

PORSCHE

Technical Manual

Boxster

Repair

Contents:

Group 1

Engine

Part 2 (as of Repair Group 15)

Foreword

The workshop documentation for the Boxster model has the designation "**Boxster**" **Technical Manual** and contains **Technical Information** as well as instructions on **Repairs**.

The integration of the technical information published in the "Boxster" Technical Manual with the descriptive matter on repairs provides the user with a complex reference work that combines into one book associated or cross-referenced material of relevance to workshops and originating from various information media.

The "Boxster" Technical Manual consists of 15 folders, subdivided into the following Groups

0	Entire vehicle – General
0	Diagnosis, part 1 (up to Repair Group 45) * ¹
0	Diagnosis, part 2 (as of Repair Group 69) * ²
1	Engine, part 1 (up to Repair Group 13) * ³
1	Engine, part 2 (as of Repair Group 15) * ⁴
2	Fuel, exhaust, engine electronics
3	Transmission, manual transmission
3	Transmission, automatic transmission
4	Running gear
5	Body
6	Body equipment, exterior
7	Body equipment, interior
8 / 9	Air conditioning / Electrics
9	Circuit diagrams, part 1 (up to and including the '99 model) * ⁵
9	Circuit diagrams, part 2 (as of the '00 model) * ⁶

- *¹ The two folders with Group 0 are to be regarded as one folder; i.e. file the "Technical Information" notices only in front of the repair descriptions in the folder "Group 0 – Diagnosis, part 1" (**up to Repair Group 45**).
- *² The **second folder** "Group 0 – Diagnosis, part 2" (**as of Repair Group 69**) includes the further Repair Groups belonging to Group 0.
- *³ The two folders with Group 1 are to be regarded as one folder; i.e. file the "Technical Information" notices only in front of the repair descriptions in the folder "Group 1 – Engine, part 1" (**up to Repair Group 13**).
- *⁴ The **second folder** "Group 1 – Engine, part 2" (**as of Repair Group 15**) includes the further Repair Groups belonging to Group 1.

- *5 The two folders with Group 9 are to be regarded as one folder; i.e. file the "Technical Information" notices only in front of the repair descriptions in the folder "Group 9 – Circuit diagrams, part 1" (**up to the '99 model**).
- *6 The **second folder** "Group 9 – Circuit diagrams, part 2" (**as of the '00 model**) includes the further circuit diagrams belonging to Group 9.

The "Boxster" Technical Manual has the same structure in each folder, with the following breakdown for all Groups:

Title page, "Boxster" Technical Manual

> Foreword

Title page: "Technical Information"

> Table of Contents, Technical information
> Technical information

Title page: "Repair"

> Repair Groups: overview
> Table of Contents, repairs
> General / technical data
> Instructions on repairs

As can be seen from the breakdown, the published Technical Information is in the front part of each folder – numbered according to the Groups. The Table of Contents assigned to each Group will be periodically updated.

Following the Technical Information, separated by a title page, the instructions on repairs – assigned according to the Groups or broken down into Repair Groups – are included in the folder.

The instructions on repairs will be extended and updated by means of supplements.

Note

Sheets that already exist in the "Boxster" Technical Manual and are updated or revised and thereby exchanged by a supplement are designated "Replacement sheet". Revisions or technical modifications on pages of these replacement sheets are identified for the user with a vertical bar at the margin.

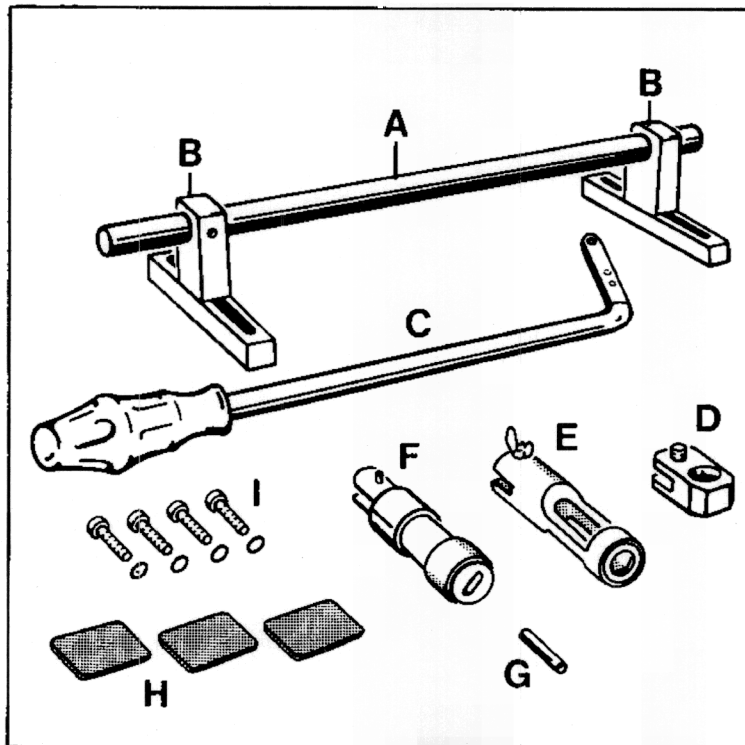
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15 70 37 Disassembling and assembling cylinder head

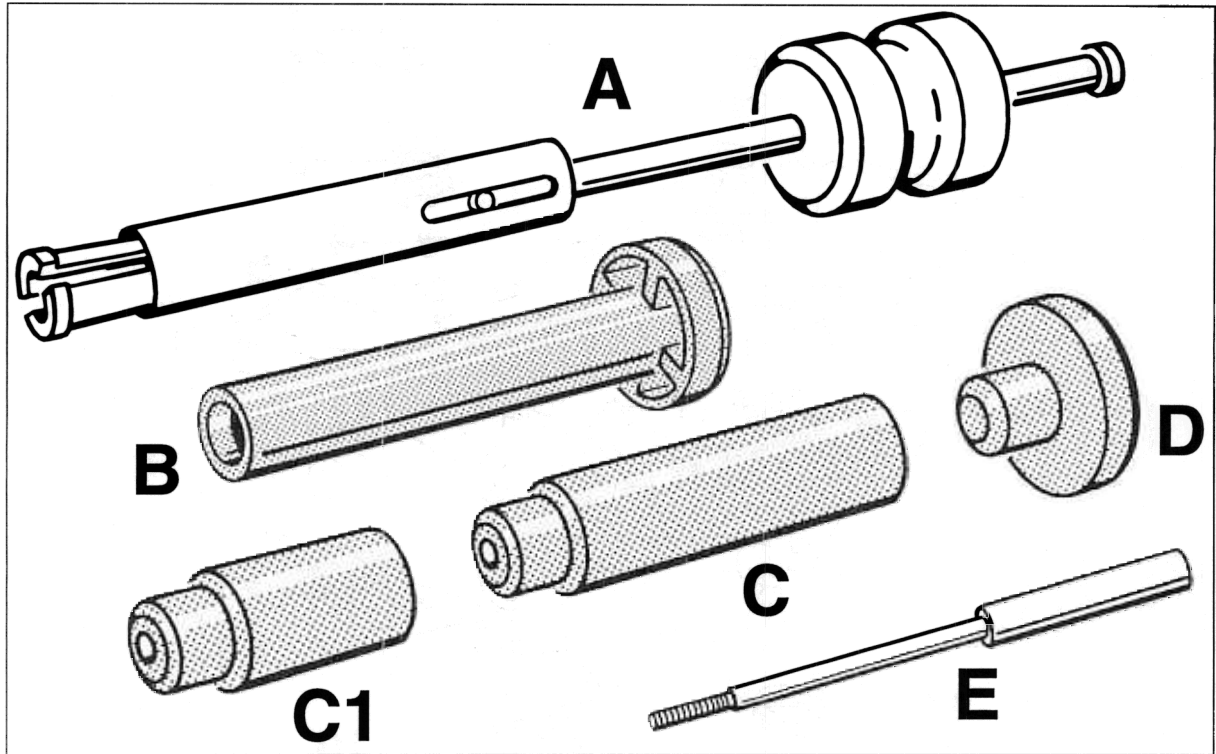
Tools (commercially available)



216-96g

No.	Designation	Special tool	Explanation
A	Shaft (∅ 20 x 450 mm)		Art. No. 6024515
B	Aluminium supports (1 pair)		Art. No. 6023620
C	Lever arm		Art. No. 6023530
D	Joint with screw		Art. No. 6024520
E	Magnetic disassembly head		Art. No. 6024650
F	Assembly head 1b for valve keys		Art. No. 6000102
G	Pressure piece 6e (3 ea.)		Art. No. 6006015
H	Pad for valve discs (3 ea.)		Art. No. 6025665
	Screws for aluminium supports (4 ea.)		(Items A to H: refer to Workshop Equipment Manual, Chapter 2.4, No. 54) Commercially available, M6 x 40

Tools

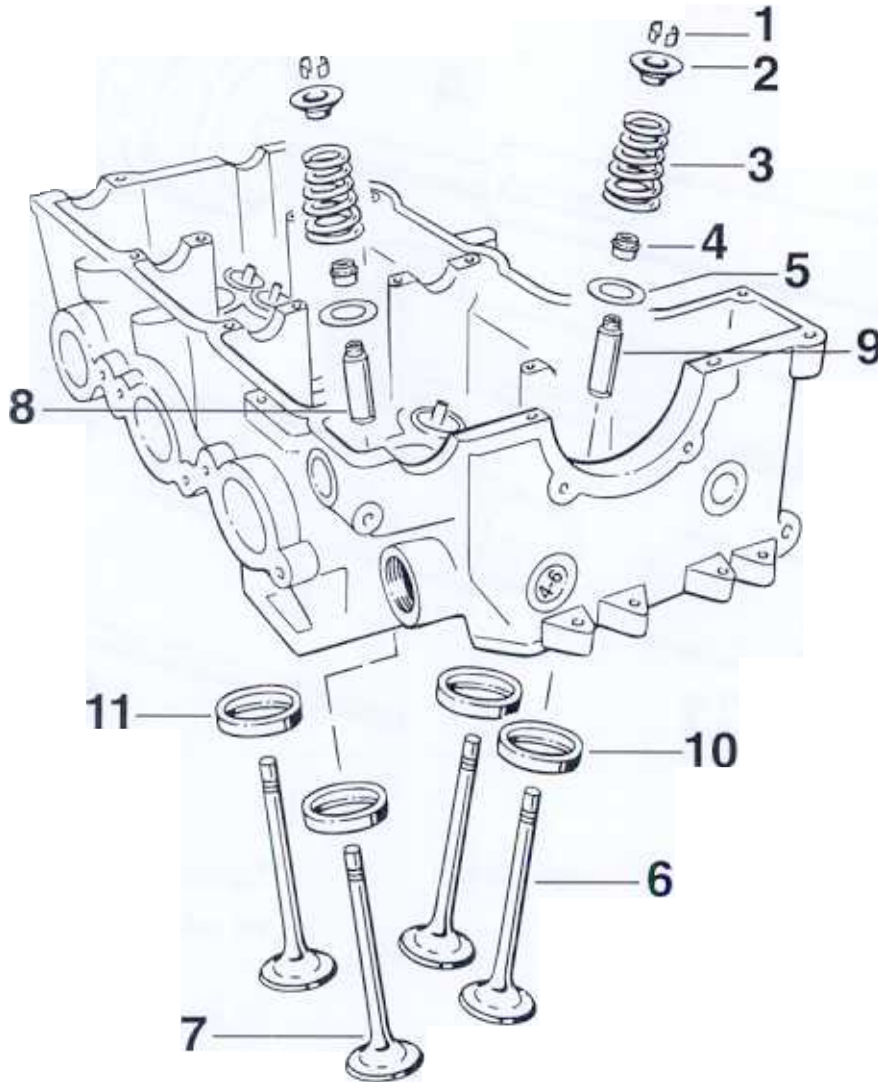


691_97

Item	Designation	Special tool	Explanation
A	Extractor for valve stem seal	3364	VW special tool
B	Press-on tool for valve stem seal	3365	VW special tool
C	Pressure piece, for fitting the oil protection tubes	9605	
C1	Pressure piece, for fitting the oil protection tubes (engine installed)	9605/1	
D	Hand pressure piece	9604	
E	Tensioning screw for relieving the tensioning elements (VarioCam)	9632	Use tensioning screw 9632/1 as of engine number 65X19696.

Disassembling and assembling cylinder head

Diagram shows cylinder head 4 - 6



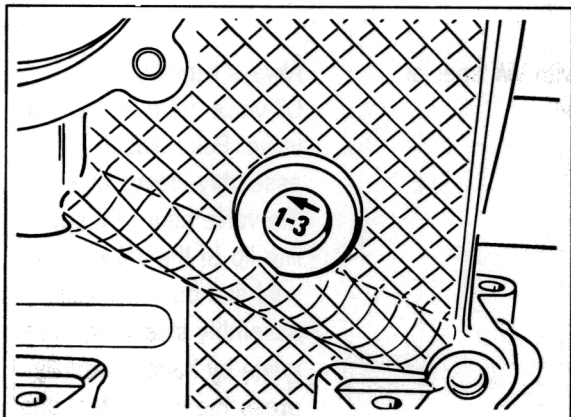
692_97

Disassembling and assembling cylinder head

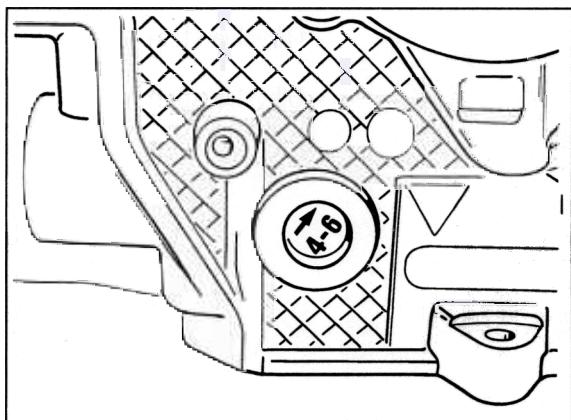
No.	Designation	Qty.	Removal	Note:	
				Installation	
	Valve collet	12			Ensure correct seating
2	Spring seat	6			
3	Valve spring	6			
4	Valve-stem seal	6	Pull off with VW special tool 3364		Always replace. Oil valve stem and install valve. Push plastic assembly sleeve over the valve stem. Oil sealing lip of the valve stem seal and push onto the assembly sleeve or valve guide by hand. Carefully press the valve stem seal as far as it will go onto the valve guide using the press-on tool, VW special tool 3365
5	Valve spring support disc	6			
6	Exhaust valve	3			Oil valve stem
7	Inlet valve	3			Oil valve stem
8	Valve guide, inlet	6			
9	Valve guide, exhaust				
10	Valve seat ring, exhaust	3			
11	Valve seat ring, inlet	3			

Assembly instructions

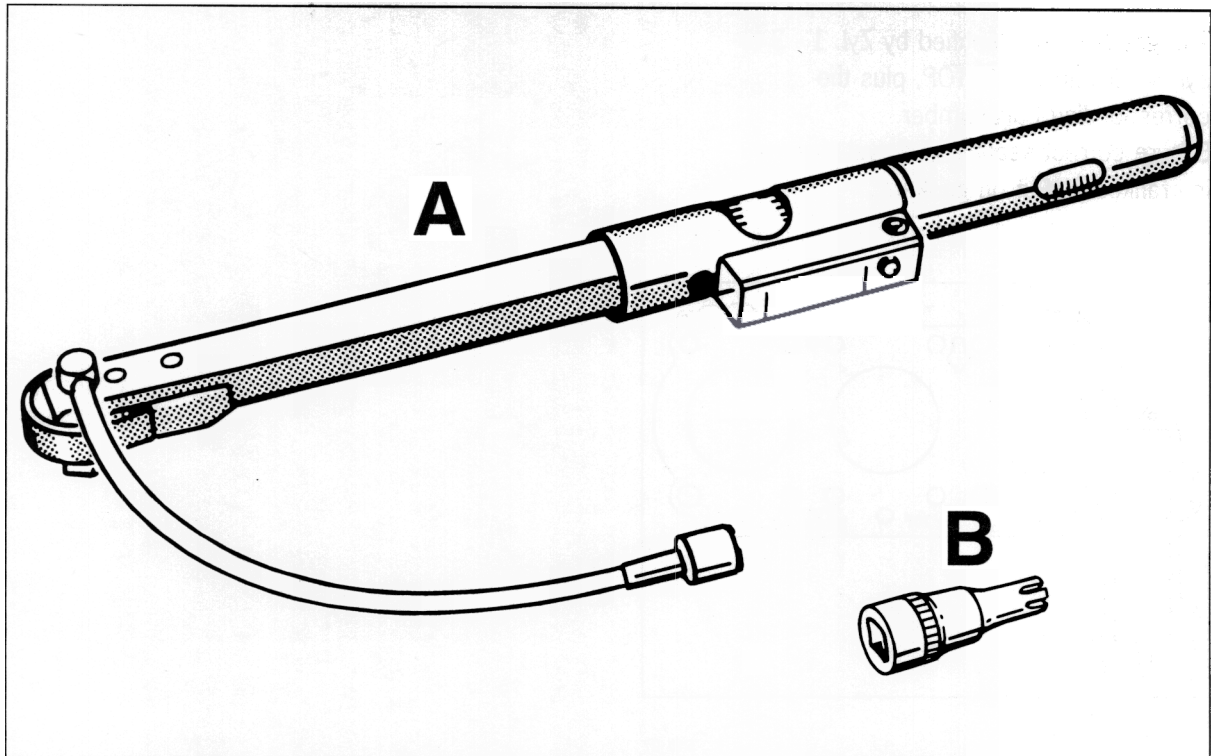
The cylinder heads differ in the area of the chain tensioners and are therefore marked on the front with 1 - 3 or 4 - 6 to prevent mix-ups.

Cylinder bank 1 - 3

96-567

Cylinder bank 4 - 6

96-568

Fastening cylinder heads**Tools**

598_97

Item	Designation	Special tool	Explanation
A	Torque angle Torque wrench		Refer to Workshop Equipment Manual, Chapter 2.4, No. 88
B	Socket wrench insert Torx T50	9633	
	Socket wrench insert Torx T55	Commercially available	As of engine number M962065X02485 (modified cylinder head screws)

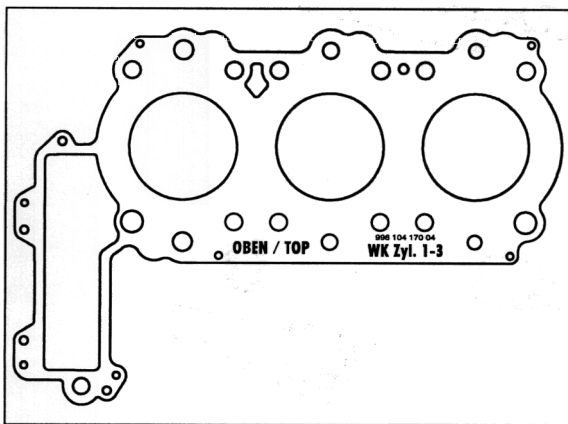
Fastening cylinder heads

1. Fit cylinder head gaskets.

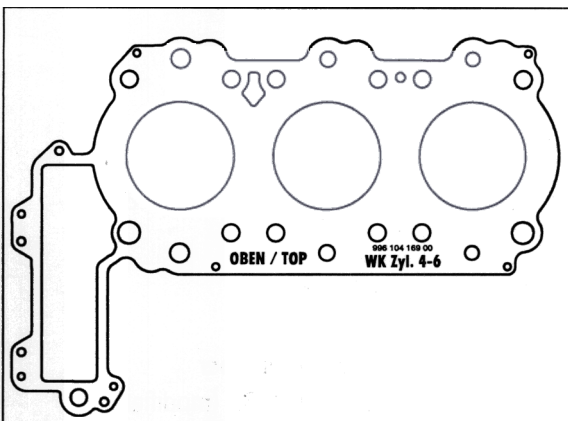
Note

The gaskets are identified by Zyl. 1 - 3 or Zyl. 4 - 6 with OBEN/TOP, plus the corresponding part number.

Ensure correct seating of dowel sleeves in crankcase. Put on gaskets.



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2. Fasten cylinder heads.

Moisten cylinder-head screws thinly
with engine oil.

Tightening sequence of the cylinder-head screws

Initial tightening or tightening to flatten

1st step: 30 Nm (22 ftlb.)

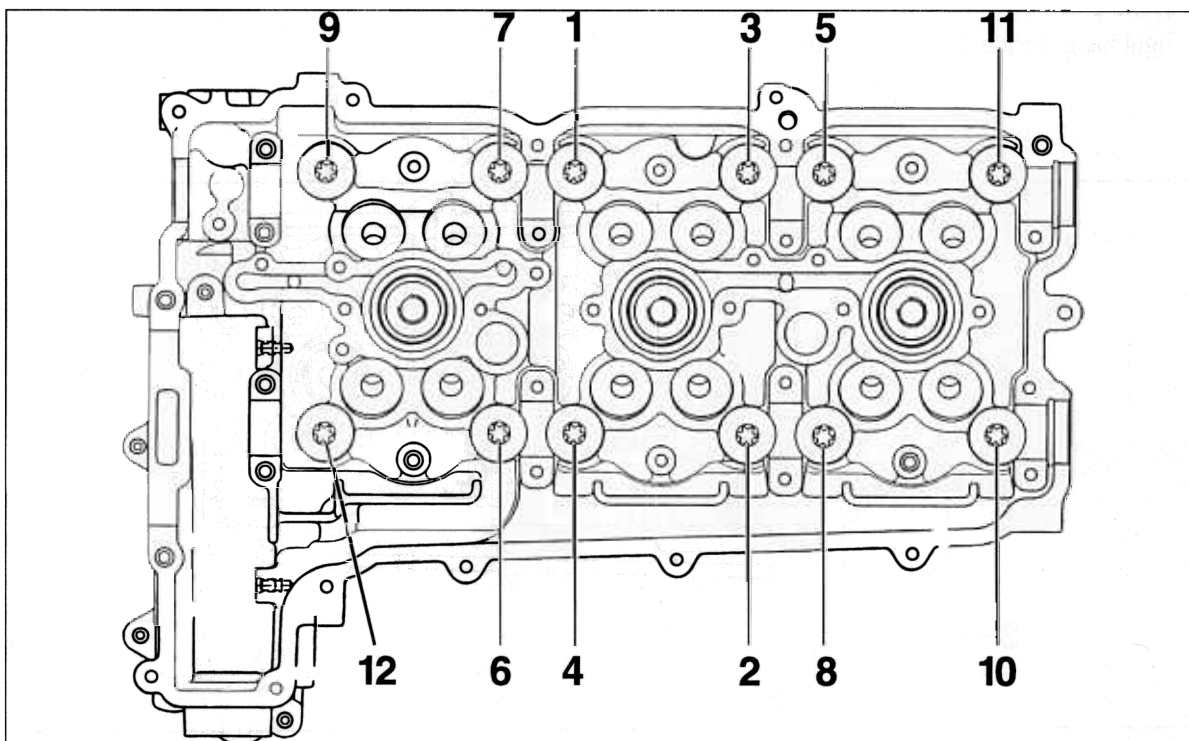
2nd step: Completely loosen cylinder head screws

Final tightening

1st step: Application torque 20 Nm (15 ftlb.) according to **prescribed**
tightening sequence

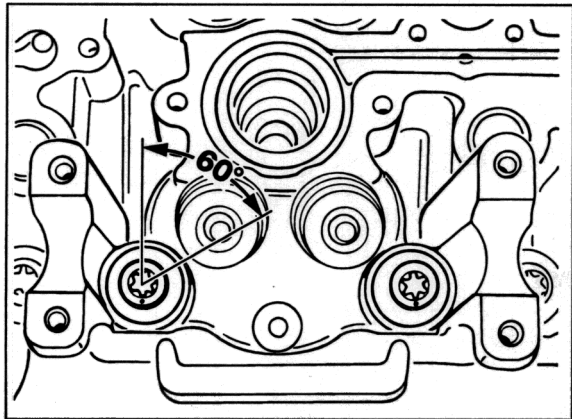
2nd step: Torque-angle tightening 1 x 60° ± 2° in same sequence

3rd step: Torque-angle tightening 1 x 60° ± 2° in same sequence



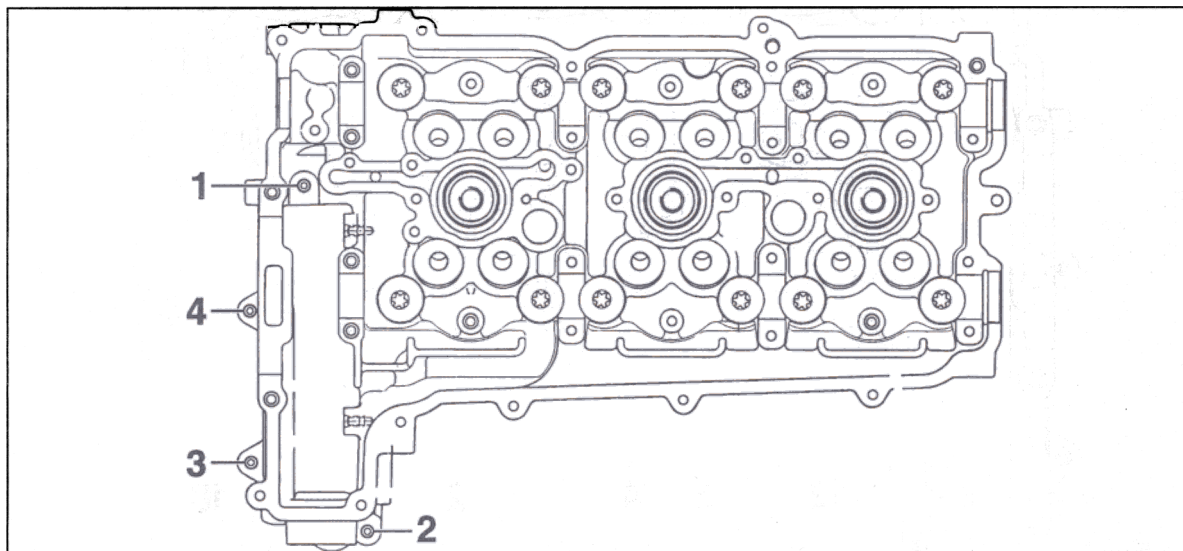
652_97

Diagram shows torque-angle tightening with 60°.



97-273

3. After tightening the cylinder-head screws, additionally screw in four pan-head screws M6 x 35 (with captive washers) in the area of the chain box.
Tightening torque 10 Nm (7.5 ftlb.)



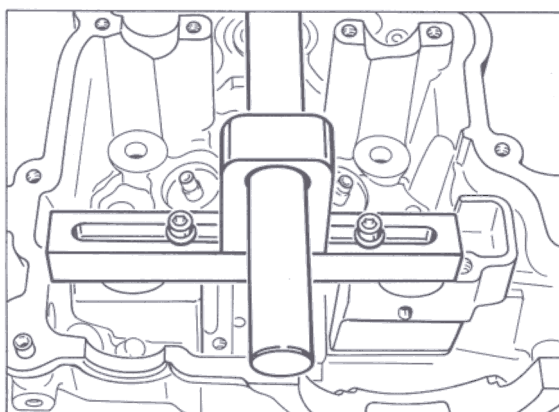
637_97

15 65 19 Removing and installing valve springs

Use special tool from the Sauer company

Removal

1. Put shim plates under the valve discs (3 ea.).
2. Mount shaft with aluminium supports on the cylinder head. Fasten cylinder head to the workbench with screw clamps.

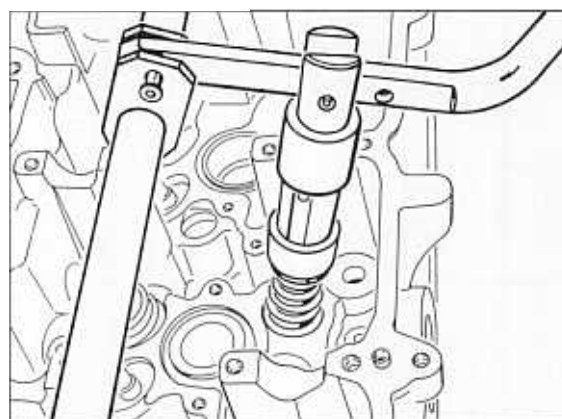


217 - 96

Note

Put the screw clamps only on the aluminium supports, under no circumstances on the sealing surface.

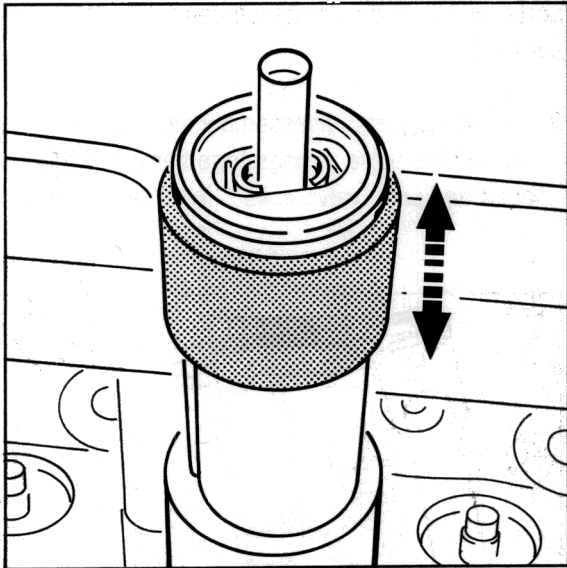
3. Fasten magnetic disassembly head to lever arm. Press valve springs together in cylinder head and undo valve collets from valve stem.



219 - 96

Installation

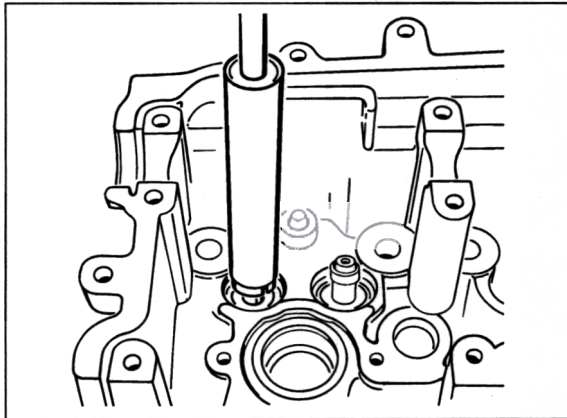
1. Fasten assembly head to lever arm. Shift sliding sleeve accordingly and lay the valve collets in the assembly head. Lightly oil valve collets, valve-stem end and valve spring seat.
2. Insert valve spring support disc, valve spring and valve spring seat into cylinder head and press together with the assembly head. With slight pressure, allow valve collets to engage. The valve collets are then automatically positioned at the right point.



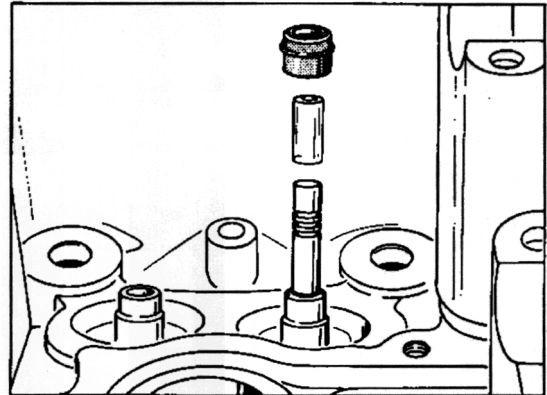
220 - 96

15 63 19 Removing and installing valve-stem seal**Removal**

Engage VW special tool 3364 on rib of valve-stem seal and pull out.



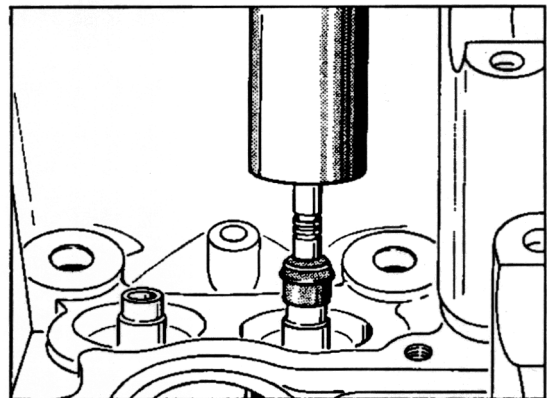
448-97



223-96

Installation

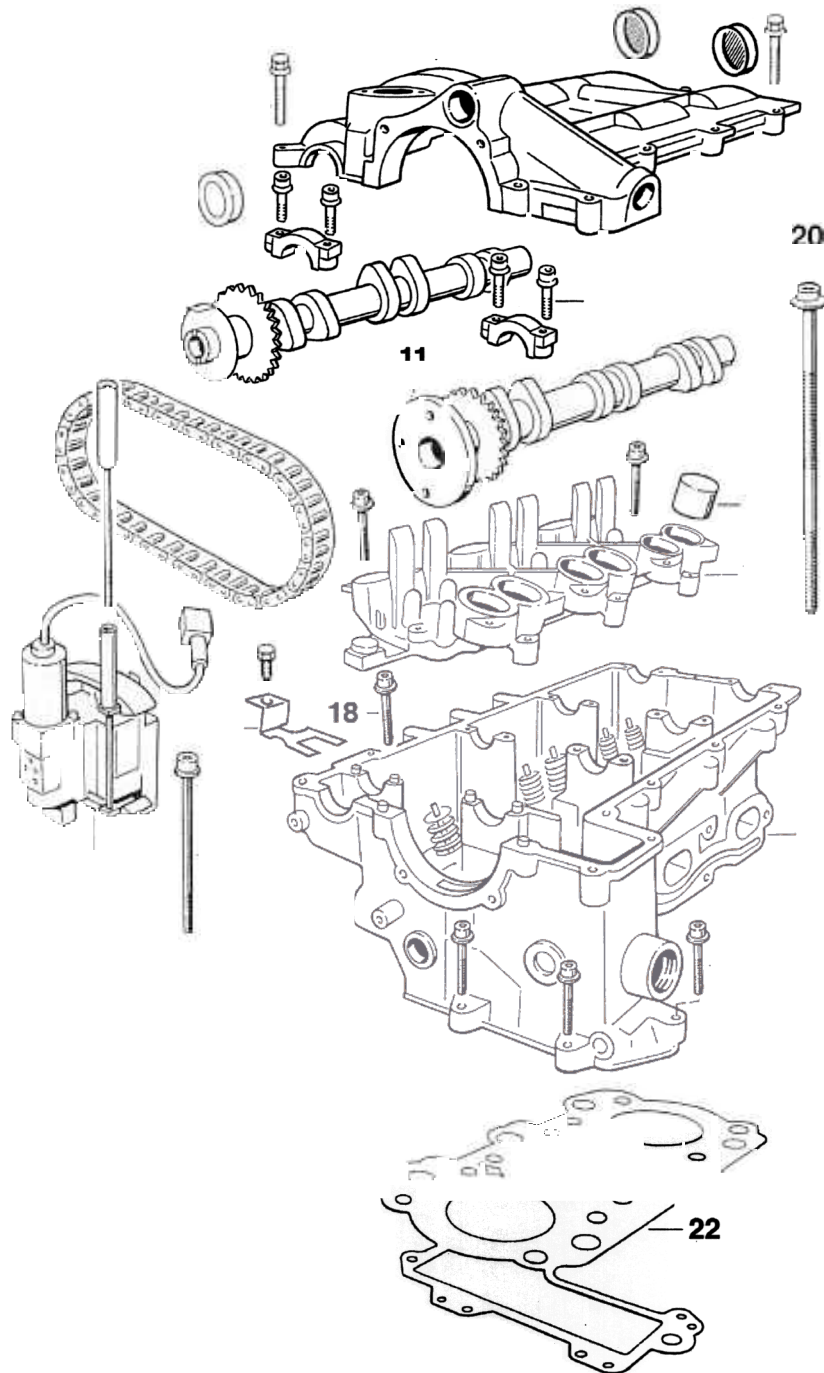
Fit original valve spring support disc. Slide plastic assembly sleeve (\varnothing 6 mm) onto valve stem. Oil sealing lip and seat of valve-stem seal, put on by hand and, with assembly mandrel (VW special tool 3365), gently tap as far as the stop on the valve guide. Remove plastic sleeve.



224-96

1.05.1 Removing and installing camshafts

Preparation shows cylinder head



Removing and installing camshafts

No.	Designation	Qty.	Removal	Note:	
				Installation	
1	Hexagon-head bolt M6 x 30	23			Tightening torque 13 Nm (10 ftlb.)
2	Cylinder head cover	1	Protect sealing surface against damage		Apply silicone Type 1209 from Messrs. Drei Bond on sealing surface. Compare pairing numbers with cylinder head and bearing saddles
3	Camshaft cover	3			Remove any emerging silicone material. Fit cover dry. Drive on cover with a plastic hammer as far as it will go.
4	Tensioning screw (Tensioning screw is already fitted on new chain tensioner at the transport lock)	1			Remove tensioning screw once both camshaft bearing saddles have been fastened.
5	Pan-head screw M6 x 35	4	Attach holding down device (special tool 9611) before unscrewing the pan-head screws		Attach holding-down device (special tool 9611) before tightening the pan-head screws.
6	Bearing saddle for outlet camshaft	1			Observe code (A) and pairing number, refer to Assembly Instructions.
7	Bearing saddle for inlet camshaft	1			Observe code (E) and pairing number, refer to Assembly Instructions.
8	Pan-head screw with captive washer M6 x 95	3			Tightening torque 10 Nm (7.5 ftlb.)

No.	Designation	Qty.	Removal	Note:	
				Installation	
9	Tensioning element for camshafts	1	Relieve with the special tool, tensioning screw 9632, before removal of the camshafts		Remove tensioning screw 9632 only after the camshafts or tensioning element has been fastened on the cylinder head
10	Timing chain	1			See Assembly instructions
11	Exhaust camshaft	1			Check for wear (scoring), observe identification
12	Inlet camshaft	1			Check for wear (scoring), observe identification
13	Valve tappet	12	Do not interchange; store in suitable place		Check for wear (scoring)
14	Pan-head screw with captive washer M6 x 35	15			
15	Guide for valve tappets	1			Tightening sequence: tighten from the inside to the outside. Check for wear (scoring)
16	Hexagon-head bolt M6 x 16	1			
17	Shield (fitted only on cylinder head 1 - 3)	1			Fit before installing guide for valve tappets
18	Pan-head screw with captive washer M6 x 35	1			Fit before installing the shield
19	Pan-head screw with captive washer M6 x 35	3			

No.	Designation	Qty.	Removal	Note:	
					Installation
(20)	Cylinder-head screw M10 x 234	12			Always replace, or replace by cylinder-head screw M10 x 230 (10.9)
20	Cylinder-head screw M10 x 230 (10.9)	12			Can be re-used
21	Cylinder head	1	Ensure sealing surfaces are protected from damage; use suitable pad		Compare pairing numbers with cylinder head cover and bearing saddles. Cylinder heads are identified with 1 - 3 or 4 - 6. See Assembly instructions
22	Cylinder-head gasket	1			Always replace. The gaskets are identified by Cyl. 1 - 3 or Cyl. 4 - 6 and the corresponding part number. When they are fitted, the cylinder-head identification or the part number must face downward toward the exhaust side.

Note

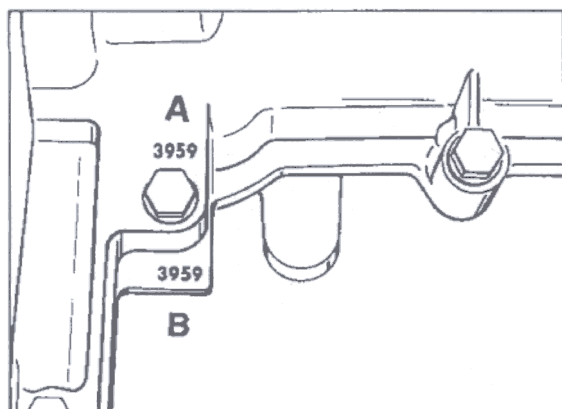
Magnetised tools or magnets must not be used when removing and installing valve tappets (flat-base tappets).

A suitable removal tool is a rubber suction cup, for example.

Assembly instructions

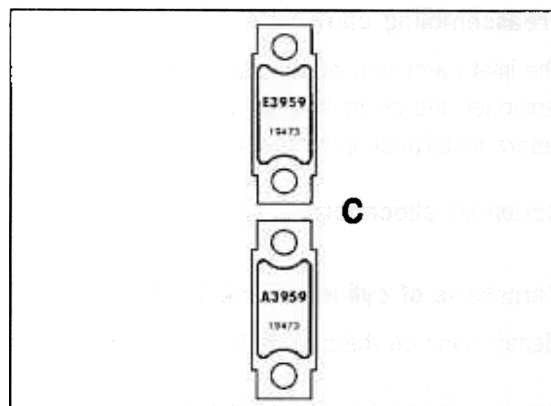
Pairing numbers or identification for cylinder head, cylinder-head cover and camshaft bearing saddles

Cylinder head, cylinder-head cover and camshaft bearing saddles were machined together and must always be installed together. Observe pairing numbers.



400-96

A – Pairing number, cylinder-head cover
B – Pairing number, cylinder head



401-96

C – Pairing number of the two bearing saddles

Note

The letters E or A before pairing numbers mean:

E = Bearing saddle for inlet camshaft
A = Bearing saddle for outlet camshaft

Assembly instructions

Preassembling camshafts

The inlet camshaft, outlet camshaft, chain tensioner and chain must be preassembled before installation in the cylinder head.

Camshaft allocation

Camshafts of cylinder bank 1 - 3

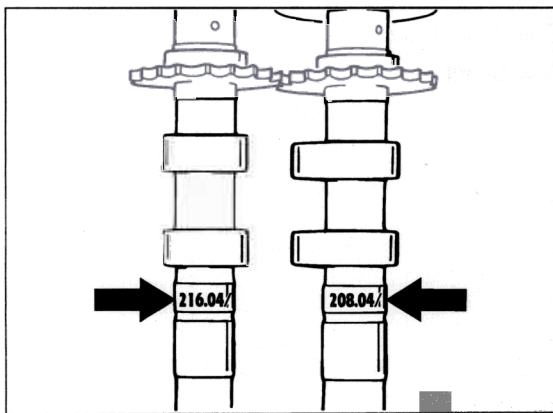
Identification on the camshaft

Inlet camshaft: 221.04/2.5 IN 13
 Outlet camshaft: 222.04/2.5 EX 13

Camshafts of cylinder bank 4 - 6

Identification on the camshaft

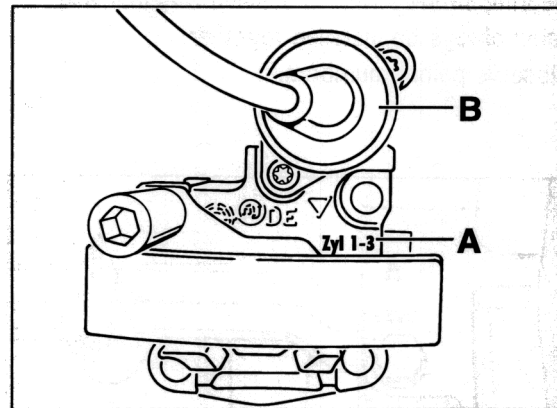
Inlet camshaft: 216.04/2.5 IN 46
 Outlet camshaft: 218.04/2.5 EX 46



516_97

Allocating chain tensioners

Identification of the chain tensioner for cylinder bank 1 - 3:



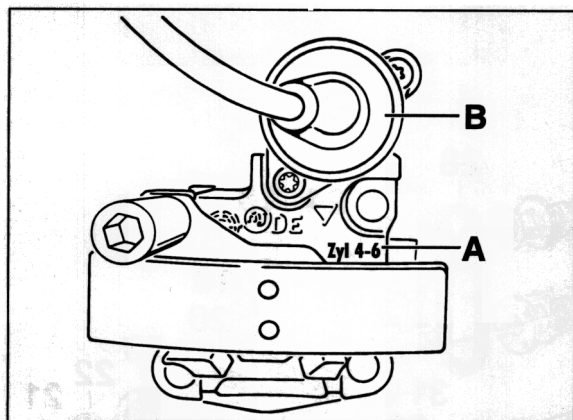
464-97

A = Cyl. 1 - 3

B = Solenoid valve surface colour black

Identification of the chain tensioner for cylinder bank 4 - 6: refer to next page.

Identification of the tensioning element
for cylinder bank 4 - 6:

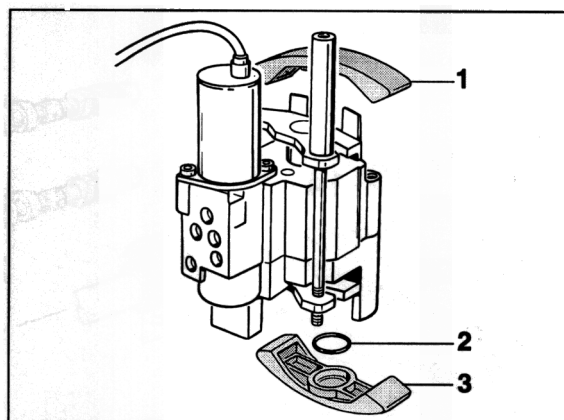


465_97

A = Cylinder bank 4 - 6
B = Solenoid valve surface colour grey

Guide rails for tensioning element

Check guide rails for wear marks and replace
if necessary



*Illustration shows tensioning element
of cylinder bank 1 - 3*

623_97

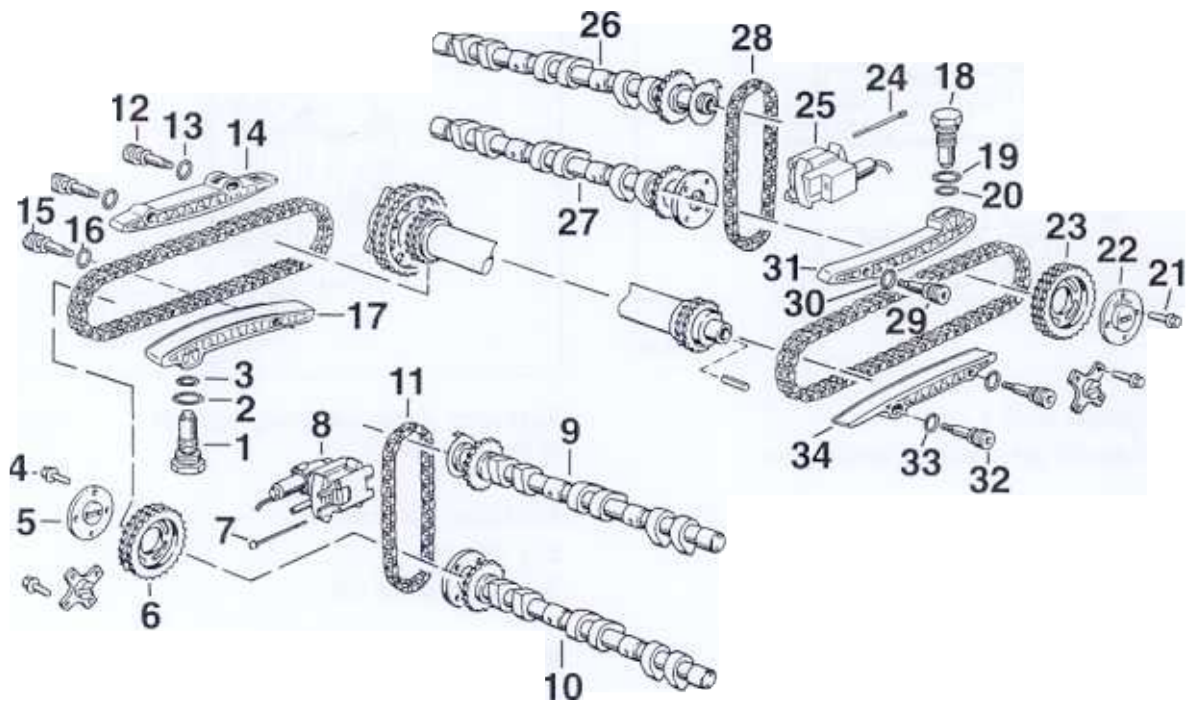
1 = Upper guide rail
2 = O-ring
3 = Lower guide rail

Note

Parts 1 to 3 are available together
as a spare-part repair set via
the Parts Service.

Removing and installing camshafts

Illustration shows camshafts with accessories



592_97

Illustration shows view from the belt pulley side

Removing and installing camshafts

No.	Designation	Qty.	Removal	Note:	
				Installation	
1	Chain tensioner on cylinder bank 1 - 3	1			Observe identification, tightening torque: 80 Nm (59 ftlb.) Wrench size 32 mm
2	Sealing ring A27 x 32	1			Always replace
3	O-ring 18.77 x 1.78	1			Replace
4	Hexagon-head bolt M6 x 15 (10.9)	4			Tightening torque 14 Nm (10.5 ftlb.)
5	Drive plate or driving plate for oil extraction pump				
6	Sprocket wheel	1			The deeper recess on the sprocket wheel must face the camshaft
7	Pan-head screw with captive washer M6 x 95	3			Tightening torque 10 Nm (7.5 ftlb.)
8	Tensioning element	1	Relieve tensioning element with the special tool, tensioning screw 9632, before removal of the camshafts. Inspect guide rails for wear marks and replace if necessary		Observe identification; remove tensioning screw 9632 only after the camshafts or fastening element has been fastened on the cylinder head
9	Inlet camshaft of cylinder bank 1 - 3	1			Identification 221.04/2.5 IN 13
10	Exhaust camshaft of cylinder bank 1 - 3	1			Identification 222.04/2.5 EX 13
11	Timing chain	1			Observe allocation to the camshafts; two chain links identified
12	Fastening screw for guide rail	2			Tightening torque 10 Nm (7.5 ftlb.)

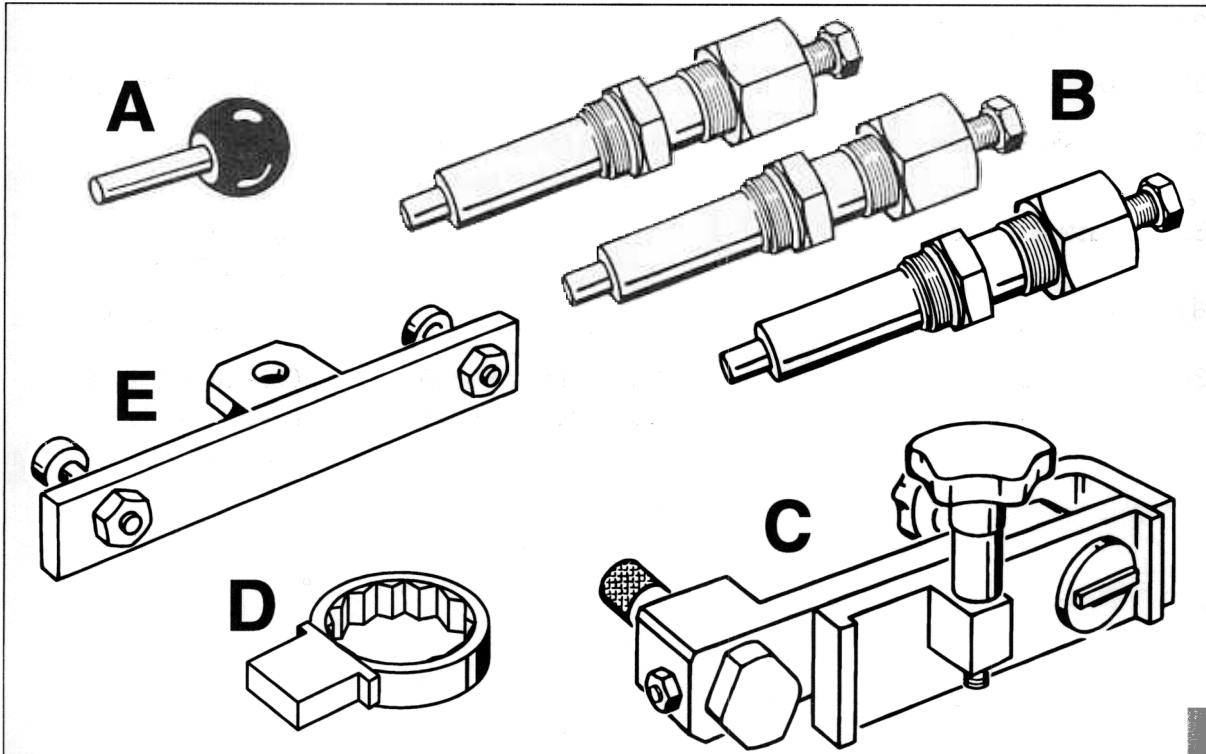
No.	Designation	Qty.	Removal	Note:	
					Installation
13	O-ring	2			Replace; grease lightly
14	Guide rail	1	Inspect for wear marks and replace if necessary		Observe installation position; slot faces the crankshaft
15	Fastening screw for tensioning rail	1			Tightening torque 10 Nm (7.5 ftlb.)
16	O-ring	1			Replace; grease lightly
17	Tensioning rail	1	Inspect for wear marks and replace if necessary		
18	Chain tensioner on cylinder bank 4 - 6	1			Tightening torque 80 Nm (59 ftlb.) Wrench size 32 mm
19	Sealing ring A27 x 32	1			Always replace
20	O-ring	1			Replace
21	Hexagon-head bolt M6 x 15 (10.9)	4			Tightening torque 14 Nm (10.5 ftlb.)
22	Drive plate Driving plate for oil extraction pump	1			
23	Sprocket wheel	1			The deeper recess on the sprocket wheel must face the camshaft
24	Pan-head screw M6 x 95	3			Tightening torque 10 Nm (7.5 ftlb.)
25	Tensioning element	1	Relieve tensioning element with special tool, tensioning screw 9632, before removal of the camshafts. Check guide rails for scoring and replace if necessary		Observe identification; remove tensioning screw 9632 only after the camshafts or fastening element has been fastened on the cylinder head
26	Inlet camshaft of cylinder bank 4 - 6	1			Identification 216.04/2.5 IN 46
27	Exhaust camshaft of cylinder bank 4 - 6	1			Identification 218.04/2.5 EX 46

No.	Designation	Qty.	Removal	Note:	
				Installation	
28	Timing chain	1		Observe allocation to the camshafts; two chain links identified	
29	Fastening screw				
30	O-ring	1		Replace; grease lightly	
31	Tensioning rail	1	Inspect for wear marks and replace if necessary		
32	Fastening screw	2		Tightening torque 10 Nm (7.5 ftlb.)	
33	O-ring	2		Replace; grease lightly	
34	Guide rail	1	Inspect for wear marks and replace if necessary	Observe installation position; slot faces the crankshaft	

Installing camshafts

Engine removed

Tools



654_97

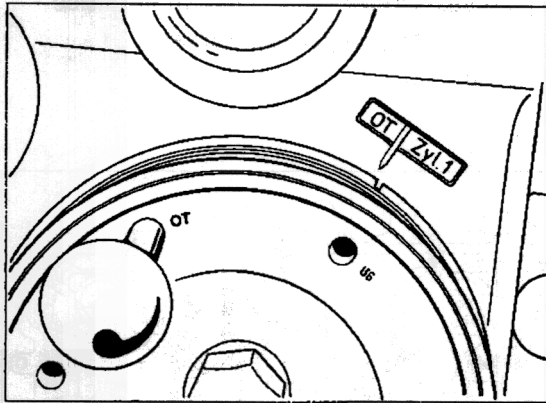
Item	Designation	Special tool	Explanation
A	Fixing pin for belt pulley	9595	1 set = 2 ea. (use short fixing pin)
B	Auxiliary chain tensioner for valve timing adjustment	9599	1 set = 3 ea.
C	Locking device for camshafts in timing position	9612	
D	Ring wrench (32 mm)		
E	Holding-down device for camshafts	9634	
	Holding-down device for camshafts	9611	1 set = 4 ea.

Installing camshafts

Requirements

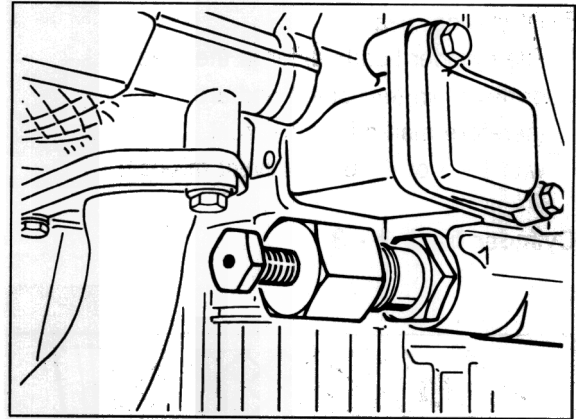
Oil pump with coolant guide housing, intermediate-shaft flange, belt pulley and guide rails fitted on the crankcase.

Move camshaft to basic position.
Turn crankshaft clockwise until the bore 1 OT (top dead centre) in the belt pulley is aligned with the fixing bore on the crankcase. Position or fix with fixing pin (short) of special tool 9595.



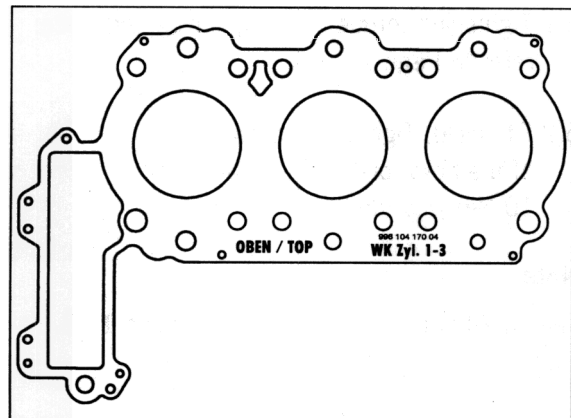
497_96

- Fit auxiliary chain tensioner of special tool 9599 on the crankcase half of cylinder bank 4 - 6.
Fit auxiliary chain tensioner without sealing ring and fasten on the crankcase **only hand-tight**. Adjust pretension with the hexagon-head bolt. The necessary pre-tension force has been achieved when the measuring pin is **flush** with the face surface of the pressure screw.



468_97

- Turn engine by 90° on assembly support until cylinder bank 1 - 3 faces upwards.
- Fit cylinder head gasket. The gasket is identified by Zyl. 1 - 3 and OBEN/TOP, plus the corresponding part number. Ensure correct seating of dowel sleeves in crankcase.

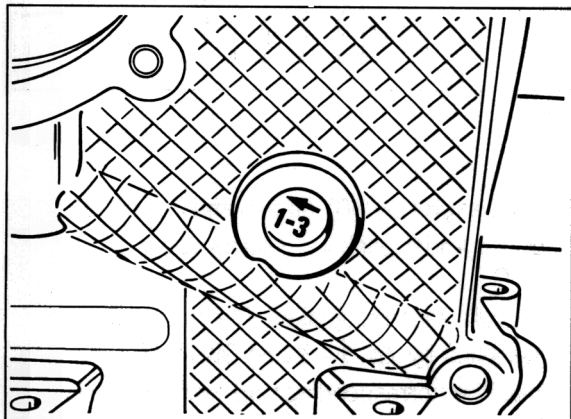


510_97

5. Fit cylinder head.

The cylinder heads differ in the area of the chain tensioners and are therefore marked on the front with 1 - 3 or 4 - 6 to prevent mix-ups.

Cylinder bank 1 - 3



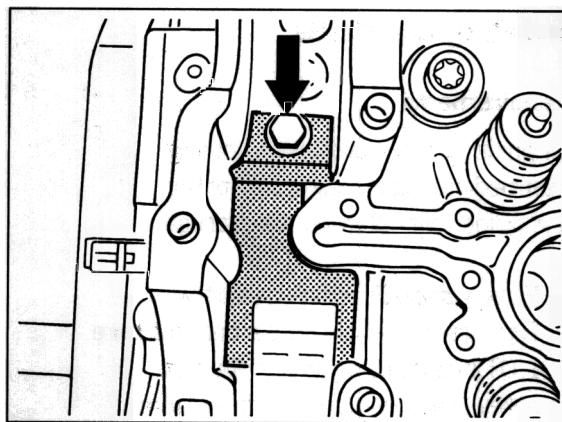
567_96

5.1 Tightening torques and tightening sequence: refer to Page 15 - 8a.

5.2 Fit shield. Tightening torque of the hexagon-head bolt M6 x 16: 10 Nm (7.5 ftlb.)

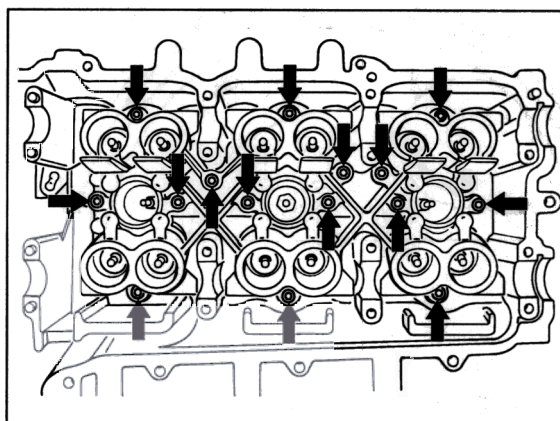
Note

The shield is fitted only on cylinder head 1 - 3.



493_97

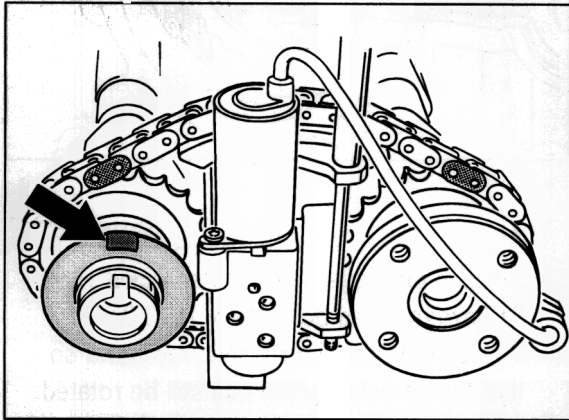
6. Fit guide for valve tappets. Tighten pan-head screws (M6 x 35) from the inside to the outside. Tightening torque: 10 Nm (7.5 ftlb.)



659_97

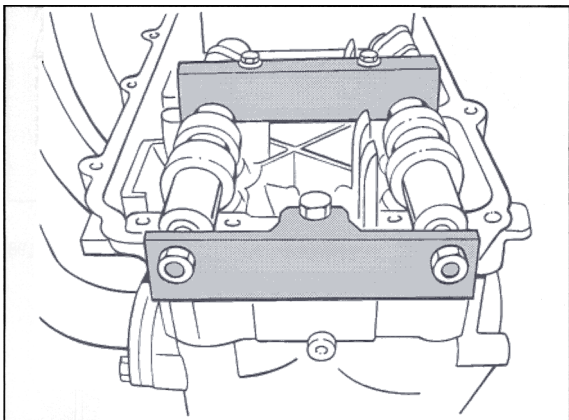
7. Lightly oil the valve tappet and fit it in the guide.

8. Lay the completely preassembled unit, camshafts with chain and tensioning element into the cylinder head. The groove on the inlet camshaft or the lug on the camshaft position sensor cover faces **upward**.



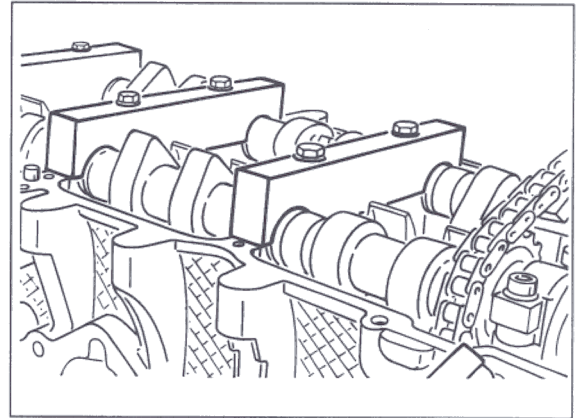
246_97

9. Align camshafts accordingly and fasten with holding-down device, special tool 9611, and holding-down device, special tool 9624.



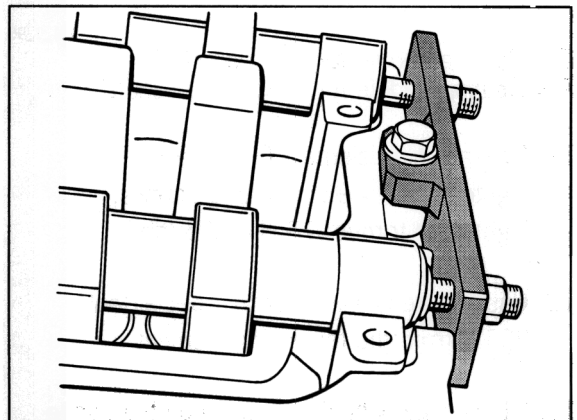
752_97

- 9.1 Fasten holding-down device 9611 with auxiliary screws M6 x 45.



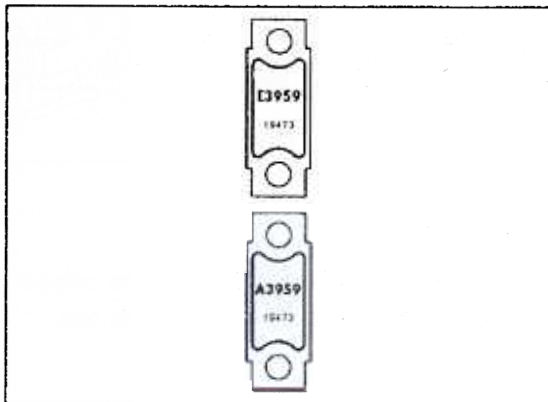
218_97

- 9.2 Fit holding-down device 9624 on the cylinder head using a M8 x 30 hexagon-head bolt.



633_97

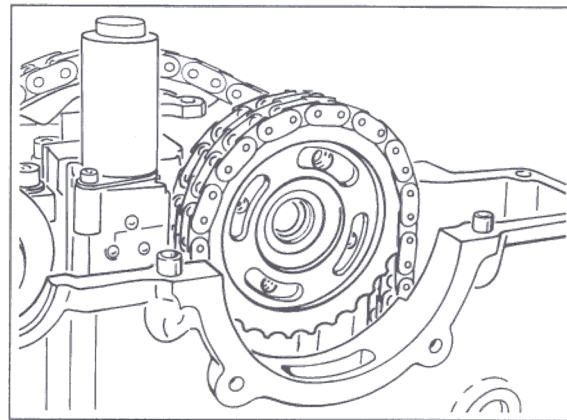
10. Check dowel sleeves (4 ea.) of the bearing saddles to ensure that they are properly seated in the cylinder head. Grease bearing surface, fit bearing saddles in **correct** position and tighten **evenly**.
Tightening torque: 10 Nm (7.5 ftlb.).
It is **essential** to compare the pairing numbers of cylinder head, cylinder-head cover and bearing saddles.



401_1_96

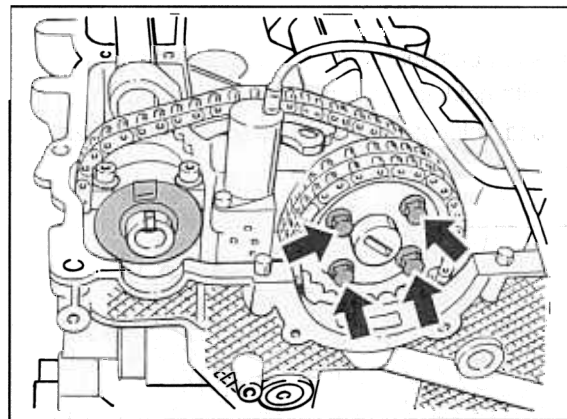
E = Bearing saddle for inlet camshaft
A = Bearing saddle for exhaust camshaft

11. Fit tensioning element (VarioCam).
Tighten 3 M6 x 95 pan-head screws.
Tightening torque: 10 Nm (7.5 ftlb.)
12. Unscrew tensioning screw, special tool 9632, from the tensioning element.
13. Fit sprocket wheel with chain on the flange of the exhaust camshaft. Fasten guide rail.
Tightening torque: 10 Nm (7.5 ftlb.)



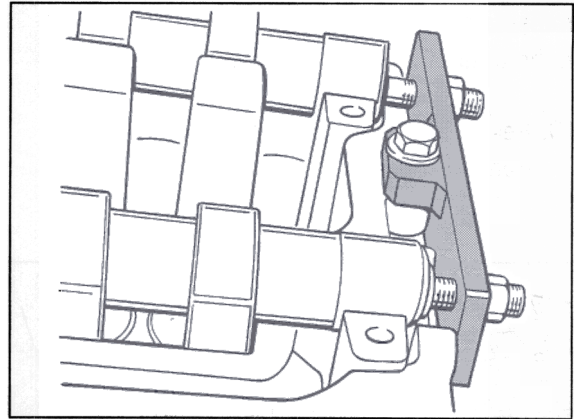
500_96

14. Position driving plate on the sprocket wheel.
Fit hexagon-head bolts M6 x 15 (10.9).
Tighten hexagon-head screws **by hand** so that the sprocket wheel can still be rotated.

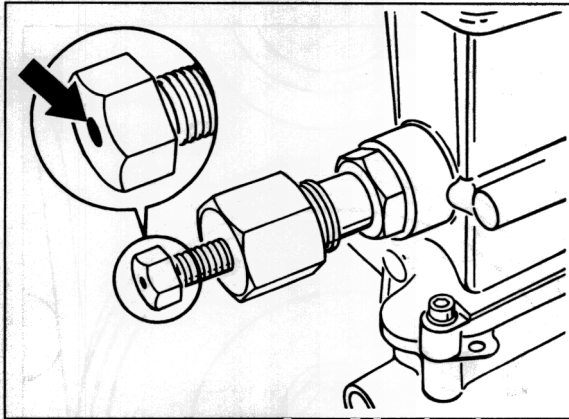


74_98

15. Fit auxiliary chain tensioner of special tool 9599 on cylinder head 1 - 3.
Fit auxiliary chain tensioner without sealing ring and fasten on the cylinder head **only hand-tight**. Adjust pretension force with the hexagon-head bolt. The necessary pre-tension force has been achieved when the measuring pin is **flush** with the face surface of the pressure screw.
- 15.1 Slightly tighten hexagon-head bolt on the sprocket wheel to 10 Nm (7.5 ftlb.).



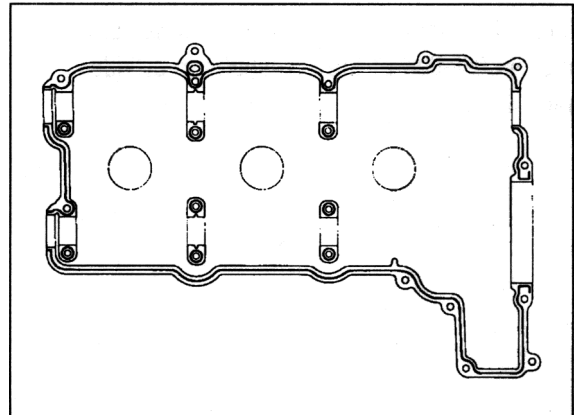
633_97



449_97

16. Remove holding-down device, special tool 9611.
17. Holding down device 9624 remains on the cylinder head until the cylinder head cover is fastened.

18. Prepare cylinder head cover for installation:
Clean sealing surface of the cylinder head and cylinder head cover very carefully. Apply bead of silicone on the cylinder-head cover. Refer to: Sealing cover for camshaft housing (cylinder head cover), Service No. 15 91 51.

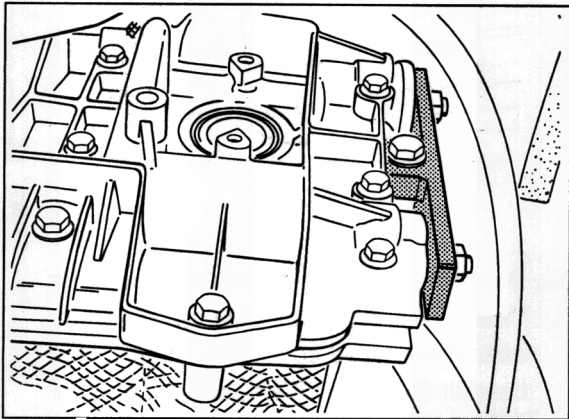


430_1_96

Carefully place the cylinder head cover in the correct position so that the sealing bead is not damaged. Screw two studs or centring pins into the corners of the cylinder head as centring aids.

Immediately remove silicone material emerging in the area of the camshaft closure cap.

19. Remove holding-down device 9624 from the cylinder head.



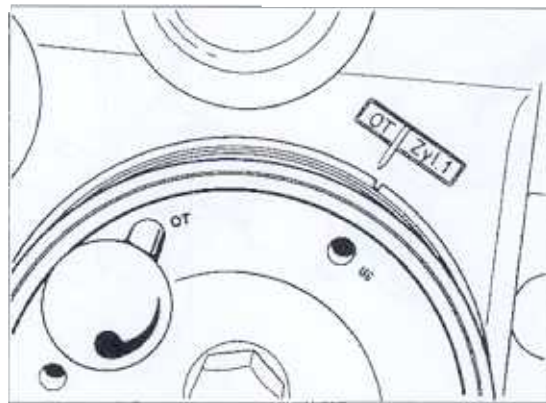
721_97

Note

Fine adjustment of the camshafts is performed after installation of the camshafts in cylinder bank 4 - 6.

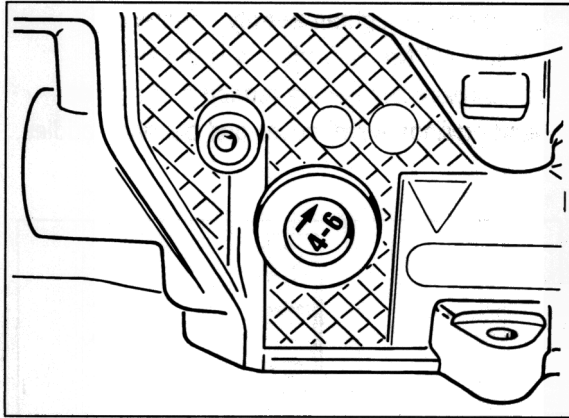
Installing camshafts of cylinder bank 4 - 6

1. Turn engine to installation position on assembly support. Remove fixing pin. Advance crankshaft 360° clockwise until the bore 1 OT (top dead centre) in the belt pulley is aligned with the fixing bore on the crankcase. Position or fix with fixing pin (short) of special tool 9595.
 - 1.1 Turn engine 90° counterclockwise on the assembly support until cylinder bank 4 - 6 faces up.



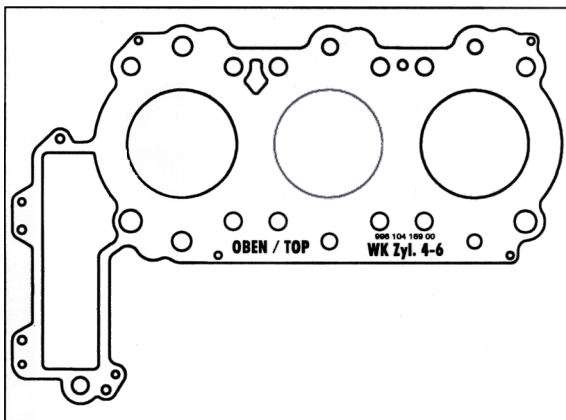
497_96

2. Fit cylinder head. Observe identification on the cylinder head.



568_96

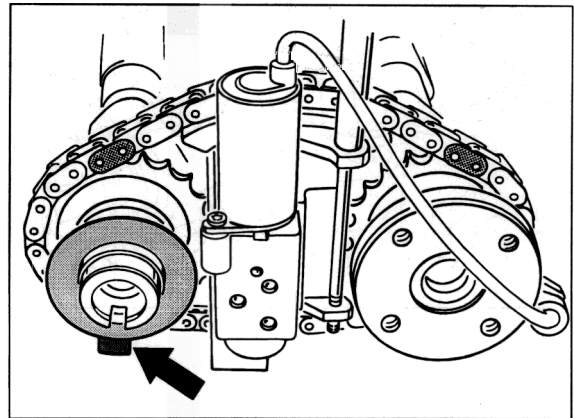
- 2.1 Fit cylinder head gasket. The gasket is identified by Zyl. 4 - 6 with OBEN/TOP, plus the corresponding part number. Ensure correct seating of dowel sleeves in crankcase. Fit gasket.



514_97

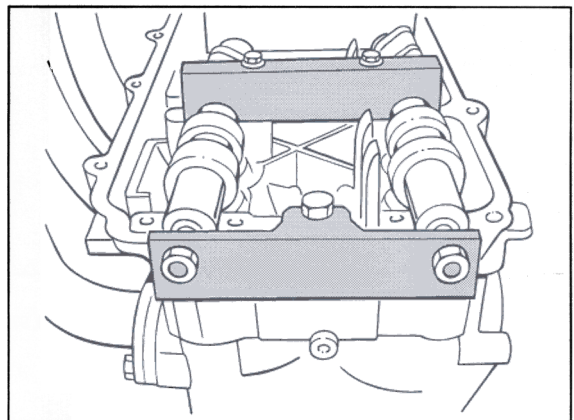
3. Fit guide housing for valve tappets.

4. Lay the completely preassembled unit, camshafts with chain and tensioning element into the cylinder head. The groove on the inlet camshaft or lug of the camshaft position sensor cover must face **downward**.



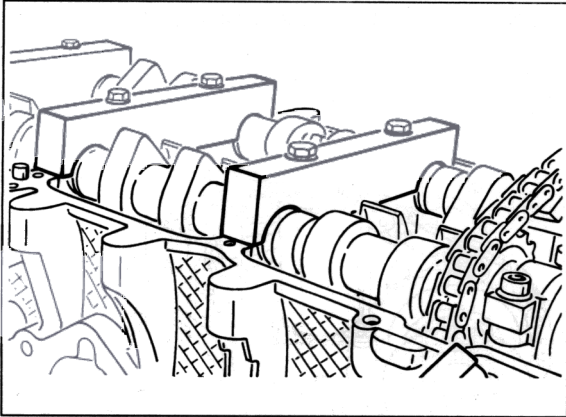
243_97

5. Align camshafts accordingly and fasten with holding-down device, special tool 9611, and holding-down device, special tool 9624.



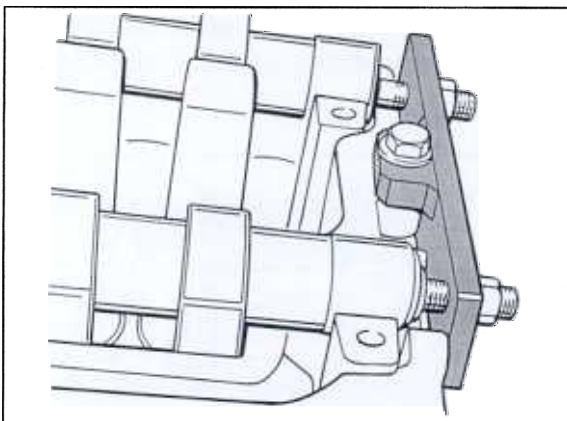
752_97

- 5.1 Fasten holding-down device 9611 with auxiliary screws M6 x 45.



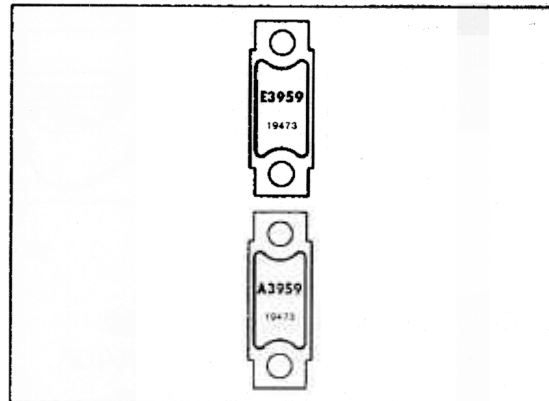
218_97

- 5.2 Fit holding-down device 9624 on the cylinder head using a M8 x 30 hexagon-head bolt.



633_97

6. Check dowel sleeves (4 ea.) of the bearing saddles to ensure that they are properly seated in the cylinder head. Grease bearing surface, fit bearing saddles in **correct position** and tighten **evenly**. Tightening torque: 10 Nm (7.5 ftlb.). It is essential to compare the pairing numbers of cylinder head, cylinder-head cover and bearing saddles.

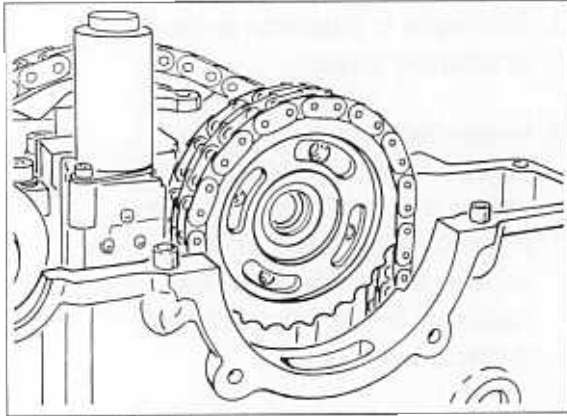


401_1_96

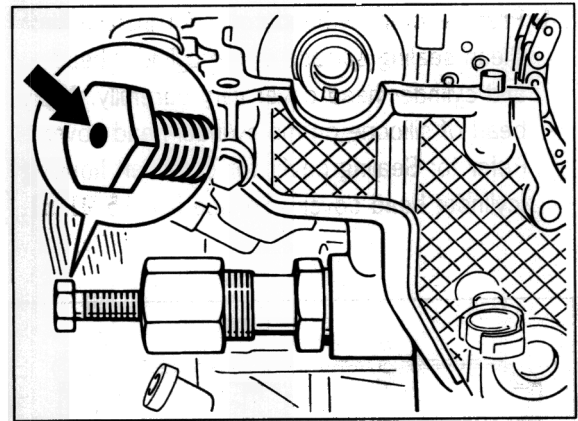
E = Bearing saddle for inlet camshaft
A = Bearing saddle for exhaust camshaft

7. Fit tensioning element (VarioCam).
 Tighten 3 M6 x 95 pan-head screws.
 Tightening torque: 10 Nm (7.5 ftlb.)
8. Unscrew tensioning screw, special tool 9632, from the tensioning element.

9. Fit sprocket wheel with chain on the flange of the exhaust camshaft.
Fasten guide rail.
Tightening torque: 10 Nm (7.5 ftlb.)



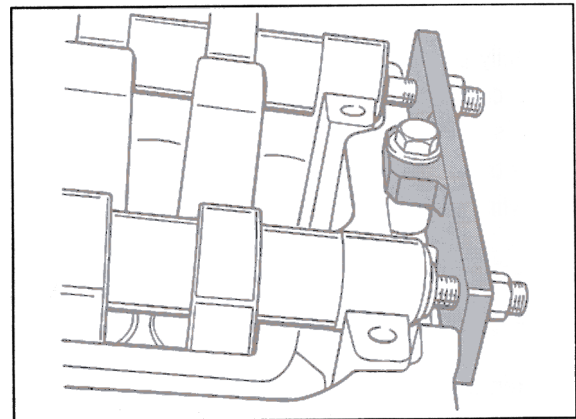
500_96



513_97

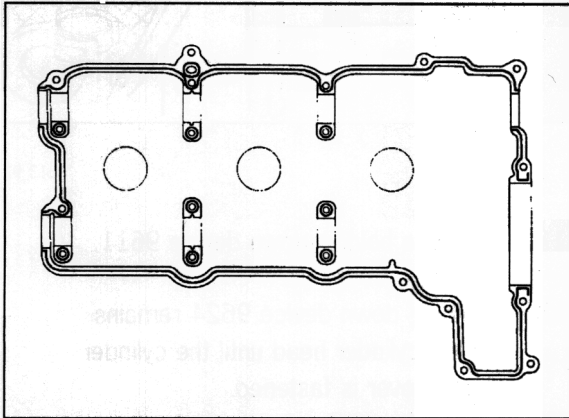
12. Remove holding-down device 9611
13. Holding down device 9624 remains in the cylinder head until the cylinder head cover is fastened.

10. Position drive plate on the sprocket wheel.
Fit hexagon-head bolt M6 x 15 (10.9).
Tighten hexagon-head bolts **by hand** only.
11. Fit auxiliary chain tensioner of special tool 9599 on cylinder head 4 - 6. Fit auxiliary chain tensioner **without** sealing ring and fasten on the crankcase **only hand-tight**.
Adjust pretension force with the hexagon-head bolt.
- 11.1 Slightly tighten hexagon-head bolts on the sprocket wheel to 10 Nm (7.5 ftlb.)



633_97

14. Prepare cylinder head cover for installation:
Clean sealing surface of the cylinder head and cylinder head cover very carefully. Apply bead of silicone on the cylinder-head cover. Refer to: Sealing cover for camshaft housing (cylinder head cover), Service No. 15 91 51.



430_1_96

Carefully place the cylinder head cover in the correct position so that the sealing bead is not damaged. Screw two studs or centring pins into the corners of the cylinder head as centring aids.

Immediately remove silicone material emerging in the area of the camshaft closure cap.

15. Remove holding-down device 9624 from the cylinder head.

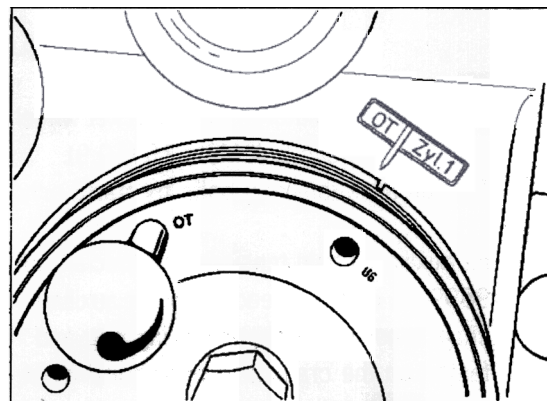
Adjusting timing at cylinder bank 1 - 3

Requirements

Three auxiliary chain tensioners fitted with correct pretension.

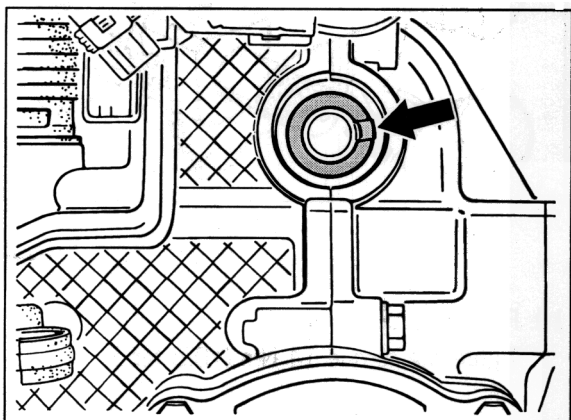
Turn engine to installation position on assembly support.

2. Remove fixing pin.
Advance crankshaft 360° clockwise until the bore 1 OT (top dead centre) in the belt pulley is aligned with the fixing bore on the crankcase. Position or fix with fixing pin (short) of special tool 9595.



497_96

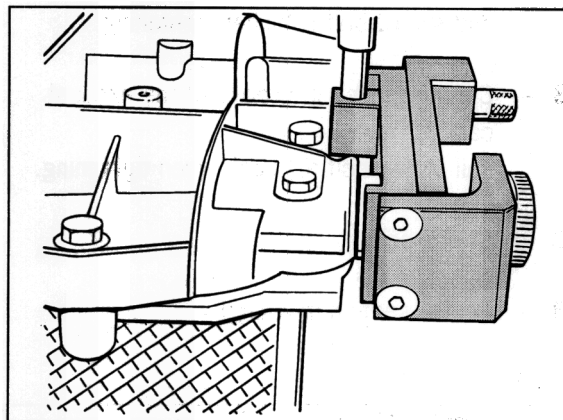
3. Check basic camshaft adjustment of **cylinder bank 1 - 3**
The groove in the camshaft must face **outward** toward the cylinder-head cover.



View from the flywheel side

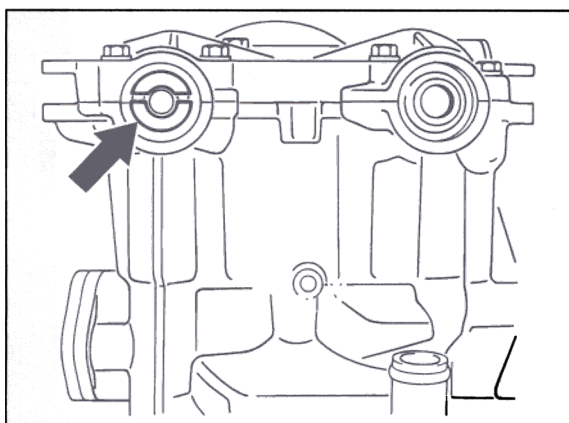
625_97

6. Fasten blocking device (special tool 9612) on the cylinder head.



718_97

4. Turn engine 90° clockwise on the assembly support. Cylinder bank 1 - 3 faces upward.
5. If the allocation is correct, the narrow segment must face the cylinder head cover on the opposite side of the cylinder head.

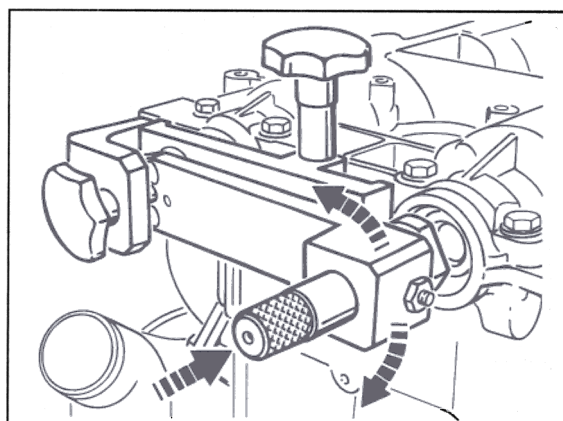


View from the belt pulley side

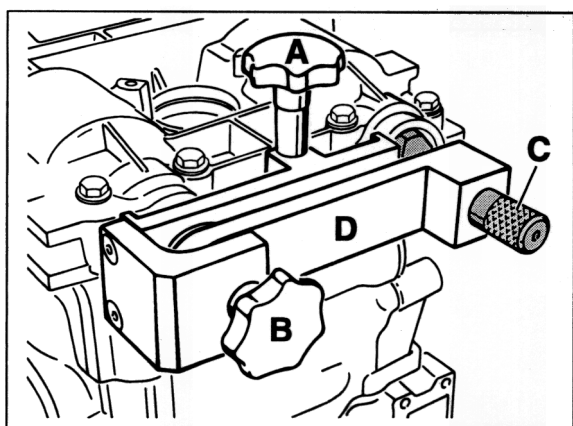
474_97

7. Special tool fitting sequence:

- A** – Fastening screw with star knob on cylinder head lug. Pull back centring piece (B) and sword bolt (C) when tightening.
- B** – Centring piece in groove of the exhaust camshaft. Pull sword bolt (C) back when tightening.
- C** – Sword bolt
- D** – Centre section (pivoting).



220_97



503_96

8. Undo four hexagon-head screws (M6 x 15) on the sprocket wheel on the opposite side.

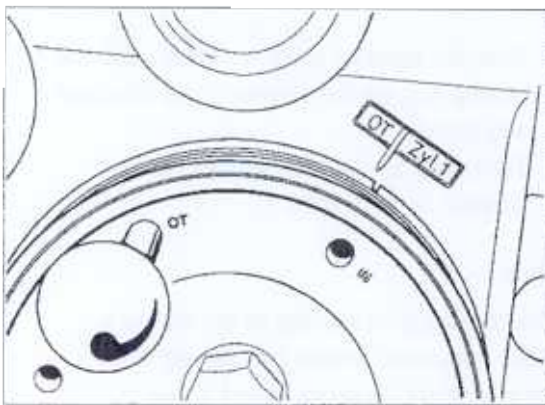
9. Allocate camshafts; to do this, turn the pre-tensioned centre piece (D) accordingly until the sword bolt (C) can be fixed in the bearing bore of the inlet camshaft.

10. Fasten sprocket wheel.
Tightening torque 14 Nm (10.5 ftlb.)

11. Remove blocking device.

Adjusting timing at cylinder bank 4 - 6

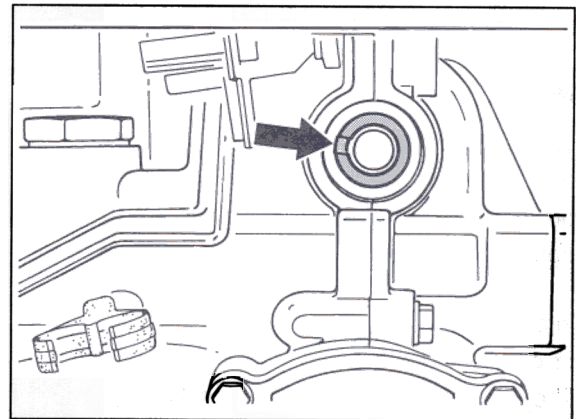
1. Turn engine to installation position on assembly support.
2. Remove fixing pin.
Advance crankshaft 360° clockwise until the bore 1 OT (top dead centre) in the belt pulley is aligned with the fixing bore on the crankcase. Position or fix with fixing pin (short) of special tool 9595.



497_96

3. Check camshaft adjustment at cylinder bank 4 - 6:

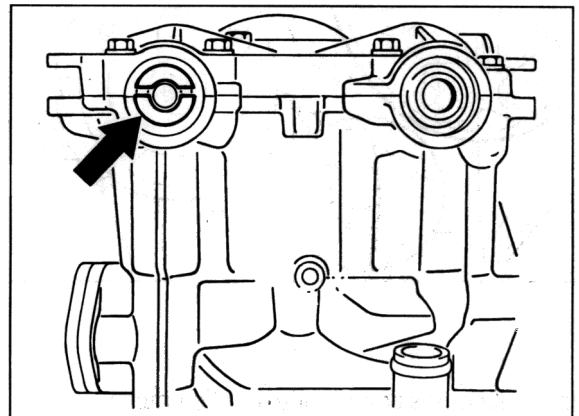
The groove in the camshaft must face inward toward the crankcase.



View from the belt pulley side

624_97

4. Turn engine 90° counterclockwise on the assembly support.
Cylinder bank 4 - 6 faces upward.
5. If the allocation is correct, the narrow segment must face the cylinder head cover on the opposite side of the cylinder head.



474_97

6. Fasten blocking device (special tool 9612) on the cylinder head (4 - 6).
7. Perform following assembly steps for timing adjustment as described from Step 7 to Step 11.

8. Fit oil extraction pumps

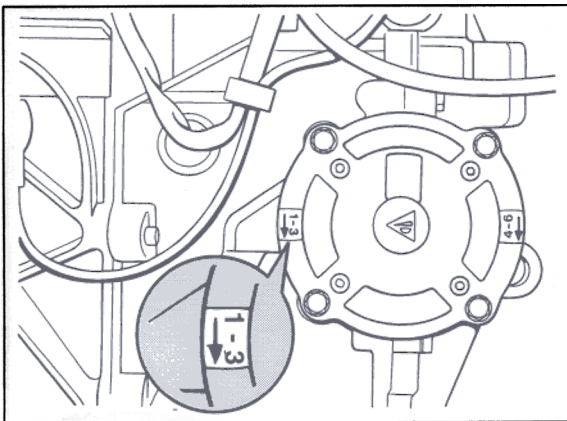
Note

The oil extraction pumps on the cylinder heads are identical parts. Therefore, the installation position and direction of rotation must be correct.

Installation position of oil extraction pump at **cylinder head 1 - 3** (flywheel side):

The arrow for the direction of rotation or the marking "1 - 3" must face the crankcase. Fit oil extraction pump. Use new sealing ring and new micro-encapsulated hexagon socket head screws.

Tightening torque: 10 Nm (7.5 ftlb.)

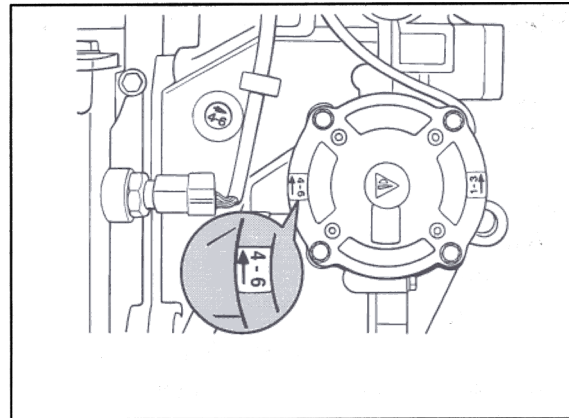


667_97

Installation position of oil extraction pump at **cylinder head 4 - 6** (belt pulley side):

The arrow for the direction of rotation or the marking "4 - 6" must face the crankcase. Fit oil extraction pump. Use new sealing ring and new micro-encapsulated hexagon socket head screws.

Tightening torque: 10 Nm (7.5 ftlb.)



668_97

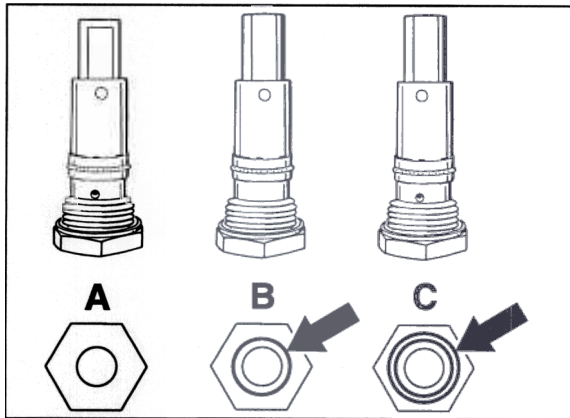
9. Unscrew auxiliary chain tensioner, put new sealing ring on the original chain tensioner and install.

Tightening torque: 80 Nm (59 ftlb.)
(Wrench size 30 mm)

Note

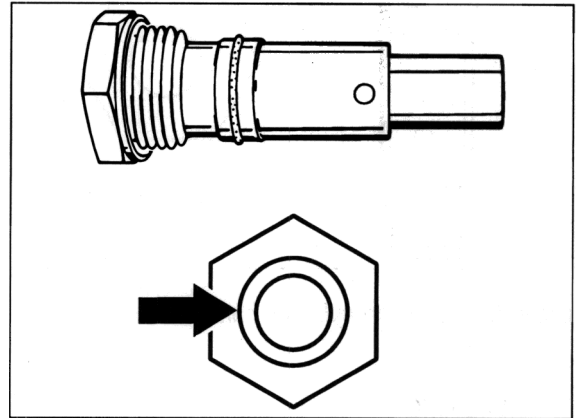
The compression springs of the auxiliary chain tensioners should be relieved after measurement. Unscrew thrust screw (wrench size 19 mm).

Allocation of chain tensioners



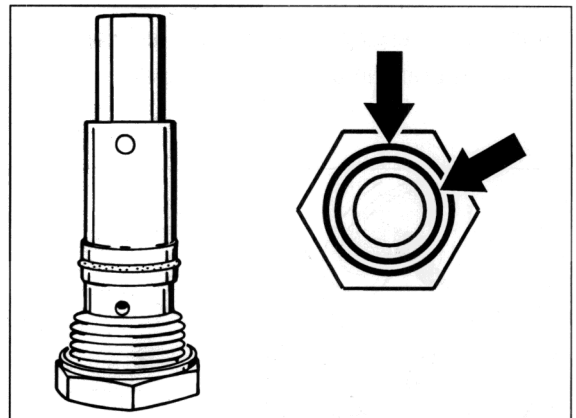
502_97

- A – Chain tensioner, **cylinder bank 4 - 6**
Identification "Without"
- B – Chain tensioner **on crankcase**
Identification "1 ring"
- C – Chain tensioner, **cylinder bank 1 - 3**
Identification "2 rings"

Installation position of the chain tensioners
(engine in installed position)

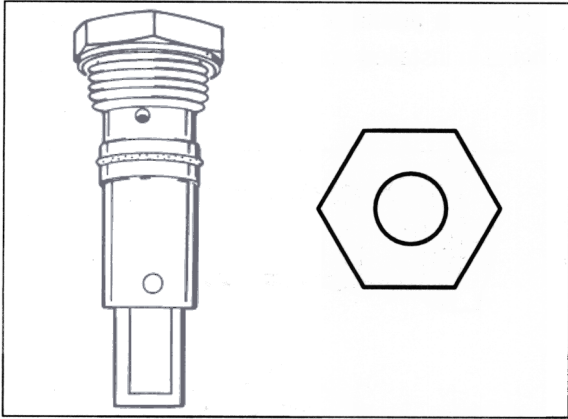
Chain tensioner on the crankcase

508_97



Chain tensioner on cylinder bank 1 - 3

509_97

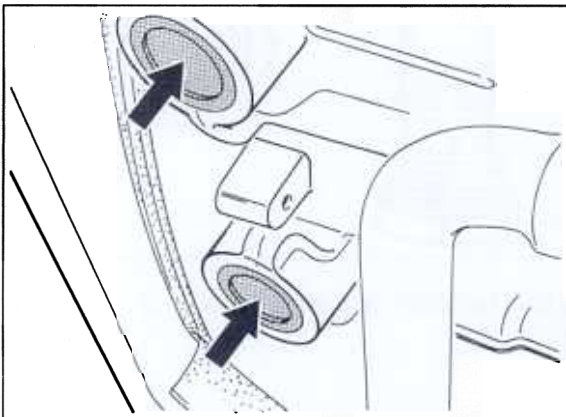


Chain tensioner on cylinder bank 4 - 6 507_97

10. Fit caps (6 ea.) for camshaft bores.

Installation

1. Clean receiving bore; remove any silicone material emerging. **Manually** fit new cap **dry** and press in as far as it will go.

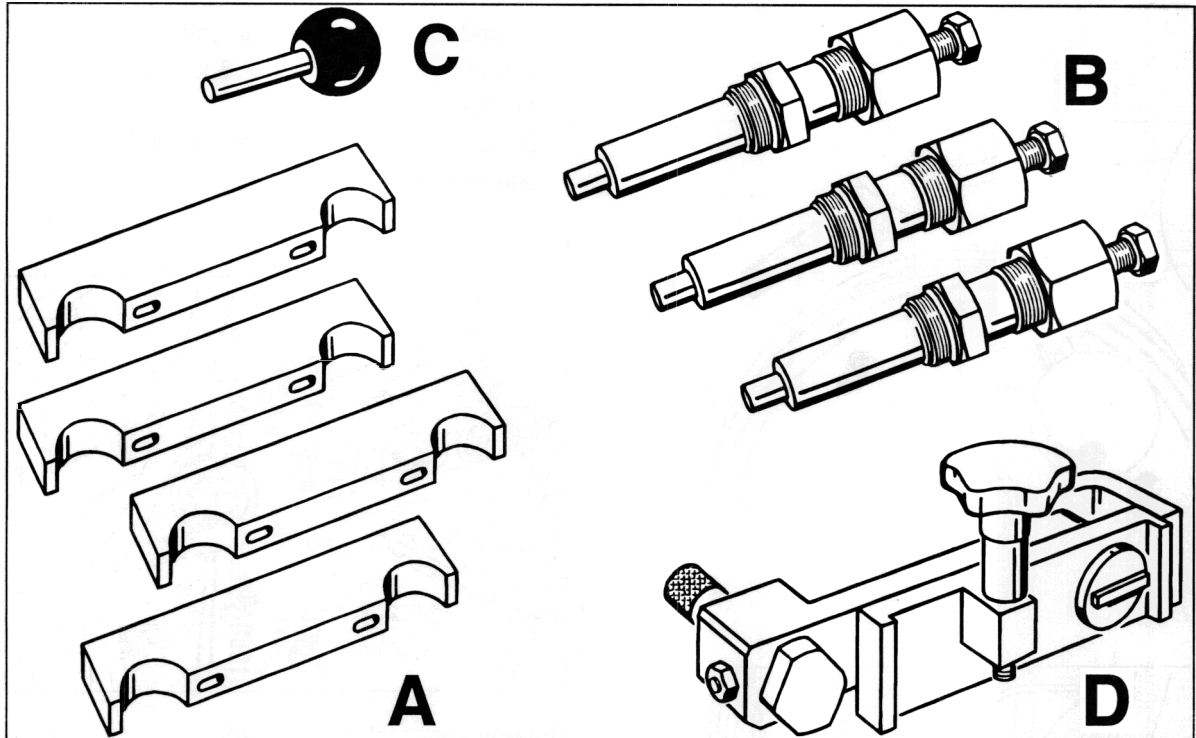


685_97

15 59 20 Removing and installing valve tappets engine removed

Removing and installing engine: refer to Boxster Technical Manual, Group 1, Service No. 10 01 19

Tools



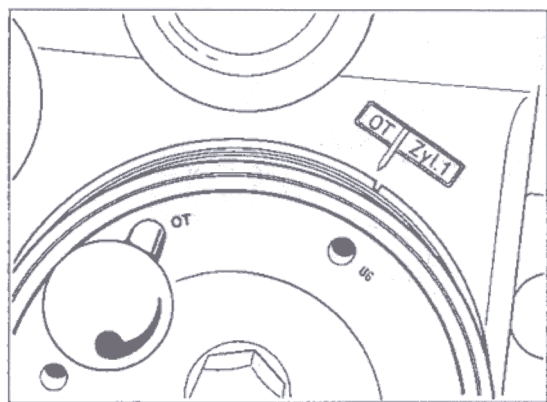
666_97

Item	Designation	Special tool	Explanation
A	Holding-down device for camshafts	9611	1 set = 4 ea.
B	Auxiliary chain tensioner for valve timing adjustment	9599	1 set = 3 ea.
C	Fixing pin for pulley	9595	1 set = 2 ea. (use short fixing pin)
D	Locking device for camshafts in timing position	9612	

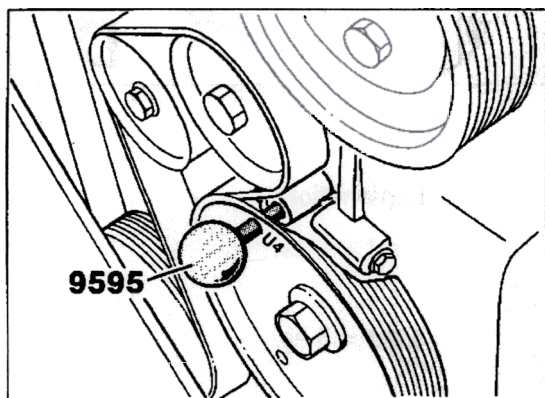
Removing and installing valve tappets

Move camshafts and crankshaft to basic position

1. Turn crankshaft clockwise until the bore 1 OT (top dead centre) in the pulley is aligned with the fixing bore on the crankcase. Position or fix with fixing pin (short) of special tool 9595.



497_96

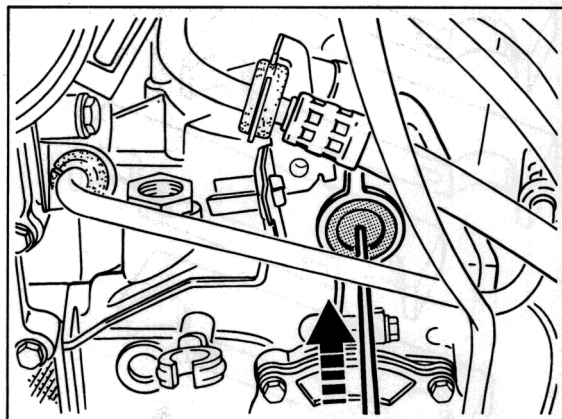


151_96

Note

The basic camshaft adjustment can be checked only after removal of the camshaft closure caps.

2. Remove camshaft closure caps above the cylinder-head oil extraction pumps. The closure cap of **cylinder bank 1 - 3** is located on the flywheel side and the closure cap of **cylinder bank 4 - 6** is located on the pulley side.
Drive awl into **centre** of the closure cap and lever off the cap.



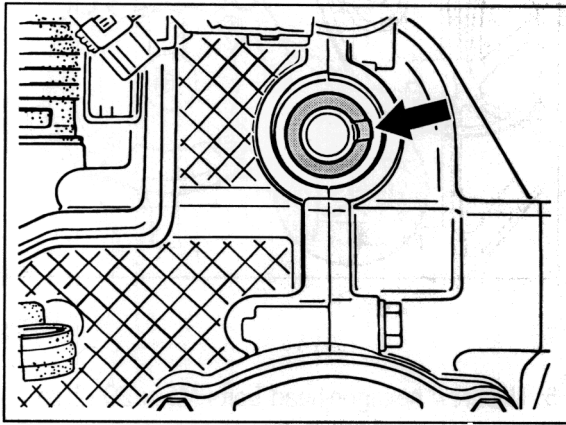
602_97

Drawing shows closure cap of cylinder bank 4 - 6 (pulley side)

3. Check basic camshaft adjustment.

Basic camshaft adjustment of cylinder bank 1 - 3

For adjustment, the groove in the camshaft must face **outward** toward the cylinder-head cover.



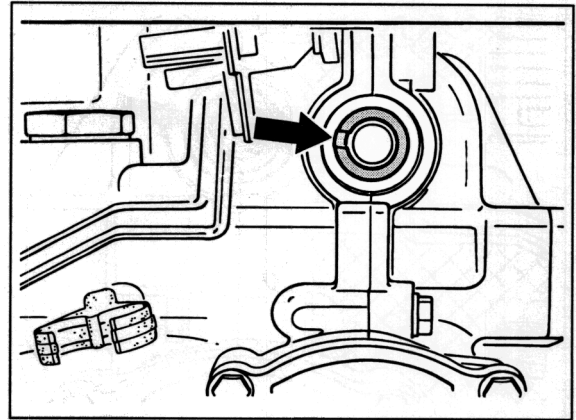
View from the flywheel side

625_97

If the position of the camshafts is incorrect, remove fixing pin at the pulley and rotate the crankshaft 360° clockwise.

Basic camshaft adjustment of cylinder bank 4 - 6

For adjustment, the groove in the camshaft must face **inward** toward the crankcase.



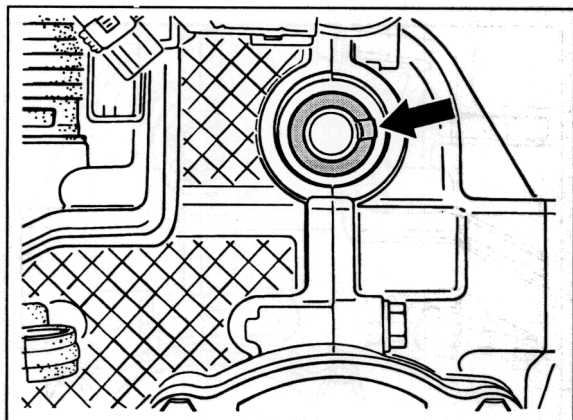
View from the pulley side

624_97

If the position of the camshafts is incorrect, remove fixing pin at the pulley and rotate the crankshaft 360° clockwise.

Removing valve tappets of cylinder bank 1 - 3

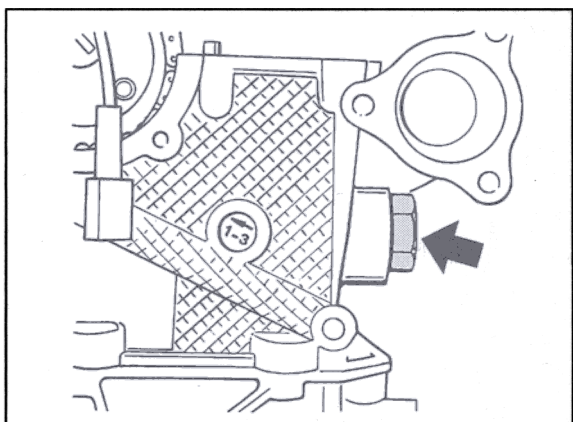
1. Move camshafts to basic position.
The groove in the camshaft must face **outward** toward the cylinder-head cover.



View from the flywheel side

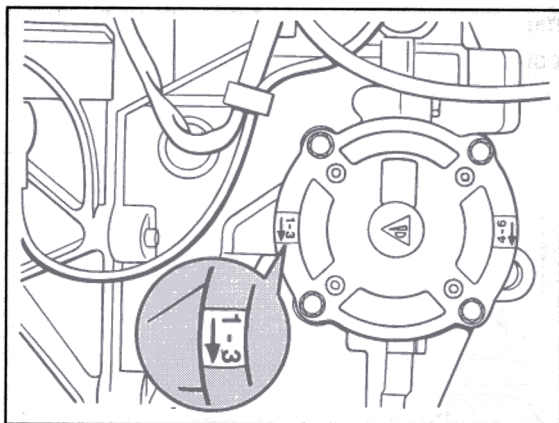
625_97

2. Turn engine on assembly support until cylinder bank 1 - 3 faces upwards.
3. Unscrew chain tensioner of cylinder bank 3.



665_97

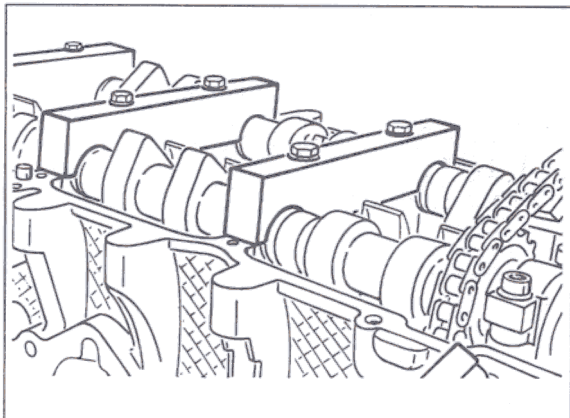
4. Detach and remove oil extraction pump at cylinder head 1 - 3 — on flywheel side.



667_97

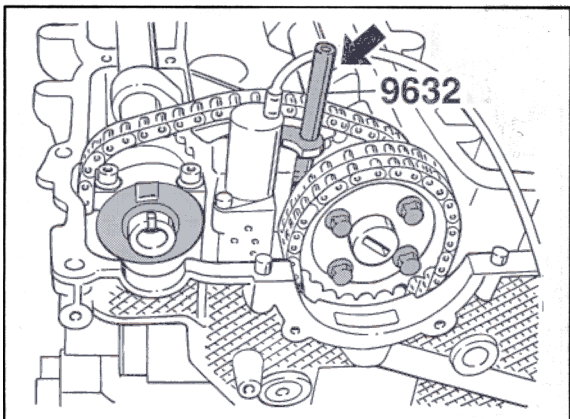
5. Unscrew hexagon-head bolts M6 x 20 (2 ea.). Remove closure cap from tensioning element (VarioCam).
6. Remove cylinder-head cover. Loosen hexagon-head bolts from the outside to the inside.

7. Fasten special tool 9611 (holding-down device for camshafts) with auxiliary screws M6 x 45.



97-218

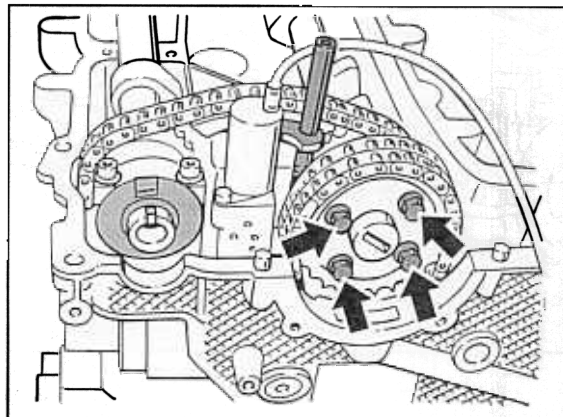
8. Relieve camshaft tensioning element with special tool, tensioning screw 9632.



630_97

9. Unscrew three fastening screws (M6 x 95) for tensioning element.

10. Affix auxiliary chain tensioner (screw in by approx. 3 turns). Undo four hexagon-head bolts (M6 x 15) on the chain sprocket. Remove auxiliary chain tensioner again.

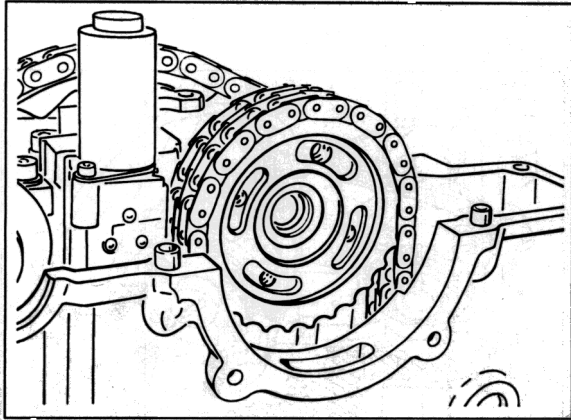


663_97

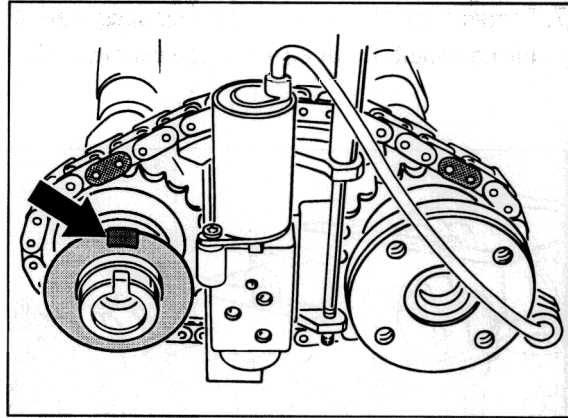
Note

Screw tensioning screw in only until the chain is slightly relieved.

1. Remove drive plate. Connect sprocket wheel and chain with a tie wrap (installation position). With a second tie wrap, suspend the sprocket wheel and chain to the side under slight tension.

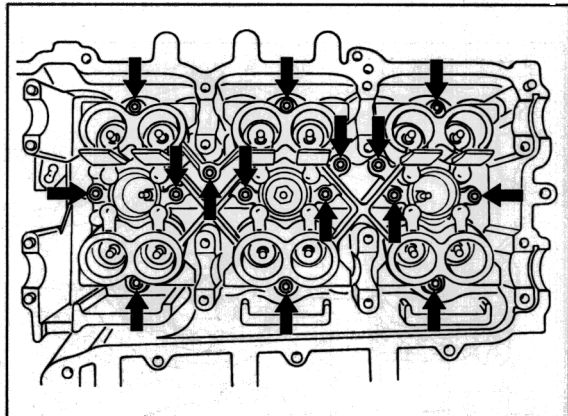


500_96



246_97

12. Detach two bearing saddles. Lever bearing saddles out of the guide sleeves.
13. Remove holding-down device (special tool 9611) from the camshafts.
14. Carefully lift the complete unit, camshafts with chain and tensioning element, out of the cylinder head. The chain must not jump over during this operation.

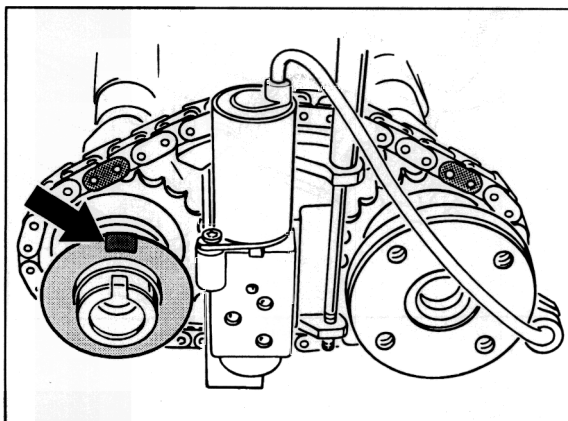


659_97

15. Lift out valve tappets with a magnet.
16. Detach guide for valve tappets. Undo the pan-head screws (15 ea.) from the outside to the inside and remove the guide.

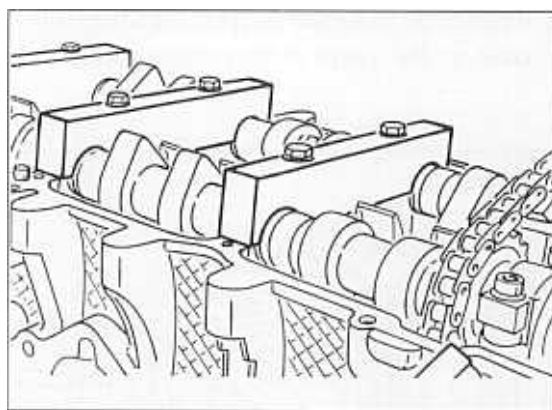
Installing valve tappets

1. Check guide for damage.
Refer to: Checking guide for valve tappets, Service No. 15 59 02.
2. Fit guide. Tighten pan-head screws (M6 x 35) from the inside to the outside. Tightening torque 10 Nm (7.5 ftlb.).
3. Lightly oil the valve tappets and fit in the guide.
4. Lay the complete unit, camshafts with chain and tensioning element, into the cylinder head. The groove or the tab of the camshaft position sensor cover must face **upward**. If the allocation should be uncertain, e.g. chain jumped over, reallocation is necessary. Refer to: Completing camshafts, Service No. 15 05 33.



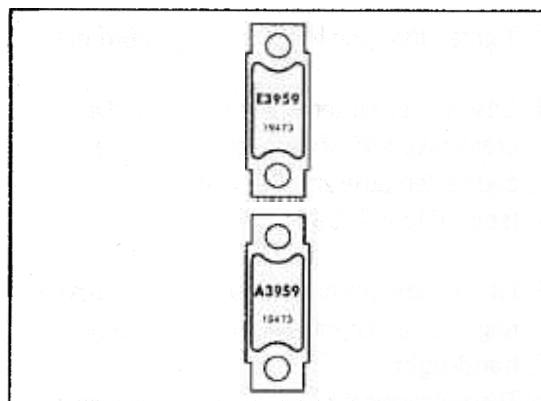
246_97

5. Fit special tool 9611, holding-down device for camshafts. Fit auxiliary screws M6 x 45 with washers and tighten to 10 Nm (7.5 ftlb.).



97-218

6. Check dowel sleeves (4 ea.) of the bearing saddles to ensure that they are properly seated in the cylinder head. Oil bearing surface. Fit bearing saddles in the **correct** position and tighten **evenly**. Tightening torque 10 Nm (7.5 ftlb.).

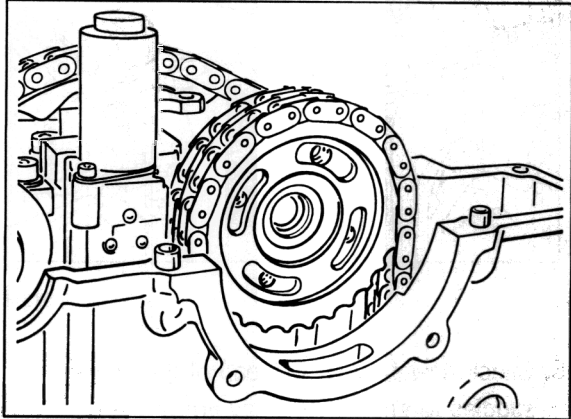


- E* = Bearing saddle for inlet camshaft
A = Bearing saddle for exhaust camshaft

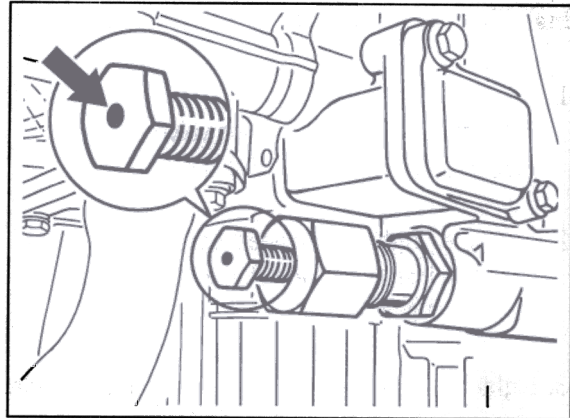
401_1_96

7. Fit tensioning element (VarioCam). Tighten 3 M6 x 95 pan-head screws. Tightening torque 10 Nm (7.5 ftlb.).
8. Unscrew tensioning screw (special tool 9632) from the tensioning element.

9. Remove tie wrap and fit sprocket wheel with chain on the flange of the exhaust camshaft.



500_96



468_97

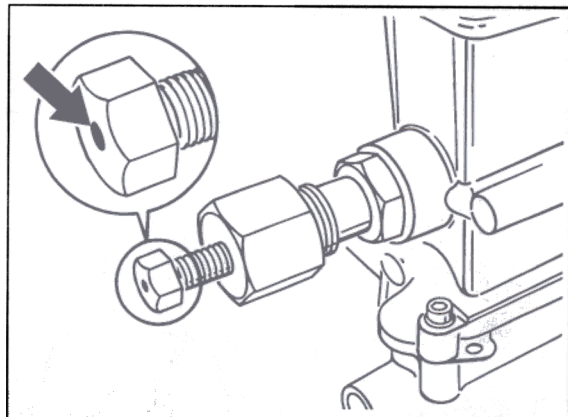
13. Fit auxiliary chain tensioner on cylinder head 1 - 3 and adjust pre-tension force (refer to step 12).

10. Position drive plate or driver star on the sprocket wheel. Fit hexagon-head bolts M6 x 15 (10.9).
Tighten hexagon-head bolts **by hand only**.

11. Unscrew chain tensioner (fitted on the crankcase half of cylinder bank 4 - 6) and fasten auxiliary chain tensioner (special tool 9599).

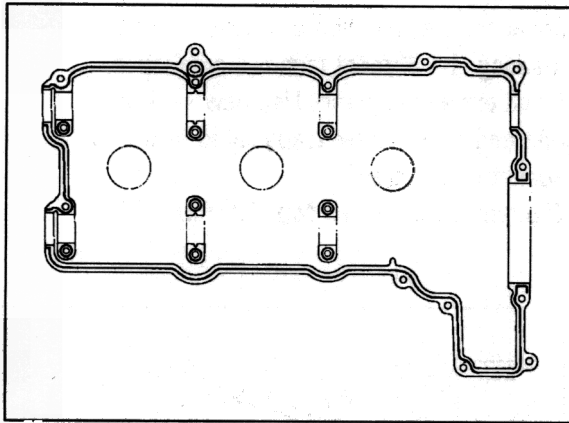
12. Fit auxiliary chain tensioner without sealing ring and fasten on the crankcase **only hand-tight**.

The mechanical auxiliary chain tensioners must be installed with the correct pre-tension when the valve timing is adjusted or checked. The necessary pre-tension force has been reached when the measuring pin is **flush** with the face surface of the thrust screw. Turn the screw if necessary.



449-97

14. Fit cylinder-head cover. Remove holding-down device 9611.
Clean sealing surface of the cylinder head and cylinder-head cover very carefully. Apply bead of silicone on the cylinder-head cover. Refer to: Sealing cover for camshaft housing (cylinder-head cover), Service No. 15 91 51.

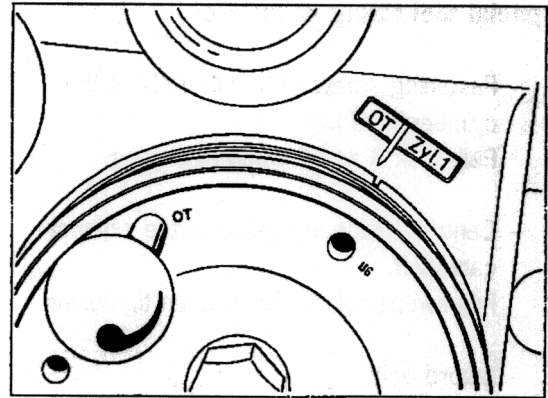


430_1_96

Carefully place the cylinder-head cover in the correct position so that the sealing bead is not damaged. Screw two studs or centring pins into the corners of the cylinder head as centring aids.

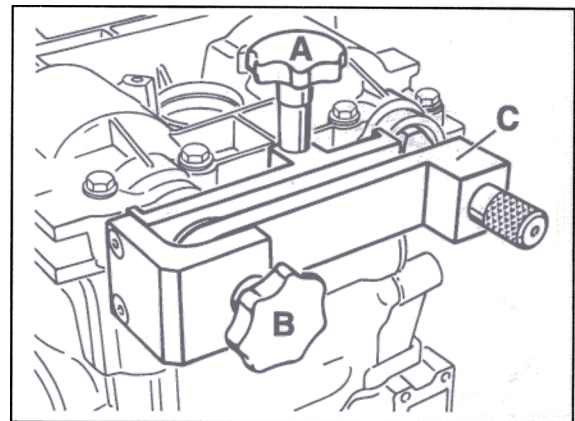
Immediately remove silicone material emerging in the area of the camshaft closure cap.

15. For the subsequent adjustment work on the camshaft, the pulley must be fixed at bore 1 OT (TDC) with the fixing pin (special tool 9595).



497_96

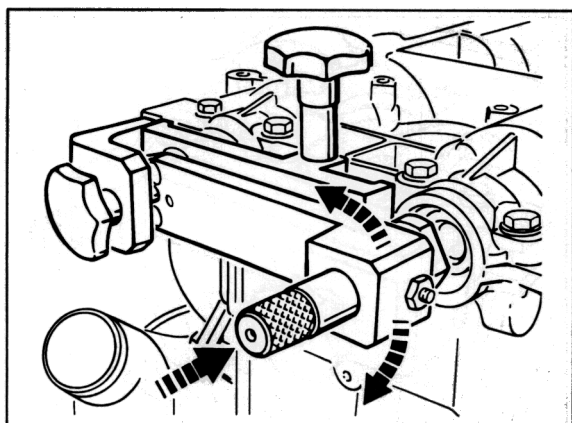
16. Fasten blocking device (special tool 9612) on the cylinder head.



503_96

Special tool fitting sequence:

- A – Fastening screw with star knob on the cylinder-head lug.
Pull back B and C when tightening.
 - B – Centring piece in groove of the exhaust camshaft.
Pull sword bolt (C) back when tightening.
 - C – Sword bolt
17. Allocate camshafts; to do this, turn the pre-tensioned centre piece accordingly until the sword bolt can be fixed in the bearing bore.



97-220

18. Fasten sprocket wheel.
Tightening torque: 14 Nm (10.5 ftlb.)
19. Remove blocking device.

Note

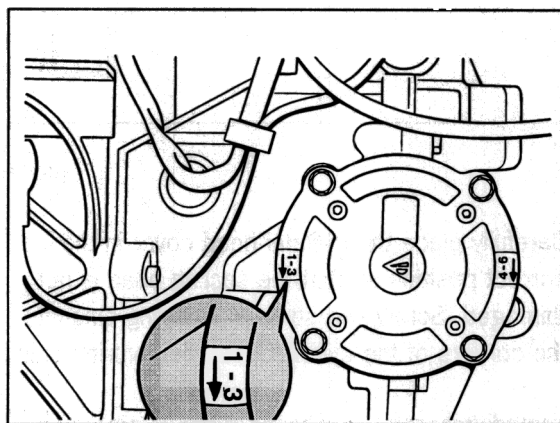
The auxiliary chain tensioners must remain fitted on cylinder bank 4 - 6 for the subsequent assembly work.

20. Fit oil extraction pump

Note

The oil extraction pumps on the cylinder heads are identical parts. Therefore, the installation position or direction of rotation must be correct.

Installation position of oil extraction pump at **cylinder head 1 - 3** (flywheel side): The arrow for the direction of rotation or the marking "1 - 3" must face the crankcase. Fit oil extraction pump. Use new sealing ring and new micro-encapsulated hexagon socket head screws.
Tightening torque: 10 Nm (7.5 ftlb.).



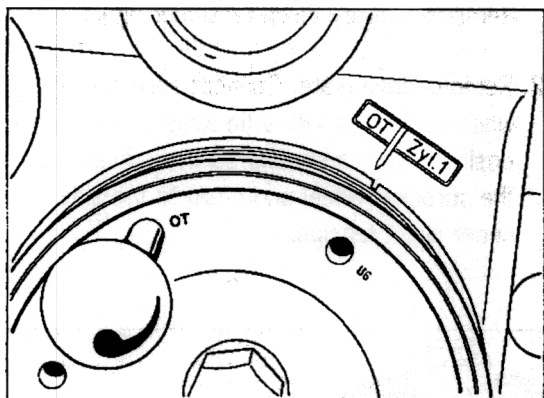
667_97

21. Fit camshaft closure cap dry.
22. Fit closure cap on tensioning element (VarioCam).
Tightening torque 10 Nm (7.5 ftlb.).

Removing valve tappets of cylinder bank 4 - 6

1. Remove fixing pin.

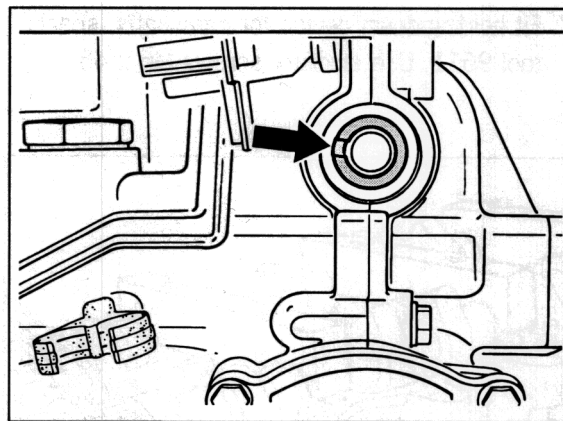
Turn crankshaft clockwise until the bore 1 OT (top dead centre) in the pulley is aligned with the fixing bore on the crankcase. Position or fix with fixing pin (short) of special tool 9595.



497_96

2. Check camshaft adjustment at cylinder bank 4 - 6:

The groove in the camshaft must face inward toward the crankcase.

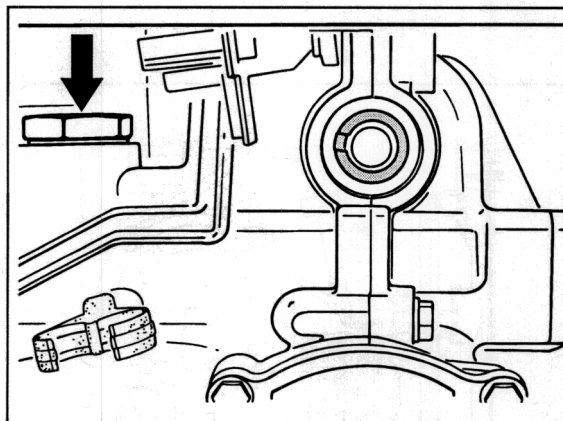


View from the pulley side

624_97

3. Turn engine by 90° on assembly support until cylinder bank 4 - 6 faces upwards.

4. Unscrew chain tensioner of cylinder bank 4 - 6.

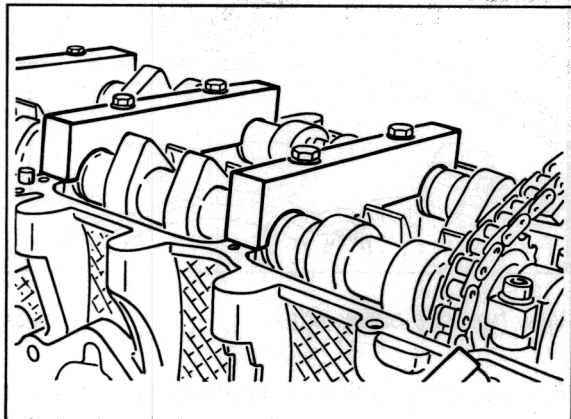


672_97

5. Remove closure cap from tensioning element (VarioCam). Hexagon-head bolts M6 x 20 (2 ea.).

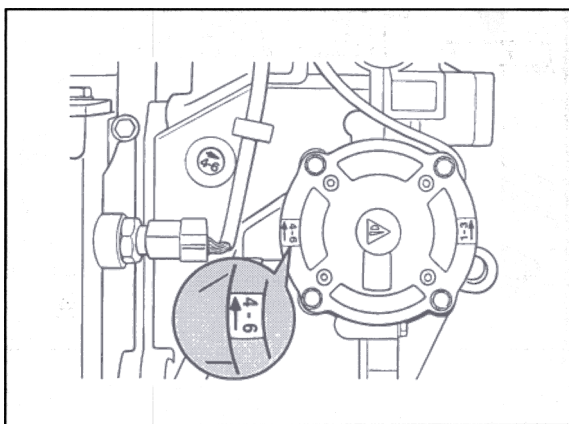
6. Remove cylinder-head cover. Loosen hexagon-head bolts from the outside to the inside.

7. Fit holding-down device for camshafts, special tool 9611. Use auxiliary screws M6 x 45.



97-218

8. Detach and remove oil extraction pump at cylinder head 4 - 6 (pulley side).



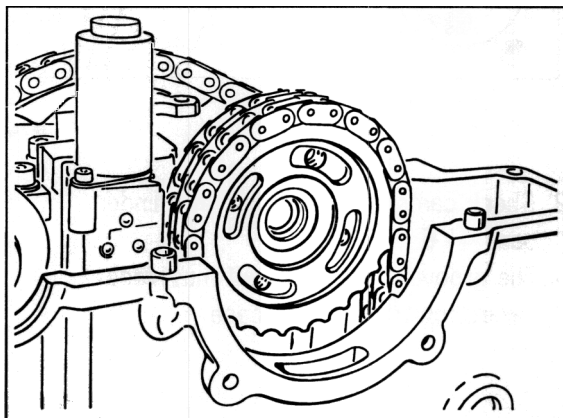
668_97

9. Relieve camshaft tensioning element with tensioning screw, special tool 9632.

Note

Screw tensioning screw in only until the chain is slightly relieved.

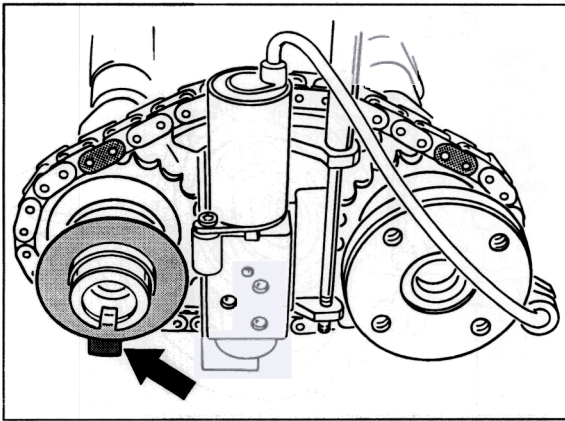
10. Unscrew three fastening screws (M6 x 95) for tensioning element.
11. Affix auxiliary chain tensioner (screw in by approx. 3 turns). Undo four hexagon-head bolts (M6 x 15) on the chain sprocket. Remove auxiliary chain tensioner again.
12. Remove drive plate. Connect sprocket wheel and chain with a tie wrap (installation position). With a second tie wrap, suspend the sprocket wheel and chain to the side under slight tension.



500_96

13. Detach two bearing saddles. Lever bearing saddles out of the guide sleeves.
14. Remove holding-down device (special tool 9611) from the camshafts.

15. Carefully lift the complete unit, camshafts with chain and tensioning element, out of the cylinder head. The chain must not jump over. The groove or tab of the camshaft position sensor cover must face **downward**. If the allocation should be uncertain, e.g. chain jumped over, reallocation is necessary. Refer to: Completing camshafts, Service No. 15 05 33.

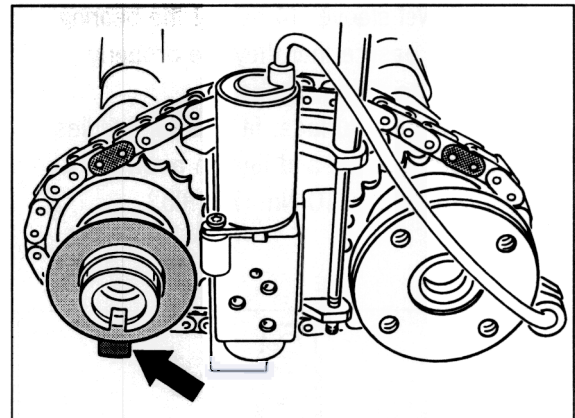


243_97

16. Lift out valve tappets with a magnet.
17. Detach guide for valve tappets. Undo the pan-head screws (15 ea.) from the outside to the inside and remove the guide.

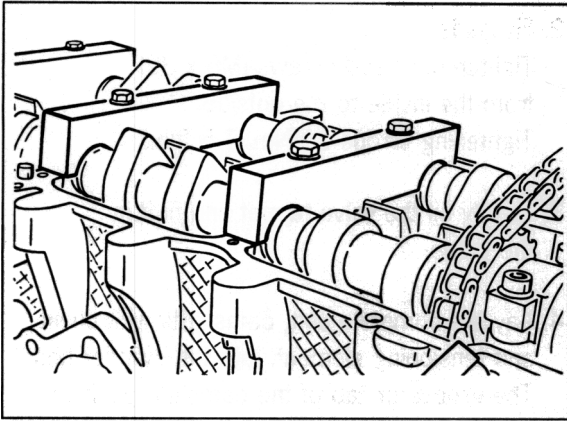
Installing valve tappets

1. Check guide for damage.
Refer to: Checking guide for valve tappets, Service No. 15 59 02.
2. Fit guide.
Tighten pan-head screws (M6 x 35) from the inside to the outside.
Tightening torque 10 Nm (7.5 ftlb.)
3. Lightly oil the valve tappet and fit it in the guide.
4. Lay the complete unit, camshafts with chain and tensioning element, into the cylinder head. The groove or tab of the camshaft position sensor cover must face **downward**.



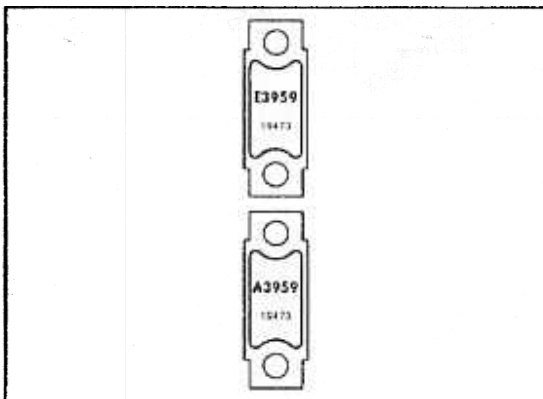
243_97

5. Fit special tool 9611, holding-down device for camshafts. Fit auxiliary screws M6 x 45 with washers and tighten to 10 Nm (7.5 ftlb.).



97-218

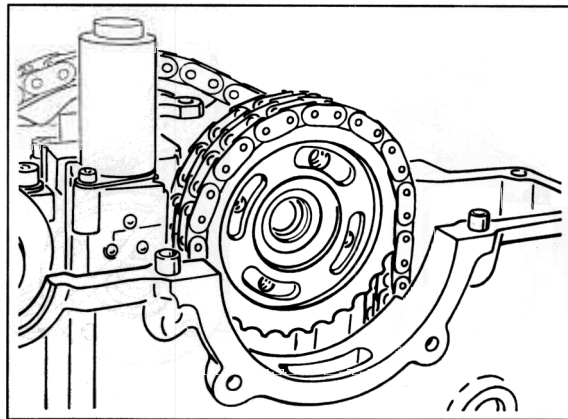
6. Check dowel sleeves (4 ea.) of the bearing saddles to ensure that they are properly seated in the cylinder head. Grease bearing surface, fit bearing saddles in **correct** position and tighten **evenly**. Tightening torque 10 Nm (7.5 ftlb.)



- E = Bearing saddle for inlet camshaft
 A = Bearing saddle for exhaust camshaft

401_1_96

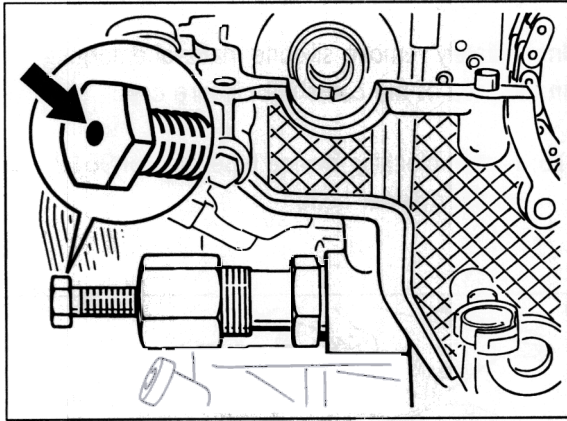
7. Fit tensioning element (VarioCam). Tighten 3 M6 x 95 pan-head screws. Tightening torque 10 Nm (7.5 ftlb.)
8. Unscrew tensioning screw, special tool 9632, from the tensioning element.
9. Remove tie wrap and fit sprocket wheel with chain on the flange of the exhaust camshaft.



500_96

10. Position drive plate or driver star on the sprocket wheel. Fit hexagon-head bolts M6 x 15 (10.9). Tighten hexagon-head bolts **by hand only**.

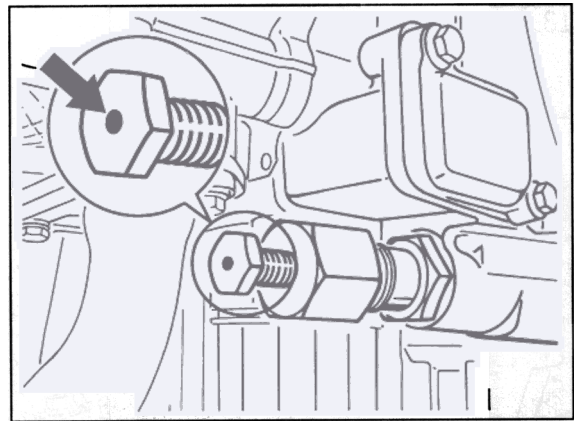
11. Fit auxiliary chain tensioner, special tool 9599, on cylinder head 4 - 6.



513_97

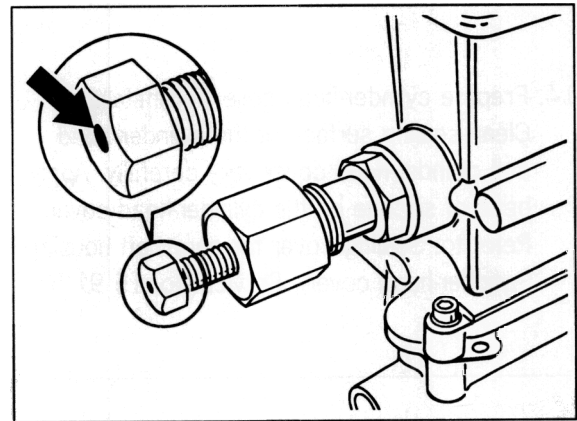
Fit auxiliary chain tensioner without sealing ring and fasten on the crankcase **only hand-tight**. The mechanical auxiliary chain tensioners must be installed with the correct pre-tension when the valve timing is adjusted or checked. The necessary pre-tension force has been reached when the measuring pin is **flush** with the face surface of the thrust screw. Turn the screw if necessary.

12. Check whether the auxiliary chain tensioners of cylinder bank 1 - 3 and the auxiliary chain tensioner are fitted on the crankcase half.



Chain tensioner on the crankcase

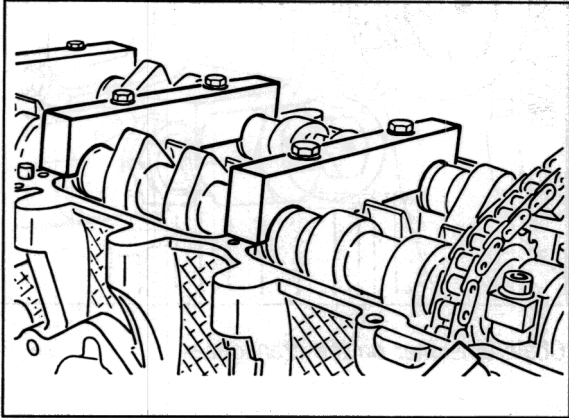
468_97



Chain tensioner on cylinder head 1 - 3

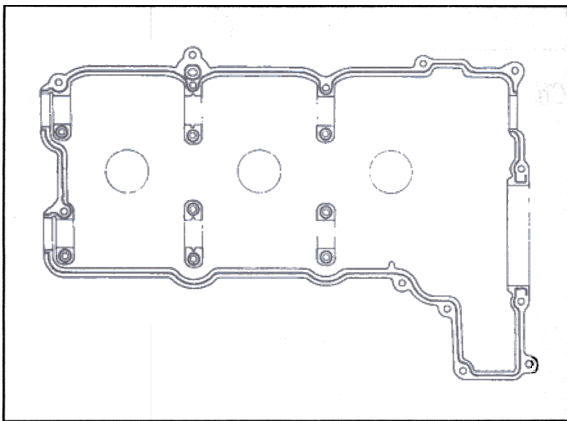
449_97

13. Remove holding-down device 9611



97-218

14. Prepare cylinder-head cover for installation:
Clean sealing surface of the cylinder head and cylinder-head cover very carefully. Apply bead of silicone on the cylinder-head cover. Refer to: Sealing cover for camshaft housing (cylinder-head cover), Service No. 15 91 51.

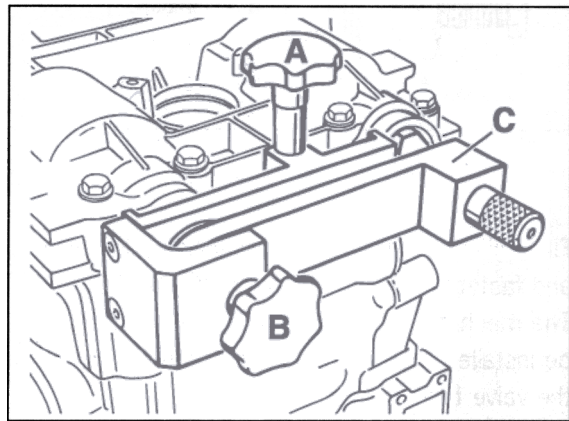


430_1_96

Carefully place the cylinder-head cover in the correct position so that the sealing bead is not damaged. Screw two studs or centring pins into the corners of the cylinder head as centring aids.

Immediately remove silicone material emerging in the area of the camshaft closure cap.

15. Fasten blocking device (special tool 9612) on the cylinder head.

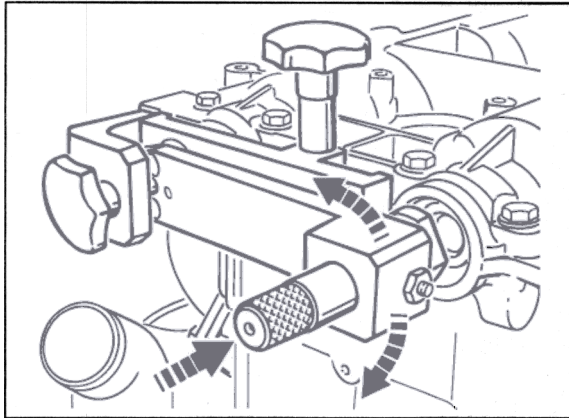


503_96

Special tool fitting sequence:

- A – Fastening screw with star knob on the cylinder-head lug. Pull back B and C when tightening.
- B – Centring piece in groove of the exhaust camshaft. Pull sword bolt (C) back when tightening.
- C – Sword bolt

16. Allocate camshafts; to do this, turn the pre-tensioned centre piece accordingly until the sword bolt can be fixed in the bearing bore.



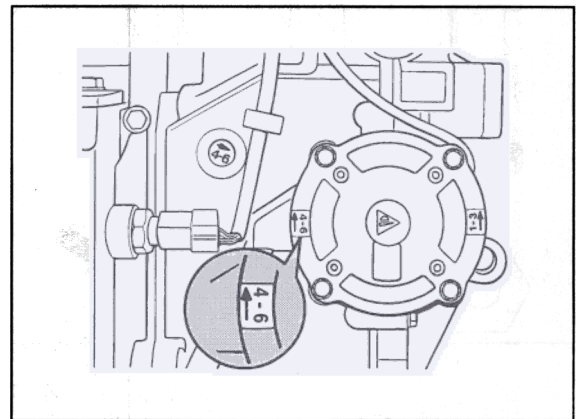
97-220

17. Fasten sprocket wheel.
Tightening torque 14 Nm (10.5 ftlb.)
18. Remove blocking device.
19. Fit camshaft closure caps (3 ea.) **dry**.
20. Fit closure cap on tensioning element (VarioCam).
Tightening torque 10 Nm (7.5 ftlb.)
21. Fit oil supply pump.

Note

The oil extraction pumps on the cylinder heads are identical parts. Therefore, the installation position or direction of rotation must be correct.

Installation position of oil extraction pump at **cylinder head 4 - 6** (pulley side): The arrow for the direction of rotation or the marking "4 - 6" must face the crankcase. Fit oil extraction pump. Use new sealing ring and new micro-encapsulated hexagon socket head screws.
Tightening torque 10 Nm (7.5 ftlb.)

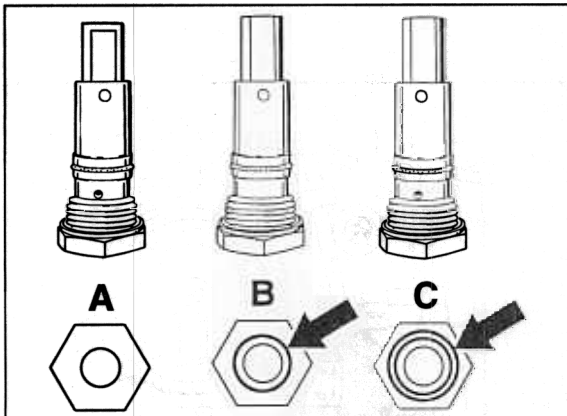


668_97

22. Unscrew auxiliary chain tensioner, put new sealing ring on the original chain tensioner and install.

Tightening torque 80 Nm (59 ftlb.)

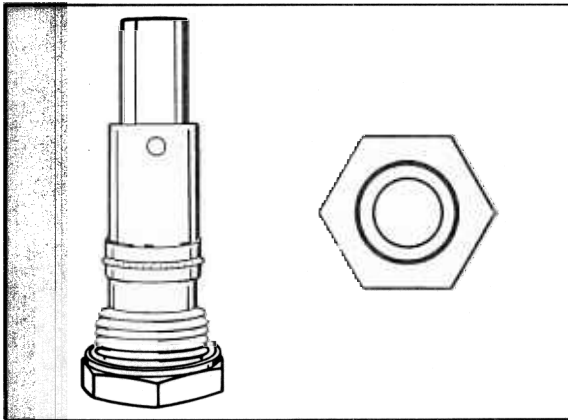
Allocation of chain tensioners



502_97

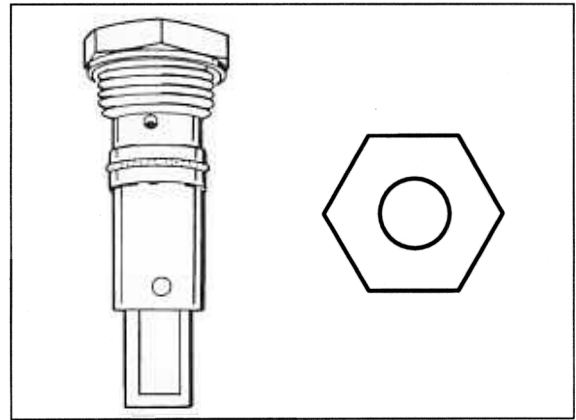
- A – Chain tensioner, **cylinder bank 4 - 6**
Identification "Without"
- B – Chain tensioner **on the crankcase**
Identification "1 ring"
- C – Chain tensioner, **cylinder bank 1 - 3**
Identification "2 rings"

Installation position of the chain tensioners
(engine in installed position)



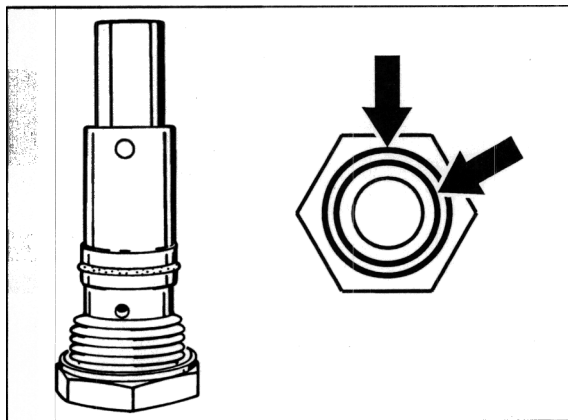
Chain tensioner on the crankcase

508_97



Chain tensioner on cylinder bank 4 - 6

507_97



Chain tensioner on cylinder bank 1 - 3

509_97

15 05 33 Completing camshafts

Preassembling camshafts

The inlet camshaft, exhaust camshaft, tensioning element (VarioCam) and chain must be pre-assembled before installation in the cylinder head.

Camshaft allocation

Camshafts of cylinder bank 1 - 3

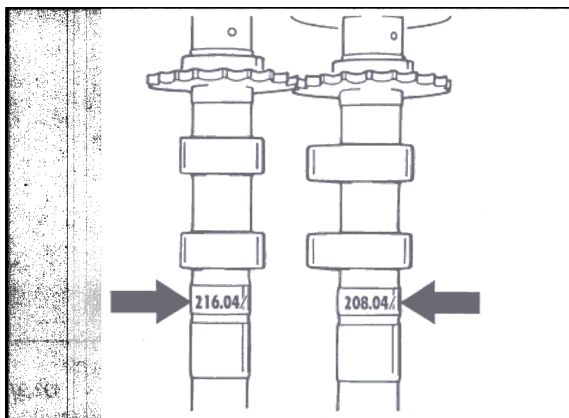
Identification on the camshaft

Inlet camshaft: 221.04/2.5 IN 13
Exhaust camshaft: 222.04/2.5 EX 13

Camshafts of cylinder bank 4 - 6

Identification on the camshaft

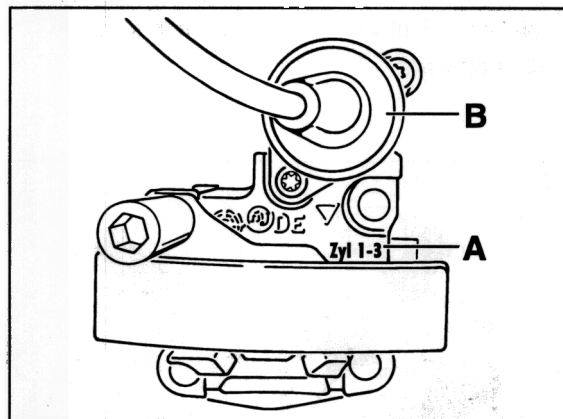
Inlet camshaft: 216.04/2.5 IN 46
Exhaust camshaft: 218.04/2.5 EX 46



516_97

Allocating tensioning elements

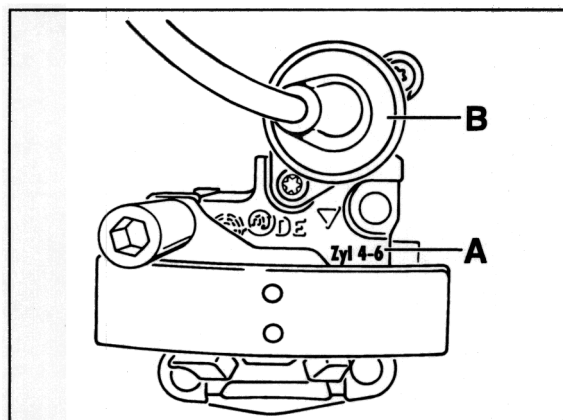
Identification for cylinder bank 1 - 3:



A = Cyl. 1 - 3
B = Solenoid valve surface colour
black

464_97

Identification for cylinder bank 4 - 6:

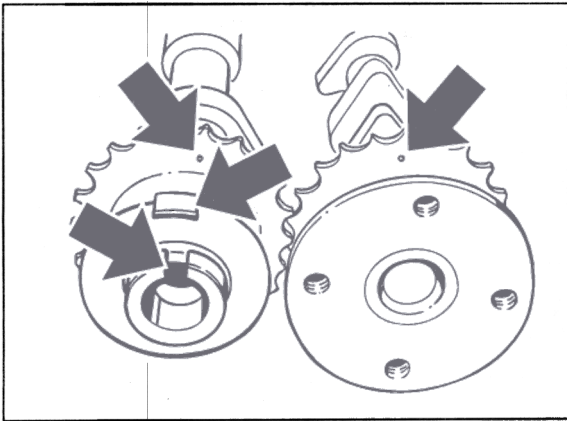


A = Cyl. bank 4 - 6
B = Solenoid valve surface colour
grey

465_97

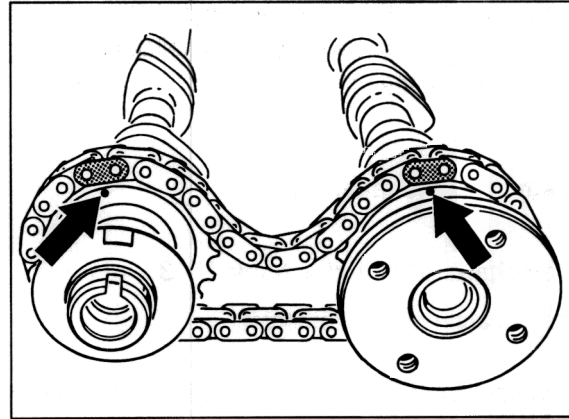
Move camshafts, chain and tensioning element of cylinder bank 1 - 3 to basic position or installation position.

1. Place the inlet camshaft and exhaust camshaft on a soft surface. The lug of the camshaft position sensor cover or the groove on the inlet camshaft and the dotting marks must face **upward**.



648_97

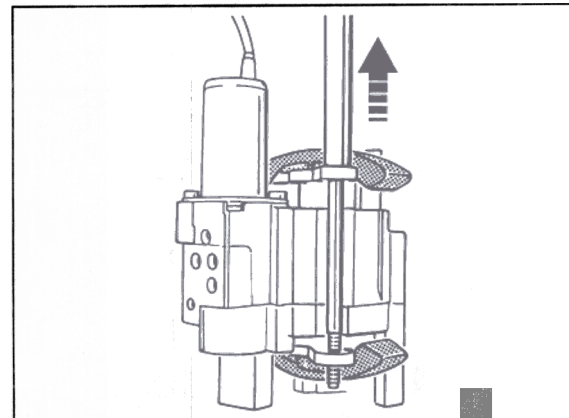
2. Place chain on the drive sprockets of the camshafts. The coloured outer lugs of the chain must face the dotting marks.



471-97

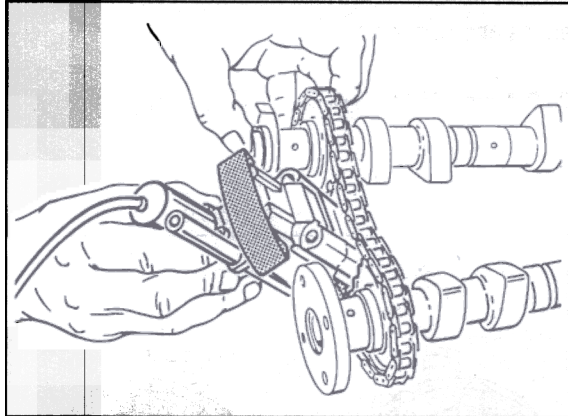
3. Fit tensioning element.

- 3.1 Press slide rails together and push upward.



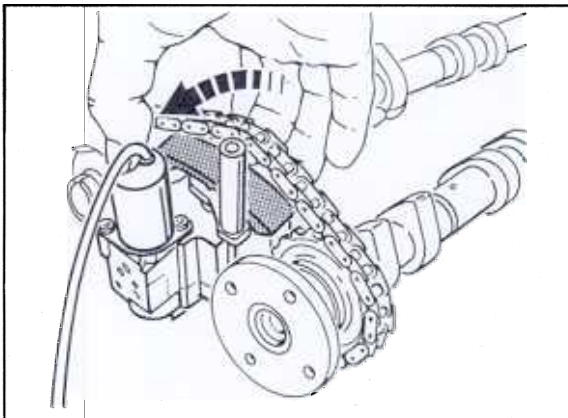
492_97

3.2 Lift inlet camshaft and insert tensioning element from the front.

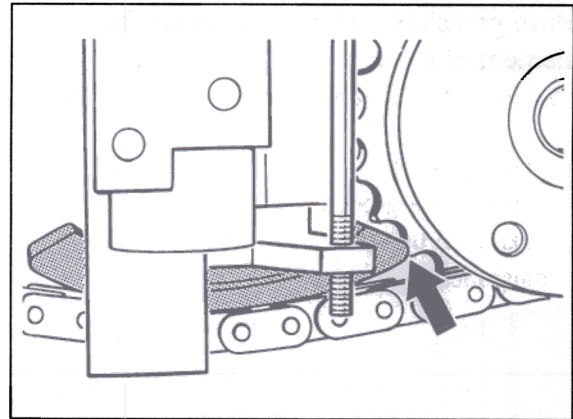


491_97

3.3 Fit chain; when doing so, observe clearance between the gear wheels and the lower slide rail.

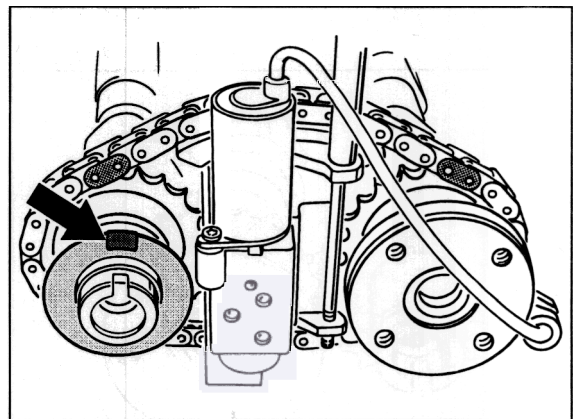


490_97



635_97

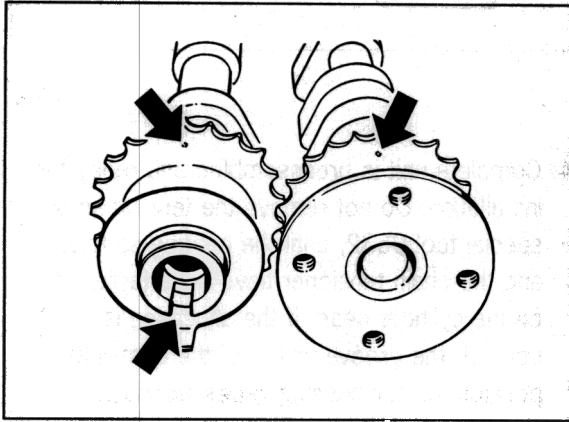
4. Complete unit is preassembled and ready for installation. Do not remove the tension screw, special tool 9632, until the bearing saddles and the chain tensioner have been fastened on the cylinder head. If the allocation is correct, the groove or lug of the camshaft position sensor housing **faces upward**.



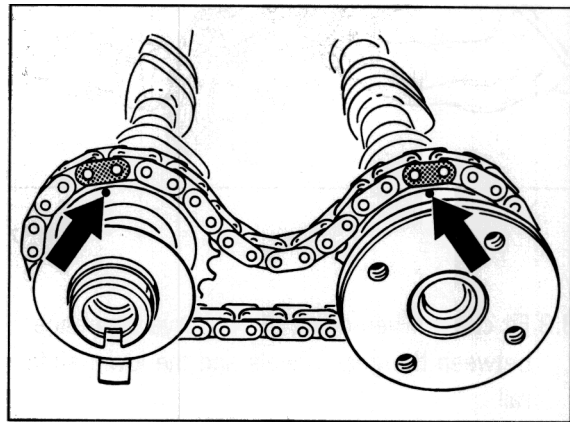
246_97

Move camshafts, chain and tensioning element of cylinder bank 4 - 6 to basic position or installation position.

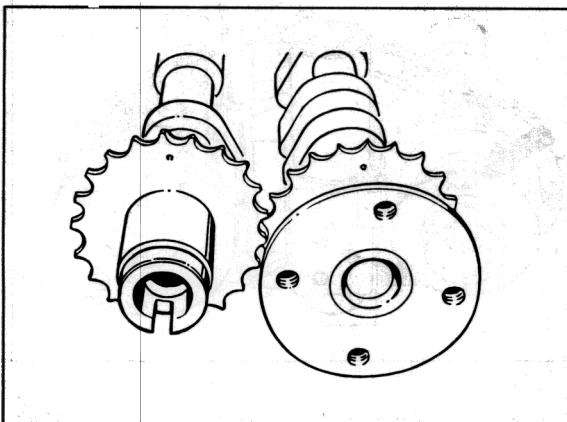
1. The lug of the camshaft position sensor cover or the groove on the inlet camshaft must face **upward**. The dotting marks must face **upward**.



649_97



443_97



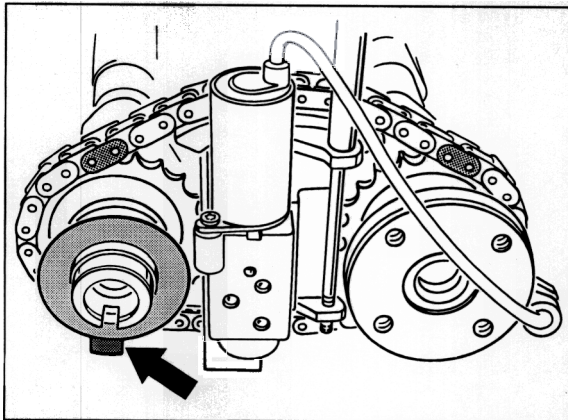
650_97

Note

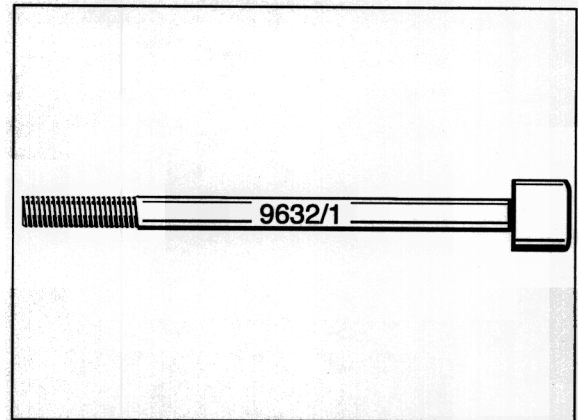
The rotor cover for the camshaft position sensor is no longer installed in vehicles without M660 (OBDII) or M661 (stricter emissions concept).

2. Put on and fit chain as described for cylinder bank 1 - 3.

3. Completely assembled and ready for installation. Do not remove the tensioning screw, special tool 9632, until the bearing saddles and the chain tensioner have been fastened on the cylinder head. If allocation is correct, the groove or lug of the camshaft position sensor housing faces **downward**.



243_97



317_99

Note:

Modified tensioning element (VarioCam) as of June 1999. The tensioning screw has been changed to a left-hand thread. Can be identified by the index (57) in the area of the guide rails.

Introduction as of engine number
65X19696

15 91 51 Sealing cover for camshaft housing (cylinder head cover)

Sealing the sealing surface of the cylinder head cover

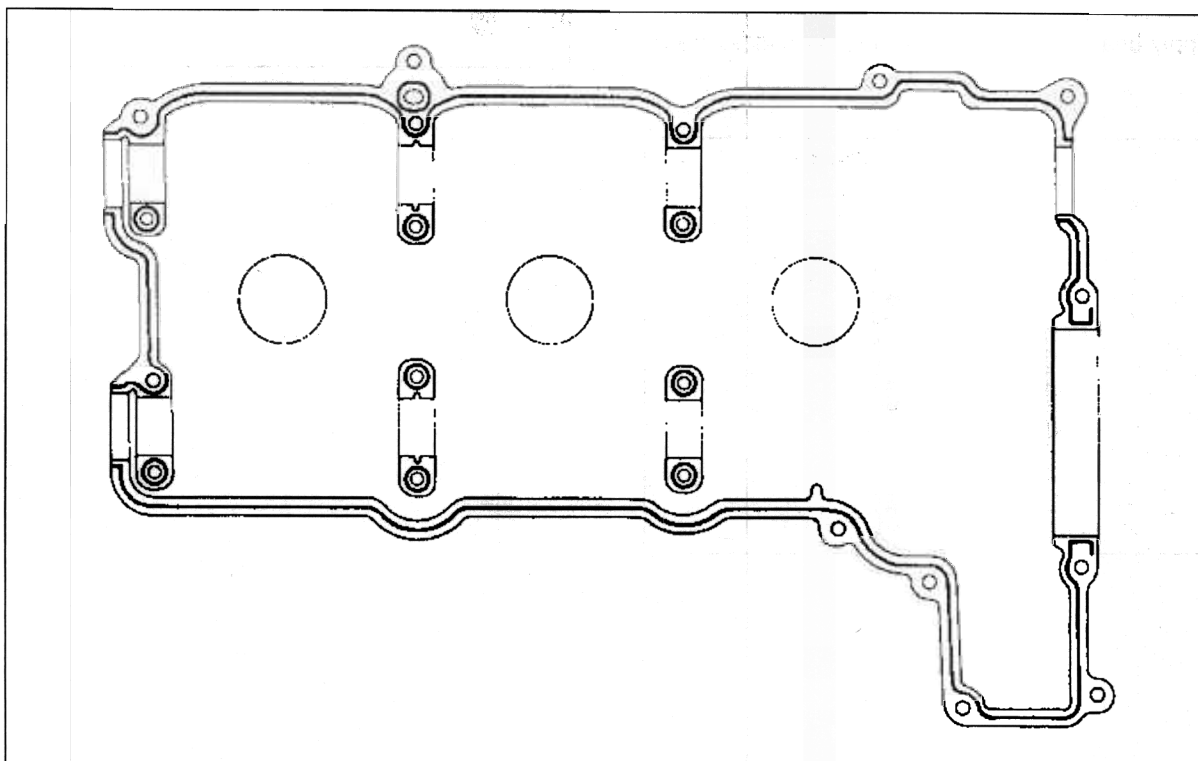
Use only the sealants **Drei Bond silicone type 1209** and **Loctite 5900** to seal the sealing surface on the cylinder head cover.

Note

After the sealant has been applied, the cylinder head must be joined with the cylinder head cover within 5 minutes.

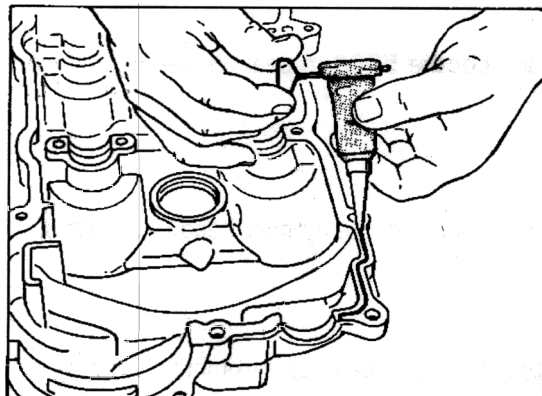
Application of silicone bead

At the processing nozzle, cut off the first metering step. Apply a uniform bead approximately 1.5 mm wide to the cleaned sealing surface of the cylinder head cover.



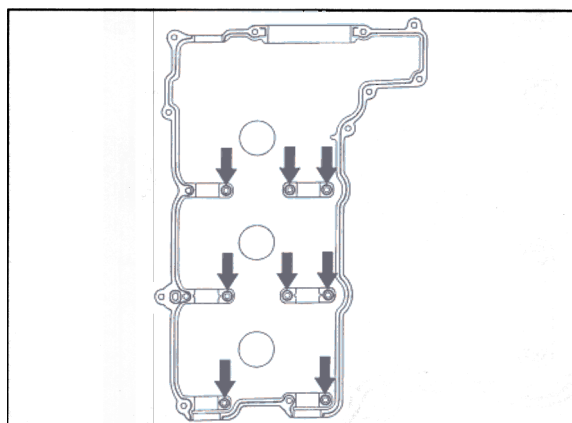
430_1_96

Applying the sealant on the sealing surface of the cylinder head cover



451_96

Apply bead of sealant in the bearing saddle area.

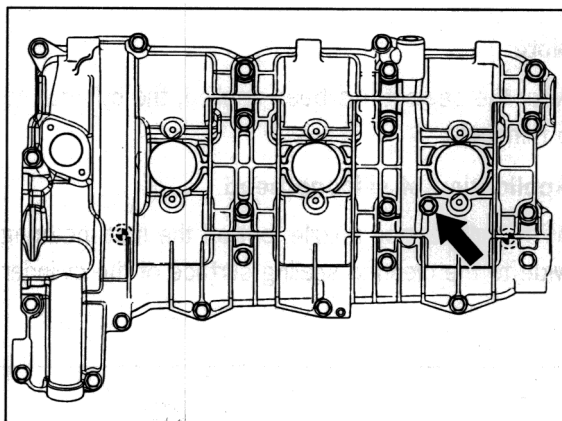


671_97

Seal screw union at the oil pressure duct.

If the hexagon-head bolt (arrow) was loosened, the micro-encapsulated hexagon-head bolt must always be replaced.

Part number 900.378.163.09 (M6 x 16)



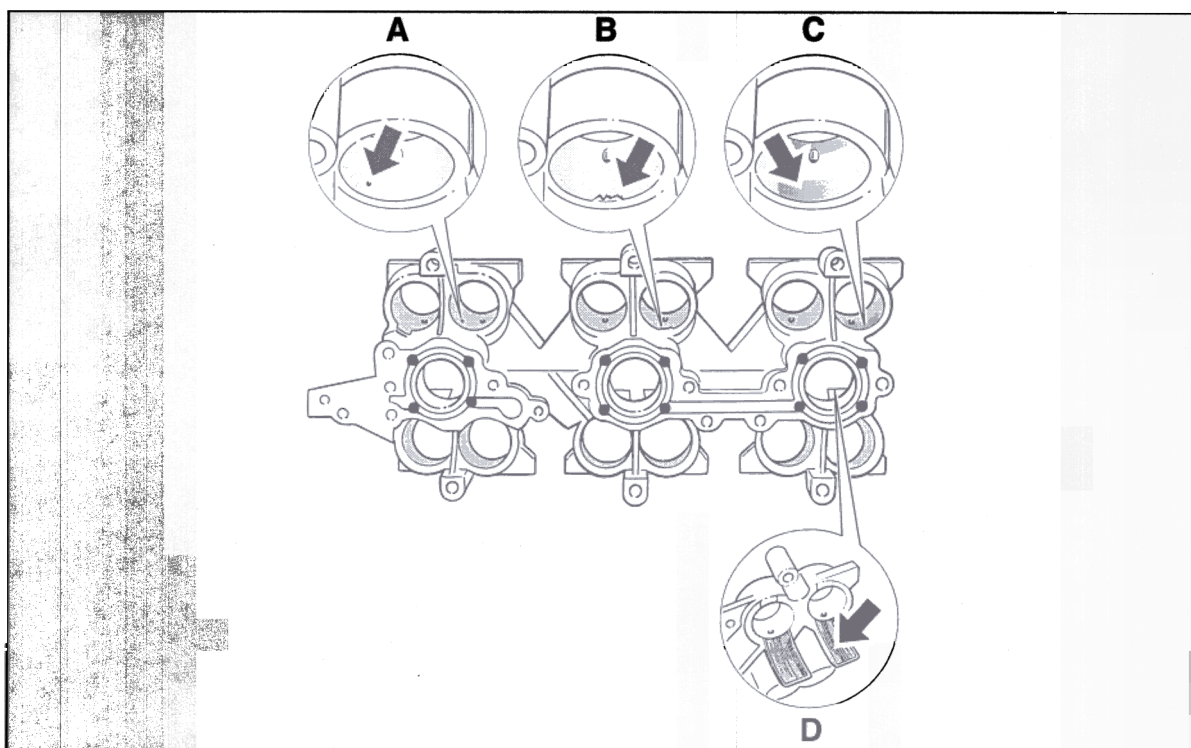
664_97

15 59 02 Checking guide for valve tappets

Before installing the valve tappet guide in the cylinder head, check it for damage or existing defects. The valve tappet guide must be replaced if it displays irregularities deviating from the limit-sample picture.

Limit sample picture

The irregularities shown in the limit sample picture are normal and are not regarded as damage influencing the function of the part or requiring replacement of the part.



644_97

Permissible irregularities:

A = Voids up to max. 1 mm²

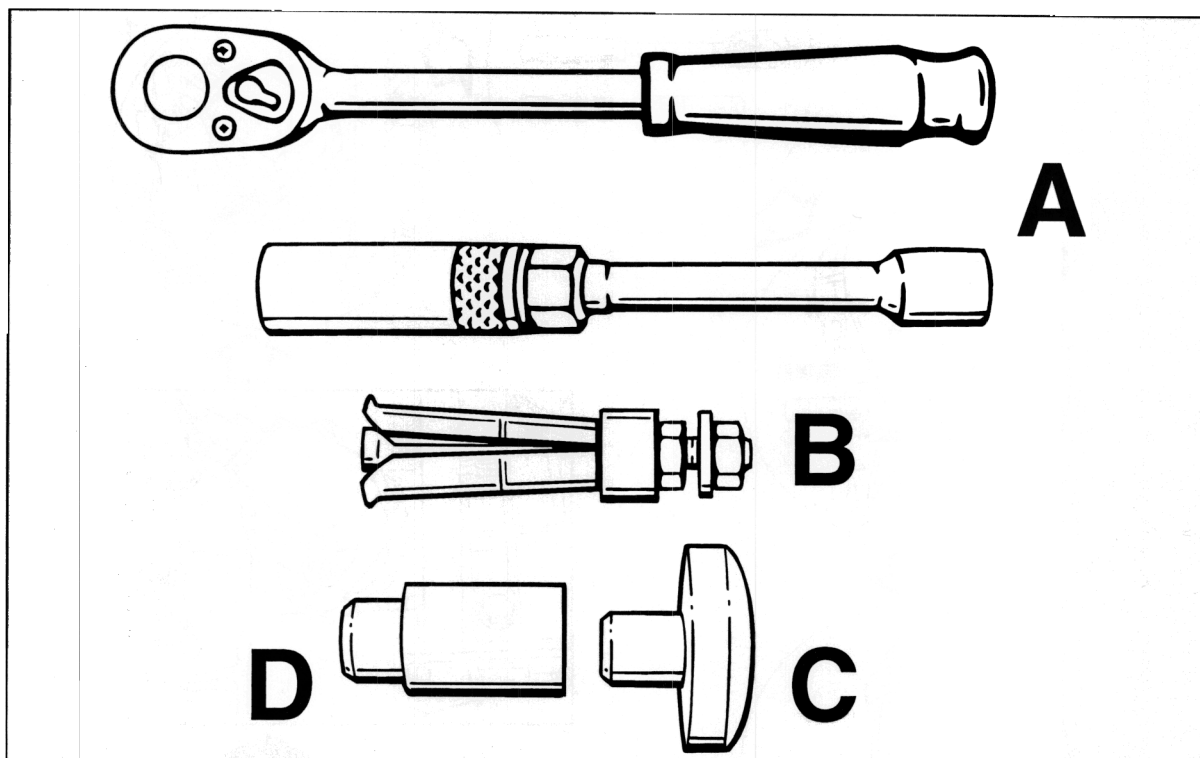
B = Fractures at the edges of the running surface of the valve tappet guide

C = Irregular contact patterns in the running surfaces of the valve tappet guide

D = Grooves in the oil pockets

15 46 19 Removing and installing oil protection tube – engine installed

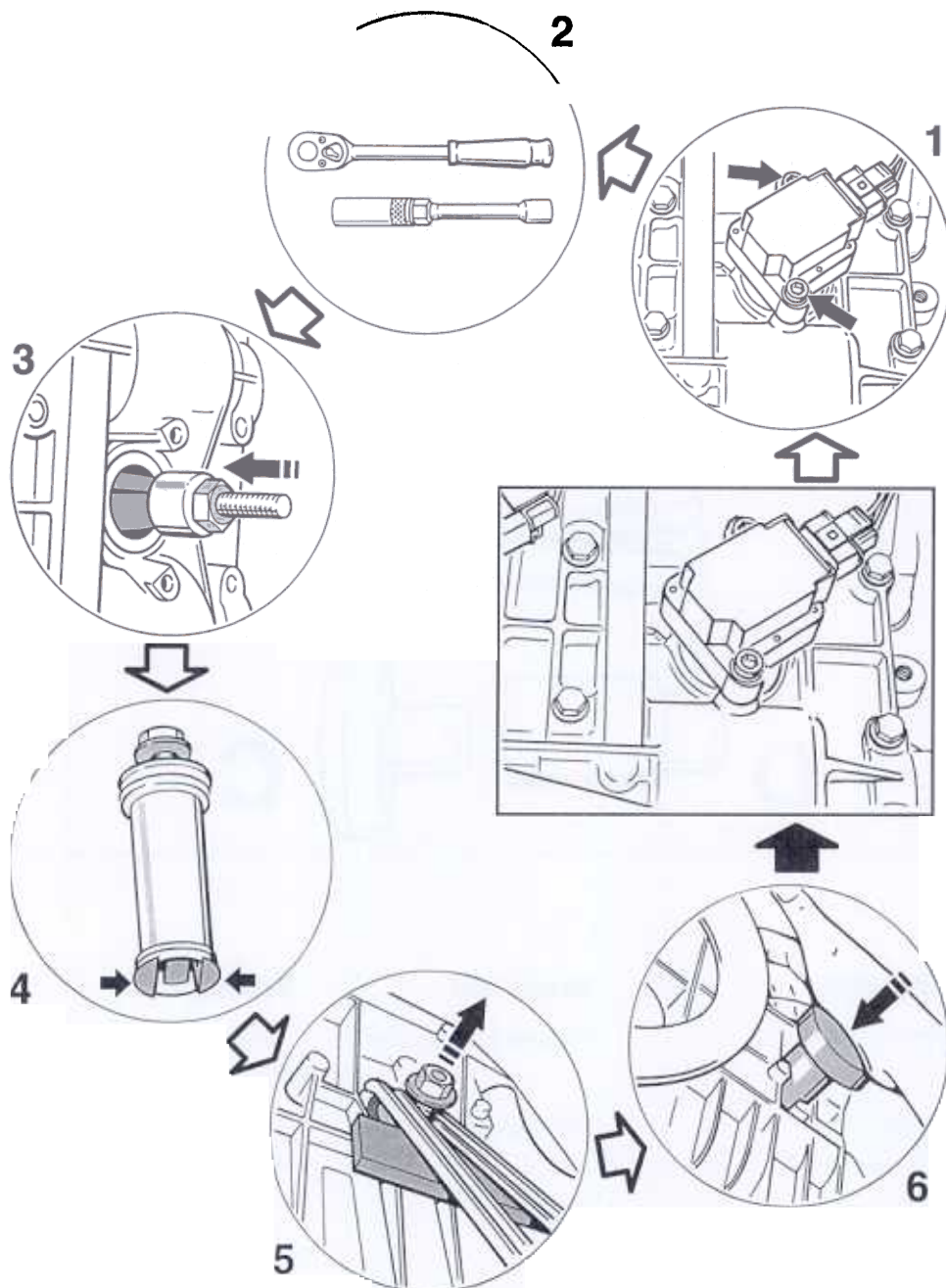
Tools



631_97

Item	Designation	Special tool	Explanation
A	Spark-plug wrench	commercially available	Refer to Workshop Equipment Manual, Chapter 2.4, Nos. 14 + 15
B	Internal puller 23.5 - 30 mm \varnothing	commercially available	Refer to Workshop Equipment Manual, Chapter 2.4, No. 108
C	Hand pressure piece, for fitting the oil protection tubes	9604	
D	Pressure piece, for fitting the oil protection tubes	9605/1	

Removing and installing oil protection tube – engine installed



632_97

Removal

Note

For removal ("**Removing oil protection tube**"), the cylinder-head cover must be heated in the area of the oil protection tube. Two different methods can be used for this:

First method: Heat cylinder-head cover in the area of the oil protection tube using an industrial hot-air gun.

Second method: Warm engine up to operating temperature.

The second method is preferable if no further assembly work has to be performed, e.g. sealing cylinder-head cover, replacing tensioning element (VarioCam) or replacing the flat-base tappets, etc.

No.	Procedure	Instructions
	Removing ignition coil	Lift the vehicle. Pull off plug. Unscrew hexagon socket head screws (wrench size 5) and pull off ignition coil with ignition-coil plug.
2	Removing spark plugs	Unscrew spark plugs using commercially available socket wrench insert; refer to Workshop Equipment Manual, Chapter 2.4, Nos. 14 and 15.
		<p>Note</p> <p>Only the Snap-on spark-plug wrench, order No. S 9706, and the Snap-on extension, order No. FXW 4, are approved for this work.</p>
3 + 4	Fitting internal puller in the oil protection tube	Push internal puller as far as it will go into the oil protection tube. Turn hexagon nut on the threaded rod clockwise until the spreader arms are in position. For improved representation, drawing No. 4 shows the removed oil protection tube with the internal puller spread.

Installation

No.	Procedure	Instructions
5	Pulling off oil protection tube	Fit washer (approx. 40 mm ø) and hexagon nut (M10) on the threaded rod. Press oil protection tube outward using two mounting levers, always using a suitable wooden support.
6	Fitting oil protection tube	Fit new sealing rings and coat with tyre mounting paste. Using the pressure piece (special tool 9605/1) and hand pressure piece (special tool 9604), manually press in the oil protection tube as far as it will go.
	Fitting spark plug	Fit spark plug with the prescribed spark-plug wrench. Tightening torque 25 ± 5 Nm (19 ± 3.5 ftlb.)
	Fitting ignition coil	Tightening torque 10 Nm (7.5 ftlb.)

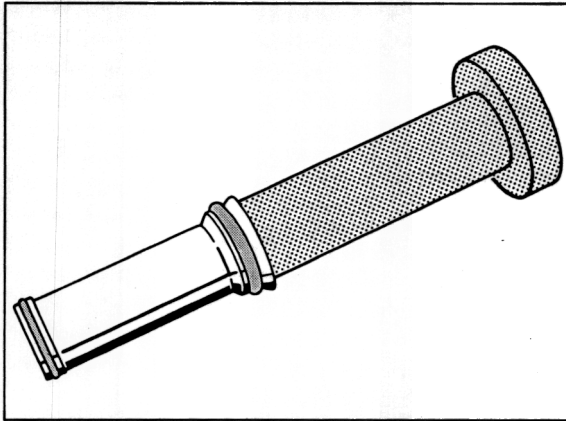
15 46 19 Removing and installing oil protection tube – engine removed**Removal**

Remove the cylinder-head cover, heat upper area with a hot-air gun and press the oil protection tube out.

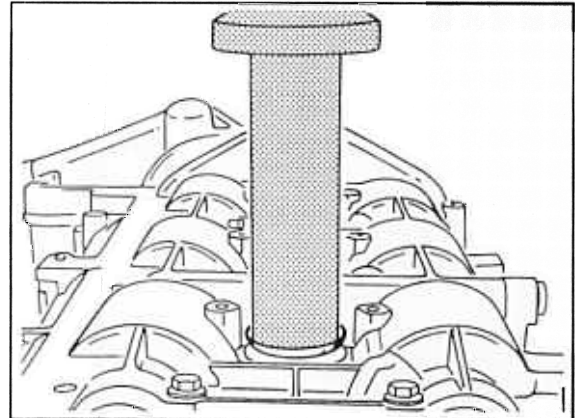
2. **Manually** press the oil protection tube as far as it will go into the fitted cylinder-head cover.

Installation

1. Coat sealing rings with tyre mounting paste. Push tube onto pressure piece, special tool 9605. Place hand pressure piece, special tool 9604, onto the pressure piece.



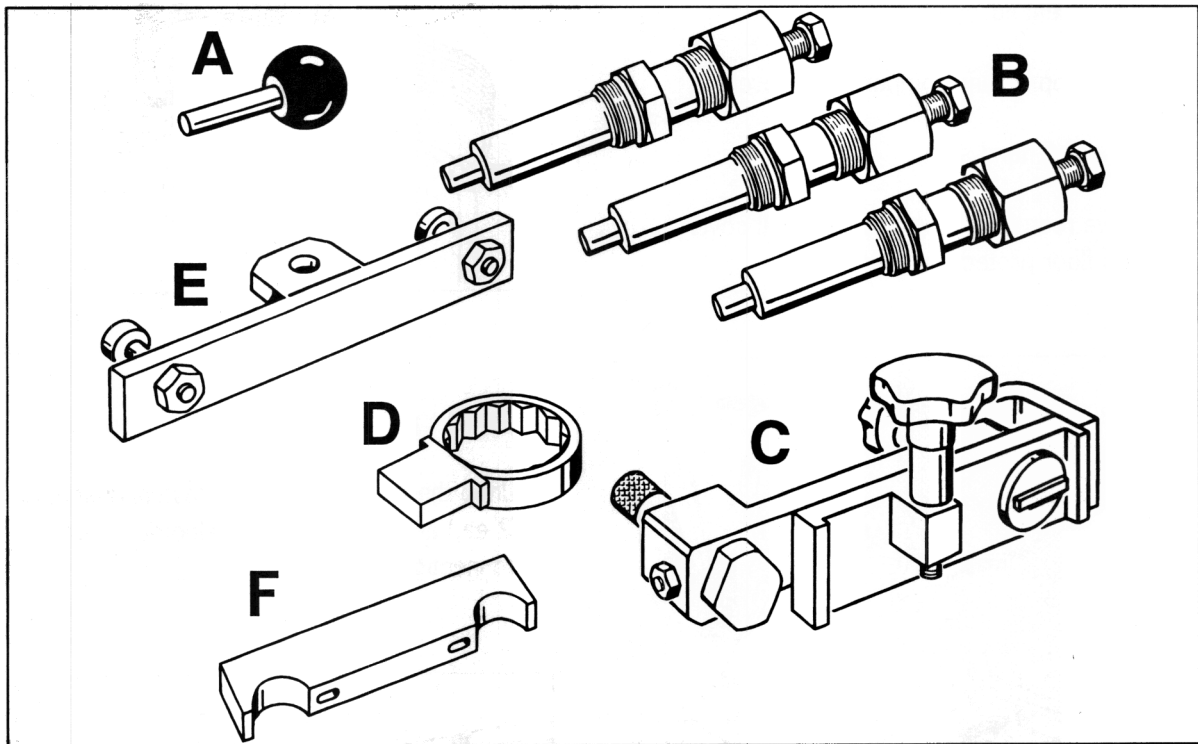
518_97



519_97

15 59 20 Removing and installing valve tappets – engine installed

Tools

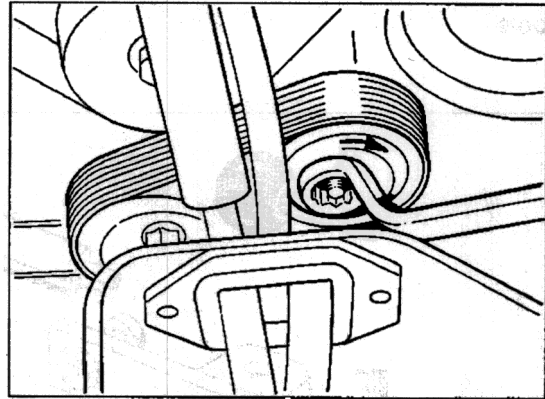


654_97

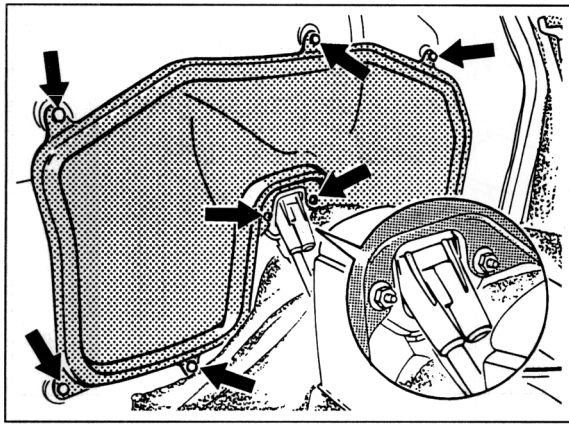
Item	Designation	Special tool	Explanation
A	Fixing pin for pulley	9595	1 set = 2 ea. (use short fixing pin)
B	Auxiliary chain tensioner for valve timing adjustment	9599	1 set = 3 ea.
C	Locking device for camshafts in timing position	9612	
D	Ring wrench (32 mm)		
E	Holding-down device for camshafts	9634	
F	Holding-down device for camshafts	9611	1 set = 4 ea.

Preliminary work for valve tappet removal

1. Disconnect battery.
2. Set up and secure convertible top compartment lid.
3. Remove top engine-compartment cover.
4. Remove left-hand seat.
5. Remove rear wall lining and rear wall cover
Put on floor protection cover.



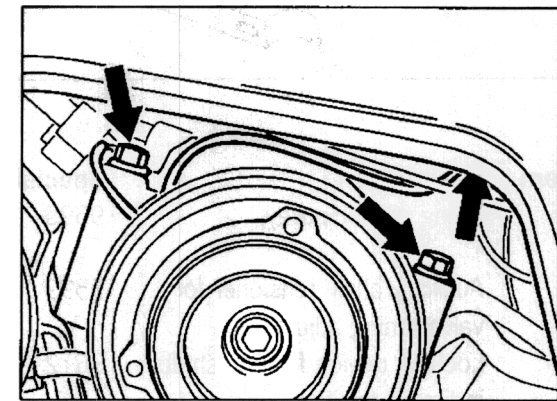
275-96



414-97

6. In vehicles with air conditioning, the following additional operations must be performed:

- 6.1 Remove drive belt. Mark the running direction of the belt with a coloured pen. Relieve the belt tension. To do this, turn the tensioning roller (wrench size 24 mm) clockwise and simultaneously remove the belt from the drive pulleys.

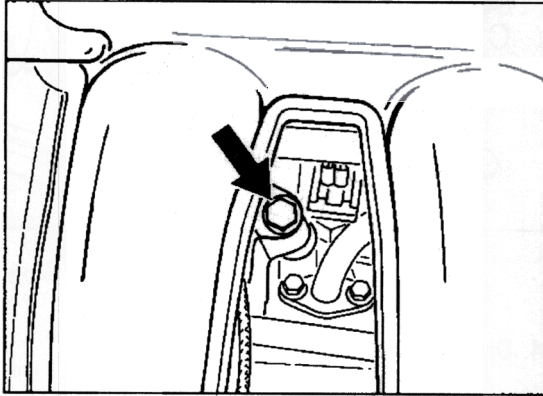


2796

- 6.2 Remove pulley of the hydraulic pump.

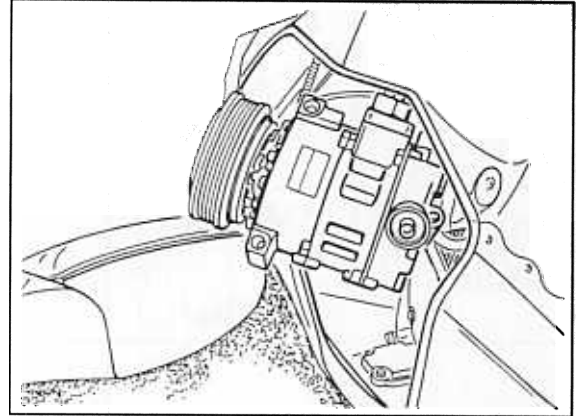
- 6.3 Undo the front compressor fastening screws (2 ea.) and disconnect the electrical plug connection.

- 6.4 Undo the compressor fastening screw between the intake pipes of cylinders 4 and 5.



26-96

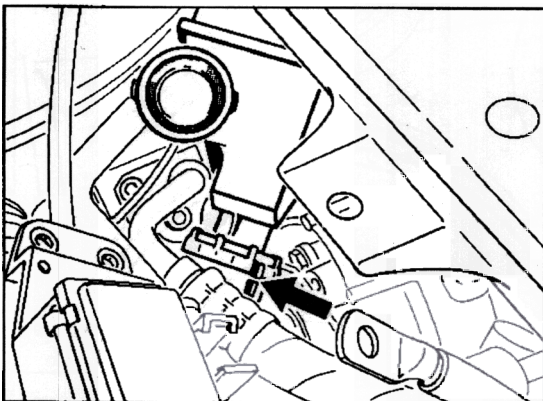
- 6.7 Lift the air-conditioning compressor with the connected lines out of the engine compartment and place on a wooden surface on the centre tunnel or console.



626_97

- 6.5 Undo the B+ connection (box) on the engine and put it aside.

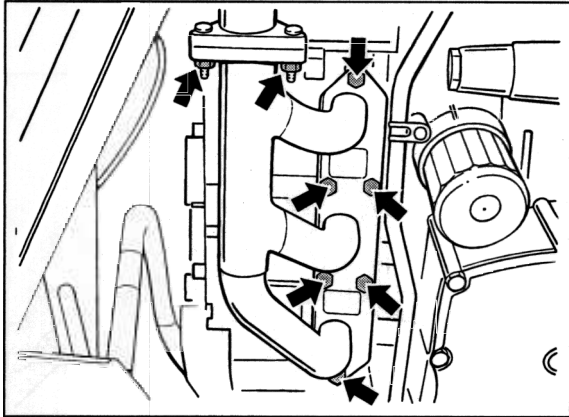
- 6.6 Suck out fluid from power steering reservoir until level is below the joint. Open bayonet lock and remove the reservoir. Close opening.



25-96

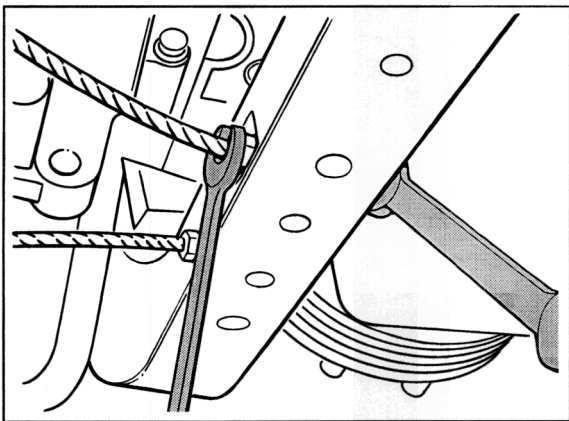
7. Remove the rear wheels.
8. Remove right and left diagonal braces.
9. Remove rear support sheet.

10. Detach and remove exhaust manifold of cylinder head 4 - 6.



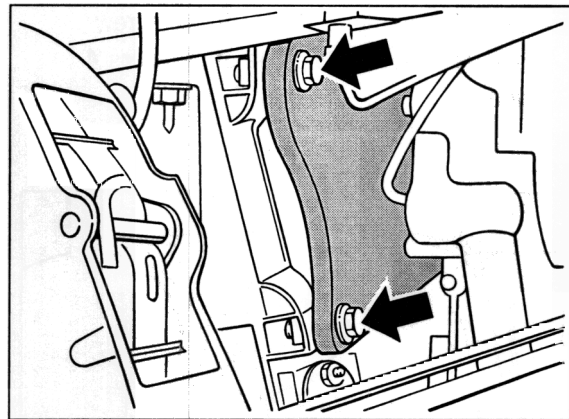
715_97

11. Unclip oxygen-sensor plug from the brackets of the rear-axle support.
12. Detach cable between engine and rear-axle support at the rear-axle support.



717_97

13. Detach rear-axle support and remove to the side.

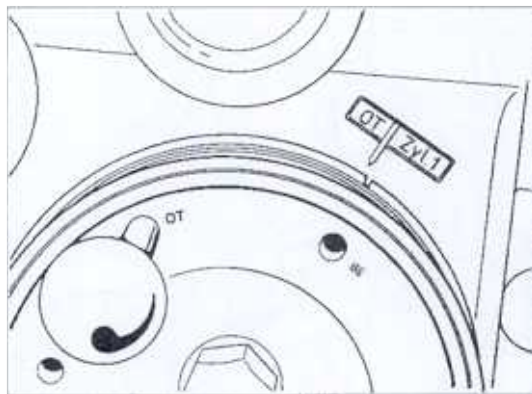


707_97

14. Drain engine oil.

Removing valve tappets of cylinder bank 1 - 3

1. Move camshafts of cylinder bank 1 - 3 to basic position or removal position. Turn crankshaft clockwise until the bore 1 OT (top dead centre) in the pulley is aligned with the fixing bore on the crankcase. Position or fix with fixing pin (short) of special tool 9595.

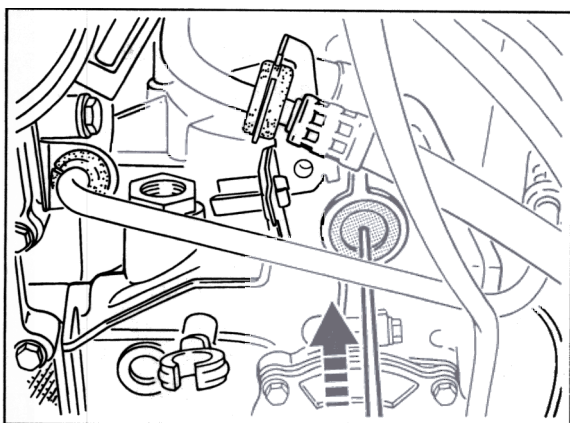


497_96

Note

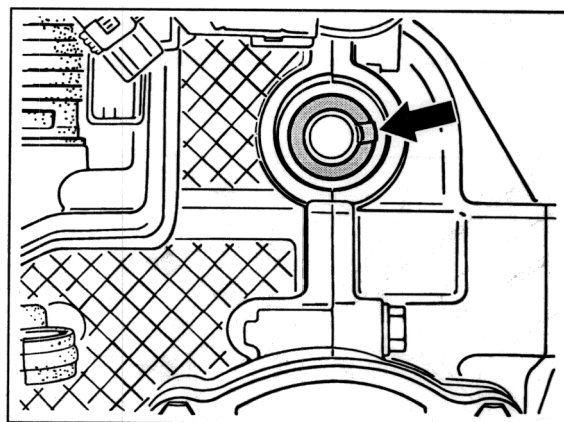
The basic camshaft adjustment can be checked only after removal of the camshaft closure caps.

- Remove camshaft closure caps above the cylinder-head oil pumps. The closure cap of **cylinder bank 1 - 3** is located on the flywheel side and the closure cap of **cylinder bank 4 - 6** is located on the pulley side. Drive awl into **centre** of the closure cap and lever off the cap.



Drawing shows closure cap of cylinder bank 4 - 6 (pulley side) 602_97

- Check basic camshaft adjustment of cylinder bank 1 - 3 .
The groove in the camshaft must face **outward** toward the cylinder-head cover.

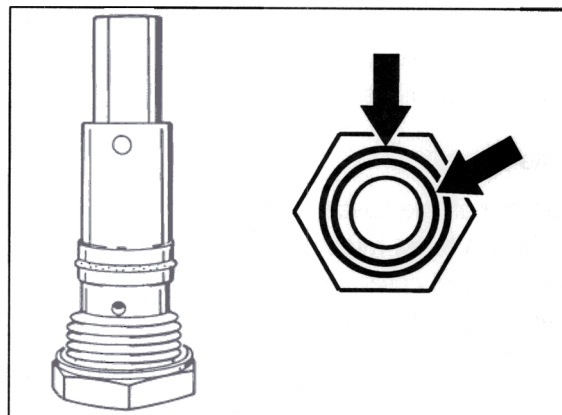


View from the flywheel side

625_97

If the position of the camshafts is incorrect, remove fixing pin at the pulley and rotate the crankshaft 360° clockwise. Then position or fix the fixing pin in the bore (1 OT) and in the fixing bore in the crankcase again.

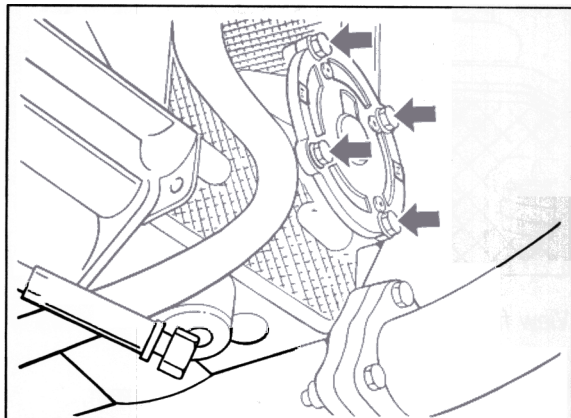
- Unscrew chain tensioner of cylinder bank 1 - 3.



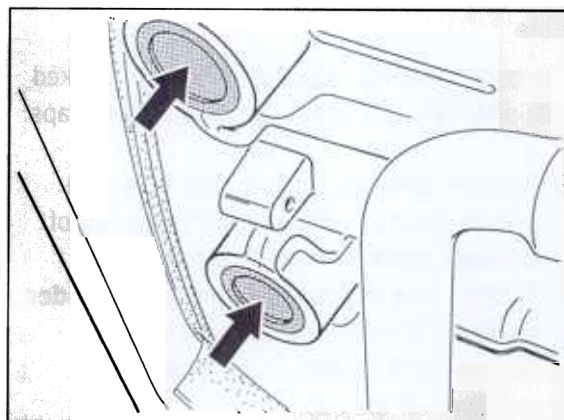
Installation position of chain tensioner on cylinder bank 1 - 3

509_97

5. Detach and remove oil extraction pump at cylinder head 1 - 3 – on the flywheel side.



713_97



685_97

6. Separate plug connection of the tensioning element (VarioCam).
7. Unscrew two hexagon-head bolts (M6 x 20) and remove closure cap from the tensioning element (VarioCam).
8. Remove ignition coils, spark plugs and oil protection tubes.

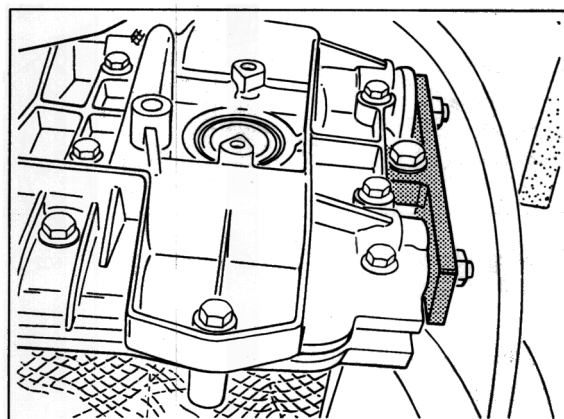
Note

As the available space is limited, the oil protection tubes must be removed before the cylinder-head cover can be removed.

"Removing and installing oil protection tube": refer to Group 1, Service No. 15 46 19.

9. Remove the camshaft closure caps from the passenger compartment side. Drive awl into **centre** of the closure cap and lever off the cap.

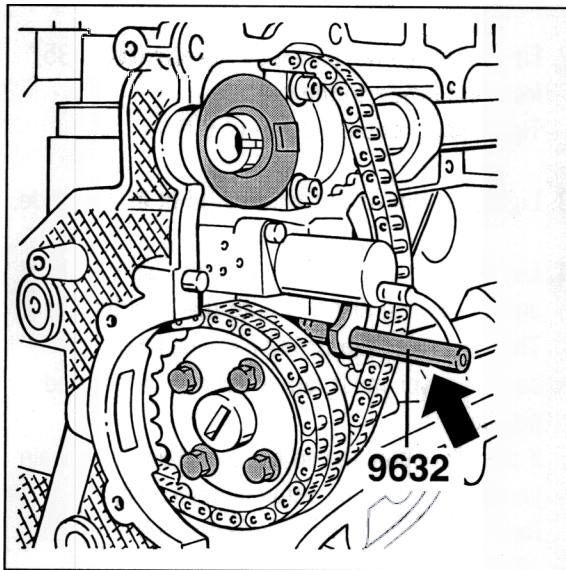
10. Fit special tool, holding-down device 9624, on the cylinder head. Fasten holding-down device with a hexagon-head bolt M8 x 30.



721_97

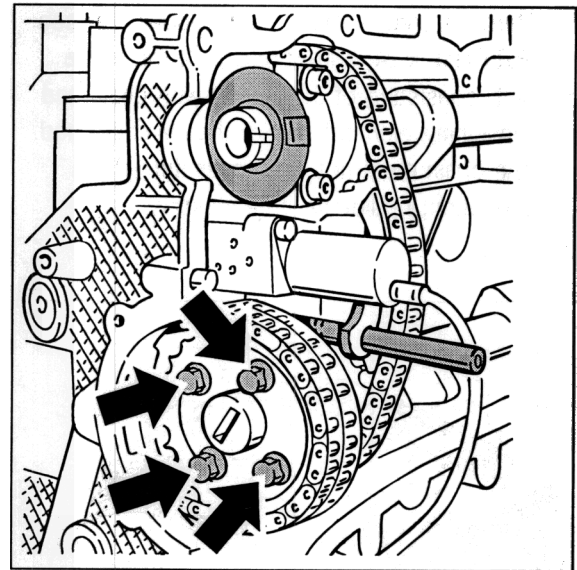
11. Remove cylinder-head cover. Loosen the hexagon-head bolts from the outside to the inside. Detach cylinder-head cover by tapping lightly with a plastic hammer.
12. Additionally fasten a holding-down device of special tool 9611 using M6 x 45 auxiliary screws.

13. Relieve camshaft tensioning element with special tool, tensioning screw 9632. Screw tensioning screw in only until the chain is slightly relieved.



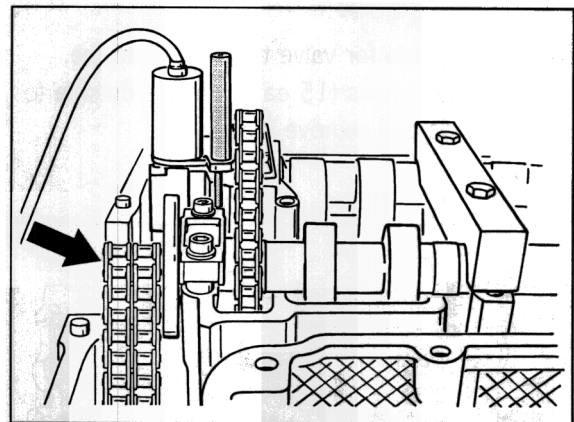
724_97

14. Unscrew three fastening screws (M6 x 95) for tensioning element.
15. Affix auxiliary chain tensioner (screw in by approx. 3 turns). Undo four hexagon-head bolts (M6 x 15) on the chain sprocket. Remove auxiliary chain tensioner again.



723_97

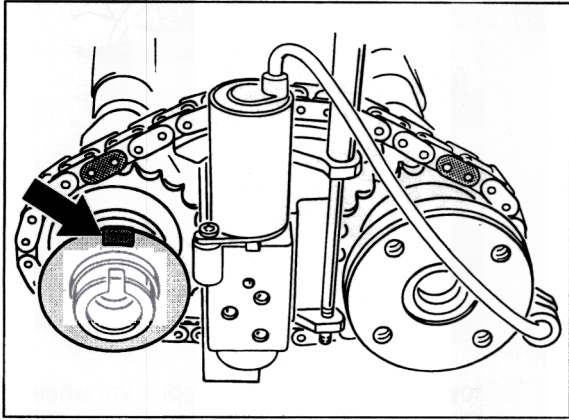
16. Remove drive plate. Remove sprocket wheel and chain and connect with a tie wrap (installation position).



658_97

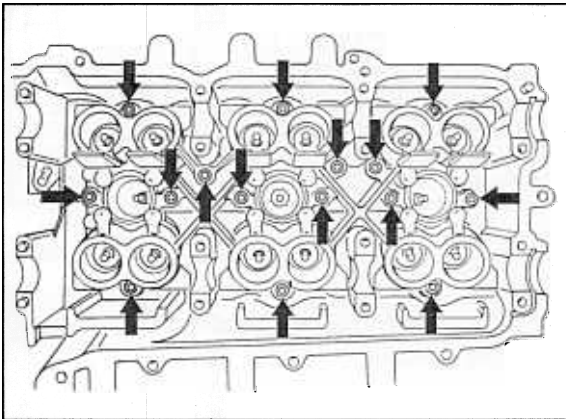
17. Detach bearing saddles and lever out of the guide sleeves.

18. Remove special tools, holding-down devices 9611 and 9624, and carefully lift the entire unit, consisting of camshafts with chain and tensioning element, out of the cylinder head. The chain must not jump over during this operation; reallocate if necessary.



246_97

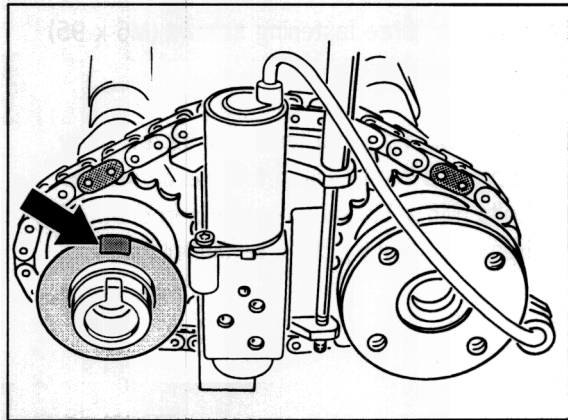
19. Lift out valve tappets with a magnet.
20. Detach guide for valve tappets. Undo the pan-head screws (15 ea.) from the outside to the inside and remove the guide.



659_97

Installing valve tappets of cylinder bank 1 - 3

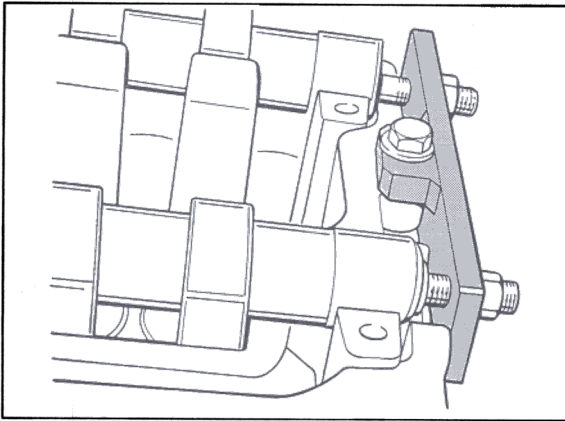
1. Check guide for damage.
Refer to: Checking guide for valve tappets, Service No. 15 59 02.
2. Fit guide. Tighten pan-head screws (M6 x 35) from the inside to the outside.
Tightening torque: 10 Nm (7.5 ftlb.)
3. Lightly oil the valve tappets and fit in the guide.
4. Lay the complete unit, camshafts with chain and tensioning element, into the cylinder head. The groove or tab of the camshaft position sensor cover must face **outward** in installed position.
If the allocation should be uncertain, e.g. chain jumped over, reallocation is necessary.
Refer to: Completing camshafts, Service No. 15 05 33.



246_97

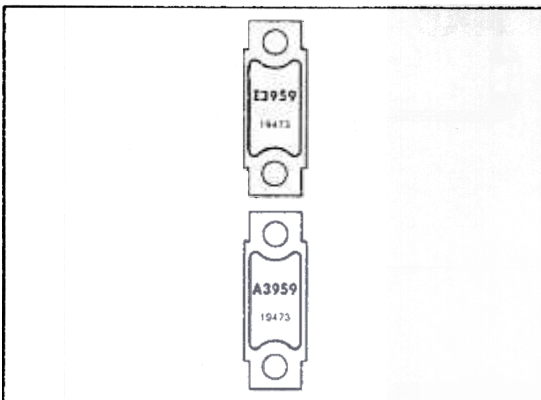
5. Fasten special tool, holding-down device 9611, with auxiliary screws M6 x 45.

6. Fit special tool, holding-down device 9624, on the cylinder head using a hexagon-head bolt M8 x 30.



633_97

7. Check dowel sleeves (4 ea.) of the bearing saddles to ensure that they are properly seated in the cylinder head. Oil bearing surface. Fit bearing saddles in the **correct** position and tighten **evenly**.
Tightening torque: 10 Nm (7.5 ftlb.)



E = Bearing saddle for inlet camshaft
A = Bearing saddle for exhaust camshaft

401_1_96

8. Fit tensioning element (VarioCam). Tighten 3 M6 x 95 pan-head screws.
Tightening torque: 10 Nm (7.5 ftlb.).

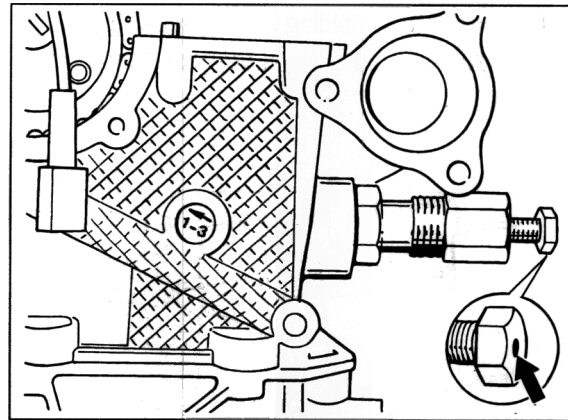
9. Unscrew tensioning screw, special tool 9632, from the tensioning element.

10. Remove tie wrap and fit sprocket wheel with chain on the flange of the exhaust camshaft.

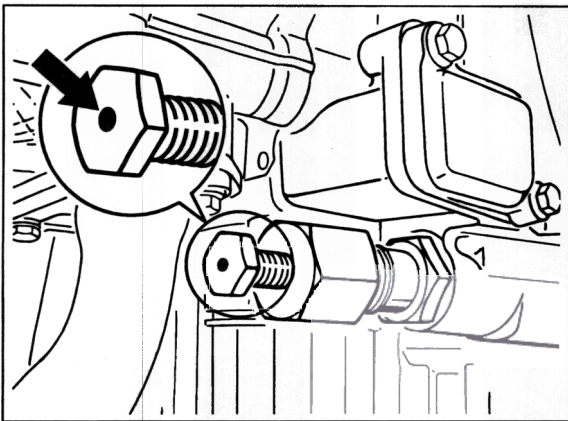
11. Position drive plate or driver star on the sprocket wheel. Fit hexagon-head bolt M6 x 15 (10.9).
Tighten hexagon-head bolt **by hand** only.

12. Unscrew chain tensioner (fitted on the crankcase half of cylinder bank 4 - 6) and fasten auxiliary chain tensioner (special tool 9599). Fit auxiliary chain tensioner without sealing ring and fasten on the crankcase **only hand-tight**.

The mechanical auxiliary chain tensioners must be installed with the correct pre-tension when the valve timing is adjusted or checked. The necessary pre-tension force has been reached when the measuring pin is **flush** with the face surface of the thrust screw. Turn the screw if necessary.



669_97

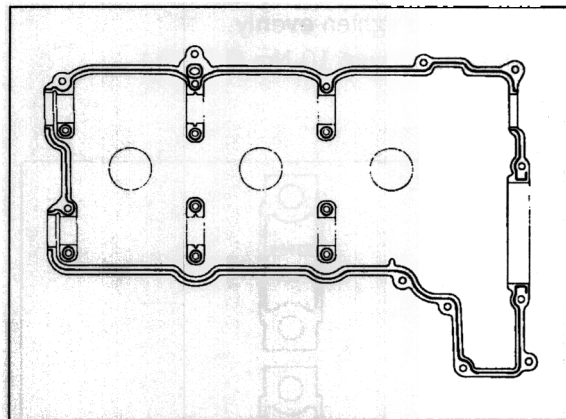


468_97

13. Fit auxiliary chain tensioner on cylinder head 1 - 3 and adjust pre-tension force (refer to step 12).

14. Fit cylinder-head cover. Remove holding-down device 9611.

Clean sealing surface of the cylinder head and cylinder-head cover very carefully. Apply bead of silicone on the cylinder-head cover. Refer to: Sealing cover for camshaft housing (cylinder-head cover), Service No. 15 91 51.

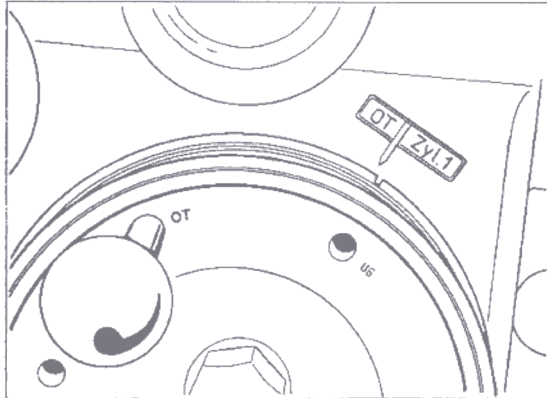


430_1_96

Carefully place the cylinder-head cover in the correct position so that the sealing bead is not damaged. Screw two studs or centring pins into the corners of the cylinder head as centring aids. Tightening torque: 13 Nm (10.0 ftlb.)

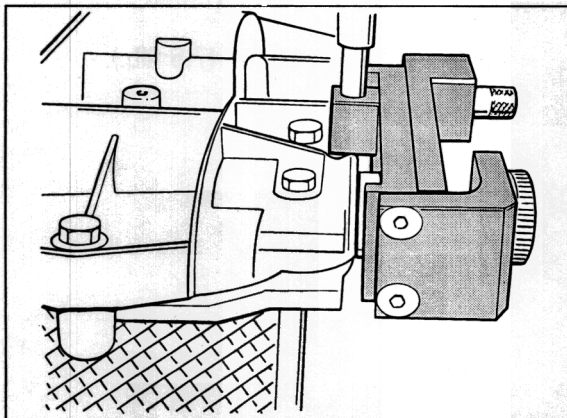
Immediately remove silicone material emerging in the area of the camshaft closure cap.

15. For the subsequent adjustment work on the camshaft, the pulley must be fixed at bore 1 OT (TDC) with the fixing pin (special tool 9595).



497_96

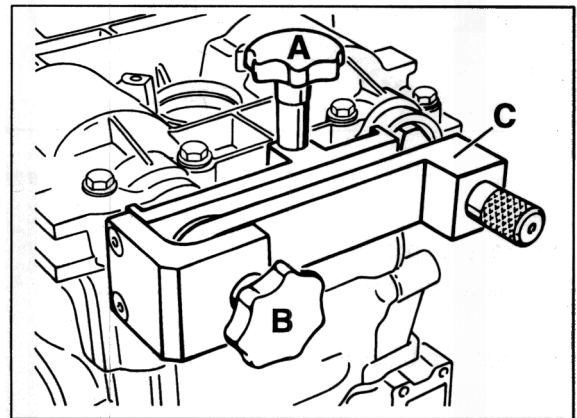
16. Fasten blocking device (special tool 9612) on the cylinder head.



718_97

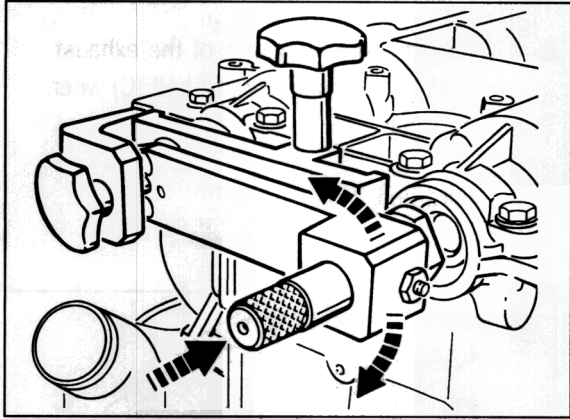
Special-tool fitting sequence:

- A – Fastening screw with star knob on the cylinder-head lug. Pull back centring piece (B) and sword bolt (C) when tightening.
- B – Centring piece in groove of the exhaust camshaft. Pull back sword bolt (C) when tightening.
- C – Sword bolt



503_96

17. Allocate camshafts; to do this, turn the pre-tensioned centre piece accordingly until the sword bolt can be fixed in the bearing bore.



97-220

18. Fasten sprocket wheel.
Tightening torque: 14 Nm (10.5 ftlb.)

19. Remove blocking device.

Note

The auxiliary chain tensioners must remain fitted on cylinder bank 4 - 6 for the subsequent assembly work.

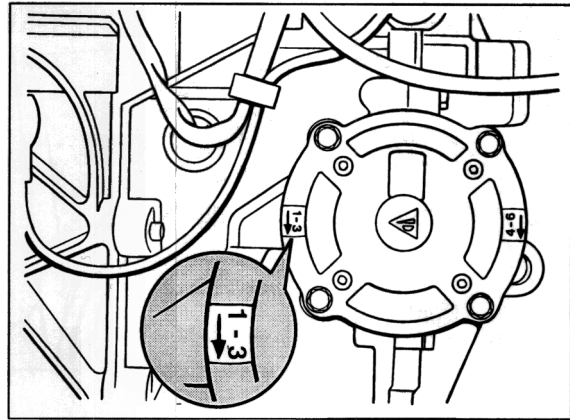
20. Fit oil extraction pump.

Note

The oil extraction pumps on the cylinder heads are identical parts. Therefore, the installation position or direction of rotation must be correct.

Installation position of oil extraction pump at **cylinder head 1 - 3** (flywheel side): The arrow for the direction of rotation or the marking "1 - 3" must face the crankcase. Fit oil extraction pump. Use new sealing ring and new micro-encapsulated hexagon socket head screws.

Tightening torque: 10 Nm (7.5 ftlb.).



667_97

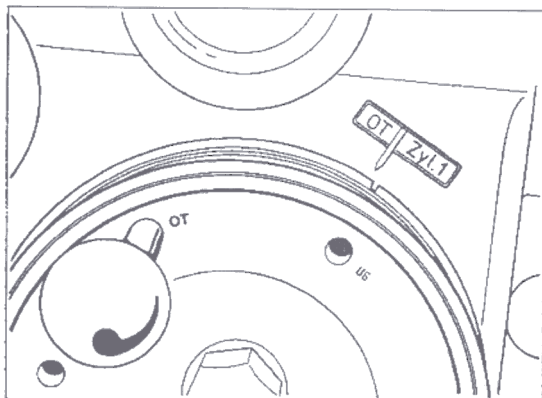
21. Fit camshaft closure cap dry.

22. Fit closure cap on tensioning element (VarioCam).
Tightening torque: 10 Nm (7.5 ftlb.).

Removing valve tappets of cylinder bank 4 - 6

1. Remove fixing pin.

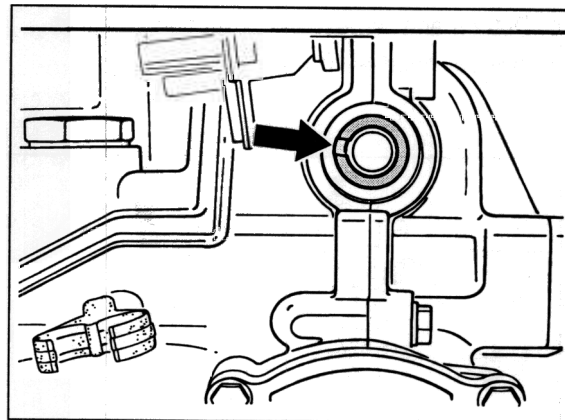
Turn crankshaft 360° clockwise until the bore 1 OT (top dead centre) in the pulley is aligned with the fixing bore on the crankcase. Position or fix with fixing pin (short) of special tool 9595.



497_96

2. Check camshaft adjustment at cylinder bank 4 - 6:

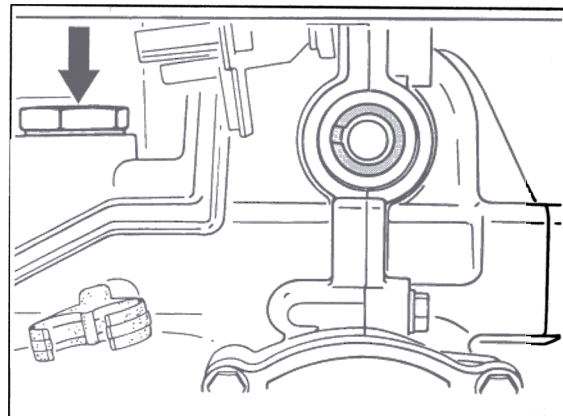
The groove in the camshaft must face inward toward the crankcase.



View from the pulley side

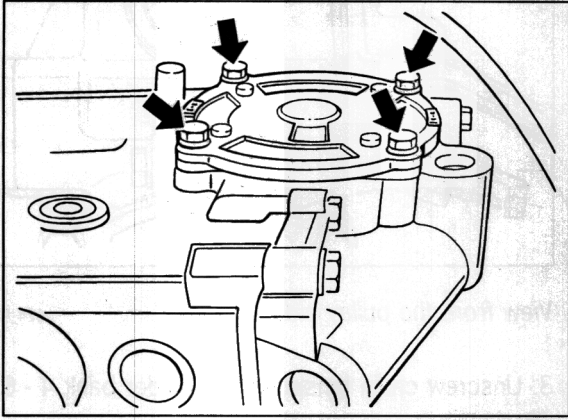
624_97

3. Unscrew chain tensioner of cylinder bank 4 - 6.



672_97

4. Detach and remove oil extraction pump at cylinder head 4 - 6 (pulley side).



714_97

5. Separate plug connection of the tensioning element (VarioCam).
6. Unscrew two hexagon-head bolts (M6 x 20) and remove closure cap from the tensioning element (VarioCam).
7. Remove ignition coils, spark plugs and oil protection tubes.

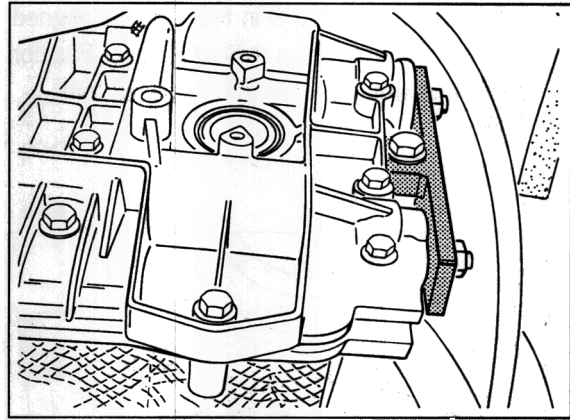
Note

As the available space is limited, the oil protection tubes must be removed before the cylinder-head cover can be removed.

"Removing and installing oil protection tube": refer to Group 1, Service No. 15 46 19.

8. Remove the camshaft closure caps from the underside of the vehicle. Drive awl into **centre** of the closure cap and lever off the cap.

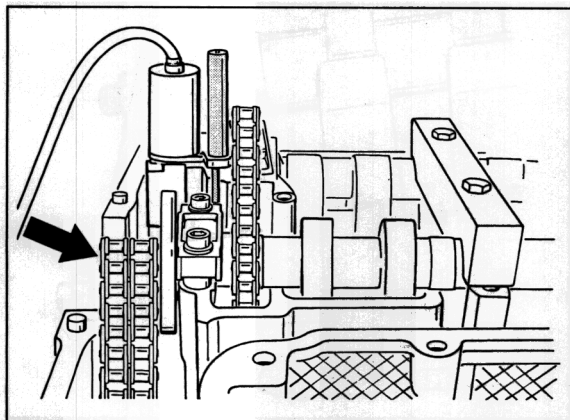
9. Fit special tool, holding-down device 9624, on the cylinder head. Fasten holding-down device with a hexagon-head bolt M8 x 30.



721_97

10. Remove cylinder-head cover. Loosen the hexagon-head bolts from the outside to the inside. Detach cylinder-head cover by tapping lightly with a plastic hammer.
11. Additionally fasten a holding-down device of special tool 9611 using M6 x 45 auxiliary screws.
12. Relieve camshaft tensioning element with tensioning screw, special tool 9632. Screw tensioning screw in only until the chain is slightly relieved.
13. Unscrew three fastening screws (M6 x 95) for tensioning element.
14. Affix auxiliary chain tensioner (screw in by approx. 3 turns). Undo four hexagon-head bolts (M6 x 15) on the chain sprocket. Remove auxiliary chain tensioner again.

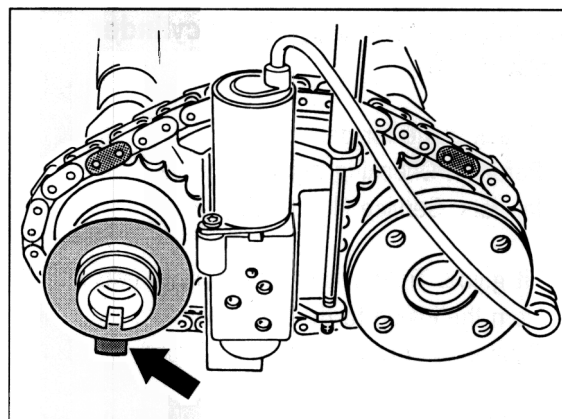
15. Remove drive plate. Remove sprocket wheel and chain and connect with a tie wrap for the subsequent installation position.



658_97

16. Detach bearing saddles and lever out of the guide sleeves.

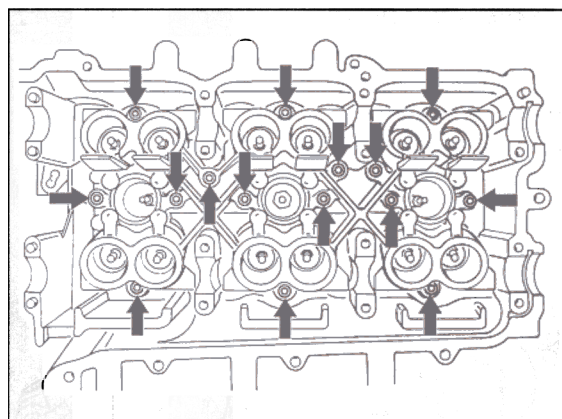
17. Remove special tools, holding-down devices 9611 and 9624, and carefully lift the entire unit, consisting of camshafts with chain and tensioning element, out of the cylinder heads. The chain must not jump over during this operation; reallocate if necessary.



243_97

18. Lift out valve tappets with a magnet.

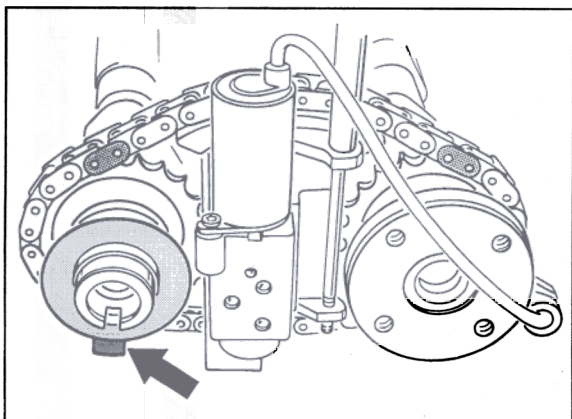
19. Detach guide for valve tappets. Undo the pan-head screws (15 ea.) from the outside to the inside and remove the guide.



659_97

Installing valve tappets of cylinder bank 4 - 6

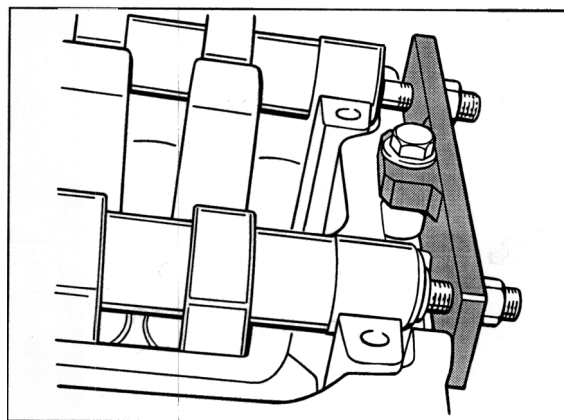
1. Check guide for damage.
Refer to: Checking guide for valve tappets, Service No. 15 59 02.
2. Fit guide. Tighten pan-head screws (M6 x 35) from the inside to the outside.
Tightening torque: 10 Nm (7.5 ftlb.)
3. Lightly oil the valve tappets and fit in the guide.
4. Lay the complete unit, camshafts with chain and tensioning element, into the cylinder head.
The groove or tab of the camshaft position sensor cover must face **outward** in installed position.
If the allocation should be uncertain, e.g. chain jumped over, reallocation is necessary.
Refer to: Completing camshafts, Service No. 15 05 33.



243_97

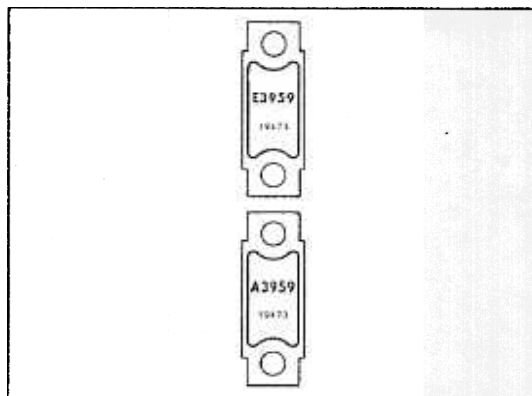
5. Fasten special tool, holding-down device 9611, with auxiliary screws M6 x 45.

6. Fit special tool, holding-down device 9624, on the cylinder head using a hexagon-head bolt M8 x 30.



633_97

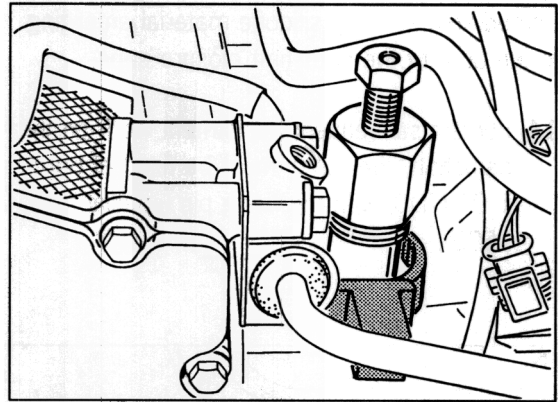
7. Check dowel sleeves (4 ea.) of the bearing saddles to ensure that they are properly seated in the cylinder head. Oil bearing surface. Fit bearing saddles in the **correct** position and tighten **evenly**.
Tightening torque: 10 Nm (7.5 ftlb.)



E = Bearing saddle for inlet camshaft
A = Bearing saddle for exhaust camshaft

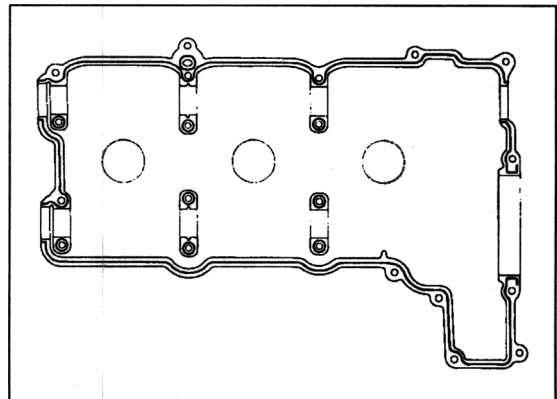
401_1_96

8. Fit tensioning element (VarioCam). Tighten 3 M6 x 95 pan-head screws.
Tightening torque: 10 Nm (7.5 ftlb.)
9. Unscrew tensioning screw, special tool 9632, from the tensioning element.
10. Remove tie wrap and fit sprocket wheel with chain on the flange of the exhaust camshaft.
11. Position drive plate or driver star on the sprocket wheel. Fit hexagon-head bolt M6 x 15 (10.9).
Tighten hexagon-head bolt **by hand** only.
12. Fit auxiliary chain tensioner, special tool 9599, on cylinder head 4 - 6.
Fit auxiliary chain tensioner without sealing ring and fasten on the crankcase **only hand-tight**.
The mechanical auxiliary chain tensioners must be installed with the correct pre-tension when the valve timing is adjusted or checked. The necessary pre-tension force has been reached when the measuring pin is **flush** with the face surface of the thrust screw. Turn the screw if necessary.



636_97

13. Fit cylinder-head cover. Remove holding-down device 9611.
Clean sealing surface of the cylinder head and cylinder-head cover very carefully. Apply bead of silicone on the cylinder-head cover. Refer to: Sealing cover for camshaft housing (cylinder-head cover), Service No. 15 91 51.

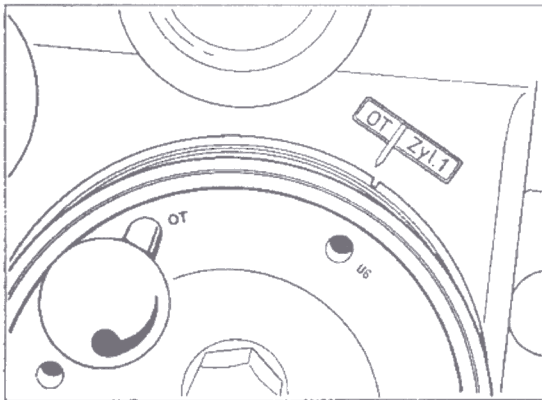


430_1_96

Carefully place the cylinder-head cover in the correct position so that the sealing bead is not damaged. Screw two studs or centring pins into the corners of the cylinder head as centring aids. Tightening torque: 13 Nm (10.0 ftlb.)

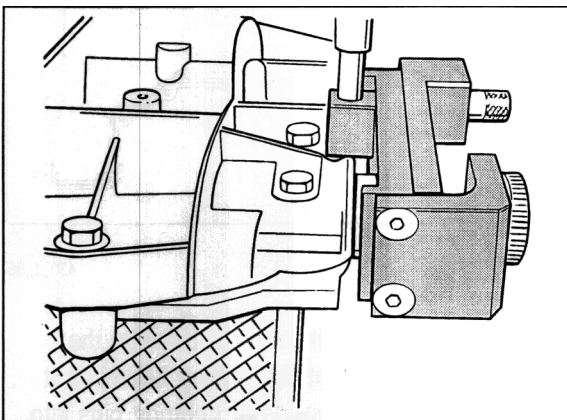
Immediately remove silicone material emerging in the area of the camshaft closure caps.

14. For the subsequent adjustment work on the camshaft, the pulley must be fixed at bore 1 OT (TDC) with the fixing pin (special tool 9595).



497_96

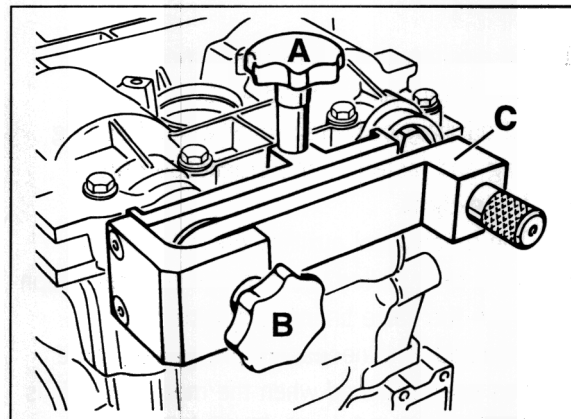
15. Fasten blocking device (special tool 9612) on the cylinder head.



718_97

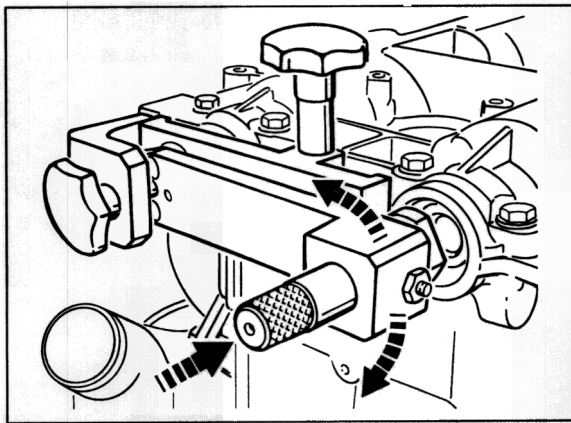
Special-tool fitting sequence:

- A – Fastening screw with star knob on the cylinder-head lug. Pull back centring piece (B) and sword bolt (C) when tightening.
- B – Centring piece in groove of the exhaust camshaft. Pull back sword bolt (C) when tightening.
- C – Sword bolt



503_96

16. Allocate camshafts; to do this, turn the pre-tensioned centre piece accordingly until the sword bolt can be fixed in the bearing bore.



97-220

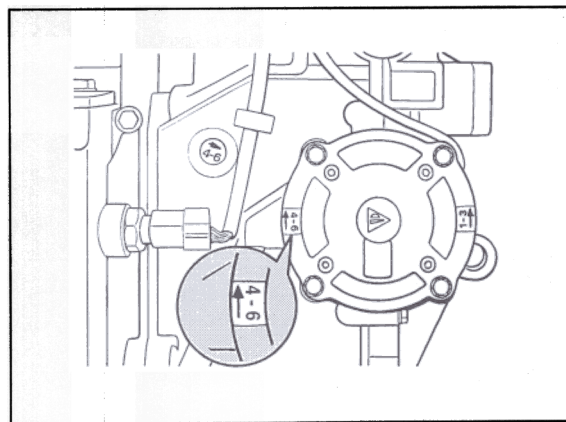
17. Fasten sprocket wheel.
Tightening torque: 14 Nm (10.5 ftlb.)
18. Remove blocking device.
19. Fit oil extraction pump.

Note

The oil extraction pumps on the cylinder heads are identical parts. Therefore, the installation position or direction of rotation must be correct.

Installation position of oil extraction pump at **cylinder head 4 - 6** (flywheel side): The arrow for the direction of rotation or the marking "4 - 6" must face the crankcase. Fit oil extraction pump. Use new sealing ring and new micro-encapsulated hexagon socket head screws.

Tightening torque: 10 Nm (7.5 ftlb.)



668_97

20. Fit camshaft closure cap dry.
21. Fit closure cap on tensioning element (VarioCam).
Tightening torque: 10 Nm (7.5 ftlb.)

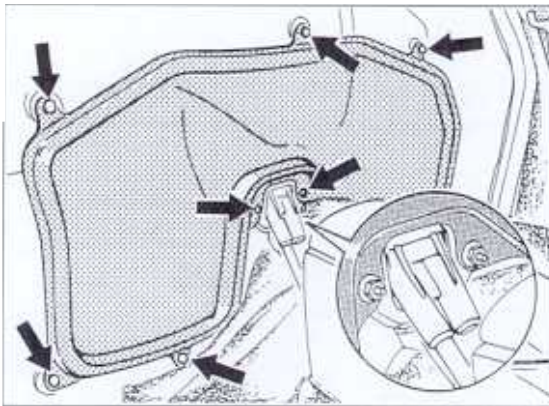
15 18 20 Removing and installing closure caps for camshaft bore

Engine installed

Installing and removing closure caps at cylinder head 1 - 3 – pulley side

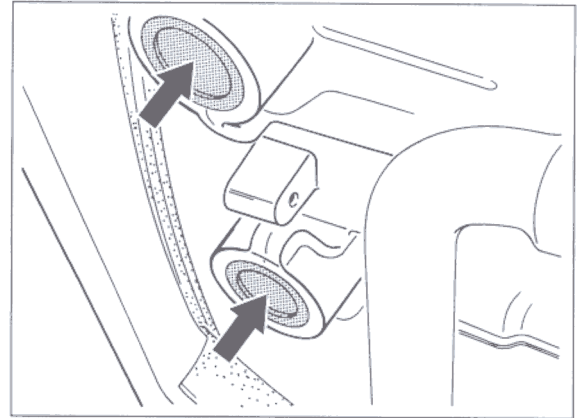
Removal

1. Remove rear wall lining and rear wall cover.



41497

2. Drive awl into **centre** of the closure cap and lever off the cap.



685_97

Installation

1. Clean receiving bore. Fit new cap **dry** and press in as far as it will go.
2. Fit rear wall cover and rear wall lining.

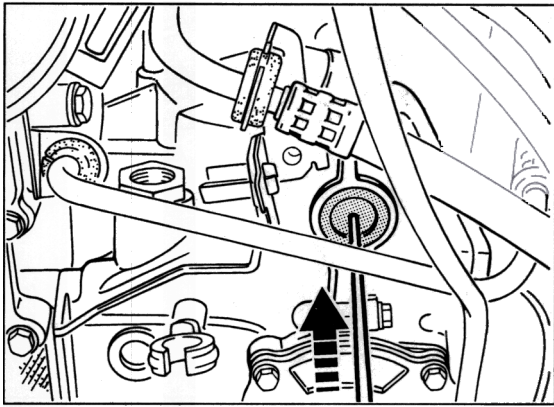
Installing and removing closure caps at cylinder head 4 - 6 – pulley side

Removal

1. Remove rear wall lining and rear wall cover.
2. Drive awl into **centre** of the closure cap and lever off the cap.

Installation

3. Clean receiving bore. Fit new cap **dry** and press in as far as it will go.

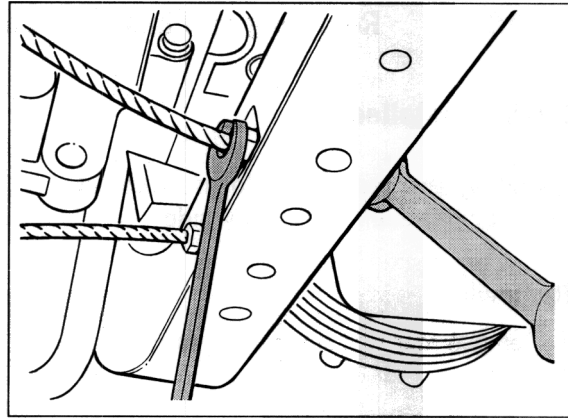


602-97

4. Fit rear wall cover and rear wall lining.

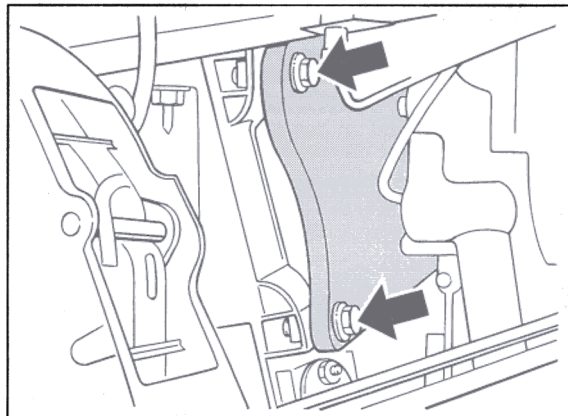
Installing and removing closure caps at cylinder head 1 - 3 - flywheel side**Removal**

1. Remove the rear wheels.
2. Detach cable between engine and rear-axle support at the rear-axle support. When loosening, hold with a second wrench (a/f 13).



717_97

3. Unscrew four fastening screws on both sides of the rear-axle support (a/f 15).

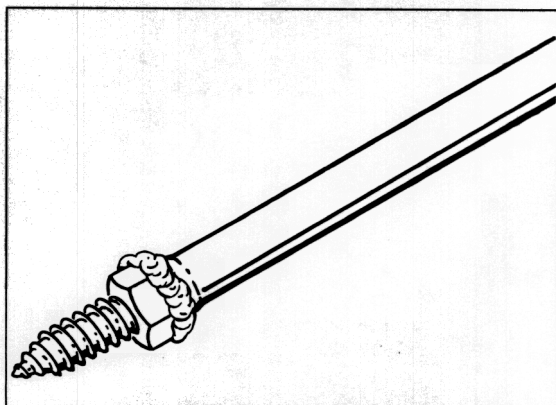


707_97

4. A shop-made tool is required in order to pull off the cap.

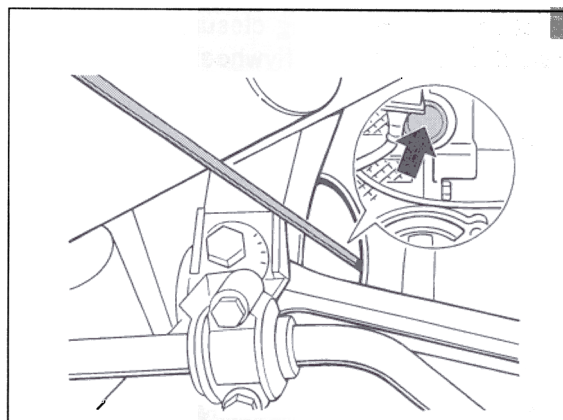
Making the tool:

Weld a 6.3 x 14 sheetmetal screw with hexagon head onto a 1000 mm long iron rod, e.g. \varnothing 8 mm round steel bar (see drawing).



710_97

- a. Shift the loosened rear-axle support accordingly until the closure cap becomes accessible.
- b. Screw puller into **centre** of the closure cap and pull off the cap.



708_97

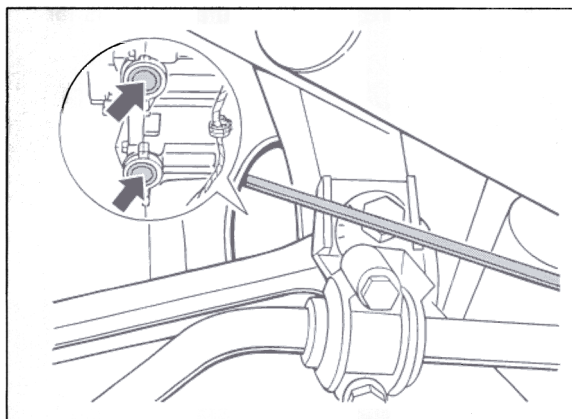
Installation

1. Fit new closure cap **dry** and press in as far as it will go.
2. Fit rear-axle support.
Tightening torque
3. Fasten cable.
4. Mount rear wheels.

Installing and removing closure caps at cylinder head 4 - 6 – flywheel side

Removal

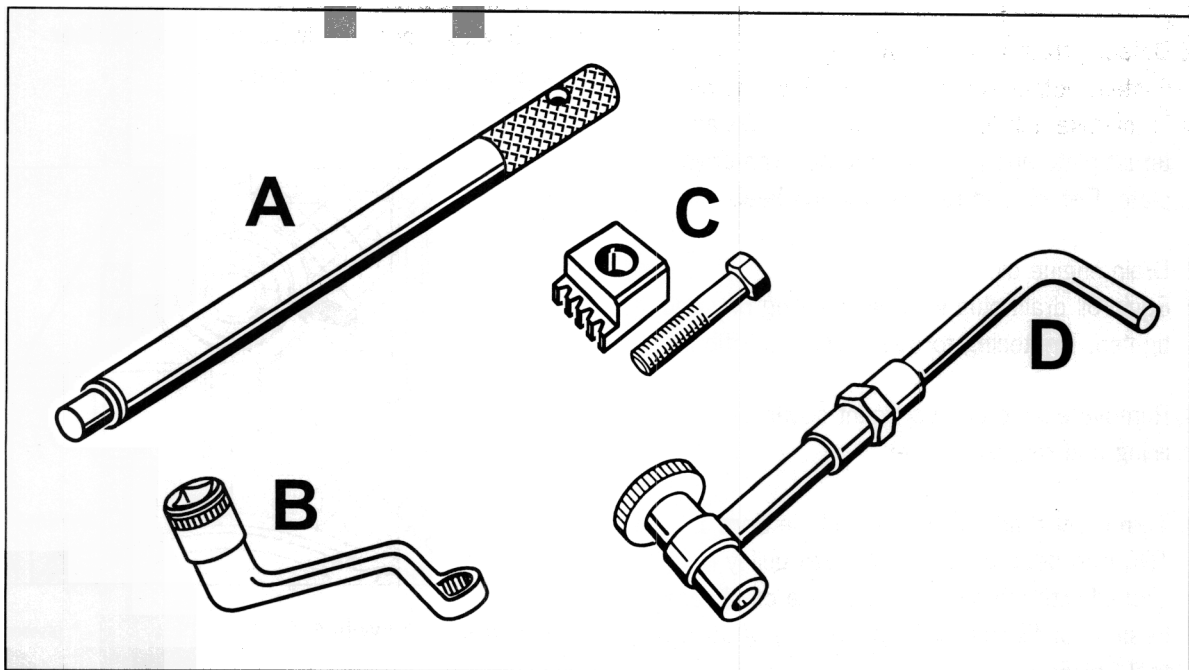
1. Perform assembly work as described in "Removing and installing closure caps at cylinder head 1 - 3".
2. Shift the loosened rear-axle support accordingly until the closure caps become accessible.
3. Turn puller into **centre** of the closure cap and pull off the cap.



70997

15 23 19 Removing and installing sealing ring for intermediate shaft**Engine installed (flywheel side)**

Tools



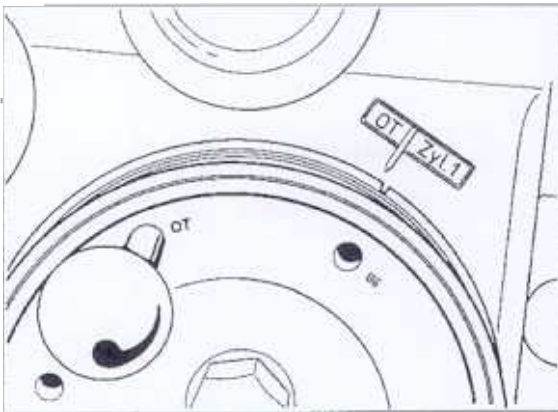
13230005

Item	Designation	Special tool	Explanation
A	Centring mandrel	3176	VW special tool
B	Socket wrench	9110	
C	Toothed segment with hexagon-head bolt M12 x 50	9538/1	
D	Retaining device	9642	

Remove sealing ring for intermediate shaft

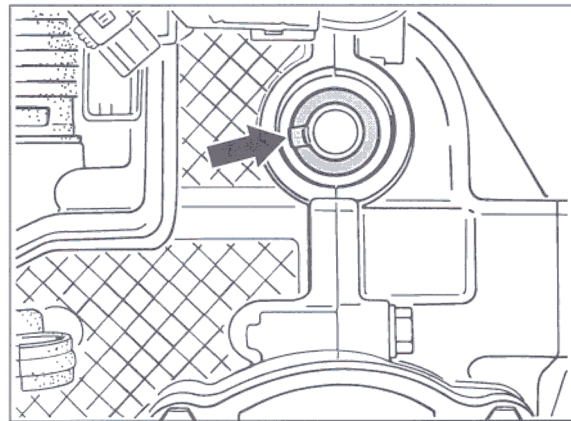
Preliminary work: Removing transmission, refer to Boxster Technical Manual, Group 3 – Manual transmission, Service No. 34 35 19 or Group 3 – Tiptronic transmission, Service No. 37 01 19

1. Detach thrust plate or flywheel.
Fasten toothed segment 9538/1 to the right crankcase half (cylinder bank 1 - 3). Detach thrust plate and remove together with drive plate. Detach and remove the flywheel.
2. Drain engine oil.
Equip oil drain plug with new sealing ring and tighten. Tightening torque 50 Nm (37 ftlb.).
3. Remove engine compartment cover, rear wall lining and rear wall cover.
4. Turn crankshaft clockwise until the bore 1 TDC (top dead centre) in the belt pulley is aligned with the fixing bore on the crankcase. Position or fix with fixing pin (short) of special tool 9595.



497-96

5. Remove camshaft closure caps from cylinder bank 1 - 3. The closure cap of cylinder bank 1 - 3 is located on the flywheel side. Drive awl into centre of the closure cap and lever off the cap.
6. Check basic camshaft adjustment.
If the position is not correct, remove the dowel pin and turn the crankshaft a further 360° in clockwise direction.



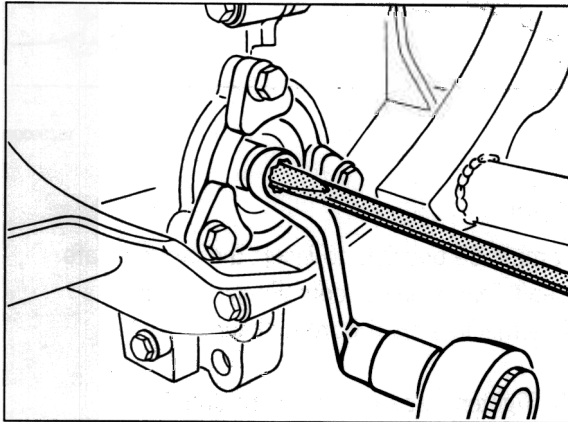
View from the flywheel side

15590001

7. Turn primary chain tensioner out of the left-hand crankcase (cylinder bank 4 - 6).
8. Turn secondary chain tensioner out of the right-hand cylinder head (1 - 3).

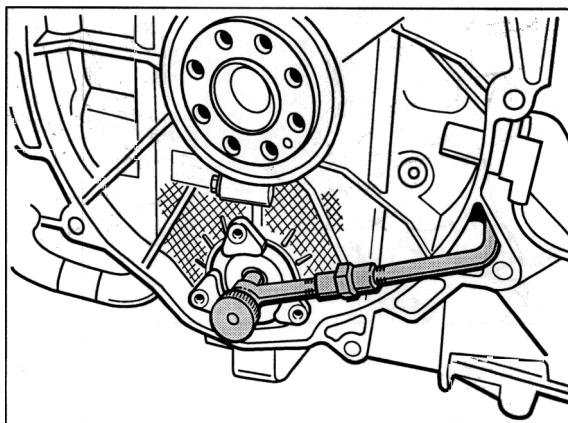
9. Undo intermediate shaft flange.

Unscrew the three fastening screws M6 x 20 on the intermediate-shaft flange. Undo the locknut using the socket wrench, special tool 9110. For this purpose, hold with a slotted screwdriver 7.0 x 1.1 at the slotted threaded pin.

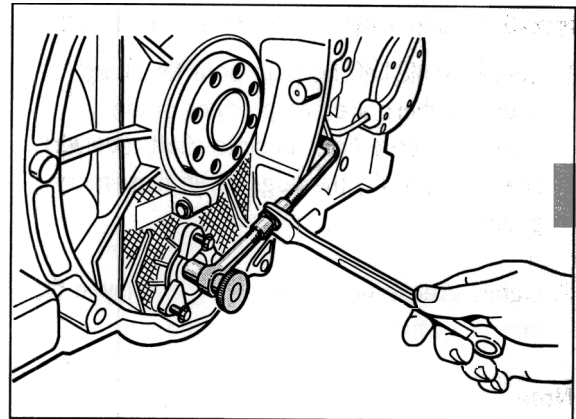


442_97

10. Position and align retaining device special tool 9642.

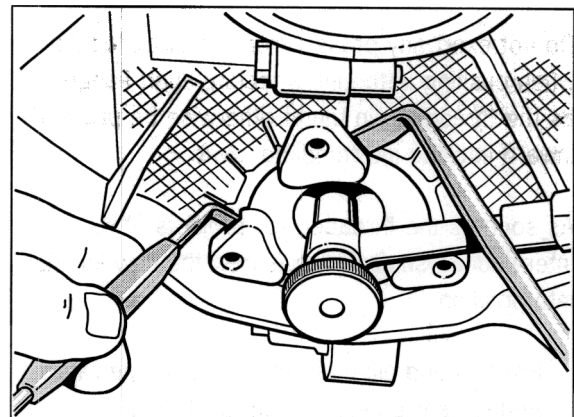


15230008



15230001

11. Carefully press off the intermediate flange. Proceed carefully so as not to damage the sealing surfaces.



15230007

Install sealing ring for intermediate shaft

1. Check crankshaft housing bore for sharp edges. If there are sharp edges in the crankcase bore (intermediate shaft receiver), chamfer (debur) the edges with fine emery paper.
2. Lightly grease new sealing ring and lay in the groove of the intermediate flange.

Note

The sealing ring must not be **twisted** and must not be **pulled** over **sharp edges** of the flange.

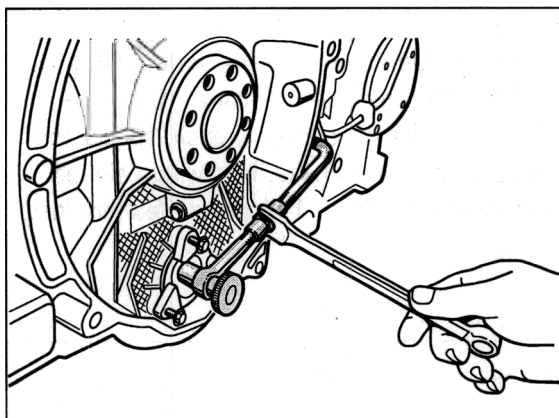
3. Position intermediate shaft flange on the bore and affix with new micro-encapsulated hexagon-head bolts.

Note

Do not exert any pressure on the threaded pin when pushing in the intermediate shaft flange, as the threaded pin might otherwise be pressed inward into the intermediate shaft.

As soon as the threaded pin projects at the intermediate shaft flange, screw the new locknut into position.

4. Position and align retaining device special tool 9642. Centre intermediate shaft and intermediate shaft flange by turning the crankshaft to and fro a little (max. 2° to 3°, remove dowel pin from the belt pulley first).

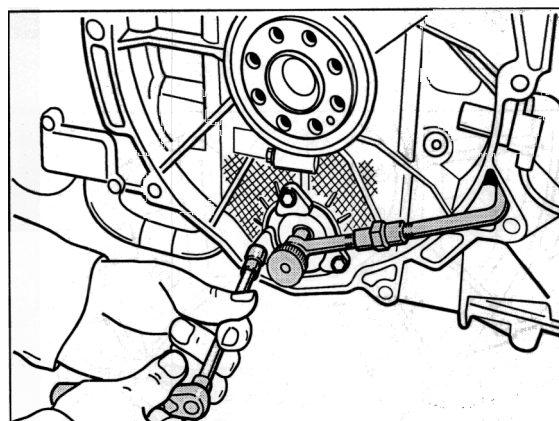


15230001

Note

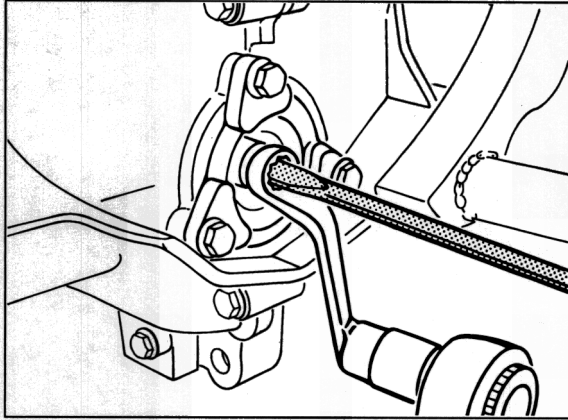
It must be possible to insert the intermediate shaft flange almost completely into the intermediate shaft bore by hand.

5. Tighten three micro-encapsulated hexagon-head bolts (M6 x 20) evenly (tightening torque 10 Nm [7.5 ftlb.])



15230003

6. Tighten lock nut with the socket wrench, special tool 9110. For this purpose, hold with a slotted screwdriver 7.9 x 1.1 at the slotted threaded pin. Tightening torque 11 Nm (8.0 ftlb.)



442_97

7. Equip both chain tensioners with new sealing rings, screw in and tighten. Tightening torque 80 Nm (59 ftlb.)
8. Fill in engine oil.
9. Fit engine compartment cover, rear wall lining and rear wall cover.
10. Fit flywheel, drive plate and thrust plate.
11. Install transmission.

15 37 19 Removing and installing solenoid hydraulic valve

Preliminary work: Removing and installing camshafts – engine removed – Serv. No. 150519

Removal

1. Remove solenoid hydraulic valve

Note

Install the solenoid valve only if the VarioCam tensioning element is **vertical**. Correct seating of the compression spring (No. 4) is no longer ensured if the solenoid hydraulic valve is installed horizontally (installation position of engine).

2. Undo self-tapping screws (Torx T 20) No. 1

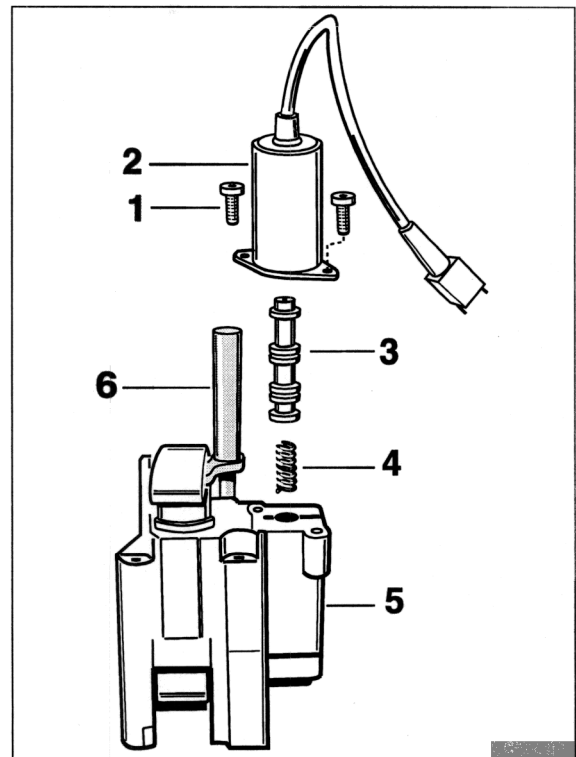
Note

Mark a threaded screw and threaded bore for reinstallation:

3. Remove solenoid valve. Leave valve plunger and compression spring in installation position.

Installation

1. Fit new solenoid valve. Screw in threaded screws by hand. The thread cut when the screw was screwed in for the first time must be found again.
Tightening torque 3.7 + 0.15 Nm
(2.7 + 0.10 ftlb.)



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1. Self-tapping screws
2. Solenoid hydraulic valve
3. Valve plunger
4. Compression spring
5. VarioCam tensioner
6. Tension screw

15 70 49 Reworking cylinder head

Check cylinder head for distortion.

Check sealing surface for distortion using a straight-edge.

Permissible unevenness of the parting plane:
0.05 mm

Cylinder heads with distorted sealing surface can be repaired by planing them.

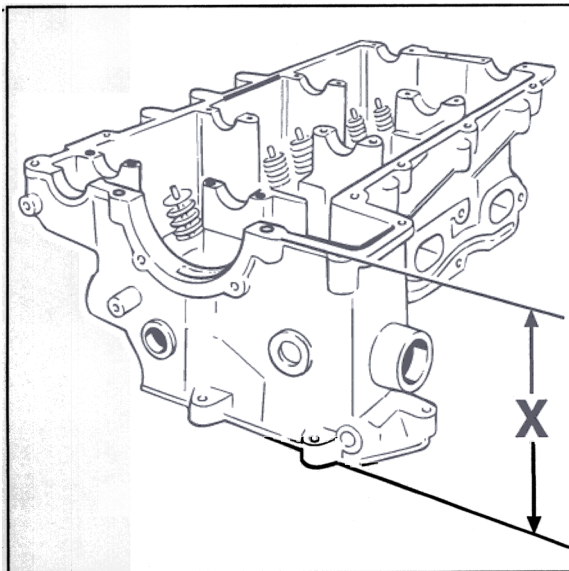
Permissible unevenness after machining:
0.03 mm

Rework sealing surface of the cylinder head only until a flat surface has been achieved.

Wear dimension: 141.80 mm

Note on machining the sealing surface:

Peak-to-valley height = 0.015 mm



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15 05 Camshaft assignment

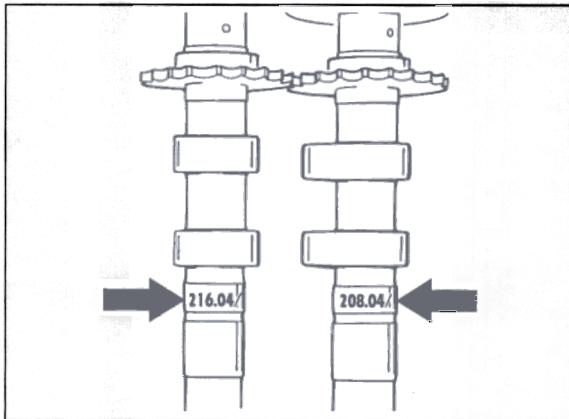
Engine type M96/20 (2.5 l)

Engine type M96/22 (2.7 l)

Engine type M96/21 (3.2 l)

Note

The code is engraved into the camshaft.



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Boxster camshafts (2.5 l)
Engine type M96/20

Camshafts of cylinder bank 1 - 3

Identification on the camshaft:

Inlet camshaft: 221.04/2.5 IN 1 - 3
Exhaust camshaft: 222.04/2.5 EX 1 - 3

Camshafts of cylinder bank 4 - 6

Identification on the camshaft:

Inlet camshaft: 216.04/2.5 IN 4 - 6
Exhaust camshaft: 218.04/2.5 EX 4 - 6

Boxster camshafts (2.7 l)
Engine type M96/22

Camshafts of cylinder bank 1 - 3

Identification on the camshaft:

Inlet camshaft: 221.05/2.7 IN 1 - 3
Exhaust camshaft: 222.05/2.7 EX 4 - 6

Camshafts of cylinder bank 4 - 6

Identification on the camshaft:

Inlet camshaft: 216.05/2.7 IN 4 - 6
Exhaust camshaft: 218.05/2.7 EX 4 - 6

Boxster S camshafts (3.2 l)
Engine type M96/21

Camshafts of cylinder bank 1 - 3

Identification on the camshaft:

Inlet camshaft: 221.55/3.2/3.4 IN 1 - 3
Exhaust camshaft: 222.55/3.2/3.4 EX 1 - 3

Camshafts of cylinder bank 4 - 6

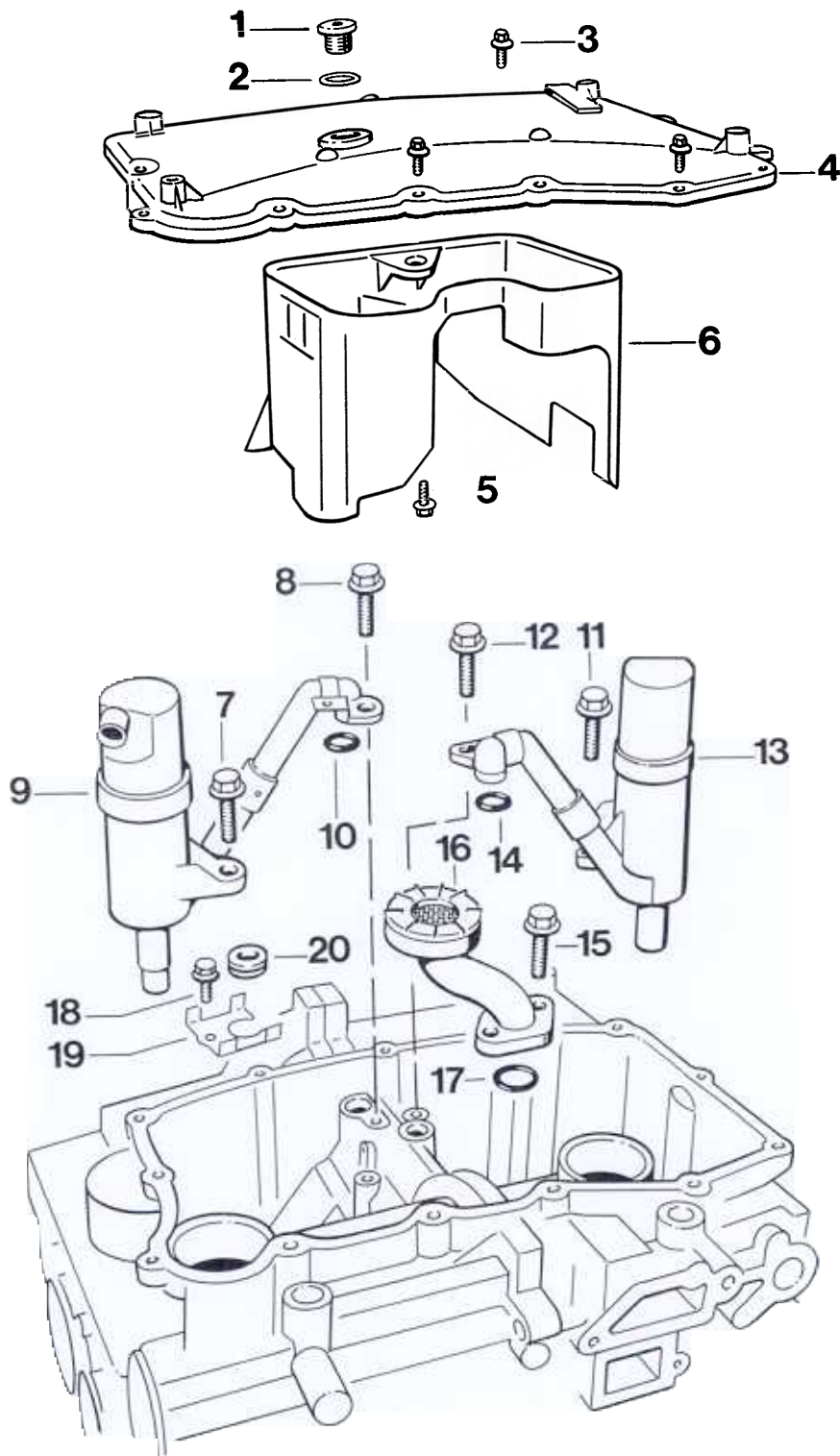
Identification on the camshaft:

Inlet camshaft: 216.55/3.2/3.4 IN 4 - 6
Exhaust camshaft: 218.55/3.2/3.4 EX 4 - 6



Removing and installing air/oil separator

Engine in working position (engine turned 180°)

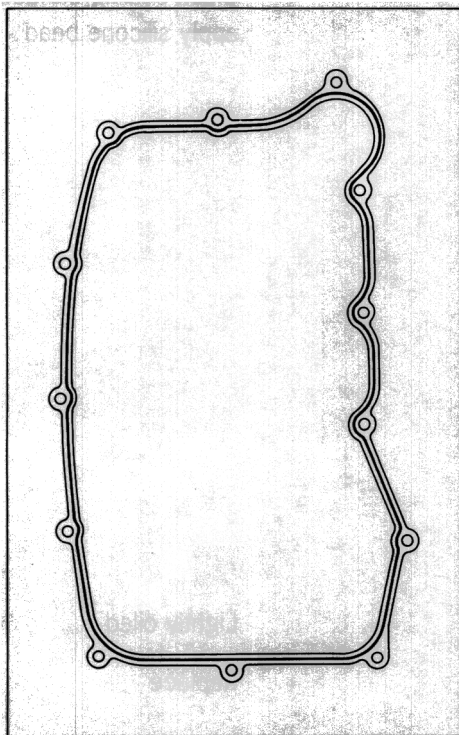


No.	Designation	Qty.	Removal	Note:	
					Installation
	Oil drain plug M18 x 1.5	1			
2	Sealing ring A18 x 24	1			Always replace
3	Hexagon-head bolt M6 x 16	13			
4	Oil pan	1			Clean sealing surface and apply silicone bead
5	Hexagon-head bolt M6 x 16	3			
6	Bulkhead box	1			
7	Hexagon-head bolt M6 x 20	1			
8	Hexagon-head bolt M6 x 20	1			
9	Air/oil separator	1			
10	O-ring 12 x 2				
11	Hexagon-head bolt M6 x 20	1			
12	Hexagon-head bolt M6 x 12	1			
13	Air/oil separator	1			
14	O-ring 12 x 2	1			Lightly oiled
15	Hexagon-head bolt M6 x 20 (micro-encapsulated)	2			Replace
16	Oil suction pipe				
17	O-ring 30 x 3				Lightly oiled
18	Hexagon-head bolt M6 x 12				
19	Holder for oil probe				
20	Grommet 9.5 x 18 x 1.2	1			

Assembly instructions

Sealing the oil pan

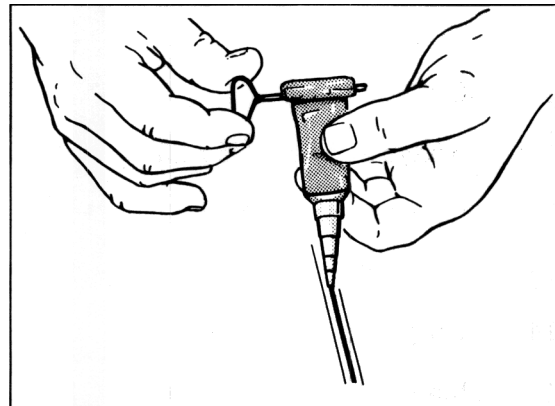
Only "Drei Bond" silicone type 1209 should be used as surface seal. After application of surface seal (silicone bead), screw together within five minutes.



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Application of silicone bead

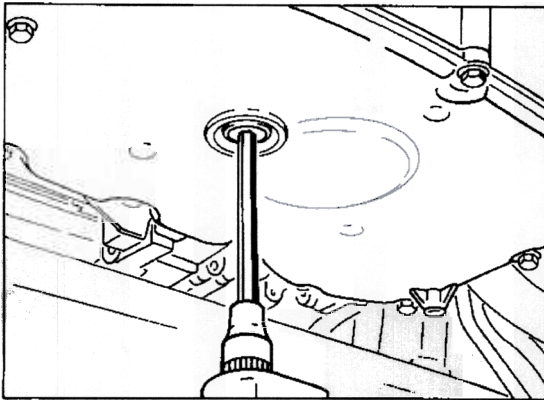
1. At the processing nozzle, cut off the first metering step.
2. Apply a uniform bead approximately 1.5 mm wide to the cleaned sealing surface of the oil pan.
3. Place the oil pan in the correct position carefully, so that the sealing bead is not damaged. Screw two studs or centring pins into the corners of the crankcase housing halves as centering aids.



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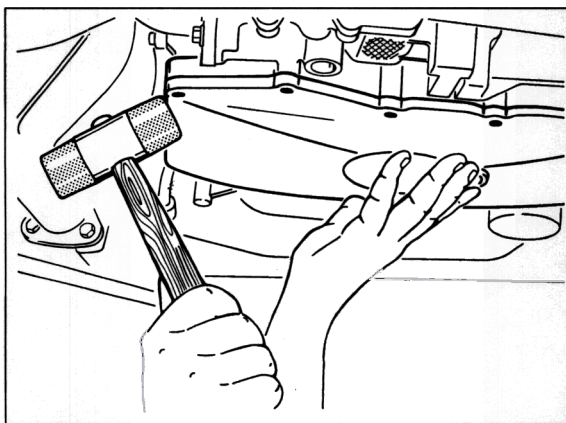
17 50 19 Removing and installing oil pan – engine installed

1. Unscrew cap of the oil filler opening.
2. Lift the vehicle. Drain engine oil.



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3. Undo oil pan fastening screws (M6 x 16, 13 ea.).
Detach oil pan by tapping it at the sides with a plastic hammer.

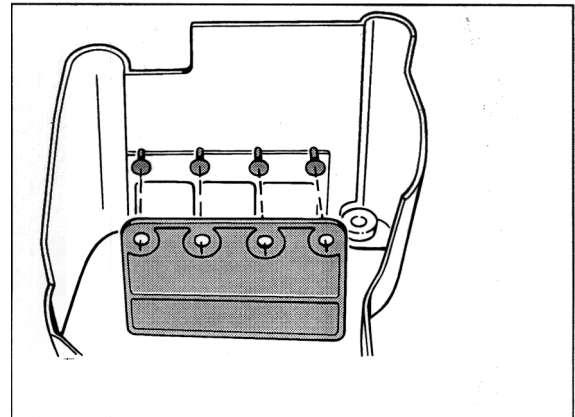


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4. Clean oil pan sealing surface and crankcase sealing surface thoroughly.

Note

If the oil pan is cleaned with the partition box fitted, remove the two rubber flaps on the partition box before cleaning.



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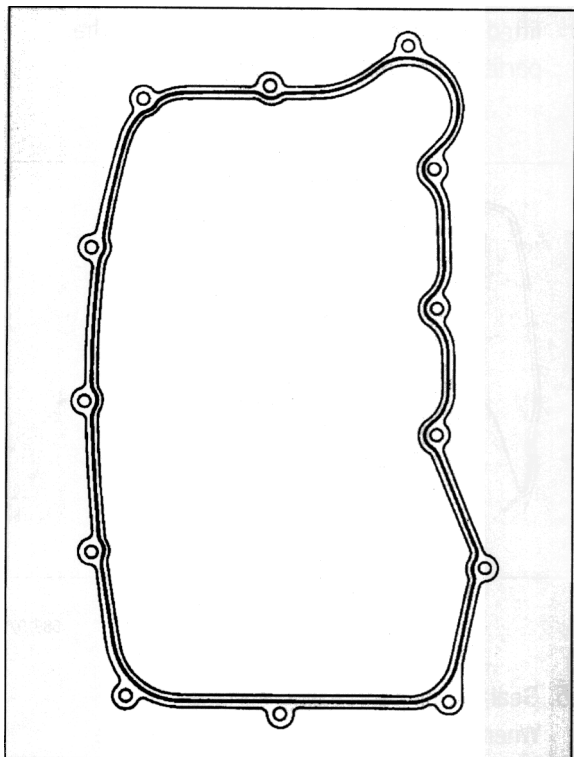
5. Seal the oil pan sealing surface.
When sealing the sealing surface on the oil pan, use only the sealant **Drei Bond Silikon — type 1209**.

Note

After the sealant has been applied, the crankcase must be joined with the oil pan within 5 minutes.

Application of silicone bead

At the processing nozzle, cut off the first metering step. Apply a uniform bead approximately 1.5 mm wide on the cleaned sealing surface of the oil pan.

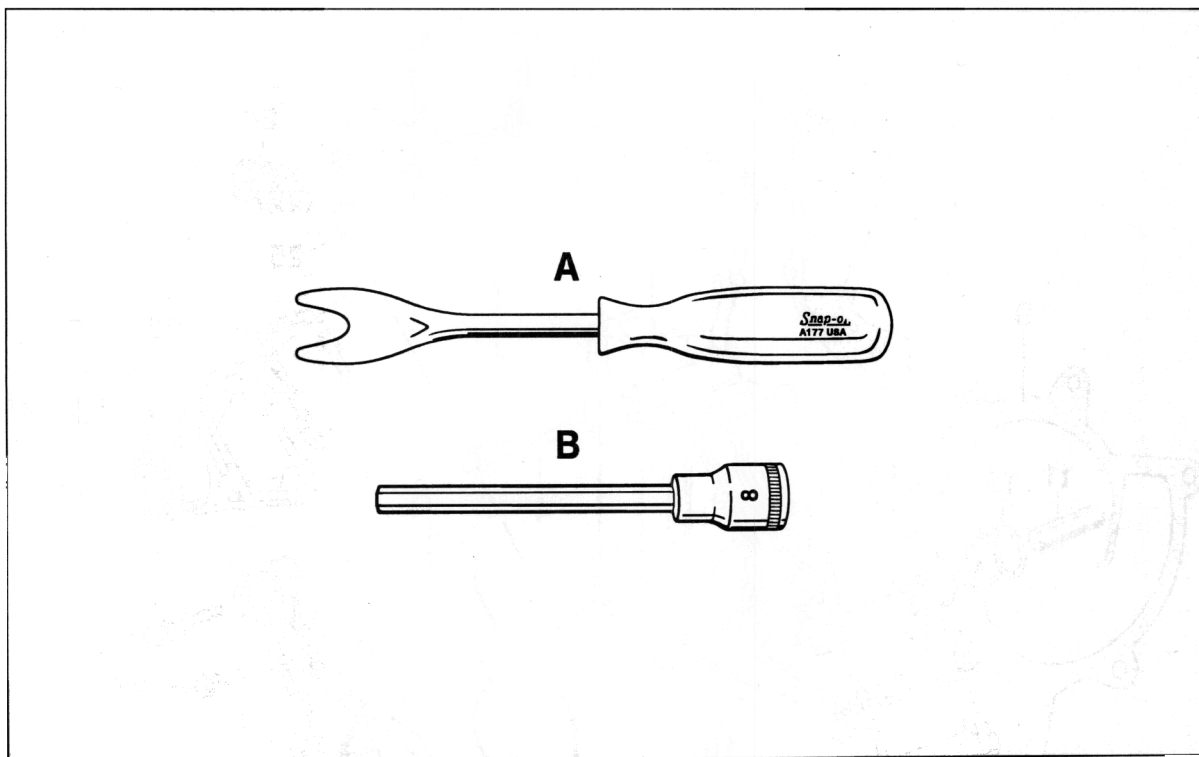


641-96

6. Fit oil drain plug with new sealing ring.
Tightening torque: 50 Nm (37 ftlb.)
7. Fill in engine oil.

17 20 19 Removing and installing oil pump with coolant guide housing

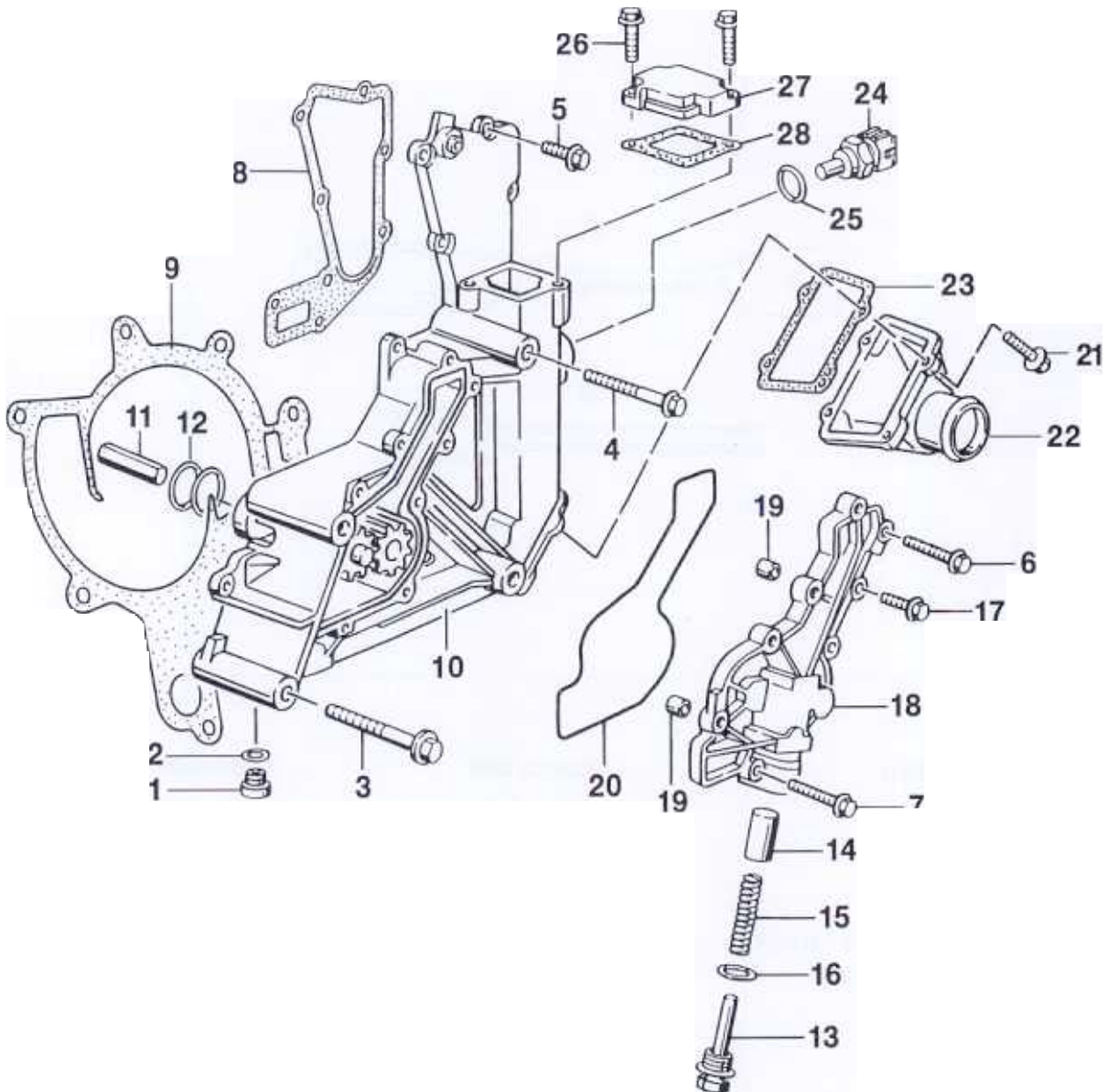
Tools



485_97

Item	Designation	Special tool	Explanation
A	Removal tool	Commercially available	Refer to Workshop Equipment Manual, Chapter 2.4, No. 21
B	Socket insert for hexagon socket head screws	Commercially available	

Removing and installing oil pump with coolant guide housing

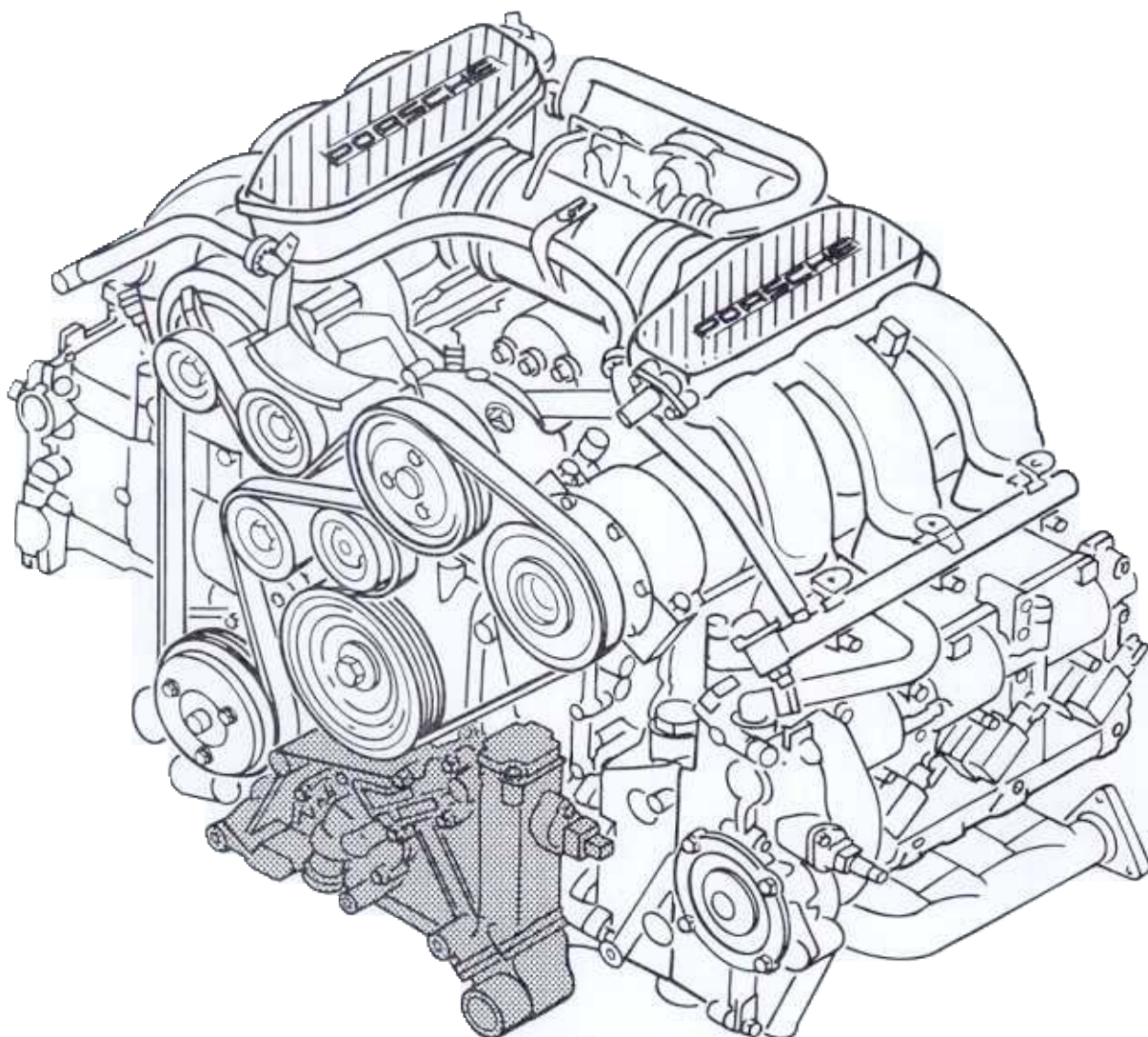


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Removing and installing oil pump with coolant guide housing

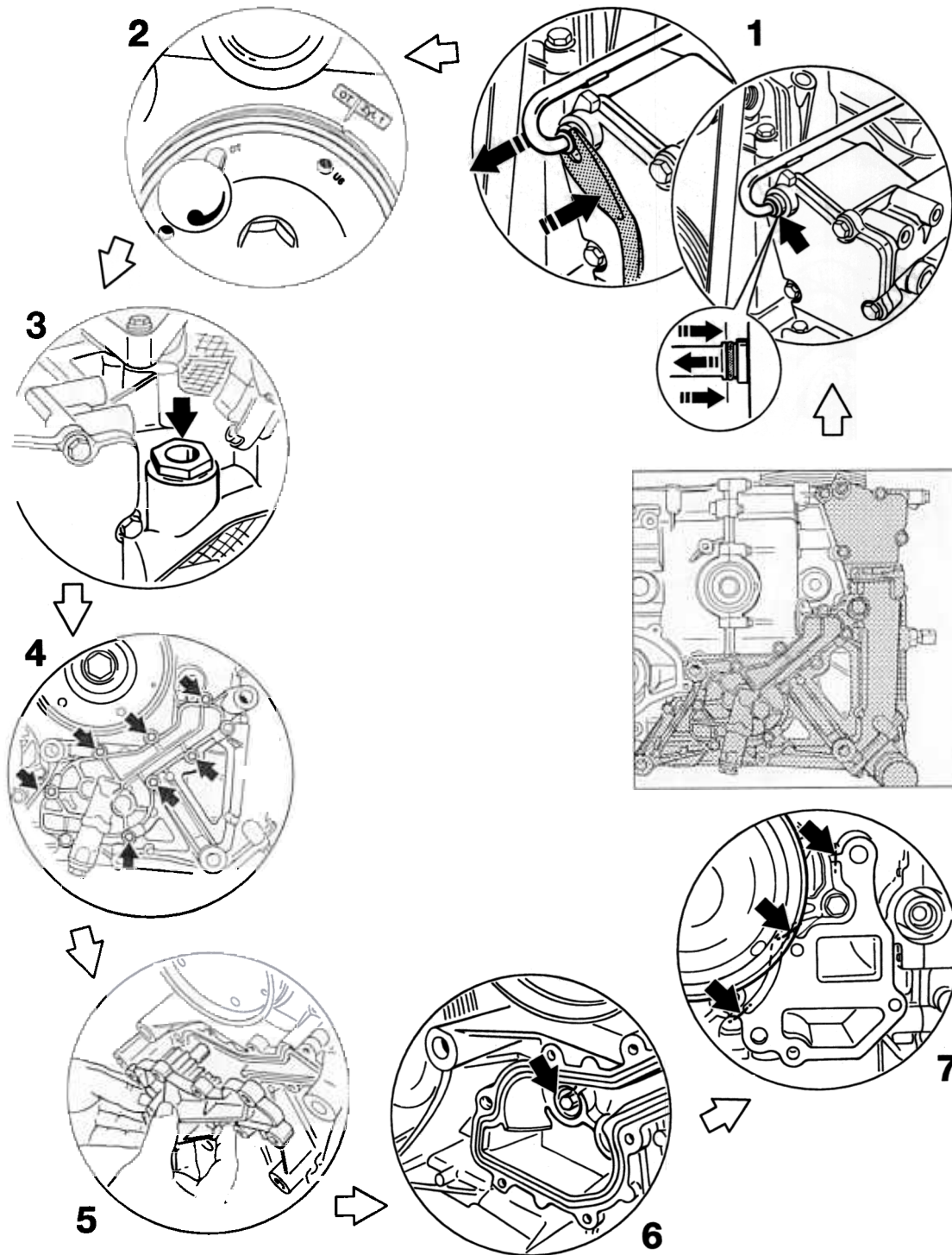
No.	Designation	Qty.	Removal	Note:	
					Installation
1	Coolant drain plug M10 x 1	1			Tightening torque: 10 + 5 Nm (7.5 + 3.5 ftlb.)
	Sealing ring A10 x 13.5	1			Always replace
3	Hexagon-head bolt M10 x 100	3			Tightening torque: 45 Nm (33 ftlb.)
4	Hexagon-head bolt M10 x 100	1			Tightening torque: 45 Nm (33 ftlb.)
5	Hexagon-head bolt M6 x 20	8			Tightening torque: 10 Nm (7.5 ftlb.)
6	Hexagon-head bolt M6 x 70	1			
7	Hexagon-head bolt M6 x 70	1			
8	Gasket	1			Always replace; insert or fit only when coolant guide housing has been put onto the crankcase
9	Gasket	1			Always replace; insert or fit only when coolant guide housing has been put onto the crankcase
10	Oil pump with coolant guide housing	1			Check front edge of guide flange of coolant guide housing for burrs and deburr if necessary.
11	Driver	1			

No.	Designation	Qty.	Removal	Note:	
					Installation
12	O-ring	2			Always replace; grease flange and O-rings
13	Plug with guide pin	1			Tightening torque: 25 Nm (18 ftlb.)
14	Piston	1			Oil
15	Spring	1			
16	Sealing ring	1			Replace
17	Hexagon-head bolt M6 x 25	7			Tightening torque: 10 Nm (7 ftlb.), tighten crosswise
18	Oil pump cover	1			
19	Dowel sleeve 8.2 x 7	2			Fit in oil pump cover
20	Sealing ring	1			Replace
21	Pan-head screw M6 x 20	4			Tightening torque: 10 Nm (7.5 ftlb.)
22	Neck	1			
23	Gasket	1			Replace
24	Temperature sensor with captive sealing ring	1			Tightening torque: 25 ± 5 Nm (18 ± 4 ftlb.)
25	Sealing ring	1			Replacement sealing ring for Item 24 (fit if sealing ring of Item 24 has been damaged)
26	Hexagon-head bolt M6 x 20	2			Tightening torque: 10 Nm (7.5 ftlb.)
27	Cap	1			
28	Gasket	1			Replace

Removing and installing oil pump with coolant guide housing

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Removing oil pump with coolant guide housing



486_97

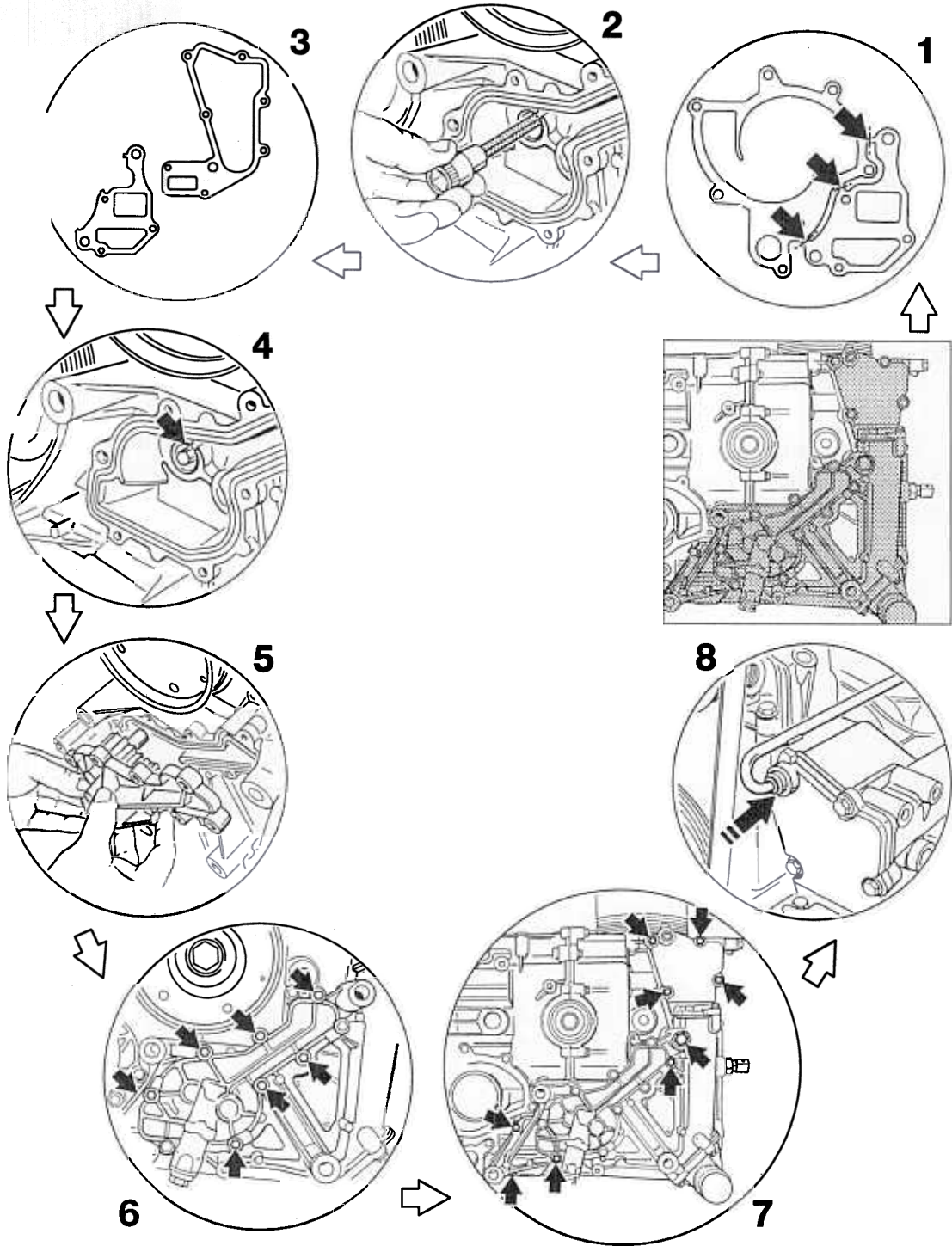
Removal overview of the components

- 1 Detaching coolant vent line with tool
- 2 Positioning crankshaft to the OT (TDC)/cyl. 1 marking
- 3 Removing chain tensioner
- 4 Detaching oil pump lid
- 5 Removing oil pump lid with oil pump wheels
- 6 Pulling out oil pump driver
- 7 Cutting the seal

Removing oil pump with coolant guide housing

No.	Procedure	Instructions
	Detaching coolant vent line (without tool)	In order to detach the line, push the unlocking ring forward (arrows) and simultaneously pull out the line. Use two plastic spatulas to press the unlocking ring.
	Detaching coolant vent line (with tool)	The line can also be detached using a commercially available tool. Insert tool between line and the unlocking ring and unlock. Pull line to the rear and simultaneously press the tool against the ring. Carefully protect the line end against dirt and scratches with a cap.
2	Positioning crankshaft to the OT (TDC)/ cyl. 1 marking	Turn crankshaft clockwise until the mark 1 OT (top dead centre) on the pulley is aligned with the fixing bore on the crankcase. Position or fix locating pin (short) of special tool 9595.
3	Removing chain tensioner	Remove chain tensioner of cylinder bank 4 - 6 to relieve the intermediate shaft (a/f 32).
4	Detaching oil pump lid	Loosen the nine hexagon-head bolts crosswise, from the outside inward.
5	Removing oil pump lid	Remove the oil pump lid together with the oil pump wheels and set them down together.
6	Removing oil pump driver	Pull out the oil pump driver using a pair of flat-nosed pliers.
7	Cutting the seal	Cut old sealing ring between coolant pump and water guide housing at the connecting webs.

Installing oil pump with coolant guide housing



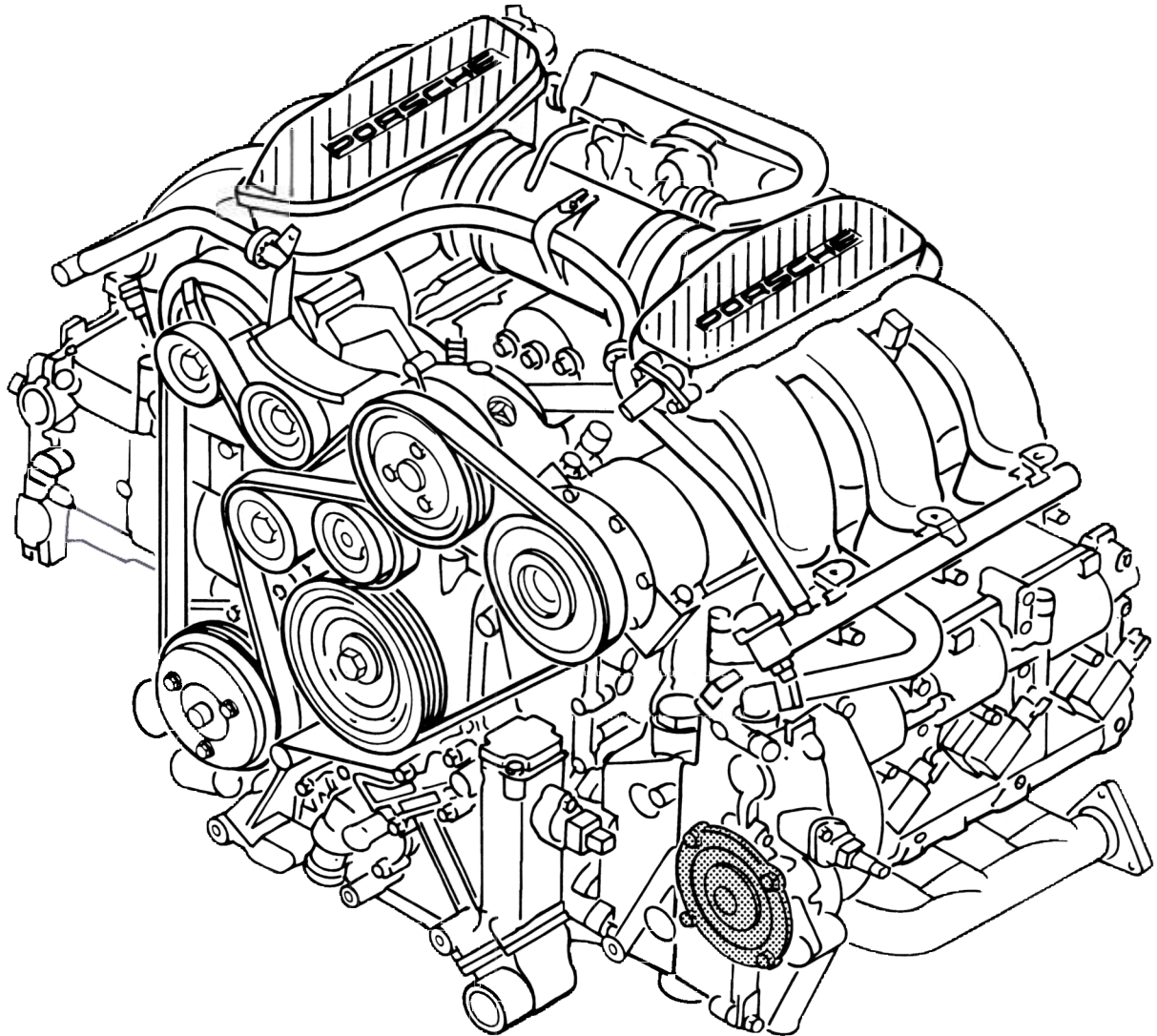
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Installing oil pump with coolant guide housing

No.	Procedure	Instructions
	Preparing new replacement metal seal for installation	<p>Cut new replacement metal gasket (combination seal for coolant pump and coolant guide housing) at the connecting webs.</p> <p>Note</p> <p>Store the non-required half of the coolant pump gasket separately.</p>
2	Centring intermediate shaft and putting on coolant guide housing	<p>Before putting coolant guide housing on the crankcase, visually inspect and note any offset position of the intermediate shaft.</p> <p>Grease flange and O-rings.</p> <p>Put on the coolant guide housing and simultaneously use a hexagon wrench (8 mm, approx. 140 mm long) to centre the intermediate shaft until the housing is aligned and can be pushed in.</p> <p>Note</p> <p>Do not use excess force.</p>
3	Replacing seals	<p>Push cut-off metal gasket behind the housing and screw in the outer hexagon-head bolts. Push upper metal gasket behind the housing and screw in the hexagon-head bolts.</p>
4	Fitting driver	<p>Lightly oil the oil pump driver and fit in the intermediate shaft.</p>
5	Fitting oil pump	<p>Insert new oil pump lid gasket.</p> <p>Fit oil pump lid with oiled and fitted wheels. If necessary, turn the wheels until the driver engages.</p>

No.	Procedure	Instructions
6	Fastening oil pump lid	Tighten hexagon-head bolts crosswise.
7	Fastening coolant guide housing	Tighten M6 hexagon-head bolts. Tightening torque: 10 Nm (7.5 ftlb.) Tighten M10 hexagon-head bolt. Tightening torque: 45 Nm (33 ftlb.)
8	Fitting coolant vent line	Insert line into the pilot bushing in a straight line. Then pull slightly to ensure that the connection is properly locked.

17 19 19 Removing and installing oil extraction pumps



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Removing and installing oil extraction pumps

Removal

At each cylinder head, undo 4 hexagon-head bolts fastening the oil extraction pump.

Note

After removing the oil extraction pumps, do not lay them on the drivers.

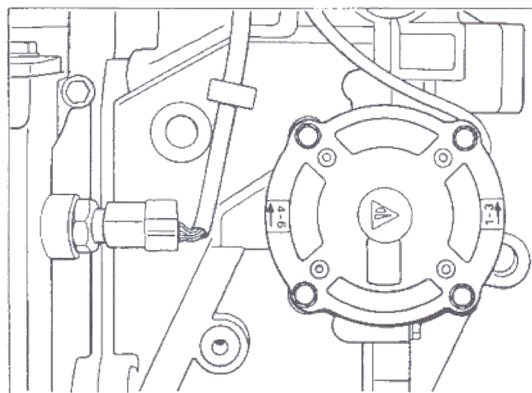
Installation

Note

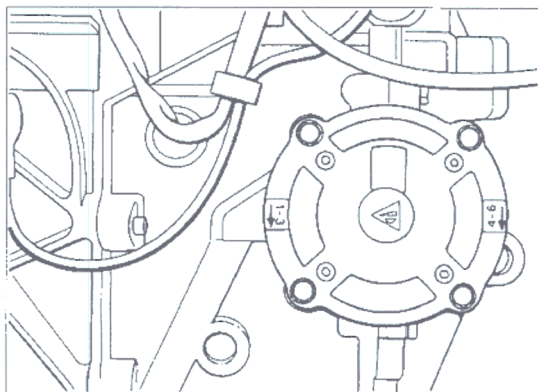
The oil extraction pumps on the cylinder heads are identical parts. Therefore, the installation position or direction of rotation must be correct.

Installation position of oil extraction pump at **cylinder head 1-3** (flywheel side): The arrow for the direction of rotation or the marking "1 - 3" must face the crankcase.

Installation position of oil extraction pump at **cylinder head 4-6** (pulley side): The arrow for the direction of rotation or the marking "4 - 6" must face the crankcase or the coolant temperature sensor.



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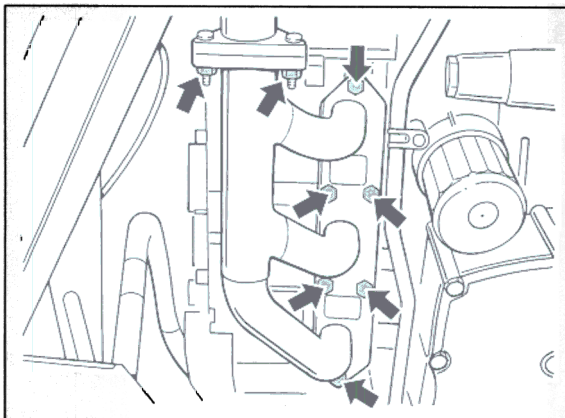
416-96

17 19 19 Removing and installing oil extraction pump – engine installed

Oil extraction pump of cylinder bank 1 - 3
(flywheel side)

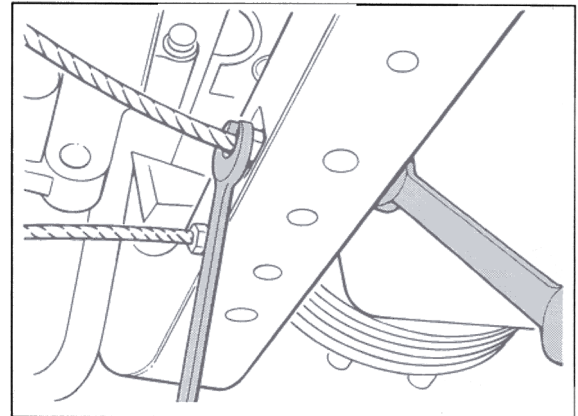
Removal

1. Remove left rear wheel.
2. Remove diagonal braces and strut panel.
3. Remove exhaust manifold of cylinder bank 4 - 6.



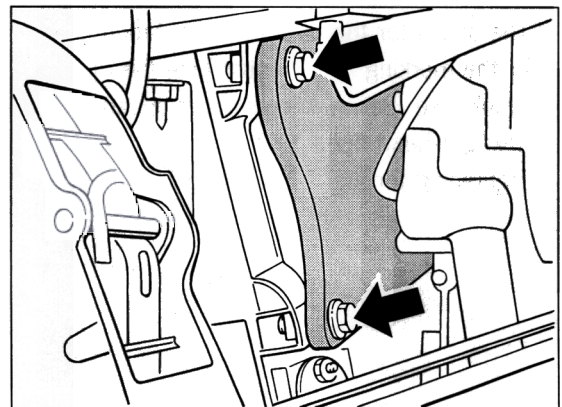
715_97

4. Pull plug connections of the oxygen sensors up and out out of the holders on the rear-axle support.
5. Detach cable between engine and rear-axle support at the rear-axle support. When loosening, hold with a second wrench (a/f 13).



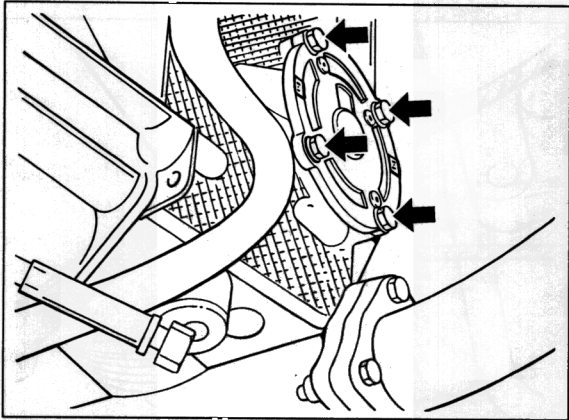
717_97

6. Unscrew four fastening screws on both sides of the rear-axle support (a/f 15) and remove rear-axle support to the left side.



707_97

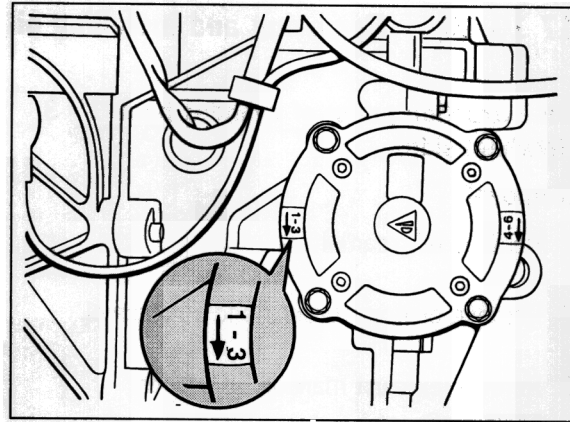
7. Unscrew four fastening screws and remove the oil extraction pump.



713_97

Installation

1. Lightly grease the new sealing ring and lay it in the oil extraction pump.
2. Align oil extraction pump driver and fit oil extraction pump in the correct position. The arrow for the direction of rotation or the marking "1 - 3" must face the crankcase. Screw in new micro-encapsulated hexagon-head bolts. Tightening torque: 10 Nm (7.5 ftlb.)



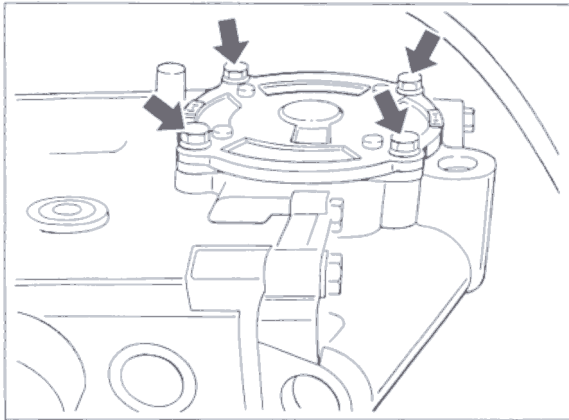
667_97

3. Fit rear-axle support. Tightening torque: 65 Nm (48 ftlb.)
4. Fit cable.
5. Fit exhaust manifold with new gaskets. Fit the gasket in the correct position between the exhaust manifold and cylinder head. The bent-up sheetmetal tab must point upward toward the cylinder head. Tightening torque: 25 Nm (19 ftlb.)
6. Mount rear wheel. Tightening torque: 130 Nm (96 ftlb.)

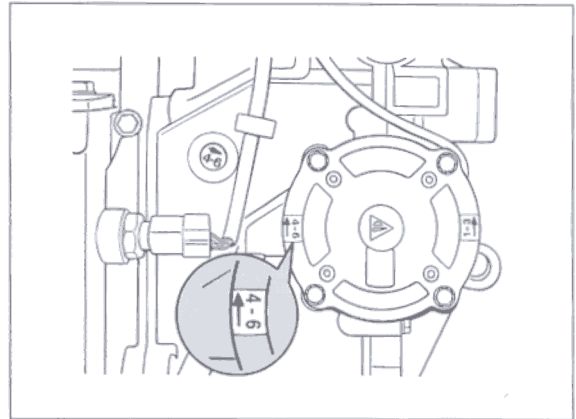
Oil extraction pump of cylinders 4 - 6 (pulley side)

Removal

1. Remove rear underbody cover.
2. Unscrew four fastening screws and remove the oil extraction pump.



14_97



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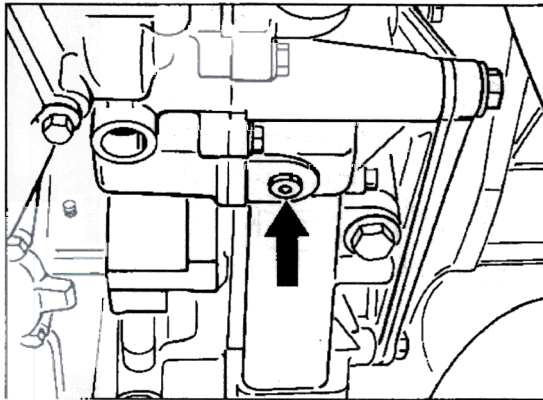
3. Fit the underbody cover.

Installation

1. Lightly grease the new sealing ring and lay it in the oil extraction pump.
2. Align oil extraction pump driver and fit oil extraction pump in the correct position. The arrow for the direction of rotation or the marking "4 - 6" must face the crankcase.

17 40 19 Removing and installing oil-water heat exchanger engine installed**Removing oil-water heat exchanger**

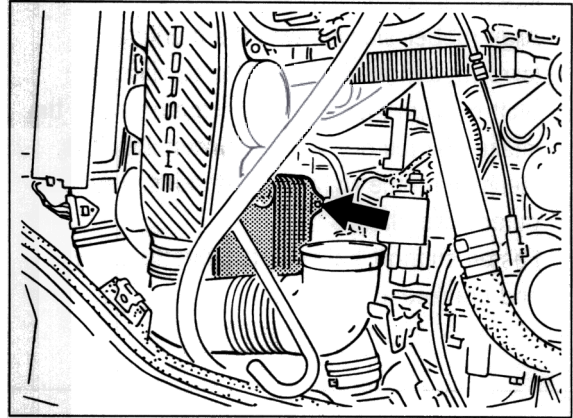
1. Remove cap on coolant expansion tank.
2. Undo drain plug on the coolant guide housing and drain the coolant.



471-96

3. Equip drain plug with a new sealing ring and fit in the coolant guide housing.
Tightening torque: 10+5 Nm (7.5+3.5 ftlb.)
4. Raise convertible top compartment lid.
5. Remove engine-compartment cover.
6. Remove throttle body with intake distributor intermediate piece.

7. Remove oil-water heat exchanger.



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Installing oil-water heat exchanger

1. Insert new sealing rings and fit oil-water heat exchanger.

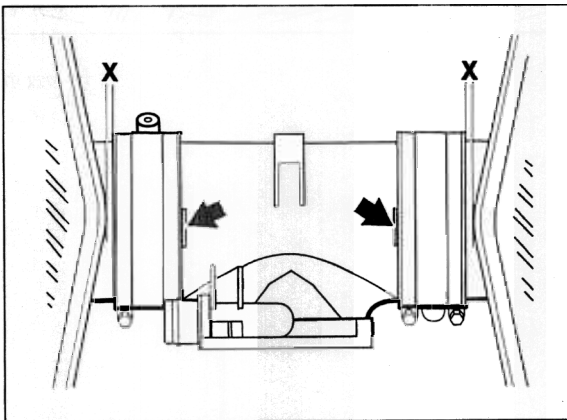
Tightening torque: 10 Nm (7.5 ftlb.)

2. Fit throttle body with intake distributor intermediate piece.

Align rubber sleeves with the markings (arrows) and tighten **inner** hose clamps.

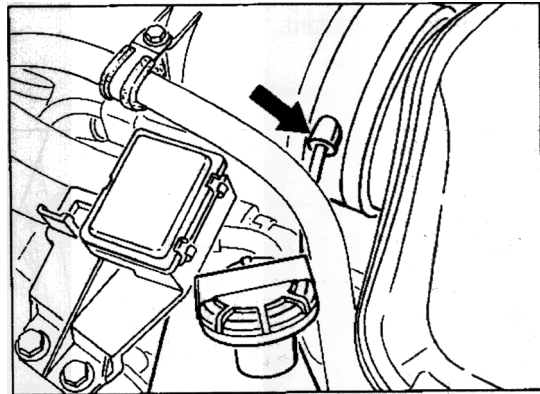
Shift or align the distributor pipe between the intake distributors so that **dimension X** is identical on the right and left sides. Tighten outer hose clamps.

Fasten support between the throttle body and crankcase.



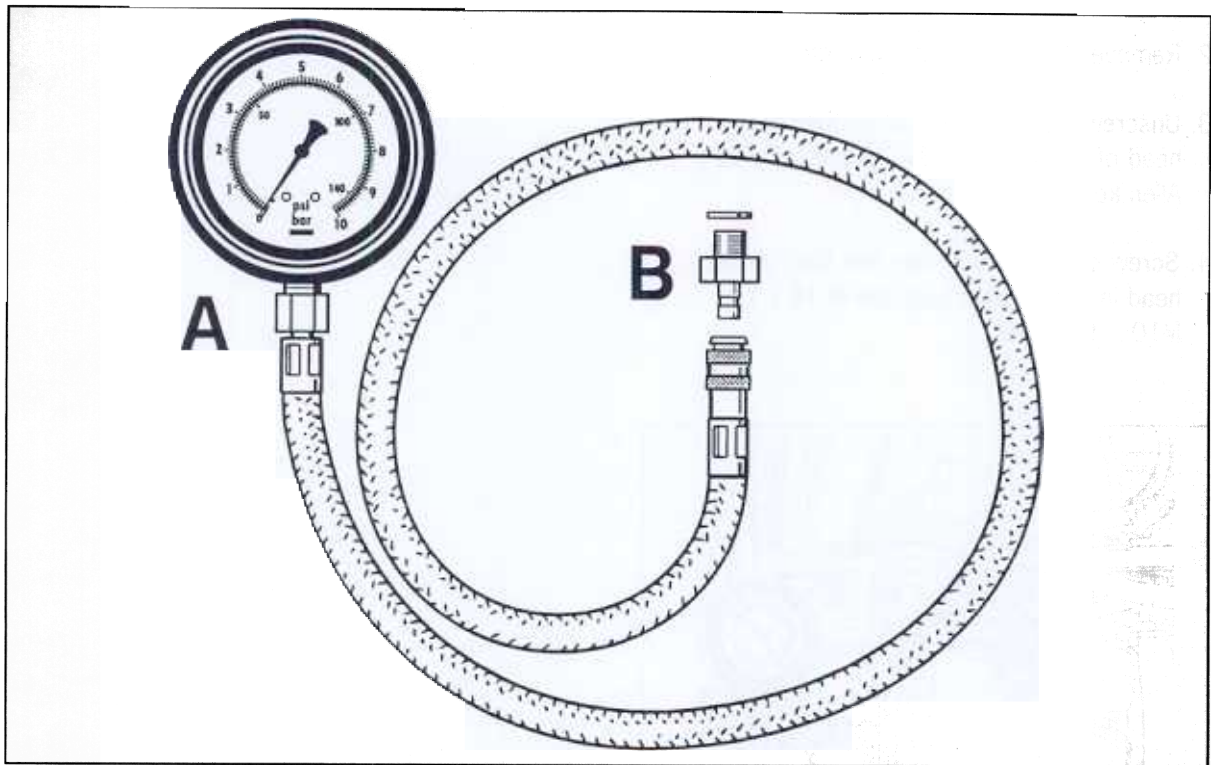
171-97

3. Check whether the vacuum control line is seated properly. The vacuum control line must be securely seated in the left rubber sleeve.



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4. Fit engine compartment cover.
5. Fill in coolant and bleed the system; refer to Boxster Technical Manual, Group 19, Service No. 19 38 17.

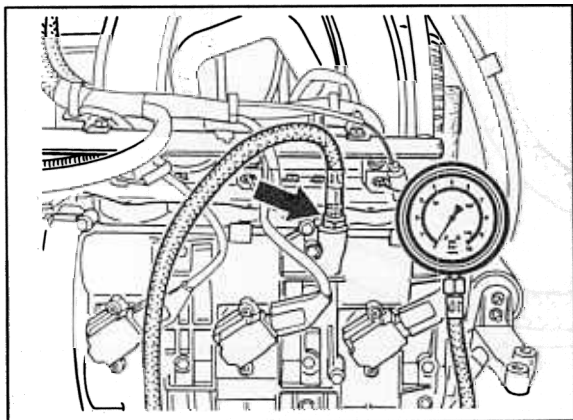
17 03 01 Checking oil pressure**Tools**

168_98

Item	Designation	Special tool	Explanation
A	Oil-pressure tester		
B	M14 x 1.5 adapter		

Checking oil pressure

1. Move convertible top to service position.
On vehicles with hardtop, additionally remove the hardtop.
2. Remove upper engine compartment lid.
3. Unscrew plug (M14 x 1.5) on the cylinder head of cylinder bank 1 - 3. Use a 6 mm Allen key.
4. Screw oil pressure tester into the cylinder head in combination with the M 14 x 1.5/ M10 x 1 adapter.
8. Remove oil pressure tester with adapter.
Fit plug with a new sealing ring (A14 x 18).
Tightening torque: 20 ± 5 Nm (15 ± 3.5 ftlb.)



Engine removed for the sake of clarity (cylinder bank 1 - 3) 342_98

5. Warm up engine to operating temperature (80 - 90° C oil temperature). The oil temperature can be read out with the Porsche System Tester 2 under the "Actual values" menu.
6. The oil pressure should be approx. 1.5 bar at idle.
7. Have a second person increase the engine speed to 4000 rpm. Read off the oil pressure on the oil pressure tester. The oil pressure should be approx. 5.5 bar.

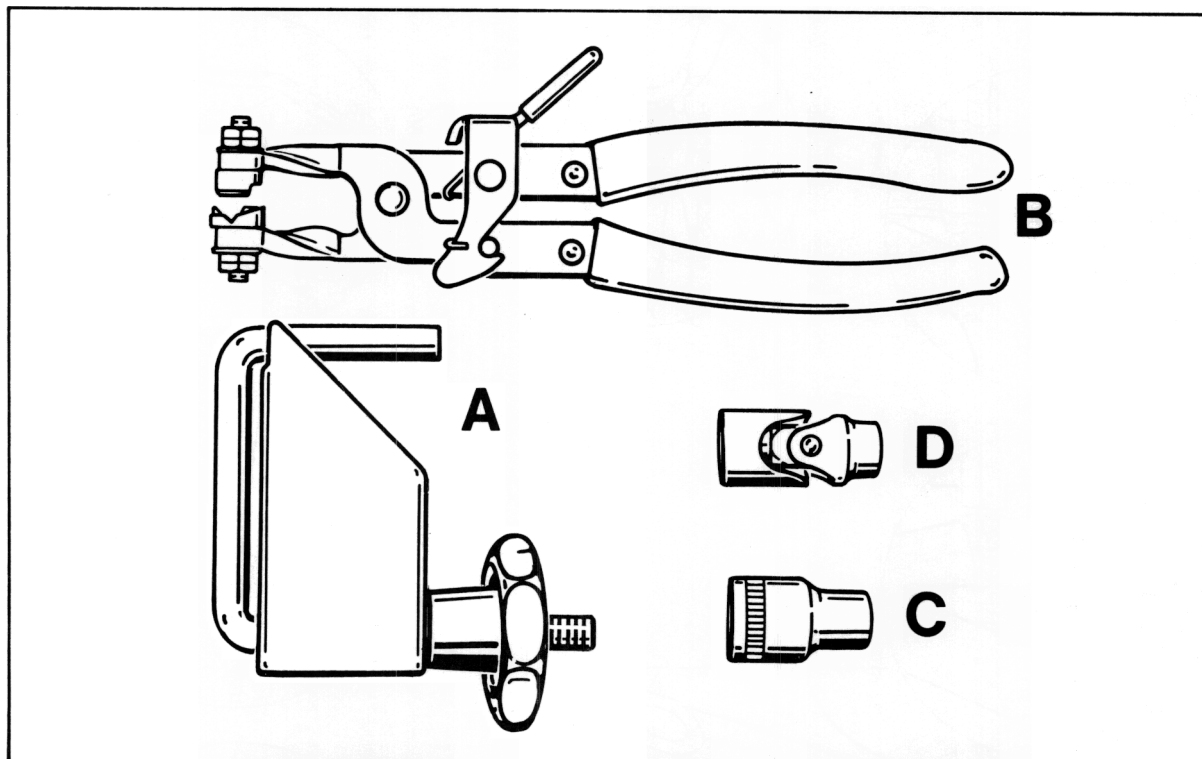
19 50 19 Removing and installing coolant pump



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Removing and installing coolant pump

Tools

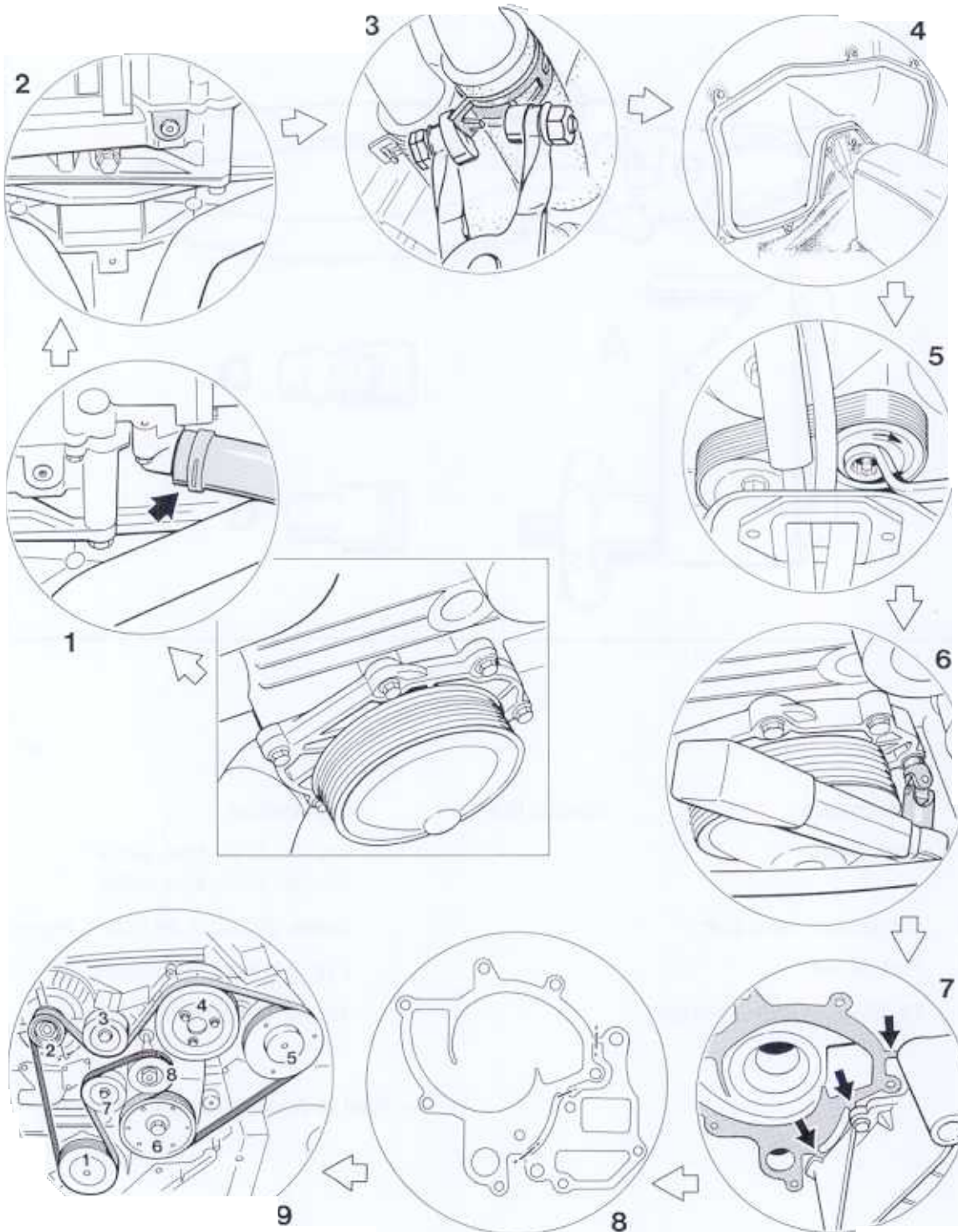


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No.	Designation	Special tool	Explanation
A	Hose clamp		Art. No. 3093, from Saltus* Art. No. 3094, from Saltus*
B	Spring-band clamp pliers		Mubea G0-190, from Muhr & Bender*
C	Torx socket		E12 (3/8 inch), from Stahlwille*
D	Flexible-head socket wrench		Art. No. 4001-10, from Stahlwille*

= Refer to Workshop Equipment Manual

Removing coolant pump



Removing coolant pump

Assembly work from below

No.	Procedure	Instruction
	Remove underside panel	
1	Clamp shut coolant hoses	Clamp shut coolant hoses with hose clamps by Saltus, order numbers 3093 and 3094.
	Drain coolant	Undo drain plug at water guide housing and collect coolant
3	Undo spring-band clamps	Undo spring-band clamps with pliers type MUBEA G0-190

Assembly work from above

No.	Procedure	Instruction
	Remove right-hand seat	Disconnect electrical plug connection. Undo four Torx screws with socket E12 (3/8 inch).
4	Remove service cover at passenger compartment rear wall	Remove rear-wall lining. Undo nine hexagon-head bolts (wrench size 10 mm) and remove cover.
5	Remove drive belt	Mark belt travel direction with a coloured pen. Slacken belt, turning the tensioning pulley (wrench size 19 mm) clockwise, hold still and simultaneously take the belt off the drive pulleys. Visually check state of belt and replace if necessary.

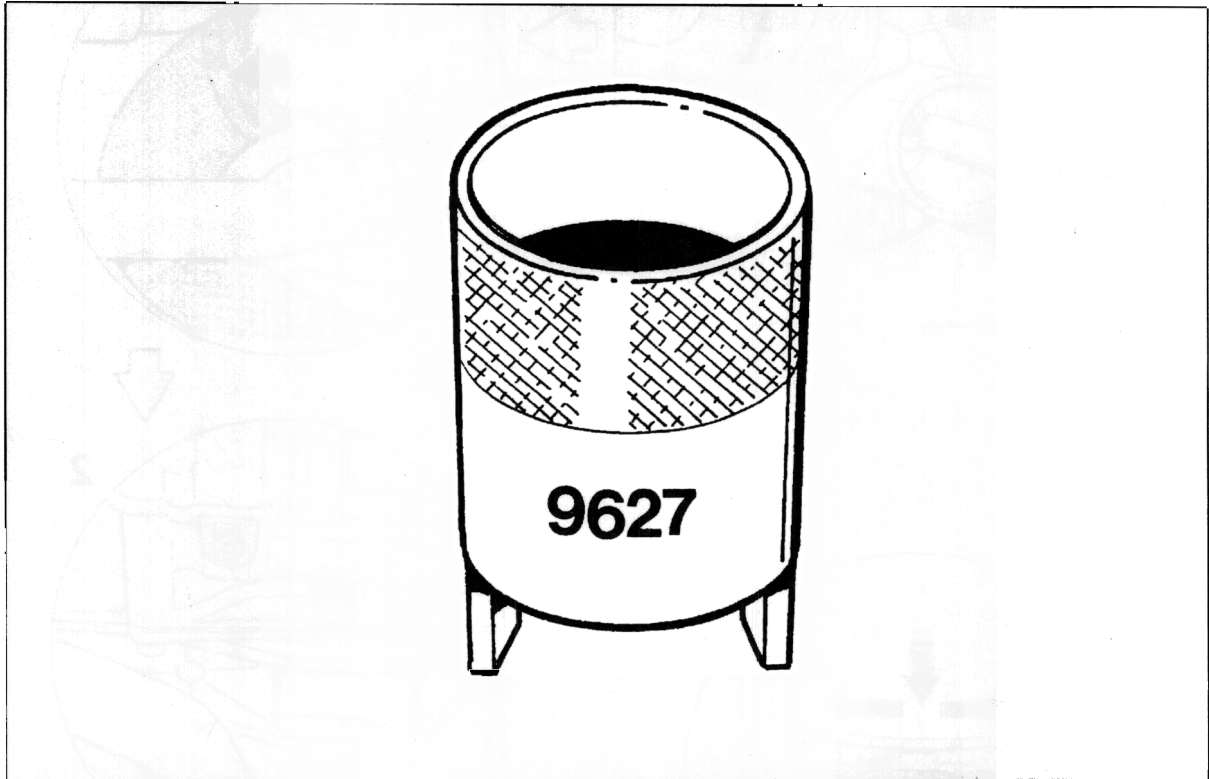
No.	Procedure	Instruction
6	Remove coolant pump	Undo hexagon-head bolts. The lower right hexagon-head bolt is difficult to reach. To undo it, use flexible-head socket wrench 4001-10 by Stahlwille.
7	Separate metal seal	Cut old metal seal between coolant pump and water guide housing at the connecting webs.

Installing coolant pump

No.	Procedure	Instruction
8	Rework new spare metal seal	Cut new spare metal seal (combination seal) for coolant pump and water guide housing at the connecting webs.
	Fasten coolant pump	Fit new seal and coolant pump simultaneously and fasten. Tightening torque 10 Nm (7 ftlb.).
9	Fit drive belt and tension	Fit drive belt by hand, slightly pre-tensioned, in the following sequence: First onto the coolant-pump drive pulley (1), alternator drive pulley (2), intermediate roller (3), power-steering pump drive pulley (4), air-conditioning compressor drive pulley (5), crankshaft pulley (6), idler roller (7), then over the tensioning roller (8). To do this, turn the tensioning roller (wrench size 19 mm) clockwise, hold still and put on the belt at the same time. Slowly relieve the tensioning roller. Check that the belt is correctly seated on all drive pulleys.
	Install rear-wall lining, service cover and left-hand seat	Insert rear-wall lining in lower area behind the heel-plate lining. Fasten service cover with 9 hexagon-head bolts. Tightening torque 10 Nm (7 ftlb.) Connect electrical plug connection and fasten seat. Tightening torque of Torx screws 20 Nm (15 ftlb.).

19 58 19 Removing and installing coolant regulator

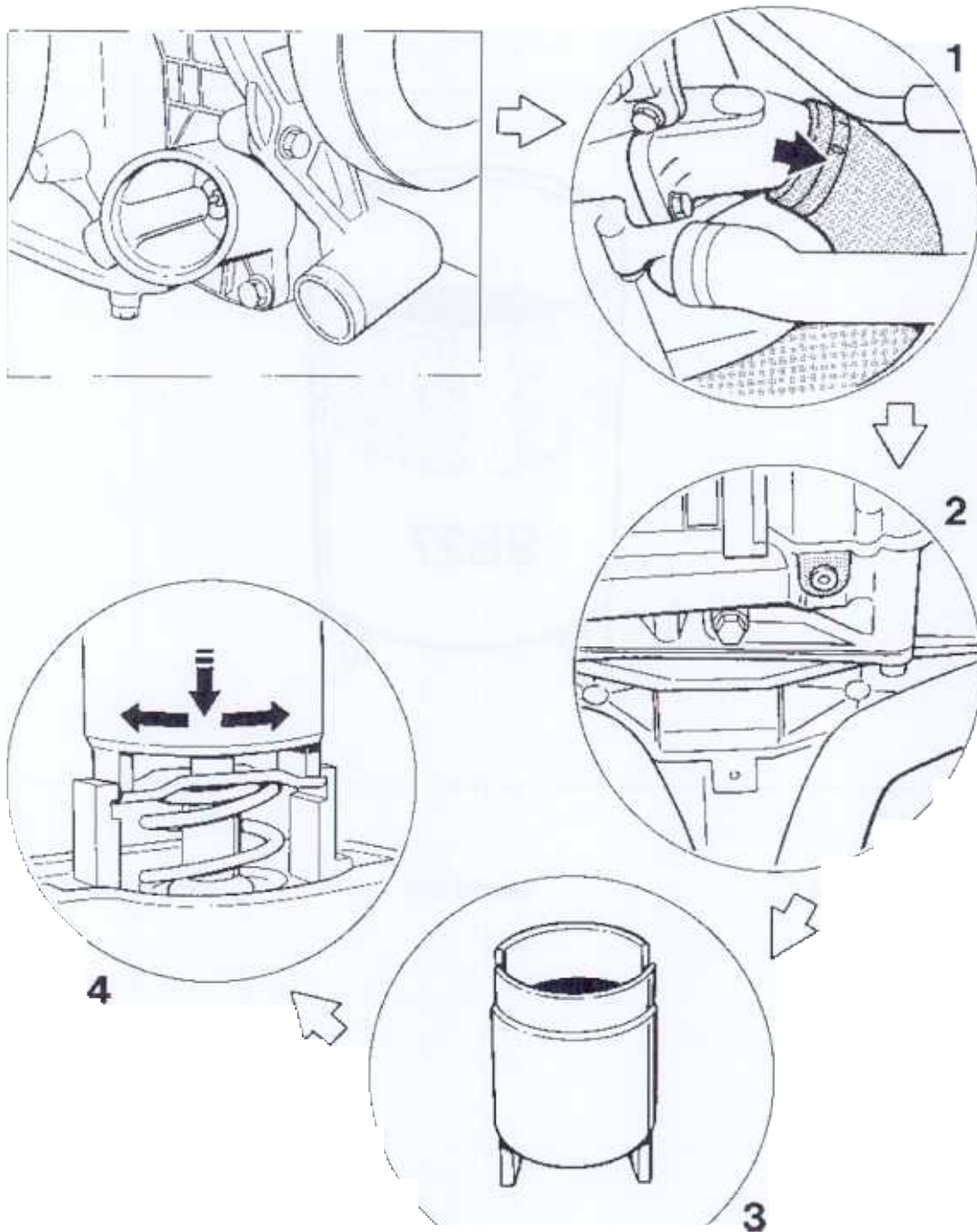
Tools



302_97

Item	Designation	Special tool	Explanation
	Assembly aid	9627	

Removing and installing coolant regulator



3396r

Removing and installing coolant regulator

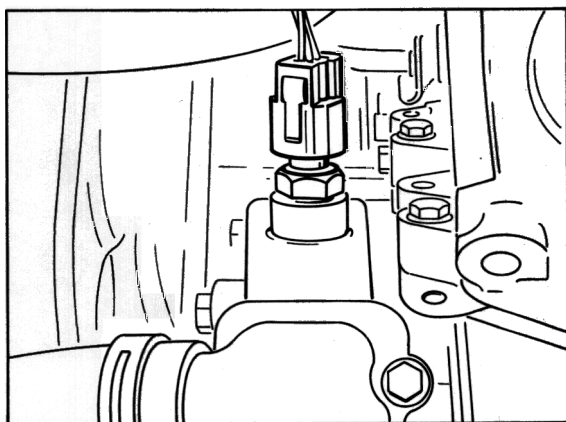
No.	Procedure	Instruction
	Remove rear underside panel	
	Undo spring-band clamps	Clamp shut coolant hoses and undo spring-band clamp with pliers.
2	Drain coolant	Undo drain plug at water guide housing and collect coolant. Undo four hexagon-head bolts and remove housing with coolant regulator. Replace gasket for drain plug. Tightening torque 10 + 5 Nm (7.5 + 3.5 ftlb.)
3+4	Remove or install coolant regulator	Press special tool assembly aid 9627 down against the spring force and simultaneously turn coolant regulator out of the housing guide or into the housing guide in the case of installation.
	Install housing with coolant regulator	Replace housing seal and install housing with assembled coolant regulator. Tightening torque 10 Nm (7.5 ftlb.).

19 78 19 Removing and installing coolant temperature sensor

The place of installation is at the left front in the direction of travel, in the area of cylinder 4.

Removal

1. Remove rear underside panel.
2. Pull off electrical plug connection. Undo temperature sensor (wrench size 22).



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Installation

1. Check sealing ring and use a KD (service) sealing ring if necessary.

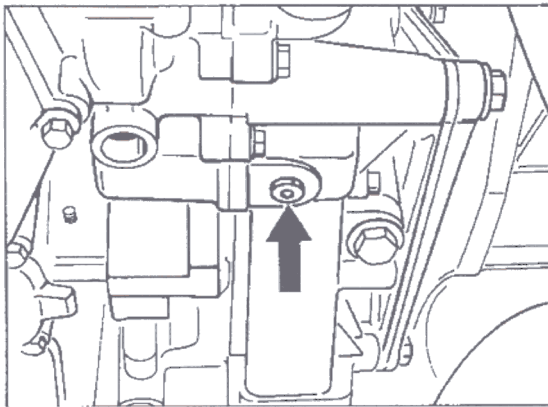
Note

As standard, the temperature sensor has a captive sealing ring.

Tightening torque 25 ± 5 Nm (18 ± 3.5 ftlb.)

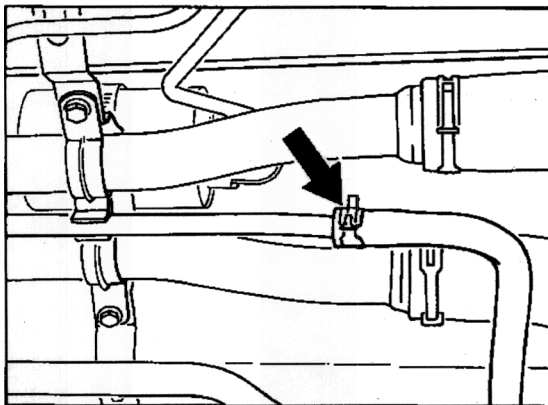
19 38 17 Draining and filling in coolant (includes: bleeding the cooling system)**Drain coolant**

1. Remove cap from coolant expansion tank.
2. Undo drain plug on water guide housing.



471-96

3. Disconnect vent line.



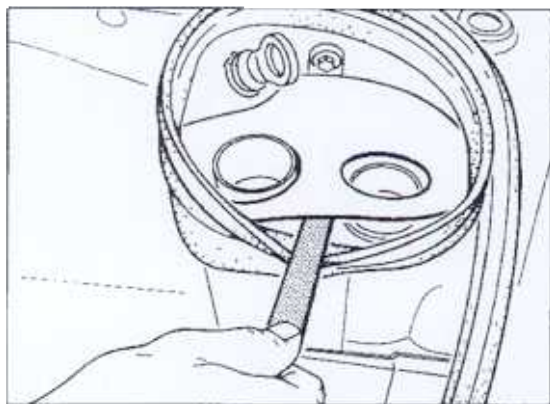
467-96

Filling in coolant and bleeding

Note

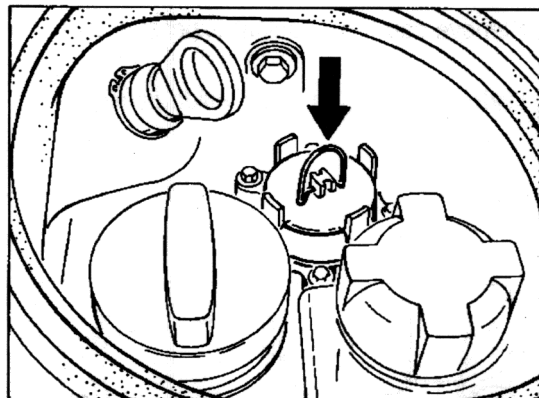
The engine cooling system is factory-filled with a lifetime engine coolant. This engine coolant must not be mixed or replaced with other coolants. Use only original Porsche coolant when changing or topping up the engine coolant.

1. Remove both caps (engine oil and coolant).
2. Lever cover off with a spatula.



406-96

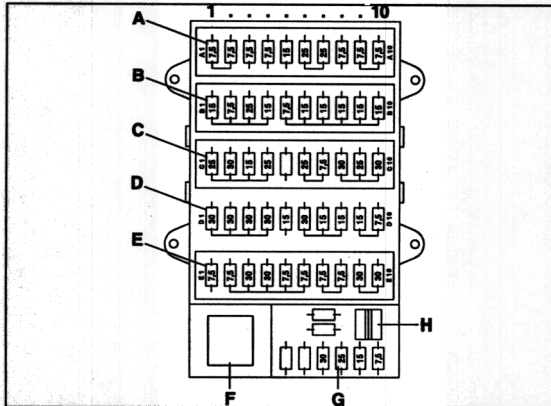
3. Lift bow on bleeder valve. Screw oil cap on again.



407-96

4. On **Tiptronic** vehicles, the pneumatically triggered coolant shutoff valve (flat-seat valve) **must be opened** for the bleeding process. The electric switch-over valve must be **switched off** for this purpose.

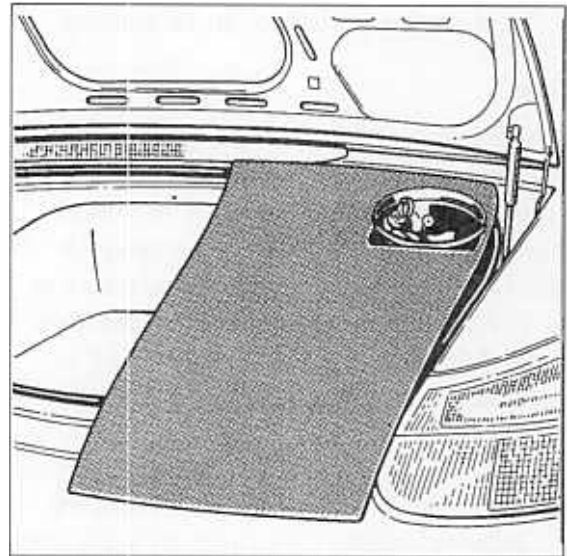
Triggering can be performed with the Porsche System Tester 2 or by pulling out the Tiptronic control module fuse B1 **with the ignition switched off**.



Fuse B1 (arrow)

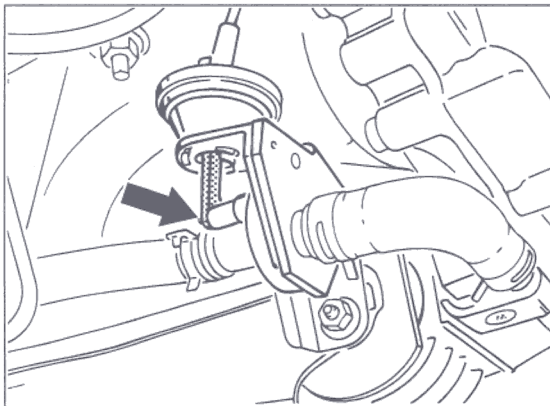
97-335

6. Put on protective cover. (Manufacturer: refer to Workshop Equipment Manual.)



711_96

5. Check whether the coolant shutoff valve is open.



97-277

7. Fill with coolant up to the bottom edge of the filler neck.

8. Run the engine at idle speed and top up with coolant until no more coolant flows into the cooling system when the engine is revved moderately. (Coolant level now at **lower edge of filler neck**.) **The coolant temperature must not exceed 80 °C; proceed directly to the next work step if necessary.**

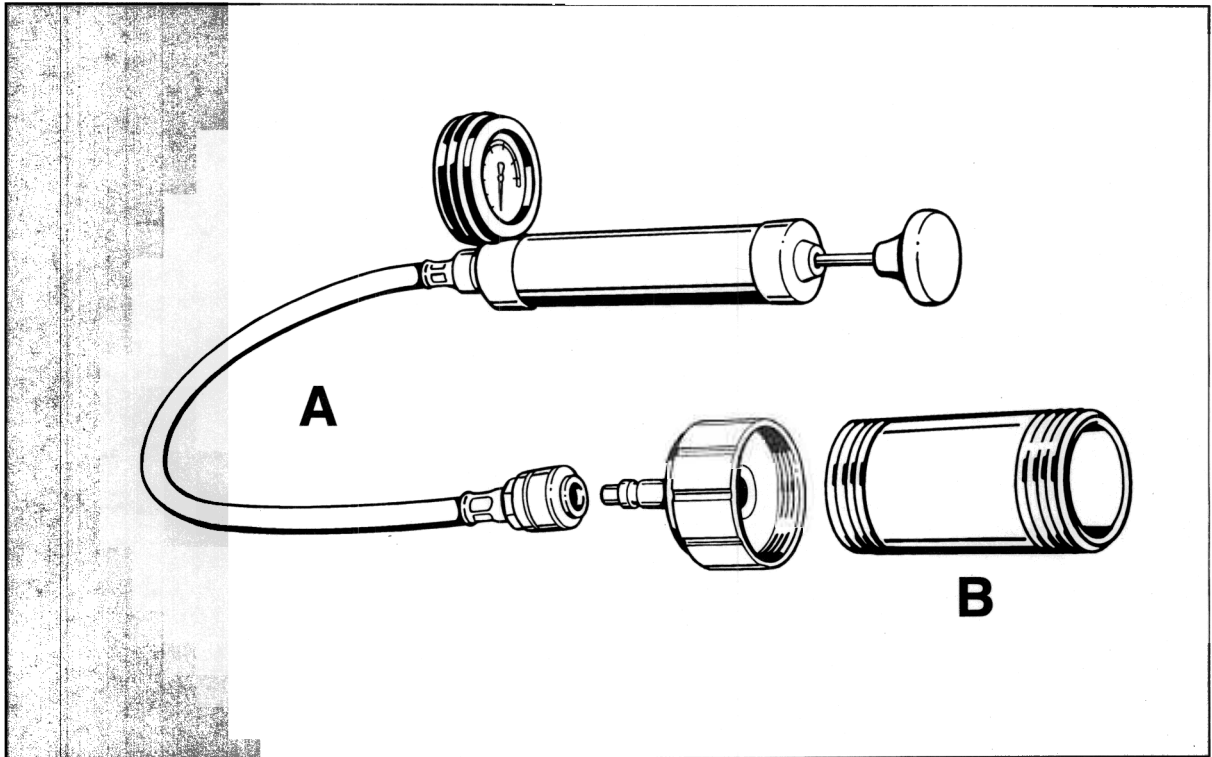
9. **Close reservoir and warm engine up to operating temperature** at a speed of ~ 2500 rpm until the thermostat opens after approx. 10 minutes (coolant temperature ~ 90 °C).
Check: The radiator supply lines and return lines in the front wheel housings must be hot.

10. Allow engine to run an additional 5 minutes at ~ 2500 rpm. Every 30 seconds, **briefly rev up the engine to ~ 5000 rpm**. Rpm surges are important for proper bleeding.

Note

The level warning light can light up during the bleeding process (reset by restarting the engine). Interrupt the procedure if the coolant level is below the "MIN" mark. Open reservoir with extreme caution and allow overpressure to escape until the coolant level reaches the lower edge of the filler neck; top up with coolant if necessary. Again intermittently rev the engine for 5 minutes.

11. Allow engine to run at idle speed until any activated radiator fans switch off again. Then switch off the engine. Open reservoir cap **with extreme caution** until the reservoir is depressurised (danger of scalding!).
12. Top up coolant expansion tank until level reaches **lower edge of filler neck** (cold, this corresponds to = "MAX").
13. Reposition bow on bleeder shutoff valve. Unscrew oil cap.
14. Put on cover and body seal. Screw on both caps. Remove protective cover.
15. **Reactivate ATF shut-off valve** on Tiptronic vehicles.

19 01 01 Checking cooling system for leaks

441_97

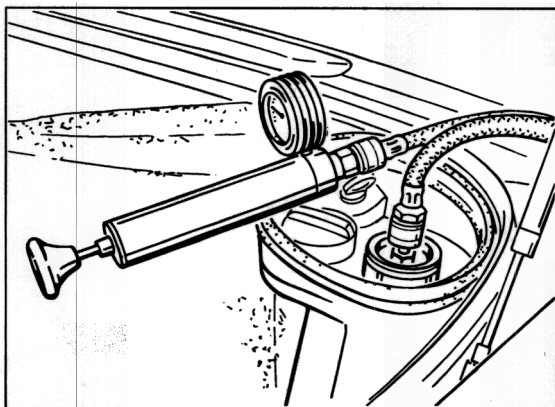
Item	Designation	Special tool	Explanation
A	Tester for cooling system tightness test	Commercially available	Refer to Workshop Equipment Manual, Chapter 3
B	Adapter for cap tightness test	Commercially available	Refer to Workshop Equipment Manual, Chapter 3

Checking the cooling system for leaks

Note

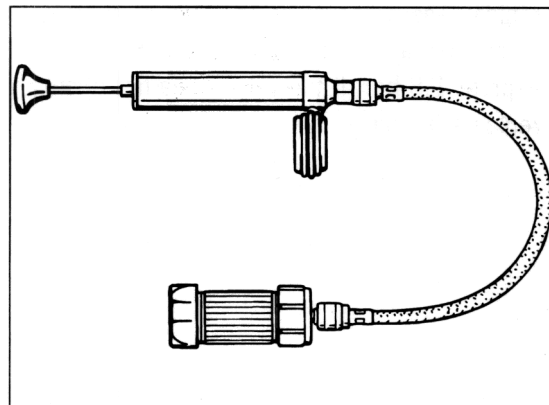
Perform the leak test only on a cold engine.

1. Remove cap and attach tester.



503_97

2. Pump the cooling system up to an excess pressure of 1.3 bar.
If the pressure decreases, locate the leak and remedy the fault.
Check pressure relief valve(s) in the cap.
Screw the tester, adapter and cap together.



504_97

Test, single-stage cap

Part number 443 121 321

1. Generate excess pressure.
2. The pressure relief valve opens and the pressure remains constant at an excess pressure of 1.3 bar.
If the pressure decreases, replace the cap.
The two-stage cap is the preferred version.

Test, two-stage cap

Part number 996 106 447 00

1. Generate excess pressure (stage 1)
2. The pressure relief valve opens at an excess pressure of approx. 1.4 bar; the pressure then slowly decreases again and the valve closes at 1.0 bar. If the pressure decreases further, replace the cap.

3. If the test pressure of stage 1 is maintained, test stage 2. Apply excess pressure to the pressure relief valve of stage one by pumping rapidly. The pressure relief valve of stage 2 must open at an excess pressure of approx. 1.8 bar. If the valve does not open, replace the cap.