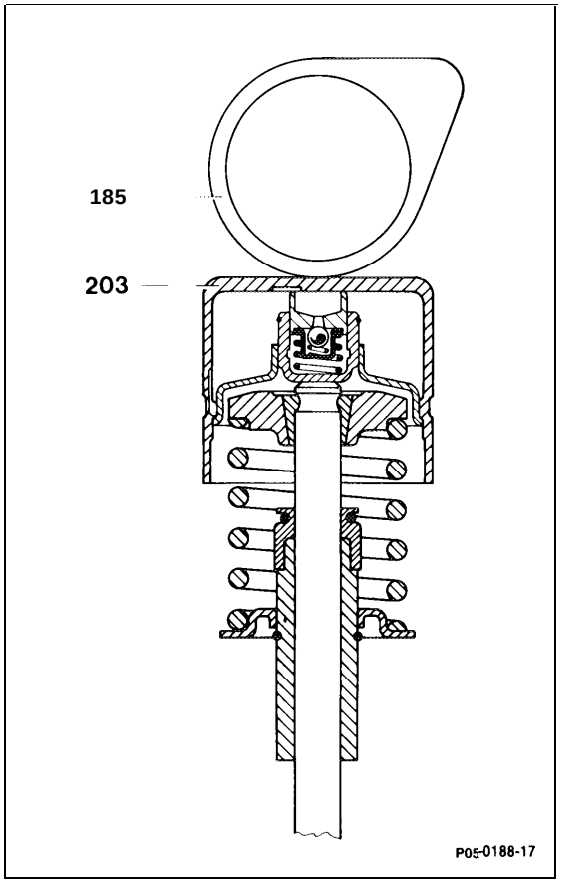
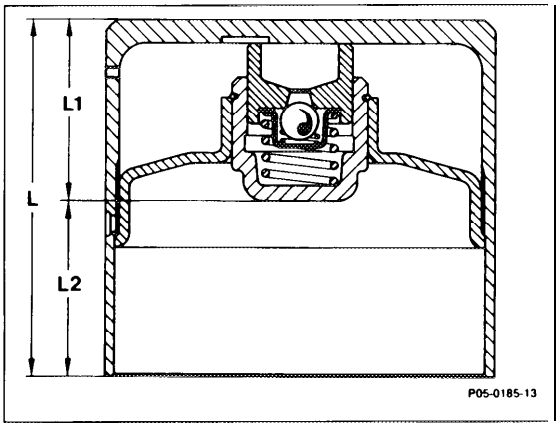
Engine thing, valves

Job No.

05-211 Checking and renewal of hydraulic valve clearance compensating elements





Engine	bring to operating temperature (80°C).
Engine oil level	check.

Caution!
Do not overfill.

Turbo engine:

Charge air pipe	remove, install.
Cylinder head cover	remove, install, 10 Nm.
Valve tappet (203)	check with a mandrel, to do this first check on the cylinder which is exactly on Ignition TDC (cam tips for inlet and exhaust valve point upwards).

Caution!
Unnecessary rotation of the engine causes the valve clearance compensating elements to sink.

A valve clearance compensating element must only be removed when an air gap >0.4 mm is established between cam and element. The engine must not be turned by the camshaft timing gear bolt.

If the valve tappet sinks quicker than the others, measure pre-stroke.

Pre-stroke . . . . . measure, reference value: 0.25 - 2.0 mm (Numbers 6 - 10).

With excessive pre-stroke:

Valve tappet (203) . . . . . remove, install in the same position again, magnetic lifter 102 589 02 61 00.

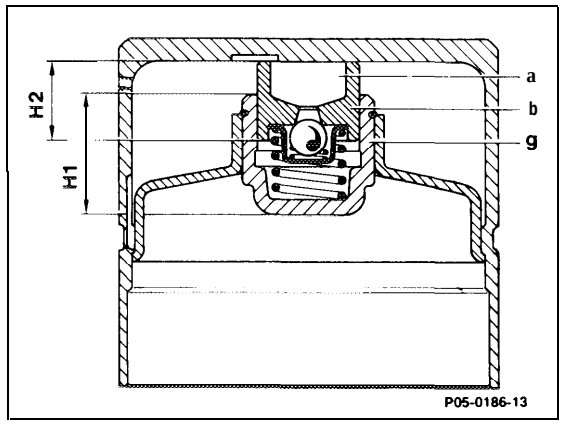
Dimension L1 . . . . . determine. The dimension L1 is the difference between the dimensions L and L2. Reference value 18 - 19 mm (Number 12 - 14).

Parts of the valve tappet . . . . . clean. The valve tappet must be replaced if oil loss cannot be eliminated.

Data	1st Design	2nd Design from 08 84	3rd Design from 01 90
Plunger "b" dimension H 2 (mm)	8.0	8.6	9.1
Guide sleeve "g" dimens. H 1 (mm)	12.5	13.2	13.2

Note

Hydraulic valve clearance compensating elements have been fitted with a larger oil reservoir chamber since the start of production on engines 602 and 603.

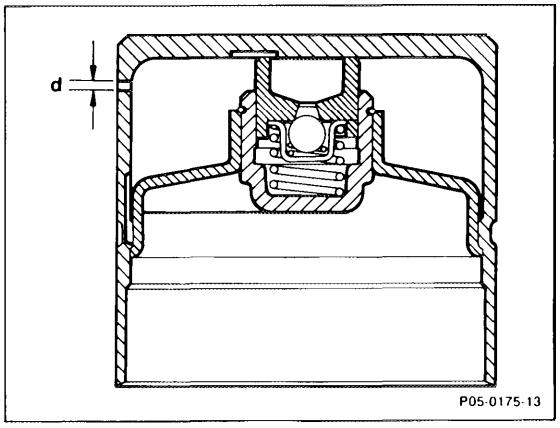


a Storage chamber

Break date: **08/84**

Model	Engine	Engine end No. Manual transmission	Engine end No. Automatic transmission	Vehicle identification end No. A	Vehicle identification end No. F
201.122	601.921	001712	004503	104388	028653

From 09/87 valve tappets have been installed with a ventilation bore (d = 0.2 mm), in order to prevent tappet rattle during short distance operation.



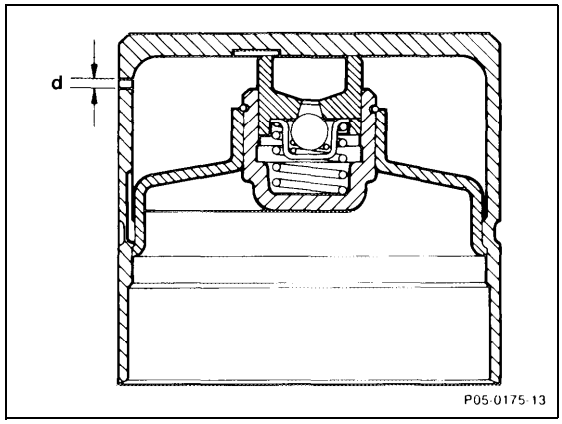
a Reservoir chamber
b Plunger
c Working chamber

Production breakpoint: **09/87**

Model	Engine	Engine end No.		Vehicle identification end No.	
		Manual transmission	Automatic transmission	A	F
124.133 124.193	603.960	–	013998	*	*
124.133	603.960	–	000433	*	*
201.126	602.911	050700	011065	*	*
201.128	602.961	–	001542	*	*

* not recorded

From 01/90 revised valve clearance compensating elements have been installed. These compensating elements have a reduced residual stroke, i.e. the stroke of the plunger (b) and the working chamber (c) have been reduced and the reservoir chamber (a) enlarged.
Less oil is needed in the working chamber due to the reduced stroke. Therefore the working chamber fills up more quickly after initial engine starting.



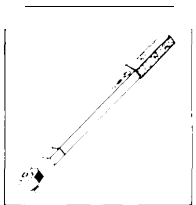
Production breakpoint: 01/90

Model	Engine	Engine end No.		Vehicle identification end No.	
		Manual transmission	Automatic transmission	A	F
124.128	602.962	001938	004158	*	*
124.133 124.193	603.960	–	025508	*	*
126.135	603.970	–	000057	*	*
201.126	602.911	087710	017102	*	*
201.128	602.961	001314	007602	*	*

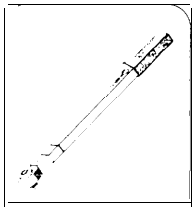
* not recorded

Tightening torque	Nm
Hexagon bolts for cylinder head cover	10

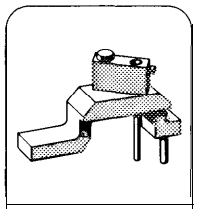
Special tools



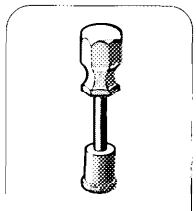
001 589 72 21 00
00



001 589 66 21 00
00



601 589 08 21 00
05



102 589 03 40 00
05

Conventional tool

Dial gauge	e. g.	Mahr D-7300 Esslingen Part No. 810

Checking

1 Run engine to operating temperature (80°C).

2 Check engine oil level, making absolutely sure it is not overfilled.

Turbo engine:

3 Remove charge air pipe.

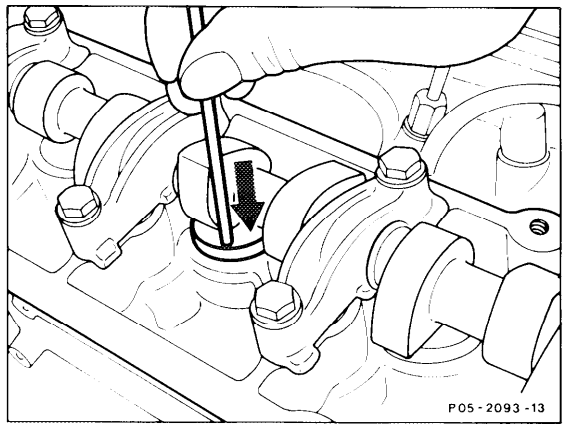
4 Remove cylinder head cover.

Caution!

Turning the engine unnecessarily causes valve play compensating elements to sink.
The engine must not be turned by the camshaft timing gear bolt.

5 First check the cylinder which is exactly on TDC. (Cam tips for inlet and outlet valves point upwards).

6 In order to check with a mandrel press lightly on the valve clearance compensating element and thus check the clearance. Continue turning the engine until the next cylinder in the firing order can be checked.
A valve clearance compensating element must only be replaced when a clearance of >0.4 mm is established between cam and element. If the valve tappet sinks quicker than the others, or has play at the cam base circle, the pre-stroke of the valve tappet must be measured.



Measuring pre-stroke

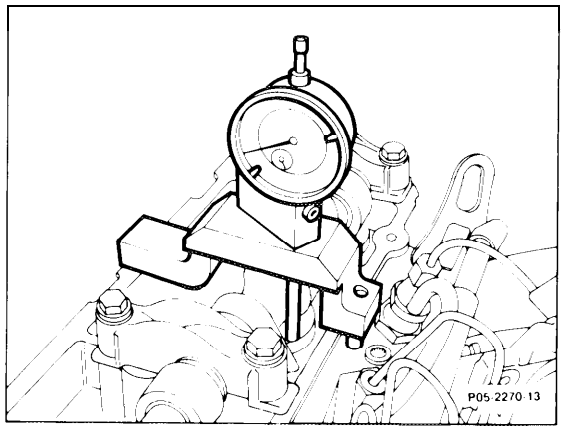
7 The basic setting of the dial gauge has to be undertaken before measurement. To do this insert the dial gauge in the measuring bridge 601 589 08 21 00 and push in until there is a preload of approx. 1 mm. The probe in the measuring bridge must be in the basic position (lower stop).

The basic setting must not be changed during measurement.

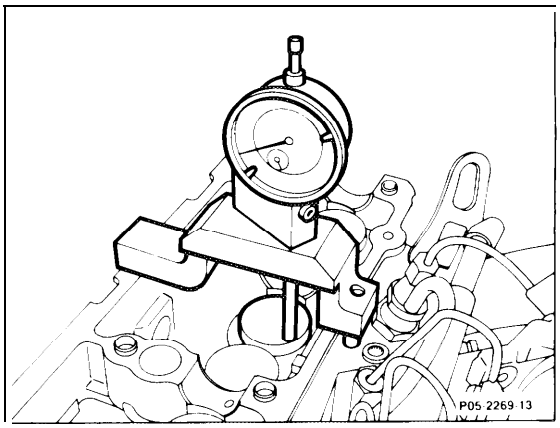
8 In order to measure and note dimension "X" (cylinder head mating surface to valve tappet), put measuring bridge on the cylinder head mating surface over the valve tappet.

Note

If required, measure dimension "X" on all valve tappets.



9 Remove camshaft (05220).



10 Measure dimension "Y" (cylinder head mating surface to valve tappet).

The difference between the dimension "X" and "Y" is the pre-stroke of the valve tappet.

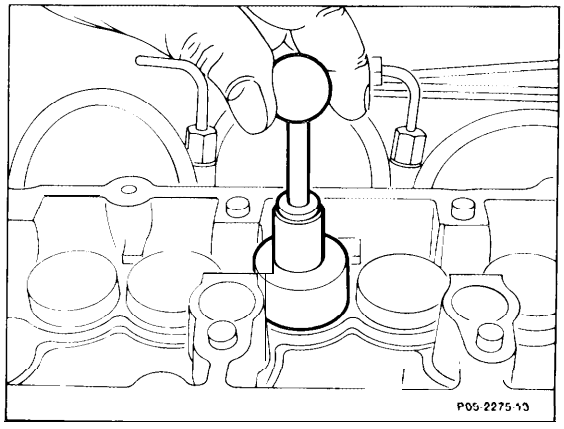
Reference value: 0.25 – 2.0 mm.

Example:

No. 1 Cylinder		A (exhaust)	E (Inlet)
Dimension "Y"	mm	2.82	2.98
Dimension "X"	mm	1.95	1.92
Pre-stroke	mm	0.87	1.06

11 If the valve tappet sinks too quickly or if the dimension differs from the reference value, lift out valve tappet with the magnetic lifter 102 589 03 40 00.

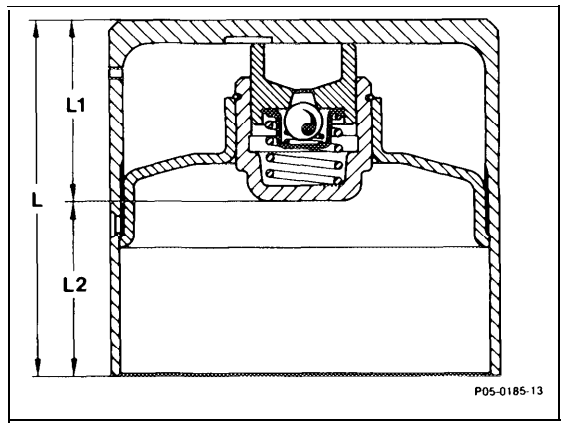
Note location of valve tappet.



12 Measure dimension "L" on valve tappet.
13 Measure dimension "L2" on valve tappet.

The dimension L1 is the difference between L and L2.

Reference value: 18 - 19 mm

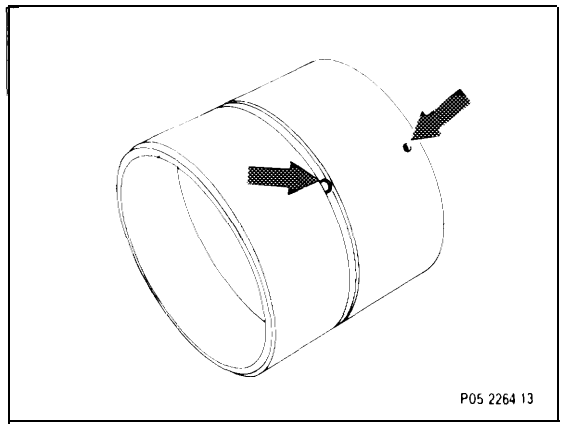


14 If the dimension "L1" is outside the reference value remove guide sleeve.
To do this pull out guide sleeve out of the valve tappet with rotary movements using pliers.
Do not damage guide sleeve.

15 Pull plunger out of the guide sleeve and remove compression spring.

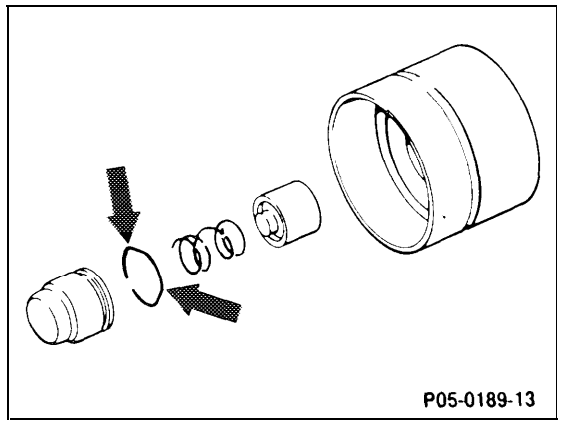
16 Blow through all individual parts with compressed air.

Blow air through valve tappet at the oil supply bore and ventilation bore (arrows).

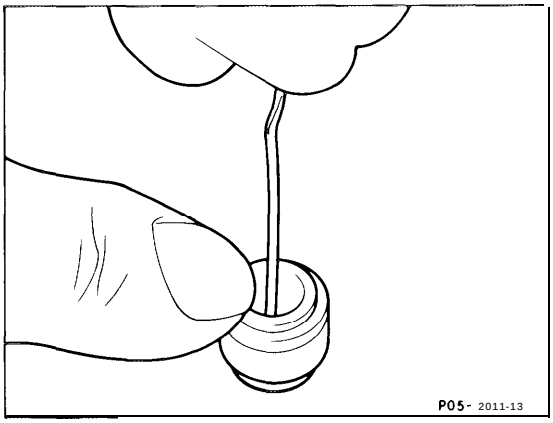


17 Remove snap ring from the guide sleeves and pinch slightly at the edges (arrows) and reassemble on the guide sleeve.

18 Install guide sleeve, compression spring and plunger in sequence.



19 Fill plunger with engine oil. Press off ball valve with a suitable pin and then ventilate the working chamber by pumping the plunger, close ball valve and possibly replenish oil. Then no oil should escape from the ball valve when it is gently compressed.



Note
If oil escapes, renew valve tappet.

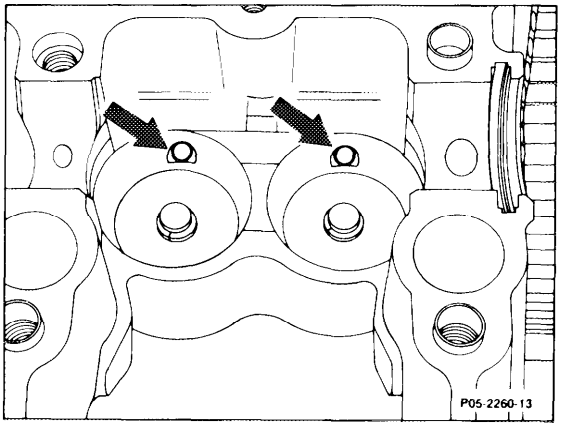
20 Fill valve tappet with engine oil and insert vented plunger with guide sleeve into the valve tappet.

Fit guide sleeve into valve tappet until the snap ring engages, press in, if necessary.

21 Recheck dimension "L1".

22 Check oil supply to cylinder head. **To** do this unscrew sealing plug of the oil channel in cylinder head.

Blow compressed air into the oil channel, while checking exit bores (arrows) at the seat for the valve tappet for air.



23 Lubricate valve tappet and install in the same position, noting sequence.

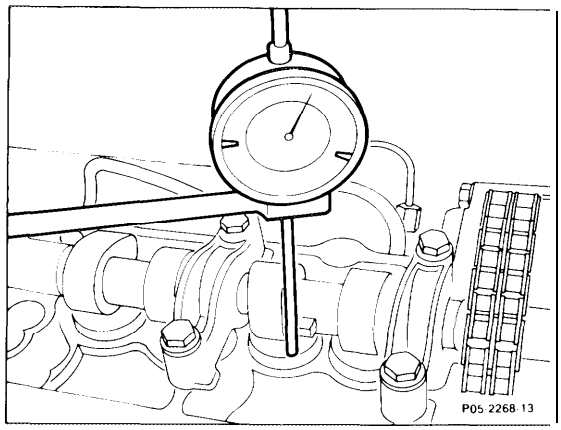
24 Install camshafts (05-220).

25 Install cylinder head cover, 10 Nm.

Turbo engine:
26 Install charge air pipe.

05-215 Checking camshaft timing

Preceding work:
Cylinder head cover removed.
Injection nozzles removed (07.1-230).
Charge air pipe removed (turbo engines).



Dial gauge holder 363 589 02 21 00 ..... attach, remove at the No. 1 cylinder inlet valve. Dial gauge with 3 mm preload on valve tappet.

Engine ..... turn in direction of rotation.

Caution!
Engine must not be turned by the camshaft.

With 2 mm valve stroke ..... engine must be at 12° after TDC.

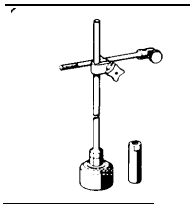
Timing

Engine	Camshafts Code number[1]	Inlet valve		Exhaust valve	
		opens after TDC	closes after BDC	opens before BDC	closes before BDC
602 603	06/10[3]/08[5]/12[6]	11° 12°[4]	17°	28°	15°
	07/11[3]/09[5]/13[6]				

[1] The camshaft code number is stamped in on the collar next to the TDC notch.
[2] Not used.
[3] With M1 1 thread from 11/88.
[4] On used camshafts.
[5] Repair camshafts with 0.5 mm larger bearing diameter and M10 thread.
[6] Repair camshafts with 0.5 mm larger bearing diameter and M1 1 thread.

Tightening torque	Nm
Bolts for cylinder head cover	10

Special tool



363 589 02 21 00
00

Conventional tool

Dial gauge A 1 DIN 878	e. g.	Mahr D-7300 Esslingen Part No. 810

Note

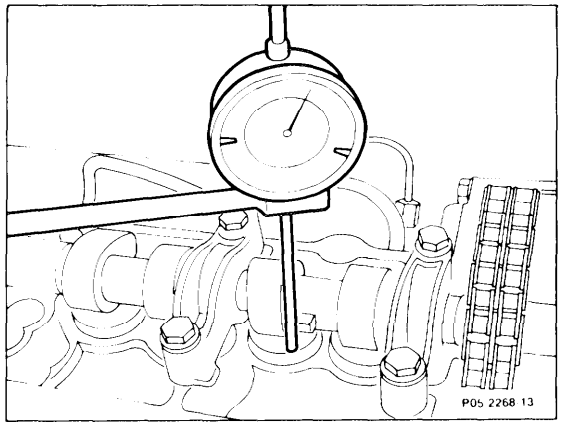
It is not possible to correct timing. The timing chain should be checked for elongation if the test values differ.
The timing chain is to be replaced with more than 4° at the crankshaft.

Checking

Caution!
The engine must not be turned by the camshaft timing gear bolt. Do not turn engine backwards during measurement, otherwise measuring errors result.

1 Turn crankshaft in direction of rotation of the engine until cam tip of the 2nd cam points upwards.

2 Fasten dial gauge holder 363 589 02 21 00 on the cylinder head (above the No. 1 cylinder inlet valve).



3 Insert dial gauge and extension and fasten so that probe pin sits on the valve tappet with a preload of 3 mm (small dial gauge pointer).

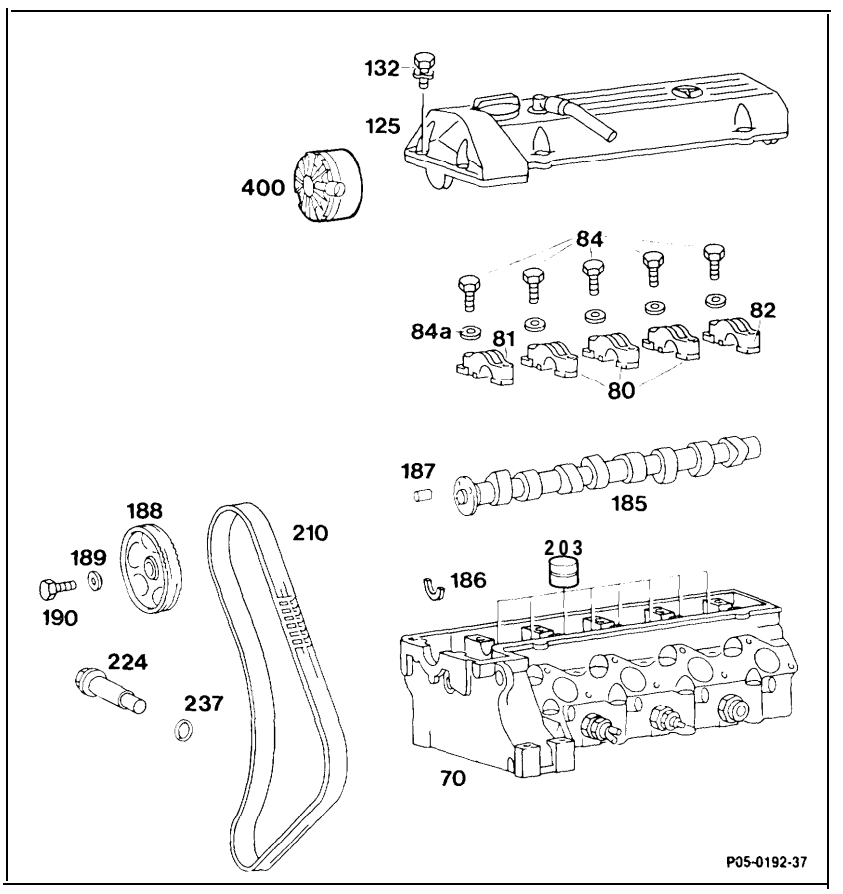
4 Turn dial gauge scale until the large pointer is on "0".

Caution!
The probe pin of the dial gauge must be exactly vertical to the valve tappet.

5 Turn crankshaft further in direction of rotation of engine, until the small pointer of the dial gauge has moved back by 2 mm to 1 mm.

In this position the marking at the crankshaft pulley or vibration damper must be at 11 - 12" after TDC. If this value is more than 12" the camshaft is to be replaced or the timing chain checked for elongation.

05-220 Removal and installation of camshaft



Turbo engine:

Charge air pipe	remove, install.
Cylinder head cover (125)	remove, install, 10 Nm.
Engine	position on ignition TDC of No. 1 cylinder.

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

Chain tensioner (224)	remove. install, replace sealing ring (237) (05310).

With self-levelling suspension:

Drive of the pressure oil pump (400)	remove, install (05437).

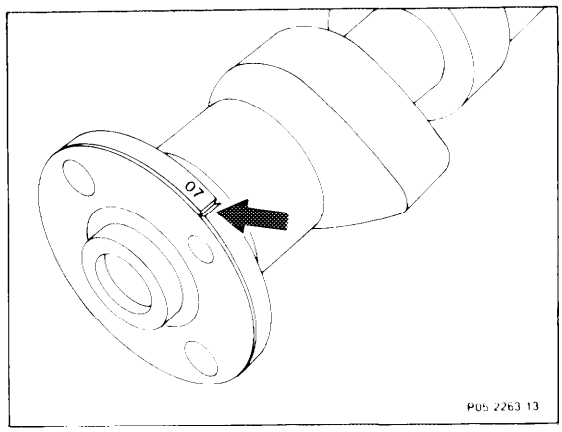
Camshaft timing gear (188)	mark at timing chain (210). Remove, install camshaft timing gear. Different bolts (190) and washers (189). Hexagon bolt, 65 Nm, bihexagonal head bolt, 25 Nm 90° angle of rotation.
	Caution! When assembling the camshaft timing gear ensure that the straight pin (187) is not pushed out towards the rear.
Camshaft bearing cap (80, 81, 82)	remove, install, note sequence, hexagon bolts (84) and washers (84a), 25 Nm.
	Caution! Note torquing diagram!
Camshaft (185)	remove, install. Check for ease of movement.
Lock washer (186)	check.
Valve tappet (203)	remove, install, check. Magnet lifter 102 589 03 40 00.
After installation	allow engine to run, check for leaks.

Data

Permitted eccentricity of center bearing pin and camshaft gear seat when accepting the camshaft in the outer bearing positions	Bearing position engine	602	603
	Camshaft timing gear seat	0.025	0.025
	2nd and 4th bearing position	–	–
	3rd bearing position	–	–
	2nd and 5th bearing position	0.030	–
	3rd and 4th bearing position	0.050	–
	2nd and 6th bearing position	–	0.030
	3rd and 5th bearing position	–	0.045
	4th bearing position	–	0.060
Scleroscope hardness of cam		70 – 82	70 – 82
Diameter of camshaft bearing pins (standard dimension)		30.945 / 30.934	
Diameter of camshaft bearing pins (repair stage + 0.5 mm)		31.445 / 31.434	

Camshaft code numbers

The code number is stamped on the flange next to the TDC notch (arrow).



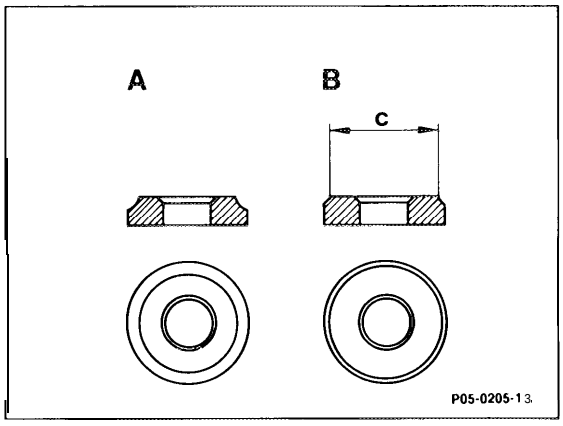
TDC marking (arrow) and code number

Engine	Thread for sprocket wheel	Camshaft code number
602, 603	M10	07, OS')
	M11	11, 13')

') Repair camshaft with 0.5 mm larger bearing Ø

Washer for camshaft timing gear bolt

A revised washer with a larger outer diameter (c) has been fitted in order to prevent the camshaft timing gear bolt loosening.



A 1 st Design
B 2nd Design

Production breakpoint: 12/86

Model	Engine	Engine end No.		Vehicle Identification end No.	
		Manual transmission	Automatic transmission	A	F
124.133 124.193	603.960		007763	*	*
126.125	603.961	–	007994	*	*
201.126	602.911	033213	008022	*	*
201.128	602.961	–	000200	*	*

* not recorded

Camshaft timing gear bolt

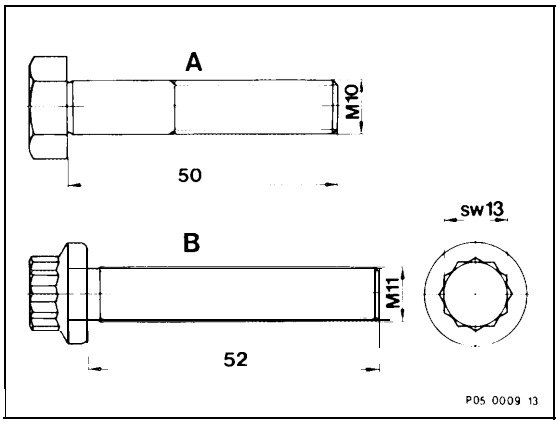
From 11/88 the camshaft timing gear fixing has been revised from a **MI 0** hexagon bolt to a **MI 1** bihexagon necked down bolt on all engines.

Tightening torques

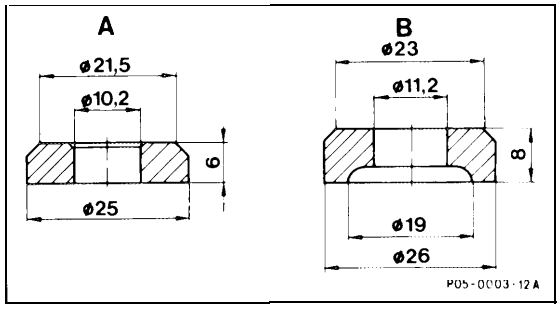
Hexagon bolt (A) 65 Nm
Bihexagon necked down bolt (B)
Pre-torque 25 Nm
Torsion angle 90”

Caution!

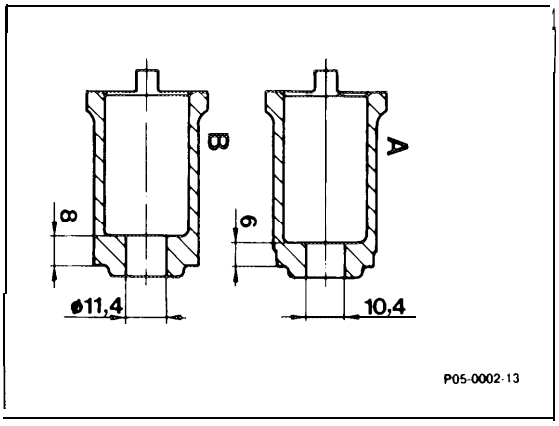
Note revised plain washer!



Use the plain washer (A) for the hexagon bolt, and plain washer (B) for the bihexagon necked down bolt.



Use carrier (A) for previous hexagon bolt, carrier (B) for bihexagon necked down bolt.



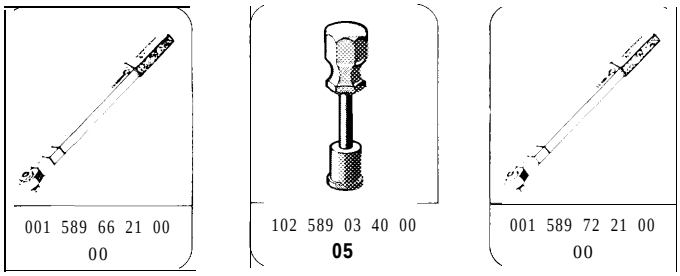
Production breakpoint: 1 **1/88**

Model	Engine	Engine end No.		Vehicle identification end No.	
		Manual transmission	Automatic transmission	A	F
124	602.962	–	000187	*	*
	603.960	–	019336		
201	602.911	070124	014216	*	*
	602.961	–	004561		

* **not recorded**

Tightening torques and angles of rotation	Nm	
Hexagon bolts on cylinder head cover	10	
Hexagon bolts on camshaft timing gear	65	
Bihexagonal head bolt on camshaft timing gear	25	90”
Hexagon bolts on camshaft bearing cap	25	

Special tools



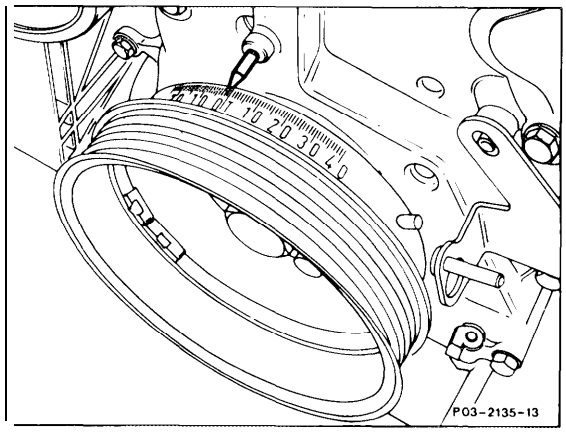
Removal

Turbo engine:

1 Remove, install charge air pipe.

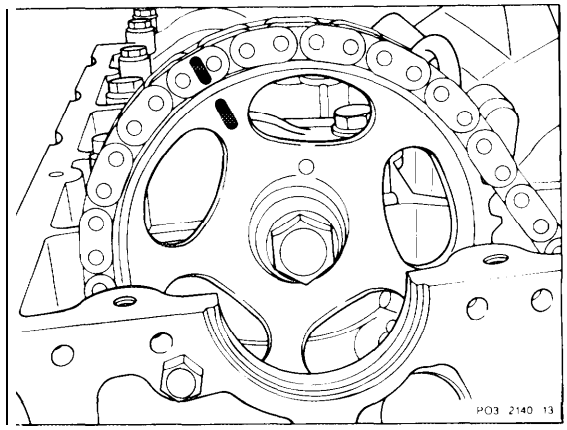
2 Remove cylinder head cover.

3 Position engine on ignition TDC of No. 1 cylinder (arrow).



Caution!
Do not turn engine by the camshaft timing gear bolt. Do not turn engine backwards.

4 Remove chain tensioner (05310).

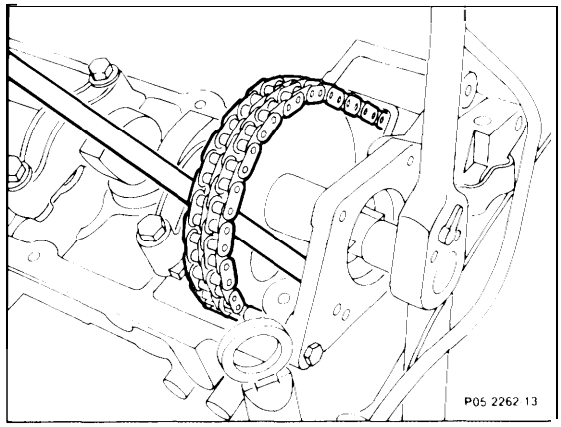


With self-levelling suspension

5 Remove pressure oil pump (05437).

6 Align camshaft timing gear and timing chain.

7 Unscrew hexagon bolt or bihexagonal head bolt on camshaft timing gear, whilst holding the camshaft with a mandrel.



8 Remove camshaft timing gear and allow timing chain to sag.

Note
The timing chain is prevented from twisting when the timing case cover is assembled.

Caution!
Note different bolt and washer.

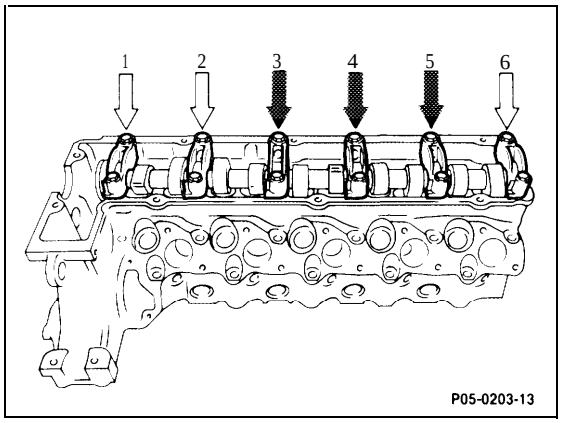
Caution!

9 **It** is absolutely essential to observe the following sequence during **removal and installation** in order to avoid damage to the camshaft:

Engine 602

Unscrew both hexagon bolts on camshaft bearing caps 1, 2 and 6 (dark arrows).

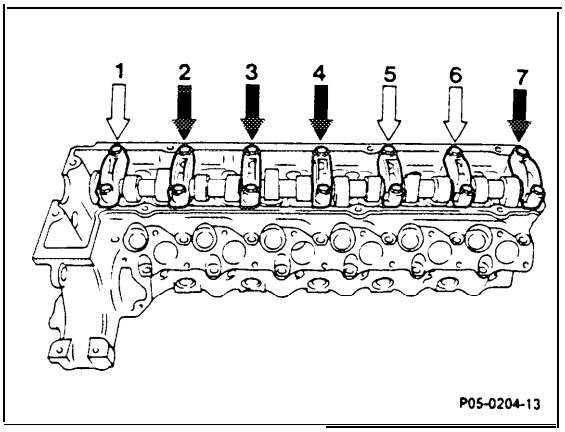
Loosen both hexagon bolts on camshaft bearing caps 3, 4 and 5 in increments of one turn respectively, until counterpressure is reduced (light arrows).



Engine 603

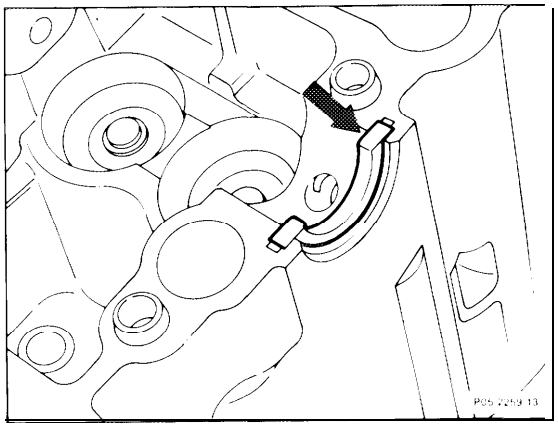
Unscrew both hexagon bolts on camshaft bearing caps 1, 5 and 6 (dark arrows).

Loosen both hexagon bolts on camshaft bearing caps 2, 3, 4 and 7 in increments of one turn respectively, until counterpressure is reduced (light arrows).



10 Remove camshaft upwards.

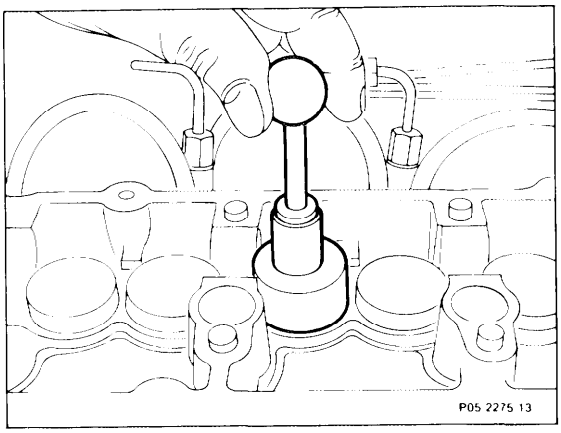
11 Remove lock washer for axial fixing (arrow) and check condition.



12 Pull out valve tappet with magnetic lifter 102 589 03 40 00.

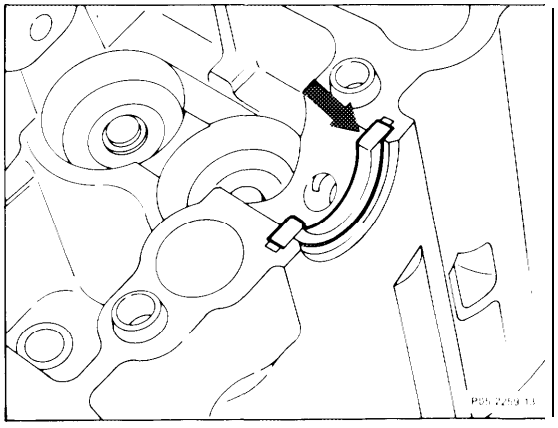
13 Check valve tappet for condition (visual inspection), replace if necessary.

Caution!
Install valve tappet in the same position again.



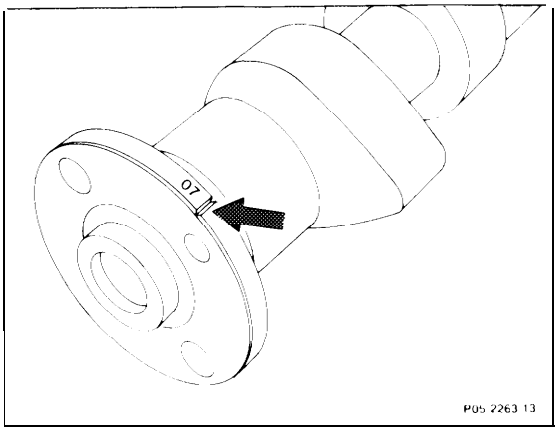
Installation

14 Insert lock washer for axial fixing (arrow) in cylinder head.



15 Lubricate camshaft and place on the cylinder head so that the TDC marking (arrow) points vertically upwards.

16 Install camshaft bearing caps. Note marking on bearing caps.



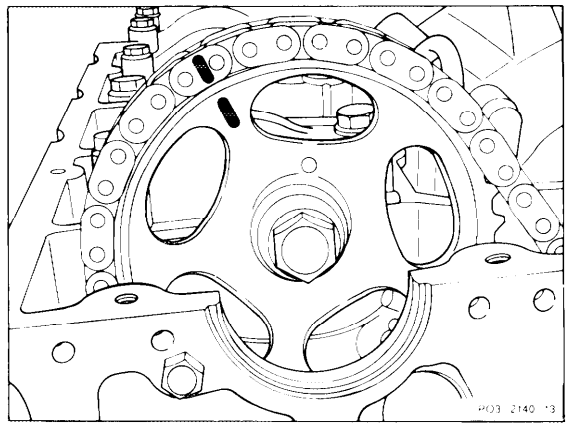
Assemble camshaft bearing cap bolts (light arrows) and torque alternately in increments of one turn respectively in accordance with torquing diagram, see work stage 9.

Engine 602; camshaft bearing caps 3, 4 and 5
Engine 603; camshaft bearing caps 2, 3, 4 and 7

The remaining camshaft bearing caps (dark arrows) can then be assembled at random.

Tightening torque 25 Nm.

17 Install camshaft timing gear according to marking and tighten. Check straight pin for correct seating.



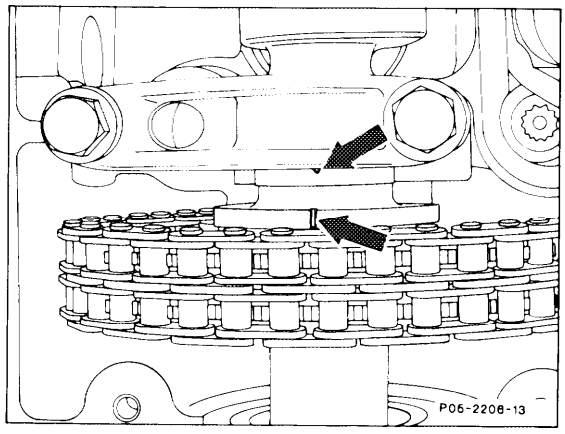
Tightening torques and angle of rotation

Hexagon bolt	65 Nm,
Bihexagonal head bolt	25 Nm, 90°

18 Install chain tensioner (05-310).

With self-levelling suspension:

19 Install pressure oil pump (05-437).



20 Position engine on TDC of the No. 1 cylinder and check markings (arrows).

21 Install cylinder head cover. Tightening torque 10 Nm.

Turbo engine:

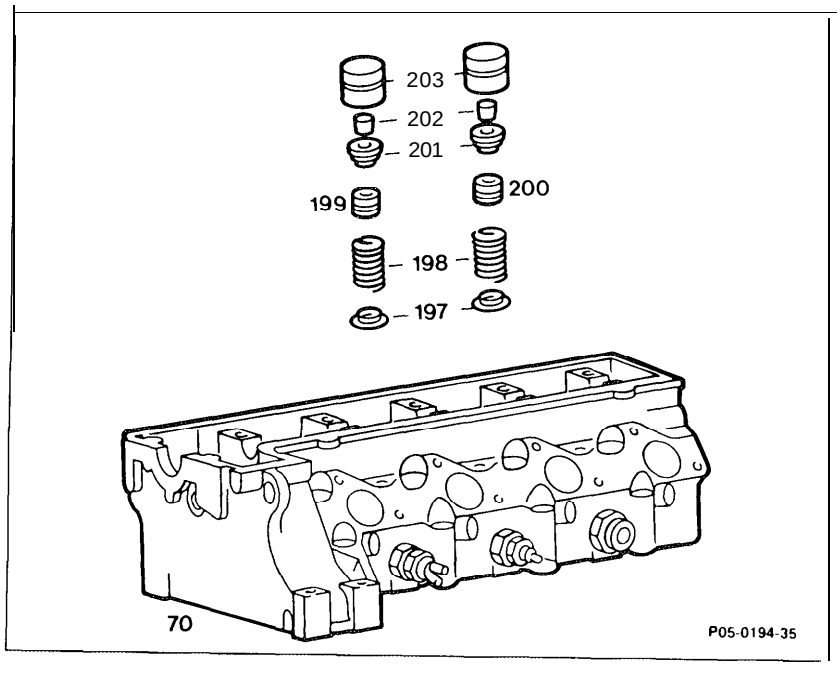
Install charge air pipe.

After installation:

22 Allow engine to run, check for leaks.

05-250 Removal and installation of valve springs

Preceding work:
Camshaft removed (05-220)



A. Cylinder head removed

Cylinder head (70)	.....	clamp. Assembly table 601 589 01 59 00, support bridge 601 589 02 59 00.
Valve tappet (203)	.....	remove, install. Magnetic lifter 102 589 03 40 00.
Valve springs (198)	.....	remove, install, check (05-260). Lever press 601 589 02 61 00, magnetic lifter 102 589 03 40 00. Color marking downwards.
Valve stem seals (199, 200)	.....	replace (05-270).

B. Cylinder head installed

Valve tappet (203)	remove, install. Magnetic lifter 102 589 03 04 00.
Piston of cylinder concerned	position on TDC. Retaining gear 601 589 01 40 00.
Valve springs (198)	remove, install, check (05260). Support bridge 601 589 02 59 00, lever press 601 589 02 61 00. Magnetic lifter 116 589 06 63 00. Color marking downwards.
Valve stem seals (199, 200)	replace (05-270).

Since 03'86 the lower valve spring retainers have been revised. They are now the same as those on the engines 102 and 103 (standardization).

Production breakpoint: 03/86

Model	Engine	Engine end No.		Vehicle identification end No.	
		Manual transmission	Automatic transmission	A	F
124.133 124.193	603.960	–	000016	*	*
126.125	603.961	–	001093	*	*
201.126	602.911	015830	003949	*	215978

* not recorded

Since 08/88 the valve spring retainers are in bath nitrided material (previously case hardened). Standardization with engines 102 and 103.

Production breakpoint: 08/88

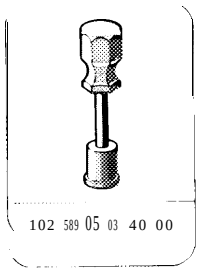
Model	Engine	Engine end No.		Vehicle identification end No.	
		Manual transmission	Automatic transmission	A	F
124.133 124.193	603.960	–	018302	*	*
201.126	602.911	067330	013824	*	*
201.128	602.961	–	003806	*	*

* not recorded

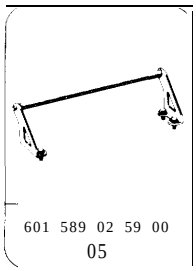
Note

Color markings of valve springs yellow green or violet/green or yellow blue or violet blue.

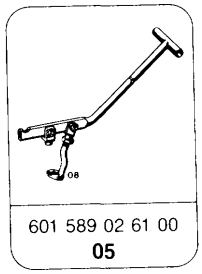
Special tools



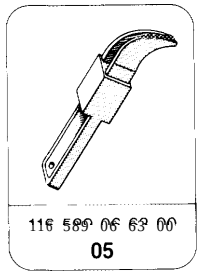
102 589 05 03 40 00



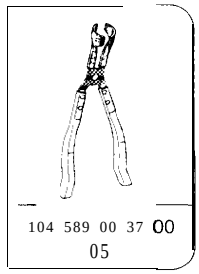
601 589 02 59 00
05



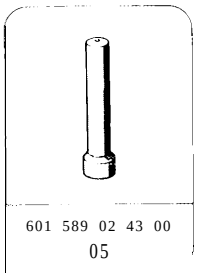
601 589 02 61 00
05



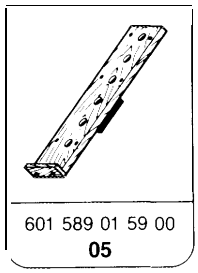
116 589 06 63 00
05



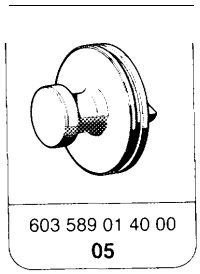
104 589 00 37 00
05



601 589 02 43 00
05



601 589 01 59 00
05



603 589 01 40 00
05

A. Cylinder head removed

Removal and installation

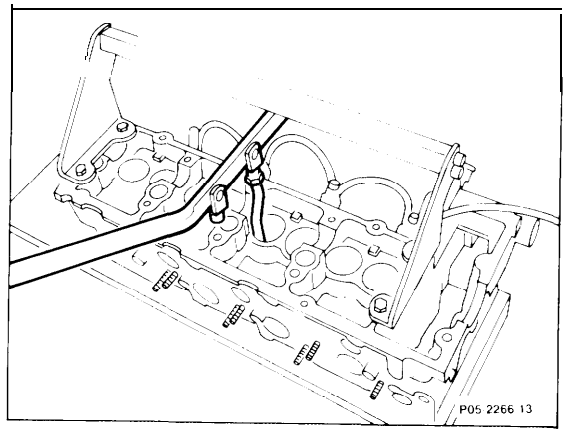
1 Clamp cylinder head on assembly table 601 589 01 59 00 with 4 cylinder head bolts.

2 Remove valve tappets. Magnetic lifter 102 589 03 40 00.

Installation note
Lubricate valve tappets. Note sequence.

3 Attach support bridge 601 589 02 59 00 to cylinder head.

4 Press valve spring retainers downwards with lever press 601 589 02 61 00.



5 Remove valve cotters with magnetic lifter 116 589 06 63 00.

6 Take out valve springs and valve spring retainers.

Installation note
Install valve springs with the color marking downwards.

7 Check valve springs (05260).

8 Replace valve stem seals (05270).

9 Installation takes place in the reverse sequence.

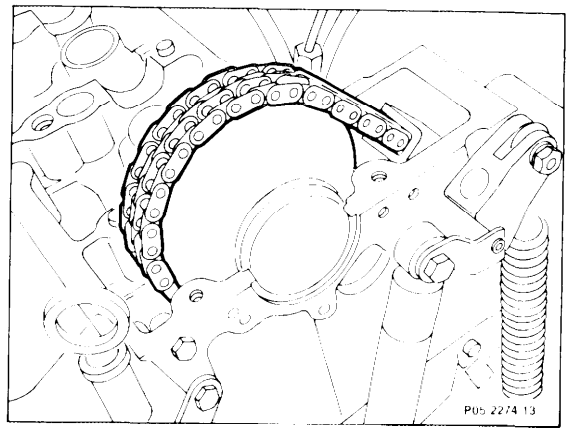
B. Cylinder head installed

Removal and installation

1 Remove valve tappets with magnetic lifter 102 589 03 40 00.

Installation note
Lubricate valve tappets, note sequence.

2 Place piston of the cylinder concerned on TDC.
Use retaining gear 603 589 01 40 00 instead of camshaft timing gear or camshaft in order to turn the engine.

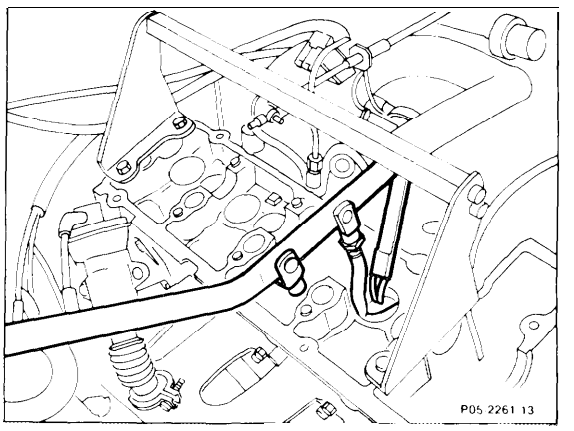


3 Attach support bridge 601 589 02 59 00 for lever press on cylinder head.

4 Press valve spring retainers downwards with lever press 601 589 02 61 00.

5 Remove valve cotters with magnetic lifter 116 589 06 63 00.

6 Remove valve springs and valve spring retainers.



Installation note

Install valve springs with the color markings downwards.

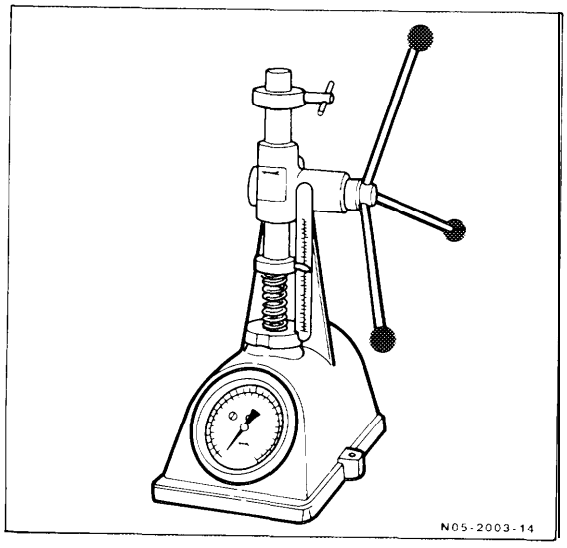
7 Check valve springs (05-260).

8 Replace valve stem seals (05-270).

9 Installation takes place in the reverse sequence.

05-260 Checking valve springs

Preceding work:
Valve springs removed (05-250).



Spring force ..... check at specified length. If limit is not achieved, replace valve spring.

Valve spring data

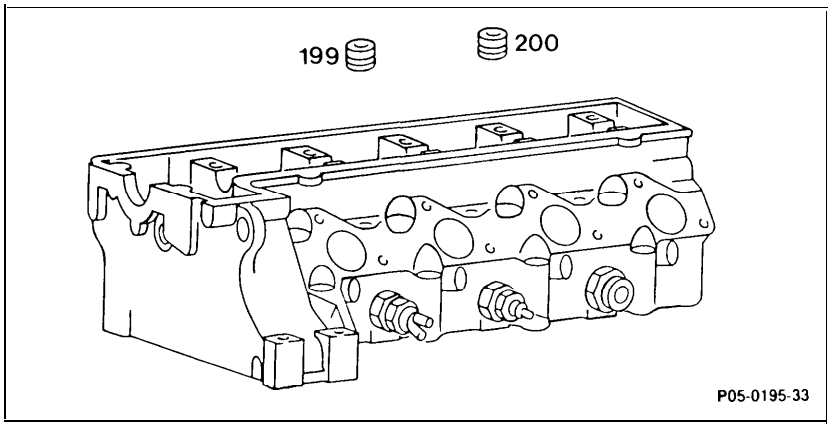
Part No.	Color marking	Outside Ø mm	Wire Ø mm	Free length mm	Spring force at preloaded length	New value N	Limit N
601 053 01 20 (1 st design)	yellow/green or violet/green	33.2	4.25	50.8	**27**	**710 – 790**	**648**
601 053 03 20 (2nd design)	yellow, blue or violet blue	33.1	4.20	50.0	27	680 – 740	612

Conventional tool

Spring test scales	e. g.	Berco Model CM130

05-270 Replacing of valve stem seals

Preceding work:
Valve springs removed (05-250).



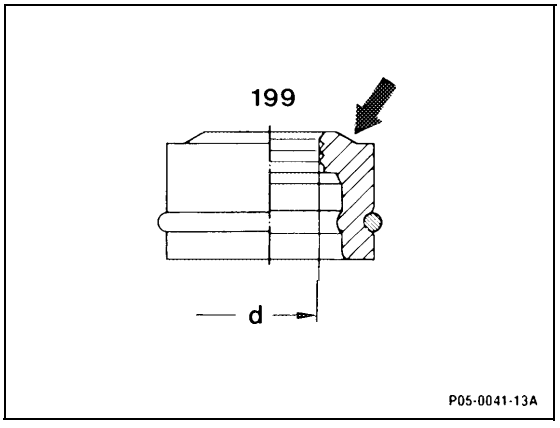
Valve stem seals (199, 200)	remove, install. Pliers 104 589 00 37 00, mandrel 601 589 02 43 00. Note color marking.
Valve stem	de-burr at groove.

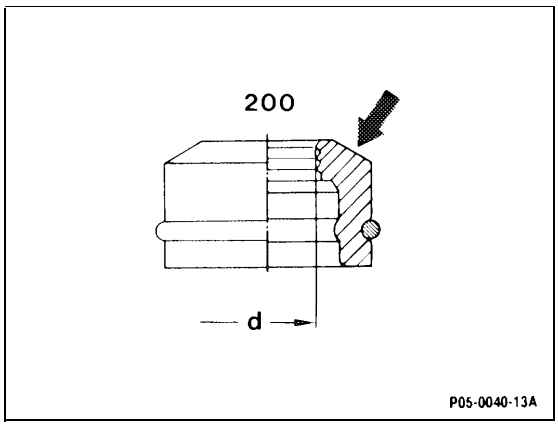
Valve stem seal designs

Distinguishing features:

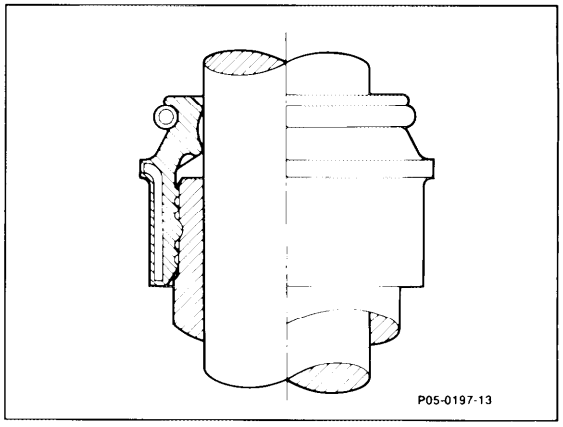
Intake valve stem seal (199)
Chamfer (arrow) shouldered
d = 7.3 mm
Wire ring: phosphated (black)
Color: brown

Exhaust valve stem seal (200)
Chamfer (arrow) straight
d = 8.2 mm
Wire ring: bright galvanized (yellow)
Color: brown





Valve stem seals with standardized exterior dimensions are installed due to automatic cylinder head assembly.



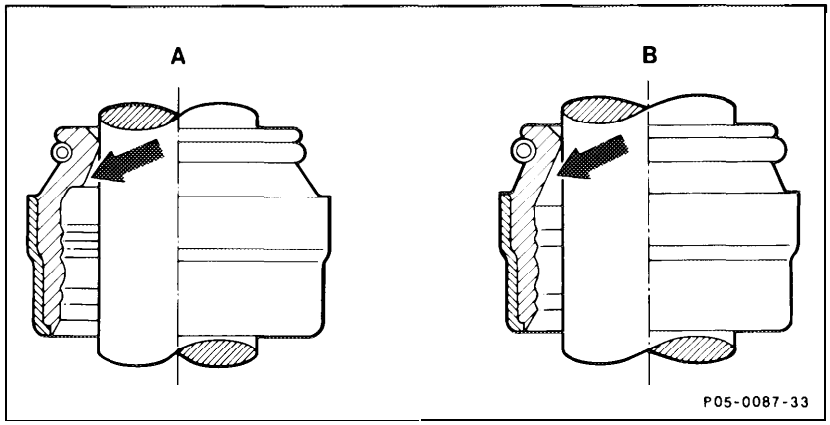
Production breakpoint: 1 1/85

Model	Engine	Engine end No.		Vehicle identification end No.	
		Manual transmission	Automatic transmission	A	F
201.126	602.911	009492	002235	*	*

* not recorded

Inlet valve stem seals without gas lip have been fitted since 09 89 and exhaust valve stem seals without gas lip since 04 90.

Viton material



A Intake valve stem seal
B Exhaust valve stem seal

Production breakpoint: 09/89 (Inlet)

Model	Engine	Engine end No.		Vehicle identification end No.	
		Manual transmission	Automatic transmission	A	F
124.128	602.962	000093	003020	*	*
124.133 124.193	603.960	–	023344	*	*
126.135	603.970	–	[1])	*	*
201.126	602.911	083331	016477	*	*
201.128	602.961	000177	007086	*	*

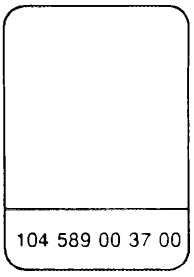
[1]) from st of production
* not rec led

Produktion breakpoint: 04/90 (Exhaust)

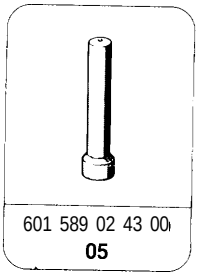
Model	Engine	Engine end No. Manual transmission	Automatic transmission	Vehicle identification end No. A	F
124.128	602.962	003684	005147	*	*
124.133 124.193	603.960	–	026930	*	*
126.135	603.970	–	[1])	*	*
201.126	602.911	090538	017538	*	*
201.128	602.961	002151	007954	*	*

[1]) from start of production
* not recorded

Special tools



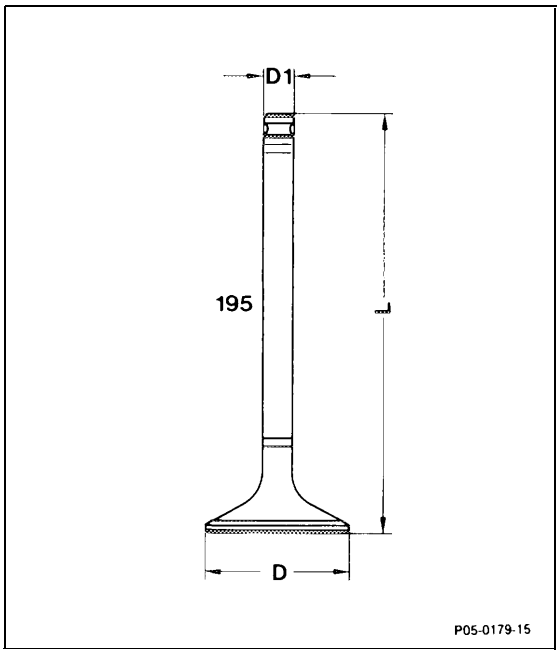
104 589 00 37 00

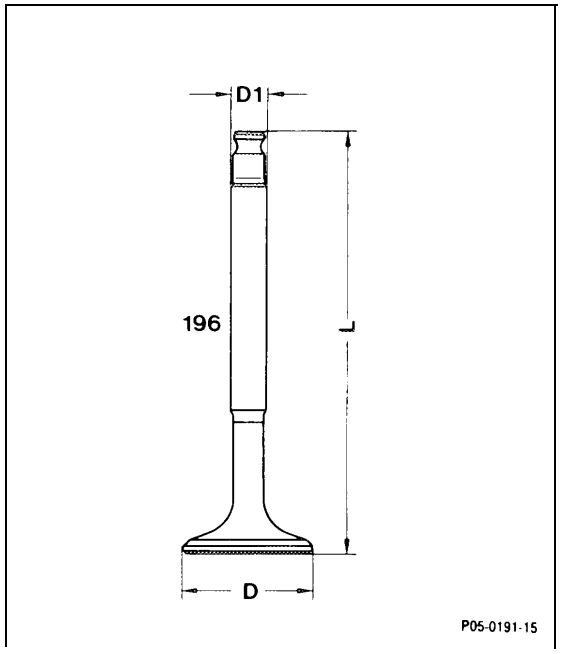


601 589 02 43 00
05

OS-280 Checking and machining valves

Preceding work:
Cylinder head removed (01-415).
Valve springs removed (05-250).
Valves removed.





Valves	
(Intake valve 195, exhaust valve 196)	clean, check visually.
Valve stem	check for eccentricity (max. 0.03 mm).
Valve seat	check for eccentricity (max. 0.03 mm), grind.
Dimensions and angles	check (table).

Data

		Intake valve		Exhaust valve	
Engine		602.91	602.96 603.96	602.91	602.96 603.96
Valve head Ø (D)		37.90 38.10	37.90 38.10	34.90 35.10	34.90 35.10
Height (h) of valve head	New value	1.75-2.05	1.75–2.05	1.75–2.05	1.75–2.05
	Limit	1.6	1.6	1.6	1.6
Setting angle (a) for machining the valve		45" + 15'	45° + 15'	45° + 15'	45° + 15'
Valve stem Ø (D 1)		7.970 7.955	7.970 7.955	8.960 8.945	8.960 8.945
Valve seat reinforcement		with	with	with	with
Sodium filled		without	with	without	with
Valve length (L)		106.6 106.2	106.6 106.2	106.6 106.2	106.6 106.2
Width of valve seat		2.0	2.0	12.0	2.0
Max. permitted eccentricity on valve stem and valve seat		0.03	0.03	0.03	0.03
Marking on end of stem		E 601 02	E 601 04	A 601 05	A 601 05

From 04/87 only exhaust valves with valve heads from revised material have been fitted.

Production breakpoint: 04/87

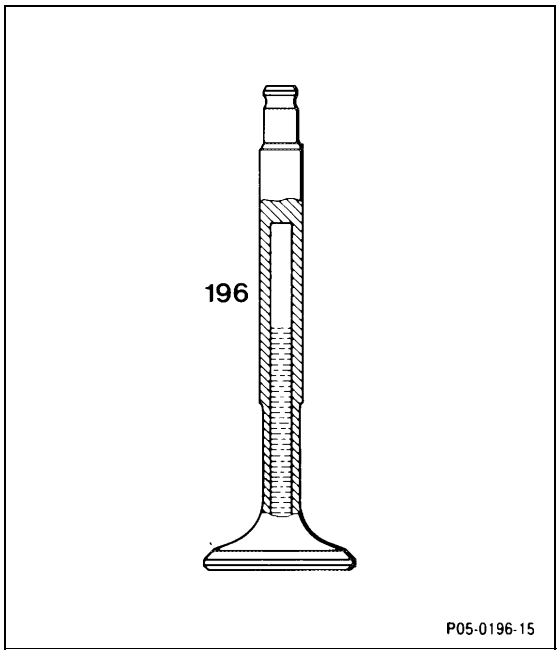
Model	Engine	Engine end No.		Vehicle identification end No.	
		Manual transmission	Automatic transmission	A	F
201.126	602.911	040584-051637	009509-011200	374038- 407495	357034- 320983

Note
On turbo engines the surface of the inlet valve head is ground (non-machined on naturally aspirated engines).

The stem of the exhaust valve (196) is chrome-plated and filled with sodium on turbo engines.

⚠ Warning
Unserviceable sodium-filled valves must be neutralised before scrapping. They must therefore be collected by the respective departmental supervisor and dispatched to:

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



196 Exhaust valve

The location of the hydraulic valve clearance compensating elements must be checked after machining or replacing the valves, and corrected if required (05211).

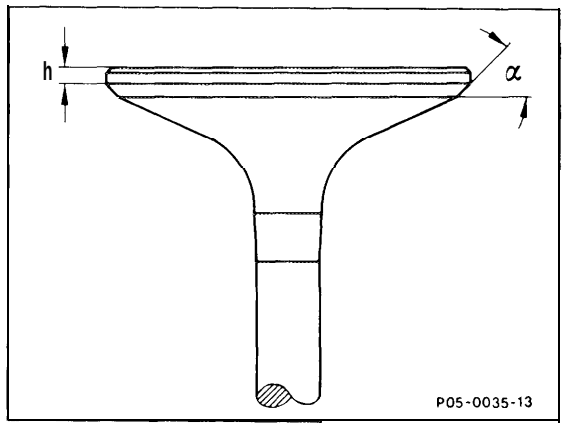
Conventional tools

Valve grinder or Valve poppet turning equipment	e. g.	Krupp, D-5309 Meckenheim Model VS
	e. g.	Hunger, D-8000 München 70 Model VKDR 1 Part No. 203.00.200
Dial gauge	e. g.	Mahr D-7300 Esslingen Part No. 810

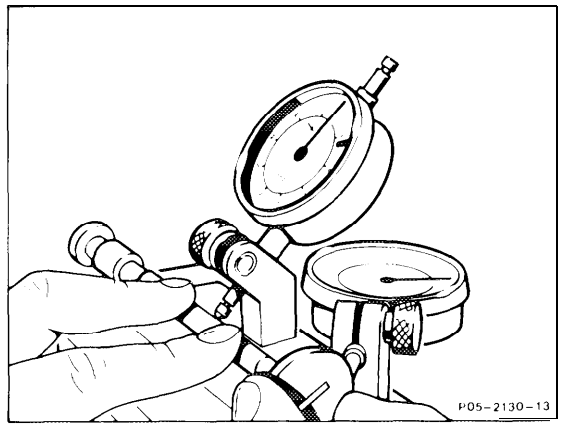
Checking and machining

1 Clean valves and carry out visual inspection.

Valves with a burnt valve head, with insufficient valve head height (h) and with worn or scored valve stem should be replaced.



2 Measure eccentricity on valve stem.
Replace valve if eccentricity exceeds 0.03 mm.

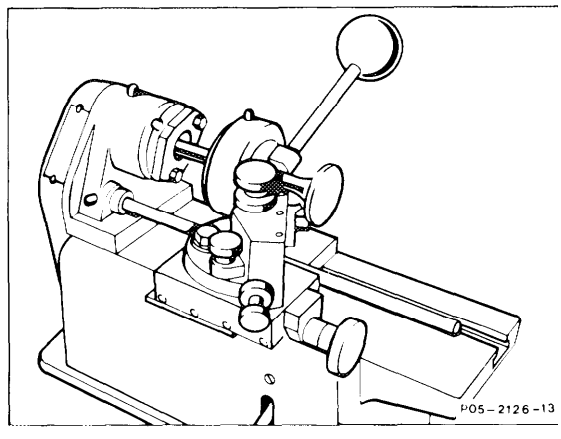


3 Machine valve seat.

Note operating instructions for the machining equipment and adjustment angle (a) 45” + 15’.

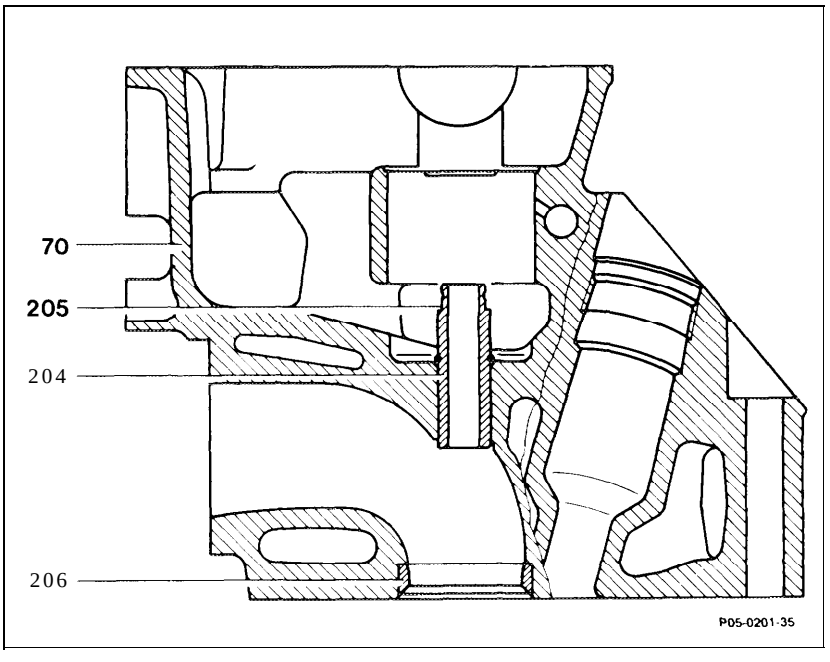
4 Measure eccentricity on valve seat and height (h) of valve head.

If eccentricity is more than 0.03 mm or the height (h) less than 1.6 mm, valve should be replaced.



05-285 Checking and replacing valve guides

Preceding work:
Cylinder head removed (01-415).
Valve springs removed(05-250).
Valves removed.



Checking

Seat for valve stem seal (205)	check. Replace valve guide (204) if valve stem seal is loose.
Valve guide (204)	clean. Cylindrical brush 000 589 10 68 00.
Valve guide (204) inside ∅	check. Plug gauge: 102 589 00 23 00 intake, 117 589 03 23 00 exhaust. Replace valve guide, if reject pin of plug gauge fits completely in the valve guide.

Replacement

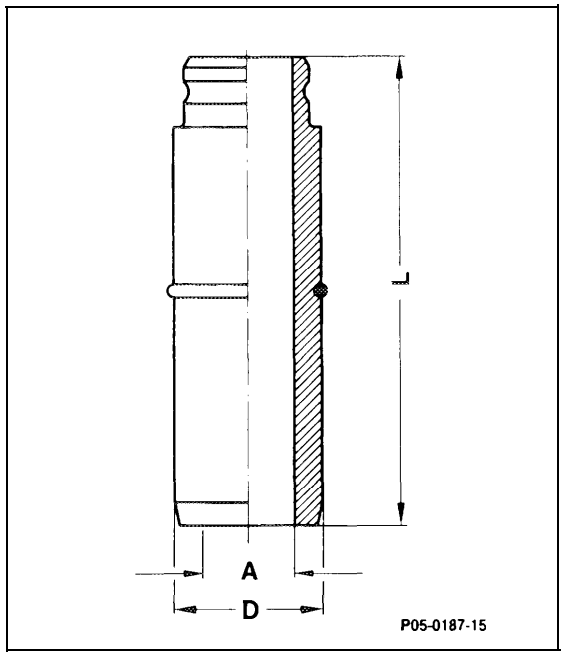
Valve guide (204)	drive out, drive home. Drift: 103 589 03 15 00 intake, 103 589 02 15 00 exhaust. Punch: 601 589 06 15 00 intake, 601 589 02 15 00 exhaust. Ream, Reamers: 000 589 21 53 00 intake 000 589 10 53 00 exhaust

Basic bore of valve guide in cylinder head (70) ..... check. If required bore out to next repair stage.
Broach (14.20 mm) 115 589 00 53 00.
Guide sleeves:
102 589 00 63 00 intake,
102 589 08 63 00 exhaust.
Broach (14.40 mm) 115 589 01 53 00
Guide sleeve 601 589 15 63 00.

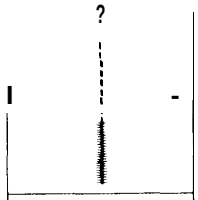
Valve seat insert (206) ..... check for eccentricity (05-291).

Valve guides (grey cast iron)

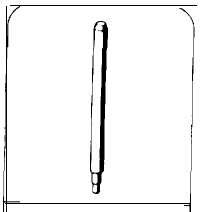
	Design and Part No.	Outside Ø (D)	Color marking	Basic bore in cylinder head	Overlap	Valve guide inside Ø (A)	Length (L)
Intake	Repair stage I 601 050 07 24	14,240-14,251	rot	14,200–14,211	0,029–0,051	8,000–8,030	39,5
	Repair stage II 601 050 08 24	14,440–14,451	weiß	14,400–14,411			
Ex-haust	Repair stage I 601 050 10 24	14,240–14,251	rot	14,200–14,211	0,029–0,051	9,000–9,050	37,7
	Repair stage II 601 050 11 24	14,440–14,451	weiß	14,400–14,411			



Special tools

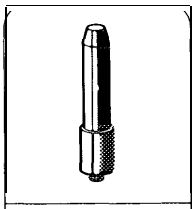


000 589 10 68 00
05

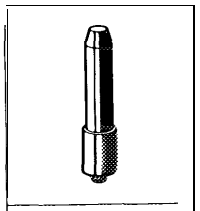


103 589 03 15 00
05

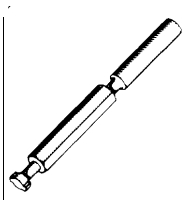
103 589 02 15 00
05



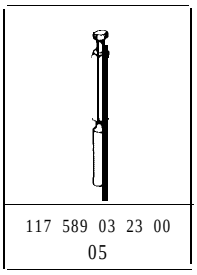
601 589 06 15 00
05



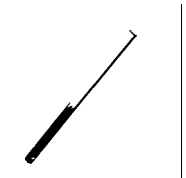
601 589 05 15 00
05



102589002300
05

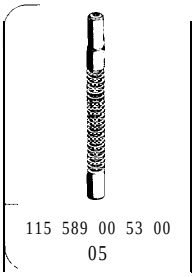


117 589 03 23 00
05

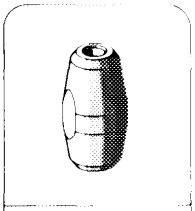


000 589 21 53 00
05

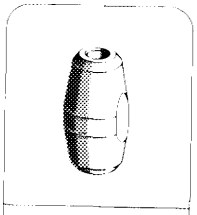
000 589 10 53 00
05



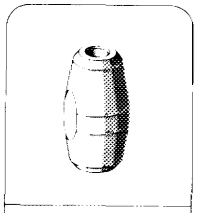
115 589 00 53 00
05



102 589 00 63 00
05



102 589 08 63 00
05



601 589 15 63 00
05

115 589 01 53 00
05

Conventional tool

Cylinder head clamping fixture	e. g.	Hunger, D-8000 München 70 Part No. 221.60.000

Broach base bore in cylinder head (Repair stage)

Decarbonize and clean cylinder head carefully, particularly the inside of the valve seat inserts. Select correct guide sleeve (2) and remove swarf from the tip of the broach (1) with a stiff plastic brush or similar tool.

Note

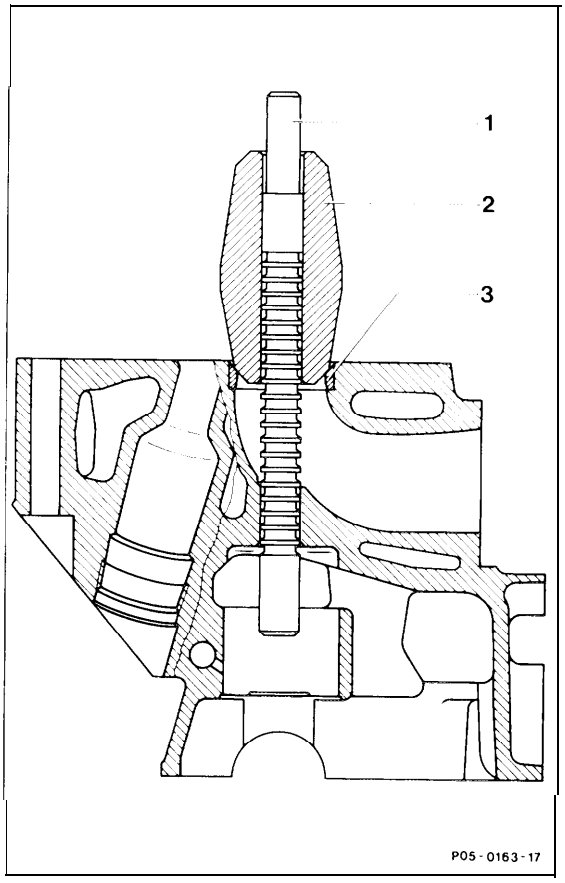
The broach cutter must be cleaned before each broaching operating.

Provide guide sleeve, basic bore and complete broach with ample supplies of paraffin.

Insert broach into the guide sleeve so that when the guide sleeve rests on the valve seat insert (3) the first cutter of the broach is located in the base bore. In so doing note that the correct side of the guide sleeve is put on the valve seat. Centre guide sleeve by rotary movements in the valve seat insert.

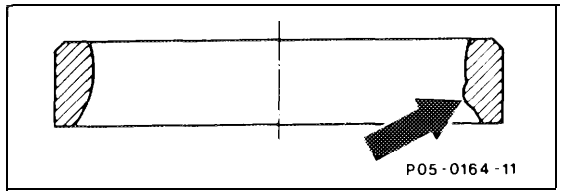
Note

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



1 Broach
2 Guide sleeve
3 Valve seat insert

Note
The high spot (arrow) on the intake valve seat inserts is to be removed before inserting the guide sleeve.



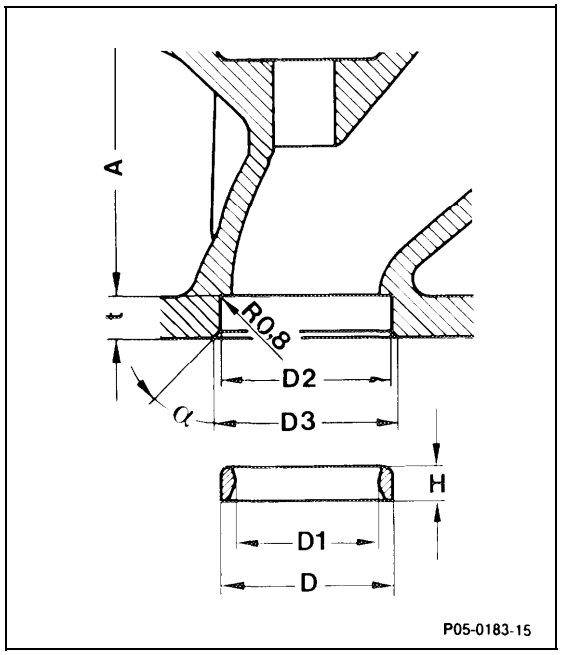
Inserting valve guide
Drive home valve guides with punch and hammer, when the valve guides are not super-cooled and the cylinder head is not heated up. Coat valve guides with wax or oil before driving home.

Assignment of guide sleeve - valve seats

Valve seat	Guide sleeve Part No.	Basic bore ∅ in cylinder head
Intake	102 589 00 **63 00**	14.2 mm
Exhaust		
Intake	601 589 15 **63 00**	14.4 mm
Exhaust		

05-290 Replacing valve seat inserts

Preceding work:
Valve guides checked (05-285).



Valve seat insert	turn out valve seat insert with the lathe tool. Note operating instructions for the valve seat turning equipment.
Basic bore (D2)	check (table). Bore out to the repair stage, if required.
	Caution! Machine basic bore for the valve seat insert if minimum overlap is not achieved (Number 3).
Valve seat insert	supercool with liquid nitrogen and insert into basic bore.
	⚠ **Warning** Do not touch supercooled valve seat inserts with bare hands. Valve seat insert must be square to the cylinder head.
Valve seats	machine (05291).

Data

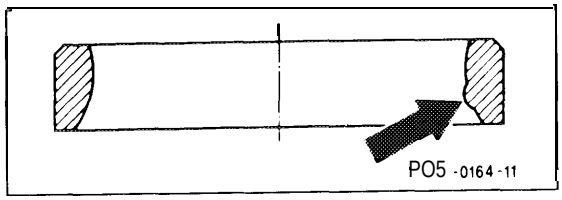
		Intake	Exhaust
Overlap of valve seat inserts in cylinder head		0.068 – 0.100	0.068 – 0.100
D 2	Standard dimension	40.000 40.016	37.000 37.016
	Repair stage max. up to	40.500 40.516	37.500 37.516
D	Standard dimension	40.100 40.084	37.100 37.084
	Repair stage	40.600 40.584	37.600 37.584
D 1		33.400 33.600	30.400 30.600
H	Standard dimension	6.955 7.045	6.955 7.045
	Repair stage	7.155 7.245	7.155 7.245
t (New value)		9.35 9.25	9.35 9.25
D 3		43.0 43.4	40.0 40.4
A (Thrs dimension is valid up to the upper edge of cylinder head on reworked cylinder head parting surface)		133.4	133.4
a		37" 30'	37" 30'

Note

Exhaust valve seat inserts are made from centrifugally cast material on the naturally-aspirated engines, and sintered metal on turbo engines.

The intake valve seat inserts are made from sintered metal on all engines.

The hardened valve seat inserts (sintered metal) had a high spot (arrow) on inside of the insert for a short time.



This high spot must be turned off in order to machine the valve seat insert. There is a repair valve seat insert with larger outside diameter as a replacement part for all valve seat insert designs. After replacing the valve seat inserts the location of the hydraulic valve clearance compensating elements must be checked and corrected, if necessary (05211).

Conventional tools

Cylinder head clamping fixture	e. g.	Hunger, D-8000 München 70 Part No. 221.60.000
Seat insert lathe tool, size 2	e. g.	Hunger, D-8000 München 70 Part No. 220.03-I 10
Valve seat turning equipment, model VDSNL 145 30	e. g.	Hunger, D-8000 München 70 Part No. 236.03.308
Test set for valves	e. g.	Hunger, D-8000 München 70 Part No. 216.93.300
65° correction steel No. 13 for lower correction angle	e. g.	Hunger, D-8000 München 70 Part No. 216.64.622
Internal-thread-measuring equipment (range 25 - 60 mm)	e. g.	Mahr, D-7300 Esslingen Part No. 844
External micrometer (range 25 - 50 mm)	e. g.	Mahr, D-7300 Esslingen Part No. 40 S

Replacement

1 Turn out old valve seat insert with lathe tool.

Note operating instructions for the tool.

2 Check valve guides, replace if required (05285).

3 Measure basic bore D2.

A new valve seat insert standard dimension can be used, when the specified overlap exists.

If the minimum overlap is not achieved, machine basic bore for valve seat insert.

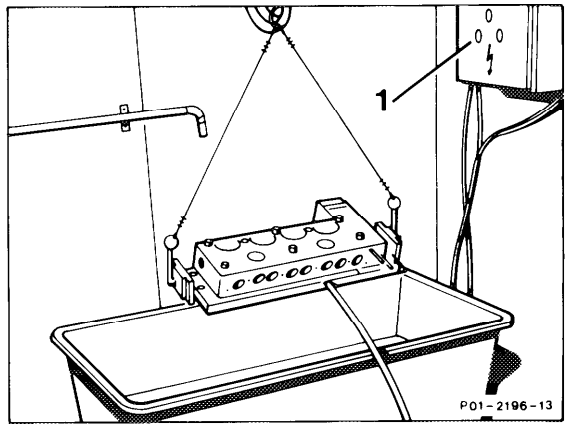
4 Turn basic bore D2 with the seat insert lathe tool so that the bore is properly cleaned up.

5 Measure machine base bore.

6 Turn valve seat insert repair stage so that the specified overlap is produced. Compensate height of reworked front face, if applicable.

7 Heat up cylinder head to approx. 80°C in water bath.

8 Supercool valve seat insert with liquid nitrogen.

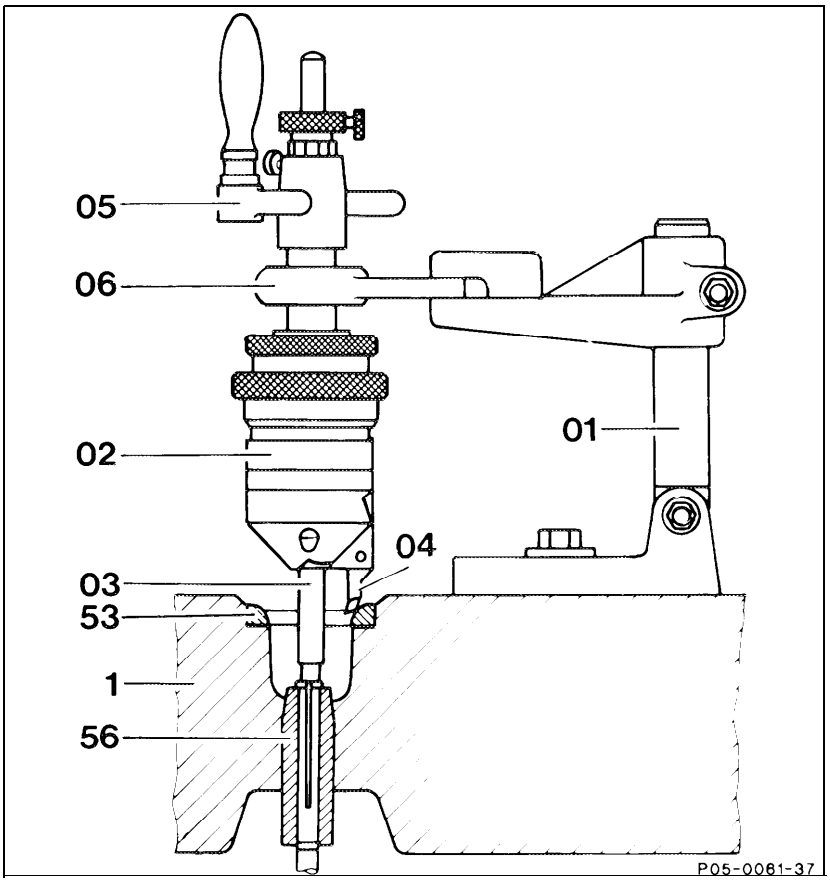


Drive home valve seat insert with suitable pilot bar.

10 Machining valve seats (05291).

05-291 Machining valve seats

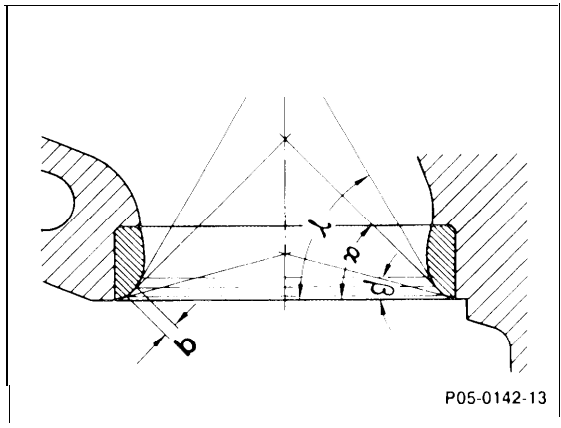
Preceding work:
Valve guides checked (05-285).



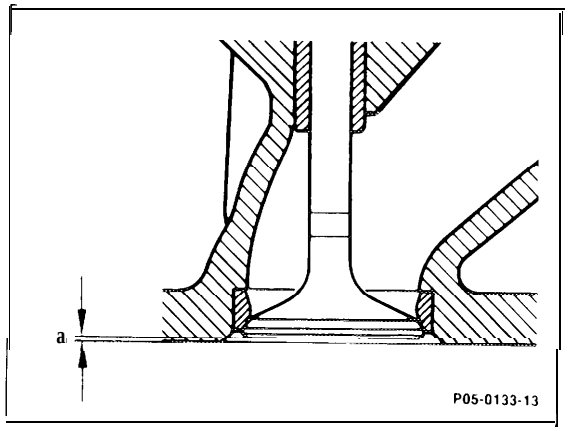
Valve seats (53)	machine in accordance with tool manufacturer's operating instructions. Refer to data for adjustments.
	Note Only loosen the pilot when eccentricity of the valve seat has been checked.
Eccentricity of valve seat	check (Number 2).
Valve seat width (b)	measure, correct if required (Number 3).
Valves	insert and measure distance (A).

Data

Valve seat	Intake	Exhaust
Valve seat width (b)	1.2 – 1.7	1.5 – 2.0
Valve seat angle (a)	45”	45”
Upper correction angle (β)	15°	15°
Lower correction angle (Y)	65°	65°
Permitted concentricity deviation of valve seat	0.03	0.03
Minimum gap (a) on new valves and new valve seats	0.1 – 0.5	0.1 – 0.5
Gap (a) on reworked valve seats and reground valves	– 1.0	– 1.0



The gap (a) reduces by the same amount as cylinder head parting surface has been reworked.



Conventional tools

Cylinder head clamping fixture	e. g.	Hunger, D-8000 München 70 Part No. 211.60.000
Valve seat turning equipment, model VDSNL 1/45 30	e. g.	Hunger, D-8000 München 70 Part No. 236.03.308
Test set for valve seats	e. g.	Hunger, D-8000 München 70 Part No. 216.93.300
65° correction steel No. 13 for lower correction angle	e. g.	Hunger, D-8000 München 70 Part No. 216.64.622

Note

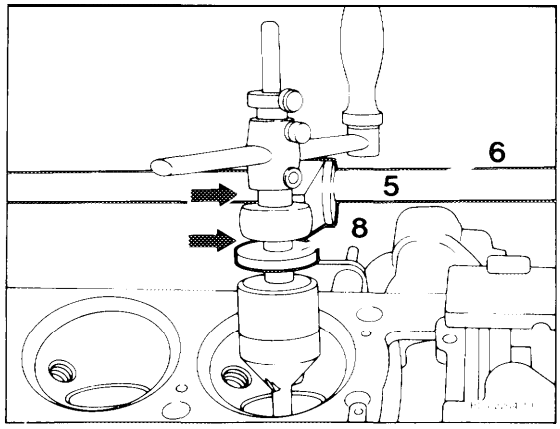
Clamp cylinder head in the clamp fixture for dismantling and machining. Machine valve seats with valve seat turning equipment, with valve seat grinder or valve seat miller. The location of the hydraulic valve clearance compensating elements must be checked after machining the valve seat Inserts and, if required corrected (05211).

Machining valve seats

1 Machine valve seat (45") (see tool manufacturer's operating Instructions).

Caution!

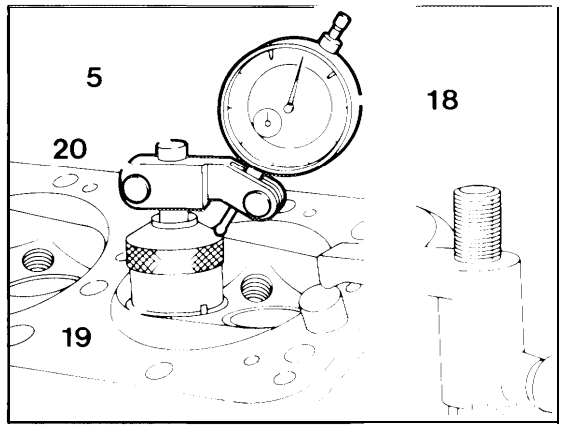
Only loosen pilot (5) when eccentricity of the valve seat has been checked.



6 Clamping fixture
8 Forward feed operation

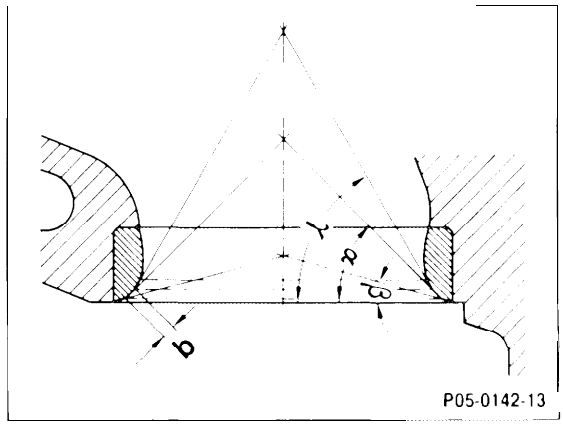
2 Check eccentricity of valve seat (max. **0.03** mm).

Slide fitting sleeve (19) and dial gauge holder (20) and dial gauge (18) onto the pilot (5).



3 Measure valve seat width (b) and, if required make a 15" adjustment at the top (β) and 65" adjustment at the bottom (γ).

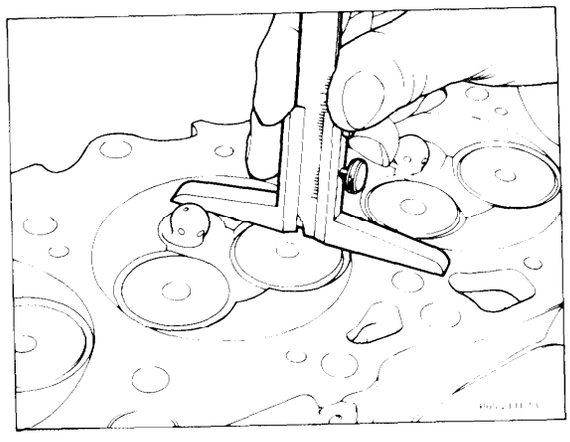
Valve seat width (b)
Intake: 1.2 - 1.7 mm
Exhaust: 1.5 - 2.0 mm.



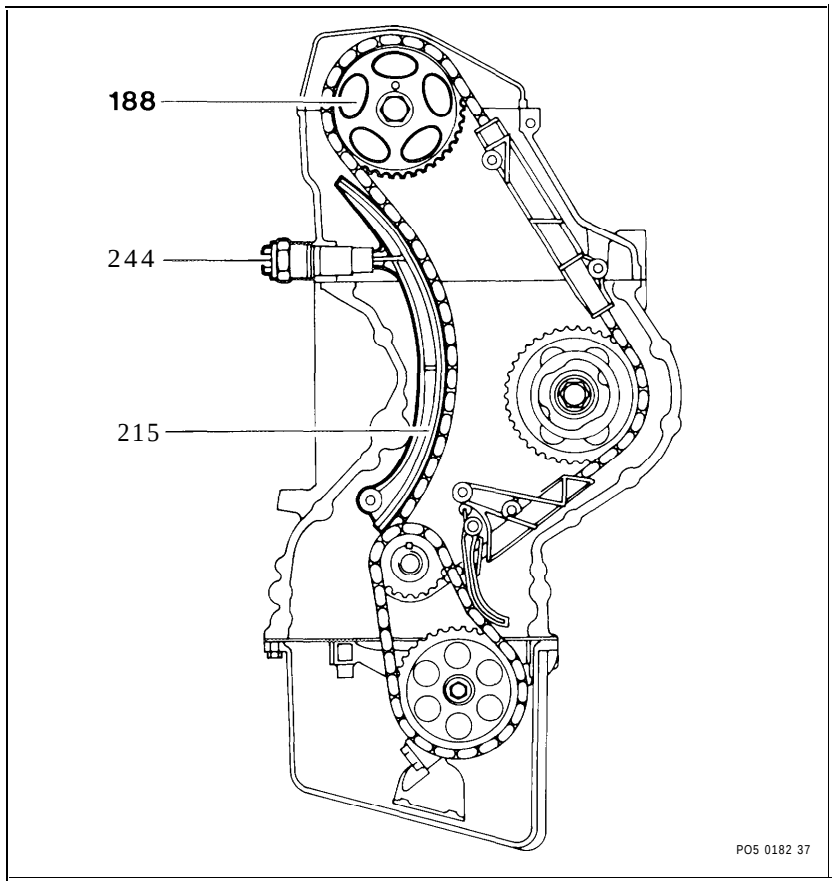
4 Insert valves and measure distance (a).

Distance (a) 0.1 - 0.5 mm.

If (a) IS outside tolerance, replace valve seat insert (05290).



OS-31 0 Removing and installing chain tensioner



Chain tensioner (224)	remove, install, 65 Nm. Replace sealing ring and install chain tensioner filled with SAE 10 engine oil.

Filling chain tensioner with engine oil:

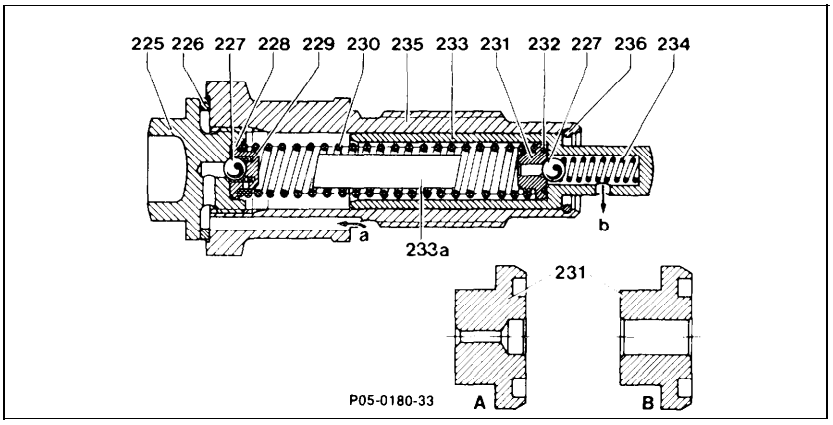
Place chain tensioner with the plunger bolt downwards in SAE engine oil until over the collar on the hexagon. Press plunger up to the stop 7 - 10 times slowly with the aid of a press or power drill.

It should be possible to compress the chain tensioner quite slowly, evenly and with little effort after filling with oil.

Note

A revised valve disk (231) has been fitted in the chain tensioner in order to avoid peak pressures of the chain tensioner on the tensioner rail.

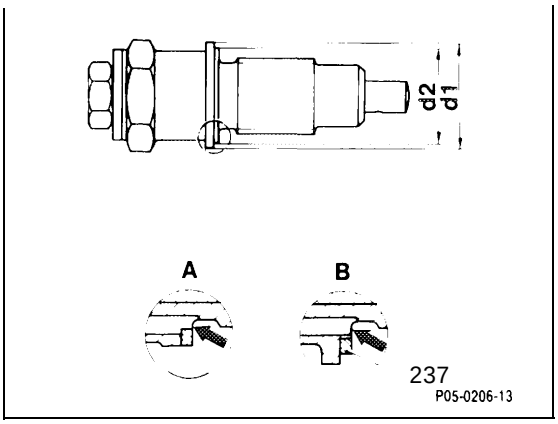
225	Sealing plug
226	Aluminium gasket A 25x30
227	5 mm Ø ball
228	Ball guide
229	Compression spring
230	Compression spring
231	Valve disk
232	0-rrng
233	Plunger
233a	Filler piece
234	Compression spring
235	Housing
236	B 16 snap ring
a	Supply bore from cylinder head
b	To oil pan
A	Former design
B	Current design



The outside diameter of the sealing surface on the chain tensioner housing has been enlarged by 2 mm. This necessitates a sealing ring (237) having dimensions of 27 x 32 mm (previously 25 x 30).

This revision prevents the formation of burrs on the sealing ring (picture, circular cut-out) when tightening the chain tenstoner.

This chain tensioner can also be installed in vehicles of earlier manufacture.



d1 32 mm
d2 27 mm

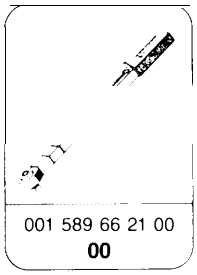
A Previous design
B Revised design

Production breakpoint: 07/87

Model	Engine	Engine end No.		Vehicle identification end No.	
		Manual transmission	Automatic transmission	A	F
124.133 124.193	603.960	–	013741	*	*
126.125	603.961	–	013507	*	*
201.126	602.911	047439	010643	*	*
201.128	602.961	–	001540	*	*

* not recorded

Special tool

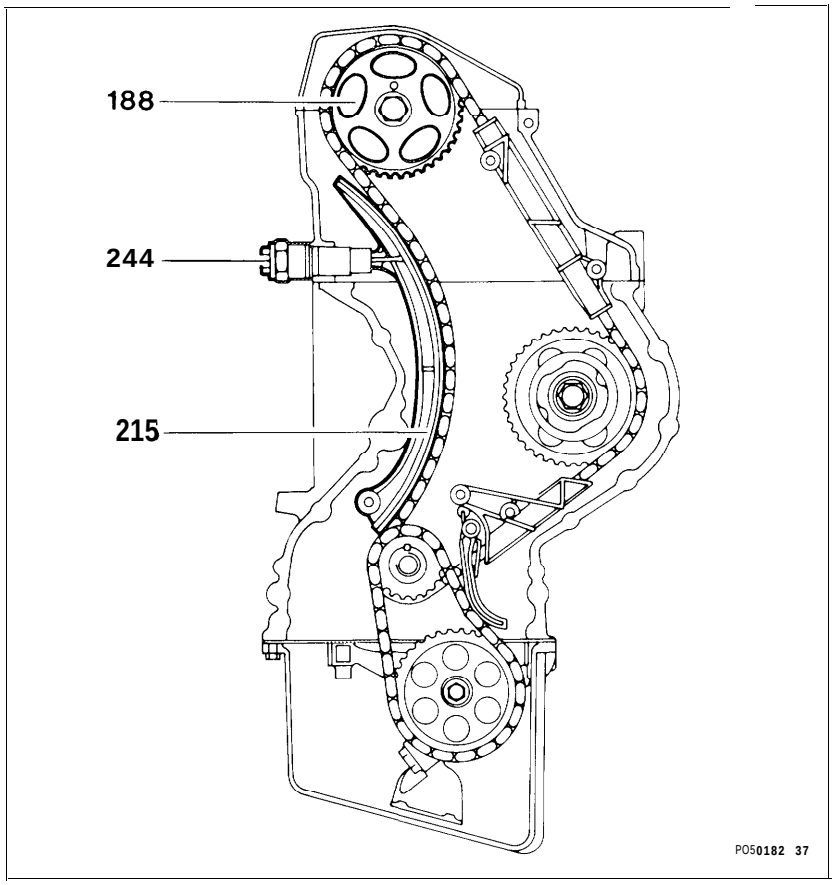


001 589 66 21 00
00

05-320 Renewal of timing chain

Preceding work:
Cylinder head cover removed.
Injection nozzles removed (07.1-230).
Fan and fan shroud removed (20-312 or 20-335).

Operation No. of Operatron Texts and Work Units, Standard Texts and Flat Rates . 05-7601



Chain tensioner (244)	Remove and install (05-310).
Camshaft timing gear (188)	check for scores and pitting (Number 2).
Timing chain	separate, mount new timing chain with connecting link to the old timing chain, turn engine and raise old timing chain and detach (Numbers 3 - 5).

Caution!
The timing chain must remain in engagement on the camshaft and crankshaft gear as the engine is turned.

Timing chain	..	insert connecting link from behind and rivet the link pins individually with assembly tool 000 589 58 43 00 (Numbers 6 - 10). Tightening torque of spindle 30 - 35 Nm.
Link pin rivet	..	check (Number 11).
After installation	..	turn crankshaft, check adjustment marking at TDC position (Number 13).

Note

Since 10 86 timing chains from an additional manufacturer have been fitted (Daido).

Identification: DID and 06BD on outer clip of the timing chain.

Production breakpoint: 1 0/86

Model	Engine	Engine end No.		Vehicle identification end No.	
		Manual transmission	Automatic transmission	A	F
124.133 124.193	603.960		005200-005645	351660-358256	024286-024446
126.125	603.961	–	**006408-006754**	290826-293731	*
201.126	602.911	029125-029709	007079-007246	335707-338278	287778-291247
201.128	602.961	–	000107-000107	335707-338278	*

* not recorded

Since 02 89 timing chains have increased clearance sleeves (Iwis Company).

Production breakpoint: 02/89

Model	Engine	Engine end No.		Vehicle identification end No.	
		Manual transmission	Automatic transmission	A	F
124.128	602.962	000008	001573	*	*
124.133 124.193	603.960	–	020941	*	*
201.126	602.911	074630	015102	*	*
201.128	602.961	–	005500	*	*

* not recorded

Since 09 89 timing chains (Daido Company) have been installed again.

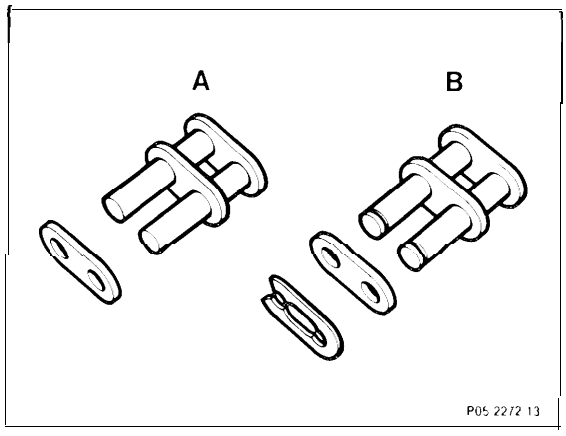
Production breakpoint: 09/89

Model	Engine	Engine end No.		Vehicle identification end No.	
		Manual transmission	Automatic transmission	A B	F
124.128	602.962	000071	002989	068356	*
124.133 124.193	603.960	**–**	**023241**	**066158**	**122989**
126.135	603.970	–	*	488196	*
201.126	1602.911	1082936	016428	533524	666204
201.128	602.961	000121	007042	*	667950

* not recorded

Repair timing chain

Only a riveted design of connecting link (A) is available for the timing chain. Design (B) is not to be used.



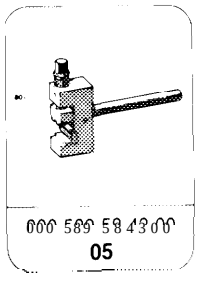
The outer clips of connecting link (A) are colored blue and its link pins have no grooves.

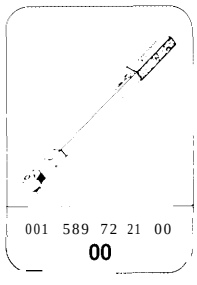
The outer clip of revised connecting link (A) must be pressed on and riveted with assembly tool 000 589 58 43 00.

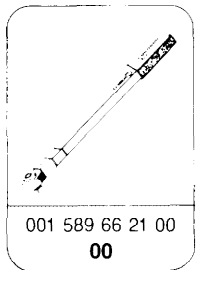
The former assembly tool 000 589 57 43 00 for connecting link with stop spring (B) can be modified with the conversion kit 000 589 58 43 80.

Part No. of the assembly tool is to be changed to 000 589 58 43 00.

Special tools







Renewal

1 Remove chain tensioner (05310)

2 Check camshaft timing gear for scores and pitting. Cover chain case with a cloth and grind off both link pins at a timing chain link.

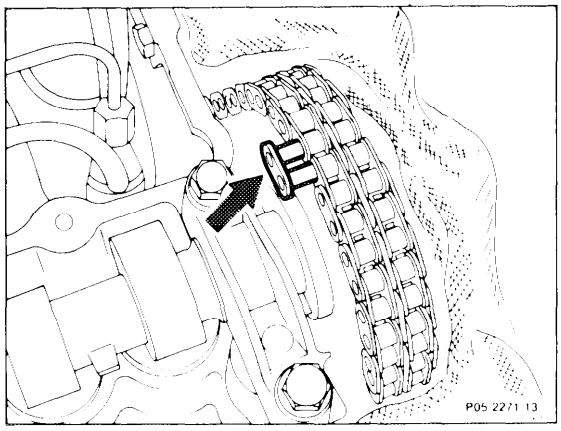
3 Mount new timing chain with connecting link on the old timing chain.

4 Slowly turn crankshaft in the direction of rotation of the engine, while simultaneously raising the old timing chain until the connecting link is located at the uppermost position of the camshaft timing gear.
Pull out the released end of the old timing chain evenly, to match pulling on the new timing chain.

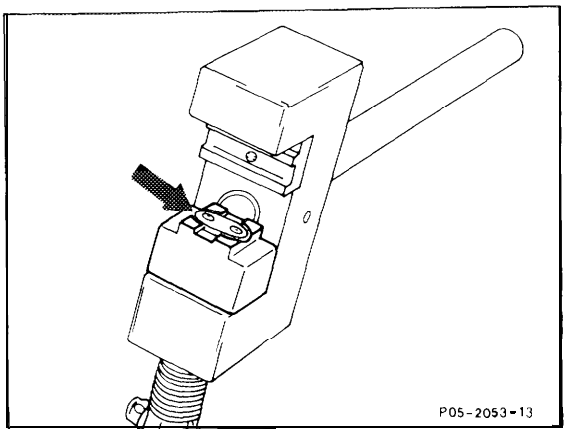
Caution!
The timing chain must remain engaged with the camshaft and crankshaft gear while engine is turned.

5 Detach old timing chain and connect the ends of the new timing chain with a connecting link. Secure ends of chain on camshaft timing gear with wire.

6 Insert connecting link in the timing chain from behind (arrow).

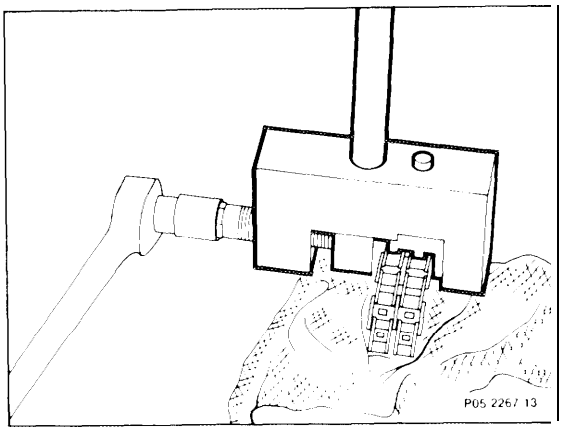


7 Place loose enclosed outer clip of the connecting link (with the IWIS marking stamped on) in assembly tool 000 589 58 43 00 (arrow). The outer clip is retained magnetically.

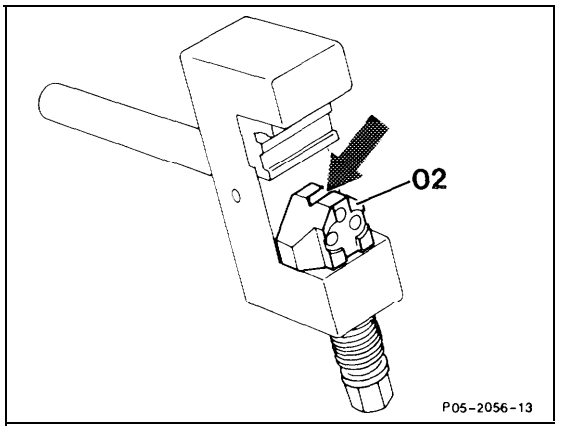


8 Put assembly tool 000 589 58 43 00 on connecting link and press on clip up to the stop.

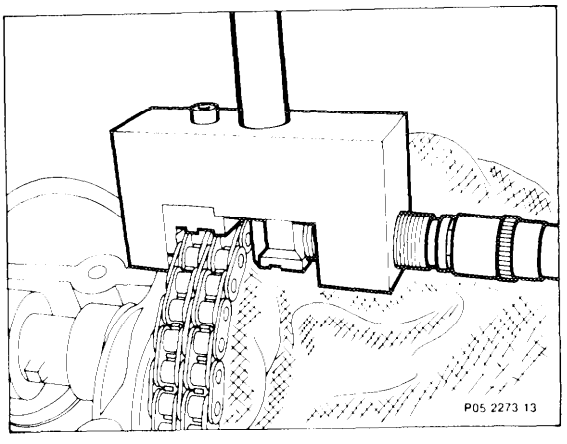
Caution!
Put clip on so that both rivet pins engage.



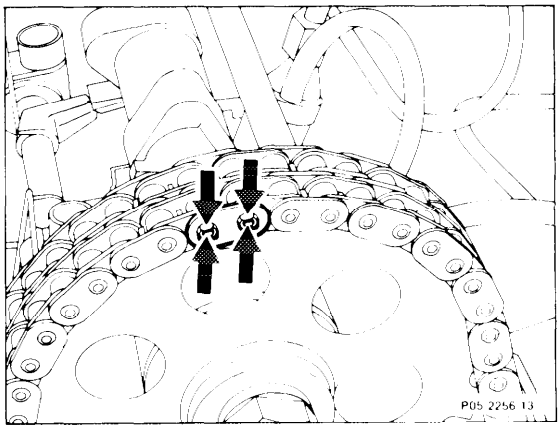
9 Turn punch (02) of assembly tool 000 589 58 43 00 so that the notch (arrow) points forwards.



10 Place assembly tool exactly over the center of the pins. Rivet the connecting link pins individually, whilst tightening spindle to approx. 30 - 35 Nm (Reference value).

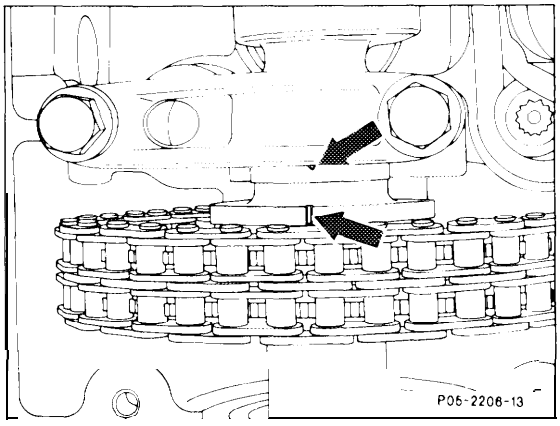


11 Check link pin rivet, if necessary re-rivet (arrows).



12 Install chain tensioner (05-310).

13 Turn crankshaft and check adjustment marking at TDC position of engine.

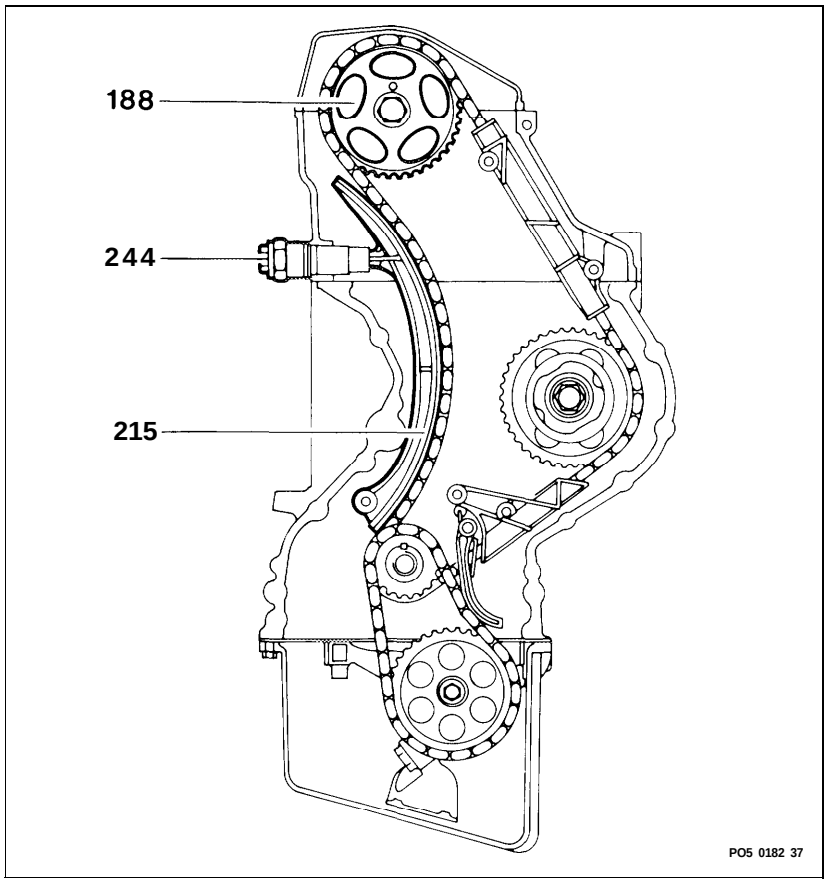


Note

If adjustment markings do not align, the camshaft timing (05-215) and start of delivery of the injection pump (07.1-I 11) must be checked.

05-330 Removal and installation of tensloner rail

Preceding work:
Cylinder head removed (01-4 15)
Timing case cover removed (01-210)
Chain tensioner removed (05-310).



Tensioner rail (215)	.....	pull off, reinstall.

Note
Plastic support of the tensioner rail cannot be replaced.

Note

Since 08 86 unhardened straight pins have been fitted for the tensioner rail bearing.

Production breakpoint: **08/86**

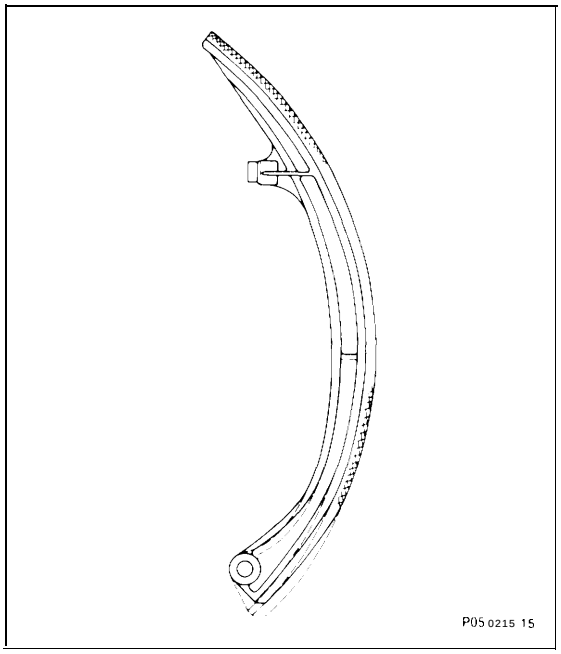
Model	Engine	Engine end No.		Vehicle identification end No.	
		Manual transmission	Automatic transmission	A	F
124.133 124.193	603.960	–	003526	313431	019062
126.125	1603.961	–	004997	278305	*
201.126	602.911	025293	006190	332559	266086

* not recorded

Data

Since 09 86 the lead-in tangent (abutment surface) on the tensioner rail has been extended, thus reducing lining wear.

Dotted line shows former design.



Production breakpoint: 09/86

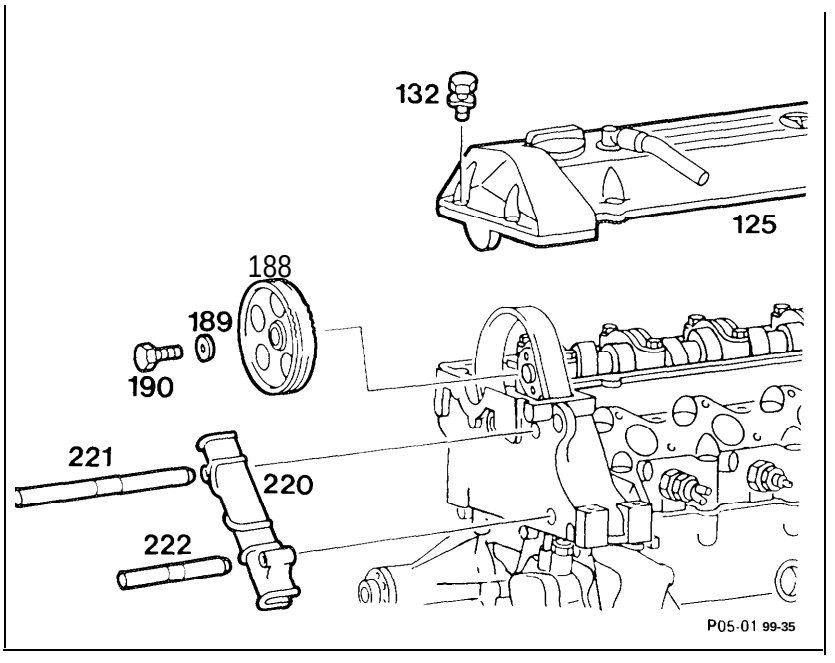
Model	Engine	Engine end No. Manual transmission	Automatic transmission	Vehicle identification end No. A	F
124.133 124.193	603.960	–	004863	342586	023347
126.125	603.961	–	006205	389319	*
201.126	602.911	028504	006859	333489	286635

not recorded

05-341 Removal and installation of guide rail

Preceding work:
Poly-V belt removed (13-345).
Chain tensioner removed (05-310)
Charge air pipe removed (turbo engines).

A. Removal and installation of guide rail in cylinder head



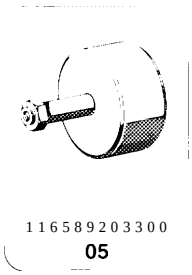
Cylinder head cover (125)	remove, install, bolt (132) 10 Nm.
With self-levelling suspension:	
Pressure oil pump drive	remove, install (05437).
Camshaft timing gear (188)	mark at timing chain. Remove, install camshaft timing gear. Different bolts (190) and washers (189) with different tightening torques. Hexagon bolt 65 Nm. Bihexagonal head bolt 25 Nm 90° (05220) (Numbers 3 - 5).

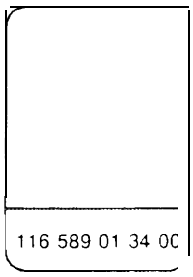
Bearing pins (221, 222)	. . . . .	remove, install. Special tools 116 589 20 33 00 and 116 589 01 34 00. Check guide blade (220), replace if necessary. (Number 6).

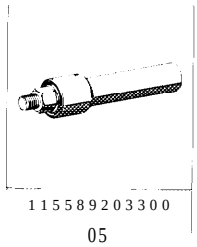
Caution!
The extractor 115 589 20 33 00 can be used together with stud 115 589 01 34 00 if the bearing pins have seized.

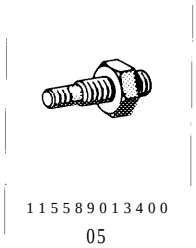
Tightening torques and angle of rotation	Nm	
Hexagon bolts on cylinder head cover	10	
Hexagon bolt on camshaft timing gear	65	
Bihexagonal head bolt on camshaft timing gear	**25**	**90”**

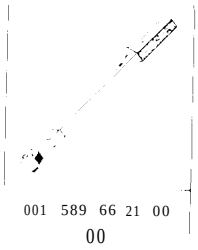
Special tools

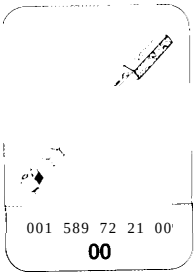












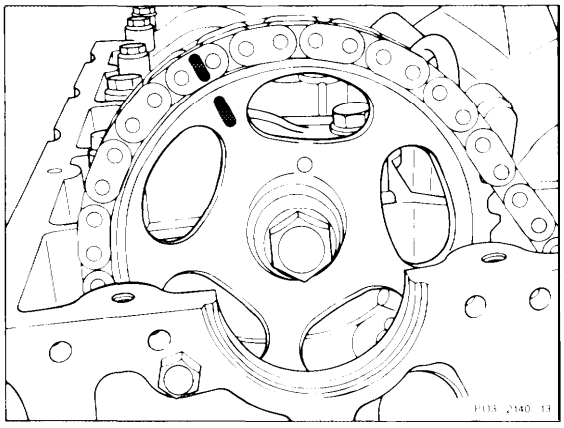
Removal

1 Remove cylinder head cover.

With **self-levelling** suspension:

2 Remove pressure oil pump drive (05437).

3 Align timing chain and camshaft timing gear.

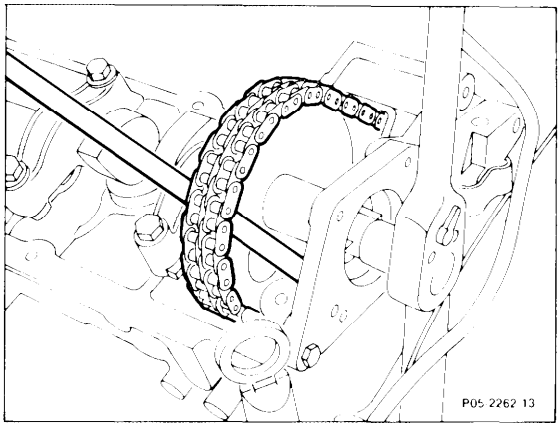


4 Remove hexagon bolt or bihexagonal head bolt on camshaft timing gear, while holding camshaft with a mandrel.

5 Remove camshaft timing gear and allow timing chain to sag.

Caution!

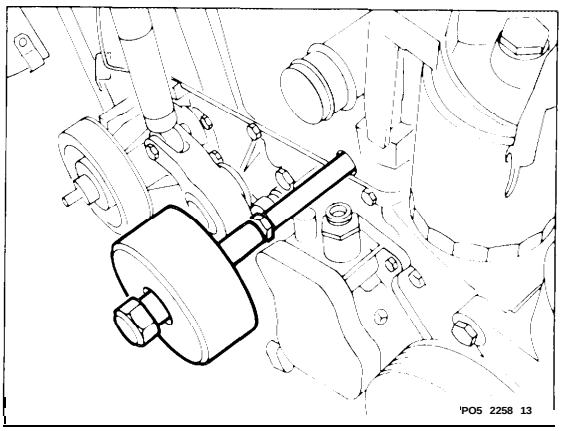
Note different bolt and washer (05220).



6 Drive out both bearing bolts with the Impact puller 116 589 20 33 00, and 116 589 01 34 00 and remove guide rail. Check guiderail and replace if necessary.

Caution!

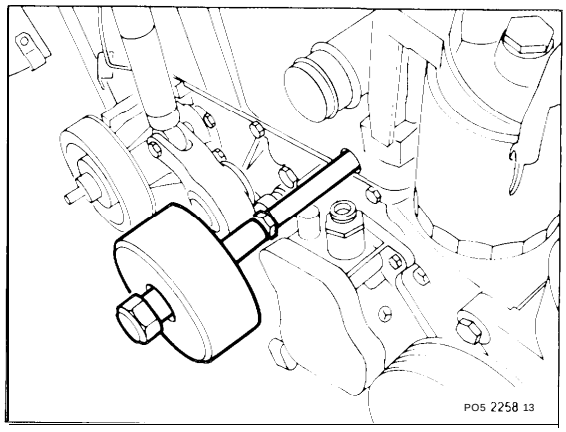
Seized bearing bolts can also be pulled out with puller 115 589 20 33 00 and stud 115 589 01 34 00.



Installation

6 Coat bearing pin collar with sealing compound.

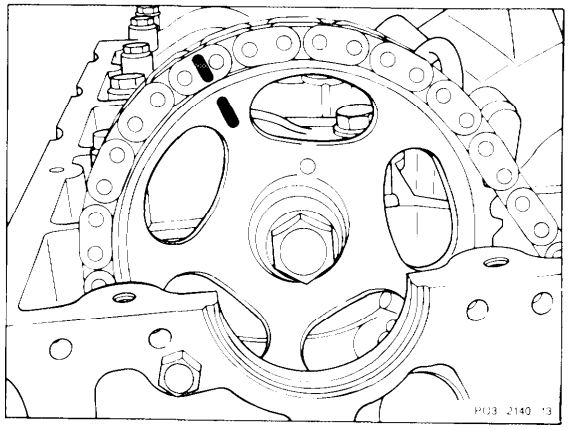
7 Insert guide rail and drive home bearing pin with impact puller 116 589 20 33 00 and 116 589 01 34 00.



8 Install camshaft timing gear according to the marking and tighten, noting the color markings.

Tightening torque and angle of rotation

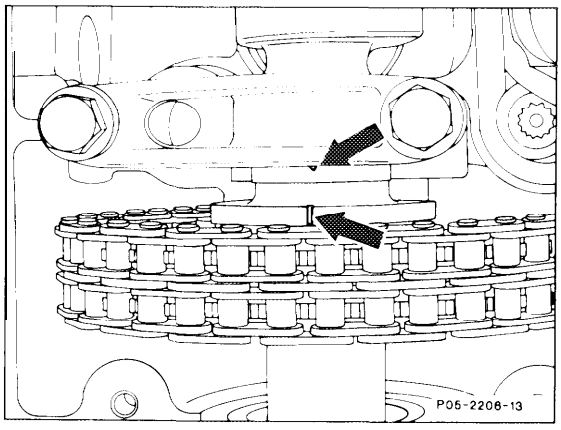
Hexagon bolt	65 Nm,
Bihexagonal head bolt	25 Nm, 90°.



9 Position engine on ignition TDC of No. 1 cylinder and check marking (arrows).

⚠ Warning

Do not turn engrne by camshaft timing gear bolt.



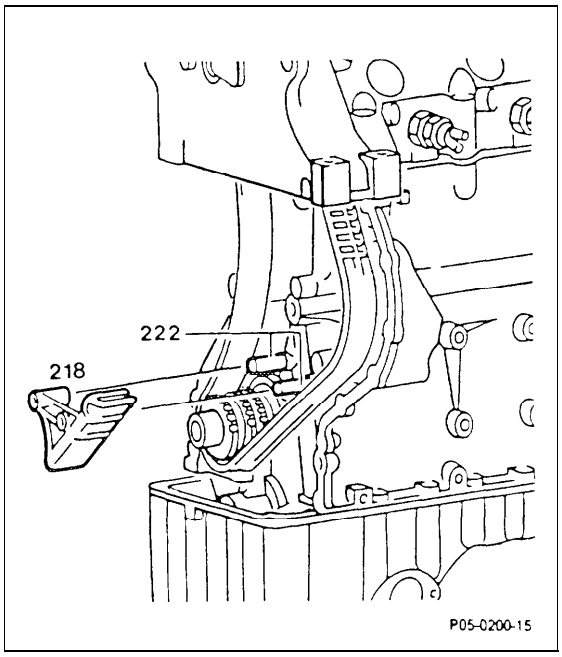
With self-levelling suspension:

10 Install pressure oil pump drive (05-437).

11 Install cylinder head cover, 10 Nm.

Preceding work:
Timing case cover removed (01-210).
Chain tensioner removed (05-310).

B. Removal and installation of guide rail in timing case



Guiding rail (218)	pull off from guiding blade bolt (222), put on. Check guiding rail, renew if necessary.

Note
Since 09 86 unhardened straight pins have been fitted for the guiding rail bearing.

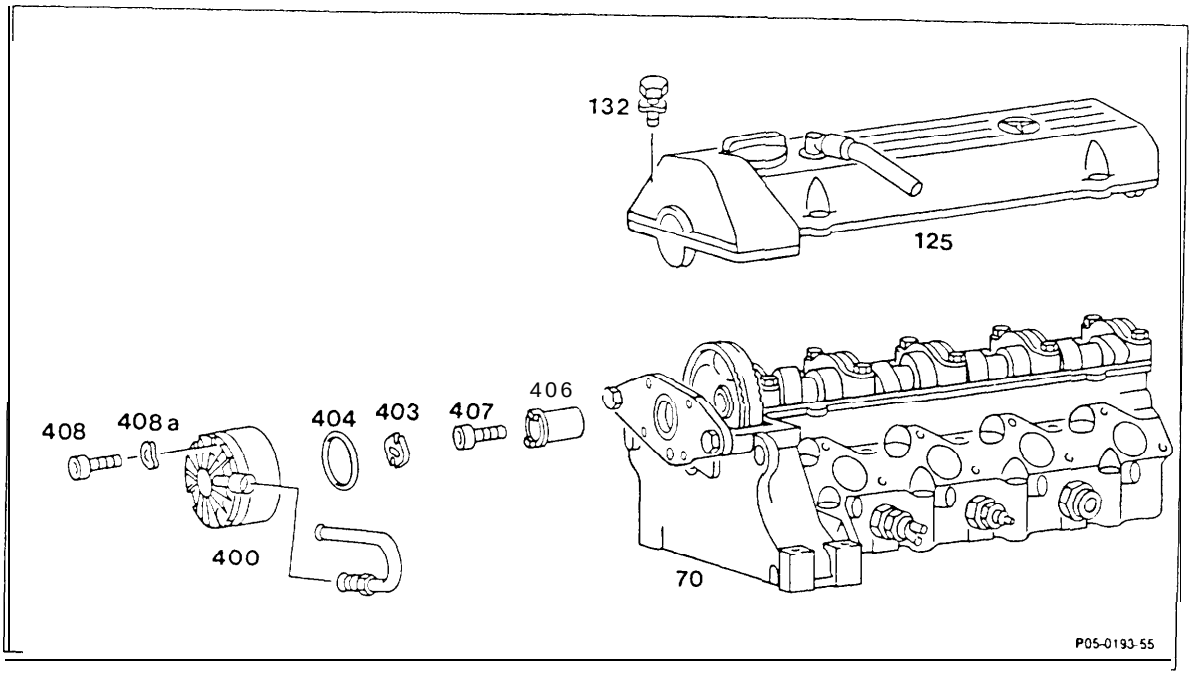
Production breakpoint: 08/86

Model	Engine	Engine end No.		Vehicle identification end No.	
		Manual transmission	Automatic transmission	A	F
124.133 124.193	603.960	–	003526	313431	019062
126.125	603.961	–	004997	278305	*
201.126	602.911	025293	006190	332559	266086

not recorded

05-437 Removal and installation of pressure oil pump drive

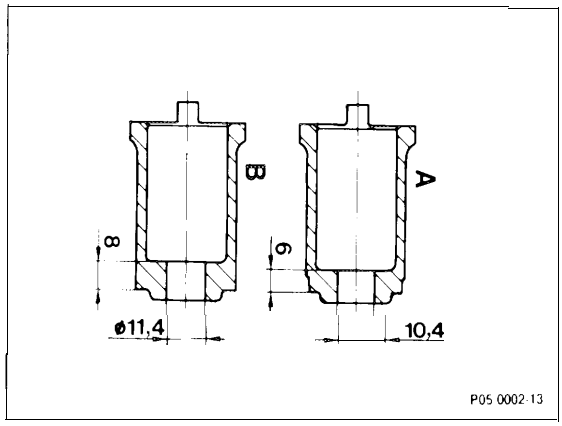
Preceding work:
Charge air pipe removed (turbo engines).



Cylinder head cover (125)	remove, Install, fixing bolt (132), 10 Nm.
Pressure oil pump (400)	unbolt, reinstall, fixing bolt (408) wrth washers (408a), 11 Nm, put pressure oil pump to one side with lines connected.
	Note Do not unbolt the upper and lower bolt with continuous thread (visible between housing and cover).
O-ring (404)	replace.
Carrier (403)	remove, install, check.
Bolt(407)	unbolt, reinstall. Note different bolt (05-220). Tightening torque and angle of rotation Hexagon bolt 25 Nm, Bihexagonal necked down bolt 25 Nm, 90”.
Carrier sleeve (406)	remove, install. Use grease when Installing. Note different design (05220).

Note

Since 11 88 the camshaft timing gear has been fitted with a bihexagonal necked down bolt M1 1 (previously hexagon bolt M10). The carrier has been revised as a result of this change.



A Previous Design
B Revised Design

Production breakpoint: 1 1/88

Model	Engine	Engine end No. Manual transmission	Automatic transmission	Vehicle [illegible] end No. A
124	602.962 603.960 603.963		000187 019336	* *
201	602.911 602.961	070124 -	014216 004561	*

* not recorded

Special tool