

Technical Manual

*911 Carrera* (996)

Technical Information

Repair

Contents:

Group 1

Engine

Part 2 (as of Repair Group 15)

### Supplement Overview

Supplement	Edition	Topic	Article number
	05/1997	Basic edition	
0	05/2000		WKD483721
5	12/1997	General supplement	WKD483721.05
9	05/1998	General supplement	WKD483721.09
10	05/1998	General supplement	WKD483721.10
17	10/1998	General supplement	WKD483721.17
20	01/1999	General supplement	WKD483721.20
21	01/1999	General supplement	WKD483721.21
22	02/1999	General supplement	WKD483721.22
23	02/1999	General supplement	WKD483721.23
25	03/1999	General supplement	WKD483721.25
26	04/1999	General supplement	WKD483721.26
28	05/1999	General supplement	WKD483721.28
29	06/1999	General supplement	WKD483721.29
31	07/1999	General supplement	WKD483721.31
32	09/1999	General supplement	WKD483721.32
33	09/1999	General supplement	WKD483721.33
35	10/1999	General supplement	WKD483721.35
37	12/1999	General supplement	WKD483721.37
38	12/1999	General supplement	WKD483721.38
39	05/2000	General supplement	WKD483721.39
44	11/2000	General supplement	WKD483721.44



## Foreword

The workshop documentation for the 911 Carrera (1996) model has the designation

**"911 Carrera (1996)" Technical Manual**

and contains **Technical Information** as well as instructions on **Repairs**.

The integration of the technical information published in the "911 Carrera (1996)" Technical Manual with the instructions 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 "911 Carrera (1996)" Technical Manual consists of 15 folders, subdivided into the following Groups

0	Entire vehicle – General
0	Diagnosis, part 1 (up to Repair Group 45) * <sup>1</sup>
0	Diagnosis, part 2 (as of Repair Group 61) * <sup>2</sup>
1	Engine, part 1 (up to Repair Group 13) * <sup>3</sup>
1	Engine, part 2 (as of Repair Group 15) * <sup>4</sup>
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) * <sup>5</sup>
9	Circuit diagrams, part 2 (as of the '00 model) * <sup>6</sup>

| \*<sup>1</sup> 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**).

| \*<sup>2</sup> The **second folder** "Group 0 – Diagnosis, part 2" (**as of Repair Group 61**) includes the further Repair Groups belonging to Group 0.

| \*<sup>3</sup> 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**).

\*<sup>4</sup> 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 and including 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 "911 Carrera (1996)" Technical Manual has the same structure in each folder, with the following breakdown for all Groups:

**Title page: "911 Carrera (1996)" 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 folders.

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

## Note

Sheets that already exist in the "911 Carrera (1996)" 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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## 17 Engine - Lubrication

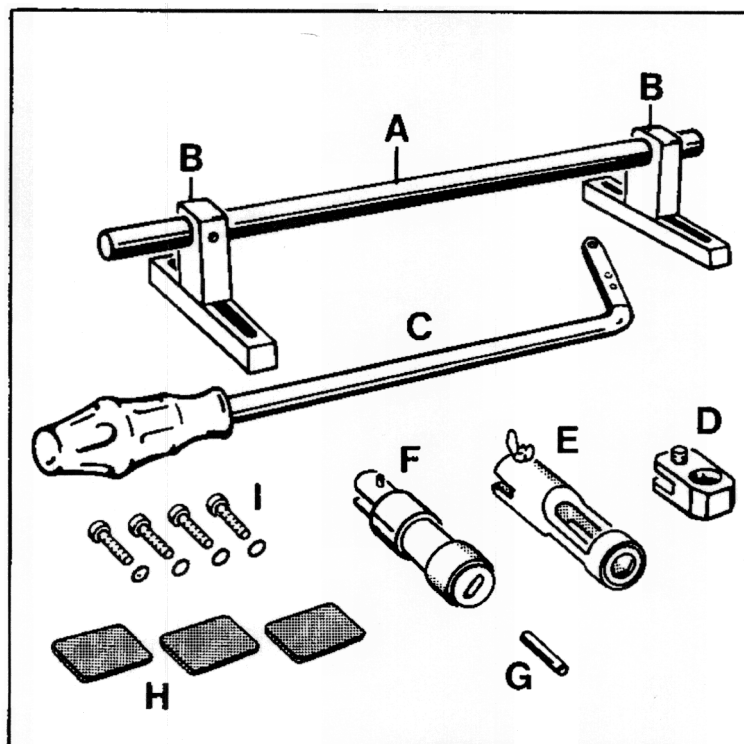
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## 15 70 37 Disassembling and assembling cylinder head — Inner parts

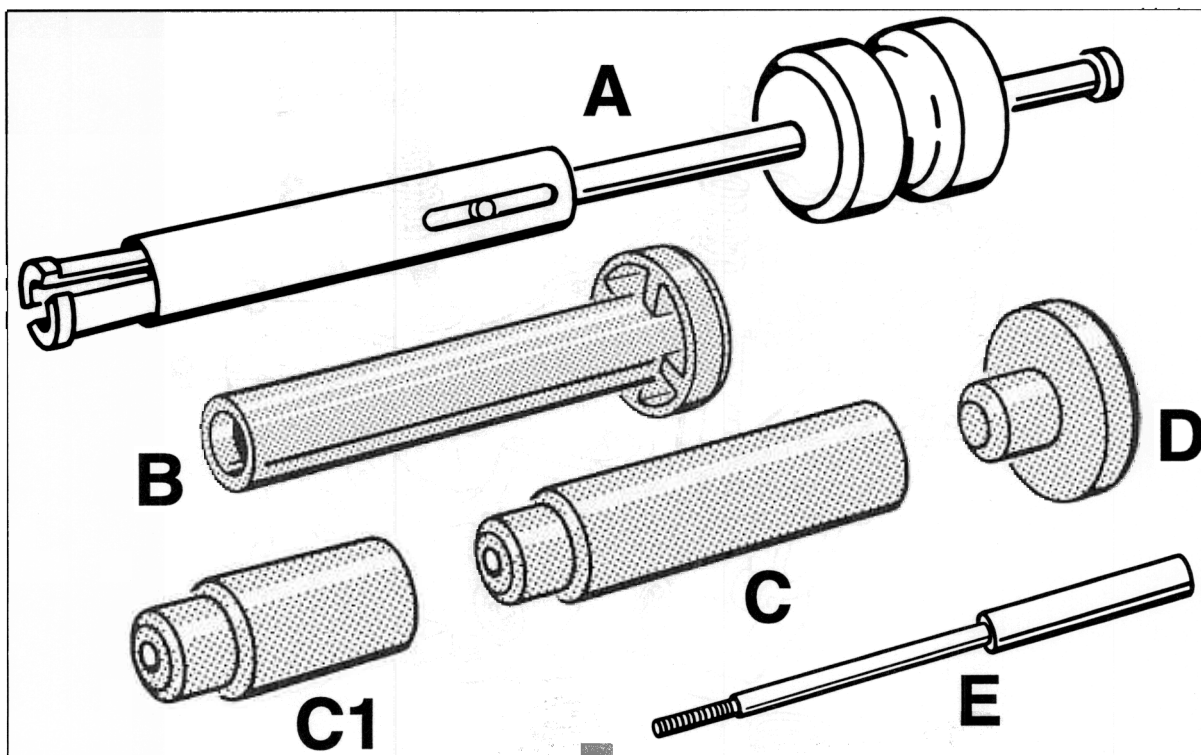
Tools (commercially available)



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Item	Designation	Special tool	Explanation
A	Shaft (ø 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 (Items A to H: refer to Workshop Equipment Manual, Chapter 2.4, No. 54)
	Screws for aluminium supports (4 ea.)		Commercially available, M6 x 40

## Tools

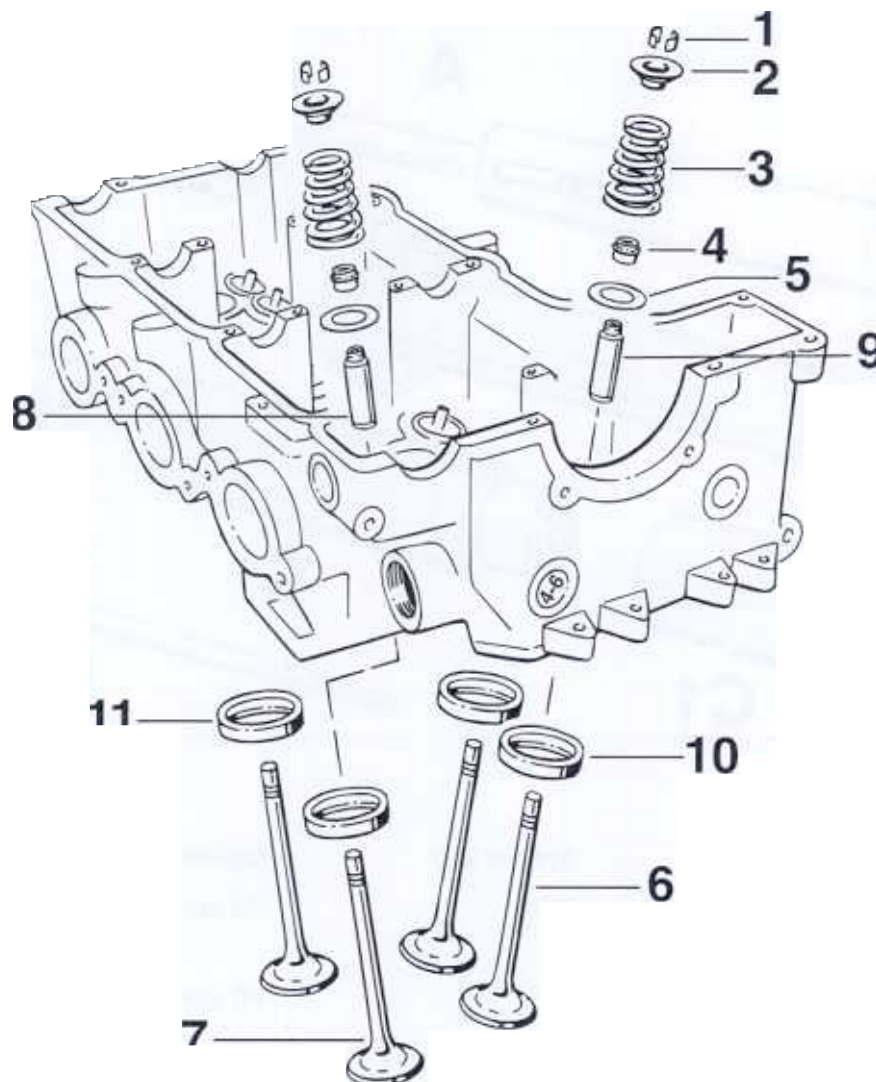


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Item	Designation	Special tool	Explanation
A	Extractor for valve stem seal	3364	VW special tool
B	Press-on tool for valve stem seal	3365	VW special tool
C	Pressure piece, for fitting the oil protection tubes	9605	
C1	Pressure piece, for fitting the oil protection tubes (engine installed)	9605/1	
D	Hand pressure piece	9604	
E	Tensioning screw for relieving the tensioning elements (VarioCam)	9632	1 set = 2 ea.

**Disassembling and assembling cylinder head**

Diagram shows cylinder head 4 - 6



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**Disassembling and assembling cylinder head**

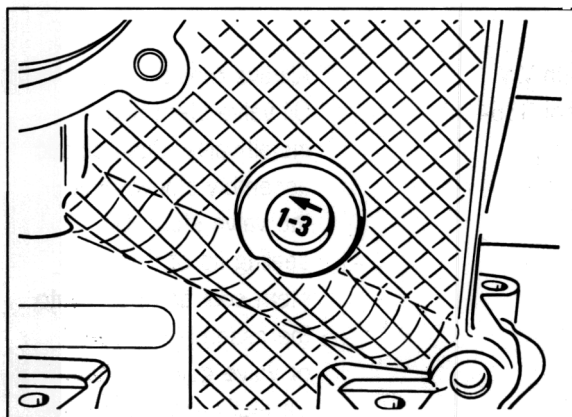
No.	Designation	Qty.	Removal	Note: Installation
1	Valve collet	12		Ensure correct seating
2	Spring seat	6		
3	Valve spring	6		
4	Valve stem seal	6	Pull off with VW special tool 3364	Always replace. Oil valve stem and install valve. Push plastic assembly sleeve over the valve stem. Oil sealing lip of 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 into 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		
	Valve seat ring, inlet	3		



### Assembly instructions

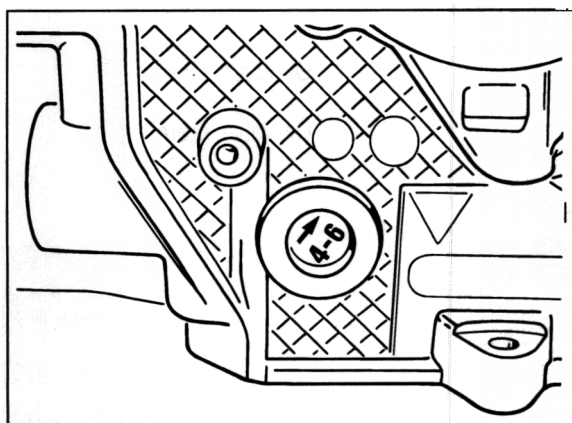
The cylinder heads differ in the area of the chain tensioners and are therefore marked on the front with 1 - 3 or 4 - 6 to prevent mix-ups.

#### Cylinder bank 1 - 3



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#### Cylinder bank 4 - 6



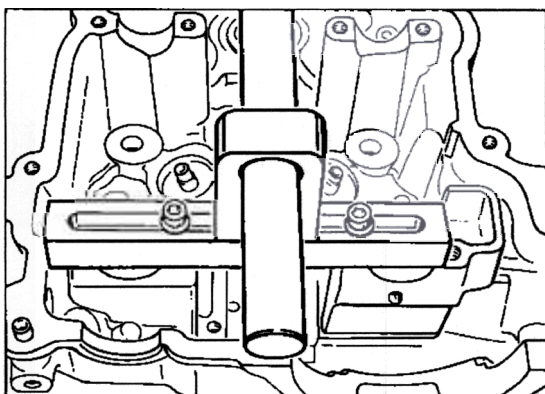
568\_96

## 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.

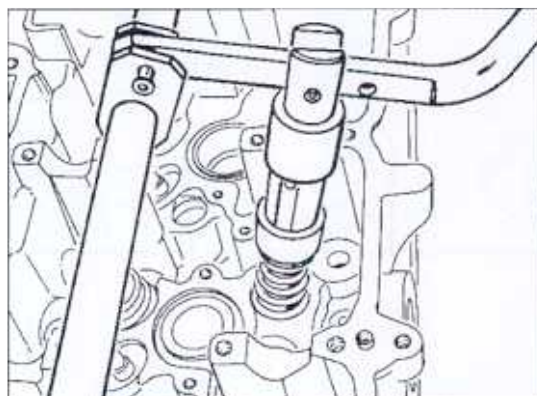


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### Note

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

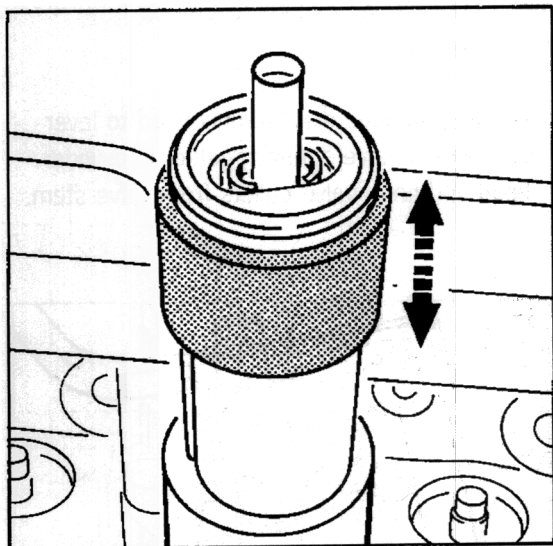
3. Fasten magnetic disassembly head to lever arm. Press valve spring together in cylinder head and undo valve collets from valve stem.



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### 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 in the right place.

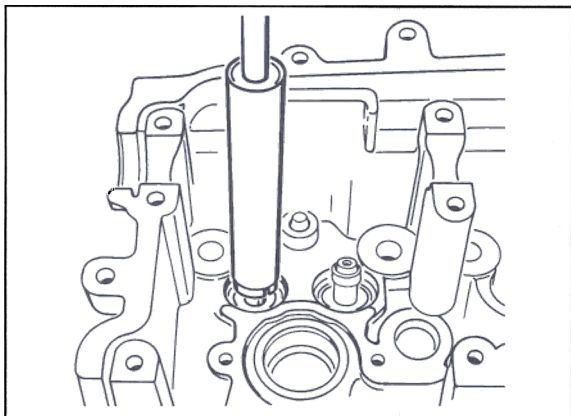


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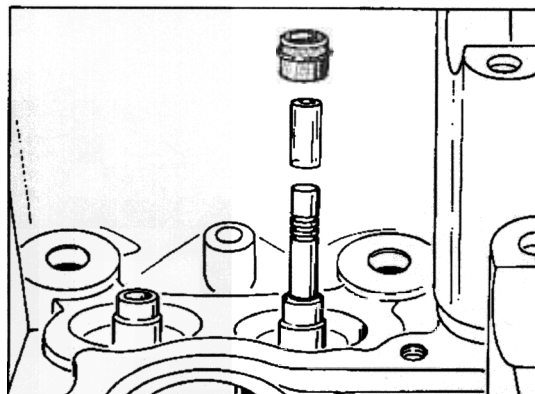
## 15 63 19 Removing and installing valve stem seal

### Removal

Insert VW special tool 3364 into rib of valve stem seal and pull out.



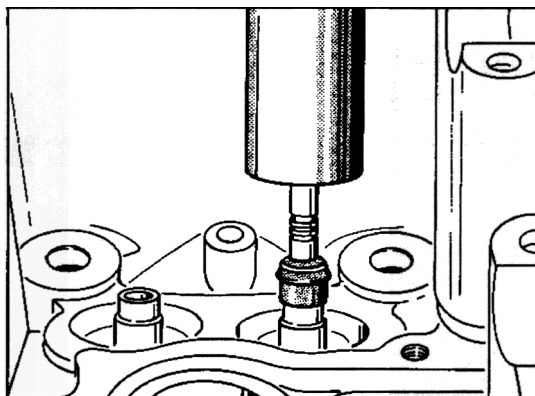
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### Installation

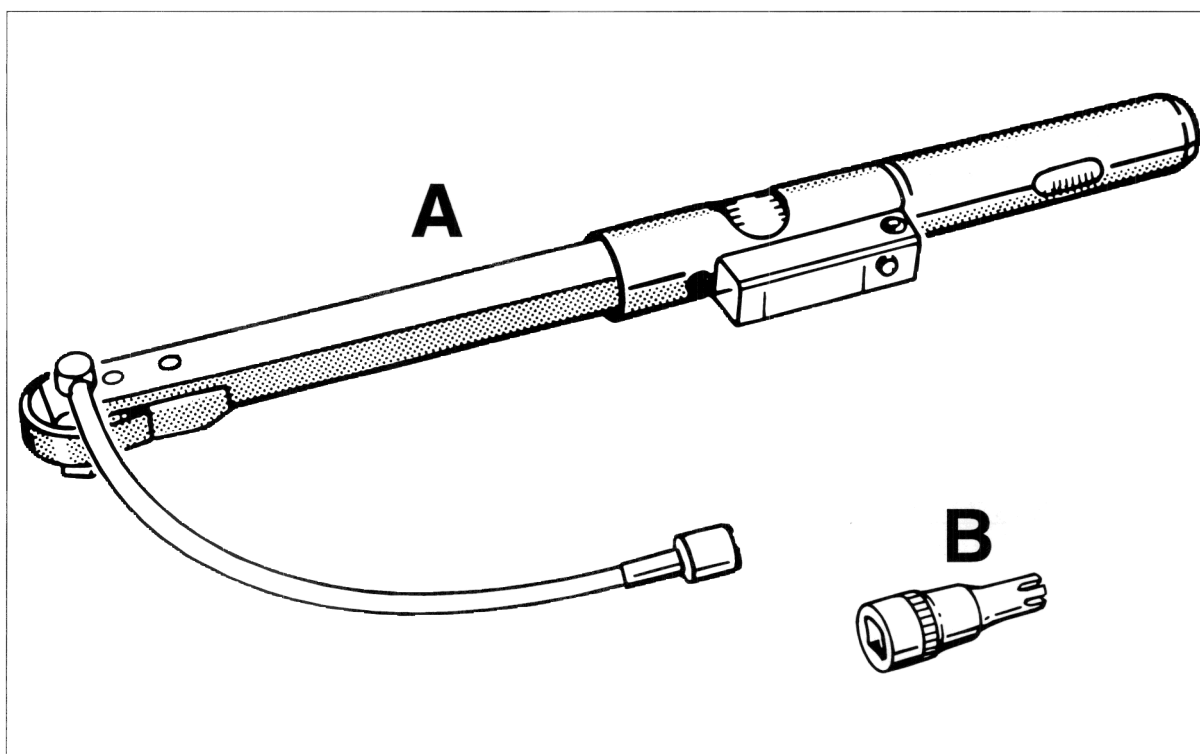
Fit original valve spring support disc. Slide plastic assembly sleeve (ø 6 mm) onto valve stem. Oil sealing lip and seating surface of valve stem seal, put on by hand and, with assembly mandrel (VW special tool 3365), gently tap as far as the stop on the valve guide. Remove plastic sleeve.



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## 15 70 23 Installing cylinder head

### 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 M96/01 66X03084 M96/02 68X01044 (modified cylinder head screws)



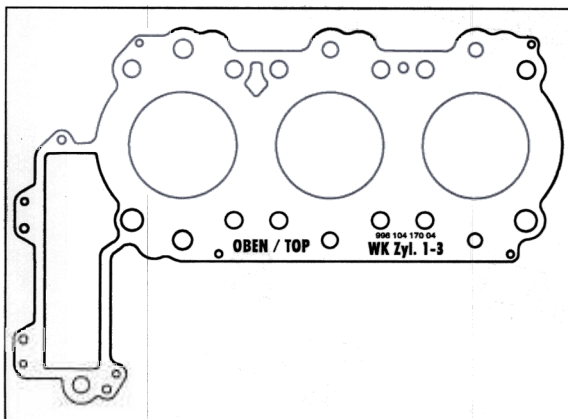
## Installing cylinder head

Fit cylinder head gaskets.

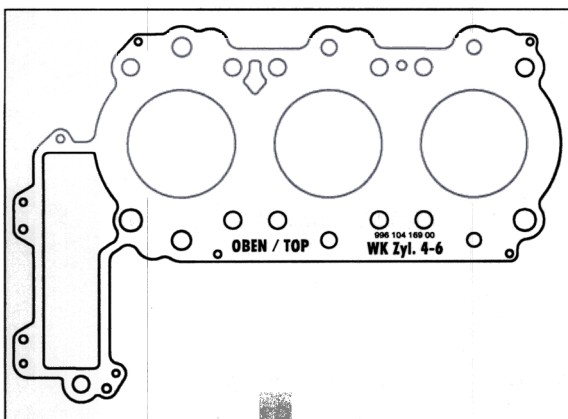
### Note

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 cylinder-head screws

#### Initial tightening or tightening to flatten

**1st step:** 30 Nm (23 ftlb.)

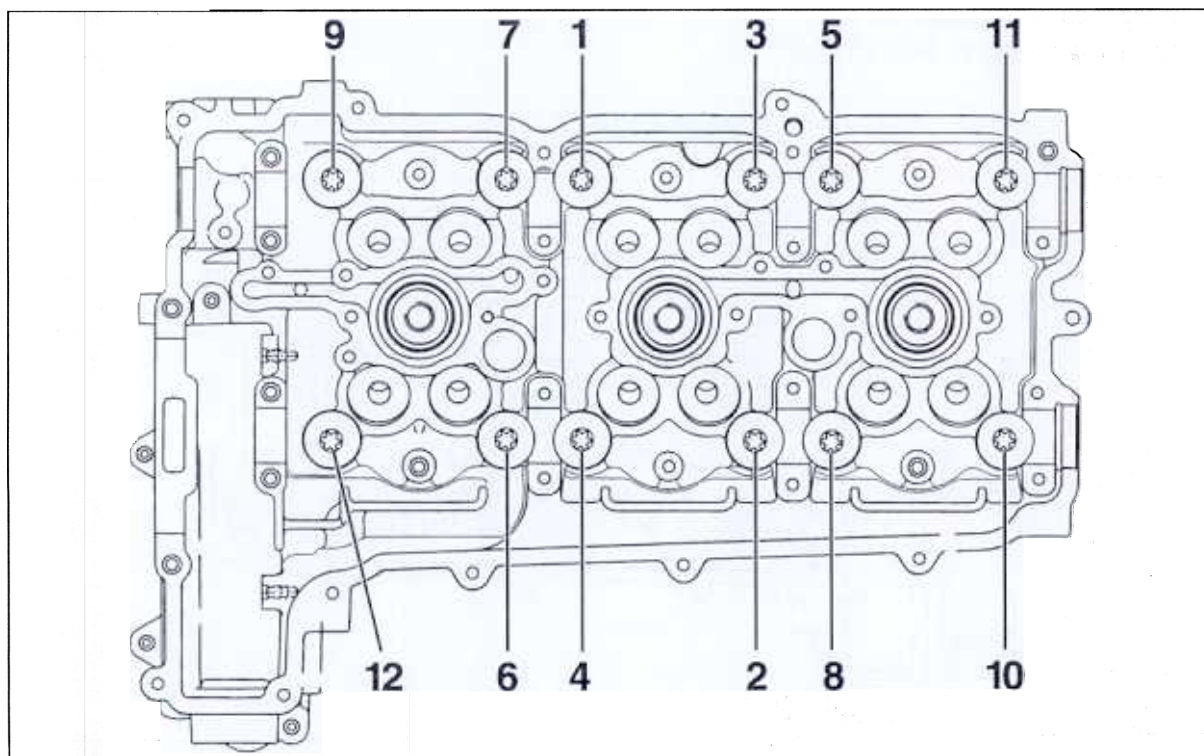
**2nd step:** Completely loosen cylinder head screws

#### Final tightening

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

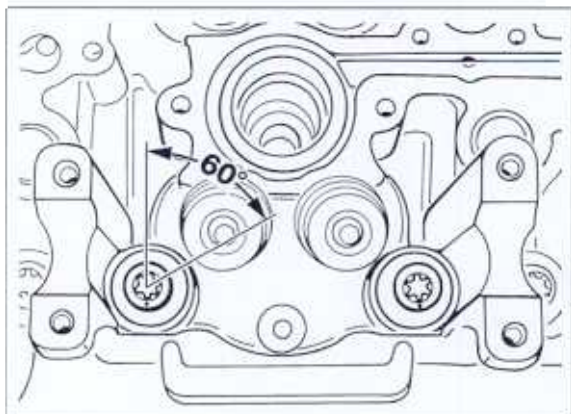
**2nd step:** Torque-angle tightening 1 x 60° ± 2° in same sequence

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



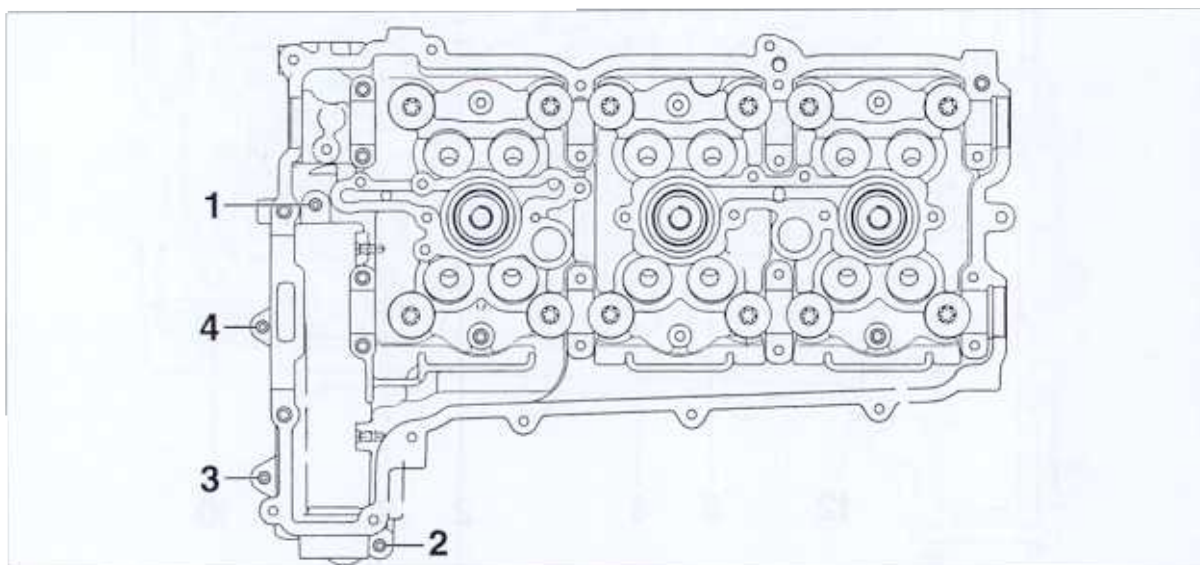
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Diagram shows torque-angle tightening with 60°



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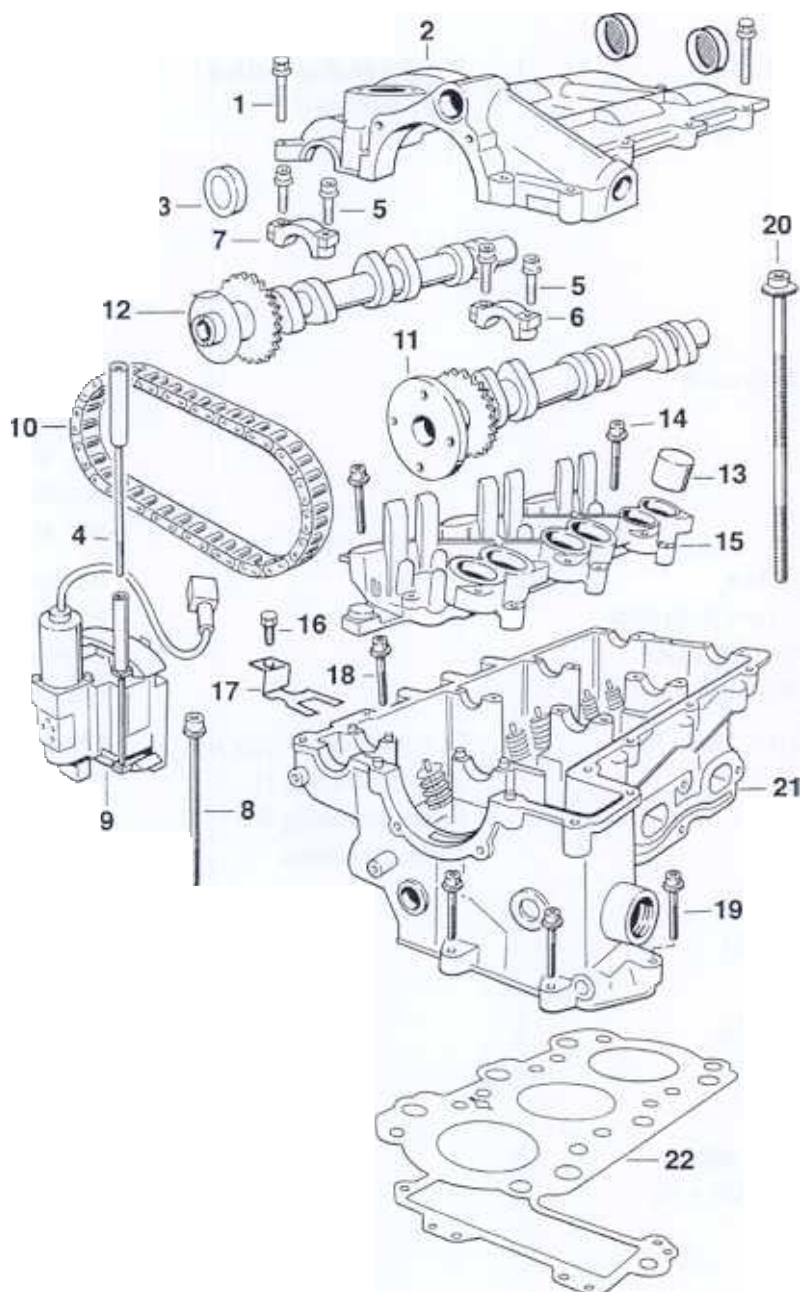
3. After tightening the cylinder-head screws, additionally fasten four pan-head screws M6 x 35 (10.9) (with captive washers) in the area of the chain box.  
Tightening torque 13 Nm (10 ftlb.)



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## 15 70 37 Disassembling and assembling cylinder head — Camshaft drive

Diagram shows cylinder head 1 - 3



460\_97

## Disassembling and assembling cylinder head Camshaft drive

No.	Designation	Qty.	Removal	Note: Installation
1	Hexagon-head bolt M6 x 30	23		Tightening torque 13 Nm (10.0 ftlb.)
2	Cylinder head cover	1	Protect sealing surface from damage	Apply silicone type 1209 from the Drei Bond company on sealing surface. The pairing number of the cylinder head/bearing saddles/ cylinder head cover must agree
3	Camshaft closure cap	3		Remove emerging silicone material. Fit cap dry. Using a plastic hammer, drive in the cap as far as it will go.
4	Tensioning screw (tensioning screw is already fitted as a transport lock on new chain tensioners)	1		Remove tensioning screw once both camshaft bearing saddles have been fastened
5	Pan-head screw M6 x 35	4	Fit holding-down device (special tool 9611) before loosening the pan-head screws	Fit holding-down device (special tool 9611) before tightening the pan-head screws
6	Bearing saddle for exhaust 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 (VarioCam) for camshafts	1	Relieve tensioning element with special tool, tensioning screw 9632 (with right-hand thread) or 9632/1 (with left-hand thread), before removal of the camshafts	Remove tensioning screw 9632 or 9632/1 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 Zyl. 1 - 3 or Zyl. 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**

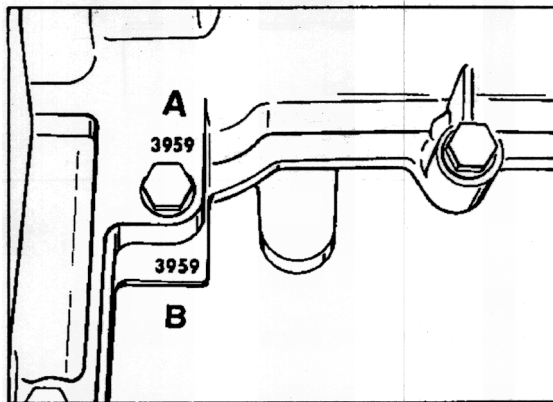
**Magnetised tools or magnets must not be used** when removing and installing valve tappets (flat-base tappets).

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

## Cylinder head assembly instructions

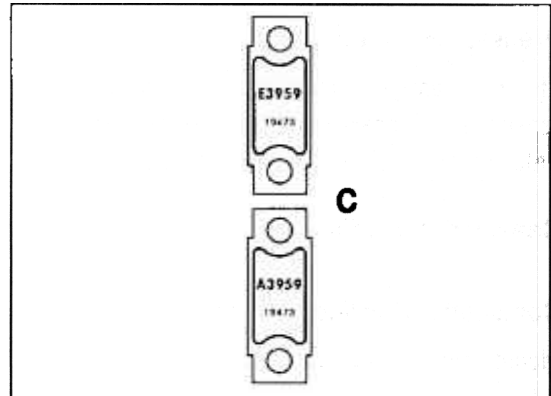
Pairing numbers or identification for cylinder head, cylinder head cover and camshaft bearing saddles.

The cylinder head, cylinder head cover and camshaft bearing saddles are machined together and must therefore always be installed together. Observe pairing numbers.



A – Pairing number of cylinder head cover  
B – Pairing number of cylinder head

400\_96



C – Pairing number of the two bearing saddles

401\_96

### Note

The letters E or A before pairing numbers mean:

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

## Camshaft assembly instructions

### Preassemble camshafts

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

### Camshaft allocation

#### Camshafts of cylinder bank 1 - 3

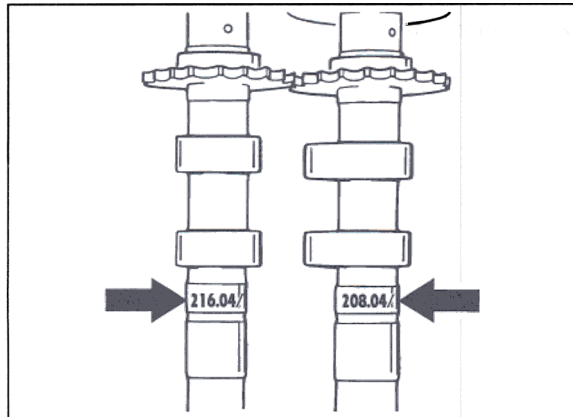
Identification on the camshaft

Inlet camshaft: 221.55/3.4 IN 13  
Exhaust camshaft: 222.55/3.4 EX 13

#### Camshafts of cylinder bank 4 - 6

Identification on the camshaft

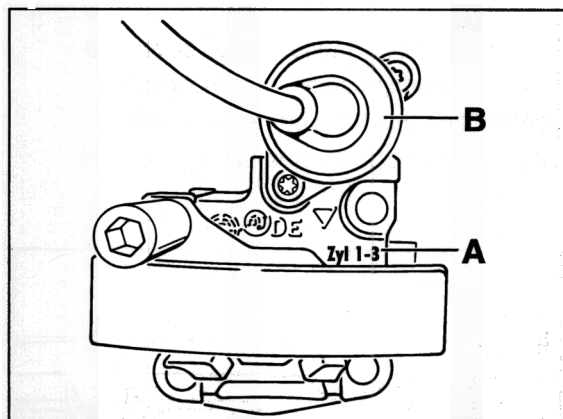
Inlet camshaft: 216.55/3.4 IN 46  
Exhaust camshaft: 218.55/3.4 EX 46



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### Allocating tensioning elements

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

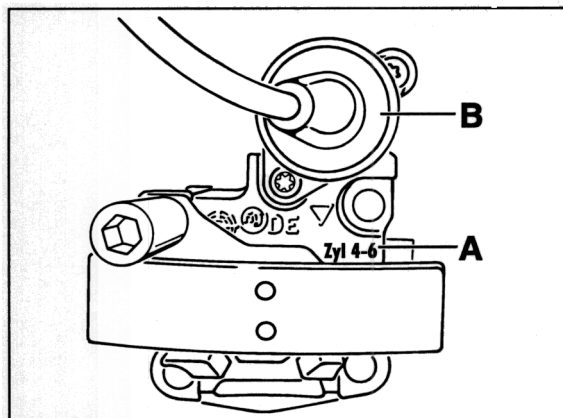


464\_97

A = Cyl. 1 - 3

B = Solenoid valve surface colour black

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



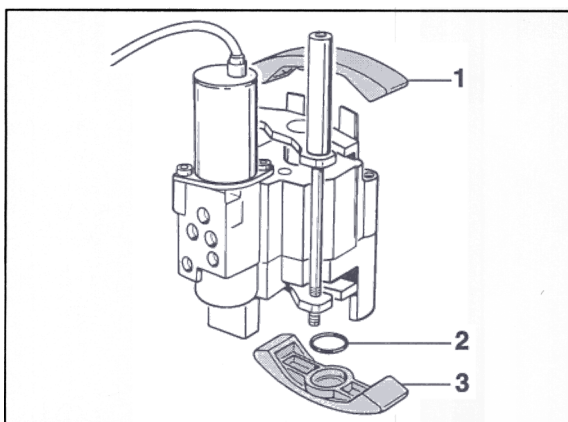
465\_97

A = Cylinder bank 4 - 6

B = Solenoid valve surface colour grey

### Guide rails for tensioning element

Check guide rails for scoring and replace if necessary



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

623\_97

1 = Upper guide rail

2 = O-ring

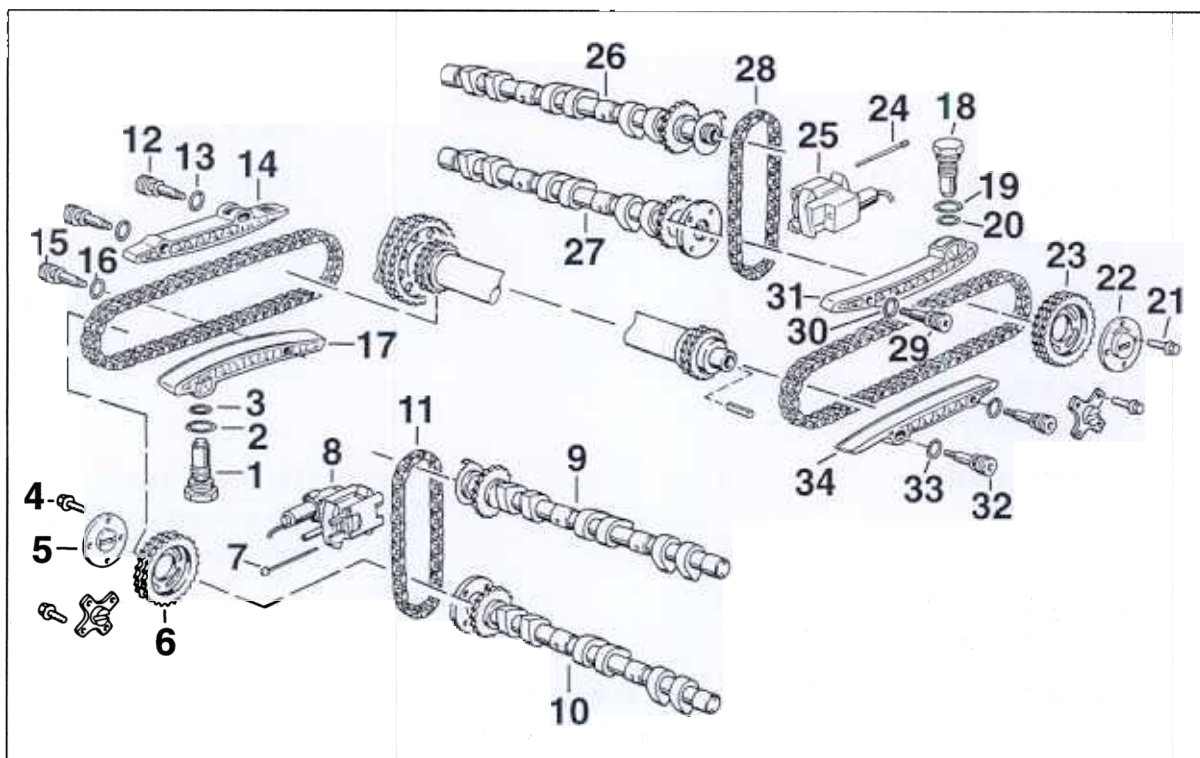
3 = Lower guide rail

### Note

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

## 15 05 19 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 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
9	Inlet camshaft of cylinder bank 1 - 3	1		Identification 221.55/3.4 IN 13
10	Exhaust camshaft of cylinder bank 1 - 3	1		Identification 222.55/3.4 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.)



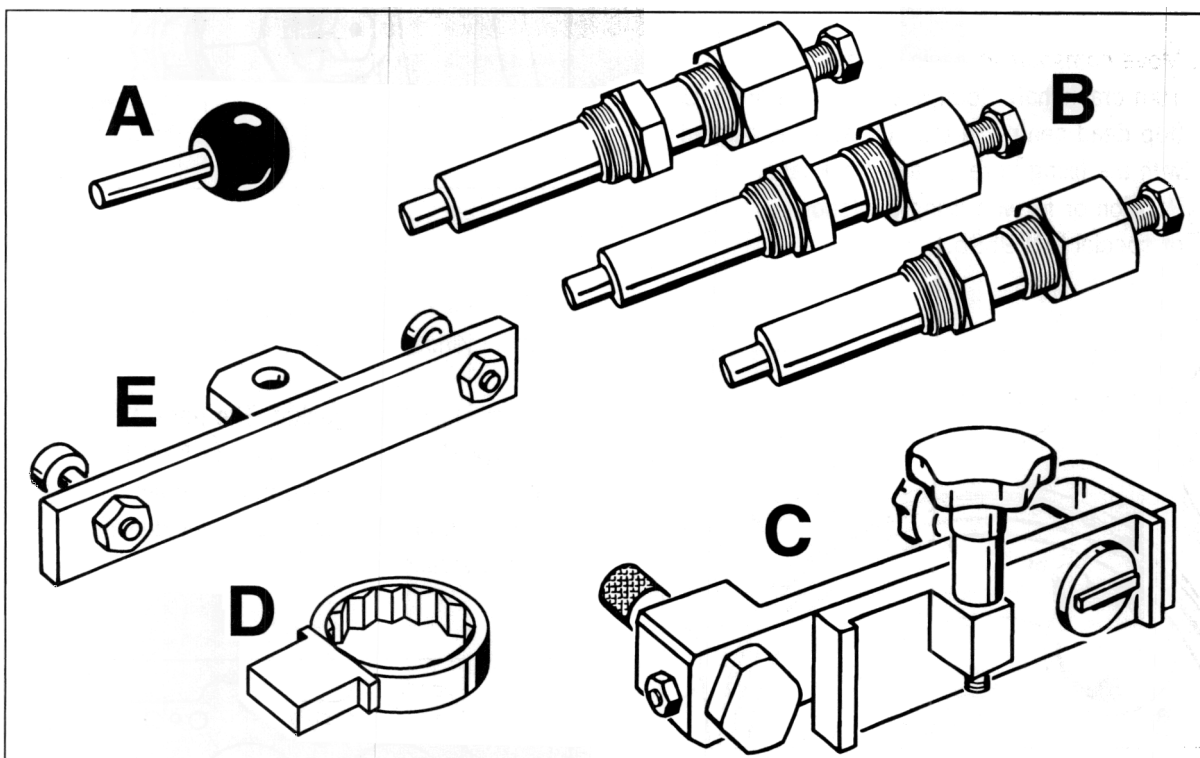
No.	Designation	Qty.	Removal	Note: Installation
13	O-ring	2		Replace; grease lightly
14	Guide rail	1	Inspect for scoring and replace if necessary	Observe installation position; slot faces the crankshaft
15	Fastening screw for tensioning rail	1		Tightening torque 10 Nm (7.5 ftlb.)
16	O-ring	1		Replace; grease lightly
17	Tensioning rail	1	Inspect for scoring and replace if necessary	
18	Chain tensioner on cylinder bank 4 - 6	1		Tigtening 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			
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 216.55/3.4 IN 46

No.	Designation	Qty.	Removal	Note:
				Installation
27	Exhaust camshaft of cylinder bank 4 - 6	1		Identification 218.55/3.4 EX 46
28	Timing chain	1		Observe allocation to the camshafts; two chain links identified
29	Fastening screw	1		
30	O-ring	1		Replace; grease lightly
31	Tensioning rail	1	Inspect for scoring 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 scoring and replace if necessary	Observe installation position; slot faces the crankshaft

## 15 05 22 Installing camshafts

Engine removed

Tools



654\_97

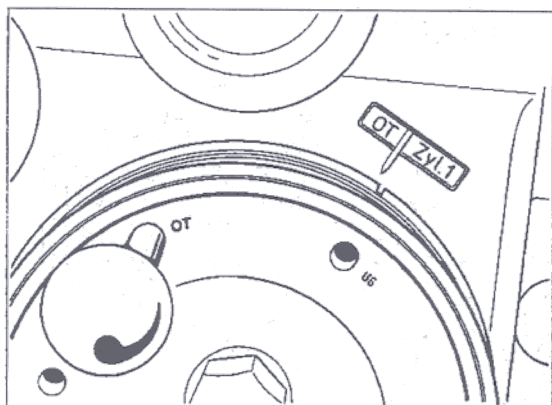
Item	Designation	Special tool	Explanation
A	Fixing pin for belt pulley	9595	1 set = 2 ea. (use short fixing pin)
B	Auxiliary chain tensioner for valve timing adjustment	9599	1 set = 3 ea.
C	Locking device for camshafts in timing position	9612	
D	Ring wrench (32 mm)		
E	Holding-down device for camshafts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

## Installing camshafts

### Requirements

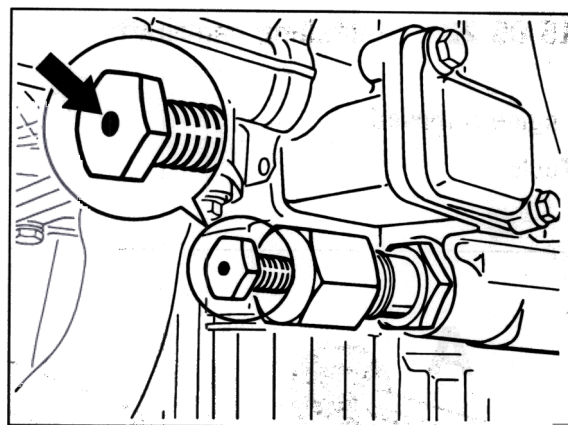
Oil pump with coolant guide housing, intermediate shaft flange, belt pulley and guide rails fitted on the crankcase.

1. 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.



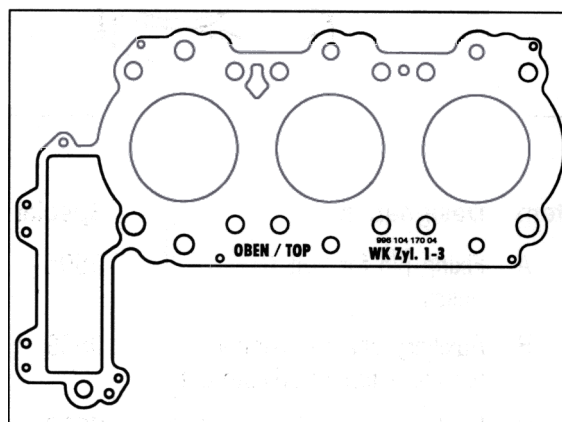
497\_96

2. 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 pre-tension 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.



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3. Turn engine by 90° on assembly support until cylinder bank 1 - 3 faces upwards.
4. 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.

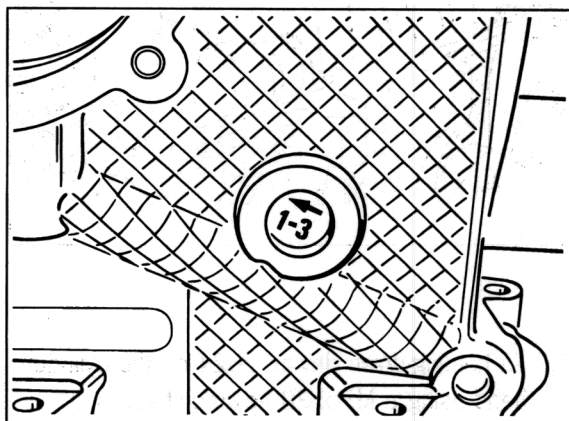


510\_97

# 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



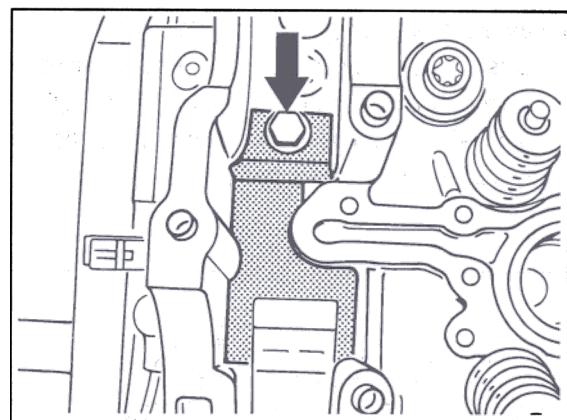
567\_96

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.)

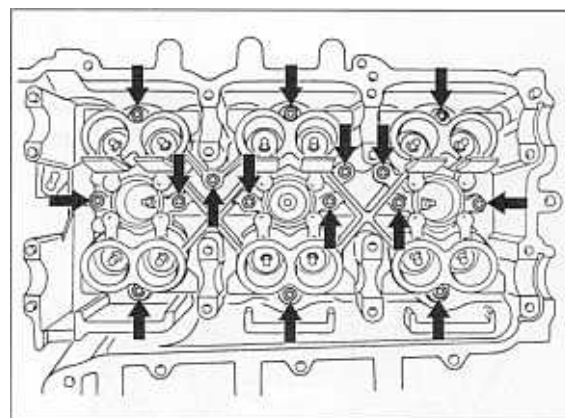
## Note

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



493\_97

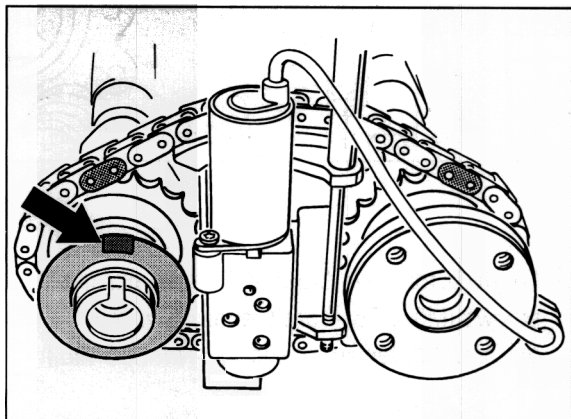
6. Fit guide for valve tappets. Tighten pan-head screws (M6 x 35) from the inside to the outside. Tightening torque: 10 Nm (7.5 ftlb.)



659\_97

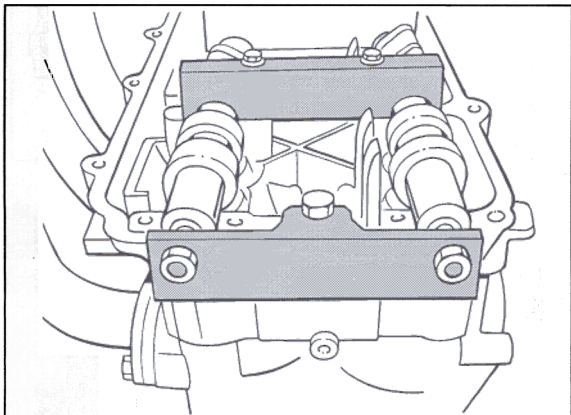
7. Lightly oil the valve tappet and fit it in the guide.

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**.



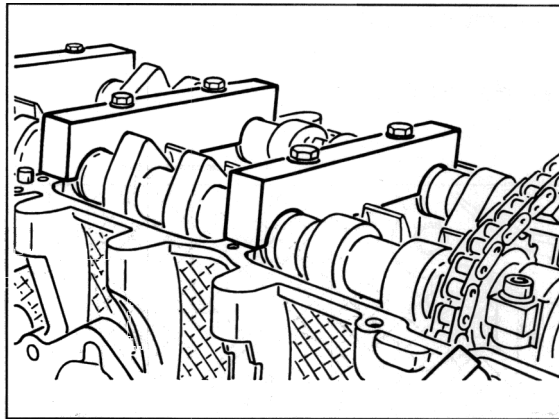
246\_97

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



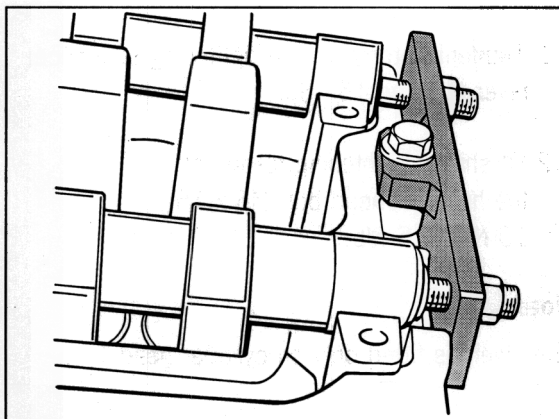
752\_97

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



218\_97

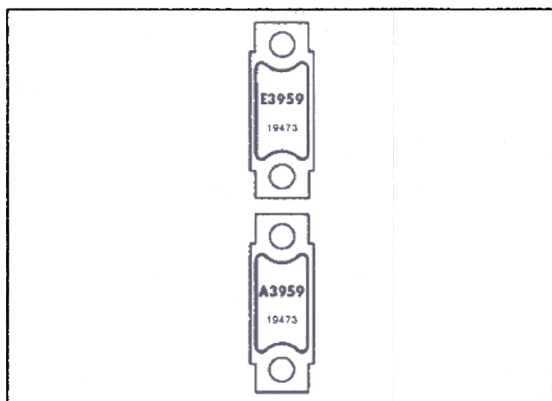
- 9.2 Fit holding-down device 9624 on the cylinder head using a M8 x 30 hexagon-head bolt.



633\_97



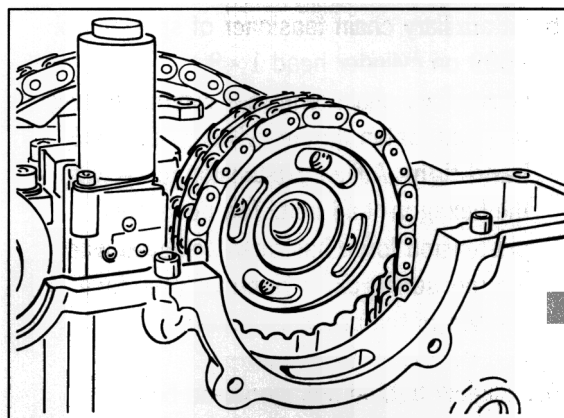
10. Check dowel sleeves (4 ea.) of the bearing saddles to ensure that they are properly seated in the cylinder head. Grease bearing surface, fit bearing saddles in **correct** position and tighten **evenly**.  
Tightening torque: 10 Nm (7.5 ftlb.)  
It is **essential** to compare the pairing numbers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



401\_1\_96

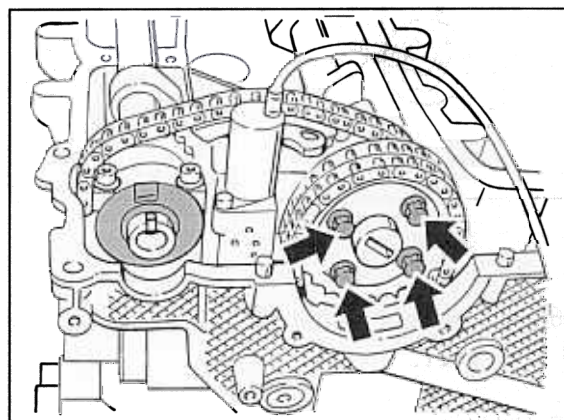
*E = Bearing saddle for inlet camshaft*  
*A = Bearing saddle for exhaust camshaft*

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 drive 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.

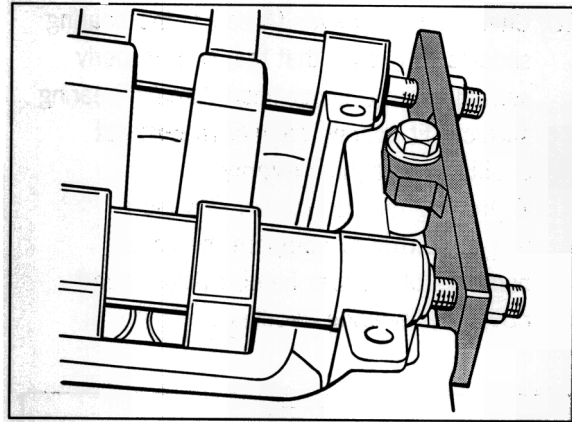


74\_98

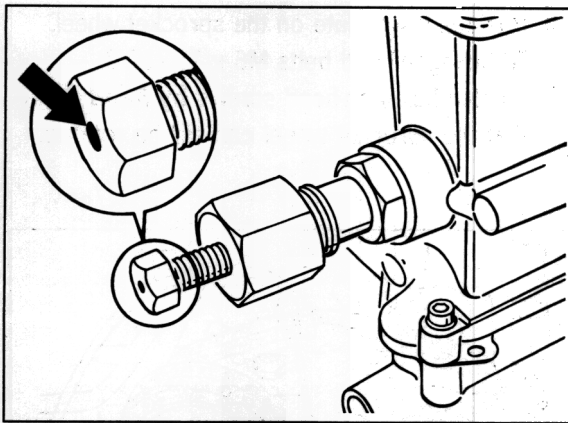
15. Fit auxiliary chain tensioner of special tool 9599 on cylinder head 1 - 3.

Fit auxiliary chain tensioner without sealing ring and fasten on the cylinder head **only hand-tight**. Adjust pre-tension 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

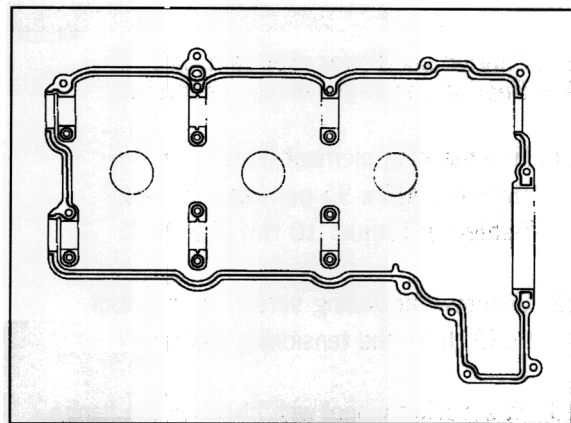


449\_97

16. Remove holding-down device, special tool 9611.

7. 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 a silicone bead to the cylinder head cover. Refer to: Sealing cover for camshaft housing (cylinder head cover), Serv. No. 15 91 51.

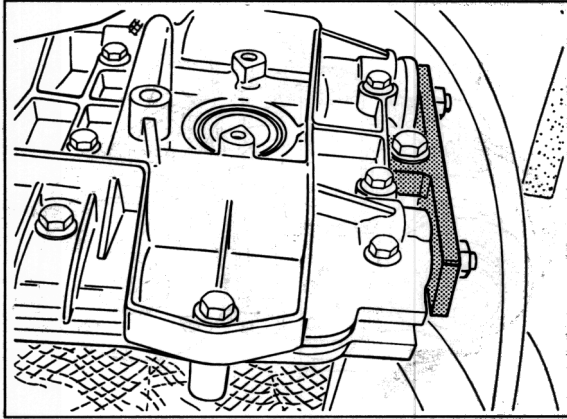


430\_1\_96

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

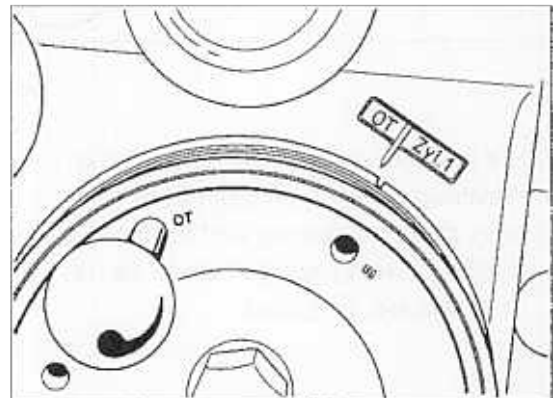
#### Note

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

#### Installing camshafts of cylinder bank 4 - 6

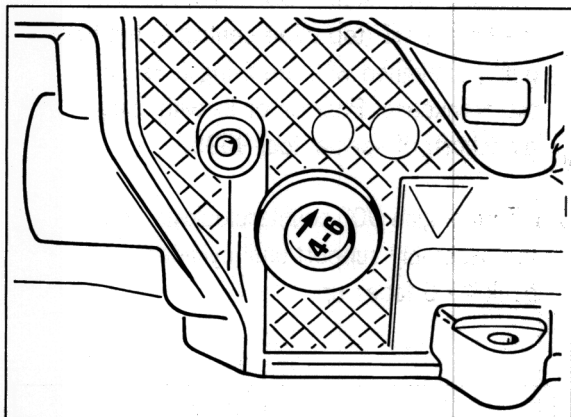
1. Turn engine to installation position on assembly support. Remove fixing pin. Advance crankshaft 360° clockwise until the bore 1 OT (top dead centre) in the belt pulley is aligned with the fixing bore on the crankcase. Position or fix with fixing pin (short) of special tool 9595.

- 1.1 Turn engine 90° counterclockwise on the assembly support until cylinder bank 4 - 6 faces up.



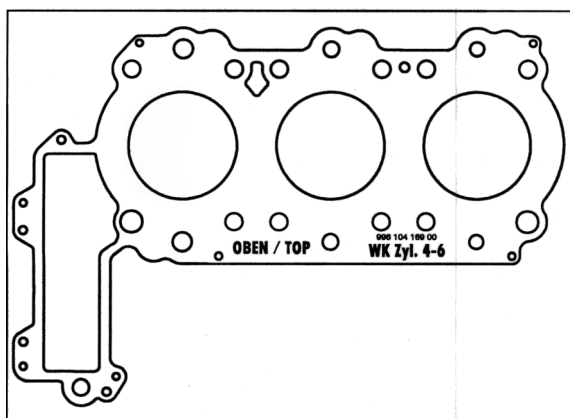
497\_96

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



568\_96

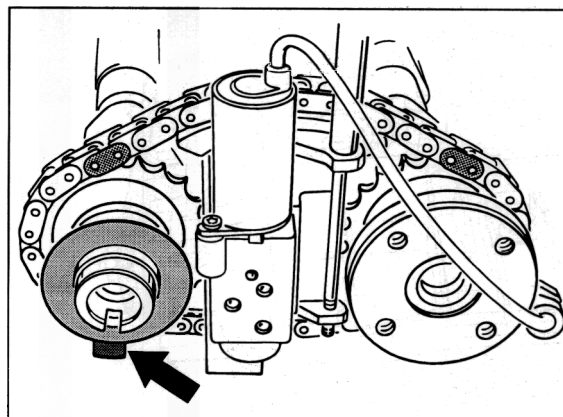
- 2.1 Fit cylinder head gasket. The gasket is identified by Zyl. 4 - 6 with OBEN/TOP, plus the corresponding part number. Ensure correct seating of dowel sleeves in crankcase. Fit gasket.



514\_97

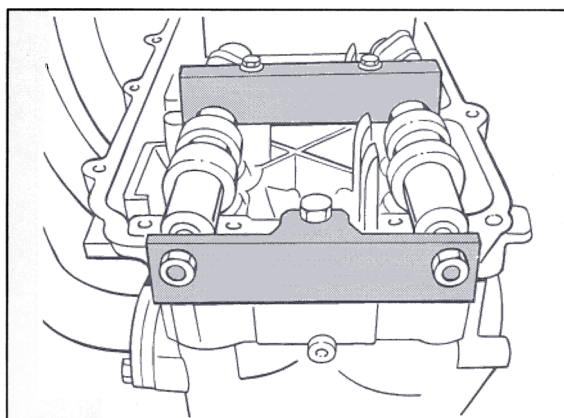
3. Fit guide housing for valve tappets.

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

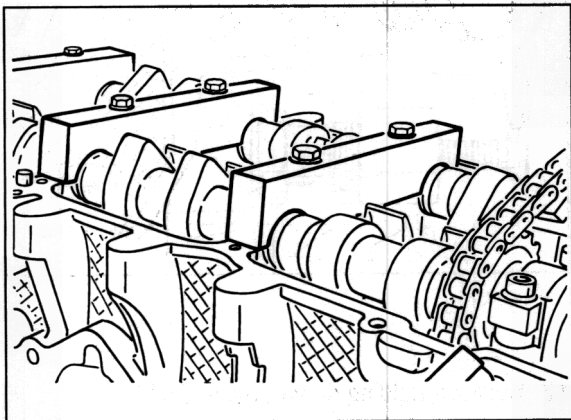
5. Align camshafts accordingly and fasten with holding-down device, special tool 9611, and holding-down device, special tool 9624.



752\_97

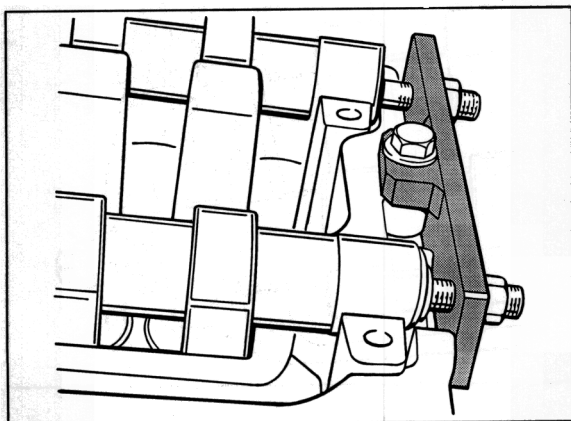


- 5.1 Fasten holding-down device 9611 with auxiliary screws M6 x 45.



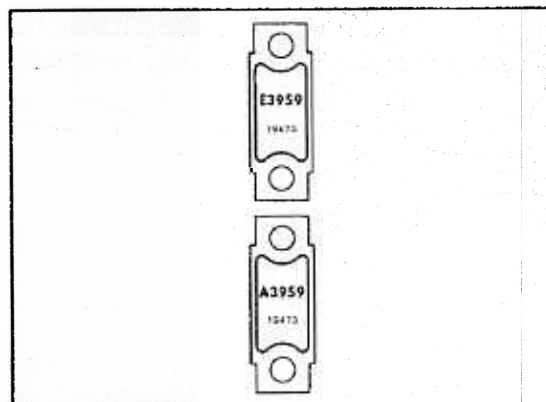
218\_97

- 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.

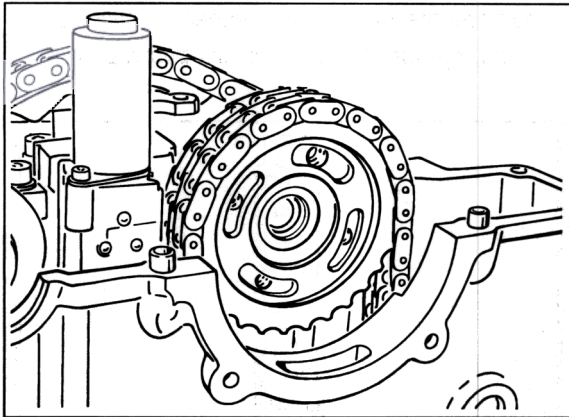


401\_1\_96

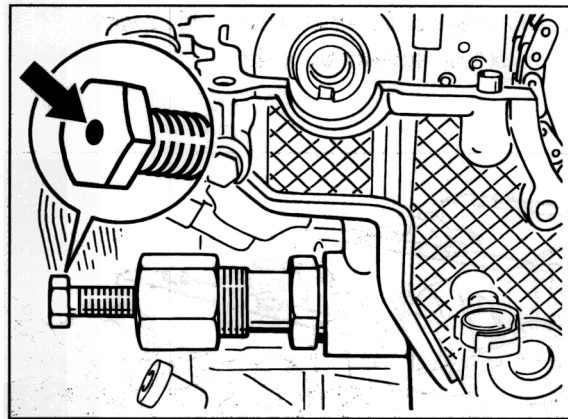
*E = Bearing saddle for inlet camshaft  
A = Bearing saddle for exhaust camshaft*

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.)



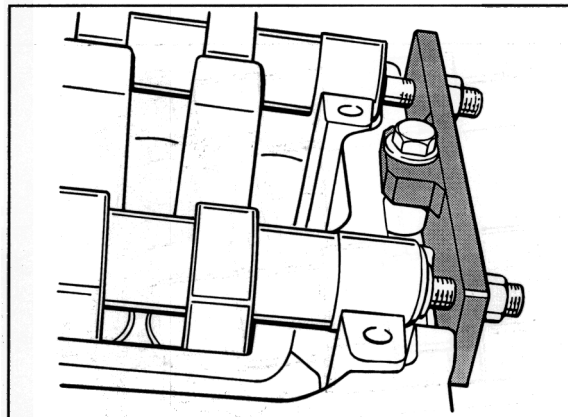
500\_96



513\_97

12. Remove holding-down device 961
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 pre-tension force with the hexagon-head bolt.
- 11.1 Slightly tighten hexagon-head bolts on the sprocket wheel to 10 Nm (7.5 ftlb.)



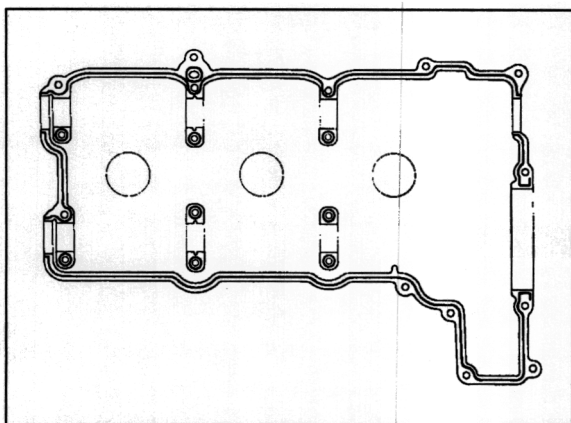
633\_97



14. Prepare cylinder head cover for installation:

Clean sealing surface of the cylinder head and cylinder head cover very carefully. Apply a silicone bead to the cylinder head cover.

Refer to: Sealing cover for camshaft housing (cylinder head cover), Serv. 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.

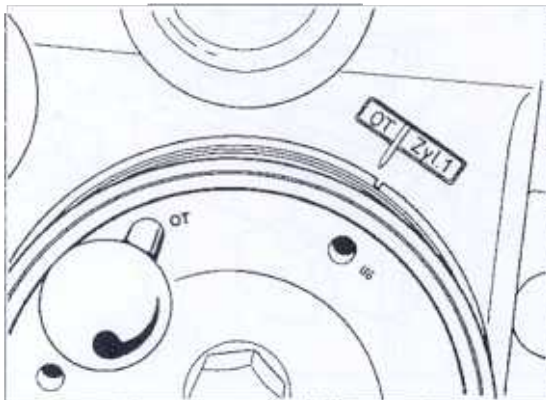
15. Remove holding-down device 9624 from the cylinder head.

## 15 05 15 Adjusting timing Cylinder bank 1 - 3

### Requirements

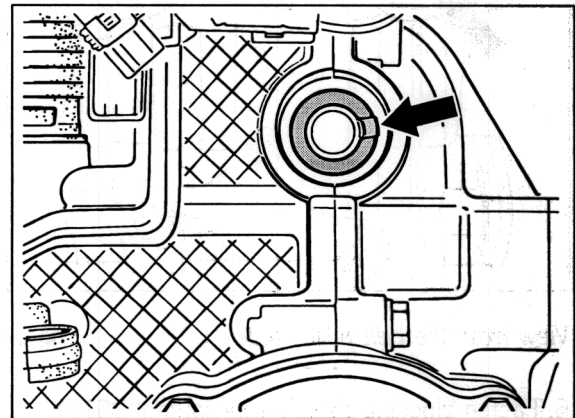
Three auxiliary chain tensioners fitted with correct pre-tension.

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 basic camshaft adjustment of **cylinder bank 1 - 3**  
Ensure that the groove in the camshaft faces **outward** toward the cylinder head cover.

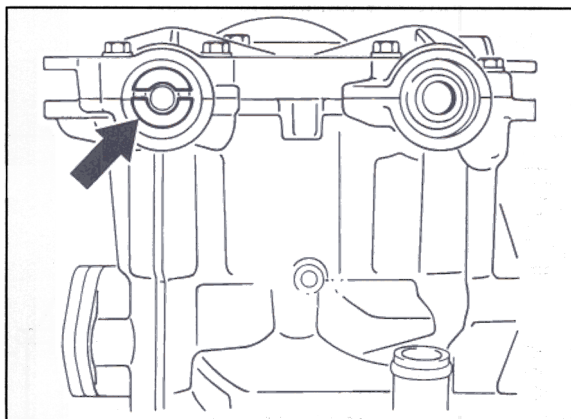


View from the flywheel side

625\_97

4. Turn engine 90° clockwise on the assembly support. Cylinder bank 1 - 3 faces upward.

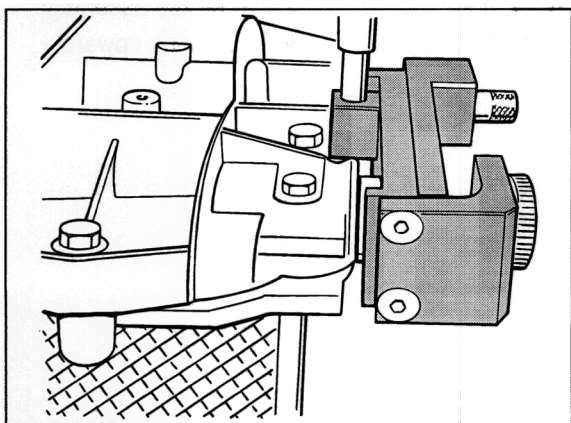
5. If the allocation is correct, the narrow segment must face the cylinder head cover on the opposite side of the cylinder head.



View from the belt pulley side

474\_97

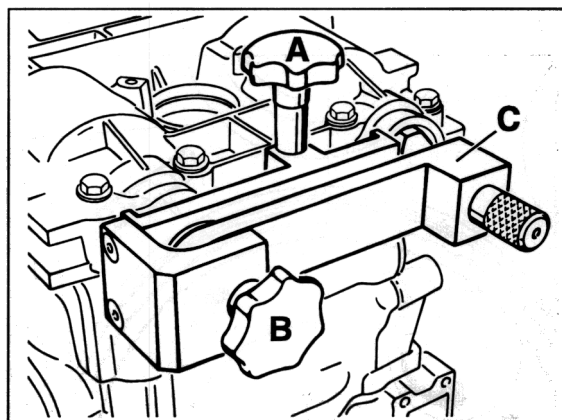
6. Fasten blocking device (special tool 9612) on the cylinder head.



718\_97

### 7. Special tool fitting sequence:

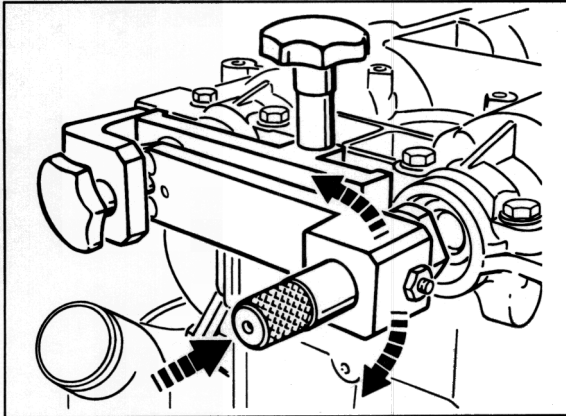
- A** – Fastening screw with star knob on cylinder head lug. Pull back centring piece (B) and sword bolt (C) when tightening.
- B** – Centring piece in groove of the exhaust camshaft. Pull sword bolt (C) back when tightening.
- C** – Sword bolt
- D** – Centre section (pivoting).



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.

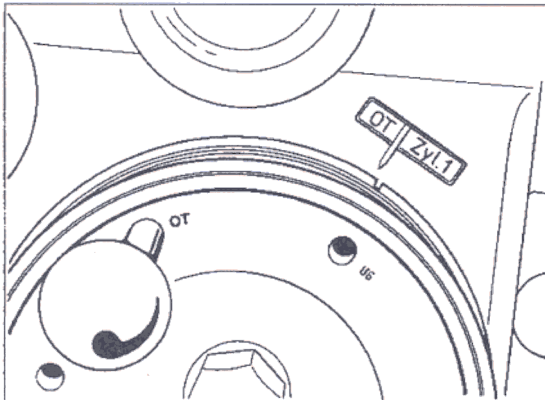


220\_97

10. Fasten sprocket wheel.  
Tightening torque 14 Nm (10.5 ftlb.)
11. Remove blocking device.

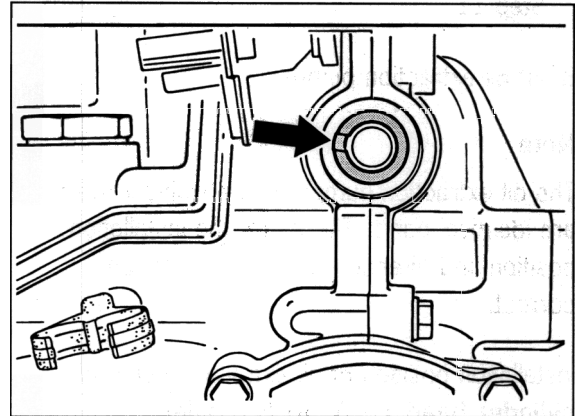
## 15 05 15 Adjusting timing Cylinder bank 4 - 6

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

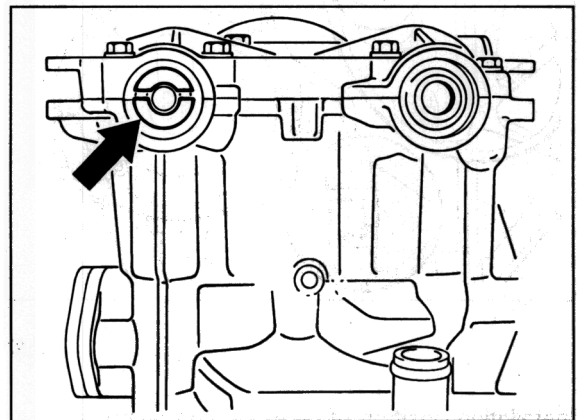
3. Check camshaft adjustment at **cylinder bank 4 - 6**:  
The groove in the camshaft must face inward toward the crankcase.



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

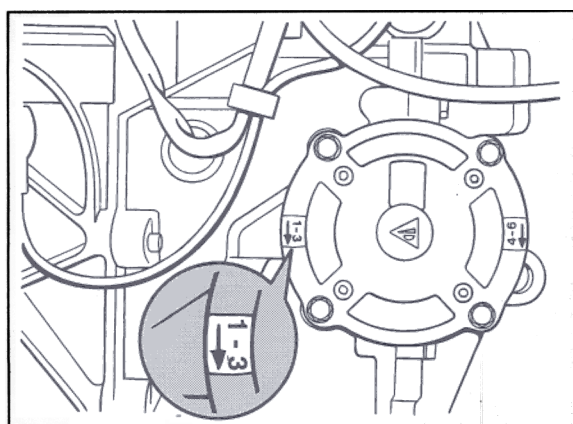
### Note

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.)



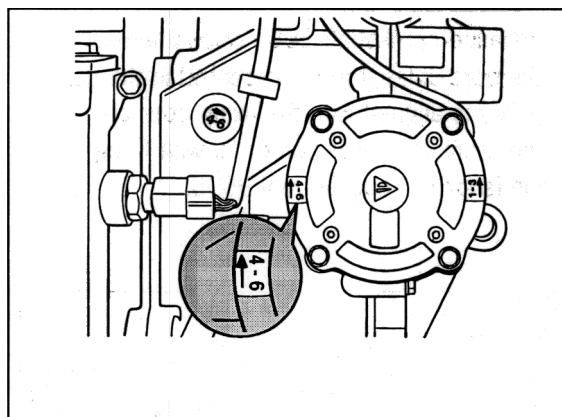
667\_97

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.

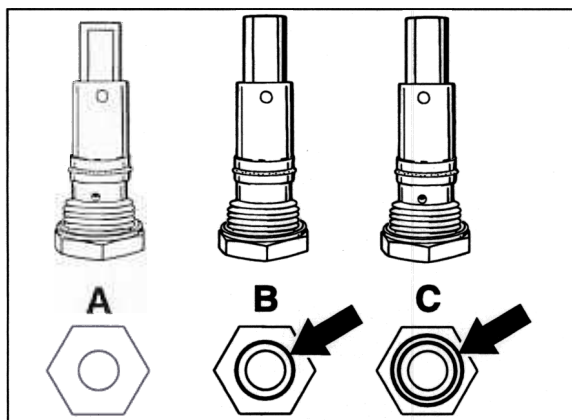
Tightening torque: 80 Nm (59 ftlb.)  
(Wrench size 30 mm.)

### Note

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



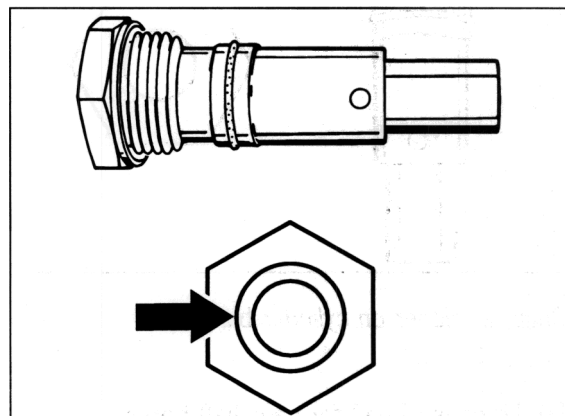
### Allocation of chain tensioners



502\_97

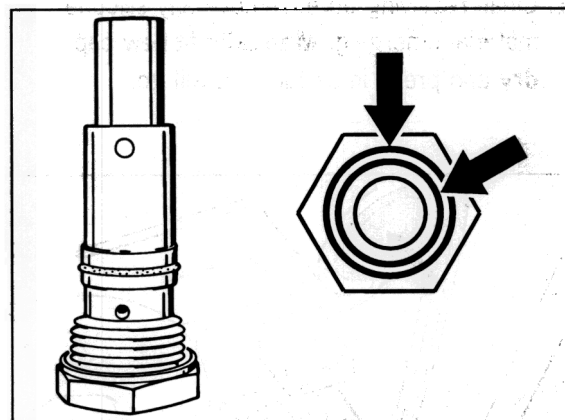
- A – Chain tensioner, **cylinder bank 4 - 6**  
Identification "Without"
- B – Chain tensioner **on crankcase**  
Identification "1 ring"
- C – Chain tensioner, **cylinder bank 1 - 3**  
Identification "2 rings"

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



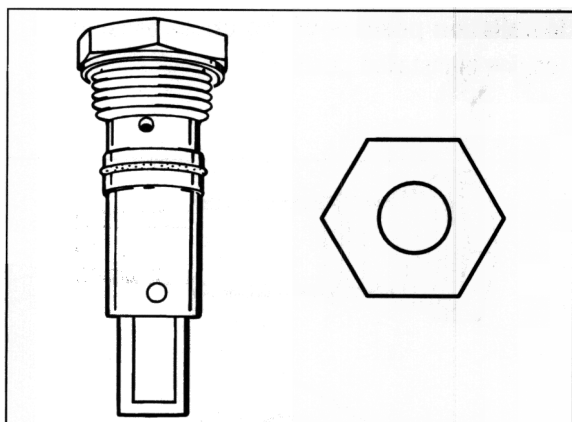
Chain tensioner on the crankcase

508\_97



Chain tensioner on cylinder bank 1 - 3

509\_97



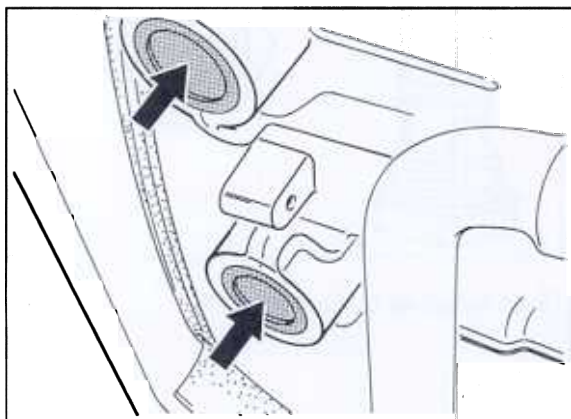
Chain tensioner on cylinder bank 4 - 6

507\_97

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

### Installation

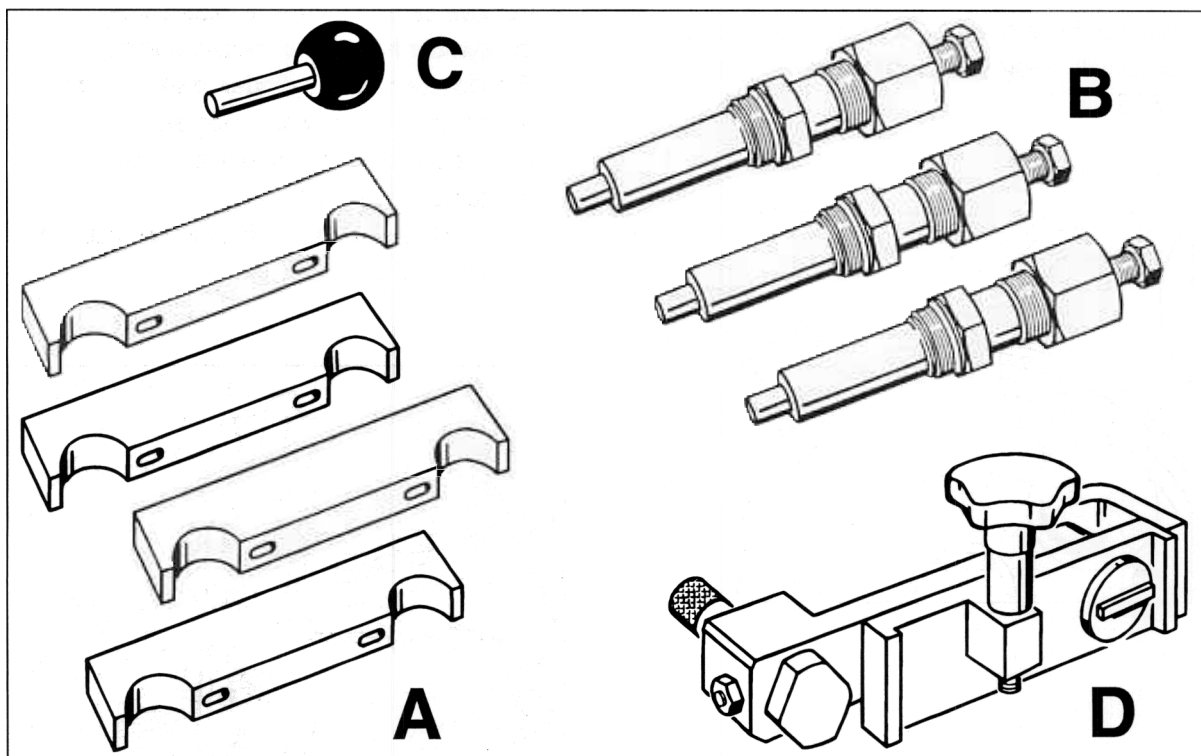
1. Clean receiving bore; remove any silicone material emerging. **Manually** fit new cap **dry** and press in as far as it will go.



685\_97

## 15 59 20 Removing and installing valve tappets — Engine removed

### Tools



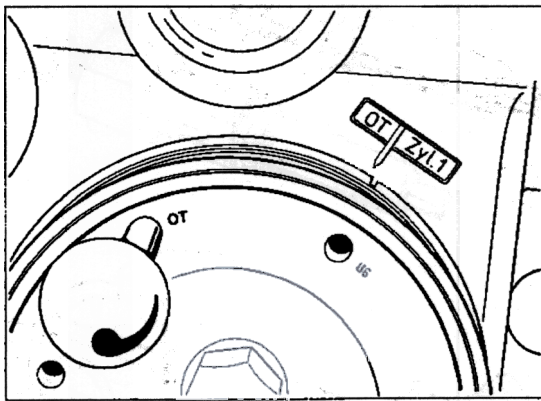
666\_97

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 belt pulley	9595	1 set = 2 ea. (use short fixing pin)
D	Locking device for camshafts in timing position	9612	

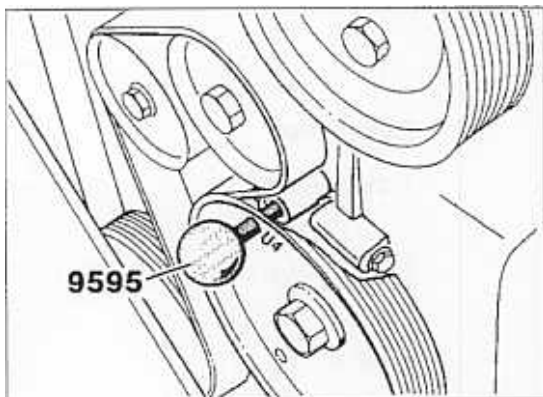
## Removing and installing valve tappets

### Move camshafts and crankshaft to basic position

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



497\_96

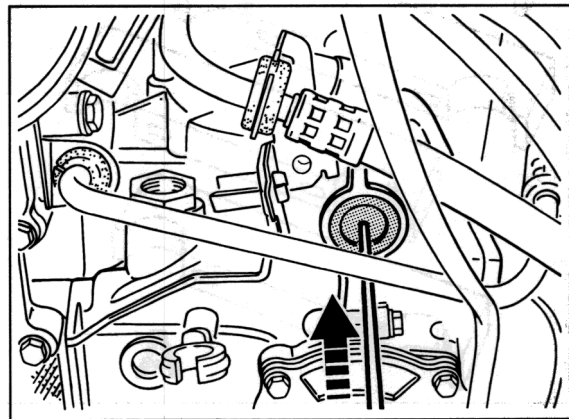


151\_96

### Note

The basic camshaft setting 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. Driveawl into **centre** of the closure cap and lever off the cap.



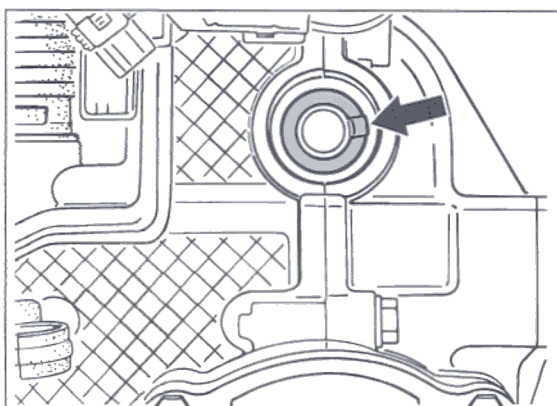
*Drawing shows closure cap of cylinder bank 4 - 6 (pulley side)*

602\_97

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.



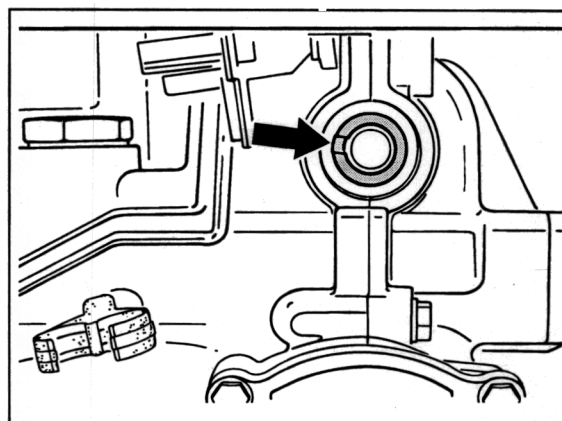
View from the flywheel side

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.



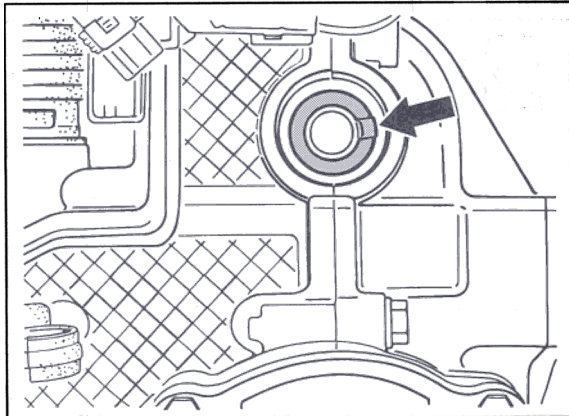
View from the belt pulley side

624\_97

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

## 15 59 22 Removing valve tappets of cylinder bank 1 – 3

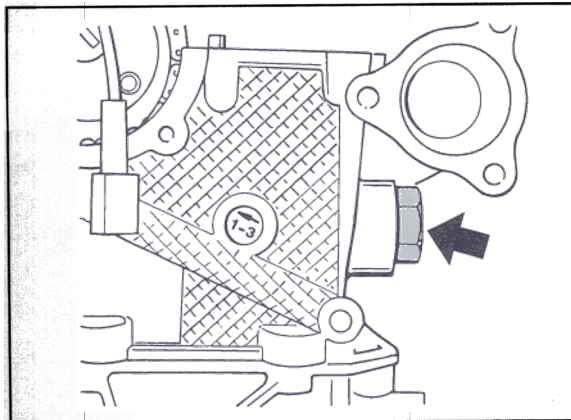
1. Move camshafts to basic position.  
The groove in the camshaft must face **outward** toward the cylinder head cover.



View from the flywheel side

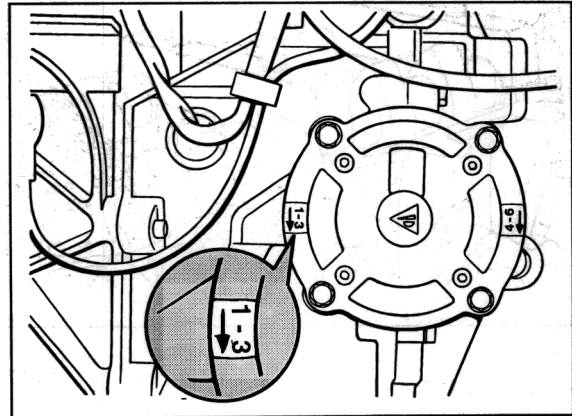
625\_97

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



665\_97

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

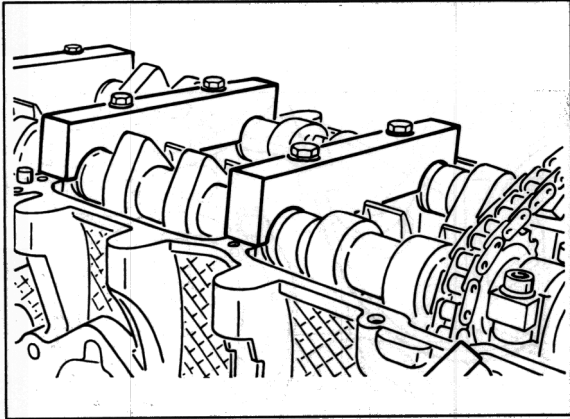


667\_97

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.

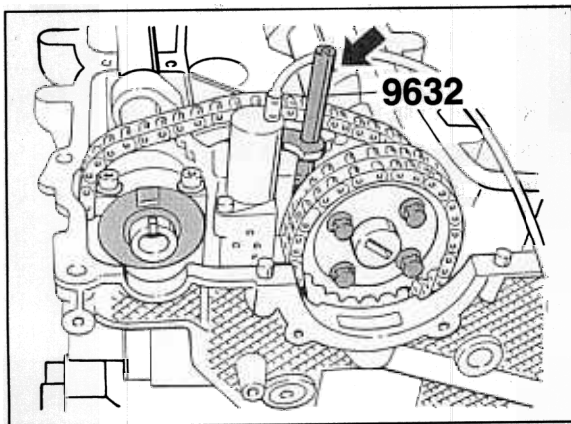


7. Fasten special tool 9611, holding-down device for camshafts, with auxiliary screws M6 x 45.



218\_97

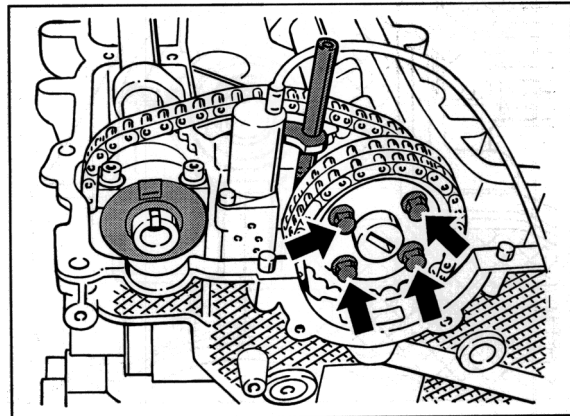
8. Relieve camshaft tensioning element with special tool, tensioning screw 9632.



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.



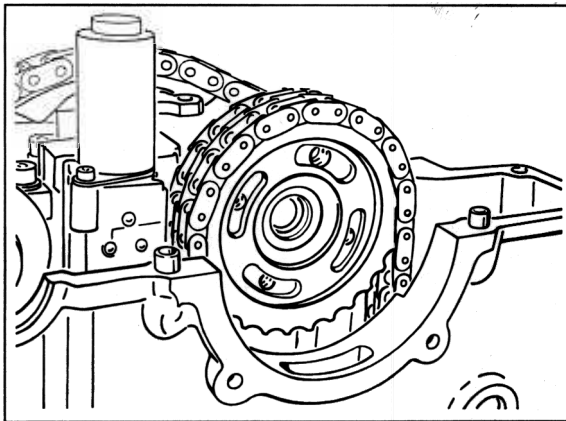
663\_97

### Note

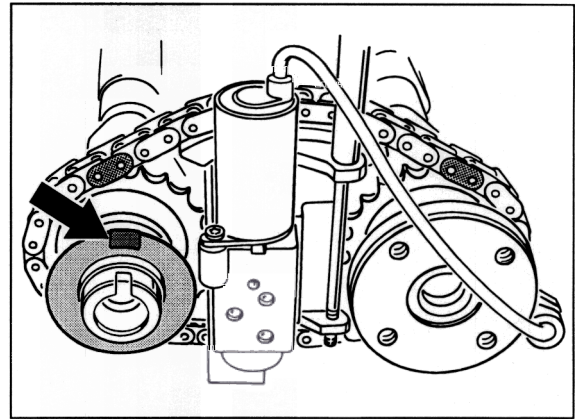
Screw tensioning screw in only until the chain is slightly relieved.



11. 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.



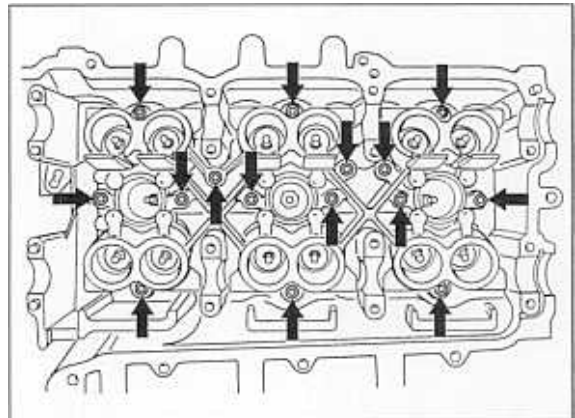
500\_96



246\_97

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

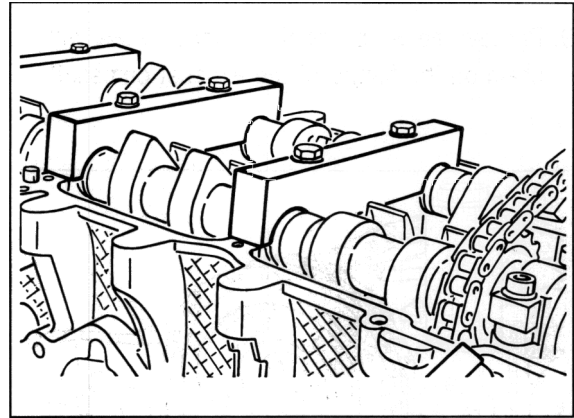
12. Detach two bearing saddles. Lever bearing saddles out of the guide sleeves.
13. Remove holding-down device (special tool 9611) from the camshafts.
14. Carefully lift the complete unit, camshafts with chain and tensioning element out of the cylinder head. The chain must not jump over.



659\_97

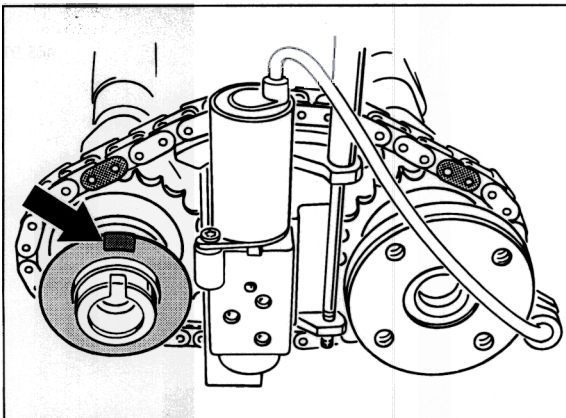
## 15 59 24 Installing valve tappets

1. Check guide for damage.  
Refer to: Checking guide for valve tappet, Serv. 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 in the cylinder head. The groove or 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, Serv. No 15 05 33.

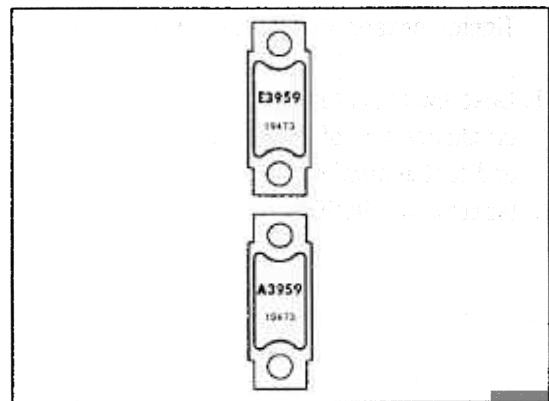


218\_97

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.)



246\_97



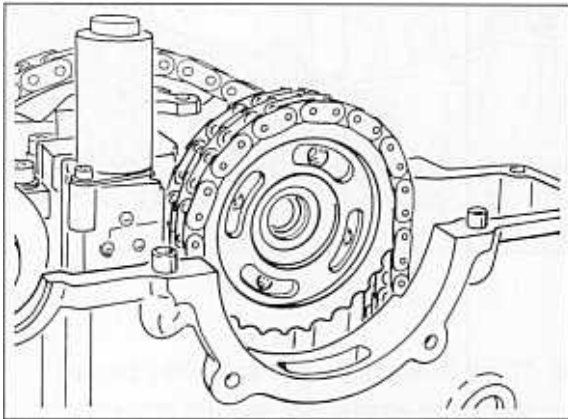
401\_1\_96

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

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

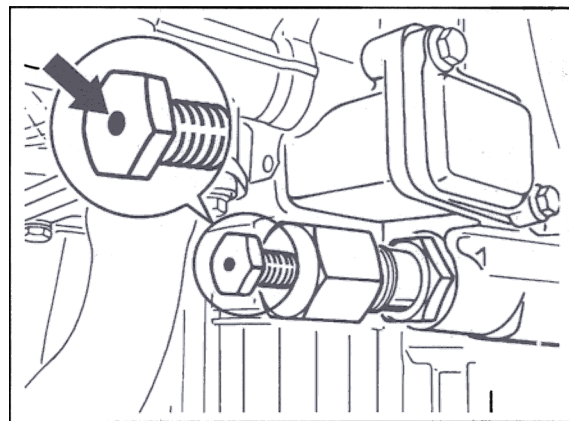


500\_96

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

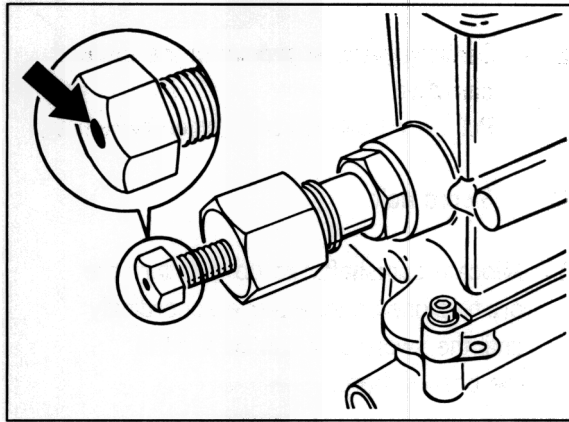
12. Fit auxiliary chain tensioner without sealing ring and fasten on the crankcase **only hand-tight**.

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 achieved when the measuring pin is **flush** with the face surface of the pressure screw. Turn the screw if necessary.



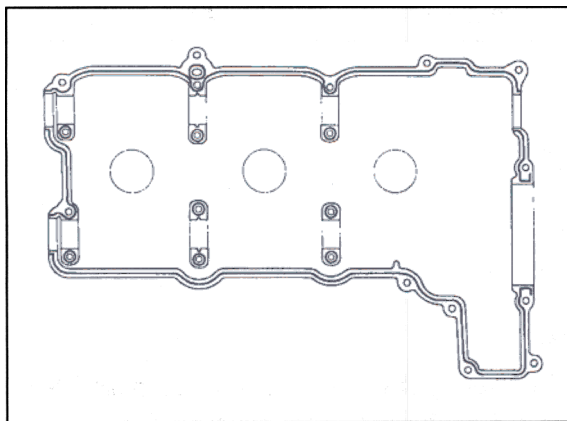
468\_97

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



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 a silicone bead to the cylinder head cover.  
Refer to: Sealing cover for camshaft housing (cylinder head cover), Serv. No. 15 91 51.

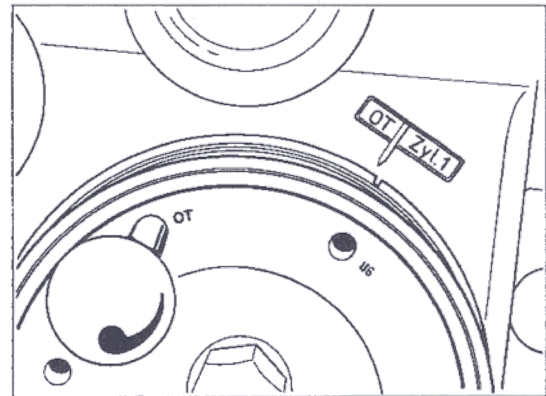


430\_1\_96

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.

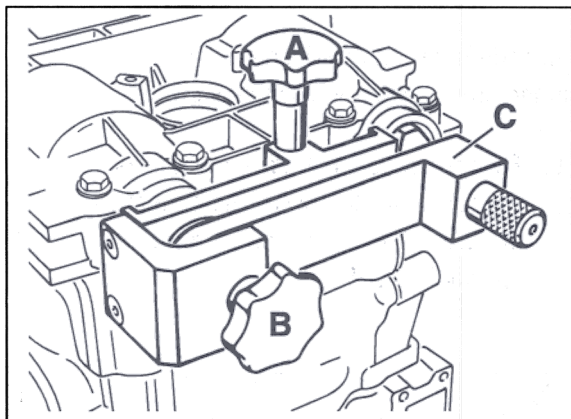
Immediately remove silicone material emerging in the area of the camshaft closure cap.

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.

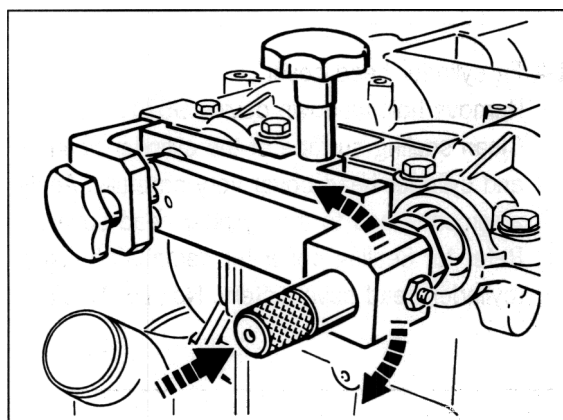


503\_96

Special tool fitting sequence:

- A – Fastening screw with star knob on 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.



220\_97

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

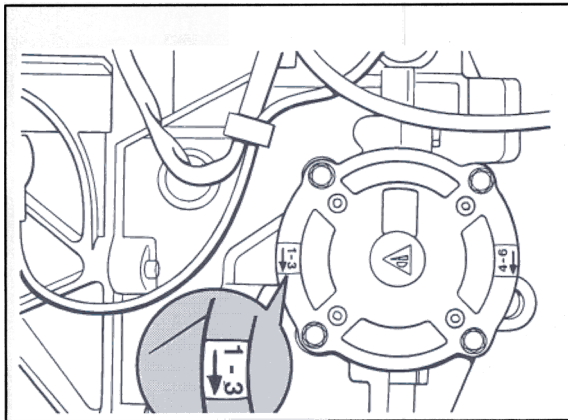
**Note**

The oil extraction pumps on the cylinder heads are identical parts. Therefore, the installation position 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

## 21. Fit camshaft closure cap dry.

## 22. Fit closure cap on tensioning element (VarioCam).

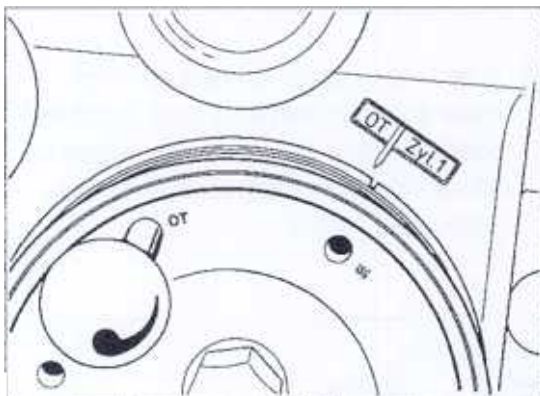
Tightening torque 10 Nm (7.5 ftlb.)



## 15 59 22 Removing valve tappets of cylinder bank 4 – 6

### 1. Remove fixing pin.

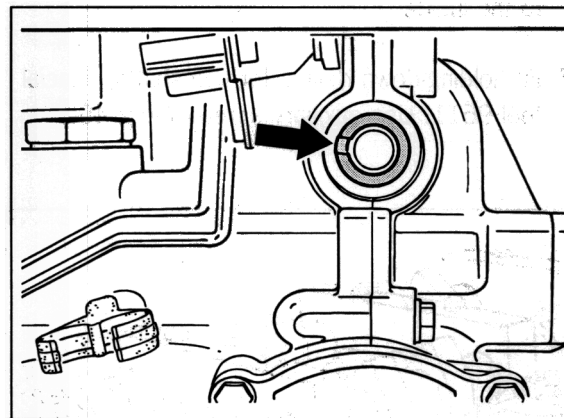
Turn crankshaft clockwise until the bore 1 OT (top dead centre) in the belt pulley is aligned with the fixing bore on the crankcase. Position or fix with fixing pin (short) of special tool 9595.



497\_96

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

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

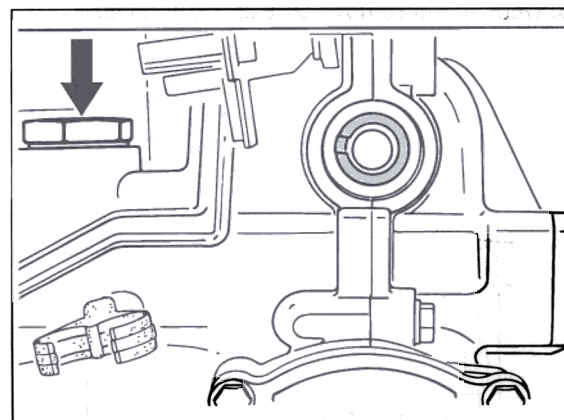


View from the belt pulley side

624\_97

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

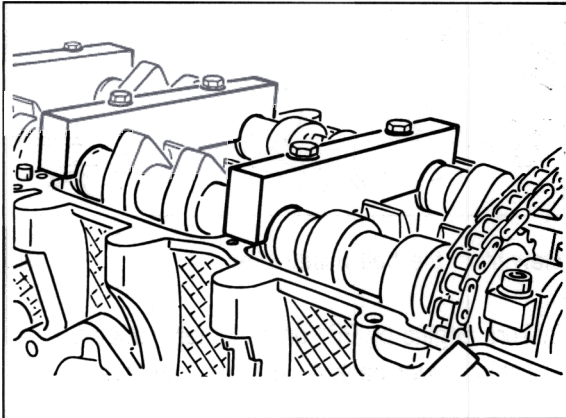
### 4. Unscrew chain tensioner of cylinder bank 4 - 6.



672\_97

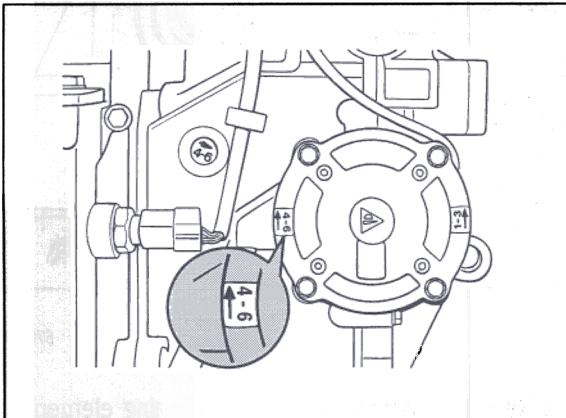
### 5. Remove closure cap from tensioning element (VarioCam). Hexagon-head bolts M6 x 20 (2 ea.).

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.



218\_97

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



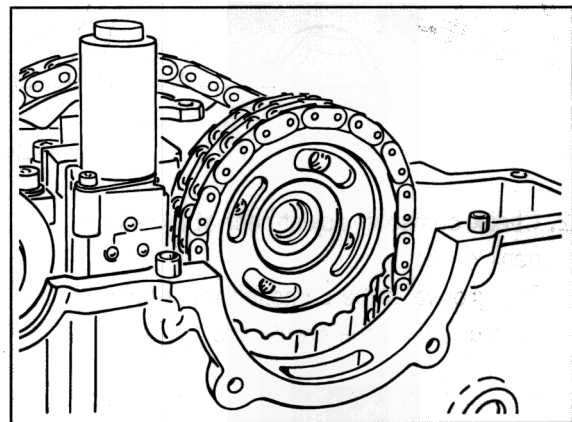
668\_97

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

### Note

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

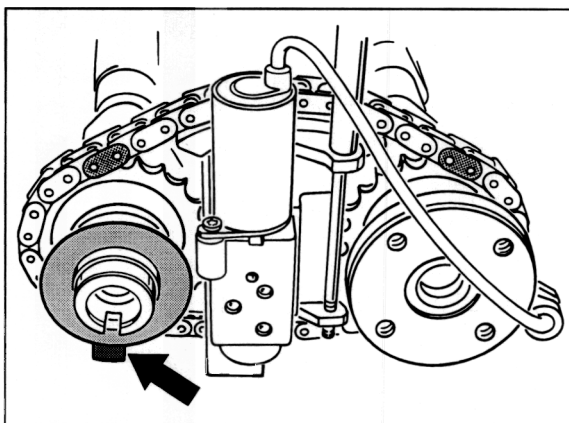
10. Unscrew three fastening screws (M6 x 95) for tensioning element.
11. Affix auxiliary chain tensioner (screw in by approx. 3 turns). Undo four hexagon-head bolts (M6 x 15) on the chain sprocket. Remove auxiliary chain tensioner again.
12. Remove drive plate. Connect sprocket wheel and chain with a 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, Serv. No. 15 05 33.

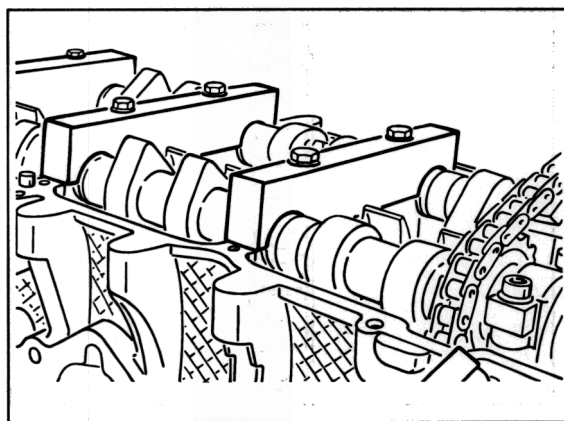


243\_97

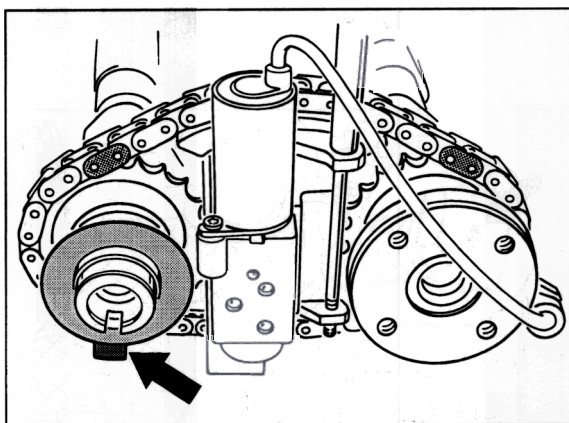
16. Lift out valve tappets with a magnet.
17. Detach guide for valve tappet. Undo the pan-head screws (15 ea.) from the outside to the inside, and remove the guide.

**15 59 24 Installing valve tappets**

1. Check guide for damage.  
Refer to: Checking guide for valve tappet, Serv. 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**.
5. Special tool 9611; fit holding-down device for camshafts. Fit auxiliary screws M6 x 45 with washers and tighten to 10 Nm (7.5 ftlb.).

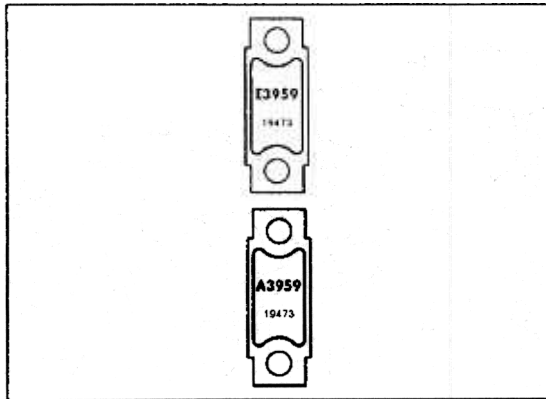


218\_97



243\_97

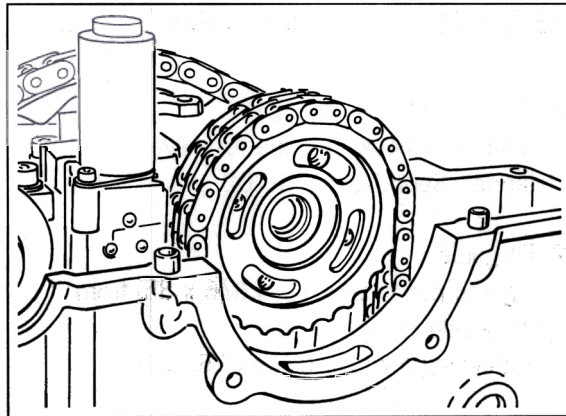
6. Check dowel sleeves (4 ea.) of the bearing saddles to ensure that they are properly seated in the cylinder head. Grease bearing surface, fit bearing saddles in **correct** position and tighten **evenly**. Tightening torque 10 Nm (7.5 ftlb.)



401\_1\_96

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

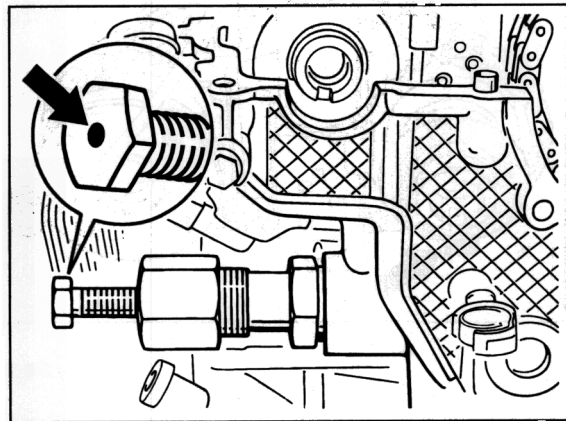
7. Fit tensioning element (VarioCam).  
Tighten 3 M6 x 95 pan-head screws.  
Tightening torque 10 Nm (7.5 ftlb.)
8. Unscrew tensioning screw, special tool 9632, from the tensioning element.
9. Remove tie wrap and fit sprocket wheel with chain on the flange of the exhaust camshaft.



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.



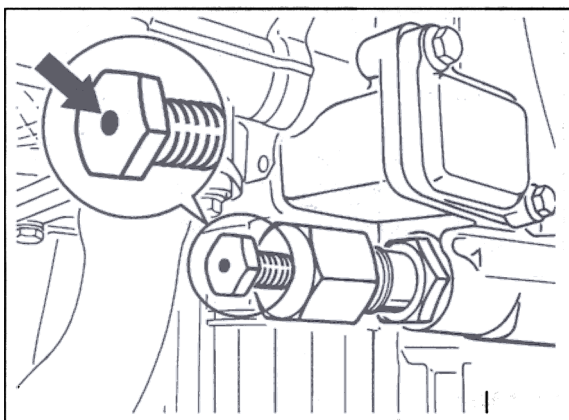
513\_97

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 achieved when the measuring pin is **flush** with the face surface of the pressure screw. Turn the screw if necessary.

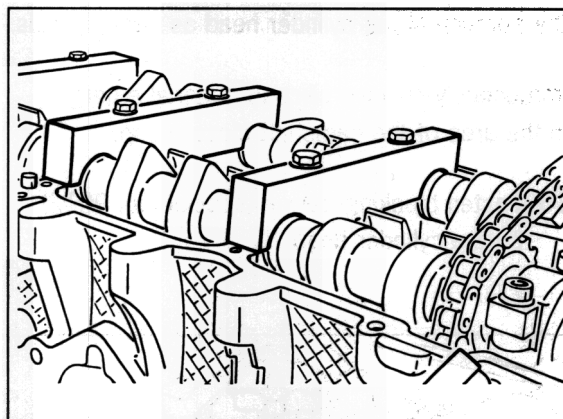
12. Check whether the auxiliary chain tensioners of cylinder bank 1 - 3 and the auxiliary chain tensioner are fitted on the crankcase half.



Chain tensioner on the crankcase

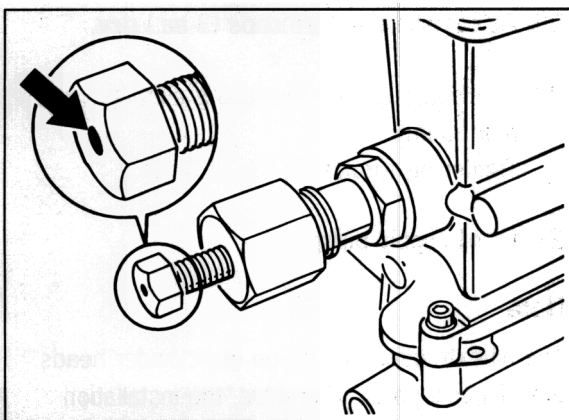
468\_97

13. Remove holding-down device 9611.



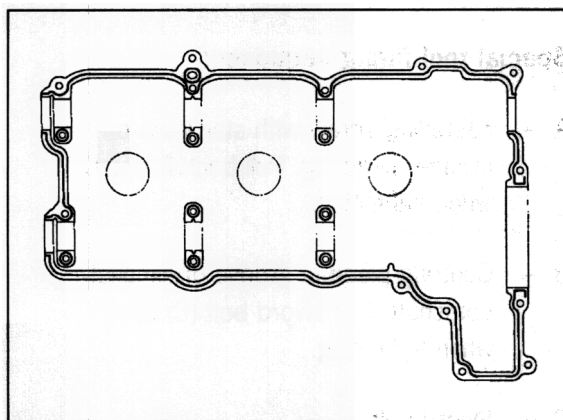
218\_97

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



Chain tensioner on cylinder head 1 - 3

449\_97



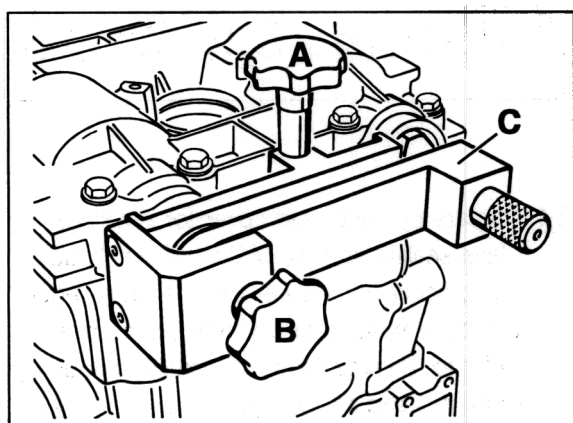
430\_1\_96



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.

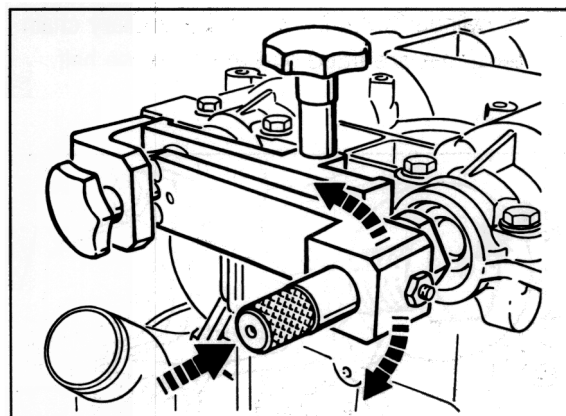


503\_96

#### Special tool fitting sequence:

- A – Fastening screw with star knob on cylinder head lug. Pull back B and C when tightening.
- B – Centring piece in groove of 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.



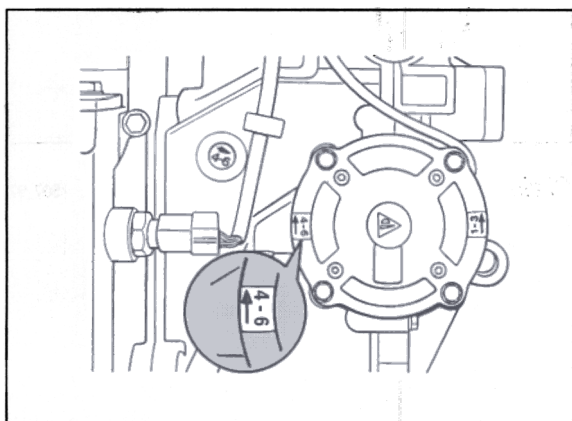
220\_97

- 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 and direction of rotation must be correct.

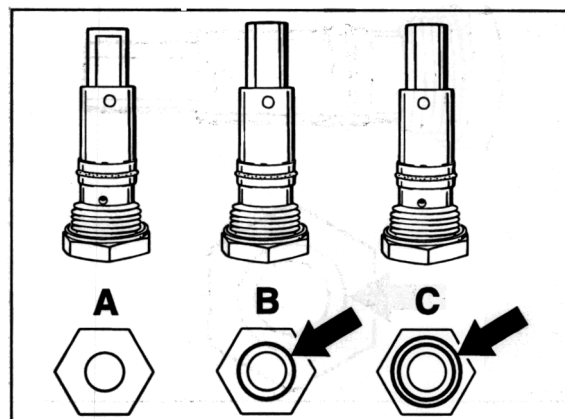
Installation position of oil extraction pump at **cylinder head 4 - 6** (belt pulley side).  
The arrow for the direction of rotation or the marking "4 - 6" must face the crankcase.  
Fit oil extraction pump. Use new sealing ring and new micro-encapsulated hexagon socket head screws.  
Tightening torque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



668\_97

22. Unscrew auxiliary chain tensioner, put new sealing ring on the original chain tensioner and install.  
Tightening torque 80 Nm (59 ftlb.)

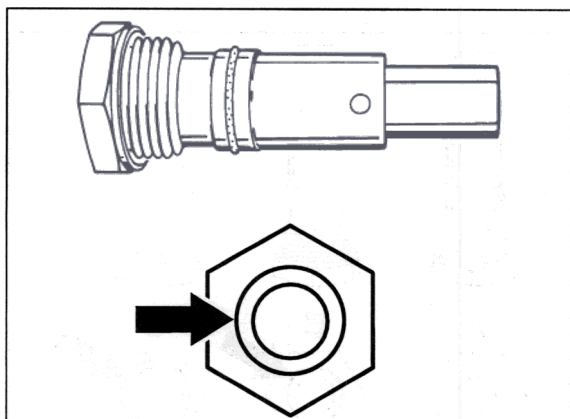
Allocation of chain tensioners



502\_97

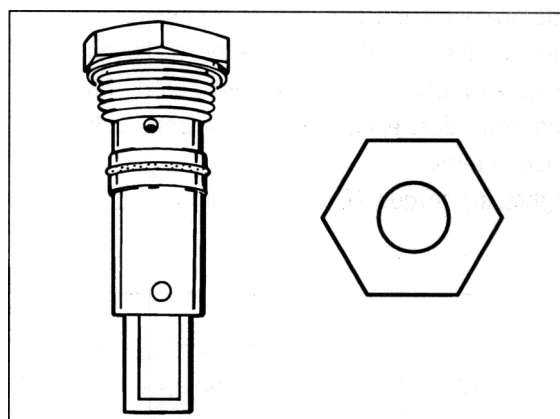
- A – Chain tensioner, **cylinder bank 4 - 6**  
Identification "Without"
- B – Chain tensioner **on crankcase**  
Identification "1 ring"
- C – Chain tensioner, **cylinder bank 1 - 3**  
Identification "2 rings"

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



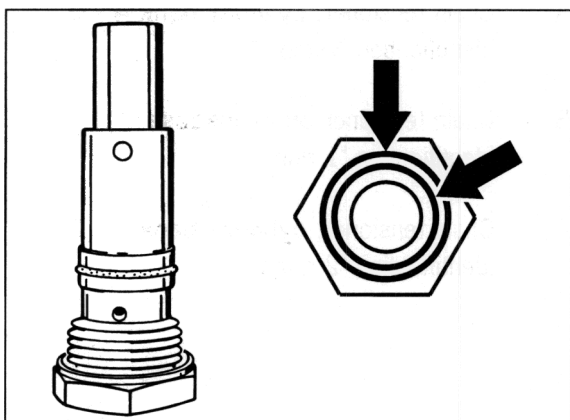
Chain tensioner on the crankcase

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

### Preassemble camshafts

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

### Camshaft allocation

#### Camshafts of cylinder bank 1 - 3

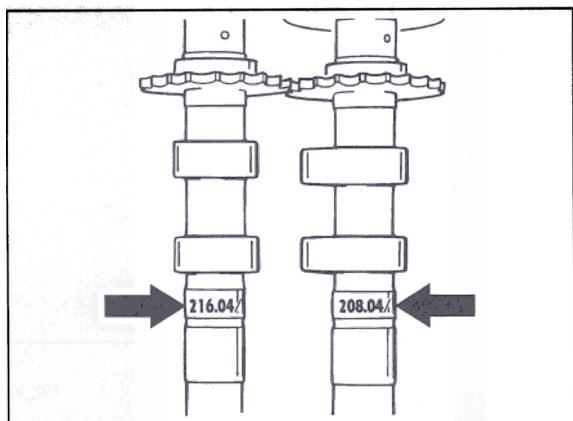
Identification on the camshaft

Inlet camshaft: 221.55/3.4 IN 13  
Exhaust camshaft: 222.55/3.4 EX 13

#### Camshafts of cylinder bank 4 - 6

Identification on the camshaft

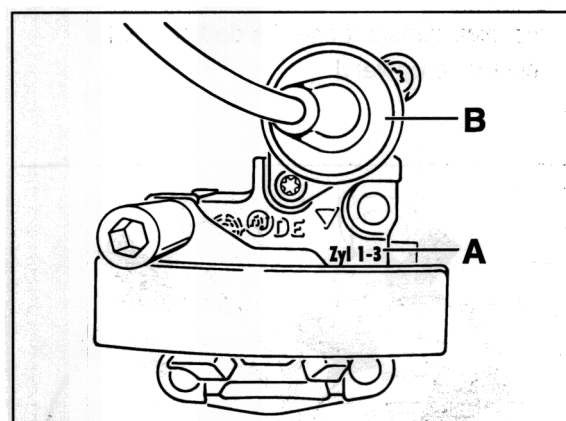
Inlet camshaft: 216.55/3.4 IN 46  
Exhaust camshaft: 218.55/3.4 EX 46



516\_97

### Allocating tensioning elements

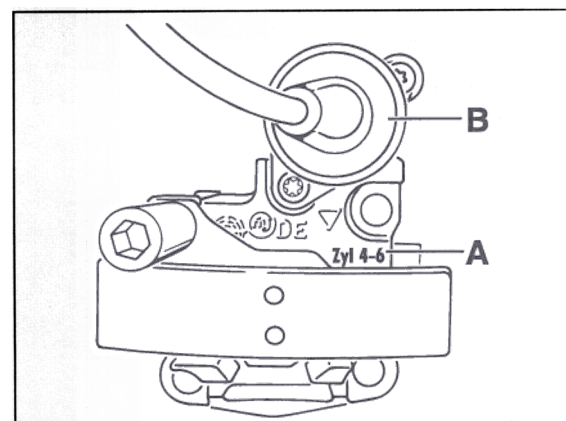
Identification for cylinder bank 1 - 3:



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

464\_97

Identification for cylinder bank 4 - 6:

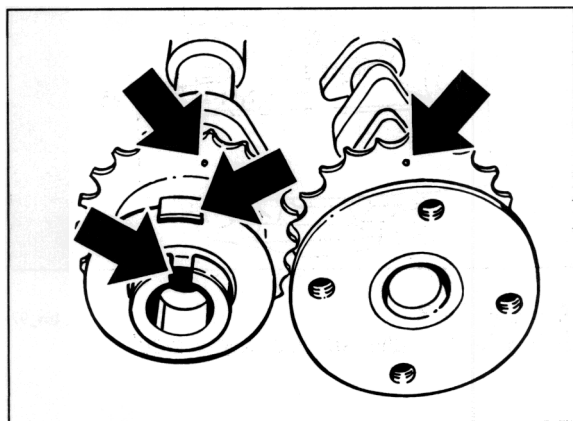


A = Cylinder bank 4 - 6  
B = Solenoid valve surface colour grey

465\_97

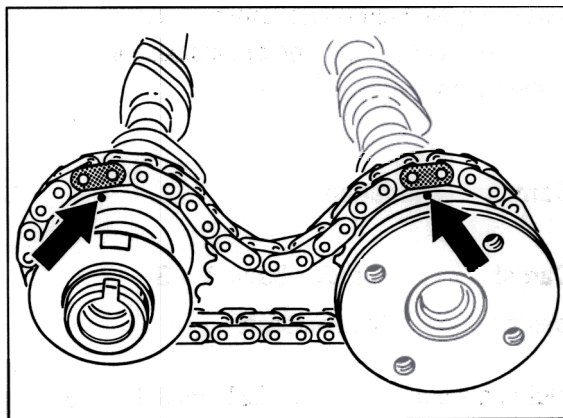
**Move camshafts, chain and tensioning element of cylinder bank 1 - 3 to basic position or installation position.**

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

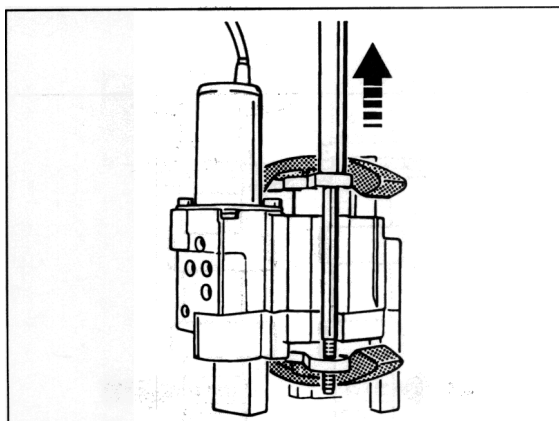
2. Place chain on the drive sprockets of the camshafts. The coloured outer lugs of the chain must face the dotting marks.



471\_97

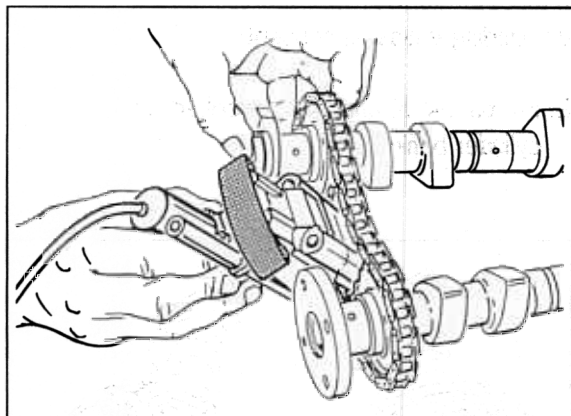
3. Fit tensioning element.

- 3.1 Press slide rails together and push upward.



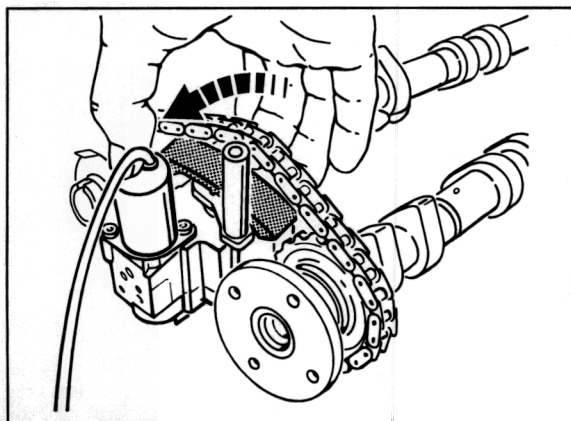
492\_97

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

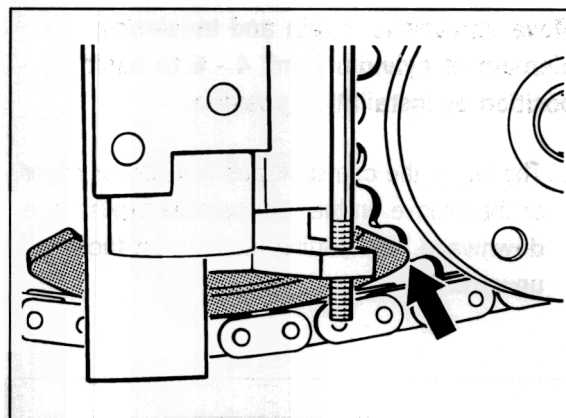


491\_97

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

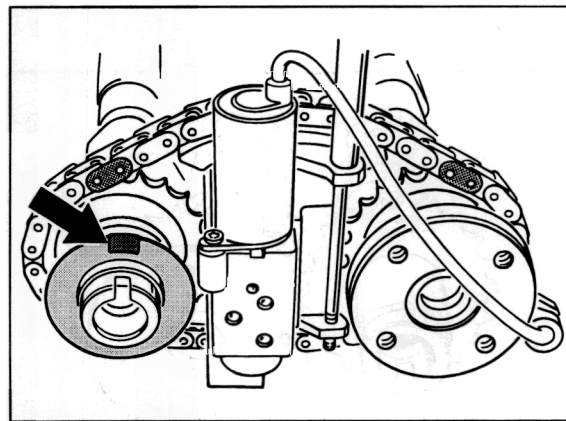


490\_97



635\_97

4. Completely 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 allocation is correct, the groove or lug of the camshaft position sensor housing face **upward**.



246\_97



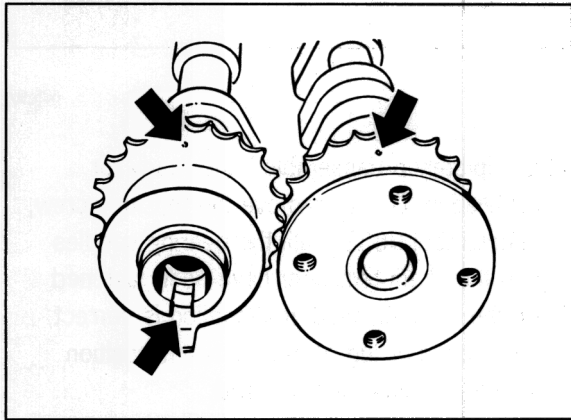
Move camshafts, chain and tensioning element of cylinder bank 4 - 6 to basic position or installation position.

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

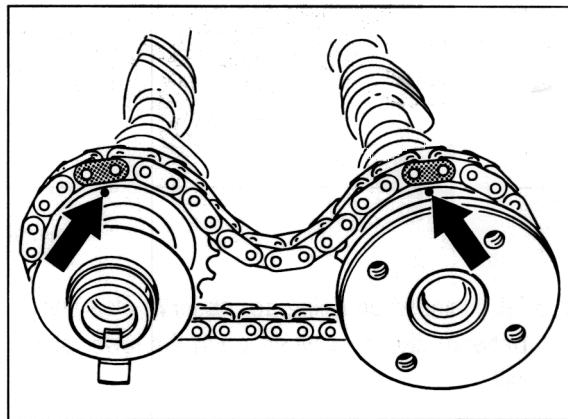
#### Note

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

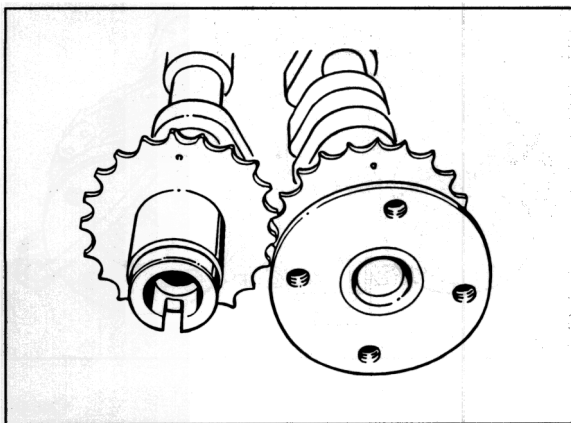
2. Put on and fit chain as described for cylinder bank 1 - 3.



649\_97

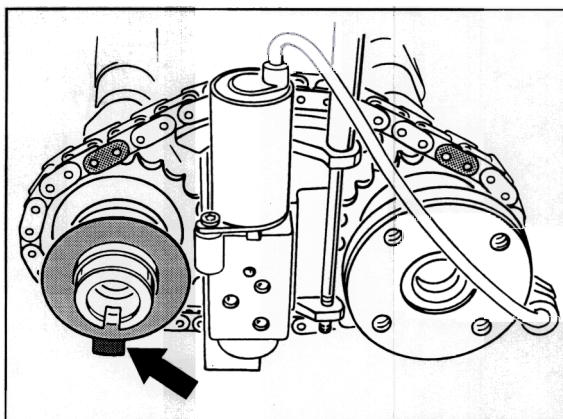


443\_97



650\_97

3. Completely assembled and ready for installation. Do not remove the tensioning screw, special tool 9632 (with right-hand thread) or 9632/1 (with left-hand thread) 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

#### Information:

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:

96/01 66X13484 for the C2

96/02 68X06737 for the C4

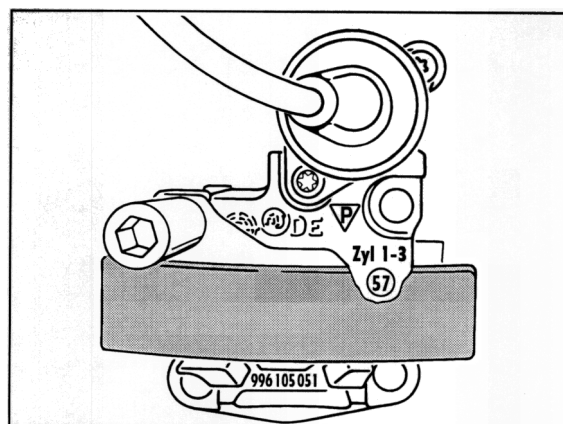
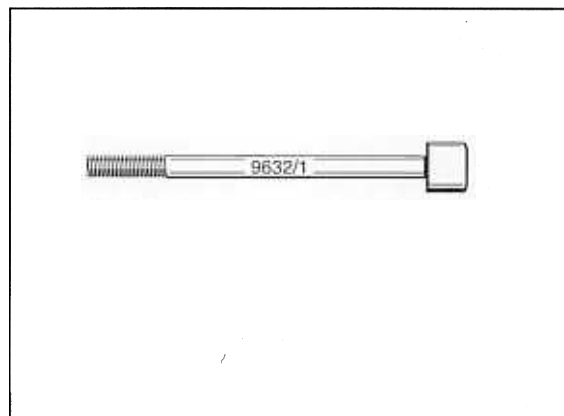


Illustration shows tensioning element of cylinder bank 1 - 3

345\_99

Relieve using new special tool 9632/1 (with left-hand thread)



317\_99

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

Sealing the sealing surface of the cylinder head cover

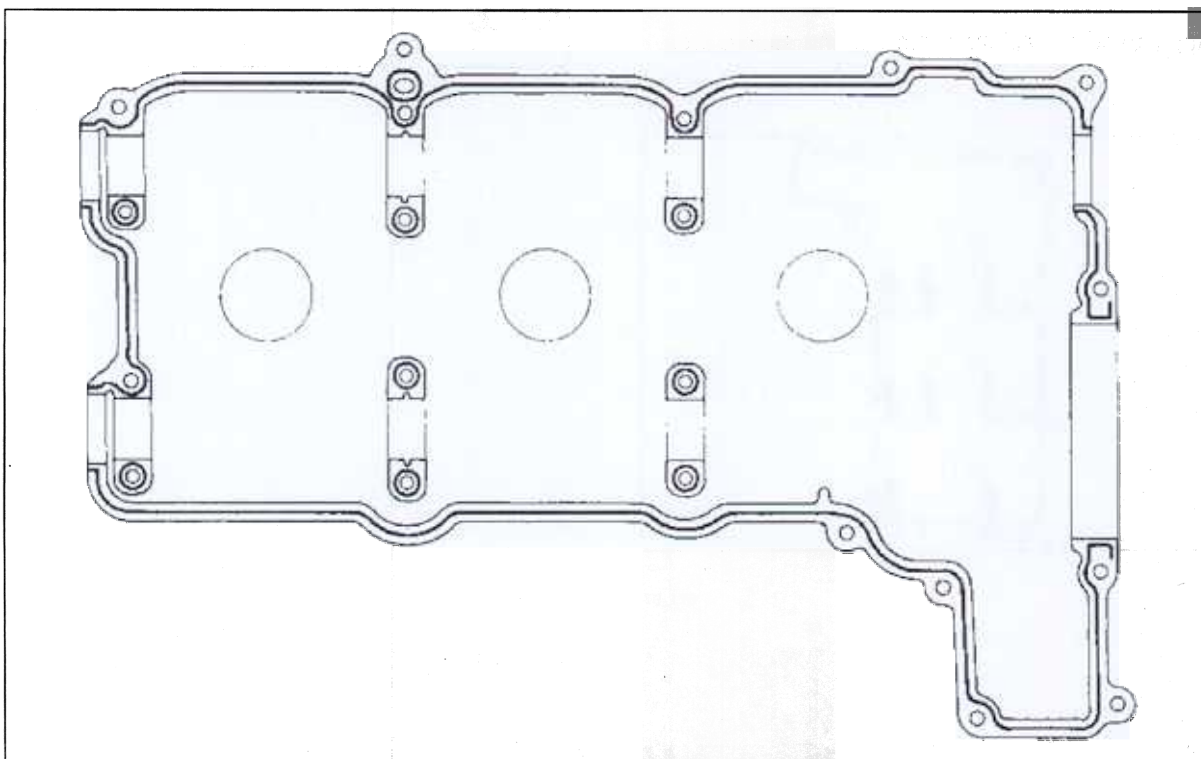
Use only the sealant **Drei Bond silicone – Type 1209** and **Loctite 5900** – to seal the sealing surface on the cylinder head cover.

**Note**

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

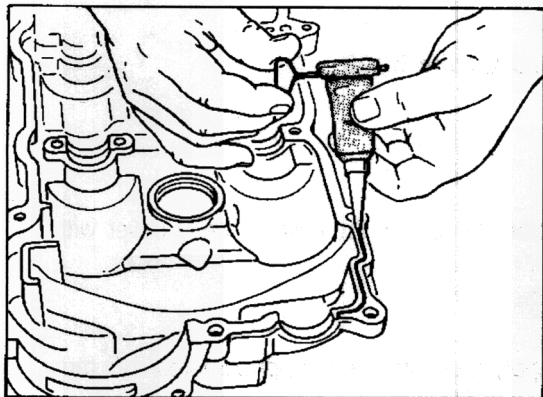
**Application of silicone bead**

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.



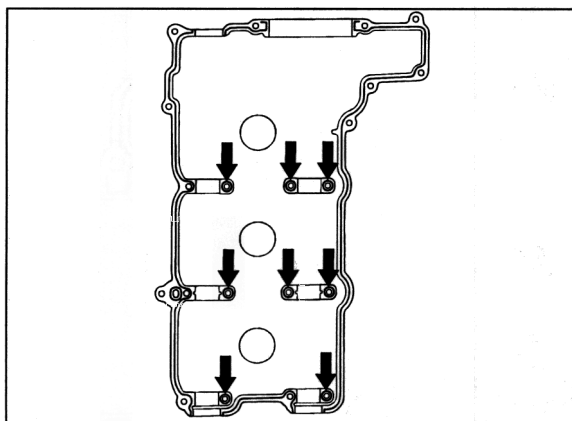
430\_1\_96

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



151\_96

Apply bead of sealant in the bearing saddle area.

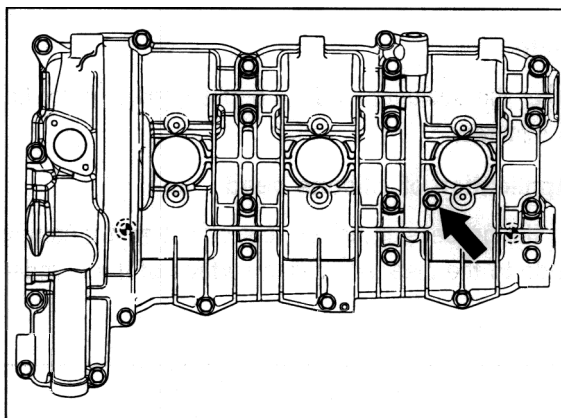


671\_97

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)

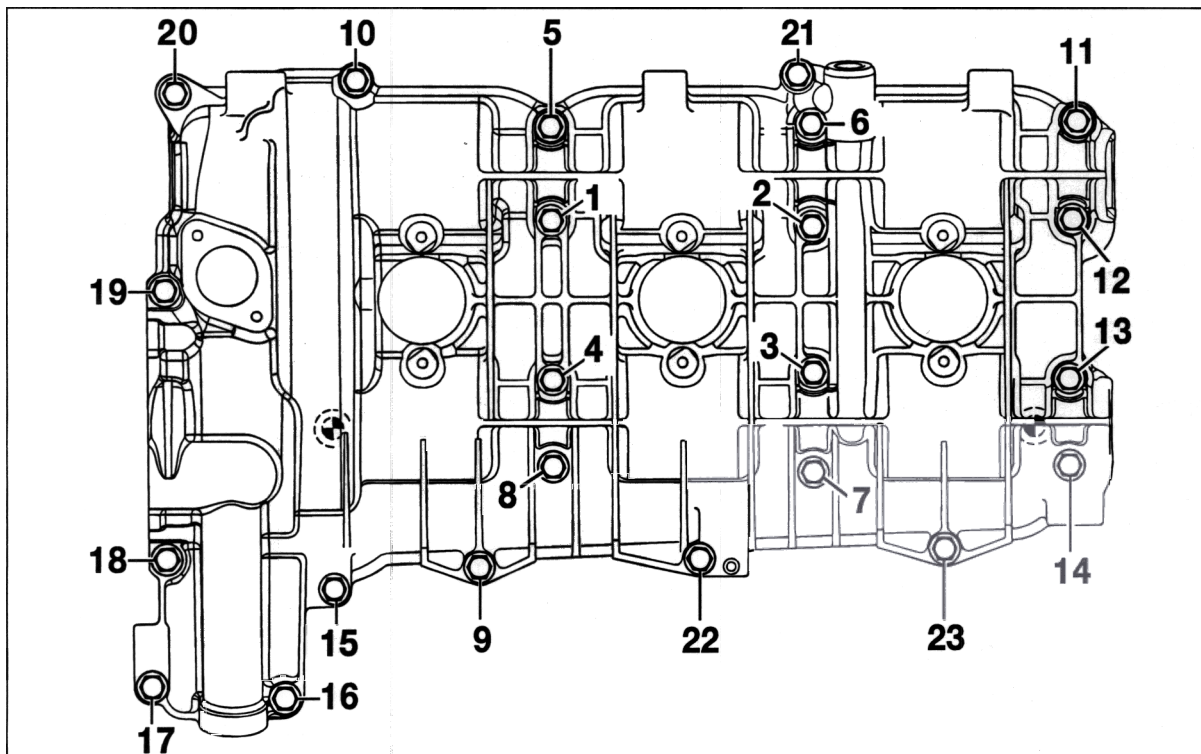


664\_97

## Fastening cover for camshaft housing (cylinder head cover)

Tightening torque 13 Nm (10.0 ftlb.)

Tightening sequence



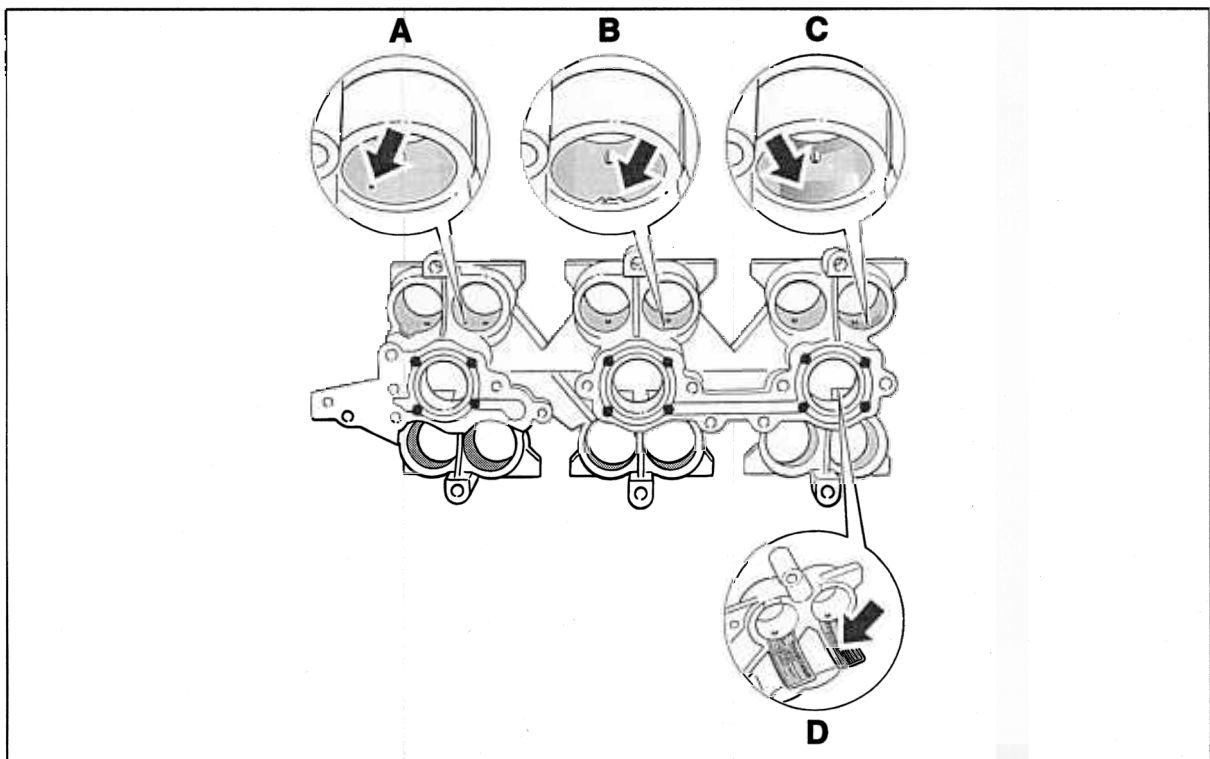
396\_97

**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 photo.

**Limit sample photo**

The irregularities shown in the limit sample photo are normal and must not be classified as damage influencing the function of the part or requiring replacement of the part.



644\_97

**Permissible irregularities:**

A = Voids up to max. 1 mm<sup>2</sup>

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

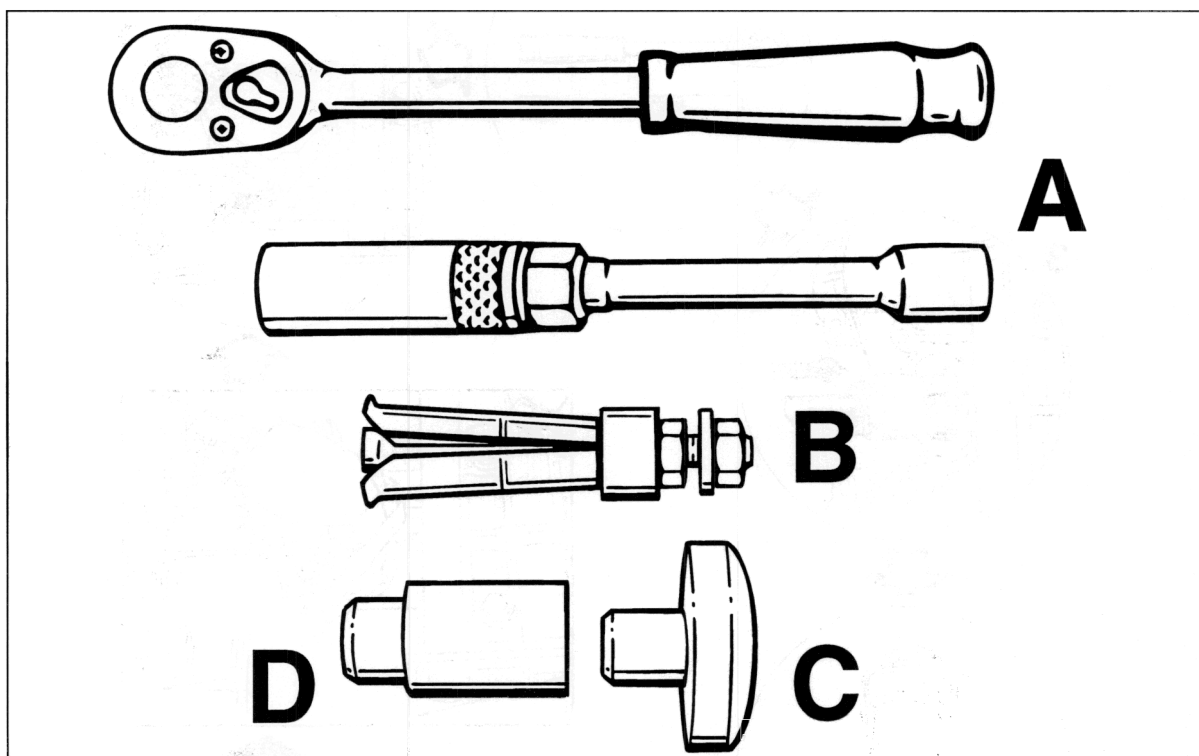
C = Irregular contact patterns in the running surfaces of the valve tappet guide

D = Grooves in the oil pockets



## 15 46 19 Removing and installing oil protection tubes – Engine installed

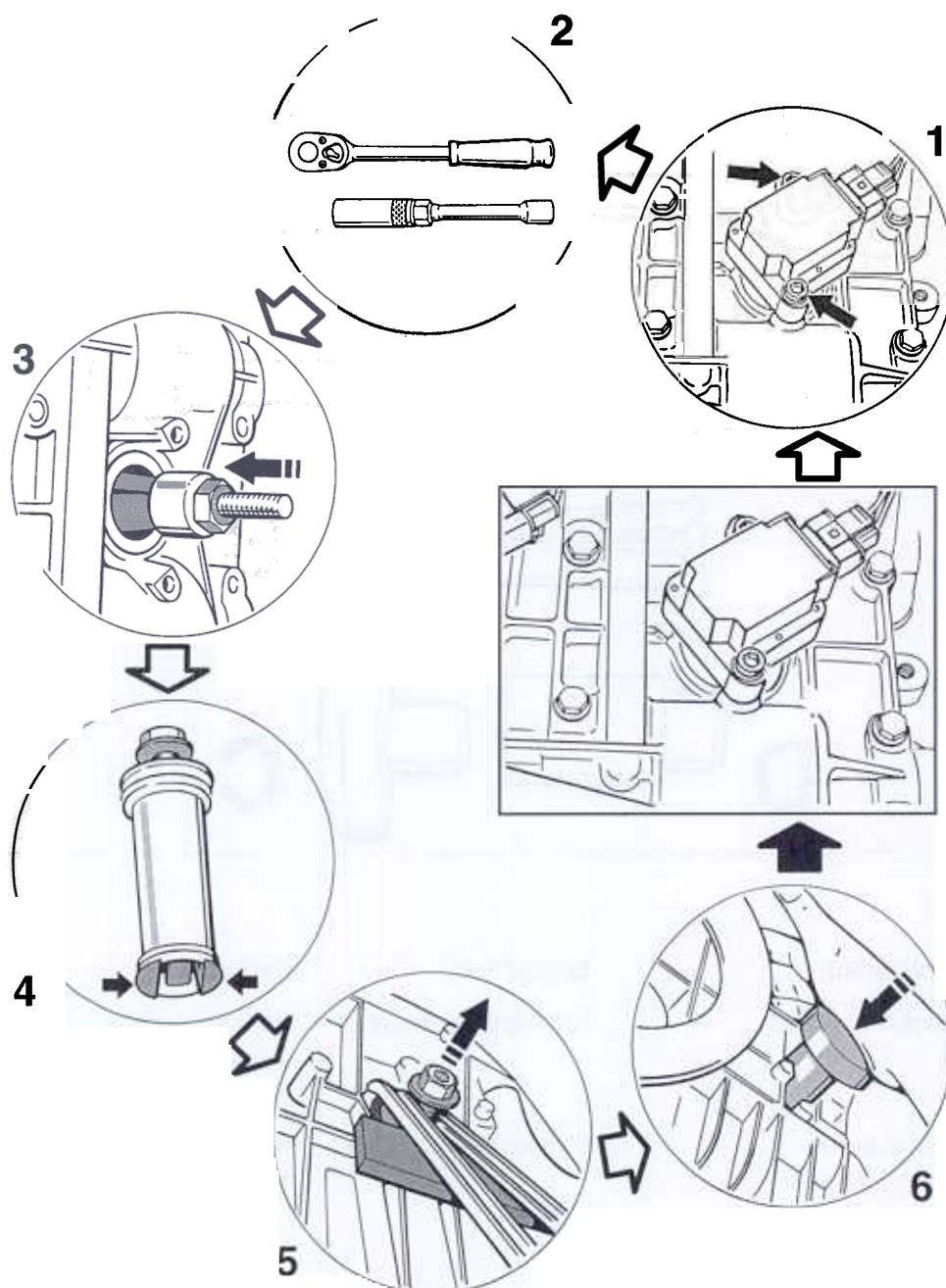
### Tools



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 ø	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 tubes – Engine installed



632\_97

**Removal****Note**

For disassembly "**Removing oil protection tube**", the cylinder head cover in the vicinity of the oil protection tube must be heated up. 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
1	Remove 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	Remove spark plugs	Unscrew spark plugs using commercially available socket wrench insert; refer to Workshop Equipment Manual, Chapter 2.4, Nos. 14 and 15.
<b>Note</b> 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.		
3 + 4	Fit 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	Pull 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	Fit oil protection tube	Fit new sealing rings and coat with tyre mounting paste. Using the pressure piece (special tool 96051/1) and hand pressure piece (special tool 9604), <b>manually</b> press in the oil protection tube as far as it will go.
	Fit spark plug	Fit spark plug with the prescribed spark-plug wrench. Tightening torque $25 \pm 5$ Nm ( $19 \pm 3.5$ ftlb.)
	Fit ignition coil	Tightening torque 10 Nm (7.5 ftlb.)

## 15 46 19 Removing and installing oil protection tubes – Engine removed

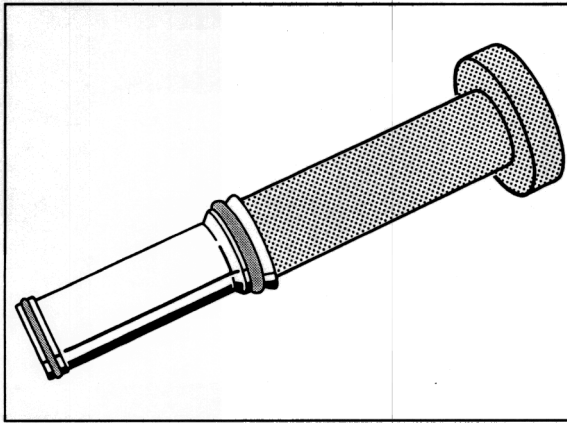
### Removal

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

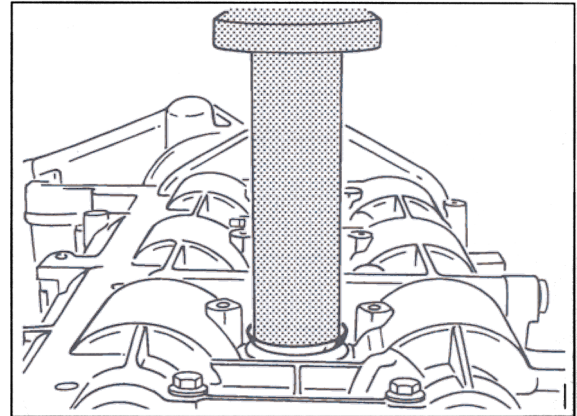
2. **Manually** press the oil protection tube as far as it will go into the fitted cylinder head cover.

### 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.



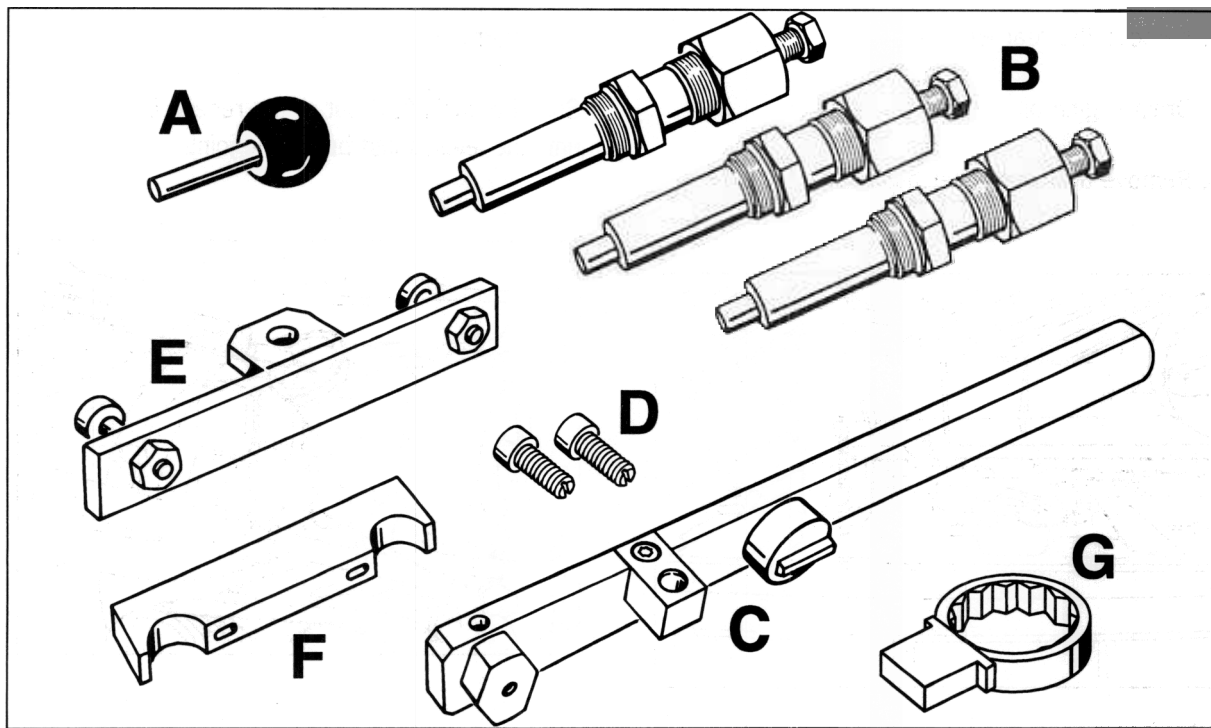
518\_97



519\_97

## 15 59 20 Removing and installing valve tappets – Engine installed

### Tools



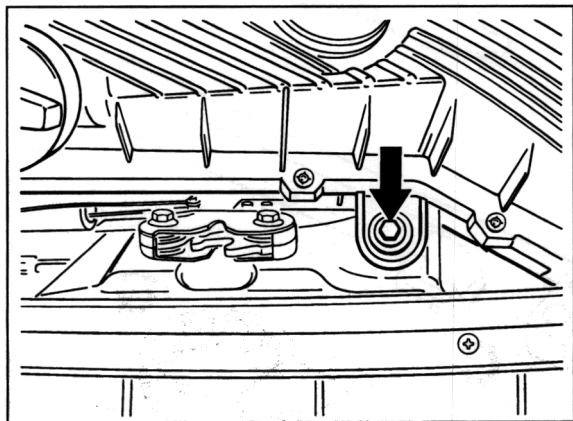
150\_98

Item	Designation	Special tool	Explanation
A	Fixing pin for belt pulley	9595 or from 9595/1	1 set = 2 ea. (use short fixing pin)
B	Auxiliary chain tensioner for valve timing adjustment	9599	1 set = 3 ea.
C	Adjustment device	9612/9	Only used with engine installed
D	Screws for holding-down device	9634/5	Only used with engine installed
E	Holding-down device for camshafts	9634	
F	Holding-down device for camshafts	9611	1 set = 4 ea.
G	Ring wrench (32 mm)		For applying auxiliary chain tensioner to cylinder bank 4 - 6

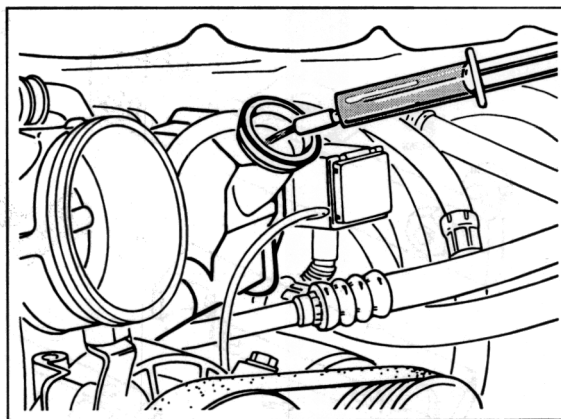


## Preliminary work for valve tappet removal – Engine installed

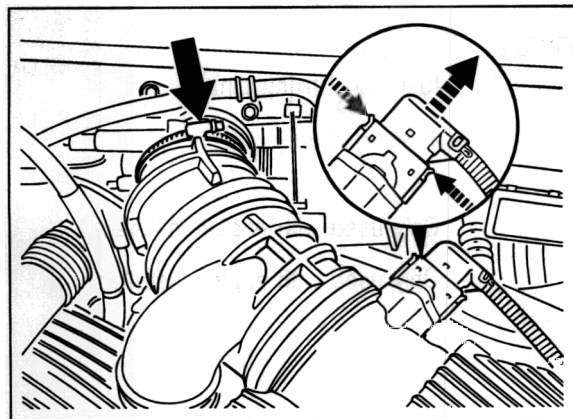
1. Disconnect battery.
2. Remove the rear wheels
3. Drain engine oil.
4. Remove the air cleaner assembly.
5. In vehicles with air conditioning, the following additional assembly operations must be performed:  
Suck Pentosin fluid out of the reservoir until the level is just below the joint.



261\_97

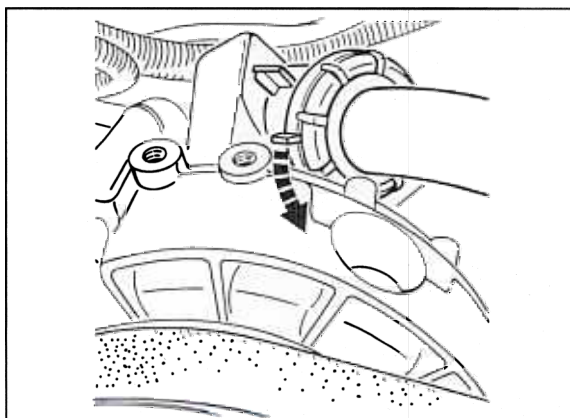


151\_98



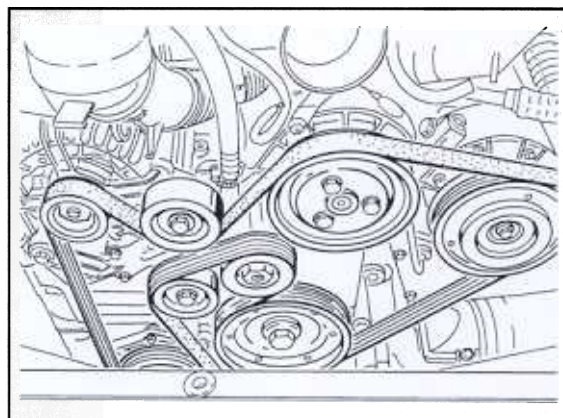
249\_97

- 5.1 Turn bayonet lock in the direction indicated by the arrow and pull off the reservoir. Immediately seal the lower reservoir with a suitable plug (30 mm  $\varnothing$ ).



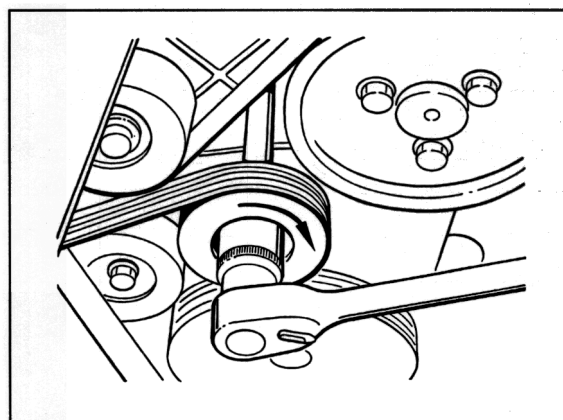
Bayonett lock open

264\_97



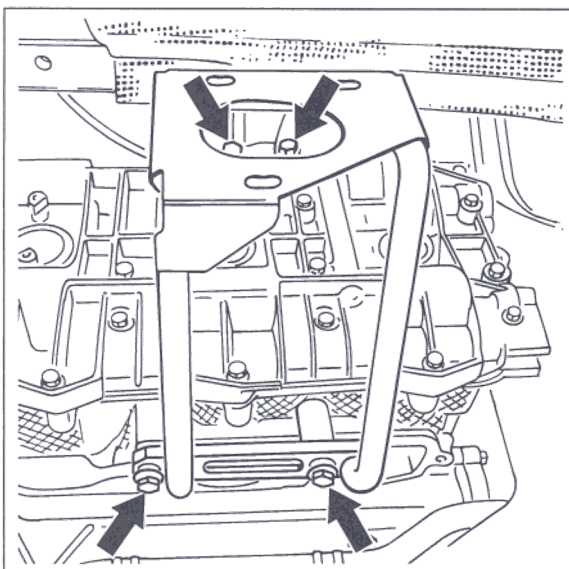
263\_97

- 5.2 Remove drive belt. Mark belt travel direction with a coloured pen. Slacken belt, turning the tensioning pulley (wrench size 24 mm) **clockwise**, hold still and simultaneously take the belt off the drive pulleys.



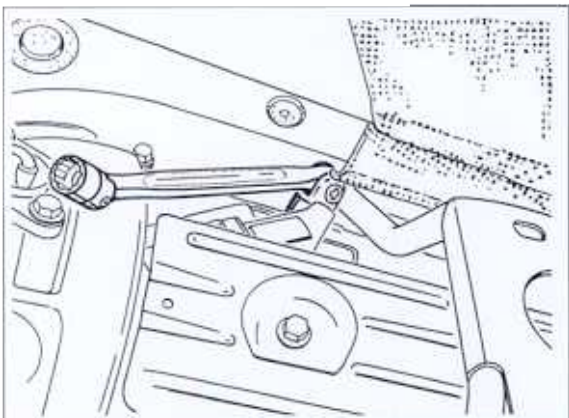
229\_97

8. Remove holder for rear muffler.



022\_98

8.1 Undo upper hexagon-head bolts using a flexible-head socket wrench (wrench size 13). Detach holder.

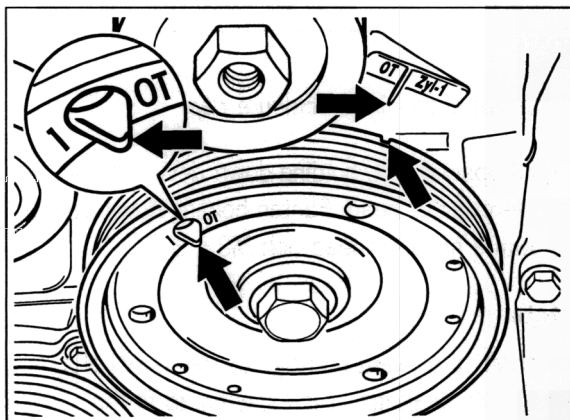


217\_98

9. Remove shield of cylinder head cover.

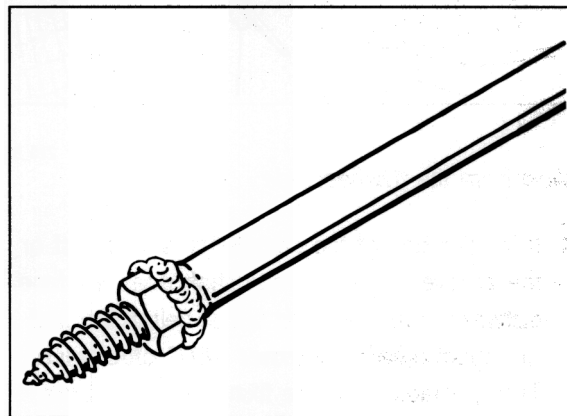
## 15 59 27 Removing valve tappets of cylinder bank 1 - 3

1. Move camshafts of cylinder bank 1 - 3 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 or 9595/1.

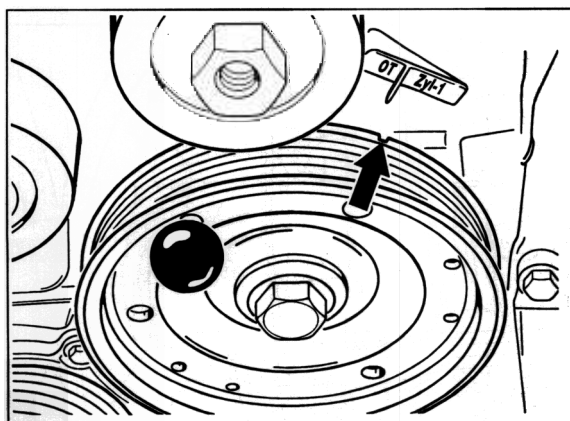


166\_98

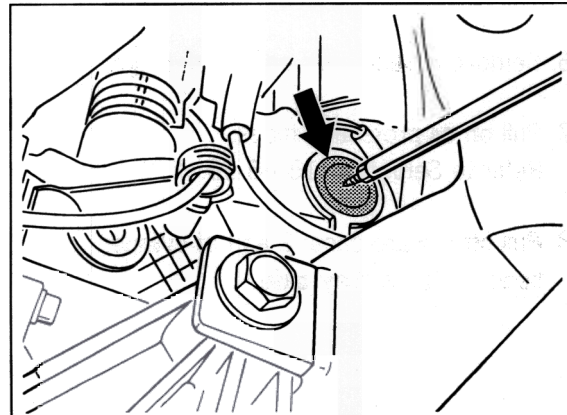
2. Pull off closure caps of cylinder head 1 - 3 – flywheel side. Turn shop-made extractor into **centre** of piercing point of closure cap and pull off the cap.



710\_97



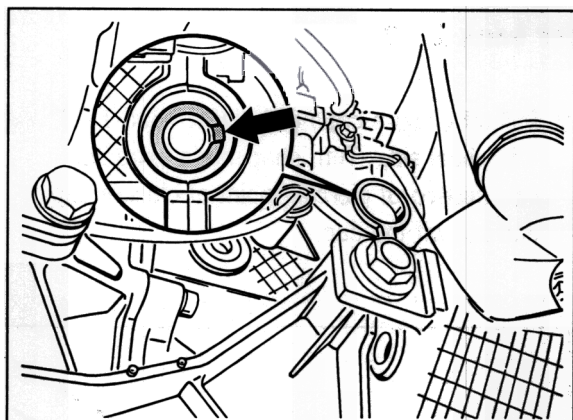
155\_98



188\_98

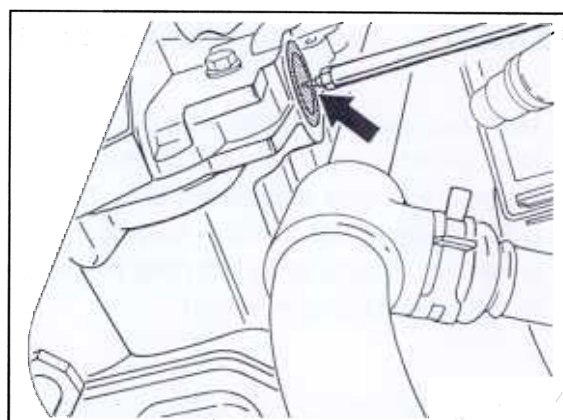
3. Check basic camshaft adjustment of **cylinder bank 1 - 3**. Ensure that the groove in the camshaft faces **outward** toward the cylinder head cover.





215\_98

View from the flywheel side



203\_98

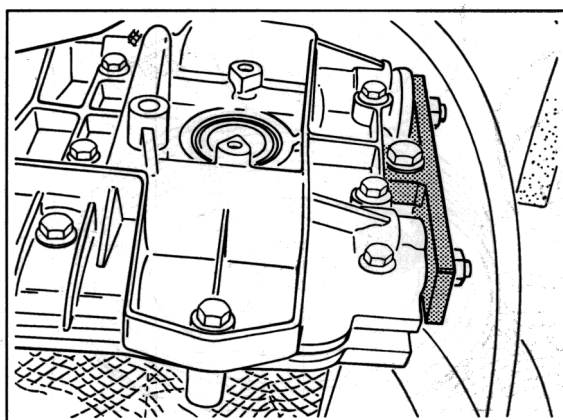
Diagram shows lower closure cap

4. If the position of the camshafts is incorrect or the groove in the inlet camshaft does not face **outward**, remove fixing pin of belt pulley and turn **crankshaft a further 360° clockwise**. Then position or fix the fixing pin in the bore (1 OT) and the fixing bore in the crankcase again.
5. Check the position of the groove again.
6. Remove ignition coils and spark plugs.
7. Pull off oil protection tubes.  
Refer to Serv. No. 15 46 19.
8. Pull off closure caps (2 ea.) of cylinder head 1 - 3 – **pulley side**.

9. Fit special tool, holding-down device 9634, on the cylinder head. Fasten holding-down device with a hexagon-head bolt M8 x 3.

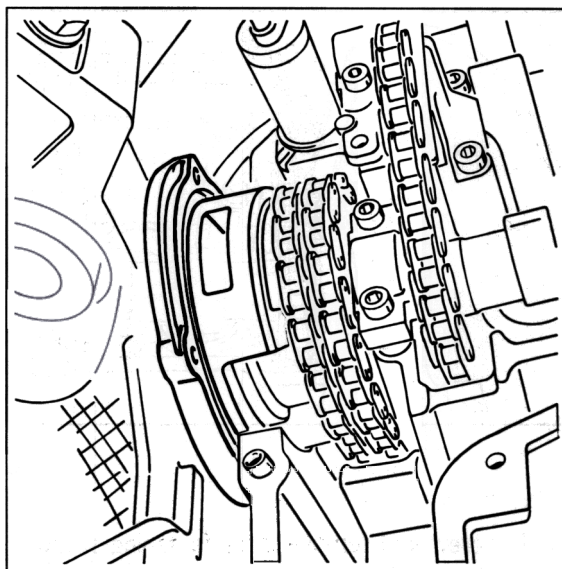
**Note**

In order to prevent damage to the camshafts or saddle bearings, it is essential to fit the holding-down device before detaching the cylinder head cover.

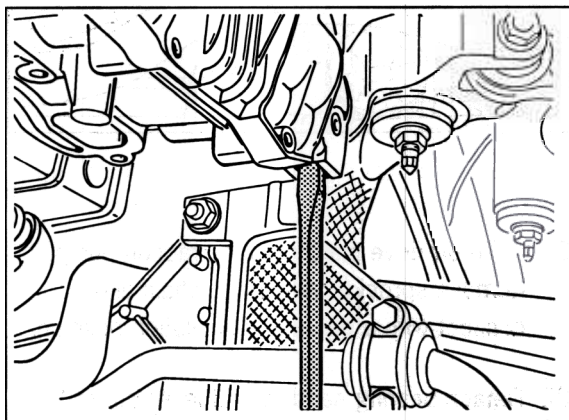


721\_97

10. Separate plug connection of the tensioning element (VarioCam).
11. Unscrew two hexagon-head bolts (M6 x 20) and remove closure cap from the tensioning element (VarioCam).
12. Undo the fastening screws of the oil extraction pump.
13. Remove cylinder head cover. Loosen the hexagon-head bolts from the outside to the inside. Detach the cylinder head cover by knocking it gently with a plastic hammer, and press off carefully.



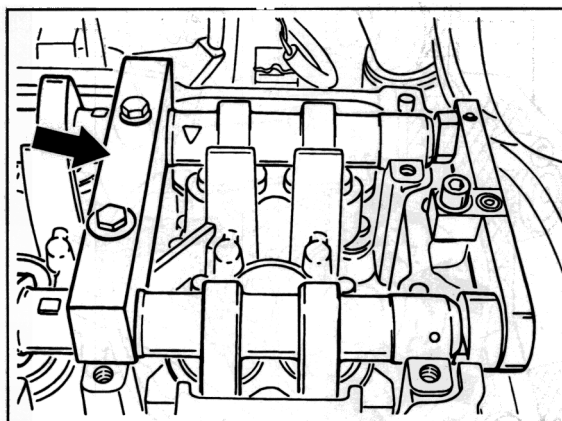
153\_98



156\_98

14. Remove oil extraction pump.

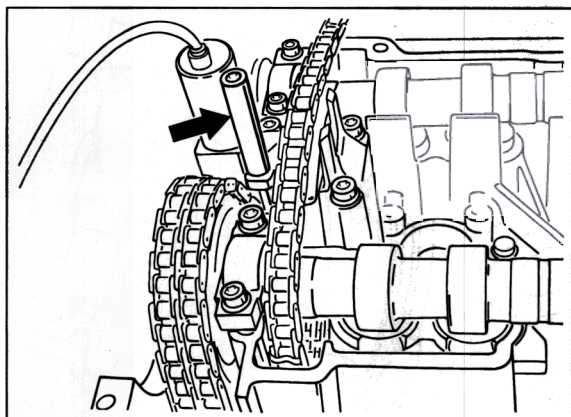
15. To relieve the camshafts from strain, additionally fasten a holding-down device of special tool 9611 using M6 x 45 auxiliary screws.



021\_98

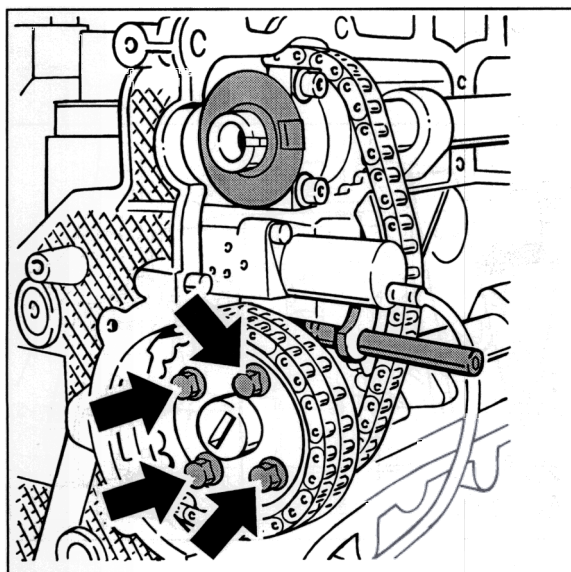
16. Relieve camshaft tensioning element (VarioCam) with special tool, tensioning screw 9632. Screw in tensioning screw only so far as to slightly relieve the chain.





266\_98

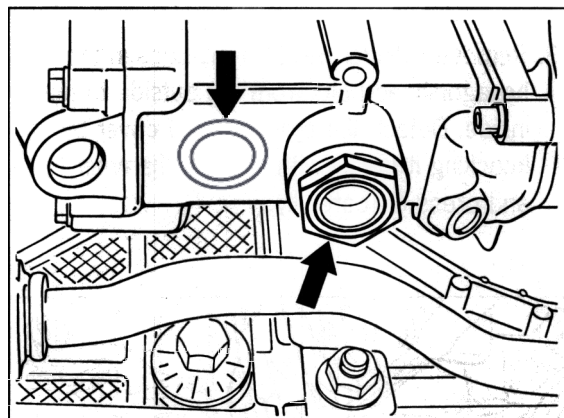
7. Unscrew and remove three fastening screws (M6 x 95) for tensioning element.
18. Undo four hexagon-head bolts (M6 x 15) on the chain sprocket.



723\_97

Rear axle cross member  
removed for clearer illustration

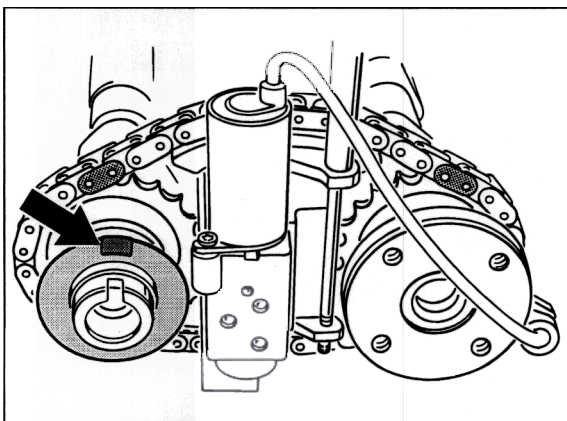
19. Undo four hexagon-head bolts (M6 x 15) on the chain sprocket.
20. Relieve chain of tension. Unscrew chain tensioner of cylinder bank 1 - 3. ("2 rings" identification on chain tensioner and crankcase).



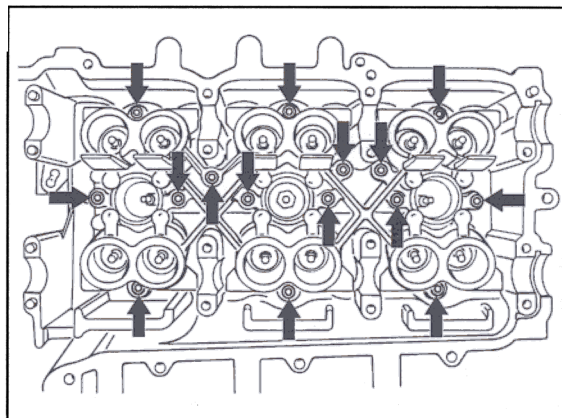
221\_98

21. Take off drive plate of oil extraction pump. Remove sprocket wheel and chain and connect with a tie wrap (installation position).
22. Detach bearing saddles and lever out of the guide sleeves by hand. Do not use a tool.

23. Remove special tools (holding-down devices 9611 and 9634) 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. The groove or tab of the camshaft position sensor cover must face upward.



246\_97



659\_97

24. Pull out valve tappets by hand.

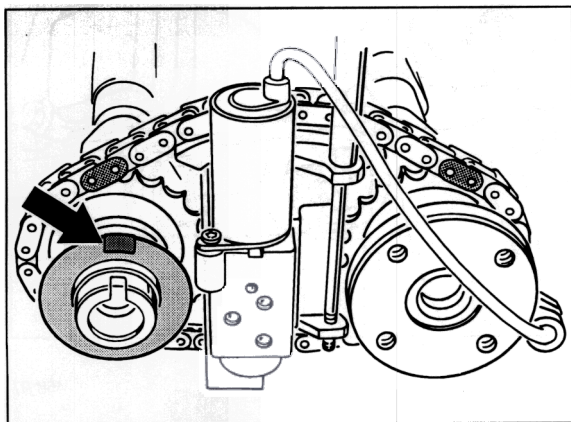
#### Note

Do not use a magnet.

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

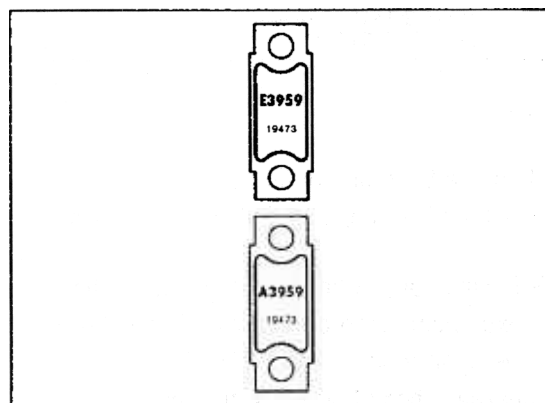
## 15 59 24 Installing valve tappets of cylinder bank 1- 3

1. Check guide for damage. Refer to: Checking guide for valve tappet, Serv. 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, in 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, Serv. No. 15 05 33.



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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.)

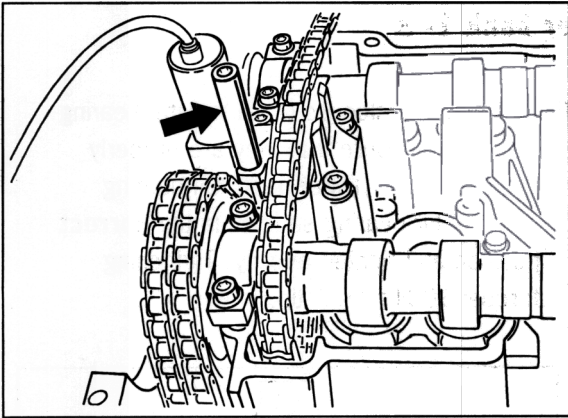


401\_1\_98

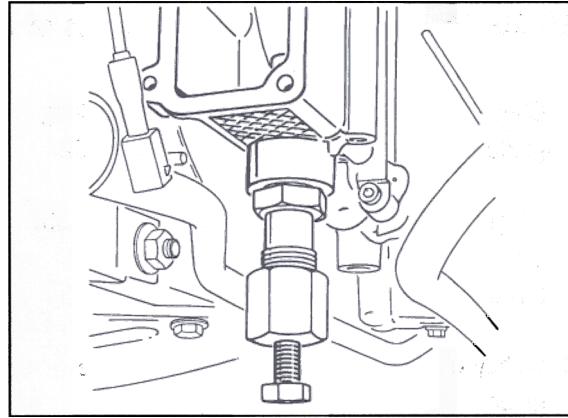
E = Bearing saddle for inlet camshaft  
A = Bearing saddle for exhaust camshaft

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.

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



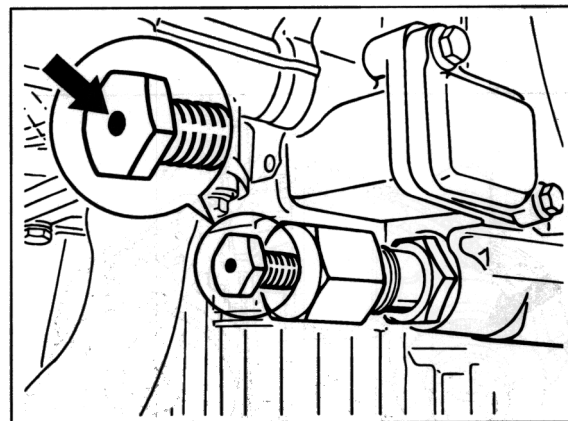
266\_98



271\_98

9. Remove tie wrap and fit sprocket wheel with chain on the flange of the exhaust camshaft.
10. Position drive plate or driver star of the oil extraction pump on the sprocket wheel. Fit hexagon-head bolt M6 x 15 (10.9). Tighten hexagon-head bolt **by hand only**.
11. Fit auxiliary chain tensioner of special tool 9599 on cylinder head 1 - 3. 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 achieved when the measuring pin is **flush** with the face surface of the pressure screw. Turn the screw if necessary.

12. Unscrew the chain tensioner (fitted to the crankcase half of cylinder bank 4 - 6), attach auxiliary chain tensioner (special tool 9599) and adjust pre-tension force (see Item 12).

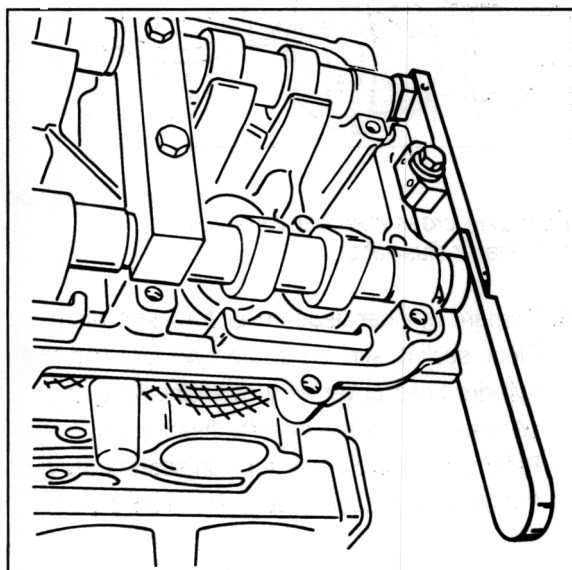


468\_97



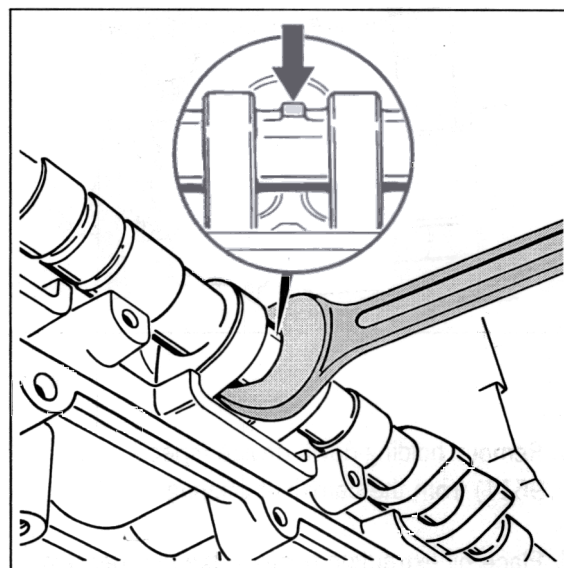
## 15 05 15 Adjusting timing at cylinder bank 1 – 3

1. Position special tool, adjustment device 9612/9, on the cylinder head or the camshaft bores.



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2. If the special tool cannot be inserted in the bores, allocate the camshafts accordingly and turn the exhaust camshafts with an open-ended wrench (wrench size 24) until the adjustment device can be inserted with ease. Fasten adjustment device with a hexagon-head bolt M8 x 30.

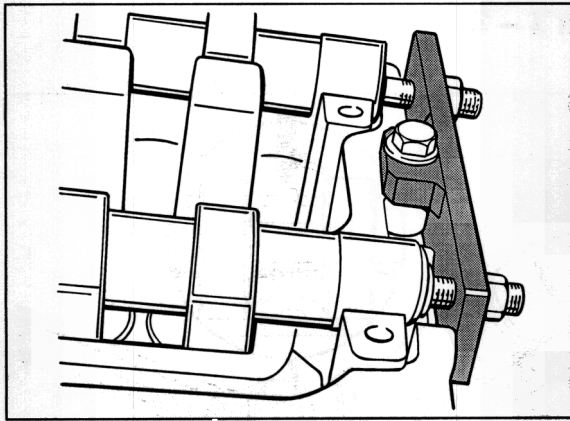


152\_98

3. Fasten four hexagon-head bolts (M6 x 15) on the chain sprocket.
4. Take special tool, adjustment device 9612/9, off the cylinder head.
5. Fasten special tool, holding-down device 9634, on the cylinder head using a hexagon-head bolt M8 x 30.

### Note

Only remove holding-down device 9634 when the cylinder head cover has been fitted.



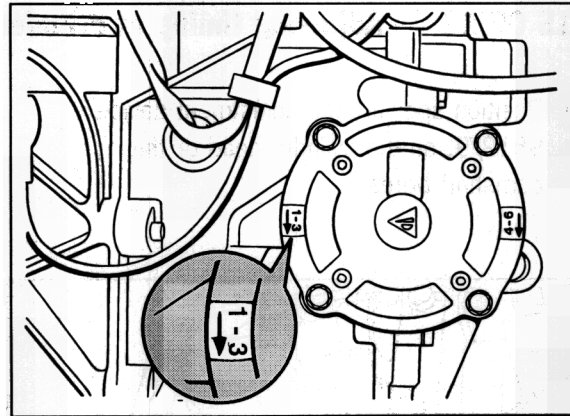
633\_97

6. Remove holding-down device (special tool 9611) from the camshaft bearing saddles.
7. Place oil extraction pump in the cylinder head.

**Note**

For reasons of space, the oil extraction pump must be fitted before the cylinder head cover is installed.

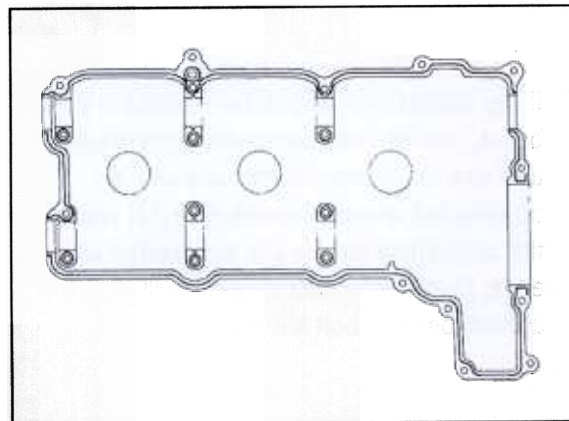
8. Lightly grease the new sealing ring and lay it in the oil extraction pump. Align oil extraction pump driver and fit oil extraction pump in the correct position. The arrow for the direction of rotation or the marking "1 - 3" must face the crankcase. Insert new micro-encapsulated hexagon-head bolts loosely in the oil extraction pump.



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*Rear axle cross member removed for clearer illustration*

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



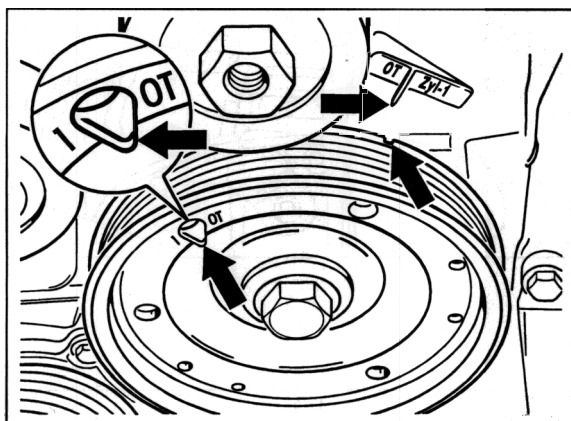
430\_1\_96



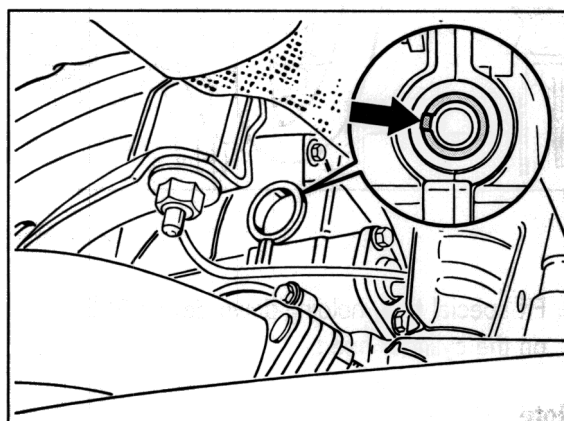
10. Carefully place the cylinder head cover in the correct position so that the sealing bead is not damaged. Screw two studs or centring pins into the corners of the cylinder head as centring aids. Tightening torque 13 Nm (10.0 ftlb.). Observe tightening sequence.
11. Remove holding-down device 9634.
12. Immediately remove silicone material emerging in the area of the camshaft closure cap.

## 15 59 22 Removing valve tappets of cylinder bank 4 - 6

1. Remove fixing pin. Move camshafts of **cylinder bank 4 - 6** 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 or 9595/1.
2. Pull off closure cap of camshaft bore using a shop-made tool.
3. Check basic camshaft position of cylinder bank 4 - 6. The groove in the camshaft must face **inward** toward the crankcase.

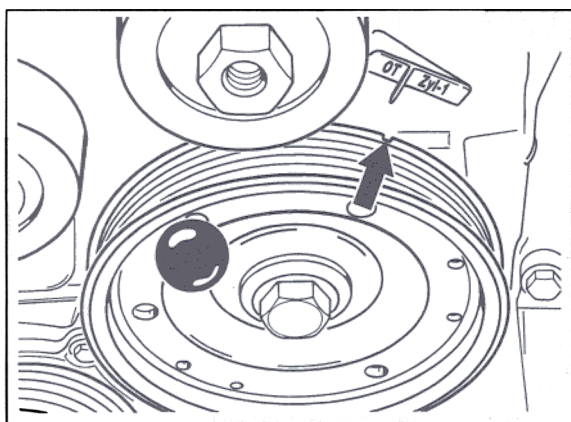


166\_98



216\_98

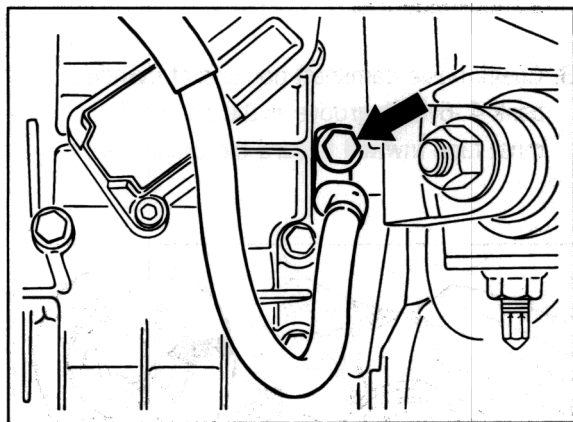
*View from the belt pulley side*



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4. Remove ignition coils and spark plugs.
5. Pull off oil protection tubes. Refer to Serv. No. 15 46 19.
6. Pull off closure caps (2 ea.) of cylinder head 4 - 6 – flywheel side.

7. Undo ground strap of engine (cylinder head, near cylinder 6).

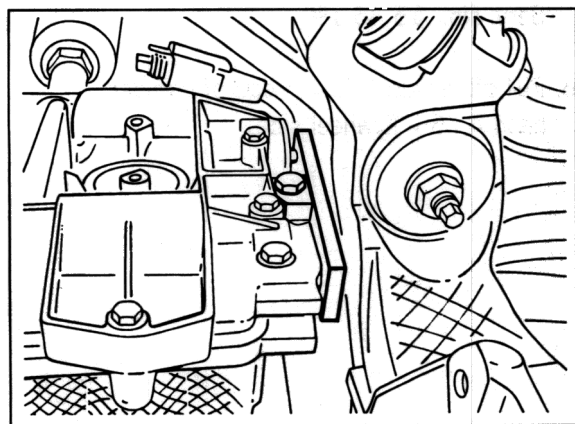


201\_97

8. Fit special tool, holding-down device 9634, on the cylinder head.

#### Note

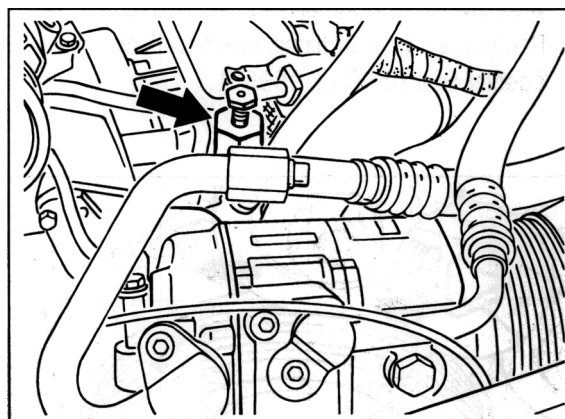
For reasons of space, the position of the holding-down device must be changed. To do so, remove original bolts and replace by bolts from special tool 9634/5.



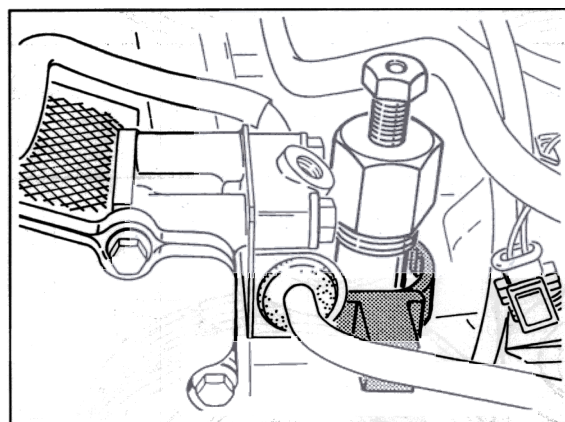
204\_98

9. Perform remaining assembly work on cylinder bank 4 - 6 as described in Item 10 - 19.

10. Relieve chain of tension. Unscrew chain tensioner from cylinder bank 4 - 6.



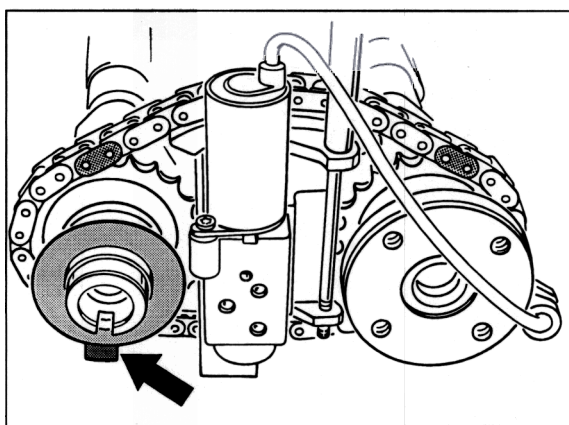
020\_98



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11. Take off drive plate of oil extraction pump. Remove sprocket wheel and chain and connect with a tie wrap (installation position).

12. Detach bearing saddles and lever out of the guide sleeves by hand. Do not use a tool.
13. Remove special tools (holding-down devices 9611 and 9634) 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. The groove or tab of the camshaft position sensor cover must face downward.



243\_97

14. Pull out valve tappets by hand.

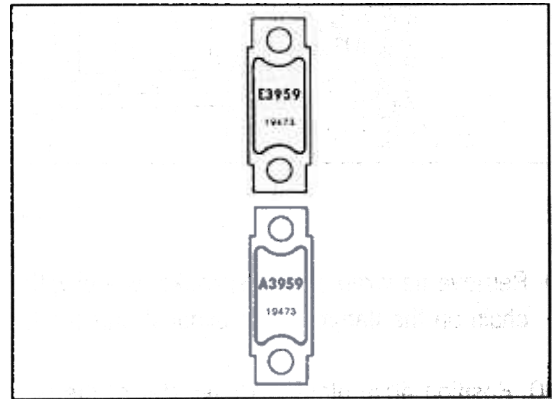
**Note**

Do not use a magnet.

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

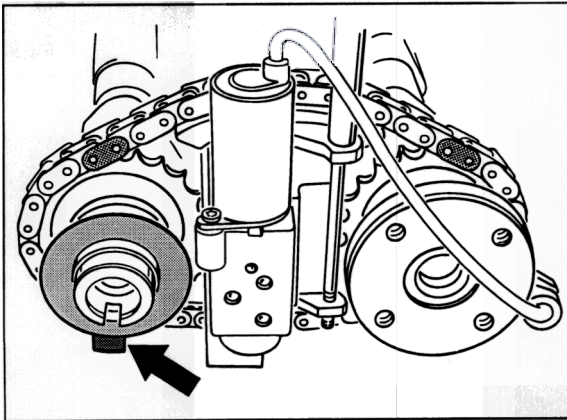
**15 59 24 Installing valve tappets of cylinder bank 4 - 6**

1. Check guide for damage. Refer to: Checking guide for valve tappet, Serv. 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, in the cylinder head. The groove or tab of the camshaft position sensor cover must face **inward** in installed position. If the allocation should be uncertain, e.g. chain jumped over, reallocation is necessary. Refer to: Completing camshafts, Serv. No. 15 05 33.
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.)



401\_1\_96

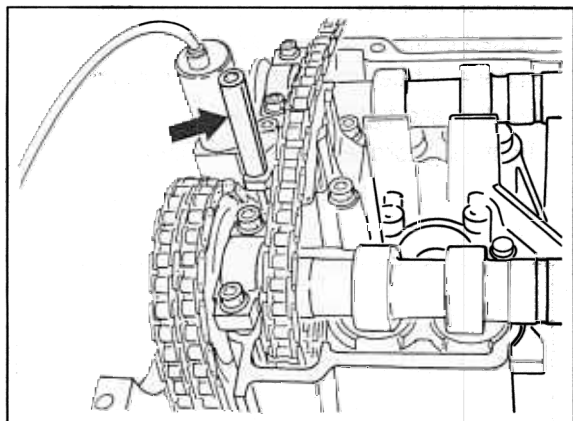
E = Bearing saddle for inlet camshaft  
A = Bearing saddle for exhaust camshaft



243\_97

5. Fasten special tool, holding-down device 9611, with auxiliary screws M6 x 45.
7. Fit tensioning element (VarioCam). Tighten 3 M6 x 95 pan-head screws. Tightening torque 10 Nm (7.5 ftlb.)

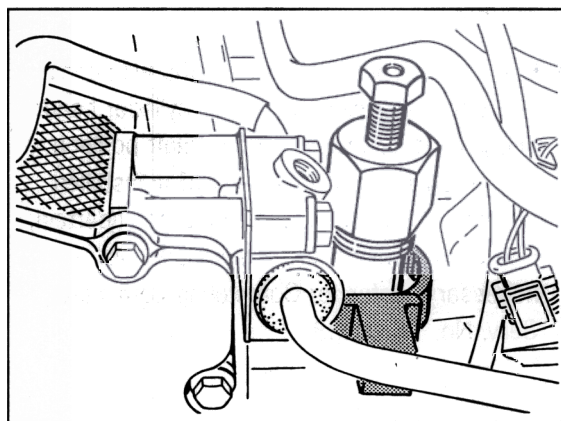
8. Unscrew tensioning screw, special tool 9632, from the tensioning element.



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9. Remove tie wrap and fit sprocket wheel with chain on the flange of the exhaust camshaft.
10. Position drive plate or driver star of the oil extraction pump on the sprocket wheel. Fit hexagon-head bolt M6 x 15 (10.9). Tighten hexagon-head bolt **by hand** only.
11. Fit auxiliary chain tensioner on cylinder head 4 - 6.

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 achieved when the measuring pin is **flush** with the face surface of the pressure screw. Turn the screw if necessary.

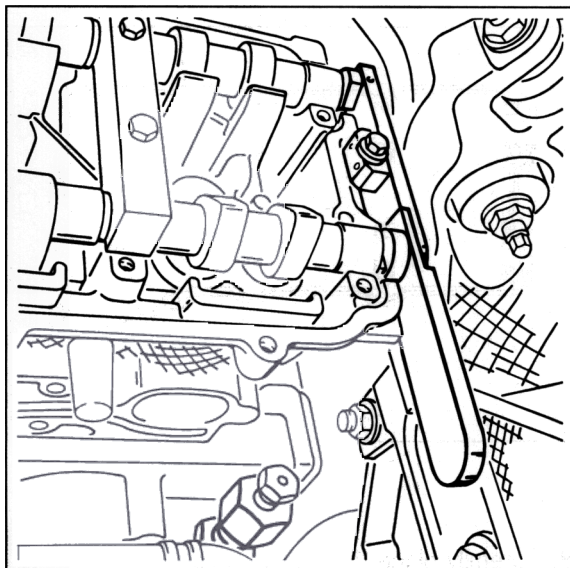


636\_97



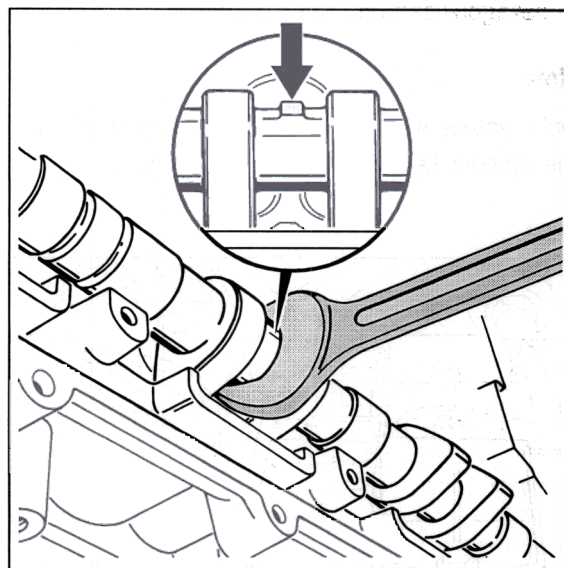
## 15 05 15 Adjusting timing at cylinder bank 4 – 6

1. Position special tool, adjustment device 9612/9, on the cylinder head or the camshaft bores.



157\_98

2. If the special tool cannot be inserted in the bores, allocate the camshafts accordingly and turn the exhaust camshafts with an open-ended wrench (wrench size 24) until the adjustment device can be inserted with ease. Fasten adjustment device with a hexagon-head bolt M8 x 30.



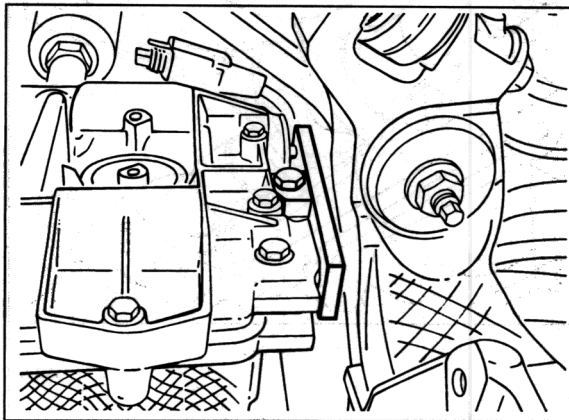
152\_98

3. Fasten four hexagon-head bolts (M6 x 15) on the chain sprocket.
4. Take special tool, adjustment device 9612/9, off the cylinder head.

5. Fasten special tool, holding-down device 9634, on the cylinder head using a hexagon-head bolt M8 x 30.

**Note**

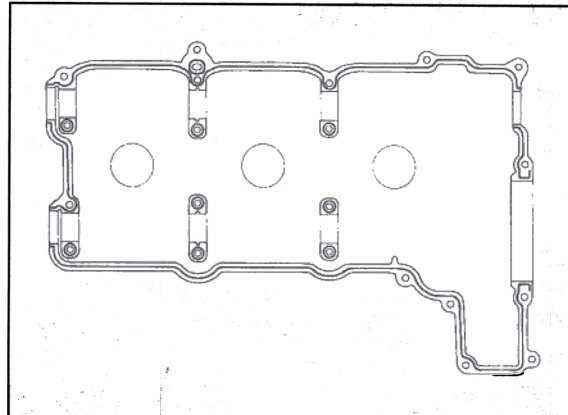
Only remove holding-down device 9634 when the cylinder head cover has been fitted.



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6. Remove holding-down device (special tool 9611) from the camshaft bearing saddles.

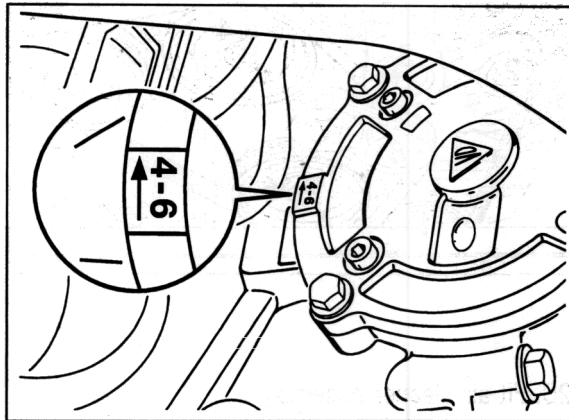
7. Prepare cylinder head cover for installation:  
Clean sealing surface of the cylinder head and cylinder head cover very carefully. Apply a silicone bead to the cylinder head cover.  
Refer to: Sealing cover for camshaft housing (cylinder head cover), Serv. No. 15 91 51.



430\_1\_96

8. 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.) Observe tightening sequence.
9. Remove holding-down device 9634.
10. Immediately remove silicone material emerging in the area of the camshaft closure cap.

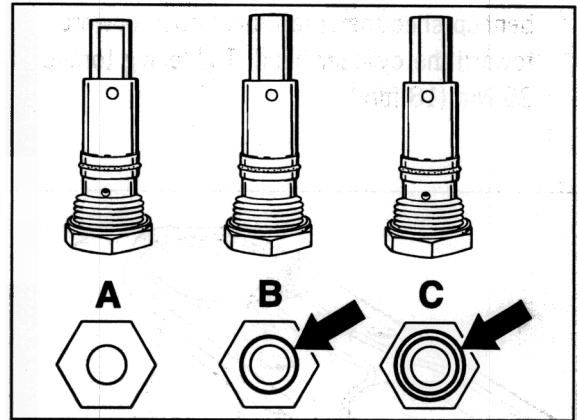
11. Fit oil extraction pump. Align oil extraction pump driver and fit oil extraction pump in the correct position. The arrow for the direction of rotation or the marking "4 - 6" must face the crankcase.



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12. Fit camshaft closure caps (6 ea.) **dry**.
13. Take off auxiliary chain tensioner, fit original chain tensioner with new sealing ring.  
Tightening torque: 80 Nm (59 ftlb.)

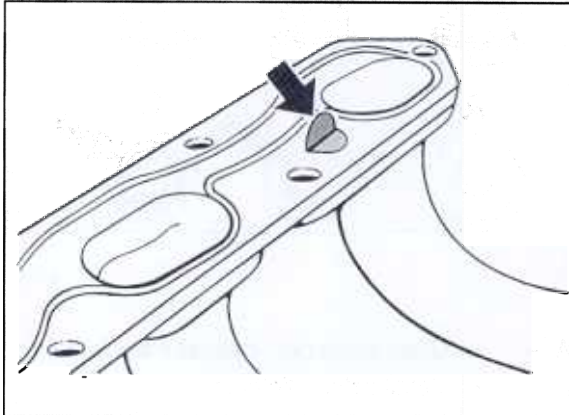
#### Allocation of chain tensioners



502\_97

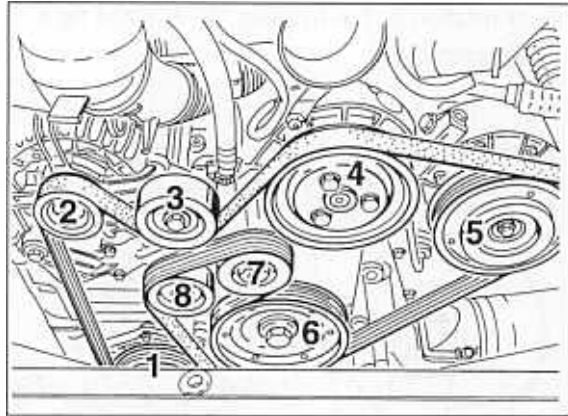
- A – Chain tensioner, **cylinder bank 4 - 6**  
Identification "Without"
- B – Chain tensioner **on crankcase**  
Identification "1 ring"
- C – Chain tensioner, **cylinder bank 1 - 3**  
Identification "2 rings"
14. Pull fixing pin off belt pulley.
15. Fill in engine oil.

16. 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 (18 ftlb.)



716\_97

19. Fit drive belt.



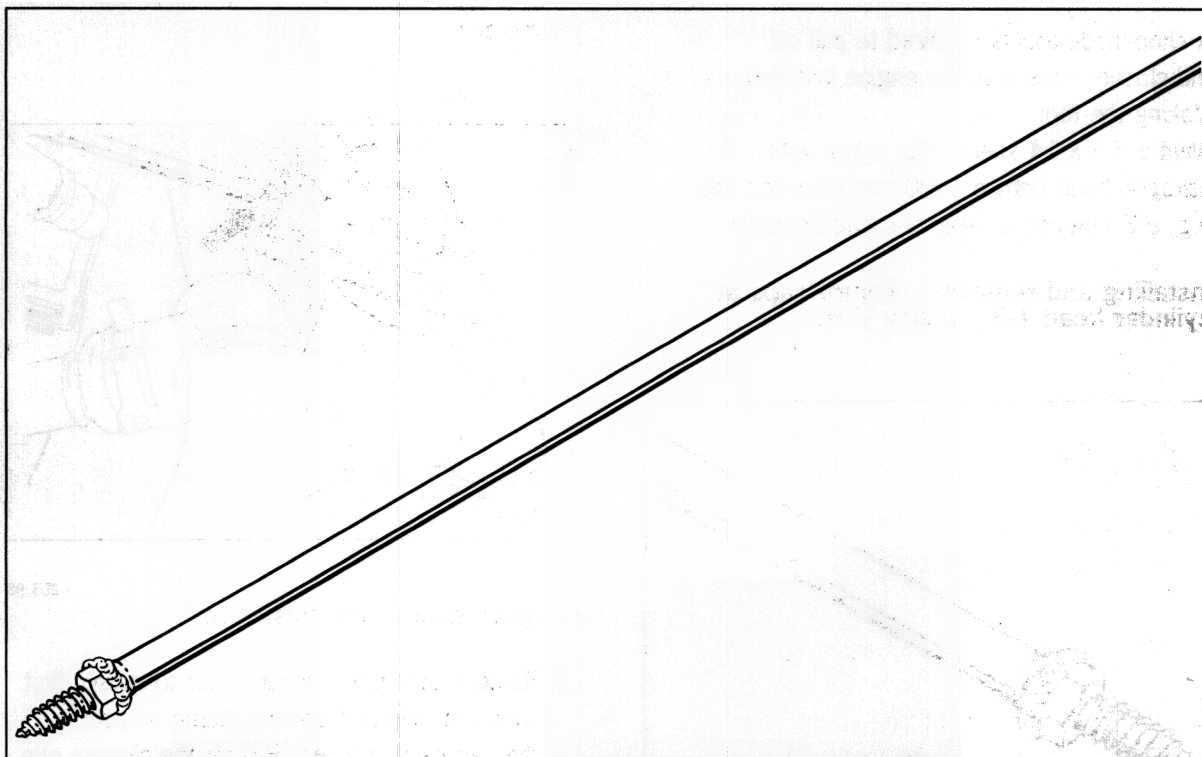
214\_98

17. Fit air-conditioning compressor

18. Fit Pentosin reservoir and fill with fluid. For instructions refer to Serv. No. 48, Page 48 - 3.

20. Fit air cleaner assembly.

21. Mount rear wheels. Tightening torque 130 Nm (96 ftlb.).

**15 18 20 Removing and installing closure cap for camshaft bore****Tools**

206\_98

Item	Designation	Special tool	Explanation
	Extractor		Shop-made tool, see note on Page 15 - 118

## Removing and installing closure cap for camshaft bore

### Engine installed

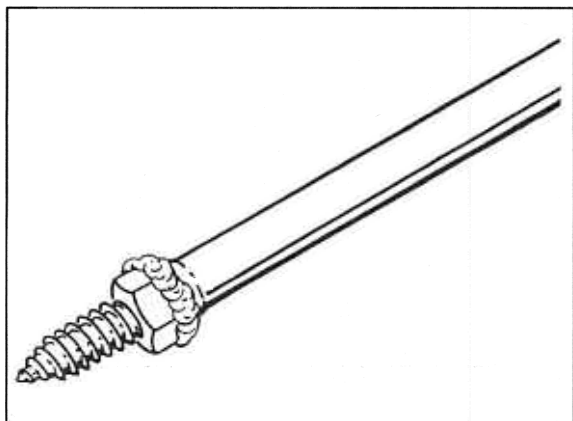
#### Note

A shop-made tool is required to pull off the closure caps with the engine installed.

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).

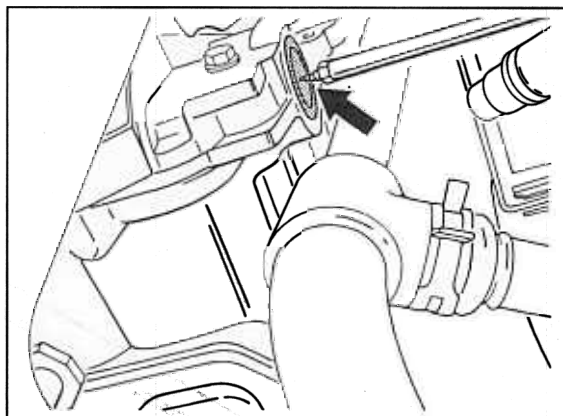
Installing and removing closure caps at cylinder head 1-3 – pulley side.



710\_97

### Removal

1. Turn shop-made extractor into **centre** of piercing point of closure cap and pull off the cap.



203\_98

Diagram shows lower closure cap

2. Remove the upper closure cap; to do so, first undo the tailpipe fastening clamp and twist the tailpipe downward. Pull off the closure cap.

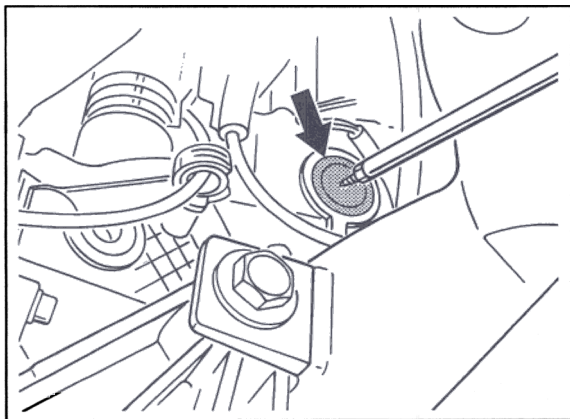
### Installation

1. Clean the camshaft bore.
2. Fit new cap **dry** and press in by hand as far as it will go.
3. Align tailpipe and tightening fastening clamp.



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

1. Turn shop-made extractor into **centre** of piercing point of closure cap and pull off the cap.



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**Installation**

1. Clean the camshaft bore.
2. Fit new cap **dry** and press in by hand as far as it will go.

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

1. Turn shop-made extractor into **centre** of piercing point of closure cap and pull off the cap.

Remove the upper closure cap; to do so, first undo the tailpipe fastening clamp and twist the tailpipe downward. Pull off the closure cap.

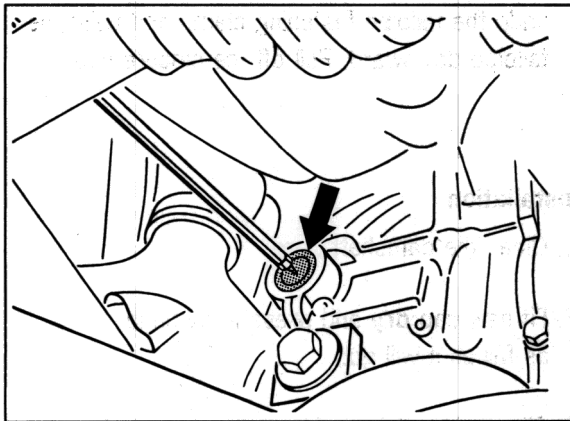
**Installation**

1. Clean the camshaft bore.
2. Fit new cap **dry** and press in by hand as far as it will go.
3. Align tailpipe and tightening fastening clamp.

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

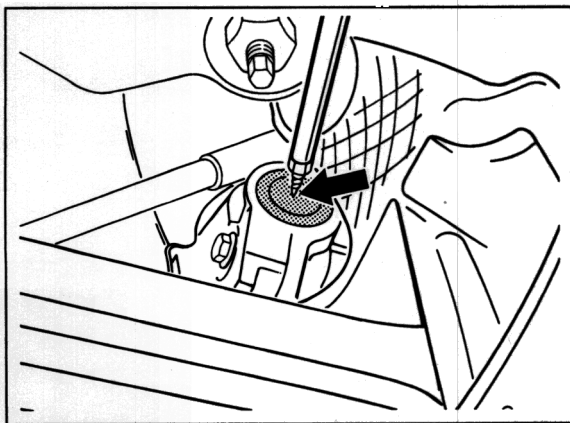
## Removal

1. Turn shop-made extractor into **centre** of piercing point of closure cap and pull off the cap.



189\_98

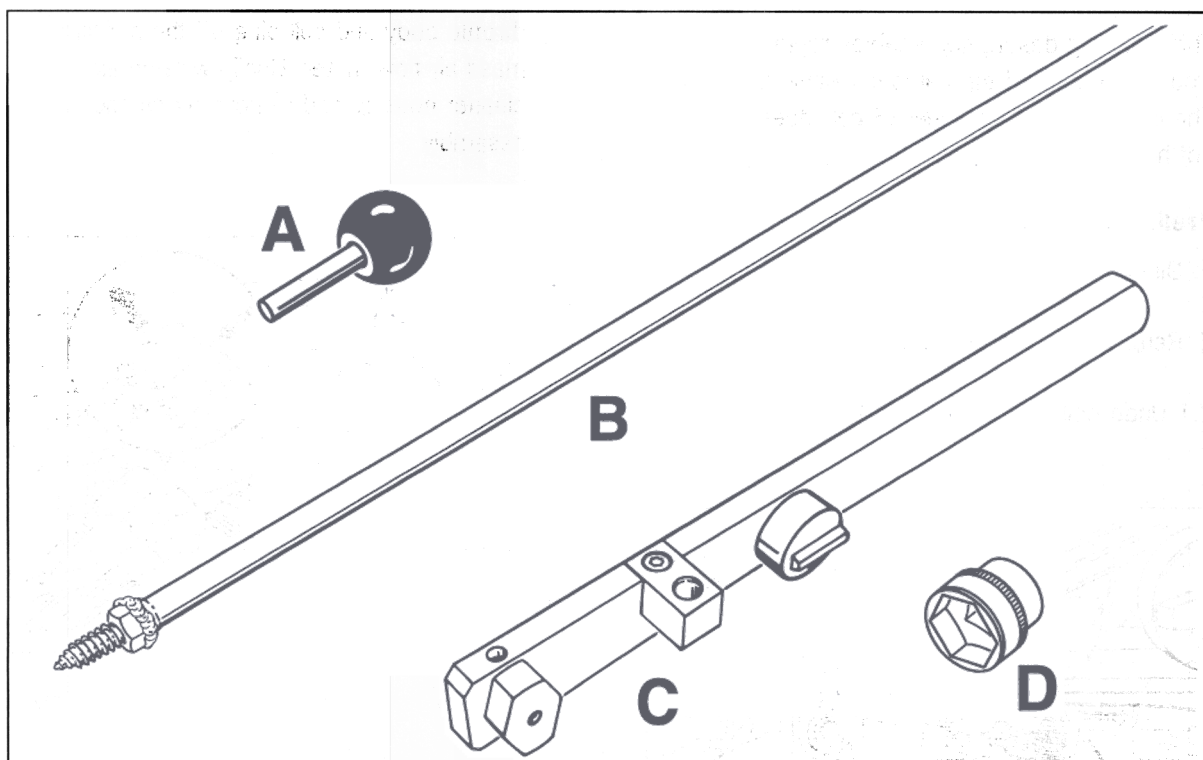
Diagram shows upper closure cap



202\_98

Diagram shows lower closure cap

## 15 05 02 Checking camshafts (timing) – Engine installed



207\_98

Item	Designation	Special tool	Explanation
A	Fixing pin for belt pulley	9595 or 9595/1	1 set = 2 ea. (use short fixing pin)
B	Extractor for closure caps of camshaft bores		Shop-made tool, iron rod or threaded rod approx. 1000 mm long, with welded on sheetmetal screw 6.3 x 14 with hexagon head
C	Adjustment device for valve timing	9612/9	Use only with engine <b>installed</b> , if engine is <b>removed</b> use blocking device 9612
D	Socket wrench insert	9594	

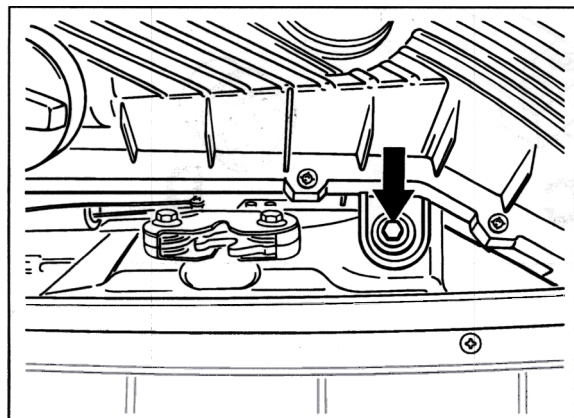
## Checking camshafts

### Note

The following description enables rapid trouble-shooting of the camshaft drive. The original chain tensioner (3 ea.) does not have to be removed.

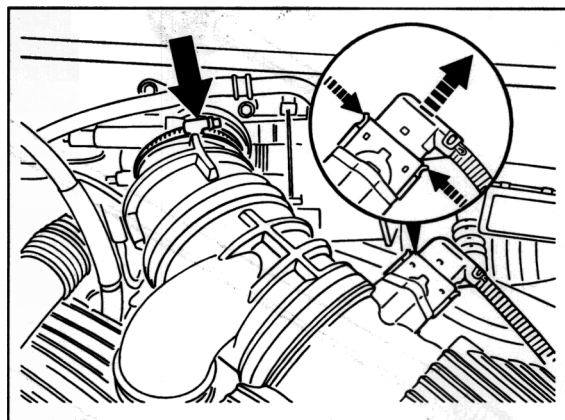
### Preliminary work

1. Disconnect battery.
2. Remove air cleaner assembly.
  - 2.1 Undo collar screw M6 x 34.



261\_97

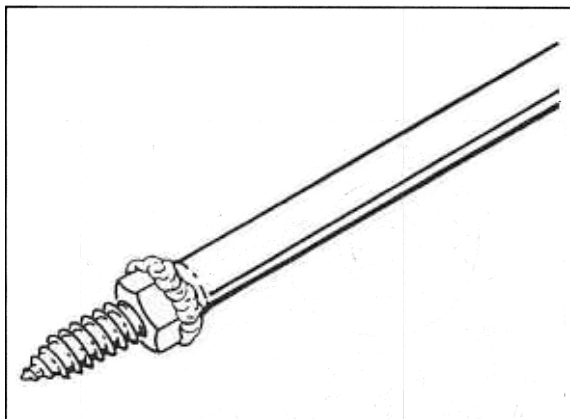
- 2.2 Detach oil filler neck. Undo hose clamp on throttle body and pull plug off the hot film mass air flow meter. Unclip wire on air cleaner housing and remove air cleaner assembly.



249\_97

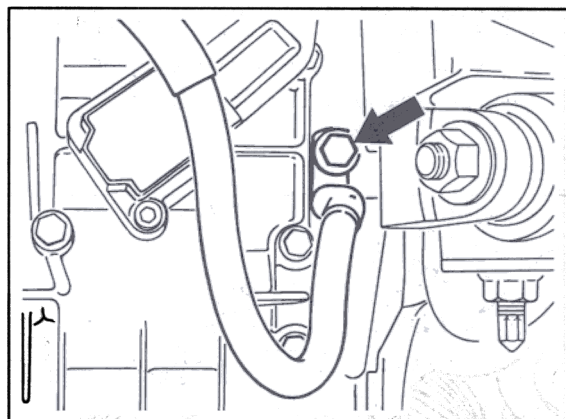
3. Remove right rear wheel.

4. Pull off caps of camshaft bores (6 ea.) using the shop-made tool.  
Refer to Serv. No. 15 18 20, Page 15 - 117.

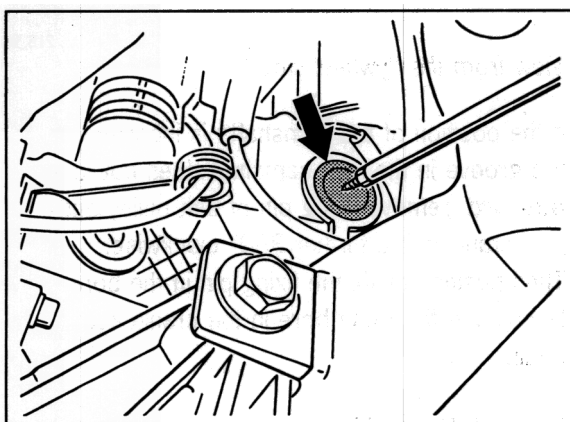


710\_97

5. Undo ground strap between engine and body.  
Undo the strap at the engine (cylinder head, near cylinder 6).



201\_97

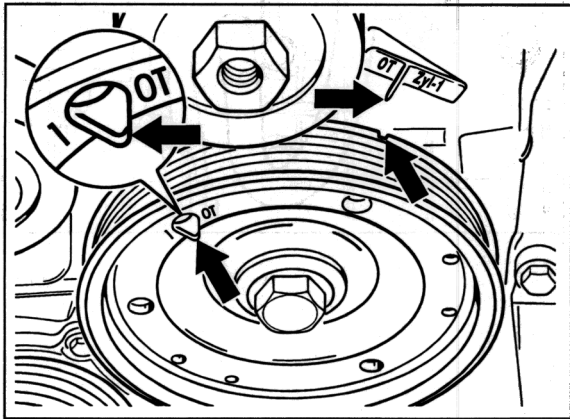


188\_98

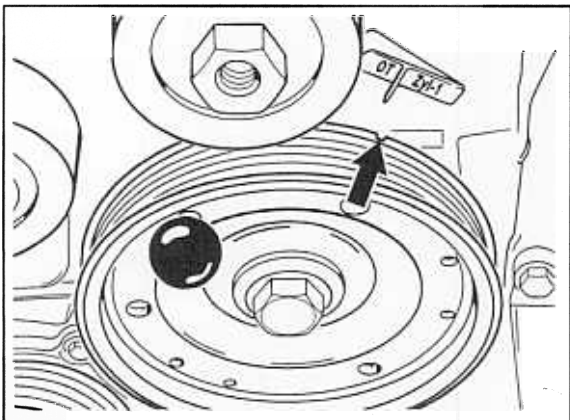
Drawing shows closure cap on  
cylinder head 1 - 3 (flywheel side)

## Checking camshafts of cylinder bank 1 - 3

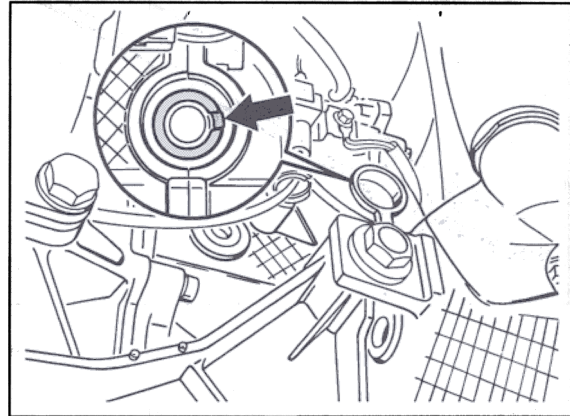
1. Move camshafts of cylinder bank 1 - 3 to basic position. Turn crankshaft clockwise until the bore 1 OT (top dead centre) in the belt pulley is aligned with the fixing bore on the crankcase. Position or fix with fixing pin (short) of special tool 9595 or 9595/1.
2. Check basic camshaft adjustment of cylinder bank 1 - 3. Ensure that the groove in the camshaft faces **outward** toward the cylinder head cover.



166\_98



155\_98



215\_98

*View from the flywheel side*

If the position of the camshafts is incorrect or the groove in the inlet camshaft does not face **outward**, remove fixing pin of belt pulley and turn crankshaft a further 360° clockwise. Then position or fix the fixing pin in the bore (1 OT) and the fixing bore in the crankcase again.

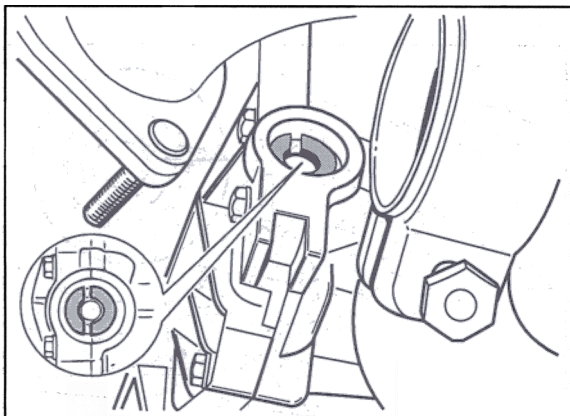
3. Check the position of the groove again.



4. If the allocation is correct, at the same time, the narrow segment of the exhaust camshaft on the opposite side must face the cylinder head cover:

**Note**

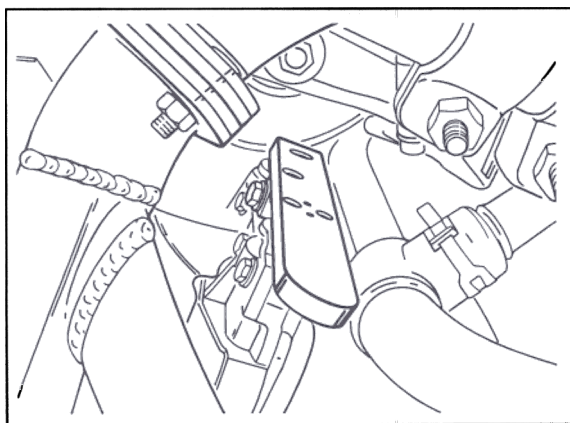
Do not use force when positioning the special tool. It should be possible to fit the special tool and hexagon-head bolt with ease.



252\_98

*View from the belt pulley side.  
Rear muffler removed for clearer illustration.*

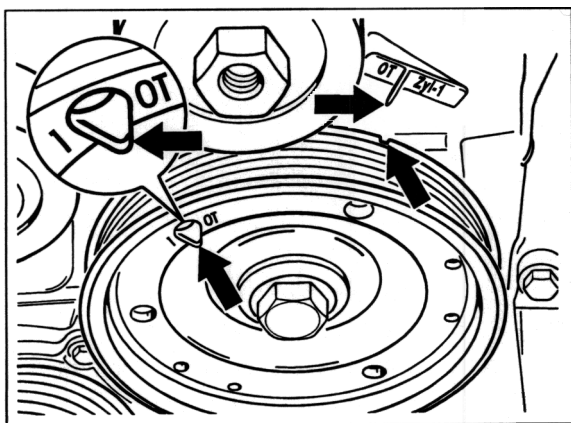
5. Position special tool, adjustment device 9612/9, on the cylinder head and fasten with a hexagon-head bolt M8 x 30.



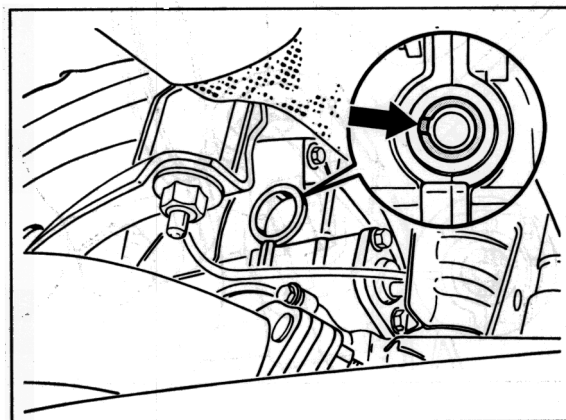
219\_98

## Checking camshafts of cylinder bank 4 - 6

1. Remove fixing pin. Move camshafts of cylinder bank 4 - 6 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 or 9595/1.
2. Check basic camshaft position of cylinder bank 4 - 6 . The groove in the camshaft must face **inward** toward the crankcase.

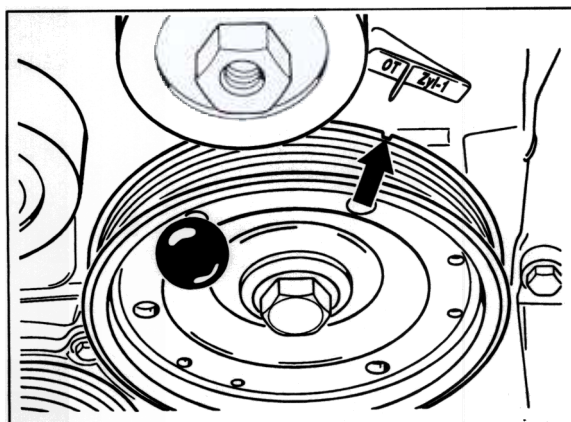


166\_98



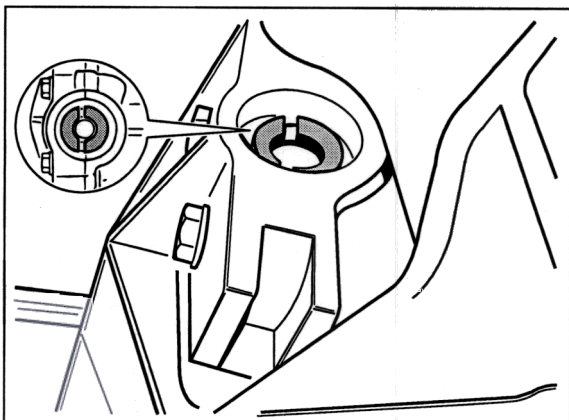
216\_98

View from the belt pulley side



155\_98

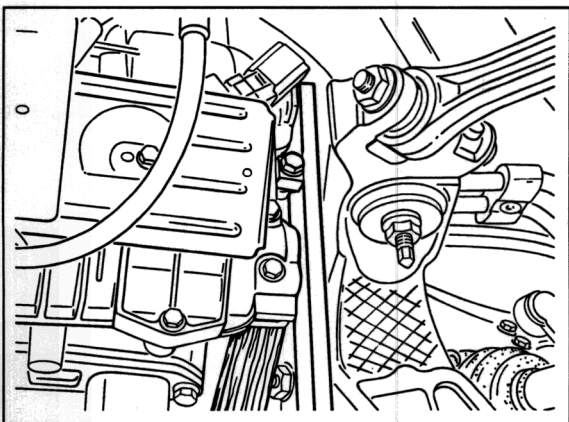
3. If the allocation is correct, at the same time, the narrow segment of the exhaust camshaft on the opposite side must face the cylinder head cover.



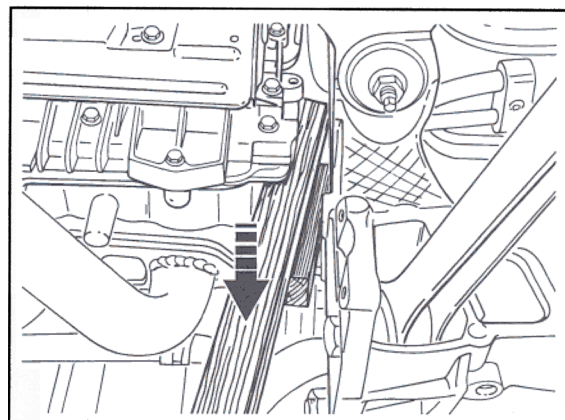
View from the flywheel side

253\_98

4. Position special tool, adjustment device 9612/9, on the cylinder head and fasten with a hexagon-head bolt M8 x 30.



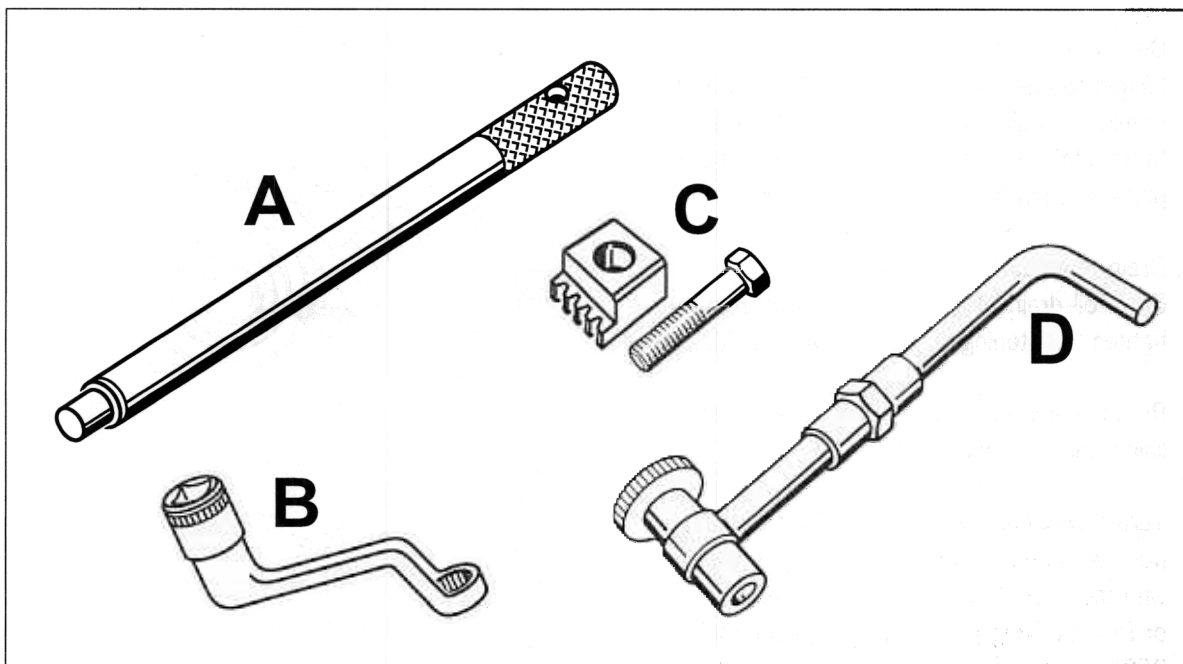
220\_98



205\_98

#### Note

If the special tool cannot be inserted in the cylinder head for reasons of space, proceed as follows: Insert a suitable piece of wood between the cylinder head and the side member as a support. Press the piece of wood forward and simultaneously insert the special tool. Do not use force when positioning the special tool. It should be possible to fit the special tool and hexagon-head bolt with ease.

**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	

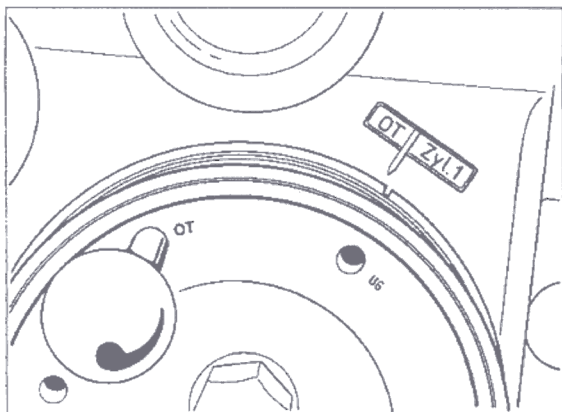
**Remove sealing ring for intermediate shaft**

**Preliminary work:** Remove transmission: refer to Technical Manual,

**Group 3 – Manual transmission, Service No. 34 35 19 or**

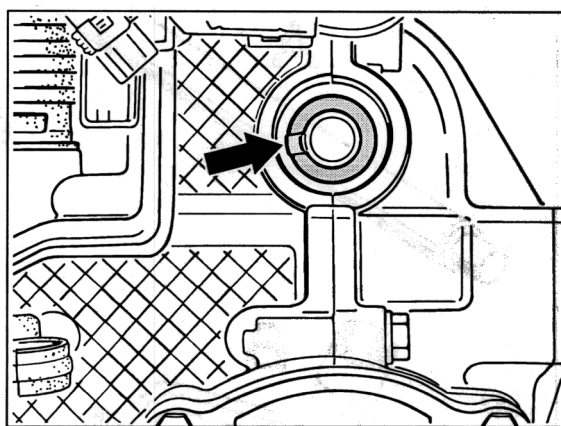
**Group 3 – Tiptronic transmission, Service No. 37 01 19**

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 (22 ftlb.)
3. Remove engine compartment cover, rear wall lining and rear wall cover.
4. 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

5. Remove camshaft closure caps from **cylinder bank 1 - 3**. The closure cap of **cylinder bank 1 - 3** is located on the flywheel side. Driveawl 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

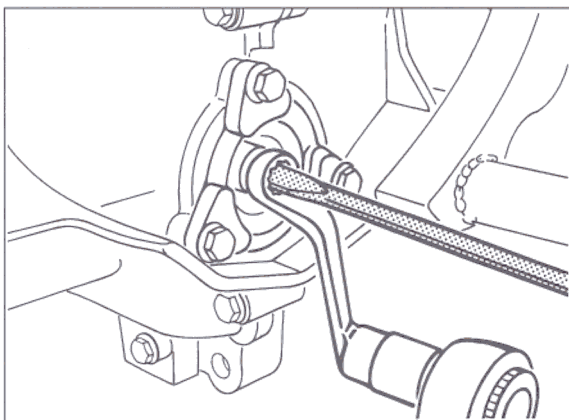
15590001

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).

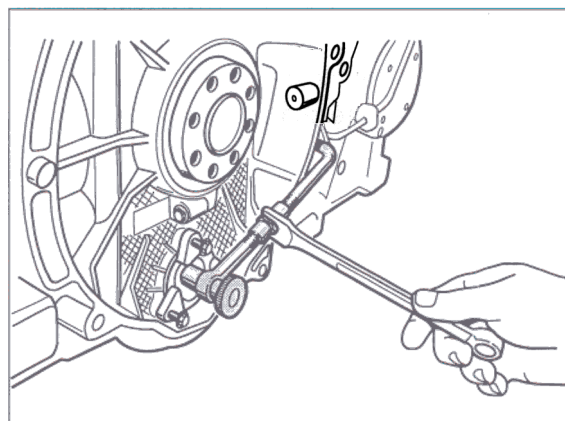


9. Undo intermediate shaft flange.

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.

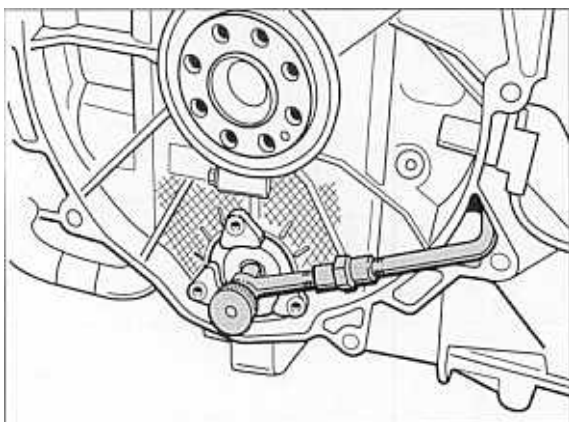


442\_97

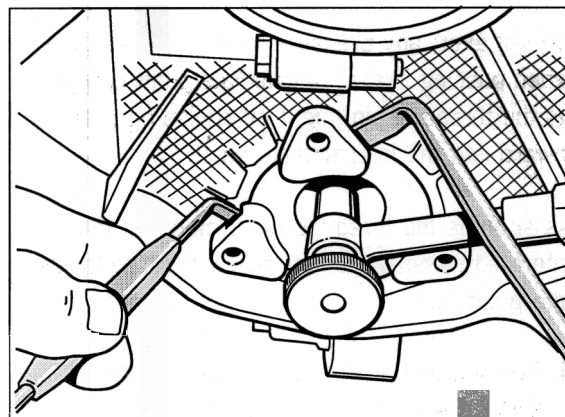


11. Carefully press off the intermediate flange. Proceed carefully so as not to damage the sealing surfaces.

10. Position and align retaining device special tool 9642.



15230008



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 (deburr) 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.

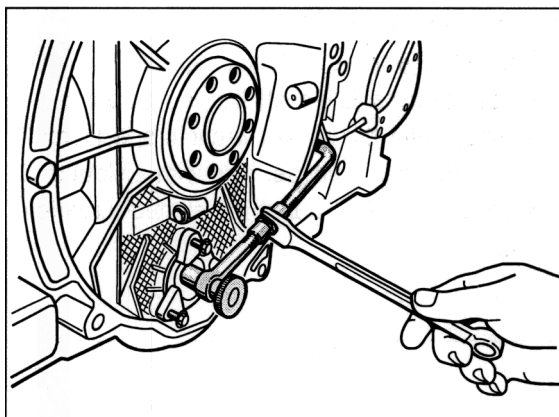
3. Position intermediate shaft flange on the bore and affix with new micro-encapsulated hexagon-head bolts.

#### 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).

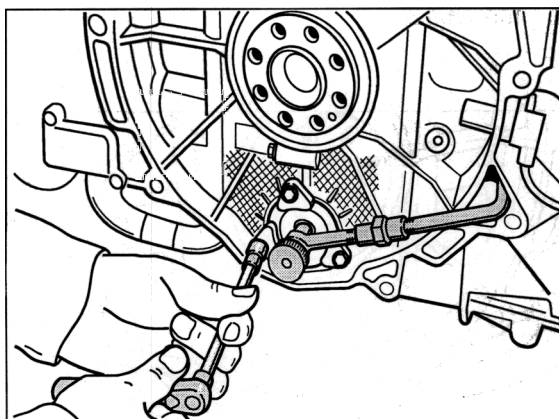


15230001

#### Note

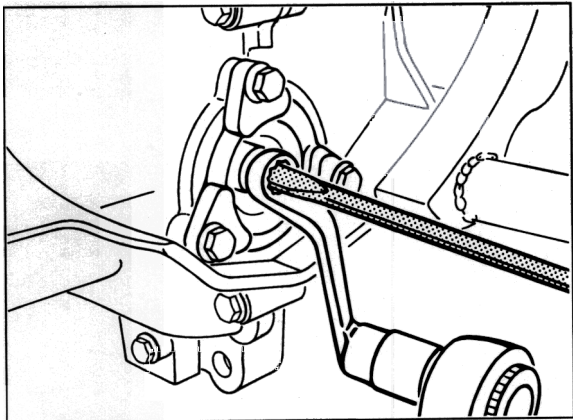
It must be possible to insert the intermediate shaft flange almost completely into the intermediate shaft bore by hand.

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 (22 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 pressure 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

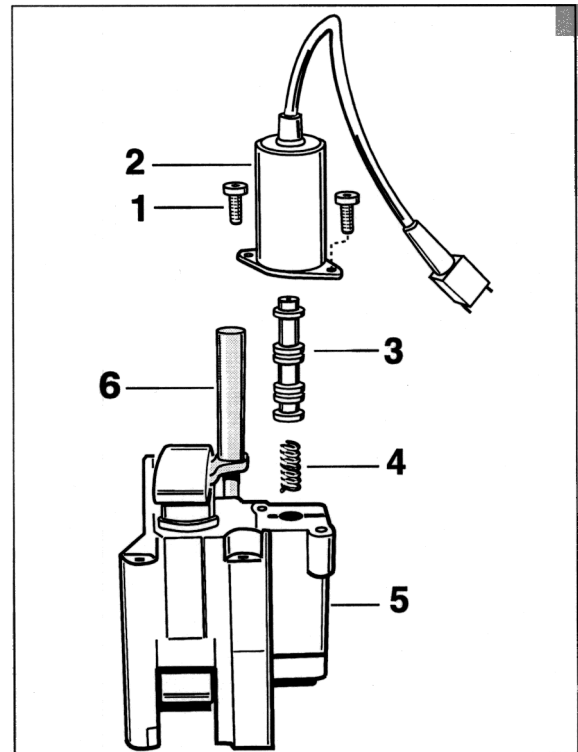
**Note**

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  $3.7 + 0.15 \text{ Nm}$   
( $2.7 + 0.10 \text{ ftlb.}$ )



331\_98

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.

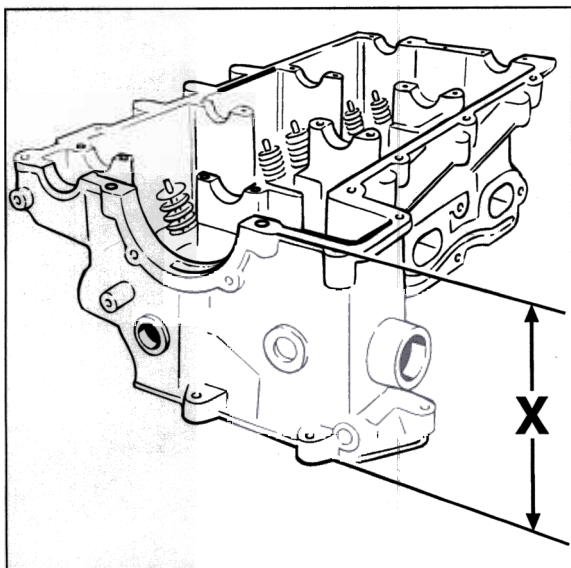
Permissible unevenness after machining:  
0.03 mm.

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

Wear dimension: 141.65 mm

Note on machining the sealing surface:

Peak-to-valley height = 0.015 mm



349\_98

## **15 03 19 Removing and installing camshaft housing – GT3**

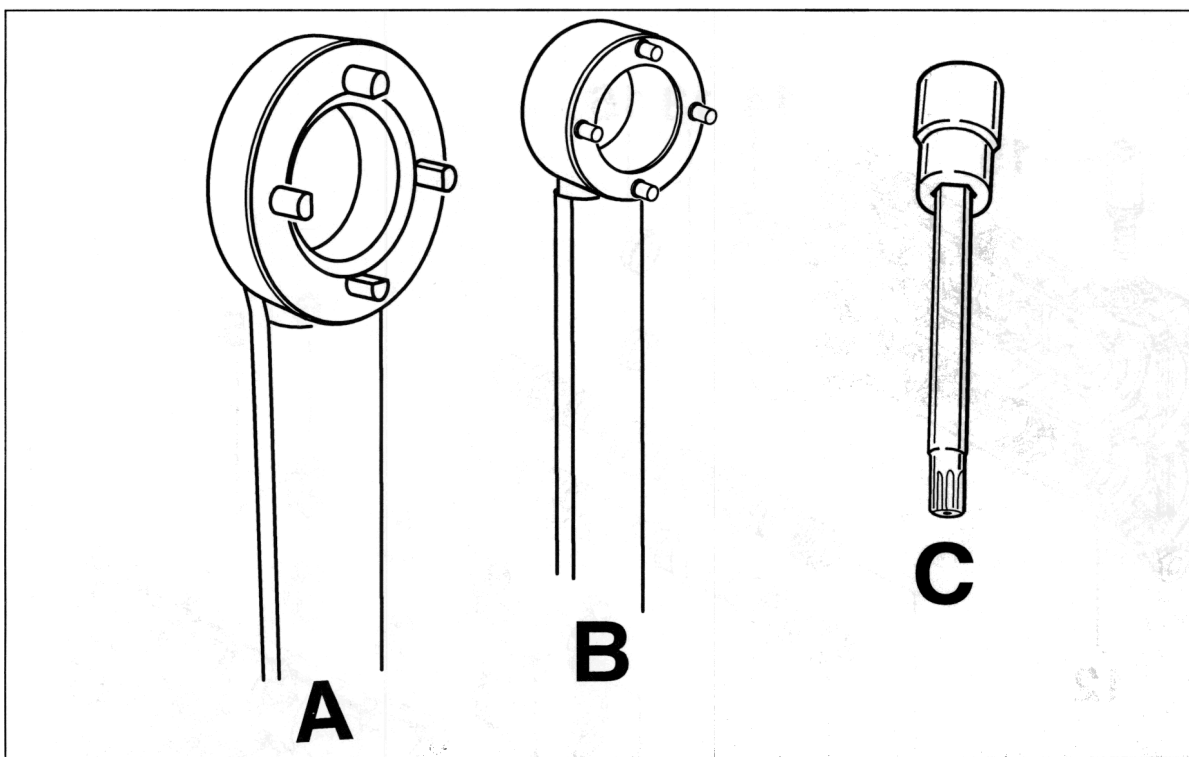
### **Includes:**

**15 03 21 Removing camshaft housing – GT3**

**15 03 21 Installing camshaft housing – GT3**

## 15 03 21 Removing camshaft housing – GT3

Tools – overview

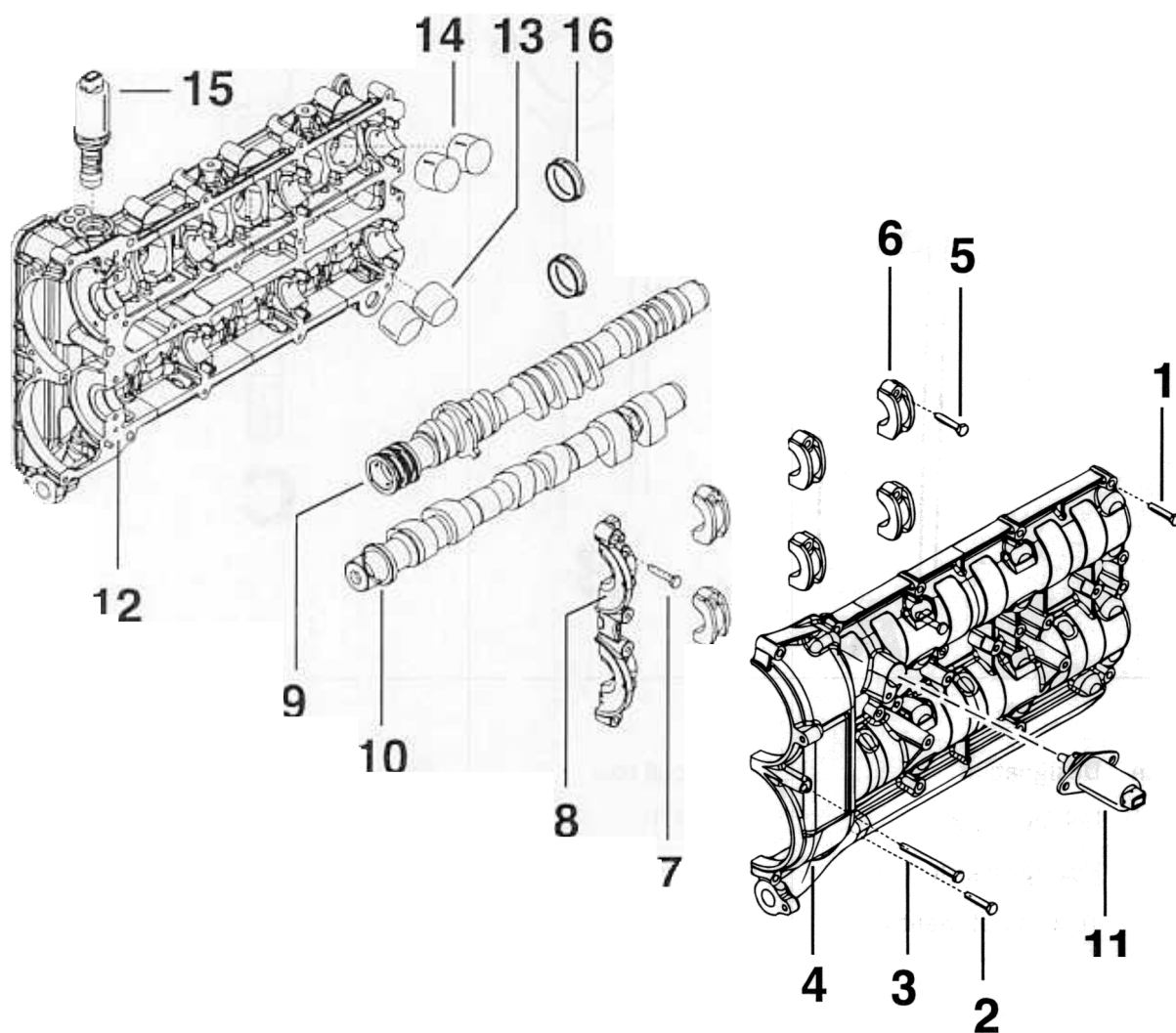


15050002

Item	Designation	Special tool	Explanation
A	Holding wrench	9653/1	For stopping the exhaust camshaft
B	Holding wrench	9653	For stopping the inlet camshaft
C	Torx socket wrench	9330	



Remove camshaft housing GT3



**Removing camshaft housing – GT3**

1	Hexagon-head bolt M6 x 35	16	10 Nm (7.5 ftlb.)
2	Hexagon-head bolt M6 x 45	2	10 Nm (7.5 ftlb.)
3	Hexagon-head bolt M6 x 70	1	10 Nm (7.5 ftlb.)
4	Camshaft housing lid	1	Matching number
5	Hexagon-head bolt M6 x 30	12	Bolt quality 10.9; 13 Nm (9.5 ftlb.)
6	Camshaft bearing saddle	6	Location, position and matching number
7	Hexagon-head bolt M6 x 35	4	Bolt quality 10.9; 13 Nm (9.5 ftlb.)
8	Thrust bearing cover	1	
9	Inlet camshaft	1	Varies between cylinder bank 1-3 and 4-6
10	Exhaust camshaft	1	
11	Hall sensor	1	
13,14	Flat-base tappet	12	Do not exchange
15	Hydraulic valve	1	Equip with new sealing rings
16	Closure cap	2	Replace

## Removing camshaft housing – GT3

### Preliminary work:

Remove exhaust system  
(Serv. No.: 26 01 21)

Remove intake distributor  
(Serv. No.: 24 26 21)

Remove oil container  
(Serv. No.: 17 52 21)

Remove oil/water bracket  
(Serv. No.: 17 62 21)

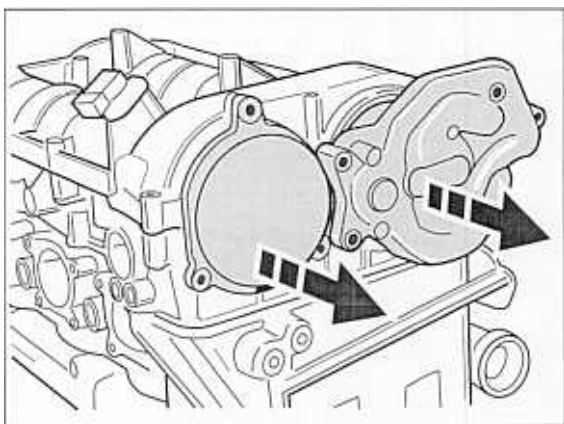
Remove coolant guide housing

Remove bracket for generator  
(Serv. No.: 27 27 19)

Remove spark plugs  
(Serv. No.: 28 71 21)

1. Remove oil extraction pump  
(Serv. No.: 17 19 21).

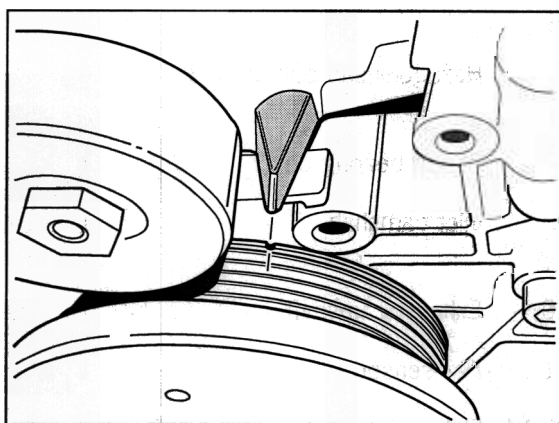
To do so, unscrew the fastening screws and remove the oil extraction pump. Unscrew the three screws on the closure cap and remove the cap.



269\_99

2. Set engine to top dead centre.

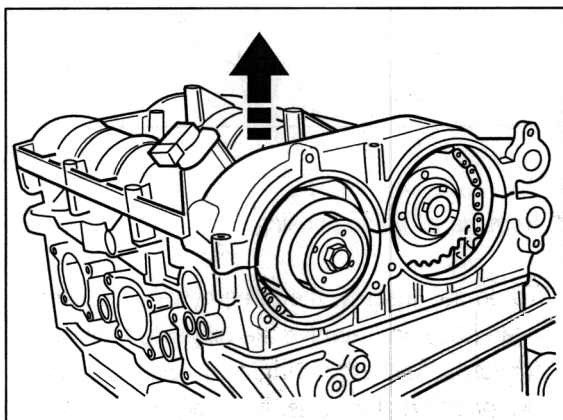
To do so, only push the generator bracket into place. Set engine to top dead centre. Turn the engine using the belt pulley in running direction until the TDC markings on the belt pulley and on the generator bracket coincide. Remove bracket for the generator.



210\_99

### 3. Remove valve cover.

Unscrew the valve cover screws (17 pieces) and remove the valve cover. If the valve cover is stuck, loosen it by gently tapping with a plastic hammer.



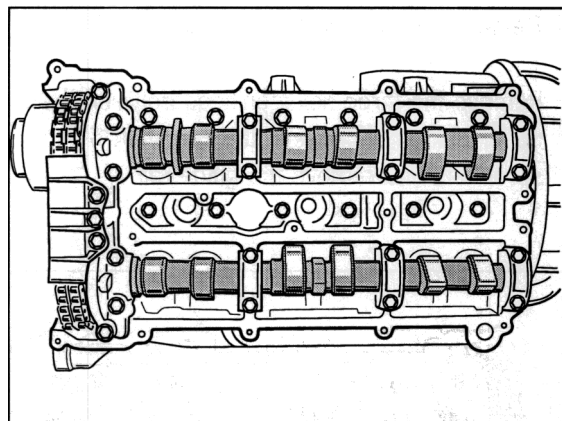
176\_99

### 4. Relieve camshaft.

For any further work, it is sensible to turn the engine in such a way that the camshafts do not press on the valves.

With cylinder bank 1-3, the cams of the first cylinder should point outwards and diagonally upwards.

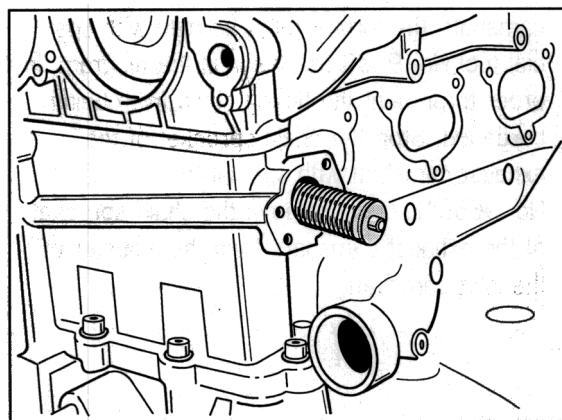
With cylinder bank 4-6, the cams of the fourth cylinder should point outwards and diagonally downwards.



251\_99

### 5. Relieve the timing chain.

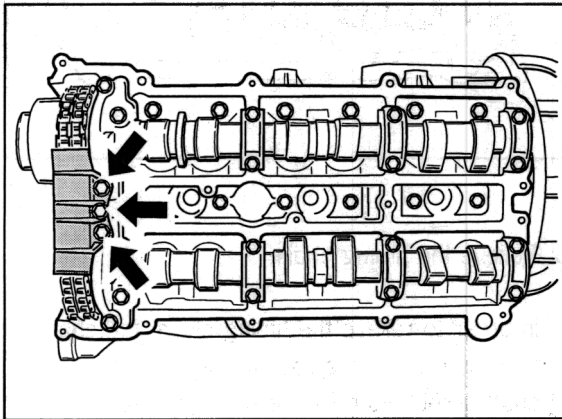
In order to relieve the timing chain, the chain tensioner and the guide rail between the camshaft sprockets must be removed. Remove both the hexagon-head bolts of the chain tensioner. Remove the chain tensioner cover and the chain tensioner.



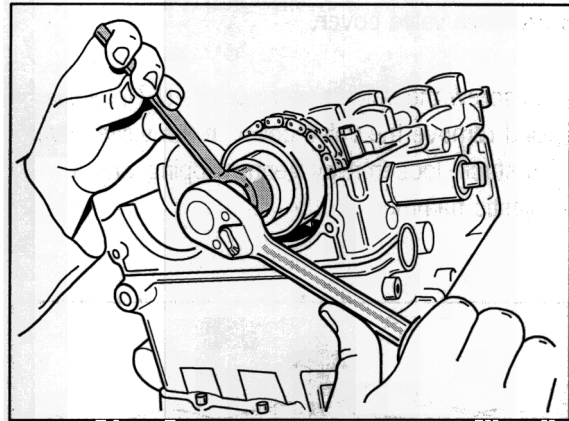
267\_99

6. Remove the guide rail.

Remove the three hexagon-head bolts on the upper guide rail between the camshaft sprockets and remove the guide rail.



!11\_99



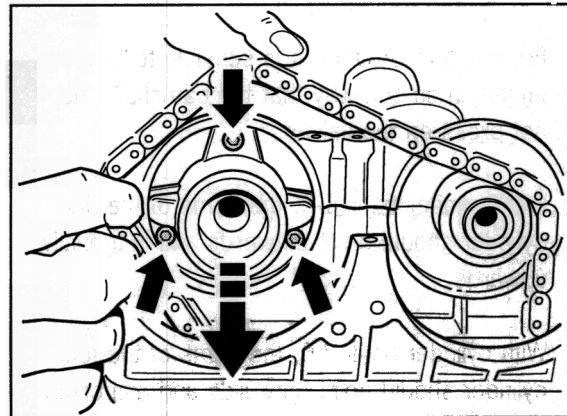
233\_99

8. Remove oil guide housing.

To do so, unscrew the three hexagon socket head bolts and remove the oil guide housing forwards. The left and right oil guide housings are of different lengths. If the oil guide housing is stuck, loosen the thrust bearing cover.

7. Remove the chain sprockets of the camshafts.

When removing the chain sprocket of the inlet camshaft, the former must be held with special tool No. 9653 as shown in the diagram, in order to prevent the timing chain from being burdened. Stop the chain sprocket of the exhaust camshaft with special tool No. 9653/1. First remove the chain sprocket of the exhaust camshaft, then the adjuster of the inlet camshaft.



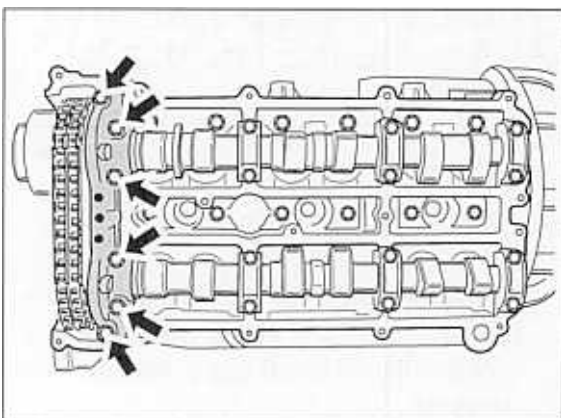
264\_99



## Removing camshaft housing – GT3

### 9. Remove the thrust bearing cover.

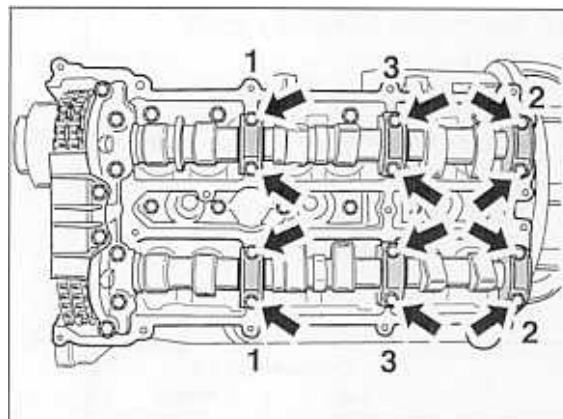
In order to remove the thrust bearing cover of the camshafts, unscrew the remaining six hexagon-head bolts and remove the thrust bearing cover forwards.



212\_99

### 10. Removing camshafts.

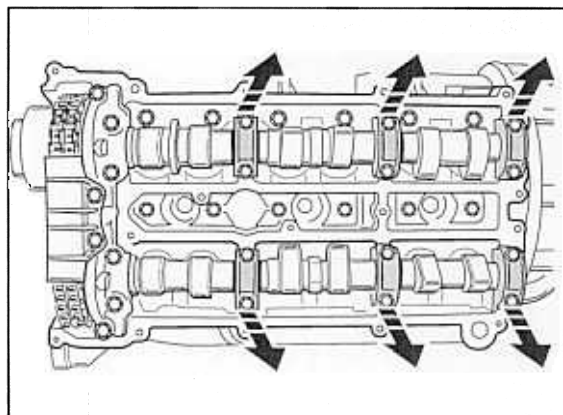
Unscrew the fastening screws of the six camshaft bearings alternately in 1/2-turn steps in the given order, until the camshaft is completely free of tension. If the bearing saddles are stuck, loosen them with a light tap at the side with a screwdriver handle.



213\_99

### 11. Remove camshaft bearing saddles.

Lift the camshaft bearing saddles up and off. The bearing saddles must not be exchanged or twisted under any circumstances. Therefore it is sensible to sort the bearing saddles. The bearing saddles possess a matching number to the respective cylinder head and an identification showing the installation position. Lift the camshafts carefully up out of the camshaft housing.



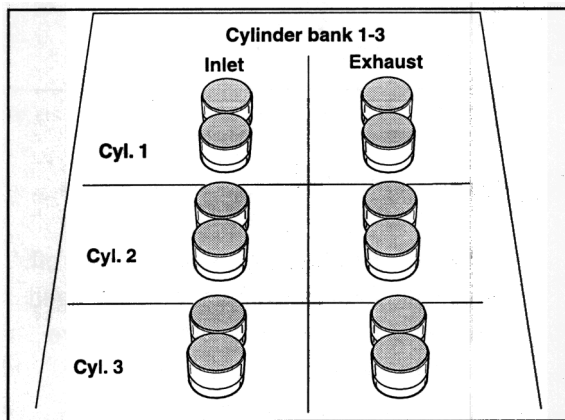
271\_99



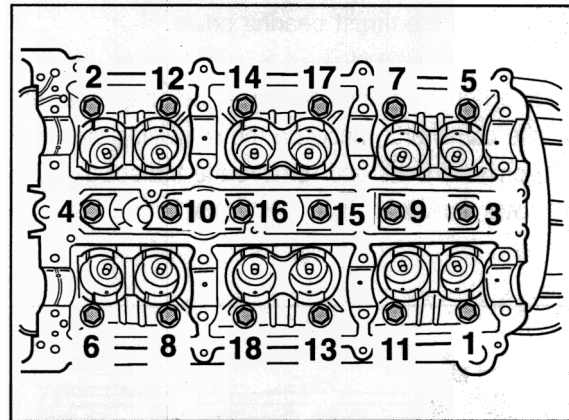
## Removing camshaft housing – GT3

### 12. Remove the flat-based tappets.

Pull the flat-based tappets upwards out of the cylinder head. In order to avoid confusing the corresponding flat-based tappets, lie them on a prepared sheet of paper as shown in the diagram.



208\_99



261\_99

### 14. Remove the camshaft housing.

Remove the camshaft housing upwards, moving it evenly and without tilting. Make sure that the flat-based tappet guides are not damaged.

### 15. Remove the seals.

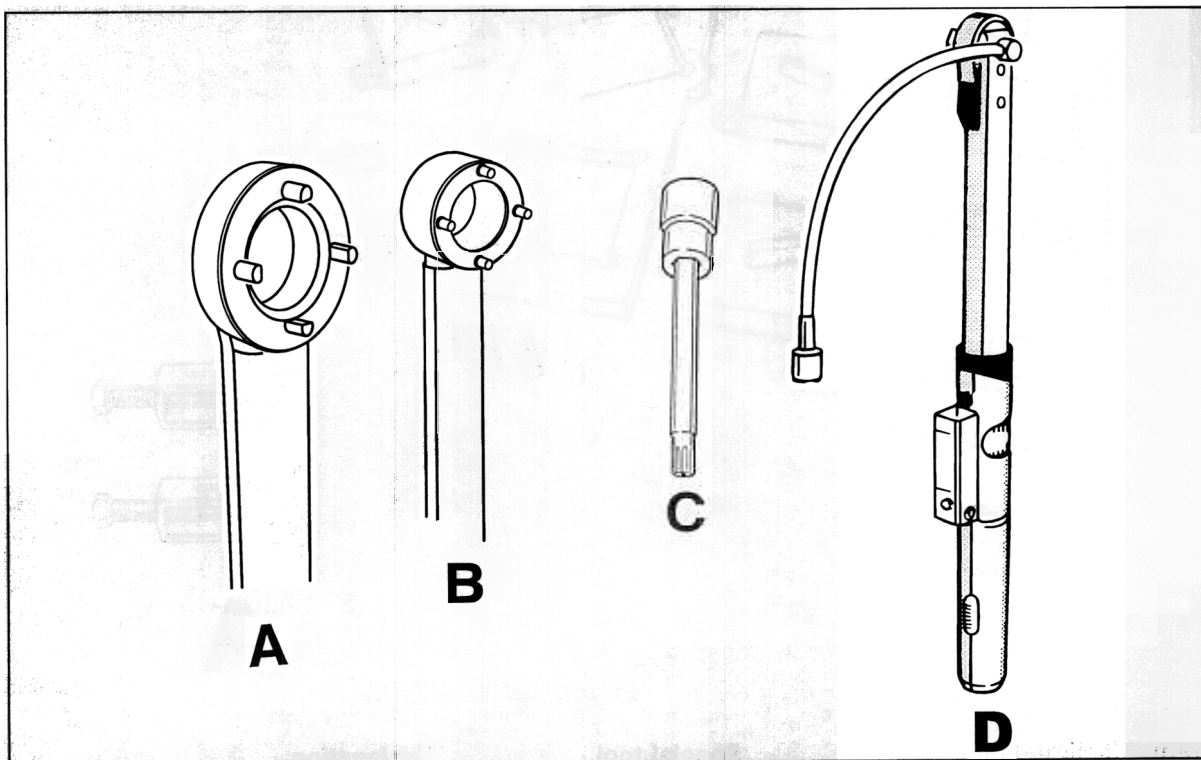
Remove the seal between the camshaft housing and the cylinder head. Do not use the seal again.

### 13. Remove the camshaft housing.

Unscrew the 18 hexagon-head bolts of the camshaft housing. Unscrew the camshaft housing bolts as shown in 1/2-turn steps from the outside inwards.

## 15 03 23 Installing camshaft housing – GT3

### Tools – overview

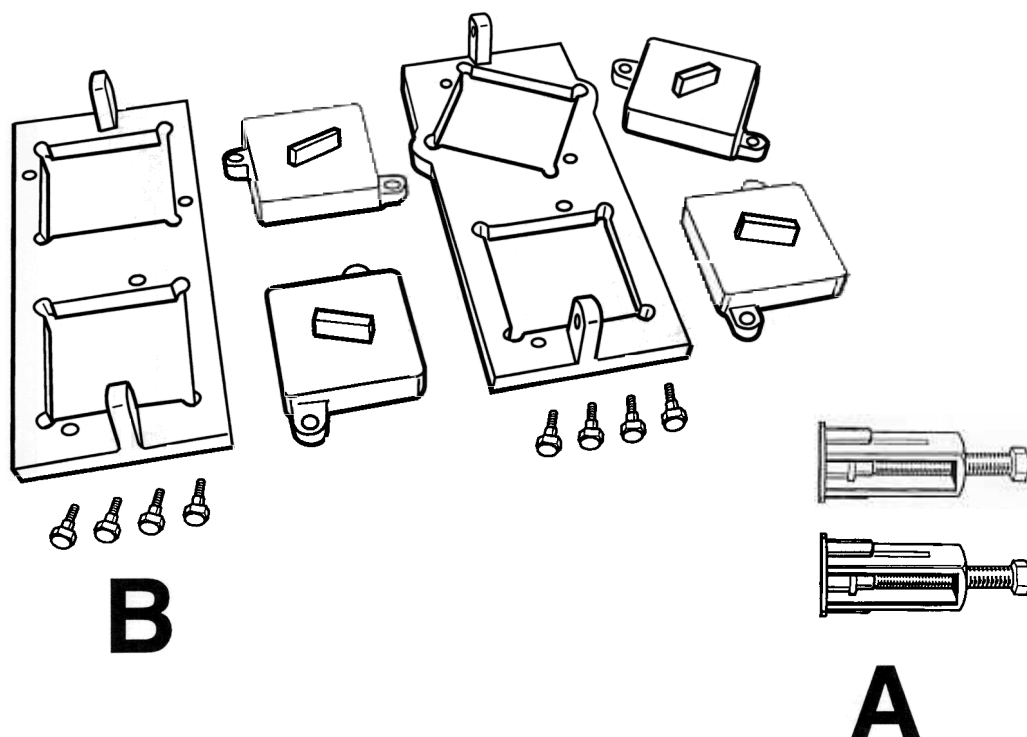


15050001

Item	Designation	Special tool	Explanation
A	Holding wrench	9653/1	For stopping the exhaust camshaft
B	Holding wrench	9653	For stopping the inlet camshaft
C	Torx socket wrench	9330	
D	Torque angle wrench - gradoscope	715/20 or 716/20	For torque-angle-controlled tightening of screw connections

## Installing camshaft housing – GT3

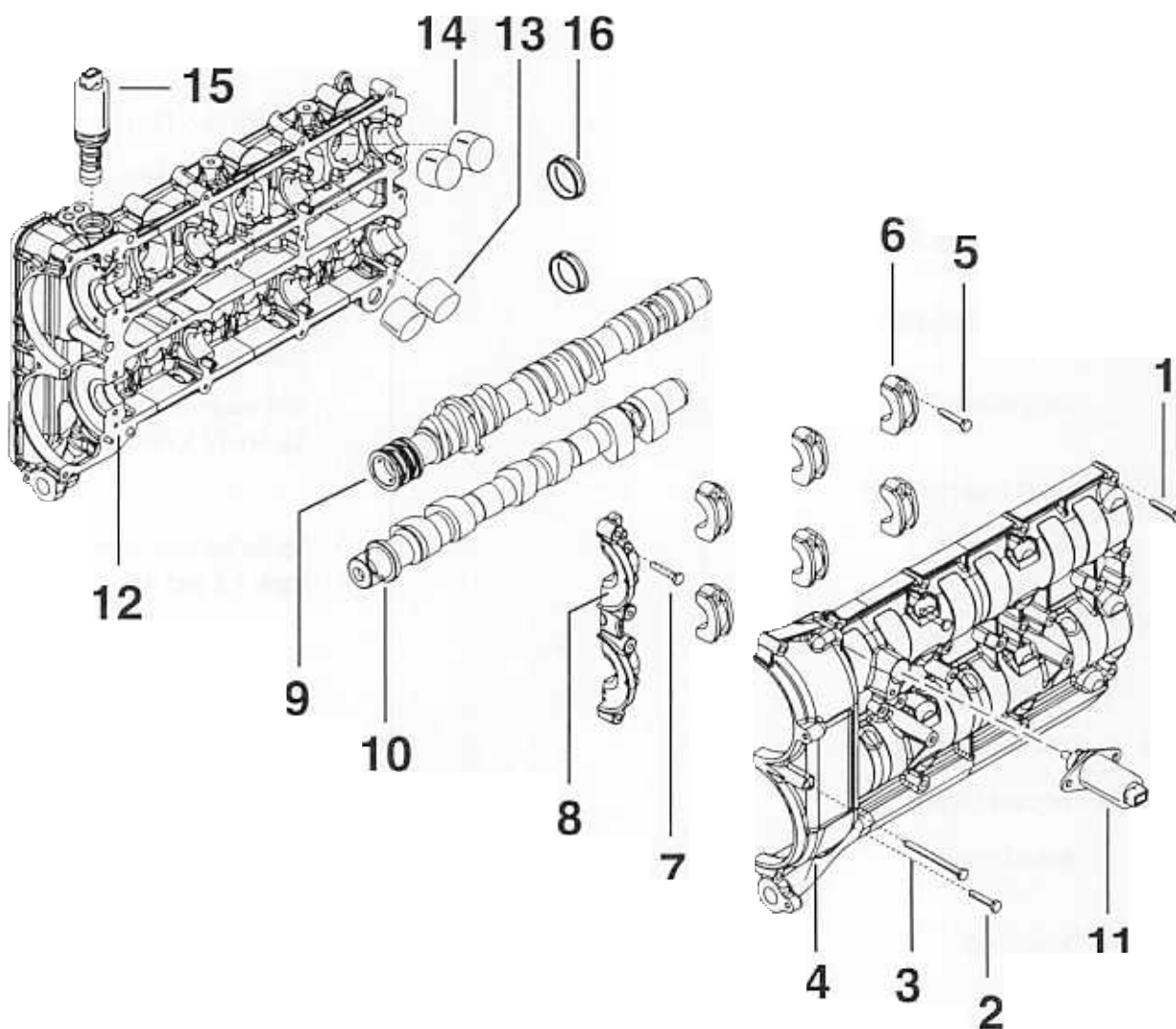
### Tools - overview



15700013

Item	Designation	Special tool	Explanation
A	Auxiliary chain tensioner	9401	In order to remove play from the control chain
B	Camshaft staking tool	9661, 9661/2	In order to fix the camshafts in the correct position

## Installing camshaft housing – GT3



217\_99

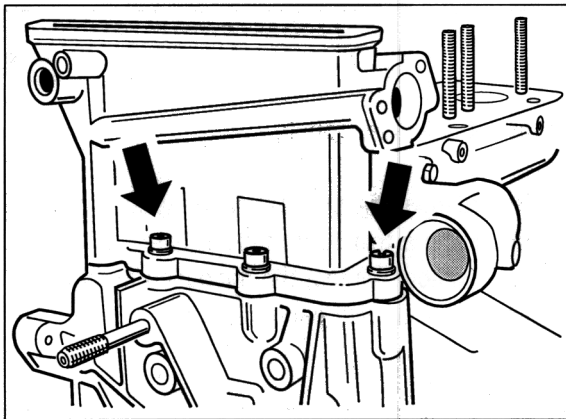
### Installing camshaft housing – GT3

No.	Designation	Qty.	Removal	Note:	Installation
1	Hexagon-head bolt M6 x 35	16			10Nm
2	Hexagon-head bolt M6 x 45	2			10 Nm (1.5 ftlb.)
3	Hexagon-head bolt M6 x 70	1			10 Nm (1.5 ftlb.)
4	Camshaft housing lid	1			Observe pairing number.
5	Hexagon-head bolt M6 x 30	12			Bolt quality 10.9; 13 Nm (9.5 ftlb.)
6	Camshaft bearing saddle	6			Location, position and matching number
7	Hexagon-head bolts M6 x 30	4			Bolt quality 10.9; 13 Nm (9.5 ftlb.)
8	Thrust bearing cover				
9	Inlet camshaft	1			Varies between cylinder bank 1-3 and 4-6
10	Exhaust camshaft	1			
11	Hall sensor	1			
12	Camshaft housing	1			Matching number
13, 14	Flat-base tappets	12			Do not exchange
15	Hydraulic valve	1			Equip with new sealing ring
16	Closure cap	2			Replace; fit dry

## Installing camshaft housing – GT3

Insert chain box.

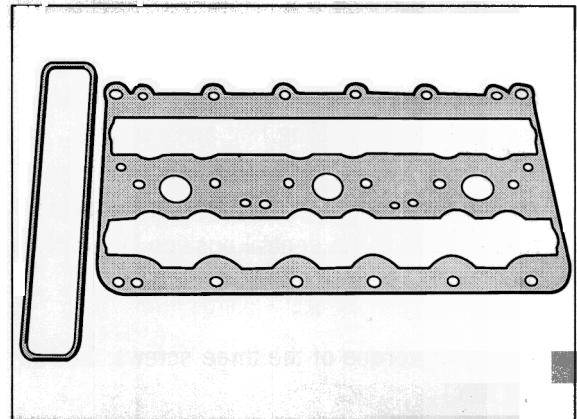
Replace lower seal on chain box. Tighten the five hexagon socket head bolts of the chain box with a commercially available socket with socket wrench insert a/f 6 (Commercially available tools, Chapter 2.4, No.: 17-1). The two indicated screws are longer. Tightening torque: 23 Nm (17 ftlb.)



218\_99

### 2. Replace seals.

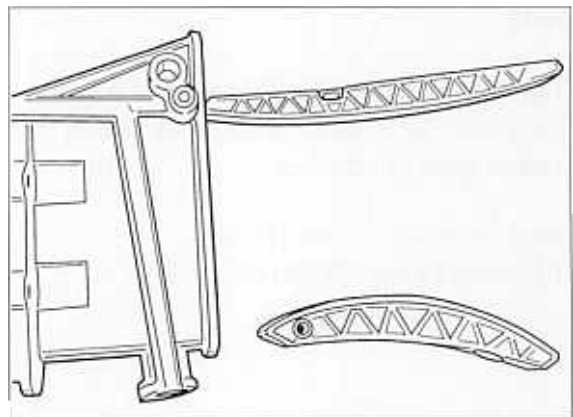
Replace the seals on the upper chain box and the seal between the cylinder head and the camshaft housing. Make sure that the designation "TOP" faces upwards.



259\_99

### 3. Insert guide rails

Insert the shorter, curved guide rail in the chain tensioner. Insert the longer guide rail in such a way that the slot points towards the crankcase. The guide rails of the left and right sides of the engine are of different lengths. The guide rail of cylinder bank 4 - 6 is longer.



294\_99

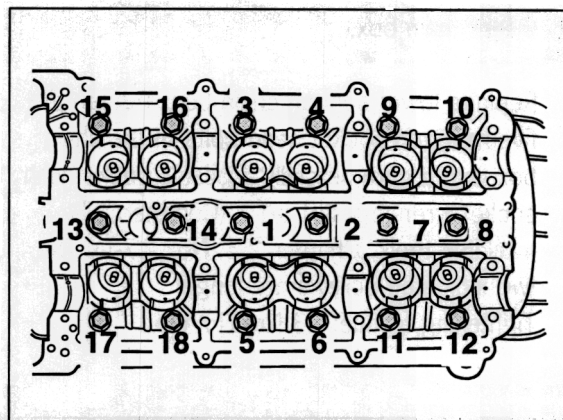


## Installing camshaft housing – GT3

### 4. Tighten guide rails

Equip the three fastening screws of the guide rails with a new sealing ring and screw in place. The two lighter anodised screws must go into the crankcase. Ensure that the guide rails engage in the central position in the chain box.

Tightening torque of the three screws: 31 Nm (17 ftlb.)



### 5. Place the camshaft housing in position.

364\_99

Place the camshaft housing carefully in position. Make sure that the flat-based tappet guides are not damaged.

### 6. Mount the 18 hexagon-head bolts.

Prepare and position the 18 hexagon-head bolts. Tighten the bolts from the inside outwards in the shown sequence.

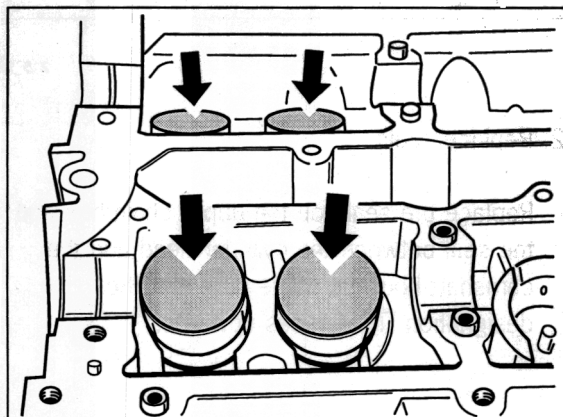
#### Note:

The fastening screws on the camshaft housing must be of 10.9 quality. If the quality is 8.8, the screws must be replaced.

Initial tightening: 23 Nm (17 ftlb.)  
Tightening torque: 28 Nm (21 ftlb.)

### 7. Insert flat-base tappets.

Before inserting the flat-based tappets, smear them with a thin coat of clean engine oil. Make sure without fail that the flat-based tappets are not confused with each other.



293\_99

## Installing camshaft housing – GT3

### 8. Install camshafts.

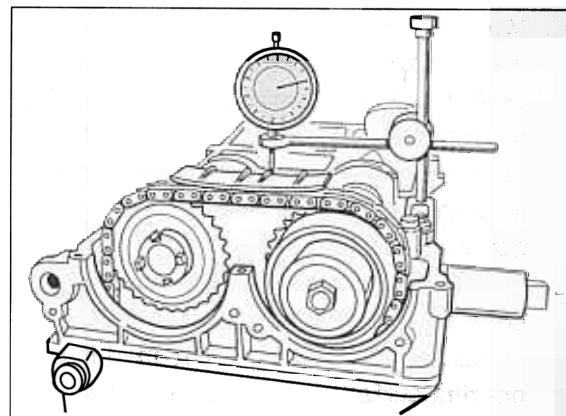
Apply a **thin** coat of Optimol Optipit (00004320417) grease on the camshaft bearing surfaces. Insert the camshafts into the camshaft housing.

Designation of the camshaft cylinder bank 1-3

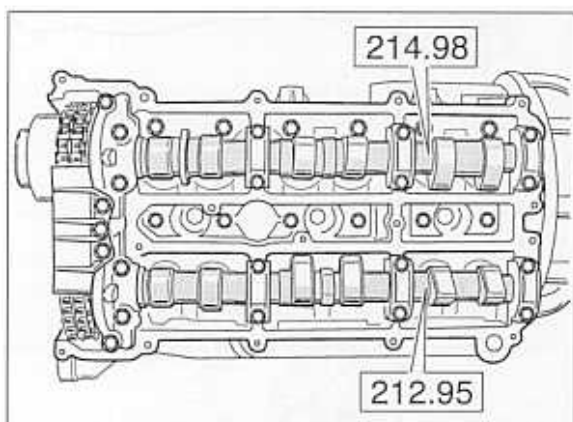
Inlet: 214.99 Exhaust: 212.95

Designation of the camshaft cylinder bank 4-6

Inlet: 214.98 Exhaust: 212.95



15700001

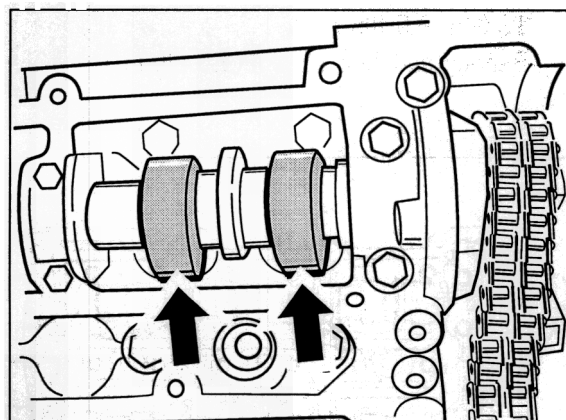


Designation position

393\_99

### 10. Insert camshafts.

With cylinder bank 1-3, insert the camshafts in such a way that the cams of the first cylinder point inwards and diagonally inwards.



View of a camshaft, cyl. 1

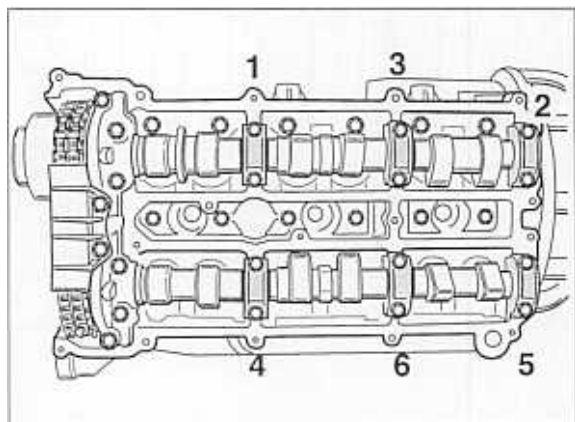
15700018

### 9. Set engine to top dead centre.

Using a universal holder, mount a dial gauge on each of the cylinder heads in such a way that it is possible to measure from the gauge on the piston crown from cylinder 1 or 4. Turn the engine in running direction until no further deflection takes place on the dial gauge or until the first and fourth cylinders are at top dead centre.

## Installing camshaft housing – GT3

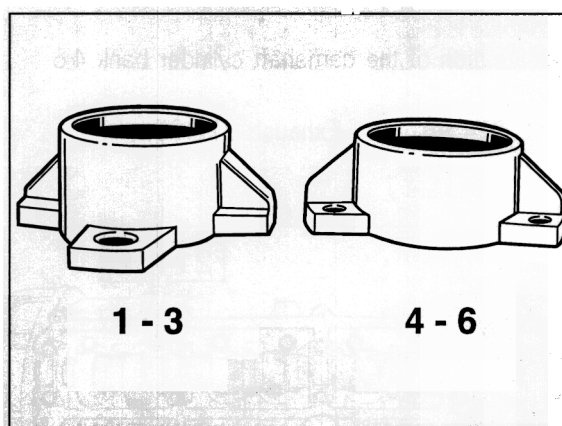
11. Make sure that the timing chain lies above the camshafts. Place the camshaft bearing saddles in their original installation position. Pay attention to the matching number to the camshaft bearing housing. The installation numbers on the bearing saddle and on the camshaft bearing housing must point towards each other. Place the thrust bearing cover on top. It must be ensured that the camshafts **are properly positioned in the bearing surfaces**. Screw in fastening screws (M6x30) by hand. Tighten the thrust bearing cover and the camshaft bearing saddles in the sequence shown. Push both camshafts towards the engine support. Use a plastic hammer for this purpose. Grease the bearing surfaces of the double bearing saddle and fit. Fasten the bearing saddles only when the double bearing saddle lies absolutely flat on the camshaft housing. Tightening must be carried out evenly. Tightening torques: Thrust bearing cover: 13 Nm (9.5 ftlb.)  
Bearing saddles: 13 Nm (9.5 ftlb.)



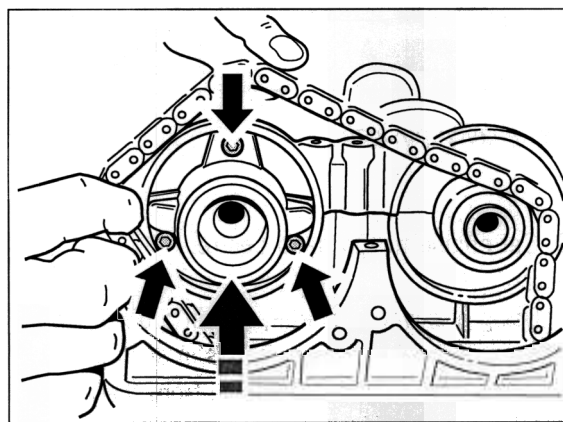
262\_99

12. Mount the oil guide housing.

The oil guide housings of the individual cylinder banks are of different lengths (right (cylinders 4-6) 27 mm, left (cylinders 1-3) 31 mm). Replace the three hexagon socket head bolts, bond them in with Loctite 270 and tighten them to 9.7 Nm (7.0 ftlb.).



263\_99



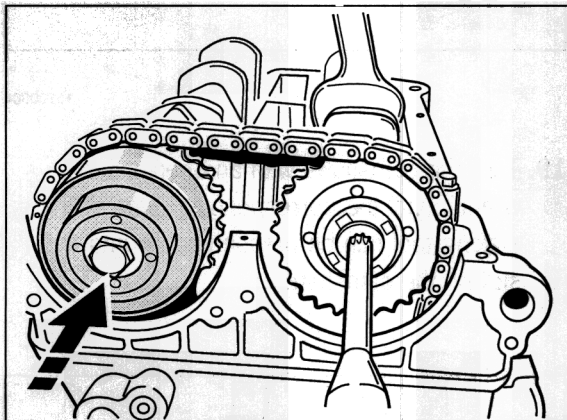
263\_99



## Installing camshaft housing GT3

### 3. Mount the inlet camshaft adjuster.

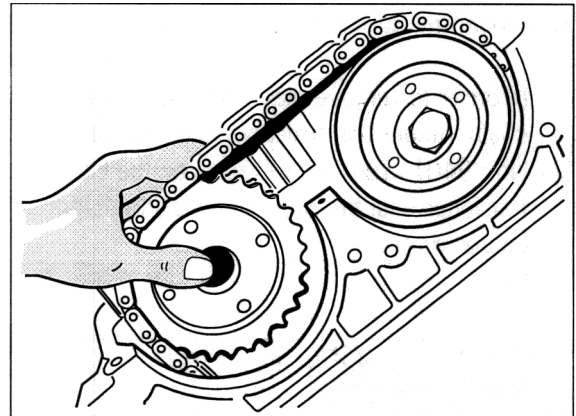
Place the inlet camshaft adjuster on the inlet camshaft and at the same time place the timing chain on the inlet camshaft adjuster. Place the fastening screw in position, but do not tighten it. Make sure that the timing chain is fed correctly in the guide rail.



412\_99

### 14. Mount the chain sprocket of the exhaust camshaft.

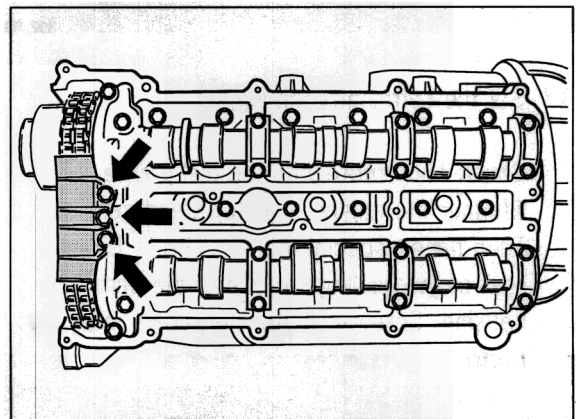
Clean the assembly surfaces of the exhaust camshaft and of the chain sprocket and remove all oil and grease. Place the chain sprocket for the exhaust camshaft into the timing chain and place them together onto the exhaust camshaft. Mount the driver for the oil pump and place the fastening screw in position, but do not tighten it. The inscription "left" must be legible on cylinder bank 1-3 and the inscription "right" on cylinder bank 4-6.



266\_99

### 15. Mount the guide rail between the camshaft wheels.

Tighten the three hexagon-head bolts to 13 Nm (9.5 ftlb.).

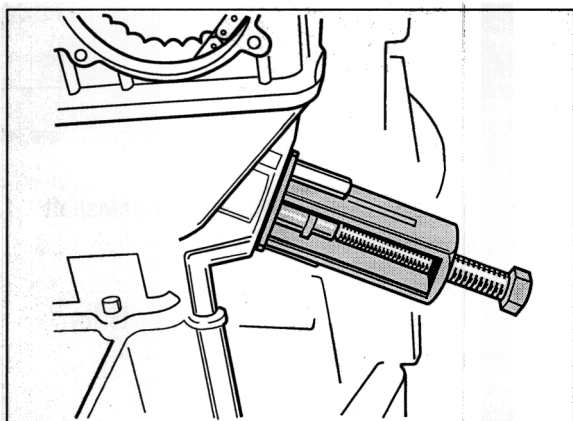


211\_99

## Installing camshaft housing – GT3

### 16. Mount the auxiliary chain tensioner.

In order to remove play from the timing chain, mount the auxiliary chain tensioner No.: 9401. Turn the hexagon on the chain tensioner until the ring on the piston is no longer visible.



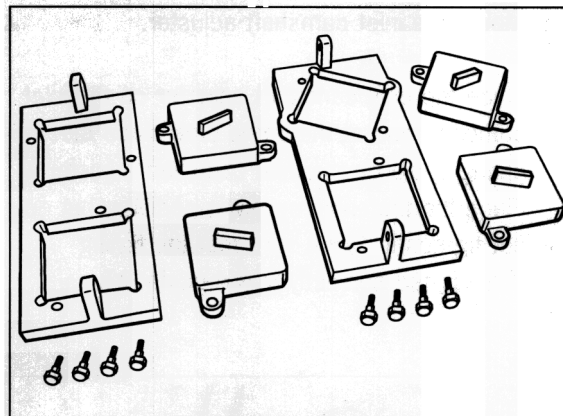
392\_99

### 17. Set the camshafts (timing).

Check once more with the dial gauge whether the engine is at top dead centre. Then flange special tool No.: 9661 on the rear of the sealing surface of the camshaft housing. Screw in fastening screws **only by hand**.

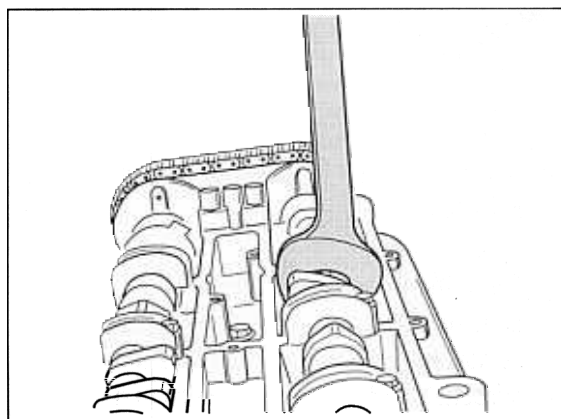
### 18. Place the staking tool in position.

Position the plates in such a way that the text is legible in a normal way. Place the individual plates into the assembly frame.



15700004

19. Turn the camshafts with an open-ended wrench until the corresponding plate of the staking tool can be pressed easily into the slot on the camshaft.



15700011

## Installing camshaft housing – GT3

### 20. Tighten the camshafts.

Before the camshafts are tightened, the adjusting unit must be turned with special tool No.: 9653 as far as the right stop. Tighten the camshafts to 30 Nm (22 ftlb.). Then remove the plates from the frame of the staking tool. **If the camshaft is tightened with the staking tool, there is a danger that the camshafts may be damaged.**

21. Stop the exhaust camshaft with the tool 9653/1 and tighten it with a 90° turn. The camshaft must not be turned in the process.

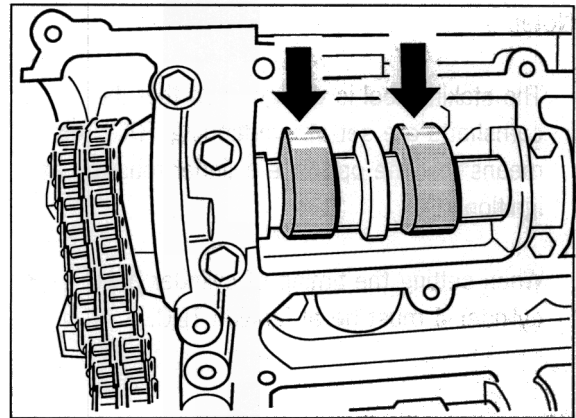
22. Stop the inlet camshaft with the tool 9653 and tighten it with a 130° turn. The camshaft must not be turned in the process.

23. Set the timing.

Rotate the crankshaft of the engine through 720° and check the timing setting.

23. Set the timing of cylinder bank 4 - 6.

Rotate the crankshaft of the engine 360° further. On cylinder bank 4 - 6, insert the camshafts in such a way that the cams of the fourth cylinder point outwards and diagonally outwards. Install camshafts analogous to cylinder bank 1 - 3.



View: Cams cylinder 4

15700017

Mount the staking tool on the other cylinder head. Check that the first or fourth cylinder stands at top dead centre. Set the timing with the same procedure as on the other cylinder head.



#### Caution!

**Engine damage if timing is not set correctly!**

- > 1. Engine must be at top dead centre.
- > 2. The opposite cylinder must be at ignition TDC!



## Installing camshaft housing GT3

Note:

The staking tool is designed so that the camshafts are set at overlapping TDC. This means that the opposite cylinder must be at ignition TDC.

When setting the timing of cylinder bank 1 - 3, cylinder 4 must be at ignition TDC.

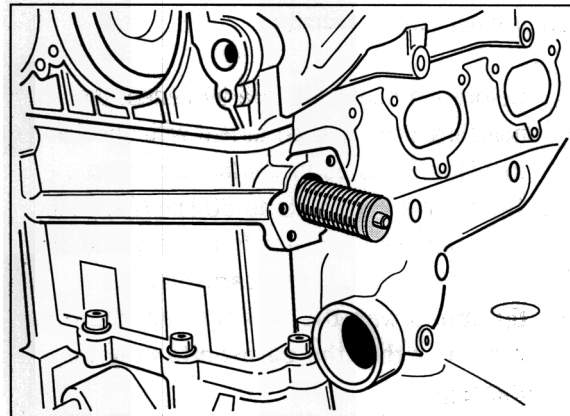
When setting the timing of cylinder bank 4 - 6, cylinder 1 must be at ignition TDC.

### 24. Check the timing.

Remove the staking tool. Turn the engine through two revolutions in running direction. Set engine to top dead centre again. Mount staking tool and check the camshafts on both cylinder heads.

### 26. Install chain tensioner.

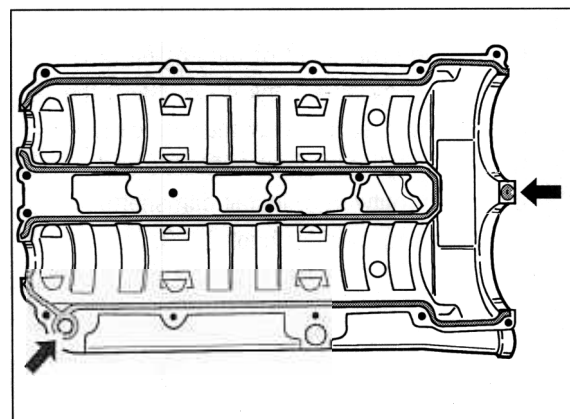
Remove the auxiliary chain tensioner. Insert the chain tensioner in the chain box. Check for the correct position and designation of the chain tensioner. Position the chain tensioner cover with new seal and tighten the two screws to 9.7 Nm (7.0 ftlb.).



267\_99

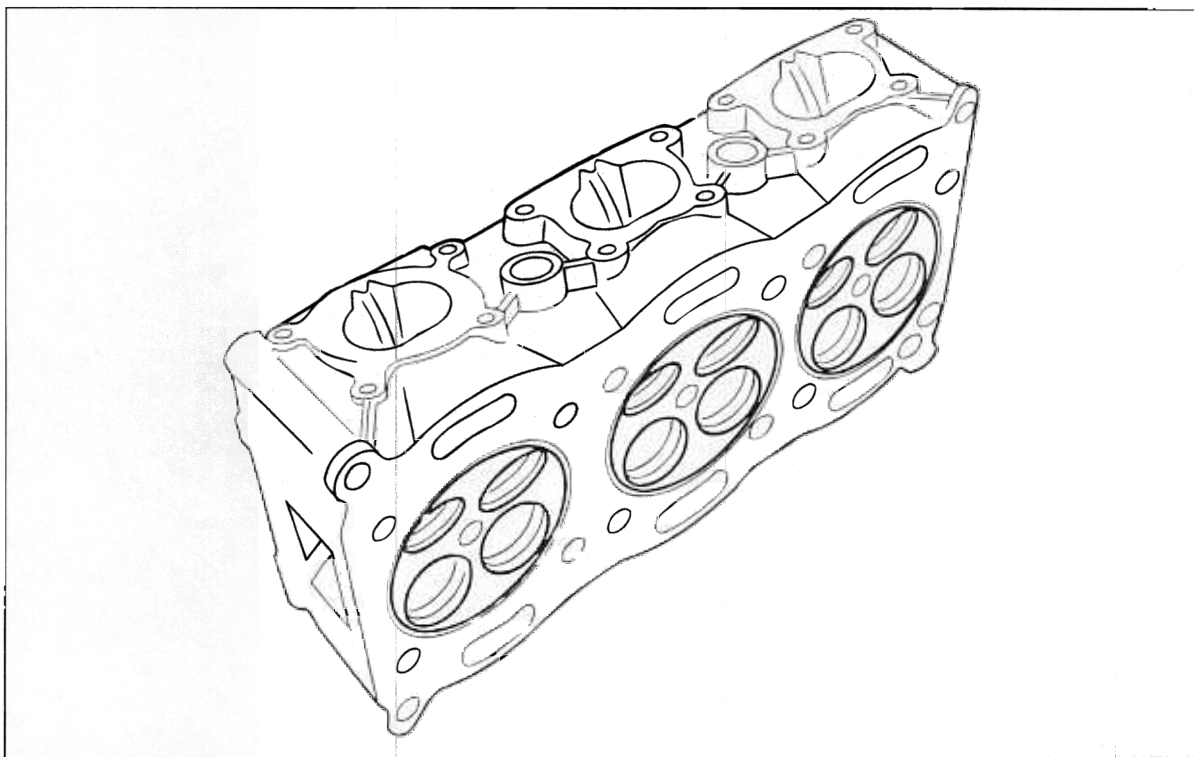
### 27. Replace valve cover.

Apply a further bead of sealant (Drei Bond 1209) to the cleaned valve cover (as shown in the picture). No more than five minutes must elapse between starting the application and replacing the valve cover. Apply a bead of no more than 1.5 mm thickness. Tighten screws to 9.7 Nm (7.0 ftlb.) from the inside outwards.



268\_99

**15 70 19 Removing and installing cylinder head – GT3**



10200001

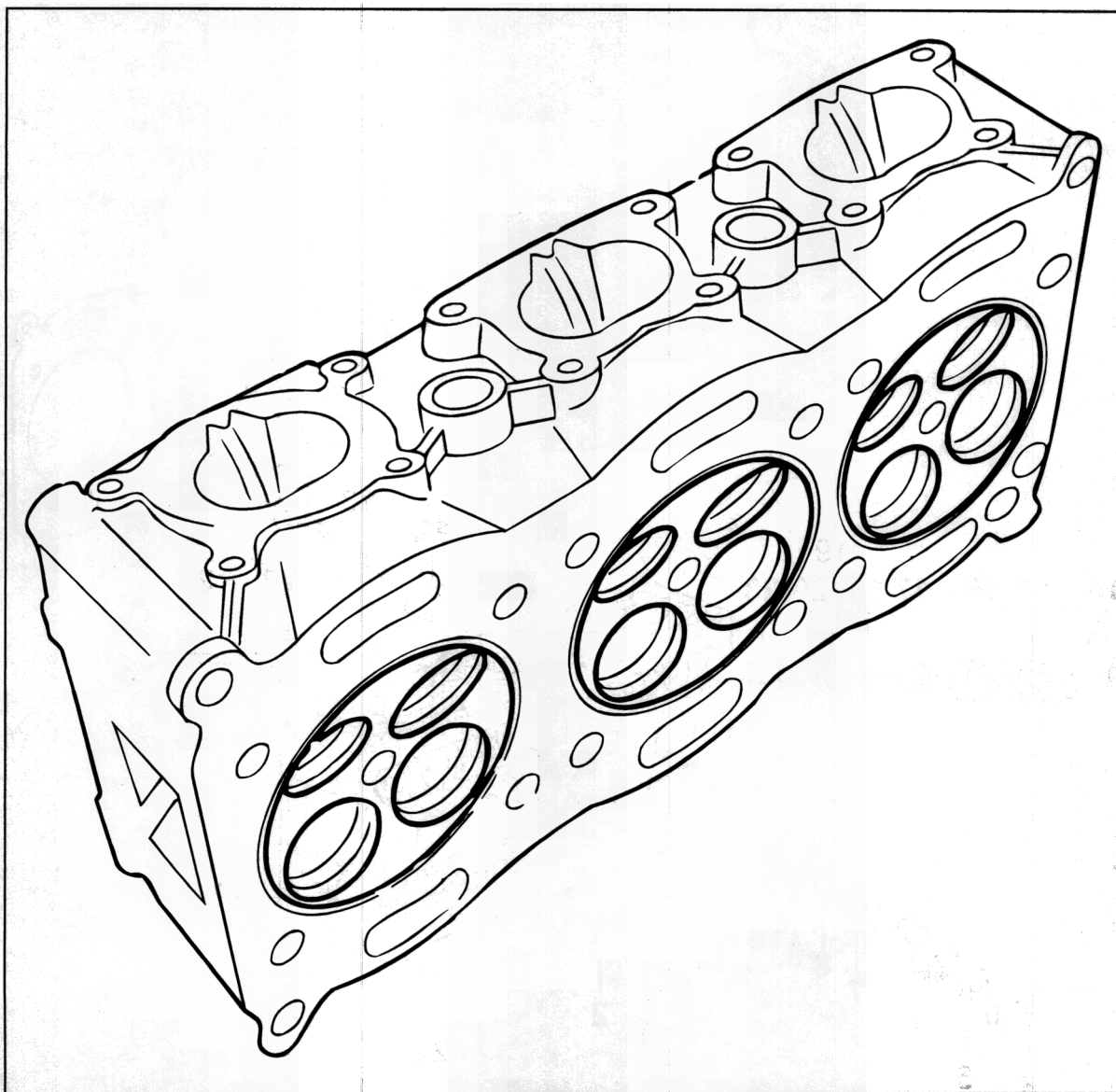
**Includes:**

**15 70 21 Removing cylinder head – GT3**

**15 20 23 Installing cylinder head – GT3**

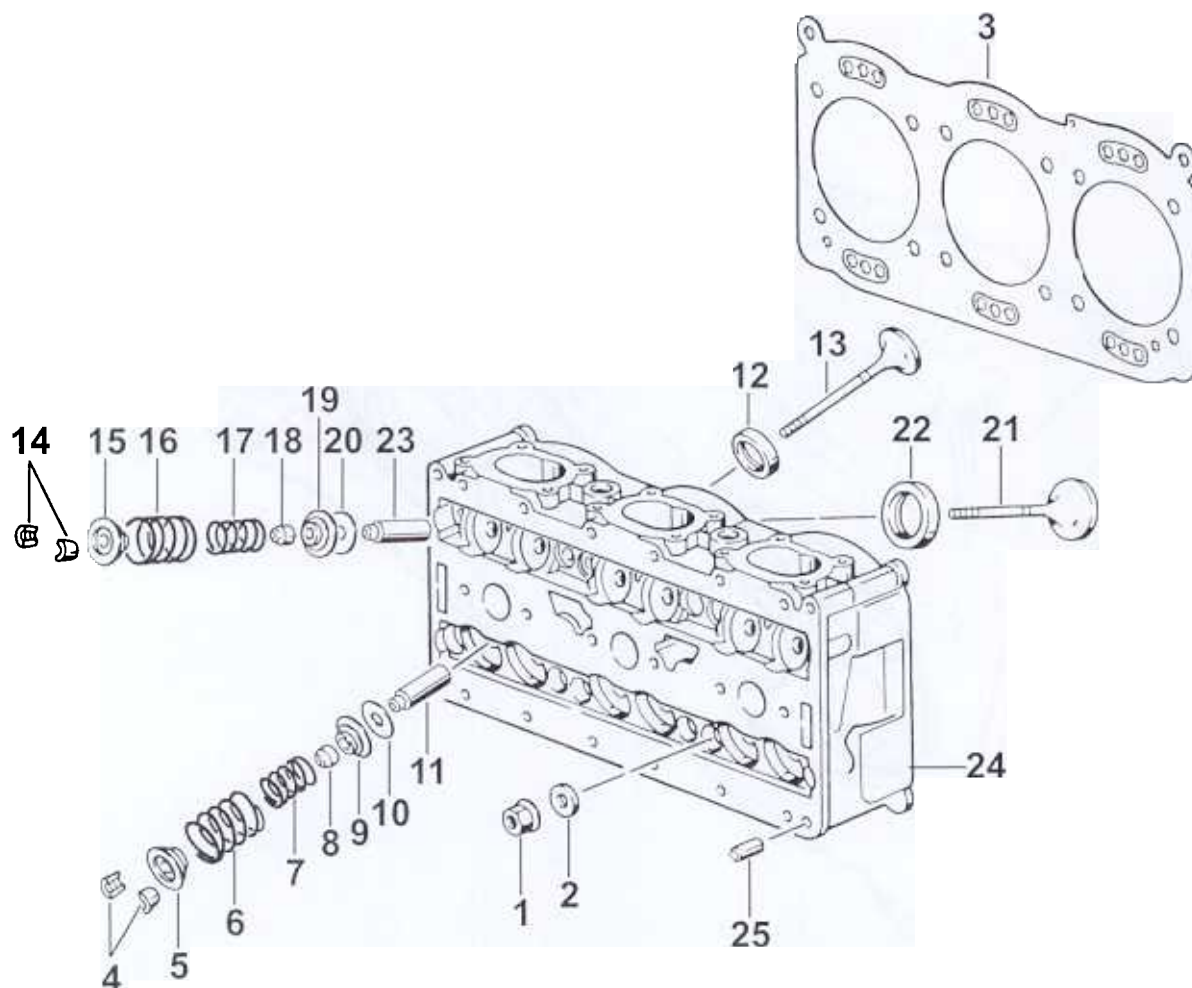


## 15 70 21 Removing cylinder head – GT3



10200001

## Removing cylinder head – GT3



413\_99

## Removing cylinder head – GT3

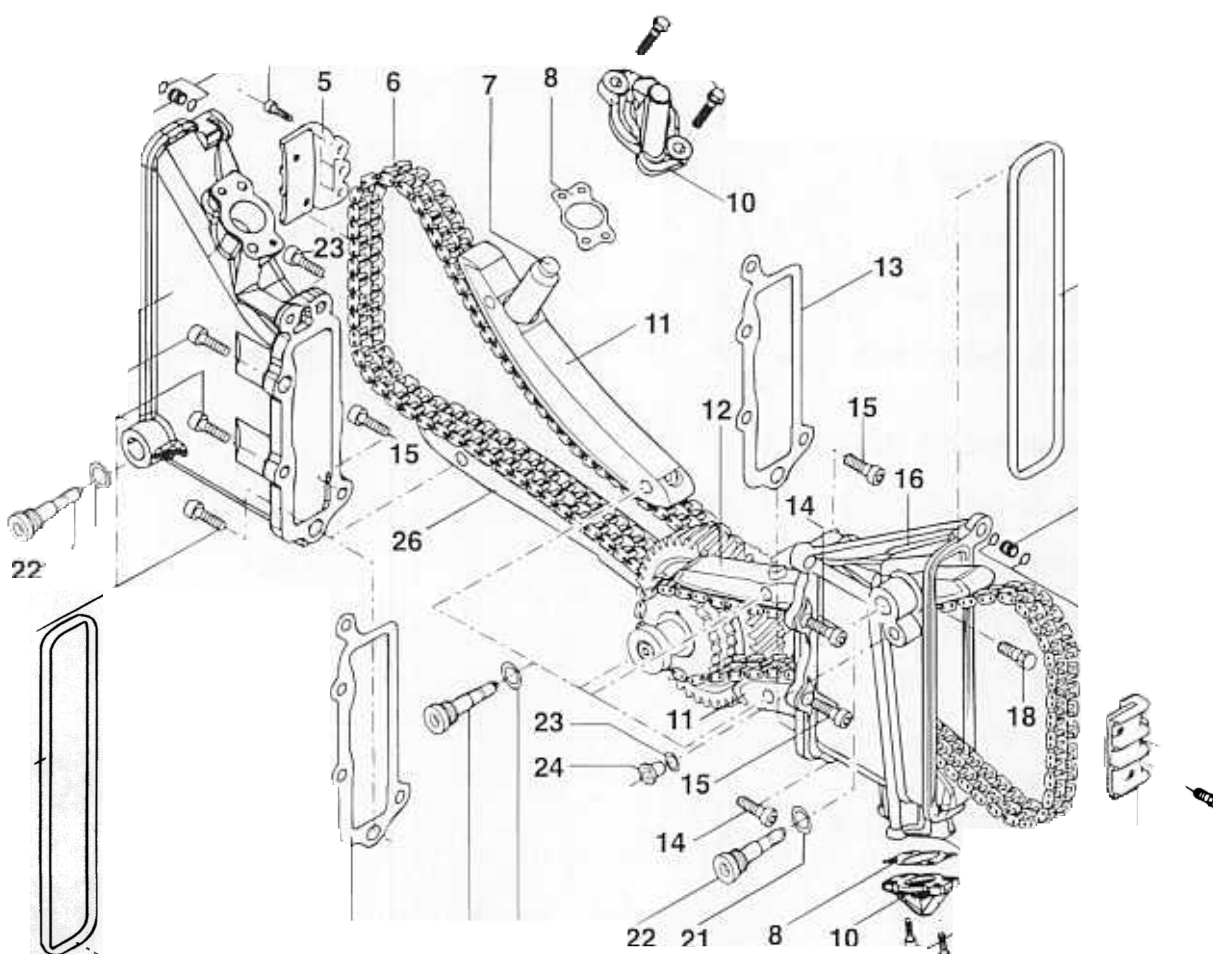
No.	Designation	Qty.	Removal	Note:	Installation
	Fastening nut	12			
2	Washer	12			
3	Cylinder-head gasket	1			Replace
4	Valve keys – exhaust valve	12			
5	Upper spring retainer – exhaust valve	6			
6	Outer valve spring – exhaust valve	6			
7	Inner valve spring – exhaust valve	6			
8	Valve stem seal	6			Replace
9	Lower valve retainer – exhaust valve	6			
10	Spacer – exhaust valve	6			
	Valve guide – exhaust valve	6			
12	Exhaust valve seat ring	6			
13	Exhaust valve	6			
14	Valve keys – inlet valve	12			
15	Upper spring retainer – inlet valve	6			
16	Outer valve spring	6			
17	Inner valve spring	6			
18	Valve stem seal – inlet valve	6			Replace
19	Lower valve retainer	6			
20	Spacer – inlet valve	6			
21	Inlet valve	6			



# Removing cylinder head – GT3

No	Designation	Qty.	Removal	Note:	Installation
22	Inlet valve seat ring	6			
23	Valve guide – inlet valve	6			
24	Cylinder head	1			
25	Dowel sleeve				

# Removing cylinder head GT3



## Removing cylinder head

No.	Designation	Qty.	Note:	
			Removal	Installation
1	Chain box, left	1		
2	Sealing sleeve between chain box and camshaft housing	2		
3	O-ring 9.25 x 1.78 N	4		Replace
4	Hexagon-head bolt M6 x 25	6		
5	Guide rail, short, left	1		
6	Duplex roller chain	2		
	Chain tensioner, left			
8	Seal for chain tensioner cover	2		Replace
9	Hexagon-head bolt M6 x 20	4		
10	Cover for chain tensioner	2		
	Tensioning rail	2		Check
12	Guide rail, right	1		Check
3	Chain box base seal	2		Replace
14	Hexagon socket head bolt M8 x 35	4		
	Hexagon socket head bolt M8 x 30	5		
16	Chain box, right			
17	Chain box seal, right			Replace
18	Hexagon-head bolt M8 x 25			
19	Guide rail, short, right	1		Check
20	Chain tensioner, right			
21	16x20 sealing ring	6		Replace

**Removing cylinder head – GT3**

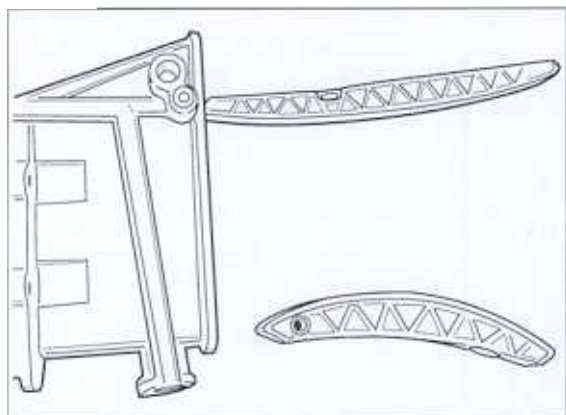
No.	Designation	Qty.	Removal	Note:	Installation
22	Shaft bolt	2			Must engage in the guide rail
23	12x1.5 sealing ring	1			Replace
24	Screw plug	1			
25	Shaft bolt	4			
26	Guide rail, left	1			Check
27	Chain box seal	1			Replace

## Removing cylinder head – GT3

Preliminary work: Remove camshaft housing (Serv. No.: 15 70 21)

1. Remove the seal between the camshaft housing and the cylinder head. Do not use the seal again.
2. Remove guide rails.

To do so, unscrew the three hexagon socket head bolts and take the guide rails out of the chain box.



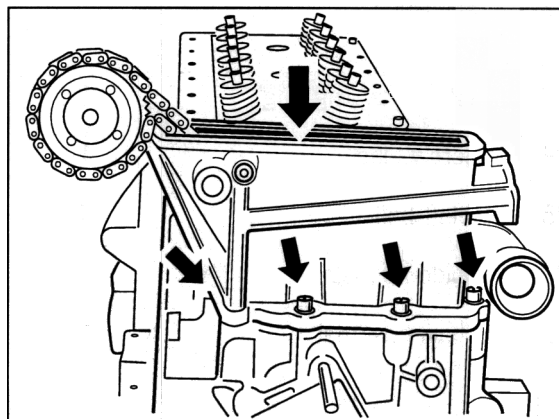
294\_99

3. Remove chain box.

Unscrew the five hexagon socket head bolts for this purpose.

### Important!

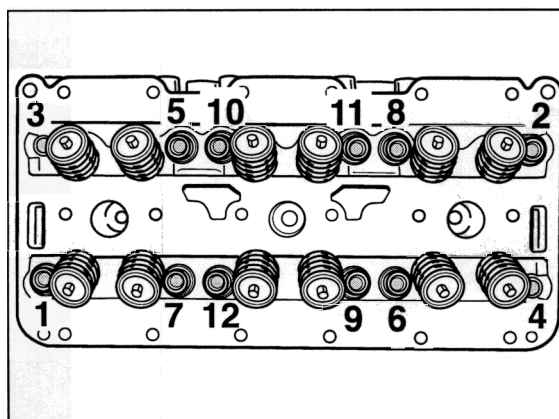
Do not forget the bolt in the chain box.



10200002

4. Unscrew cylinder head.

Unscrew the twelve internal serration screws in 1/2-turn steps. In order to avoid distortion of the cylinder head, work from the outside inwards (as shown in the picture).



257\_99

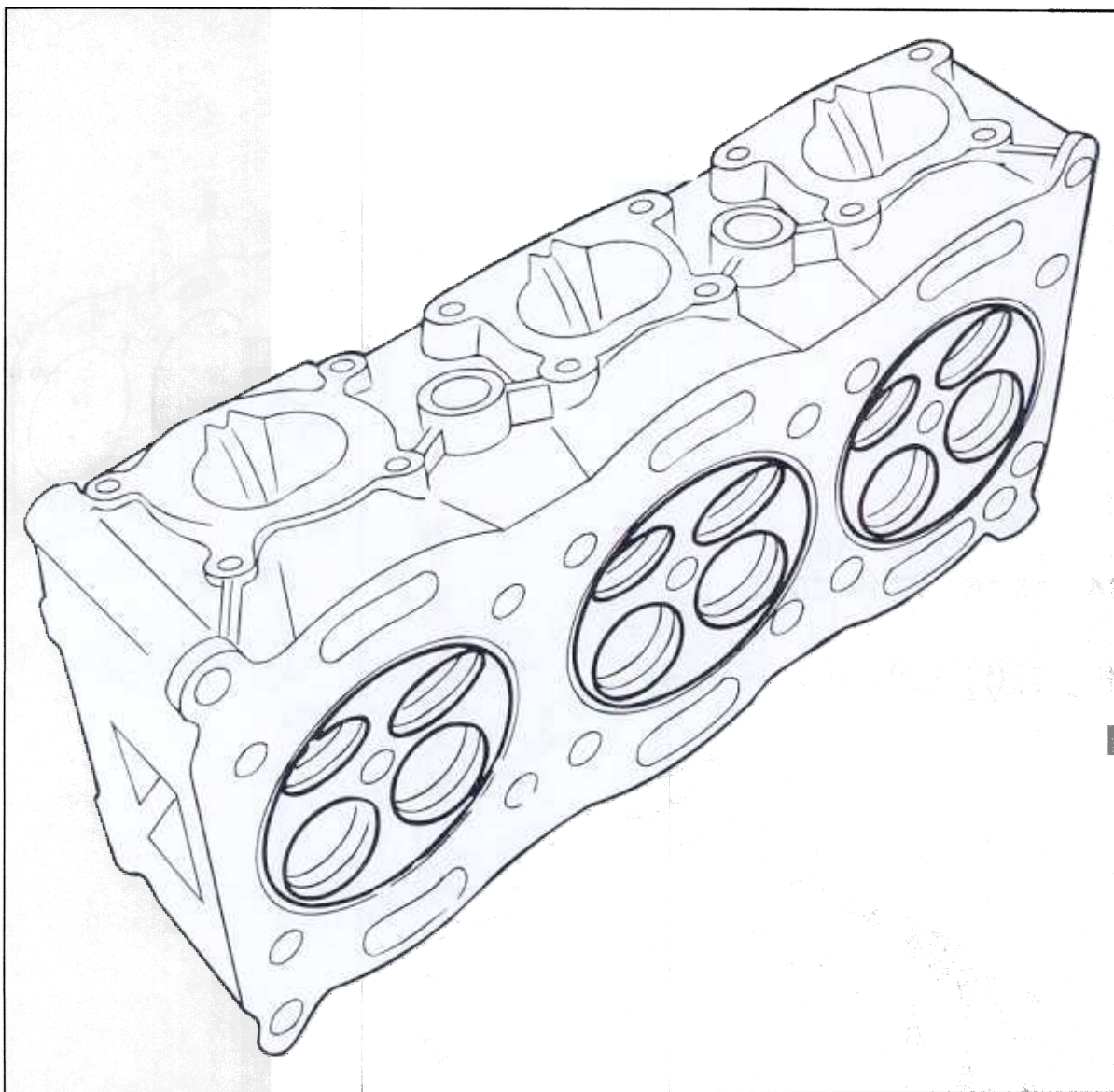


## Removing cylinder head – GT3

### 6. Remove cylinder head.

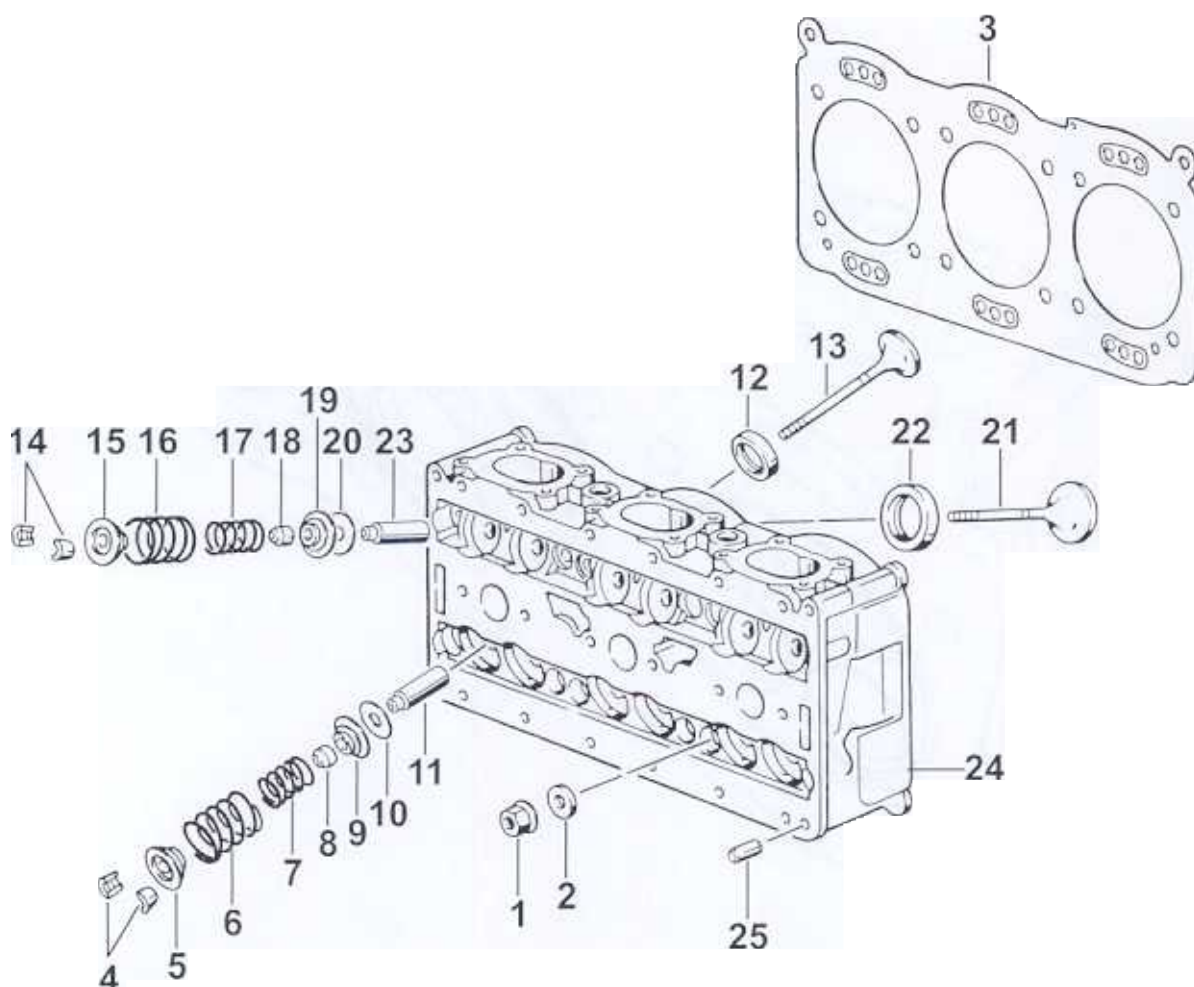
Lift the cylinder head up and off. Do not use the cylinder head gasket again.

**15 70 23 Installing cylinder head – GT3**



10200001

# Installing cylinder head – GT3



113\_99

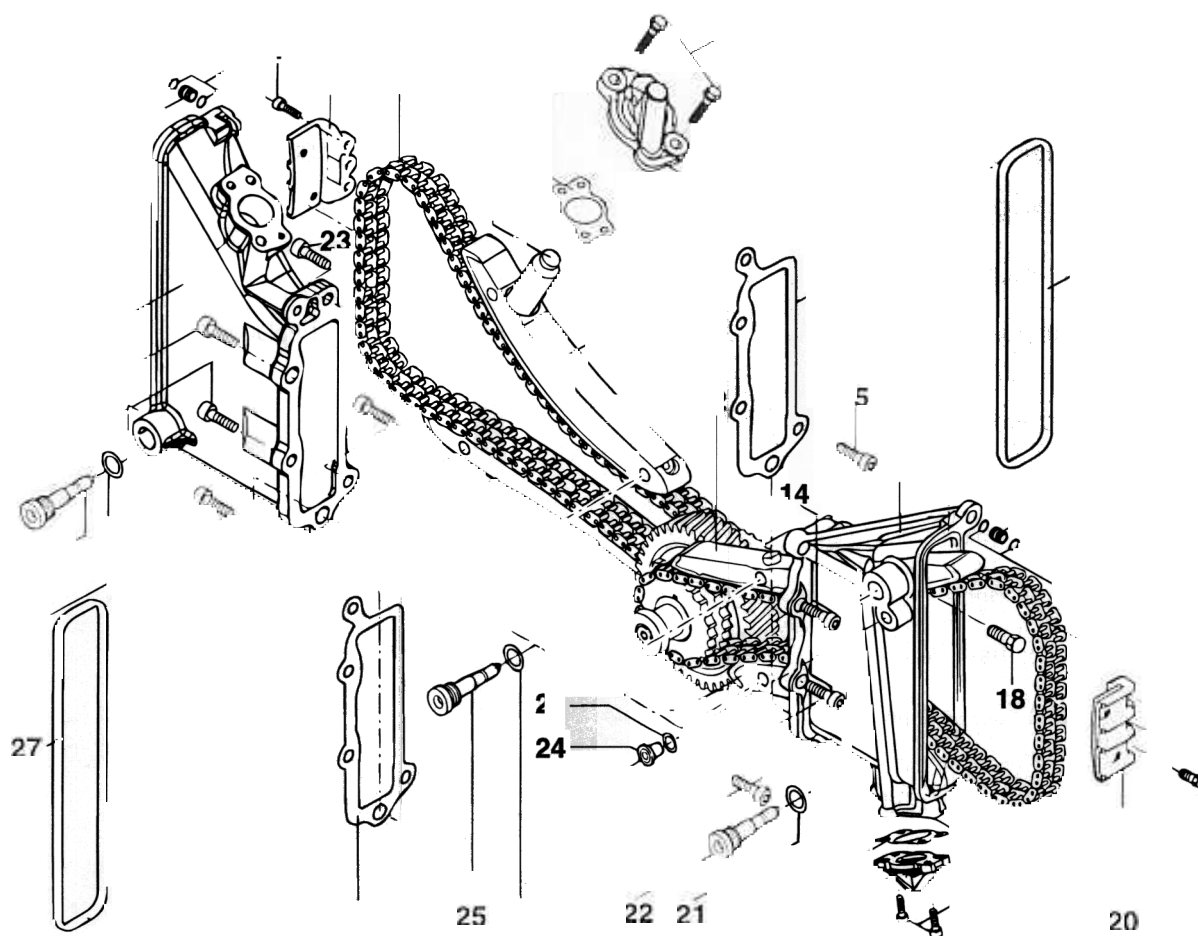
**Installing cylinder head – GT3**

No.	Designation	Qty.	Removal	Note:	
				Installation	
1	Fastening nut	12			
2	Washer	12			
3	Cylinder-head gasket	1			Replace
4	Valve keys – exhaust valve	12			
5	Upper spring retainer – exhaust valve	6			
6	Outer valve spring – exhaust valve	6			
7	Inner valve spring – exhaust valve	6			
8	Valve stem seal	6			Replace
9	Lower valve retainer – exhaust valve	6			
10	Spacer – exhaust valve	6			
1	Valve guide – exhaust valve	6			
12	Exhaust valve seat ring	6			
13	Exhaust valve	6			
14	Valve keys – inlet valve	12			
15	Upper spring retainer – inlet valve	6			
16	Outer valve spring	6			
17	Inner valve spring	6			
18	Valve stem seal – inlet valve	6			Replace
19	Lower valve retainer	6			
20	Spacer – inlet valve	6			
21	Inlet valve	6			

## Installing cylinder head – GT3

No.	Designation	Qty.	Removal	Note:	Installation
22	Inlet valve seat ring	6			
23	Valve guide – inlet valve	6			
24	Cylinder head				
25	Dowel sleeve	1			

Installing cylinder head GT3





**Installing cylinder head – GT3**

No.	Designation	Qty.	Removal	Note:	
				Installation	
1	Chain box, left	1			
2	Sealing sleeve between chain box and camshaft housing	2			
3	O-ring 9.25 x 1.78 N	4			Replace
4	Hexagon-head bolt M6 x 25	6			
5	Guide rail, short, left	1			Check
6	Duplex roller chain	2			
7	Chain tensioner, left	1			
8	Seal for chain tensioner cover	2			Replace
9	Hexagon-head bolt M6 x 20	4			
10	Cover for chain tensioner	2			
11	Tensioning rail	2			Check
12	Guide rail, right	1			Check
13	Chain box base seal	2			Replace
14	Hexagon socket head bolt M8 x 35	4			
15	Hexagon socket head bolt M8 x 30	5			
16	Chain box, right	1			
17	Chain box seal, right	1			Replace
18	Hexagon-head bolt M8 x 25	1			
19	Guide rail, short, right	1			Check
20	Chain tensioner, right	1			
21	16x20 sealing ring	6			Replace

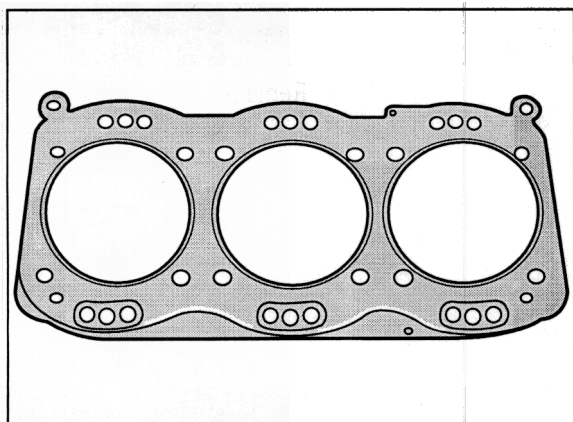
**Installing cylinder head – GT3**

No.	Designation	Qty.	Removal	Note:	Installation
22	Shaft bolt	2			Must engage in the guide rail
23	12x1.5 sealing ring	1			Replace
24	Screw plug	1			
25	Shaft bolt	4			
26	Guide rail, left	1			Check
27	Chain box seal	1			Replace

## Installing cylinder head – GT3

### 1. Replace cylinder-head gasket.

Replace the seal between the cylinder head and the cylinder housing. The designation "Top" must face upwards.



255\_99

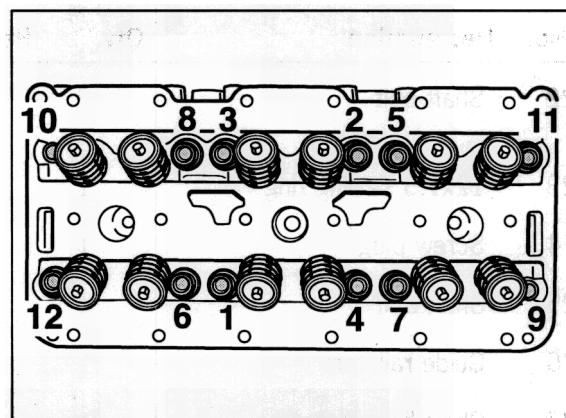
### 2. Place cylinder head in position.

Place the cylinder head back on the cylinders. In doing so, make sure that the inlet ducts in their correct position point upwards (inlet ducts on the same side as the knock sensor). Mount the 12 internal serration screws with washers and tighten from the inside outwards as shown in the picture.

#### Tightening torque:

Initial tightening: 30 Nm (22 ftlb.), then unscrew.

Final tightening: 20 Nm (15 ftlb.), then 1 x 90° turn



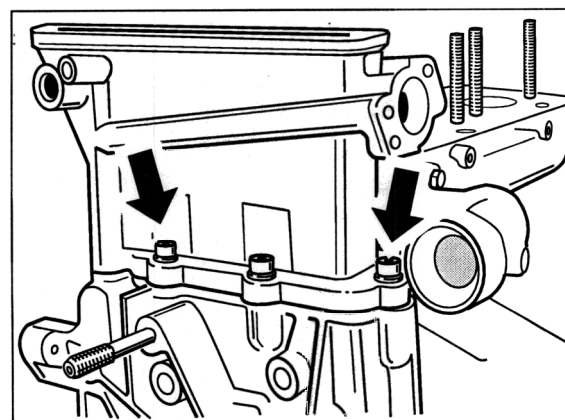
256\_99

### 3. Mount chain box.

Replace the chain box base seal. Place the chain box in position and tighten the five fastening screws.

Screws M8 x 30 and M8 x 35 (arrows in picture). Do not forget the screw in the chain box!

Tightening torque: 23 Nm (17 ftlb.)



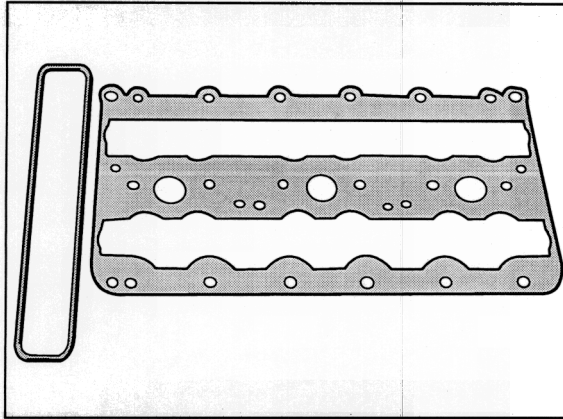
M8 x 35 screws - see arrows -

218\_99

## Installing cylinder head – GT3

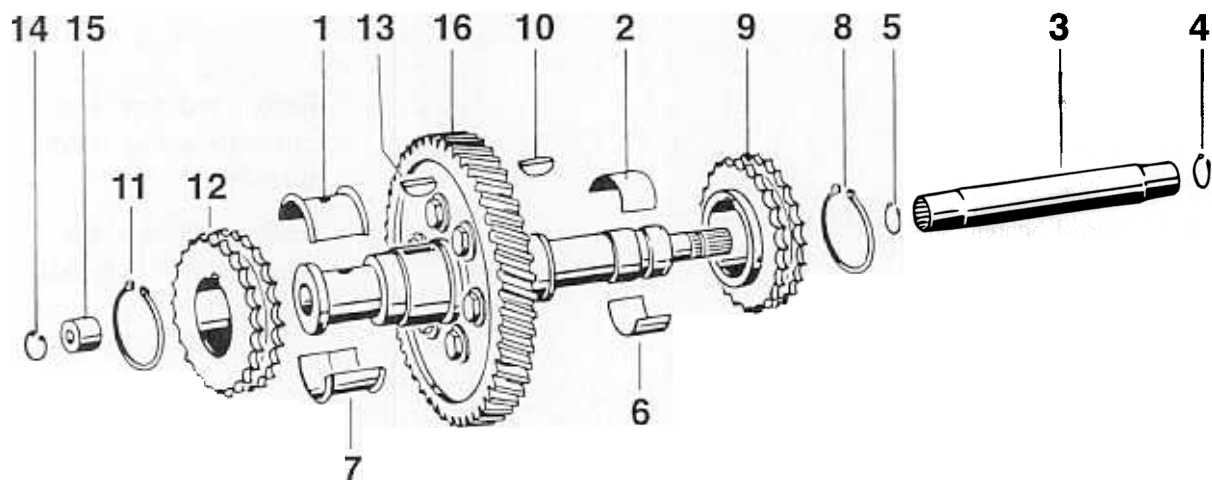
### 4. Replace seals.

Replace the upper seal on the chain box and the seal between the cylinder head and the camshaft housing.



259\_99

## 15 20 37 Disassembling and assembling intermediate shaft – GT3



248\_99

No.	Designation	Qty.	Removal	Note:	Installation
1	Thrust bearing half	1			Replace and insert into crankcase half of cylinder bank 1-3
2	Bearing half	1			Replace and insert into crankcase half of cylinder bank 1-3
3	Dumb-bell shaft	1			Check for true running without any problems; it must be possible to shift shaft slightly
4	Snap ring 13 x 1	1			
5	Snap ring 13 x 1				
6	Bearing shell half	1			Replace and insert into crankcase half of cylinder bank 4-6
7	Thrust bearing shell half	1			Replace and insert into crankcase half of cylinder bank 4-6
8	Snap ring 36 x 1.75	1			
9	Sprocket wheel		Check toothing for wear, press off if necessary		Warm on heating plate, push on up to stop. Collar points towards intermediate shaft gearwheel
10	Woodruff key 6.0 x 7.5	1			
11	Snap ring 36 x 1.75	1			
12	Sprocket wheel	1	Check toothing for wear, press off if necessary		Warm on heating plate, push on up to stop. Collar points towards intermediate shaft gearwheel
13	Woodruff key	1			
14	Snap ring 16 x	1			



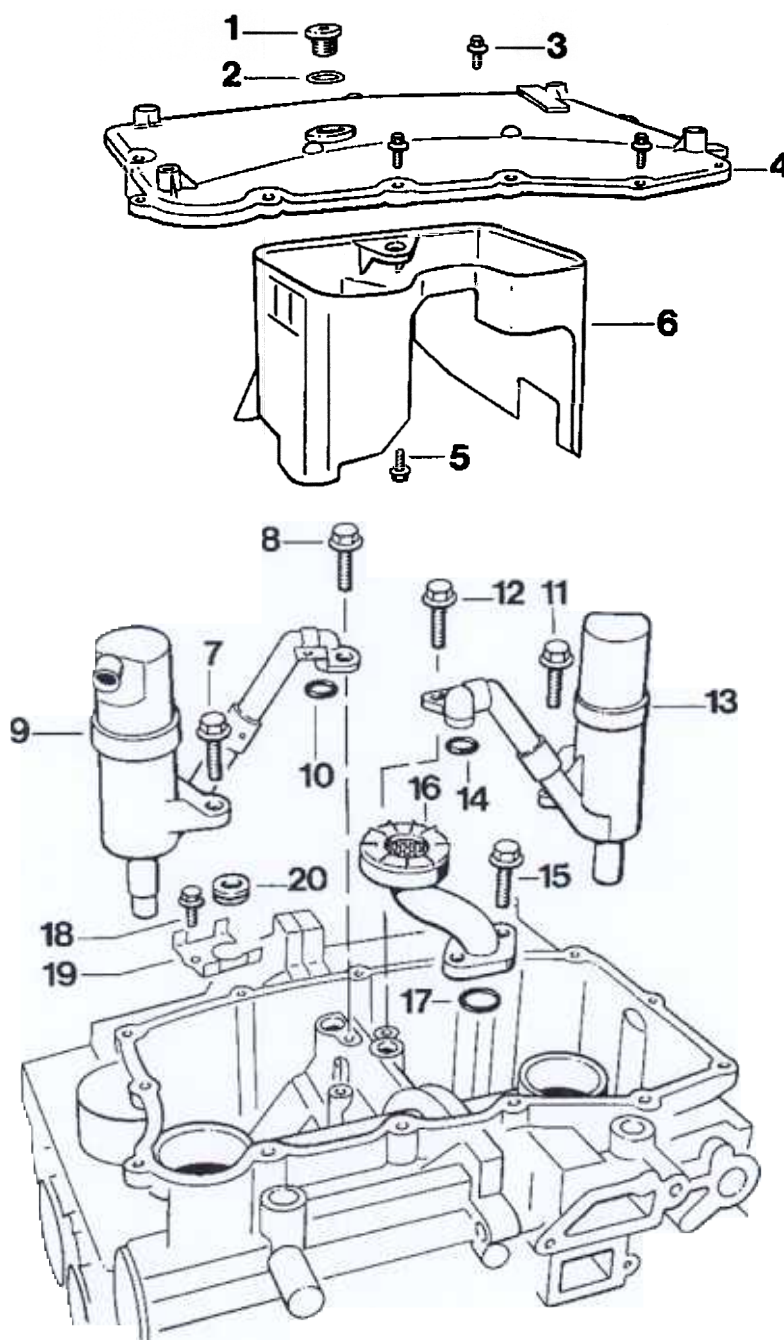
No.	Designation	Qty.	Removal	Note:	
				Installation	
15	Sealing plug	1	Pull out in case of bearing damage and clean the oil bore		
16	Intermediate shaft	1		paired with timing gear of the crankshaft, only install together, take note of the identification on the crankcase	

## **17 53 19    Removing and installing air/oil separator**

Engine removed

## Removing and installing air/oil separator

Engine in working position (engine turned 180°)



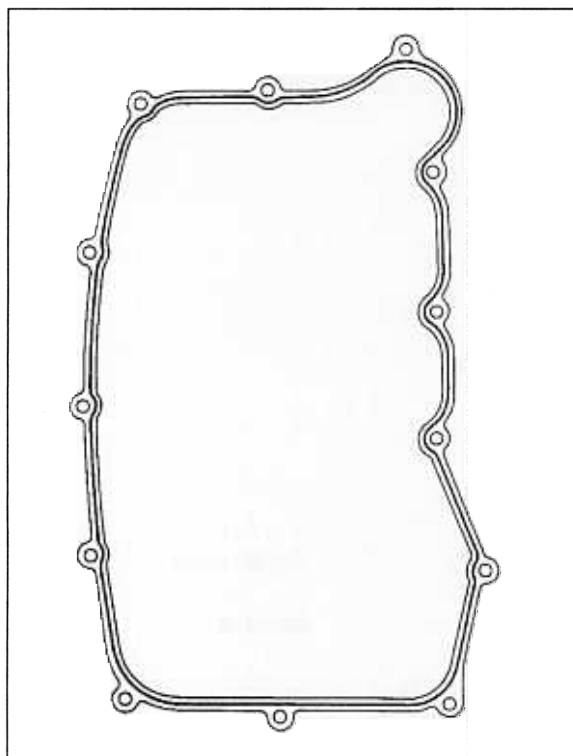
191g - 96

No.	Designation	Qty.	Removal	Note: Installation
1	Oil drain plug M18 x 1.5	1		
2	Sealing ring A18 x 24	1		Always replace
3	Hexagon-head bolt M6 x 20	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 20	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	1		
17	O-ring 30 x 3	1		Lightly oiled
18	Hexagon-head bolt M6 x 12	1		
19	Holder for oil probe	1		
20	Grommet 9.5 x 18 x 1.2	1		

## Assembly instructions

### Sealing the oil pan

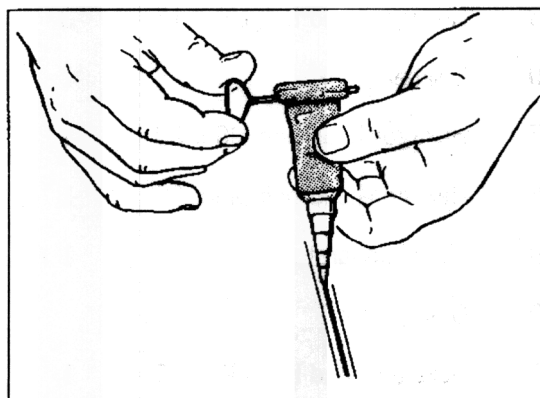
Only "Drei Bond" silicone type 1209, part No. 000.043.203.73 (30-gram tube) should be used as the surface seal. After application of surface seal (silicone bead), screw together within five minutes.



641\_96

### 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.

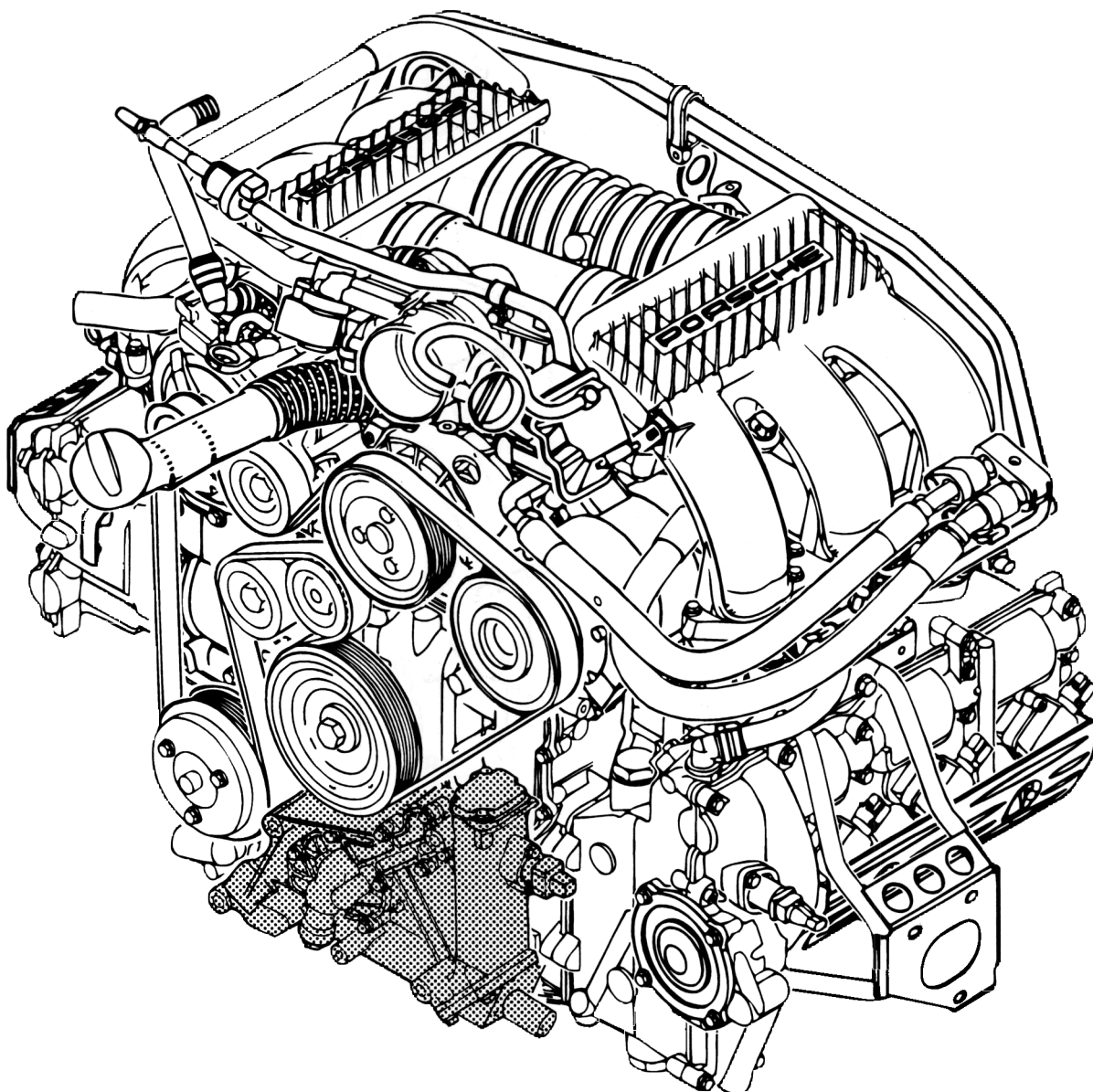


486\_96

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 halves as centring aids.

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

Engine removed

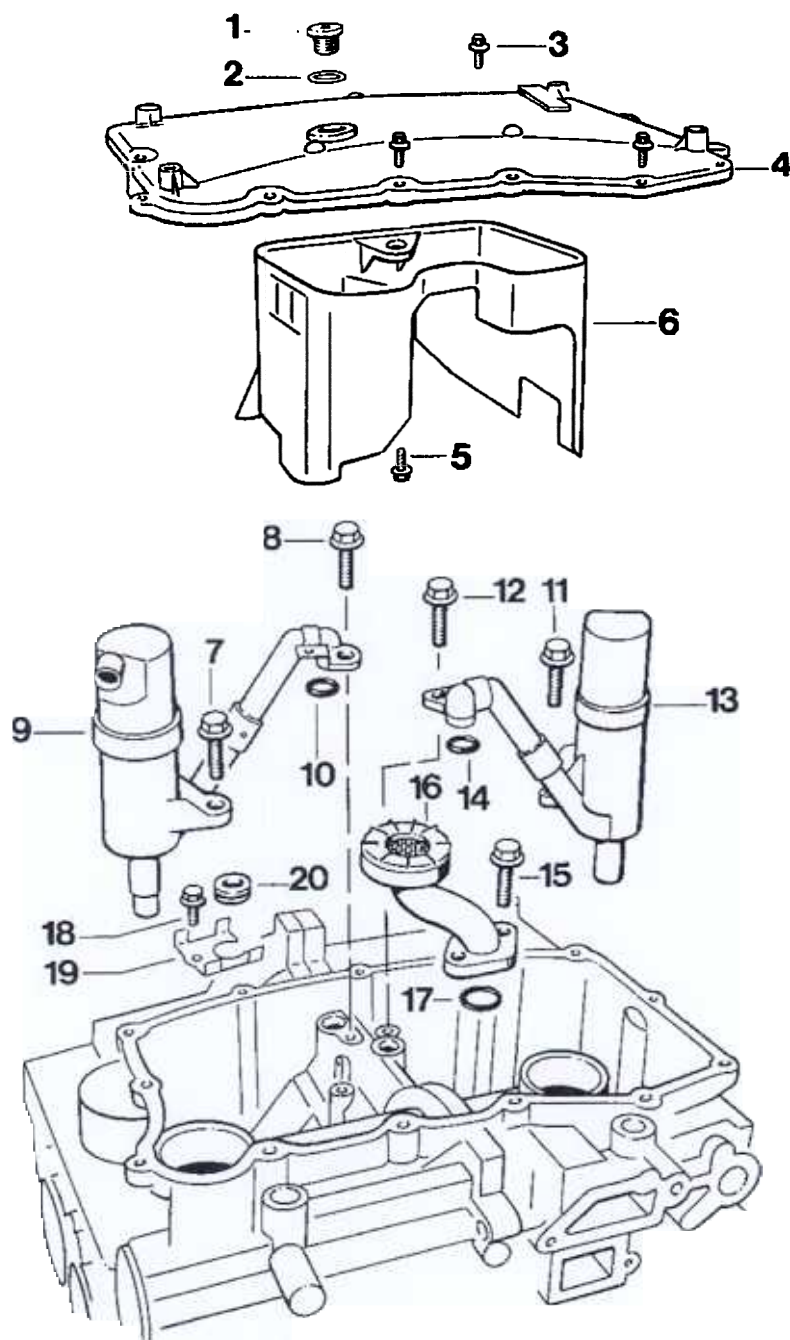


357 - 97



## Removing and installing air/oil separator

Engine in working position (engine turned 180°)



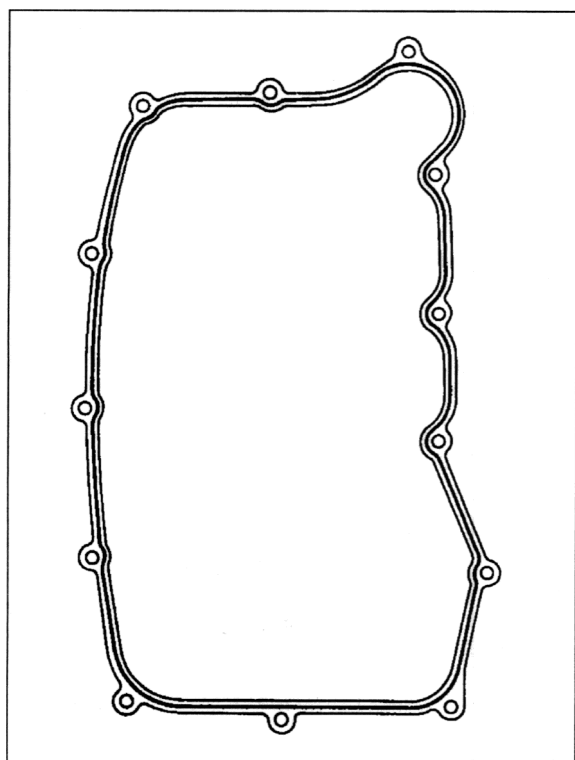
191g - 96

No.	Designation	Qty.	Removal	Note: Installation
1	Oil drain plug M18 x 1.5			
2	Sealing ring A18 x 24	1		Always replace
3	Hexagon-head bolt M6 x 20	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			
	Hexagon-head bolt M6 x 20	1		
12	Hexagon-head bolt M6 x 20	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	1		
17	O-ring 30 x 3	1		Lightly oiled
18	Hexagon-head bolt M6 x 12	1		
19	Holder for oil probe	1		
20	Grommet 9.5 x 18 x 1.2	1		

## Assembly instructions

### Sealing the oil pan

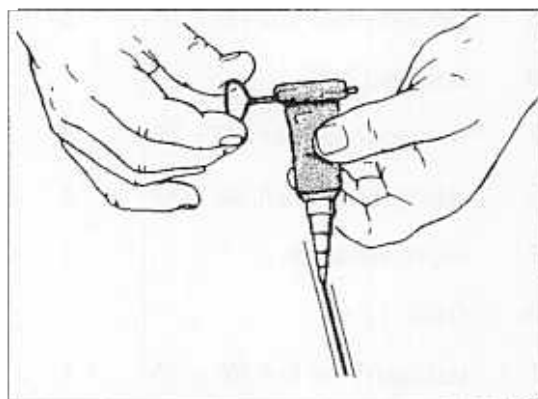
Only "Drei Bond" silicone type 1209, part No. 000.043.203.73 (30-gram tube) should be used as the surface seal. After application of surface seal (silicone bead), screw together within five minutes.



641\_96

### 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.

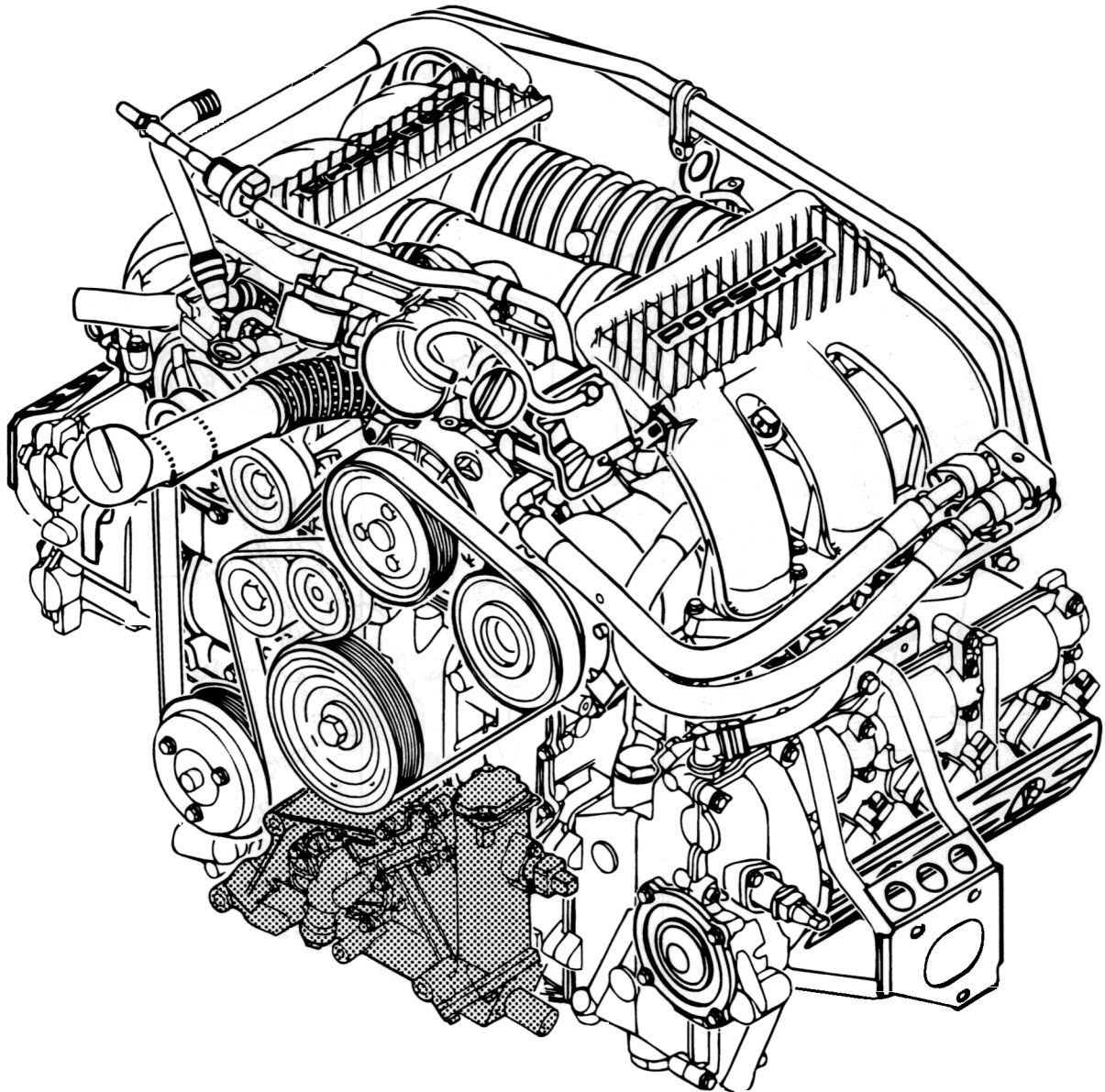


486\_96

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 halves as centring aids.

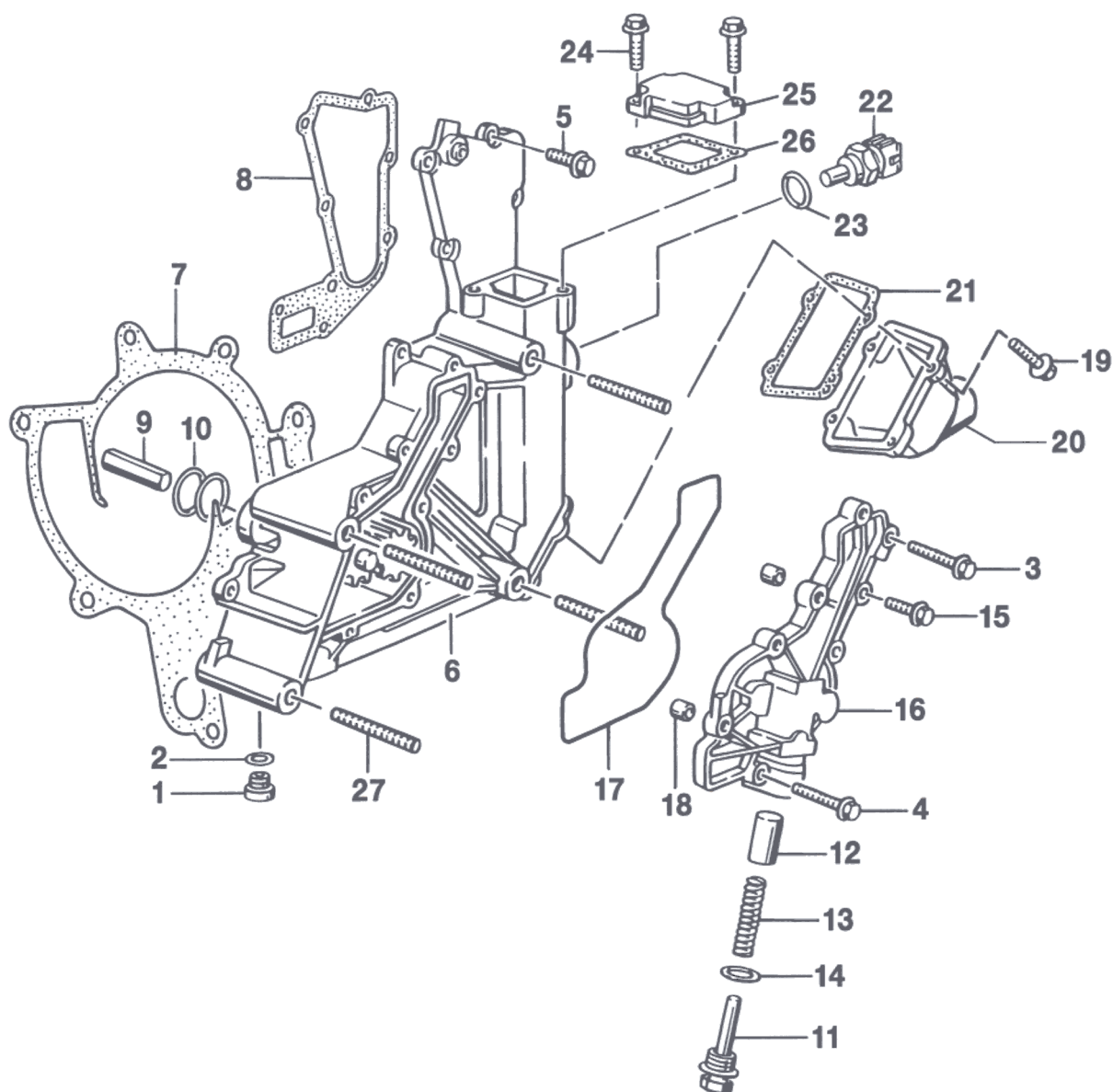
## 17 20 19 Removing and installing oil pump with coolant guide housing

Engine removed



357 - 97

# Removing and installing oil pump with coolant guide housing



316 - 97

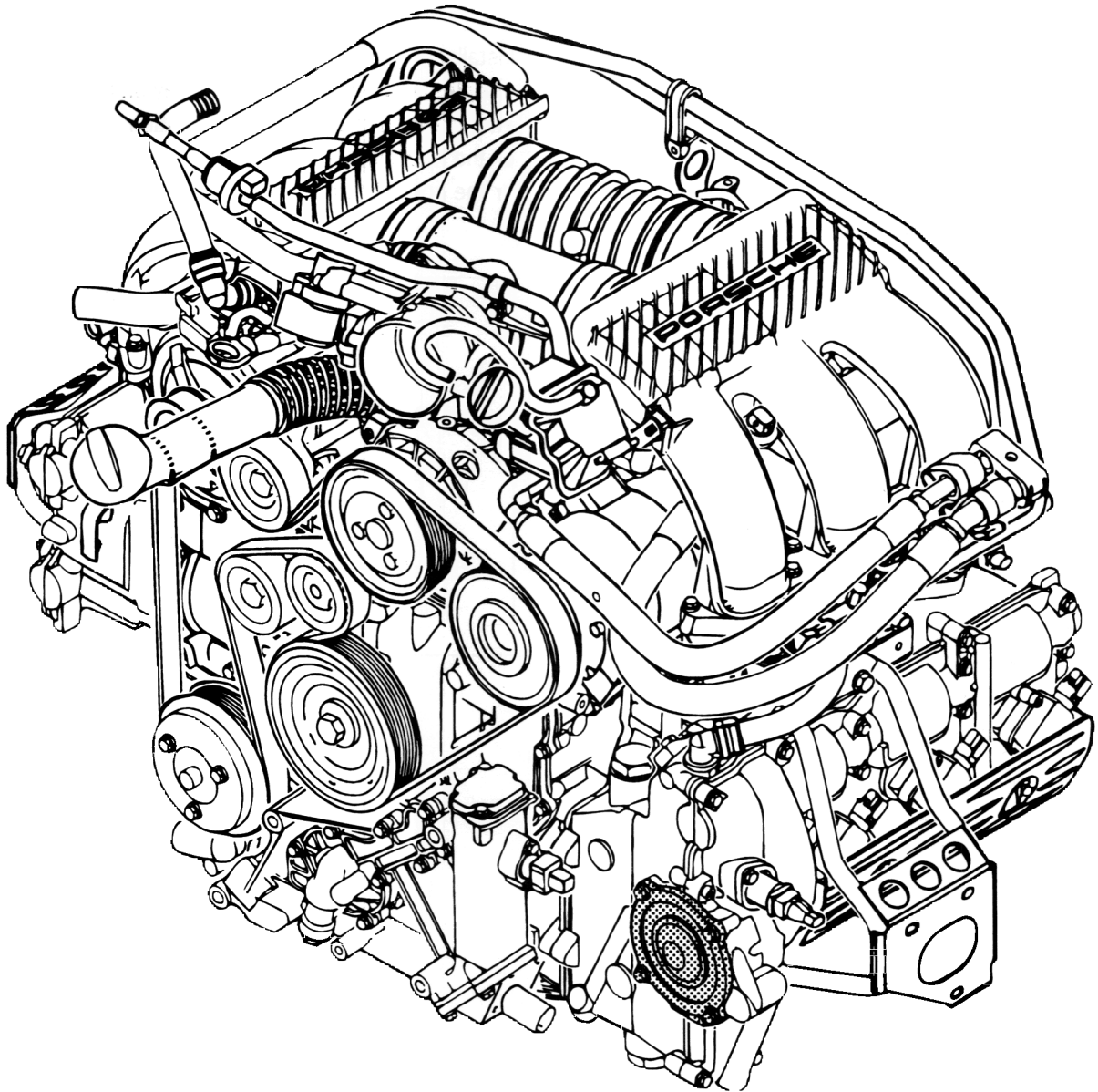
Removing and installing oil pump with coolant guide housing

No.	Designation	Qty.	Removal	Note:	
				Installation	
1	Coolant drain plug M10 x 1	1		Tightening torque: 10 + 5 Nm (7.5 + 3.5 ftlb.)	
2	Sealing ring A18 x 13.5	1		Always replace	
3	Hexagon-head bolt M6 x 70	1			
4	Hexagon-head bolt M6 x 70	1			
5	Hexagon-head bolt M6 x 20	8		Tightening torque 10 Nm (7.5 ftlb.)	
6	Oil pump with coolant guide housing	1			
7	Gasket	1		Always replace; insert or fit only if coolant guide housing has been put onto the crankcase	
8	Gasket	1		Always replace; insert or fit only if coolant guide housing has been put onto the crankcase	
9	Driver	1			
10	O-ring	2		Always replace	
11	Plug with guide pin	1		Tightening torque 25 Nm (19 ftlb.)	
12	Piston	1		Oil	
13	Spring	1			
14	Sealing ring	1		Replace	



No.	Designation	Qty.	Removal	Note:	
				Installation	
15	Hexagon-head bolt M6 x 25	8			
16	Oil-pump cover	1			
17	Sealing ring	1			Replace
18	Dowel sleeve 8.2 x 7	2			Fit in oil-pump cover
19	Pan-head screw M6 x 20	4			Tightening torque 10 Nm (7.5 ftlb.)
20	Neck				
21	Gasket	1			
22	Temperature sensor with captive sealing ring	1			Tightening torque 25 ± 5 Nm (19 ± 3.5 ftlb.)
23	Sealing ring	1			Replacement sealing ring for item 22 (fit if sealing ring of item 22 has been damaged)
24	Hexagon-head bolt M6 x 20	2			Tightening torque 10 Nm (7.5 ftlb.)
25	Cap	1			
26	Gasket	1			Replace
27	Stud M10 x 105	4			Screw micro-encapsu- lated end into the crank- case. Tightening torque: 15 + 3 Nm (11.0 + 2.0 ftlb.)

**17 19 19 Removing and installing oil extraction pumps – Engine removed**



## Removing and installing oil extraction pumps – Engine removed

### Removal

At each cylinder head, undo the 4 hexagon-head bolts which fasten the oil extraction pumps.

#### Note

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

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" faces the crankcase or the coolant temperature sensor.

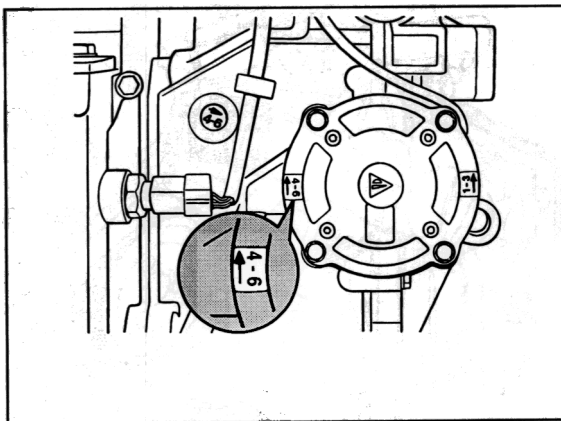
### Installation

#### Note

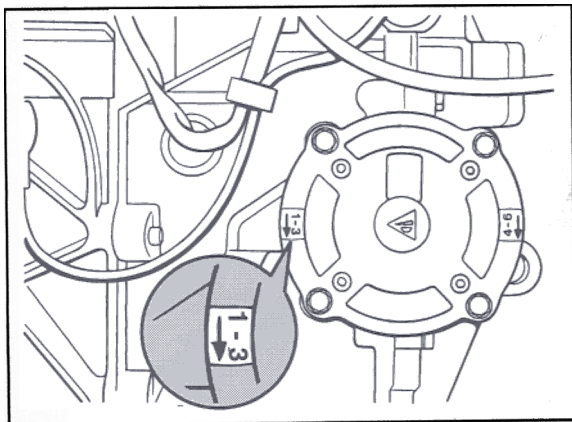
The oil extraction pumps on the cylinder heads are identical parts. Therefore, the installation position and direction of rotation must be correct.

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" faces the crankcase.



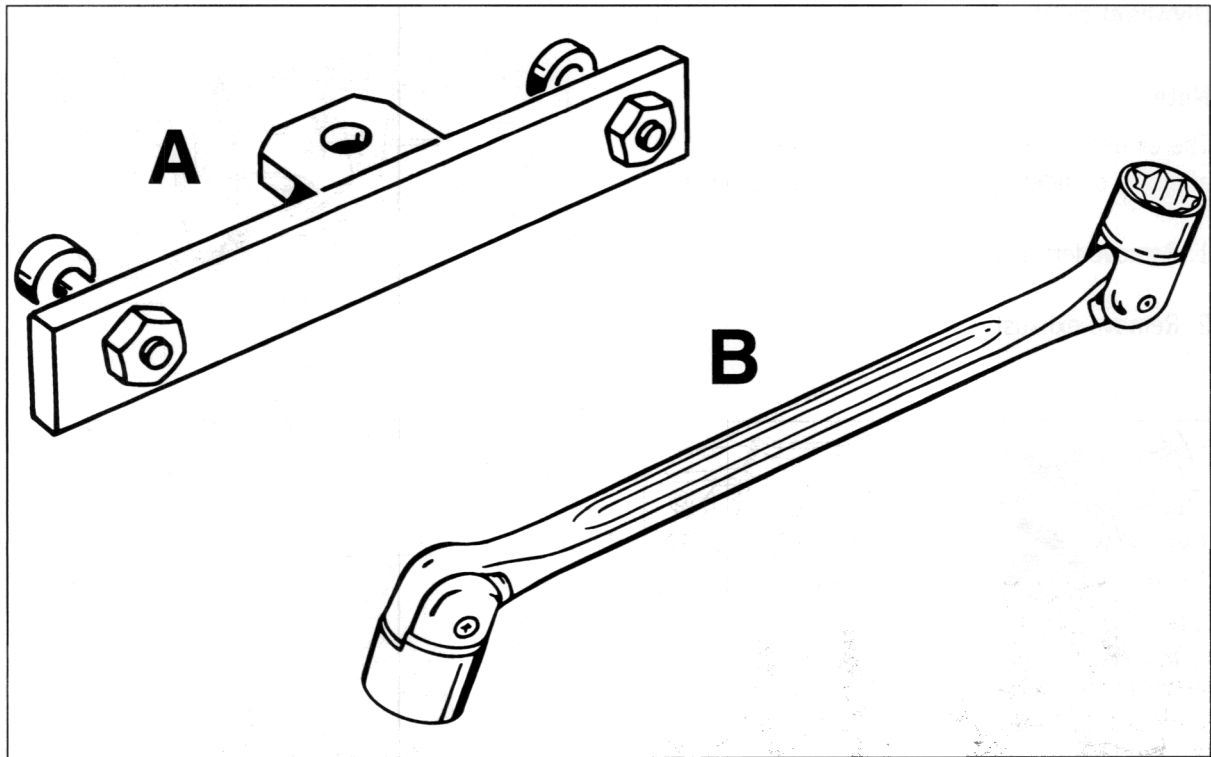
668\_97



667\_97

## 17 19 19 Removing and installing oil extraction pumps – Engine installed

### Tools



268\_98

Item	Designation	Special tool	Explanation
A	Holding-down device for camshafts	9634	
B	Flexible-head socket wrench 12/13		Commercially available tool for fitting rear muffler holder

## Removing and installing oil extraction pumps – Engine installed

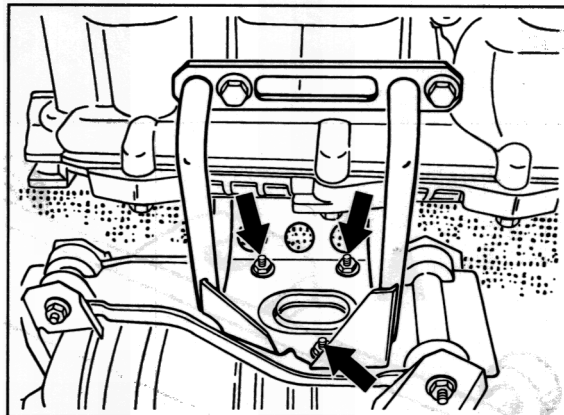
### Removal

Oil extraction pump on cylinder head 1 - 3 (flywheel side)

### Note

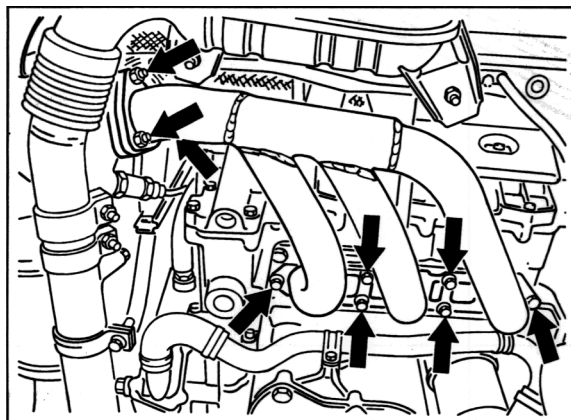
The oil extraction pump can only be removed after the cylinder head cover has been taken off.

1. Remove left rear wheel.
2. Remove exhaust manifold.



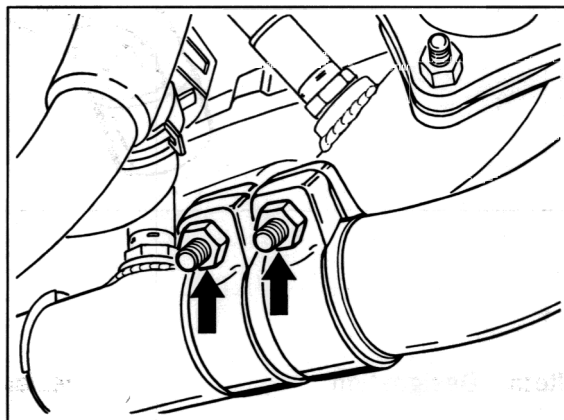
218\_98

- 3.1 Undo clamping sleeve and remove rear muffler.



154\_98

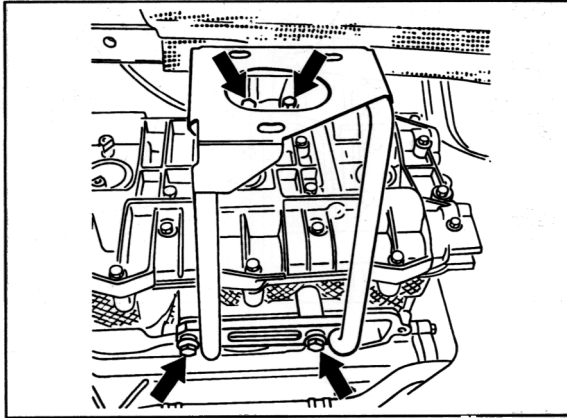
3. Remove rear muffler. Undo three hexagon nuts.



269\_98

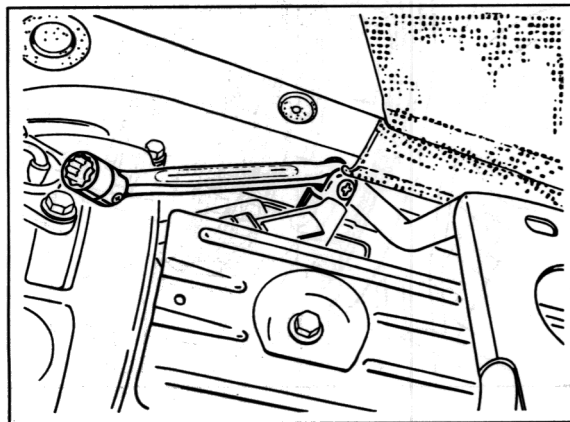


4. Remove holder for rear muffler.



022\_98

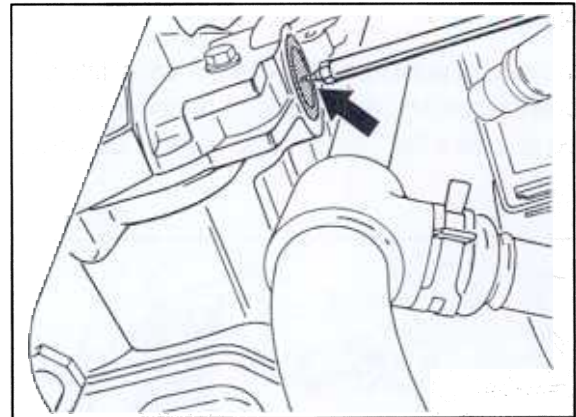
4. Undo upper hexagon-head bolts using a flexible-head socket wrench (wrench size 13). Detach holder.



217\_98

5. Remove shield of cylinder head cover.

6. Pull off both closure caps of cylinder head 1 - 3 (pulley side).



203\_98

Diagram shows lower closure cap

- 6.1 Turn shop-made extractor into **centre** of piercing point of closure cap and pull off the cap. Refer to Serv. No. 15 18 20, Page 15 - 78.

7. Remove ignition coils and spark plugs.

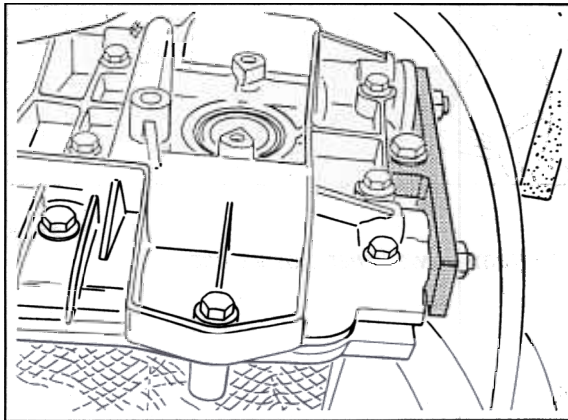
8. Pull off oil protection tubes. Refer to Serv. No. 15 46 19.

9. Fit special tool, holding-down device 9634, on the cylinder head. Fasten holding-down device with a hexagon-head bolt M8 x 30.



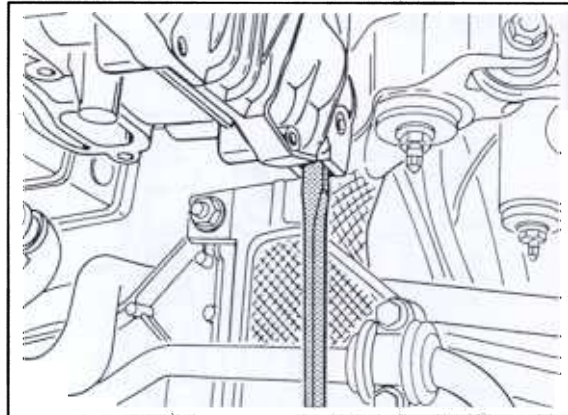
### Note

In order to prevent damage to the camshafts or bearing saddles, the holding-down device must be fit before the cylinder head cover is detached.



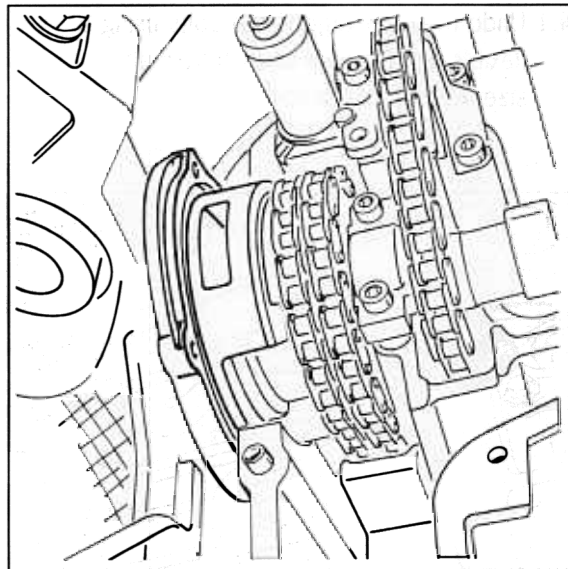
721\_97

10. Separate plug connection of the tensioning element (VarioCam).
11. Unscrew two hexagon-head bolts (M6 x 20) and remove closure cap from the tensioning element (VarioCam).
12. Undo the fastening screws of the oil extraction pump.
13. Remove cylinder head cover. Loosen the hexagon-head bolts from the outside to the inside. Detach the cylinder head cover by knocking it gently with a plastic hammer, and press off carefully.



156\_98

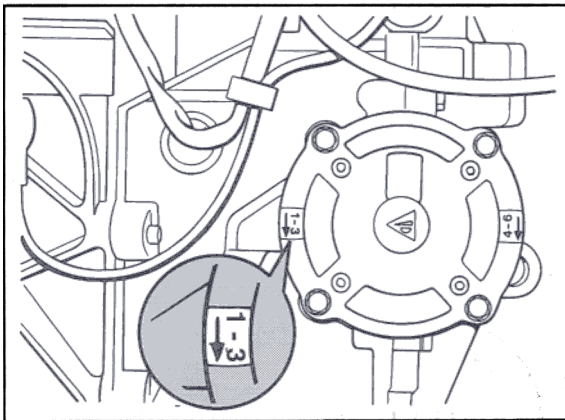
14. Remove oil extraction pump.



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## Installation

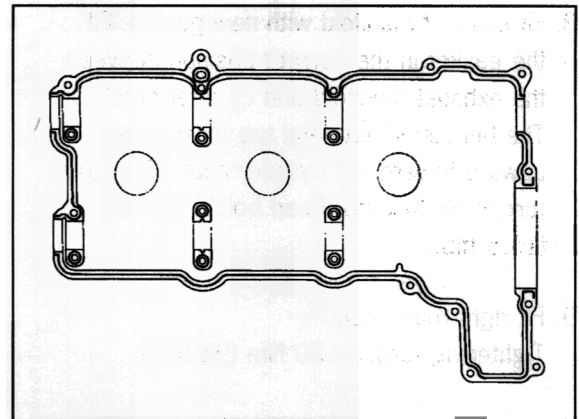
1. Lightly grease the new sealing ring and lay it in the oil extraction pump.
2. Align oil extraction pump driver and fit oil extraction pump in the correct position. The arrow for the direction of rotation or the marking "1 - 3" must face the crankcase. Insert new micro-encapsulated hexagon-head bolts loosely in the oil extraction pump.



667\_97

*Engine removed in drawing for clearer illustration*

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



430\_1\_96

- 3.1 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 for hexagon-head bolts 13 Nm (10 ftlb.). Observe tightening sequence.

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

4. Tighten micro-encapsulated hexagon socket head bolts of oil extraction pump. Tightening torque: 10 Nm (7.5 ftlb.)
5. Fit camshaft closure cap dry.
6. Fit closure cap on tensioning element (VarioCam). Tightening torque: 10 Nm (7.5 ftlb.)
7. Fit oil protection tubes, spark plugs, ignition coils, holder for rear muffler and rear muffler.

8. Fit exhaust manifold with new gasket. 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 for hexagon-head bolts 25 Nm (18.5 ftlb.)

9. Fit right rear wheel.  
Tightening torque 130 Nm (96 ftlb.).

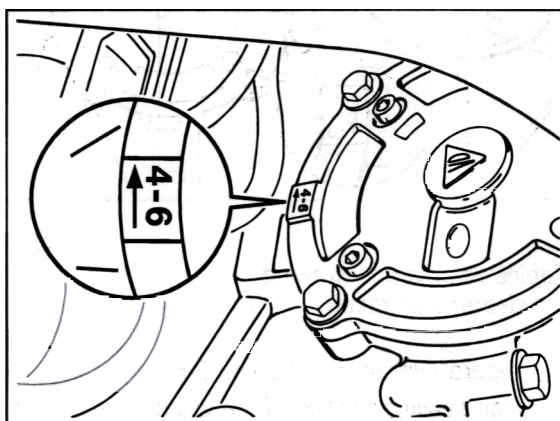
### Oil extraction pump of cylinders 4 - 6 (pulley side)

#### Removal

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

#### 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.



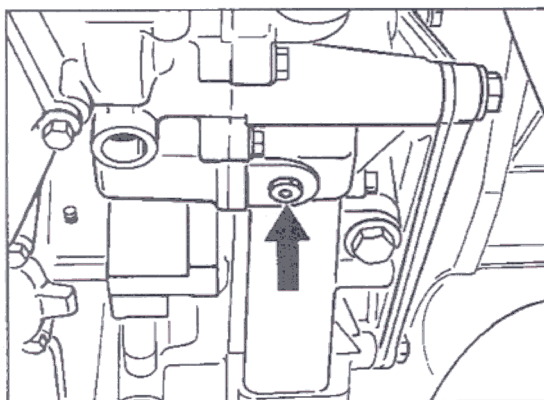
223\_98

3. Tighten micro-encapsulated hexagon socket head bolts. Tightening torque 10 Nm (7.5 ftlb.)

## 17 40 19 Removing and installing oil-water heat exchanger – Engine installed

### Removing oil-water heat exchanger

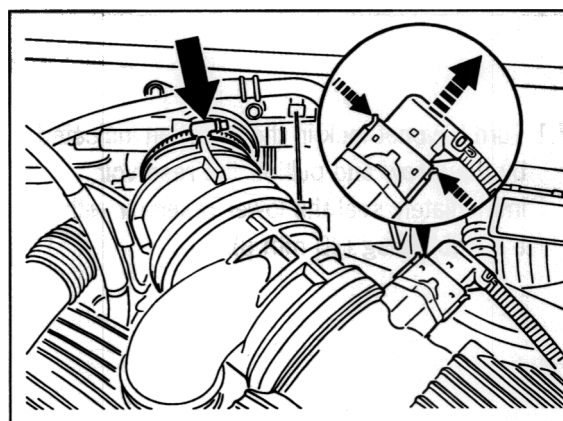
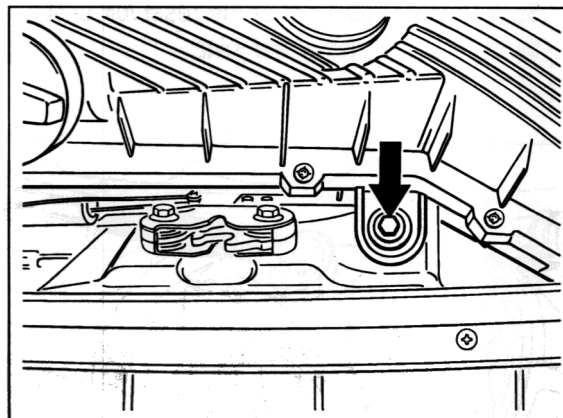
1. Put body-protection covers on.
2. Disconnect battery.
3. Remove cap on coolant expansion tank.
4. Undo drain plug on the coolant guide housing and drain the coolant.



471\_96

5. 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.).

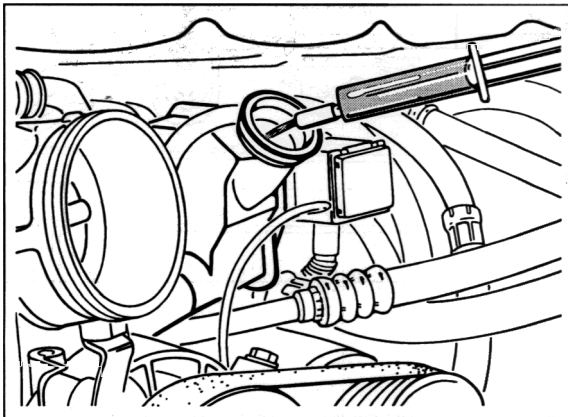
6. Remove the air cleaner assembly.



249\_97

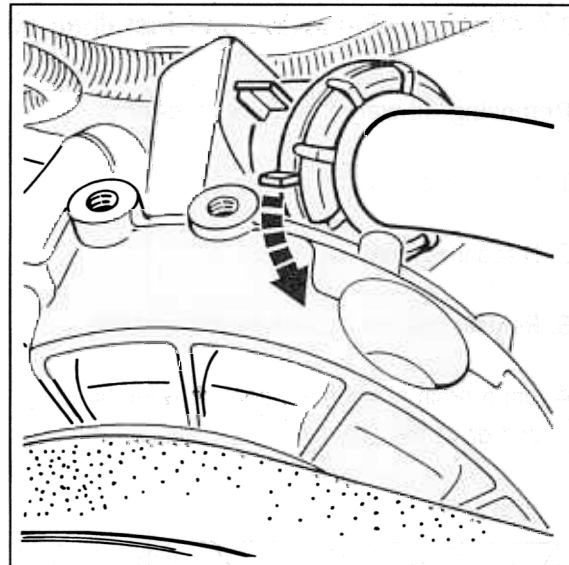
7. In vehicles with air conditioning, the following additional assembly operations must be performed:

Suck Pentosin fluid out of the reservoir until the level is just below the joint.



151\_98

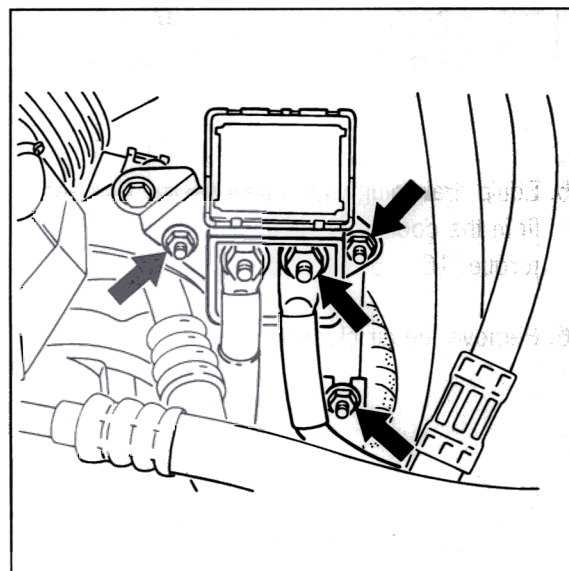
- 7.1 Turn bayonet lock in the direction indicated by the arrow and pull off the reservoir. Immediately seal the lower reservoir with a suitable plug (30 mm  $\varnothing$ ).



264\_97

*Bayonett lock open*

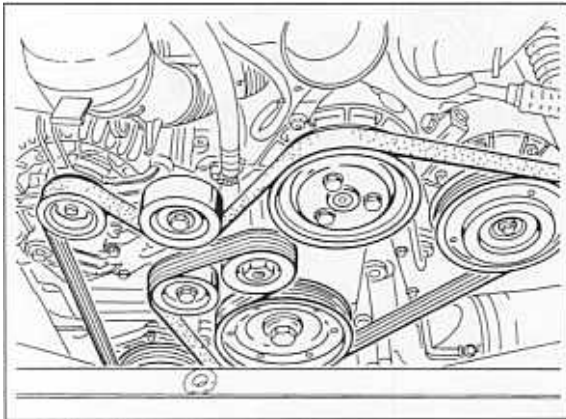
- 7.2 Disconnect battery positive at B+ disconnection point. Undo the hexagon nuts and set the box aside.



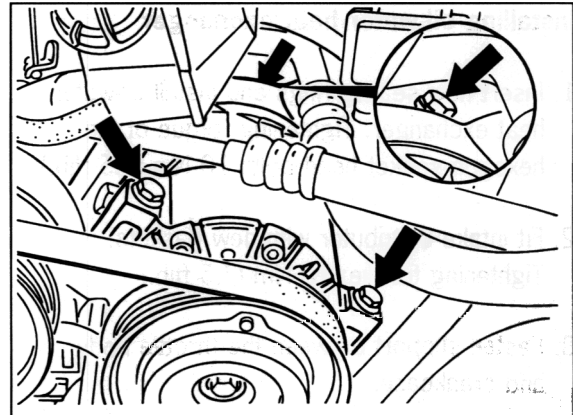
205\_97



- 7.3 Remove drive belt. Mark belt travel direction with a coloured pen. Slacken belt, turning the tensioning pulley (wrench size 24 mm) **clockwise**, hold still and simultaneously take the belt off the drive pulleys.



263\_97



248\_97

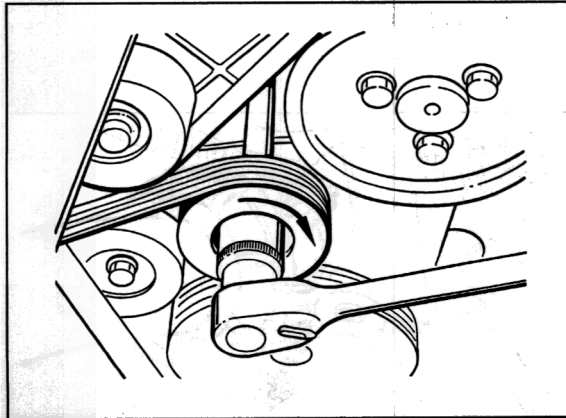
- 7.5 Lift the compressor out, set it down with the hoses connected and secure it against being dropped.

8. Undo the support between the throttle body and crankcase.

9. Loosen outer hose clamps at intake distributor.

10. Undo hexagon-head bolts (6 ea.) on intake distributor and take off intake distributor.

11. Remove oil-water heat exchanger. Undo hexagon socket head bolts. Lift oil-water heat exchanger and simultaneously place a cloth or drip tray underneath it. Remove heat exchanger.



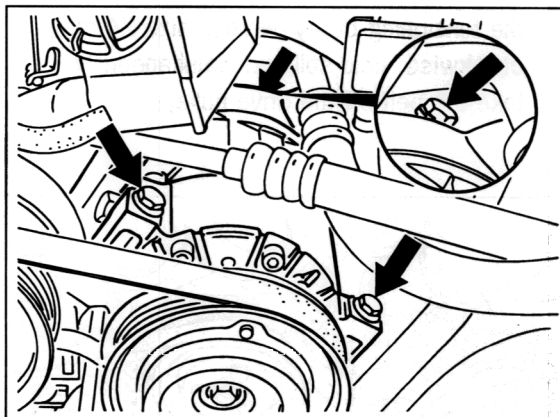
229\_97

- 7.4 Undo front compressor fastening screws (2 ea.). Undo rear fastening screw between the intake pipes of cylinders 4 and 5. Disconnect the electrical plug connection.

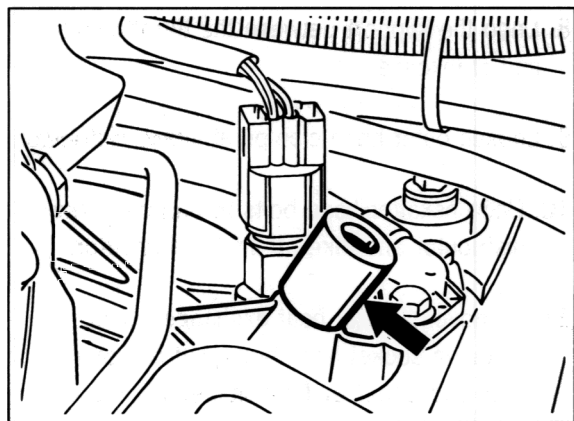


### Installing oil-water heat exchanger

1. Insert new sealing rings and install oil-water heat exchanger. Tightening torque of the hexagon socket head bolts 10 Nm (7.5 ftlb.).
2. Fit intake distributor with new gaskets. Tightening torque: 10 Nm (7.5 ftlb.)
3. Fasten support between the throttle body and crankcase.
4. Install air-conditioning compressor. Before installation, check whether the spacer sleeve is fitted or present at the rear fastening point. Grease sleeve before fitting if necessary.

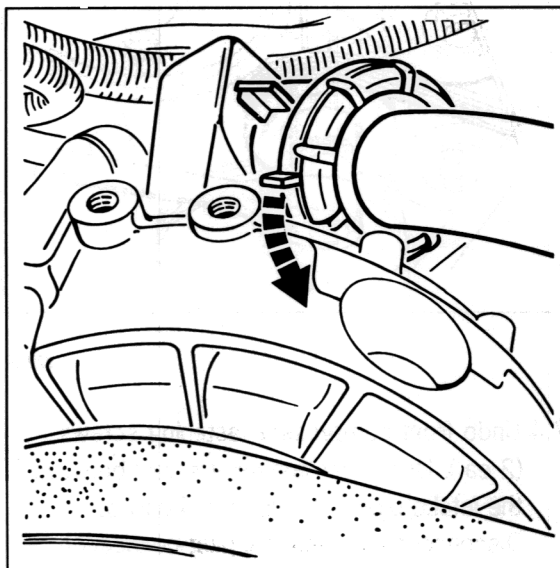


248\_97



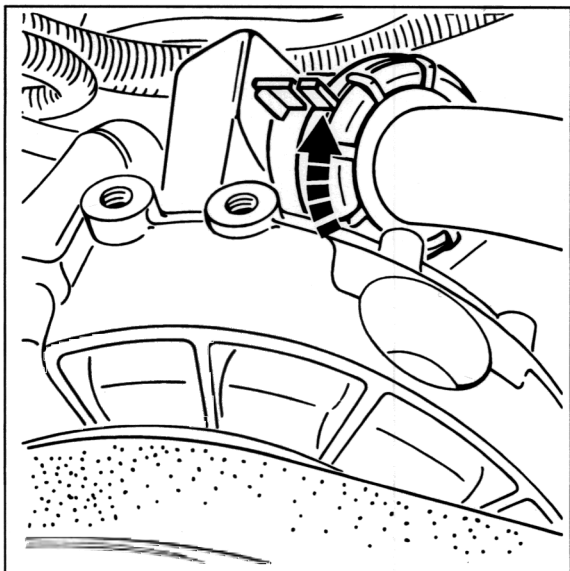
206\_97

5. Fit B+ box.
6. Remove plugs and install reservoir for power steering system.
- 6.1 Turn adjusting ring counterclockwise to its original position.



264\_97

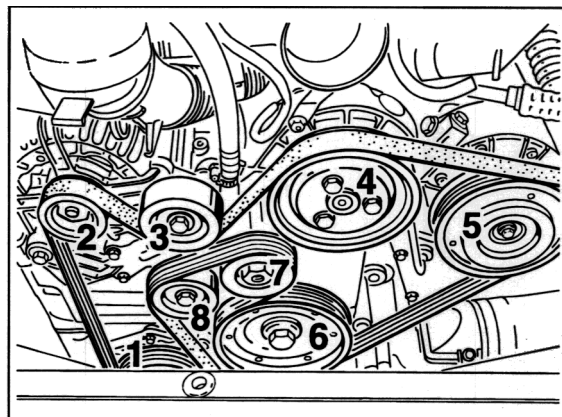
- 6.2 Push reservoir downward and turn adjusting ring clockwise until the marks line up.



265\_97

- 6.3 Fill in Pentosin. Observe the specification for bleeding. Refer to Serv. No. 48 00 00.

7. Check grooves of drive belt for foreign bodies. Fit drive belt. Observe sequence when fitting the belt and direction of motion if the belt was run.



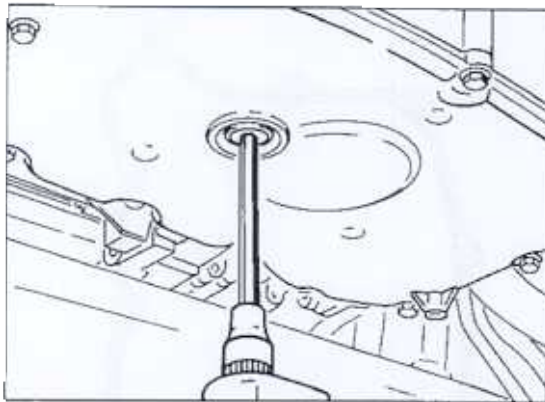
338\_97

8. Fit air cleaner assembly.
9. Fill in coolant and bleed the system; refer to Group 19, Serv. No. 19 38 17, Page 19 - 13.
10. Perform tightness test.

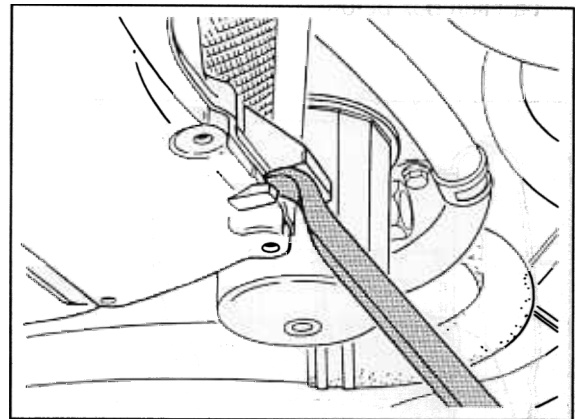
## 17 50 19 Removing and installing oil pan – Engine installed

### Removal

1. Unscrew cap of the oil filler opening.
2. Lift the vehicle. Drain engine oil.
- 3.1 If the oil pan has a leverage bar, lever the oil pan off using a plastic-coated mounting lever.

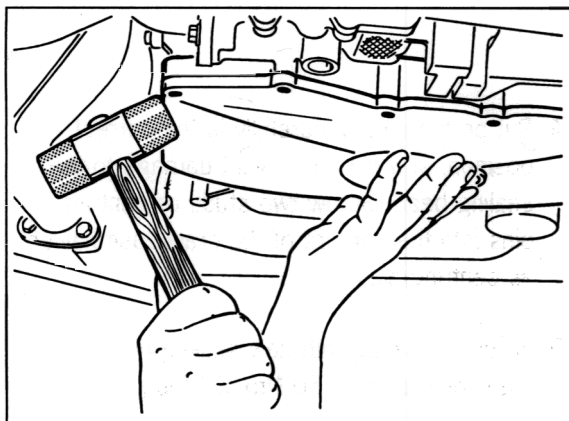


271\_96



167\_98

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



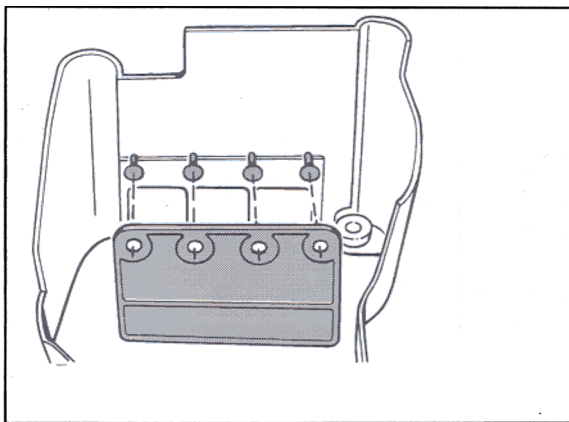
686\_97

## Installation

1. 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.



589\_97

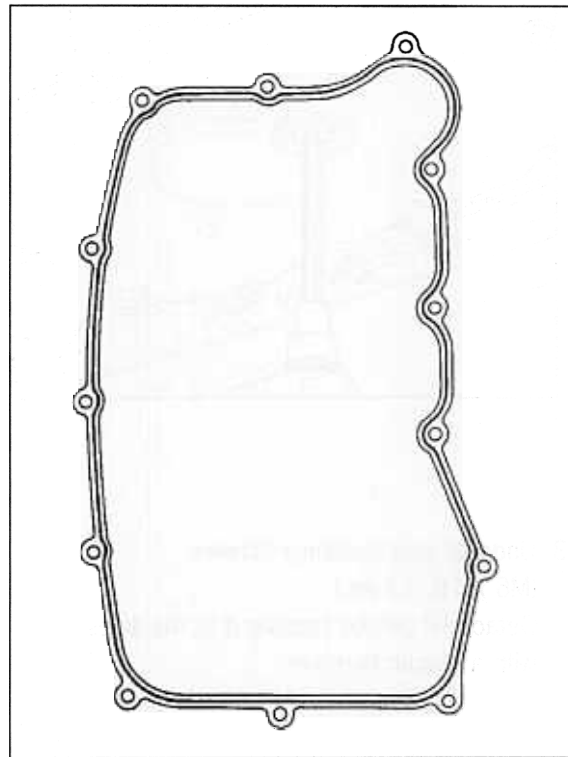
2. Seal the oil pan sealing surface.  
When sealing the sealing surface on the oil pan, use only the sealant **Drei Bond Silikon — type 1209**.

### Note

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

3. Apply 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

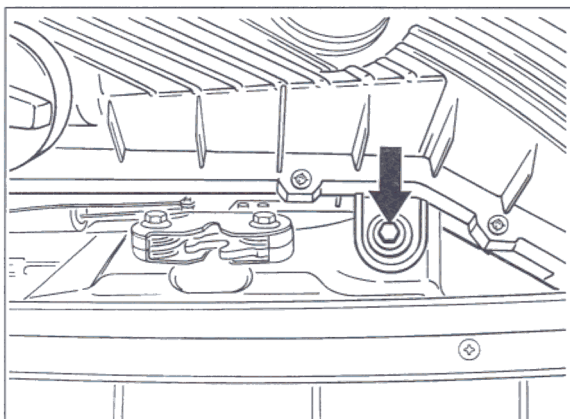
4. Put on the oil pan carefully in the correct position, in order to prevent damage to the sealing bead. Screw two studs or centring pins into the corners of the crankcase halves as centring aids.
5. Fit oil drain plug with new sealing ring.  
Tightening torque: 50 Nm (37 ftlb.).

6. Fill in engine oil. Before filling with engine oil, affix the luggage compartment protective cover recommended in the Workshop Equipment Manual.
7. Bring the engine to operating temperature and check the oil pan for leaks.

## 17 15 19 Removing and installing oil filler neck

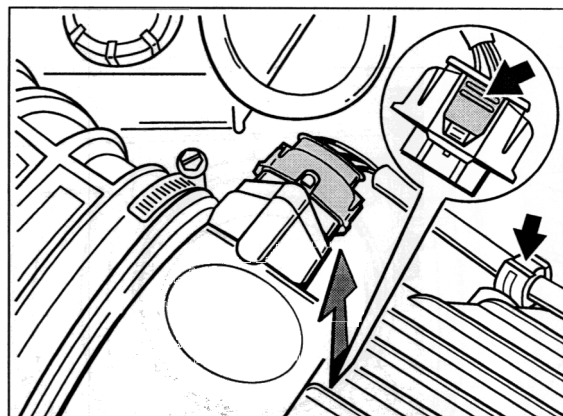
### Removal

1. Disconnect the battery and cover terminal or battery.
2. Remove the complete air cleaner assembly:
  - 2.1 Unclip oil filler neck from upper part of the air cleaner.
  - 2.2 Undo hexagon-head bolt M6 x 34.



261\_97

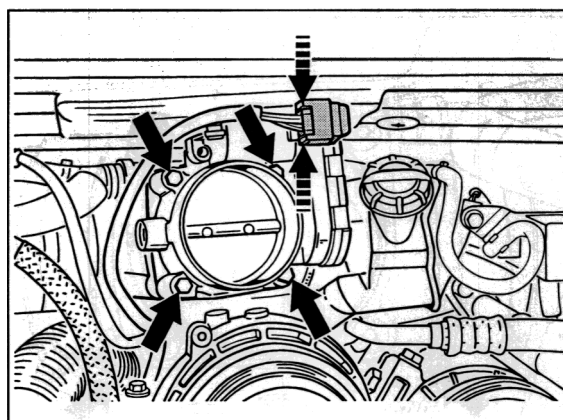
- 2.3 Pull plug off the mass air flow sensor. To do this, push the button and simultaneously pull the plug off. Loosen hose clamp on the throttle body, unclip cable on the air cleaner housing and remove the air cleaner system.



The plug is shown turned to show the button more clearly.

186\_98

3. Pull plug off the throttle body. Undo 4 hexagon-head bolts (M6 x 40) and remove the throttle body.

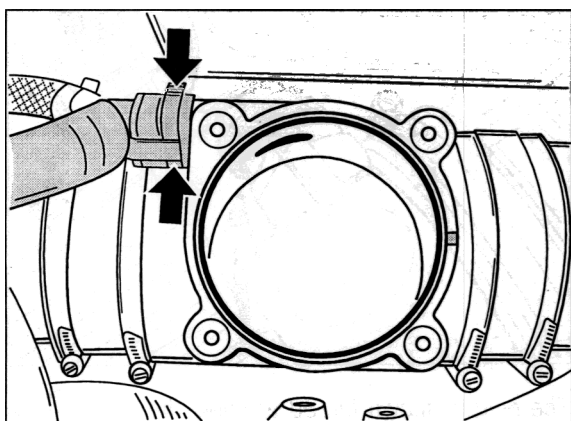


359\_98



4. Release vent line.

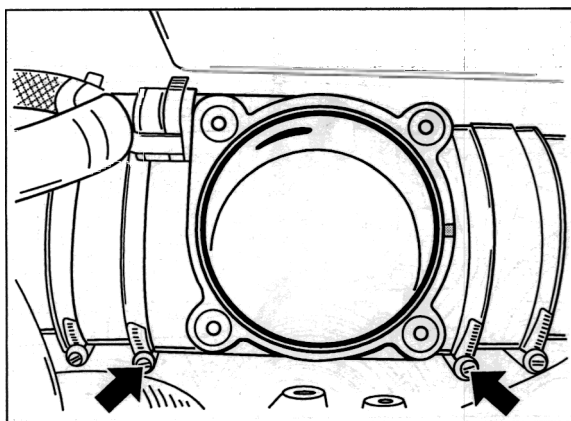
To release vent line, push the outer unlocking ring (arrows) and simultaneously pull out the line.



447\_98

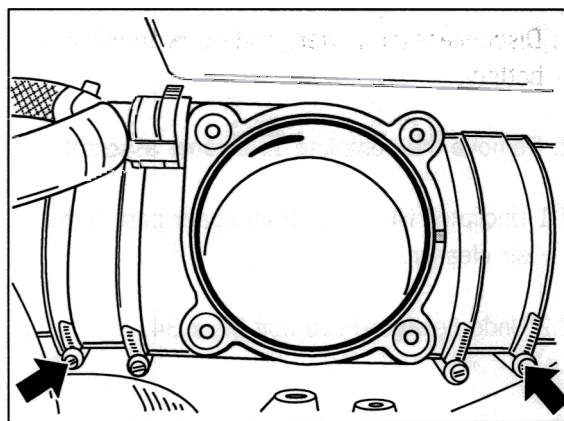
5. Remove intake distributor - centre.

Loosen inner hose clamps at intake distributor. Loosen fit by swivelling intake distributor.



436\_98

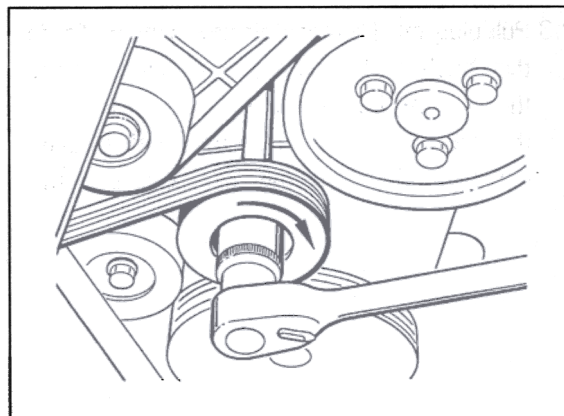
6. Tighten inner hose clamps again. Loosen outer hose clamps. Swivel to loosen fit.



437\_98

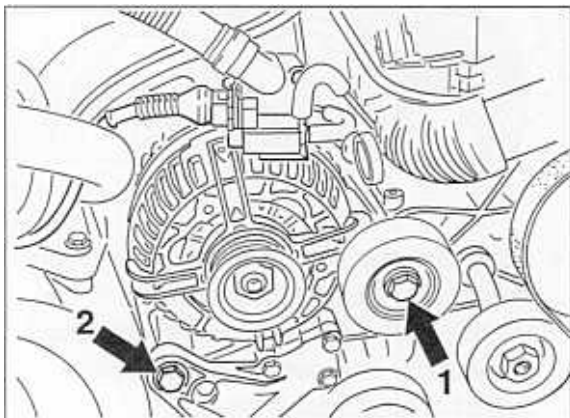
7. Loosen inner clamp hoses and remove intake distributor.

8. Remove generator from bracket. To do this, relieve drive belt, turn the tensioning roller (wrench size 24 mm) clockwise and simultaneously remove the belt from the tensioning roller. Remove belt from drive wheel of generator.



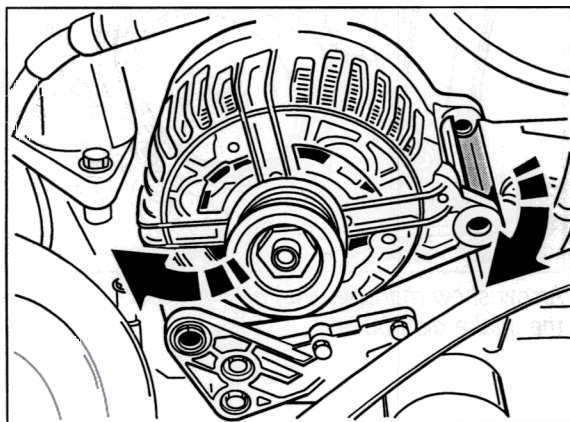
229\_97

8.1 Undo upper right-hand fastening screw on generator (1) by approx. 3 turns. A gentle tap on the fastening screw loosens the front fastening bushing in the generator arm. Unscrew fastening screw (2).

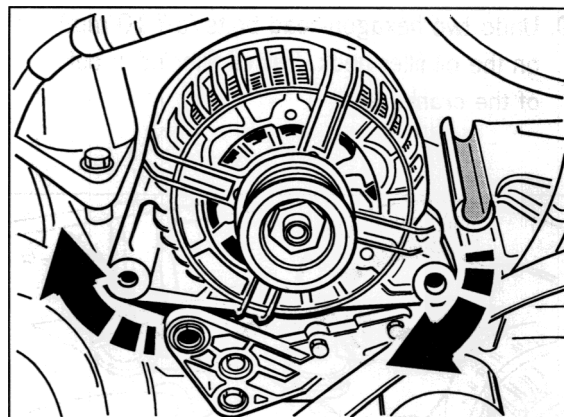


441\_98

8.2 Turn generator clockwise and remove from bracket.

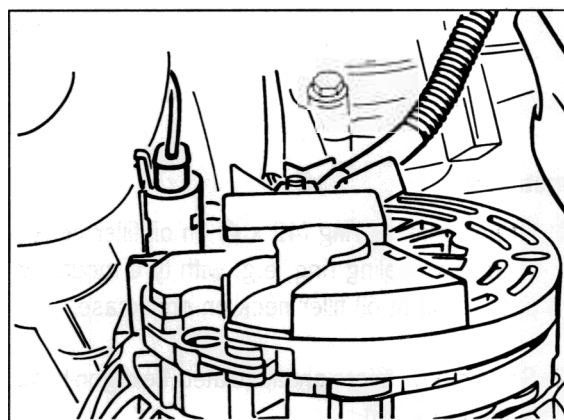


444\_98



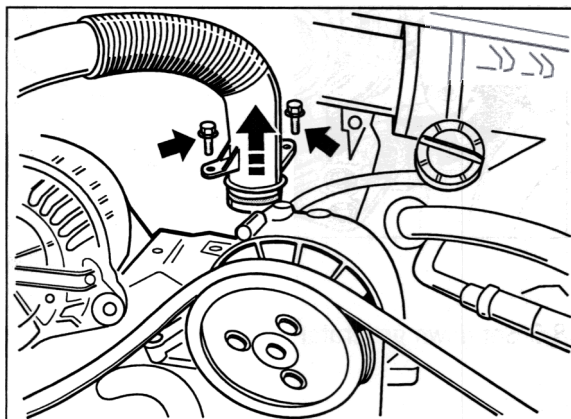
445\_98

8.3 Set down generator with connected lines.



442\_98

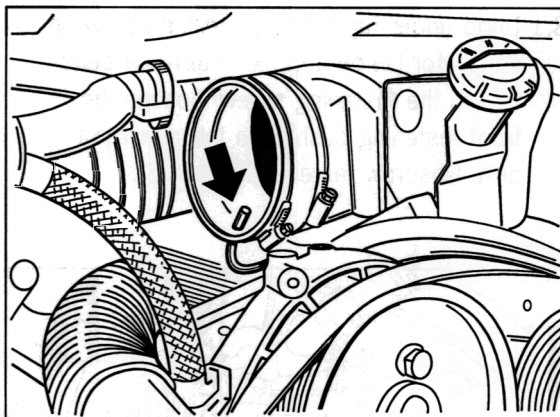
9. Undo two hexagon-head bolts (a/f 10 mm) on the oil filler neck. Pull oil filler neck out of the crankcase.



439\_98

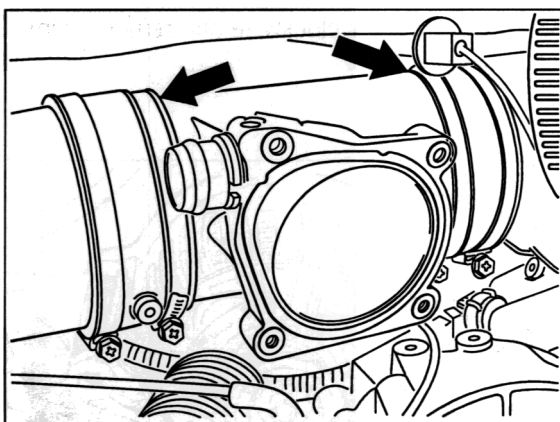
### Installation

1. Fit new sealing ring (42 x 4) on oil filler neck. Coat new sealing ring, e.g. with tyre mounting paste, and fit oil filler neck on crankcase.
2. Secure new micro-encapsulated hexagon-head bolts (M6 x 16).  
Tightening torque: 10 Nm (7.5 ftlb.)
3. Fit intake distributor. Ensure that the vacuum line is seated correctly in the right rubber sleeve.



443\_98

4. Centre the intake distributor. Push both rubber sleeves onto the intake distributor up to the marking (line). Check distance between intake distributor and support for hydraulic pump, they must be at least 5 mm apart.

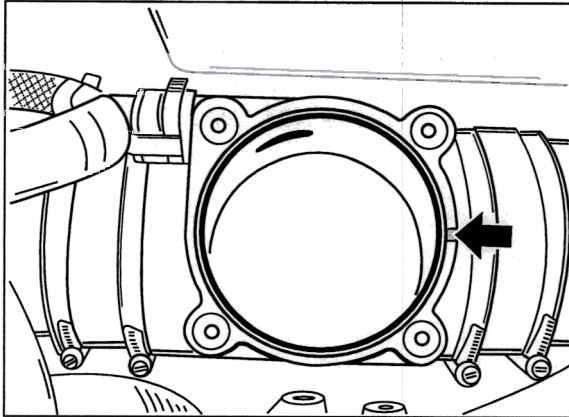


Arrow show marking (line) on the intake distributor

104\_97

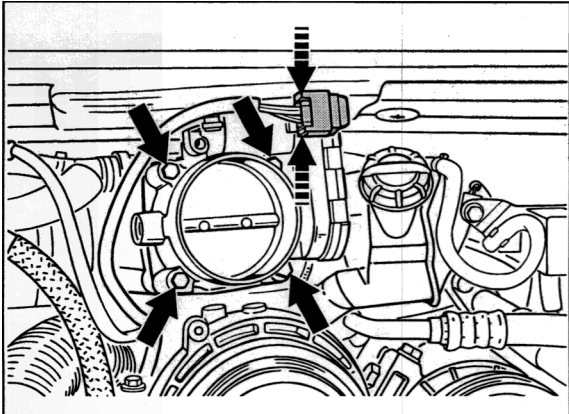


5. Fit throttle body. Insert new sealing ring in the correct position.



378\_98

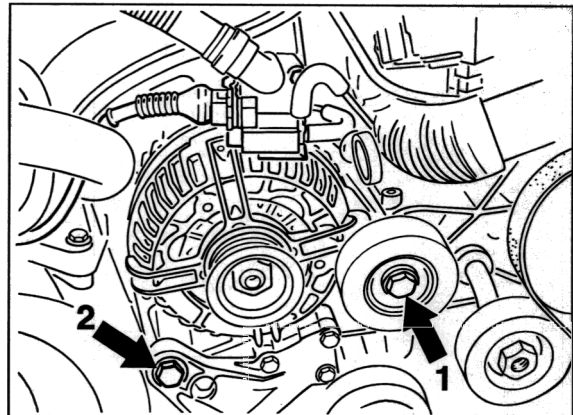
- 5.1 Secure 4 hexagon-head bolts (M6 x 40).  
Tightening torque 10 Nm (7.5 ftlb.). Fit plug.



359\_98

6. Install generator.

Tightening torque of the hexagon-head bolt  
M10 x 145 (8.8) (No.1) 46 Nm (34 ftlb.).  
Tightening torque of the hexagon-head bolt  
M10 x 30 (No.2) 46 Nm (34 ftlb.).



441\_98

7. Fit drive belt.

8. Install air cleaner assembly.

#### Note

Before installation, make sure that the rubber sleeves (2 ea.) are present and properly seated in the transverse lock panel. Clip oil filler neck onto upper part of the air cleaner.

9. Connect battery.

#### 10. Carry out adaptation

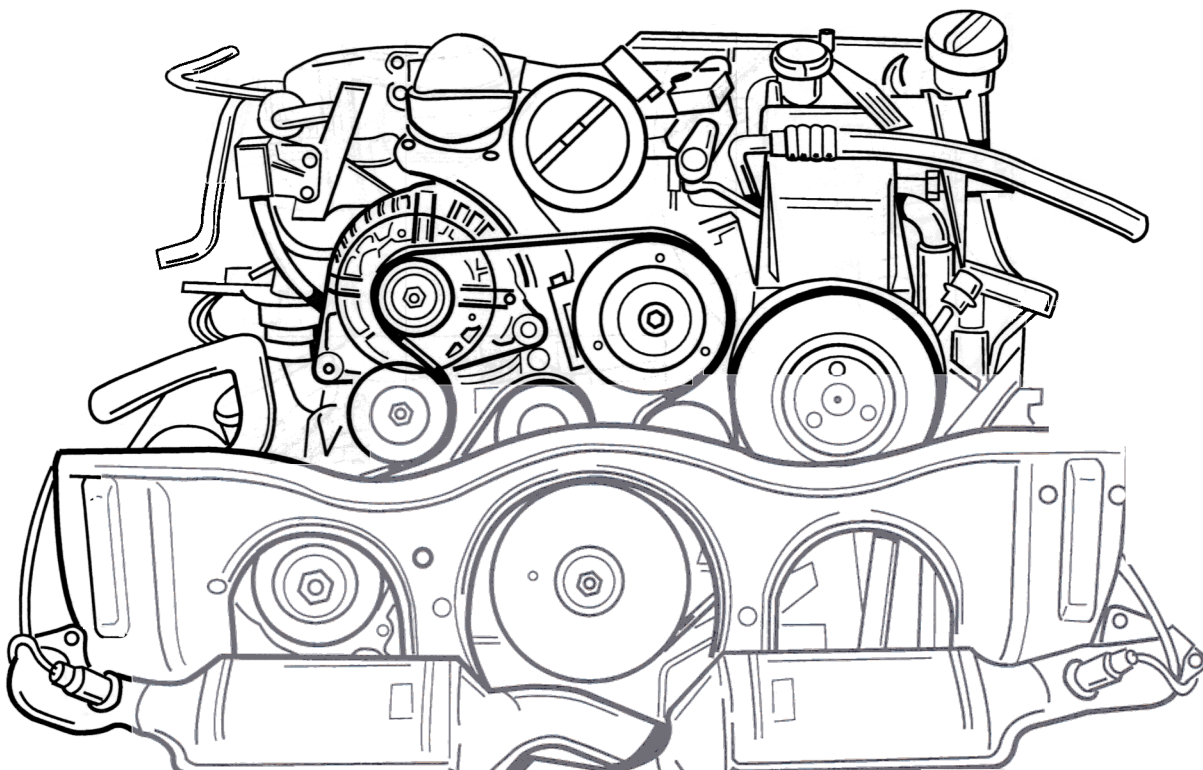
- 10.1 Switch on ignition.

- 10.2 Wait one minute. (Do not operate accelerator pedal).

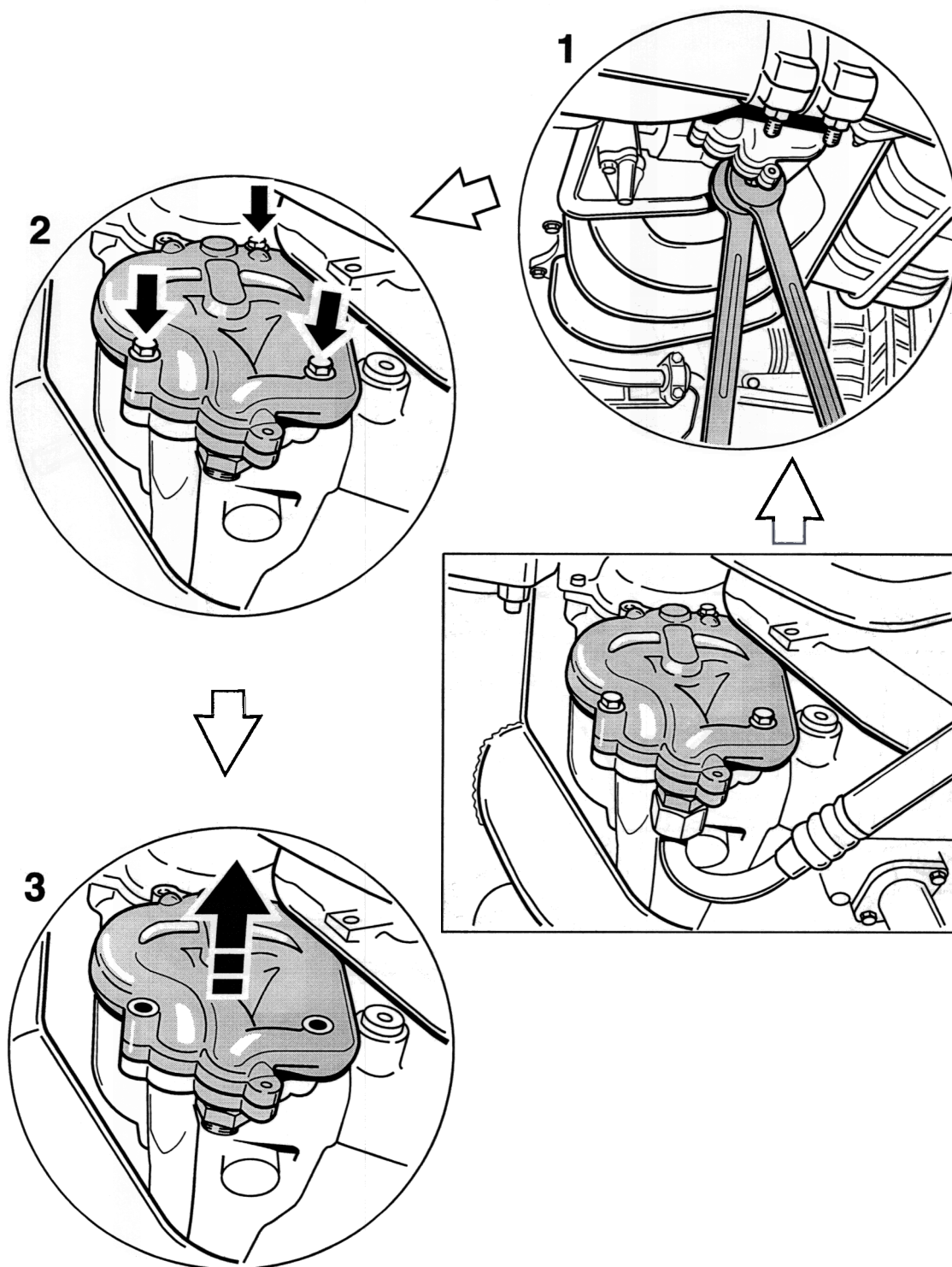
- 10.3 Switch off ignition for at least 10 seconds.

- 10.4 Read out fault memory.

**17 19 21     Removing oil extraction pump – GT3**



130\_99

**Removal overview of the oil extraction pump – GT3**



### **Removal overview of the oil extraction pump – GT3**

- Undo return line
- 2 Undo fastening screws
- 3 Remove oil extraction pump

## Removing oil extraction pump – GT3

No.	Procedure	Instructions
-----	-----------	--------------

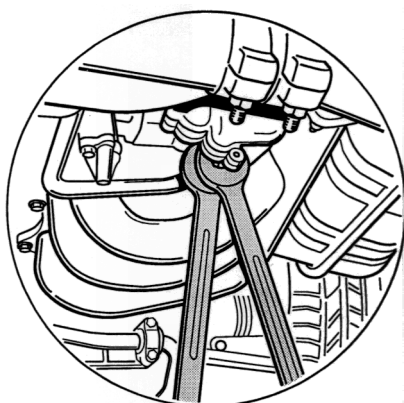


### Warning!

Danger of scalding from draining oil!

> wear protective equipment specified.

1

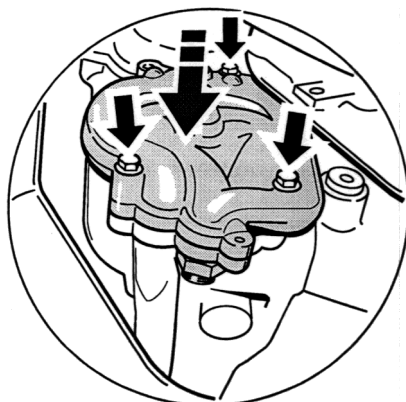


201\_a\_99

Undo return line

Undo return line on the oil extraction pump. Make sure to counter with a wrench when doing this. Collect draining oil.

2

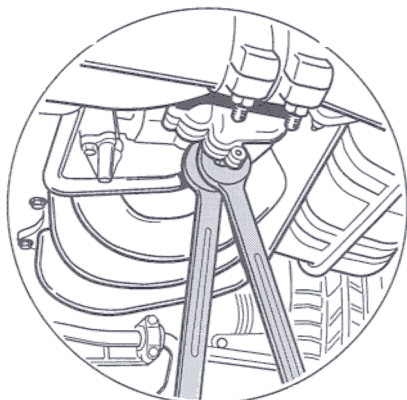


202\_b\_99

Undo fastening screws

Undo the three fastening screws and remove.

3

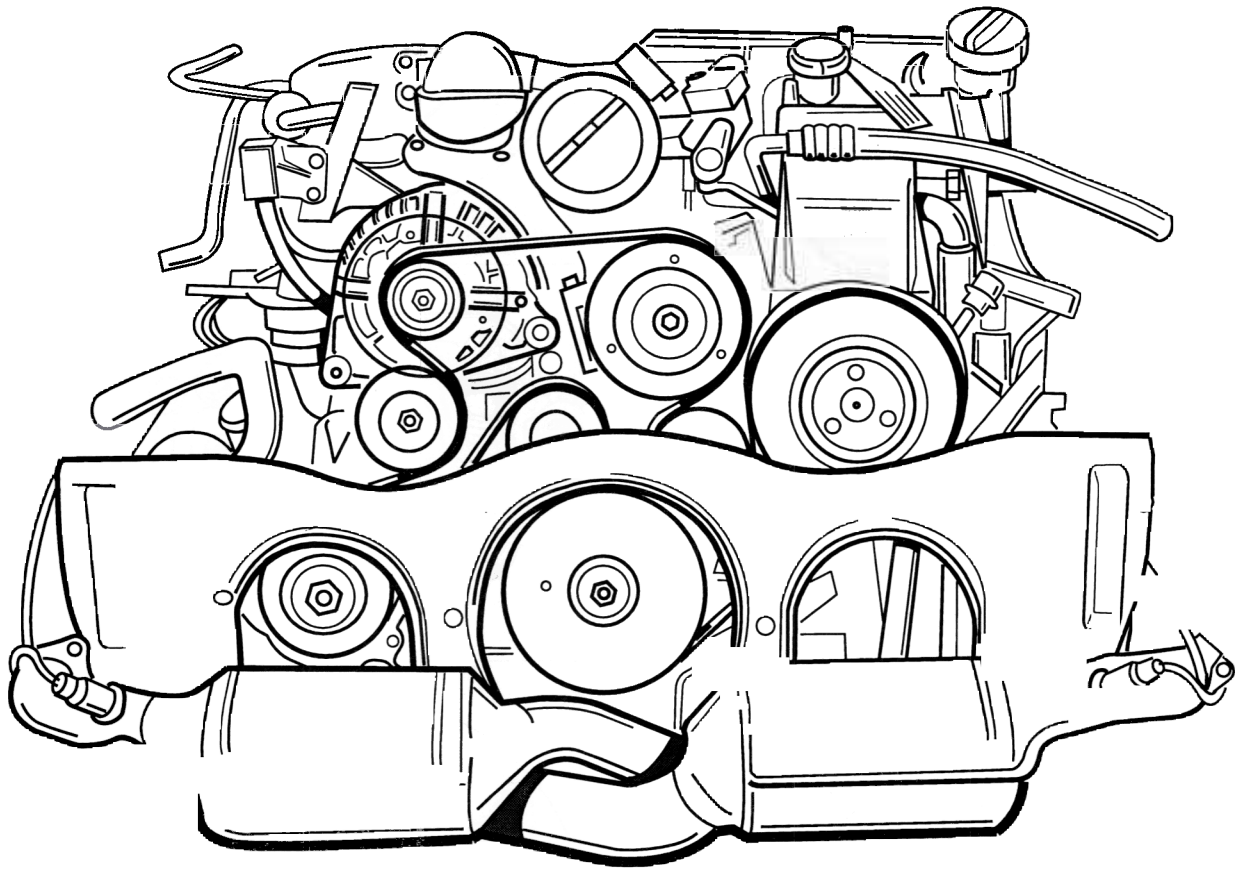


202\_c\_99

### Remove oil extraction pump

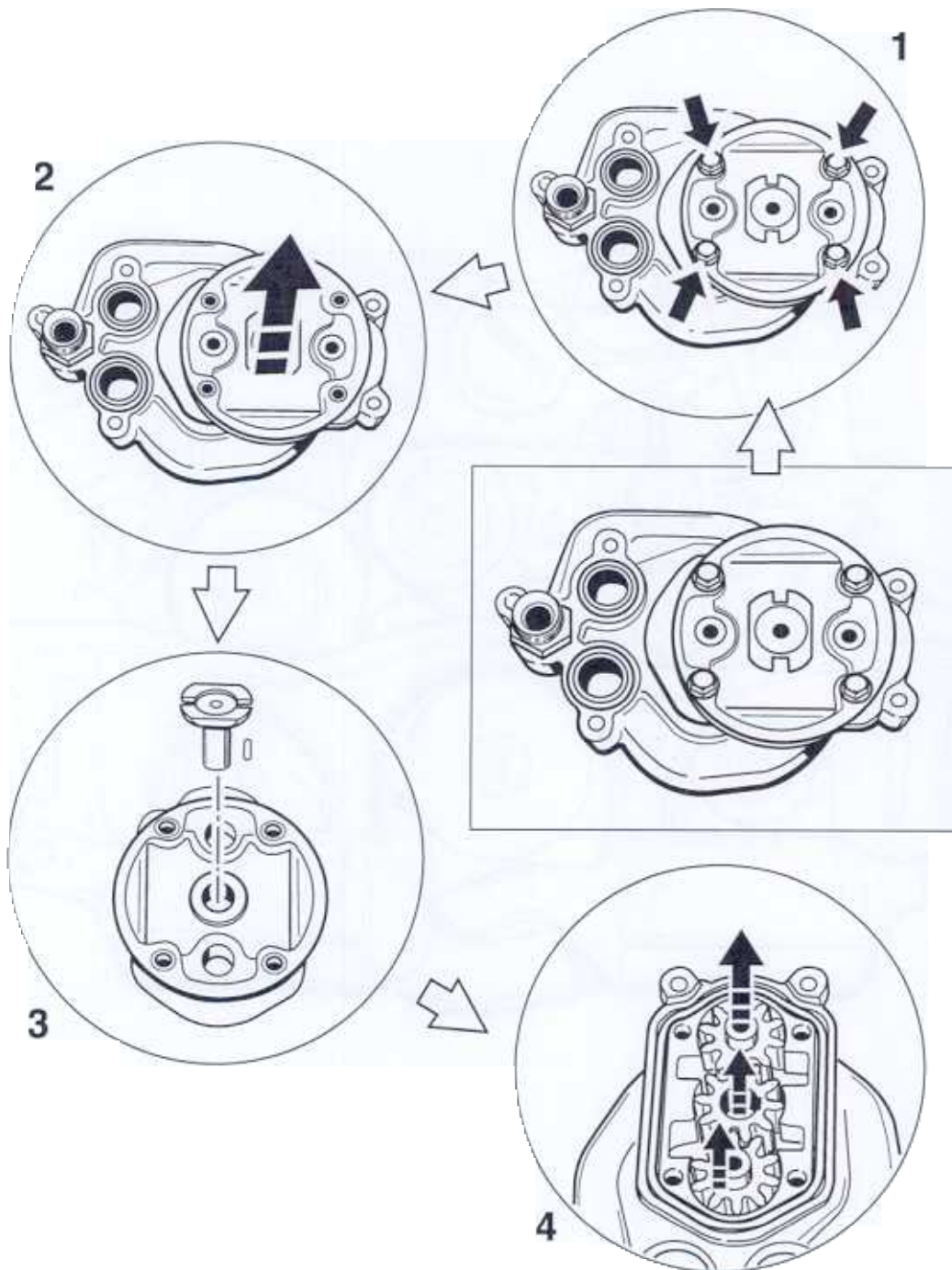
Remove oil extraction pump at the camshaft housing. If the oil extraction pump is stuck, loosen the oil pump by gently tapping with a plastic hammer. Remove the oil pump to the rear.

**17 19 37 Disassembling and assembling oil extraction pump – GT3**



## Disassembling oil extraction pump – GT3

Overview:



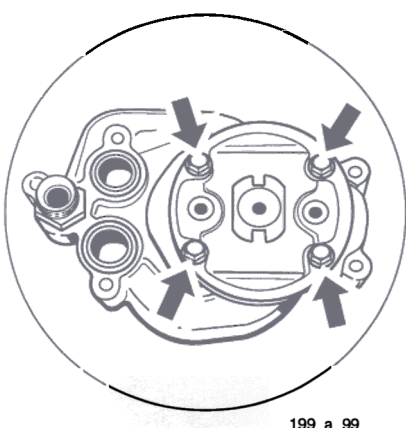
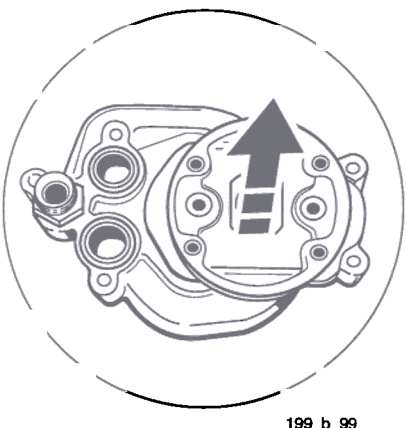
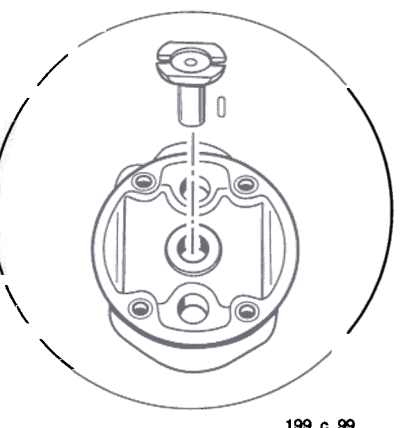
## **Disassembling oil extraction pump – GT3**

Overview:

- Undo assembly screws
- 2 Take off oil pump lid
- 3 Remove input shaft
- 4 Remove gear wheels



## Disassembling oil extraction pump – GT3

No.	Procedure	Instructions
1	 <p>199_a_99</p>	<p>Undo assembly screws</p> <p>Undo the four assembly screws crosswise and remove.</p>
2	 <p>199_b_99</p>	<p>Take off oil pump lid</p> <p>If the oil pump lid is stuck, lever off carefully with a plastic wedge. The housing must not be damaged during this procedure.</p>
3	 <p>199_c_99</p>	<p>Remove input shaft</p> <p>Take feather key out of the input shaft and lift input shaft out of the oil pump lid.</p>

**No. Procedure**

**Instructions**

4



Remove gear wheels

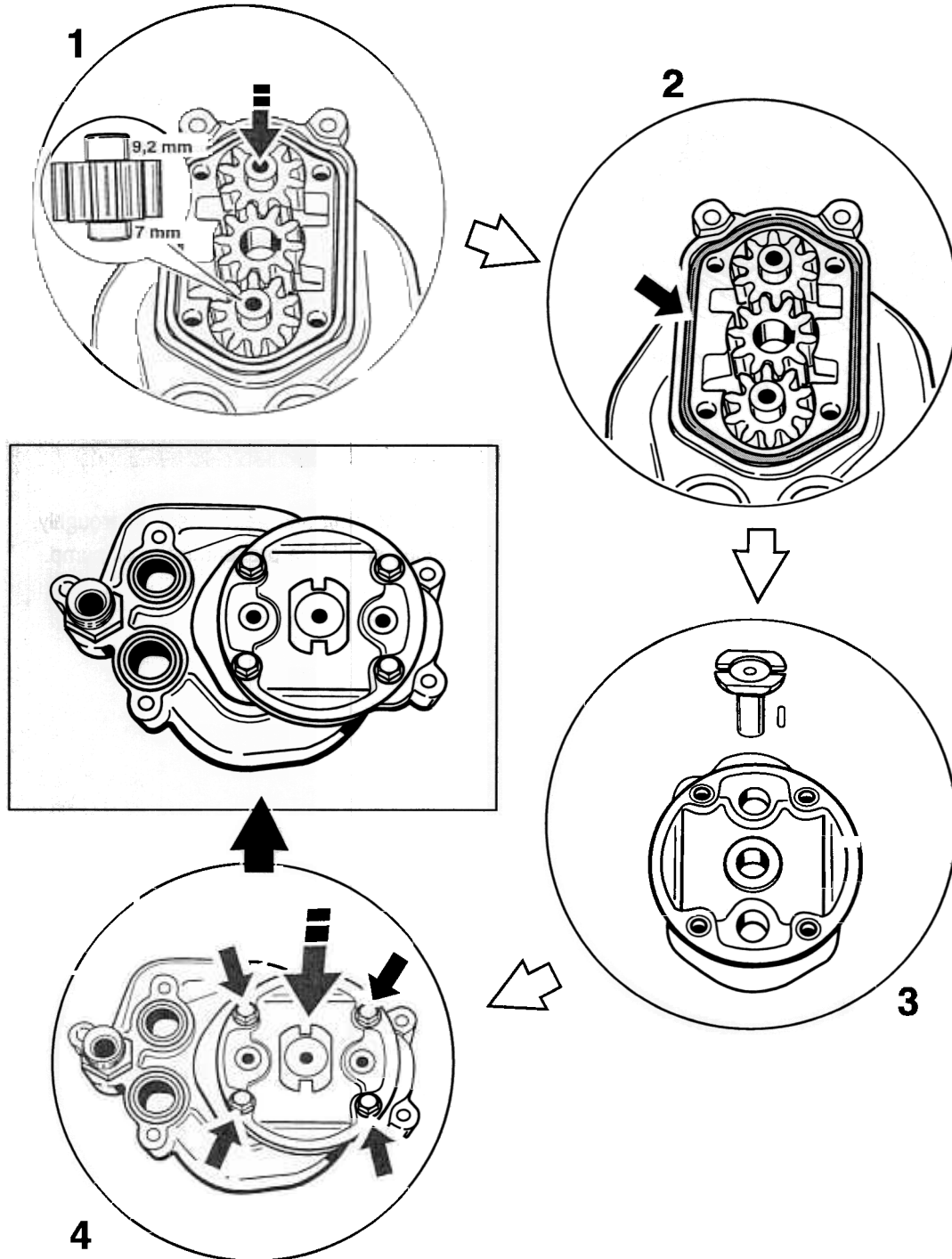
Lift oil extraction pump gear wheels up and out. The axle ends are different lengths. Avoid confusing the gear wheels in the oil extraction pump housing.

Clean oil pump thoroughly

Clean oil pump housing and gear wheels thoroughly.  
No dirt particles should be present in the oil pump.

## Assembling oil extraction pump – GT3

Overview:

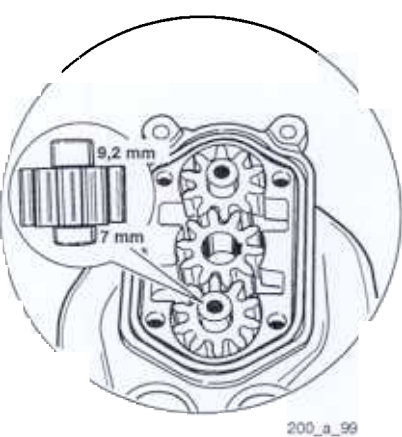
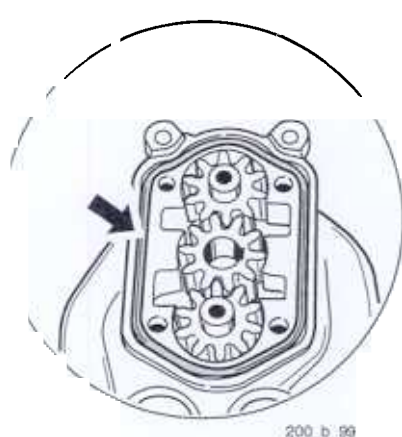
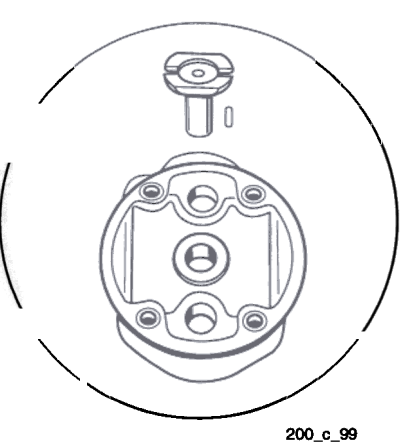


### **Assembling oil extraction pump – GT3**

Overview:

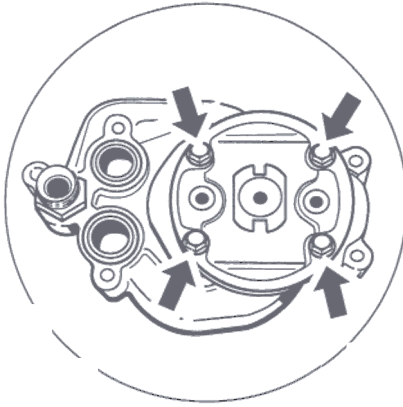
- 1            Insert gear wheels
- 2            Replace seals
- 3            Fit input shaft
- 4            Fit lid

## Assembling oil extraction pump – GT3

No.	Procedure	Instructions
1	 <p>200_a_99</p>	<p><b>Insert gear wheels</b></p> <p>Insert the gear wheels of the oil extraction pump. The gear wheels with the axles are located on the outer sides. The short axle end (7 mm) must be inserted face downwards in the oil pump housing.</p>
2	 <p>200_b_99</p>	<p><b>Replace seal</b></p> <p>The O-ring must always be replaced. Insert sealing ring carefully into the groove provided.</p>
3	 <p>200_c_99</p>	<p><b>Fit input shaft</b></p> <p>Push input shaft through the opening in the oil extraction pump lid. Insert feather key in the input shaft.</p>

**No. Procedure****Instructions**

4



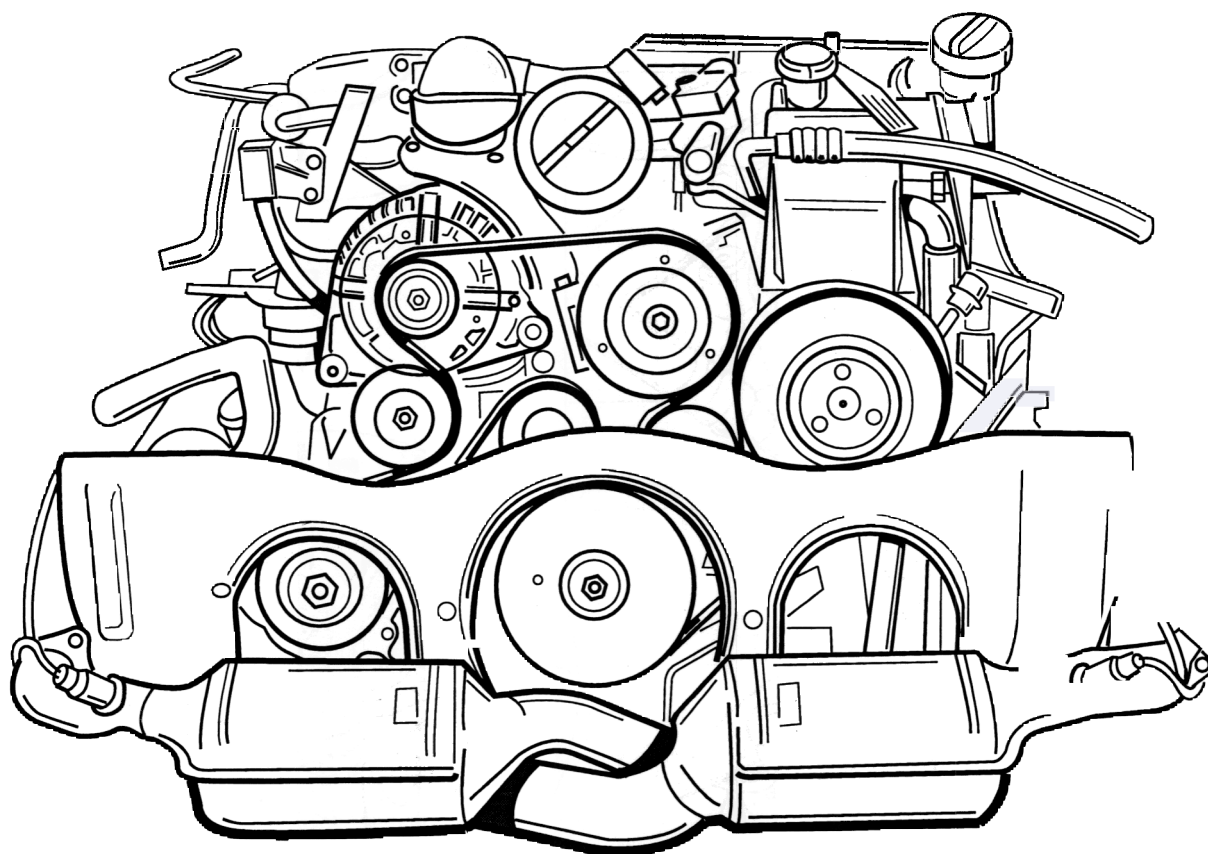
200\_d\_99

Fit oil extraction pump lid

Fit oil extraction pump lid with input shaft. Insert feather key into the groove in the centre gear wheel. Place lid on the oil extraction pump and position the four fastening screws. Tighten the four screws crosswise to 10 Nm (7.5 ftlb.).

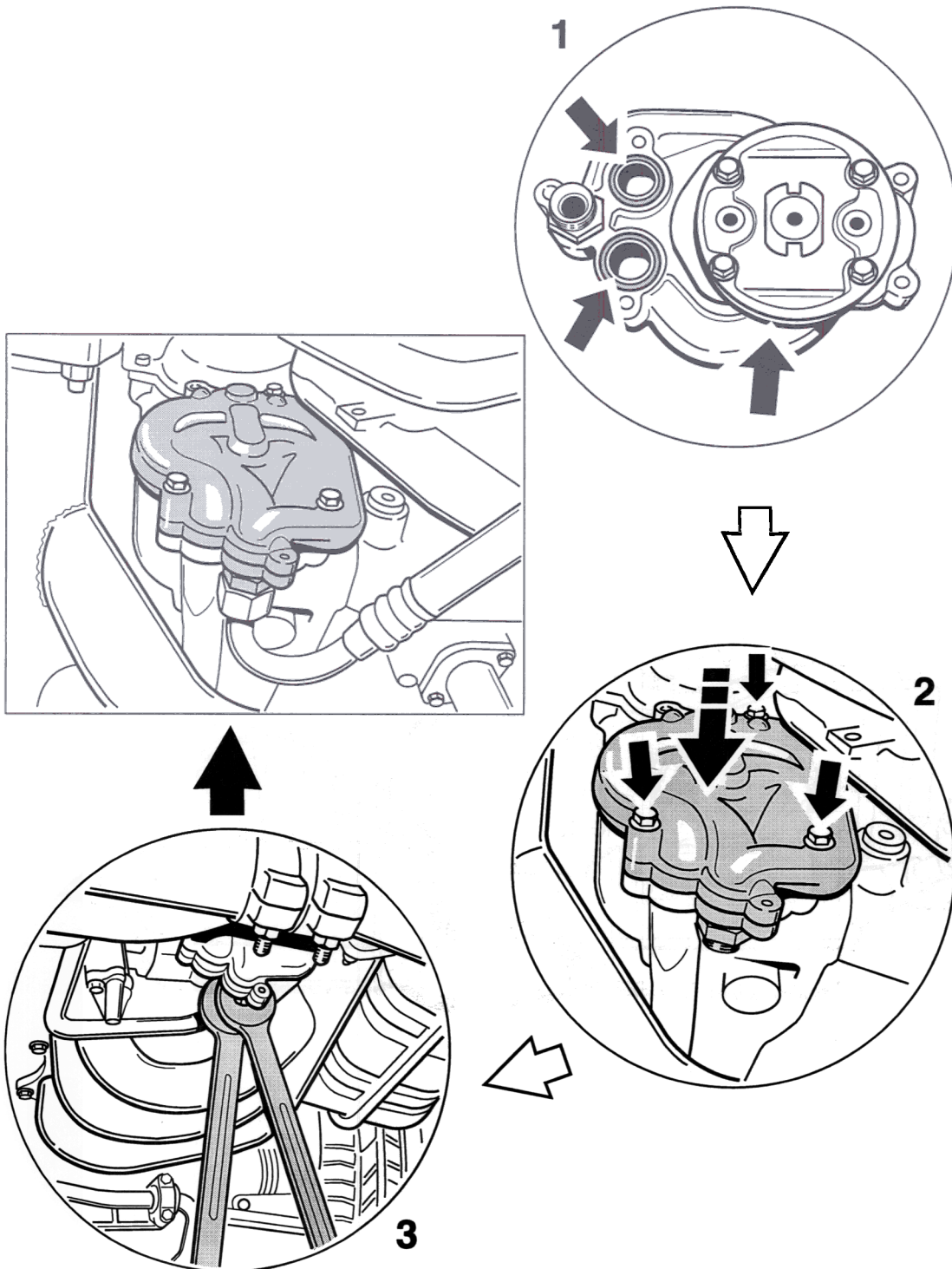


**17 19 23**    **Installing oil extraction pump – GT3**



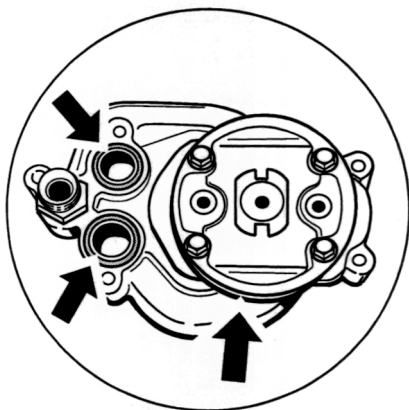
130\_99

### Installation overview of the oil extraction pump – GT3



### **Installation overview of the oil extraction pump – GT3**

- 1            Replace seals
- 2            Put on oil extraction pump
- 3            Tighten return line

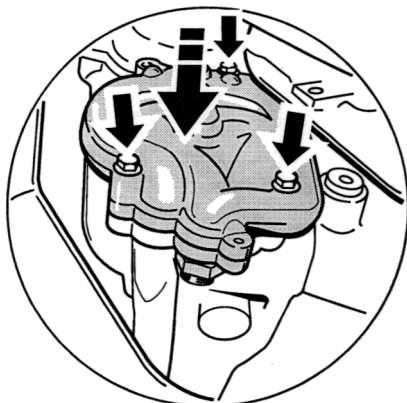
**Installing oil extraction pump – GT3****No. Procedure****Instructions**

202\_a\_99

**Replace seals**

The three seals shown must always be replaced. Coat the large O-ring with acid-free grease to facilitate assembly of the oil extraction pump.

2

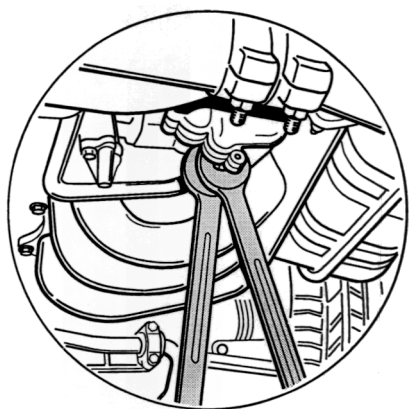


202\_b\_99

**Put on oil extraction pump**

Put on oil extraction pump. When doing this, make sure that the driver and the input shaft of the oil extraction pump are correctly aligned. Tighten the three fastening screws to 13 Nm (10 ftlb.).

3



202\_c\_99

**Tighten return line**

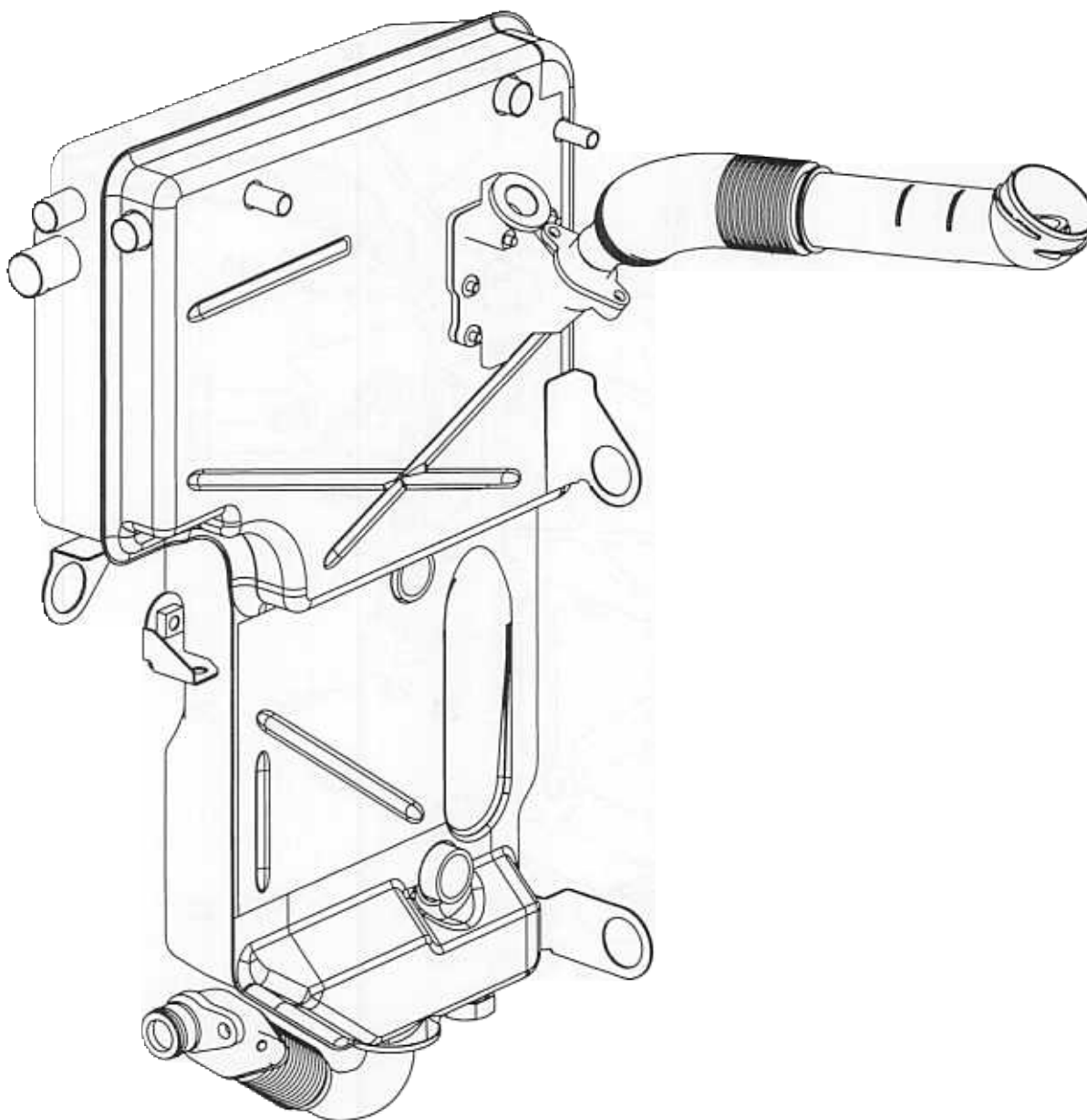
Tighten return line on the oil extraction pump. Make sure to counter with a wrench when doing this.

### Installing oil extraction pump – GT3

No.	Procedure	Instructions
		Fill in drained oil again.
		Fill the uncontaminated oil back into the engine through the oil filler opening. Then check the engine oil level.

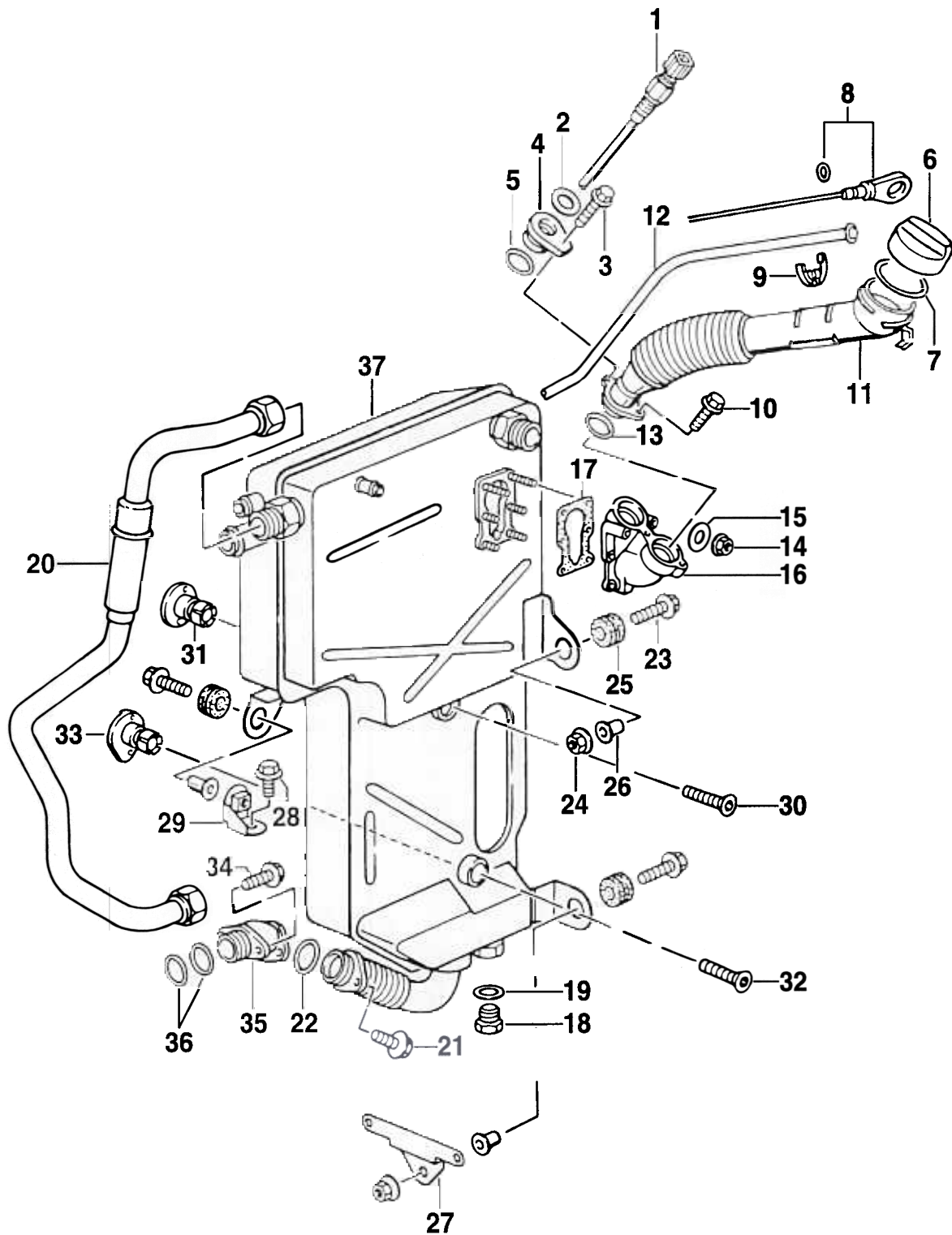
## 17 52 19 Removing and installing oil container – GT3

Preliminary work: Removing and installing engine (Service No. 10 01 19).



379\_99



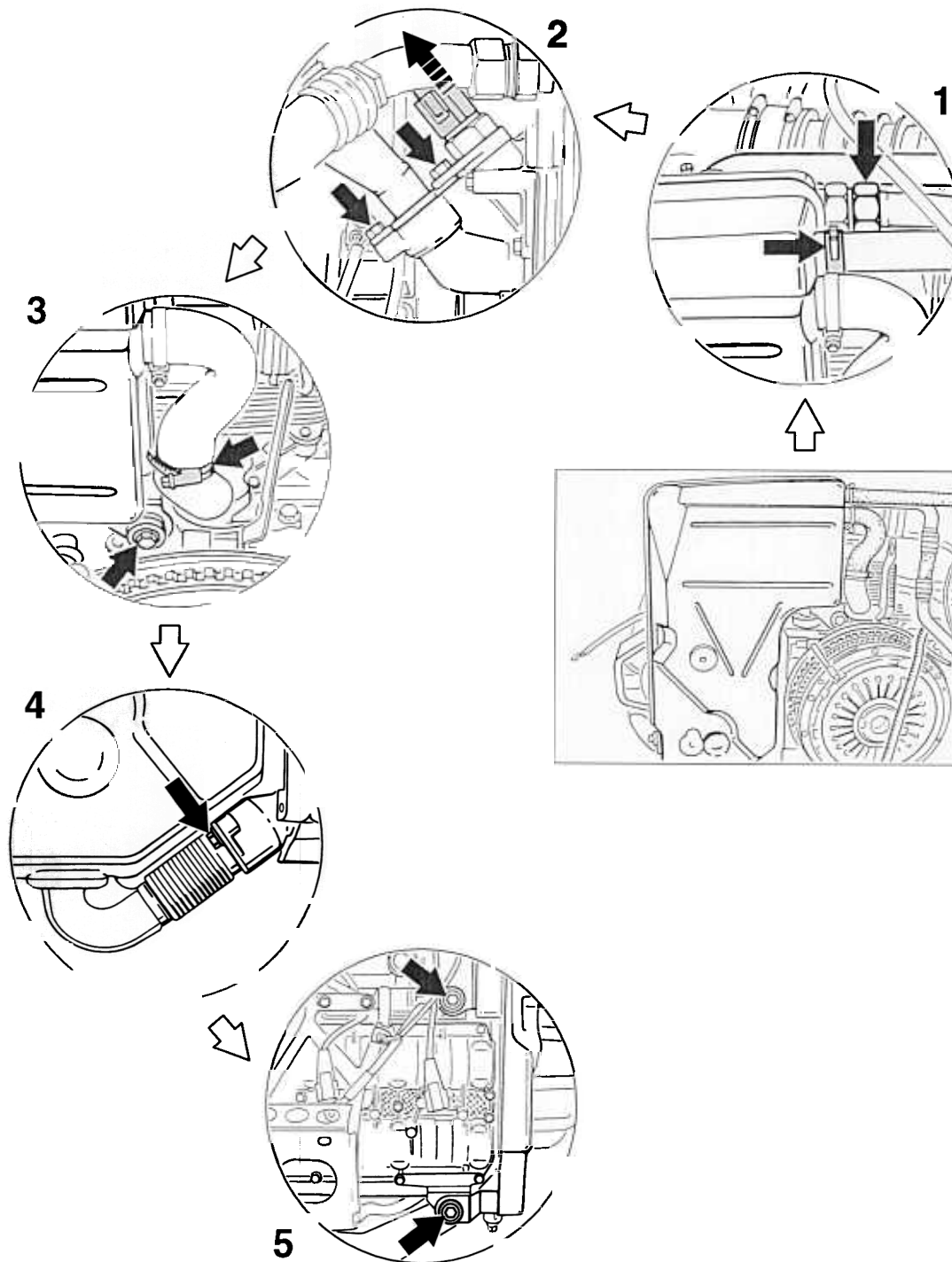


No.	Designation	Qty.	Removal	Note:	Installation
	Oil level sender	1			Tightening torque 25 Nm (19 ftlb.)
2	Sealing ring	1			Replace
3	M 6x20 hexagon-head bolt	1			
4	Flange	1			
5	O-ring 25x3.15	1			Check, replace if necessary
6	Closure cap	1			
7	O-ring 51x3.15	1			Check, replace if necessary
8	Oil dipstick	1			
9	Clamp	1			
10	M 6x16 hexagon-head bolt	1			
11	Filler tube	1			
12	Guide tube for oil dipstick	1			
13	O-ring 25x3.15	1			Check, replace if necessary
14	M 5 hexagon nut	6			
15	5.3x9.5x1 washer	6			
16	Adapter	1			
17	Seal	1			Replace
18	Oil drain plug	1			Tightening torque 60 Nm (44 ftlb.)
19	A 22x27x3 sealing ring	1			Always replace
20	Return line	1			
21	M 6x16 hexagon-head bolt	2			
22	30x2.5 O-ring	1			Check, replace if necessary
23	AM 8x35 hexagon-head bolt	3			

No.	Designation	Qty.	Removal	Note:	
				Installation	
24	Hexagon nut M8	3			
25	17.0x24.0x1.8 grommet	3			
26	8.4x1.8 spacer sleeve	3			
27	Holder				
28	M 8x16 hexagon-head bolt	1			
29	Holder	1			
30	M 12x40 hexagon-head bolt	1			
31	Upper spacer	1			
32	M 12x40 hexagon-head bolt	1			
33	Lower spacer	1			
34	M 8x30 pan-head screw	1			
35	Suction pipe fitting				
36	21.89x2.62 O-ring	2			Check, replace if necessary
37	Oil container				

## Removing and installing oil container – GT3

Removal overview:



445\_99

**Removal overview:**

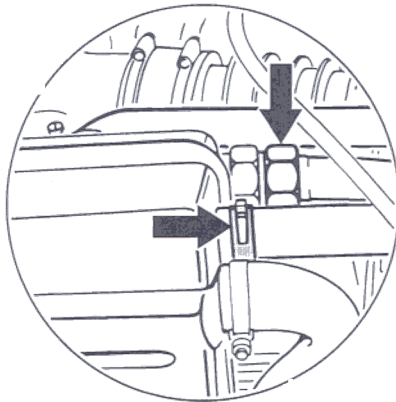
- 1 Detaching oil return line and vent line.
- 2 Pulling plug off oil level sender and detaching oil line.
- 3 Detaching positive crankcase ventilation and oil container fastening.
- 4 Detaching inlet line.
- 5 Unscrewing fastening screws.

## Removing oil container – GT3

### No. Procedure

### Instructions

1

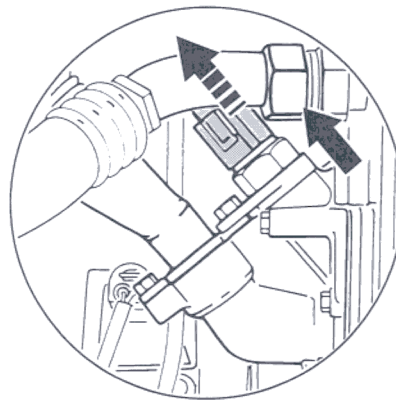


099\_a\_99

Detaching oil return line and vent line.

Detach return line on the oil container. Make sure to counter with a wrench at the oil container. Loosen the hose clamp at the vent line and pull off the vent hose.

2

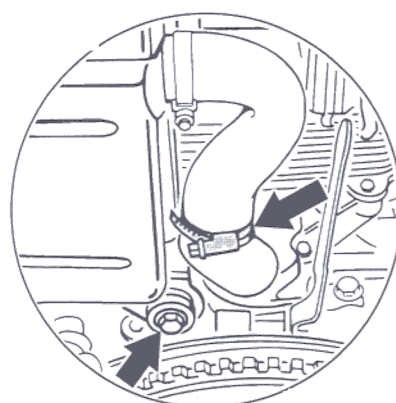


099\_b\_99

Pulling plug off oil level sender and detaching oil line.

Pull plug off the oil level sender and set it aside. Then detach the return line from the cylinder head. Make sure to counter with a wrench when doing this in order to prevent damage to the oil container.

3



099\_c\_99

Detaching positive crankcase ventilation and oil container fastening.

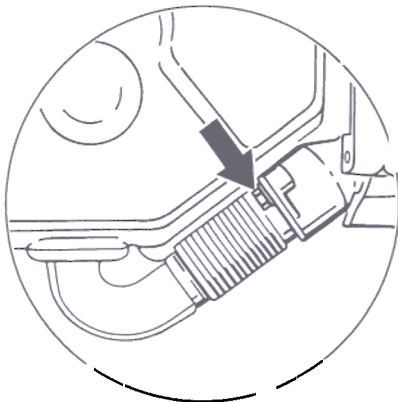
Loosen the hose clamp on the positive crankcase ventilation hose on the engine and pull off the vent hose. Loosen the oil container fastening screw.



## Removing oil container – GT3

No.	Procedure	Instructions
-----	-----------	--------------

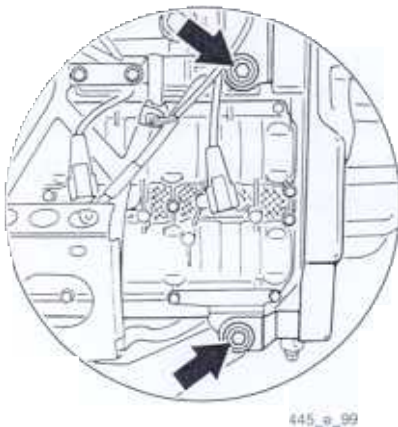
4



Detaching inlet line.

Detach inlet line between the oil container and the engine. Unscrew the two hexagon socket head bolts for this purpose.

5

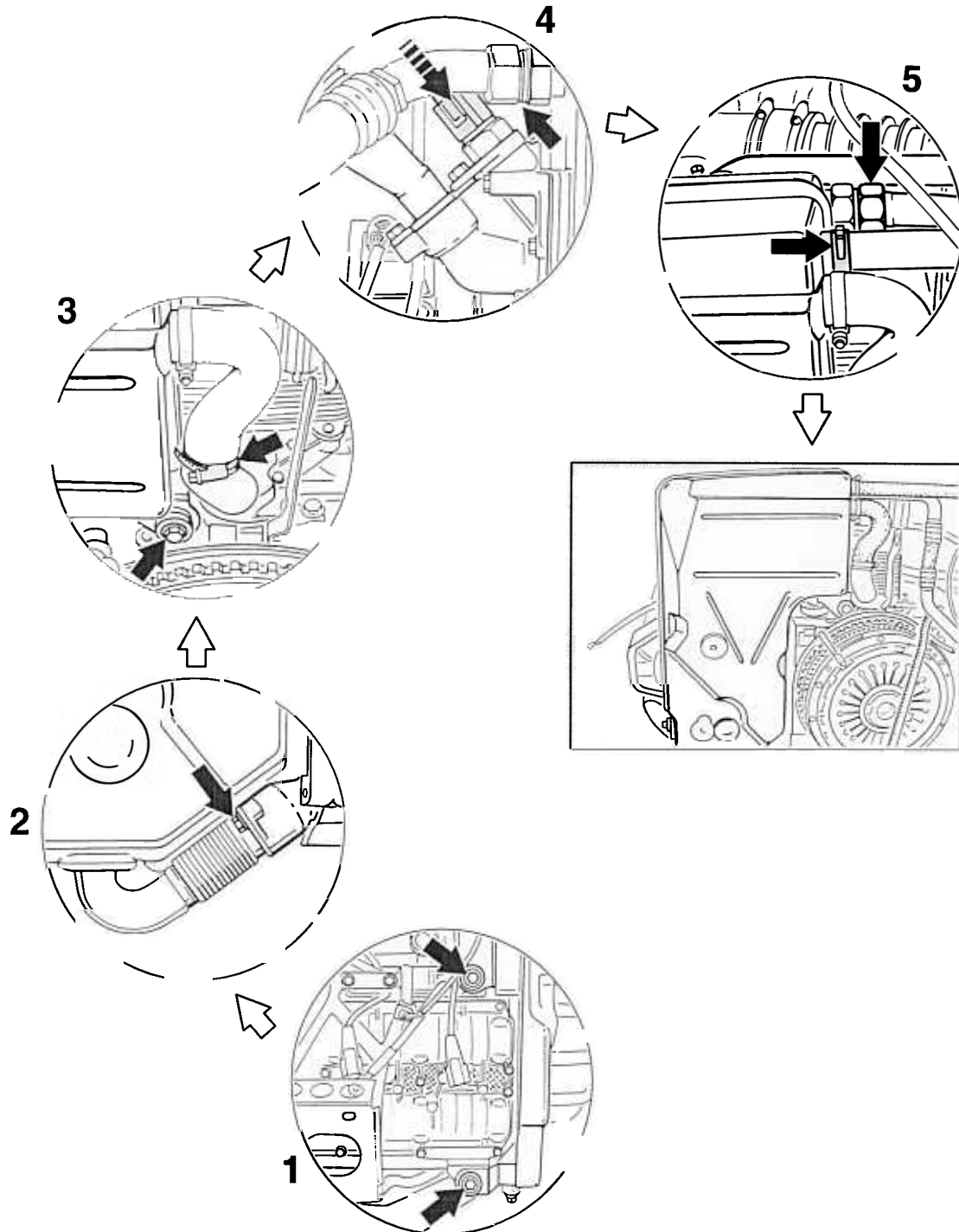


Unscrewing fastening screws.

Loosen the two oil container fastening screw at the sides.

## Removing and installing oil container – GT3

Installation overview:



447\_99

## Removing and installing oil container – GT3

### Installation overview:

- 1 Tightening fastening screws.
- 2 Tightening inlet line.
- 3 Tightening positive crankcase ventilation and oil container fastening.
- 4 Pushing on oil level sender and tightening the oil line.  
Tightening oil return line and vent line.

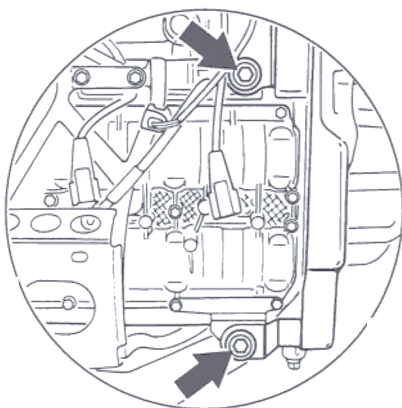


## Installing oil container – GT3

### No. Procedure

### Instructions

1

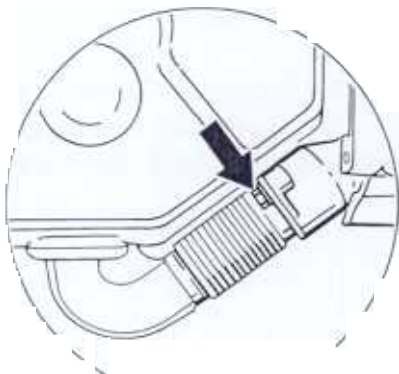


445\_e\_99

Tightening fastening screws.

Tighten the two oil container fastening screws at the lateral holders to 23 Nm (17 ftlb.).

2



445\_d\_99

Tightening inlet line.

Fit a new O-ring on the inlet line between the oil container and engine and insert the line. Tighten the two hexagon socket head bolts to 9.7 Nm (7.0 ftlb.).

3



099\_c\_99

Tightening positive crankcase ventilation and oil container fastening.

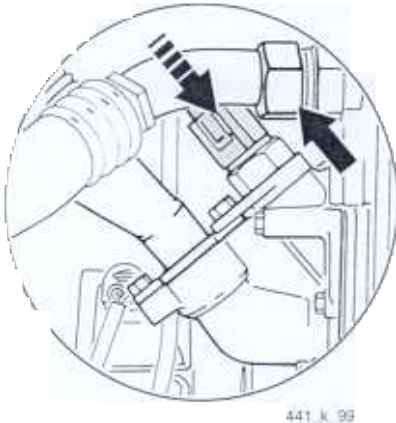
Push on the positive crankcase ventilation hose again and tighten the hose clamp. Screw in the oil container fastening screw and tighten to 23 Nm (17 ftlb.).

## Installing oil container – GT3

### No. Procedure

### Instructions

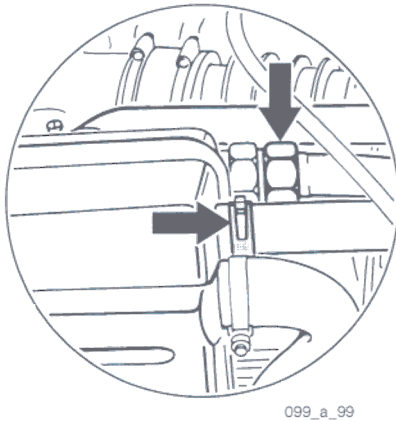
4



Pushing on oil level sender plug and tightening the oil line.

Push on the oil level sender connecting cable again. Then tighten the oil return line from the cylinder head. Make sure to counter with a wrench at the oil container when doing this.

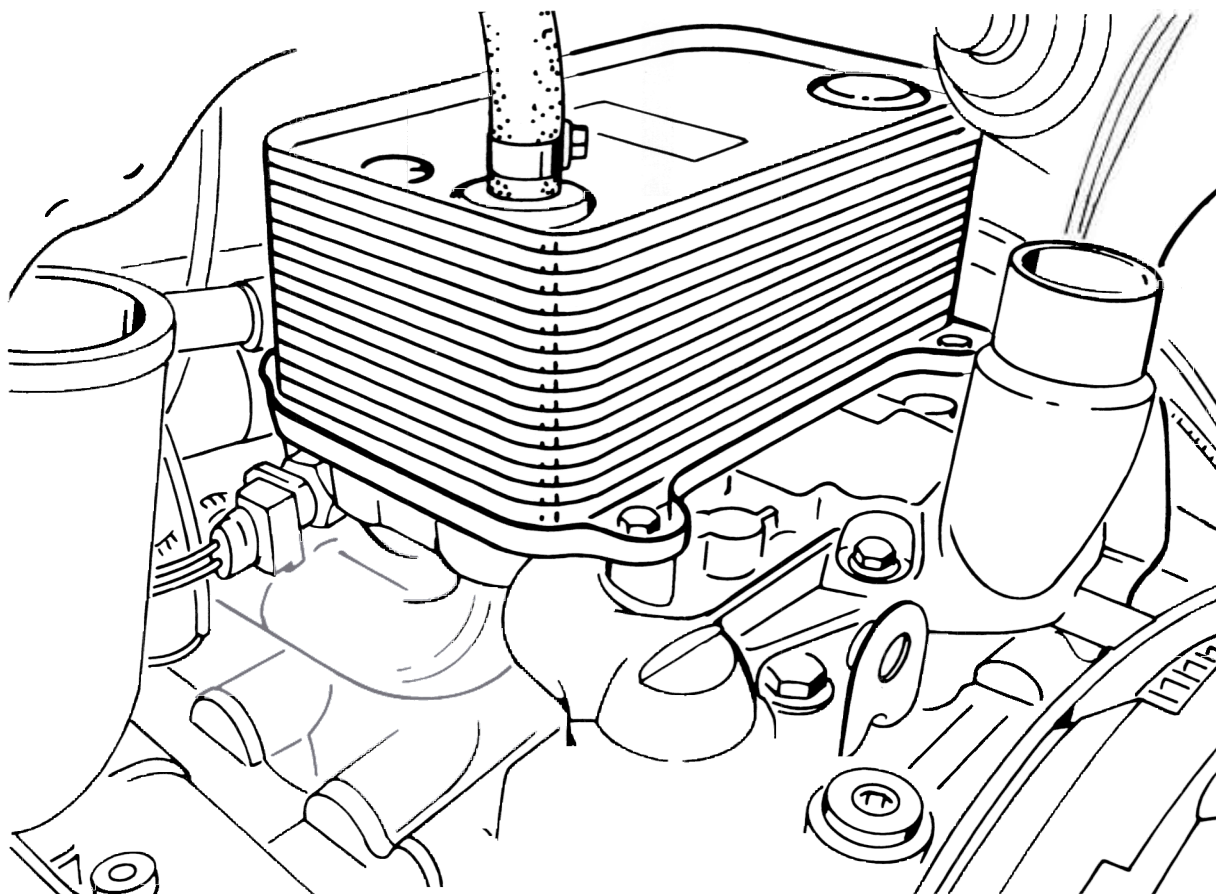
5



Tightening oil return line and vent line.

Tighten oil return line on the oil container. Make sure to counter with a wrench at the oil container when doing this. Push on vent hose again and fit the spring band clamp.

**17 67 19 Removing and installing bracket for oil cooler – GT3**



430\_99

Includes:

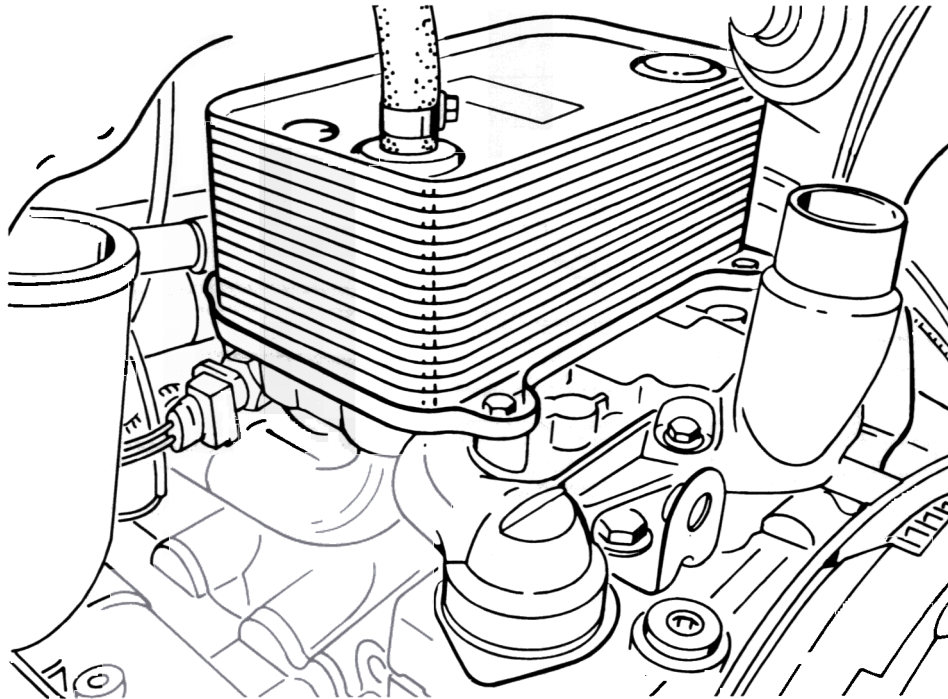
17 67 21 Removing bracket for oil cooler – GT3

17 67 23 Installing bracket for oil cooler – GT3



## 17 67 21 Removing bracket for oil cooler – GT3

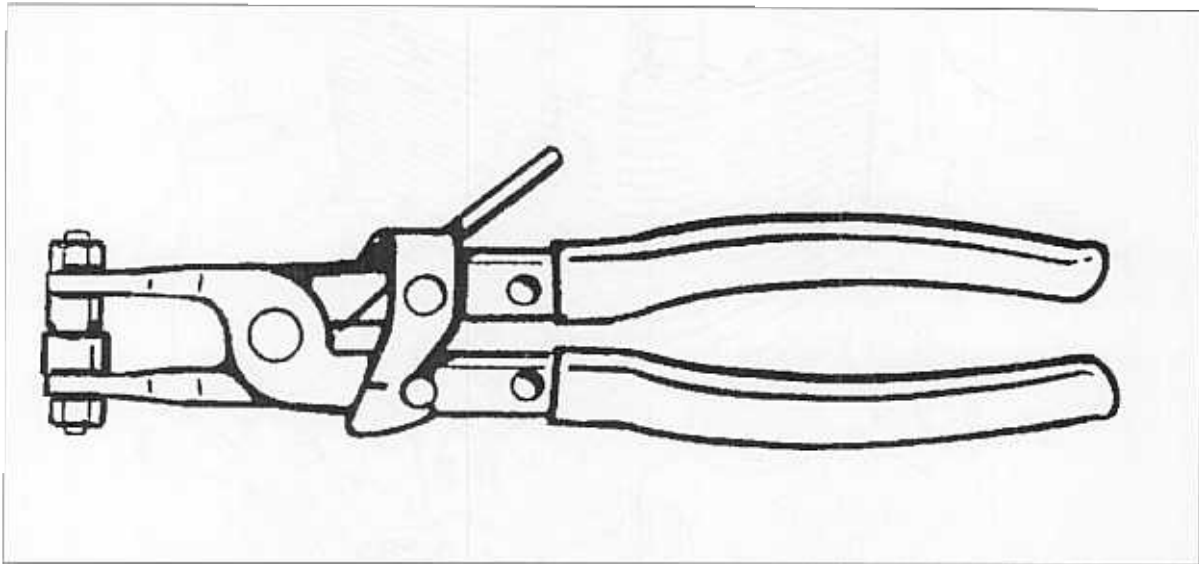
Preliminary work: Removing and installing engine (Service No. 10 01 19).



430\_99

## Removing bracket for oil cooler – GT3

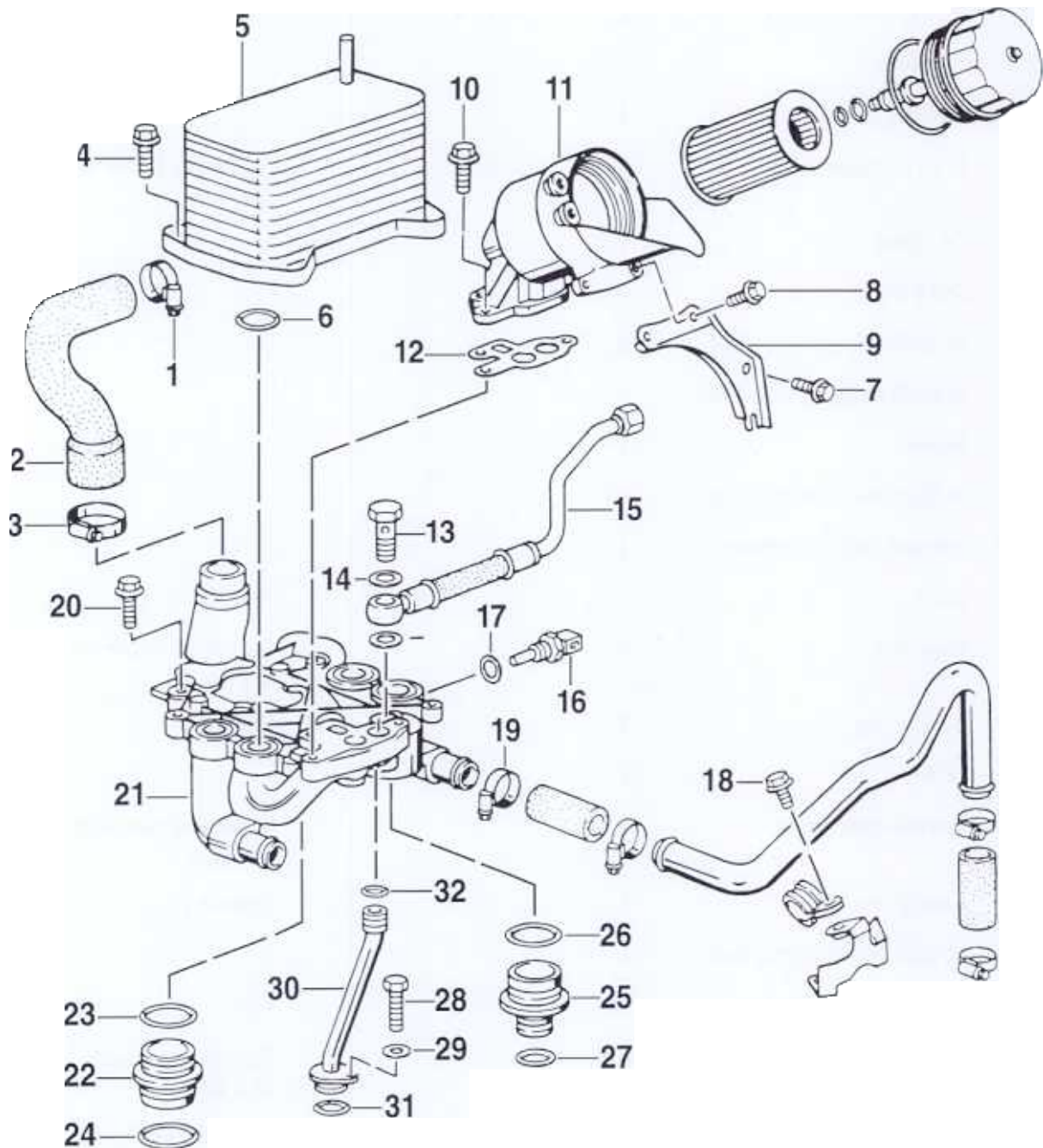
### Special tools



70\_99

Item	Designation	Special tool	Explanation
	Spring-band clamp pliers	Commercially available; refer to Workshop Equipment Manual, Chapter 2.4, No. 72 or 73	For opening and closing spring-band clamps

# Removing bracket for oil cooler – GT3



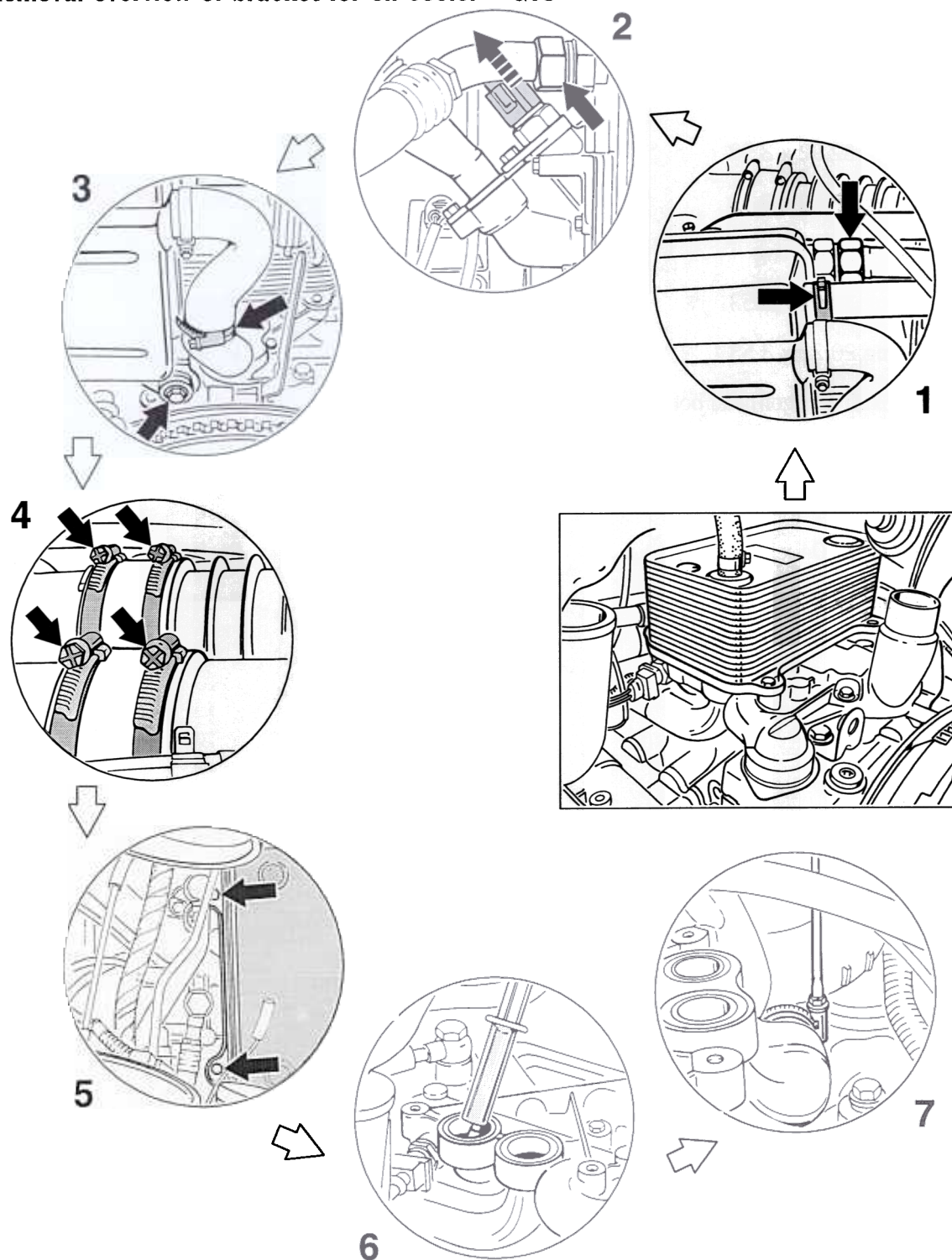
428\_99

**Removing bracket for oil cooler – GT3**

No.	Designation	Qty.	Removal	Note:	Installation
1	23-35/9 hose clamp				
2	Vent hose				
3	40-60/9 hose clamp				
4	M 6x16 hexagon-head bolt	4			Tightening torque 9.7 Nm (7.0 ftlb.)
5	Oil cooler				
6	26x3 O-ring	4			
7	M 6x25 hexagon-head bolt	2			
8	M 8x35 hexagon-head bolt	2			
9	Holder	1			
10	M 6x25 hexagon-head bolt	3			
11	Housing with filter element	1			
12	Seal				Replace
13	Banjo bolt	1			Tightening torque 30 Nm (22 ftlb.)
14	Sealing ring	2			Replace
15	Oil line	1			
16	Temperature sensor	1			Tightening torque 25 Nm (19 ftlb.)
17	Sealing ring	1			Replace
18	M 6x12 hexagon-head bolt	1			
19	23-35/9 hose clamp				
20	M 6x25 hexagon-head bolt	4			Tightening torque 9.7 Nm (7.0 ftlb.)
21	Bracket	1			Coat seal facing crankcase with Drei Bond type 1209

**Removing bracket for oil cooler – GT3**

No.	Designation	Qty.	Removal	Note:	Installation
22	Connection fitting	1			Replace
23	O-ring 32.92 x 3.53	1			Replace
24	O-ring 37.69 x 3.53				
25	Connection fitting				
26	O-ring 32.92 x 3.53	1			Replace
27	O-ring 20.22 x 3.53	1			Replace
28	M 6x30 hexagon-head bolt				
29	A 6.4 washer				
30	Oil return line				
31	O-ring 17.04 x 3.53	1			Replace
32	O-ring 12 x 2	1			Replace

**Removal overview of bracket for oil cooler – GT3**

099\_99



## Removal overview of bracket for oil cooler – GT3

Preliminary work:

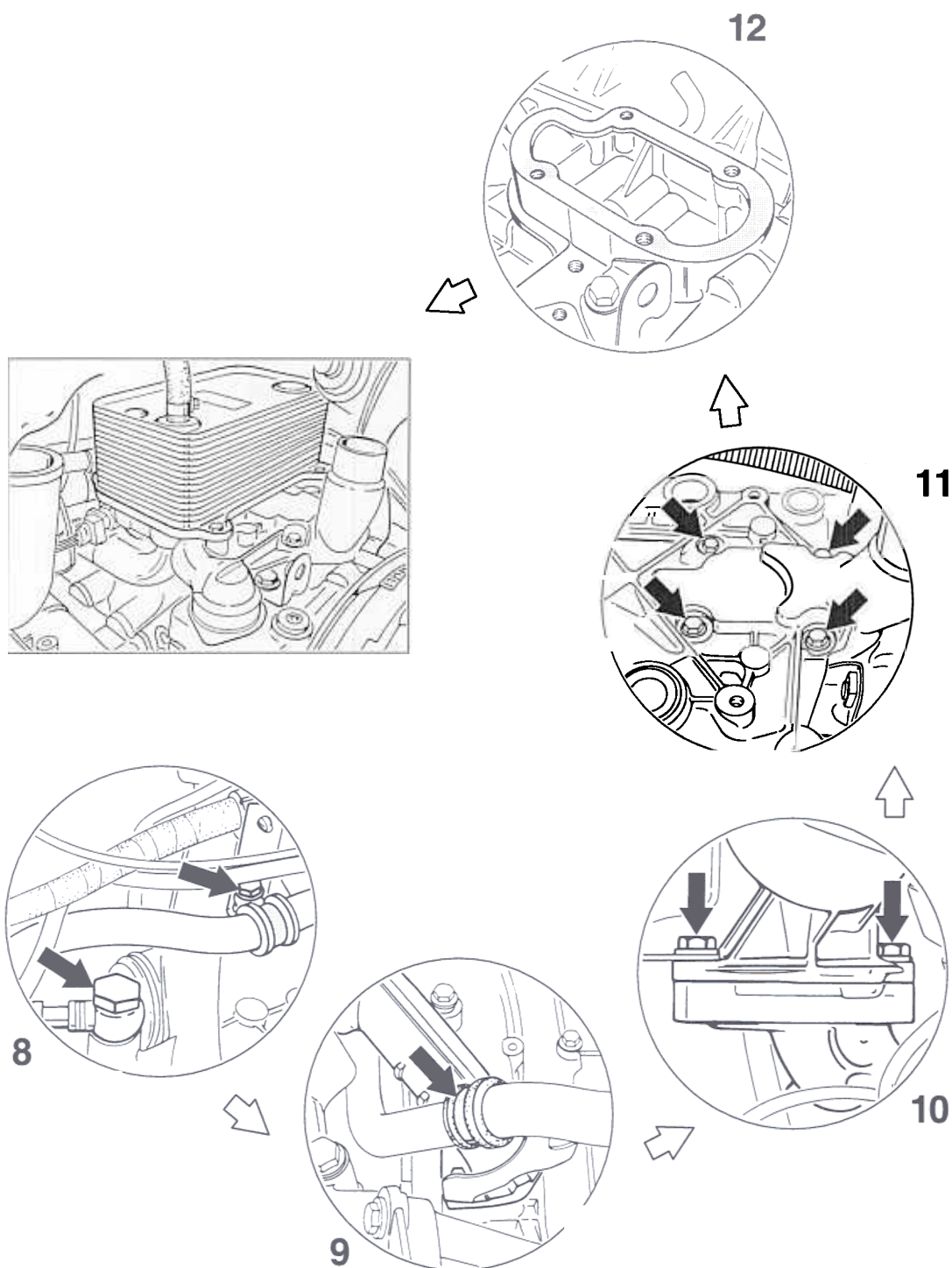
Drain oil at the oil container.

Unscrew the oil drain plug on the oil container and drain off the oil. Always counter when loosening in order to prevent damage to the oil container. Unscrew oil container fastening screws and press the oil container forward.

Detaching oil return line and vent line.

- 2 Pulling plug off oil level sender and detaching oil line.
- 3 Detaching positive crankcase ventilation and oil container fastening.
- 4 Loosening hose clamps on the intake system.
- 5 Unscrewing fastening screws on the oil cooler.
- 6 Sucking out remaining oil.
- 7 Detaching coolant line.

# Removal overview of bracket for oil cooler – GT3



432\_99

### **Removal overview of bracket for oil cooler – GT3**

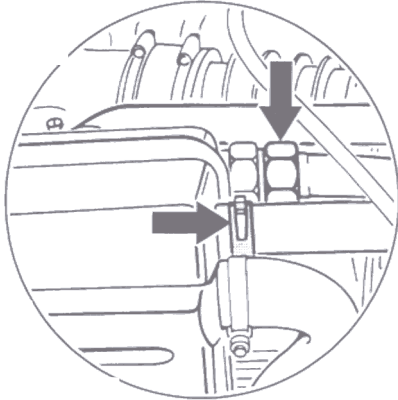
- 8            Loosening banjo bolt of the oil line and loosening hose fastening.
- 9            Loosening hose fastening of the coolant line.
- 10          Separating flange between bracket and oil filter.
- 11          Unscrewing bracket fastening screws.
- 12          Cleaning sealing surface.

## Removing bracket for oil cooler – GT3

### No. Procedure

### Instructions

1

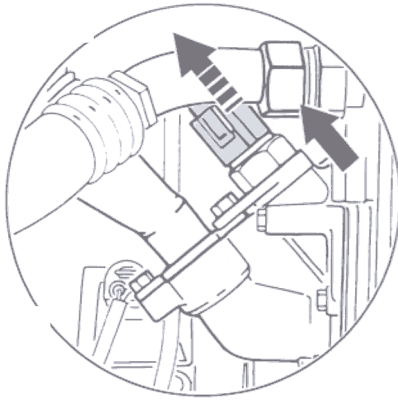


099\_a\_99

Detaching oil return line and vent line.

Detach return line on the oil tank. Make sure to counter with a wrench at the oil tank. Loosen the hose clamp at the vent line and pull off the vent hose.

2

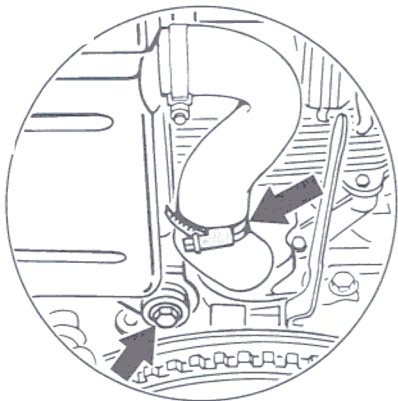


099\_b\_99

Pulling plug off oil level sender and detaching oil line.

Pull plug off the oil level sender and set it aside. Then detach the return line from the cylinder head. Make sure to counter with a wrench when doing this in order to prevent damage to the oil tank.

3



099\_c\_99

Detaching positive crankcase ventilation and oil container fastening.

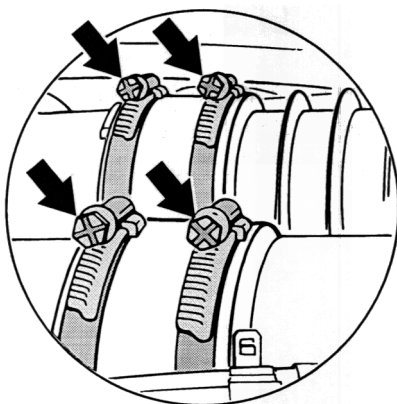
Loosen the hose clamp on the positive crankcase ventilation hose on the engine and pull off the vent hose. Unscrew the three oil container fastening screws and remove the oil container.

## Removing bracket for oil cooler – GT3

### No. Procedure

### Instructions

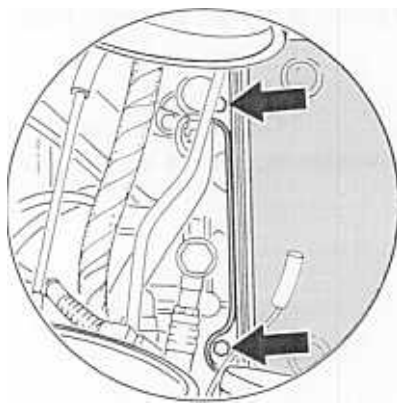
4



Loosening hose clamps on the intake system.

Loosen the eight hose clamps on the throttle body and tuning pipe. Take out the throttle body and tuning pipe.

5



Unscrewing fastening screws on the oil cooler.

Unscrew the four oil cooler fastening screws and take off the oil cooler.


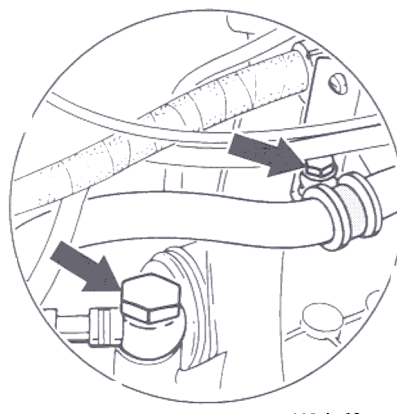
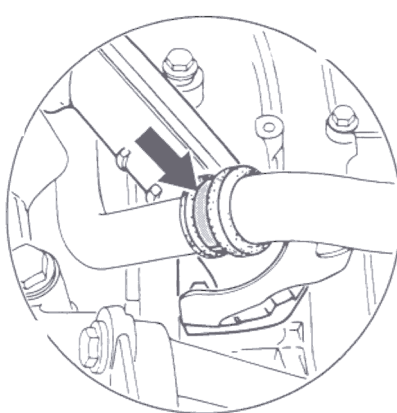
6



Sucking out remaining oil.

Suck out the remaining oil using a suitable pump.

## Removing bracket for oil cooler – GT3

No.	Procedure	Instructions
7	 <p data-bbox="494 850 566 871">099_g_99</p>	<p data-bbox="678 430 933 464">Detaching coolant line.</p> <p data-bbox="678 504 1337 619">Detach the coolant line between the coolant guide housing and the oil cooler bracket. To do this, unscrew the hose clamp at the bracket and pull off the coolant hose.</p>
8	 <p data-bbox="494 1323 566 1344">099_h_99</p>	<p data-bbox="678 913 1337 976">Loosening banjo bolt of the oil line and loosening hose fastening.</p> <p data-bbox="678 1018 1337 1123">Unscrew the banjo bolt and detach the hose fastening of the line. Lay the oil line aside. Do not use the two sealing rings again.</p>
9	 <p data-bbox="494 1795 566 1816">099_i_99</p>	<p data-bbox="678 1375 1189 1409">Loosening hose fastening of the coolant line.</p> <p data-bbox="678 1449 1337 1522">Loosen the coolant hose fastening between the generator bracket and oil cooler bracket.</p>

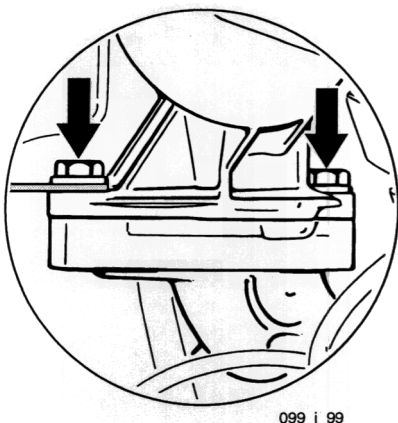


## Removing bracket for oil cooler – GT3

### No. Procedure

### Instructions

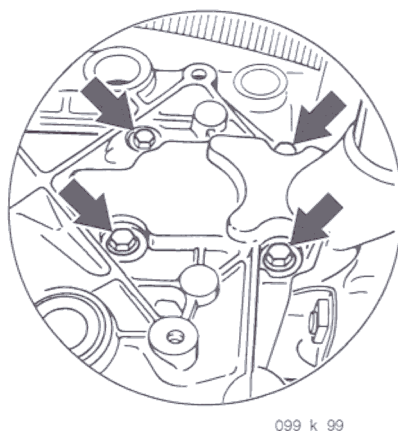
10



Separating flange between bracket and oil filter

Unscrew the two fastening screws between the bracket and the oil filter and pull out the return line.

11



Unscrewing bracket fastening screws.

Unscrew the four bracket fastening screws and lift the bracket off.

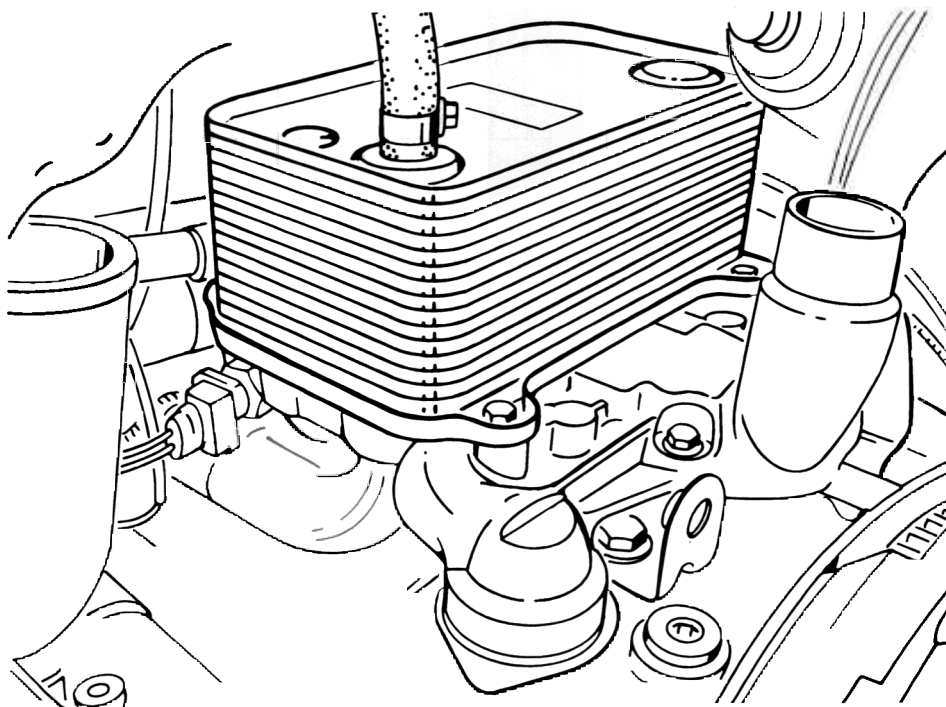
12



Clean sealing surface.

Clean the sealing surface between the oil cooler bracket and the crankcase. Make sure that no sealant residues fall into the crankcase.

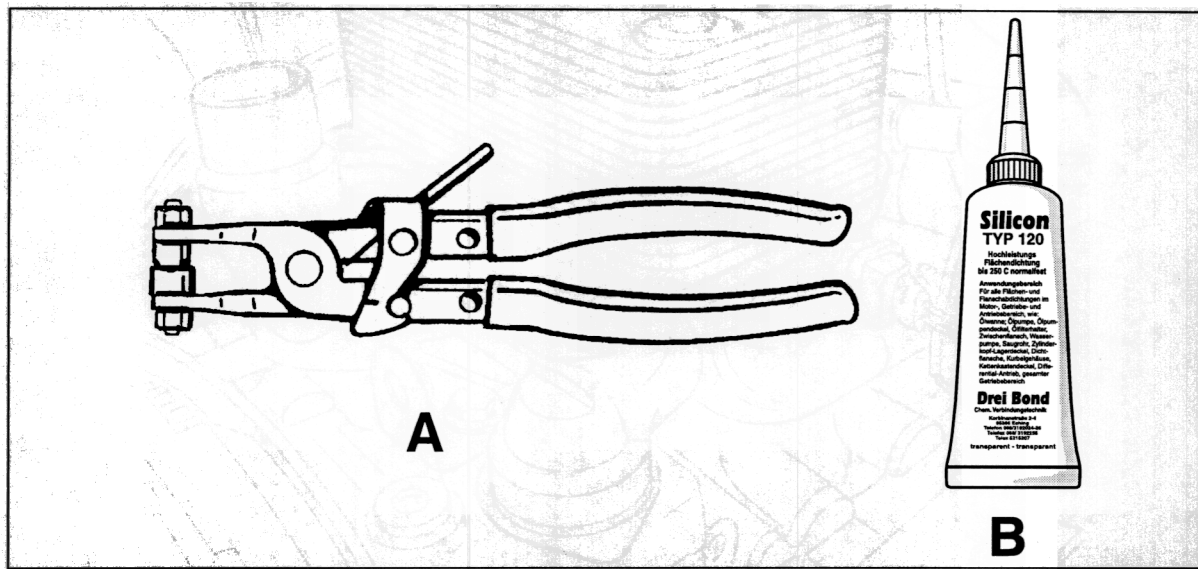
**17 67 23 Installing bracket for oil cooler – GT3**



430\_99

## Installing bracket for oil cooler – GT3

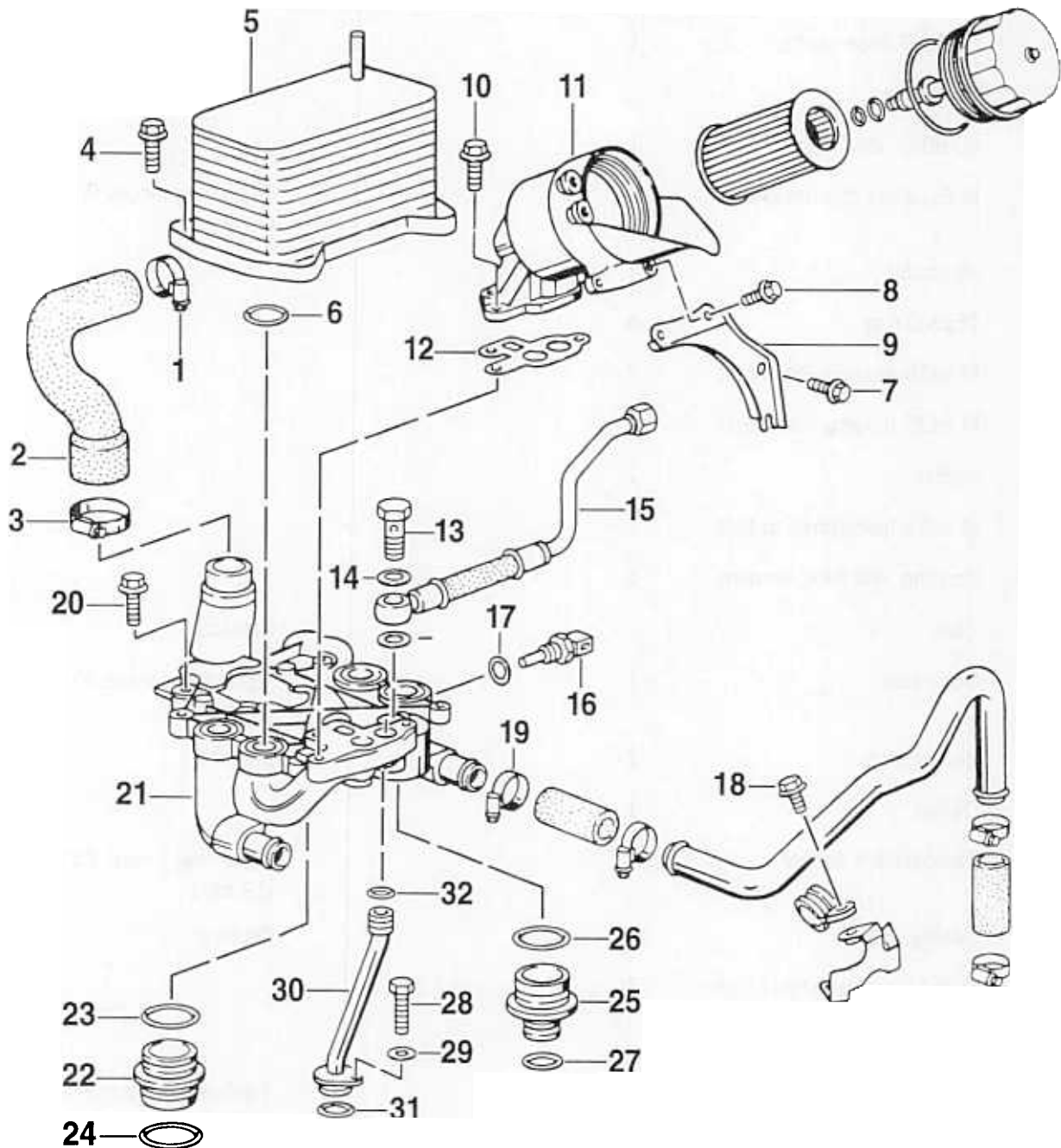
### Special tool



446\_99

Item	Designation	Special tool	Explanation
A	Spring-band clamp pliers	Commercially available; refer to Workshop Equipment Manual, Chapter 2.4, No. 72 or 73	For opening and closing spring-band clamps
B	Sealant		Silicon Drei Bond 1209

### Installing bracket for oil cooler – GT3



428\_99

**Installing bracket for oil cooler – GT3**

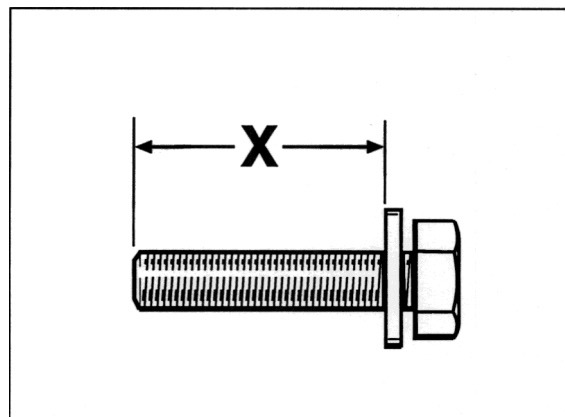
No.	Designation	Qty.	Removal	Note:	Installation
1	23-35/9 hose clamp	1			
2	Vent hose				
3	40-60/9 hose clamp	1			
4	M 6x16 hexagon-head bolt	4			Tightening torque 9.7 Nm (7.0 ftlb.)
5	Oil cooler	1			
6	26x3 O-ring	4			
7	M 6x25 hexagon-head bolt	2			
8	M 8x35 hexagon-head bolt	2			
9	Holder	1			
10	M 6x25 hexagon-head bolt	3			
11	Housing with filter element	1			
12	Seal				Replace
13	Banjo bolt	1			Tightening torque 30 Nm (22 ftlb.)
14	Sealing ring	2			Replace
15	Oil line	1			
16	Temperature sensor	1			Tightening torque 25 Nm (19 ftlb.)
17	Sealing ring	1			Replace
18	M 6x12 hexagon-head bolt	1			
19	23-35/9 hose clamp				
20	M 6x25 hexagon-head bolt	4			Tightening torque 9.7 Nm (7.0 ftlb.). Observe assembly note on page 17 - 87

**Installing bracket for oil cooler – GT3**

				Note:
No.	Designation	Qty.	Removal	Installation
21	Bracket	1		Coat sealing surface facing crankcase with Drei Bond type 1209.
22	Connection fitting	1		Replace
23	O-ring 32.92 x 3.53	1		Replace
24	O-ring 37.69 x 3.53	1		Replace
25	Connection fitting	1		
26	O-ring 32.92 x 3.53	1		Replace
27	O-ring 20.22 x 3.53	1		Replace
28	M 6x30 hexagon-head bolt			
29	A 6.4 washer	1		
30	Oil return line			
31	O-ring 17.04 x 3.53	1		Replace
32	O-ring 12 x 2	1		Replace

**Assembly note**

Make sure the four fastening screws on the oil cooler bracket are used correctly. See legend No. 20. Only hexagon-head screws with the Part No. 900 075 341 02 may be used. These can be recognised from their captive washer and yellow chromated screw.



Screw-in depth, dimension "X" 23 mm

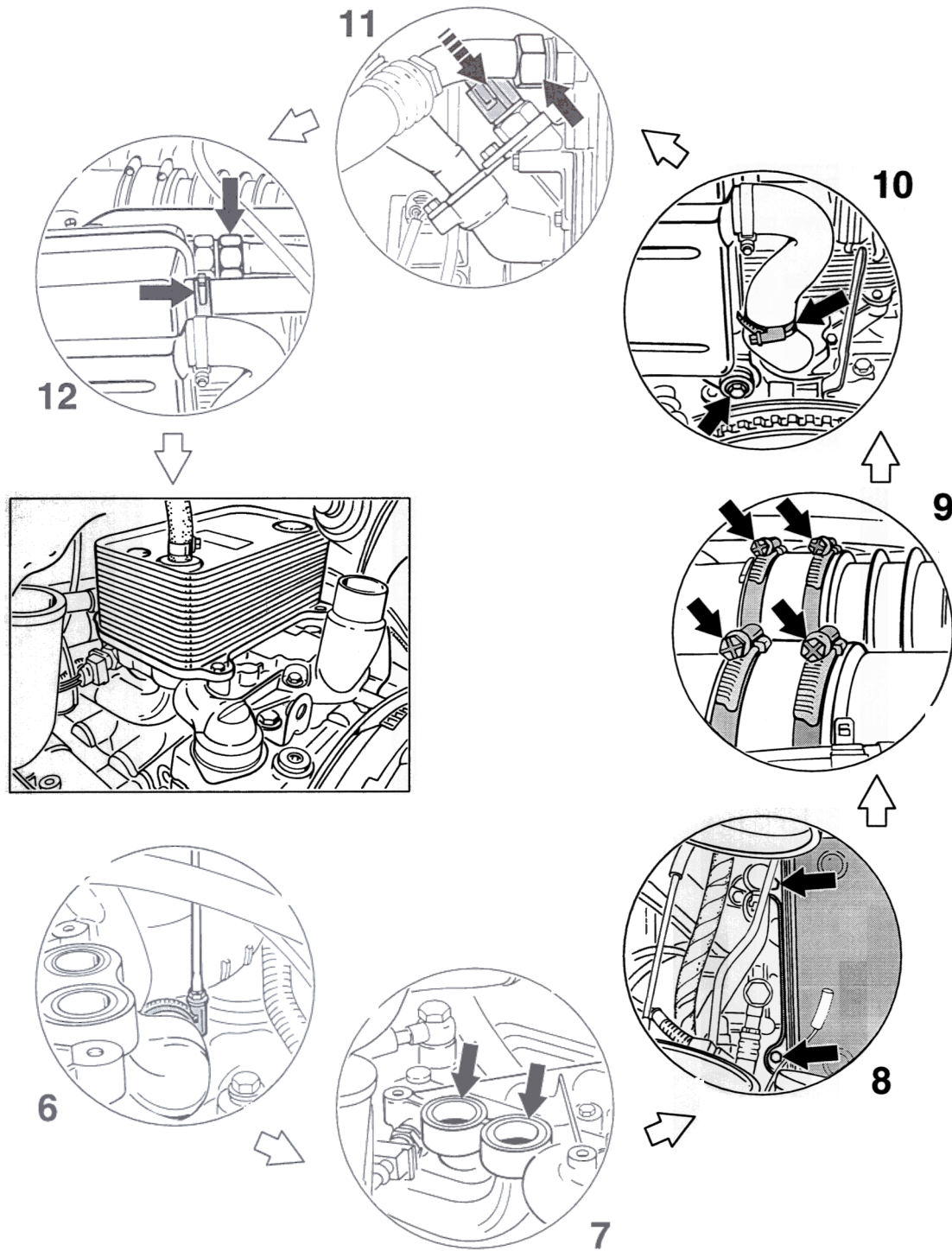
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### **Installation overview of bracket for oil cooler – GT3**

- 1           Applying sealant.
- 2           Inserting oil return line.
- 3           Fastening bracket for oil cooler.
- 4           Screwing on hose fastening of the coolant line.
- 5           Screwing on banjo bolt of the oil line and screwing on hose fastening.

Installation overview of bracket for oil cooler – GT3



### Installation overview of bracket for oil cooler – GT3

- 6 Fastening coolant line.
- 7 Replacing seals.
- 8 Tightening oil cooler fastening screws.
- 9 Tightening hose clamps on the intake system.
- 10 Fastening positive crankcase ventilation and oil tank.
- 11 Pushing on oil level sender and tightening the oil line.
- 12 Tightening oil return line and vent line.

## Installing bracket for oil cooler – GT3

### No. Procedure

### Instructions

1

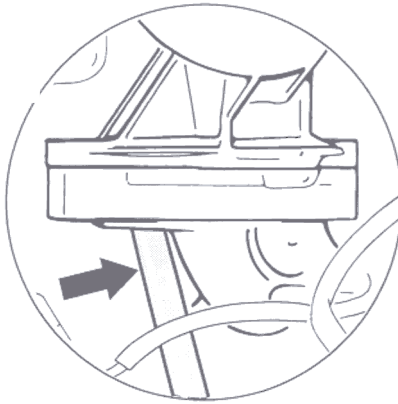


099\_l\_99

Applying sealant.

Apply a thin coat of sealant (Drei Bond 1209) on the cleaned sealing surface. The sealant layer must not be too thick. **Sealant must not enter the oil or coolant circuit.**

2

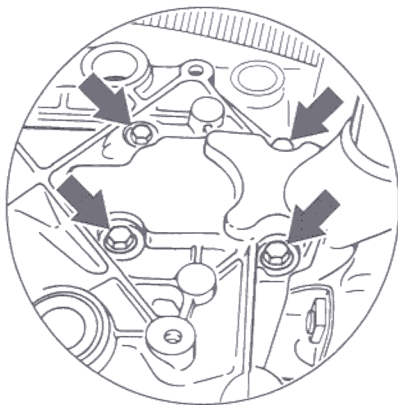


440\_b\_99

Inserting oil return line.

Replace O-ring on the oil return line and insert the oil return line into the oil cooler bracket. Position the bracket on the crankcase at the same time.

3



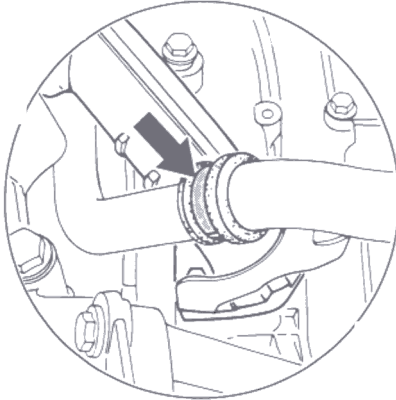
099\_k\_99

Fastening bracket for oil cooler.

Tighten the four bracket fastening screws to 9.7 Nm (7.0 ftlb.). Tighten the fastening screws on the flange between the bracket and oil filter to 9.7 Nm (7.0 ftlb.).

### Installing bracket for oil cooler – GT3

4

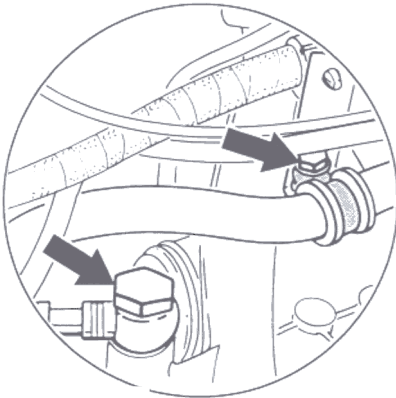


099\_i\_99

Screwing on hose fastening of the coolant line.

Tighten the coolant hose fastening between the generator bracket and oil cooler bracket to 9.7 Nm (7.0 ftlb).

5

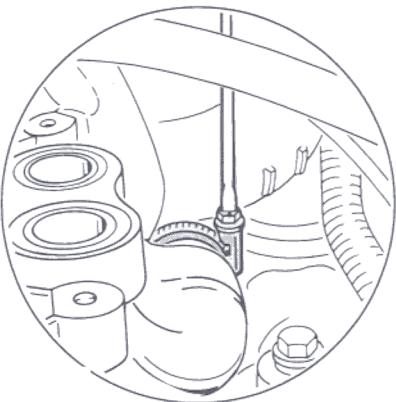


099\_h\_99

Screwing on banjo bolt of the oil line and screwing on hose fastening.

Put on the banjo bolt of the oil line with two new seal rings and tighten to 30 Nm (22 ftlb). Put on the hose fastening again and tighten to 9.7 Nm (7.0 ftlb.).

6



099\_g\_99

Fastening coolant line.

Push on the coolant line between the coolant guide housing and oil cooler bracket and tighten the hose clamp again.

## Installing bracket for oil cooler – GT3

7

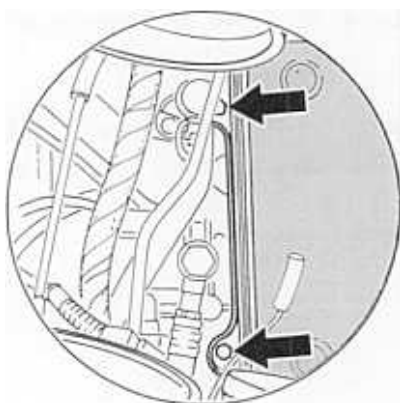


441\_g\_99

Replacing seals.

Replace the four O-rings between the bracket and oil cooler. Insert O-rings with grease. Push on the oil cooler again.

8

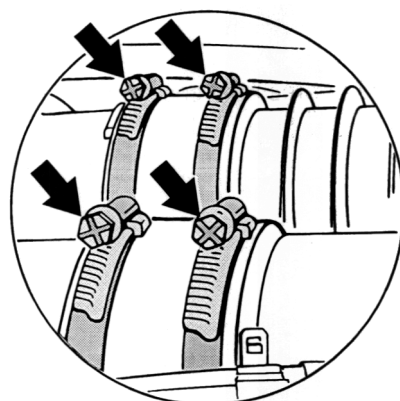


099\_e\_99

Tightening oil cooler fastening screws.

Screw in the four oil cooler fastening screws and tighten to 9.7 Nm (7.0 ftlb.).

9



099\_d\_99

Tightening hose clamps on the intake system.

Insert and align the throttle body and the tuning pipe again. Tighten the eight hose clamps.



## Installing bracket for oil cooler – GT3

10

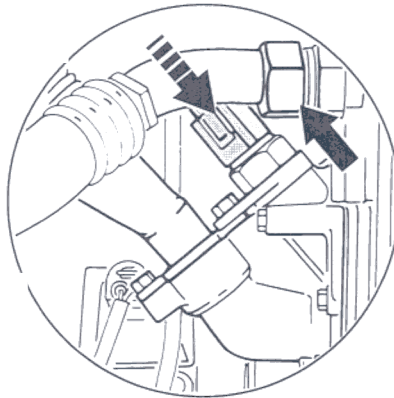


099\_c\_99

Fastening positive crankcase ventilation and oil container.

Push on the positive crankcase ventilation hose again and tighten the hose clamp. Screw in the oil container fastening screws again and tighten to 23 Nm (17 ftlb.).

11

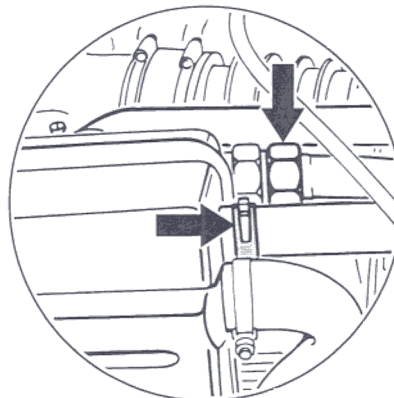


441\_f\_99

Pushing on oil level sender and tightening the oil line.

Push on the connecting cable of the oil level sender. Then tighten the oil return line of the cylinder head. Make sure to counter with a wrench at the oil container when doing this.

12



099\_a\_99

Tightening oil return line and vent line.

Tighten oil return line on the oil container. Make sure to counter with a wrench at the oil container when doing this. Push on the ventilation hose again and tighten the hose clamp.

**Installing bracket for oil cooler – GT3**

Subsequent work:

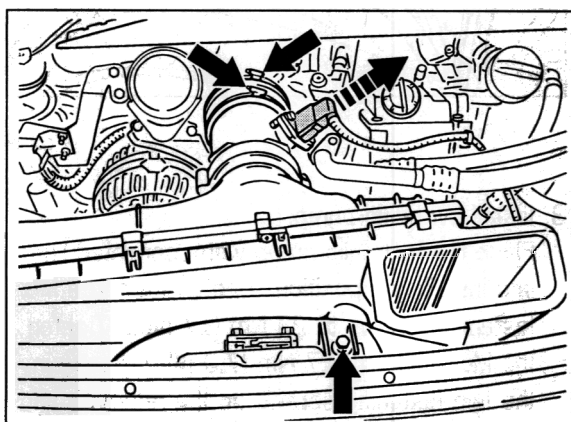
Reinstall engine and transmission (Serv. No. 10 01 19), fill in oil, bleed the coolant circuit. Check oil level with the engine running and at an oil temperature of at least 80 °C.

## 17 07 19 Removing and installing oil temperature sensor – GT3

### Removing oil temperature sensor

#### 1. Remove the air cleaner assembly.

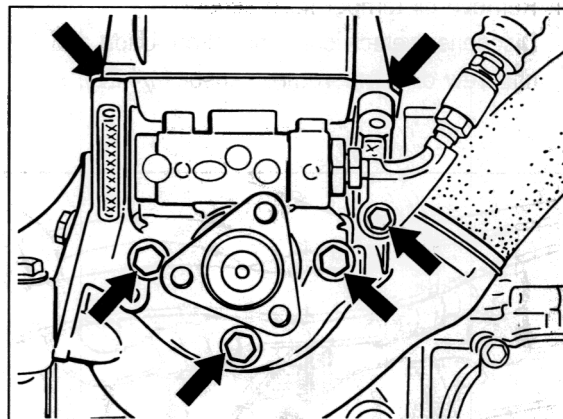
Unscrew hexagon-head bolt M6 x 34. Undo the hose clamp on the throttle body. Pull off plug from hot film mass air flow sensor and remove air cleaner assembly.



58\_99

#### 2. Remove hydraulic pump.

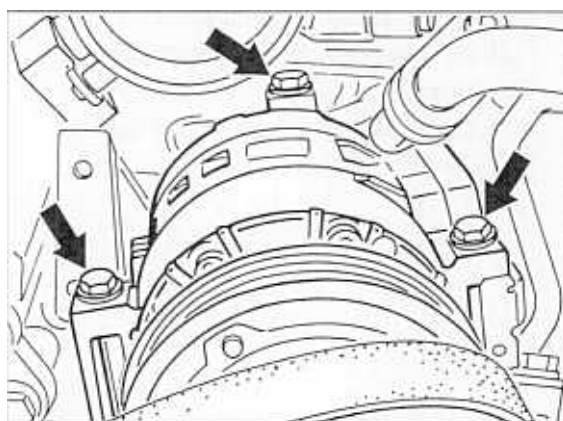
Undo the three hexagon-head bolts on the servo pump by approx. one half turn. Remove drive belt. Remove servo pump pulley. Unscrew fastening screws on the reservoir (two M8 screws) and four screws (three M8 screws and one M6 screw) on the hydraulic pump. Pull the expansion tank with hydraulic pump and connected lines up out of the fastening bracket and lay aside to the right-hand side.



059\_99

#### 3 Remove air-conditioning compressor (Serv. No.: 87 34 19).

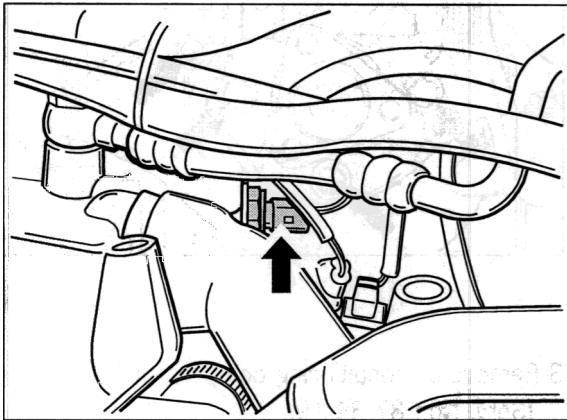
Remove compressor from the bracket for the generator. Unscrew the three screws for this purpose. Disconnect the electrical connection on the compressor. Lift the compressor out of the engine compartment and lay it aside **with the leads still connected**. Protect the body from damage with a cover.



061\_99

### Removing oil temperature sensor – GT3

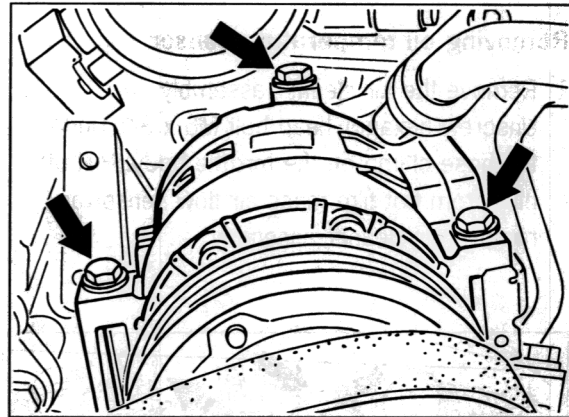
4. Remove oil temperature sensor.  
Disconnect electrical connection. Undo and unscrew oil temperature sensor (a/f 22).



406\_99

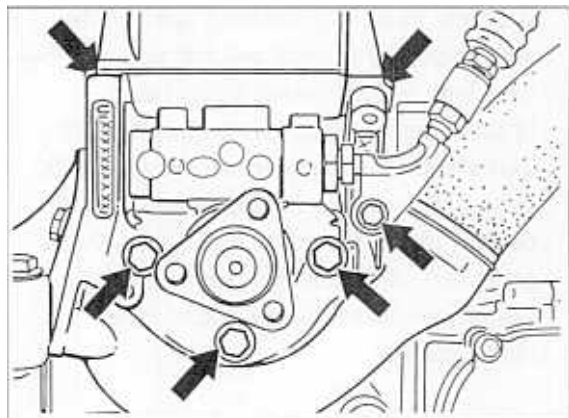
### Installing oil temperature sensor – GT3

1. Install oil temperature sensor.  
Fit oil temperature sensor with a new sealing ring and screw in. Tightening torque 25 Nm (19 ftlb.). Connect electrical connection.
2. Install air-conditioning compressor.  
Push the compressor onto the bracket for the generator again. Screw in the three compressor fastening screws and tighten to 23 Nm (17 ftlb.).



061\_99

3. Install hydraulic pump.  
Place the hydraulic pump with connected lines into installation position. Tighten the three M8 fastening screws to 23 Nm (17 ftlb.). Tighten the M6 screw to 9.7 Nm (7.0 ftlb.). Screw in the two fastening screws on the reservoir and tighten to 23 Nm (17 ftlb.). Tighten the servo pump pulley to 23 Nm (17 ftlb.). Fit drive belt.

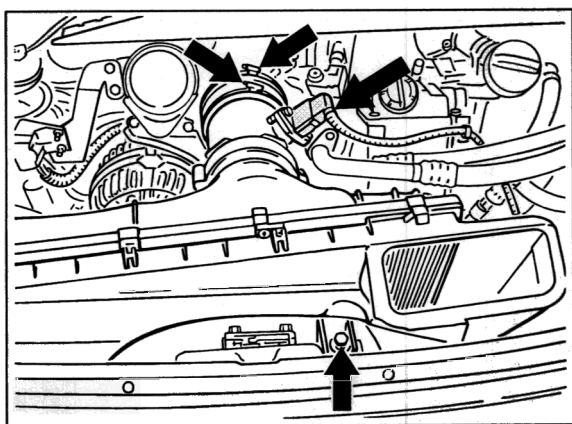


059\_99

**Installing oil temperature sensor – GT3****4. Install air cleaner assembly.**

Insert air cleaner housing in its holder again.

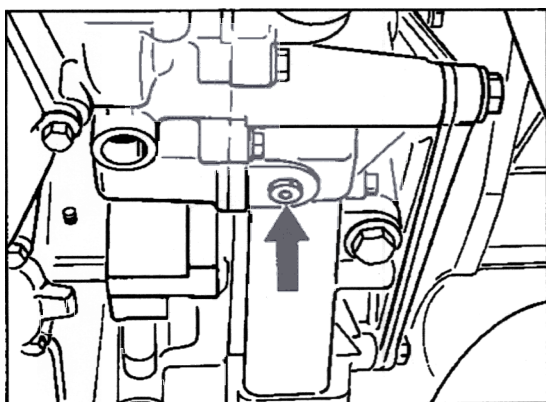
Tighten the M6 x 34 hexagon-head bolt to 9.7 Nm (7.0 ftlb.) Tighten the hose clamp on the throttle body and push the plug onto the hot film mass air flow sensor.



429\_99

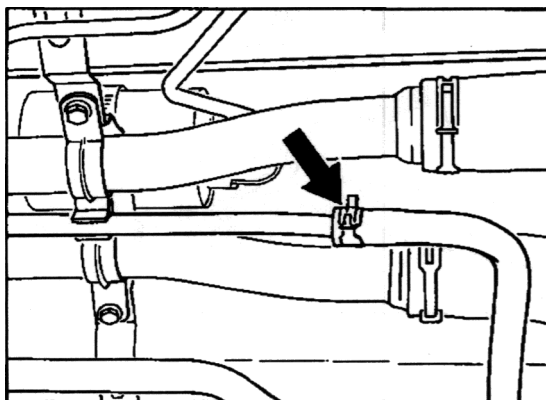
**19 38 17 Draining and filling in coolant (includes: bleeding the cooling system)****Draining coolant**

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



471 - 96

3. Disconnect vent line.



467 - 96

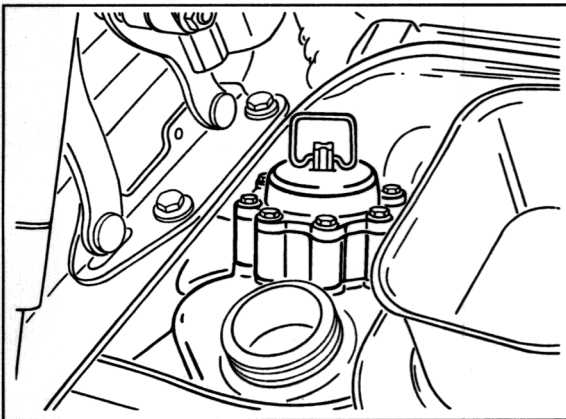


## Filling in coolant and bleeding

### 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 cap.
2. Lift bow on bleeder valve.



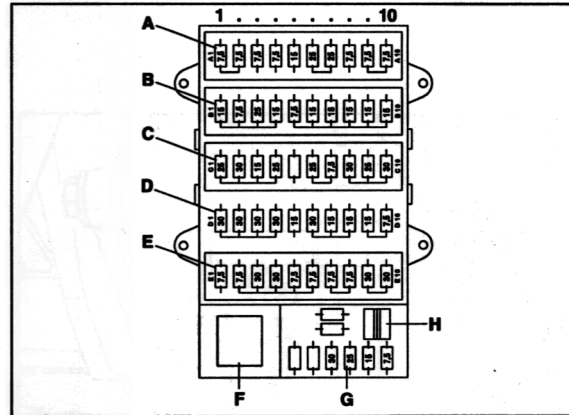
200 - 97

3. 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.

### Note

In normal operation, this occurs with the ignition switched on or with the engine running only at high engine temperature > 85 °C or high ATF temperature > 90 °C.

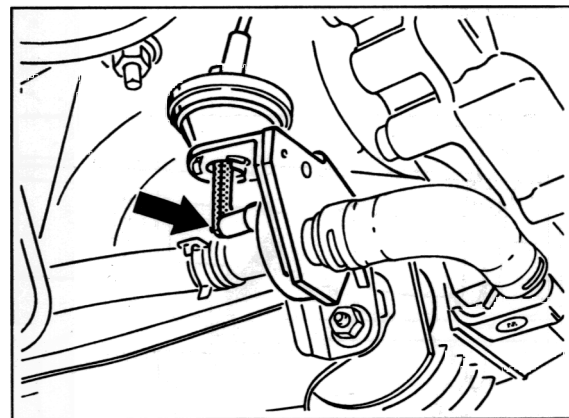
Triggering can be performed either with the Porsche System Tester 2 or by pulling off the Tiptronic control module fuse B1 with **the ignition switched off**.



Fuse B1 (arrow)

335 - 97

4. Check if the coolant shutoff valve is open.



277 - 97

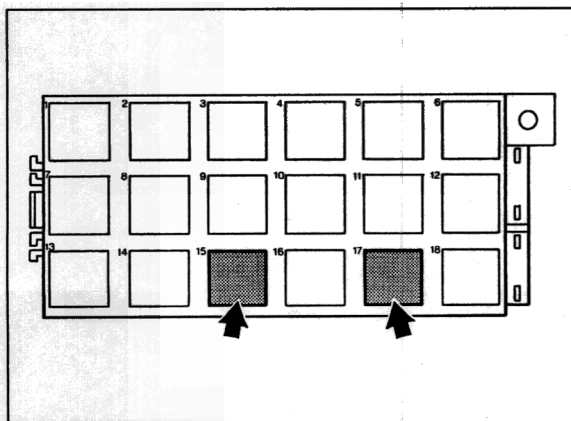
5. Fill with coolant up to the bottom edge of the filler neck.

6. 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 lies **lower edge of filler neck**). **The coolant temperature must not exceed 80 °C; proceed directly to the next work step if necessary.**

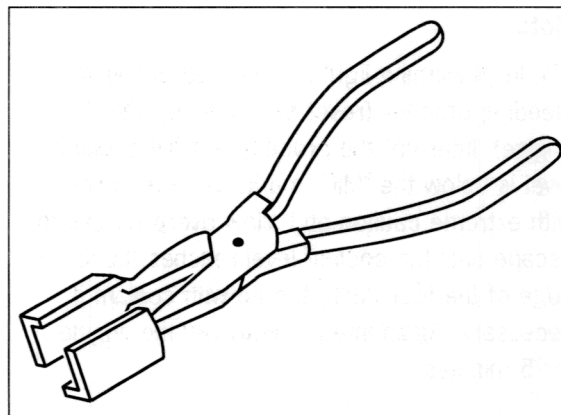
7. **Close reservoir** and **warm engine up to operating temperature** at a speed of ~ 2500 rpm until the thermostat opens after approx. 10 minutes (coolant temperature ~ 90 °C).

Check: The radiator supply lines and return lines in the front wheel housings must be hot.

8. Forcibly engage both secondary fans at stage 2. To do this, use special tool 9235 (relay pliers) to pull the radiator fan relays No. 20 and No. 22 out of relay carrier 1 (on the left side in the driver's footwell).

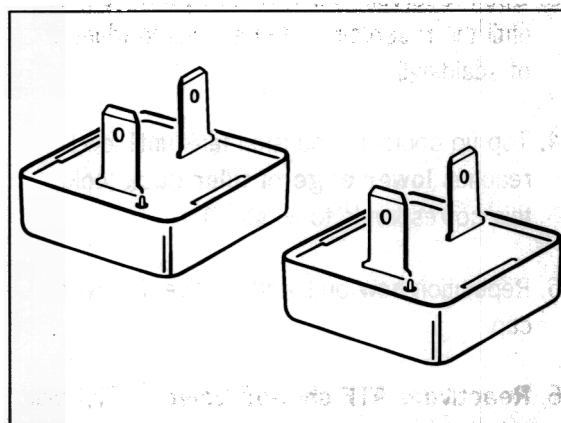


208\_97



621\_96

9. Insert the jumper (Part No. 964.610.184.00) into relay sockets No. 20 and No. 22.



315\_97

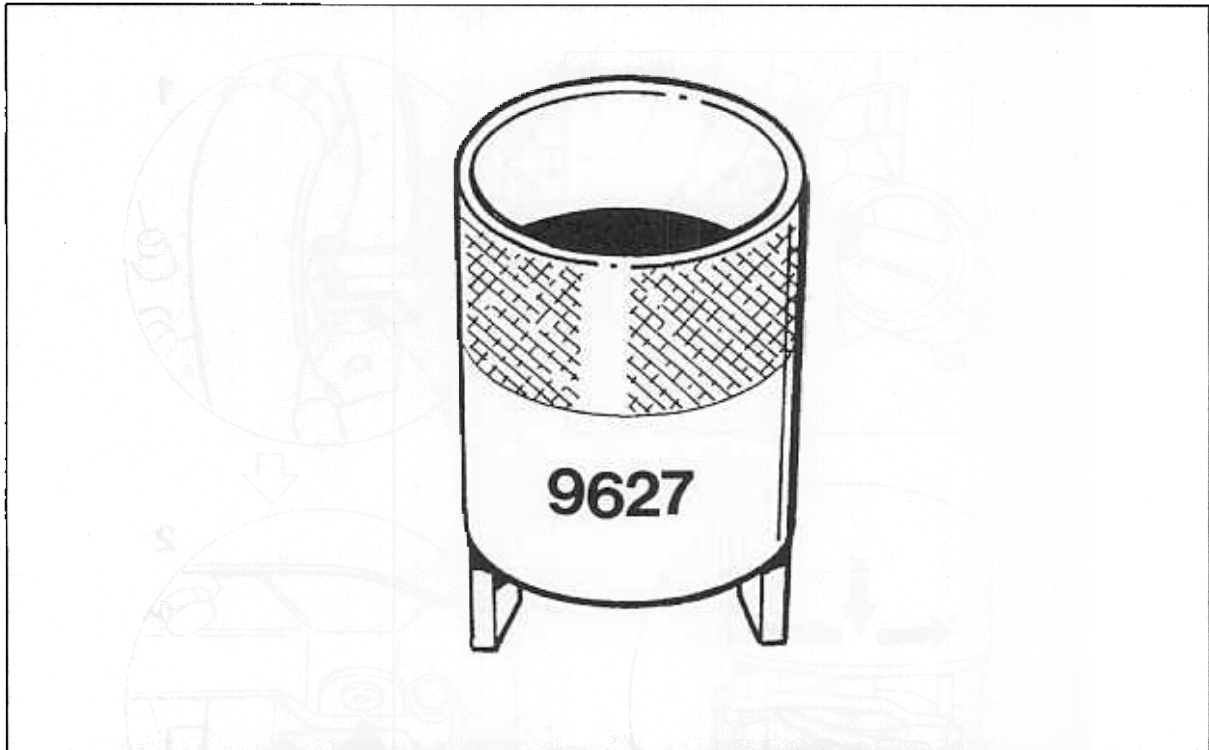
10. Allow engine to run an additional 5 minutes at ~ 2500 rpm. Every 30 seconds, **briefly rev up the engine to ~ 5000 rpm**. Rpm surges are important for proper bleeding.

**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.

1. Deactivate auxiliary fans again. Replace jumpers by the standard relays.
  12. **Wait until coolant has cooled to 80 °C** (cooling time approx. 25 minutes).
  13. Open reservoir cap **with extreme caution** until the reservoir is depressurised (danger of scalding!).
  14. Top up coolant expansion tank until level reaches **lower edge of filler neck** (cold, this corresponds to = "MAX").
  15. Reposition bow on bleeder valve. Screw on cap.
  16. **Reactivate ATF shut-off valve** on Tiptronic vehicles.
-

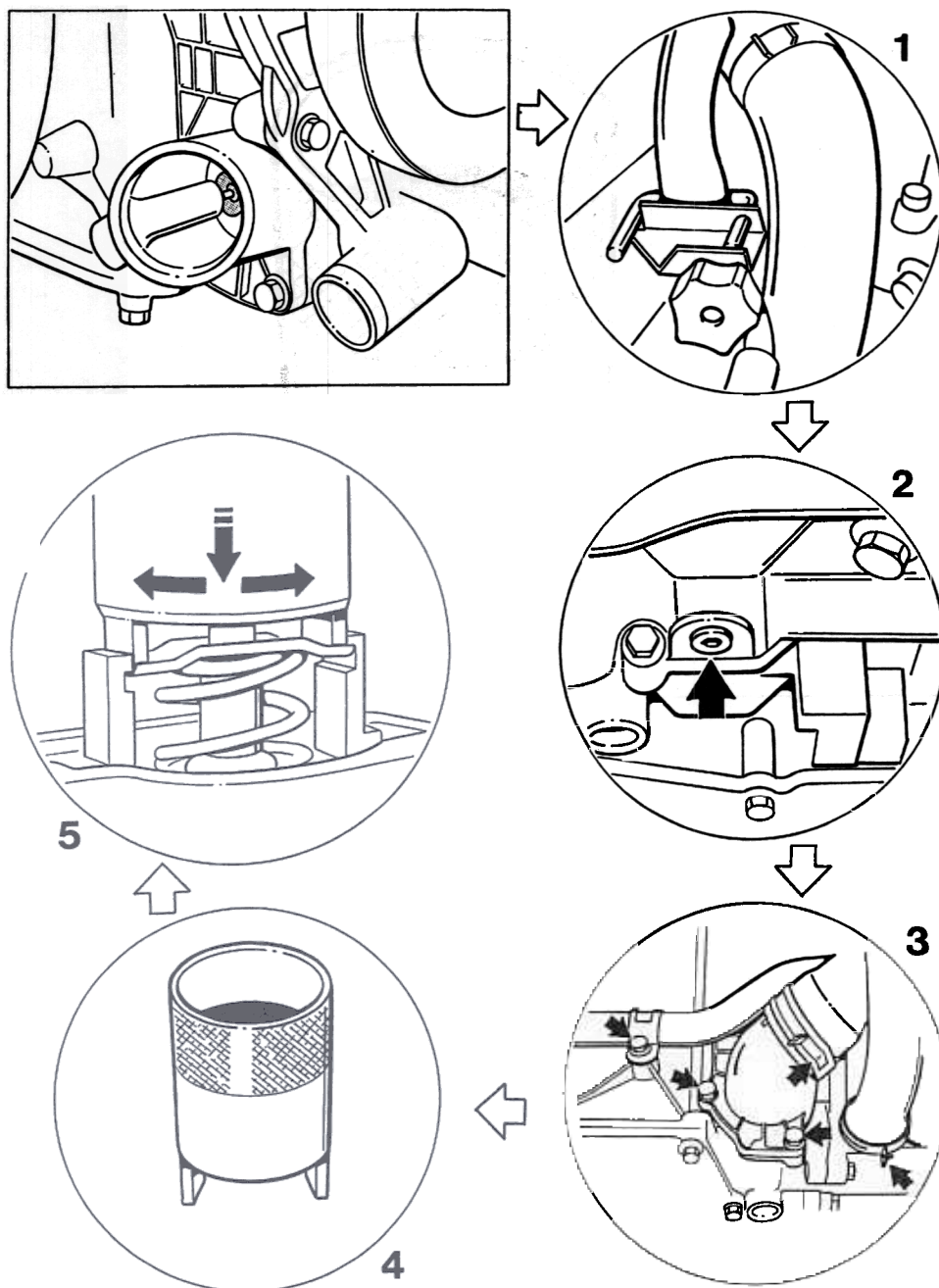
## 19 58 19 Removing and installing coolant regulator



302 - 97

No.	Designation	Special tool	Explanation
	Assembly aid	9627	

## Removing and installing coolant regulator



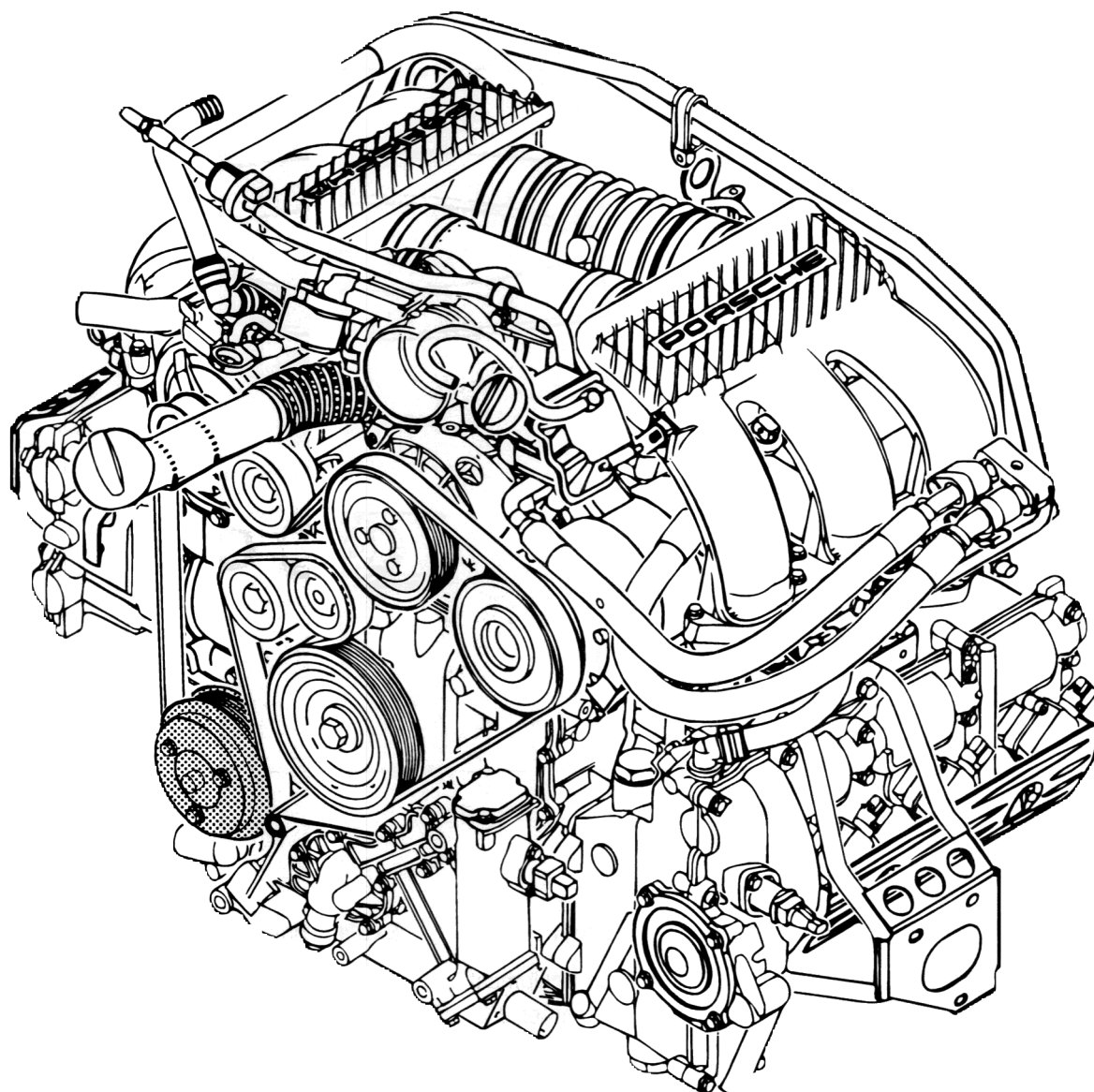
325 - 97

**Removing and installing coolant regulator**

No.	Procedure	Instructions
1	Undo spring-band clamps	Clamp shut coolant hoses and undo spring-band clamp with pliers type MUBEA 60-190.
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 seal for drain plug. Tightening torque: 10 + 5 Nm (7.5 + 3.5 ftlb.)
3 + 4	Remove or install coolant regulator	Push special tool 9627 (assembly aid) downward against the spring resistance and simultaneously twist coolant regulator out of the housing guide (or into the housing guide when installing).
	Install housing with coolant regulator	Replace housing seal and install housing with coolant regulator. Tightening torque of the housing screws 10 Nm (7.5 ftlb.).

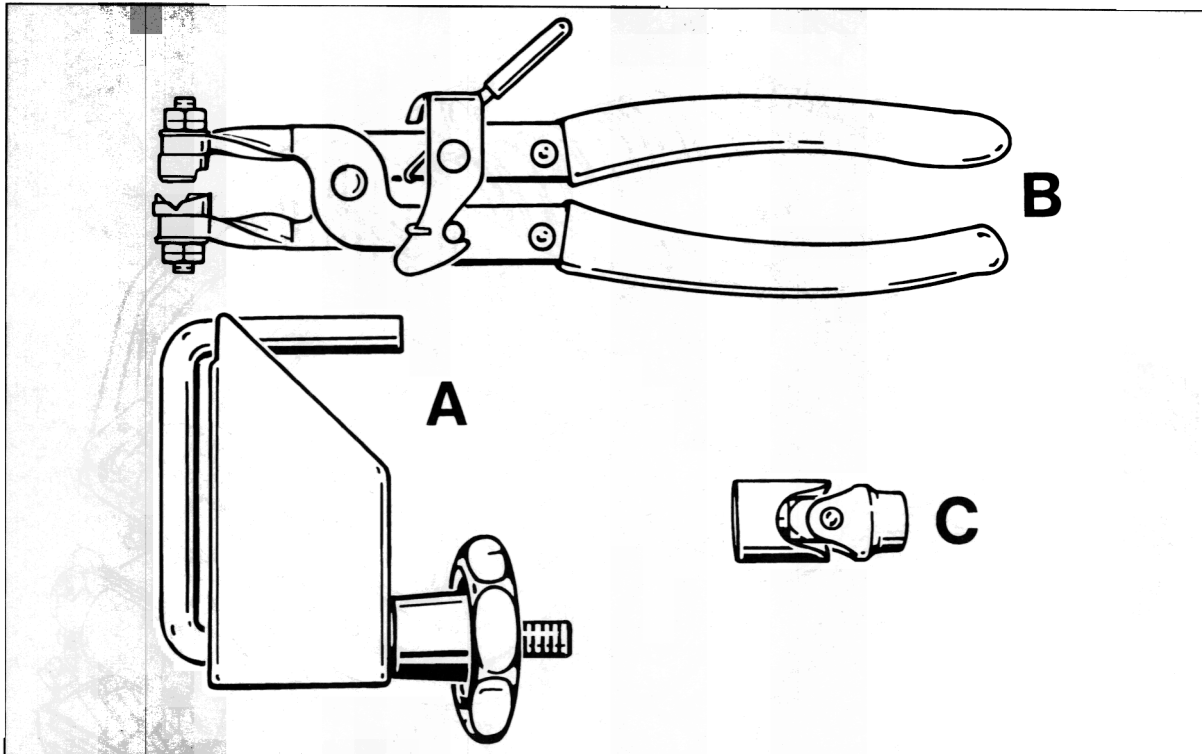


19 50 19 Removing and installing coolant pump (engine installed)



## Removing and installing coolant pump

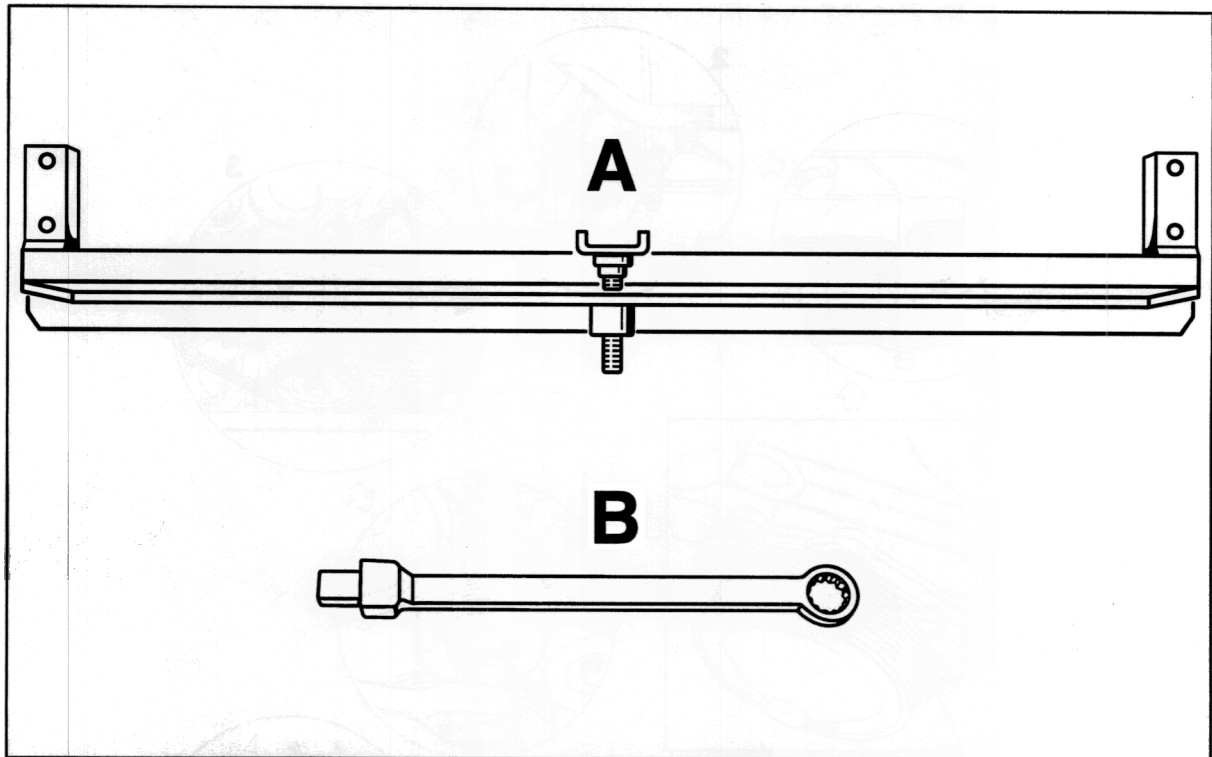
### Tools



419\_96

Item	Designation	Special tool	Explanation
A	Hose clamp	Workshop Equipment Manual, Chapter 2.2, No. 3093 or 3094	
B	Spring-band clamp pliers	Refer to Workshop Equipment Manual, Chapter 2.4, No. 72 or 73	For opening and closing spring-band clamps
C	Flexible-head socket wrench	Refer to Workshop Equipment Manual, Chapter 2.4, No. 40	

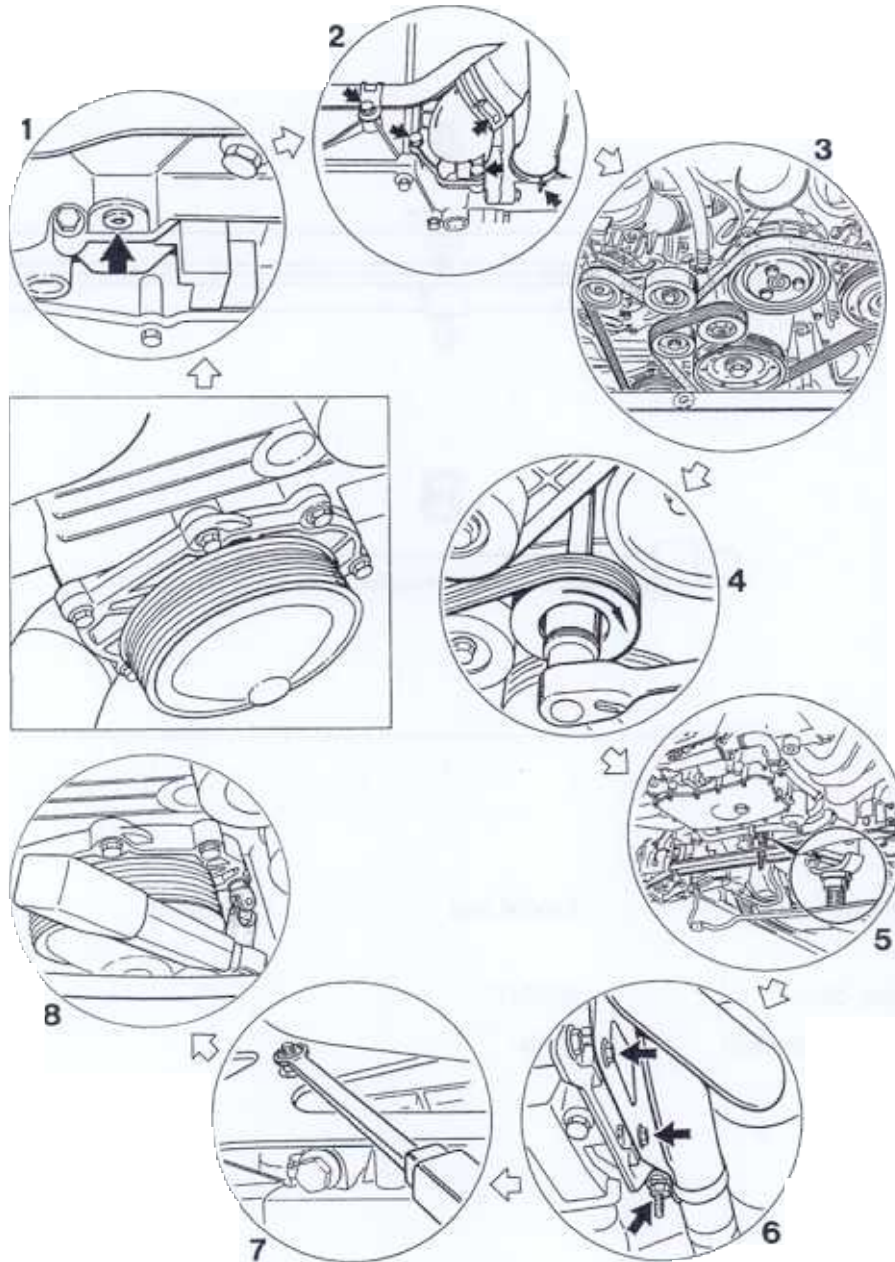
# Tools



397 - 97

Item	Designation	Special tool	Explanation
A	Retaining device	9624/1	
B	Socket wrench insert	9614	

## Removing coolant pump



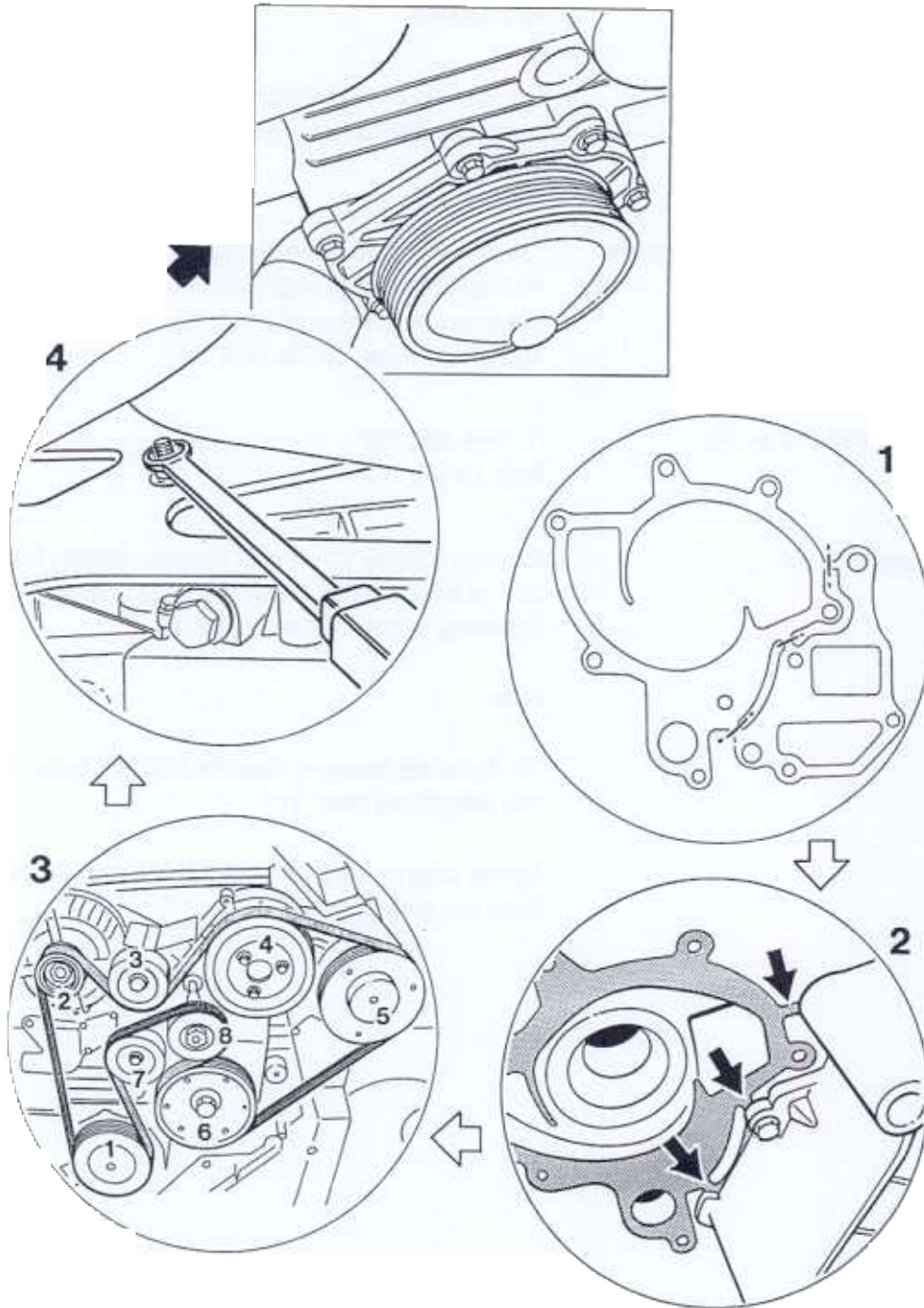
**Removing coolant pump**

No.	Procedure	Instructions
	Drain coolant	Undo drain plug at water guide housing and collect coolant. After draining the coolant, fit a new sealing ring on the drain plug. Tightening torque: 10 + 5 Nm (7.5 + 3.5 ftlb.)
2	Clamp shut coolant hoses	Clamp shut coolant hoses with hose clamps by Saltus, order numbers 3093 and 3094. Undo spring-band clamps with pliers type MUBEA GO-190.
3 + 4	Remove drive belt	Remove the complete air cleaner assembly. Mark belt travel direction with a coloured pen. Slacken belt, turning the tensioning pulley (wrench size 24 mm) clockwise, hold still and simultaneously take the belt off the drive pulleys. Visually check state of belt and replace if necessary.
5	Support engine-transmission unit	Undo stabilizer. To do this, remove both bearing blocks and disengage stabilizer. Fasten support bridge (special tool 9624/1) at the take-up points of the bearing blocks. Screw in the pressure screw until the pressure disc has contact with the crankcase under slight pressure.
6	Remove bracket for catalytic converter.	Undo restraining straps (2 ea.) and hexagon-head bolts (2 ea.) and remove bracket.

No.	Procedure	Instructions
7	Undo engine carrier	Undo four fastening nuts with socket wrench insert (special tool 9614). Unscrew the upper two hexagon nuts only as far as the end of the thread. Remove the lower two hexagon nuts. Unscrew centring screw (M6). Swivel engine carrier to the rear.
8	Loosen 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 from Messrs. Stahlwille. Guide the coolant pump out, taking care not to damage the pump vanes and sealing surface.



### Installing coolant pump



318 - 97

**Installing coolant pump**

<b>No.</b>	<b>Procedure</b>	<b>Instructions</b>
1	Rework new replacement metal seal.	Cut new replacement metal seal (combination seal) for coolant pump and water guide housing at the connecting webs.
2	Cut metal seal and install coolant pump	Cut old metal seal between coolant pump and water guide housing at the connecting webs. Position new seal and coolant pump simultaneously and fasten. Tightening torque: 10 Nm (7.5 ftlb.)
3	Fit drive belt and tension	Fit drive belt, see Page 13 - 2.
4	Fit engine carrier	Screw in centring screw (M6) by hand. Tighten fastening nuts on engine carrier using special tool 9614. Tightening torque: 30 Nm (22 ftlb.)

**Note**

The tightening torque is specially matched to the special tool. (length and lever arm)

Tighten centring screw. Fit bracket for catalytic converters.  
Bleed the cooling system

**19 12 01    Coolant warning light in instrument cluster****Note**

In order to prevent excessive engine coolant temperature, make sure that the cooling-air ducts are not obstructed by coverings (e.g. films, stone shields). Leaves and insects on the radiator/condenser fins can be vacuumed off or removed using a high-pressure cleaner.

Four functions of the coolant warning light:

1. Engine coolant level too low

light flashes slowly (0.5 Hz)

2. Engine compartment temperature too high

light flashes slowly (0.5 Hz)

(engine compartment blower might be faulty)

3. Engine coolant temperature too high

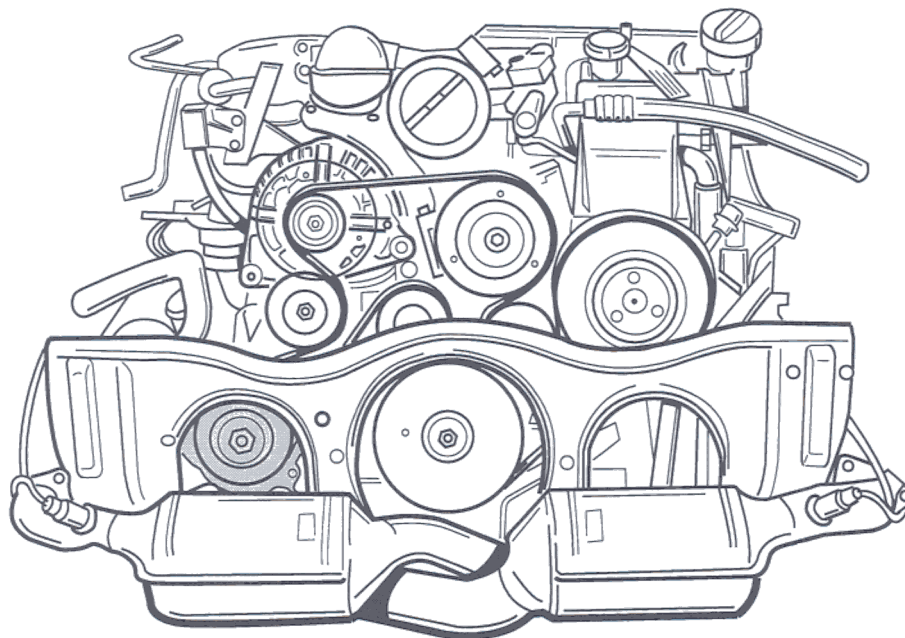
– light is lit; pointer on the right

4. Temperature sensor at water outlet faulty

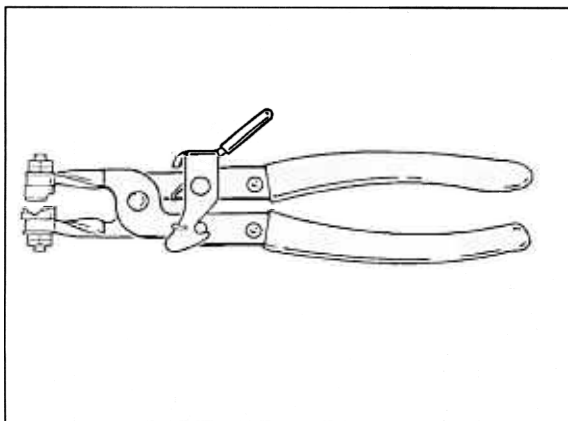
– light flashes rapidly (1 Hz);  
pointer on the right

**Note**

The temperature warning in point three is indicated if the conditions "engine coolant temperature too high" and "engine coolant level too low" are present simultaneously.

**19 50 21 Removing coolant pump (engine installed) – GT3**

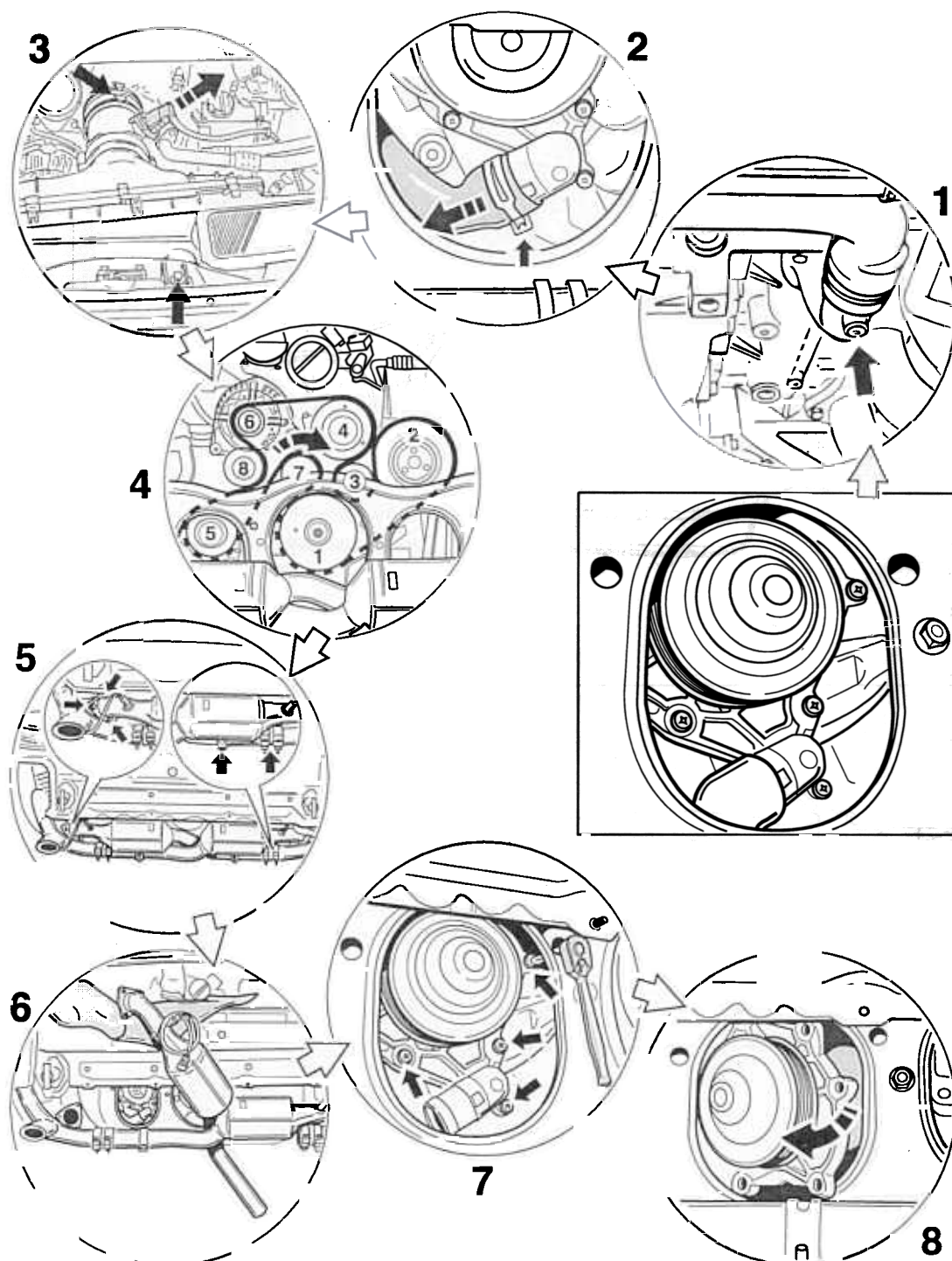
129\_99

**Tools**

70\_99

Item	Designation	Special tool	Explanation
A	Spring-band clamp pliers	Commercially available, see Workshop Equipment Manual, Chapter 2.4, No. 72 or 73	For opening and closing spring-band clamps

Removal overview of the coolant pump (engine installed) – GT3



79\_99

## Removal overview of the coolant pump – GT3

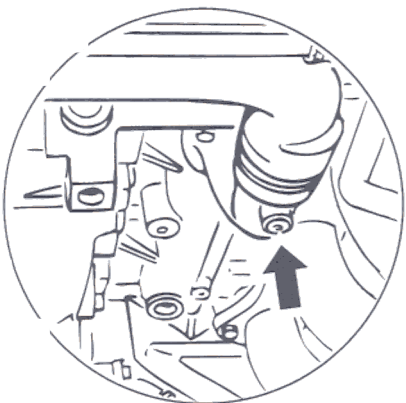
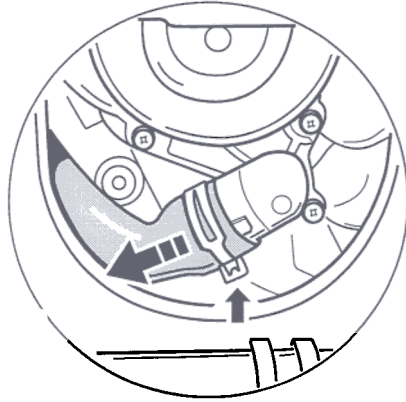

Preliminary work:

Disassemble the accessories of the rear spoiler Serv. No. 6355  
(contains: rear end, bottom centre heat shield and bumpers).

- 1 Drain coolant
- 2 Remove coolant hose
- 3 Remove air cleaner assembly
- 4 Remove drive belt
- 5 Remove catalytic converter of cylinder bank 1 – 3
- 6 Secure catalytic converter
- 7 Loosen coolant pump
- 8 Remove coolant pump



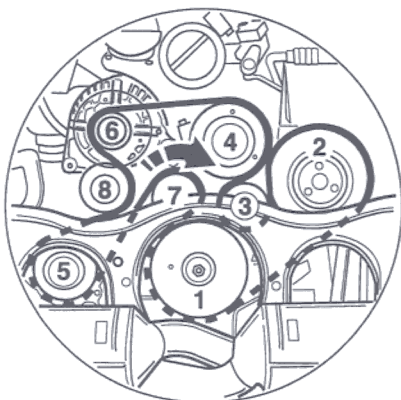
## Removing coolant pump – GT3

No.	Procedure	Instructions
1	 <p data-bbox="517 840 580 861">79_a_99</p>	<p data-bbox="687 432 839 466">Drain coolant</p> <p data-bbox="687 504 1370 684">Undo the drain plugs on the two necks for coolant and collect coolant. After draining the coolant, fit new sealing rings on the drain plug. Tightening torque 10 Nm (7.5 ftlb) to 15 Nm (11 ftlb). (Figure shows only one of the two necks)</p>
2		<p data-bbox="687 907 935 940">Remove coolant hose</p> <p data-bbox="687 978 1370 1121">Pull off the coolant hose between the coolant expansion tank and coolant pump on the pump neck. Undo spring-band clamps with the commercially available pliers No. 72 or 73.</p>
3	 <p data-bbox="517 1776 580 1797">79_c_99</p>	<p data-bbox="687 1369 1031 1402">Remove air cleaner assembly</p> <p data-bbox="687 1440 1370 1583">Remove air cleaner assembly completely. Undo fastening screw M6 x 34. Pull off cable from hot film mass air flow sensor and set aside. Undo the hose clamp on the throttle body. Take out air cleaner assembly.</p>

**No. Procedure**

**Instructions**

4

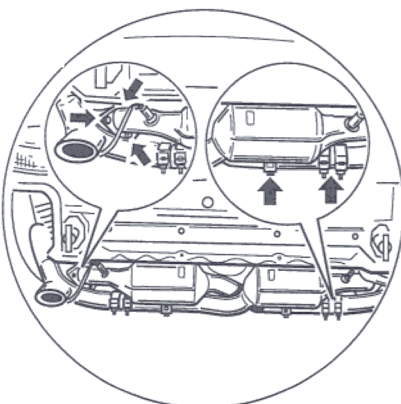


79\_d\_99

Remove drive belt

Slacken belt by turning the tensioning pulley (wrench size 24 mm) clockwise, hold still and simultaneously take the belt off the drive pulleys and set aside.

5

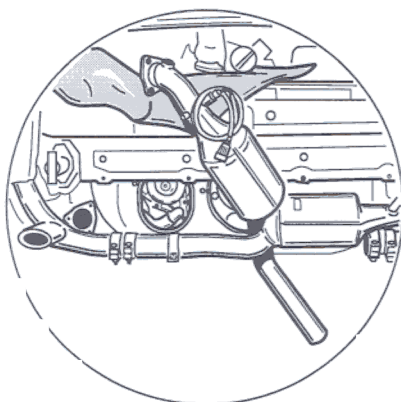


79\_e\_99

Remove catalytic converter of cylinder bank 1 – 3

Undo the catalytic converter of cylinder bank 1 – 3 at the exhaust manifold. Unplug oxygen sensor cable and unclip. Remove the holding clamp between the catalytic converter and support sheet and undo the two exhaust clamps. Take catalytic converter off of the exhaust manifold, pull out of end muffler.

6



79\_f\_99

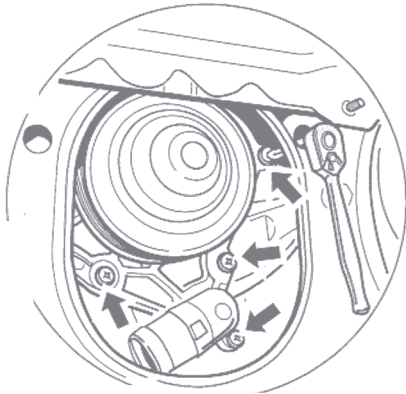
Secure catalytic converter

Turn the catalytic converter and tie in place as shown in the illustration. Cover body to protect from damage.

No. Procedure

Instructions

7

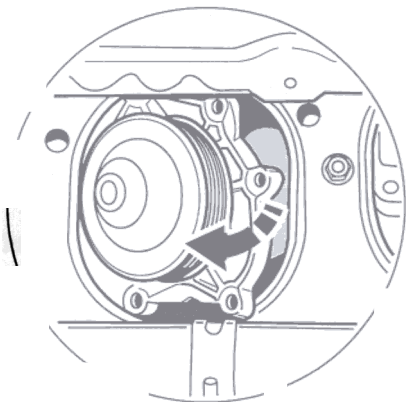


79\_g\_99

Loosen coolant pump

Undo the seven Torx screws on the coolant pump with a T30 wrench. **Observe the different lengths of the screws.** The two lighter screws are longer.

8

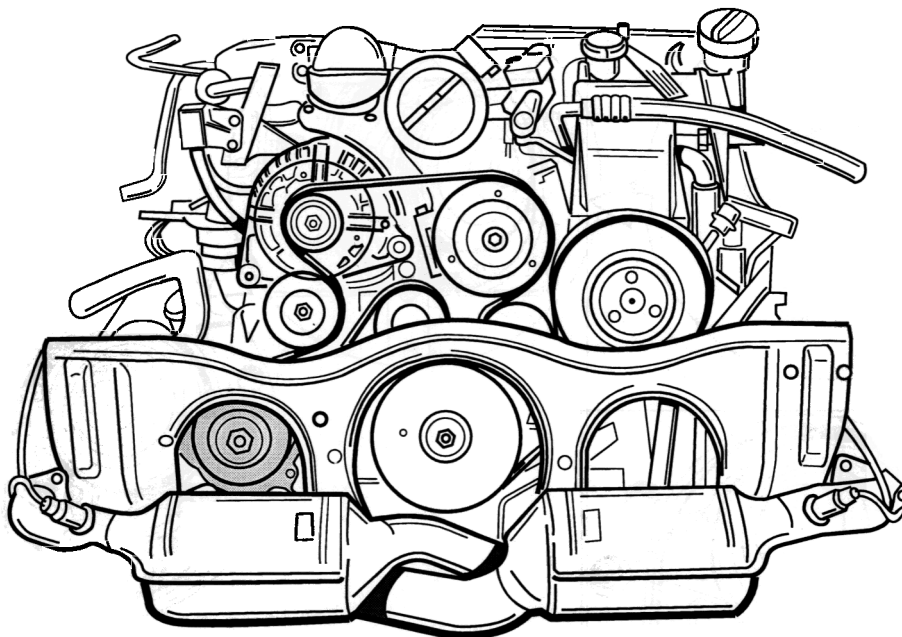


79\_h\_99

Remove coolant pump

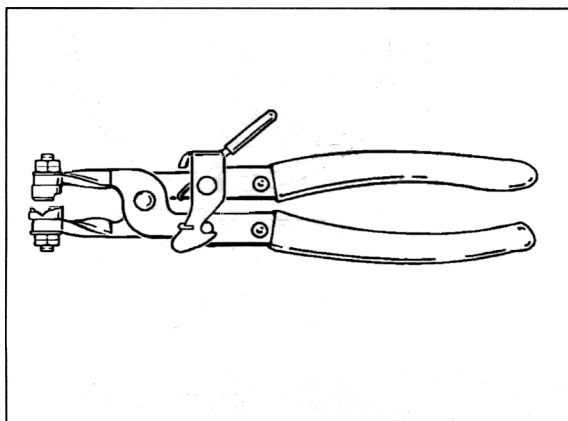
Lift off coolant pump and pull out towards the rear through the opening in the support plate. The coolant pump must be slightly tilted to do this. The impeller must not be damaged during this procedure.

## 19 50 23 Installing coolant pump (engine installed) – GT3



129\_99

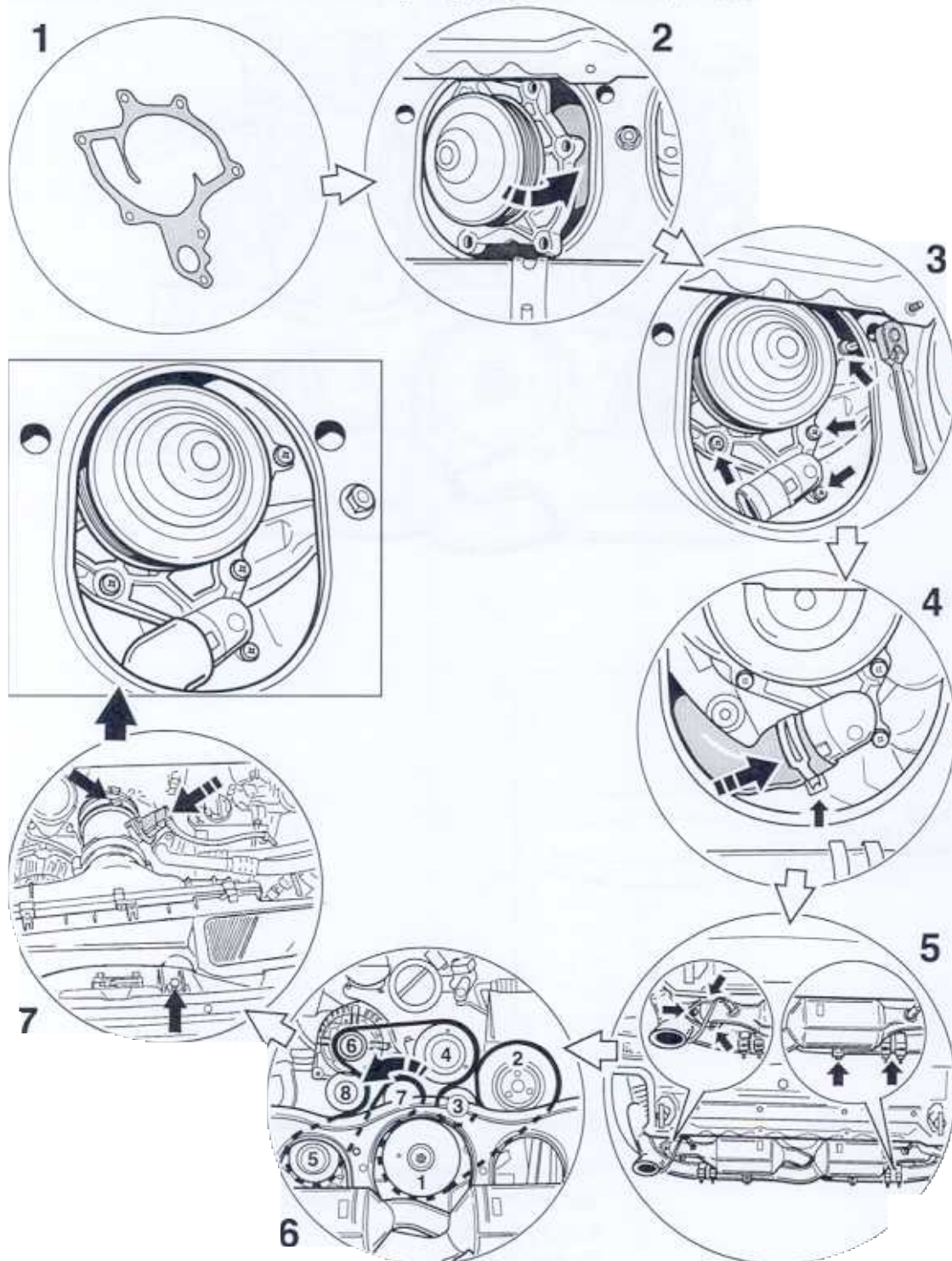
### Tools



70\_99

Item	Designation	Special tool	Explanation
A	Spring-band clamp pliers	Commercially available, see Workshop Equipment Manual, Chapter 2.4, No. 72 or 73	For opening and closing spring-band clamps

Installation overview of the coolant pump (engine installed) – GT3



### **Installation overview of the coolant pump (engine installed) – GT3**

- 1            Insert new metal seal
- 2            Mount coolant pump
- 3            Install coolant pump
- 4            Push on coolant hose
- 5            Install catalytic converter
- 6            Fit and tension the drive belt
- 7            Install air cleaner assembly

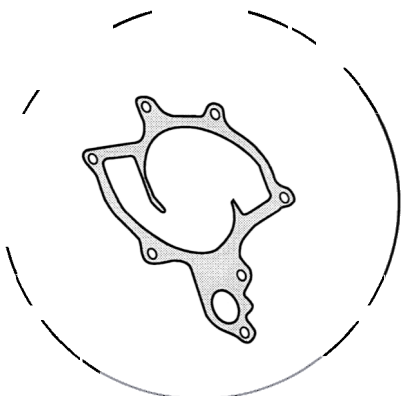


## Installing coolant pump – GT3

### No. Procedure

### Instructions

1

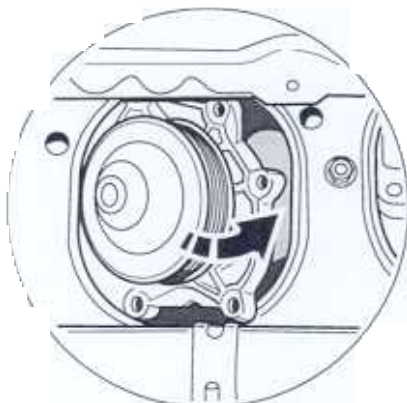


80\_a\_99

Insert new metal seal

Remove old seal carefully, clean and degrease the sealing surfaces. Insert new metal seal for coolant pump and water guide housing.

2

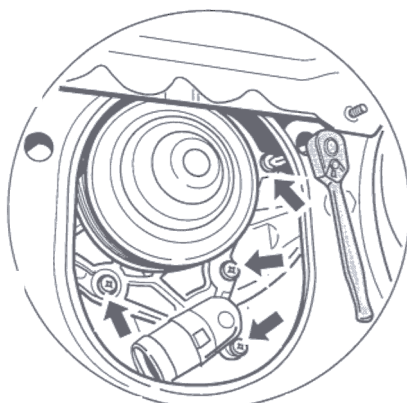


80\_b\_99

Mount coolant pump

Put on the coolant pump carefully through the support plate. The impeller and the seal must not be damaged during this procedure.

3



80\_c\_99

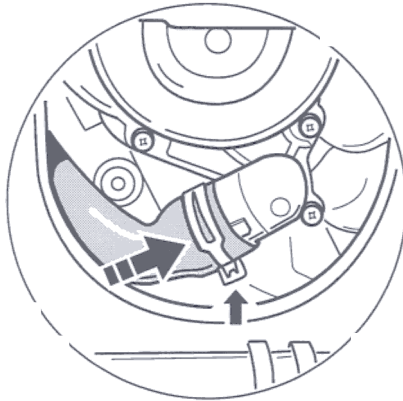
Install coolant pump

Position new seal and coolant pump simultaneously and fasten. Observe the different screw lengths. Tighten screws in diagonally opposite sequence. Tightening torque: 10 Nm (7.5 ftlb.)

No. Procedure

Instructions

4

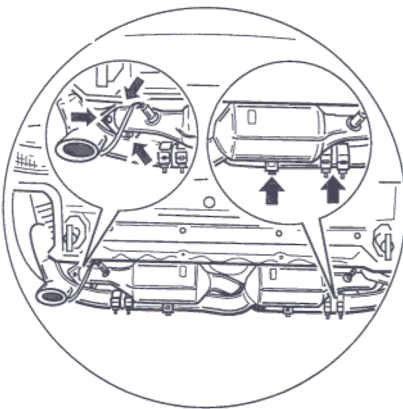


80\_d\_99

Push on coolant hose

Push on the coolant hose between the coolant expansion tank and coolant pump on the pump neck. Fasten spring-band clamp with the commercially available pliers No. 72 or 73.

5

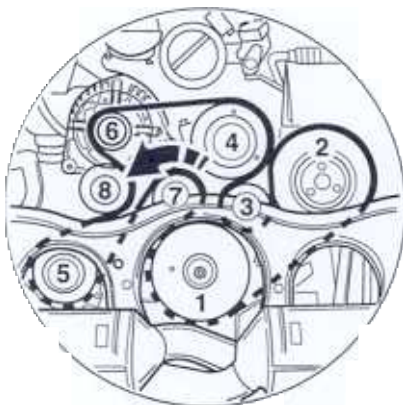


80\_e\_99

Install catalytic converter

Install the catalytic converter of cylinder bank 1 – 3 with a **new** manifold seal. Screw holding clamp and exhaust clamps into horizontal position if possible. Use new nuts on the exhaust manifold. Push on and clip in oxygen sensor cable.

6



80\_d\_99

Fit and tension the drive belt

Fit the drive belt in the old running direction on all belt pulleys and tension. Observe the order for fitting. **It is absolutely necessary to check that the drive belt is correctly seated on all belt pulleys.**

See Serv. No.: 13 78 19

No. Procedure

Instructions

7



80\_g\_99

Install air cleaner assembly.

Place the air cleaner assembly in the engine compartment again. Tighten the hose clamp on the throttle body. Tighten fastening screw M6 x 34. Fix cable onto hot film mass air flow sensor.

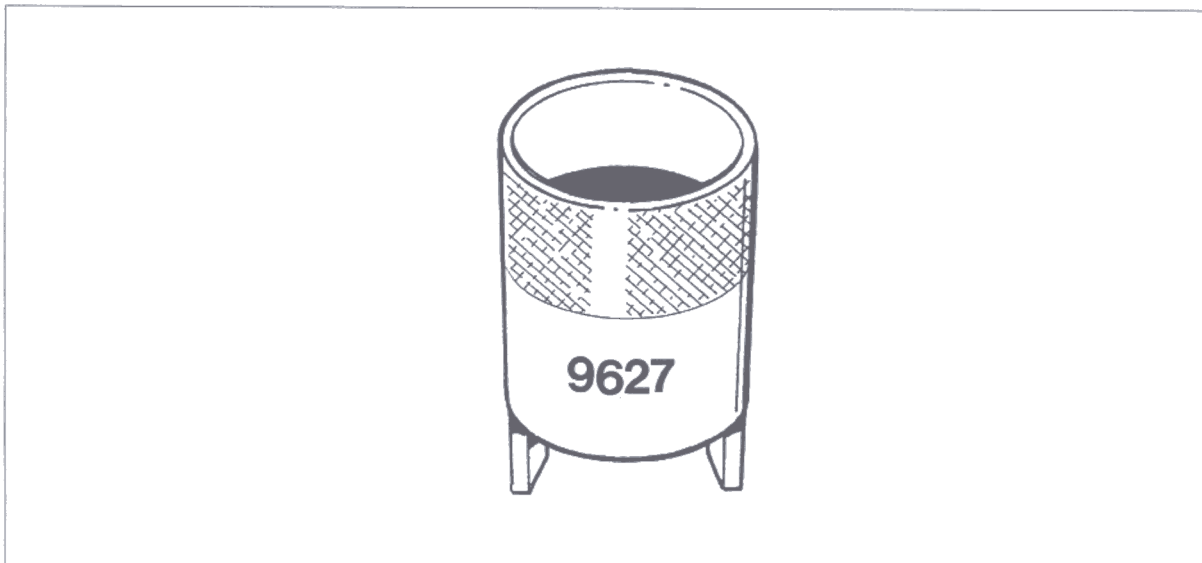
Fit rear spoiler

Fit the accessories of the rear spoiler Serv. No. 6355 (contains: rear end, bottom centre heat shield and bumpers).

Fill in coolant

Fill coolant into coolant expansion tank. Bleed the cooling circuit carefully (refer to Service No. 193817).

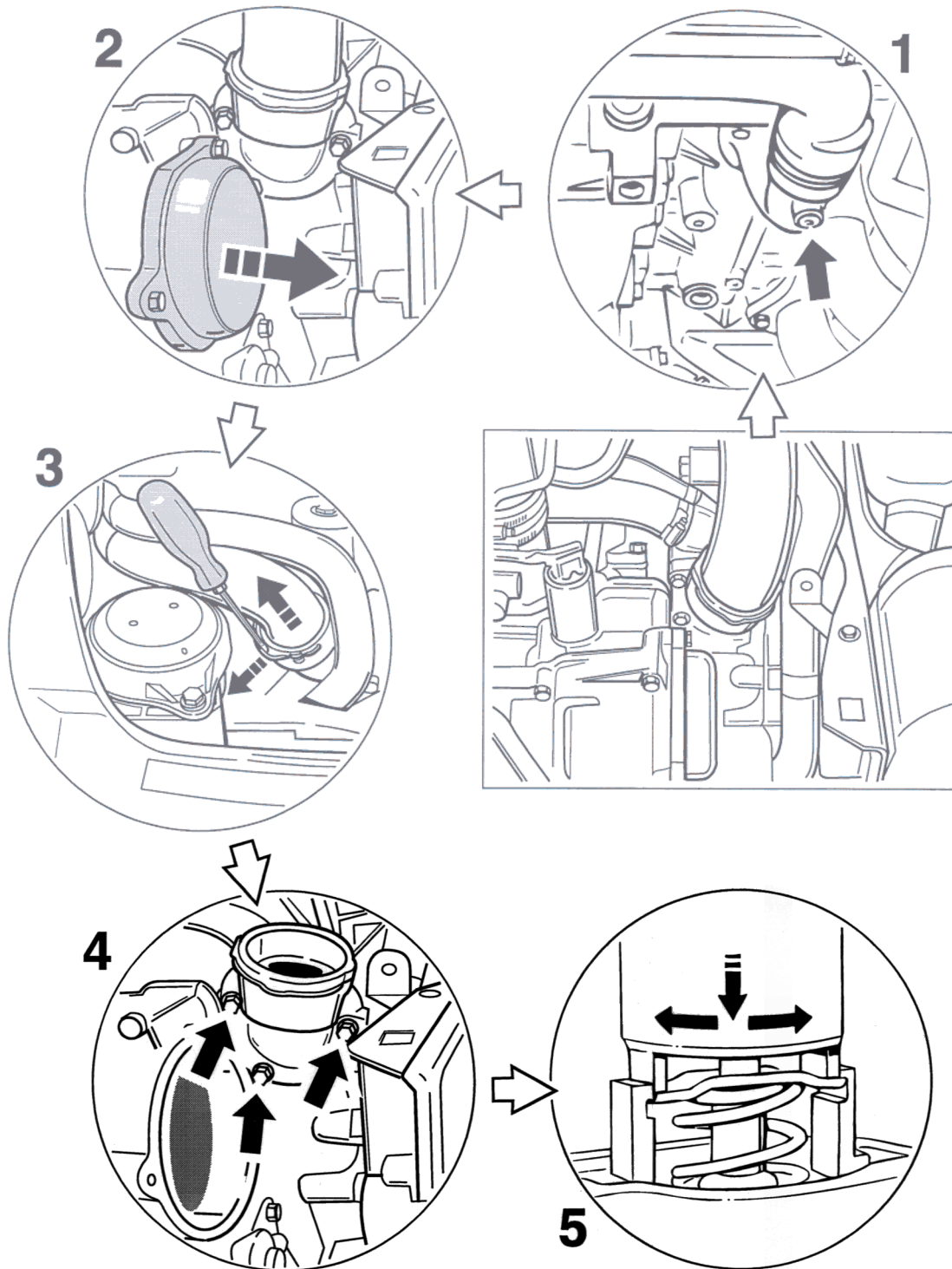
**19 58 19 Removing and installing coolant regulator – GT3**



302\_97

No.	Designation	Special tool	Explanation
	Assembly aid	Refer to Workshop Equipment Manual, Chapter 2.2, No. 9627	To change the coolant regulator

Removal overview of the coolant regulator – GT3



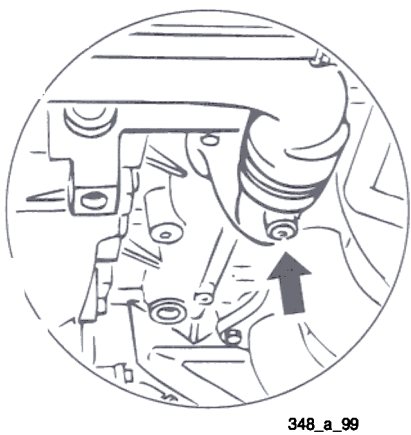
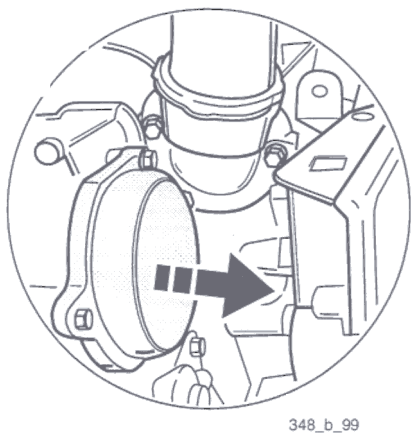
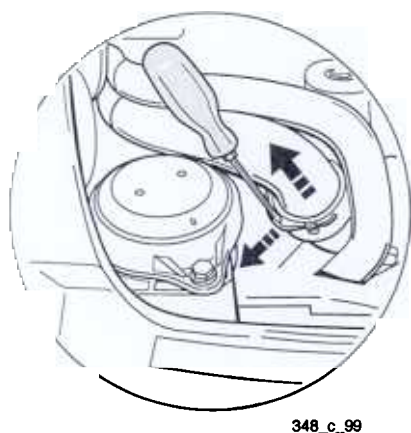
### Removal overview of the coolant regulator – GT3

Drain coolant

- 2 Remove closure cap
- 3 Remove coolant hose
- 4 Remove coolant regulator housing
- 5 Remove coolant regulator



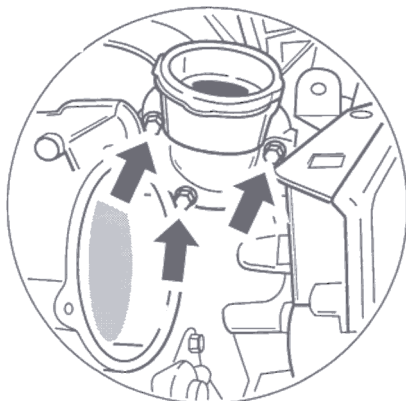
## Removal overview of the coolant regulator – GT3

No.	Procedure	Instructions
1	 <p>348_a_99</p>	<p><b>Drain coolant</b></p> <p>Open lid on the expansion tank. Undo the drain plugs on the two necks for coolant and collect coolant. After draining the coolant, fit new sealing rings on the drain plugs.</p> <p>Tightening torque 10 Nm (7.5 ftlb.) to 15 Nm (11 ftlb.). (Figure shows only one of the two necks)</p>
2	 <p>348_b_99</p>	<p><b>Remove closure cap</b></p> <p>Remove the closure cap on the cylinder head over the oil extraction pump of the cylinder bank 1 to 3. To do this, remove the three hexagon-head bolts and remove the closure cap.</p>
3	 <p>348_c_99</p>	<p><b>Remove coolant hose</b></p> <p>Unclip the coolant hose on the housing of the coolant regulator with a screwdriver and pull the coolant hose up and off.</p>

**No. Procedure**

**Instructions**

4

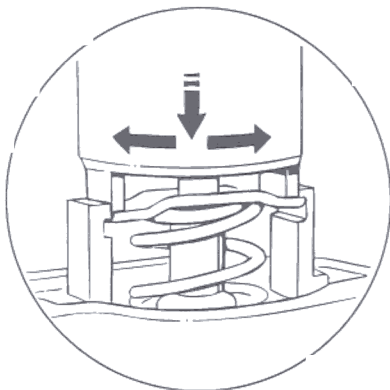


348\_d\_99

Remove coolant regulator housing

Undo the three fastening screws on the coolant regulator housing. Remove the coolant regulator housing. Do not use the seal again.

5

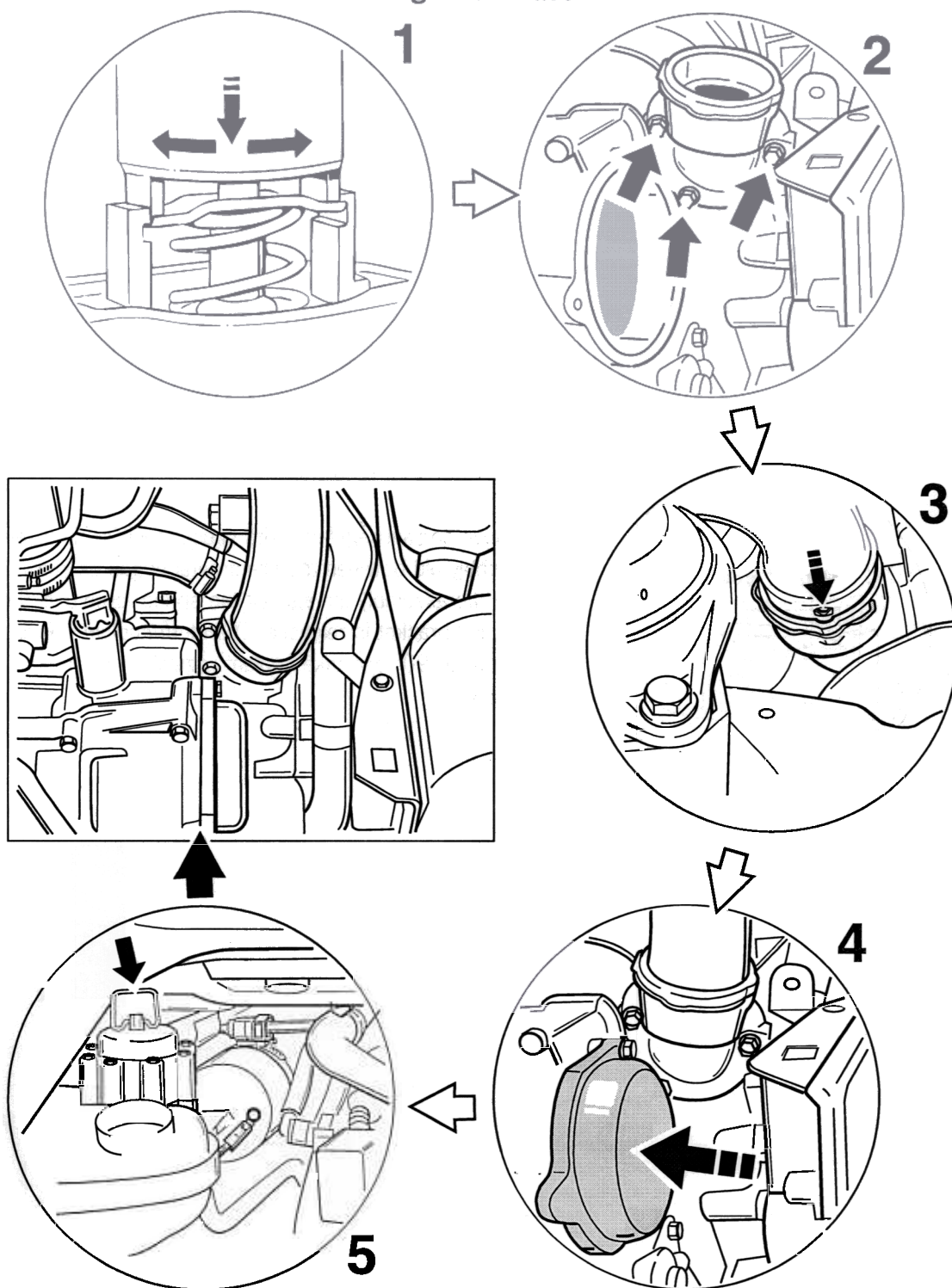


348\_e\_99

Remove coolant regulator

Remove coolant regulator with special tool 9627. Insert assembly aid between the sheetmetal edges as shown. Push the assembly aid against the spring force until the retaining bracket is released. Then turn coolant regulator by approx. 90° and take coolant regulator out of the housing.

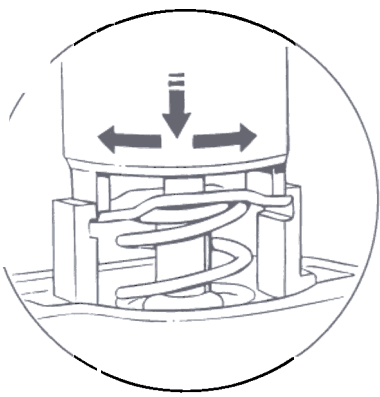
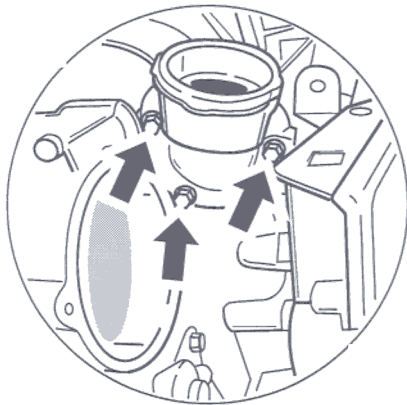
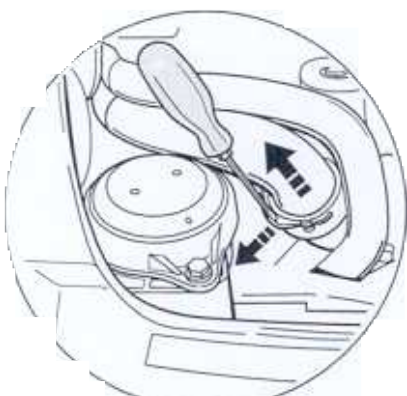
Installation overview of the coolant regulator – GT3



### **Removal overview of the coolant regulator – GT3**

- 1 Install coolant regulator
- 2 Install coolant regulator housing
- 3 Push on coolant hose
- 4 Install closure cap
- 5 Bleed coolant circuit

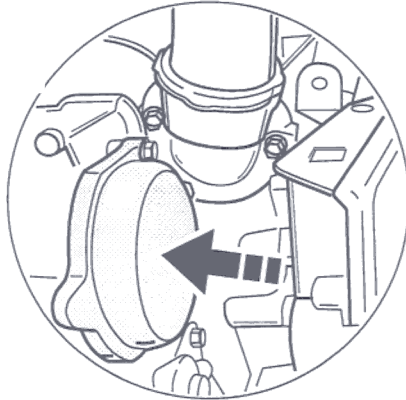
## Installation overview of the coolant regulator – GT3

No.	Procedure	Instructions
1	 <p data-bbox="507 842 582 865">348_e_99</p>	<p data-bbox="691 436 954 466">Install coolant regulator</p> <p data-bbox="691 506 1370 613">Insert coolant regulator in the housing as shown. Push against the spring force using special tool 9627 and turn until both sheetmetal edges are touching the housing.</p>
2	 <p data-bbox="507 1314 582 1337">348_d_99</p>	<p data-bbox="691 909 1053 938">Install coolant regulator housing</p> <p data-bbox="691 978 1370 1085">Clean sealing surface. Position coolant regulator housing with a new seal. Tighten the three fastening screws to 10 Nm (7.5 ftlb.).</p>
3	 <p data-bbox="507 1787 582 1806">348_c_99</p>	<p data-bbox="691 1381 941 1411">Push on coolant hose</p> <p data-bbox="691 1451 1370 1596">Insert retaining clip. Push the coolant hose with a new seal into the coolant regulator housing. Push hose downwards until the retaining clip is heard to engage. Check the hose for secure seating.</p>

**No. Procedure**

**Instructions**

4

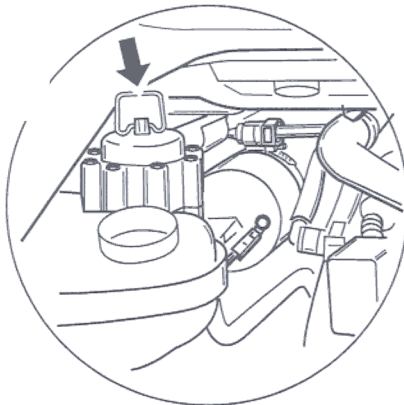


349\_d\_99

Install closure cap

Reinstall the closure cap beside the oil extraction pump on the cylinder bank 1 to 3. Lightly grease the O-ring to do this. Press in the closure cap evenly by hand. Tighten the three fastening screws to 10 Nm (7.5 ftlb.).

5



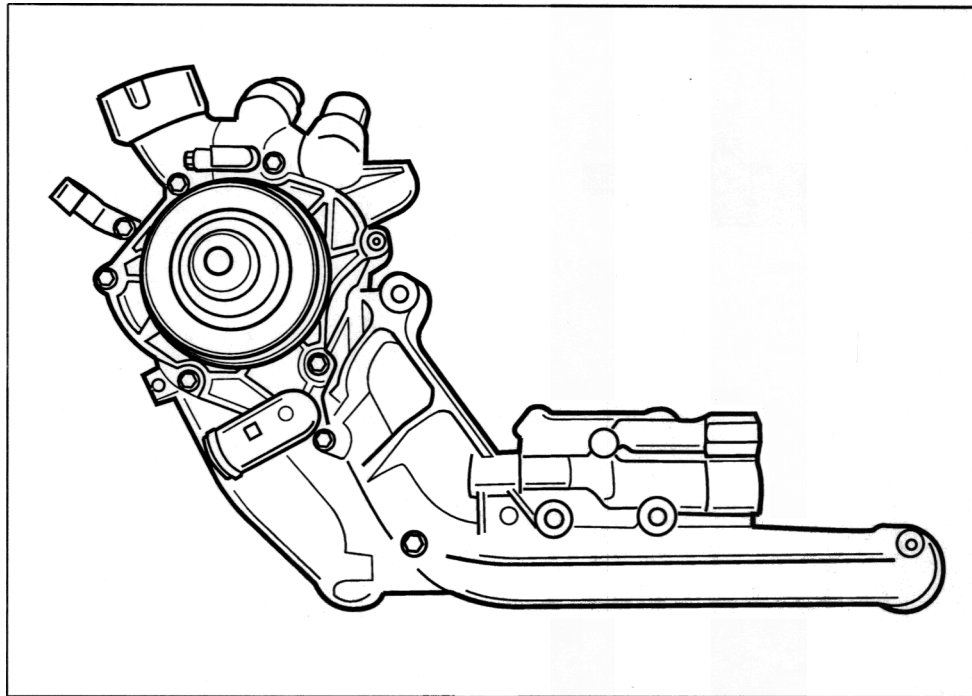
349\_e\_99

Bleed coolant circuit

Bleed the coolant circuit carefully. To do this, lift the bow on the closure cap. (Serv. No.: 19 38 17 ). Replace missing coolant.



**19 55 19 Removing and installing housing for coolant guide – GT3**



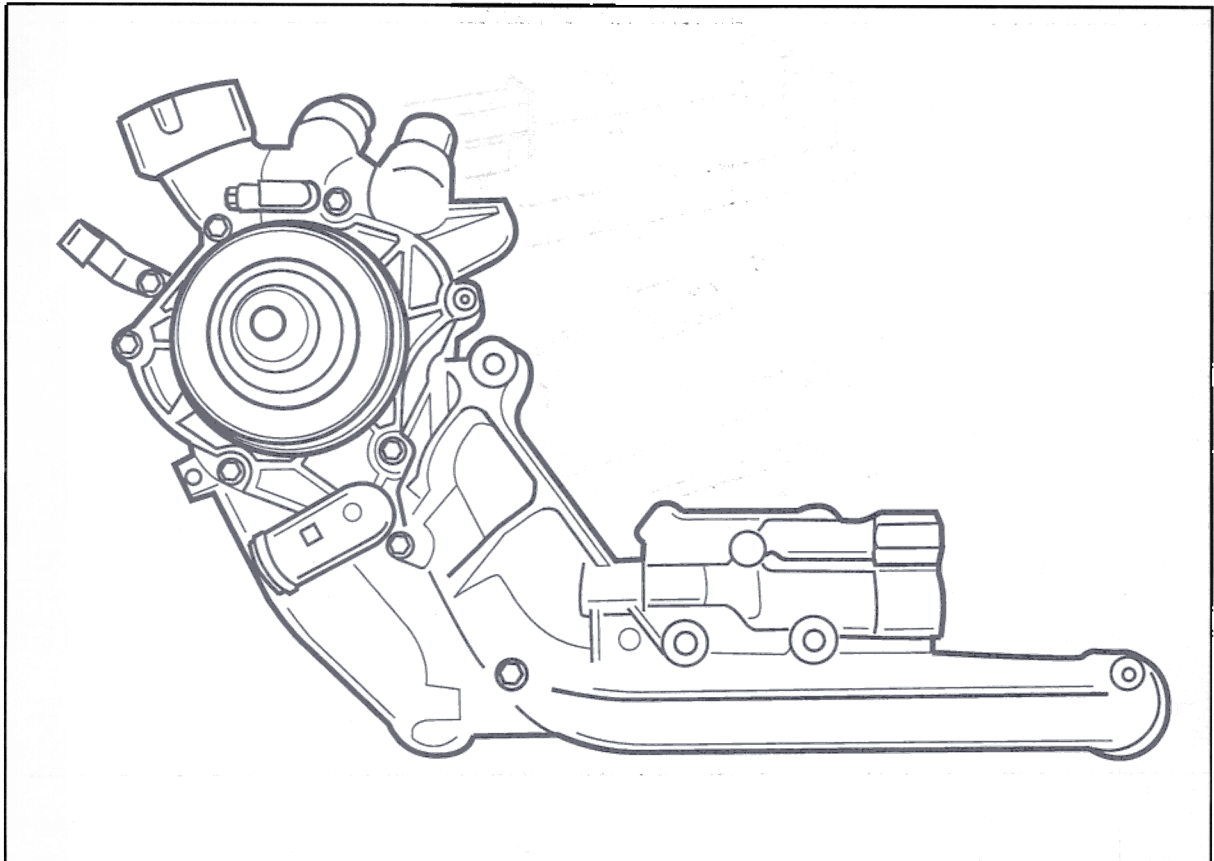
19550021

Includes:

**19 55 21 Removing housing for coolant guide – GT3**

**19 55 23 Installing housing for coolant guide – GT3**

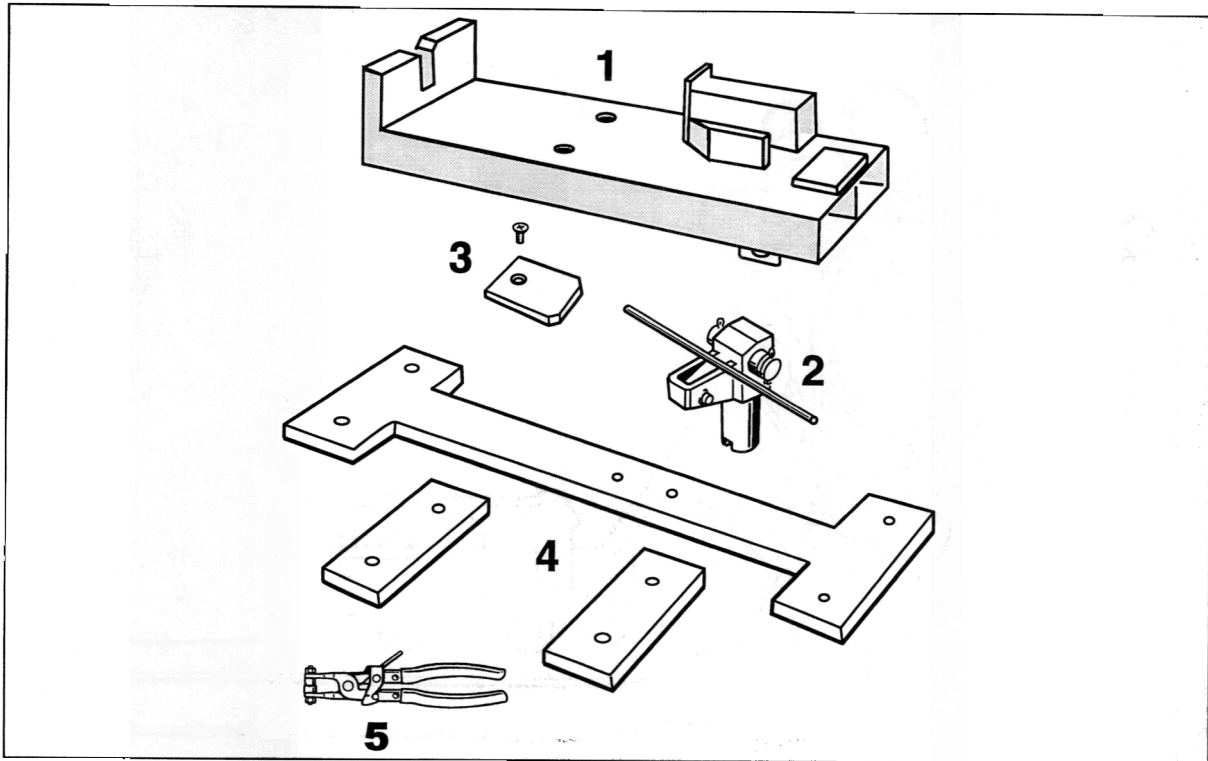
**19 55 21 Removing housing for coolant guide – GT3**



19550021

## Removing housing for coolant guide – GT3

### Tools



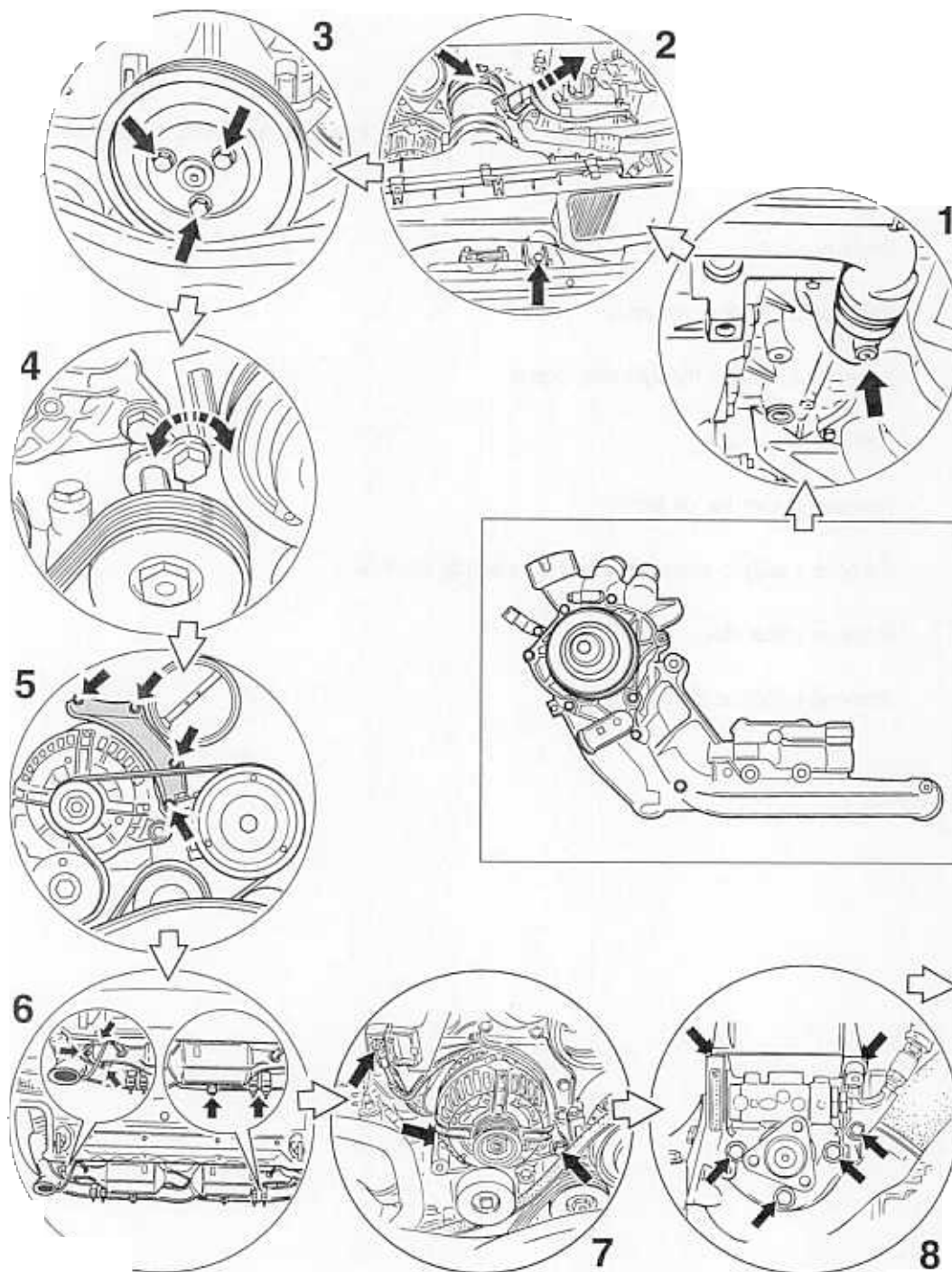
19550026

Item	Designation	Special tool	Explanation
1	Engine retainer plate	9111/3	
2	Adapter for engine retainer plate	9111/1	
3	Spacer	9111/5	To compensate for the engine retainer plate in the necessary horizontal position
4	Support plate	9111/4	
5	Spring-band clamp pliers	Commercially available; refer to Workshop Equipment Manual, Chapter 2.4, No. 72 or 73	



## Removing housing for coolant guide GT3

Removal overview:



19550001

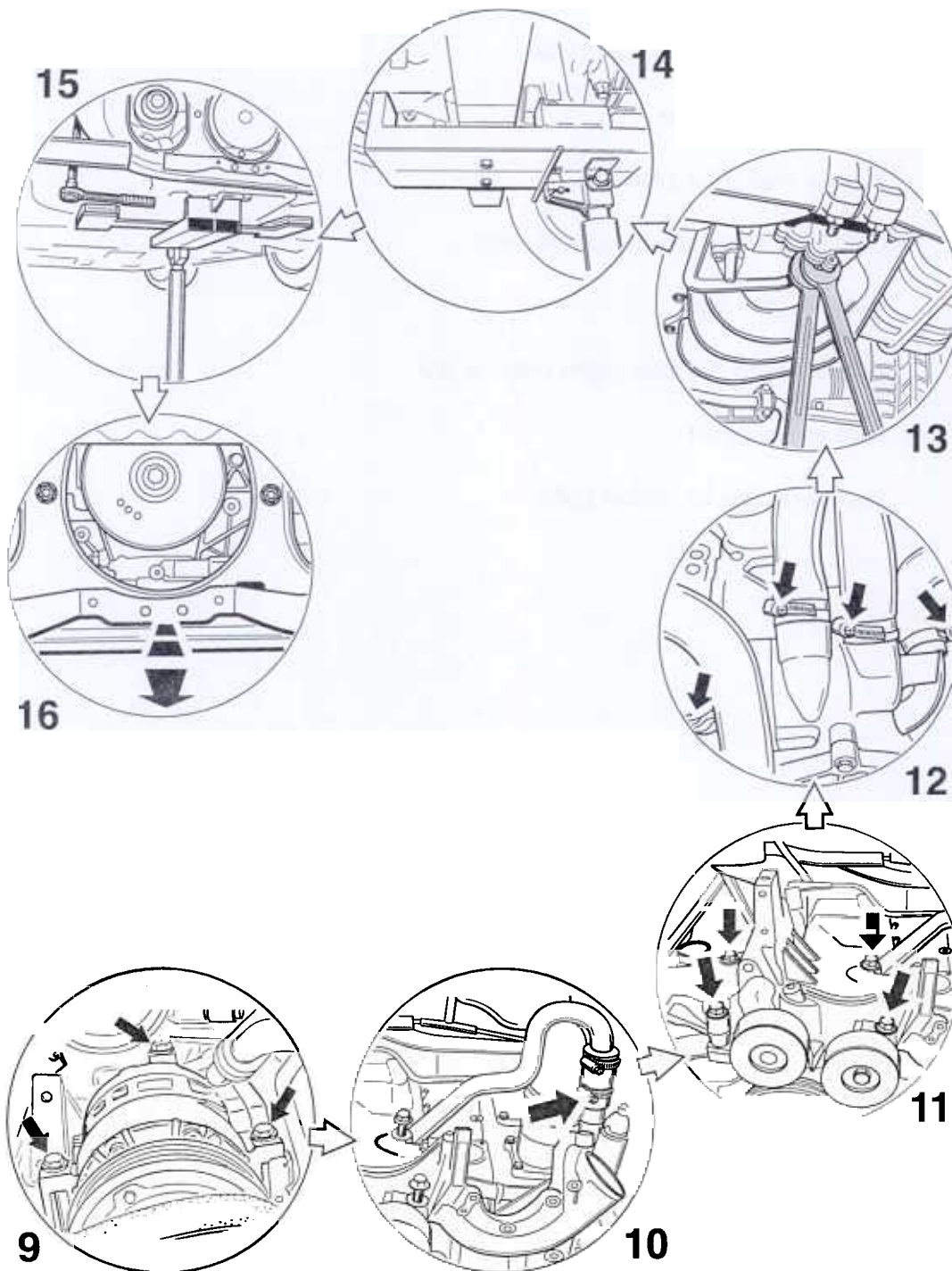
**Removing housing for coolant guide GT3****Removal overview:****Preliminary work:**

Disassemble the accessories of the rear spoiler Serv. No. 6355 (contains: rear end, bottom centre heat shield and bumper).

- 1 Drain coolant
- 2 Remove air cleaner assembly
- 3 Loosen belt pulley for hydraulic pump
- 4 Remove drive belt
- 5 Remove holder for oil filter
- 6 Remove catalytic converters and connecting sleeves
- 7 Remove generator
- 8 Remove hydraulic pump

## Removing housing for coolant guide – GT3

Removal overview:



19550002



### **Removing housing for coolant guide – GT3**

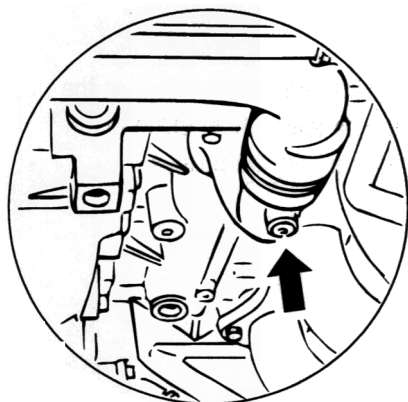
Removal overview:

- 9 Remove air-conditioning compressor
  - 10 Undo connecting hose
  - 11 Remove bracket for generator
  - 12 Undo hose connections on coolant pump
  - 13 Undo oil return lines
  - 14 Support engine and undo engine mount at rear
  - 15 Undo engine carrier
  - 16 Remove housing for coolant guide
-

## Removing housing for coolant guide – GT3

### No. Procedure

### Instructions



19550005

Drain coolant.

Open lid on the expansion tank. Undo the drain plugs on the two necks for coolant and collect the coolant. After draining the coolant, fit new sealing rings on the drain plugs.

Tightening torque 10 Nm (7.5 ftlb.) to 15 Nm (11 ftlb.).  
(Figure shows only one of the two necks)

2



19550006

Remove the air cleaner assembly.

Remove the complete air cleaner assembly. To do this, unscrew the M6 x 34 fastening screws. Pull off cable from hot film mass air flow sensor and set aside. Undo the hose clamp on the throttle body. Take out air cleaner assembly. Then undo the rear hose clamp of the connecting hose on the throttle body and remove the connecting hose.

3

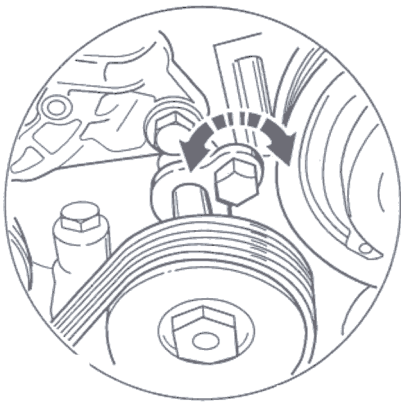
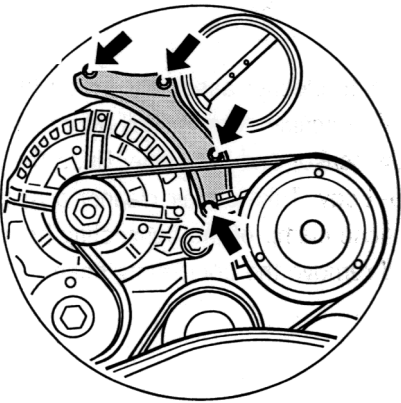
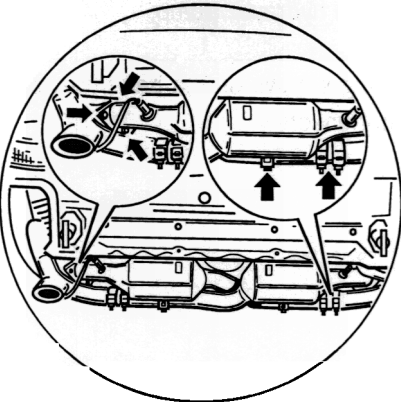


19550007

Loosen belt pulley on the hydraulic pump.

Undo the three fastening screws on the belt pulley of the hydraulic pump, do not unscrew.

## Removing housing for coolant guide – GT3

No.	Procedure	Instructions
4	 <p data-bbox="492 844 561 863">19550008</p>	<p>Remove drive belt.</p> <p>Slacken belt by turning the tensioning pulley at the hexagon in a clockwise direction, hold still and simultaneously take the belt off the pulleys.</p>
5	 <p data-bbox="492 1316 561 1335">19550009</p>	<p>Remove holder for oil filter.</p> <p>Unscrew the upper two fastening screws. Unscrew the third screw from the top and undo the fourth screw. Lift the holder out.</p>
6	 <p data-bbox="492 1789 561 1808">19550010</p>	<p>Remove catalytic converters and connecting sleeves.</p> <p>Screw off each of the catalytic converters at the manifold. Unplug oxygen sensor cable and unclip. Undo each of the three clamps. Pull the catalytic converters out of the exhaust manifold and pull out of the end mufflers. Then pull off the connecting sleeves between the end mufflers and the exhaust catalytic converters.</p>

## Removing housing for coolant guide – GT3

### No. Procedure

### Instructions

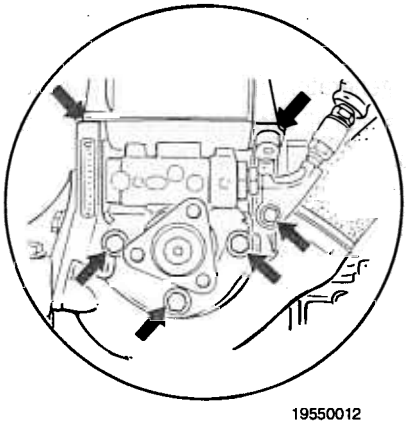
7



Remove generator.

With the battery disconnected, screw off the B+ wire of the alternating current generator. Unscrew the rear left fastening screw. Unscrew the front left fastening screw by approx. 1 cm and drive in again by tapping with a hammer (pressing out the rear threaded bushing). Unscrew the front left fastening screw and lift out the generator.

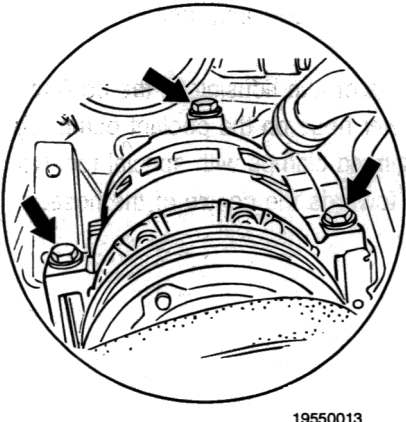
8



Remove hydraulic pump.

Undo the three fastening screws on the belt pulley and remove the belt pulley. Unscrew the two fastening screws on the expansion tank and the four fastening screws on the hydraulic pump. Pull the hydraulic pump and connected lines up out of the fastening bracket and set down on the right-hand side.

9



Remove air-conditioning compressor.

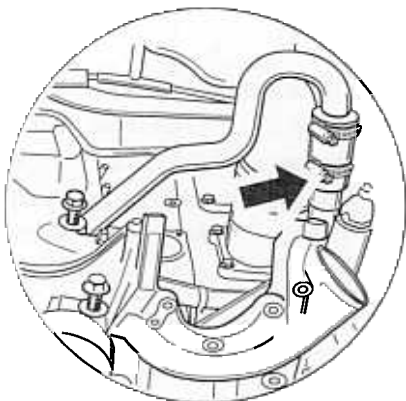
Remove the compressor from the bracket. Unscrew the three fastening screws for this purpose. For better accessibility to the fastening screws, the throttle body can be swung upwards after releasing the left and right clamps on the intake distributor.

## Removing housing for coolant guide GT3

### No. Procedure

### Instructions

10

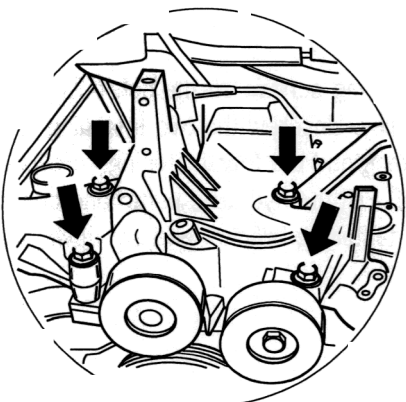


19550014

Undo connecting hose.

Pull off the connecting hose between the bracket for the generator and the bracket for the oil cooler. To do this, undo the clamp and pull off the hose at one side.

11

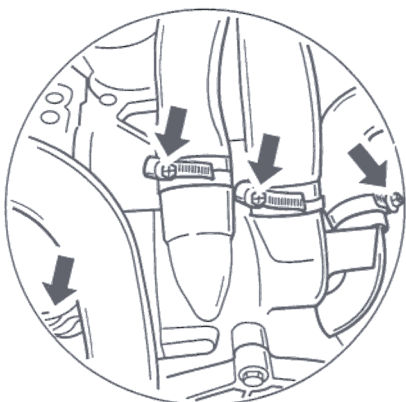


19550015

Remove bracket for generator.

Remove bracket for generator. To do this, unscrew the four fastening screws and lift the bracket for the generator out of the engine compartment. (Serv. No.: 27 27 21)

12



19550016

Remove the hoses from the coolant pump.

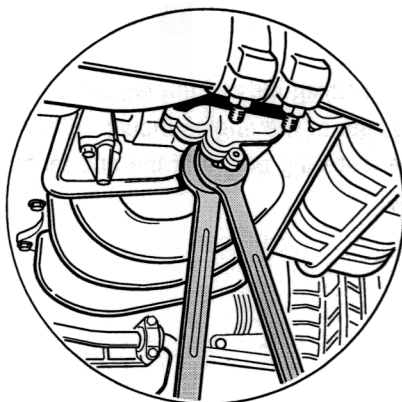
Pull off the three hoses on the housing of the coolant pump. Pull off the lower hose on the coolant pump. To do this, open the spring-band clamps with special tool No. 72 or No. 73 and push towards the centre of the hose.

## Removing housing for coolant guide – GT3

### No. Procedure

### Instructions

13

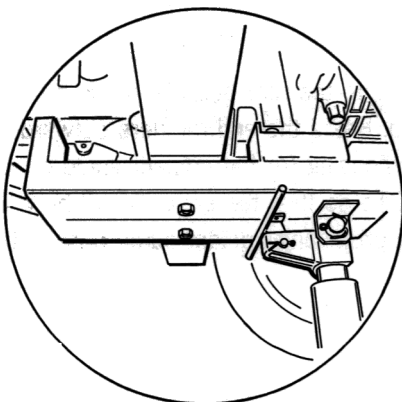


19550017

Undo oil return line.

Screw off the oil return line on the oil extraction pumps. Make sure to counter with an open-ended wrench when doing this.

14



19550018

Support engine.

Support the engine with special tool 9111/3. Undo the two engine mounts on the left and right, and lower the engine a little.



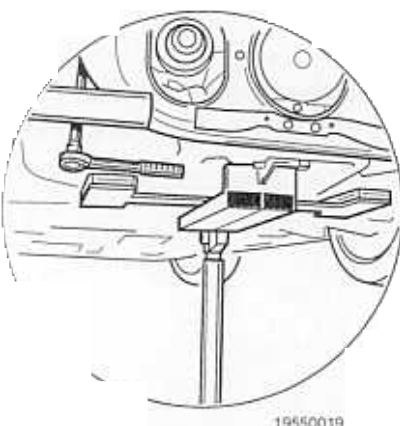
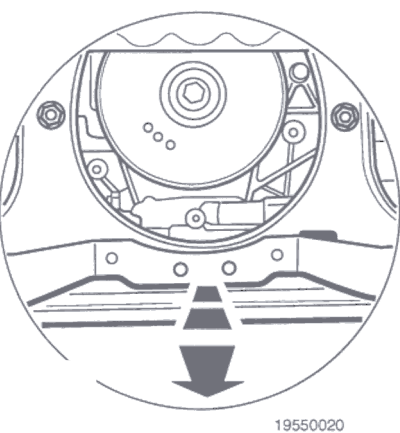
### Danger

**Danger of vehicle crash when changing the lifting platform position!**

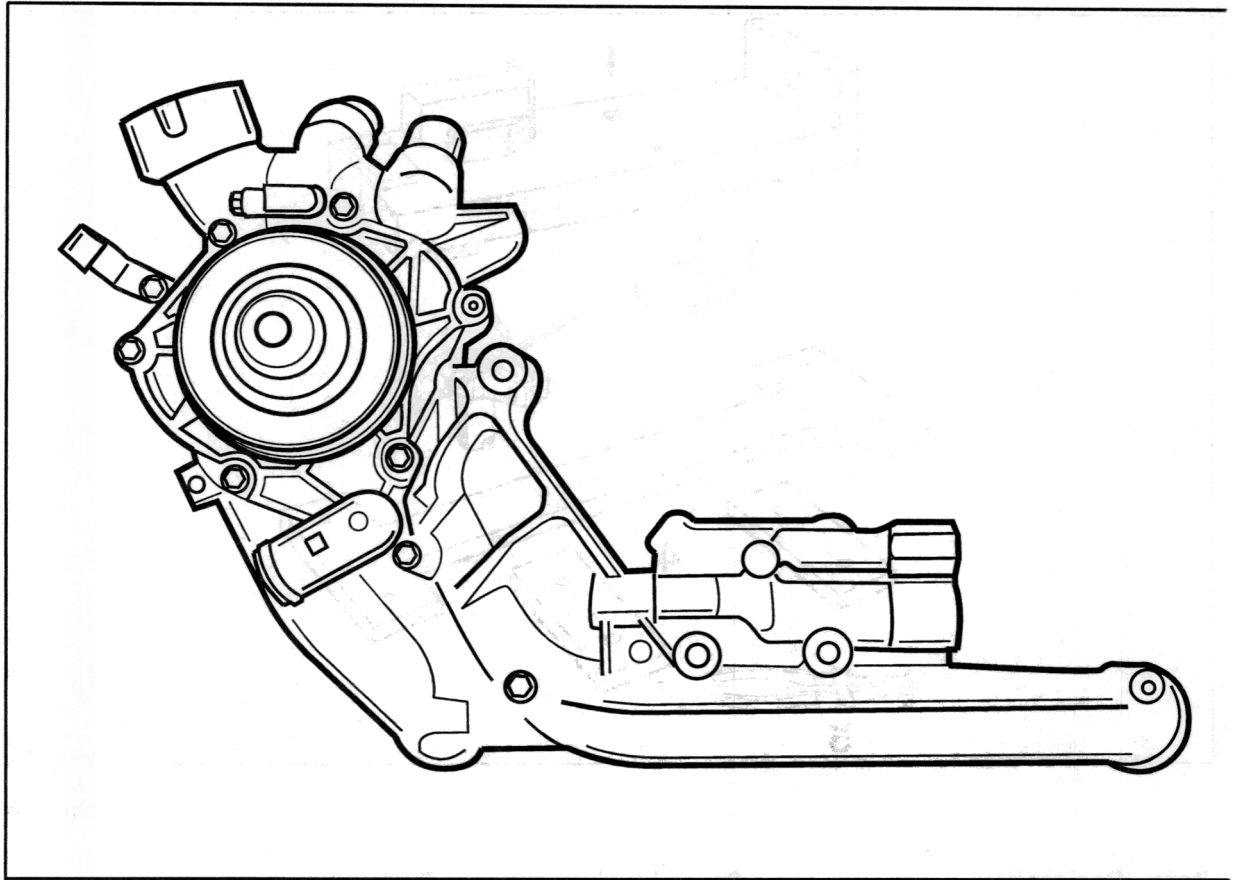
- > Protect the lifting platform and transmission jack from unauthorised use or accidental operation.
- > Observe the change in the vehicle's centre of gravity with disassembling components.



## Removing housing for coolant guide – GT3

No.	Procedure	Instructions
15	 <p>19550019</p>	<p>Remove engine carrier.</p> <p>Screw off the four fastening nuts of the engine mount. Undo the fastening nuts of the engine mount on the left and right. Undo the fastening points of the end mufflers, but do not unscrew.</p>
16	 <p>19550020</p>	<p>Remove housing for coolant.</p> <p>Swivel engine carrier to the rear and pull out in a downward direction. Press the end mufflers outwards when doing this. Pull the housing for the coolant guide off of the engine to the rear. To do this, the engine must be lowered enough so that the projecting coolant pump passes the body.</p>

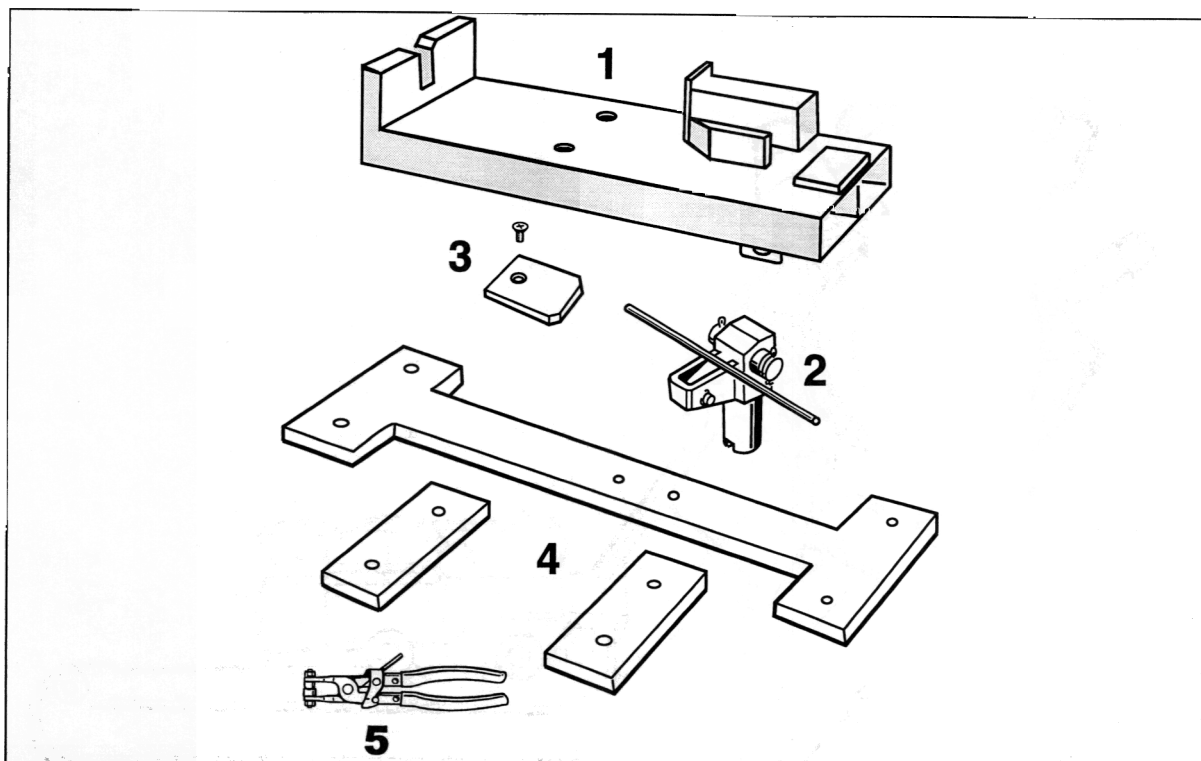
**19 55 23**    Installing housing for coolant guide – GT3



19550021

## Installing housing for coolant guide – GT3

### Tools

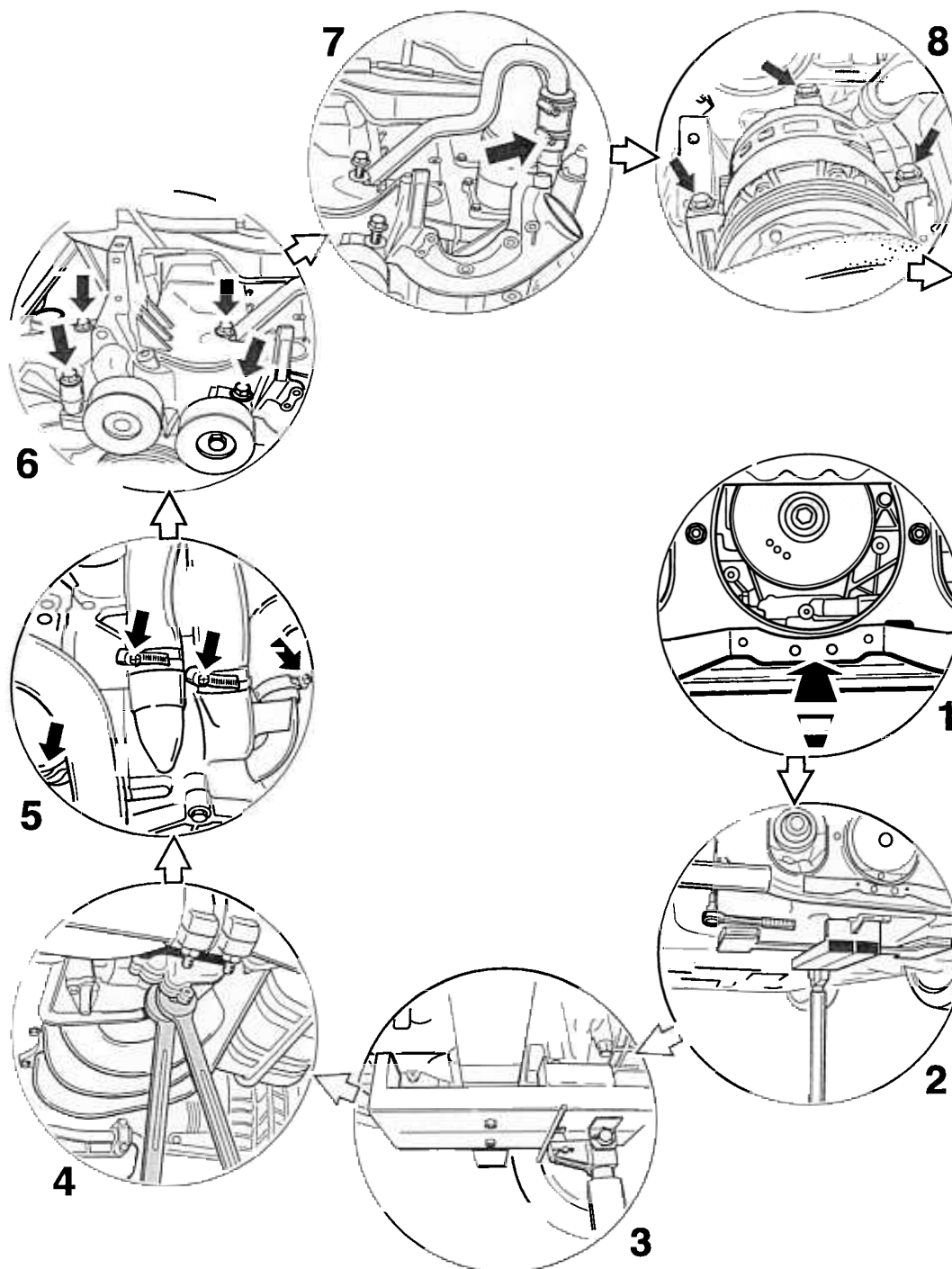


19550026

Item	Designation	Special tool	Explanation
1	Engine retainer plate	9111/3	
2	Adapter for engine retainer plate	9111/1	
3	Spacer	9111/5	To compensate for the engine retainer plate in the necessary horizontal position
4	Support plate	9111/4	
5	Spring-band clamp pliers	Commercially available; refer to Workshop Equipment Manual, Chapter 2.4, No. 72 or 73	

## Installing housing for coolant guide – GT3

Installation overview:



19550004

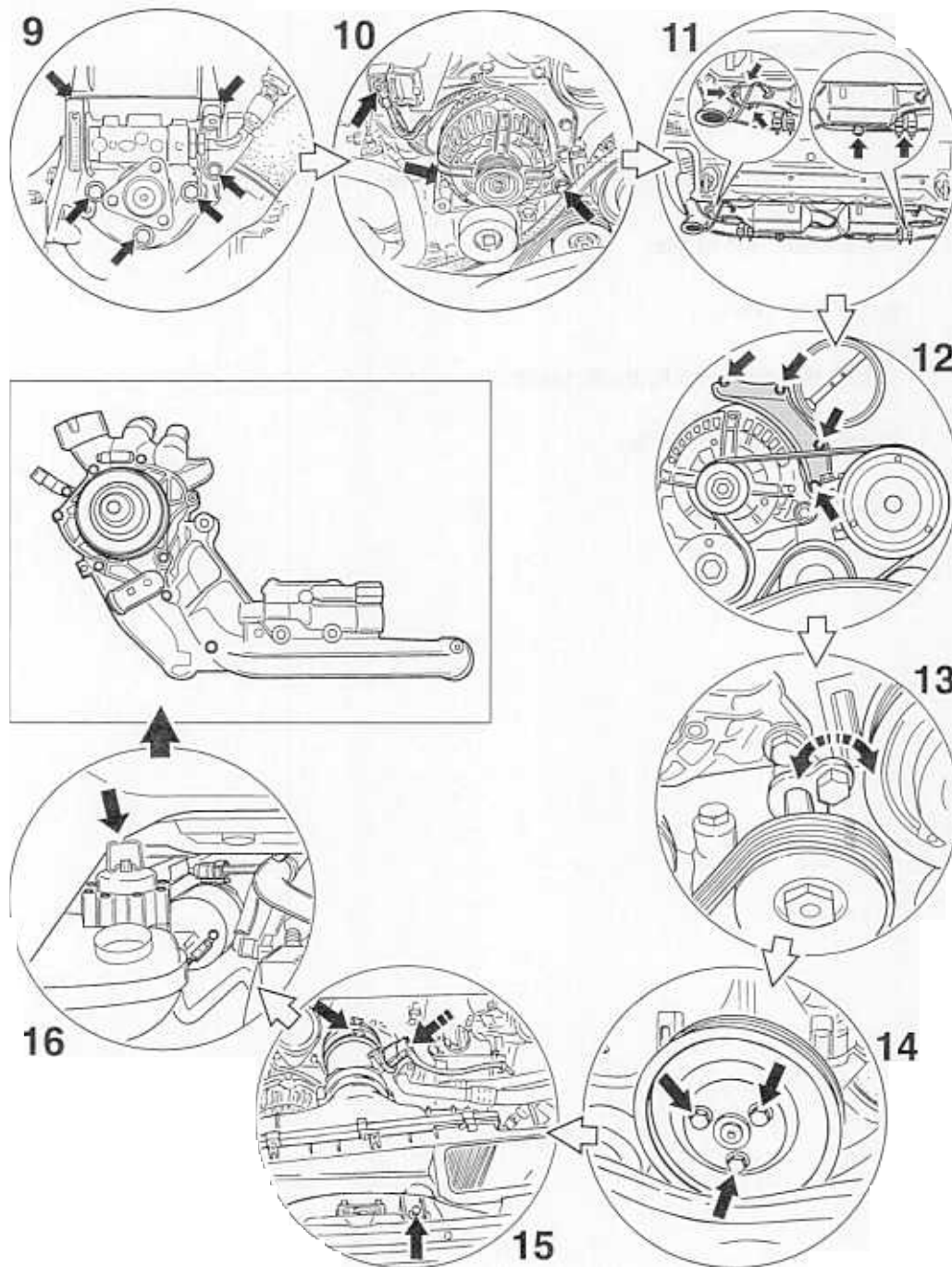
## Installing housing for coolant guide – GT3

### Installation overview:

- Position housing for coolant
- 2 Install engine carrier
- 3 Tighten engine mount
- 4 Tighten oil return line
- 5 Push hose connections onto coolant pump
- 6 Install bracket for generator
- 7 Push on connecting hose
- 8 Install air-conditioning compressor

## Installing housing for coolant guide – GT3

Installation overview:



19550005



## Installing housing for coolant guide GT3

Installation overview:

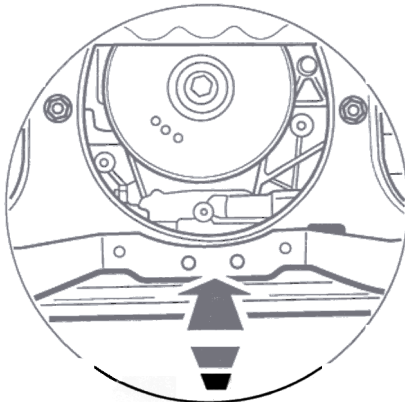
- 9            Install hydraulic pump
- 10          Install generator  
              Install catalytic converters and connecting sleeves
- 12          Install holder for oil filter
- 13          Install drive belt
- 14          Fasten belt pulley for hydraulic pump
- 15          Install air cleaner assembly
- 16          Bleed coolant circuit

## Installing housing for coolant guide – GT3

### No. Procedure

### Instructions

1

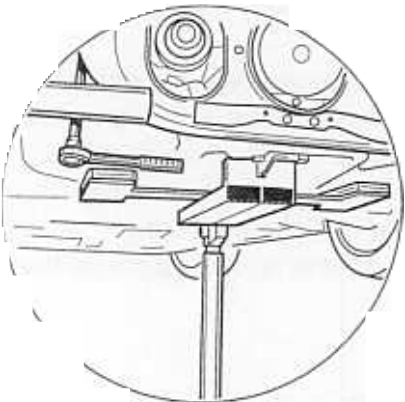


19550022

Position housing for coolant guide.

Replace the four O-rings on the two connection fittings, grease lightly and insert. Position the housing for coolant and fit the three upper hoses on the coolant pump. Then fit the engine carrier again. To do this, insert the engine carrier in the studs of the engine mounts and then swivel towards the engine.

2

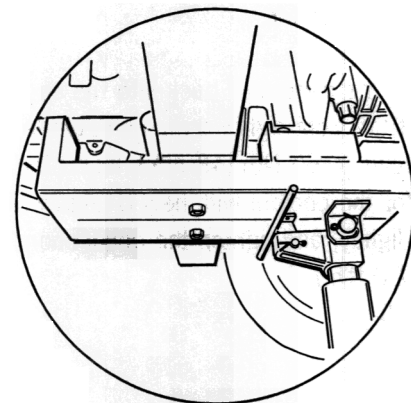


19550019

Tighten engine carrier.

Screw on the four fastening screws and tighten to 65 Nm (48 ftlb.). Tighten the engine mounts on the left and right to 85 Nm (63 ftlb.).

3



19550019

Remove engine support.

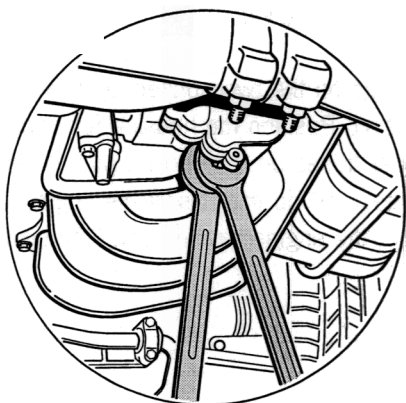
Carefully remove special tool 9111/3.

## Installing housing for coolant guide – GT3

### No. Procedure

### Instructions

4

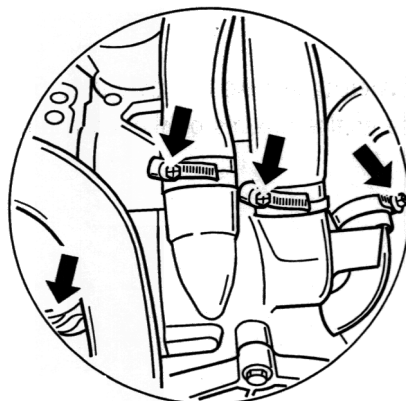


19550017

Tighten oil return lines.

Tighten the oil return lines on the oil extraction pumps. Make sure to stop with an open-ended wrench when doing this.

5

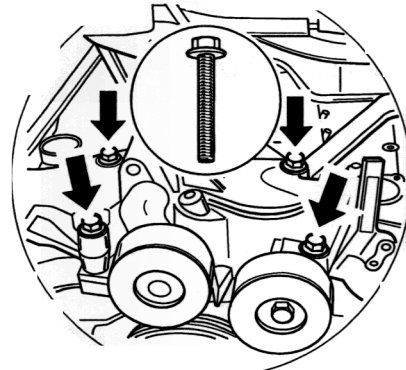


19550016

Push hose connections onto coolant pump.

Push the three upper hoses securely on the coolant pump. Fit the three hose clamps as shown in the figure. The hose clamps must be aligned so that the bracket for the generator is not pressing on top of them. Tighten the eight hose clamps. Push the lower hose onto the coolant pump and fit the spring band clamp again using special tool No. 72 or 73.

6



19550025

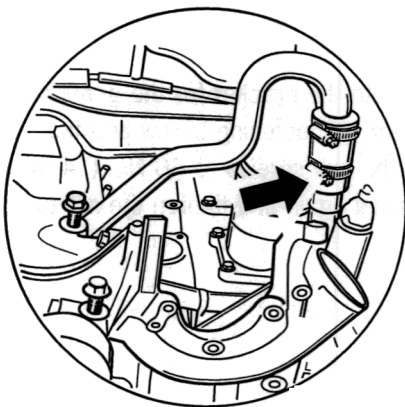
Install bracket for the generator.

Place the bracket for the generator back into the engine compartment. Insert the front right screw with Loctite 574. Tighten the four screws to 65 Nm (48 ftlb.). Insert the connection fittings for the coolant with new O-rings which have been greased lightly, and tighten the connection fittings to 9.7 Nm (7.0 ftlb.) (Serv. No.: 27 27 23)

## Installing housing for coolant guide – GT3

### No. Procedure

### Instructions

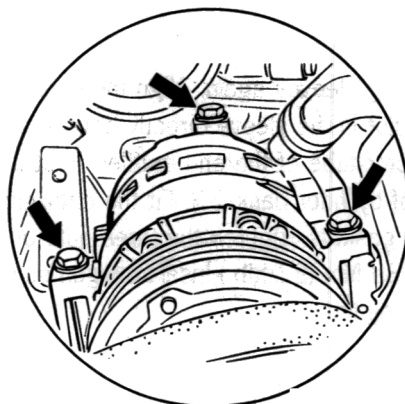


19550014

Push on connecting hose.

Push on the connecting hose between the bracket for the generator and the bracket for the oil cooler. Tighten the hose clamp. Tighten the lower hose holder to 9.7 Nm (7.0 ftlb.).

8

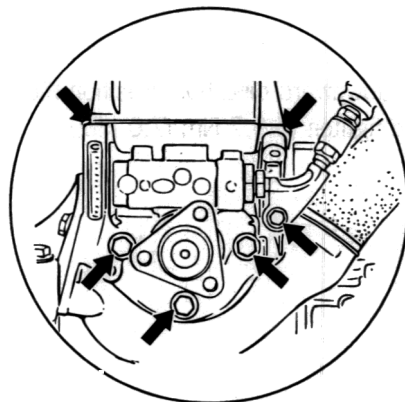


19550013

Install air-conditioning compressor.

Place the air-conditioning compressor onto the bracket for the generator again. Connect electrical connections again. Screw in the three fastening screws and tighten to 23 Nm (17 ftlb.).

9



19550012

Install hydraulic pump

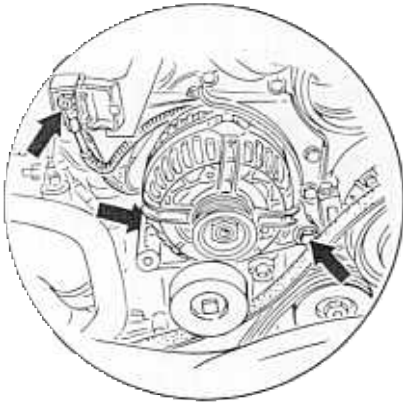
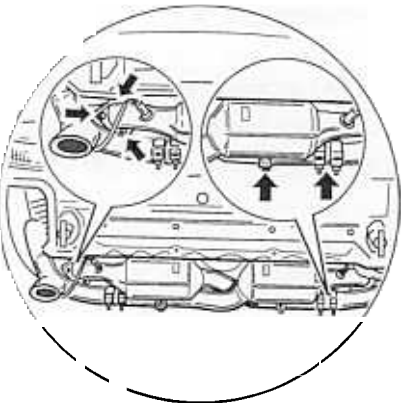
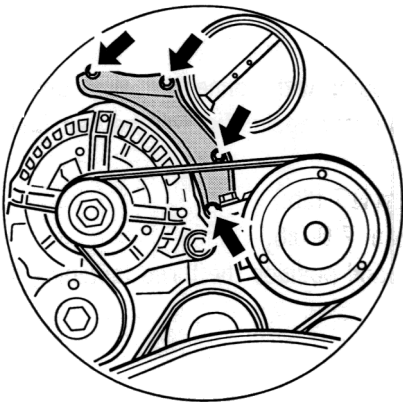
Place the hydraulic pump with connected wires onto the bracket for the generator again. Tighten the four fastening screws.

M8 screw to 23 Nm (17 ftlb.)

M6 screw to 9.7 Nm (7.0 ftlb.)

Push on belt pulley and position the three fastening screws

## Installing housing for coolant guide – GT3

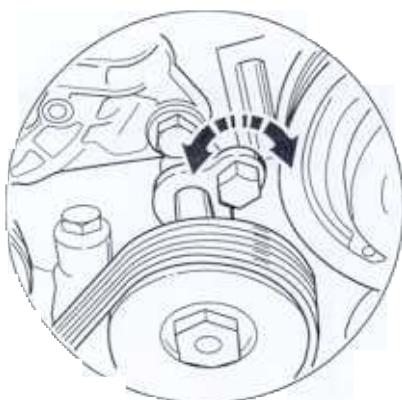
- | No. | Procedure   | Instructions   |
|-----|---|--|
| 10  |  <p>19550011</p>   | <p>Install generator.</p> <p>Place the generator onto the bracket for the generator again. Position the rear left fastening screw and the front right screw. Tighten the two screws to 46 Nm (34 ftlb.). Connect the B+ terminal again and tighten the nut to 15 Nm (11 ftlb.)</p>   |
| 11  |  <p>19550010</p>  | <p>Install catalytic converters.</p> <p>Push on the connecting sleeves again. Align the connecting sleeves so that the slot in the sleeve directly covers the arrow on the connector tube of the end muffler. First fit the catalytic converter of cylinder bank 1-3. Fit the catalytic converters with new gaskets. Tighten the three nuts on the exhaust manifold to 30 Nm (22 ftlb.) Insert oxygen sensors and clip in the cable again.</p> |
| 12  |  <p>19550009</p> | <p>Install holder for oil filter.</p> <p>Push in the holder in downward direction. Position the four fastening screws and tighten to 9.7 Nm (7.0 ftlb.).</p>   |

## Installing housing for coolant guide – GT3

### No. Procedure

### Instructions

13

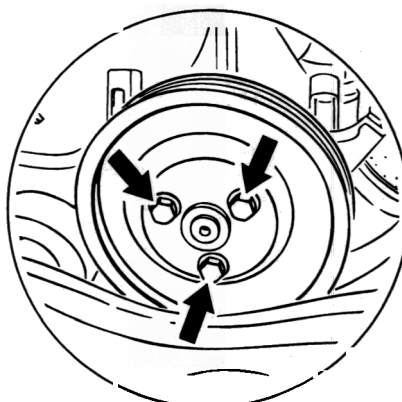


19550008

Installing drive belt.

Fit the drive belt on all pulleys. Put on the servo pump pulley with the drive belt and position the three fastening screws. Tension the drive belt on the tensioning roller. It is absolutely necessary to check that the drive belt is correctly seated on all belt pulleys. (Serv. No.: 13 78 19)

14

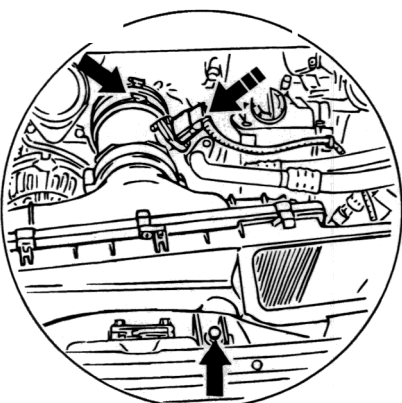


19550007

Tighten belt pulley on the hydraulic pump.

Tighten the three fastening screws on the belt pulley of the hydraulic pump to 23 Nm (17 ftlb.).

15



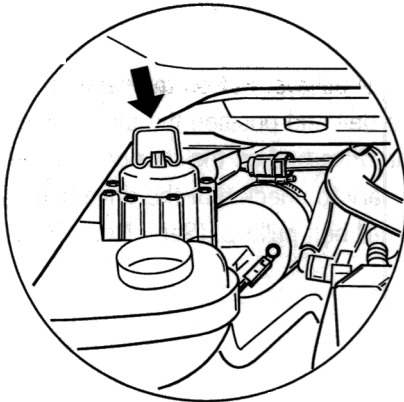
19550023

Install air cleaner assembly.

Place the air cleaner assembly in the engine compartment. Align the throttle body and tighten the clamps on the left and right of the throttle body again. Tighten the clamp on the connecting sleeve. Push on the plug of the hot film mass air flow meter and tighten the M6 x 34 hexagon-head bolt to 9.7 Nm (7.0 ftlb.).



### Installing housing for coolant guide – GT3

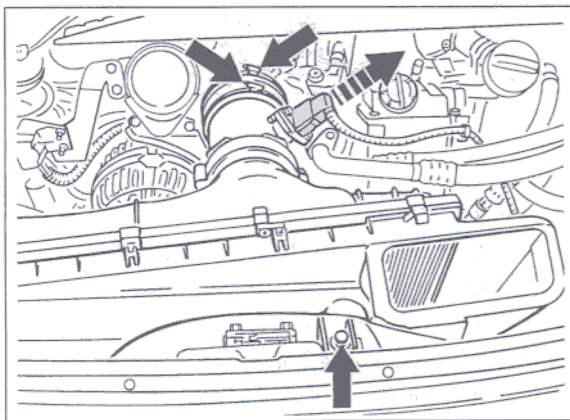
No.	Procedure	Instructions
16		<p data-bbox="680 436 909 470">Bleed coolant circuit</p> <p data-bbox="680 512 1332 619">Lift bow on bleeder valve. Allow engine to warm up and carry out brief accelerations. Top up missing coolant. Set antifreeze protection to - 37 °C.</p>

19550024

## 19 78 19 Removing and installing temperature sensor for coolant – GT3

### 1. Remove air filter.

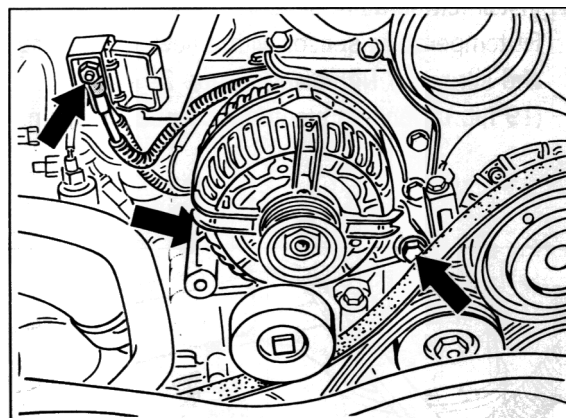
Unscrew hexagon-head bolt M6 x 34. Undo the hose clamp on the throttle body. Pull off plug from hot film mass air flow sensor and remove air cleaner assembly.



58\_99

### 2. Remove generator (Serv. No.: 27 22 19).

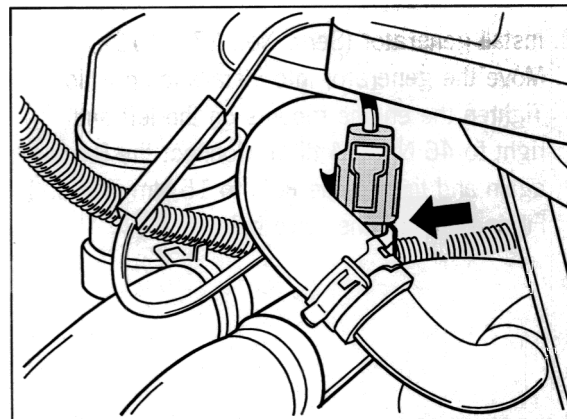
Unscrew B+ wire of battery. Relieve drive belt and remove from the idler pulley. Unscrew the left fastening screw of the generator. Unscrew the right fastening screw by approx. 1 cm and tap with the hammer until the screw head makes contact again. Then unscrew the right fastening screw. Lift the generator out.



427\_99

### 3. Remove temperature sensor.

Disconnect electrical connection and set to one side. Unscrew temperature sensor (a/f 22). Collect emerging coolant if necessary.

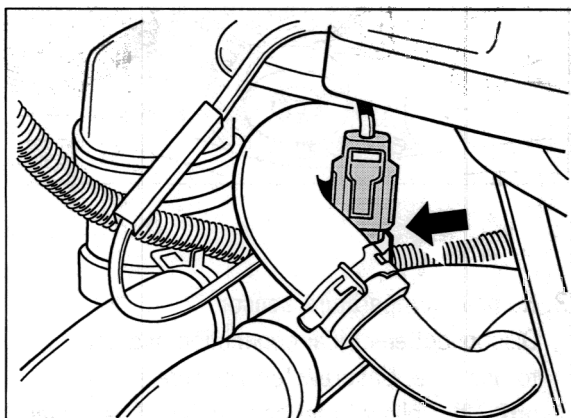


405\_99

### Installing temperature sensor for coolant – GT3

#### 1. Install temperature sensor.

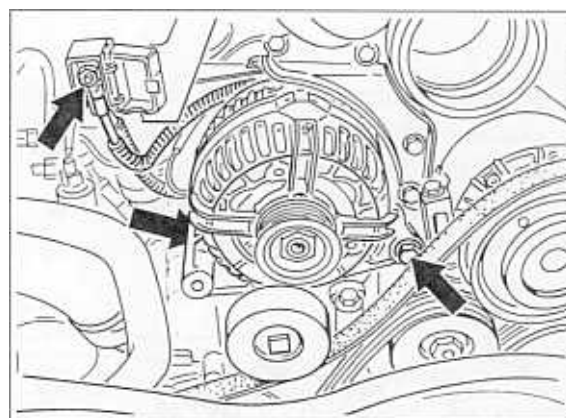
Fit temperature sensor with a new sealing ring and screw in. Tightening torque 25 Nm (19 ftlb.). Connect electrical connection again.



405\_99

#### 2. Install generator (Serv. No.: 27 22 19).

Move the generator into installation position. Tighten the engine mounts on the left and right to 46 Nm (34 ftlb.). Connect the B+ wire again and tighten the nuts to 15 Nm (11 ftlb.) Fit and tension the drive belt.



427\_99

#### 3. Install air cleaner assembly.

Insert air cleaner housing in its holder again. Tighten the M6 x 34 hexagon-head bolt to 9.7 Nm (7.0 ftlb.) Tighten the hose clamp on the throttle body and push the plug onto the hot film mass air flow sensor.

#### 4. Check coolant level, top up if necessary.

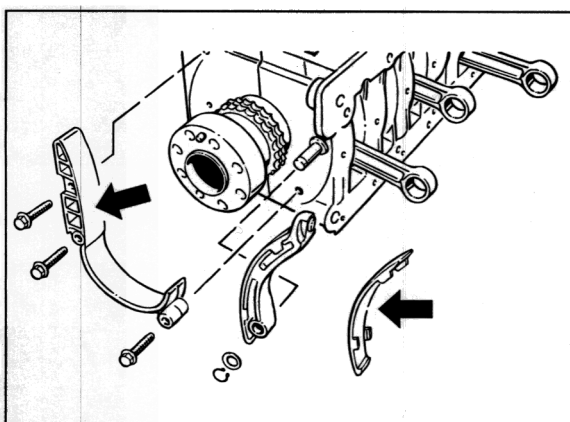
## 19 01 00 Oil/coolant mixing

1. Proceed as follow in the case of the complaint

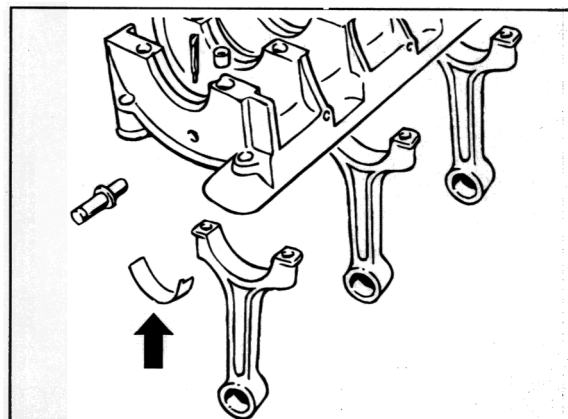
### "Coolant in the engine oil":

If coolant has entered the engine oil as a result of a leaking oil cooler, all guide and tensioning rails must be checked.

Damaged and well worn rails must be replaced.



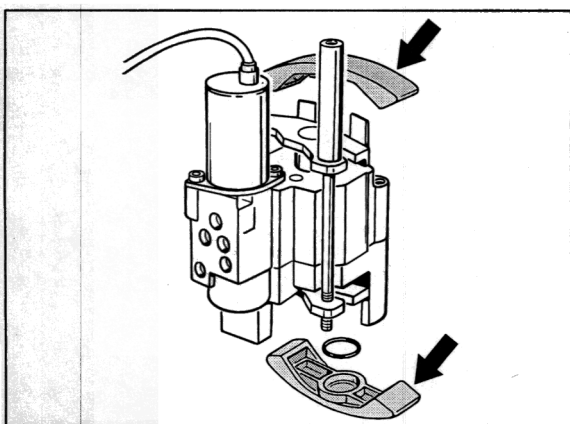
1348001



13490001

3. Inspect the bearing shells of the crankshaft for scoring and replace if necessary

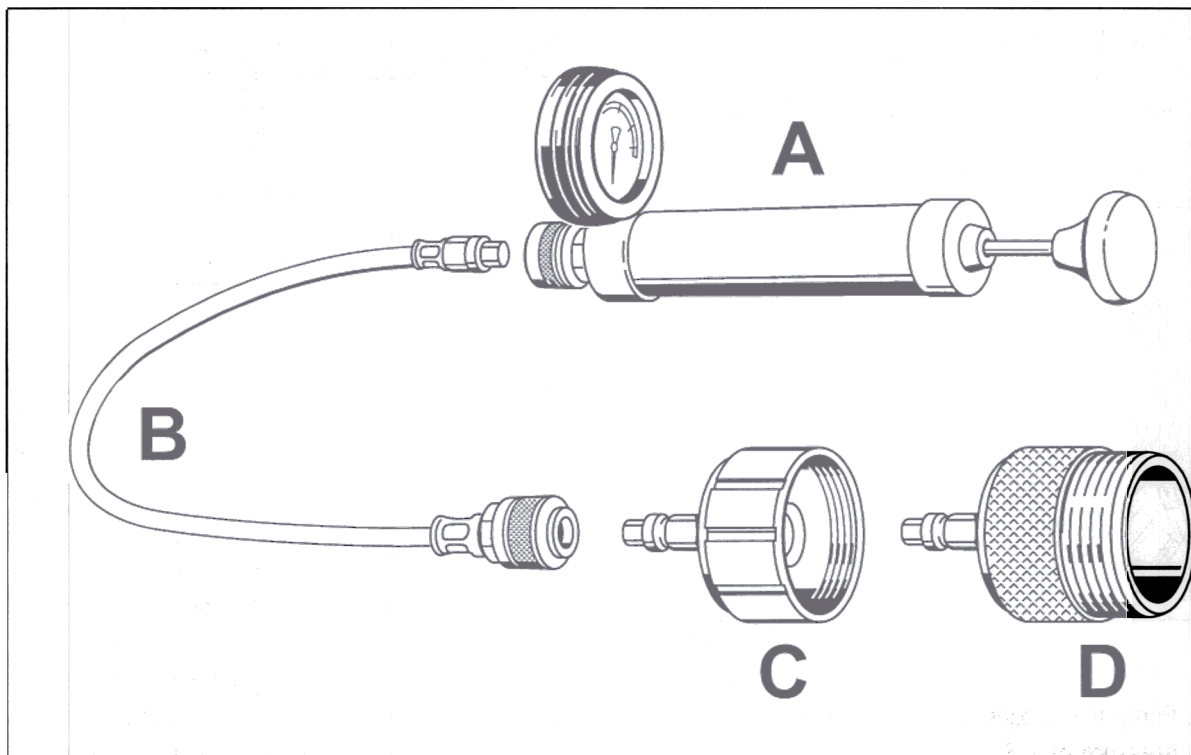
4. Check the camshaft bearing, replace cylinder heads if necessary.



15840001

2. The connecting-rod bearings must **always** be replaced.

## 19 01 01 Checking the cooling system for leaks



19010001

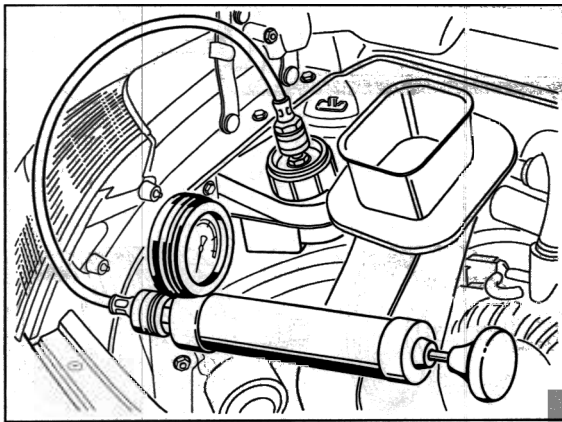
Item	Designation	Special tool	Explanation
A	Tester for cooling system tightness test	Commercially available	Items A to D, see General Workshop Equipment Manual, Chapter 2.5
B	Hose with plug-in coupling		
C	Adapter for cap tightness test		
D	Adapter for closure cap test		

## Checking the cooling system for leaks

### Note

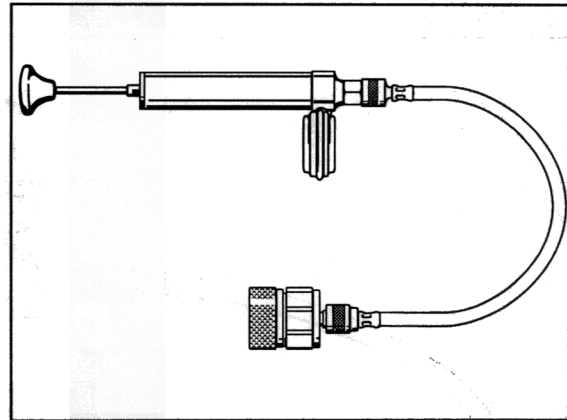
Perform the leak test only on a cold engine.

1. Remove cap and attach tester.



19010003

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.



19010002

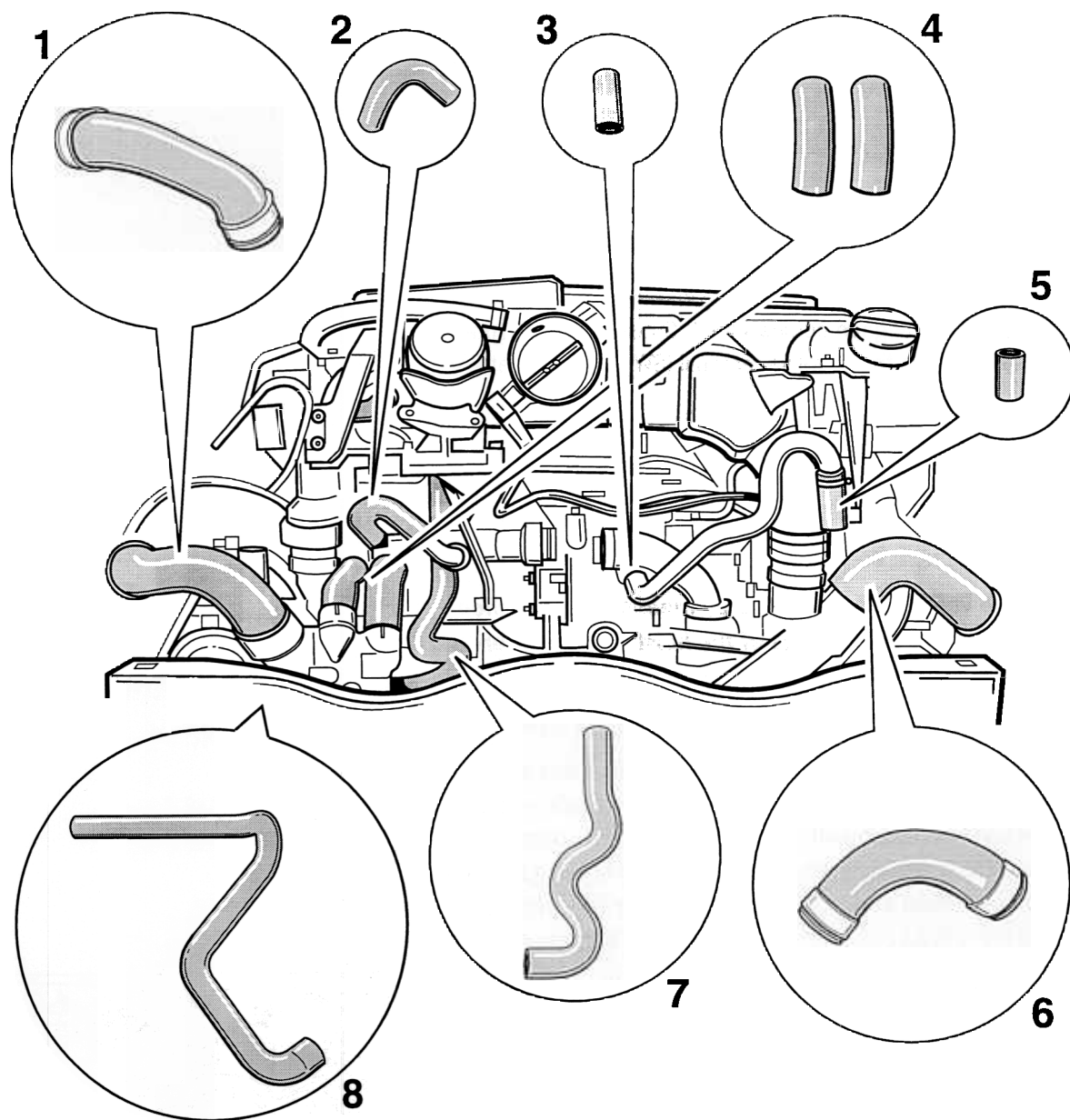
### Test, two-step cap

Part number 996 106 447 00

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

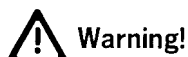


## Removing and installing coolant hoses - GT3



## Removing coolant hoses

1. Open engine compartment lid.
2. Install protective supports.



**Warning!**

### **Data loss!**

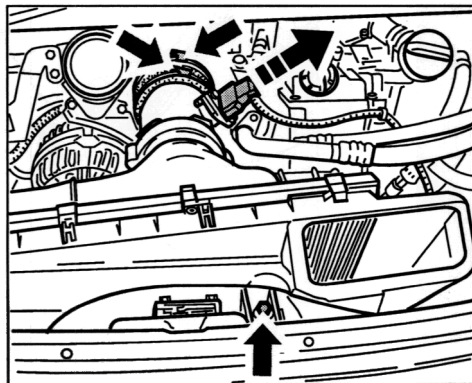
- *Before disconnecting the battery, find out the theft codes.*
  - *Before disconnecting the battery, read out the fault memory.*
3. Open the front luggage compartment. Subsequently disconnect and remove the negative terminal (SW 10) of the battery.



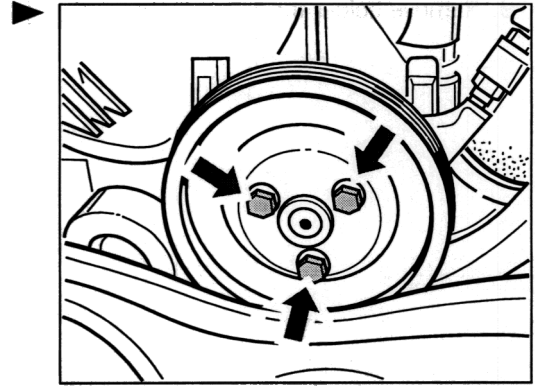
**Caution!**

### **Risk of damage if the vehicle is raised incorrectly!**

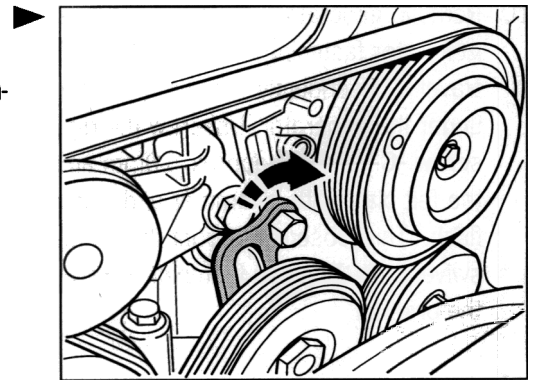
- *Raise the vehicle at the prescribed jacking points*
  - *Raise the vehicle at the engine by means of a workshop jack so that the swivel arms of the hoist passes underneath the kick plates.*
4. Raise the vehicle to working height with the lifting platform.
  5. Pull off electrical wire connector of the hot film mass air flow meter. To do this, push the plug on the groove surface at the sides and pull the plug off in an upward direction. Open the omega clip on the right side of the air cleaner housing and take out the electrical wire of the hot film mass air flow meter. Reclose the omega clip for the removal (risk of breakage).
- Unscrew the fastening screw M6 x 34 (SW 13) at the rear of the air cleaner housing. ►



6. Before removing or relieving the drive belt, loosen the drive wheel of the hydraulic pump. Unscrew three hexagon-head bolts by approx. 1/4 turn.

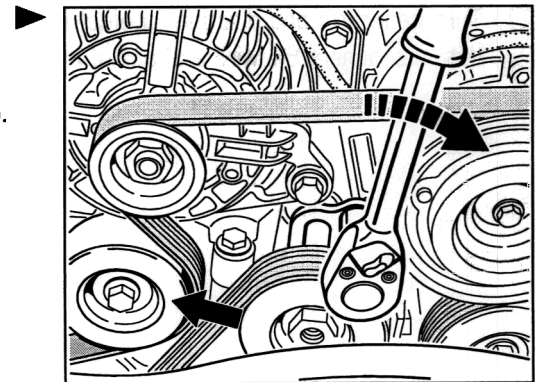


7. Relieve drive belt. To do this, turn the tensioning lever of the tensioning roller clockwise with a socket wrench (SW 15) and hold, remove the belt from the drive pulleys of the air-conditioning compressor, hydraulic pump and the generator.

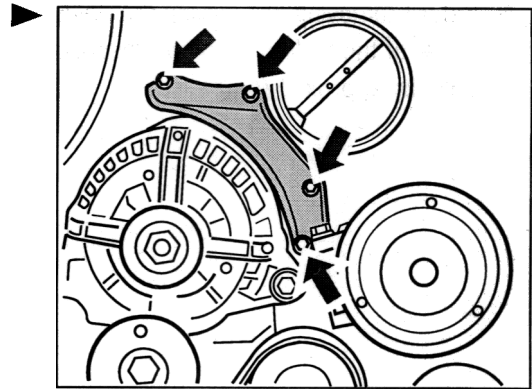


#### Relieving and removing belt.

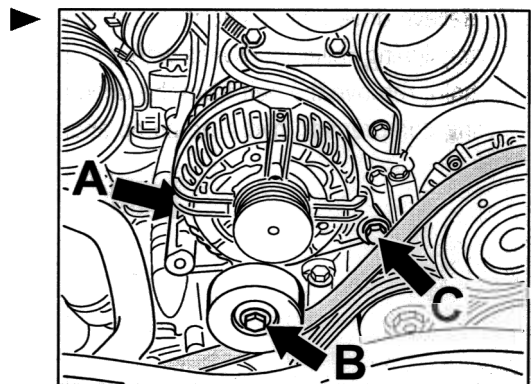
8. Unscrew the three already loosened fastening screws of the belt pulley and remove the belt pulley from the hydraulic pump.



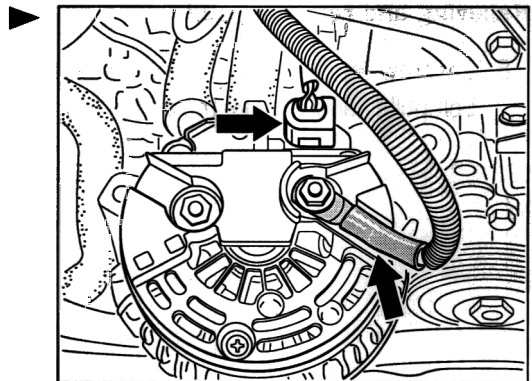
9. Remove holder for oil cooler bracket.



10. Remove generator. To do this, unscrew and remove the left generator fastening screw **-A-** (SW 15) in the direction of travel. Subsequently remove the deflection roller (SW 15) **-B-** under the generator. Unscrew the right generator fastening screw **-C-** (SW 15) approx. 10mm and subsequently drive in the felt plate with a hammer and aluminium mandrel until it is flush. This loosens the front threaded bushing in the generator swivel arm. Remove fastening screw. Remove generator from the bracket.



11. Turn generator and disconnect electrical connections. To do this, disconnect B+ wire and pull off the plug.

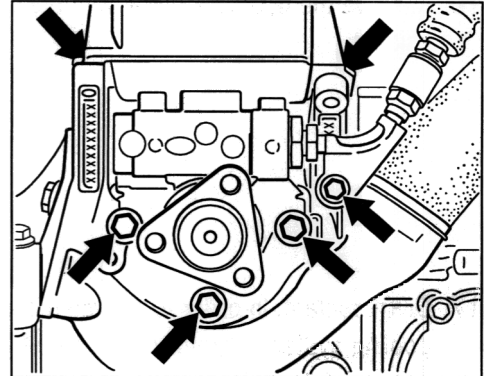




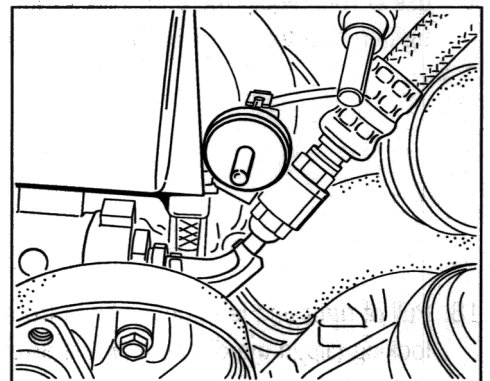
**Note!**

*The hydraulic pump can only be removed after removing the air-conditioning compressor.*

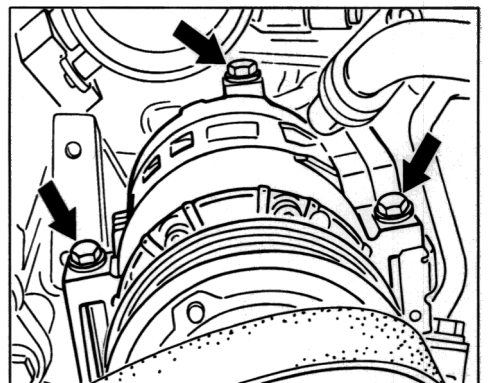
12. Remove hydraulic pump. To do this, undo the fastening screws (M8) of the expansion tank **-(upper two arrows)-** and loosen the four screws **-lower arrows-** (three M8 screws and one M6 screw) on the hydraulic pump.



13. Remove temperature sensors for engine-compartment fan.

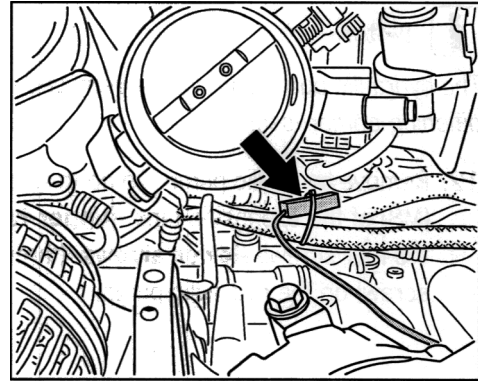


14. Loosen three hexagon-head bolts on the air-conditioning compressor.

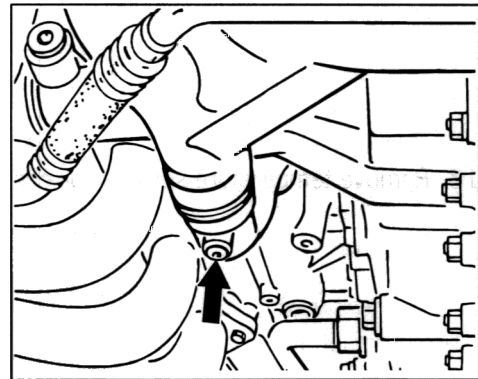




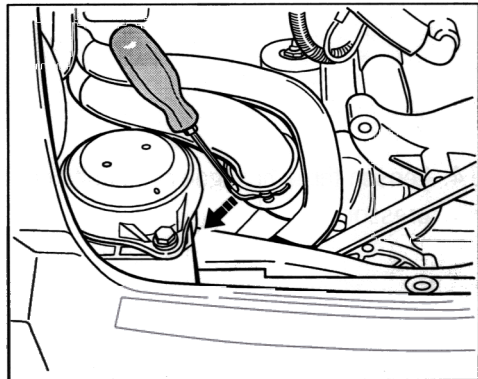
15. Remove air-conditioning compressor with the connected leads towards the rear and disconnect the electrical plug connection at the same time. Place the air-conditioning compressor onto a padded surface.
16. Remove the hydraulic pump with the connected leads and set aside.



17. Drain coolant. In order to reduce the excess pressure in the cooling system, carefully open the closure caps of the coolant expansion tank. Undo coolant drain plugs on the left and right and collect coolant in a suitable container, so that it can be re-used. Then equip the drain plugs with new sealing rings and tighten to a torque of 10 Nm (7.5 ft lb) to 15 Nm (11 ftlb.).

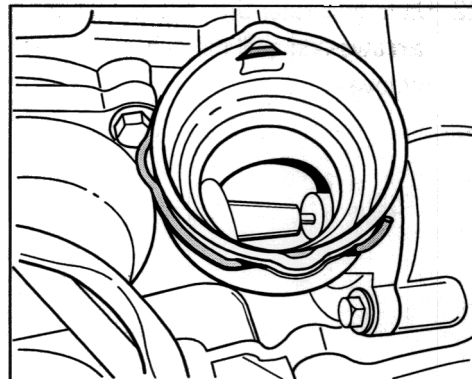


18. Pull of right and left coolant hose from the necks. Remove the locking clip in the direction of the arrow for this purpose.

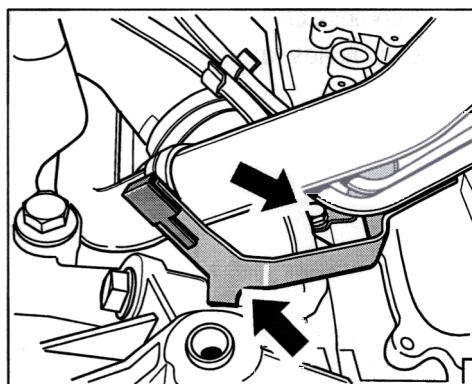




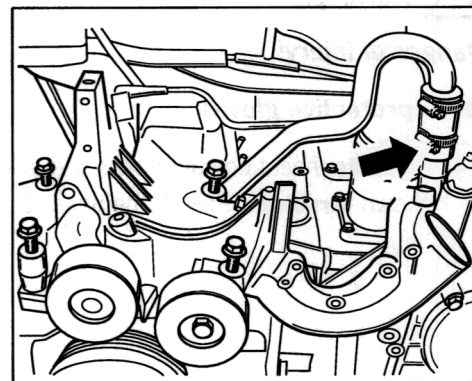
19. Check or renew the locking clip if necessary. Remount the locking clip onto the coolant necks. ►



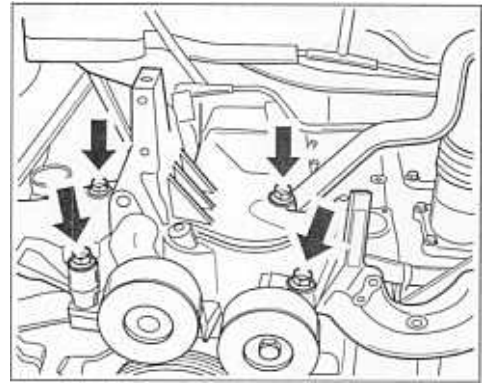
20. Remove coolant flange on the right cylinder head (cylinder 4-6). ►  
Remove the holding clamp on the coolant pipe. Loosen two hexagon-head bolts. Remove holder and coolant flange.



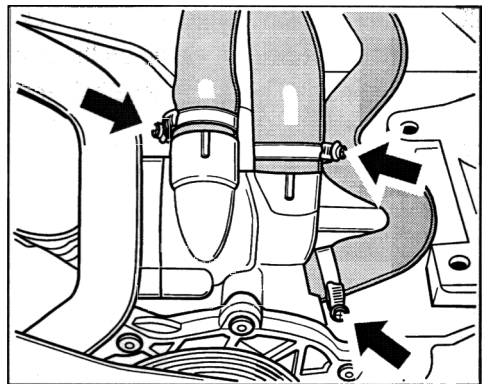
21. Loosen hose clamp **-arrow-** on the coolant hose and pull coolant hose off the bracket. ►



22. Undo generator bracket. Loosen the four fastening screws **-arrows-** and pull the generator bracket to the right and remove.



23. Undo hose clamps on the coolant hoses. To do this, open the hose clamps **-arrow-**.

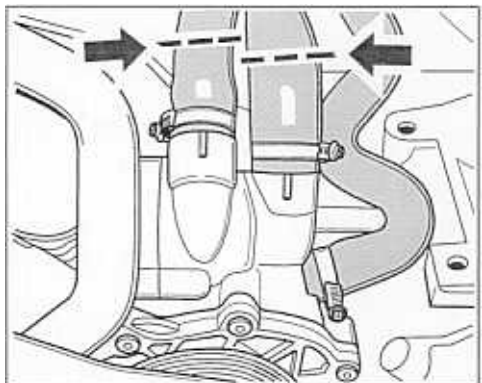


**Warning!**

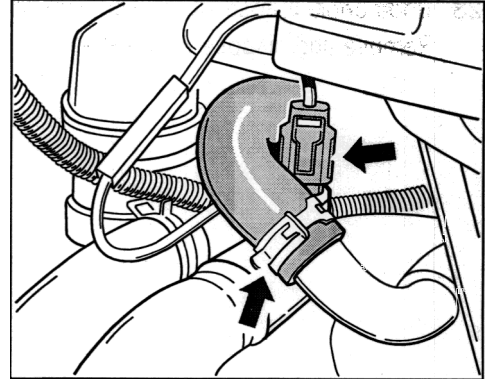
***Danger of injury!***

***Wear protective gloves!***

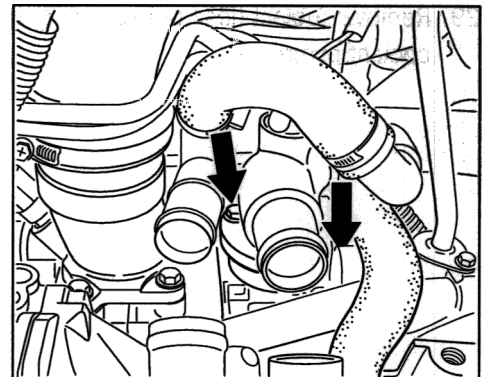
24. e.g. Disconnect coolant hoses with a knife in the positions shown **-arrows-**. Pull off the hose residues.



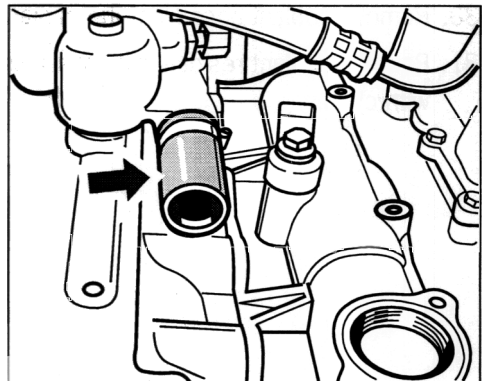
25. Remove coolant flange on the left cylinder head (cylinder 1-3). Pull the electrical plug connection off the temperature sensor and open the spring band clamp. ►



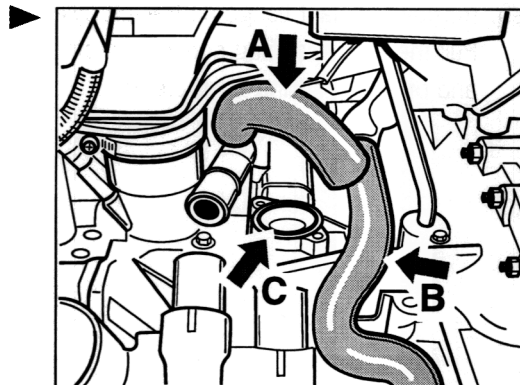
26. Loosen two hexagon-head bolts (M6) and remove flange from link cylinder head. ►



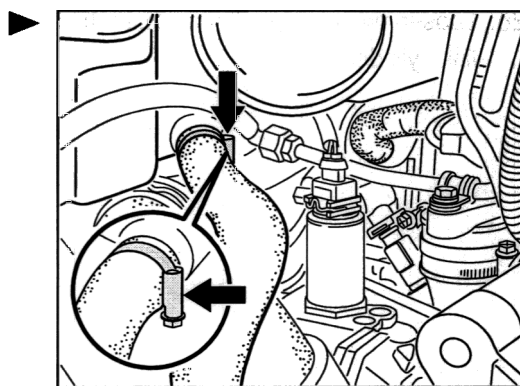
27. Undo coolant hose from the oil cooler bracket and pull off. ►



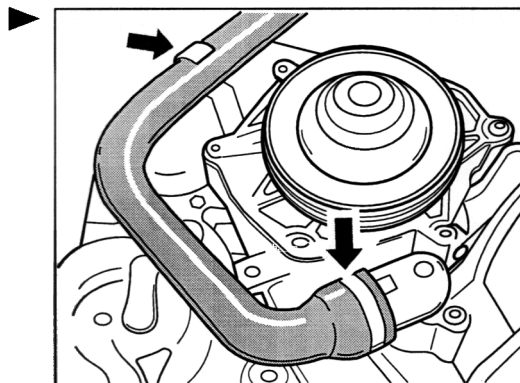
28. Undo coolant hose **-A-** and coolant hose **-B-** and pull off.  
Remove and dispose of seal **-C-**.



29. Remove coolant hose between coolant expansion tank and coolant pump.

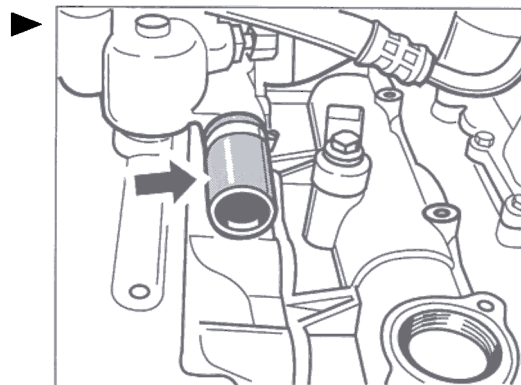


30. Remove coolant hose from the coolant pump.
31. Remove coolant residue from the housing ribbing, e.g. remove with cloth.

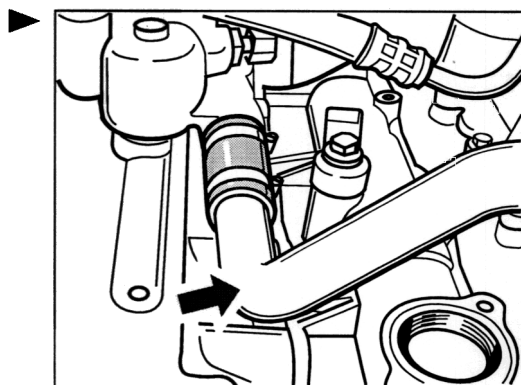


## Installing coolant hoses

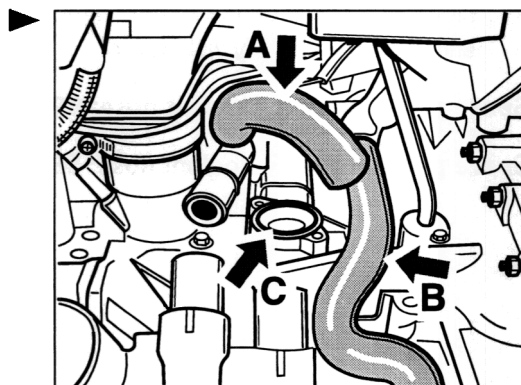
1. Fasten right coolant hose to the oil cooler bracket.



2. Mount the coolant line in the area of the cylinder bank 4-6.

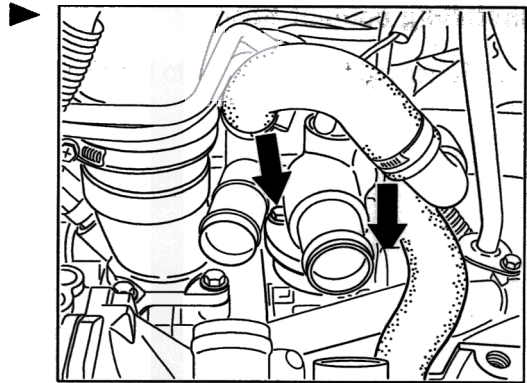


3. Fasten coolant hose **-A-** and coolant hose **-B-** to the cylinder bank between the oil cooler bracket and coolant guide housing. Insert new sealing ring **-C-**.

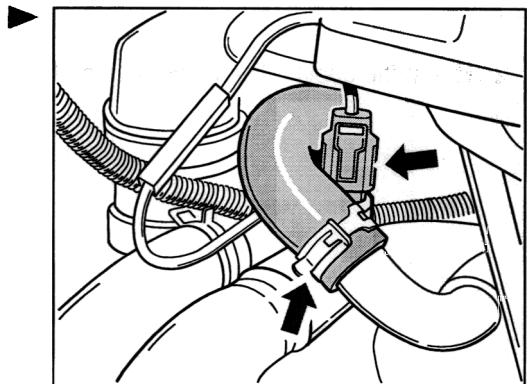




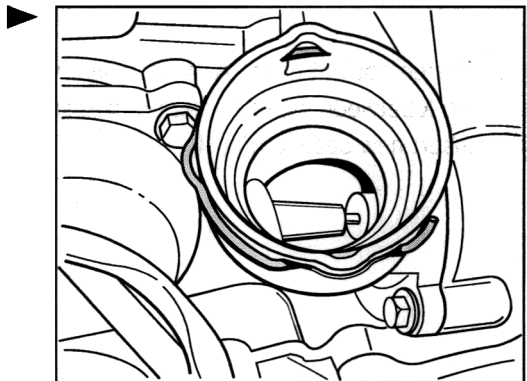
4. Mount the left coolant flange to cylinder bank 1-3.



5. Mount the spring band clamp and electrical connection plug to the coolant temperature sensor.



6. Check whether locking clips are properly seated.  
7. Fit coolant hoses on the left and right. Coat the sealing rings and seal area liberally with water.

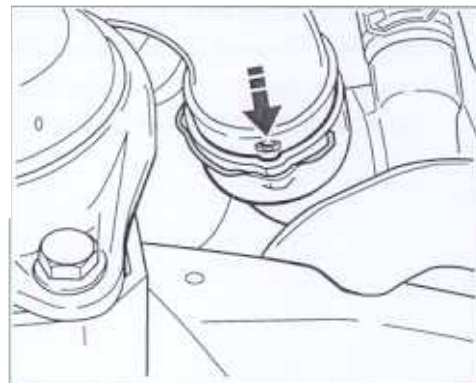


Spare part number L Coolant hose: 99610650274

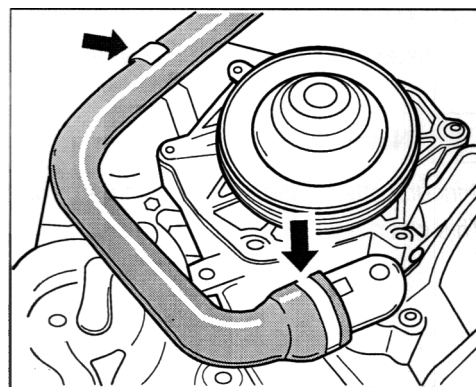
Spare part number R Coolant hose: 99610650174



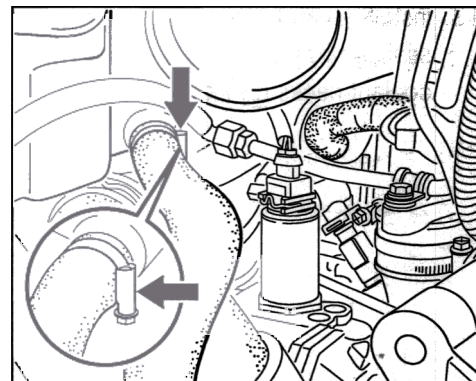
8. Push on coolant hose. To do this, align the flange of the coolant hose as shown (lug/groove). The coolant hose must engage audibly. Then check whether it is fitted properly by tilting it on both sides and by pulling on it.



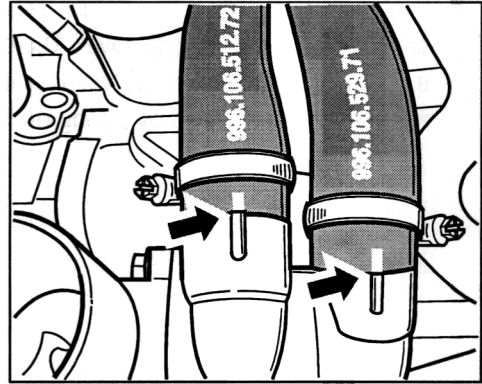
9. Coat the coolant hose with water and fasten to the flange for the coolant hose. Engage coolant hose to the upper holder.



10. Coat the coolant hose with water and fasten to the flange for the coolant expansion tank. Observe the installation position of the hose clamp or spring band clamp.



11. Fit coolant hoses over the coolant pump. Use water for easier mounting. Observe the position of the hoses. The markings for the coolant hose must be aligned with the lugs of the bracket. The part numbers must be legible from the right.

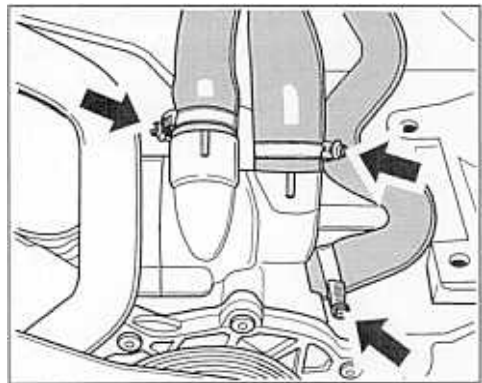


12. Fasten hose clamps. Observe the correct position. Fasten the hose clamps twisted slightly downwards.

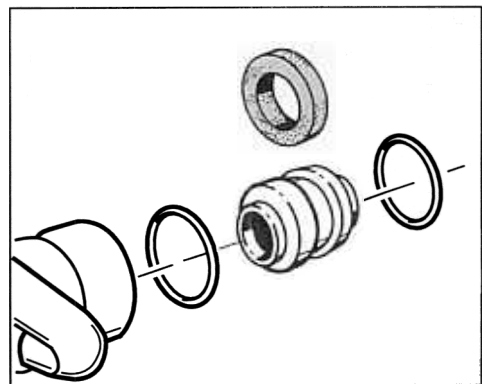


**Note!**

*If incorrectly positioned, the generator bracket can make contact. This could lead to leaks.*



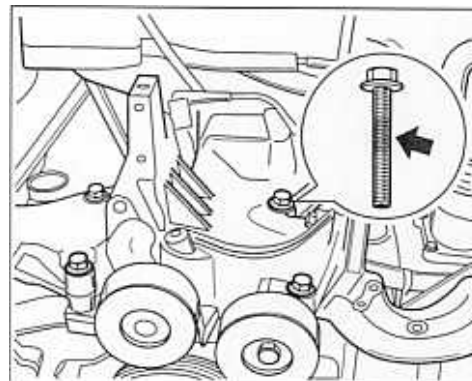
3. Install generator bracket. Equip the connection fitting with new sealing rings (2 ea.) and attach the generator bracket to the coolant necks (cylinder bank 1-3).



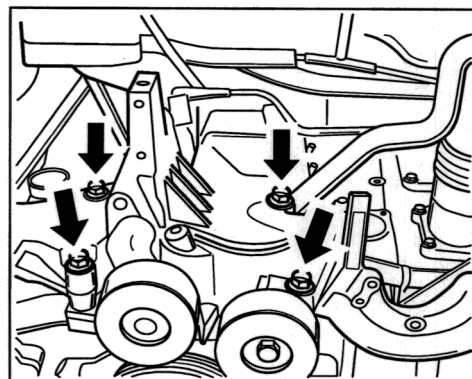
**Note!**

Insert the front right hexagon-head bolt **-inset-** with Loctite 574. ►

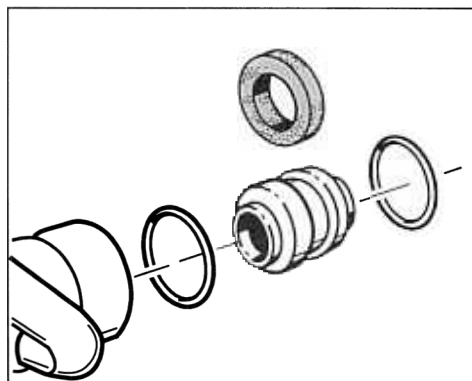
14. Fasten generator bracket.



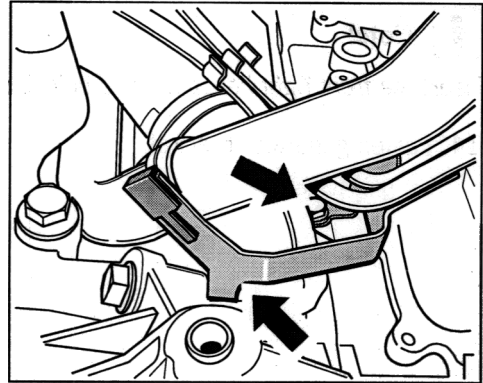
Tightening torque: 65 Nm (34 ftlb.) ►



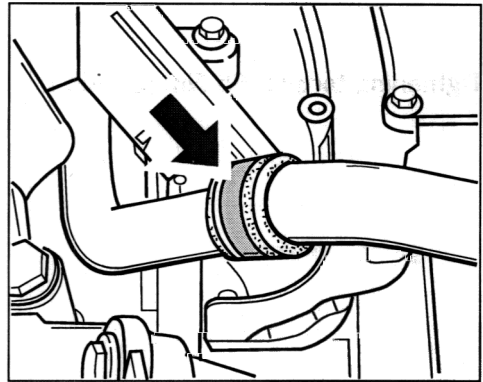
15. Mount right coolant flange to the cylinder bank 4-6. To do this, ►  
equip the connection fitting with new sealing rings (2 ea.) and  
insert new sealing ring to the cylinder head.



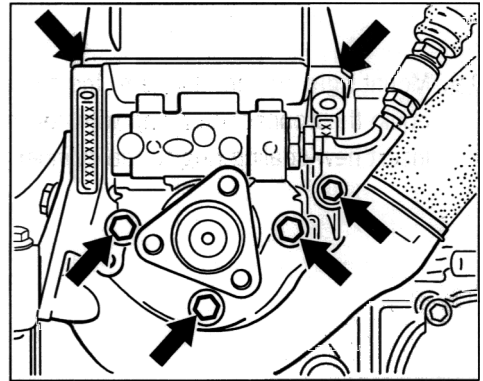
16. Fasten two hexagon-head screws and holder to the coolant flange.



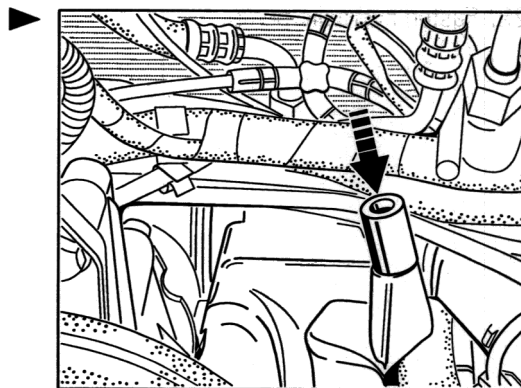
17. Fix the coolant pipe with holding clamp.



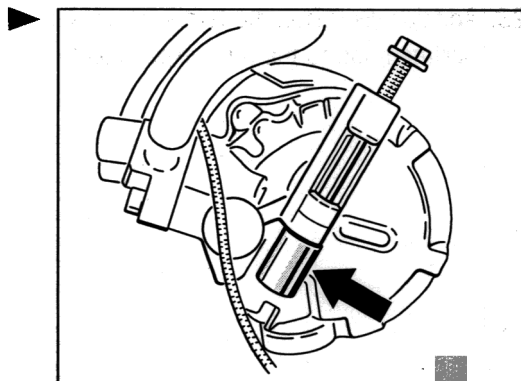
18. Insert hydraulic pump into the bracket but do not fasten yet.



19. Mount air-conditioning compressor, insert spacer sleeve for this purpose or fasten the spacer sleeve to the hexagon-head bolt with grease.

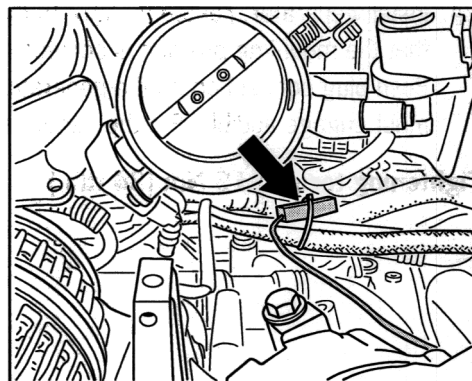


20. Fasten the spacer sleeves with grease.



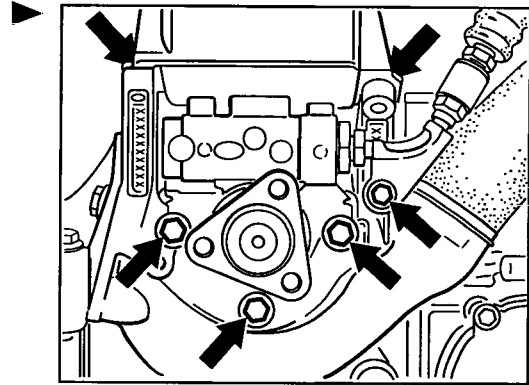
21. Join the electrical connections before the final installation position. Insert the air-conditioning compressor and fasten.

Tightening torque: 23 Nm (34 ftlb.)

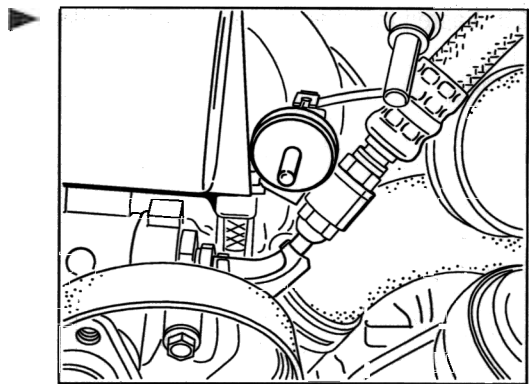




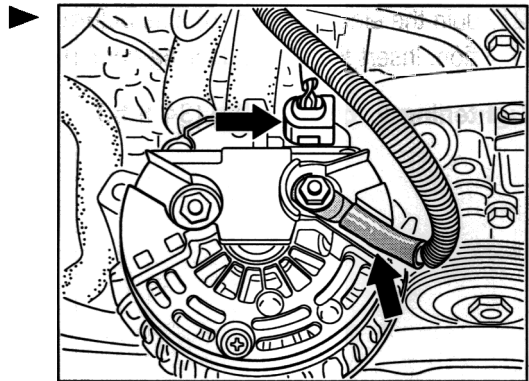
22. Fasten hydraulic pump.



23. Additionally fasten the temperature sensor for the engine compartment fan to the right expansion tank fastening screw.



24. Install generator. Fasten B+ wire to the generator. Make sure that the mounting position is correct in the upper cable guide. Push plug connection on the generator and press in. The plug must engage audibly. Put the generator into the bracket.

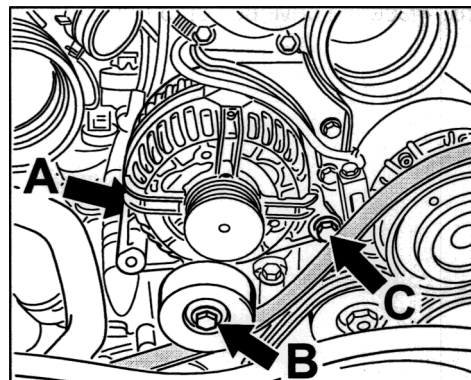


**Tightening torque: 15 Nm (34 ftlb.)**



25. Position the right fastening screw **-C-**. Position the left generator fastening screw **-A-** in the direction of travel. Install deflection roller **-B-** under the generator and tighten. Tighten the right and left tightening screw of the generator.

**Tightening torque for all three screws: 46 Nm (34 ftlb.)**

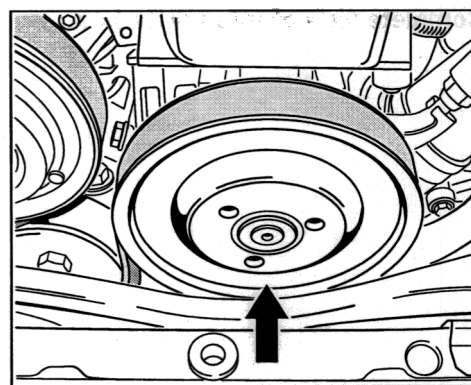


26. Mount the belt pulley of the hydraulic pump with the fitted drive belt of the hydraulic pump. Screw in three hexagon-head bolts by hand.

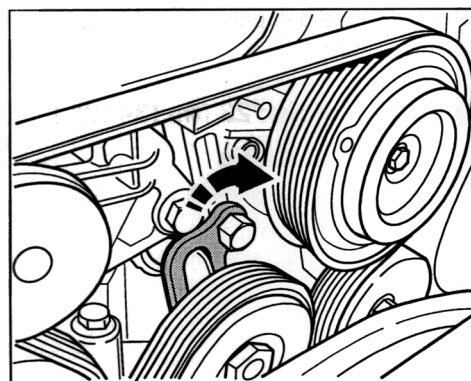


**Note!**

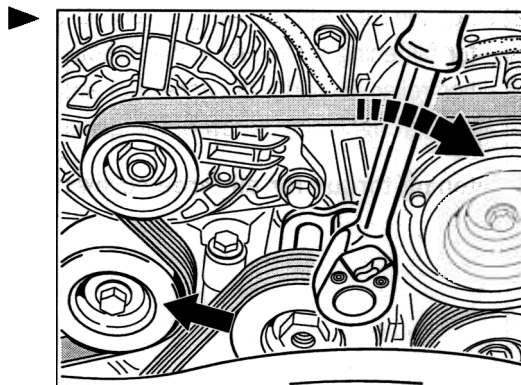
*The hexagon-head screws can be fastened after tensioning the drive belt.*



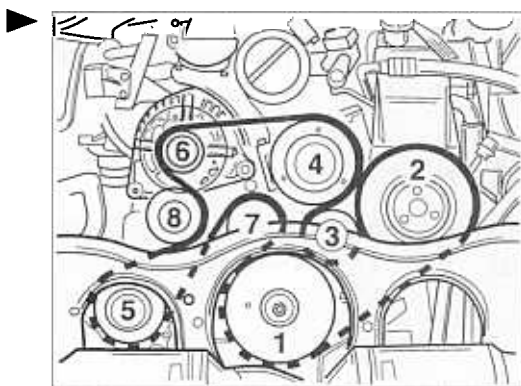
27. Fit drive belt. To do this, turn the tensioning lever of the tensioning roller clockwise and hold. At the same time, place the drive belt onto the drive wheels of the air-conditioning compressor, the idler pulley and the generator. Now slowly release the tensioning lever.



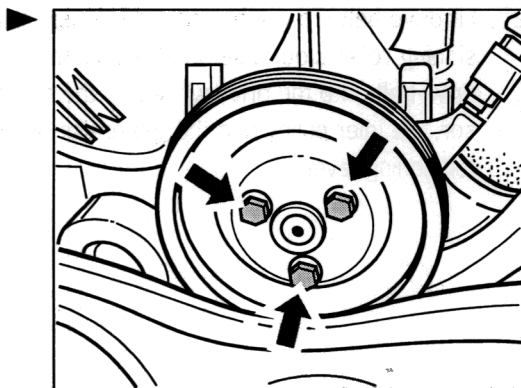
28. Place the drive belt onto the idler pulley.



Complete view of fitted drive belt.



29. Fasten the belt pulley of the hydraulic pump after tensioning the drive belt



Tightening torque: 23 Nm (34 ftlb.)

**Note!**

Check that the installation position of the drive belt on all drive wheels is correct. Raise vehicle and check the drive wheels underneath. Always use a light source to do this (e.g. mini electric torch).

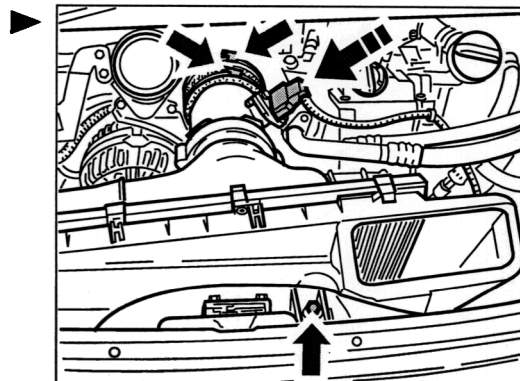
30. Fit air cleaner assembly.

31. Bleed the cooling system.

⇒ Rep. Gr. 19 38 17; Draining and filling in coolant (includes: bleeding the cooling system).

32. Enter radio code.

33. Perform a test drive.

**Tightening torques**

Location	Thread	Tightening torque Nm (ftlb.)
Generator bracket		65
Air-conditioning compressor		23
B+ wire on generator		15
Generator fastening screws		46
Deflection roller fastening screw		46
Hydraulic pump belt pulley		23