

Technical Manual

*911 Carrera* (996)

Technical Information

Repair

Contents:

Group 1

Engine

Part 1 (up to Repair Group 13)

## Foreword

This manual contains Technical Information as well as instructions on repairs for Porsche vehicles. It is intended for the sole use of workshops belonging to Porsche AG.

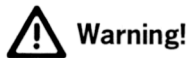
The descriptions form the basis for professional and correct maintenance and repair work. The content of the work procedures described is based on the level of training of a fitter who has completed vocational training and has a sound knowledge of the product. This level of knowledge is necessary in order to carry out the work described.

### Warning notes

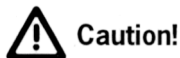
The warning notes and safety instructions are classified by the respective signalling word (Danger, Warning, Caution) beside the warning symbol.



***Warns against death or very serious injury which will certainly occur if the instructions are not observed.***



***Warns against death or very serious injury which may occur if the instructions are not observed.***



***Warns against minor injury or damage to property if the instructions are not observed.***

To prevent injury and restricted operating and traffic safety of the vehicle, or damage to the vehicle as the result of incorrect work, read these instructions carefully and observe them without fail.

It is not possible for Porsche AG to give a detailed evaluation of all danger situations for the persons carrying out the work. It is therefore imperative that all persons carrying out repair and maintenance work on Porsche vehicles use their specialist knowledge to ensure that their own safety is not at risk and the procedure chosen will not have any negative effects on the vehicle - especially with regard to safety.

It is therefore expressly specified that all work involved in the work procedures described should be carried out only in accordance with the valid guidelines and regulations of the local authorities responsible with respect to health and accident prevention and environmen-



tal protection, and in compliance with the legal requirements of individual countries.

## Notes

Notes contain advisory information related to the work procedure which makes the fitter's work easier. The following pictogram indicates this information:



### **Note!**

*Contains advisory information which makes the work procedure easier.*

Due to the continuous development and improvement of our vehicles, there may be discrepancies between the actual technical status of the vehicles and the work descriptions. Any existing deviations are corrected by means of supplements, and the scope of the descriptions is extended with supplements.

Porsche AG retains the right to implement changes at any time and without prior notice.

## Table of Contents

### 1 Foreword

Foreword

Foreword

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### Supplement Overview

| Supple-<br>ment | Edition | Topic         | Article number |
|-----------------|---------|---------------|----------------|
|                 | 05/1997 | Basic edition |                |
| 0               | 05/2000 |               | WKD483721      |
| 44              | 11/2000 | Foreword      | WKD483721.44   |

## Use

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, 1 Engine, part 1 (up to Repair Group 45)
- ◆ 0 Diagnosis, 1 Engine, part 2 (up to Repair Group 69)
- ◆ 1 Engine, part 1 (up to Repair Group 13)
- ◆ 1 Engine, part 2 (as of Repair Group 15)
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- ◆ 7 Body equipment, interior
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- ◆ 9 Circuit diagrams, part 1 (up to and including '99 model)
- ◆ 9 Circuit diagrams, part 2 (as of and including '00 model)

The two folders with Group 0 are to be regarded as one folder; i.e. file the "Technical Information" notices only in the folder "Group 0 Diagnosis, part 1" **-up to Repair Group 45-**.

The second folder Group 0 Diagnosis, part 2 **-as of Repair Group 69-** includes the further Repair Groups belonging to Group 0.

The two folders with Group 1 are to be regarded as one folder; i.e. file the "Technical Information" only in front of the repair descriptions in the folder Group 1 – Engine, part 1 **-up to Repair Group 13-**.

The second folder Group 1 Diagnosis, part 2 **-as of Repair Group 15-** includes the further Repair Groups belonging to Group 0.

The two folders with Group 9 are to be regarded as one folder; i.e. file the "Technical Information" notices only in the folder Group 9 Circuit diagrams, part 1 **-up to '99 model-**.

The second folder Group 9 Circuit diagrams, part 2 **-as of '00 model-** includes the further Repair Groups belonging to Group 9.

The "Boxster (986)" Technical Manual has the same structure in each folder, with the following breakdown for all Groups:

## Title page: "Boxster (986)" 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 (996)" Technical Manual and are updated or revised and thereby exchanged by a supplement are designated in the footer with the supplement number corresponding to the current version: e.g. "Printed in Germany - 2,- 2000"*



### Note!

*Due to a system modification in the Technical Literature production, the following procedures have changed in model year 2000!*

- 1 - The previous record sheet in the folder "O-General" and the supplement contents sheet -red sheet- have been omitted. A supplement overview now appears separately in each folder. The new supplement contents sheet can be destroyed after the supplement is filed in the folder.



**Note!**

*The supplement overview sheet is replaced with the relevant supplement in the corresponding folder and must no longer be maintained by hand.*

- 2 - The page numbering in the new and the replaced chapters are no longer continuous. Each new chapter is now given an additional chapter number followed by the page number e.g.-2 Page 11 ⇒ Rep. Gr. 0; General
- 3 - The old page numbering still applies to existing chapters and those that are not replaced.

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# **1 Engine, part 1 (up to Repair Group 13)**

## **1 Engine**

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## 1 Tightening torques for engine M96/01

### Crankshaft, bearing housing, crankcase

| Location                                    | Thread              | Tightening torque<br>Nm (ftlb.) |
|---|---------------------|---------------------------------|
| Screws, bearing housing                     | M9 x 129            |                                 |
| Initial tightening:                         |                     | 25 (19)                         |
| Final tightening:                           |                     | 1 x 90° turn                    |
| Connecting-rod screws                       | M9 x 1.25           |                                 |
| Initial tightening:                         |                     | 20 (15)                         |
| Final tightening:                           |                     | 1 x 90° turn                    |
| Oil guide on bearing housing                | M6 (micro-encaps.)  | 10 (7.5)                        |
| Screws for joining crankcase halves         | M6                  | 13 (10.0)                       |
| Additional bolts, crankcase/bearing housing | M9 x 160<br>M9 x 95 | 22 (16)<br>22 (16)              |
| Oil suction pipe to crankcase               | M6                  | 10 (7.5)                        |
| Air/oil separator to crankcase              | M6                  | 10 (7.5)                        |
| Oil pan to crankcase                        | M6                  | 10 (7.5)                        |
| Oil drain plug to oil pan                   | M18 x 1.5           | 50 (37)                         |
| Oil filter to crankcase                     | S80 x 3             | 25 ± 1 (19 ± 1)                 |
| Coolant guide housing to crankcase          | M10                 | 45 (33)                         |
| Coolant drain plug                          | M10 x 1             | 10 + 5 (7.5 + 3.5)              |
| Screw plug for oil relief valve             | M20 x 1.5           | 25 (19)                         |

| Location   | Thread                              | Tightening torque<br>Nm (ftlb.) |
|--|-------------------------------------|---------------------------------|
| Intermediate shaft flange<br>to crankcase  | M6 (micro-encaps.                   | 10 (7.5)                        |
| Lock nut on intermediate<br>shaft flange   | M8 x 1<br>special tool 9110 is used | 13 (10.0) or 11 (8.0) if        |
| Screw plug for piston pin<br>assembly bore on cylinder<br>bank 4 - 6                 | M27 x 2                             | 80 (59)                         |
| Engine carrier to engine   | M10                                 | 46 (34)                         |
| Bolt for guide rail  | M6                                  | 10 (7.5)                        |
| Pulley to<br>crankshaft<br>Initial tightening:<br>Final tightening:                  | M16 x 15                            | 50 (37)<br>1 x 90° turn         |
| Double-mass flywheel to<br>crankshaft<br>Initial tightening:<br>Final tightening:    | M10 x 1 x 50 (12.9)                 | 25 (19)<br>1 x 90° turn         |
| Thrust plate to double-mass<br>flywheel  | M8                                  | 23 (17)                         |
| Drive plate on crankshaft<br>(Tiptronic)<br>Initial tightening:<br>Final tightening: | M10 x 1 x 25 (12.9)                 | 25 (19)<br>1 x 90° turn         |
| Water pump to<br>crankcase   | M6                                  | 10 (7.5)                        |
| Chain tensioner to<br>crankcase  | M27 x 2                             | 80 (59)                         |
| Belt tensioner roller on<br>lever for tensioning element                             | M10                                 | 60 (44)                         |

| Location  | Thread                              | Tightening torque<br>Nm (ftlb.) |
|---|-------------------------------------|---------------------------------|
| Belt deflection roller 1<br>to crankcase                  | M10 x 145 (10.9)<br>M10 x 145 (8.8) | 65 (48)<br>46 (34)              |
| Belt deflection roller 2<br>to bracket for hydraulic pump | M8 x 55                             | 23 (17)                         |
| Belt pulley to generator                                  | M16 x 1.5                           | 65 ± 5 (48 ± 3.5)               |
| Belt pulley to hydraulic pump                             | M8 x 12                             | 23 (17)                         |

## Cylinder head

| Location   | Thread                                 | Tightening torque<br>Nm (ftlb.)                                 |
|--|--|---|
| Cylinder head to crankcase                             | M10 x 230                              |   |
| <b>Initial tightening or<br/>tightening to flatten</b> |  |   |
| 1st step   |  | 30 (22)   |
| 2nd step   | Cylinder head screws completely undone |   |
| <b>Final tightening</b>                                |  |   |
| 1st step   |  | 20 (15)   |
| 2nd step   |  | 60° turn  |
| 3rd step   |  | 60° turn  |
| Flat-base tappet housing<br>to cylinder head           | M6                                     | 10 (7.5)  |
| Camshaft bearing saddles<br>to cylinder head           | M6                                     | 10 (7.5)  |
| Cylinder-head cover<br>to cylinder head                | M6                                     | 13 (10.0)   |
| Spark plugs  | M14 x 1.25                             | 30 (22) + 3 (2.0) first fitting<br>25 (19) + 5 (3.5) re-fitting |
| Camshaft drive pinion and<br>drive plate to camshaft   | M6 x 15 (10.9)                         | 14 (10.5)   |
| Chain tensioner to cylinder head                       | M27 x 2                                | 80 (59)   |
| Intake pipe to cylinder head                           | M6 (micro-encaps.)                     | 9.7 (7.0)   |
| Plug, oil-pressure duct<br>to cylinder head            | M10 x 1                                | 10 (7.5)  |
| Oil return pump<br>to cylinder head                    | M6                                     | 10 (7.5)  |

**Accessories  
sensors, sending units, switches and ancillaries**

| Location   | Thread             | Tightening torque<br>Nm (ftlb.) |
|--|--------------------|---------------------------------|
| Oil-level sender to<br>crankcase                   | M14 x 1.25         | max. 20 (15)                    |
| Oxygen sensor to<br>catalytic converter            | M18                | 55 ± 5 (41 ± 3.5)               |
| Knock sensor                                       | M8                 | 20 ± 2 (15 ± 1.5)               |
| Hall sender  | M6 (micro-encaps.) | 10 ± 0.5 (7.5 ± 0.5)            |
| Speed sender                                       | M6 (micro-encaps.) | 10 ± 0.5 (7.5 ± 0.5)            |
| NTC<br>coolant temperature                         | M14 x 1.5          | 25 ± 5 (19 ± 3.5)               |
| Oil-pressure switch                                | M14 x 1.5          | 25 ± 5 (19 ± 3.5)               |
| Starter  | M10                | 45 (33)                         |
| Generator  | M10                | 45 (33)                         |
| Ignition coil to cylinder<br>head cover            | M6                 | 10 (7.5)                        |
| Power steering pump (hydraulic<br>pump) to bracket | M8                 | 23 (17)                         |
| Pressure pipe to power<br>steering pump            | M16                | 24 (18)                         |
| Oil reservoir to<br>power steering pump            | M8                 | 23 (17)                         |
| Check valve for<br>auxiliary air pump              | M22 x 1.5          | 32 (24)                         |
| Coolant pump to<br>crankcase                       | M6                 | 10 (7.5)                        |



# **1 3.4 engine performance kit / X51 (not for USA vehicles)**

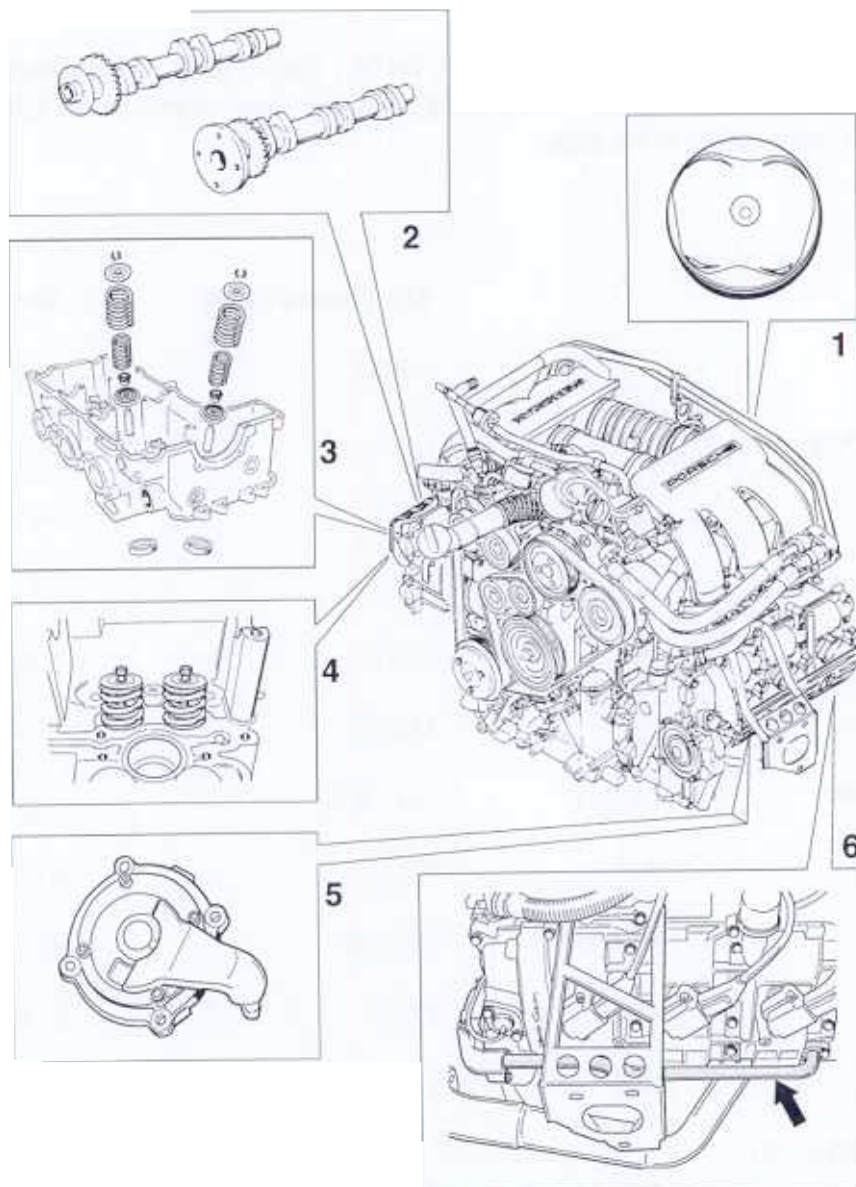
## **Foreword**

The following chapter describes a performance kit for the 911 Carrera (996). A characteristic of the new engine is its continuous power development, particularly at higher engine speeds above 5,000 rpm. The only changes are modifications to the engine.

## **Technical data**

| <b>Engine</b>                             |                 | <b>911 Carrera (996)</b> | <b>X51</b>  |
|---|-----------------|--------------------------|-------------|
| Engine type                               |                 | M96/01                   | M 96/01 S   |
| Number of cylinders                       |                 | 6                        | 6           |
| Bore                                      | mm              | 96                       | 96          |
| Stroke                                    | mm              | 78                       | 78          |
| Displacement                              | cm <sup>3</sup> | 3,387                    | 3,387       |
| Compression ratio                         |                 | 11.3                     | 11.3 1      |
| Max. engine power                         | kW (HP)         | 221 (300)                | 235 (320)   |
| at engine speed                           | rpm             | 6,800                    | 6,600       |
| Max. torque                               | Nm (ftlb.)      | 350 (259)                | 360 (266)   |
| at engine speed                           | rpm             | 4,600                    | 5,000       |
| Max. litre output                         | kW (HP/l)       | 63.8 (86.8)              | 66.4 (94.5) |
| Engine speed limitation by fuel cutoff at | rpm             | 7,300                    | 7,400       |
| Idle speed                                | rpm             | 700                      | 800         |
| Top speed                                 | km/h            | 280                      | 287         |

## Differences



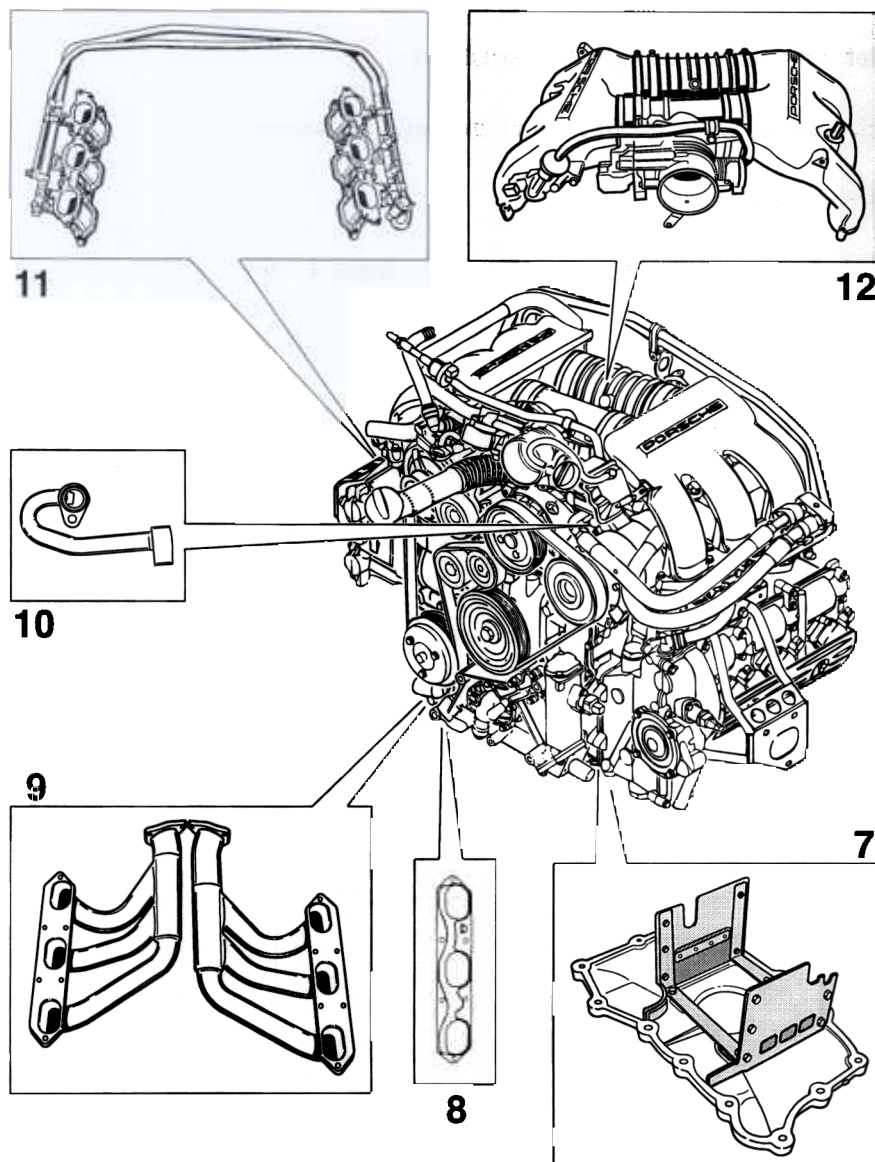
22\_99



## Differences

- Item 1      Pistons
- Item 2      Inlet camshafts and exhaust camshafts
- Item 3      Valve discs, valve springs, valve guides, valve seats
- Item 4      Valves, valve caps
- Item 5      Dual-chamber suction pump at cylinder bank 4 - 6
- Item 6      Oil suction pipe

## Differences



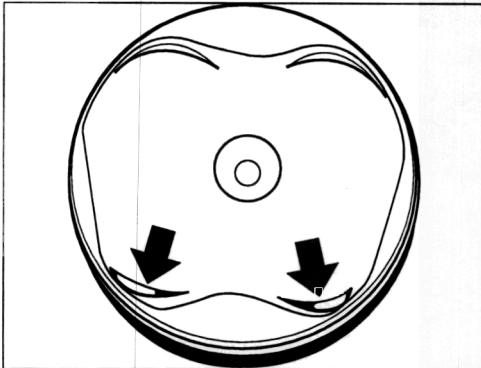
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## Differences

- Item 7 Oil pan with partition box
- Item 8 Gasket for exhaust manifolds
- Item 9 Exhaust manifolds
- Item 10 Suction line on A/C compressor
- Item 11 Intake pipes
- Item 12 Intake distributors

## Differences

### Item 1

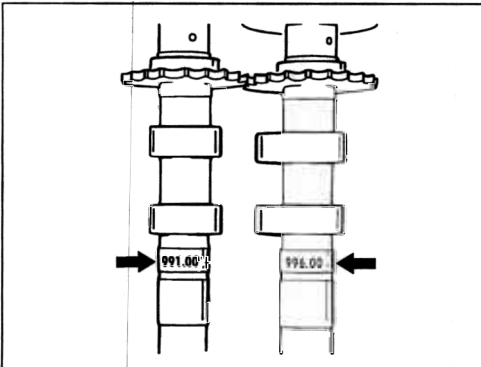


603\_98

### Pistons

The valve recesses were mechanically adjusted to provide clearance for the exhaust valves. (Arrows.)

### further to Item 2



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### Camshafts

The inlet camshafts and exhaust camshafts possess a greater cam stroke.

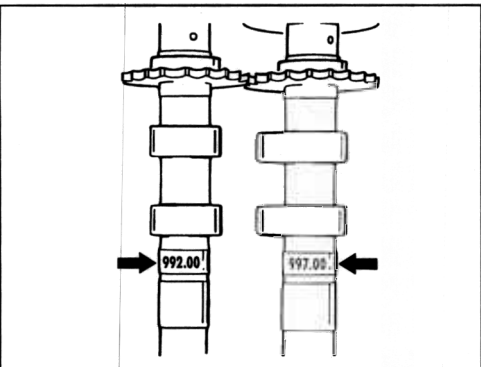
#### Camshafts of cylinder bank 1 - 3

Identification on the camshaft

Inlet camshaft: 991.00 3,4 L/KIT IN 1-3

Exhaust camshaft: 996.00 3,4 L/KIT IN 1-3

### further to Item 2



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#### Camshafts of cylinder bank 4 - 6

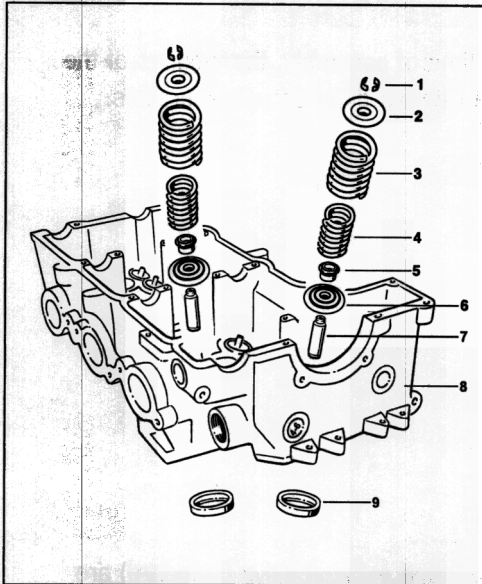
Identification on the camshaft

Inlet camshaft: 992.00 3,4 L/KIT IN 4-6

Exhaust camshaft: 997.00 3,4 L/KIT IN 4-6

## Differences

### Item 3



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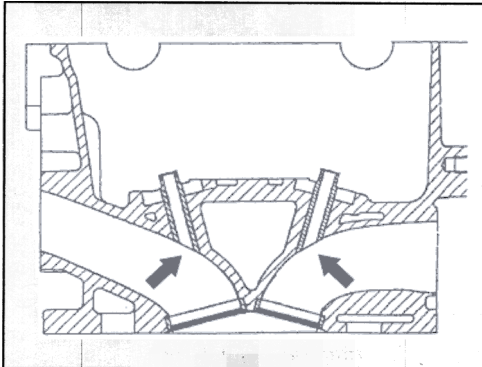
### Valve discs, valve springs

The following parts distinguish the higher-performance engine from the standard engine in the area of the cylinder head:

1. Valve keys (standard part)
2. Valve disc at top
3. Valve spring on outside
4. Valve spring on inside
5. Valve seal (standard part)
6. Valve disc at bottom
7. Valve guides
8. Cylinder head
9. Valve seats

The valve seats are additionally provided with a seat surface of 60°.

### further to Item 3

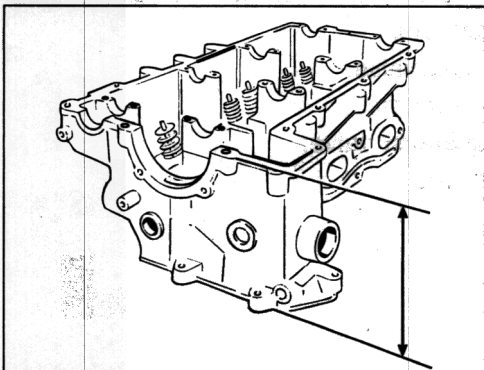


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### Valve guides

The valve guides were shortened in the area of the inlet and outlet ducts.

### further to Item 3



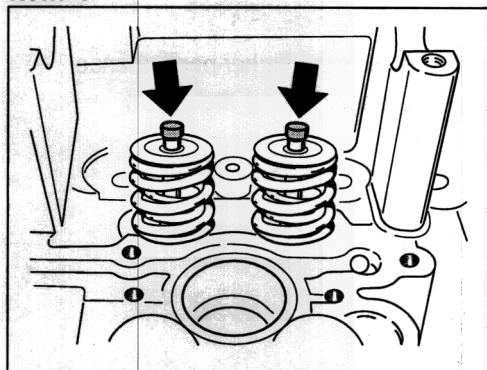
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### Cylinder head

The cylinder heads already have a reduced height. Subsequent machining of the sealing surface is therefore **not permissible**.

## Differences

### Item 4

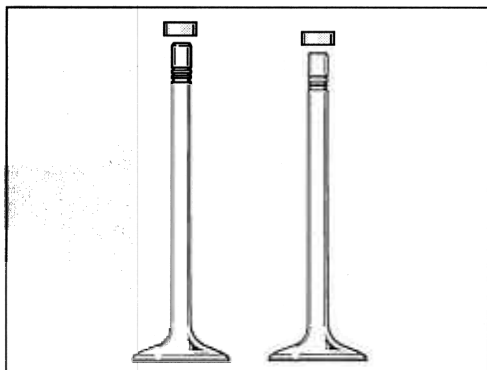


590\_98

### Valves

Depending on the time of assembly, the engines of the X51 are equipped with two different valve versions.

### further to Item 4



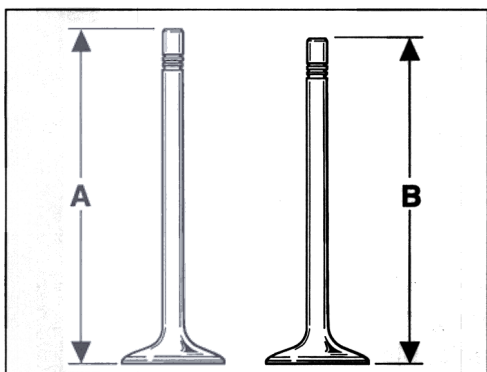
17\_99

### Valves

#### Version 1:

Inlet valve (standard) and exhaust valve (standard) are additionally equipped with valve caps.

### further to Item 4



18\_99

### Valves

#### Version 2: (Introduced in December '98)

Inlet and exhaust valves lengthened by 1.5 mm. Valve caps were omitted after introduction of the valves (version 2). The valve caps will remain in stock as replacement parts for the shorter standard valves of the 911 Carrera (996).

#### Identification of inlet valve:

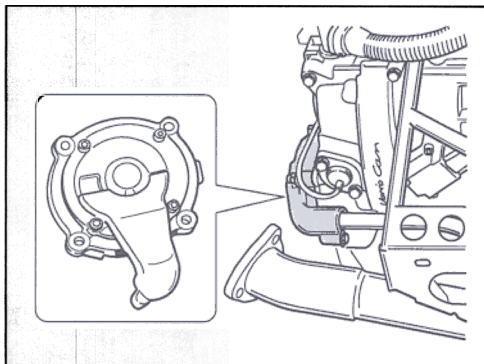
Yellow dot on the valve disc

#### Identification of exhaust valve:

Black dot on valve disc

## Differences

### Item 5



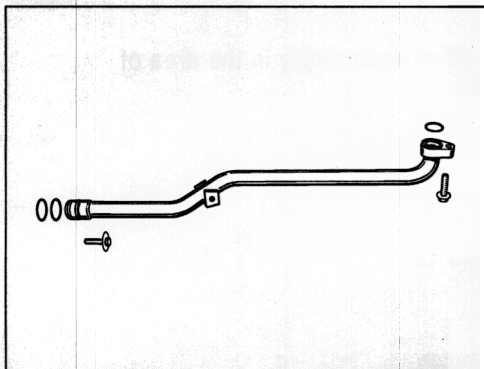
592\_98

### Dual-chamber suction pump

A dual-chamber suction pump, which is sealed with two sealing rings, is fitted on the cylinder head of cylinder bank 4 - 6.

The M6 x 30 fastening screws (4 ea.) are fitted with Loctite 242 or 243.

### Item 6



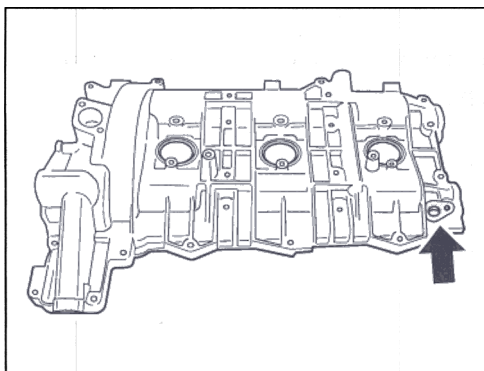
597\_98

### Oil suction pipe

The oil suction pipe is fitted between the dual-chamber suction pump and the cylinder head cover.

The rear M6 x 40 fastening screw is fitted with Loctite 242 or 243.

### further to Item 6



595\_98

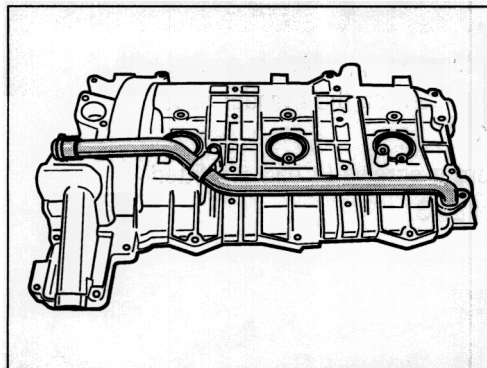
### Oil suction pipe

A take-up bore for the oil suction pipe was added on the cylinder head cover of cylinder bank 4 - 6.



## Differences

further to Item 6

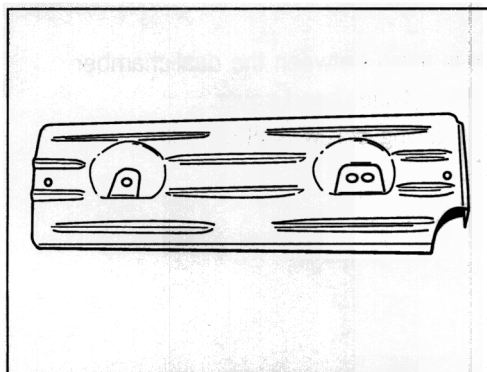


596\_98

### Oil suction pipe

Oil suction pipe on cylinder head.

Item 6

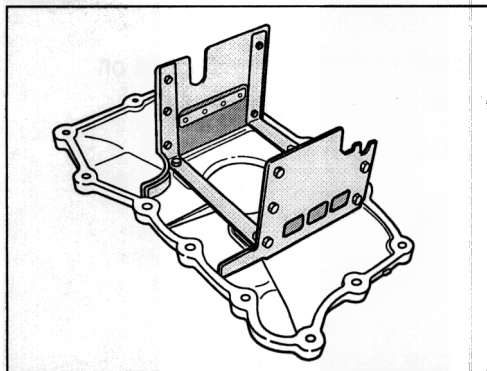


604\_98

### Shield

The shield was modified accordingly in the area of the oil suction pipe.

Item 7



601\_98

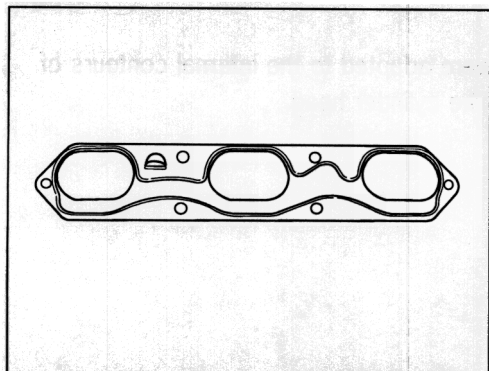
### Oil pan with partition box

The partition box was redesigned and consists of metal (aluminium sheetmetal). The standard parts consist of plastic.



## Differences

### Item 8

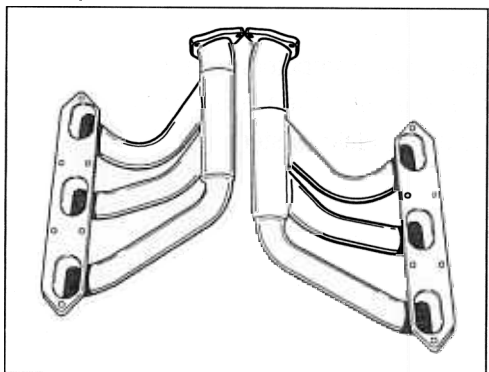


594\_98

### Gasket for exhaust manifolds

The gaskets were adapted to the larger exhaust ducts.

### Item 9



600\_98

### Exhaust manifolds

The exhaust manifolds were also adapted to the larger exhaust ducts.

### Item 10



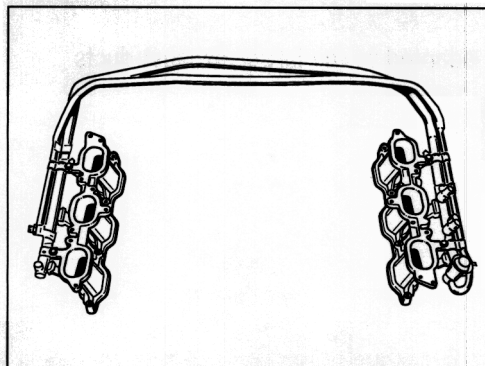
30\_99

### Suction line on the A/C compressor

The suction line was modified for space reasons.

## Differences

### Item 11

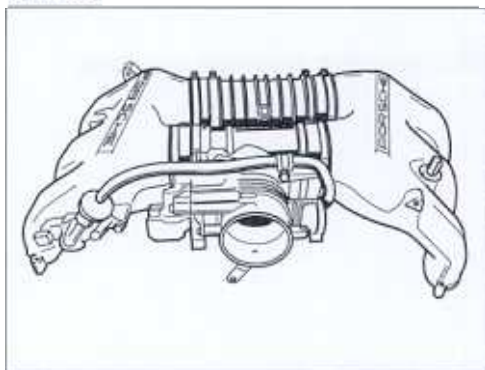


598\_98

### Intake pipes

The intake pipes were adapted to the internal contours of the inlet ducts on the cylinder head.

### Item 12



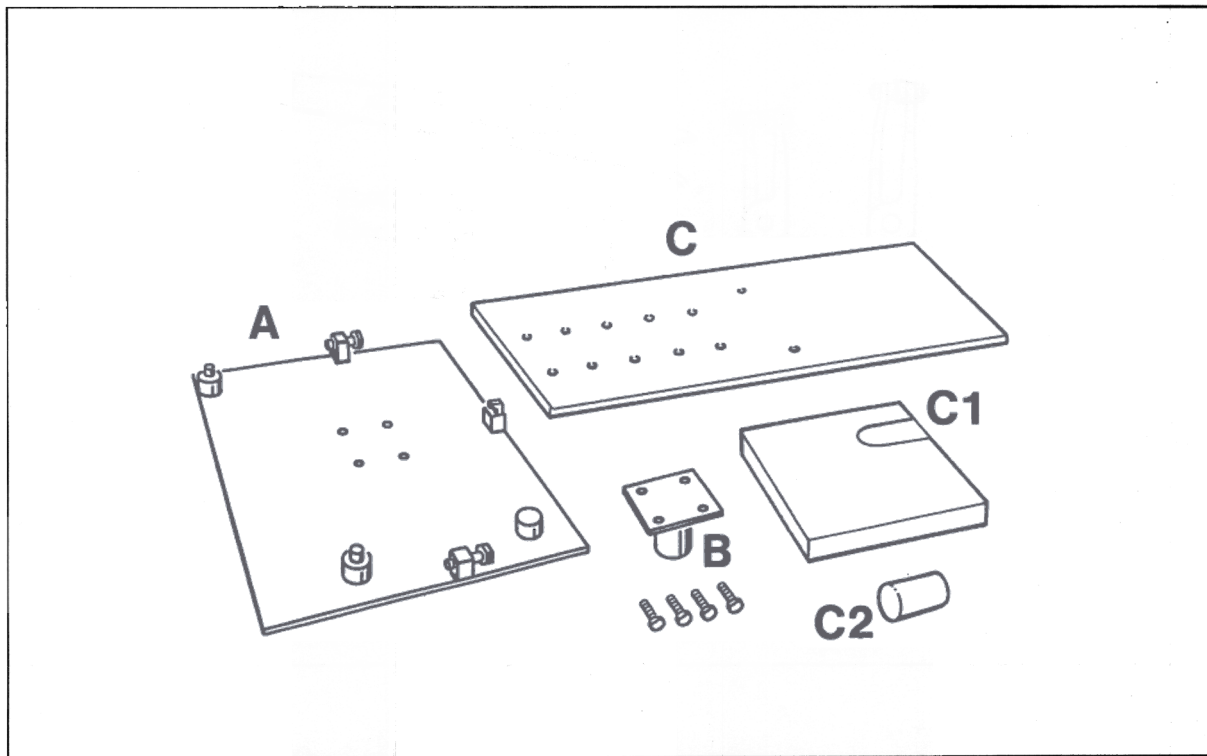
599\_98

### Intake distributors

The right and the left intake distributors have been modified and are now castings. The figure shows the completely assembled intake system.

## 10 01 19 Removing and installing engine (vehicle with Tiptronic transmission)

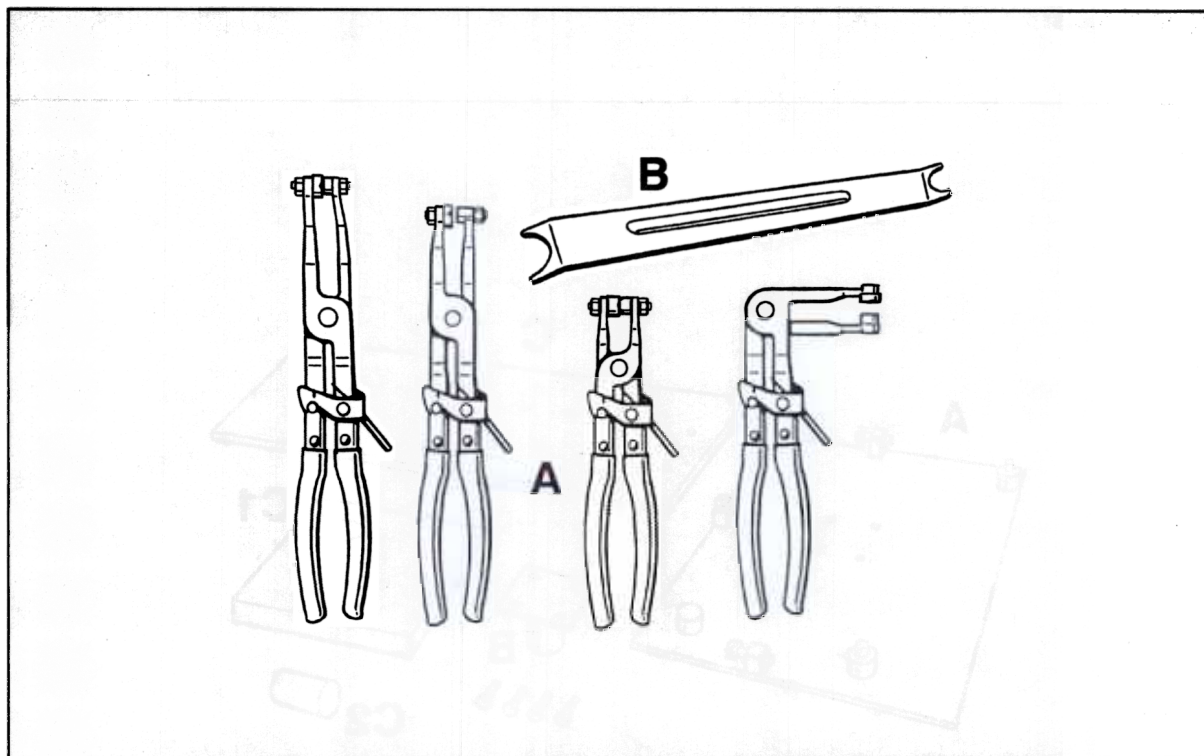
### Special tools



300 - 97

| Item | Designation                        | Special tool | Explanation  |
|------|------------------------------------|--------------|--|
| A    | Retainer plate                     | 9592         | In conjunction with workshop jack  |
| B    | Adapter                            | 9163/2       | or use adapter of transmission holding plate, special tool 9163, for the 928 model |
| C    | Support plate                      | 9592/1       |  |
| C1   | Support for Tiptronic transmission |              | Included in 9592/1 scope of delivery   |
| C2   | Support for manual transmission    |              | Included in 9592/1 scope of delivery   |

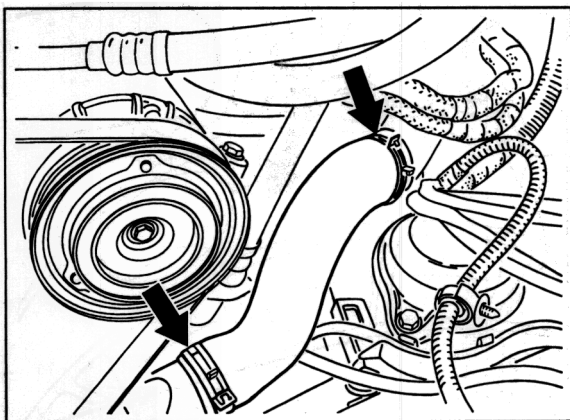
# Special tools



209/1 - 97

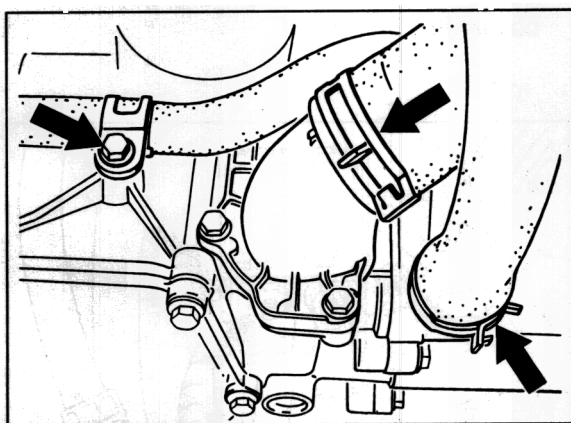
| Item | Designation                        | Special tool | Explanation  |
|------|------------------------------------|--------------|--|
| A    | Spring-band clamp pliers           |              | E.g. Messrs. Muhr u. Bender, see Workshop Equipment Manual   |
| B    | Testing tool for plug-in couplings | 9623         | Used to check whether the plug-in couplings are seated properly. Suitable for pressure and return lines (nominal diameter 6 and nominal diameter 10) |

11. Detach and remove right-hand coolant hose.



202 - 97

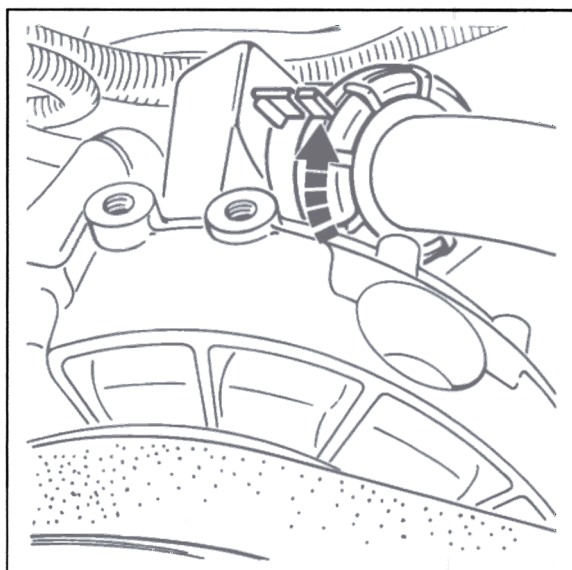
12. Detach and remove left-hand coolant hose.



281 - 97

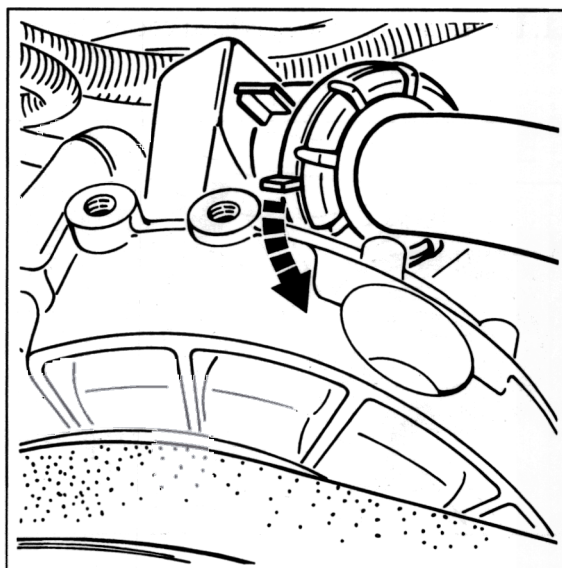
13. In vehicles with air conditioning, the following assembly operations must be performed:

- a: Suck Pentosin fluid out of the reservoir until the level is just below the joint. 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  $\varnothing$ ).



Bayonet lock closed

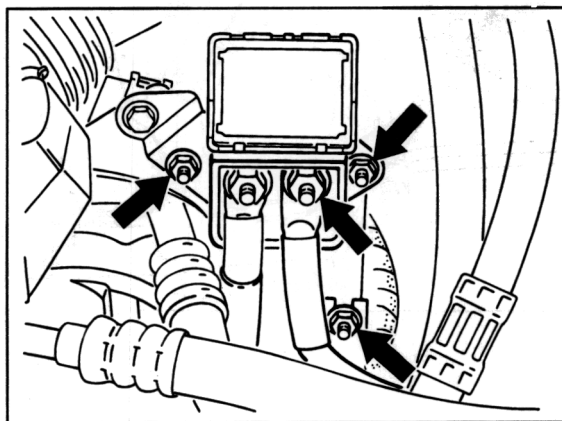
265 - 97



Bayonet lock open

264 - 97

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



205 - 97

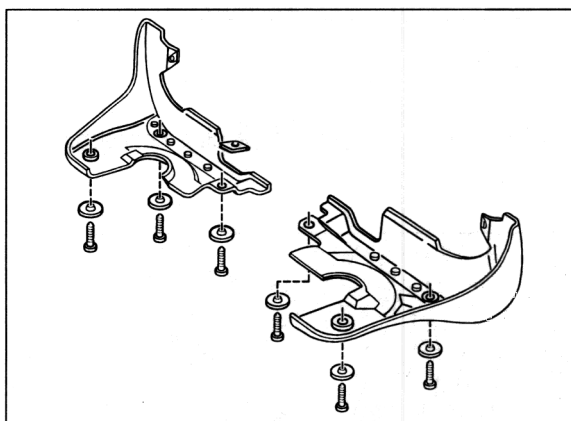


## Removing and installing engine

The entire engine-transmission unit is removed in downward direction.

### Removal

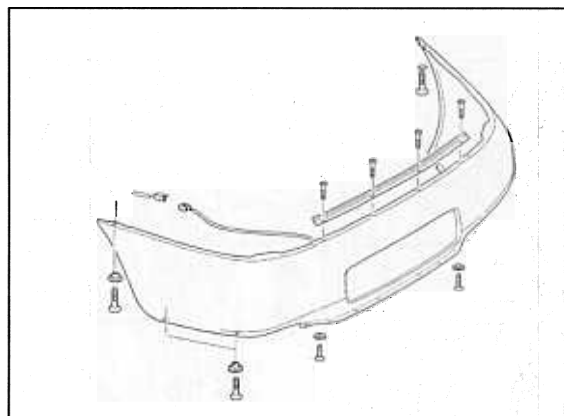
1. Put body-protection covers on vehicle.
2. Disconnect the battery and cover terminal or battery.
3. Before the vehicle is raised, the side covers of the underside panel must be removed in the rear area of the jacking points.



278\_97

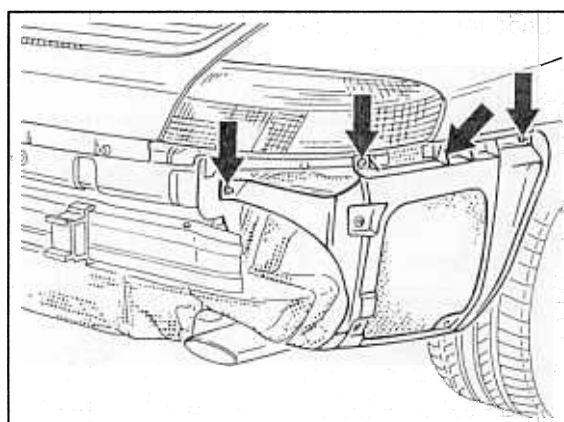
4. Raise vehicle at the prescribed jacking points and remove the rear wheels. Remove the centre and rear underside panels.

5. Remove rear spoiler.



363\_97

6. Remove side retaining brackets (heat shield).



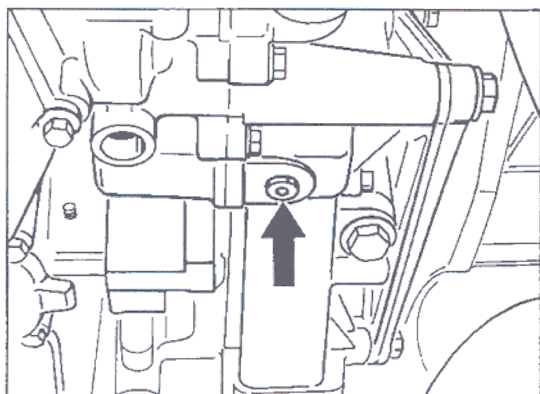
279\_97

7. Unscrew coolant reservoir cap.

8. Undo coolant drain plug and drain the coolant; remove the coolant hoses.

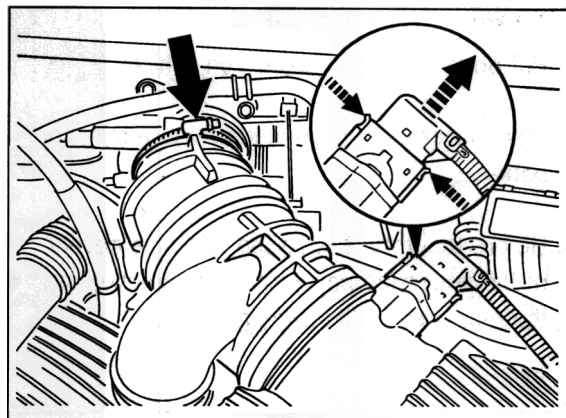
After draining the coolant, fit a new sealing ring on the drain plug.

Tightening torque 10 + 5 Nm (7.5 + 3.5 ftlb.).



471\_96

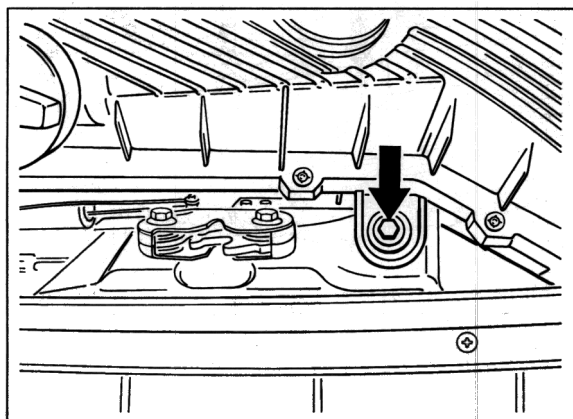
- b. Undo hose clamp on throttle body and pull plug off the mass air flow meter. Unclip wire on air cleaner housing and remove air cleaner assembly.



249\_97

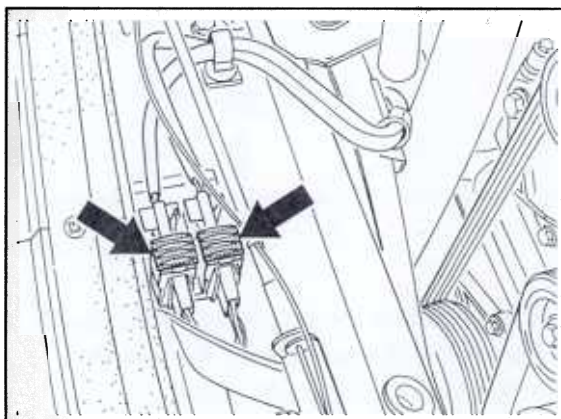
9. Remove air cleaner assembly:

- a. Undo hexagon-head bolt M6 x 34.



261\_97

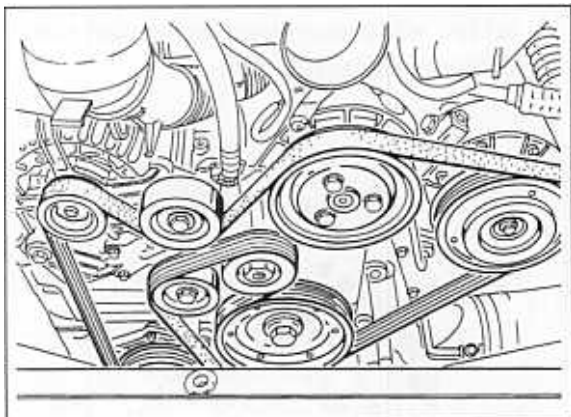
10. Disconnect oxygen sensor plug connections.



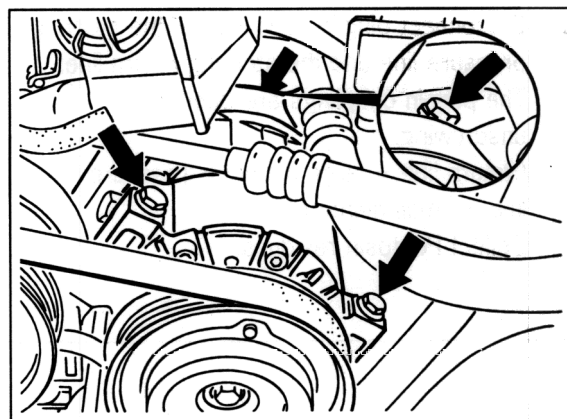
280\_97



- c. 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.

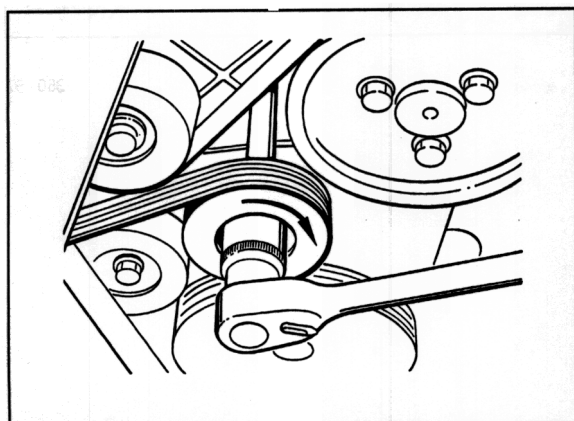


263 - 97



248 - 97

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



229 - 97

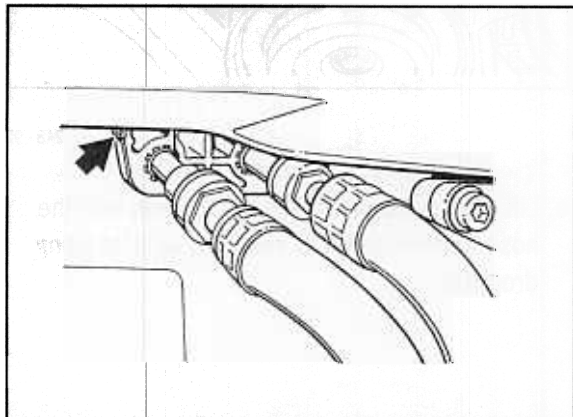
- d. Undo front compressor fastening screws (2 ea.). Undo rear fastening screw between the intake pipes of cylinders 4 and 5. Disconnect the electrical plug connection.

14. Disconnect plug-in couplings of the steering pressure line and the steering return line.  
The plug-in couplings are opened by unscrewing.  
(Return line = large diameter/pressure line = small diameter.)  
Collect Pentosin residues.

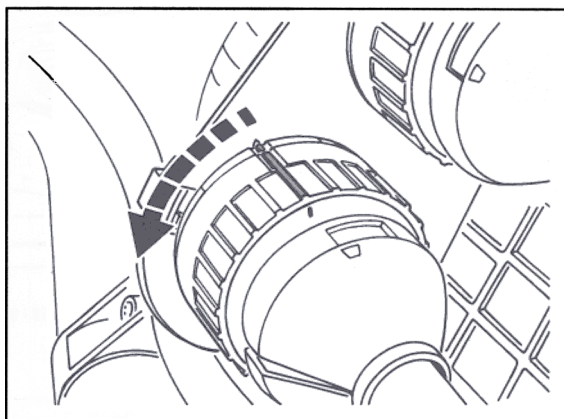
**Note**

The steering lines also can be detached immediately after the engine-transmission unit has been lowered out of the vehicle (better accessibility).

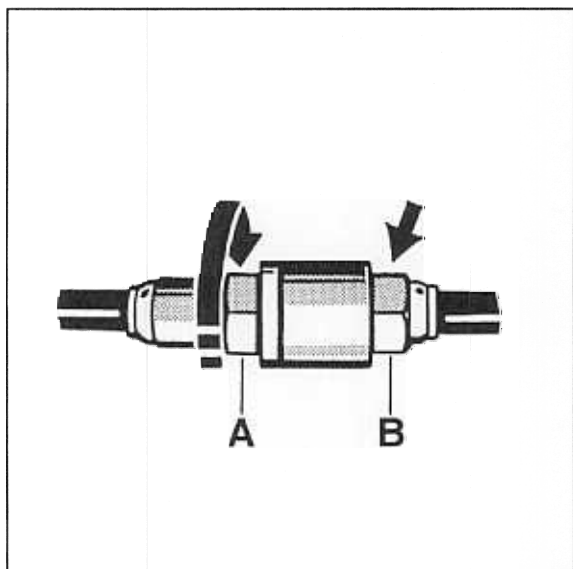
15. Undo engine wiring harnesses (round connectors with bayonet lock) on the right side in the engine compartment.



364 - 97



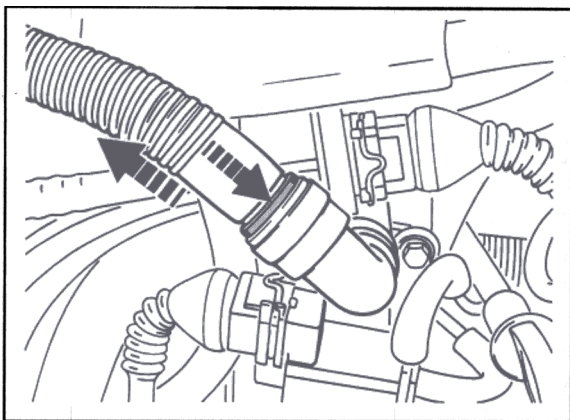
360 - 97



A – open with open-ended wrench  
B – hold with open-ended wrench

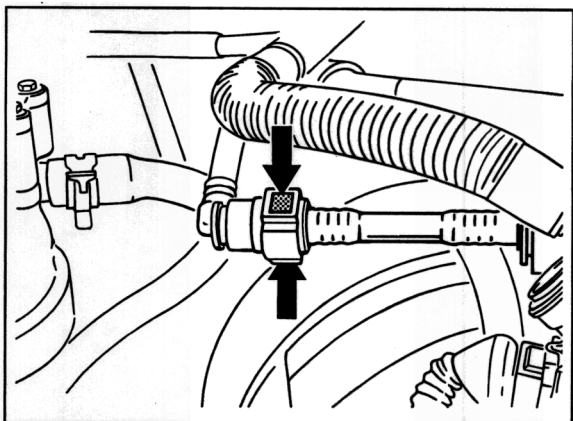
365 - 97

16. Disconnect vacuum line for the brake booster. Press the black unlocking ring (arrow) and simultaneously pull the line off.



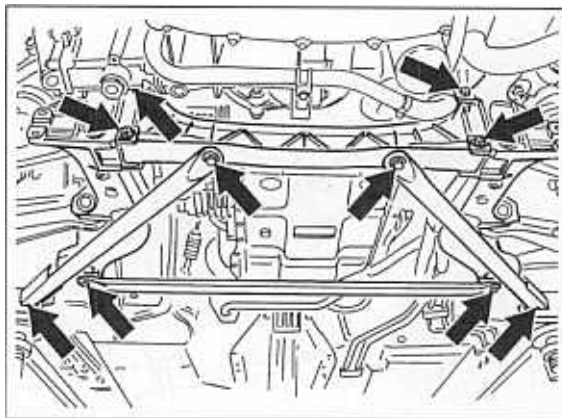
203 - 97

17. Disconnect plug connection of tank vent.  
Press unlocking buttons and simultaneously pull off the line.



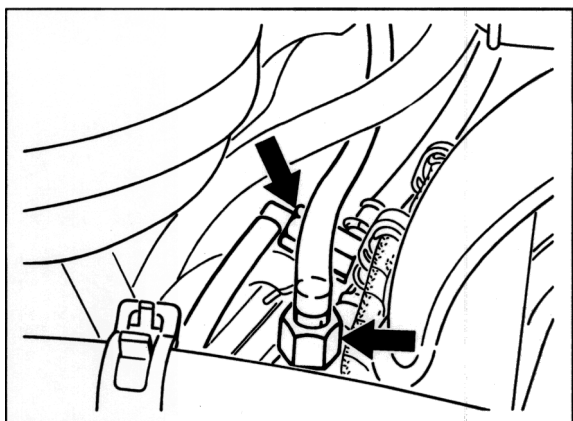
262 - 97

19. Raise the vehicle and remove the rear-axle drive shafts, diagonal braces, and front and rear cross members.



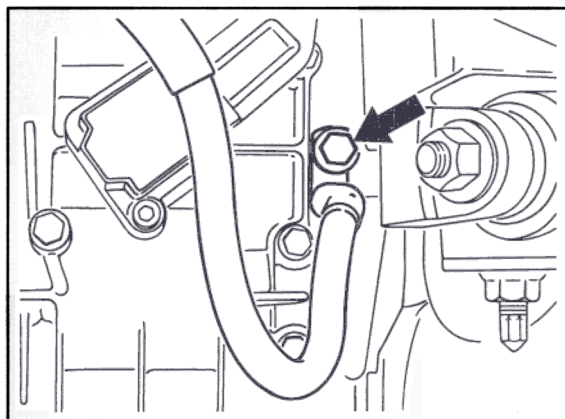
336 - 97

18. Undo the fuel supply line and fuel return line in the engine compartment (left). It is very important to counter when performing this step. Collect residual fuel.



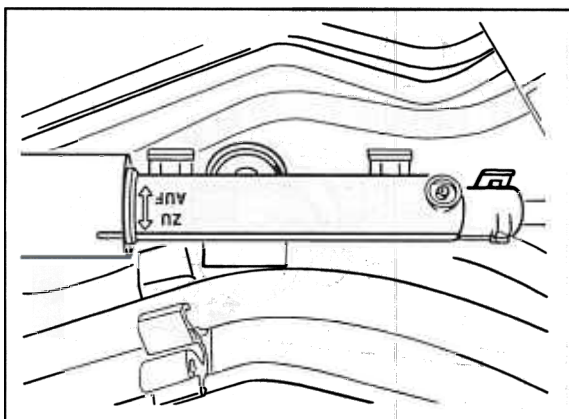
204 - 97

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



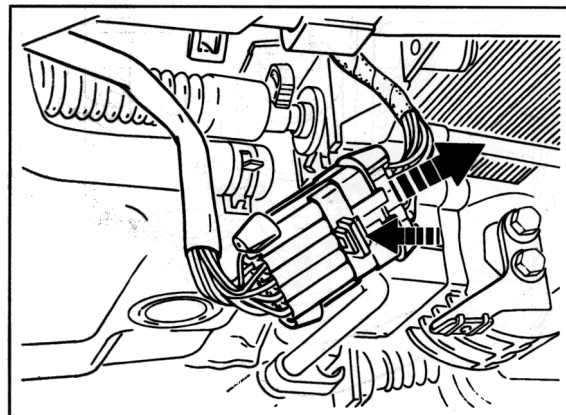
201 - 97

21. Undo accelerator cable. To do this turn the left-hand rotary sleeve in the direction indicated by the arrow.



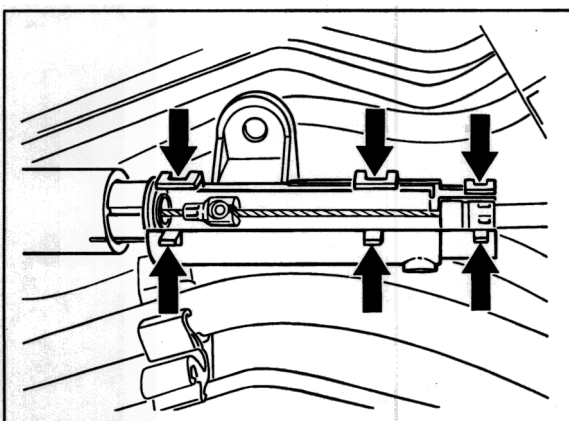
266 - 97

22. Disengage Tiptronic plug and disconnect plug connection.



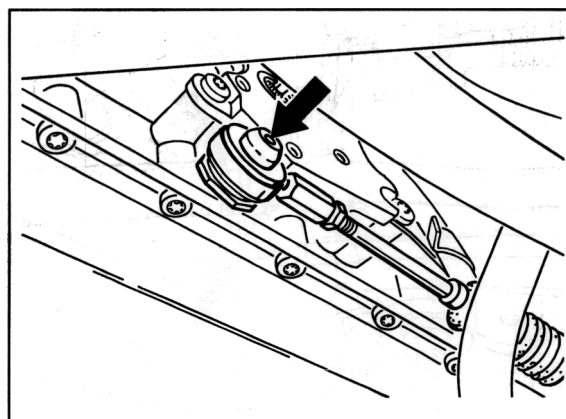
260 - 97

- a. Unclip right-hand accelerator cable mount sleeve and disengage the accelerator cable.



250 - 97

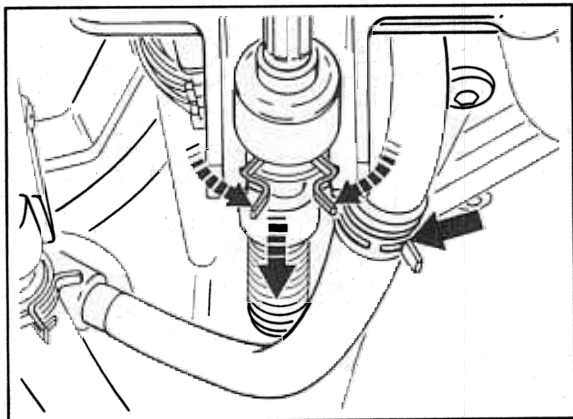
23. Disengage Tiptronic selector lever cable.



186 - 97

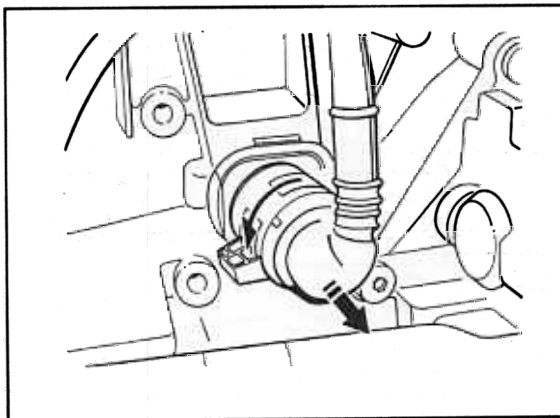


- a. Disengage Tiptronic selector lever cable from the mount. Pull off coolant line.



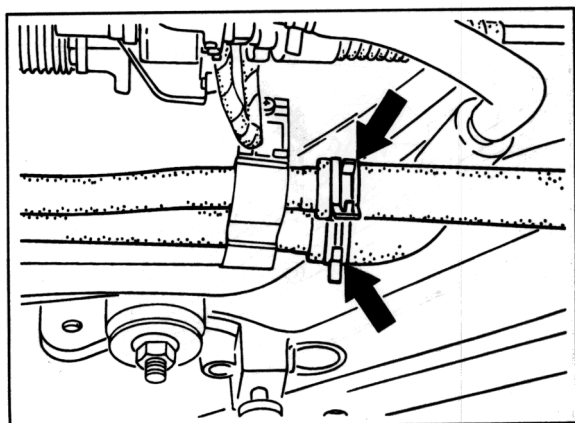
207 - 97

25. Turn round electrical connector (bayonet lock) in the direction indicated by the arrow and pull it off.



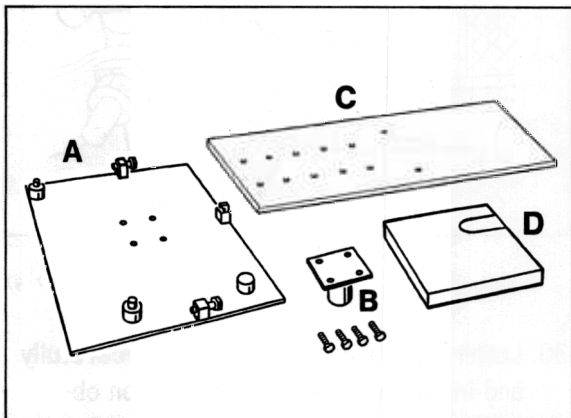
224 - 97

24. Remove coolant hoses.



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26. Prepare retainer plate (A) – special tool 9592 – for the removal operation.  
Place adapter (B) 9163/2 on the area of the support plate (C) 9592/1 that is identified "996" and screw the adapter together with the retaining plate 9592 (A). Screw support (D) together with the support plate.

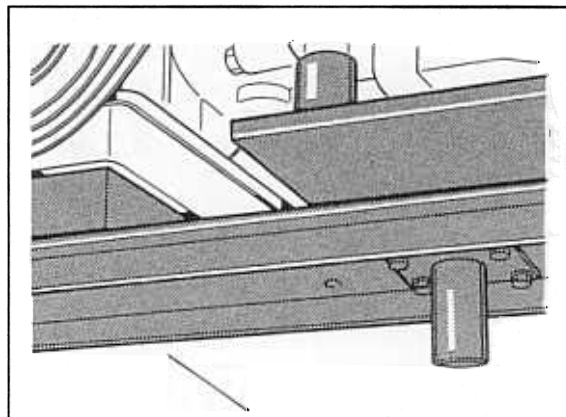


A = Retainer plate  
B = Adapter  
C = Support plate  
D = Support for Tiptronic transmission

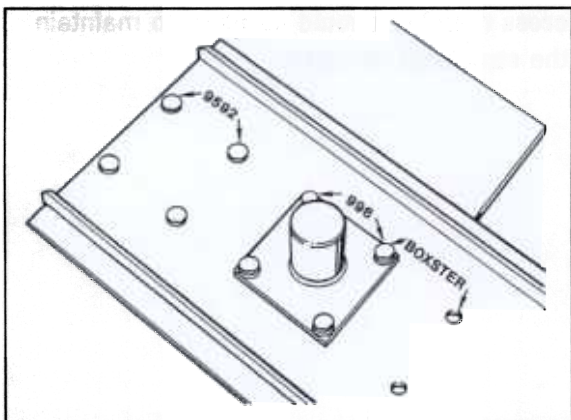
300 - 97

27. Place pre-fitted retainer plate on the crankcase.

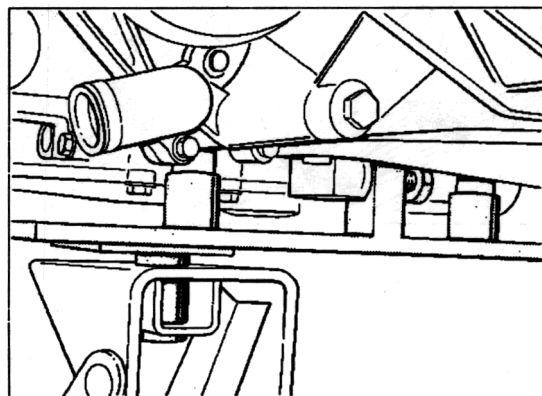
It is recommended that the retainer plate be fitted to the crankcase first. Only then should the workshop car jack be fitted. Place car jack underneath under slight load.



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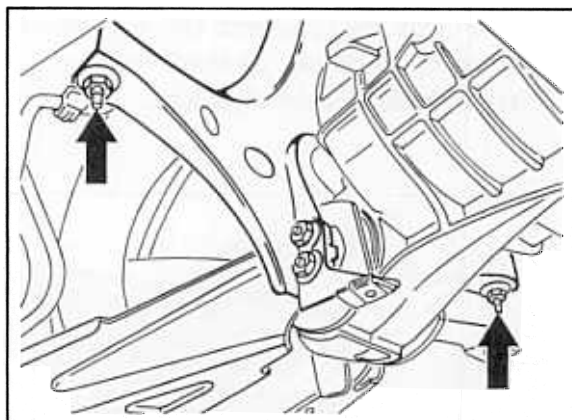


239 - 97



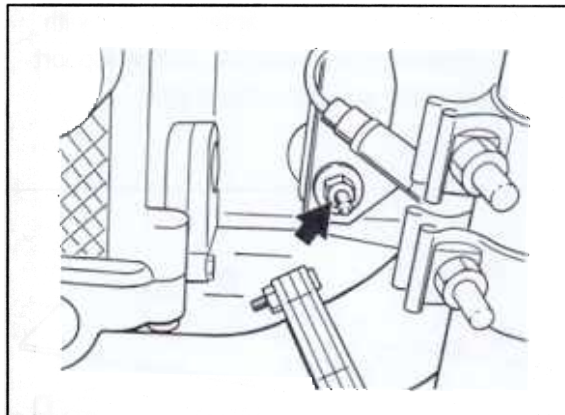
481 - 96

28. Undo transmission support

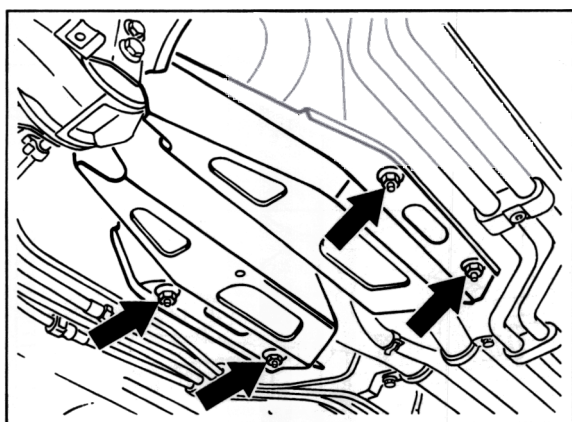


301 - 97

29. Separate engine carrier from the engine mounts (wrench size 18).



227 - 97



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30. Lower the engine-transmission unit **carefully** and **in steps**. Have a second person observe the engine-transmission clearance at the same time.

#### Note

**Important:** If the vehicle is placed on its wheels or moved in the workshop, the rear cross member should be fitted to maintain the structural strength.

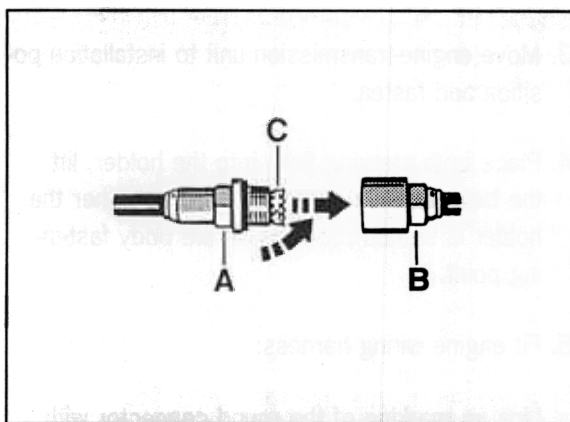


### Installation

The engine-transmission unit is installed in the reverse order. The following points must be given special attention:

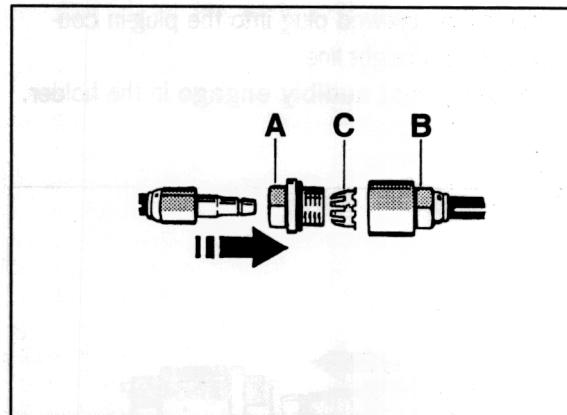
1. Before the engine is installed, prepare plug-in couplings of the steering lines for plugging together:

a. Tilt holder C on one side and simultaneously pull to disengage.



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b. Detach threaded part A by pulling it off the nipple.

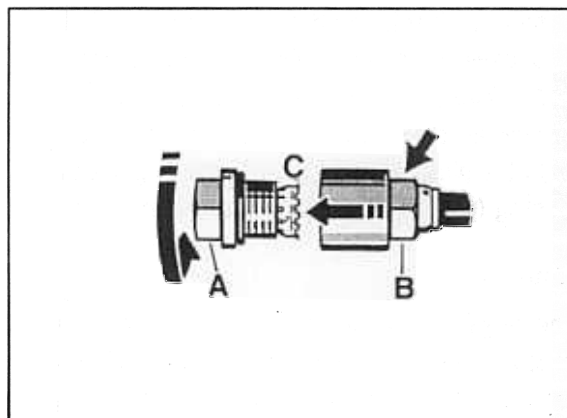


367 - 97

c. Close holder C. Screw threaded part A with fitted holder C into plug-in coupling B and tighten. Counter when tightening.

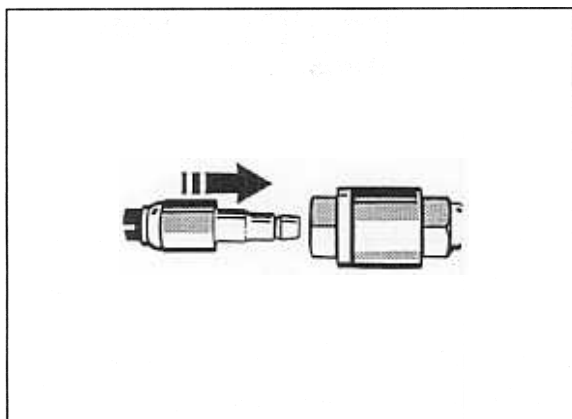
Tightening torque of the steering pressure line (wrench size 15) 30 Nm (22 ftlb.).

Tightening torque of the steering return line (wrench size 19) 40 Nm (30 ftlb.).



368 - 97

2. Lift the engine-transmission unit and connect the plug-in couplings immediately prior to reaching the final installation position.
- a. Insert the screwed plug into the plug-in coupling in a straight line.  
The plug **must audibly engage** in the holder.

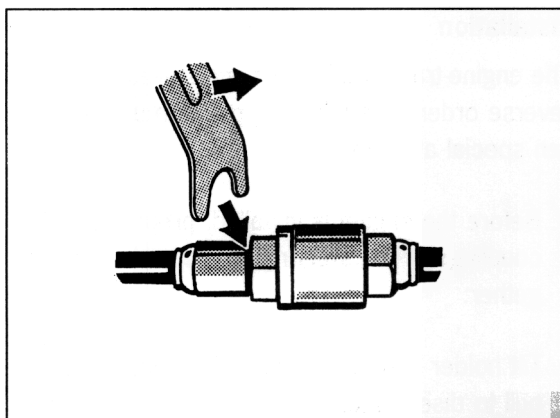


369 - 97

- b. Use special tool 9263 to check whether the plug-in coupling was engaged properly. Insert special tool 9263 into the groove (arrow) and apply **slight pressure** on the special tool **to check whether the connection is securely locked (holder is seated properly). The plug must not slide out.** If the special tool cannot be inserted in the groove of the plug, shift the plug in the plug-in coupling (pull on plug without using excess force).

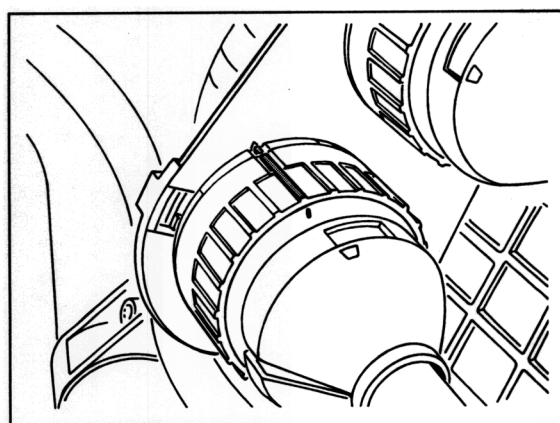
#### Note

The plug-in connection is designed so that the plug can be shifted in the plug-in coupling by approx. 1 mm in axial direction by slightly pulling or pressing.



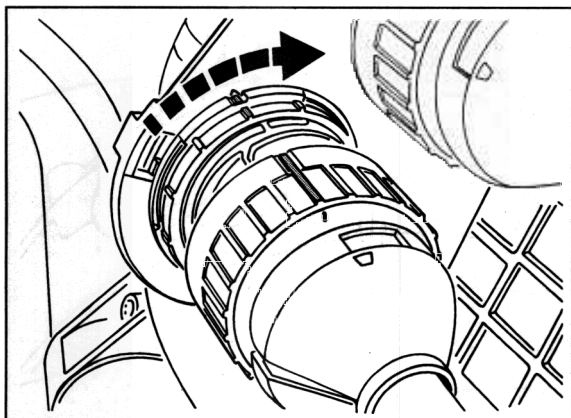
370 - 97

3. Move engine-transmission unit to installation position and fasten.
4. Place both steering lines into the holder, lift the bow and let it engage. Check whether the holder is seated properly on the body fastening point.
5. Fit engine wiring harness:
  - a. Line up marking of the round connector with marking on the housing.



361 - 97

- b. Turn round connector clockwise by approx. 90° (bayonet lock).



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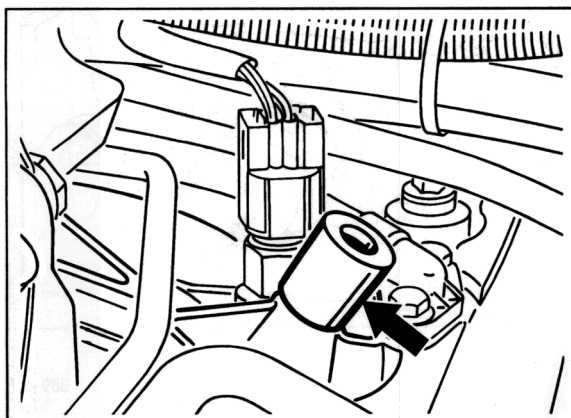
#### Note

The round connectors are marked.

Left connector – white mark

Right connector – blue mark.

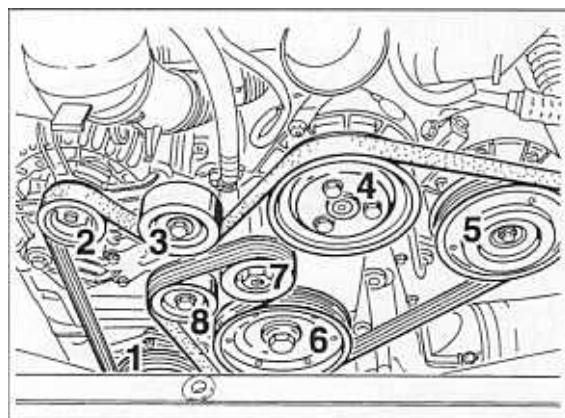
6. Fit air conditioning compressor  
Before installation, check whether the spacer sleeve is fitted or present at the rear fastening point. Grease and fit sleeve.



206 - 97

7. Fit drive belt.

Observe sequence when fitting the belt and direction of motion if the belt was run.

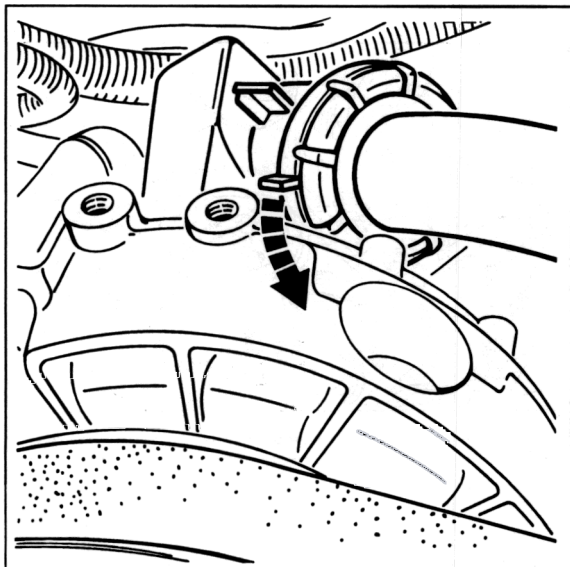


338 - 97

8. Fit reservoir for power steering system.

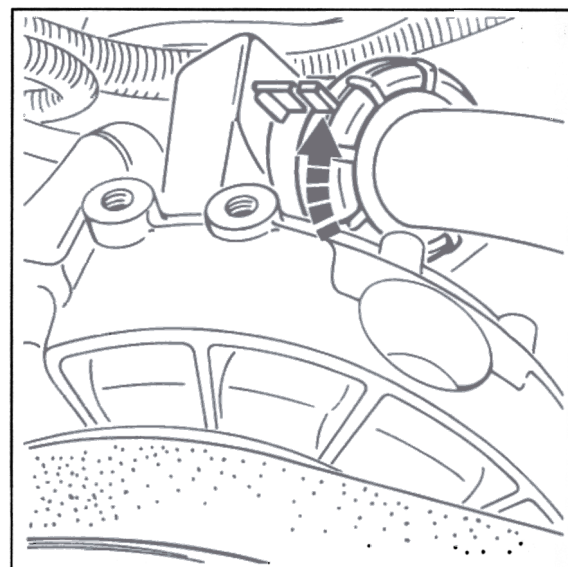
- a. Remove plug.

- b. Turn adjusting ring counter-clockwise to its original position.



264 - 97

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

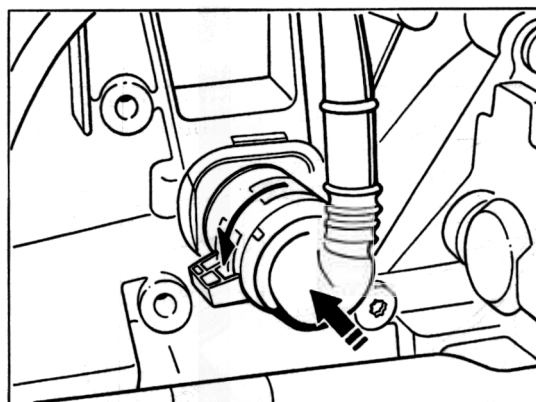


265 - 97

- d. Fill in Pentosin. Observe the specification for bleeding. See Group 48, Page 48 - 4.

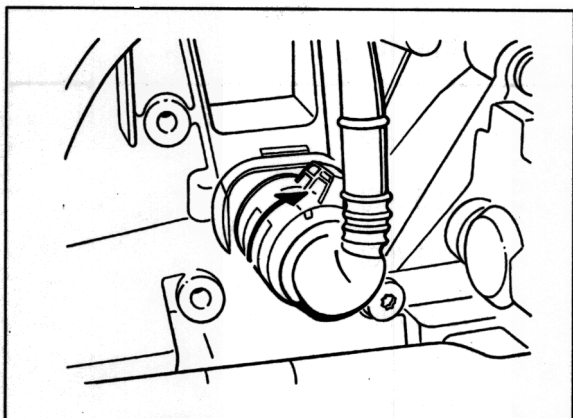
9. Fit round connector on Tiptronic transmission.

- a. Turn adjusting ring counter-clockwise to its original position.



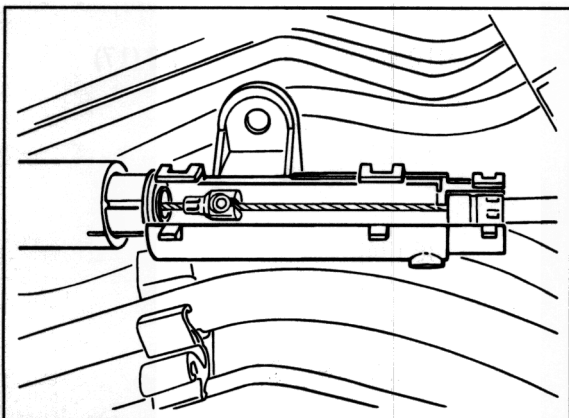
389 - 97

- b. Turn adjusting right clockwise until the plug engages. (bayonet lock)



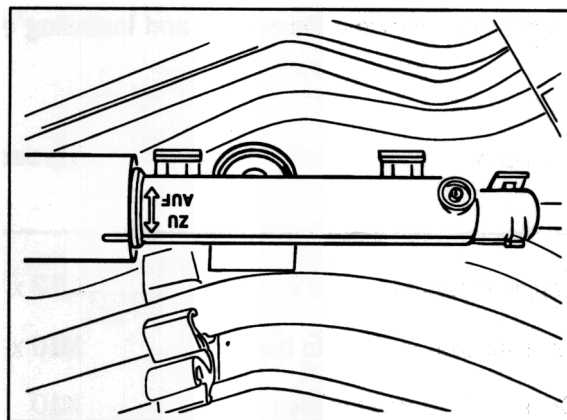
225 - 97

10. Engage accelerator cable and close accelerator cable mount sleeve.



378 - 97

- a. Turn rotary sleeve in the direction indicated by the arrow (closed) and line up the marks on the accelerator mount sleeve and rotary sleeve.



266 - 97

11. Fill in coolant and bleed cooling system.  
See Group 19, Page 19 - 1.

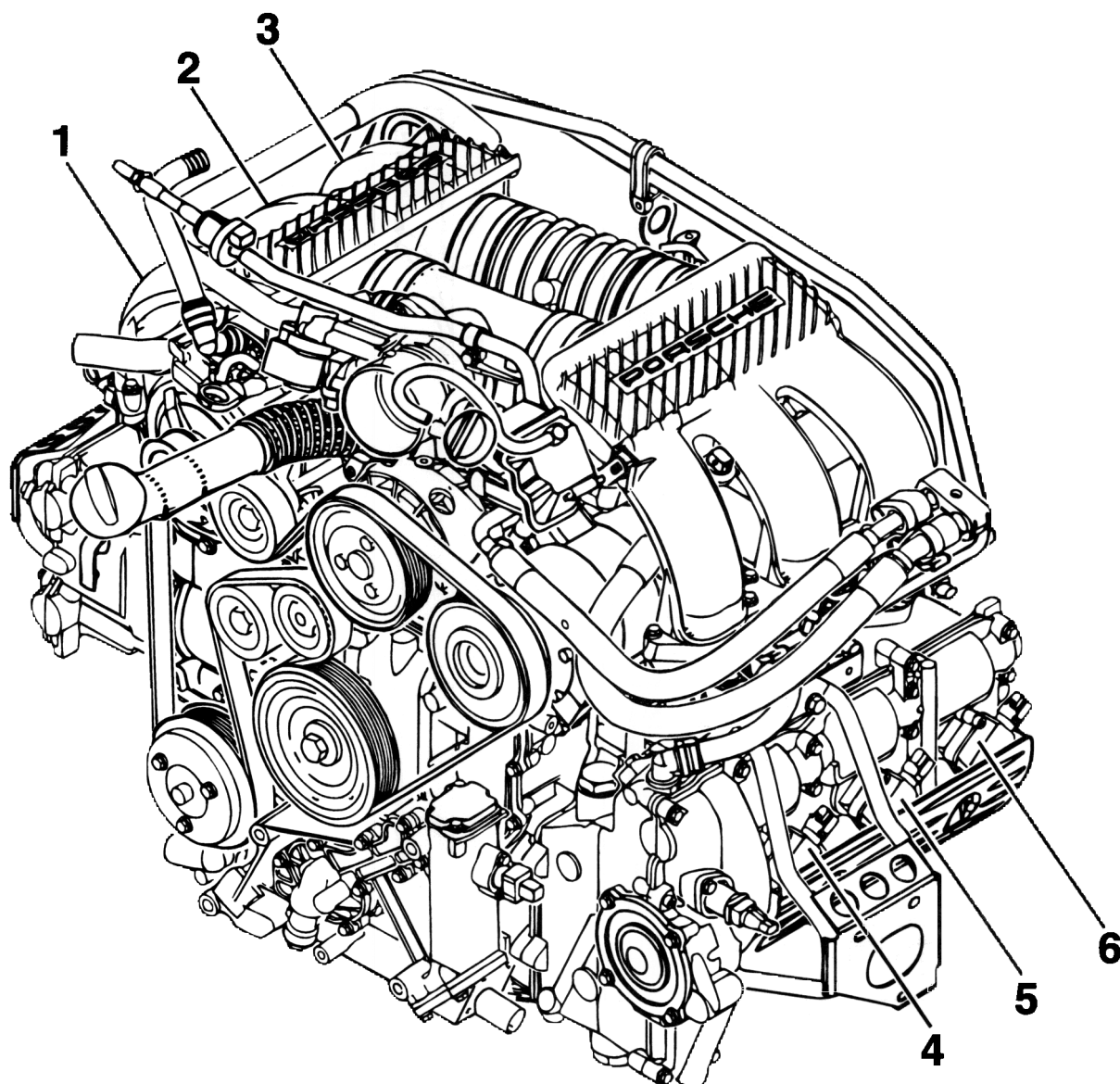


**Tightening torques: Removing and installing engine**

| Location   | Thread    | Tightening torque<br>Nm (ftlb.) |         |
|--|-----------|---------------------------------|---------|
| Engine mount to engine carrier                         | M12 x 1.5 | 85 (63)                         |         |
| Transmission support to body                           | M10 x 1.5 | 65 (48)                         |         |
| Drive shaft to transmission                            | M10       | 81 (60)                         |         |
| Wheel to wheel hub                                     | M14 x 1.5 | 130 (96)                        |         |
| Cross member at rear<br>to carrier side section        | M12 x 1.5 | 100 (74)                        |         |
| Cross member at front<br>to carrier side section       | M10 x 1.5 | 65 (48)                         |         |
| Diagonal brace to body                                 | M10 x 1.5 | 65 (48)                         |         |
| Diagonal brace to cross member                         | M12 x 1.5 | 100 (74)                        |         |
| Diagonal brace to carrier<br>side section (collar nut) |           | M10 x 1.5                       | 23 (17) |
| Stabilizer to carrier<br>side section                  | M8        | 23 (17)                         |         |
| Stabilizer to stabilisor<br>mount                      | M10 x 1.5 | 46 (34)                         |         |
| Ground strap to engine                                 | M8        | 23 (17)                         |         |
| Fuel return line                                       | M14 x 1.5 | 25 ± 5 (19 ± 3.5)               |         |
| Fuel supply line                                       | M16 x 1.5 | 30 + 5 (22 + 3.5)               |         |
| Plug-in coupling, steering<br>pressure line            |           | 30 (22)                         |         |
| Plug-in coupling, steering<br>return line              | 40 (30)   |                                 |         |
| Coolant drain plug                                     | M10 x 1   | 10 + 5 (7.5 + 3.5)              |         |

## 10 01 37 Disassembling and assembling engine

### Designation of cylinders

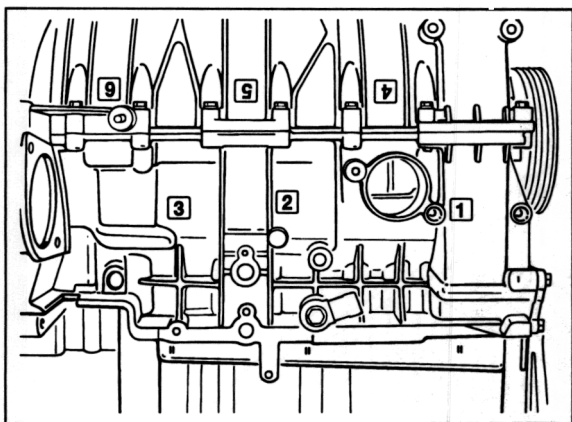


355 - 97

**FIRING ORDER 1 - 6 - 2 - 4 - 3 - 5**

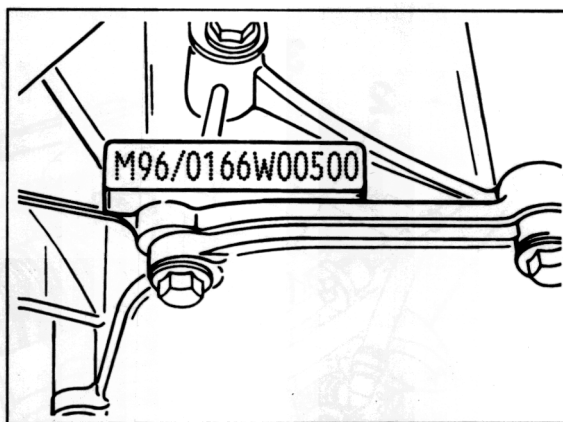
## Identification on engine

Cylinder arrangement



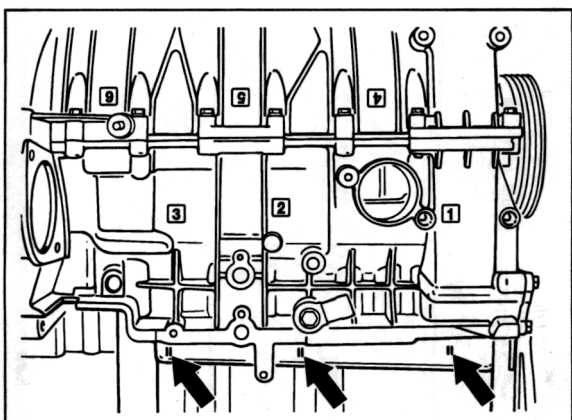
339 - 97

Engine type and engine number



380 - 97

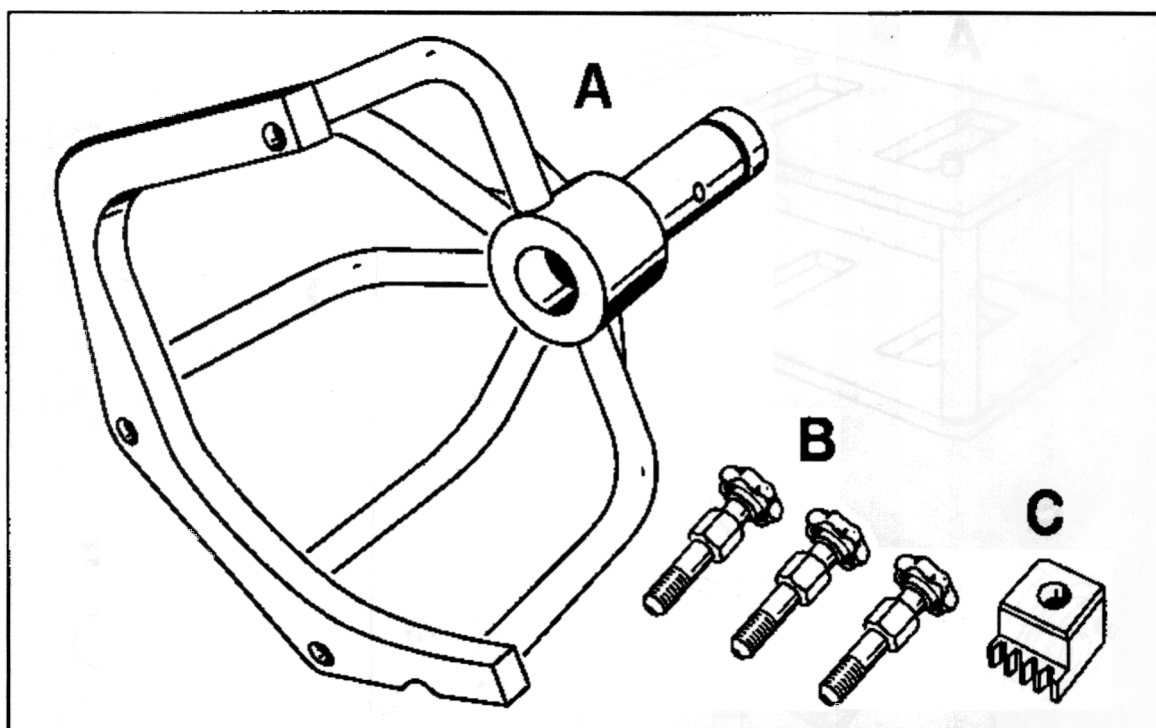
Identification of the dimensional groups, cylinder/piston



340 - 97



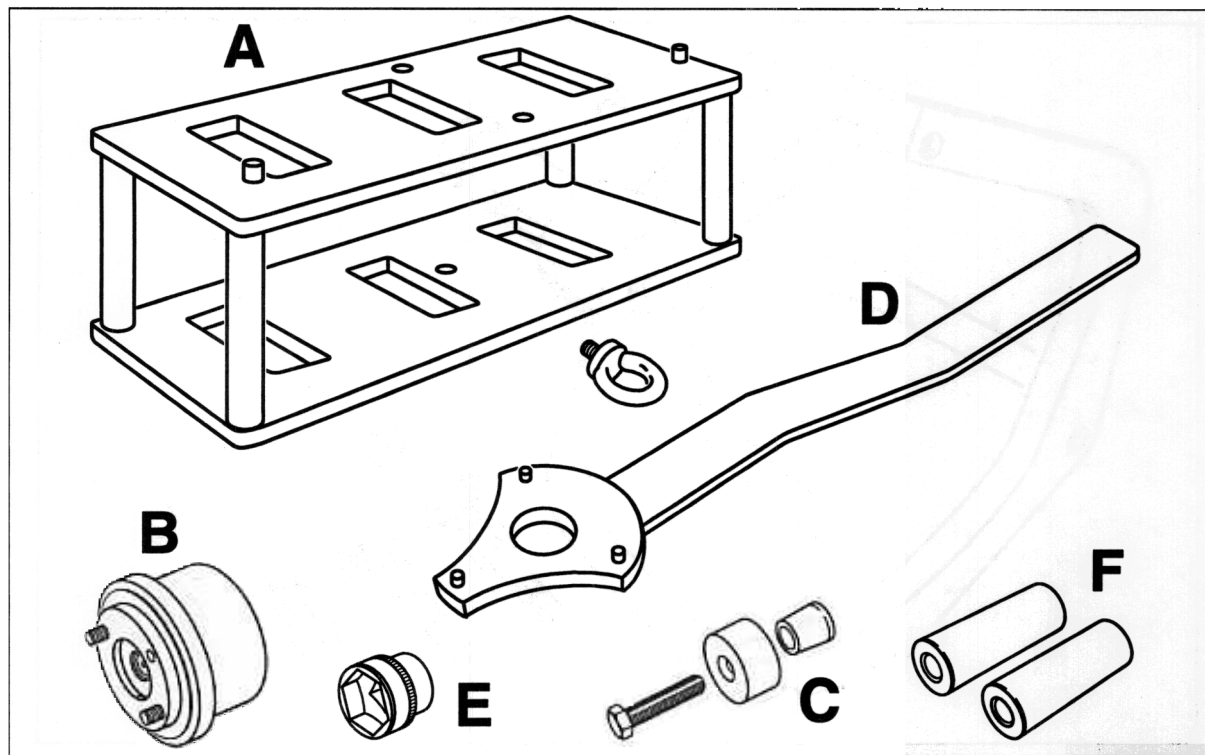
## Tools – overview, part 1



489g - 96

| Item | Designation                                 | Special tool | Explanation   |
|------|---|--------------|---|
| A    | Engine holder                               | 9589         | In combination with VW 313 clamping block and 3054 assembly stand   |
| B    | Parts for fastening engine to engine holder | 9590         |   |
| C    | Toothed segment                             | 9538/1       | Secure with hexagon-head bolt M12 x 50<br><b>Note</b><br>Do not use toothed segment to undo the belt pulley; use only special tool "holder 9593". |

## Tools – overview, part 2



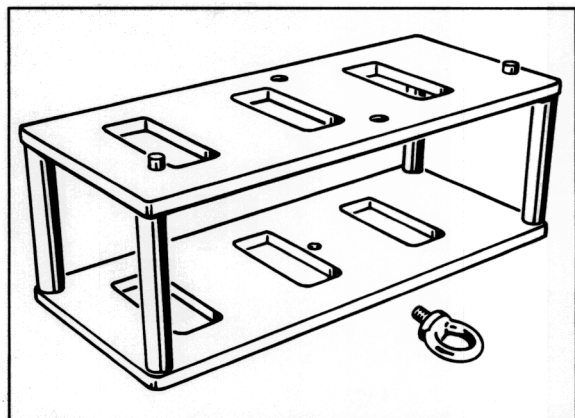
379 - 97

| Item | Designation   | Special tool | Explanation |
|------|---|--------------|-------------|
| A    | Mounting device<br>for bearing housing                            | 9607         |             |
| B    | Insertion device for<br>crankcase sealing ring<br>(flywheel side) | 9609         |             |
| C    | Insertion device for<br>crankcase sealing ring<br>(pulley side)   | 9610         |             |
| D    | Holder for pulley   | 9593         |             |

| Item | Designation  | Special tool | Explanation |
|------|--|--------------|-------------|
| E    | Socket wrench insert<br>for screwing the pulley<br>screws with the engine<br>installed | 9594         |             |
| F    | Spacer sleeves<br>for holding the<br>bearing housing                                   | 9613         |             |

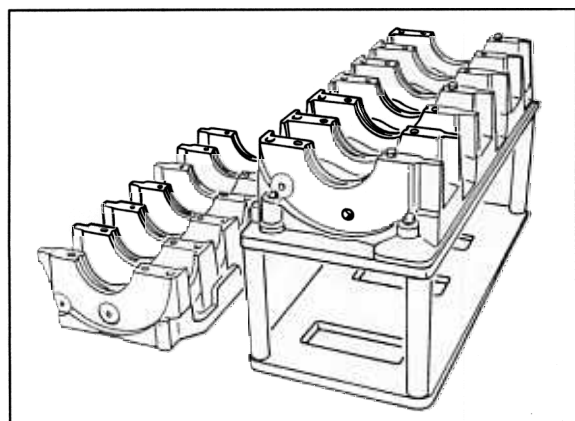
## Locations for special tool (mounting device) 9607

Special tool 9607

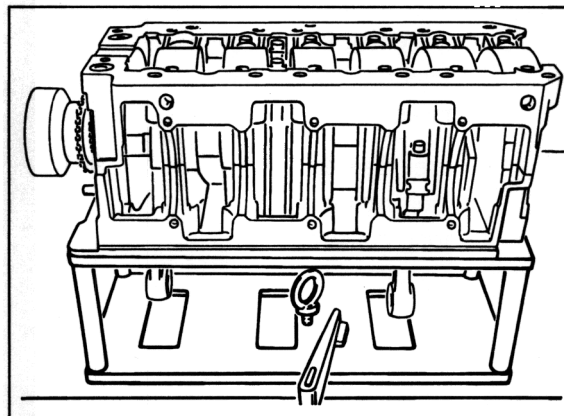


482 - 96

Disassembling and assembling bearing housing, crankshaft and connecting rods of cylinders 4 - 6.

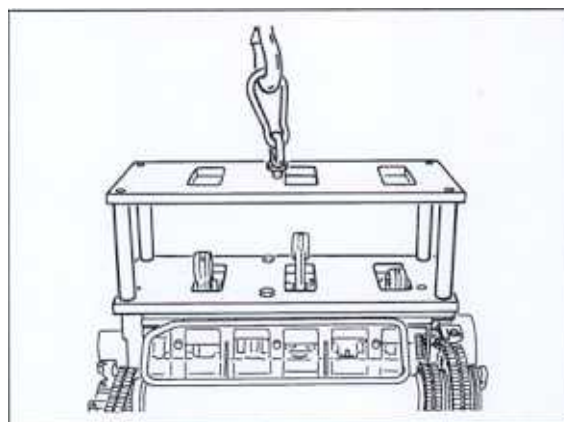


483 - 96

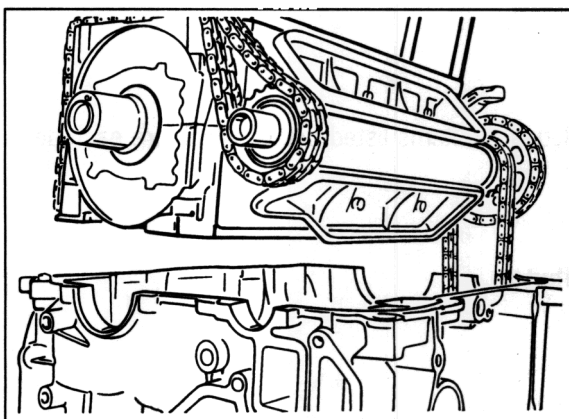


484 - 96

Removal or installation of the complete bearing housing in the crankcase half, cylinders 1 - 3. As the bearing housing is heavy, it should be removed and installed using a workshop crane.



345 - 97



382 - 97

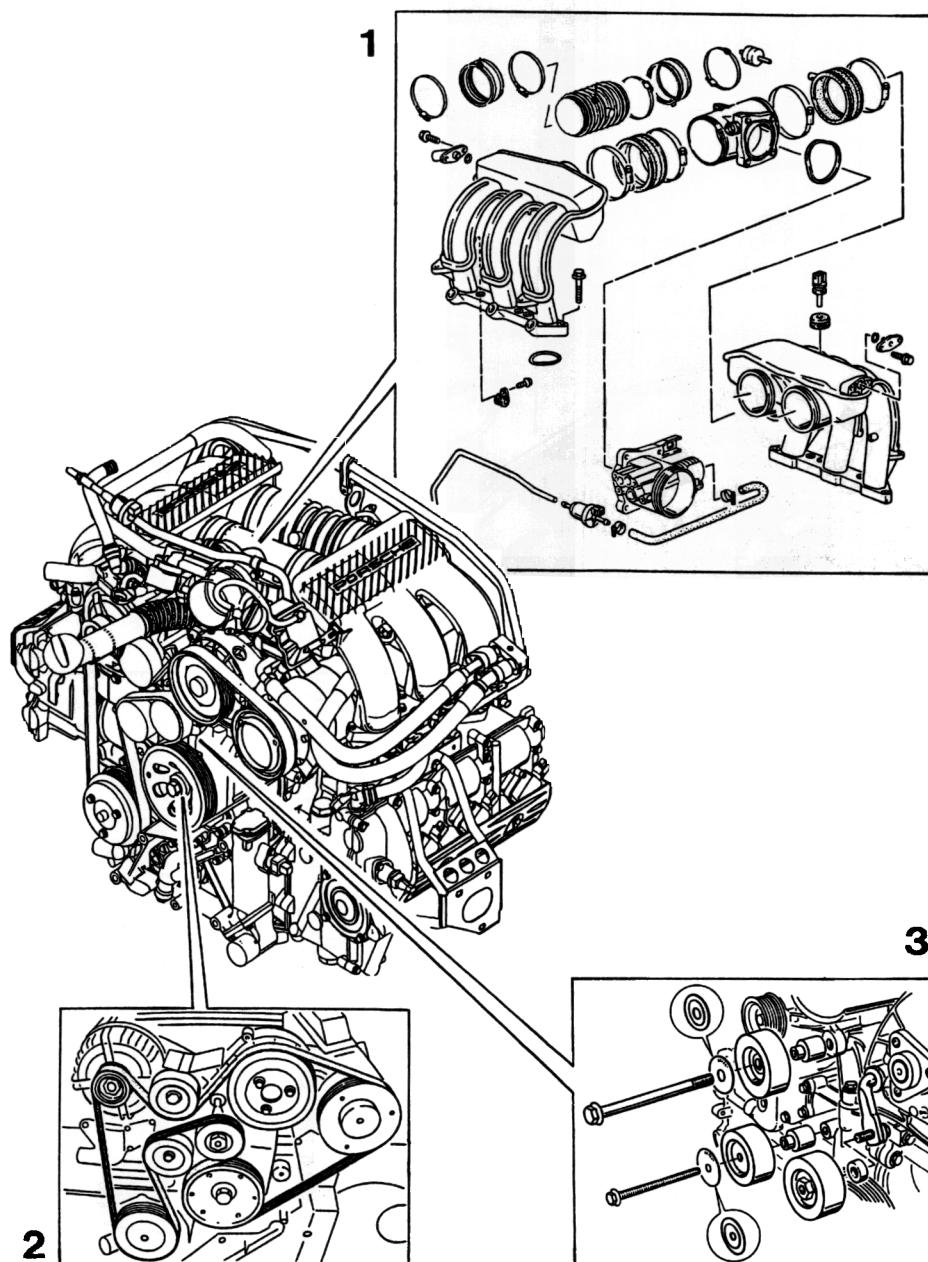
## **Disassembling and assembling engine**

The topic "**Disassembling and assembling engine**" includes the items listed below, which are each described in the respective Repair Groups.

- Item 1 Disassembling and assembling intake distributor**
- Item 2 Removing and installing drive belt**
- Item 3 Removing and installing deflection rollers and tensioning roller for drive belt**
- Item 4 Removing and installing oil pump with coolant guide housing**
- Item 5 Removing and installing air/oil separator**
- Item 6 Removing and installing camshafts**
- Item 7 Disassembling and assembling cylinder head**
- Item 8 Disassembling and assembling crankcase halves**
- Item 9 Removing and installing pistons**
- Item 10 Disassembling and assembling intermediate shaft on bearing housing**
- Item 11 Disassembling and assembling bearing housing with crankshaft**



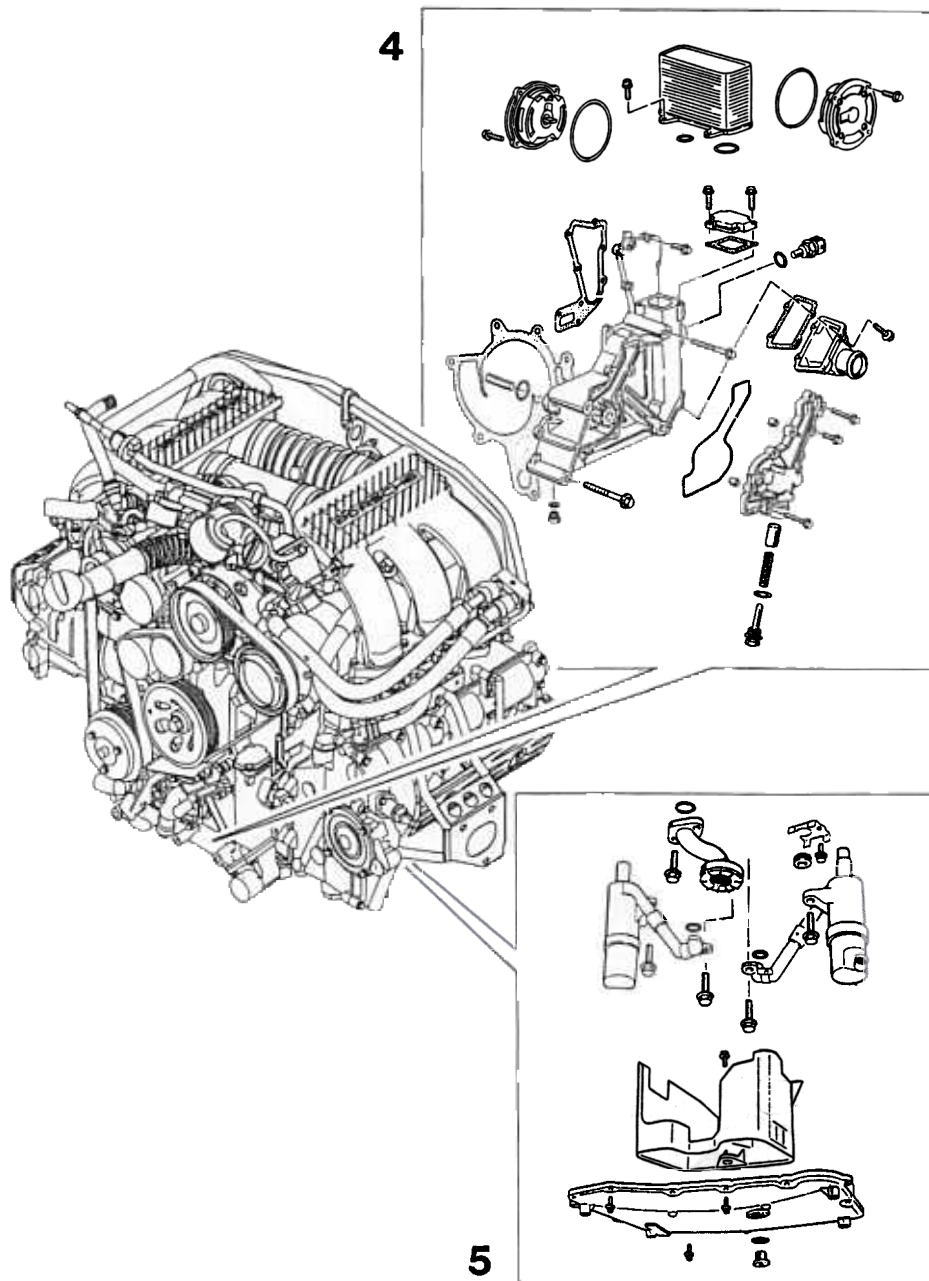
## Disassembling and assembling engine



373 - 97

- Item 1 Disassembling and assembling intake distributor
- Item 2 Removing and installing drive belt
- Item 3 Removing and installing deflection rollers and tensioning roller for drive belt

# Disassembling and assembling engine

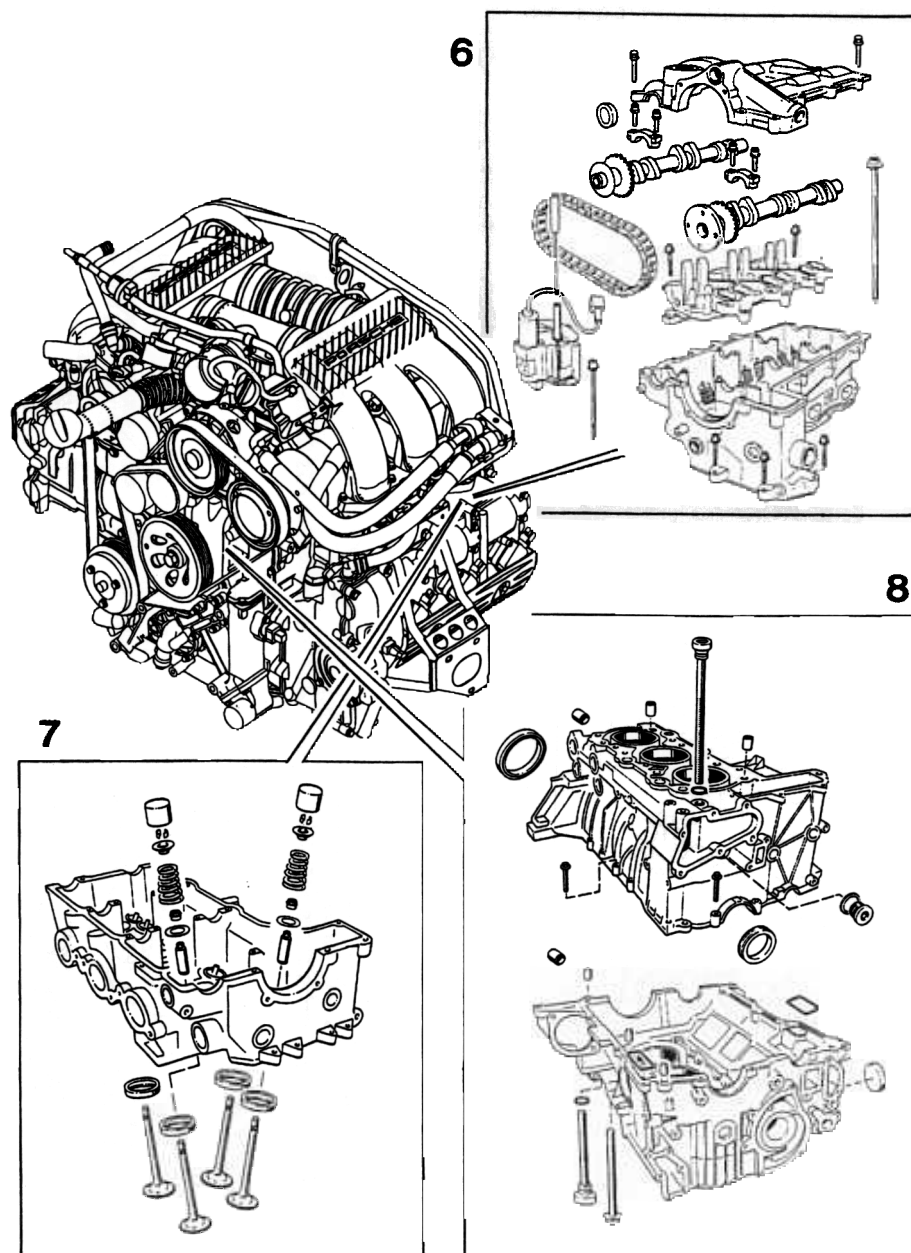


374 - 97

- Item 4 Removing and installing oil pump with coolant guide housing
- Item 5 Removing and installing air/oil separator

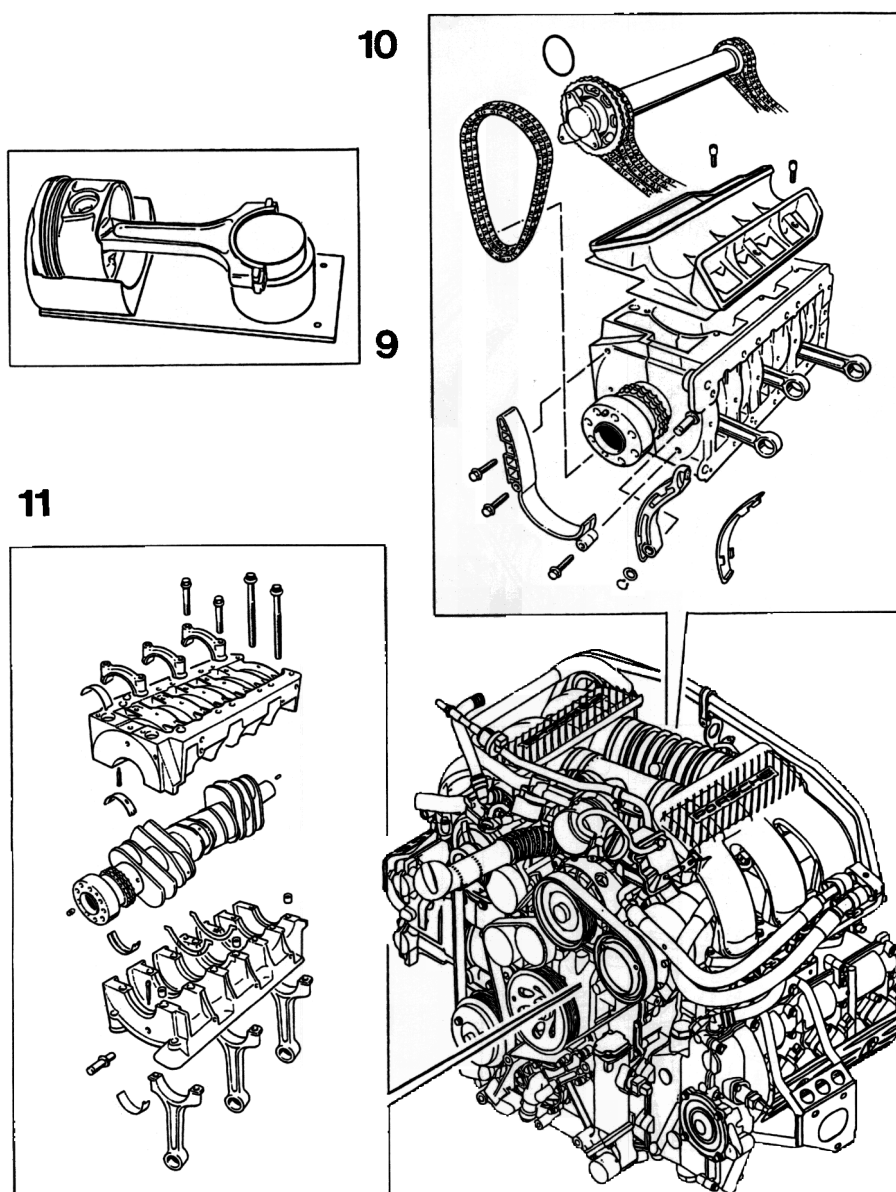


## Disassembling and assembling engine



Removing and installing camshafts  
 Disassembling and assembling cylinder head  
 Disassembling and assembling crankcase halves

# Disassembling and assembling engine



376 - 97

- Item 9 Removing and installing pistons
- Item 10 Disassembling and assembling intermediate shaft on bearing housing
- Item 11 Disassembling and assembling bearing housing with crankshaft

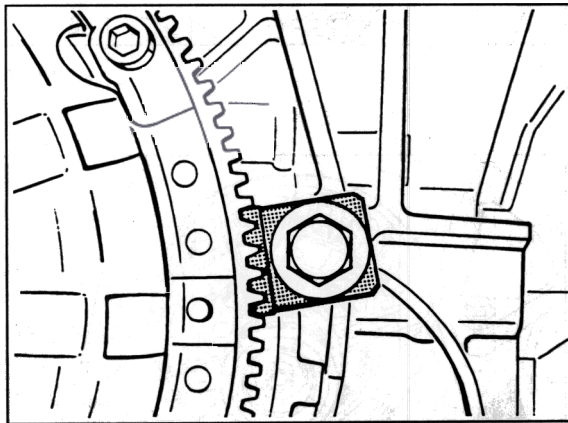
## 10 01 37 Disassembling and assembling engine

### Disassembly

#### Note

Before the engine is fastened to the engine holder or assembly stand, detach and remove the thrust plate and flywheel.

1. Fasten toothed segment (special tool 9538/1) on the crankcase half (cylinder bank 1 - 3) with hexagon-head bolt M12 x 50.



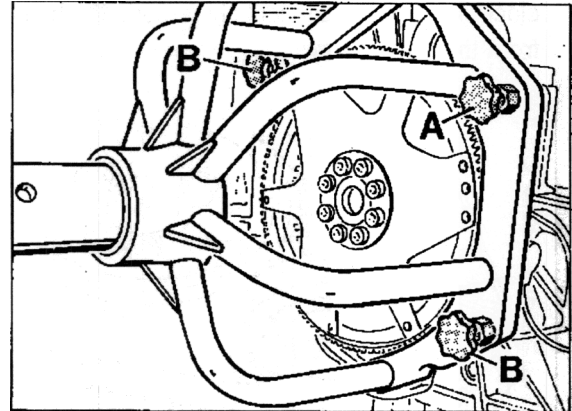
607\_97

2. Detach thrust plate.

#### Note

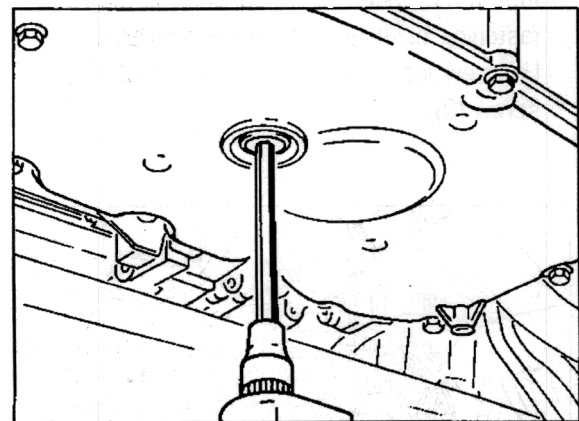
In order to avoid deformation of the thrust plate housing, always loosen screws in **several stages** and in **diametrically opposite** sequence.

3. Remove thrust plate and drive plate.
4. Detach flywheel (Torx T55).
5. Fasten engine holder, special tool 9589, to the crankcase half of cylinder bank 1 - 3.



408\_96

6. Undo the oil drain plug on the oil pan and drain off the engine oil. Use a hexagon socket wrench insert for 8 mm hexagon socket head bolts.



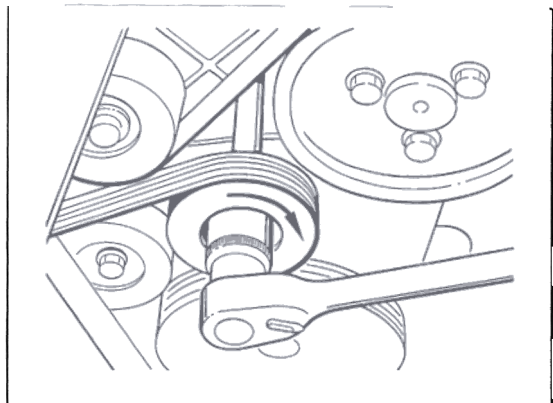
271\_96

7. Remove engine carrier.



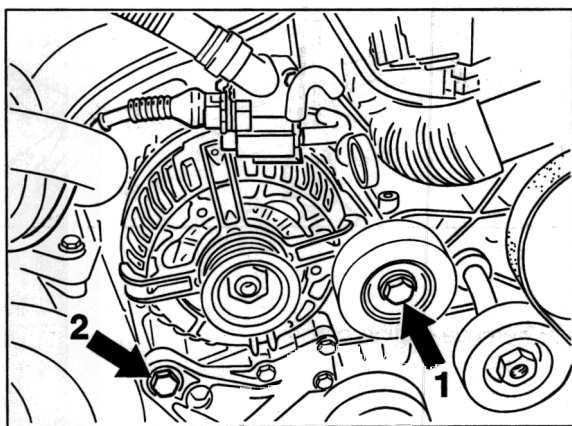
8. Remove drive belt.

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



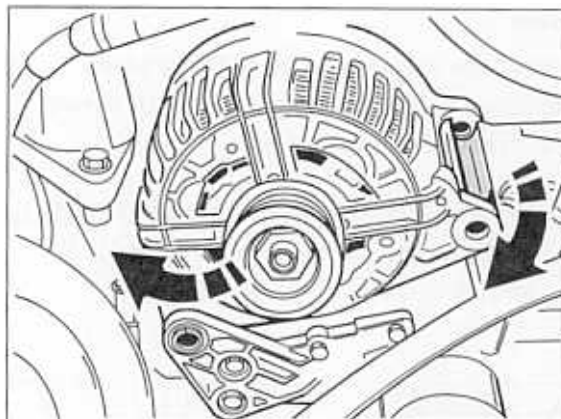
229\_97

9. Remove generator from bracket. To do this, 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 (1) and fastening screw (2).

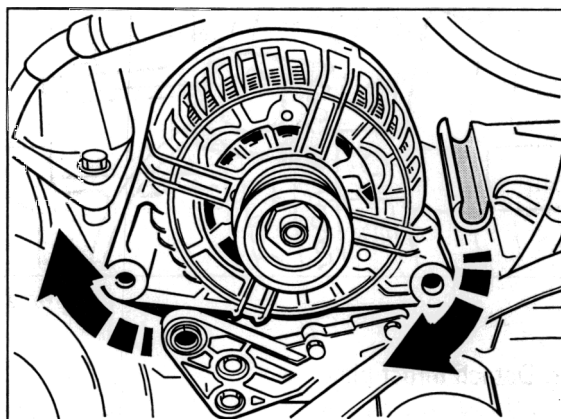


441\_98

9.1 Turn generator clockwise and remove from bracket.

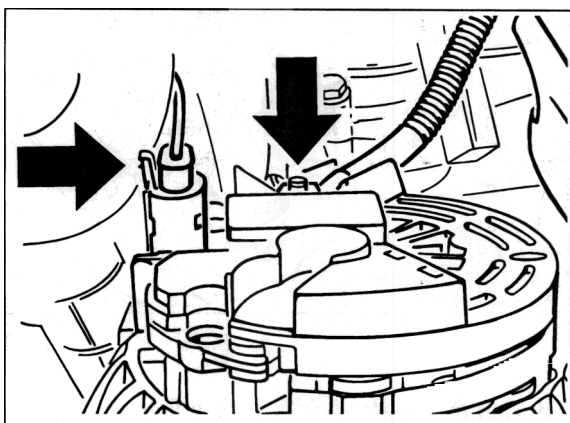


444\_98



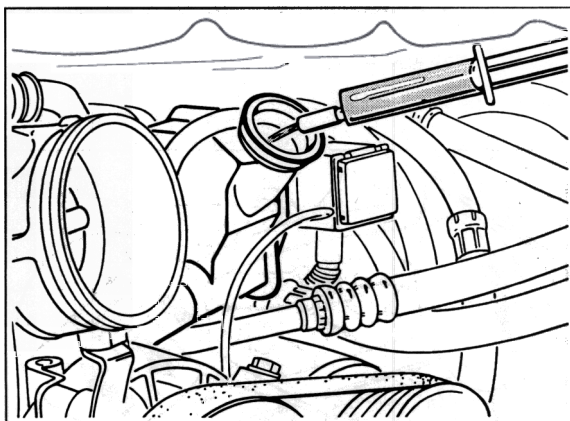
445\_98

9.2 Disconnect electrical plug connection.



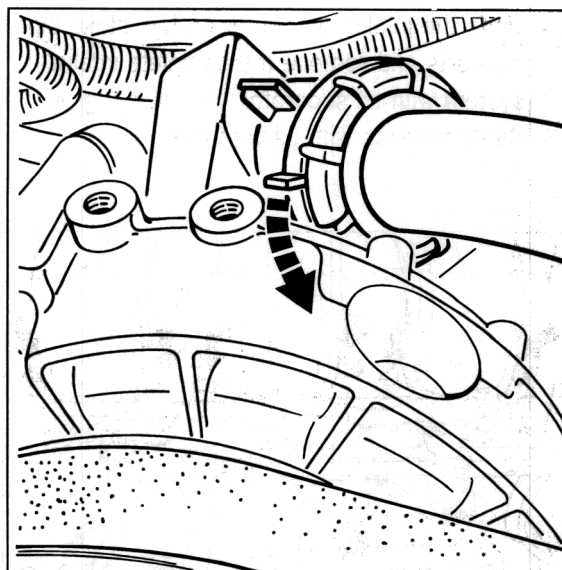
531\_98

10. Remove supply tank of the power steering system. To do this, **remove** the fluid in the upper supply tank until **below the joint**.



151\_98

11. Turn bayonet lock in the direction indicated by the arrow and pull off the supply tank.

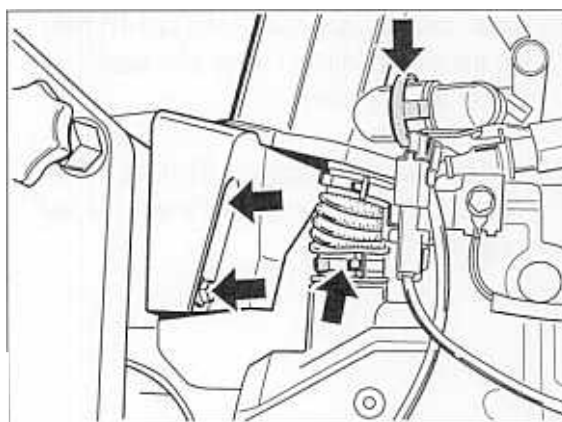


Bayonet lock open

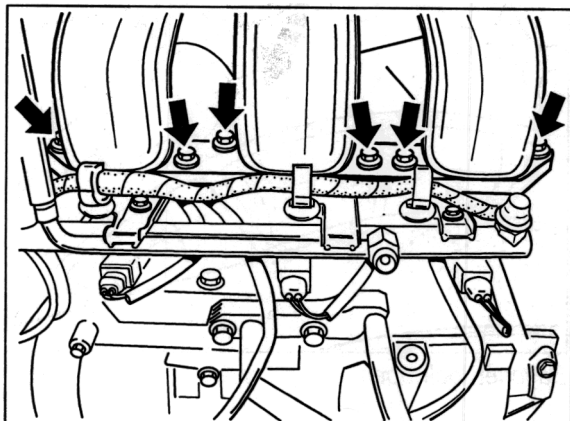
264\_97

12. Remove fluid in lower supply tank.

13. Undo oil separator on the crankshaft.

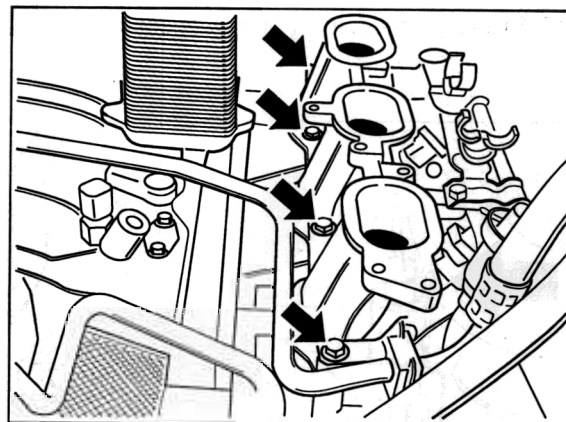


14. Undo the intake distributor on the intake pipe supports and remove the complete intake system with oil separator. Remove engine wiring harness with oil vent line.



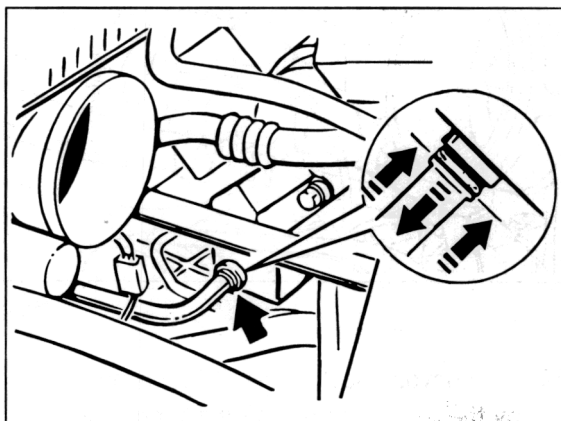
546\_98

15. Pull out oil dipstick and undo guide for dipstick.
16. Undo two hexagon-head bolts (a/f 10 mm) on the oil filler neck. Pull oil filler neck out of the crankcase.
17. Undo intake pipe supports from the cylinder heads and remove completely with the fuel ring pipe.



547\_98

18. Remove starter (width across flats 16 mm).
19. Loosen belt pulley on the hydraulic pump.
20. Detaching steering return line.  
In order to detach the line from the supply tank, **push the red unlocking ring forward (arrows) and simultaneously pull out the line.** Use two plastic spatulas to press the unlocking ring.

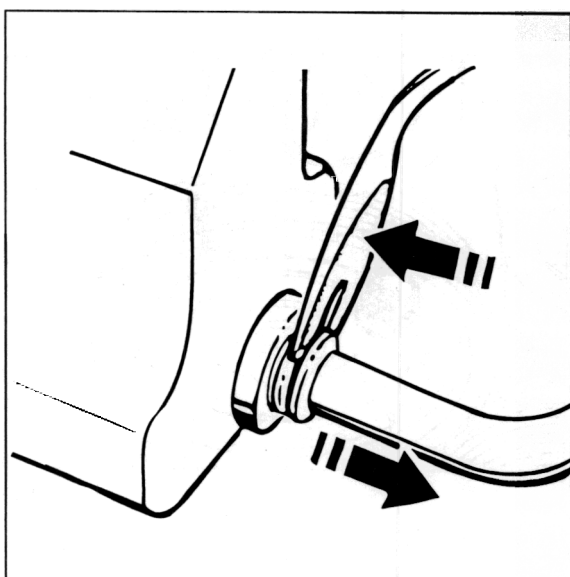


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21. Detaching steering return line from the supply tank **with tool**.

The line can also be detached using a commercially available tool. The removal tool from Messrs. Snap-On, for example, is recommendable. Insert tool between line and the red unlocking ring and unlock. Pull line to the rear and **simultaneously** press the tool against the red ring. Carefully protect the line against dirt and scratches with a cap.

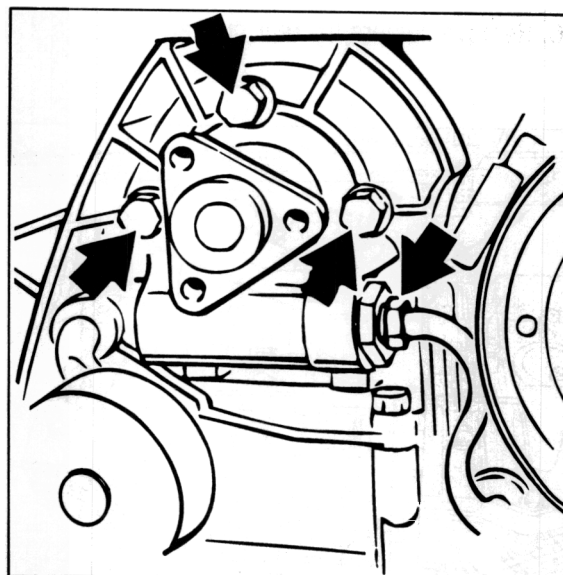


544\_98

22. Detach hydraulic pump and steering supply line.

Undo steering supply line (wrench size 17); simultaneously counter at the body (wrench size 27).

Undo three hexagon-head bolts (M8 x 12) and remove hydraulic pump to the rear.



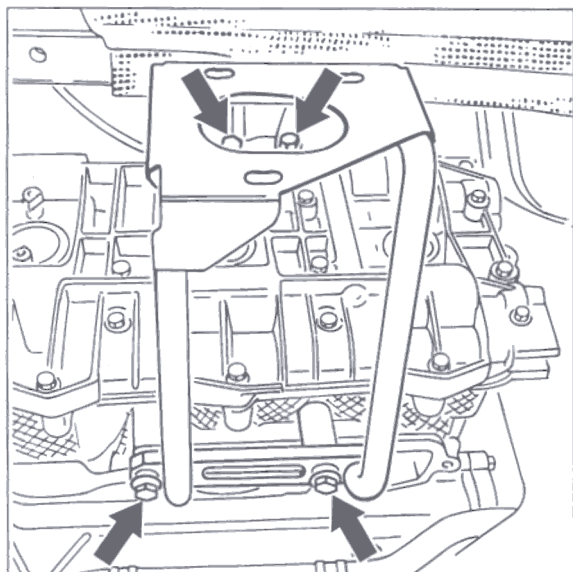
545\_98

23. Remove oil-water heat exchanger. Remove vent line. Undo four hexagon socket head bolts (a/f 5 mm).

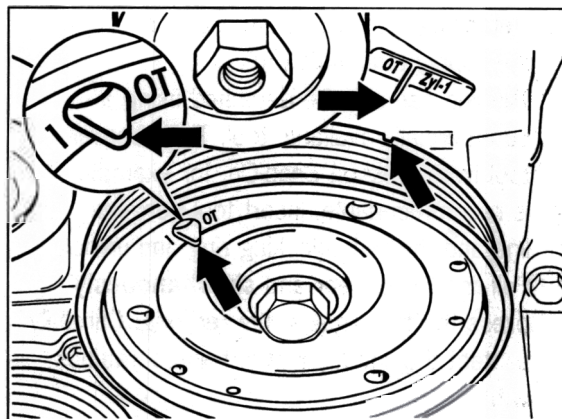
24. Remove vacuum tank.

25. Remove knock sensors.

26. Remove holders for rear muffler.



022\_98



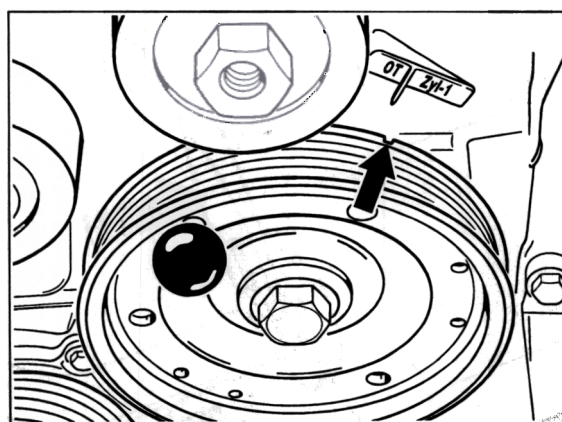
166\_98

27. Remove shields from cylinder heads.

28. Remove ignition coils

29. Remove exhaust manifold.

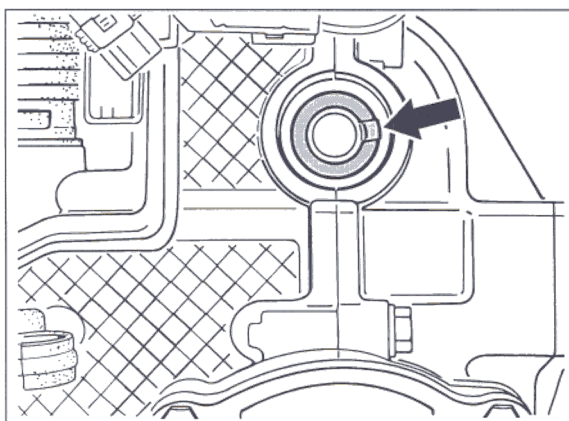
30. Turn crankshaft clockwise until the bore 1 OT (top dead centre) in the belt pulley is aligned with the fixing bore on the crankcase. Position or fix with fixing pin (short) of special tool 9595/1.



155\_98



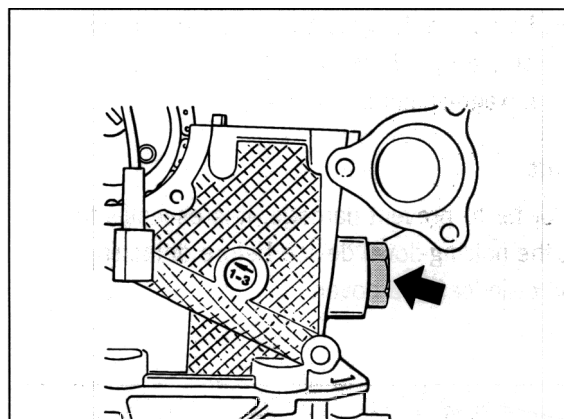
31. Check basic camshaft position of **cylinder bank 1 - 3**. Remove closure cap. The closure cap of cylinder bank 1 - 3 is located on the **flywheel side**. Ensure that the groove in the camshaft faces outward toward the cylinder head cover.



View from the flywheel side

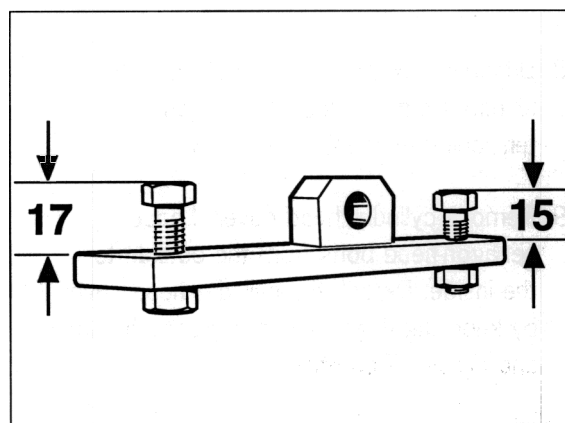
625\_97

32. If the position of the camshafts is incorrect, remove fixing pin at the pulley and rotate the crankshaft 360° clockwise.
33. Relieve camshaft drive chains. Unscrew chain tensioner of **cylinder bank 1 - 3**. ("2 rings" identification on hexagon of chain tensioner and on cylinder head, a/f 32 mm).



665\_97

34. Pull off camshaft closure caps at **pulley side** of cylinder head 1 - 3.
35. Prepare special tool, holding-down device 9643, for installation: Unscrew hexagon socket head bolts and replace with M8 x 25 hexagon-head bolts. Adjust insertion depth. Insertion depth for inlet camshaft 15 mm, insertion depth for outlet camshaft 17 mm.

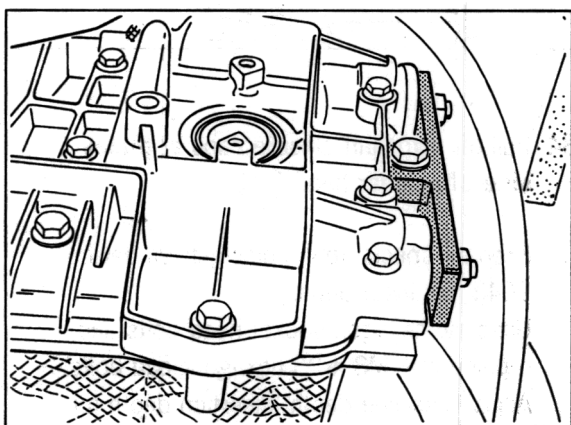


550\_98

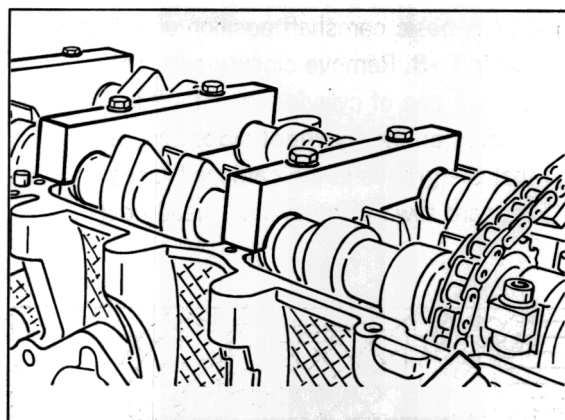
36. Fit special tool, holding-down device 9643, on the cylinder head and fasten with a hexagon-head bolt M8 x 30.

**Note**

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

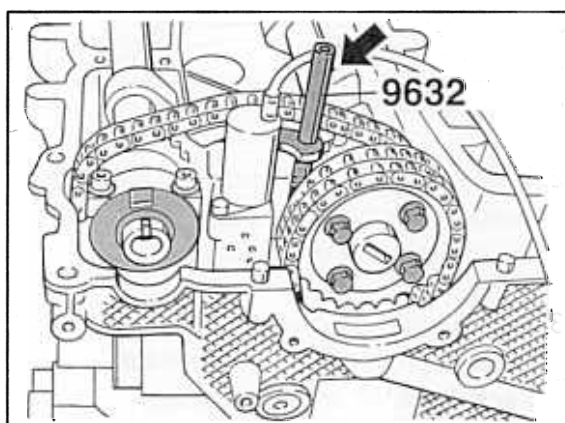


721\_97



218\_97

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



630\_97

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

38. Unscrew hexagon-head bolts M6 x 20 (2 ea.). Remove closure cap from tensioning element (VarioCam).

39. Remove cylinder head cover. Loosen 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.

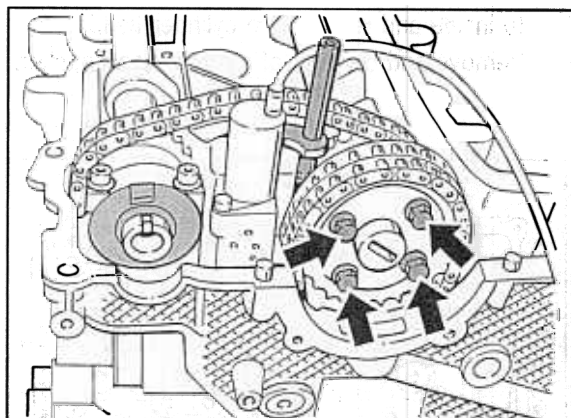
40. Fasten special tool 9611, holding-down device for camshafts, with auxiliary screws M6 x 45.

**Note**

Screw in tensioning screw only so far as to slightly relieve the chain.

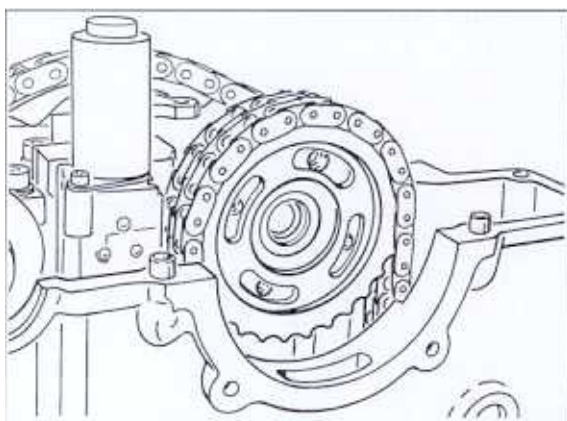
42. Unscrew three fastening screws (M6 x 95) on tensioning element.

43. Undo four hexagon-head bolts (M6 x 15) on the chain sprocket.



663\_97

44. Remove drive plate and sprocket wheel.

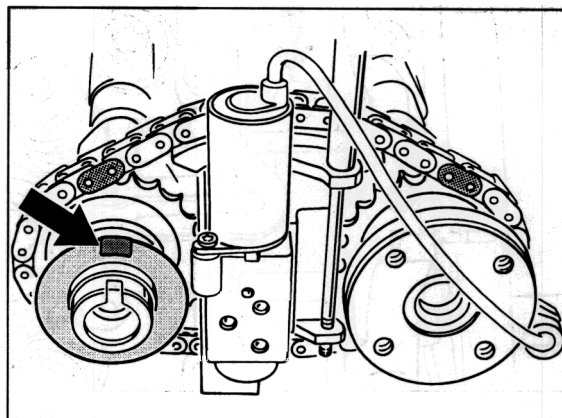


500\_96

45. Detach two bearing saddles. Lever bearing saddles out of the guide sleeves.

46. Remove holding-down device (special tools 9611 and 9643).

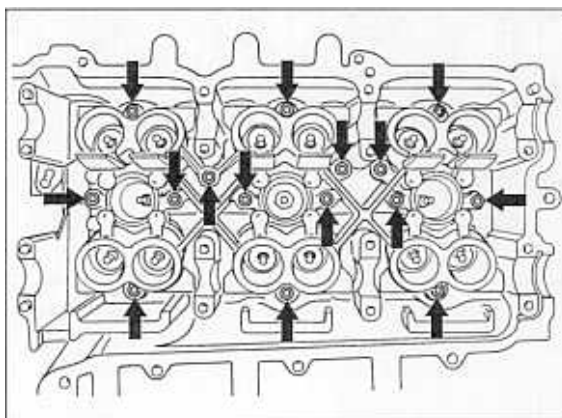
47. Carefully lift the complete unit, camshafts with chain and tensioning element out of the cylinder head. The chain must not jump over. Perform reallocation during refitting if necessary.



246\_97

48. Remove valve tappets.

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



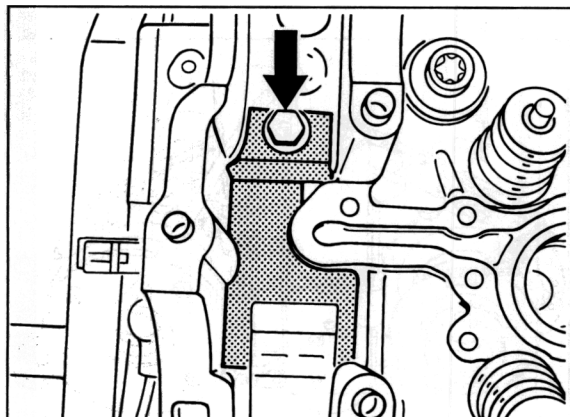
659\_97



50. Undo oil baffle (hexagon-head bolt M6 x 16).

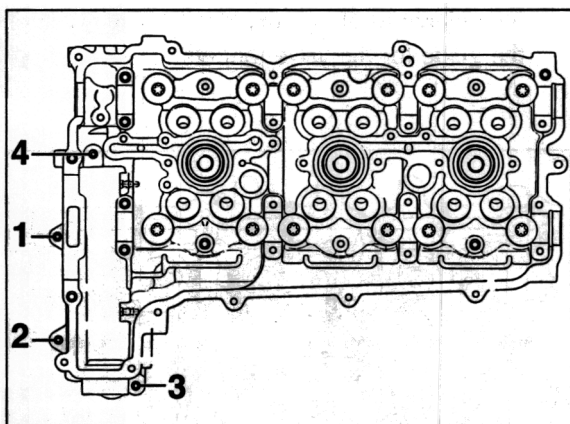
**Note**

The oil baffle is fitted only on cylinder head 1 - 3.



493\_97

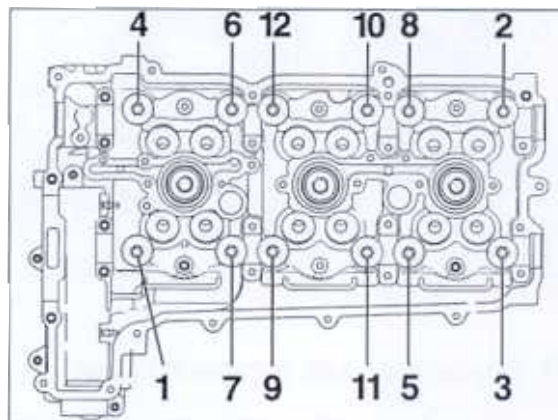
51. Unscrew four pan-head screws M6 x 35 (with captive washers) in the area of the chain box.



541\_98

52. Undo the upper fastening screw for guide rails. Use a 6 mm Allen key.

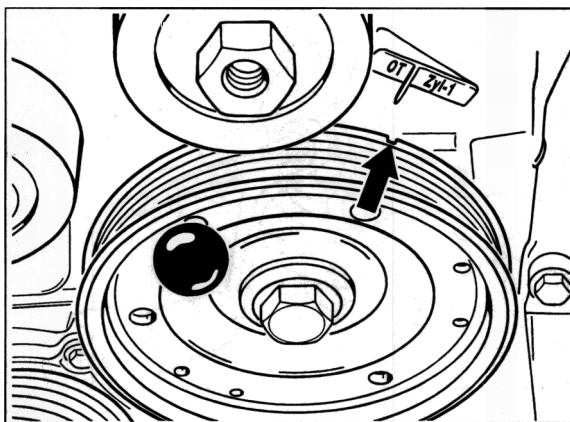
53. Loosen cylinder head screws from outside to inside and remove the cylinder head. Remove and dispose of cylinder head gasket.



540\_98

54. Remove cylinder head **from cylinder bank 4 - 6.**

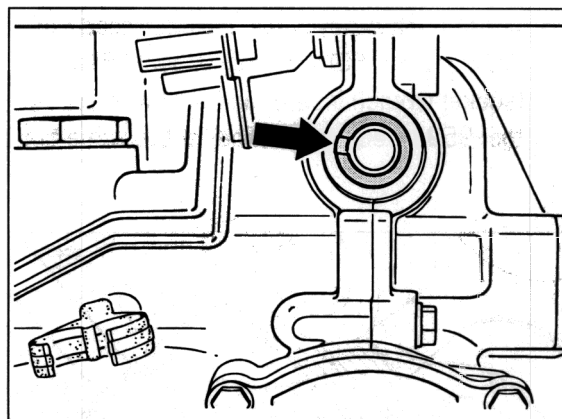
Advance crankshaft 360° clockwise until the bore 1 OT (top dead centre) in the belt pulley is aligned with the fixing bore on the crankcase. Position or fix with fixing pin (short) of special tool 9595.



155\_98

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

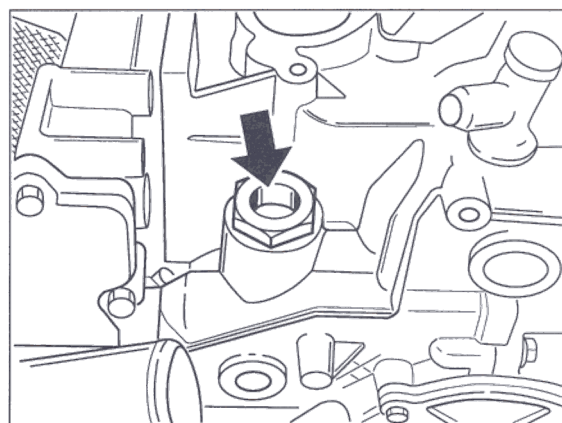
The groove in the camshaft must face inward toward the crankcase.



View from the belt pulley side

624\_97

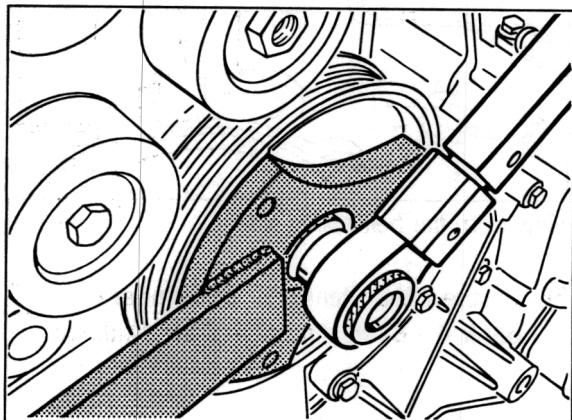
56. Unscrew chain tensioner of **cylinder bank 4 - 6**. Identification "Ohne" (without)



549\_98

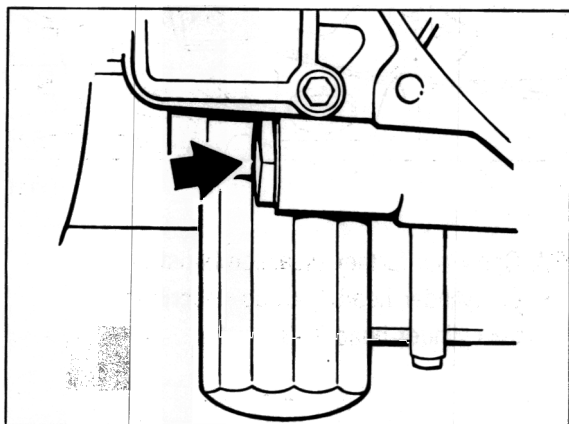
57. Carry out further disassembly steps on cylinder head 4 -6, as described for cylinder head 1 -3.

58. Loosen belt pulley. Undo hexagon-head bolt (M16 x 1.5 x 60) with special tool 9594 (socket wrench insert), and hold with special tool 9593 (retaining device) at the same time.



252\_97

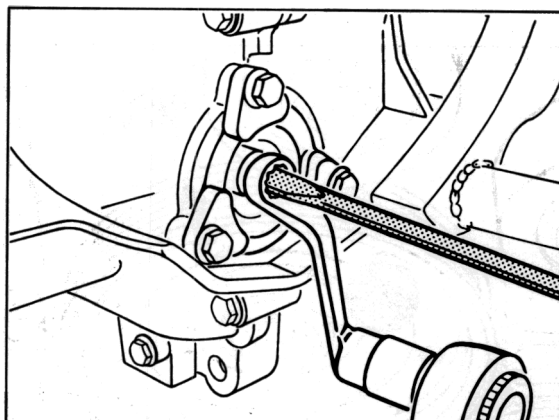
59. Turn primary chain tensioner out of the crankcase (cylinder bank 4 - 6).  
"1 Ring" identification



62\_98

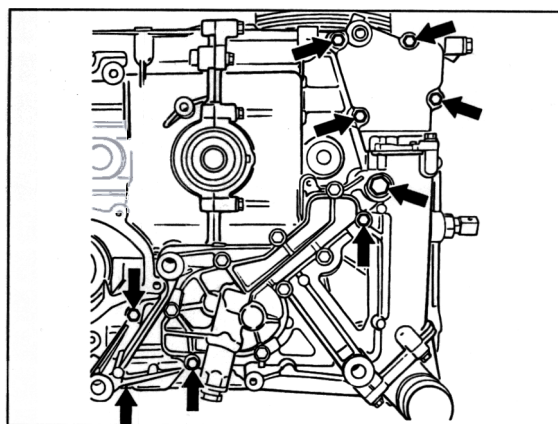
60. Undo intermediate shaft flange.

Unscrew the three fastening screws M6 x 20 on the intermediate-shaft flange. Undo the lock nut with the special tool 9110 (socket wrench insert) and hold with a screwdriver 7.0 x 1.1 at the slotted threaded pin at the same time.



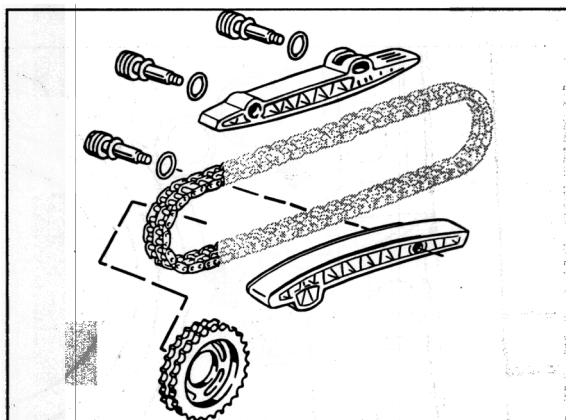
442\_97

61. Remove coolant guide housing with oil pump. Pull hexagon oil pump driver out of intermediate-shaft flange.



597\_97

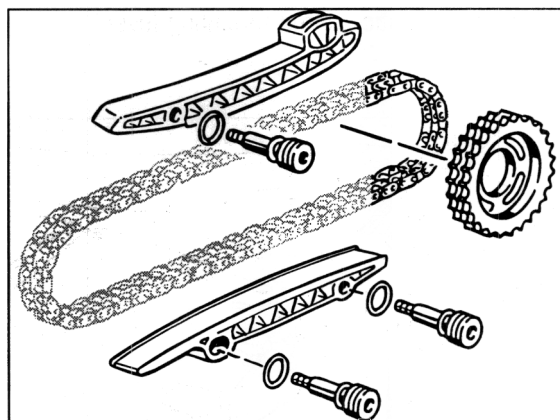
62. Detach guide rail and tensioning rail of **cylinder bank 1 - 3** (flywheel side).



View from the belt pulley side

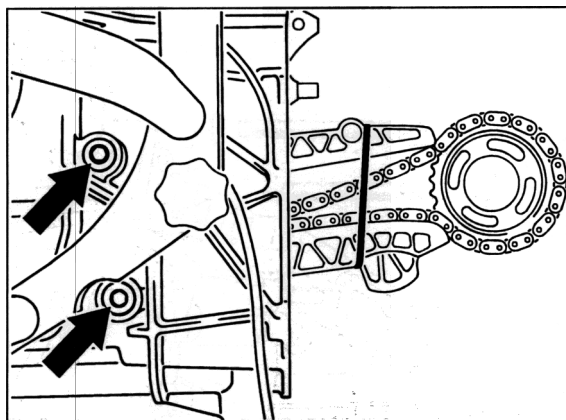
71\_98

63. Detach slide rails and tensioning rails of **cylinder bank 4 - 6** (flywheel side).



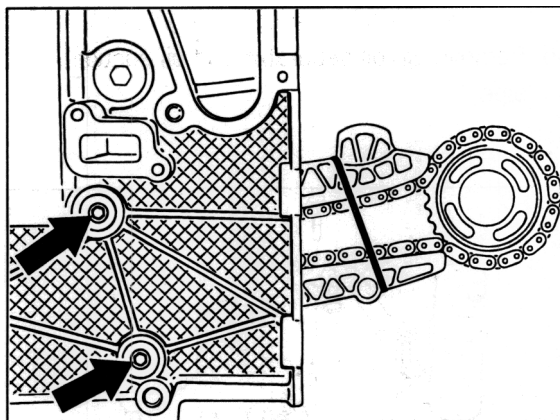
View from the belt pulley side

72\_98



View from the flywheel side

469\_97

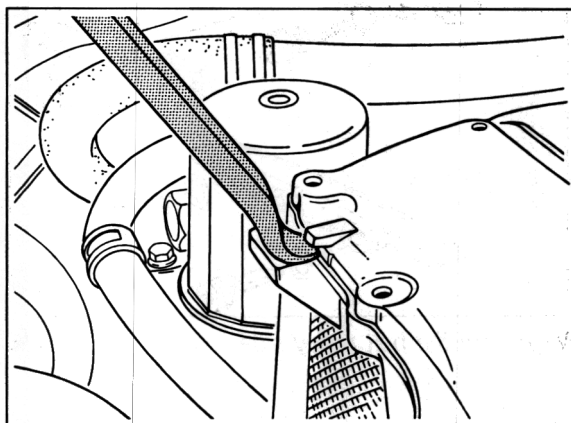


View from the belt pulley side

073\_98

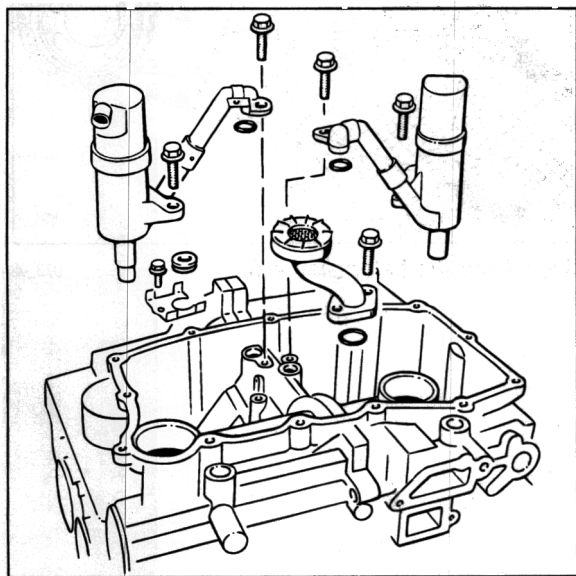


64. Turn crankcase by 180°. Undo oil pan fastening screws (M6 x 16, 13 ea.). Detach oil pan by tapping it at the sides with a plastic hammer and lever the oil pan off at the leverage bar using a plastic-coated mounting lever.



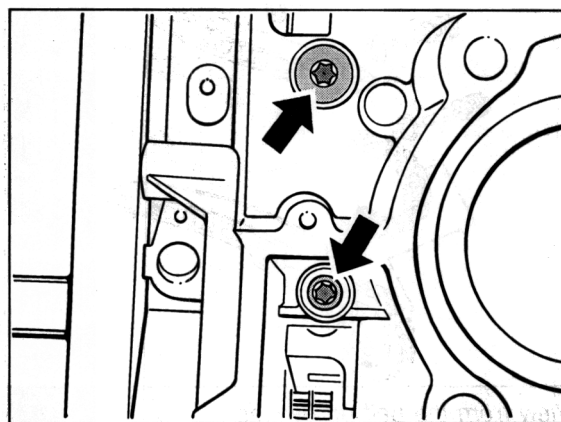
538\_98

65. Remove air/oil separator and oil suction pipe.

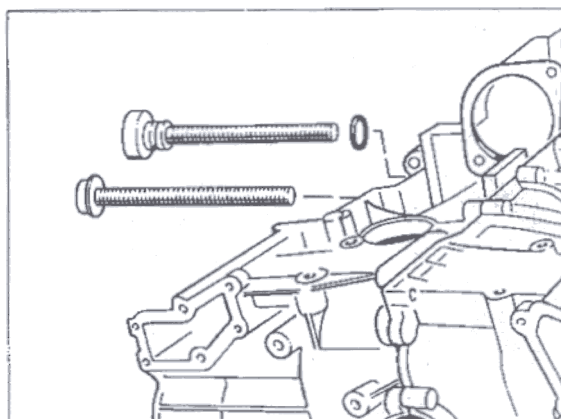


542\_98

66. Turn crankcase by 180°. Undo fastening screws between crankcase half of **cylinder bank 1 - 3** and bearing housing.

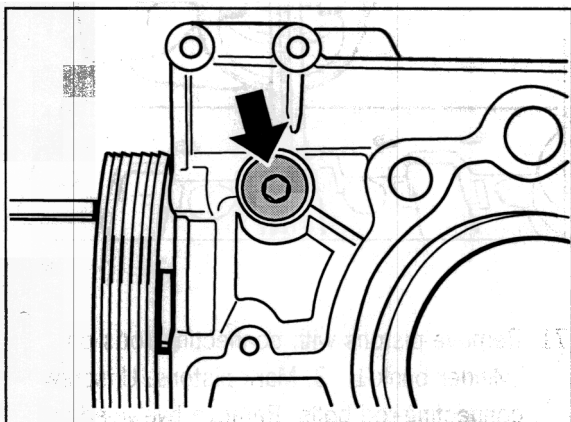


594\_97

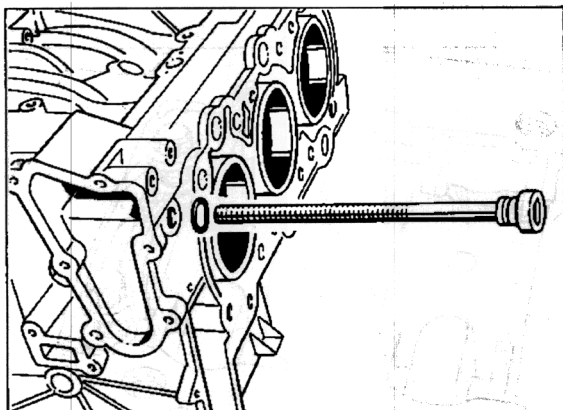


496\_96

67. Undo fastening screw between crankcase half of **cylinder bank 4 - 6** and bearing housing.



57\_98



495\_96

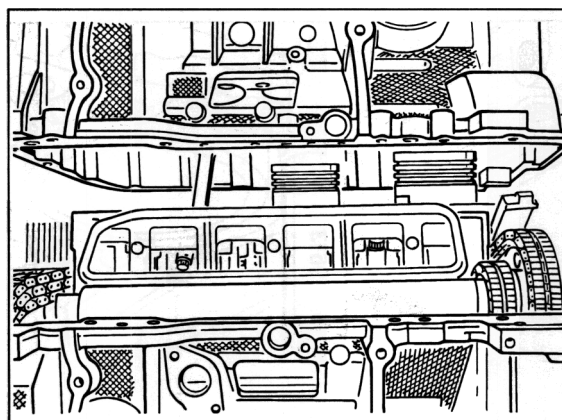
68. Turn crankcase 90° further. Crankcase half of **cylinder bank 4 - 6 faces upward**. Undo hexagon-head bolts (M6 x 35, 24 ea.) joining the crankcase halves.



**Warning:**

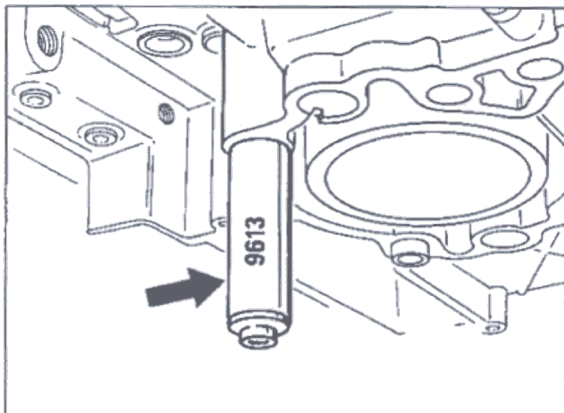
**Danger of damage to pistons if crankcase half is tilted!**

- > Do not tilt crankshaft half
- > Lift the crankcase half up and off
- > Two people required to remove crankcase half



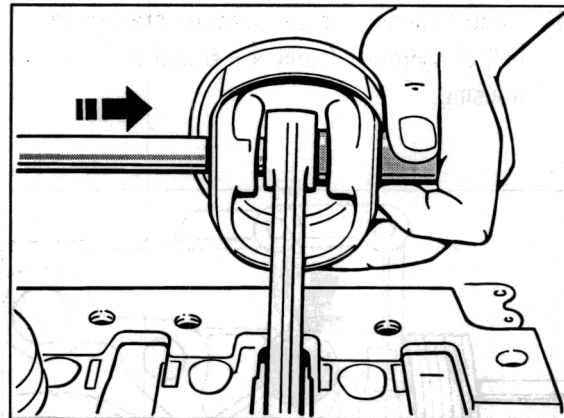
608\_97

69. For the following disassembly procedure, the crankcase half and bearing housing unit must be held by at least two screwed connections for safety reasons. For this purpose, fasten two original cylinder head screws and plastic spacer sleeves, special tool 9613, from below. Tightening torque approx. 20 Nm (15 ftlb.). Use Torx screwdriver insert T50 or T55.



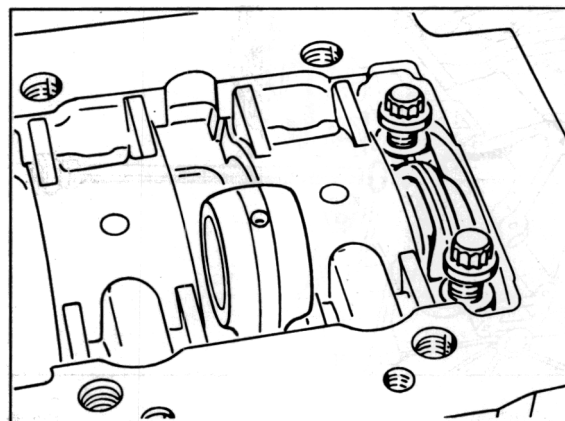
491\_96

70. Identify pistons of cylinder 4 - 6. Lever off front piston pin circlip. Push out piston pin. Allocate the same corresponding pistons to the piston pins again after disassembly.



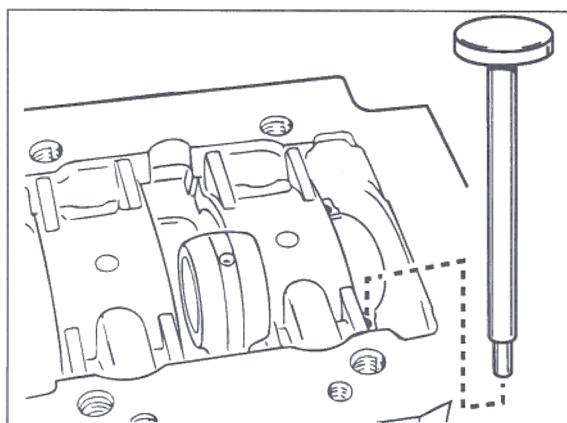
593\_97

71. Remove pistons with connecting rods on cylinder bank 1 - 3. Mark pistons. Unscrew connecting-rod bolts. Remove twelve-edged socket wrench insert a/f 14 mm and connecting-rod bearing cap.



506\_97

72. Push connecting rod with piston downwards out of the cylinder using a shop-made plastic mandrel.

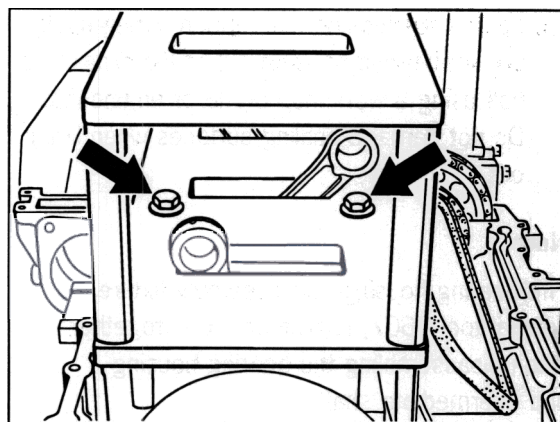


551\_98

### Note

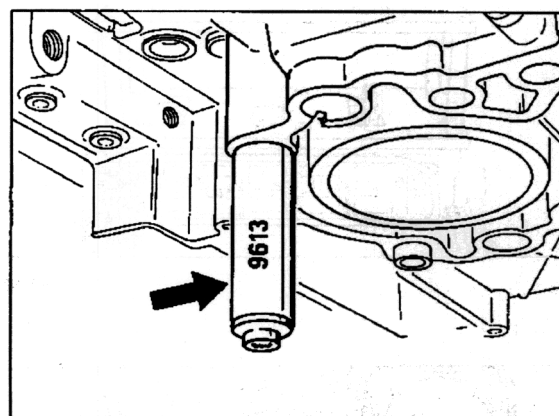
Join connecting rod and connecting-rod bearing cap again immediately after removal. The connecting-rod bearing caps must **always remain allocated** to the respective connecting rods and **must never be interchanged**.

73. Fasten assembly fixture (special tool 9607) on the bearing housing with two M10 x 25 hexagon-head bolts.



581\_97

74. Remove plastic spacer sleeves, special tool 9613 again.



491\_96

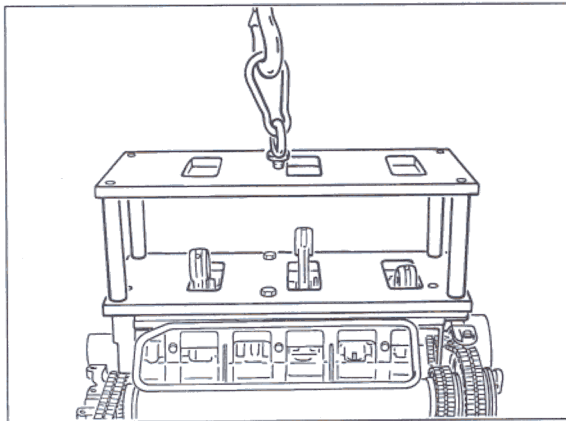
75. Fasten suspension eye, attach spring hook, and lift bearing housing out of the crankcase half using a workshop crane or engine lifter. Do not damage sealing surfaces when lifting out.

76. Disassemble bearing housing on intermediate shaft. See Group 13, Page 13 - 23.

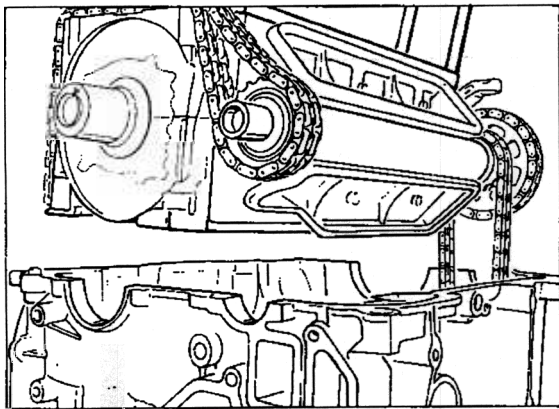
77. Remove crankcase half cylinder bank 1 - 3 from the engine holder.

#### Note

The bearing housing and assembly fixture, special tool 9607, remain screwed together when disassembling the bearing housing and intermediate shaft.



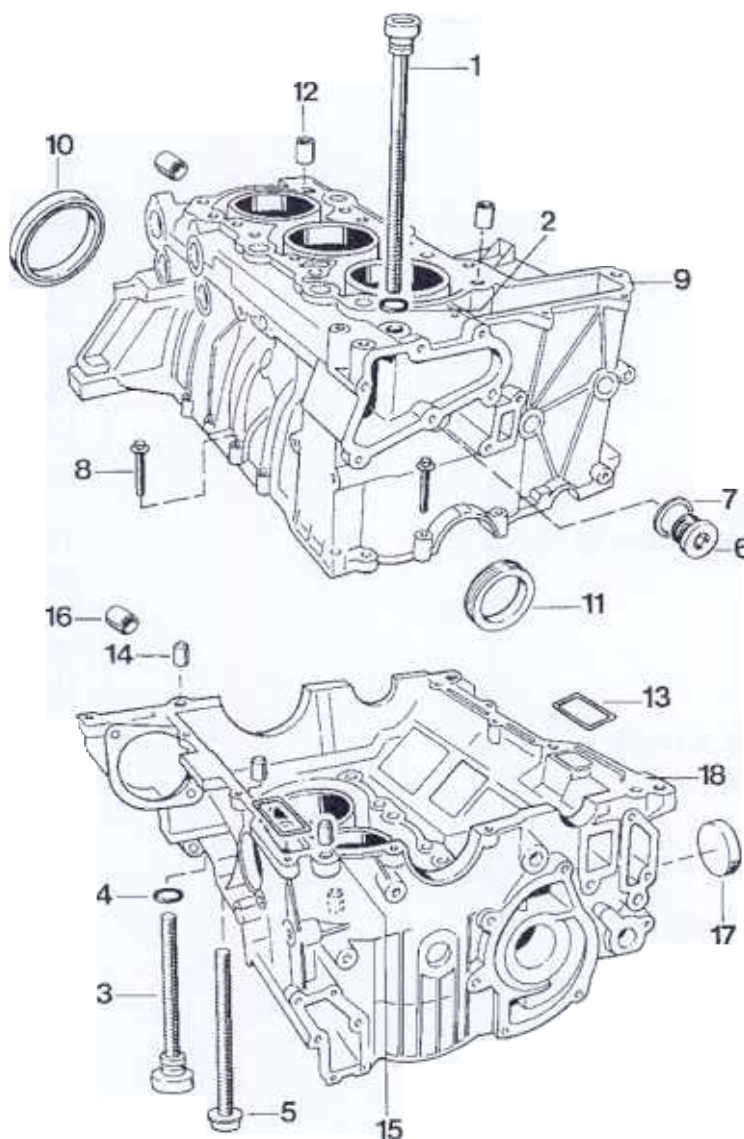
345\_97



484\_96



## 10 10 37 Disassembling and assembling crankcase halves



420\_g\_96

## Disassembling and assembling crankcase halves

| No. | Designation   | Qty. | Removal | Note:<br>Installation  |
|-----|---|------|---------|--|
| 1   | Fastening screw for bearing housing M9 x 150                      | 1    |         | Tighten only after the cylinder heads have been fastened. Tightening torque 22 Nm (16 ftlb.) |
| 2   | O-ring 12 x 2   | 1    |         | Always replace   |
| 3   | Fastening screw for bearing housing M9 x 94                       | 1    |         | Tighten only after the cylinder heads have been fastened. Tightening torque 22 Nm (16 ftlb.) |
| 4   | O-ring  | 1    |         | Always replace   |
| 5   | Fastening screw for bearing housing                               | 1    |         | Tighten only after the cylinder heads have been fastened. Tightening torque 22 Nm (16 ftlb.) |
| 6   | Screw plug for assembly bore of the piston pin M27 x 2            | 1    |         | Tightening torque 80 Nm (59 ftlb.)   |
| 7   | Sealing ring A27 x 32   | 1    |         | Always replace   |
| 8   | Hexagon-head bolts for screwing together crankcase halves M6 x 35 | 25   |         | Tightening torque 13 Nm (10.0 ftlb.)<br>Refer to assembly instructions for sequence          |
| 9   | Crankcase half, cylinder bank 4 - 6                               | 1    |         | Apply a silicone bead on the sealing surface; see Assembly instructions                      |
| 10  | Sealing ring  | 1    |         | Replace; fit with insertion tool, special tool 9609  |
| 11  | Sealing ring  | 1    |         | Replace; fit with assembly sleeve – special tool 9610  |
| 12  | Dowel sleeve 17 M6 x 18.5   | 4    |         |  |



| No. | Designation                         | Qty. | Removal   | Note: | Installation   |
|-----|-------------------------------------|------|---|-------|--|
| 12  | Dowel sleeve 17 M6 x 18.5           | 4    |   |       |  |
| 13  | Gasket                              | 2    |   |       | Replace  |
| 14  | Cylindrical pin 12 x 22             | 3    |   |       |  |
| 15  | Dowel sleeve                        | 2    |   |       |  |
| 16  | Dowel sleeve                        | 1    |   |       |  |
| 17  | Closure cap                         | 1    |   |       |  |
| 18  | Crankcase half, cylinder bank 1 - 3 | 1    | For disassembly, fasten to engine holder, special tool 9589 |       | For assembly, fasten to engine holder, special tool 9689 |

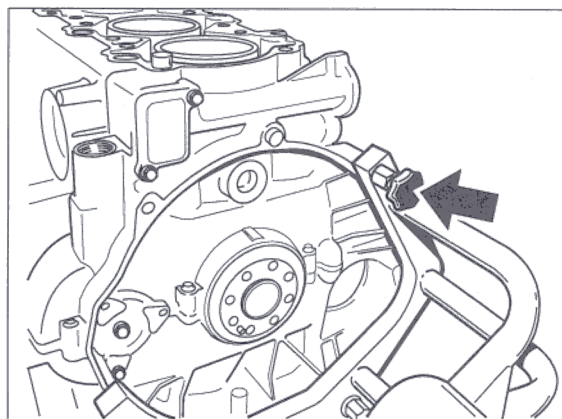
## Assembly instructions

### Separating crankcase halves

#### Note

"Loctite 5900" sealant is used to seal the crankcase halves. This makes it somewhat more difficult to separate the crankcase halves. The sealant can be recognised by its "black" colour.

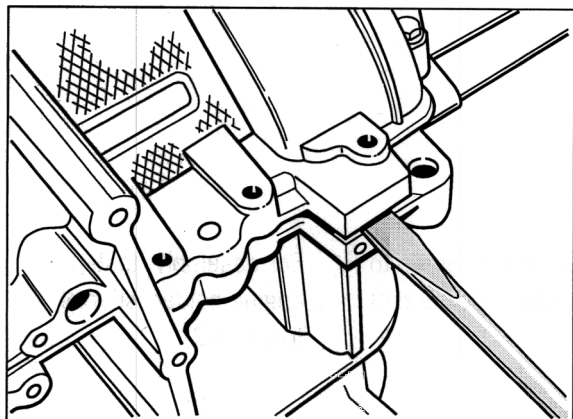
1. Undo ring-edge bolt.
2. Undo the third fastening point on the crankcase half cylinder 4 - 6 of the engine support, special tool 9589.



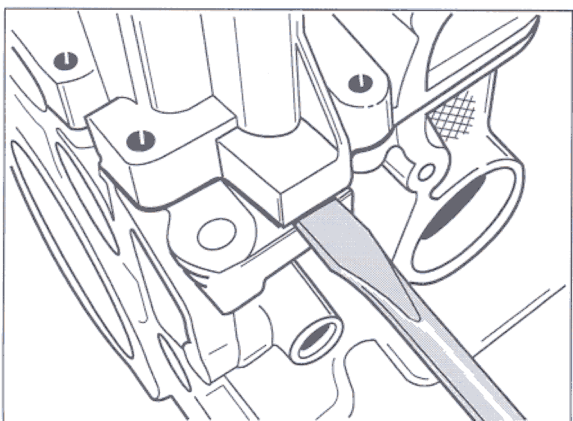
567\_98

3. Use a slotted screwdriver with a tip which is 14 mm wide and 250 mm long to separate the crankcase halves.

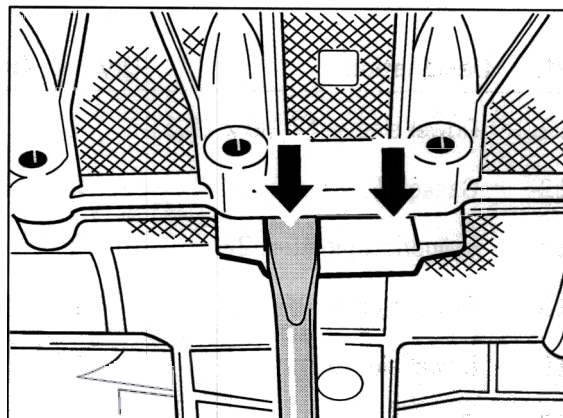
4. Insert the screwdriver in the lugs of the crankcase halves and separate the crankcase halves by tapping gently. Alternate the sides during separation.



10100016



10100017



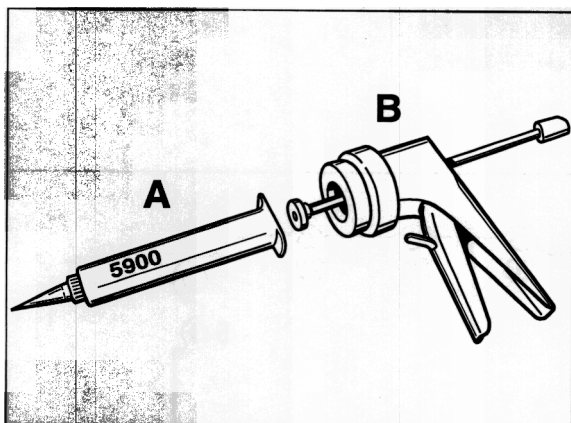
10100018

### Assembly instructions

#### Sealing of crankcase halves

Only "Drei Bond silicone type 1209" and "Loctite 5900" should be used for surface sealing. After application of surface seals (silicone bead), screw together within five minutes.

### Application of silicone bead

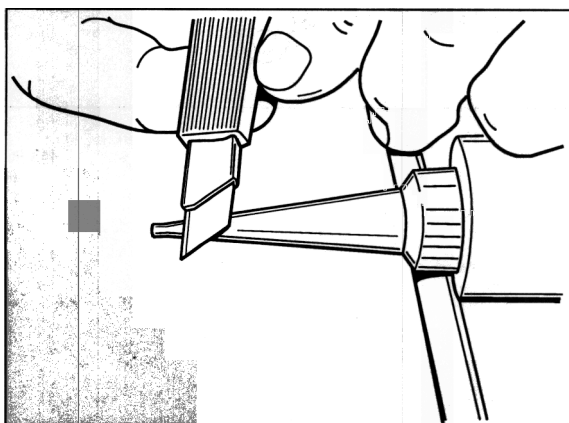


10100013

A = Surface seal Loctite 5900

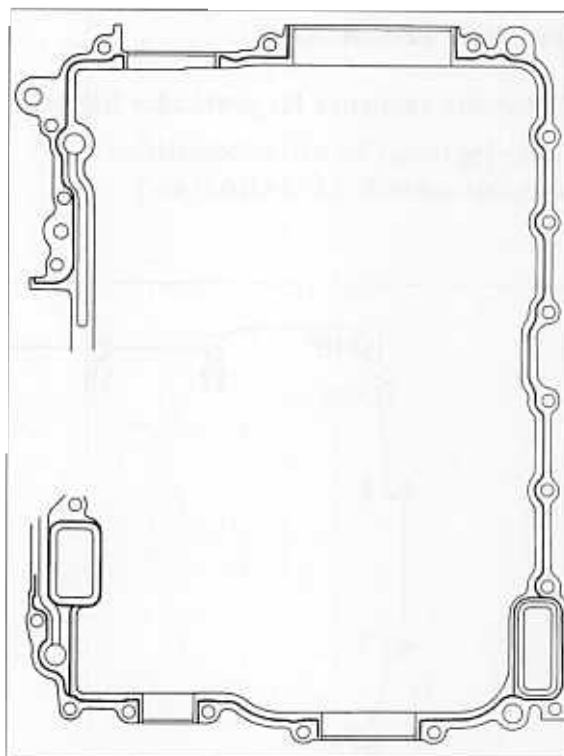
B = Metering pistol, refer to Workshop Equipment Manual, Chapter 2.4, No. 75-1

1. At the processing nozzle, cut off the first metering step at an angle.



10100012

2. Apply a uniform bead approximately 1.5 mm wide to the cleaned sealing surface of the crankcase half (**cylinders 4 - 6**).



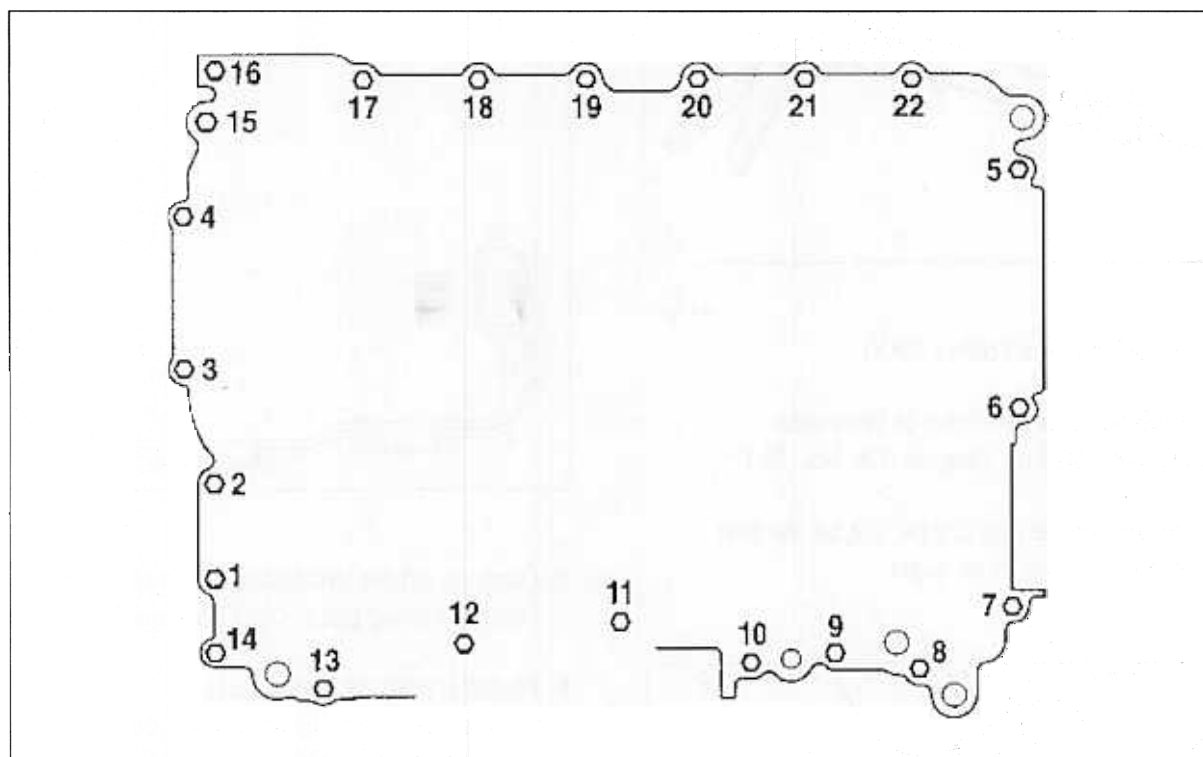
515\_1\_97

3. Carefully set the crankcase half in place so that the sealing bead is not damaged.
4. Fasten crankcase. Always use micro-encapsulated hexagon-head bolts. Tightening torque 13 Nm (7.5 ftlb.). Observe tightening sequence.

## Assembly instructions

### Tightening sequence for crankcase halves

Tightening torque for micro-encapsulated  
hexagon-head bolts 13 Nm (10.0 ftlb.)



443\_96

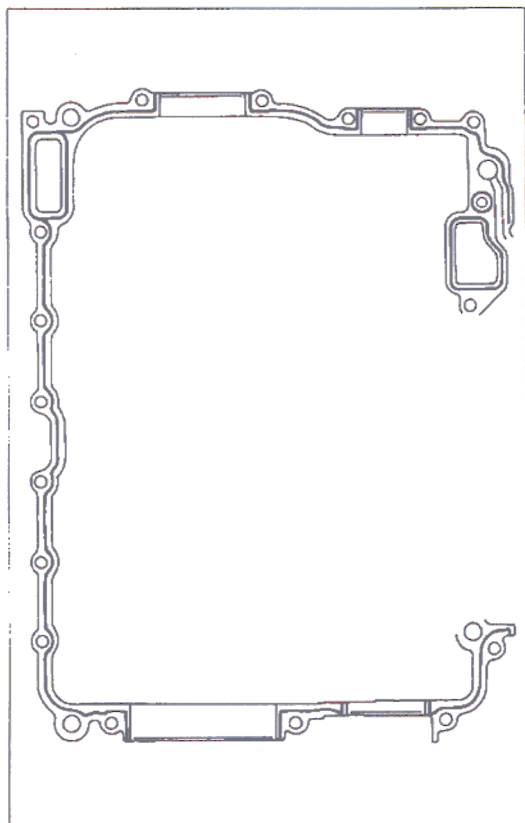


| No. | Designation                            | Qty. | Removal   | Note:<br>Installation  |
|-----|--|------|---|--|
| 13  | Gasket                                 | 2    |   | Replace  |
| 14  | Cylindrical pin 12 x 22                | 3    |   |  |
| 15  | Dowel sleeve                           | 2    |   |  |
| 16  | Dowel sleeve                           | 1    |   |  |
| 17  | Cap                                    | 1    |   |  |
| 18  | Crankcase half,<br>cylinder bank 1 - 3 | 1    | For disassembly, fasten to<br>engine holder, special tool<br>9589 | For assembly, fasten to<br>engine holder, special<br>tool 9689 |

## Assembly instructions

### Sealing of crankcase halves

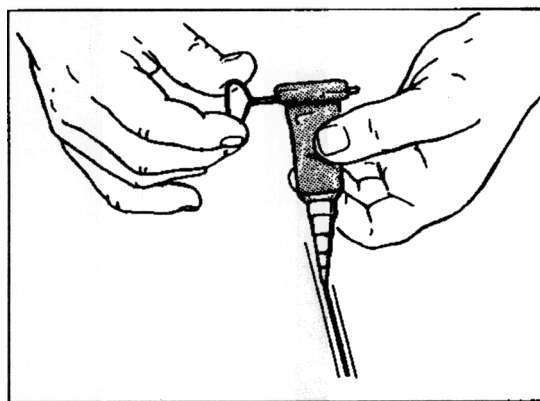
Only Drei Bond silicone type 1209 should be used for surface sealing. After application of surface seal (silicone bead), screw together within five minutes.



444 - 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 crankcase half (cylinders 4 - 6).
3. Carefully set the crankcase half in place so that the sealing bead is not damaged.

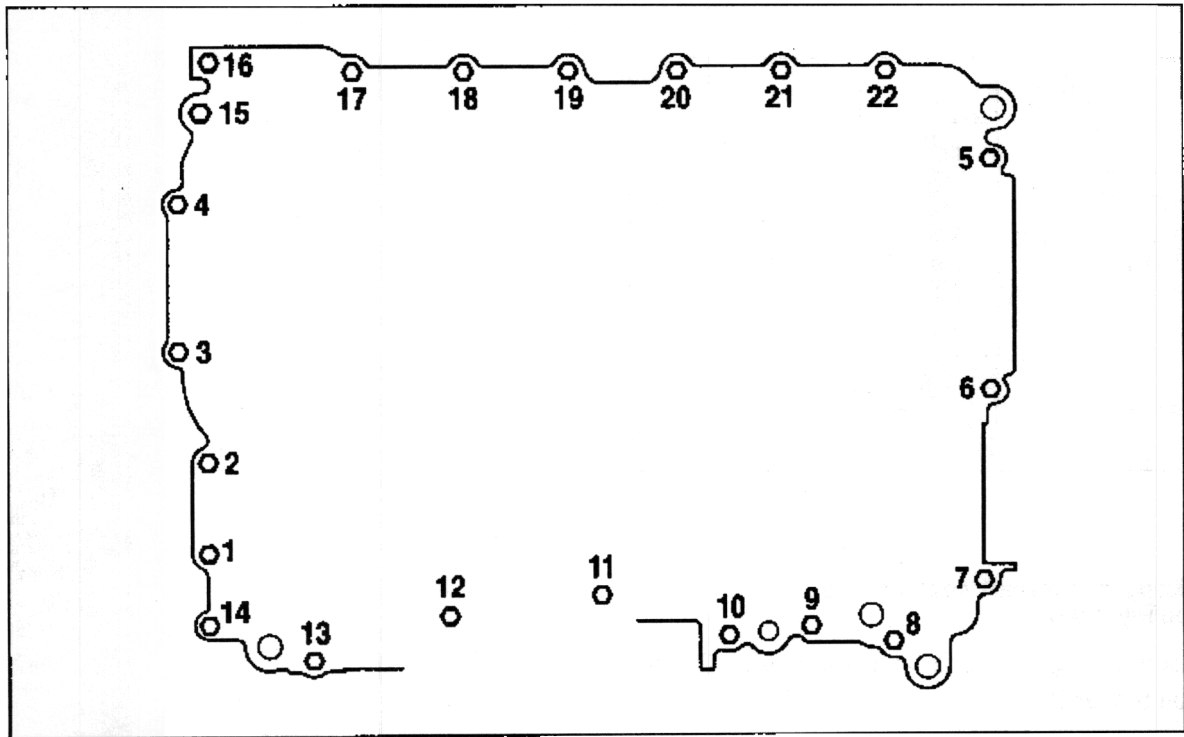


486 - 96

## Assembly instructions

### Tightening sequence for crankcase halves

Tightening torque for hexagon-head bolts 13 Nm (10.0 ftlb.)



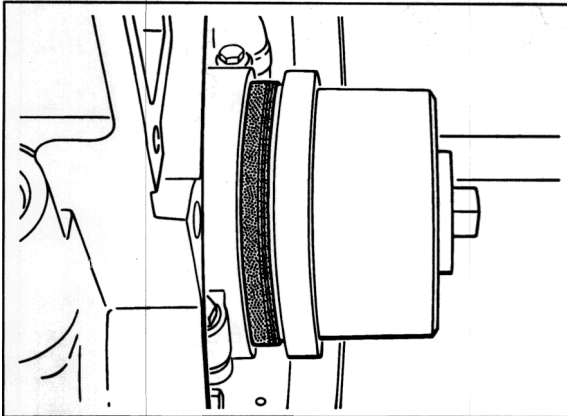
443g - 96



## Assembly instructions

### Fitting crankshaft sealing ring (flwheel side)

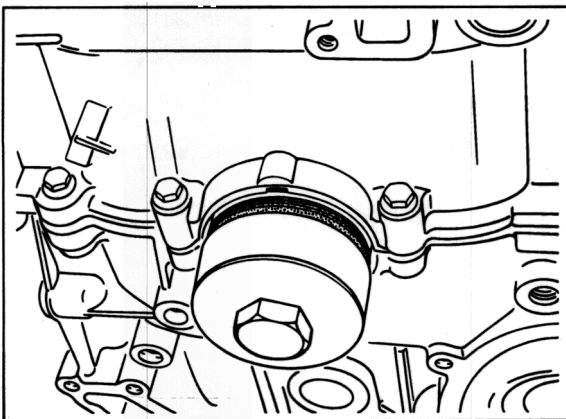
Insert sealing ring as far as it will go using insertion tool 9609.



240 - 97

### Fitting crankshaft sealing ring (pulley side)

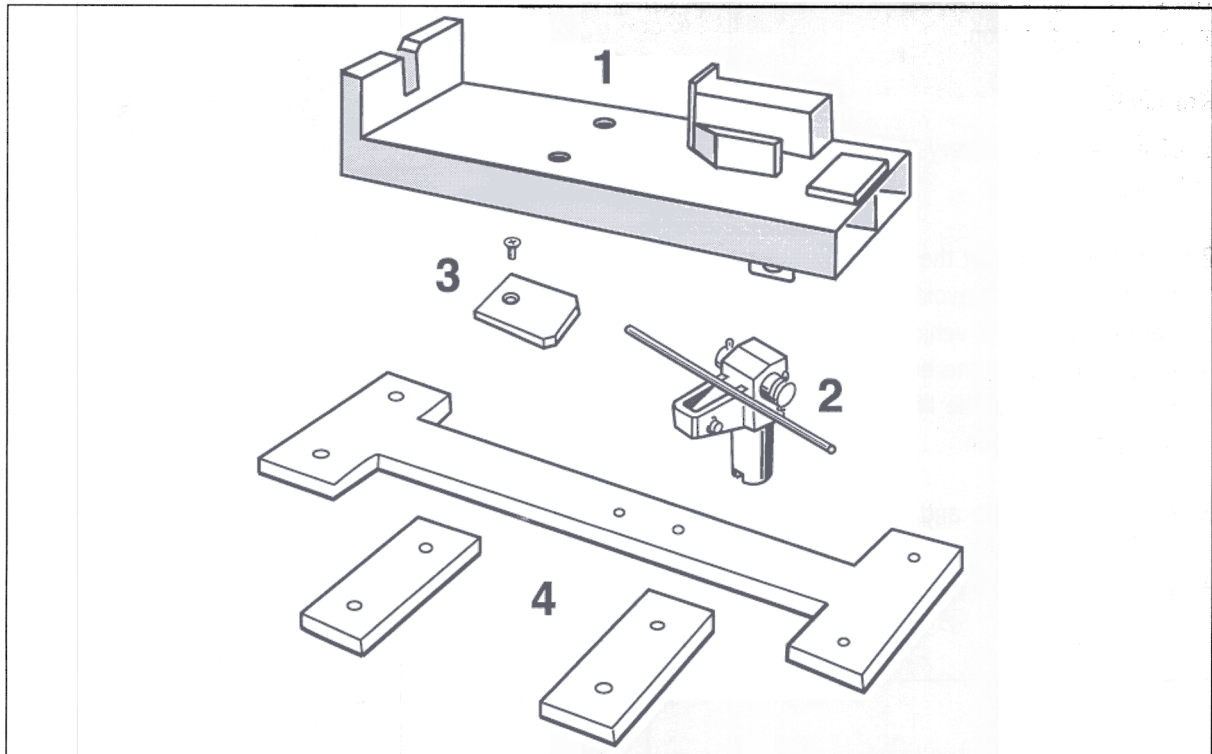
Insert sealing ring as far as it will go using insertion tool 9610.



210 - 97

## 10 01 19 Removing and installing engine – GT3

### Special tools



84\_99

| 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       |  |

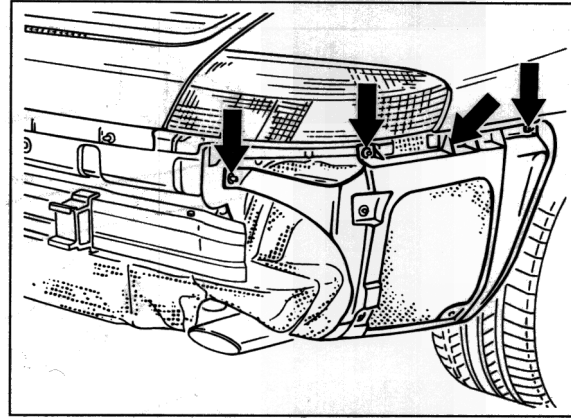
## 10 01 19

### Removing and installing engine – GT3

The entire engine-transmission unit is removed in downward direction.

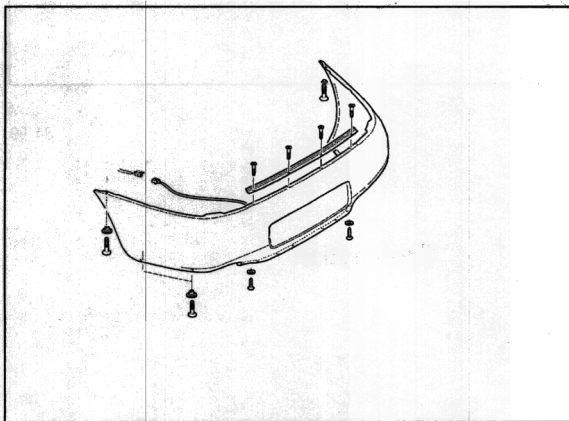
#### Removal

1. Disconnect the battery and cover terminal or battery.
2. Raise the vehicle at the prescribed jacking points. In order to avoid damage to the side member, raise the vehicle by means of a workshop jack on the engine and move the mounting plate of the lifting platform into the highest position.



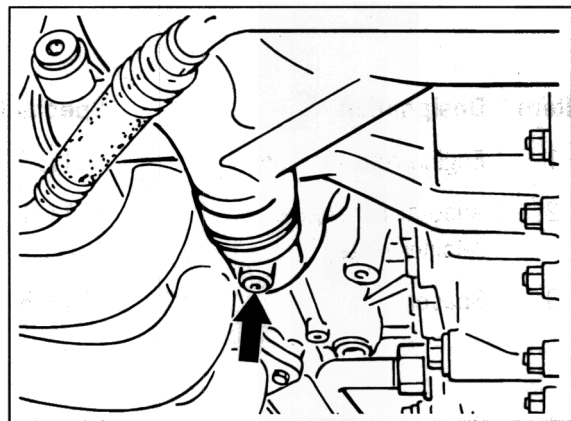
279\_97

3. Remove the centre and rear underside panels.
4. Remove rear spoiler.



363\_97

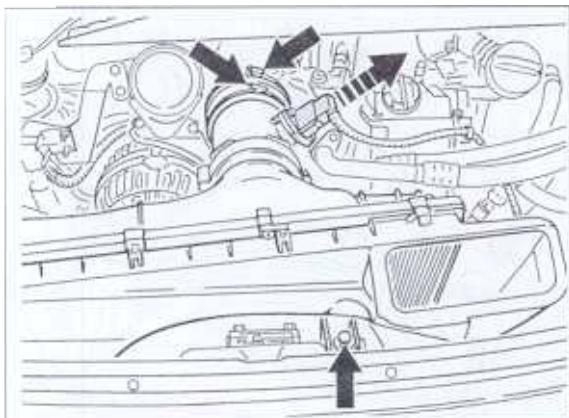
6. Unscrew cap from coolant expansion tank.
7. Undo coolant drain plug on right and left and drain the coolant. After draining the coolant, fit new sealing rings on the drain plug.  
Tightening torque 10 + 5 Nm  
(7.5 + 3.5 ftlb.)



186\_99

5. Remove side retaining brackets (heat shield).

8. Remove the air cleaner assembly. Undo hexagon-head bolt M6 x 34. Undo hose clamps on throttle body and pull plug off the mass air flow meter.



058\_99

9. Disconnect oxygen sensor plug connections on the rear closing panel.

10. Remove right and left-hand coolant hose, lever off safety bracket to do this. Remove coolant hose on the expansion tank.

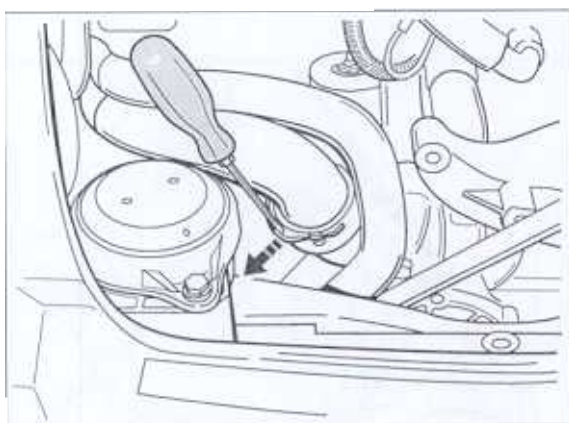
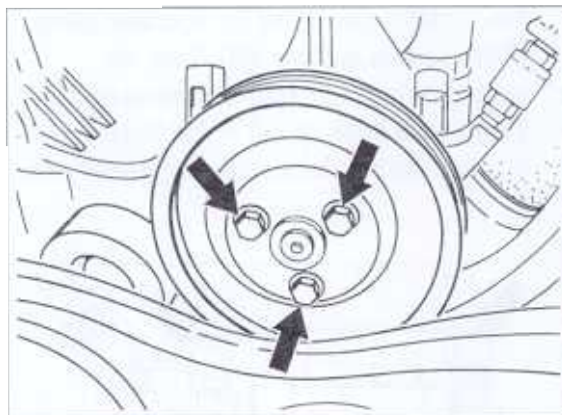


Illustration shows left-hand coolant hose

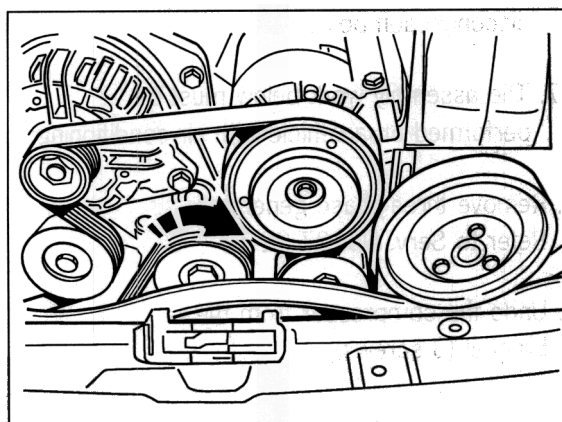
54\_99

11. Undo three hexagon-head bolts on the hydraulic pump by approx. one half turn.



060\_99

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

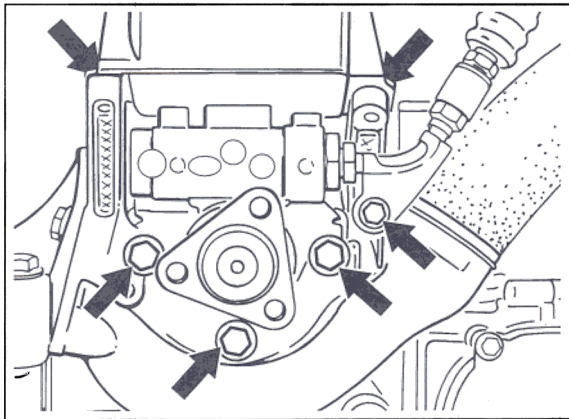


82\_99

13. Remove pulley of the hydraulic pump.



14. Unclip electric cable from the air flow sensor on the expansion tank of the hydraulic pump.
15. Undo fastening screws on the expansion tank (2 M8 screws) and the hydraulic pump (3 M8 screws and one M6). Take the expansion tank with hydraulic pump and **connected lines** up out of the fastening bracket and set down on the right-hand side.

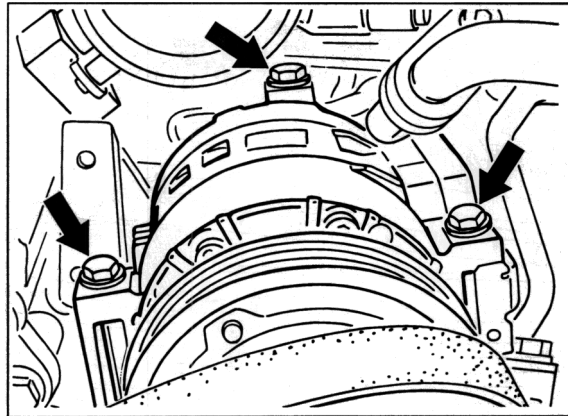


059\_99

16. Disconnect battery positive at B+ disconnection point.
17. The assembly work below must be performed on a vehicle with air conditioning:
  - a. Remove three-phase generator. Refer to Serv. No. 27 22 19
  - b. Undo the compressor from the bracket (3 screws).

#### Note

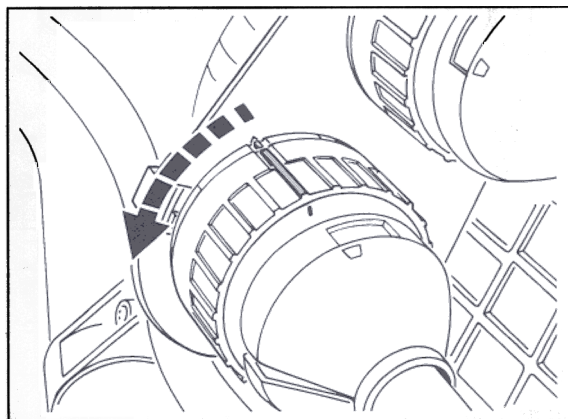
The throttle body can be swung upward for better accessibility to the front screw. To do this, both inner hose clamps must be removed.



061\_99

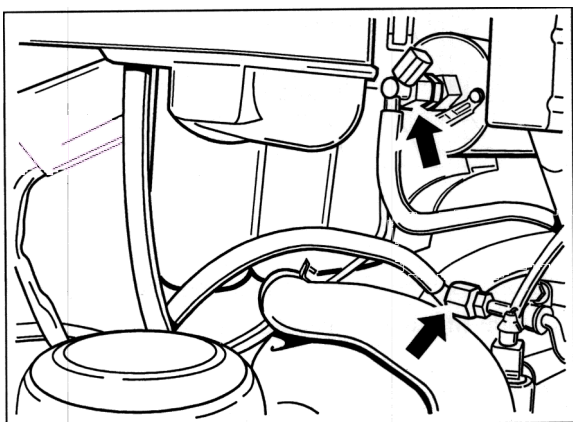
- c. Disconnect electrical plug connection. Lift out compressor and set it down with the hoses connected.

18. Undo engine wiring harnesses (round connectors with bayonet lock) on the right side in the engine compartment.



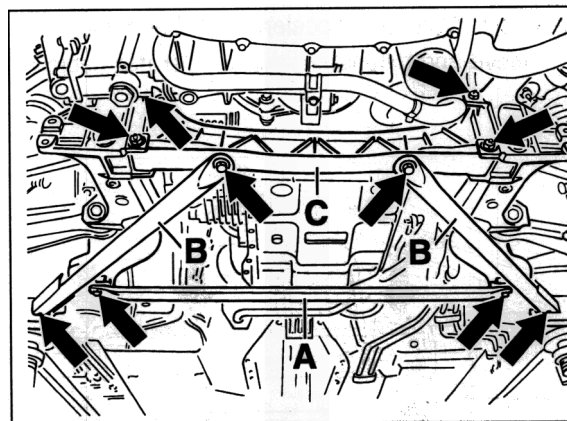
360\_97

19. Disconnect plug connection of tank vent.  
Press unlocking buttons and simultaneously pull off the line.
20. Disconnect the vacuum line for the brake booster. To do this, remove the snap ring. Push the inner sleeve against the outer sleeve and pull off both sleeves together towards the rear.
21. Undo the fuel supply line and fuel return line in the engine compartment (left). It is very important to counter when performing this step. Collect residual fuel.



55\_99

22. Raise the vehicle and remove the stabilizer, rear-axle drive shafts, diagonal braces, and front and rear cross members.

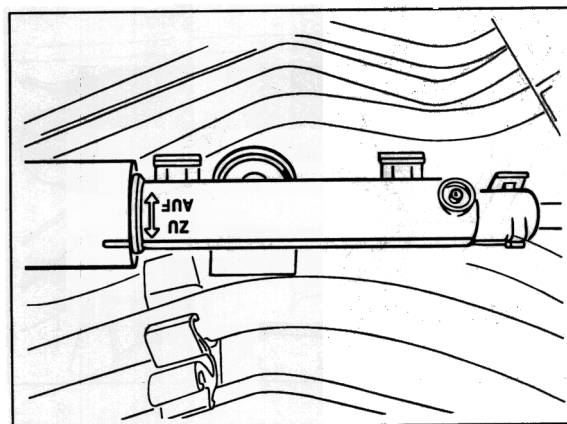


336\_97

#### Note

Drill an access bore of approx. 30 mm Ø on the side members for better access to the outer fastening screws on the diagonal braces.

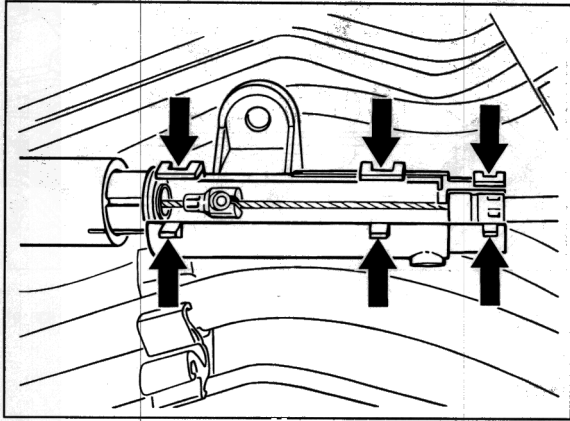
23. Undo accelerator cable. To do this turn the left-hand rotary sleeve in the direction indicated by the arrow.



266\_97

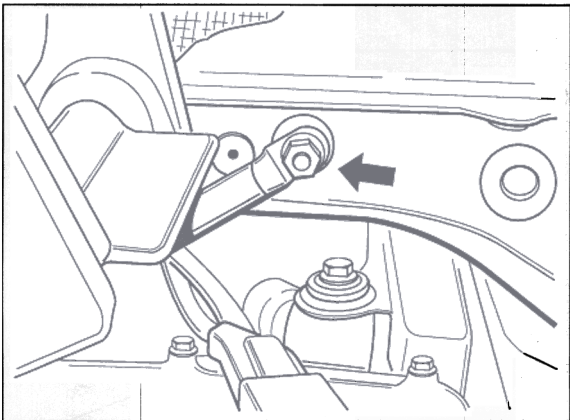


- a. Unclip right-hand accelerator cable mount sleeve and disengage the accelerator cable.



250\_97

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

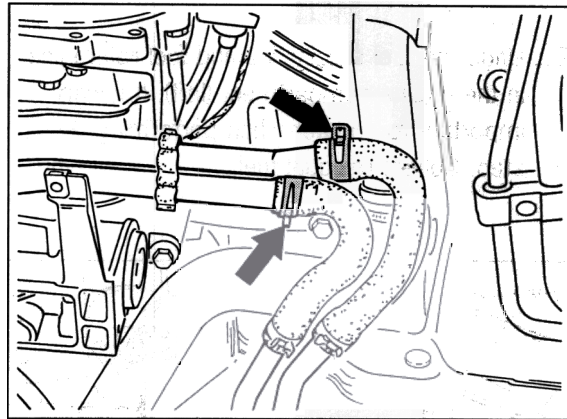


52\_99

25. Remove starter.

26. Move shift lever to neutral position and disengage shift cables on the transmission. Use a commercially available removal tool for this purpose (refer to Workshop Equipment Manual, Chapter 2.4, No. 21).

27. Remove coolant hoses.



176\_99

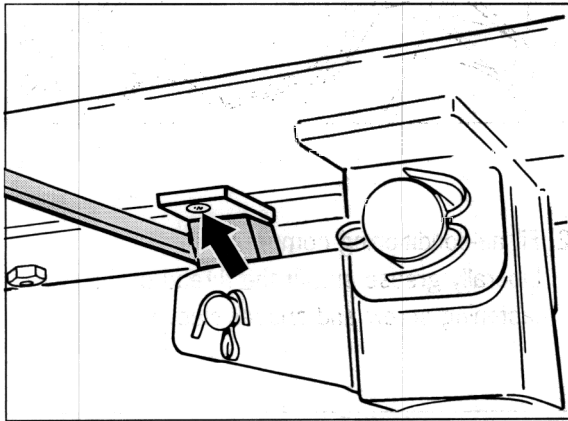
28. Undo clutch slave cylinder and hang to one side with the connected line.

#### Note

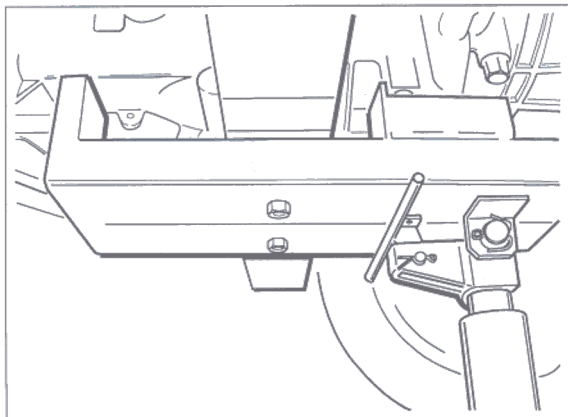
The clutch pedal must not be pressed if the slave cylinder has been removed. **Affix a warning note in the vehicle.**

29. Place workshop jack and preassembled engine retainer plate underneath with slight load.

Observe the position of the engine retainer plate. Engage support lever in horizontal position. Spacer, special tool 9111/5 fitted.

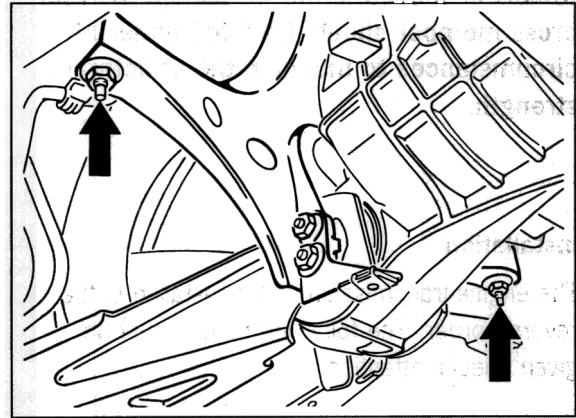


178\_99

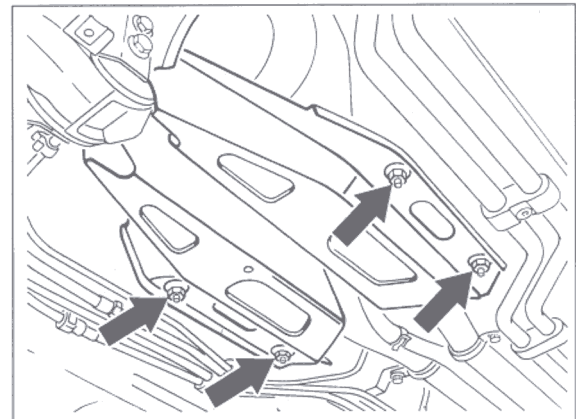


81\_99

30. Undo transmission support.



301\_97



122\_97

31. Separate engine carrier from the engine mounts (wrench size 18).

32. Lower the engine-transmission unit **carefully** and **in steps**. Have a second person observe the engine-transmission clearance at the same time, especially near the oil container.

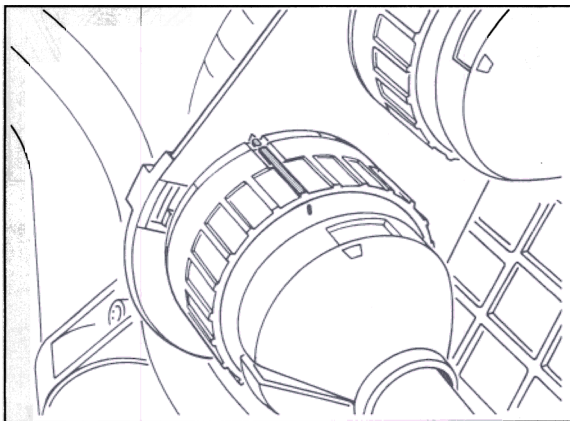
### Note

**Important:** If the vehicle is placed on its wheels or moved in the workshop, the rear cross member should be fitted under all circumstances to maintain the structural strength.

### Installation

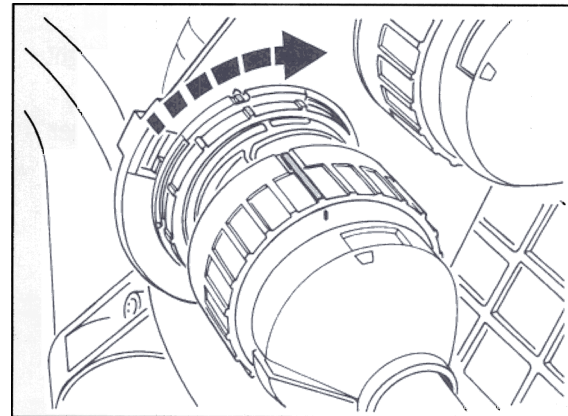
The engine-transmission unit is installed in the reverse order. The following points must be given special attention:

1. Fit engine wiring harness:  
The round plugs are colour-coded on the inside:  
upper plug – black  
lower plug – grey
- a. Line up marking of the round connector with marking on the housing.



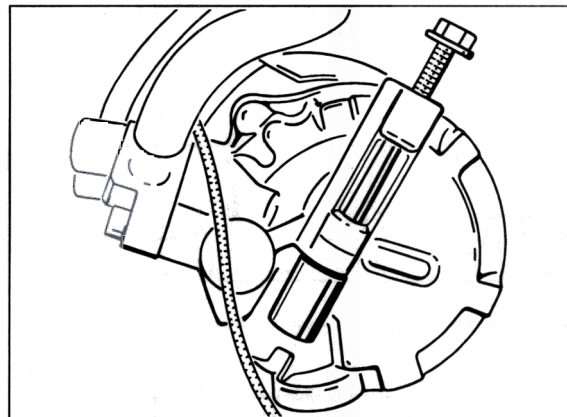
361\_97

- b. Turn round connector clockwise by approx. 90° (bayonet lock).



362\_97

2. Fit air-conditioning compressor  
Liberally grease and fit the thread of the rear fastening screw and spacer sleeve.

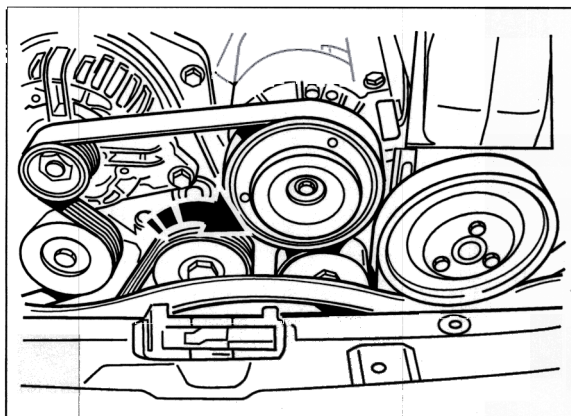


177\_99

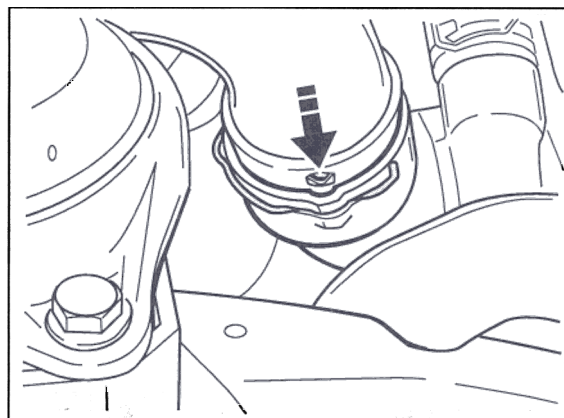
3. Install three-phase generator.
4. Install hydraulic pump.

5. Fit drive belt.

Observe sequence when fitting the belt and direction of motion if the belt was run.



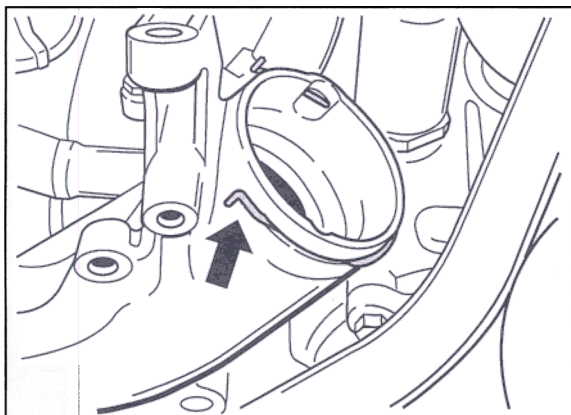
82\_99



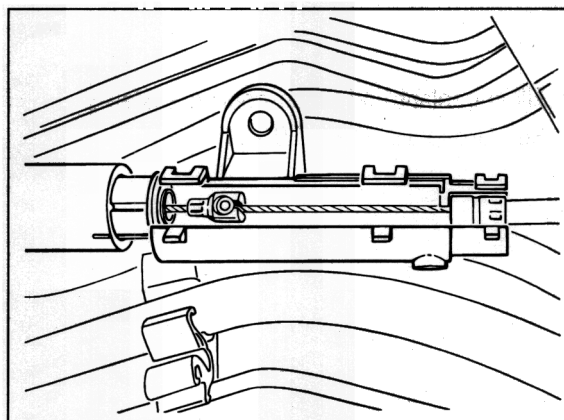
88\_99

8. Engage accelerator cable and close accelerator cable mount sleeve.

6. Fit coolant hoses with new O-rings. Attach the safety brackets onto the coolant supports before engaging the coolant hoses.



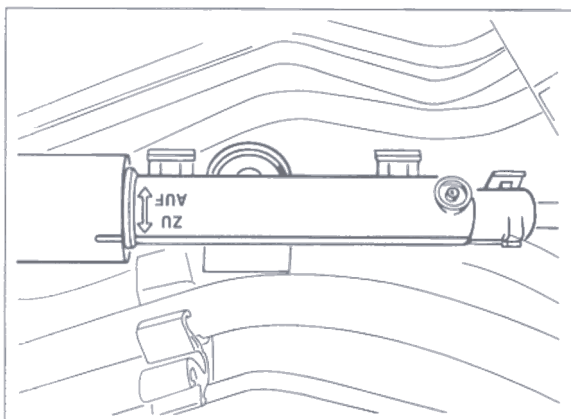
87\_99



378\_97

7. Move coolant hoses into installation position (arrow). The coolant hoses must audibly engage when pushed into the supports.

- a. Turn rotary sleeve in the direction indicated by the arrow (closed) and line up the marks on the accelerator mount sleeve and rotary sleeve.



266\_97

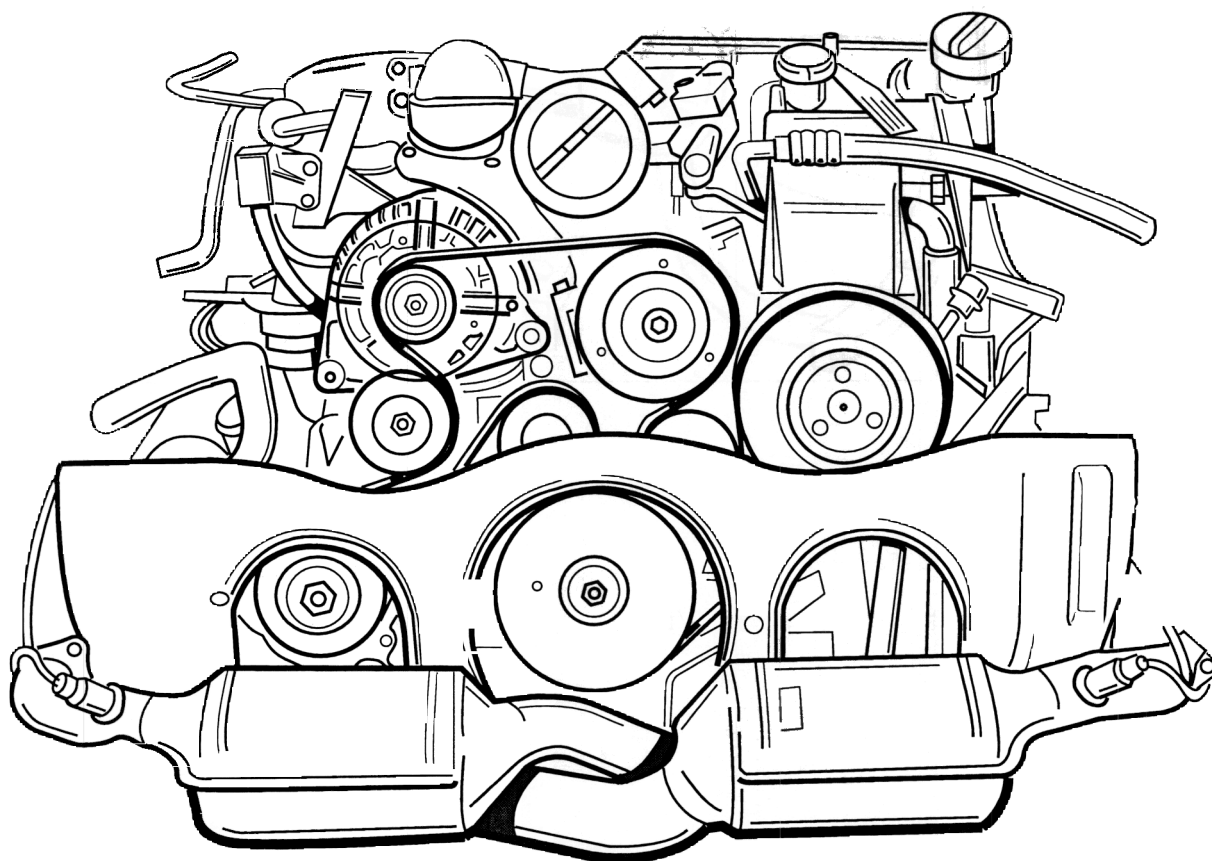
9. Fill in coolant and bleed cooling system  
See Group 19, Page 19 - 1.

**Tightening torques: Removing and installing engine – GT3**

| Location   | Thread    | Tightening torque<br>Nm (ftlb.) |
|--|-----------|---------------------------------|
| Engine mount to engine carrier                         | M12 x 1.5 | 85 (63)                         |
| Transmission support to body                           | M10 x 1.5 | 65 (48)                         |
| Drive shaft to transmission                            | M10       | 81 (60)                         |
| Wheel on wheel hub                                     | M14 x 1.5 | 130 (96)                        |
| Rear axle member<br>to carrier side section            | M12 x 1.5 | 100 (74)                        |
| Cross member at front<br>to carrier side section       | M10 x 1.5 | 65 (48)                         |
| Diagonal brace to body                                 | M10 x 1.5 | 65 (48)                         |
| Diagonal brace to cross member                         | M12 x 1.5 | 100 (74)                        |
| Diagonal brace to carrier<br>side section (collar nut) | M10 x 1.5 | 23 (17)                         |
| Stabilizer to carrier<br>side section                  | M8        | 23 (17)                         |
| Stabilizer to stabilizer<br>mount                      | M10 x 1.5 | 46 (34)                         |
| Ground strap to body                                   | M8        | 23 (17)                         |
| Fuel return line                                       | M14 x 1.5 | 25 ± 5 (19 ± 3.5)               |
| Fuel supply line                                       | M16 x 1.5 | 30 + 5 (22 + 3.5)               |
| Coolant drain plug                                     | M10 x 1   | 10 + 5 (7.5 + 3.5)              |



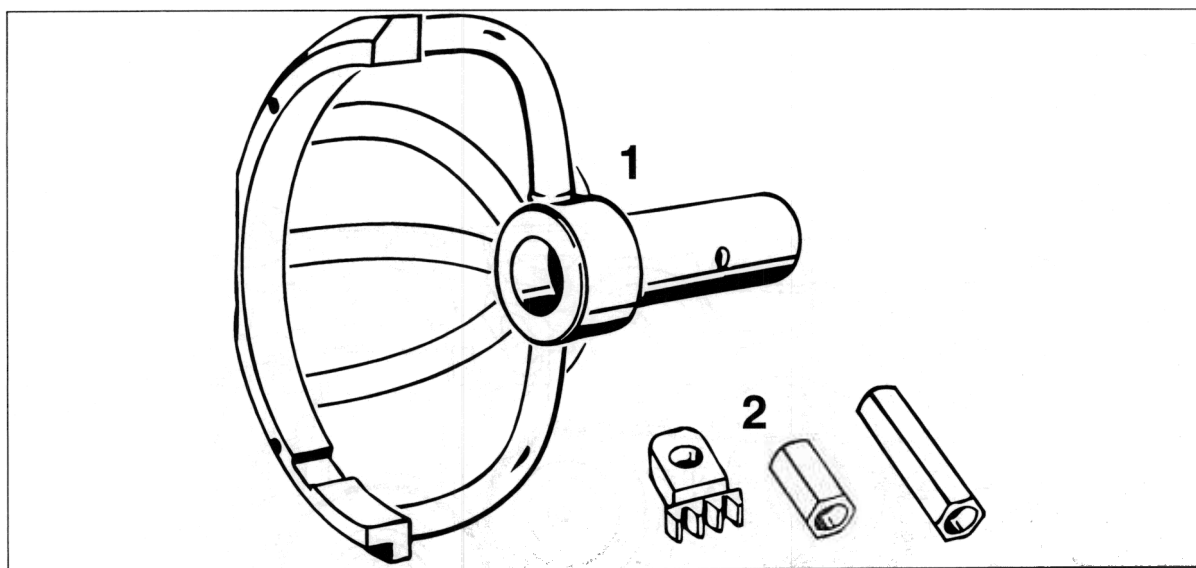
**10 01 37 Disassembling and assembling engine – GT3**



130\_99

## Disassembling and assembling engine – GT3

### Tools overview

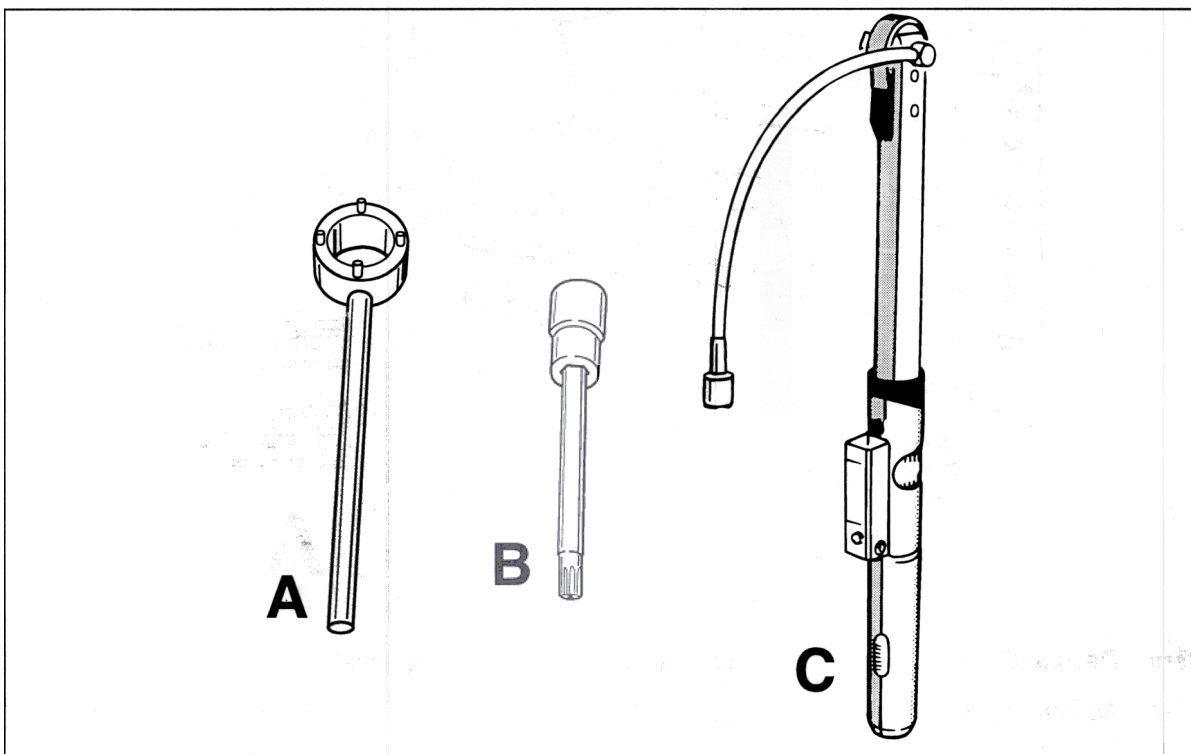


249\_99

| No. | Designation     | Special tool | Explanation                                    |
|-----|-----------------|--------------|--|
| 1   | Assembly holder | 9589         | For holding the engine on the assembly support |
| 2   | Toothed segment | 9538/1       | For blocking the crankshaft                    |

## Disassembling and assembling engine – GT3

### Tools overview

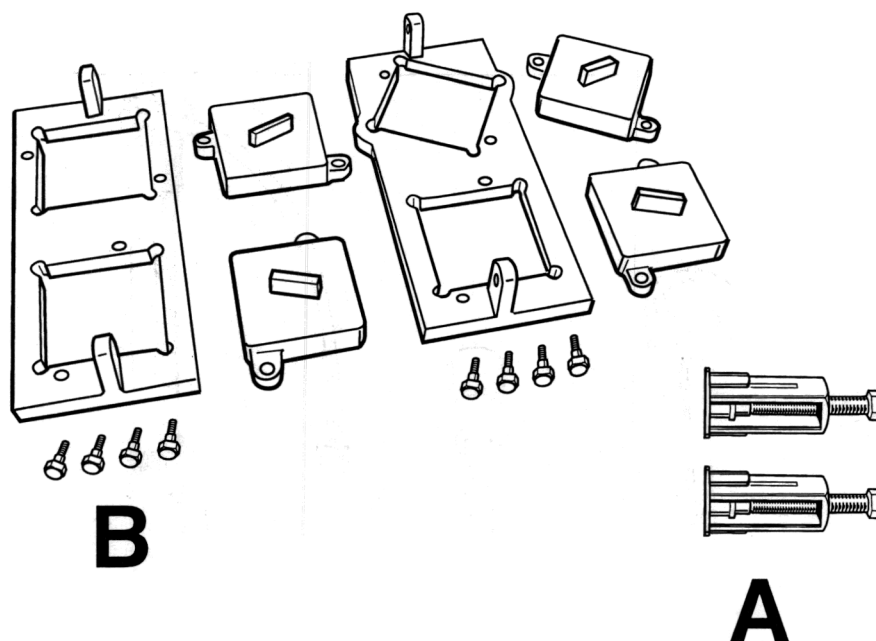


273\_99

| No. | Designation                         | Special tool     | Explanation                       |
|-----|-------------------------------------|------------------|-----------------------------------|
| A   | Holding wrench                      | 9653             | For turning the camshaft adjuster |
| B   | Torx socket wrench                  | 9330             |                                   |
| C   | Torque angle wrench –<br>gradoscope | 715/20 or 716/20 |                                   |

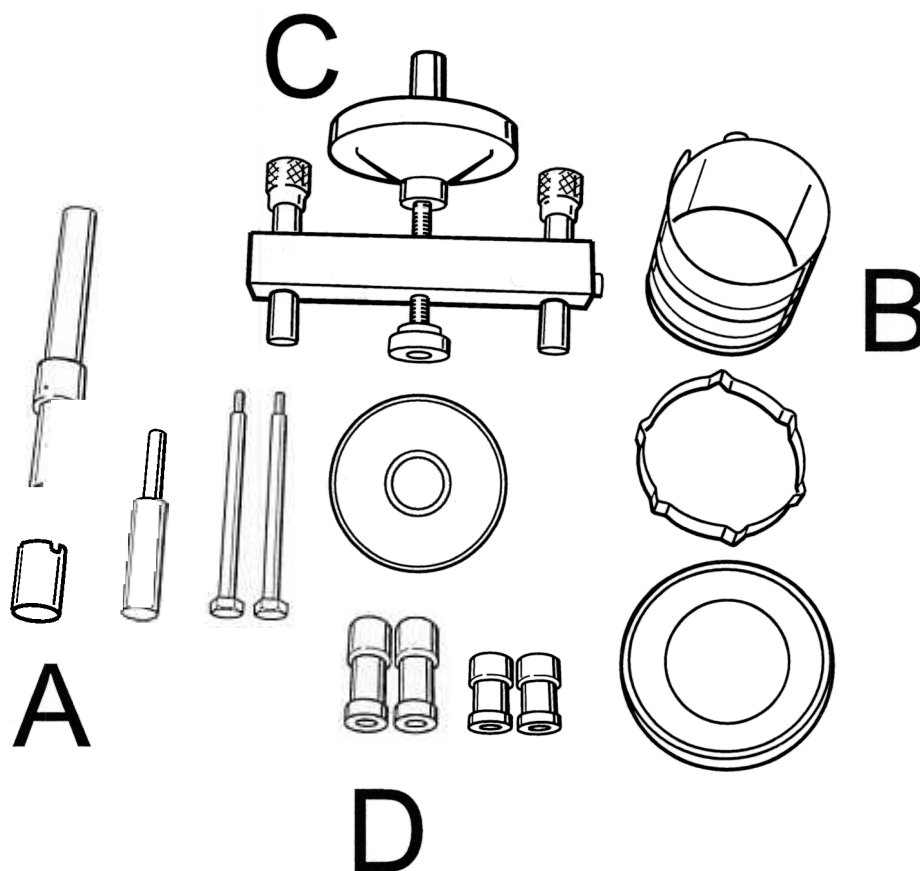
## Disassembling and assembling engine – GT3

### Tools overview



15700013

| Item | Designation               | Special tool    | Explanation   |
|------|---------------------------|-----------------|---|
| A    | Adjustment device         | 9661 and 9661/1 | Tool for valve timing adjustment of the camshafts. With this tool, the camshafts can be fixed in the correct position |
| B    | Auxiliary chain tensioner | 9401            | In order to remove play from the timing chain   |

**Disassembling and assembling engine – GT3****Tools overview**

15700008

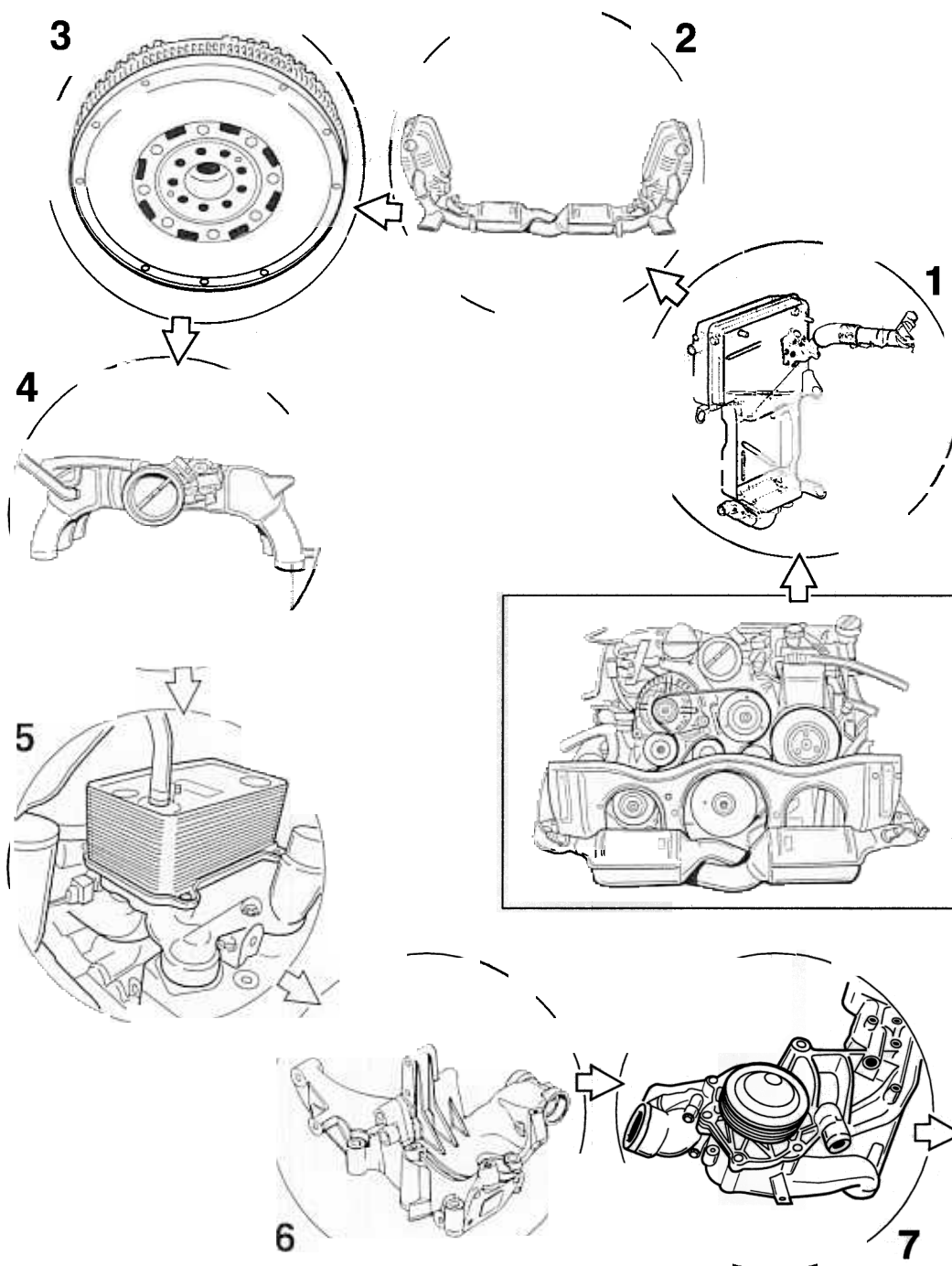
| Item | Designation                   | Special tool | Explanation   |
|------|-------------------------------|--------------|---|
| A    | Assembly aid                  | 9657         | For positioning the restraining strap over the piston rings |
| B    | Restraining strap             | 9659         | For the piston assembly of pistons from cylinders 2 and 5   |
| C    | Piston ring restraining strap |              | Refer to Workshop Equipment Manual, Chapter 2.4, No.: 57    |
| D    | Pushing device                | 9660         |   |
| E    | Spacing pieces                | 9651         |   |
| F    | Holder for cylinder           | P140         |   |

| Item | Designation              | Special tool | Explanation                            |
|------|--------------------------|--------------|--|
| G    | Assembly aid             | 9500/6       | For pre-assembly of circlips in 9500/5 |
| H    | Plunger                  | 9500/4       |  |
|      | Assembly tool            | 9500/5       | For assembly of piston-pin circlip     |
|      | Assembly aid for circlip | 9500/3       | For pre-assembly of circlips in 9500/5 |
| K    | Grease for O-rings       |              | Part No.: 999.917.788.00               |



## Disassembling engine – GT3

### Overview



296\_99

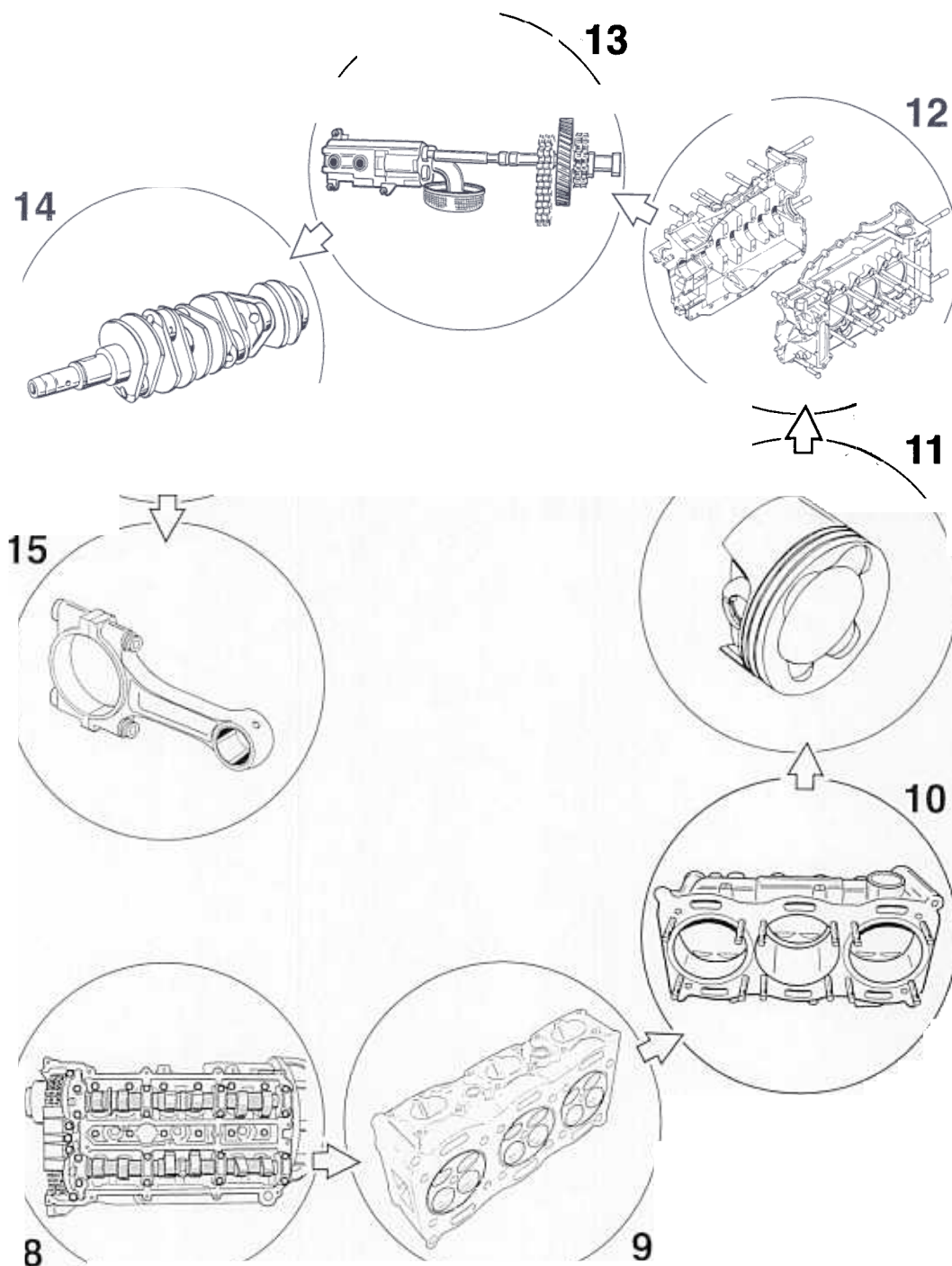
## Disassembling engine – GT3

### Overview

| No. | Activity                               | Repair number |
|-----|--|---------------|
| 1   | Removing oil container                 | 17 52 19      |
| 2   | Removing exhaust system                | 26 01 21      |
| 3   | Removing clutch                        | 30 50 21      |
| 4   | Removing<br>intake distributor         | 24 26 37      |
| 5   | Removing bracket for oil cooler        | 17 67 21      |
| 6   | Removing bracket for generator         | 27 27 19      |
| 7   | Removing housing for coolant<br>guide. | 19 55 21      |

## Disassembling engine – GT3

### Overview



299\_99

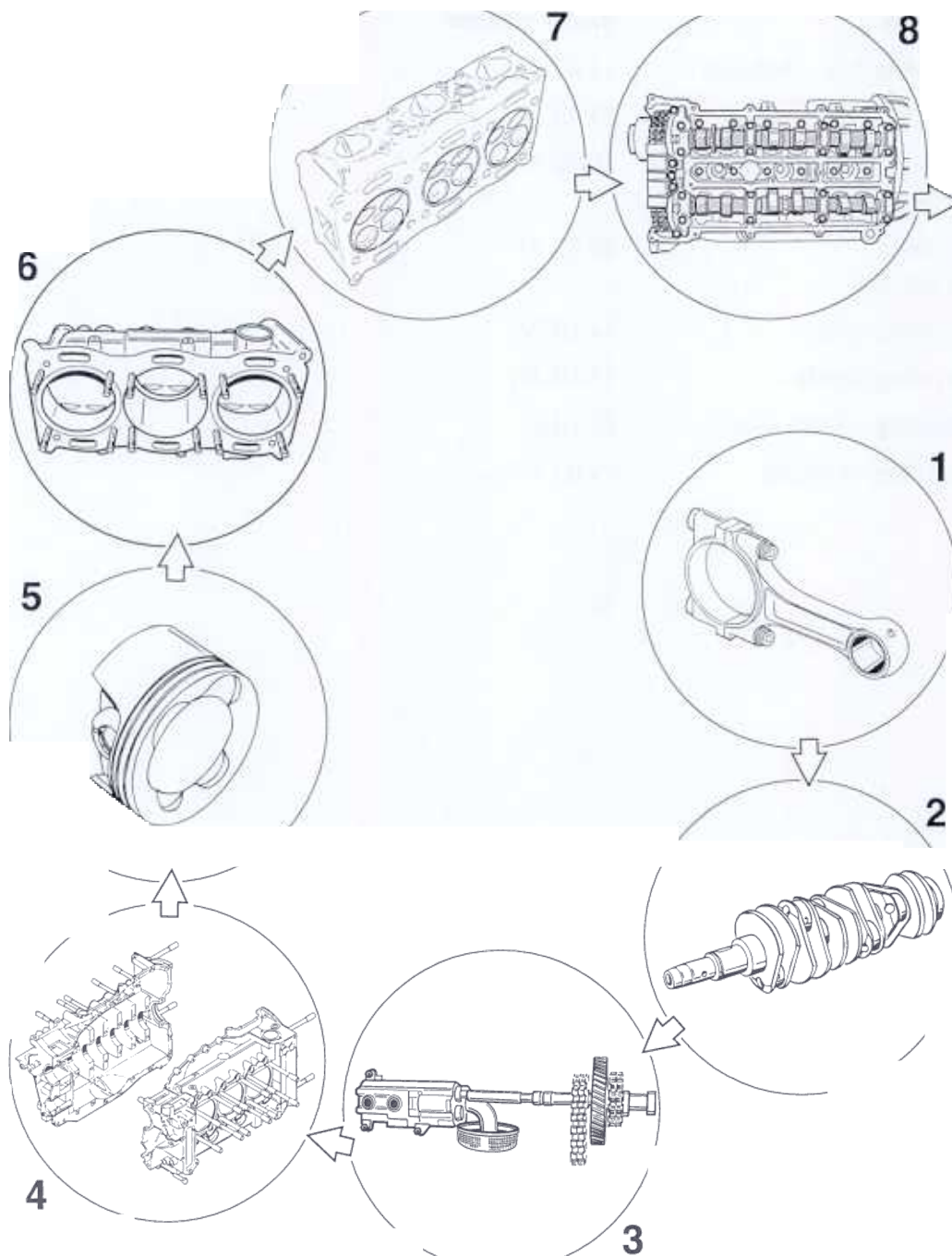
## Disassembling engine – GT3

### Overview

| No. | Activity                                 | Repair number |
|-----|--|---------------|
| 8   | Removing camshafts                       | 15 03 21      |
| 9   | Removing cylinder head                   | 15 70 21      |
| 10  | Removing cylinders                       | 10 20 21      |
| 1   | Removing pistons                         | 13 10 19      |
| 12  | Removing crankcase                       | 10 10 37      |
| 3   | Removing intermediate shaft and oil pump | 15 20 37      |
| 14  | Removing crankshaft                      | 13 48 37      |
| 15  | Removing connecting rods                 | 13 48 37      |

## Assembling engine – GT3

### Overview



297\_99

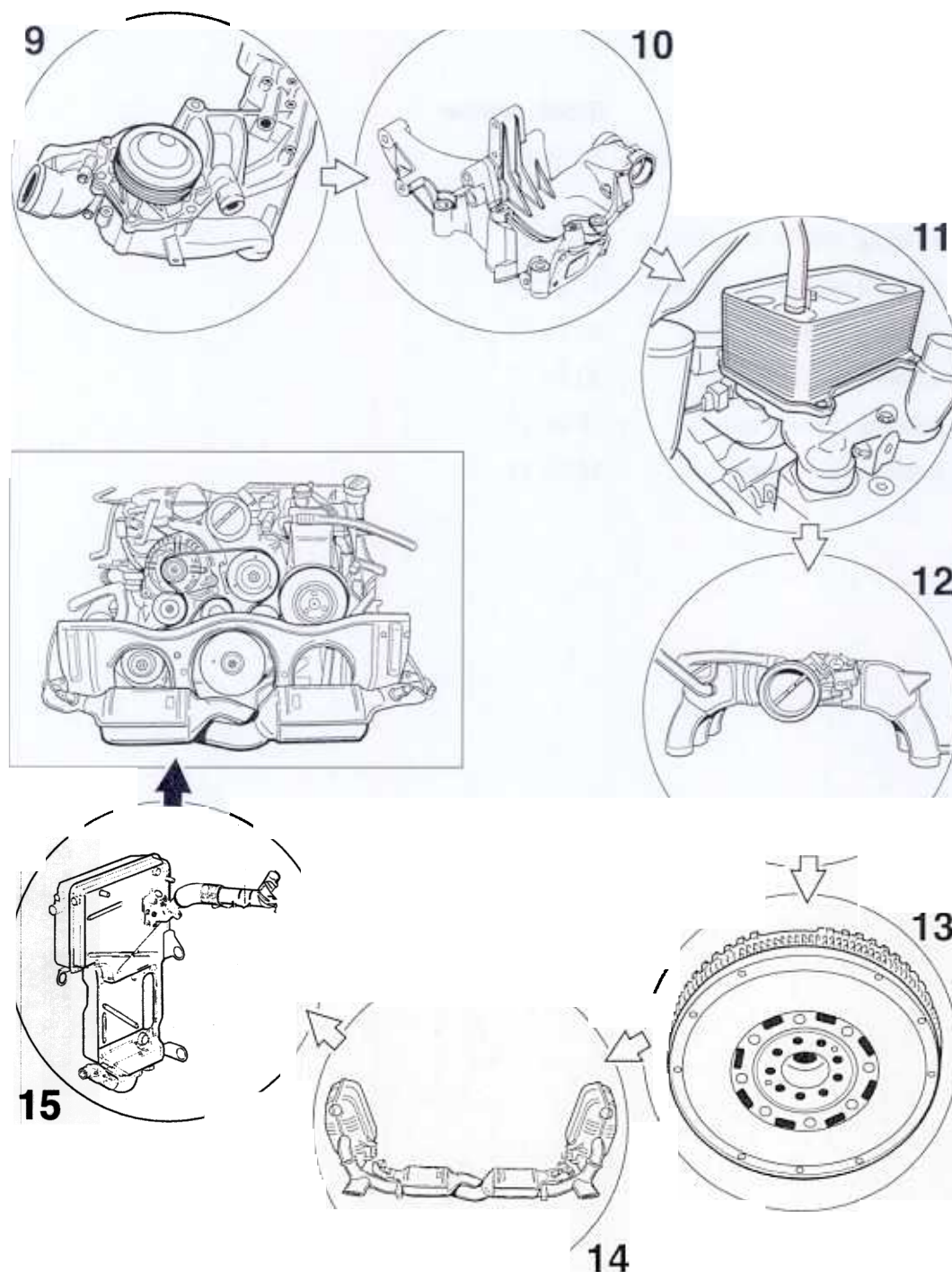
**Assembling engine – GT3****Overview**

| No. | Activity                                      | Repair number |
|-----|---|---------------|
| 1   | Installing connecting rods                    | 13 48 37      |
| 2   | Installing crankshaft                         | 13 48 37      |
| 3   | Installing intermediate shaft<br>and oil pump | 15 20 37      |
| 4   | Installing<br>crankcase                       | 10 10 37      |
| 5   | Installing pistons                            | 13 10 37      |
| 6   | Installing cylinders                          | 13 10 37      |
| 7   | Installing cylinder head                      | 15 70 23      |
| 8   | Installing camshafts                          | 15 03 23      |



## Assembling engine – GT3

### Overview



298\_99

## Assembling engine – GT3

### Overview

| No. | Activity                             | Repair number |
|-----|--------------------------------------|---------------|
| 9   | Installing housing for coolant guide | 19 55 23      |
| 10  | Installing bracket for generator     | 27 27 19      |
| 11  | Installing bracket for oil cooler    | 17 67 23      |
| 12  | Installing intake distributor        | 24 26 37      |
| 13  | Installing clutch                    | 30 50 23      |
| 14  | Installing exhaust system            | 26 01 23      |
| 15  | Installing oil container             | 17 52 19      |

**Disassembling and assembling engine – GT3**

Tightening torques: Disassembling and assembling engine – GT3 in overview

| Location                               | Thread   | Tightening torque<br>in Nm |
|--|----------|----------------------------|
| Exhaust manifolds                      | M 8      | 33 (24 ftlb.)              |
| Shields                                | M 6      | 10 (7.5 ftlb.)             |
| Unit support on crankcase              | M 10     | 65 (48 ftlb.)              |
| Intake pipes                           | M 6      | 10 (7.5 ftlb.)             |
| Cover over oil extraction pump         | M 6      | 10 (7.5 ftlb.)             |
| Pressure/temp. sensor on pressure pipe | M 5      | 3.3 (2.5 ftlb.)            |
| Inlet/outlet pipes on cylinder housing | M 6      | 10 (7.5 ftlb.)             |
| Screwed socket (crankcase)             | M 22x1.5 | 70 (52 ftlb.)              |
| Rear muffler holder                    | M 8      | 23 (17 ftlb.)              |
| Generator                              | M 10     | 65 (48 ftlb.)              |
| Guide/tensioning rail on crankcase     | M 16x1.5 | 31 (23 ftlb.)              |
| Short guide rail on camshaft housing   | M 6      | 13 (9.5 ftlb.)             |
| Hall sensor                            | M 6      | 10 (7.5 ftlb.)             |
| Hydraulic pump                         | M 8      | 23 (17 ftlb.)              |
| Cooling compressor                     | M 8      | 23 (17 ftlb.)              |
| Catalytic conv. on exh. manifold       | M 8      | 30 (22 ftlb.)              |
| Chain box                              | M 8      | 23 (17 ftlb.)              |
| Chain tensioner cover                  | M 6      | 10 (7.5 ftlb.)             |
| Knock sensor                           | M 8      | 23 (17 ftlb.)              |
| Bracket for heat exchanger             | M 6      | 10 (7.5 ftlb.)             |
| Coolant neck                           | M 6      | 10 (7.5 ftlb.)             |

**Disassembling and assembling engine – GT3**

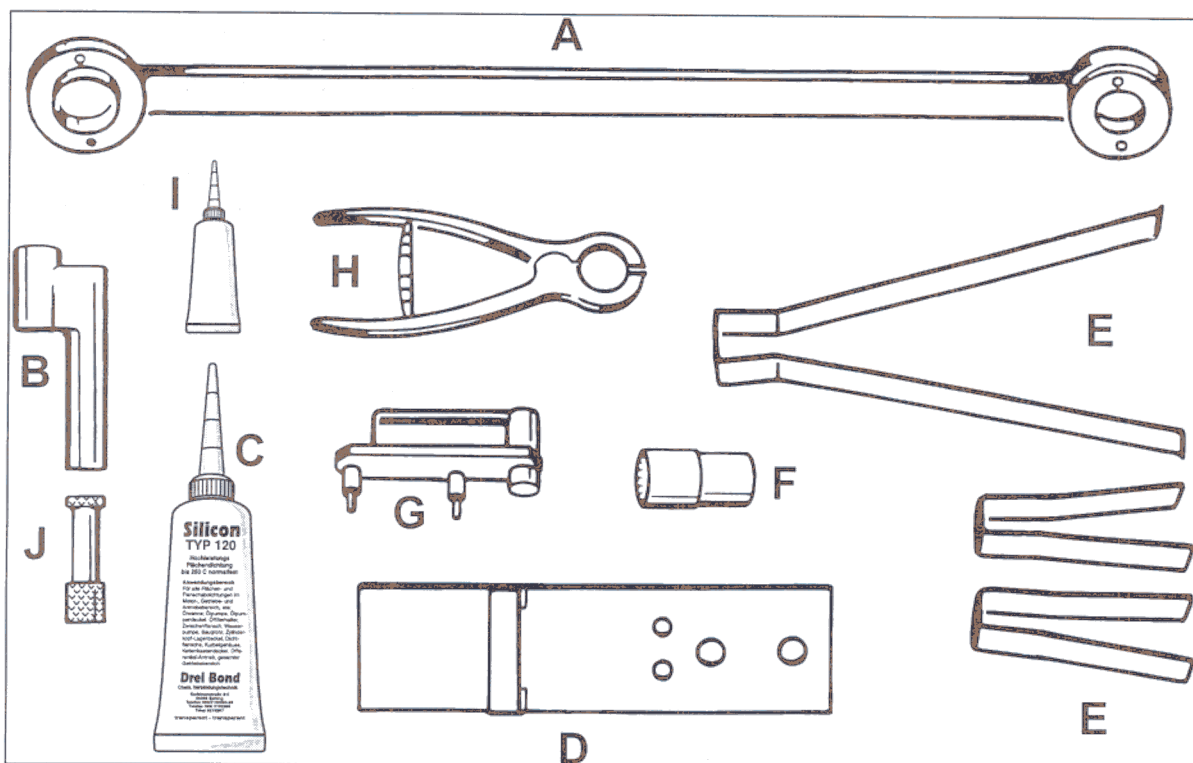
| Location                            | Thread    | Tightening torque<br>in Nm   |
|-------------------------------------|-----------|--|
| Clutch pressure plate               | M 8       | 23 (17 ftlb.)  |
| Clutch flywheel                     | M 10x1    | 90 (67 ftlb.)  |
| Crankcase bolts                     | M 10x1.25 | 50 (37 ftlb.)  |
| Crankcase bolts                     | M 8       | 23 (17 ftlb.)  |
| Camshaft housing                    | M 8       | 23 (17 ftlb.), then 28 (21 ftlb.)  |
| Camshaft housing cover              | M 6       | 10 (7.5 ftlb.)   |
| Camshaft bearing housing            | M 6       | 13 (9.5 ftlb.)   |
| Camshaft wheel (outlet)             | M 12x1.2  | 30 (22 ftlb.), then 90° turn   |
| Camshaft adjuster                   | M 12x1.5  | 30 (22 ftlb.), then 130° turn  |
| Oil drain plug on the oil container | M 20x1.5  | 60 (44 ftlb.)  |
| Oil drain plug (crankcase)          | M 20x1.5  | 60 (44 ftlb.)  |
| Oil extraction pump                 | M 6       | 13 (9.5 ftlb.)   |
| Oil extraction pump cover           | M 6       | 10 (7.5 ftlb.)   |
| Oil container fastening             | M 8       | 23 (17 ftlb.)  |
| Oil filler neck                     | M 6       | 10 (7.5 ftlb.)   |
| Oil filter housing                  | M 8       | 23 (17 ftlb.)  |
| Oil guide housing                   | M 6       | 10 (7.5 ftlb.)   |
| Thrust bearing cover                | M 6       | 13 (9.5 ftlb.)   |
| Connecting rod                      | M 9x1.25  | 30 (22 ftlb.), then 90° turn; use<br><b>special grease 000.043.30012</b><br>without fail. The con-rod bolts<br>must be replaced after they have<br>been unscrewed. |

**Disassembling and assembling engine – GT3**

| Location                          | Thread    | Tightening torque<br>in Nm                                     |
|-----------------------------------|-----------|--|
| Vibration damper on crankshaft    |           | 235 (174 ftlb.)  |
| Flywheel on crankshaft            | M 10x1.25 | 85 (63 ftlb.)  |
| Restraining strap, rear muffler   |           | 15 (11.0 ftlb.)  |
| Deflection roller on unit support | M 10      | 46 (34 ftlb.)  |
| Plug (crankcase)                  | M 18x1.5  | 45 (33 ftlb.)  |
| Plug (relief valve)               | M 18x1.5  | 60 (44 ftlb.)  |
| Plug (excess pressure valve)      | M 18x1.5  | 60 (44 ftlb.)  |
| Heat exchanger                    | M 6       | 10 (7.5 ftlb.)   |
| Ignition coils                    | M 6       | 10 (7.5 ftlb.)   |
| Cylinder-head nuts                | M 10      | 30 (22 ftlb.), undo again, then<br>20 Nm (15 ftlb.) + 90° turn |

## 10 10 37 Disassembling and assembling crankcase – GT3

### Tools



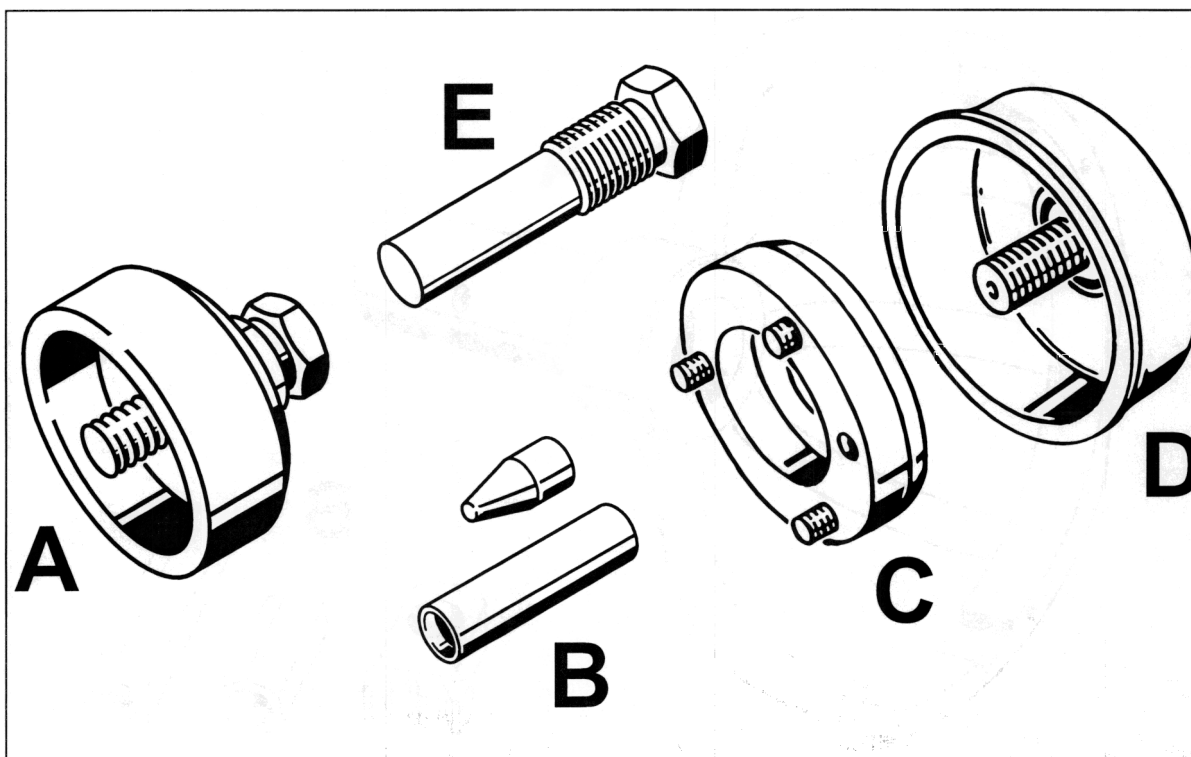
1100005

| Item | Designation                                       | Special tool | Explanation   |
|------|---|--------------|---|
| A    | Holding wrench for belt pulley (vibration damper) | 9548         |   |
| B    | Retaining device                                  | 9662         | For bracing the tension rod bolts when tightening   |
| C    | Surface seal Drei Bond Silicon Type 1209          |              |   |
| D    | Retainer plate                                    | 209a         | Screw the crankshaft to the retainer plate with internal serration screws Part No. 928.102.152 01 |
| E    | Restraining straps (connecting rod)               | P 221        |   |



| Item | Designation  | Special tool | Explanation  |
|------|--|--------------|--|
| F    | Socket M14 for tension rod threaded part           |              |  |
| G    | Assembly fixture for flywheel                      | P 238b       |  |
| H    | Snap ring pliers                                   |              | Commercially available   |
|      | <b>Special grease</b> for con-rod bolts (titanium) |              | <b>Part No. 000.043.300.12</b>   |
|      | Holder for cylinder                                | P 140        | For stabilising the retaining device 9662 when bracing the tension rod bolts |

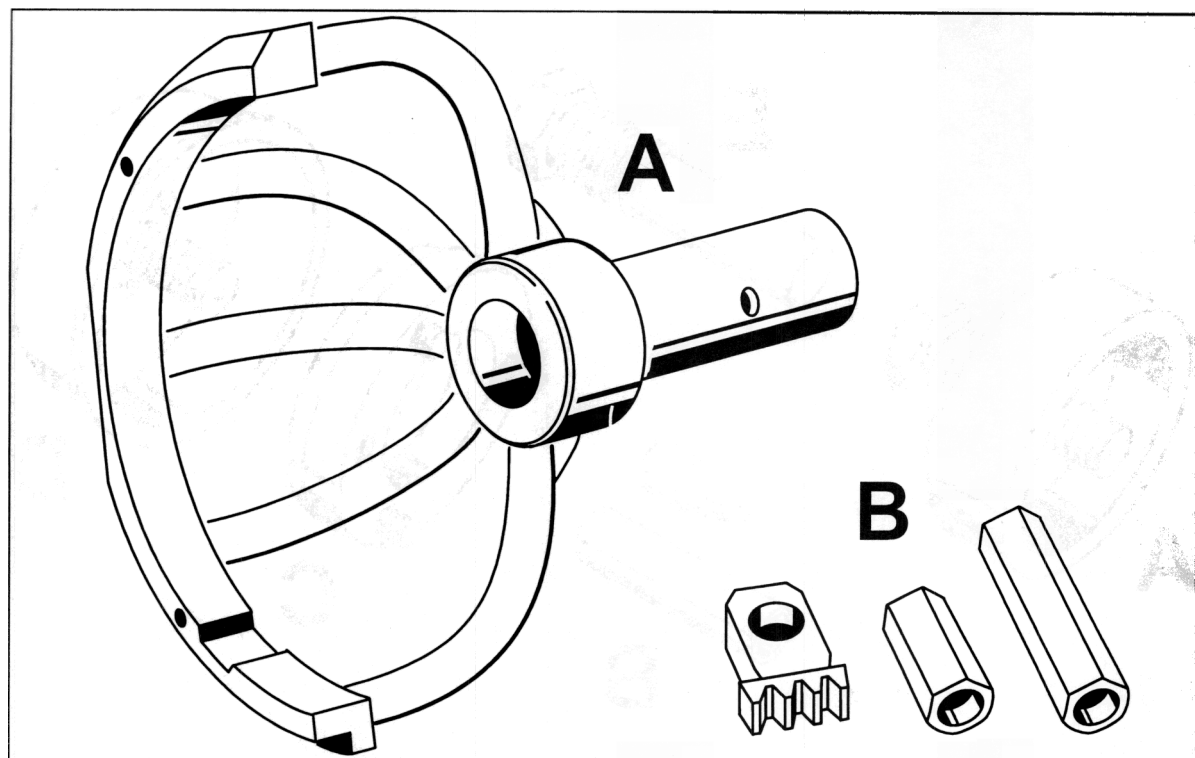
# Tools



10100006

| Item | Designation                                     | Special tool | Explanation |
|------|---|--------------|-------------|
| A    | Insertion device for sealing ring               | P 16d        |             |
| B    | Assembly sleeves for tension rod bolt seal      | 9511         |             |
| C    | Assembly aid                                    | 9517/1       |             |
| D    | Pressure piece for sealing ring (flywheel side) | 9517         |             |
| E    | Forcing screw for vibration damper              | 9285/1       |             |

# Tools

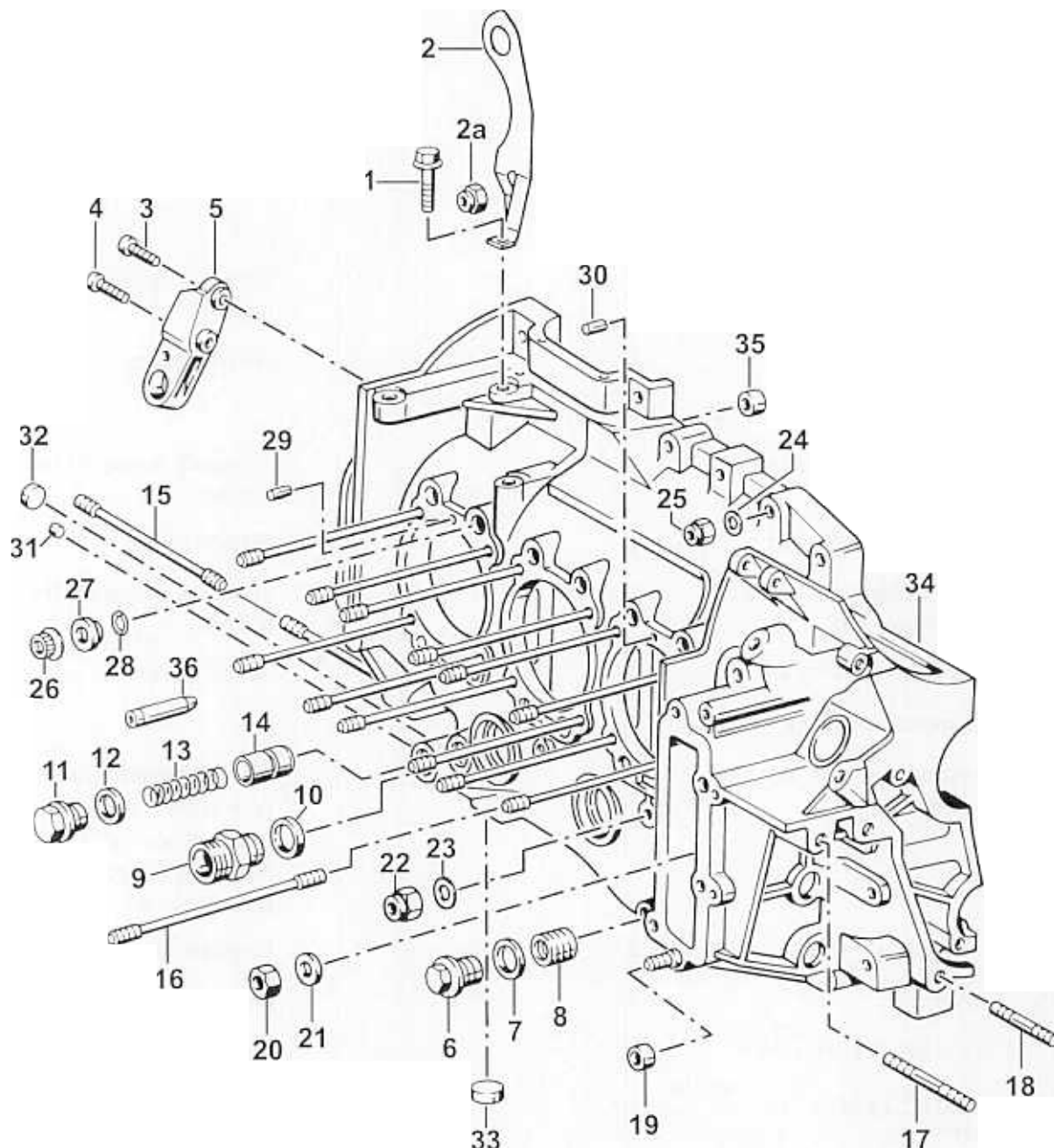


1010010

| Item | Designation                           | Special tool | Explanation  |
|------|---------------------------------------|--------------|--|
| A    | Engine holder                         | P 201        | Fasten to the right half of the crankcase (cyl. 4 - 6) |
| B    | Toothed segment and mounting elements | P 201b       |  |

## Disassembling and assembling crankcase

### Left crankcase half (cylinder bank 1 - 3)



10100001

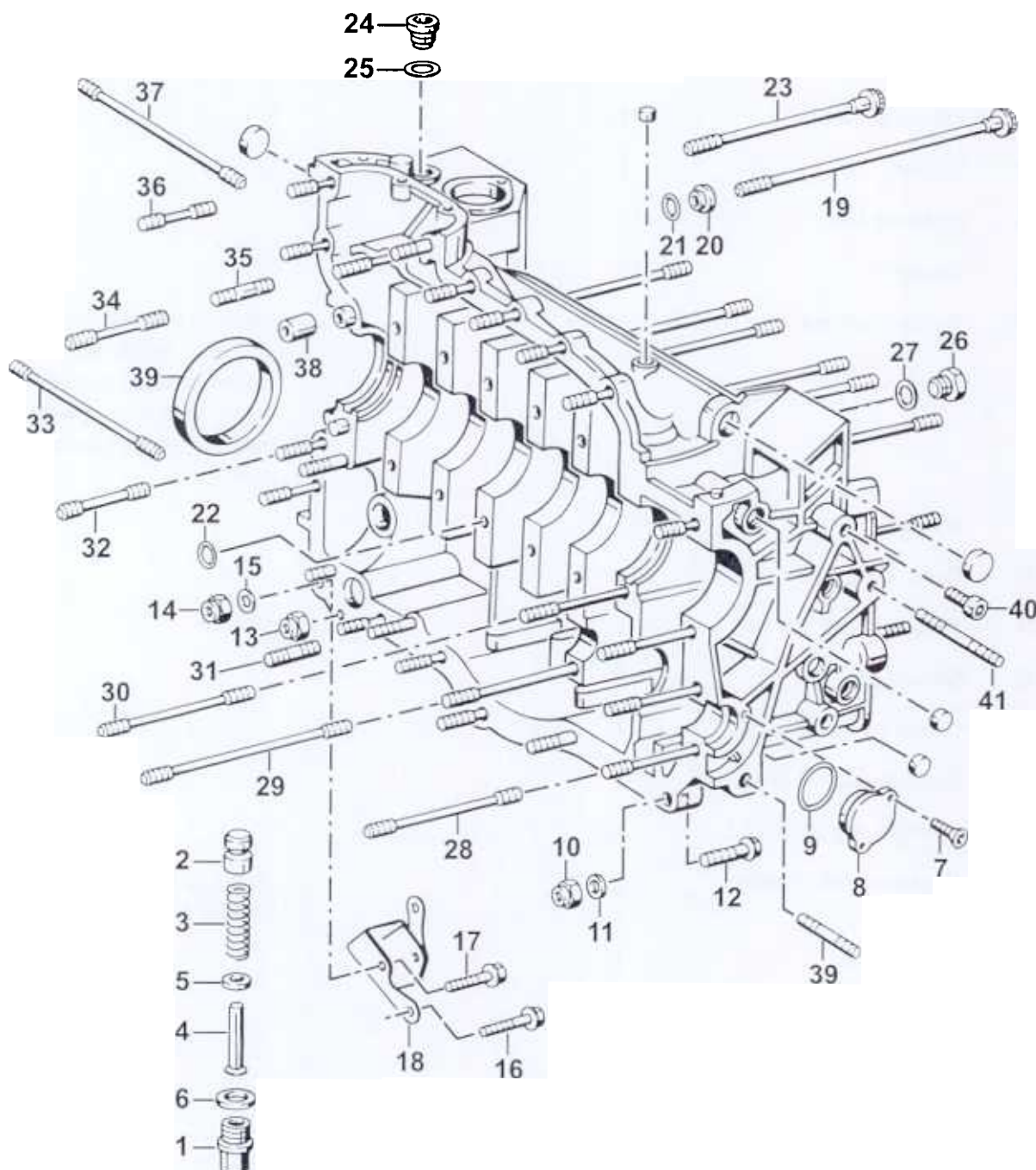
| No. | Designation  | Qty. | Removal | Note: | Installation  |
|-----|--|------|---------|-------|---|
|     |  |      |         |       |   |
| 1   | Hexagon-head bolt M8 x 50                            | 1    |         |       |   |
| 2   | Holder   | 1    |         |       |   |
| 2a  | Fastening nut M8                                     |      |         |       |   |
| 3   | Hexagon-head bolt M6 x 25                            | 1    |         |       |   |
| 4   | Hexagon-head bolt M6 x 35                            |      |         |       |   |
| 5   | Sensor holder  | 1    |         |       |   |
| 6   | Screw plug   | 1    |         |       | Tightening torque 70 Nm<br>(52 ftlb.)   |
| 7   | Sealing ring A22 x 27                                | 1    |         |       | Always replace  |
| 8   | Threaded insert M20 x 1.5                            | 1    |         |       |   |
| 9   | Screw-in flanges (oil return)                        | 1    |         |       | Tightening torque 70 Nm<br>(52 ftlb.)   |
| 10  | Sealing ring A22 x 27                                | 1    |         |       | Always replace  |
| 11  | Screw plug for oil pressure<br>relief valve M18 x 24 | 1    |         |       | Tightening torque 60 Nm<br>(44 ftlb.)   |
| 12  | Sealing ring A18 x 24                                | 1    |         |       | Always replace  |
| 13  | Compression spring                                   | 1    |         |       |   |
| 14  | Piston for excess pressure<br>valve                  | 1    |         |       | Examine the piston and<br>bore in the housing for<br>traces of scoring, if<br>necessary replace the<br>piston, then oil |
| 15  | Stud BM10 x 105                                      | 2    |         |       | Projection length 106 mm  |
| 16  | Stud   | 24   |         |       | Projection length 150 mm  |
| 17  | Stud BM10 x 70                                       | 1    |         |       | Projection length 161 mm  |
| 18  | Stud M10 x 60<br>M10 x 60                            | 1    |         |       | Projection length 169 mm  |
| 19  | Dowel sleeve   | 1    |         |       |   |

| No. | Designation                         | Qty. | Removal | Note: | Installation  |
|-----|-------------------------------------|------|---------|-------|---|
| 20  | Hexagon nut M10 x 1.25              | 1    |         |       | Tightening torque 50 Nm (37 ftlb.)  |
| 21  | Washer A10.5                        | 1    |         |       | Replace   |
| 22  | Fastening nut M10                   |      |         |       |   |
| 23  | Washer                              | 1    |         |       |   |
| 24  | Fastening nut                       | 18   |         |       |   |
| 25  | Washer                              | 18   |         |       |   |
| 26  | Multiple-tooth nut                  | 11   |         |       | Tightening torque 50 Nm (37 ftlb.), tighten with double hexagon wrench insert while bracing with retaining device, special tool 9662. |
| 27  | Washer                              | 11   |         |       |   |
| 28  | O-ring 8 x 2                        | 11   |         |       |   |
| 29  | Straight pin A8.0 x 14              |      |         |       |   |
| 30  | Straight pin                        |      |         |       |   |
| 31  | Oversize plug 8.5 x 8.0             |      |         |       |   |
| 32  | Oversize plug 14.00 x 8.5           |      |         |       |   |
| 33  | Oversize plug 20.0 x 13             | 1    |         |       |   |
| 34  | Crankcase half, cylinder bank 1 - 3 | 1    |         |       | Apply surface seal to sealing surface   |
| 35  | Dowel sleeve                        |      |         |       |   |
| 36  | Oil spray jet for piston cooling    | 3    |         |       |   |



## Disassembling and assembling crankcase

Right crankcase half (cylinder bank 4 - 6)



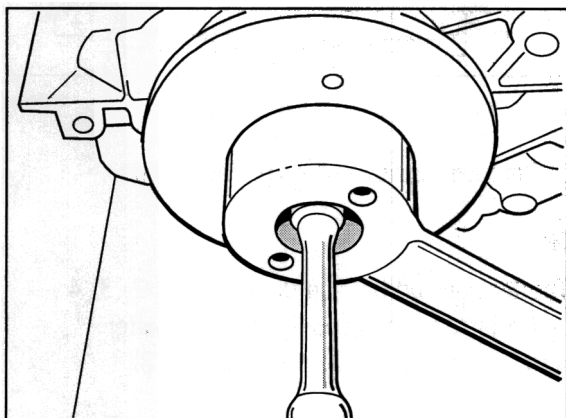
10100002

| No. | Designation               | Qty. | Removal | Note: | Installation                         |
|-----|---------------------------|------|---------|-------|--------------------------------------|
| 1   | Screw plug                | 1    |         |       |                                      |
| 2   | Piston                    | 1    |         |       | Oil                                  |
| 3   | Compression spring        | 1    |         |       |                                      |
| 4   | Guide sleeve              | 1    |         |       |                                      |
| 5   | Spacer ring               | 1    |         |       |                                      |
| 6   | Sealing ring A18 x 24     | 1    |         |       | Replace                              |
| 7   | Countersunk screw M6 x 15 | 2    |         |       |                                      |
| 8   | Cover plate               |      |         |       |                                      |
| 9   | Round seal 33.3 x 2.4     | 1    |         |       | Replace                              |
| 10  | Fastening nut M8          |      |         |       |                                      |
|     | Washer 8.4                |      |         |       |                                      |
| 12  | Hexagon-head bolt M8 x 45 |      |         |       |                                      |
| 13  | Fastening nut M8          |      |         |       |                                      |
| 14  | Fastening nut M8          | 1    |         |       |                                      |
| 15  | Washer                    |      |         |       |                                      |
| 16  | Hexagon-head bolt M8 x 55 | 1    |         |       |                                      |
| 17  | Hexagon-head bolt M8 x 45 |      |         |       |                                      |
| 18  | Locking hook              |      |         |       |                                      |
| 19  | Tension rod bolt          | 1    |         |       |                                      |
| 20  | Washer                    | 11   |         |       |                                      |
| 21  | O-ring 8 x 2              | 11   |         |       | Replace, oiled lightly               |
| 22  | O-ring 8.3 x 2.4          | 4    |         |       |                                      |
| 23  | Tension rod bolt          | 2    |         |       |                                      |
| 24  | Plug M18 x 1.5            | 1    |         |       | Tightening torque<br>00 Nm (0 ftlb.) |

| No. | Designation             | Qty. | Removal | Note: | Installation                          |
|-----|-------------------------|------|---------|-------|---------------------------------------|
| 25  | Sealing ring A18 x 22   | 1    |         |       | Replace                               |
| 26  | Plug M16 x 1.5          |      |         |       |                                       |
| 27  | Sealing ring A16 x 20   | 1    |         |       | Replace                               |
| 28  | Stud BM8 x 78           | 1    |         |       | Projection length 80 mm               |
| 29  | Stud BM10 x 110         | 1    |         |       | Projection length 110 mm              |
| 30  | Stud                    | 1    |         |       | Projection length 60 mm               |
| 31  | Stud BM8 x 22           | 3    |         |       | Projection length 22 mm               |
| 32  | Stud BM8 x 48           | 2    |         |       | Projection length 49 mm               |
| 33  | Stud BM10 x 105         | 1    |         |       | Projection length 107 mm              |
| 34  | Stud BM8 x 52           | 1    |         |       |                                       |
| 35  | Stud BM8 x 28           |      |         |       |                                       |
| 36  | Stud BM8 x 32           | 1    |         |       |                                       |
| 37  | Stud BM10 x 140         |      |         |       |                                       |
| 38  | Dowel sleeve            | 2    |         |       |                                       |
| 39  | Stud BM10 x 60          | 1    |         |       | Projection length 69.5 mm             |
| 40  | Pan-head screw M10 x 18 | 1    |         |       | Tightening torque 45 Nm<br>(33 ftlb.) |
| 41  | Stud BM10 x 70          |      |         |       | Projection length 60 mm               |

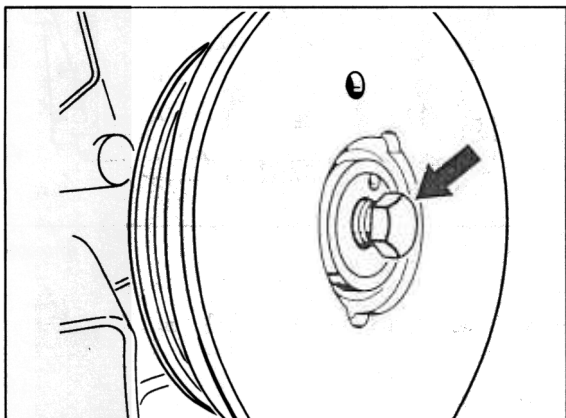
### Disassembling the crankcase

1. Fasten engine support, special tool P 201, to the right crankcase half of cylinder bank 4 - 6.
2. Loosen the vibration damper (belt pulley) with the help of a second person, bracing with holding wrench, special tool 9548.



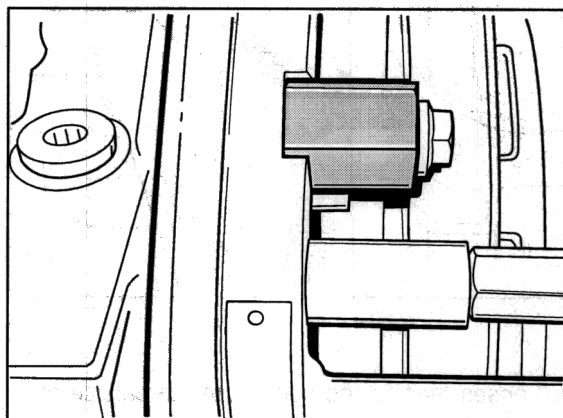
231\_99

3. Force vibration damper (belt pulley) off with the forcing screw, special tool 9285/1.

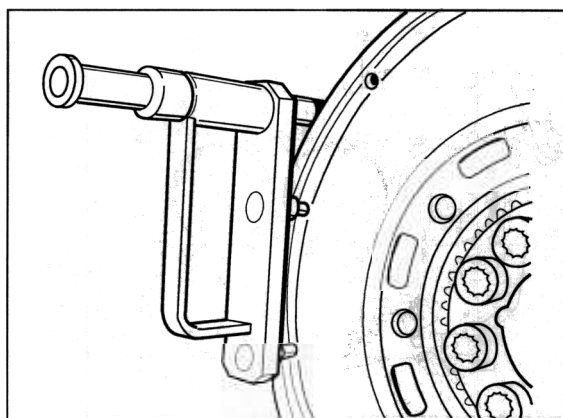


332\_99

4. Unscrew flywheel. Fasten the toothed segment of special tool P 201b or the assembly fixture, special tool P 2380, to engine support, special tool P 201.



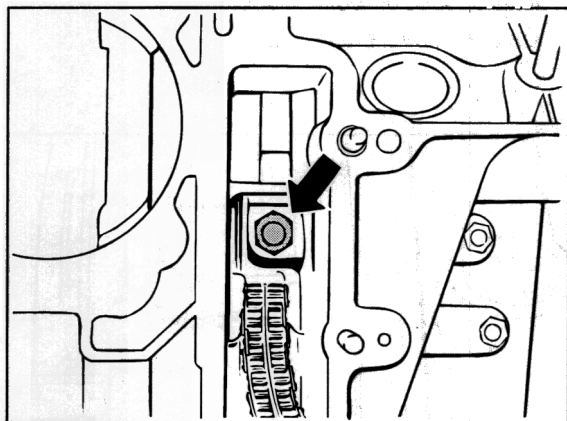
232\_99



411\_99

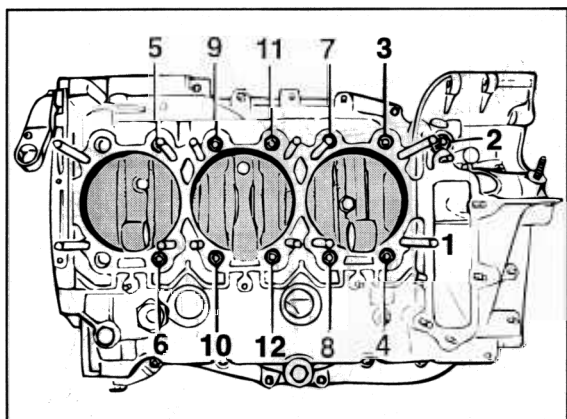
5. Turn crankcase through 90°; cylinder bank 1 - 3 points upwards. Unscrew all hexagon nuts (M8) in the ring-edge bolt.

6. Unscrew hexagon nut on the left crankcase half of cylinder bank 1 - 3.

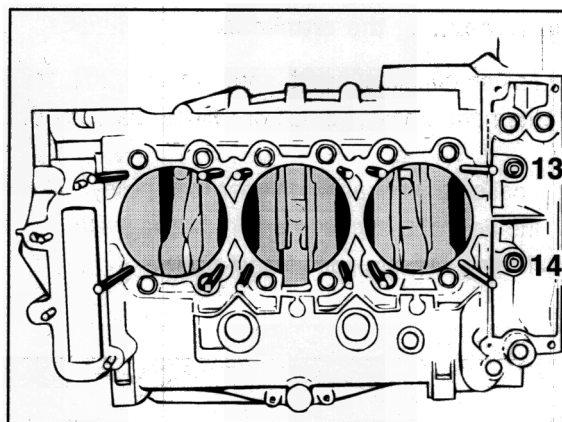


244\_93

7. Loosen tension rod bolts from the outside to the inside.



10100007

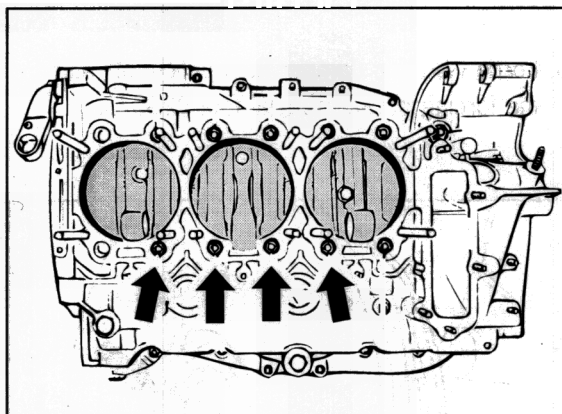


10100008

8. Remove tension rod bolts downwards.

### Note

The tension rod bolts in thrust blocks 2, 3, 4 and 5 (arrows) can only be removed after removing the crankcase half (cyl. 1 - 3).

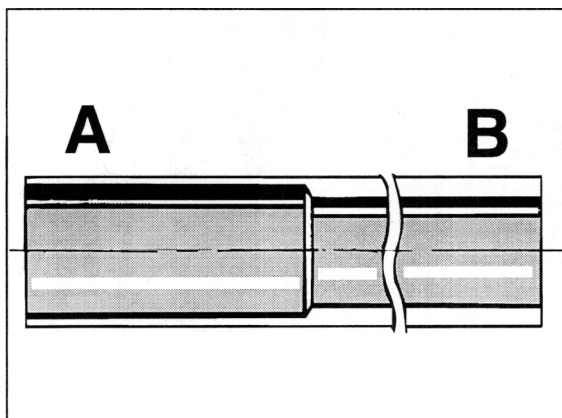


10100009

9. Remove crankcase half (cyl. 1 - 3).

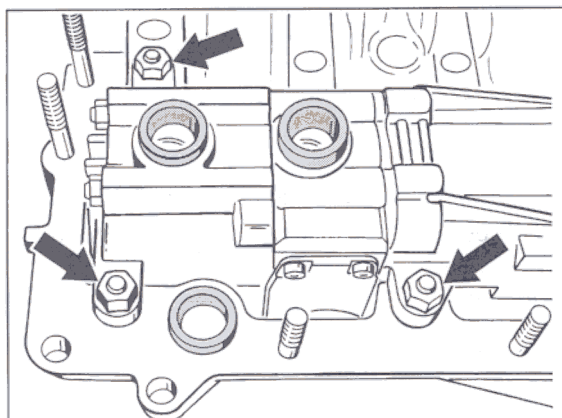


10. Remove O-rings and tension rod bolts of thrust blocks 2, 3, 4 and 5.



243\_99

11. Lift crankshaft out with connecting rods from the crankcase half cyl. 4 - 6.
12. Unscrew fastening nuts of oil pump and lift out oil pump with intermediate shaft.

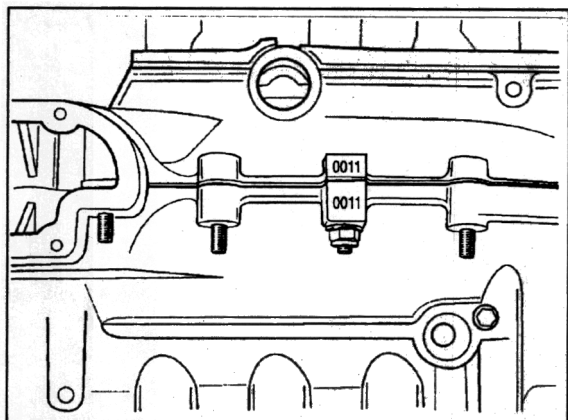


285\_99



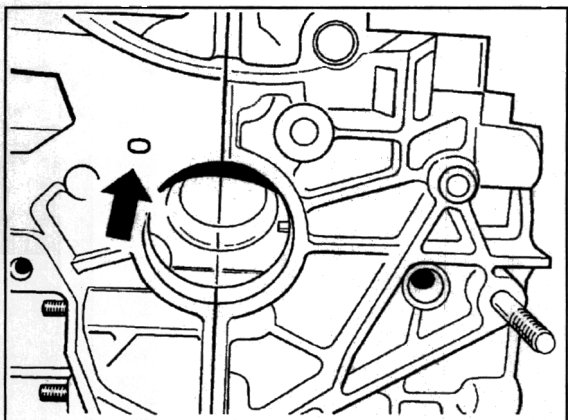
### Assembling the crankcase

1. Fasten engine support, special tool P 201, to the right crankcase half of cylinder bank 4 - 6.
2. Check the matching numbers of the crankcase halves.

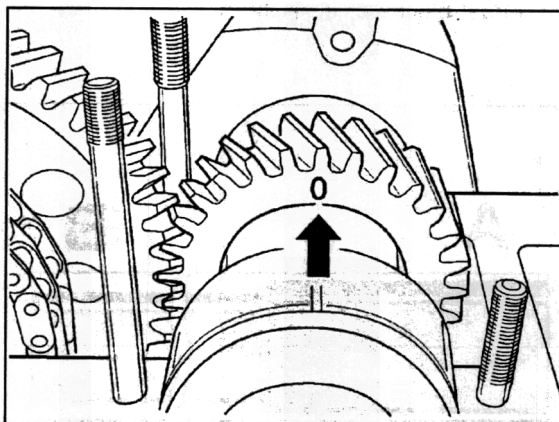


425\_99

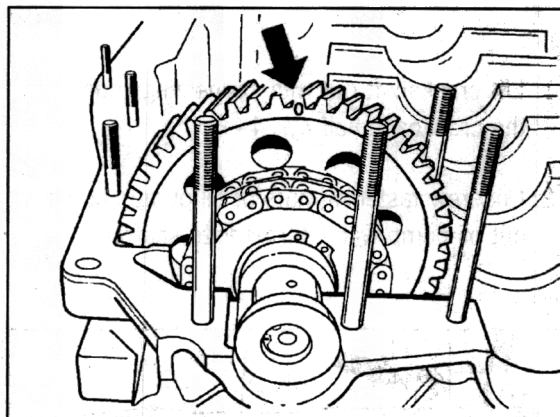
3. Check allocation of crankcase, crankshaft gearwheel and intermediate shaft gearwheel.



422\_99



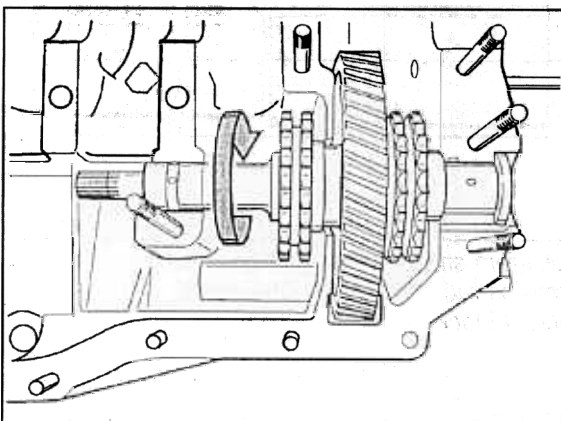
424\_99



423\_99

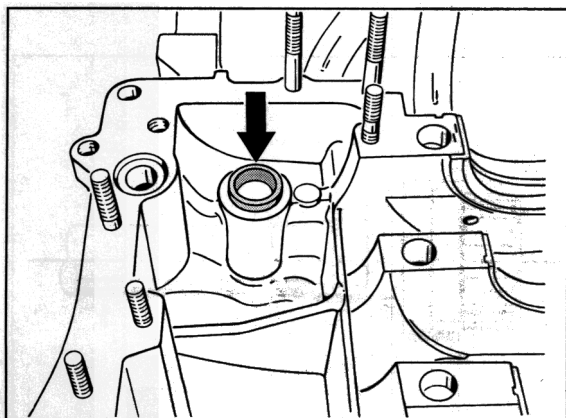
4. Insert a new thrust bearing shell half and a new bearing shell half into the crankcase half

5. Oil the bearing surfaces. Insert intermediate shaft and check for true running. Remove intermediate shaft.



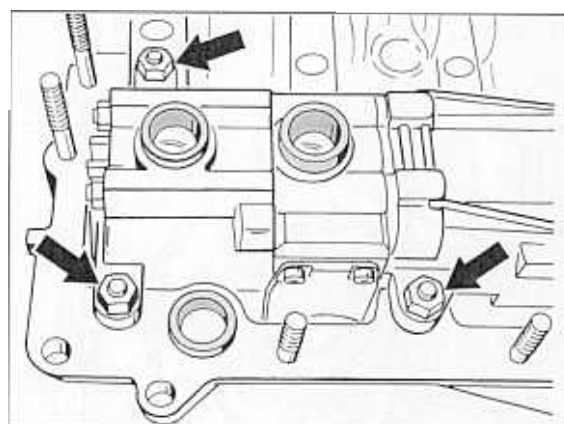
426\_99

6. Grease both sides of sealing ring and insert it into the crankcase half 4 - 6.



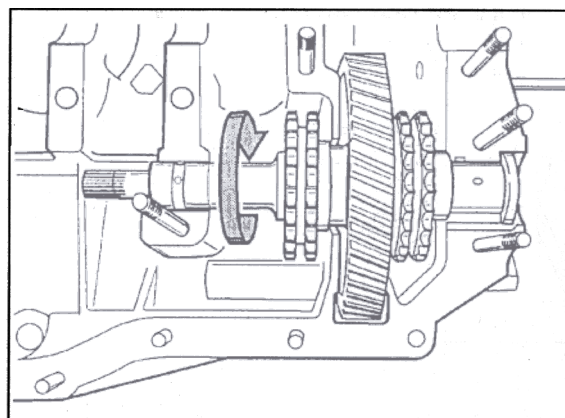
284\_99

7. Insert the complete unit, oil pump, dumb-bell shaft and intermediate shaft with chains into the crankcase half.
8. Fasten new collar nuts (3 pieces). Tightening torque 23 Nm (17 ftlb.).



285\_99

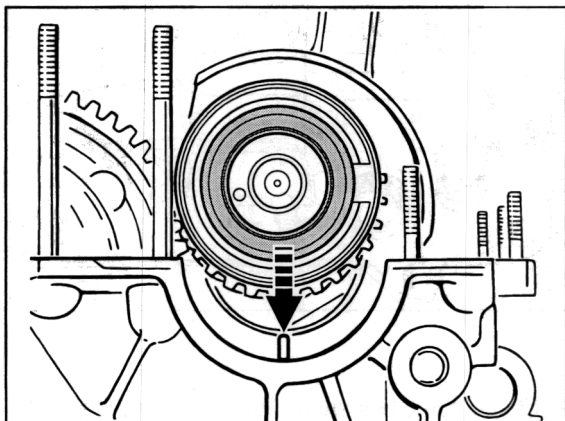
9. Check dumb-bell shaft. The dumb-bell shaft must be easily movable. If necessary, loosen the oil pump with the intermediate shaft and shift the dumb-bell shaft.



426\_99

10. Insert bearing shells of the crankshafts. Insert crankshaft with bearing 8 and mounted connecting rods into crankcase.

11. Insert bearing 8 into the dowel pin



327\_99

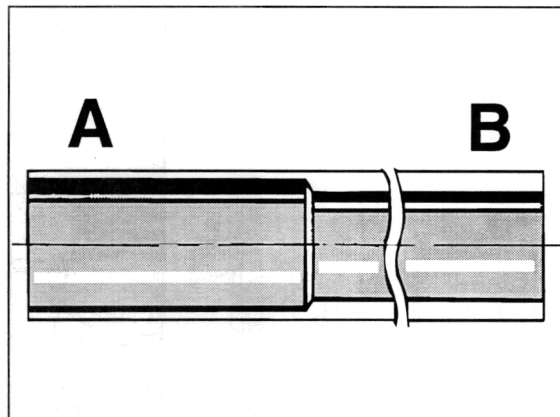
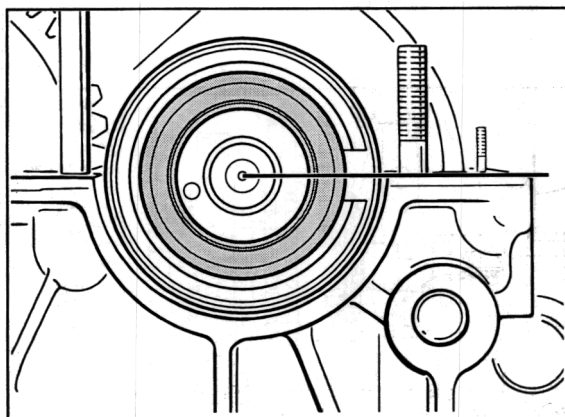


Diagram shows the already mounted tension rod bolts in the designated thrust blocks

243\_99

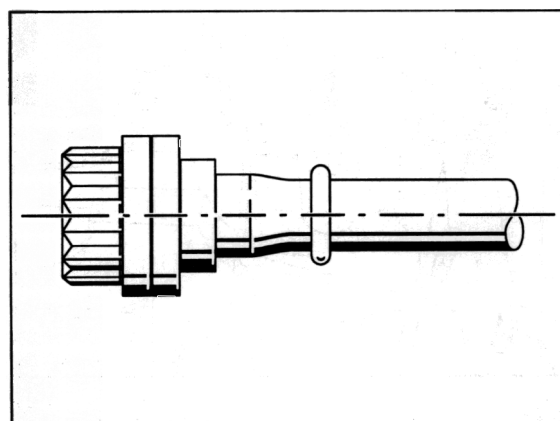


328\_99

12. Prepare tension rod bolts for installation.

**Note**

On 4 tension rod bolts of the lower thrust block fastening, thrust blocks 2, 3, 4 and 5, O-rings (6 x 2.5) are also inserted (Part No. 999.707.288 40).

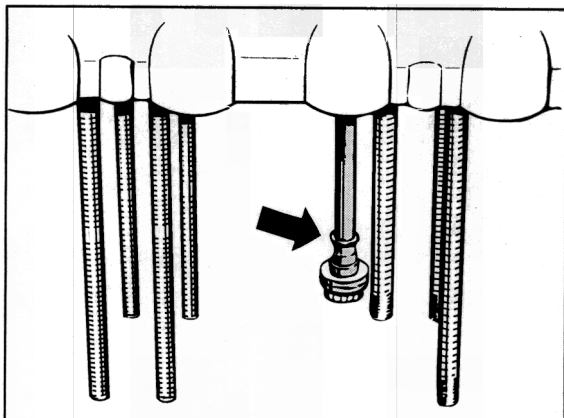


10100011

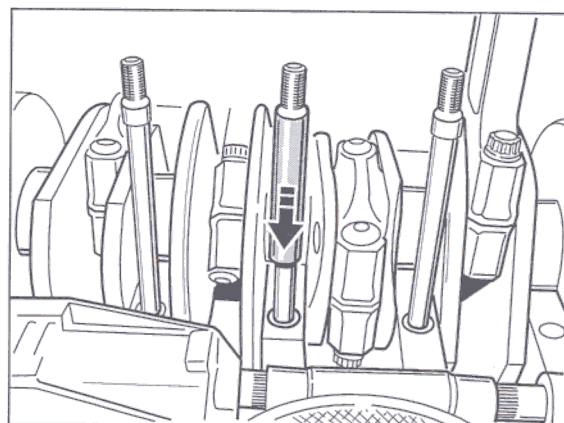
**Note**

Do not push O-rings on to the bolt collar (ø 10 mm).

- 12.2 Push prepared tension rod bolts from below into the right crankcase half (cyl. 4 - 6) as far as the stop.

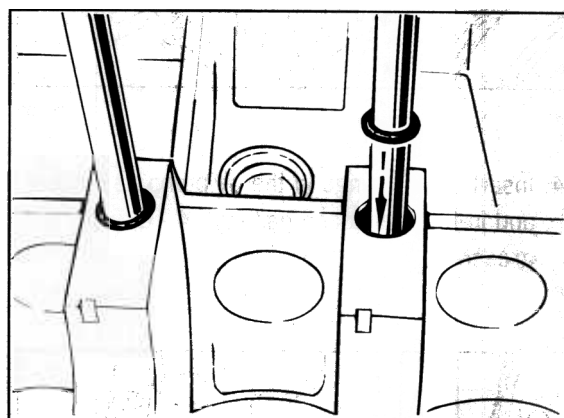


239\_99

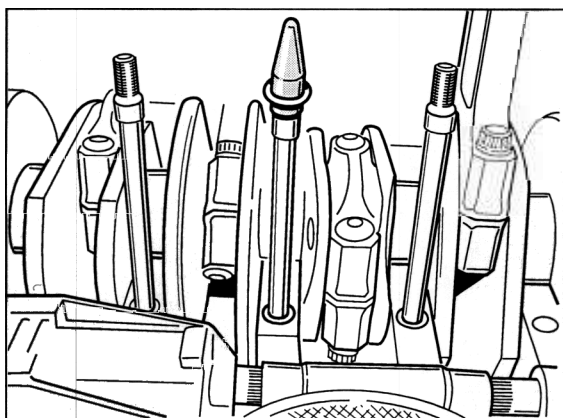


221\_99

- 12.3 Place conical sleeve on end of the thread. Push O-ring (dry) over the conical sleeve. Remove conical sleeve and push the O-ring with the cylinder sleeve as far as the chamfer in the thrust block. Remove cylinder sleeve.



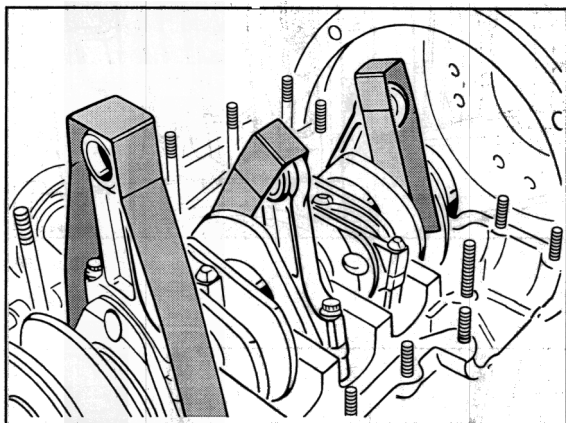
235\_99



220\_99

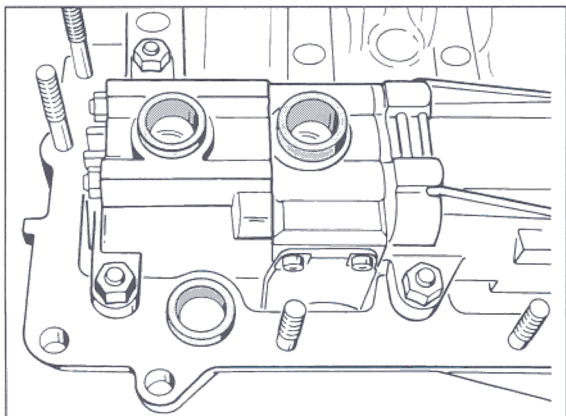


13. Set the connecting rods from cyl. 4, 5 and 6 upright with restraining straps, special tool P 221.



431\_99

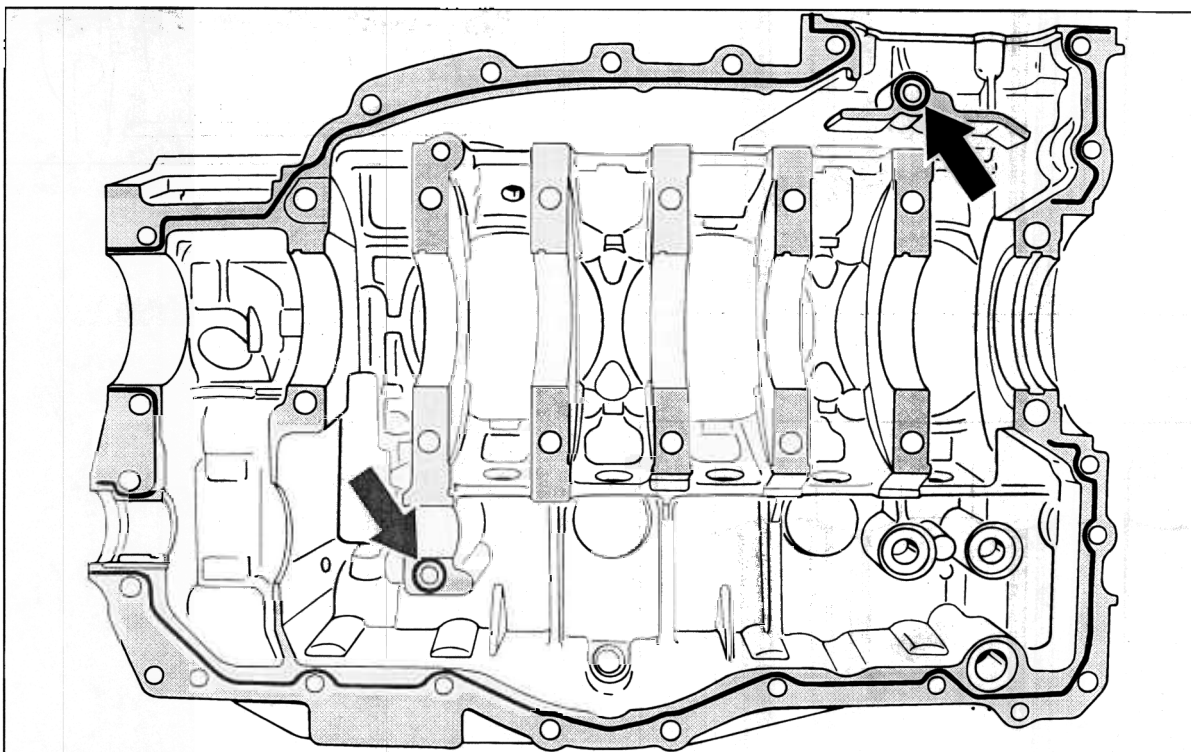
14. Insert sealing rings in the oil pump (2 pieces) and in the crankcase half (cyl. 4 - 6) with grease.



385\_99

15. Insert bearing halves of the crankshaft bearing and of the intermediate shaft of cyl. 1 - 3.

16. Degrease the sealing surfaces of the crankcase halves. On the sealing surface of the crankcase half (cyl. 1 - 3), apply a uniform bead of silicone (Drei Bond Type 1209) approximately 1.5 mm wide.

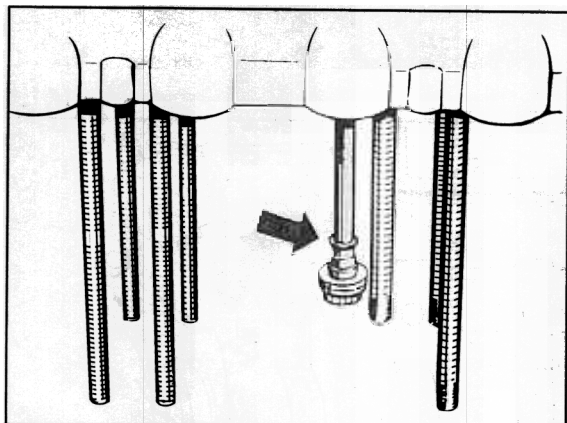


336\_99

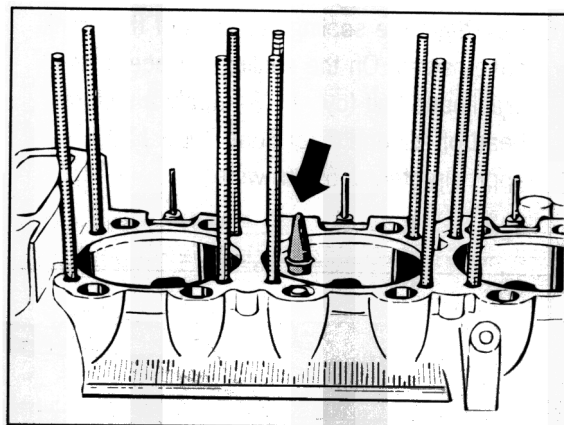
17. Insert the crankcase half carefully over the preassembled tension rod bolts of thrust blocks 2, 3, 4 and 5, at the same time having a second person pull the chain upwards through the chain space.



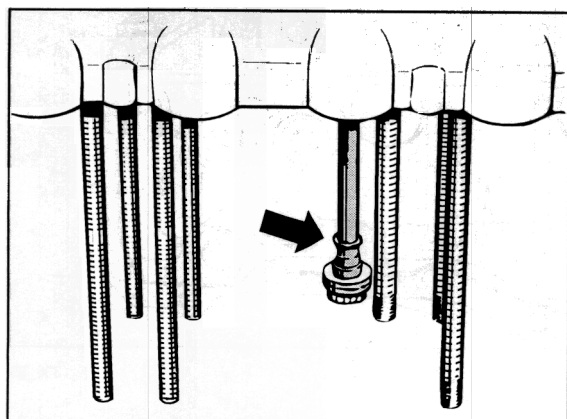
18. Push the prepared tension rod bolts from below to the stop.



239\_99



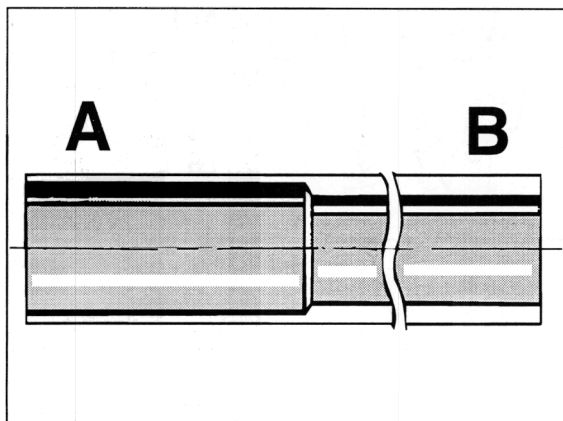
240\_99



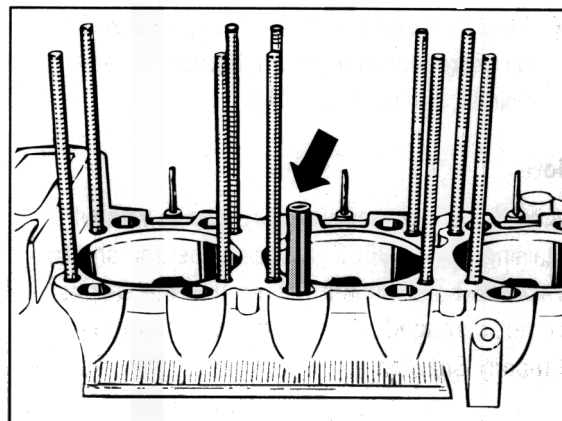
239\_99

19. Push the conical sleeve of special tool 9511 with an oiled O-ring to the end of the thread.

20. Push the O-ring carefully away from the conical sleeve with the A-side (thin wall) of the cylinder sleeve.

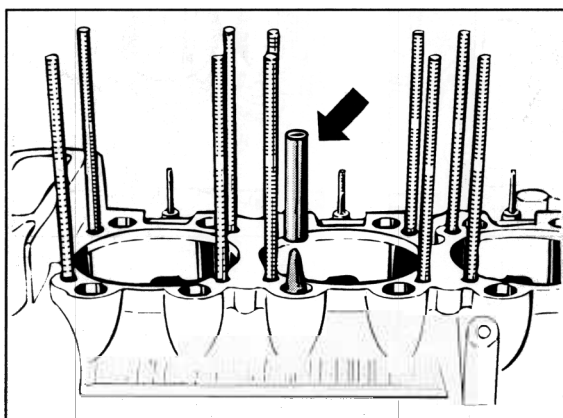


243\_99



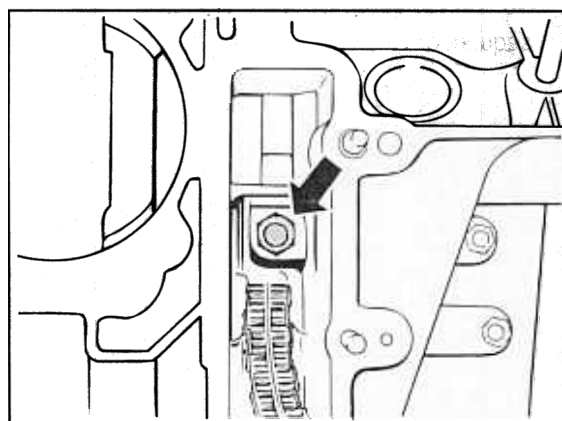
242\_99

22. Mount sealing washers (dry) and press slightly with B-side of cylinder sleeve.
23. Screw on multiple-tooth nuts (thread oiled) by hand.
24. Proceed in the same way with both studs on the right crankcase half (area of bearing 1).
25. Mount hexagon nut M10 x 1.25 and washer A10.5 on stud, with rounded side pointing towards the hexagon nut.



241\_99

21. Remove conical sleeve and carefully push round seal to its end position with the B-side (thick wall) of the cylinder sleeve, while bracing the bolt head.

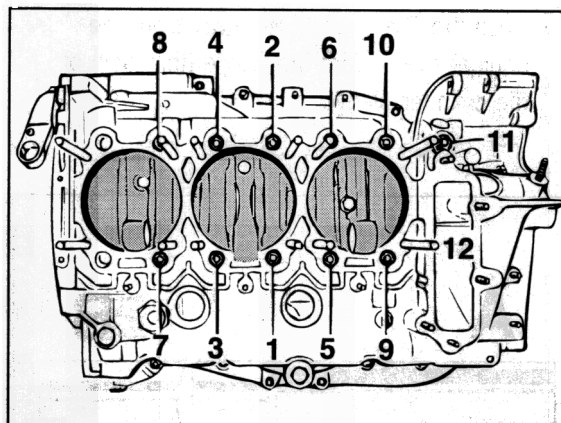


244\_99

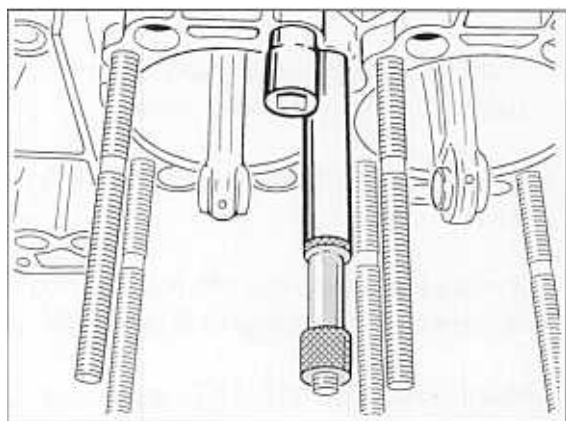
26. Mount retaining device, special tool 9662, on corresponding stud and position with holder, special tool P140.

**Note**

When tightening the tension rod bolts without a retaining device 9662, a second person should brace the bolts without fail, so that the O-rings are not damaged. Use socket M14 from the company Snap on.

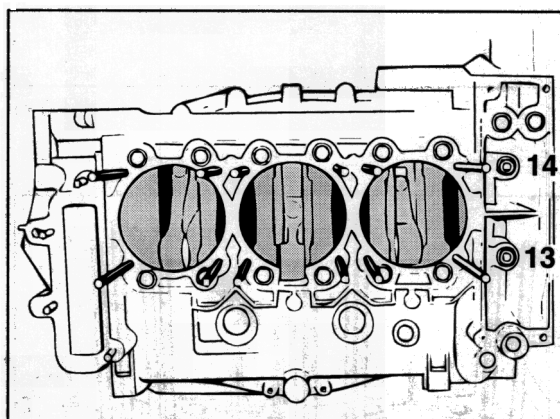


237\_99



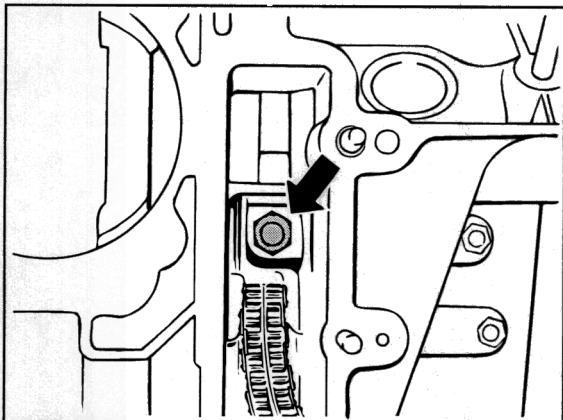
402\_99

27. Tighten tension rod bolts or studs with 50 Nm (37 ftlb.). Observe tightening sequence.



238\_99

28. Tighten hexagon nut M10 x 1.25. Tightening torque 50 Nm (37 ftlb.).

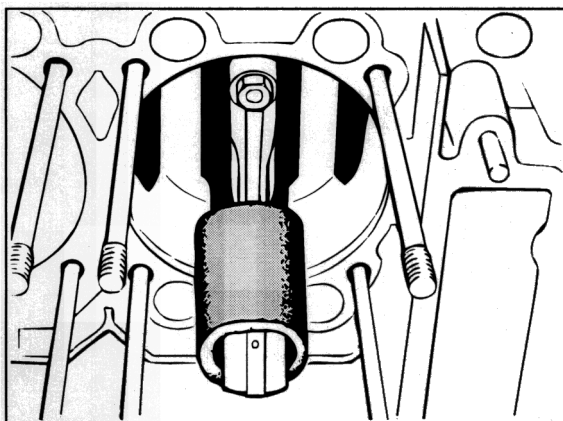


244\_99

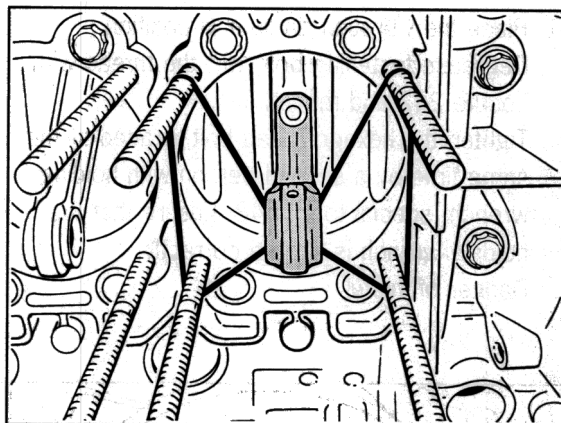
29. Mount the remaining crankcase bolt (self-locking hexagon nuts (M8) with washers). Tightening torque 23 Nm (17 ftlb.).

**Note**

In the case of connecting rod cyl. 1 and 4, attach damage protection to the rod (hose or rubber). Otherwise, the sealing surface may be damaged when turning the crankcase.

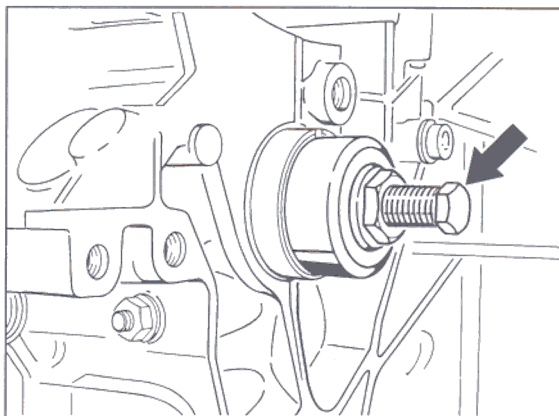


245\_99



282\_99

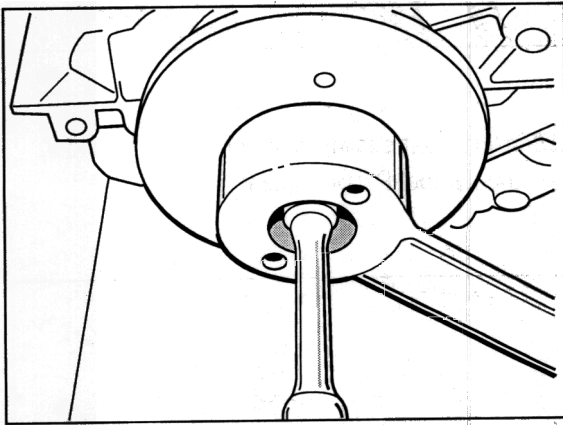
30. Insert front sealing ring using insertion tool, special tool P 16d, until it is flush.



329\_99



31. Place the vibration damper in position.  
Degrease fastening bolt, wet the thread with Loctite 242 and mount.  
Tighten the hexagon-head bolt, braced at the same time by a second person with holding wrench, special tool 9548. Ensure that the holding wrench is seated correctly.  
Danger of injury!



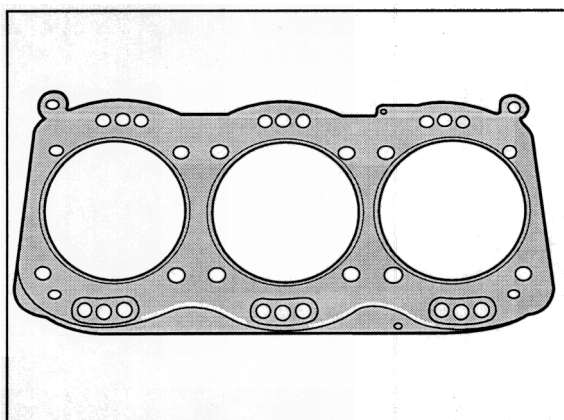
:31\_99

## 10 20 21 Removing cylinder – GT3

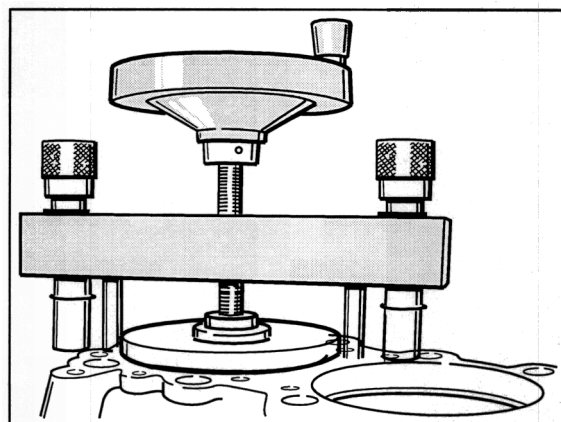
Preliminary work: Removing cylinder head (Serv. No.: 15 70 21)

### 1. Remove seal.

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



255\_99



10200003

### 4. Replace sealing rings.

Remove and replace the three sealing rings (two in the cylinder, one on the bushing).

### 2. Take cylinder from crankcase.

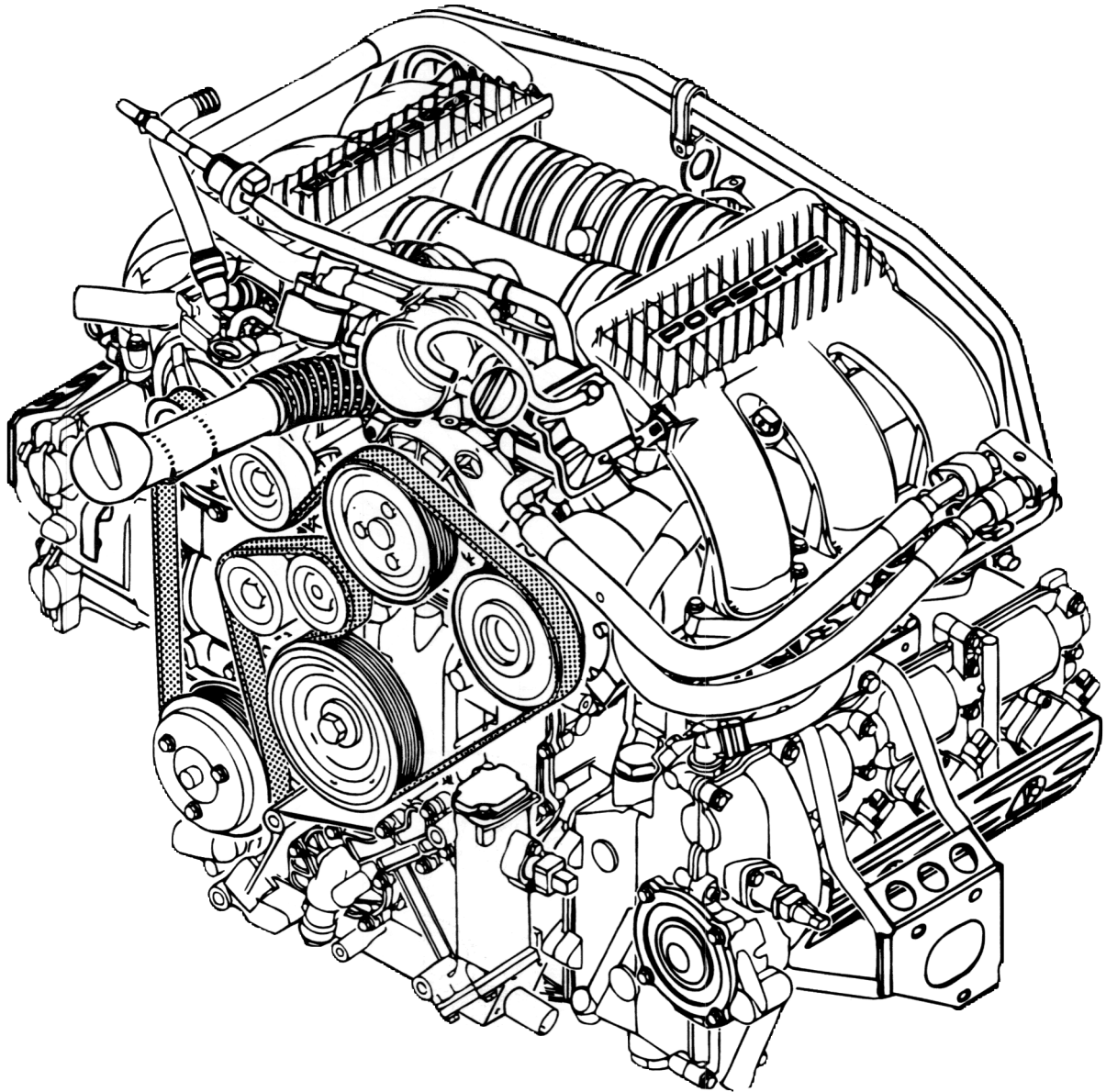
Carefully pull the cylinder out of crankcase. Make sure that the pistons and the piston rings are not damaged.

### 3. Press cylinder out.

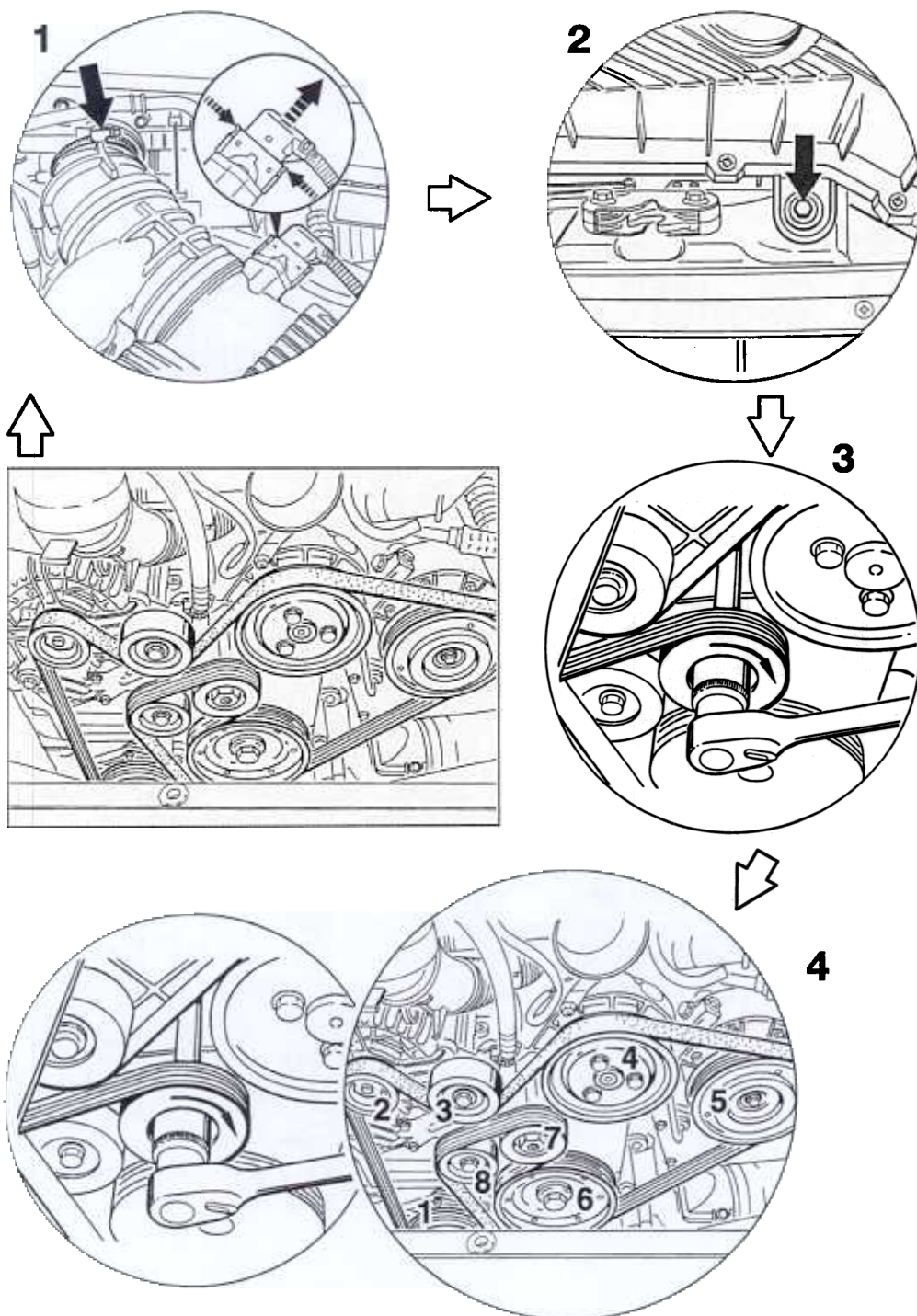
Press the cylinder bushing out from below with special tool No. 9660.



**13 78 19** Removing and installing drive belt



# Removing and installing drive belt



381 - 97

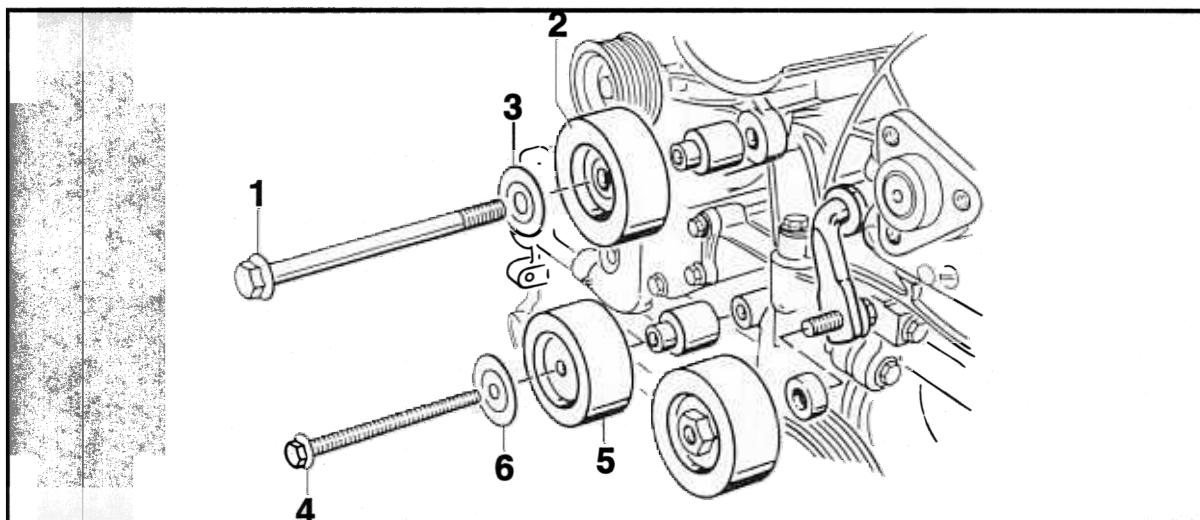
**Removing drive belt**

| No.   | Procedure                          | Instructions   |
|-------|------------------------------------|--|
| 1 + 2 | Removing the air cleaner assembly. | Unclip oil filler neck. Undo hexagon-head bolt M6 x 25. Undo hose clamp on throttle body and pull plug off the mass air flow meter. Unclip wire on air cleaner housing and remove entire air cleaner assembly.                                       |
| 3     | Removing the 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. Visually check state of belt and replace if necessary. |

**Installing drive belt**

| No. | Procedure                            | Instructions   |
|-----|--------------------------------------|--|
| 4   | Fiting and tensioning the drive belt | <p>Fit drive belt by hand, slightly pre-tensioned, in the following sequence:</p> <ol style="list-style-type: none"><li>1. Coolant pump drive pulley (1)</li><li>2. Generator drive pulley (2)</li><li>3. Deflection roller 1 (3)</li><li>4. Power steering pump drive pulley (4)</li><li>5. Air conditioning compressor drive pulley (5)</li><li>6. Crankshaft pulley (6)</li><li>7. Tensioning roller (7)</li></ol> <p>Then turn the tensioning roller (7) clockwise and simultaneously fit the drive belt onto the tensioning roller 2 (8). Slowly relieve the tensioning roller.</p> <p><b>Check that the belt is correctly seated on all drive pulleys.</b></p> |

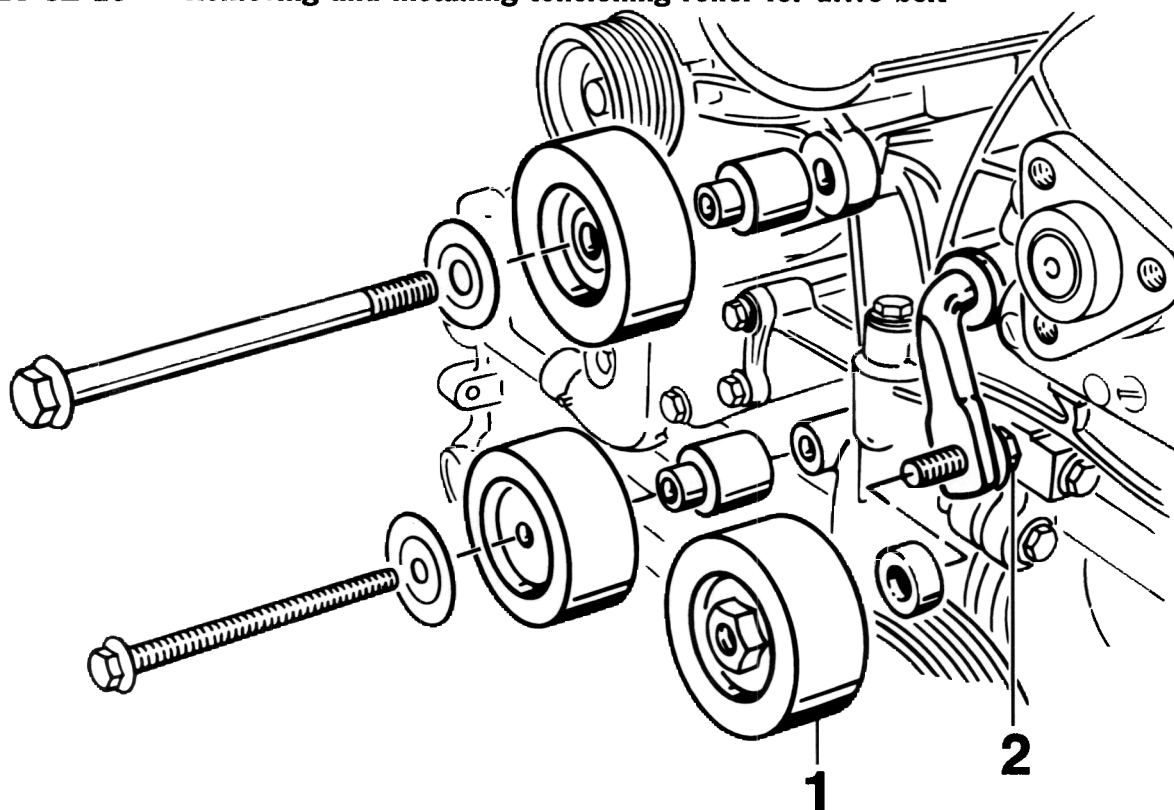
# **13 77 20 Removing and installing deflection rollers for drive belt**



317\_97

| No. | Designation                            | Qty. | Removal  | Note:<br>Installation   |
|-----|--|------|--|---|
| 1   | Hexagon-head bolt<br>M10 x 145 (8.8)   | 1    |  | Tightening torque 46 Nm<br>(34 ftlb.)   |
| 2   | Deflection roller 1<br>with spacer pin | 1    | Check for smooth running<br>or roughness before<br>undoing |   |
| 3   | Cover plate                            |      |  | When fitting a curved<br>cover plate, observe<br>the installation position.<br>The inscription must<br>face the bolt head |
| 4   | Hexagon-head bolt<br>M8 x 55           | 1    |  | Tightening torque 23 Nm<br>(17 ftlb.)   |
| 5   | Deflection roller 2<br>with spacer pin | 1    | Check for smooth running<br>or roughness before<br>undoing |   |
| 6   | Cover plate                            | 1    |  | When fitting a curved<br>cover plate, observe<br>the installation position.<br>The inscription must<br>face the bolt head |



**13 82 19 Removing and installing tensioning roller for drive belt**

328 - 97

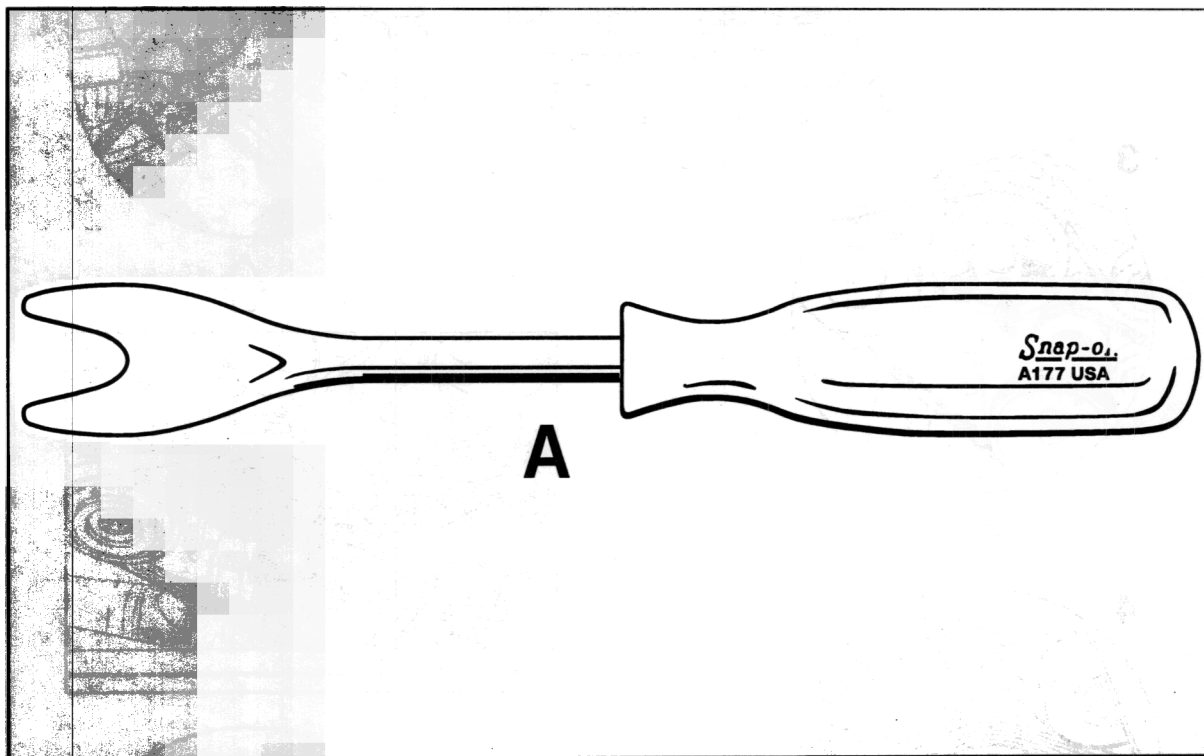
| No. | Designation                            | Qty. | Removal   | Note:  |  |
|-----|--|------|---|--|--|
|     |  |      |   | Installation   |  |
| 1   | Tensioning roller with spacer ring     | 1    | Undo at the hexagon (wrench size: 24) and simultaneously counter at the hexagon-head bolt   | Tightening torque 60 Nm (44 ftlb.)<br>Counter at the hexagon-head bolt when tightening (wrench size 15). |  |
| 2   | Hexagon-head bolt (micro-encapsulated) | 1    | This is <b>not</b> not required for removal and installation of the tensioning roller. The hexagon-head bolt can be removed only after the belt tensioner or the bracket has been loosened. | Apply a thin coat of screw locking lacquer to the thread of the hexagon-head bolt.<br>(Observe note)     |  |

**Note:** Either the screw locking lacquer Loctite **242** "Mittelfest" (medium strength) or screw locking lacquer Loctite **270** "Hochfest" (high strength) can be used. **If screw locking lacquer 270 is used, coat only the first four threads.**

**13 73 19 Removing and installing belt tensioner**

Engine installed

Tools

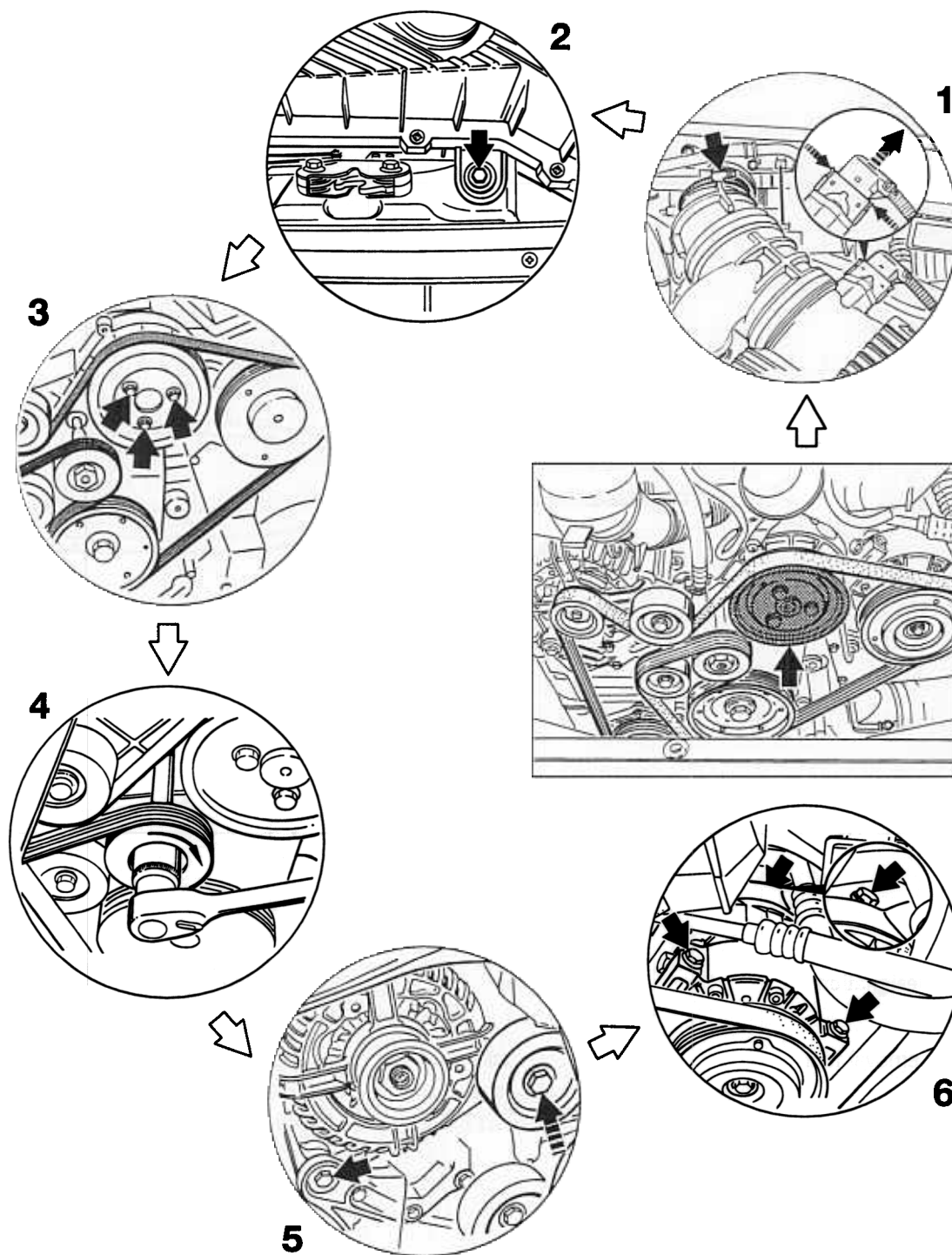


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| Item | Designation  | Special tool  | Explanation  |
|------|--------------|---|--|
| A    | Removal tool | Commercially available,<br>e.g. Snap-on,<br>order No. A177A | Supplier's address:<br>refer to Workshop<br>Equipment Manual |



## Removing belt tensioner

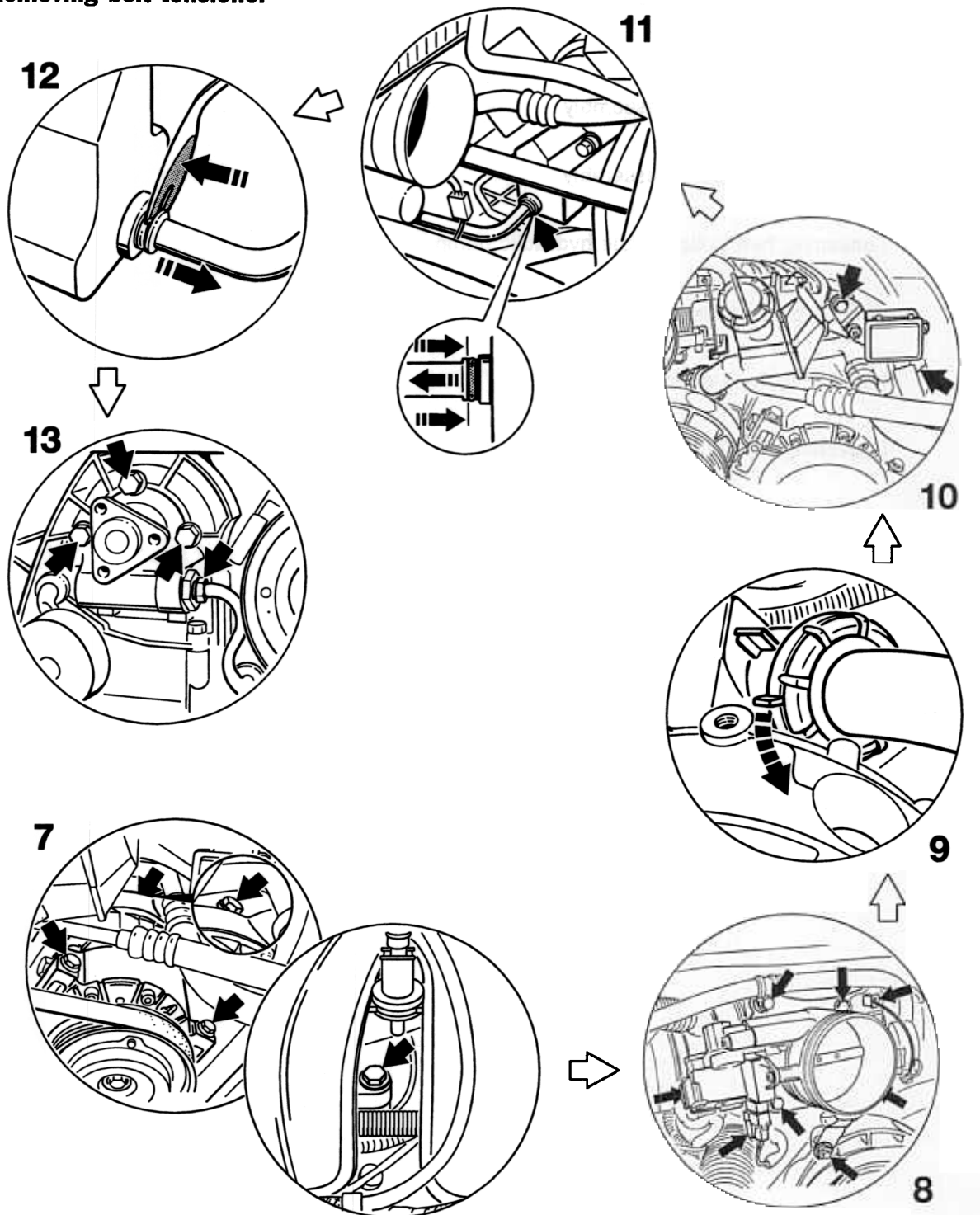


383A - 97

## Removal overview of the components

- 1 Removing air cleaner assembly
- 2 Removing air cleaner assembly
- 3 Loosening belt pulley of the hydraulic pump
- 4 Relieving and removing drive belt
- 5 Loosening three-phase generator
- 6 Loosening air conditioning compressor

Removing belt tensioner



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## **Removal overview of the components**

- 7      Loosening air conditioning compressor**
- 8      Removing throttle body**
- 9      Removing supply tank of the power steering system**
- 10     Removing supply tank of the power steering system**
- 11     Detaching steering return line**
- 12     Detaching steering return line from the supply tank with tool**
- 13     Detaching hydraulic pump and steering supply line**

**Removing belt tensioner**

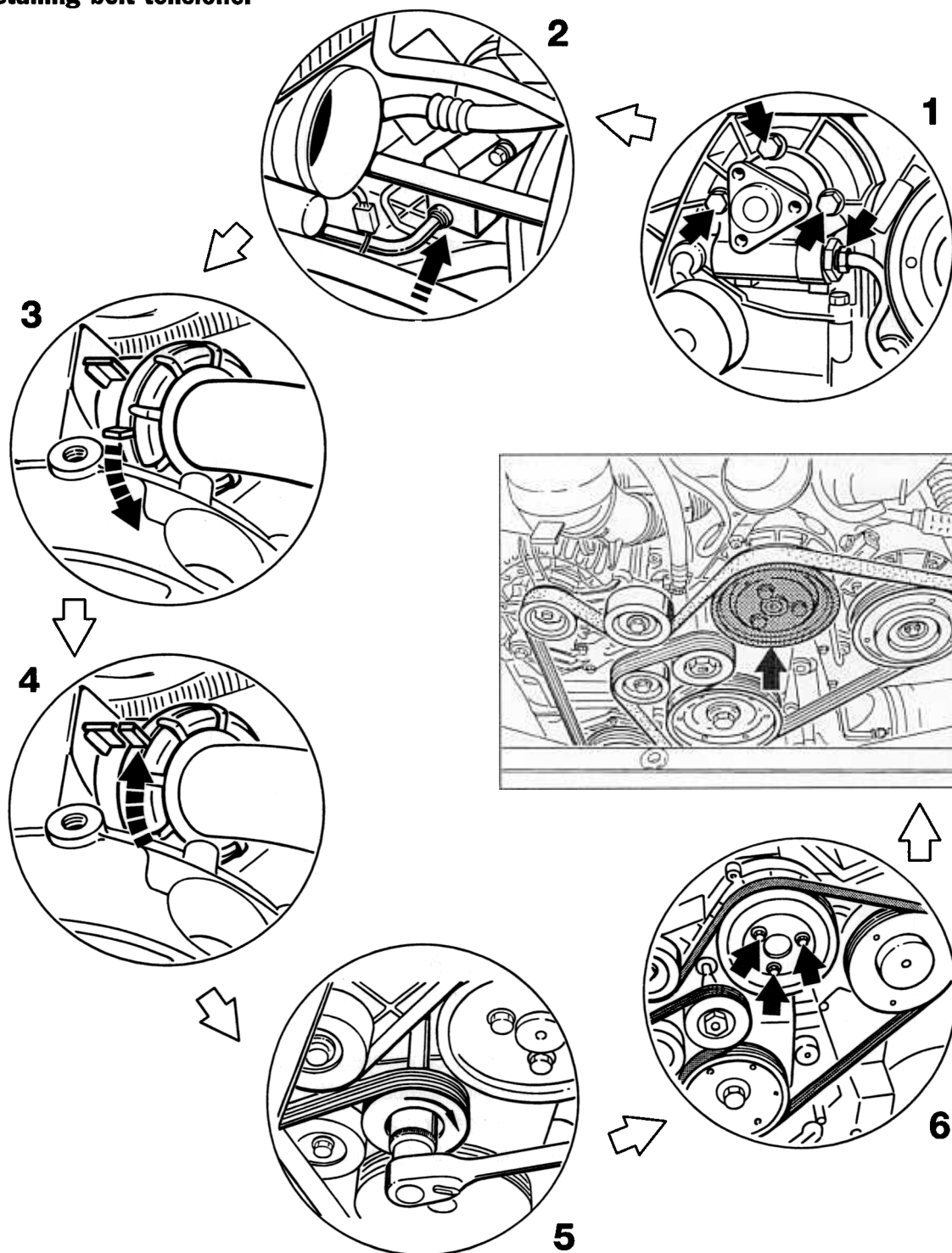
| No. | Procedure                             | Instructions  |
|-----|---------------------------------------|---|
| 1   | Removing air cleaner assembly         | Undo the hose clamp on the throttle body. Remove connector from mass air flow meter. Unclip electrical lead on throttle body.   |
| 2   | Removing air cleaner assembly.        | Unclip oil filler neck. Undo hexagon-head bolt M6 x 20 and remove entire air cleaner assembly.  |
| 3   | Loosening belt pulley                 | Undo three hexagon-head bolts (M8 x 12) by approx. one half turn.<br><br><b>Note</b><br><br>The belt pulley can also be loosened with a restraining strap after removal of the drive belt.  |
| 4   | Removing 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.   |
| 5   | Loosening three-phase generator       | Undo right-hand fastening screw (in direction of travel) and unscrew.<br><br>Undo left-hand fastening screw (with deflection roller) by three turns. A gentle tap on the fastening screw loosens the threaded bushing in the generator arm (use aluminium mandrel). |
| 6   | Loosening air conditioning compressor | Undo front compressor fastening screws (2 ea.) and disconnect electrical plug connection.   |

| No. | Procedure   | Instructions   |
|-----|---|--|
|     |   | <p>Lift generator up and out of the slotted generator bracket. Unscrew fastening screw and remove with deflection roller.</p>  |
|     |   | <b>Note</b>  |
|     |   | <p>Do not disconnect electrical connections or plug connection.</p>  |
| 7   | Loosening air conditioning compressor             | Undo compressor fastening screw between the intake pipes of cylinders 4 and 5.   |
| 8   | Removing throttle body                            | Disengage accelerator cable and remove throttle body. Pull off vacuum check valve.   |
| 9   | Removing supply tank of the power steering system | Suck fluid out of the upper supply tank until the level is below the joint. Turn bayonet lock ring counter-clockwise.  |
| 10  | Removing supply tank                              | Detach bracket from supply tank and B+ disconnection point and set aside. Pull supply tank up and off. Suck off fluid level of the lower supply tank and then immediately close the opening with a suitable plug (ø 30). |
| 1   | Detaching steering return line                    | In order to detach the line from the supply tank, <b>push the red unlocking ring forward (arrows)</b> and <b>simultaneously</b> pull out the line. Use two plastic spatulas to press the unlocking ring.                 |



| No. | Procedure  | Instructions   |
|-----|--|--|
| 12  | Detaching steering return line from the supply tank <b>with tool</b> | The line can also be detached using a commercially available tool. The removal tool from Messrs. Snap-on, for example, is recommendable. Insert tool between line and the red unlocking ring and unlock. Pull line to the rear and simultaneously press the tool against the red ring. Carefully protect the line against dirt and scratches with a cap. |
| 13  | Detaching hydraulic pump and steering supply line                    | Undo steering supply line (wrench size 17); simultaneously counter at the body (wrench size 27).<br>Undo three hexagon-head bolts (M8 x 12) and remove hydraulic pump to the rear.   |
|     |  | <b>Note</b>  |
|     |  | If coolant hoses come into contact with Pentosin, clean them thoroughly without delay.   |
|     | Removing bracket with tensioning element                             | Undo flange for oil filler neck at the left rear bracket fastening screw. Immediately seal bore on the crankcase.<br>Undo four hexagon-head bolts and remove bracket with tensioning element.  |

# Installing belt tensioner



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**Installing belt tensioner**

| No. | Procedure                                     | Instructions  |
|-----|---|---|
| 1   | Installing hydraulic pump                     | Fasten bracket with tensioning element on the crankcase.<br>Tightening torque: 23 Nm (17 ftlb.)<br>Insert hydraulic pump from the rear and fasten.<br>Tightening torque: 23 Nm (17 ftlb.) |
| 2   | Fitting steering return line                  | Insert line into the plug-in coupling in a straight line. Then pull slightly to ensure that the connection is properly locked.  |
| 3   | Fitting supply tank for power steering system | Turn bayonet lock to its initial position.  |
| 4   | Fitting supply tank for power steering system | Remove plug. Position tank (observe markings). Lock bayonet lock.   |
| 5   | Fitting drive belt.                           | Fit belt pulley of the hydraulic pump and screw in hexagon-head bolts. Fit drive belt.<br>Assembly instructions on Page 13-1  |
| 6   | Fastening belt pulley for hydraulic pump      | Tighten three hexagon-head bolts.<br>Tightening torque: 23 Nm (17 ftlb.)  |

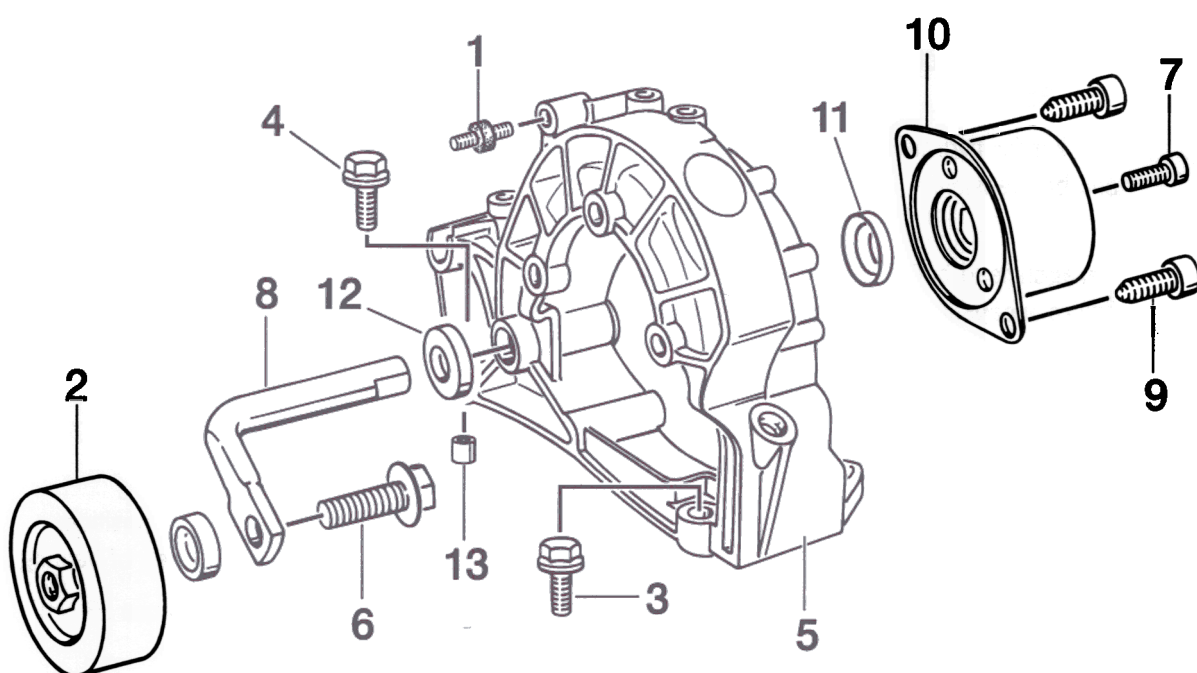
**Note**

The belt pulley can also be held and tightened with a restraining strap before the drive belt is fitted.

Fasten air conditioning compressor.  
Tightening torque: 28 Nm (21 ftlb.)  
Fasten generator.  
Fit throttle body and air cleaner assembly.



**13 73 37 Disassembling and assembling belt tensioner**



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| No. | Designation                                   | Qty. | Removal  | Note: | Installation   |
|-----|---|------|--|-------|--|
|     |   |      |  |       |  |
| 1   | Rubber-metal buffer                           | 1    |  |       |  |
| 2   | Tensioning roller                             | 1    | Undo at the hexagon (wrench size 24) and simultaneously counter at the hexagon-head bolt             |       | Tightening torque 60 Nm (44 ftlb.) Counter at the hexagon-head bolt when tightening (wrench size 15) |
| 3   | Hexagon-head bolt M8 x 25                     | 2    |  |       |  |
| 4   | Hexagon-head bolt M8 x 35                     | 2    |  |       |  |
| 5   | Bracket for hydraulic pump and belt tensioner | 1    |  |       | Grease plastic bushings of the lever bearing with Olista Longtime 3 EP                               |
| 6   | Hexagon-head bolt (micro-encapsulated)        | 1    | The hexagon-head bolt can be removed only after the belt tensioner or the bracket has been loosened. |       | Apply a thin coat of screw locking lacquer to the thread of the hexagon-head bolt. (Observe note)    |
| 7   | Pan-head screw                                | 1    |  |       | Tightening torque 9.7 Nm (7.0 ftlb.)   |
| 8   | Lever   | 1    | Drive out of the tensioning element with a drift (ø 5)   |       | Fit in correct position; grease in area of bearing   |
| 9   | Pan-head screw                                | 2    |  |       | Tightening torque 23 Nm (17 ftlb.)   |
| 10  | Tensioning element                            | 1    |  |       |  |
| 11  | Dust cap                                      | 1    |  |       |  |

| No. | Designation  | Qty. | Removal | Note:   |
|-----|--------------|------|---------|---|
|     |              |      |         | Installation  |
| 12  | Dust cap     | 1    |         |   |
| 13  | Dowel sleeve | 2    |         | Fit in the two bores of the bracket (on right side in direction of travel). |

**Note**

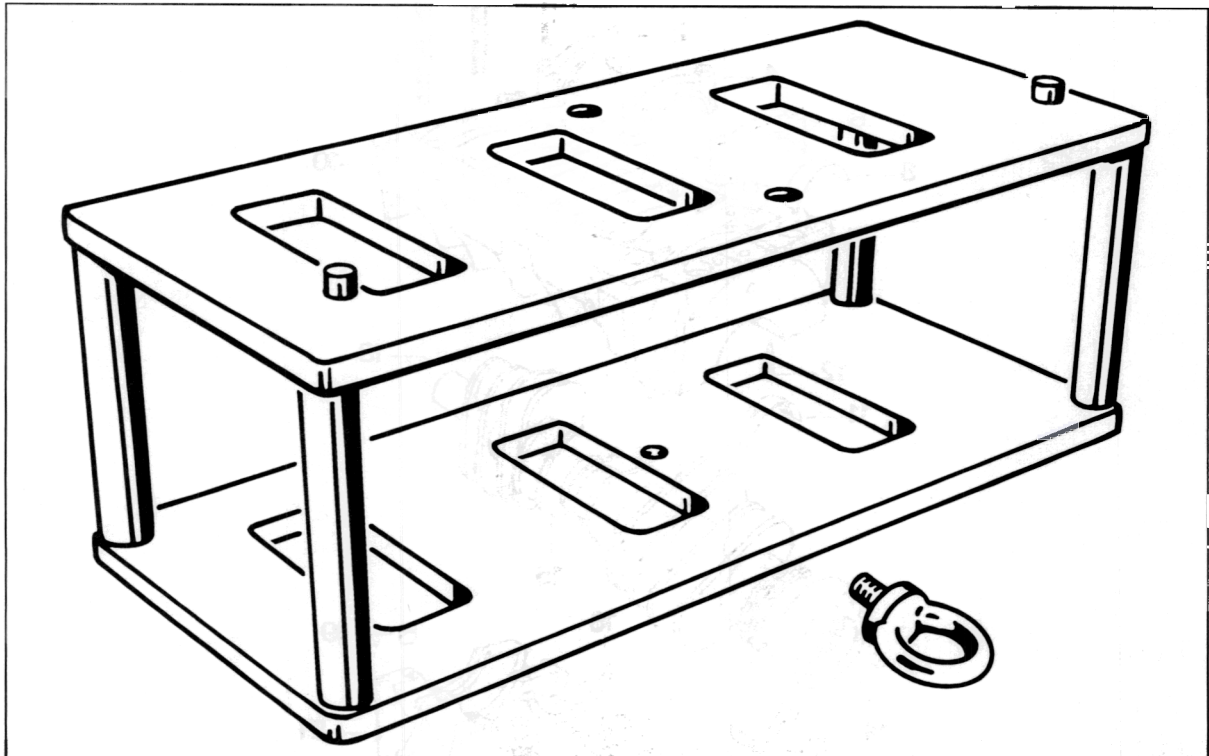
Either the screw locking lacquer Loctite **242** "Mittelfest" (medium strength) or screw locking lacquer Loctite **270** "Hochfest" (high strength) can be used.

**If screw locking lacquer 270 is used, coat only the first four threads.**



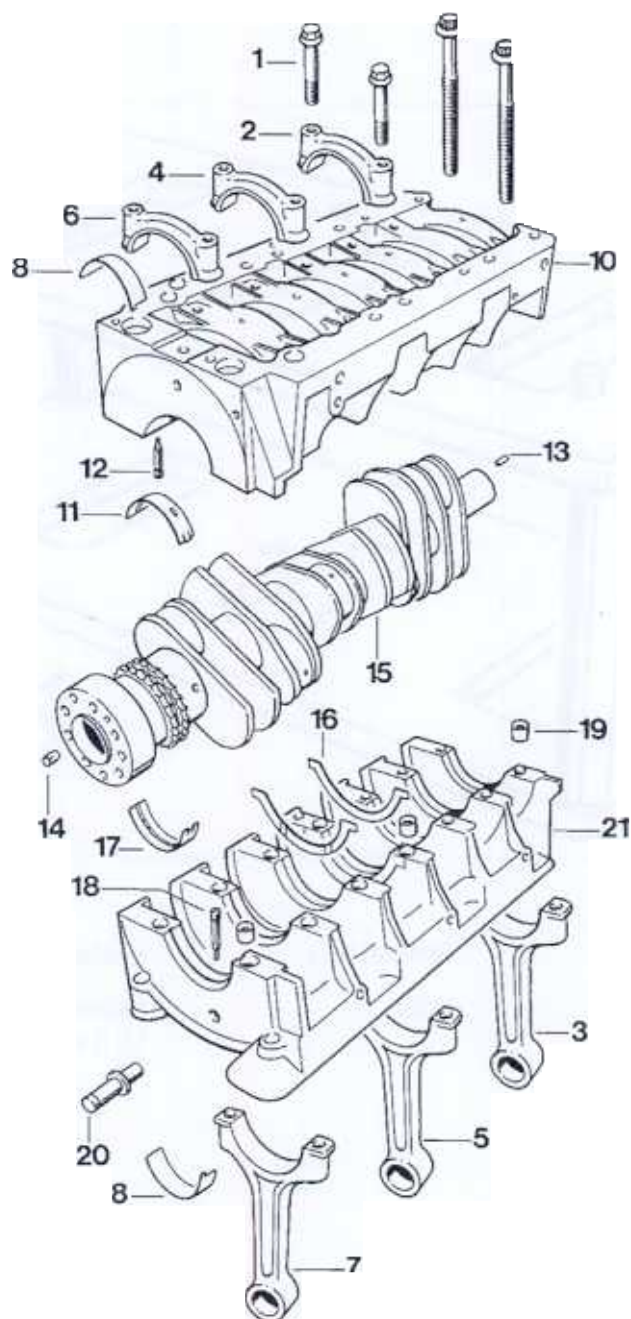
## 13 49 37 Disassembling and assembling bearing housing with crankshaft

### Tools



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| Item | Designation                          | Special tool | Explanation  |
|------|--------------------------------------|--------------|--|
|      | Assembly fixture for bearing housing | 9607         | Fasten bearing housing with two M10 x 30 hexagon-head bolts. |

**Disassembling and assembling bearing housing with crankshaft**

**Disassembling and assembling bearing housing with crankshaft****Warning!**

**Danger to engine if connecting-rod bearing cap and connecting rod are mixed up!**

The connecting-rod bearing caps must always remain allocated to the respective connecting rods and must never be interchanged.

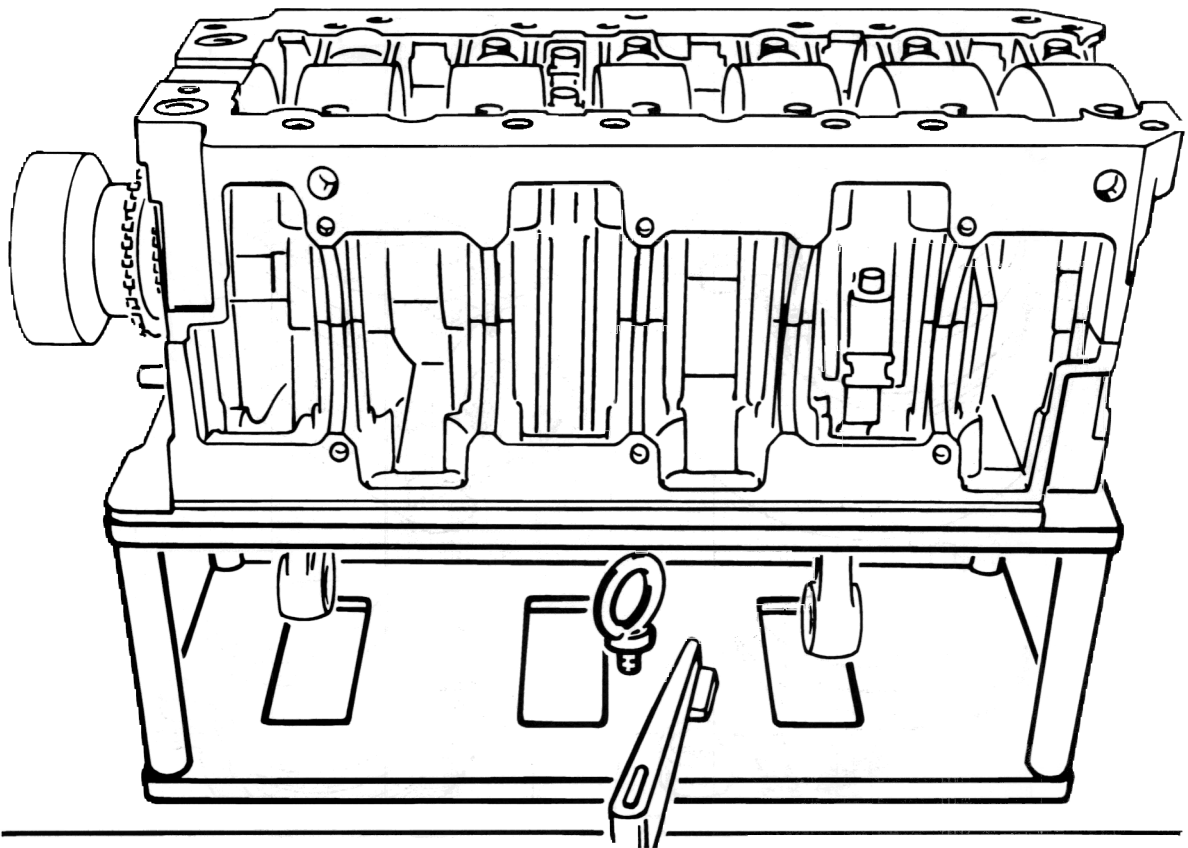
**Recommendation:** After disassembly, immediately re-join the connecting-rod bearing cap and connecting rod or mark them on the sides with an electric scribing tool (e.g. with the cylinder designation). **Never mark these parts with sharp objects such as prick punches or number embossing tools.**

| No. | Designation                               | Qty. | Removal  | Note:<br>Installation   |
|-----|---|------|--|---|
|     | Connecting-rod bolt                       | 6    |  | Lightly oil thread and bearing surface  |
| 2   | Connecting-rod bearing cap, cyl. 4        | 1    |  |   |
| 3   | Connecting rod, cyl. 4                    | 1    | Immediately join with the connecting-rod bearing cap after removal |   |
| 4   | Connecting-rod bearing cap, cyl. 5        | 1    |  |   |
| 5   | Connecting rod, cyl. 5                    | 1    | Immediately join with the connecting-rod bearing cap after removal |   |
| 6   | Connecting-rod bearing cap, cyl. 6        | 1    |  |   |
| 7   | Connecting rod, cyl. 6                    | 1    | Immediately join with the connecting-rod bearing cap after removal |   |
| 8   | Connecting-rod bearing shell half         | 6    |  | Replace   |
| 9   | Thrust-bearing screw M9 x 127             | 14   |  | Lightly oil bearing surface and thread  |
| 10  | Bearing housing half, cylinder bank 1 - 3 | 1    |  |   |
| 11  | Crankshaft bearing shell half             | 7    |  | Replace;<br>insert in correct position,<br>locating stud faces<br>towards dowel-sleeve side |

| No. | Designation  | Qty. | Removal   | Note:<br>Installation  |
|-----|--|------|---|--|
| 12  | Oil spray jets for piston cooling in bearing housing half, cylinder bank 1 - 3 | 3    | Press out from rear side of bearing housing half using a plastic mandrel  | Press in with plastic mandrel (4 mm)   |
| 13  | Cylindrical pin A4.0 x 10  | 1    |   | Check for bending  |
| 14  | Roll pin 6.0 x 16  | 1    |   |  |
| 15  | Crankshaft   | 1    |   | Check axial play. <b>Never process bearing pins e.g. by sanding</b>  |
| 16  | Thrust plate   | 2    |   | Replace, insert in correct position into bearing-housing half (cyl. 4 - 6), oil groove faces the belt pulley, oil groove of opposite thrust plate faces the flywheel, insert thrust plates with grease |
| 17  | Crankshaft bearing shell half  | 7    |   | Insert in correct position, locating stud or anti-turn lock towards dowel-sleeve side  |
| 18  | Oil spray jets for piston cooling in bearing housing half, cylinder bank 4 - 6 | 3    |   | Press in with plastic mandrel (4 mm)   |
| 19  | Dowel sleeve in bearing housing half cylinder bank 4 - 6                       | 3    |   | Check that it is present and seated properly   |
| 20  | Pin for tensioning rail  | 1    |   | Press into bearing housing half (cyl. 4 - 6)   |
| 21  | Bearing housing half, cylinder bank 4 - 6                                      | 1    | Do not damage sealing surfaces, fit on assembly fixture (special tool 9607) and fasten with M10 x 30 hexagon-head bolts |  |

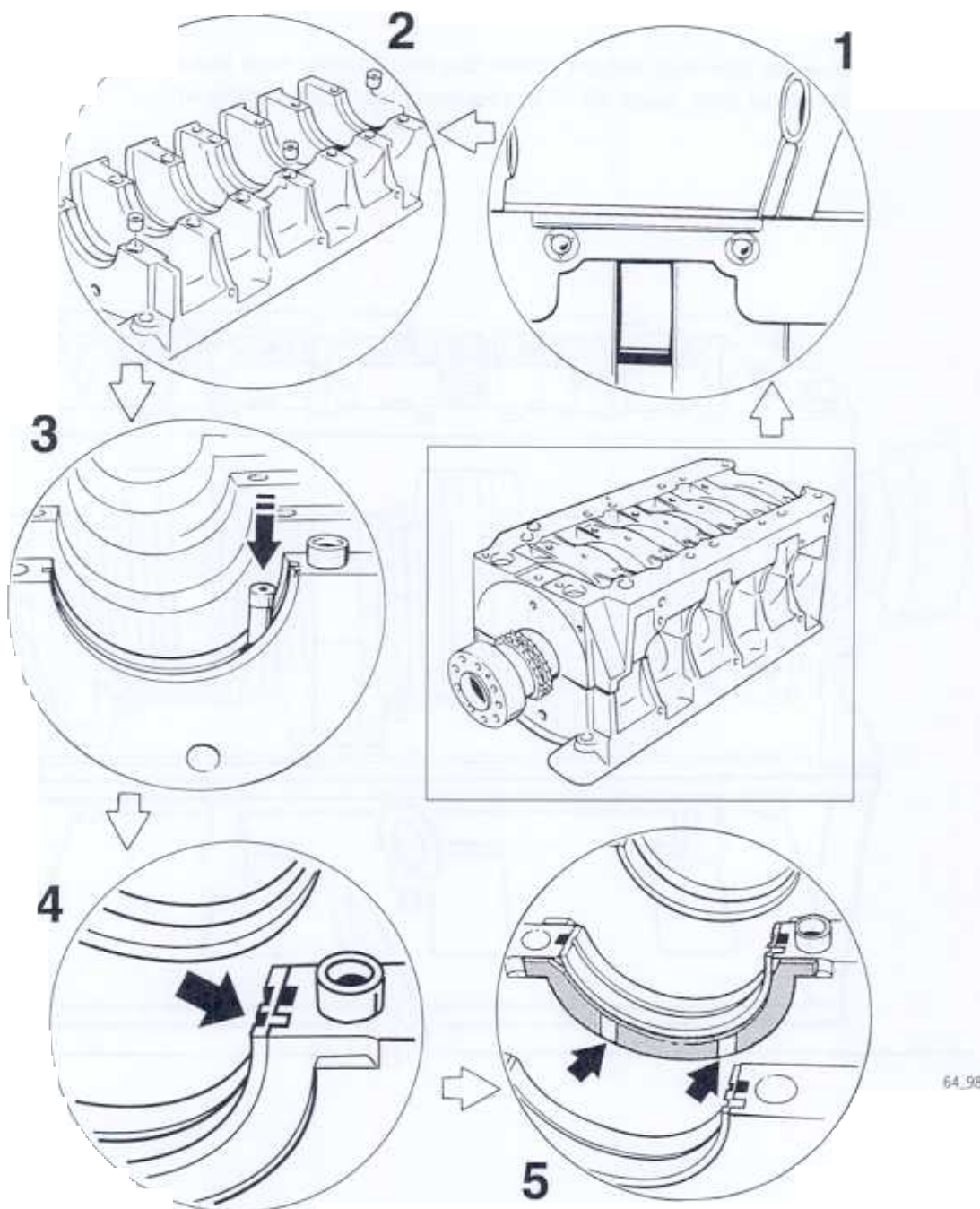
### Disassembling and assembling bearing housing with crankshaft

**Important:** Bearing housings without connecting-rod bearing twist locks should not be installed.  
See twist lock, page 13 - 28, sequence figure no. 4 (arrow)



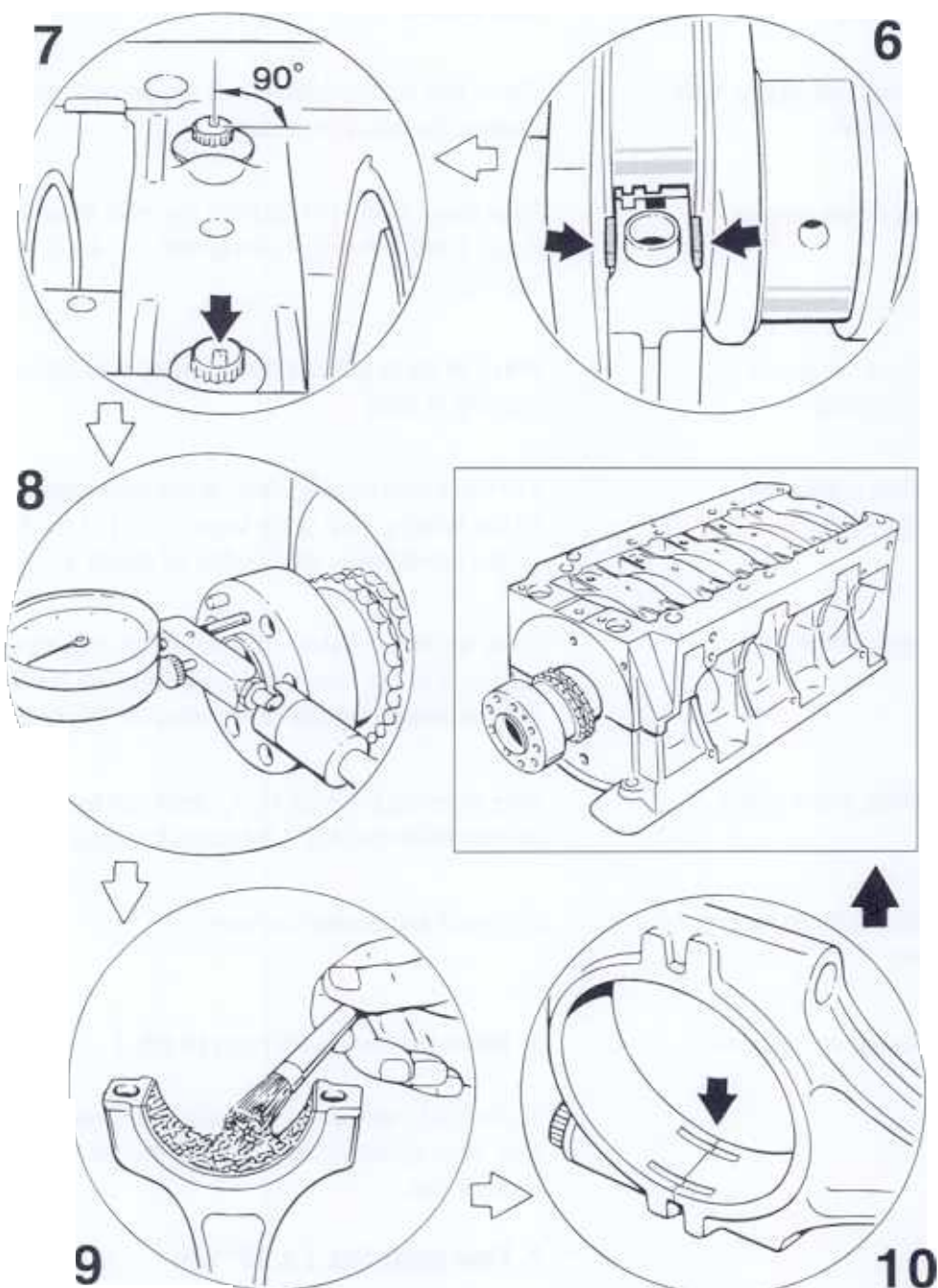
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Disassembling and assembling bearing housing with crankshaft





# Disassembling and assembling bearing housing with crankshaft



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**Disassembling and assembling bearing housing with crankshaft**

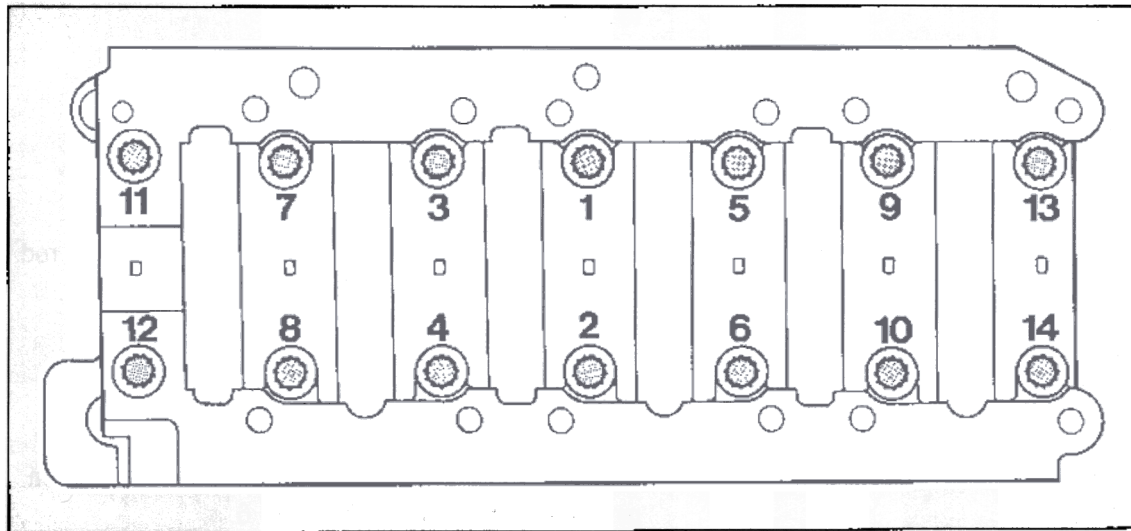
| No. | Procedure                                 | Instructions   |
|-----|---|--|
| 1   | Checking that sealing balls are present   | Check that sealing balls (6 ea.) are present and correctly caulked. Rework if necessary.   |
| 2   | Fitting dowel sleeves                     | Push dowel sleeves (3 ea.) into the main thrust bearings 7, 4 and 1 of the bearing-housing half, cyl. 4 - 6, as far as the stop.   |
| 3   | Fitting oil spray jets for piston cooling | Press oil spray jets into the receiving bore with a plastic mandrel (4 mm).  |
| 4   | Inserting crankshaft bearing shells       | Lay crankshaft bearing shells in the main thrust bearings. Fit the locating stud or the locating stud of the twist lock on the dowel-sleeve side. Lightly oil sliding surfaces.  |
| 5   | Inserting thrust plates                   | Insert the thrust plates in the recess of main thrust bearing 4 of the bearing-housing half of cyl. 4 - 6.<br><b>The oil pockets must face pulley or flywheel side.</b>  |
| 6   | Checking thrust plates                    | After inserting the crankshaft, check the two thrust plates at main thrust bearing 4 for correct seating.  |
| 7   | Tightening thrust-bearing screws          | Oil thread and contact surface.  |
|     | Tightening specification                  | <p><b>1. Initial tightening 25 Nm (19 ftlb.</b></p> <p>To facilitate subsequent checks it is recommended that, after initial tightening, the screw heads be marked with a colour line.</p> <p><b>2. Final tightening 1 x 90° turn</b></p> <p>Observe tightening sequence: see Assembly instructions.</p> |

| No.              | Procedure                               | Instructions  |                  |                 |            |         |
|------------------|---|---|------------------|-----------------|------------|---------|
| 8                | Checking axial play of crankshaft       | <p>Screw gauge with gauge holder VW 387 to bearing housing and place against crankshaft flange. Press crankshaft by hand against the gauge and set gauge to zero.</p> <p>Press crankshaft away from gauge.</p> <p>Read off value:</p> <table><tr><td>New installation</td><td>0.05 to 0.24 mm</td></tr><tr><td>Wear limit</td><td>0.28 mm</td></tr></table> | New installation | 0.05 to 0.24 mm | Wear limit | 0.28 mm |
| New installation | 0.05 to 0.24 mm                         |   |                  |                 |            |         |
| Wear limit       | 0.28 mm                                 |   |                  |                 |            |         |
| 9                | Inserting connecting-rod bearing shells | <p>Insert connecting-rod bearing shells into connecting rod. Lubricate sliding surface liberally with grease, e.g. Optimol Optipit (00004320417).</p> <p><b>Note</b></p> <p>Grease to facilitate assembly during subsequent piston pin installation of cylinder bank 4 - 6.</p>   |                  |                 |            |         |
| 10               | Completing connecting rod               | <p>Join connecting rod and connecting-rod bearing cap. The recesses of the connecting-rod bearing twist lock must face each other.</p>  |                  |                 |            |         |
|                  | Tightening specification                | <p>Oil thread and contact surface.</p> <p><b>1. Initial tightening 20 Nm (15 ftlb.)</b></p> <p>To facilitate subsequent checks it is recommended that, after initial tightening, the screw heads be marked with a colour line.</p> <p><b>2. Final tightening 1 x 90° turn</b></p>   |                  |                 |            |         |



### Assembly instructions

Tightening sequence for thrust-bearing screws



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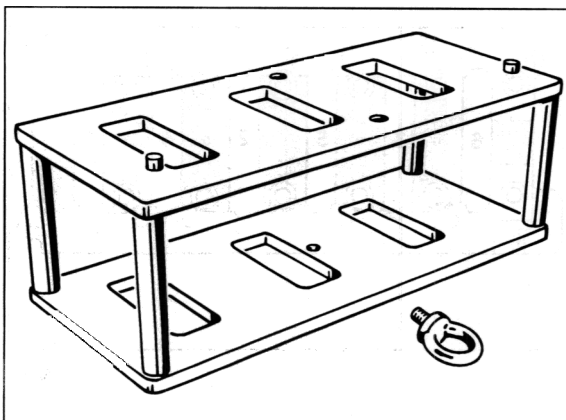
### Screws, bearing housing

Initial tightening: 25 Nm (19 ftlb.)

Final tightening: 1 x 90° turn

### Assembly instructions

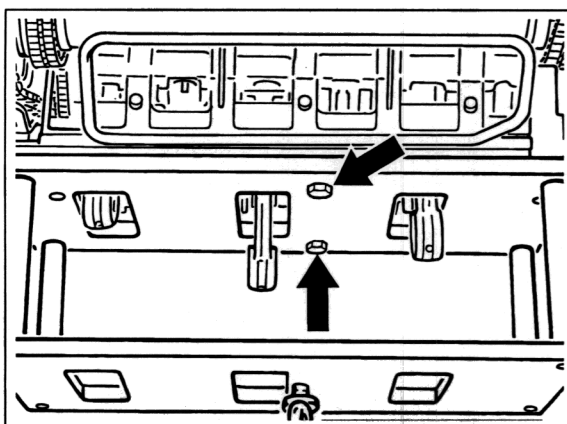
1. Use special tool, assembly fixture 9607, for disassembly and assembly of the bearing housing, crankshaft and connecting rods of cylinder bank 4 - 6.



Special tool 9607

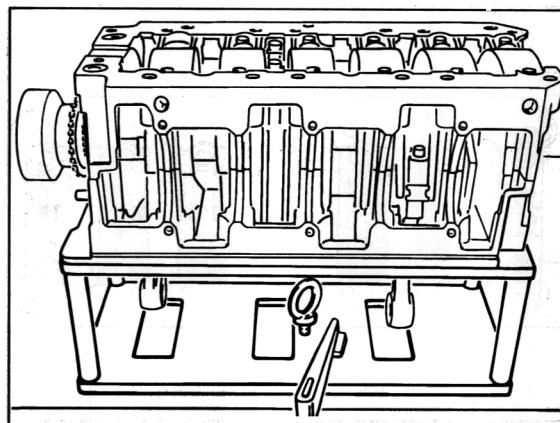
482\_96

2. Fasten bearing housing on the assembly fixture with two M10 x 20 hexagon-head bolts. Tighten hexagon-head bolts only slightly.



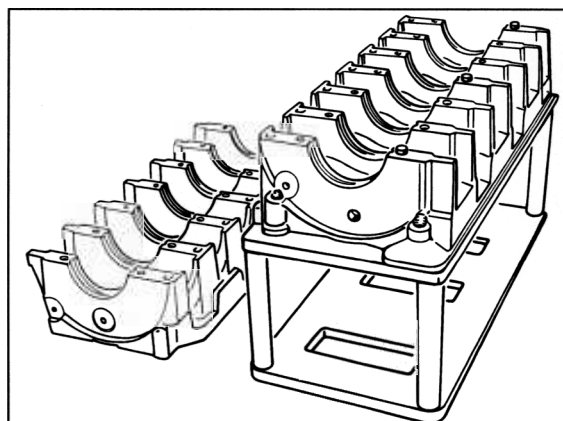
085\_98

3. Additionally fasten the assembly fixture on the workbench using C-clamps.



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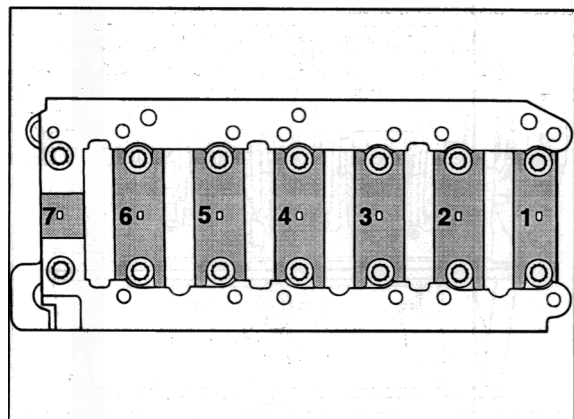
4. Place and fasten the bearing housing half of cylinder bank 4 - 6 on the special tool for assembly.



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### Assembly instructions

Arrangement of the main thrust bearings on the bearing housing.

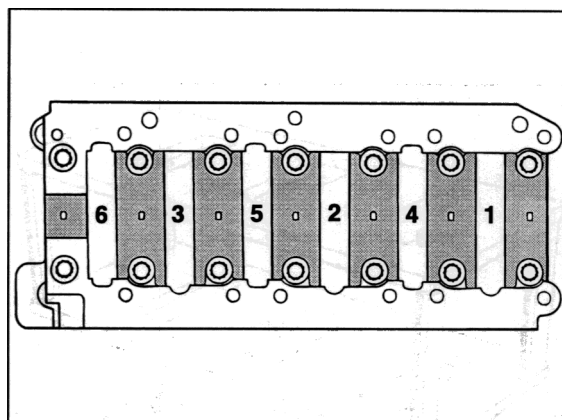


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Main thrust bearing 1 on the **belt pulley side**

Main thrust bearing 7 on the **flywheel side**

Arrangement of the connecting-rod bearings in the bearing housing.



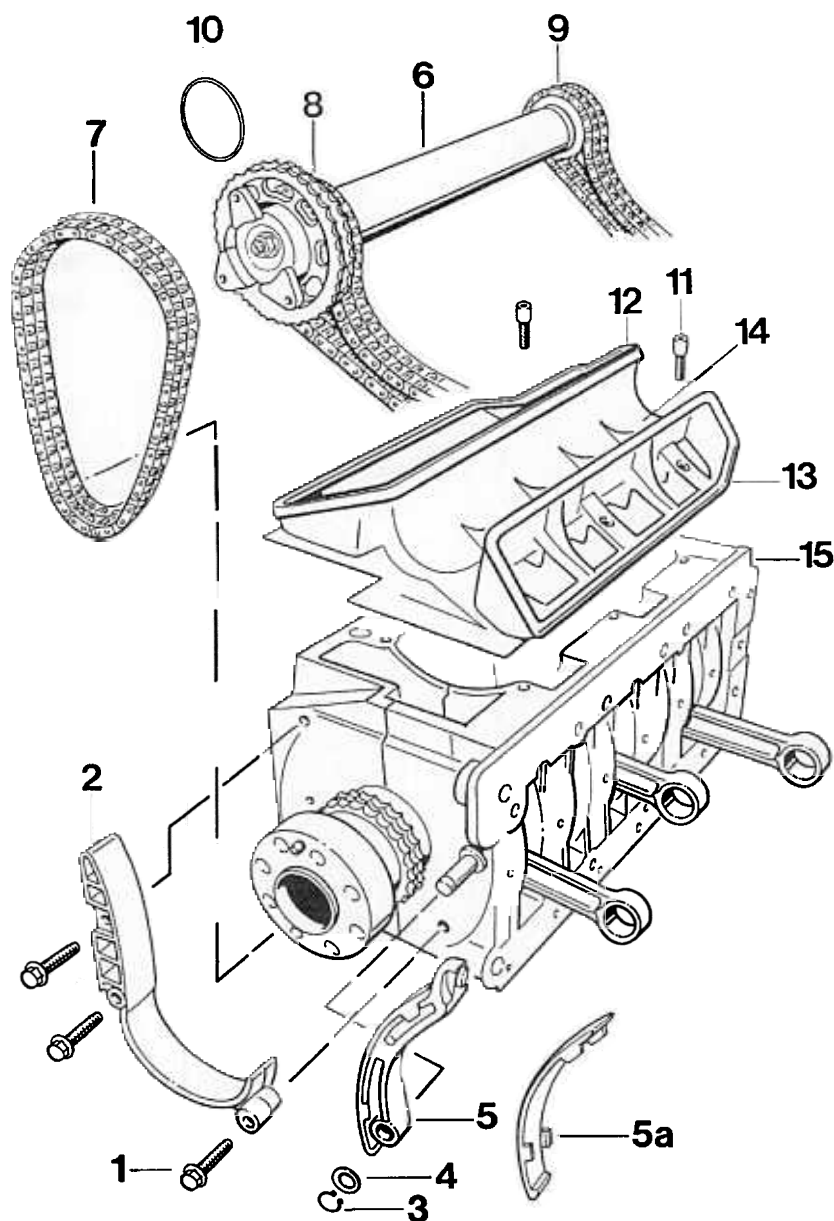
68\_98

Connecting-rod bearing of cylinder 1 on the **belt pulley side**

Connecting-rod bearing of cylinder 6 on the **flywheel side**



# Disassembling and assembling bearing housing with intermediate shaft

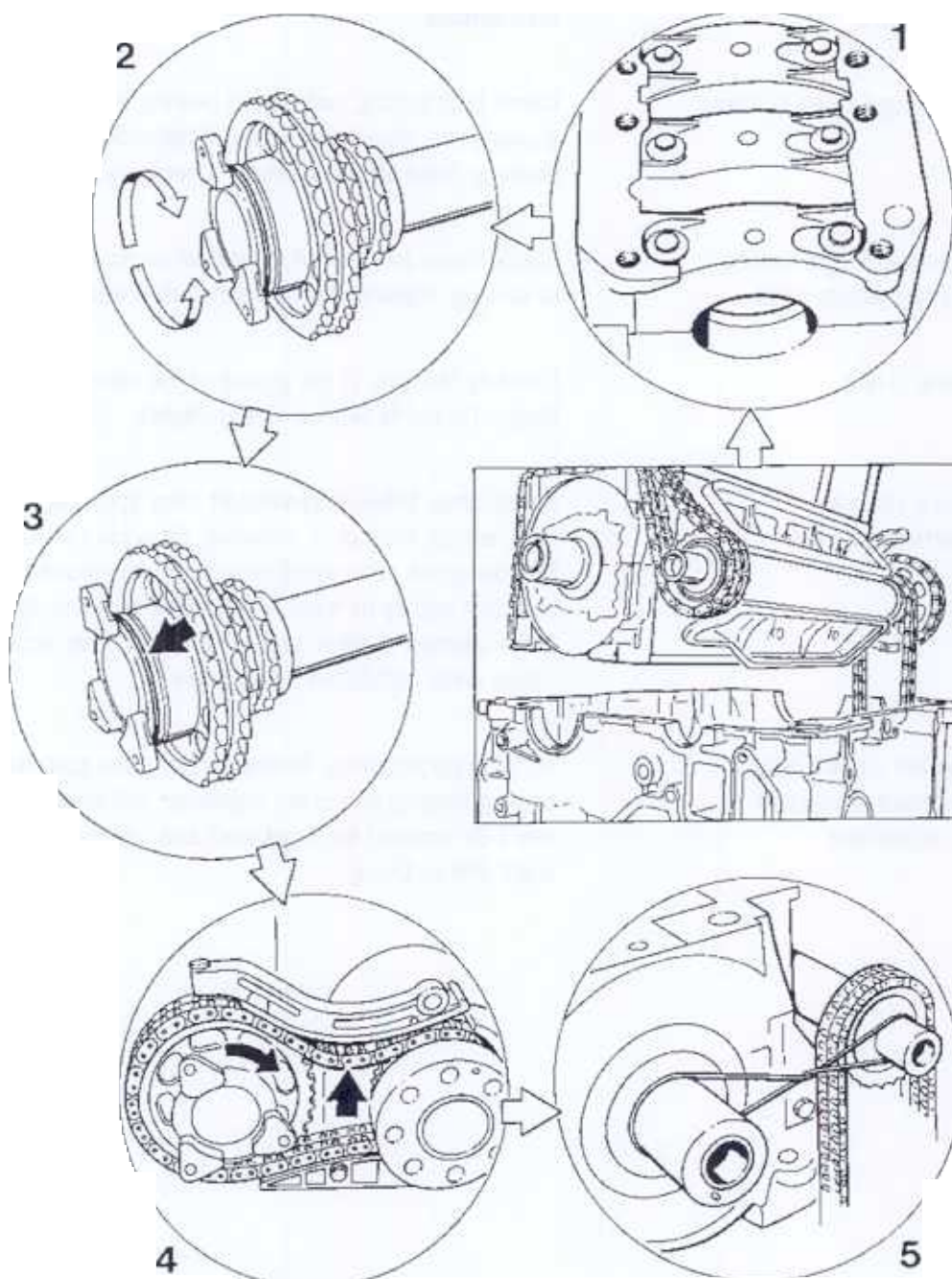


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**Disassembling and assembling bearing housing with intermediate shaft**

| No. | Designation                                     | Qty. | Removal                           | Note:<br>Installation                         |
|-----|---|------|-----------------------------------|---|
|     | Hexagon-head screw with captive washer M6 x 40  | 3    |                                   |   |
| 2   | Guide rail                                      | 1    |                                   | Check for wear marks and replace if necessary |
| 3   | Snap ring                                       | 1    |                                   | Replace; ensure correct seating               |
| 4   | Shim 10 x 16 x 1.2                              | 1    |                                   |   |
| 5   | Tensioning rail                                 | 1    |                                   |   |
| 5a  | Lining for tensioning rail                      | 1    | Unclip                            | Check for wear marks and replace if necessary |
| 6   | Intermediate shaft                              | 1    |                                   |   |
| 7   | Chain for intermediate shaft drive              | 1    |                                   |   |
| 8   | Chain for camshaft drive of cylinder bank 1 - 3 | 1    |                                   |   |
| 9   | Chain for camshaft drive of cylinder bank 4 - 6 | 1    |                                   |   |
| 10  | O-ring 52 x 2.5                                 | 1    |                                   | Always replace; do not fit twisted            |
| 11  | Pan-head screw M6 x 16 (micro-encapsulated)     | 6    |                                   | Replace                                       |
| 12  | Gasket  | 1    |                                   |   |
| 13  | Gasket  | 1    |                                   | Ensure correct seating                        |
| 14  | Oil guide                                       |      |                                   | Ensure correct seating                        |
| 15  | Bearing housing, completely preassembled        | 1    | Assemble on assembly fixture 9607 | Assemble on assembly fixture 9607             |

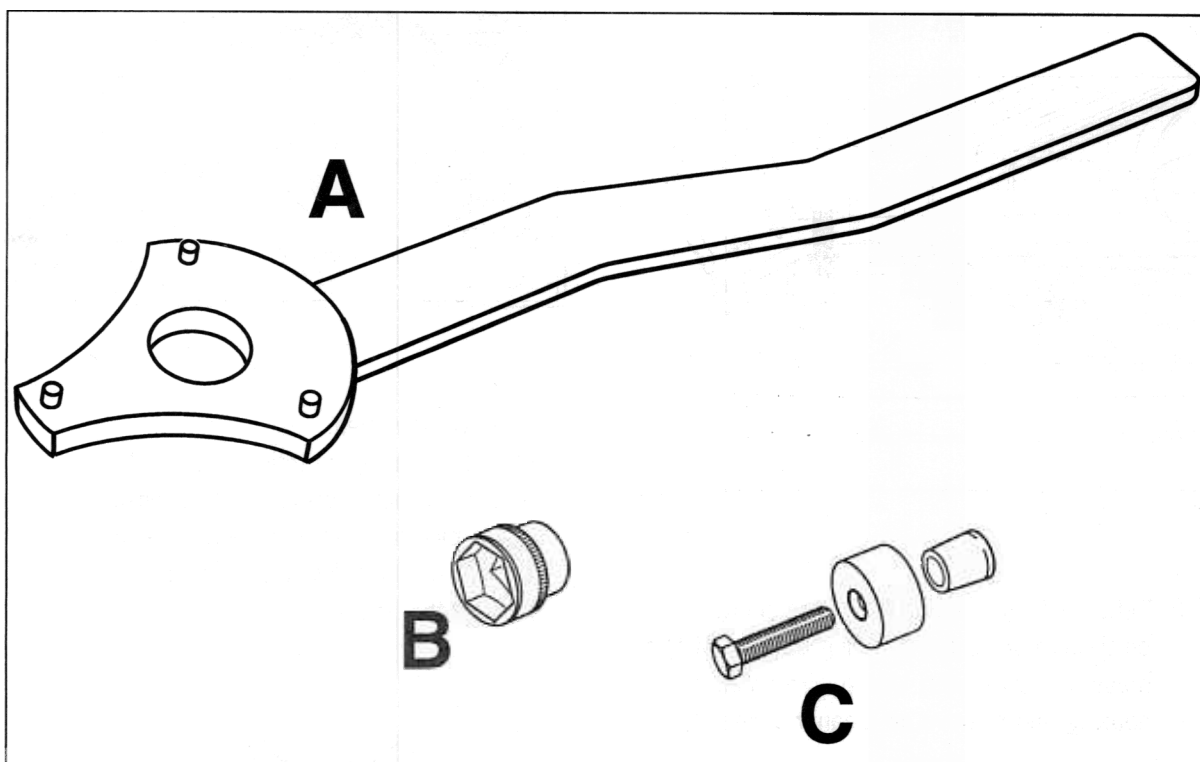
# Disassembling and assembling bearing housing with intermediate shaft



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**Disassembling and assembling bearing housing with intermediate shaft**

| No. | Procedure  | Instructions  |
|-----|--|---|
|     | Checking sealing surfaces                                  | Check both sealing surfaces of bearing housing for damage and cleanliness before installation in the bearing housing. Grind off sharp edges if necessary.   |
| 2   | Checking flange bearing of intermediate shaft              | Check flange for ease of movement or roughness of bearing; replace intermediate shaft if necessary.   |
| 3   | Fitting O-ring   | Carefully fit O-ring in the groove of the intermediate-shaft flange. Do not fit twisted. Grease lightly   |
| 4   | Fitting chain for intermediate shaft                       | Put on chain between crankshaft drive sprocket and intermediate shaft drive sprocket. Fit guide rail and tensioning rail. After installation, turn intermediate shaft sprocket slightly by hand in clockwise direction and check whether there is sag in the upper chain area. Check chain installation if necessary. |
| 5   | Prepare intermediate shaft and crankshaft for installation | To facilitate assembly, before installing the complete bearing housing unit in the crankcase half (cylinder row 1-3), connect the crankshaft and intermediate shaft with an O-ring.   |

**13 74 19 Removing and installing crankshaft sealing ring****Engine installed (pulley side)****Tools**

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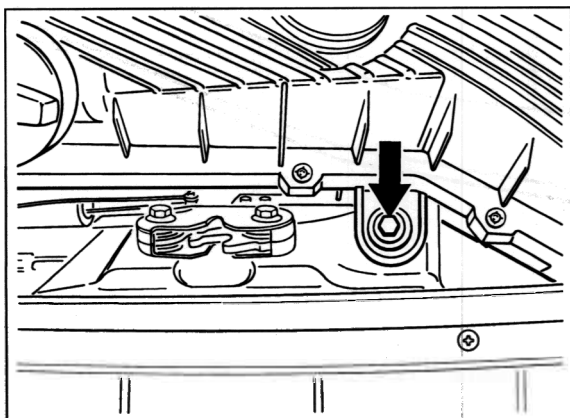
| Item | Designation          | Special tool | Explanation |
|------|----------------------|--------------|-------------|
| A    | Retaining device     | 9593         |             |
| B    | Socket wrench insert | 9594         |             |
| C    | Insertion tool       | 9610         |             |

## Removing and installing crankshaft sealing ring – Engine installed (pulley side)

### Removal

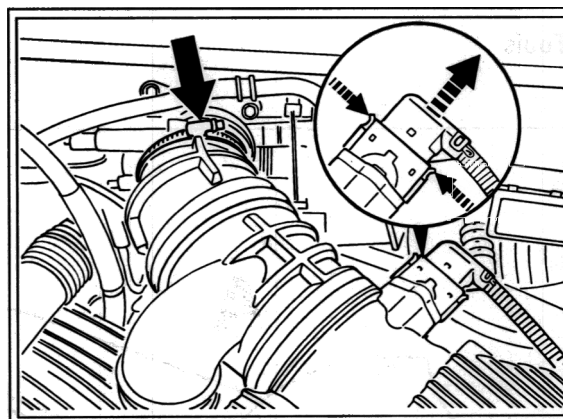
1. Remove the air cleaner assembly.

1.1. Undo collar screw M 6x34.



261\_97

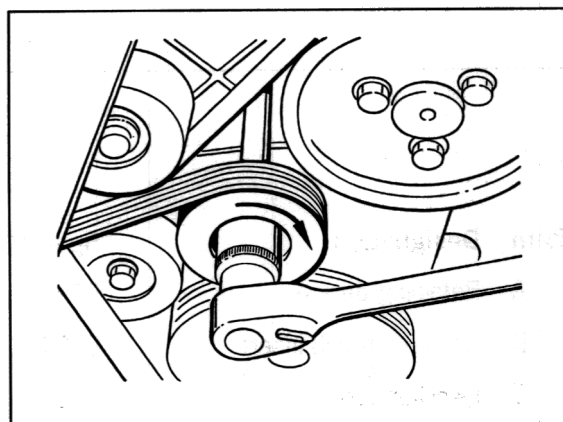
1.2. Detach oil filler neck. Undo hose clamp on throttle body and pull plug off the hot film mass air flow meter. Unclip wire on air cleaner housing and remove air cleaner assembly.



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2. Remove drive belt.

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

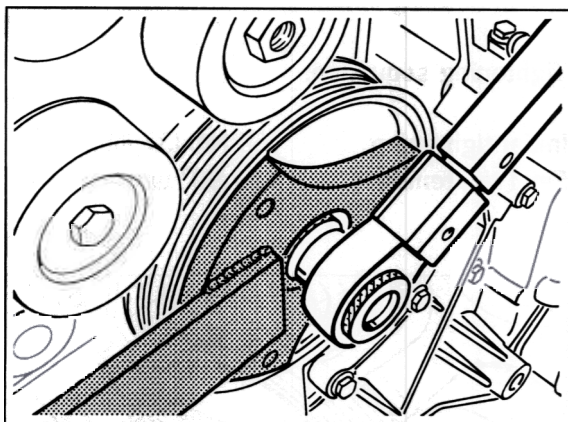


229\_97

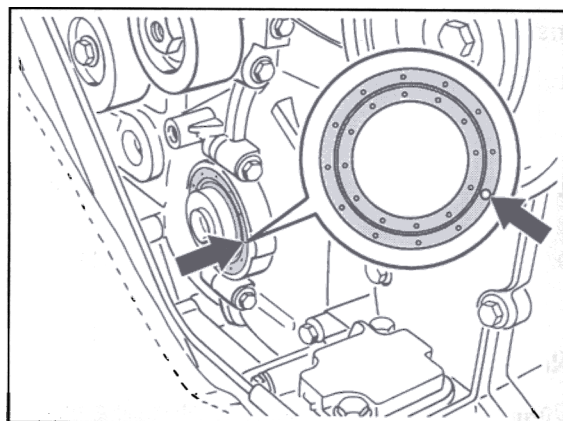


### 3. Loosen belt pulley.

Undo hexagon-head bolt (M16 x 1.5 x 60) with special tool 9594 (socket wrench insert); to do this, hold with special tool 9593 (retaining device).



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Screw sheetmetal screw with washer approx. 5 mm into the bore.

Position mounting lever on the sheetmetal screw; place support between the mounting lever and crankcase.

Lever crankshaft sealing ring out of the crankcase.

### 4. Remove crankshaft sealing ring.

The following tools and parts are required for removal of the crankshaft sealing ring:

Angle drill

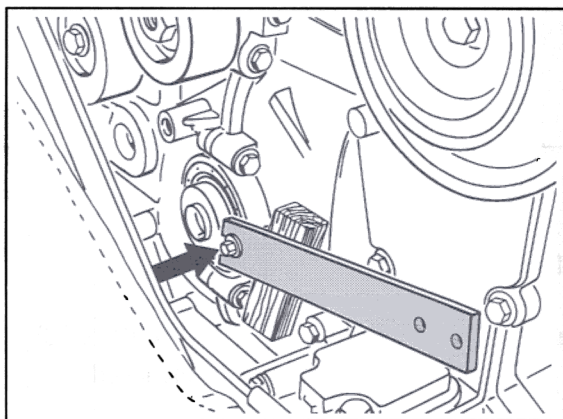
Drill bit,  $\varnothing$  3 mm

Mounting lever, e.g. special tool 9182

Sheetmetal screw with hexagon head (5.0 x 20)

Washer

Support, e.g. wooden block 50 x 30 x 20 mm



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### Removal procedure:

Drill sealing ring on face side (refer to drawing).

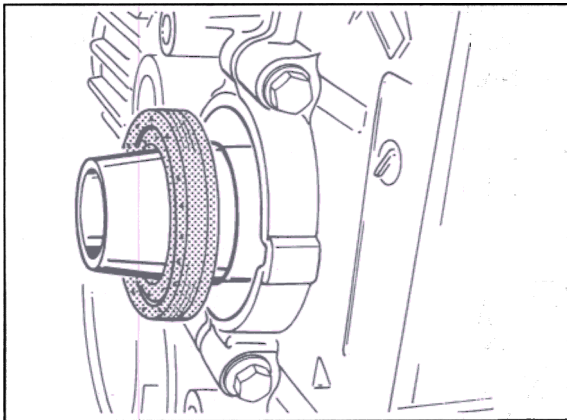
**Installation**

1. Insert new sealing ring using special tool 9610 (insertion tool):
- a. Place assembly sleeve on crankshaft journal.
- b. Thoroughly lubricate the crankshaft journal, assembly sleeve and sealing lip.

**Note**

Do **not** lubricate outer diameter of sealing ring; **it must be fitted dry.**

- c. Position sealing ring by hand and push off the assembly sleeve onto the crankshaft journal.



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- d. Remove assembly sleeve.
- e. Position hexagon-head bolt (M16 x 1.5 x 60) and outer part of special tool and insert sealing ring as far as it will go.
2. Fit belt pulley.

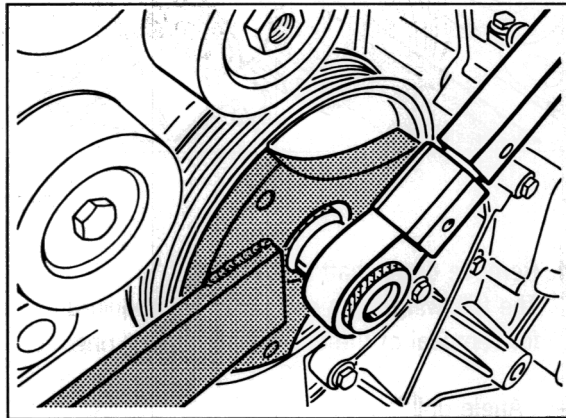
**Note**

Check whether there are foreign objects in the drive belt grooves of the pulley.

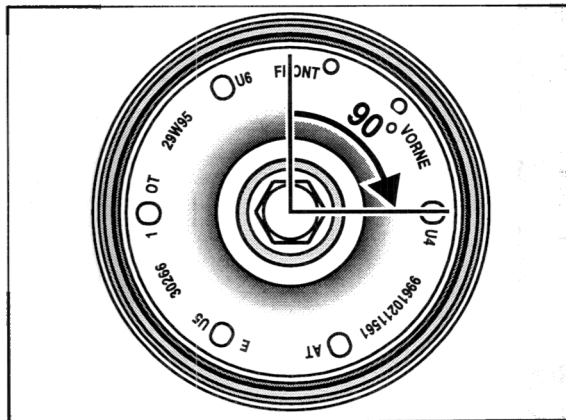
3. Tighten hexagon-head bolt using the socket wrench insert 9594; simultaneously hold with retaining device 9593.

**Tightening sequence:**

|                    |                  |
|--------------------|------------------|
| Initial tightening | 50 Nm (37 ftlb.) |
| Final tightening   | 1 x 90° turn     |



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213\_97

#### 4. Fit drive belt.

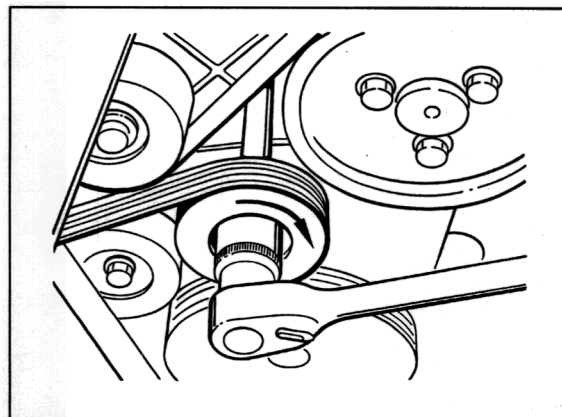
##### Note

Visually inspect the condition of the belt; remove foreign objects from the grooves if necessary. Observe running direction (colour pen marking).

##### Installation

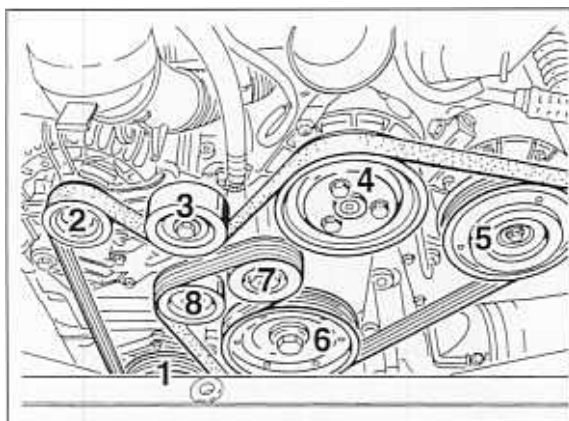
1. Fit drive belt by hand, slightly pre-tensioned, in the following sequence:
  1. Coolant pump drive pulley (1)
  2. Alternator drive pulley (2)
  3. Deflection roller 1 (3)
  4. Power steering pump drive pulley (4)
  5. Air-conditioning compressor drive pulley (5)
  6. Crankshaft pulley (6)
  7. Tensioning roller (7)

Then turn the tensioning roller (7) in clockwise direction and simultaneously fit the drive belt on the deflection roller 2 (8).



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2. Visually check whether the belt is correctly positioned on all drive pulleys.
3. Install air cleaner assembly
4. Connect the battery.
5. Perform tightness test.



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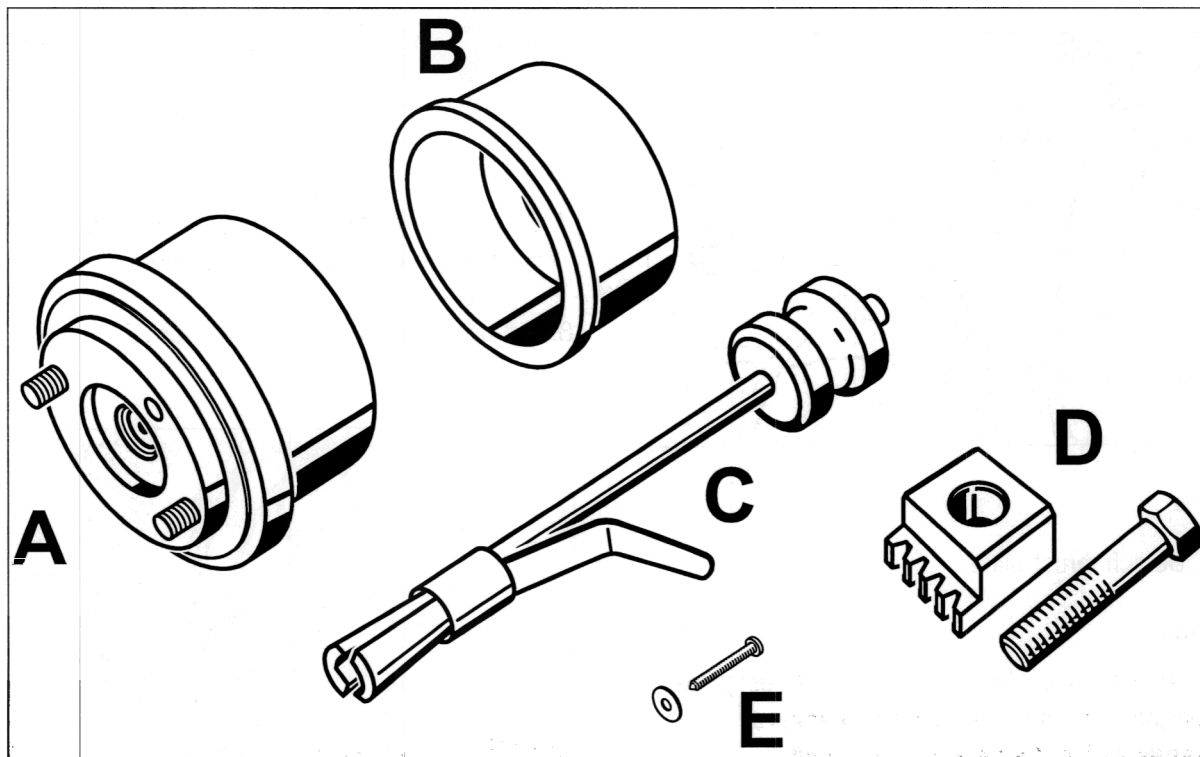
## 13 59 19 Removing and installing crankshaft sealing ring – engine installed

Removing and installing transmission: refer to Technical Manual,

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

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

Tools



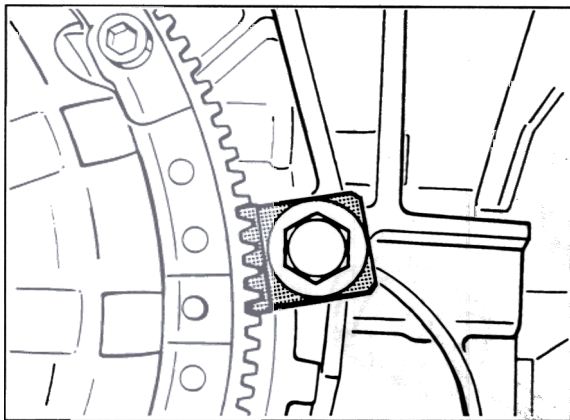
13590001

| Item | Designation                  | Special tool | Explanation                               |
|------|------------------------------|--------------|---|
| A    | Insertion tool               | 9609         |   |
| B    | Mounting bell                | 9609/1       |   |
| C    | Extractor                    | 3237         |   |
| D    | Toothed segment              | 9538/1       | Fasten with hexagon-head bolt<br>M12 x 50 |
| E    | Sheetmetal screw with washer |              | Commercially available                    |



### Removal

1. Remove clutch and flywheel (manual transmission) or drive plate (Tiptronic).
2. Fasten toothed segment (special tool 9538/1) on the crankcase half (cylinder bank 1 - 3) with hexagon-head bolt M12 x 50.



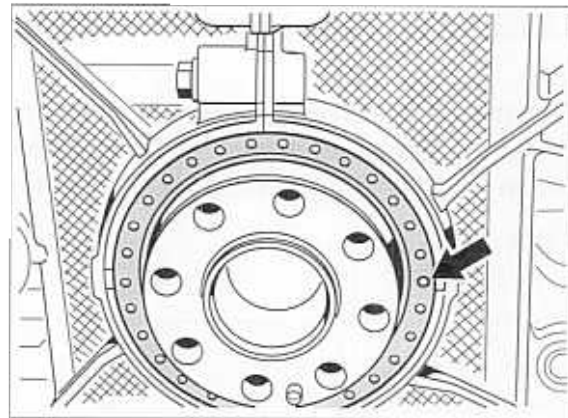
607\_97

3. Detach thrust plate.

### Note

In order to avoid deformation of the thrust plate housing, always loosen screws in **several stages** and in **diametrically opposite** sequence.

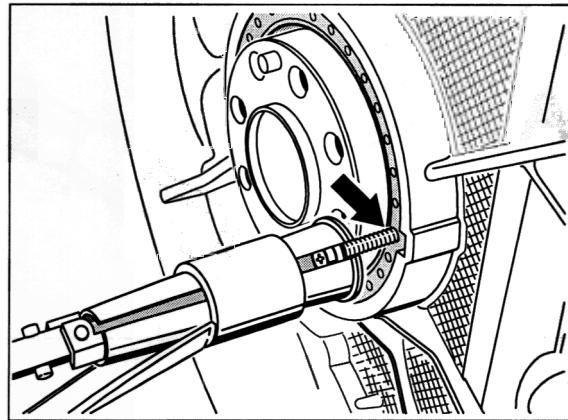
4. Remove thrust plate and drive plate.
5. Detach flywheel (Torx T55) and remove.
6. Drill sealing ring on face side, use  $\varnothing 3$  mm drill. Grease drill.



13590002

7. Screw sheetmetal screws (5.0 x 20) with washer approx. 5 mm into the bore.

8. Pull out sealing ring with extractor 3237.



9. Clean crankshaft journal and crankcase bore thoroughly. Remove any sharp edges which may be present.

## Installation

### Note

The tools should always be examined for burred spots before assembly of a sealing ring. Check all surfaces over which the sealing ring is pushed. Even minor damage to the tool can damage the **micro sealing lips** of the new sealing ring.

1. Remove any burred spots with a nail file, then pull off with a fine abrasive or polishing cloth.

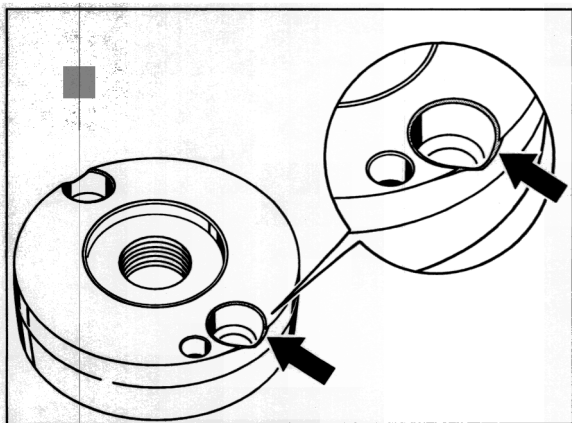


Illustration shows rounded edges on the recesses in the centring piece.

13590005

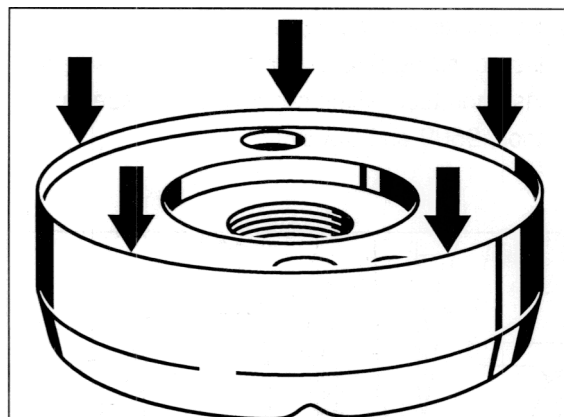


Illustration shows surrounding edge of centring piece. The surrounding edge must not be damaged.

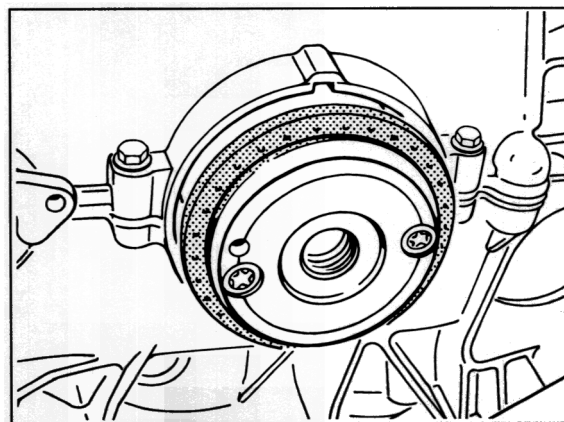
13590004

2. Fasten assembly sleeve of special tool 9609.
3. Lubricate crankshaft journal and assembly sleeve.

### Note

The micro sealing lip of the sealing ring must neither be touched by hand nor lubricated.

4. Put on sealing ring by hand. Do **not** lubricate outer diameter of sealing ring, do not use sealant, it must be fitted dry.

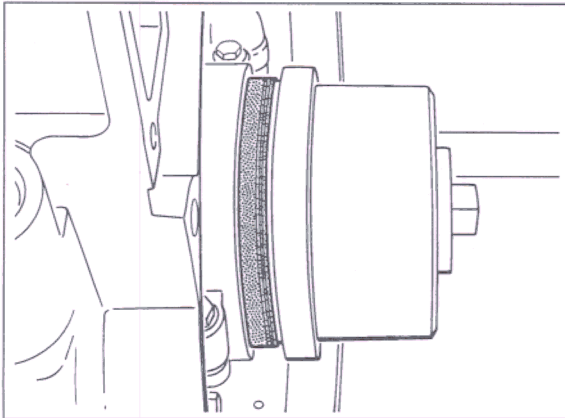


499\_97



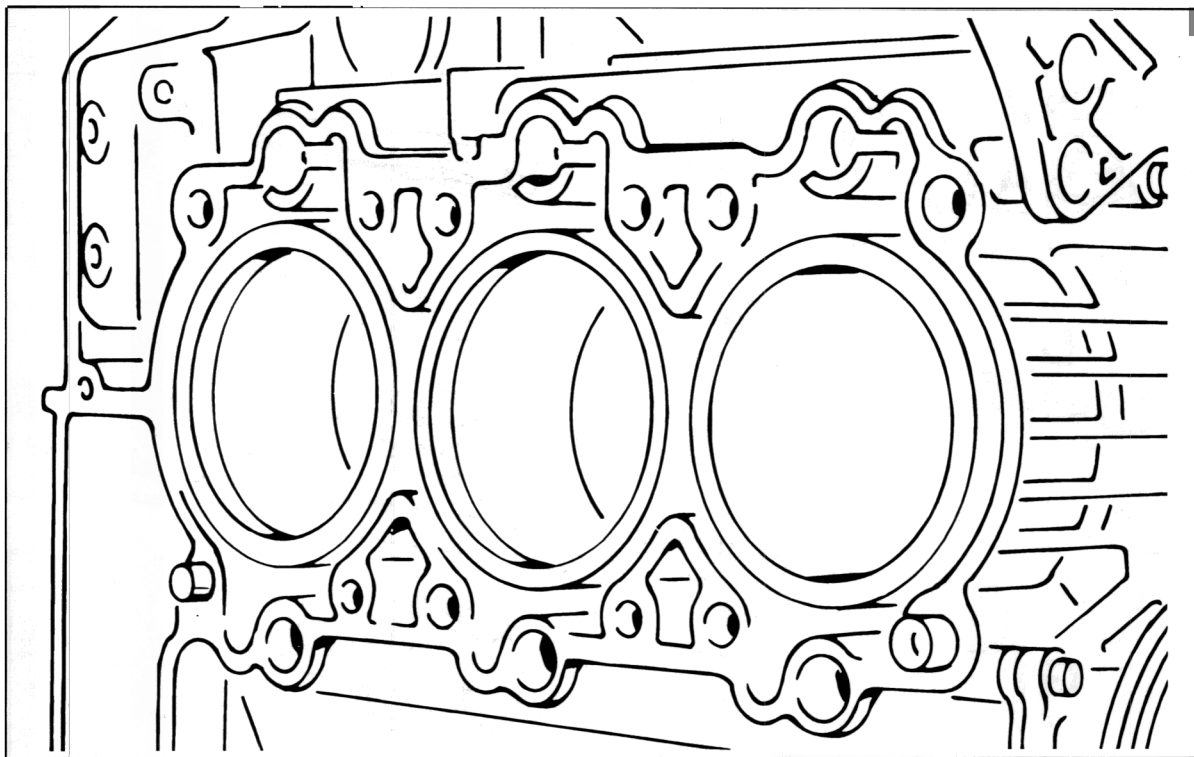
5. Fit crankshaft sealing ring.

Insert sealing ring as far as it will go using the insertion tool, which consists of the special tools 9609 and 9609/1.



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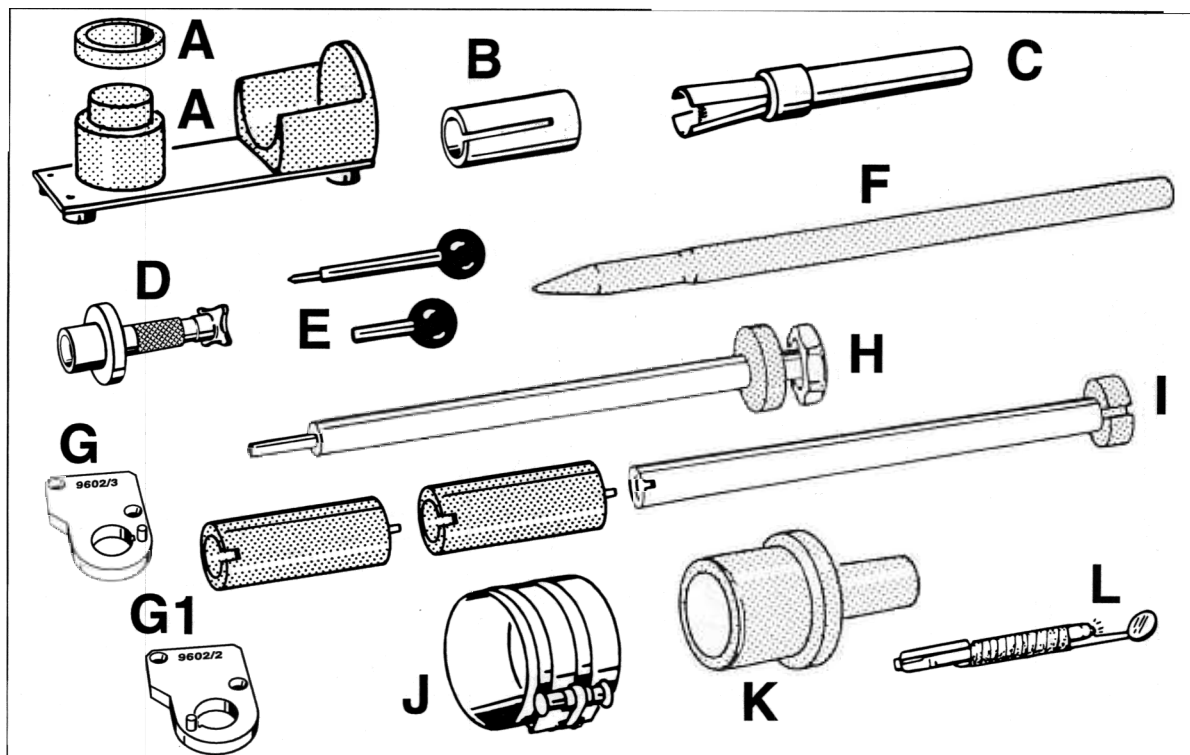
**13 10 19 Removing and installing pistons**



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## Removing and installing pistons

### Tools



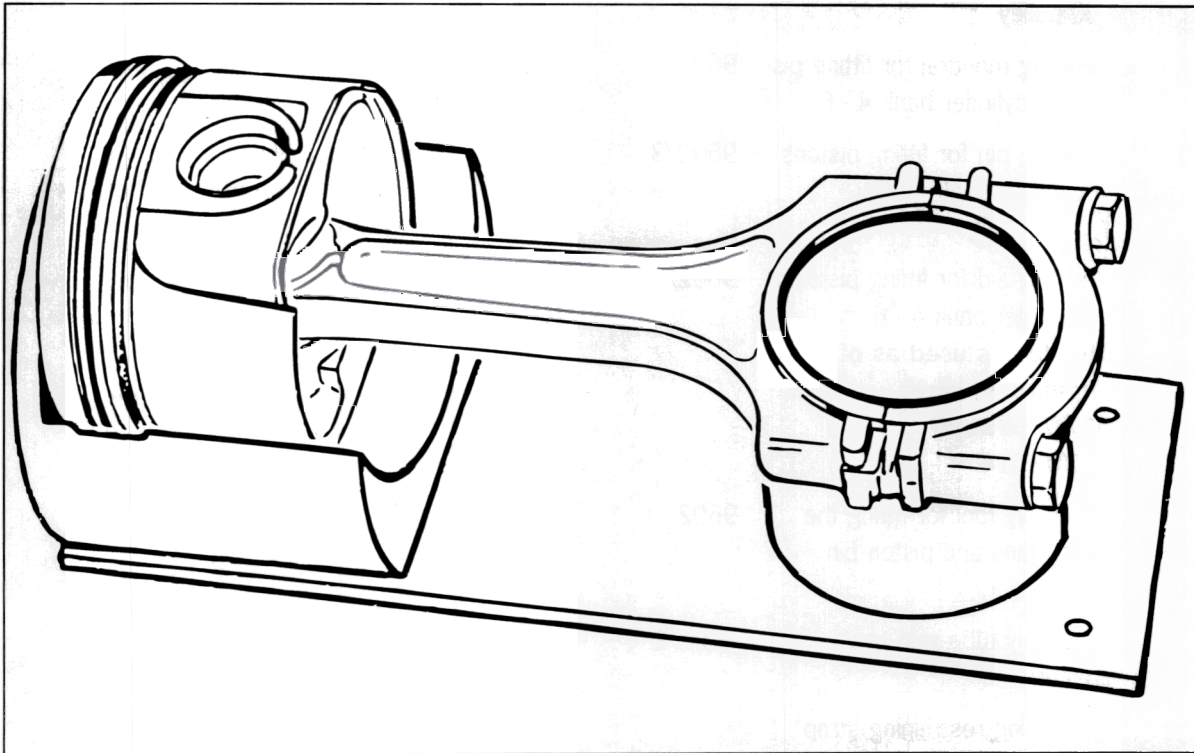
513\_98

| Item | Designation  | Special tool | Explanation |
|------|--|--------------|-------------|
| A    | Retaining device<br>for pistons and connecting<br>rods for pre-fitting the piston<br>pins of cylinder bank 1 - 3 | 9597         |             |
| A1   | Spacer ring  | 9597/1       |             |
| B    | Assembly sleeves for pre-fitting<br>the piston pin circlips  | 9603/1       |             |
| C    | Assembly fixture for fitting<br>piston pin circlips in assembly<br>sleeve 9603/1                                 | 9500/3       |             |

| Item | Designation   | Special tool | Explanation   |
|------|---|--------------|---|
| D    | Centring mandrel for centring crankcase halves  | 9645         |   |
| E    | Fixing pin for fixing the belt pulley   | 9595/1       | 1 set = 2 parts (use short fixing pin)  |
|      | Centring mandrel for fitting pistons in cylinder bank 4 - 6   | 9608         |   |
| G    | Centring pin for fitting pistons in cylinder bank 4 - 6   | 9602/3       | Fasten on crankcase with two M6 x 20 (crosshead) countersunk screws   |
| G1   | Centring aid for fitting pistons of cylinder bank 4 - 6<br><b>This tool is used as of engine numbers:<br/>66X07679<br/>68X03514</b> | 9602/2       | Fasten on crankcase with two M6 x 20 (crosshead) countersunk screws<br><b>Reason: Piston pin circlips installed in different position</b> |
| H    | Assembly tool for fitting the piston pins and piston pin circlips   | 9602         |   |
|      | Assembly tube with two spacers  | 9602/1       | 1 set = 3 parts   |
|      | Piston ring restraining strap   |              | Refer to Workshop Equipment Manual, Chapter 2.4, No. 57   |
| K    | Assembly aid for positioning the pistons  | 9598         | 1 set = 2 parts<br>Use assembly aid with larger diameter and insertion depth  |
| L    | Electric torch with mirror to check the piston pin circlips of cylinder bank 4 - 6  |              | Shop-made or, for example, illuminated adjustable mirror. Refer to Workshop Equipment Manual, Chapter 2.4, No. 20                         |

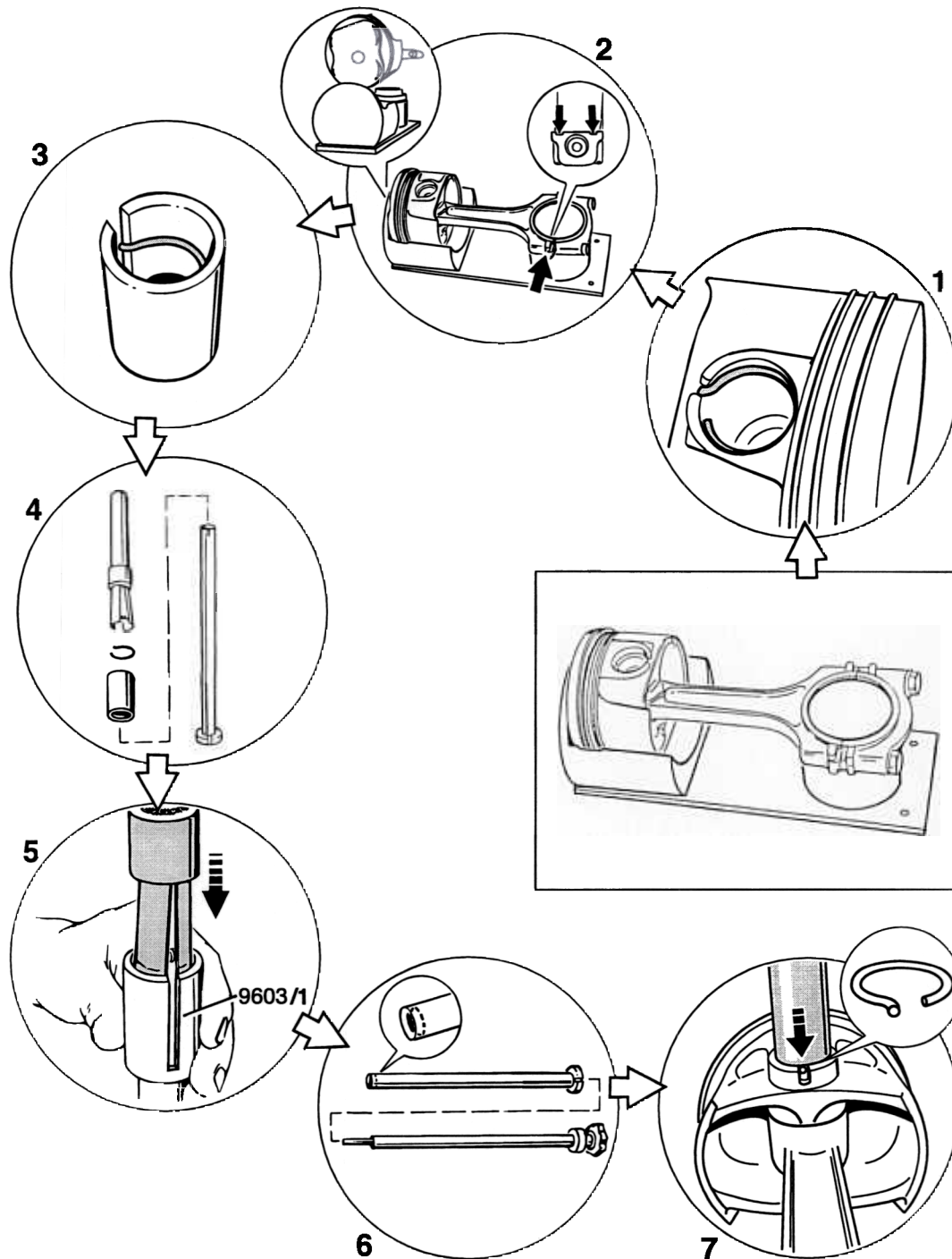
### Fitting pistons and connecting rods

Prepare pistons and connecting rods for installation in the crankcase half of cylinders 1 - 3.



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## Fitting pistons and connecting rods



512\_98



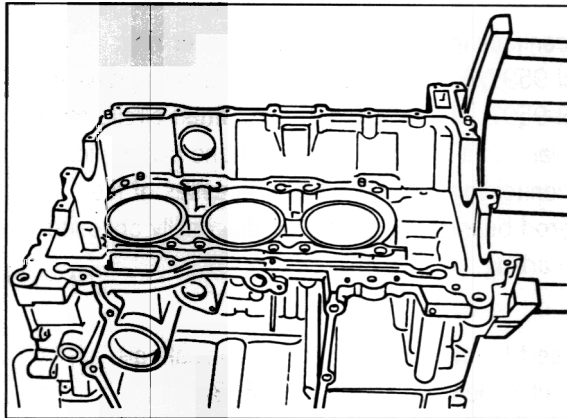
**Fitting pistons and connecting rods**

| No.   | Procedure   | Instructions   |
|-------|---|--|
| 1     | Check piston pin circlip                          | Make sure that the circlip is present and seated securely. The circlip has been pre-fitted on one side of the piston pin by the manufacturer. The circlip opening must lie opposite the groove in the piston.  |
| 2     | Insert piston and connecting rod                  | Complete connecting rod support with spacer ring, special tool 9597/1. Insert piston in the retaining device, special tool 9597. The side with the pre-fitted circlip must face downwards. Fit the connecting rod and piston pin. Insert the connecting rod so that the recesses of the connecting-rod bearing twist lock are diagonally opposite the "TOP" marking. |
| 3     | Fit piston pin circlip                            | Manually insert the new circlip into the conical part of the assembly sleeve, special tool 9603/1.   |
| 4 + 5 | Press piston pin circlip into the assembly tube   | Place the cylindrical part of the assembly sleeve 9603/1 on the assembly tube of special tool 9602. Use assembly aid, special tool 9500/3, to slide the circlip from the conical part of the assembly sleeve into the assembly tube. Remove assembly aid 9500/3 and visually inspect the correct position of the circlip in the assembly tube from the side.         |
| 6 + 7 | Position piston pin circlip on the piston pin eye | Position assembly tube on the piston pin eye. Press pressure pin of special tool 9602 down until the circlip is heard to engage in the ring groove.<br><b>Visually inspect correct seating.</b><br><br>It is important to pre-fit the circlip on a firm surface. The circlip must be pre-fitted only immediately prior to fitting on the piston pin eye.             |

## Fitting pistons and piston rods in the crankcase half or bearing housing of cylinder bank 1 - 3

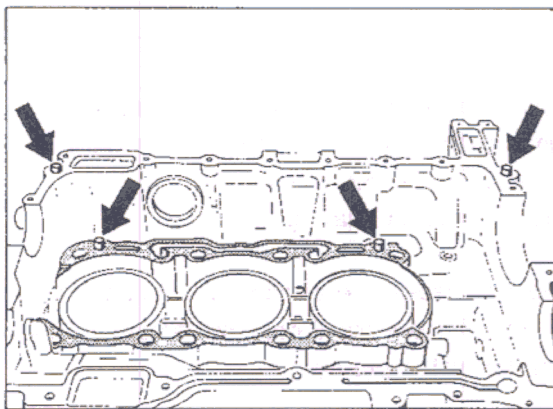
### Installation

1. Fasten crankcase half, cylinder 1-3, in conjunction with mounting elements 9590 to engine holder 9589.



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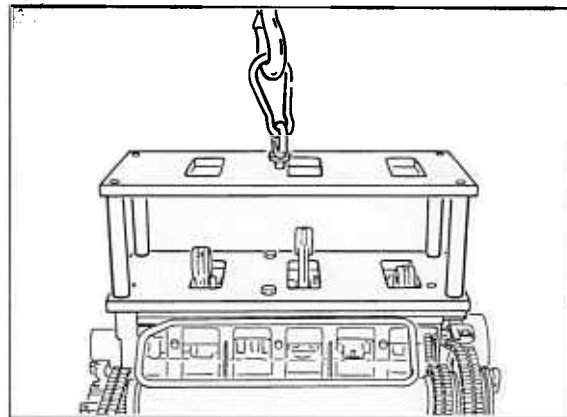
2. Clean bearing housing support surface, particularly in area of oil duct. Check dowel sleeves for correct seating.



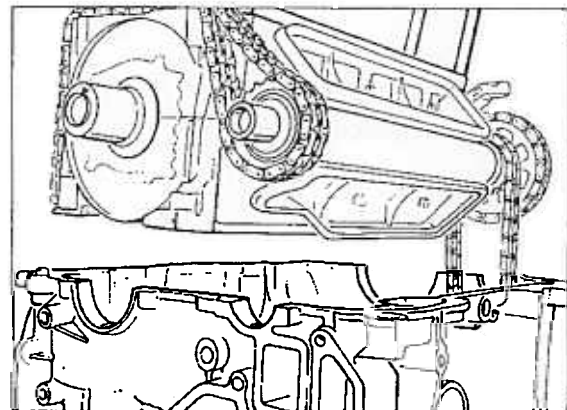
490\_96

3. Installation of the complete bearing housing in the crankcase half, cylinders 1 - 3.  
As the bearing housing is heavy, it should be installed using a workshop crane.

Carefully and in stages, lower bearing housing with fitted holder 9607 and workshop crane towards the dowel sleeves (2 ea.), observing the following points:

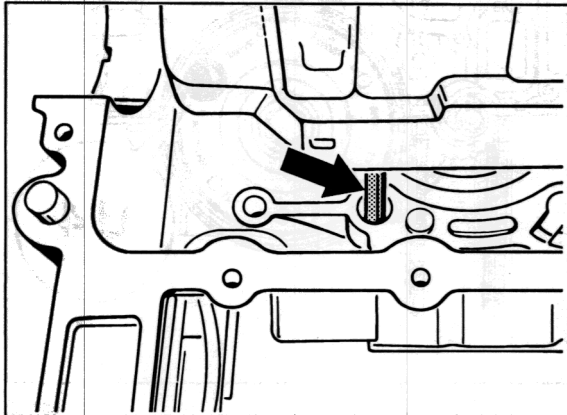


345\_97



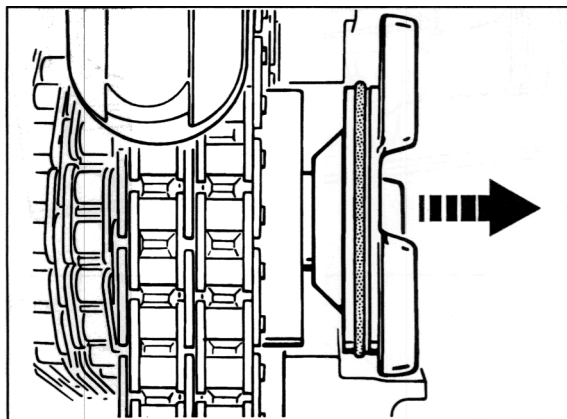
484\_96

3.1 To aid in guiding, screw pan head screws approx. 3 turns into the bearing housing from below.

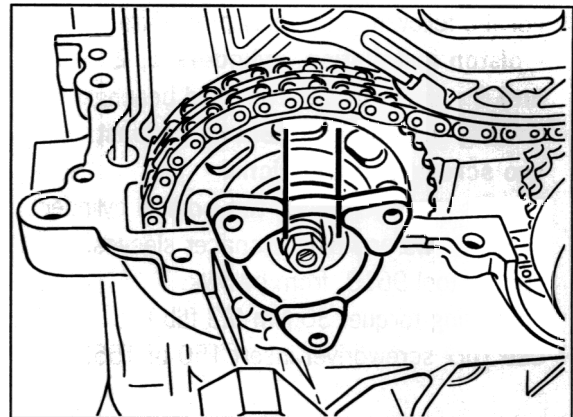


467\_97

3.2 Just before reaching the final installation position, pull the loosened intermediate-shaft flange out of the housing area and rotate the flange so that the two flange lugs that are spaced closest together face upwards.

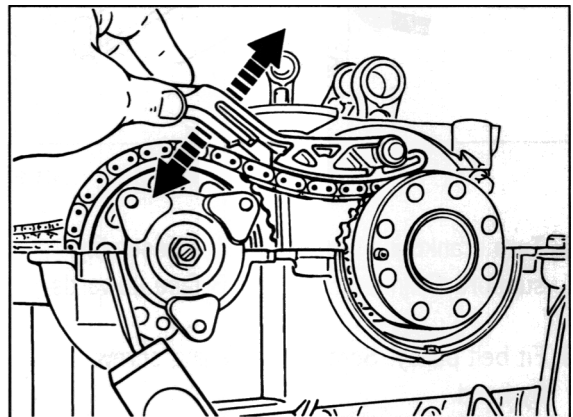


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3.3 After lowering, check whether there is sag in the upper chain area or sufficient lever travel exists. Lift the bearing housing and check the chain installation if necessary.



440\_97

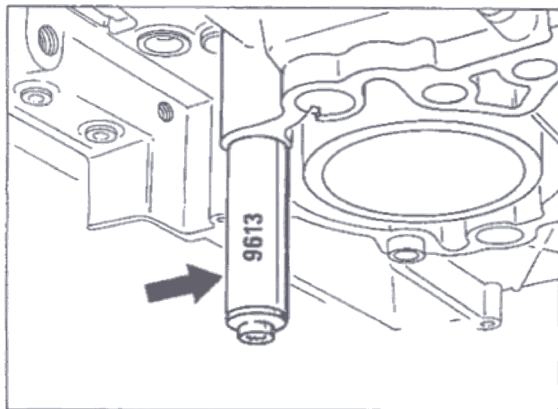
3.4 Remove two cap head screws (guide aid).

4. For the following assembly procedure – **piston installation, cylinders 1, 2 and 3** – the crankcase half and bearing housing unit **must be held by at least two screwed connections**.

For this purpose, fasten two original cylinder head screws and plastic spacer sleeves, special tool 9613, from below.

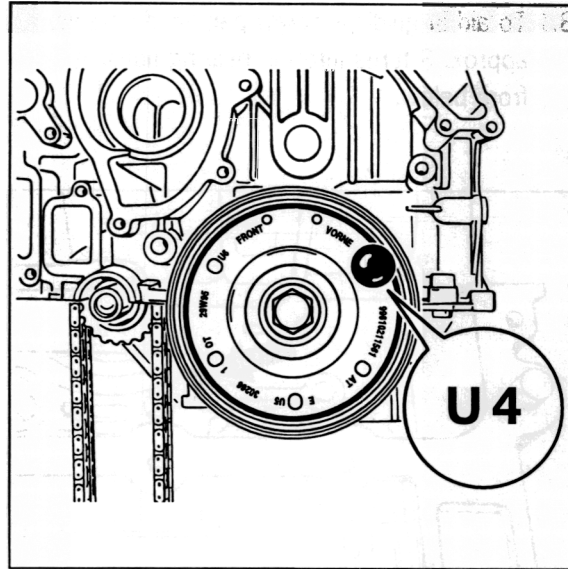
Tightening torque: 30 Nm (23 ftlb.)

Use Torx screwdriver insert T50 or T55.



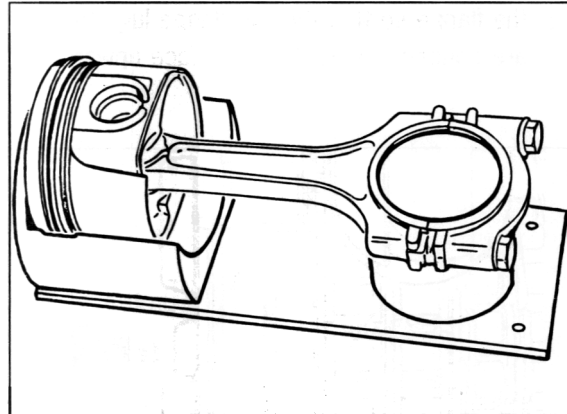
491\_96

5. Turn crankcase by 180° on the assembly support. Cylinders 1, 2 and 3 face upwards.
6. Fit belt pulley. Screw in fastening screw by hand.
7. Turn crankshaft clockwise until the bore **U4** on the pulley is aligned with the fixing bore on the crankcase. Position or fix with fixing pin (short) of special tool 9595.



604\_97

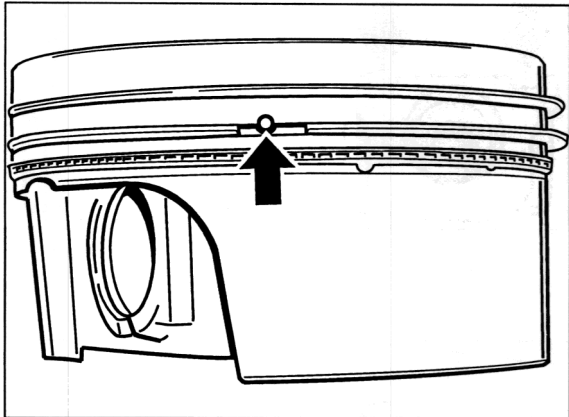
8. Remove preassembled connecting rod with piston of **cylinder 1** from the assembly fixture.



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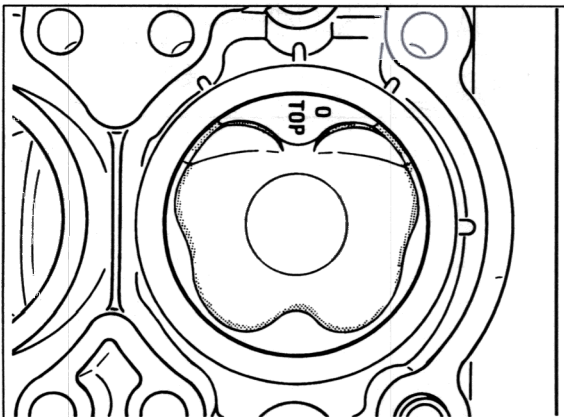


9. Align the gaps of the upper piston rings offset by 180°. Make sure that the gap of the second piston ring is aligned with the twist lock.



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10. Place piston with connecting rod in installation position.

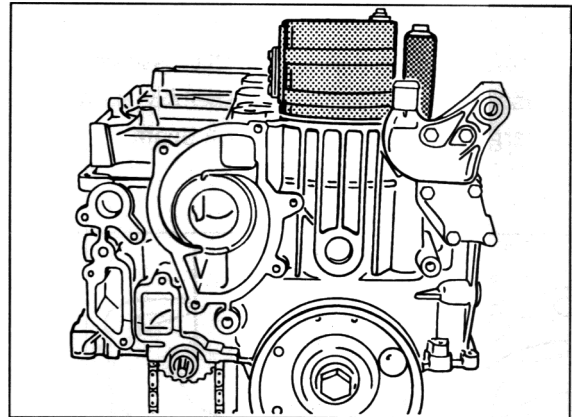


258\_97

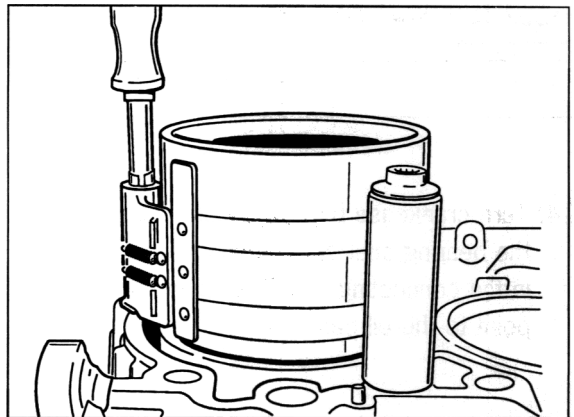
11. Tighten piston ring clamp and fit piston with connecting rod.

#### Note

**Generously** coat the piston and restraining strap with engine oil before fitting the piston.



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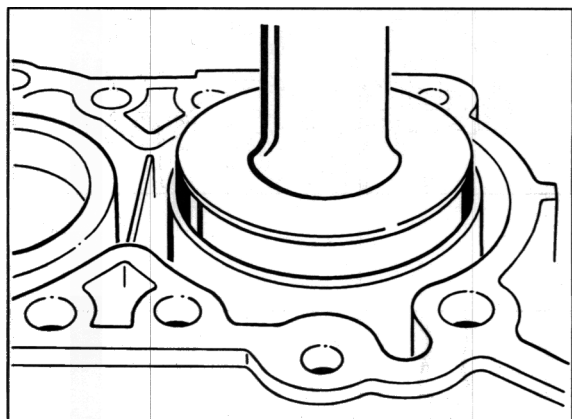
558\_98

12. Use the handle of a hammer to tap the piston into the cylinder while firmly pressing on the edge of the restraining strap. Use protective gloves.

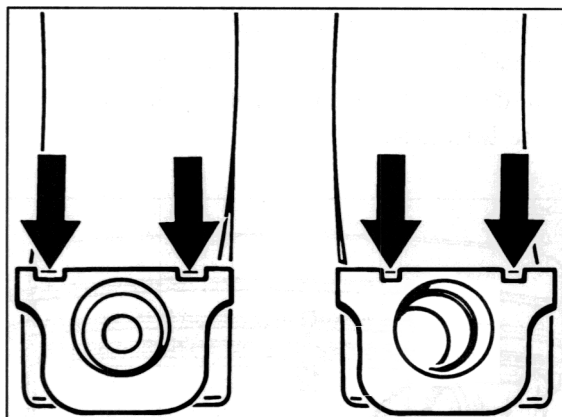
#### Note

The piston must be fitted in the cylinder carefully and with feeling. If the resistance increases, **immediately interrupt** the assembly process. Reposition the piston ring restraining strap and repeat the assembly operation.

13. Centre the piston in the cylinder bore and carefully push it down with the assembly aid (special tool 9598). Use assembly aid with larger diameter and insertion depth.

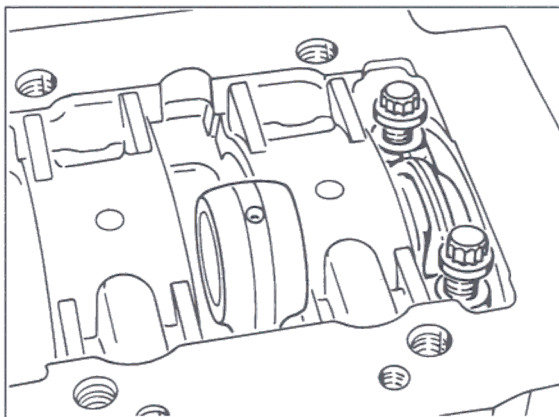


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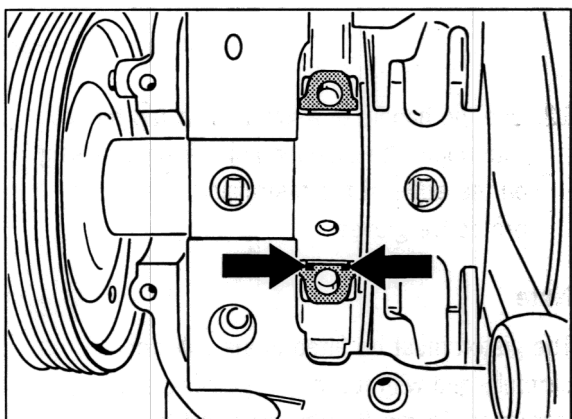


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14. Turn crankcase by 180°. Make sure the bearing shell is correctly seated in the connecting rod. The fixing lugs point to the oil pan.



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15. Fit end caps. Lubricate bearing shells.  
The recesses of the connecting-rod bearing twist lock must face each other.



16. Tightening specification:

Oil thread and contact surface.

1. Initial tightening 20 Nm (15 ftlb.)

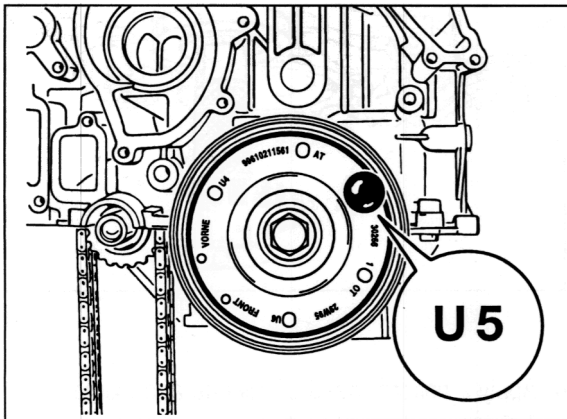
To facilitate subsequent checks it is recommended that, after initial tightening, the screw heads be marked with a coloured pen.

2. Final tightening 1 x 90° turn

Use 10 mm socket wrench insert (double hexagon).

17. Fitting piston and connecting rod in cylinder 2

Turn crankcase by 180°. Turn crankshaft clockwise until the bore **U5** on the pulley is aligned with the fixing bore on the crankcase. Position or fix with fixing pin (short) of special tool 9595.



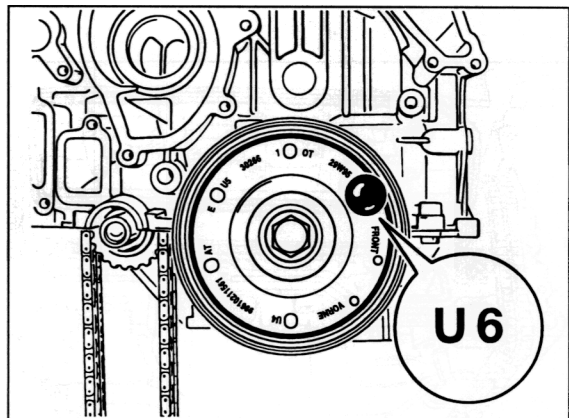
605\_97

18. Prepare preassembled connecting rod of **cylinder 2** for installation.

Perform the following assembly steps as described from Step 8 to Step 16.

19. Fitting piston and connecting rod in cylinder 3

Rotate crankshaft clockwise until bore **U6** on the belt pulley is aligned with the fixing bore on the crankcase. Position or fix with fixing pin (short) of special tool 9595.



603\_97

20. Prepare preassembled connecting rod of **cylinder 3** for installation. Perform the following assembly steps as described from Step 8 to Step 16.

**Note**

Leave crankshaft at position **U6** after fitting the piston and connecting rod in cylinder 3. This position is necessary for subsequent fitting of the piston of cylinder 6.

21. Remove belt pulley.

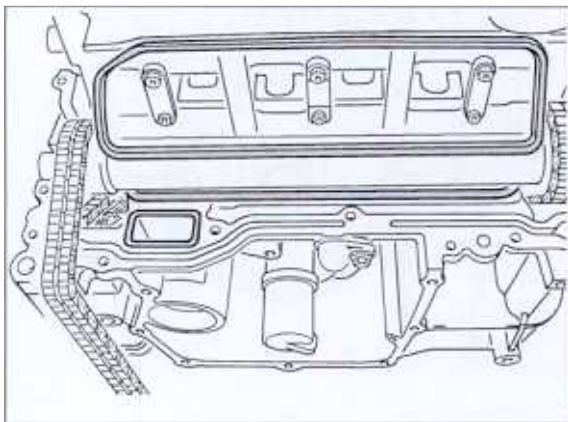
## Fitting pistons on cylinder bank 4 - 6

### Note

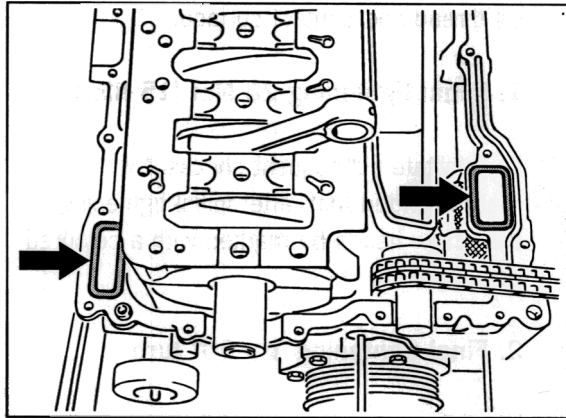
The crankcase half of **cylinder bank 4 - 6** must be fitted before installation of the pistons.

### Installation

1. Thoroughly clean sealing surface of the crankcase half of cylinder bank 1 - 3.
2. Ensure that the profile seals on the oil guide and the two seals left and right of the coolant duct are seated correctly

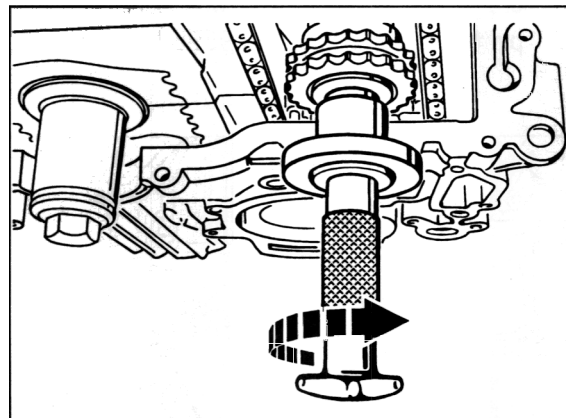


590\_97



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3. Place centring mandrel, special tool 9645 on the receiving bore of the oil pump and turn the star knob clockwise until the centring mandrel is braced in the crankcase half (oil pressure builds up in centring mandrel).

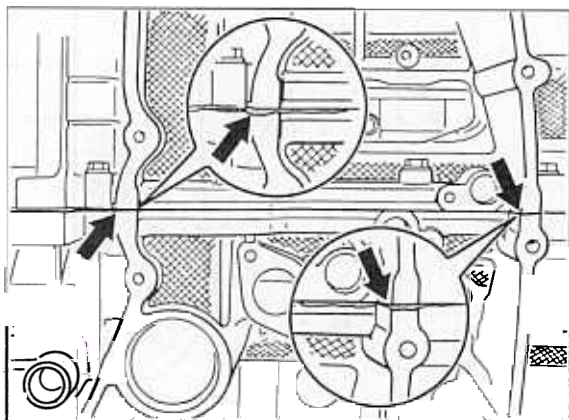


511\_98

4. Apply a uniform bead of silicone approximately 1.5 mm wide to the cleaned sealing surface of the crankcase half of **cylinder bank 4 - 6**. Instructions: see Group 10, Page 10 - 36.

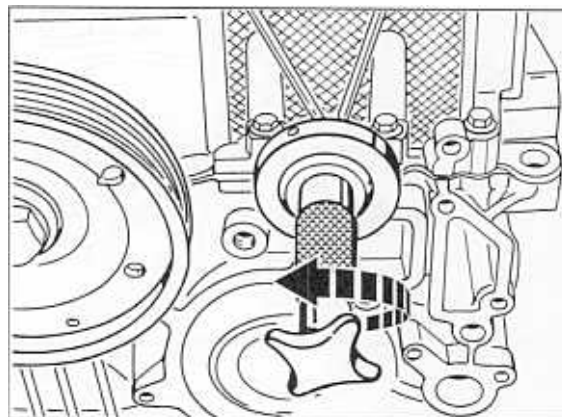
5. Before fitting the crankcase half, have a second person pull the drive chain out of the chain space using a wire.
6. Carefully set the crankcase half in place so that the sealing bead is not damaged.
7. Fasten crankcase half. Tightening torque: 13 Nm (10 ftlb.) Tightening sequence, see Group 10, Page 10 - 37.

Immediately remove silicone material emerging in the area of the oil pan sealing surface.



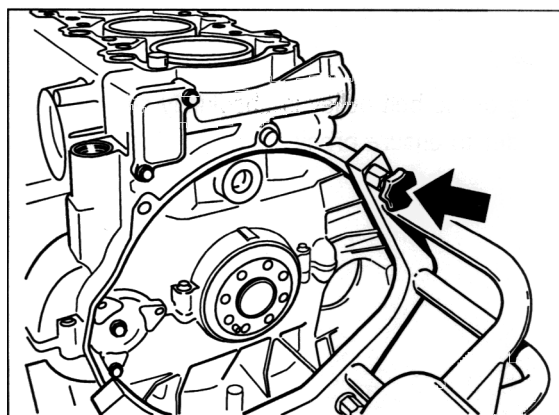
599\_97

8. Relieve centring mandrel.  
Turn star knob anti-clockwise (oil pressure drops) and remove centring mandrel. Remove silicone residue.



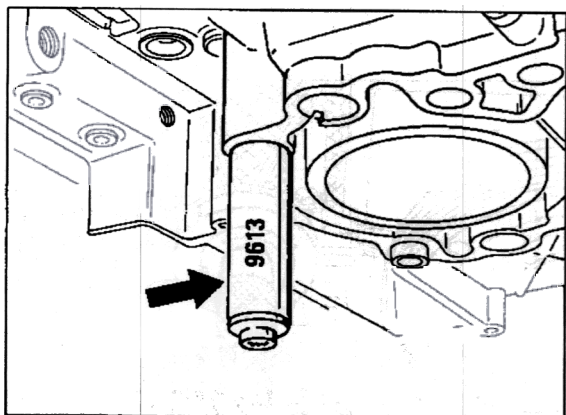
520\_98

9. Fasten engine holder, special tool 9589, to the crankcase half of cylinder 4 - 6 (3rd fastening point).



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10. Remove plastic spacer sleeves, special tool 9613.



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11. Fit belt pulley. Screw in fastening screw by hand.

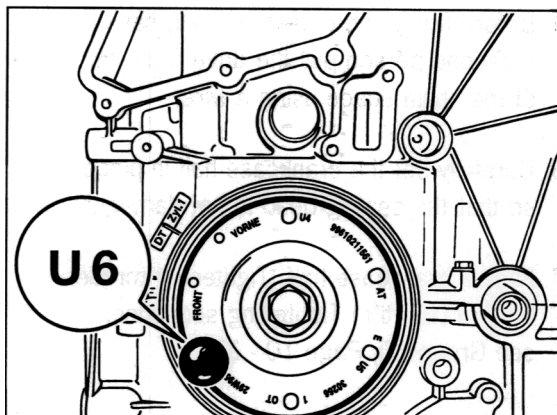
**Cylinder bank 4 - 6 faces upward.**

Bore **U6** on the belt pulley must be aligned with the fixing bore on the crankcase.

Position or fix with fixing pin (short) of special tool 9595.

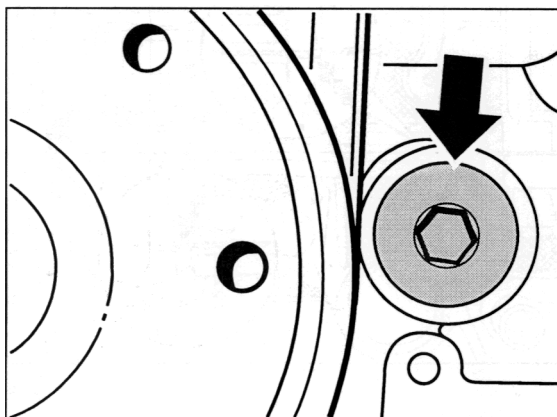
#### Note

Fixing of the belt pulley is absolutely necessary in order to ensure precise fitting of the pistons.



606\_97

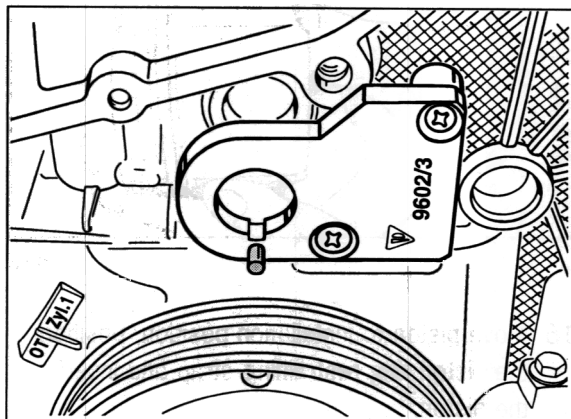
12. Unscrew plug for piston pin assembly bore. Use a 12 mm hexagon socket wrench insert.



66\_98



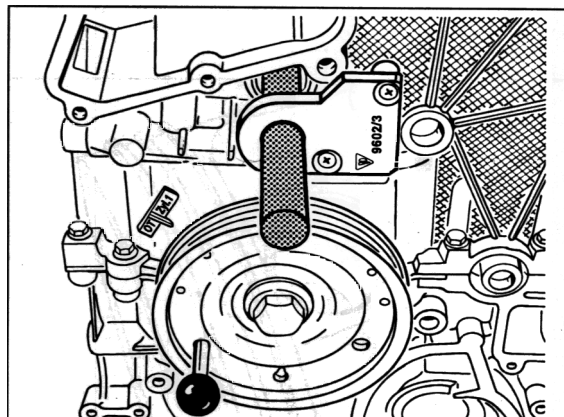
13. Fasten centring aid, special tool 9602/3, with two countersunk screws with crosshead (M6 x 20) on the crankcase.



View: Special tool 9602/3

502\_98

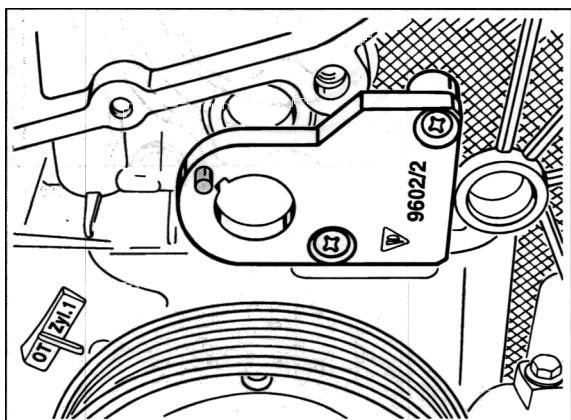
14. Align connecting rod of **cylinder 6**. Insert centring mandrel, special tool 9608, in the assembly bore.



506\_98

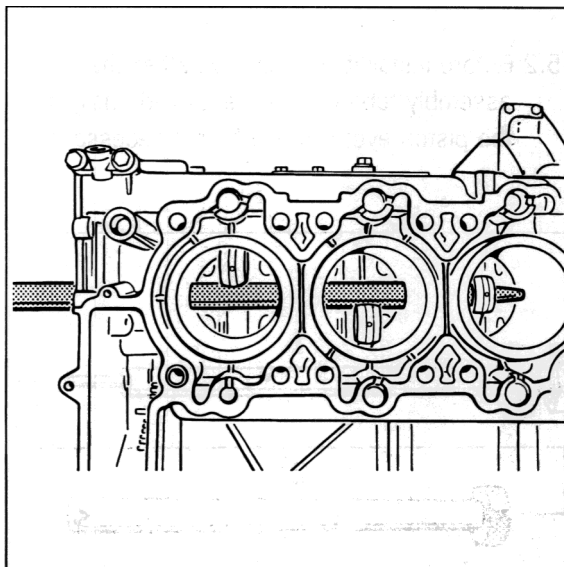
#### Note

Centring aid, special tool **9602/2**, is used as from engine numbers **66X07679** and **68X03514**.



View: Special tool 9602/2

448\_99



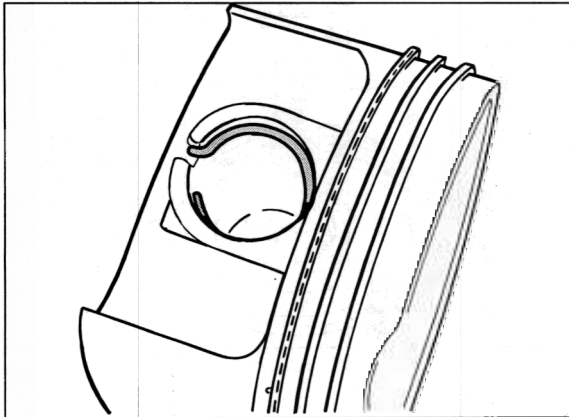
466\_97

#### Note

The centring mandrel remains in the eye of the connecting rod until the piston contacts the centring mandrel during fitting.

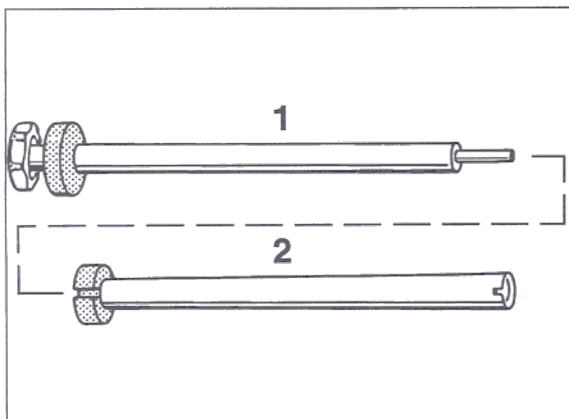
## 15. Install piston of cylinder 6.

15.1 Check whether the piston pin circlip is present and was fitted correctly (flywheel side).

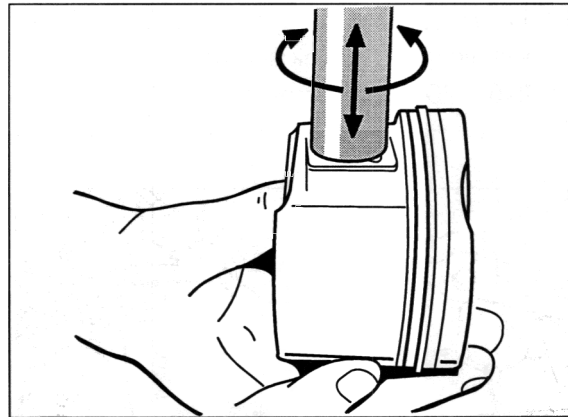


530\_98

15.2 Before installation, check whether the assembly tube (2) can be moved easily in the piston eye; remove burr if necessary.

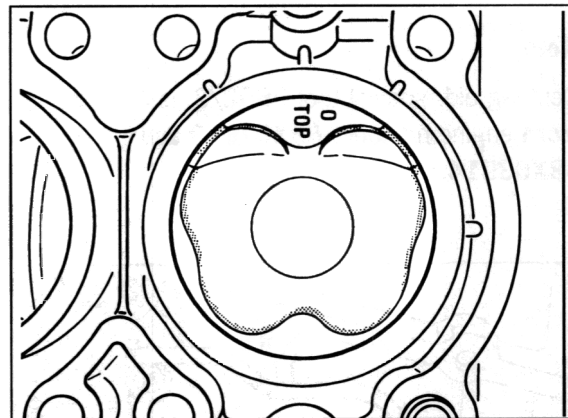


526\_98



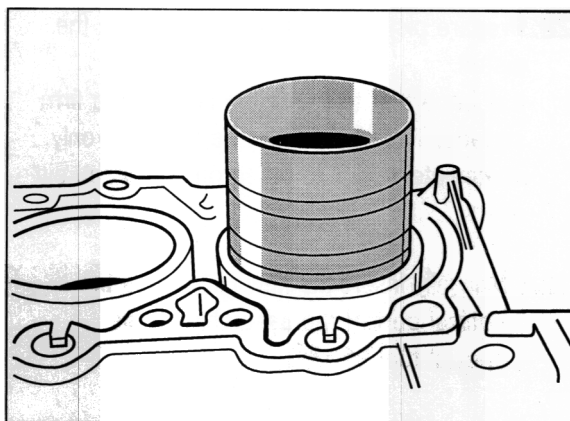
59\_98

16. Move piston to installation position, position the piston ring restraining strap and insert the piston.

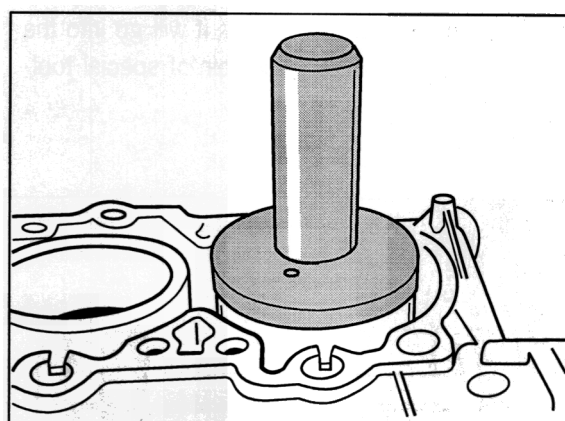


258\_97





58\_98



60\_98

### Note

**Generously** coat the piston, cylinder and restraining strap with engine oil before fitting the piston.

17. Use the handle of a hammer to tap the piston gently into the cylinder while firmly pressing on the edge of the restraining strap. Use protective gloves.

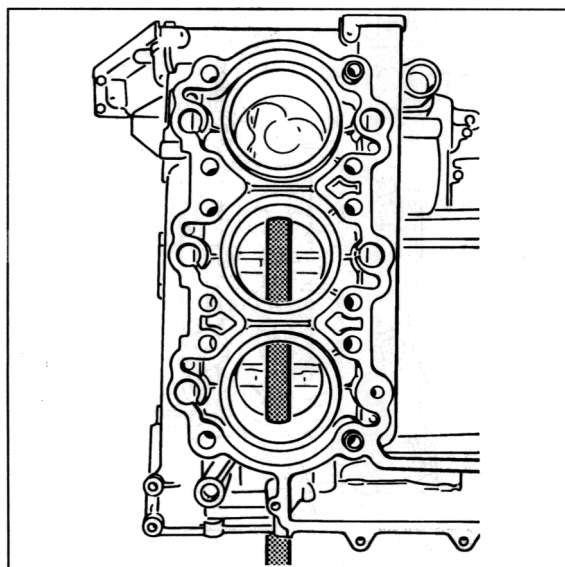
### Note

The piston must be fitted in the cylinder carefully and with feeling. If the resistance increases, **immediately interrupt** the assembly process. Reposition the piston ring restraining strap and repeat the assembly operation.

18. Centre the piston in the cylinder bore and carefully push it down with the assembly aid (special tool 9698) to the centring mandrel stop.

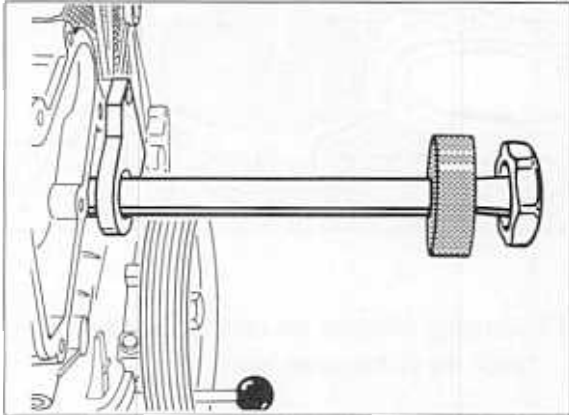
19. Carefully withdraw the centring mandrel and push the piston down to the stop.

20. Align piston and connecting rod again using the centring mandrel.



222\_97

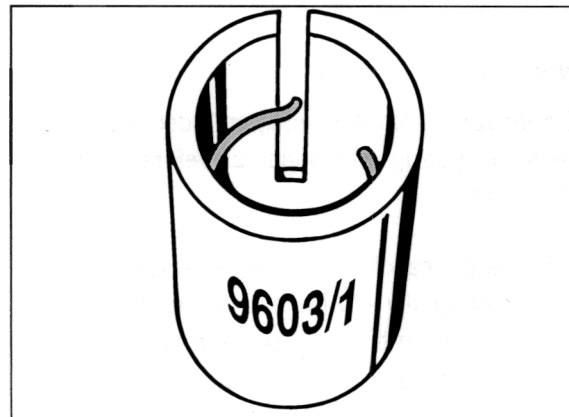
21. Push in piston pin as far as it will go into the piston using the pressure pin of special tool 9602.



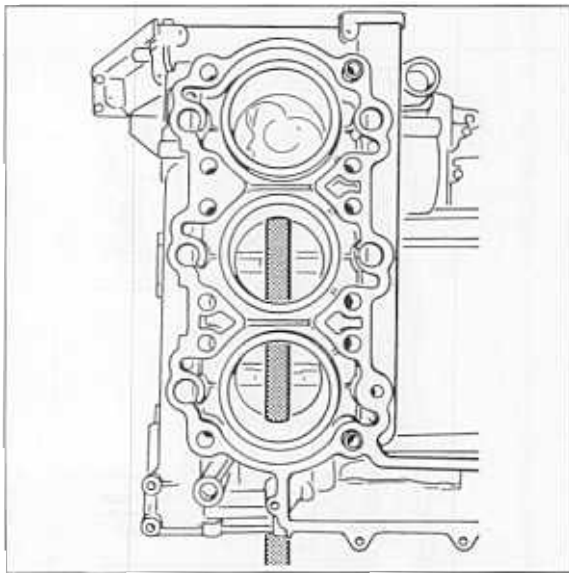
503\_98

22. Prepare piston pin circlip for fitting on the piston.  
It is important to pre-fit the circlip on a firm surface. The circlip must be pre-fitted only immediately prior to fitting on the piston pin eye.

- 22.1 Manually insert the new circlip into the conical part of the assembly sleeve, special tool 9603/1.



522\_98



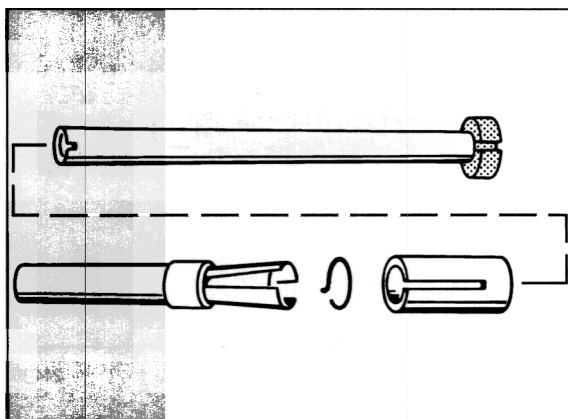
222\_97

22.2 Place assembly sleeve 9603/1 onto the assembly tube of special tool 9602. Use assembly aid, special tool 9500/3, to slide the circlip from the conical sleeve into the assembly tube.

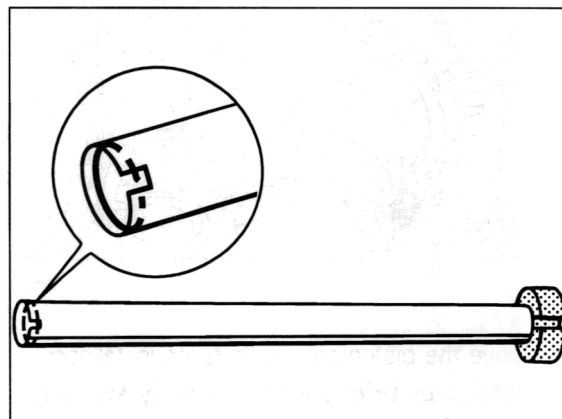


**Warning:**  
Danger of injury if circlip springs out!

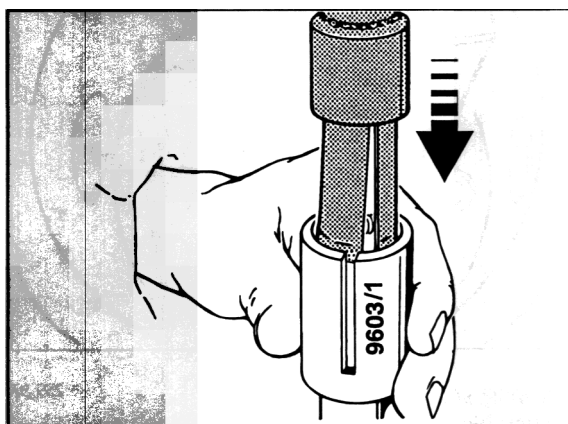
> Check position of the circlip only by visual inspection of the assembly tube from the side.



523\_98



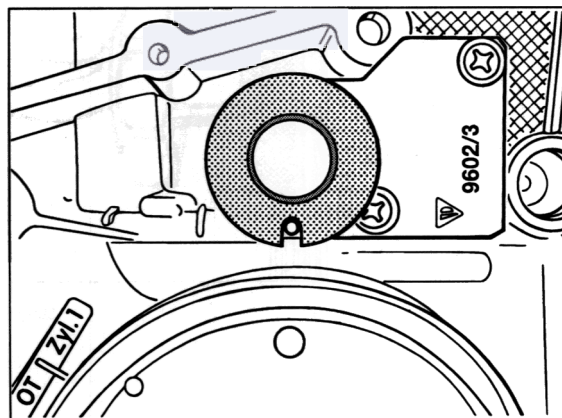
528\_98



527\_98

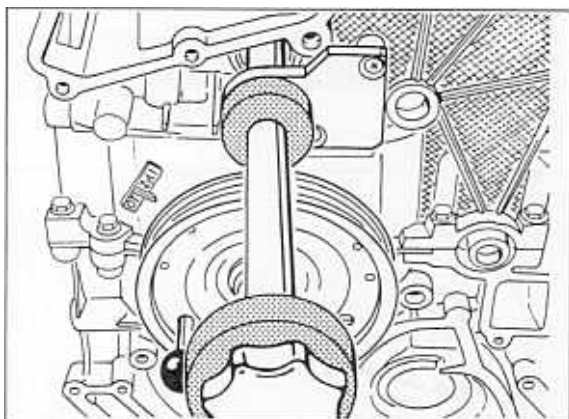
22.3 Remove assembly sleeve 9603/1 and visually inspect the correct position of the circlip in the assembly tube.

23. Push assembly tube through the centring piece into the crankcase assembly bore with the circlip fitted.



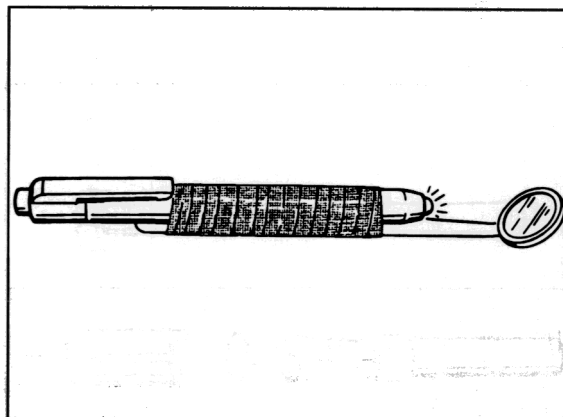
507\_98

24. Carefully and gently insert the pressure pin until it contacts the piston pin circlip.



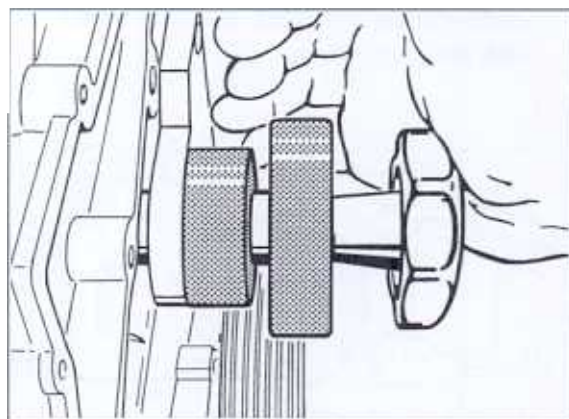
504\_98

26. Visually inspect correct seating of the piston pin circlip, e.g. with a shop-made electric torch with mirror.

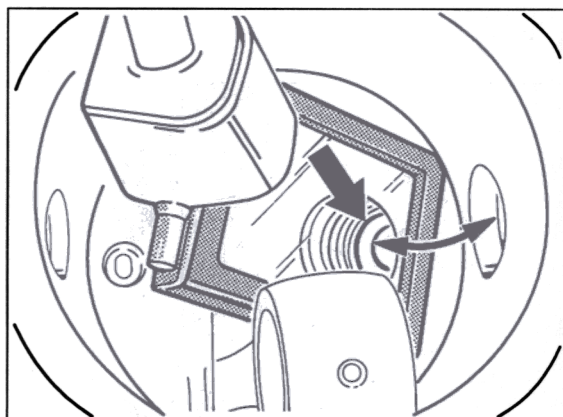


244\_97

25. Move the piston pin circlip to its installation position by **briefly and forcefully striking the palm against the star knob of the pressure pin.**



505\_98

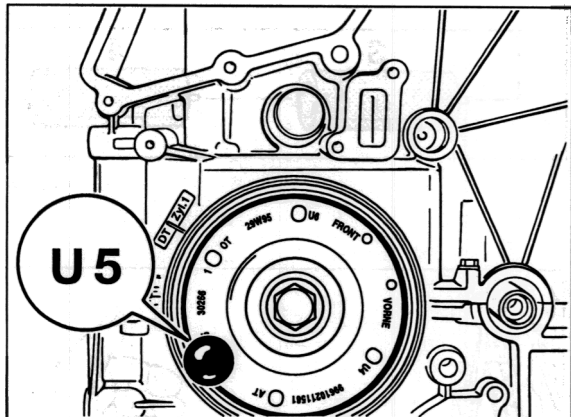


*Drawing shows a torch with adjustable mirror*

259\_97



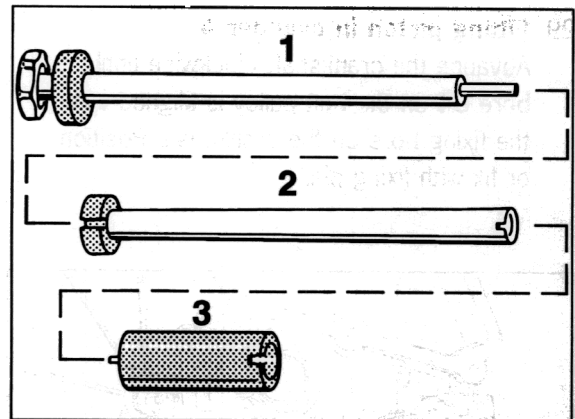
27. **Fitting piston in cylinder 5.** Advance the crankshaft clockwise until bore **U5** on the belt pulley is aligned with the fixing bore on the crankcase. Position or fix with fixing pin.



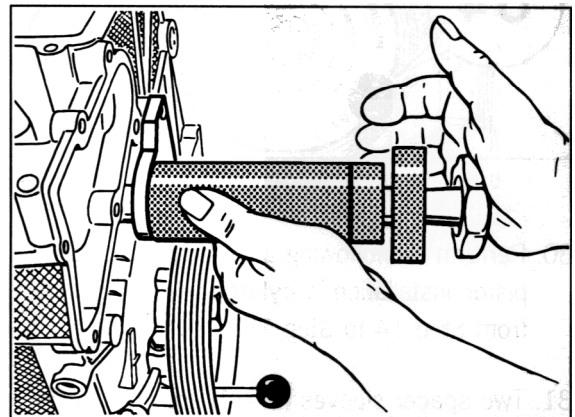
046\_98

28. Perform the following assembly steps for piston installation in **cylinder 5** as described from Step 14 to Step 26.

A spacer sleeve (3) is additionally required when fitting the piston pin circlip in the piston of **cylinder 5**.



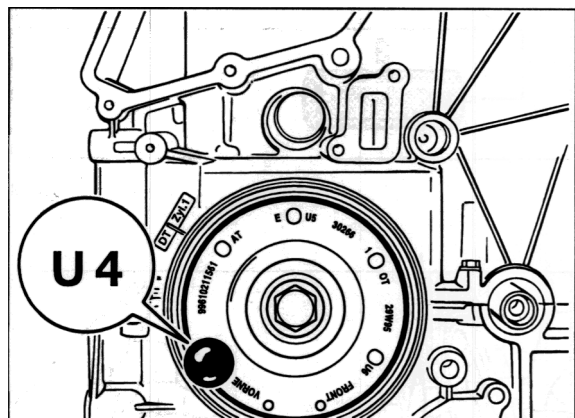
524\_98



508\_98

29. **Fitting piston in cylinder 4.**

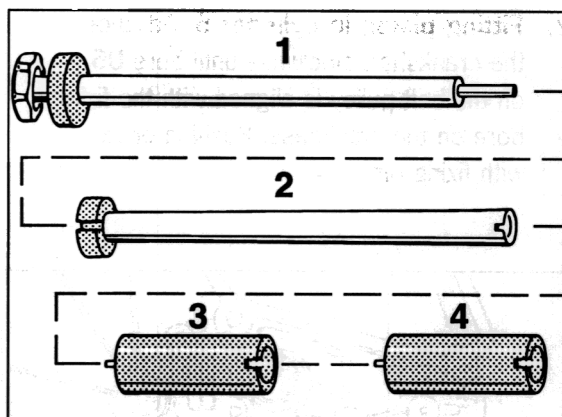
Advance the crankshaft clockwise until bore **U4** on the belt pulley is aligned with the fixing bore on the crankcase. Position or fix with fixing pin.



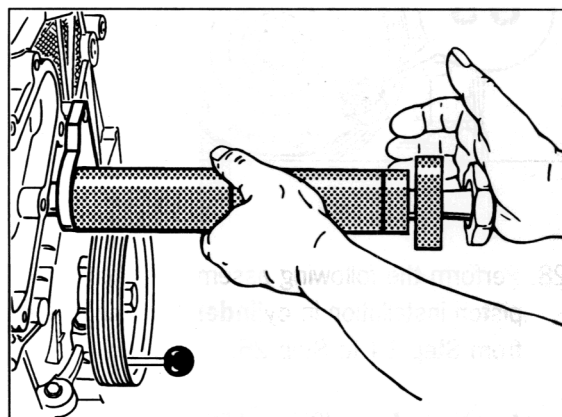
044\_98

30. Perform the following assembly steps for piston installation in **cylinder 4** as described from Step 14 to Step 26.

31. Two spacer sleeves (3 + 4) are additionally required when fitting the piston pin circlip in the **piston of cylinder 4**.



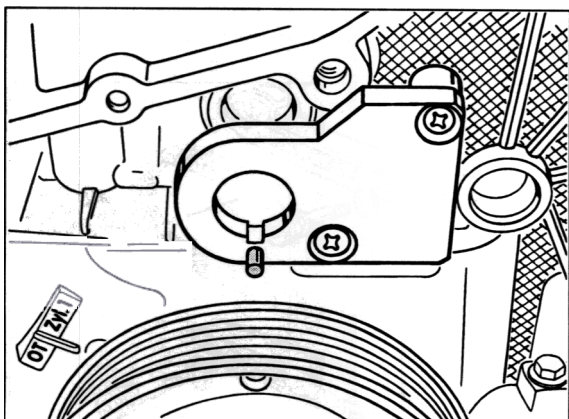
525\_98



509\_98

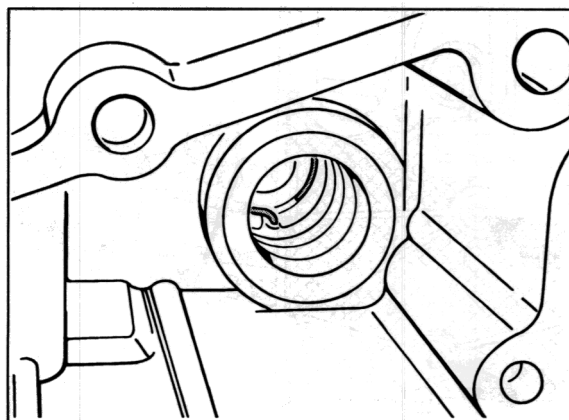


32. Remove centring pin 9602/3.



502\_98

33. Visually inspect correct seating of the piston circlip on the piston of **cylinder 4**.

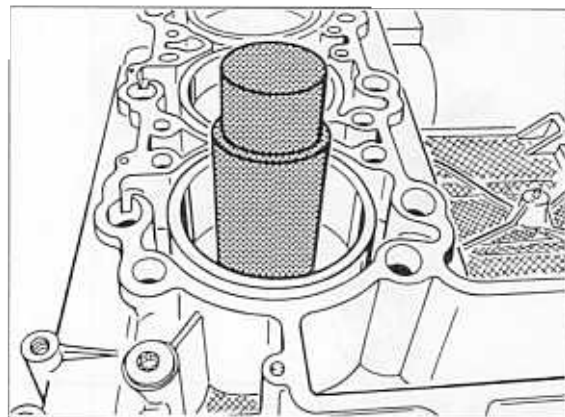


501\_98

#### Note

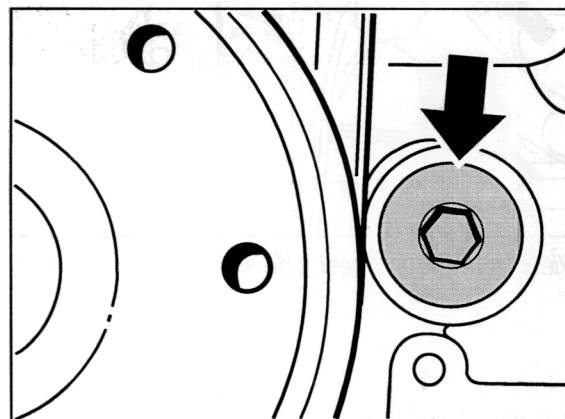
If the piston, piston pin or piston pin circlip are incorrectly assembled, the corresponding piston can be pulled out of the cylinder as follows.

Degrease centre of piston crown. Coat suitable plastic mandrel with instant adhesive. Allow the adhesive to cure. Pull out piston. Remove plastic mandrel immediately.



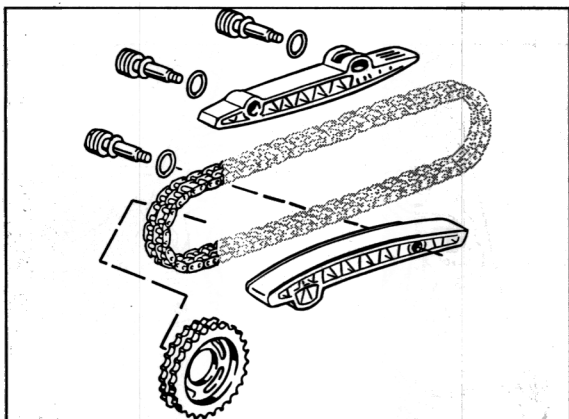
510\_98

34. After fitting the pistons, fit a screw plug and new sealing ring in the assembly bore. Use a 12 mm hexagon socket wrench insert. Tightening torque: 80 Nm (59 ftlb.)



66\_98

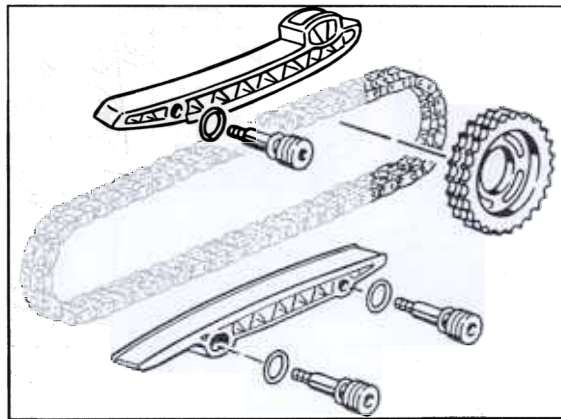
35. Fit guide rail and tensioning rail of **cylinder bank 1 - 3** (flywheel side);  
fit guide rails in correct position.



View from the belt pulley side

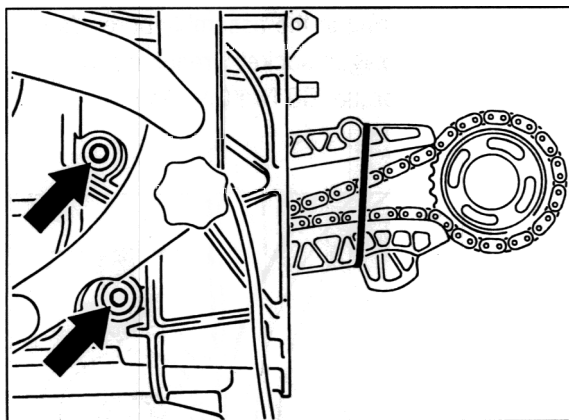
71\_98

36. Fit guide rails and tensioning rails of **cylinder bank 4 - 6** (flywheel side);  
fit guide rails in correct position.



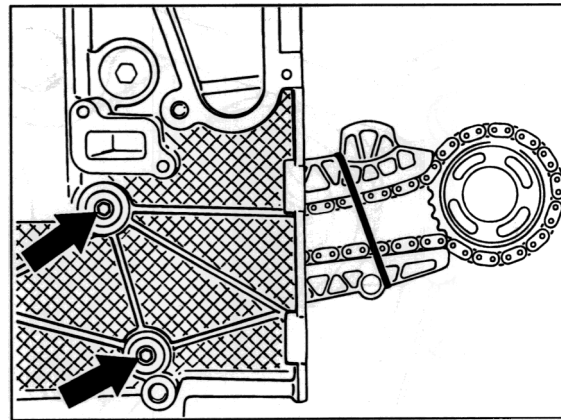
View from the belt pulley side

72\_98



View from the flywheel side

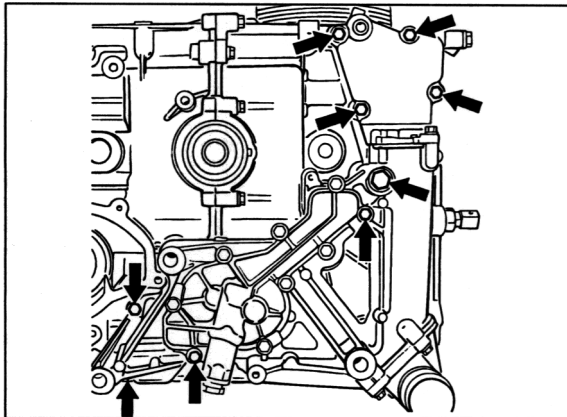
469\_97



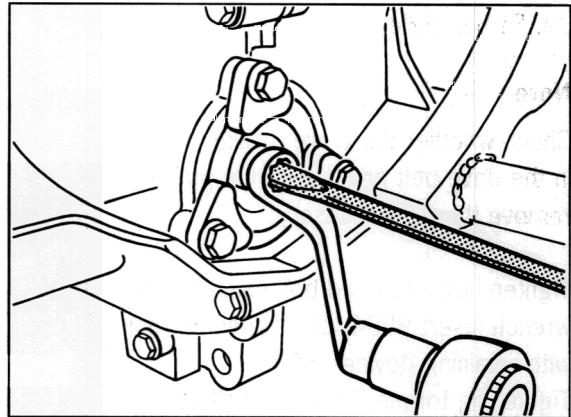
View from the belt pulley side

073\_98

37. Fit oil pump with coolant guide housing.  
Assembly instructions: Group 17,  
Page 17 - 5.



597\_97



442\_97

38. Fit intermediate shaft flange  
Grease sealing ring in area of intermediate shaft flange. Grease receiver bore in area of the crankcase. Carefully press in the intermediate flange.

Screw in new micro-encapsulated hexagon-head bolts M6 x 20 (3 ea.).

Tightening torque: 10 Nm (7.5 ftlb.).

Tighten locknut with the socket wrench, special tool 9110. For this purpose, hold with a slotted screwdriver 7.9 x 1.1 at the slotted threaded pin.

Tightening torque: 11 Nm (8 ftlb.).

39. Fit belt pulley.

**Note**

Check whether there are foreign objects in the drive belt grooves of the pulley and remove them if necessary.

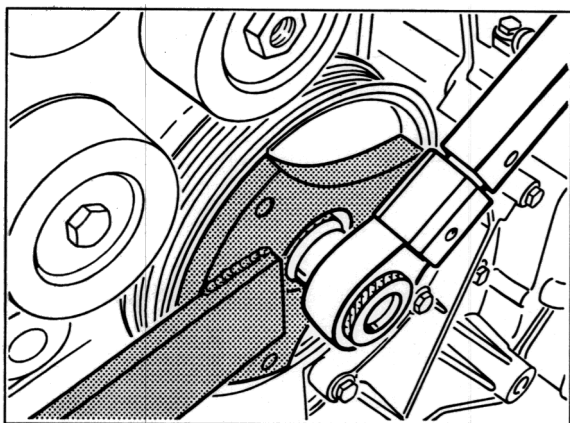
Tighten hexagon-head bolt using the socket wrench insert 9594; simultaneously hold with retaining device 9593.

Tightening torque 50 Nm (37 ftlb.)

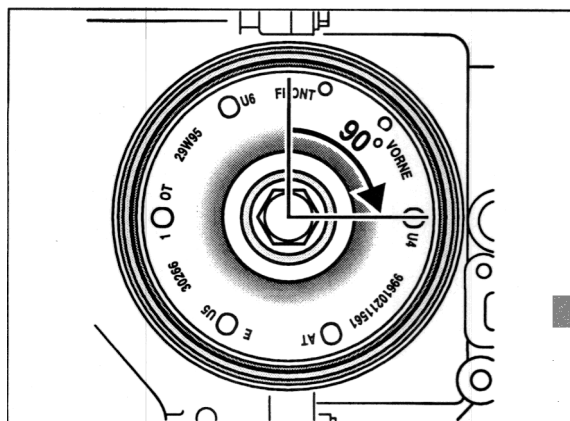
**Tightening sequence:**

**Initial tightening** 50 Nm (37 ftlb.)

**Final tightening** 1 x 90° turn



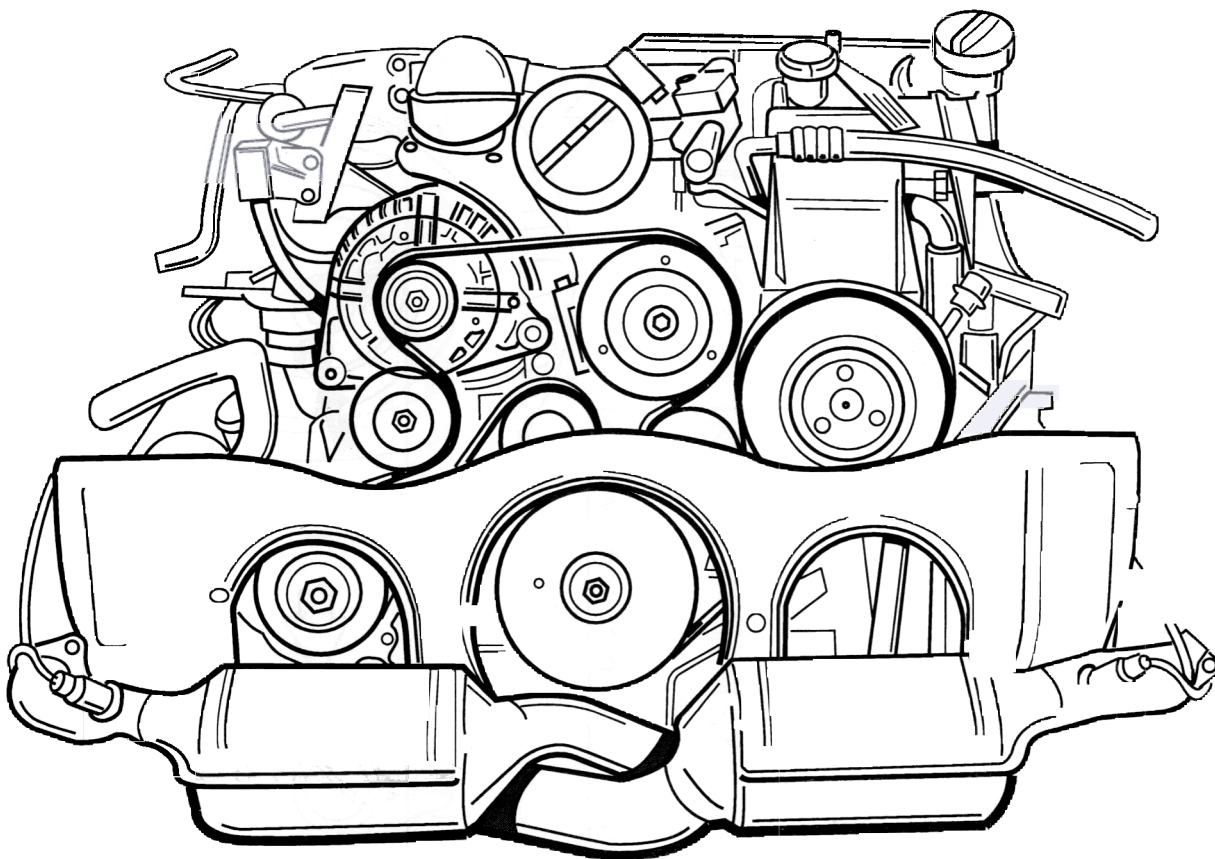
252\_97



213\_97

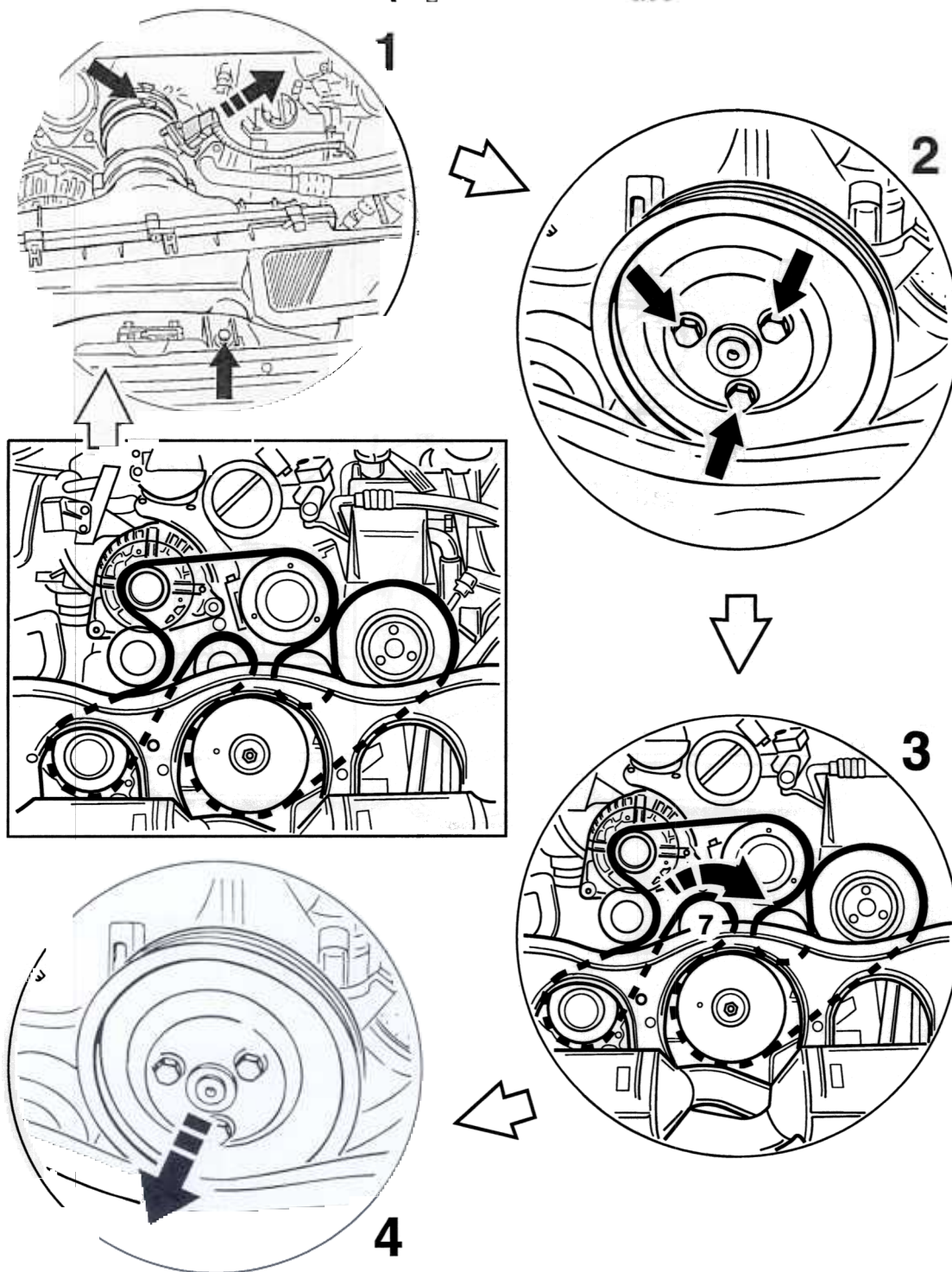


**13 78 19 Removing and installing drive belt (engine installed) – GT3**



129\_99

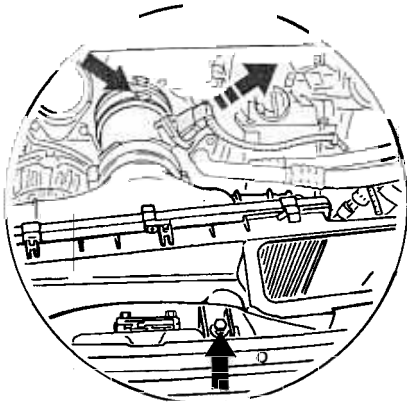
## Removal overview of the drive belt (engine installed) GT3





## Removal overview of the drive belt – GT3

- Remove air cleaner assembly
- 2 Loosen servo pump wheel
- 3 Relieve drive belt
- 4 Remove servo pump wheel
- 5 Remove drive belt

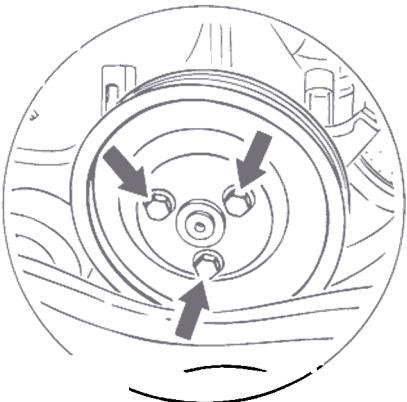
**Removing drive belt – GT3****No. Procedure****Instructions**

188\_a\_99

Remove air cleaner assembly

Remove air cleaner assembly completely. Undo 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.

2

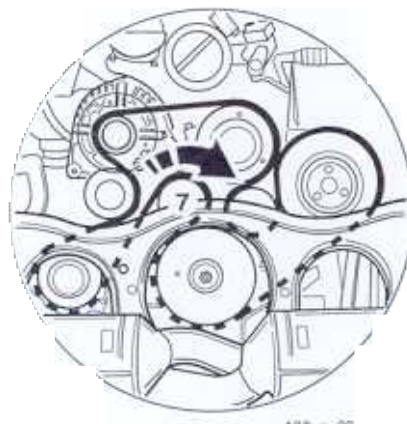


188\_b\_99

Loosen servo pump wheel

Mark belt travel direction with a coloured pen. Undo the three hexagon-head bolts on the servo pump by approx. one half turn.

3



188\_c\_99

Relieve drive belt

Relieve the belt tension. To do this, turn the tensioning roller clockwise and simultaneously remove the belt from the drive pulleys.

No. Procedure

Instructions

4



188\_d\_99

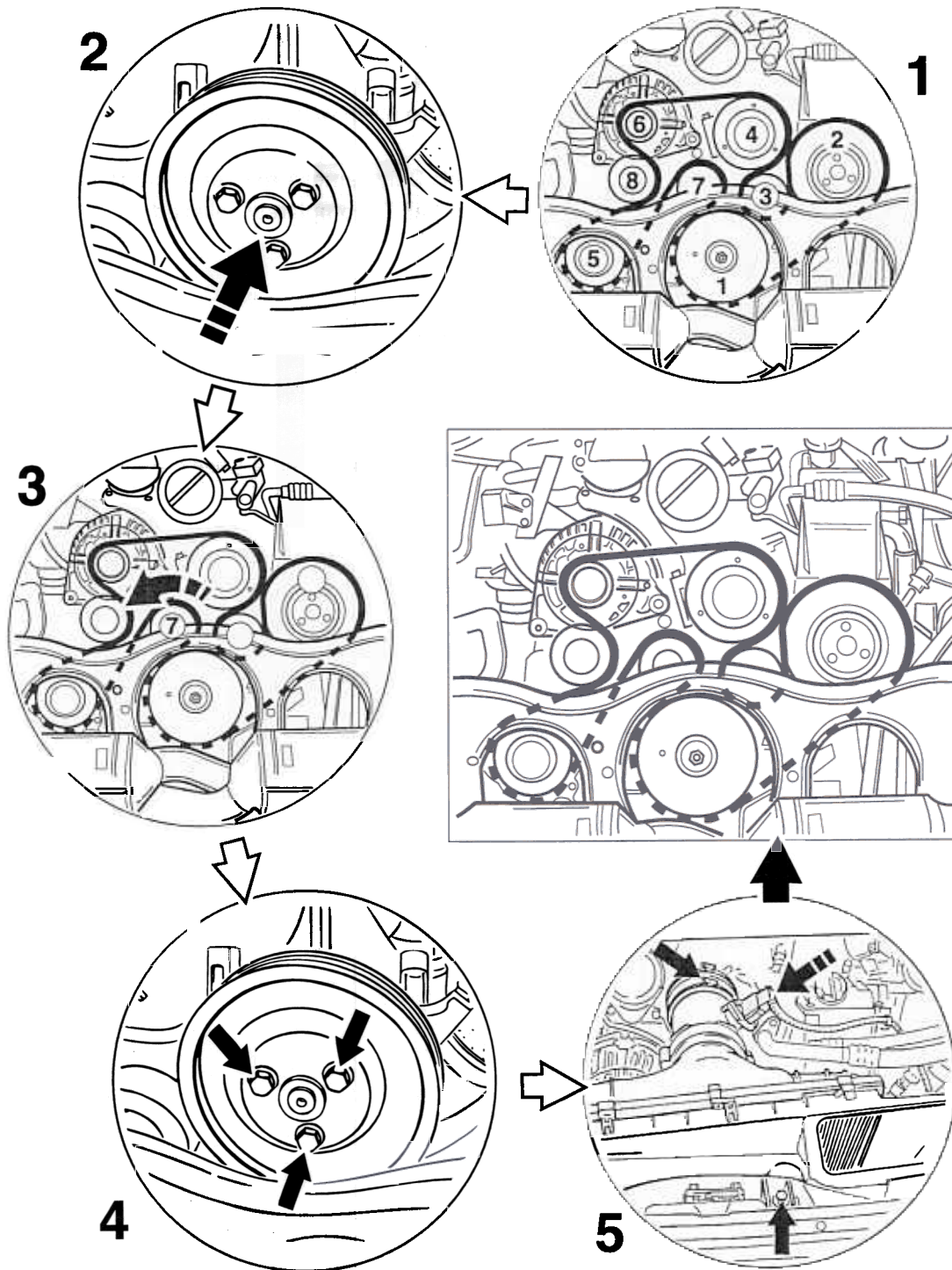
Remove servo pump wheel

Remove servo pump wheel with drive belt to the rear.

**Important: Only remove the servo pump wheel when the drive belt is completely relieved.**

Remove the belt from all drive wheels and lift up to remove.

Installation overview of the drive belt (engine installed) – GT3



### **Installation overview of the drive belt (engine installed) – GT3**

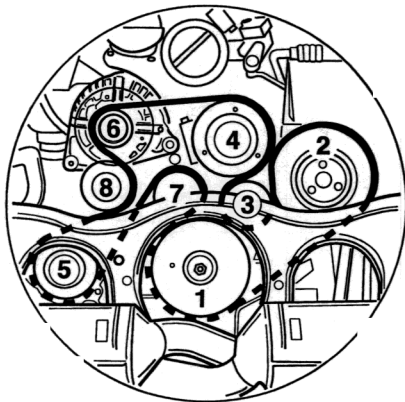
- Fit drive belt
- 2 Position servo pump wheel
- 3 Tension drive belt
- 4 Tighten fastening screws on servo pump
- 5 Install air cleaner assembly

## Installing drive belt – GT3

### No. Procedure

### Instructions

1

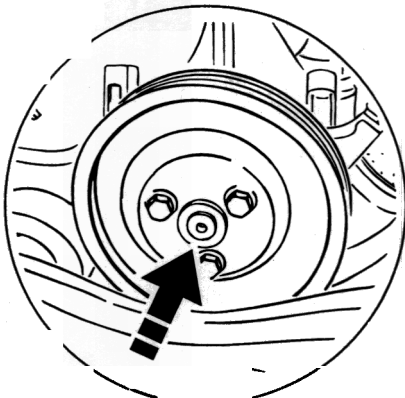


189\_a\_99

Fit drive belt

Fit the belt onto the drive wheels.

2

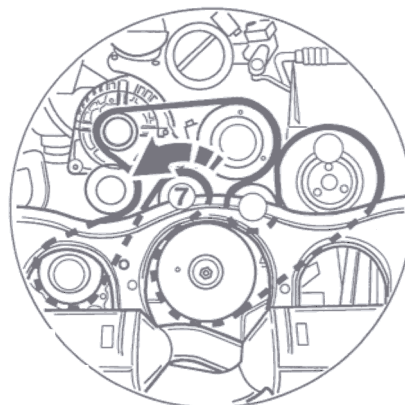


189\_b\_99

Position servo pump wheel

Put on the servo pump wheel together with the drive belt. Slightly tighten the three fastening screws on the servo pump wheel.

3



189\_c\_99

Tension drive belt

To tension the drive belt, turn the tensioning roller (7) in clockwise direction and simultaneously fit the drive belt on the deflection roller (8). Then slowly relieve. To do this, turn the tensioning roller slowly anti-clockwise.

**It is absolutely necessary to check that the drive belt is correctly seated on all belt pulleys.**



No. Procedure

Instructions

4



Tighten the fastening screws on the servo pump

Tighten the fastening screws of the servo pump drive wheel. The three screws are tightened to 23 Nm (17 ftlb.).

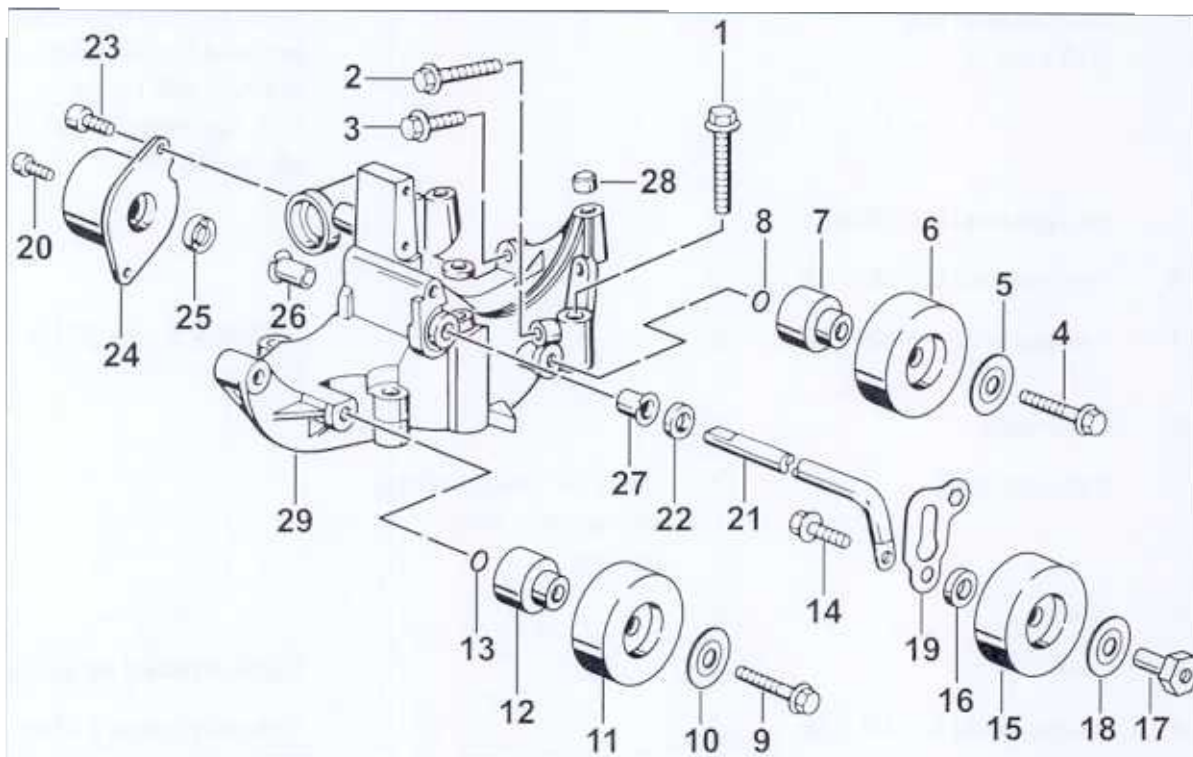
5



Install air cleaner assembly

Install air cleaner assembly completely. Attach connector onto mass air flow meter. Tighten the hose clamp on the throttle body. Tighten hexagon-head bolt M6 x 34.

**13 73 37 Disassembling and assembling belt tensioner – GT3**



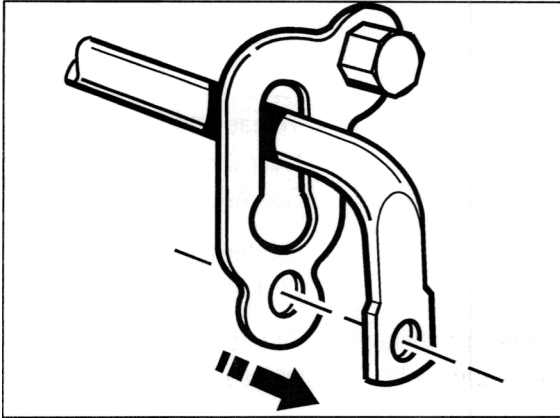
13730001

| No. | Designation                                     | Qty. | Removal  | Note: | Installation  |
|-----|---|------|--|-------|---|
|     | Hexagon-head bolt M10 x 60                      | 4    |  |       | Insert the front right hexagon-head bolt (direction of travel) with Loctite 574. Tightening torque 65 Nm (48 ftlb.) |
| 2   | Hexagon-head bolt M8 x 55                       | 1    |  |       |   |
| 3   | Hexagon-head bolt M8 x 25                       | 2    |  |       |   |
| 4   | Hexagon-head bolt M8 x 55                       | 1    |  |       | Tightening torque 23 Nm (17 ftlb.)  |
|     | Cover plate                                     | 1    |  |       |   |
| 6   | Deflection roller                               | 1    | Check for smooth running or roughness before undoing                                     |       |   |
| 7   | Spacer  |      |  |       |   |
| 8   | O-ring  | 1    |  |       | Check, replace if necessary   |
| 9   | Hexagon-head bolt M8 x 55                       | 1    |  |       | Tightening torque 23 Nm (17 ftlb.)  |
| 10  | Cover plate                                     | 1    |  |       |   |
|     | Deflection roller                               | 1    | Check for smooth running or roughness before undoing                                     |       |   |
| 12  | Spacer  | 1    |  |       |   |
| 13  | O-ring  | 1    |  |       | Check, replace if necessary   |
| 14  | Hexagon-head bolt (micro-encapsulated) M10 x 30 | 1    |  |       | Replace   |
| 15  | Tensioning roller                               | 1    | Undo at the hexagon (wrench size 24) and simultaneously counter at the hexagon-head bolt |       | Tightening torque 60 Nm (44 ftlb.). Counter at the hexagon-head bolt when tightening (wrench size 15)               |

| No. | Designation   | Qty. | Removal  | Note: | Installation   |
|-----|---|------|--|-------|--|
|     |   |      |  |       |  |
| 16  | Spacer ring   |      |  |       |  |
| 17  | Threaded sleeve with hexagon (wrench size 24)       | 1    |  |       |  |
| 18  | Cover plate   | 1    |  |       |  |
| 19  | Transmission lever with hexagon (wrench size 15 mm) | 1    |  |       | Thread on to tensioning lever (No. 21).<br>See Assembly note |
| 20  | Pan-head screw M6 x 16                              | 1    |  |       | Tightening torque 9.7 Nm (7.0 ftlb.)                         |
| 21  | Tensioning lever                                    | 1    | Drive out of the tensioning element with a drift (ø 5) |       | Fit in correct position; grease in area of bearing           |
| 22  | Dust cap  |      |  |       |  |
| 23  | Pan-head screw M8 x 16                              | 2    |  |       | Tightening torque 23 Nm (17 ftlb.)                           |
| 24  | Tensioning element                                  | 1    |  |       |  |
| 25  | Dust cap  |      |  |       |  |
| 26  | Bearing sleeve                                      | 1    |  |       | Grease with Optimol Optipit grease                           |
| 27  | Bearing sleeve                                      | 1    |  |       | Grease with Optimol Optipit grease                           |
| 28  | Dowel sleeve 11 M6 x 10                             | 2    |  |       |  |
| 29  | Bracket   |      |  |       |  |

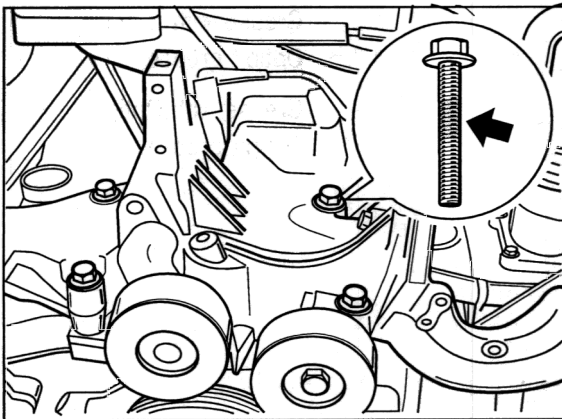
**Assembly note**

1. Thread transmission lever on to tensioning lever.



13730002

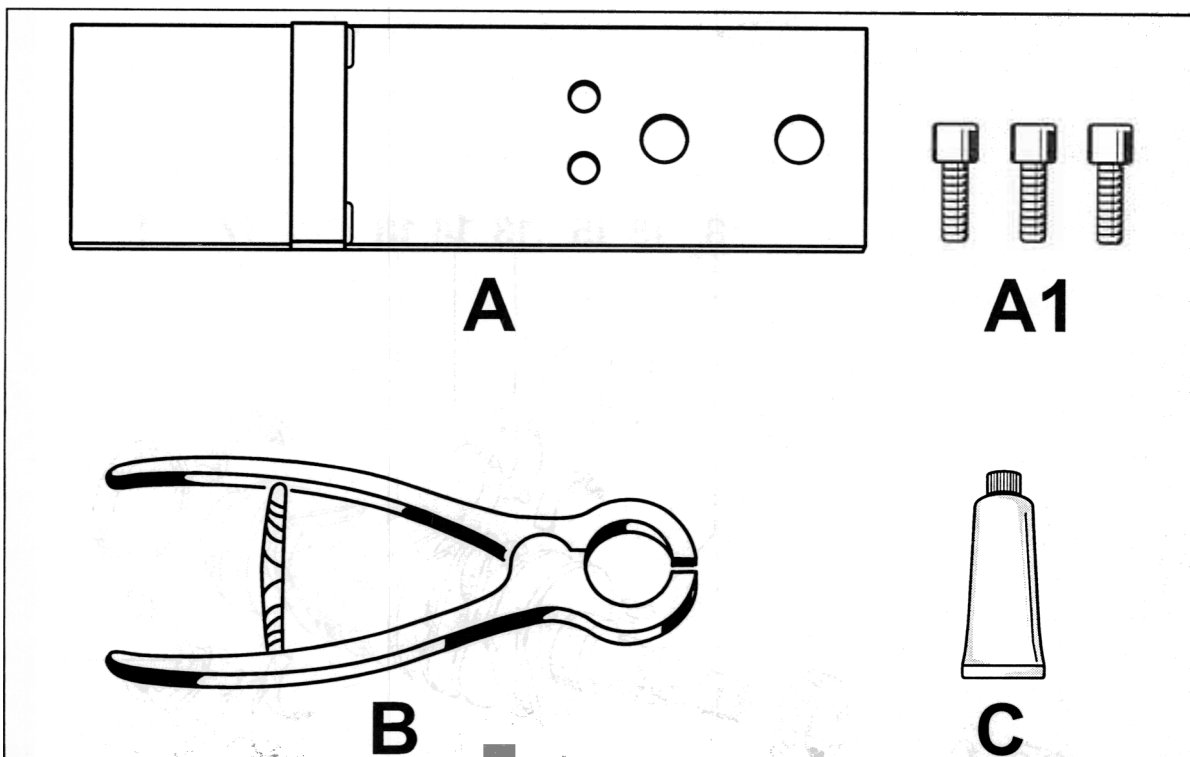
2. Insert the front right hexagon-head bolt on the bracket with Loctite 574.  
Tightening torque 65 Nm (48 ftlb.).



420\_99

# 13 48 37 Disassembling and assembling crankshaft – GT3

## Tools

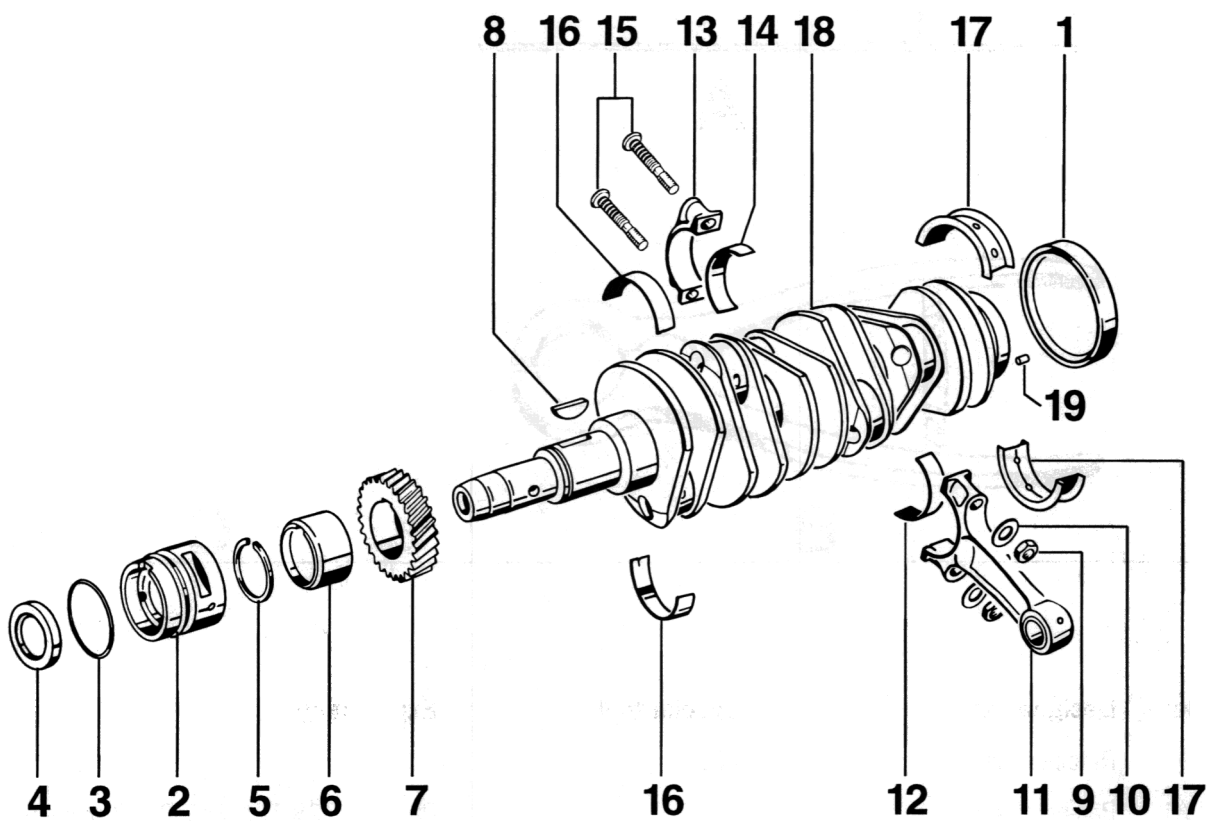


10100003

| Item | Designation                | Special tool | Explanation                        |
|------|----------------------------|--------------|------------------------------------|
| A    | Retainer plate             | 209a         |                                    |
| A1   | Pan-head screws            |              | Part No. 928 102 151 01 (3 pieces) |
| B    | Special grease Volta-EF 90 |              | Part No. 000.043.300.12            |
| C    | Snap ring pliers           |              | Commercially available             |



13 48 37 Disassembling and assembling crankshaft



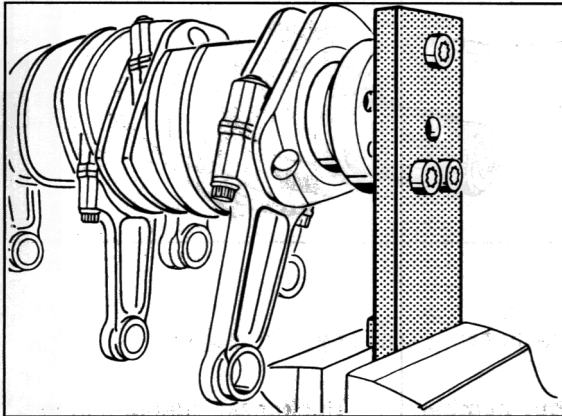
| No. | Designation                          | Qty. | Removal   | Note: | Installation   |
|-----|--------------------------------------|------|---|-------|--|
|     | Radial sealing ring                  | 1    |   |       |  |
| 2   | Bearing sleeve, bearing 8            | 1    |   |       | Replace  |
| 3   | Round seal                           | 1    |   |       | Replace,<br>do not fit twisted   |
| 4   | Radial sealing ring                  | 1    |   |       | Replace  |
| 5   | Snap ring                            | 1    |   |       | Carry out insertion test   |
| 6   | Spacer ring                          |      |   |       | Warm on heating plate,<br>push on up to stop   |
| 7   | Timing gear                          | 1    | Check toothing for wear,<br>remove if necessary |       | Note reference number,<br>paired with intermediate<br>shaft, only install<br>together, warm on heat-<br>ing plate, push on up to<br>stop. The collar of the<br>timing gear must point to<br>bearing 7. |
| 8   | Woodruff key                         | 1    |   |       |  |
| 9   | Connecting rod nut<br>M9 x 1.25      | 12   |   |       | Tightening torque<br>Initial tightening:<br>30 Nm (22 ftlb.)<br>Final tightening:<br>1 x 90° turn  |
| 10  | Washer                               | 12   |   |       |  |
| 11  | Connecting rod                       | 6    |   |       | Note installation position<br>and weight. Note classifi-<br>cation or matching num-<br>ber to connecting-rod<br>bearing cap  |
| 12  | Connecting rod bearing<br>shell half | 6    |   |       | Replace  |
| 13  | Connecting-rod bearing cap           | 6    |   |       | Note matching number to<br>connecting rod  |

| No. | Designation                           | Qty. | Removal                                 | Note: | Installation  |
|-----|---------------------------------------|------|---|-------|---|
|     |                                       |      |   |       |   |
| 14  | Connecting rod bearing shell half     | 6    |   |       | Replace   |
| 15  | Con-rod bolts                         | 12   |   |       | Grease thread of the con-rod bolts, use only special grease Part No. 000.043.300.12 |
| 16  | Main bearing shells of bearings 2 - 7 | 12   |   |       | Replace   |
| 17  | Main thrust bearing shells 1          | 2    |   |       | Replace   |
| 18  | Crankshaft                            | 1    | Check for wear, carry out sounding test |       |   |
| 19  | Roll pin 6.0 x 16                     | 1    |   |       | Check for presence and correct seat   |

## Disassembling and assembling crankshaft

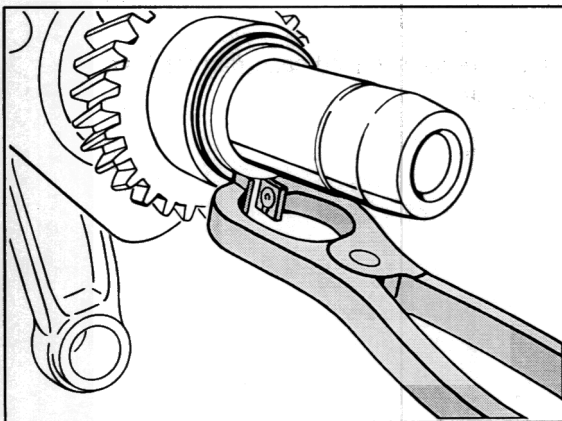
### Disassembly

1. Remove tensioning sleeve (6 x 16) with a vice-grip wrench. Clamp special tool retaining plate P 209a in the vice. Fasten the crankshaft to the retaining plate with 3 pan-head screws LO No. 928 102 151 01.



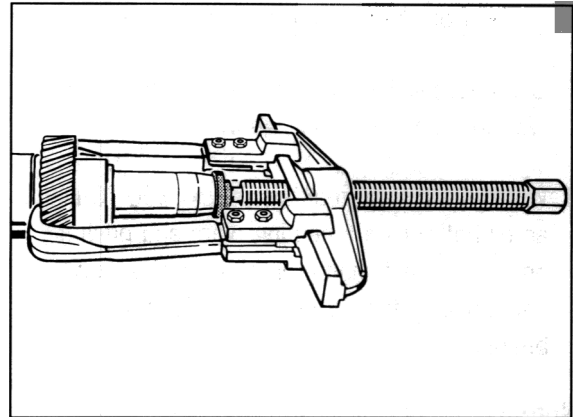
281\_99

2. Loosen connecting rods with socket wrench insert M14 and remove.
3. Remove snap ring with snap ring pliers.



280\_99

4. Remove spacer ring and timing gear with a conventional puller.



277\_99

5. Remove Woodruff key.
6. Remove crankshaft from retaining plate. Check crankshaft for shocks, cracks and wear. Carry out sounding test.

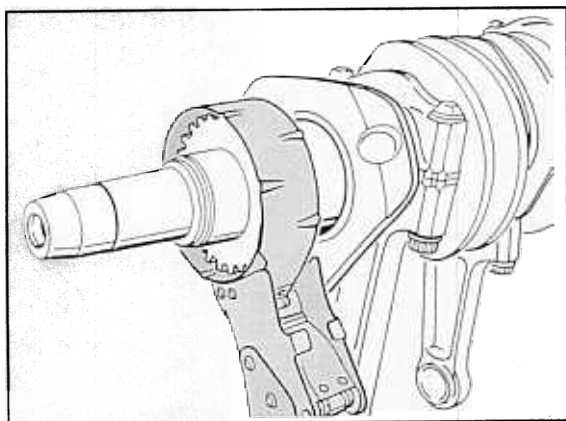


### Assembly

1. Clean crankshaft thoroughly. Rinse out oil bores with a hand pump and solvent naphtha. With a visual inspection, check whether the oil ducts are blocked at the bearing surfaces and on the front face (aluminium stoppers).
2. Clamp crankshaft. Insert and align new Woodruff key for timing gear.
3. Warm the timing gear to approx. 150 °C in an oil bath or on a heating plate and push it on to the crankshaft journal up to the stop. The collar of the timing gear must point to bearing 7.

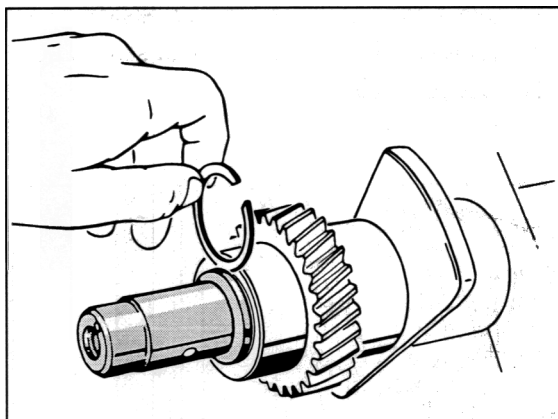
### Note

As an assembly aid, remove the timing gear from the heat source e.g. with a piston restraining strap and quickly mount or push it into place on the journal.



279\_99

5. Mount snap ring. Select the corresponding snap ring using an insertion test. The snap ring must be inserted without play.



401\_99

The following snap rings are available:

| Part number    | Thickness<br>mm | Identification             |
|----------------|-----------------|----------------------------|
| 901.102.148.00 | 2.4             | blank                      |
| 901.102.148.01 | 2.3             | tempered blue*             |
| 901.102.148.02 | 2.2             | tempered yellow/<br>brown  |
| 901.102.148.03 | 2.1             | black,<br>gun-metal finish |

\* most frequently used snap ring for first assembly.

4. Heat up the spacer ring in the same way and push it on up to the stop.

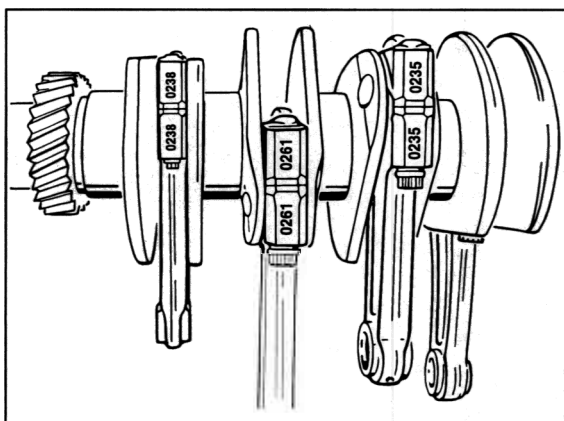
6. Mount connecting rods on the crankshaft. The thread of the con-rod bolts **must be greased without fail**.

Use special grease Part No. 000.043.300.12.  
The matching numbers of the con-rods and the con-rod bearing caps must all point to the same side.

Tightening torque:

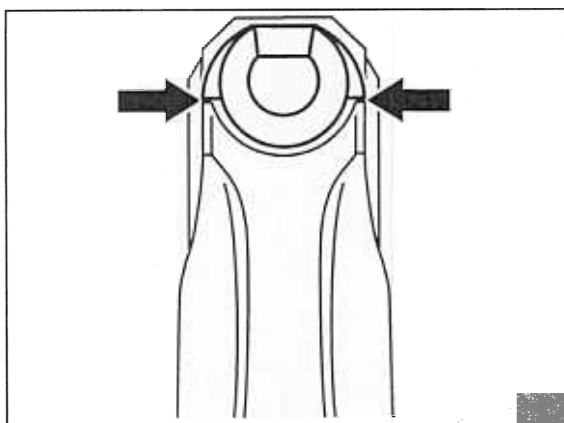
Initial tightening 30 Nm (22 ftlb).

Final tightening 1 x 90 ° turn



278\_99

7. Tighten con-rod nuts. When tightening, the con-rod bolt must be protected against turning at the same time by a second person using a feeler gauge.

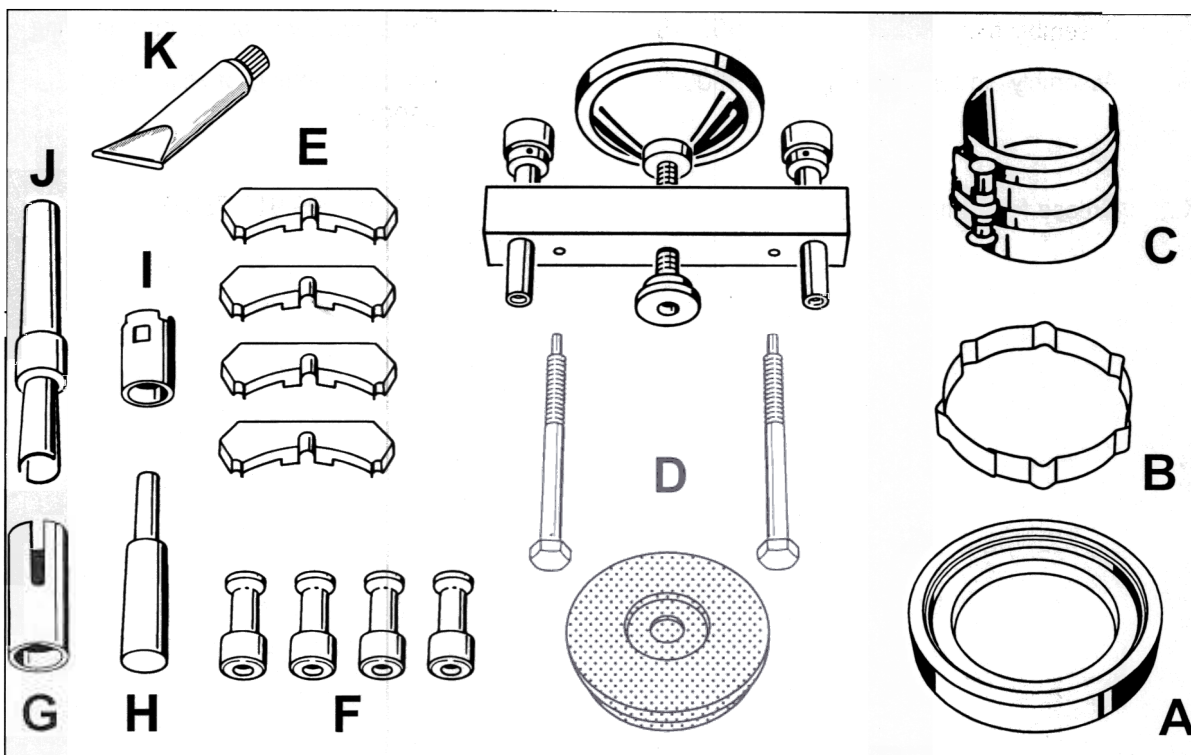


326\_99



## 13 10 19 Removing and installing pistons – GT3

### Tools



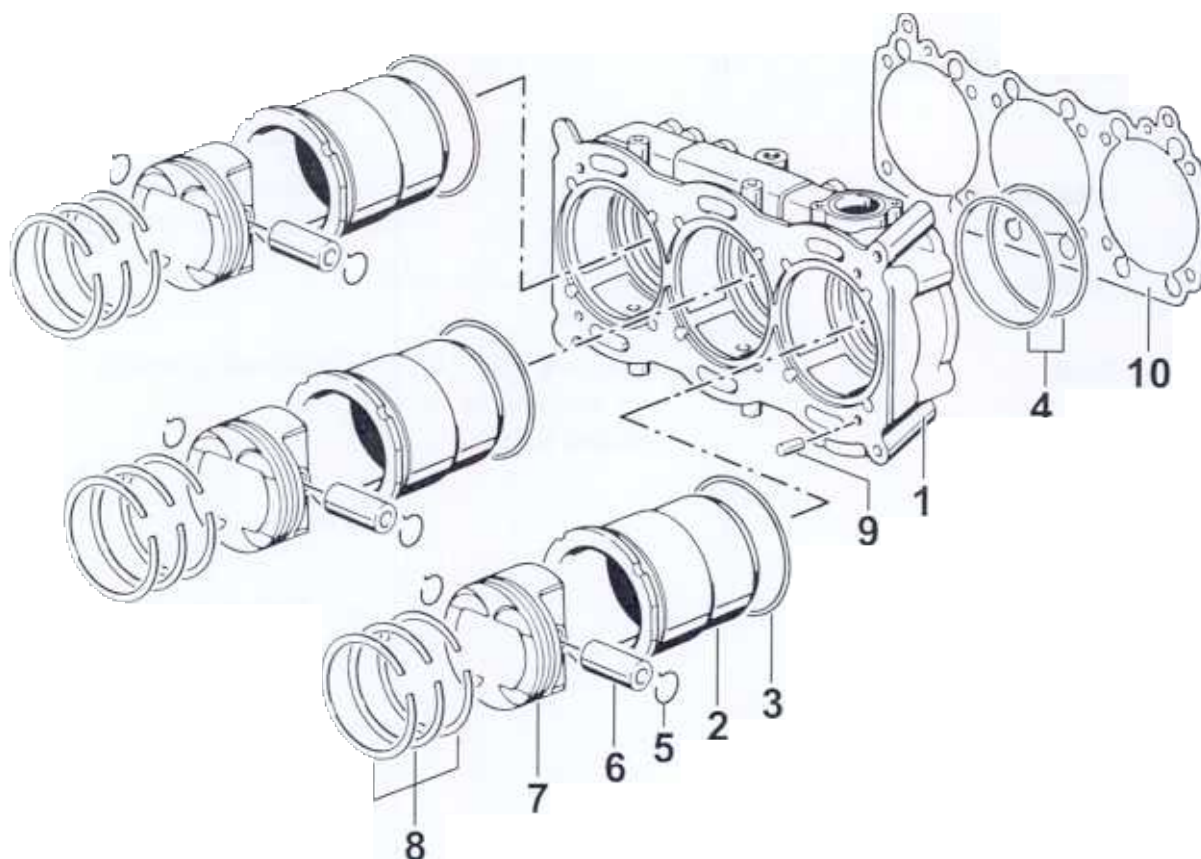
13100016

| Item | Designation                   | Special tool | Explanation   |
|------|-------------------------------|--------------|---|
| A    | Assembly aid                  | 9657         | For positioning the restraining strap over the piston rings |
| B    | Restraining strap             | 9659         | For the piston assembly of pistons from cylinders 2 and 5   |
| C    | Piston ring restraining strap |              | Refer to Workshop Equipment Manual, Chapter 2.4, No. 57     |
| D    | Pushing device                | 9660         |   |
| E    | Spacing pieces                | 9651         |   |
|      | Holder for cylinder           | P 140        |   |

| Item | Designation                | Special tool | Explanation                              |
|------|----------------------------|--------------|--|
| G    | Assembly aid               | 9500/6       | For pre-assembly of snap rings in 9500/5 |
| H    | Plunger                    | 9500/4       |  |
|      | Assembly tool              | 9500/5       | For assembly of piston pin snap ring     |
| J    | Assembly aid for snap ring | 9500/3       | For pre-assembly of snap ring in 9500/5  |
| K    | Grease for O-rings         |              | Part No. 999.917.788.00                  |

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## Removing and installing pistons

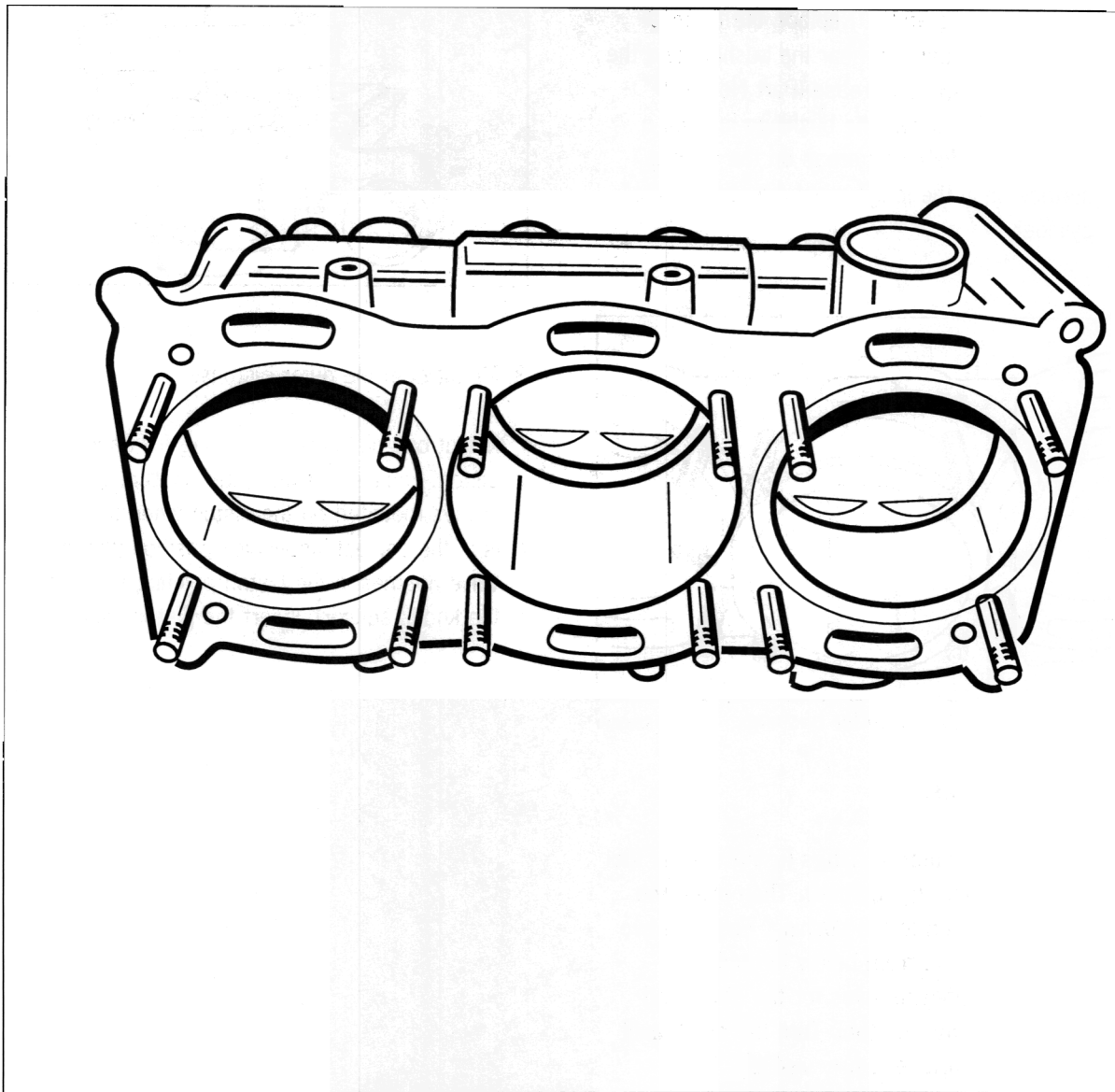


346\_99

| No. | Designation            | Qty. | Removal   | Note: | Installation  |
|-----|------------------------|------|---|-------|---|
| 1   | Cylinder               |      | Identify, e.g. with cyl. 1 - 3  |       |   |
| 2   | Bushings               | 3    | Identify, e.g. with cyl. 1, 2 or 3, assign to the corresponding piston  |       | Oil running surface   |
| 3   | O-ring 104.00 x 2.00   | 3    |   |       | Replace on principle, wet with grease, do not mount twisted             |
| 4   | O-ring 110.00 x 2.50   | 6    |   |       | Replace on principle, wet with grease, do not mount twisted             |
| 5   | Piston pin circlip     | 6    | Lever out   |       | Replace on principle, ensure correct seating                            |
| 6   | Piston pin             | 3    | Assign to the corresponding piston                                      |       |   |
|     | Piston                 | 3    | Identify, e.g. with cyl. 1, 2 or 3, assign to the corresponding bushing |       | Oil running surface   |
| 8   | Piston rings           | 9    |   |       |   |
| 9   | Straight pin A8.0 x 14 | 1    |   |       |   |
| 10  | Cylinder base seal     | 1    |   |       | Replace on principle, note installation position, "Top" faces the front |

## 13 20 23 Installing pistons – GT3

Includes removing and installing cylinders

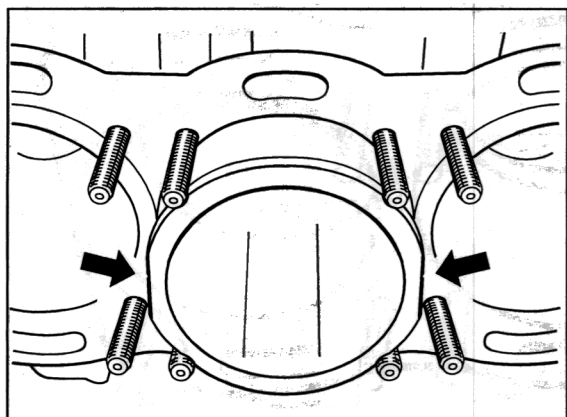


10200004

## Installing pistons GT3

### 1. Mount bushings.

Press the left and right bushings (not centre) back into the cylinder. Replace the three O-rings in each case. Smear the bushing and the O-rings with special grease (Part No.: 999 917 788 00). Insert the bushings in such a way that the flattened areas on the sealing surface lie in the longitudinal direction of the cylinder.

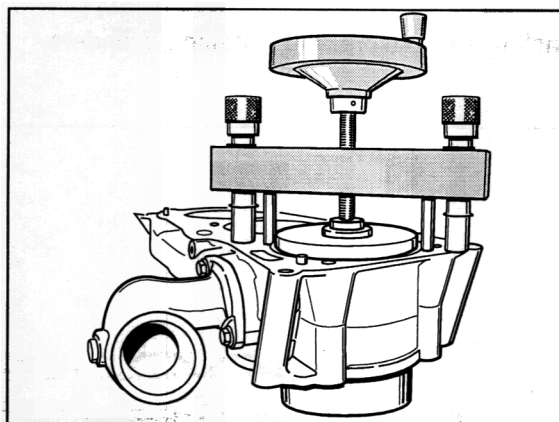


View shows central cylinder bushing

15700010

### 2. Pull in bushings.

Pull both the outer bushings (using special tool No.: 9660) into the cylinder. Then place the plastic cover on to the bushing. Push the two retaining screws from below through two diagonally opposite holes for the studs and screw them into the tool. Turn the crank until the sealing surface is fully visible.



304\_99

### 3. Mount both the outer pistons.

Mount one piston pin snap ring for each piston. Ensure that the outer snap ring is always mounted on the piston when the piston is in the correct installation position (the large valve notches in the piston pointing towards the knock sensor). Insert the piston pins.

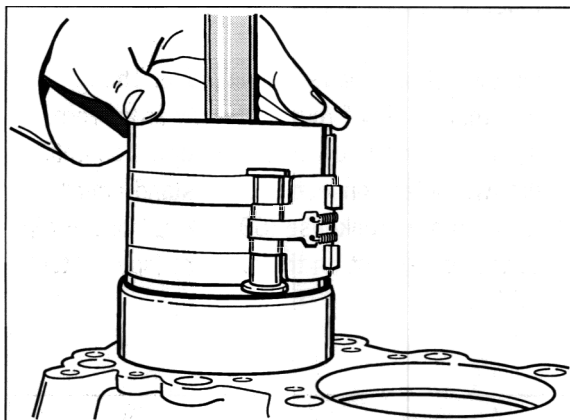


## Installing pistons – GT3

4. Press the piston rings together with the help of a restraining strap. Ensure that the gaps of the piston rings are always offset by 120° and lie correctly in their grooves. Position the pistons on the bushings from below and push them quickly into place. At the same time, hold the restraining strap with one hand. Wear gloves.

### Note

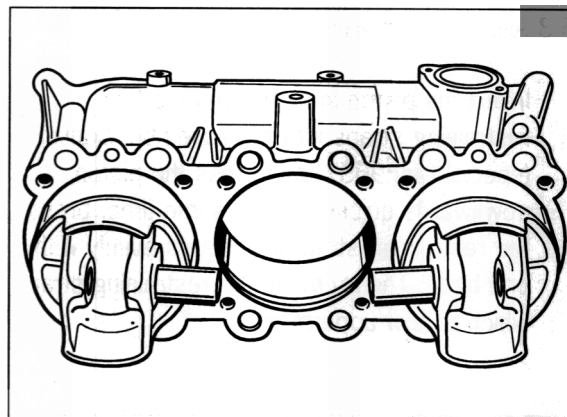
During the assembly, use **plenty** of oil.



219\_99

### 5. Align pistons.

Pull the pistons far enough out of the cylinder again that the piston pins just pass the bushing. Align the pistons in such a way that the piston pins lie along the longitudinal axis of the cylinder. Pull the pin far enough out of the piston that it finishes flush with the inner edge of the piston.



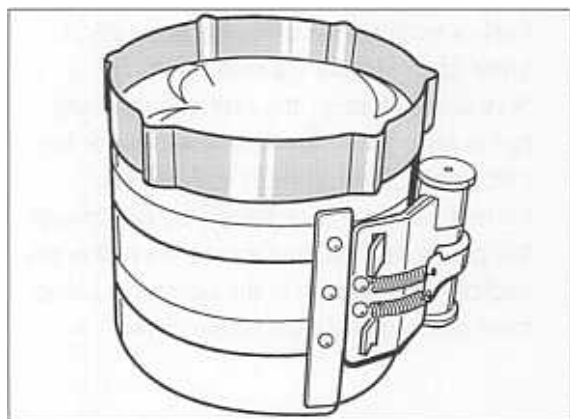
15700005

### 6. Mount the central piston.

- 6.1 Offset the gaps of the piston rings by 120° and mount the restraining strap.

#### 6.2 Mount restraining strap.

Position the restraining strap (special tool 9659) on top of the piston. Ensure that the gap in the special tool lies between the inlet valve recesses.

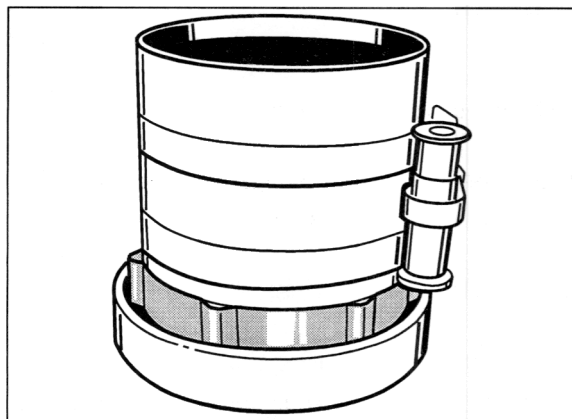


229\_99

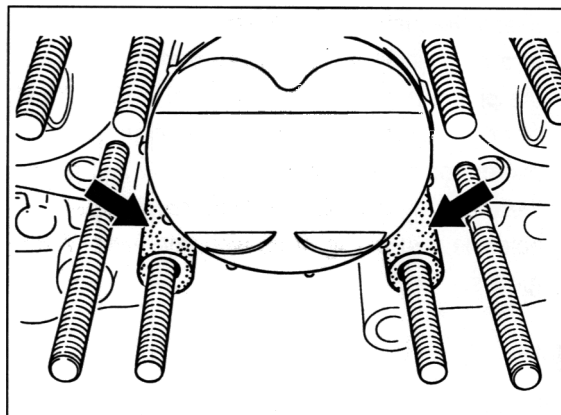
## Installing pistons – GT3

### 6.3 Align the restraining strap.

Insert the piston inverted with the two restraining straps into the assembly fixture (special tool 9657) and press the piston downwards quickly. At the same time, press the restraining strap downwards evenly with one hand. Then remove the restraining strap which is now uppermost.



228\_99



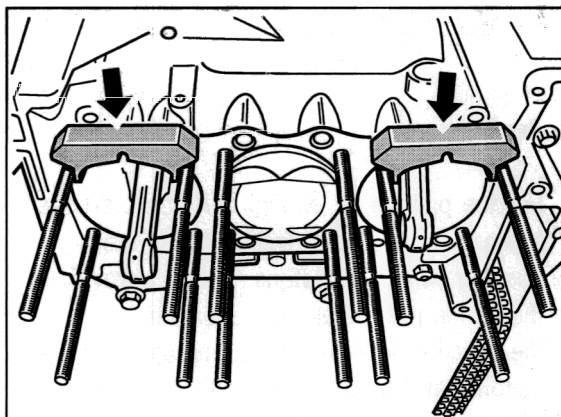
330\_99

### 7. Place the cylinder in position.

Lie the cylinder base seal in place. The designation "TOP" must face upwards. Turn the engine forwards in running direction until the two outer connecting rods stand equally far from the crankcase (60° crk in front of top dead centre). Put on the spacers (special tool 9651).

### 6.4 Mounting the piston on the connecting rod.

Push a rubber hose on to the two central, lower studs. Mount the piston with the restraining strap on the central connecting rod in such a way that the recesses for the inlet valves point upwards when in the correct position. Push the piston pin through the connecting rod and mount the piston pin circlips. The opening in the piston pin circlip must point towards the piston crown.

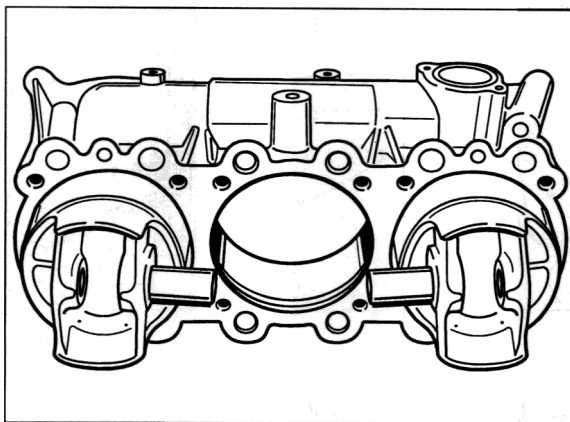


305\_99

## Installing pistons – GT3

### 8. Put cylinder in place

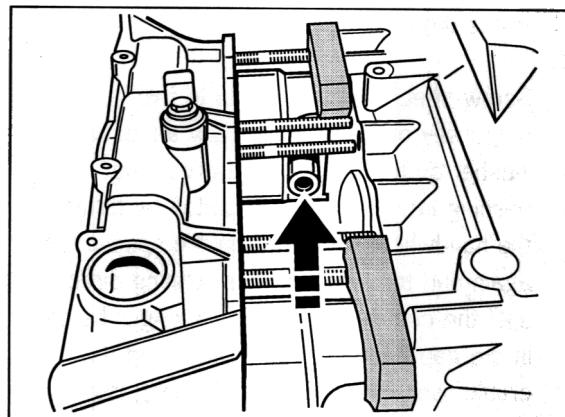
Take the prepared cylinder and push it over the studs. Push the cylinder on until the two outer connecting rods can be mounted. Place the connecting rods in position and insert the piston pin.



15700005

### 9. Mount the piston pin circlip.

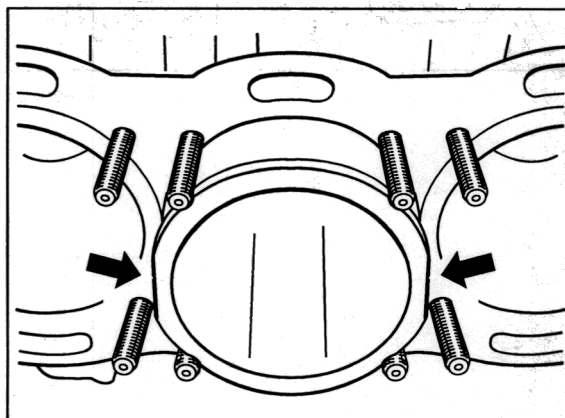
Mount the piston pin circlips of both pistons of the outer cylinders. Work through the opening in the cylinder for the central bushing. Ensure that the openings of the circlip always point towards the piston crown. Position special tool 9500/5 on the piston, guide it with one hand and press the circlip into place. Then check whether the circlip is sitting correctly in the groove. Then push the cylinder up to the spacers as far as it will go. Secure the cylinder against falling down.



15700007

### 10. Insert central bushing

Turn the engine in running direction until the central piston stands at bottom dead centre. Then place the central bushing in place and push it on until the bushing is guided by the studs. Ensure that the flattened areas on the bushing point towards the neighbouring bushings.

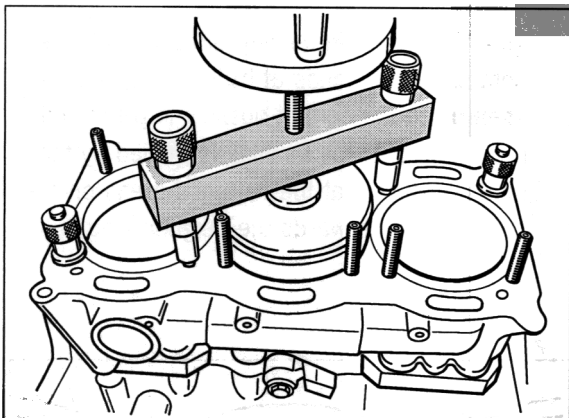


15700010

## Installing pistons – GT3

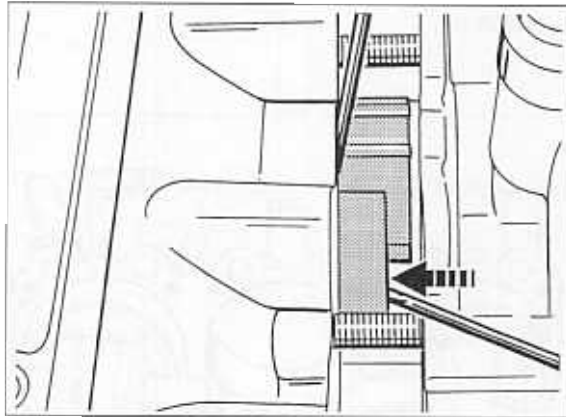
### 11. Press the bushing into place.

Screw special tool 9659 on to two diagonally opposite studs. Lay a plastic washer on the bushing and press the bushing into place on the piston by turning the handwheel. Then loosen the special tool again and turn the motor in running direction until the central piston can no longer be seen in the gap between the cylinder and the crankcase. Then press the bushing into place with the special tool until the restraining strap falls away from the piston.



15700006

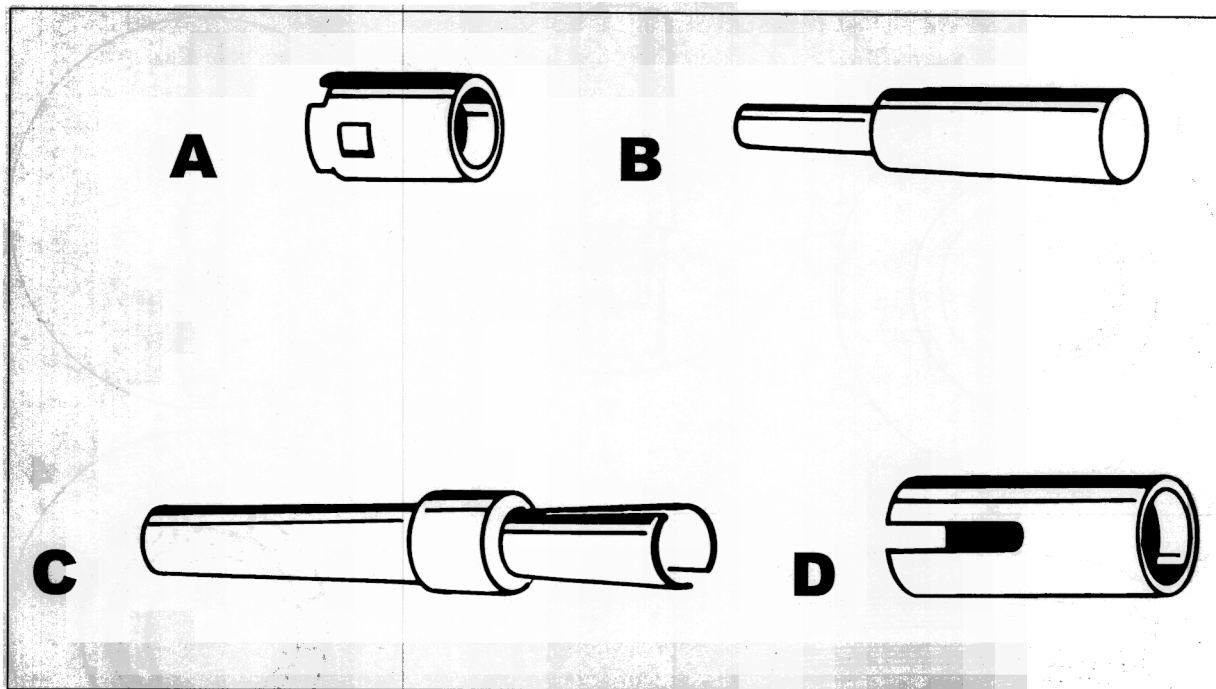
### 12. Push the restraining strap away using two screwdrivers and pull it out between the crankcase and the bushing. Then push the bushing in as far as it will go.



### 12. Place the cylinder in position.

Screw the cylinder retainer down. Ease the strain on the cylinder slightly and remove the spacers. Then push the cylinder towards the crankcase.

# 13 26 23 Installing piston pin with piston-pin circlip – GT3

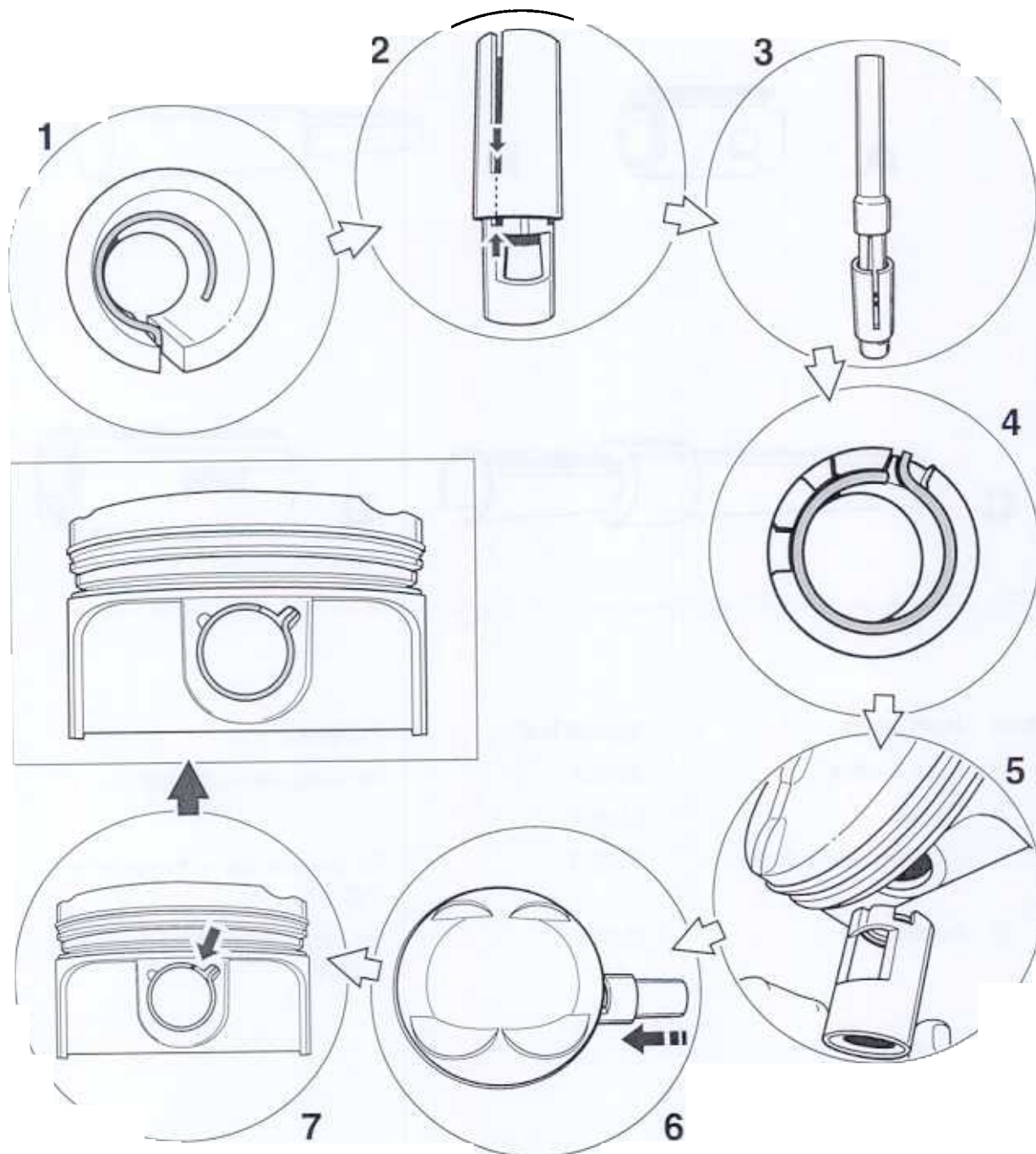


13100024

| Item | Designation              | Special tool | Explanation                               |
|------|--------------------------|--------------|---|
| A    | Assembly tool            | 9500/5       | For fitting piston-pin circlip            |
| B    | Plunger                  | 9500/4       |   |
| C    | Assembly aid for circlip | 9500/3       | For pre-assembly of the circlip in 9500/5 |
| D    | Assembly aid             | 9500/6       | For pre-assembly of the circlip in 9500/5 |



# Installing piston-pin circlip – GT3



24460014



### Installing piston-pin circlip – GT3

Insert piston-pin circlip in assembly aid 9500/6

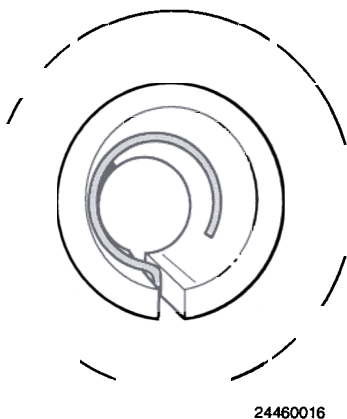
- 2 Position the piston-pin circlip 9500/5
- 3 Press piston-pin circlip into assembly tool 9500/5
- 4 Check position of the circlip
- 5 Position the assembly tool
- 6 Press in the piston-pin circlip with the plunger
- 7 Check for correct fitting

## Installing piston-pin circlip – GT3

### No. Procedure

### Instructions

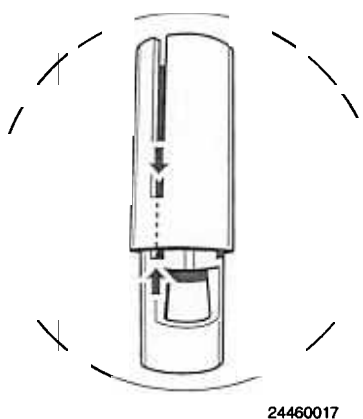
1



Insert piston-pin circlip in the assembly aid.

Insert the circlip into assembly aid 9500/6 and push it down until the circlip engages by itself. Attention must be paid to whether the piston-pin circlip is fitted in the piston from the left or from the right.

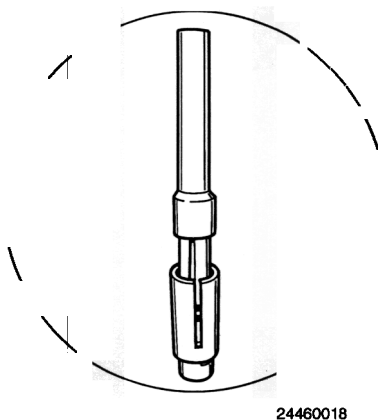
2



Position the assembly tool

Position the assembly tool 9500/5 under assembly aid 9500/6. It must be ensured that the groove in the mounting aid is aligned with the milled cut in the assembly tool (see arrows).

3

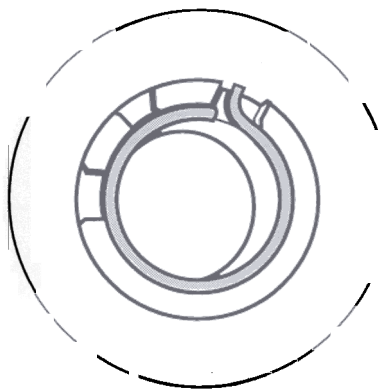


Press piston-pin circlip into the assembly tool.

To do this, insert assembly aid 9500/3 into sleeve 9500/6 as shown in the figure, and then push it down swiftly.

**Installing piston-pin circlip – GT3****No. Procedure****Instructions**

4



24460019

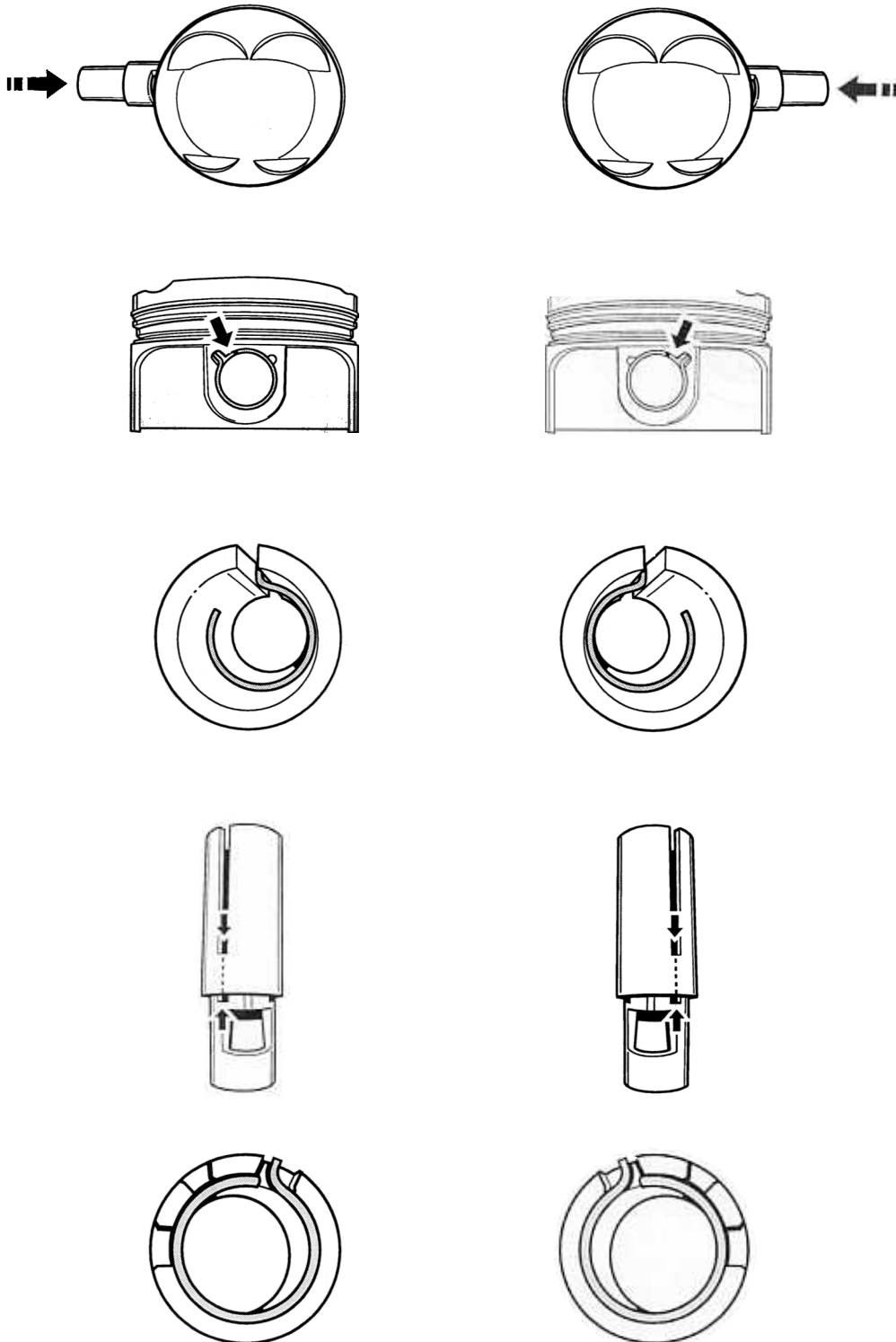
Check position of the circlip.

Ensure that the piston-pin circlip was not pressed in tilted in the assembly tool. It is necessary to check whether the circlip has been fitted in the correct cutout, depending on whether it is fitted from the left or from the right.

**Note:**

Different insertion (see figure below) into the assembly aids and in the assembly tool is necessary, because this depends on whether the circlip is inserted into the piston from the left or from the right. The left-hand column of the following illustration shows fitting from the left; the right-hand column shows fitting from the right.

Installing piston-pin circlip – GT3



## Installing piston-pin circlip – GT3

### No. Procedure

### Instructions

5

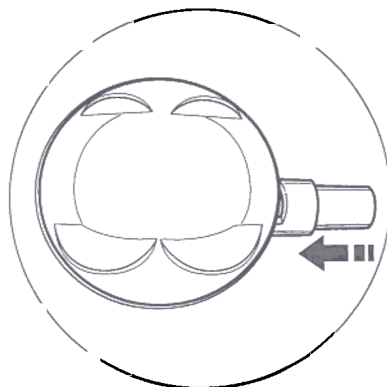


24460020

Position the assembly tool.

Position the assembly tool on the piston so that the window in assembly tool 9500/5 faces the piston crown and the piston-pin circlip faces the piston.

6

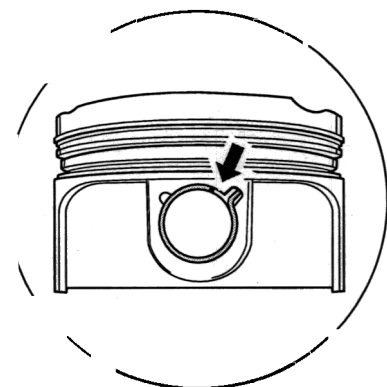


24460021

Press in the piston-pin circlip.

Press the assembly tool against the piston and insert the plunger 9500/4 into the assembly tool. Press the plunger firmly against the piston. The circlip must audibly engage.

7



24460015

Check for correct fitting.

The twist lock must lie in the large groove in the piston. The opening in the piston-pin circlip must be angled in the direction of the piston crown and must never lie in the direction of the longitudinal axis. The circlip must lie completely in the piston-pin circlip groove.