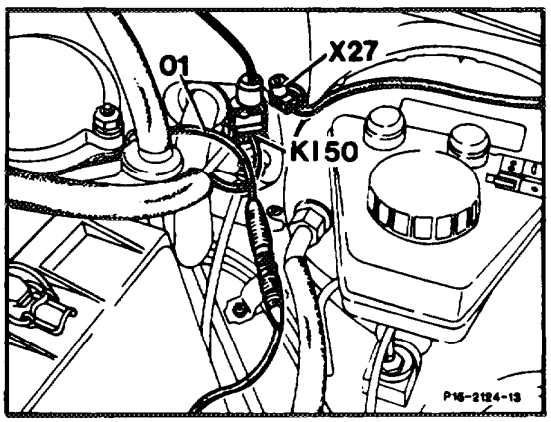
Model 201

2 Connect compression pressure recorder. This is done by clamping one of the two alligator clamps (arrow) of the compression pressure recorder, Part No. 001 589 76 21 00, to the positive terminal post of the battery.



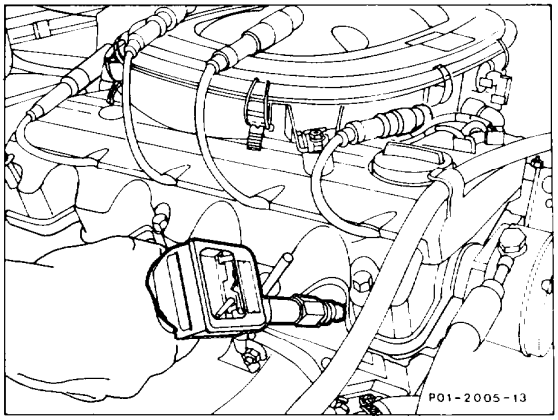
3 Detach connector (X27) from plug connection (terminal 50).

4 Plug in connector of adapter cable (01), Part No. 124 589 36 63 00.



Model 201

5 Crank engine several times with starter motor, in idle position, selector lever in position "P", and parking brake applied so that residues and soot are ejected.



6 To test each cylinder, press the compression pressure recorder into the spark plug hole of the particular cylinder and, with the throttle valve fully opened, crank engine approx. 8 revolutions. Test all the cylinders in this way.

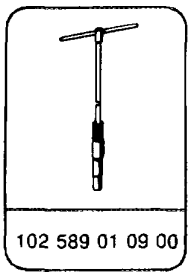
7 Blow out spark plug recesses with compressed air. Remove any residues on the tapered sealing seat.

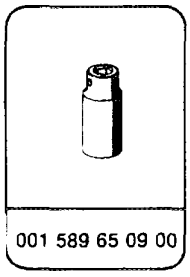
01-015 Testing cylinder leaktightness

Data	
Total pressure loss	max. 25%
At valves and cylinder head gasket	max. 10%
At pistons and piston rings	max. 20%

Tightening torque	Nm
Spark plugs	20

Special tools





Commercial tool

Cylinder leaktightness tester	e. g. Bosch, EFAW 210 A Sun, CLT 228

Testlng

1 Run engine until at normal operating temperature.

2 Blow out spark plug recesses with compressed air.

3 Remove spark plugs.

4 Top off coolant and leave filler opening at coolant expansion tank open.

5 Remove oil filler cap.

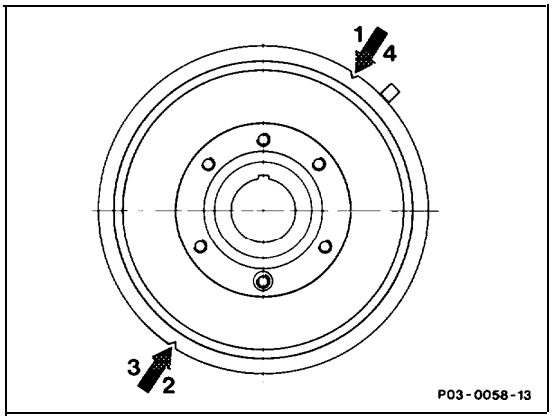
6 Remove air filter (09-400 or 09-410).

7 Connect cylinder leaktightness tester to a compressed air system and calibrate tester.

8 Position piston of No. 1 cylinder to ignition TDC. This is done by turning the crankshaft with a tool combination consisting of wrench socket (27 mm, 1/2" square) and reversible ratchet handle, at the central bolt (front of crankshaft).

Note

The respective pistons are in the TDC position when the markings shown in the drawing opposite on the vibration damper or on the belt pulley are below the TDC pointer.



9 Open throttle fully.

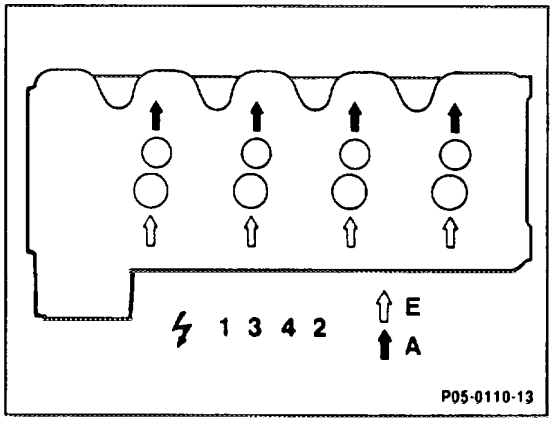
10 Screw connection hose into the 1 st spark plug bore and attach to the connecting hose of the tester.

The crankshaft must not turn when performing this step.

11 Read off pressure loss at tester.

12 Determine by listening whether the pressure escapes through intake manifold, exhaust, oil filler opening, spark plug bore of adjacent cylinder or coolant filler opening.

13 Test all the cylinders in the firing order.



Notes

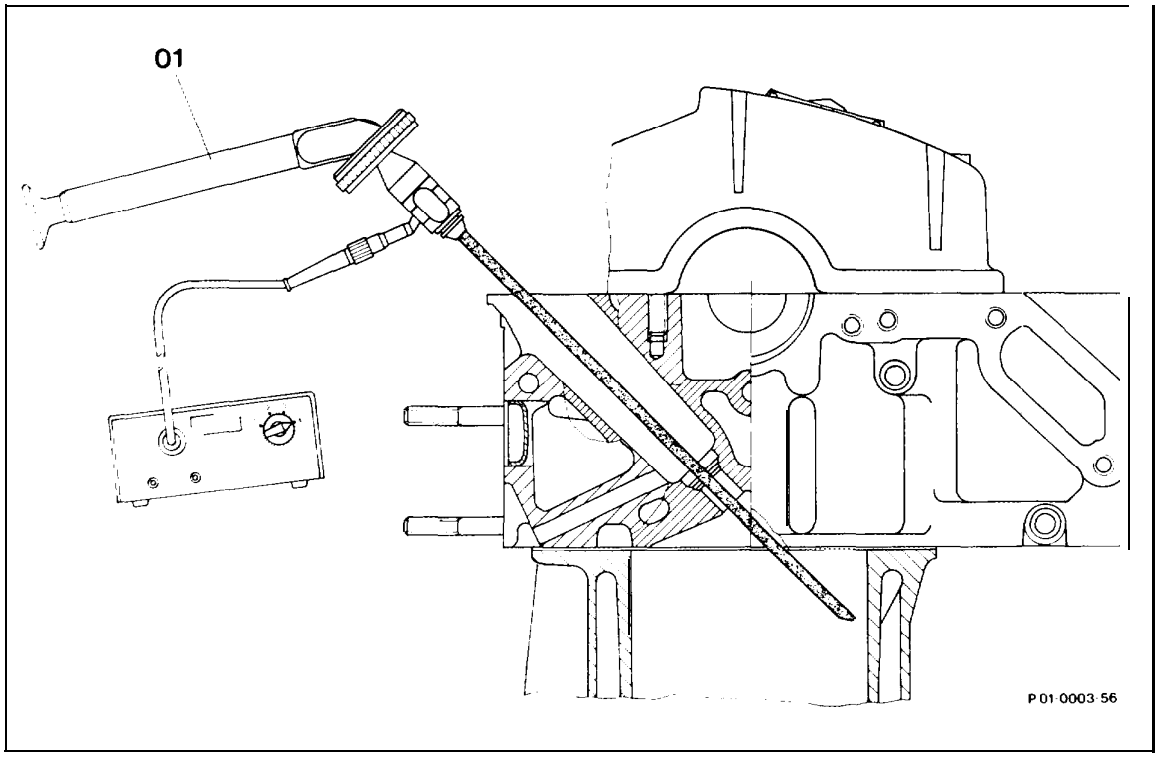
It is possible that the piston ring gaps of individual pistons are directly above each other which falsifies the test result.

In cases of doubt, allow vehicle to run and test cylinder leaktightness once again after some time.

After spraying oil onto the piston crown, it is possible to determine whether the leak exists at the piston rings or at the valves or the cylinder head gasket.

01-020 Illuminating cylinders

Preceding work:
Removing spark plugs (15-018).



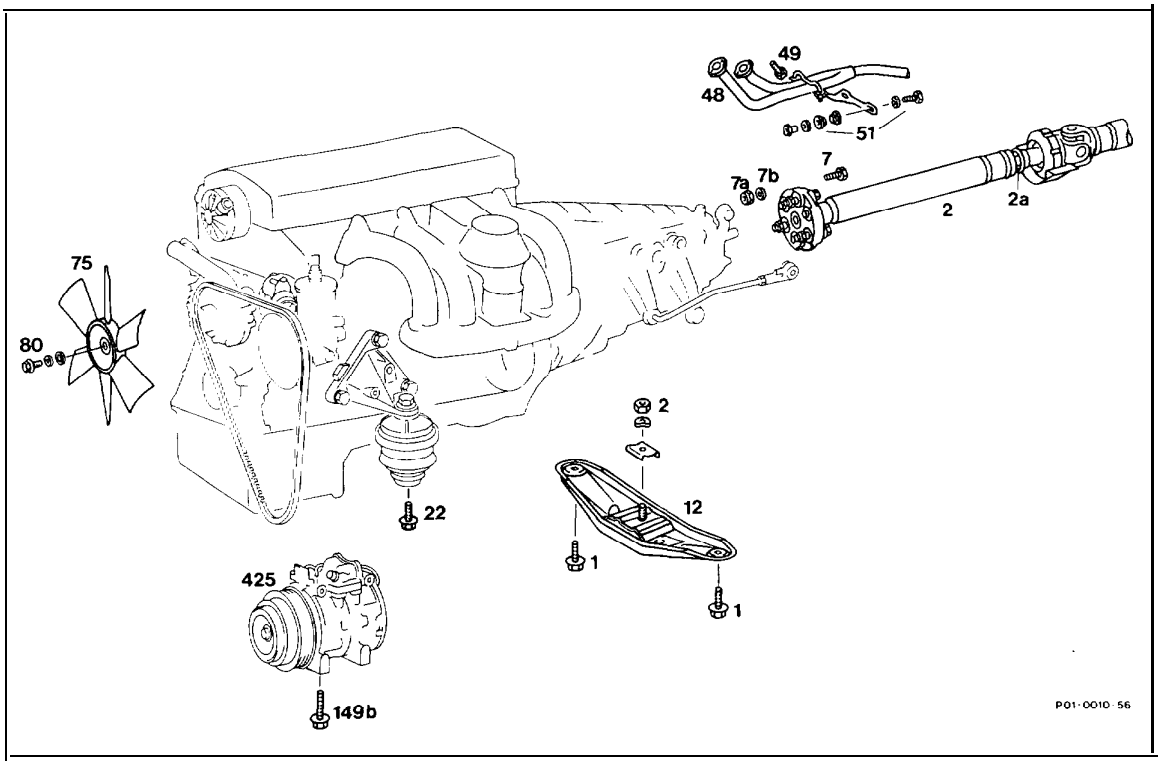
Cylinder (01)	illuminate with cylinder inspection lamp (01), distinguish between “optical rub marks and seizing rub marks”. “Optical rub marks” may result from the ring gap. Traces of honing are still visible, engine in order. “Seizing rub marks”; honing marks no longer visible, recondition engine.

Commercial tool

Cylinder inspection lamp	e. g. Karl Storz GmbH, D-7200 Tuttlingen Motoskop TW (cold light) with lens probes 103 26 CW (570 mm) and 103 26 CT (210)

01-030 Removal and installation of englne

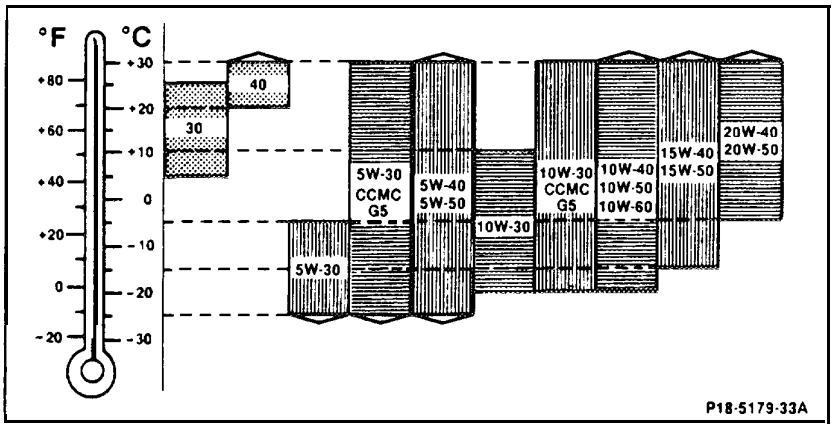
Preceding work:
Removal and installation of bottom engine compartment fairing (01-006).
Removal and installation of air filter (09-400 or 09-410).
Removal and installation of radiator (20-420).



Battery positive cable	disconnect, connect.
Fan (75)	remove, install, 25 Nm.
Alternator cable connector	detach (step 3).
Lines for pressure oil pump	detach, attach (step 4).
Cover for evaporator	insert (step 5).
Cover for engine wiring harness	remove at component partition wall (steps 6 and 7).
Starter wiring harness	remove, install (step 8).
Terminal block terminal 50	disconnect, connect (step 9).
Terminal 30	disconnect, connect at terminal block (step 10).
Engine wiring harness	disconnect, connect at the individual connections (steps 11 to 18).

Fuel evaporation system	detach, attach (step 19).
Ground cable	unbolt, bolt on at intake manifold (step 20).
Accelerator control	disconnect, connect Bowden cable, adjust (step 21).
Fuel lines	detach, attach (step 22).
Coolant hose, heater supply line	detach, attach (step 23).
Vacuum line, brake booster	detach, attach (step 24).
Air conditioning compressor (425)	Note On vehicles with air conditioning, the A/C compressor can be unbolted with the lines connected and without draining the system (steps 25 to 34).
Engine hoist	attach to suspension lugs, detach (step 35).
Guard plate	insert between component compartment and engine, remove (step 37).
Exhaust system (48)	unbolt at exhaust manifold and transmission mount (51), bolt on (steps 38 and 39), 25 Nm.
Lambda sensor	remove, install (step 40).
Engine supporting bracket (12)	unbolt, bolt on (step 42). Tightening torques: Bolt (1) 25 Nm, Nut (2) 70 Nm.
Drive shaft to transmission (2)	detach, attach, replace self-locking nuts (7a) (step 44).
Clamping nut (2a)	loosen, tighten (step 45), 45 Nm.
Speedometer shaft	disconnect, connect to transmission (step 46).
Ground cable at transmission	disconnect, connect (step 47).
Shift rods at transmission	detach, attach (step 48).
Cable connector for starter lockout, backup light switch	unplug, plug in (step 49).
Cable for kickdown solenoid valve	disconnect, connect (step 50).
Front engine mounting (22)	unbolt, bolt on at bottom (step 51), 40 Nm.

Engine with transmission	.....	lift out, insert (step 52).
Lines, hoses and engine mounts	. . . . .	examine for signs of wear, replace if necessary. Examine antifreeze protection, adjust to correct level if necessary. Test leaktightness.



Viscosity grades for engine oils according to SAE

Adhering to the SAE grades in accordance with ambient temperatures would result in frequent oil changes. Consequently, the temperature ranges are merely guidelines, which can be exceeded in the upper or lower limits for brief periods.
In moderate climatic zones SAE 30 may be used from the spring on for all engine models. SAE 10W-40 or SAE 10W-50 may be used as an all-seasons oil for all gasoline engines.

Refer to the most current “Factory Approved Service Products” for further information regarding specified viscosity grades and approved engine oils.

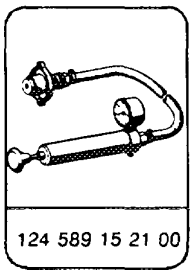
Oil capacity in liters

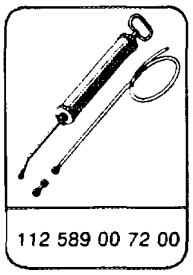
(refer to Factory Approved Service Products for approved engine oils)

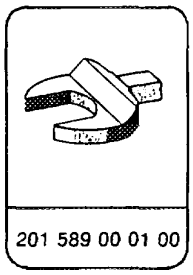
Engine (total capacity when refilling)	5.5
Engine capacity when changing oil and filter	5.0

Tightening torques	Nm
Fan to engine coolant pump	**25**
Exhaust pipe to exhaust manifold	25
Exhaust bracket to transmission	25
Hexagon bolt of belt pulley to power steering pump	25
Bracket for A/C compressor to oil sump	10
Bracket for AC compressor to AC compressor	25
V bracket servo pump – engine supporting bracket – A/C compressor	25
Servo pump to supporting bracket	25
A/C compressor to supporting bracket	30
Propeller shaft to transmission	45
Clamping nut to spline end of propeller shaft	45
Ground cable to transmission	45
Engine mount to axle carrier	40

Special tools







Commercial tool

Engine hoist No. 3188 self-locking	e. g. Messrs. Backer Herderstraße D-5630 Remscheid

Shop-made tools

Guard plate for radiator/evaporator	Dimensions approx. 480 x 600 x 1
Metal panel for component compartment wall	Dimensions approx. 320 x 380 x 1

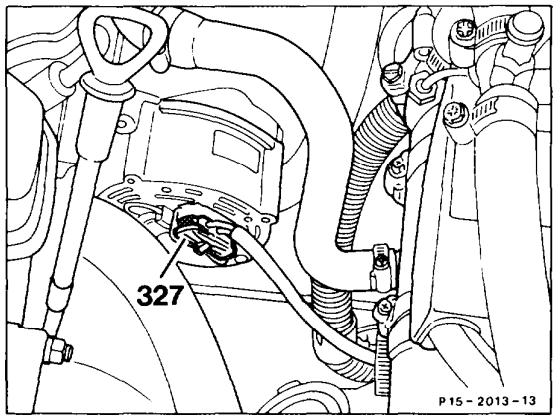
Note
Remove and install engine together with transmission.

Removal and installation

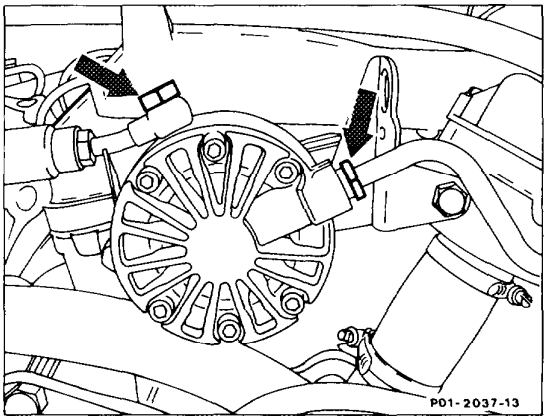
1 Disconnect battery negative terminal, connect.

2 Remove fan. install.

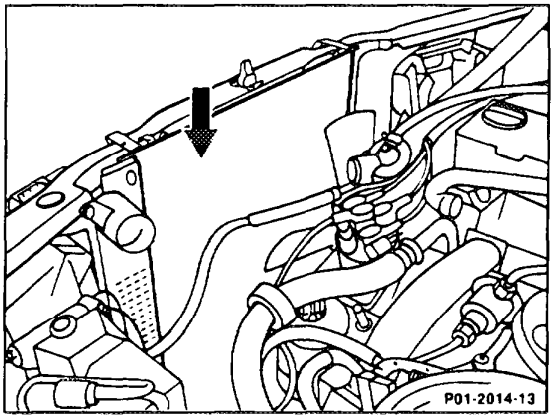
3 Unplug cable connector (327) at alternator, plug in.



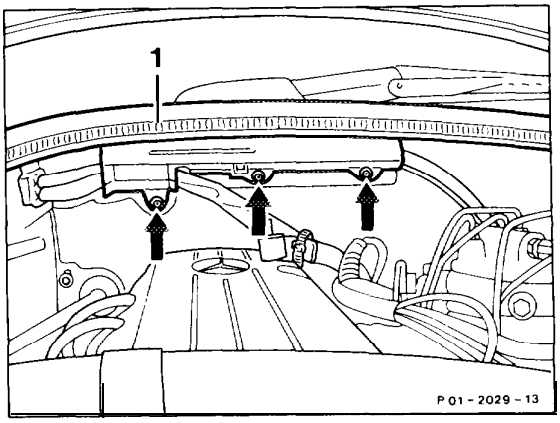
4 Detach lines for pressure oil pump at cylinder head, connect (arrows).



5 If equipped with air conditioning: install guard plate (arrow) to evaporator of air conditioning system.

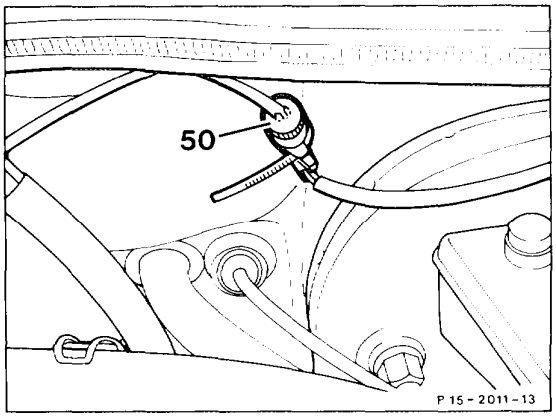


7 On Model 201, pull off rubber strip (1) above fire wall.
Take out clips (arrows), fold fixture upwards.



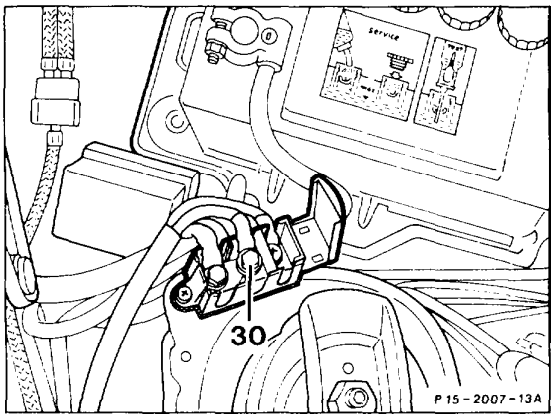
Model 201

9 On Model 201, unplug cable connector (50) at the plug connection, plug in.



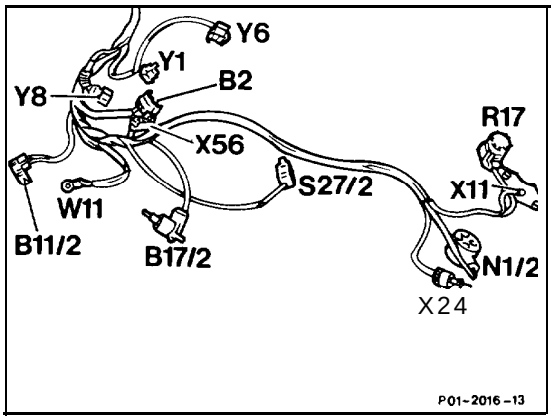
Model 201

10 Unbolt battery positive terminal. Disconnect terminal (30) at cable connector and pull cable through component compartment wall and place over engine.



Model 201 terminal 30

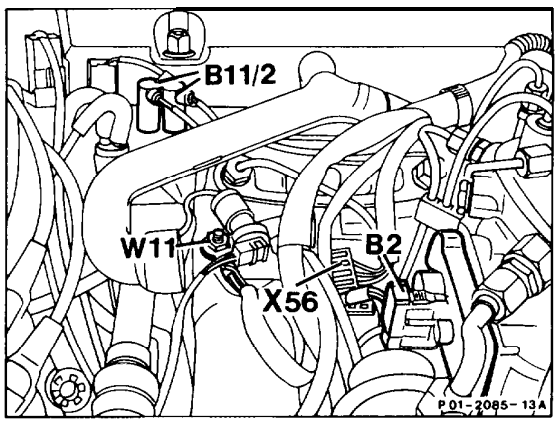
11 Disconnect engine wiring harness at the individual connections and place over the component compartment wall.



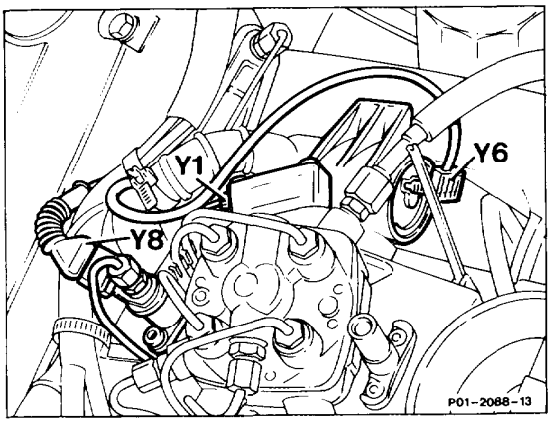
Engine wiring harness, shown on Model 201

B2	Volume air flow sensor position Indicator
B11/2	Engine coolant temperature sensor (CFI), 2-pin
B17/2	Intake air temperature sensor, CFI injection system
N1/2	Ignition control module
R17	Reference resistor, CFI injection system
S27/2	Deceleration shutoff microswitch
W11	Engine ground (electric lead bolted on)
x11	Diagnostic connector/terminal block terminal TD
X24	Connector, headlamp wiring harness
X56	Throttle body switch connector
Y1	Electrohydraulic actuator
Y6	Idle air control valve
Y8	Start valve

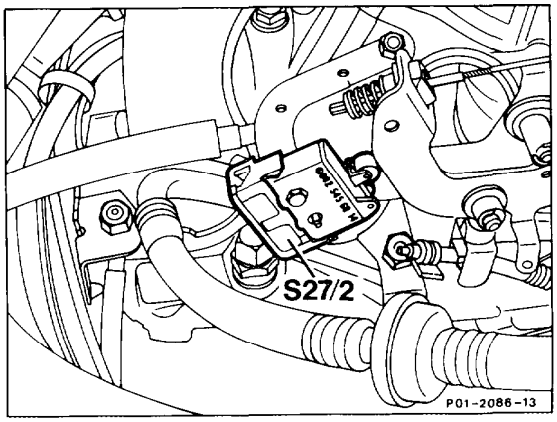
12 Detach twin connector (B1112) for engine coolant temperature sensor (CFI), plug in.
Unbolt engine ground (W11), bolt on.
Unplug throttle body switch connector (X56), plug in.
Unplug volume air flow sensor position indicator (B2), plug in.



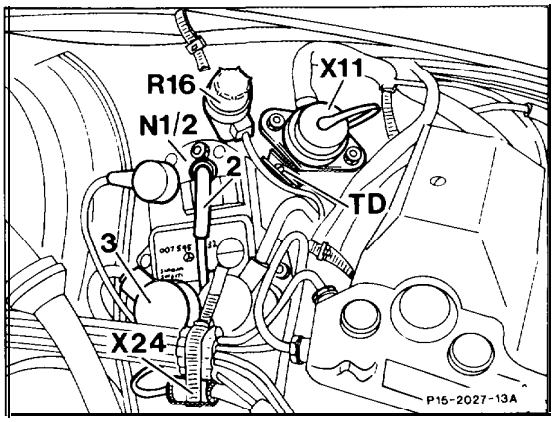
13 Unplug start valve (Y8), plug in.
Unplug electrohydraulic actuator (Y1), plug in.
Unplug idle air control valve (Y6), plug in.



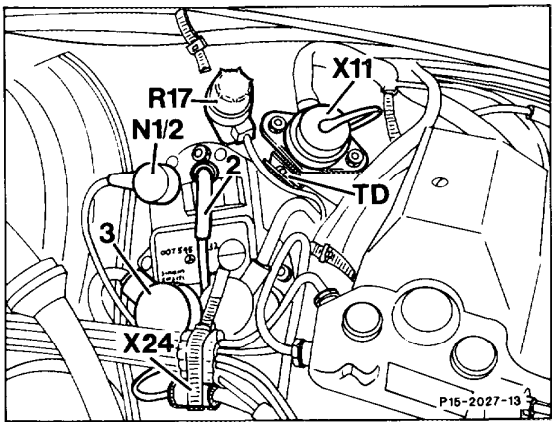
14 Unplug deceleration shutoff microswitch (S27/2), plug in.



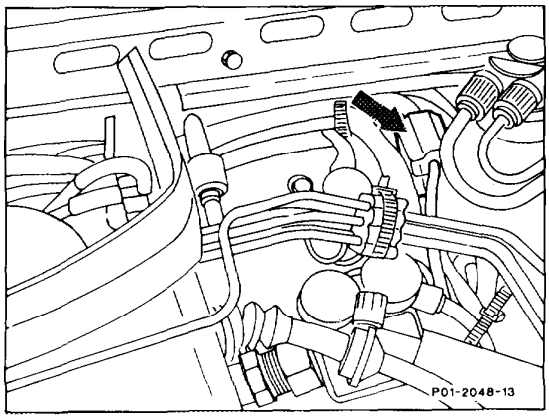
15 Unplug connector for crankshaft position sensor on ignition control module (N1/2), plug in.
Unplug vacuum line (2) and 4-pin connector (3), plug in.



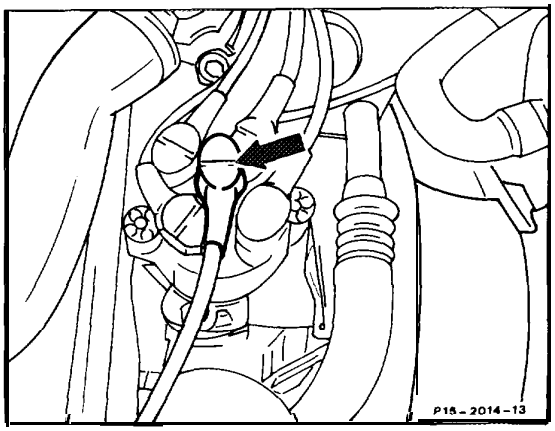
16 Unbolt terminal TD at terminal block of diagnostic connector (Xl 1), bolt on. Unscrew diagnostic connector (Xl 1) and unplug on the bottom the grey cable for TDC pulse generator, plug in.



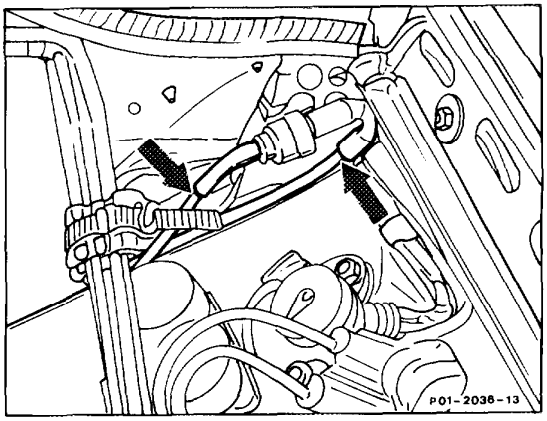
17 On models equipped with cruise control, unplug connector (arrow), plug in.



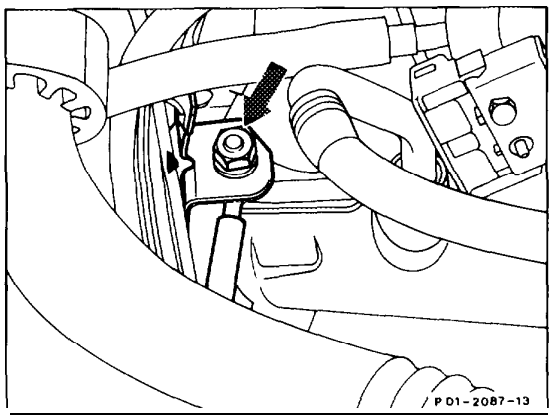
18 Unplug ignition cable 4 (arrow) at ignition distributor, plug in.



19 Detach vacuum lines (arrows) for fuel evaporative emission control system, attach.



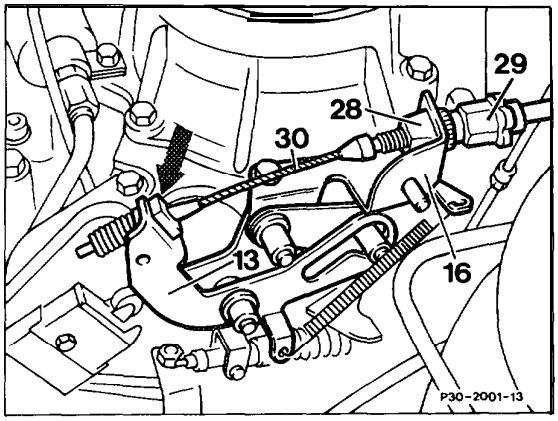
20 Unbolt ground cable at intake manifold, screw on (arrow).



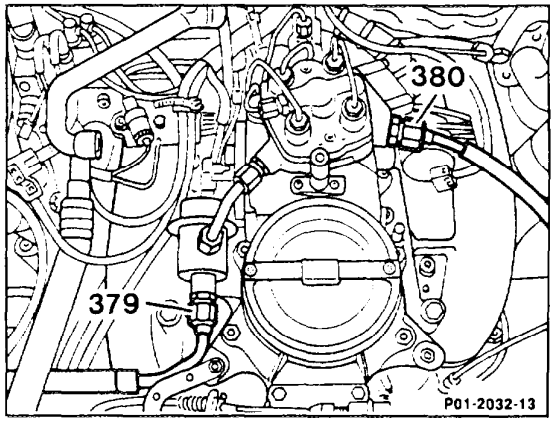
21 Detach Bowden cable (30) for accelerator control, attach. Press plastic guide (arrow) out of its seat in the fulcrum lever (13) to perform this step, and take Bowden cable (30) out of the slot in the fulcrum lever.

Installation instruction

Adjust Bowden cable (30) (30-325).

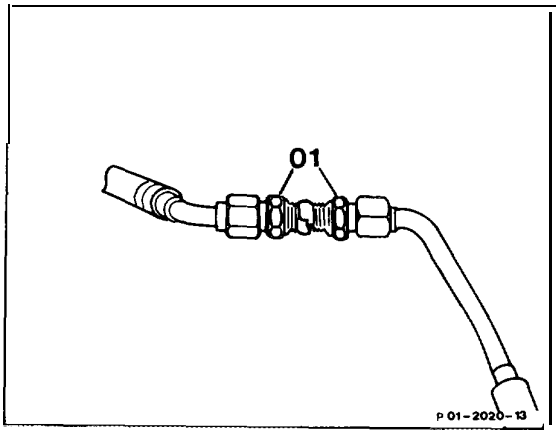


22 Reduce fuel pressure in the fuel lines by briefly opening fuel tank cap.
Unbolt fuel lines (379 and 380), bolt on.

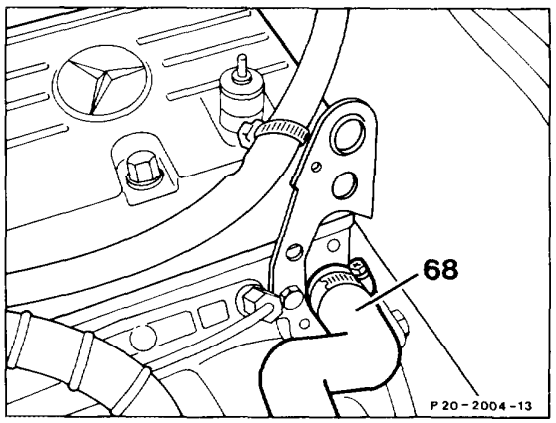


Note

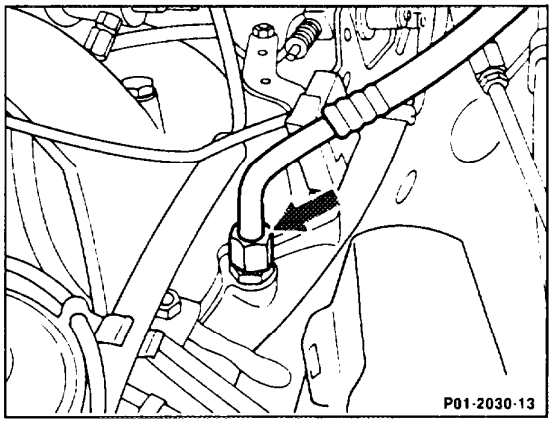
To prevent fuel flowing out of the disconnected fuel lines, both fuel lines can be plugged with a fitting (01, shop-made).



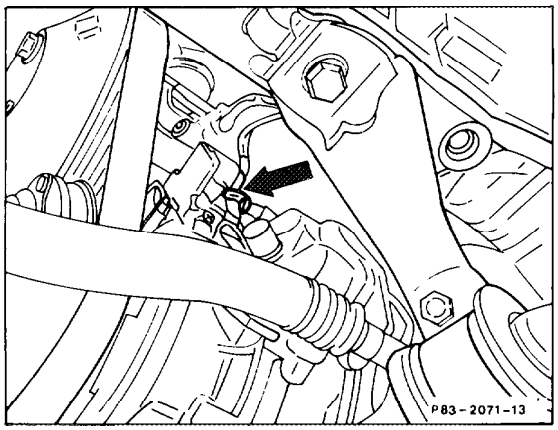
23 Disconnect engine coolant hose (68) for heater supply line at the cylinder head, connect.



24 Disconnect vacuum line for brake booster at intake manifold (arrow), connect.



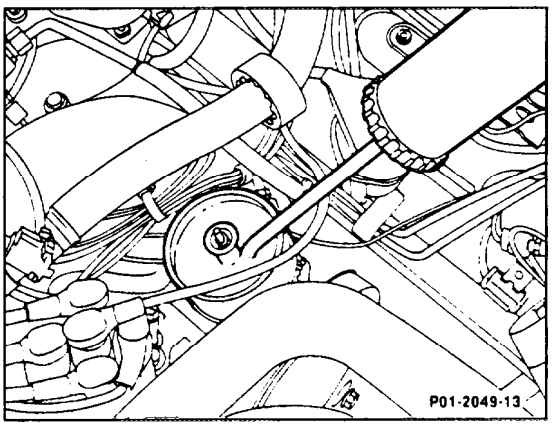
25 On models with A/C compressor, disconnect electric lead at A/C compressor, connect (arrow).



26 Disconnect piping group (170) at the cylinder head, connect (arrows).

27 Extract oil from the reservoir for power steering.

28 Disconnect oil lines at power steering pump, connect.



Installation instruction

Adjust oil level of power steering to correct level. When engine is running, top off oil to the marking. Turn steering several times from full left to full right lock.

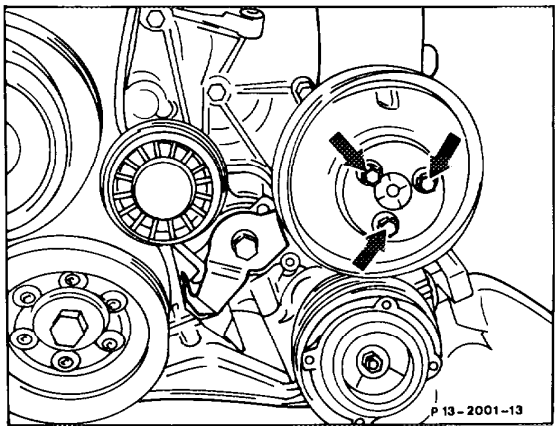
Oil level when oil at normal operating temperature (approx. 80 °C) 18 – 26 mm below the top edge of reservoir.

Oil level when oil cold (room temperature, approx. 20 “C) between Min. and Max. markings.

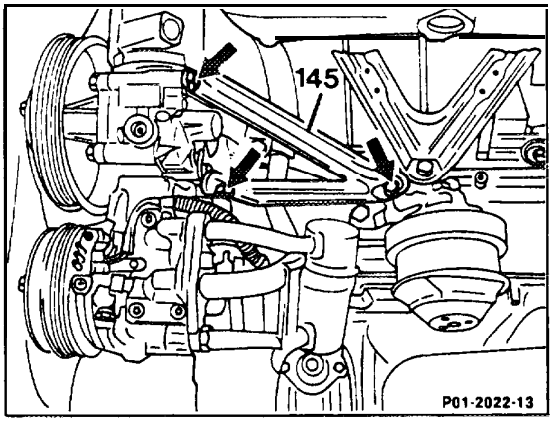
29 On models with AC compressor, remove poly V-belt, install (13-342).

30 Remove and install tensioning device for V-belt (13-345).

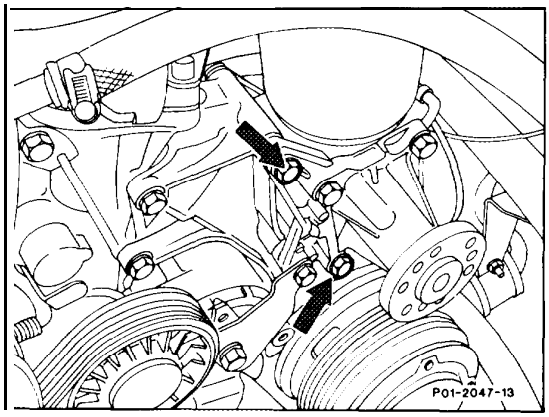
31 Unbolt belt pulley for high pressure pump of power steering, bolt on (arrows).



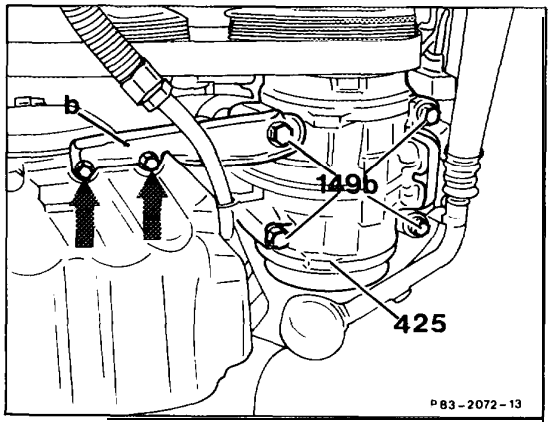
32 Unbolt strut (145) for high pressure oil pump and AC compressor (arrows), bolt on. Tightening torque 25 Nm.



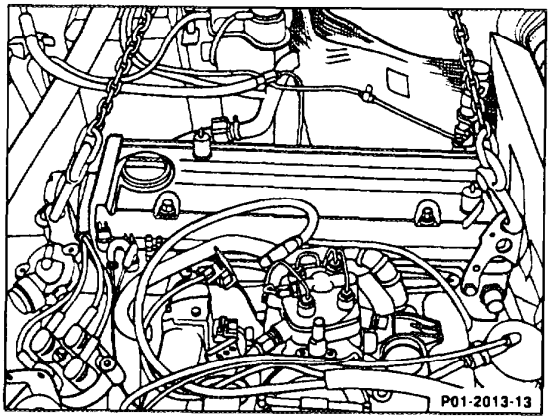
33 Unbolt high pressure oil pump, bolt on (arrows) and place to the side with the lines connected, tightening torque 25 Nm.



34 Unbolt AC compressor (425) at the supporting bracket, bolt on, and place to the side with lines connected. Bolts (149b), tightening torque 25 Nm.
Unbolt bracket (b), bolt on.

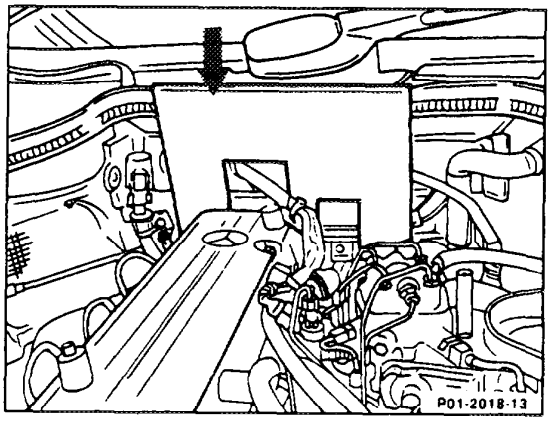


35 Attach engine hoist into the suspension lug of the engine.
Adjust engine hoist so that the engine can be raised horizontally.

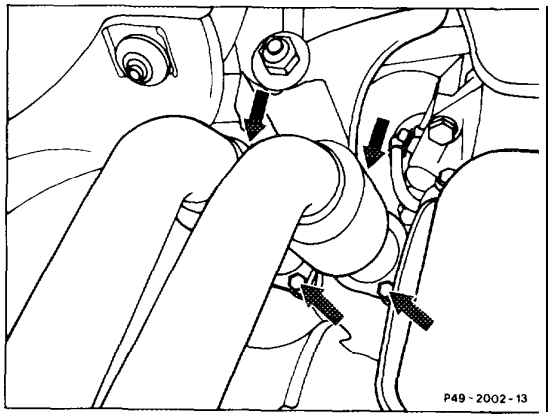


36 Disconnect all remaining lines, e. g. vacuum, oil, fuel lines and electric cables, running to the engine; connect.

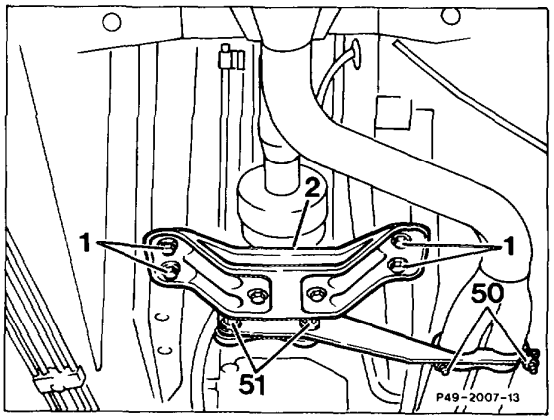
37 Insert guard plate (arrow) between component compartment and engine, remove.



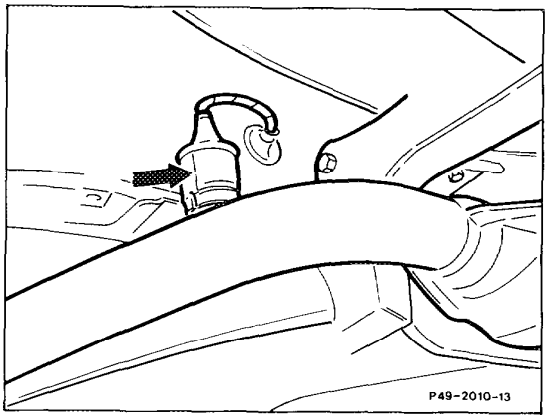
38 Unbolt exhaust at the exhaust manifold, bolt on (arrows), tightening torque 25 *Nm.*



39 Unbolt exhaust holder (50 and 51) at the exhaust and transmission, bolt on, tightening torque 25 Nm.

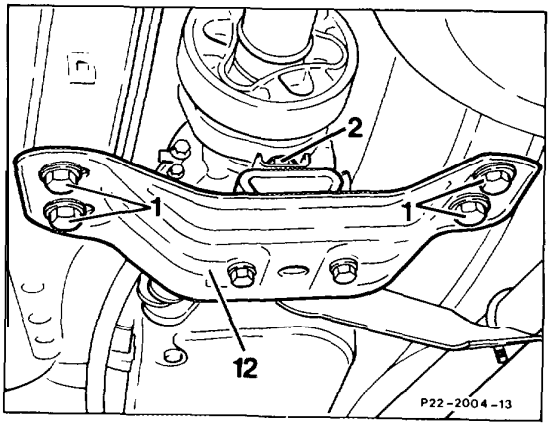


40 Remove lambda sensor at exhaust pipe, install. Remove cover (arrow) to perform this step.

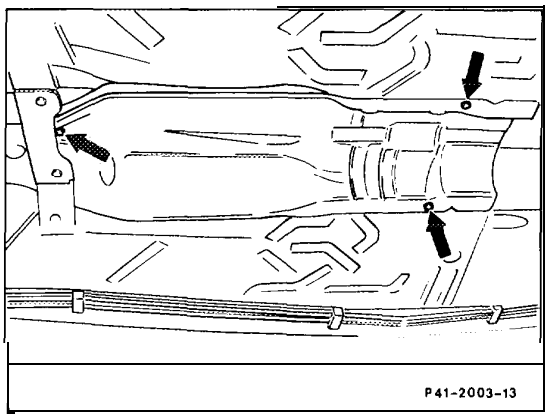


41 Remove and install exhaust system (49-100).

42 Unbolt engine supporting bracket (12), bolt on.
Tightening torques:
Bolt (1) 25 Nm,
Nut (2) 70 Nm.



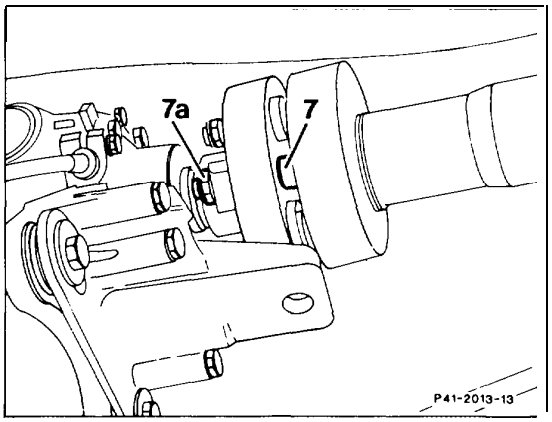
43 Unbolt shield, bolt on (arrows).



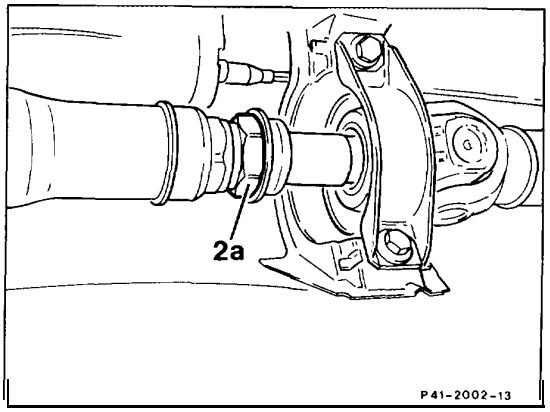
44 Unbolt drive shaft, bolt on. Loosen the bolts (7) and nut (7a) to perform this step. Tightening torque 45 Nm.

Note

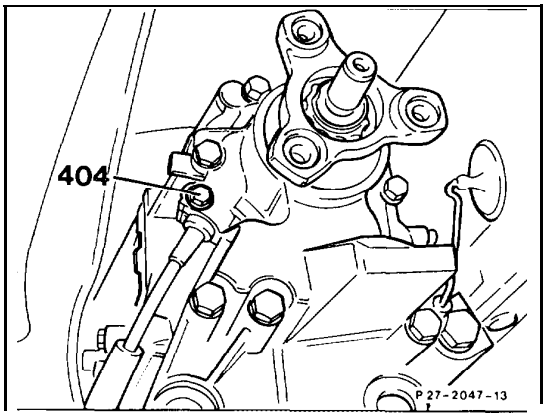
Flexible coupling remains on drive shaft.



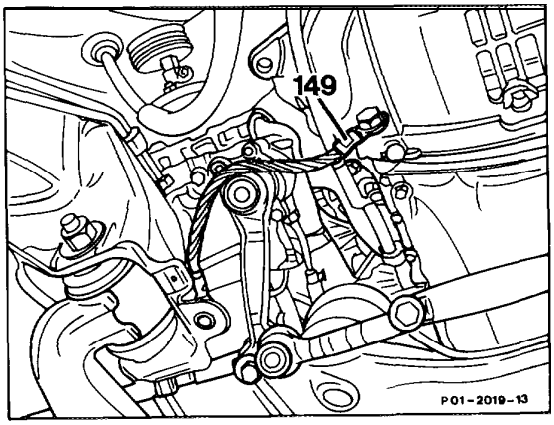
45 Loosen clamping nut (2a), tighten (wrench waf 41/46). Push drive shaft back as far as possible. Tightening torque 45 Nm.



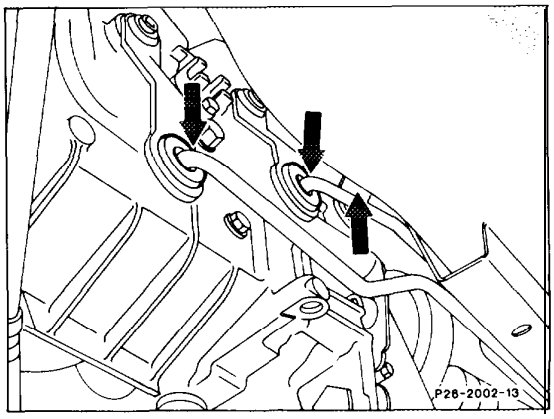
46 Detach speedometer shaft at transmission, attach. Remove bolt (404) to perform this step.



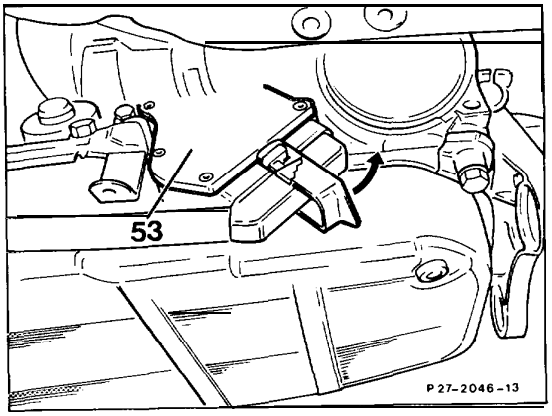
47 Unbolt ground cable (149) at transmission, bolt on. Tightening torque 45 Nm.



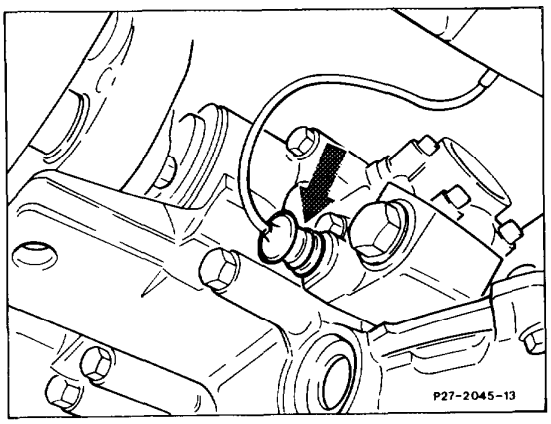
48 Detach shift rods at transmission, attach (arrows). Take the clip locks off the transmission shift levers to perform this step.



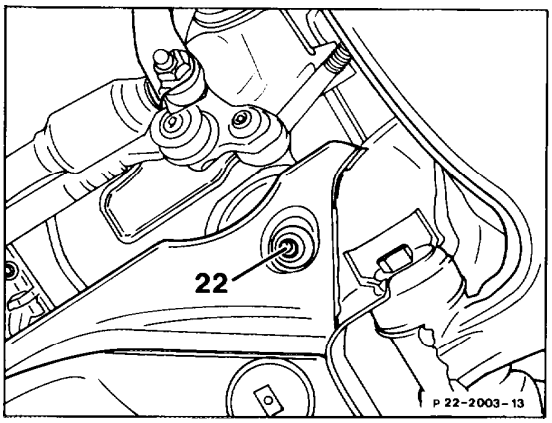
49 If equipped with automatic transmission, turn white plastic lock on starter lockout, backup light switch (53) approx. 45° to the right and unplug cable connector, plug in.



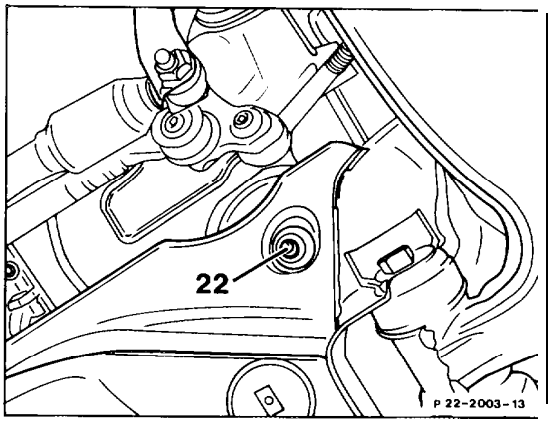
50 Unplug cable (arrow) at the kickdown solenoid valve, plug in.



51 Remove both bolts (22) for engine mounting. Tightening torque 40 Nm.



52 Lift out engine together with transmission at an angle of approx. 45°.

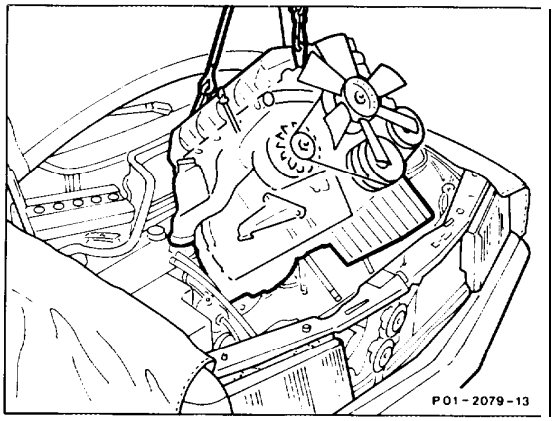


53 Install in the reverse order.

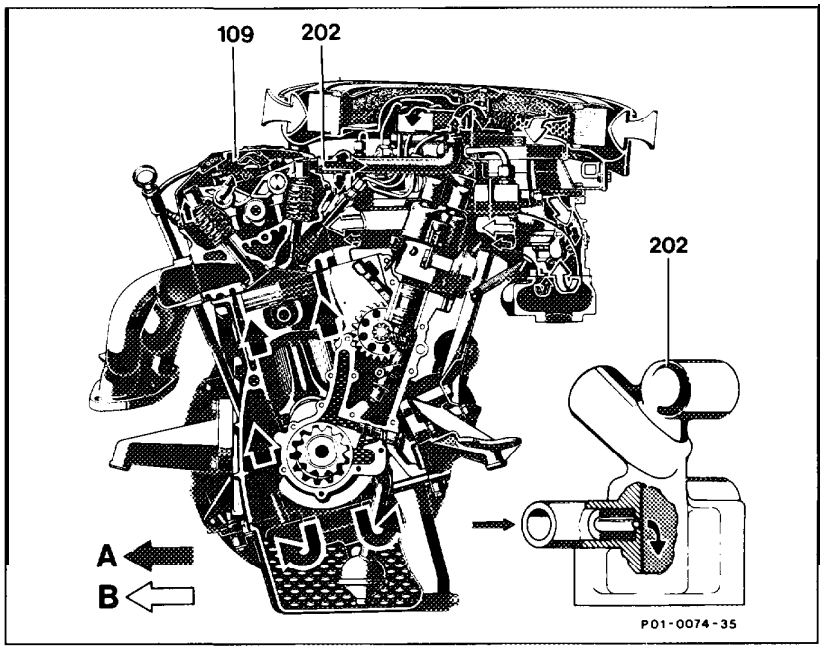
54 Check front and rear engine mounts.

55 Check fluid levels, adjust to correct levels if necessary.

56 Check leaktightness with engine running.



Engine 102.985 (CFI system)



109 Oil separator
202 Idle air distributor (bypass passage dia. 1.5 mm)
A Fresh air
B Blowby gases

Function

The engine blowby gases flow through the oil separator (109) at the cylinder head cover and through a pipeline to the idle air distributor (202) or to the air filter (clean air side).

The oil separated out in the oil separator (109) flows back through a passage (dia. 3 mm) to the cylinder head.

At a high intake manifold vacuum, the blowby gases are drawn through the bypass passage (dia. 1.5 mm) in the idle air distributor (202) and the idle air passage in the intake manifold and flow to the combustion chambers. At the same time, a small quantity of clean air from the air filter is drawn in as well through the bypass passage.
At a low or no intake manifold vacuum. the blowby gases flow to the clean air side in the air filter and pass together with the intake air to the combustion chambers.

01-l 10 Measuring, boring and honing cylinders

Data

Engine	Gr. No.	1 st version 102.985	Gr. code letter	2nd version 102.985
Standard	0	95.498 – 95.508	A	195.500 – 95.506
	1	95.509 – 95.518	X	95.507 – 95.512
	2	95.519 – 95.528	B	95.513 – 95.518
1st repair size (+0.5)	0	95.998 – 96.008	A	96.000 – 96.006
	1	96.009 – 96.018	X	96.007 – 96.012
	2	95.519 – 96.028	B	96.013 – 96.018
2nd repair size (+1.0)	0	96.498 – 96.508	A	96.500 – 96.506
	1	96.509 – 96.518	X	96.507 – 96.512
	2	96.519 – 96.528	B	96.513 – 96.518

Wear limit in direction of travel or transverse direction		0.10
Permissible variation of cylinder shape	when new	0.007
	wear limit	0.05
Permissible variation from rectangularity related to cylinder height		0.05
Averaged peak-to-valley height (Rz) after ceramic finish honing		0.002 – 0.004
Permissible height of unevenness (Wt)		50 % of PTV height
Chamfer of cylinder bores		see instruction
Honing angle		50° ± 10°

Commercial tool

Snap gauge for internal measurements, Ø 80 – 100 mm	e. g. Hahn und Kolb Borsigstraße 50 D-7000 Stuttgart 30 Order No. G422K

Note
Since 04/88 the tolerance stages of piston and cylinder bore dia. have been identified with letters (hitherto figures, refer to data). As previously in the figures, the letters are also stamped in the mating face of the crankcase and in the piston crowns.

Identification of tolerance stages

previous	current
0	A
1	X
2	B

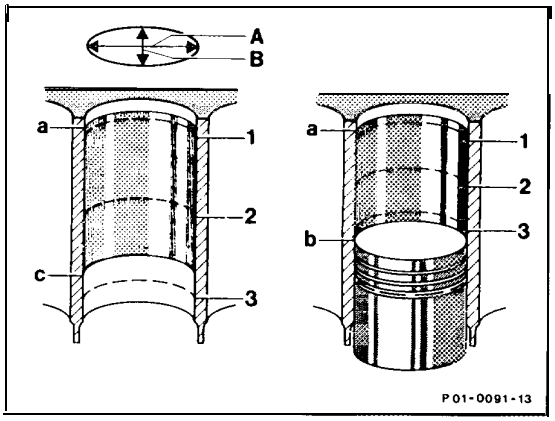
Standard **implementation:** 041'88

Model	Engine	Engine End No.	
		Manual transmission	Automatic transmission
201.028	102.985	024336	072359

When performing repairs, ensure that the tolerance stage identification of piston and cylinder bore agrees. It is possible to install pistons with a code letter identification in cylinder bores with a digit identification if this tolerance stage identification agrees according to the table. If, when performing repairs, no identical pairing is possible, reference can be made to the piston installation play of 0.016 – 0.040 mm to determine a suitable piston.

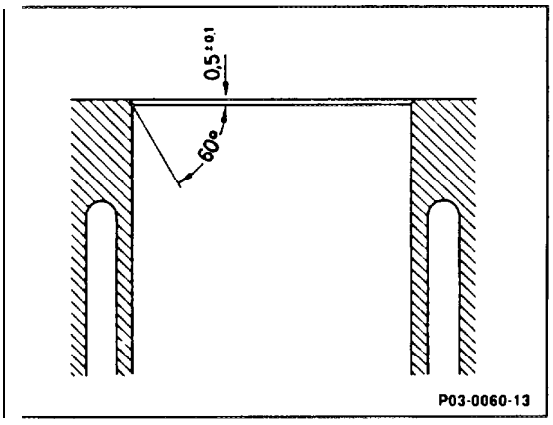
Measuring

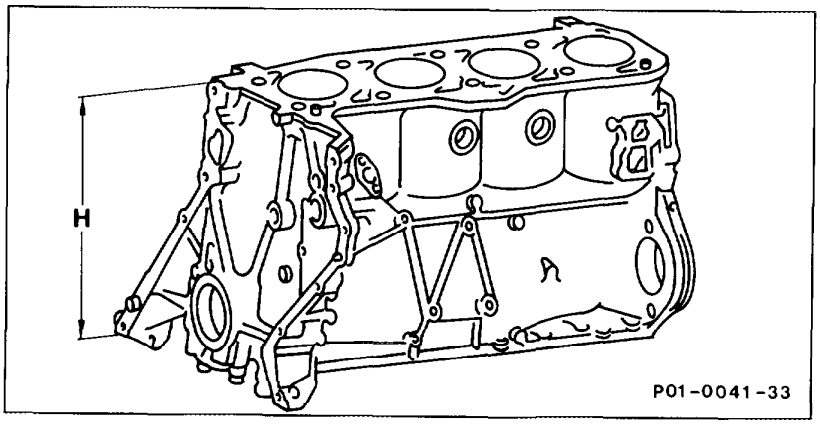
Measure the cleaned cylinder bores with an internal measuring device at measuring points 1, 2 and 3 in longitudinal direction A (piston pin axis) and in transverse direction B.
With pistons installed, measuring point 3 is just above the piston, which must be at bottom dead center.



Measuring points 1 – 3
A Longitudinal direction
B Transverse direction
a Top reversal point of 1st piston ring
b Bottom dead center of piston
c Bottom reversal point of oil scraper ring

Chamfer the cylinder bores after boring.
The material allowance for honing should be not more than 0.05 mm.





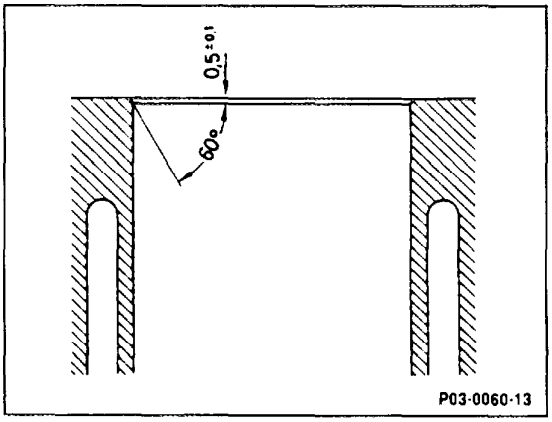
Data

Height "H" of crankcase when new		292.45 ± 0.05
Minimum height after necessary stock removal		292.35
Permissible unevenness	top crankcase mating face	0.03
	bottom crankcase mating face	0.04
Permissible variation of parallelism of top to bottom crankcase mating face in longitudinal direction		0.1
Peak-to-valley height (Rz)	top crankcase mating face	0.005 – 0.020
	bottom crankcase mating face	0.025
Test pressure with air under water in bar gauge pressure		1.5
Chamfer of cylinder bores		0.5 ± 0.1 × 60°

Note

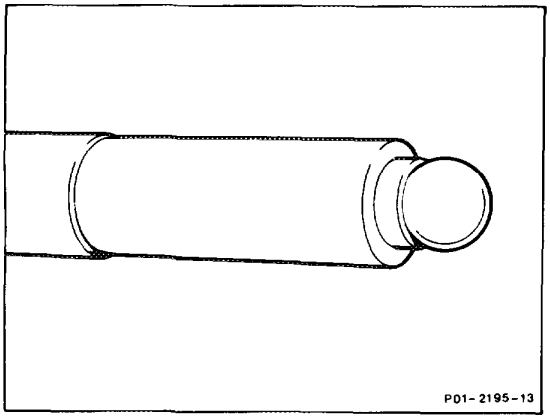
Chamfer the cylinder bores after completing machine work.

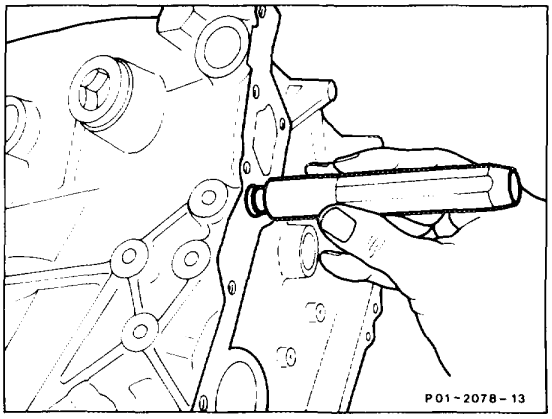
If the crankcase mating face has been remachined, the timing must be reset (05215). The timing case cover must be bolted tight to the crankcase and also be machined when machining the top or bottom crankcase mating faces.



01-130 Removal and installation of steel balls in main oil gallery

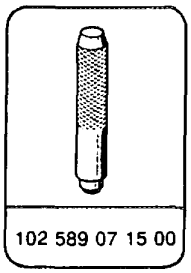
Preceding work:
Removal of engine coolant pump (20-210).
Removal of flywheel (03-410).





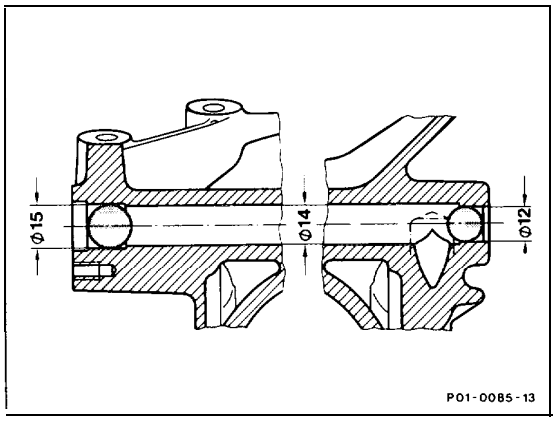
Both steel balls	knock out together from back to front with a round steel bar (dia. 11 mm, approx. 500 mm long). If the rear ball moves into the cross passage to the oil filter, remove the oil filter to enable the ball to be removed.
Bores	thoroughly clean in the area in which the steel balls are pressed in.
Cup on fitting mandrel	coat with grease and install steel ball into the cup.
Steel ball	position with the installation mandrel and knock in each at front and rear as far as the stop on the mandrel.

Special tool



Notes

The main oil gallery is closed with steel balls, dia. 15 mm at the front, dia. 12 mm at the rear.

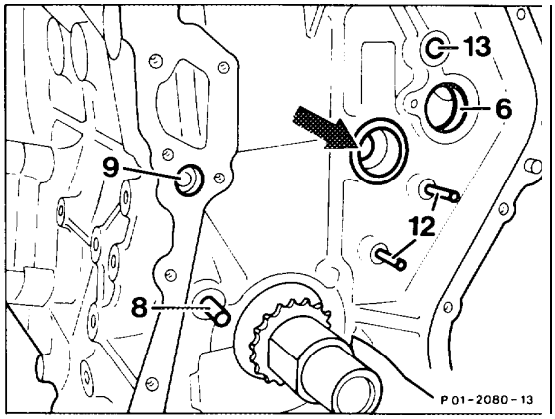


When reconditioning the engine, the steel bails must be knocked out from the rear in order to clean the main oil galleries.

Undamaged steel balls may be reused several times without machining the ball seat.

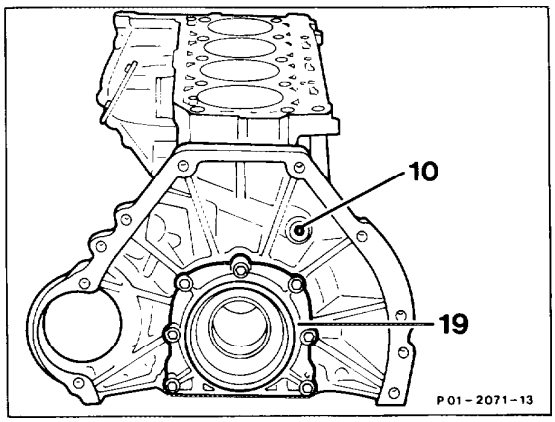
Replace damaged steel balls.

If a leak exists, reset steel balls approx. 1 mm (size is fixed on installation mandrel). Special tool 102 589 07 15 00.



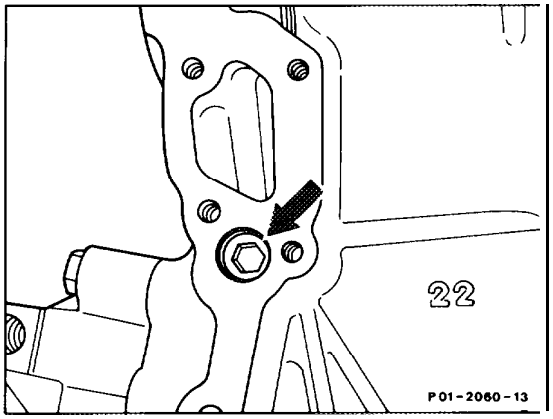
9 Front steel ball (Ø 15 mm)

Should the leaks not be repaired after this, knock out both steel balls and seal the main oil passage end in question with a screw plug.

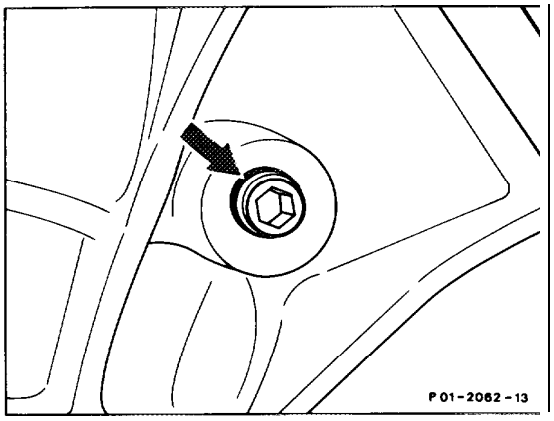


10 Rear steel ball (Ø 12 mm)

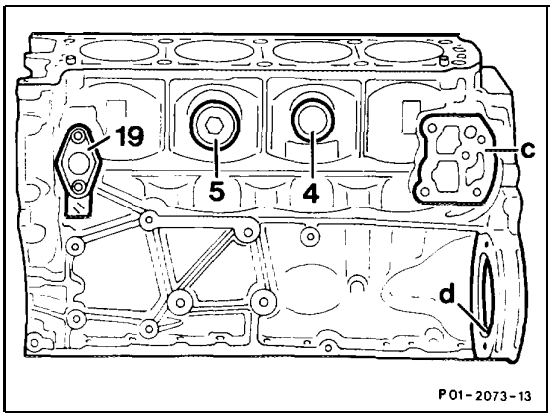
This is done by tapping an Ml 6 ✕ 1.5 thread approx. 10 mm deep at the front of the main oil gallery. Thoroughly remove chips from the oil gallery.
Coat Ml6 ✕ 1.5 screw plug Part No. 000 906 016 002 with sealing adhesive 002 989 94 71 and screw in (arrow).

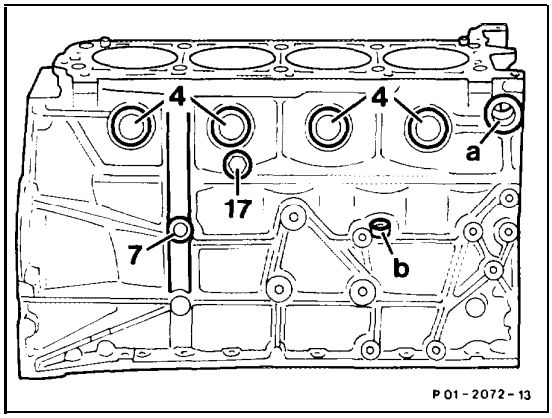


Tap an Ml 4 ✕ 1.5 thread approx. 12 mm deep into the rear of the main oil gallery. Thoroughly remove chips from the main oil gallery.
Coat Ml 4 x 1.5 screw plug, Part No. 000 906 014 000, with sealing adhesive 002 989 94 71 and screw in (arrow).



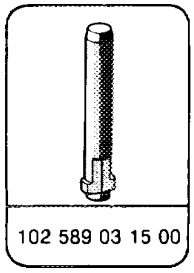
01-140 Replacing core plug in crankcase

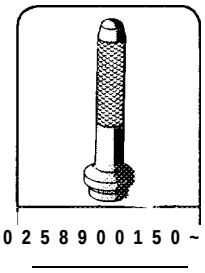




Coolant	drain completely, pour in (20-010).
Components which restrict access	remove, install.
Core plug (4)	remove. Position a chisel with narrow blade or a screwdriver in the deep-drawn edge of the plug (step 3). Carefully knock in plug on one side far enough for it to turn through its own longitudinal axis (approx. 90°), and pull out with the pliers (step 4).
Sealing surface in crankcase	Thoroughly clean of residues. The sealing surface must be free of grease.
New core plug	install. Coat sealing surface with the sealant Loctite 241, 002 989 94 71. Note curing time of approx. 45 minutes (step 6). Knock in core plug with the matching mandrel (step 7).
Engine	run until warm and check leaktightness.

Special tools



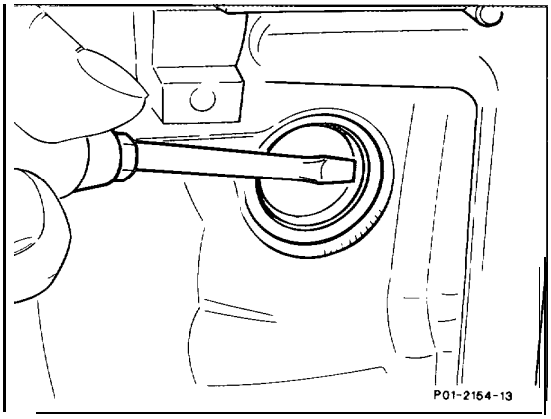


Replacement

1 Completely drain engine coolant (20-010).

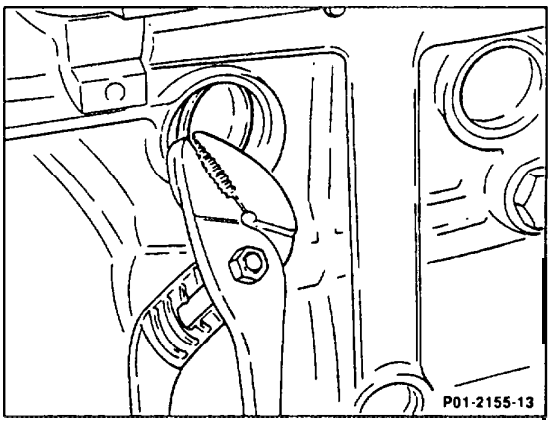
2 Remove components which restrict access.

3 Position a chisel with narrow blade or a screwdriver into the deep-drawn edge of the plug.



4 Carefully knock in plug on one side far enough for it to turn through its own longitudinal axis (approx. 90°) and withdraw with pliers.

5 Thoroughly clean sealing surface of residues. The sealing surface must be free of grease.

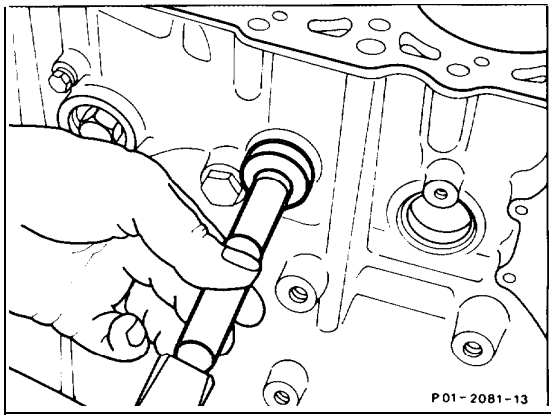


6 Coat sealing surface with sealant Loctite 241, 002 989 94 71.

Note

The sealant must cure for approx. 45 minutes before adding the engine coolant.

7 Knock in new core plug with the matching mandrel.



mm 0	Special tool
34	102 589 00 15 00
20	102 589 03 15 00

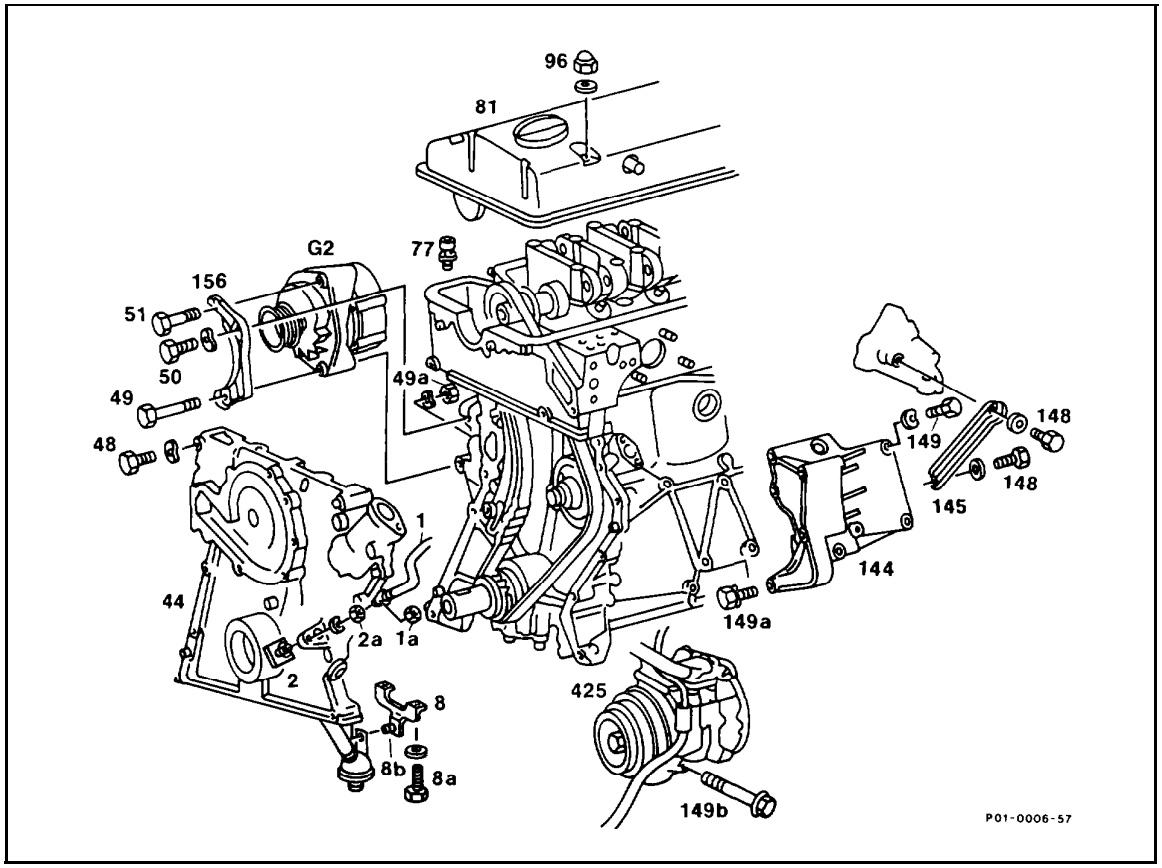
8 Install removed components.

9 Add engine coolant (20-010).

10 Run engine until warm and check leaktightness.

01-210 Removal and installation of timing case cover

Preceding work:
Removal of radiator (20-420).
Removal of power steering pump (46-710).
Removal of torsion bar (32-300).
Removal of oil sump (01-310).
Removal of V-belt tensioning device (13345).
Removal of vibration damper or hub and belt pulley (03-342)
Removal of engine coolant pump (20-210).
Removal of air filter (09-400, or 09-410).
Removal of ignition distributor (15-l 10).
Removal of pressure oil pump for level control (32640).

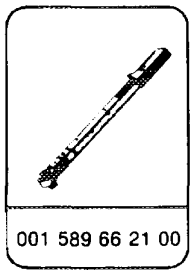


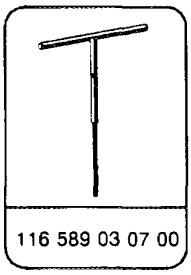
Cylinder head cover (81)	remove, install, together with ignition cable and distributor cover (01-406).
Hexagon socket bolts (77)	3 off, remove and install, 25 Nm (reference value, step 2).
Strut (145)	unbolt, bolt on, 25 Nm (step 3).
A/C compressor (425)	unscrew, screw on and place to the side with connected lines, 25 Nm. Unbolt, bolt on bracket (b), 10 Nm (step 4).

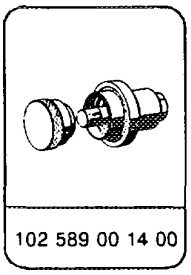
Connector (327)	unplug at alternator, plug in (step 5).
Alternator (G2)	unscrew, screw on, 30 Nm (step 6).
Bracket (156)	for alternator, unbolt, bolt on, 25 Nm (step 7).
TDC pulse generator cable (1)	unbolt, bolt on (step 8). If timing case cover has been replaced, the TDC pulse generator bracket must be adjusted (03345).
Bracket (8)	for oil pump strainer basket, unbolt, bolt on, 25 Nm, (step 9).
Timing case cover	remove remaining bolts, take off timing case cover (steps 10 and 11). Do not damage cylinder head gasket: replace cylinder head gasket if damaged.
Mating surfaces	clean (step 12).
Timing case cover	coat with sealant 001 989 25 20 and install timing case cover (steps 13 and 14). Use fitting tool 102 589 00 14 00 and spacer ring 102 589 01 14 00 for replacement of radial seal.

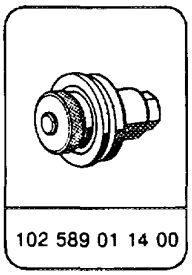
Special tools


001 589 72 21 00


001 589 66 21 00


116 589 03 07 00


102 589 00 14 00


102 589 01 14 00

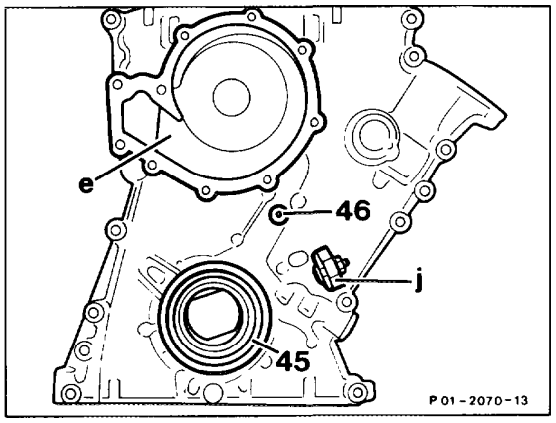
Notes

The timing case cover closes off the crankcase at the front. It is fixed in position with 2 straight pins 10 x 14 and attached to the crankcase with 15 hexagon bolts.

The timing case cover is sealed to the crankcase with the sealant Loctite 573, Part No. 001 989 25 20.

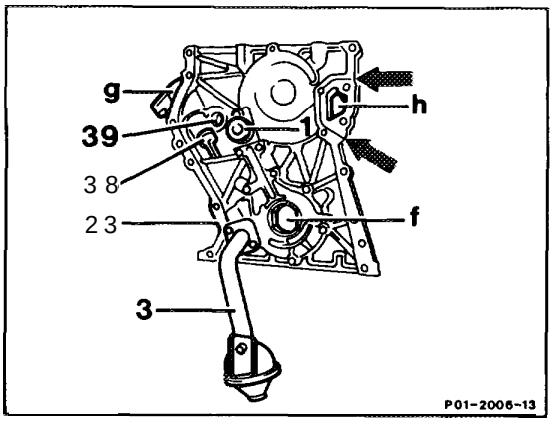
The timing case cover also acts as a support or housing for the following components or component parts:

Engine coolant pump
Ignition distributor
Oil pump
Oil overpressure valve
Radial seal for sealing crankshaft at front
Setting pointer
TDC pulse generator



Front side of timing case cover
45 Crankshaft radial seal
46 Setting pointer for TDC
e Coolant pump chamber with inlet
j Bracket for TDC pulse generator

To avoid any engine coolant mixing with the engine oil should a leak occur between crankcase and timing case cover, a groove (arrows) has been provided around the coolant inlet (h) to allow the coolant to flow to the outside.



Rear side of timing case cover
1 O-ring
23 Oil overpressure valve plug
38 Thrust piece
39 Bearing bush for Intermediate gear shaft
f Oil pump
g Mount for ignition distributor
h Coolant inlet

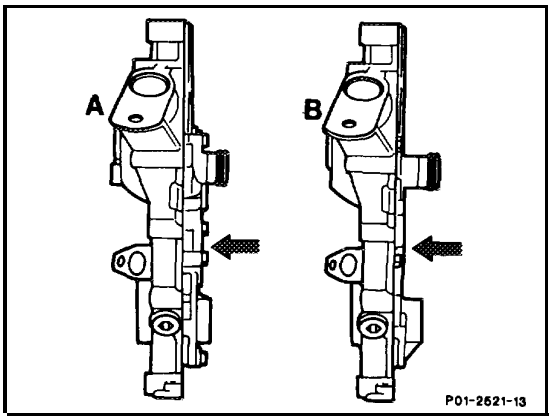
The timing case cover is always supplied as a replacement part with the oil pump installed, but without radial seal for the front of the crankshaft and without oil suction pipe with oil strainer.

Note

A gasket for sealing the timing case must not be installed on these engines (with single belt drive).

The timing case cover was modified effective 11/87.

The contours on the rear side have been lowered. This is detectible from the cast Part No. 102 015 11 01 on the front side of the cover. This timing case cover can also be installed on engines manufactured prior to this date.



A Previous version
B Present version

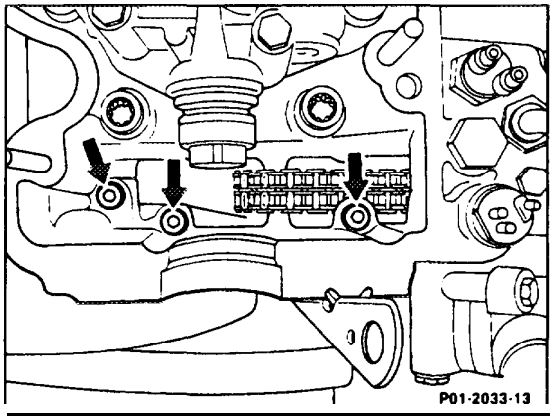
Standard implementation: 11/87

Model	Engine	Engine End No.	
		Manual transmission	Automatic transmission
201.028	102.985	020073	063591

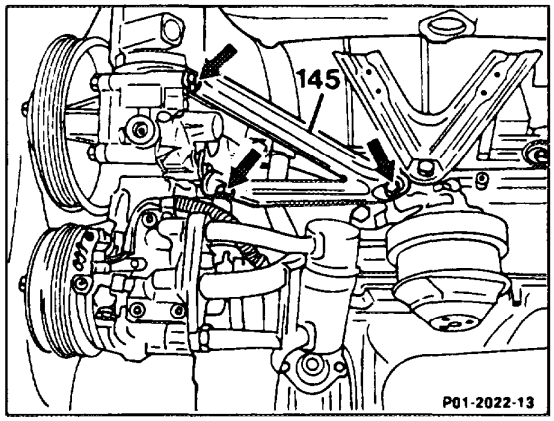
Removal

1 Remove cylinder head cover (01-406).

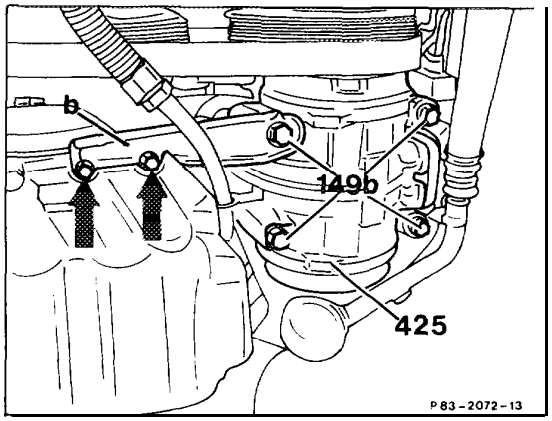
2 Remove hexagon socket bolts (3 off M8, arrows) in the chain box with a stud wrench 116 589 03 07 00. Tightening torque 25 Nm (reference value).



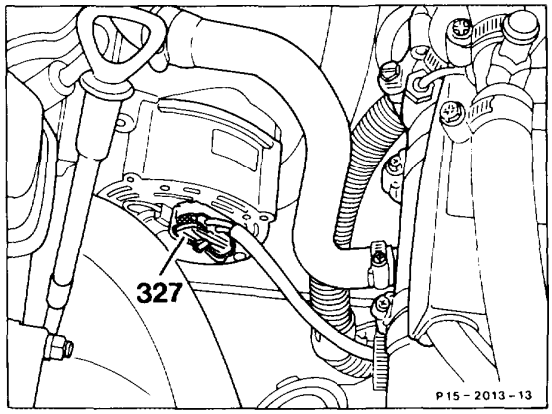
3 Remove strut (145) for power steering pump and A/C compressor (arrows). Tightening torque 45 Nm.



4 On models equipped with A/C compressor, unbolt compressor. Unbolt bracket (b) to perform this step.
Place A/C compressor to the side with the pipe group connected.

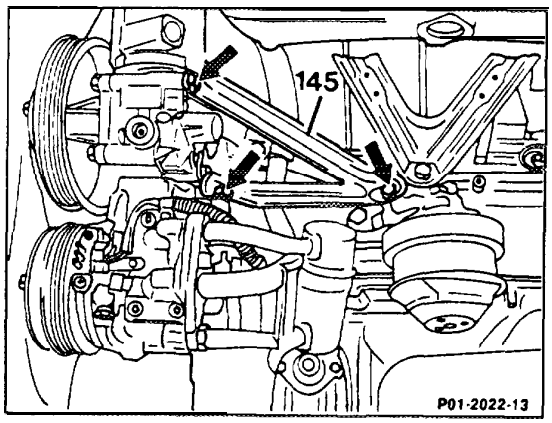


5 Unplug connector (327) at the alternator, plug in.

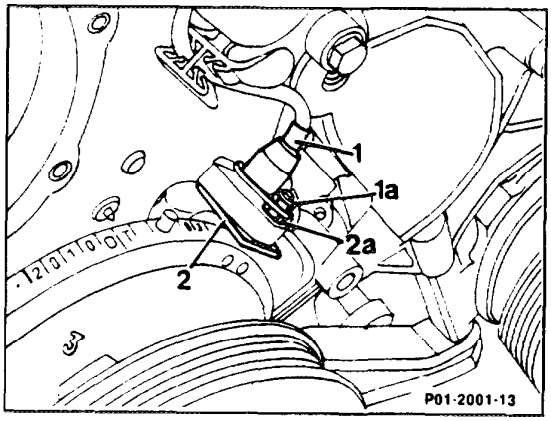


6 Remove bolts (49 and 51), bolt on; remove alternator, insert. Tightening torque 30 Nm.

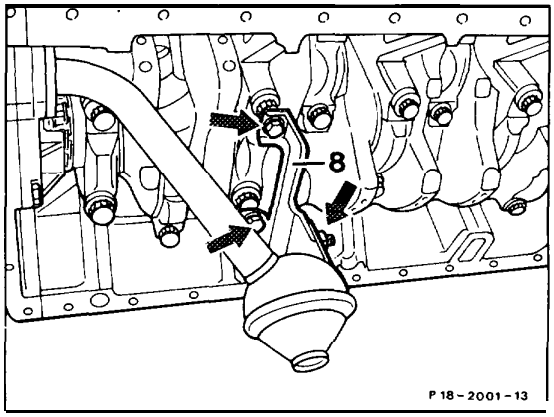
7 Unbolt bracket (156), bolt on. Tightening torque 25 Nm.



8 Unbolt TDC pulse generator cable (1) at the holder (2), screw on.



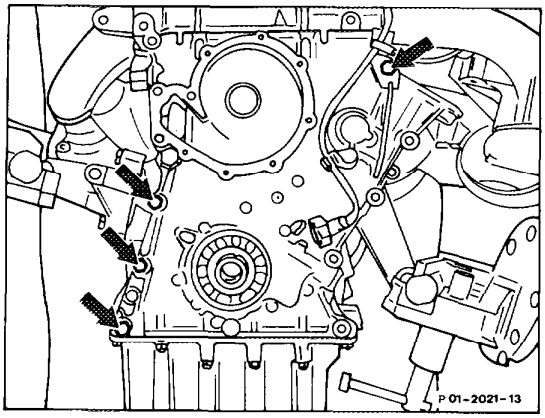
9 Unbolt bracket (8) for oil pump strainer basket, bolt on (arrows).



10 Remove remaining bolts (arrows) for timing case cover.

11 Remove timing case cover.

Caution!
Do not damage cylinder head gasket. Replace cylinder head gasket if damaged.



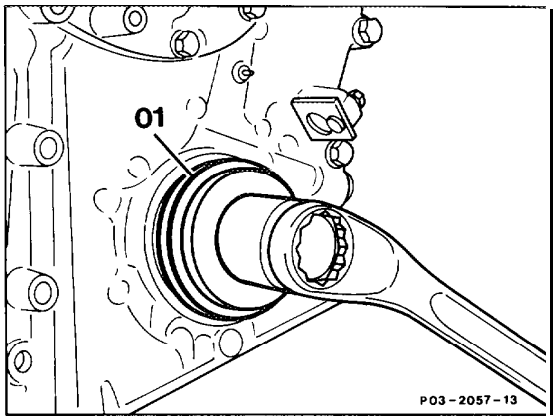
Installation

12 Clean mating faces.

13 Coat mating face of timing case cover with the sealant, Part No. 001 989 25 20.

14 Carefully install timing case cover, paying attention to the cylinder head gasket, and bolt tight.
Note bolt lengths.

15 If the radial seal has been removed, insert new radial seal with the sleeve 102 589 00 14 00.
Install spacer ring (01) 102 589 01 14 00 for the timing case cover with double roller chain.



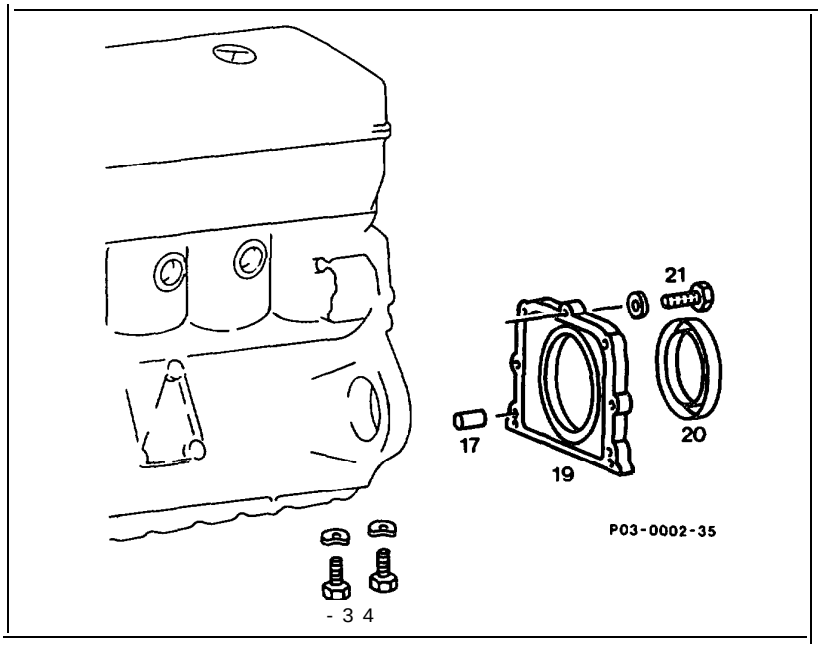
Note
If the timing case cover has been replaced, the TDC pulse generator holder must be adjusted (03-345).

16 The remaining parts are installed in the reverse order.

17 Run engine and check for leaks.

01-222 Removal and installation of end cover

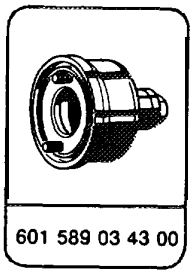
Preceding work:
Removal of transmission **(26-020** or **27-600).**
Removal of flywheel **(03-410).**

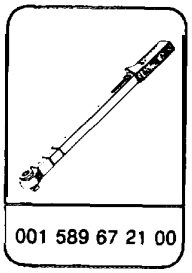


End cover (19) . . . . . remove, install (pay attention to instructions). Clean mating face, insert roll pins (17). Coat mating face and bolts (21 and 34) with sealant 001 989 45 20 10, 10 Nm.

Radial seal (20) . . . . . replace, use special tool 601 589 03 43 00.

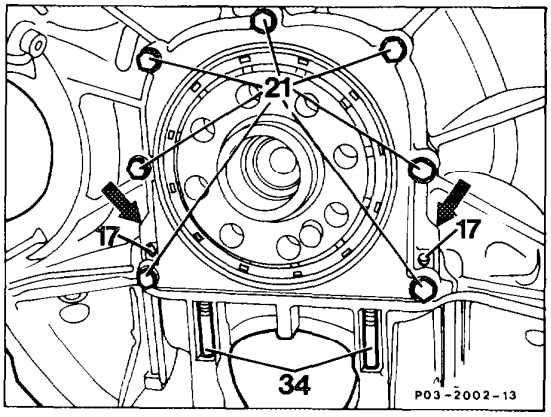
Special tools


601 589 03 43 00


001 589 67 21 00

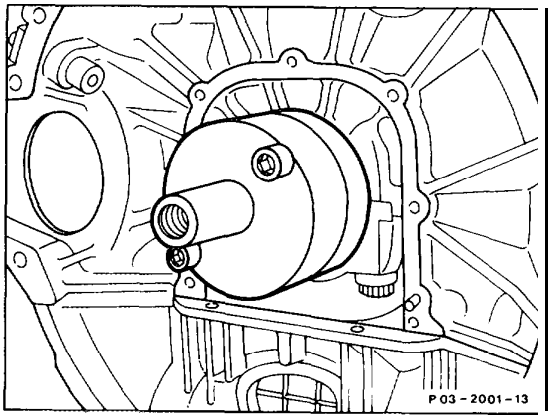
Notes

The center installation position relative to crankshaft center is fixed with two roll pins (17). Press end cover off at both side plates (arrows).



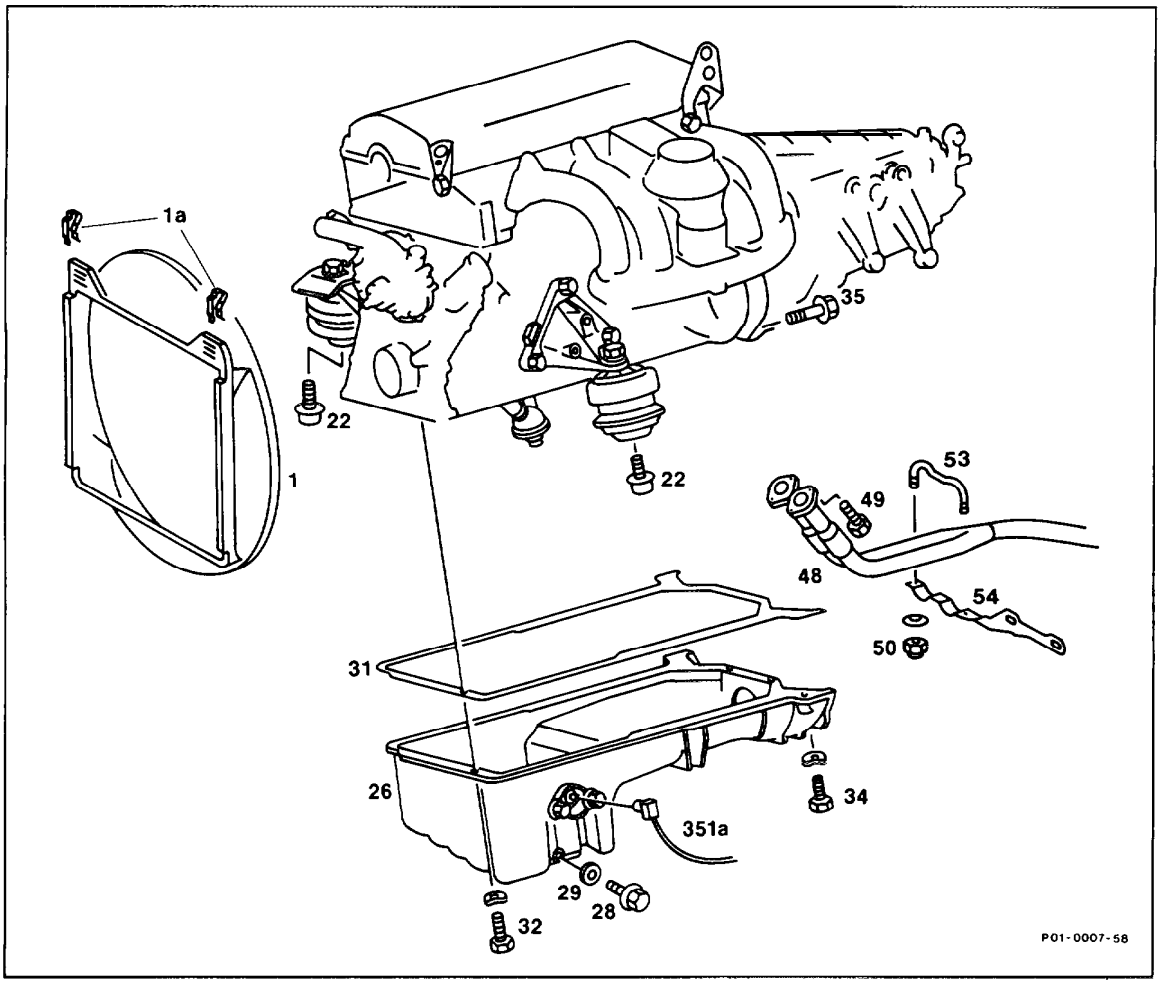
17 Roll pin
21 Bolt-washer assy (M6 x 22)
34 Bolt-washer assy (M6 x 65)

Push end cover with radial seal installed in place over the bolted-on assembly sleeve.



01-310 Removal and installation of oil pan

Preceding work:
Removal of air filter (09-400 or 09-410).
Removal of bottom engine compartment cover (01-006).
Removal of torsion bar (32-300).



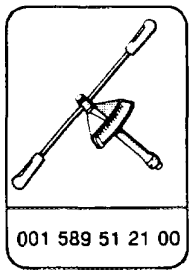
Engineoil	drain, add. Unscrew oil drain plug (28) to perform this step, screw in, 25 Nm. Replace sealing ring (29).
Cable (351a)	unplug, plug in.
Clips (la)	pull off, detach, attach fan shroud **(1),** place over fan.
Exhaust pipes (48)	unbolt at exhaust manifold, bolt on, 25 Nm (step **4).**

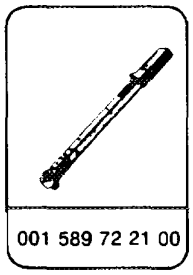
Pipe clip (53)	unbolt, bolt on, 25 Nm (step 5). Replace nuts (50).
Bolts (35)	2 off M10, unbolt, bolt on, 45 Nm (step 6).
Bolts (22)	unbolt, bolt on, 45 Nm, attach engine hoist to suspension lugs and raise (steps 7 and 8).
Oil pan (26)	remove, install. Remove bolts (32, 34) for this step, bolt on. Clean sealing surface. Replace gasket (31) (step 9). Tightening torque: M6 10 Nm, M8 25 Nm.

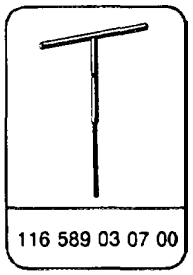
Oil capacity in litres

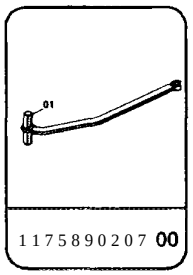
Total capacity for oil and filter change	5.5
Oil pan max. / min.	4.8 12.8

Special tools









Commercial tool

Engine hoist No. 3180	e. g. Messrs. Backer Herderstraße D-5630 Remscheid

Shop-made tools

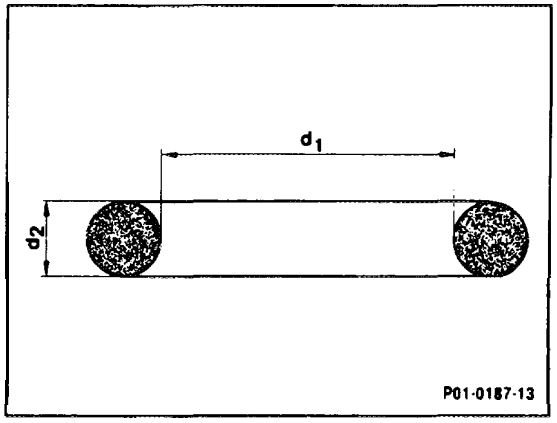
Metal panel for component compartment wall	Dimensions: approx.320 × 380 × 1
Guard plate for radiator/evaporator	Dimensions: approx. 480 × 600 × 1

Note
The O-ring for sealing the oil level pickup to the oil pan has been improved. In addition, the diameter has been increased from 3 mm to 3.15 mm. Color: green (previously black).

Standard implementation: 09/86

Model	Engine	Engine End No.	
		Manual transmission	Automatic transmission
201.024 (USA)	102.985	004381	040652

In June 1987 the O-ring of the oil level pickup was once again modified.



Modification

Size	Previous version mm	Present version mm
d_1	40.20	37.20
d_2	3.15	3.2

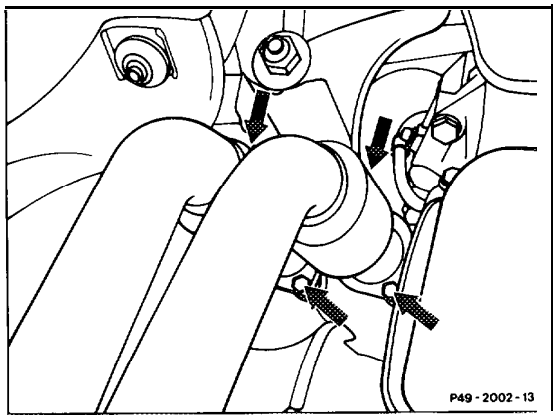
Removal and installation

1 Drain engine oil.

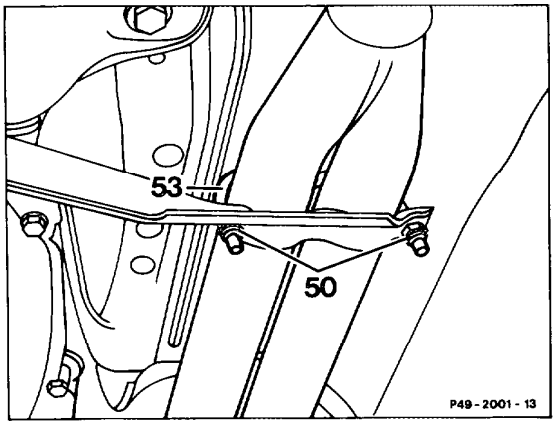
2 Unplug cable (351a) at the oil level pickup, plug in.

3 Detach clips (la) for fan shroud, detach, attach fan shroud (1), place over fan.

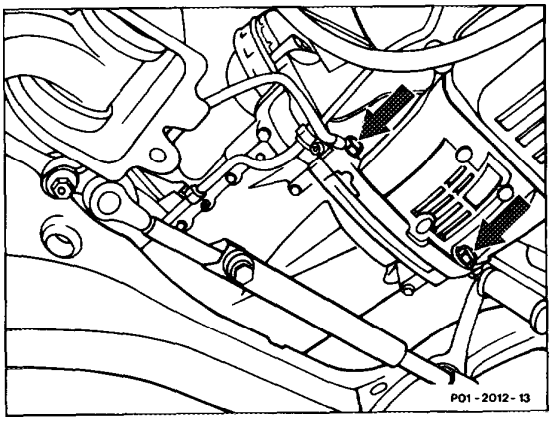
4 Unbolt exhaust pipes at exhaust manifold, bolt on (arrows).



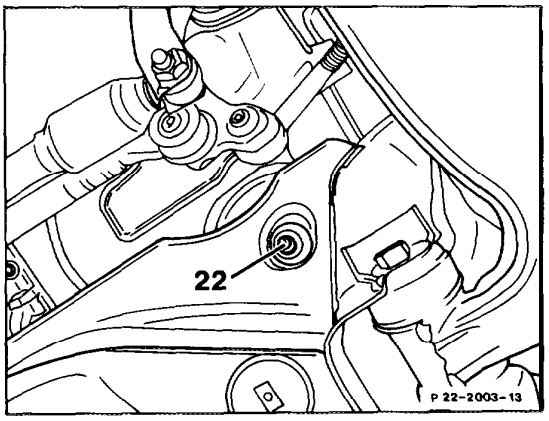
5 Unscrew pipe clip (53) at the front exhaust bracket to the transmission. Replace nuts (50). Tightening torque 25 Nm.



6 Remove two bolts at the transmission – engine joint (M10, arrows), bolt on. Tightening torque 45 Nm.



7 Remove both bottom bolts (22) for engine mounting fixture, bolt on. Tightening torque 45 Nm.

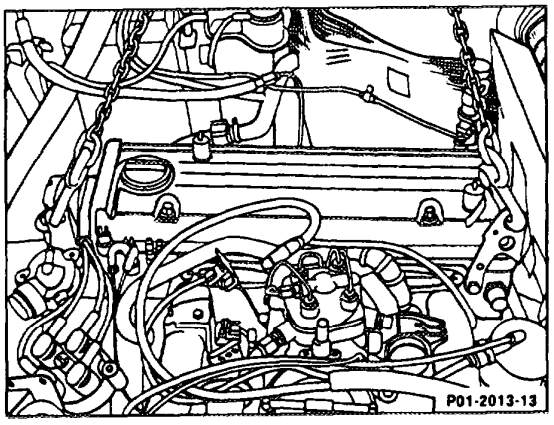


Len side shown

8 Raise engine with the engine hoist.

9 Remove remaining bolts (32, 34) for attaching oil pan, bolt on and remove oil pan. Tightening torque:
M6 10 Nm,
M8 25 Nm.

10 Carefully clean mating face at oil pan and on crankcase.



11 install oil pan with new gasket. Pay attention to bolt lengths and tightening torques.

12 Lower engine and attach engine mounts.

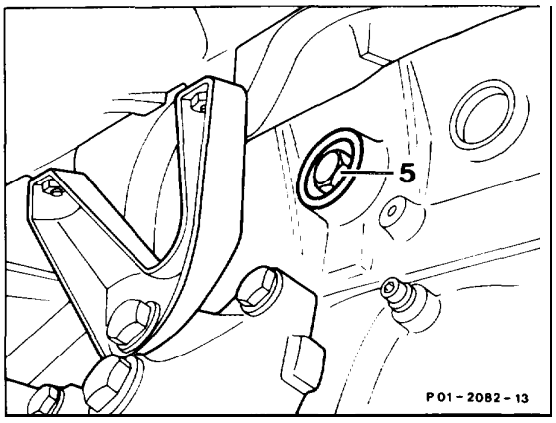
13 Add engine oil and adjust to correct level.

14 Check for leaks with engine running.

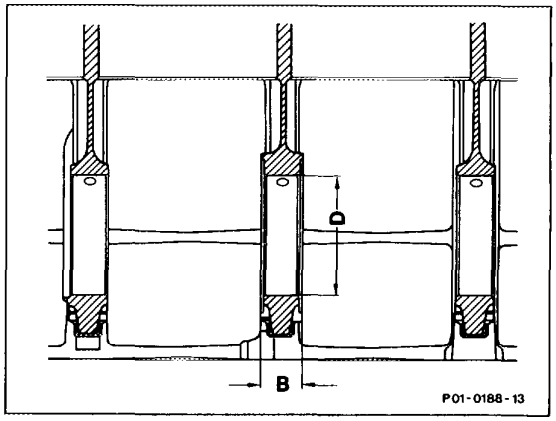
Crankcase

The tapped hole for attaching the power steering pump carrier (compared to engines with multi-belt drive) have been converted from M8 to M10.

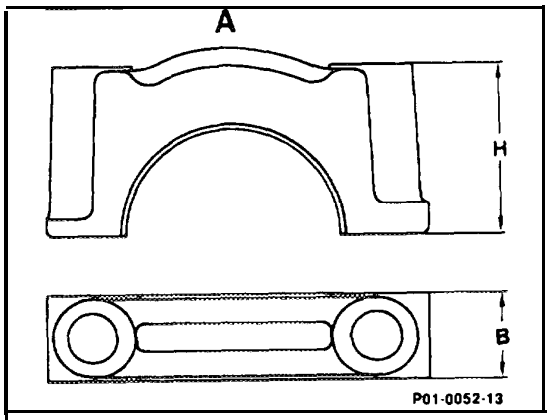
The M 38 × 1.5 tapped hole for mounting the coolant preheater on the left side is shorter. It is sealed with a screw plug (5) and an O-ring from engines 116/117 and 601.



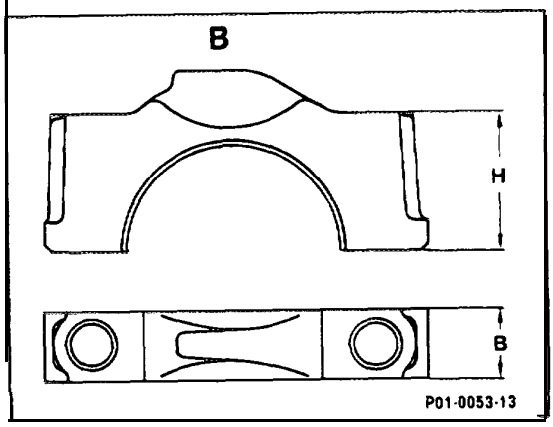
The crankshaft bearings in the crankcase have been modified (size "B").
Multi-belt drive = 24 mm
Single-belt drive = 20 mm



At the same time, the crankshaft bearing covers are 8 mm lower (H = 40 mm).

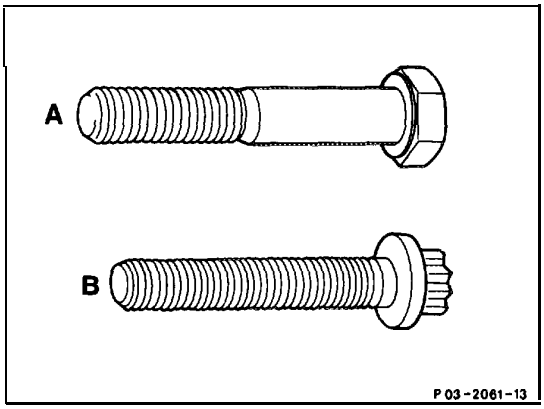


Engines with multi-belt drive (102.985)
H = 48 mm



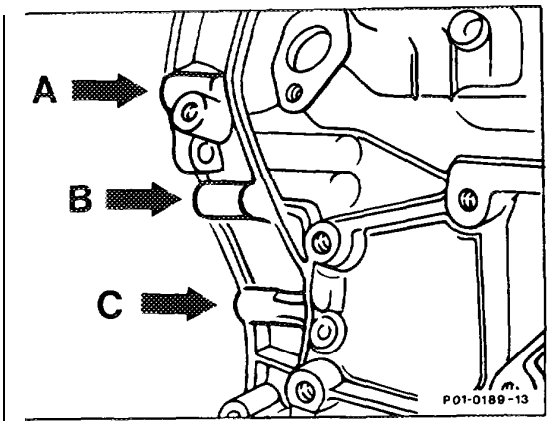
Engines with single-belt drive (102.961)
H = 40 mm

Fastening bolts of the crankshaft bearing covers converted to Ml 1× 62 twelve-side stretch bolts with collar. Previously, Ml 2 x 70 hexagon bolts.

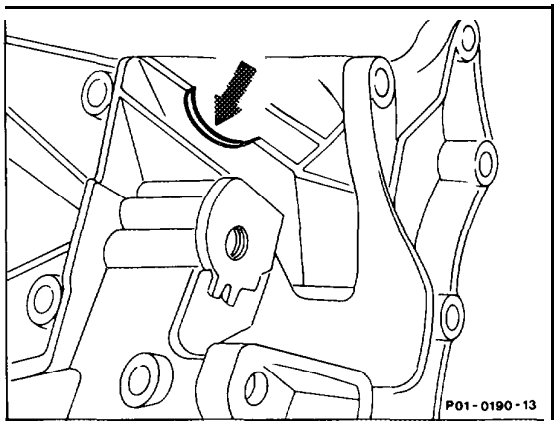


A M 12 x 70 hexagon bolts
B Mt 1 x 62 twelve-side stretch bolt

Bolt projections (A, 6, C) on crankcase for fastening bolts of timing case cover lengthened.



Because of the lengthened bolt extensions, the power steering pump carrier has been provided with a semi-circular cutout at the second reinforcing rib (arrow).



Standard Implementation: 06186

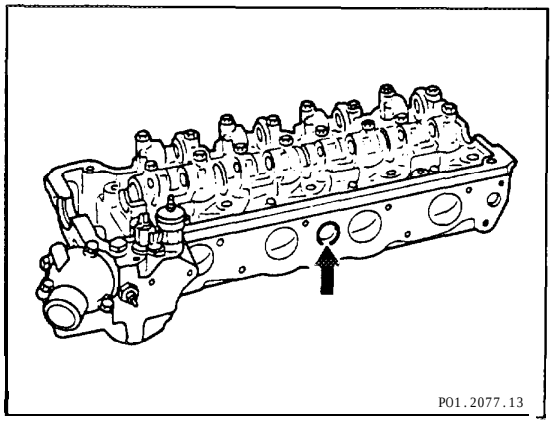
Model	Engine	Engine End No.		Vehicle Ident End No.	
		Manual transmission	Automatic transmission	A	F
201.024 (USA)	102.985	003938	036445	313424	246820

Cylinder head

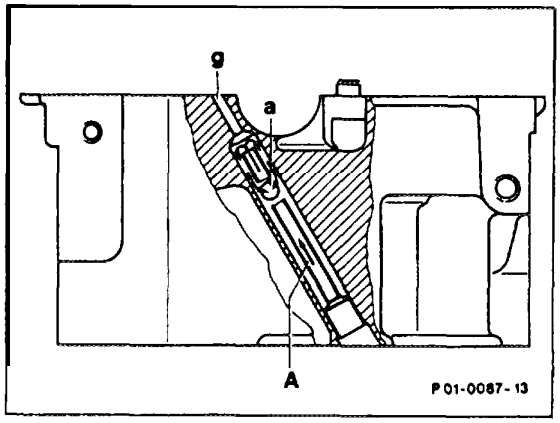
The same cylinder head is installed on engines 102.9221924 as on engines 102.962/982/985.
Only one cylinder head version is supplied as a replacement part.
This cylinder head must not be installed on the previous engine 102.961.

A core plug, Part No. 000 443 025 003 should be inserted with MB sealant 002 989 94 71 and the installation mandrel 102 589 02 15 00 for engine 102.985.

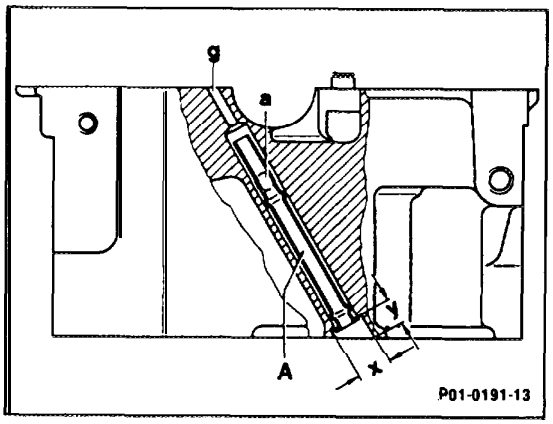
Caution!
If the core hole is not closed (arrow), coolant may get into the cylinders on engine 102.985.



An oil pipe (A) is inserted in the oil feed passage at the rear of the cylinder head to prevent the oil passages running empty when the engine is off.

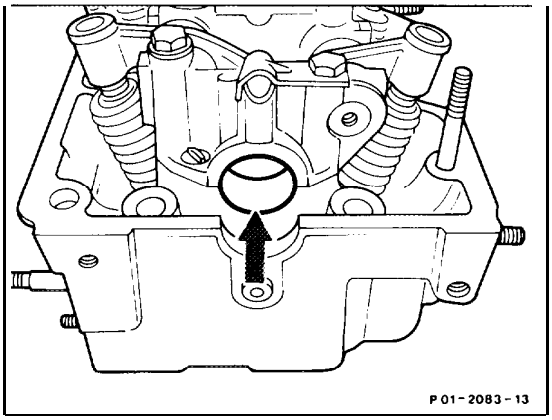


Since 071'87 the oil pipe (A) has a stop collar (arrow). This prevents the oil pipe "migrating upward" in the cylinder head. At the same time, the recess in the cylinder head has been modified.



Dimension	Previous version	Present version
X	9.0 mm	9.5 mm
Y	7.0 mm	7.0 mm

No oil passage is provided at the 4th bearing point for camshaft lubrication (arrow).



Cylinder head gasket

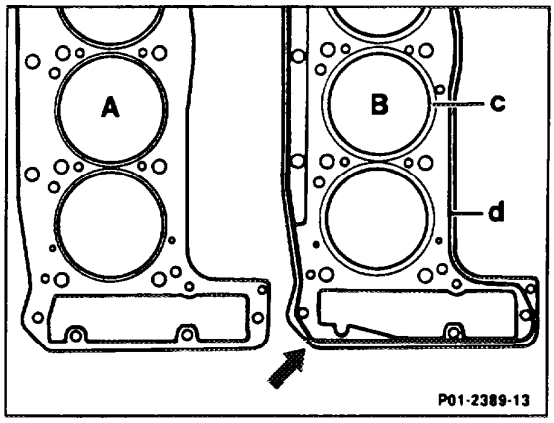
Cylinder head gaskets of asbestos-free material were installed for a certain period on engines 102.985.

Standard implementation: February – March 1988 (manufacturer Elring)

Model	Engine	Engine End No.		Vehicle Ident End No.	
		Manual transmission	Automatic transmission	A	F
201.028	102.985	022847 – 023481	068903 – 070235	437591 – 441023	*

* not covered

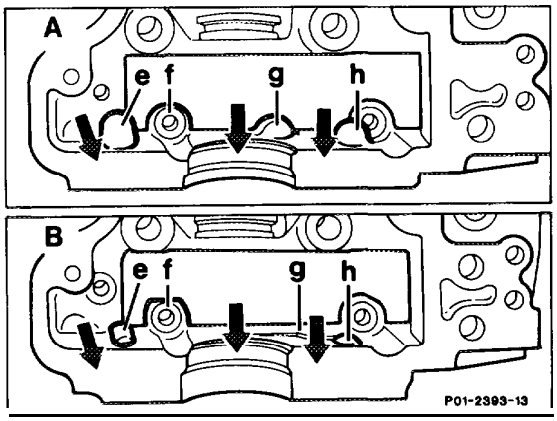
The cylinder head gasket in the chain box area was modified with implementation of the double roller chain (B, arrow).
In addition, sealing surfaces with modified coating and widened combustion chamber chamfered faces (c) as well as silicone strips (d) running all round the outer edge.



Standard implementation: 01/88

Model	Engine	Engine End No.	
		Manual transmission	Automatic transmission
201.028	102.985	021822	066697

To achieve greater clearance for the double roller chain, the front wall at the cylinder head was lengthened. In addition, the bolt extensions were flattened off at the radius (f).



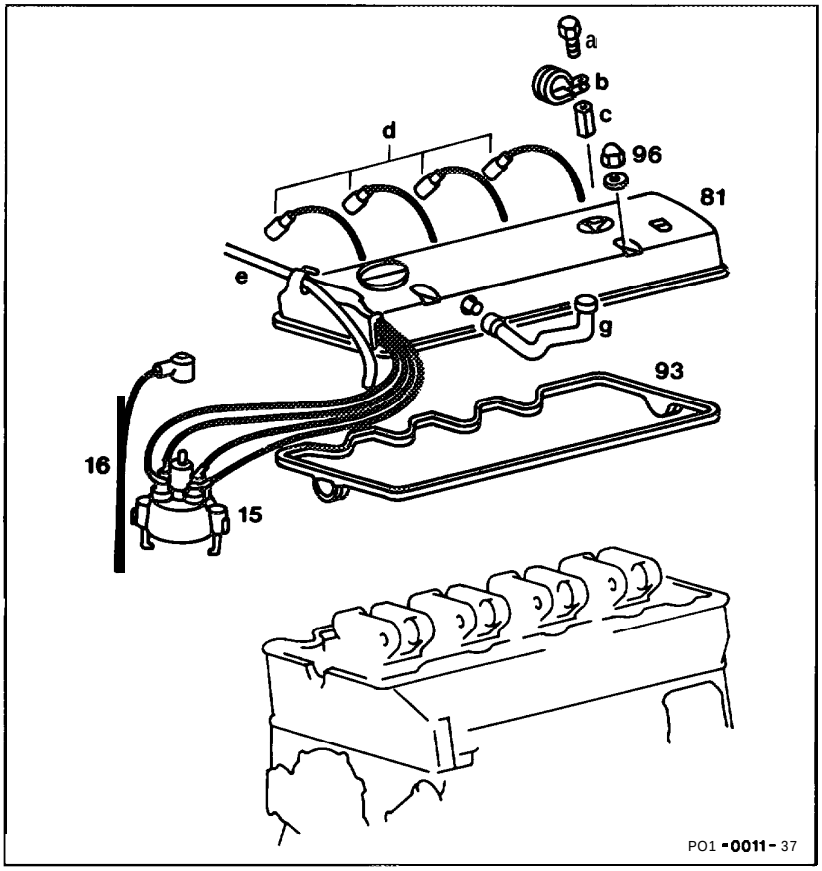
A Single roller chain
B Double roller chain

Standard implementation: 01188

Model	Engine	Engine End No.	
		Manual transmission	Automatic transmission
201.028	102.985	022013	067143

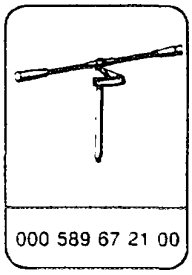
01-406 Removal and installation of cylinder head cover

Preceding work:
Removing air filter (09-400 or 09-410).



Ignition cable (16)	unplug at distributor cover, plug in.
Ignition distributor cover (15)	unbolt at distributor, bolt on.
Spark plug connector (d)	detach from spark plugs, fit on.
Vent line (e)	detach, attach.
Holder (b)	unbolt, bolt on if equipped with automatic transmission.
Cap nut (96) or hexagon nut (c)	unbolt, bolt on, 15 Nm.
Cylinder head cover (81)	remove with ignition cables, refit. Pay attention to instructions.
Gasket (93)	check, replace if necessary.

Special tool

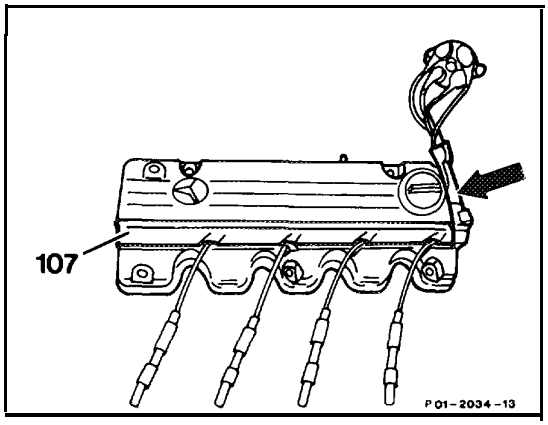


Notes

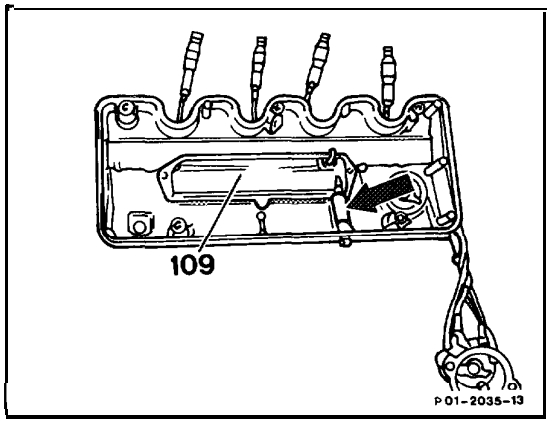
The cylinder head cover is manufactured from a magnesium alloy and is coated on the outside with a black colored plastic.

A two-part, glass fibre reinforced polyamide rectangular tube (107) in which the ignition cables run is inserted in a longitudinal groove of the cylinder head cover.

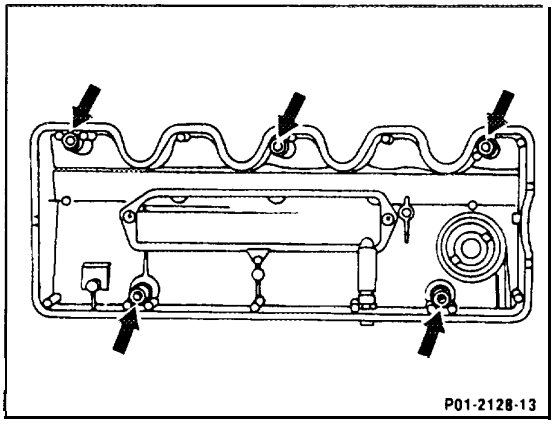
In addition, the ignition cables and the vent line at the face end of the cylinder head cover run through a plastic holder (arrow).



On the inside, the oil separator (109) and the related outlet pipe are fixed in place with the hose piece (arrow) of the crankcase ventilation (function description 01-140).



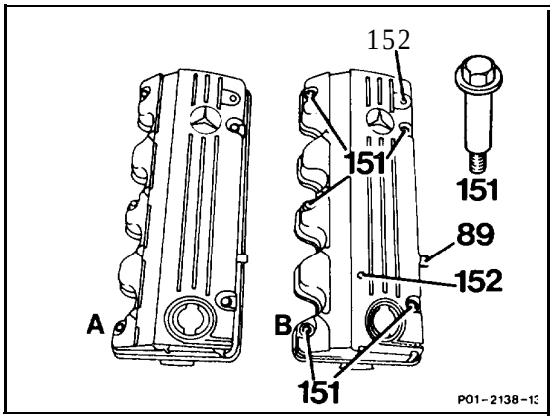
The spacer sleeves (arrows) prevent the gasket being squeezed when tightened.



In January 1986 a cylinder head cover made of plastic was fitted (on engines without pressure oil pump for level control).

Distinguishing features:

- Collar bolt (151)
- Hose connection for crankcase ventilation with larger OD.

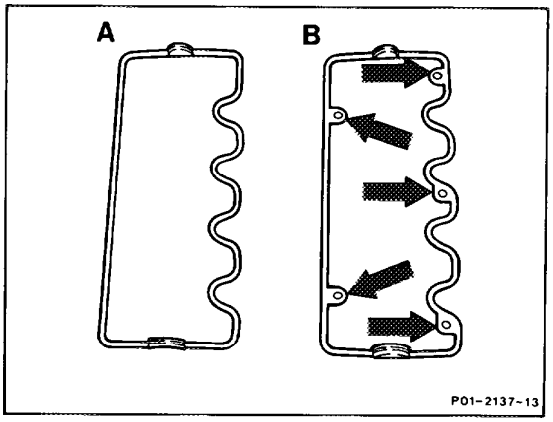


A Cylinder head cover (magnesium)
B Plastic cylinder head cover

The cylinder head gasket has wider plates (arrows) for sealing the bolt guides.

Caution1

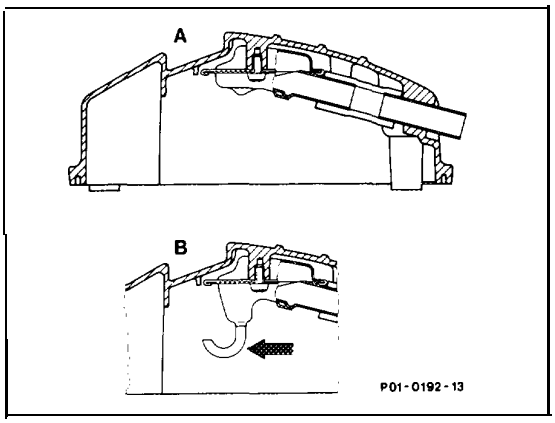
If the cylinder head cover has to be replaced, e. g. because of cracking, install the previous magnesium cylinder head cover.



Model affected

Model	Vehicle Ident End No.	
	from	to
201.024	A 277147 F 159163	280307 192314

As of February/March 1985 the oil separator is installed in the cylinder head cover with a vent pipe.



A 1 st version
B 2nd version

Standard implementation: 02/85

On models with level control

Model	Engine	Engine End No.		Chassis End No.
		Manual transmission	Automatic transmission	
201.024 (USA)	102.985	001321	011371	A 198009 / F 084320

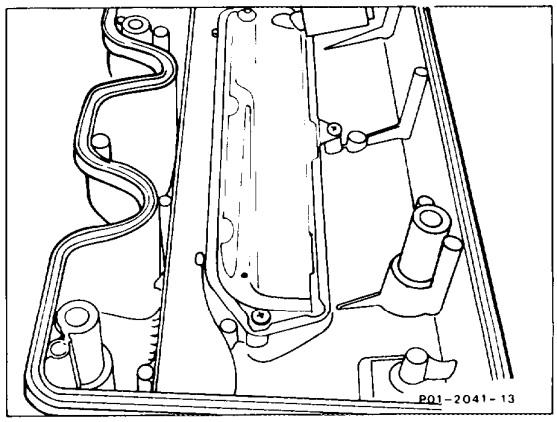
Standard implementation: 03/815

Model	Engine	Engine End No.		Chassis End No.
		Manual transmission	Automatic transmission	
201.024 (USA)	102.985	001460	012597	

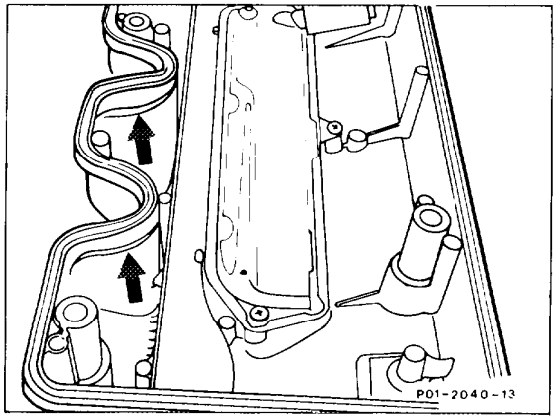
Since 12/88 **a** cylinder head cover has been installed which has a recessed wall (arrows) in the area of the spark plug recesses.

This prevents the valve spring or the valve spring plate rubbing the cylinder head cover and causing noises.

The modified cylinder head cover can also be installed on previous engines in the event of complaints.



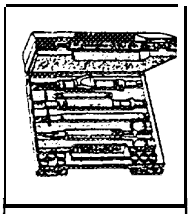
Cylinder head cover **1 st** version



Cylinder head cover 2nd **version**

01-407 Reconditioning spark plug thread In cylinder head

Special tool

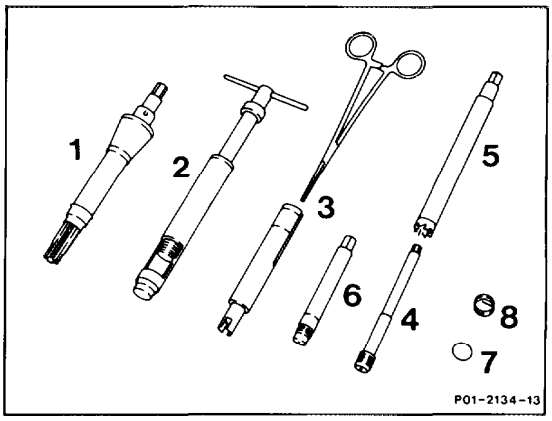


102 589 00 99 00

Note

The spark plug threads in the cylinder head can be reconditioned on all gasoline engines with the HELI-COIL repair set.

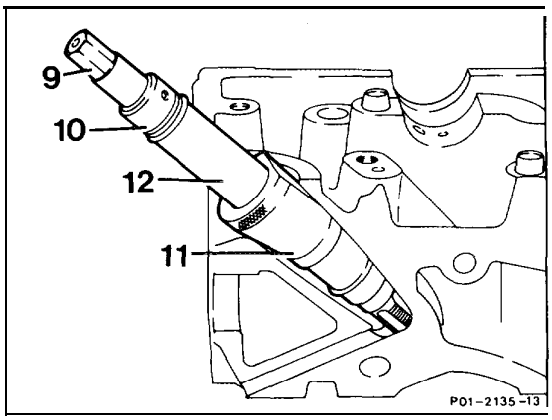
The cylinder head should only be removed for reconditioning the spark plug thread if the spark plug bore in question is not accessible for the tool.



Recondltionina

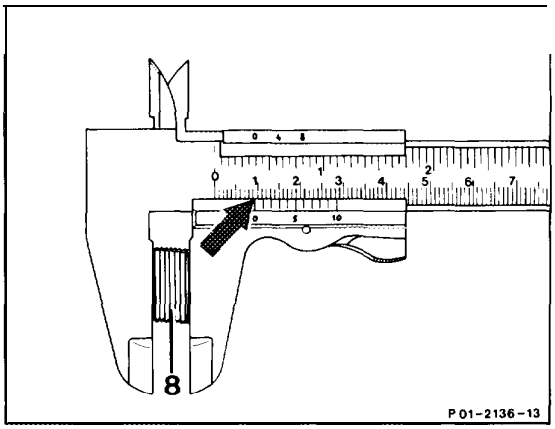
1 Set piston at the cylinder in question to 20° – 30° before TDC.

2 Pack grooves of the combination tap (9) of the tapping unit (1, ill. note) with grease and screw combination tap into the damaged thread. At the same time, press the guide bush (11) into the spark plug recess. Screw in combination tap far enough for the guide tube (12) to move up and be touching the stop ring (10).

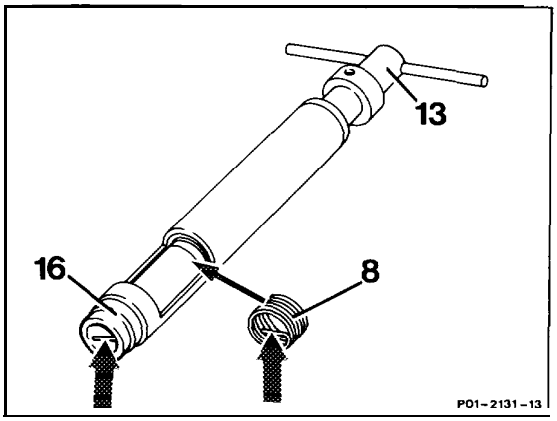


Caution!
If the cylinder head is installed, unbolt combination tap after approx. each five turns, clean grooves of swarf and grease and again pack with grease.

3 Check length of the HELI-COIL thread insert (8).
Use only the HELI-COIL inset-t with 9.1 mm block length.



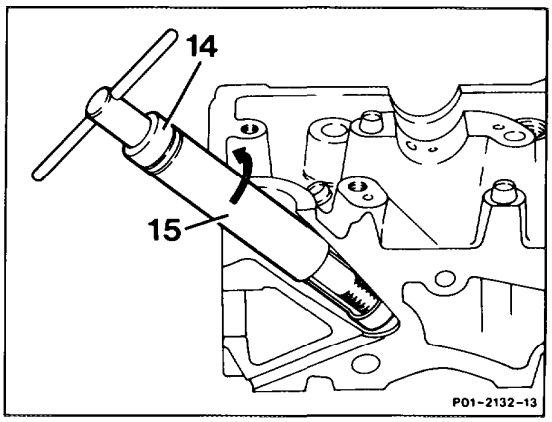
4 Install HELI-COIL thread insert. To perform this step, insert HELI-COIL insert (8) into the tool (2, ill. note) so that the bar (arrow) of the insert is facing the preload cartridge (16).
Turn HELI-COIL insert with the turning spindle (13) far enough through the preload cartridge until the bar (arrow) is flush with the face of the preload cartridge.



Install installation tool onto the tapped hole, hold jacket sleeve (15) tight and turn spindle for long enough until the stop ring (14) is touching the jacket sleeve.

Note

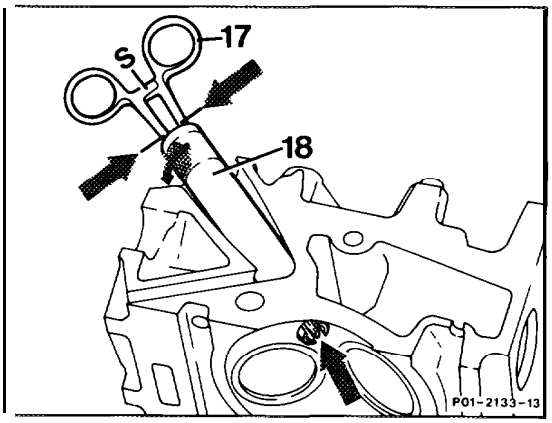
When installing the HELI-COIL thread insert, turn back jacket sleeve slightly (15) if it is jamming.



5 Break off bar (arrow) of the HELI-COIL thread insert.

This is done by installing the sleeve (18) of the bar breaking unit (3, ill. note) over the bar, introducing the opened pliers (17) as far as the mark (arrow) into the sleeve and closing pliers. The serrated tooth lock (s) must engage.

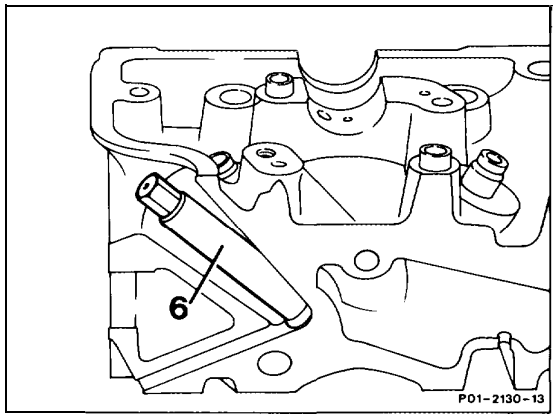
Turn sleeve to the left as far as the stop and hold tight. Move pliers slightly up and down and break off bar.



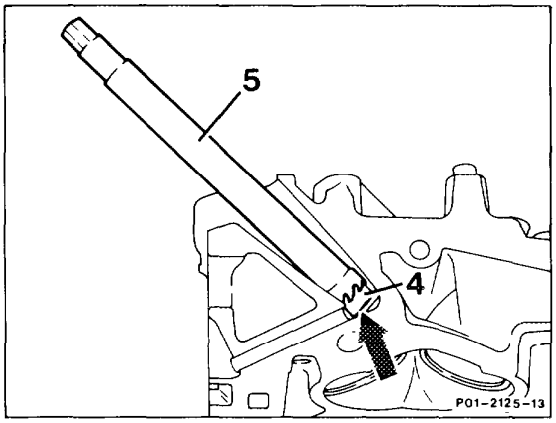
Caution!

It is essential to remove a bar which may have dropped on the piston crown with a magnet.

6 Caulk HELI-COIL thread insert. This is done by greasing the conical thread of the caulking tool (6), screwing caulking tool into the fitted HELI-COIL insert, tightening to 25 Nm and removing the caulking tool.



7 Mill mounting seat for the copper seal (7). This is done by screwing in the guide mandrel (4) far enough for the stop collar (arrow) to be touching the tapped hole.
Push milling cutter (5) over guide mandrel and mill the seat for the sealing ring. Always blow out the chips from time to time.
Once the milling cutter is seated on the stop collar of the guide mandrel, the required milling depth is reached (no further cutting resistance).

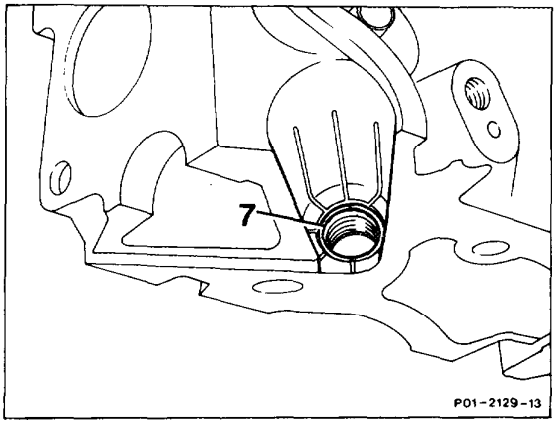


Once again thoroughly blow out spark plug recess before then removing the guide mandrel. Turn crankshaft several times with starter motor and contact handle in order to remove any chips which may have dropped onto the piston crown.

8 Place copper seal (7) into the milled mounting seat, screw in spark plug and tighten to 30 Nm.

Note

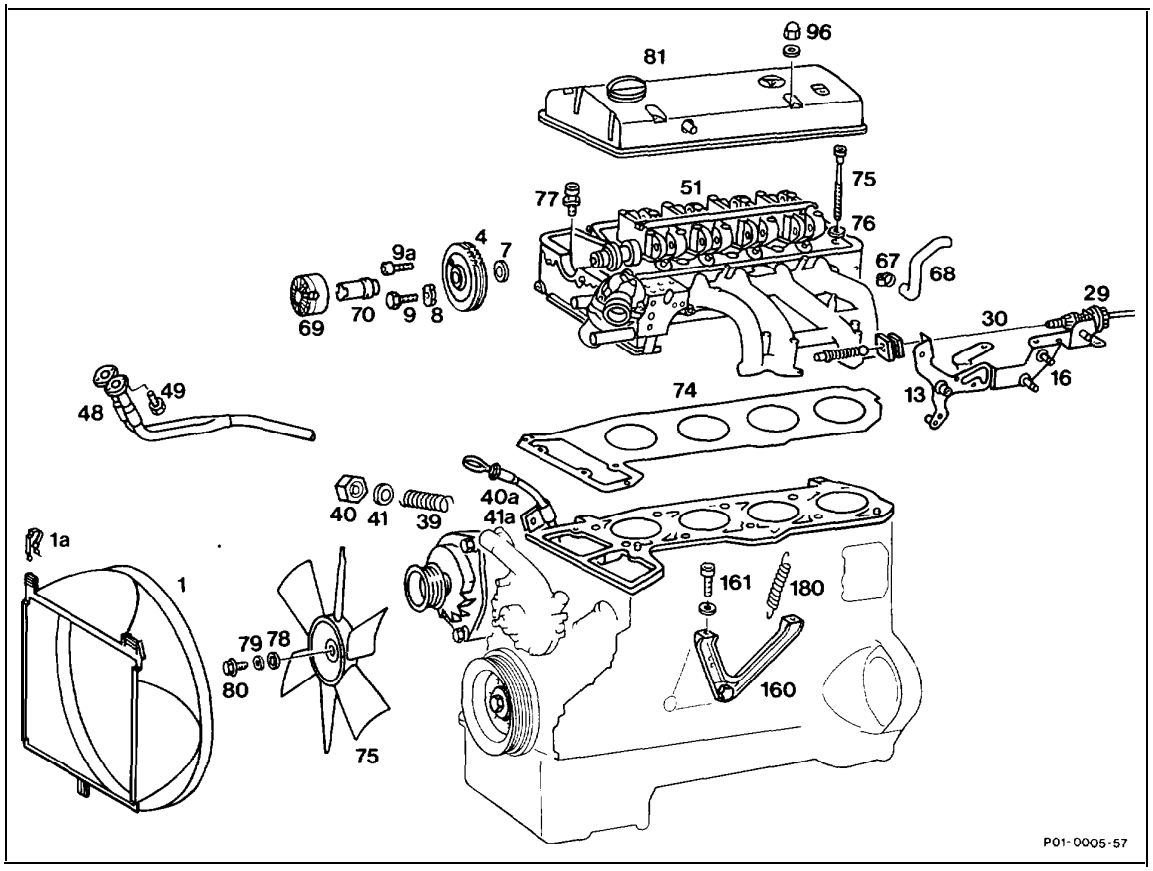
When performing this step, the tapered seat of the spark plug is pressed into the copper seal.



9 Loosen spark plug fully and tighten to 15 Nm.

01-415 Removal and installation of cylinder head

Preceding work:
Removal of air filter (09-400).
Draining engine coolant (20-010).
Removal of guide rail in cylinder head (05-340).
Removing poly V-belt (13-342).



Fan shroud (1) and fan (75)	remove, install, 25 Nm (steps 1 and 2).
Cylinder head cover (81)	remove, install, with ignition cable and distributor cover (01-406).
Exhaust pipes (48)	unbolt at exhaust manifold, bolt on, 25 Nm (step 4).
Dipstick guide tube (40a)	unbolt, bolt on (step 5).
Bowden cable (30)	detach, attach, adjust (30-325, step 6).
Intake manifold strut (160) and return spring (180)	at intake manifold, unbolt, bolt on, return spring, detach, attach (steps 7 and 8).

Engine coolant hose (68) supply line for heater	disconnect, connect (step 9).
Engine wiring harness	disconnect, connect (steps 10 to 14).
Brake booster vacuum line	disconnect, connect (step 15).
Fuel lines	disconnect, connect, dump overpressure (step 16).
Air conditioning pipe group holder	disconnect, connect (step 17).
Piston of No. 1 cylinder	set to ignition TDC (step 18).
Alternator	swing away to the outside (steps 19 and 20).
Closing nut (40)	for chain tensioner, remove and install, replace sealing ring (41) (05310, step 21).
Camshaft gear (4)	mark relative to timing chain (step 22).
Pressure oil pump (69)	unbolt, bolt on, place to the side with lines connected (step 23).
Camshaft gear (4)	unbolt, bolt on, 80 Nm, check TDC marking (steps 24 and 25).
Hexagon socket bolts (77)	unbolt, bolt on with pin wrench 116 589 03 07 00, 25 Nm (reference value), (step 26).
Cylinder head bolts (75)	unbolt, bolt in, check, tighten (steps 27, 31 to 33). Refer to table for tightening torques.
Cylinder head (51)	remove, refit, clean mating surfaces, replace cylinder head gasket (74) (steps 28 to 30).

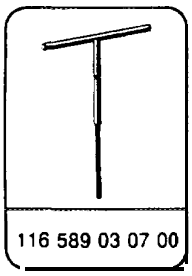
Tightening torques in Nm and angle of rotation torque

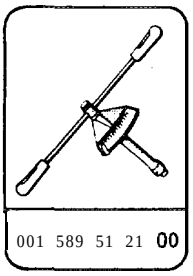
Diagram for step-by-step tightening: refer to step 31 for order:

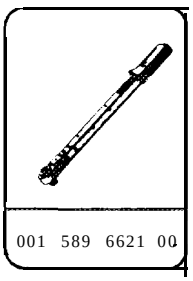
Step-by-step tightening **angle of rotatlon torque** when engine cold

	1st stage	2nd stage	3rd stage
M12 cylinder head bolts	55 Nm	90°	90°
Hexagon socket bolts	25 Nm (reference value)	–	

Special tools


116 589 03 07 00


001 589 51 21 00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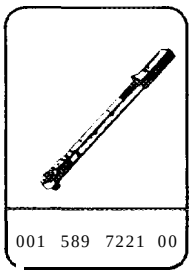
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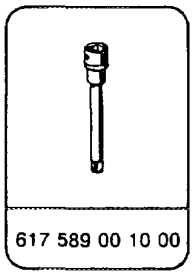

617 589 00 10 00

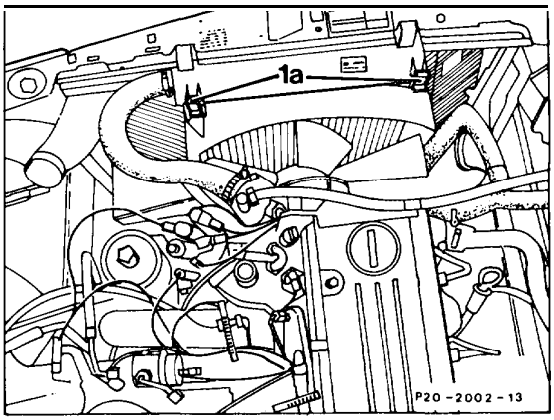
Note
Remove cylinder head together with camshaft, intake manifold and exhaust manifold once engine has cooled down.

Removal and installation

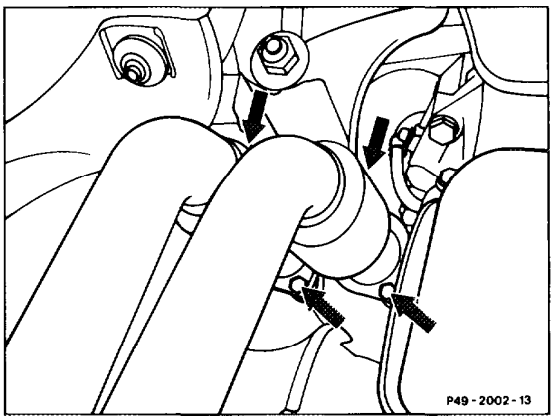
1 Detach fan shroud (1) and place over fan. When installing, ensure clearance to fan.

2 Unbolt fan (75), remove together with fan shroud, bolt on.

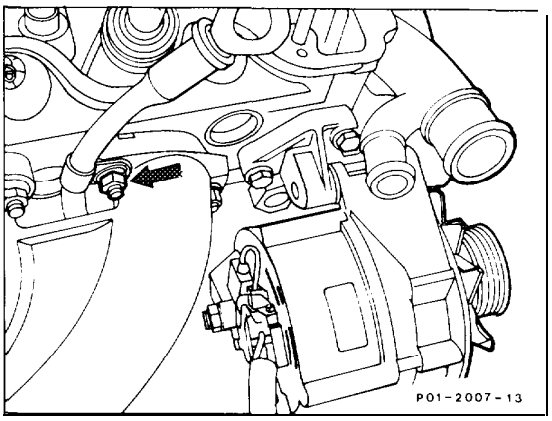
3 Remove cylinder head cover together with spark plug connector and distributor cover (01-406).



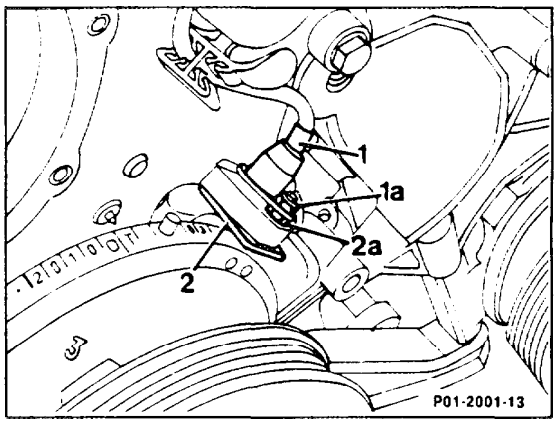
4 Unbolt exhaust pipes at exhaust manifold, bolt on.



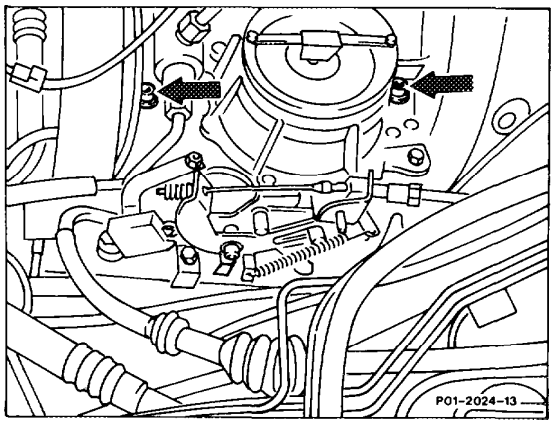
5 Unscrew dipstick guide tube at exhaust manifold, screw in (arrow).



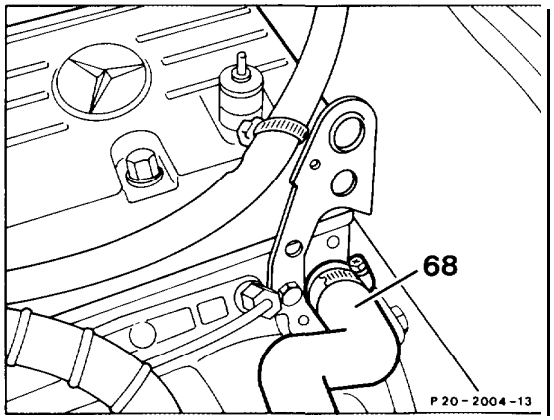
6 Detach Bowden cable (30) for accelerator control, attach, press plastic guide (arrow) out of its seat in the fulcrum lever (13) to perform this step, and take Bowden cable (30) out of the slot in the fulcrum lever.
Compress plastic clip (28) and push clip together with Bowden cable to the rear through the holder (16).
Adjust Bowden cable (30) (30-325).



7 Unbolt strut at intake manifold. To perform this step, unbolt 2 hexagon socket bolts (arrows) on injection engine, bolt on.
Detach return spring for throttle body assembly (below intake manifold), attach.



8 Detach coolant hose (68) of supply line for heater, attach.



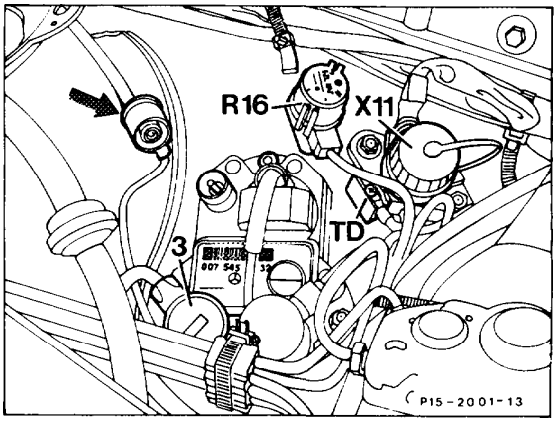
9 Detach connector pickup of control cable (arrow) and 4-pin connector pickup (3) at ignition control module, plug in.

10 Detach cable from reference resistor (R16) (Model 201 only).

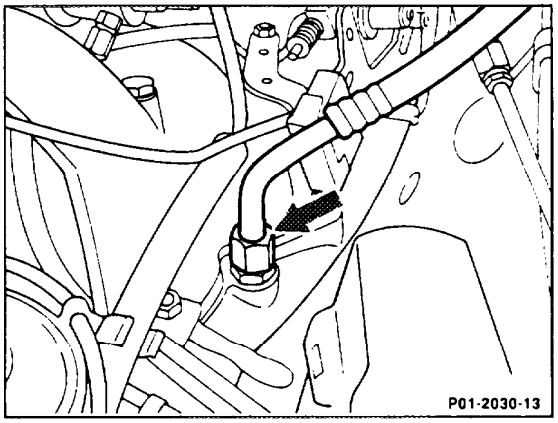
11 Unbolt terminal TD at the diagnostic connector (Xl 1), bolt on.

12 Unbolt diagnostic connector (Xl 1), unplug grey cable from the TDC pulse generator at the rear of the diagnostic connector, plug in.

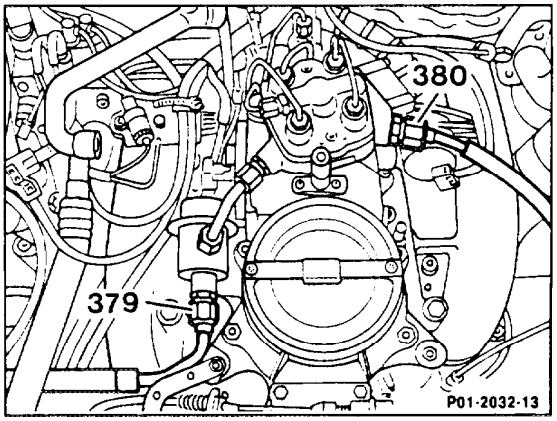
13 Unplug all connectors and vacuum lines at thermo valves and temperature switches, plug in.



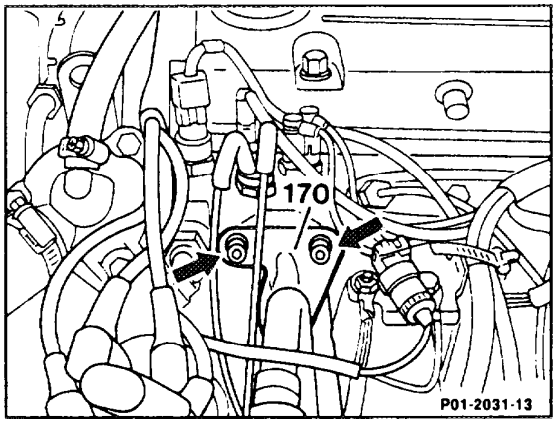
14 Disconnect vacuum line for brake booster, connect (arrow).



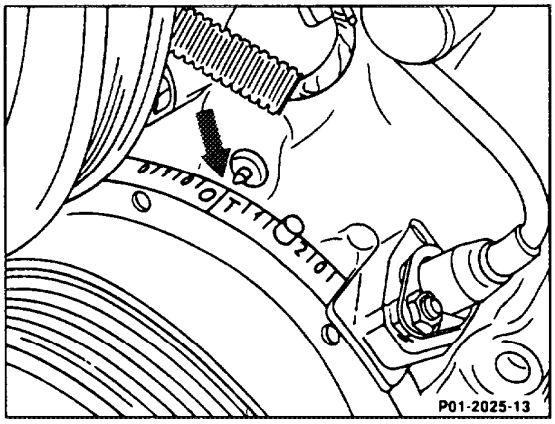
15 Lower fuel pressure in the fuel lines by briefly opening fuel filler cap.
Unbolt fuel lines (379, 380), bolt on. When detaching the fuel line (380), hold connection to prevent it from turning.



16 On models equipped with air conditioning, unbolt bracket for pipe group (170) of A/C compressor at cylinder head, bolt on.

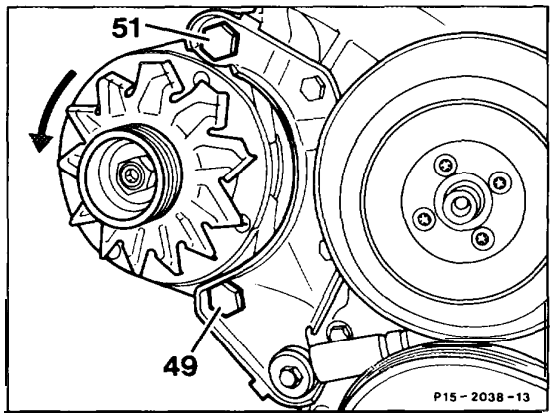


17 Set engine to ignition TDC of No. 1 cylinder.

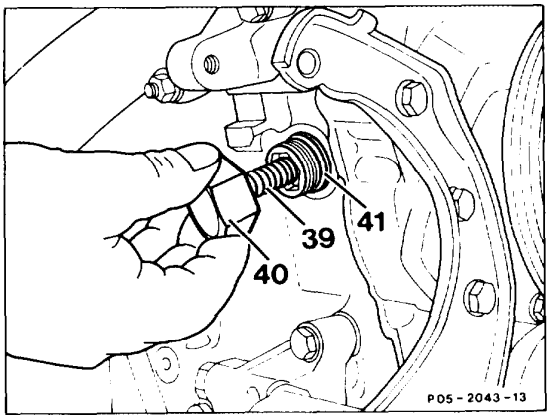


18 Loosen bottom bolt (49) for alternator fixture, tighten.

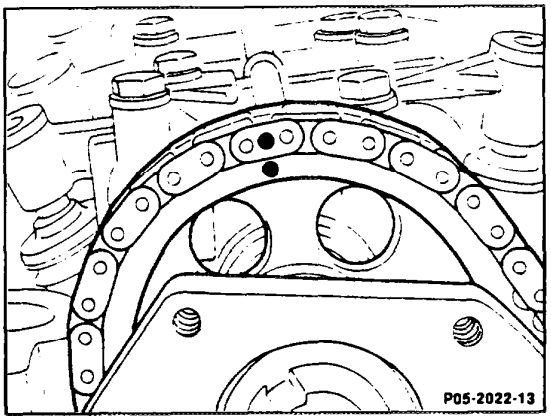
19 Remove top bolt (51), swivel alternator out of the way to the outside (arrow).



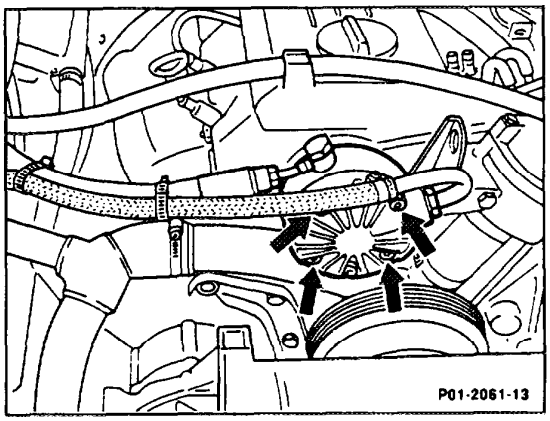
20 Unscrew locking nut (40) of the chain tensioner, bolt on. Replace seal (41). Tightening torque 70 Nm.



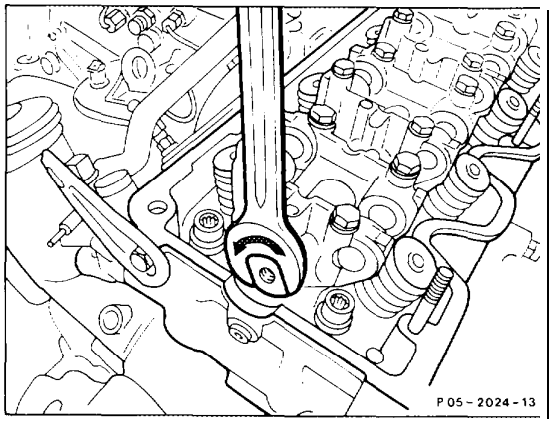
21 Mark camshaft gear and timing chain relative to each other.



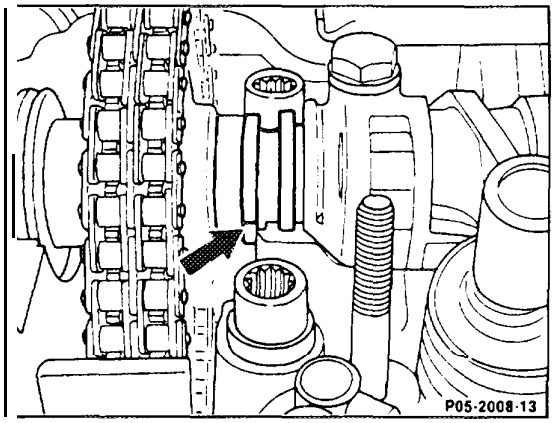
22 Unbolt pressure oil pump, place to the side with lines connected, bolt on (arrows).



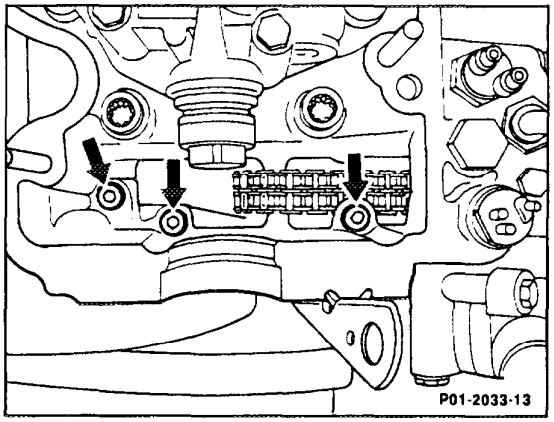
23 Unbolt camshaft gear, remove and bolt on. Place timing chain in chain box. Tightening torque 80 Nm.
Hold camshaft gear tight with an open-end wrench (waf 24 mm) for loosening or tightening the camshaft bolt.



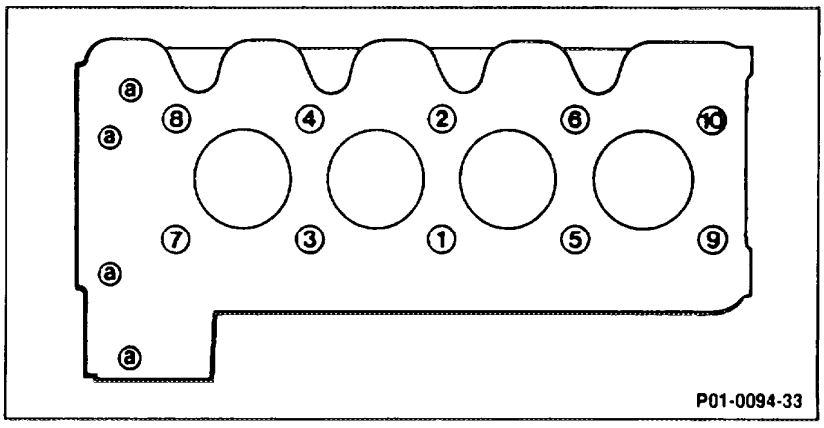
24 Check setting marking on camshaft (arrow).



25 Unscrew hexagon socket bolts (arrows) with the pin wrench 116 589 03 07 00, screw on. Tightening torque 25 Nm (reference value).



26 Remove cylinder head bolts in stages in the reverse order of the tightening diagram with the torque wrench insert 617 589 00 10 00 with engine cold.



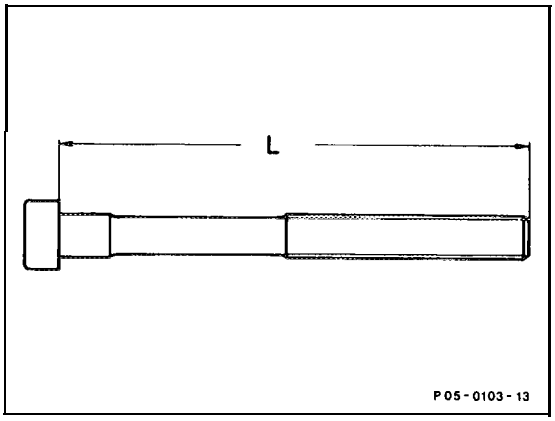
27 Remove cylinder head (51).

28 Clean mating faces on cylinder head and crankcase.

29 Replace cylinder head gasket.

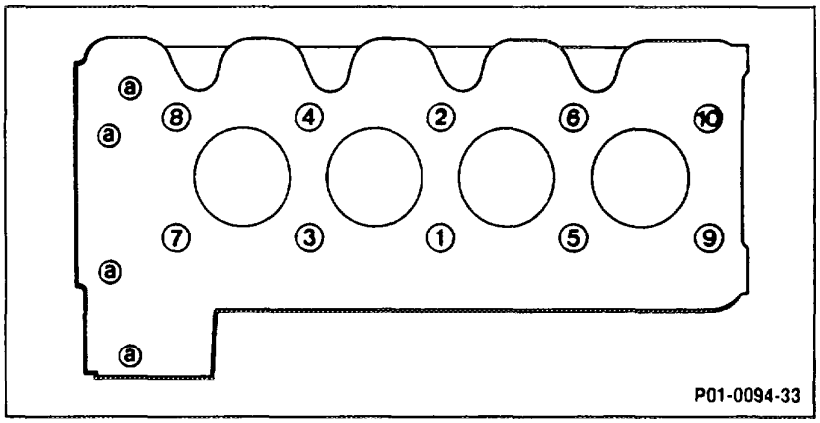
30 Check the shaft length of the cylinder head bolts.
If the maximum length (L) of 122 mm is exceeded, the bolts should be replaced with new ones.

31 Oil thread and head contact face of cylinder head bolts and insert.



32 Tighten cylinder head bolts in stages in the order of the tightening diagram, beginning with 1.

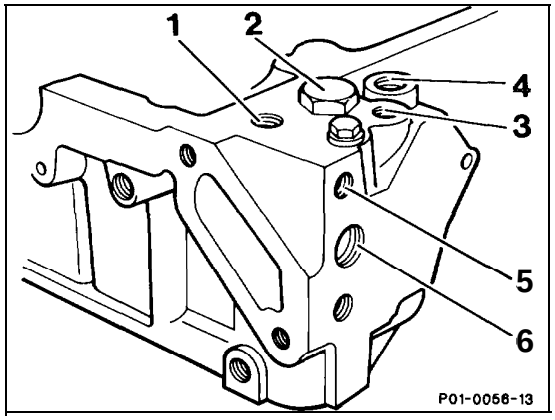
1st tightening stage 55 Nm
2nd tightening stage 90° angle of rotation
3rd tightening stage 90" angle of rotation
Hexagon socket bolts (a), 25 Nm.



33 Check for leaks with engine running.

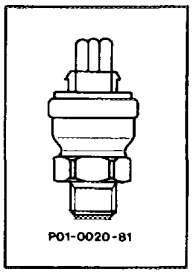
01-416 Matching measuring sensors to cylinder head

Note
Different temperature switches, thermo-time switches or thermovalves are installed in the measuring sensor box on the cylinder head depending on the engine version.

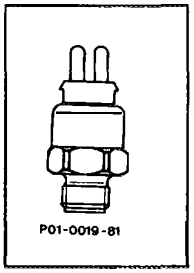


Items on cylinder head

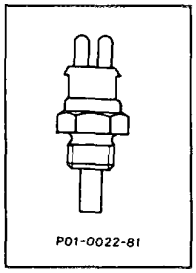
Item 1
Temperature switch for magnetic fan coupling and 2nd stage auxiliary fan red 100 °C.



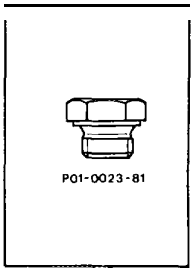
Temperature switch for magnetic fan coupling red 100 °C.



Item 2
Temperature sensor for A/C compressor blue.

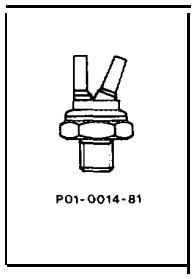


Item 2 **and 5**
Screw plug Ml4 x 1.5

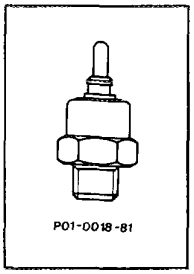


Item 3
Thermovalve for:

Ignition switchover	white	60 °C
Purge	red	50 °C
	black	40 °C

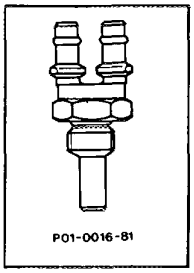


Item 4
Temperature switch for intake manifold heater black 110 °C.

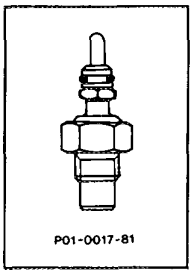


Temperature sensor for:

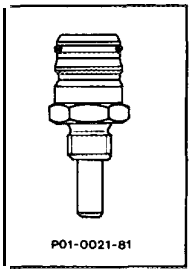
CFI control	black
Ignition control and CFI control module	green



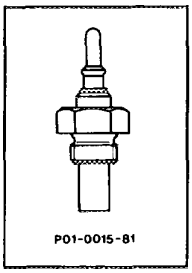
Temperature sensor for CFI injection system black.



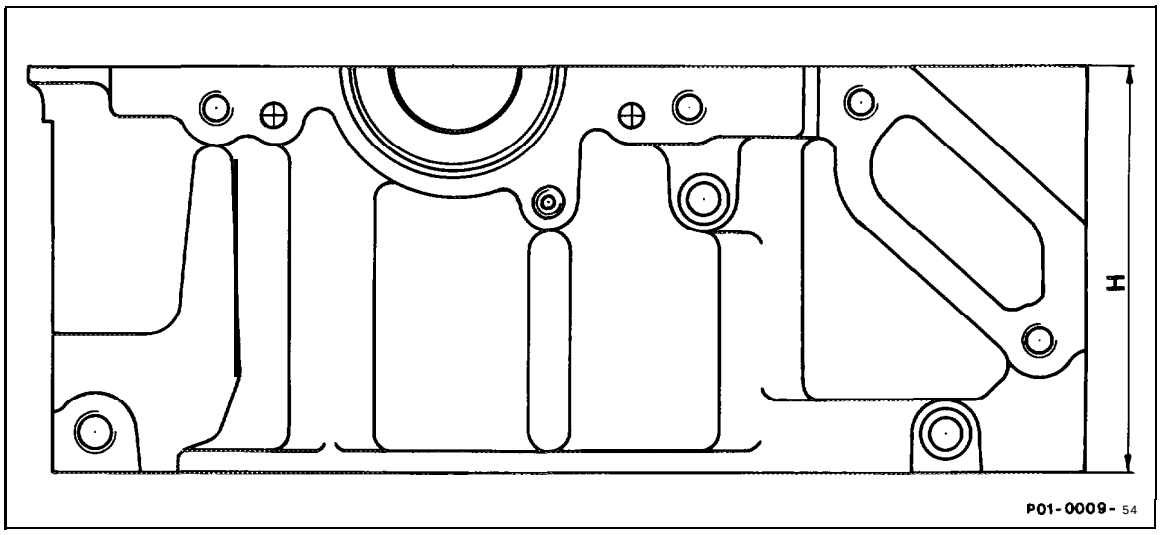
Double temperature sensor for ON board, CFI control and ignition control black.



Item 6
Temperature sensor for instrument cluster.



01-418 Facing cylinder head mating face



Data

Total height "H" of cylinder head		98.4 – 98.5
Minimum height after machining		97.8
Permissible variation of evenness of mating face	in longitudinal direction	0.15
	in transverse direction	0.05
Permissible variation of parallelism of top to bottom mating face in longitudinal direction		0.1
Peak-to-valley height		0.003 – 0.010
Test pressure with air under water in bar gauge pressure		2

Valve clearance to cylinder head mating face

Engines		102.961 (USA) as of 1984
Minimum clearance “A” with new valve seats and valves	Inlet (172)	1.2
	Exhaust (173)	0.5
Maximum clearance “A” with machined valve seats and reground valves	Inlet (172)	2.1
	Exhaust (173)	1.4

Commercial tools

Surface grinding machine with milling device for light alloy surfaces.	e. g. Sceledum, Type RTY Messrs. Roaro u. Fi. Schioiltaly
Knife-edge straightedge approx. 500 mm long	e. g. Messrs. Roaro u. Fi. Schioiltaly

Note
Only machine cylinder head mating face if there are porous or damaged areas.

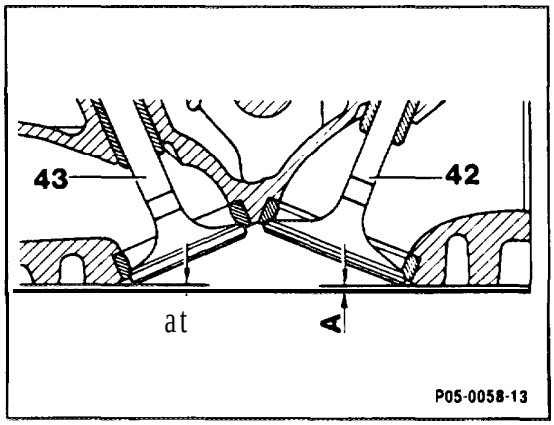
Caution!
Clamp cylinder head absolutely flat for facing. Failure to observe this instruction may result in the camshaft jamming when the cylinder head is reinstalled. In this case, the cylinder head must be replaced.

Facing

1 Face cylinder head mating face.

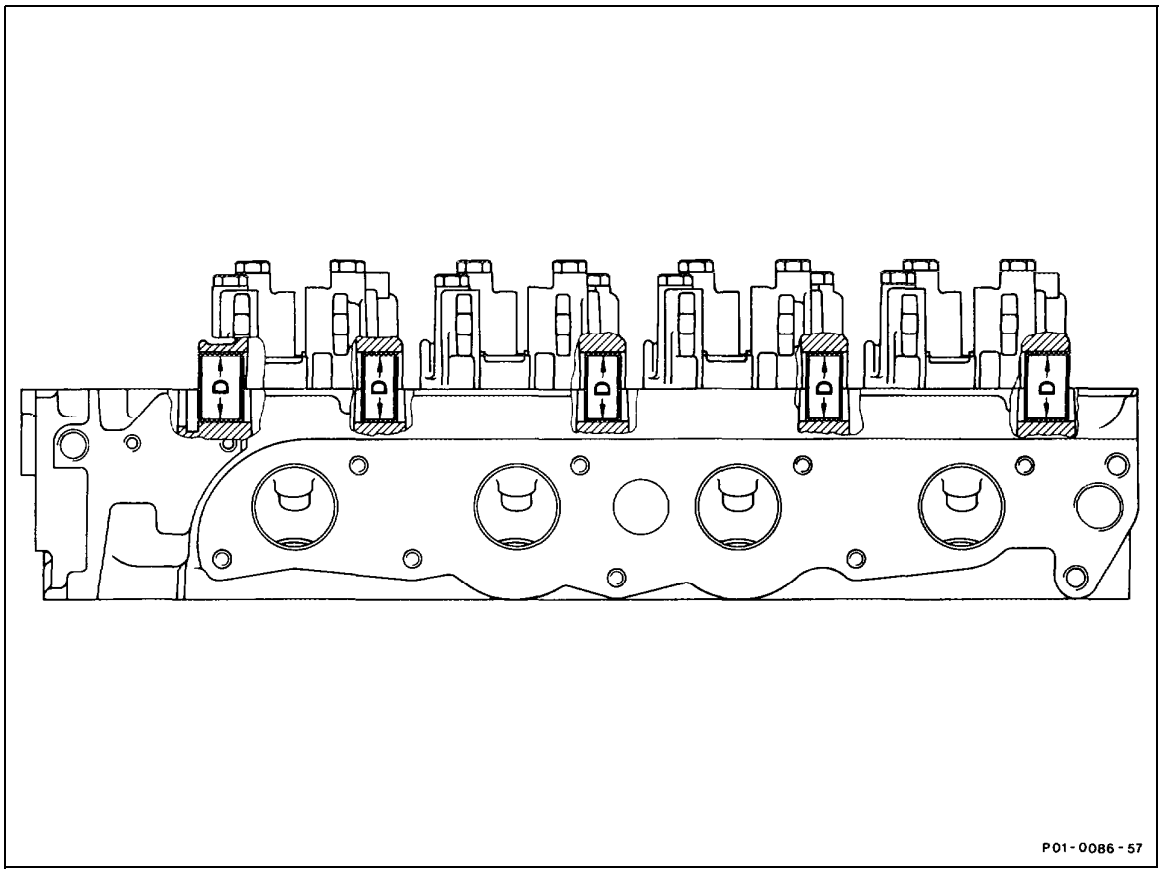
2 Remachine valve seats far enough for the minimum distance “A” to be achieved (05-291).

3 Check timing (05-215).



01-419 Enlarging camshaft bearing bores (repalr size)

Preceding work:
Removal and installation of cylinder head (01-415).
Removal and installation of camshaft (05-220).
Disassembling cylinder head.

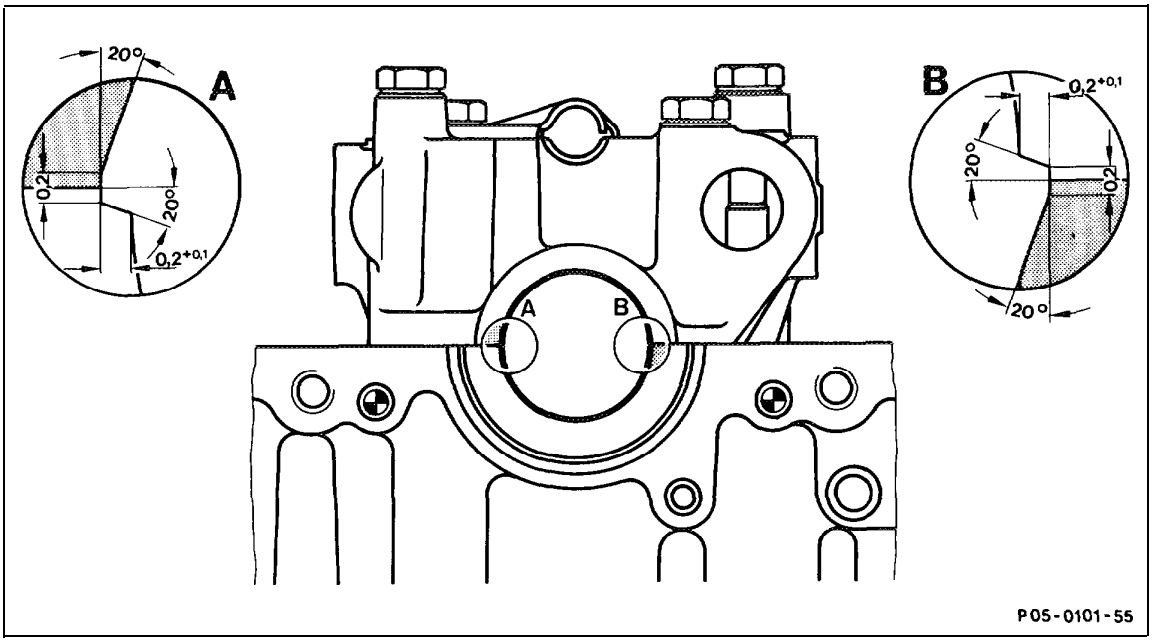


Camshaft bearing data

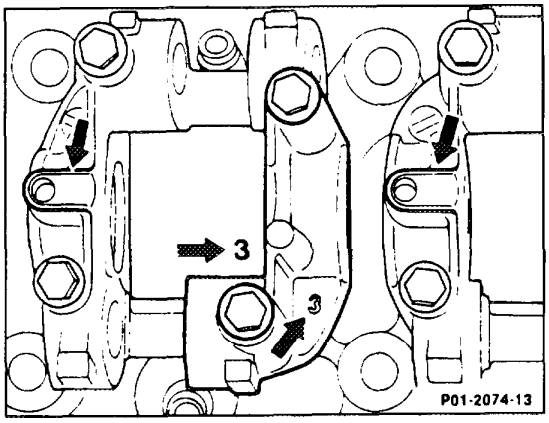
Normal size	Camshaft bearing dia. D	32.000 32.025
	Journal dia. D1	31.934 31.950
Repair size	Camshaft bearing dia. D	32.500 32.525
	Journal dia. D1	32.434 32.450
Camshaft bearing bores	Peak-to-valley height	0.003 – 0.006
	Permissible variation from cylindrical shape	0.012

		When new	Wear limit
Bearing play	radial	0.050 – 0.091	0.11
	axial	0.07 – 0.15	0.18

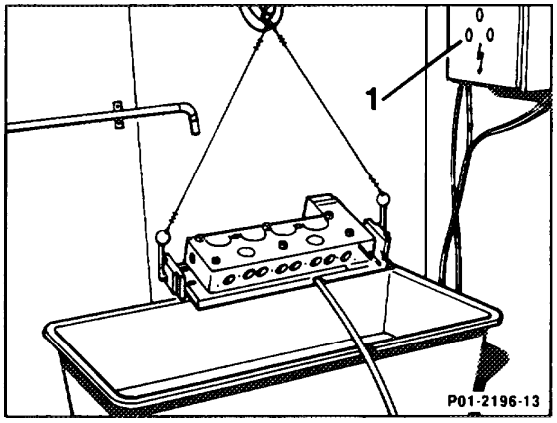
Note
If bearing seizure or severe scoring is present, the camshaft bearings in the cylinder head can be enlarged by 0.5 mm and camshafts with oversize bearing journals installed.
These camshafts have different code numbers (05-215 and 220).
If the rocker arm bearing brackets are equipped for enlarging without the rocker arm shafts, the fastening bolts of the bearing brackets must be tightened to max. 15 Nm otherwise the bores for the rocker arm shafts will be distorted. When machining the basic bores, ensure that the half-bores for mounting the cylinder head cover gasket or the sealing disc at front and rear on the cylinder head are not widened. After widening the basic bores, the edges at the mating face of the cylinder head bracket (A) or at the mating face of the cylinder head (B) on the camshaft bearings 1 to 4 must be machined in accordance with the specified dimensions. If the edges are not machined, the lubrication film will tear at these points, causing damage (seizure) to the camshaft bearings.



The bearing brackets differ. Each bearing bracket has a number stamped to identify it. This number must agree with the number stamped on the cylinder head (arrows). If correctly installed, the contact faces for the oil pump are facing to the rear and the code numbers are on the righthand side (direction of travel) (arrows).

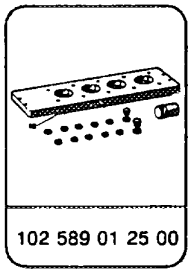


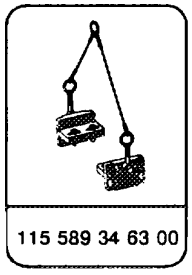
01-420 Pressure-testing cylinder head



Pressure-testing plate	bolt onto cleaned cylinder head.
Bores and connections	plug.
Compressed air hose	connect and adjust compressed air to 2 bar gauge pressure.
Cylinder head	Attach to suspension device and immerse into the heated water (approx. 80 “C). If air bubbles rise up, determine leak point and mark.

Special tools


102 589 01 25 00

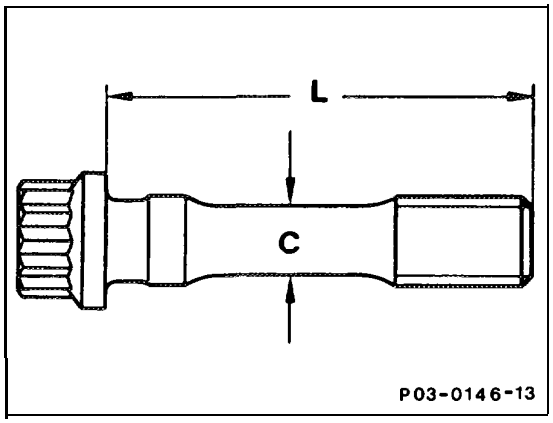

115 589 34 63 00

Commercial tool

Electrically heated water bath	e. g. Messrs. Otto Dürr D-71 23 Sachsenheim-Ochsenbach

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 – 1 00°, use special tool 001 589 66 21 00. Pay **attention** to note.

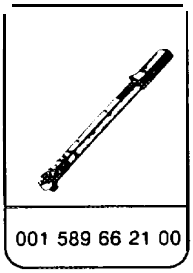
Dimensions of conrod bolts

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

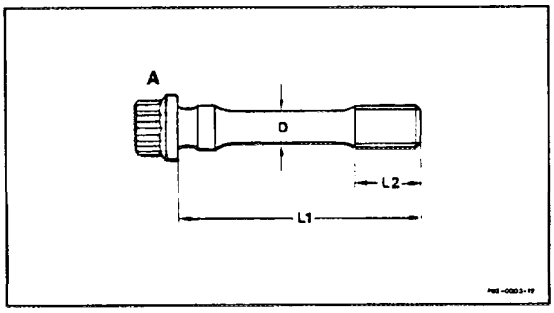
Initial tightening torque	30 Nm
Angle of rotation torque	90" – 100"

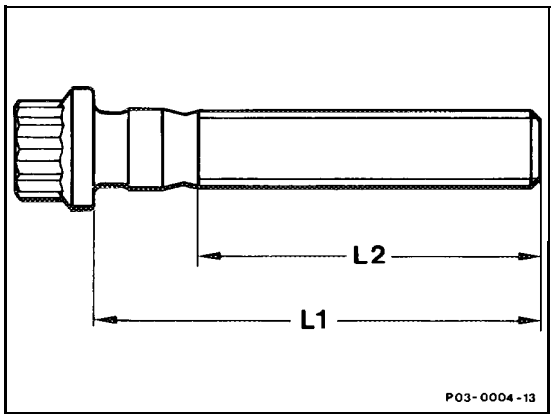
Special tool



Note

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



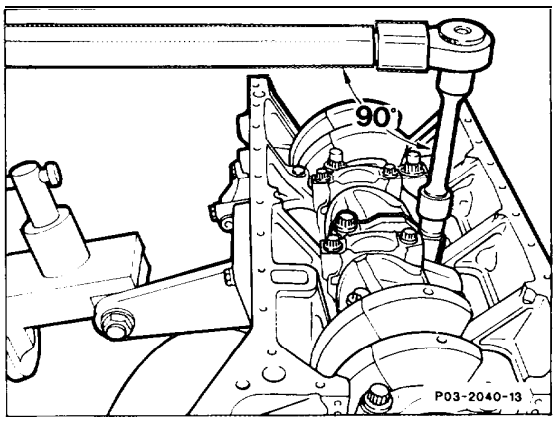


A 1st version
B 2nd **version**

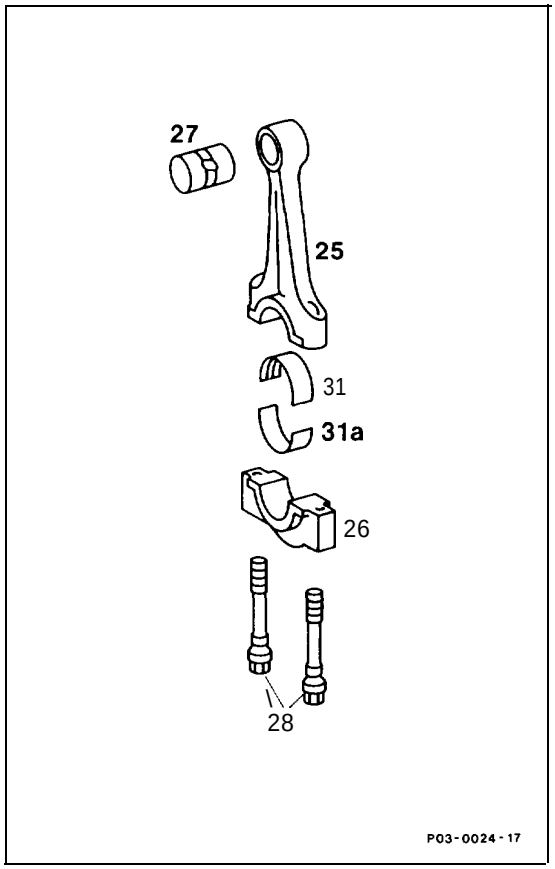
Standard implementation: 09/86

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

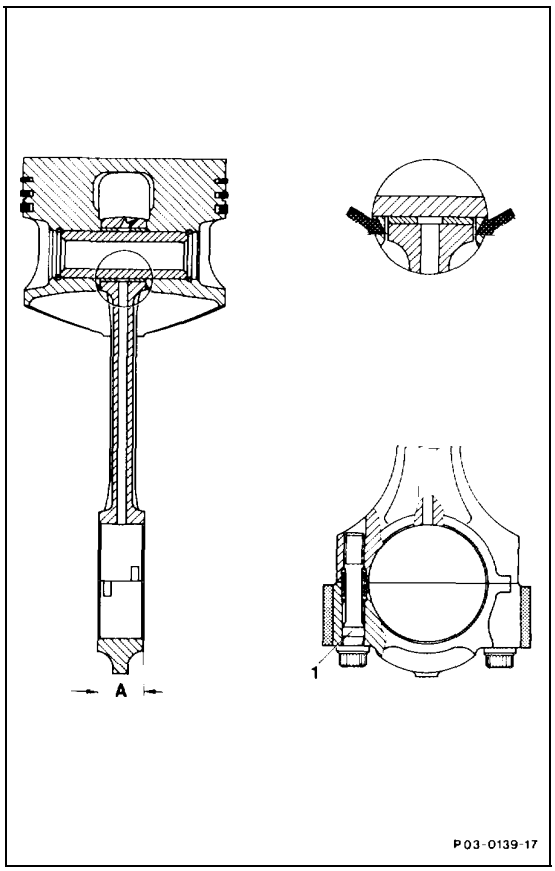
Conrod aligning tool	e. g. Hahn & Kolb D-7000 Stuttgart Model BC 503

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

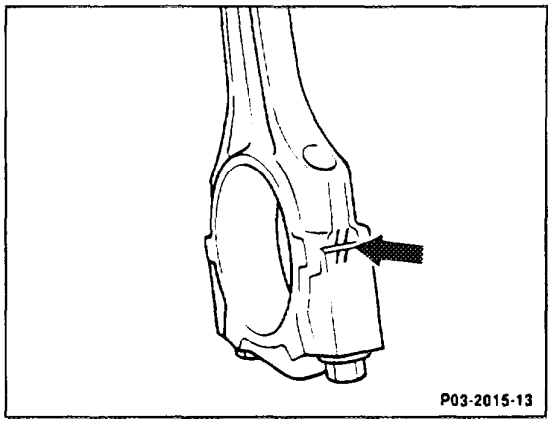
The end play of the conrod is limited not at the crankshaft journals but at the piston pin bosses (piston-guided conrod, arrows).



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

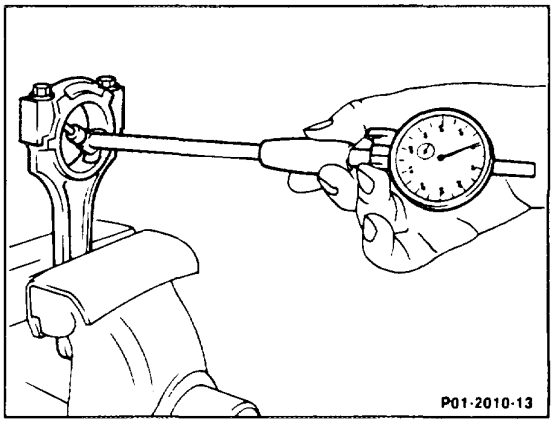
Effective 09/89 all conrods are subject to additonal heat treatment to prevent conrod distortion resulting in noises when the engine is operating at normal temperature.

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.

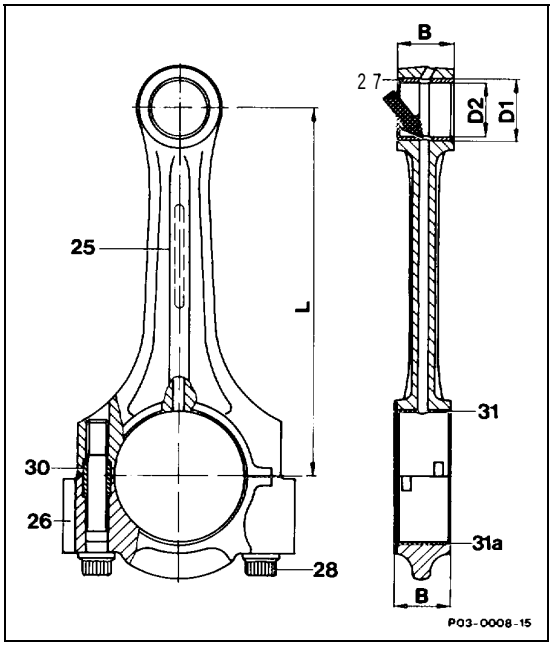
3 Measure conrod bearing basic bore. If the basic bore exceeds the value of 51.619 mm or is conical, dress contact face of bearing cover on a surface plate to max. 0.02 mm.



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

5 Hollow out small end bushing by turning or reaming.

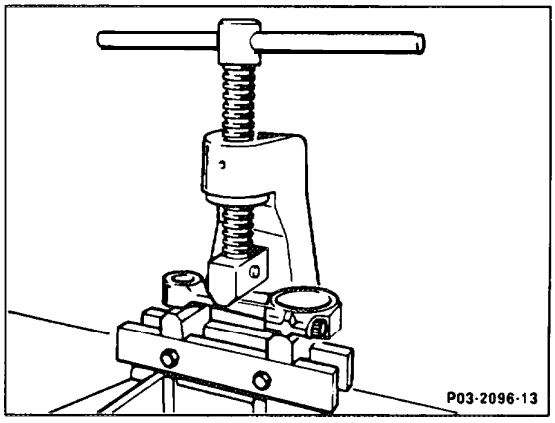
6 Dress side contact faces of conrod on the surface plate.



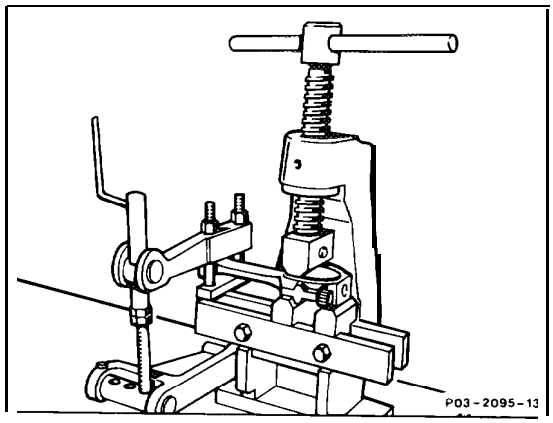
Checking angles

7 Check angles of bearing bores with a conrod tester.

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

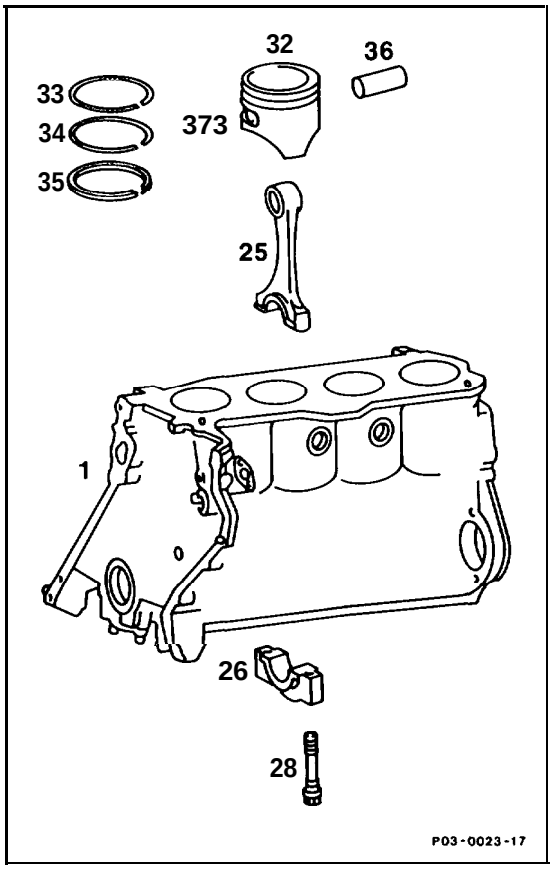


9 Check axial twist of conrod bearing bore relative to small end bushing bore and correct, if necessary.



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).



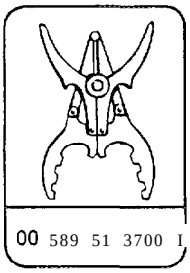
Conrod bearing cover (26)	unbolt, bolt on, 30 Nm and 90” angle of rotation torque. Do not mix up top and bottom bearing shells. Pay attention to matching of conrod and bearing cap (step 12).
Conrod bolt (28)	check (03-310).
Piston (32) and conrod (25)	push out of crankcase upwards.
Locking ring (37)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

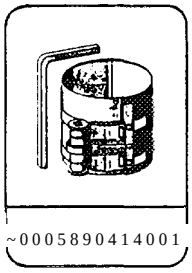
Installation Instructlon

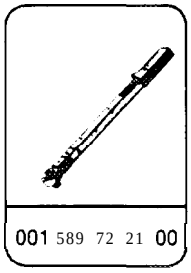
Insert conrod into piston so that the chamfered splash bore in the small end bearing with the arrow in the piston crown are pointing in direction of travel; **do not** heat piston.

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

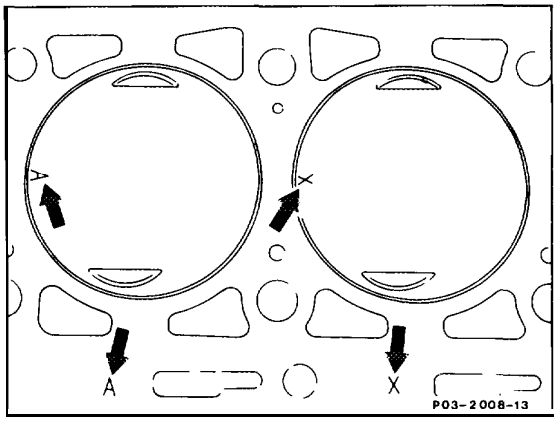
Test data

		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.



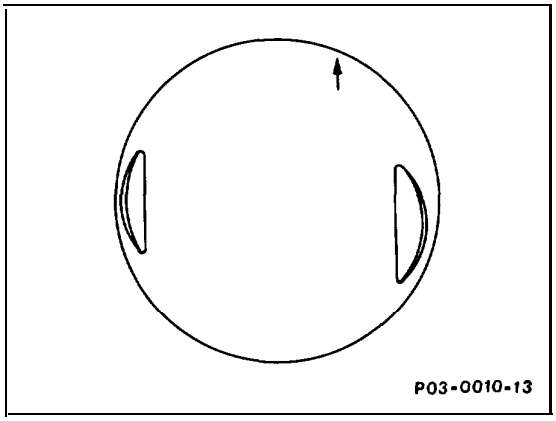
previously	now
0	A
1	X
2	B

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.

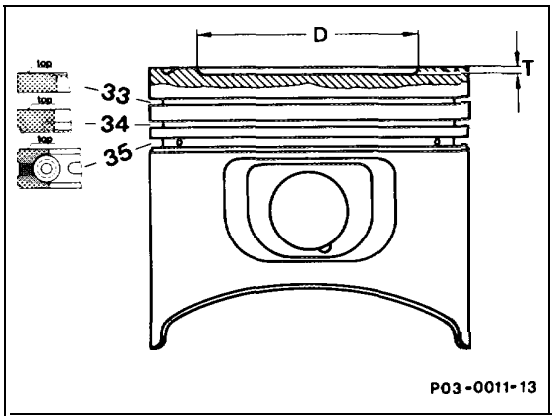
The piston crown is designed differently in the individual engines. The piston crown of normal compression engines is either smooth or provided with a recess. In addition, there are two valve niches each in the piston crown.

Caution!

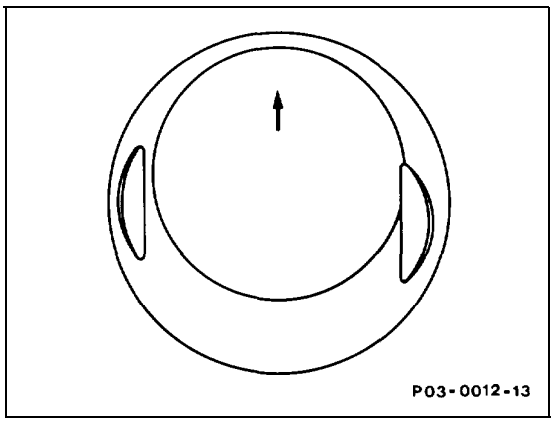
A recess with a diameter of 50 mm appears on the piston crown of pistons in repair size version.



Piston crown smooth, two valve niches

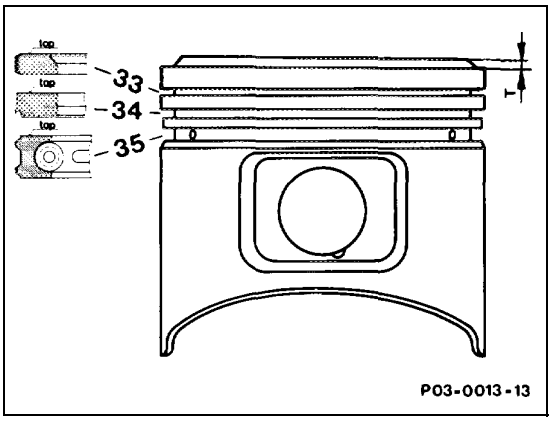


Engine 102.985

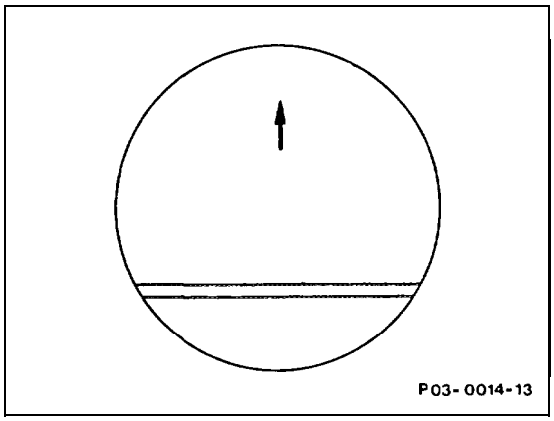


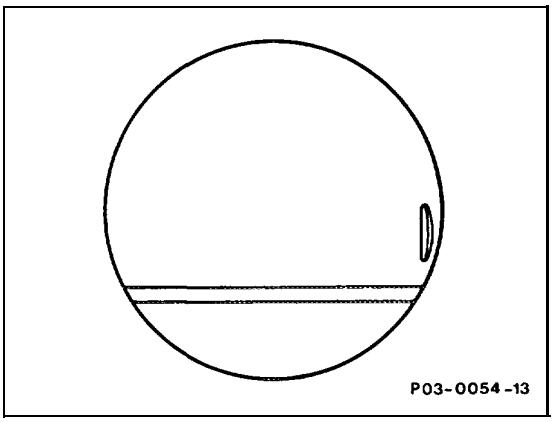
Recess in piston crown, two valve niches
D 70 mm dia.
T vanes according to piston (normal size, repair sizes)

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.

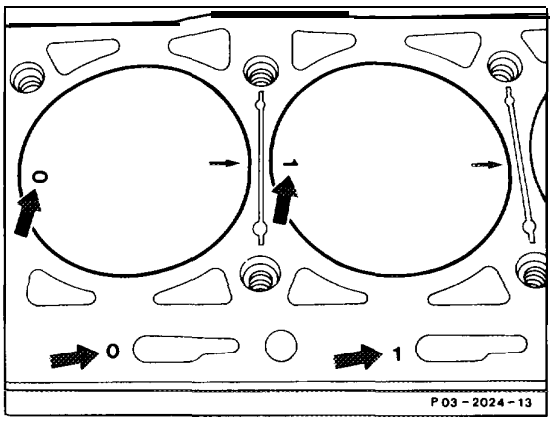
Standard Implementation: 03/88 (Mahle)

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

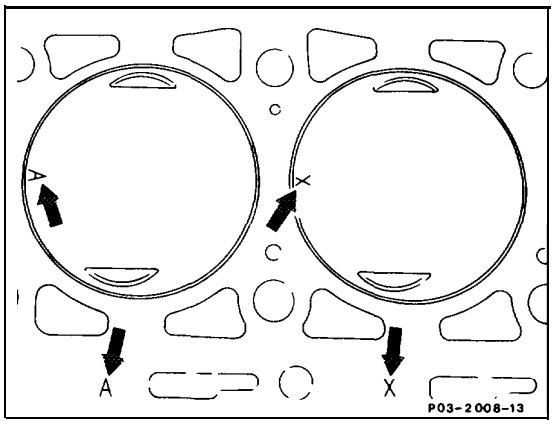
Standard Implementation: 03/88 (KS)

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).



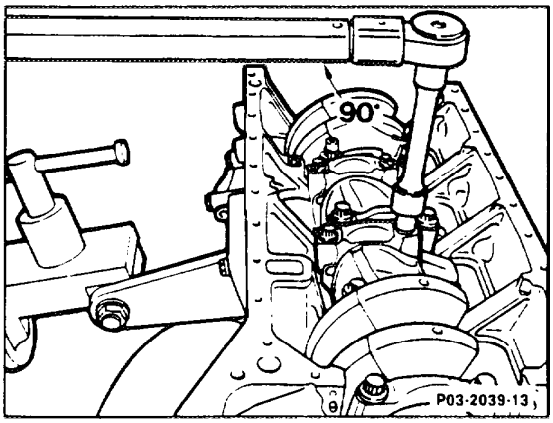
Crankcase with Group numbers



Crankcase with Group code letters

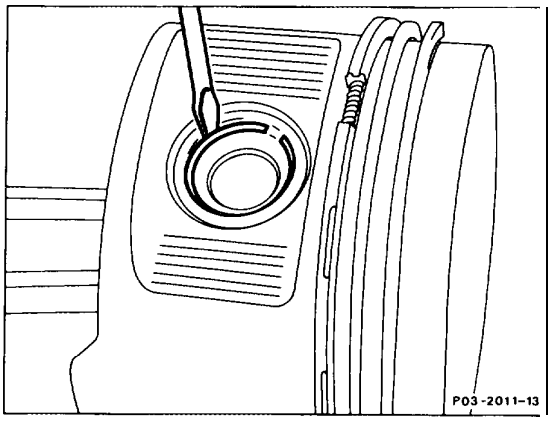
Removal and installation

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.



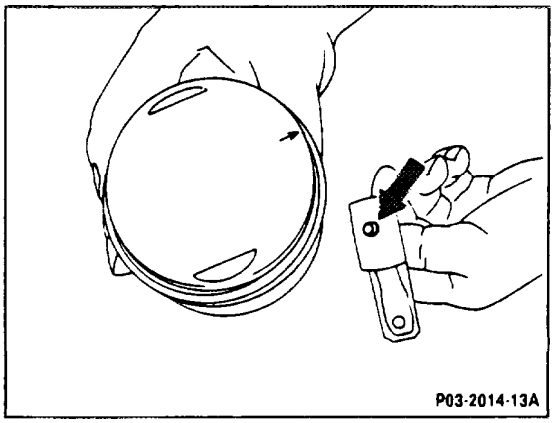
4 Recondition conrod and check angles of bearing bores, if necessary (03-313).

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.

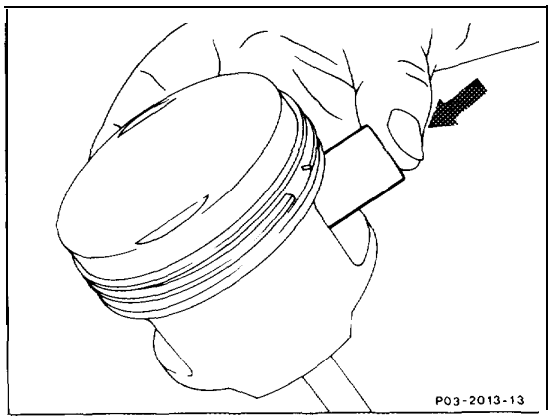
6 Oil piston pin and small end bushes.

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.

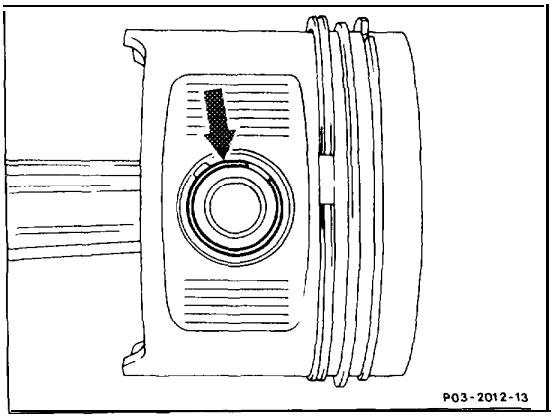


8 Press in piston pin by hand.

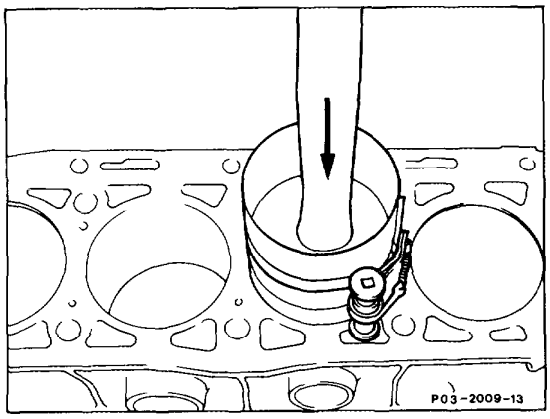


9 Insert piston pin locking element into the groove.

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

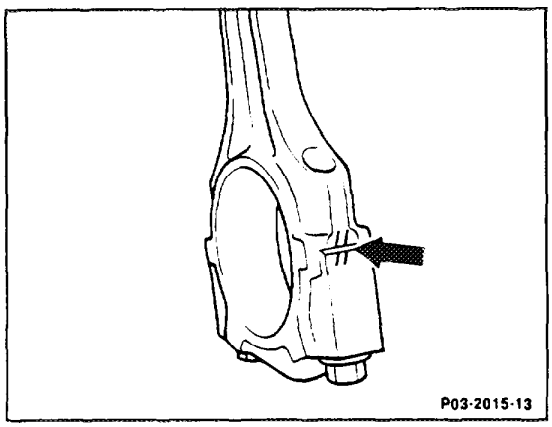


11 Install tensioning strap for piston rings and install piston into cylinder bore with arrow facing in direction of travel.

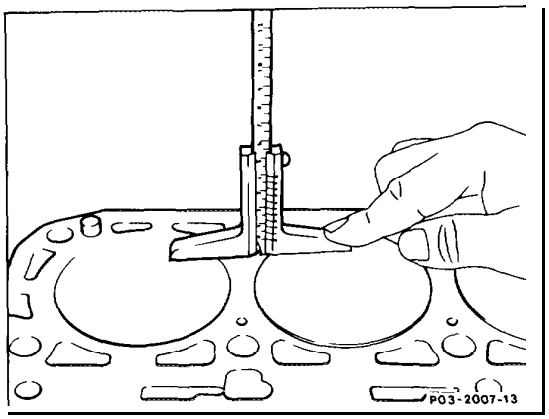


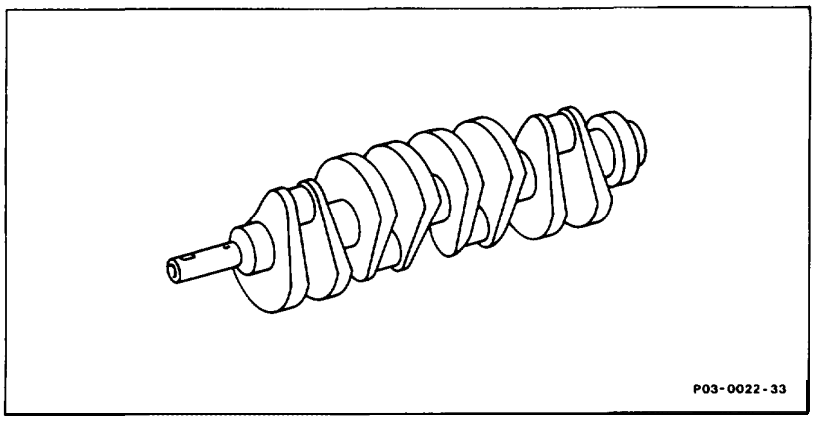
12 Mount conrod bearing cover onto the conrod with the code marks (arrows) aligned with each other and torque conrod bolts to an initial torque of 30 Nm and angle of rotation torque of 90".

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).





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	

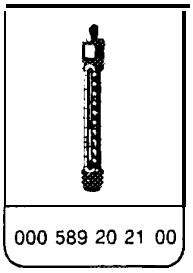
Permissible out-of-roundness of crankshaft journals and crankpins		0.0025
Permissible conicity	crankpins	0.010
	crankshaft journals	0.010
Permissible axial runout of fit bearing		0.02
Fillet radii at the	crankshaft bearing journals	2.0 – 2.2
	crankpins	2.8 – 3.0
Bearing journals ground and fine-lapped, 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



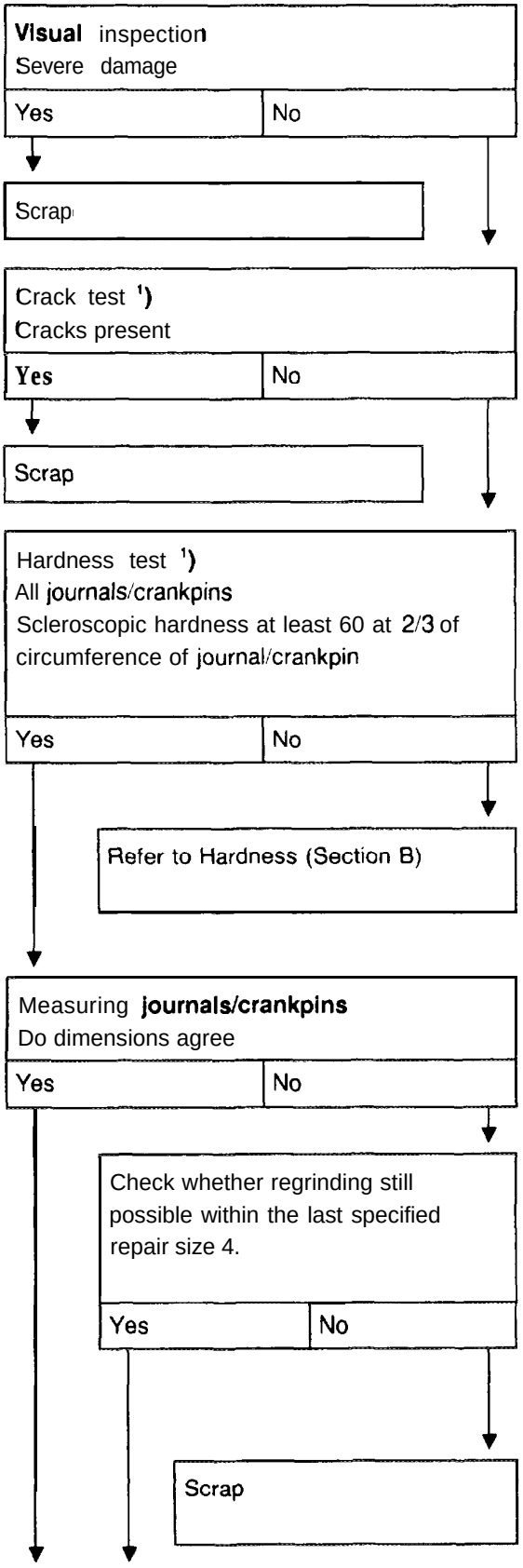
Note

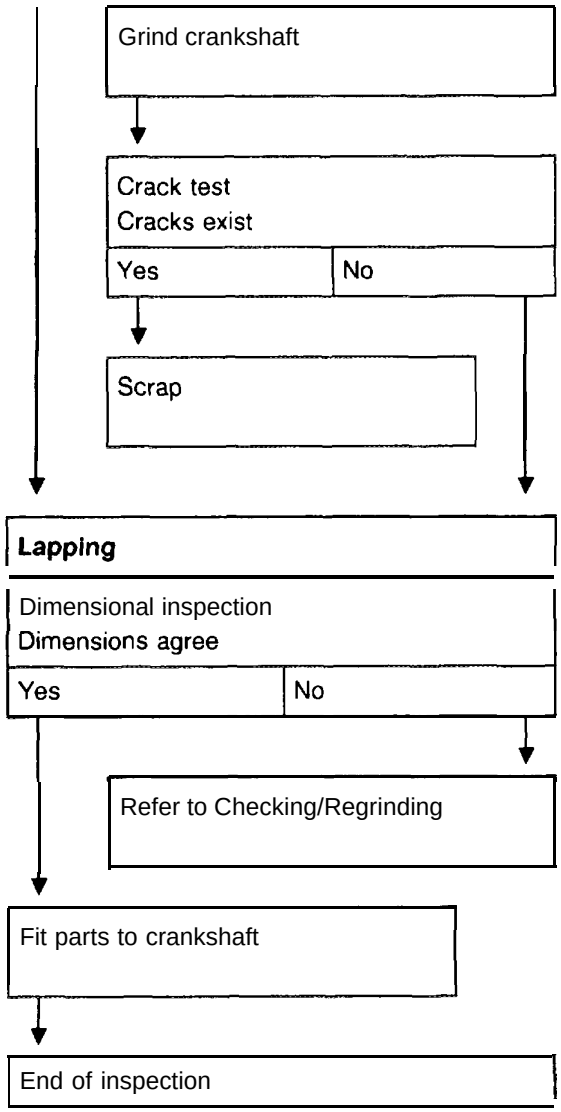
Adhere to the sequence of operations of the diagram below when checking and reconditioning crankshafts.

Dianram

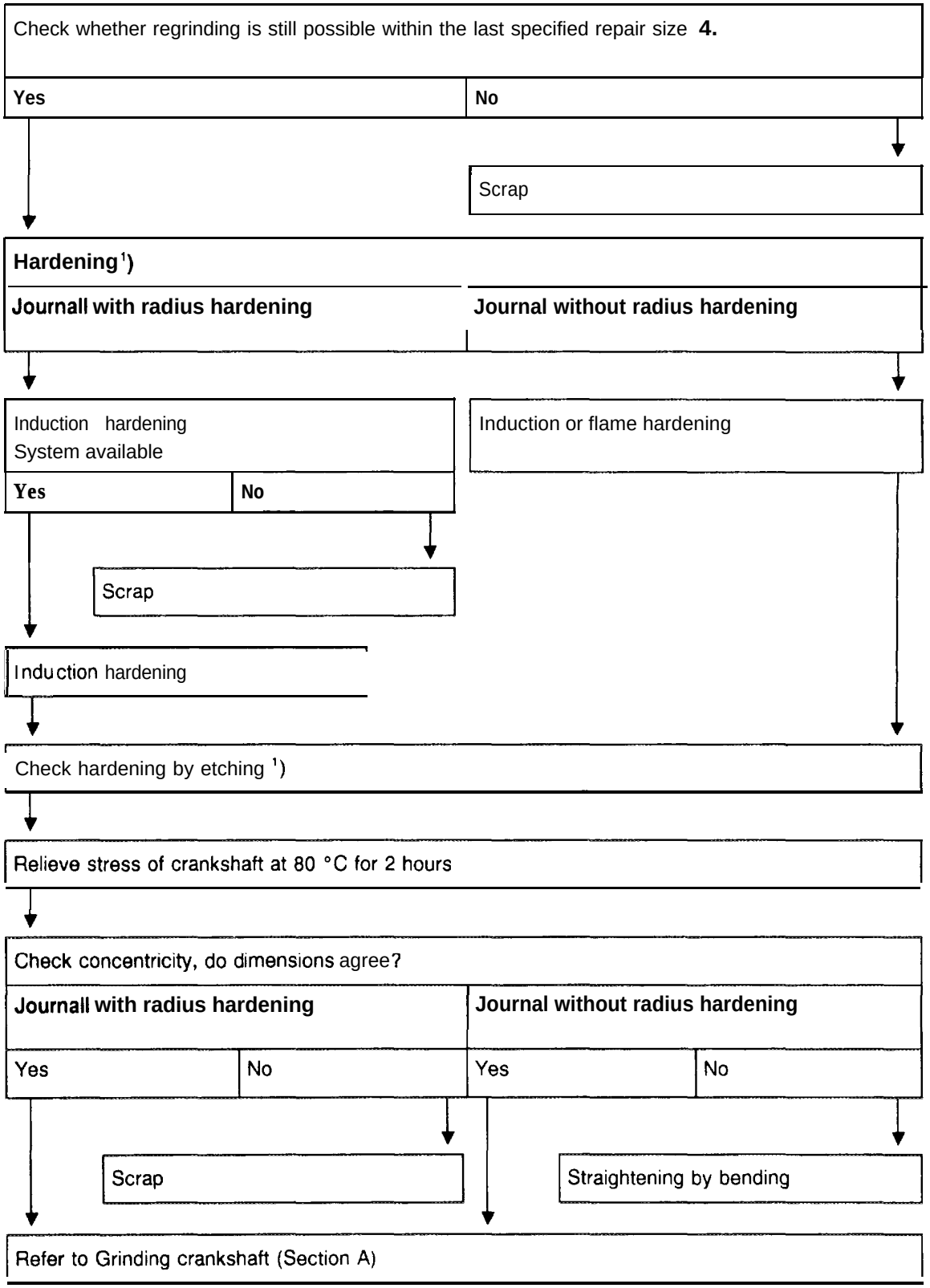
[1]) Refer to Section “Explanatory notes regarding diagram”.

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

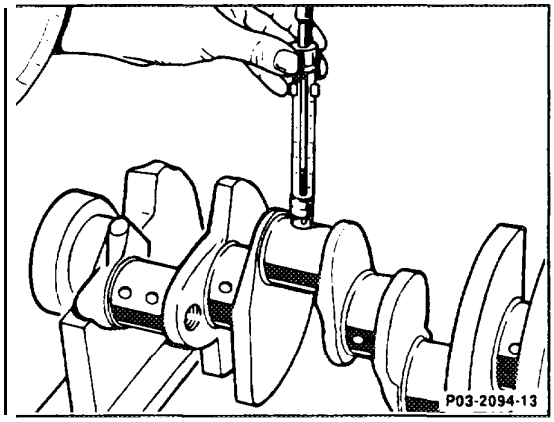
Crack test

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

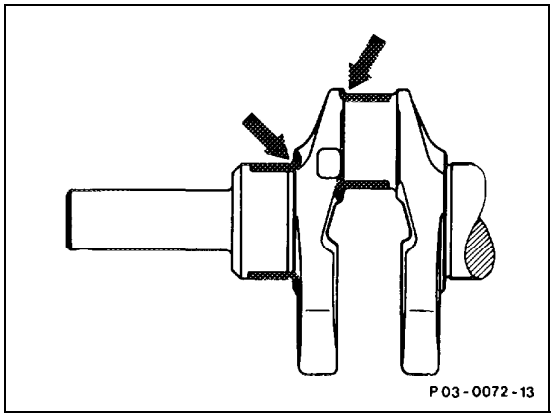
Test hardness with the drop hardness tester (scleroscopic hardness).
The minimum hardness of 60 must exist at 2/3 of the circumference of the journal.



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.

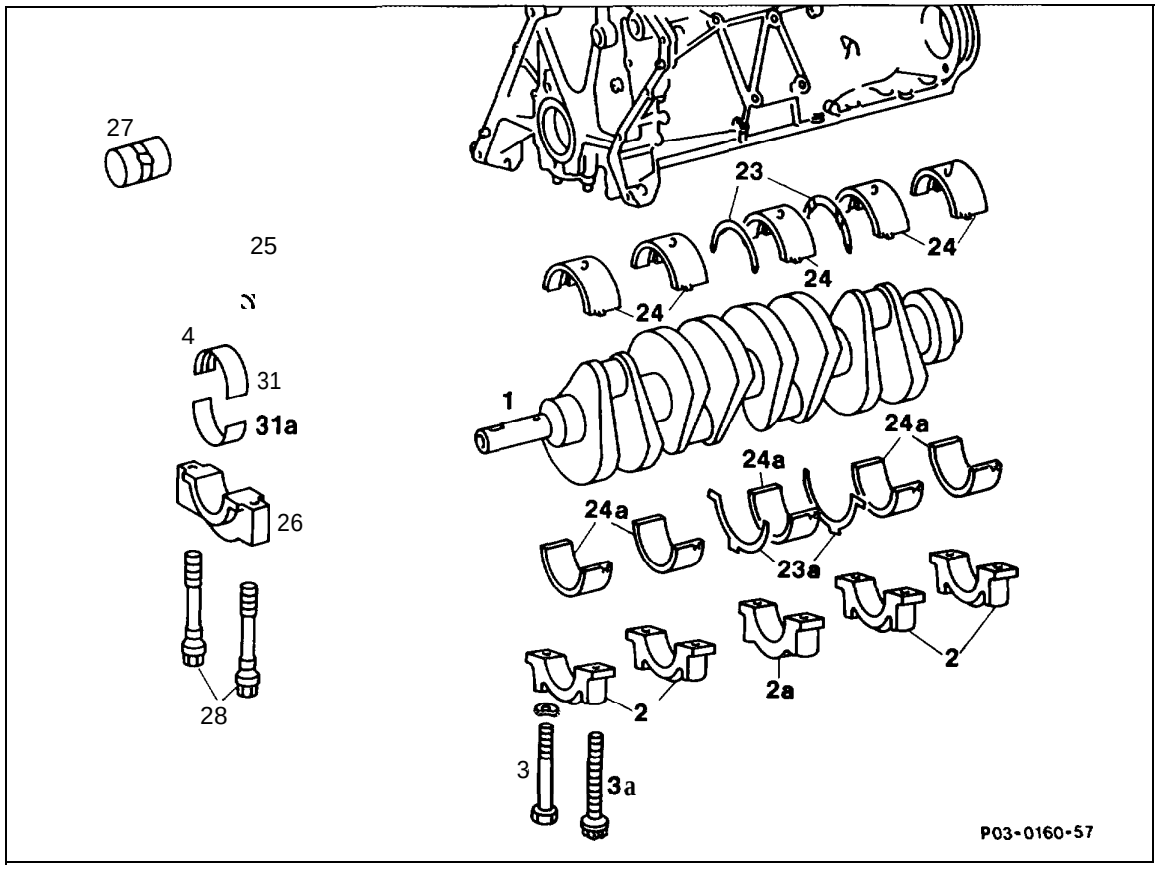
Following this, carefully wash off the nitric acid with alcohol.

Corrosion protection

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

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).

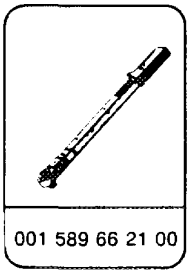


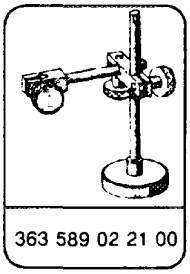
Crankshaft bearing covers (2 and 2 a)	.....	install without bearing shells, pay attention to markings, tighten. Hex. bolt 90 Nm, stretch bolt, initial torque 55 Nm, angle of rotation torque 90" (steps 1 and 2).
Basic bore	.....	measure conicity in direction A, B and C (step 3).

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

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.

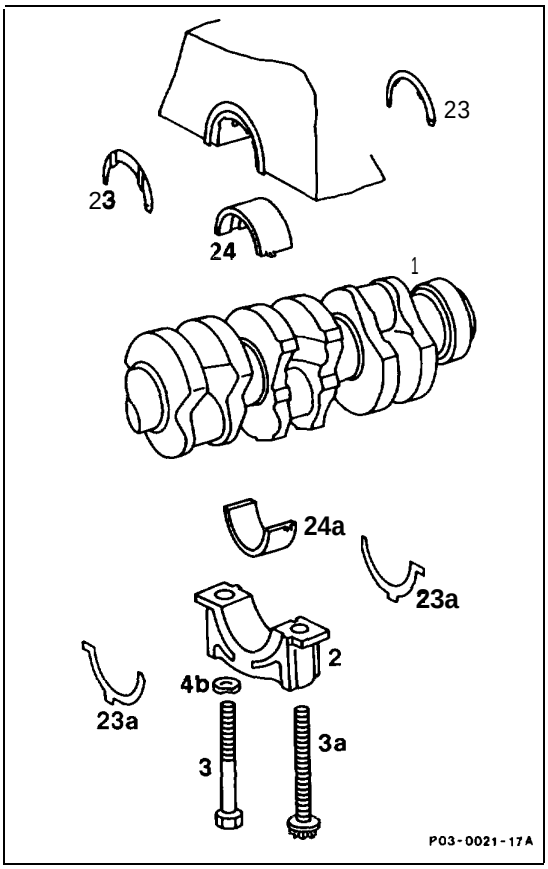
Basic bore and bearinaplay

		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 beating cover

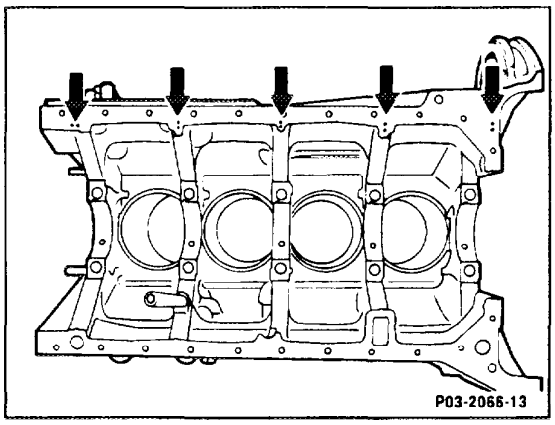
Thrust washers of the same thickness must always be installed on both sides.
It is not permitted to regrind thrust washers.
The thrust washers are available only as sets as replacement parts. A set consists of one top and one bottom thrust washer (23 and 23a).

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

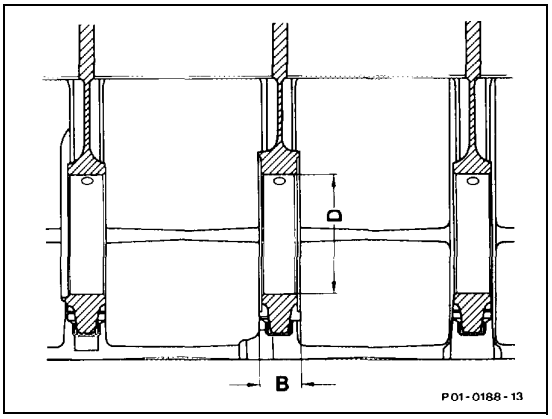
[1] Colored dots on the crank webs or counterweights next to the crankshaft journals.
[2] Chisel marks in mating face of crankcase at oil sump end next to basic bore.

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.

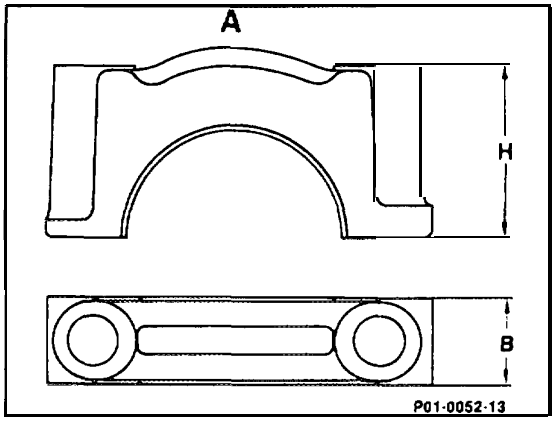


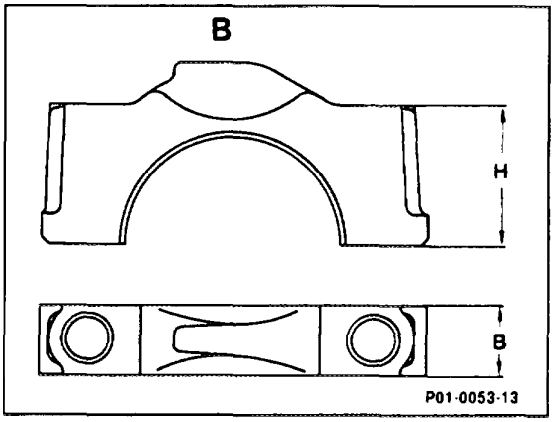
Chisel marks for matching crankshaft bearing shells

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



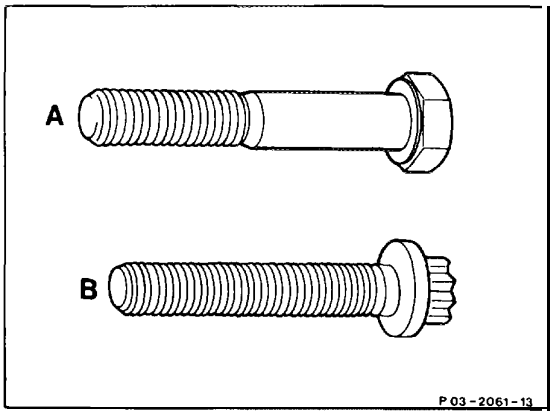
At the same time, the crankshaft bearing covers were reduced in height by 8 mm (H = 40 mm).





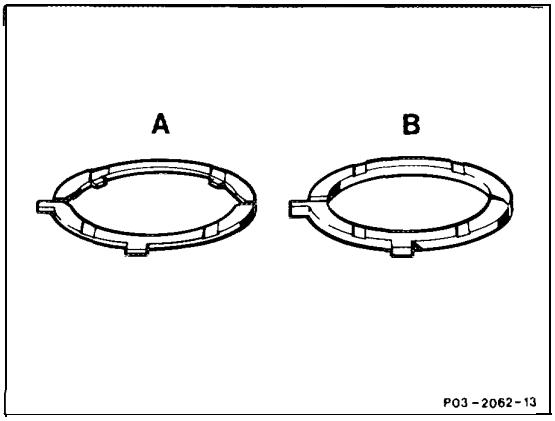
A 1st version H 48 mm
B 24 mm
B 2nd version H 40 mm
B 20 mm

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).

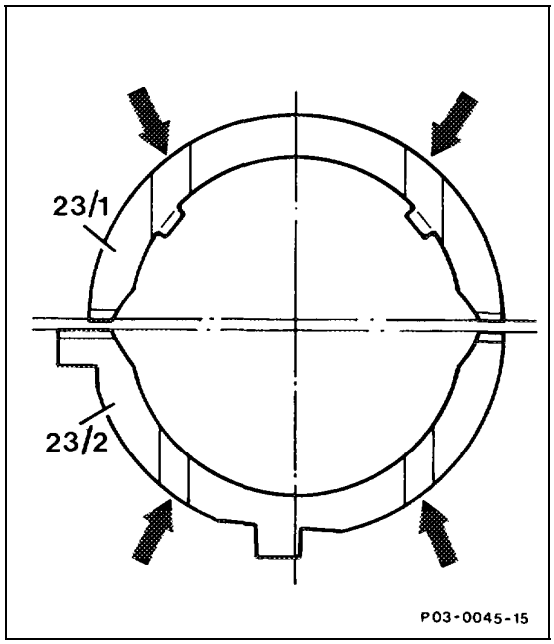


A 2.15 mm thick thrust washers
B 4.15 mm thick thrust washers

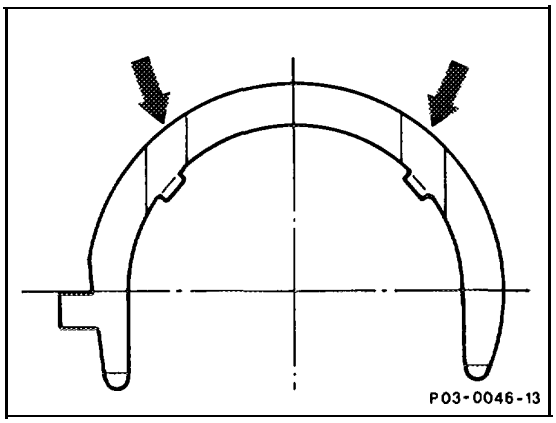
Standard implementation: 06186

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



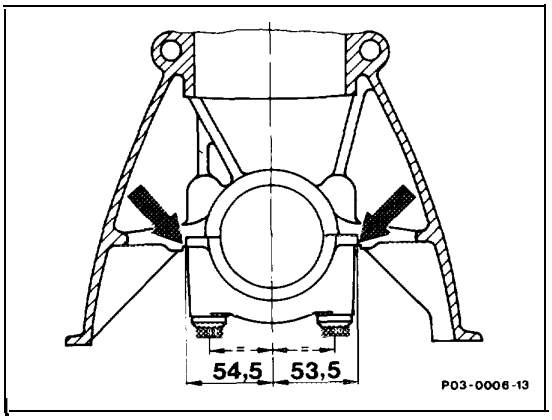
B Single-section thrust washers

Matching crankshaft bearings, installing crankshaft

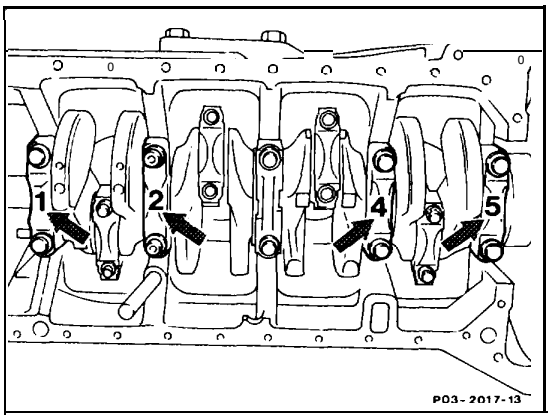
Note

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.



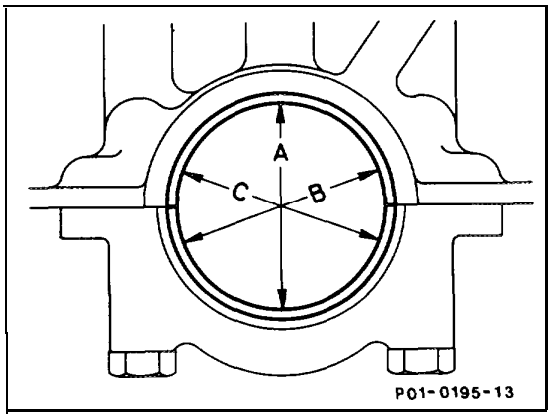
In addition, they are marked from front to rear with the code numbers 1, 2, 4 and 5 (arrows), with the exception of the thrust bearing covers,, and must not be interchanged or replaced.



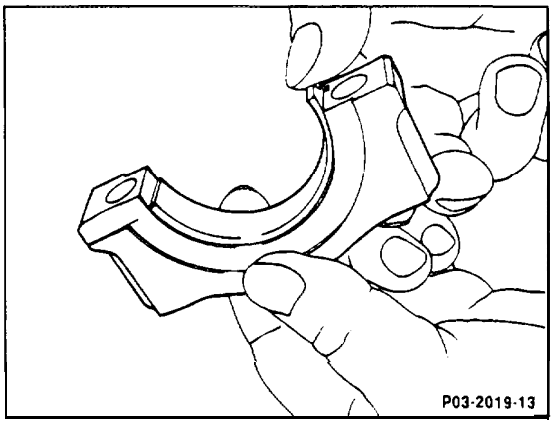
1 Install crankshaft bearing covers without bearing shells.

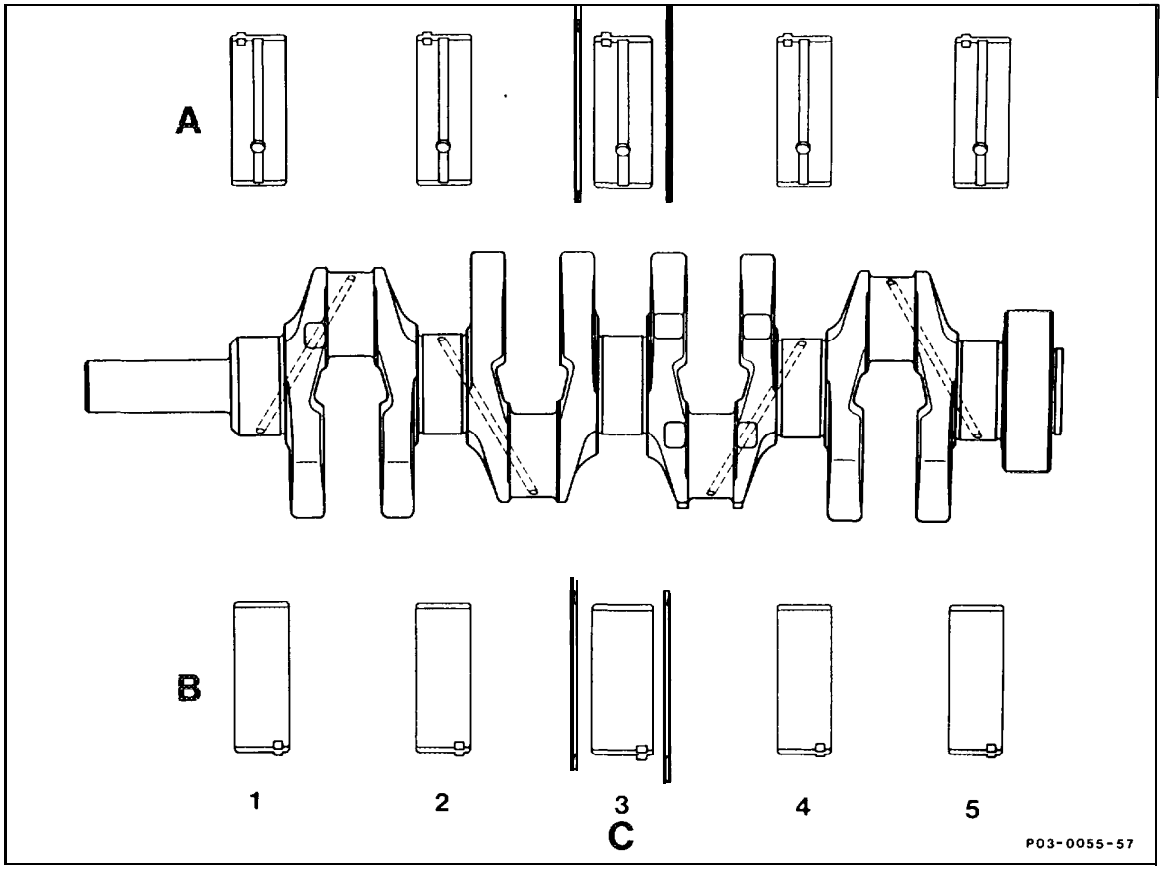
2 Oil fastening bolts for crankshaft bearing covers and tighten to 90 Nm (hexagon bolts) or 55 Nm initial torque and 90° angle of rotation torque (stretch bolts), respectively.

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.



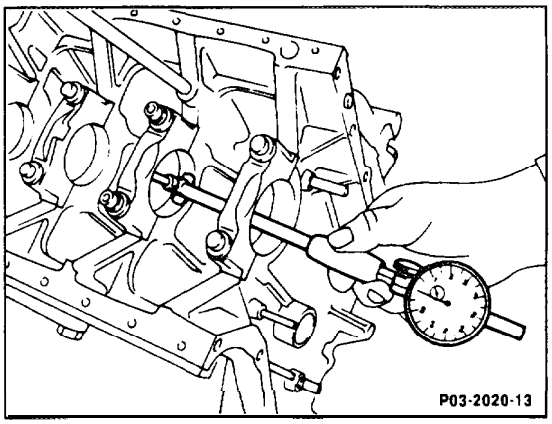
4 Insert crankshaft bearing shells, install bearing covers, screw in fastening bolts and tighten to 90 Nm (hexagon bolts) or 55 Nm initial torque and 90” angle of rotation torque (stretch bolts), respectively.





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

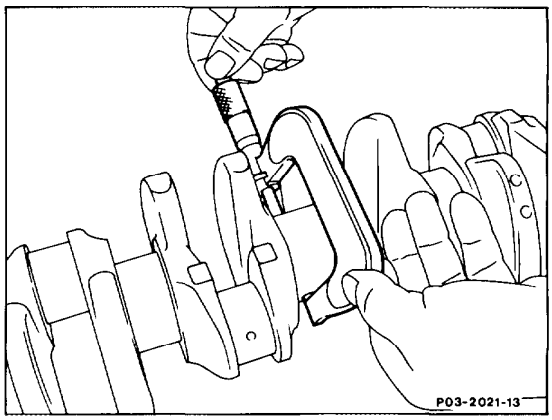
5 Measure and note bearing diameters.



6 Measure crankshaft bearing journals, determine radial play of crankshaft bearings.

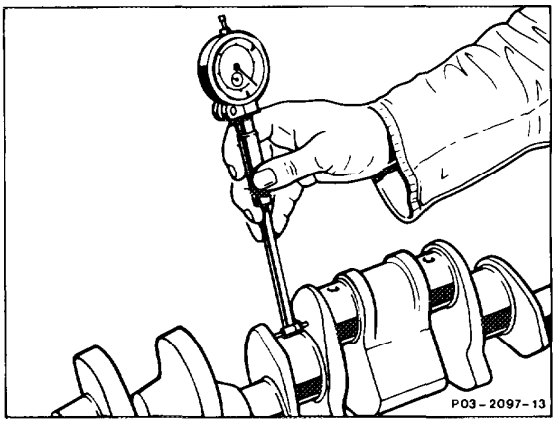
Note

Bearing play can be corrected by replacing the bearing shells (refer to table for matching crankshaft bearing shells to crankcase).

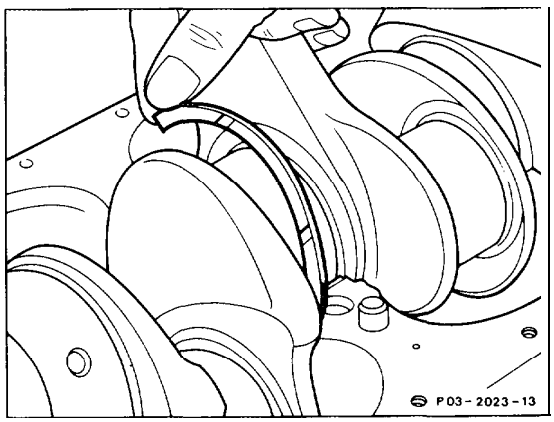


7 Measure width of thrust bearing journal and match appropriate thrust washers (refer to table, Section " Data").

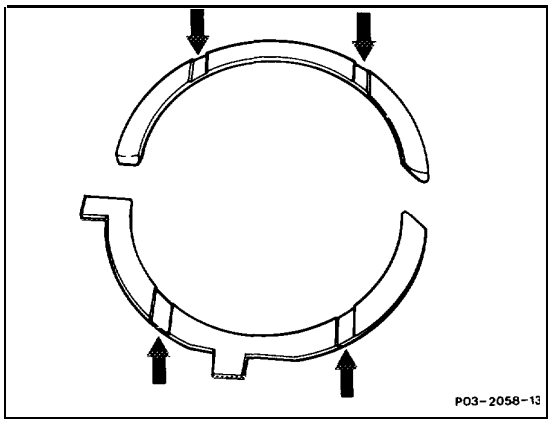
8 Oil bearing shells and crankshaft with engine oil and insert crankshaft.



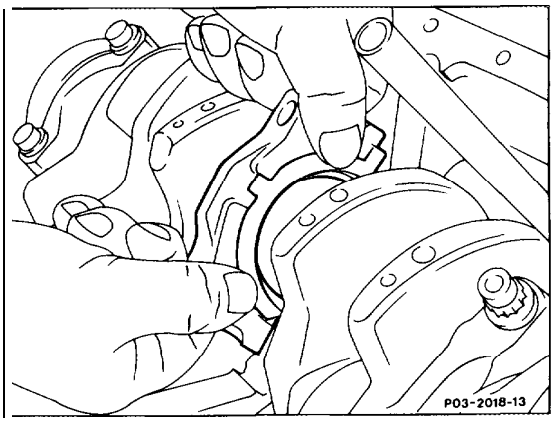
9 Oil thrust washers with engine oil and fit the grooves on the thrust bearing (crankcase).



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



10 Install thrust bearing cover.



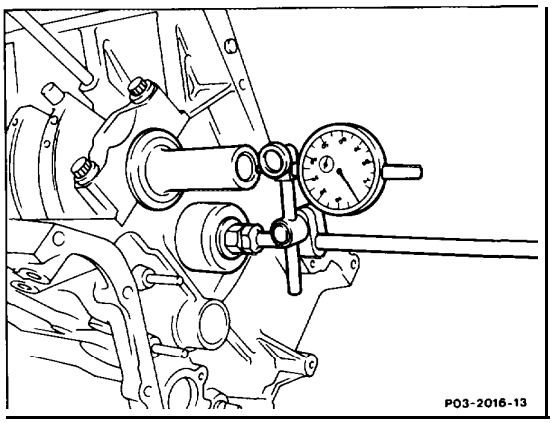
Caution!
Oil thrust washers with engine oil and place into the grooves on the thrust bearing cover. The two oil grooves in the thrust washers must be facing the crankshaft webs.
When installing the thrust bearing cover, hold both thrust washers tight.

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

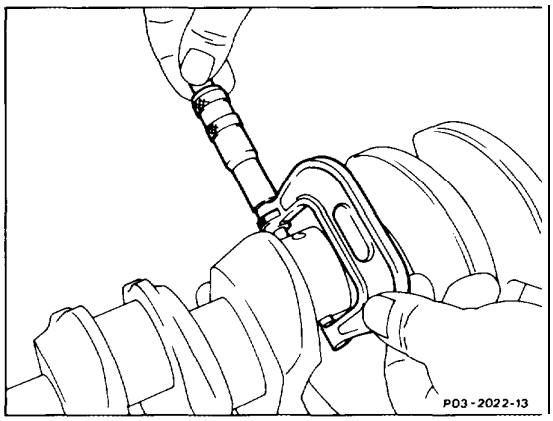
15 Recondition conrod and check angles of bearing bores relative to each other (03-313).

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.

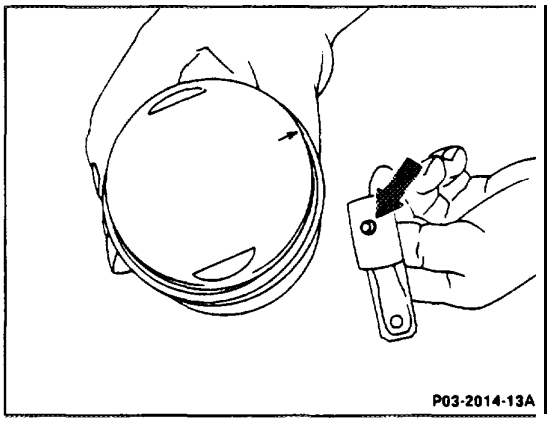
Note

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.

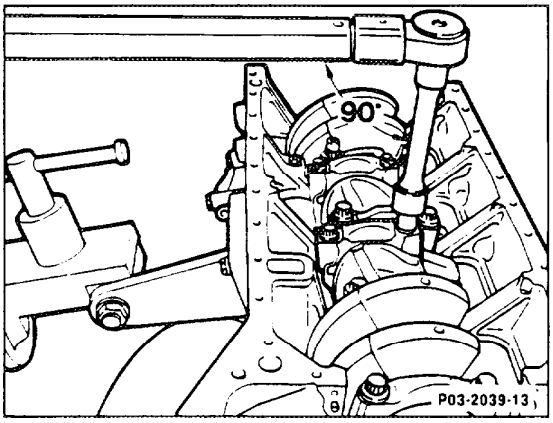
19 Fit pistons to conrod and install (03-316).

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".

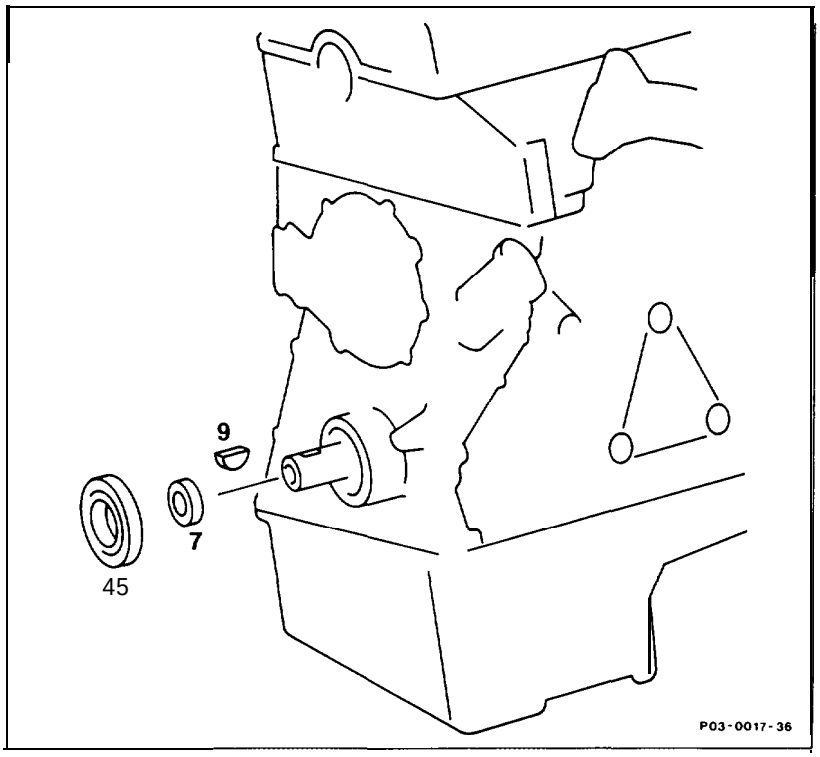


Caution!
Remove oil pump, clean, replace, if necessary, oil pump gears and drive sleeve (18-210). Remove oil pressure relief valve and check ease of movement of pistons (18-215). Remove oil filter (18-l 10), disassemble and clean.

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

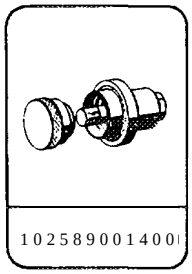
03-324 Replacing front crankshaft radial seal

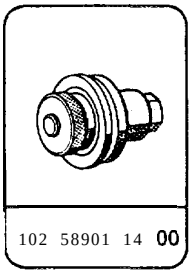
Preceding work:
Drain coolant (20-010).
Remove radiator (20-420).
Remove poly V-Belt (13-342).
Remove belt pulley and vibration damper (03342).

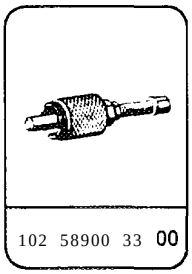


Radial seal (45)	. . . . .	remove, replace and install (steps 1, 3 and 4)
Spacer ring (7)	. . . . .	check, replace if necessary (step 2).
Mounting hole	. . . . .	clean, check.

Special tools

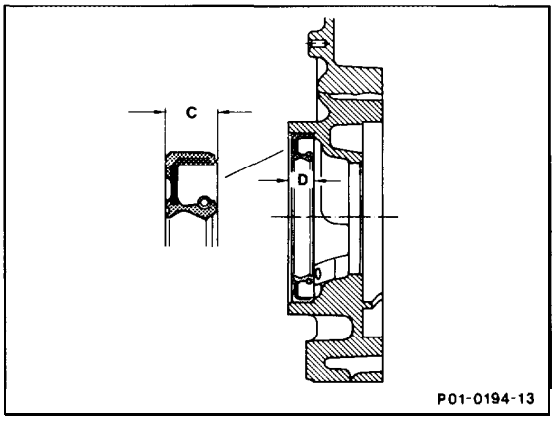






Notes

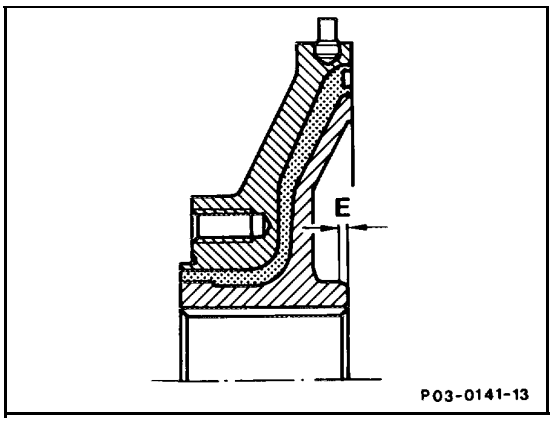
Since August 1986 (implementation of use of double roller chain) a 4 mm narrower radial seal has been installed.
Size "C" 8 mm (previously 12 mm).
For the same reason, the mounting in the timing case cover (D) was made 3.4 mm flatter.
Size "D" 9.8 mm (previously 13.2 mm).



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).

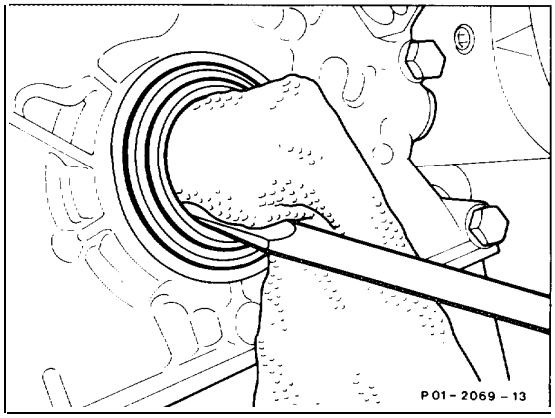
This is done by cleaning the bottom area of the timing case cover free of oil, drying and spraying it with “MB contrast spray white”,

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

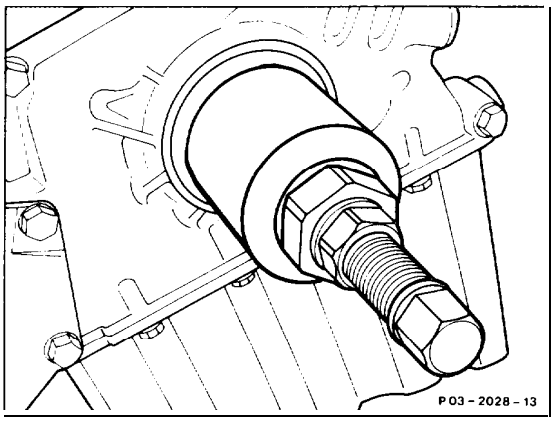
1 Pry radial seal (45) out of the timing case cover with a screwdriver.

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

Deburr mounting hole, if necessary.



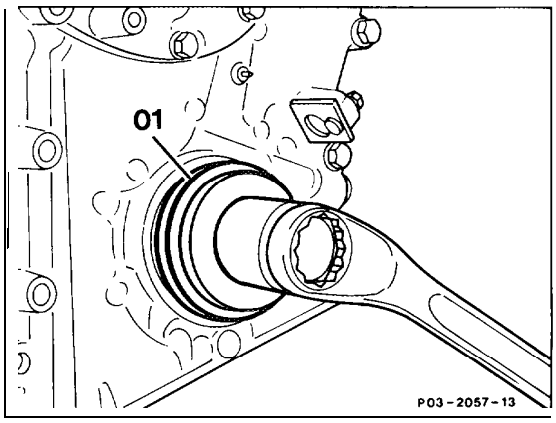
2 Check whether the sealing lip of the radial seal has worn at the spacer ring (7) (groove). If necessary, remove spacer ring with the puller 102 589 00 33 00.
If necessary, install new spacer ring.



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

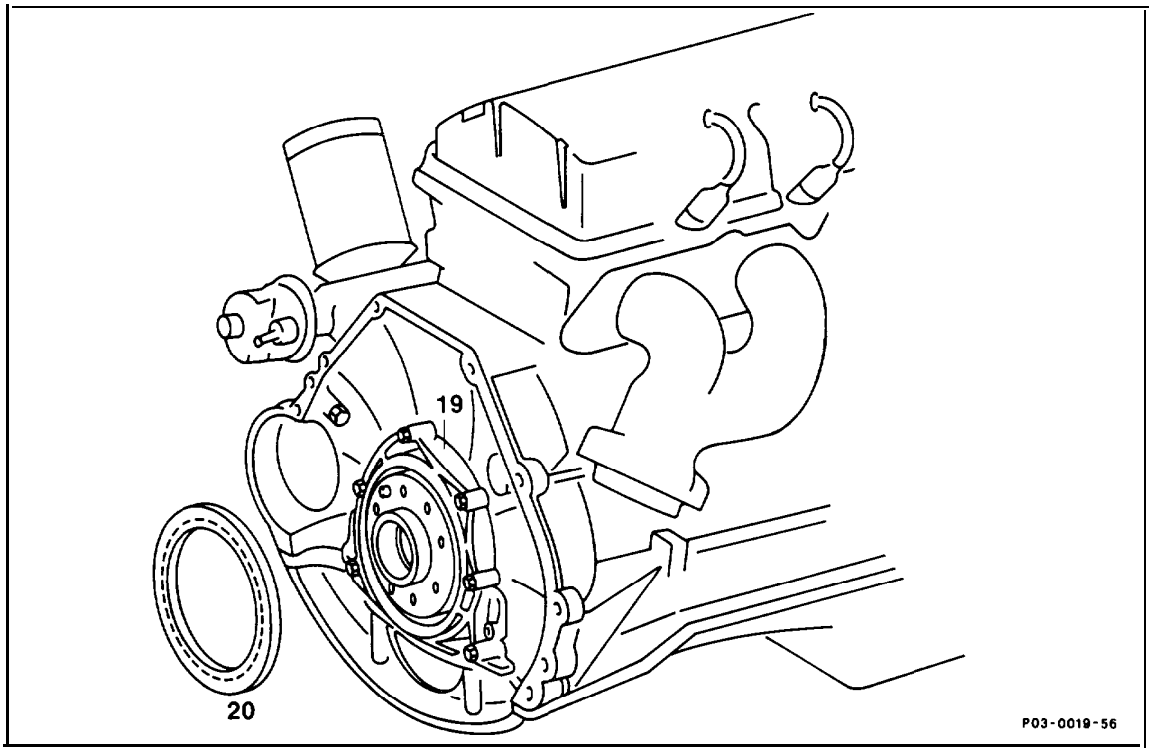
Caution!
Do not use any grease. Grease prevents the inclined webs on the sealing lip from positioning.

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.



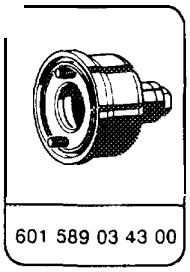
03-327 Replacing rear crankshaft radial seal

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

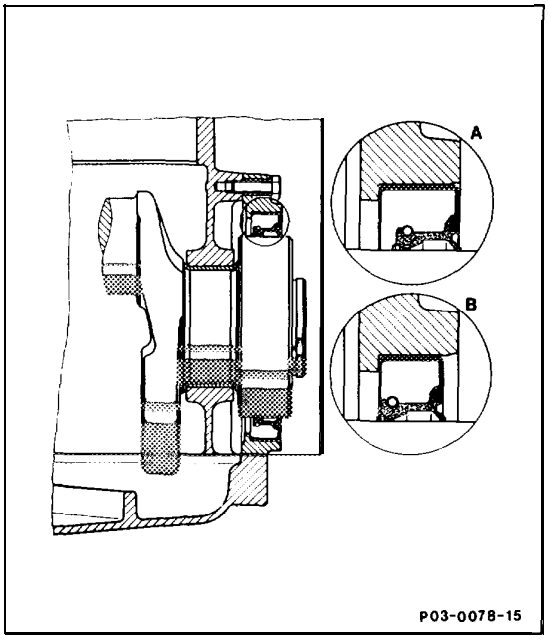


Radial seal (20)	remove, replace and install.
Mounting hole	clean, check.
Sealing lip	oil.
Leaks when engine running	check.

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.

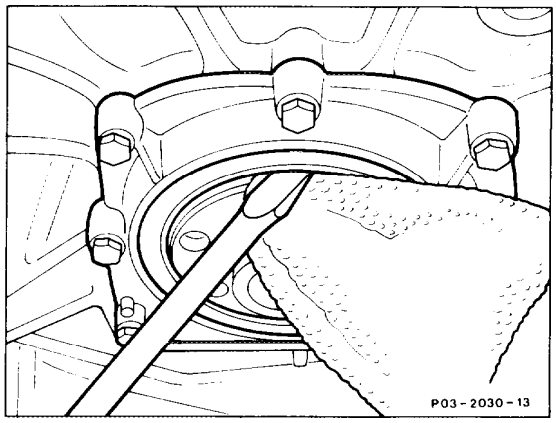


A Standard radial seal
B Repair radial seal

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.



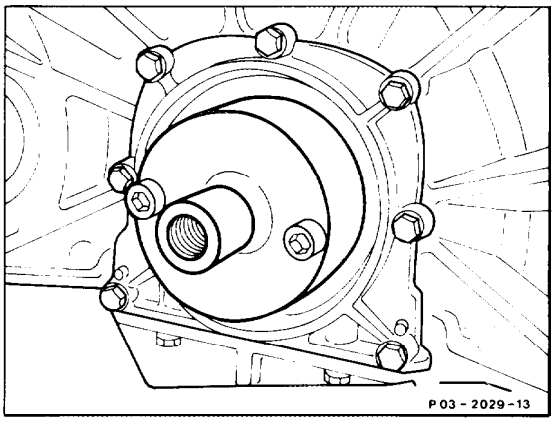
2 Check running surface for radial seal on the crankshaft for signs of damage.

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

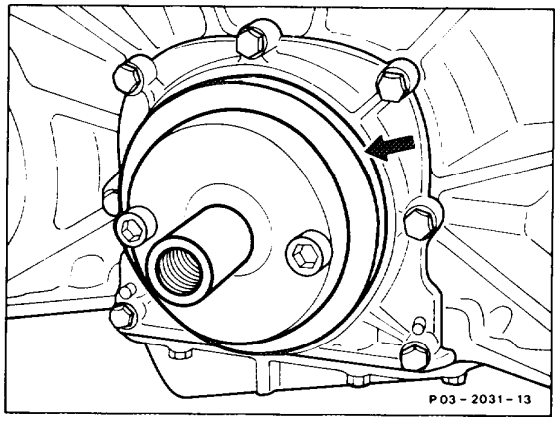
4 Screw inner part of installation tool onto crankshaft flange.

5 Oil sealing lip of radial seal.

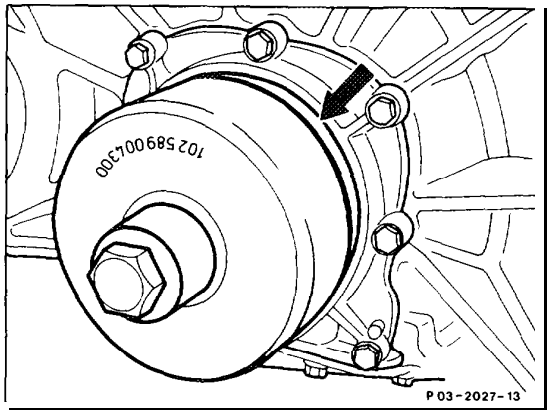
Caution!
Do not use any grease. Grease prevents the inclined webs on the sealing lip from repositioning.



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.

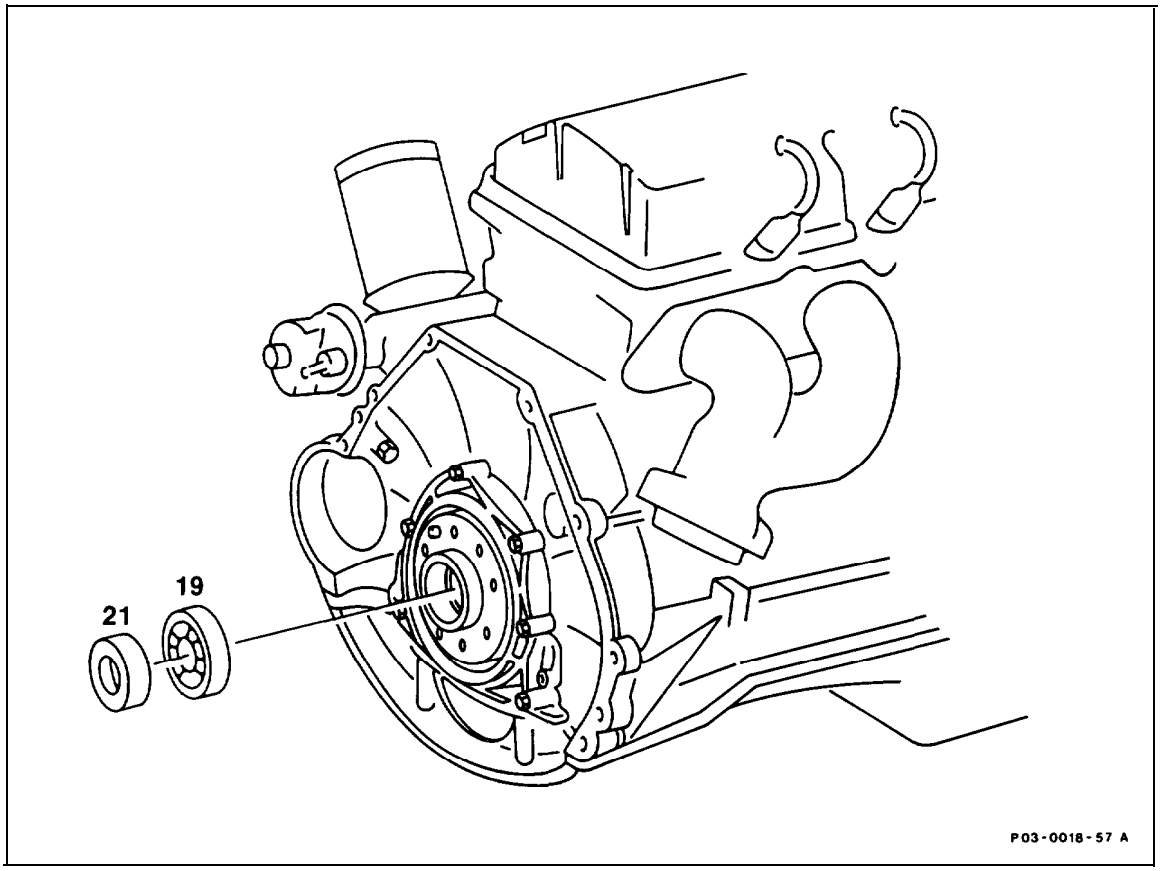


Caution!
The radial seal must be positioned exactly at right angles to the crankshaft flange or inner part of the installation tool to ensure that it provides a proper seal.

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).

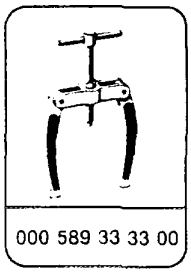


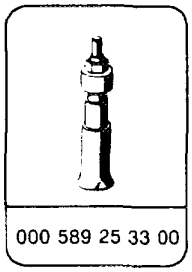
Grooved ball bearing (19) and locking ring (21) . . withdraw, special tool 000 589 33 33 00 and 000 589 25 33 00.

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.

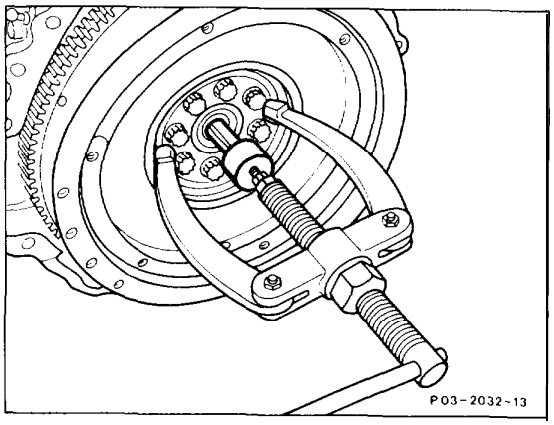
Special tools





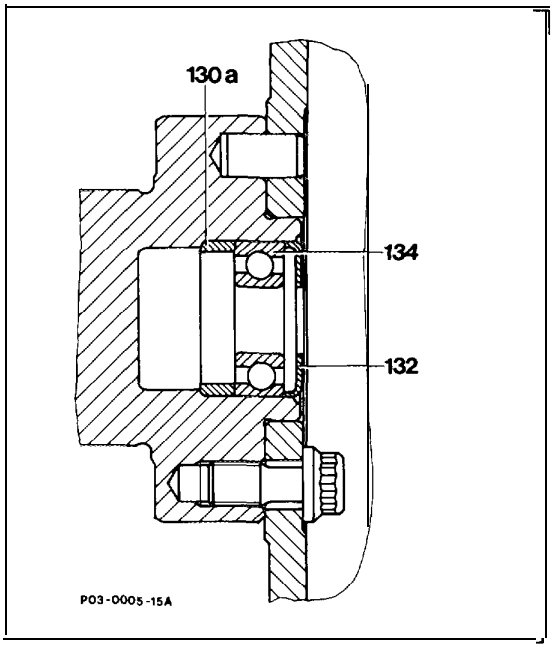
Removal and installation

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



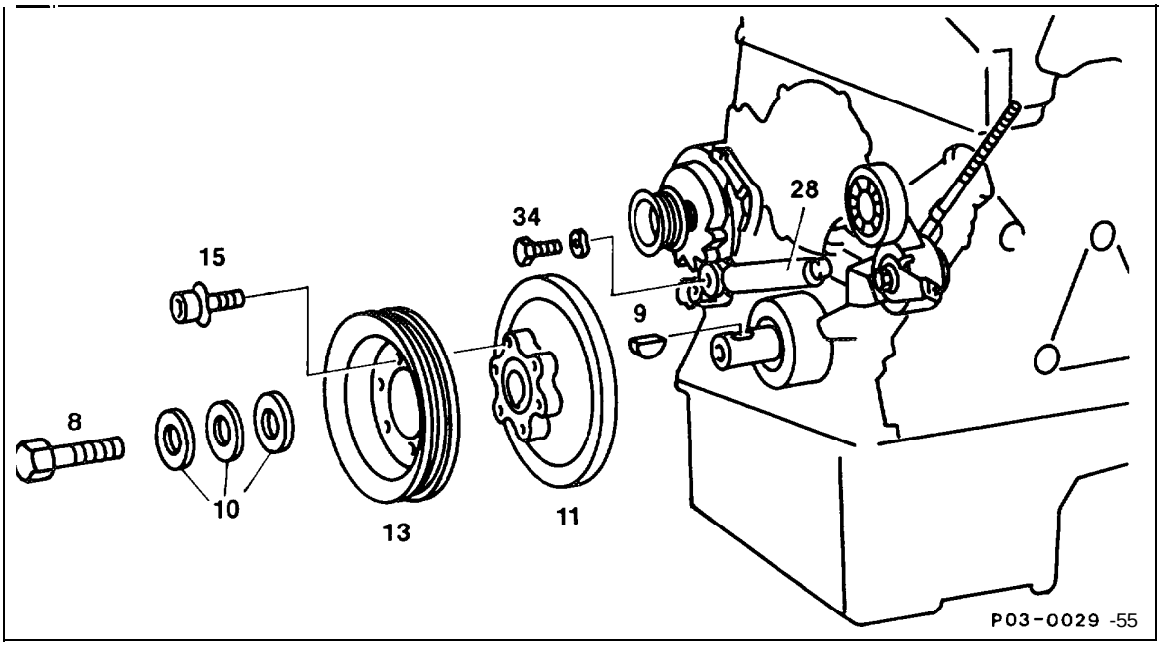
2 Coat the new grooved ball bearing with the adhesive 002 989 94 71 and knock the outer race with a suitable drift to insert it into the crankshaft as far as the stop.

3 Knock in locking ring (132) flush.



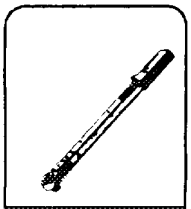
03-342 Removal and installation of vibration damper or hub and belt pulley

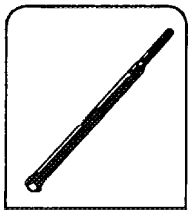
Preceding work:
Draining coolant (20-010).
Removing radiator (20-420).
Removing poly V-belt (13-340).

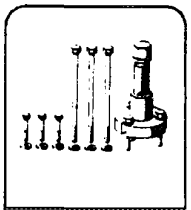


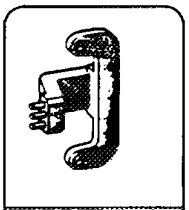
Retaining lock on starter ring gear	remove and install, special tool 601 589 02 40 00.
Belt pulley (13)	unbolt, bolt on, 25 Nm.
Hexagon bolt (8)	unscrew, bolt on, 300 Nm.
Shock absorber (28)	Unbolt at bottom, bolt on (step 4) and press up, 25 Nm.
Vibration damper (11)	pull off, special tool 601 589 08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

Special tools


001 589 72 21 00


001 589 74 21 00


103 589 00 33 00

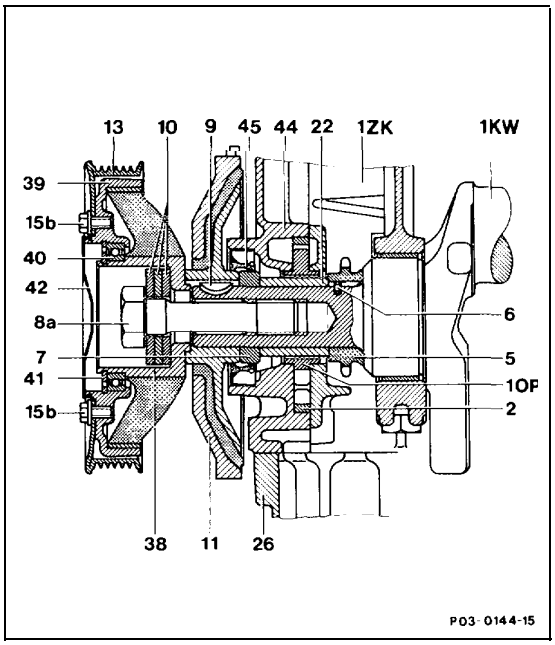

601 589 02 40 00

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.

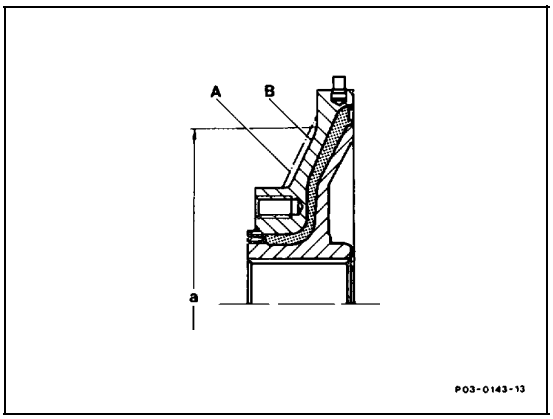
The uneven running of the crankshaft, particularly at low engine speeds and during cutin surges of the A/C compressor, are damped by the coupling so that the V-belt runs practically slip-free on the belt pulley.



1KW	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

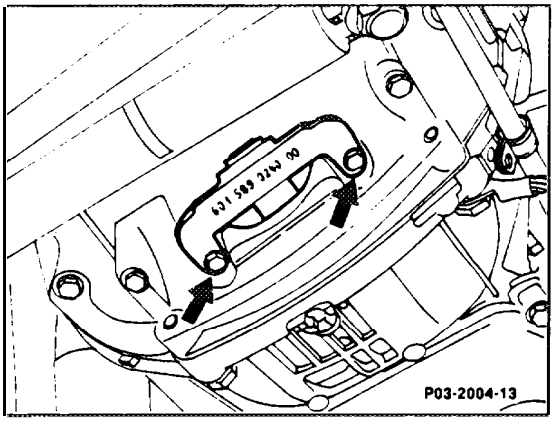
Standard implementation: 10/87

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

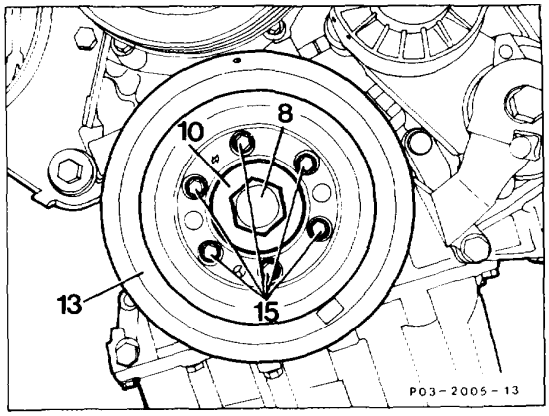
The spacer ring on the crankshaft was made 3.65 mm narrower with implementation of the double roller chain.

Removal and installation

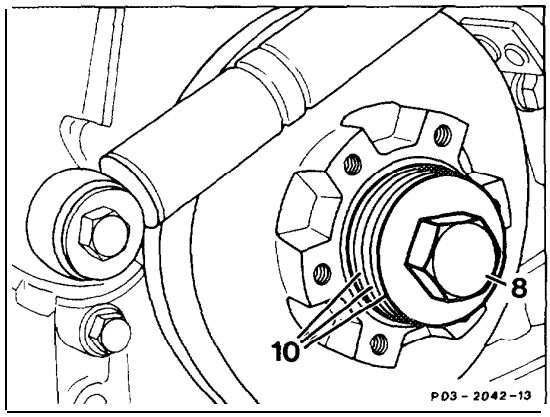
1 Attach retaining lock 601 589 02 40 00 with two bolts to the oil pan (arrows).



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

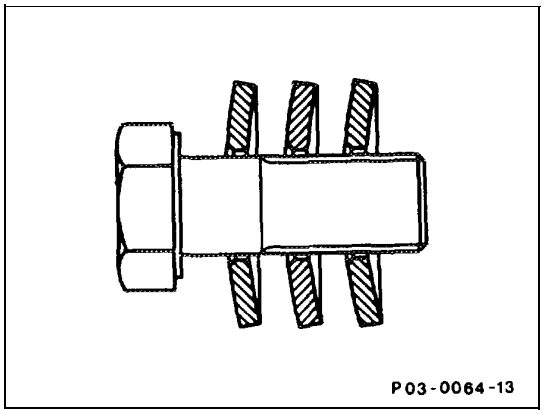


3 Remove bolt (8) and take off Belleville spring washers (10).

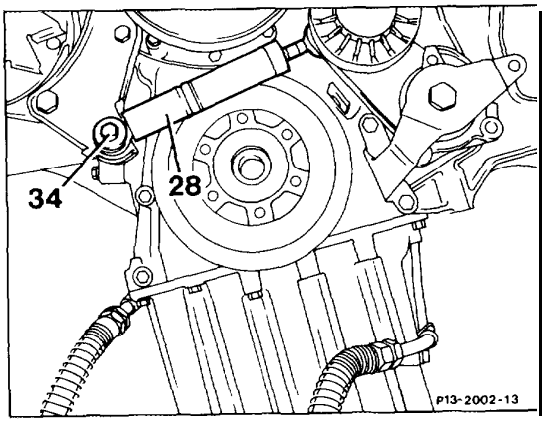


Installation Instruction

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



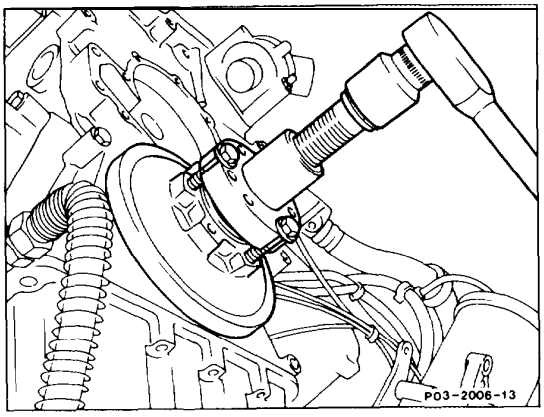
4 Remove bolt (34) for bottom shock absorber mounting and swing shock abosrber (28) upwards. Tightening torque 25 Nm.



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

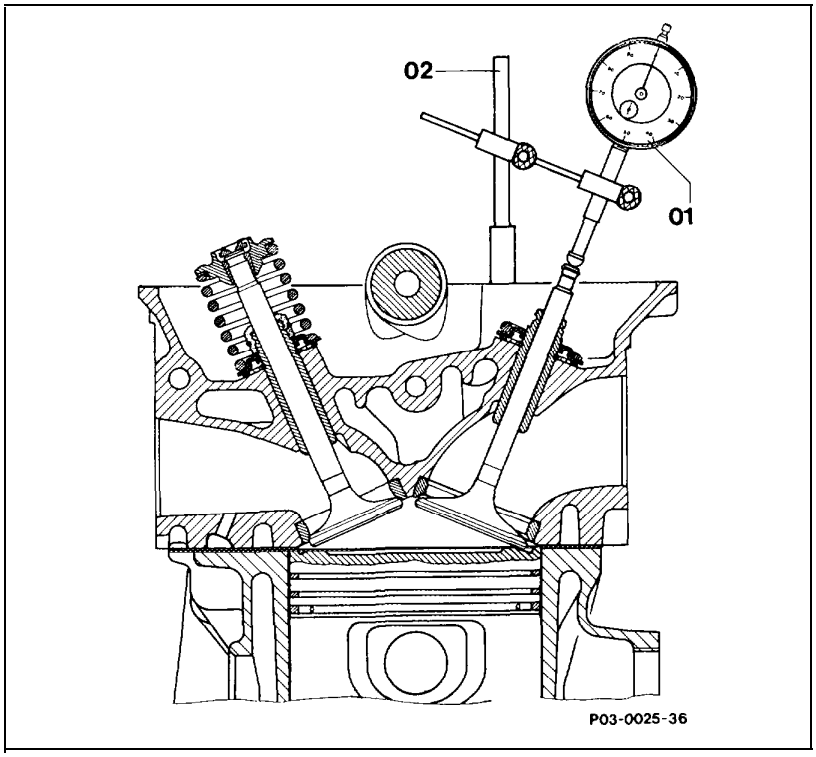
Installation instruction

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).



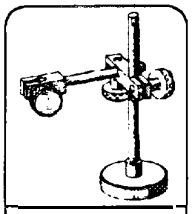
Fan and fan coupling	remove and install (step 1).
No. 1 cylinder piston	set to ignition TDC (step 2).
No. 1 cylinder rocker arm bearing bracket	remove and install, 20 Nm (step 3).
Valve spring	remove from 1st intake valve, install (05-250).
Valve stem seal	remove from 1st intake valve, install (step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

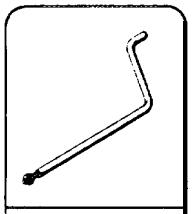
TDC setting	measure by attaching dial gauge holder 363 589 02 21 00 to cylinder head. Mount valve on piston crown. Turn back crankshaft to approx. 10° before TDC of No 1 cylinder. Inset-t dial gauge in holder. Fit tracer pin of dial gauge onto valve stem with preload of 2 mm. Slowly turn crankshaft in 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).

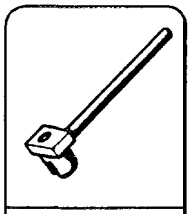
Data

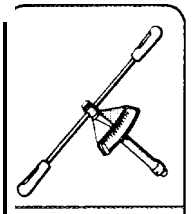
Piston travel at crankshaft setting 20° after TDC	measured over intake valve	2.85 mm
	measured directly at piston crown	3.07 mm

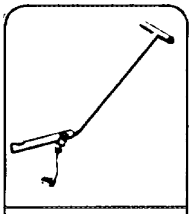
Special tools

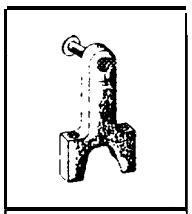

363 589 02 21 00

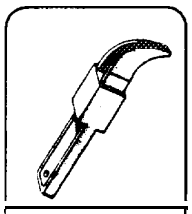

123 589 09 63 00

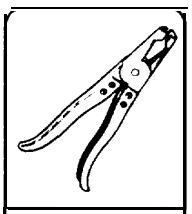

119 589 00 21 00


001 589 51 21 00


102 589 00 61 00


1102589 01 61 00


116 589 06 63 00

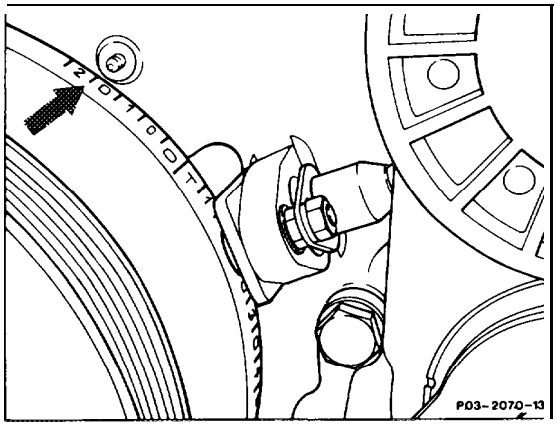

104 58900 3700

Commercial tool

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

Notes

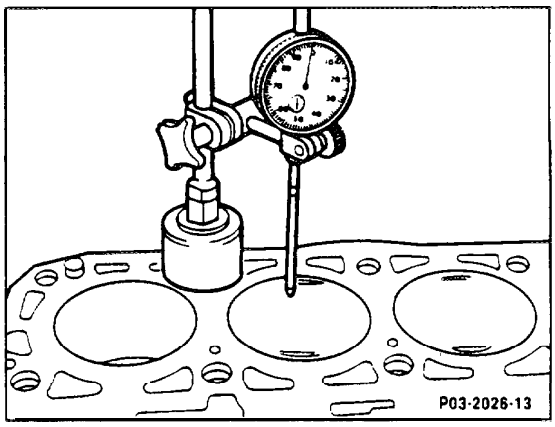
The TDS pulse generator with holder (1) is attached to the timing case cover.
The pin in the vibration damper or on the belt pulley must be positioned exactly below the TDC pulse generator at a crankshaft setting of 20” after TDC.



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

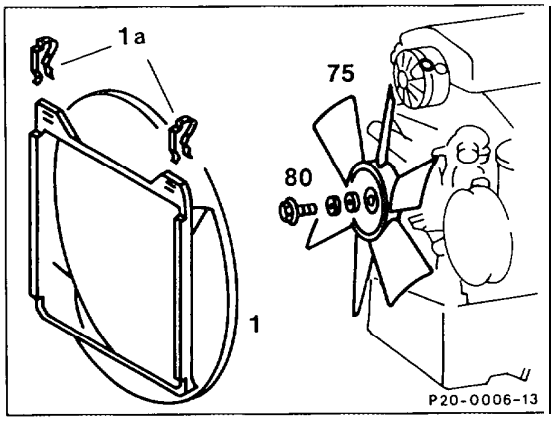
- When replacing the crankshaft or the vibration damper.
- When replacing the timing case cover.
- When installing parts to reconditioned engines.

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.

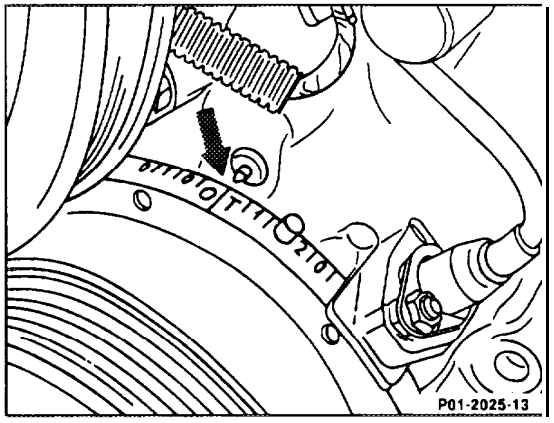


Checking

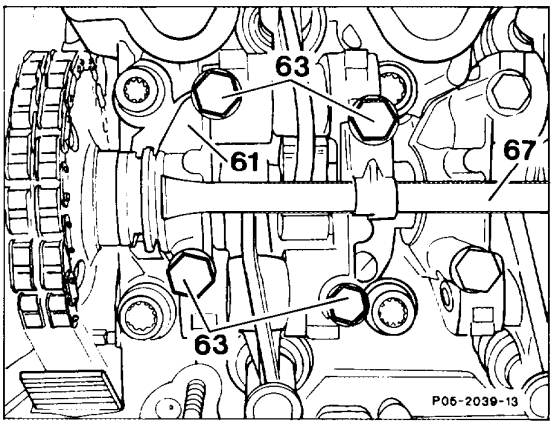
1 Remove and install fan shroud (1) and fan (75), tightening torque of bolt (80), 25 Nm.



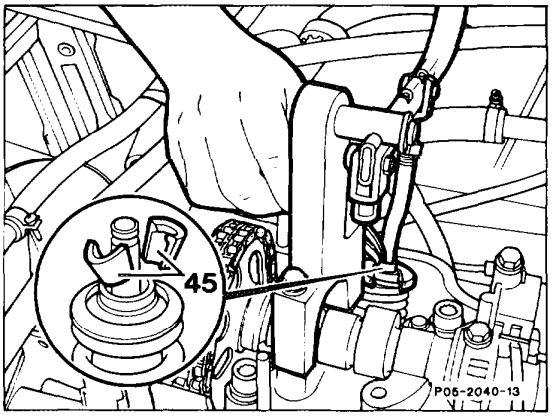
2 Set engine to ignition TDC of No. 1 cylinder.



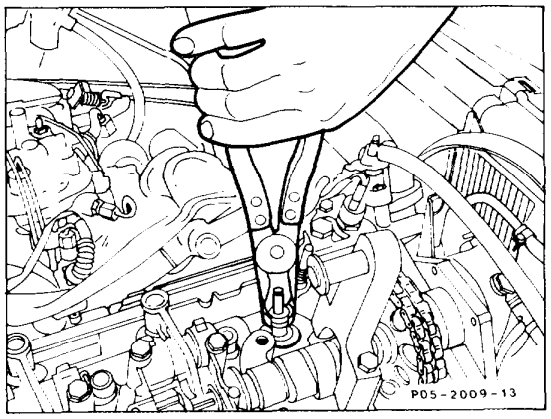
3 Remove and install rocker arm bearing bracket (61) by unscrewing oil pipe. Tightening torque of bolts (63), 21 Nm.



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



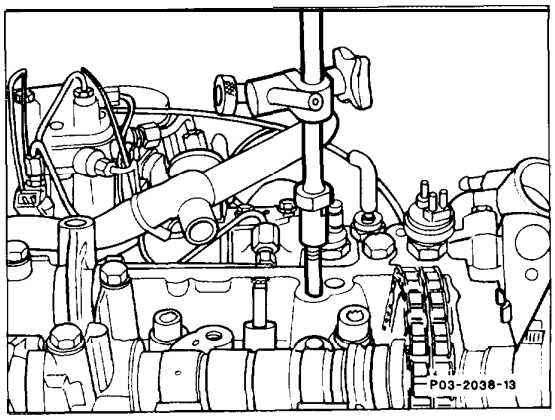
5 Remove and install valve stem seal of No. 1 intake valve. Oil new valve stem seal and press on by hand. Mount assembly sleeve on the valve stem for performing this step (05-270).



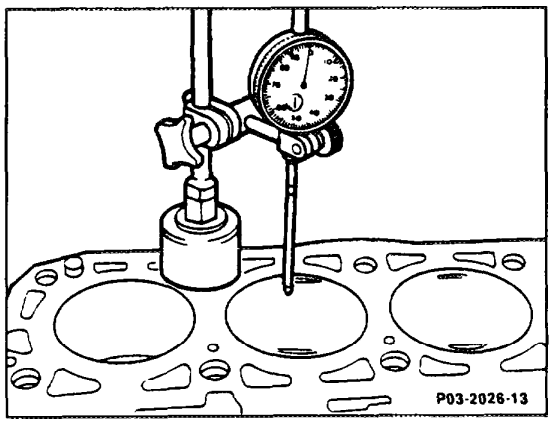
6 Mount valve on piston crown.

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

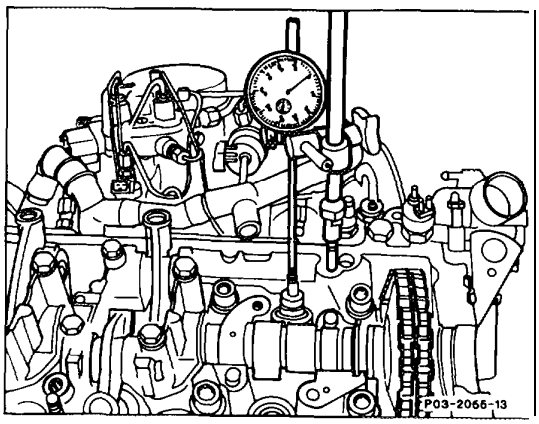
8 Bolt dial gauge holder 363 589 02 21 00 with threaded sleeve onto cylinder head set bolt at front left.



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



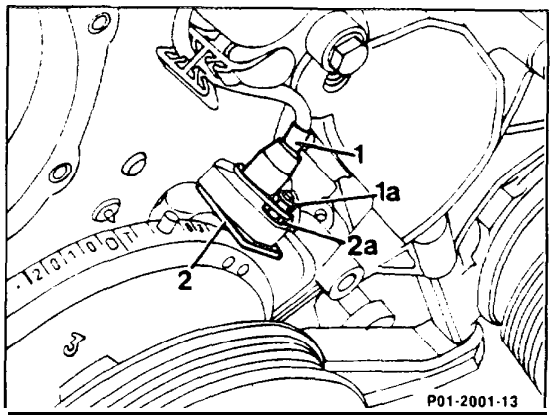
9 Insert dial gauge with extension.



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

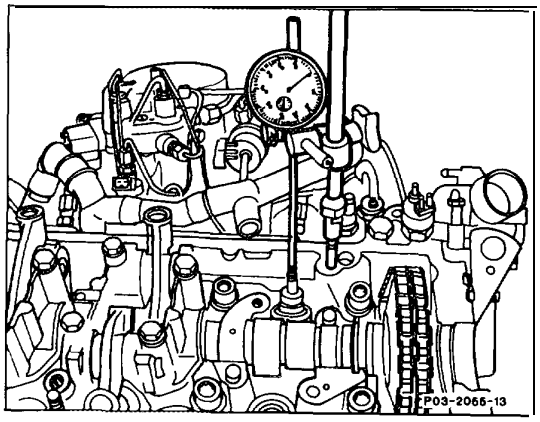
11 Slowly turn crankshaft in direction of rotattion of *engine* until the larger pointer of the dial gauge stops (TDC setting).

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



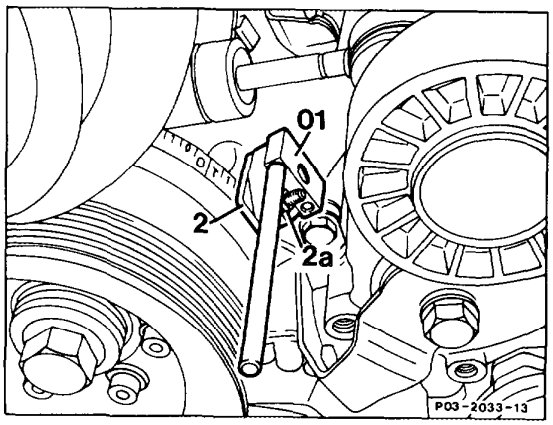
13 Loosen dial gauge and mount extension with 5 mm preload onto the valve stem or piston crown. Turn scale of gauge until the large pointer is at zero.

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).

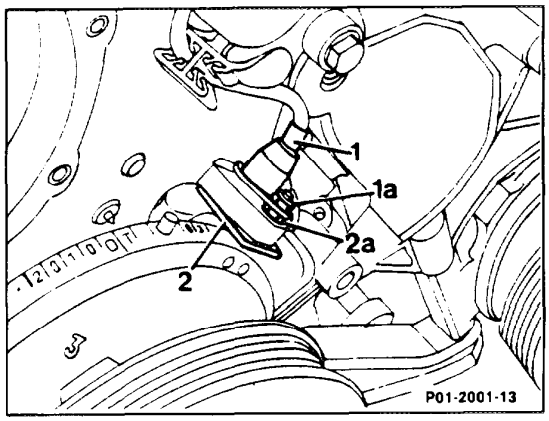
If the pin does not engage, adjust position of setting slide.



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.

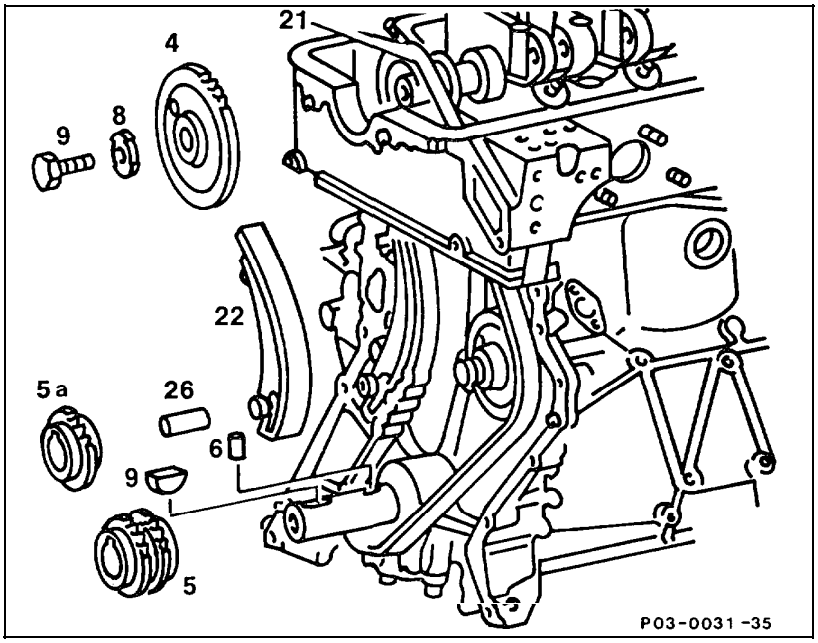


18 Insert TDC pulse generator and bolt on.

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.

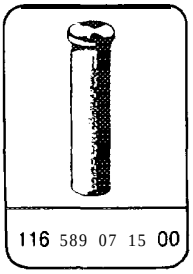
Note

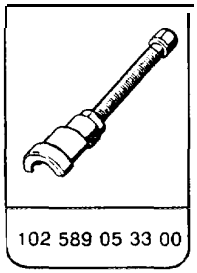
Drill bearing pin (26) of engines with double roller chain, tap M6 thread and knock out with impact extractor 115 589 12 33 00 and extension 100 589 00 43 00.

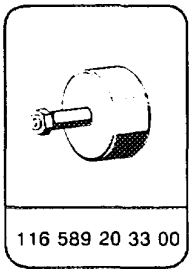
When installing tensioning rail, insert new bearing pin together with tensioning rail (steps 4 and 9).

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





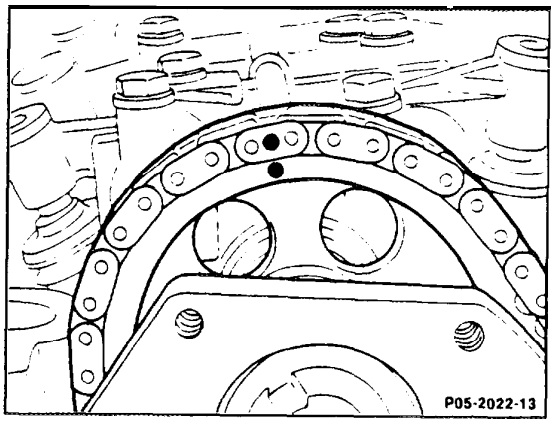


Note

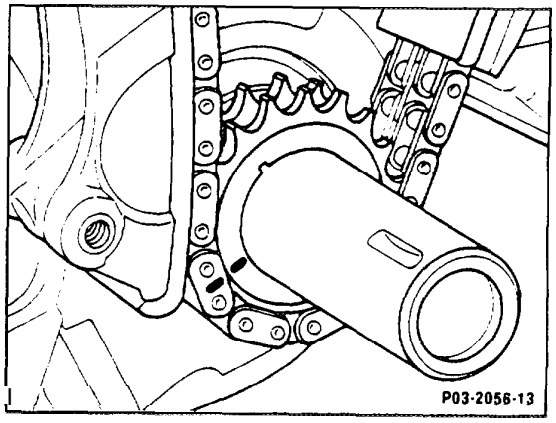
As of January 1988 a double roller timing chain has been installed.

Removal and installation

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

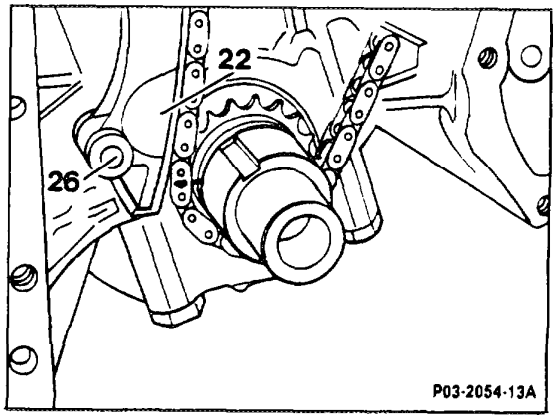


2 Mark timing chain and crankshaft gear relative to each other.



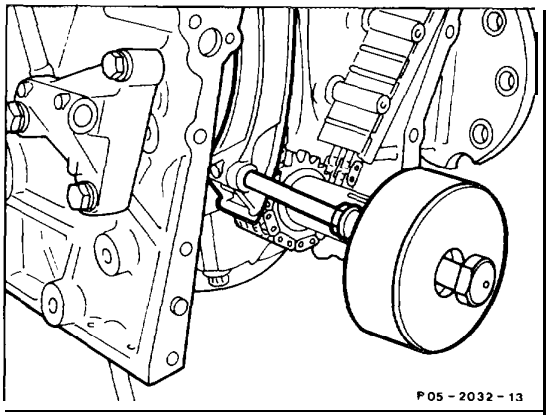
3 Unbolt camshaft gear and place timing chain in chain box.

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

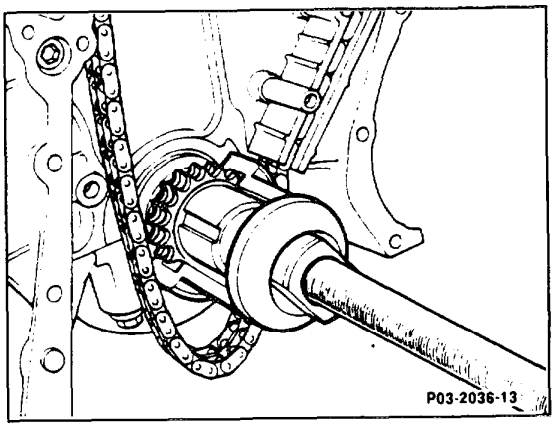


Note

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.

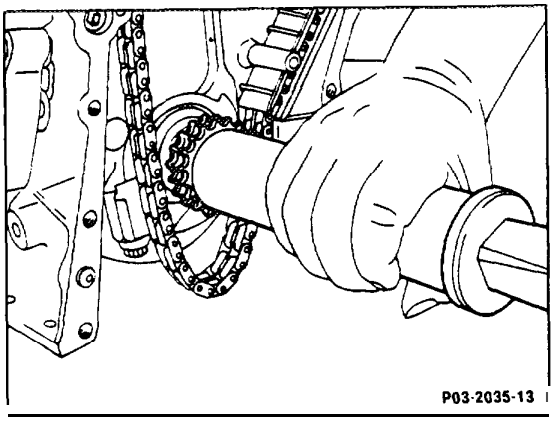


5 Pull off crankshaft gear and oil pump drive sleeve with the puller 102 589 05 33 00.



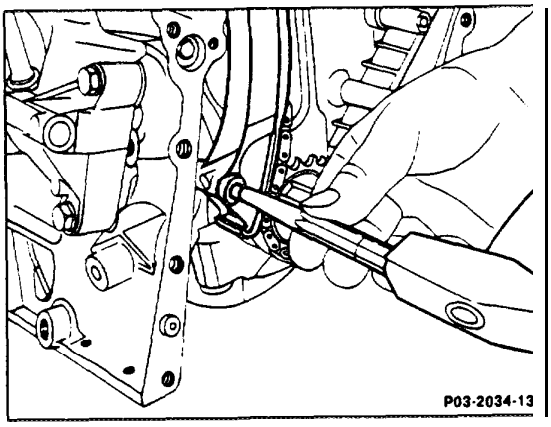
6 If the crankshaft gear is replaced, transfer color marking from the old to the new crankshaft gear.

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.



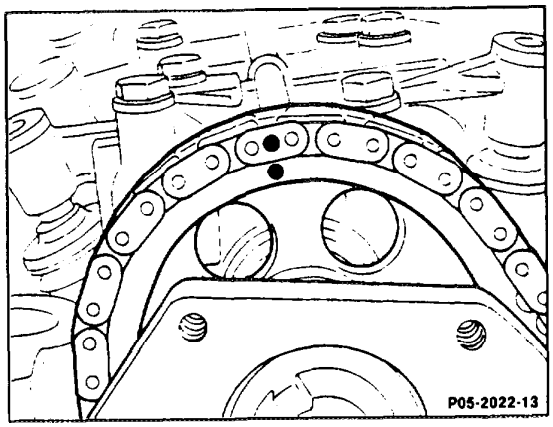
8 Insert drive sleeve.

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



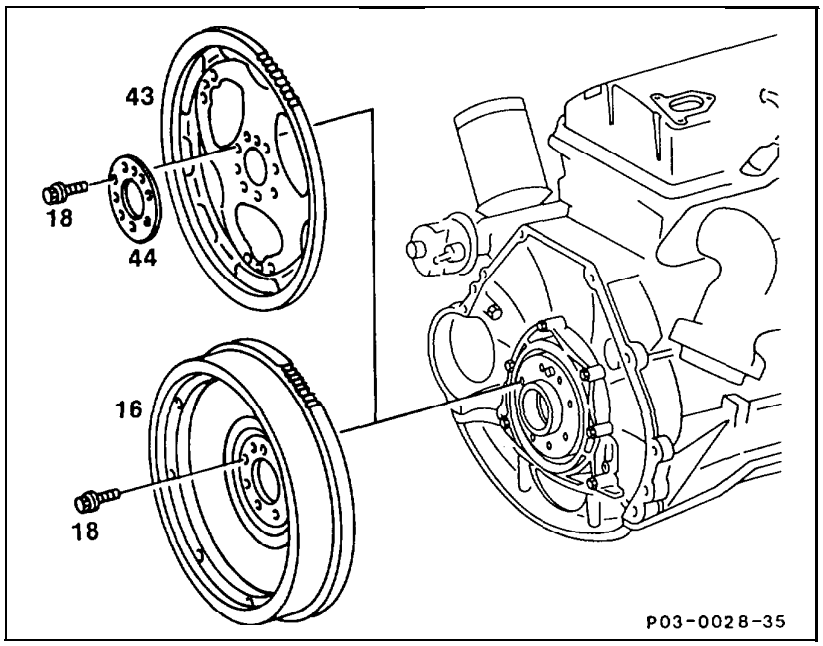
10 Install camshaft gear (pay attention to color marking), tightening torque 80 Nm.

11 Check for leaks with engine running.



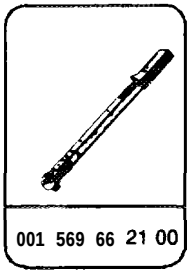
03-410 Removal and Installation of flywheel or flex plate

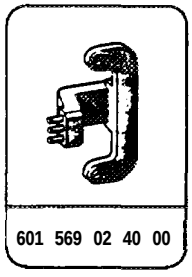
Preceding work:
Removing transmission (26-020 or 27-600).
Removing clutch (25-050).



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

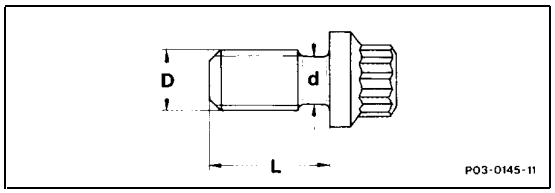

001 569 66 21 00


601 569 02 40 00

Stretch bolt

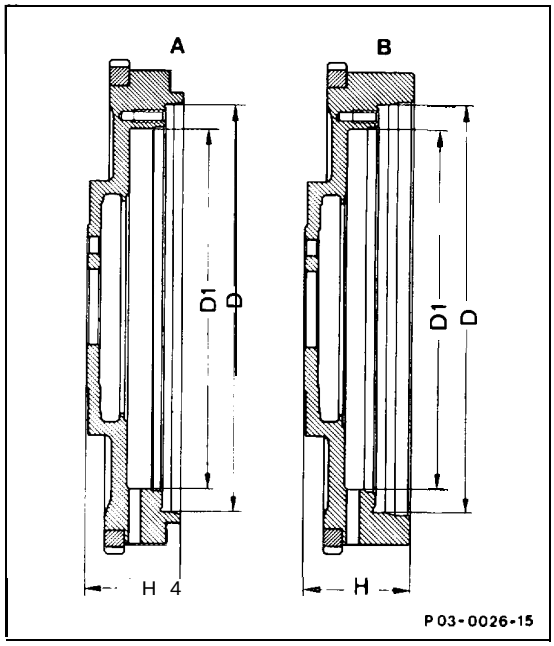
Part No.		102 **032 00** 71	103 032 00 71 [1])
Thread dia. D		M10 × 1	M10 × 1
Thread shaft dia. d	when new	8.5 -0.2	8.5 -0.2
	minimum dia.	8.0	8.1
Length L	when new	22 ±0.2	57 ±0.2
	maximum length	22.5	

[1]) Stretch bolt with two-mass flywheel



Notes

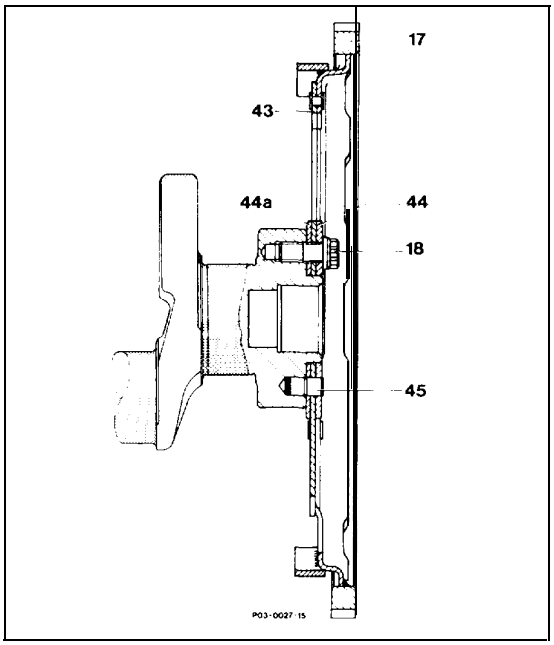
The engines 102.922/924/962/963 have the same flywheels (standard flywheel). Compared to this standard flywheel, the flywheel of engine 102.985 is lighter and the hole circle for the tapped holes for mounting the clutch are larger. The flywheels must not be interchanged and can be replaced without the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



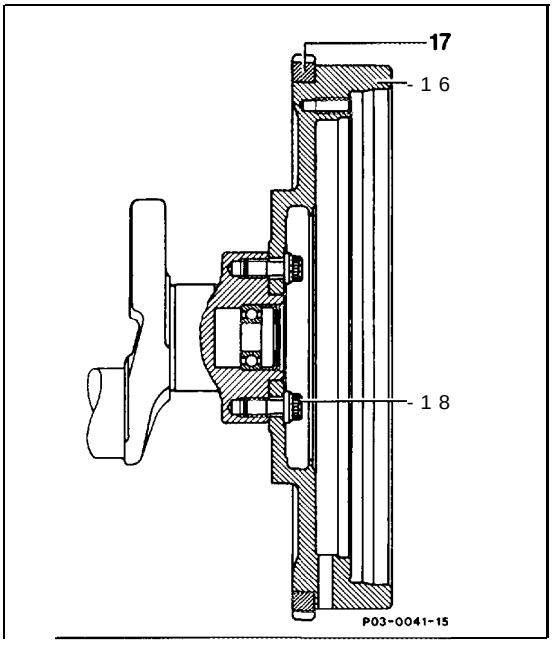
A Engines **102.922/924/962/963**
D **253** mm
D1 223 mm
H 58.6 mm

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.

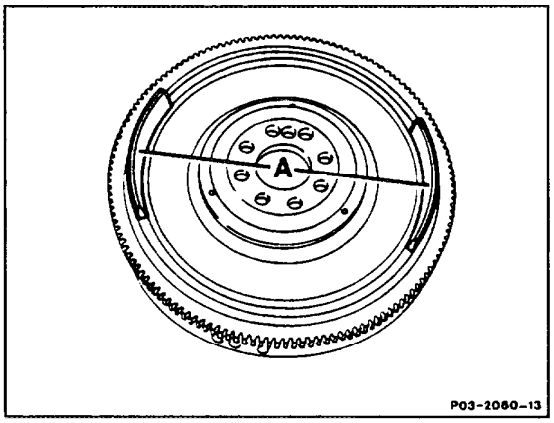


Arrangement of flex plate on crankshaft of engines with automatic transmission.
17 Ring gear
18 Ml0 x 1 x22 stretch bolt
43 Flex plate
44 Spacer disc
44a Spacer disc (bonded on)

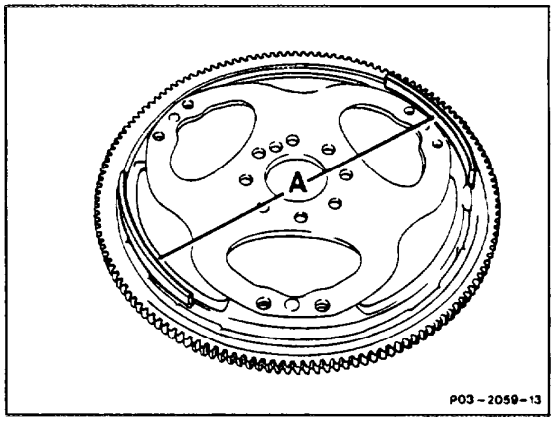


Arrangement of flywheel on crankshaft of engines with manual transmission.
16 Flywheel
17 Ring gear
1a M10 x 1 x22 stretch bolt

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.



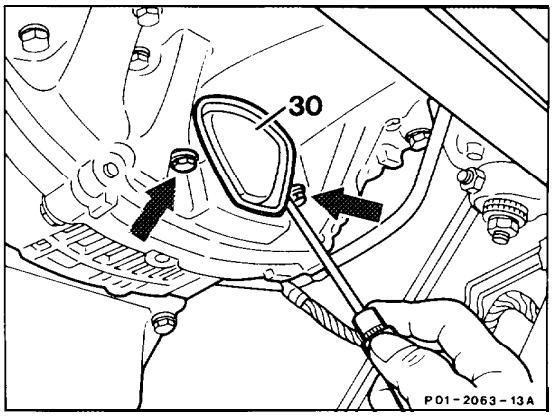
Flywheel of manual transmission



Flex plate of automatic transmission

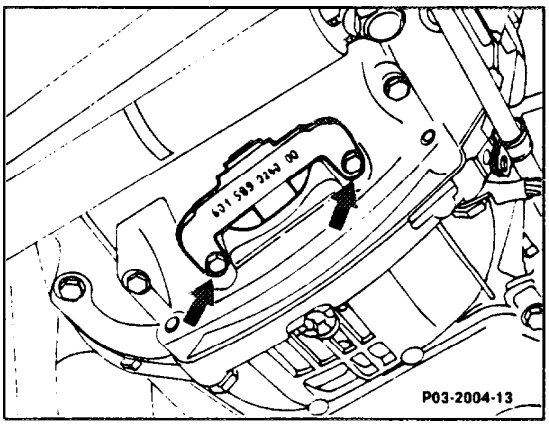
Removal and installation

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.

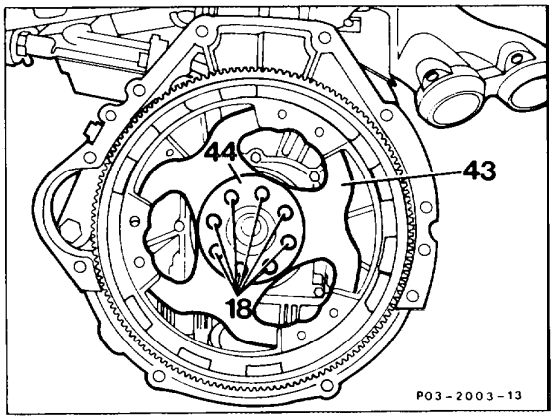
3 Unscrew stretch bolts (18).
Take off flywheel or driven member with bonded spacer disc (44a) and spacer disc (44).



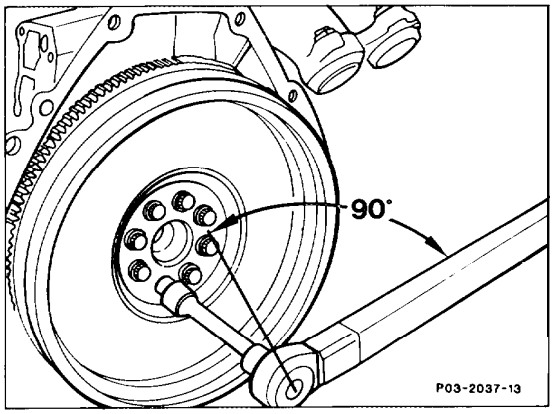
4 Check stretch bolts (see table).

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.

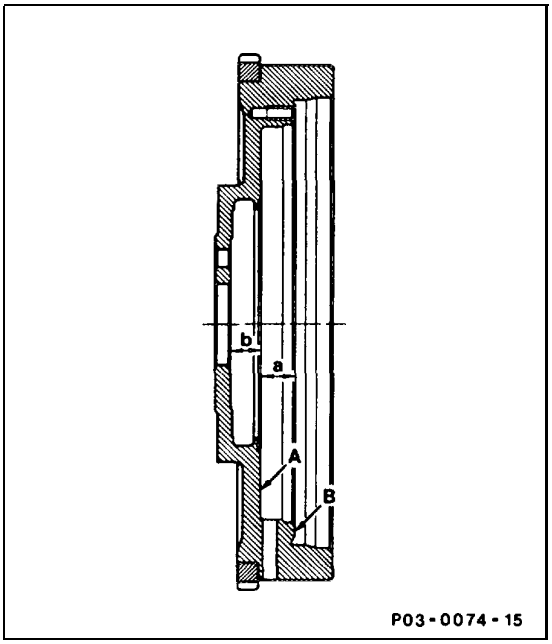


7 Torque stretch bolts (18) in a single operation by the specified angle of rotation torque of 90".



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.

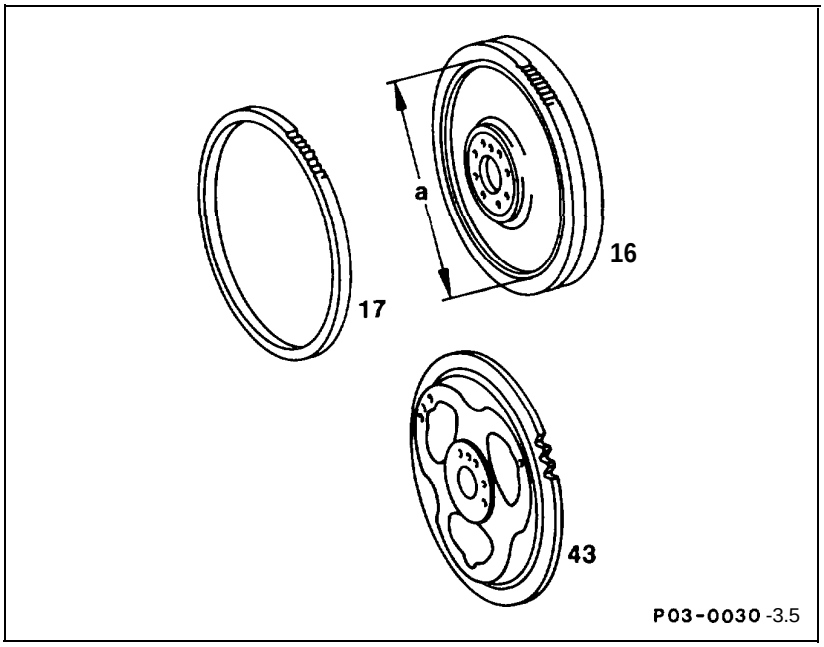
The size b must be maintained as a minimum when performing repairs.

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.

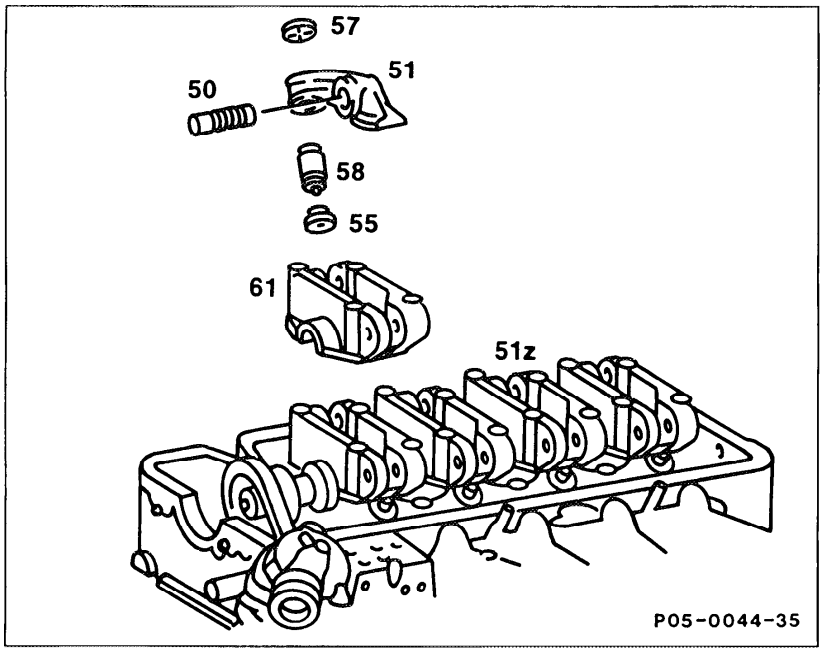
Standard implementation: April – July 1986 standard

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

Job No.

05-211 Checking and replacement of hydraulic valve clearance compensation element

Preceding work:
Air cleaner removed (09-400 and 09-410).
Cylinder head cover removed (01-406).



Check

Cam . . . . . position hydraulic element under test on the base circle. Load hydraulic element for approx. 5 to 10 seconds. If the element drops, remove it. To do this remove corresponding rocker arm bearing support (OS- 235). If a leaking hydraulic element is not found, check fitting position (05-214).

Note

When pressure testing the compensating elements, do not press valves against the piston crown (Numbers 1 and 2).

Valve clearance compensating element (58) . . . .

Fill up reservoir chamber of valve clearance compensating element on test with engine oil. Press on ball valve with a suitable pin and vent working chamber by pumping set bolt up and down. Close ball valve, if necessary replenish oil. After this no oil shall escape at ball valve when compressed and set bolt may not drop. If this is not the case, replace compensating element (Number 3).

Note

If compensating element is satisfactory, check oil bores in cylinder head, rocker shaft and rocker arm for passage, and clean if required. If several compensating elements are soft, replace oil pipe in cylinder head (01-415), for this purpose remove cylinder head (01- 415).

Replacement

Valve clearance compensating element (58) . . . .

With oil reservoir chamber full and original washer (57) push into the rocker arm up to the stop on the snap ring (56) (Number 4).

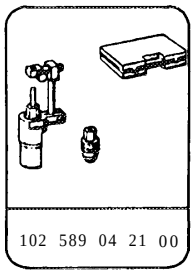
Rocker arm bearing support (61) . . . . . .

Install (05-235), at the same time fit original ball socket (55).

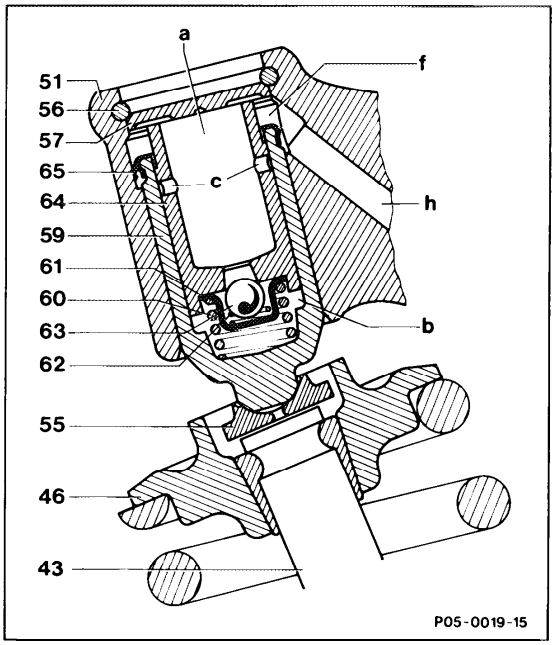
Note

Use ball socket 103 055 00 24, if a new ball socket is to be installed. Check and if required correct fitting position (05-214, Numbers 5 and 6).

Special tool



Hydraulic valve clearance compensation



43 Valve
46 Valve spring retainer
51 Rocker arm
55 Ball socket
56 Snap ring
57 Washer
59 Guide sleeve
60 Compression spring
61 Telescopic type ball bearing traveler
62 Compression spnng
63 Ball (5 mm 0)
64 Set bolt
65 Sealing cap
a Oil reservoir chamber
b Working chamber
c Return and venting bores

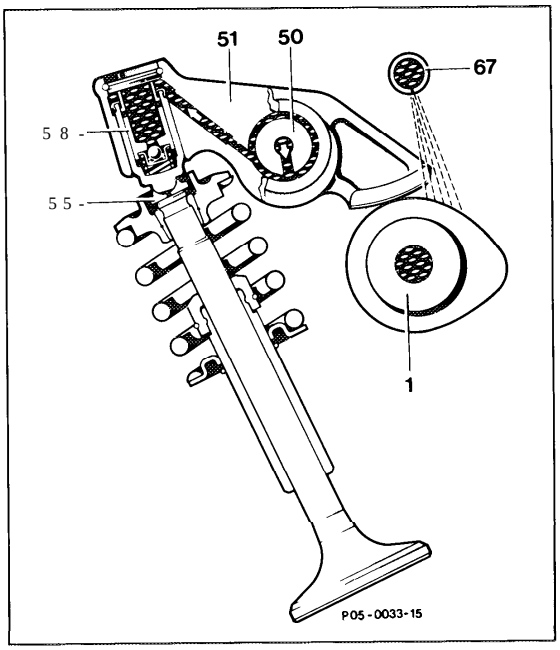
Valve adjustment Is no longer required when equipped with hydraulic valve clearance adjusters

The maintenance-free hydraulic valve clearance compensating elements located in the rocker arms eliminate valve clearance, i.e. dimensional changes in the valve train due to thermal expansion and wear are compensated by the elements. Valve train noise is low, because rocker arm is in continuous contact with the cam.

The hydraulic valve clearance compensating elements consist of the following components:

- Set bolt (64) with oil reservoir chamber (a) as well as return and venting bores (c) and a ball valve, consisting of a 5 mm Ø ball (63), telescopic type ball bearing traveler (61) and compression spring (62).

- Guide sleeve (59) with working chamber (b), compression spring (60) and sealing cap (65).



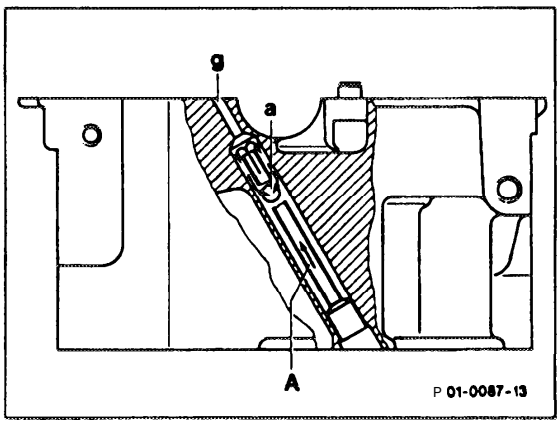
The element can drop completely when the engine is not running and the cam tip presses against the rocker arm and thus also against the element. Oil expelled from the working chamber (b) flows via the annular gap (built-in clearance between guide sleeve and set bolt) to the reservoir chamber (a).
When the cam tip moves away from the rocker arm, the set bolt (64) is relieved of load and the compression spring (60) presses the set bolt upwards until the rocker arm contacts the cam.

The vacuum, arising from the upward movement of the set bolt, opens the ball valve, and oil flows out of the reservoir chamber (a) into the working chamber (b).
As soon as the cam presses against the rocker arm and thus loads the set bolt, the ball valve closes. The oil in the working chamber acts as an “hydraulically rigid connection” and the respective valve is opened.
When the engine is running, depending on engine speed and cam position, the set bolt is only pressed slightly downwards.

The oil needed for operating the hydraulic valve clearance compensating elements, flows from the longitudinal channel and the transverse bores in the cylinder head to the rocker arm bearing points. From here it reaches the ring channel (f) through the bore (h) in the rocker arm and the reservoir chamber (a) via grooves in the washer (57).
Any air in the reservoir chamber can separate from the oil (solid oil), with the result that, if necessary, defoamed oil is led to the working chamber.

The oil quantity in the reservoir chamber is sufficient to fill the working chamber under all engine operating conditions. Any air in the reservoir chamber can escape to the ring channel (f) via the grooves in the washer (57) and from there via the annular gap between washer and rocker arm and the joint gap of the snap ring (56).

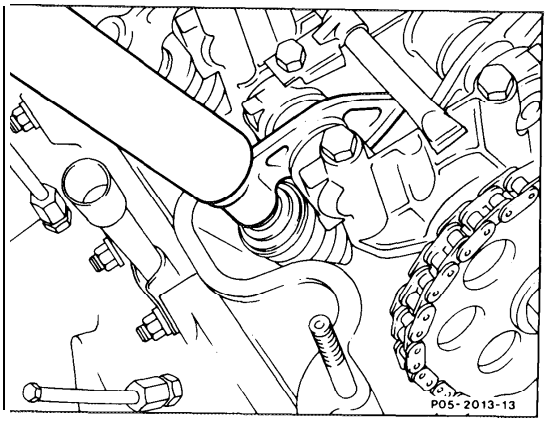
In order that the hydraulic valve clearance compensating elements can be supplied with oil pressure corresponding to the respective engine speed, oil flows unrestricted via nozzle (A) into the longitudinal channel (a) in the cylinder head (pressure-orientated oil feed). The nozzle simultaneously blocks off the oil return, preventing the channels up to the hydraulic elements emptying when the engine is not running.



The sealing cap (65) is shaped so that it secures the hydraulic valve clearance compensating element captive in the rocker arm.
Only store the compensating elements upright, and do not dismantle them. It is essential that rocker arm, compensating element, washer (57) and ball socket (55) are installed in their original position.

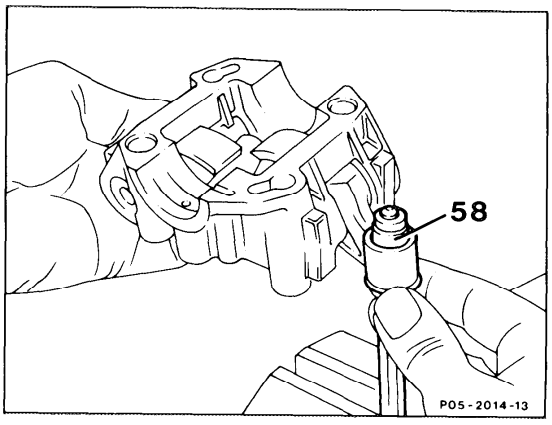
Checking

1 Position camshaft on the hydraulic element under test so that the rocker arms contact the cam base circle.



2 Press on the rocker arm with a hammer butt or similar above the hydraulic valve clearance compensating element for 5 - 10 seconds.

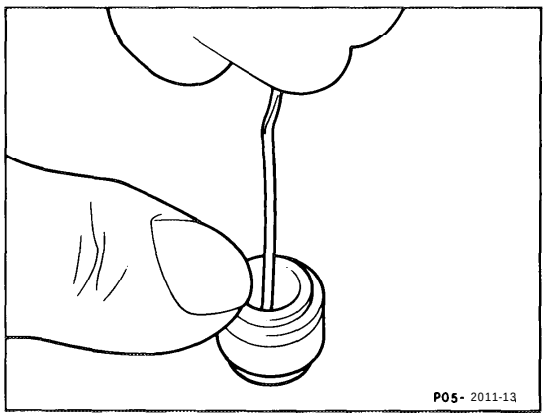
If one compensating element drops noticeably compared to others, compensating element should be removed. To do this, remove rocker arm bearing support (05-235) and press the compensating element (58) together with the washer carefully out of the rocker arm with an aluminium or brass mandrel.



If a leaking compensating element cannot be detected, try to move the rocker arm by hand. If play is detected when doing this, check and correct fitting position of the hydraulic valve clearance compensating elements (05-214).

Caution!
When testing compensating elements, do not press valves against the piston crown.

3 Fill reservoir chamber of the hydraulic valve clearance compensating element with engine oil, carefully press on ball valve in the setbolt with a wire (approx. 1.5 mm Ø) and press setbolt downwards as far as the stop and release. Repeat process two or three times.



After this, press compensating element setbolt heavily downwards for about 5 - 10 seconds with hammer butt or similar. If the setbolt drops noticeably when doing this, replace the compensating element.

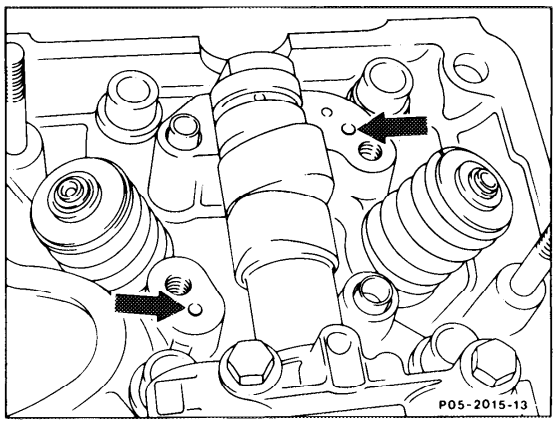
Note

Compensating element must be vertical when filling the working chamber as well as during the test.

If compensating element does not drop noticeably, check the respective oil bore in the cylinder head (arrow) as well as the oil bores in the rocker shaft and in the rocker arm for free passage, and clean if required.

To do this remove rocker arm (05240).

If several compensating elements are loud or soft the oil nozzle in the cylinder head should be checked for firm seating and replaced if required.



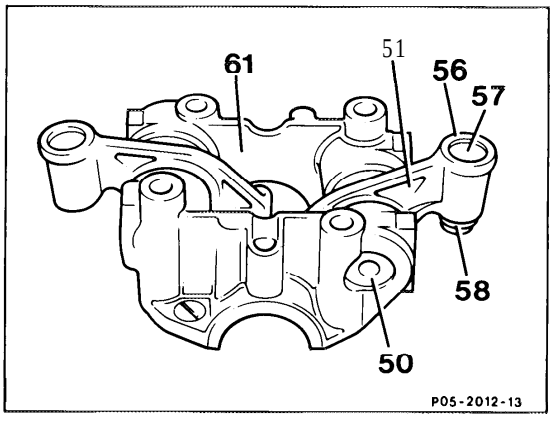
Replacement

4 Slide new valve clearance compensating element (58) with the original washer (57) into the rocker arm (51) as far as the stop on the snap ring (56).

Note

Install new compensating element with the working chamber and reservoir chamber filled with oil. (See Figure 3 for filling the hydraulic valve clearance compensating element).

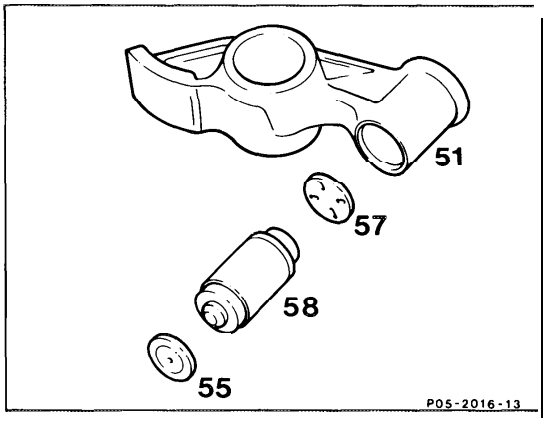
The grooves in the washer (57) must point to the compensating element (58) (Figure 5).



5 Install rocker arm bearing support (05-235). In so doing install the original ball socket (55).

Note

Use ball socket Part No. 103 055 00 24 if a new ball socket is installed.

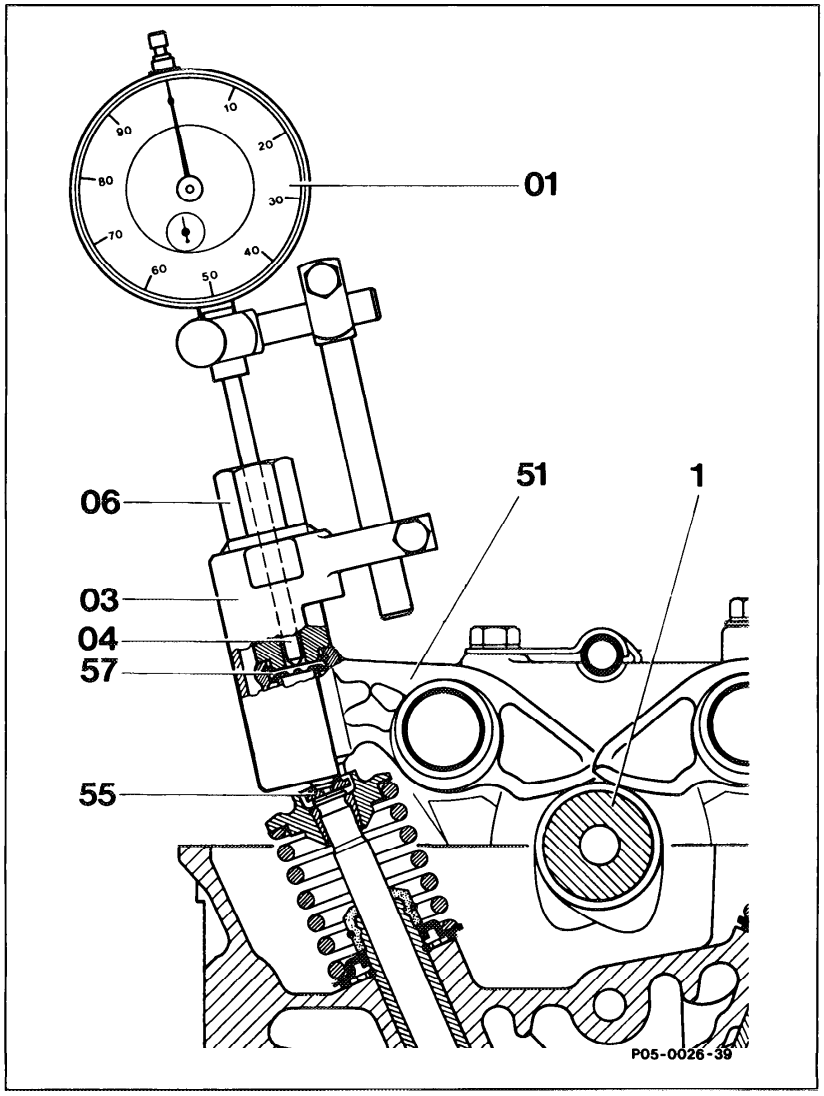


6 Check the installation position of the new valve clearance compensating element, correct if necessary (05-2 14).

7 Install in the reverse sequence.

05-214 Checking and correcting the installation position of hydraulic valve clearance compensating elements

Preceding work:
Air cleaner removed (09-400 and 09-410).
Cylinder head cover removed (01-406).



Camshaft (1)	position the cylinder under test so that rocker arm (51) contacts the cam base circle (Number 1).
Measuring fixture	mount, set dial gauge with 5 mm pretension, set dial gauge pointer to "0".

Checking . . . . . Turn pressure pad (06) to the right until a detectable pressure point is reached.
Read setting range (residual stroke) on the dial gauge. Reference value 0.5 - 2.4 mm. Correct the fitting position if the residual stroke is larger or smaller (Number 2).

Adjusting the residual stroke . . . . . Remove and install rocker arm bearing support (05235). Remove hydraulic valve clearance compensating element and slide into the rocker arm again up to the snap ring stop. If residual stroke is too small use a thinner washer (57), or a thicker washer if residual stroke is too large. Measure residual stroke again. If the specified residual stroke has still not been achieved, a thinner or thicker ball socket (55) can be fitted (Numbers 3 to 6), if necessary.

Note

Before installation of the hydraulic valve clearance compensating element fill reservoir chamber with engine oil.

Rocker arm bearing support . . . . . Install, repeat test (Numbers 7 and 8). Prior to this, turn the engine with the starter and contact handle a few times.

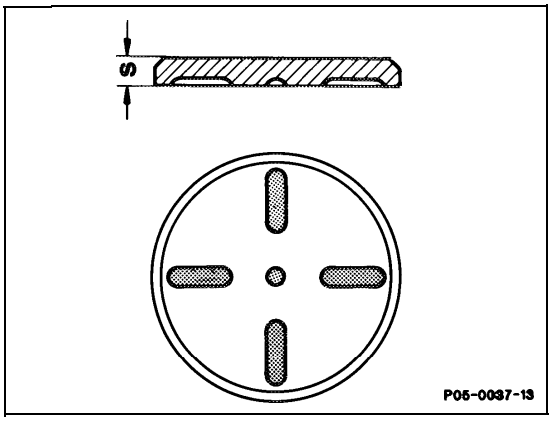
Installation specification of washer and ball socket

Assembly condition	Washer		Ball socket	
	Dimension "s" mm	Part No.	Dimension "a"	Part No.
Standard [1])	1.5	103 055 07 76	3.0	103 055 00 24
Standard[2])	1.8	103 055 06 76	3.5	103 055 02 24
Repair [3])	2.2	103 055 09 76		

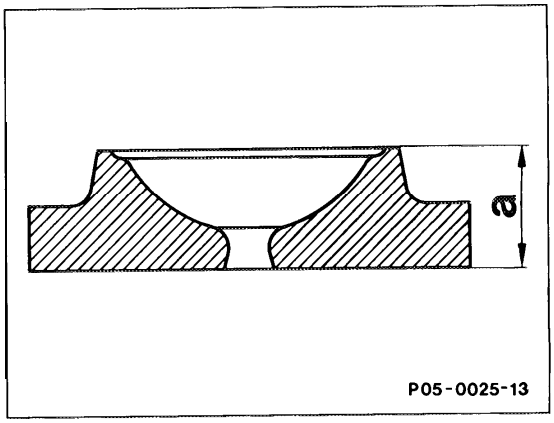
[1]) Production: install in the case of repair, when valve timing parts (rocker arm beannq supports, rocker arms, camshaft, etc.) are renewed. Camshaft with normal cam base circle without identification letter next to the camshaft identification number.

[2]) Production: Install in the case of repair, when valve timing parts (rocker arm beannq supports, rocker arms, camshaft, etc.) are renewed. Camshaft with small cam base circle and identification letter "E" next to the camshaft identification number.

3) Install in the case of repair, when valves and/or valve seat inserts have been resunk by machining.

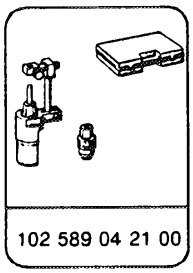


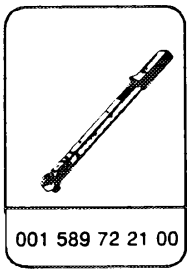
Washer

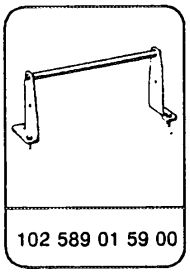


Ball socket

Special tools







Conventional tool

Dial gauge Al DIN 878	e.g. Mahr, D-7300 Esslingen Part No. 311000

Note

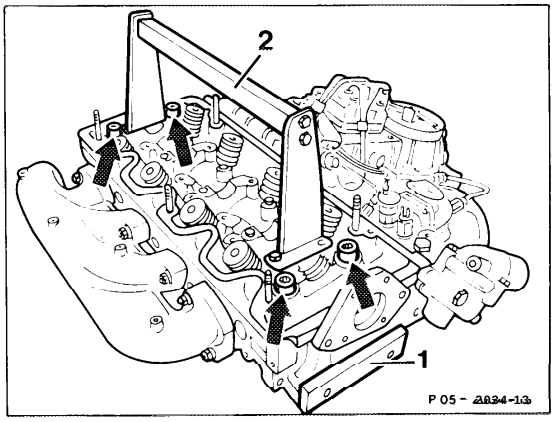
The fitting position of the hydraulic valve clearance compensating elements must be checked

a) If there have been complaints of valve train noise and no malfunctions have been established when checking the compensating element in accordance with 05211.

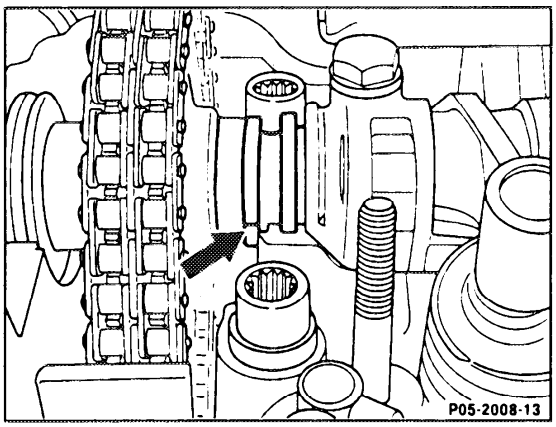
b) If valve timing parts, which are installed or mounted on the cylinder head (apart from the camshaft timing gear, valve guides, valve stem seals) have been renewed, or when valves and/or valve seat inserts have been machined.

For testing, all timing parts located on the cylinder head must be installed correctly and working chamber of valve clearance compensating elements must be filled with engine oil.

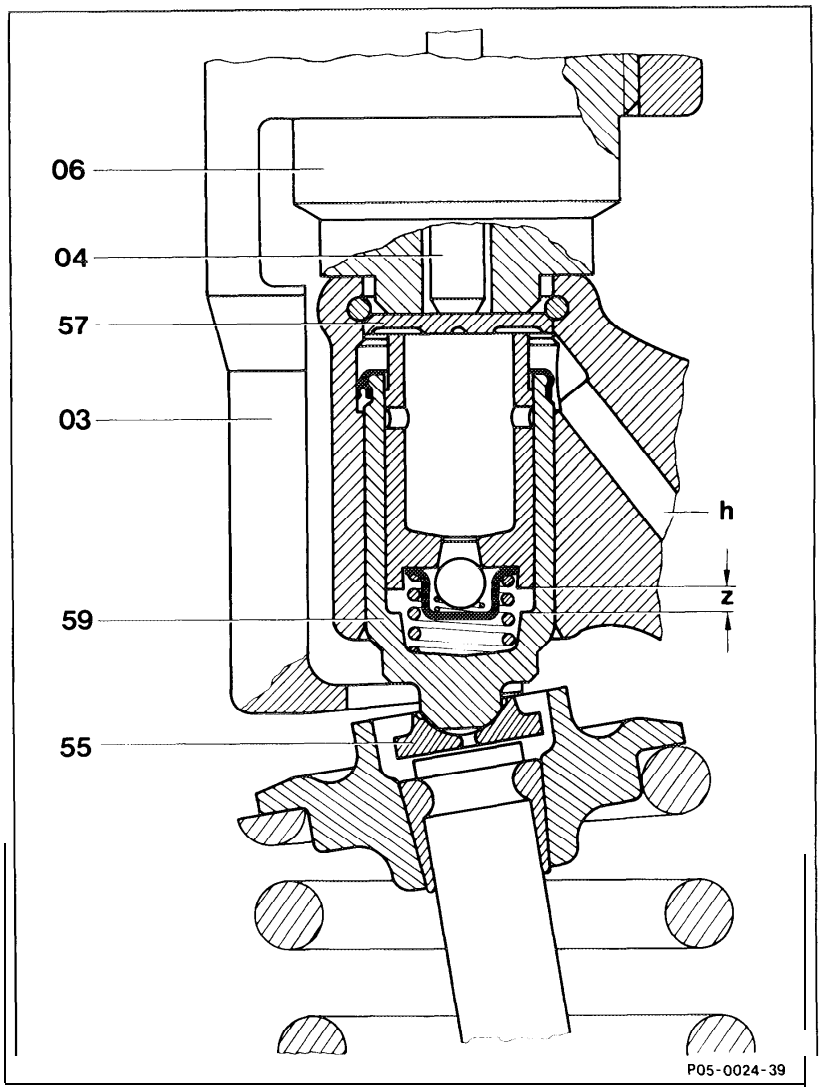
The tests can also be carried out when the cylinder head is removed. To do this clamp cylinder head with four cylinder head bolts (arrows) on assembly board 102 589 00 59 00 (1). In this case turn the camshaft on rear flats with a fork wrench (24 mm).



After the test, position camshaft so that indentation on the collar agrees with the edge on the cylinder head (arrow).



In order to determine the specified fitting position of the hydraulic valve clearance compensating element, the residual stroke "Z" of the compensating elements must be measured. The permitted **residual stroke** is 0.5 **to** 2.4 mm. If a residual stroke smaller than 0.5 mm or larger than 2.0 mm is measured despite installing a washer and a ball socket in accordance with the "installation specification" table, compensation is to be carried out with the next thinnest or thickest washer or ball socket.



Checking

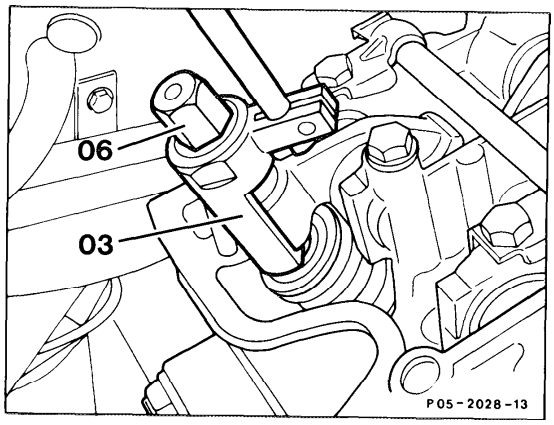
1 Position camshaft by turning the crankshaft so that the rocker arms contact the cam base circle on cylinder under test.

2 Place measuring fixture 102 589 04 21 00 so that the claws of the claw sleeve (03) contact the ring shaped area around the hemispherical mushroom pad of the guide sleeve (59).

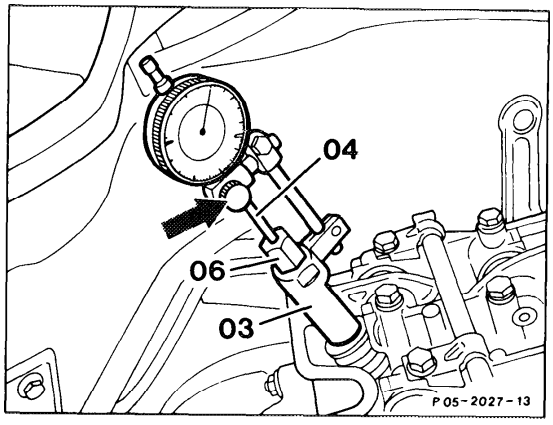
Turn the pressure pad (06) by hand to the right sufficiently until it contacts the washer (57, previous picture), and a clearly detectable pressure point is reached.

Note

The pressure pad must contact the washer and not the rocker arm.



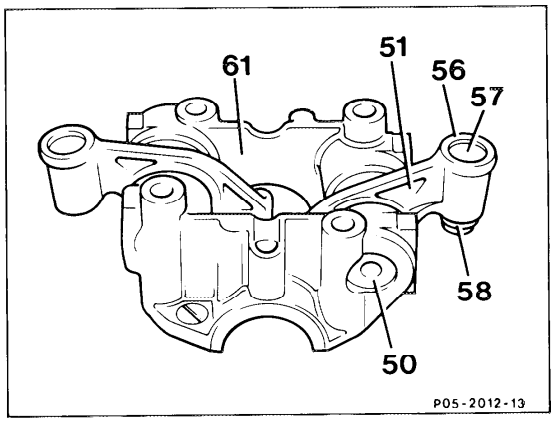
3 Insert measuring pin adapter (04) in the central bore of the pressure pad (06), set dial gauge measuring pin on the measuring pin adapter with 5 mm pretension (small pointer) and attach the dial gauge to claw sleeve bracket (arrow). Position large dial gauge pointer on zero by turning the dial gauge scale.



4 Turn pressure pad (06) slowly to the right with a fork wrench (17 mm) on the hexagon until a clearly detectable pressure point is reached. Read off setting range (residual stroke) on dial gauge. It must be 0.5 - 2.4 mm. In event of smaller or larger residual stroke, correct installation position of the hydraulic valve clearance compensating element.

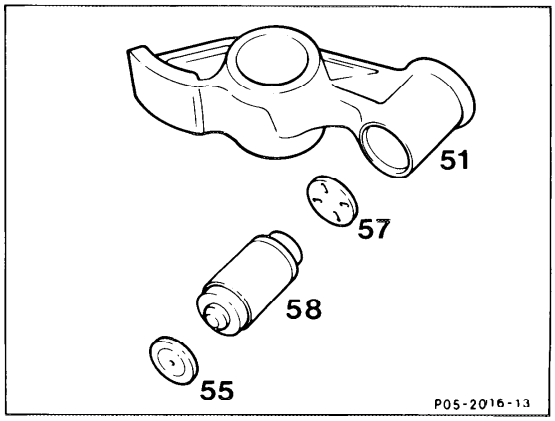
Corrections

5 Remove rocker arm bearing support **(05235).**



6 Press hydraulic valve clearance compensating element (58), together with the washer (57), carefully out of the rocker arm with an aluminum or brass mandrel, and finally slide into the rocker arm up to the snap ring stop (56) again. Use a thinner washer (residual stroke too small) or a thicker washer (residual stroke too large).

If specified residual stroke cannot be achieved with the washers available (57), depending on residual stroke measured, use a thinner or thicker ball socket (55) (see note, on the washer and ball socket tables).



Caution!
Before carrying out the installation fill reservoir chamber of the hydraulic valve clearance compensating element with engine oil (05- 211, Number 3).

The grooves in the washer (57) must point in the direction of the compensating element setbolt.

7 Install rocker arm bearing support (05-235).

8 Repeat tests, Numbers 1 to 3.

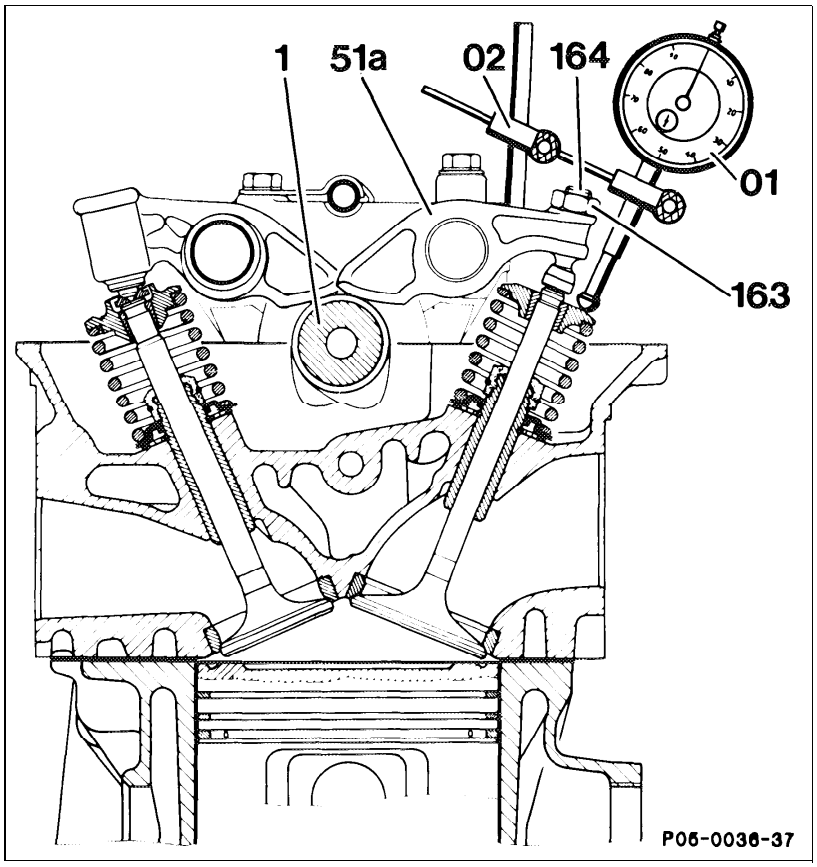
Note
Before carrying out the test turn the crankshaft a few times by using the starter.

9 The installation is carried out in the reverse sequence of the removal.

10 Check for leaks when engine is running.

05-215 Checking and adjusting camshaft timing

Preceding work:
Air cleaner removed (09-400 and 09-410).
Cylinder head cover removed (01-406).



Checking ..... Position the No. 1 cylinder camshaft so that the rocker arm (51a) contacts the cam base circle. Remove No. 1 cylinder rocker arm bearing support (05-235). Remove rocker arm and hydraulic valve clearance compensating element and adjustable rocker arm 102 055 00 01 together with adjusting screw 102 050 0220 (164) and fit locknut (163). Eliminate valve clearance by turning the adjustment screw (164) (Numbers 1 to 4).

Dial gauge bracket (02) ..... Screw onto stud bolt at front left part of cylinder head (Number 5).

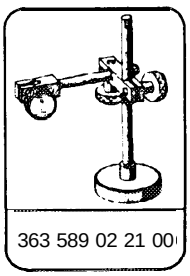
Dial gauge (01)	Insert and put tip vertically on valve spring retainer with 3 mm pretension (small pointer) (Number 6).
Crankshaft	Turn in the direction of rotation of the engine until the small pointer on the dial gauge has travelled back by 2 mm (valve stroke). The value now read off on the vibration damper must agree with the value in the table “Intake valve open” (Number 7).
Adjustment	Put engine on ignition TDC of No.1 cylinder (Number 8).
Chain tensioner locknut (40)	Unbolt and bolt up, replace sealing ring (41), 70 Nm (Numbers 9 and 19).
Oil pressure pump	Unbolt, set to one side with lines connected (Number 10).
Camshaft timing gear	Align with timing chain. Unbolt camshaft timing gear (Numbers 11 to 13 and 15).
Woodruff key (6)	Select from table and insert (Numbers 14 and 15).
Camshaft timing gear	Assemble, note color marking, only install set bolt. Repeat tests (Numbers 6 and 7). Tighten set bolt (9). 80 Nm (Numbers 16 to 18).
Dial gauge (01) and dial gauge (02)	Detach.
Rocker arm bearing support and rocker arm with hydraulic valve clearance compensating element	Install (Number 20). Proceed with installation in reverse sequence

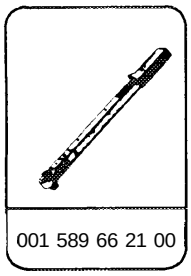
Valve timing with 2 mm valve stroke

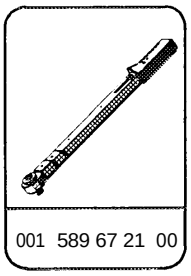
Engine	Identification number of camshaft stamped at the rear of the camshaft	Intake valve		Exhaust valve	
		Opens after TDC	Closes after BDC	Opens before BDC	Closes before TDC
102.96 102.985	27/28 [1]) 35 [3])/36 [1])/44[4])	11" (12°)	17"	32"	13°

Value for used chain in brackets.
[1]) Repair camshaft with 0.5 mm larger bearing diameter.
[2]) Camshaft with wider cam (19 mm) and tin-plated.
[3]) Chilled cast iron camshaft.
[4]) Chilled cast iron camshaft (with crowned cams) from 09/89.

. Special tools


363 589 02 21 00


001 589 66 21 00

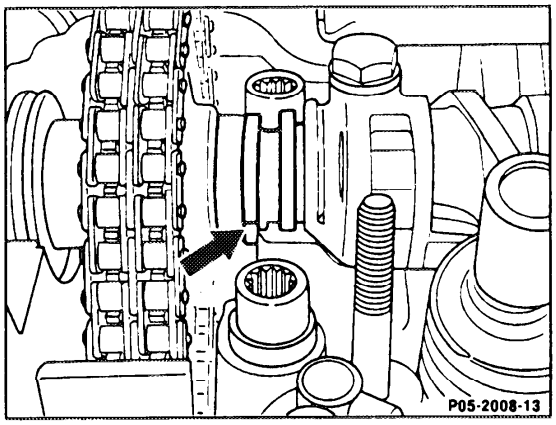

001 589 67 21 00

Conventional tool

Dial gauge A 1 DIN 878	e.g.	Mahr, D-7300 Esslingen Bestell-Nr. 311000

Note

It is sufficient during assembly work, if the marking on the camshaft agrees with the cylinder head edge in the ignition TDC position of the No 1. cylinder (arrow). In special cases, for example when there are performance problems, the start of opening of No. 1 cylinder intake valve is to be checked as described in the following, and to be adjusted, if required. The valve timings are measured at
2 mm valve stroke. Valve clearance must be eliminated for this purpose.



Checking

1 Turn crankshaft until cam tips of No. 1 cylinder intake valve point downwards (valve closed).

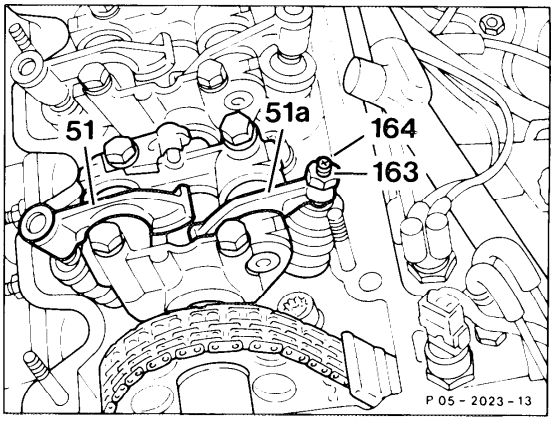
Caution!
The engine must not be turned at the camshaft timing gear fixing bolt.

Under no circumstances turn engine backwards during the measurement, otherwise considerable measuring errors result, and chain tensioner lock setbolt can spring forwards.

2 Remove rocker arm bearing support of No. 1 cylinder (05-235).

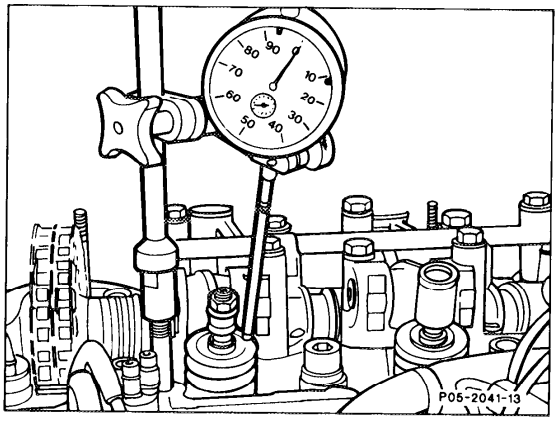
3 Install intake valve rocker arm against the rigid rocker arm (51a) Part No. 102 055 00 01 together with the adjustment bolt (164) Part No. 102 050 02 20 and the locknut (163) Part No. 000936 008009 (05-240).

4 Install rocker arm bearing support, 21 Nm.



5 Install the dial gauge bracket with threaded sleeve onto the stud on the front left part of the cylinder head.

6 Insert dial gauge and attach so that tip is **exactly vertical** on valve spring retainer with a pretension of 3 mm (small pointer on the dial gauge). Turn dial gauge clockface until large pointer is on "0".



7 Turn crankshaft in direction of rotation of the engine until dial gauge small pointer has returned by 2 mm (valve stroke). In this position the value on the vibration damper must agree with the value “intake valve opens after TDC” in the valve timing table.

Adjustment

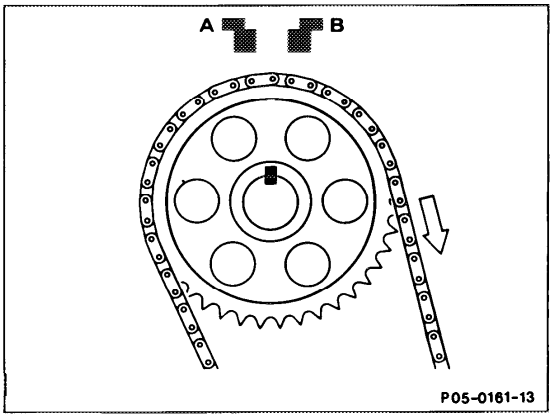
If valve timing settings have to be corrected, an offset Woodruff key has to be installed, and a new timing chain when chain length is excessive.

Woodruff keys are available in the following stages:

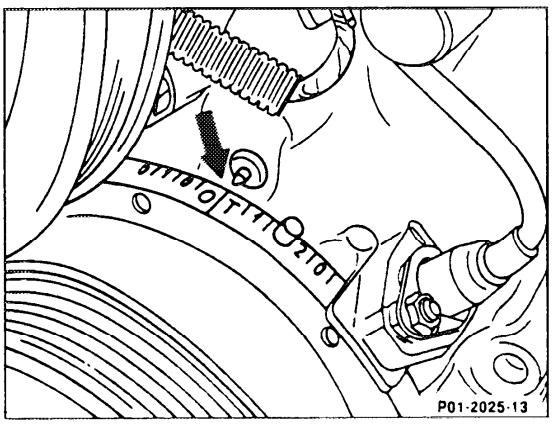
Offset mm	Part No.	for a correction of approx.
0.7	621 991 04 67	6” CKA
0.9	621 991 02 67	8” CKA
1.1	621 991 01 67	9.5” CKA
1.3	621 991 00 67	11.5” CKA

CKA = CranK Angle

An offset of one tooth on the camshaft timing gear produces approx. 20 at the crankshaft. Offsetting the Woodruff keys to the right (in direction of travel A) causes the valves to open earlier and an offset to the left (B) causes the valves to open later.

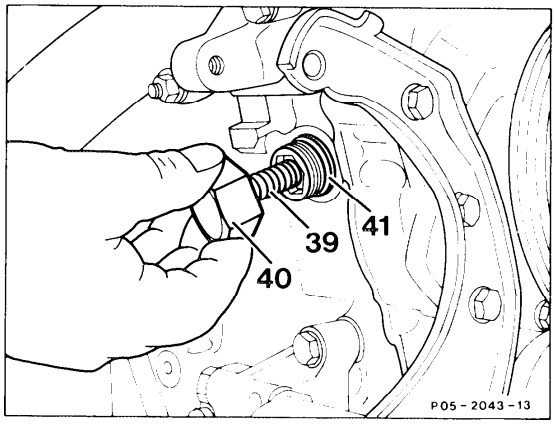


8 Position engine on ignition TDC of No. 1 cylinder.

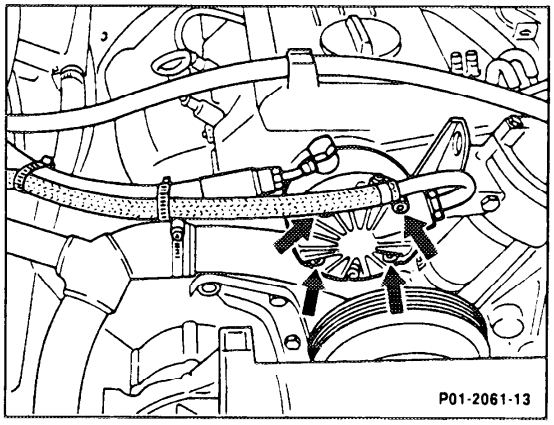


9 Unscrew hexagon cap nut (40) for chain tensioner and remove sealing ring (41) as well as compression spring (39) (see 05310).

Caution!
The chain tensioner hexagon cap nut is under pressure from the compression spring.

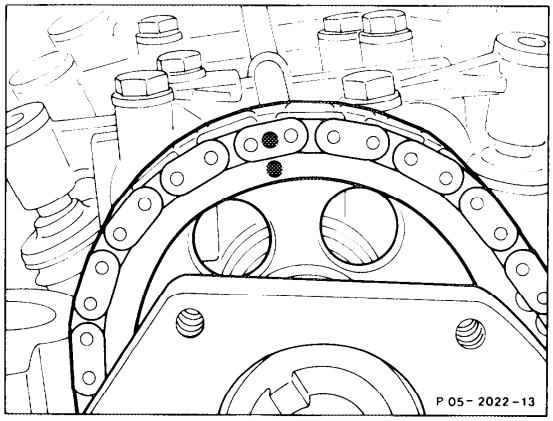


10 Unscrew oil pressure pump (arrows) and set to one side with the lines connected.



11 Align camshaft timing gear and timing chain.

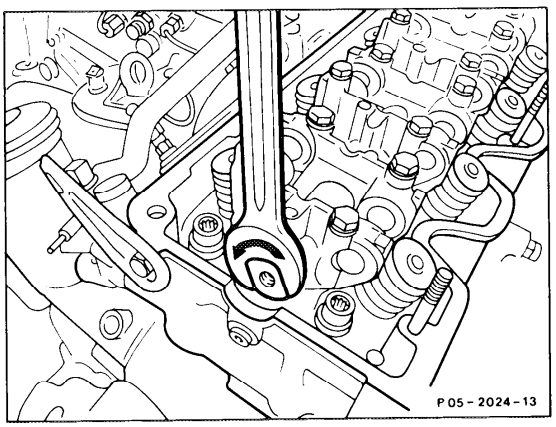
12 Remove camshaft timing gear set bolt.



To do this hold in position with a fork wrench (24 mm) on flats at the rear end of the camshaft.

Note

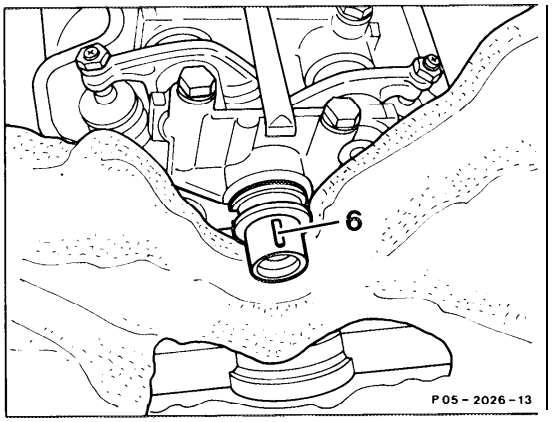
On vehicles with self-levelling suspension the camshaft timing gear and driving sleeve are attached by a bolt with hexagon recessed hole. Take out the driving sleeve.



13 Remove camshaft timing gear.

14 Place cleaning rag over the timing case and remove Woodruff key (6).

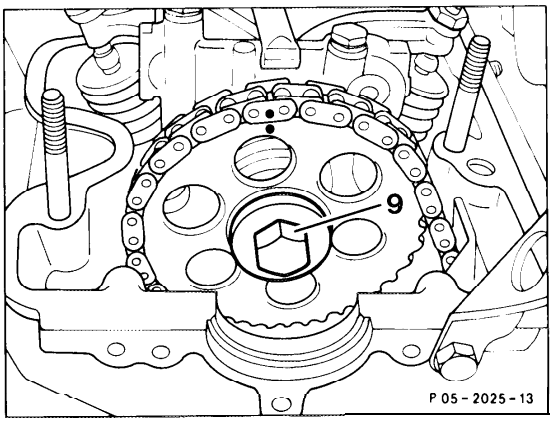
15 Insert selected Woodruff key.



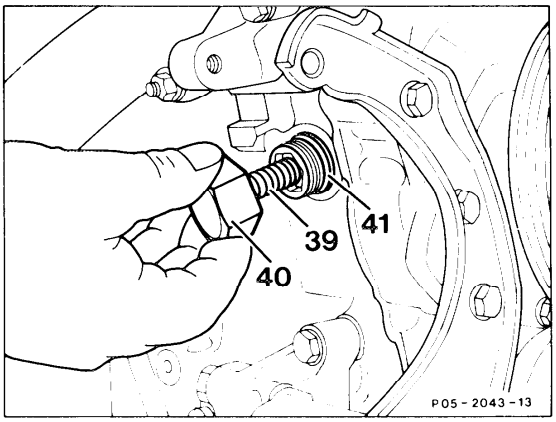
16 Put on camshaft timing gear. In the process note that the colour markings on the camshaft timing gear and the timing chain align.
Do not torque the set bolt (9) yet.

17 Repeat test Numbers 6 and 7.

18 Torque camshaft timing gear set bolt (9) to 80 Nm. For this hold in position with a fork wrench (24mm) on flats at the rear of the camshaft.

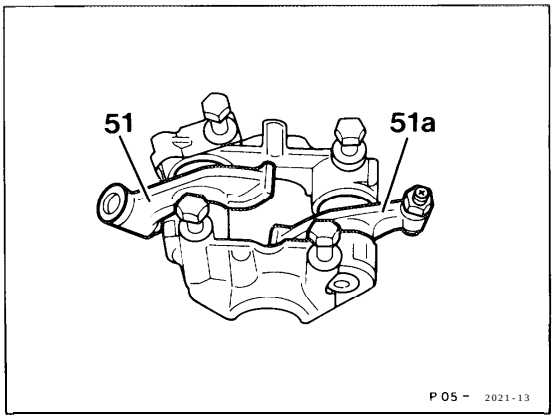


19 Insert compression spring (39), replace sealing ring (41), bolt in screw plug (40) and tighten to 70 Nm.



20 Unbolt rocker arm bearing support from **No.1** cylinder and withdraw rocker arm (51a) for hydraulic valve clearance compensation.

21 Install rocker arm bearing support, tightening torque 20 Nm (05- 235).



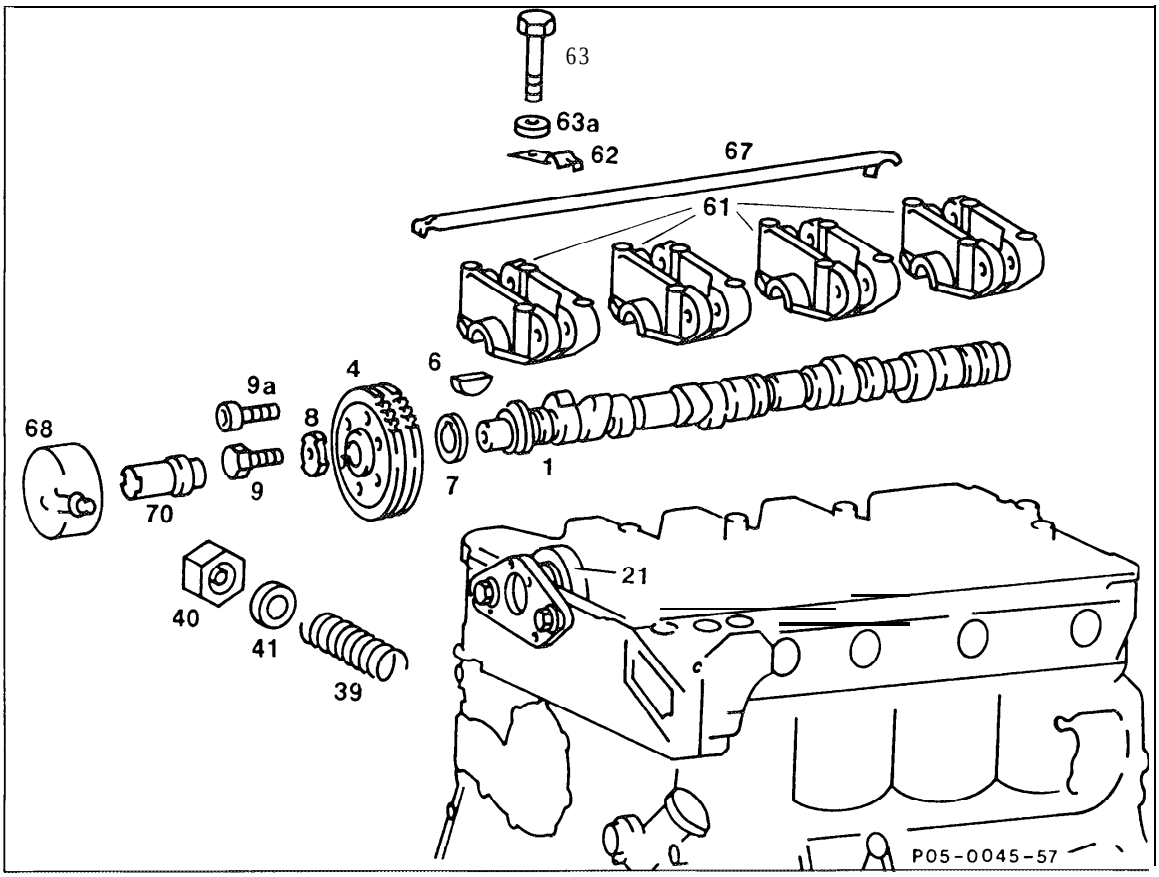
22 Remove dial gauge and dial gauge bracket.

23 The remaining installation takes place in the reverse sequence.

24 Check for leaks when engine is running.

05-220 Removal and installation of camshaft

Preceding work:
Air cleaner removed (09-400 and 09-410).
Cylinder head cover removed (01-406).

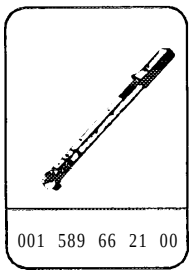


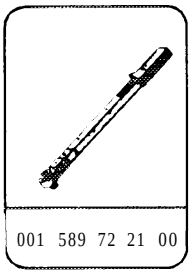
Piston of No. 1 cylinder	position on ignition TDC, note markings (Numbers 1 and 2).
Screw plug (40)	of the chain tensioner, unbolt, bolt in, 70 Nm.
	Warning! Screw plug is under pressure. Remove compression spring (39), replace sealing ring (41)(Numbers 3 and 11).
Oil pressure pump (68)	unbolt, bolt in, set to one side with lines connected (Number 4).
Camshaft timing gear (4) and timing chain	align. When installing note markings. Screw (9 and 9a), 80 Nm (Numbers 5 to 8).

All rocker arm bearing supports (61) with rocker arms and oil pipe (67) . . . . . unbolt, bolt on, 20 Nm. Note oil pipe designs (Number 9).

Camshaft (1) . . . . . remove, replace, oil bearing points with engine oil. Check condition of camshaft, note identification number. Position engine on ignition TDC and check markings on camshaft and vibration damper (Number 10).

Special tools





Test values

		New value	Wear limit
Permitted deviation from true running when locating camshaft in bearing positions 1 and 5	At the seat of camshaft timing gear	0.025	
	At the bearing points 2, 3 and 4	0.030	–
Camshaft bearing play	radial	0.050 – 0.091	0.11
	axial	0.070 – 0.150	0.18
Camshaft journals Ø	Normal dimension	32.000 – 32.025	–
	Repair stage	32.500 – 32.525	–
Scleroscope hardness of the cams		70 – 82	63

Camshaft identification numbers and valve timings with 2 mm valve stroke

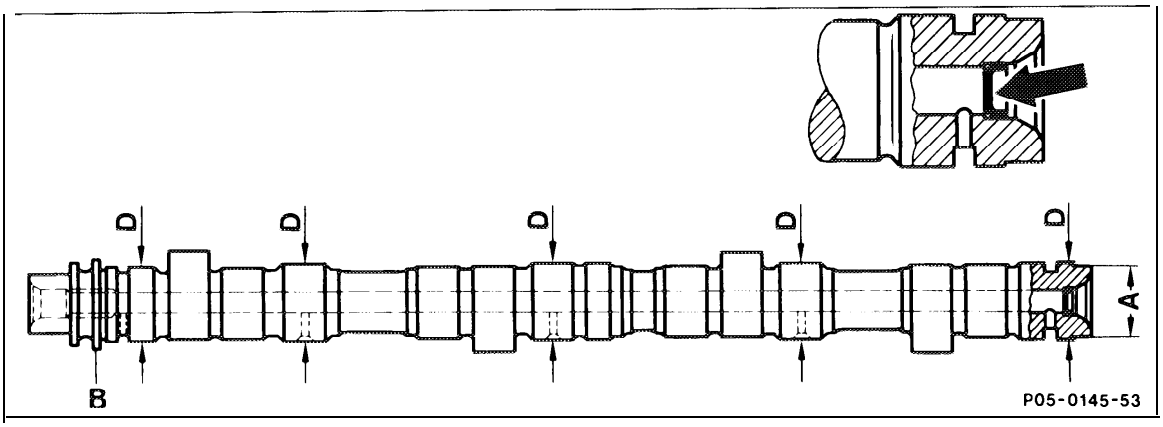
Engine	Camshaft identification number stamped at rear of camshaft	Intake valve		Exhaust valve	
		Opens after TDC	Closes after BDC	Opens before BDC	Closes before TDC
102.96 102.985	27128 [1]) 35 [3])/6 [1])/44 [4])	11° (12°)	17°	32"	13°

Value for used chains in brackets.
[1]) Repair camshaft with 0.5 mm larger bearing diameter.
[2]) Camshaft with wider cams (19 mm) and tin-plated.
[3]) Chilled cast iron camshaft.
[4]) Chilled cast iron camshaft (with crowned cams) from 09/89.

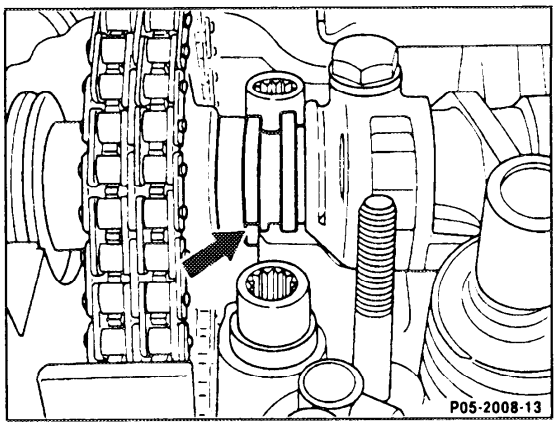
Note

The camshaft supported on 5 bearings is drilled hollow. The bearing points are supplied with oil via the longitudinal bore (10.5 mm Ø), which is sealed at the front with the camshaft timing gear set bolt and at the rear with a pressed cover (arrow). The oil feed takes place via a groove (360°) and a transverse bore (3.5 mm Ø) in the rear journals.
The diameter (D) of all 5 bearing points is 32 mm (repair stage 32.5 mm).

A fork wrench can be put on flats (A, 24 mm) at the rear end of the camshaft for turning the camshaft when camshaft timing gear is removed and for holding in position when loosening and tightening camshaft timing gear set bolt. The collar (B), which runs in a groove in the cylinder head, locates the camshaft axially.



The marking for the ignition TDC position of the No. 1 piston is placed on this collar. It must match up with the edge on the cylinder head (arrow).



The camshaft can be removed from above. The rocker arm bearing supports and the camshaft timing gear have to be removed for this.
If the camshaft is to be replaced, all the rocker arms have to be replaced as well.
In the event of scored bearings or pronounced striation, the camshaft bearings in the cylinder head and in the rocker arm bearing supports can be bored out by 0.5 mm and a camshaft with over dimensioned bearing spigots installed (01-419).

The running in and wear characteristics have been improved by short- stroke honed camshafts (formerly tin-plated).

Introduced in production: January 1986

Model	Engine	Engine end number		Vehicle identification end number	
		Manual transmission	Automatic transmission	A	F
201.024 (USA)	102.985	003326	030324		193767

Since October 1987 camshafts have been fitted with 19 mm wide tinplated cams (formerly 18 mm).
Identification number: 39

Note

As a temporary measure this camshaft has been given the identification number "3".

Introduced in production: October 1987

Model	Engine	Engine end number		Vehicle identification end number	
		Manual transmission	Automatic transmission	A	F
201.028	102.985	019320	062484	416851	435608

Since 1988, in order to avoid camshaft wear, chilled cast iron camshafts and rocker arms with soldered on hard metal pads have been equipped.
If the chilled cast iron camshaft has been installed on previous engines, rocker arms with hard metal cam follower must also be installed.
As a temporary measure this camshaft has been given the identification number “5”.

Introduced in production: October 1988

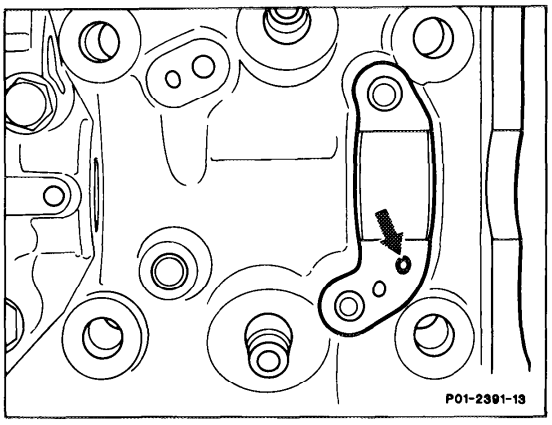
Model	Engine	Engine end number Manual transmission	Engine end number Automatic transmission
201.028	102.985	027671	077053

From 09/89 a chilled cast iron camshaft with crowned cams has been installed. This camshaft is also supplied as a replacement part.
Identification number: 44

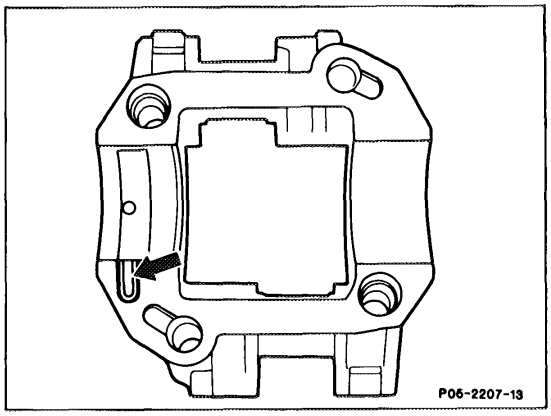
Introduced in production: September 1989

Model	Engine	Engine end number		Vehicle identification end number	
		Manual transmission	Automatic transmission	A/B	F
201.028	102.985	033962	080108	B 525380	–

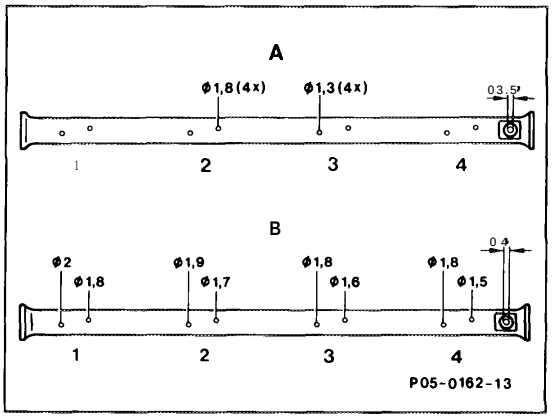
In order to improve camshaft lubrication the oil feed bore in the cylinder head has been enlarged from 3 mm to 4 mm Ø (arrow).



The oil groove in the rocker arm bearing support has also been widened from 4 mm to 5.5 mm (arrow).



The injection bores in the oil pipe for camshaft lubrication have a different diameter depending on position.



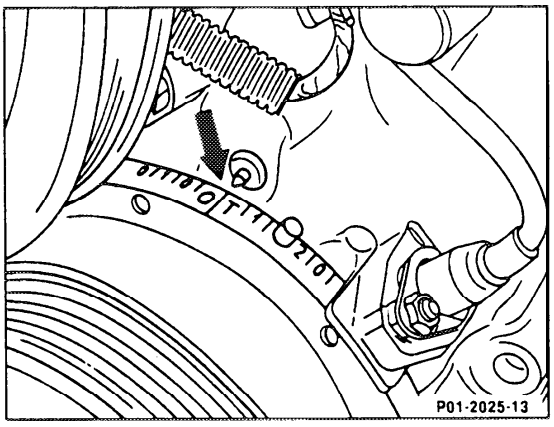
A Oil pipe - first design
B Oil pipe - second design

Introduced in production: January 1988

Model	Engine	Engine end number Manual transmission	Engine end number Automatic transmission
201.028	102.985	022013	067143

Removal and installation

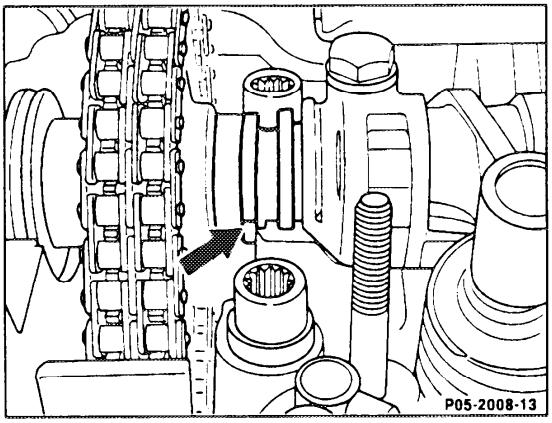
1 Position piston of No. 1 cylinder on ignition TDC.



2 Marking on camshaft collar must align with the edge on the cylinder head (arrow).
Before turning the crankshaft, switch off the ignition and remove the plug for the inductive sensor at the switching unit.

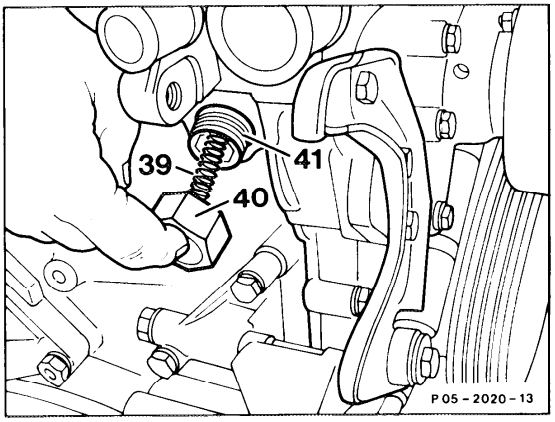
Caution!

Do not turn the engine by the camshaft timing gear set bolt.
Do not turn the crankshaft backwards.

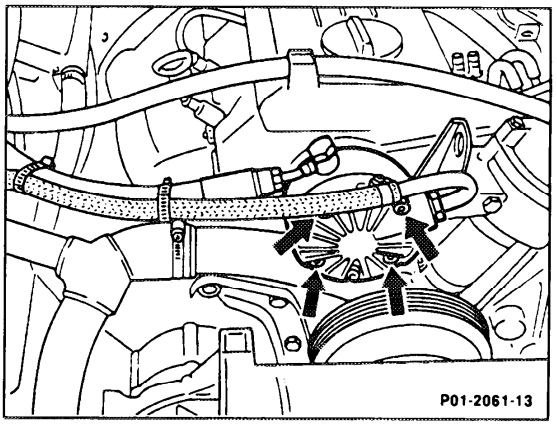


3 Unscrew the chain tensioner hexagon cap nut (40) and remove sealing ring (41) as well as compression spring, tightening torque 70 Nm (05-310).

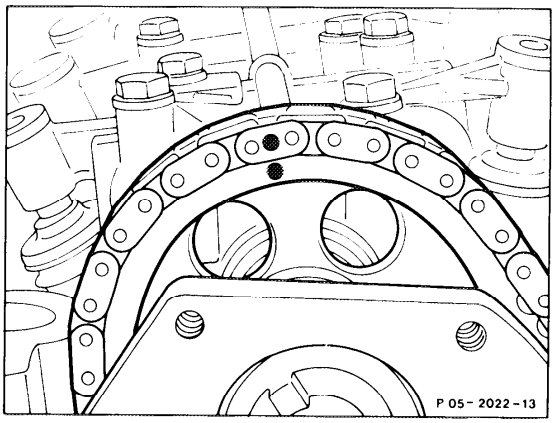
Caution!
The chain tensioner hexagon cap nut is pressurized by the compression spring.



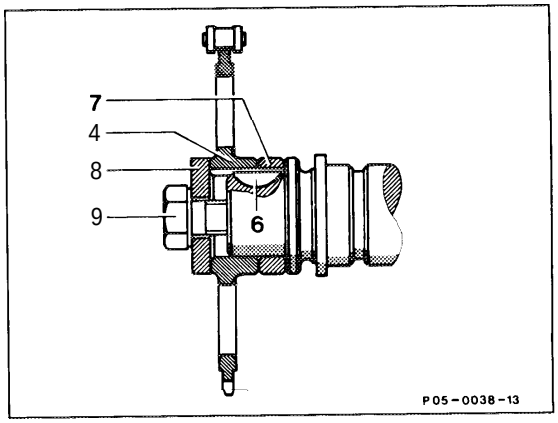
4 Unbolt, bolt on oil pressure pump (68) (arrows) and put to one side with the lines connected.



5 Align camshaft timing gear and timing chain.



6 Remove camshaft timing gear, remove timing chain and place in the timing case, tightening torque 80 Nm.



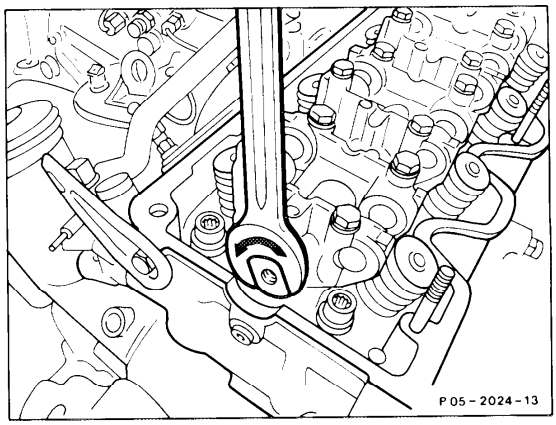
7 Remove and install Woodruff key (6) and spacer washer (7).

Installation note

Note color markings on camshaft timing gear and timing chain.

Assemble camshaft timing gear so that on the single roller chain the wide collar points to the camshaft and on the dual roller chain the curvature points to the camshaft.

8 In order to loosen or tighten up camshaft timing gear hold in position with flats at the rear of camshaft with a fork wrench (24 mm).

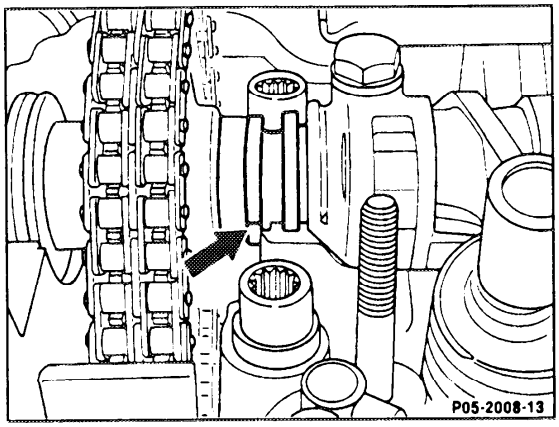


9 Remove and install rocker arm bearing supports (61) (05-235), tightening torque 20 Nm.

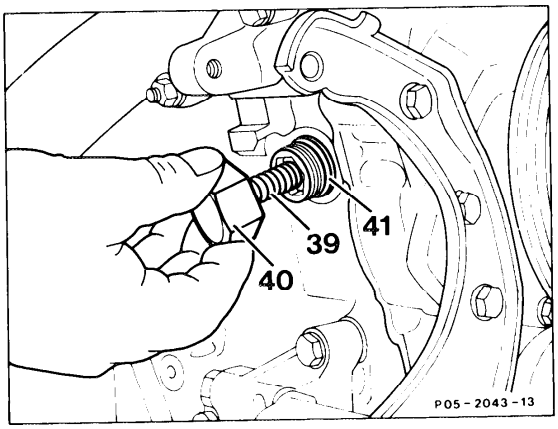
10 Remove camshaft. Before installing lubricate all bearing points with engine oil. Check, whether the marking on set collar aligns with edge on the cylinder head.

Installation note

If camshaft is to be replaced, all rocker arms and rocker shafts have to be replaced as a set.



11 Install hexagon cap nut (40) and compression spring (39) with new sealing ring (41), tightening torque 70 Nm.

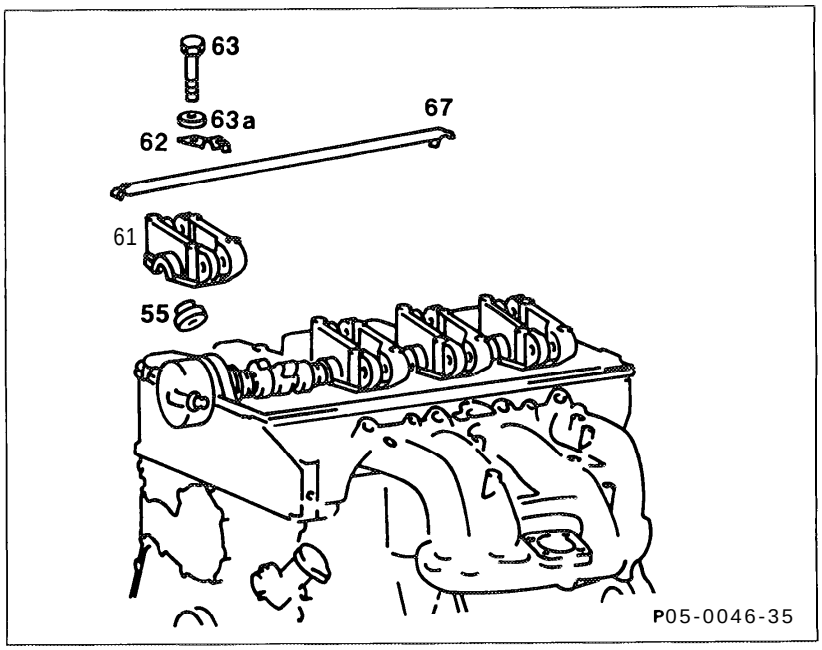


12 The installation proceeds in reverse sequence.

13 Check for leaks when engine is running.

05-235 Removal and installation of rocker arm bearing supports with rocker arms

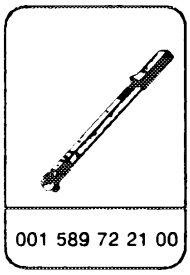
Preceding work:
Air cleaner removed (09-400 and 09-410).
Cylinder head cover removed (01-406).



Engine	turn, so that rocker arm of bearing support being removed is on base circle of cam (cam tips pointing downwards).
Oil pipe (67)	remove, install (Number 2).
Rocker arm bearing support (61)	remove, install, 20 Nm (Number 3).

Installation note
Install ball socket (55) in original position.
Note identification number on cylinder head and camshaft bearing cap.

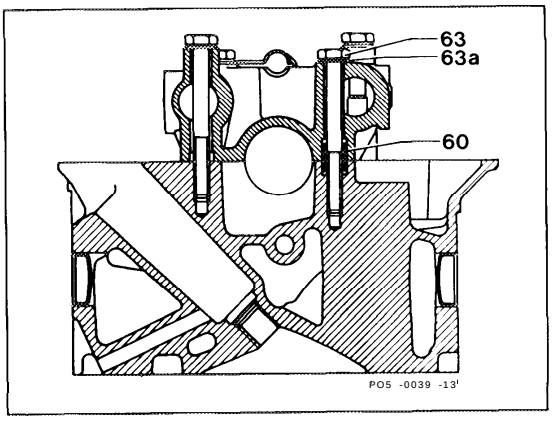
Special tool



Note

The five bearing bores for camshaft support are each located half in the cylinder head and on top in the four rocker arm bearing supports. The front rocker arm bearing support has two half bearing bores.

Each of the four bearing supports is attached with four bolts (63) and with two installation sleeves (60). Each bearing support simultaneously acts as a rocker arm carrier.



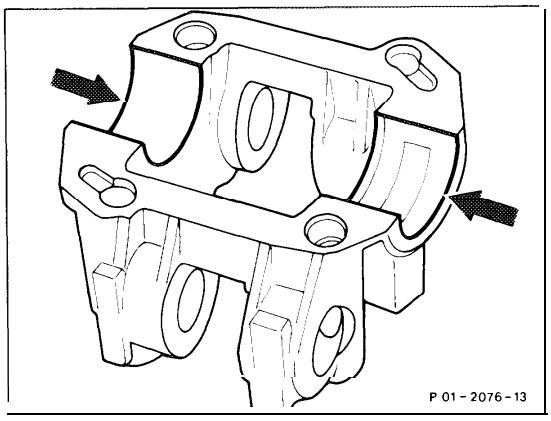
The rocker arm bearing supports can be distinguished by the following features.

Front bearing support

Code No. 1. Two bearing positions (arrows).

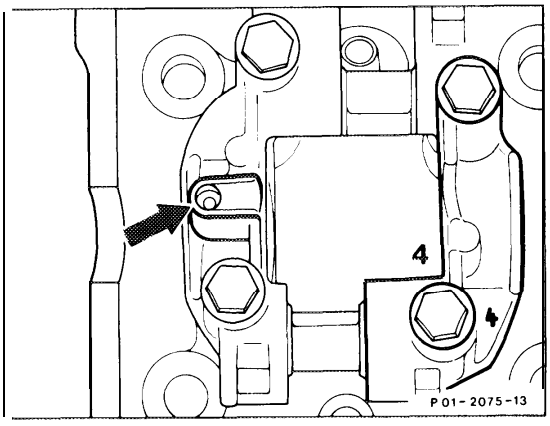
Center bearing supports

Code No. 2 and 3. These two bearing supports are the same apart from the identification numbers.

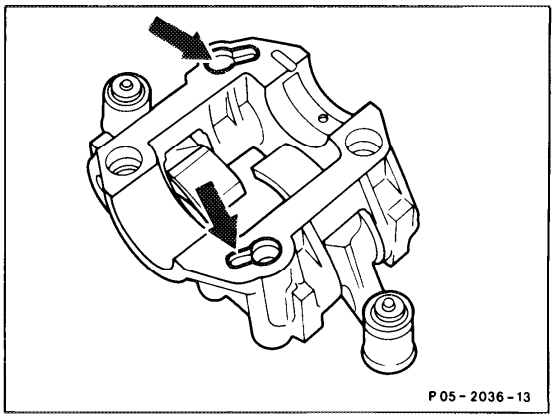


Rear bearing support

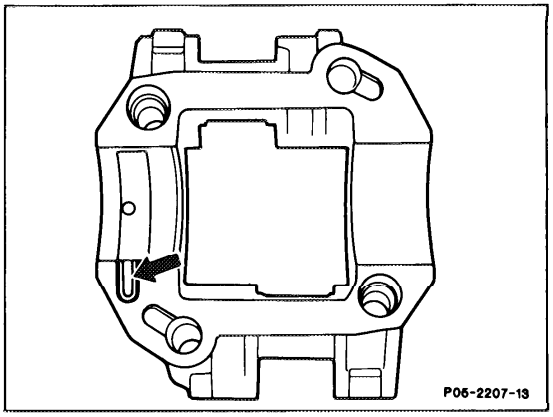
Code No. 4. Connection bore for oil pipe (arrow).



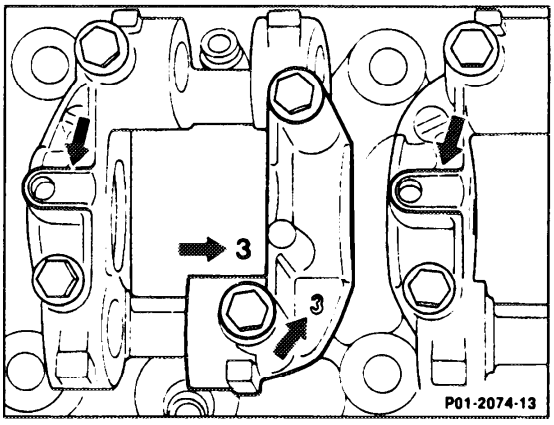
The two oil grooves (arrows) act as oil supply to the hydraulic valve clearance compensating elements.



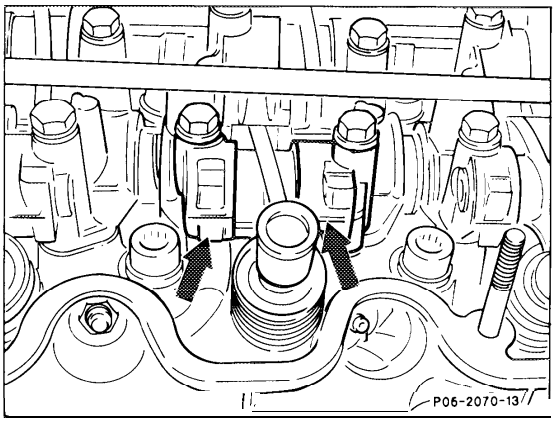
The oil pipe for camshaft lubrication is supplied with oil via the groove (arrow) on the rocker arm bearing support.



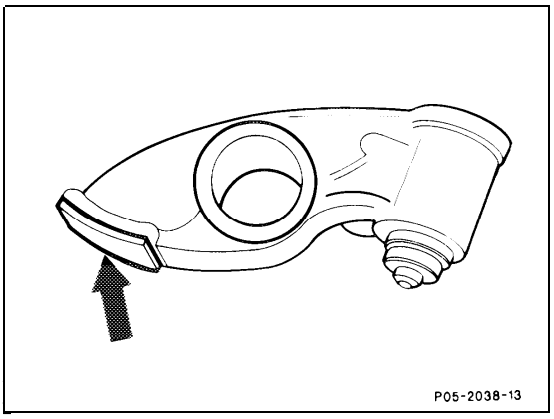
The rocker arm bearing supports should not be confused with each other. They are therefore identified on the right-hand side with the Numbers 1, 2, 3 and 4 from the front to the back. The identification of the bearing support must agree with the number, which is cast in the cylinder head (arrows).
In the replacement parts area the bearing supports are made individually and without code numbers stamped on. The corresponding code number is to be applied after installation.



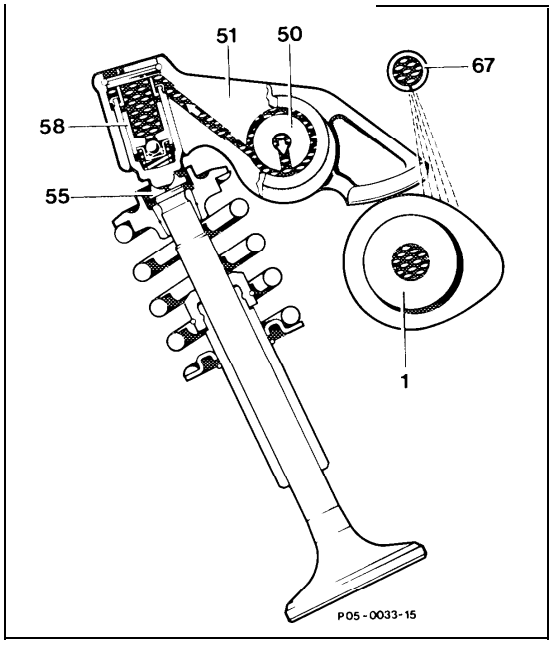
The rocker arms for operating the valves are supported individually on a rocker shaft fitted in a bearing support on both sides (arrows).



Rocker arms with soldered on cemented carbide tips have been installed since October 1988 (arrow).

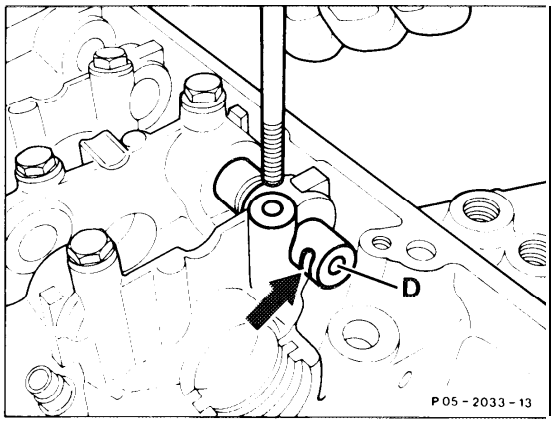


The oil required for lubricating the rocker arm bearings reaches the rocker arm bearing shaft (50) and hydraulic valve clearance compensating element via a longitudinal channel in the cylinder head and a feed bore in the bearing support (which is also the set bolt bore).



1 Camshaft
50 Rocker shaft
51 Rocker arm
55 Ball socket
58 Hydraulic valve clearance compensating element
68 Oil pipe

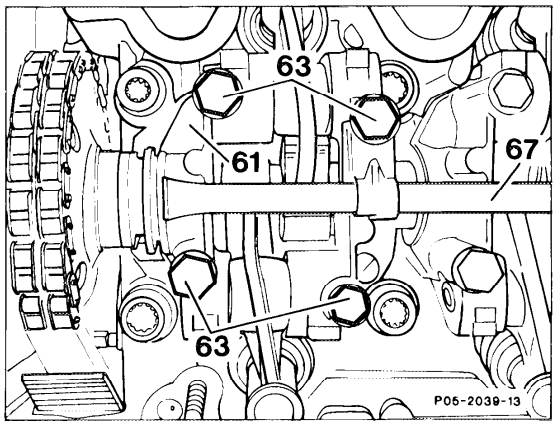
The rocker shaft is secured in the axial and rotary direction by a bearing support set bolt. For this a half bore is attached to the shaft, in which one half of the screw shaft is located (arrow).
An M8 thread (D) has been incorporated in the front face for installation and removal of the rocker shaft.



Removal, installation

1 Turn engine so that the camshaft tips of the bearing support being removed point downwards and rocker arms are on the base circle.

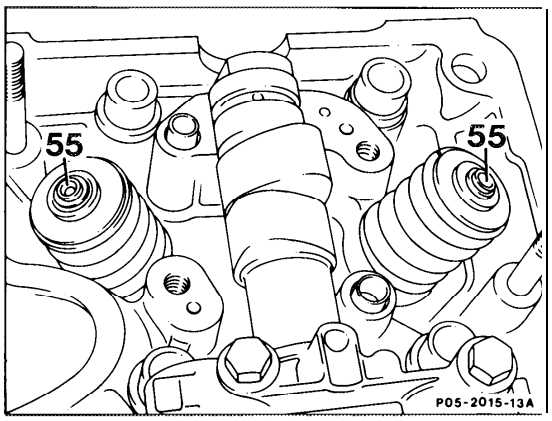
2 Remove oil pipe (67), to do this unbolt, bolt up the two bolts (63) on the pipe clamps, tightening torque 20 Nm.



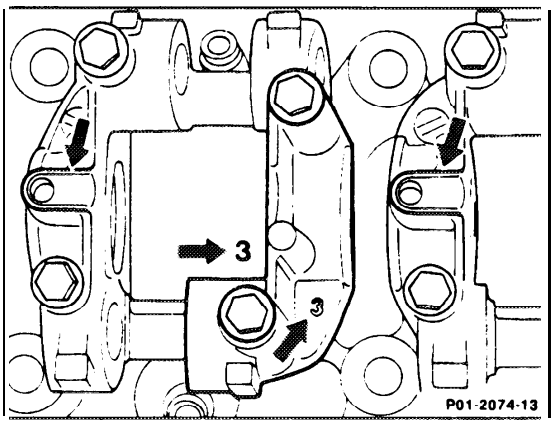
3 Remove, install relevant rocker arm bearing support, tightening torque 20 Nm.

Note

Loosen seized bearing supports using light blows with a plastic hammer.
The ball sockets (55) on the hydraulic elements can stick or fall down when removing the bearing support. Install ball sockets in their original positions.

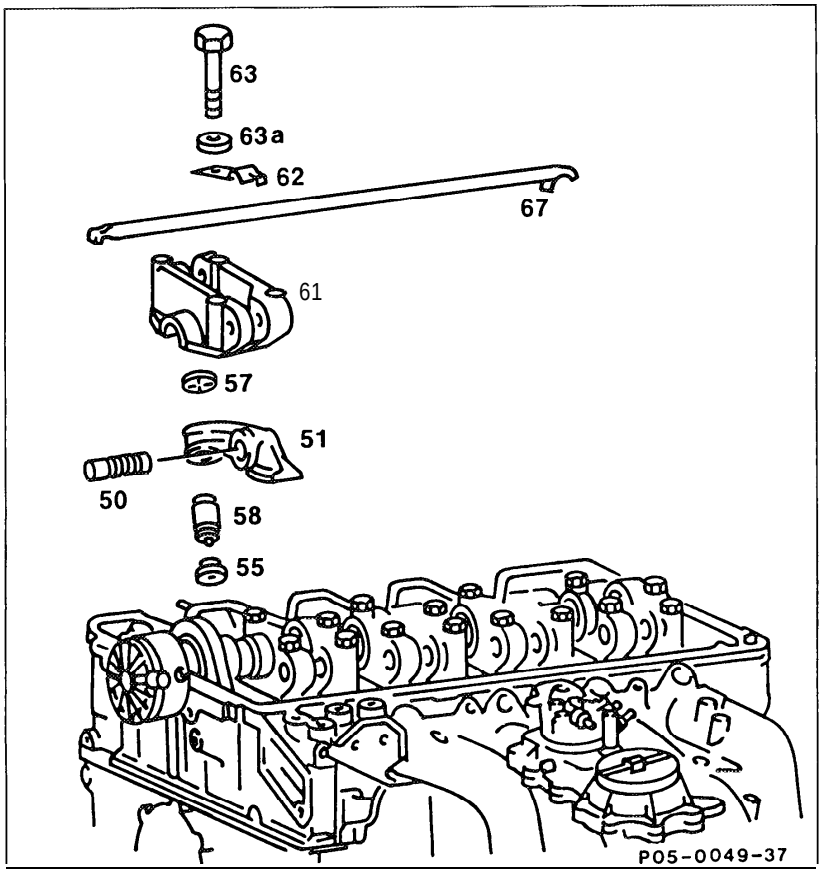


install the rocker arm bearing support so that the support areas for the oil pipe point rear-wards, the code numbers of the bearing supports are on the right-hand side (direction of travel) and correspond to the number cast on the cylinder head (arrows).



05-240 **Replacement** of rocker arms and rocker arm bearing supports

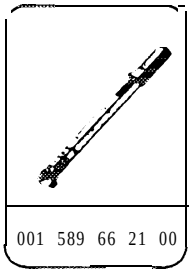
Preceding work:
Air cleaner removed (09-400 and 09-410)
Cylinder head cover removed (01-406).



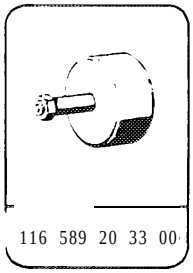
Camshaft	position so that rocker arms of bearing support being removed is on base circle of the cam (Number 1).
Oil pipe (67)	remove, install (Number 2)
Bearing support (61)	remove.
Rocker shaft (50)	pull out with impact extractor 116 589 20 33 00 and extension 616 589 00 34 00. Lubricate new rocker arm and rocker shaft and install. Prior to this rebuild hydraulic valve clearance compensating element (05-211, Numbers 4 and 5).
New bearing support (61)	install with rocker shaft without rocker arm, 20 Nm (Numbers 6 and 7).

Camshaft	turn and check for smooth running, possibly fit new bearing support (Number 8).
Bearing support (61)	remove, complete with rocker arm (51) and install rocker shaft (50) and bearing support (Numbers 9 and 10), 20 Nm.

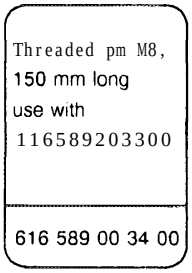
Special tools



001 589 66 21 00



116 589 20 33 00



616 589 00 34 00

Data

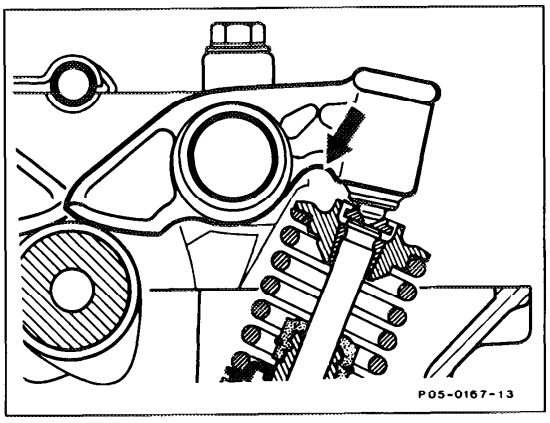
Rocker arm bore	18.016 18.027
Rocker shaft diameter	17.089 18.000
Radial clearance between rocker arm and rocker shaft	0.016 0.038
Rocker arm bearing support bore	18.000 18.018

Note

Only one bearing support can be replaced on an engine, otherwise camshaft binding will result.

Only rocker arm bearing supports where camshaft bearing half bore is 0.05 mm larger than on production parts are supplied as spare parts. This prevents the camshaft binding when replacing a bearing support.
In the event of bearing seizure or pronounced striation the camshaft bearings can be bored out by 0.5 mm and a camshaft with oversized journals installed (01-419). These camshafts have different code numbers
(05-215 and 05-220).
If the bearing supports are put together without rocker shafts, tighten the set bolts to max. 15 Nm, otherwise the shaft bores distort.

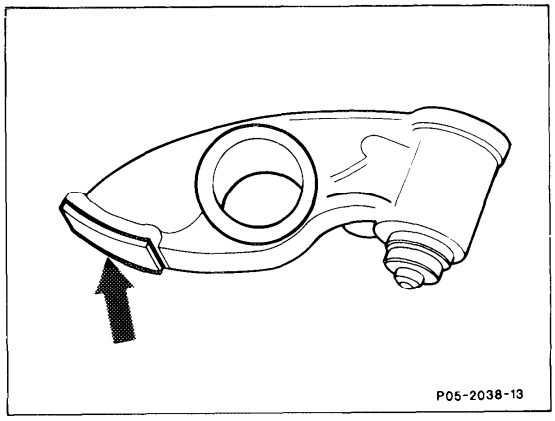
The radius on the rocker arm has been changed in order to increase the clearance between the rocker arm and the valve spring retainer (arrow).



Introduced in production: December 1984

Model	Engine	Engine end number		Vehicle identification end number	
		Manual transmission	Automatic transmission	A	F
201.024	102.985	000871	007129	172188	063323

In order to avoid camshaft wear, rocker arms with soldered on cemented carbide tips have been installed (arrow).
Only this rocker arm is still supplied as a replacement part.
These rocker arms may only be installed together with the chilled cast iron camshaft.



Introduced in production: October 1988

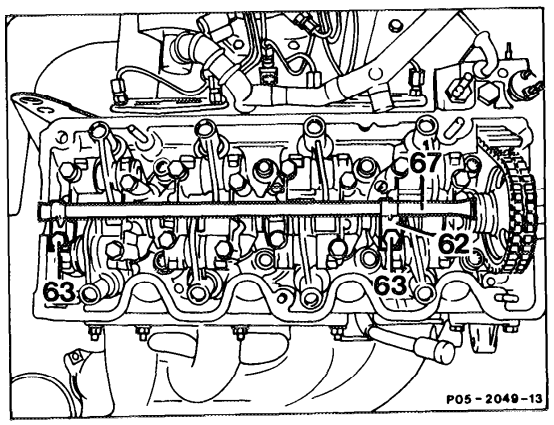
Model	Engine	Engine end number Manual transmission	Engine end number Autom. transmission
201.028	102.985	027671	077053

Replacement

a) Rocker arms and rocker shafts

1 Turn the engine so that the cam tips of the bearing support being removed point downwards and the rocker arms are on the base circle.

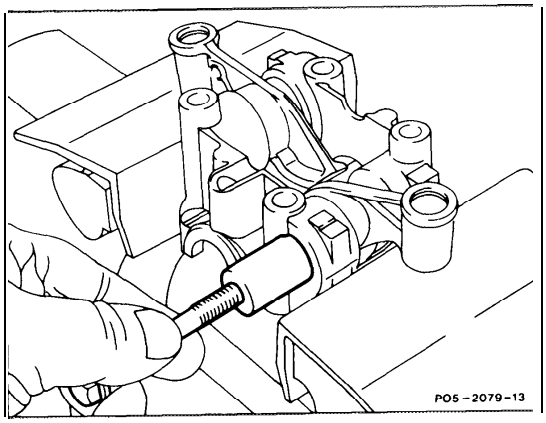
2 Remove, install oil pipe (67).



3 Remove bearing support.

4 Pull out rocker shaft with the impact extractor 116 589 20 33 00 and extension 616 589 00 34 00 or with an M8 bolt.

5 Lubricate new rocker arm and rocker shaft and install.

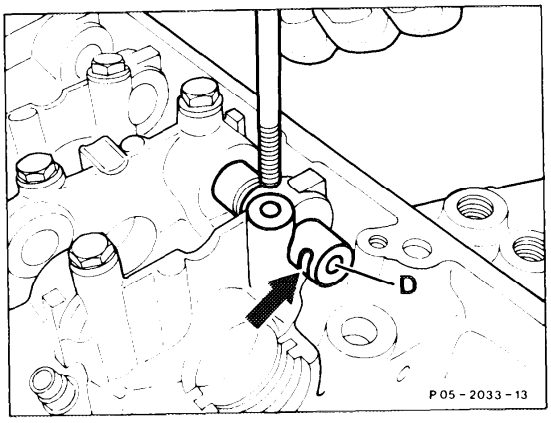


b) Bearing support

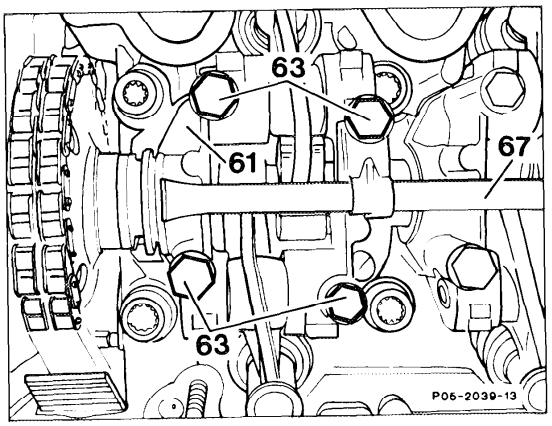
6 Lubricate new rocker shaft and install without rocker arm in the new bearing support.

Note

Insert the rocker shaft so that the half-bore (arrow) is located in one half of the screw shaft.



7 Put on bearing support, tighten set bolts (63) to 20 Nm, install oil pipe (67).

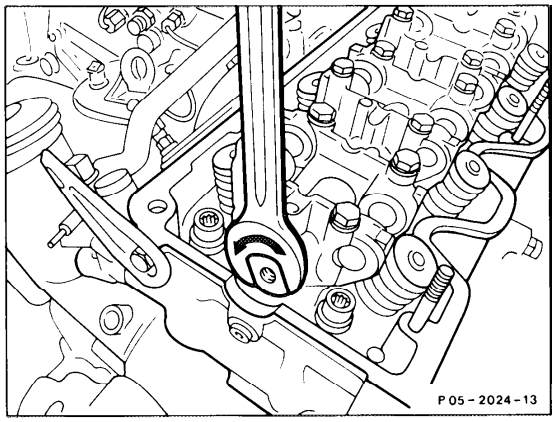


8 Turn camshaft by the fiats with a fork wrench (24 mm) and check for ease of movement. If binding occurs, remove the bearing support again and replace with another.

9 Remove new rocker arm bearing support and pull out rocker shafts (Figure Number 4).

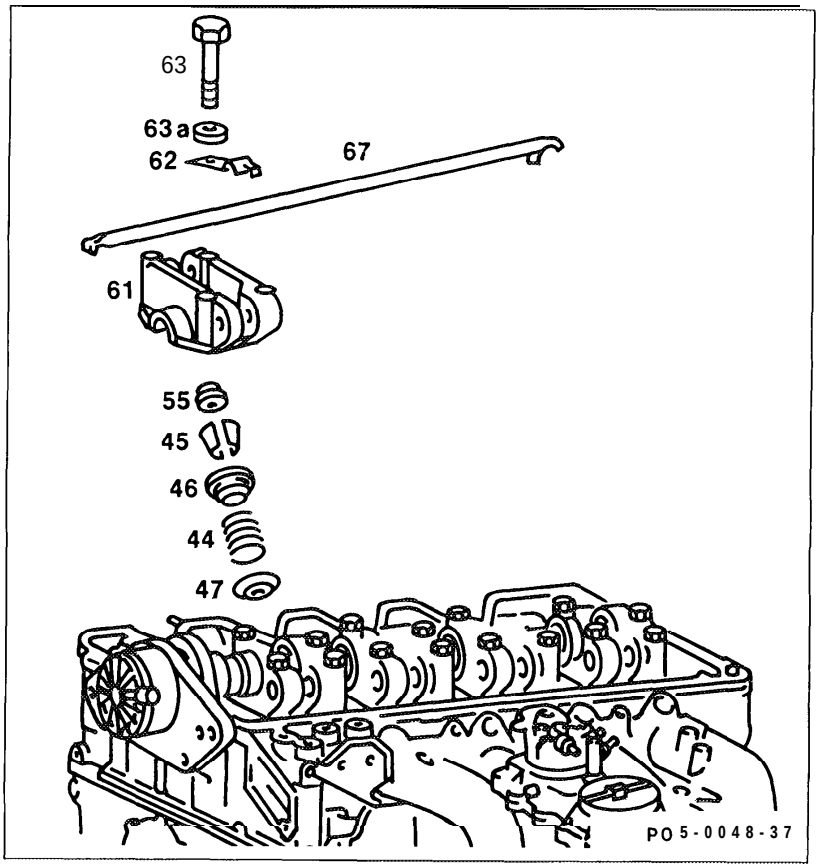
10 Lubricate rocker arms and rocker shafts and install in bearing support.

11 The installation proceeds in the reverse sequence.



05-250 Removal and installation of valve springs

Preceding work:
Air cleaner removed (09-400 and 09-410).
Cylinder head cover removed **(01-406).**
Spark plugs removed **(15-018).**



A. Cylinder head removed

Cylinder head	clamp on assembly board 102 589 00 59 00. Remove, install rocker arm bearing supports. Attach support bridge 102 589 01 59 00 to cylinder head. Remove, install valve springs with the lever compressor 601 589 02 61 00.

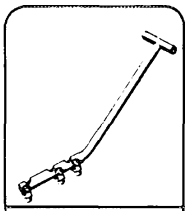
B. Cylinder head installed

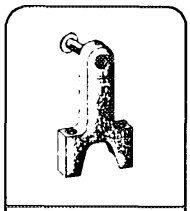
Piston of the relevant cylinder	position on ignition TDC (Number 1).
Oil pipe (67)	remove, install (Number 2).

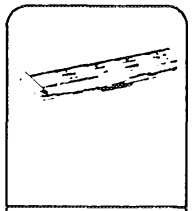
Rocker arm bearing support (61)	remove, install, 20 Nm (Number 3).
	Repair note
	Lubricate camshaft journals.
	Ball sockets (55) must be installed in the same position again.
	Note installation position of the rocker arm bearing bolt.
support	install 102 589 01 61 00 (Number 4).
Cylinder leakage tester	Disconnect, connect to the relevant cylinder (Number 5). Pressurize cylinder.
Valve cotters (45)	remove and install with the lever compressor 601 589 02 61 00 and magnet 116 589 06 63 00. Remove, insert valve springs (Numbers 7 to **9).**
	Installation note
	Install valve spring so that the color marking and the narrower coil point downwards.

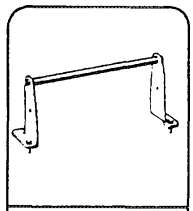
Special tools

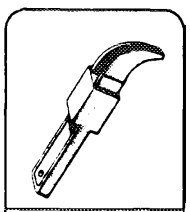

001 589 72 21 00


119 58901 61 00


102 589 01 61 00


102 589 00 59 00

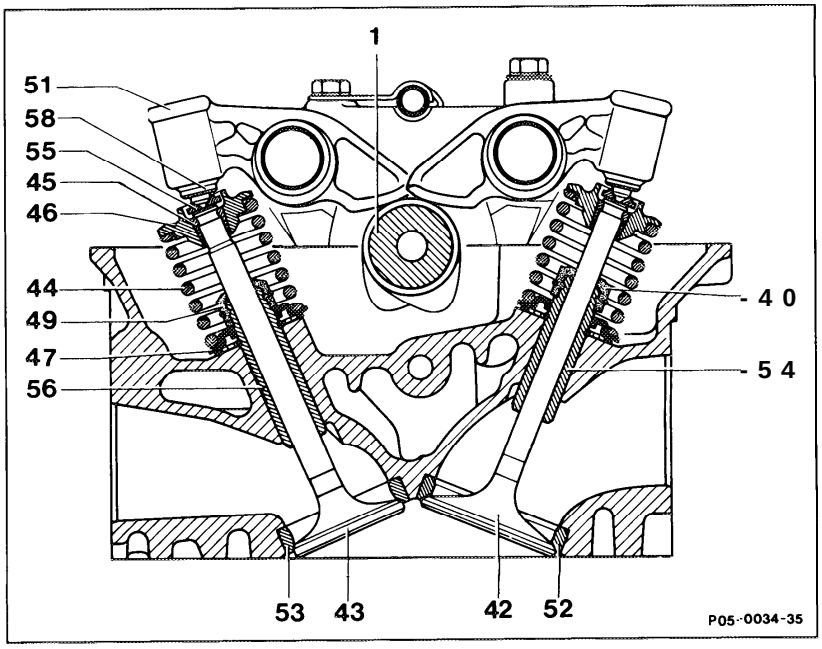

102 589 01 59 00


116 58906 63 00

Conventional tool

Cylinder leakage tester	e. g.	Bosch, E F A W **210** A **Sun,** CLT 228

Note
Valve springs and valve spring retainers with scoring on the mounting surfaces must be replaced.

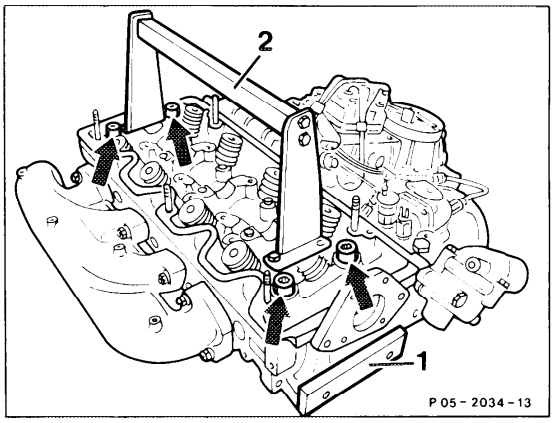


The valve springs act progressively and must be installed so that the color marking (narrow coil) points towards the thrust collar (47).
Color marking : yellow/red or
violet/red
A thrust collar (47) is inserted under the valve springs, which is supported on the cylinder head via anti-rotation lugs.
As on all other engines, the valve spring thrust bearing at the top forms valve spring retainers (46), which are attached to the valves with valve cone halves (45).

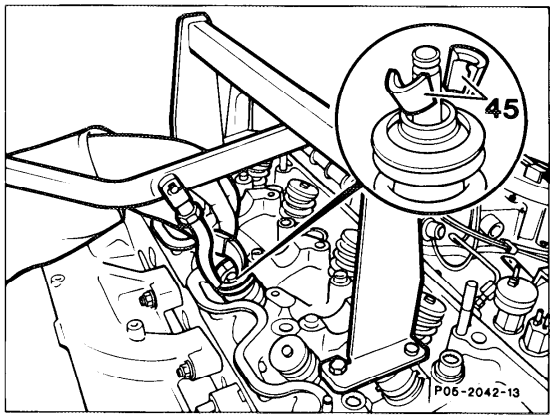
A. Cylinder head removed

When the cylinder head is removed the valve springs can be removed as follows:

Clamp cylinder head with four cylinder head bolts (arrows) on assembly board 102 589 00 59 00 (1). Remove rocker arm bearing supports with rocker arms and camshaft.



Attach support bridge 102 589 01 59 00 to the cylinder head and remove the valve springs with the lever compressor.



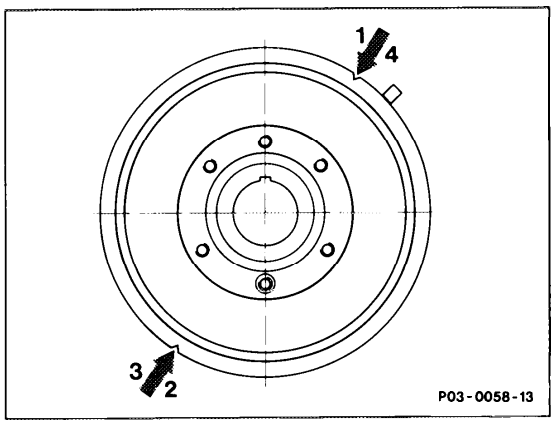
B. Cylinder headl installed

Removal, installation

1 Put piston of the relevant cylinder on ignition TDC.

Note

The respective pistons are in the ignition TDC position, when the markings on vibration damper shown in the adjacent drawing are beneath the TDC pointer.



Marking	TDC	180"
Piston at TDC on cylinder	1 and 4	2 and 3

2 Removal and installation of oil pipe (67).

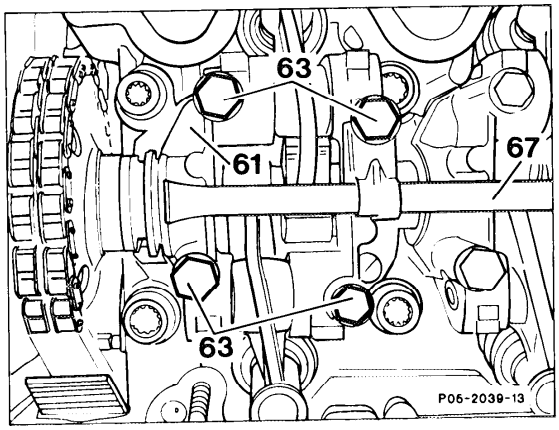
3 Remove and install the required rocker arm bearing support (61), tightening torque 20 Nm.

Installation note

Before installing rocker arm bearing support lubricate camshaft journals.

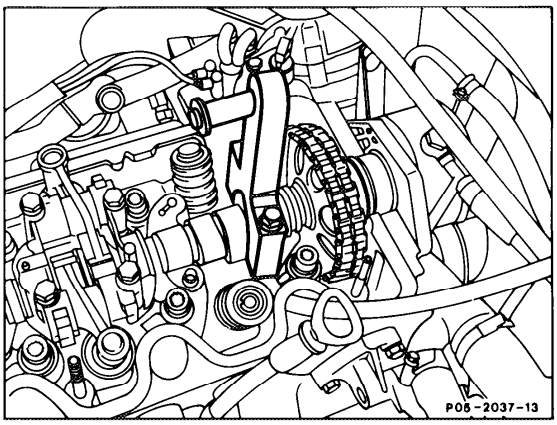
Install the rocker arm bearing support so that the support area for the oil pipe points rearwards and the code number is on the right (in the direction of travel).

The ball sockets (55) must be installed in the same position again.



4 Bolt up, unbolt support for lever compressor,

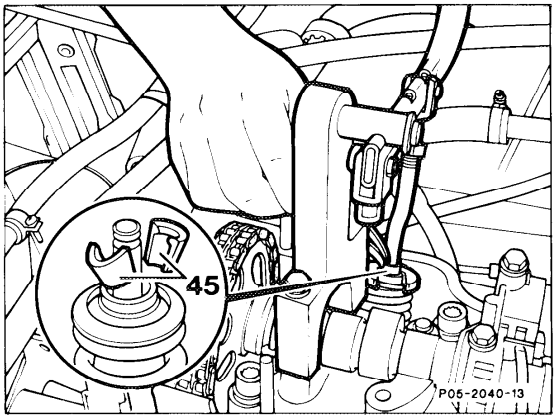
5 Connect cylinder leakage tester and pressurize cylinder.



6 Mount lever compressor on the support and install the valve spring retainer.

7 Compress valve spring and take out valve cone halves with the magnetic lever.

Caution!
Do not remove the valve springs without compressed air in the cylinder, otherwise damage can occur due to contact between the valves and the piston.

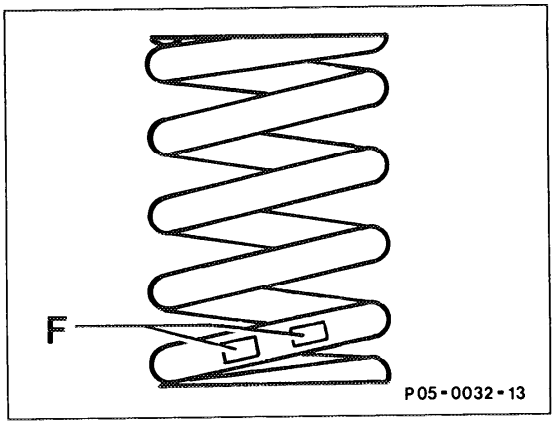


8 Remove, install valve spring retainers and valve spring.

9 Check valve spring (05-260) and valve spring retainers, replace as necessary.

10 Installation is the reverse of removal.

05-260 Checking valve springs



Data

	Valve spring Part no.	Colour identification (F)	Out-side Ø mm	Wire Ø mm	Free length mm	Spring force at the pre-loaded length		
						mm	New value N	Limit value N
1st design	102 053 02 20	yellow-red or violet-red	34.7	5.0	49	30.4	1084 + 30 - 50	–760
2nd design	102 053 11 20	violet-yellow orange or yellow-yellow orange						

Note

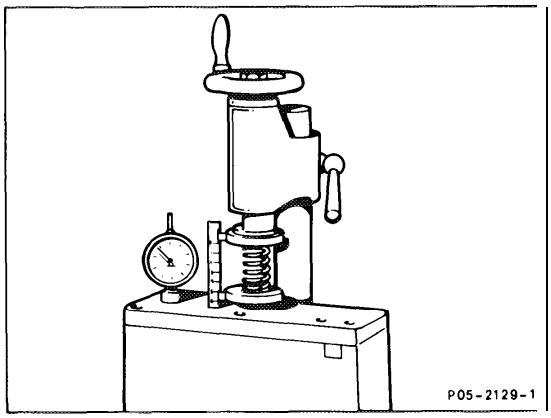
When carrying out repairs valve springs are to be checked for corrosion before re-use and to be replaced as necessary.

Checking

1 Check valve springs with a valve spring tester or with a spring test scale.

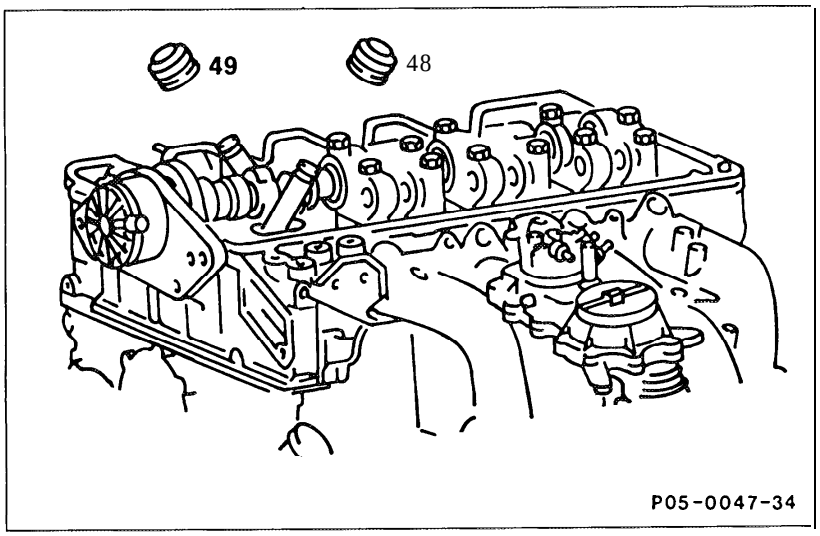
2 Check spring force at the specified length.

3 If the limit value is not achieved, replace valve springs.



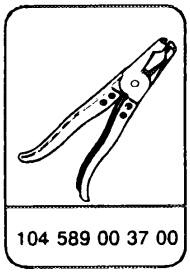
05-270 Replacement of valve stem seals

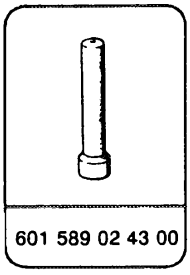
Preceding work:
Air cleaner removed (09-400 and 09-410).
Cylinder head cover removed (01-406).
Spark plugs removed (15-018).
Valve springs removed (05-250).



Valve stem seal (48 and 49) . . . . . extract with special tool 104 589 00 37 00.
Deburr valve stem at the groove. Replace hammered valve cone halves, spring seats and thrust collars.
Lubricate valve stem seal and insert.
Special tool 601 589 02 43 00. Note color marking, use assembly sleeve.

Special tools


104 589 00 37 00

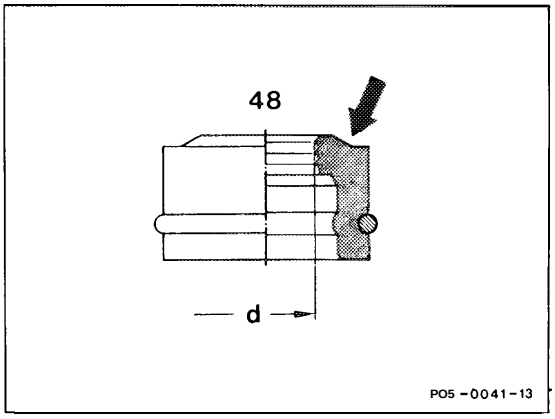

601 589 02 43 00

Note

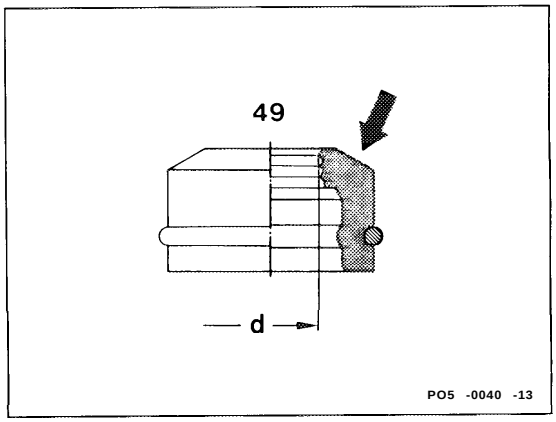
The valve stem seals including assembly sleeves are supplied in the repair set. Since September 1988 standardized valve stem seals in Viton (formerly Polyacrylic) are installed for intake and exhaust valves. The valve stem seals must not be interchanged due to the different inside Ø.

Distinguishing features:

Intake valve stem seal **(48)**
Chamfer (arrow) relieved
d = 7.3 mm
Wire ring : phosphated (black)
Color: brown



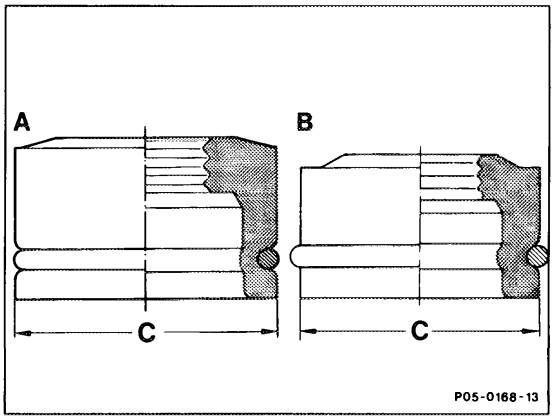
Exhaust valve stem seal (49)
Chamfer (arrow) inclined
d = **8.2** mm
Wire ring **:** bright galvanized (yellow)
Color: brown



Valve guides, which are opened out at the retaining groove for the valve stem seal, must be replaced.
When installing the valve stem seal on the intake valves it is absolutely essential that the plastic sleeve, which is enclosed in the repair set, is placed on the valve stem, because without the sleeve damage to the sealing lip of the valve stem seal is unavoidable.

As a temporary measure valve stem seals with a smaller inlet Ø c = 16 mm (previously 17.5 mm) have been installed.
Identification: revised outside contour

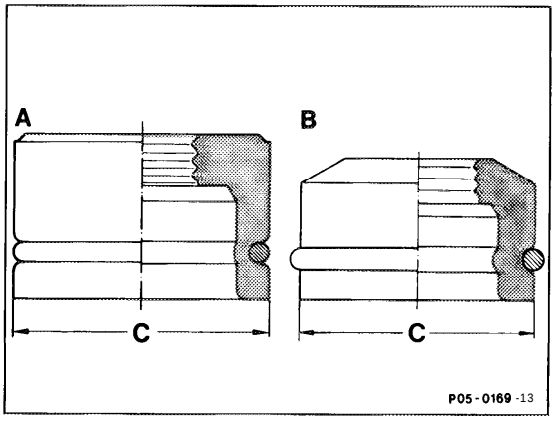
A Temporary design
B Production design



Intake valve stem seal

Introduced in production: January to February 1986

Model	Engine	Engine end number Manual transmission	Engine end number Automatic transmission
201.024	102.985	003217 – 003513	029482 – 031994



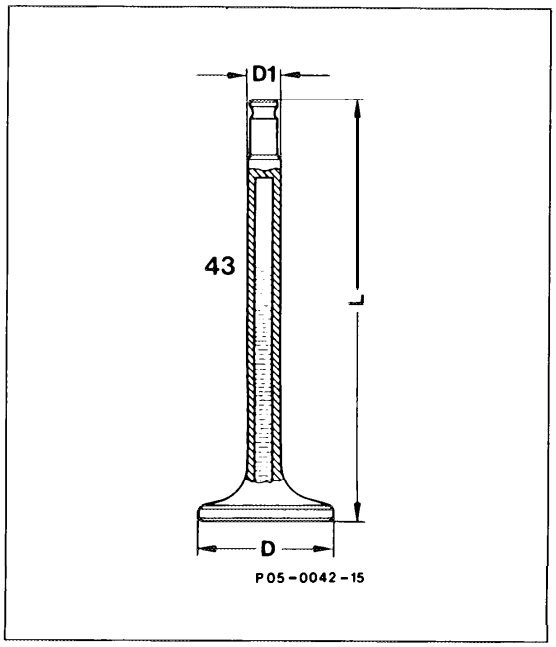
Exhaust valve stem seal

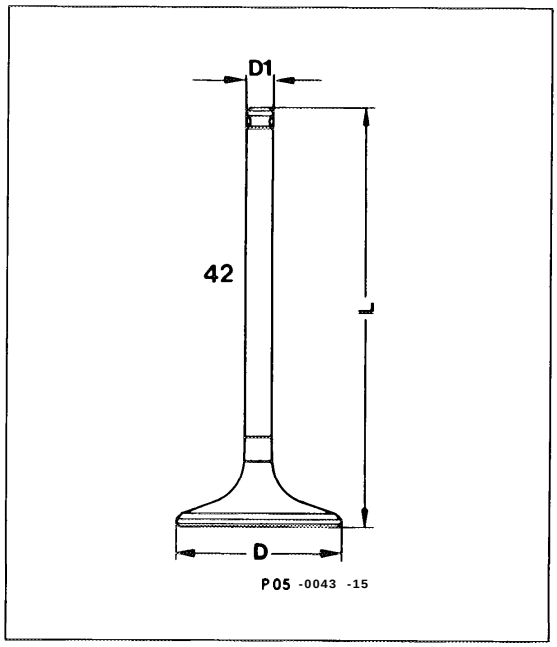
Introduction of Viton valve stem seal
Color identification: brown

Introduced in production: June 1988

Model	Engine	Engine end number Manual transmission	Engine end number Automatic transmission
201.028 (USA)	102.985	025442	074595

05-280 Checking and machining valves





Checking	clean valves. Visual inspection: Valves with burnt valve heads, insufficent valve head height (h) worn or grooved valve stem must be replaced (Number 1).
Checking	Measure valve stem eccentricity. Replace valve when eccentricity is more than 0.03 mm (Number 2).
Machining valve seat	Note operating instructions for machining equipment. Note adjustment angle “a” 45 + 15’. Replace valve when maximum tolerances are reached (Numbers 3 and 4).

Conventional tools

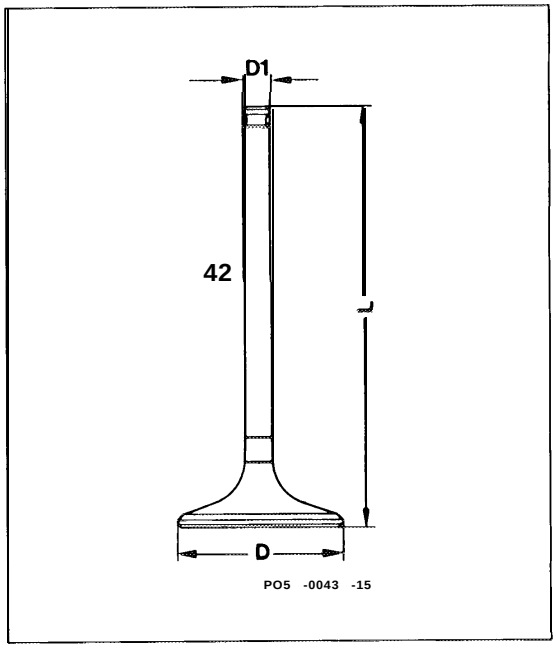
Valve cone grinding machine or	e.g.	Krupp, D-5309 Meckenheim VS Model
Valve cone turning equipment	e.g.	Hunger, D-8000 München 70 Type VKDR1, Part Number 203.00.200

Data

		Intake valve (42)	Exhaust valve (43)
Engine		102.985	102.985
Valve head Ø D		45.90 46.10	38.90 39.10
Height "h" of the valve head (Figure Number 1):	New value	1.6	2.7
	Limit Value	1.0	2.0
Adjusting angle „∝" for machining the valve (Figure Number 1)		45° + 15'	45° + 15'
Valve stem Ø D1		7.970 7.950	8.960 8.938
Valve seat reinforcement		without	with
Sodium filled		without	with
Valve length		114.70 115.10	115.60 116.00
Width of valve seat		1.8 – 2.5	1.5 – 2.5
Permitted eccentricity on valve stemand valve seat max.		0.03	0.03

Identification on end of stem

Engine	Inlet valve	Exhaust valve
102.985	E 102 08	A 102 03 27

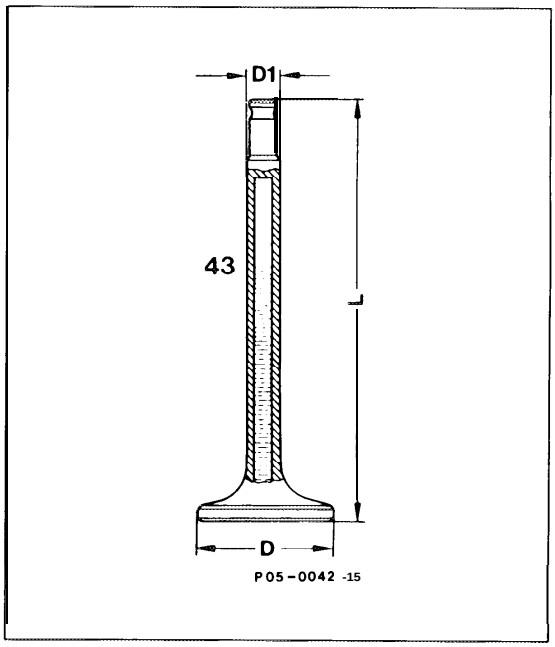


42 Intake valve

Note
The exhaust valve stem is chrome-plated on these engines and filled with sodium due to high temperatures in the combustion chamber.

Warning!
Unserviceable sodium filled valves must be neutralised before scrapping. They must therefore be collected and sent to:

Mercedes Benz AG
Werk Marienfelde
Daimlerstraße 145
Anlieferstelle KST 3153
Arbeitsvorbereitung TAI

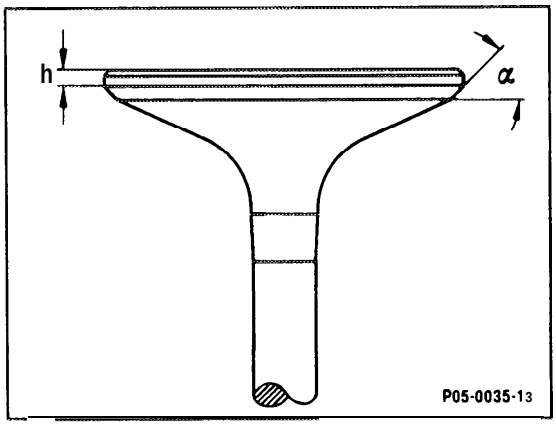


43 Exhaust valve

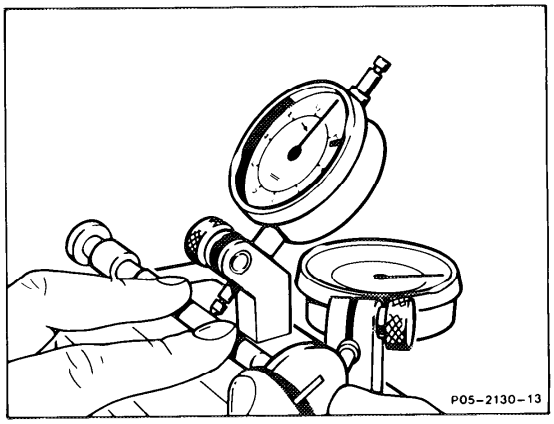
After machining or replacing valves, the installed length of hydraulic valve clearance compensating elements must be checked and corrected if necessary (05214).

Checking and machining

1 Clean valves and carry out visual inspection. Valves with burnt valve heads with insufficient valve head height "h" and with worn or scored valve stem are to be replaced.

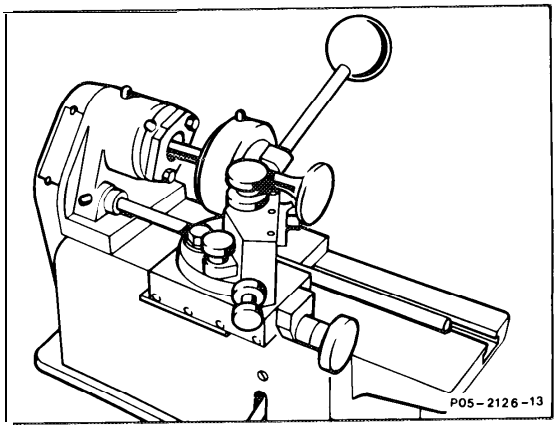


2 Measure valve stem eccentricity. Replace valve when an eccentricity of more than 0.03 mm is measured.

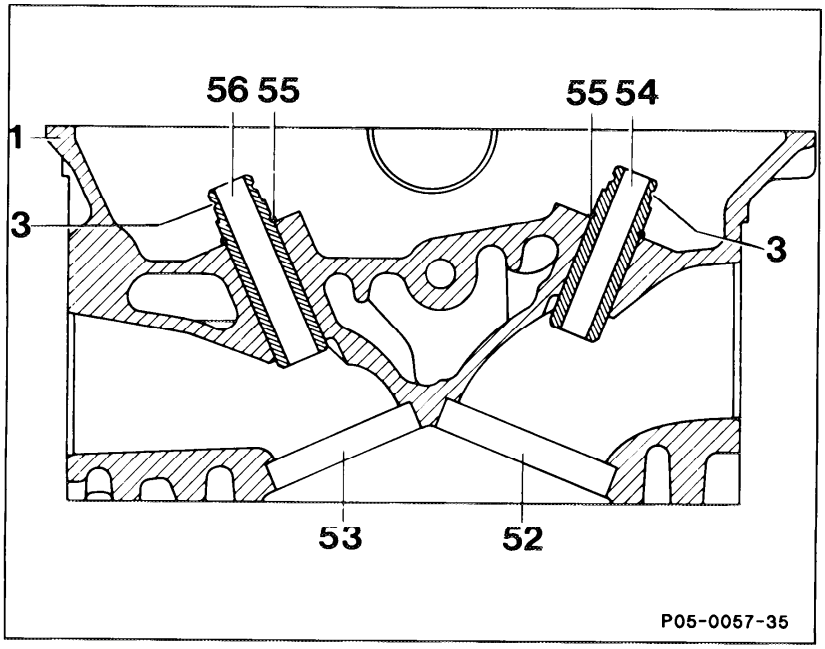


3 Machine valve seat. Note operating instructions of the machining equipment and adjustment angle "α" 45 + 15'.

4 Measure valve seat eccentricity and valve head height "h". Replace valve if the limit values are reached.



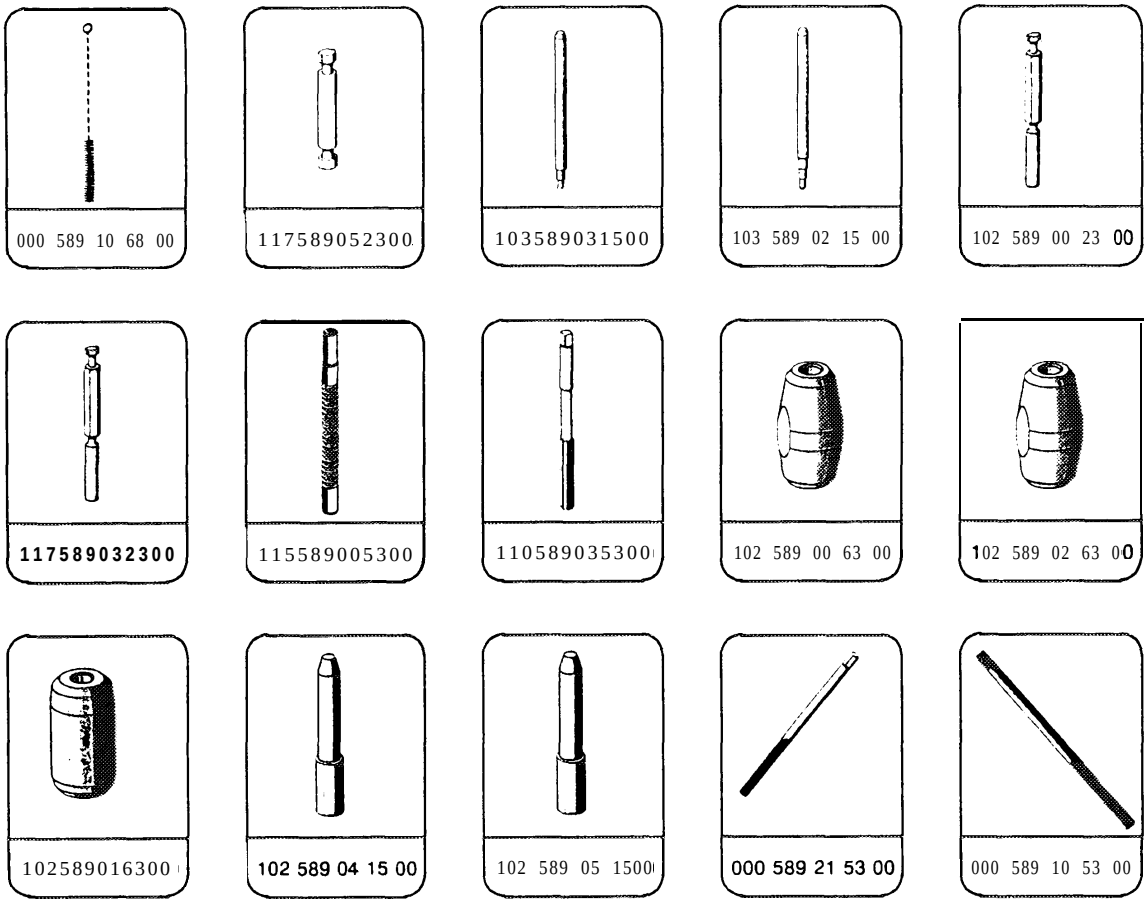
05-285 Checking and replacing valve guides



Valve stem seal seat (3)	check for wear. If the valve stem seal is no longer firmly seated, replace valve guide, special tools 103 589 02 15 00, 103 589 03 15 00.
Valve guide (54 and. 56)	clean, check, special tools 000 589 10 68 00, 102 589 00 23 00 and 117 589 03 23 00. If the go pin of the checking mandrel can be slid in longitudinally or laterally to the full extent (6.5 mm), replace valve guide. Special tools 103 589 02 15 00 and 103 589 03 15 00. Insert: Super cool in liquid nitrogen approx. (3 minutes), special tools 102 589 04 15 00 and 102 589 05 15 00. See repair note. After insertion check inside Ø with testing mandrel, special tools 102 589 00 23 00 and 117 589 03 23 00; if required, ream, special tools 000 589 21 53 00 and 000 589 10 53 00.

Base bore for valve guide in the cylinder head (1)	check before inserting a valve guide. Special tool 117 589 05 23 00. If normal dimension valve guide can be used; Ream base bore with reamer 14.035 mm Ø, 1105890300 When the checking pin can be inserted to the full extent, broach base bore to 14.2 mm Ø. Special tools 115 589 00 53 00, 102 589 00 63 00, 102 589 01 63 00 and 102 589 02 63 00. See repair note.
Valve seat ring (53 and 54)	after installing a new valve guide check for eccentricity, if necessary machine (05-291).

Special tools



Conventional tool

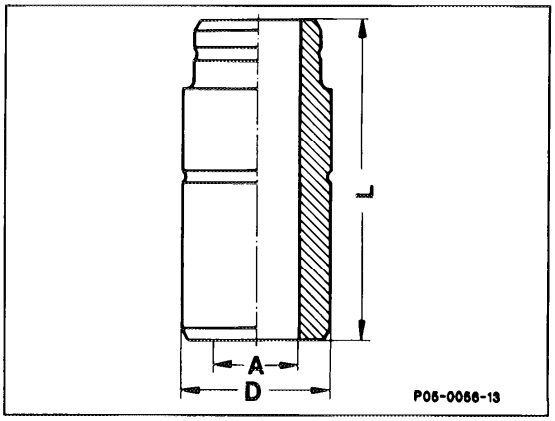
Cylinder head clamping fixture	e.g.	f-lunger, D-8000 München 70 Part Number 221.60.000

Valve guides

	Intake valve		Exhaust valve	
	Normal dimension	Repair stage	Normal dimension	Repair stage
Part Number	11020501724	11020501024	11020501824	11020501324
Outside Ø (D)	114.044 – 14.051	114.214 – 14.222	114.044 – 14.051	14.214 – 14.222
Color identification	grey-brown	red	grey-brown	red
Base bore in cylinder head	14.030 – 14.035	114.198 – 14.203	114.030 – 14.035	114.198 – 14.203
Overlap	0.009 – 0.021	0.011 – 0.024	0.009 – 0.021	0.011 – 0.024
Valve guide inside Ø (A)	8.000 – 8.015	8.000 – 8.015	9.000 – 9.015	9.000 – 9.015
Length (L)	46.0	46.0	51.0	51.0

Note

Valve guides are made of different materials on the intake and exhaust side.
Intake valve guide (54): copper olours
Exhaust valve guide (56): brass colors



Valve guides produced by another manufacturer have been installed between June and September 1986.

Introduced in production: June - September 1986

Model	Engine	Engine end number		Vehicle identification end number	
		Man. transmission	Auto. transmission	A	F
201.024 (USA)	102.985	003910 – 004391	036130 – 040796	–	262533 – 277581

1) not recorded

Broach base bore in cylinder head (repair stage)

Remove rust and clean the cylinder head thoroughly, particularly the inside of valve seat rings.

Select correct guide sleeve (2) and remove swarf from the cutting edge of broach (1) with a stiff plastic brush or similar.

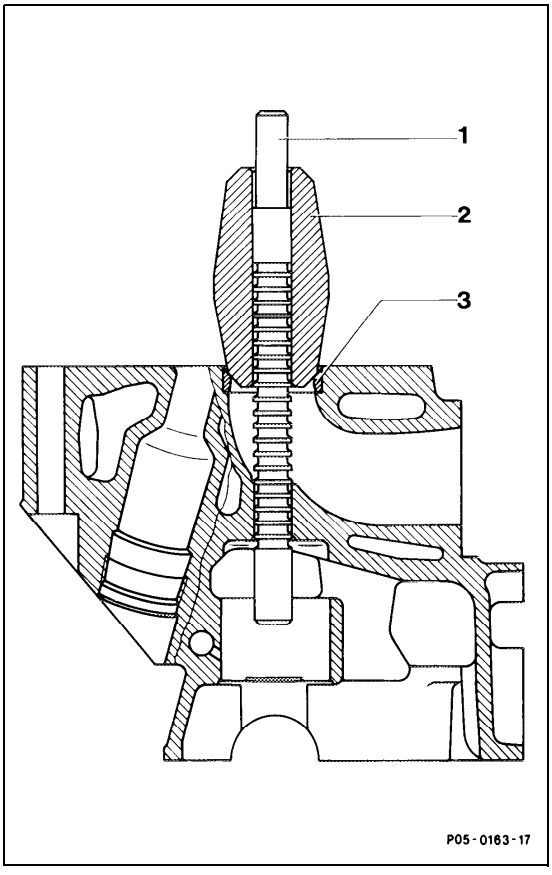
Note

The broaching tool cutting edges must be cleaned before every broaching process. Provide guide sleeve, base bore and complete broach with ample supply of kerosene.

Slide broaching tool in direction of broaching into the guide sleeve, so that when putting the guide sleeve on the valve seat ring (3) the first broach cutter is inserted in the base bore. When doing this, note that the correct side (A or B) of the guide sleeve is placed on the valve seat. Center guide sleeve by rotary movements in valve seat ring.

Note

Drive home the broach briskly with an aluminium mandrel, approx. 130 mm long, and a plastic hammer of approx. 250 g.



1 Broach
2 Guide sleeve
3 Valve seat ring

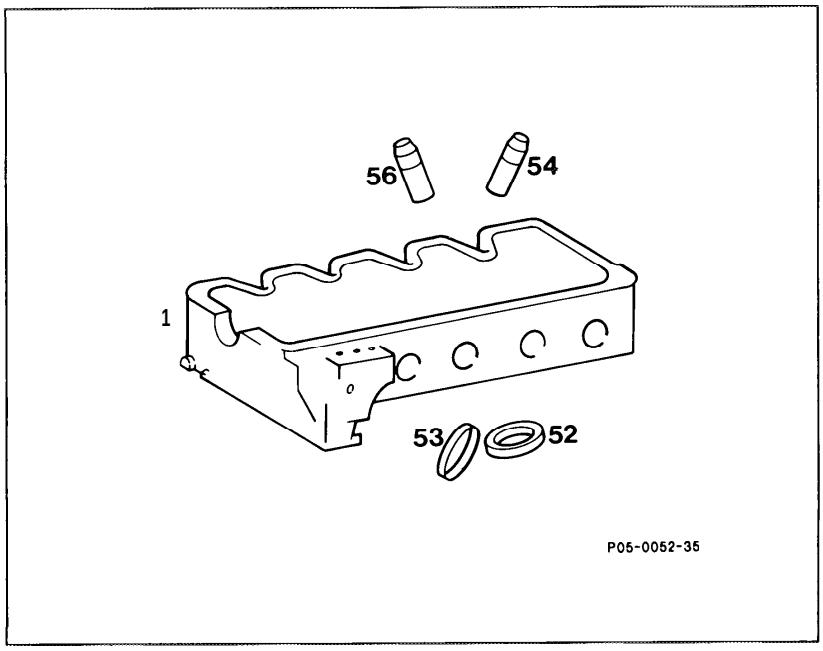
Inserting valve guide

Drive in the valve guides with impact mandrel and hammer, when the valve guides are not super cooled and cylinder head is not heated up. Coat valve guides with wax or oil before driving in.

Guide sleeve - valve seat allocation to enaine

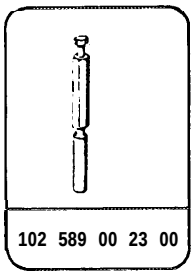
Valve seat	Engine	Guide sleeve Part No.	Base bore Ø in cylinder head
Intake	102.922/924 102.962.963	102 589 01 63 00	14. 2 mm
	102.985	102 589 02 63 00	
Exhaust	102.985	102 589 00 63 00	

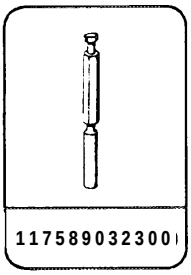
05-290 Replacing valve seat ring



Valve seat ring (52 and 53)	unscrew with seat ring turning tool Note turning tool operating instructions.
Valve guides (54 and 56)	check, replace if necessary (05-285).
Base bore (D2)	measure. **Note** A new valve seat ring with normal dimensions can be used, when specified overlap is present. If minimum overlap is not achieved, machine base bore for valve seat ring.
Machined base bore	measure.
Valve seat ring repair stage	skim, so that the specified overlap is achieved.
Cylinder head (1)	heat up in water bath.
Valve seat ring	Super cool with liquid nitrogen and stamp with a suitable mandrel. Machine valve seat (05-291).

Special tools



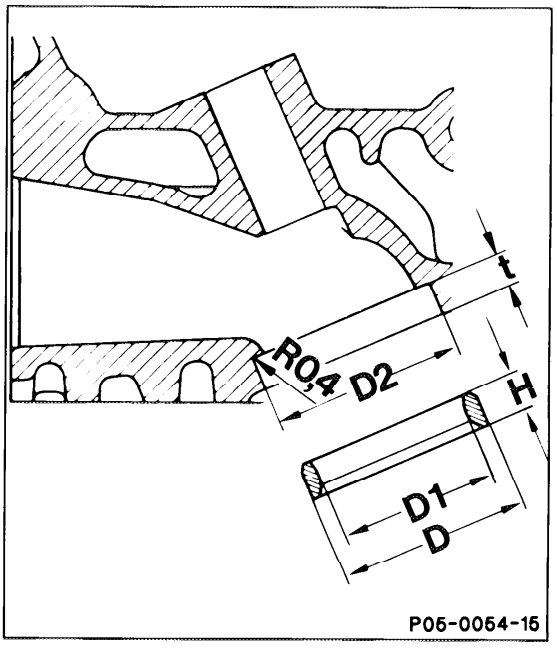


Conventional tools

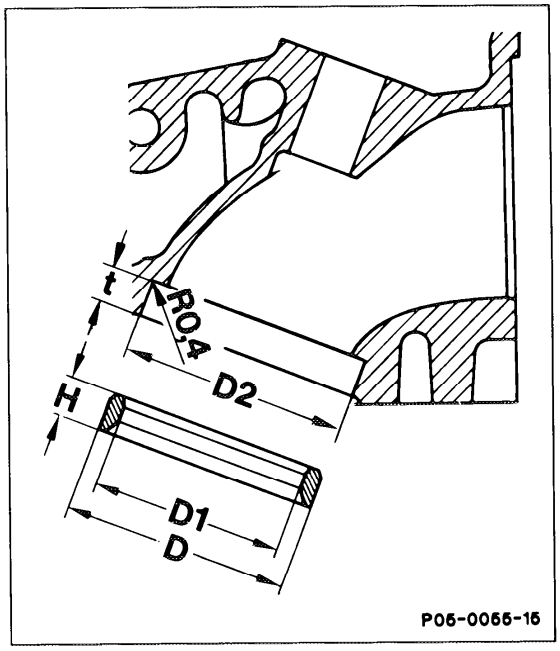
Cylinder head clamping fixture	e.g.	Hunger, D-8000 München 70 Part No. 221.60.000
Ring seat turning tool	e.g.	Hunger, D-8000 München 70 Size 2, Part No. 220.03.110
Valve seat turning device	e.g.	Hunger, D-8000 München 70 Type VDSN 1/45/30, Part No. 236.03308
Test set for valve seats	e.g.	Hunger, D-8000 München 70 Part No. 216.93.300
Internal measuring instrument (measuring range 35 - 100 mm)	e.g.	Mahr, D-7300 Esslingen Part No. 844 N
External micrometer (measuring range 25 - 50 mm)	e.g.	Mahr, D-7300 Esslingen Part No. 40 S H

Data

		Intake		Exhaust
Engines		102.922/924 102.962/963	102.982/985	102.922/924 102.962/963 102.982/985
Overlap of valve seat rings in cylinder head		+ 0.074 to + 0.100	+ 0.074 to + 0.100	+ 0.074 to + 0.100
D2	Normal dimension	46.000 46.016	49.000 49.016	42.000 42.016
	Repair stage max. to	47.0	50.0	43.0
D	Normal dimension	46.090 46.100	49.090 49.100	42.090 42.100
	Pre-turning dimension	47.3	50.3	43.3
D1		38	42.0	35.0
H	Normal dimension and repair stages	7.910 8.000	7.910 8.000	7.910 8.000
t	(New value)	8.0	8.0	8.0



Exhaust

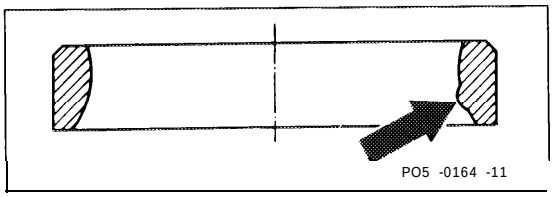


Intake

Note

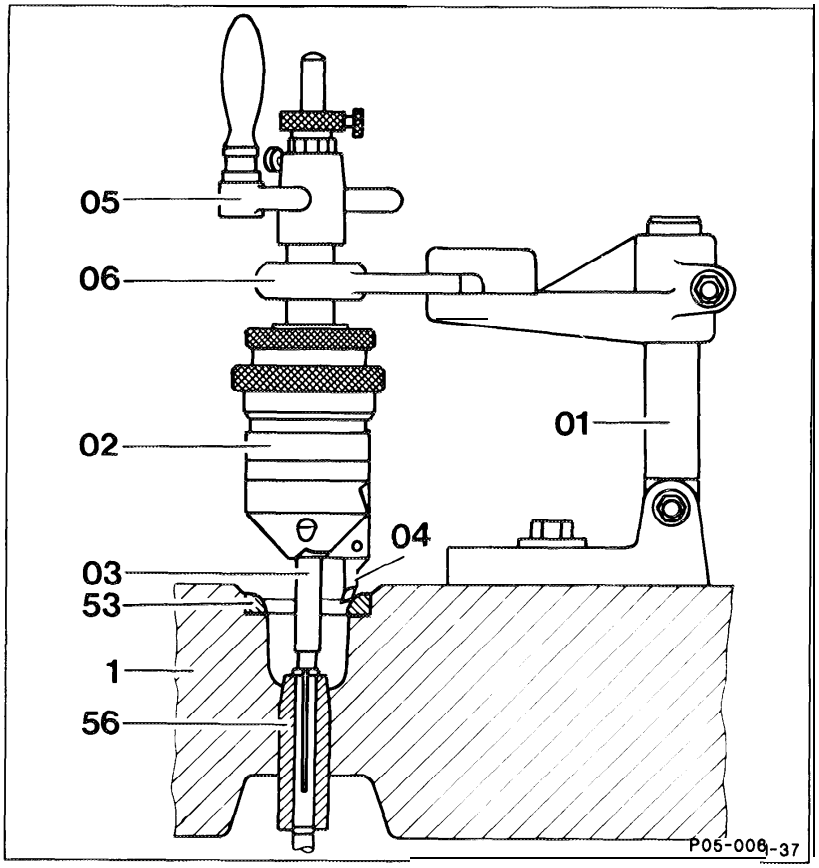
The valve seat rings are sintered metal on account of lead free fuel.

These hardened valve seat rings temporarily had a step (arrow) on the inside of the ring.



This step must be turned off in order to machine the valve seat ring. There is a repair valve seat ring with larger outside diameter as a replacement part for all valve seat ring designs. After renewing valve seat rings, the fitting condition of the hydraulic valve clearance compensating elements must be checked and corrected if necessary (05-214).

05-291 Machining valve seats

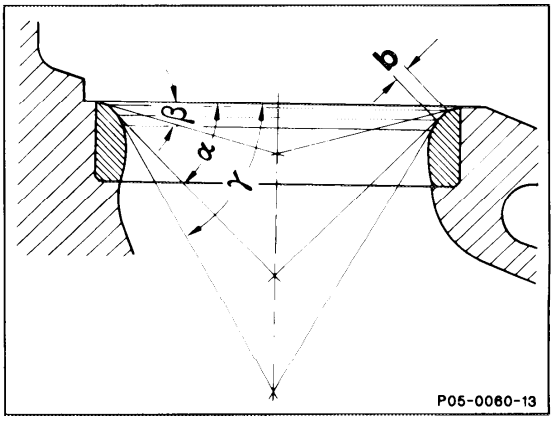


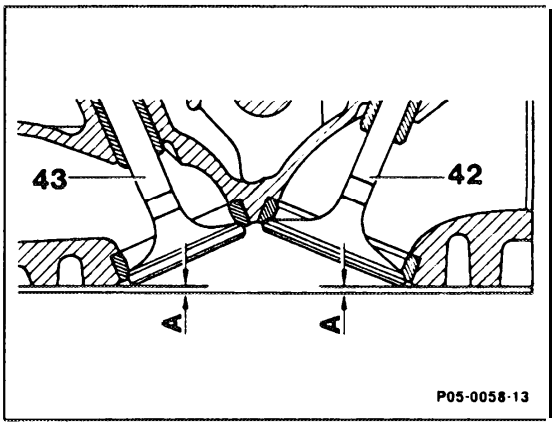
Valve guides (56)	check (05285).
Valve seats (53)	machine in accordance with manufacturer's operating instructions. See data for adjustment. **Note** Only loosen pilot, when eccentricity of valve seat ring has been checked.
Valve seat eccentricity	check (Number 3).
Valve seat width (b)	measure, correct if required (Number 4).
Valves	insert and measure, stand off (A).

Conventional tools

Cylinder head clamping fixture	e.g.	Hunger, D-8000 München 70 Part No. 221.60.000
Valve seat turning equipment	e.g.	Hunger, D-8000 München 70 Type VDSN 1/45/30, Part No. 236.03.308
Test set for valve seats	e.g.	Hunger, D-8000 München 70 Part No. 216.93.300
60" correction steel No. 13 for correction angle below(y)	e.g.	Hunger, D-8000 München 70 Part No. 216.64.622

Data	Inlet	Exhaust
Valve seat width b	1.8 – 2.5	1.5 – 2.5
Valve seat angle α	45° –15'	45° –15'
Correction angle upper β	15°	15°
Correction angle lower γ	60°	60°
Permitted deviation in valve seat concentricity	0.05	0.05





Valve distance to cylinder head parting surface

Engines		102.922/924 102.9621963	102.982/985
Minimum distance A with new valve seats and new valves	Intake (42)	1.7	1.2
	Exhaust (43)	0.5	0.5
Largest distance A with reworked valve seats and reground valves	Intake (42)	2.6	2.1
	Exhaust (43)	1.4	1.4

Largest distance A reduces by the same dimension, by which the cylinder head parting surface has been reworked.

Note

Clamp cylinder head in clamping fixture for stripping down and machining.

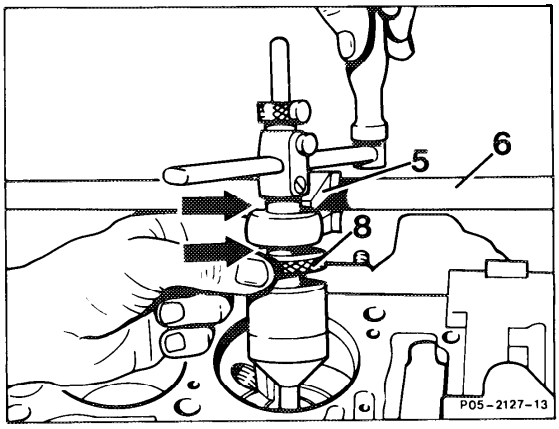
Machine valve seats with valve seat turning equipment, with valve seat grinding machine or with valve seat miller. After machining the valve seat rings the installation position of the hydraulic valve clearance compensating elements must be checked and corrected if necessary (05214).

Machining valve seats

1 Check valve guide, replace if necessary (05-285).

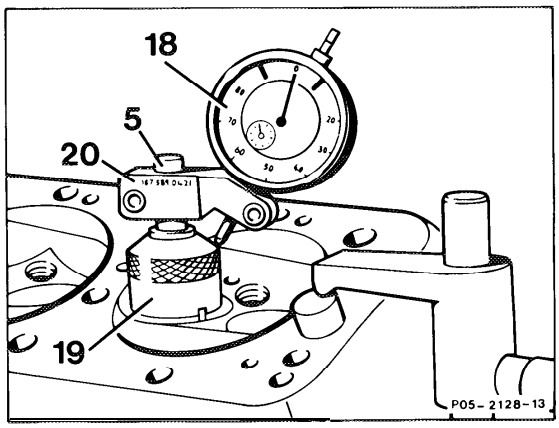
2 Machine valve seats (see manufacturer's operating instructions).

Caution!
Only loosen pilot, when eccentricity of valve seat has been checked (Number 3).

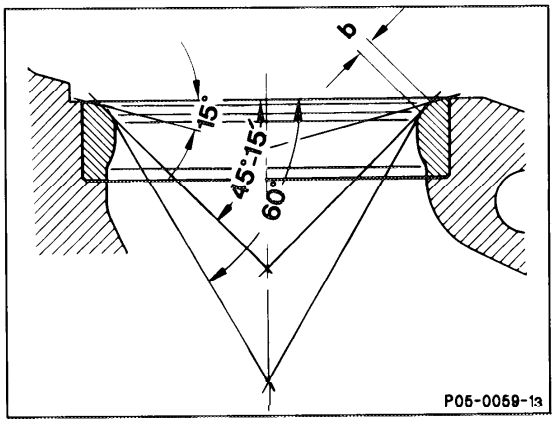


3 Check valve seat eccentricity. For this push test sleeve (19) with dial gauge bracket (20) and dial gauge on the pilot (5).

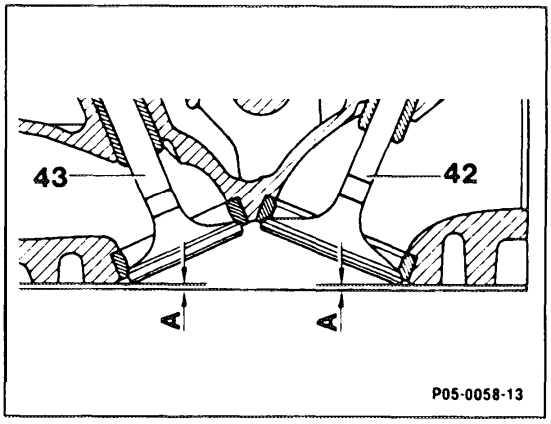
5 Pilot
18 Dial gauge
19 Test sleeve
20 Dial gauge bracket



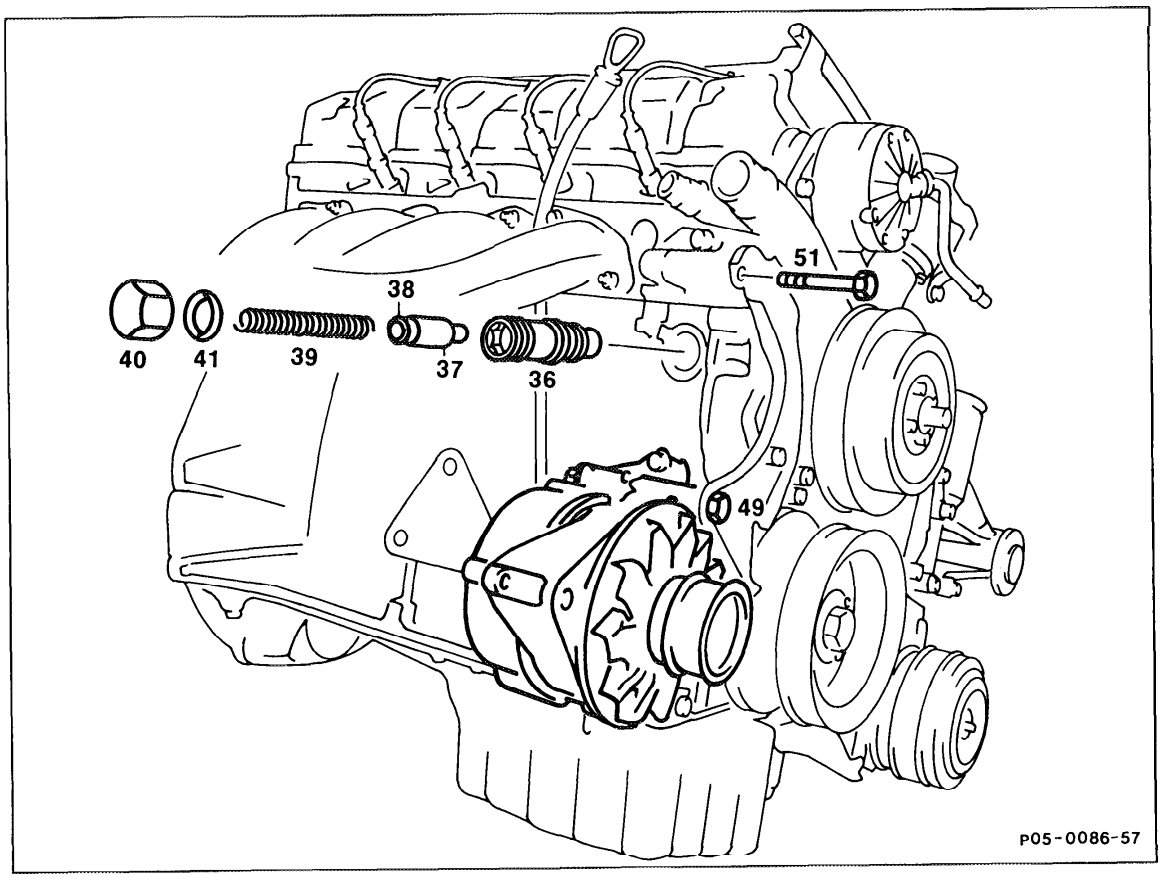
4 Measure valve seat width (b), and if required correct top(P) 15° angle and the bottom (y) 60° angle.



5 Insert valves and measure distance A.



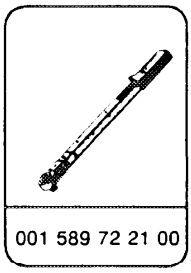
05-310 Removal and installation of chain tensioner



V-ribbed belt	detach, assemble (13-342).
Bolt (49)	loosen (Number 2).
Bolt (51)	unbolt (Number 3).
Alternator	swing outwards.
Sealing plug (40)	unbolt.
	Note The sealing plug is under pressure (Number 4).
Sealing ring (41)	replace.
Compression spring (39)	remove, install.
Chain tensioner casing (36) with setbolt (37)	unbolt (Number 5).

Setbolt (37) with locking spring (38)	press out of chain tensioning casing in the direction of pressure. Check individual parts for wear (Number 6).
Chain tensioner casing (36)	screw into cylinder crankcase, 15 Nm (Number 7).
Setbolt (37) with locking spring (38)	push in (Number 8).
Sealing plug (40) with compression spring (39) and new sealing ring (41)	screw in, 70 Nm (Number 9).
Alternator	mount (Number 10).
V belt	assemble (13-342).
When engine is running	check for leakage.

Special tools

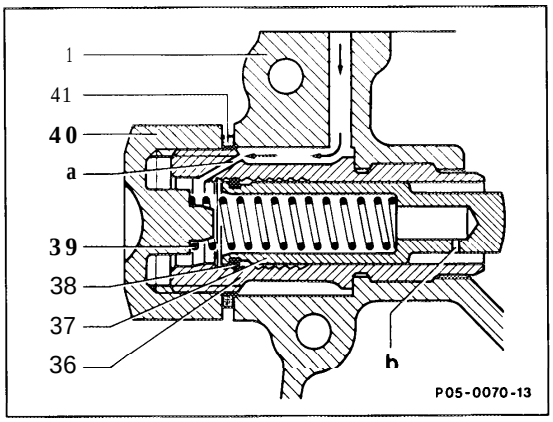


Conventional tool

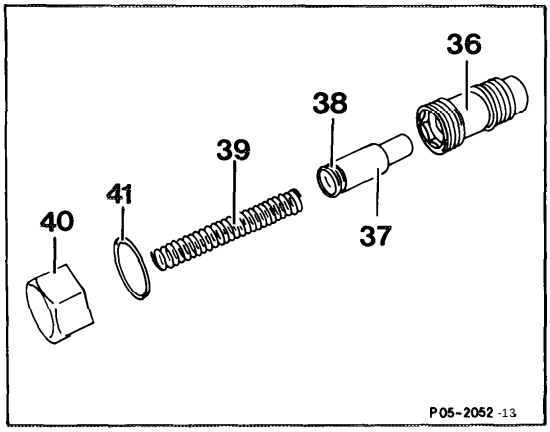
Stud driver insert 17 mm, 1/2" square	e.g.	Hazet, D-5630 Remscheid Part No. 985/1 7

Note

The housing (36) of valveless, hydraulic lock chain tensioner is bolted to the crank case (1). The application force required to tension the chain is comprised of the force from compression spring (39) and oil pressure in the chain tensioner, depending on engine oil pressure.



In the event of sudden load the oil feed bore with 1.1 mm Ø (a) and an orifice bore (b) in the setbolt of 1.2 mm Ø prevents the oil escaping rapidly and thus has a damping effect. An embossing is provided in the chain tensioner casing (36) and a locking spring (38) on the setbolt.

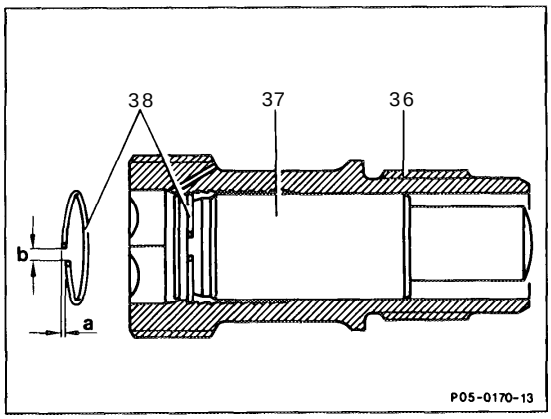


36 Chain tensioner casing
37 Setbolt
38 Locking spring
39 Compression spring
40 Cap nut
41 Sealing ring

The locking spring (38) has been modified in order to improve the function of the chain tensioner.

Changes:

- Ends free from burrs
- Smaller twist
  (dimension "a" = 0.1 mm, was 0.5 mm)
- Improved material
- Dimension "b" = 3.5 mm, was 4.0 mm.



Introduced in production: December 1985

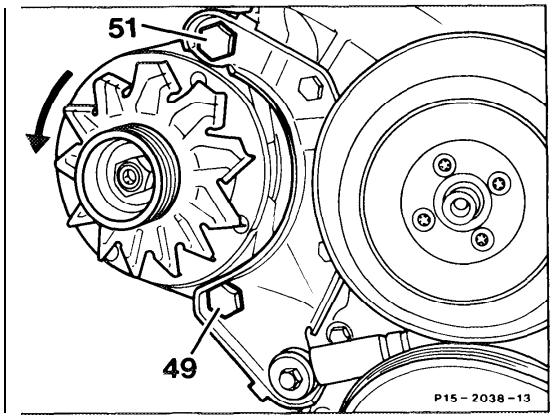
Model	Engine	Engine end number Manual transmission	Engine end number Automatic transmission
201.024 (USA)	102.985	003199	**029429**

Removal and installation

1 Removal and installation of Poly V- belt (13-342).

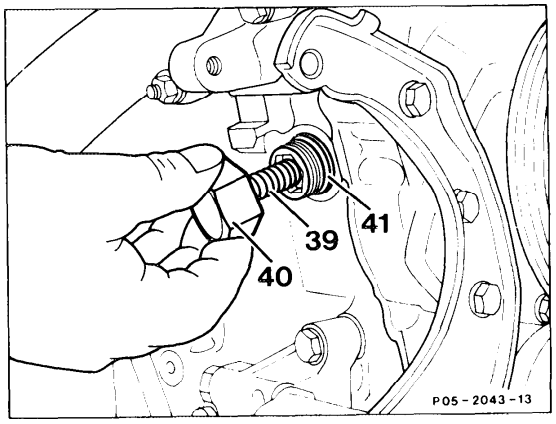
2 Loosen lower bolt (49) for alternator positioning.

3 Remove upper bolt (51), swing alternator outwards (arrow).

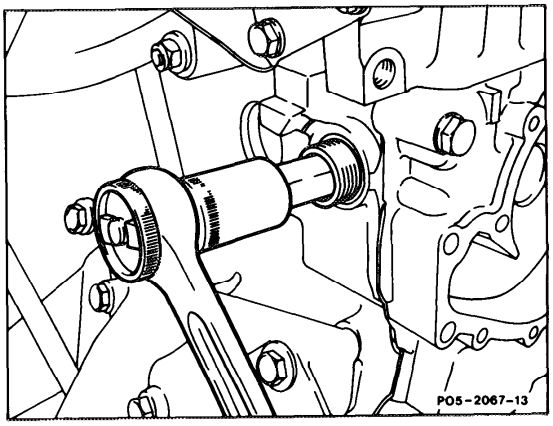


4 Unscrew sealing plug (40) and sealing ring (41) and remove compression spring (39).

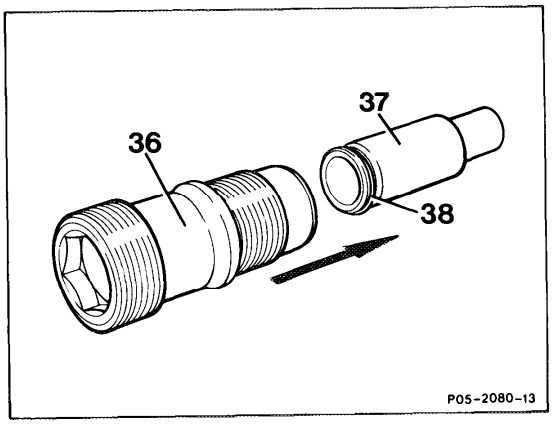
Caution!
Sealing plug is pressurized by the compression spring.



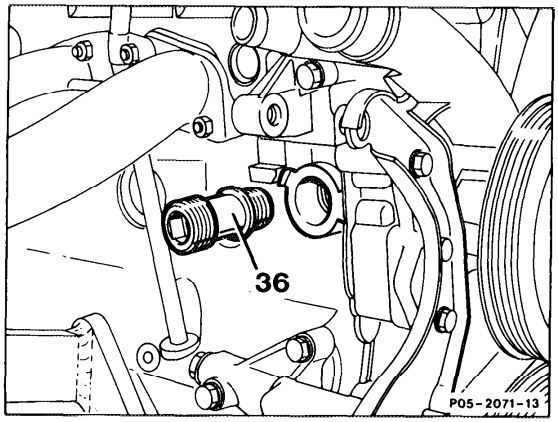
5 Unbolt chain tensioner case (36) from the cylinder crankcase with the stud driver insert.



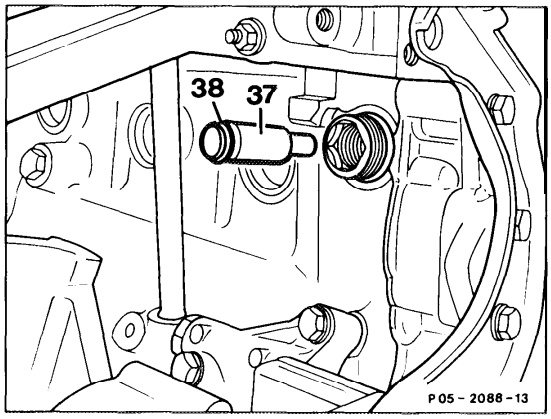
6 The chain tensioner must be stripped down before assembly. To do this press the setbolt (37) and locking spring (38) out of chain tensioner casing (36) in the direction of the arrow. Clean parts and check for wear.



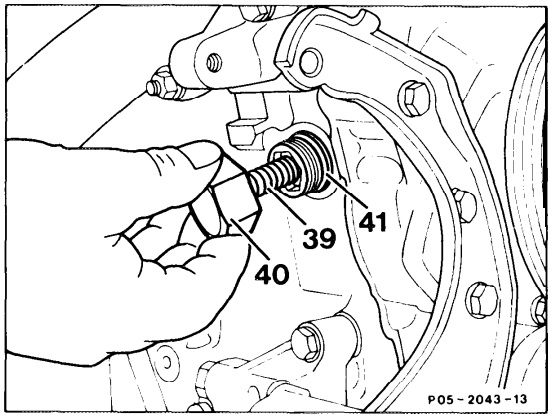
7 Bolt chain tensioner casing (36) onto crankcase, tightening torque 15 Nm.



8 Push setbolt (37) and locking spring (38) into the assembled chain tensioner casing.



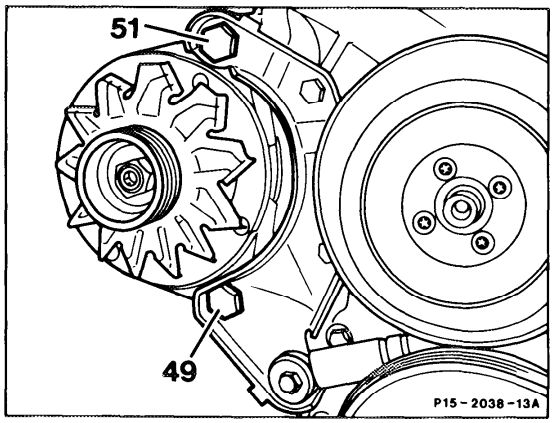
9 Mount compression spring (39) and sealing plug (40) with new sealing ring (41), tightening torque 70 Nm.



10 Mount alternator, tightening torque of the bolts (49 and 51), 25 Nm.

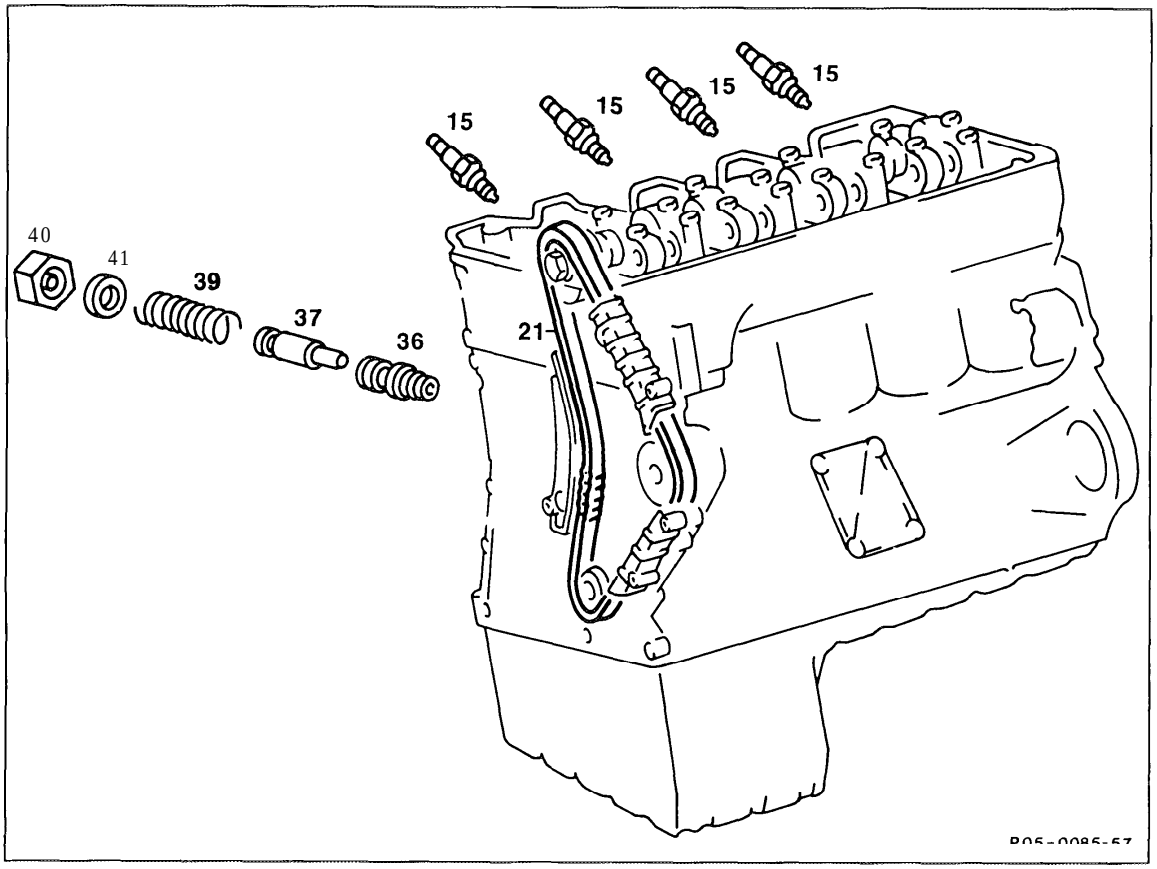
11 Install Poly V- belt (13-342).

12 Check for leaks when engine is running.



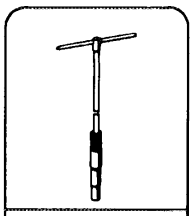
05-320 Replacement of timing chain

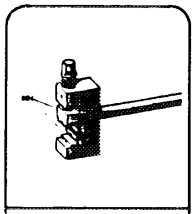
Preceding work:
Air cleaner removed (09-400 and 09-410).
Cylinder head cover removed (01-406).

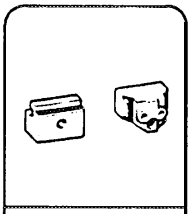


Spark plugs (15)	remove, install (15-318).
Chain tensioner (36 to 41)	remove and install (05-310).
Chain bolt	grind off (Number 3).
New timing chain with old timing chain (21)	connect, pull in (Numbers 4 to 7).
Exterior bracket	press on with riveting tool 000 589 58 43 00, rivet set 103 589 01 63 00 for single roller chain, conversion set 000 589 53 43 for double roller chain (Numbers 8 to 10).
Riveting tool	remove, convert (Number 11).
Connector link bolt	rivet individually (Numbers 12 and 13).

Special tools


102 589 01 09 00


000 589 58 43 00


103 589 01 63 00

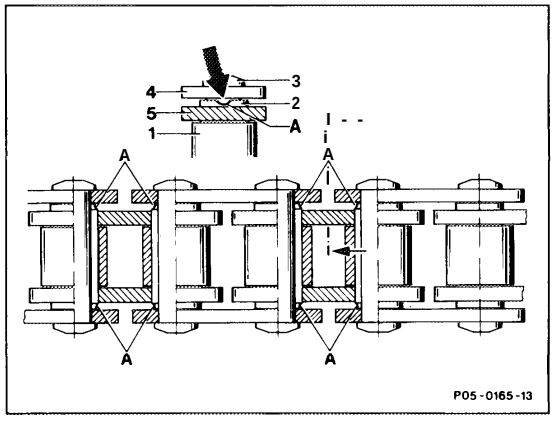
Note

An open timing chain with connector link is supplied for repairs. The sprockets are to be checked for scores and pitting as well as the chain tensioner for perfect function before installing a new timing chain.

Improved timing chains have been installed since November 1985.

Changes:

Sleeves (2) with recesses (notches, arrow and A). Hence improved oil supply to bolts (3) and sleeves (2).



Introduced in production: November 1985 - May 1986

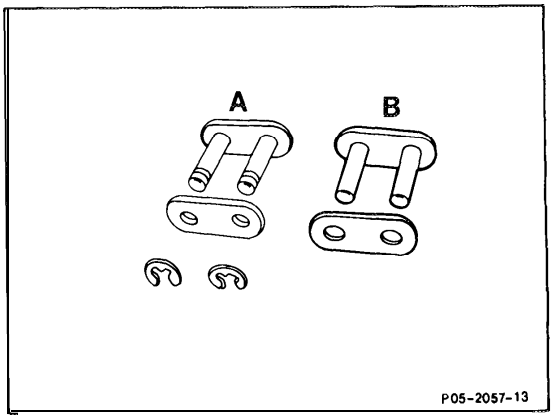
Model	Engine	Engine end number Manual transmission	Engine end number Automatic transmission
201.024 (USA)	102.985	003057-003893	027366-036001

Introduced in production: June 1986

Model	Engine	Engine end No. Manual transmission	Engine end No. Automatic transmission	Vehicle chassis end No.	
				A	F
201.024 (USA)	102.985	003925	036289	312513	Not recorded

Double roller timing chains have been installed since January 1988.

The former connector link with locking devices (A) has been deleted. Only the connector link (B) is still supplied for riveting.



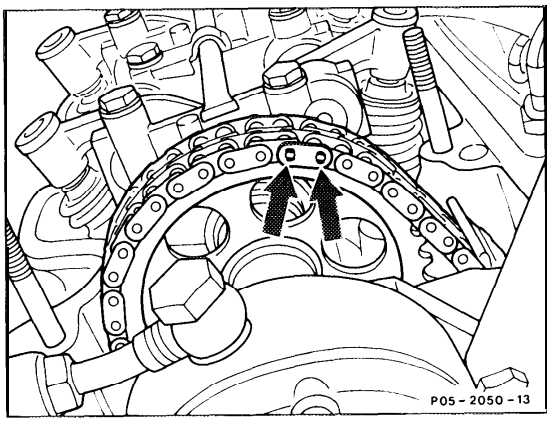
A Former connecting link with locking devices
B Modified connecting link - can be riveted

Replacement

1 Remove, install spark plugs (15018).

2 Remove, install chain tensioner (05-310).

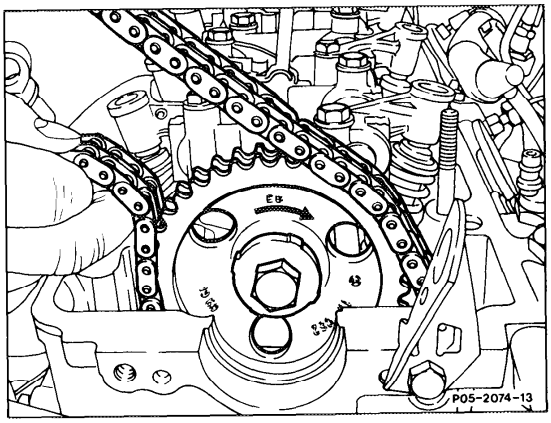
3 Cover the open part of the chain casing with a rag, grind off both chain bolts (arrows) at a double link in the timing chain.



4 Attach new timing chain and the connector link onto the old timing chain. To do this press out ground off double link.

5 Put the new timing chain connected with the old timing chain onto the camshaft timing gear. Rotate crankshaft.

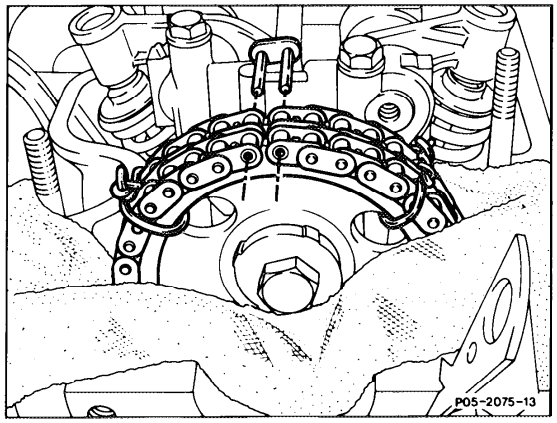
Caution!
The timing chain must remain engaged while rotating the camshaft timing gear.



6 Pull out the released end of the old timing chain evenly, to correspond with drawing on the new timing chain.

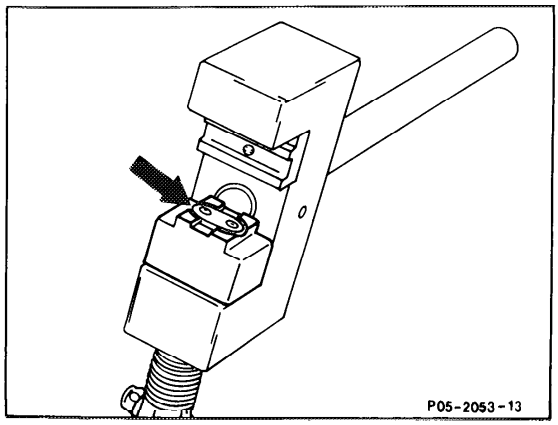
Caution!
The timing chain must remain engaged while turning the camshaft timing gear and crankshaft gear.

7 Secure the ends of the chain to the camshaft timing gear with wire. Detach old timing chain and connect the ends of the new timing chain with the repair connector link.
Note
Connector link must be inserted from behind.

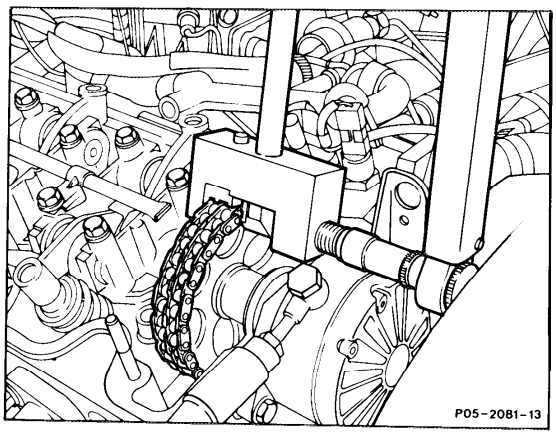


8 Fit riveting set 103 589 01 63 00 to the basic tool 000 589 43 00 corresponding to the timing chain design (single or double roller chain).

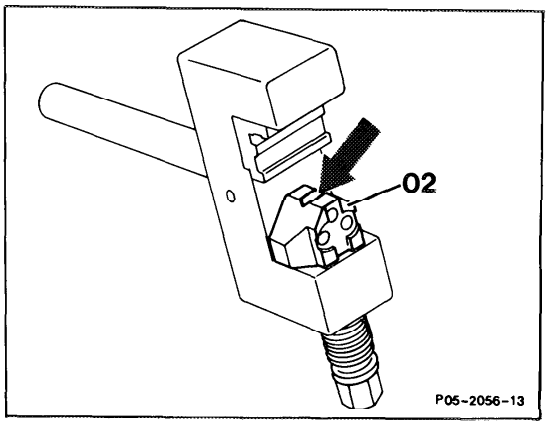
9 Put loosely attached exterior bracket of the connector link in the press tool (arrow).
The exterior bracket is held magnetically.



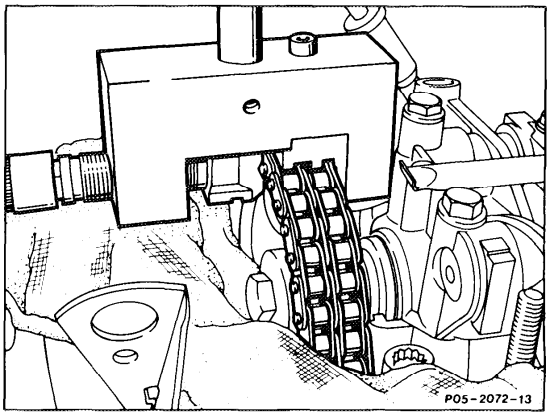
10 Put press tool on the connector link and press on bracket up to the stop.
Note
Put on clip so that both rivet pins engage.



11 Remove assembly tool and turn punch (02) so that the notch (arrow) points forward.

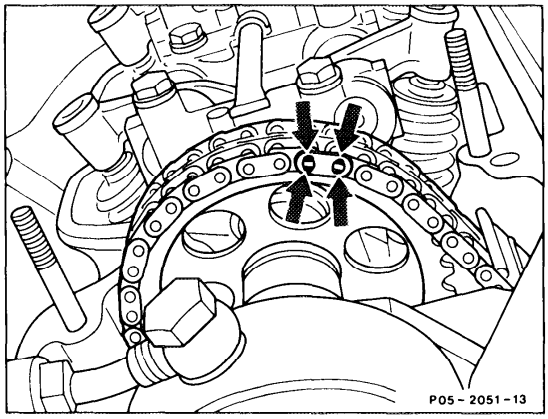


12 Install assembly tool exactly over the center bolt. Rivet bolts of the connector links individually, tightening up spindle to approx. 30 - 35 Nm (reference value).



13 Check riveting (arrows), re-rivet if required.

14 Install chain tensioner (05310).

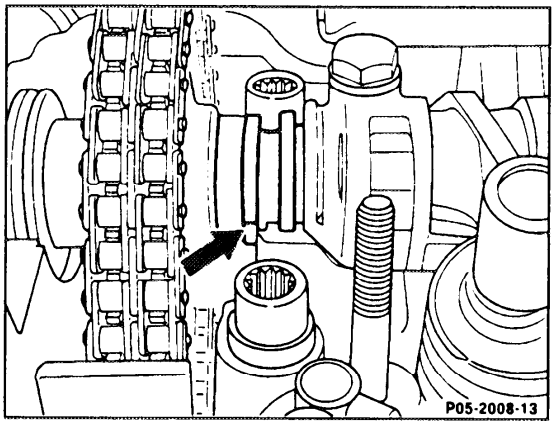


15 Turn crankshaft and check adjustment markings at engine TDC position.

Note

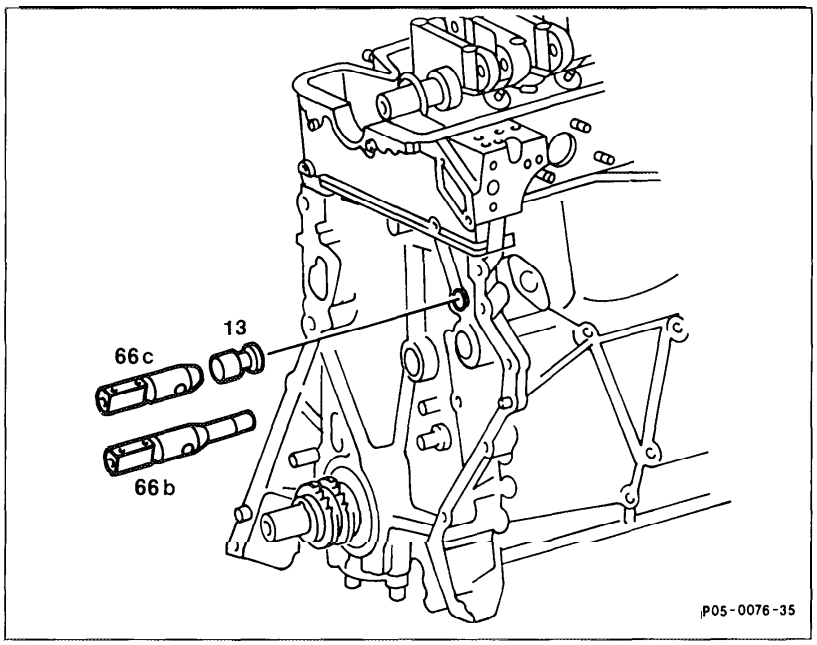
If the adjustment markings do not align, the valve timing settings of the camshaft must be checked (05215).

16 Assembly is completed in the reverse order.



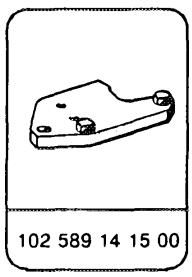
05328 Installation of oil spray nozzle retroactively

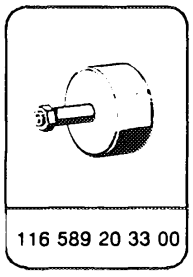
Preceding work:
Timing case cover removed (01-210).
idler gear shaft removed (05-412).

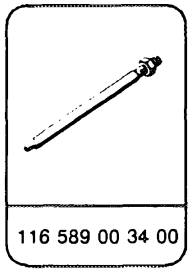


Sealing plug (13)	remove (Numbers 1 and 2).
Joggle plate	Part No. 102 589 14 15 00 bolt up, unbolt (Number 3).
Oil spray nozzle (66b and 66c).	drive home up to stop (Number 4).
Idler gear shaft	install (05-412).
Timing case cover	install (01-210).
On engine	change oil and filter.
When engine is running	check for leaks.

Special tools

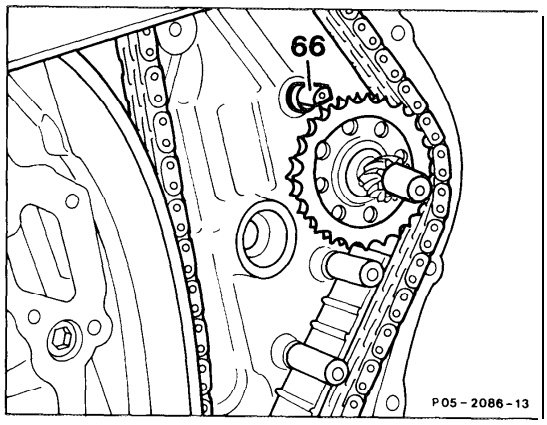

102 589 14 15 00


116 589 20 33 00


116 589 00 34 00

Note

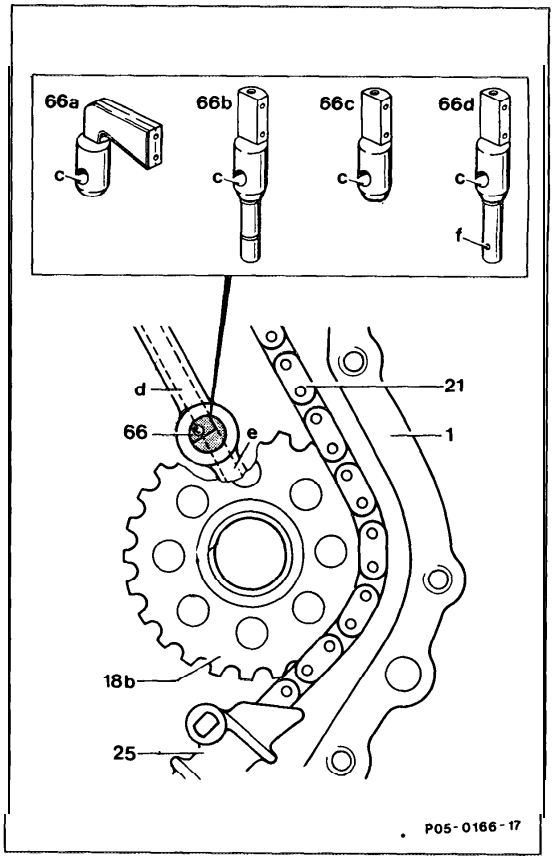
In order to achieve better lubrication of the timing chain, an additional oil spray nozzle (66) has been fitted in the front face of the main oil channel. This oil spray nozzle, can be installed retroactively. The retroactive installation should only be carried out, when for example the timing case cover has already been removed for other work.



Production breakpoint of the various designs

Injection engines

66a 1st design March to April and May 1986
66b 2nd design November 1986 to July 1987
66c 3rd design July 1987



Production breakpoint: March - April 1986
(Injection engines 1st design)

Model	Engine	Engine end No. Man. transm.	Engine end No. Autom. transm.
201.024 (USA)	102.985	003626-003670	**033140-033543**

Production breakpoint: May 1986
(Injection engines 1 st design)

Model	Engine	Engine end No. Man. transm.	Engine end No. Autom. transm.
201.024 (USA)	102.985	00381 **I-003828**	**03521 o-035424**

Production breakpoint: November 1986
(Injection engines 2nd Design)

Model	Engine	Engine end No. Man. transm.	Engine end No. Autom. transm.
201.028	102.985	007099	045782

Production breakpoint: July 1987
(Injection engines 3rd Design)

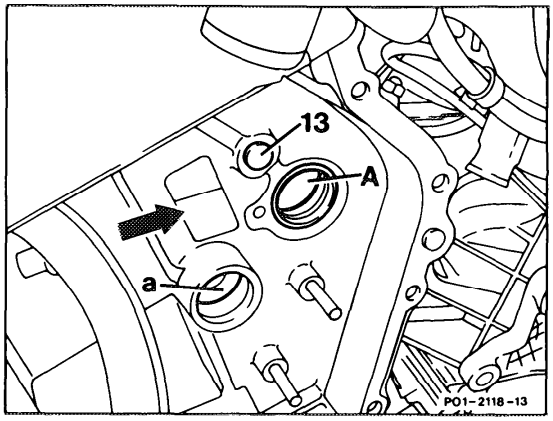
Model	Engine	Engine end No. Man. transm.	Engine end No. Autom. transm.
201.028	102.985	015733	057671

Installation

1 Remove sealing plug (13), to do this drill a core hole (5 mm Ø, 10 mm deep).

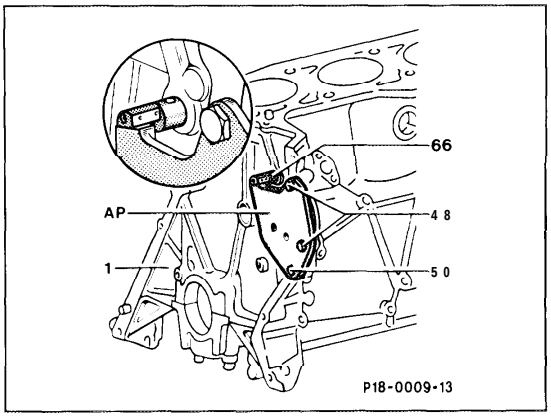
Note

Carefully cover oil channel (a), bearing bore (A) and window (arrow).



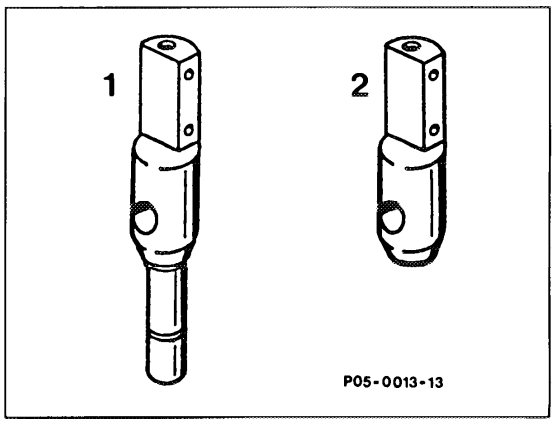
2 Unscrew sealing plug with impact extractor 116 589 20 33 00 and stud 116 589 00 34 00

3 Attach joggle plate (AP) 102 589 14 15 00 with two hexagon bolts M8 x 15 (48).



1 Cylinder crankcase
48 Fixing bolts
50 Straight pin (guide for timing case cover)
66 Oil spray nozzle
AP Joggle plate

4 Select correct oil spray nozzle (carburettor or injection engine) and drive home the cylinder crankcase up to the stop. The correct fitting position of the oil spray nozzle is achieved when this is laid on the joggle plate, as shown in Figure (Number 3).



1 Carburettor engines (non-US)
2 Injection engines

5 Detach joggle plate.

6 Install idler gear shaft (05412).

7 Install timing case cover (01-210).

8 Change engine oil and filter.

9 Check for leaks when engine is running.

Parts required	Part No.
Oil spray nozzle	102 180 09 43 (Carburettor engine) 102 180 08 43 (Injection engine)

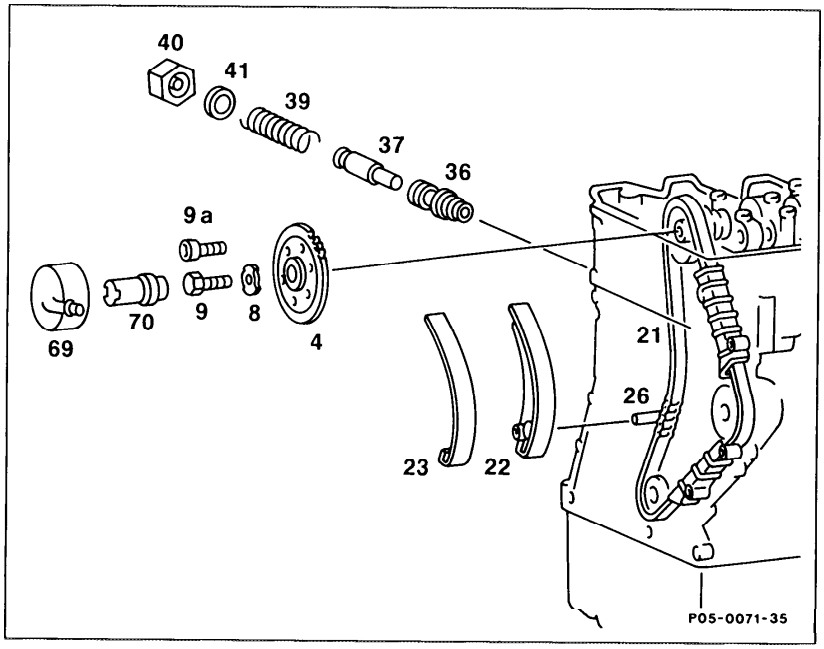
Standard Text and flat rates

Install oil spray nozzle for timing chain (Idler gear shaft removed)	02-0367/01	Related work, 5 flat rates or 0.4 hours

The operation number is to be placed in front of the book/column number.

05-330 Removal and installation of tensioner blade

Preceding work:
Timing case cover removed (01-210).



Timing chain (21) and crankshaft gear	mark (Number 1).
Timing chain and camshaft timing gear (4)	mark (Number 2).
Chain tensioner (36 to 41)	remove, install (05310).
Oil pressure pump (69)	unbolt, bolt up, put to one side with lines connected (Number 4).
Camshaft timing gear (4)	unbolt, bolt up, 80 Nm (Number 5).
Tensioner blade (22)	remove from bearing bolt, put on.

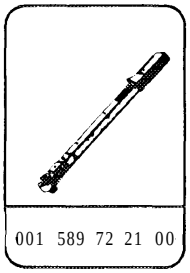
Note

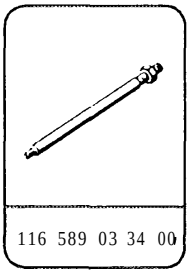
On double roller chain, spot drill bearing pin (26) and drive out with the impact extractor 115 589 12 33 00. Install new tensioner blade with bearing pin (Numbers 7 and 9).

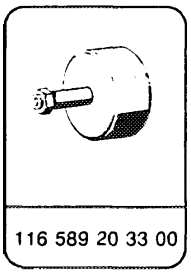
Plastic support (23)	check, possibly renew (Number 8).
Camshaft adjustment	check (Number 11).

Special tools


001 589 66 21 00


001 589 72 21 00

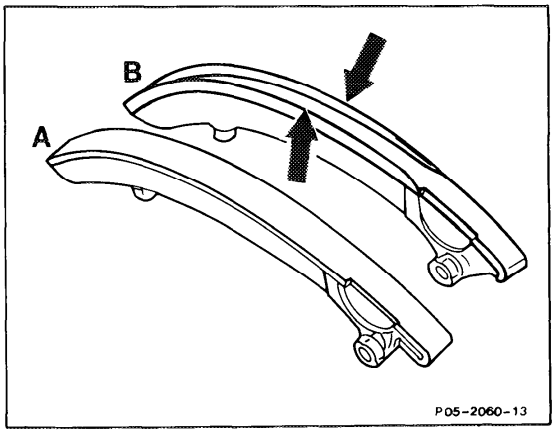

116 589 03 34 00


116 589 20 33 00

Note

In order to achieve better guidance of the timing chain, the plastic support has lateral guide bars (arrows). The plastic support is also fixed differently; in this way the support is prevented from slipping off the tensioner blade.

A Former design
B Current design

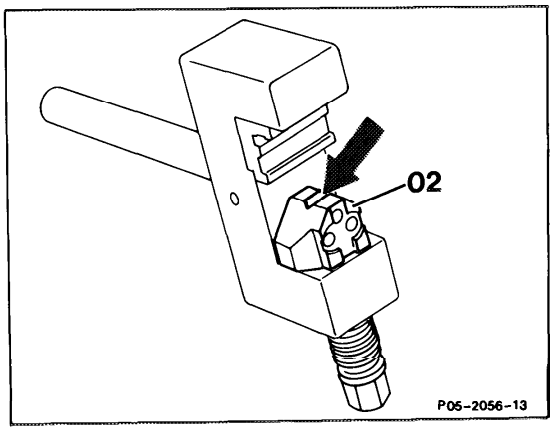


Production breakpoint: August 1986

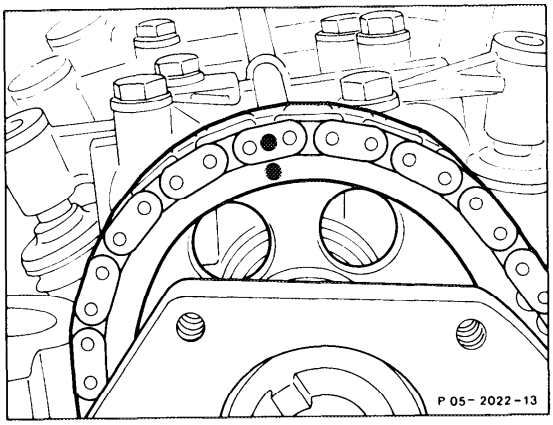
Model	Engine	Engine end No. Man. transmission	Engine end No. Auto. transmission	Vehicle chassis end No.	
				A	F
201.023	102.924	026699	006810	325157	268097
201.024	102.962	102052	051653		268146
201.024 (USA)	102.985	004185	039295		266691

Removal and installation

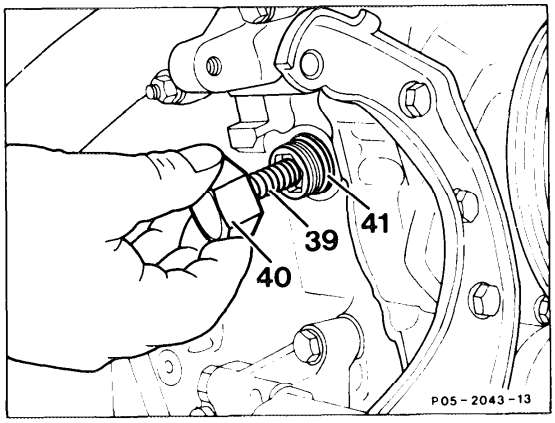
1 Align timing chain and crankshaft gear.



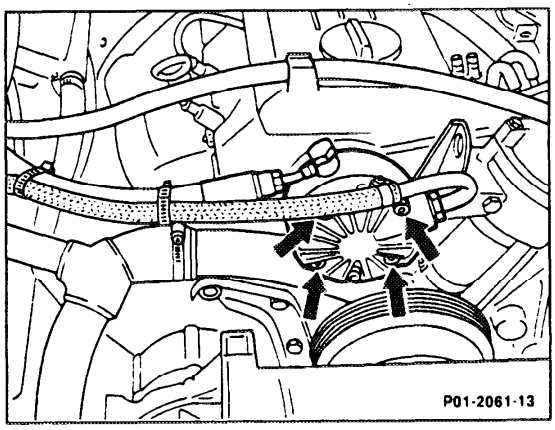
2 Align timing chain and camshaft timing gear.



3 Remove chain tensioner (05-310).



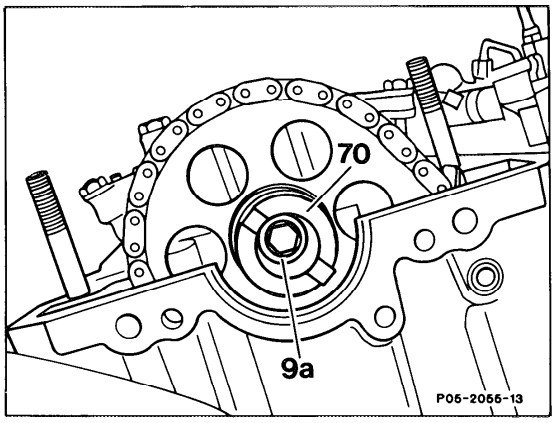
4 Unbolt oil pressure pump with lines connected (arrows) and put to one side.



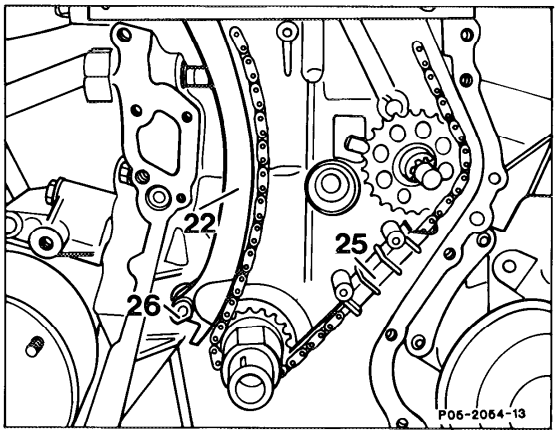
5 Unbolt, bolt up camshaft timing gear, bolt (9a), tightening torque 80 Nm. Note color markings on camshaft timing gear and crankshaft gear.

Note

On vehicles with oil pressure pump remove driving disc sleeve (70).

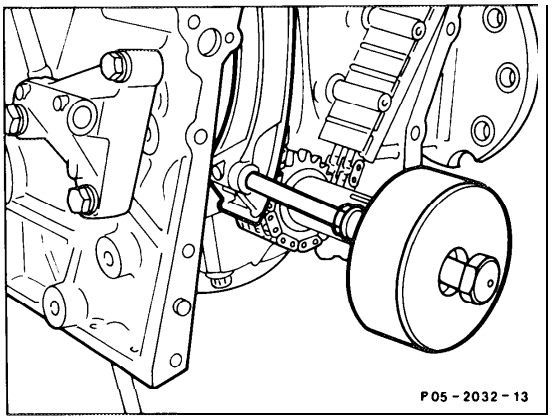


6 Swing tensioner blade (22) for single roller chain inwards and remove from bearing pin (26), install.

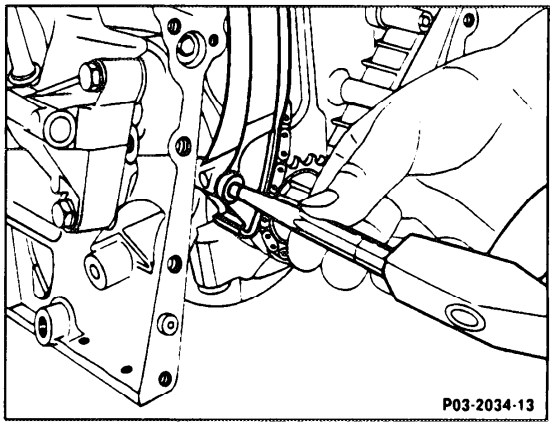


7 On engines with double roller chain, drive out bearing pin (26) of the tensioner blade with the impact extractor 116 589 20 33 00 and extension 116 589 03 34 00. To do this cut an M6 thread approx. 10 mm deep on the bearing pin. Remove tensioner blade.

8 Check plastic support for wear, replace if necessary.



9 Insert new tensioner blade and drive home bearing pin up to stop.

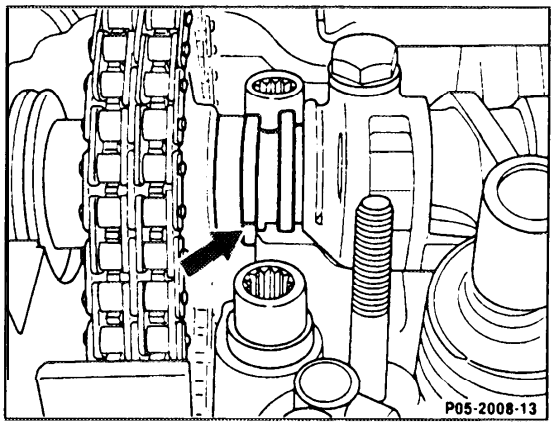


10 Install chain tensioner (05-310).

11 Turn crankshaft and check adjusting marking at TDC position of engine.

12 The installation proceeds in the reverse sequenceas removal.

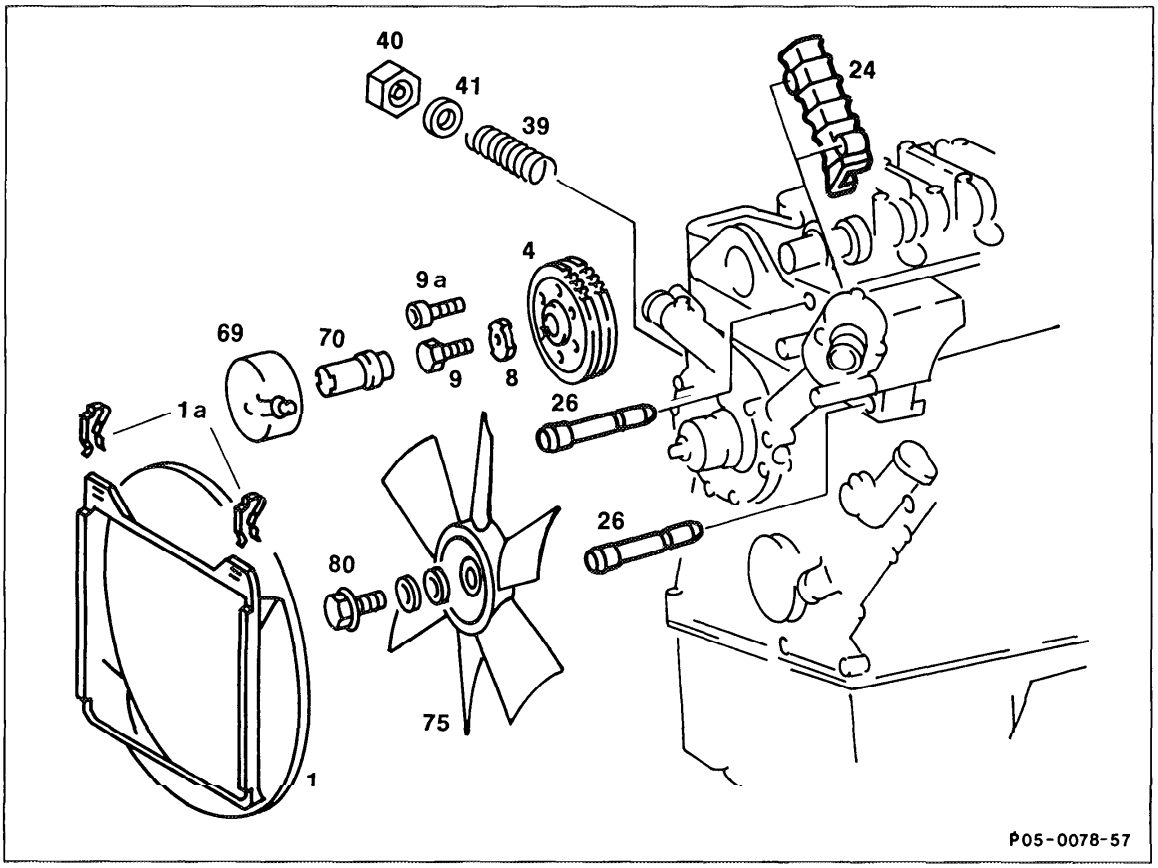
13 Run engine, check for leaks.



05-340 Removal and installation of guide rails

A. Guide rail (24) in cylinder head

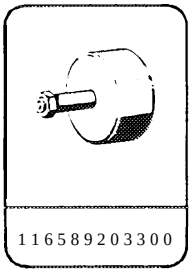
Preceding work:
Air cleaner removed (09-400 and 09-410).
Cylinder head cover removed (01-460).

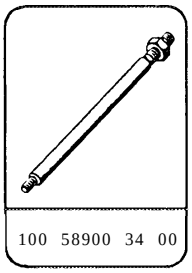


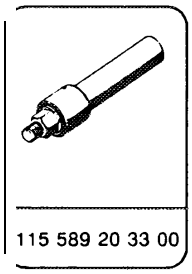
Chain tensioner (39 to 41)	. . . . .	remove, install 70 Nm (Number 1).
Fan shroud (1) and fan (75)	. . . . .	remove, install, bolt (80), 25 Nm (Number 2).
Piston of No. 1 cylinder	. . . . .	position on ignition TDC (Number 3).

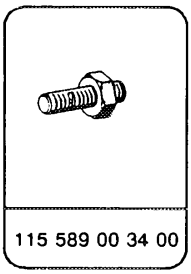
Oil pressure pump (69)	.....	unbolt, bolt up, put to one side with lines connected (Number 4).
Timing chain and camshaft timing gear (4)	....	align and unbolt, bolt (9 and 9a), 80 Nm (Number 5).
Guide rail bolt (26)	.....	extract, with impact extractor 116 589 20 33 00 and stud 100 589 00 34 00, drive home **Note** Insert guide rail bolt with sealant 001 989 25 20. Note that the fixing nose on the guide rail engages in the guide rail bolt (Numbers 6 and 7).
When engine is running	....	check for leaks.

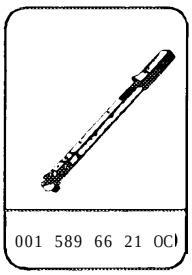
Special tools

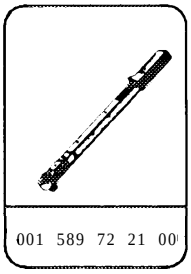






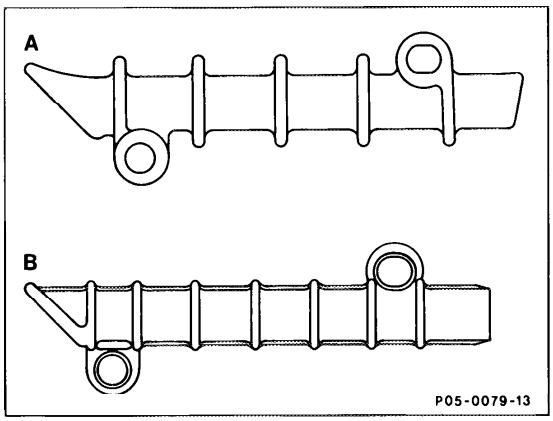






Note

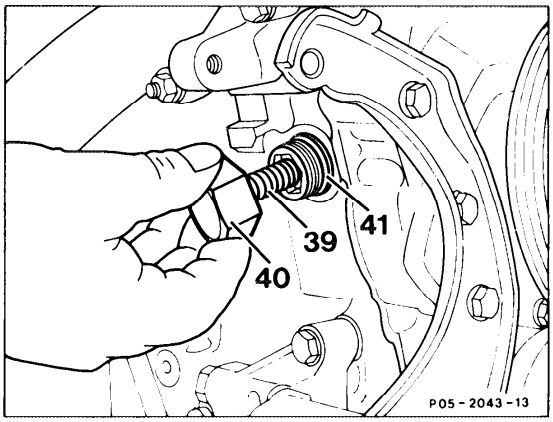
The guide rails have been changed with the introduction of the double roller chain.



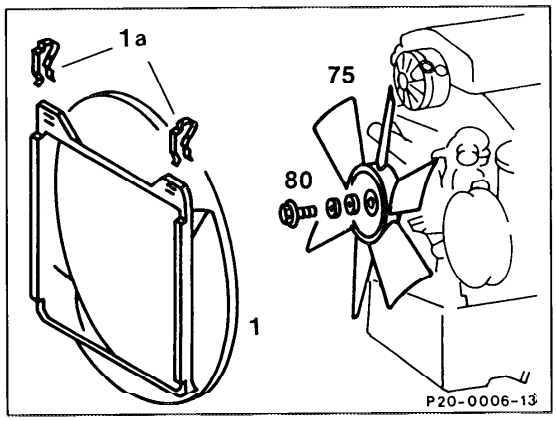
A Guide rail for single roller chain
B Guide rail for double roller chain

Removal and installation

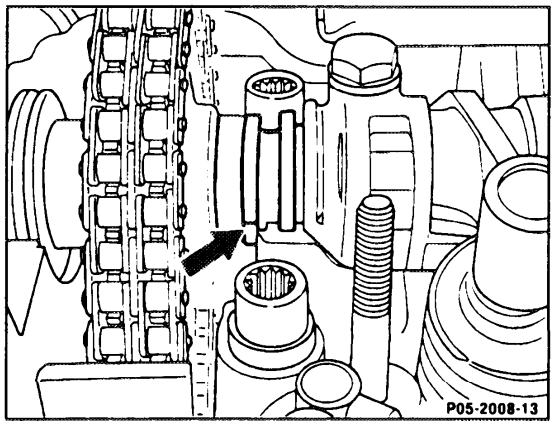
1 Removal and installation of chain tensioner (05310). Tightening torque of hexagon cap nut (40) 70 Nm.



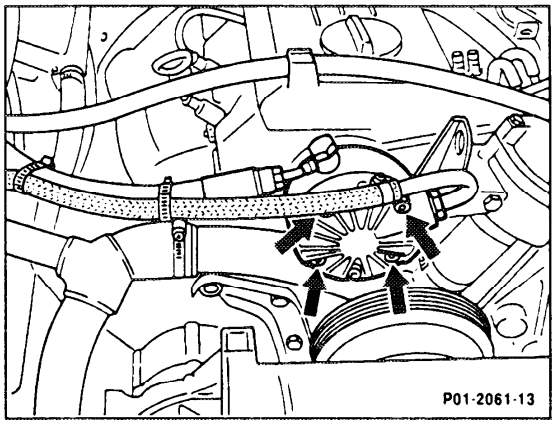
2 Remove fan shroud (1) and fan (75). Tightening torque of bolt (80) 25 Nm.



3 Position piston of No. 1 cylinder on ignition TDC.



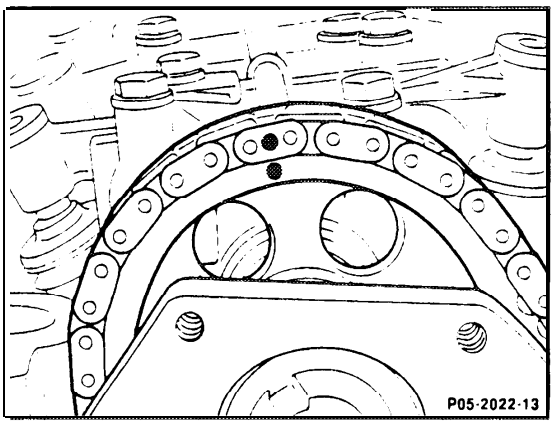
4 Unbolt oil pressure pump with lines connected (arrows) and set to one side.



5 Align timing chain and camshaft timing gear. Unbolt camshaft timing gear and remove sprocket.

Note

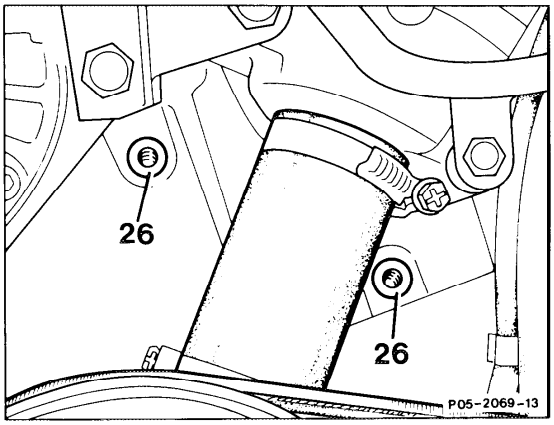
When installing the sprocket note color markings. Tightening torque of set bolt 80 Nm.

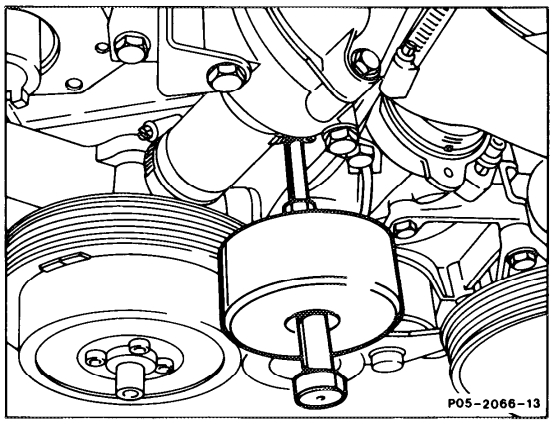


6 Withdraw both guide rail bolts (26) with impact extractor 116 589 20 33 00 and stud 100 589 00 34 00.

Note

If the guide rail bolts are too tight, the extractor 115 589 20 33 00 with stud 115 589 00 34 00 can also be used.





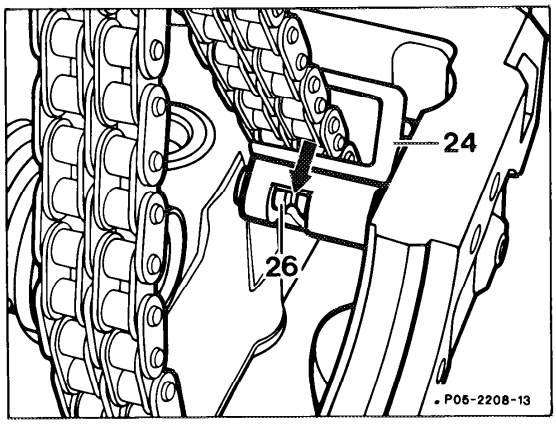
Impact extractor in place

7 Install guide rail (24) so that the locating lug (arrow) engages in the groove of the upper guide rail bolt.

Note

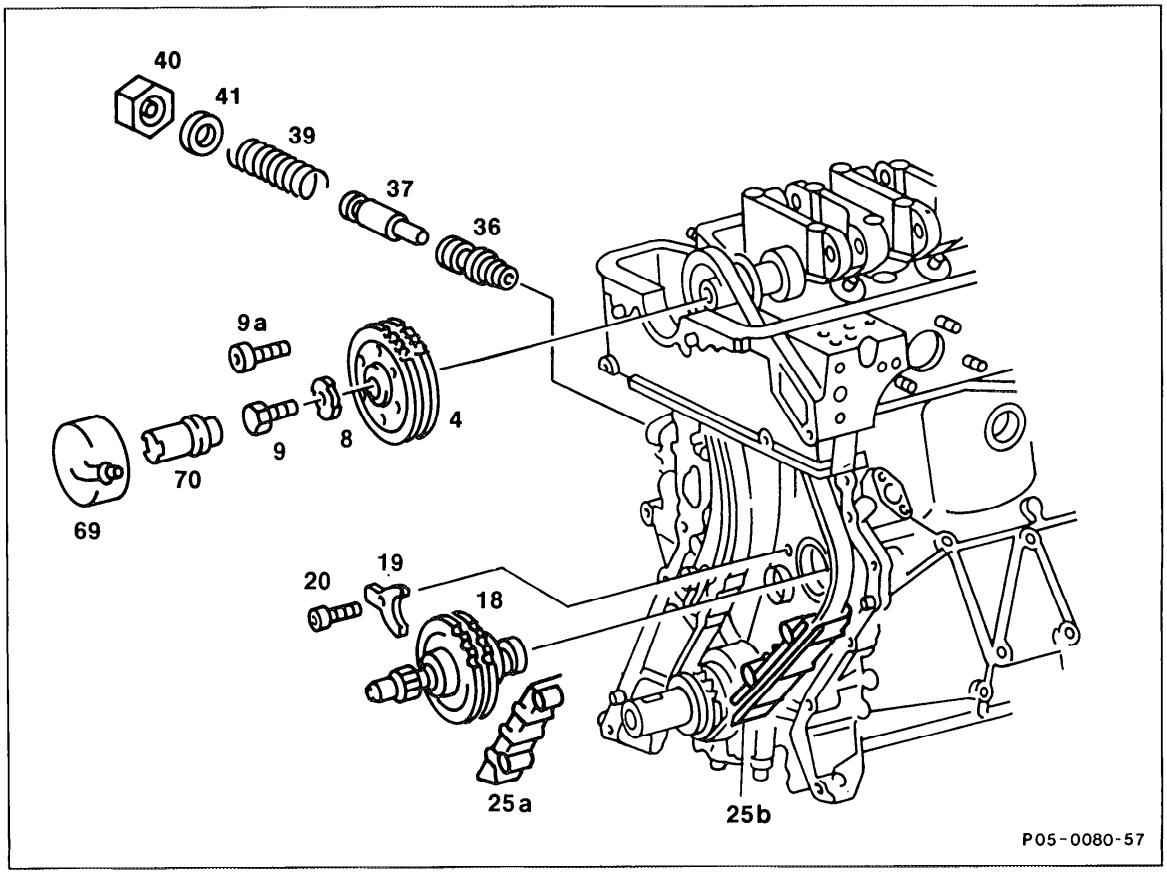
Apply sealant 001 989 25 20 at collar of guide rail bolts.

8 Check for leaks when engine is running.



B. Guide rail in cylinder crankcase

Preceding work:
Timing case cover removed (01-210).



a. With single roller chain

Guide rail (25a, single roller chain)	remove, put on (Number 1).

b. With double roller chain

Piston of No. 1 cylinder	position on ignition TDC (Number 2).
Oil pressure pump (69)	unbolt, bolt up, put to one side with lines connected (Number 3).
Chain tensioner	remove, install (05310).

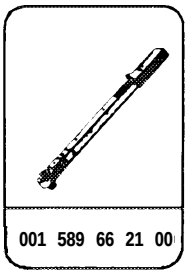
Timing chain and camshaft timing gear (4)	align and unbolt, (9 and 9a), 80 Nm (Number 5).
Timing chain and crankshaft gear	align (Number 6).
Bolt (20)	unscrew, remove clip (19) and idler gear shaft (18) (Numbers 7 and 8).
Timing chain with crankshaft gear	pull forward as far as possible, remove and fit guide rail (25b) (Number 9).

Note

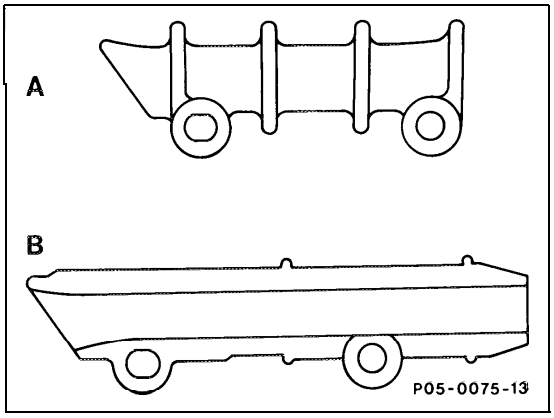
When pushing back the crankshaft gear, and the timing chain, note the positioning pin in the camshaft flange and alignment of timing chain to tension lever.

Idler gear shaft (18)	install, bolt (20), 5 Nm (Number 10).
Further installation	in reverse sequence.
When engine is running	check for leaks.

Special tool



Note
The guide rails have changed with the introduction of the double roller chain.

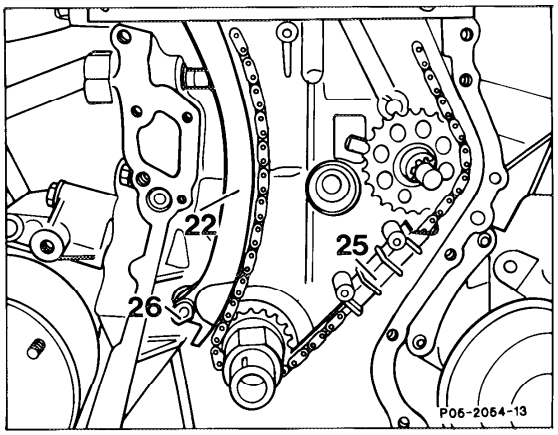


A Guide rail for single roller chain
B Guide rail for double roller chain

Removal and installation

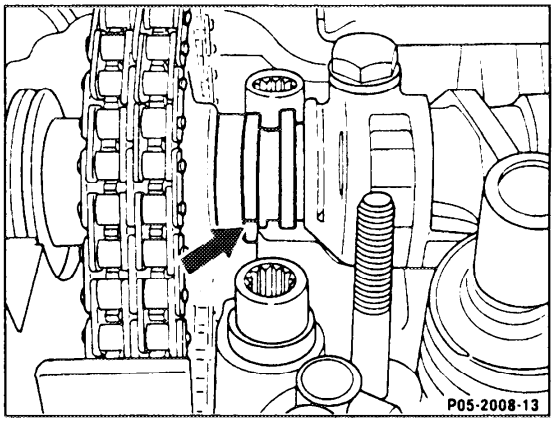
a. With single roller chain

1 Pull off guide rail (25), install.

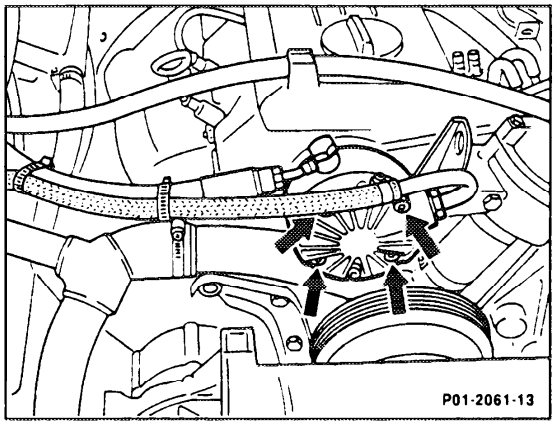


b. With double roller chain

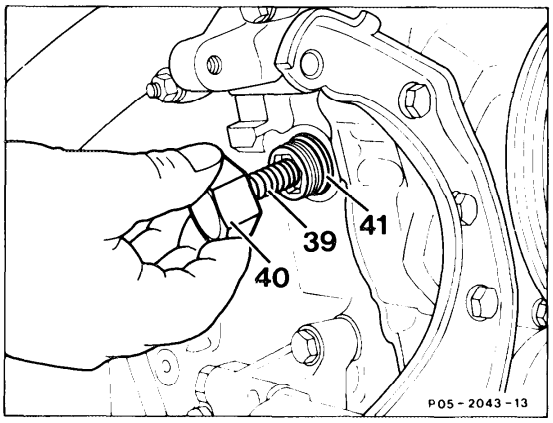
2 Position piston of No. 1 cylinder on ignition TDC.



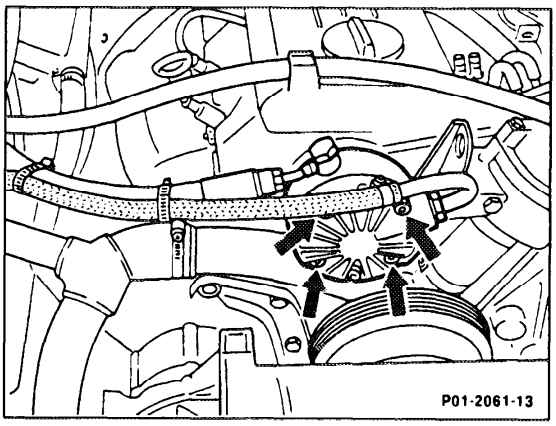
3 Unbolt, bolt up oil pressure pump (arrows) and put to one side with lines connected.



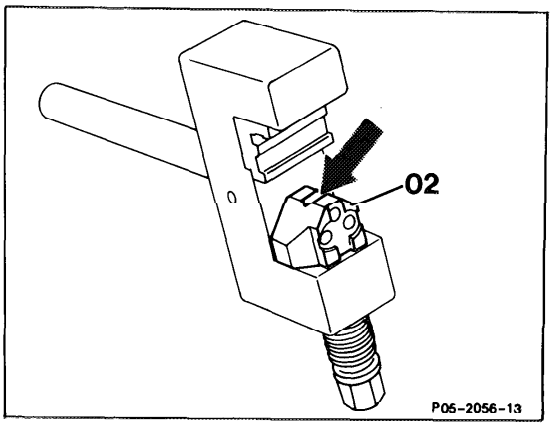
4 Remove chain tensioner (05-310).



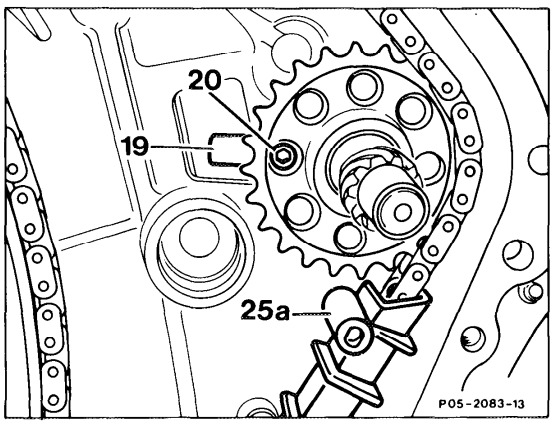
5 Align timing chain and camshaft timing gear and unbolt camshaft timing gear. Put timing chain in timing case.



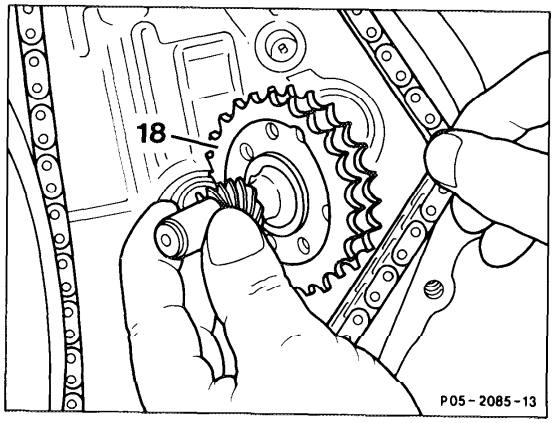
6 Align timing chain and crankshaft gear.



7 Unscrew bolt (20) and remove retaining clip (19).



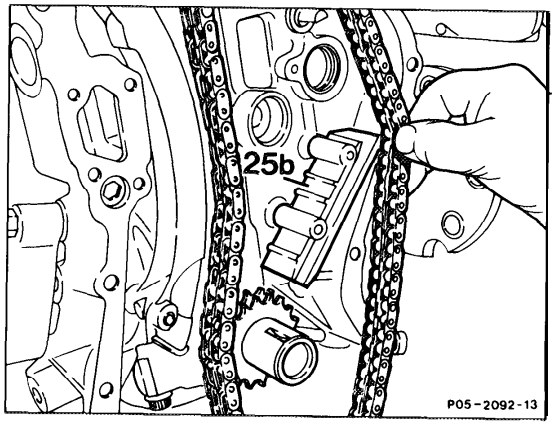
8 **Pull** out idler gear shaft (18) and remove timing chain.



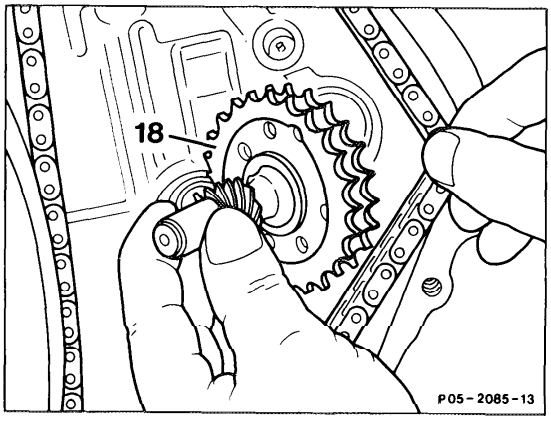
9 Remove, install, pull timing chain and crankshaft gear forward as far as possible and remove guide rail (25b). Put on timing chain and push back crankshaft gear together with timing chain.

Note

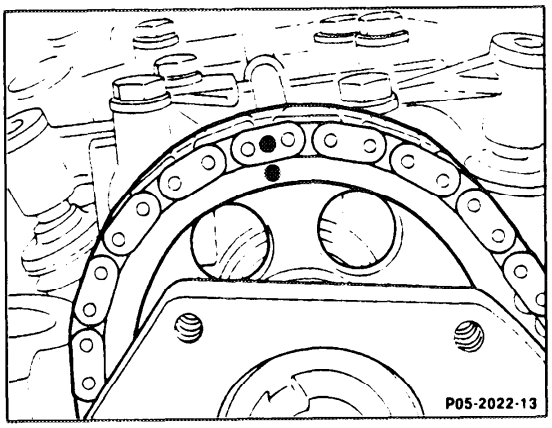
When pushing back the crankshaft gear, note the positioning pin in the camshaft timing gear flange and the color marking.



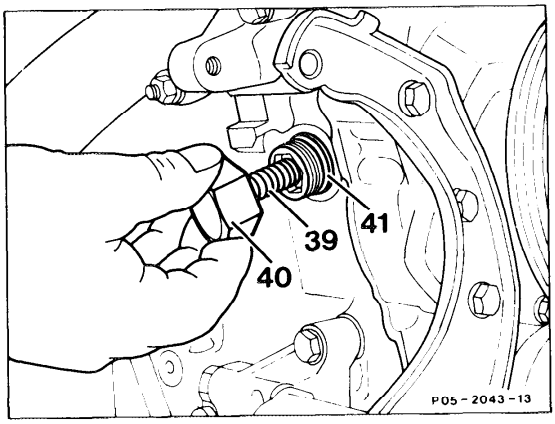
10 Install idler gear shaft, tightening torque of the hexagonal socket screw (20) 5 Nm (reference value).



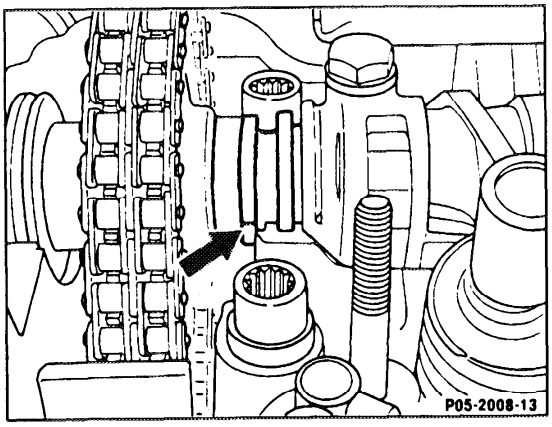
11 Install timing chain and camshaft timing gear, note marking. Tightening torque of camshaft timing gear set bolt 80 Nm.



12 Install chain tensioner (05-310). Tightening torque of sealing plug (40), 70 Nm.



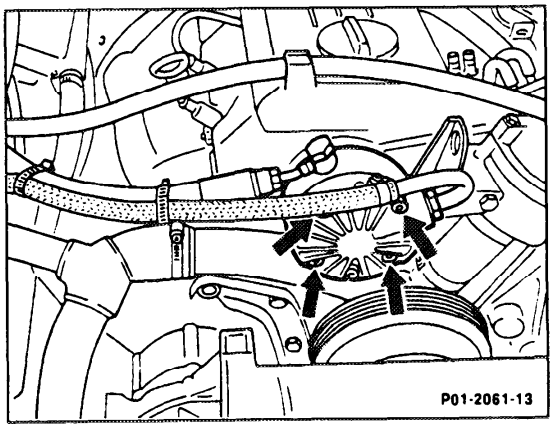
13 Check adjustment marking of camshaft (arrow) at ignition TDC position of engine, correct if necessary.



14 Install oil pressure pump, in so doing note driving disc.

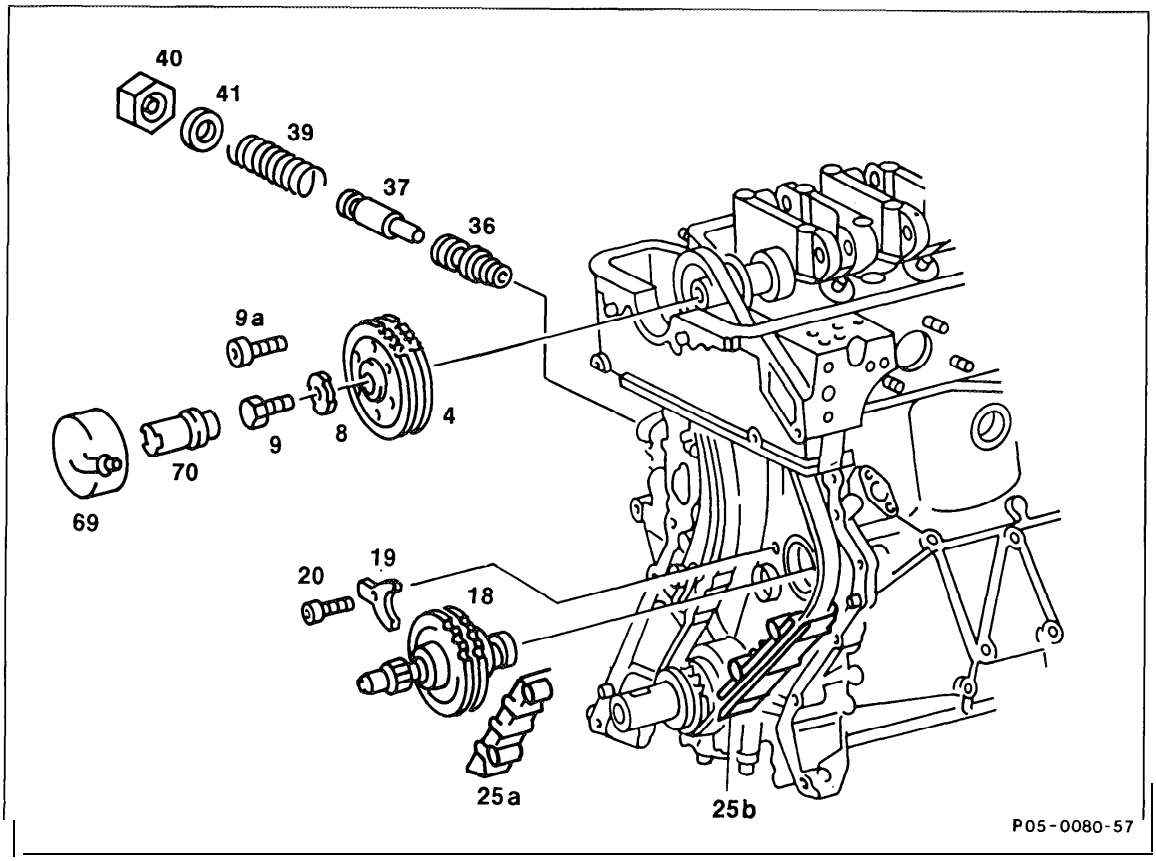
15 The installation is the reverse of removal.

16 Check for leaks when engine is running.



05-412 Removal and installation of idler gear shaft

Preceding work:
Timing case cover removed (01-210).
Fuel pump removed (07.2-212, only carburettor engines).



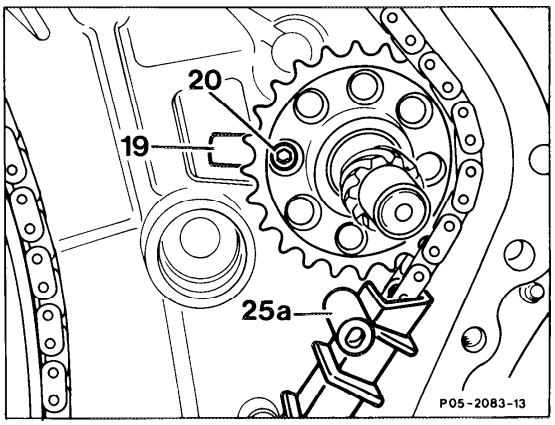
Chain tensioner (36 to 41)	remove, install (05-310).
Oil pressure pump (69)	unbolt, bolt up, set to one side with lines connected (Number 2).
Camshaft timing gear (4)	align with timing chain (Number 3).
Crankshaft gear	align with timing chain (Number 4).
Bolt (9 and 9a)	unbolt, bolt up and remove camshaft timing gear, 80 Nm. Note marking (Number 5).
Guide rail (25a)	remove, install (only on single roller chain, Number 6).

Hexagon socket bolt (20)	unbolt, bolt up, 5 Nm. Remove, install retaining clip (19) (Number 7).
Idler gear shaft (18)	withdraw from rear bearing and remove from timing chain, insert (Numbers 8 and 9).
When engine is running	check for leaks.

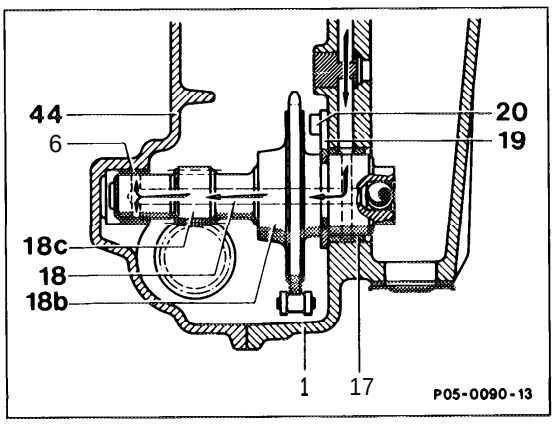
Special tool

Note

The idler gear (18b) is pressed on the idler gear shaft (18) supported on bearings in timing case cover and cylinder crankcase. It is fixed axially by a retaining clip (19) bolted on the cylinder crankcase, which engages in a groove on the idler gear shaft. The teeth for driving the ignition distributor (18c) are located behind the front bearing position.



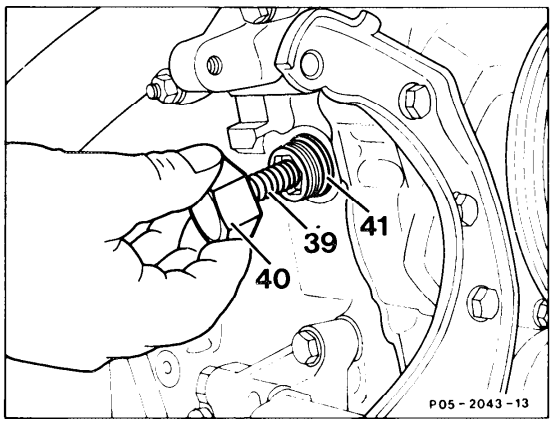
Arrangement of idler gear shaft Engines 102.985



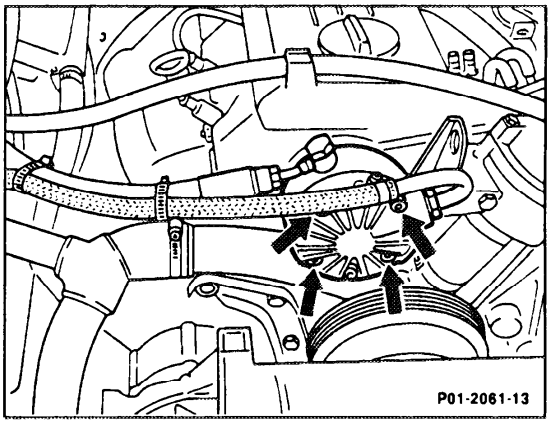
1 Cylinder crankcase
6 Bearing bush in timing case cover
17 Bearing bush in cylinder crankcase
18 Idler gear shaft
18b Idler gear
18c Teeth for ignition distributor drive
19 Retaining clip
20 Bolt M5 × 18 mm
44 Timing case cover

Removal and installation

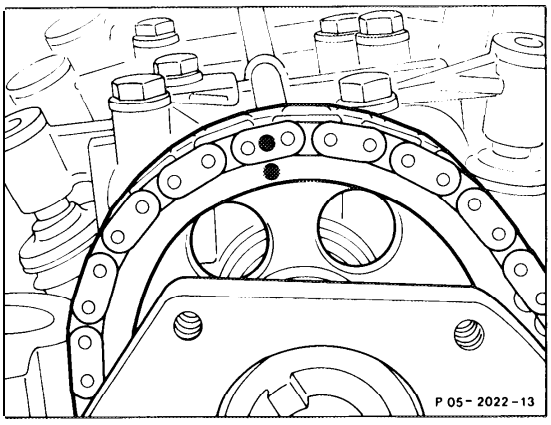
1 Remove chain tensioner (05-310).



2 Unbolt, bolt up oil pressure pump (arrows) and put to one side with lines connected.

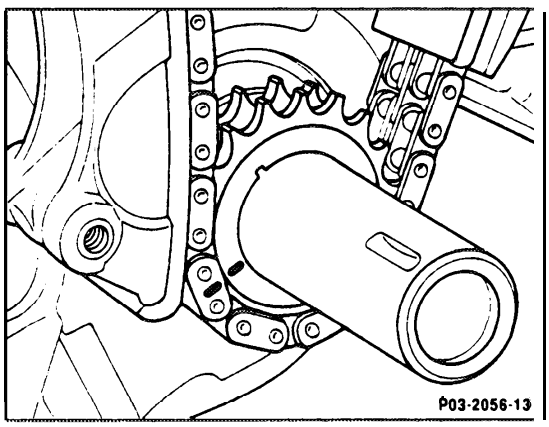


3 Align camshaft timing gear and timing chain.



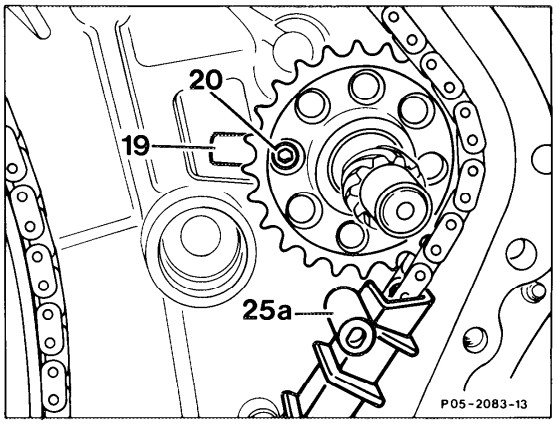
4 Align crankshaft gear and timing chain.

5 Unbolt camshaft timing gear and remove, put timing chain in timing case.



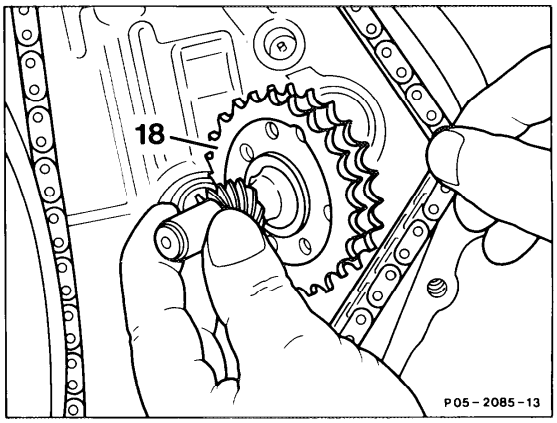
6 Remove guide rail (25a) (only on single roller chain).

7 Unbolt hexagon socket bolt (20) and remove retaining clip (19).



8 Remove idler gear shaft (18), install, in so doing raise timing chain somewhat.

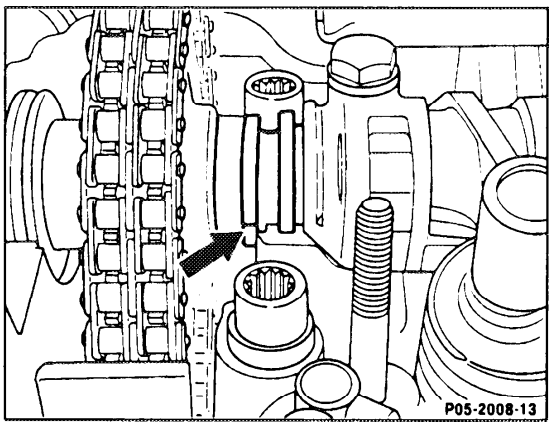
9 Install retaining clip (19) and secure with bolt (20), tightening torque 5 Nm (reference value).



10 Install guide rail (25a).

11 Assemble camshaft timing gear, at the same time noting colored markings, tightening torque 80 Nm.

12 Check adjustment marking of the camshaft (arrow) at ignition TDC position of engine, correct if necessary.



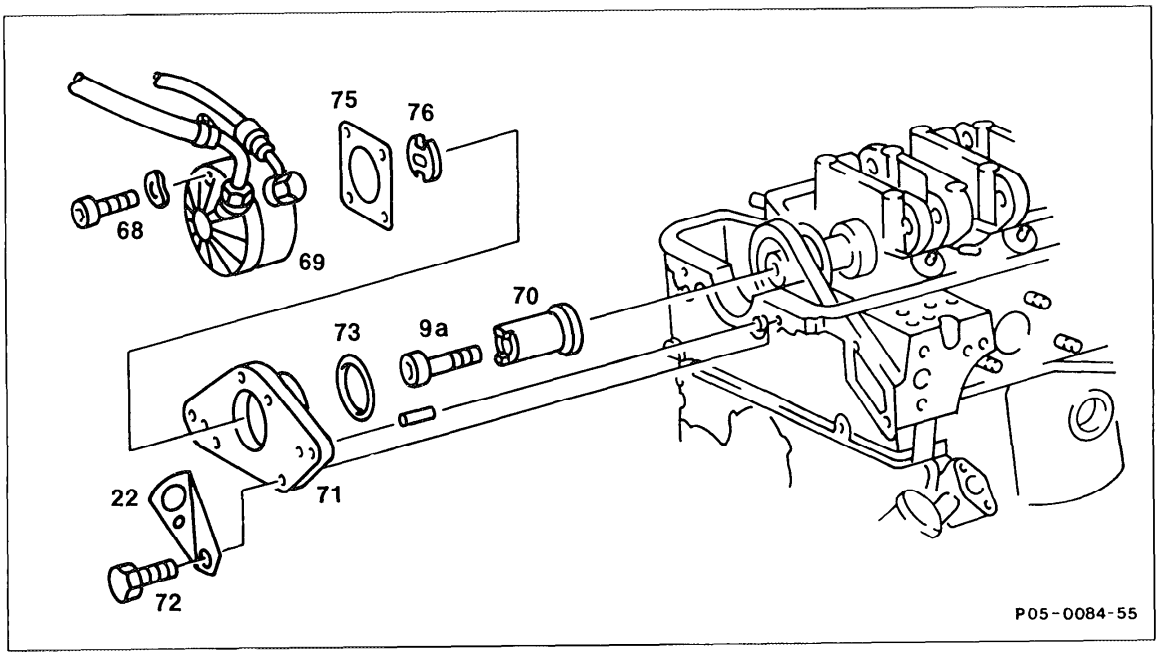
13 Install chain tensioner (05310).

14 The installation is the reverse of removal.

15 Check for leaks when engine is running.

05-437 Removal and installation of oil pressure pump drive

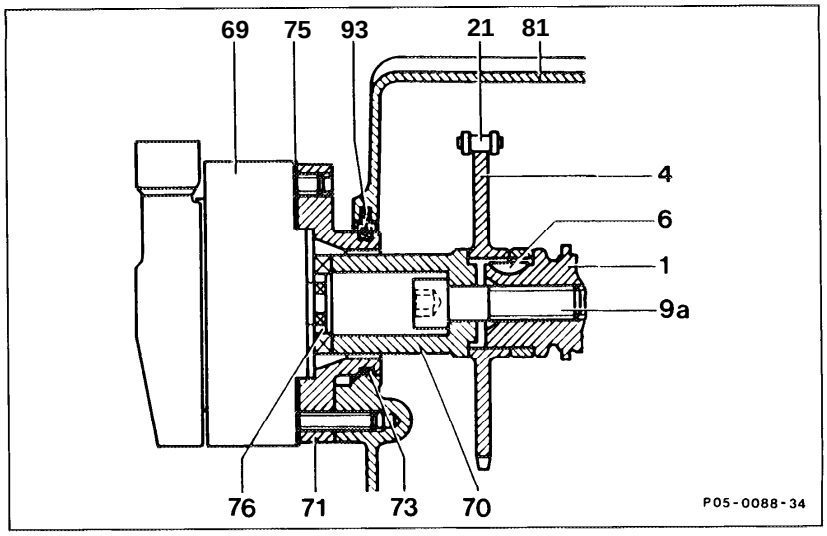
Preceding work:
Cylinder head cover removed (01-406).



Set bolts (68)	unbolt, bolt up, 15 Nm (Numbers 1 and 2).
Oil pressure pump (69)	remove together with driving disc (76). On Model 201 set oil pressure pump with lines connected to one side.
Gasket (75)	renew.
Driving disc (76)	remove, install.
Flange (71)	unbolt, bolt up, with attachment eye (22), 25 Nm (Number 4).
O-Ring (73)	replace.
Hexagon socket bolt (9a)	unbolt, bolt up, 80 Nm. Remove, install driving disc sleeve (70) (Number 5).

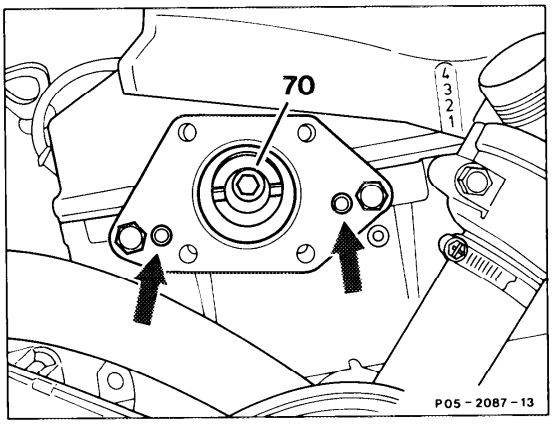
Special tools

1 Camshaft
4 Camshaft timing gear
6 Woodruff key
9a Hexagon socket bolt
21 Timing chain
69 Oil pressure pump
70 Driving disc sleeve
71 Flange
73 O-Ring
75 Gasket
76 Driving disc
81 Cylinder head cover
93 Cylinder head cover gasket



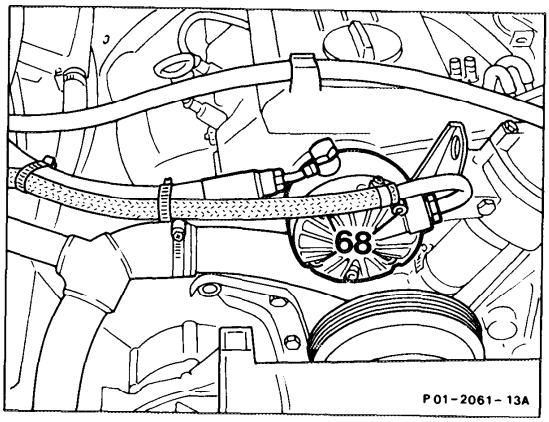
Note

The oil pressure pump (69) is driven directly by the camshaft **(1)** via the driving disc sleeve **(70)** and the driving disc (76) and is attached to the cylinder head by a flange **(71).** The fitting position of the flange on the cylinder head is fixed by two straight pins (arrows). The camshaft timing gear (4) is attached to the camshaft with the driving disc sleeve (70) and the hexagon socket screw (9a). The O-Ring (73) on the flange **(71)** seals the front semicircular bore in the cylinder head and in the cylinder head cover (81).



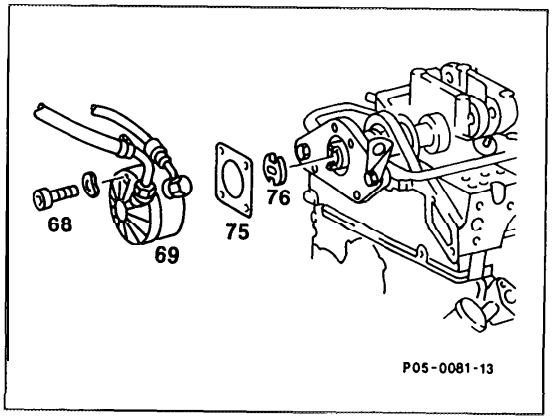
Removal and installation

1 On Model 201 remove bolts (68), remove oil pressure pump and set to one side with lines connected.

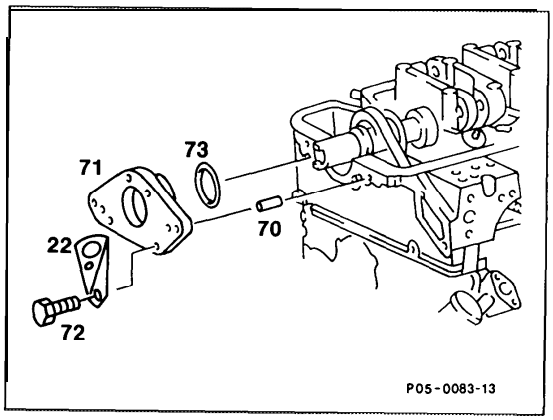


Model 201

2 Remove, install driver (76). Replace gasket (75).



3 Unbolt, bolt up flange (71) together with the attachment eye (22), renew O-Ring (73). Tightening torque of bolts (72) 25 Nm. Note both dowels (70).



4 Unscrew hexagon socket bolt (9a) and remove, insert driver sleeve (70), tightening torque 80 Nm.