



## Audi A3 1997 ➤

### 4-cyl. Diesel Direct Injection Engine (TDI), Mech. Components

|           |     |     |     |     |  |  |  |  |  |
|-----------|-----|-----|-----|-----|--|--|--|--|--|
| Engine ID | AGR | AHF | ALH | ASV |  |  |  |  |  |
|-----------|-----|-----|-----|-----|--|--|--|--|--|

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Edition 09.1996

# List of Workshop Manual Repair GroupsList of Workshop Manual Repair Groups

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#### Repair Group

- 00 - Technical data
- 10 - Removing and installing engine
- 13 - Crankshaft group
- 15 - Cylinder head, Valve gear
- 17 - Lubrication
- 19 - Cooling system
- 21 - Charging
- 26 - Exhaust system

Technical information should always be available to the foremen and mechanics, because their careful and constant adherence to the instructions is essential to ensure vehicle road-worthiness and safety. In addition, the normal basic safety precautions for working on motor vehicles must, as a matter of course, be observed.

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Audi A3 1997 ➤

**Audi 4-cyl. Diesel Direct Injection Engine (TDI), Mech. Components - Edition 09.1996**

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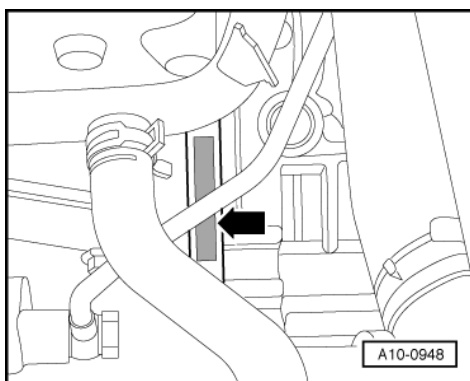
## 00 - Technical data

### 1 - Technical data

#### 1.1 - Technical data

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#### 1.2 - Engine number



-> The engine number ("Engine code" and "Serial number") can be found at the front joint between engine and gearbox.

Additionally there is a sticker on the toothed belt guard showing the engine code and serial number.

The engine code is also indicated on the vehicle data stickers.

#### 1.3 - Engine data

| Code letters                     |           | AGR      | AHF      | ALH      | ASV      |
|----------------------------------|-----------|----------|----------|----------|----------|
| Capacity                         | l         | 1.896    | 1.896    | 1.896    | 1.896    |
| Output                           | kW at rpm | 66/4000  | 81/4150  | 66/3750  | 81/4000  |
| Torque                           | Nm at rpm | 210/1900 | 235/1900 | 210/1900 | 235/1900 |
| Bore                             | ø in mm   | 79.5     | 79.5     | 79.5     | 79.5     |
| Stroke                           | mm        | 95.5     | 95.5     | 95.5     | 95.5     |
| Compression                      |           | 19.5     | 19.5     | 19.5     | 19.5     |
| CN                               | at least  | 49       | 49       | 49       | 49       |
| Firing order                     |           | 1-3-4-2  | 1-3-4-2  | 1-3-4-2  | 1-3-4-2  |
| Exhaust gas recirculation system |           | yes      | yes      | yes      | yes      |
| Charge air cooler                |           | yes      | yes      | yes      | yes      |
| Valve timing 1)                  |           |          |          |          |          |
| Inlet opens after TDC            |           | 16.0°    | 16.0°    | 16.0°    | 16.0°    |
| Inlet closes after BDC           |           | 25.0°    | 25.0°    | 25.0°    | 25.0°    |
| Exhaust opens before BDC         |           | 28.0°    | 28.0°    | 28.0°    | 28.0°    |



| Code letters              | AGR   | AHF   | ALH   | ASV   |
|---------------------------|-------|-------|-------|-------|
| Exhaust closes before TDC | 19.0° | 19.0° | 19.0° | 19.0° |

- 1) with 1 mm valve lift and 0 mm valve play

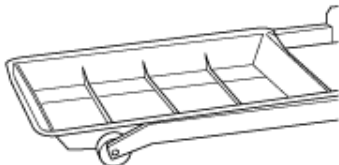
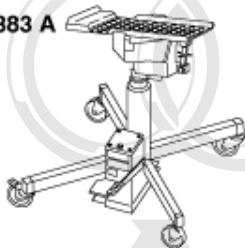
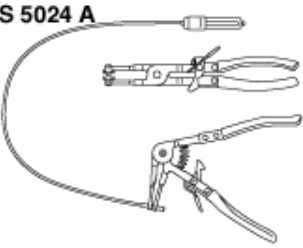
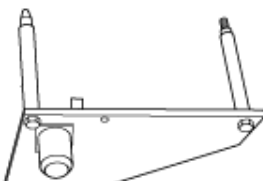


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## 10 - Removing and installing engine

### 1 - Removing and installing engine

#### 1.1 - Removing and installing engine

|                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>V.A.G 1306</b></p>   | <p><b>V.A.G 1383 A</b></p>                                                                                                                                                                                                                                                                                       |
| <p><b>VAS 5024 A</b></p>  | <p><b>VAS 5085</b></p>  <p>Protected by copyright. Copying for private or commercial purposes, in part or in whole, is not permitted unless authorised by AUDI AG. AUDI AG does not guarantee or accept any liability with respect to the correctness of information in this document. Copyright by AUDI AG.</p> |
| <p><b>T 10012</b></p>    | <p><b>G10-0051</b></p>                                                                                                                                                                                                                                                                                                                                                                             |

#### Special tools and workshop equipment required

- ♦ V.A.G 1306
- ♦ V.A.G 1383 A
- ♦ VAS 5024 A
- ♦ VAS 5085
- ♦ Engine mounting T10012



## 1.2 - Removing

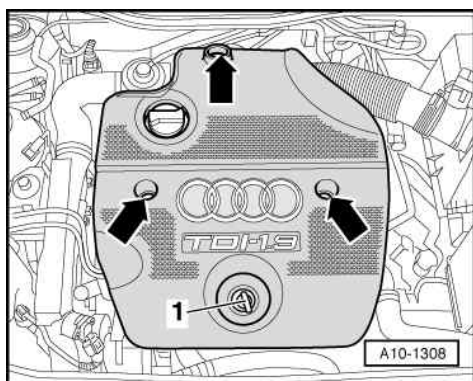
### Notes:

- ♦ The engine is removed from underneath together with the gearbox.
- ♦ Renew all cut and defective cable ties. Refit cable ties in the same position when installing the engine.
- ♦ Catch drained coolant in a clean container for re use or disposal.
- Refer to coding on vehicles with encoded radio/radio navigation system (RNS); if necessary, interrogate.
- Disconnect earthing strap at battery with ignition switched off.

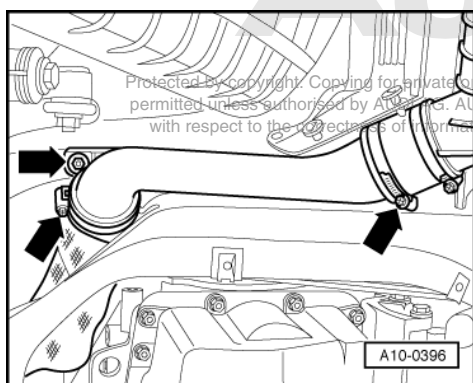
### Important

Hot steam or hot coolant can escape when opening expansion tank. Cover cap with a cloth and open carefully.

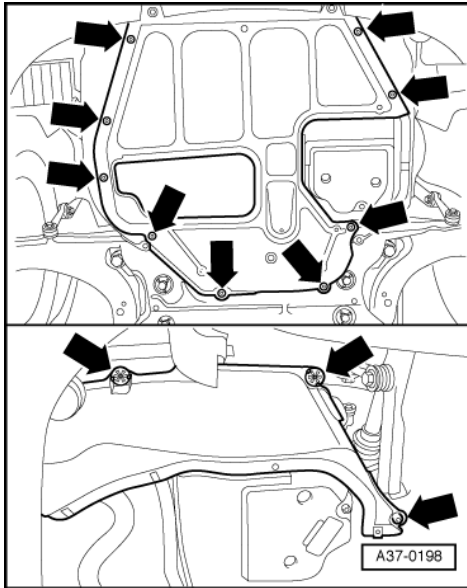
- Open the cover of the coolant expansion tank



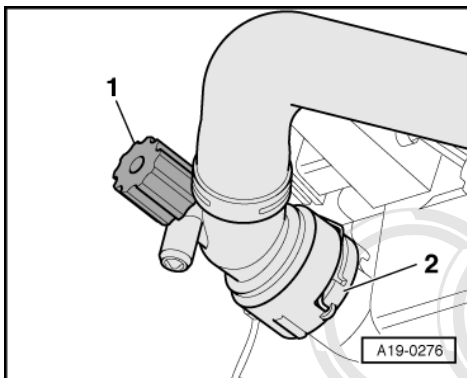
- -> Remove oil dipstick -1- from guide tube.
- Unclip caps.
- Unscrew nuts -arrows- and remove engine cover.
- Reinsert dipstick in guide tube.



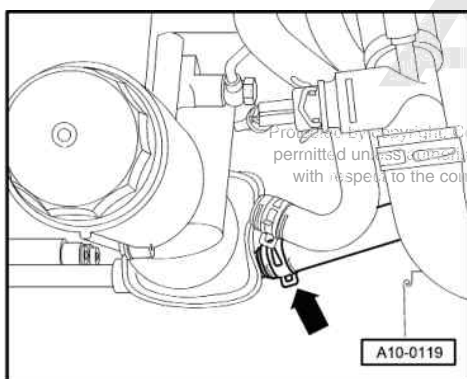
- -> Remove lower air duct pipe -arrows-.



- -> Remove noise insulation from centre, left and right sides -arrows-

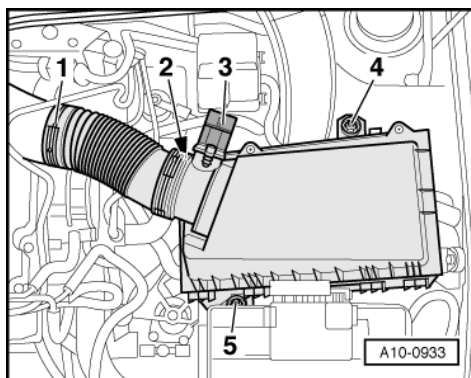


- Place drip tray V.A.G 1306 below engine.
- -> Turn drain plug -1- on radiator anti-clockwise, fit auxiliary hose to connection if necessary.
- Pull off retaining clip -2- for bottom coolant hose and detach coolant hose from radiator.

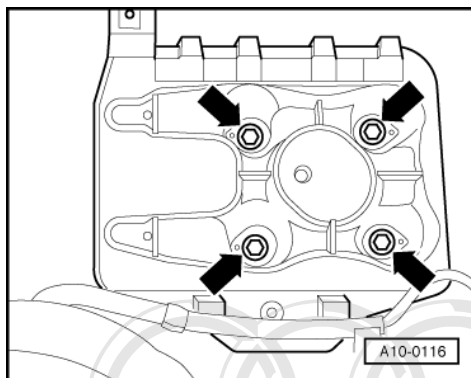


- -> Also disconnect lower coolant hose on oil cooler -arrow-, and drain off remaining coolant.

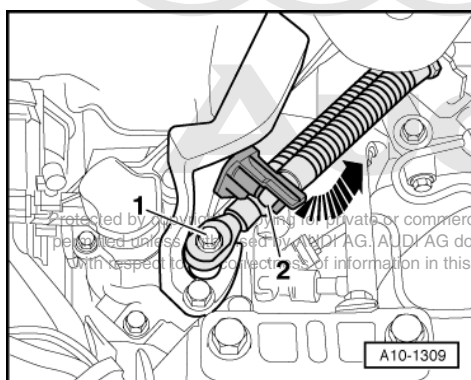
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- -> Remove air duct hose -1- from air duct pipe.
- Detach connector of air mass meter -3-.
- Unscrew bolts -4- and -5-.
- Remove vent hose -2- from rear of air cleaner housing.
- Take out air cleaner housing.

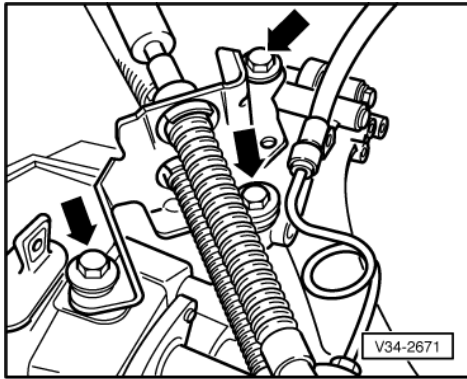


- Remove the battery.
- -> Remove battery carrier -arrows-.

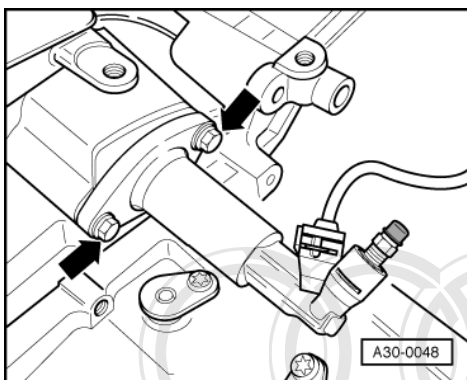


### Vehicles with manual gearbox

- -> Pull the retaining clip upwards -arrow- and push off the selector lever -2-.
- Remove the gear selector cable -1-.



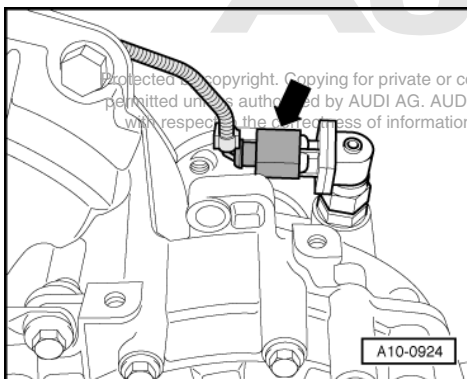
- Unclip slave cylinder hose at cable support bracket.
- -> Remove cable support bracket from gearbox -arrows- and place to one side.



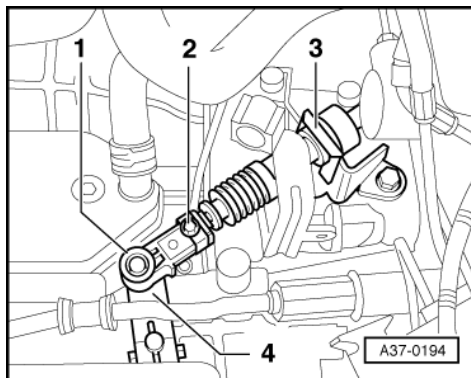
- -> Remove the slave cylinder -arrows- and lay it aside.
- Secure the slave cylinder using a wire, do not open hydraulic lines.

**Note:**

*Do not depress clutch pedal after removing slave cylinder.*

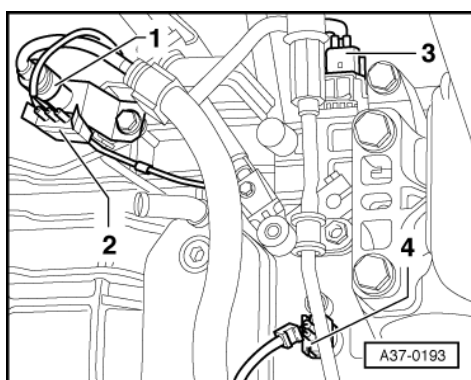


- -> Detach connector -arrow- from speedometer sender -G22 from gearbox, expose electrical wires.

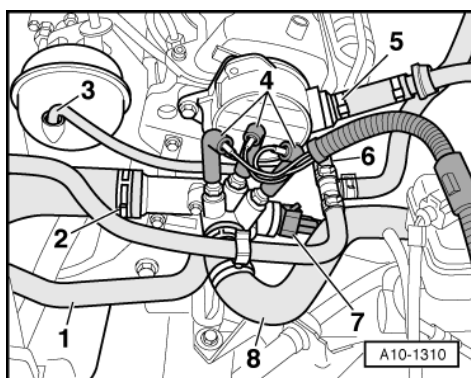


**Vehicles with automatic gearbox:**

- -> Press off selector lever cable -1- with screwdriver at gearbox selector lever -4- detach securing clip -3- from support bracket.
- Detach selector cable and move to one side.
- Unbolt bracket for power steering pressure pipe from gearbox support.

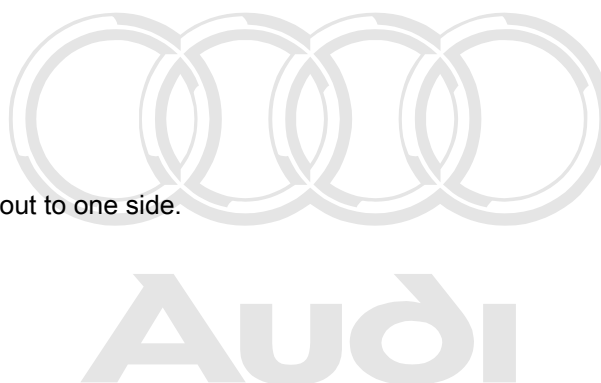


- -> Disconnect electrical connectors:
  - 1 - to solenoid valves (10-pin connector)
  - 2 - to road speed sender -G68
  - 3 - at multi-function switch -F125
  - 4 - at gearbox speed sender -G38
  - to road speed sender -G22
- Disengage wiring harness from retainers, and take out to one side.



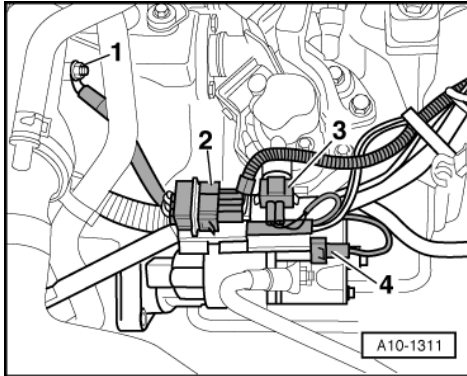
**All models:**

- -> Disconnect the electrical connections at the glow plugs (coolant) -Q7 -Item 4- (manual gearbox only).
- Disconnect the electrical connection -7- at the coolant temperature sender -G62 and expose wiring.

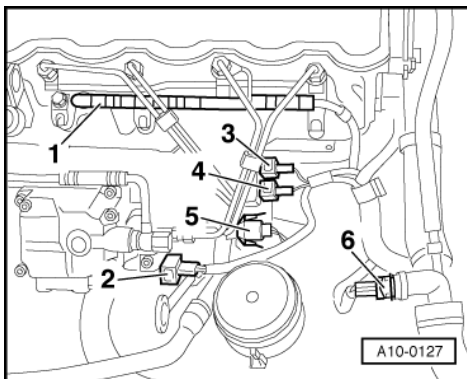


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- Pull vacuum pipe -5- off at exhauster.
- Detach the coolant hoses -1-, -2-, -6- and -8-.
- Disconnect coolant hose to radiator heat exchanger from coolant pipe (rear of engine).
- Pull vacuum hose -3- from vacuum-reservoir and expose it, if so equipped.

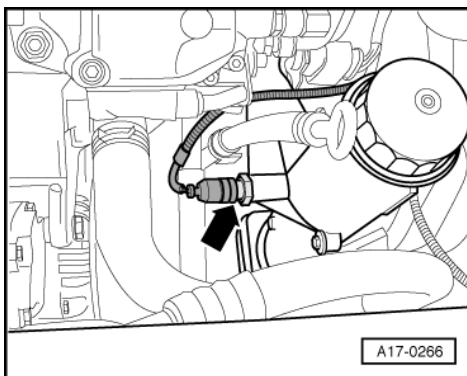


- -> Unscrew earth wiring -1- from flange engine/gearbox.
- Disconnect electrical connector -3- for reversing light switch (for manual gearbox) at gearbox.
- Unplug connector -2- and pull out of retainer.
- Detach connector -4- from starter.
- Detach wiring from starter bracket.



- -> Disconnect wires/unplug connectors:

- 1 - Glow plug connector console
- 2 - Injection pump electrical connector - where present
- 3 - Connector for needle lift sender -G80 (brown)
- 4 - Connector for engine speed sender -G28 (black)
- 5 - Connector for injection pump
- 6 - Connector for electronic thermostat -F76 (brown, only on models with air conditioner)
- Connector for coolant temperature sender -G62 (black)

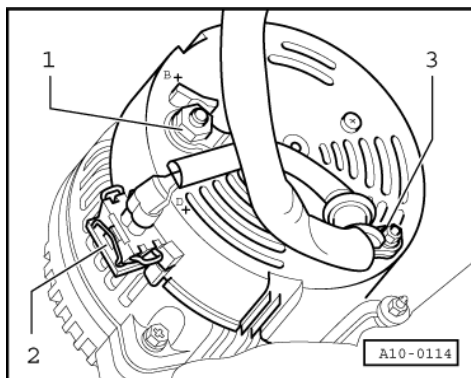


- -> Unplug electrical connector on oil pressure switch -arrow-.

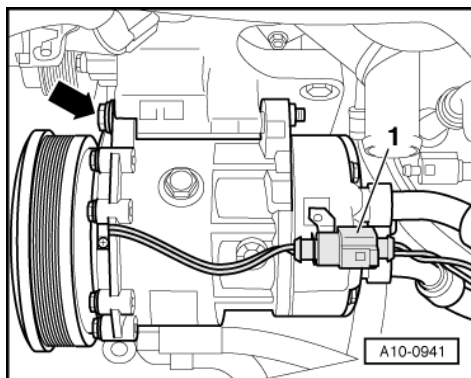
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- Detach electrical connector from oil temperature sender -G8, where present.

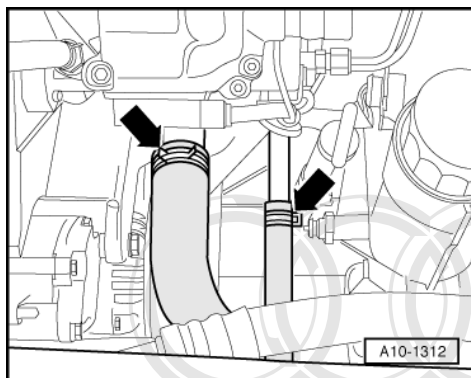


- -> Detach connector-2-.
- Unscrew electrical wire -1- from alternator.
- Unbolt cable clamp -3-.



#### Vehicles with air conditioning:

- -> Detach electrical connector -1- for solenoid clutch on air conditioner compressor.
- Expose both engine wiring harnesses.

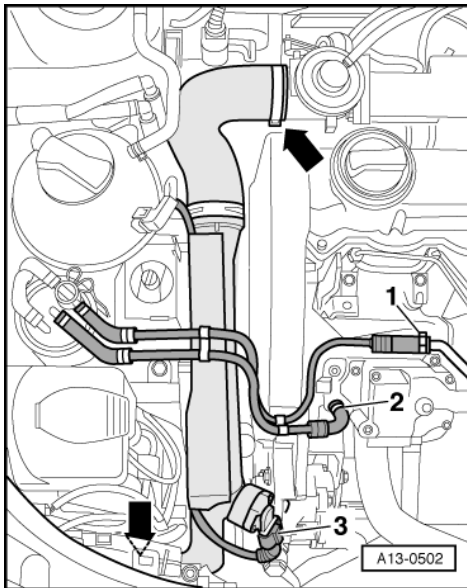


#### Vehicles with automatic gearbox:

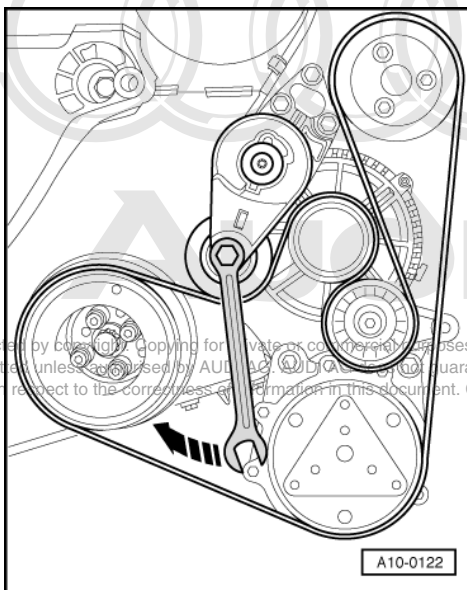
- Detach coolant hose from front of ATF cooler.

#### All models:

- -> Detach coolant hoses -arrows- from front of engine.
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- Detach the cover and the electrical connector at the right headlight unit.
- -> Disconnect fuel-feed line -2- and fuel-return line -1- at injection pump.
- Disconnect the electrical connection -3- at the sender -G71/-G72.
- Expose the wiring at the air duct pipe.
- Remove the air duct pipe on right side -arrows-.

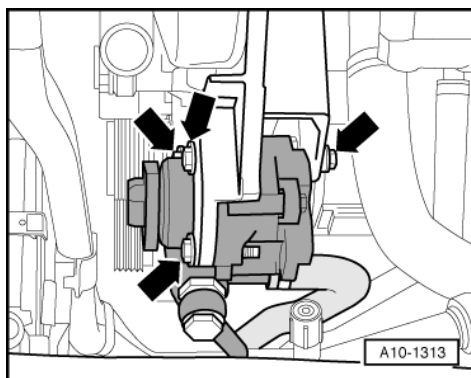


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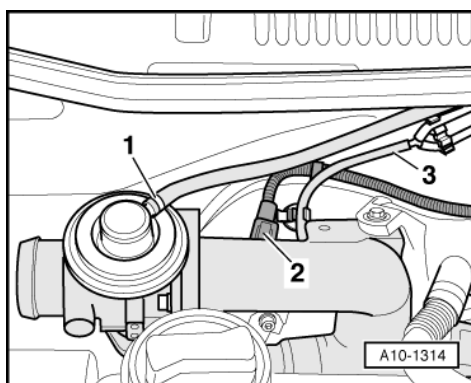
**Note:**

*Mark the running direction with chalk or a felt-tipped pen before removing the ribbed belt. If the belt runs in the opposite direction when it is refitted, this can cause breakage.*

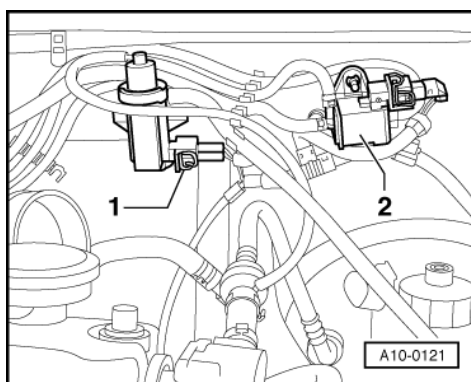
- Fit flat 16 mm ring spanner at hexagon of tensioner.
- -> Swivel tensioning roller in direction of arrow to slacken ribbed V-belt.
- Remove ribbed V-belt.



- Detach pulley from power steering vane pump.
- -> Detach vane pump for power steering -arrows-. Do not open hydraulic connections.
- Detach retaining clamp for power steering pressure line.
- Suspend vane pump for power steering at lock carrier.



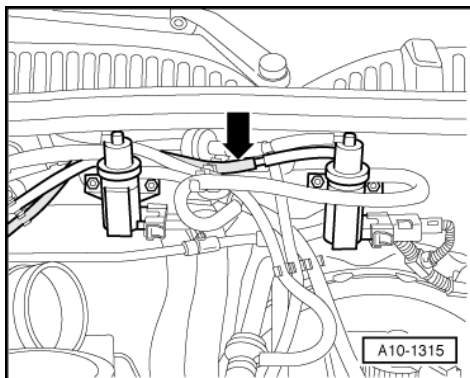
- -> Detach electrical connector for heating resistor (crankcase venting) -N79 -Pos. 2-.
- Disconnect vacuum hose -1- at exhaust gas recirculation valve.
- Detach the vacuum hose -3- at the Y-piece.



#### Engine code AGR:

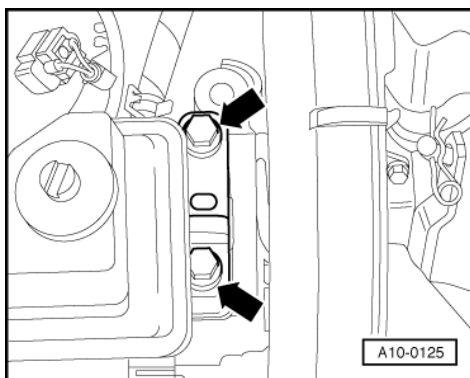
- -> Disconnect the electrical connector at the exhaust gas recirculation valve -N18 -Item 1- and at the boost pressure limitation solenoid valve -N75 -Item 2-.
- Detach the boost pressure limitation solenoid valve -N75 from the bracket and lay on the engine (hoses remain connected).

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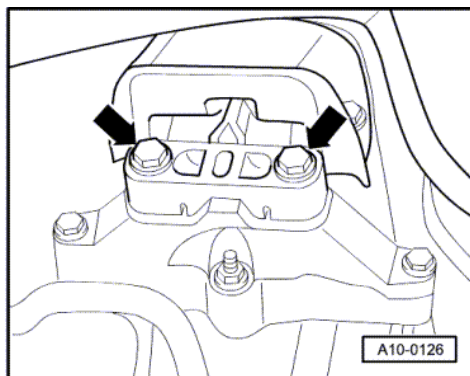
Engine codes AHF, ALH, ASV:

- -> Remove the vacuum hose -arrow- and expose.

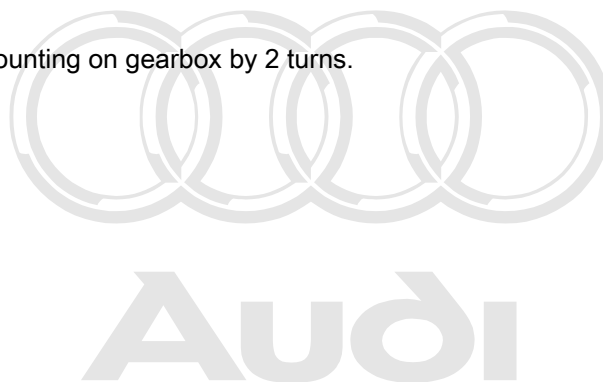
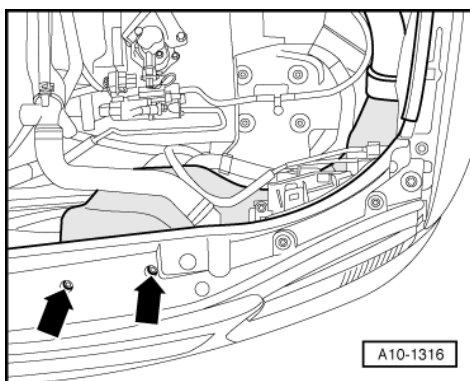


All models:

- -> Loosen bolts -arrows- of assembly mounting on engine by 2 turns.



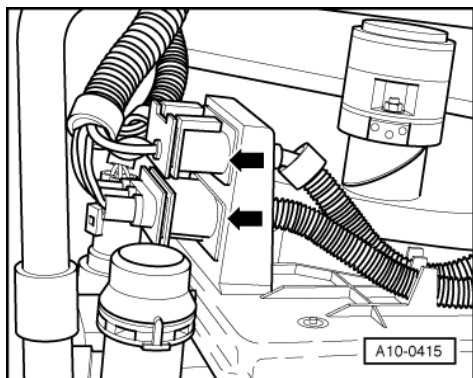
- -> Loosen bolts -arrows- of assembly mounting on gearbox by 2 turns.



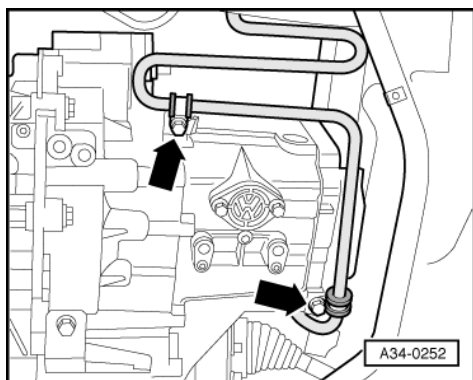
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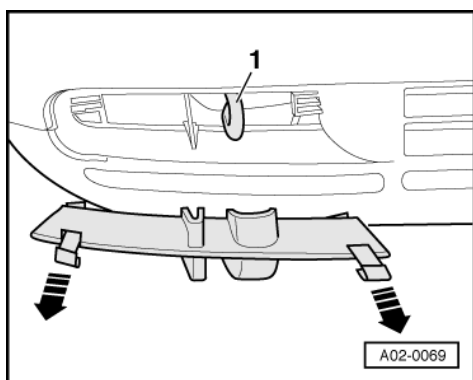
- -> Unscrew bolts -arrows-.
- Detach air duct at front from lock carrier and from air duct pipe.
- Unscrew bolts accessible from above securing bolts for radiator cowl.



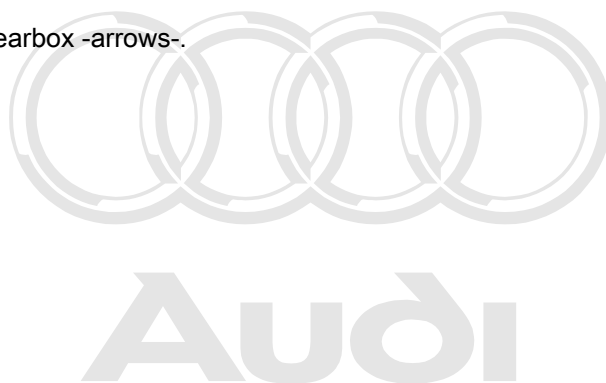
- -> Detach both connectors for left radiator fan on bottom of radiator cowl.
- Unscrew bolts accessible from below on radiator cowl.
- Remove the radiator cowl with both vents from below.



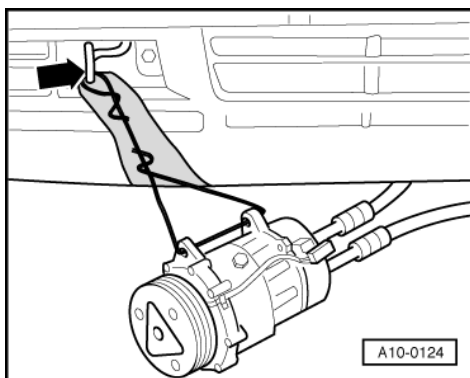
- -> Remove power steering wiring from gearbox -arrows-.



- -> Pull release tabs -arrows- and remove air intake grille.



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#### Vehicles with air conditioning:

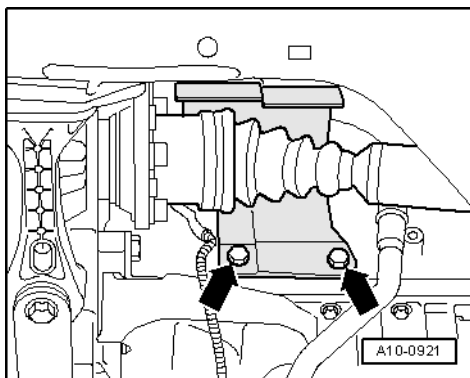
**Important**  
The air conditioner refrigerant circuit must not be opened.

- Detach retainers for refrigerant hoses.
- -> Detach air conditioning compressor, lower together with connected refrigerant hoses and suspend at towing eye -arrow- using wire.

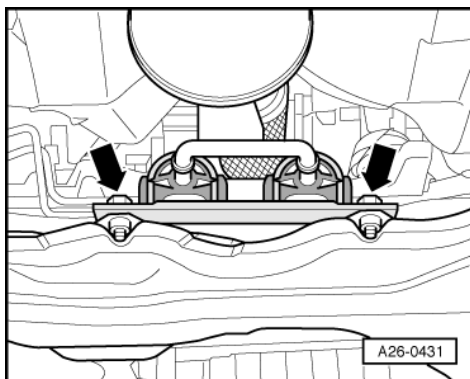
#### Note:

*Protect bumper from scratches by using an adhesive tape.*

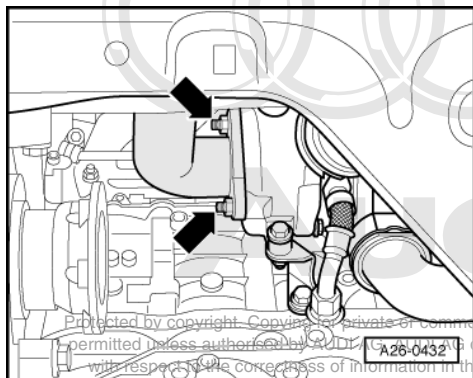
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- -> Unbolt heat shield for right drive shaft -arrows-.



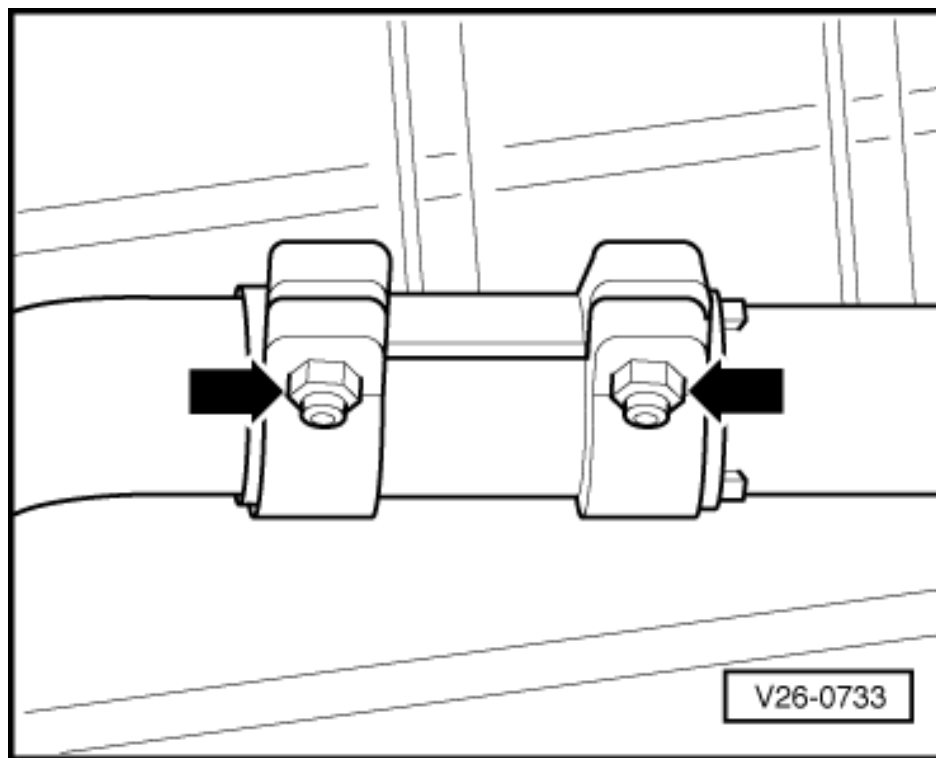
- -> Unbolt bracket for exhaust system from assembly mounting -arrows-.



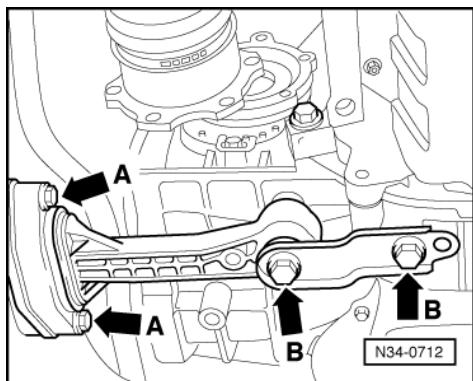
**Note:**

*The isolating element in front exhaust pipe must not be deflected more than 10° to avoid damage..*

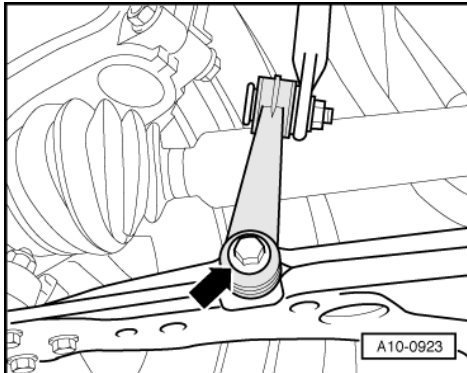
- -> Unscrew securing bolts -arrows- of front exhaust pipe/exhaust turbocharger.



- -> Detach the exhaust system at the clamping sleeve -arrows-.
- Remove the front exhaust pipe.



- -> First remove bolts -A- and then bolts -B- from pendulum support.
- Detach pendulum support.

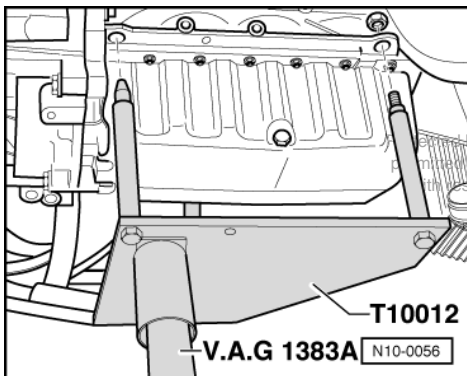


- -> Unbolt right connecting rod on A-arm -arrows-.
- Unscrew drive shaft on left and right from gearbox flange.
- Push engine forward and at the same time swivel right drive shaft towards front.
- Attach right drive shaft at towing eye using a wire loop.

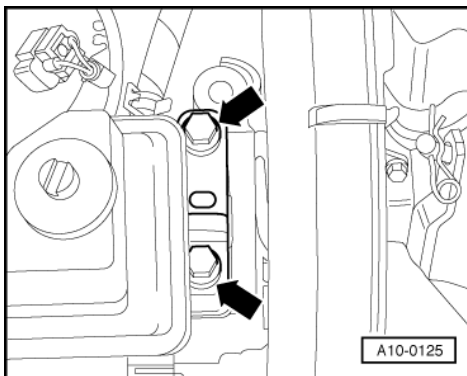
**Note:**

*Protect bumper from scratches by using an adhesive tape.*

- Move left drive shaft towards rear and suspend using wire loop.



- -> Attach engine bracket T10012 with securing nut and bolt with approx. 20 Nm to cylinder block.
- Insert engine/gearbox lifter V.A.G 1383 A in engine bracket T10012 and lift slightly.

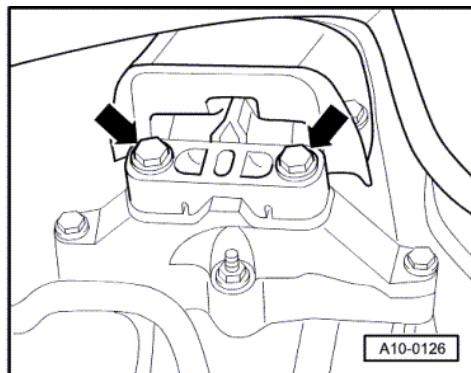




**Note:**

To unscrew bolts for assembly mounting use stepladder VAS 5085.

- -> Loosen bolts -arrows- of assembly mounting on engine...

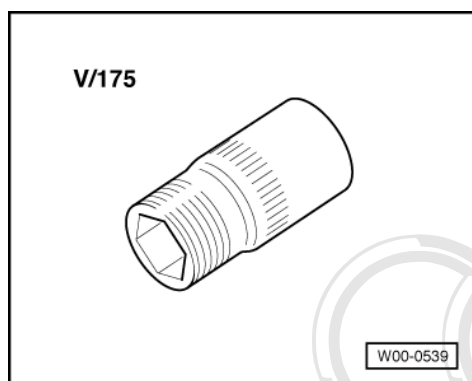


- -> ... and from gearbox.

**Notes:**

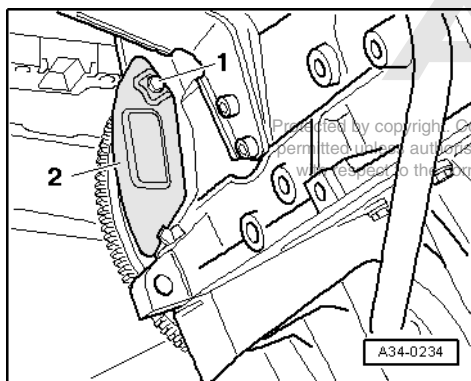
- ♦ Check that all hoses and wiring connections between engine, gearbox and body have been detached.
  - ♦ Carefully guide engine/gearbox assembly when lowering to avoid damages.
  - ♦ Make especially sure that there is free movement to vacuum unit of exhaust turbocharger.
- Pull engine/gearbox assembly as far forward as possible, and lower gradually.

### 1.3 - Separating engine from gearbox



**Special tools and workshop equipment required**

- ♦ Socket 15 mm A/F, Matra V175  
(Vehicles with automatic gearbox)



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## Procedure

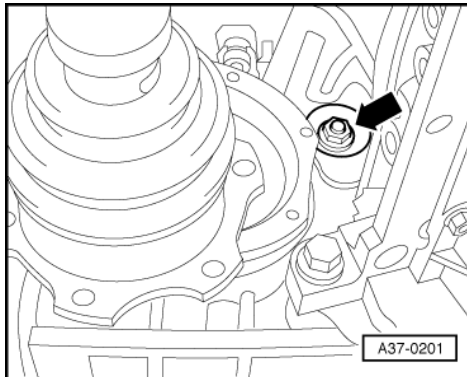
- Engine/gearbox assembly removed and attached to engine bracket T10012.

## Vehicles with manual gearbox

- -> Unscrew bolt -1- with gearbox installed.
- Pull up splash plate -2-.

### Note:

*Shown in illustration with gearbox removed.*

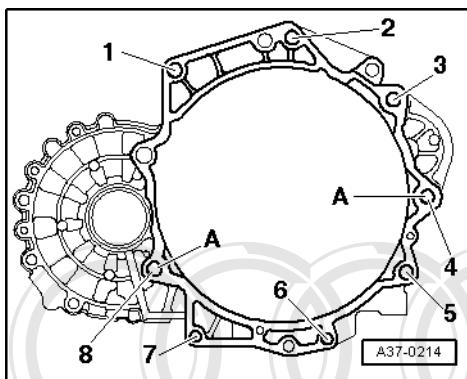


## Vehicles with automatic gearbox:

- -> Screw out 3 nuts of torque converter -arrow- with socket attachment SW 15 Matra V/175 (turn crankshaft 1/3 of a turn each time).

### Note:

*To prevent engine from turning when loosening torque converter nuts, counterhold central bolt on vibration damper.*



## All models:

- -> Unscrew bolts -1 ... 8- at engine/gearbox flange.
- Remove starter.

### Note:

*A 2nd mechanic is required to separate engine/gearbox assembly.*

## Remove gearbox from engine.

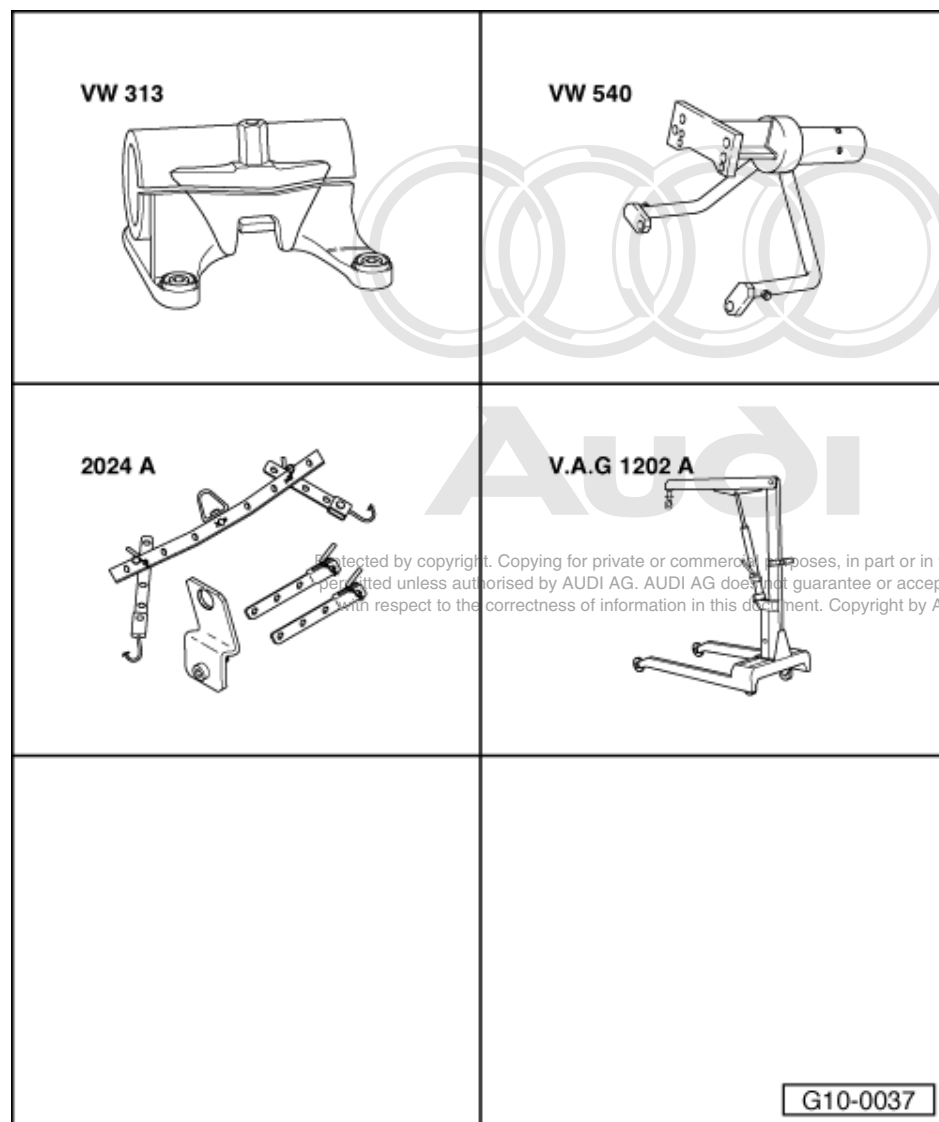
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### Vehicles with automatic gearbox:

- If necessary, secure torque converter in gearbox with wire to prevent it falling out.

## 1.4 - Attaching engine to engine stand

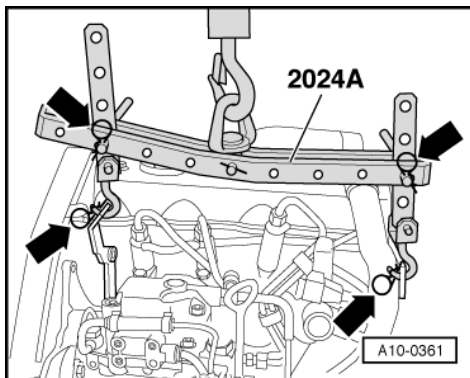


### Special tools and workshop equipment required

- ♦ Support clamp VW 313
- ♦ Engine and gearbox support VW 540
- ♦ Lifting tackle 2024 A
- ♦ V.A.G 1202 A

or

- ♦ VAS 6100



#### Procedure

- -> Attach lifting tackle 2024 A to engine and workshop lifter VAS 6100 or V.A.G 1202 A, respectively.

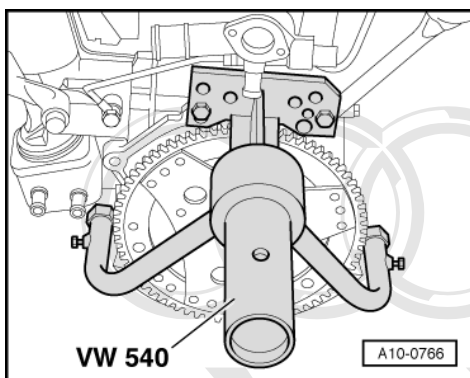
#### Note:

To balance the centre of gravity of the engine, position the hook attachments as shown in the illustration.

#### Important

The hooks and locating pins of the lifting tackle must be secured with locking pins -arrows in illustration-. .

- Lift engine off engine bracket T10012 using workshop crane VAS 6100 or V.A.G 1202 A, respectively.



- > When working on the engine, it should be secured to the repair stand using the engine bracket VW 540.

## 1.5 - Installing

#### Special tools and workshop equipment required

- ♦ Depth measurement (vehicles with automatic gearbox)

#### Procedure

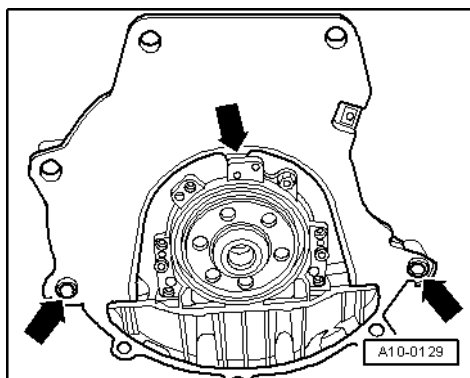
- Engine installed on engine bracket T10012.

Installation is carried out in the reverse order to removal, noting the following:

#### Notes:

- ♦ When performing installation procedures always replace self-locking nuts and bolts.
- ♦ Replace seals, gaskets, and bolts which have a specified tightening angle.

- ♦ Hose connections and hoses for charge air system must be free of oil and grease before assembly.
- Check whether the dowel sleeves for centralising engine/gearbox are in the cylinder block, install if necessary.



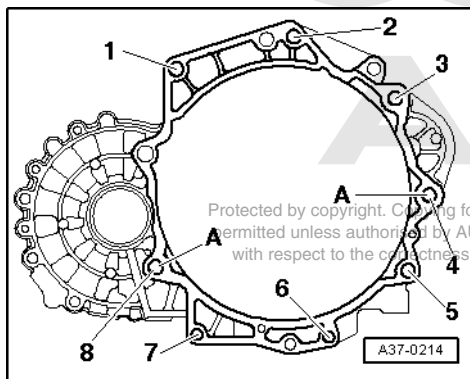
- -> Engage intermediate plate on sealing flange and slide onto dowel sleeves -arrows-.

### Vehicles with manual gearbox

- If necessary, check that clutch plate is properly centralised.
- Check clutch release bearing for wear, renew if necessary.
- Lightly lubricate clutch release bearing, release bearing guide sleeve and splines on input shaft with G 000 100.
- Attach gearbox to engine.

### Notes:

- ♦ The tightening torques listed on this page apply only to lightly greased, oiled, phosphated, or black finished nuts and bolts.
- ♦ Additional lubricant such as engine or gearbox oil may be used, but do not use graphite lubricant.
- ♦ Do not use degreased parts.
- ♦ Tightening torque tolerance  $\pm 15\%$ .

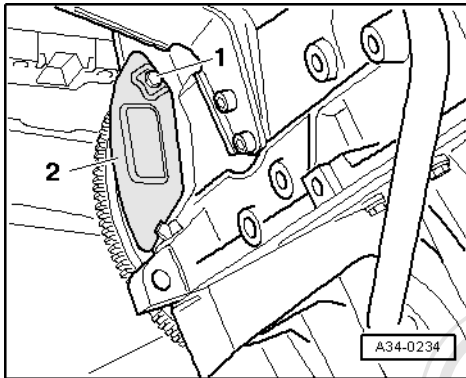


-> Engine/gearbox mountings (manual gearbox)

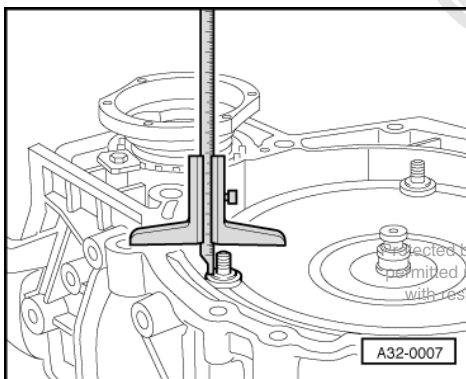
| Item       | Bolt      | Nm |
|------------|-----------|----|
| 1, 2 1), 8 | M12 x 55  | 80 |
| 3 1), 4    | M12 x 150 | 80 |
| 5 ... 7    | M10 x 50  | 45 |

1) Bolt with threaded pin M8

A: Centring sleeves



- -> Push in splash plate -2- in so that the lower lug engages into the cylinder block and secure at top with bolt -1-.



#### Vehicles with automatic gearbox:

- To secure the torque converter on the drive plate only use the correct nuts as specified in the parts catalogue.

#### => Parts List

-> If the torque converter is correctly installed, the depth between the contact surfaces at the bottom of the studs on the torque converter and the contact surface of the torque converter bell housing is about 22 mm.

If the torque converter has not been completely inserted, this distance will be approx. 10 mm.

#### Important

If the torque converter is not installed correctly, the torque converter drive plate or the ATF pump will be seriously damaged when the gearbox is joined to the engine.

- Before installing engine, rotate torque converter and drive plate so that one hole and one stud are level with the aperture for the starter motor.

#### Important

On vehicles with automatic gearbox 01M, continually check that the torque converter behind the drive plate can be turned before and during tightening of bolts at engine/gearbox flange. If the converter cannot be turned, it must be assumed that it has not been installed correctly and the drive plate of the converter or the ATF pump will be damaged during final tightening of bolted connections.

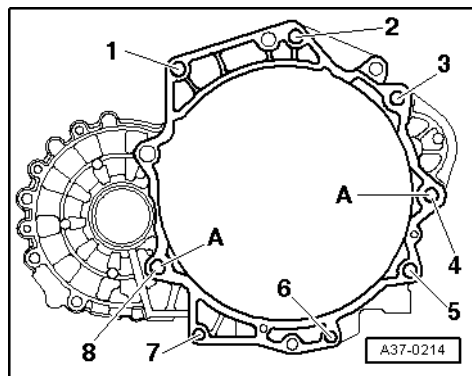
- Attach gearbox to engine.
- Secure nuts of torque converter with special tool Matra V/175.

#### Notes:

- ♦ The tightening torques listed on this page apply only to lightly greased, oiled, phosphated, or black finished nuts and bolts.



- ♦ Additional lubricant such as engine or gearbox oil may be used, but do not use graphite lubricant.
- ♦ Do not use degreased parts.
- ♦ Tightening torque tolerance  $\pm 15\%$ .

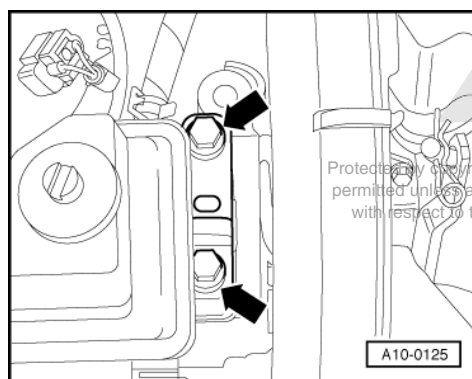


-> Securing engine to gearbox in vehicles with automatic gearbox

| Item       | Bolt      | Nm |
|------------|-----------|----|
| 1, 2 1)    | M12 x 65  | 80 |
| 3 1), 4 1) | M12 x 180 | 80 |
| 5 ... 7    | M10 x 50  | 45 |
| 8          | M12 x 80  | 80 |

1) Bolt with threaded pin M8

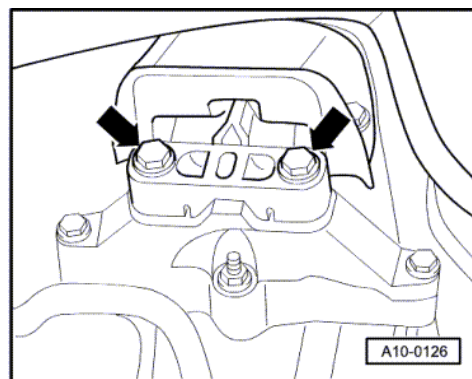
A: Centring sleeves



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**All models:**

- Guide engine/gearbox assembly into the body.
- -> Insert bolts -arrows- for engine support to engine console...



- -> ... and gearbox support to gearbox console handtight.
- Only use new bolts to secure.

**Note:**

*The bolts are tightened to final torque only after adjusting the engine mountings => Page 27.*

- Remove engine bracket T10012 from engine.
- Install drive shafts.

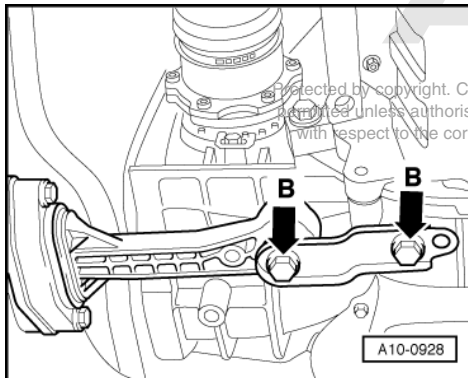
=> Running Gear; Repair group 40; Removing and installing drive shaft Removing and installing drive shaft

**Note:**

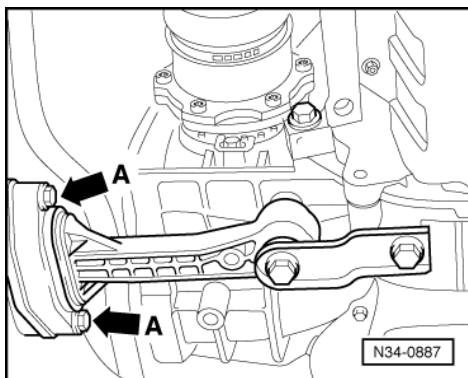
*Before further assembly carry out the installation of the drive shafts.*

- Install the connecting rod.

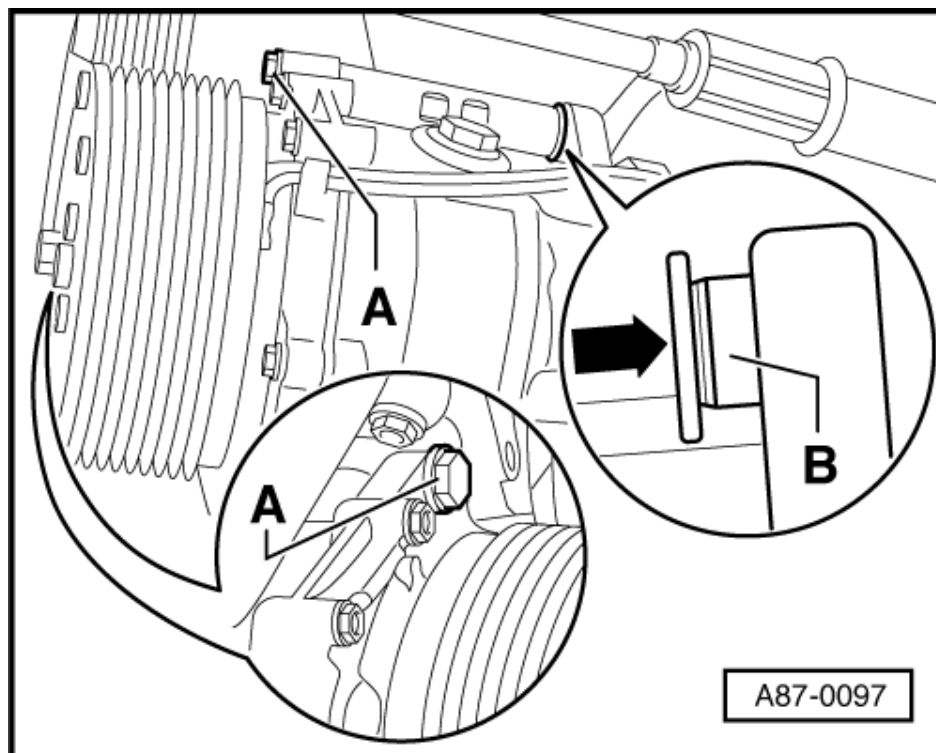
=> Running Gear; Repair group 40; Removing and installing stabiliser bar Removing and installing stabiliser bar



- -> Bolt pendulum support to gearbox -arrows B-.
- Only use new bolts to secure.



- -> Bolt pendulum support to subframe -arrows A-.
- Only use new bolts to secure.



#### Vehicles with air conditioning:

- ➔ To facilitate the attachment of the air conditioner compressor drive back bush -B- for securing bolt -A- slightly.

#### Vehicles with manual gearbox

- Install hydraulic clutch slave cylinder:

=> 5-speed Manual Gearbox 02J; Repair group 30; Servicing clutch release mechanism Servicing clutch release mechanism

- Attach selector cables to gearbox and adjust:

=> 5-speed Manual Gearbox 02J; Repair group 34; Servicing shift mechanism; Removing and installing selector cables Servicing shift mechanism Removing and installing selector cables

The remaining installation steps are carried out in the reverse sequence.

- Install ribbed belt=> Page 38 .
- Adjust engine mountings => Page 27 .
- Install vacuum hoses =>as of Page 186 .

- Electrical connections and routing:

=> Current Flow Diagrams, Electrical Fault-finding and Fitting Locations binder

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#### Important

Do not use charging unit for boost starting! There is danger of damaging the vehicle control units.

#### Note:

*If the battery is reconnected, please ensure that the vehicle equipment (radio, radio/navigation system, clock, electric window lifters) is activated as described in the operating instructions.*

- Top up coolant => Page 158 .

#### Notes:

- ♦ Drained coolant may only be used again if the original cylinder head and cylinder block are re installed.
- ♦ Coolant must not be used again if it is dirty.
- Check oil level before starting engine.

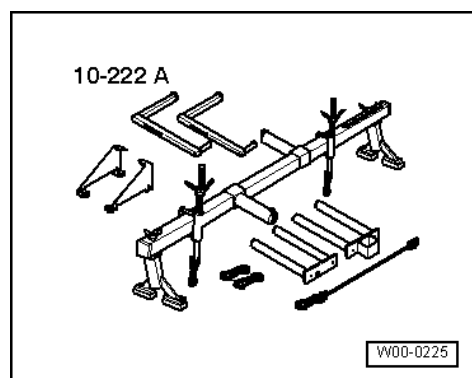
#### Tightening torques

| Component                                                                   |     | Nm            |
|-----------------------------------------------------------------------------|-----|---------------|
| Bolts/nuts                                                                  | M6  | 10            |
|                                                                             | M8  | 20            |
|                                                                             | M10 | 45            |
|                                                                             | M12 | 65            |
| Except for the following:                                                   |     |               |
| Drive plate to torque M10 x1 converter                                      |     | 85            |
| Front exhaust pipe to exhaust turbo-charger                                 |     | 25            |
| Pendulum support to gearbox                                                 |     | 40 + 90° 1)2) |
| Pendulum support to subframe                                                |     | 20 + 90°1)2)  |
| Drive shaft heat shield to cylinder block                                   |     | 35            |
| Air conditioner compressor to bracket for auxiliary mechanical units        |     | 45            |
| Vane pump for power steering pump to bracket for auxiliary mechanical units |     | 23            |

- 1) Stretch bolts, replace
- 2) 90° corresponds to a quarter of a turn

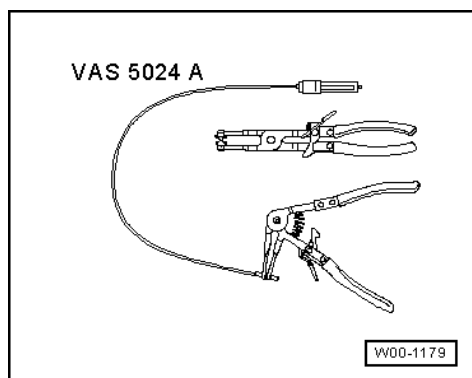
## 2 - Adjusting engine mountings

### 2.1 - Adjusting engine mountings

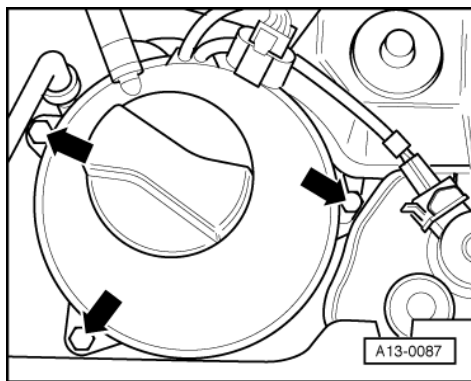


#### Special tools and workshop equipment required

- ♦ Support bar 10-222A

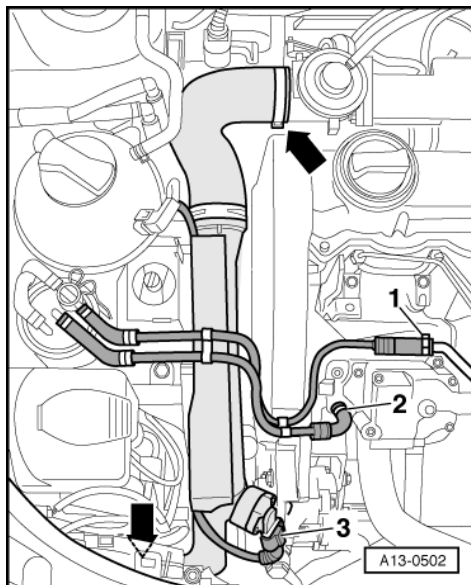


- ♦ VAS 5024 A



### Check adjustment

- -> Unscrew coolant expansion tank and refill reservoir for power steering -arrows-.

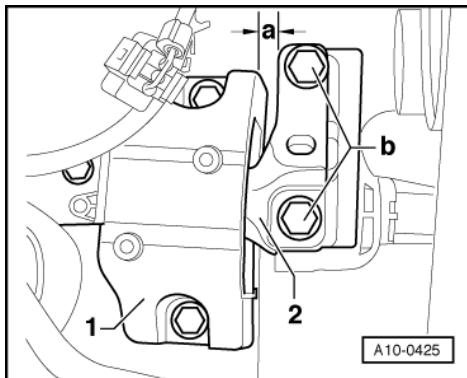


- Detach the cover and the electrical connector at the right headlight unit.
- -> Disconnect fuel-feed line -2- and fuel-return line -1- at injection pump.
- Disconnect the electrical connection -3- at the sender -G71/-G72.
- Expose the wiring at the air duct pipe.



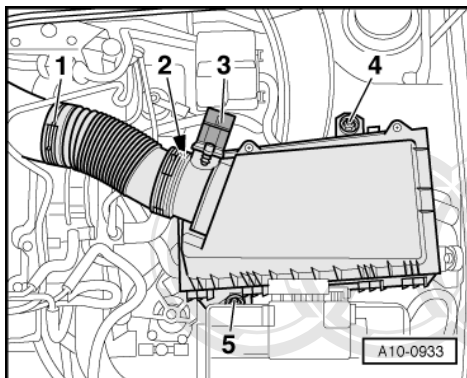
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- Remove the air duct pipe on right side -arrows-.



- -> Both bolt heads -b- must be flush with the edge of the support arm -2-.
- Between engine heads console -1- and support arm -2- of the right engine mounting must be a distance  $a = 13$  mm.

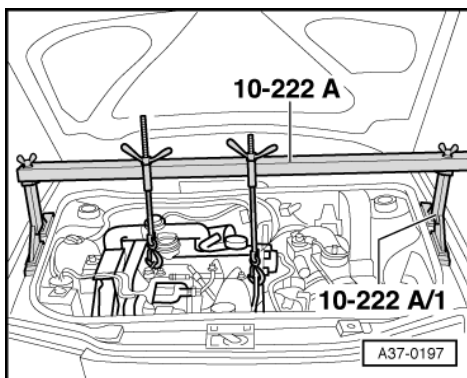
Use a 12 mm flat bar (if necessary, use special tool 2011) to check distance -a-. It must be easy to insert the flat bar.



### Adjusting

If the distance measured is too small or too large, proceed as follows:

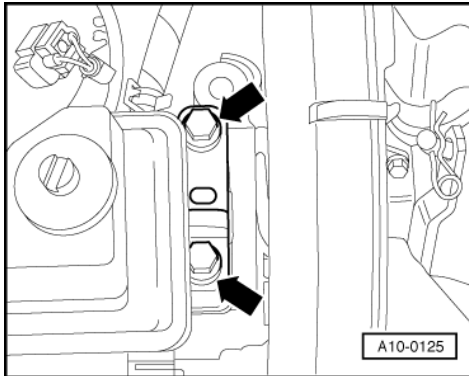
- -> Remove air duct hose -1- from air duct pipe.
- Detach connector of air mass meter -3-.
- Unscrew bolts -4- and -5-.
- Remove vent hose -2- from rear of air cleaner housing.
- Take out air cleaner housing.



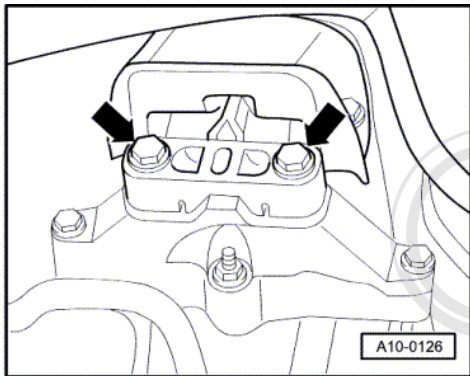
- -> Set up support bar 10-222 A on wing panel bolt flange.
- Attach spindles in both lifting eyes.



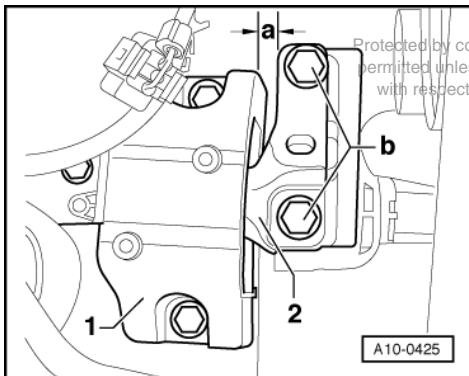
- Slightly lift engine using both spindles evenly.



- -> Loosen bolts -arrows- of assembly mounting on engine...

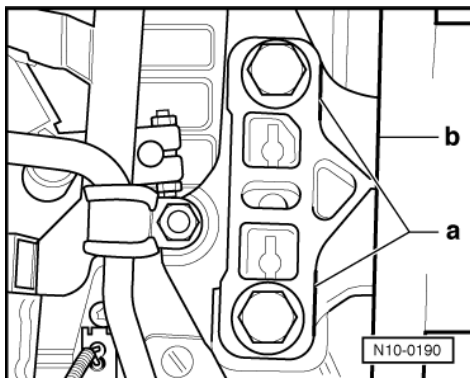


- -> ... and from gearbox. Replace all 4 bolts one by one (if not already done so when engine was installed) and hand-tighten.



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- -> Loosen bolts -b- of support arms on left and right approx. two turns.
- Using an tyre lever, displace engine between engine console -1- and support arm -2- until the distance on the engine side is  $a = 13 \text{ mm}$ .
  - It must be easy to insert a 12 mm flat bar (or special tool 2011).
  - Both bolt heads -b- must be flush with the edge of the support arm.
- Tighten the bolts -b- to 100 Nm on assembly mounting on engine side.



- -> Ensure that the edges on the load arm on the gearbox side -a- and gearbox console -b- are parallel.
- Tighten the bolts to 100 Nmon assembly mounting on gearbox side.

The remaining installation steps are carried out in the reverse sequence:



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## 13 - Crankshaft group

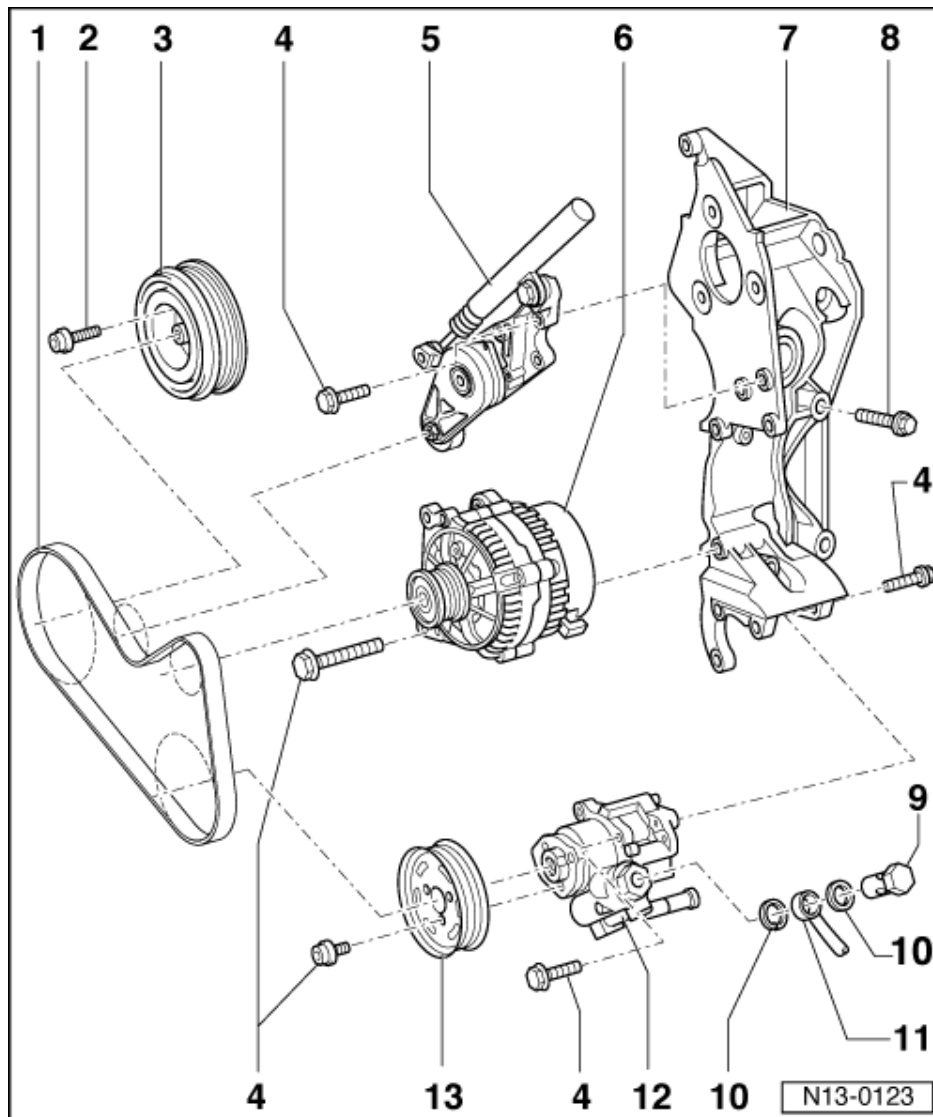
### 1 - Dismantling and assembling engine

#### 1.1 - Dismantling and assembling engine

#### 1.2 - Removing and installing ribbed belt

##### Notes:

- ♦ The following illustration shows the belt drive on vehicles without air conditioner.
- ♦ Mark the direction of rotation before removing the ribbed V-belt. If the belt runs in the opposite direction when it is refitted, this can cause breakage. Ensure that the belt is properly seated in the pulleys when installing.
- ♦ Removing and installing ribbed belt idler roller on vehicles with air conditioning => Fig. 35 .
- ♦ Install air conditioner compressor => Fig. 36 .



### 1 Ribbed V-belt

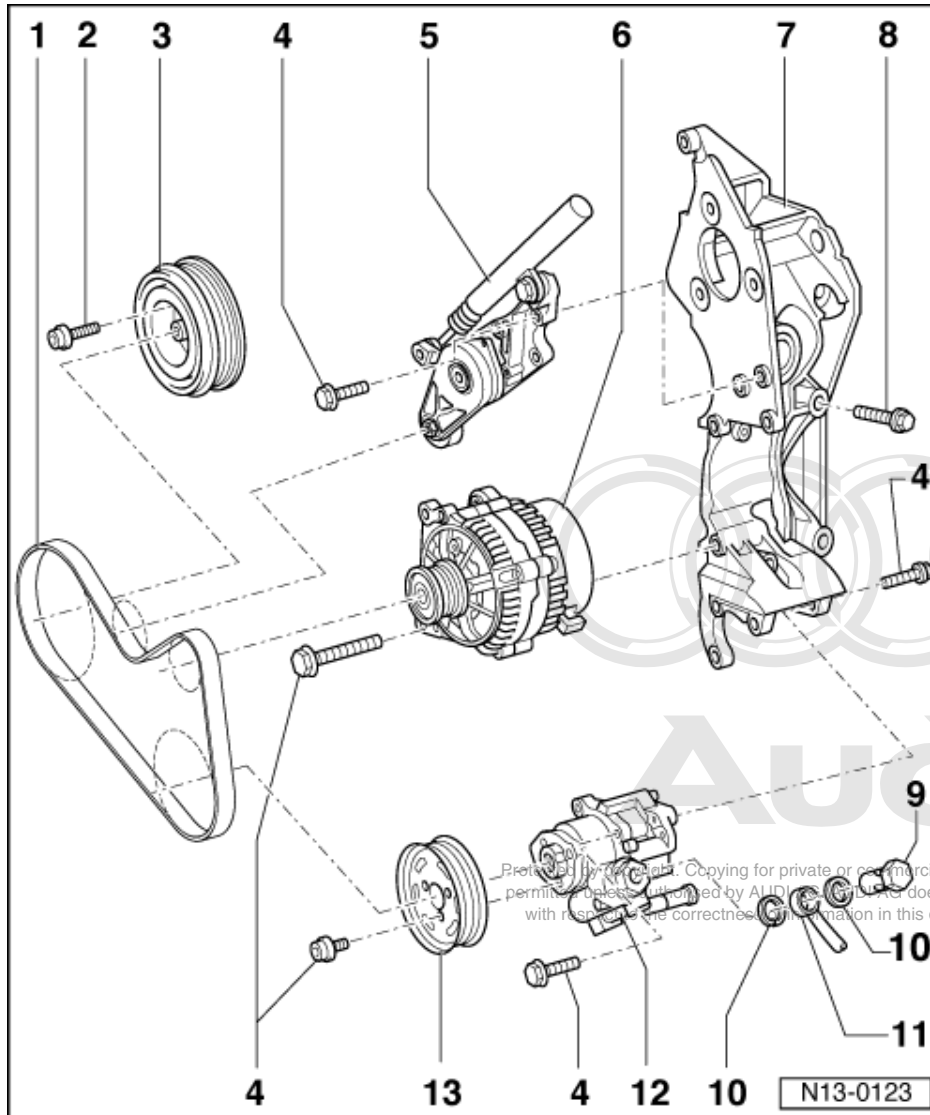
- ♦ Mark D.O.R. before removing
- ♦ Ribbed belt on vehicles without air conditioner=>Fig. 35
- ♦ Ribbed belt on vehicles with air conditioner=>Fig. 35
- ♦ Check for wear
- ♦ Do not kink
- ♦ Removing and installing  
=>Page 37.

### 2 10 Nm + 1/4 turn (90°) further

- ♦ Replace

### 3 Vibration damper

- ♦ With pulley for ribbed belt



4 25 Nm

5 Tensioning element

6 Alternator

- ♦ Removing and installing:

=> Electrical System; Repair group 27

- ♦ To facilitate the positioning of alternator knock back bushes for retaining bolts slightly.

## 7 Bracket for auxiliary mechanical units

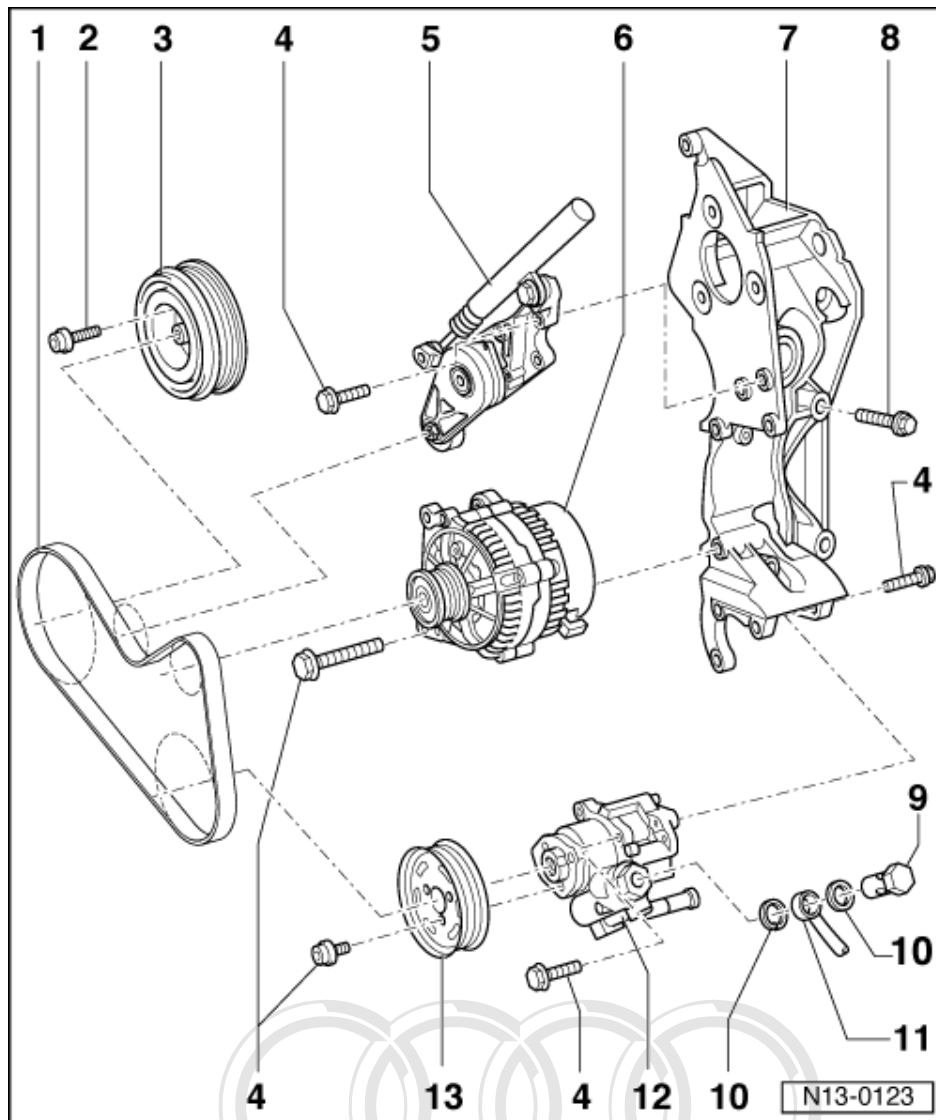
- ♦ shown in Fig. Vehicles without air conditioner:

8 45 Nm

9 30 Nm

## 10 Sealing ring

- ♦ Replace



## 11 Pressure pipe

## 12 Vane pump

- ♦ For power steering
- ♦ Removing and installing:

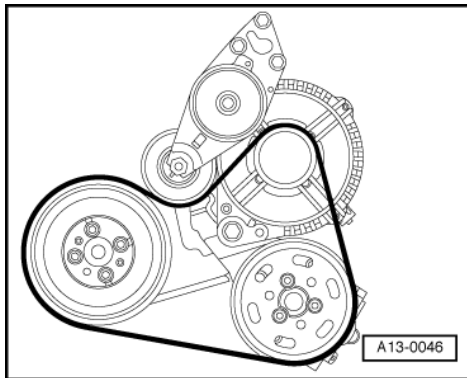
=> Running Gear; Repair group 48; Removing and installing vane pump Removing and installing vane pump

- ♦ To facilitate the positioning of vane pump knock back bushes for retaining bolts slightly.

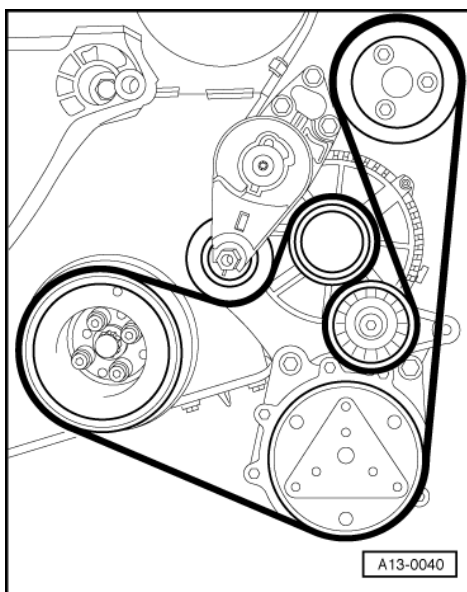
## 13 Belt pulley

- ♦ For vane pump

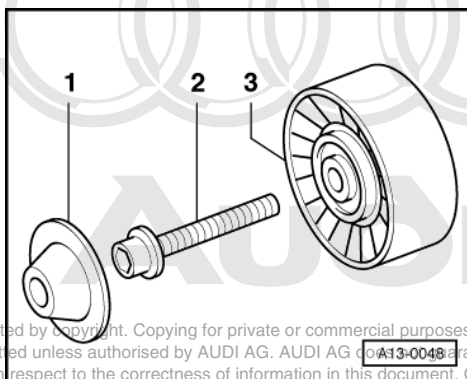
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-> Fig.1 Ribbed belt routing on vehicles without air conditioner



-> Fig.2 Ribbed belt routing on vehicles with air conditioner



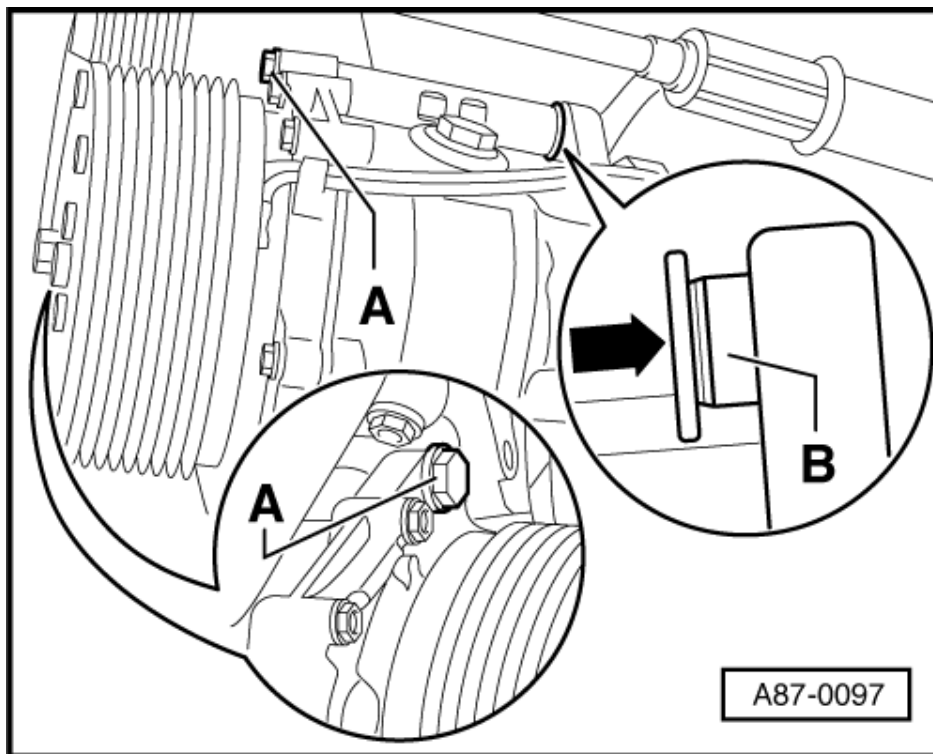
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-> Fig.3 Removing and installing ribbed belt idler roller

- Vehicles with air conditioning

- 1 - Cover
- 2 - 25 Nm

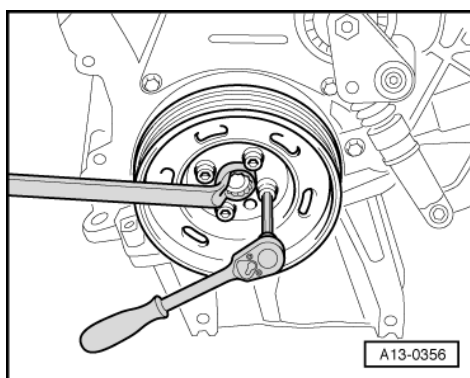
### 3 - Idler roller



#### ➔ Fig.4 Installing air conditioner compressor

- To facilitate installing the air conditioner compressor, knock back threaded bushes B for mounting bolts A slightly in the direction indicated (arrow).
- Tighten bolts to 45 Nm.

### 1.3 - Removing and installing vibration damper



#### Removing

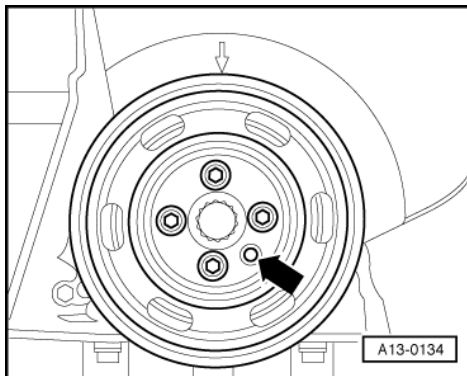
- Ribbed belt must be removed =>Page 37 .
- ➔ Unbolt vibration damper.



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**Note:**

To loosen and tighten the vibration damper counterhold with ring spanner on central bolt.

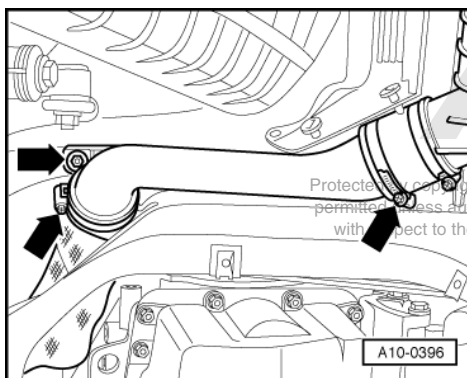
**Installing**

Installation is carried out in the reverse order; note the following:

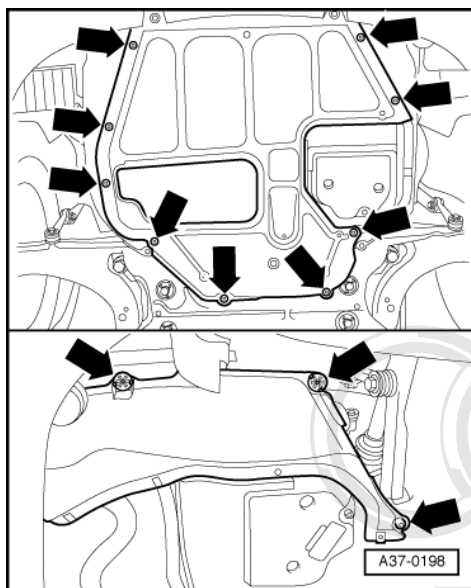
- Only use new bolts to secure.
- -> When installing vibration damper, use only original bolts:

=> Parts List

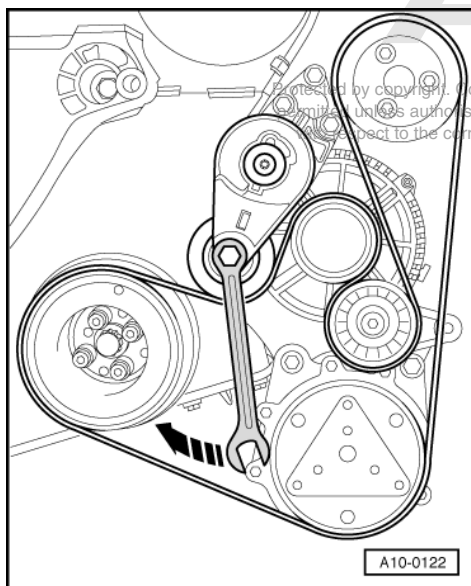
- Can only be installed in one position. The hole -arrow- in the vibration damper must fit over the projection on the toothed belt sprocket.
- Tighten bolts of vibration damper to 10 Nm + 90° (1/4 turn).

**1.4 - Removing and installing ribbed belt****Removing**

- -> Remove lower air duct pipe -arrows-.



- -> Remove noise insulation in centre and on right -arrows-.



**Note:**

*Mark the running direction with chalk or a felt-tipped pen before removing the ribbed belt. If the belt runs in the opposite direction when it is refitted, this can cause breakage.*

- Fit flat 16 mm ring spanner at hexagon of tensioner.
- -> Swivel tensioning roller in direction of arrow to slacken ribbed V-belt.
- Remove ribbed V-belt.

**Installing**

Installation is carried out in the reverse order; note the following:

**Note:**

Before fitting the ribbed belt ensure that all sub-assemblies (alternator, air conditioner compressor, vane pump) are tight.

- Check that ribbed belt is properly seated.

**Vehicles without air conditioner:**

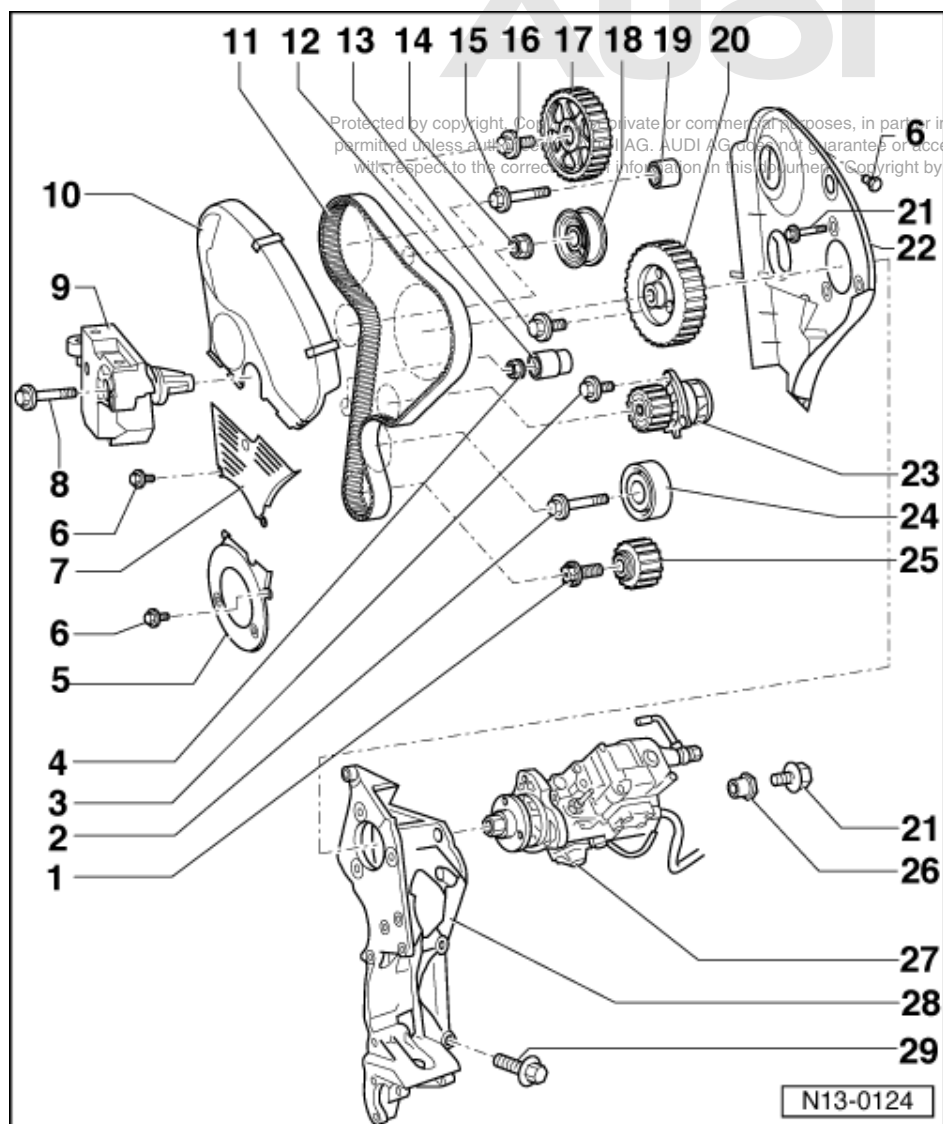
- Routing of ribbed belt => Fig. 35

**Vehicles with air conditioning:**

- Routing of ribbed belt => Fig. 35

**All models:**

- Start engine and check belt running.

**1.5 - Toothed belt drive**

**Note:**

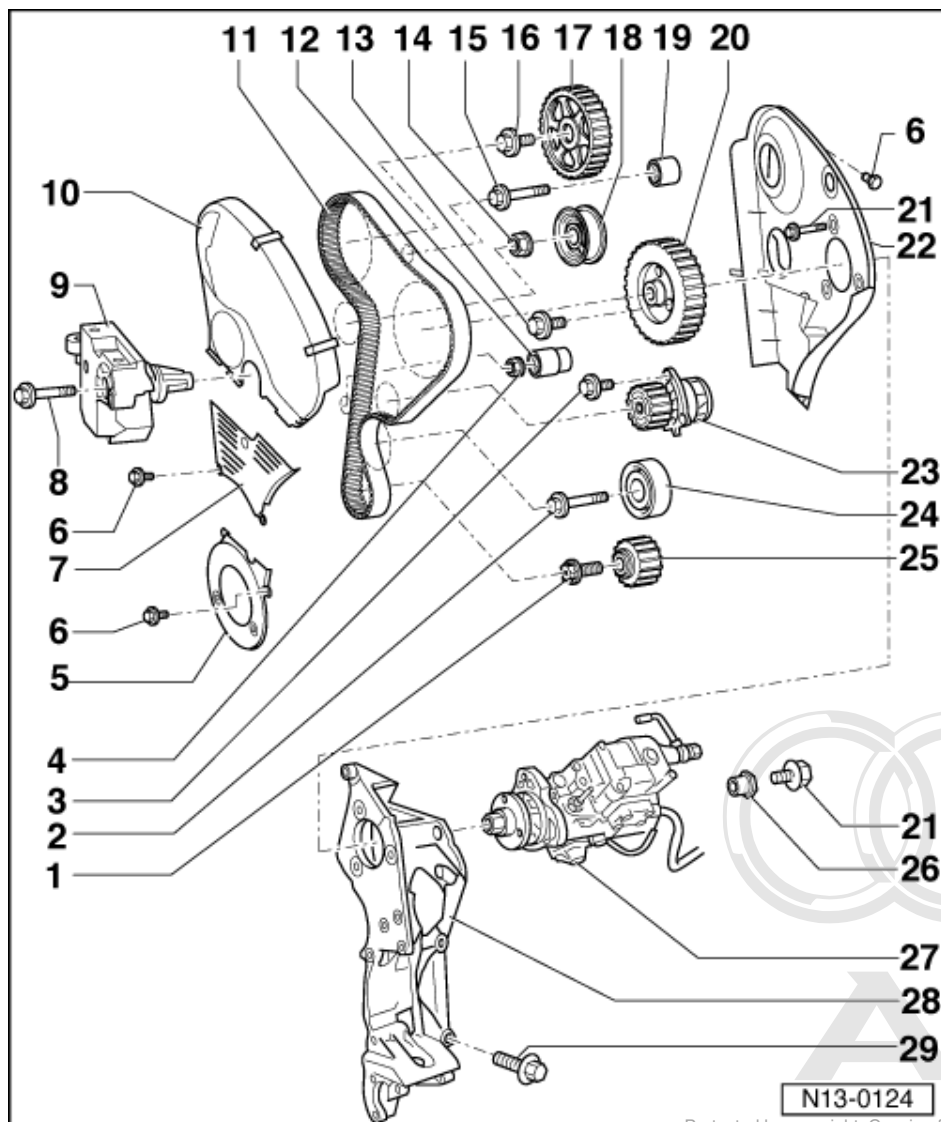
Mark the running direction with chalk or felt pen before removing the toothed belt. If the belt runs in the opposite direction when it is refitted, this can cause breakage.

**1 120 Nm + 1/4 turn (90°) further**

- ♦ Replace
- ♦ Do not oil
- ♦ To loosen and tighten use counterhold 3415  
=> Fig. 45

**2 40 Nm + 1/4 turn (90°) further**

- ♦ Replace

**3 15 Nm**

**4 22 Nm**

- ♦ Only vehicles as of 10.97

**5 Toothed belt guard - lower**
**6 10 Nm**
**7 Toothed belt guard - centre**
**8 45 Nm**

- ♦ Observe tightening sequence =>Fig. 45

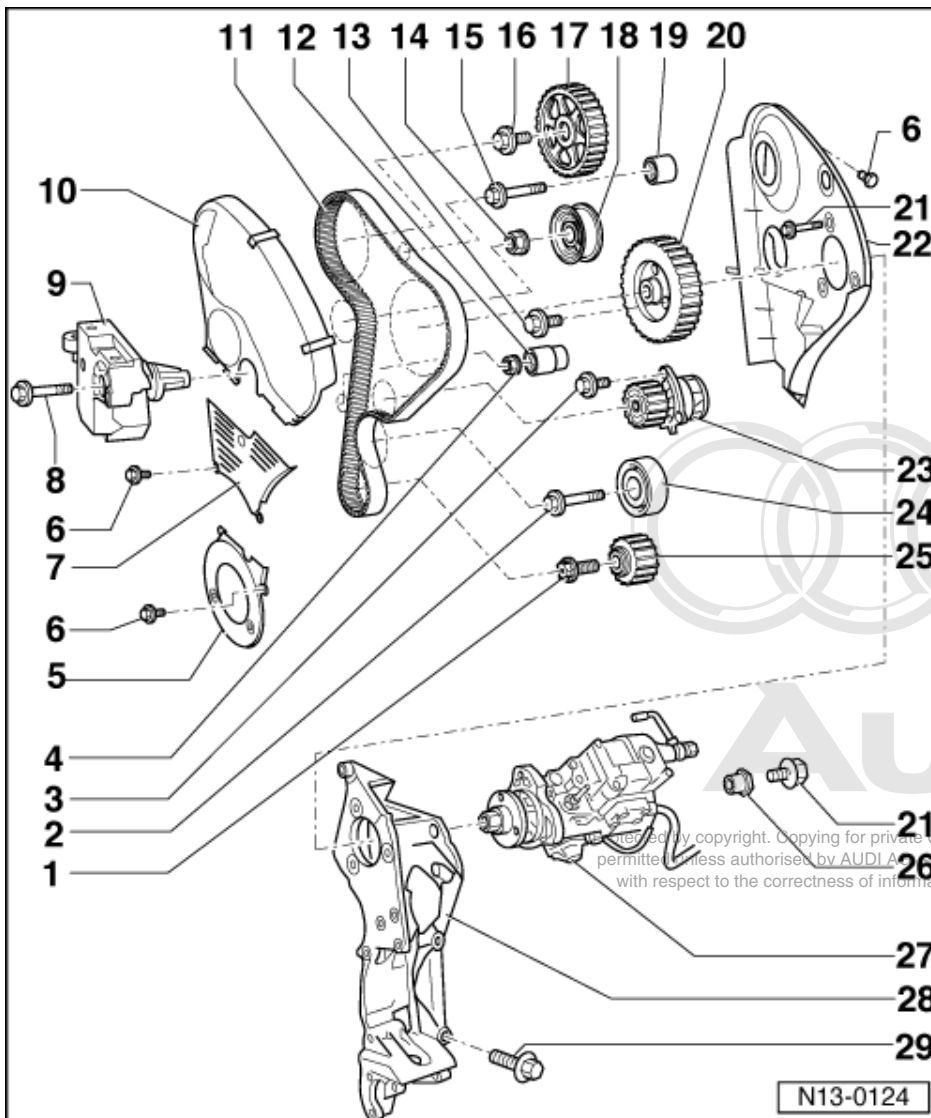
**9 Engine support**

- ♦ Install => Fig. 45

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### 10 Toothed belt guard - top

- ♦ For removal remove right air duct pipe
- ♦ When installing, engage carefully in centre toothed belt guard.



### 11 Toothed belts

- ♦ Mark running direction with chalk or felt pen before removing
- ♦ Check for wear
- ♦ Removing => Page 48
- ♦ Install (adjust valve timing) => Page 53 .

### 12 Idler roller

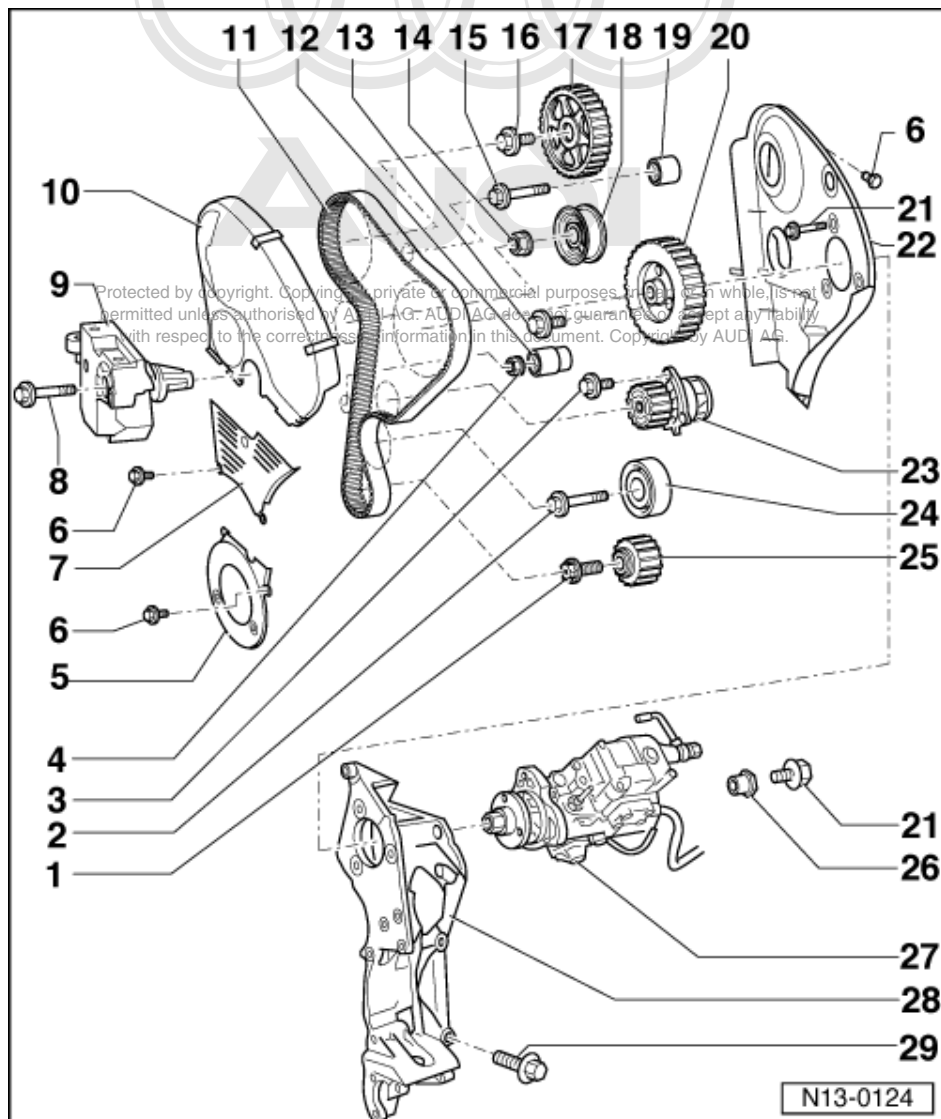
- ♦ Only vehicles as of 10.97

### 13 Bolt

- ♦ Different versions
- ♦ Tightening torque => Fig. 47

14 20 Nm

15 20 Nm



16 45 Nm

- ◆ Hold using counterhold 3036 for loosening and tightening camshaft sprocket

#### 17 Camshaft sprocket

- ◆ Pull off using special tool T40001 => Fig. 45

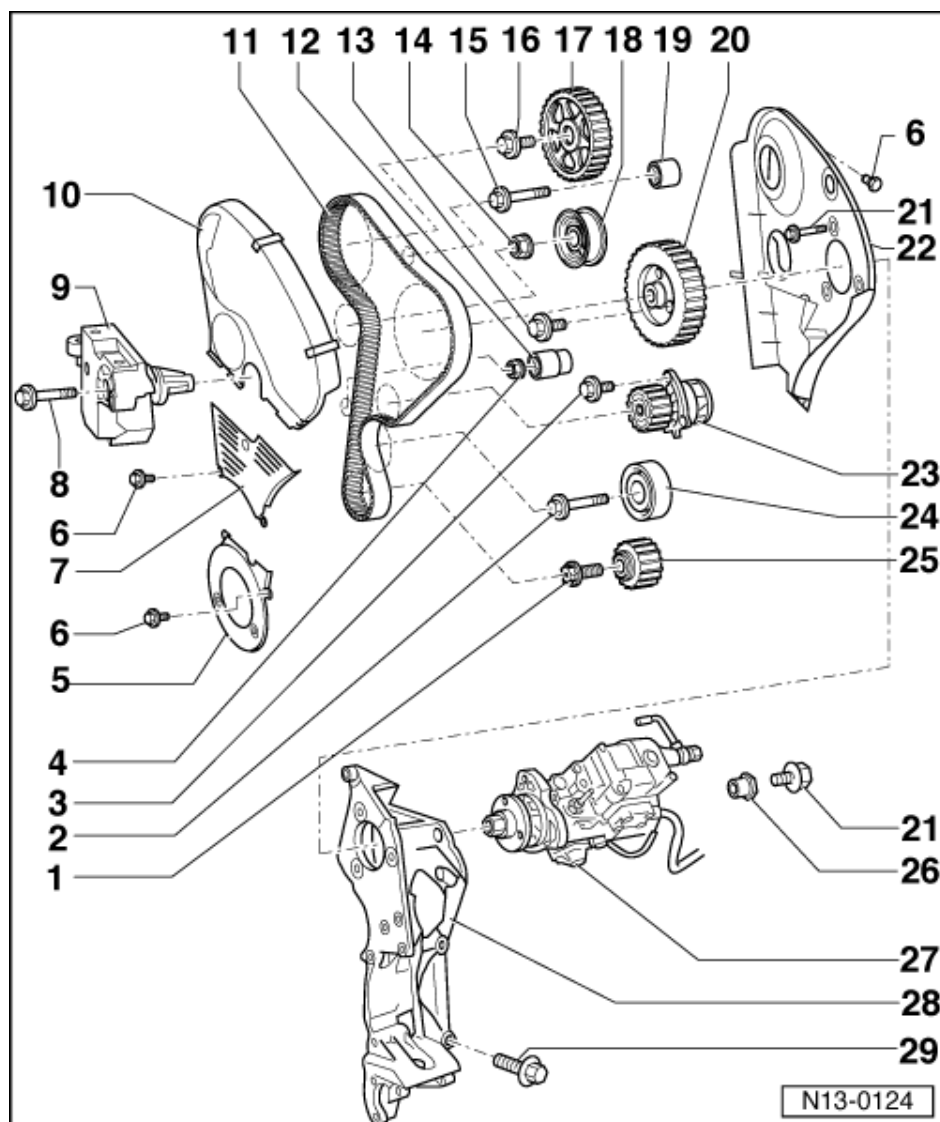
#### 18 Semi-automatic toothed belt tensioning roller

- ◆ Checking => Page 58
- ◆ Installation position => Fig. 45

#### 19 Idler roller

#### 20 Injection pump sprocket

- ◆ Two-piece
- ◆ Different versions. Allocation of bolts -Item 47
- ◆ Removing and installing => Fig. 46



21 30 Nm

22 Toothed belt guard - rear

- ♦ Engage in front at lower edge behind sealing flange.

23 Coolant pump

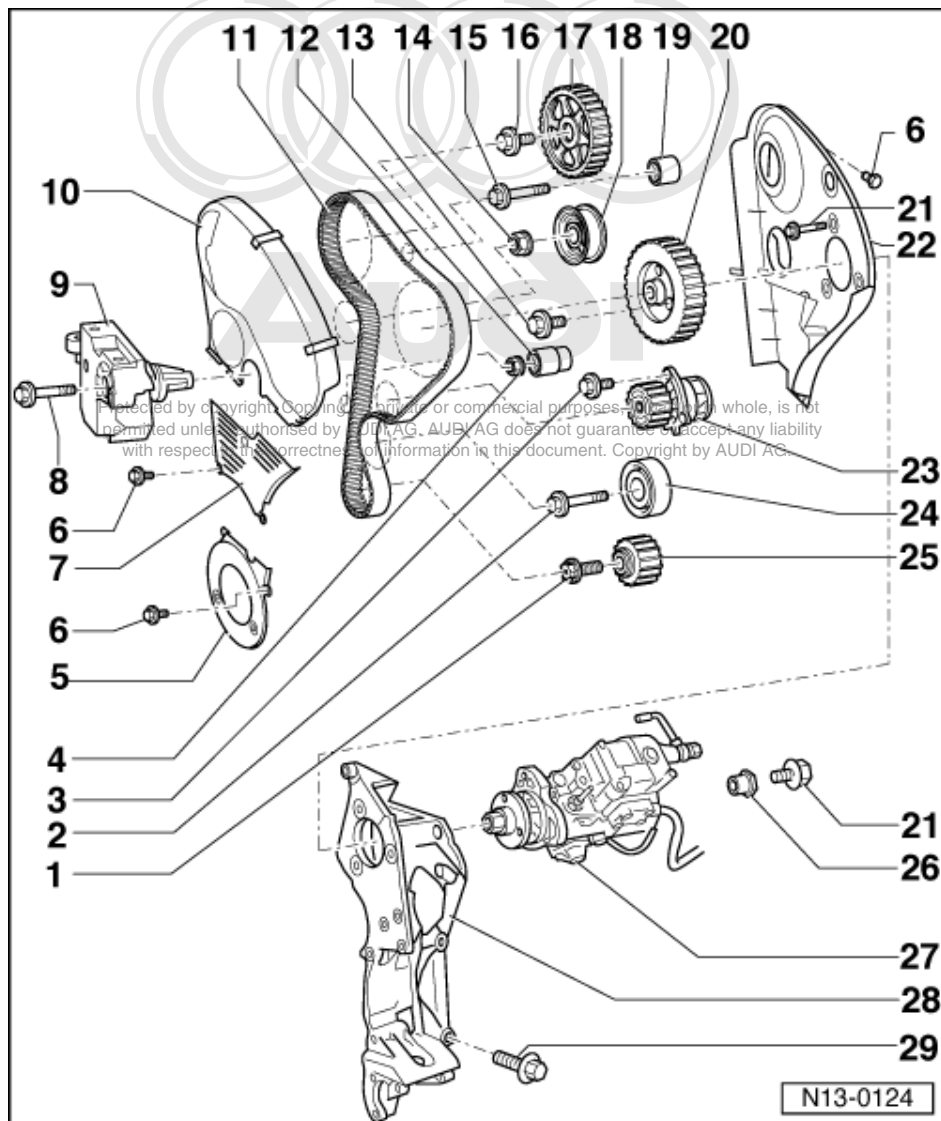
- ♦ Removing and installing=>Page 160

24 Idler roller

- ♦ Unscrew to remove coolant pump

25 Crankshaft sprocket

- ♦ Contact surface between sprocket and crankshaft must be free of oil
- ♦ Can only be installed in one position



26 Threaded bushing

27 Injection pump

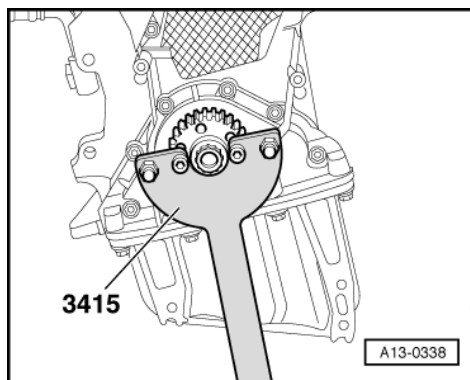
- ◆ Never loosen central nut
- ◆ Removing and installing

=> Diesel Direct Injection and Glow Plug System (4-cyl. TDI) > 07.99; Repair group 23

=> TDI Injection and Glow Plug System (4-cyl.) 08.99 >; Repair group 23

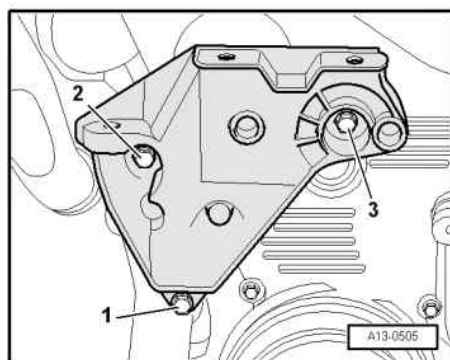
28 Bracket for auxiliary mechanical units

29 45 Nm



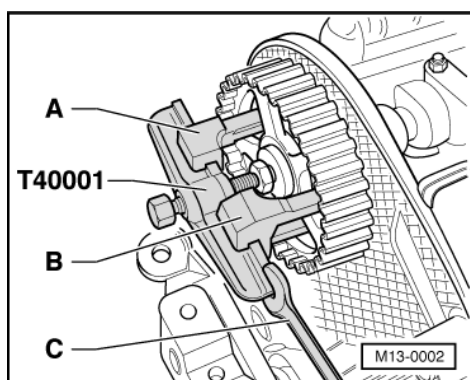
-> Fig.1 Removing and installing crankshaft sprocket

- Use counter-hold tool 3415 to loosen and tighten the central bolt.



-> Fig.2 Installing engine support

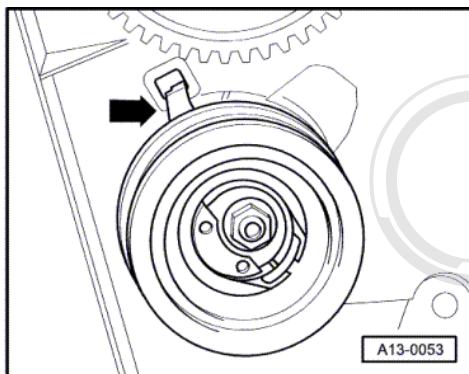
- Insert bolts -1 ... 3- hand-tight initially.
- Then tighten the bolts -1 ... 3- to 45 Nm.



-> Fig.3 Pull camshaft sprocket off camshaft

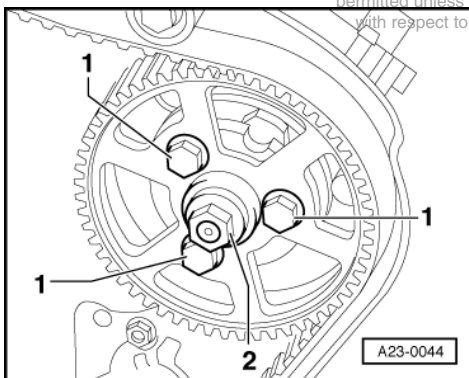
- Toothed belt removed => Page 48

- Unscrew the camshaft sprocket bolt one half turn .
- Place the two-arm puller T40001 with claw T40001/2 -Item A- and the two-arm claw T40001/3 -Item B- centralised onto the camshaft sprocket.
- Pull off the camshaft sprocket using the two-arm puller. Counterhold using an open-end spanner -C- in the process.



-> Fig.4 Fitting location of semi-automatic tensioning roller

Retaining lug -arrow- must engage in rear toothed belt guard slot.

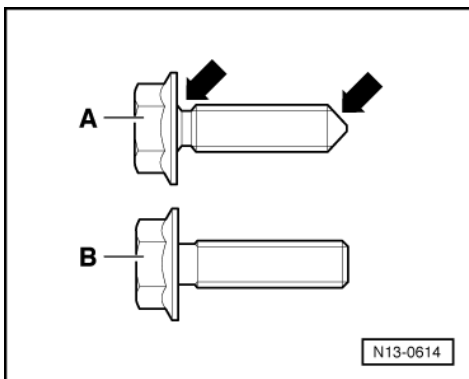


-> Fig.5 Removing and installing injection pump sprocket

#### Important

- ♦ To remove the injection pump sprocket, unscrew only the bolts -1-.
- ♦ Never loosen the injection pump sprocket central nut -2-. Otherwise the injection pump basic setting is incorrectly adjusted and cannot be corrected again using workshop equipment.

- When installing the injection pump sprocket, note the different securing bolts -1- => Fig. 47 .



-> Fig.6 Different securing bolts for injection pump sprocket

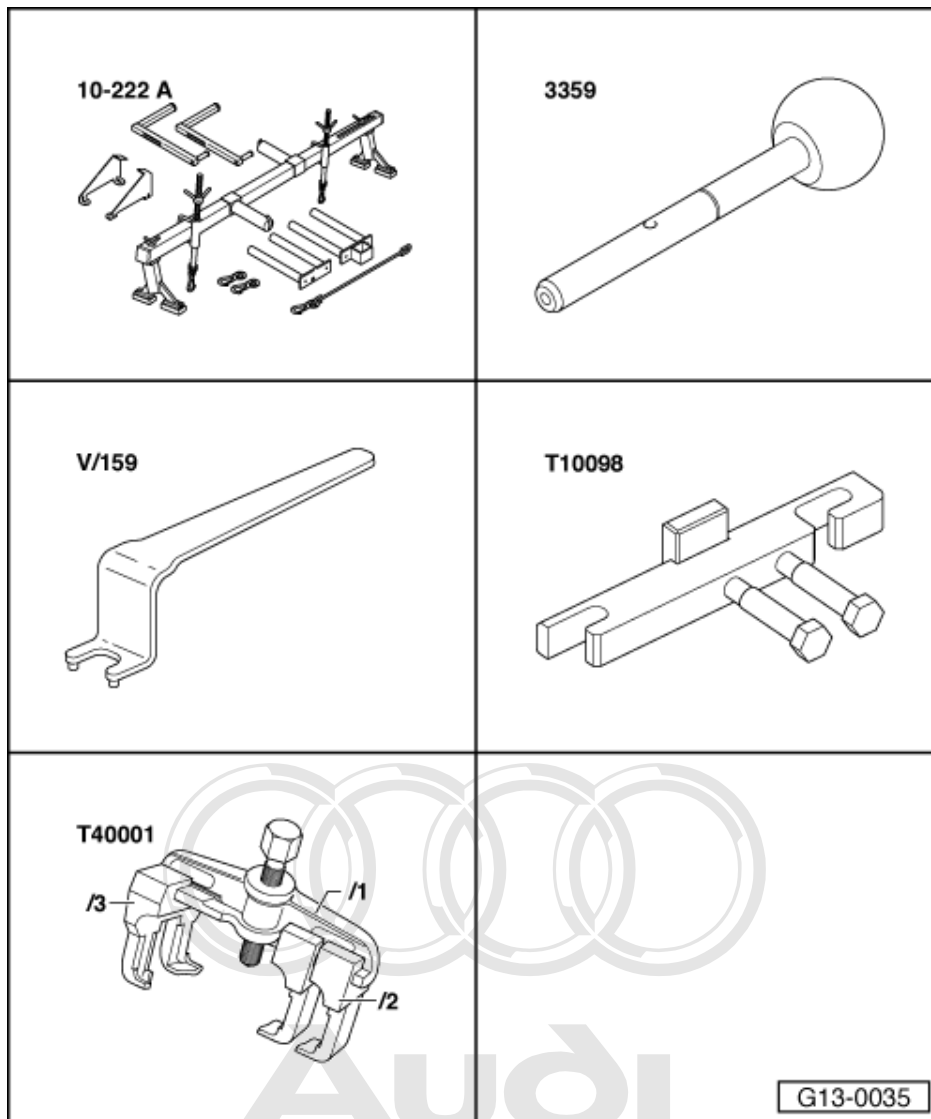
**A - Version with tip and punch mark -arrows-:**

- Use only for injection pump sprocket with part-No. 038 130 111 A
- Tightening torque: 20 Nm + 90° (1/4 turn)
- Replace bolt after each loosening operation

**B - Version without tip and punch mark:**

- Use only for injection pump sprocket with part-No. 038 130 111 B
- Tightening torque: 25 Nm
- Bolt may be re-used

## 1.6 - Removing and installing toothed belt

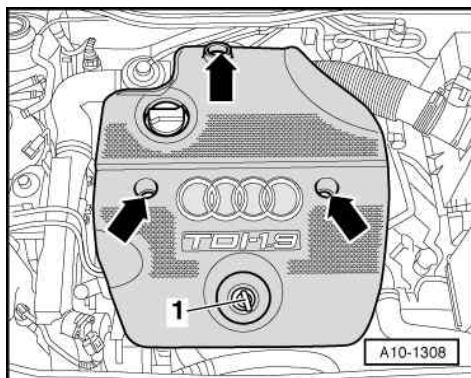


### Special tools and workshop equipment required

- ◆ Support bar 10-222A
- ◆ Pin 3359
- ◆ Special tool Matra V/159
- ◆ Camshaft straightedge T10098

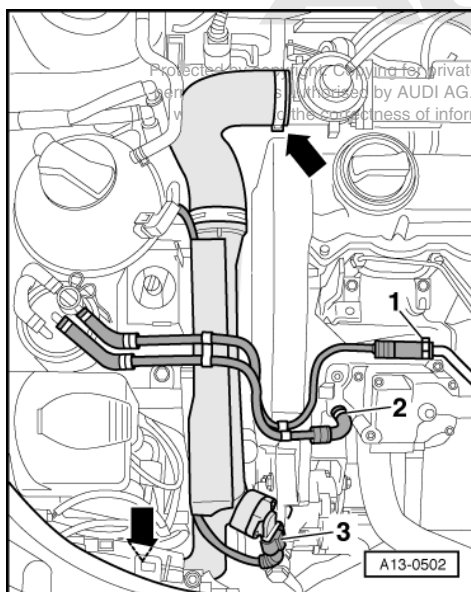


- ♦ Two-arm puller T40001

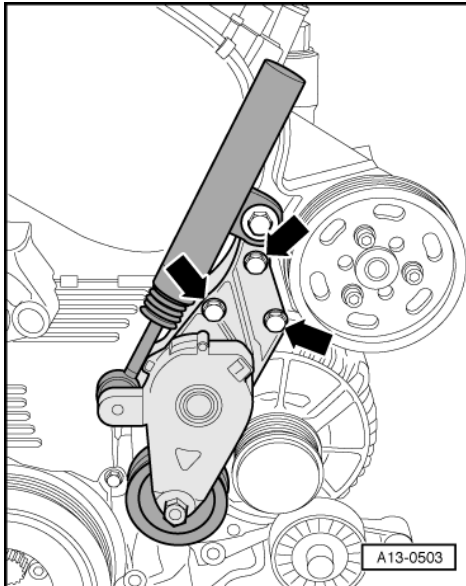


### Removing

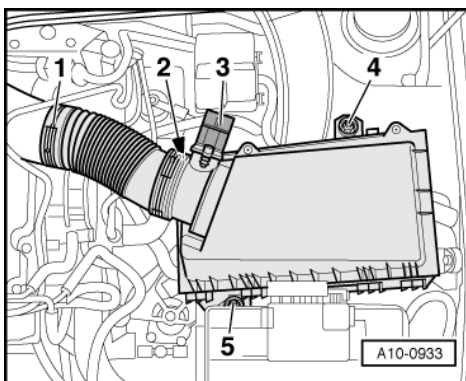
- Engine in vehicle
  - -> Remove oil dipstick -1- from guide tube.
  - Unclip caps.
  - Unscrew nuts -arrows- and remove engine cover.
  - Reinsert oil dipstick in guide tube.



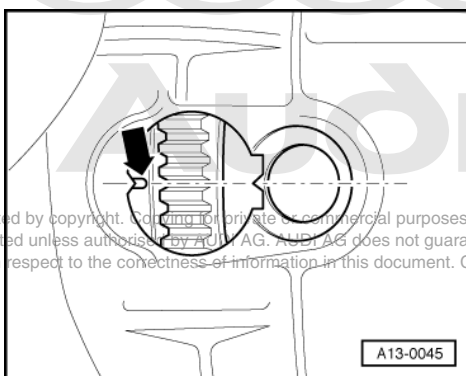
- Detach the cover and the electrical connector at the right headlight unit.
- -> Disconnect fuel-feed line -2- and fuel-return line -1- at injection pump.
- Disconnect the electrical connection -3- at the sender -G71/-G72.
- Expose the wiring at the air duct pipe.
- Remove the air duct pipe on right side -arrows-.



- Remove ribbed belt => Page 37
- -> Remove tensioner for ribbed belt -arrows-.

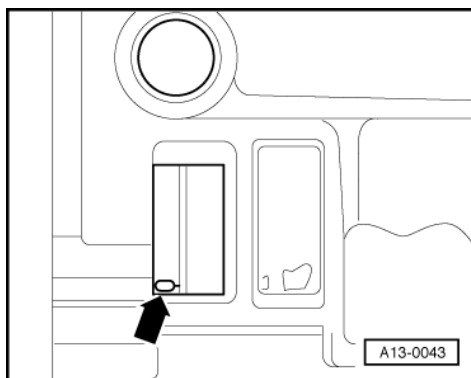


- -> Remove air duct hose -1- from air duct pipe.
- Detach connector of air mass meter -3-.
- Unscrew bolts -4- and -5-.
- Remove vent hose -2- from rear of air cleaner housing.
- Take out air cleaner housing.



- -> Turn crankshaft to TDC No. 1 cylinder -arrow- (vehicles with manual gearbox).

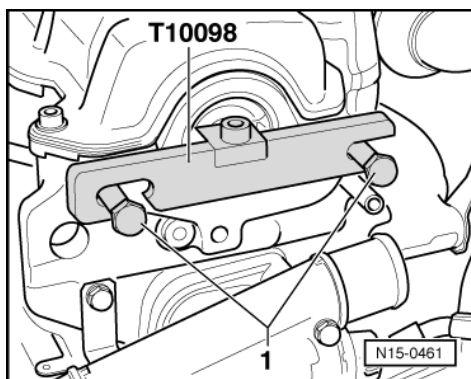
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- -> Turn crankshaft to TDC No. 1 cylinder -arrow- (vehicles with automatic gearbox).

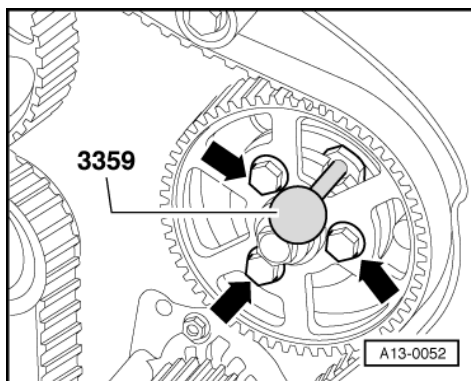
**Note:**

Position crankshaft to TDC for cylinder 1 with engine removed=> Page 58 .

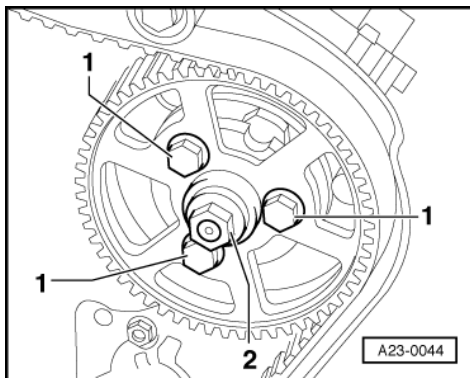


- Remove the exhauster => Fig. 96 .
- -> Turn the bolts -1- by hand up to stop into the cylinder head.
- Lock the camshaft using camshaft straightedge T10098 as shown in the illustration.
- If the camshaft straightedge T10098 cannot be inserted, rotate crankshaft 1 additional turn (360°).

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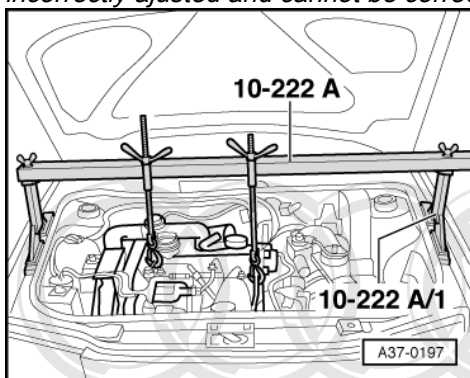


- Remove upper toothed belt guard.
- -> Lock injection pump sprocket using pin 3359.
- Loosen injection pump sprocket securing bolts -arrows-.

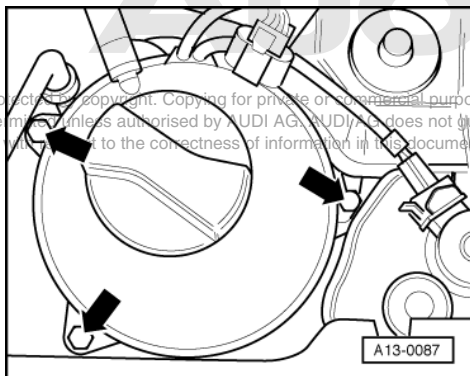


**Note:**

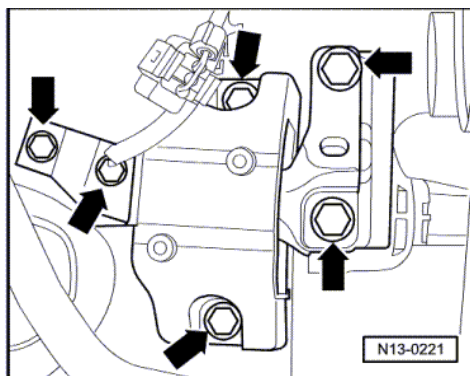
-> Never loosen the injection pump sprocket central nut -2-. Otherwise the injection pump basic setting is incorrectly adjusted and cannot be corrected again using workshop equipment.



- -> Set up support bar 10-222 A on wing panel bolt flange.
- Attach spindles in both lifting eyes.
- Slightly lift engine using both spindles evenly.

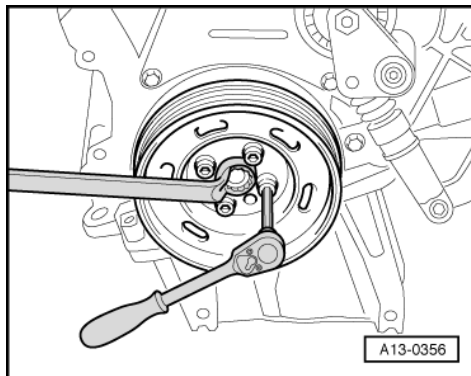


- -> Unscrew coolant expansion tank and refill reservoir for power steering -arrows-.





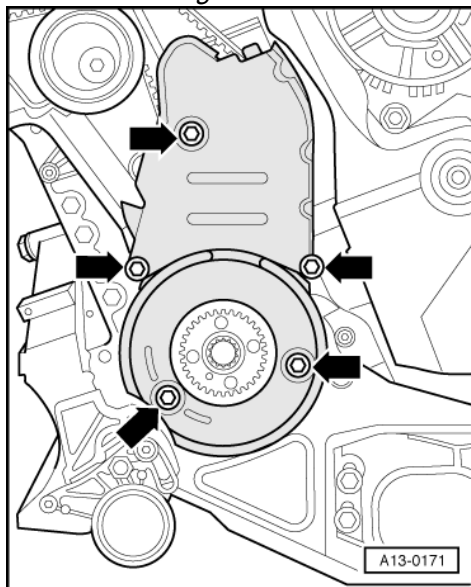
- -> Unbolt brace between engine console and body-arrows-.
- Unbolt engine console from engine support and from body -arrows-.
- Take out engine console.



- -> Unbolt vibration damper.

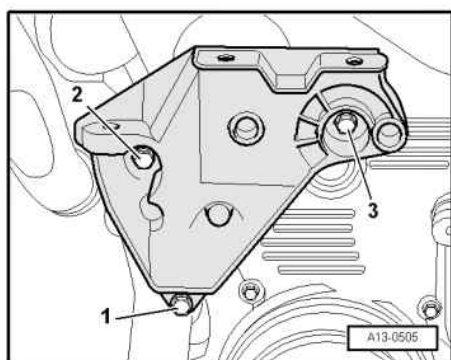
**Note:**

*To loosen and tighten the vibration damper counterhold with ring spanner on central bolt.*



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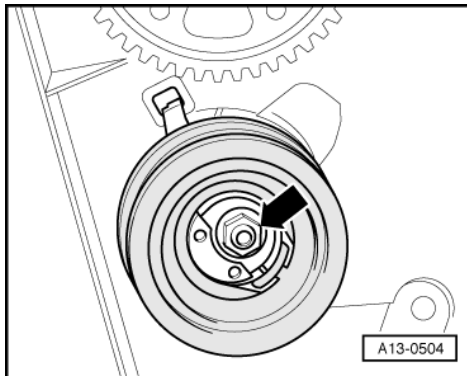
- -> Unbolt bottom and centre section of toothed belt guard -arrows-.



- -> Unscrew engine support bolts -1 ... 3- and swivel engine support slightly rearwards.

**Note:**

To remove the bolts for the engine support, raise or lower the engine slightly as necessary using the spindles on engine support bracket 10-222A.



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- Mark running direction of belt with chalk or felt pen.
- -> Loosen the tensioning roller nut -arrow- by several turns.
- Remove toothed belt.

**Installing (adjusting valve timing)**

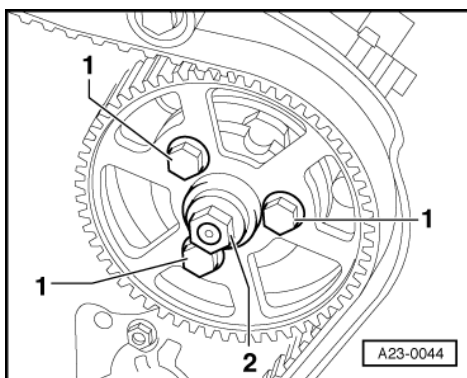
- Camshaft locked using camshaft straightedge T10098.
- Injection pump locked using pin 3359.

**Notes:**

- ♦ The position of the toothed belt must be set as described below, even after repairs in which the belt is only taken off the camshaft sprocket.
- ♦ When turning the camshaft, the crankshaft must not be at TDC at any cylinder. Danger of damage to valves/piston crown.
- ♦ When loosening and tightening the camshaft sprocket, never use the camshaft straightedge T10098 to counterhold! Counterhold using 3036.
- ♦ Secure all hose connections with the correct hose clamps (same as original equipment):

=> Parts List

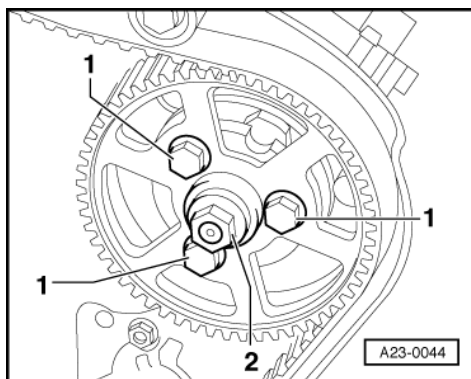
- ♦ Replace seals and gaskets.



**Vehicles with injection pump sprocket, part no. 038 130 111 A:**

- -> Replace the securing bolts -1- for injection pump sprocket and install the new bolts hand-tight => Note, Page 47.
- The injection pump sprocket should be just able to be turned and must not tilt

- Turn the injection pump sprocket in its longitudinal holes clockwise up to stop.



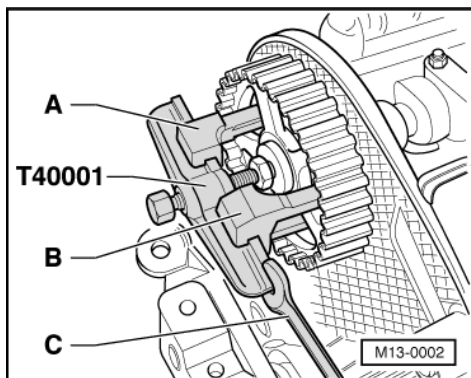
#### Vehicles with injection pump sprocket, part no. 038 130 111 B:

- -> Loosen injection pump sprocket securing bolts -1-.
- The injection pump sprocket should be just able to be turned and must not tilt

#### Note:

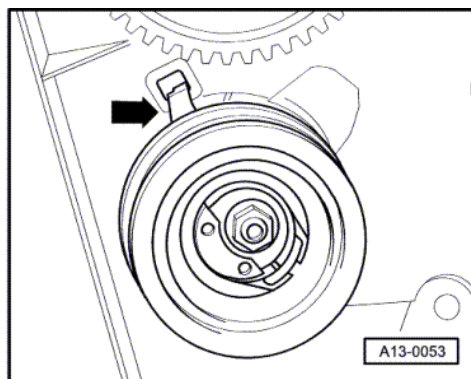
The bolts do not require replacement

- Turn the injection pump sprocket in its longitudinal holes clockwise up to stop.



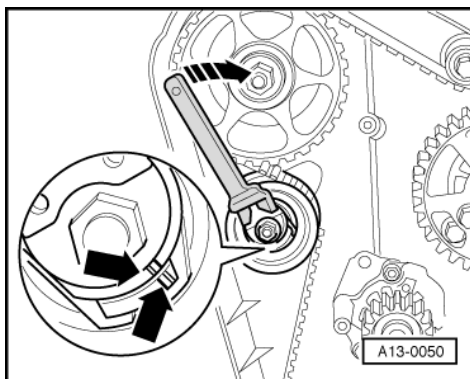
#### All models:

- -> Unscrew the camshaft sprocket bolt by one half turn .
- Place the two-arm puller T40001 with claw T40001/2 -Item A- and the two-arm claw T40001/3 -Item B- centralised onto the camshaft sprocket.
- Pull off the camshaft sprocket using the two-arm puller. Counterhold using an open-end spanner -C- in the process.
- Place toothed belt on crankshaft toothed belt sprocket, idler roller, coolant pump, injection pump sprocket and tensioning roller (note toothed belt running direction).
- Attach camshaft sprocket together with toothed belt and affix using securing bolts (camshaft sprocket still able to be turned).
- Check again whether TDC mark on flywheel and reference mark are aligned.



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- -> When inserting tensioning roller ensure that lug -arrow- engages in rear of toothed belt guard.



- -> Rotate tensioning roller eccentric cam to the right using nut driver (e.g. Matra V/159) until notch and lug align -arrows-.

**Note:**

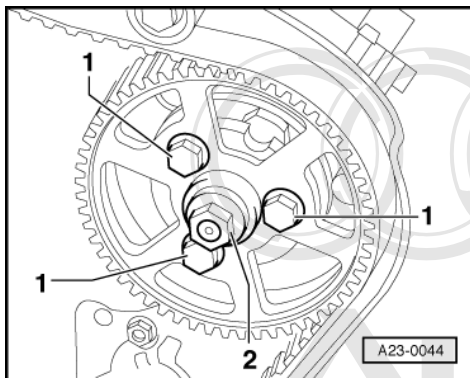
*First completely release load on tensioning roller, if the eccentric cam was accidentally rotated too far to the right while tensioning. Then again rotate the eccentric cam to the right to tighten.*

- Tighten lock nut on tensioning roller to 20 Nm.
- Check again whether TDC mark on flywheel and reference mark are aligned.
- Tighten camshaft sprocket securing bolt and torque to 45 Nm.

**Note:**

*When loosening and tightening the camshaft sprocket, never use the camshaft straightedge T10098 to counterhold! Counterhold using 3036.*

- Remove camshaft straightedge T10098.

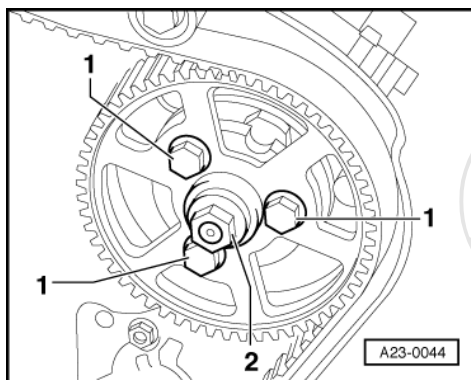


**Vehicles with injection pump sprocket, part-No. 038 130 111 A:**

- -> First tighten the new securing bolts -1- for the injection pump sprocket to 20 Nm.

**Notes:**

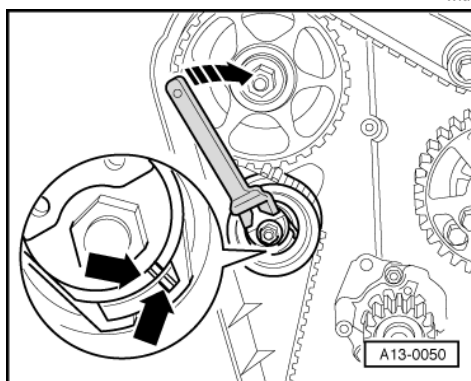
- ◆ After the dynamic start of injection test, securing bolts must be tightened by another 1/4 turn (90°).
- ◆ The securing bolts are stretch bolts which may only be used once. Once tightened to final torque (20 Nm + 90°), they must be replaced after being loosened => Note, Fig. 47.



Vehicles with injection pump sprocket, part no. 038 130 111 B:

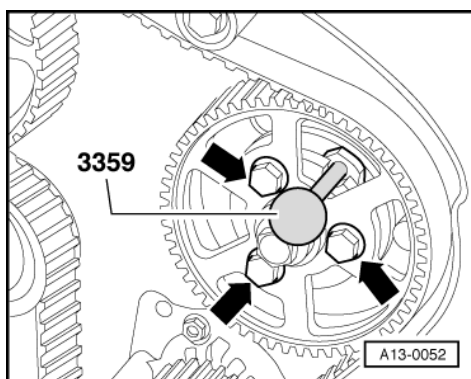
- -> Tighten the securing bolts -1- for the injection pump sprocket to 25 Nm.

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All models:

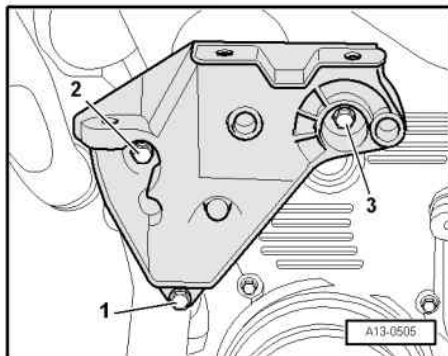
- Turn crankshaft an additional two turns in direction of engine rotation until the engine is back at TDC cylinder 1.
- -> Check toothed belt tension.
  - The marks -arrows- must align
- Re-tension toothed belt as necessary.
- Check whether injection pump sprocket can be locked using pin 3359.
- Check camshaft position using camshaft straightedge T10098.



Notes:

- ♦ Repeat adjustment if it is not possible to insert the camshaft straightedge.

- ♦ If the pin 3359 cannot be inserted:
  - -> Loosen injection pump sprocket securing bolts-arrows-.
  - Rotate injection pump sprocket hub until pin engages.
  - Re-tighten injection pump sprocket securing bolts => from Page 55 .



The remaining installation steps are carried out in the reverse sequence - note the following points:

-> Fasten the engine support in place as follows:

- Screw out bolts -1 ... 3- hand-tight at first.
- Then torque the bolts -1 ... 3- to 45 Nm.
- Install engine console.
- Install the vibration damper=> Page 36 .
- Install the exhauster => Fig. 96 .
- Adjust engine mounting => Page 27 .
- Install ribbed belt=> Page 38 .
- Perform dynamic start of injection test

=> Diesel Direct Injection and Glow Plug System (4-cyl. TDI) > 07.99; Repair group 23; Diesel direct injection system Diesel direct injection system

=> TDI Injection and Glow Plug System (4-cyl.) 08.99 >; Repair group 23; Servicing diesel direct injection system; Dynamic start of injection test Servicing diesel direct injection system Dynamic start of injection test

### Tightening torques

| Component                                              | Nm       |
|--------------------------------------------------------|----------|
| Semi-automatic tensioning roller to cylinder block     | 20       |
| Toothed belt sprocket to camshaft                      | 45       |
| Toothed belt guard, centre and lower to cylinder block | 10       |
| Engine support to cylinder block                       | 45       |
| Engine console to body                                 | 50       |
| Brace to engine console/body                           | 25       |
| Engine support to engine console                       | 100 1)2) |

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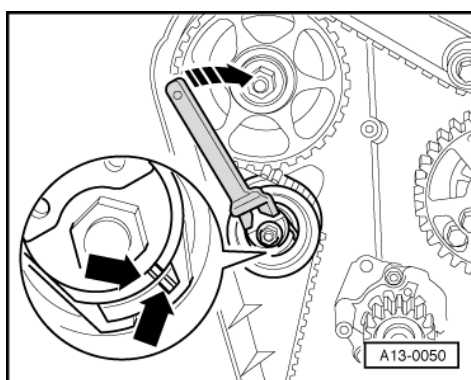
| Component                                                                     | Nm |
|-------------------------------------------------------------------------------|----|
| Tensioner for ribbed belt tensioner to bracket for auxiliary mechanical units | 25 |

- 1) Replace bolts
- 2) Only tighten to final torque after adjusting the engine mountings => Page 27

## 1.7 - Checking semi-automatic toothed belt tensioning roller

### Test condition

- Toothed belt in position and tensioned.

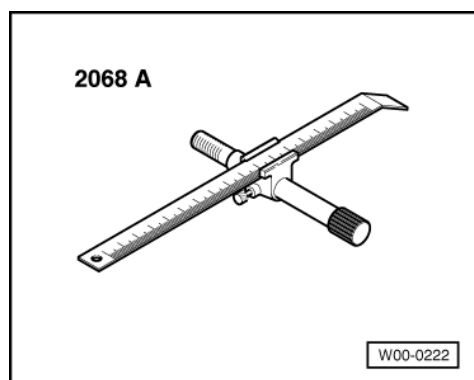


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### Test sequence

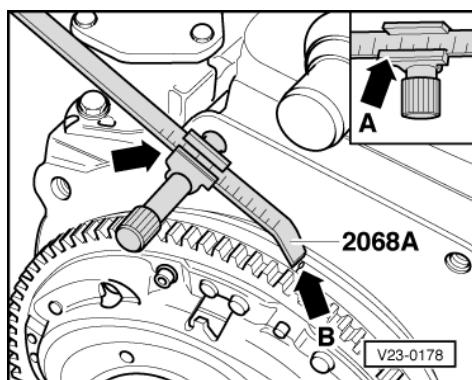
- -> Tension toothed belt with firm thumb pressure. Notch and lug -arrow- must move.
- Release thumb pressure on toothed belt. Tensioner must return to initial position.
  - Marks -arrows- must align

## 1.8 - Positioning crankshaft to TDC with engine removed



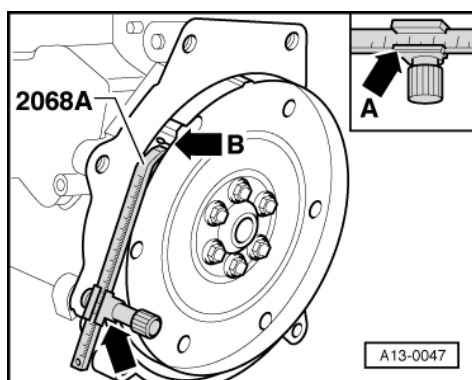
### Special tools and workshop equipment required

- ♦ TDC adjustment device-2068 A



#### Vehicles with manual gearbox

- -> Screw in TDC adjustment device-2068 A, as shown in the illustration.
- Set adjustment device to 96 mm -arrow- (the left notch on the scale -arrow A- is the reference point).
- Turn crankshaft until TDC-mark on flywheel -arrow B- aligns with adjustment device edge.



#### Vehicles with automatic gearbox:

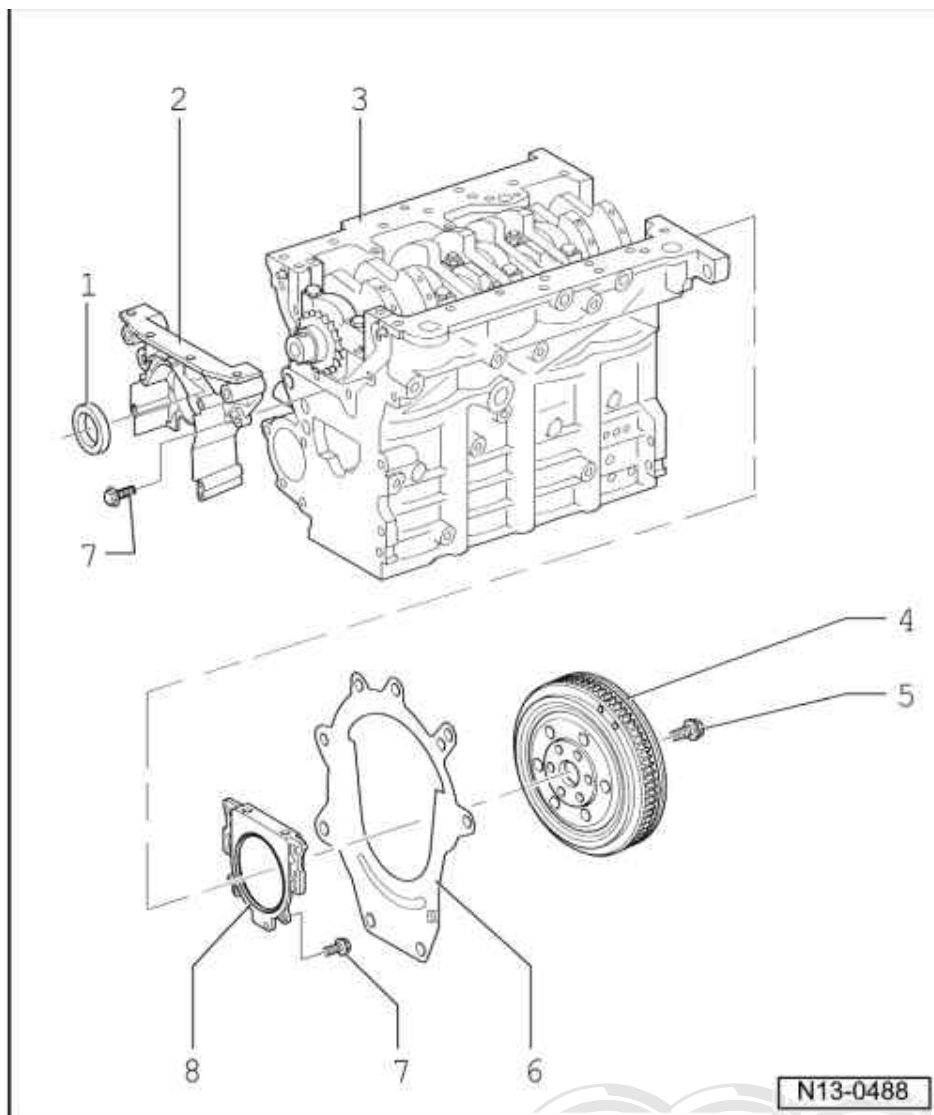
- -> Screw in TDC adjustment device-2068 A, as shown in the illustration.
- Set adjustment device to 30 mm -arrow- (the left notch on the scale -arrow A- is the reference point).
- Turn crankshaft until TDC-mark on drive plate -arrow B- aligns with adjustment device edge.



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## 2 - Removing and installing sealing flanges and flywheel/drive plate

### 2.1 - Removing and installing sealing flanges and flywheel/drive plate



#### Note:

For repairs to the clutch:

=> 5-speed Manual Gearbox 02J; Repair group 30; Servicing clutch Servicing clutch

#### 1 Sealing ring

- ◆ Replacing => Page 63 .
- ◆ Do not oil

#### 2 Sealing flange - front

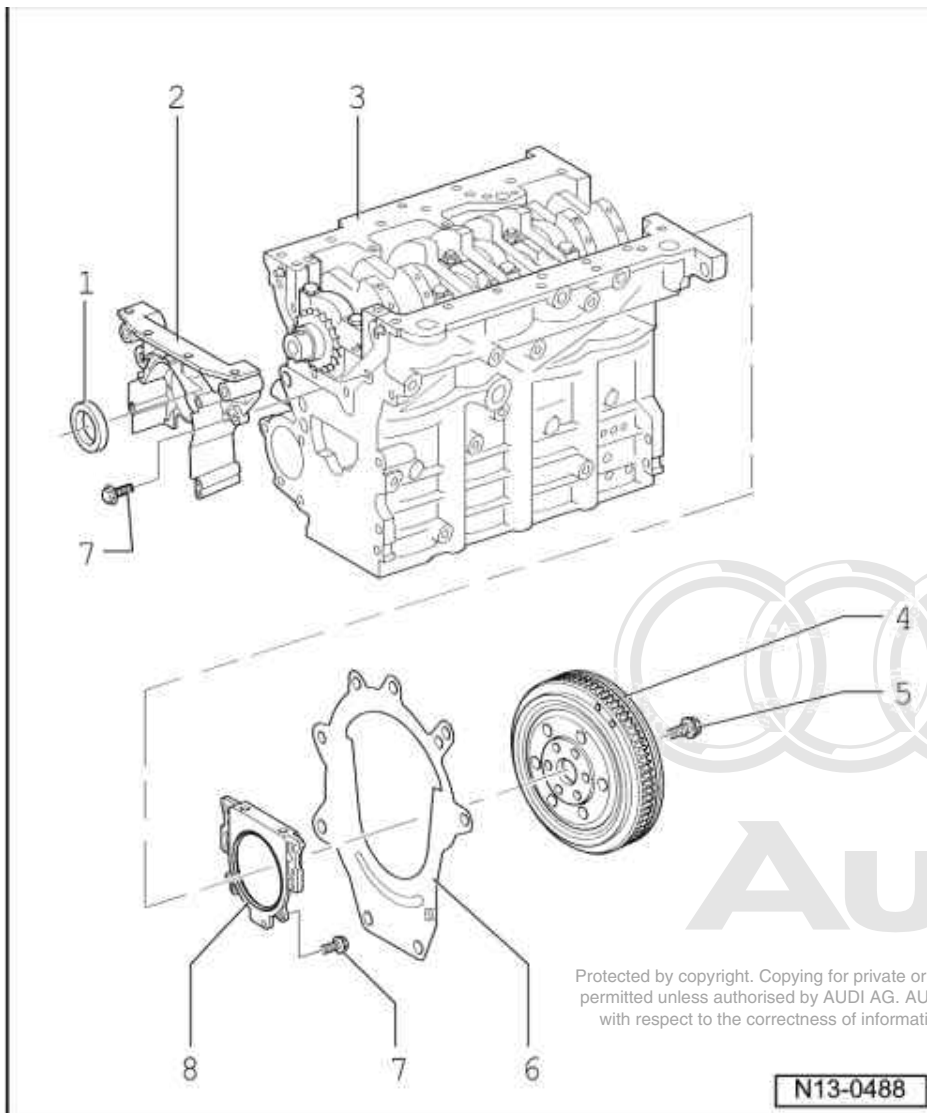
- ◆ Must be located on dowel sleeves
- ◆ Removing and installing  
=>Page 66 .

#### 3 Cylinder block

- ◆ Removing and installing crankshaft=> Page 72

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- ♦ Dismantling and assembling pistons and conrods => Page 79



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#### 4 Flywheel or drive plate

- ♦ Removing and installing flywheel => Page 68
- ♦ Removing and installing drive plate => Page 70
- ♦ Can only be installed in one position. Holes are off set

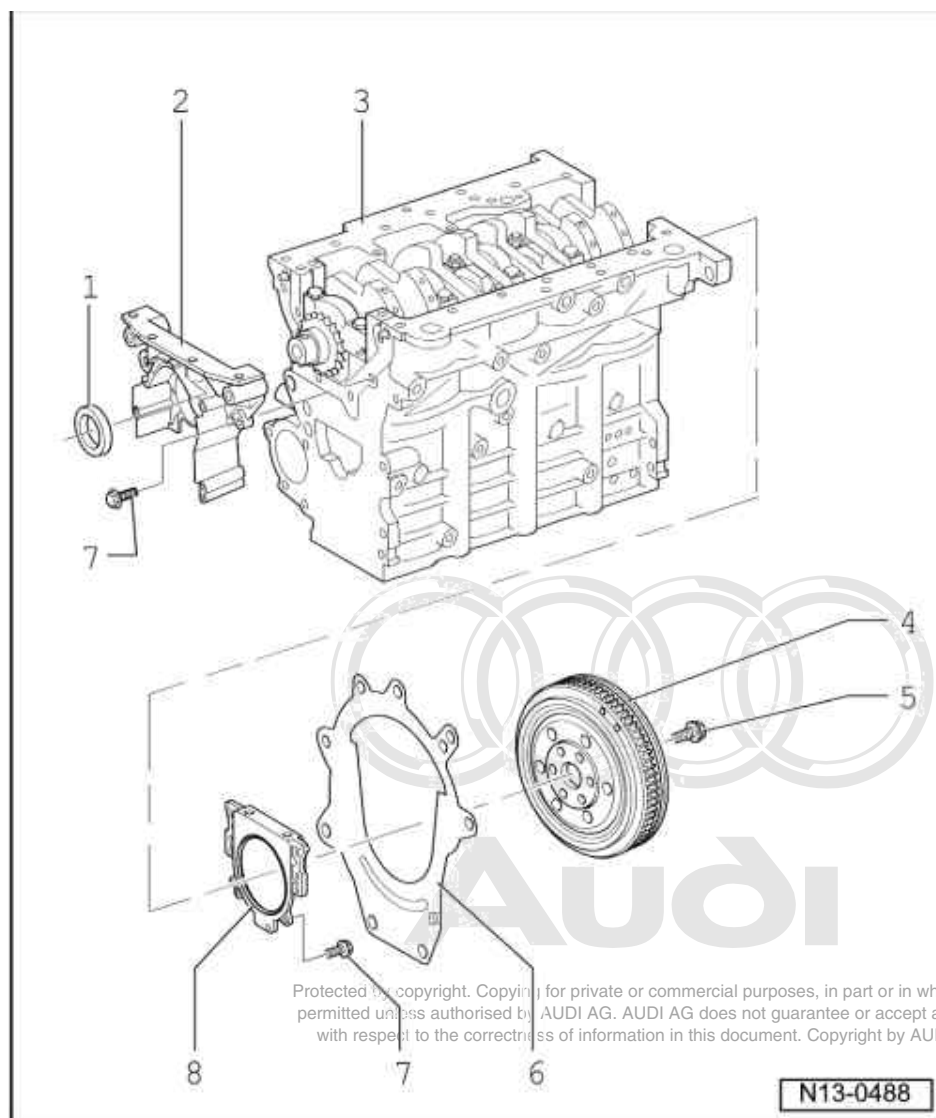
#### 5 60 Nm + 90° (1/4 turn) further

- ♦ Replace

#### 6 Intermediate plate

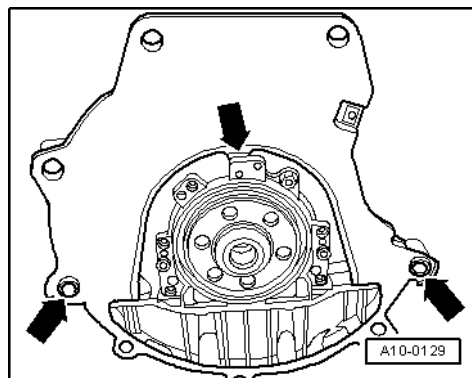
- ♦ Must be located on dowel sleeves
- ♦ Do not damage/bend when assembling.
- ♦ attached to sealing flange => Fig. 63

#### 7 15 Nm



### 8 Rear sealing flange with oil seal

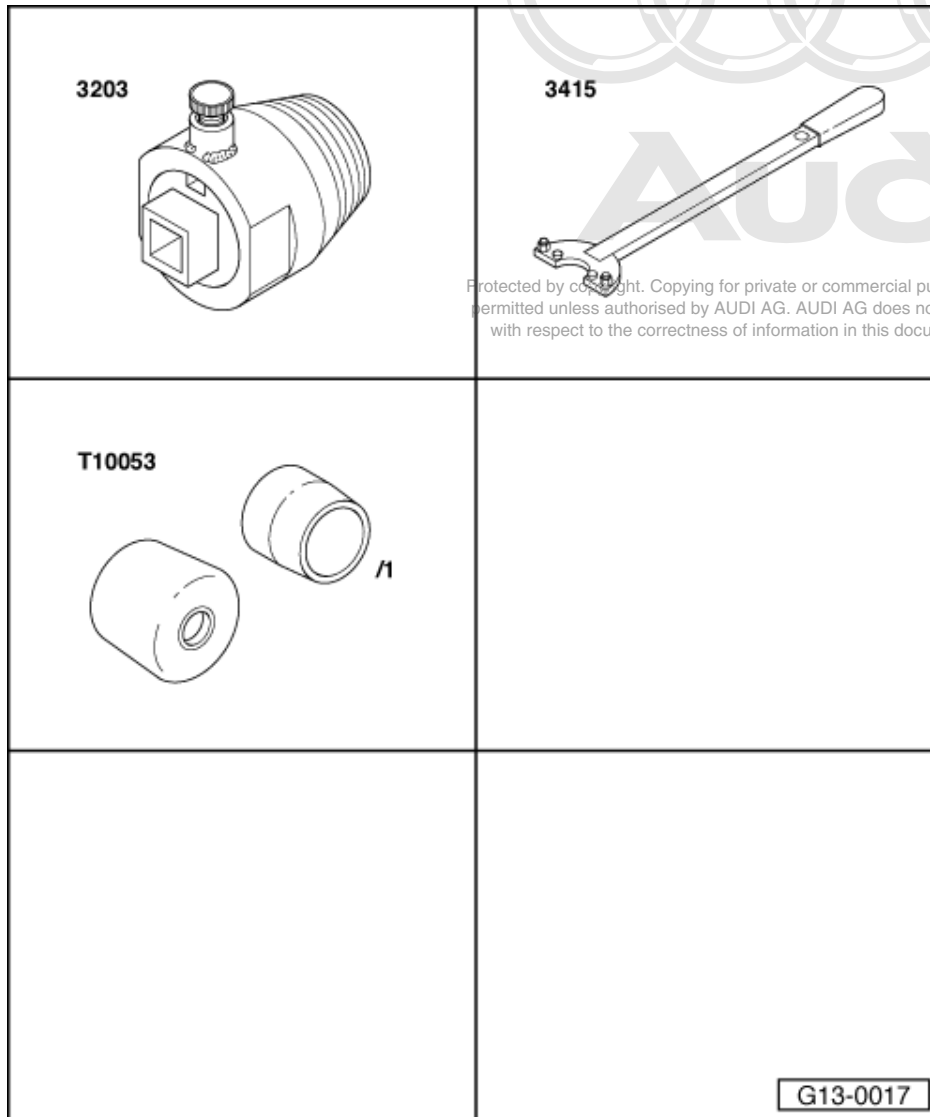
- ◆ With gasket for cylinder block
- ◆ Do not oil
- ◆ Make sure that the sealing lip of the sealing ring is not folded back or damaged when installing
- ◆ Removal and installation, removing sump => Page 146
- ◆ When installing, push guide sleeve from repair kit onto crankshaft.



-> Fig.1 Install intermediate plate

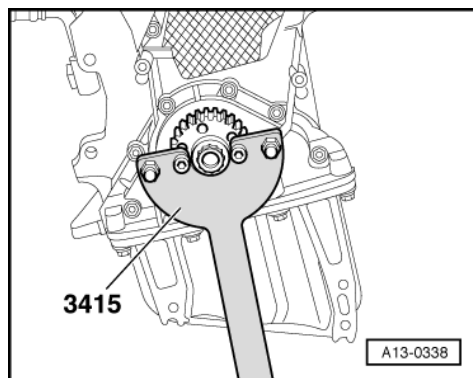
- Attach intermediate plate on sealing flange and press onto dowel sleeves -arrows-.

## 2.2 - Renewing crankshaft oil seal on pulley end



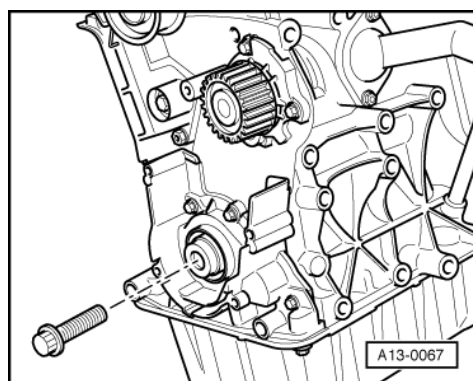
### Special tools and workshop equipment required

- ◆ Oil seal extractor 3203
- ◆ Holding tool 3415
- ◆ Assembly tool T10053

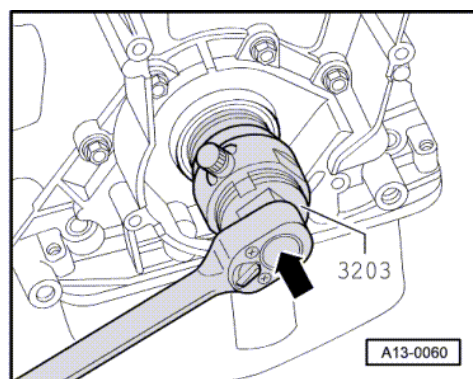


## Removing

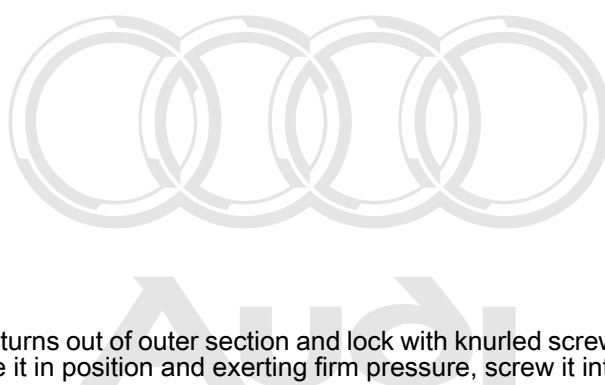
- Engine in vehicle
- Remove toothed belt => Page 48 .
- -> Remove crankshaft toothed belt sprocket. Counter hold sprocket with 3415.

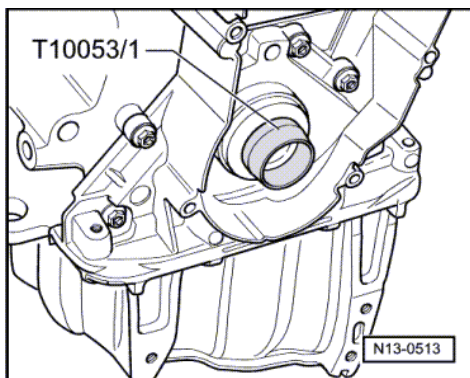


- -> Before applying oil seal extractor, screw central bolt for toothed belt sprocket into crankshaft until limit stop.



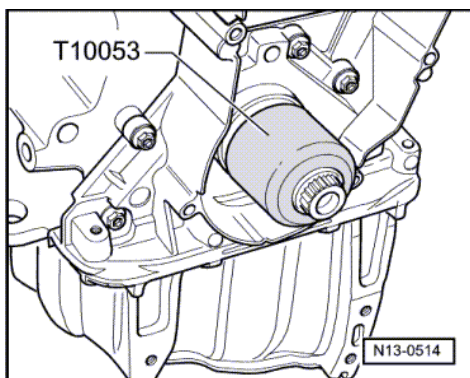
- Unscrew inner section of oil seal extractor 3203 eight turns out of outer section and lock with knurled screw.
- -> Lubricate threaded head of oil seal extractor, place it in position and exerting firm pressure, screw it into oil seal as far as possible.
- Loosen knurled screw and turn inner part against crankshaft until the oil seal is pulled out.
- Clamp flats of oil seal extractor in vice. Remove oil seal with pliers.
- Clean contact surface and sealing surface.



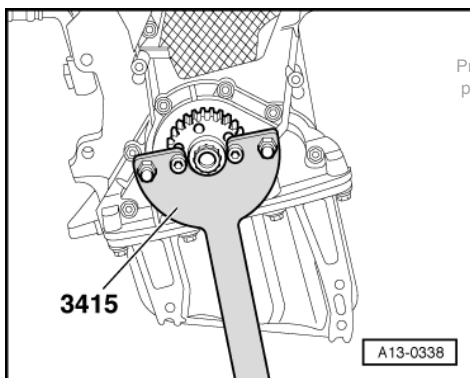


### Installing

- Do not lubricate sealing lip or outer circumference of seal before pressing in.
- -> Place guide sleeve T10053/1 onto crankshaft journal.
- Slide oil seal over guide sleeve.



- -> Press in sealing ring with central bolt of toothed belt sprocket and press sleeve of T10053 until flush.



- Replace bolt for crankshaft sprocket.
- -> Install toothed belt crankshaft sprocket. Counter hold toothed belt sprocket with counterhold 3415.

### Notes:

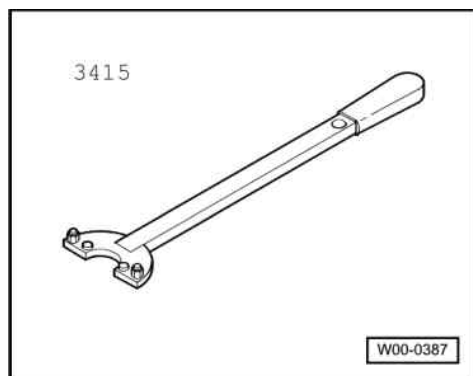
- ◆ Contact surface between sprocket and crankshaft must be free of oil.
- ◆ Do not oil bolt for crankshaft sprocket.
- Install toothed belt (adjust valve timing) => Page 53 .
- Install ribbed belt=> Page 38 .

## Tightening torque

| Component                           | Nm            |
|-------------------------------------|---------------|
| Toothed belt sprocket to crankshaft | 120 + 90°1)2) |

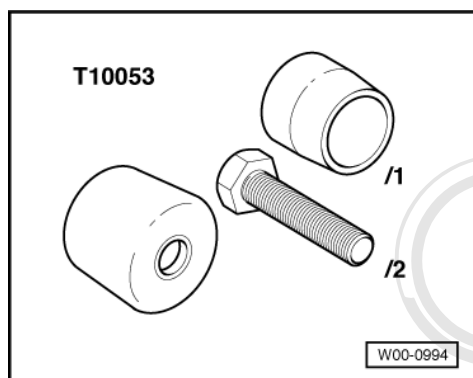
- 1) Replace bolt
- 2) 90° corresponds to a quarter of a turn

## 2.3 - Removing and installing front sealing flange



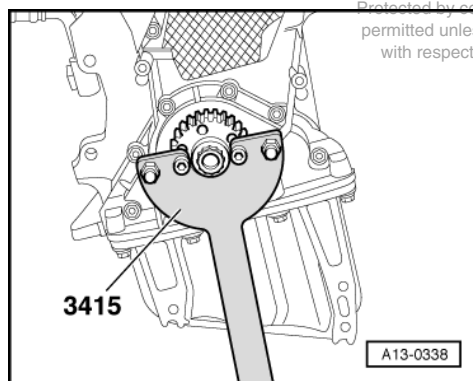
### Special tools, workshop equipment, and other items required

- ♦ Holding tool 3415



- ♦ Assembly tool T10053
- ♦ Electric drill with plastic brush attachment
- ♦ Protective goggles
- ♦ Silicone sealant

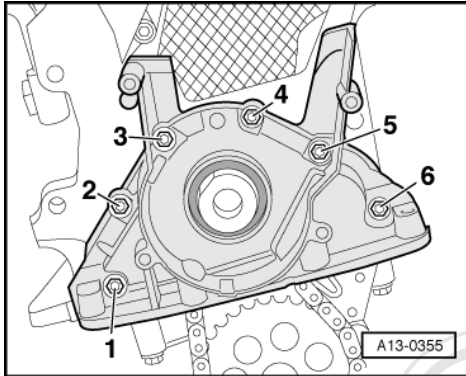
### => Parts List



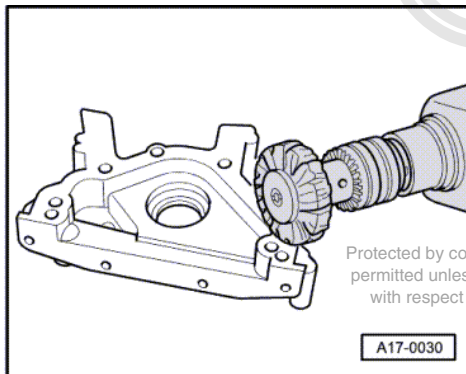
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## Removing

- Engine in vehicle
- Remove toothed belt => Page 48 .
- -> Remove crankshaft toothed belt sprocket. Counter hold sprocket with 3415.
- Remove oil pan => Page 146 .



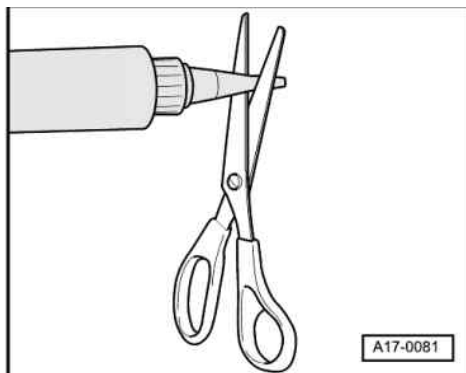
- -> Unscrew bolts -1 ... 6-.
- Prise off sealing flange and remove.
- Carefully remove any remains of sealant from cylinder block.



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Important  
Wear protective glasses.

- -> Remove sealant residues from sealing flange, e.g. with rotating plastic brush or similar.
- Clean sealing surfaces: they must be free of oil and grease.



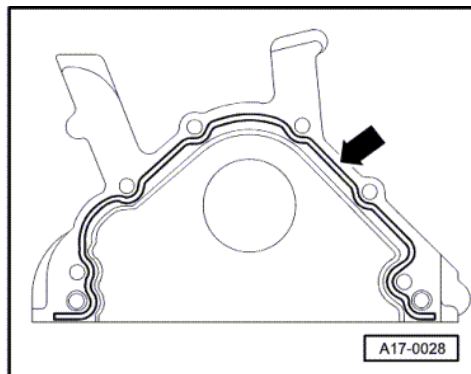


## Installing

### Note:

*The sealing flange must be installed within 5 minutes after applying silicone sealant.*

- -> Cut off nozzle of tube at front marking (ø of nozzle approx. 3 mm).



- -> Apply the bead of silicone sealant -arrow-onto the clean sealing surface of the sealing flange, as illustrated (arrow).
- Thickness of sealant bead: 2 ... 3 mm

### Note:

*The bead of sealant must not be thicker than prescribed, as otherwise excess sealant will enter the sump and obstruct the strainer in the oil intake manifold.*

- Fit the sealing flange immediately, and tighten all bolts lightly.

### Note:

*To fit sealing flange with the oil seal already installed, use guide sleeve T10053/1.*

- Tighten sealing flange bolts in diagonal sequence.
- Installing oil pan => page 147

### Note:

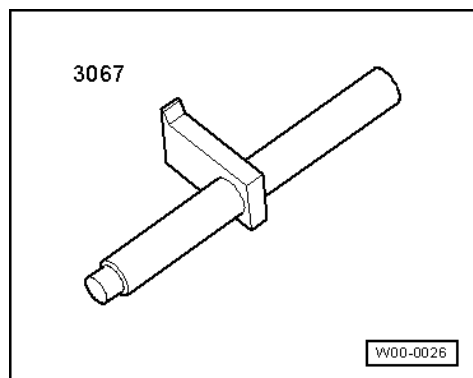
*After assembly, the sealant must dry for ca. 30 min. Only then may the engine oil be filled.*

- Install crankshaft oil seal => Page 65 .
- Install toothed belt (adjust valve timing) => Page 53 .

## Tightening torque

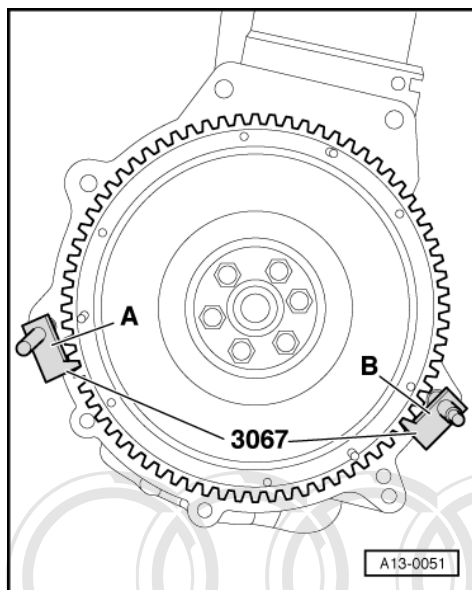
| Component                        | Nm |
|----------------------------------|----|
| Sealing flange to cylinder block | 15 |

## 2.4 - Removing and installing flywheel/drive plate



**Dual-mass flywheel****Special tools and workshop equipment required**

- ♦ Holding tool 3067

**Removing**

- Clutch removed
- -> Push counterhold 3067 into bore in cylinder block and attach to flywheel.
- Installation position for counter hold tool:
  - A - To tighten
  - B - To slacken
- Mark position of flywheel relative to engine.
- Unbolt flywheel.

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**Installing**

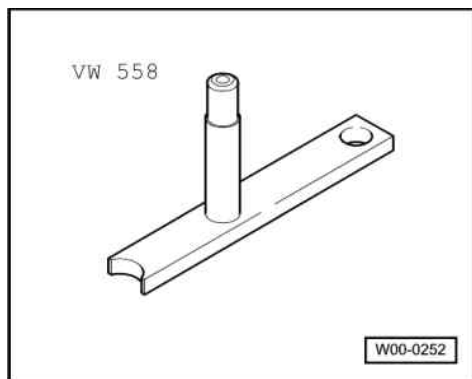
Installation is carried out in the reverse order; note the following:

- Only use new bolts to secure.

**Tightening torque**

| Component              | Nm          |
|------------------------|-------------|
| Flywheel to crankshaft | 60 + 90° 1) |

- 1) 90° corresponds to a quarter of a turn

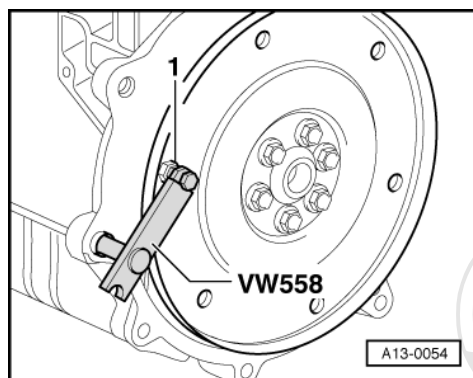




## Drive plate

### Special tools and workshop equipment required

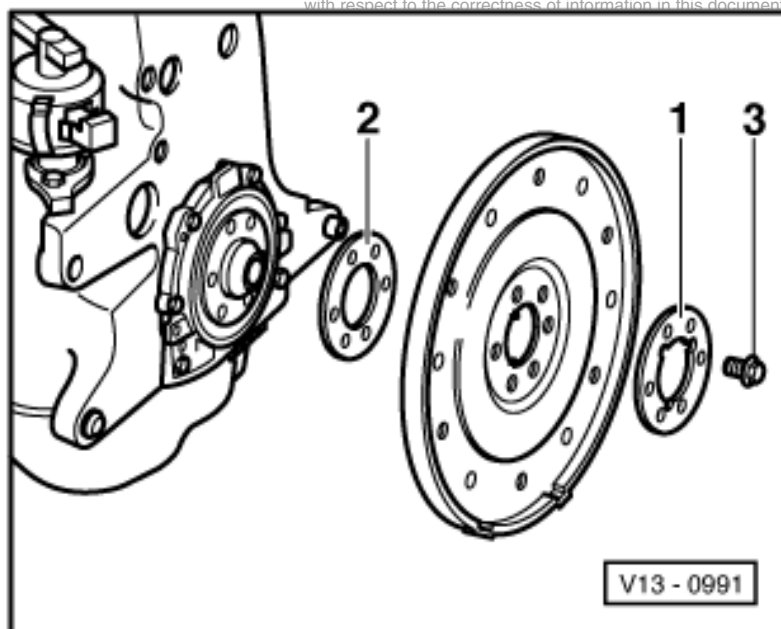
- ♦ Counterhold VW 558
- ♦ Hexagon bolt M8 x 45 and two M10 hexagon nuts
- ♦ Caliper gauge or depth gauge



### Removing

- -> Secure counter hold tool VW 558 to the drive plate with a hexagon bolt M8 x 45. Place two M10 hexagon nuts between counter hold tool and drive plate.
- Mark position of drive plate relative to engine.
- Unbolt drive plate.

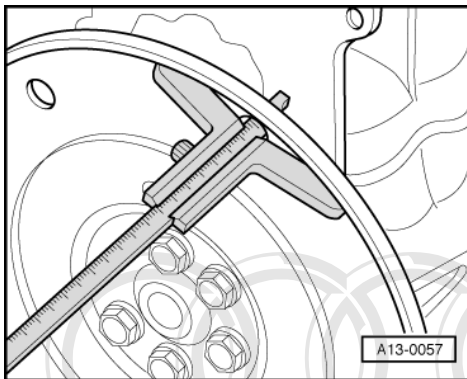
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### Installing

- -> Place drive plate with shim -2- and washer -1- in position.

- Insert at least 3 of the old securing bolts -3- and tighten to 30 Nm.

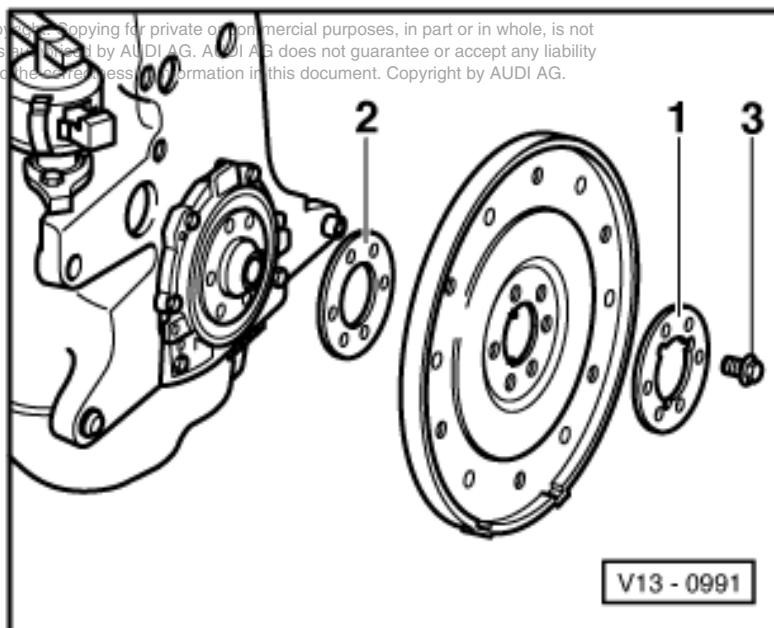


- -> Check fitting location of drive plate by measuring at three points and calculate average.
- Specified value: 19.5...21.1 mm

**Note:**

*Measurement is taken through the hole in the drive plate to the machined surface of the cylinder block.*

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If nominal value is exceeded:

- -> Remove drive plate again and fit without shim -2-. Retighten bolts to 30 Nm.
- Measure distance again.

If specified value is attained:

- Fit new bolts and tighten.

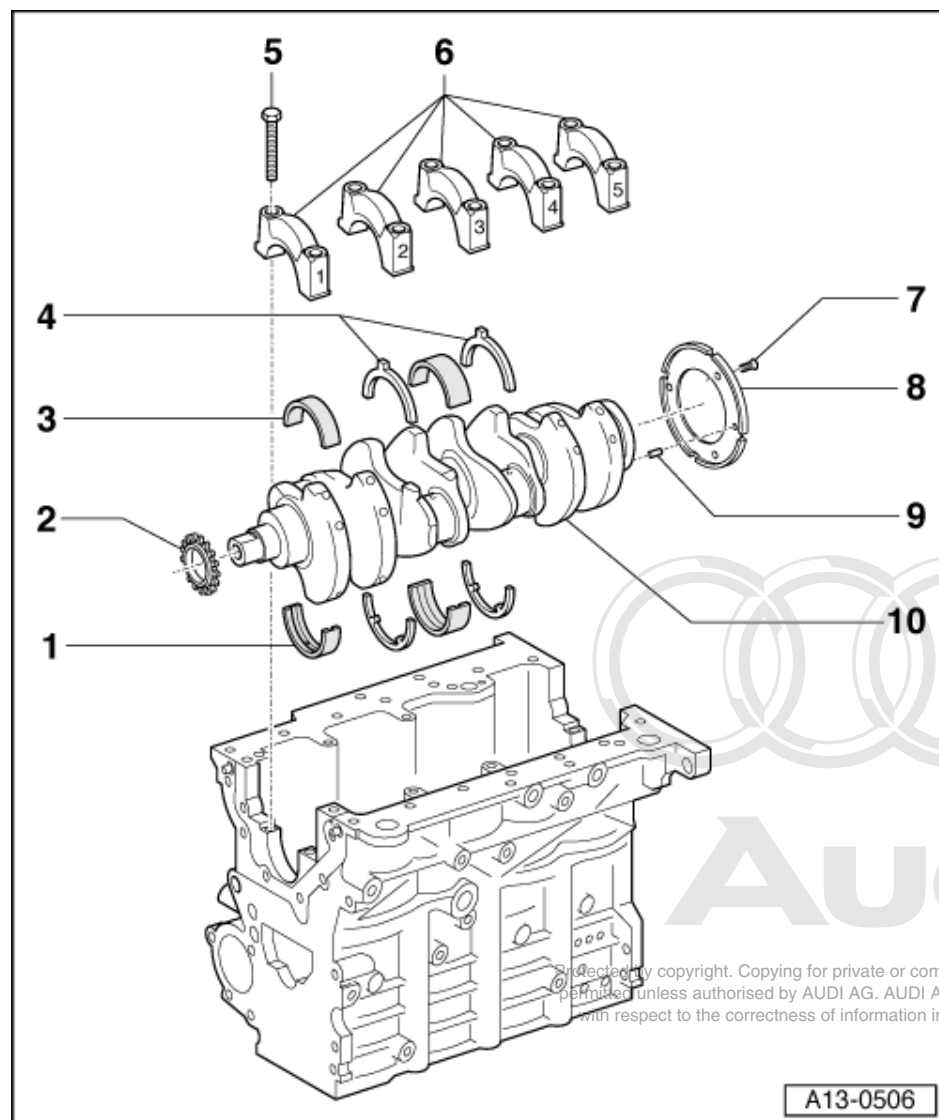
## Tightening torque

| Component                 | Nm         |
|---------------------------|------------|
| Drive plate to crankshaft | 60 + 90°1) |

1) 90° corresponds to a quarter of a turn

## 3 - Removing and installing crankshaft

### 3.1 - Removing and installing crankshaft



#### Note:

When working on the engine, it should be secured to the engine stand using the engine bracket VW 540 => Page 20.

#### 1 Bearing shell

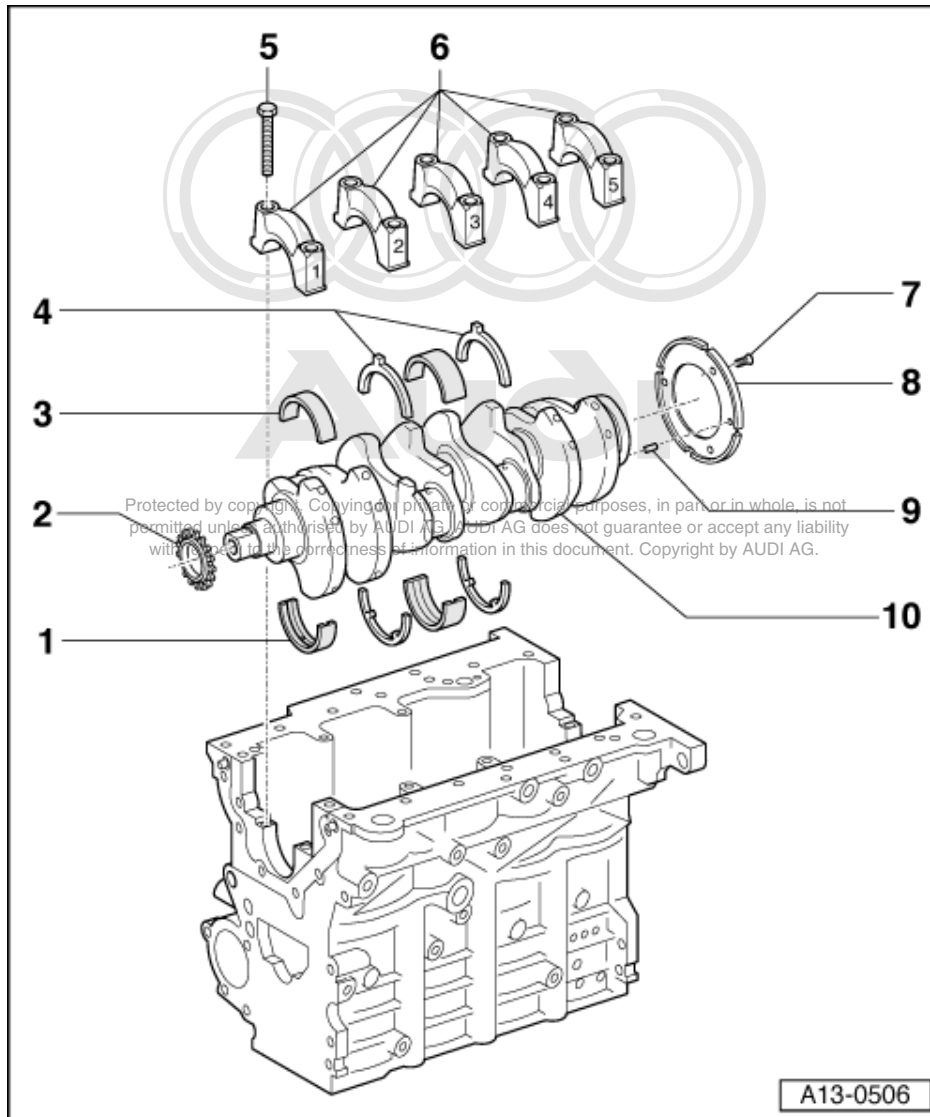
- ♦ For cylinder block with oil groove
- ♦ Do not interchange used bearing shells (mark).

#### 2 Chain sprocket

- ♦ For oil pump drive chain
- ♦ Replacing => Page 77.

### 3 Bearing shell

- ♦ For bearing cap without oil groove
- ♦ Do not interchange used bearing shells (mark).



### 4 Thrust washers

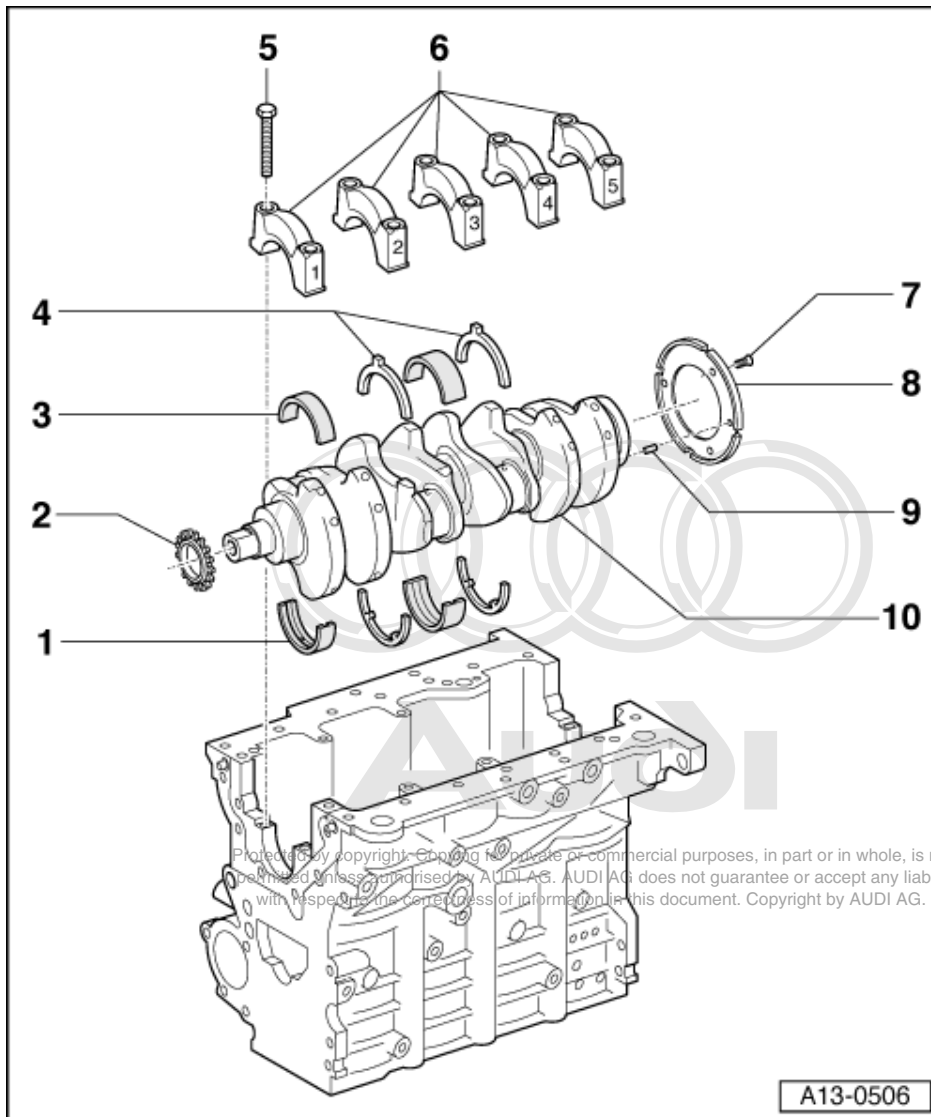
- ♦ For mounting 3
- ♦ Different types for cylinder block and bearing cap
- ♦ Note fixing arrangement

### 5 65 Nm + 90° (1/4 turn) further

- ♦ Replace
- ♦ When measuring radial clearance of crankshaft, tighten to 65 Nm but do not turn further.

### 6 Bearing cap

- ♦ Bearing cap 1: Pulley end
- ♦ Bearing cap 3 with recesses for thrust washers
- ♦ Bearing shell retaining lugs (cylinder block/bearing cap) must be on the same side.



## 7 10 Nm + 90° (1/4 turn) further

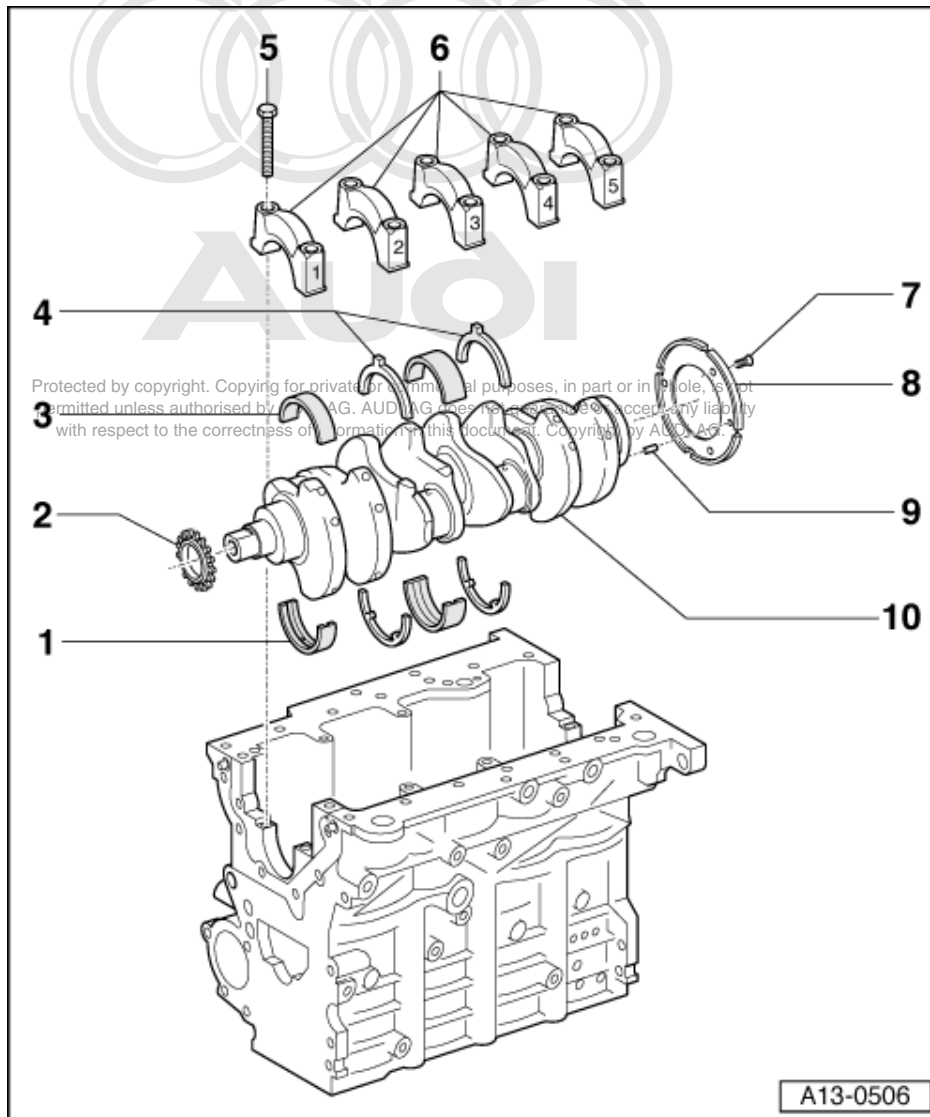
- ◆ Replace
- ◆ After each loosening of bolts replace sender wheel  
=> Fig. 76

## 8 Sender wheel

- ◆ For engine speed sender -G28
- ◆ Can only be installed in one position. Holes are off set
- ◆ Always renew sender wheel if securing bolts have been unscrewed.
- ◆ Removing and installing  
=> Fig. 76

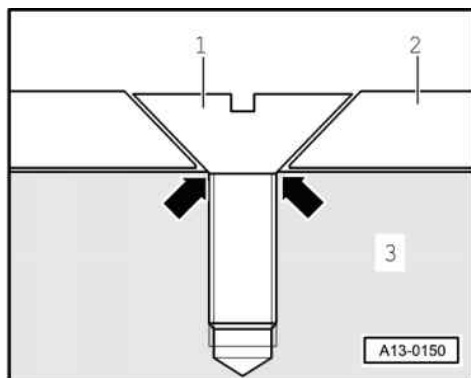
## 9 Dowel pin

- ◆ Check projection from crankshaft => Fig. 76



### 10 Crankshaft

- ♦ Axial clearance new: 0.07...0.23 mm  
Wear limit: 0.30 mm
- ♦ Check radial play with Plastigage  
New: 0.02...0.04 mm  
Wear limit: 0.15 mm
- ♦ Do not rotate the crankshaft when checking the radial play.
- ♦ Crankshaft dimensions  
=>Page 77 .



➔ Fig.1 Removing and installing sender wheel

- Always renew sender wheel -2- if securing bolts -1- have been unscrewed.

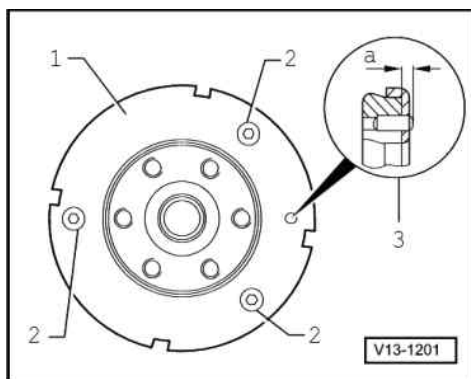
#### Notes:

- ♦ If the securing bolts are tightened a second time, the seats for the countersunk bolt heads in the sender wheel will be distorted to such an extent that the bolt heads will come into direct contact with the crankshaft -3- (- arrows -) and the sender wheel will only fit loosely under the bolts.
- ♦ The mounting holes are asymmetrically spaced, so it is only possible to install the sender wheel in one position.

#### Tightening torque

| Component                  | Nm            |
|----------------------------|---------------|
| Sender wheel to crankshaft | 10 + 90° 1)2) |

- 1) Replace bolts
- 2) 90° corresponds to a quarter of a turn



➔ Fig.2 Check projection of dowel sleeve from crankshaft

Projection of dowel sleeve -3- from crankshaft

- ♦  $a = 2.5 \dots 3.0 \text{ mm}$



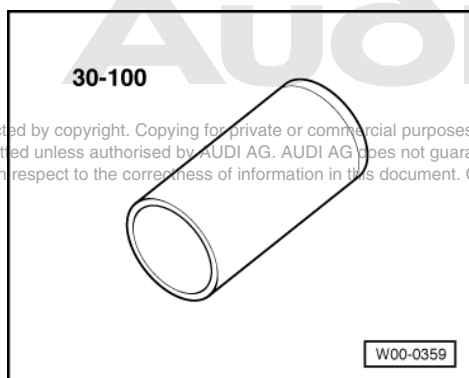
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### 3.2 - Crankshaft dimensions

(in mm)

| Honing dimension | Crankshaft bearing main journal $\varnothing$ | Conrod bearing main journal $\varnothing$ |
|------------------|-----------------------------------------------|-------------------------------------------|
| Basic dimension  | -0.022<br>54.00<br>-0.042                     | -0.022<br>50.90<br>-0.042                 |
| 1st undersize    | -0.022<br>53.75<br>-0.042                     | -0.022<br>50.65<br>-0.042                 |
| 2nd undersize    | -0.022<br>53.50<br>-0.042                     | -0.022<br>50.40<br>-0.042                 |
| 3rd undersize    | -0.022<br>53.25<br>-0.042                     | -0.022<br>50.15<br>-0.042                 |

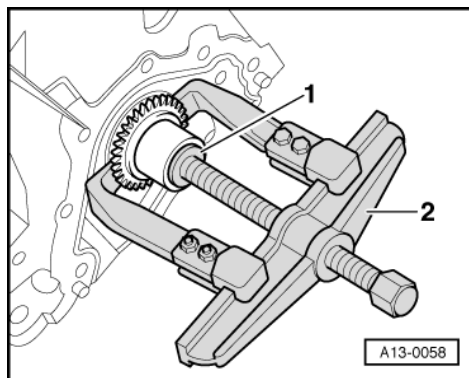
### 3.3 - Removing and installing chain sprocket



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#### Special tools and workshop equipment required

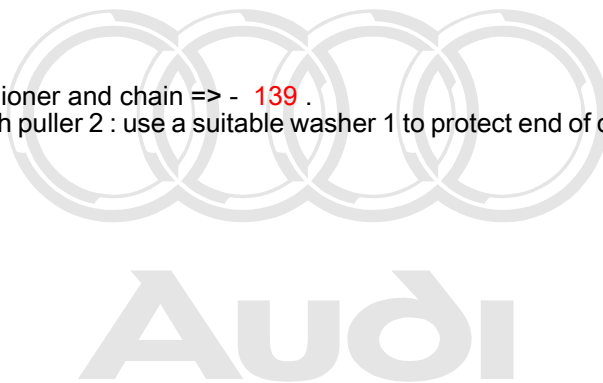
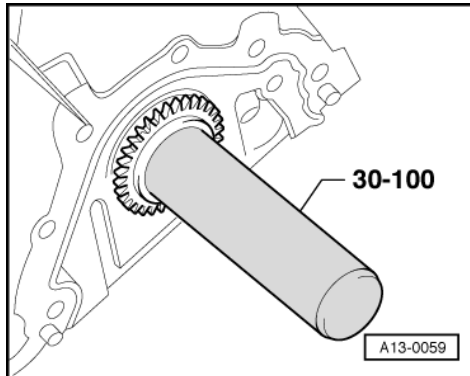
- ◆ Sleeve 30-100
- ◆ Two-arm puller, commercially available.
- ◆ Protective gloves





## Removing

- Remove oil pan => Page **146** .
- Removing front sealing flange => Page **66** .
- Remove chain wheel of oil pump, chain tensioner and chain => - **139** .
- -> Detach chain sprocket from crankshaft with puller 2 : use a suitable washer 1 to protect end of crankshaft.



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## Installing

Installation is carried out in the reverse order; note the following:

**Important**  
Wear protective gloves.

- Heat chain sprocket in oven for approx. 15 minutes to 220 °C.

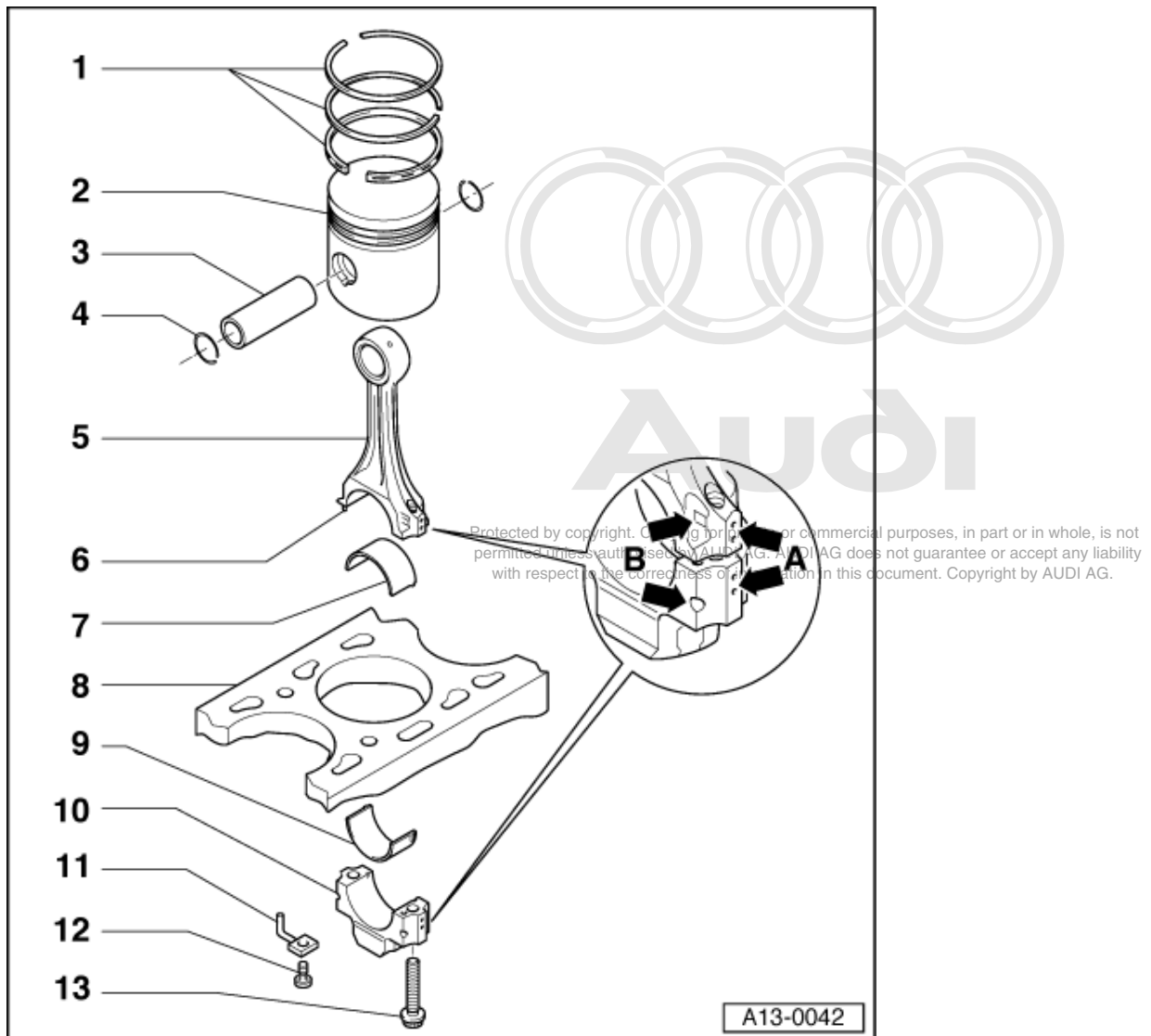
### **Note:**

*Installation position: wide collar on sprocket facing towards engine.*

- -> Fit chain sprocket on end of crankshaft using pliers and push onto seat on crankshaft with drift sleeve 30-100.

## 4 - Dismantling and assembling pistons and conrods

### 4.1 - Dismantling and assembling pistons and conrods



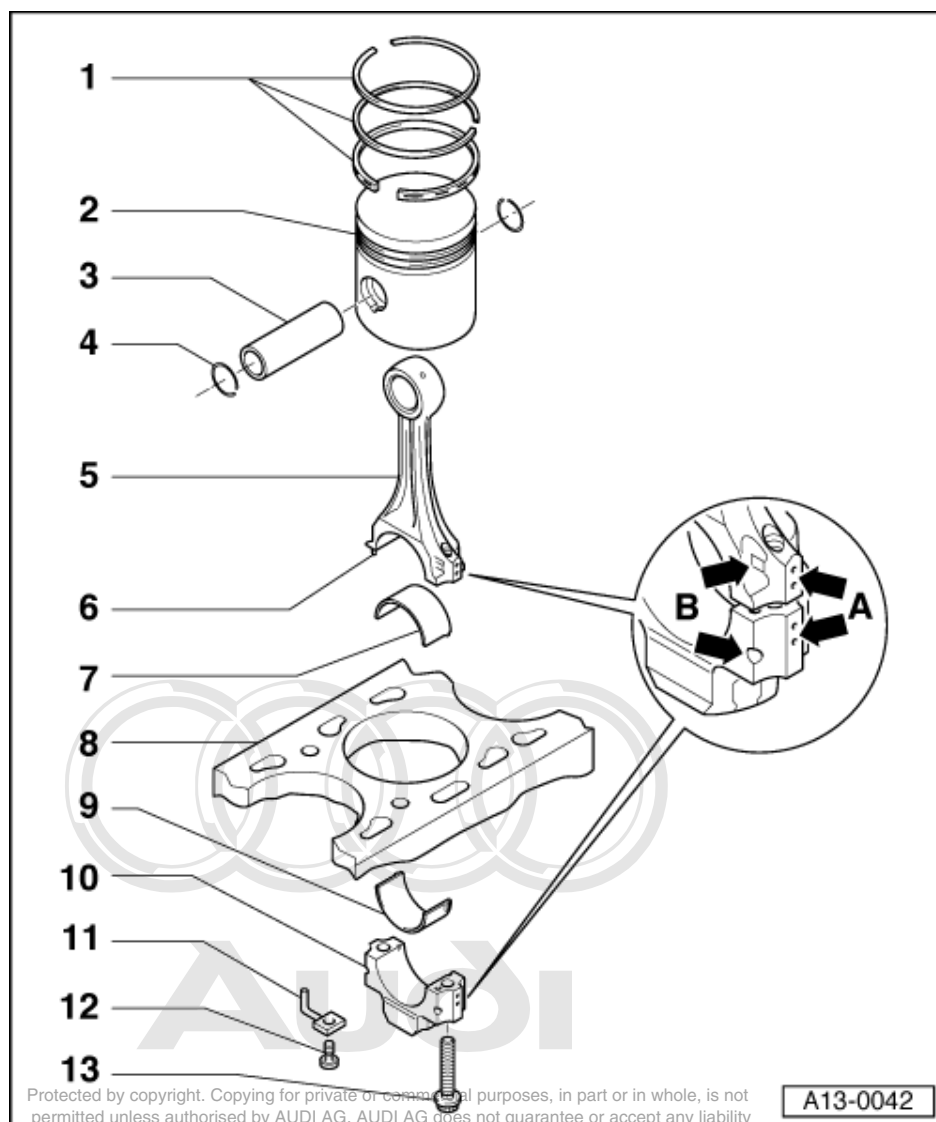
#### Note:

The following connecting rod versions are factory-installed in alternating fashion:

- ◆ Connecting rod with dowel pin -Item 6 -. Use connecting rod bolts without centring feature for this type.
- ◆ Connecting rods without dowel pin. Use connecting rod bolts with centring feature for this type.

#### 1 Piston rings

- ◆ Offset gaps by 120°
- ◆ Remove and install with piston ring pliers.
- ◆ "TOP" faces towards piston crown
- ◆ Checking ring gap  
=> Fig. 85
- ◆ Checking ring to groove clearance  
=> Fig. 85

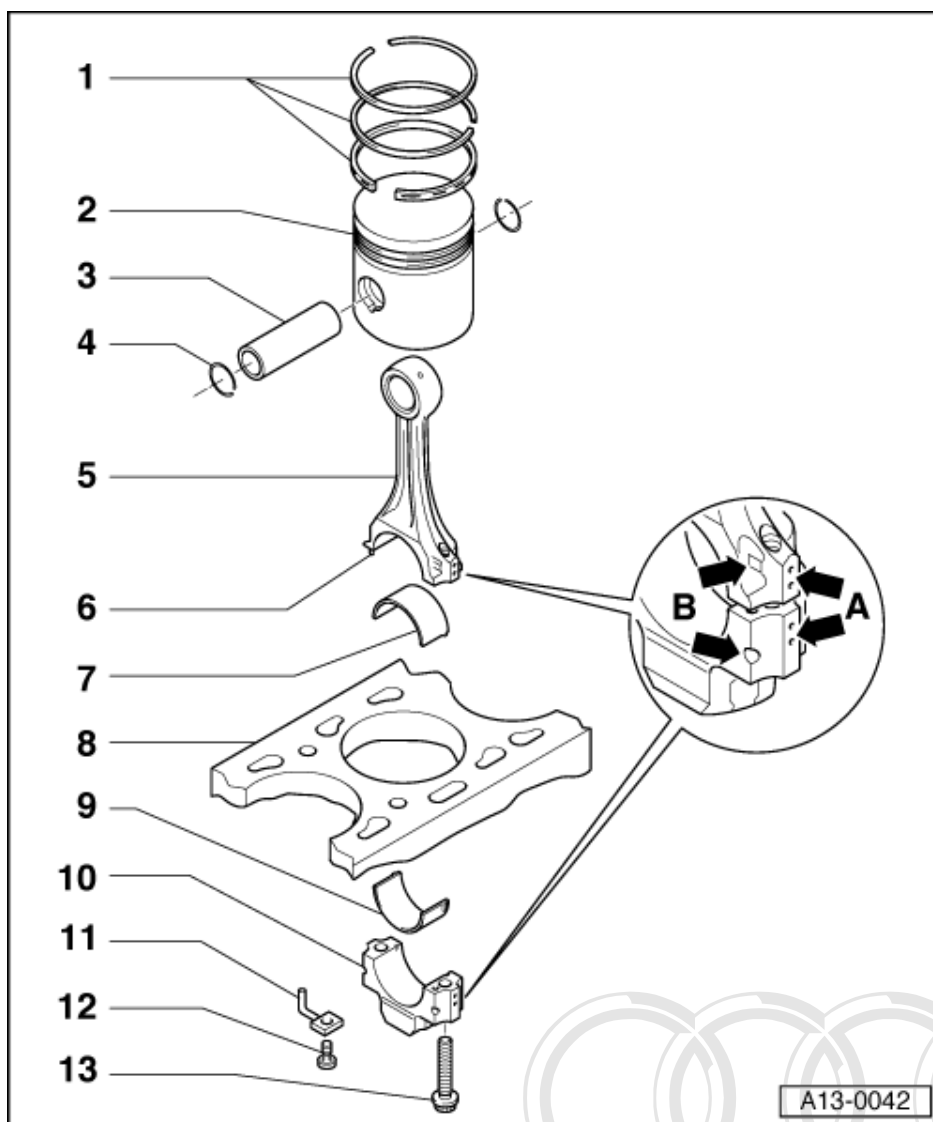


## 2 Piston

- ♦ Mark installation position and cylinder number.
- ♦ Installation position and arrangement of piston/cylinder  
=> Fig. 86
- ♦ Arrow on piston crown points to pulley end.
- ♦ Install using piston ring clamp.
- ♦ If cracking is visible on piston skirt, replace piston
- ♦ Checking piston projection at TDC =>Page 87
- ♦ Piston and cylinder dimensions  
=>Page 89.
- ♦ Checking => Fig. 86

## 3 Piston pin

- ♦ If difficult to remove, heat piston to 60 °C
- ♦ Remove and install with VW 222a



4 Circlip

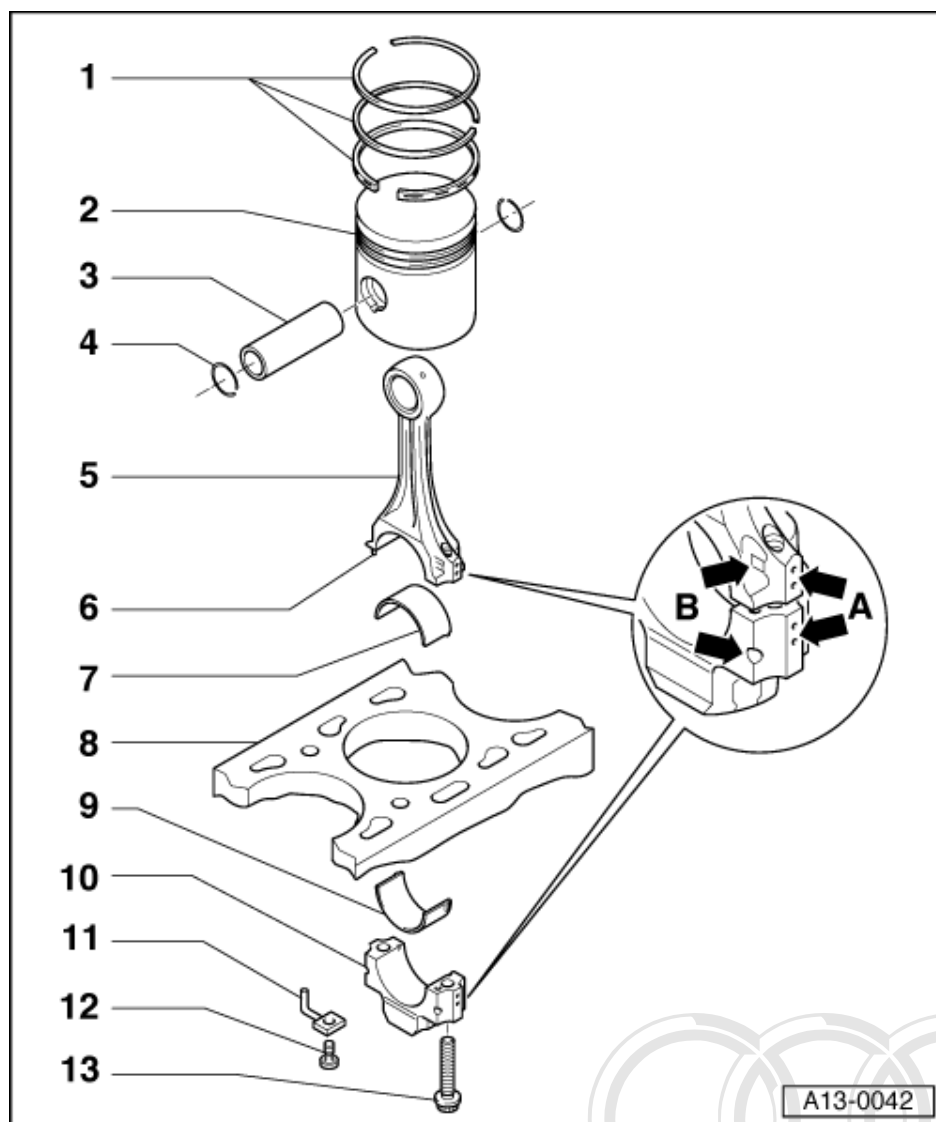
5 Conrod

- ♦ Only renew as a set
- ♦ Mark cylinder allocation -A-
- ♦ Installation position:  
Markings -B- face towards pulley side

6 Dowel pin

- ♦ Must be firmly seated in conrod, not in conrod bearing cap

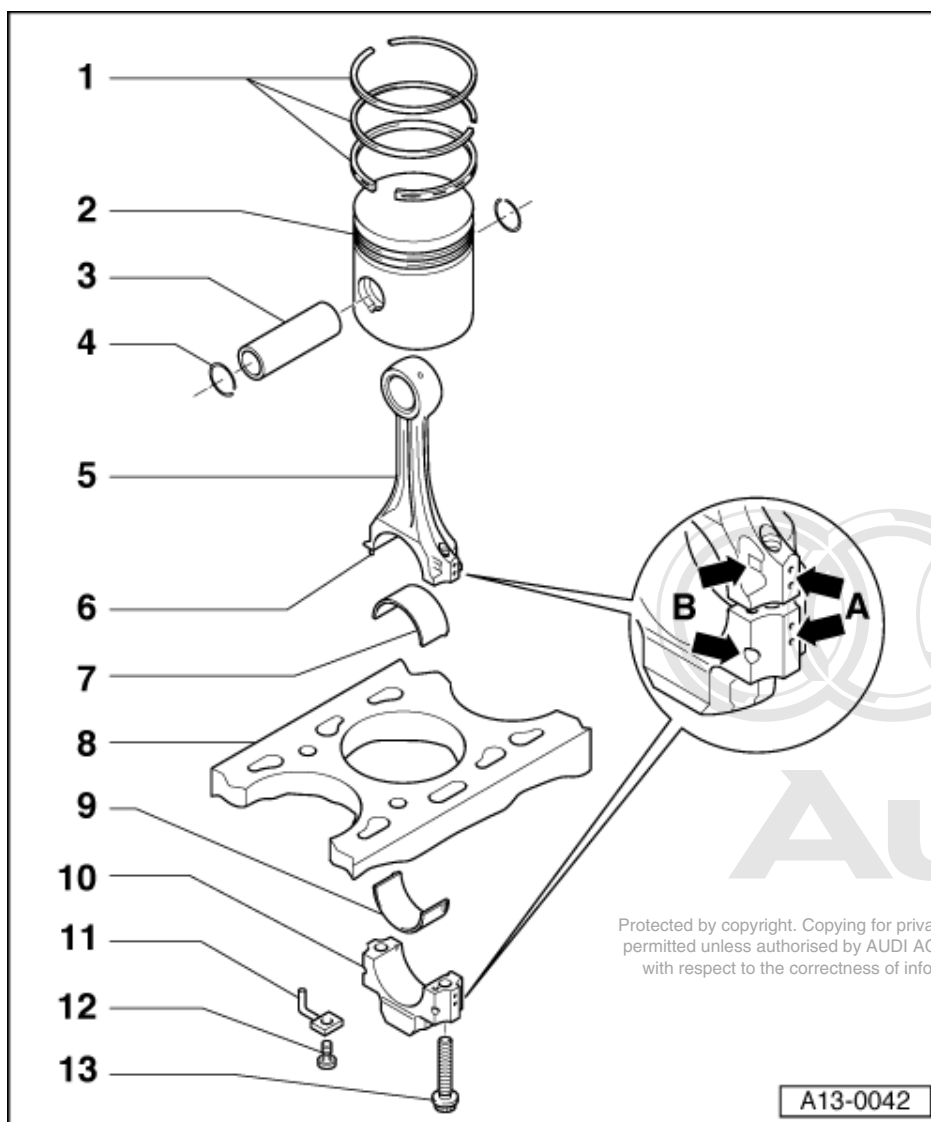
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## 7 Bearing shell

- ◆ Do not interchange used bearing shells (mark).
  - ◆ Note versions: For engine codes AHF, ASV upper bearing shell (facing piston) made of more wear-resistant material Identifying characteristic for new bearing shells: Black line on running surface in separation edge area
  - ◆ Ensure tight fit
  - ◆ Axial play  
Wear limit: 0.37 mm
  - ◆ Check radial play with Plastigage:  
Wear limit: 0.08 mm
- Do not rotate crankshaft when checking radial play

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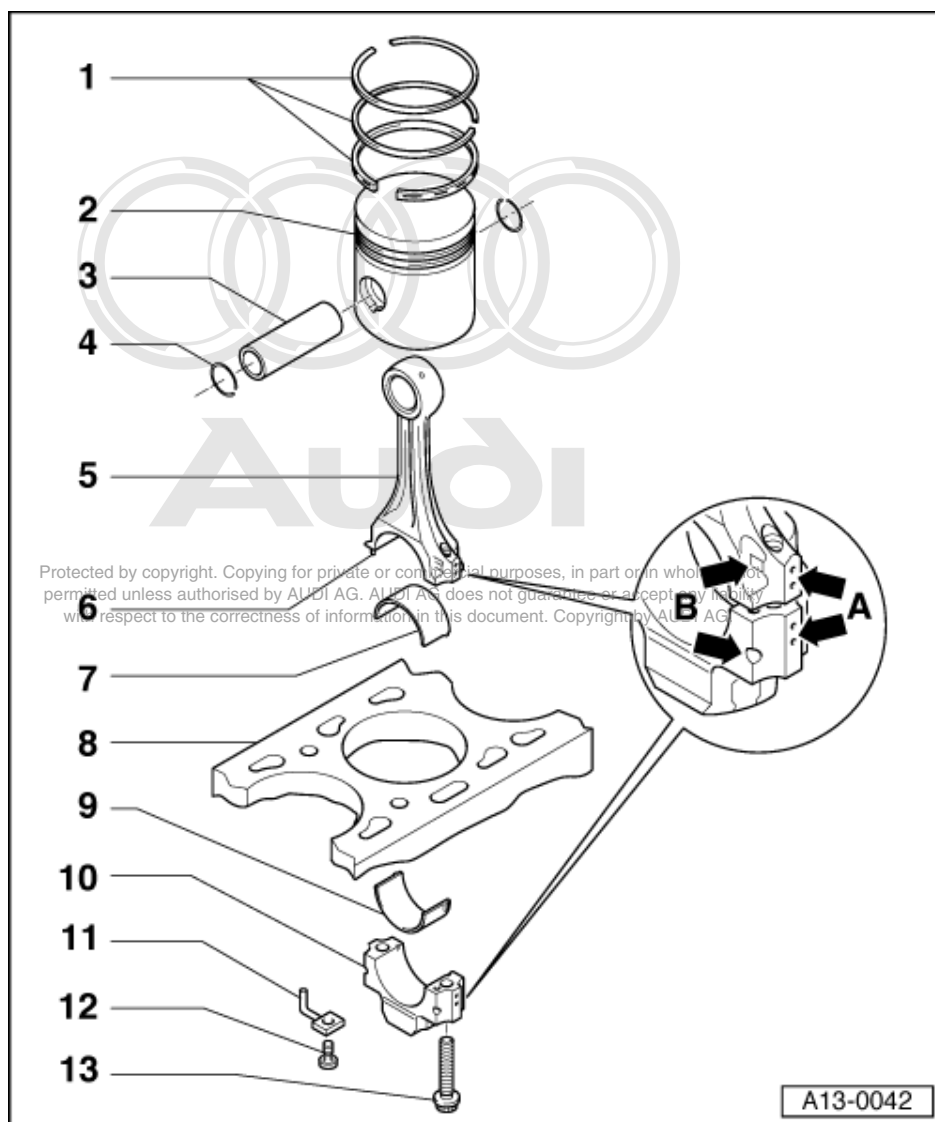


## 8 Cylinder block

- ♦ Checking cylinder bore  
=> Fig. 87
- ♦ Piston and cylinder dimensions  
=>Page 89.

## 9 Bearing shell

- ♦ Note installation position
- ♦ Do not interchange used bearing shells
- ♦ Ensure retaining lugs fit tightly in recesses.
- ♦ Axial play  
Wear limit: 0.37 mm
- ♦ Check radial play with Plastigage:  
Wear limit: 0.08 mm  
Do not rotate crankshaft when checking radial play



#### 10 Conrod bearing cap

- ♦ Mark cylinder allocation -A-
- ♦ Installation position:  
Markings -B- face towards pulley side

#### 11 Oil spray jet

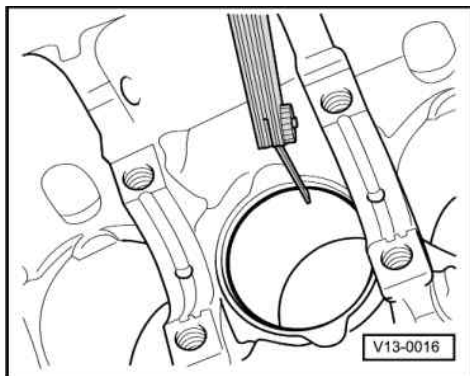
- ♦ For piston cooling

#### 12 25 Nm

- ♦ With pressure relief valve
- ♦ Do not apply sealant when installing.

#### 13 Conrod bolt - 30 Nm + 90° (1/4 turn) further

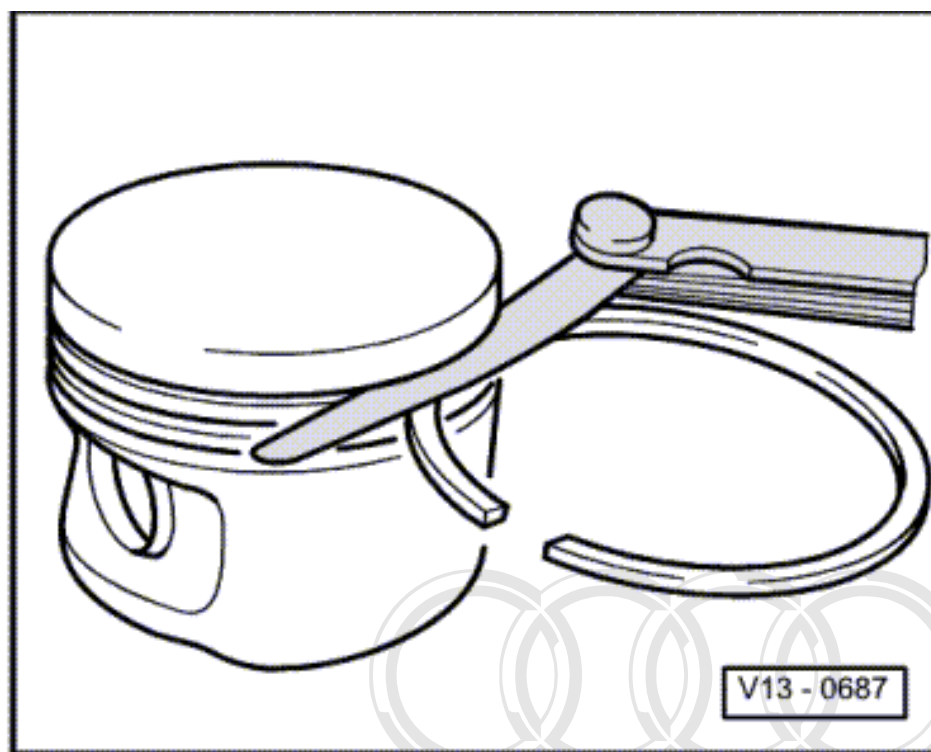
- ♦ Replace
- ♦ Oil threads and contact surface
- ♦ To measure radial play tighten to 30 Nm but not further



-> Fig. 1 Checking piston ring gap

- Push ring into cylinder seated squarely on cylinder wall from top down up to approx. 15 mm before bottom edge of cylinder. Use a piston without rings.

| Piston ring<br>Dimensions in mm | New        | Wear limit |
|---------------------------------|------------|------------|
| 1st compression ring            | 0.25....40 | 1.0        |
| 2nd compression ring            | 0.25....40 | 1.0        |
| Oil scraper ring                | 0.25....50 | 1.0        |



-> Fig. 2 Checking ring to groove clearance

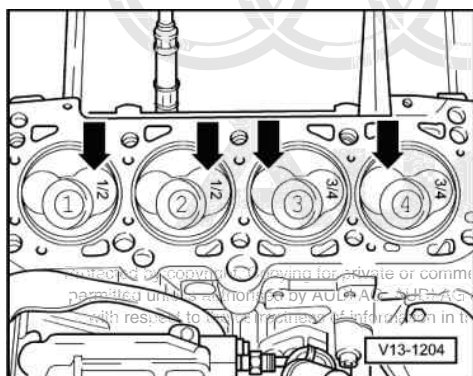
- Clean groove before checking clearance.

| Piston ring<br>Dimensions in mm | New        | Wear limit |
|---------------------------------|------------|------------|
| 1st compression ring            | 0.06....09 | 0.25       |
| 2nd compression ring            | 0.05....08 | 0.25       |

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| Piston ring<br>Dimensions in mm | New        | Wear limit |
|---------------------------------|------------|------------|
| Oil scraper ring                | 0.03....06 | 0.15       |



-> Fig.3 Piston installation position and arrangement of piston/cylinder

- Mark installation position and allocation on inside of piston (not on piston crown) with electric pen or felt-tip pen.

Piston in cylinder 1 and 2:

Large valve pocket for inlet valve towards flywheel side -arrows-

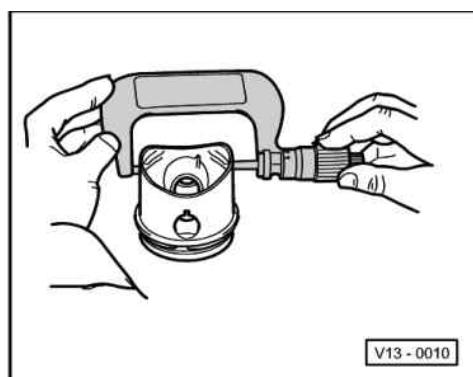
Piston in cylinder 3 and 4:

Large valve pocket for inlet valve towards pulley side -arrows-

**Note:**

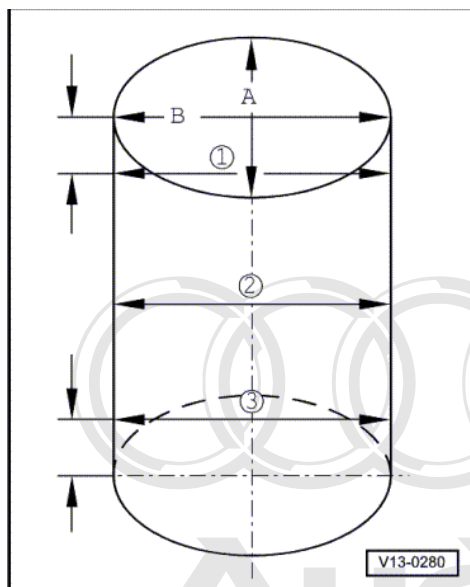
*On new pistons the cylinder numbers are marked in colour on the piston crowns.*

- ♦ Piston for cylinder 1 and 2:  
are marked 1/2
- ♦ Piston for cylinder 3 and 4:  
are marked 3/4



-> Fig.4 Checking piston

- Measure approx. 10 mm from the lower edge, offset by 90° to the piston pin axis.
  - Permissible deviation from nominal dimension:  
no more than 0.04 mm.



-> Fig.5 Checking cylinder bores.

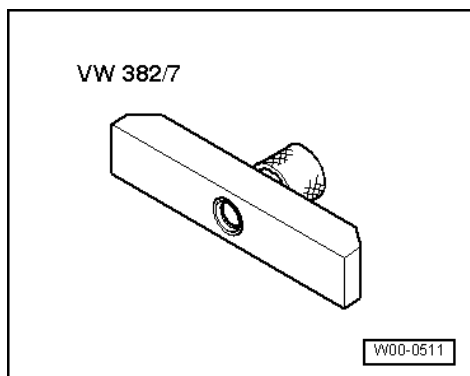
**Special tools and workshop equipment required**

- ♦ Use internal dial gauge 50 ... 100 mm.

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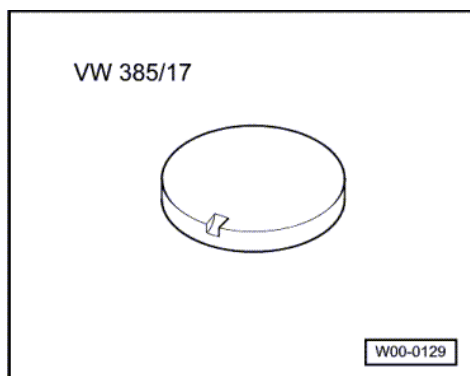
- Take measurements at 3 positions in both lateral direction -A- and longitudinal direction -B-.
  - Permissible deviation from nominal dimension: no more than 0.10 mm.

## 4.2 - Checking piston projection at TDC



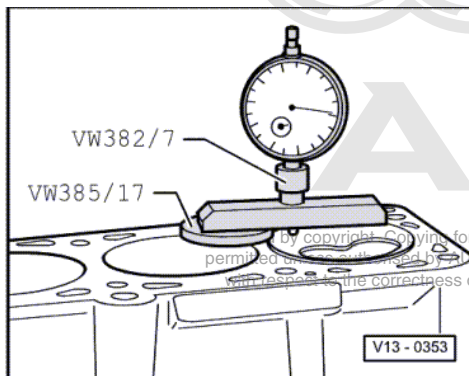
**Special tools and workshop equipment required**

- ♦ Special tool VW 382/7



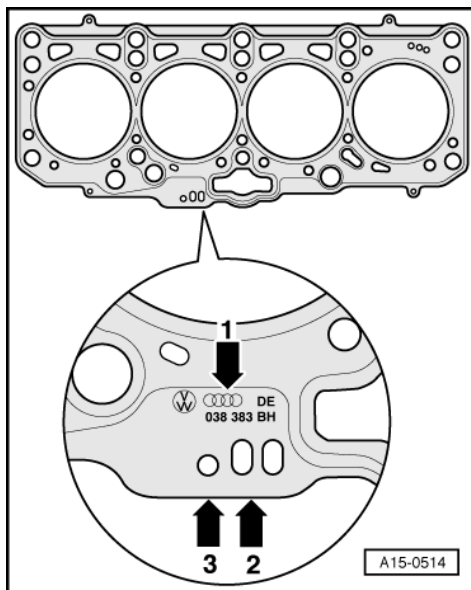


- ♦ Measuring plate VW 385/17



-> Piston projection at TDC must be measured when installing new pistons or a short engine. Depending on piston projection, install the corresponding cylinder head gasket according to following table:

| Piston projection above top surface of cylinder block | Identification (No. of holes) |
|-------------------------------------------------------|-------------------------------|
| 0.91 mm ... 1.00 mm                                   | 1                             |
| 1.01 mm ... 1.10 mm                                   | 2                             |
| 1.11 mm ... 1.20 mm                                   | 3                             |



-> Cylinder head gasket identification

- ♦ Part-No. = arrow 1
- ♦ Production control code = arrow 2 (can be disregarded!)
- ♦ Holes = arrow 3

**Note:**

*If the measured values for piston projection are not the same for all the pistons, use the highest value to determine the correct gasket size*

### 4.3 - Piston and cylinder dimensions

| Honing dimension   | Piston- $\emptyset$ | Cylinder bore - $\emptyset$ |
|--------------------|---------------------|-----------------------------|
| Basic dimension mm | 79.47               | 79.51                       |
| 1st undersize mm   | 79.72               | 79.76                       |
| 2nd undersize mm   | 79.97               | 80.01                       |



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## 15 - Cylinder head, Valve gear

### 1 - Removing and installing cylinder head

#### 1.1 - Removing and installing cylinder head

##### *Notes:*

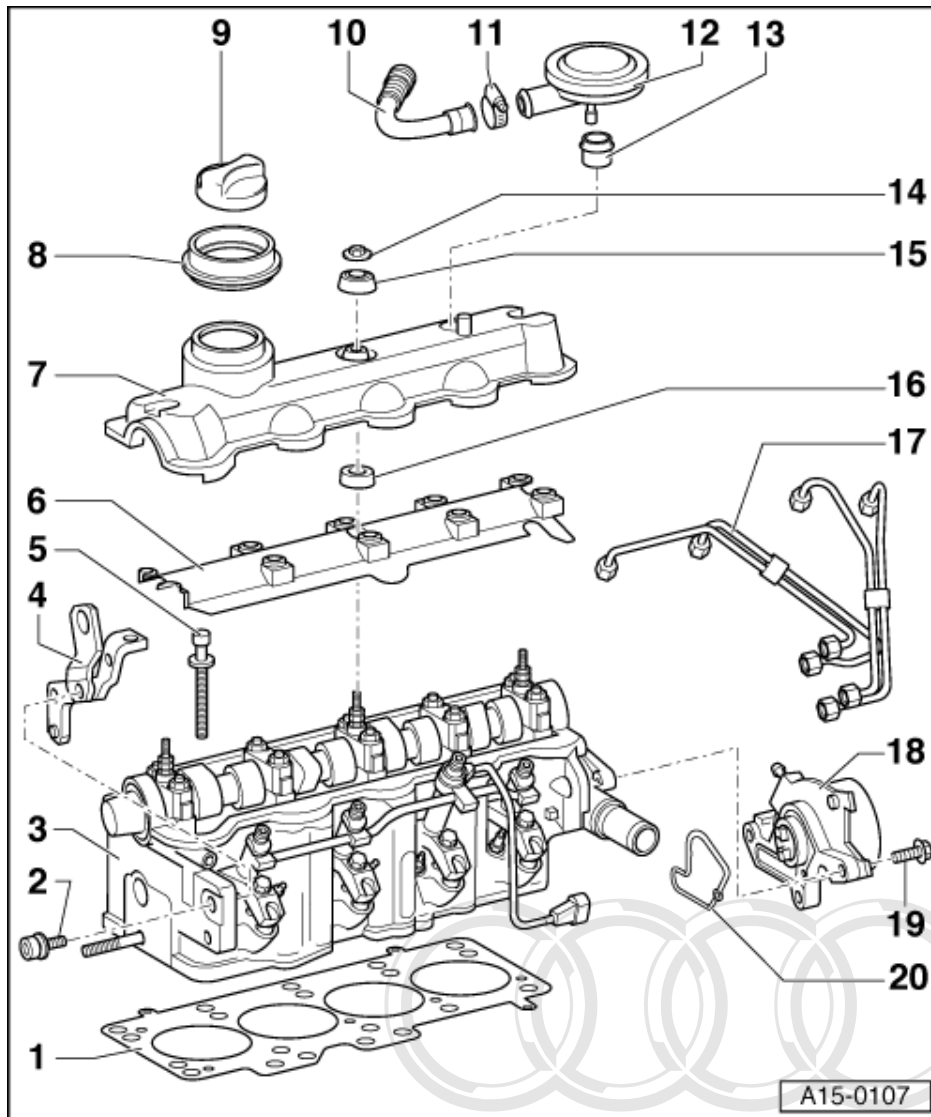
- ♦ Cylinder heads with cracks between the valve seats can be used without reducing the service life if the cracks are small and a maximum of 0.5 mm wide.
- ♦ When fitting a new cylinder head or cylinder head gasket, drain off all the old coolant and re-fill with new coolant.
- ♦ When engine oil is contaminated perform oil change:

=> Maintenance Manual

- ♦ The cylinder head on a diesel engine must not be reworked.
- ♦ When installing an exchange cylinder head with fitted camshaft, the contact surfaces between tappets and cams must be oiled after installing the head.
- ♦ The plastic protectors fitted to protect the open valves must only be removed immediately before fitting the cylinder head.
- ♦ Hose connections and hoses for charge air system must be free of oil and grease before assembly.



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# 1 Cylinder head gasket

- ♦ Renew => Removing cylinder head, Page 102.
- ♦ Observe marking  
=> Fig. 95
- ♦ After replacing, fill with fresh coolant

# 2 20 Nm

# 3 Cylinder head

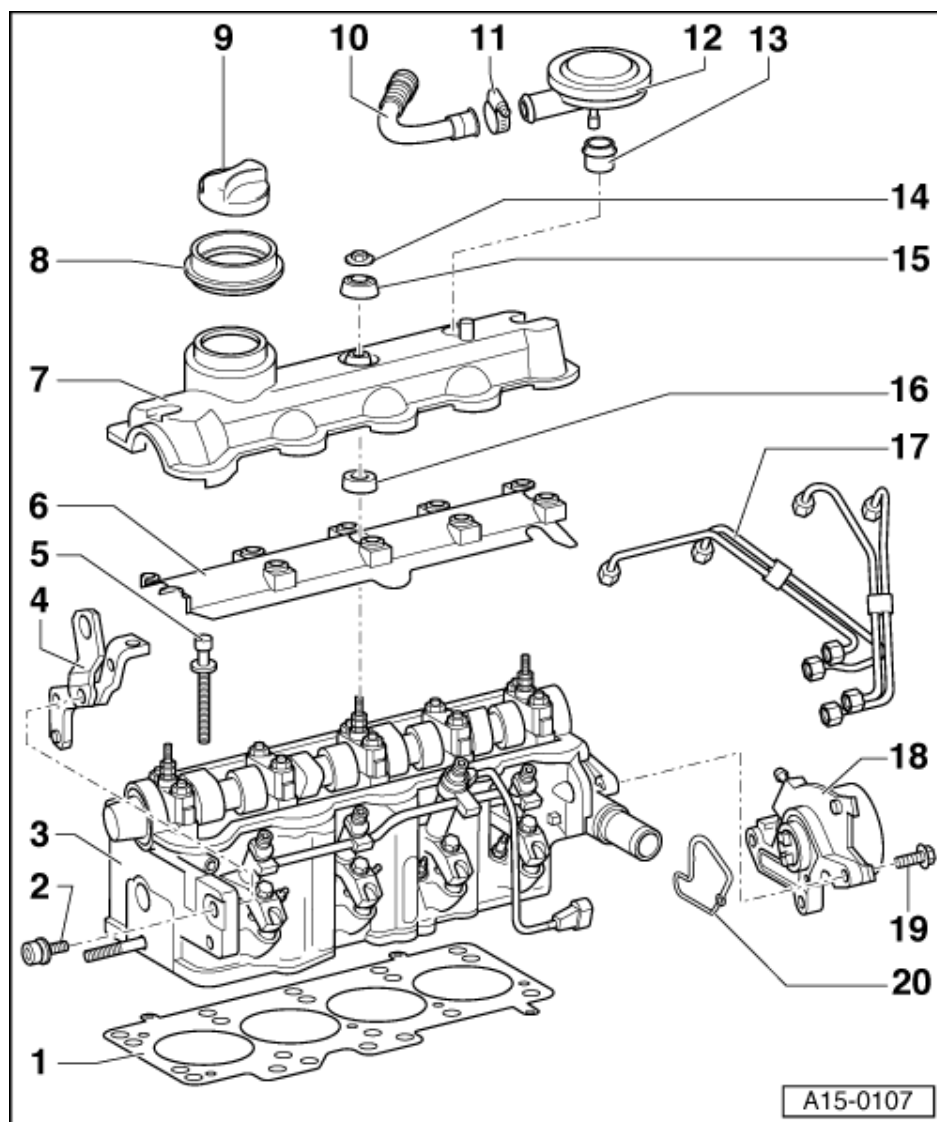
- ♦ Removing => Page 102
- ♦ Checking for distortion  
=> Fig. 95
- ♦ Installing => Page 112
- ♦ After replacing, fill with fresh coolant

# 4 Lifting eye

# 5 Cylinder head bolt

- ♦ Replace
- ♦ Note sequence when loosening => Page 112
- ♦ Note sequence when tightening => Page 115

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**6 Oil deflector**

- ♦ Bolted to cylinder head cover as of 10.97 (tightening torque 5 Nm)

**7 Cylinder head cover**

- ♦ With gasket vulcanised in place
- ♦ Handle gasket with care
- ♦ Replace cylinder head cover if gasket is damaged
- ♦ Removing and installing  
=>Page 96 .

**8 Sealing collar**

**9 Cap**

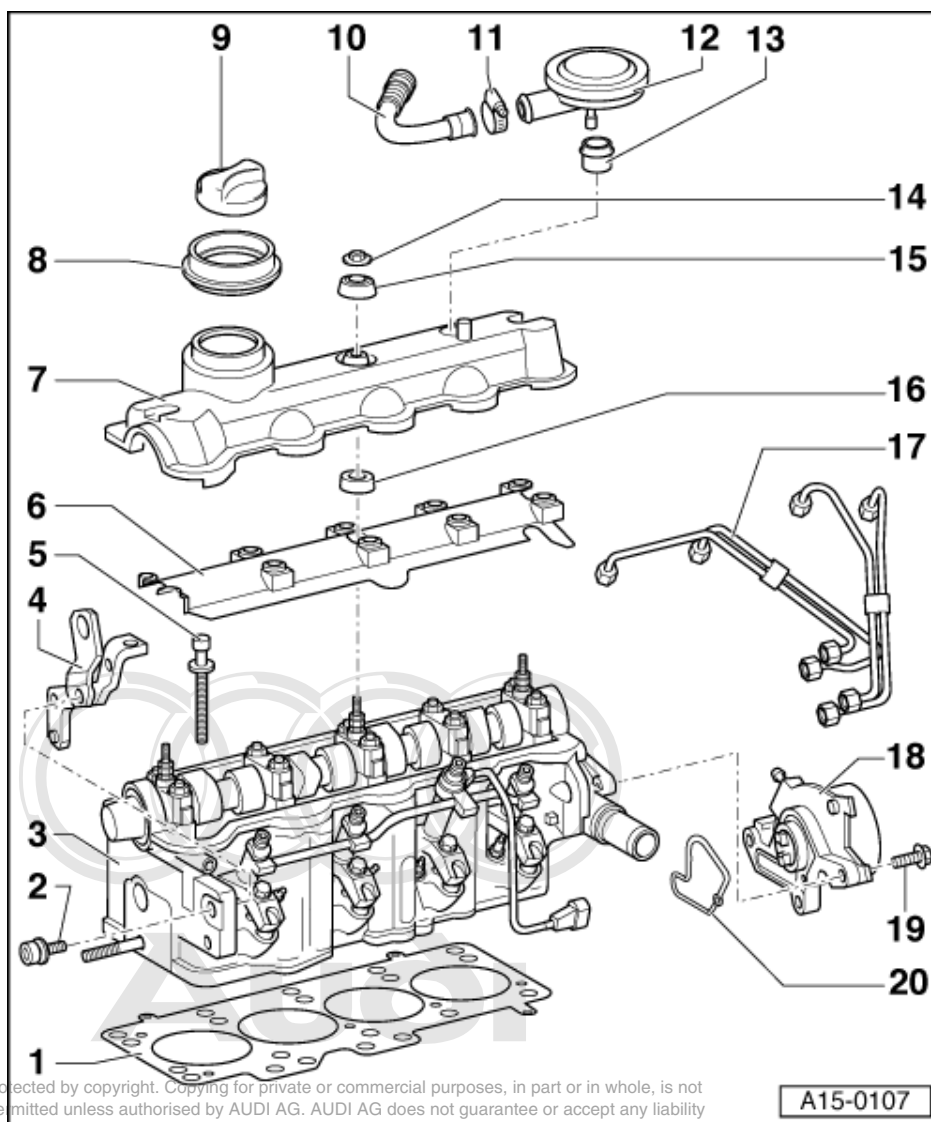
- ♦ Renew seal if damaged

**10 Vent pipe**

- ♦ To rear air duct pipe

**11 Hose clamp**

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A15-0107

#### 12 Pressure regulating valve

- ♦ For crankcase breather

#### 13 Rubber grommet

- ♦ Replace if damaged

#### 14 Collared nut - 10 Nm

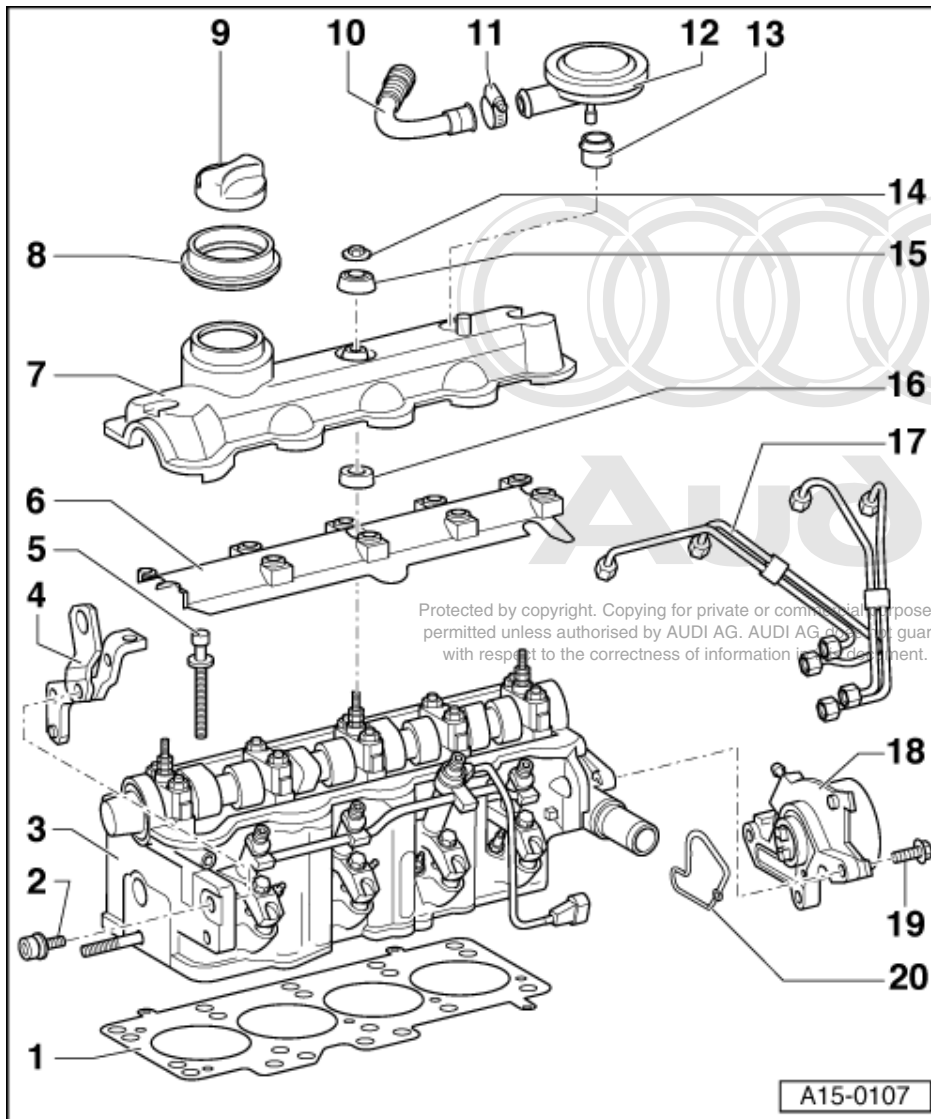
- ♦ Is tightened on block
- ♦ If tightening on block is not accomplished, oil contact surface
- ♦ Cylinder head cover mounting changed as of 10.97 => Page 97

#### 15 Sealing washer, upper

- ♦ Replace if damaged
- ♦ Cylinder head cover mounting changed as of 10.97 => Page 97

#### 16 Sealing cone, lower

- ♦ Cylinder head cover mounting changed as of 10.97 => Page 97



#### 17 Injector pipes

- ◆ Tighten to 25 Nm
- ◆ Remove using 3035
- ◆ Always remove pipework as a complete unit
- ◆ Do not alter shape

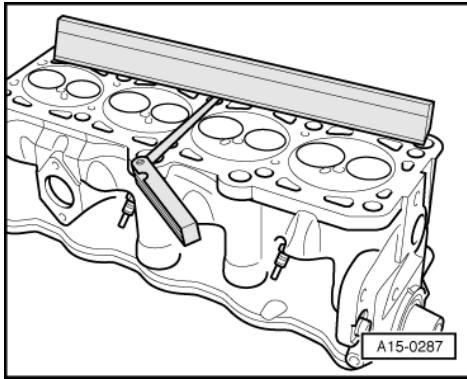
#### 18 Exhauster

- ◆ For brake servo
- ◆ Removing and installing => Fig. 96

#### 19 20 Nm

#### 20 Gasket

- ◆ Replace

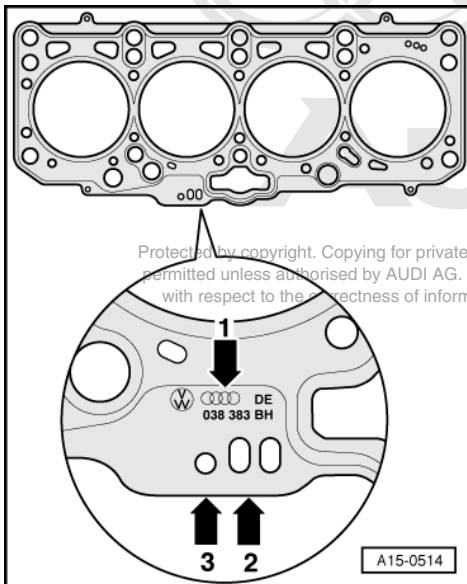


-> Fig.1 Check cylinder head for distortion.

- Use knife edge, straightedge and feeler gauge to measure at several points.
- Max. permissible distortion: 0.1 mm

**Note:**

*The cylinder head on a diesel engine must not be reworked.*

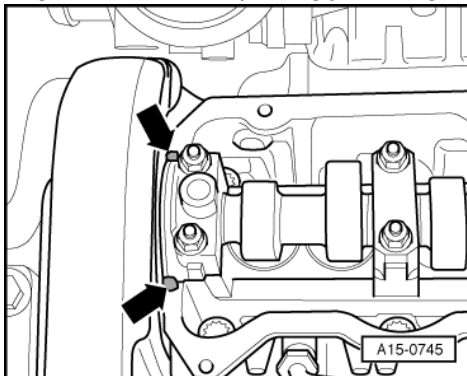


-> Fig.2 Cylinder head gasket-marking

- ◆ Part-No. = arrow 1
- ◆ Production control code = arrow 2 (can be disregarded!)
- ◆ Holes = arrow 3

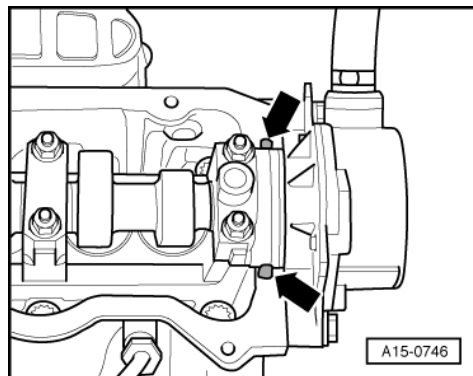
**Note:**

*Cylinder head gaskets of different thicknesses are fitted depending on the amount of piston projection => Page 87. When replacing just the gasket, the new gasket should have the same markings.*



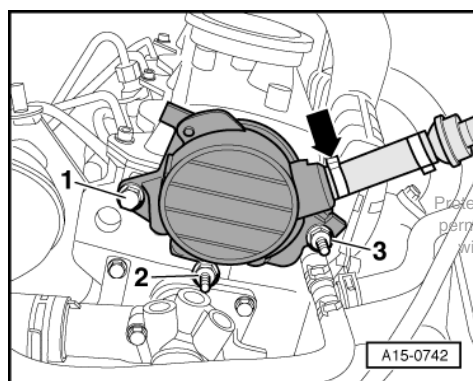
### -> Fig. 3 Seal connections between bearing cap and cylinder head

- Coat both edges on the sealing edges of bearing cap/cylinder head -arrows- on front...



- -> ... and apply a drop of sealing fluid at rear ( $\varnothing$  approx. 5 mm) -arrows-.
- Sealants

### => Parts List



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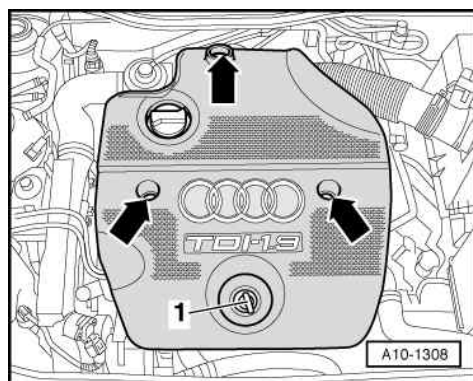
### -> Fig.4 Removing and installing exhauster pump

- Where present, unscrew the vacuum hose bracket from the dual bolt -2- and -3-.
- Disconnect the vacuum hose -arrow- from the brake servo.
- Screw out bolts -1 ... 3- and remove the exhauster.

### Tightening torque

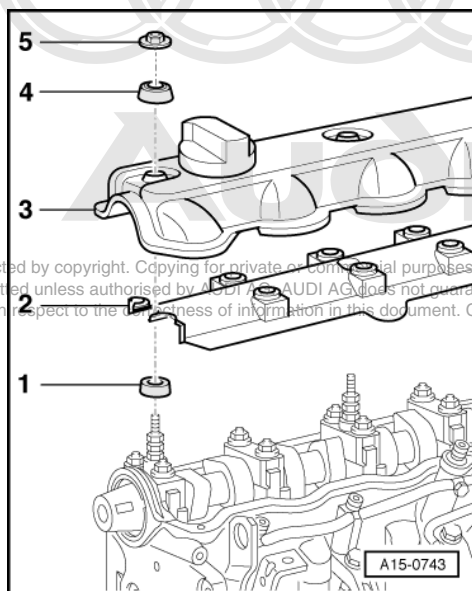
| Component                       | Nm |
|---------------------------------|----|
| Exhauster pump to cylinder head | 20 |

## 1.2 - Removing and installing cylinder head cover



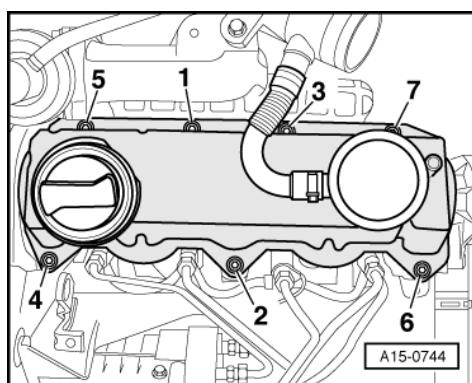
## Removing

- -> Remove oil dipstick -1- from guide tube.
- Unclip caps.
- Unscrew nuts -arrows- and remove engine cover.
- Reinsert oil dipstick in guide tube.
- Pull the crankcase ventilation pipe from the air duct pipe at rear.



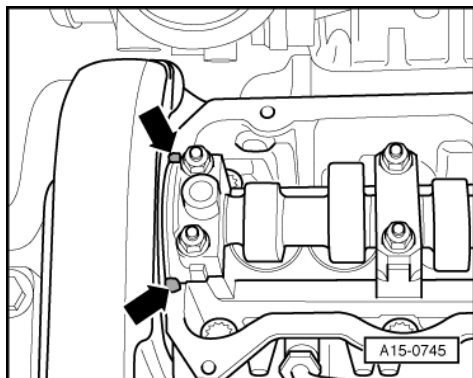
### Vehicles up to approx. 09.97:

- -> Unscrew the nuts -5- for the cylinder head cover.
- Remove the upper sealing washer -4-.
- Remove the cylinder head cover -3-.
- Remove the oil deflector -2- and the sealing cone below -1-.



### Vehicles as of approx. 10.97:

- -> Loosen cylinder head bolts in the sequence -7 ... 1- and remove the cylinder head cover.



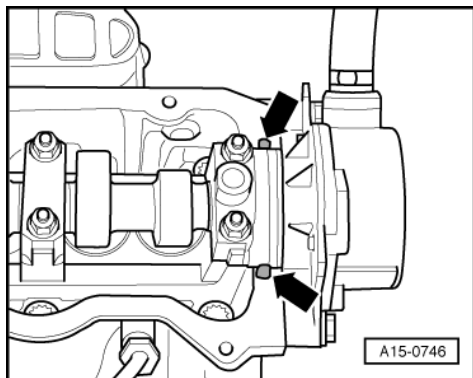
### Installing

Installation is carried out in the reverse order; note the following:

**Note:**

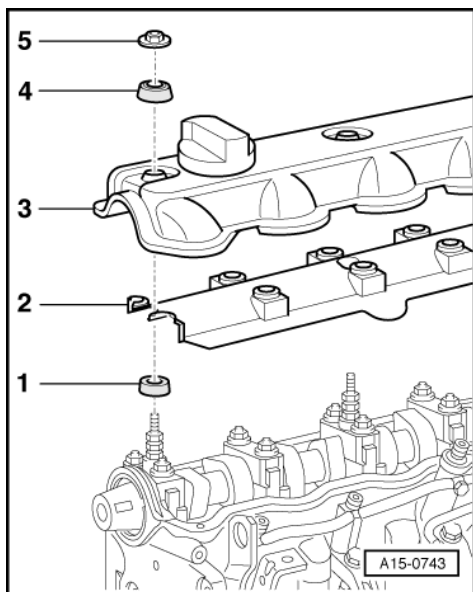
*Replace cylinder head cover if gasket is damaged.*

- -> Both edges on the sealing edges of bearing cap/cylinder head -arrows- on front...



- -> ... and apply a drop of sealing fluid at rear (ø approx. 5 mm) -arrows-.
- Sealants

### => Parts List



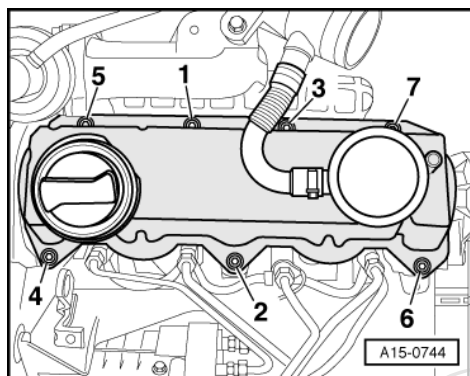
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Vehicles up to approx. 09.97:

- -> Install the parts -1 ... 4- and tighten the nuts -5- to 10 Nm on block.

**Note:**

*If tightening on block is not accomplished, oil contact surface.*



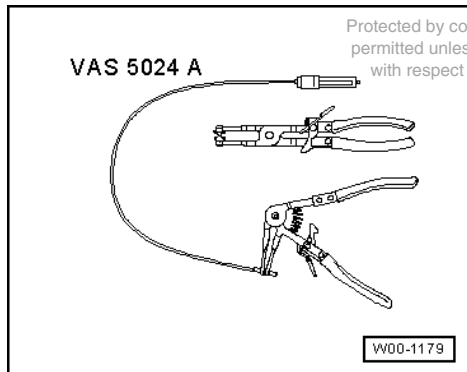
Vehicles as of approx. 10.97:

- -> Screw in cylinder head bolts in the sequence -1 ... 7- hand tight.
- Tighten bolts in sequence -1 ... 7-

**Tightening torque**

| Component                            | Nm |
|--------------------------------------|----|
| Cylinder head cover to cylinder head | 10 |

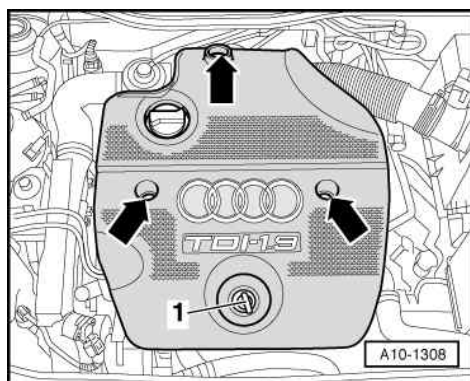
### 1.3 - Removing and installing intake manifold



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**Special tools and workshop equipment required**

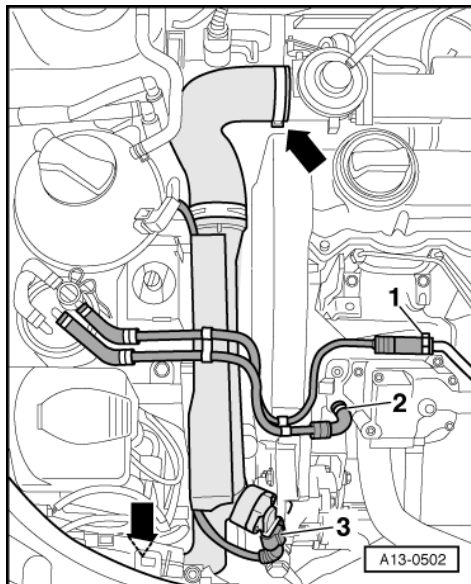
- ♦ VAS 5024 A





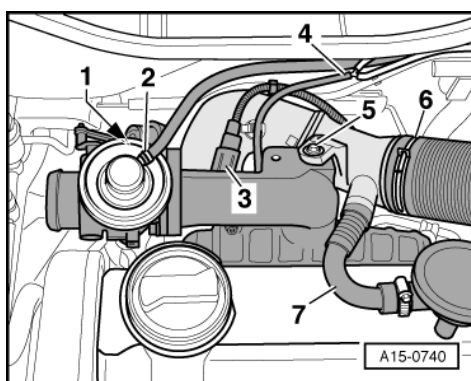
## Removing

- -> Remove oil dipstick -1- from guide tube.
- Unclip caps.
- Unscrew nuts -arrows- and remove engine cover.
- Reinsert oil dipstick in guide tube.

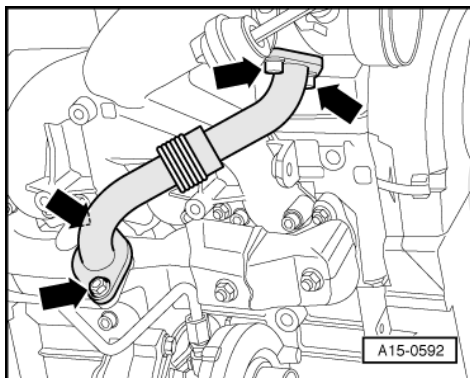


- Detach the cover and the electrical connector at the right headlight unit.
- -> Disconnect fuel-feed line -2- and fuel-return line -1- at injection pump.
- Disconnect the electrical connection -3- at the sender -G71/-G72.
- Expose the wiring at the air duct pipe.
- Remove the air duct pipe on right side -arrows-.

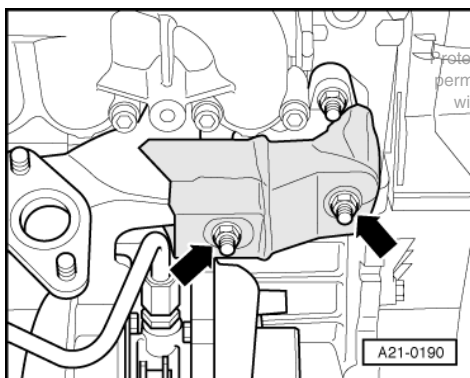
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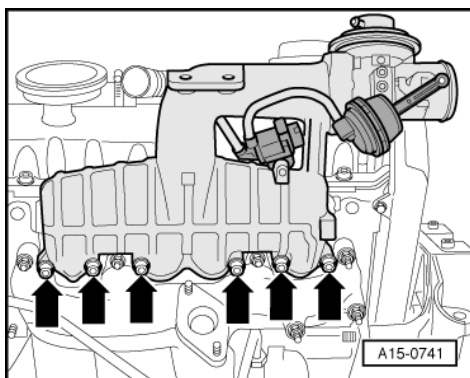
- -> Pull off the vacuum hoses -2- at the exhaust gas recirculation valve or at the Y-piece-4-, respectively.
- Detach electrical connector for heating resistance (crankcase ventilation system) -N79 -Item 3-.
- Disconnect hose -6- to air cleaner housing.
- Pull crankcase vent pipe -7- off rear of air duct hose.
- Loosen spring clip on exhaust turbocharger using VAS 5024.
- Expose vacuum hoses at rear air duct pipe.
- Unscrew bolts -1- and -5- and remove the air duct pipe -4-.



- -> Remove connection pipe for exhaust gas recirculation -arrows-.



- -> Remove heat shield from exhaust manifold -arrows-.



- -> Remove intake manifold -arrows-.

## Installing

Installation is carried out in the reverse order; note the following:

### Notes:

- ◆ Always replace seals, gaskets and self-locking nuts.
- ◆ Note installation position of intake manifold seal.
- ◆ Hose connections and hoses for charge air system must be free of oil and grease before assembly.

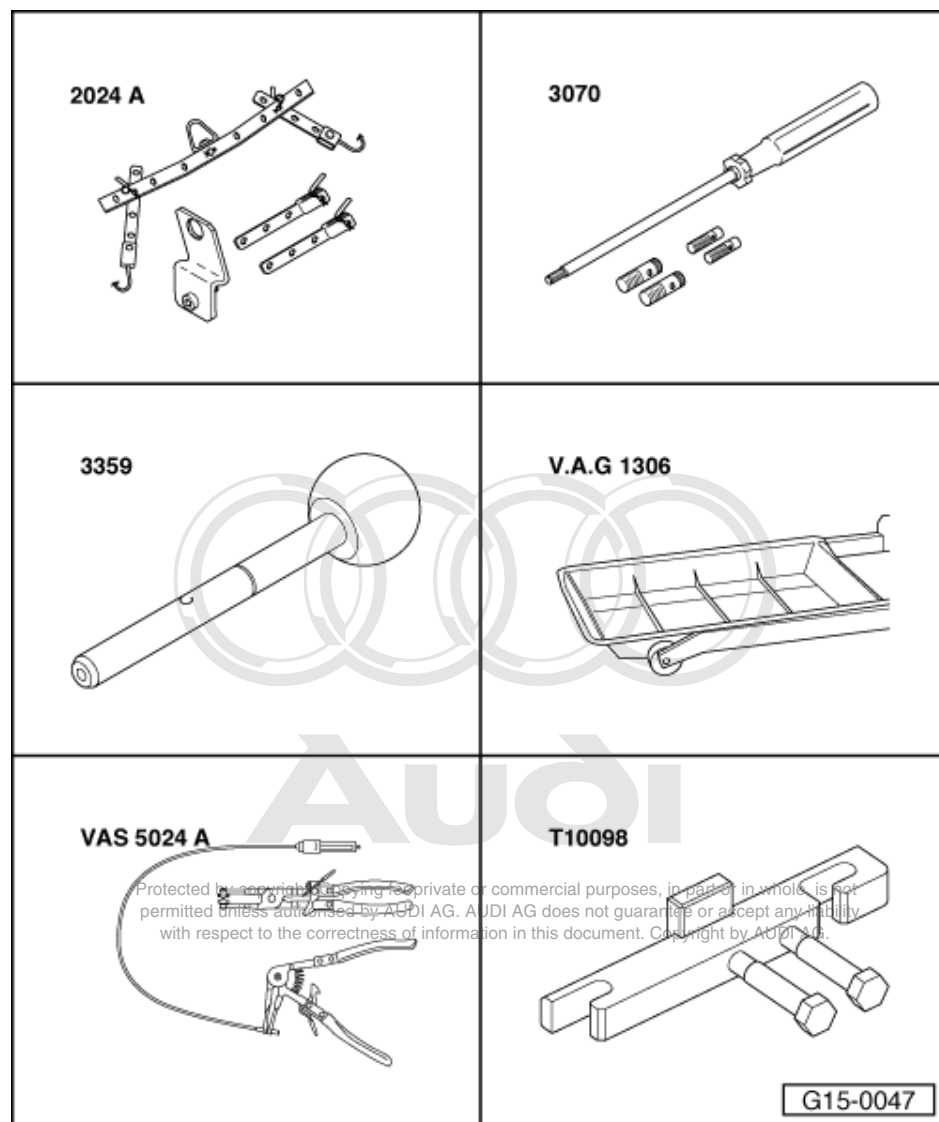
### Tightening torques

| Component                        | Nm |
|----------------------------------|----|
| Intake manifold to cylinder head | 22 |



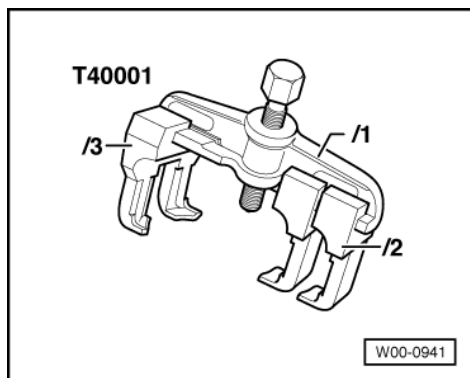
|                                                     |                   |    |
|-----------------------------------------------------|-------------------|----|
| Connection pipe for exhaust<br>gas recirculation to | intake connection | 22 |
|                                                     | exhaust manifold  | 22 |

## 1.4 - Removing cylinder head



### Special tools and workshop equipment required

- ♦ Lifting tackle 2024 A
- ♦ Guide pin 3070
- ♦ Pin 3359
- ♦ V.A.G 1306
- ♦ VAS 5024 A
- ♦ Camshaft straightedge T10098



- ◆ Two-arm puller T40001

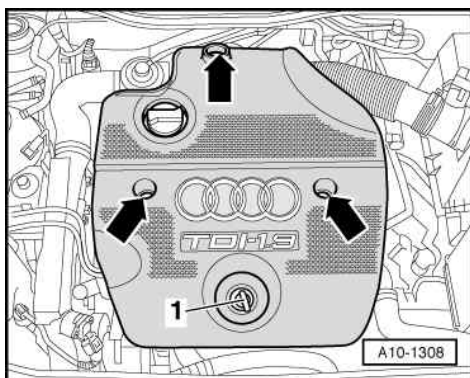
### Procedure

- Engine in vehicle

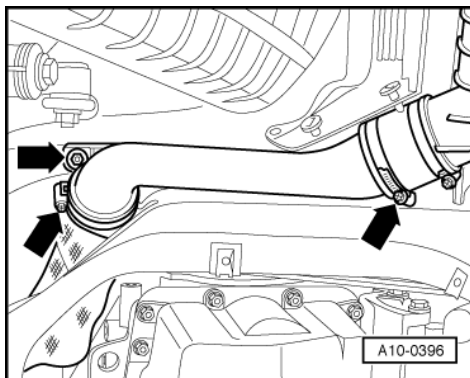
#### Note:

*All cable ties which are released or cut open when removing must be fitted in the same position when installing.*

- Refer to coding on vehicles with encoded radio/radio navigation system (RNS); if necessary, interrogate.
- With the ignition switched off disconnect the battery earth strap.



- -> Remove oil dipstick -1- from guide tube.
- Unclip caps.
- Unscrew nuts -arrows- and remove engine cover.
- Reinsert oil dipstick in guide tube.



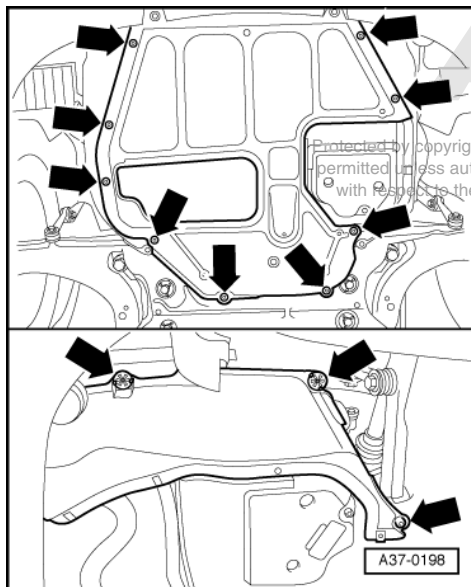
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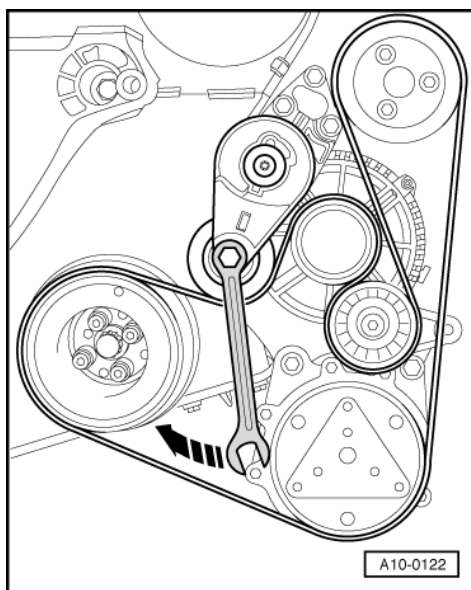
**Important**

Hot steam or hot coolant can escape when opening expansion tank. Cover cap with a cloth and open carefully.

- Open the cover of the coolant expansion tank
- -> Remove lower air duct pipe -arrows-.



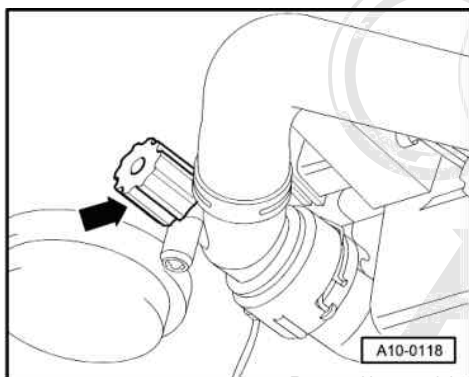
- -> Remove noise insulation in centre and on right -arrows-.



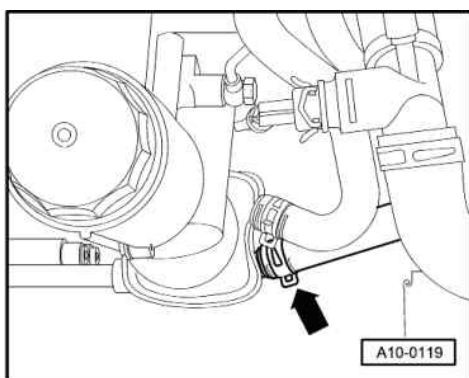
**Note:**

*Mark the running direction with chalk or a felt-tipped pen before removing the ribbed belt. If the belt runs in the opposite direction when it is refitted, this can cause breakage.*

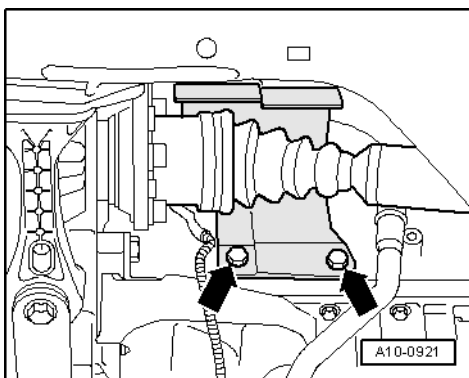
- Fit flat 16 mm box wrench at hexagon of tensioner.
- -> Swivel tensioning roller in direction of arrow to slacken ribbed belt.
- Remove ribbed belt.



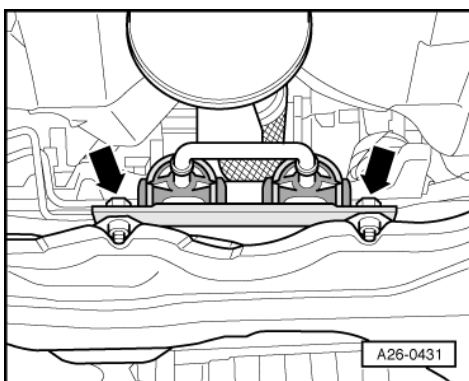
- Place drip tray V.A.G 1306 below engine.
- -> Turn drain plug -arrow- on radiator anti-clockwise. If necessary, fit drain hose on connection.



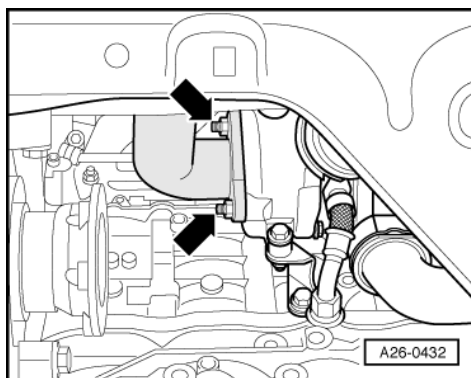
- -> Also disconnect lower coolant hose on oil cooler -arrow-, and drain off remaining coolant.



- -> Unbolt heat shield for right drive shaft -arrows-.



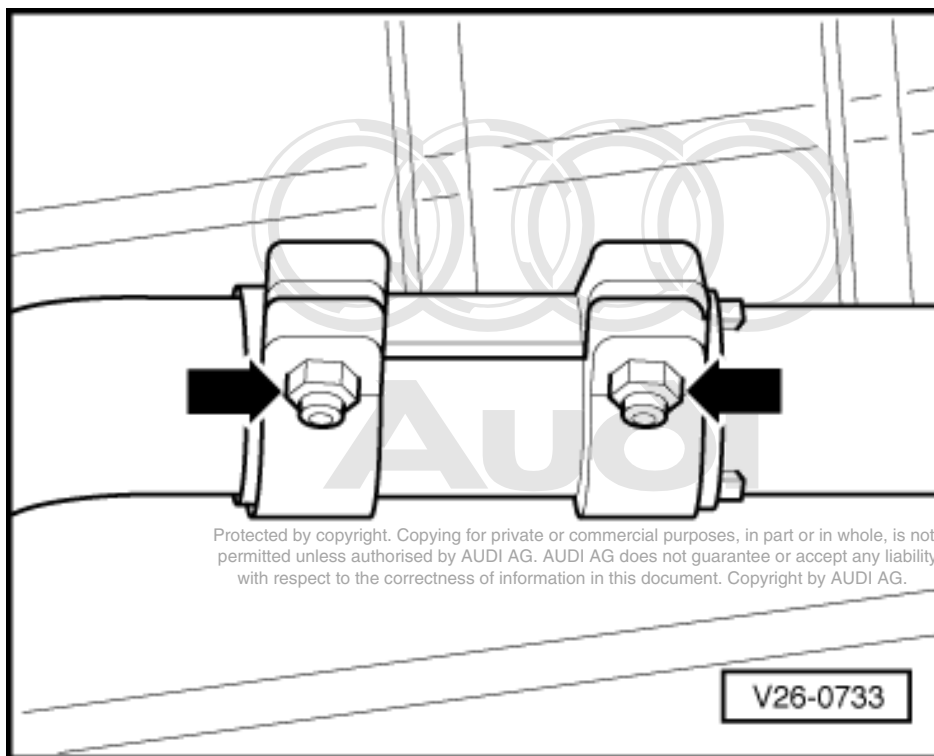
- -> Unbolt bracket for exhaust system from assembly mounting -arrows-.



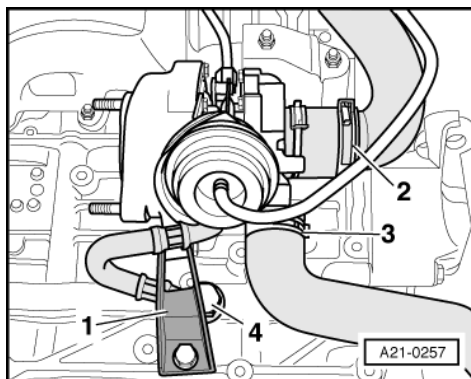
**Note:**

*The isolating element in front exhaust pipe must not be deflected more than 10° to avoid damage..*

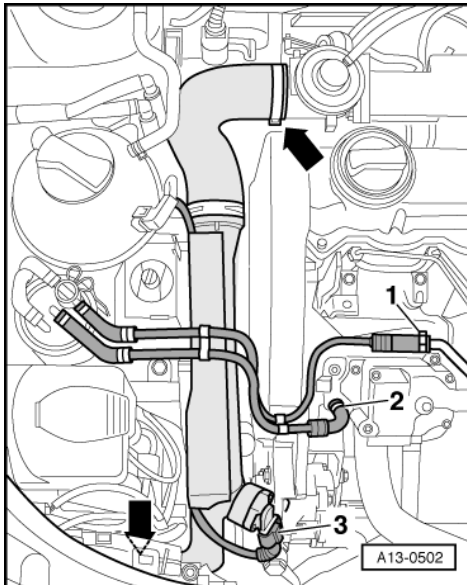
- -> Unscrew securing bolts -arrows- of front exhaust pipe/exhaust turbocharger.



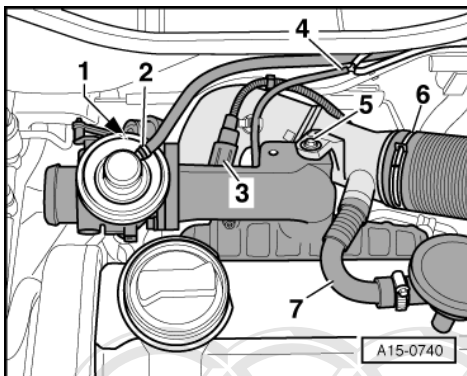
- -> Detach the exhaust system at the clamping sleeve -arrows-.
- Remove the front exhaust pipe.



- -> Remove air duct hoses -2- and -3- from turbocharger.
- Unscrew turbocharger bracket -1-.
- Remove oil return pipe -4- at cylinder block.

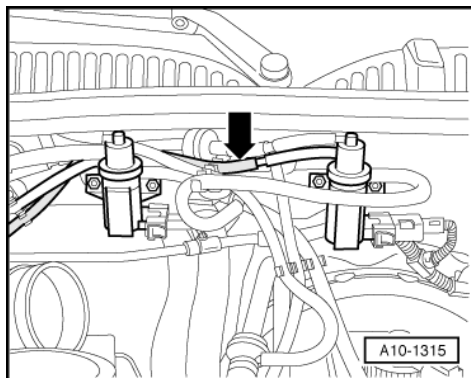


- Detach the cover and the electrical connector at the right headlight unit.
- -> Disconnect fuel-feed line -2- and fuel-return line -1- at injection pump.
- Disconnect the electrical connection -3- at the sender -G71/-G72.
- Expose the wiring at the air duct pipe.
- Remove the air duct pipe on right side -arrows-.

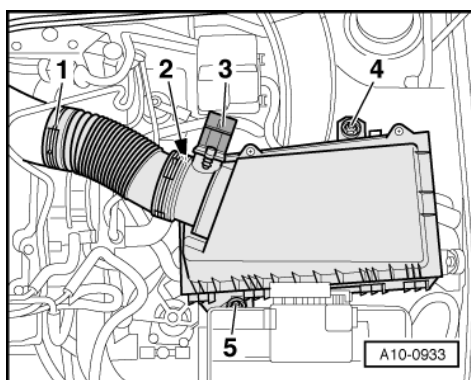


- -> Pull off the vacuum hoses -2- at the exhaust gas recirculation valve or at the Y-piece -4-, respectively.
- Disconnect electrical connector for heating resistance (crankcase ventilation system) -N79 -Item 3-.
- Disconnect hose -6- to air cleaner housing.
- Pull crankcase ventilation pipe -7- off rear of air duct pipe.
- Unscrew bolts -1- and -5- and remove the air duct pipe at rear.

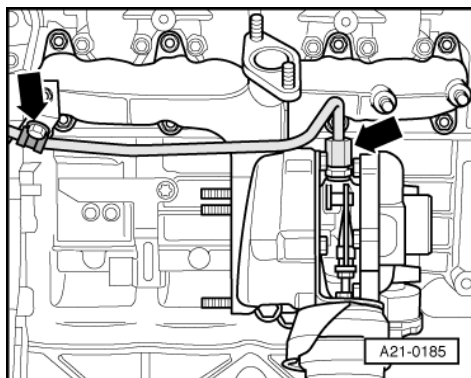
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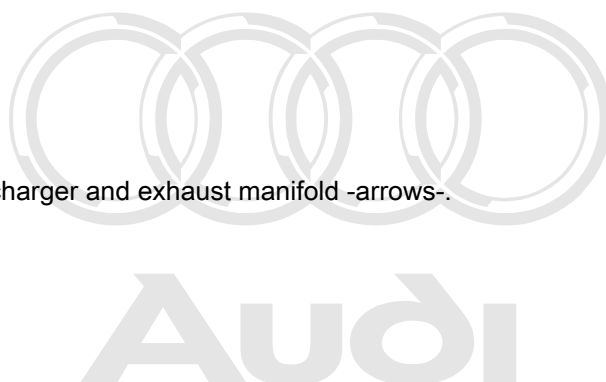
- -> Remove the vacuum hose -arrow- and expose the vacuum hose.



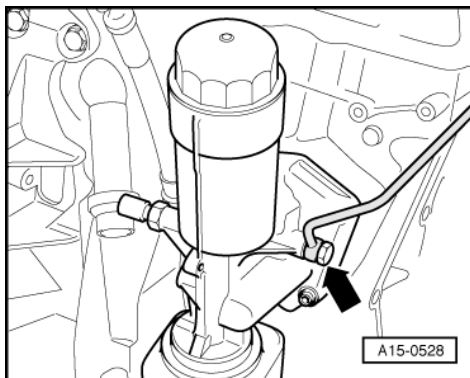
- -> Remove air duct hose -1- from air duct pipe.
- Detach connector of air mass meter -3-.
- Unscrew bolts -4- and -5-.
- Remove vent hose -2- from rear of air cleaner housing.
- Take out air cleaner housing.



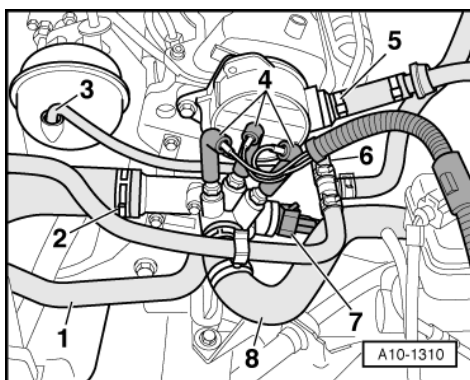
- -> Unscrew oil feed pipe from exhaust turbocharger and exhaust manifold -arrows-.



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- -> Unscrew oil feed line from oil filter bracket -arrow- and also on cylinder head and lay line aside.

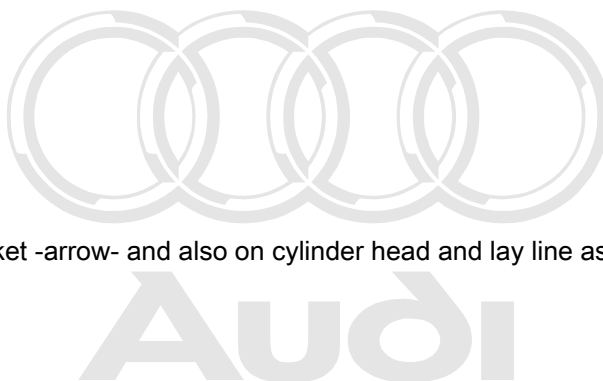
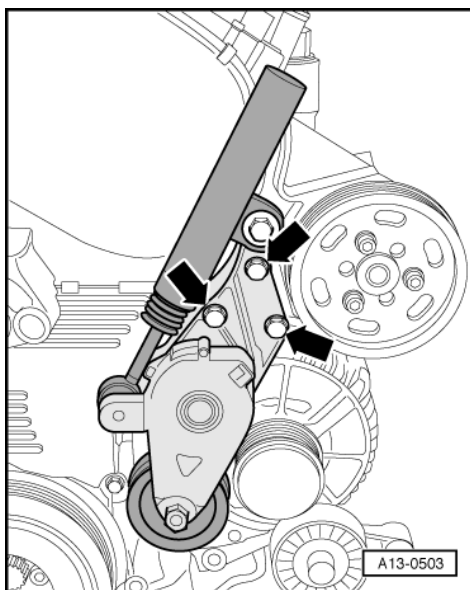


- -> Disconnect the electrical connections at the glow plugs (coolant) -Q7 -Item 4- (manual gearbox only).
- Disconnect the electrical connection -7- at the coolant temperature sender -G62 and expose wiring.
- Pull vacuum pipe -5- off at exhauster.
- Detach the coolant hoses -1-, -2-, -6- and -8-.
- Remove injector pipes.

**Note:**

*Always remove complete pipe set. Use injector pipe spanner 3035.*

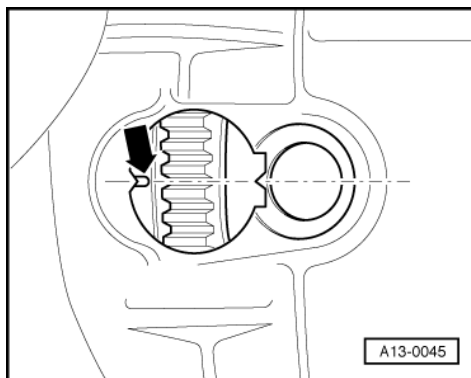
- Detach injector/injection pump return line.
- Detach glow plug connector console.
- Take needle lift sender electrical connection from bracket and disconnect it.



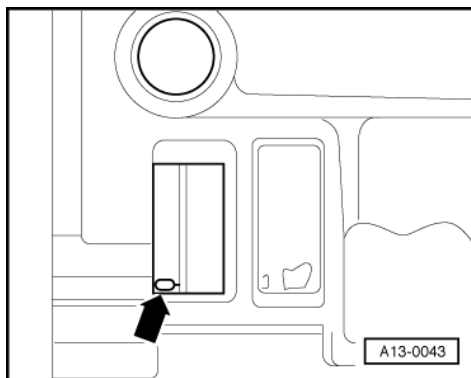
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- -> Remove tensioner for ribbed belt -arrows-.
- Remove upper toothed belt guard.
- Unscrew 2 toothed belt guard bolts at rear on both sides of the cylinder head.



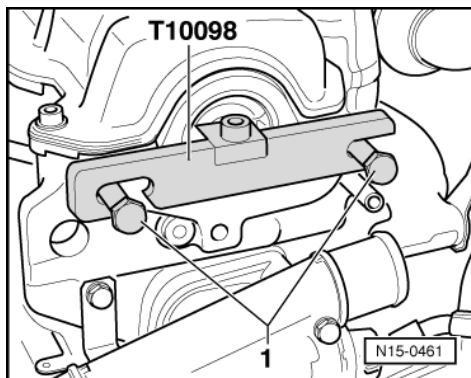
- -> Turn crankshaft to TDC No. 1 cylinder -arrow- (vehicles with manual gearbox).



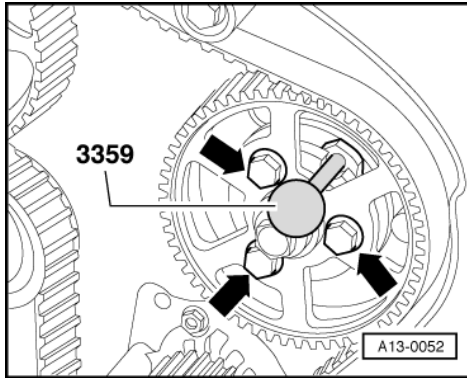
- -> Turn crankshaft to TDC No. 1 cylinder -arrow- (vehicles with automatic gearbox).

**Note:**

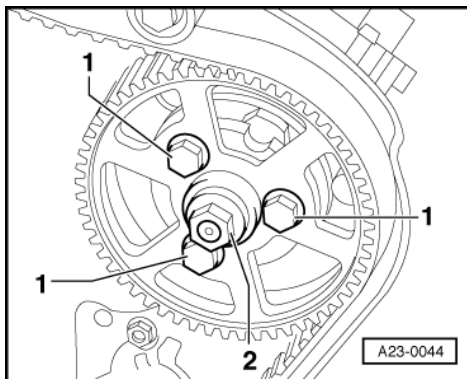
Position crankshaft to TDC No. 1 cylinder 1 with engine removed=> Page 58. Protected by copyright. Copying for private or commercial purposes, in part or in whole, is not permitted without the written permission of AUDI AG. AUDI AG does not guarantee or accept any liability with respect to the correctness of information in this document. Copyright by AUDI AG.



- Remove the exhauster => Fig. 96 .
- -> Turn the bolts -1- by hand up to stop into the cylinder head.
- Lock the camshaft using camshaft straightedge T10098 as shown in the illustration.
- If the camshaft straightedge T10098 cannot be inserted, rotate crankshaft 1 additional turn (360°).

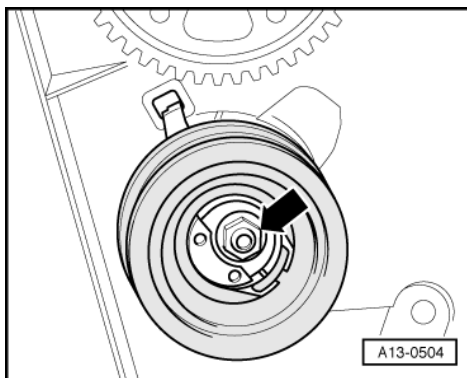


- -> Lock injection pump sprocket using pin 3359.
- Loosen injection pump sprocket securing bolts -arrows-.

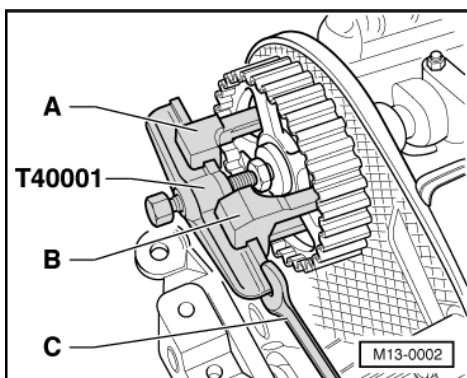


**Note:**

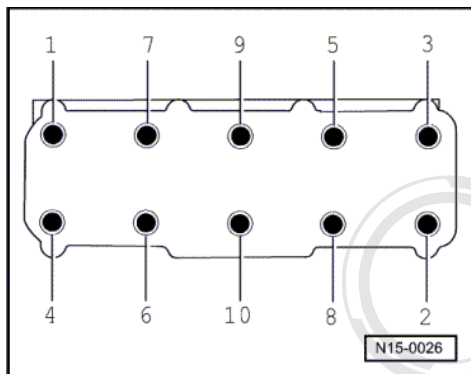
-> Never loosen the injection pump sprocket central nut -2-. Otherwise the injection pump basic setting is incorrectly adjusted and cannot be corrected again using workshop equipment.



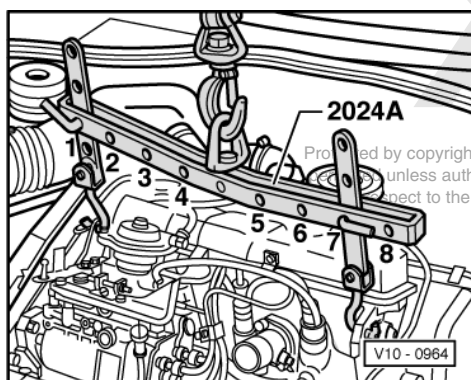
- -> Unscrew the tensioning roller nut -arrow-.



- Remove the toothed belt from the camshaft toothed belt sprocket.
- > Unscrew the camshaft sprocket bolt by one half turn .
- Place the two-arm puller T40001 with claw T40001/2 -Item A- and the two-arm claw T40001/3 -Item B- centralised onto the camshaft sprocket.
- Pull off the camshaft sprocket using the two-arm puller. Counterhold using an open-end spanner -C- in the process.
- Removing camshaft toothed belt sprocket.
- Remove cylinder head cover => Page 96 .



- -> Loosen cylinder head bolts in the sequence 1 ... 10.



- -> Attach lifting tackle 2024 A on cylinder head.

#### Important

The hook attachments and locating pins on the lifting tackle must be secured with locking pins.

#### Note:

*In addition, tie intake manifold to lifting tackle eye in order to obtain a stable centre of gravity position for the cylinder head.*

- Slightly lift cylinder head using workshop crane.
- Simultaneously move cylinder head to the left out of rear of toothed belt guard and remove tensioning roller.

## 1.5 - Installing cylinder head

#### Notes:

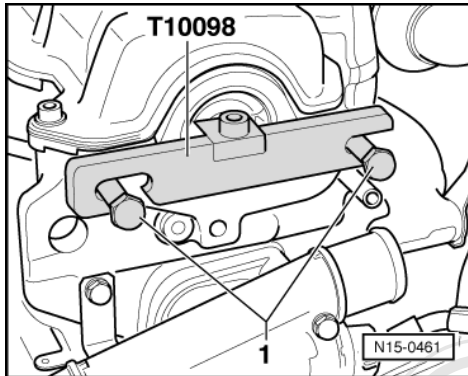
- ♦ Replace the cylinder head bolts.
- ♦ When performing installation procedures always replace self-locking nuts and bolts.
- ♦ Replace seals, gaskets, and bolts which have a specified tightening angle.
- ♦ Hose connections and hoses for charge air system must be free of oil and grease before assembly.

- ◆ Secure all hose connections with the correct hose clamps (same as original equipment):

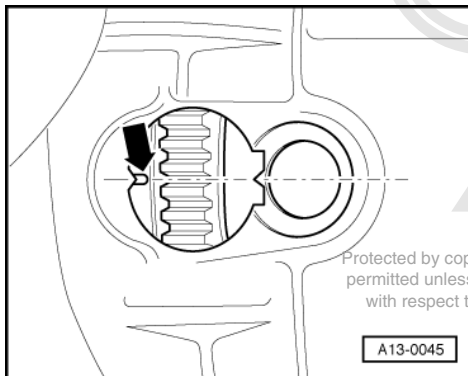
=> Parts List

- ◆ If repairing, carefully remove any remains of gasket material from the cylinder head and cylinder block. Make sure that no long scores or scratches are made on the surfaces.
- ◆ Carefully remove any remaining emery and abrasive material.
- ◆ Remove new cylinder head gasket from packaging, just before installation.
- ◆ Handle gasket extremely carefully. Damaging the silicone layer or the indented area will lead to leaks.
- ◆ No oil or coolant must be allowed to remain in the blind holes for the cylinder head bolts in the cylinder head.

Installation is carried out in the reverse order; note the following:



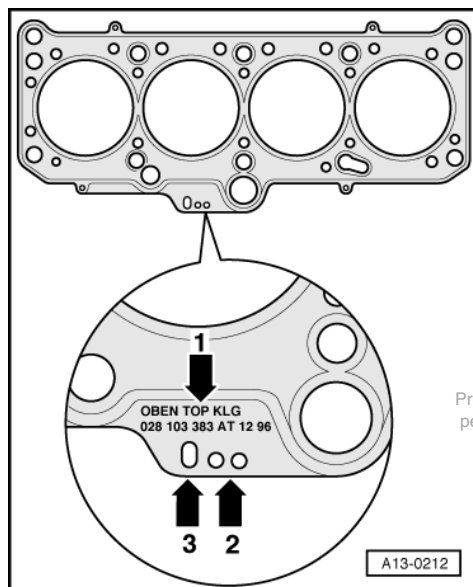
- -> Before positioning cylinder head, set crankshaft and camshaft to TDC of No. 1 cylinder. It must be possible to insert camshaft straightedge T10098 into camshaft...



- -> ... and the TDC-mark must be located at the reference edge.

**Note:**

*Illustration shows vehicle with manual gearbox.*

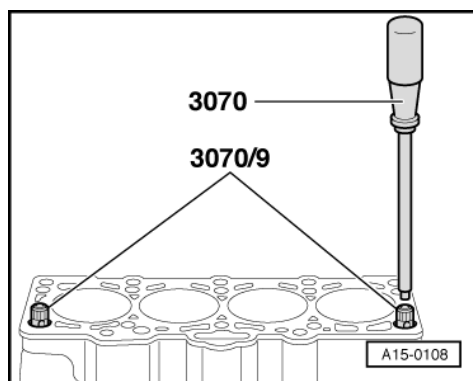


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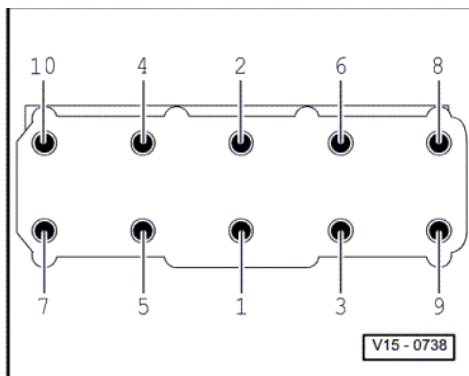
- -> Note markings on cylinder head gasket.
- Part no. = arrow 1
- Holes = arrow 2
- Production control code = arrow 3 (can be disregarded!)

**Notes:**

- ♦ If the cylinder head gasket or the cylinder head has been replaced, select a new gasket according to the number of holes on the old gasket.
- ♦ If parts of the crankshaft drive have been replaced, the new cylinder head gasket must be selected by measuring the piston projection at TDC => Page 87 .



- -> To centralise, screw guide pins 3070/9 from 3070 into the outer cylinder block holes.
- Place cylinder head gasket in position.
  - Note centring sleeve in cylinder block.
  - Check installation position of cylinder head gasket: mark "top" or the part no. must face cylinder head.
- Position cylinder head.
- Fit 8 cylinder head bolts and tighten by hand.
- Unscrew guide pins with removal tool from 3070 through bolt holes in cylinder head and install remaining cylinder head bolts.



- -> Tighten cylinder head bolts in four stages in sequence shown as follows:
- Tighten using torque wrench:
  - 1st Stage: 40 Nm
  - 2nd Stage: 60 Nm
- Tighten with rigid wrench:
  - 3rd Stage: 90° (1/4 turn) further
  - 4th Stage: 90° (1/4 turn) further

**Note:**

*It is not necessary to retighten cylinder head bolts after repairs have been performed.*

- Install toothed belt (adjust valve timing) => Page 53 .

**Note:**

*Observe all instructions on removing and installing the toothed belt => from Page 48 .*

- Install cylinder head cover => Page 98 .
- Install ribbed belt => Page 38 .
- Install exhaust system and align it stress-free => Page 232 .
- Check the oil level.

**Note:**

*When engine oil is contaminated perform oil change:*

=> Maintenance Manual

- Replace coolant => Page 158 .

**Note:**

*If the battery is reconnected, please ensure that the vehicle equipment (radio, radio/navigation system, clock, electric window lifters) is activated as described in the operating instructions.*

**Tightening torques**

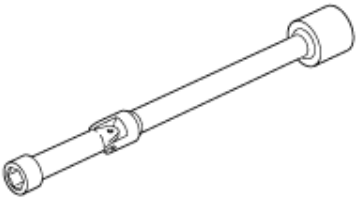
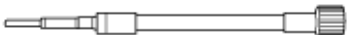
| Component                                | Nm |
|------------------------------------------|----|
| Rear toothed belt guard to cylinder head | 10 |
| Bracket for turbocharger to              |    |
| turbocharger                             | 25 |
| cylinder block                           | 40 |
| Oil return line to cylinder block        | 40 |
| Oil feed line to                         |    |
| oil filter bracket                       | 25 |
| bracket                                  | 10 |
| Exhauster pump to cylinder head          | 20 |

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| Component                                                           | Nm |
|---------------------------------------------------------------------|----|
| Injector pipes to injectors/injection pump                          | 25 |
| Tensioner for ribbed belt to bracket for auxiliary mechanical units | 25 |

## 1.6 - Checking compression

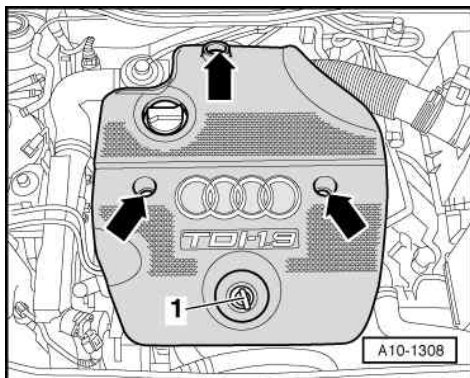
|                                                                                                             |                                                                                                                                                                                                                                                                                          |
|-------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>3220</b><br>            | <b>V.A.G 1763</b><br>                                                                                                                                                                                   |
| <b>V.A.G 1381/12</b><br> | <p>Protected by copyright. Copying for private or commercial purposes, in part or in whole, is not permitted unless authorised by AUDI AG. AUDI AG does not guarantee or accept any liability with respect to the correctness of information in this document. Copyright by AUDI AG.</p> |
|                                                                                                             | <b>G15-0002</b>                                                                                                                                                                                                                                                                          |

### Special tools and workshop equipment required

- ♦ Jointed spanner 3220
- ♦ V.A.G 1763
- ♦ V.A.G 1381/12

### Test requirements:

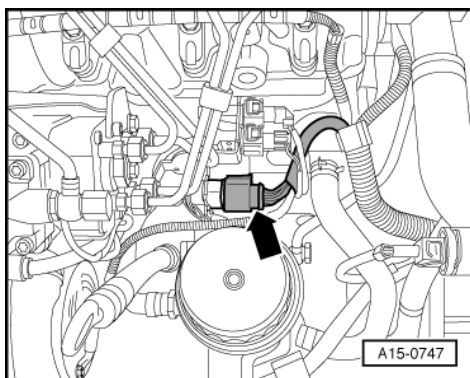
- Engine oil temperature at least 30 °C
- Battery voltage at least 12.7 V



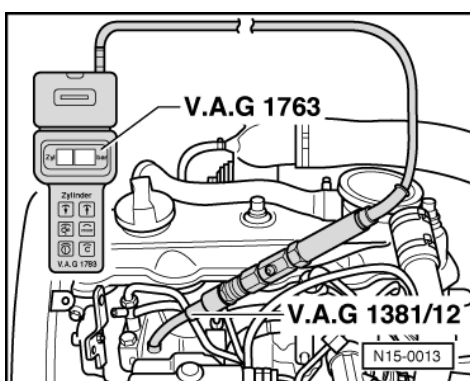
### Test sequence

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- -> Remove oil dipstick -1- from guide tube.
- Unclip caps.
- Unscrew nuts -arrows- and remove engine cover.
- Reinsert oil dipstick in guide tube.



- Disconnect the fuel cut-off valve electrical connection at the injection pump (where present as an individual electrical connection).
- -> Disconnect the injection pump electrical connection-arrow-.
- Unplug connector console from glow plugs.
- Remove all glow plugs using jointed spanner 3220.



- -> Screw in adapter V.A.G 1381/12 in place of glow plugs.
- Check compression with compression tester V.A.G 1381/V.A.G 1763.

### Note:

*Using the compression tester*



=> Operating instructions

- Operate starter until tester shows no further pressure increase.

**Compression values:**

| New excess pressure in bar | Wear limit excess pressure in bar | Permissible difference between cylinder excess pressure in bar |
|----------------------------|-----------------------------------|----------------------------------------------------------------|
| 25 ... 31                  | 19                                | max. 5                                                         |

- Install glow plugs with jointed spanner 3220.

- Interrogating and erasing fault memory:

=> Diesel Direct Injection and Glow Plug System (4-cyl TDI) > 07.99; Repair group 01; Self-diagnosis; Interrogating fault memory Self-diagnosis Interrogating fault memory

=> TDI Injection and Glow Plug System (4-cyl.) 08.99 >; Repair group 01; Self-diagnosis; Interrogating fault memory Self-diagnosis Interrogating fault memory

**Note:**

*Faults will have been recorded in the fault memory because the connectors have been unplugged. Interrogate and, if necessary, erase fault memory after completing the test.*

**Tightening torque**

| Component                   | Nm |
|-----------------------------|----|
| Glow plugs to cylinder head | 15 |

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## 2 - Servicing valve gear

### 2.1 - Servicing valve gear

### 2.2 - Different valve gear designs

As of engine No. AGR 044 442 or AHF 006 066, respectively as well as for all ALH and ASV engines, a "light valve gear" is used in place of the "old valve gear".

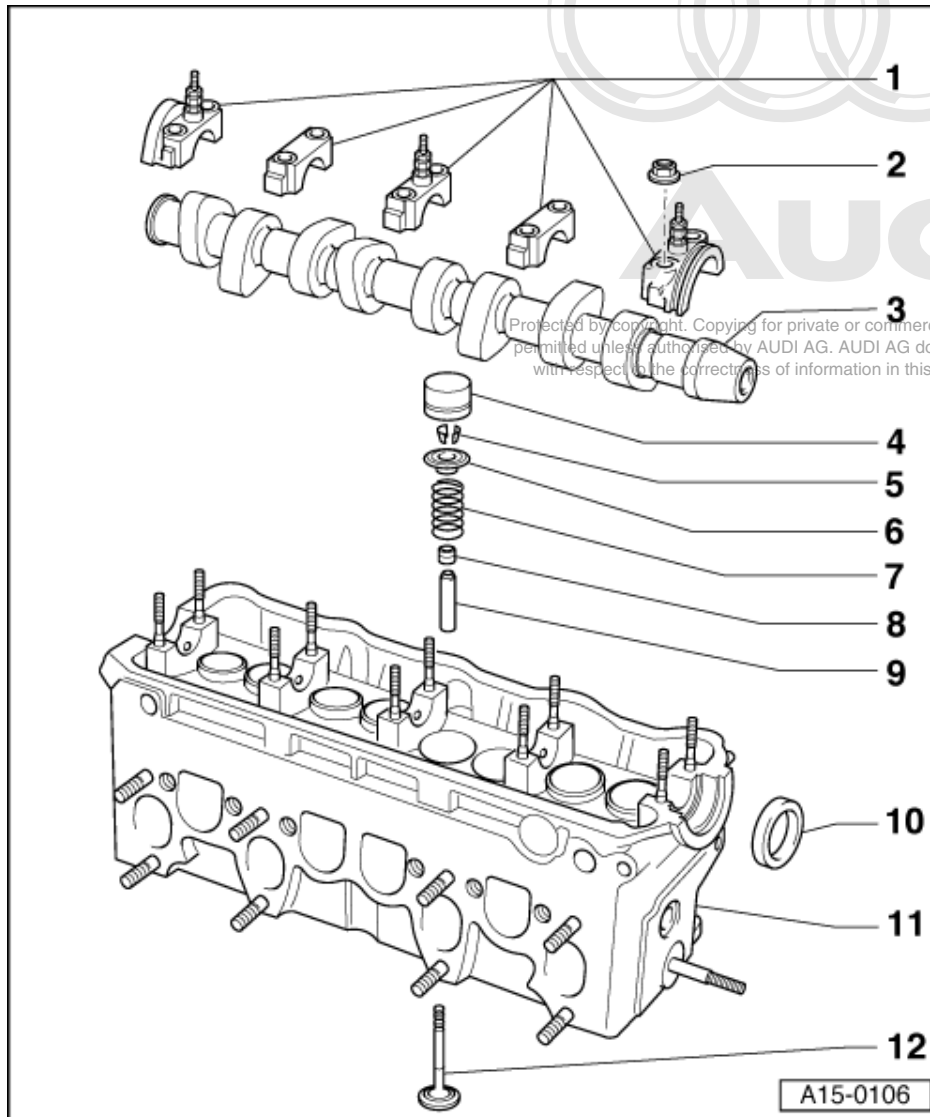
Identification characteristics for the "light valve gear":

- ♦ Inner valve springs no longer used
- ♦ Lower valve plates no longer used

**Notes:**

- ♦ Differentiating characteristics for old valve gear (up to engine -No. AGR 044 441 or AHF 006 065, respectively) => Fig. 122 .
- ♦ After installing the camshaft, wait for about 30 minutes before starting the engine. Hydraulic valve compensation elements have to settle (otherwise valves will strike pistons).
- ♦ After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.

- ♦ The following illustration shows the cylinder head with light valve gear (as of engine-No. AGR 044 442 or AHF 006 066, respectively as well as all ALH and ASV engines).



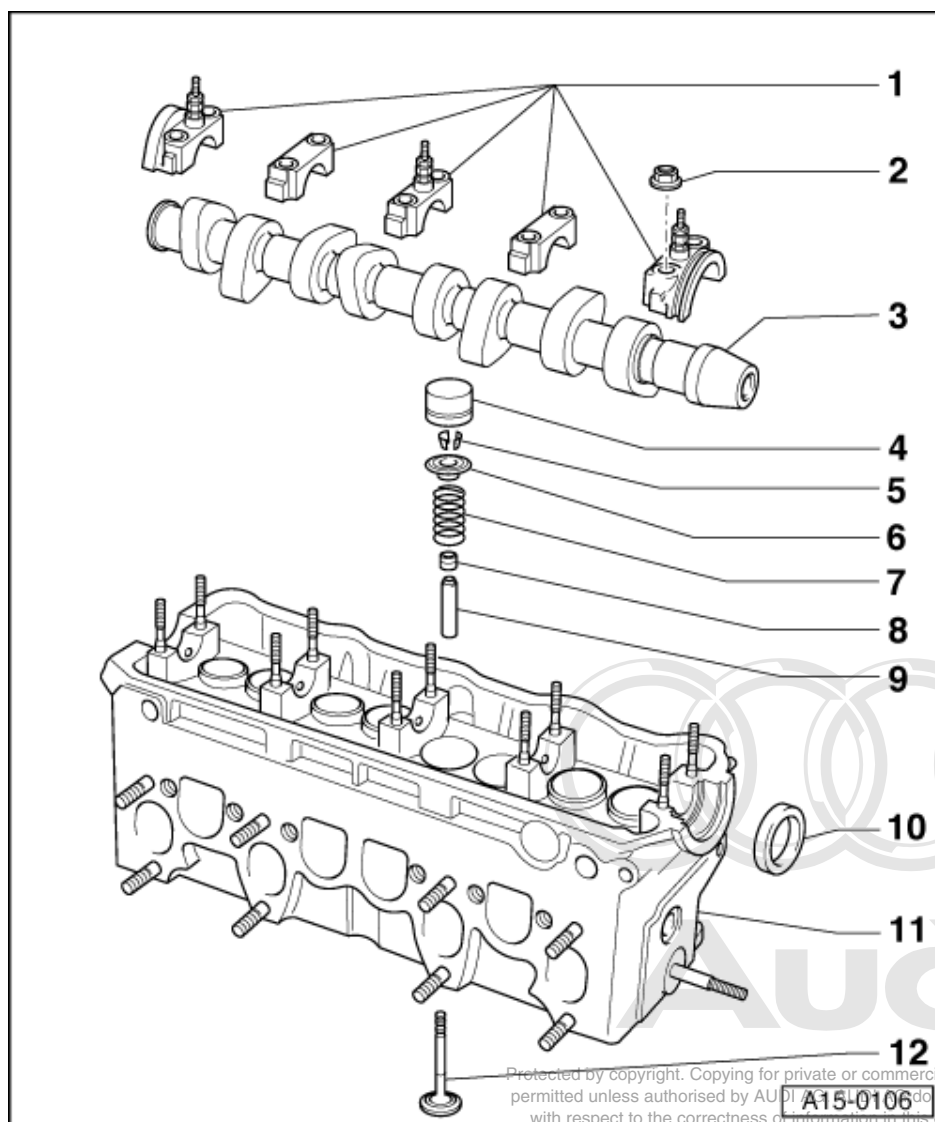
### 1 Bearing cap

- ♦ Installation position  
=> Fig. 122
- ♦ Installation sequence  
=> Page 124, Removing and installing camshaft

### 2 20 Nm

### 3 Camshaft

- ♦ Checking axial clearance  
=>Page 123.
- ♦ Removing and installing  
=>Page 124.
- ♦ Checking radial clearance with Plastigage  
Wear limit: 0.11 mm
- ♦ Run-out: no more than 0.01 mm
- ♦ Valve timing => from page 1



#### 4 Hydraulic bucket tappet

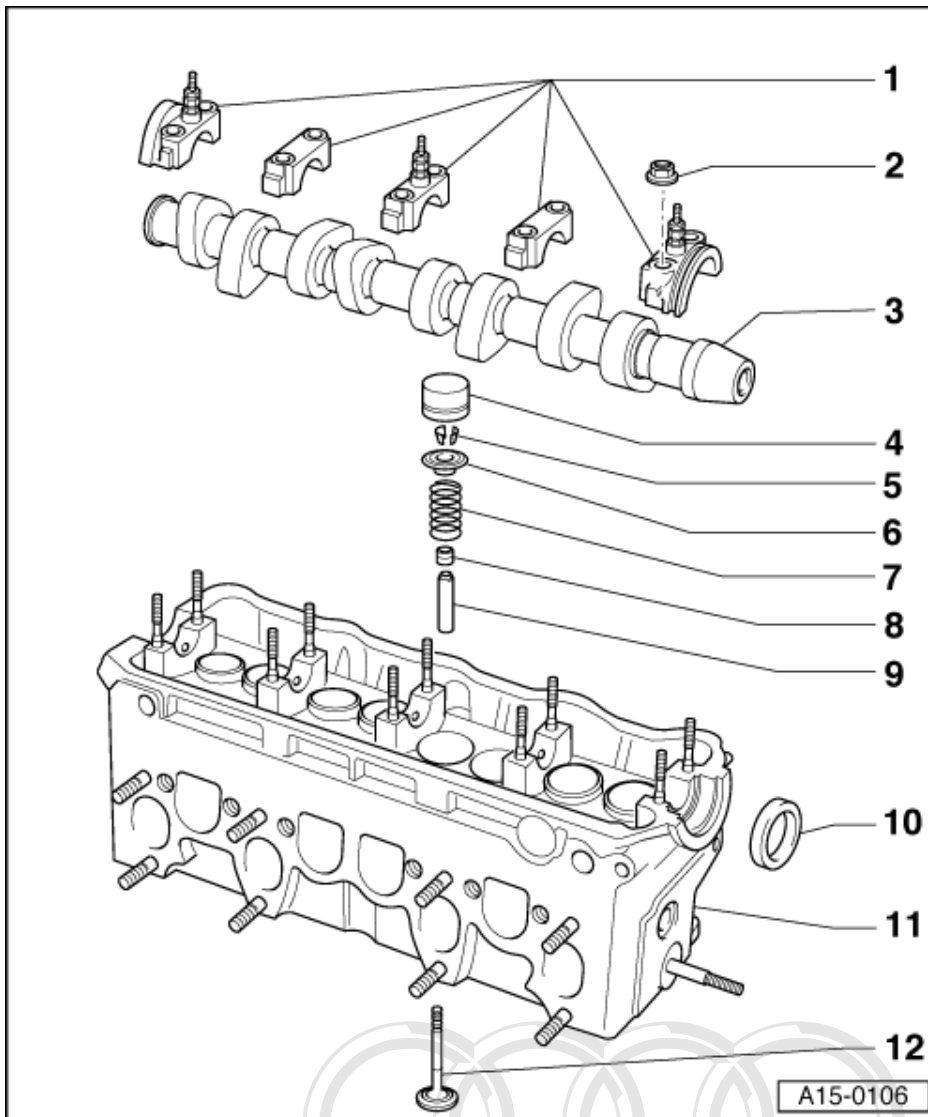
- ◆ Checking => Page 130
- ◆ Removing and installing  
=>Page 131 .
- ◆ Do not interchange
- ◆ Store with cam contact surface downwards
- ◆ Before installing check camshaft axial clearance  
=>Page 123 .
- ◆ Oil contact surface

## 5 Valve cotters

## 6 Upper valve spring bracket

## 7 Valve springs

- ◆ only one valve spring per valve for light valve gear
- ◆ Valve springs for old valve gear => Fig. 122
- ◆ Removing and installing with cylinder head installed => Page 131 .
- ◆ Removing and installing with cylinder head removed with 2037



#### 8 Valve stem seal

- ♦ Replacing => Page 131 .

#### 9 Valve guide

- ♦ Checking => Page 136
- ♦ When exceeding wear limit replace cylinder head

#### 10 Sealing ring

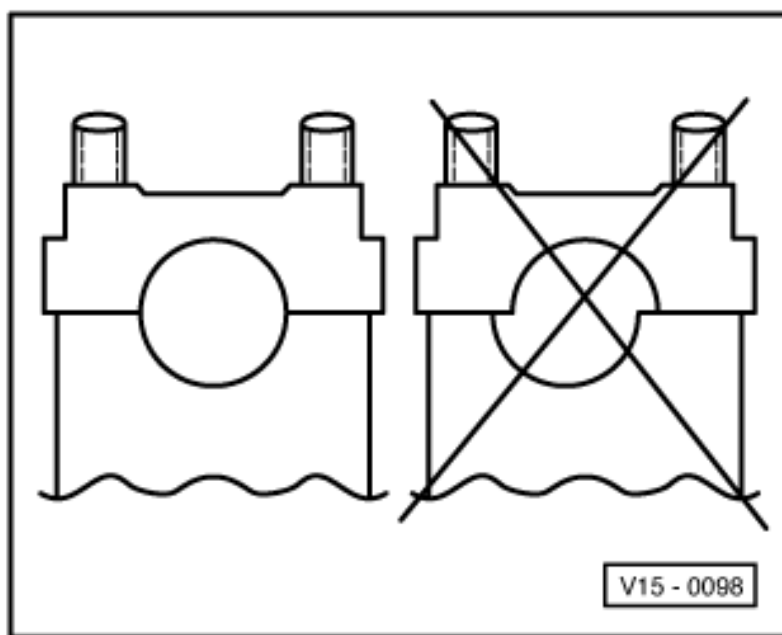
- ♦ To remove and install, remove bearing cap and toothed belt sprocket
- ♦ Removing and installing toothed belt => Page 48

#### 11 Cylinder head

- ♦ Checking valve guides
  - ♦ Rework valve seats
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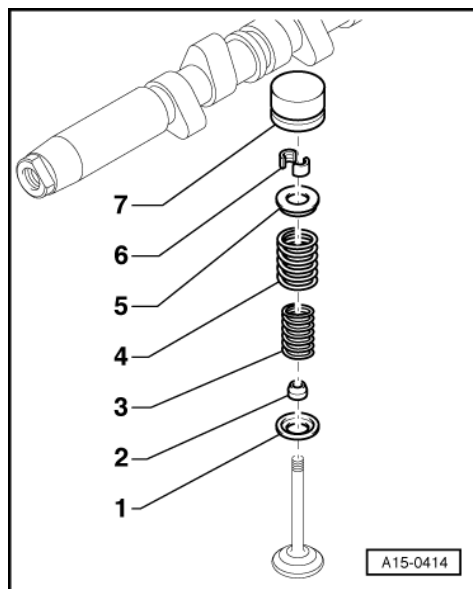
#### 12 Valve

- ♦ Do not rework only grinding in is permitted
- ♦ Valve dimensions  
=> Fig. 123



-> Fig. 1 Location of camshaft bearing cap

Note offset. Before installing camshaft fit bearing caps and determine installation position.

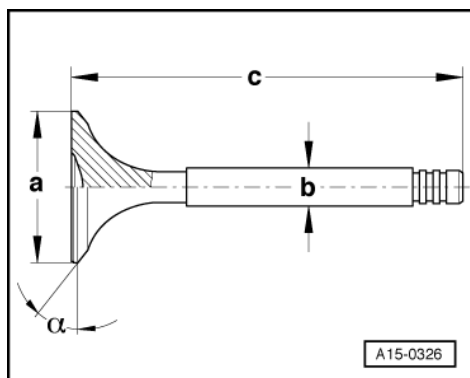


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-> Fig.2 Old valve gear (up to engine-No. AGR 044 441 or AHF 006 065, respectively)

- 1 - Lower valve spring plate
- 2 - Valve stem seal
- 3 - Inner valve spring
- 4 - Outer valve spring
- 5 - Upper valve spring plate
- 6 - Valve cotteners

## 7 - Hydraulic tappet



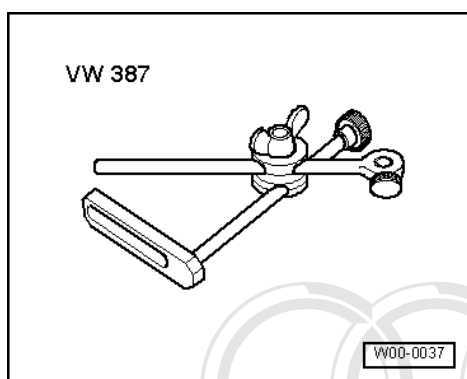
-&gt; Fig.3 Valve dimensions

**Note:**

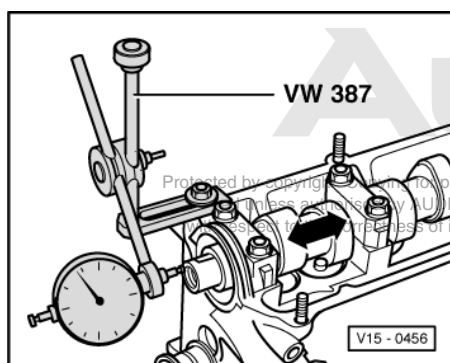
*Valves must not be reworked. Only grinding in is permitted.*

| Dim.  | Inlet valve | Exhaust valve |
|-------|-------------|---------------|
| øa mm | 35.95       | 31.45         |
| øa mm | 6.963       | 6.943         |
| c mm  | 96.85       | 96.85         |
| α <°  | 45          | 45            |

## 2.3 - Checking camshaft axial clearance

**Special tools and workshop equipment required**

- ♦ Universal dial gauge bracket VW 387
- ♦ Dial gauge

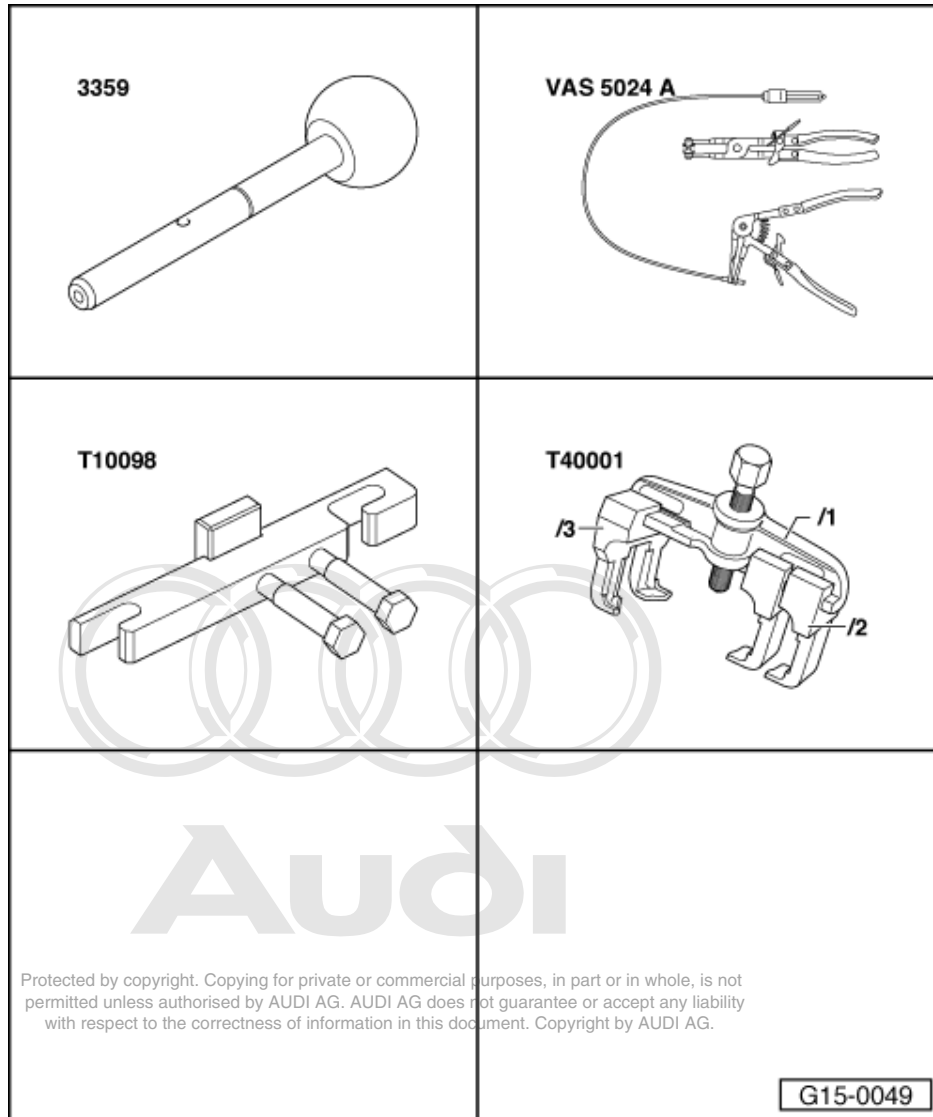




### Test sequence

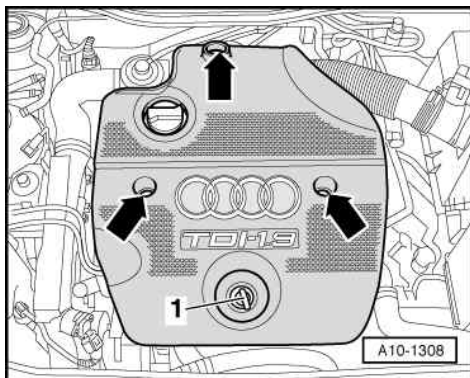
- -> Measure with bucket tappets removed and with first and last bearing caps fitted.
- Wear limit: no more than 0.15 mm

## 2.4 - Removing and installing camshaft



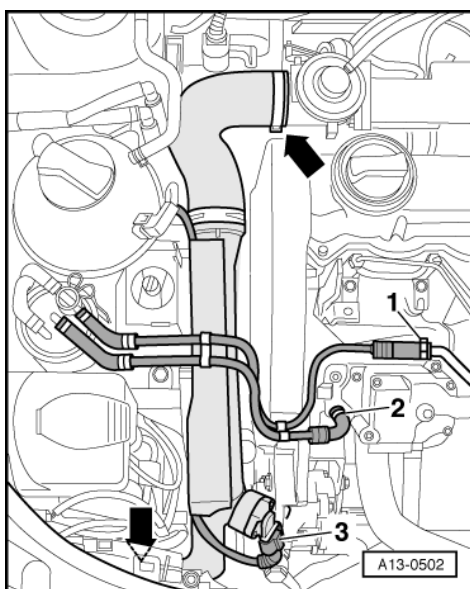
### Special tools and workshop equipment required

- ♦ Pin 3359
- ♦ VAS 5024 A
- ♦ Camshaft straightedge T10098
- ♦ Two-arm puller T40001

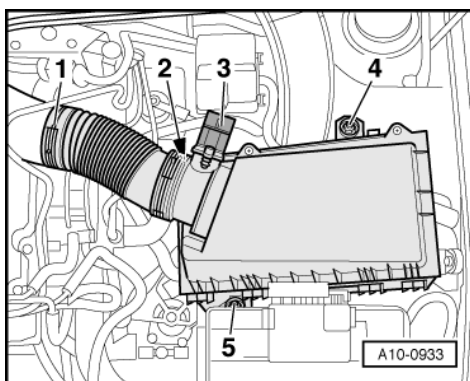


### Removing

- -> Remove oil dipstick -1- from guide tube.
- Unclip caps.
- Unscrew nuts -arrows- and remove engine cover.
- Reinsert oil dipstick in guide tube.



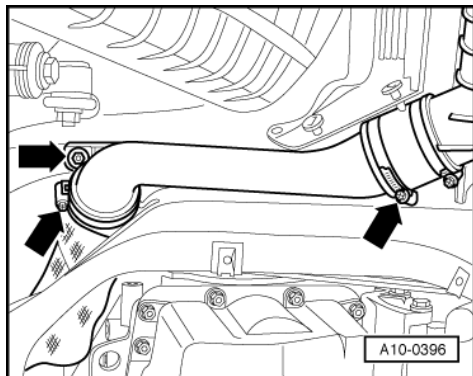
- Detach the cover and the electrical connector at the right headlight unit.
- -> Disconnect fuel-feed line -2- and fuel-return line -1- at injection pump.
- Disconnect the electrical connection -3- at the sender -G71/-G72.
- Expose the wiring at the air duct pipe.
- Remove the air duct pipe on right side -arrows-.
- Remove upper toothed belt guard.



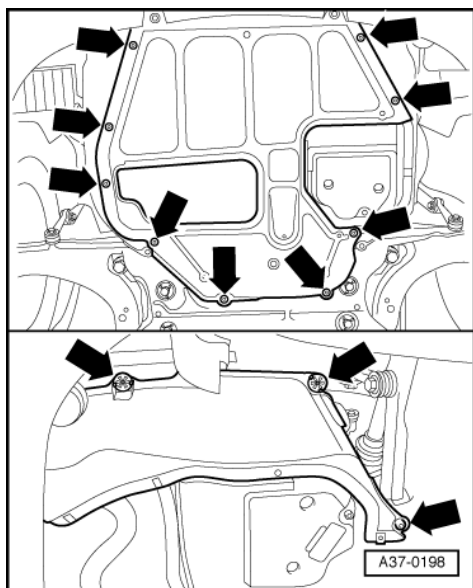
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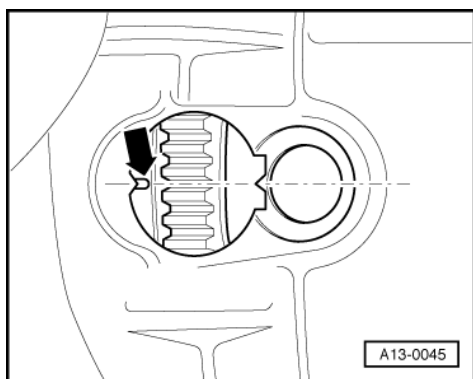
- -> Remove air duct hose -1- from air duct pipe.
- Detach connector of air mass meter -3-.
- Unscrew bolts -4- and -5-.
- Remove vent hose -2- from rear of air cleaner housing.
- Take out air cleaner housing.



- -> Remove lower air duct pipe -arrows-.



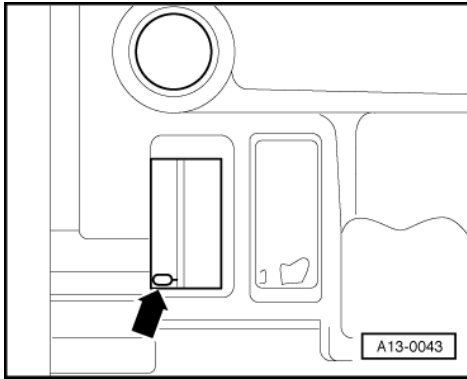
- -> Remove noise insulation in centre and on right -arrows-.



- -> Turn crankshaft to TDC No. 1 cylinder -arrow- (vehicles with manual gearbox).



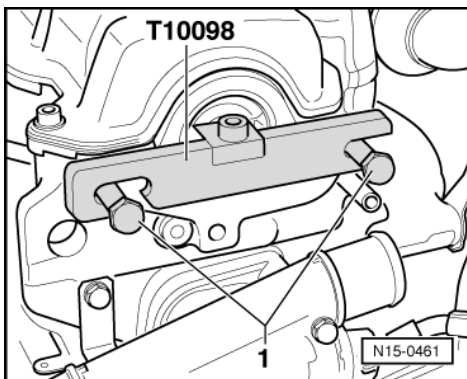
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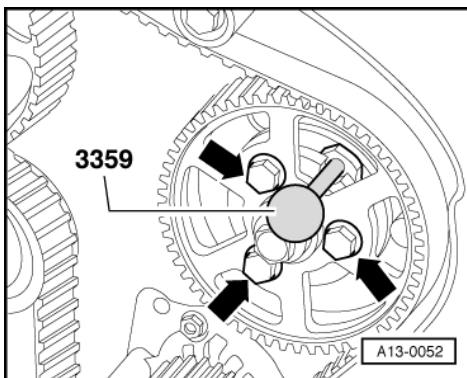
- -> Turn crankshaft to TDC No. 1 cylinder -arrow- (vehicles with automatic gearbox).

**Note:**

Position crankshaft to TDC No. 1 cylinder with engine removed=> Page 58.

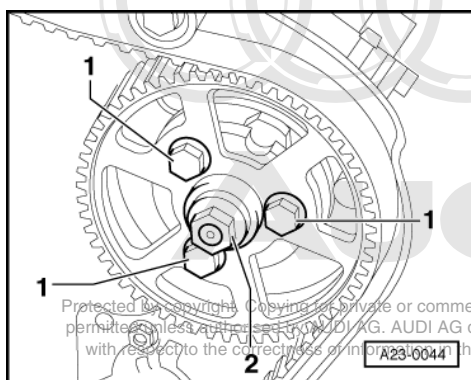


- Remove the exhauster => Fig. 96.
- -> Turn the bolts -1- by hand up to stop into the cylinder head.
- Lock the camshaft using camshaft straightedge T10098 as shown in the illustration.
- If the camshaft straightedge T10098 cannot be inserted, rotate crankshaft 1 additional turn (360°).



- -> Lock injection pump sprocket using pin 3359.
- Loosen injection pump sprocket securing bolts -arrows-.

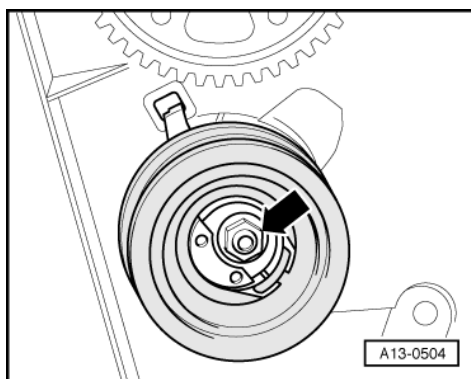
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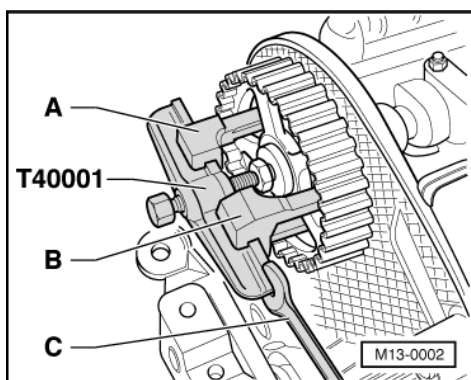
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**Note:**

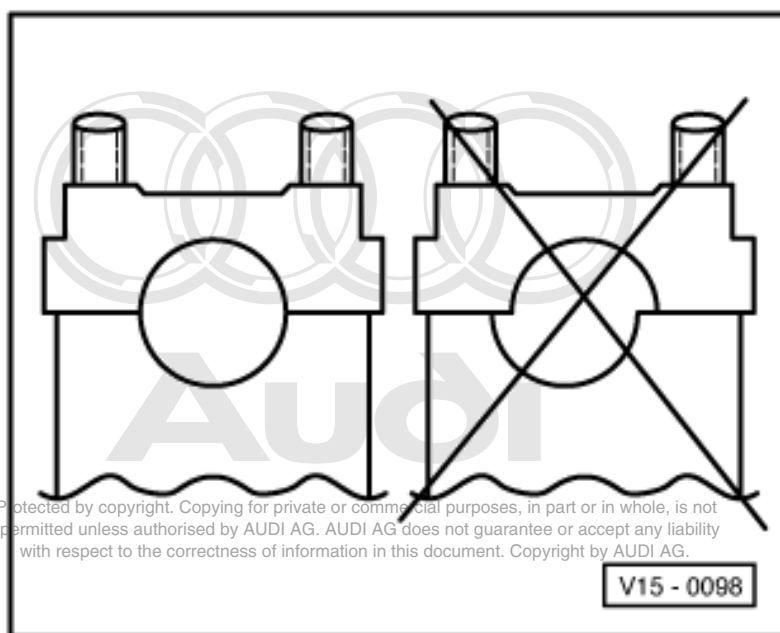
*-> Never loosen the injection pump sprocket central nut -2-. Otherwise the injection pump basic setting is incorrectly adjusted and cannot be corrected again using workshop equipment.*



- -> Loosen the tensioning roller nut -arrow- by several turns.



- Remove the toothed belt from the camshaft toothed belt sprocket.
- -> Unscrew the camshaft sprocket bolt by one half turn .
- Place the two-arm puller T40001 with claw T40001/2 -Item A- and the two-arm claw T40001/3 -Item B- centralised onto the camshaft sprocket.
- Pull off the camshaft sprocket using the two-arm puller. Counterhold using an open-end spanner -C- in the process.
- Removing camshaft toothed belt sprocket.
  
- Remove cylinder head cover => Page 96 .
- Only remove bearing caps 5, 1 and 3. Loosen bearing caps 2 and 4 alternately and diagonally.
- Take out camshaft.



## Installing

Installation is carried out in the reverse order; note the following:

### Notes:

- ◆ When installing the camshaft, No. 1 cylinder cams must point upwards.
- ◆ -> Before installing bearing caps, note bore offset and determine fitting location.
- ◆ Hose connections and hoses for charge air system must be free of oil and grease before assembly.
- ◆ Secure all hose connections with the correct hose clamps (same as original equipment):

=> Parts List

- Oil camshaft running surfaces.
- Tighten bearing caps 2 and 4 alternately and diagonally to 20 Nm.
- Install bearing caps 5, 1 and 3 and also tighten to 20 Nm.
- Attach camshaft sprocket and hand-tighten.
- Install cylinder head cover => Page 98 .
- Install toothed belt (adjust valve timing) => Page 53 .

### Notes:

- ◆ Note all instructions on removing and installing the toothed belt =>Page 48 .
- ◆ After installing the camshaft, wait for about 30 minutes before starting the engine. Hydraulic valve compensation elements have to settle (otherwise valves will strike pistons).
- ◆ After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.

## Tightening torque

| Component                    | Nm |
|------------------------------|----|
| Bearing cap to cylinder head | 20 |

## 2.5 - Checking hydraulic bucket tappets

### Special tools and workshop equipment required

- ♦ Feeler gauge
- ♦ Wood or plastic wedge

#### Notes:

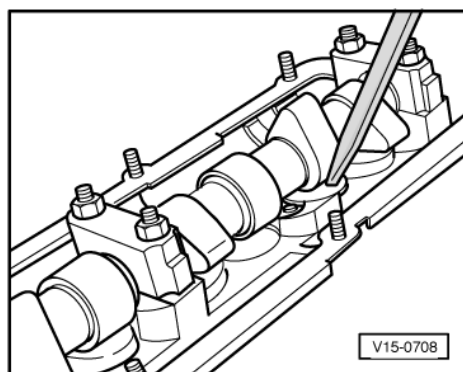
- ♦ Hydraulic tappets cannot be adjusted or repaired.
- ♦ Irregular valve noise during starting is normal.

### Test sequence

- Start engine and leave it running until coolant temperature has reached approx. 80 °C.
- Increase engine speed to about 2500 rpm for 2 minutes (perform road test if necessary).

If the hydraulic tappets are still noisy, locate defective tappets as follows:

- Remove cylinder head cover => Page **96**.
- Rotate crankshaft until the cams of the bucket tappets to be checked are pointing upwards:
  - Vehicles with manual gearbox: Push vehicle forwards with 4th gear engaged and ignition switched off.
  - Vehicles with automatic gearbox: Remove centre and right noise insulation as well as lower air duct pipe.
  - Turn crankshaft clockwise at crankshaft toothed belt sprocket central bolt.
- Determine play between cam and tappet.

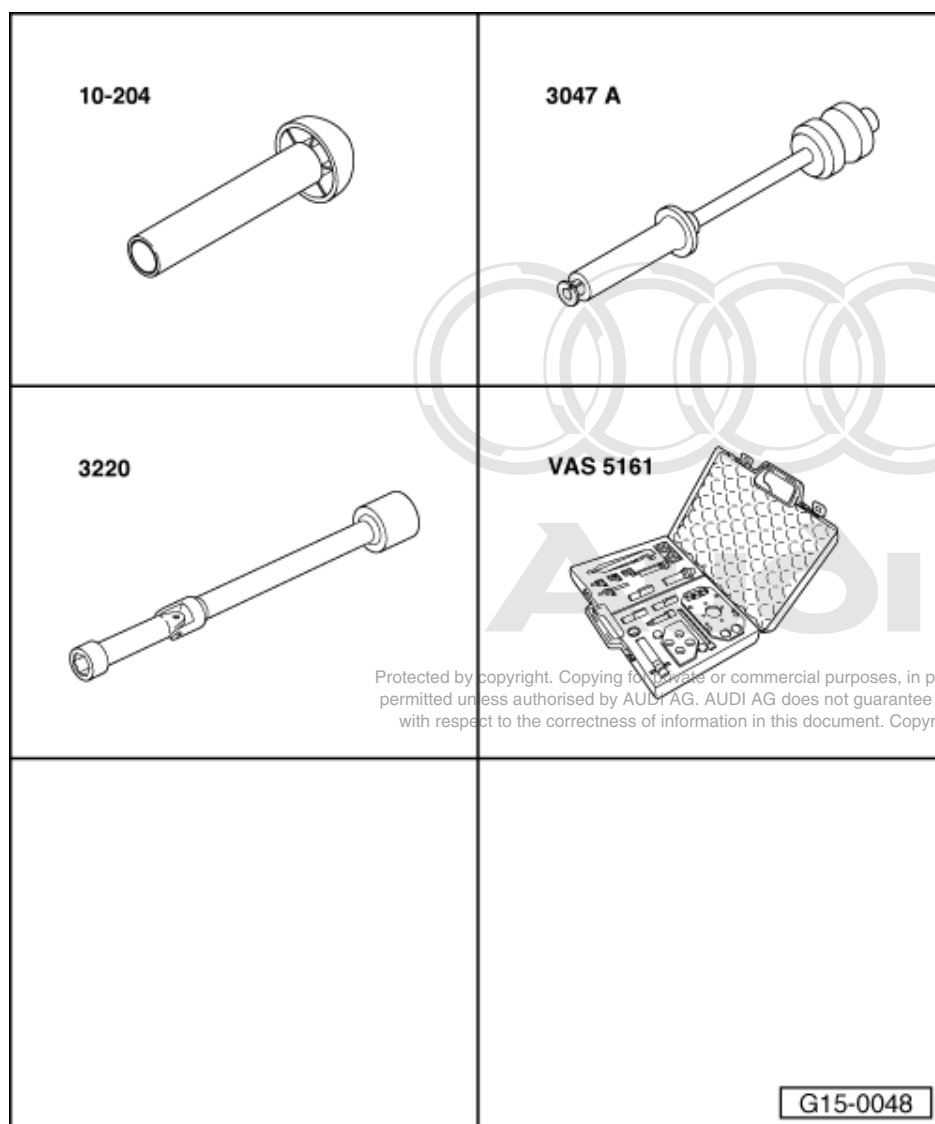


- -> Use a wooden or plastic wedge to push down bucket tappet. If an 0.20 mm feeler gauge can be inserted between camshaft and tappet, renew tappet.
- Replacing bucket tappet => Removing camshaft, Page **124**.

#### Notes:

- ♦ After installing the camshaft, wait for about 30 minutes before starting the engine. Hydraulic valve compensation elements have to settle (otherwise valves will strike pistons).
- ♦ After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.

## 2.6 - Renewing valve stem seals



### Special tools and workshop equipment required

- ◆ Press-on tool 10-204
- ◆ Puller 3047 A
- ◆ Jointed spanner 3220
- ◆ Disassembly and assembly tool VAS 5161

### Removing

- Cylinder head installed

### Note:

*When cylinder head was removed the valve stem seals can be replaced when using special tool 2037.*

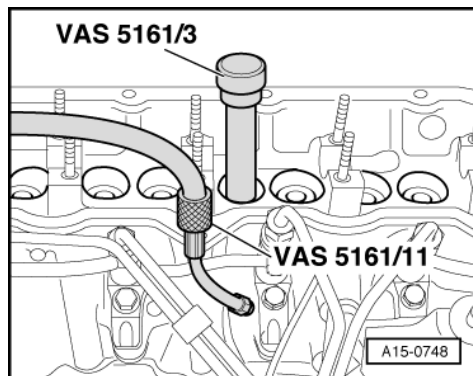
- Removing camshaft => Page 124 .

### Notes:

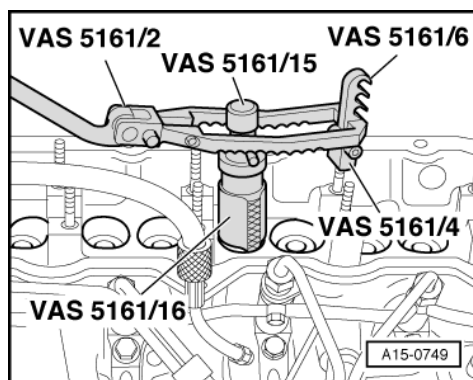
- ◆ Make sure that the bucket tappets are not interchanged.



- ♦ Mark allocation of bucket tappets on rear with a waterproof felt-tip pen.
- Remove the bucket tappets from guides and put them down with the contact surface downwards.

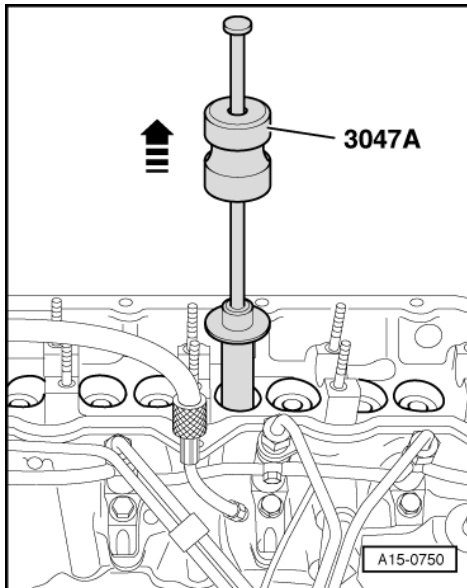


- -> Install pin VAS 5161/3 into bucket tappet guide.
- Knock valve wedges of all valves loose using a plastic hammer.
- Unplug connector console from glow plugs.
- Remove all glow plugs using jointed spanner 3220.
- Set piston of appropriate cylinder to "bottom dead centre".
- Screw the adapter VAS 5161/11 hand tight into the threaded hole of the respective glow plug.
- Connect adapter VAS 5161/11 via a commercially available intermediate piece to the pressure connection.
- Minimum pressure: 6 bar

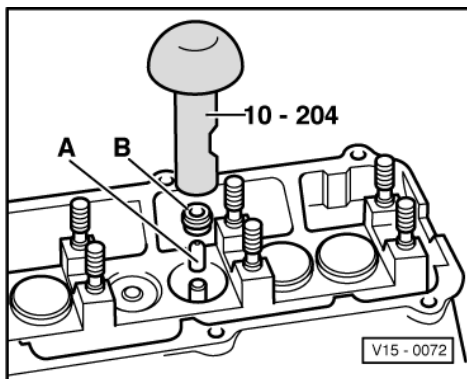


- -> Screw the catch part VAS 5161/6 with insertion fork VAS 5161/4 onto a stud on the cylinder head.
- Push guide bush VAS 5161/16 into bucket tappet guide of the valve to be removed until limit stop.
  - Installation position of guide bush: Hatched areas face driving direction
- Push assembly cartridge VAS 5161/15 into guide bush.
- Attach pressure fork VAS 5161/2 to catch part VAS 5161/6 and push assembly cartridge down.
- At the same time turn knurled screw of assembly cartridge towards the right until the tips of the valve wedges engage.
- Slightly move the knurled screw back and forth. This causes the valve wedges to be pressed apart and taken into the cartridge.
- Release the pressure fork.
- Remove assembly cartridge, guide bush, valve plate and valve springs.





- -> Use 3047 A to remove valve stem seals.

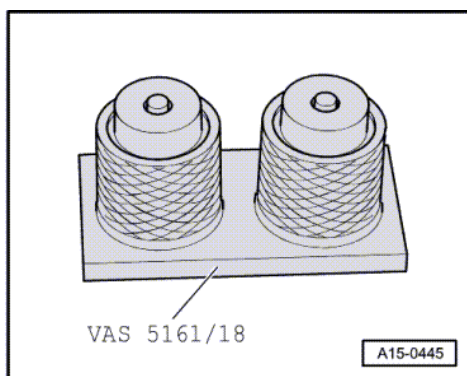


## Installing

### Note:

*A plastic sleeve -A- is included with the new valve stem seals.*

- -> To prevent damage to the new valve stem seals -B-, place plastic sleeve -A- on valve stem.
- Lightly lubricate sealing lip of valve stem seal.
- Push valve stem seal onto plastic sleeve.
- Carefully press the valve stem seal onto the valve guide using press-on tool 10-204.
- Remove plastic sleeve again.



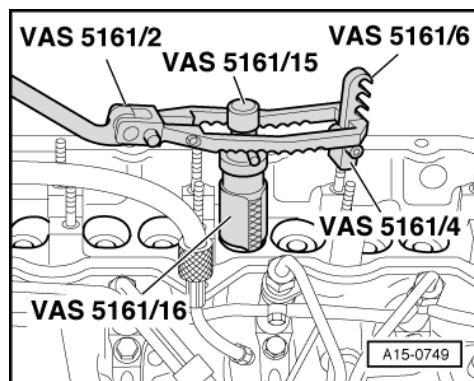
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- -> If the valve wedges were taken out of the assembly cartridge they must first be inserted into the installing tool VAS 5161/18.

#### Note:

The large diameter of the valve wedges points upwards.

- Push assembly cartridge VAS 5161/15 from the top onto installing tool and take up the valve wedges.



- -> Reinstall the assembly cartridge VAS 5161/15 into guide bush VAS 5161/16.
- Push pressure fork down and pull knurled screw upwards by turning to left and right - thus the valve wedges are installed.
- Take load of the pressure fork when knurled screw is still tight.
- Insert bucket tappet.
- Installing camshaft =>Page 129 .

#### Notes:

- ♦ After installing the camshaft, wait for about 30 minutes before starting the engine. Hydraulic valve compensation elements have to settle (otherwise valves will strike pistons).
- ♦ After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.

#### Tightening torque

| Component                   | Nm |
|-----------------------------|----|
| Glow plugs to cylinder head | 15 |

## 2.7 - Reworking valve seats

#### Note:

*If a good seating pattern cannot be obtained by grinding the valve seats (lapping), they must be refaced (re-worked):*

#### Special tools and workshop equipment required

- ♦ Depth gauge
- ♦ Valve seat machining tool

#### Notes:

- ♦ When repairing engines with leaking valves, it is not sufficient to reface the valve seats and renew the valves. The valve guides must also be checked for wear. This is particularly important on high mileage engines => Page 136 .
- ♦ Only rework the valve seats as far as is necessary to ensure a good seating pattern.
- ♦ Before starting to rework the valve seats, calculate the maximum permissible reworking dimension.

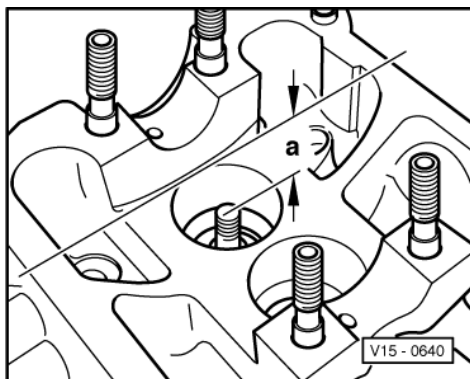
- ♦ If the maximum reworking dimension is exceeded, the hydraulic tappets will not work properly and the cylinder head will have to be renewed.

#### Calculating maximum permissible reworking dimension

- Insert valve and press firmly against valve seat.

#### Note:

If the valve must be renewed as part of a repair, use a new valve for the calculation.



- -> Measure distance -a- between valve shaft end (upper edge) and upper cylinder head area with a depth gauge.
- Calculate max. permissible reworking dimension from measured distance and minimum dimension.

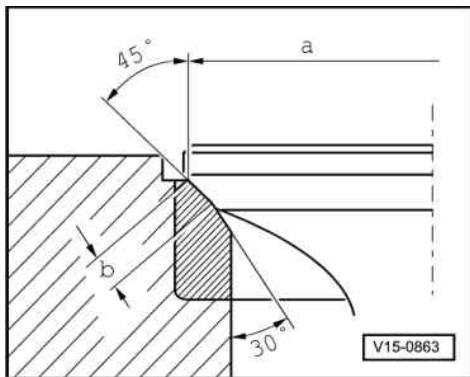
| Minimum dimensions |               |
|--------------------|---------------|
| Inlet valve        | Exhaust valve |
| 35.8 mm            | 36.1 mm       |

Measured distance minus minimum dimension  
= max. permissible reworking dimension.

|                                   |          |
|-----------------------------------|----------|
| <b>Example for inlet valve:</b>   |          |
| Measured distance                 | 36.5 mm  |
| - Minimum dimension               | -35.8 mm |
| = max. permissible reworking dim. | = 0.7 mm |

#### Note:

If the maximum permissible reworking dimension is 0 mm or less than 0 mm, repeat the measurement with a new valve. If the measured result is again 0 mm or less than 0 mm, renew the cylinder head.

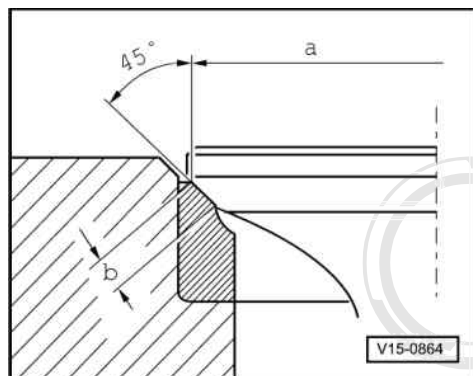


## -> Rework inlet valve seat

| Dim. |     | Inlet valve seat |
|------|-----|------------------|
| øa   | mm  | 35.7             |
| b    | mm  | 1.6              |
|      | 45° | Valve seat angle |

### Note:

The 30° angle on the valve seat is vital for the flow characteristics in the inlet duct.

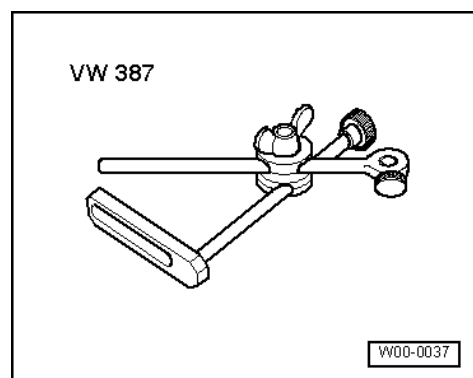


## -> Rework exhaust valve seat

| Dim. |     | Exhaust valve seat |
|------|-----|--------------------|
| øa   | mm  | 31.4               |
| b    | mm  | 2.7                |
|      | 45° | Valve seat angle   |

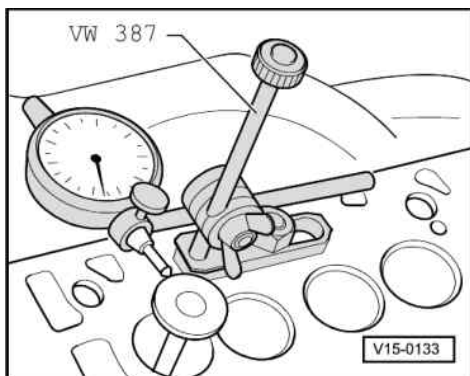
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## 2.8 - Checking valve guides



### Special tools and workshop equipment required

- ♦ Universal dial gauge bracket VW 387
- ♦ Dial gauge



### Test sequence

- -> Set valve in guide. The end of the valve stem is flush with guide.
- Determine rock.

### Wear limit

| Inlet valve guide | Exhaust valve guide |
|-------------------|---------------------|
| 1.30 mm           | 1.30 mm             |

### Notes:

- ♦ If the wear limit is exceeded, repeat the measurement with new valves. If the wear limit is again exceeded, renew the cylinder head. The valve guides cannot be replaced.
- ♦ If the valve must be renewed as part of a repair, use a new valve for the calculation.

## 2.9 - Checking valves

- Visually inspect stem and seat for scoring. Replace valves in the case of severe scoring.



## 17 - Lubrication

### 1 - Removing and installing parts of the lubrication system

#### 1.1 - Removing and installing parts of the lubrication system

**Notes:**

- ♦ If large quantities of metal shavings or particles are found in the engine oil when repairing the engine, the oil passages must be cleaned carefully, and the oil cooler renewed in order to prevent further damage occurring later.
- ♦ The oil level must not be above max. mark on dipstick - danger of damage to catalytic converter!
- ♦ Oil spray jet and pressure relief valve  
=> Fig. 142

Viscosity grades and oil specifications:

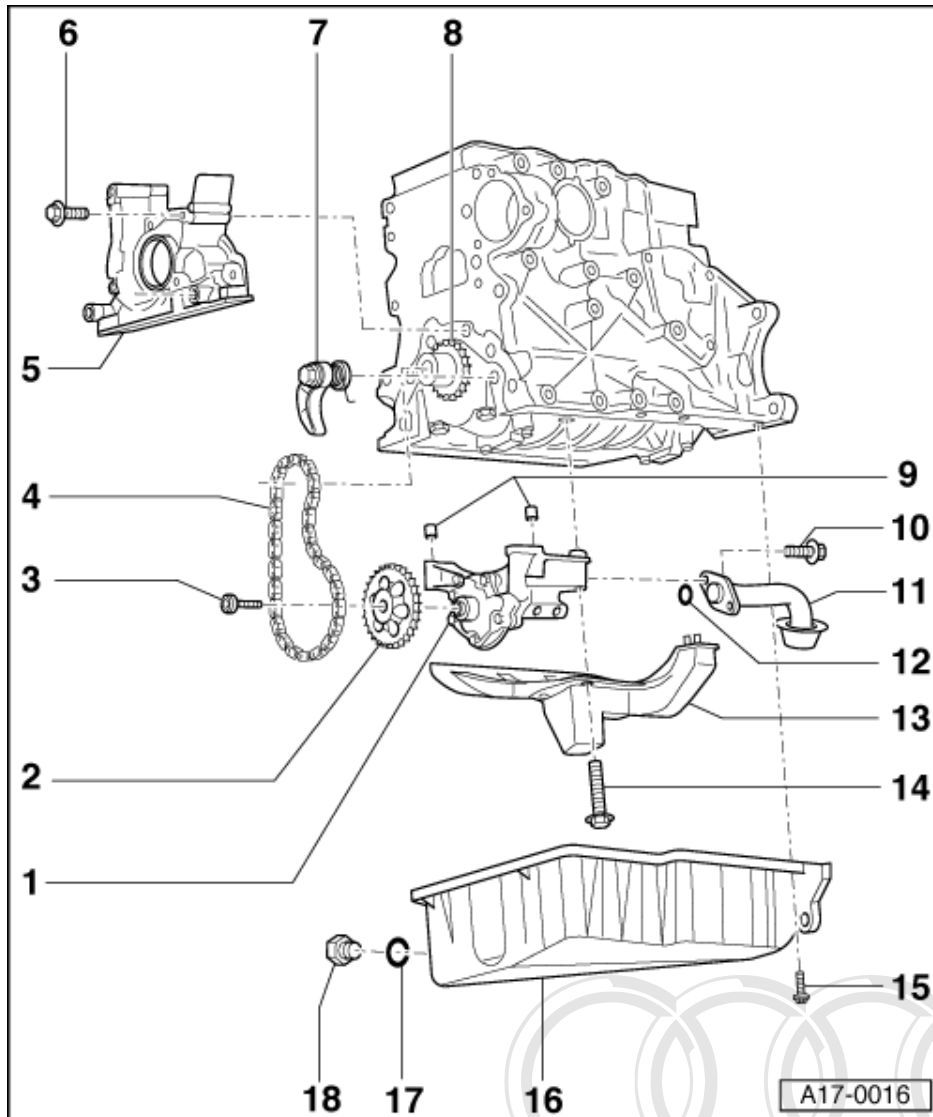
=> Maintenance Manual

Oil system capacity:

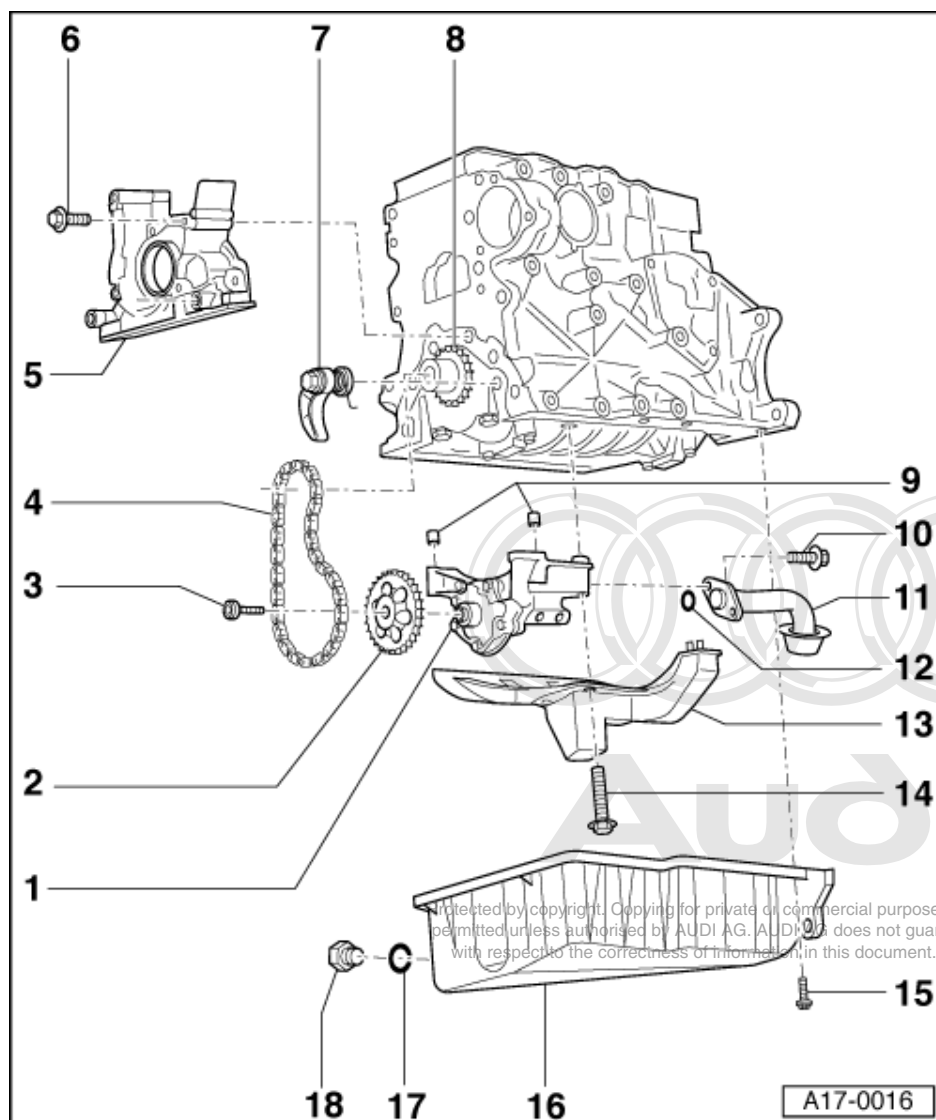
=> Exhaust Emissions Test binder



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- ◆ With pressure relief valve (12 bar)
  - ◆ Removing and installing  
=>Page 149 .
  - ◆ Prior to installation check that both of the dowel sleeves -Item 9 - used for centring the oil pump/cylinder block are still present.
  - ◆ Renew pump if there is scoring on moving surfaces and gear teeth.
  - ◆ Tightening torque for oil pump cover to oil pump housing: 10 Nm
- 2 Chain sprocket for oil pump**
- ◆ Sprocket can only be fitted on oil pump shaft in one position.
- 3 20 Nm + 90° (1/4 turn) further**
- ◆ Replace
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#### 4 Drive chain for oil pump

- ♦ Mark D.O.R. before removing
- ♦ Check for wear

#### 5 Sealing flange - front

- ♦ Removing and installing  
=>Page 66 .

#### 6 15 Nm

#### 7 Chain tensioner

- ♦ Tighten to 16 Nm
- ♦ Do not dismantle
- ♦ Note installation position
- ♦ Pre-tension spring and engage before installing

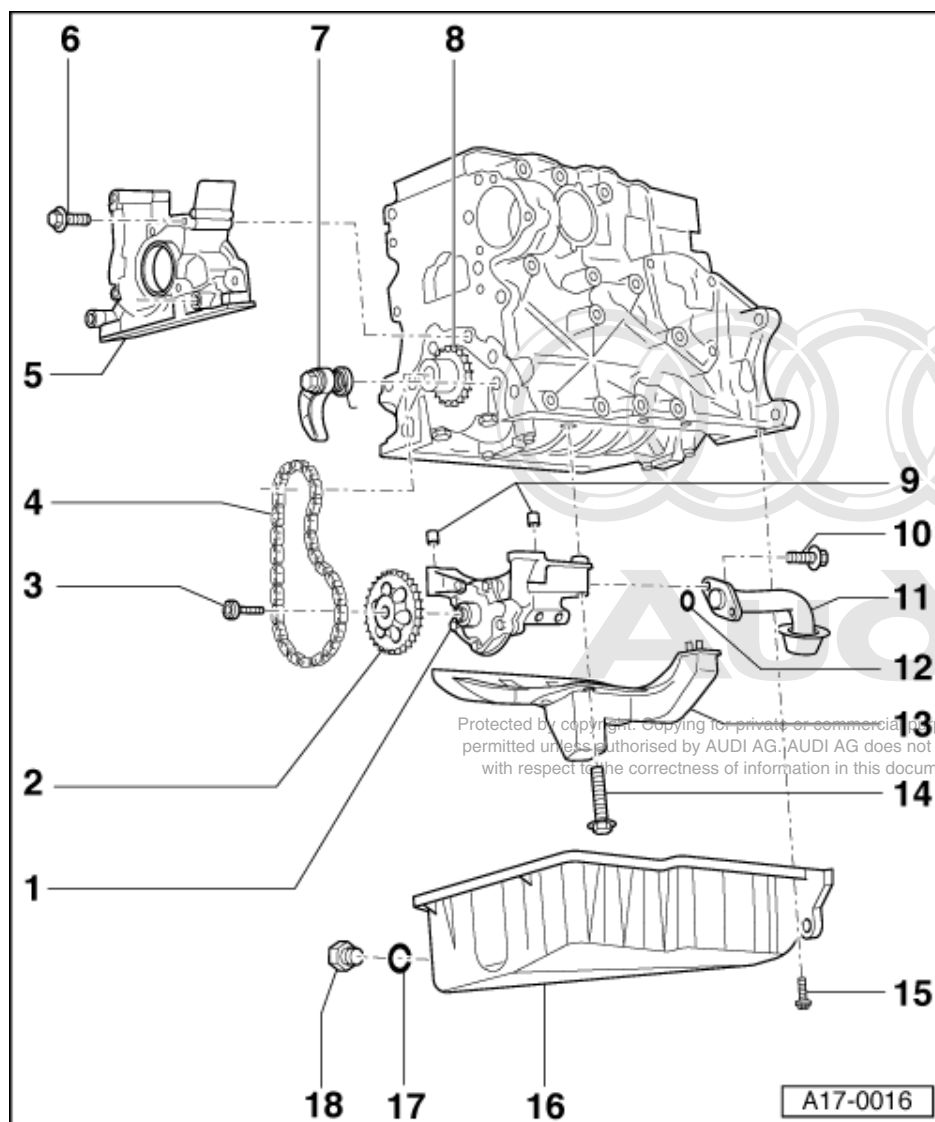
#### 8 Chain sprocket for oil pump

- ♦ Removing and installing=>Page 77

#### 9 Dowel sleeves

- ♦ 2 off

#### 10 15 Nm

**11 Suction pipe**

- ♦ Clean strainer if soiled

**12 O-ring**

- ♦ Replace

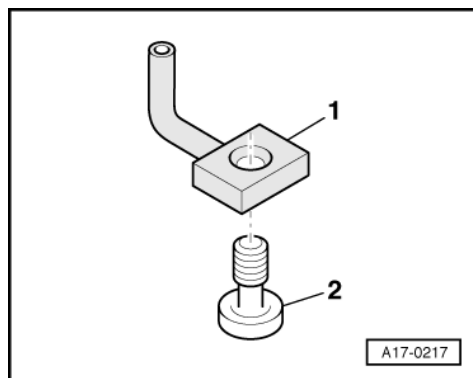
**13 Baffle plate****14 16 Nm****15 15 Nm****16 Oil pan**

- ♦ Removing and installing  
=>Page 146.

**17 Sealing ring**

- ♦ Replace

**18 Oil drain plug, 30 Nm**



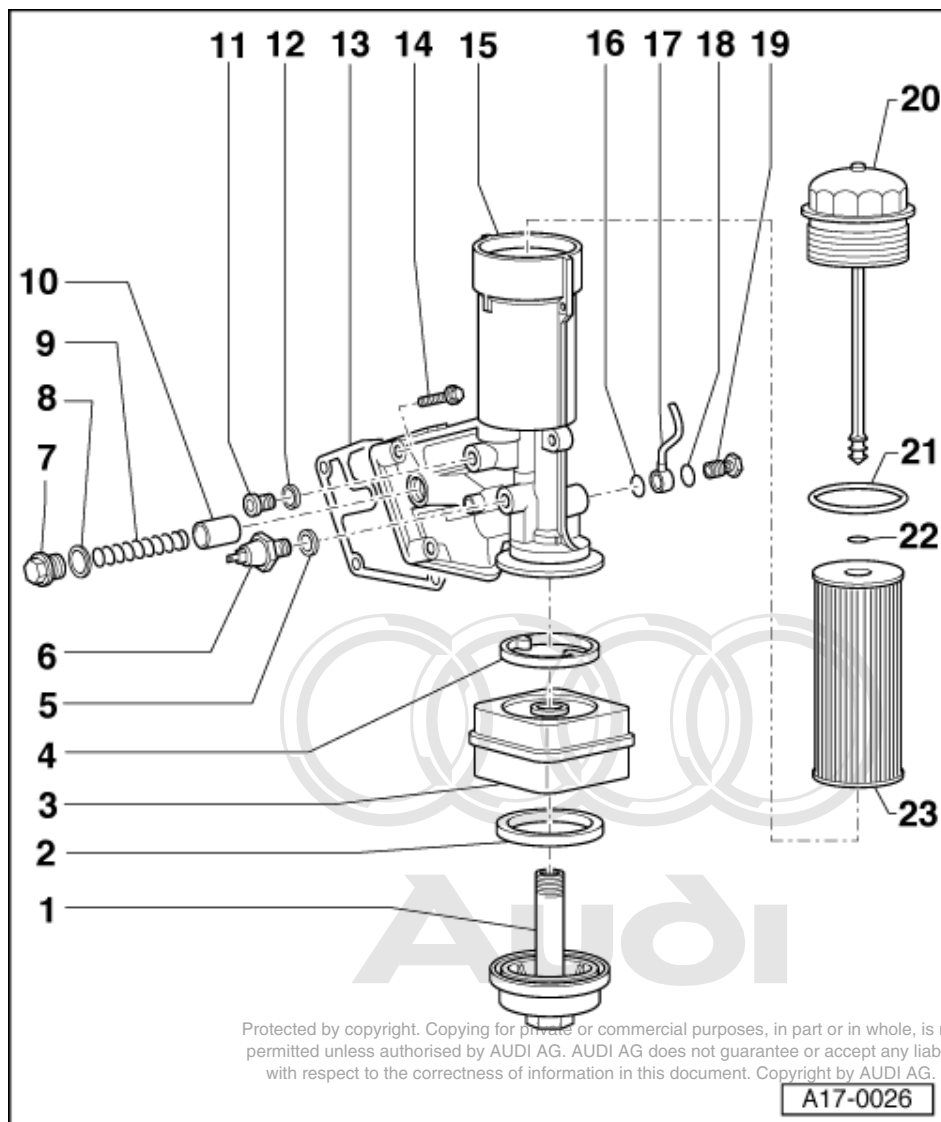
-> Fig.1 Oil spray jet and pressure relief valve

1 - Oil spray jet (for cooling of piston)

2 - Bolt with pressure relief valve - 27 Nm

- Opening pressure 1.3 ... 1.6 bar

### 1.3 - Part II



- 
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- A17-0026

- 1.3 - Part II 143



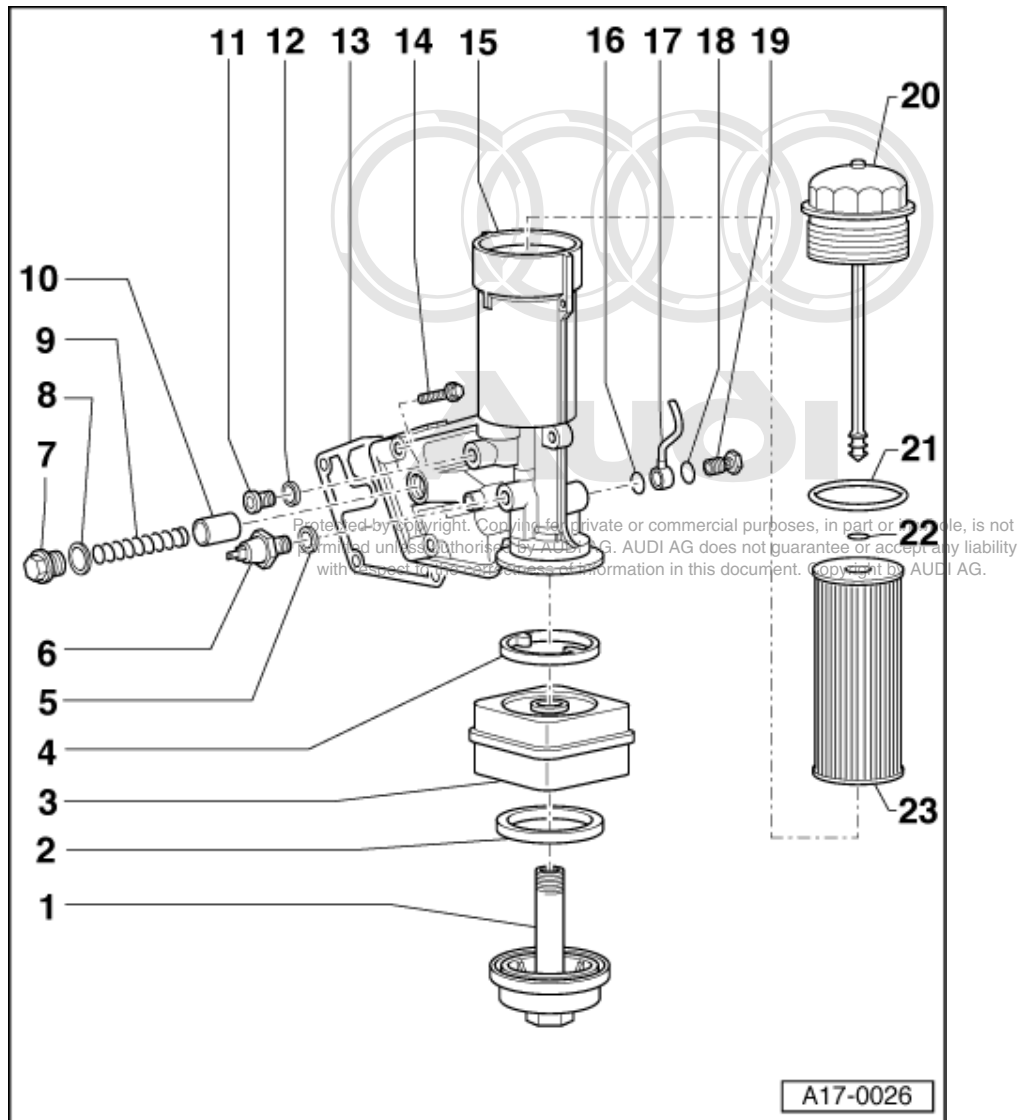
**10 Piston**

- ♦ For 5 bar pressure relief valve

**11 Screw plug - 10 Nm**

**12 Sealing ring**

- ♦ If seal is leaking, cut open and renew.



**13 Gasket**

- ♦ Replace

**14 15 Nm + 1/4 turn (90°) further**

- ♦ Replace
- ♦ First attach bolt top left and right, then tighten all four bolts diagonally

**15 Oil filter bracket**

**16 Sealing ring**

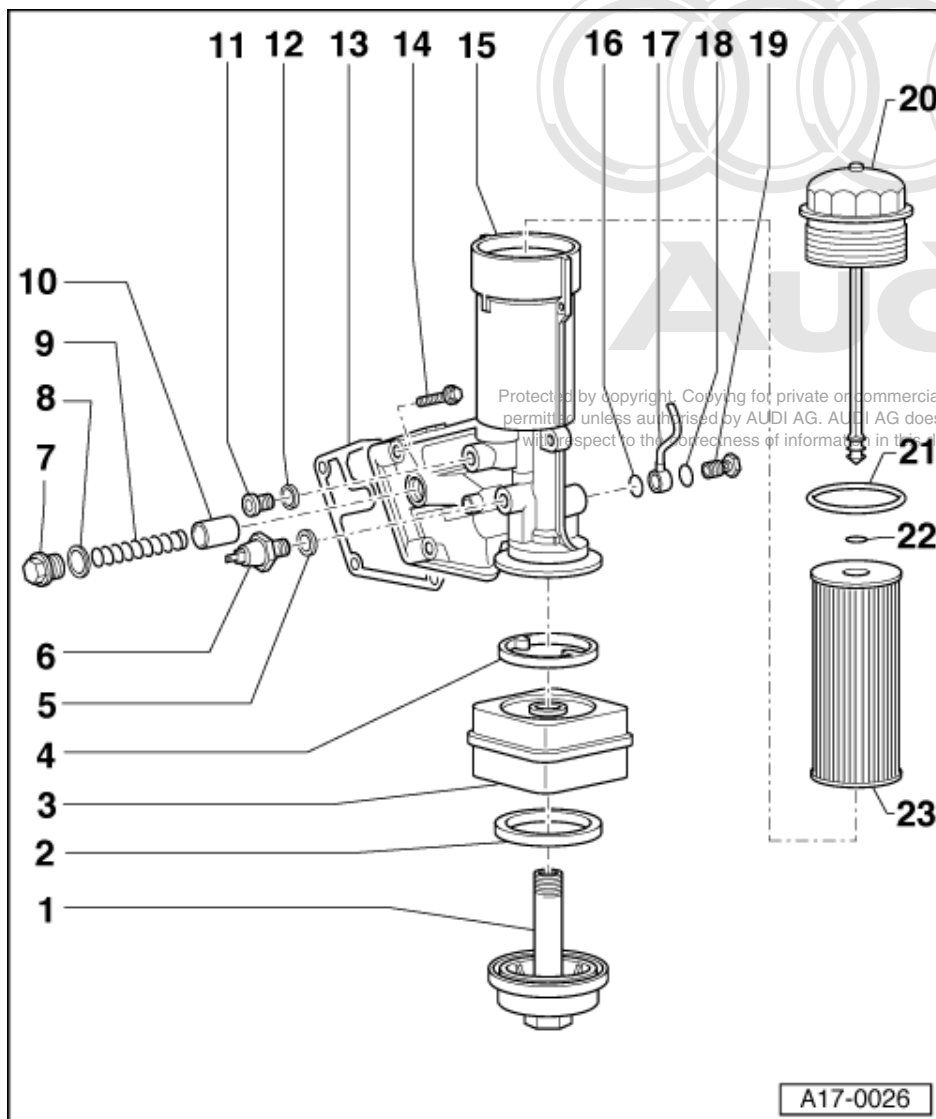
- ♦ Replace

**17 Oil supply pipe**

- ♦ To turbocharger
- ♦ Note installation sequence:
  - First screw in both wiring ends loosely.
  - Then tighten wiring ends to final torque.
  - Lastly attach bracket.

**18 Sealing ring**

- ♦ Replace



19 Banjo bolt - 25 Nm

20 Sealing cap - 25 Nm

- ♦ Loosen and tighten with oil filter wrench 3417

21 O-ring

- ♦ Replace

22 O-ring

- ♦ Replace

23 Oil filter element

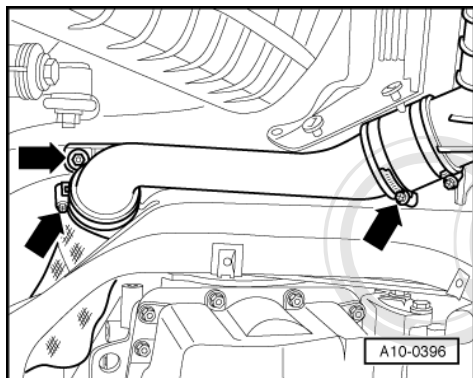
- ♦ Off sealing cap - 20 -.
- ♦ When replacing filter, replace O-rings -Item 21 and 22 -
- ♦ Note correct installation position:  
Top
- ♦ Observe change intervals

=> Maintenance Manual

## 1.4 - Removing and installing oil pan

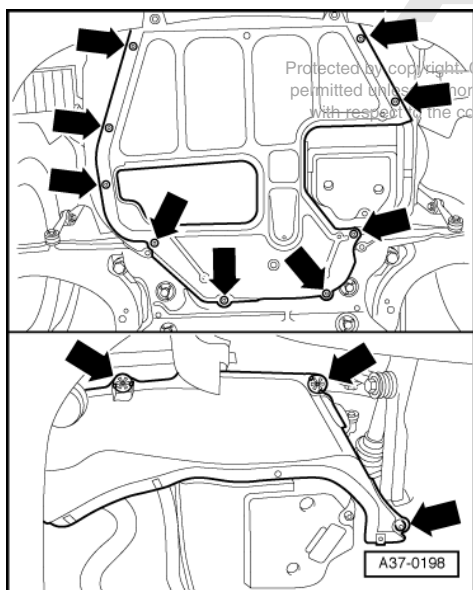
### Special tools, workshop equipment, and other items required

- ♦ Electric drill with plastic brush attachment
- ♦ Protective goggles
- ♦ Silicone sealant D 176 404 A2

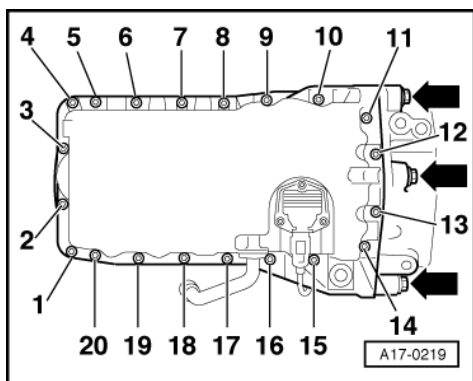


### Removing

- -> Remove lower air duct pipe -arrows-.



- -> Remove noise insulation in centre and on right -arrows-.
- Drain engine oil.

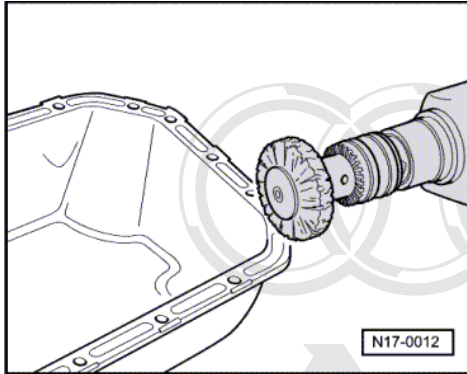


- -> Unscrew bolts of oil pan/gearbox -arrows-.
- Slacken bolts -1 ... 20- diagonally.

**Note:**

*Loosen and tighten oil pan bolts with jointed wrench 3185. Unscrew using socket attachment 3249.*

- Remove sump: if necessary loosen it by striking lightly with a rubber hammer.



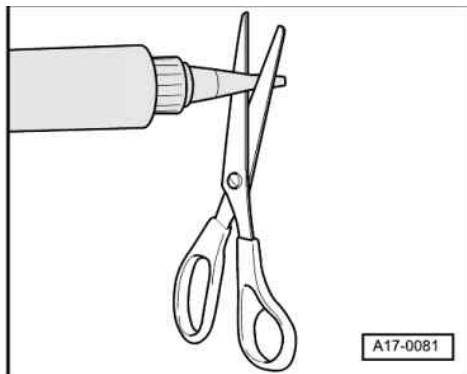
- Carefully remove sealant residues from cylinder block. For this remove baffle plate.

**Important**

**Wear protective glasses**

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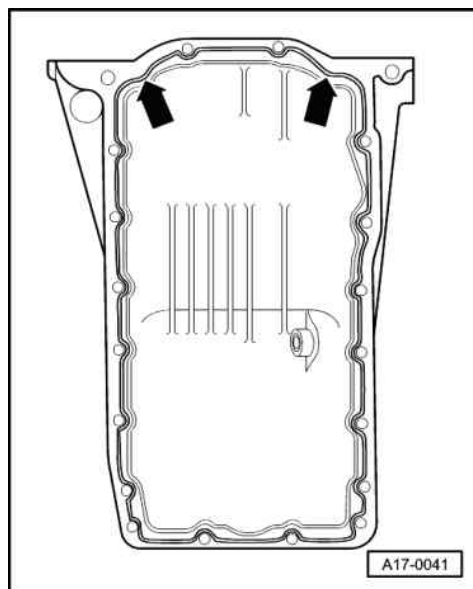
- -> Remove sealant residues from oil pan, e.g. with rotating plastic brush or similar.
- Clean sealing surfaces: they must be free of oil and grease.



**Installing**

Installation is carried out in the reverse order; note the following:

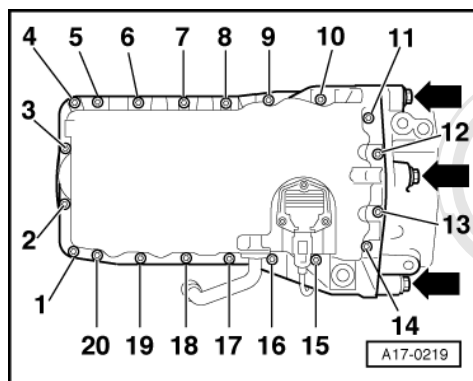
- -> Cut off nozzle of tube at front marking ( $\varnothing$  of nozzle approx. 3 mm).



- -> Apply the bead of silicone sealant onto the clean sealing surface of the oil pan, as illustrated.
- Thickness of sealant bead: 2 ... 3 mm

#### Notes:

- ♦ The oil pan must be installed within 5 minutes after applying the silicone sealant.
- ♦ The bead of sealant must not be thicker than prescribed, as otherwise excess sealant will enter the oil pan and obstruct the strainer in the oil intake manifold.
- ♦ Be particularly careful when applying the bead of sealant around the rear sealing flange (arrows in illustration).



- Immediately install oil pan and tighten bolts in the sequence mentioned:

- -> Tighten bolts -1 ... 20- diagonally to 5 Nm.
- Tighten bolts of oil pan/gearbox -arrows- to 45 Nm.
- Tighten bolts -1 ... 20- diagonally to 15 Nm.

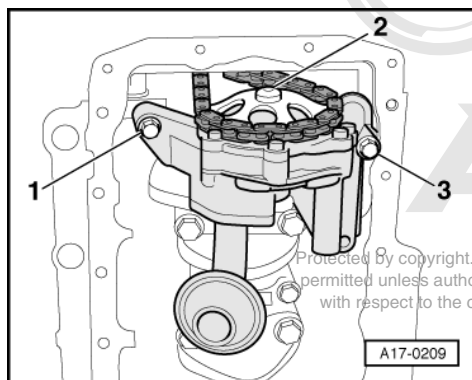
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#### Notes:

- ♦ When installing the oil pan with the engine out of the vehicle, ensure that the oil pan is flush with the cylinder block at the flywheel end.
- ♦ After fitting oil pan assembly, the sealant must dry for approx. 30 minutes. Only then may the engine oil be filled.
- Fill up with engine oil and check oil level.

**Tightening torques**

| Component                 | Nm |
|---------------------------|----|
| Oil pan to cylinder block | 15 |
| Oil pan to gearbox        | 45 |
| Oil drain plug            | 30 |

**1.5 - Removing and installing oil pump**

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**Removing**

- Remove oil pan and baffle plate  
=>Page 146 .
- -> Unscrew bolt -2-.
- Remove chain wheel from oil pump shaft.
- Screw out bolts -1- and -3- and detach oil pump.

**Installing**

Installation is carried out in the reverse order; note the following:

- Insert dowel sleeves - 140 on top of oil pump.
  - Oil pump shaft/sprocket wheel installation position: Can only be fitted in one position.
- Installing oil pan => page 147

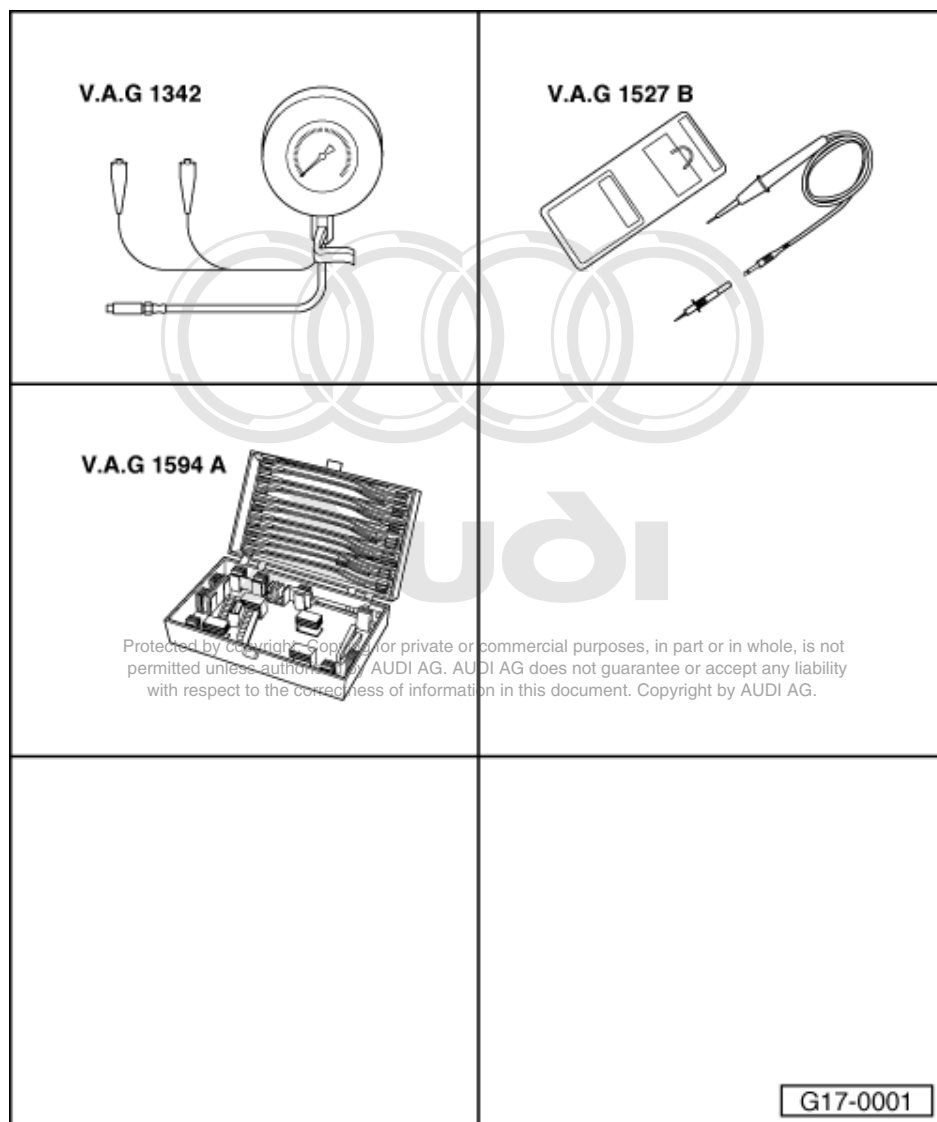
**Tightening torques**

| Component                        | Nm           |
|----------------------------------|--------------|
| Chain sprocket to oil pump shaft | 20 + 90°1)2) |
| Oil pump to cylinder block       | 16           |

- 1) Replace bolt
- 2) 90° corresponds to a quarter of a turn



## 1.6 - Checking oil pressure and oil pressure switch

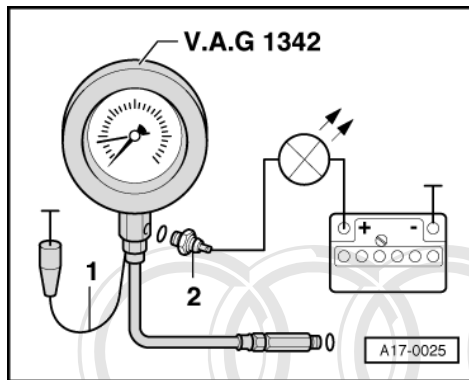


### Special tools and workshop equipment required

- ♦ V.A.G 1342
- ♦ V.A.G 1527 B
- ♦ V.A.G 1594 A

### Test requirements:

- Oil level OK.
- Engine oil temperature approx. 80 °C.
- Oil pressure warning lamp K3 must come on when ignition is switched on.
- In vehicles with driver information system (DIS) the display "OK" must light up.



Check oil pressure switch 0.7 bar (brown) or 0.9 bar (grey), respectively

- Disconnect wire from oil pressure switch.
- -> Unscrew oil pressure switch and screw in oil pressure tester V.A.G 1342.
- Screw oil pressure switch -2- into V.A.G 1342.
- Connect brown wire 1 of tester to earth (-).
- Connect voltage tester V.A.G 1527 B to oil pressure switch and positive side of battery (+) using test leads from V.A.G 1594 A.
- LED should not illuminate.

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- If the LED illuminates, fit a new oil pressure switch.
- Start the engine.

**Note:**

*The switching point of the oil pressure switch can be reached when the engine is turned by the starter motor, so watch the tester and the LED while starting the engine.*

**Oil pressure switch brown:**

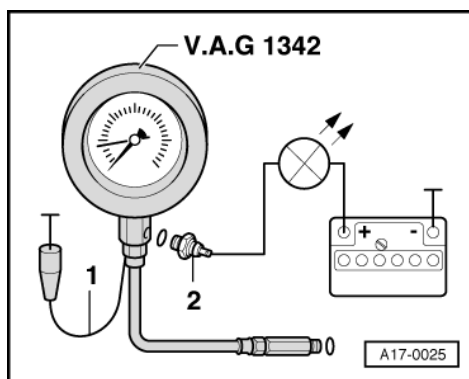
- At 0.55 ... 0.85 bar, the LED must illuminate

**Oil pressure switch, grey:**

- At 0.75 ... 1.05 bar, the LED must illuminate
- If the LED does not illuminate, fit a new oil pressure switch.

**Note:**

*As a replacement for the oil pressure switch 0.9 bar (grey) an oil pressure switch 0.7 bar (brown) is supplied.*



**Checking oil pressure**

- Disconnect wire from oil pressure switch.
- -> Unscrew oil pressure switch and screw in oil pressure tester V.A.G 1342.
- Screw oil pressure switch -2- into V.A.G 1342.



- Start engine (engine oil temperature approx. 80 °C)..
  - Oil pressure at idling speed: at least 0.8 bar
  - Oil pressure at 2000 rpm: at least 2.0 bar
  - Oil pressure at higher engine speeds: max. 7.0 bar

If the specified values are not obtained:

- Pressure relief valve or oil pump defective, replace oil pump => Page 149 .

## 1.7 - Engine oil

### Viscosity grades and oil specifications

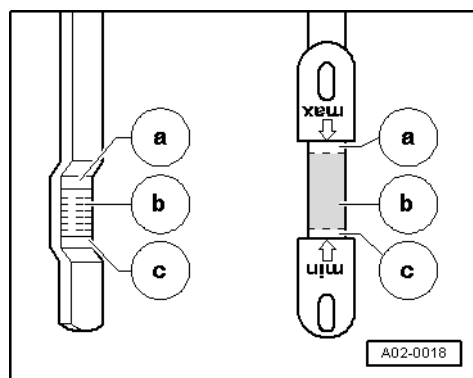
Viscosity grades and oil specifications:

=> Maintenance Manual

## 1.8 - Checking oil level

### Test requirements:

- Engine oil temperature at least 60 °C
- Vehicle must be level (horizontal)
- Wait a few minutes after switching off the engine to allow the oil to flow back into the sump.
- Pull out the dipstick, wipe with a clean cloth and insert again to stop.
- Pull out the dipstick again and read off the oil level.

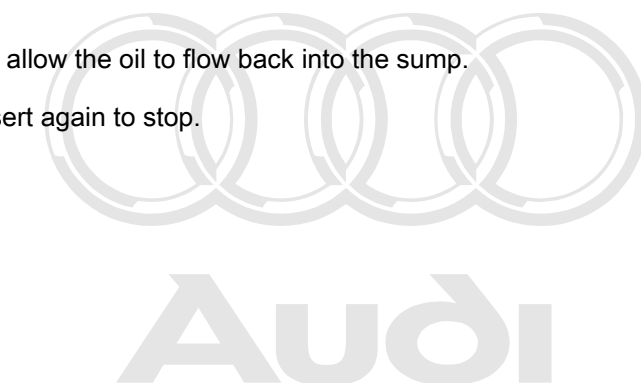


-> Markings on oil dipstick:

- a - Oil must not be topped up.
- b - Oil may be topped up. The oil level may rise as far as area -a- after topping up.
- c - Oil must be topped up. The oil level is sufficient if somewhere in area -b- (grooved area) after topping up.

### Note:

The oil level must not be above marking -a- on the dipstick.



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## 19 - Cooling system

### 1 - Removing and installing parts of the cooling system

#### 1.1 - Removing and installing parts of the cooling system

##### Important

Hot steam can escape when opening cap on expansion tank: Cover cap with a cloth and open carefully.

##### Notes:

- ♦ When the engine is warm the cooling system is under pressure. If necessary release pressure before commencing repair work.
- ♦ Secure all hose connections with the correct hose clamps (same as original equipment):

=> Parts List

- ♦ Hose clamp pliers V.A.G 1921 or spring clamp pliers VAS 5024 A are recommended for use in installing spring clamps.
- ♦ Replace seals and gaskets.
- ♦ The arrow markings on the coolant pipes and on the ends of the hoses must align.

## 1.2 - Parts of cooling system

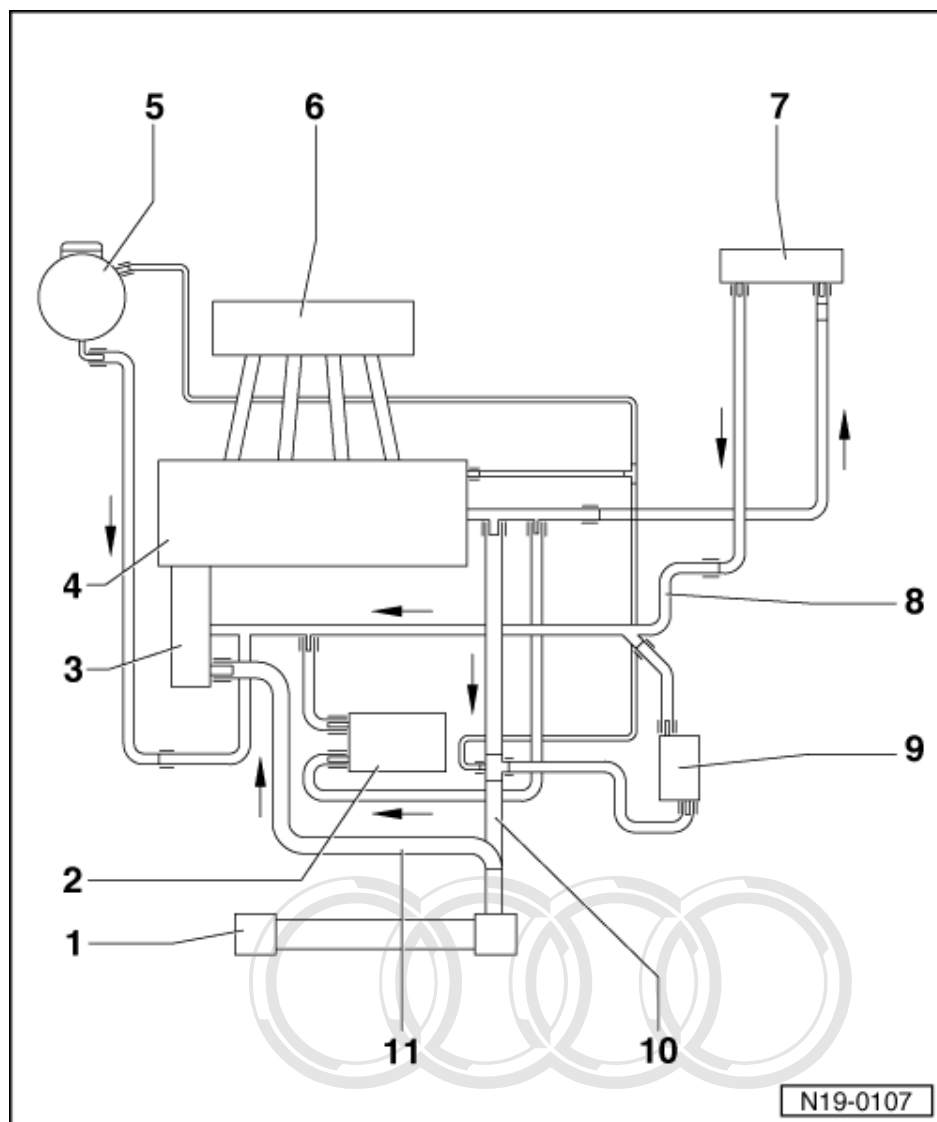


Diagram of coolant hose connections

### 1 Radiator

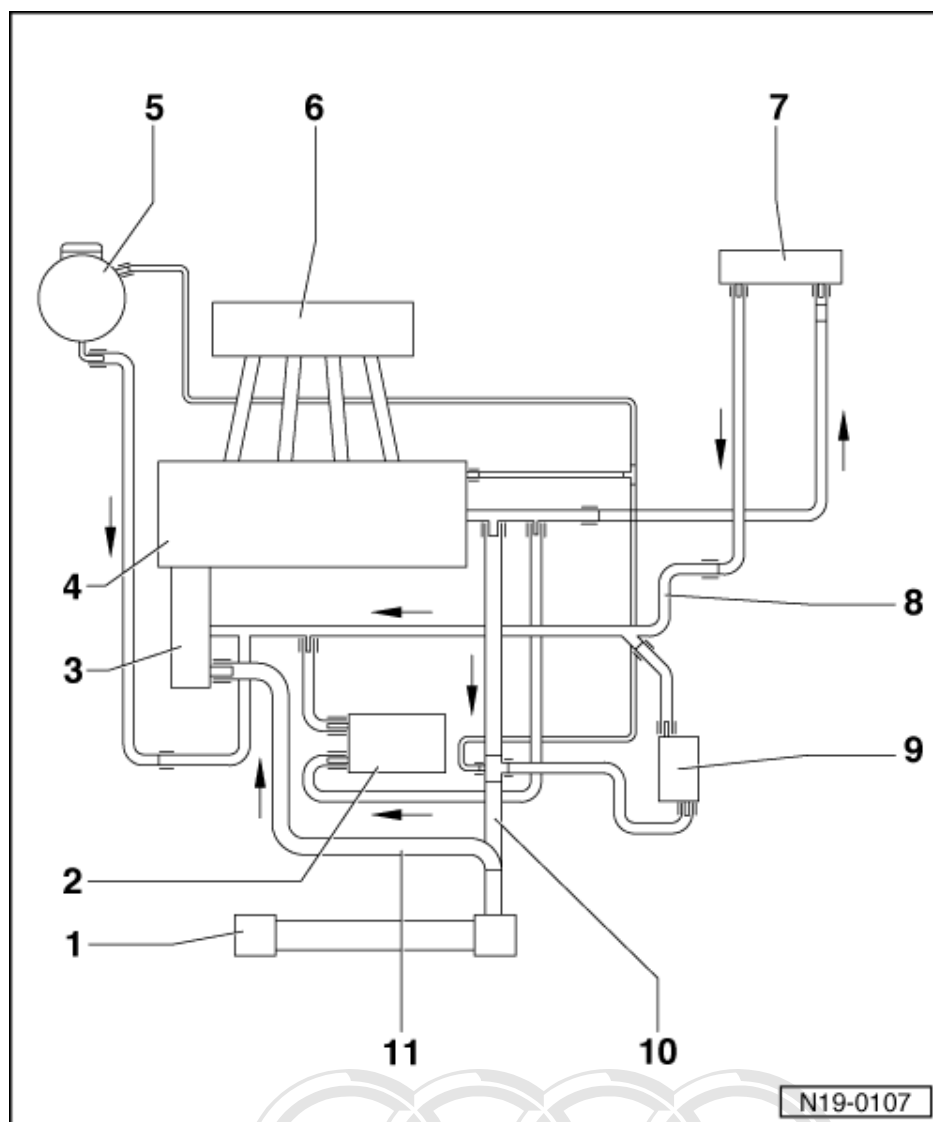
- ♦ Removing and installing  
=>Page 171
- ♦ After replacing, fill with fresh coolant

### 2 Oil cooler

- ♦ Removing and installing => 143

### 3 Coolant pump, coolant thermostat

- ♦ Removing and installing coolant pump => Page 160
- ♦ Check for ease of movement
- ♦ Removing and installing thermostat => Page 167
- ♦ Checking => Page 168



#### 4 Cylinder head/cylinder block

- ♦ After replacing, fill with fresh coolant

#### 5 Expansion tank

- ♦ With filler cap
- ♦ Check pressure relief valve in sealing cap => Page 175

#### 6 Intake manifold

#### 7 Heating system heat exchanger

- ♦ After replacing, fill with fresh coolant

#### 8 Coolant pipe

#### 9 Gearbox oil cooler

- ♦ For ATF

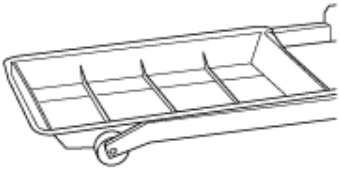
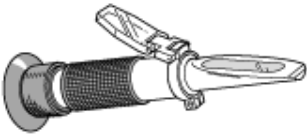
#### 10 Upper coolant hose

#### 11 Lower coolant hose

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### 1.3 - Draining and filling cooling system

|                                                                                                        |                                                                                                                                                                                                                                                                                          |
|--------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>V.A.G 1306</b><br> | <b>V.A.G 1921</b><br>                                                                                                                                                                                   |
| <b>T10007</b><br>     | <p>Protected by copyright. Copying for private or commercial purposes, in part or in whole, is not permitted unless authorised by AUDI AG. AUDI AG does not guarantee or accept any liability with respect to the correctness of information in this document. Copyright by AUDI AG.</p> |
|                                                                                                        | <div>G19-0008</div>                                                                                                                                                                                                                                                                      |

#### Special tools and workshop equipment required

- ♦ V.A.G 1306
- ♦ V.A.G 1921
- ♦ Refractometer T10007

#### Draining

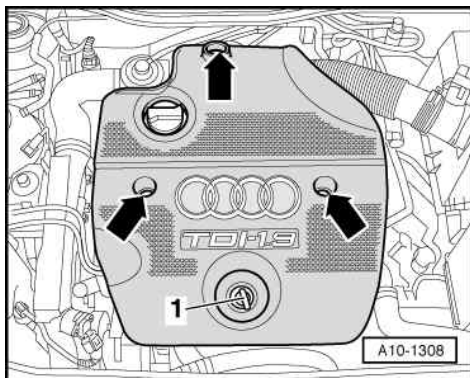
##### **Note:**

*Collect drained coolant in a clean container for re-use or disposal.*

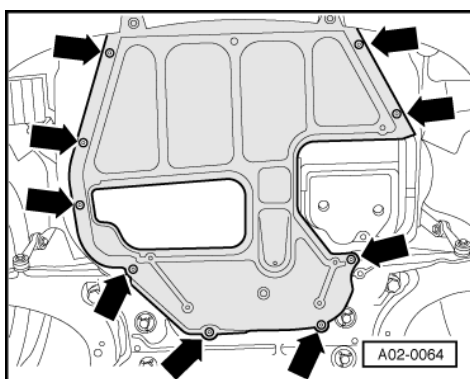
##### Important

Hot steam or hot coolant can escape when opening expansion tank. Cover cap with a cloth and open carefully.

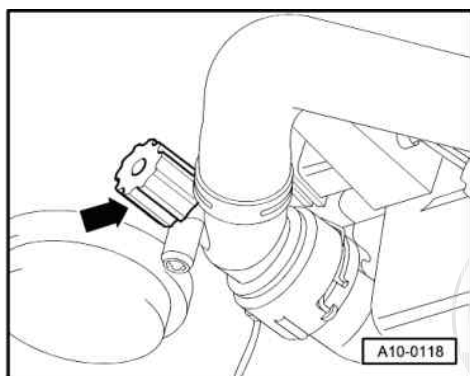
- Open the cover of the coolant expansion tank



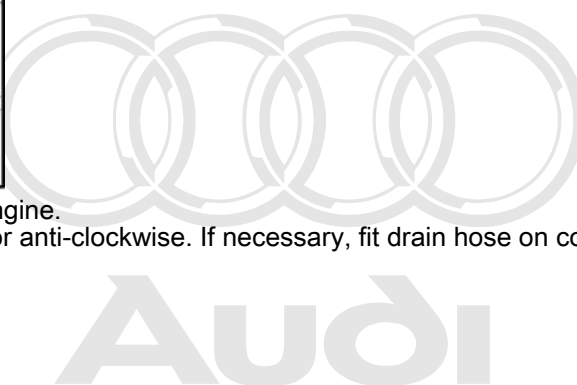
- -> Remove oil dipstick -1- from guide tube.
- Unclip caps.
- Unscrew nuts -arrows- and remove engine cover.
- Reinsert oil dipstick in guide tube.



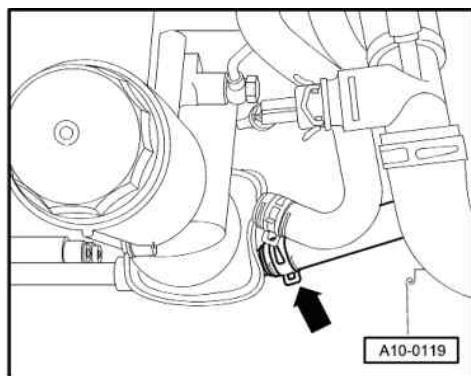
- -> Remove the noise insulation -arrows-.



- Place drip tray V.A.G 1306 below engine.
- -> Turn drain plug -arrow- on radiator anti-clockwise. If necessary, fit drain hose on connection.



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- -> Also disconnect lower coolant hose on oil cooler -arrow-, and drain off remaining coolant.

## Filling

### Notes:

- ♦ The cooling system is filled all year round with a mixture of water and antifreeze/corrosion protection agent.
- ♦ Only use coolant additive G 012 A8 D - meeting specification TL VW 774 D.  
Identification: red colour

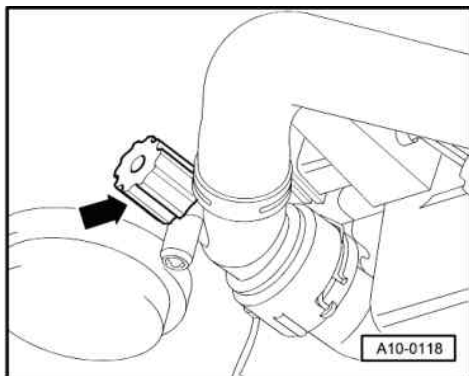
### Important G

- ♦ If the fluid in the expansion tank is brown, this means G 012 A8 D has been mixed with another type of coolant. In this case, flush out the cooling system and fill with fresh coolant. To flush the system, fill it with clean water and run the engine for about 2 minutes. This should remove as much of the old coolant as possible.
- ♦ G 012 A8 D and coolant additives marked "meeting specification TL VW 774 D" prevent frost and corrosion damage and stop scaling. and at the same time raise the boiling point of the coolant. For these reasons the cooling system must be filled all year round with the correct anti freeze and anti corrosion additive.
- ♦ Because of its high boiling point, the coolant improves engine reliability under heavy loads, particularly in countries with tropical climates.
- ♦ Protection against frost must be assured to about -25 °C (in countries with an arctic climate to about -35 °C).
- ♦ The coolant concentration must not be reduced by adding water even in warmer seasons and in warmer countries. The anti freeze ratio must be at least 40 %.
- ♦ If greater frost protection is required in very cold climates, the amount of G 012 A8 D can be increased, but only up to 60 % (this gives frost protection to about -40 °C), as otherwise frost protection is reduced again and cooling effectiveness is also reduced.
- ♦ Only use clean drinking water to mix the coolant.
- ♦ If radiator, heat exchanger, cylinder head or cylinder head gasket is replaced, do not reuse old coolant.
- ♦ Use special tool T10007 to check frost protection of coolant additive G012 A8 D in cooling system.

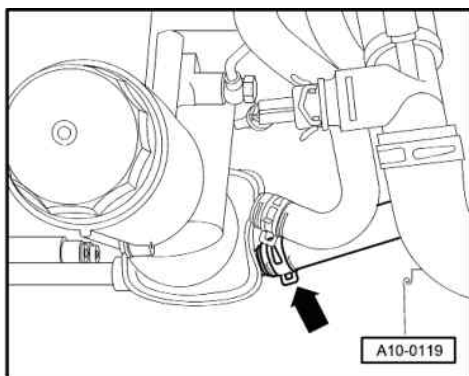
Recommended mixture ratios:

| Frost protec-<br>tion to | Anti freeze<br>concentration | G 012A8 D 1) | Water1) |
|--------------------------|------------------------------|--------------|---------|
| -25 °C                   | 40 %                         | 2.4 l        | 3.6 l   |
| -35 °C                   | 50 %                         | 3.0 l        | 3.0 l   |

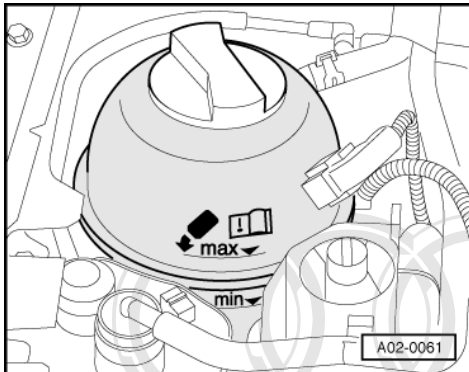
1) Coolant quantity: 6.0 litres (may vary depending upon the vehicle equipment)



- -> Turn drain bolt -arrow- on radiator clockwise.



- -> Connect the coolant hose to the oil cooler -arrow-.



- -> Top up coolant to max. mark on expansion tank.
- Start engine, allow to run at approx. 1500/rpm for max. 2 minutes, and at the same time fill with coolant up to overflow hole on the expansion tank.
- Fit expansion tank cap.
- Run engine until radiator fan cuts in.

#### Important

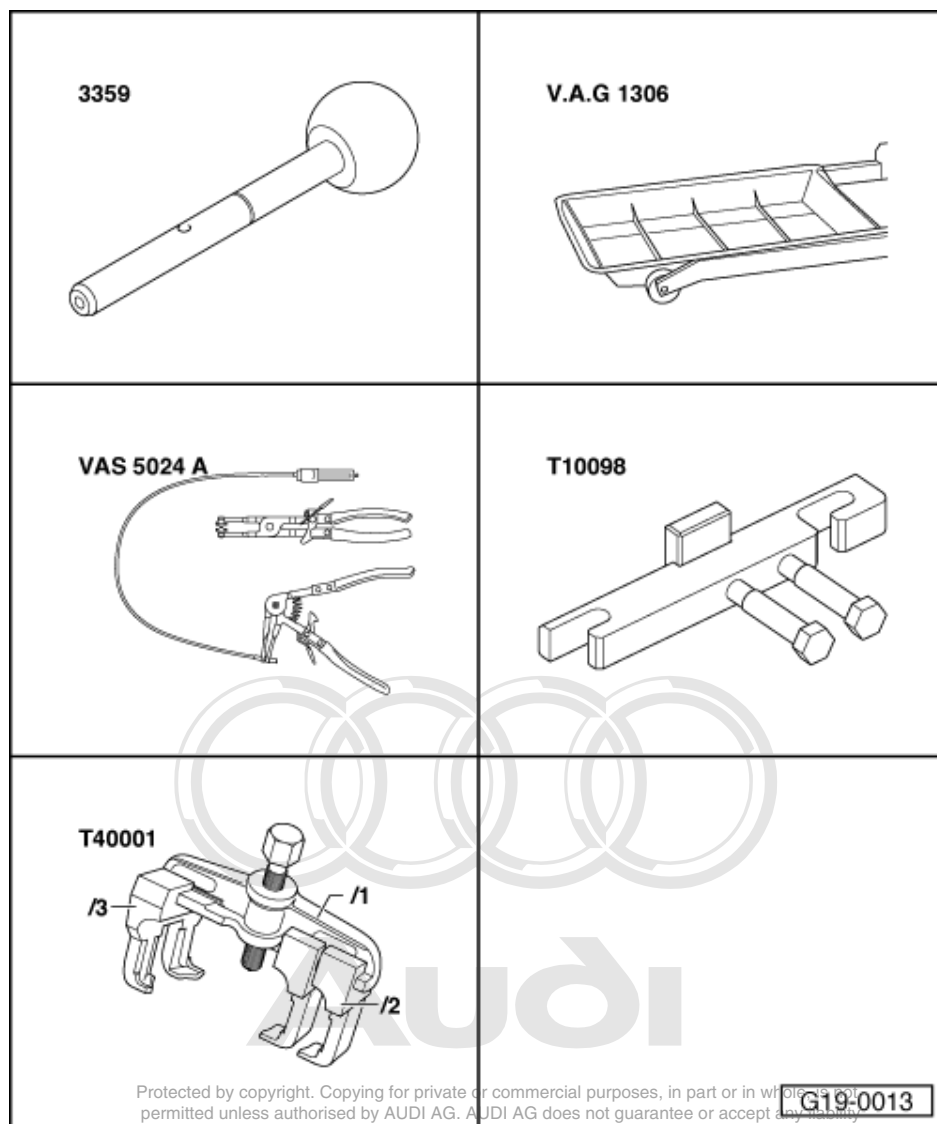
Hot steam or hot coolant can escape when opening expansion tank. Cover cap with a cloth and open carefully.

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- Check refrigerant level and top up if necessary. If the engine is warm, refrigerant level must be at max. mark; if cold, between min. and max. marks.
- Stop engine.

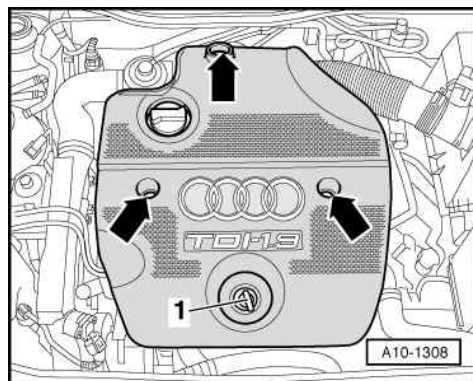


## 1.4 - Removing and installing coolant pump



### Special tools and workshop equipment required

- ♦ Pin 3359
- ♦ V.A.G 1306
- ♦ VAS 5024 A
- ♦ Camshaft straightedge T10098
- ♦ Two-arm puller T40001



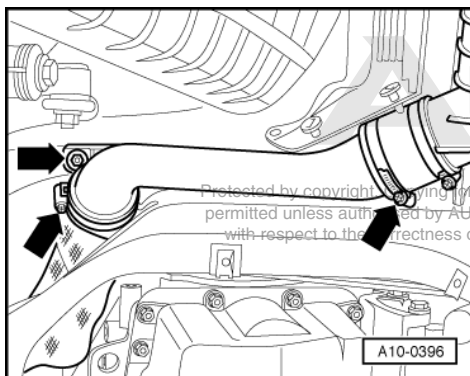
## Removing

- -> Remove oil dipstick -1- from guide tube.
- Unclip caps.
- Unscrew nuts -arrows- and remove engine cover.
- Reinsert oil dipstick in guide tube.

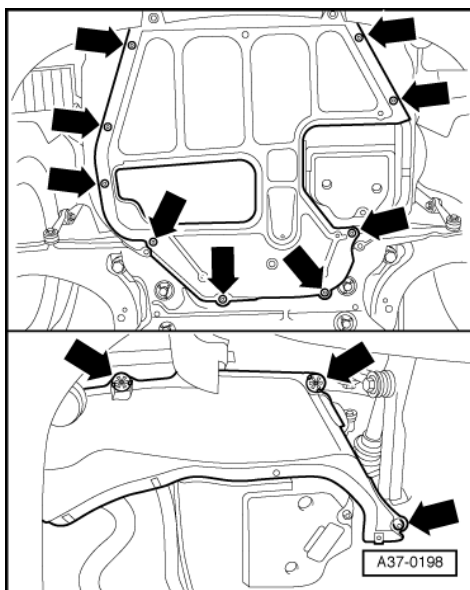
### Important

Hot steam or hot coolant can escape when opening expansion tank. Cover cap with a cloth and open carefully.

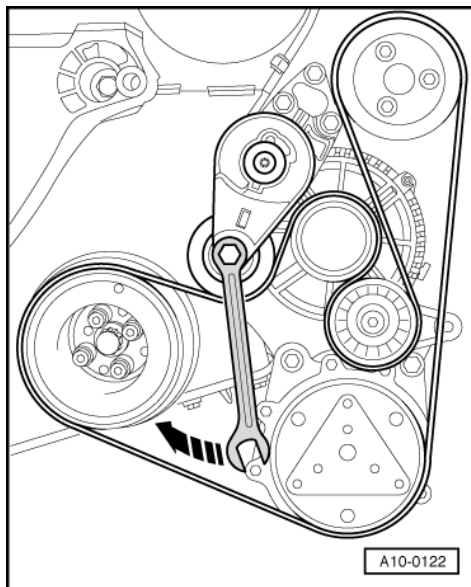
- Open the cover of the coolant expansion tank



- -> Remove lower air duct pipe -arrows-.



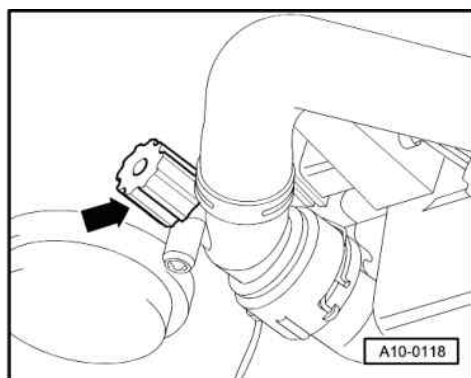
- -> Remove noise insulation in centre and on right -arrows-.



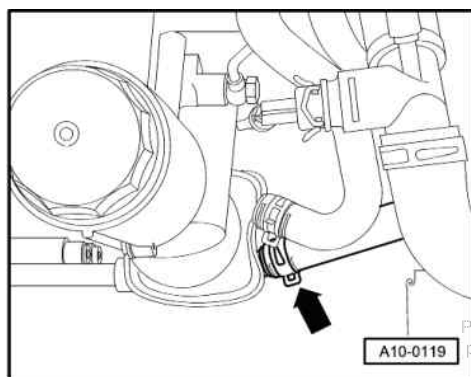
**Note:**

*Mark the running direction with chalk or a felt-tipped pen before removing the ribbed belt. If the belt runs in the opposite direction when it is refitted, this can cause breakage.*

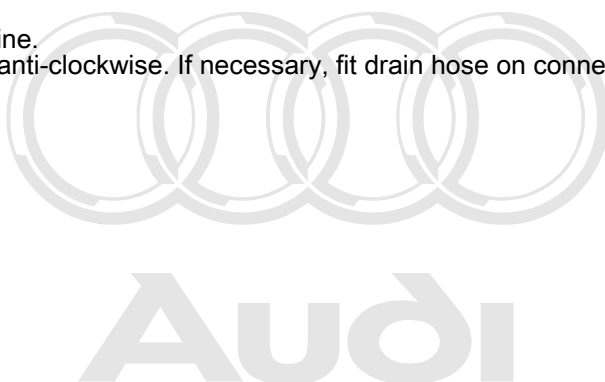
- Fit flat 16 mm ring spanner to hexagon of tensioner.
- -> Swivel tensioning roller in direction of arrow to slacken ribbed belt.
- Remove ribbed belt.



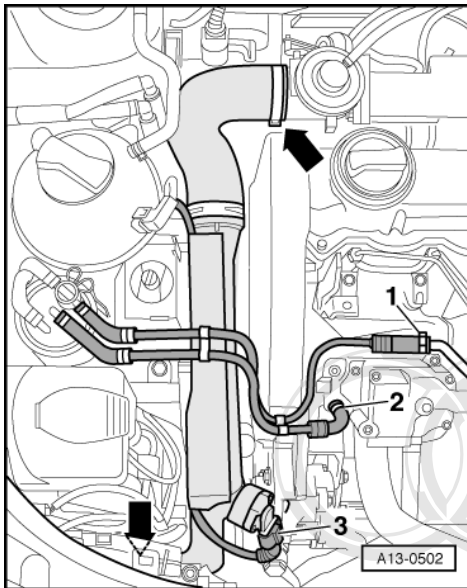
- Place drip tray V.A.G 1306 below engine.
- -> Turn drain plug -arrow- on radiator anti-clockwise. If necessary, fit drain hose on connection.



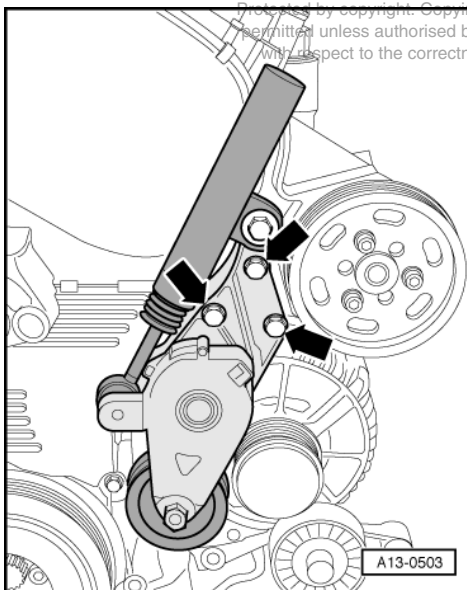
- -> Also disconnect lower coolant hose on oil cooler -arrow-, and drain off remaining coolant.



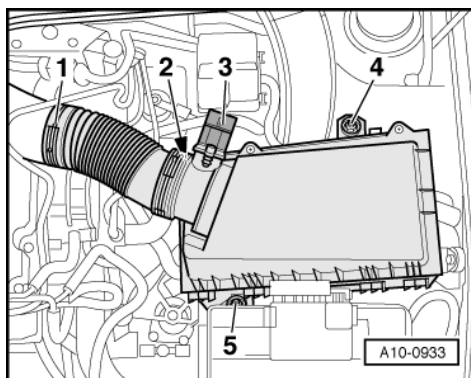
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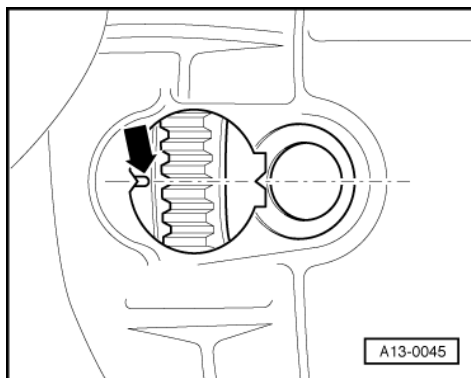
- Detach the cover and the electrical connector at the right headlight unit.
- -> Disconnect fuel-feed line -2- and fuel-return line -1- at injection pump.
- Disconnect the electrical connection -3- at the sender -G71/-G72.
- Expose the wiring at the air duct pipe.
- Remove the air duct pipe on right side -arrows-.



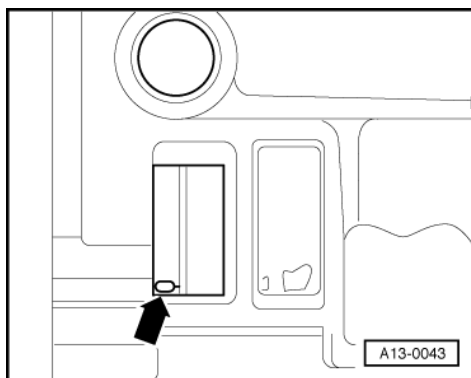
- -> Remove tensioner for ribbed belt -arrows-.
- Remove upper toothed belt guard.



- -> Remove air duct hose -1- from air duct pipe.
- Detach connector of air mass meter -3-.
- Unscrew bolts -4- and -5-.
- Remove vent hose -2- from rear of air cleaner housing.
- Take out air cleaner housing.



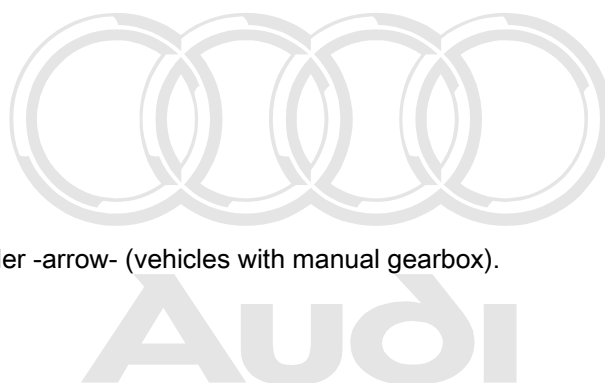
- -> Turn crankshaft to TDC No. 1 cylinder -arrow- (vehicles with manual gearbox).



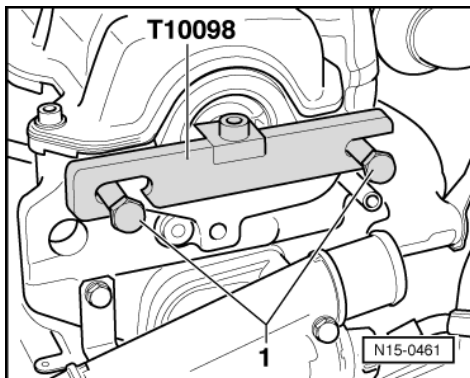
- -> Turn crankshaft to TDC No. 1 cylinder -arrow- (vehicles with automatic gearbox).

### Note:

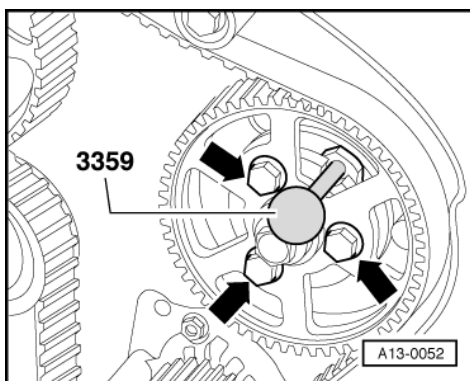
Position crankshaft to TDC No. 1 cylinder with engine removed=> Page 58.



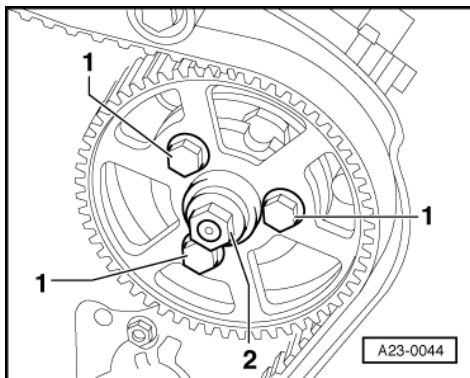
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- Remove the exhauster => Fig. 96 .
- -> Turn the bolts -1- by hand up to stop into the cylinder head.
- Lock the camshaft using camshaft straightedge T10098 as shown in the illustration.
- If the camshaft straightedge T10098 cannot be inserted, rotate crankshaft 1 additional turn (360°).



- -> Lock injection pump sprocket using pin 3359.
- Loosen injection pump sprocket securing bolts -arrows-.

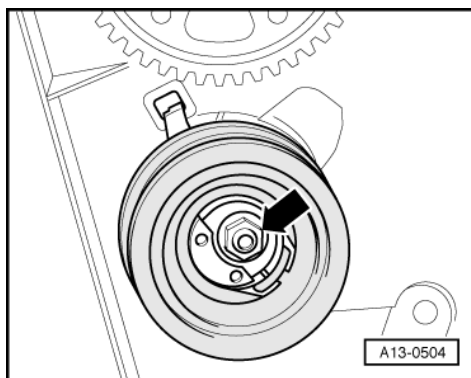


**Note:**

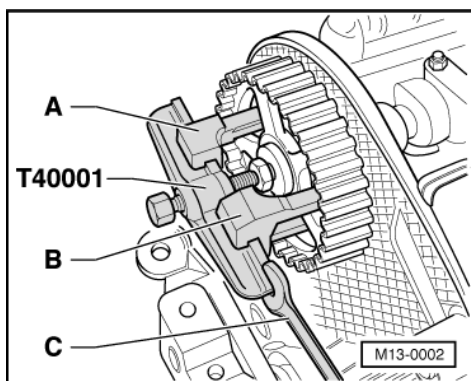
-> Never loosen the injection pump sprocket centre nut -2-. Otherwise the injection pump basic setting is incorrectly adjusted and cannot be corrected again using workshop equipment.



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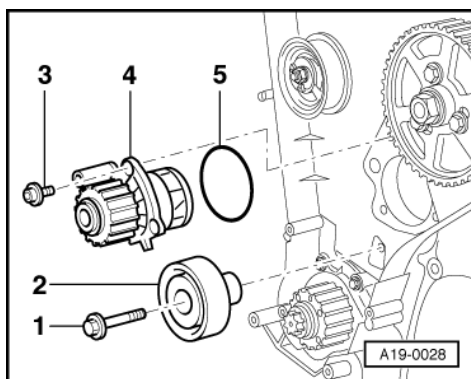
- -> Loosen the tensioning roller nut -arrow- by several turns.



- Remove the toothed belt from the camshaft toothed belt sprocket.
- -> Unscrew the camshaft sprocket bolt by 1/2 turn .
- Place the two-arm puller T40001 with claw T40001/2 -Item A- and the two-arm claw T40001/3 -Item B- centralised onto the camshaft sprocket.
- Pull off the camshaft sprocket using the two-arm puller. Counterhold using an open-end spanner -C- in the process.
- Remove camshaft toothed belt sprocket.
- Remove the centre toothed belt guard.

**Notes:**

- ♦ The vibration damper and bottom toothed belt guard do not have to be removed.
- ♦ The toothed belt should be left in position on the crankshaft sprocket.



- -> Unscrew the bolt -1- and lay the idler roller -2- downwards.
- Unscrew the bolts -3- and carefully guide the coolant pump -4- out towards rear between engine support and toothed belt guard.

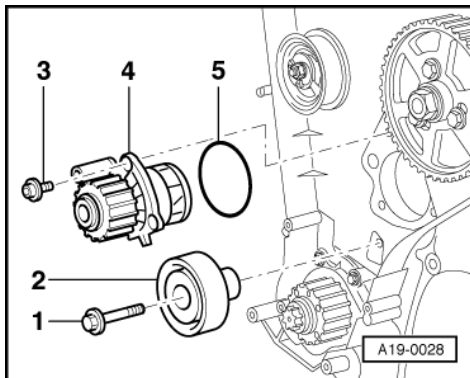
**Installing**

Installation is carried out in the reverse order; note the following:

**Notes:**

- ♦ When performing installation procedures, replace seals and gaskets, as well as stretch bolts with specified tightening angle.
- ♦ Hose connections and hoses for charge air system must be free of oil and grease before assembly.
- ♦ Secure all hose connections with the correct hose clamps (same as original equipment):

=> Parts List



- Clean and smooth down sealing surface for O- ring as required.
- -> Lightly coat new O-ring -5- with coolant G 012 A8 D.
- Fit coolant pump -4-.
  - Installation position: Sealing plug in housing faces downwards.
- Tighten bolts -3- for coolant pump to 15 Nm.
- Replace idler roller bolt -1-, torque to 40 Nm and continue to turn 1/4 turn (90°).
- Install toothed belt (adjust valve timing) => Page 53 .

**Note:**

Observe all instructions on removing and installing the toothed belt => from Page 48 .

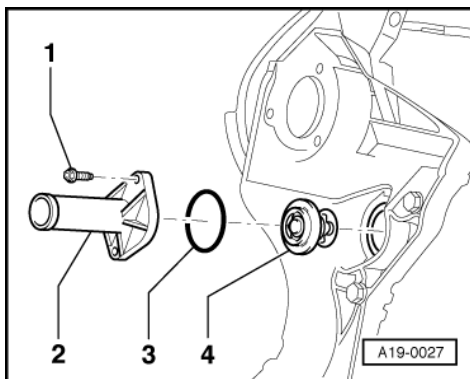
- Install ribbed belt => Page 38 .
- Top up coolant => Page 158 .

**Tightening torques**

| Component                      | Nm            |
|--------------------------------|---------------|
| Coolant pump to cylinder block | 15            |
| Idler wheel to cylinder block  | 40 + 90° 1)2) |

- 1) Replace bolt
- 2) 90° corresponds to a quarter of a turn

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**1.5 - Removing and installing cooling system thermostat**

## Removing

- Drain coolant => Page 156 .
- -> Remove coolant hose from connector 2.
- Unscrew bolts -1- remove connection together with O-ring -3- and coolant thermostat -4-.
- Turn coolant thermostat 1/4 turn (90°) to the left and remove from connection.

## Installing

Installation is carried out in the reverse order; note the following:

- Clean and smooth down sealing surface for O- ring as required.
- Insert coolant thermostat.
  - Installation position: Cross-piece on thermostat should be vertical.
- Moisten new O ring with coolant G 012 A8 D.
- Top up coolant => Page 158 .

## Tightening torque

| Component                    | Nm |
|------------------------------|----|
| Connection to cylinder block | 15 |

## Check coolant thermostat

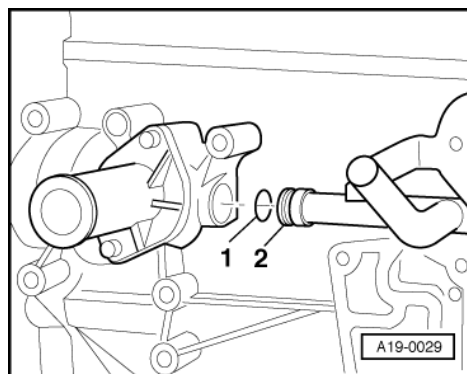
- Heat thermostat in water bath.

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| Starts to open | Fully open        | Opening travel |
|----------------|-------------------|----------------|
| approx. 87 °C  | approx. 102 °C 1) | at least 7 mm  |

- 1) cannot be tested

## 1.6 - Installing coolant pipe



### Note:

Replace seals and gaskets.

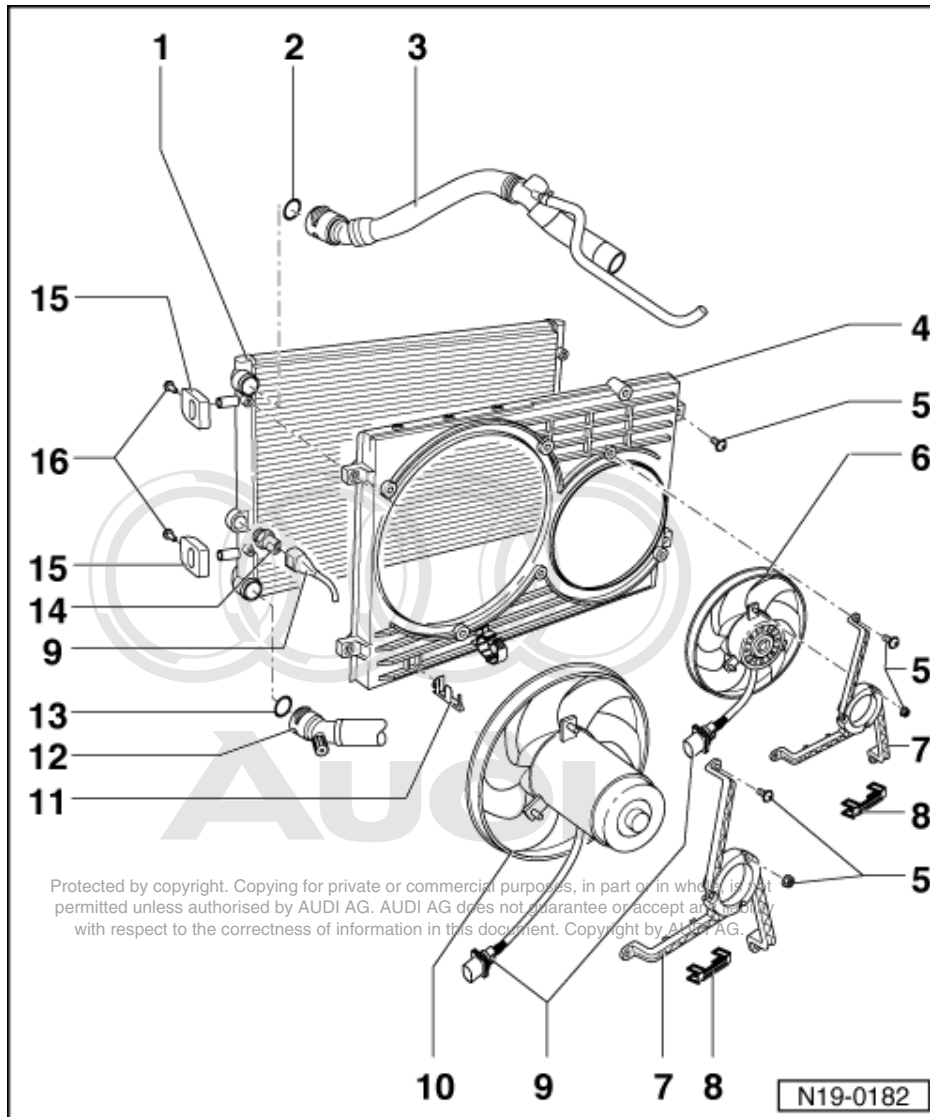
- Before installing. clean and smooth down sealing surface for O-ring.
- -> Moisten new O-ring -1- with G 012 A8 D and slide onto coolant pipe -2-.
- Push coolant pipe into opening in cylinder block.
- Top up coolant => Page 158 .

## Tightening torque

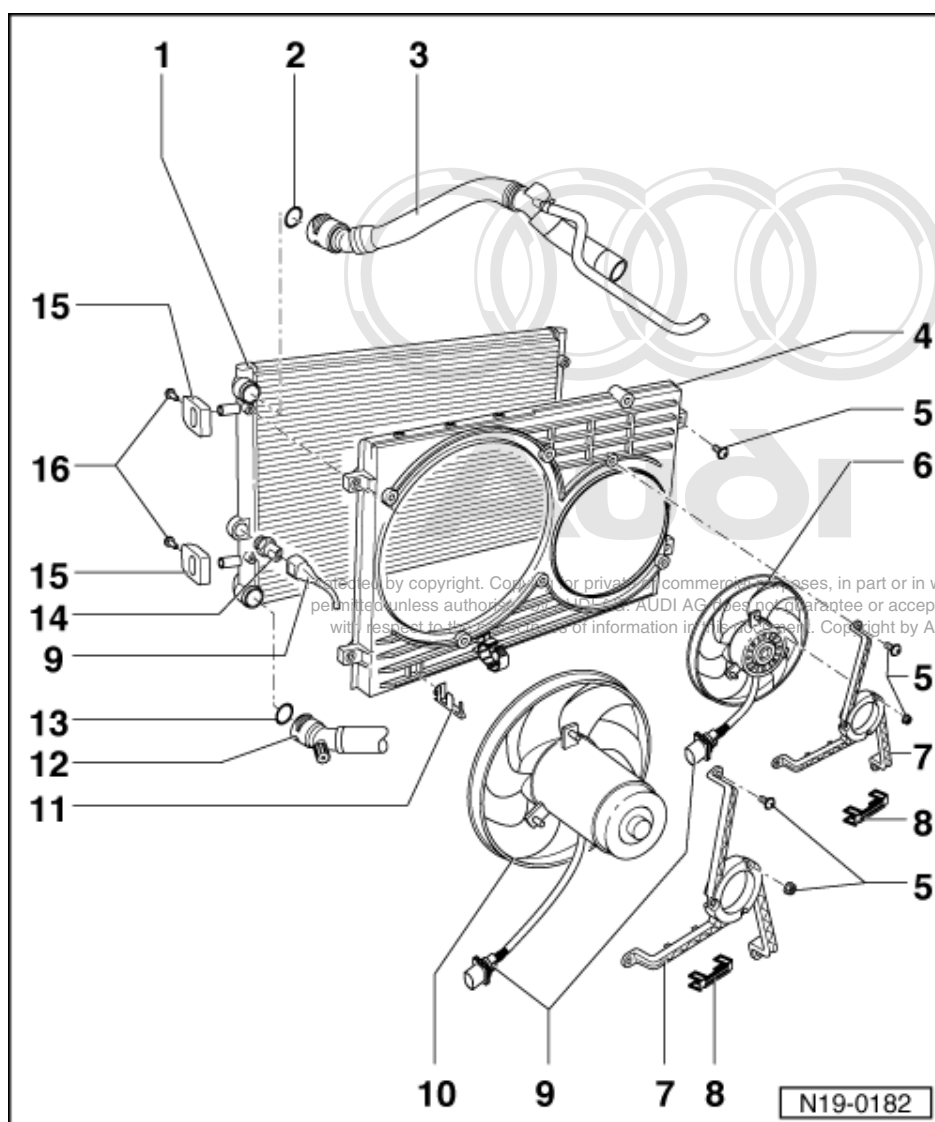
| Component | Nm |
|-----------|----|
|-----------|----|

|                                |    |
|--------------------------------|----|
| Coolant pipe to cylinder block | 10 |
|--------------------------------|----|

## 1.7 - Radiator and radiator fan - Assembly overview

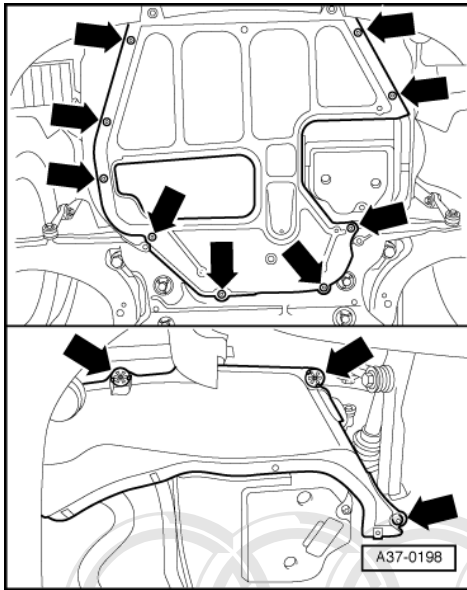


- 1 Radiator
  - ♦ Removing and installing  
=>Page 171 .
  - ♦ If replaced renew the complete coolant
- 2 O-ring
  - ♦ Replace
- 3 Upper coolant hose
- 4 Radiator cowl
- 5 10 Nm
- 6 Additional fan
  - ♦ Dependent on equipment level
- 7 Fan ring
- 8 Bracket
- 9 Connector



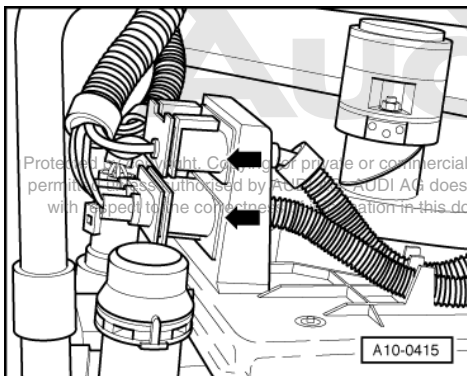
- 10 Coolant fan -V7**
- 11 Bracket**
  - ◆ For connector plug
- 12 Lower coolant hose**
  - ◆ To connection for thermostat
- 13 O-ring**
  - ◆ Replace
- 14 Thermostat for coolant fan -F18/-F54 - 35 Nm**
  - ◆ Switching temperatures:
    - 1st stage
      - on: 92...97 °C
      - off: 84...91 °C
    - 2nd stage
      - on: 99...105 °C
      - off: 91...98 °C
- 15 Bracket**
  - ◆ For radiator
  - ◆ Note installation position
- 16 15 Nm**

## 1.8 - Removing and installing radiator

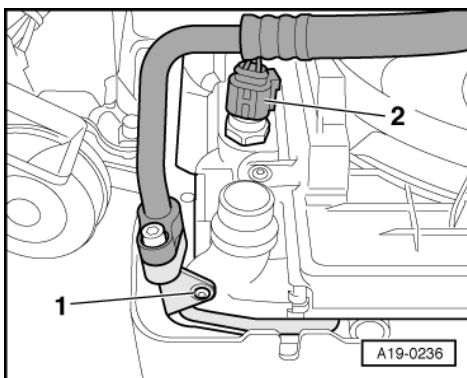


### Removing

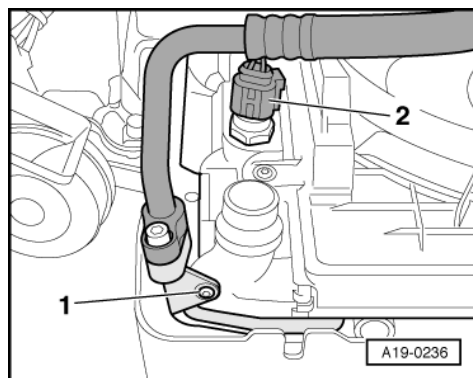
- -> Remove noise insulation from centre, left and right sides -arrows-
- Drain coolant => Page 156 .



- -> Detach both connectors -arrows- for radiator fan on bottom left of radiator cowl.



- -> Detach connector -2- from thermostat -F18.



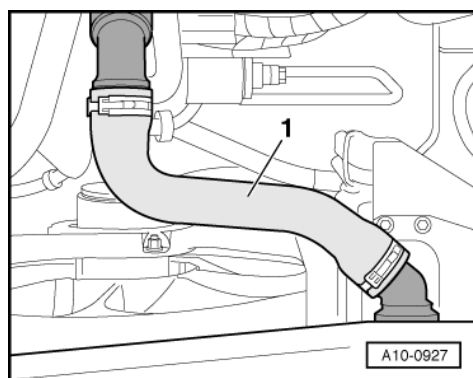
**Vehicles with air conditioning:**

**Important**  
The air conditioner refrigerant circuit must not be opened.

**Note:**

*To prevent damage to the condenser and refrigerant pipes/hoses, ensure that the pipes and hoses are not stretched, kinked or bent.*

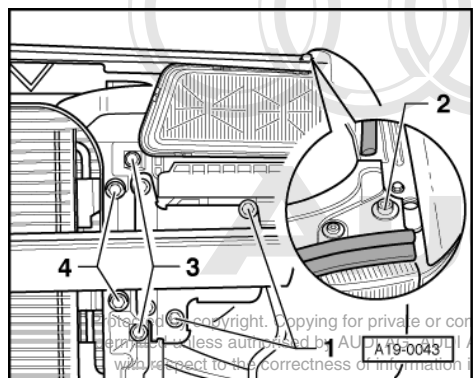
- -> Unscrew refrigerant line -1- from cooler.



**All models:**

- -> Remove coolant hose -1- from top of radiator.
- Remove the front bumper cover:

=> General Body Assembly, Exterior; Repair group 63; Front bumper; Removing and installing front bumper  
Front bumper Removing and installing front bumper



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**Vehicles with air conditioner:**

**Important**  
The air conditioner refrigerant circuit must not be opened.

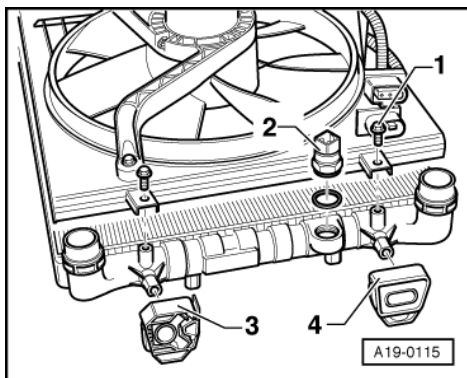
**Note:**

*To prevent damage to the condenser and refrigerant pipes/hoses, ensure that the pipes and hoses are not stretched, kinked or bent.*

- -> Unscrew securing bolts -4- of condenser.
- Suspend condenser at lock carrier using wire loop.

**All models:**

- Unscrew bolts -3- of radiator.
- Unscrew bolts -1- for lock carrier.
- Slacken bolts -2- two turns.
- Pull lock carrier carefully forward as far as possible (the help of a 2nd mechanic is required) and lower radiator and fan out of vehicle.

**Installing**

Installation is carried out in the reverse order; note the following:

- -> Fit mountings -3- and -4- on radiator as illustrated.
- Fit radiator securing bolts (the help of a 2nd mechanic is required).
- Installing lock carrier with attachments:

=> General Body Assembly, Exterior; Repair group 50; Front body; Removing and installing lock carrier with attachment parts Front body Removing and installing lock carrier with attachment parts

- Install the front bumper cover:

=> General Body Assembly, Exterior; Repair group 63; Front bumper; Removing and installing front bumper Front bumper Removing and installing front bumper

- Top up coolant => Page 158 .
- Adjust headlights.

=> Electrical System; Repair group 94; Servicing headlights; Adjusting headlights Servicing headlights Adjusting headlights

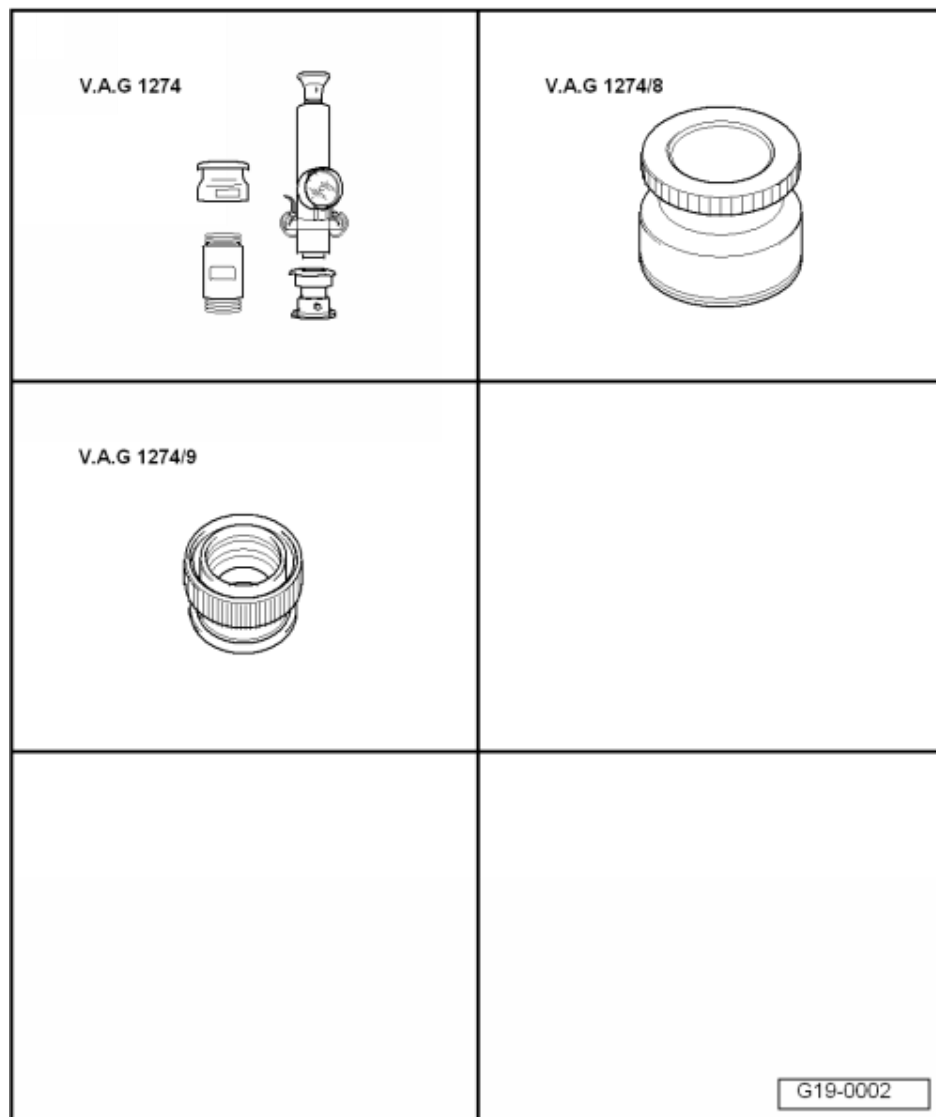
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| Component                 | Nm |
|---------------------------|----|
| Radiator cowl to radiator | 10 |
| Thermostat in radiator    | 35 |



| Component                  | Nm |
|----------------------------|----|
| Refrigerant line to cooler | 10 |
| Condenser to radiator      | 10 |
| Radiator to lock carrier   | 15 |

## 1.9 - Checking cooling system for leaks



### Special tools and workshop equipment required

- ♦ V.A.G 1274
- ♦ V.A.G 1274/8
- ♦ V.A.G 1274/9

### Test requirements:

- Engine at operating temperature.

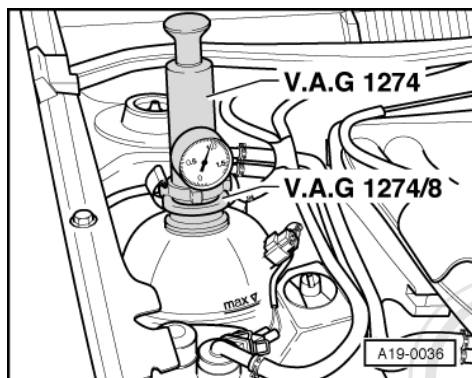
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## Test sequence

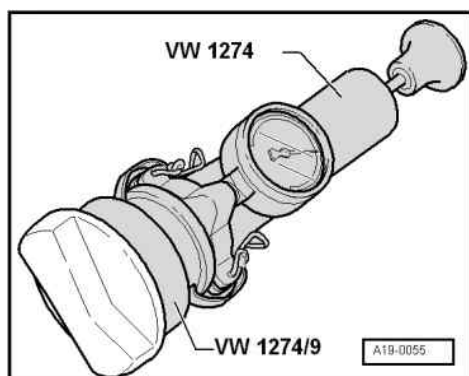
### Important

Hot steam or hot coolant can escape when opening expansion tank. Cover cap with a cloth and open carefully.

- Open the cover of the coolant expansion tank



- -> Fit tester V.A.G 1274 with adapter V.A.G 1274/8 onto expansion tank.
- Using hand pump on tester, build up a pressure of approx. 1.0 bar.
- If this pressure is not maintained, locate and rectify leaks.



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### Testing pressure relief valve in filler cap.

- -> Fit tester V.A.G 1274 with adapter V.A.G 1274/9 onto sealing cap.
- Operate hand pump.
  - The pressure relief valve should open at a pressure of 1.2 ... 1.5 bar.



## 21 - Charging

### 1 - Checking charge air system with turbocharger

#### 1.1 - Checking charge air system with turbocharger

##### *Notes:*

- ♦ For cleanliness rules, see=> Page 196 .
- ♦ Secure all hose connections with the correct hose clamps (same as original equipment):

=> Parts List

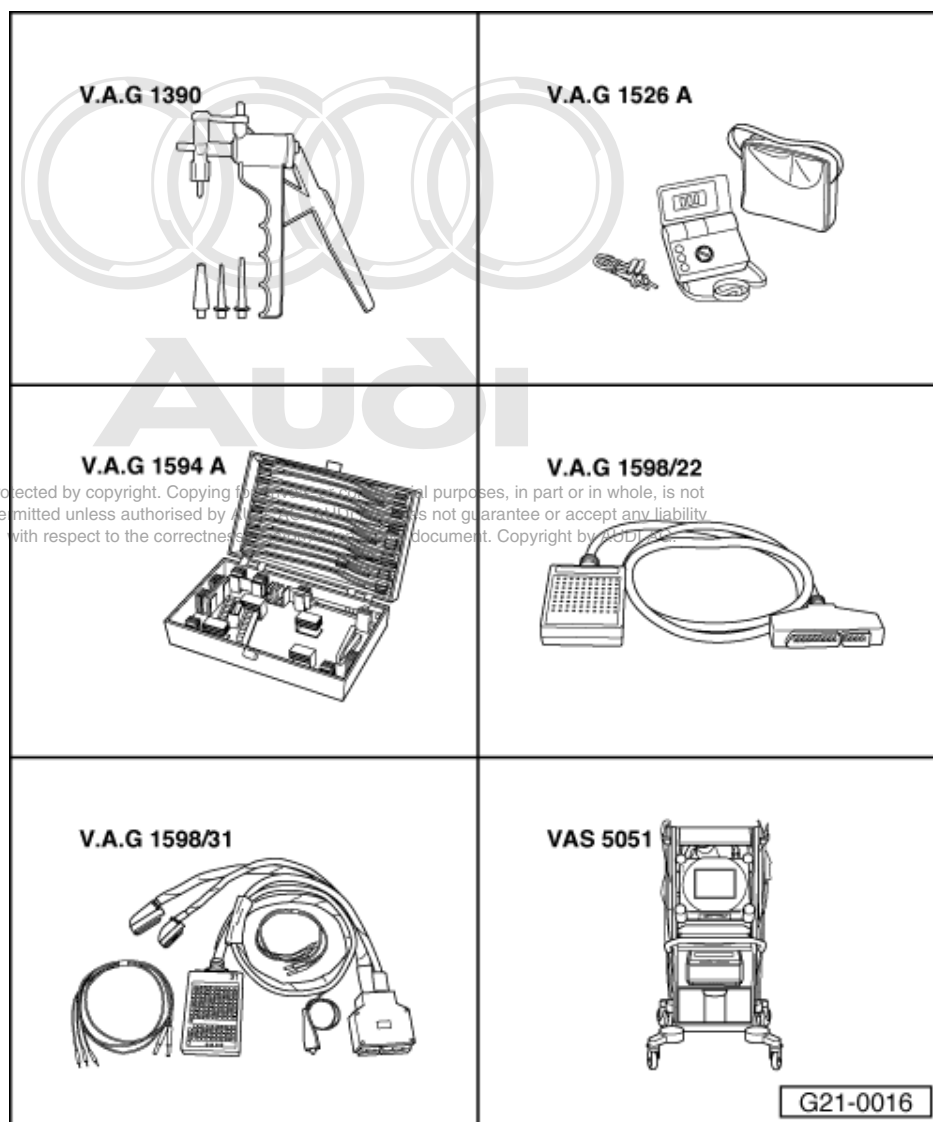
##### **Safety precautions**

Note the following points if testers and measuring instruments have to be used during a road test:

##### **Important**

- ♦ **Always install testers and measuring instruments on the back seat and have a second person operate them from there.**
- ♦ **If test equipment were operated from the front passenger seat, the person sitting there could be injured if the front passenger airbag were triggered in the event of an accident.**

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### Special tools and workshop equipment required

- ◆ V.A.G 1390
- ◆ V.A.G 1526 A
- ◆ V.A.G 1594 A
- ◆ V.A.G 1598/22  
(Vehicles up to 07.99)
- ◆ V.A.G 1598/31  
(Vehicles as of 08.99)
- ◆ VAS 5051 with VAS 5051/1

## 1.2 - Test requirements for test of exhaust turbocharging

- 1 - Coolant temperature at least 85 °C
- 2 - Fault memory of engine control unit interrogated.
- 3 - Exhaust gas recirculation OK, checking => as of Page 242 .



**Note:**

*If there is a fault in the exhaust gas recirculation it is not possible to achieve reliable values when testing the exhaust turbocharging.*

- 4. - No leaks in intake or exhaust system. Effects of leakages => Page **178**.
- 5. - Control hose to boost pressure regulating valve not obstructed, loose or leaking.
- 6. - No faults on engine or injection system, e.g. compression or injection pump or injector units, respectively.

## **1.3 - Effects of leaks in intake or exhaust system**

### **A - Leaks downstream of air mass meter**

Possible fault sources:

- 1 - Connection hoses between air mass meter and exhaust turbocharger
- 2 - Connection hose to crankcase vent

Effect:

- Loss of power

### **B - Leaks downstream of exhaust turbocharger (intake side)**

Possible fault sources:

- 1 - Connection hoses between turbocharger, charge air cooler, and intake pipe
- 2 - Intercooler
- 3 - Seal underneath intake manifold pressure sender -G71/intake manifold temperature sender -G72
- 4 - Seal between intake connection and intake manifold
- 5 - Seal between intake manifold and cylinder head

Effect:

- Boost pressure too low

### **C - Leaks downstream of exhaust turbocharger (exhaust side)**

Possible fault sources:

- 1 - Components of exhaust gas recirculation
- 2 - Turbocharger/exhaust manifold connection between (engine code AGR only)
- 3 - Connection between exhaust manifold and cylinder head

Effect:

- Boost pressure too low, possibly exhaust odours, traces of soot in engine compartment

## **1.4 - Checking boost pressure - engine code AGR**

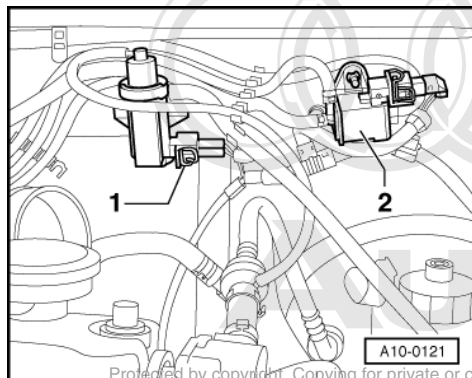
**Test requirements:**

- Vehicle diagnostic, testing and information system VAS 5051 connected, vehicle self-diagnosis and vehicle system "01 - Engine electronics" selected.

**Important**

To avoid the risk of accidents when performing measurements and test drives, please heed the safety precautions => Page 176.

- ♦ To localise faults, the turbocharger (without boost pressure control) must be checked first, followed by the boost pressure with boost pressure control.



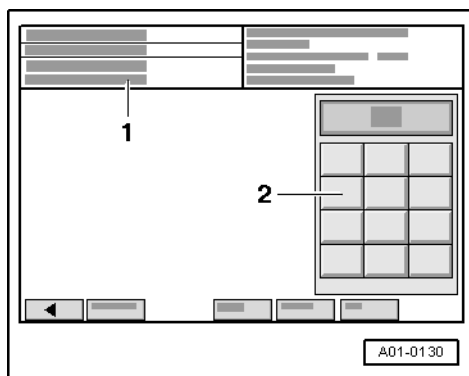
**Checking without boost pressure control:**

- -> Disconnect electrical connector at boost pressure limitation solenoid valve -N75 -Item 2-.



-> Display on VAS 5051:

- Under -1- select the diagnostic function "08 - Read measured value block".



-> Display on VAS 5051:



- 1 - Enter display group  
max. input value = 255
- Enter "011" for "display group number 011" in zone -2- and confirm the entry by pressing the Q button.
  - Fully accelerate the vehicle from 2000 rpm in third gear or with selector lever at position 2 (without kickdown) and observe rev counter.
  - At approx. 3000 rpm press the key "Print - Save result" on the VAS 5051.

|                                                                                 | Display zones |                            |                         |                                                |
|---------------------------------------------------------------------------------|---------------|----------------------------|-------------------------|------------------------------------------------|
|                                                                                 | 1             | 2                          | 3                       | 4                                              |
| <b>Display group 011: Intake manifold pressure (boost pressure) at 3000 rpm</b> |               |                            |                         |                                                |
| <b>Display</b>                                                                  | xxxx rpm      | xxxx mbar                  | xxxx mbar               | xx %                                           |
| <b>Display</b>                                                                  | Engine speed  | Boost pressure (specified) | Boost pressure (actual) | Actuation of boost pressure control valve -N75 |
| <b>Specified value</b>                                                          | 3000 rpm      | 1550...1750 mbar           | 1550...1750 mbar        | ---                                            |

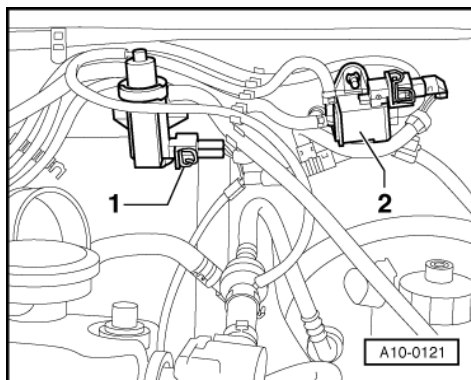
- Exit the function "08 - Read measured value block" by pressing the \*key.
- If measured boost pressure is OK, repeat boost pressure measurement with boost pressure control=> Page 180 .

If boost pressure is not obtained:

- ♦ Leak between turbocharger and intake manifold
- ♦ Fault is in boost pressure control linkage or vacuum unit. Checking => Page 183
- ♦ Turbocharger defective (turbine blocked due to foreign body)

If boost pressure is exceeded:

- ♦ Boost pressure control hoses fallen off, leaking or blocket.
- ♦ Boost pressure limitation solenoid valve restricted
- ♦ Bypass valve actuator (linkage, shaft) binding or stuck (bypass valve always closed)



Audi

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#### Checking with boost pressure control:

- -> Attach electrical connection to boost pressure limitation solenoid valve -N75 -Item 2-.
- Erase fault memory.

=> Diesel Direct Injection and Glow Plug System (4-cyl TDI) > 07.99; Repair group 01; Self-diagnosis; Interrogating fault memory Self-diagnosis Interrogating fault memory

=> TDI Injection and Glow Plug System (4-cyl.) 08.99 >; Repair group 01; Self-diagnosis; Interrogating fault memory Self-diagnosis Interrogating fault memory

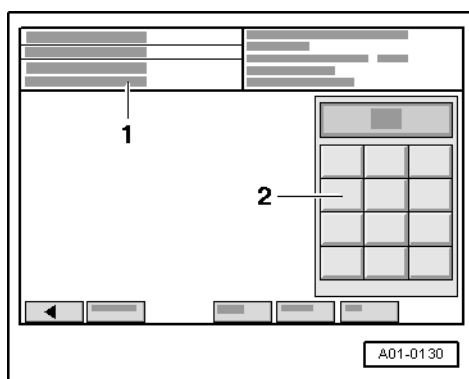
**Note:**

Disconnecting boost pressure limitation solenoid valve electrical connection -N75 caused a fault code to be set in the fault memory during the previous testing procedure.



-> Display on VAS 5051:

- Under -1- select the diagnostic function "08 - Read measured value block".



-> Display on VAS 5051:

- 1 - Enter display group  
max. input value = 255
- Enter "011" for "display group number 011" in zone -2- and confirm the entry by pressing the Q button.
- Fully accelerate the vehicle from 2000 rpm in third gear or with selector lever at position 2 (without kickdown) and observe rev counter.
- At approx. 3000 rpm press the key "Print - Save result" on the VAS 5051.

|                                                                                 | Display zones       |                            |                                |                                                |
|---------------------------------------------------------------------------------|---------------------|----------------------------|--------------------------------|------------------------------------------------|
|                                                                                 | 1                   | 2                          | 3                              | 4                                              |
| <b>Display group 011: Intake manifold pressure (boost pressure) at 3000 rpm</b> |                     |                            |                                |                                                |
| <b>Display</b>                                                                  | xxxx rpm            | xxxx mbar                  | xxxx mbar                      | xx %                                           |
| <b>Display</b>                                                                  | <b>Engine speed</b> | Boost pressure (specified) | <b>Boost pressure (actual)</b> | Actuation of boost pressure control valve -N75 |
| <b>Specified value</b>                                                          | <b>3000 rpm</b>     | 1800...2050 mbar           | <b>1800...2050 mbar</b>        | ---                                            |

- Exit the function "08 - Read measured value block" by pressing the ← key.
- Press "06 - Exit output".



If boost pressure is not obtained:

- ♦ No electrical function of boost pressure limitation solenoid valve.
- ♦ Boost pressure limitation solenoid valve -N75 is stuck in the open position

If boost pressure is exceeded:

- ♦ Solenoid valve for boost pressure limitation -N75 intermittently stuck closed.
- ♦ Boost pressure increased as a result of tuning

## 1.5 - Checking boost pressure for engine codes AHF, ALH, ASV

### *Test requirements:*

- Vehicle diagnostic, testing and information system VAS 5051 connected, vehicle self-diagnosis and vehicle system "01 - Engine electronics" selected.

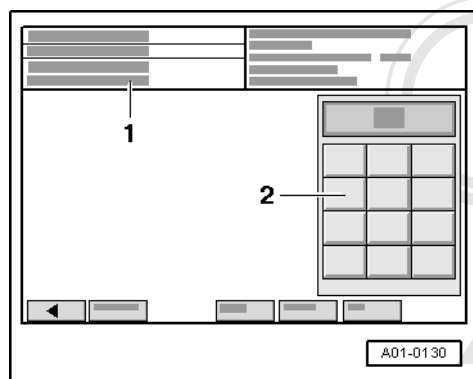
#### **Important**

To avoid the risk of accidents when performing measurements and test drives, please observe the safety precautions => Page **176**.



-> Display on VAS 5051:

- Under -1- select the diagnostic function "08 - Read measured value block".



-> Display on VAS 5051:

- 1 - Enter display group

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max. input value = 255

- Enter "011" for "display group number 011" in zone -2- and confirm the entry by pressing the Q button.
- Fully accelerate the vehicle from 2000 rpm in third gear or with selector lever at position 2 (without kickdown) and observe rev counter.
- At approx. 3000 rpm press the key "Print - Save result" on the VAS 5051.

|                                                                                 | Display zones |                            |                                |                                                |
|---------------------------------------------------------------------------------|---------------|----------------------------|--------------------------------|------------------------------------------------|
|                                                                                 | 1             | 2                          | 3                              | 4                                              |
| <b>Display group 011: Intake manifold pressure (boost pressure) at 3000 rpm</b> |               |                            |                                |                                                |
| <b>Display</b>                                                                  | xxxx rpm      | xxxx mbar                  | xxxx mbar                      | xx %                                           |
| <b>Display</b>                                                                  | Engine speed  | Boost pressure (specified) | <b>Boost pressure (actual)</b> | Actuation of boost pressure control valve -N75 |
| <b>Specified value ALH 1)</b>                                                   | 3000 rpm      | 1800...2050 mbar           | 1800...2050 mbar               | ---                                            |
| <b>AHF 1)<br/>ASV 1)</b>                                                        |               | 1800...2250 mbar           | 1800...2250 mbar               |                                                |

#### 1) Engine codes

- Exit the function "08 - Read measured value block" by pressing the ↵ key.
- Press "06 - Exit output".

If boost pressure is not within the specified range:

- Check the charge air system for leaks.
- Check linkage and vacuum unit for boost pressure control => Page 184 .
- Check boost pressure control solenoid valve -N75 => Page 189 .

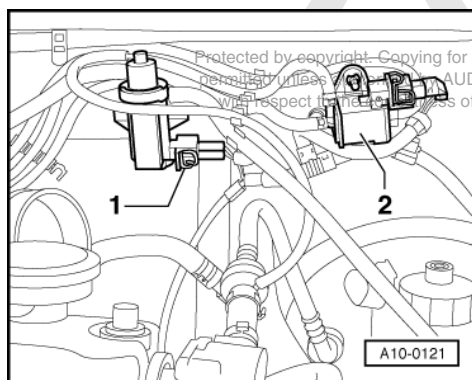
If both are OK, but the boost pressure is too low:

- Fit a new turbocharger => Page 204 .

## 1.6 - Checking boost pressure control valve linkage and pressure unit - engine code AGR

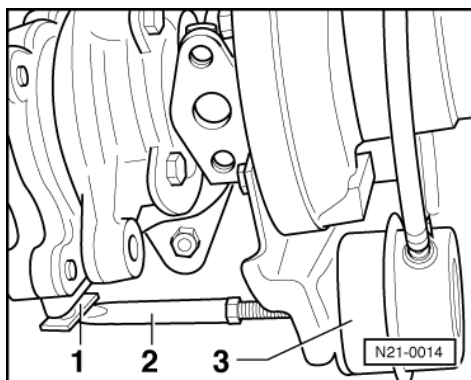
### Test requirements:

- Coolant temperature at least 80 °C.



### Test sequence

- -> Disconnect electrical connector at boost pressure limitation solenoid valve -N75 -Item 2-.



- -> Start engine and run to maximum engine speed by sharply depressing accelerator.
- The boost pressure control valve actuating rod -2- must move

If the actuating rod does not move:

- Check boost pressure valve lever -1- for ease of operation. If rusted in place, replace turbocharger.

If actuating rod does not move despite ease of operation of lever:

- Replace boost pressure control valve pressure unit -3- => Page 203 .
- Erase fault memory.

=> Diesel Direct Injection and Glow Plug System (4-cyl TDI) > 07.99; Repair group 01; Self-diagnosis; Interrogating fault memory Self-diagnosis Interrogating fault memory

=> TDI Injection and Glow Plug System (4-cyl.) 08.99 >; Repair group 01; Self-diagnosis; Interrogating fault memory Self-diagnosis Interrogating fault memory

**Note:**

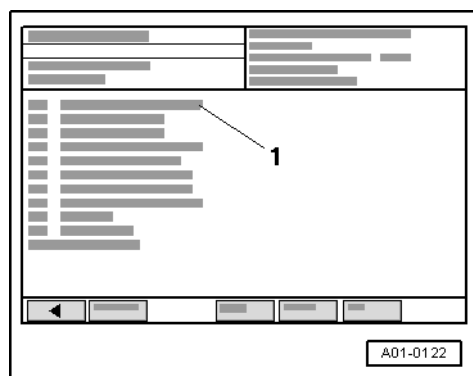
*Disconnecting boost pressure limitation solenoid valve electrical connection -N75 caused a fault code to be set in the fault memory during the previous testing procedure.*

## 1.7 - Checking boost pressure control linkage and vacuum unit - engine codes AHF, ALH, ASV

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**Test requirements:**

- Vehicle diagnostic, testing and information system VAS 5051 connected, vehicle self-diagnosis and vehicle system "01 - Engine electronics" selected.



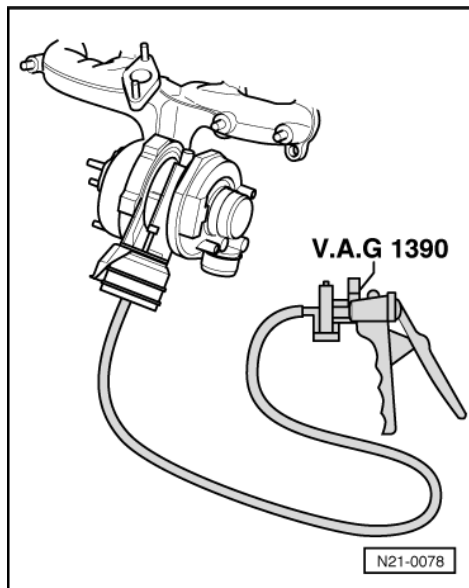
### Test sequence

-> Display on VAS 5051:

- Under -1- select the diagnostic function "03 - Final control diagnosis".
- Actuate the solenoid valve for boost pressure limitation -N75.
- ♦ Solenoid valve for boost pressure control N75 should operate audibly.
- ♦ The boost pressure control linkage of the vacuum unit on the turbo charger should move to and from (at least 3 ... 4 times while there is a vacuum in the vacuum reservoir).

If linkage does not move because solenoid valve is not working:

- Check boost pressure control solenoid valve -N75 => Page 189 .
- Check all vacuum hoses are fitted and not leaking => from Page 187 .



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If linkage does not move, even though solenoid valve is working:

- -> Connect hand vacuum pump V.A.G 1390 to boost pressure control valve and check that linkage moves freely between both end stops.

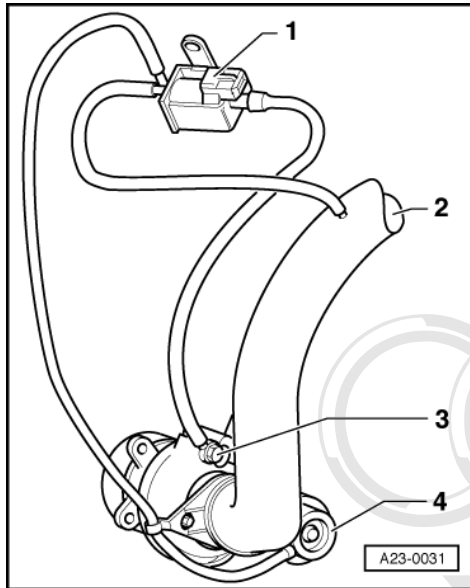
If the linkage moves, but the boost pressure specifications are not attained:

- Fit a new turbocharger => Page 214 .

If the linkage does not move freely, or moves jerkily (uneven performance when vehicle is in operation):

- Fit a new turbocharger => Page 214 .

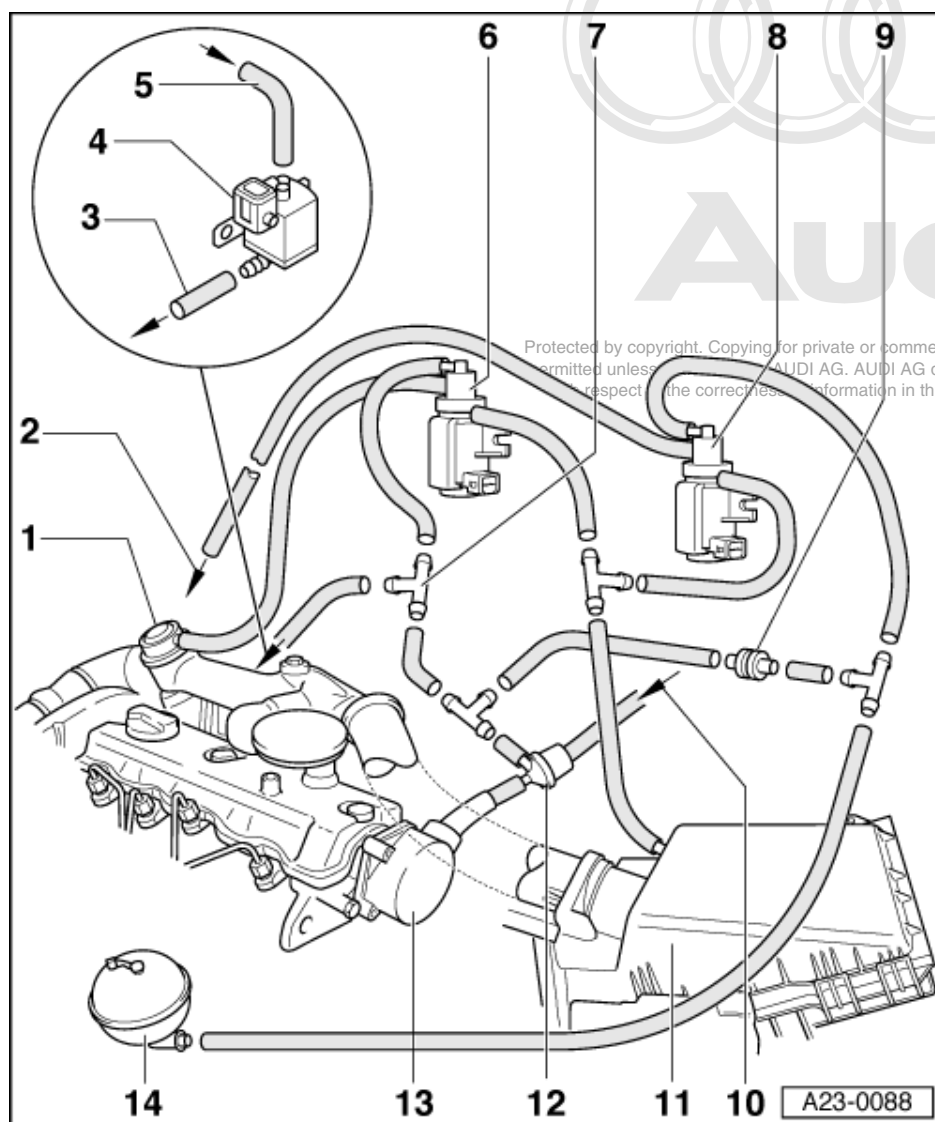
## 1.8 - Boost pressure control connection diagram - engine code AGR



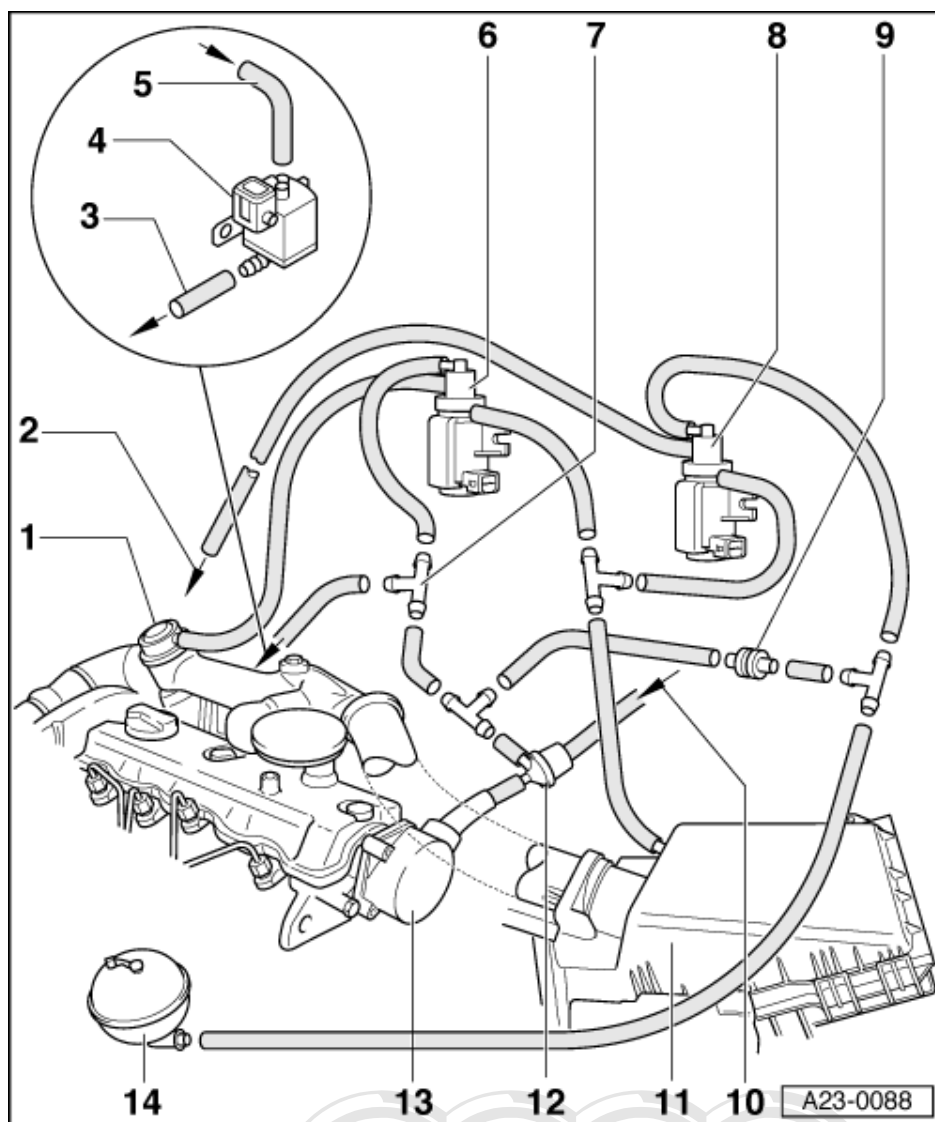
- > 1 - Boost pressure limitation solenoid valve
- 2 - Air duct pipe
- From air filter
- 3 - Turbocharger
- With pressure connection for boost pressure control
- 4 - Pressure unit
- For boost pressure control valve

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## 1.9 - Boost pressure control connection diagram - engine codes ALH, AHF, ASV



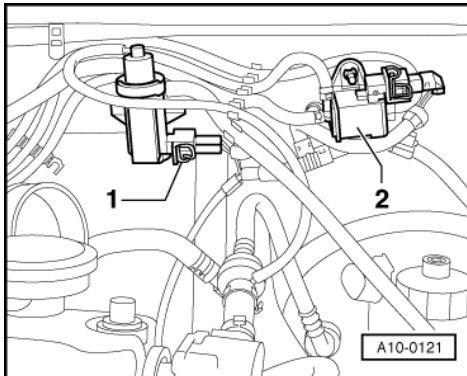
- 1 Mechanical EGR valve
- 2 To the vacuum unit for boost pressure control
  - ♦ At turbocharger
- 3 To vacuum unit for intake manifold flap
- 4 Intake manifold flap changeover valve -N239
- 5 Vacuum line
  - ♦ From T-piece -Item 7-
- 6 EGR valve -N18



- 7 T-piece
- 8 Boost pressure control solenoid valve -N75
- 9 Non-return valve
- 10 From brake servo
- 11 Air cleaner
- 12 Non-return valve
- 13 Exhauster
  - ♦ For brake servo
- 14 Vacuum reservoir

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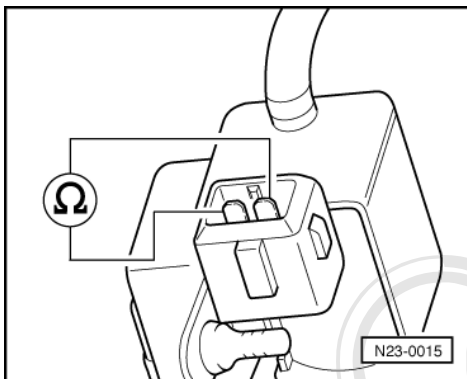
## 1.10 - Checking solenoid valve for boost pressure limitation -N75



### Checking internal resistance

#### Engine code AGR:

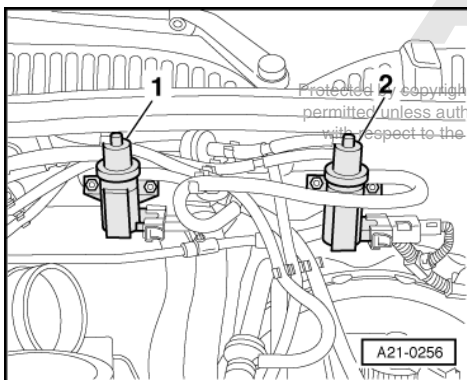
- Switch ignition off.
- -> Disconnect electrical connector at boost pressure limitation solenoid valve -N75 -Item 2-.



- -> Connect multimeter to injector to measure resistance.
- Specified value: 25...45  $\Omega$

If specified value is not attained:

- Replace solenoid valve for boost pressure control -N75.

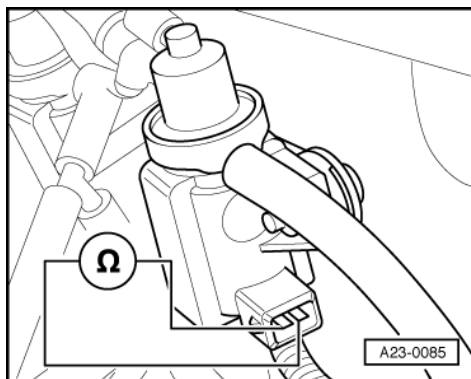


#### Engine codes AHF, ALH, ASV:

- Switch ignition off.



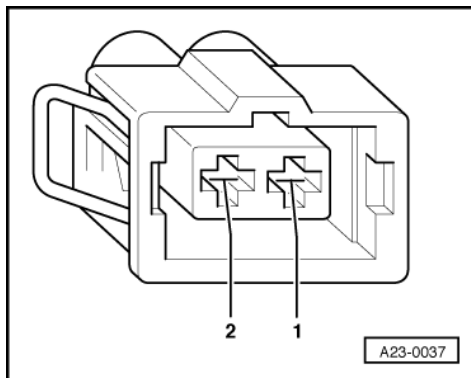
- -> Disconnect electrical connector at boost pressure limitation solenoid valve -N75 -Item 2-.



- -> Connect multimeter to injector to measure resistance.
- Specified value: 14 ... 20  $\omega$

If specified value is not attained:

- Replace solenoid valve for boost pressure control -N75.



**All models:**

If specified value is attained:

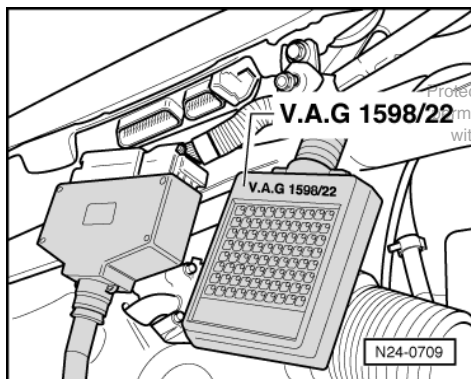
**Checking power supply**

- -> Connect multimeter between contact 1 and earth to measure voltage.
- Switch the ignition on.
- Specified value: approx. battery voltage

If specified value is not attained:

- Check wiring for open circuit and service if necessary.

If specified value is attained:



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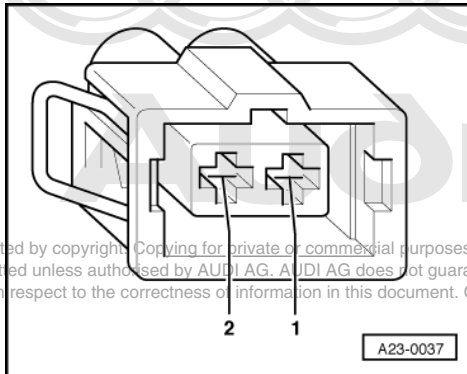
### Checking actuation - Vehicles up to 07.99

- -> Connect the test box V.A.G 1598/22 to wiring harness connectors; the engine control unit must not be connected.

=> Diesel Direct Injection and Glow Plug System (4-cyl TDI) > 07.99; Repair group 23; Wiring and component check using test box V.A.G 1598/22 Wiring and component check using test box V.A.G 1598/22

#### Important

To prevent damage to the electronic components, select appropriate measuring range before connecting the measuring cables and observe the test requirements.

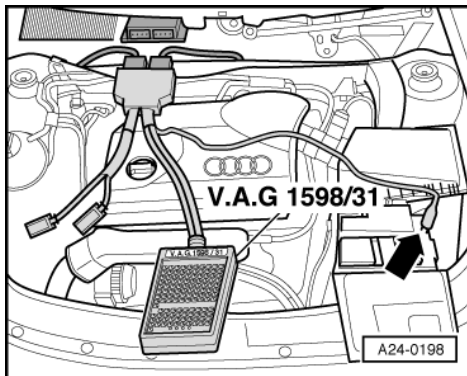


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- -> Check for open circuit and short to positive or earth in the following wiring connection:

| Connector Contact | Test box V.A.G 1598/22 Socket |
|-------------------|-------------------------------|
| 2                 | 15                            |

- Rectify any open/short circuit as necessary.



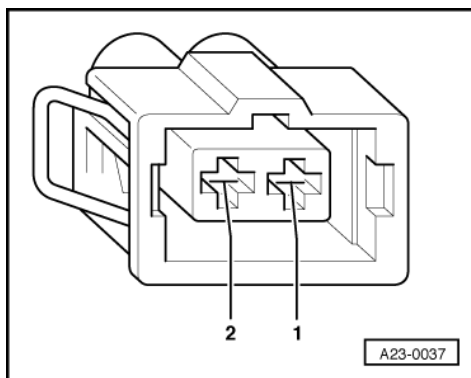
### Checking actuation - Vehicles as of 08.99

- -> Connect the V.A.G 1598/31 test box to wiring harness connectors; the engine control unit should not be connected. Attach the earth clip of test box to earth -arrow-.

=> TDI Injection and Glow Plug System (4-cyl.) 08.99 >; Repair group 23; Wiring and component check using test box V.A.G 1598/31 Wiring and component check using test box V.A.G 1598/31

#### Important

To prevent damage to the electronic components, select appropriate measuring range before connecting the measuring cables and observe the test requirements.



- -> Check for open circuit and short to positive or earth in the following wiring connection:

| Connector Contact | Test box V.A.G 1598/31 Socket |
|-------------------|-------------------------------|
| 2                 | 62                            |

- Rectify any open/short circuit as necessary.

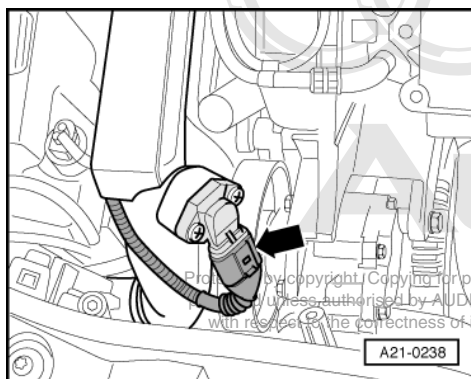
## 1.11 - Checking intake manifold pressure sender -G71

### *Test requirements:*

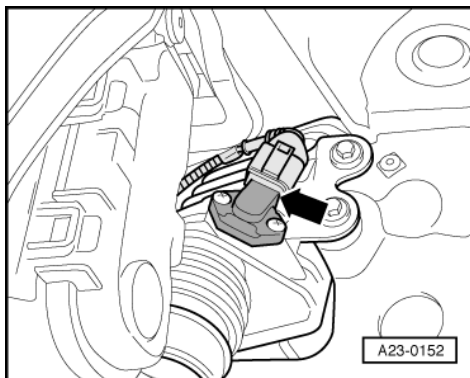
- Vehicle diagnostic, testing and information system VAS 5051 connected, vehicle self-diagnosis and vehicle system "01 - Engine electronics" selected.

### *Notes:*

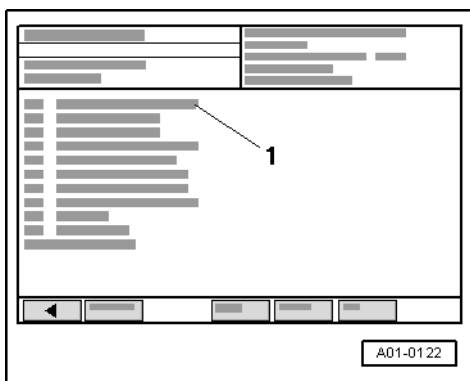
- ♦ The intake manifold sender is contained in a housing together with intake manifold temperature sender.
- ♦ Fitting location:



- -> Depending on vehicle version, the intake manifold pressure sender -arrow- is installed in the right air duct pipe ...

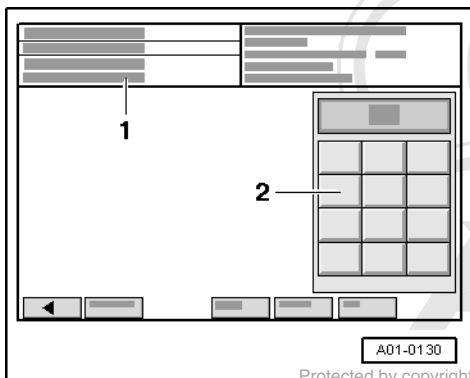


- -> ... or in the charge air cooler in the right front engine compartment, respectively -arrow-.



-> Display on VAS 5051:

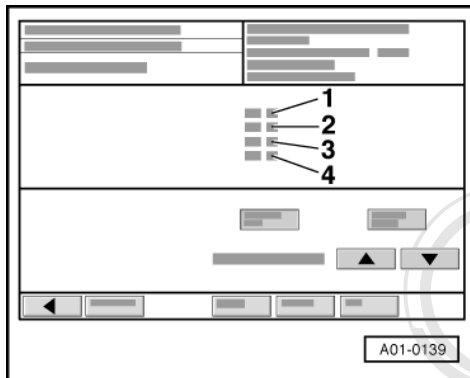
- Under -1- select the diagnostic function "08 - Read measured value block".



-> Display on VAS 5051:

- 1 - Enter display group  
max. input value = 255
- Enter "010" for "display group number 010" in zone -2- and confirm the entry by pressing the Q button.

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-> Display on VAS 5051:

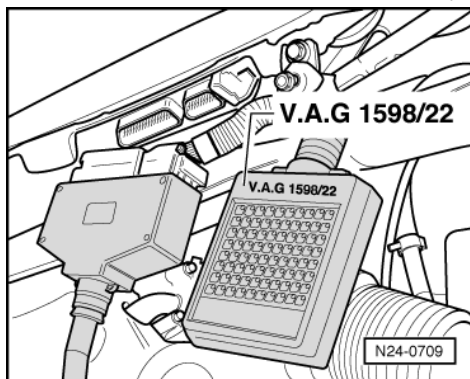
- Check readout in display zones -2- and -3-.
  - Specified value: Matching of pressures
  - Tolerance  $\pm 30$  mbar

If specified value is not attained:

#### Checking wiring connections

- Switch ignition off.

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#### Vehicles up to 07.99

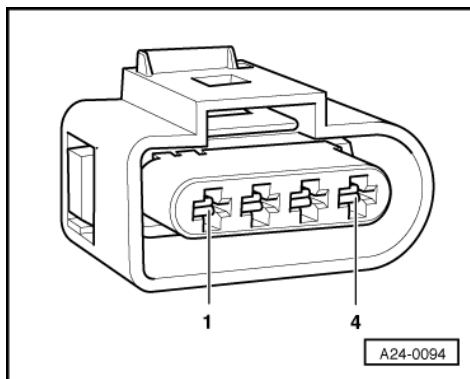
- -> Connect the test box V.A.G 1598/22 to wiring harness connectors; the engine control unit must not be connected.

=> Diesel Direct Injection and Glow Plug System (4-cyl TDI) > 07.99; Repair group 23; Wiring and component check using test box V.A.G 1598/22

#### Important

To prevent damage to the electronic components, select appropriate measuring range before connecting the measuring cables and observe the test requirements.

- Unplug electrical connector on intake manifold pressure sender.



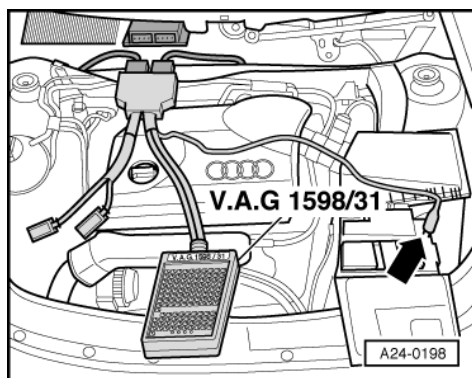
- -> Check for open circuit and short to positive or earth in the following wiring connection:

| Connector Contact | Test box V.A.G 1598/22 Socket |
|-------------------|-------------------------------|
| 1                 | 1                             |
| 3                 | 39                            |
| 4                 | 40                            |

- Rectify any open/short circuit as necessary.

If no fault is found:

- Fit a new intake manifold pressure sender.



#### Vehicles as of 08.99

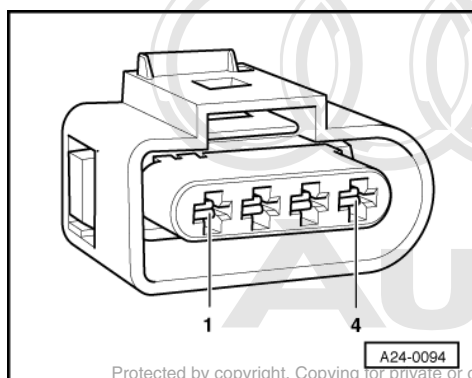
- -> Connect the V.A.G 1598/31 test box to wiring harness connectors; the engine control unit should not be connected. Attach the earth clip of test box to earth -arrow-.

=> TDI Injection and Glow Plug System (4-cyl.) 08.99 >; Repair group 23; Wiring and component check using test box V.A.G 1598/31 Wiring and component check using test box V.A.G 1598/31

#### Important

To prevent damage to the electronic components, select appropriate measuring range before connecting the measuring cables and observe the test requirements.

- Unplug electrical connector on intake manifold pressure sender.



- -> Check for open circuit and short to positive or earth in the following wiring connections:

| Connector Contact | Test box V.A.G 1598/31 Socket |
|-------------------|-------------------------------|
| 1                 | 53                            |



| Connector<br>Contact | Test box V.A.G 1598/31<br>Socket |
|----------------------|----------------------------------|
| 3                    | 31                               |
| 4                    | 71                               |

- Rectify any open/short circuit as necessary.

If no fault is found:

- Fit a new intake manifold pressure sender.

## 2 - Servicing charge air system with exhaust turbocharger

### 2.1 - Servicing charge air system with exhaust turbocharger

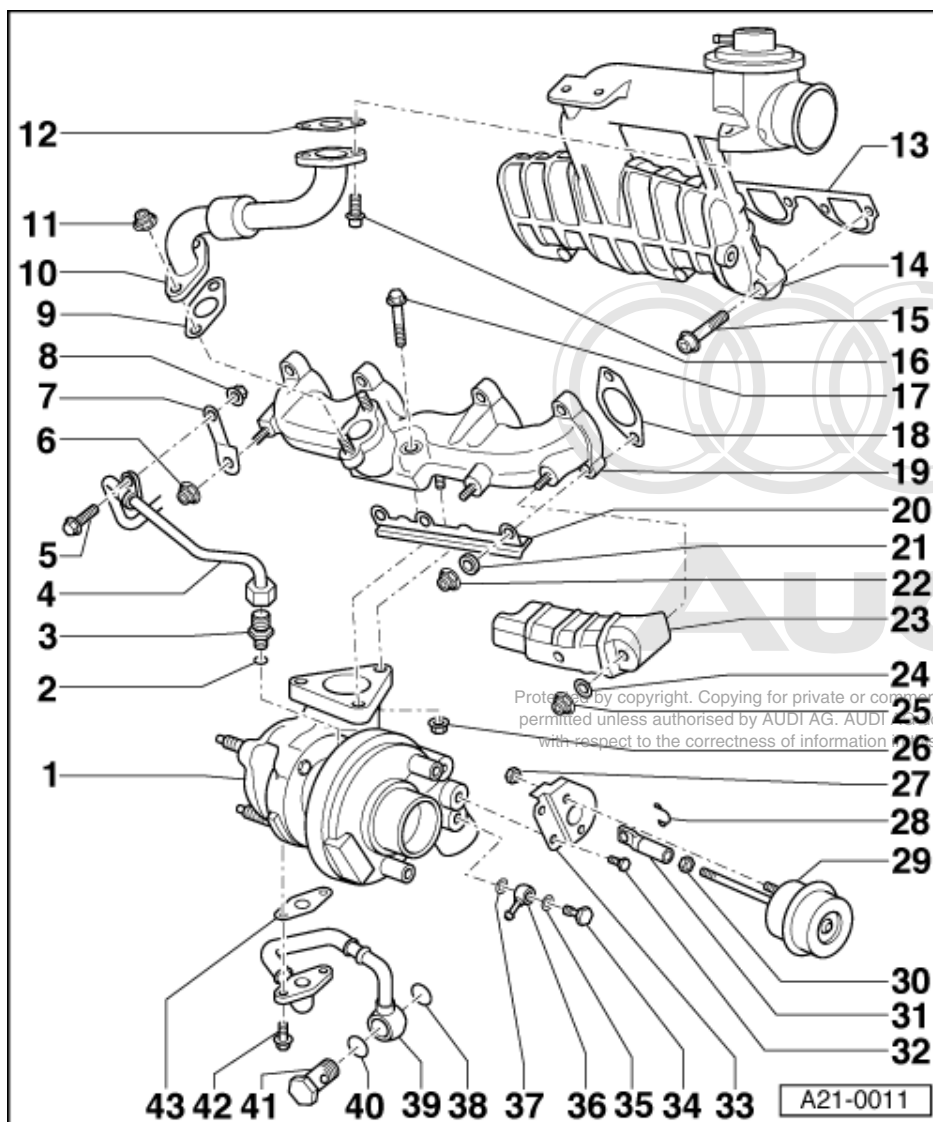
### 2.2 - Rules for cleanliness

When working on the exhaust gas turbocharger, pay careful attention to the following "5 rules":

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- ♦ Thoroughly clean all unions and the adjacent areas before disconnecting.
- ♦ Place removed parts on a clean surface and cover. Only use lint-free cloths!
- ♦ Carefully cover or seal open components if repairs cannot be carried out immediately.
- ♦ Only install clean components:  
Only remove replacement parts from packaging immediately prior to installation.  
Do not use parts that have been stored loose (e.g. in tool boxes etc.).
- ♦ When the system is open:  
Do not work with compressed air if this can be avoided.  
Do not move vehicle unless absolutely necessary.

## 2.3 - Turbocharger - engine code AGR



### 1 Turbocharger

- ◆ Checking => as of Page 176
- ◆ Removing and installing  
=>Page 204.
- ◆ Do not dismantle

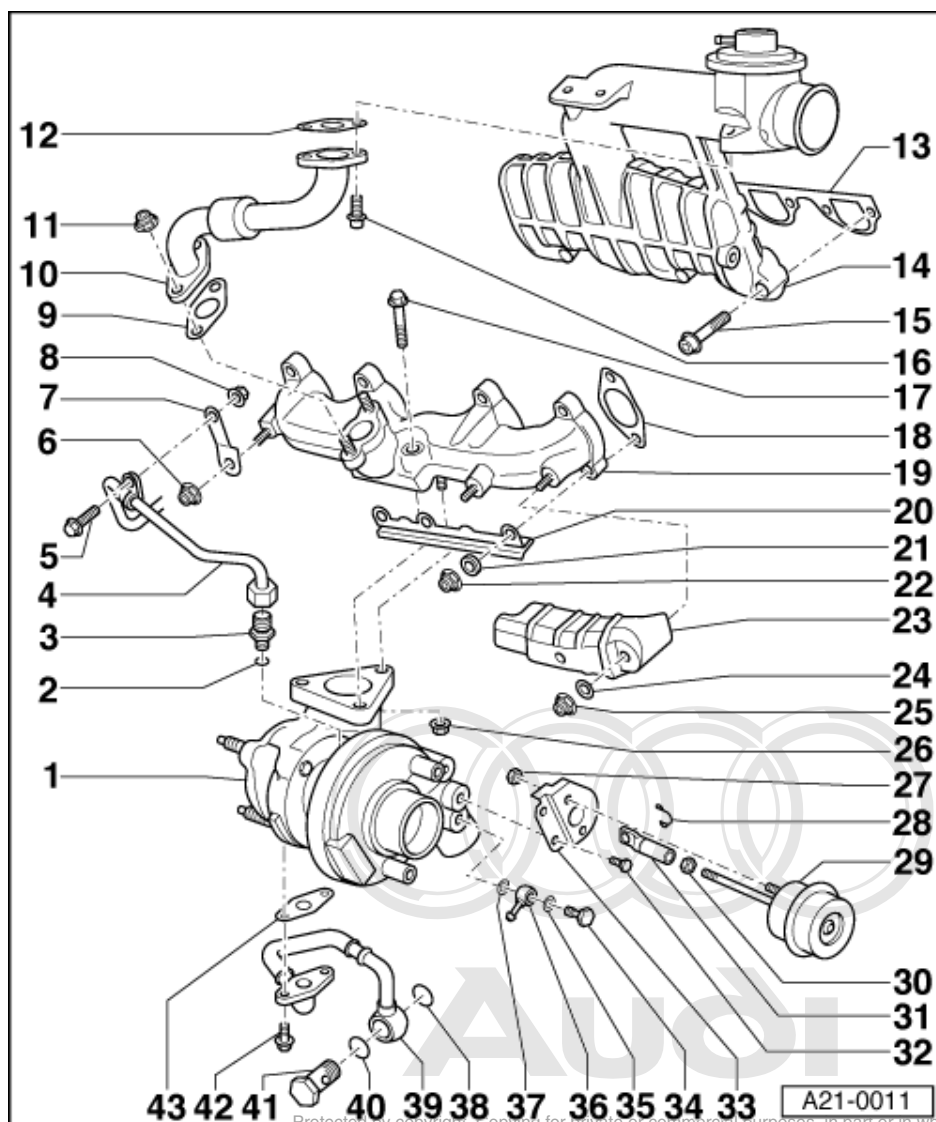
### 2 Sealing ring

- ◆ Replace

### 3 Screw fitting - 20 Nm

### 4 Oil feed line

- ◆ Tighten union nut to 22 Nm.
- ◆ From oil filter bracket => Item 144
- ◆ Note installation sequence:
  - First screw in both wiring ends loosely.
  - Then tighten wiring ends to final torque.
  - Lastly attach bracket -Item 7 -



5 10 Nm

6 25 Nm

7 Bracket

- ♦ for oil feed pipe
- ♦ Note installation sequence =>  
-Item 4 -

8 10 Nm

9 Gasket

- ♦ Replace

10 Connecting pipe

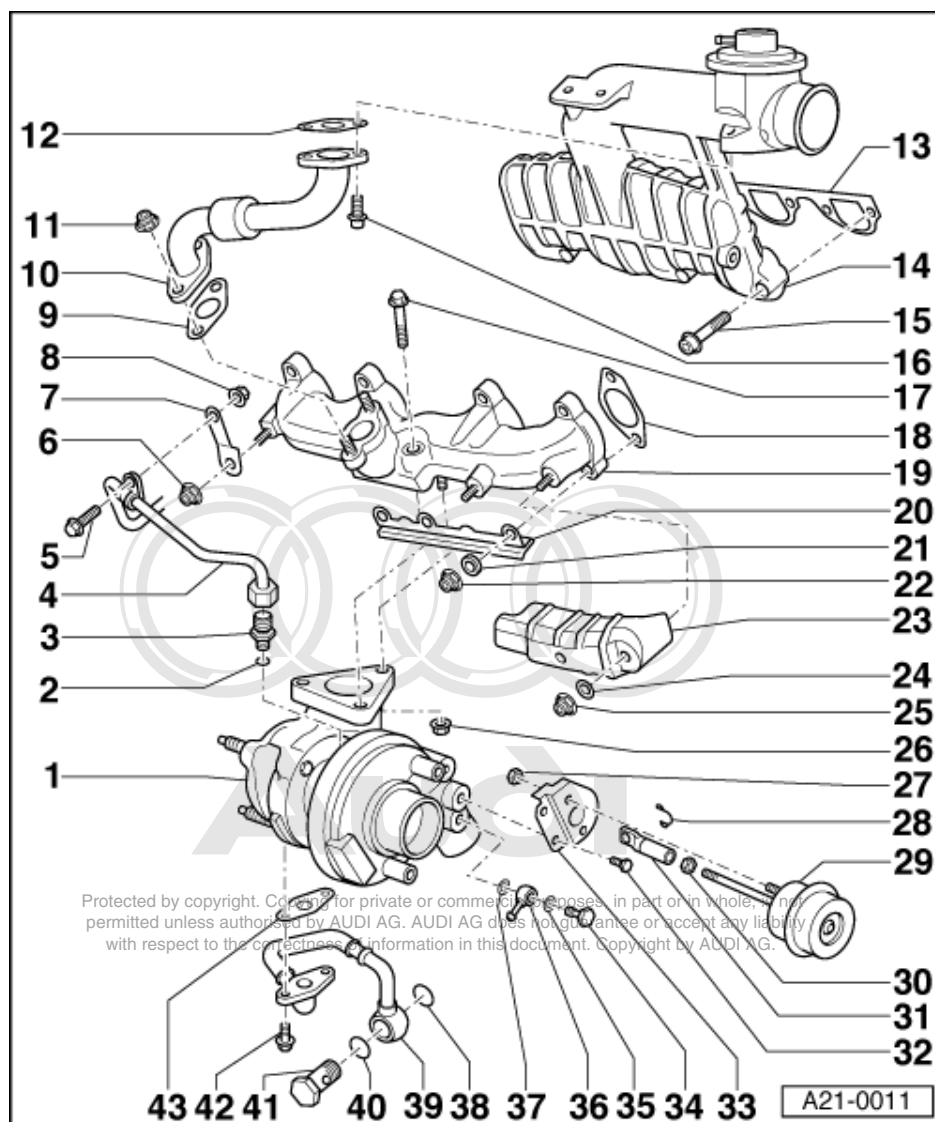
- ♦ For exhaust gas recirculation
- ♦ Note installation sequence:
  - First bolt on loosely.
  - Then tighten bolts to final torque.

11 20 Nm

12 Gasket

- ♦ Replace

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### 13 Gasket

- ♦ Replace
- ♦ Installation position: Bead faces intake manifold

### 14 Intake manifold

- ♦ With exhaust gas recirculation valve

15 20 Nm

16 20 Nm

17 30 Nm

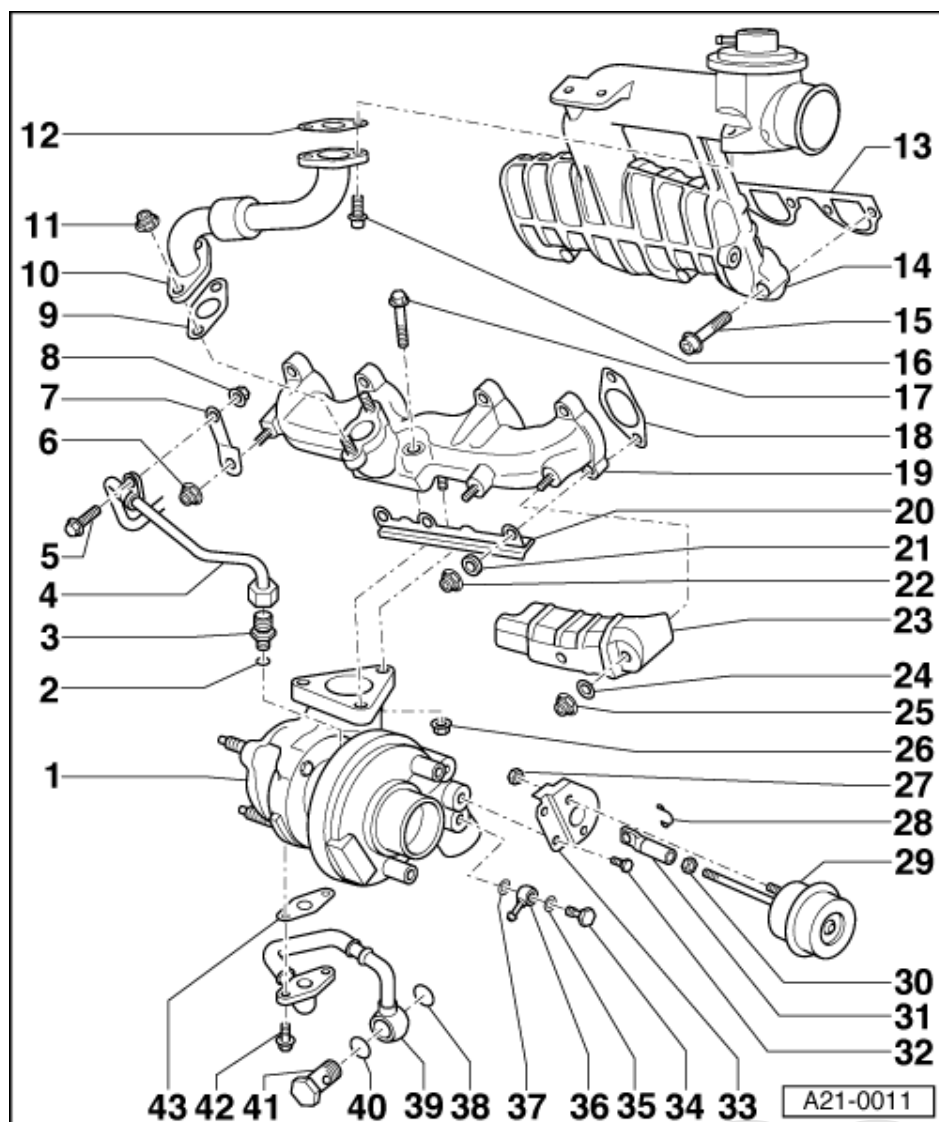
- ♦ Replace
- ♦ Coat threads and bolt head seating surface with high-temperature lubricant
- ♦ High-temperature lubricant

=> Parts List

### 18 Gasket

- ♦ Replace
- ♦ Note installation position

### 19 Exhaust manifold



20 Bracket

21 Washer

- ◆ 4 mm thick

22 25 Nm

23 Heat shield

24 Washer

- ◆ 1.6 mm thick

25 25 Nm

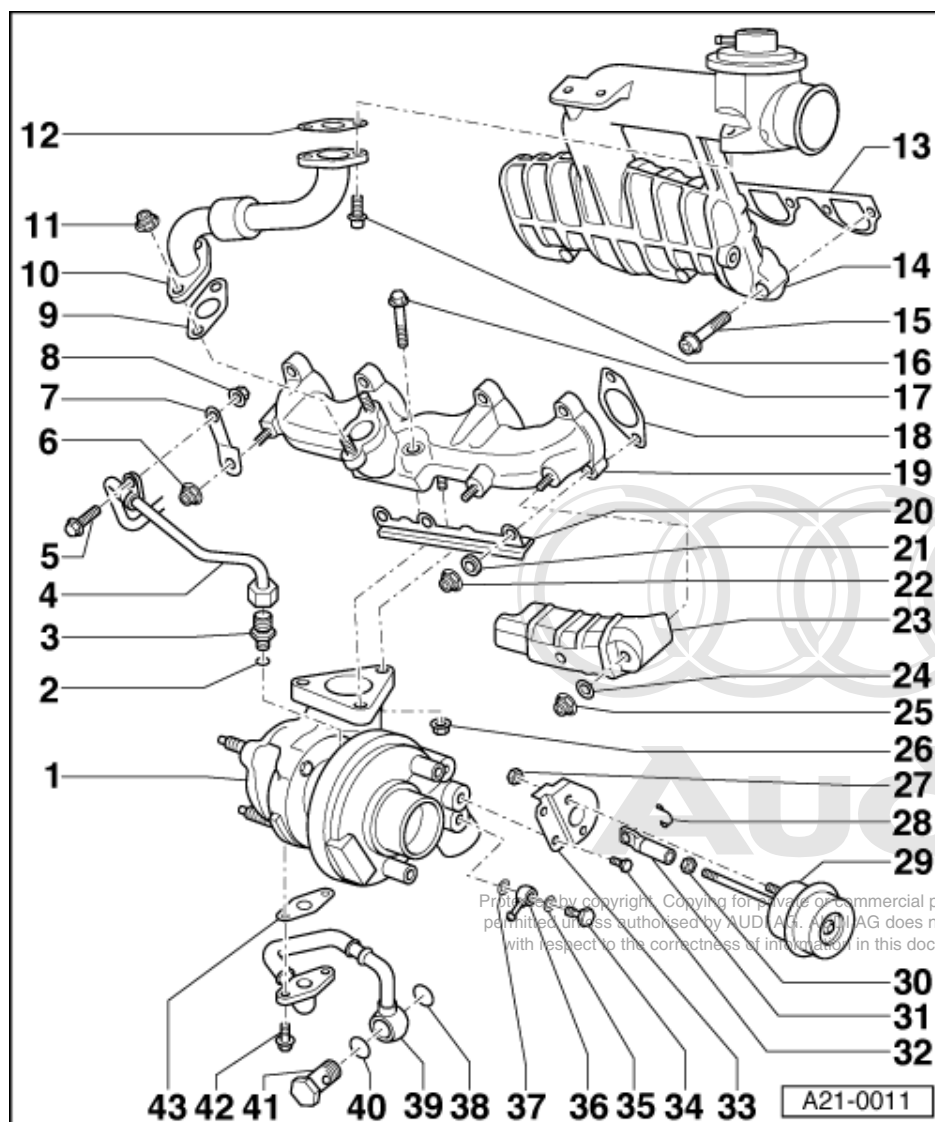
26 25 Nm

- ◆ Replace
- ◆ Coat threads and bolt head seating surface with high-temperature lubricant
- ◆ High-temperature lubricant

=> Parts List

27 10 Nm

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28 Circlip

29 Pressure unit

- ♦ For boost pressure regulating valve
- ♦ Checking => Page 183
- ♦ Removing and installing  
=>Page 203 .

30 10 Nm

31 Operating rod

- ♦ For boost pressure regulating valve

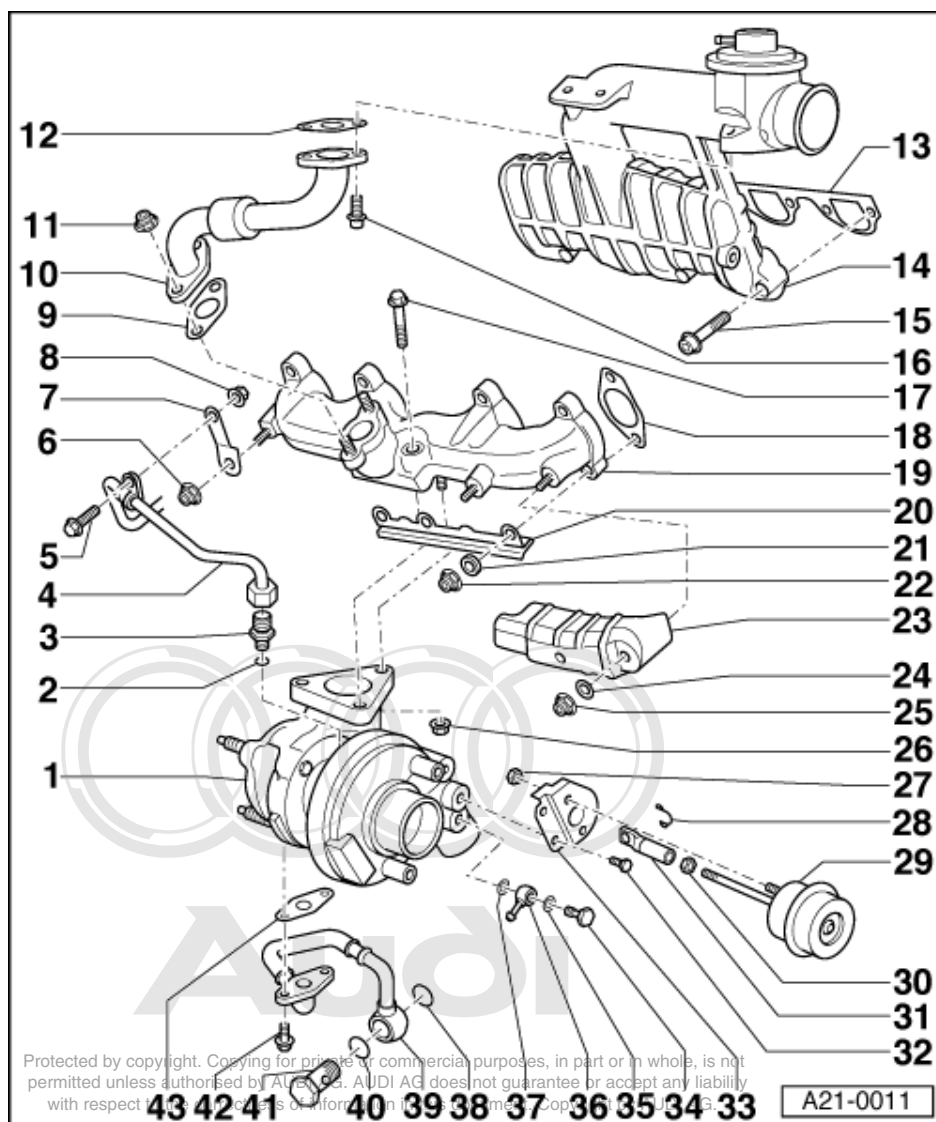
32 10 Nm

- ♦ Install using locking fluid
- ♦ Locking fluid

=> Parts List

33 Bracket

34 Banjo bolt - 15 Nm



**35 Sealing ring**

- ♦ Replace

**36 Terminal**

- ♦ For boost pressure control

**37 Sealing ring**

- ♦ Replace

**38 Sealing ring**

- ♦ Replace

**39 Oil return line**

- ♦ To cylinder block

**40 Sealing ring**

- ♦ Replace

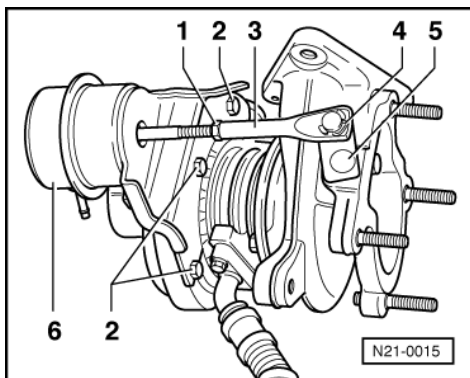
**41 Banjo bolt - 40 Nm**

**42 15 Nm**

**43 Gasket**

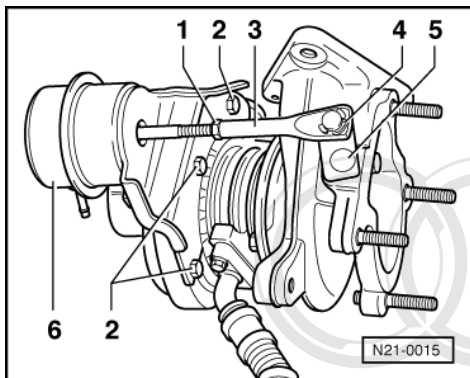
- ♦ Replace

## 2.4 - Removing and installing boost pressure control valve pressure unit - engine code AGR



## Removing

- Removing the turbocharger => Page 204
- -> Unclip retainer -4-.
- Remove bolts -2-.
- Remove pressure unit -6-.



## Installing

Installation is carried out in the reverse order; note the following:

- -> Insert bolts -2- for pressure unit -6-, into turbocharger using liquid locking fluid and tighten to 10 Nm.

◆ Locking fluid

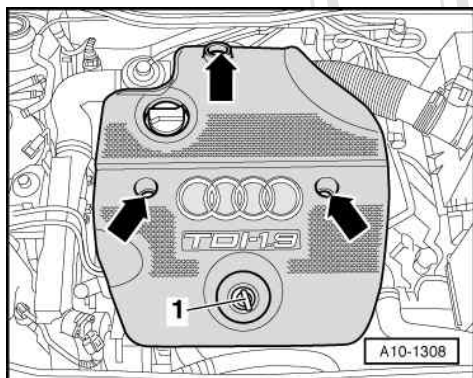
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=> Parts List

- Loosen lock nut -1- for actuation rod -3-.
- Move boost pressure valve -5- up to stop towards pressure unit and hold in place.
- Adjust actuation rod length -3- so that rod eye is easily placed over lever pin -5-. (Lever located at stop without play)
- Starting from this position, screw in actuating rod by 8 turns. (rod is shortened.)
- Tighten lock nut -1-.
- Position actuating rod on lever and slide retainer -4- in place.
- Installing the turbocharger => Page 208



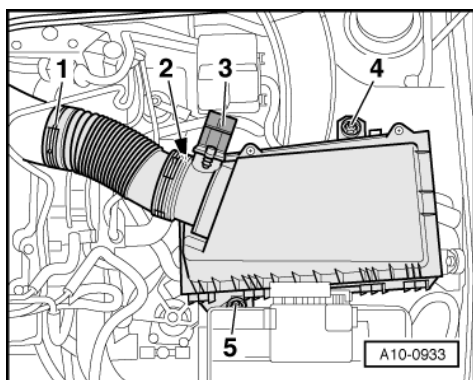
## 2.5 - Removing and installing turbocharger, engine code AGR



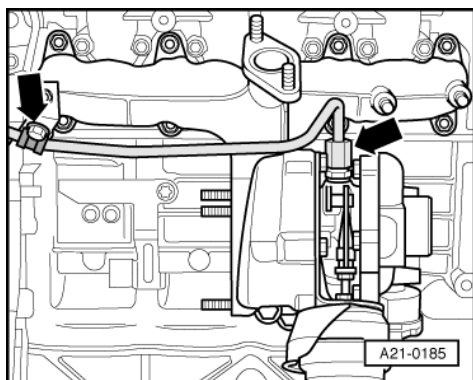
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### Removing

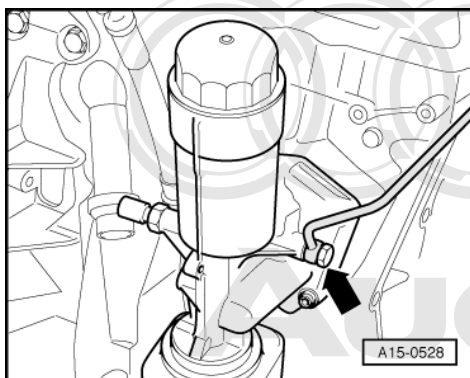
- -> Remove oil dipstick -1- from guide tube.
- Unclip caps.
- Unscrew nuts -arrows- and remove engine cover.
- Reinsert oil dipstick in guide tube.



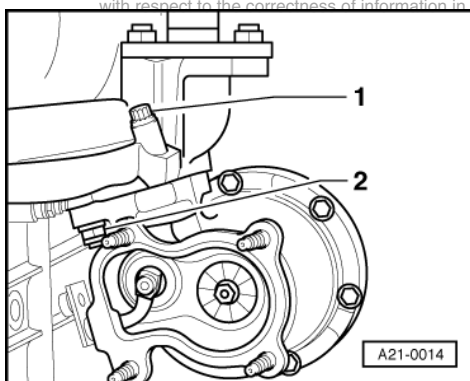
- -> Remove air duct hose-1- from air duct pipe.
- Detach connector of air mass meter -3-.
- Unscrew bolts -4- and -5-.
- Remove vent hose -2- from rear of air cleaner housing.
- Take out air cleaner housing.
- Remove air duct pipe from air filter to turbocharger.



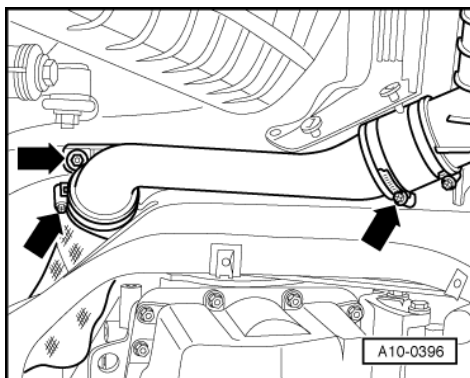
- -> Unscrew oil feed line from exhaust turbocharger and exhaust manifold -arrows-.



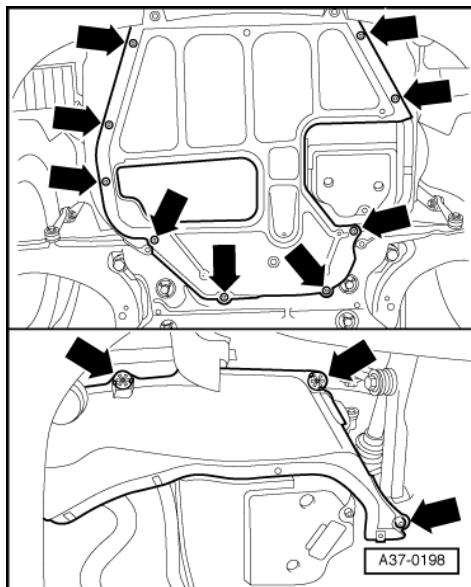
- -> Unscrew oil feed line from oil filter bracket -arrow- and also on cylinder head and lay line aside.



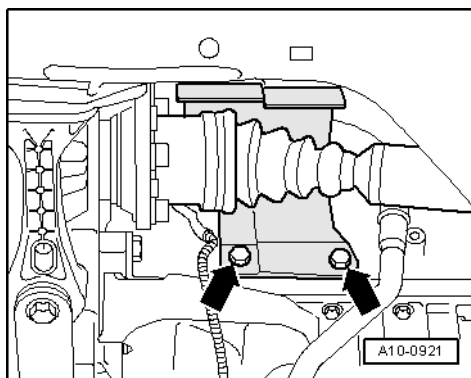
- -> Remove bolt -1- from above.



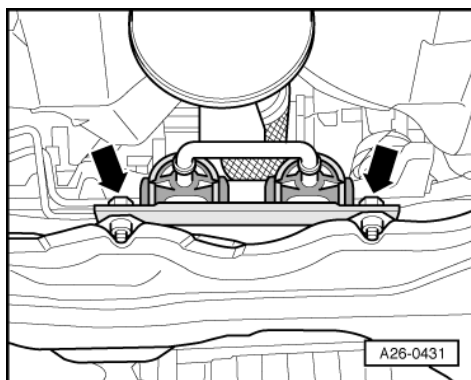
- -> Remove lower air duct pipe -arrows-.



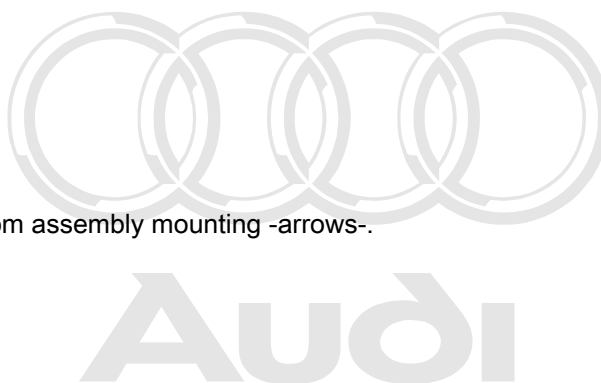
- -> Remove noise insulation in centre and on right -arrows-.



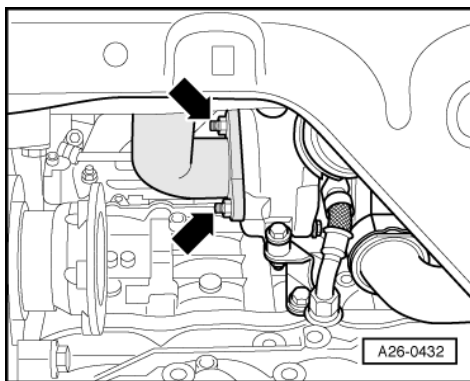
- -> Unbolt heat shield for right drive shaft -arrows-.



- -> Unbolt bracket for exhaust system from assembly mounting -arrows-.



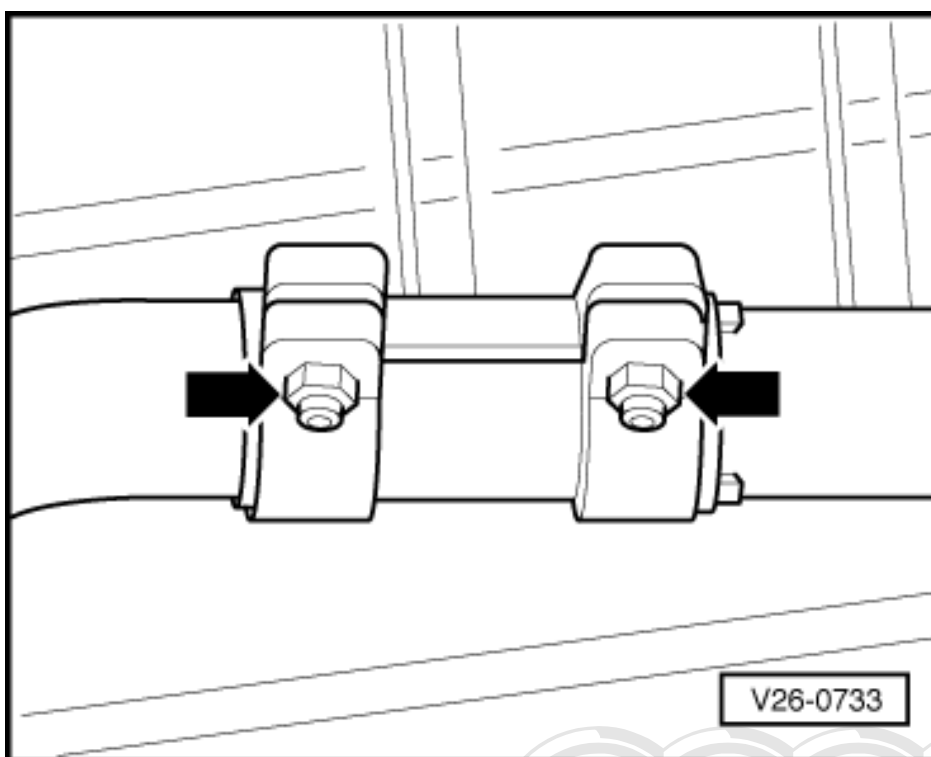
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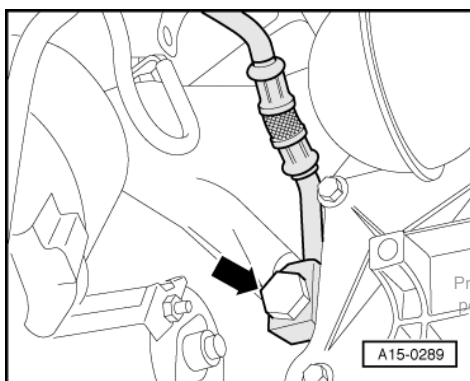
**Note:**

*The isolating element in front exhaust pipe must not be deflected more than 10° to avoid damage.*

- -> Unscrew securing bolts -arrows- of front exhaust pipe/exhaust turbocharger.



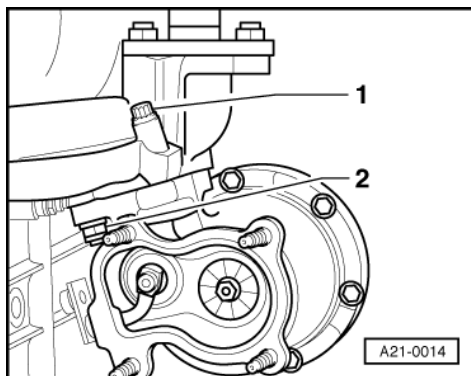
- -> Detach the exhaust system at the clamping sleeve -arrows-.
- Remove the front exhaust pipe.



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- Disconnect hose to boost pressure control solenoid valve -N75 at turbocharger or unscrew banjo bolt, respectively.
- Disconnect hose at boost pressure valve pressure unit.
- Remove air duct hoses at turbocharger.
- -> Detach the oil return line at cylinder block -arrow-.



- -> Screw out nut -2- from below.
- Remove the turbocharger.



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## Installing

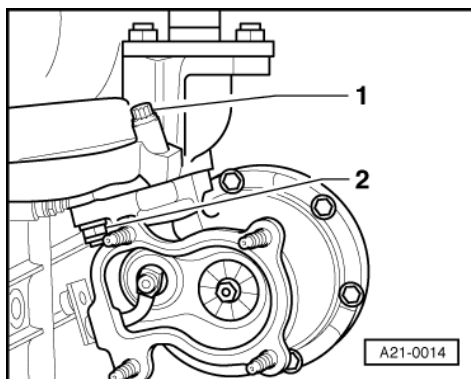
Installation is carried out in the reverse order; note the following:

### Notes:

- ♦ Always replace seals, gaskets and self-locking nuts.
- ♦ Note installation position of exhaust manifold/exhaust turbocharger gaskets.
- ♦ Fill the turbocharger with engine oil via the oil feed connection.
- ♦ Secure all hose connections with the correct hose clamps (same as original equipment):

### => Parts List

- ♦ Hose connections and hoses for charge air system must be free of oil and grease before assembly.
- Slide the hose onto the boost pressure valve pressure unit and secure it using a hose clamp.



- -> Position turbocharger on exhaust manifold and hand-tighten securing nut -2- after coating it with high-temperature lubricant.
- ♦ High-temperature lubricant

### => Parts List

- Coat threads and bolt head contact surface of securing bolts -1- with high temperature lubricant.
- Tighten the securing bolts -1- to 30 Nm and the fastening nut -2- to 25 Nm.
- Install exhaust system and align it stress-free => Page [232](#).

- Check oil level => Page 152 .

**Note:**

*After installing the turbocharger, run engine for approx. 1 minute at idling speed; do not rev up immediately. This ensures the turbocharger is properly lubricated.*

**Tightening torques**

| Component                         | Nm      |
|-----------------------------------|---------|
| Turbocharger to exhaust manifold  |         |
| Bolt                              | 30 1)3) |
| Nut                               | 25 2)3) |
| Oil return line to cylinder block | 40      |
| Oil feed line to turbocharger     | 22      |
| Oil feed line to                  |         |
| Oil filter bracket                | 25      |
| Bracket                           | 10      |

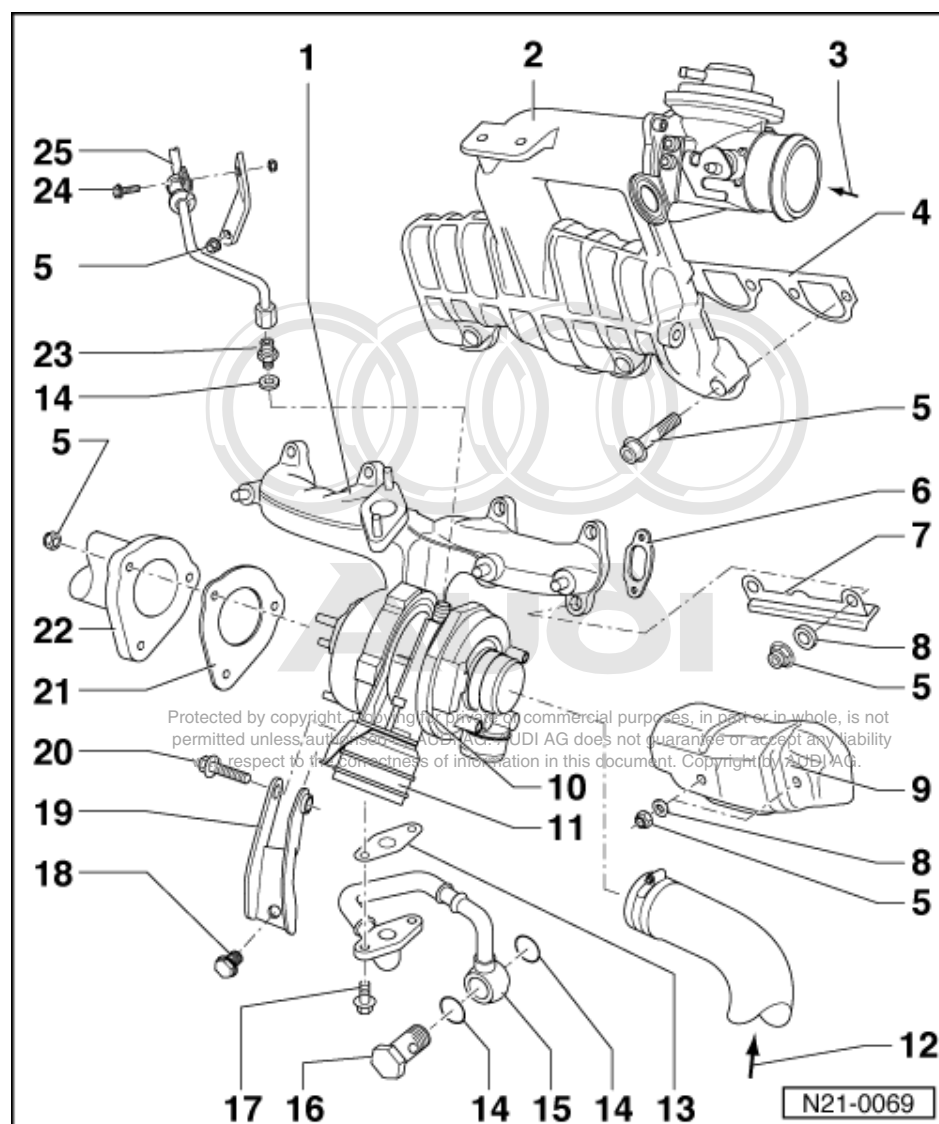
- 1) Replace bolts
- 2) Replace the nuts.
- 3) Coat threads and bolt head seating surface with high-temperature lubricant;  
High-temperature lubricant

=> Parts List

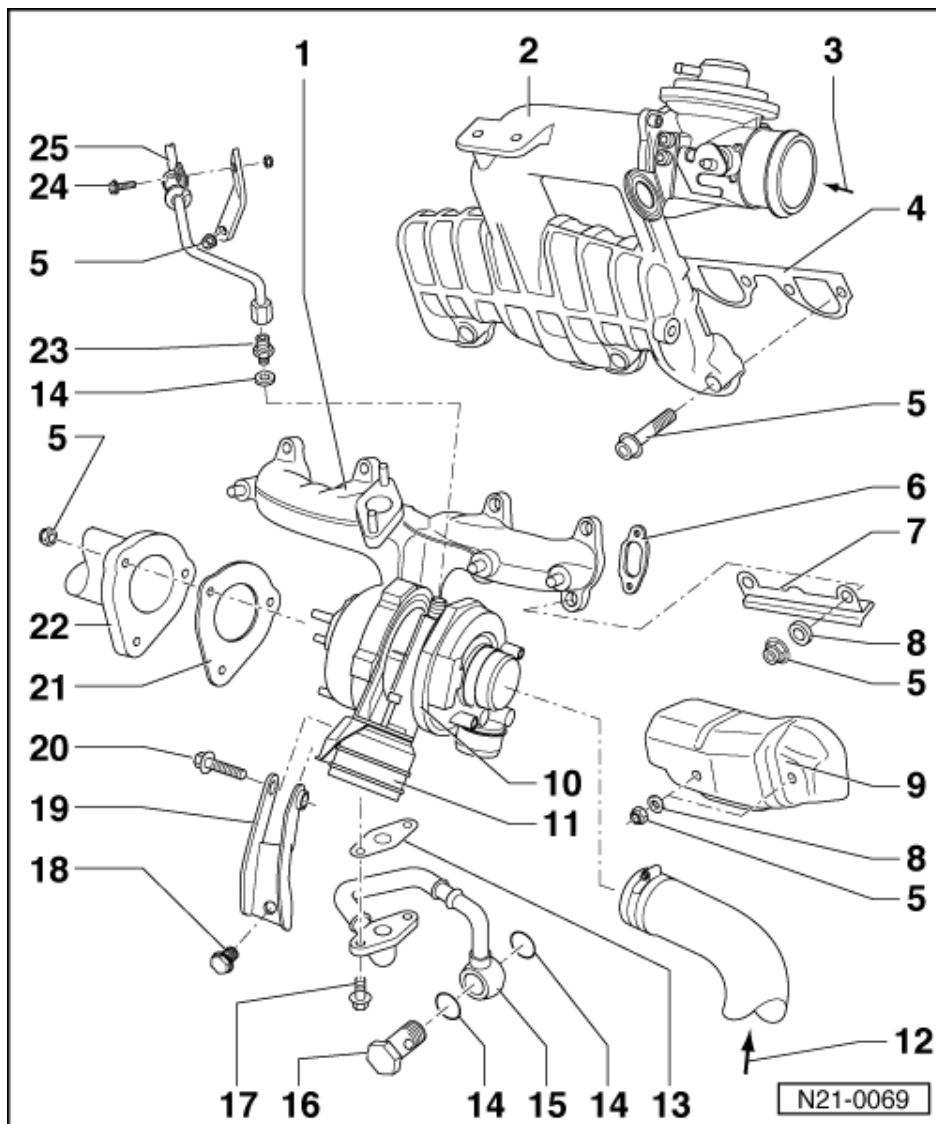


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## 2.6 - Turbocharger - engine code AFN, AHH



- 1 Exhaust manifold
  - ♦ with turbocharger
  - ♦ Cannot be renewed separately
- 2 Intake manifold
- 3 From charge air cooler
- 4 Gasket
  - ♦ Replace
  - ♦ Installation position: Bead faces intake manifold
- 5 25 Nm
- 6 Gasket
  - ♦ Replace
  - ♦ Note installation position

**7 Bracket**

- ♦ For heat shield

**8 Shim****9 Heat shield**

- ♦ Engage into bracket -Item **7** -.

**10 Turbocharger**

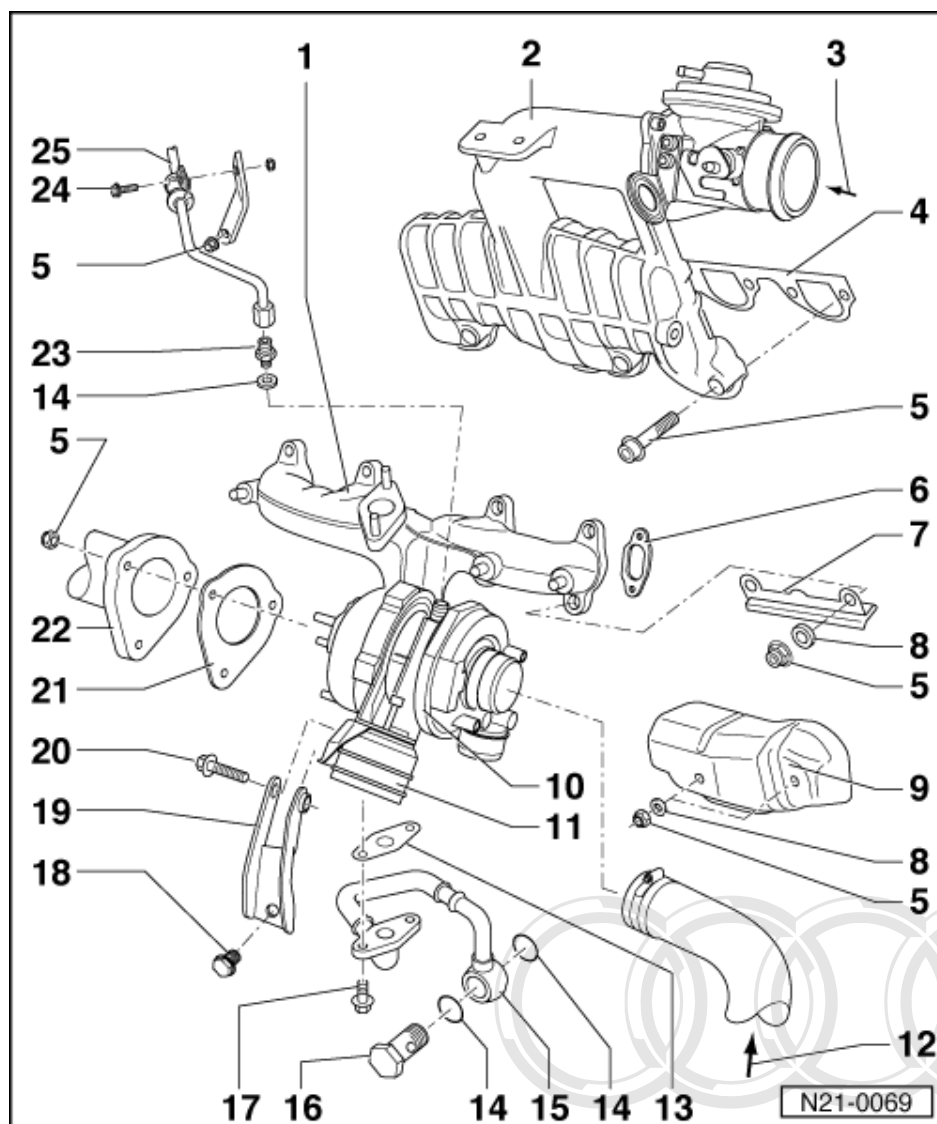
- ♦ Cannot be renewed separately
- ♦ Removing and installing  
=>Page **214**.

**11 Pressure unit**

- ♦ For boost pressure regulating valve
- ♦ Part of turbocharger, cannot be replaced as an individual component

**12 For air filter****13 Gasket**

- ♦ Replace



#### 14 Sealing ring

- ♦ Replace

#### 15 Oil return line

- ♦ To cylinder block

#### 16 Banjo bolt - 40 Nm

#### 17 15 Nm

#### 18 40 Nm

#### 19 Bracket

#### 20 25 Nm

#### 21 Gasket

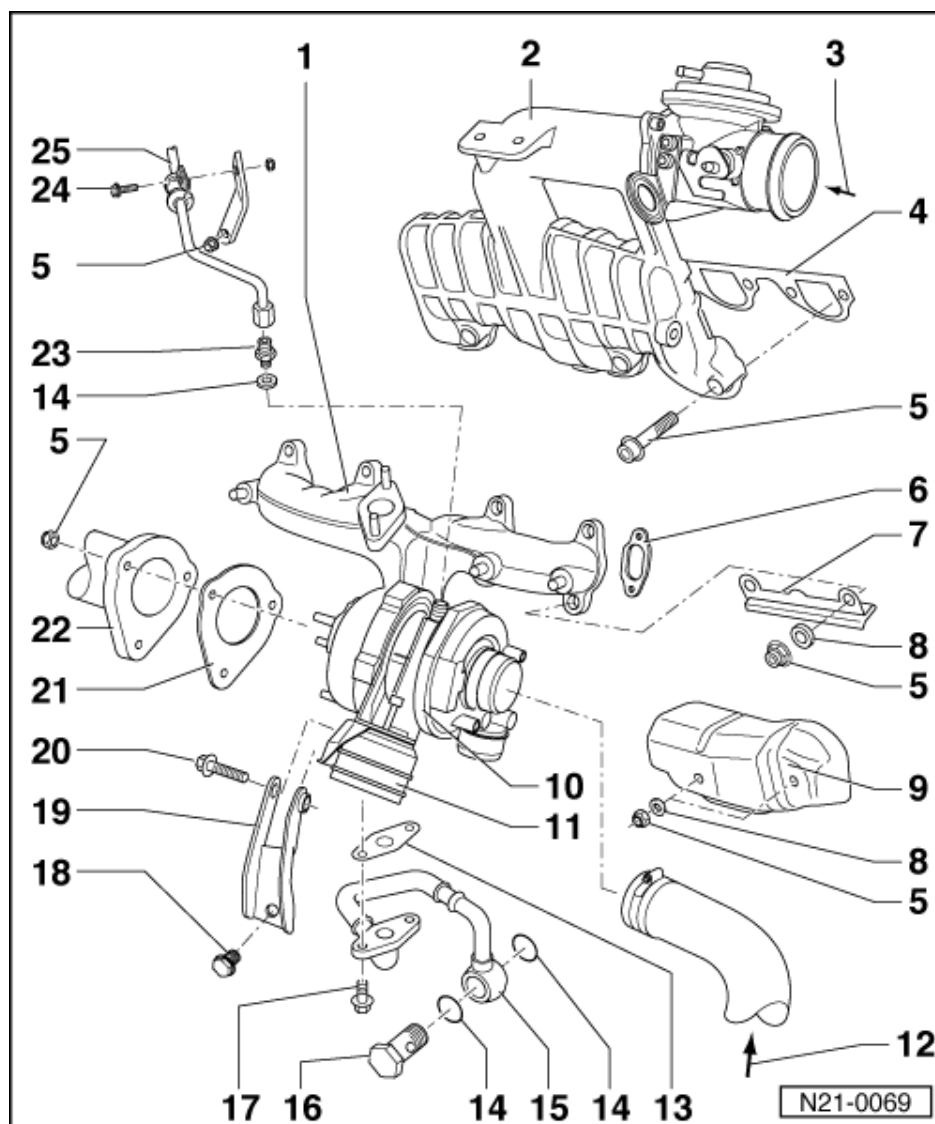
- ♦ Replace

#### 22 Front exhaust pipe

- ♦ Removing and installing  
=>Page 230 .

#### 23 Pipe union

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24 10 Nm

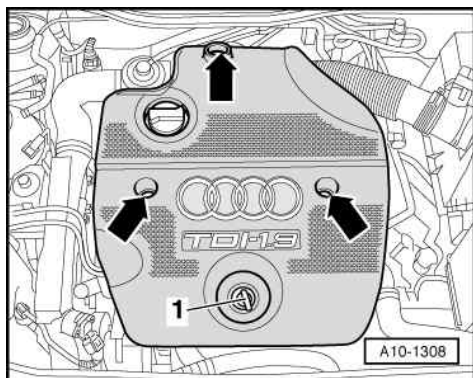
#### 25 Oil supply line

- ◆ Tighten union nut to 22 Nm.
- ◆ From oil filter bracket => Item **144**
- ◆ Note installation sequence:
  - First screw in both wiring ends loosely.
  - Then tighten wiring ends to final torque.
  - Lastly attach bracket.

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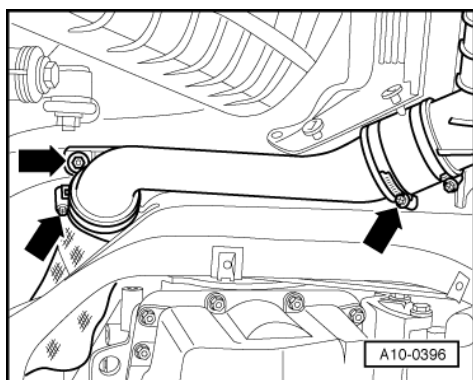


## 2.7 - Removing and installing turbocharger, engine codes AHF, ALH, ASV

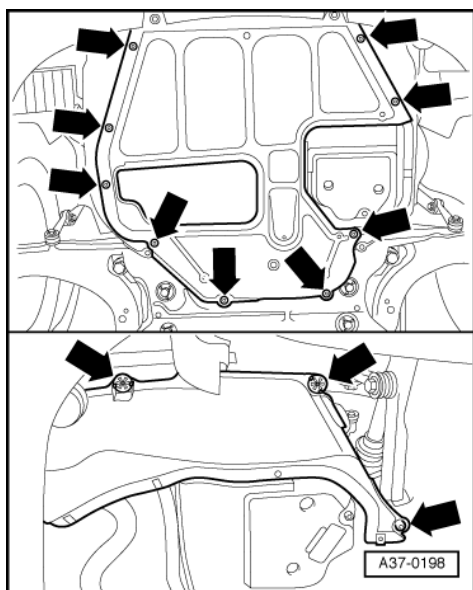


### Removing

- -> Remove oil dipstick -1- from guide tube.
- Unclip caps.
- Unscrew nuts -arrows- and remove engine cover.
- Reinsert oil dipstick in guide tube.



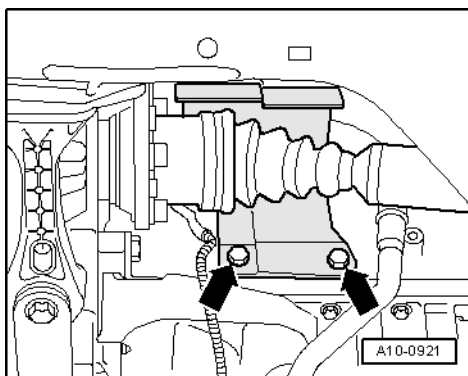
- -> Remove lower air duct pipe -arrows-.



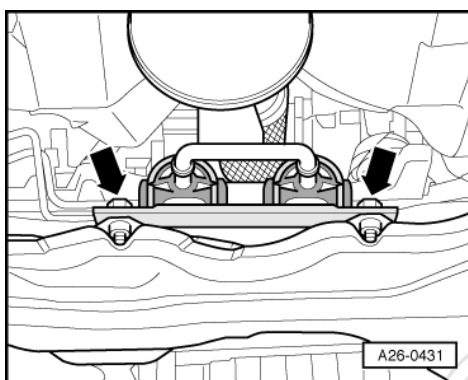
- -> Remove noise insulation in centre and on right -arrows-.



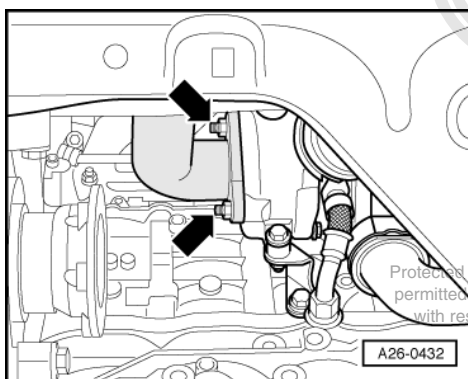
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- -> Unbolt heat shield for right drive shaft -arrows-.



- -> Unbolt bracket for exhaust system from assembly mounting -arrows-.

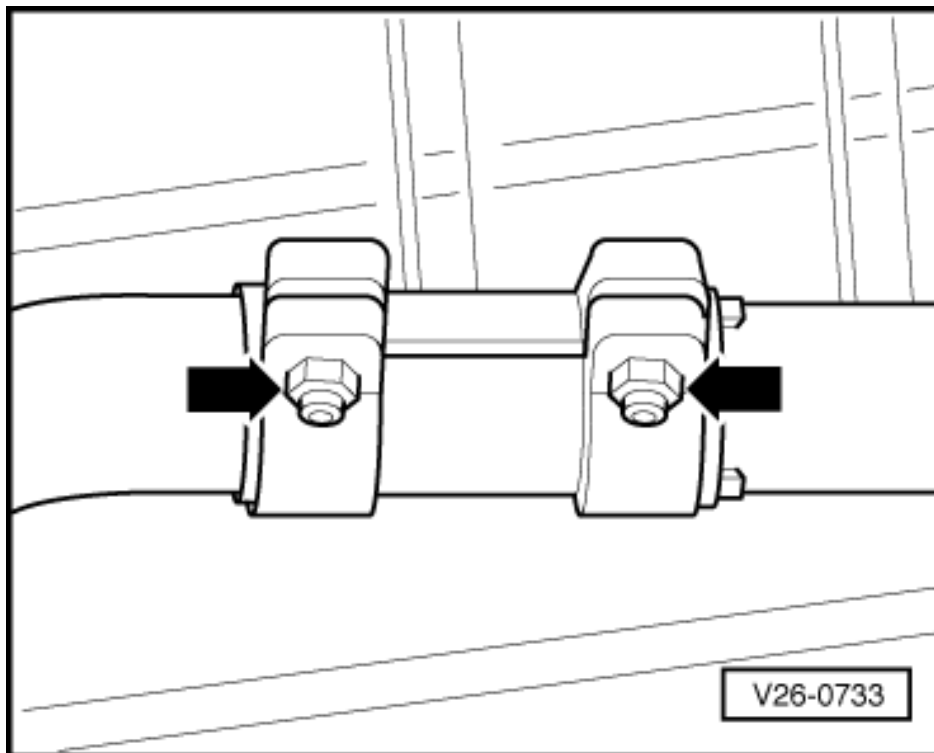


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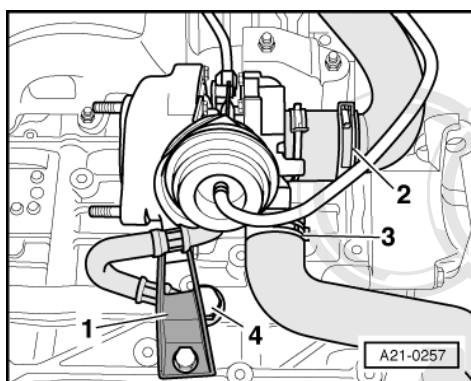
**Note:**

*The isolating element in front exhaust pipe must not be deflected more than 10° to avoid damage.*

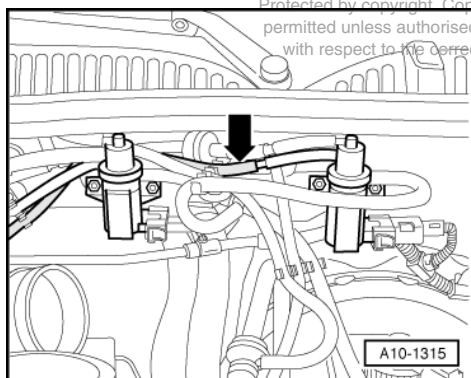
- -> Unscrew securing bolts -arrows- of front exhaust pipe/exhaust turbocharger.



- -> Detach the exhaust system at the clamping sleeve -arrows-.
- Remove the front exhaust pipe.

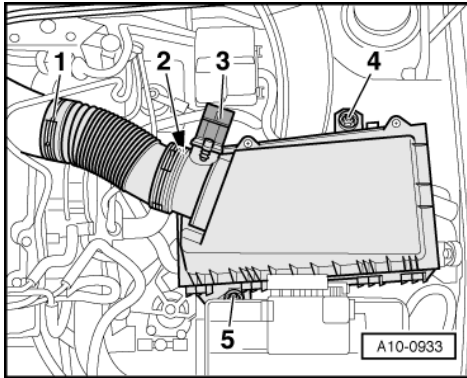


- -> Remove air duct hoses -2- and -3- from turbocharger.
- Unscrew turbocharger bracket -1-.
- Remove oil return line -4- at cylinder block.

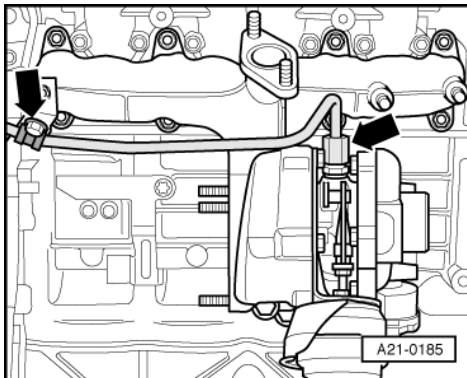


- Remove intake manifold => Page 99 .

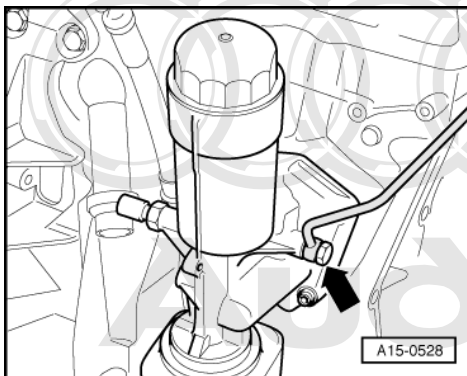
- -> Remove the vacuum hose -arrow- and expose.



- -> Remove air duct hose -1- from air duct pipe.
- Detach connector of air mass meter -3-.
- Unscrew bolts -4- and -5-.
- Remove vent hose -2- from rear of air cleaner housing.
- Take out air cleaner housing.

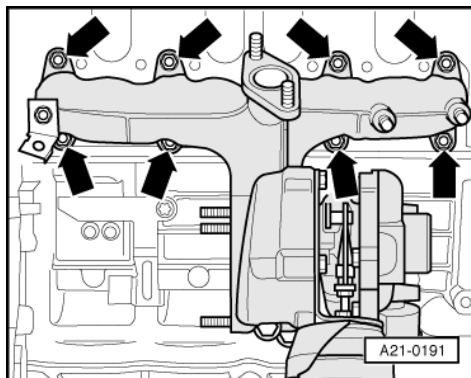


- -> Unscrew oil feed line from exhaust turbocharger and exhaust manifold -arrows-.



- -> Unscrew oil feed line from oil filter bracket -arrow- and also on cylinder head and lay line aside.

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- -> Unscrew nuts -arrows-.
- Remove packing plates.
- Remove the exhaust manifold/turbocharger.

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## Installing

Installation is carried out in the reverse order; note the following:

### Notes:

- ♦ Always replace seals, gaskets and self-locking nuts.
- ♦ Note installation position of exhaust manifold/exhaust turbocharger gaskets.
- ♦ Fill the turbocharger with engine oil via the oil feed connection.
- ♦ Secure all hose connections with the correct hose clamps (same as original equipment):

=> Parts List

- ♦ Hose connections and hoses for charge air system must be free of oil and grease before assembly.
- Install intake manifold => Page 101 .
- Install exhaust system and align it stress-free => Page 232 .
- Check oil level => Page 152 .

### Note:

After installing the turbocharger, run engine for approx. 1 minute at idling speed; do not rev up immediately. This ensures the turbocharger is properly lubricated.

## Tightening torques

| Component                                              | Nm    |
|--------------------------------------------------------|-------|
| Exhaust manifold/exhaust turbocharger to cylinder head | 25 1) |
| Oil feed line to turbocharger                          | 22    |
| Oil feed line to                                       |       |
| Oil filter bracket                                     | 25    |
| Bracket                                                | 10    |
| Heat shield to exhaust manifold/exhaust turbocharger   | 25    |

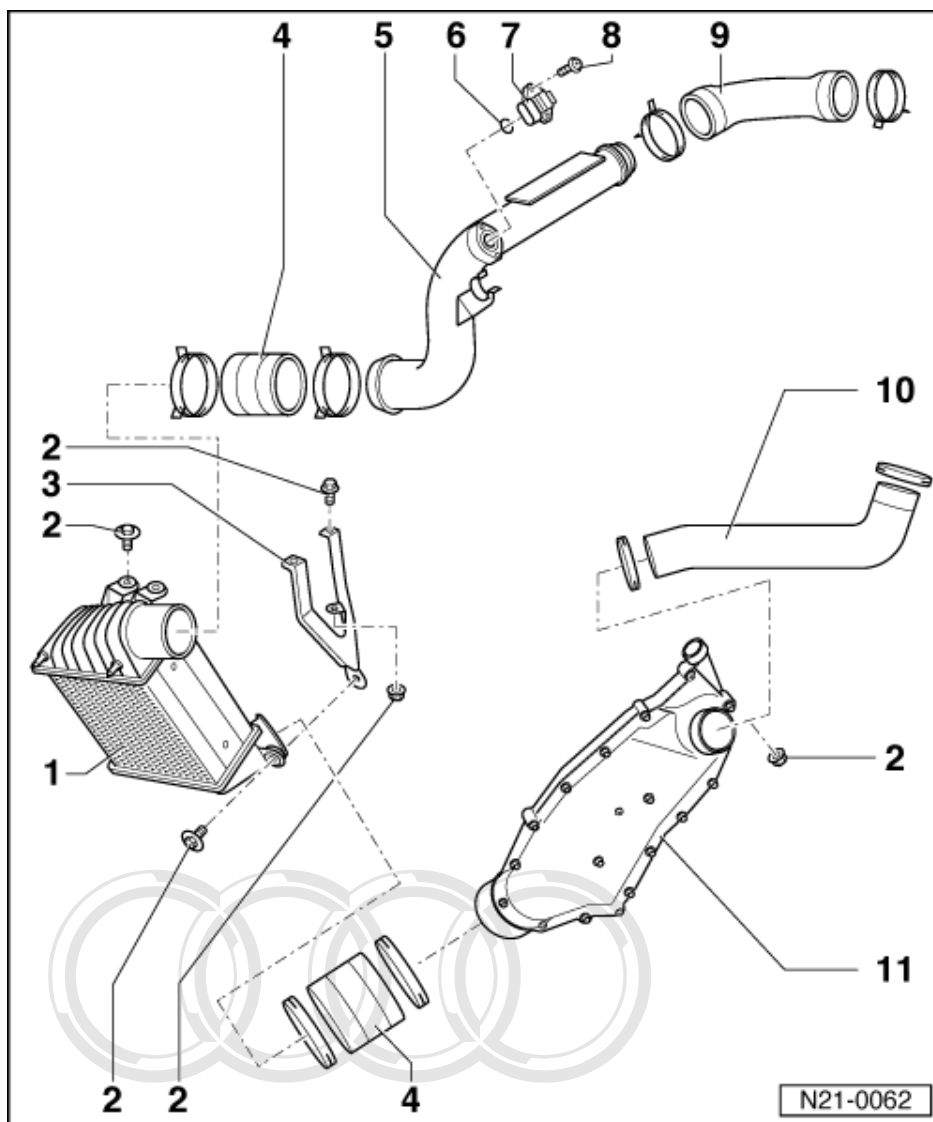
- 1) Replace self-locking nuts.

| Component                   | Nm |
|-----------------------------|----|
| Bracket for turbocharger to |    |
| cylinder block              | 40 |
| turbocharger                | 25 |

Oil return line to cylinder block

40

## 2.8 - Removing and installing parts of charge air cooling system

**Notes:**

- ◆ Secure all hose connections with the correct hose clamps (same as original equipment):

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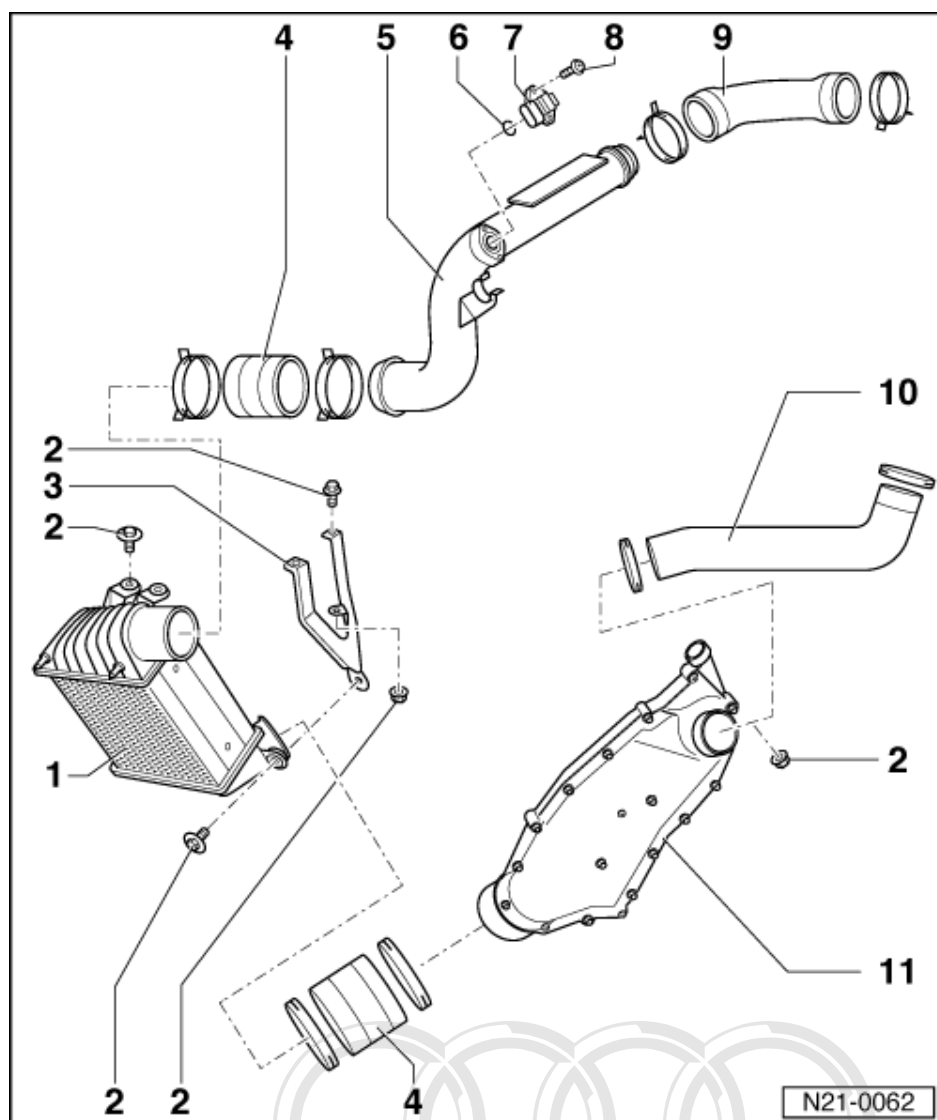
- ◆ Before a test or a repair is performed all hoses and wiring must be checked for tight fit and leakages.

**1 Intercooler**

- ◆ Removing and installing  
=>Page 221 .

**2 10 Nm****3 Bracket****4 Hose**

- ◆ Between charge air cooler and lower air duct pipe



5 Air guide pipe, right

6 O-ring

- ◆ Replace if damaged

7 Intake manifold pressure sender -G71

- ◆ On vehicles as of approx. 07.00 at charge air cooler

8 5 Nm

9 Hose

- ◆ Between right air duct pipe and intake connection

10 Hose

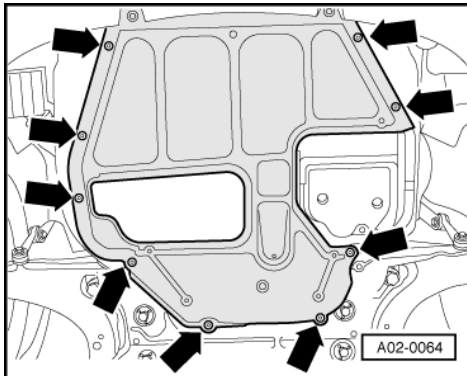
- ◆ Between lower air duct pipe and exhaust turbocharger

11 Lower air guide pipe

- ◆ Different versions
- ◆ With/without silencer

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## 2.9 - Removing and installing charge air cooler (intercooler)

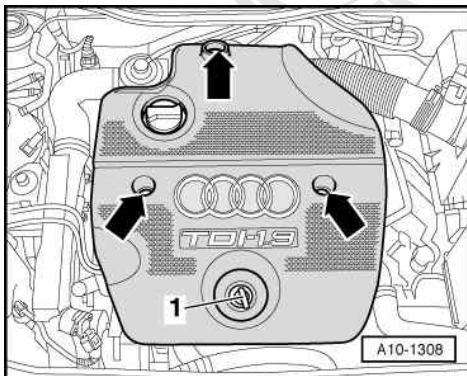


### Removing

- Remove the front bumper cover:

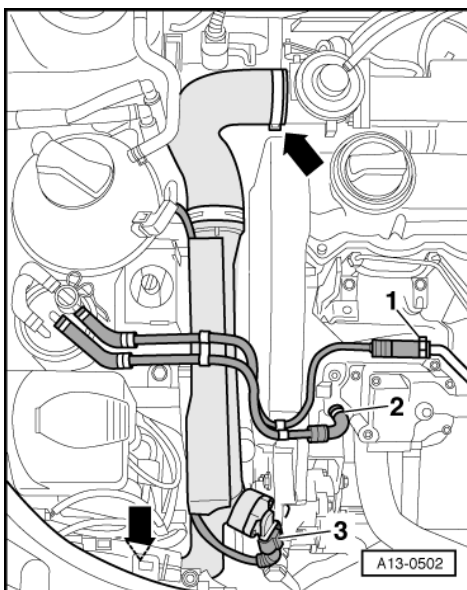
=> General Body Assembly, Exterior; Repair group 63; Front bumper; Removing and installing front bumper  
Front bumper Removing and installing front bumper

- -> Remove centre noise insulation -arrows-.

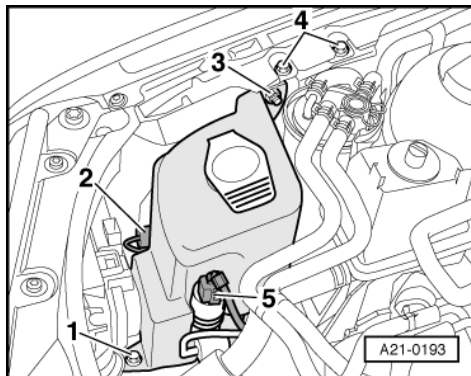


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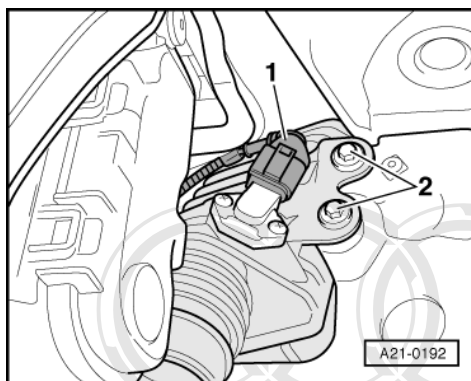
- -> Remove oil dipstick -1- from guide tube.
- Unclip caps.
- Unscrew nuts -arrows- and remove engine cover.
- Reinsert oil dipstick in guide tube.



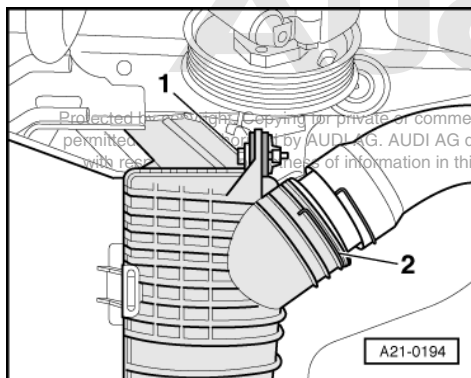
- Detach the cover and the electrical connector at the right headlight unit.
- -> Disconnect fuel-feed line -2- and fuel-return line -1- at injection pump.
- Disconnect the electrical connection -3- at the sender -G71/-G72.
- Expose the wiring at the air duct pipe.
- Remove the air duct pipe on right side -arrows-.



- -> Unscrew fuel filter bracket from body -4-. The hoses remain connected to the fuel filter.
- Detach connectors -2- and -5-.
- Remove bolt -1- and nut -3-.
- Move washer fluid reservoir to the side. Do not detach hoses.



- -> Disconnect electrical connector at intake manifold pressure sender -1-, where present.
- Unscrew bolts -2- for charge air cooler.



- -> Remove lower securing bolt -1- for charge air cooler.
- Remove charge air cooler from air duct hose -2- and remove downwards.

## Installing

Installation is carried out in the reverse order; note the following:

**Notes:**

- ♦ Hose connections and hoses for charge air system must be free of oil and grease before assembly.
- ♦ Fit new O-rings when damaged.

- Install the front bumper cover:

=> General Body Assembly, Exterior; Repair group 63; Front bumper; Removing and installing front bumper  
Front bumper Removing and installing front bumper

**Tightening torque**

| Component                    | Nm |
|------------------------------|----|
| Charge air cooler to bracket | 10 |

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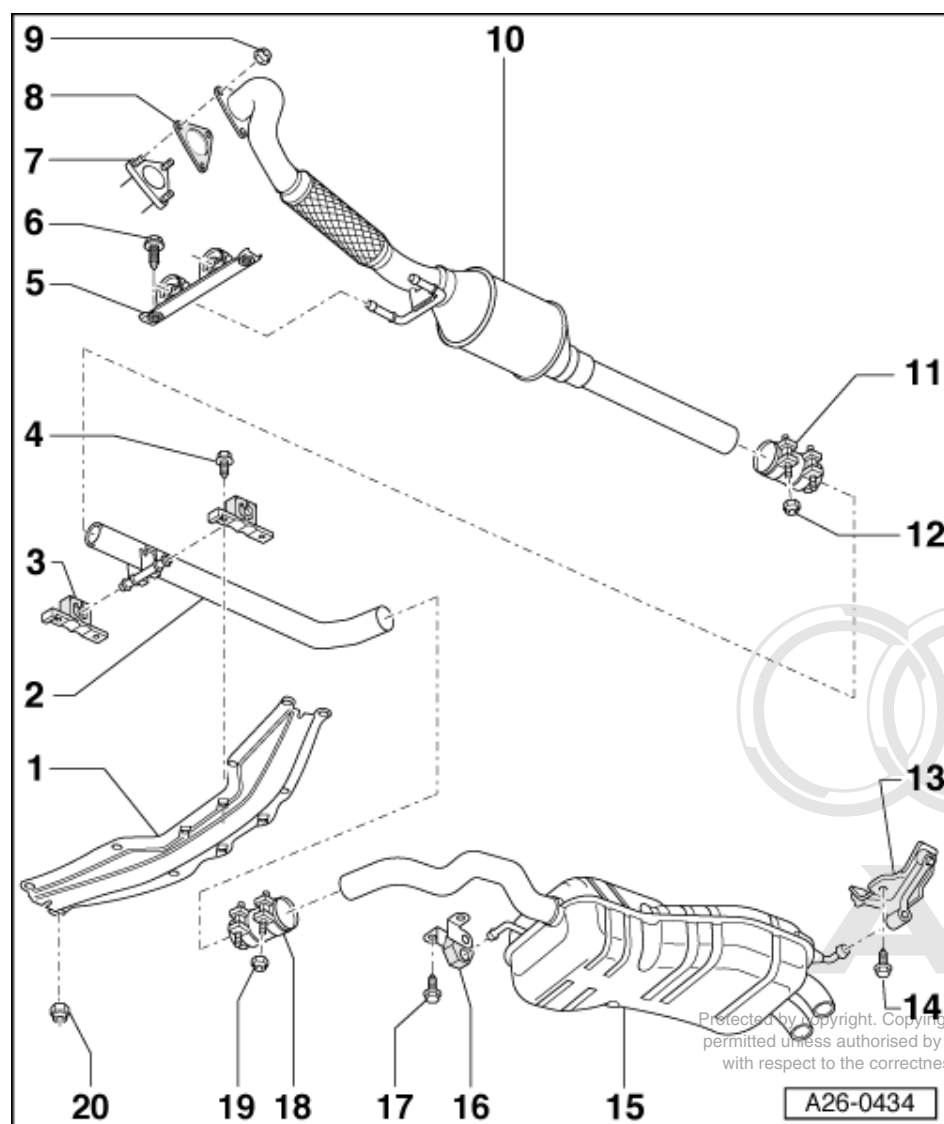
## 26 - Exhaust system

### 1 - Removing and installing parts of exhaust system

#### 1.1 - Removing and installing parts of exhaust system

##### Notes:

- ♦ Removing and installing exhaust manifold =>Page **197** , Removing and installing turbocharger with attachment parts.
- ♦ Always replace seals, gaskets and self-locking nuts.
- ♦ After working on the exhaust system ensure that the system is not under stress, and that it has sufficient clearance from the bodywork. If necessary, loosen clamp and align silencer and exhaust pipe so that sufficient clearance is maintained to the bodywork at all points and the support rings are evenly loaded.
- ♦ Slacken and tighten clamping plates for heat shields with a screwdriver.  
Tightening torque: 2 Nm
- ♦ The isolating element in front exhaust pipe must not be deflected more than 10° to avoid damage.



#### 1 Tunnel cross piece

- ♦ With bore for aligning exhaust system => Page **232**

**2 Intermediate pipe**

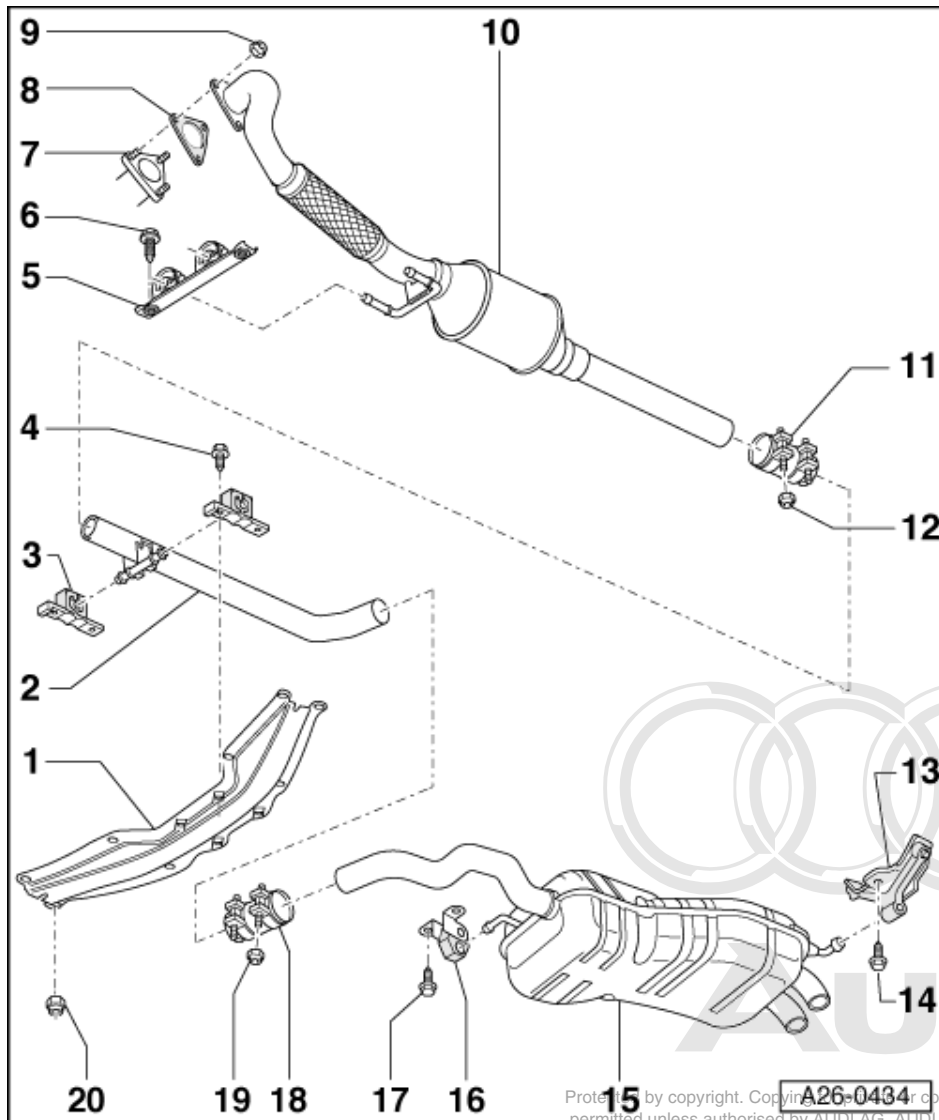
- ♦ Centre and rear silencers are one unit as original equipment. In cases of repair renew individually
- ♦ Cutting point => Page 230
- ♦ Align exhaust system so it is free of stress before tightening clamp=> Page 232

**3 Mounting**

- ♦ Installation position  
=> Fig. 229
- ♦ Replace if damaged

**4 23 Nm****5 Mounting**

- ♦ Replace if damaged

**6 23 Nm****7 Turbocharger**

- ♦ Removing and installing => Page 214, respectively.

**8 Gasket**

- ♦ Replace

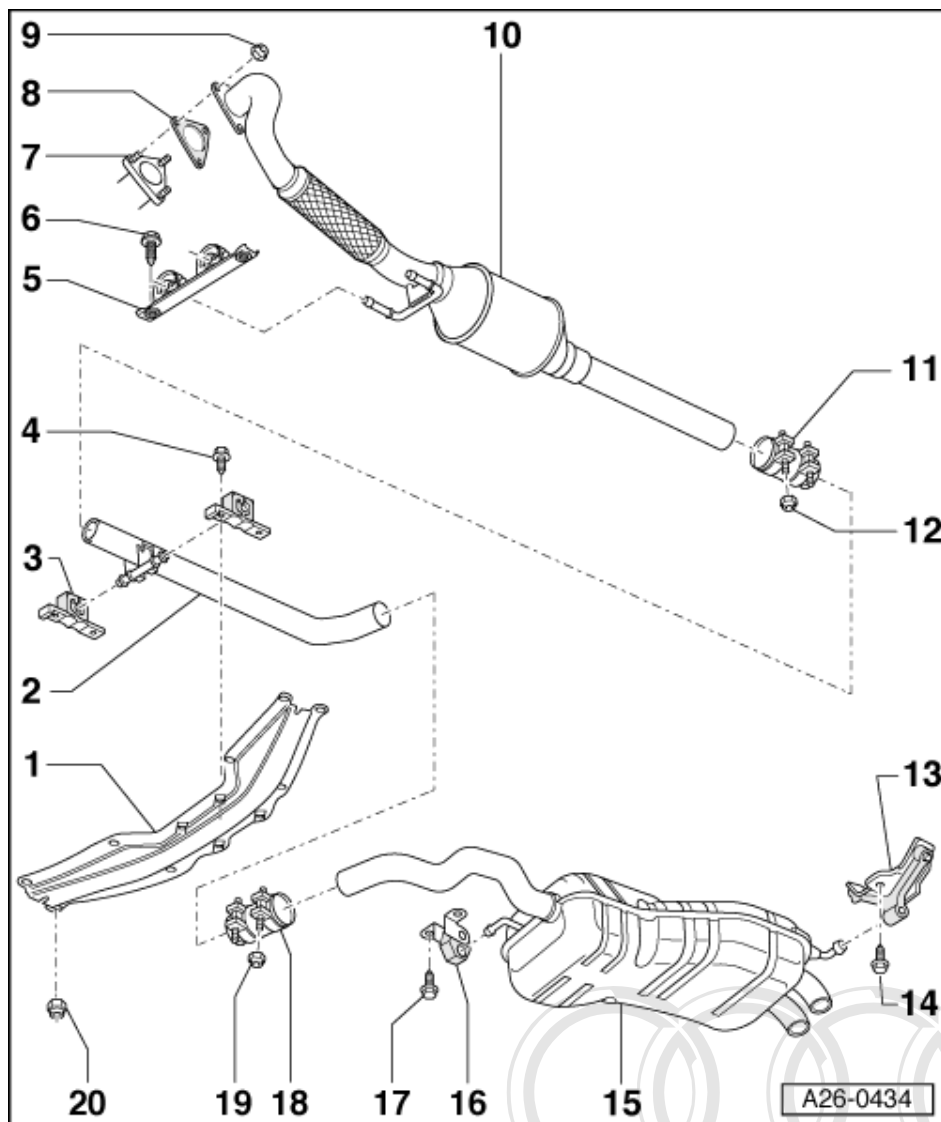
**9 23 Nm**

- ♦ Replace

**10 Front exhaust pipe**

- ♦ With oxidising catalytic converter
- ♦ Protect from damage by knocks and impact
- ♦ With flexible connection (de coupling element)

- ◆ Do not bend flexible connection more than 10° - otherwise it can be damaged.
- ◆ Removing and installing  
=>Page 230 .
- ◆ Align exhaust system so it is free of stress before tightening clamp=> Page 232



#### 11 Front clamping sleeve

- ◆ Align exhaust system so it is free of stress before tightening clamp => Page 232
- ◆ Installation position =>Fig. 228
- ◆ Tighten bolted connections evenly.

#### 12 40 Nm

#### 13 Mounting

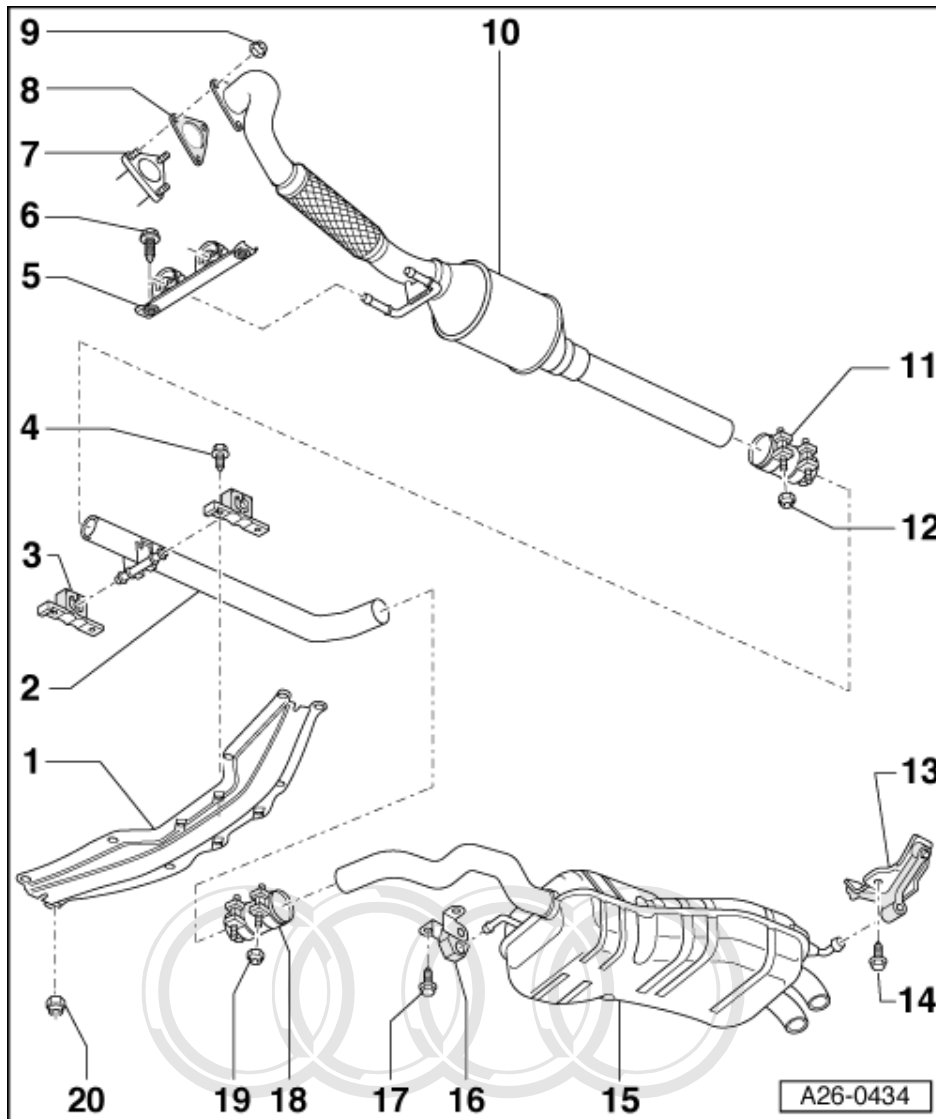
- ◆ Replace if damaged

#### 14 23 Nm

#### 15 Rear silencer

- ◆ Intermediate pipe is one unit as original equipment. In cases of repair renew individually
- ◆ Cutting point => Page 230
- ◆ Align exhaust system so it is free of stress before tightening clamp => Page 232

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#### 16 Mounting

- ♦ Replace if damaged

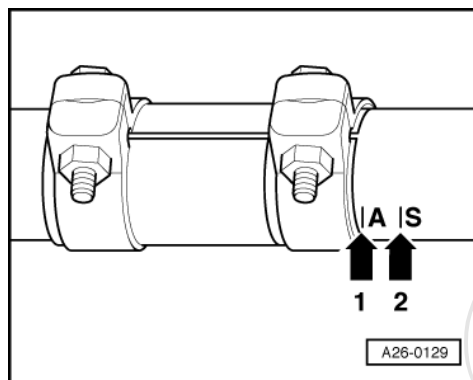
17 23 Nm

#### 18 Rear clamping sleeve

- ♦ For separate replacement of intermediate pipe and rear silencer
- ♦ Align exhaust system so it is free of stress before tightening clamp => Page 232
- ♦ Installation position  
=> Fig. 228
- ♦ Tighten bolted connections evenly.

19 40 Nm

20 23 Nm



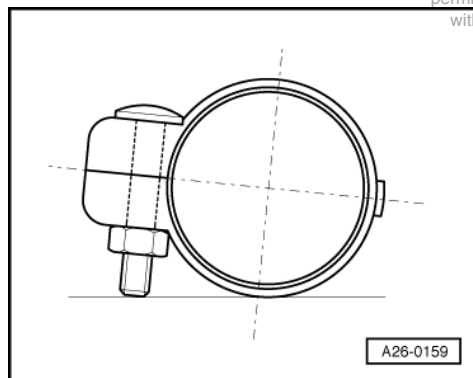
-> Fig.1 Installation position of front clamp

- Position clamp about 5 mm away from relevant marking "A" -arrow 1- and tighten to 40 Nm.

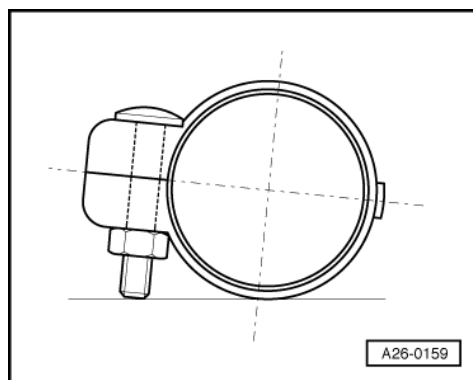
**Note:**

Ignore marking "S" -arrow 2-.

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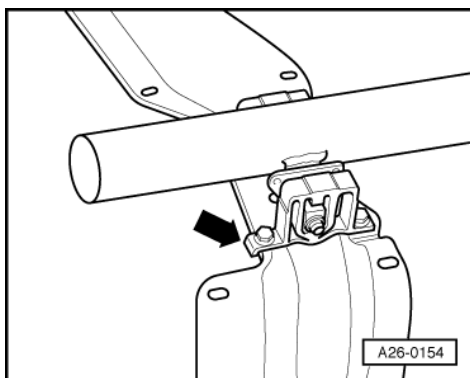


- -> Install the clamps so that the ends of the bolts do not protrude over the lower edge of the clamping sleeve.
- Bolted connection facing to the left



-> Fig.2 Installation position of rear clamp

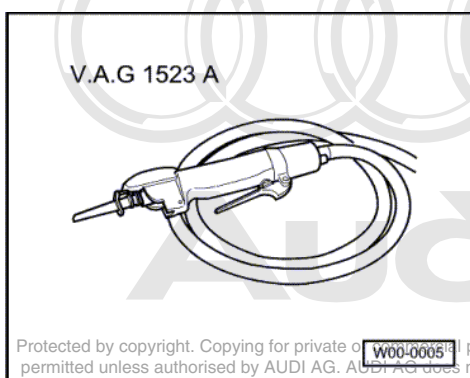
- Install the clamping sleeve so that the ends of the bolts do not protrude over the lower edge of the clamping sleeve.
- Bolted connection facing to the front



-> Fig.3 Fitting location of mounting

Angled end at base of mounting -arrow- faces in direction of travel.

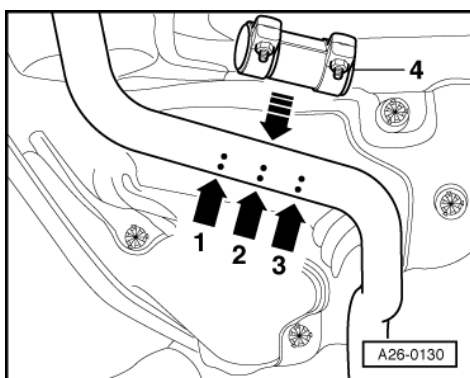
## 1.2 - Separating intermediate pipe and rear silencer



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### Special tools and workshop equipment required

- ◆ Body saw V.A.G 1523 A
- ◆ Protective goggles



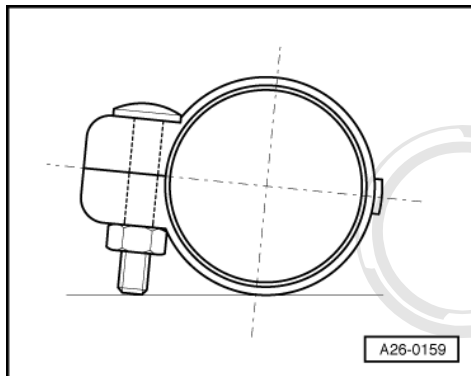
### Procedure

- ◆ The cutting point is marked with an indentation on the outside of the exhaust pipe.



Important  
Wear protective glasses.

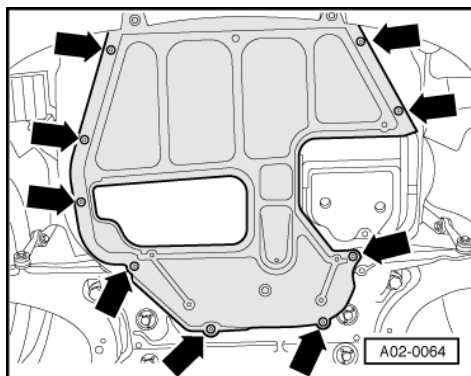
- -> Cut through exhaust pipe at right angles with body saw, e.g. V.A.G 1523 A at cutting point -arrow 2-.
- Position clamp 4 between side markings -arrows 1 and 3- when installing.



- -> Install clamping sleeves so that the bolt-ends do not protrude over the lower edge of the clamping sleeve.
- Bolted connection facing to the front
- Stress-free alignment of exhaust system => Page 232

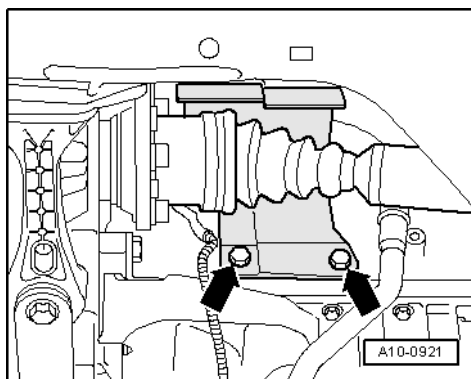
### 1.3 - Removing and installing front exhaust pipe with catalytic converter

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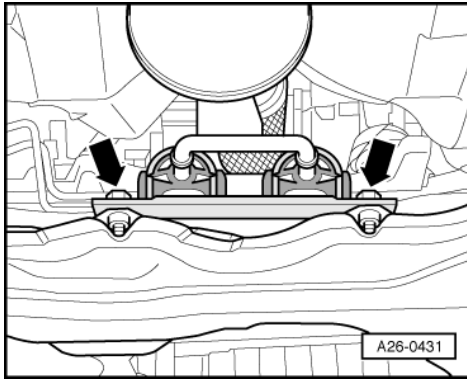


#### Removing

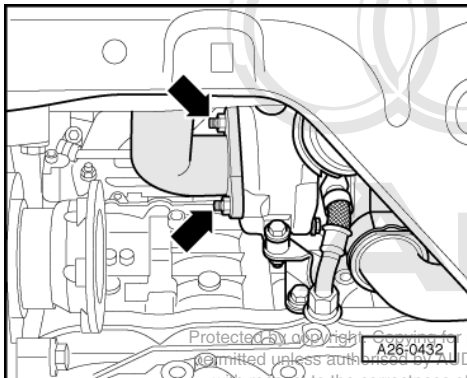
- -> Remove the noise insulation -arrows-.



- -> Unbolt heat shield for right drive shaft -arrows-.



- -> Unbolt bracket for exhaust system from assembly mounting -arrows-.

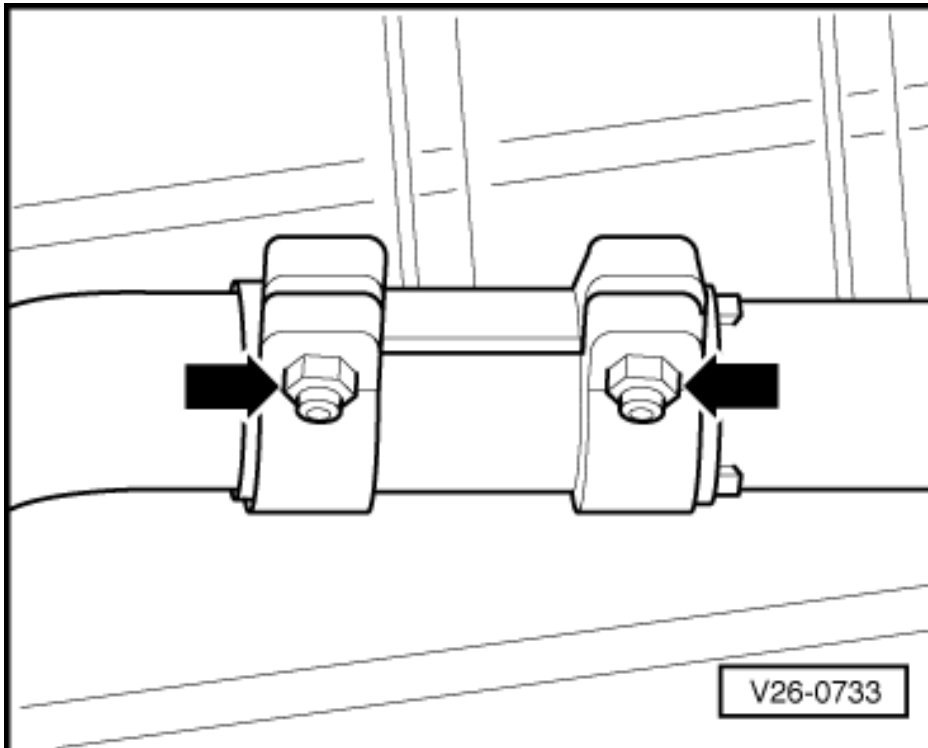


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**Note:**

*The isolating element in front exhaust pipe must not be deflected more than 10° to avoid damage.*

- -> Unscrew securing bolts -arrows- of front exhaust pipe/exhaust turbocharger.





- -> Detach the exhaust system at the clamping sleeve -arrows-.
- Remove front exhaust pipe with catalytic converter.

## Installing

Installation is carried out in the reverse order; note the following:

### **Note:**

*Always replace seals, gaskets and self-locking nuts.*

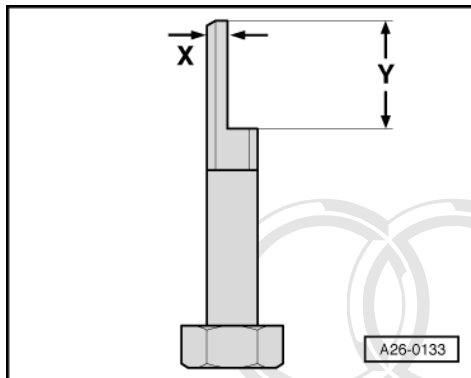
- Stress-free alignment of exhaust system => Page **232**

## Tightening torques

| Component                                 | Nm |
|-------------------------------------------|----|
| Front exhaust pipe to turbocharger        | 23 |
| Mounting to subframe                      | 23 |
| Drive shaft heat shield to cylinder block | 35 |

## 1.4 - Stress free alignment of exhaust system

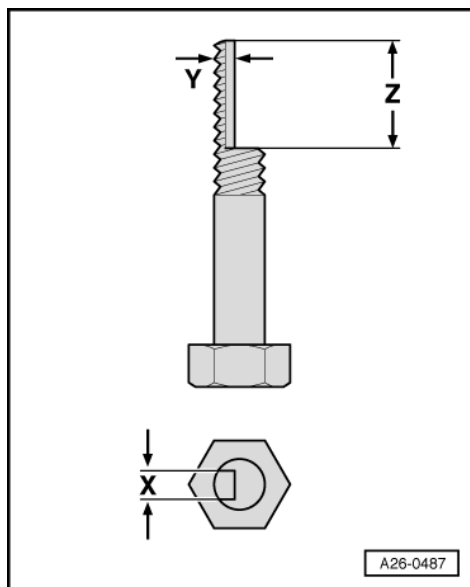
- Depending on vehicle version, a make-shift tool must be fashioned from an M10 or M14 bolt, respectively, in order to adjust the exhaust system position.
- The exhaust system must be aligned when cold.



**Vehicles with hole  $\varnothing 10.5$  mm in rear of tunnel cross piece:**

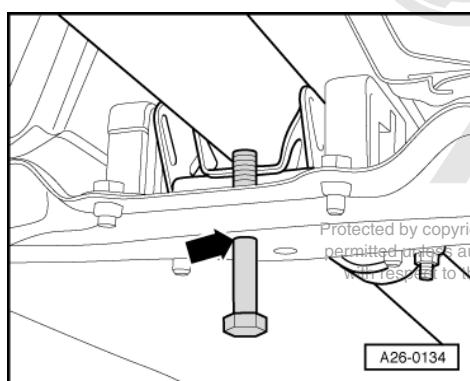
- -> Modify an M10 bolt according to the dimensions given to use as a tool for aligning the exhaust system.
- Dimension X = 4 mm
- Dimension Y = 25 mm

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#### Vehicles with hole $\varnothing 14.5$ mm in rear of tunnel cross piece:

- -> Modify an M14 bolt according to the dimensions given to use as a tool for aligning the exhaust system.
- Dimension X = 10 mm
- Dimension Y = 6 mm
- Dimension Z = 25 mm



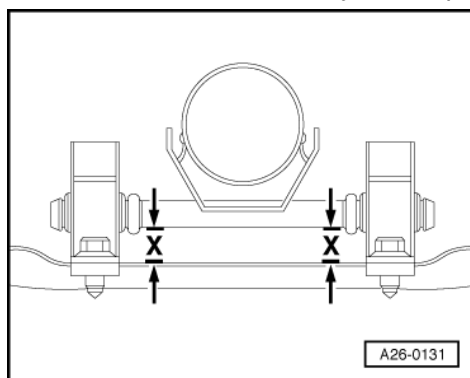
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#### All models:

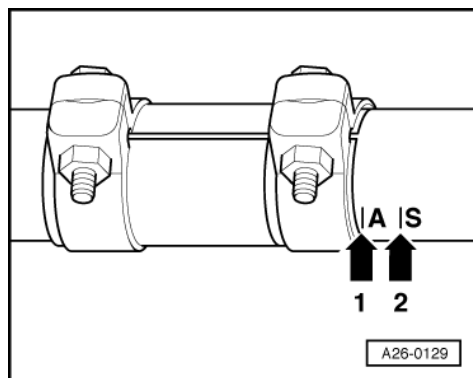
- Slacken bolted connections on front clamping sleeve -Item 226.
- -> Insert modified bolt (aligning tool) through rear bore -arrow- in tunnel cross piece, with flat part of bolt facing towards mounting pin on exhaust system.

#### Note:

With bolt inserted, exhaust system is pre tensioned in the direction of travel.



- Align centre and rear silencer horizontally:
  - -> The attachment bolt on exhaust pipe must be parallel to tunnel cross piece (dimension x on left and right is the same).



- -> Position clamping sleeve in horizontal position at approx. 5 mm distance to mark "A" -arrow 1-.

#### **Note:**

Do not observe marking "S" -arrow 2-.

- ♦ Installation position of clamping sleeve =>Fig. 228
- Align rear silencer so it is horizontal.
- Tighten bolted connections on clamp evenly to 40 Nm.

## 1.5 - Checking exhaust system for leaks

- Start engine and run at idling speed.
- Plug tailpipes with cloths or stoppers until check is completed.
- Listen for noise at the connection points of cylinder head/exhaust manifold; exhaust turbocharger/front exhaust pipe etc. to locate any leaks.
- Rectify any leaks that are found.

## 2 - Exhaust gas recirculation system

### 2.1 - Exhaust gas recirculation system

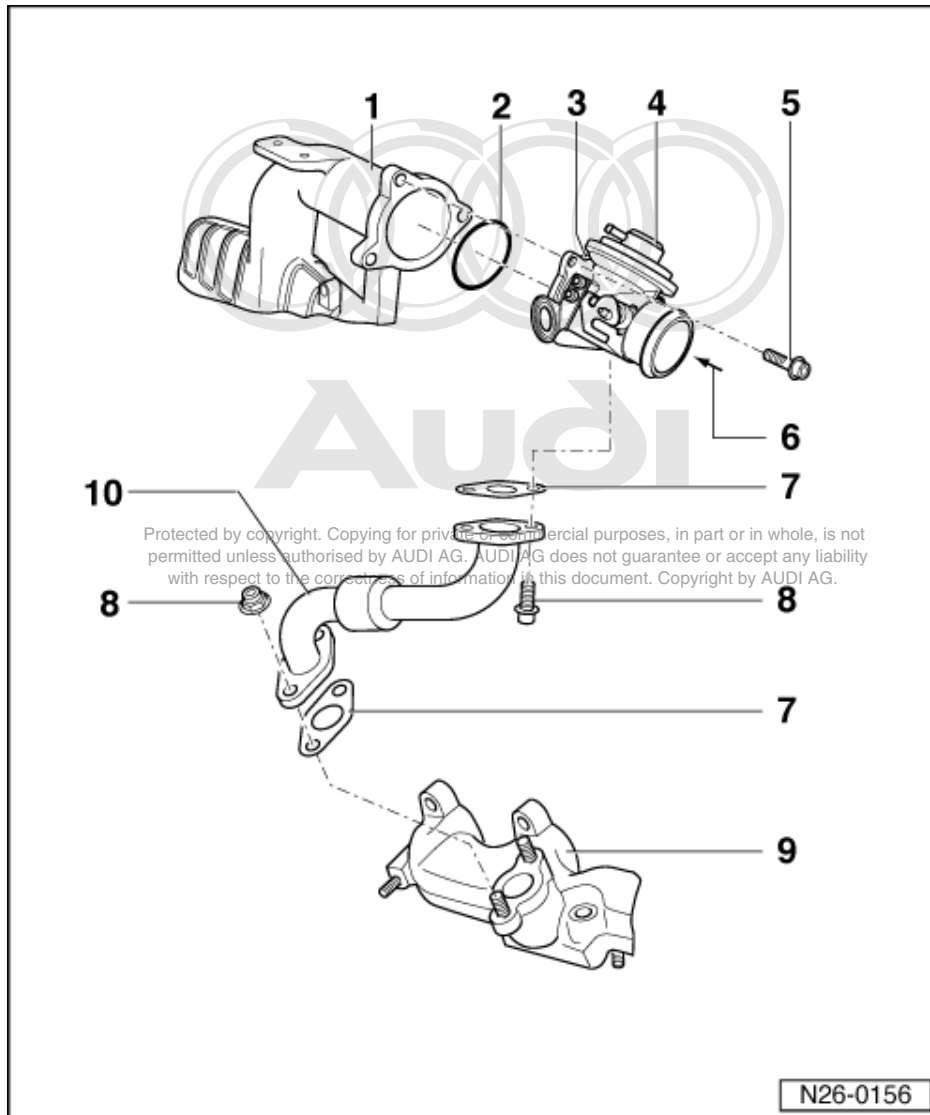
#### **Notes:**

- ♦ The function/control of the exhaust gas recirculation system is performed by the diesel direct injection system control unit (J248) via exhaust gas recirculation valve (N18) to mechanical exhaust gas recirculation valve.
- ♦ The tapered plunger in the mechanical exhaust gas recirculation valve varies the opening cross section according to valve travel.
- ♦ Every conceivable valve position is possible through pulsed control.
- ♦ The exhaust gas recirculation is switched off after approx. 10 minutes at idling speed.
- ♦ Restart the engine or briefly increase the engine speed above idling speed when longer checks are necessary. Then repeat checks.
- ♦ Secure all hose connections with the correct hose clamps (same as original equipment):

=> Parts List

- ♦ Always replace seals, gaskets and self-locking nuts.

## 2.2 - Removing and installing exhaust gas recirculation components



### 1 Intake manifold

- ♦ Removing and installing  
=>Page 99 .

### 2 O-ring

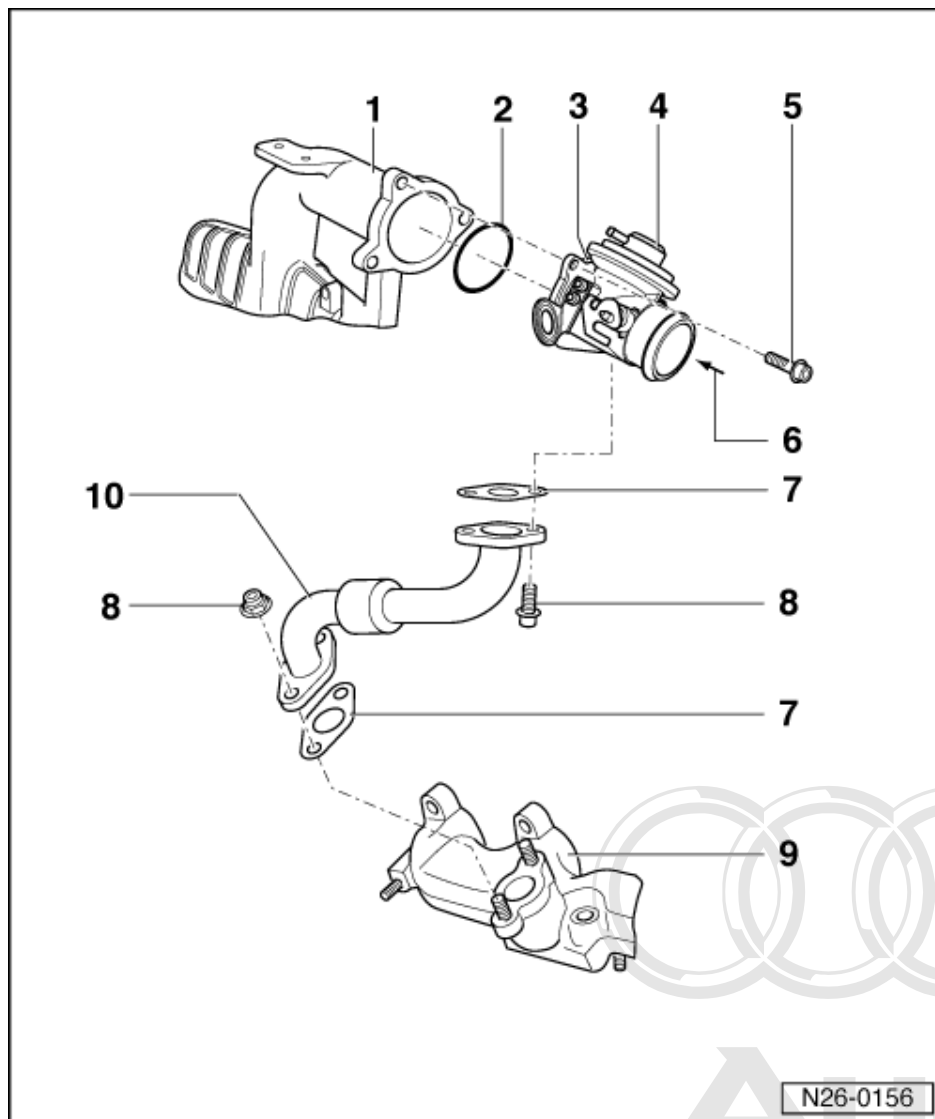
- ♦ Replace

### 3 Intake connection piece

- ♦ With EGR valve and intake manifold flap

### 4 Mechanical EGR valve

- ♦ Can only be replaced completely with intake connection
- ♦ Checking => Page 244
- ♦ Checking EGR =>Page 242



5 10 Nm

6 From charge air cooler

7 Gasket

- ♦ Replace

8 25 Nm

9 Exhaust manifold

10 Connecting pipe

- ♦ For exhaust gas recirculation
- ♦ Note installation sequence:
  - First bolt on loosely.
  - Then tighten bolts to final torque.

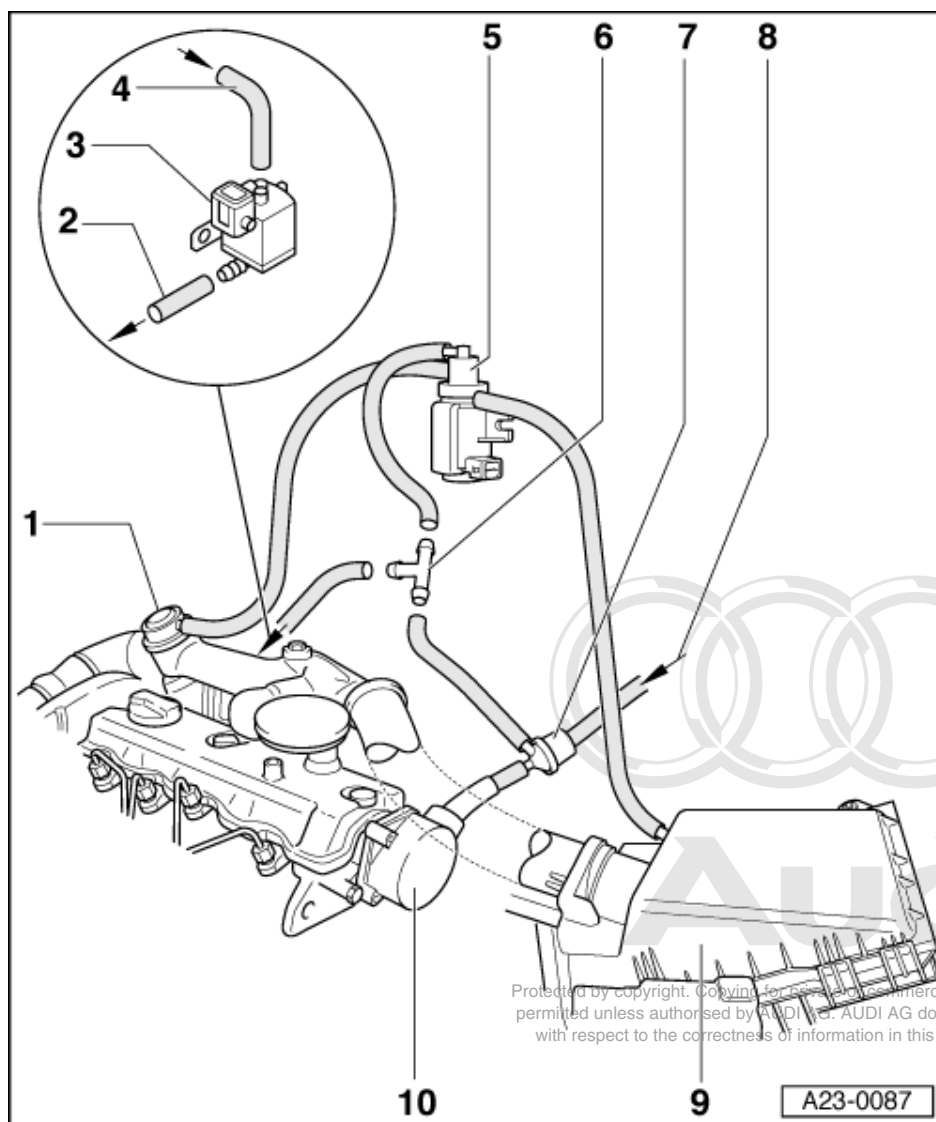
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Diagram illustrating the engine cooling system components and their assembly:

- 1: Engine block
- 2: Thermostat housing
- 3: Thermostat
- 4: Gasket
- 5: Thermostat housing (top view)
- 6: Water pump
- 7: Radiator
- 8: Radiator fan
- 9: Radiator (bottom view)
- 10: Water pump

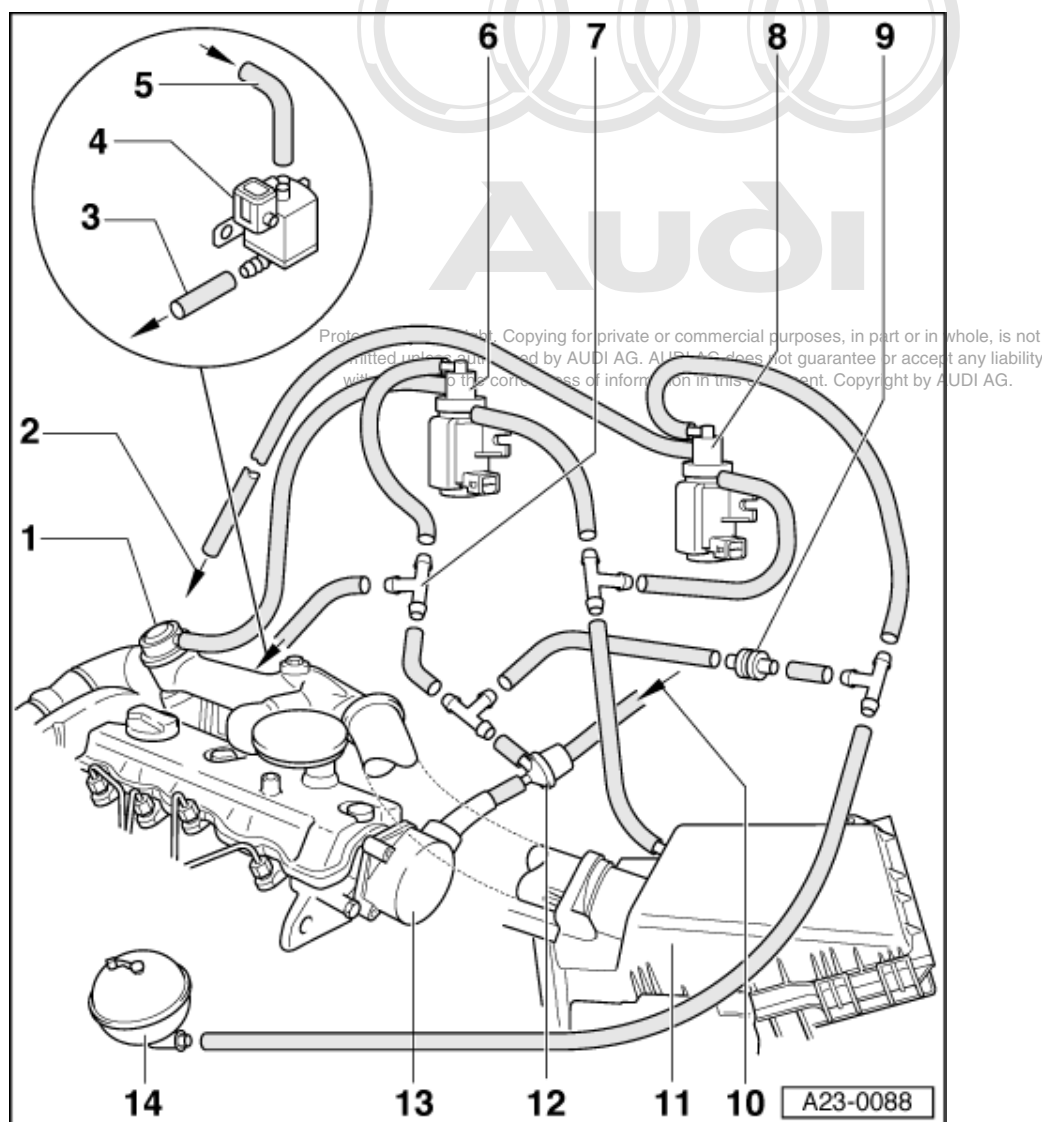
The diagram shows the engine block (1) with the water pump (10) and thermostat housing (5) installed. The thermostat (3) is shown being installed into the thermostat housing (2) with the gasket (4). The radiator (9) and radiator fan (8) are also shown.

- 1 **Mechanical EGR valve**
- 2 **To vacuum unit for intake manifold flap**
- 3 **Intake manifold flap changeover valve -N239**
  - ♦ Vehicles with intake manifold flap only
- 4 **Vacuum line**
  - ♦ From T-piece -Item 6-
- 5 **EGR valve -N18**

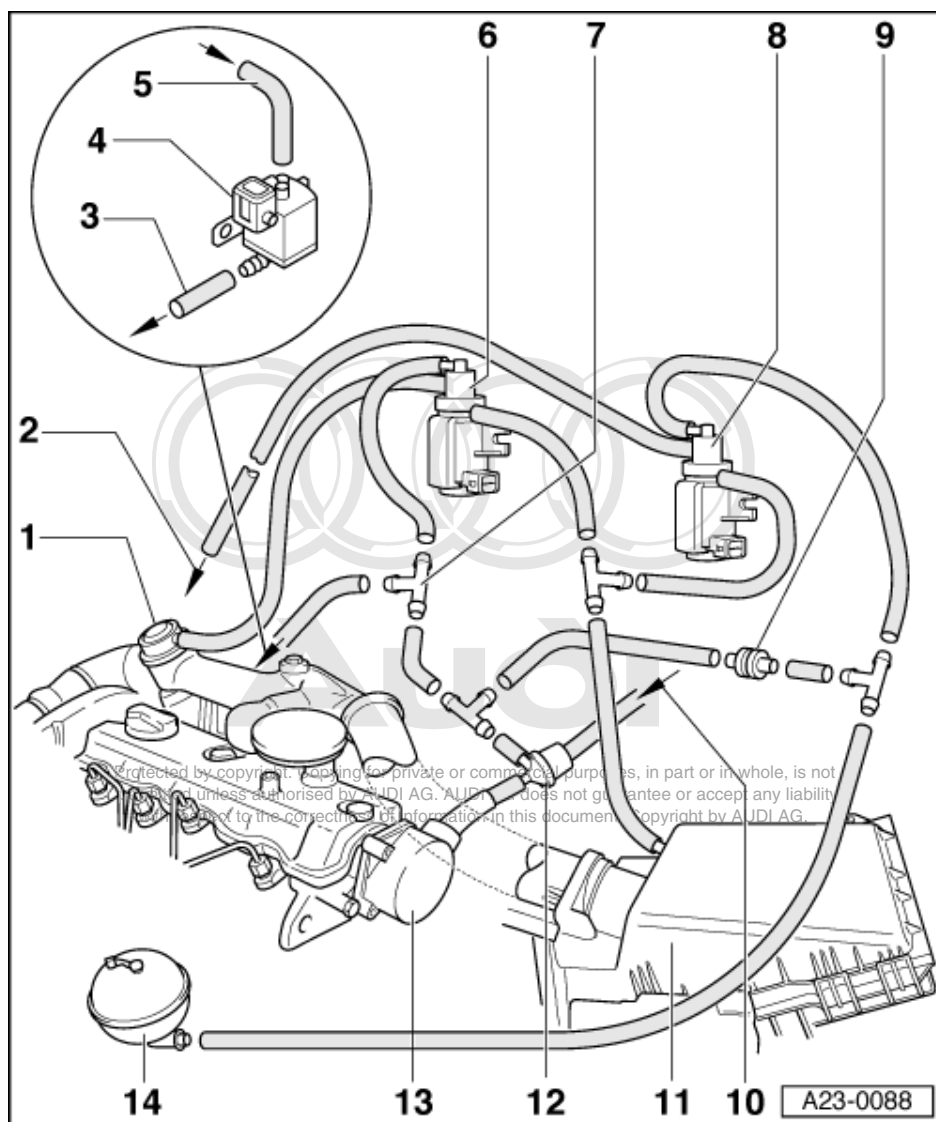


- 6 T-piece
- 7 Non-return valve
- 8 From brake servo
- 9 Air cleaner
- 10 Exhauster
  - ♦ For brake servo

## 2.4 - Exhaust gas recirculation connection diagram - engine codes ALH, AHF, ASV



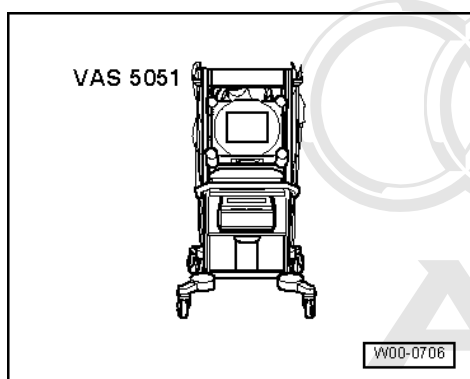
- 1 Mechanical EGR valve
- 2 To the vacuum unit for boost pressure control
  - ♦ At turbocharger
- 3 To vacuum unit for intake manifold flap
- 4 Intake manifold flap changeover valve -N239
- 5 Vacuum line
  - ♦ From T-piece -Item 7-
- 6 EGR valve -N18



- 7 T-piece
- 8 Boost pressure control solenoid valve -N75
- 9 Non-return valve
- 10 From brake servo
- 11 Air cleaner
- 12 Non-return valve
- 13 Exhauster
  - ♦ For brake servo
- 14 Vacuum reservoir

## 2.5 - Checking exhaust gas recirculation - Vehicles up to 07.99

The operation of the exhaust gas recirculation system is tested by measuring the intake air mass. If the exhaust gas is being recirculated the proportion of fresh air detected by the air mass meter is lower. The larger the quantity of recirculated exhaust gas, the lower the signal from the air mass meter.



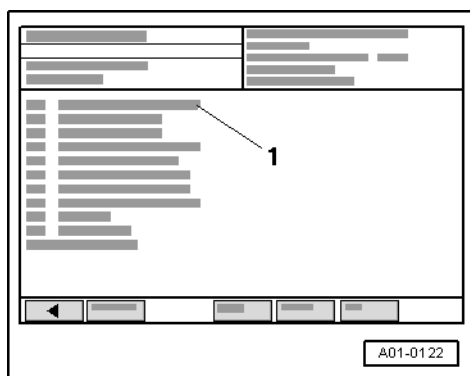
**Special tools and workshop equipment required**

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- ♦ VAS 5051 with VAS 5051/1

#### *Test requirements:*

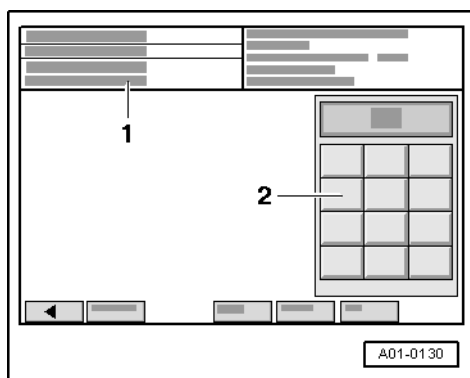
- Vehicle diagnostic, testing and information system VAS 5051 connected, vehicle self-diagnosis and vehicle system "01 - Engine electronics" selected.
- Engine running at idling speed
- Coolant temperature at least 80 °C=> display group 001, display zone 4.
- Final control diagnosis has been performed



#### **Test sequence**

-> Display on VAS 5051:

- Under -1- select the diagnostic function "08 - Read measured value block".





-> Display on VAS 5051:

1 - Enter display group  
max. input value = 255

- Enter "003" for "display group number 003" in zone -2- and confirm the entry by pressing the Q button.
- Briefly depress the accelerator pedal, then allow the engine to continue running at idling speed.

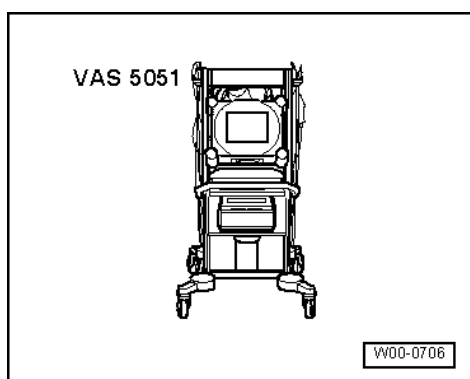
|                                                             | Display zones |                                                                                         |                                                            |                                      |
|-------------------------------------------------------------|---------------|-----------------------------------------------------------------------------------------|------------------------------------------------------------|--------------------------------------|
|                                                             | 1             | 2                                                                                       | 3                                                          | 4                                    |
| <b>Display group 003: Exhaust gas recirculation at idle</b> |               |                                                                                         |                                                            |                                      |
| <b>Display</b>                                              | xxxx rpm      | xxx mg/stroke                                                                           | xxx mg/stroke                                              | xx %                                 |
| <b>Display</b>                                              | Engine speed  | Air mass (specified)                                                                    | Air mass (actual)                                          | Checking actuation of EGR valve -N18 |
| <b>Specified value</b>                                      | 860...940 rpm | 230...370 mg/stroke                                                                     | 210...390 mg/stroke                                        | 30...80 %                            |
| <b>Note:</b>                                                |               | If a value higher than 370 mg/stroke is displayed:<br>Engine too cold => run until warm | If specified value is not attained: Evaluation => Page 242 |                                      |

#### Evaluation of display group 003

| Display zone: 3            | Possible causes of fault                                                                                                                                                                               | Fault remedy                                                                                                                                                                                                                                                                                                                            |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Constant<br>425 mg/stroke  | - Open circuit in wiring to air mass meter<br>- Air mass measured not plausible                                                                                                                        | - Testing air mass meter<br>=> Diesel Direct Injection and Glow Plug System (4-cyl TDI) > 07.99; Repair group 23<br>=> TDI-Injection- and Glow Plug System(4-cyl.) 08.99 >; Repair group 23                                                                                                                                             |
| Over<br>390 mg/stroke      | - Engine has been running for 10 min at idling speed<br>- Excessive exhaust gas recirculation<br>- Engine load from ancillaries<br>- Intake manifold temperature too high<br>- Injection pump too lean | - Briefly depress accelerator sharply<br>- Checking mechanical exhaust gas recirculation valve => Page 246<br>- Eliminate load (AC system/power steering/alternator)<br>=> Diesel Direct Injection and Glow Plug System (4-cyl TDI) > 07.99; Repair group 01<br>=> TDI-Injection- and Glow Plug System(4-cyl.) 08.99 >; Repair group 23 |
| Less than<br>210 mg/stroke | - Unmetered air in intake area<br>- Excessive exhaust gas recirculation                                                                                                                                | - Check intake are for leaks<br>- Checking mechanical exhaust gas recirculation valve => Page 246                                                                                                                                                                                                                                       |

## 2.6 - Checking exhaust gas recirculation - Vehicles as of 08.99

Checking the exhaust gas recirculation function is carried out in function "Basic setting". With this procedure the valve for the exhaust gas recirculation is pulsed every 10 seconds so that the extreme values for the exhaust gas recirculation (air mass meter) can be read in the display group 003.



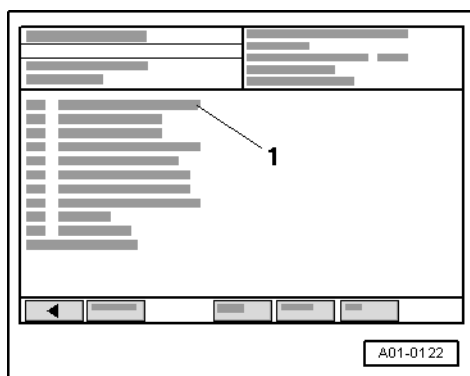
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### Special tools and workshop equipment required

- ♦ VAS 5051 with VAS 5051/1

### Test requirements:

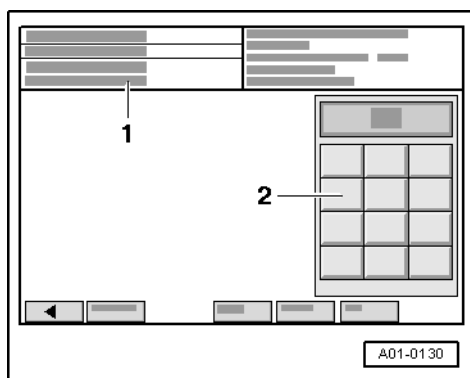
- Vehicle diagnostic, testing and information system VAS 5051 connected, vehicle self-diagnosis and vehicle system "01 - Engine electronics" selected.
- Engine running at idling speed
- Coolant temperature at least 80 °C=> display group 001, display zone 4.
- Final control diagnosis has been performed



### Test sequence

-> Display on VAS 5051:

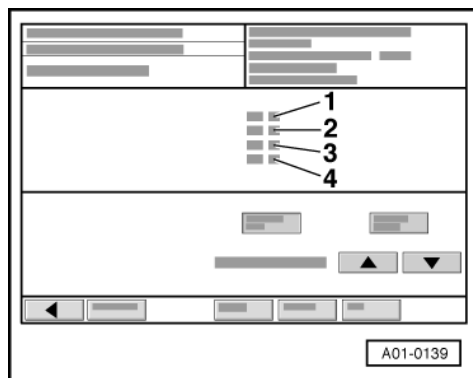
- Under -1- select the diagnostic function "04 - Basic setting".





-> Display on VAS 5051:

- 1 - Enter display group  
max. input value = 255
- Enter "003" for "display group number 003" in zone -2- and confirm the entry by pressing the Q button.
  - The idling speed is increased to 1380 ... 1420 rpm.



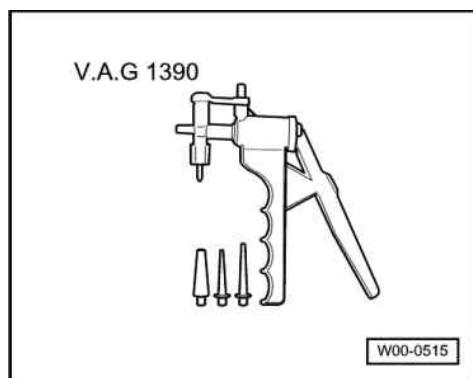
-> Display on VAS 5051:

- Check display in display zone 2.
  - Specified value: Display "EGR not active" or "EGR active" alternating every 10 seconds
- Check display in display zone 3.
  - Specified value: Display for intake air mass "... mg/stroke" must change clearly every 10 seconds
- Check display in display zone 4.
  - Specified value: Display for intake air mass "... mg/stroke" must change clearly every 10 seconds

If the specified values are not obtained:

- Check the mechanical EGR valve => Page 244 .
- Check vacuum pressure hose connection => Page 237
- Checking exhaust gas recirculation valve -N18 => Page 246
- Exit the function "04 - Basic setting" by pressing the ◀ key.

## 2.7 - Checking mechanical EGR valve

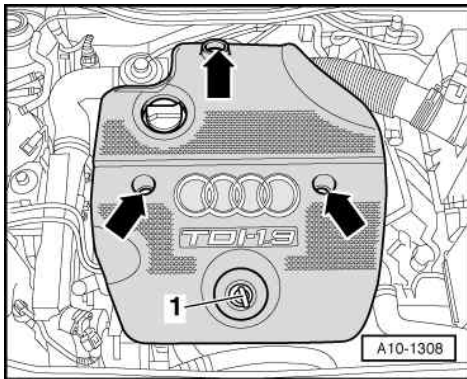


### Special tools and workshop equipment required

- ♦ Vacuum hand pump V.A.G 1390

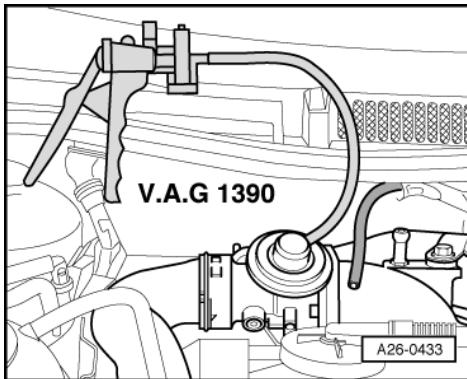


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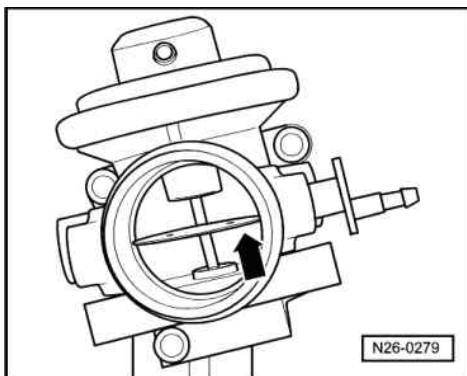


### Test sequence

- -> Remove oil dipstick -1- from guide tube.
- Unclip caps.
- Unscrew nuts -arrows- and remove engine cover.
- Reinsert oil dipstick in guide tube.



- Pull vacuum hose off mechanical EGR valve.
- -> Connect hand vacuum pump V.A.G 1390 to valve.
- Actuate hand vacuum pump.
- Pull hand vacuum pump hose off exhaust gas recirculation valve.
  - The valve must be clearly heard to close. The diaphragm rod moves towards intake manifold

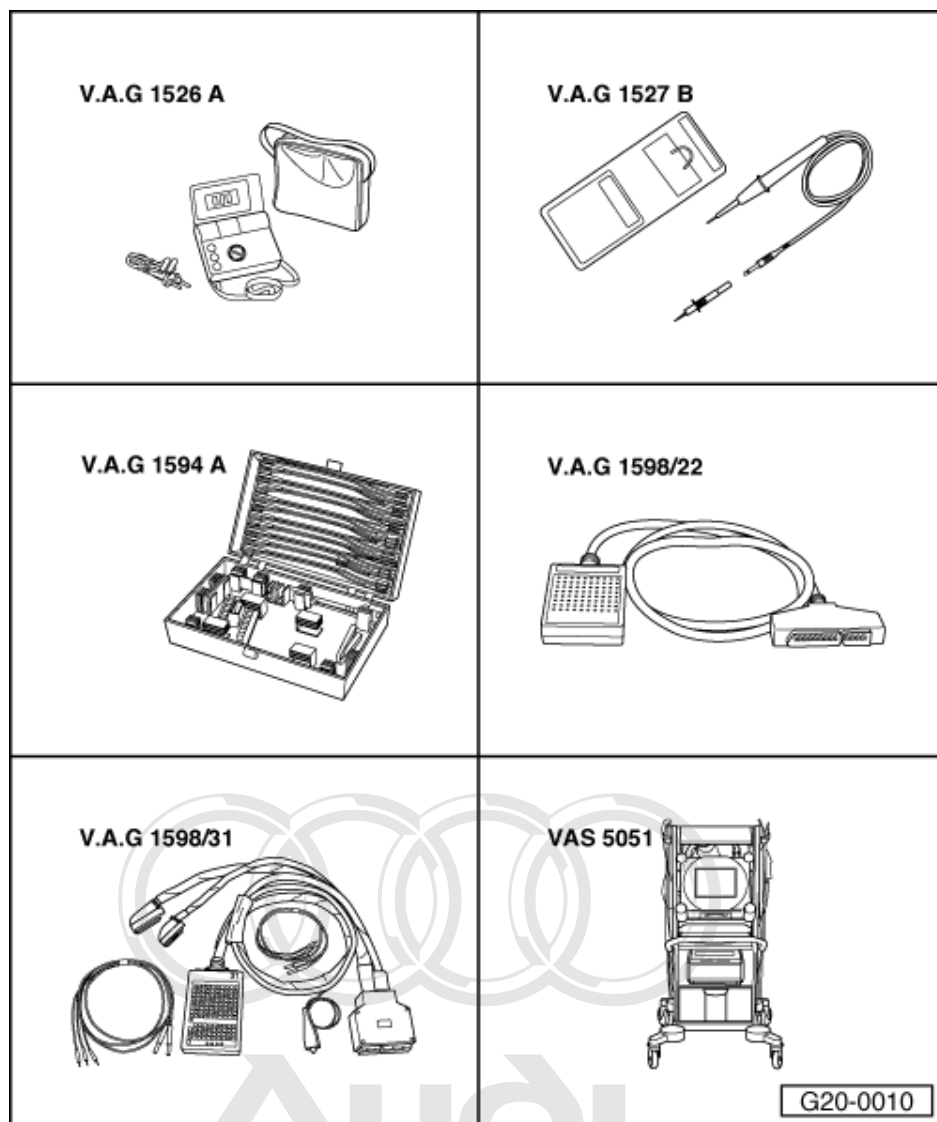


### Note:

-> When air duct hose is removed the movement of the membrane rod in the intake manifold can be observed.



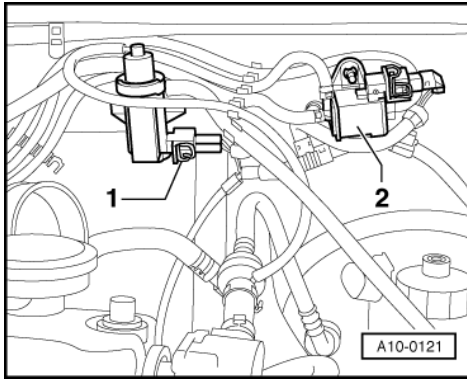
## 2.8 - Checking EGR valve -N18



### Special tools and workshop equipment required

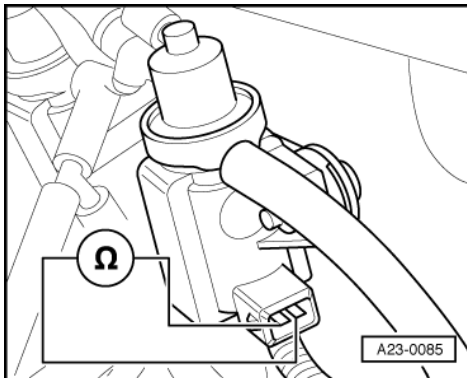
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- ♦ V.A.G 1526 A
- ♦ V.A.G 1527 B
- ♦ V.A.G 1594 A
- ♦ V.A.G 1598/22  
(vehicles up to 07.99)
- ♦ V.A.G 1598/31  
(Vehicles as of 08.99)
- ♦ VAS 5051 with VAS 5051/1



### Checking internal resistance

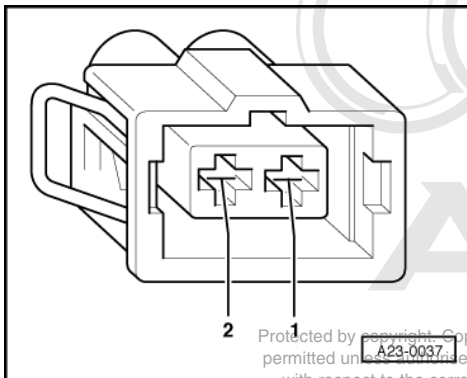
- -> Disconnect the exhaust gas recirculation valve electrical connection -N18 -Item 1-.



- -> Connect multimeter between contacts 1 and 2 to measure resistance.
- Specified value: 14 ... 20  $\Omega$

If specified value is not attained:

- Replace the exhaust gas recirculation valve -N18.



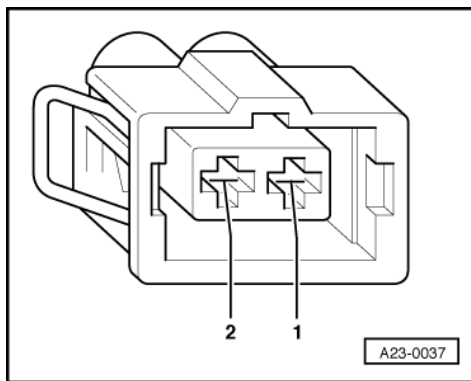
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### Checking power supply

- -> Connect multimeter between contact 2 and earth to measure voltage.
- Switch the ignition on.
  - Specified value: approx. battery voltage

If specified value is not attained:

- Check wiring for open circuit and service if necessary.



### Checking actuation

#### Test requirements:

- Vehicle diagnostic, testing and information system VAS 5051 connected, vehicle self-diagnosis and vehicle system "01 - Engine electronics" selected.
- -> Connect voltage tester V.A.G 1527 B between contacts 1 and 2.



-> Display on VAS 5051:

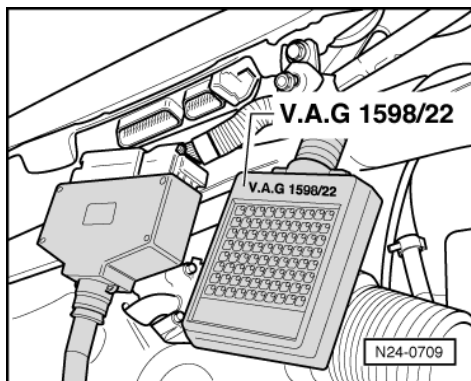
- Under -1- select the diagnostic function "03 - Final control diagnosis".
- Actuate the EGR valve -N18.
  - The LED must flash slowly.

#### Note:

*Voltage testers with a low current consumption continue to glow faintly between actuation from the engine control unit (rather than extinguishing completely) and become much brighter when actuated.*

- Exit the function "03 - Final control diagnosis" by pressing the ◀ key.
- Press "06 - End of output".

If the LED lamp does not react as described:



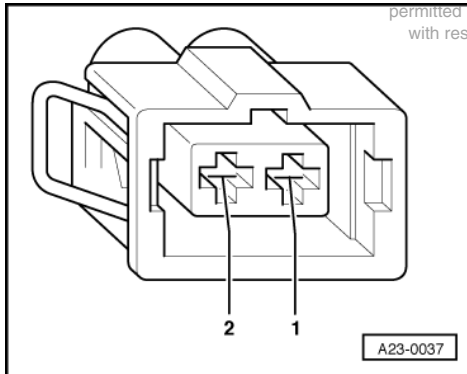
### Checking actuation - Vehicles up to 07.99

- -> Connect the test box V.A.G 1598/22 to wiring harness connectors; the engine control unit must not be connected.

=> Diesel Direct Injection and Glow Plug System (4-cyl TDI) > 07.99; Repair group 23; Wiring and component check using test box V.A.G 1598/22 Wiring and component check using test box V.A.G 1598/22

#### Important

To prevent damage to the electronic components, select appropriate measuring range before connecting the measuring cables and observe the test requirements.

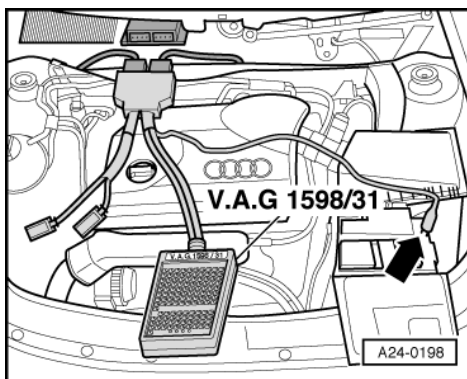


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- -> Check for open circuit and short to positive or earth in the following wiring connection:

| Connector Contact | Test box V.A.G 1598/22 Socket |
|-------------------|-------------------------------|
| 2                 | 29                            |

- Rectify any open/short circuit as necessary.



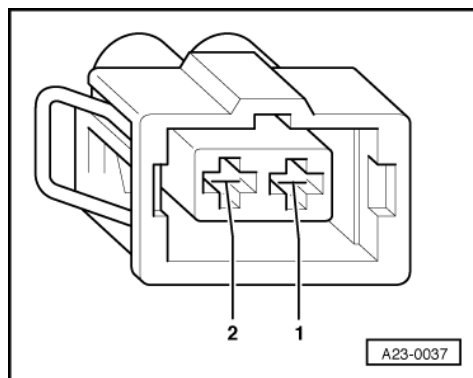
### Checking actuation - Vehicles as of 08.99

- -> Connect the V.A.G 1598/31 test box to wiring harness connectors; the engine control unit should not be connected. Attach the earth clip of test box to earth -arrow-.

=> TDI Injection and Glow Plug System (4-cyl.) 08.99 >; Repair group 23; Wiring and component check using test box V.A.G 1598/31 Wiring and component check using test box V.A.G 1598/31

#### Important

To prevent damage to the electronic components, select appropriate measuring range before connecting the measuring cables and observe the test requirements.



- -> Check for open circuit and short to positive or earth in the following wiring connection:

| Connector<br>Contact | Test box V.A.G 1598/31<br>Socket |
|----------------------|----------------------------------|
| 2                    | 61                               |

- Rectify any open/short circuit as necessary.



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