

## Workshop Manual Audi A3 2004 ➤

4-cylinder TDI unit injector engine (1.9 ltr. 2-valve),  
mechanics

|           |     |     |  |  |  |  |  |  |  |
|-----------|-----|-----|--|--|--|--|--|--|--|
| Engine ID | BKC | BXE |  |  |  |  |  |  |  |
|-----------|-----|-----|--|--|--|--|--|--|--|

Edition 09.2012



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## List of Workshop Manual Repair Groups

### Repair Group

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10 - Removing and installing engine

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15 - Cylinder head, valve gear

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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 2004 ►

4-cylinder TDI unit injector engine (1.9 ltr. 2-valve), mechanics - Edition 09.2012

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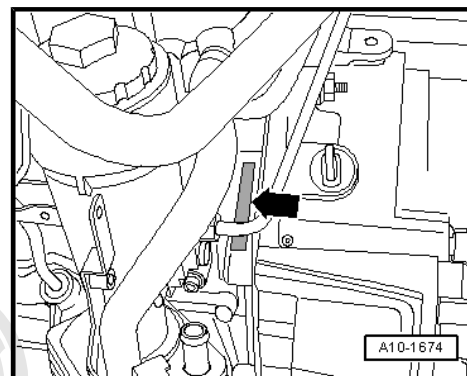
## 00 – Technical data

### 1 Technical data

(ARL002986; Edition 09.2012)

#### 1.1 Engine number

- ◆ The engine number ("Engine code" and "Serial number") can be found at the front of the joint between engine and gearbox.
- ◆ Additionally there is a sticker on the toothed belt cover showing the "engine code" and "serial number".
- ◆ The engine code is also included on the vehicle data sticker.



#### 1.2 Engine data

| Code letters                |           | BKC      | BXE      |
|-----------------------------|-----------|----------|----------|
| Capacity                    | ltr.      | 1.896    | 1.896    |
| Power output                | kW at rpm | 77/4000  | 77/4000  |
| Torque                      | Nm at rpm | 250/1900 | 250/1900 |
| Bore                        | Ø mm      | 79.5     | 79.5     |
| Stroke                      | mm        | 95.5     | 95.5     |
| Compression ratio           |           | 19.0     | 19.0     |
| CN                          | at least  | 49       | 49       |
| Firing order                |           | 1-3-4-2  | 1-3-4-2  |
| Exhaust gas recirculation   |           | yes      | yes      |
| Turbocharging/supercharging |           | yes      | yes      |
| Charge air cooling          |           | yes      | yes      |

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## 2 General repair instructions

### 2.1 Rules for cleanliness

Even small amounts of dirt can cause malfunctions. For this reason, when working on the turbocharger or the fuel supply system and injection system, please observe the following basic rules carefully:

- ◆ Carefully clean connection points and the surrounding area with engine cleaner or brake cleaner and dry thoroughly before opening.
- ◆ Plug open lines and connections with suitable protective caps immediately.
- ◆ Place parts that have been removed on a clean surface and cover them over. Do not use fluffy cloths.
- ◆ Only install clean components; replacement parts should only be unpacked immediately prior to installation. Do not use parts that have been previously unpacked and stored away loose (e.g. in toolboxes, etc.).
- ◆ When the system is open: Do not work with compressed air. Do not move the vehicle unless absolutely necessary.

### 2.2 Checking for leaks in the fuel system

- Start the engine and let it run at medium speed for a few minutes.
- Switch off ignition.
- Check the entire fuel system for leaks.
- If leaks are found although the connections have been tightened to the correct torque, the relevant component must be renewed.
- Then road-test the vehicle (accelerate with full throttle at least once).
- Then check high-pressure part of fuel system again for leakage.

### 2.3 Contact corrosion!

Contact corrosion can occur if unsuitable fasteners are used (e.g. bolts, nuts, washers, etc.).

For this reason, only fasteners with a special surface coating are used.

Additionally, all rubber and plastic parts and all adhesives are made of non-conductive materials.

Always install new parts if you are not sure whether used parts can be re-fitted ⇒ Parts catalogue .

**Note the following:**

- ◆ We recommend using only genuine replacement parts; these have been tested and are compatible with aluminium.
- ◆ We recommend the use of Audi accessories.
- ◆ Damage caused by contact corrosion is not covered under warranty.

### 3 Safety precautions

When working on the fuel system note the following warnings:



#### WARNING

*The fuel can become extremely hot. This can cause injuries.*

- ◆ *In extreme cases the fuel lines and the fuel can reach a temperature of 100 °C on vehicles with unit injector engine. Allow the fuel to cool down before disconnecting the lines - danger of scalding.*
- ◆ *Wear protective gloves.*
- ◆ *Wear safety goggles.*

Observe the following points to prevent personal injuries and damage to the injection and glow plug system:

- ◆ Always switch off the ignition before connecting or disconnecting tester cables or electrical wiring for the injection or glow plug system.
- ◆ Always switch off ignition before washing engine.
- ◆ Faults are stored in engine control unit if electrical connectors have been unplugged:
  - Connect vehicle diagnostic, testing and information system - VAS 5051B- .
  - Start “Self-diagnosis” mode.
  - Interrogate and erase fault memory of engine control unit.



#### Caution

*To prevent irreparable damage to the electronic components when disconnecting the battery:*

- ◆ *Observe notes on procedure for disconnecting the battery.*
- ◆ *Always switch off the ignition before disconnecting the battery.*

When working on the cooling system note the following warnings:



#### WARNING

*Hot steam/hot coolant can escape - risk of scalding.*

- ◆ *The cooling system is under pressure when the engine is hot.*
- ◆ *To allow pressure to dissipate, cover filler cap on expansion tank with cloth and open carefully.*



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



**WARNING**

*Persons sitting in the front passenger's seat could be seriously injured if the airbag is triggered.*

- ◆ *Test equipment must always be secured on the rear seat and operated from that position by a second person.*
- ◆ *If test and measuring instruments are operated from front passenger's seat and the vehicle is involved in an accident, the person sitting in this seat could be seriously injured when the airbag is triggered.*



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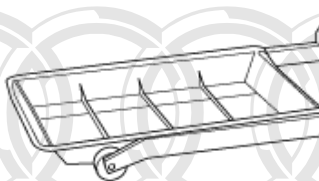
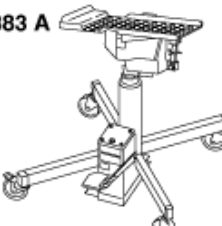
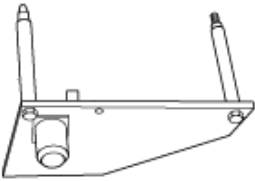
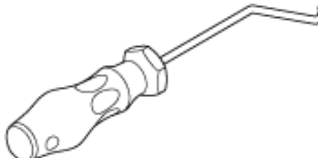
## 10 – Removing and installing engine

### 1 Removing and installing engine

#### 1.1 Removing engine

##### Special tools and workshop equipment required

- ◆ Drip tray for workshop hoist -VAS 6208- or -V.A.G 1306-
- ◆ Engine and gearbox jack -V.A.G 1383 A-
- ◆ Hose clip pliers -V.A.G 1921-
- ◆ Stepladder -VAS 5085-
- ◆ Engine bracket -T10012-
- ◆ Assembly tool -T10118-

|                                                                                                              |                                                                                                                                                       |
|--------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>V.A.G 1306</b></p>    | <p><b>V.A.G 1383 A</b></p>                                         |
| <p><b>V.A.G 1921</b></p>  | <p><b>VAS 5085</b></p>                                            |
| <p><b>T 10012</b></p>     | <p><b>T10118</b></p>  <p style="text-align: right;">G10-0080</p> |

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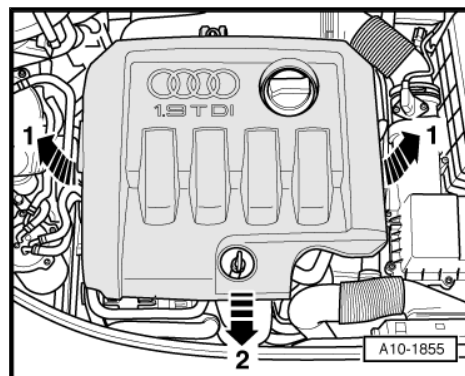
##### Procedure



##### Note

- ◆ *The engine is removed from underneath together with the gearbox.*
- ◆ *Collect drained coolant in a clean container for re-use or disposal.*

- Lift engine cover panel at sides -arrows 1- and pull off towards front -arrow 2-.

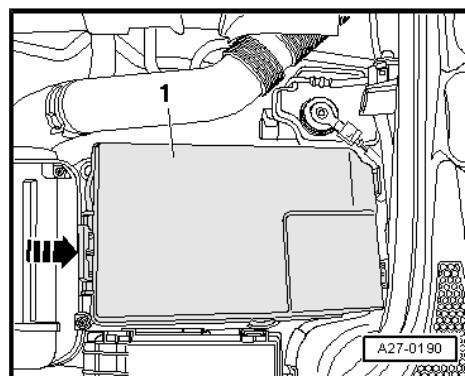


- Remove cover -1- over battery; to do so, press release tab -arrow-.



### Caution

*Observe notes on procedure for disconnecting the battery ⇒ Rep. gr. 27.*

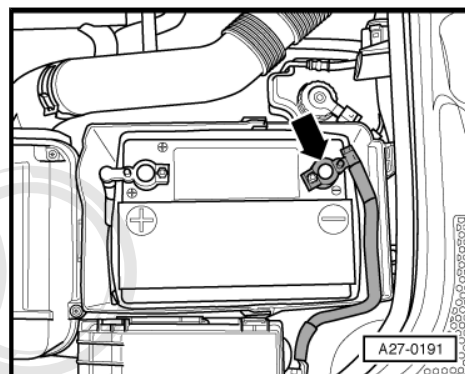


- With ignition switched off, disconnect battery earth cable -arrow-.



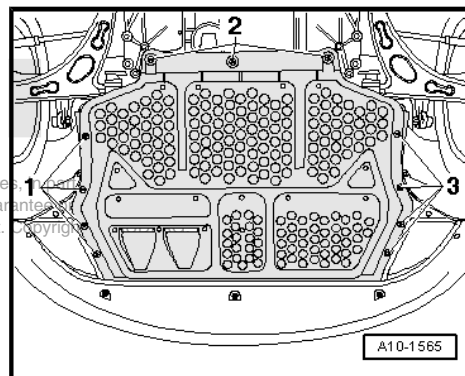
### WARNING

*Hot steam or hot coolant can escape when expansion tank is opened; cover filler cap with cloth and open carefully.*



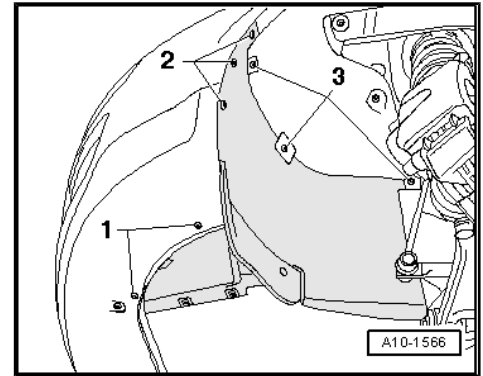
- Open filler cap on coolant expansion tank.

- Remove both front wheels.
- Remove centre noise insulation -fasteners 1 ... 3-.

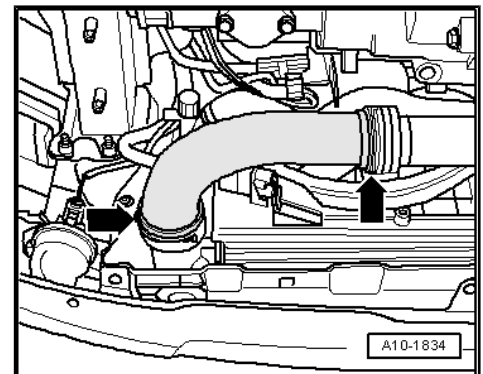


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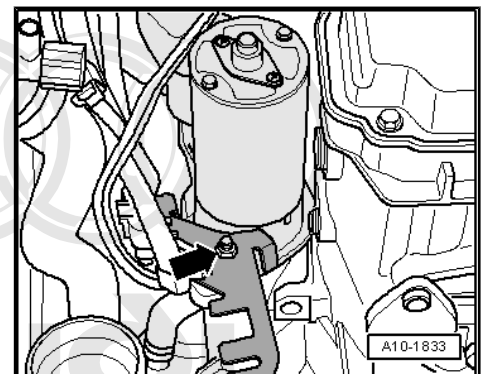
- Remove noise insulation (left and right) -fasteners 1 ... 3-



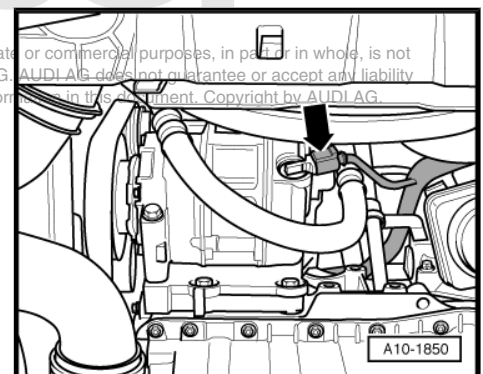
- Remove air intake hose (left-side) by lifting retaining clips -arrows- slightly.



- Unscrew nut -arrow- and remove bracket for electrical wiring from stud.

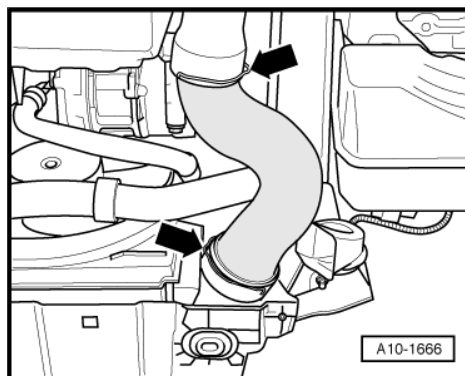


- Unplug electrical connector -arrow- for magnetic clutch of air conditioner compressor.

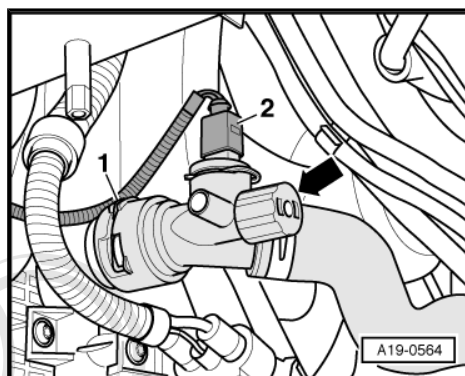


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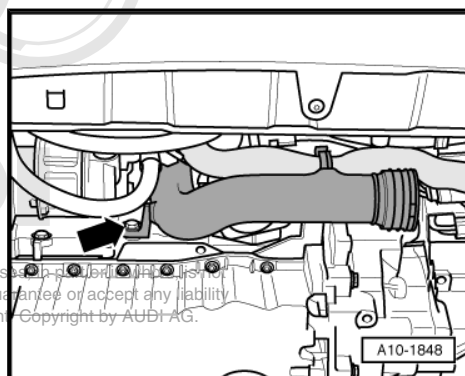
- Remove air intake hose (right-side) by lifting retaining clips -arrows- slightly.



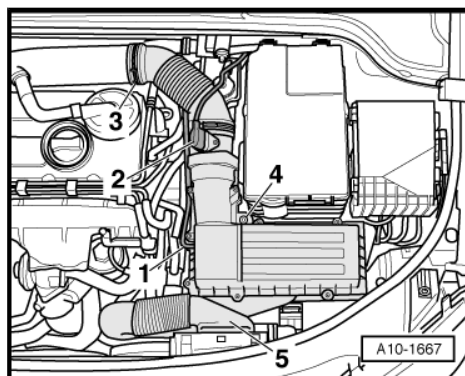
- Unplug electrical connector -2- from coolant temperature sender - radiator outlet -G83- .
- Place drip tray for workshop hoist -VAS 6208- under engine.
- Turn drain plug -arrow- on radiator anti-clockwise, if necessary fit drain hose to connection.
- Detach lower coolant hose -1-; to do so, pull out retaining clip.



- Remove securing bolt -arrow- for front air pipe.

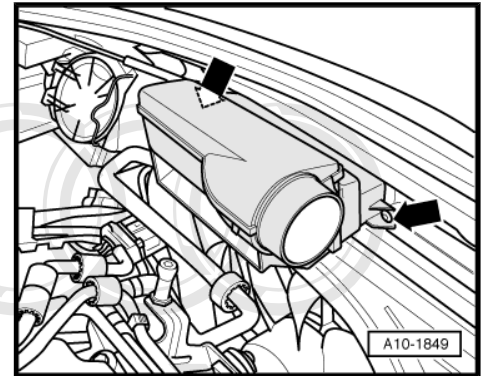


- Unplug electrical connector -2- at air mass meter -G70- .
- Detach vent hose -1- and air hoses -3- and -5-.
- Unscrew bolt -4- and remove air cleaner housing.

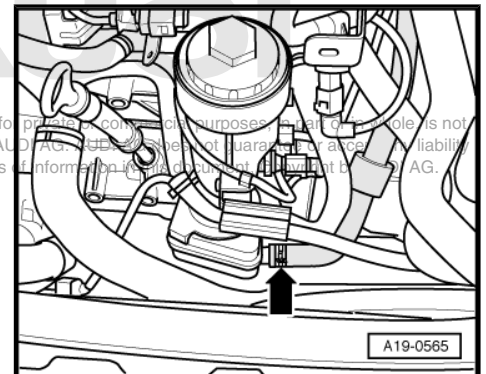


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- Unscrew air duct at lock carrier -arrows-.

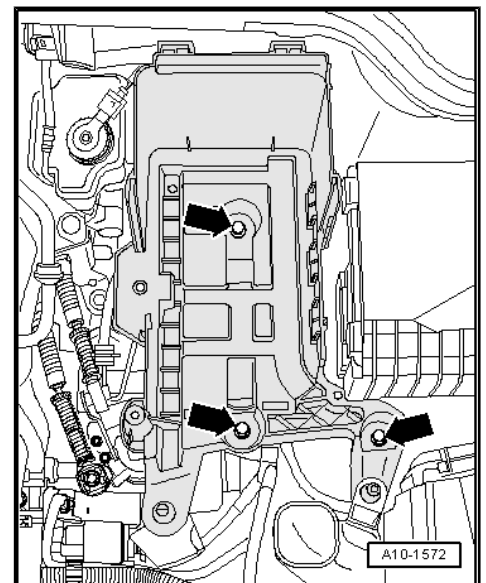


- Disconnect coolant hose at bottom of oil cooler -arrow- and drain off remaining coolant.

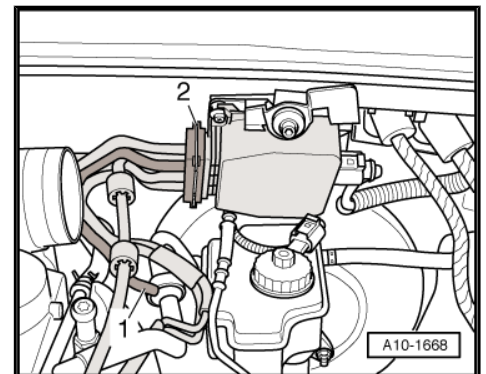


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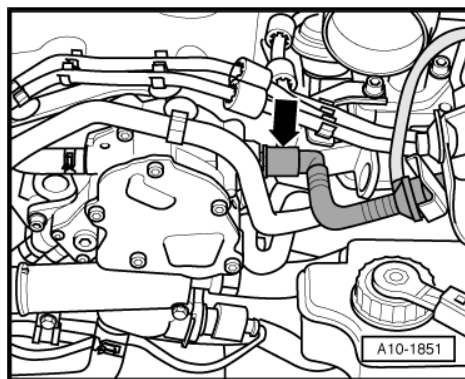
- Remove battery ⇒ Rep. gr. 27 .
- Remove battery tray -arrows-.



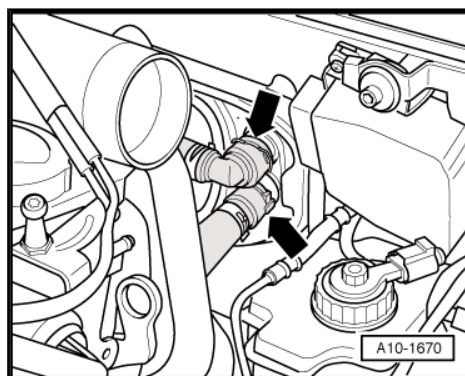
- Detach hose connection carrier -2- at solenoid valve block by releasing retaining tab.
- Detach vacuum hose -1- at non-return valve for brake servo.



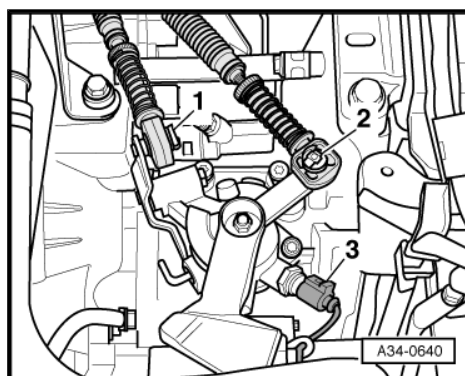
- Detach vacuum hose -arrow- going to brake servo at tandem pump.



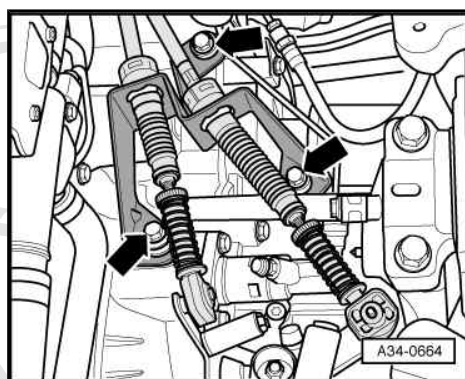
- Detach coolant hoses going to the heat exchanger at bulkhead -arrows-.



- Unclip securing clips -1- and -2- on both selector cables.
- Pull off selector cable end-pieces from gearbox selector lever and relay lever.
- Unplug electrical connector -3- at reversing light switch -F4-.



- Remove selector cable support bracket -arrows- from gearbox and place to one side.

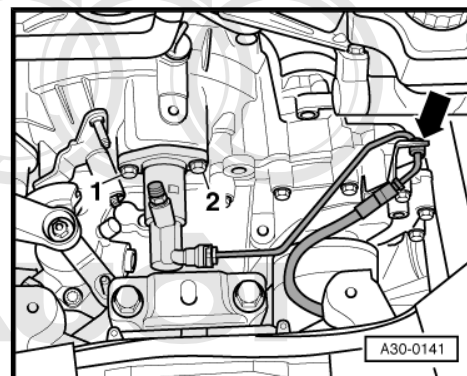


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- Remove bolts -1- and -2-.
- Disengage retainer -arrow- and place slave cylinder to one side (do not open system).

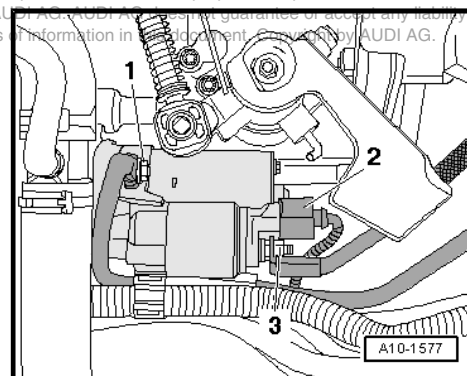
**Caution**

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

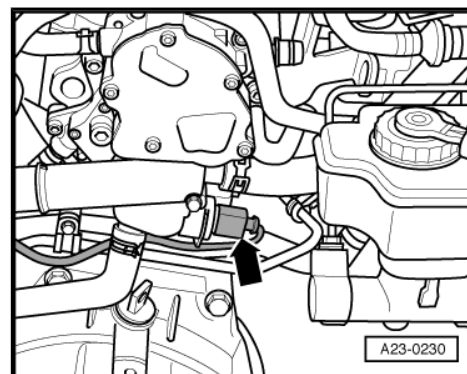


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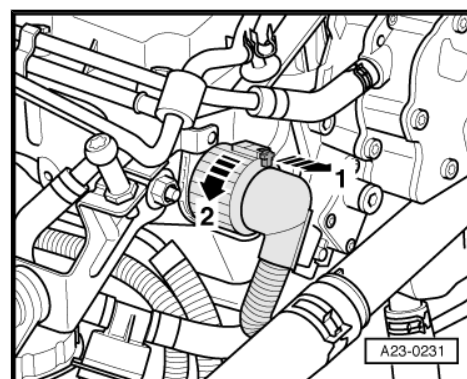
- Disconnect earth cable -1-.
- Detach wires -2- and -3- at starter.
- Move wiring clear.



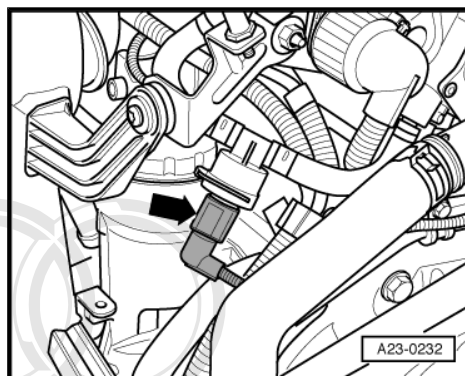
- Unplug electrical connector -arrow- at coolant temperature sender -G62-.



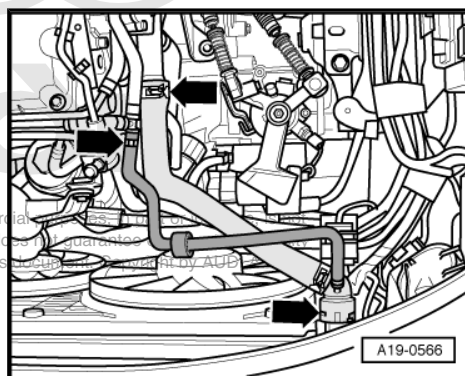
- Pull the release pin -arrow 1- and unscrew knurled nut -arrow 2-.
- Disconnect main connector for unit injectors and move wiring harness clear.



- Detach electrical connector -arrow- at fuel temperature sender -G81- and move wire clear.



- Remove coolant hose between engine and radiator -arrows-.



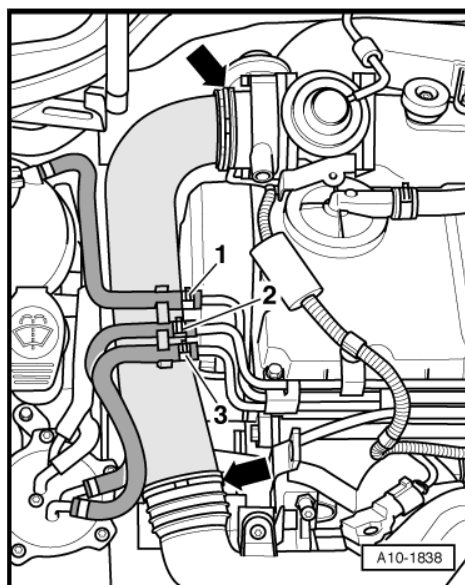
- Detach coolant hose -1- and move clear.



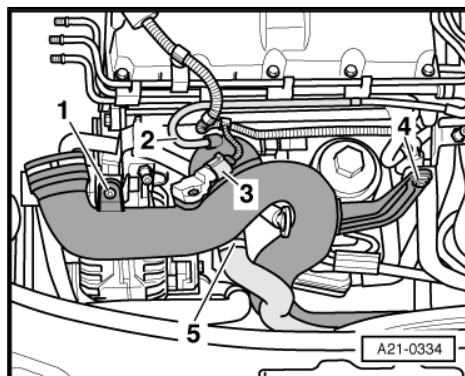
# WARNING

- ◆ *In extreme cases the fuel lines and the fuel can reach a temperature of 100 °C on vehicles with unit injector engine. Allow the fuel to cool down before disconnecting the lines - danger of scalding.*
- ◆ *Wear protective gloves.*
- ◆ *Wear safety goggles.*

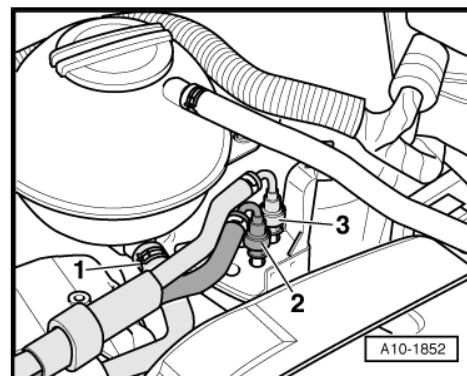
- Disconnect fuel supply line -3- and fuel return line -2- and move lines clear.
- Remove air pipe by lifting retaining clips -arrows- slightly.



- Detach vacuum pipe -2- at vacuum reservoir.
- Unplug electrical connector -3- at charge pressure sender -G31-.
- Detach coolant hose -5-.
- Unscrew bolts -1- and -4- and remove air pipe together with coolant hose.

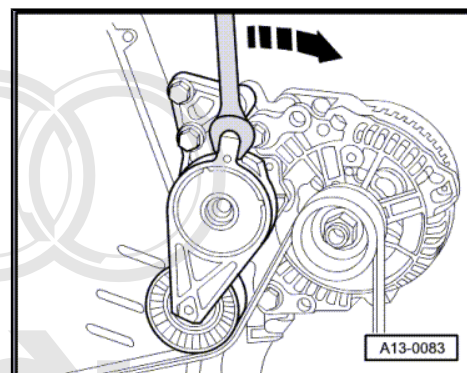


- Disconnect fuel supply line -3- and fuel return line -2- by pulling release tabs.
- Disconnect coolant hose -1- at expansion tank.

**Note**

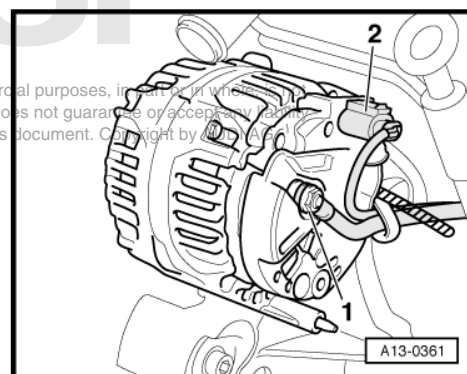
*Before removing, mark direction of rotation of poly V-belt with chalk or felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.*

- To slacken the poly V-belt, turn the tensioner in the direction of the -arrow-.
- Remove poly V-belt.



- Unplug electrical connector -2-.
- Unscrew wire -1- at alternator.
- Unscrew wire clamp on alternator.

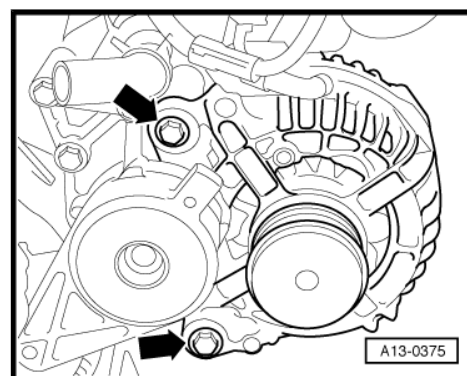
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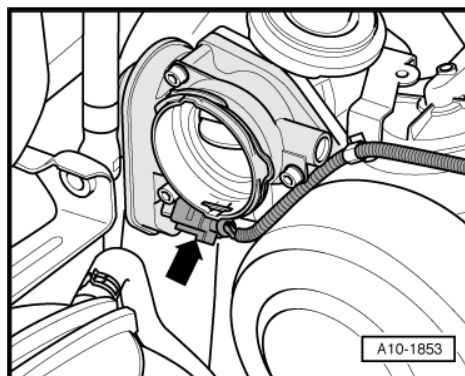
- Unscrew bolts -arrows- and remove alternator.

**Note**

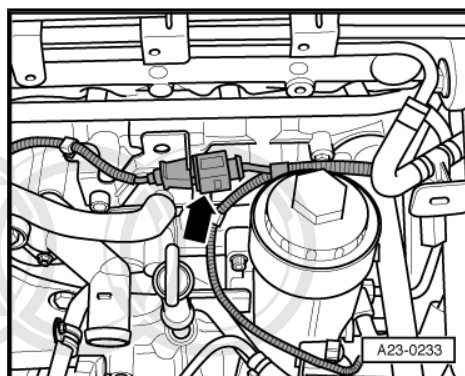
- ◆ *If alternator sticks in its bracket, screw bolt back in again down to the last 2 turns.*
- ◆ *Tap carefully on bolt heads with flat side of hammer to release bushes of alternator mountings.*



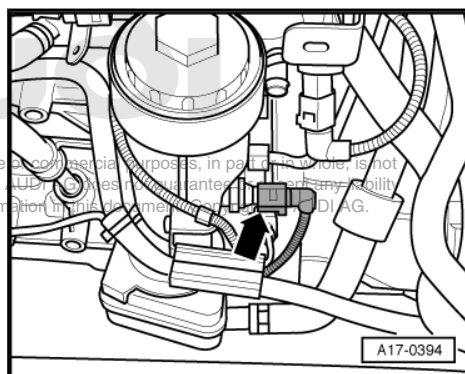
- Detach electrical connector -arrow- at intake manifold flap motor -V157- .



- Remove electrical connector -arrow- for Hall sender -G40- from bracket and unplug.



- Unplug electrical connector -arrow- at oil pressure switch -F1- .
- Unscrew oil pressure switch.



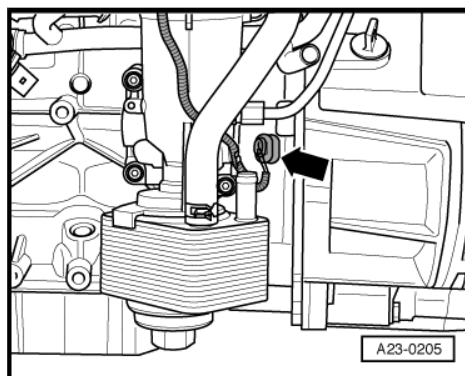
- Unplug electrical connector -arrow- at engine speed sender -G28- using assembly tool -T10118- .



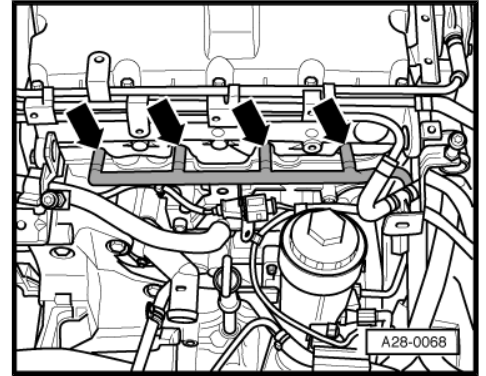
### Note

*To release electrical connector without assembly tool -T10118-, press connector on engine speed sender in with a screwdriver and at the same time lift release tab with a thin wire hook.*

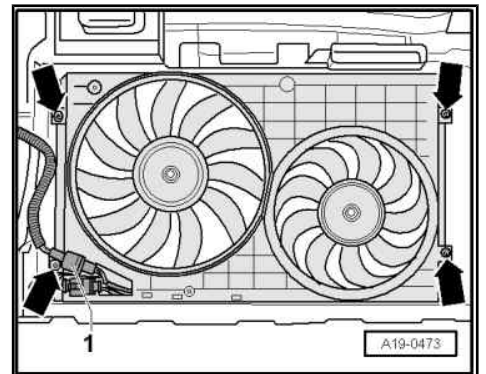
- Move wire clear.



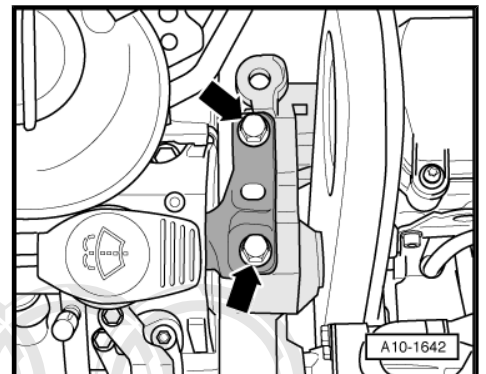
- Detach connector rail from glow plugs -arrows-.
- Set aside wiring harness leading to body.



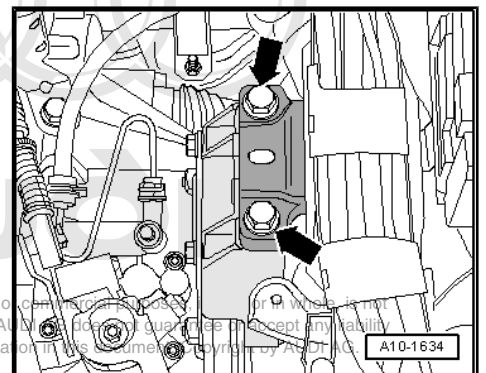
- Unscrew upper securing bolts -upper arrows- for radiator cowl.



- Loosen bolts of assembly mounting at engine -arrows- approx. 2 turns.

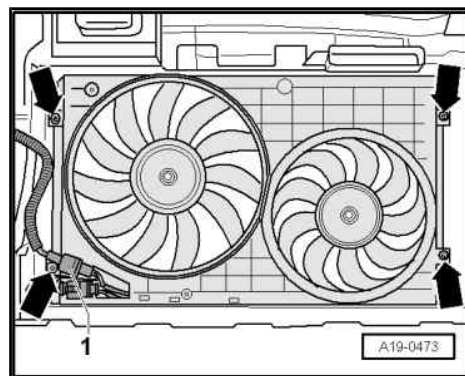


- Loosen bolts of assembly mounting at gearbox -arrows- approx. 2 turns.



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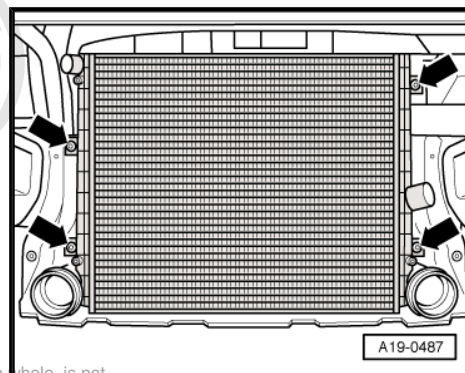
- Unplug electrical connector -1-.
- Unscrew lower securing bolts -lower arrows- for radiator cowl and remove it from below.



- Unscrew bolts -arrows- on backside of radiator.
- Lift up radiator slightly and remove from below.


**WARNING**

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

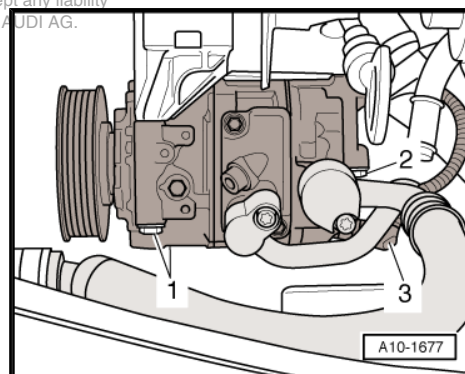


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**Note**

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

- Unscrew bolts -1- and -2- for air conditioner compressor.
- Tie air conditioner compressor up to lock carrier.


**Note**

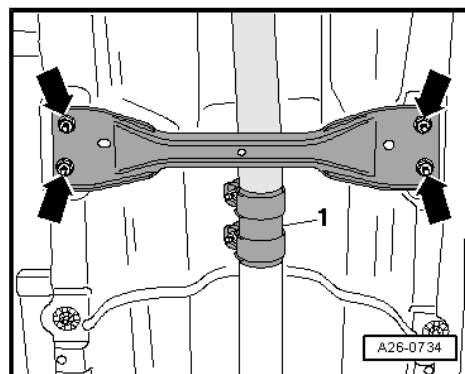
*Disregard -item 3-.*

- Remove front cross-piece for underbody -arrows-.

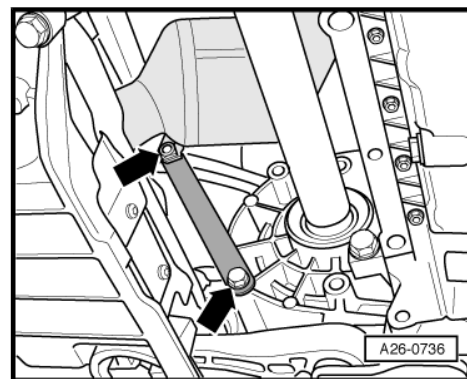

**Note**

*To avoid damage, the flexible joints in the front exhaust pipe must not be bent more than 10°.*

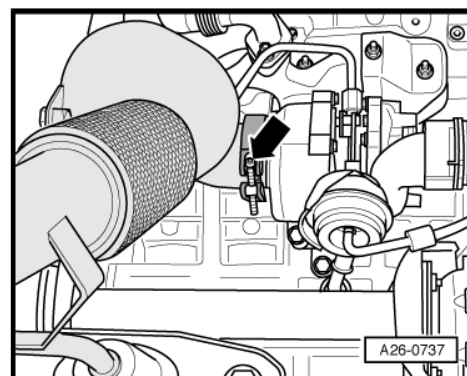
- Loosen nuts on clamp -1-.



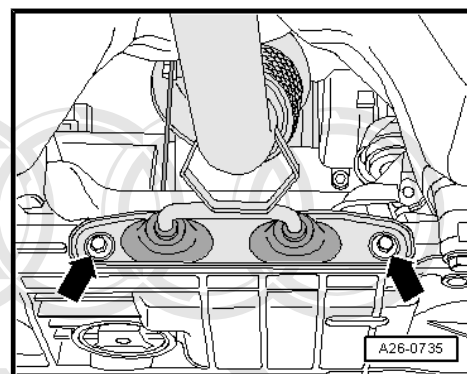
- Unbolt support for front exhaust pipe -arrows-.



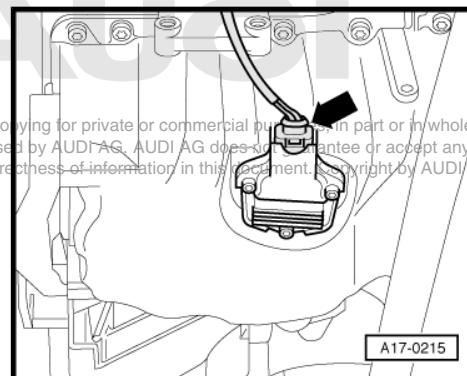
- Open clamp -arrow- and detach front exhaust pipe from turbocharger.



- Unbolt bracket for exhaust system -arrows-.
- Push the clamp back and remove the front exhaust pipe.

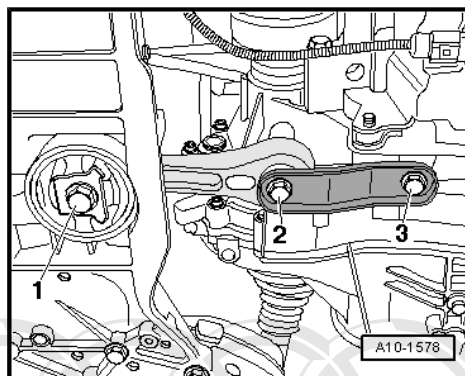


- Unplug electrical connector -arrow- at oil level and oil temperature sender -G266-.
- Unclip bracket for electrical wire at subframe.

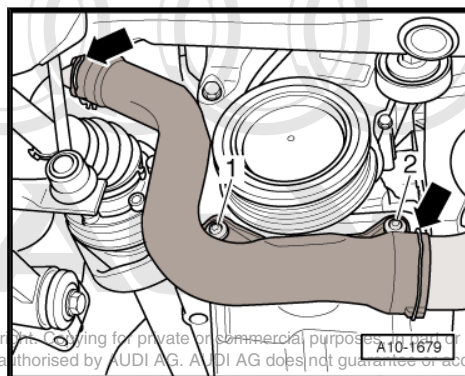


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- Unscrew bolts -1 ... 3- and remove pendulum support.

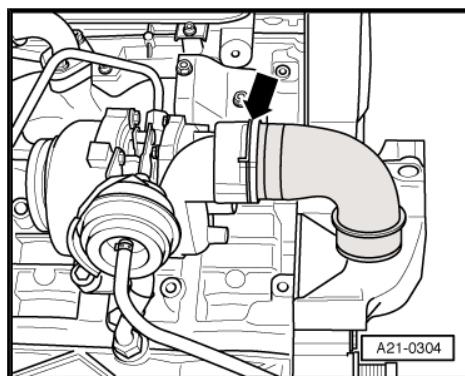


- Remove bolts -1- and -2-.
- Remove air pipe (right-side) by lifting retaining clips -arrows- slightly.

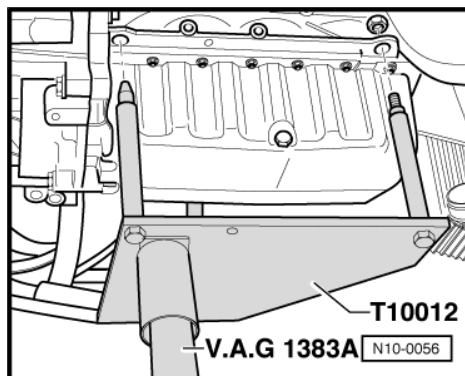


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- Detach air intake hose from turbocharger by lifting retaining clip -arrow- slightly.
- Unbolt drive shafts (left and right) from gearbox flange and centre bearing.
- Tie up drive shaft (left-side), tie back drive shaft (right-side).



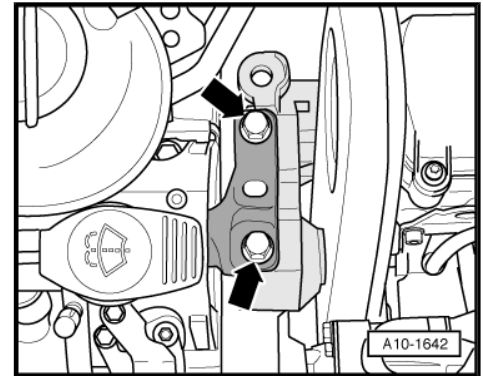
- Attach engine bracket -T10012- with securing nut and bolt to cylinder block: approx. 20 Nm.
- Insert engine and gearbox jack -V.A.G 1383 A- in engine bracket -T10012- and raise engine slightly.



**Note**

To unscrew bolts for assembly mounting use stepladder - VAS 5085- .

- Remove bolts of assembly mounting for engine -arrows-.

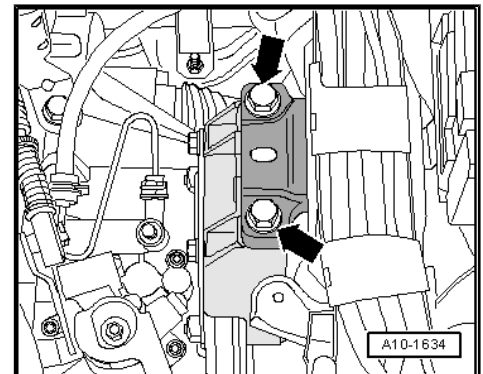


- Unscrew bolts of assembly mounting at gearbox -arrows-.

**Note**

- ◆ Check that all hoses, pipes and wiring connections between engine, gearbox and body have been detached.
- ◆ Carefully guide engine/gearbox assembly when lowering to avoid damage.
- ◆ Make sure there is sufficient clearance from air conditioner compressor and between drive shaft and turbocharger.

- First lower engine/gearbox assembly only slightly.
- Then push engine/gearbox assembly forwards and only then lower further.



## 1.2 Separating engine and gearbox

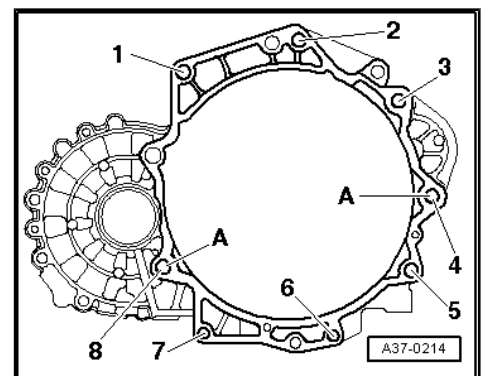
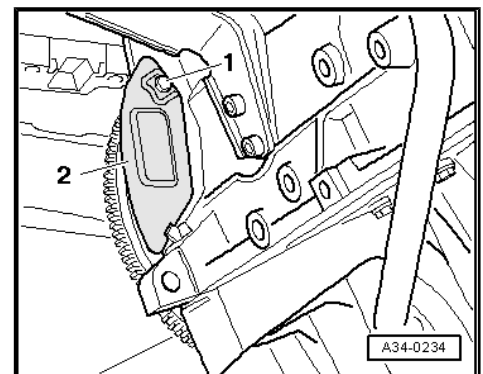
### Procedure

- Engine/gearbox assembly removed and attached to engine bracket -T10012- .
- Unscrew bolt -1- with gearbox installed.
- Pull up cover plate -2- and remove.

**Note**

Shown in illustration with gearbox removed.

- Remove bolts -1 ... 8- on engine/gearbox flange.
- Detach starter.
- Separate gearbox from engine.

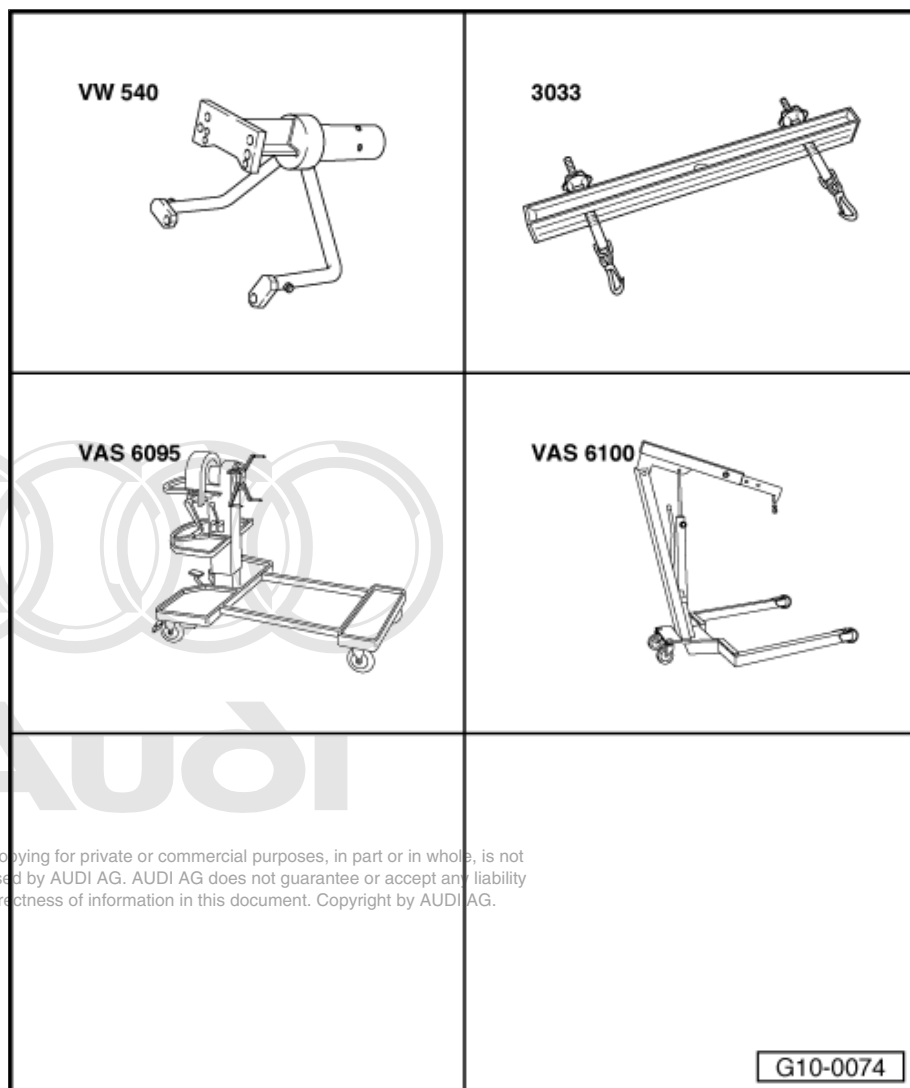


## 1.3 Securing engine to assembly stand

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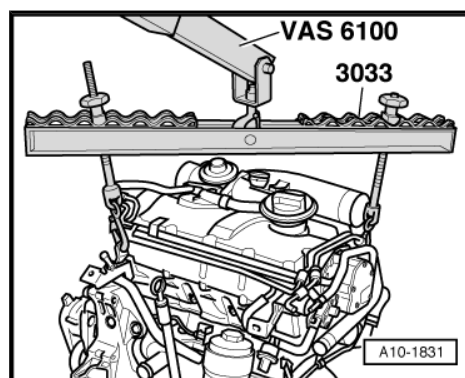
### Special tools and workshop equipment required

- ◆ Engine and gearbox support -VW 540-
- ◆ Lifting tackle -3033-
- ◆ Engine and gearbox support -VAS 6095-
- ◆ Workshop hoist - VAS 6100-

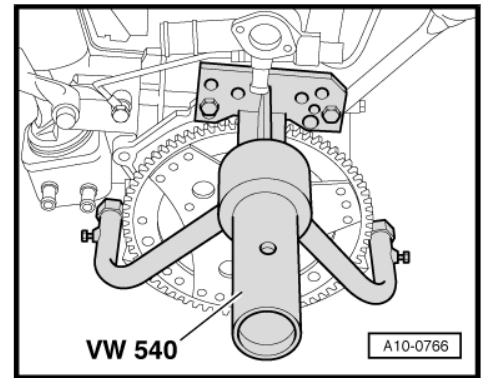


### Procedure

- Gearbox detached from engine.
- Attach lifting tackle -3033- to engine and workshop hoist - VAS 6100- as shown in illustration.
- Lift engine off engine bracket -VAS 6100- using workshop hoist -T10012- .



- Secure engine with engine and gearbox support -VW 540- to engine stand -VAS 6095- .



## 1.4 Installing engine

### Procedure

- Engine attached to engine bracket -T10012-

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



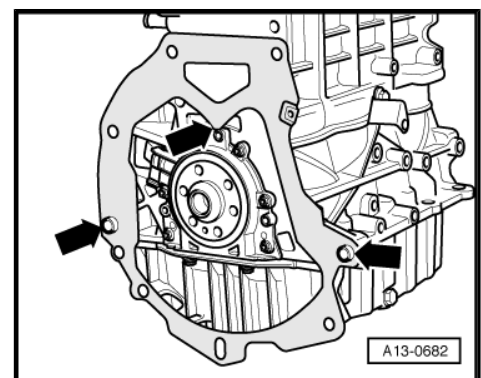
#### Note

- ◆ *Renew self-locking nuts and bolts when performing assembly work.*
- ◆ *Renew bolts which are tightened to a specified angle as well as oil seals and gaskets.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- Clean input shaft splines and (in the case of used clutch plates) the hub splines. Remove corrosion and apply only a very thin coating of grease -G 000 100- to the splines. Then move clutch plate back and forth on input shaft until the hub moves smoothly on the shaft. Remove any excess grease.
- Check whether dowel sleeves for centring the engine/gearbox assembly are fitted in the cylinder block; install if necessary.
- Ensure that the intermediate plate is engaged on the sealing flange and pushed onto the dowel sleeves -arrows-.
- Check that clutch plate is correctly centred ⇒ Rep. gr. 30 .
- Check clutch release bearing for wear, renew if necessary.
- Bolt gearbox to engine.



#### Note

- ◆ *Tightening torques apply only to lightly greased, oiled, phosphated or black-finished nuts and bolts.*
- ◆ *Additional lubricants such as engine or gearbox oil may be used, but do not use lubricants containing graphite.*
- ◆ *Do not use degreased parts.*
- ◆ *Tolerance for tightening torques: ± 15 %.*



## Securing engine to gearbox

| Item                                      | Bolt                           | Nm |
|-------------------------------------------|--------------------------------|----|
| 1, 2 <sup>1)</sup> , 8                    | M12x55                         | 80 |
| 3 <sup>1)</sup> , 4 <sup>1)</sup>         | M12x150                        | 80 |
| 5 ... 7                                   | M10x50                         | 45 |
| A                                         | Dowel sleeves for centralising |    |
| • <sup>1)</sup> Bolt with M8 threaded pin |                                |    |

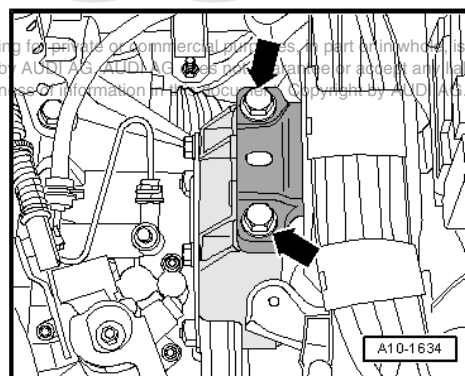
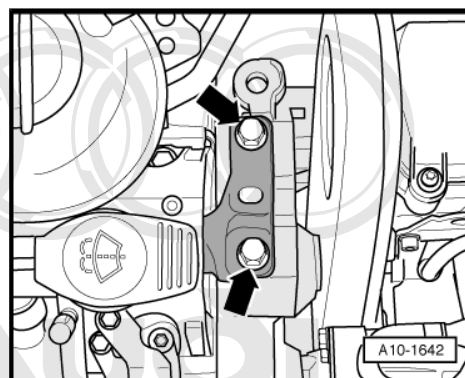
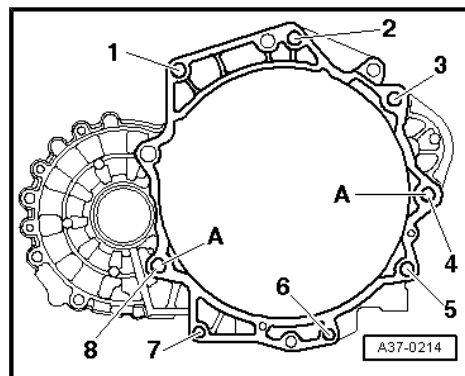
- Guide engine/gearbox assembly into the body.
- Tighten bolts of assembly mounting on engine -arrows- initially finger-tight.
- Tighten bolts of assembly mounting on gearbox -arrows- initially finger-tight.
- Use new securing bolts.



### Note

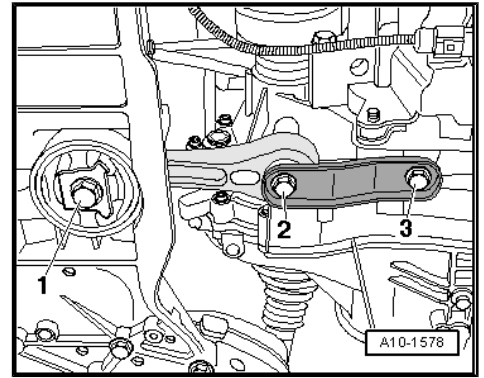
The bolts are tightened to final torque only after adjusting the engine mountings ⇒ [page 25](#) .

- Remove engine bracket -T10012- from engine.
- Install drive shafts ⇒ Rep. gr. 40 .



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- Secure pendulum support with bolts -1 ... 3- to gearbox and subframe.
- Use new securing bolts.
- Install exhaust system and align it free of stress  
⇒ [page 212](#) .
- Install air conditioner compressor ⇒ Rep. gr. 87 .
- Install radiator ⇒ [page 188](#) .
- Install alternator ⇒ Rep. gr. 27 .
- Install poly V-belt ⇒ [page 30](#) .
- Install slave cylinder for hydraulic clutch mechanism ⇒ Rep. gr. 30 .

**Caution**

***The clutch pedal must not be operated before installing slave cylinder.***

- Attach and adjust selector mechanism at gearbox ⇒ Rep. gr. 34 .
- Install air pipes/hoses with plug-in connectors ⇒ [page 196](#) .
- Adjust assembly mountings ⇒ [page 25](#) .
- Electrical connections and routing ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- Install battery ⇒ Rep. gr. 27 .

**Caution**

***Do not use a battery charger to boost starting. There is danger of damaging the vehicle's control units.***

- Check oil level ⇒ [page 168](#) .
- Fill cooling system ⇒ [page 174](#) .

**Note**

- ◆ *Drained-off coolant may only be used again if the original cylinder head and cylinder block are re-installed.*
- ◆ *Contaminated or dirty coolant must not be used again.*

**Tightening torques****Note**

- ◆ *Tightening torques apply only to lightly greased, oiled, phosphated or black-finished nuts and bolts.*
- ◆ *Additional lubricant such as engine oil or gearbox oil may be used, but do not use lubricant containing graphite.*
- ◆ *Do not use degreased parts.*
- ◆ *Tolerance for tightening torques: ± 15 %.*

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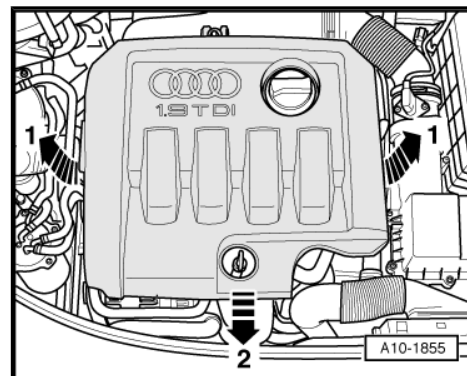
| Component                                                                                              |     | Nm             |
|--------------------------------------------------------------------------------------------------------|-----|----------------|
| Bolts/nuts                                                                                             | M6  | 10             |
|                                                                                                        | M7  | 15             |
|                                                                                                        | M8  | 20             |
|                                                                                                        | M10 | 40             |
|                                                                                                        | M12 | 65             |
| Except for the following:                                                                              |     |                |
| Gearbox support to gearbox                                                                             |     | 60 + 90° 1)2)  |
| Air intake pipe (left-side) to sump                                                                    |     | 10             |
| Pendulum support to gearbox                                                                            |     | 50 + 90° 1)2)  |
| Pendulum support to subframe                                                                           |     | 100 + 90° 1)2) |
| Terminal B+ to starter                                                                                 |     | 16             |
| Earth wire to gearbox                                                                                  |     | 22             |
| <ul style="list-style-type: none"><li>• 1) Renew bolts.</li><li>• 2) 90° = one quarter turn.</li></ul> |     |                |

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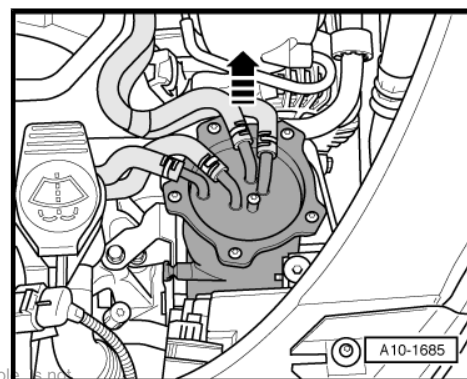
## 2 Assembly mountings

### 2.1 Checking adjustment of assembly mountings (engine/gearbox mountings)

- Lift engine cover panel at sides -arrows 1- and pull off towards front -arrow 2-.



- Release catches and pull fuel filter with hoses attached upwards out of the bracket -arrow- and place to side.



The following specifications must be obtained:

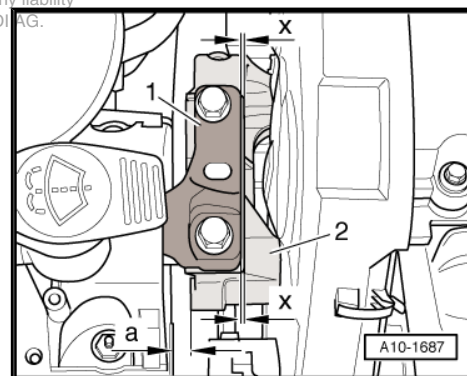
- There must be a distance of -a- = 13.5 mm between engine support and longitudinal member (right-side).
- The side of the engine support casting -2- must be aligned parallel to the support arm -1- (distance -x- = distance -x-).



#### Note

*Distance -a- = 13.5 mm can also be checked with a metal rod of suitable size, or similar.*

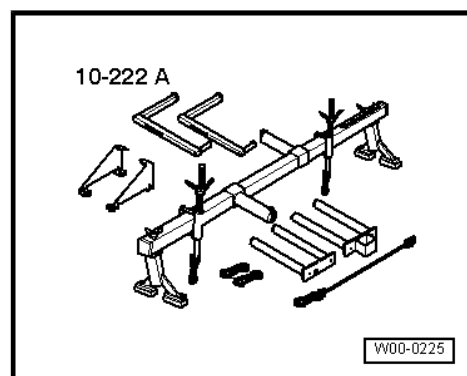
If the distance measured is too large or small, the assembly mountings must be adjusted ⇒ [page 25](#) .



### 2.2 Adjusting assembly mountings

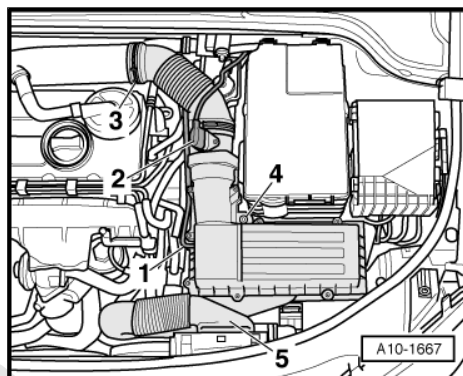
Special tools and workshop equipment required

- ◆ Support bracket -10-222 A-

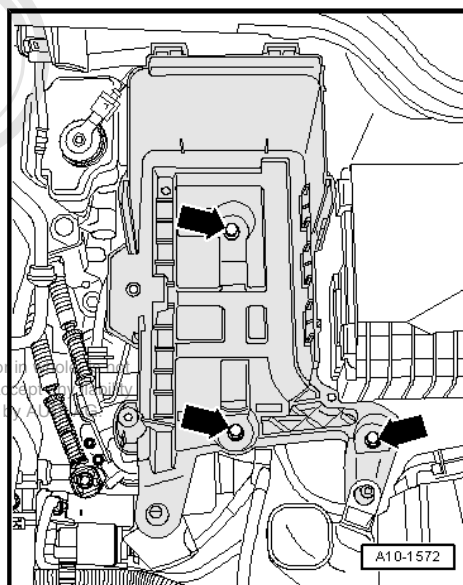


## Procedure

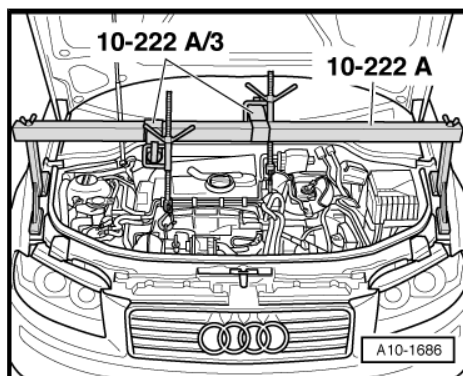
- Pull off front seal at lock carrier.
- Unplug electrical connector -2- at air mass meter -G70- .
- Detach vent hose -1- and air hoses -3- and -5-.
- Unscrew bolt -4- and remove air cleaner housing.



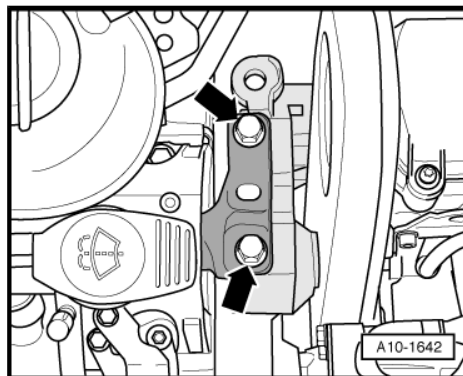
- Remove battery ⇒ Rep. gr. 27 .
- Remove battery tray -arrows-.



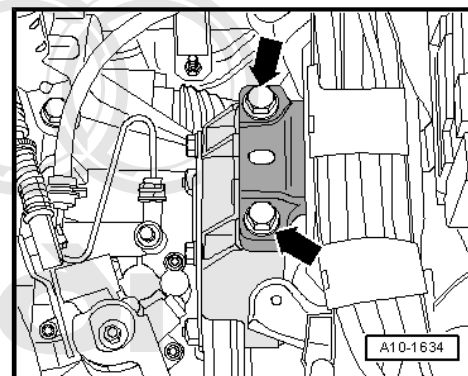
- Set up support bracket -10-222 A- with adapters -10-222 A/3- on wing panel flanges.
- Attach hooks of spindles to lifting eyes.
- Take up weight of engine evenly with both spindles (but do not raise engine).



- Renew the bolts for assembly mounting at engine -arrows- one by one (if not already renewed when engine was installed).
- Screw in new bolts initially finger-tight.



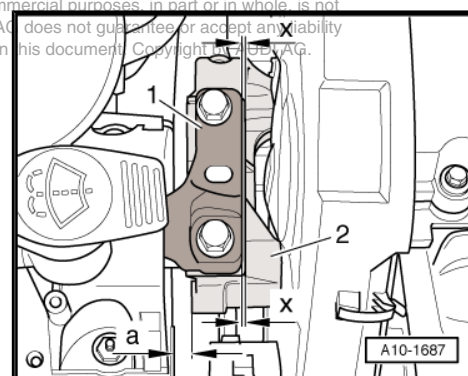
- Renew the bolts for assembly mounting at gearbox -arrows- one by one (if not already renewed when engine was installed).
- Screw in new bolts initially finger-tight.



- Using a suitable lever, adjust position of engine between engine support -2- and support arm -1- until specifications listed below are obtained:
  - There must be a distance of  $-a- = 13.5 \text{ mm}$  between engine support and longitudinal member (right-side).
  - The side of the engine support casting -2- must be aligned parallel to the support arm -1- (distance  $-x- = \text{distance } -x-$ ).

**Note**

*Distance  $-a-$  = 13.5 mm can also be checked with a metal rod of suitable size, or similar.*



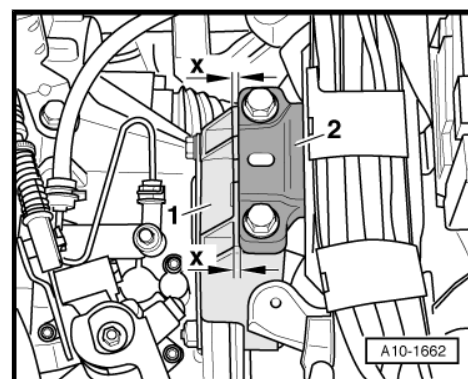
- Tighten bolts for assembly mounting (for engine) to  $60 \text{ Nm} + 90^\circ$ .
- On the gearbox side, check that the edges of the support arm -2- and gearbox support -1- are parallel (distance  $-x- = \text{distance } -x-$ ).
- Tighten bolts for assembly mounting (for gearbox) to  $60 \text{ Nm} + 90^\circ$ .

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

- Install battery  $\Rightarrow$  Rep. gr. 27 .

**Tightening torques**

| Component                                                                                                                          |                 | Nm                   |
|------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------------------|
| Support arm to:                                                                                                                    | Engine support  | $60 + 90^\circ$ 1)2) |
|                                                                                                                                    | Gearbox support | $60 + 90^\circ$ 1)2) |
| <ul style="list-style-type: none"> <li>• 1) Renew bolts.</li> <li>• 2) <math>90^\circ = \text{one quarter turn.}</math></li> </ul> |                 |                      |



## 2.3 Tightening torques for engine support

**Note**

- ◆ Different types of engine support are installed, depending on the engine version.
- ◆ The correct tightening torques are listed according to the Part Nos. of the engine supports.
- ◆ Renew bolts securing engine support.

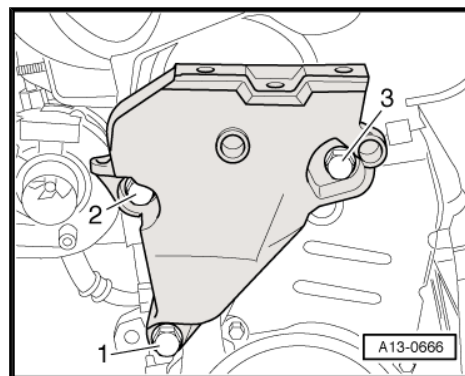
## Engine support, Part No. 03G 199 207 A and G

### Engine support, Part No. 03G 199 207 A

|          |                                                                     |
|----------|---------------------------------------------------------------------|
| 1. Stage | – Initially screw in new bolts -1 ... 3- hand-tight.                |
| 2. Stage | – Tighten bolts -1 ... 3- to 40 Nm with torque wrench.              |
| 3. Stage | – Turn bolts -1 ... 3- 90° further (1/4 turn) using a rigid wrench. |

### Engine support, Part No. 03G 199 207 G

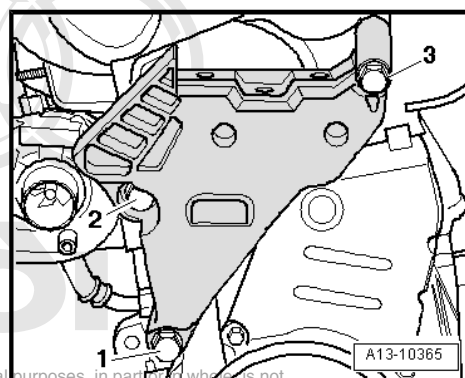
|          |                                                                      |
|----------|----------------------------------------------------------------------|
| 1. Stage | – Initially screw in new bolts -1 ... 3- hand-tight.                 |
| 2. Stage | – Tighten bolts -1 ... 3- to 40 Nm with torque wrench.               |
| 3. Stage | – Turn bolts -1 ... 3- 180° further (1/2 turn) using a rigid wrench. |



## Engine support, Part No. 03G 199 207 F

### Engine support, Part No. 03G 199 207 F

|          |                                                                      |
|----------|----------------------------------------------------------------------|
| 1. Stage | – Initially screw in new bolts -1 ... 3- hand-tight.                 |
| 2. Stage | – Tighten bolts -1 ... 3- to 40 Nm with torque wrench.               |
| 3. Stage | – Turn bolts -1 ... 3- 180° further (1/2 turn) using a rigid wrench. |



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## 13 – Crankshaft group

### 1 Dismantling and assembling engine

#### 1.1 Poly V-belt drive - exploded view

##### 1 - Vibration damper

- ☐ With pulley for poly V-belt
- ☐ Removing and installing  
⇒ [page 31](#)

##### 2 - Cover cap for vibration damper

##### 3 - Special bolt, 10 Nm + 90° (1/4 turn) further

- ☐ Renew
- ☐ Use only genuine bolts  
⇒ Parts catalogue

##### 4 - Tensioner for poly V-belt

- ☐ Pivot with open-end spanner to slacken poly V-belt
- ☐ Lock tensioner with locking pin -T10060 A- or -T10060- .

##### 5 - 23 Nm

##### 6 - Bracket for ancillaries

- ☐ Removing and installing  
⇒ [page 34](#)

##### 7 - Bush

##### 8 - 23 Nm

##### 9 - Alternator

- ☐ Removing and installing  
⇒ Rep. gr. 27

##### 10 - 45 Nm

- ☐ Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue
- ☐ Observe correct tightening sequence ⇒ [page 34](#)

##### 11 - Bush

- ☐ 2x

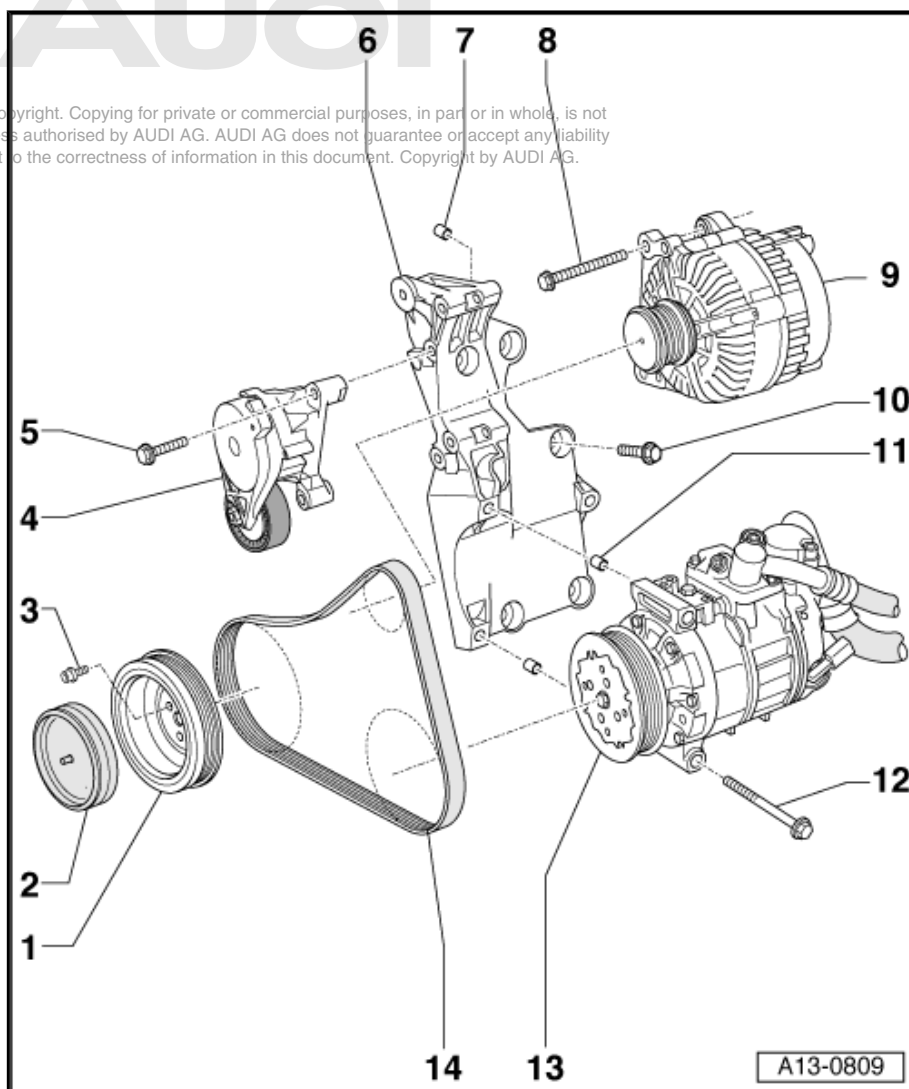
##### 12 - 25 Nm

##### 13 - Air conditioner compressor

- ☐ Removing and installing ⇒ Rep. gr. 87

##### 14 - Poly V-belt

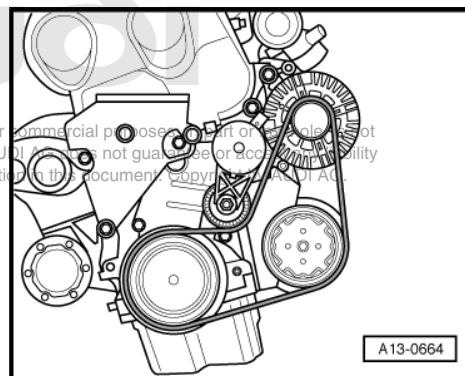
- ☐ Check for wear
- ☐ Do not kink
- ☐ Before removing, mark direction of rotation with chalk or felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.



- ❑ Removing and installing ⇒ [page 30](#)
- ❑ When installing, make sure it is properly seated on pulleys.
- ❑ Routing of poly V-belt ⇒ [page 30](#)

## Routing of poly V-belt

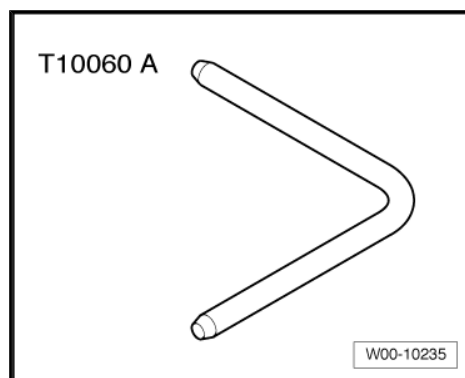
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## 1.2 Removing and installing poly V-belt

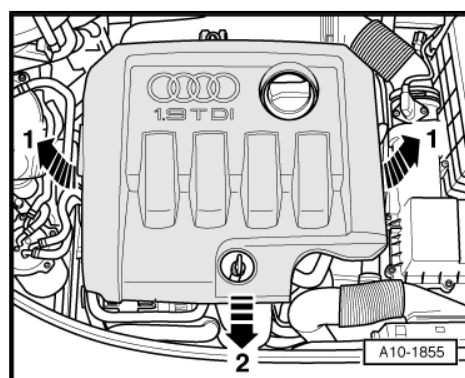
### Special tools and workshop equipment required

- ◆ Locking pin -T10060 A- or -T10060-

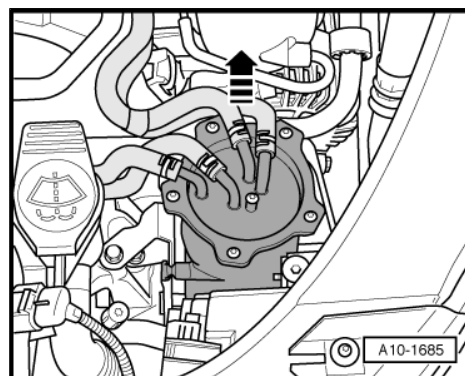


### Removing

- Lift engine cover panel at sides -arrows 1- and pull off towards front -arrow 2-.



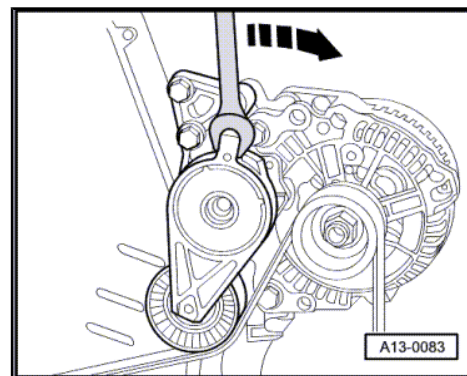
- Release catches and pull fuel filter with hoses attached upwards out of the bracket -arrow- and place to side.



**Note**

*Before removing, mark direction of rotation of poly V-belt with chalk or felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.*

- To slacken the poly V-belt, turn the tensioner in the direction of the -arrow-.



- Lock tensioner for poly V-belt in position with locking pin - T10060 A- or -T10060- .
- Remove poly V-belt.

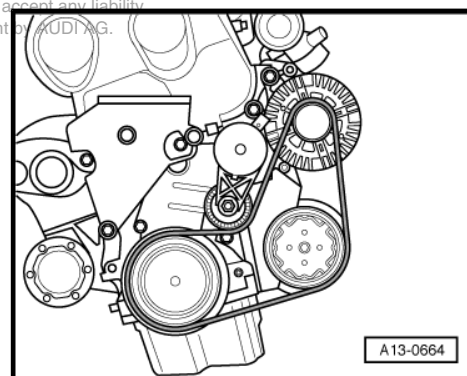
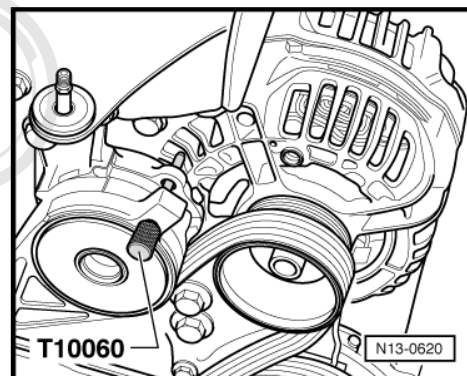
**Installing**

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

**Note**

*Before fitting poly V-belt, make sure all mechanical units (e.g. alternator and air conditioner compressor) are firmly in position.*

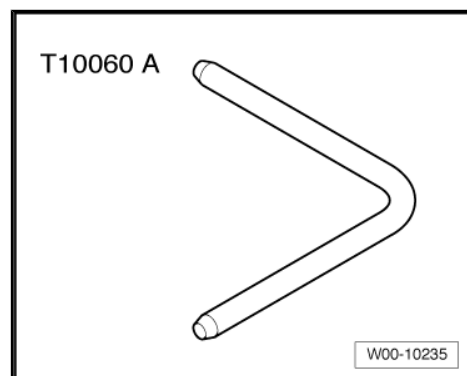
- Fit poly V-belt onto crankshaft pulley and air conditioner compressor pulley.
- Then position poly V-belt on alternator pulley and release tensioner.
- Check poly V-belt for proper seating.
- Start engine and check that belt runs properly.



### 1.3 Removing and installing vibration damper

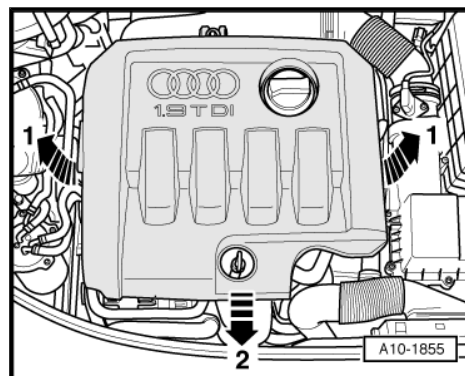
#### Special tools and workshop equipment required

- ◆ Locking pin -T10060 A- or -T10060-

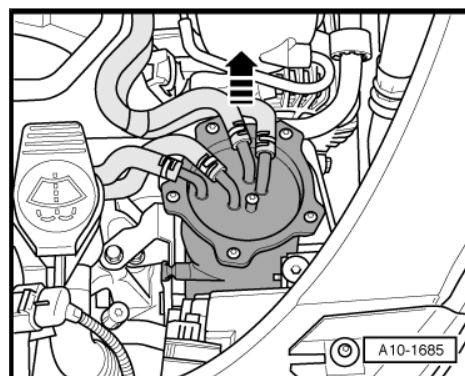


## Removing

- Lift engine cover panel at sides -arrows 1- and pull off towards front -arrow 2-.



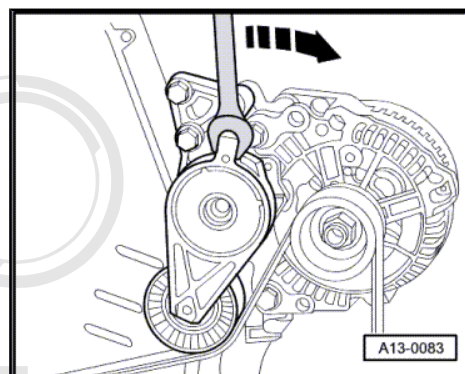
- Release catches and pull fuel filter with hoses attached upwards out of the bracket -arrow- and place to side.



## Note

Before removing, mark direction of rotation of poly V-belt with chalk or felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.

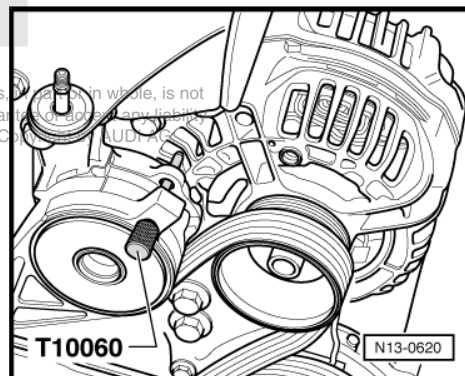
- To slacken the poly V-belt, turn the tensioner in the direction of the -arrow-.



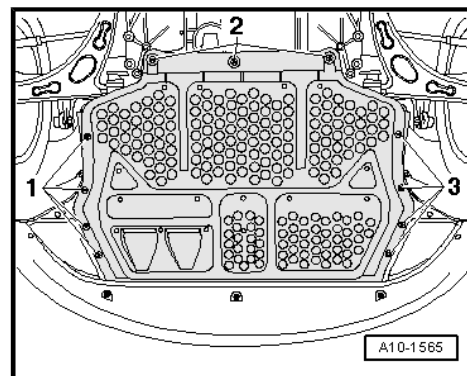
- Lock tensioner for poly V-belt in position with locking pin - T10060 A- or -T10060- .

- Remove poly V-belt.

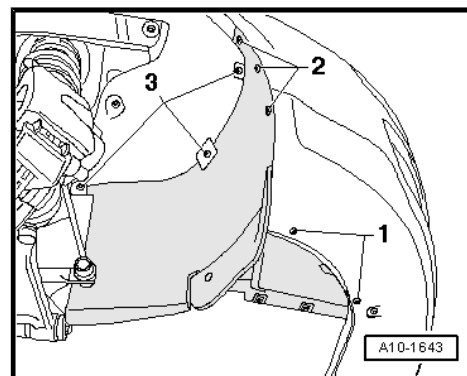
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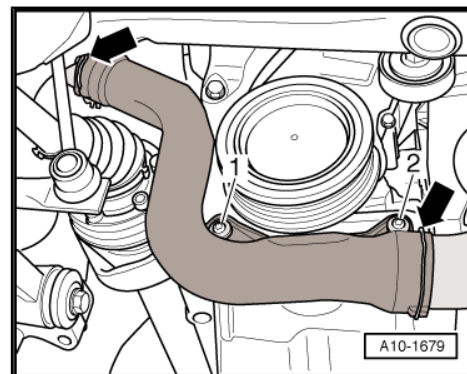
- Remove centre noise insulation -fasteners 1 ... 3-.



- Remove noise insulation (right-side) -fasteners 1 ... 3-.



- Remove bolts -1- and -2-.
- Remove air pipe (right-side) by lifting retaining clips -arrows- slightly.



- Remove cover cap for vibration damper.
- Unbolt vibration damper; counterhold on centre bolt with ring spanner.

### Installing

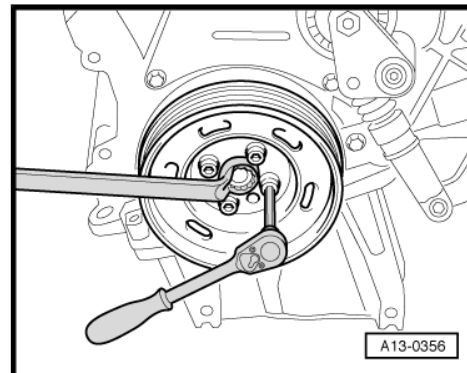
Installation is carried out in the reverse order; note the following:



#### Note

*Renew seals.*

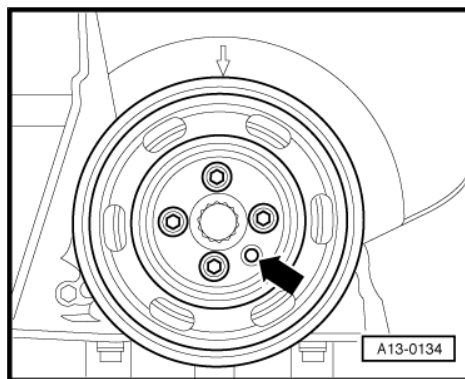
- Use new securing bolts.



- When installing the vibration damper, use only genuine bolts (same as original equipment): ⇒ Parts catalogue .
- The vibration damper can only be installed in one position. The hole -arrow- in the vibration damper must be located over the projection on the toothed belt sprocket.
- Install air pipes/hoses with plug-in connectors ⇒ [page 196](#) .
- Install poly V-belt ⇒ [page 30](#) .

#### Tightening torques

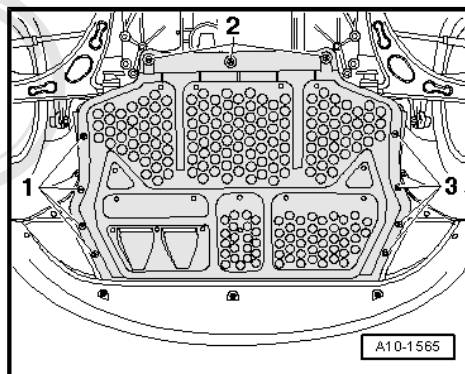
| Component                                                                                                                       | Nm                       |
|---------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| Vibration damper to crankshaft                                                                                                  | 10 + 90° <sup>1)2)</sup> |
| Air intake pipe (right-side) to sump                                                                                            | 10                       |
| <ul style="list-style-type: none"> <li>• <sup>1)</sup> Renew bolts.</li> <li>• <sup>2)</sup> 90° = one quarter turn.</li> </ul> |                          |



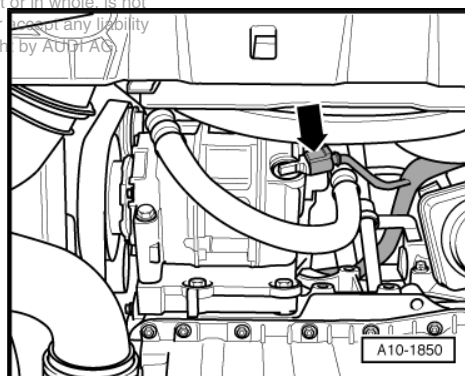
## 1.4 Removing and installing bracket for ancillaries

### Removing

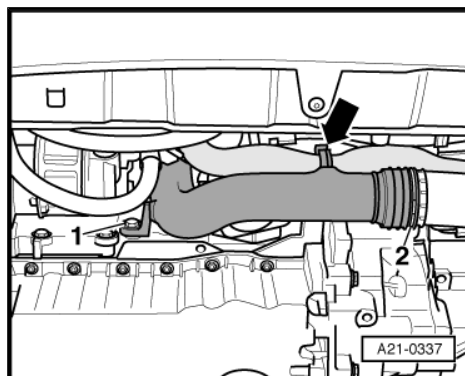
- Remove centre noise insulation -fasteners 1 ... 3-.



- Unplug electrical connector -arrow- for magnetic clutch of air conditioner compressor.



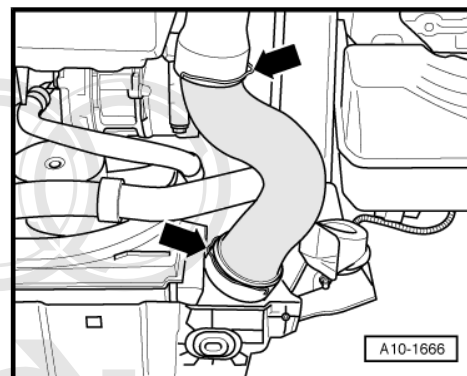
- Detach lower air intake hose (left-side) from front air pipe by lifting retaining clip -2- slightly.
- Remove bolt -1-.
- Unclip coolant hose from air pipe -arrow-.



- Remove air intake hose (right-side) by lifting retaining clips -arrows- slightly.

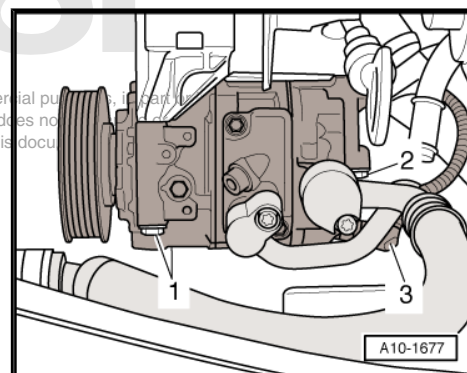
**Caution**

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

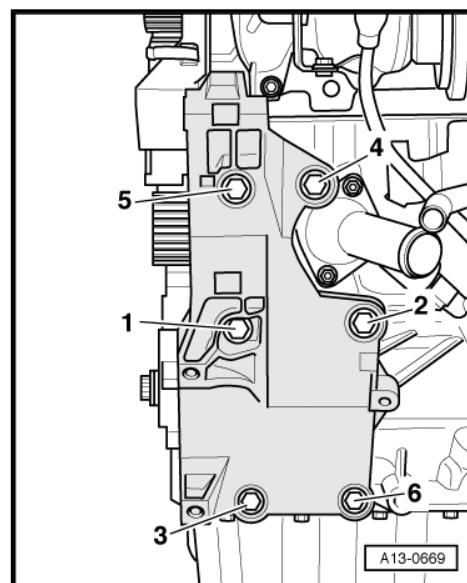
**Note**

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

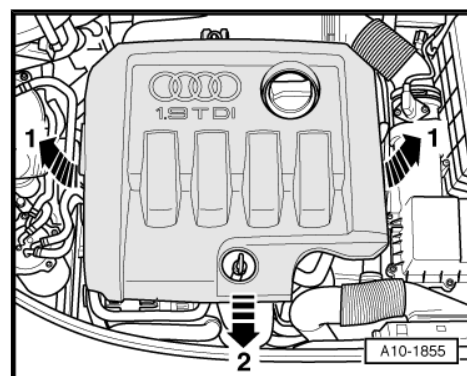
- Unscrew bolts -1- and -2- for air conditioner compressor.
- Tie air conditioner compressor up to lock carrier.



- Unscrew bolts -3- and -6- on bracket for ancillary units.



- Lift engine cover panel at sides -arrows 1- and pull off towards front -arrow 2-.

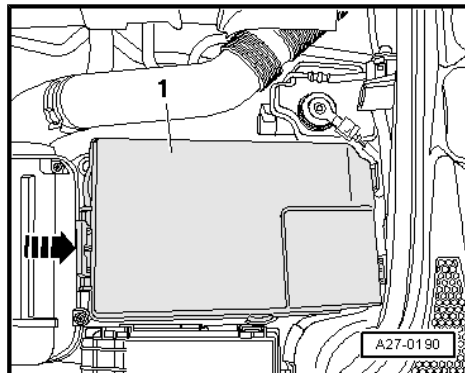


- Remove cover -1- over battery; to do so, press release tab -arrow-.

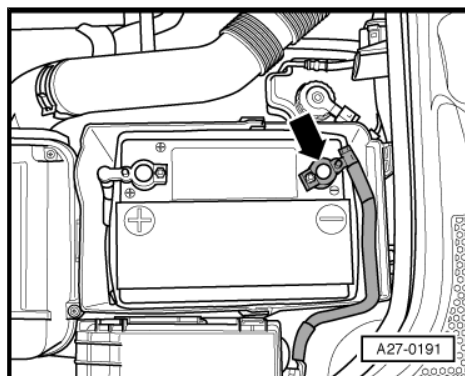


### Caution

*Observe notes on procedure for disconnecting the battery ⇒ Rep. gr. 27.*



- With ignition switched off, disconnect battery earth cable -arrow-.

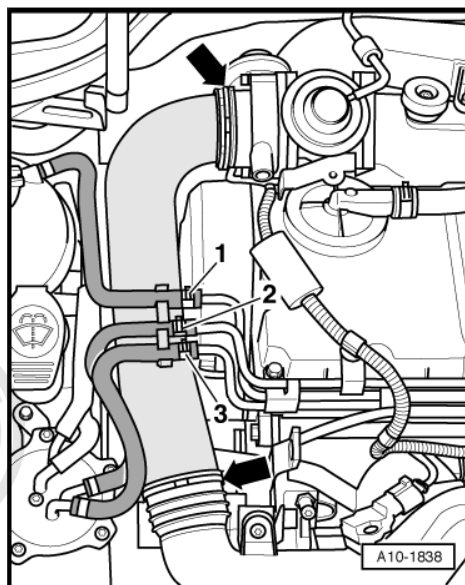


- Detach the hoses/lines -1 ... 3- from air pipe.
- Remove air pipe by lifting retaining clips -arrows- slightly.

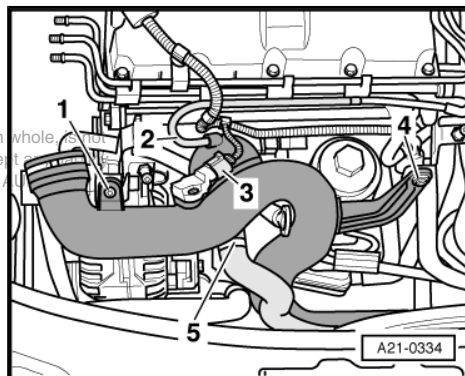


### Note

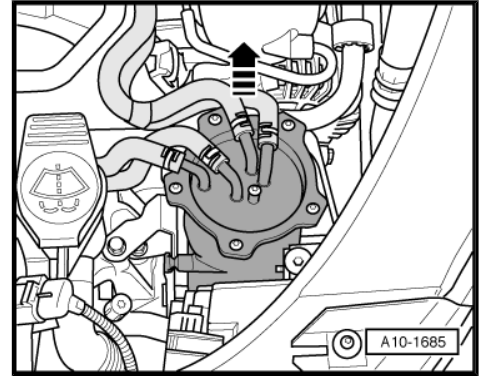
*Leave coolant hose -1- and fuel lines -2- and -3- connected.*



- Remove bolts -1- and -4-.
- Detach vacuum line -2-.
- Unplug electrical connector -3- at charge pressure sender -G31-.
- Unclip coolant hose -5- from air pipe.
- Pull air pipe approx. 10 cm upwards towards left-side of vehicle and move clear.

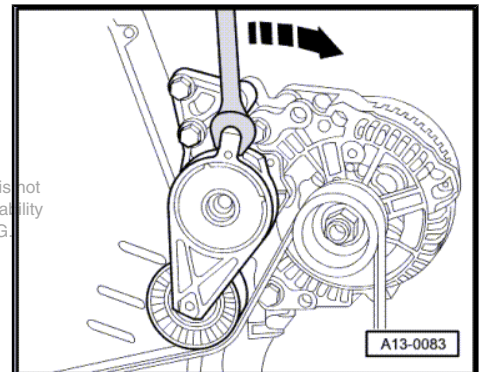


- Release catches and pull fuel filter with hoses attached upwards out of the bracket -arrow- and place to side.

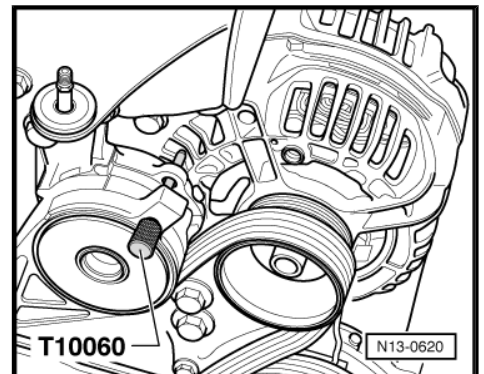
**Note**

*Before removing, mark direction of rotation of poly V-belt with chalk or felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.*

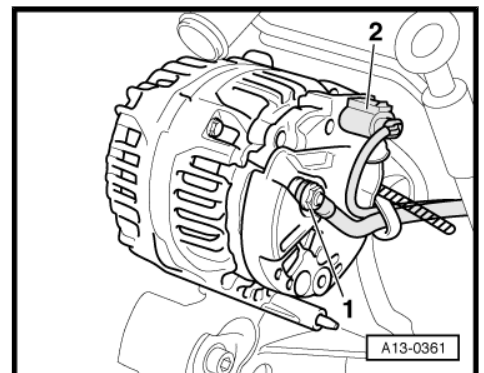
- To slacken the poly V-belt, turn the tensioner in the direction of the -arrow-.



- Lock tensioner for poly V-belt in position with locking pin - T10060 A- or -T10060- .
- Remove poly V-belt.



- Unplug electrical connector -2-.
- Unscrew wire -1- at alternator.
- Unscrew wire clamp on alternator.

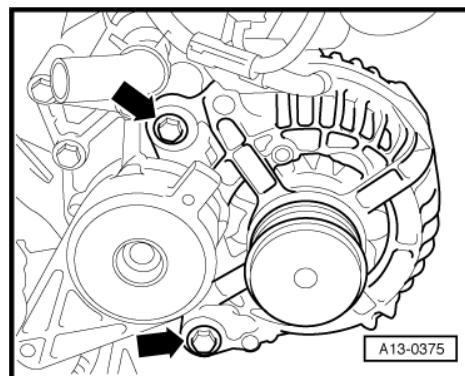


- Unscrew the bolts -arrows- and remove alternator upwards.

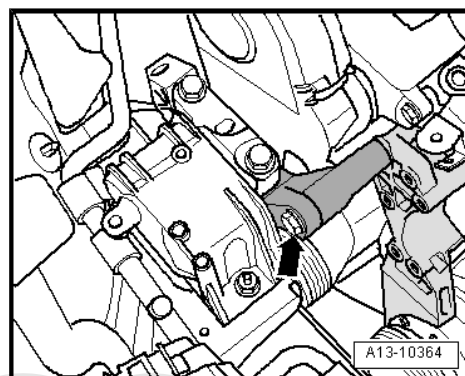


### Note

- ◆ If alternator sticks in its bracket, screw bolt back in again down to the last 2 turns.
- ◆ Tap carefully on bolt heads with flat side of hammer to release bushes of alternator mountings.



- If fitted, remove connecting bolt -arrow- between engine support and bracket for ancillaries.

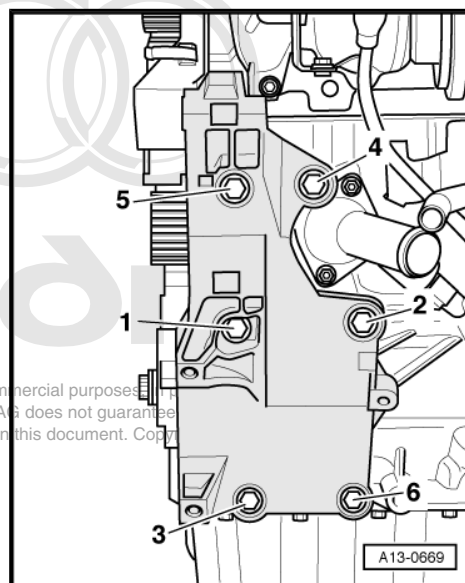


- Unscrew bolts -1-, -2-, -4- and -5- and remove bracket for ancillary units.

### Installing

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

- Check that dowel sleeve for centring the bracket for ancillary units on cylinder block is fitted; insert if necessary.
- Tighten bolts in the sequence -1 ... 6-.
- Install air conditioner compressor ⇒ Rep. gr. 87 .
- Install alternator ⇒ Rep. gr. 27 .
- Install air pipes/hoses with plug-in connectors ⇒ [page 196](#)
- Install poly V-belt ⇒ [page 30](#) .
- Connect battery. Procedures required ⇒ Rep. gr. 27 .



### Tightening torques

| Component                                                                                                                    | Nm                        |
|------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| Bracket for ancillaries to cylinder block                                                                                    | 45                        |
| Engine support to bracket for ancillaries                                                                                    | 40 + 180° <sup>1)2)</sup> |
| <ul style="list-style-type: none"> <li>• <sup>1)</sup> Renew bolt.</li> <li>• <sup>2)</sup> 180° = one half turn.</li> </ul> |                           |

## 1.5 Toothed belt drive - exploded view

1 - 10 Nm + 90° (1/4 turn) further

- ☐ Renew

2 - Vibration damper

- ☐ With pulley for poly V-belt
- ☐ Removing and installing  
⇒ [page 31](#)

3 - Toothed belt cover (bottom)

4 - 10 Nm

- ☐ Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue

5 - Toothed belt cover (centre)

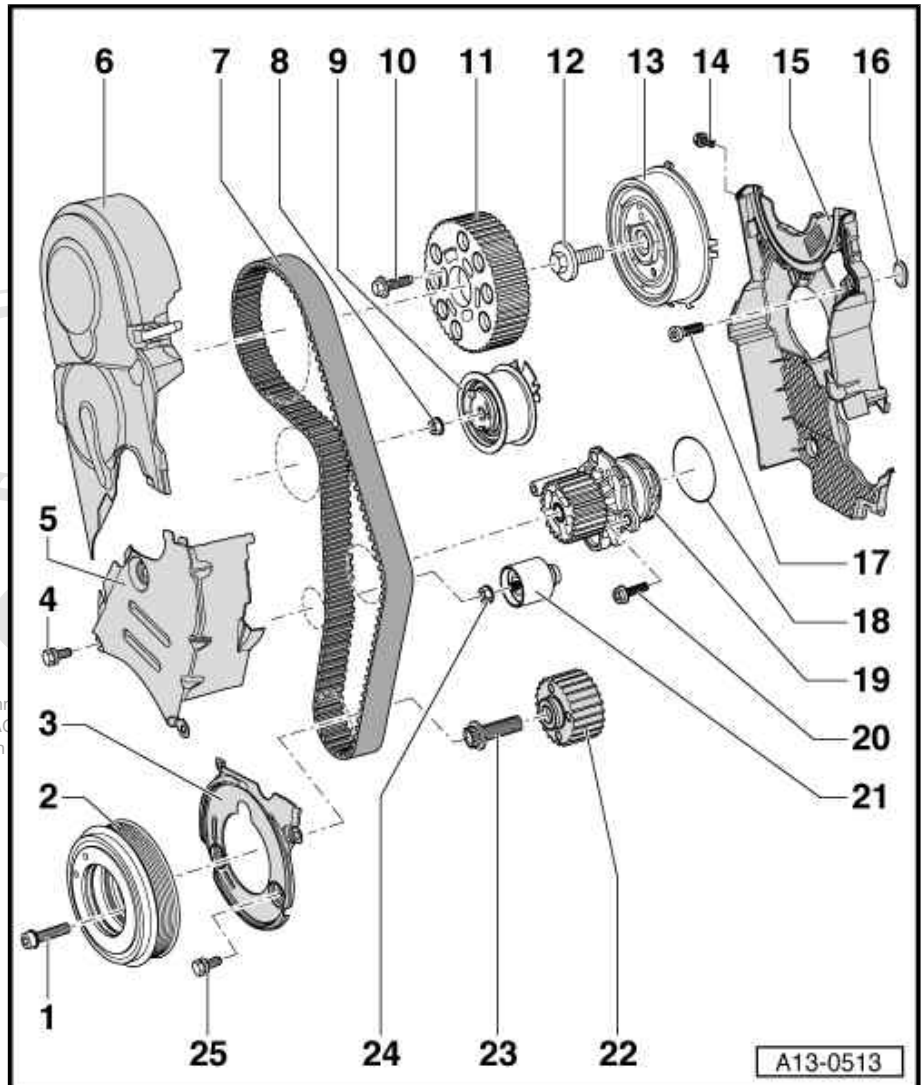
- ☐ To remove, take out top toothed belt cover and unbolt poly V-belt tensioner

6 - Toothed belt cover (top)

- ☐ To remove, take out air pipe (right-side)
- ☐ Engage carefully in centre toothed belt cover when installing

7 - Toothed belt

- ☐ Before removing, mark direction of rotation with chalk or felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.
- ☐ Check for wear



Vehicles up to approx. 05.2005

- ☐ Removing ⇒ [page 41](#)
- ☐ Installing (adjusting valve timing) ⇒ [page 49](#)

Vehicles from approx. 06.2005 onwards

- ☐ Removing ⇒ [page 53](#)
- ☐ Installing (adjusting valve timing) ⇒ [page 59](#)

8 - 20 Nm + 45° (1/8 turn) further

9 - Tensioning roller

10 - 25 Nm

11 - Camshaft sprocket

- ☐ Mark installation position

12 - 100 Nm

- ☐ Use counterhold tool -T10051- when loosening and tightening  
⇒ [“2.4 Removing and installing camshaft”, page 139](#)

13 - Hub

- ☐ With sender wheel for Hall sender -G40-
- ☐ Use counterhold tool -T10051- when loosening and tightening
- ☐ To remove, use puller -T10052-

- ☐ Pulling off: Vehicles up to approx. 05.2005 ⇒ [page 109](#) , vehicles from approx. 06.2005 onwards ⇒ [page 124](#)

**14 - 10 Nm**

- ☐ Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue

**15 - Toothed belt cover (rear)**

- ☐ To remove, take out coolant pump ⇒ [page 176](#)
- ☐ When installing, engage carefully in sealing flange at pulley end.

**16 - Rubber grommet**

- ☐ Renew if damaged

**17 - 25 Nm****18 - O-ring**

- ☐ Renew

**19 - Coolant pump**

- ☐ Removing and installing ⇒ [page 176](#)

**20 - 13 Nm****21 - Idler roller****22 - Crankshaft sprocket**

- ☐ Contact surface between sprocket and crankshaft must be free of oil
- ☐ Can only be installed in one position
- ☐ Removing and installing ⇒ [page 40](#)

**23 - 120 Nm + 90° (1/4 turn) further**

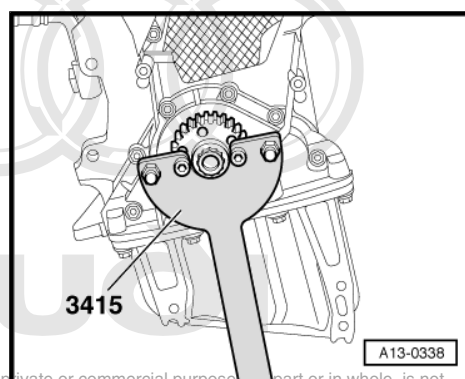
- ☐ Renew
- ☐ Do not lubricate with oil
- ☐ Use counterhold tool -3415- when loosening and tightening ⇒ [page 40](#)

**24 - 22 Nm****25 - 10 Nm**

- ☐ Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue

**Removing and installing crankshaft sprocket**

- Use counterhold tool -3415- when loosening and tightening.



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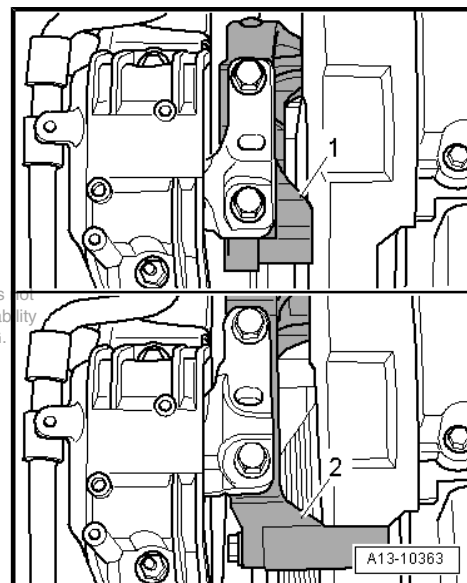
## 1.6 Removing and installing toothed belt - vehicles up to approx. 05.2005



### Note

*On vehicles up to approx. 05.2005 (can be identified by engine support -version 1-), the engine support has to be removed before removing the toothed belt.*

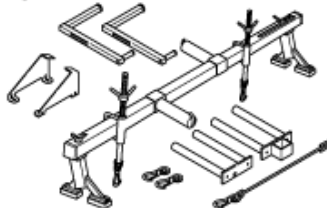
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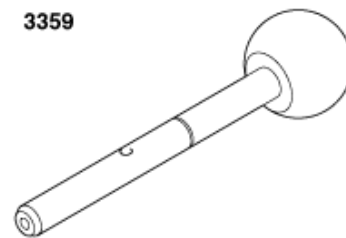
### Special tools and workshop equipment required

- ◆ Support bracket -10-222 A-
- ◆ Diesel injection pump locking pin -3359-
- ◆ Hose clip pliers -VAS 6340- or -VAS 5024 A-
- ◆ Pin wrench -T10020-
- ◆ Crankshaft stop -T10050- for engines with circular crankshaft sprocket
- ◆ Locking pin -T10060 A- or -T10060-

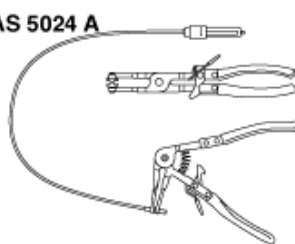
10-222 A



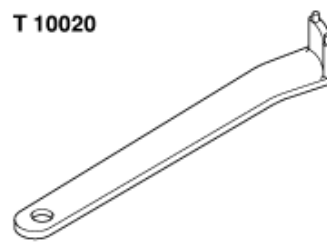
3359



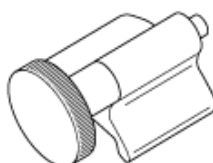
VAS 5024 A



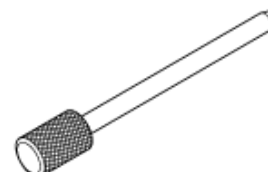
T 10020



T10050

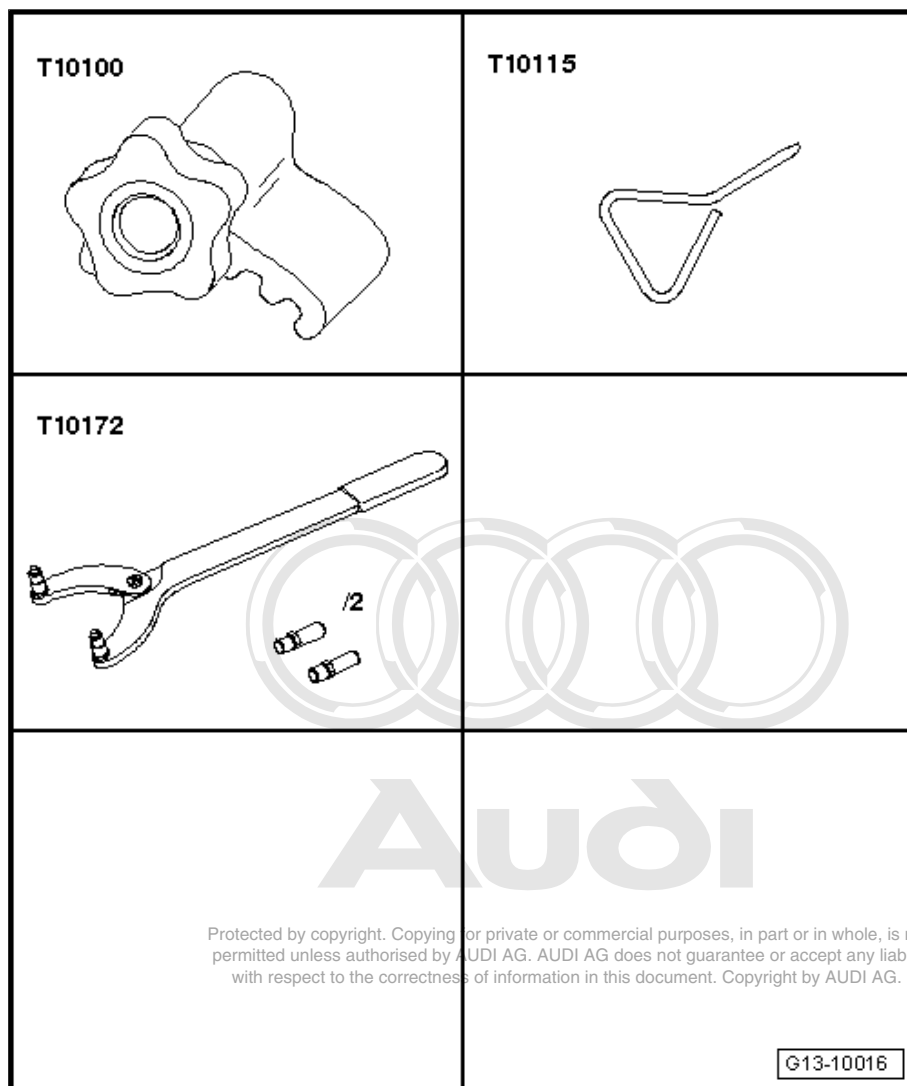


T10060



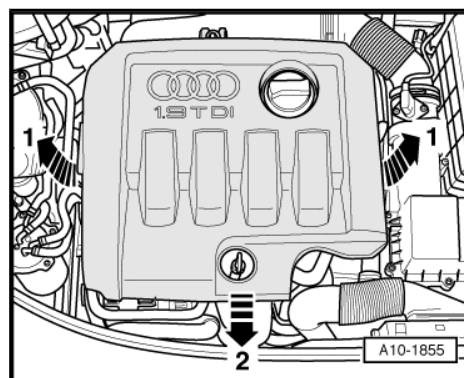
G13-0044

- ◆ Crankshaft stop -T10100-  
for engines with oval crank-  
shaft sprocket
- ◆ Locking pin -T10115-
- ◆ Counterhold tool -T10172-
- ◆ Locking fluid ⇒ Parts cata-  
logue



## Removing

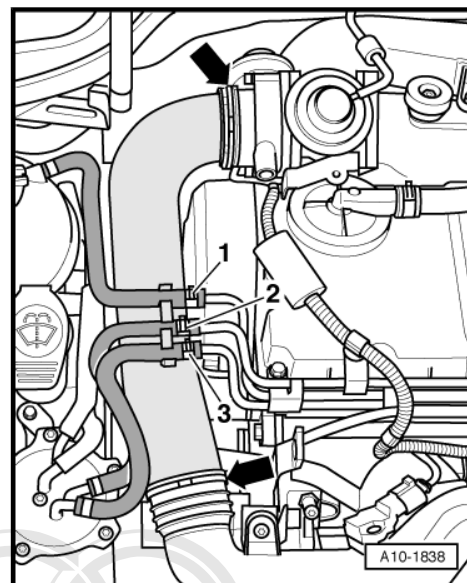
- Lift engine cover panel at sides -arrows 1- and pull off towards front -arrow 2-.



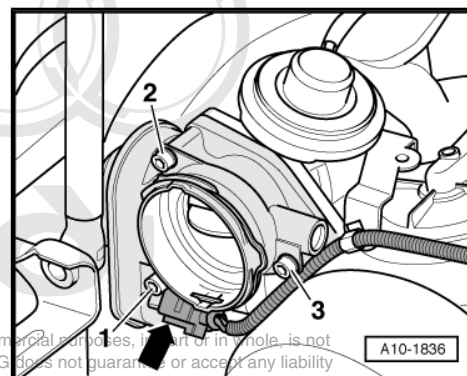
- Detach the hoses/lines -1 ... 3- from air pipe.
- Remove air pipe by lifting retaining clips -arrows- slightly.

**Note**

Leave coolant hose -1- and fuel lines -2- and -3- connected.

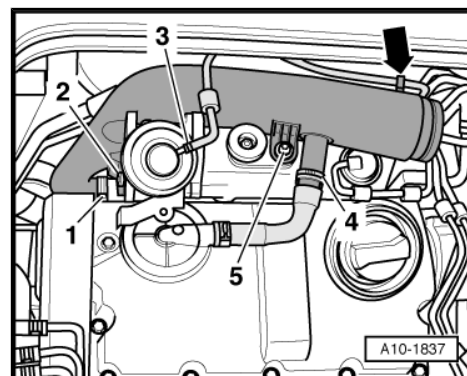


- Detach electrical connector -arrow- at intake manifold flap motor -V157- .
- Unscrew bolts -1 ... 3- and remove intake manifold flap motor -V157- .



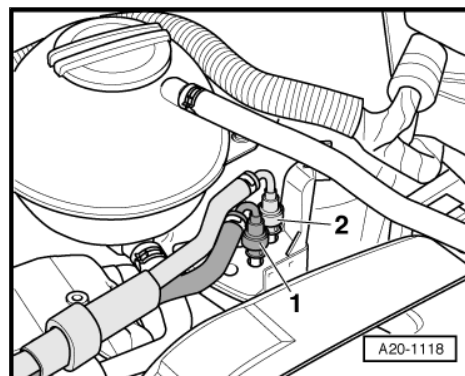
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- Disconnect vacuum hose -3- at exhaust gas recirculation valve -N18- .
- Detach pipe -4- for crankcase breather at air pipe.
- Release hose clip -1- at turbocharger using hose clip pliers -VAS 6340- .
- Move the vacuum hoses clear -arrow-.
- Unscrew bolts -2- and -5- and remove air pipe.

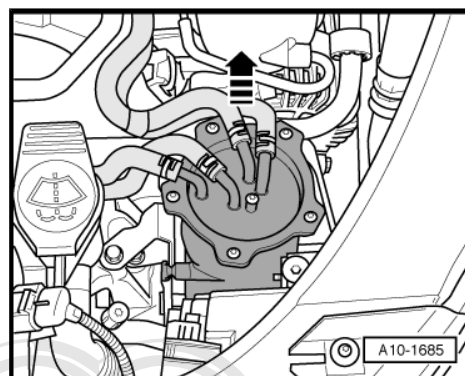
**WARNING**

- ◆ *In extreme cases the fuel lines and the fuel can reach a temperature of 100 °C on vehicles with unit injector engine. Allow the fuel to cool down before disconnecting the lines - danger of scalding.*
- ◆ *Wear protective gloves.*
- ◆ *Wear safety goggles.*

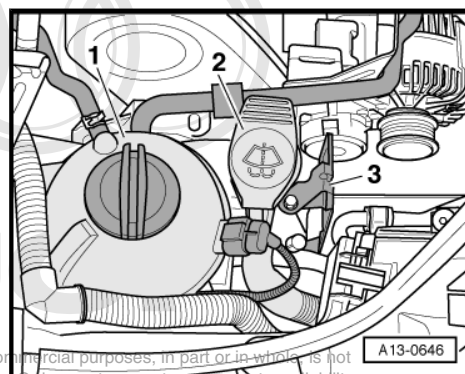
- Disconnect fuel supply line -2- and fuel return line -1- by pulling release tabs.



- Release catches and pull fuel filter with hoses attached upwards out of the bracket -arrow- and place to side.



- Unscrew bracket -3- for fuel filter.
- Unscrew bolt at filler neck -2- for washer fluid reservoir.
- Detach electrical connector at coolant expansion tank.
- Unscrew coolant expansion tank -1- and place on top of cylinder head cover with the hoses attached.



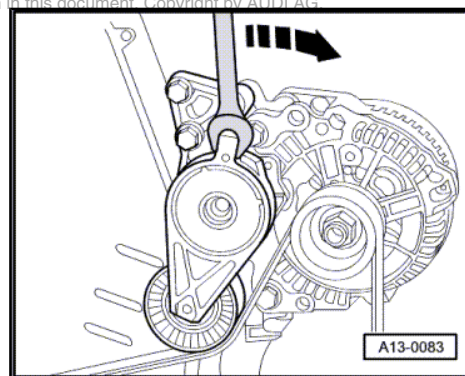
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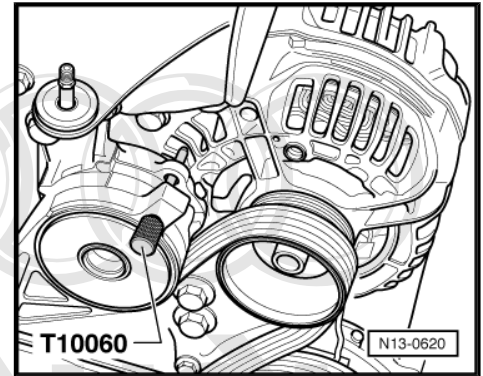
### Note

*Before removing, mark direction of rotation of poly V-belt with chalk or felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.*

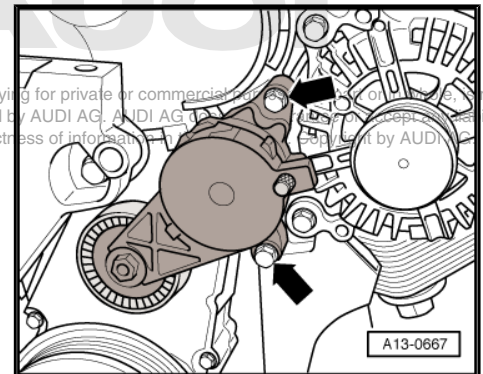
- To slacken the poly V-belt, turn the tensioner in the direction of the -arrow-.



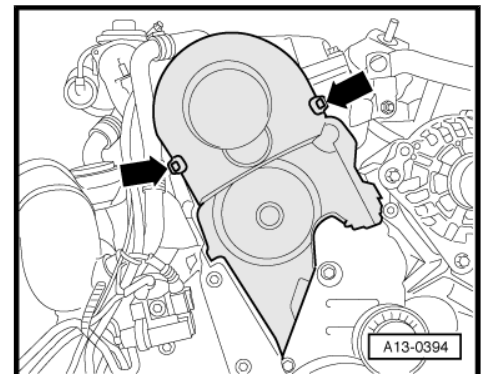
- Lock tensioner for poly V-belt in position with locking pin - T10060 A- or -T10060- .
- Remove poly V-belt.



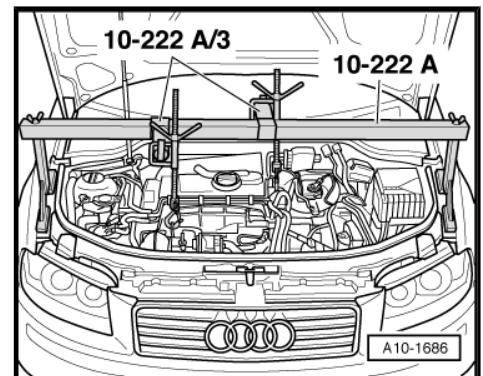
- Remove tensioner for poly V-belt -arrows-.



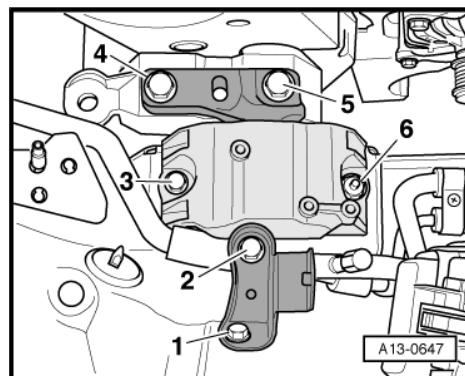
- Remove top toothed belt cover by releasing retaining clips -arrows-.



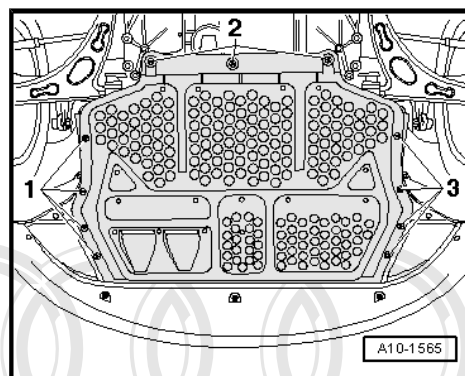
- Set up support bracket -10-222 A- with adapters -10-222 A/3- on wing panel flanges.
- Attach hooks of spindles to lifting eyes.
- Take up weight of engine evenly with both spindles (do not raise).



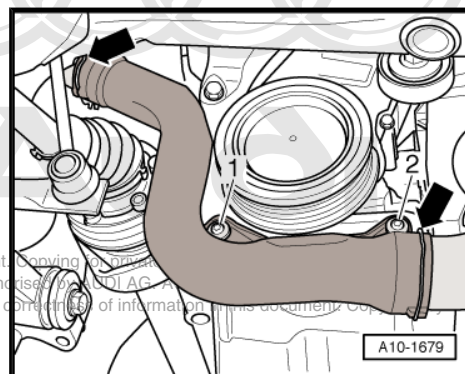
- Remove bolts -1- and -2- and detach connecting bracket.
- Remove bolts -3 ... 6- and remove engine mounting.



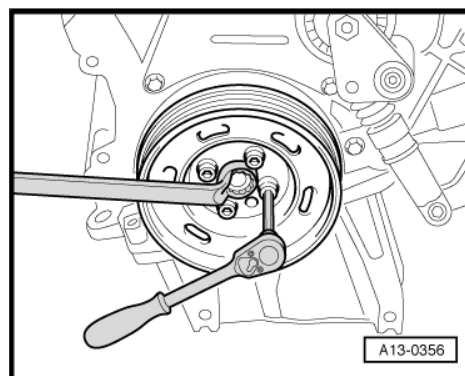
- Remove centre noise insulation -fasteners 1 ... 3-.



- Remove bolts -1- and -2-.
- Remove air pipe (right-side) by lifting retaining clips -arrows- slightly.

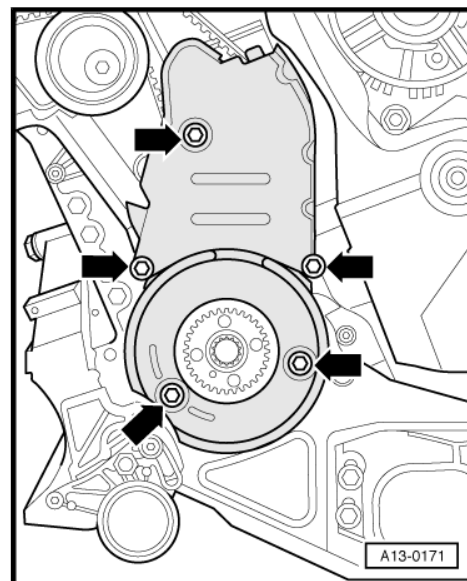


- Remove cover cap for vibration damper.
- Unbolt vibration damper; counterhold on centre bolt with ring spanner.



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- Unbolt lower and centre toothed belt covers -arrows-.

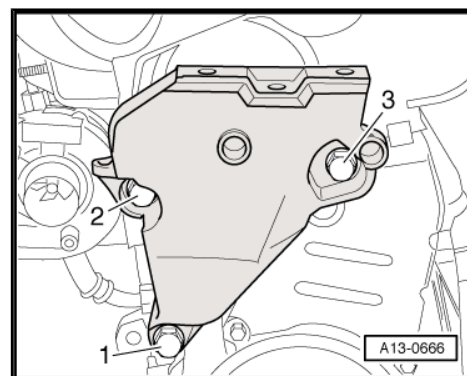


- Remove bolts -1 ... 3- for engine support.

**Note**

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

- Raise engine/gearbox assembly slightly with spindles and remove engine support.

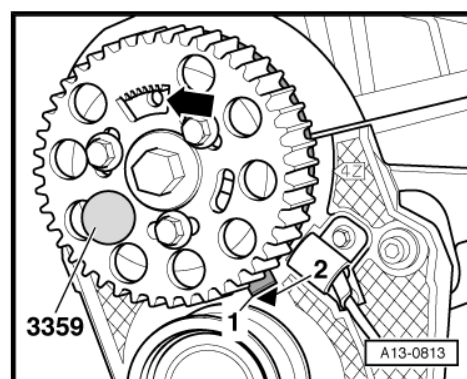
**Caution**

*The engine must only be turned at the crankshaft, in the direction of normal engine rotation (clockwise).*

- Turn the crankshaft to TDC for cylinder No. 1.
- Toothed segment -arrow- in camshaft sprocket must face upwards.
- The lug -1- on sender wheel for camshaft must align with the marking -2- on rear toothed belt cover (not fitted on all versions).

**Note**

*Camshaft sprocket is shown in illustration with toothed belt removed.*



- Lock hub on camshaft with locking pin -3359-.

- Lock crankshaft sprocket using crankshaft stop -T10050- for engines with circular crankshaft sprocket, or crankshaft stop -T10100- for engines with oval crankshaft sprocket.
- The markings on the toothed belt sprocket and the crankshaft stop must align -arrow-. The lug of the crankshaft stop must engage in the bore in the sealing flange.



### Note

*The crankshaft stop can only be pushed onto the sprocket from the front face of the teeth.*

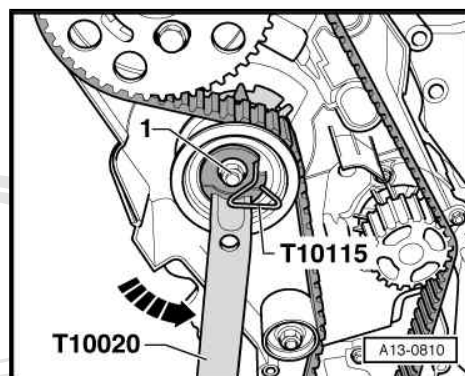
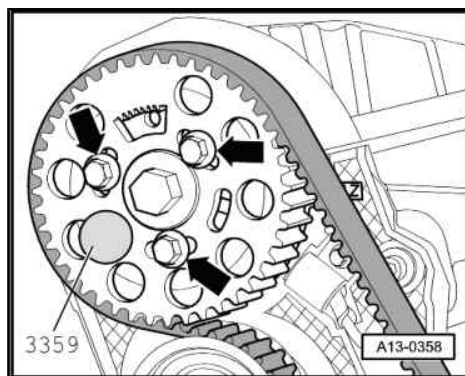
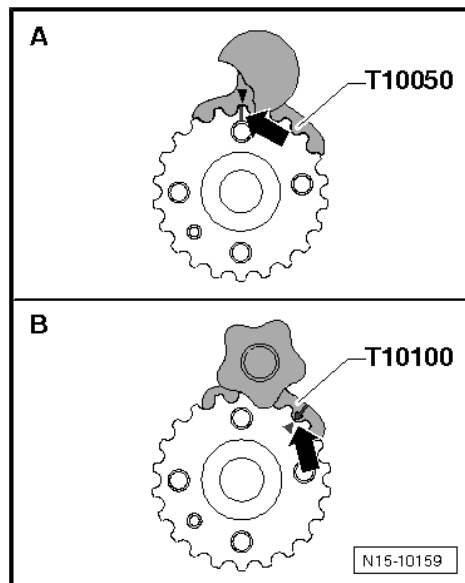
- Mark direction of rotation of toothed belt with chalk or felt-tip pen.
- Loosen securing bolts for camshaft sprocket -arrows-.

- Loosen securing nut -1- for tensioning roller.
- Turn eccentric adjuster anti-clockwise -arrow- using pin wrench -T10020- until tensioning roller can be secured with locking pin -T10115-.



### Note

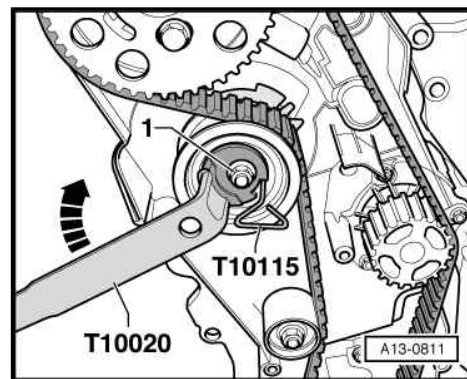
*Instead of using the pin wrench -T10020-, you can also use the 2-hole pin wrench -3387-.*



- Now turn eccentric adjuster of tensioning roller clockwise -arrow- until stop and tighten securing nut -1- finger-tight.
- Take off toothed belt first from coolant pump and then from the remaining sprockets.

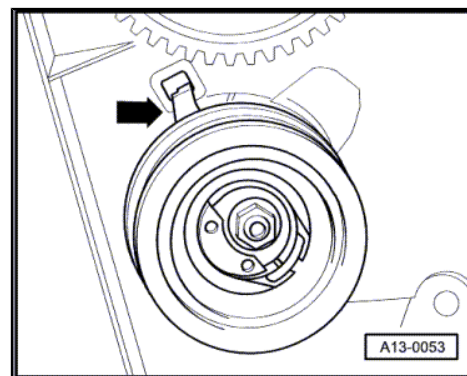
#### Installing (adjusting valve timing)

- Hub on camshaft is locked with locking pin -3359- .
- Crankshaft is locked using crankshaft stop -T10050- for engines with circular crankshaft sprocket, or crankshaft stop -T10100- for engines with oval crankshaft sprocket.
- Tensioning roller is locked with locking pin -T10115- and secured at right stop with securing nut.

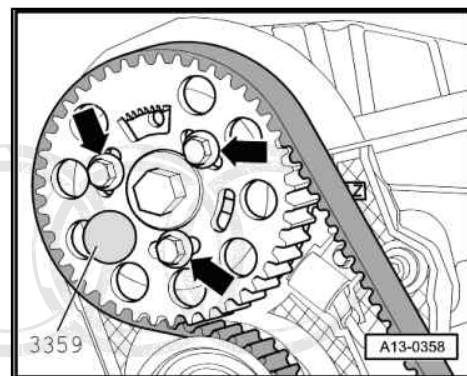


#### Note

- ◆ *Toothed belt adjustment must always be performed when the engine is cold.*
- ◆ *The crankshaft must not be at TDC at any cylinder when the camshaft is turned. Otherwise, there is a risk of damage to valves and piston crowns.*
- Ensure that tensioning roller is seated properly in rear toothed belt cover -arrow-.



- Screw in bolts -arrows-, but do not tighten.
- It should just be possible to turn the camshaft sprocket on the hub without axial movement.
- Turn the camshaft sprocket in its elongated hole clockwise until the stop.
- Fit toothed belt onto sprockets (coolant pump last).



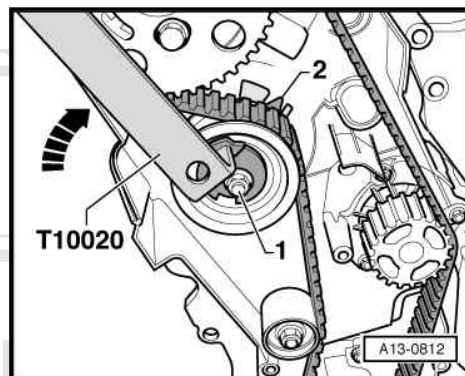
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- Adjust toothed belt tension as follows:
- Remove locking pin -T10115- .
- Loosen securing nut -1- for tensioning roller.
- Turn eccentric adjuster of tensioning roller clockwise -arrow- using pin wrench -T10020- until pointer -2- aligns with centre of slot in base plate.



### Note

*Make sure that the securing nut -1- on the tensioning roller does not turn at the same time.*



- Hold tensioning roller in this position and tighten securing nut -1- on tensioning roller to 20 Nm + 45° (1/8 turn).

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### Note

*When tightening the securing nut -1-, the pointer -2- may move up to 5 mm (maximum) to the right of the slot in the base plate. This position must not be corrected, because the toothed belt stretches slightly when running in.*

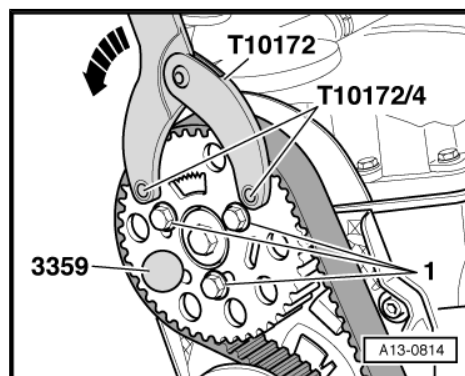
- Attach counterhold tool -T10172- with pins -T10172/4- as illustrated and apply tension to driving section of toothed belt by pressing in direction of -arrow-.
- Tighten bolts -1- on camshaft sprocket to 25 Nm.
- Remove locking pin and crankshaft stop.

### Checking valve timing:



### Caution

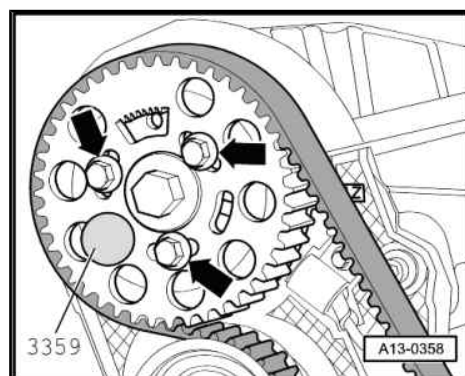
*The engine must only be turned at the crankshaft, in the direction of normal engine rotation (clockwise).*



- Turn crankshaft two rotations in normal direction of rotation until the crankshaft is just before TDC again.
- Lock the camshaft hub into place with the locking pin -3359- while turning.
- Check whether:
  - The crankshaft can be locked using crankshaft stop -T10050- for engines with circular crankshaft sprocket, or crankshaft stop -T10100- for engines with oval crankshaft sprocket.
  - The tensioner pointer is centred or a maximum of 5 mm to the right of the slot in the base plate.

### If the crankshaft cannot be locked:

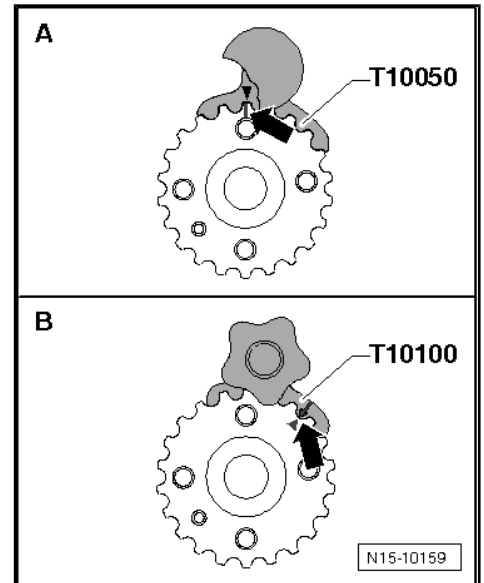
- Loosen securing bolts for camshaft sprocket -arrows-.



- Turn the crankshaft slightly further in the normal direction of rotation until it can be locked with crankshaft stop -T10050- or -T10100- .

 **Note**

*If the crankshaft has been rotated beyond TDC, turn it back slightly so you can then reset it to TDC by turning in the normal direction of rotation.*



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- Tighten securing bolts for camshaft sprocket -arrows- to 25 Nm.
- Remove locking pin and crankshaft stop.



### Caution

*The engine must only be turned at the crankshaft, in the direction of normal engine rotation (clockwise).*

- Turn crankshaft two rotations in normal direction of rotation until crankshaft is at TDC again.
- Check valve timing once again ⇒ [page 50](#) .

### Assembling

Perform further installation in reverse order, paying attention to the following:

- Install toothed belt cover (bottom and centre).



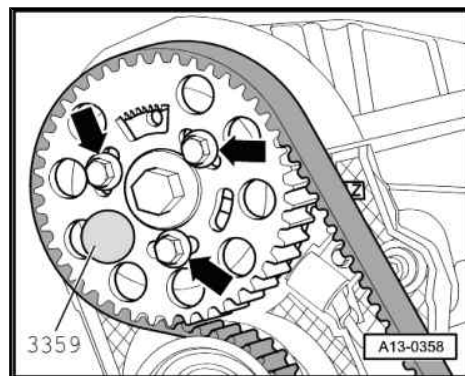
### Note

- ◆ Renew bolts for engine support.
- ◆ Renew seals and gaskets.
- ◆ Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ *Parts catalogue*.

- Secure engine support ⇒ [page 27](#) .
- Install vibration damper ⇒ [page 31](#) .
- Adjust assembly mountings ⇒ [page 25](#) .
- Install air pipes/hoses with plug-in connectors ⇒ [page 196](#) .
- Install poly V-belt ⇒ [page 30](#) .

### Tightening torques

| Component                                                                                                                                                                                                                                                                                   | Nm                       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| Tensioning roller for toothed belt to cylinder head                                                                                                                                                                                                                                         | 20 + 45° <sup>1)</sup>   |
| Camshaft sprocket to hub                                                                                                                                                                                                                                                                    | 25                       |
| Toothed belt cover (bottom) to cylinder block                                                                                                                                                                                                                                               | 10 <sup>2)</sup>         |
| Toothed belt cover (centre) to cylinder block                                                                                                                                                                                                                                               | 10 <sup>2)</sup>         |
| Engine mounting to body                                                                                                                                                                                                                                                                     | 50                       |
| Connecting bracket to engine mounting/body                                                                                                                                                                                                                                                  | 20 + 90° <sup>3)4)</sup> |
| Tensioner for poly V-belt to bracket for ancillaries                                                                                                                                                                                                                                        | 23                       |
| Air pipes to engine                                                                                                                                                                                                                                                                         | 8                        |
| <ul style="list-style-type: none"> <li>• <sup>1)</sup> 45° = one eighth turn.</li> <li>• <sup>2)</sup> Install using locking fluid; for locking fluid refer to ⇒ <i>Parts catalogue</i> .</li> <li>• <sup>3)</sup> Renew bolts.</li> <li>• <sup>4)</sup> 90° = one quarter turn.</li> </ul> |                          |



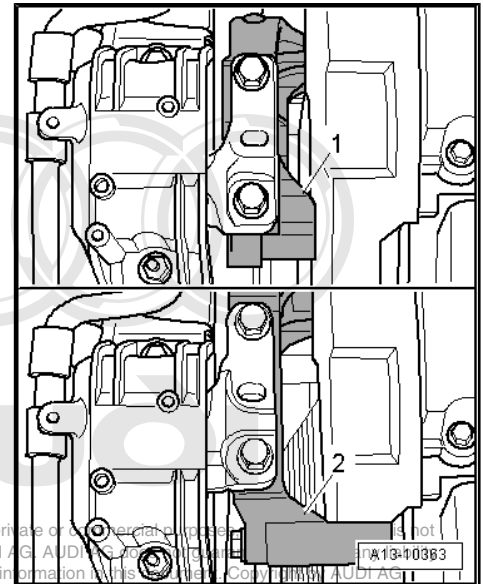
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## 1.7 Removing and installing toothed belt - vehicles from approx. 06.2005 onwards



### Note

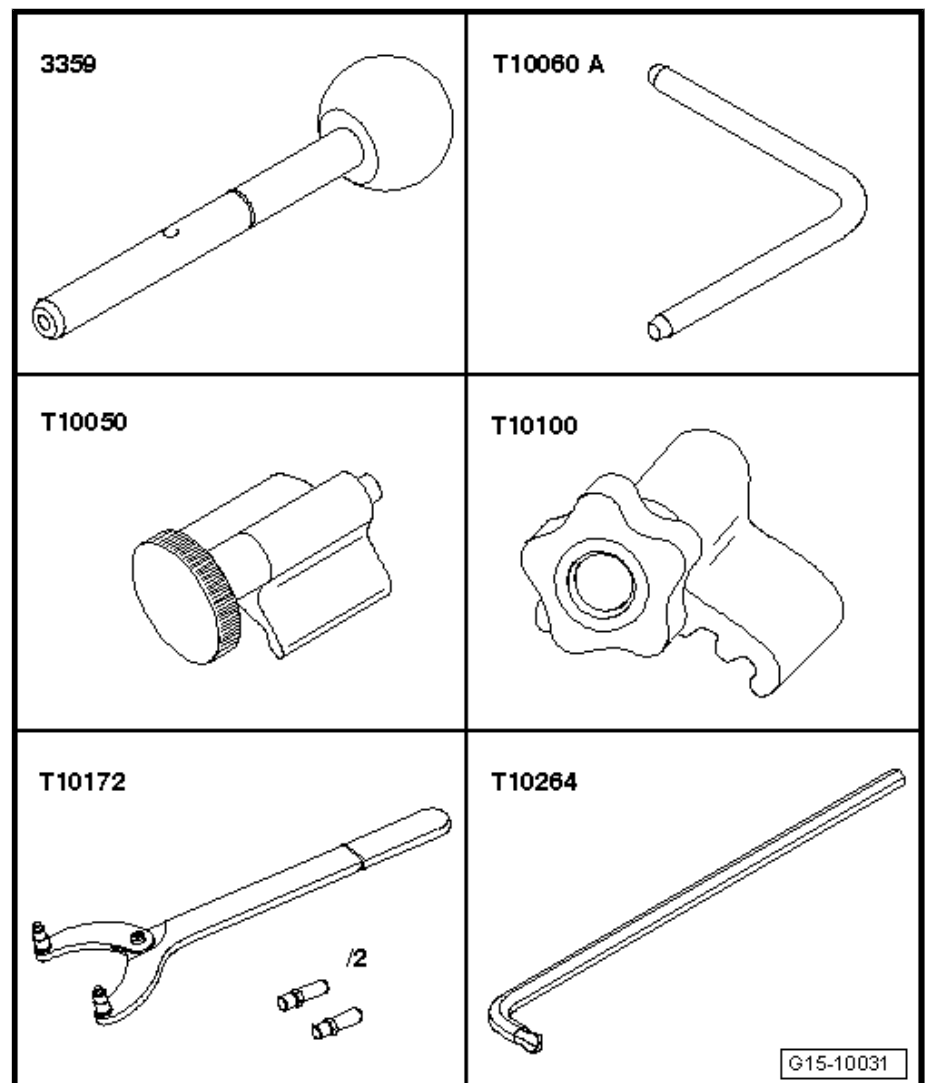
On vehicles from approx. 06.2005 onwards (can be identified by engine support -version 2-), the engine support does not have to be removed before removing the toothed belt.



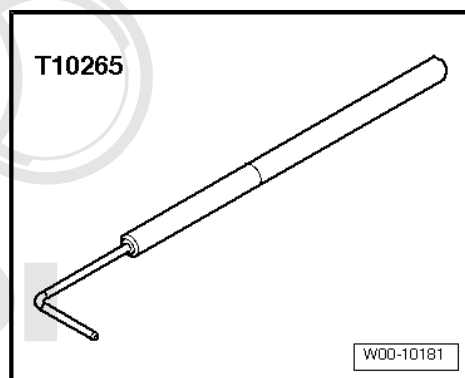
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### Special tools and workshop equipment required

- ◆ Locking pin -3359-
- ◆ Locking pin -T10060 A- or -T10060-
- ◆ Crankshaft stop -T10050-
- ◆ Crankshaft stop -T10100-
- ◆ Counter-hold tool -T10172- with pin -T10172/4-
- ◆ Angle driver -T10264-
- ◆ Locking fluid ⇒ Parts catalogue



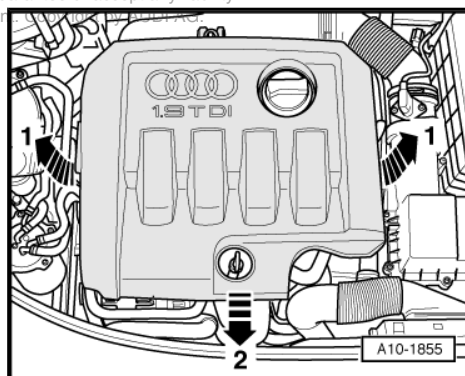
- ◆ Locking tool -T10265-



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## Removing

- Lift engine cover panel at sides -arrows 1- and pull off towards front -arrow 2-.

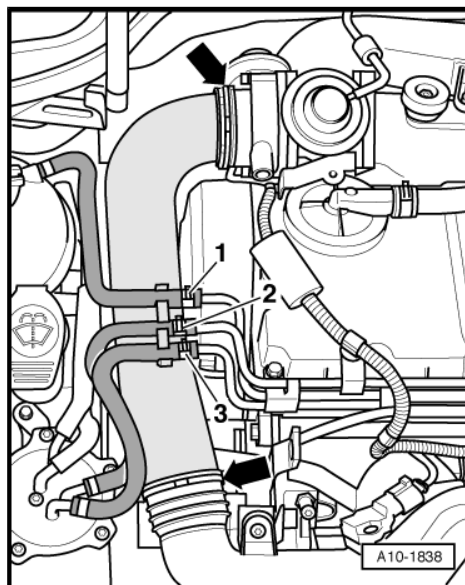


- Detach the hoses/lines -1 ... 3- from air pipe.
- Remove air pipe by lifting retaining clips -arrows- slightly.

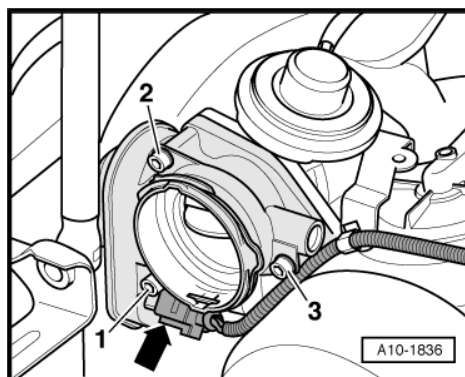


## Note

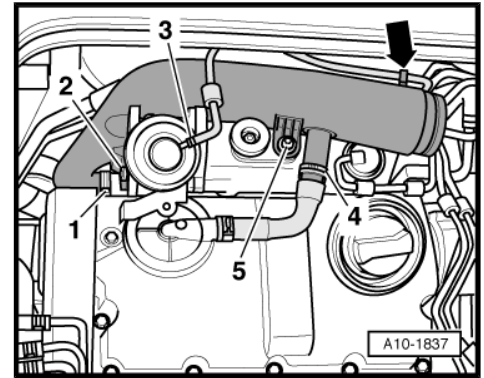
Leave coolant hose -1- and fuel lines -2- and -3- connected.



- Detach electrical connector -arrow- at intake manifold flap motor -V157- .
- Unscrew bolts -1 ... 3- and remove intake manifold flap motor -V157- .

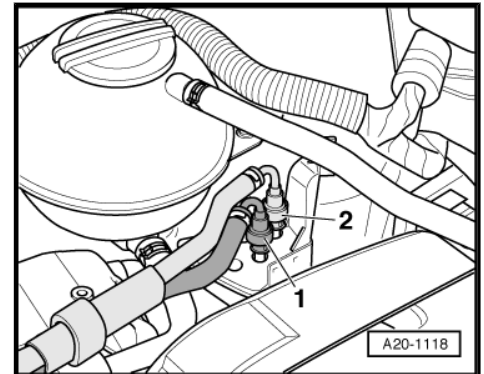


- Disconnect vacuum hose -3- at exhaust gas recirculation valve -N18- .
- Detach pipe -4- for crankcase breather at air pipe.
- Release hose clip -1- at turbocharger using hose clip pliers - VAS 6340- .
- Move the vacuum hoses clear -arrow-.
- Unscrew bolts -2- and -5- and remove air pipe.

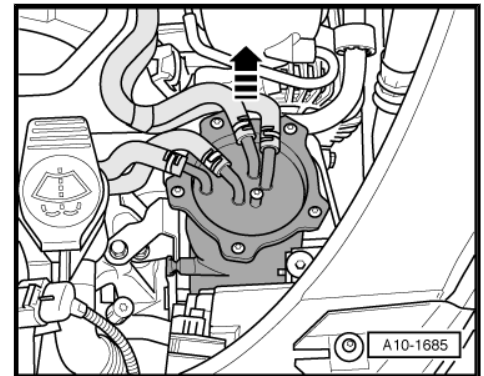
**WARNING**

- ◆ *In extreme cases the fuel lines and the fuel can reach a temperature of 100 °C on vehicles with unit injector engine. Allow the fuel to cool down before disconnecting the lines - danger of scalding.*
- ◆ *Wear protective gloves.*
- ◆ *Wear safety goggles.*

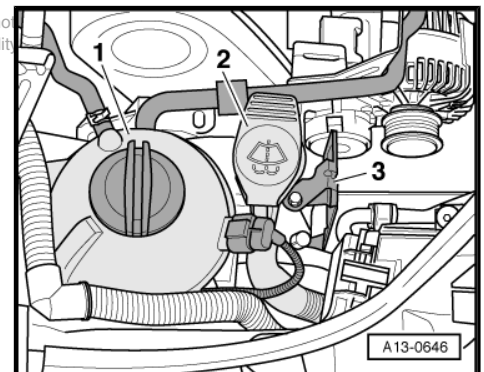
- Disconnect fuel supply line -2- and fuel return line -1- by pulling release tabs.



- Release catches and pull fuel filter with hoses attached upwards out of the bracket -arrow- and place to side.



- Unscrew bracket -3- for fuel filter.
- Unscrew bolt at filler neck -2- for washer fluid reservoir.
- Detach electrical connector at coolant expansion tank.
- Unscrew coolant expansion tank -1- and place on top of cylinder head cover with the hoses attached.

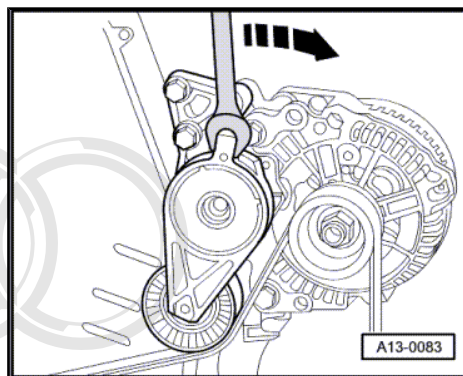




# Note

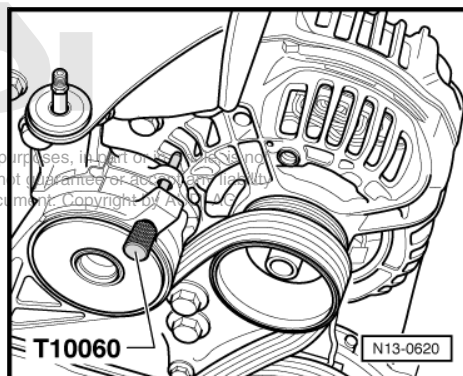
Before removing, mark direction of rotation of poly V-belt with chalk or felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.

- To slacken the poly V-belt, turn the tensioner in the direction of the -arrow-.

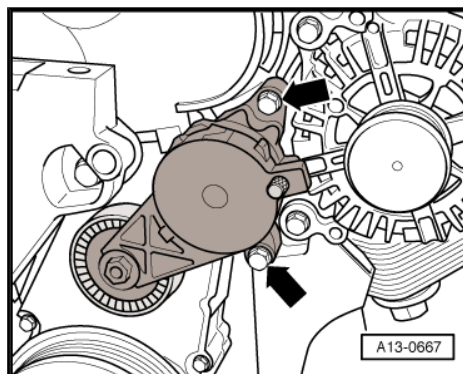


- Lock tensioner for poly V-belt in position with locking pin - T10060 A- or -T10060- .
- Remove poly V-belt.

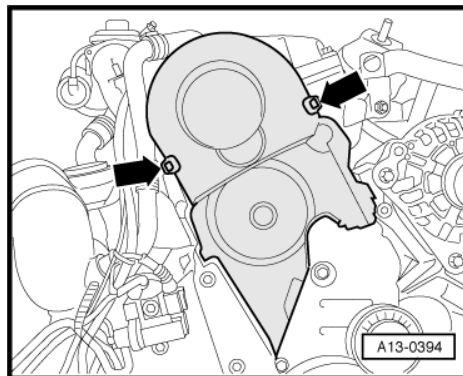
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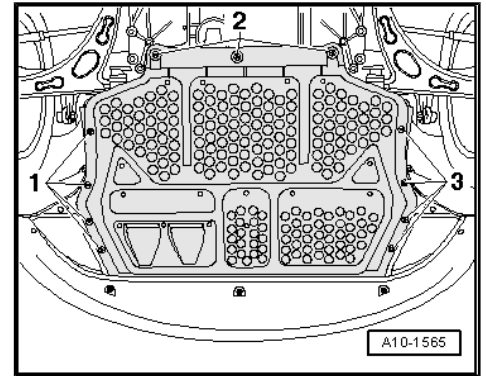
- Remove tensioner for poly V-belt -arrows-.



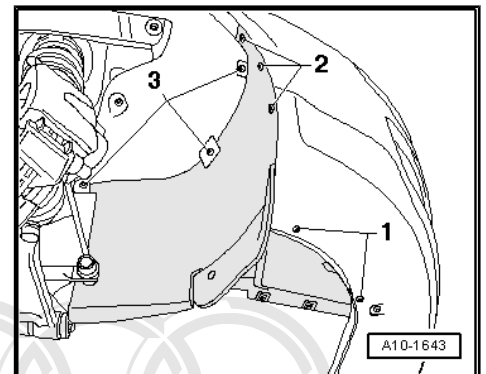
- Remove top toothed belt cover by releasing retaining clips -arrows-.



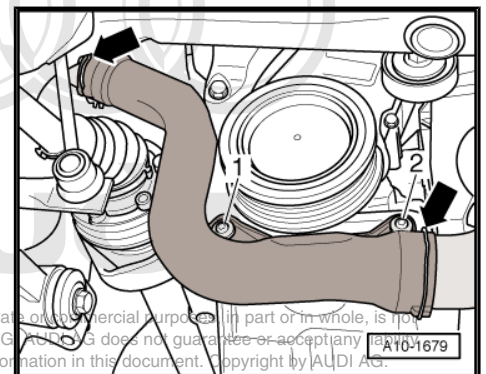
- Remove front right wheel.
- Remove centre noise insulation -fasteners 1 ... 3-.



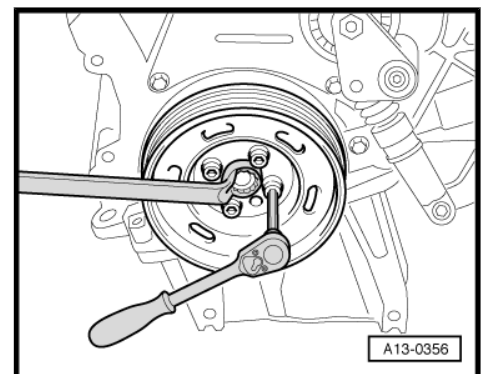
- Remove noise insulation (right-side) -fasteners 1 ... 3-.



- Remove bolts -1- and -2-.
- Remove air pipe (right-side) by lifting retaining clips -arrows- slightly.



- Remove cover cap for vibration damper.
- Unbolt vibration damper; counterhold on centre bolt with ring spanner.



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- Unbolt toothed belt cover (centre and bottom) -arrows-.



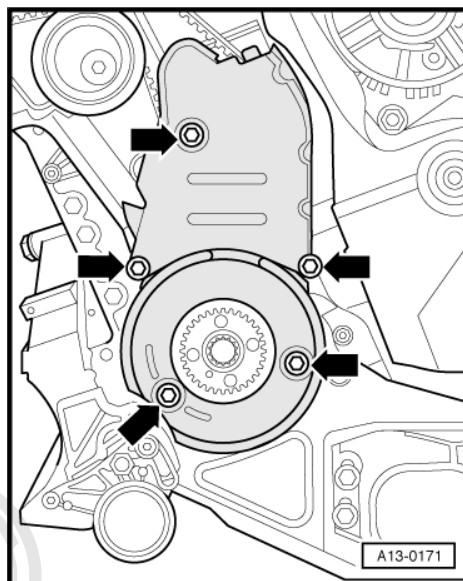
### Caution

*The engine must only be turned at the crankshaft, in the direction of normal engine rotation (clockwise).*



### Note

*Turn over the engine at the central bolt on the crankshaft.*

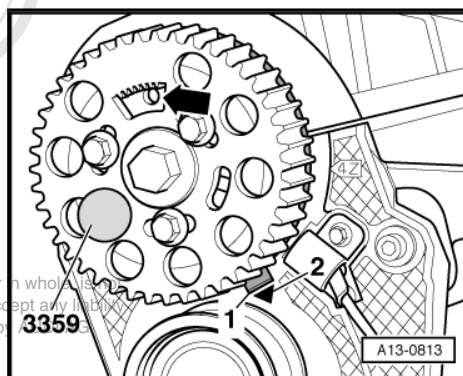


- Turn the crankshaft to TDC for cylinder No. 1.
- Toothed segment -arrow- in camshaft sprocket must face upwards.
- The lug -1- on sender wheel for camshaft must align with the marking -2- on rear toothed belt cover (not fitted on all versions).



### Note

*Camshaft sprocket is shown in illustration with toothed belt removed.*

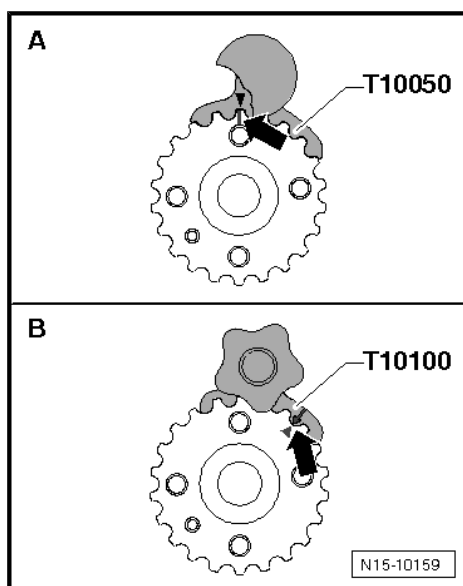


- Lock hub on camshaft with locking pin -3359- .
- Lock crankshaft sprocket using crankshaft stop -T10050- for engines with circular crankshaft sprocket, or crankshaft stop -T10100- for engines with oval crankshaft sprocket.
- The markings on the toothed belt sprocket and the crankshaft stop must align -arrow-. The lug of the crankshaft stop must engage in the bore in the sealing flange.

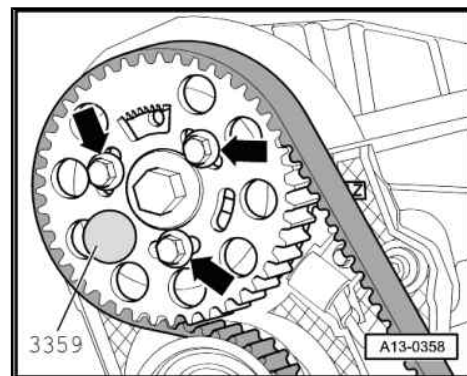


### Note

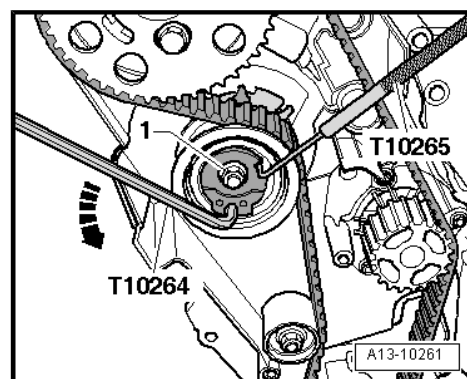
*The crankshaft stop can only be pushed onto the sprocket from the front face of the teeth.*



- Mark direction of rotation of toothed belt with chalk or felt-tip pen.
- Loosen securing bolts for camshaft sprocket -arrows-.



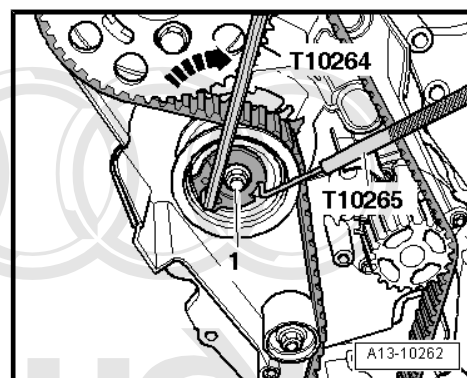
- Loosen securing nut -1- for tensioning roller.
- Turn the eccentric adjuster with the angle driver -T10264- anti-clockwise -arrow- until the tensioning roller can be secured with the locking tool -T10265-.



- Now turn eccentric adjuster of tensioning roller clockwise -arrow- until stop and tighten securing nut -1- finger-tight.
- Take off toothed belt first from coolant pump and then from the remaining sprockets.

#### Installing (adjusting valve timing)

- Hub on camshaft is locked with locking pin -3359-.
- Crankshaft is locked using crankshaft stop -T10050- for engines with circular crankshaft sprocket, or crankshaft stop -T10100- for engines with oval crankshaft sprocket.
- Tensioning roller is locked with locking pin -T10265- and secured at right stop with securing nut.

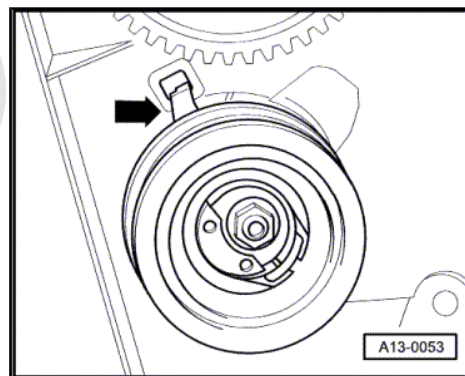


#### Note

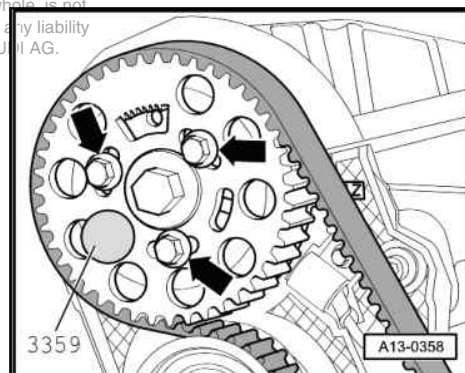
- ◆ *Toothed belt adjustment must always be performed when the engine is cold.*
- ◆ *The crankshaft must not be at TDC at any cylinder when the camshaft is turned. Otherwise, there is a risk of damage to valves and piston crowns.*

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- Ensure that tensioning roller is seated properly in rear toothed belt cover -arrow-.



- Screw in bolts -arrows- but do not tighten.
- It should just be possible to turn the camshaft sprocket on the hub without axial movement.
- Turn the camshaft sprocket in its elongated hole clockwise until the stop.
- Fit toothed belt onto sprockets (coolant pump last).

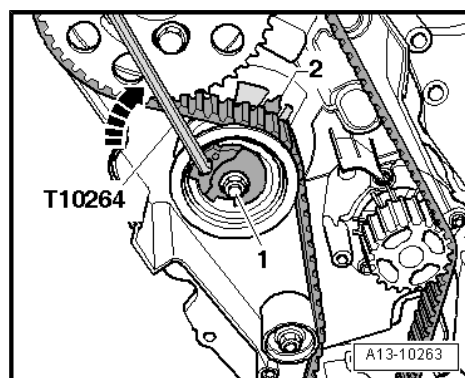


- Adjust toothed belt tension as follows:
- Remove locking tool -T10265- from tensioning roller.
- Loosen securing nut -1- for tensioning roller.
- Turn eccentric adjuster of tensioning roller clockwise -arrow- using angle driver -T10264- until pointer -2- aligns with the centre of the slot on the base plate.



### Note

Make sure that the securing nut -1- on the tensioning roller does not turn at the same time.



- Hold tensioning roller in this position and tighten securing nut -1- on tensioning roller to 20 Nm + 45° (1/8 turn).



### Note

When tightening the securing nut -1-, the pointer -2- may move up to 5 mm (maximum) to the right of the slot in the base plate. This position must not be corrected, because the toothed belt stretches slightly when running in.

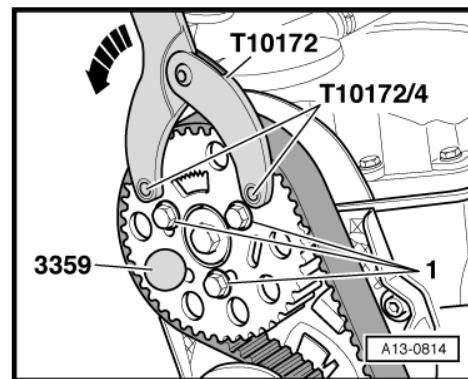
- Attach counterhold tool -T10172- with pins -T10172/4- as illustrated and apply tension to driving section of toothed belt by pressing in direction of -arrow-.
- Tighten bolts -1- on camshaft sprocket to 25 Nm.
- Remove locking pin and crankshaft stop.

#### Checking valve timing



#### Caution

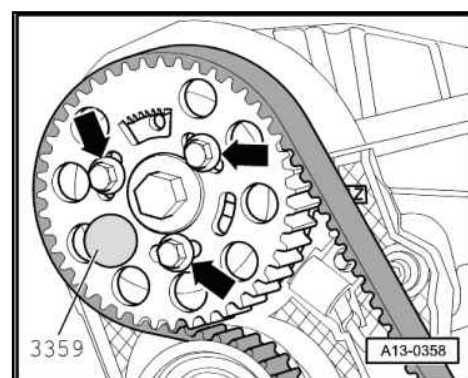
*The engine must only be turned at the crankshaft, in the direction of normal engine rotation (clockwise).*



- Turn crankshaft two rotations in normal direction of rotation until the crankshaft is just before TDC again.
- Lock the camshaft hub into place with the locking pin -3359- while turning.
- Check whether:
  - The crankshaft can be locked using crankshaft stop -T10050- for engines with circular crankshaft sprocket, or crankshaft stop -T10100- for engines with oval crankshaft sprocket.
  - The tensioner pointer is centred or a maximum of 5 mm to the right of the slot in the base plate.

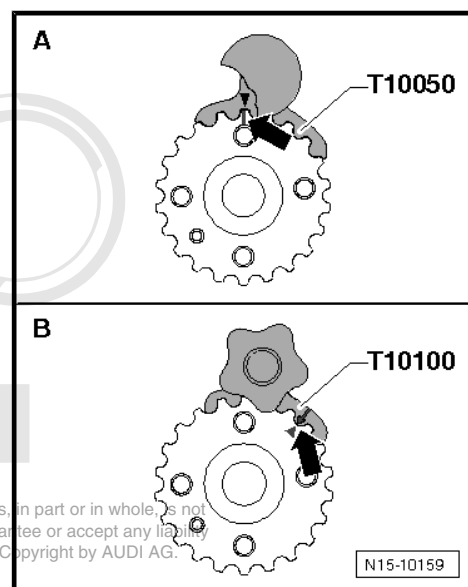
#### If the crankshaft cannot be locked:

- Loosen securing bolts for camshaft sprocket -arrows-.
- Turn the crankshaft slightly further in the normal direction of rotation until it can be locked with crankshaft stop -T10050- or -T10100-.



#### Note

*If the crankshaft has been rotated beyond TDC, turn it back slightly so you can then reset it to TDC by turning in the normal direction of rotation.*



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- Tighten securing bolts for camshaft sprocket -arrows- to 25 Nm.
- Remove locking pin and crankshaft stop.



### Caution

*The engine must only be turned at the crankshaft, in the direction of normal engine rotation (clockwise).*

- Turn crankshaft two rotations in normal direction of rotation until crankshaft is at TDC again.
- Check valve timing once again ⇒ [page 61](#) .

### Assembling

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

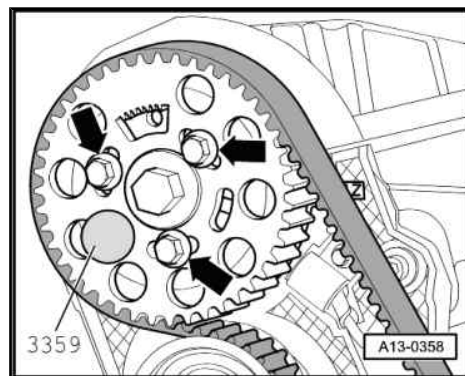


### Note

- ◆ *Renew seals and gaskets.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- Install toothed belt cover (bottom and centre).
- Install vibration damper ⇒ [page 31](#) .
- Install air pipes/hoses with plug-in connectors ⇒ [page 196](#) .
- Install poly V-belt ⇒ [page 30](#) .

### Tightening torques

| Component                                                                                                                                                                                     | Nm                     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Tensioning roller for toothed belt to cylinder head                                                                                                                                           | 20 + 45° <sup>1)</sup> |
| Camshaft sprocket to hub                                                                                                                                                                      | 25                     |
| Toothed belt cover (bottom) to cylinder block                                                                                                                                                 | 10 <sup>2)</sup>       |
| Toothed belt cover (centre) to cylinder block                                                                                                                                                 | 10 <sup>2)</sup>       |
| Tensioner for poly V-belt to bracket for ancillaries                                                                                                                                          | 23                     |
| Air pipes to engine                                                                                                                                                                           | 8                      |
| <ul style="list-style-type: none"> <li>• <sup>1)</sup> 45° = one eighth turn.</li> <li>• <sup>2)</sup> Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue .</li> </ul> |                        |



## 2 Removing and installing sealing flanges and dual-mass flywheel

### 2.1 Sealing flanges and dual-mass flywheel - exploded view



Note

*Servicing clutch ⇒ Rep. gr. 30*

1 - 15 Nm

#### 2 - Oil seal

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- ☐ Renewing ⇒ [page 64](#)
- ☐ Do not lubricate with oil

#### 3 - Sealing flange (pulley end)

- ☐ Must be positioned on dowel sleeves
- ☐ Removing and installing ⇒ [page 66](#)

#### 4 - Cylinder block

#### 5 - Dual-mass flywheel

- ☐ Removing and installing ⇒ [page 77](#)
- ☐ Can only be installed in one position (holes are off-set)

#### 6 - 60 Nm + 90° (1/4 turn) further

- ☐ Renew

#### 7 - Intermediate plate

- ☐ Must be positioned on dowel sleeves
- ☐ Do not damage/bend when assembling
- ☐ Is fitted onto sealing flange ⇒ [page 64](#)

#### 8 - Sender wheel

- ☐ For engine speed sender -G28-
- ☐ Removing and installing ⇒ "2.4 Renewing sealing flange (flywheel end)", [page 69](#)

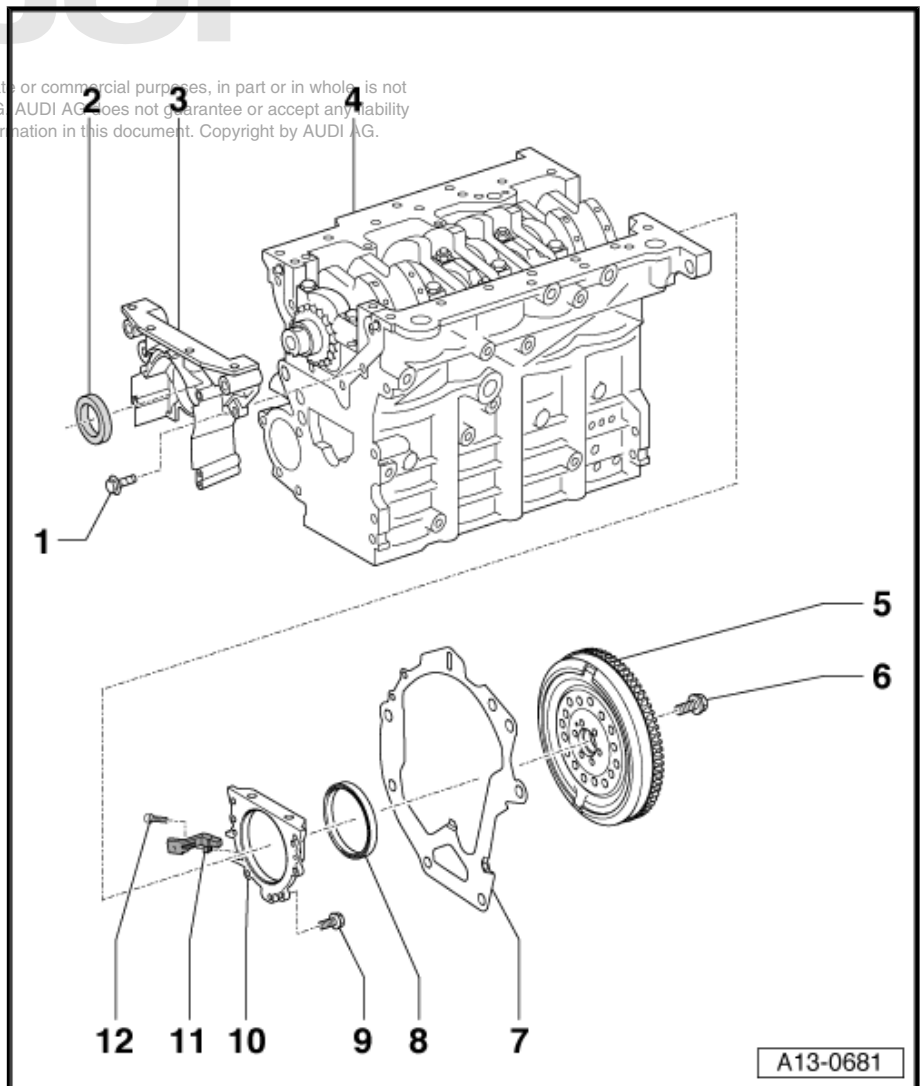
9 - 15 Nm

#### 10 - Sealing flange (flywheel end)

- ☐ With oil seal
- ☐ Renewing ⇒ [page 69](#)

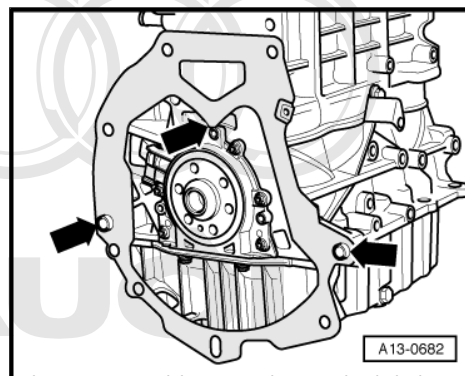
#### 11 - Engine speed sender -G28-

12 - 4.5 Nm



## Installing intermediate plate

- Fit intermediate plate on sealing flange and push onto dowel sleeves -arrows-.



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## 2.2 Renewing crankshaft oil seal (pulley end)

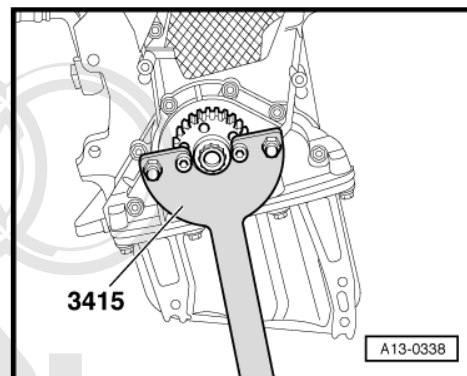
### Special tools and workshop equipment required

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

|                      |                        |
|----------------------|------------------------|
| <p><b>3203</b></p>   | <p><b>3415</b></p>     |
| <p><b>T10053</b></p> |                        |
|                      | <p><b>G13-0017</b></p> |

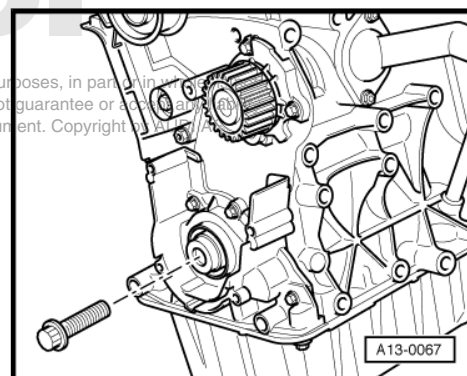
## Procedure

- Engine in vehicle.
- Remove toothed belt:
- ◆ Vehicles up to approx. 05.2005 ⇒ [page 41](#)
- ◆ Vehicles from approx. 06.2005 onwards ⇒ [page 53](#)
- Remove crankshaft sprocket; use counterhold tool -3415- to lock sprocket in place.

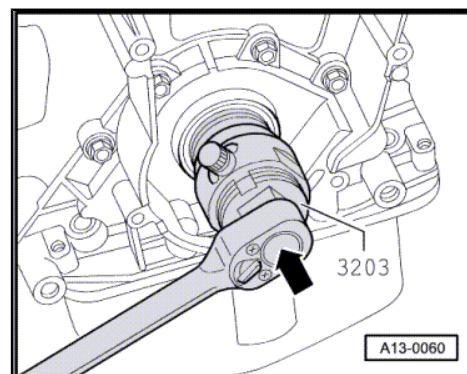


- Before fitting oil seal extractor, fully screw in centre bolt for sprocket into crankshaft.

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- Unscrew inner section of oil seal extractor -3203- 8 turns out of outer section and lock with knurled screw.
- Lubricate threaded head of oil seal extractor, place it in position and screw it into oil seal as far as possible (applying firm pressure).
- 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.



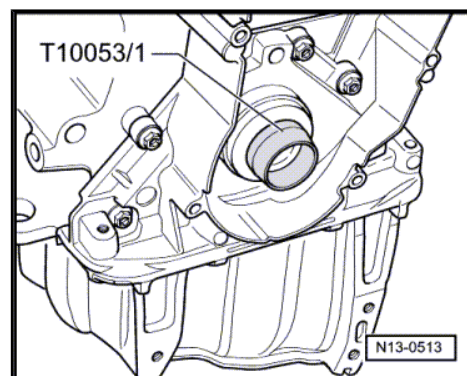
- Clean running surface and sealing surface.



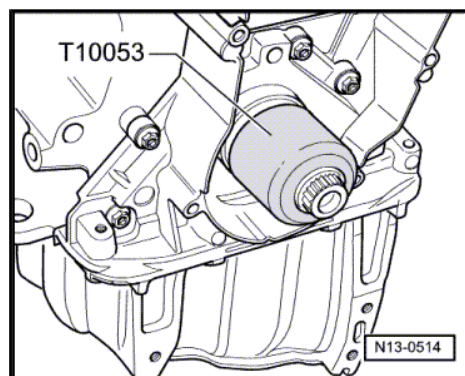
### Note

*Do not lubricate sealing lip and outer rim of oil seal before pressing in.*

- Place guide sleeve -T10053/1- onto crankshaft journal.
- Slide oil seal over guide sleeve.



- Press in oil seal flush using the centre bolt of toothed belt sprocket and press sleeve from -T10053- .

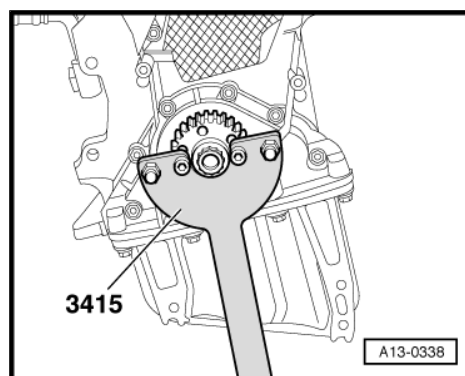


- Renew centre bolt for toothed belt sprocket.



### Note

- ◆ *Contact surface between toothed belt sprocket and crankshaft must be free of oil.*
- ◆ *Do not lubricate bolt for crankshaft sprocket.*
- Install crankshaft sprocket; use counterhold tool -3415- to lock sprocket in place.
- Fit toothed belt (adjust valve timing):
- ◆ Vehicles up to approx. 05.2005 ⇒ [page 49](#)
- ◆ Vehicles from approx. 06.2005 onwards ⇒ [page 59](#)
- Install poly V-belt ⇒ [page 30](#) .



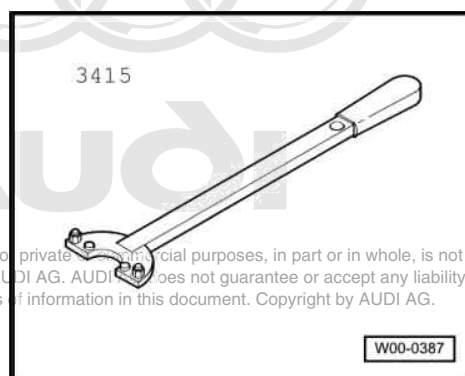
### Tightening torque

| Component                                                                                                | Nm              |
|----------------------------------------------------------------------------------------------------------|-----------------|
| Toothed belt sprocket to crankshaft                                                                      | 120 + 90° 1) 2) |
| <ul style="list-style-type: none"> <li>• 1) Renew bolt.</li> <li>• 2) 90° = one quarter turn.</li> </ul> |                 |

## 2.3 Removing and installing sealing flange, pulley end

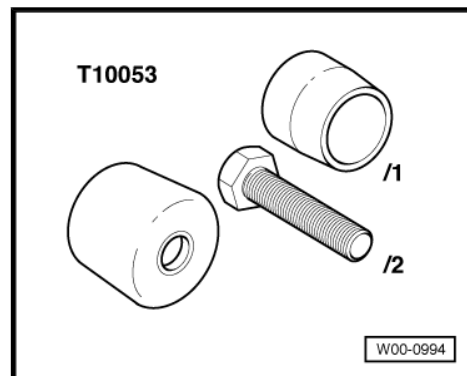
### Special tools and workshop equipment required

- ◆ Counterhold tool -3415-



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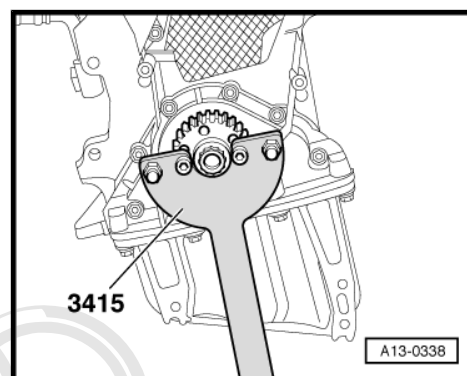
- ◆ Assembly tool -T10053-



- ◆ Electric drill with plastic brush attachment
- ◆ Safety goggles
- ◆ Sealant ⇒ Parts catalogue

### Removing

- Engine in vehicle.
- Remove toothed belt:
- ◆ Vehicles up to approx. 05.2005 ⇒ [page 41](#)
- ◆ Vehicles from approx. 06.2005 onwards ⇒ [page 53](#)
- Remove crankshaft sprocket; use counterhold tool -3415- to lock sprocket in place.



- Remove bolts -1 ... 10-.
- Pry off sealing flange (pulley end) and remove.
- Drive out oil seal with sealing flange removed.

### Installing

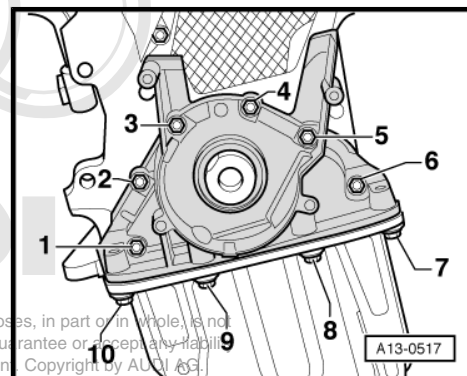
Installation is carried out in the reverse order; note the following:



#### Note

Place a cloth over the exposed section of the sump.

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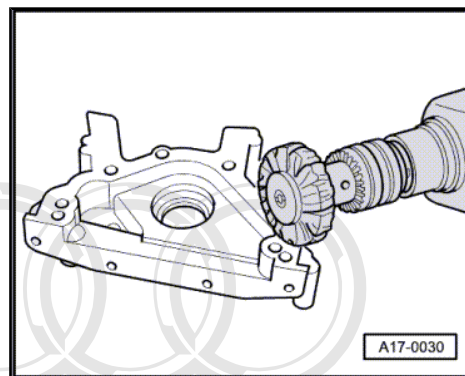
- Carefully remove any sealant residue on the cylinder block and sump.



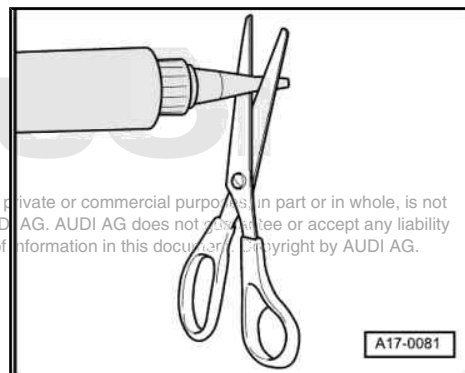
#### WARNING

*Wear safety goggles.*

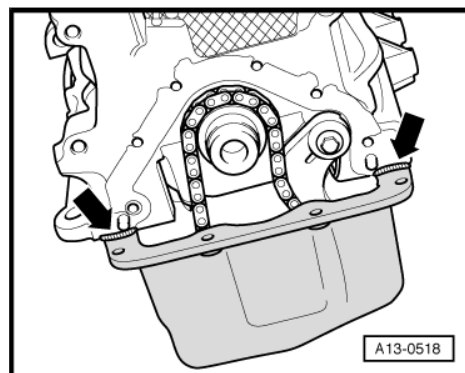
- Remove sealant residue from sealing flange with rotating plastic brush or similar.
- Clean sealing surfaces; they must be free of oil and grease.



- Cut off tube nozzle at front marking (diameter of nozzle approx. 2 mm).



- Apply a thin bead of sealant at the edge of the joint between the cylinder block and the sump -arrows-.

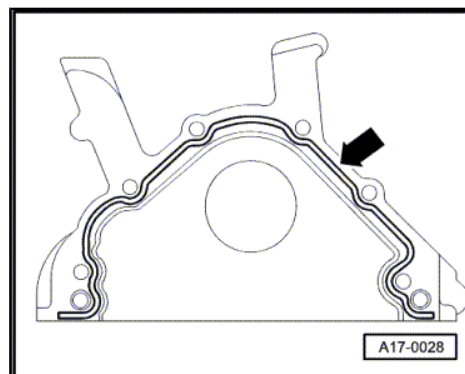


- Apply the bead of sealant onto the clean sealing surface of the sealing flange as illustrated -arrow-.
- Thickness of sealant bead: 2 ... 3 mm



### Note

*Sealant bead must not be wider than 3 mm, otherwise excess sealant could ingress into sump and clog strainer in oil intake pipe.*



- Coat the lower sealing surface on the sealing flange lightly with sealant -hatched area-.

**Note**

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

- Push the sealing flange carefully onto the dowel pins on the cylinder block.

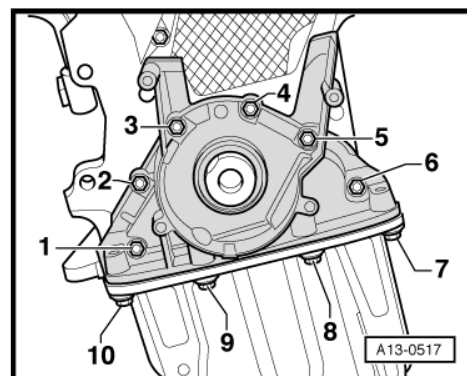
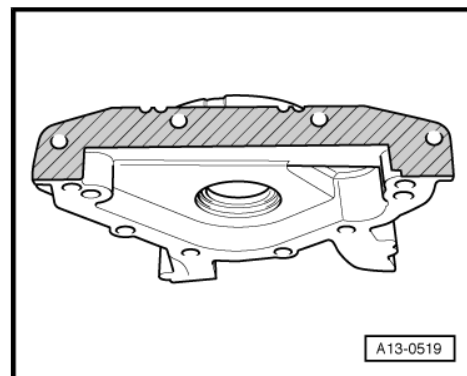
- Tighten bolts in the specified sequence:
- Tighten bolts -1 ... 6-.
- Tighten bolts -7 ... 10-.
- Install crankshaft oil seal (pulley end) ⇒ [page 65](#) .
- Fit toothed belt (adjust valve timing):

◆ Vehicles up to approx. 05.2005 ⇒ [page 49](#)

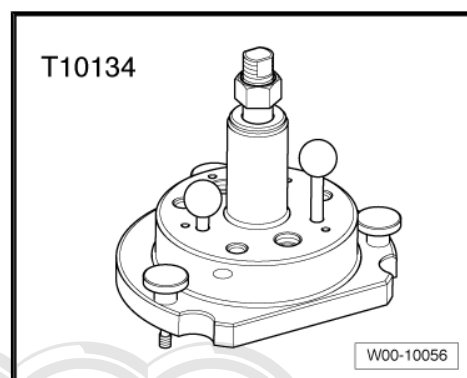
◆ Vehicles from approx. 06.2005 onwards ⇒ [page 59](#)

**Tightening torque**

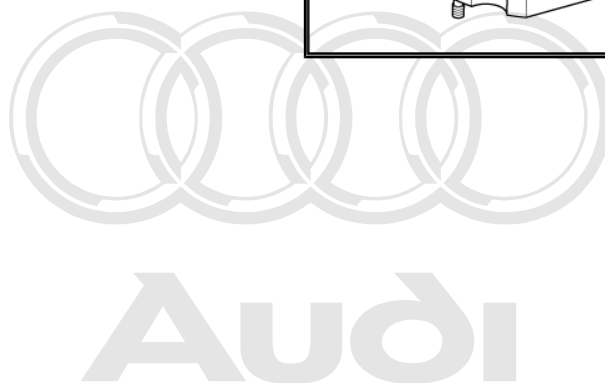
| Component                        | Nm |
|----------------------------------|----|
| Sealing flange to cylinder block | 15 |

**2.4 Renewing sealing flange (flywheel end)****Special tools and workshop equipment required**

- ◆ Assembly tool -T10134-



- ◆ Depth gauge
- ◆ Bolt M6x35 (3x)
- ◆ Bolt M7x35 (2x)

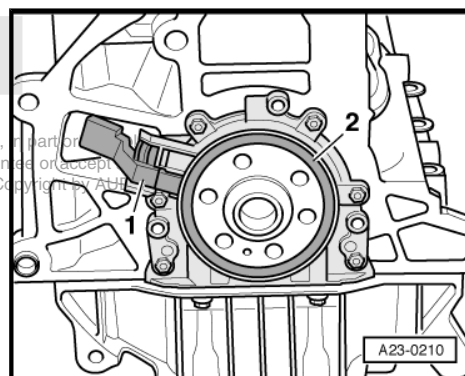
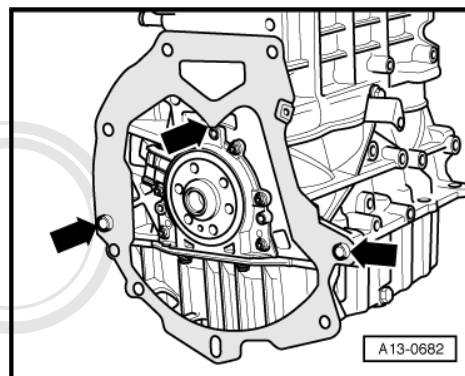


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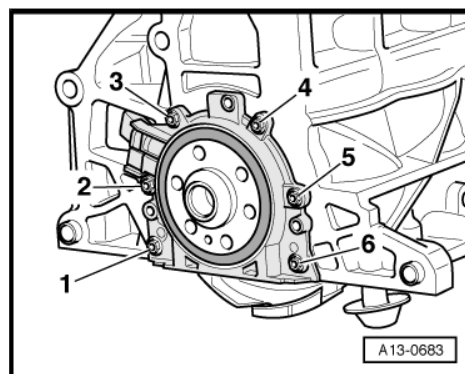
## Pressing out sealing flange with sender wheel

- Gearbox removed.
- Remove dual-mass flywheel ⇒ [page 77](#) .
- Detach intermediate plate at sealing flange and dowel sleeves -arrows-.
- Rotate engine to TDC of No. 1 cylinder:
- ◆ Vehicles up to approx. 05.2005 ⇒ [page 41](#)
- ◆ Vehicles from approx. 06.2005 onwards ⇒ [page 53](#)
- Remove engine speed sender -G28- -item 1- using a standard ball head hexagon key.
- Remove sump ⇒ [page 155](#) .

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- Unscrew securing bolts -1 ... 6- for sealing flange.



**i Note**

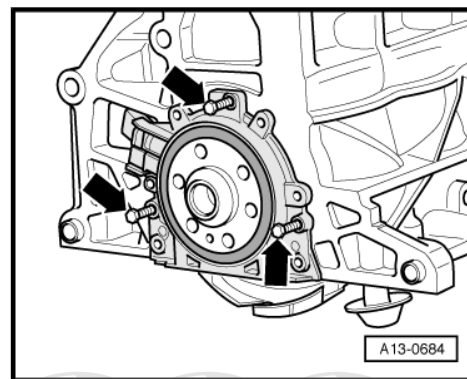
*The sealing flange is pressed off the crankshaft together with the sender wheel.*

- To press out, screw in 3 bolts M6x35 into sealing flange a max. of  $\frac{1}{2}$  turn in alternating sequence.
- Remove sealing flange together with sender wheel.

**Pressing in sealing flange with sender wheel**

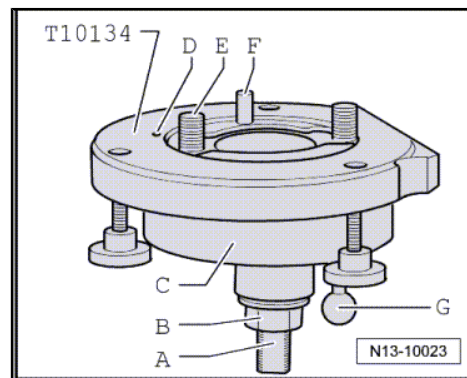
**i Note**

- ◆ *The sealing flange with PTFE oil seal is fitted with a sealing lip support ring. This support ring acts as an assembly sleeve and must not be removed before installation.*
- ◆ *Sealing flange and sender wheel must not be separated or rotated out of position after removal from packaging.*
- ◆ *The sender wheel is held in its installation position by a locating pin on the assembly tool -T10134-.*
- ◆ *The sealing flange and oil seal are one unit and can only be replaced together with the sender wheel.*
- ◆ *The assembly tool -T10134- is held in the correct position relative to the crankshaft by a guide pin which is inserted into a hole in the crankshaft.*



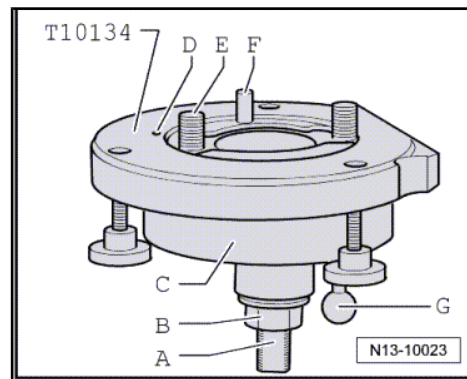
**Construction of assembly tool -T10134-**

- A - Tightening flats
- B - Hexagon nut
- C - Assembly housing
- D - Locating pin
- E - Hexagon socket-head bolt
- F - Guide pin for diesel engines (black handle)
- G - Guide pin for petrol engines (red handle)



**A - Fitting sealing flange with sender wheel onto assembly tool -T10134- :**

- Turn hexagon nut -B- until it is just in front of tightening flats -A- on threaded spindle.

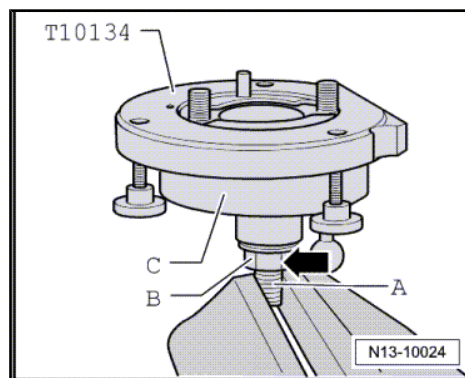


- Clamp assembly tool -T10134- in a vice on tightening flats -A- of threaded spindle.
- Press the assembly housing -C- downwards so that it lies on the hexagon nut -B- -arrow-.



### Note

*Inner part of assembly device and assembly housing must align (be level) with each other.*

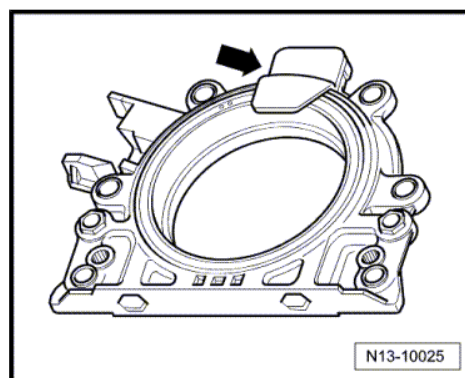


- Remove the securing clip -arrow- from new sealing flange.

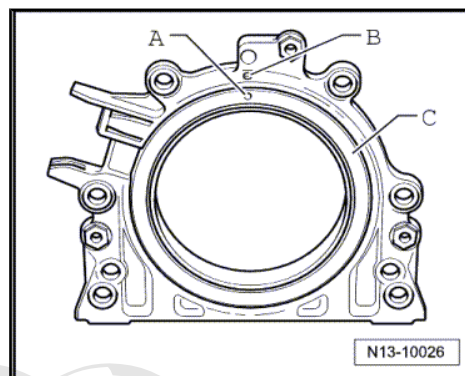


### Note

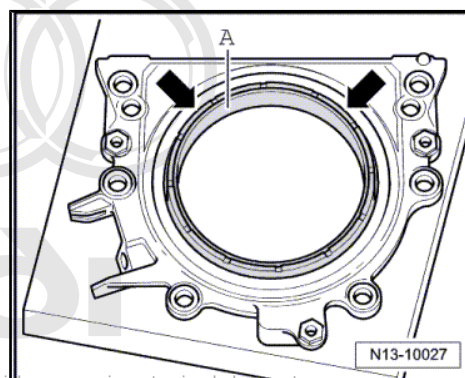
*The sender wheel must not be taken out of the sealing flange or rotated out of position.*



- The locating hole -A- on the sender wheel -C- must align with the marking -B- on the sealing flange.
- Place the sealing flange (with the front side downwards) on a clean flat surface.

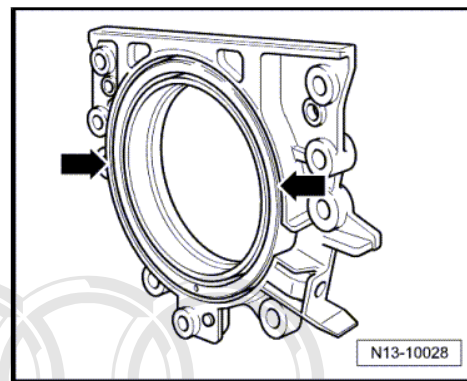


- Press the sealing lip support ring -A- downwards in direction of -arrows- until it lies against the flat surface.



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- The upper edge of the sender wheel and the front edge of the sealing flange must align -arrows-.

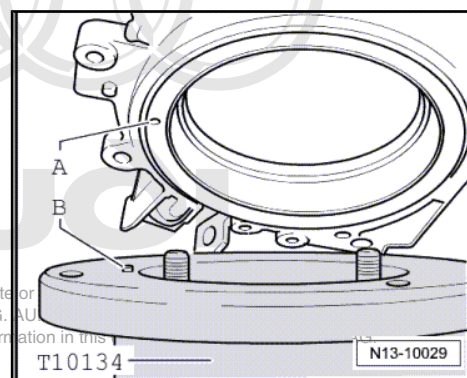


- Place the sealing flange with the front side on the assembly tool -T10134-, so that the locating pin -B- can be inserted in the sender wheel hole -A-.

**Note**

Ensure the sealing flange lies flat on the assembly tool.

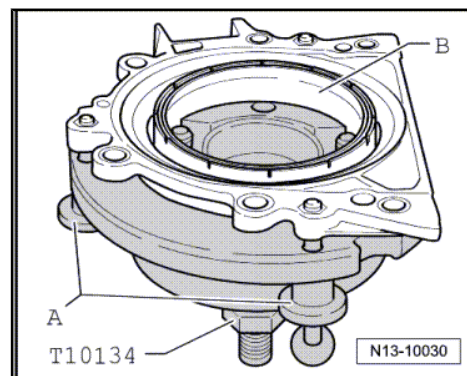
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- While tightening the three knurled screws -A-, press the sealing flange and sealing lip support ring -B- onto the surface of the assembly tool -T10134- so that the locating pin will not slip out of the hole in the sender wheel.

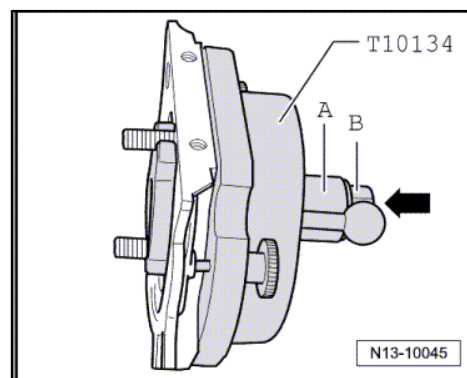
**Note**

Ensure that the sender wheel remains fixed on the assembly tool when installing the sealing flange.

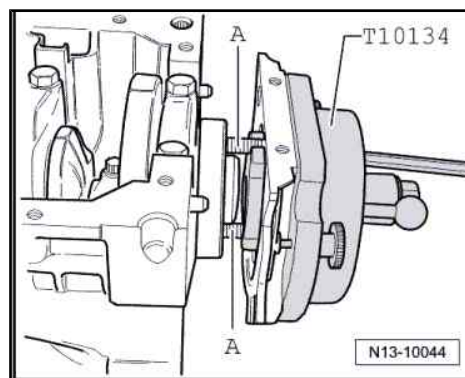


### B - Installing assembly tool -T10134- with sealing flange on crankshaft flange:

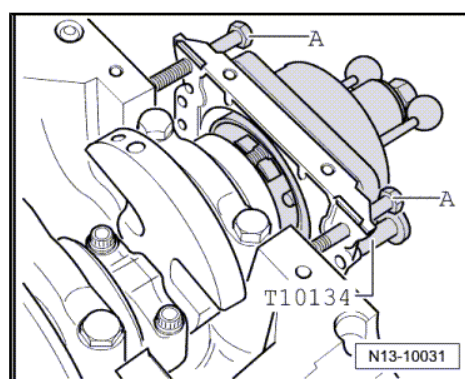
- Crankshaft flange free of oil and grease.
- Engine positioned at TDC (No. 1 cylinder).
- Screw hexagon nut -B- to end of threaded spindle.
- Press the threaded spindle of assembly tool -T10134- in direction of -arrow- until the hexagon nut -B- lies on the assembly housing -A-.
- Position flat edge of assembly housing towards sealing surface for sump on cylinder block.



- Secure assembly tool -T10134- to crankshaft flange by screwing hexagon socket head bolts -A- approx. 5 threads into crankshaft flange.

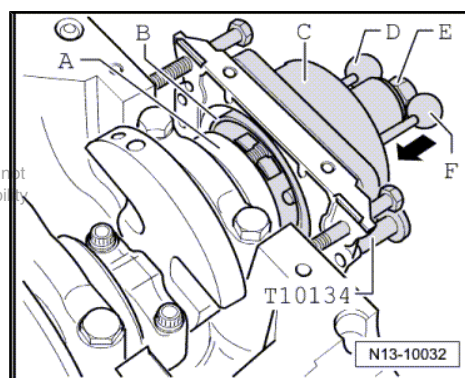


- Screw two bolts M7×35 mm -A- into cylinder block to guide sealing flange.



### C - Securing assembly tool -T10134- onto crankshaft flange:

- Press the assembly housing -C- by hand in the direction of the -arrow- until the sealing lip support ring -B- lies on the surface of the crankshaft flange -A-.
- Press the guide pin for diesel engines (black handle) -D- into hole in crankshaft. This ensures that the sender wheel reaches its final installation position.



### Note

The guide pin for PETROL engines (red handle) -F- MUST NOT be inserted into the threaded hole in the crankshaft.

- Tighten the 2 hexagon socket head bolts on assembly tool finger-tight.
- Screw hexagon nut -E- onto threaded spindle by hand until it lies against the assembly housing -C-.

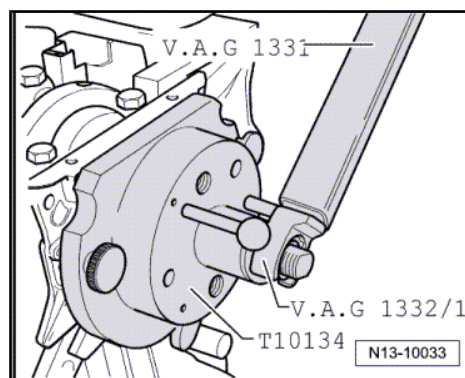
### D - Pressing sender wheel onto crankshaft flange with assembly tool -T10134- :

- Tighten hexagon nut of assembly tool -T10134- to 35 Nm.



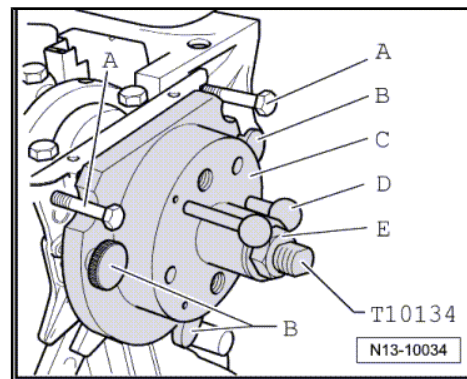
### Note

A small air gap must be present between cylinder block and sealing flange after tightening hexagon nut to 35 Nm.

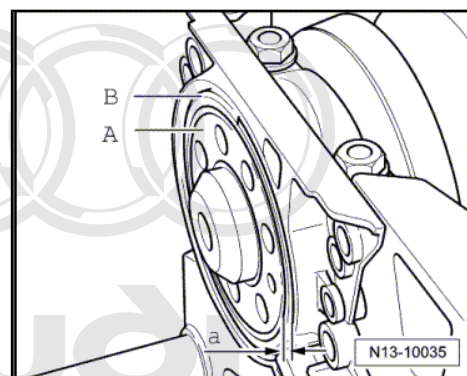


**E - Checking installation position of sender wheel on crankshaft:**

- Screw hexagon nut -E- to end of threaded spindle.
- Unscrew the 2 bolts -A- out of cylinder block.
- Unscrew the 3 knurled screws -B- from sealing flange.
- Remove assembly tool -T10134- .
- Remove sealing lip support ring.



- The sender wheel is positioned correctly on the crankshaft if the distance -a- between the crankshaft flange -A- and sender wheel -B- is 0.5 mm.



- Apply a depth gauge on the crankshaft flange.
- Measure distance -a- between crankshaft flange and sender wheel.

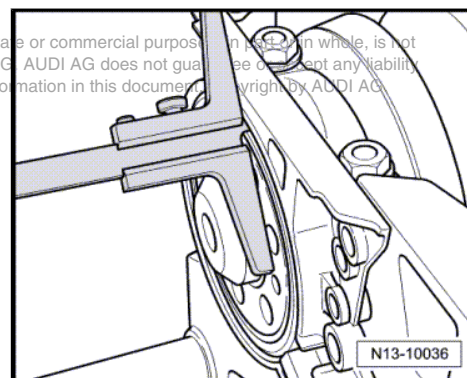
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If dimension -a- is too small:

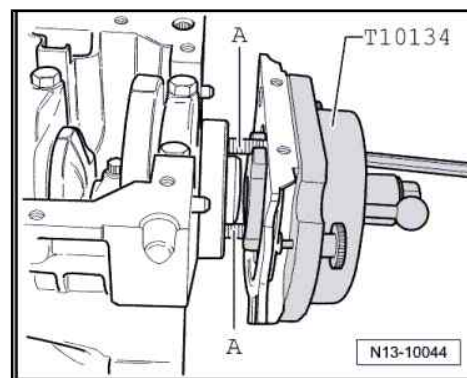
- Press in the sender wheel further ⇒ [page 75](#) .

When dimension -a- is achieved:

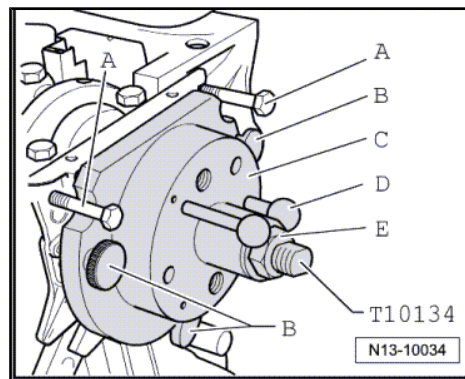
- Continue with assembly ⇒ [page 76](#) .

**F - Pressing sender wheel in further:**

- Secure assembly tool -T10134- to crankshaft flange by tightening hexagon socket head bolts finger-tight -items A-.
- Press the assembly tool -T10134- towards the sealing flange by hand.



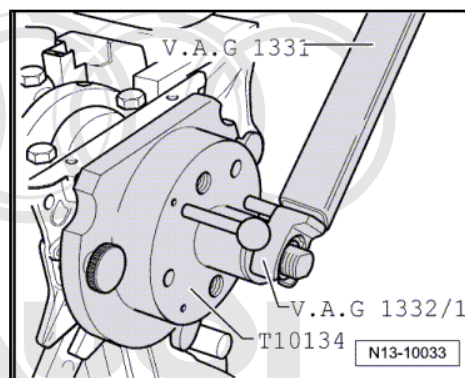
- Screw hexagon nut -E- onto threaded spindle by hand until it lies against the assembly housing -C-.



- Tighten hexagon nut of assembly tool -T10134- to 40 Nm.
- Check installation position of sender wheel on crankshaft again ⇒ [page 75](#) .

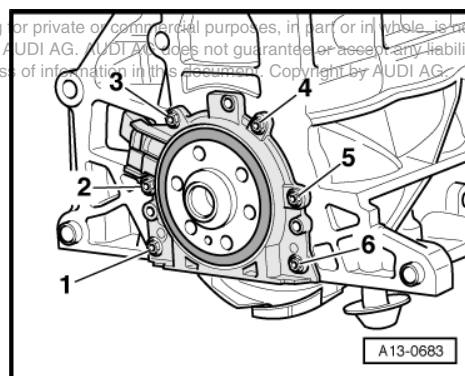
If dimension -a- is too small again:

- Tighten hexagon nut of assembly tool -T10134- to 45 Nm.
- Check installation position of sender wheel on crankshaft again ⇒ [page 75](#) .

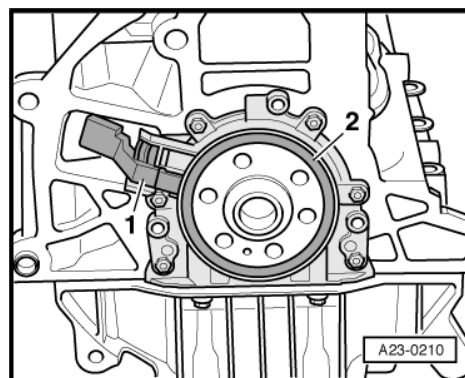


### Assembling:

- Tighten new securing bolts for sealing flange -1- and 6- in diagonal sequence.



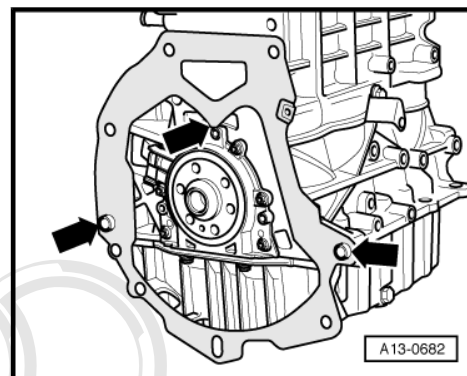
- Secure engine speed sender -G28- -item 1-.
- Install sump ⇒ [page 155](#) .



- Fit intermediate plate on sealing flange and push onto dowel sleeves -arrows-.
- Install dual-mass flywheel ⇒ [page 78](#) .

#### Tightening torques

| Component                                          | Nm               |
|----------------------------------------------------|------------------|
| Sealing flange to cylinder block                   | 15 <sup>1)</sup> |
| Engine speed sender -G28- to cylinder block        | 5                |
| • <sup>1)</sup> Tighten bolts in diagonal sequence |                  |

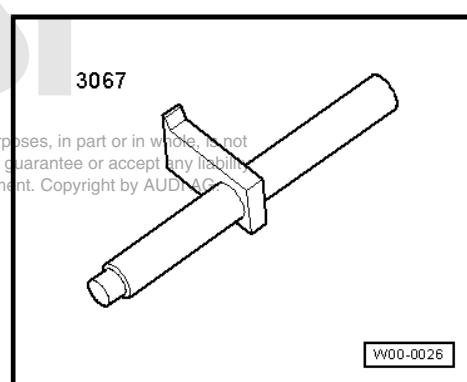


## 2.5 Removing and installing dual-mass flywheel

### Special tools and workshop equipment required

- ◆ Counterhold tool -3067-

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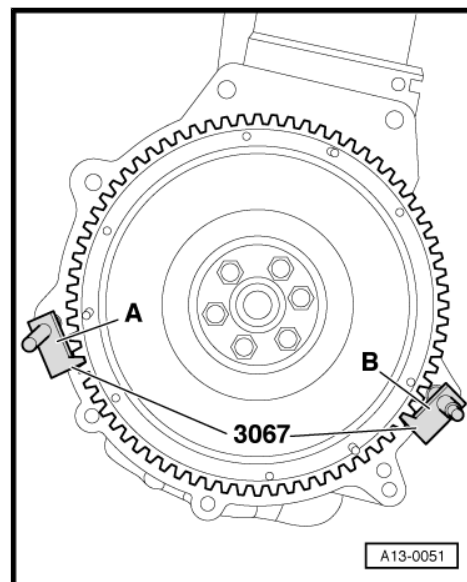
### Removing

- Insert counterhold tool -3067- in hole on cylinder block, and secure on dual-mass flywheel.

A - Installation position for counterhold tool when tightening bolts

B - Installation position for counterhold tool when slackening bolts

- Mark installation position of dual-mass flywheel on crankshaft.

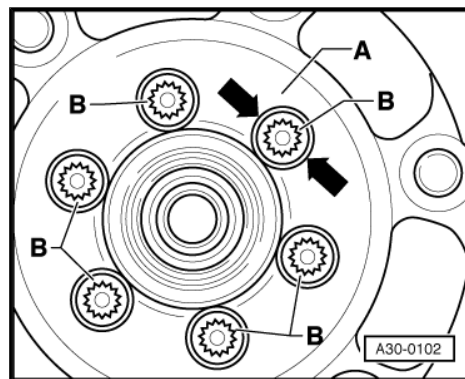




### Note

To prevent damage to the dual-mass flywheel when removing, the bolts -B- must not be removed with an impact wrench or similar. The bolts may only be removed by hand using conventional tools.

- Rotate the dual-mass flywheel -A- so that the bolts align with the holes -arrows-.
- When unscrewing the bolts, make sure that the bolt heads do not come into contact with the dual-mass flywheel; the flywheel will otherwise be damaged as the bolts are screwed out.



### Installing

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

- Use new securing bolts.

### Tightening torque

| Component                                                                                                 | Nm             |
|-----------------------------------------------------------------------------------------------------------|----------------|
| Dual-mass flywheel to crankshaft                                                                          | 60 + 90° 1) 2) |
| <ul style="list-style-type: none"> <li>• 1) Renew bolts.</li> <li>• 2) 90° = one quarter turn.</li> </ul> |                |



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### 3 Removing and installing crankshaft



#### Note

When carrying out repairs, secure engine to assembly stand with engine and gearbox support - VW 540- [⇒ page 19](#).

#### 1 - Bearing shell

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

#### 2 - Drive chain sprocket

- ☐ For oil pump
- ☐ Renewing [⇒ page 80](#)

#### 3 - Bearing shell

- ☐ For bearing cap (without oil groove)
- ☐ Do not interchange used bearing shells (mark positions)

#### 4 - Thrust washers

- ☐ For bearing No. 3
- ☐ Different types for cylinder block and bearing cap
- ☐ Note location

#### 5 - 65 Nm + 90° (1/4 turn) further

- ☐ Renew
- ☐ For measuring radial clearance of crankshaft tighten to 65 Nm, but not further

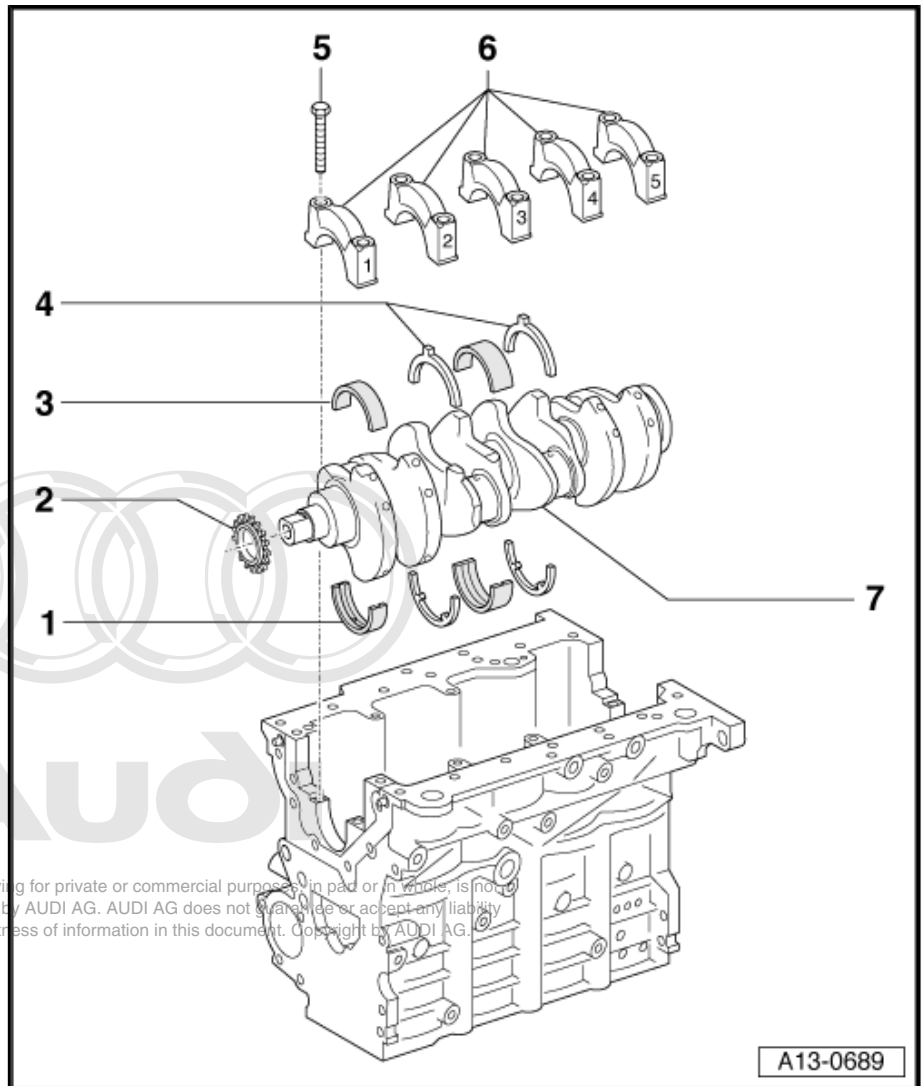
#### 6 - Bearing caps

- ☐ Bearing cap 1: Pulley end
- ☐ Bearing cap 3 with recesses for thrust washers

- ☐ Retaining lugs of cylinder block bearing shells / bearing caps must be on the same side of the bearing

#### 7 - Crankshaft

- ☐ Axial clearance when new: 0.07 ... 0.17 mm; wear limit: 0.37 mm
- ☐ Check radial clearance with Plastigage
- ☐ Radial clearance when new: 0.03 ... 0.08 mm; wear limit 0.17 mm
- ☐ Do not rotate the crankshaft when checking the radial clearance
- ☐ Crankshaft dimensions [⇒ page 80](#)



A13-0689

### 3.1 Crankshaft dimensions

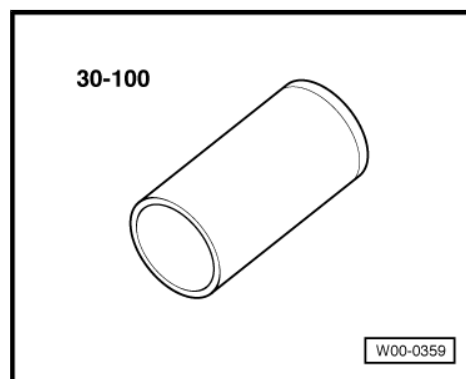
| Honing dimension<br>(in mm) | Crankshaft main<br>bearing journal Ø | Conrod<br>bearing journal Ø |
|-----------------------------|--------------------------------------|-----------------------------|
| Basic dimension             | 54.00 -0.022<br>-0.042               | 50.90 -0.022<br>-0.042      |
| 1st undersize               | 53.75 -0.022<br>-0.042               | 50.65 -0.022<br>-0.042      |
| 2nd undersize               | 53.50 -0.022<br>-0.042               | 50.40 -0.022<br>-0.042      |
| 3rd undersize               | 53.25 -0.022<br>-0.042               | 50.15 -0.022<br>-0.042      |

### 3.2 Removing and installing drive chain sprocket

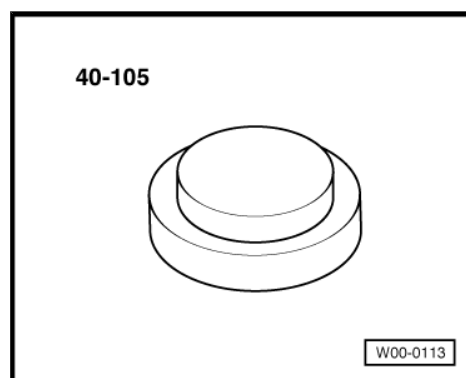
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#### Special tools and workshop equipment required

- ◆ Drift sleeve -30-100-



- ◆ Thrust plate -40-105-

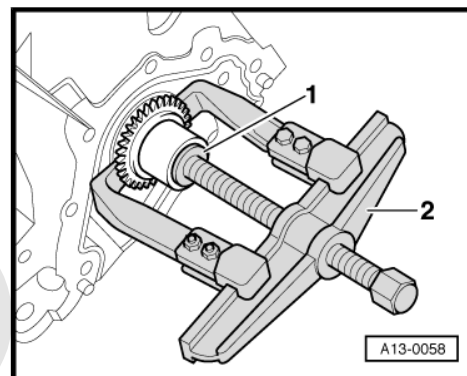


- ◆ Two-arm puller, commercially available
- ◆ Protective gloves

#### Removing

- Remove sump ⇒ [page 155](#) .
- Remove sealing flange (pulley end) ⇒ [page 66](#) .
- Remove the following components:
  - ◆ Chain sprocket for oil pump ⇒ [Item 2 \(page 154\)](#) .
  - ◆ Chain tensioner ⇒ [Item 7 \(page 154\)](#) .
  - ◆ Chain ⇒ [Item 4 \(page 154\)](#) .

- Pull off crankshaft drive chain sprocket using e.g. claw-type puller -Kukko 44-1- -item 2- (protect end of crankshaft with thrust plate -40-105- -item 1-).



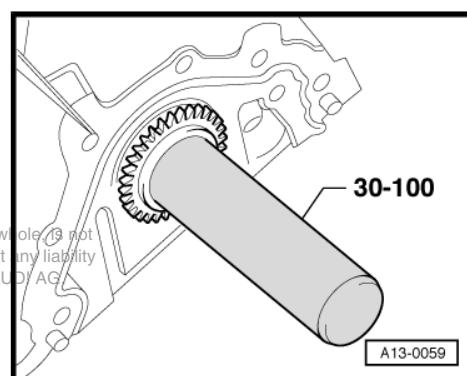
## Installing



### WARNING

*Wear protective gloves.*

- Heat drive chain sprocket in oven for approx. 15 minutes to 220°C.
- Using pliers, locate drive chain sprocket on end of crankshaft.
- Installation position: wider collar on drive chain sprocket faces engine.
- Push drive chain sprocket onto crankshaft as far as the stop using drift sleeve -30-100- .
- Install sealing flange (pulley end) ⇒ [page 66](#) .
- Install sump ⇒ [page 155](#) .



## 4 Dismantling and assembling pistons and conrods

### 4.1 Pistons and conrods - exploded view



#### Note

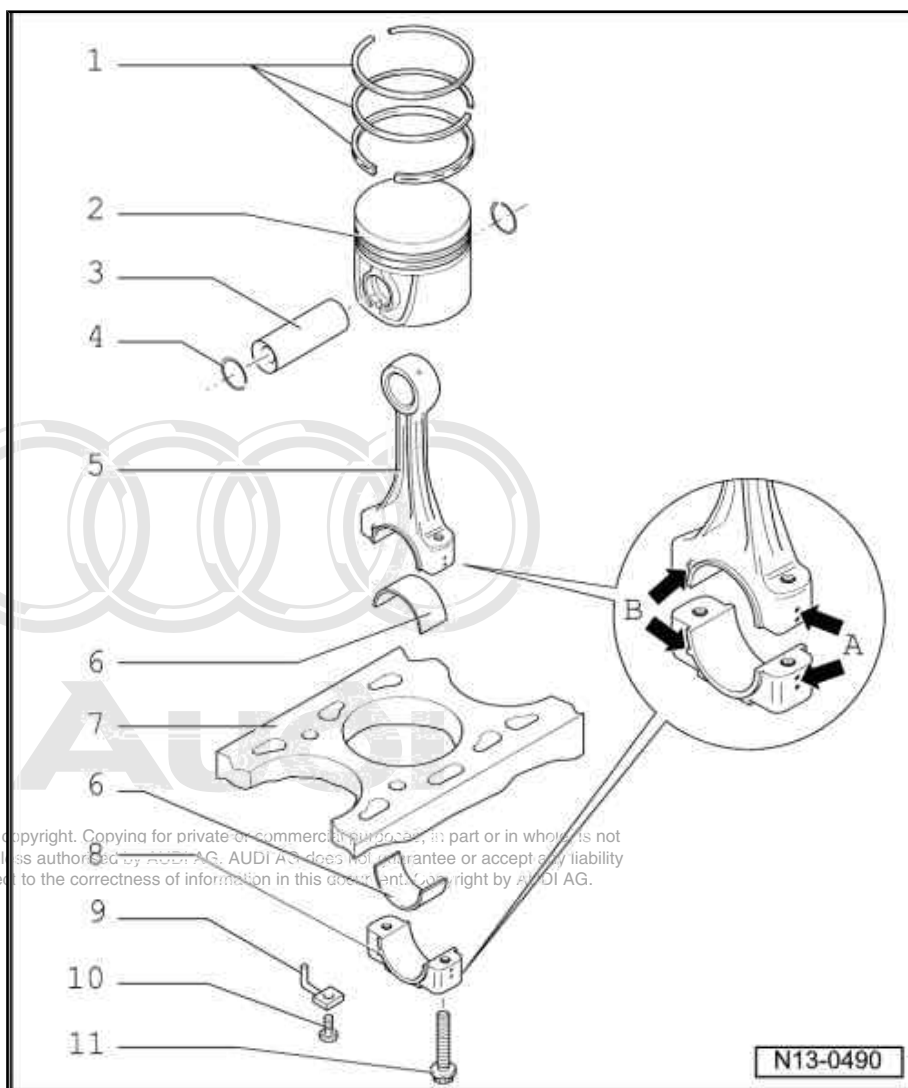
Oil spray jet and pressure relief valve ⇒ [page 155](#)

#### 1 - Piston rings

- ☐ Offset gaps by 120°
- ☐ Use piston ring pliers to remove and install
- ☐ Marking "TOP" or inscription must face piston crown.
- ☐ Checking ring gap ⇒ [page 83](#)
- ☐ Checking ring-to-groove clearance ⇒ [page 84](#)

#### 2 - Piston

- ☐ With combustion chamber
- ☐ Mark installation position and cylinder number
- ☐ Installation position and allocation of piston/cylinder ⇒ [page 84](#)
- ☐ Arrow on piston crown points to pulley end
- ☐ If cracking is visible on piston skirt, renew piston
- ☐ Checking piston ⇒ [page 84](#)
- ☐ Piston and cylinder dimensions ⇒ [page 87](#)
- ☐ Checking cylinder bore ⇒ [page 85](#)
- ☐ Install using piston ring clamp
- ☐ Checking piston projection at TDC ⇒ [page 85](#)



#### 3 - Piston pin

- ☐ If difficult to move, heat piston to approx. 60 °C
- ☐ Remove and install using drift -VW 222 A-

#### 4 - Circlip

#### 5 - Conrod

- ☐ Mark cylinder allocation -A-
- ☐ Installation position: Marking -B- faces towards pulley end

- ☐ With industrially cracked conrod bearing cap

## 6 - Bearing shell

- ☐ Installation position [⇒ page 85](#)
- ☐ Do not interchange used bearing shells (mark positions)
- ☐ Note type: upper bearing shell (closest to piston) is made of more wear-resistant material. Distinguishing feature on new bearing shells: black marking on bearing surface near joint
- ☐ Insert in the centre
- ☐ Check that it is securely seated
- ☐ Axial clearance: wear limit: 0.37 mm
- ☐ Check radial clearance with Plastigage
- ☐ Do not rotate crankshaft when checking radial clearance
- ☐ Radial clearance: wear limit: 0.08 mm

## 7 - Cylinder block

- ☐ Checking cylinder bore [⇒ page 85](#)
- ☐ Piston and cylinder dimensions [⇒ page 87](#)

## 8 - Conrod bearing cap

- ☐ Note installation position
- ☐ Since industrially cracked conrods are used (the conrod is cast as one unit and the cap is then cracked off), the conrod bearing cap can only be fitted in one position on the corresponding conrod

## 9 - Oil spray jet

- ☐ For piston cooling

## 10 - 25 Nm

- ☐ Insert without sealant

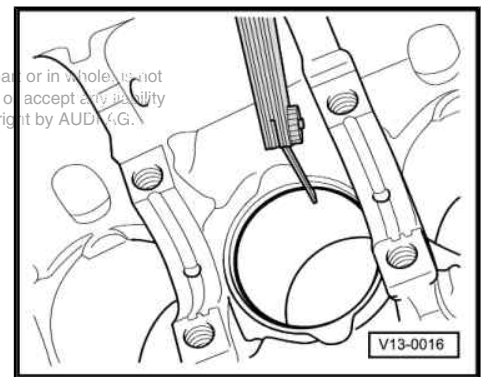
## 11 - Conrod bolt, 30 Nm + 90° (1/4 turn) further

- ☐ Renew
- ☐ Lubricate threads and contact surface
- ☐ Use old bolts when measuring radial clearance

## Checking piston ring gap

- Insert ring at right angle to cylinder wall from above and push down into lower cylinder opening approx. 15 mm from bottom of cylinder. Use a piston without rings to push ring into bore.

| Piston ring<br>(in mm) | New           | Wear limit |
|------------------------|---------------|------------|
| 1st compression ring   | 0.25 ... 0.40 | 1.00       |
| 2nd compression ring   | 0.25 ... 0.40 | 1.00       |
| Oil scraper ring       | 0.25 ... 0.50 | 1.00       |

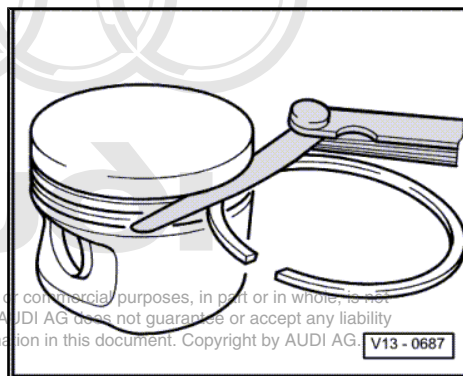


## Checking ring-to-groove clearance

- Clean groove in piston before checking clearance.

| Piston ring<br>(in mm) | New           | Wear limit |
|------------------------|---------------|------------|
| 1st compression ring   | 0.06 ... 0.09 | 0.25       |
| 2nd compression ring   | 0.05 ... 0.08 | 0.25       |
| Oil scraper ring       | 0.03 ... 0.06 | 0.25       |

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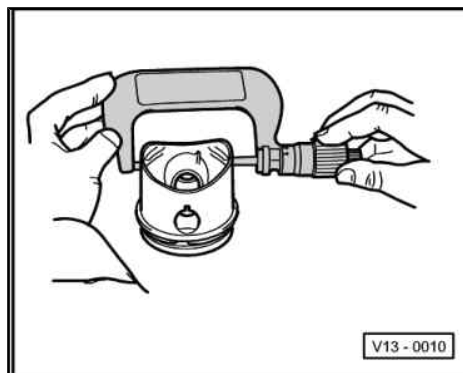


## Checking piston

- Measure approx. 10 mm from the bottom edge, perpendicular to the piston pin axis.
- Maximum deviation from nominal dimension: 0.04 mm.

Nominal dimension

⇒ [“4.3 Piston and cylinder dimensions”, page 87](#).



## Piston installation position and piston/cylinder allocation

Pistons in cylinders 1 and 2:

- Large cut-out for inlet valve faces flywheel end -arrows-.

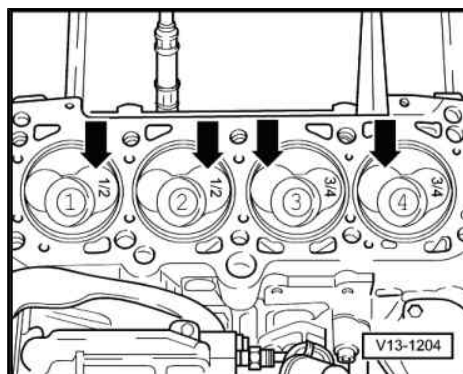
Pistons in cylinders 3 and 4:

- Large cut-out for inlet valve faces pulley end -arrows-.



### Note

- ◆ With new pistons, cylinder allocation is indicated by a coloured marking on piston crown.
- ◆ Piston for cylinder 1 and 2: marked 1/2.
- ◆ Piston for cylinder 3 and 4: marked 3/4.

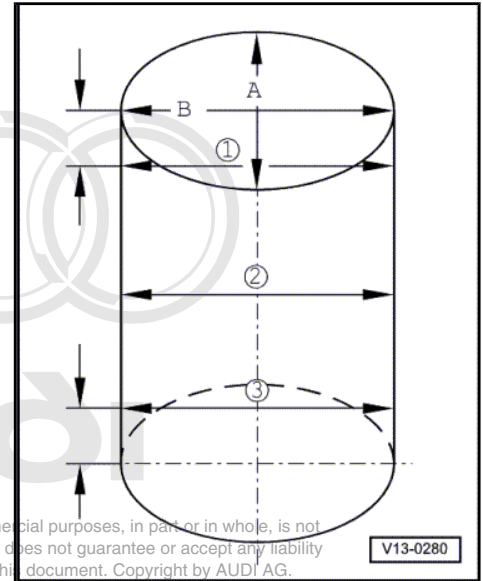


### Checking cylinder bore

- Use 50 ... 100 mm internal dial gauge to take measurements at 3 points in transverse direction -A- and longitudinal direction -B-.
- Maximum deviation from nominal dimension: 0.10 mm.

Nominal dimension

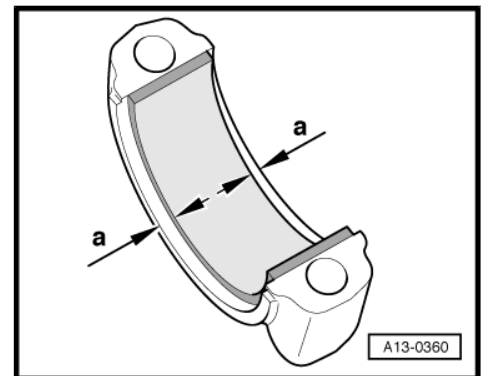
⇒ [“4.3 Piston and cylinder dimensions”, page 87](#).



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### Installation position of bearing shells in conrods

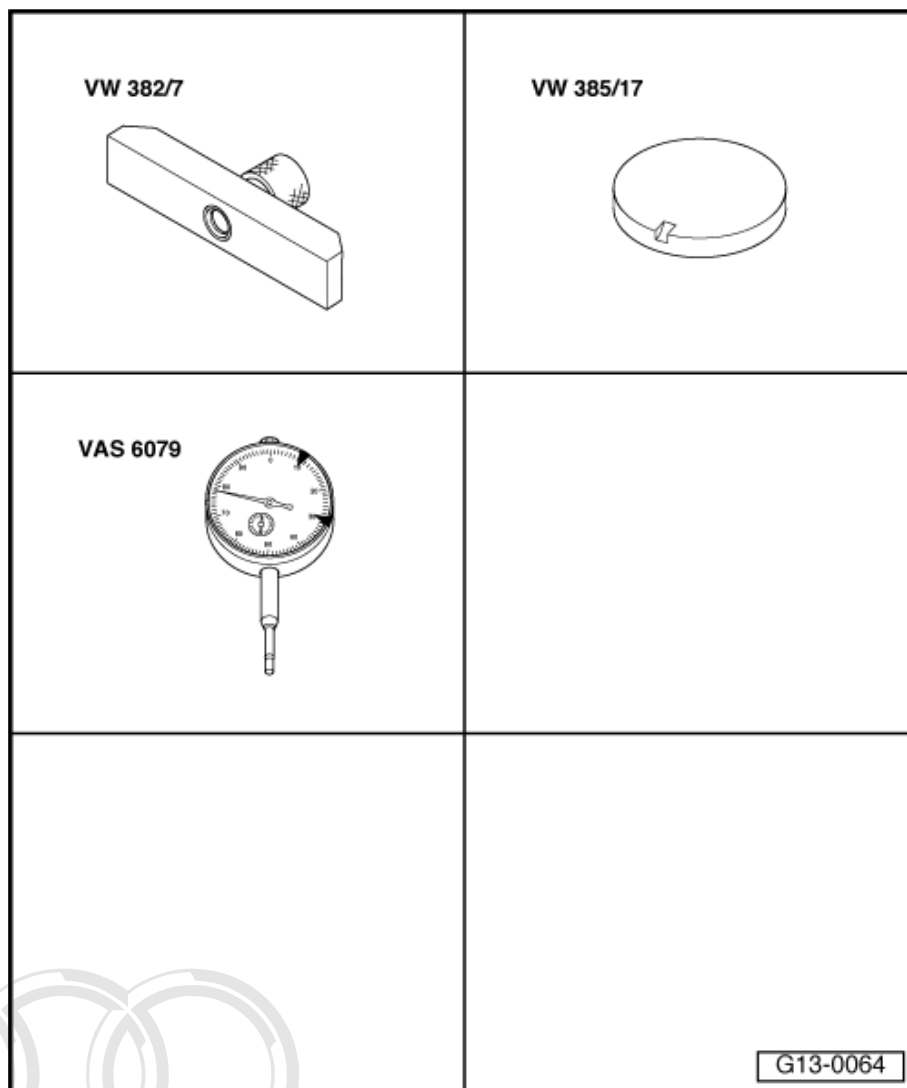
- Insert bearing shells centrally in conrod/conrod bearing cap.
- Distance -a- = 2.5 mm



## 4.2 Checking piston projection at TDC

### Special tools and workshop equipment required

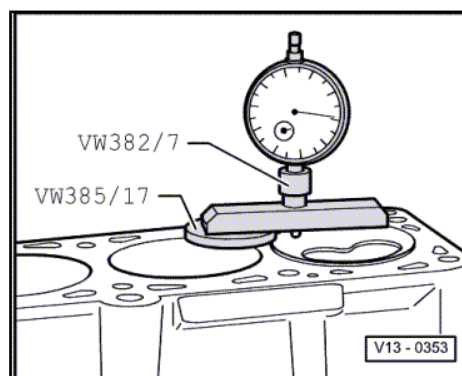
- ◆ -VW 382/7- from measuring tool -VW 382-
- ◆ -VW 385/17- from universal measuring tool -VW 385-
- ◆ Dial gauge -VAS 6079-



### Procedure

- Check piston projection at TDC when installing new pistons or short engine.
- Set up measuring tools as shown in illustration.
- Install cylinder head gasket corresponding to piston projection according to table below:

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



### Identification of cylinder head gasket

- 1 - Part No.
- 2 - Production code (can be disregarded)
- 3 - Holes



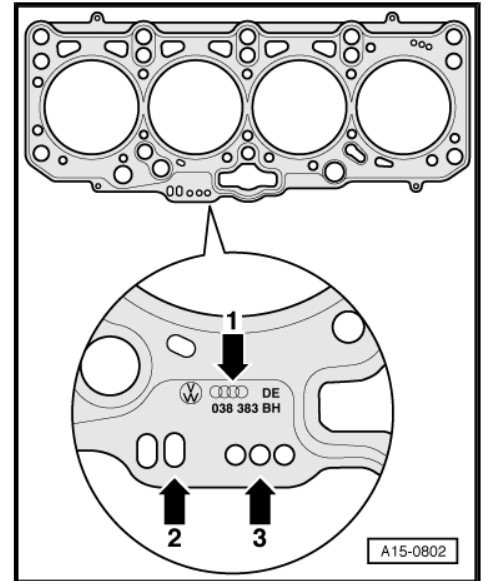
*If the measured values for piston projection are not the same for all pistons, use the highest value to determine the correct gasket size.*



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### 4.3 Piston and cylinder dimensions

| Honing dimension<br>(in mm) | Piston Ø | Cylinder bore Ø |
|-----------------------------|----------|-----------------|
| Basic dimension             | 79.47    | 79.51           |
| 1st oversize                | 79.72    | 79.76           |
| 2nd oversize                | 79.97    | 80.01           |



## 15 – Cylinder head, valve gear

### 1 Removing and installing cylinder head

#### 1.1 Cylinder head - exploded view

##### 1 - 10 Nm

- ☐ Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue

##### 2 - 15 Nm

##### 3 - 100 Nm

- ☐ Use counterhold tool - T10051- when loosening and tightening  
⇒ ["2.4 Removing and installing camshaft"](#), [page 139](#)

##### 4 - Hub

- ☐ With sender wheel for Hall sender -G40-
- ☐ To remove, use puller - T10052-  
⇒ ["2.4 Removing and installing camshaft"](#), [page 139](#)

##### 5 - Cylinder head

- ☐ Removing: Vehicles up to approx. 05.2005  
⇒ [page 93](#) , vehicles from approx. 06.2005 onwards ⇒ [page 110](#)
- ☐ Checking for distortion ⇒ [page 89](#)
- ☐ Installing ⇒ [page 126](#)
- ☐ If renewed, change coolant and engine oil

##### 6 - Cylinder head bolt

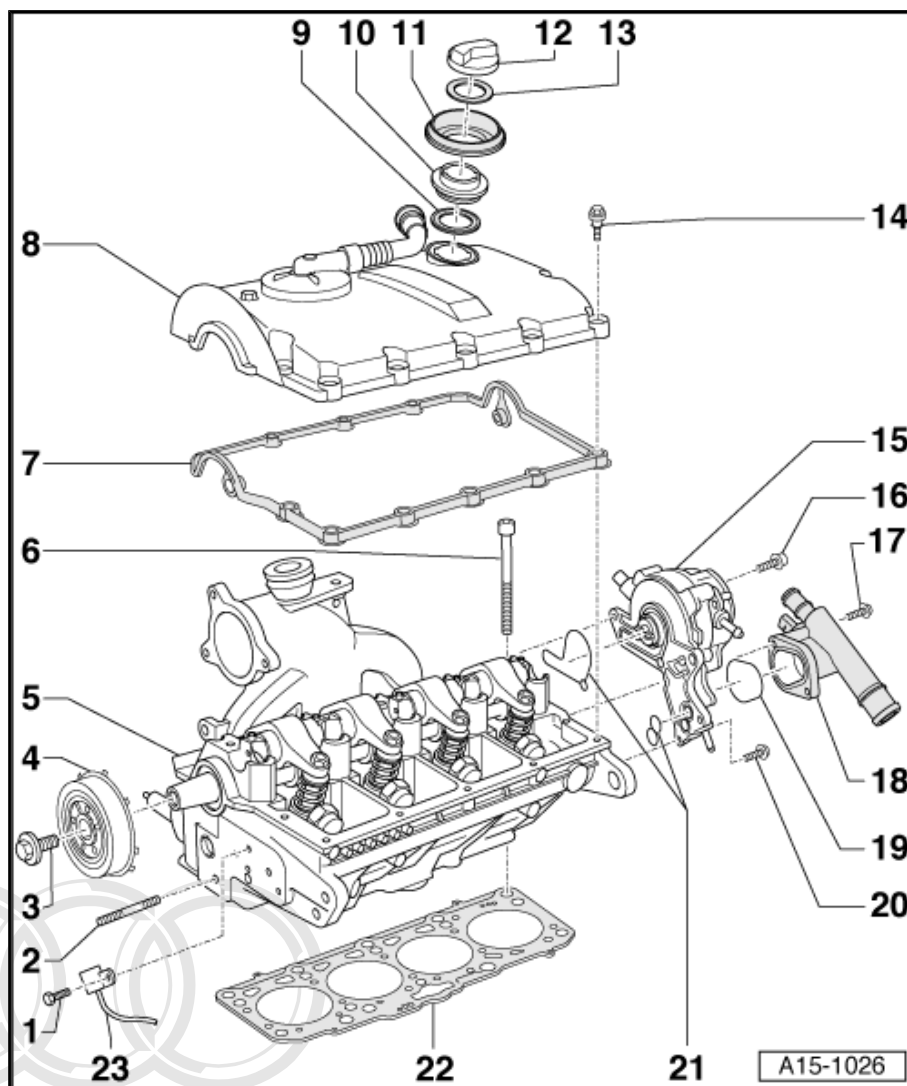
- ☐ Renew
- ☐ Note correct sequence when slackening: Vehicles up to approx. 05.2005 ⇒ [page 110](#) , vehicles from approx. 06.2005 onwards ⇒ [page 125](#)
- ☐ Note correct sequence when tightening ⇒ [page 128](#)
- ☐ Ensure that washers ⇒ [Item 9 \(page 134\)](#) are fitted in cylinder head

##### 7 - Gasket for cylinder head cover

- ☐ Renew if damaged or leaking
- ☐ Before fitting, apply sealant at sealing points ⇒ [page 90](#)
- ☐ Insert lugs into holes on cylinder head

##### 8 - Cylinder head cover

- ☐ Removing and installing ⇒ [page 90](#)



**9 - Seal**

- ☐ Renew if damaged or leaking

**10 - Intermediate flange****11 - Cover cap****12 - Filler cap****13 - Seal**

- ☐ Renew if damaged or leaking

**14 - Special bolt - 10 Nm**

- ☐ Note correct sequence for loosening and tightening  
⇒ ["1.2 Removing and installing cylinder head cover", page 90](#)

**15 - Tandem pump**

- ☐ Removing and installing ⇒ Rep. gr. 20

**16 - 20 Nm****17 - 10 Nm****18 - Coolant flange****19 - O-ring**

- ☐ Renew

**20 - 10 Nm****21 - Seals**

- ☐ Renew

**22 - Cylinder head gasket**

- ☐ Renewing: Vehicles up to approx. 05.2005 ⇒ [page 93](#) , vehicles from approx. 06.2005 onwards  
⇒ [page 110](#)
- ☐ Note marking ⇒ [page 90](#)
- ☐ If renewed, change coolant and engine oil

**23 - Hall sender -G40-**

- ☐ For camshaft position

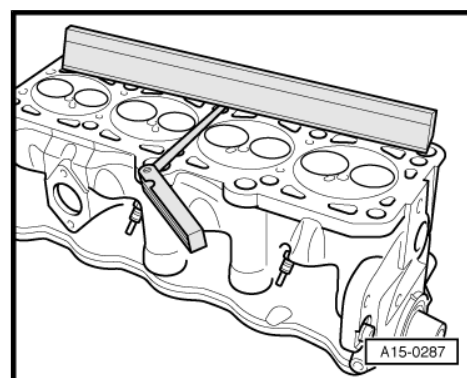
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**Checking cylinder head for distortion**

- Use straight edge and feeler gauge to measure for distortion at several points.
- Maximum permissible distortion: 0.1 mm.

**Note**

*The cylinder heads of diesel engines must not be machined.*



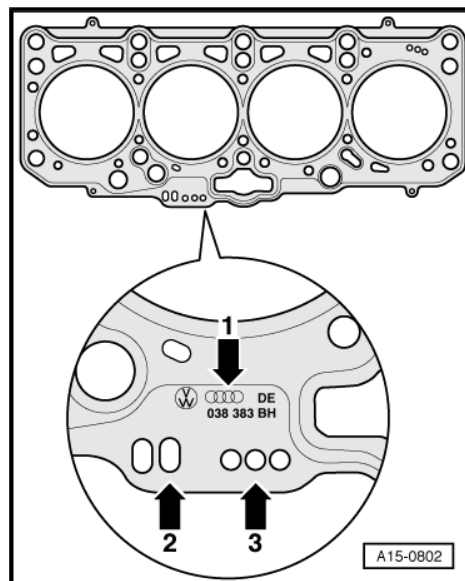
## Identification of cylinder head gasket

- 1 - Part No.
- 2 - Production code (can be disregarded)
- 3 - Holes



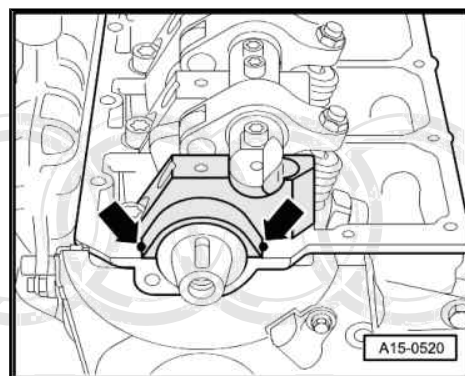
### Note

Cylinder head gaskets of different thicknesses are fitted depending on the amount of piston projection ⇒ [page 85](#). When renewing just the cylinder head gasket, the new gasket should have the same identification as the old one.

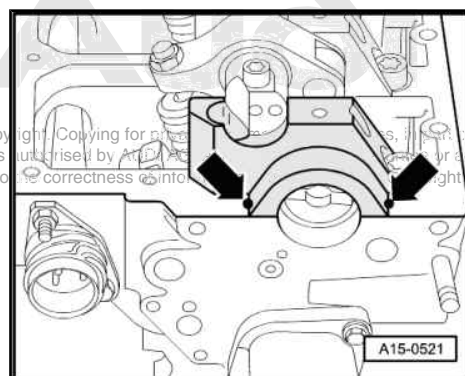


## Sealing points between bearing cap and cylinder head

- Apply one drop of sealant (Ø approx. 5 mm) to each sealing point at front bearing cap/cylinder head -arrows-; for sealant refer to ⇒ Parts catalogue .



- Apply one drop of sealant (Ø approx. 5 mm) to each sealing point at rear bearing cap/cylinder head -arrows-; for sealant refer to ⇒ Parts catalogue .

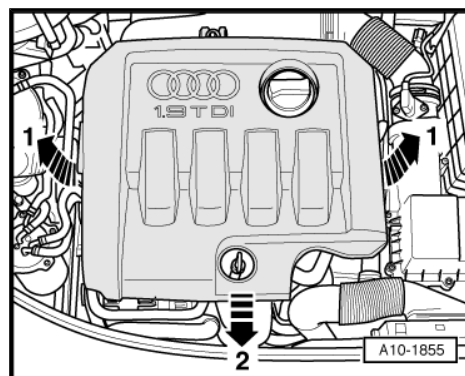


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## 1.2 Removing and installing cylinder head cover

### Removing

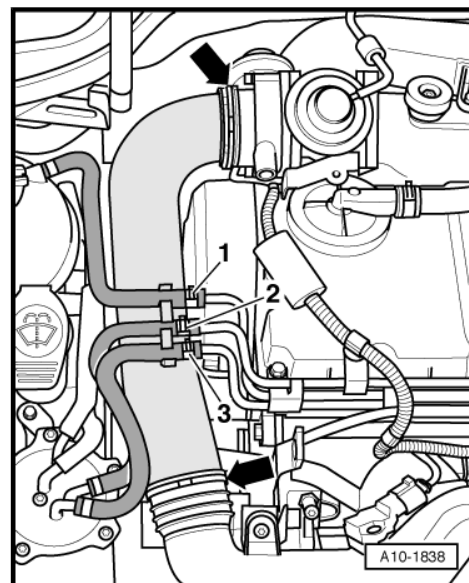
- Lift engine cover panel at sides -arrows 1- and pull off towards front -arrow 2-.



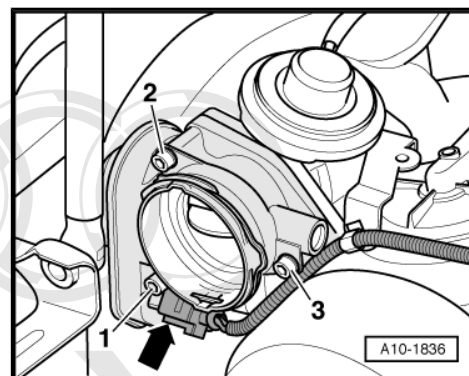
- Detach the hoses/lines -1 ... 3- from air pipe.
- Remove air pipe by lifting retaining clips -arrows- slightly.

**Note**

*Leave coolant hose -1- and fuel lines -2- and -3- connected.*



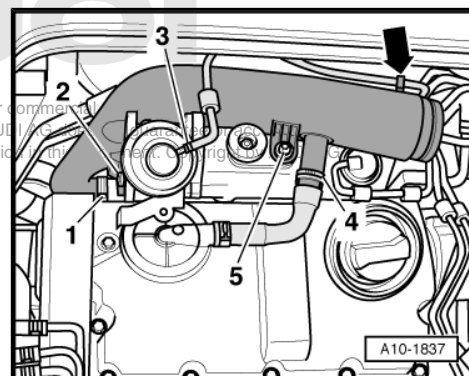
- Detach electrical connector -arrow- at intake manifold flap motor -V157- .
- Unscrew bolts -1 ... 3- and remove intake manifold flap motor -V157- .



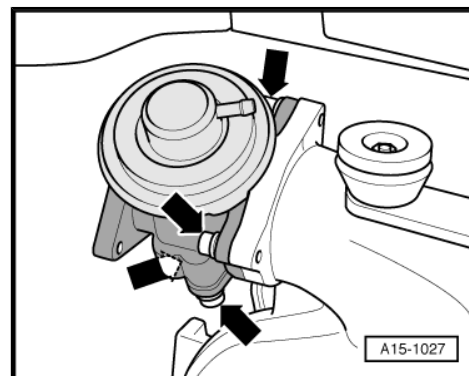
- Disconnect vacuum hose -3- at exhaust gas recirculation valve -N18- .
- Detach pipe -4- for crankcase breather at air pipe.
- Unscrew bolts -2- and -5- and push air pipe backwards.

**Note**

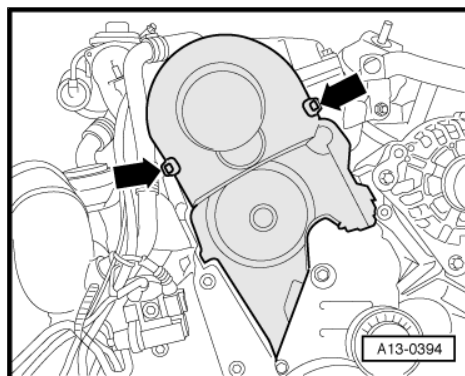
*The air pipe remains attached to turbocharger -1-.*



- Unscrew mechanical exhaust gas recirculation valve -arrows-.



- Remove top toothed belt cover by releasing retaining clips -arrows-.



- Remove cylinder head cover bolts in the sequence -13 ... 1-.
- Remove cylinder head cover.

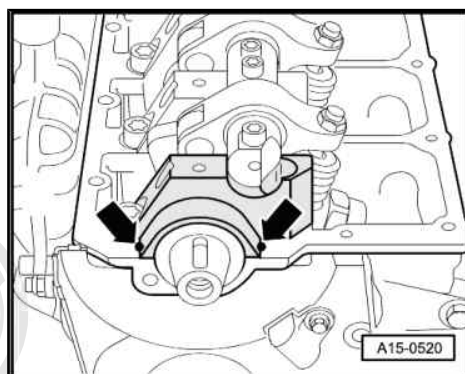
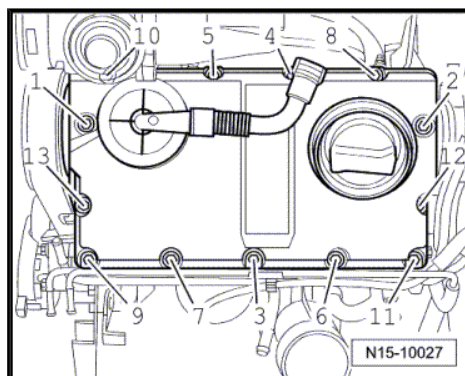
### Installing

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

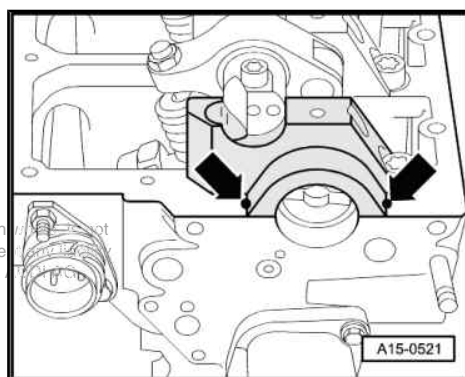


#### Note

- ◆ *Renew gasket for cylinder head cover if damaged.*
  - ◆ *If seal for bolt is damaged, renew bolt.*
- Apply one drop of sealant (Ø approx. 5 mm) to each sealing point at front bearing cap/cylinder head -arrows-; for sealant refer to ⇒ Parts catalogue .



- Apply one drop of sealant (Ø approx. 5 mm) to each sealing point at rear bearing cap/cylinder head -arrows-; for sealant refer to ⇒ Parts catalogue .

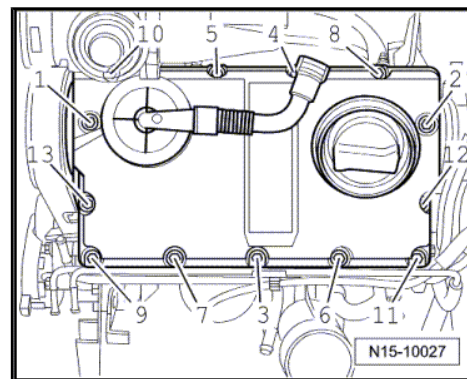


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- Tighten bolts for cylinder head cover to final setting in the sequence -1 ... 13-.

#### Tightening torques

| Component                                                     | Nm |
|---------------------------------------------------------------|----|
| Cylinder head cover to cylinder head                          | 10 |
| Air pipe to intake manifold                                   | 10 |
| Connecting pipe to mechanical exhaust gas recirculation valve | 22 |
| Mechanical exhaust gas recirculation valve to intake manifold | 10 |
| Intake manifold flap motor -V157- to intake manifold          | 10 |

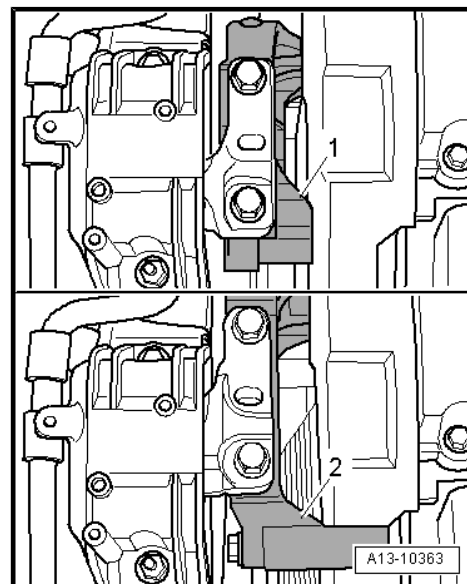


### 1.3 Removing cylinder head - vehicles up to approx. 05.2005



#### Note

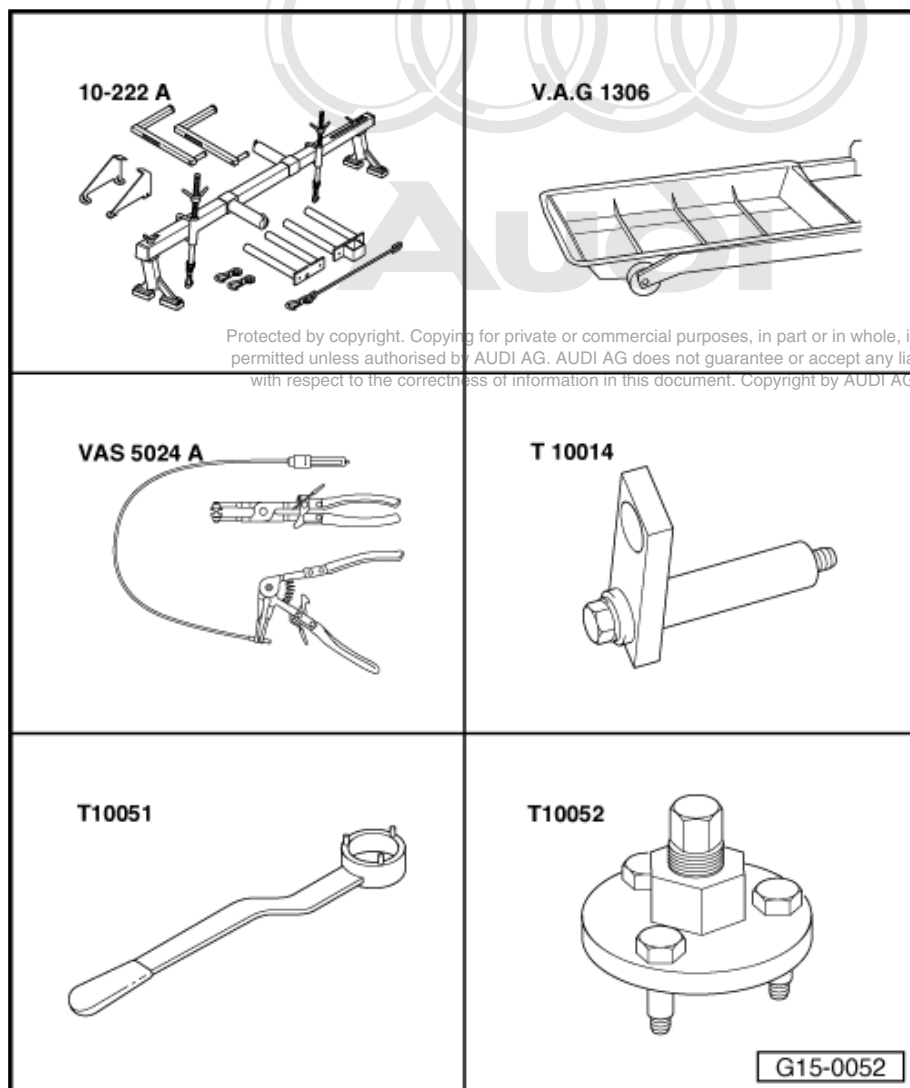
*On vehicles up to approx. 05.2005 (can be identified by engine support -version 1-), the engine support has to be removed and the engine supported from above before removing the cylinder head.*



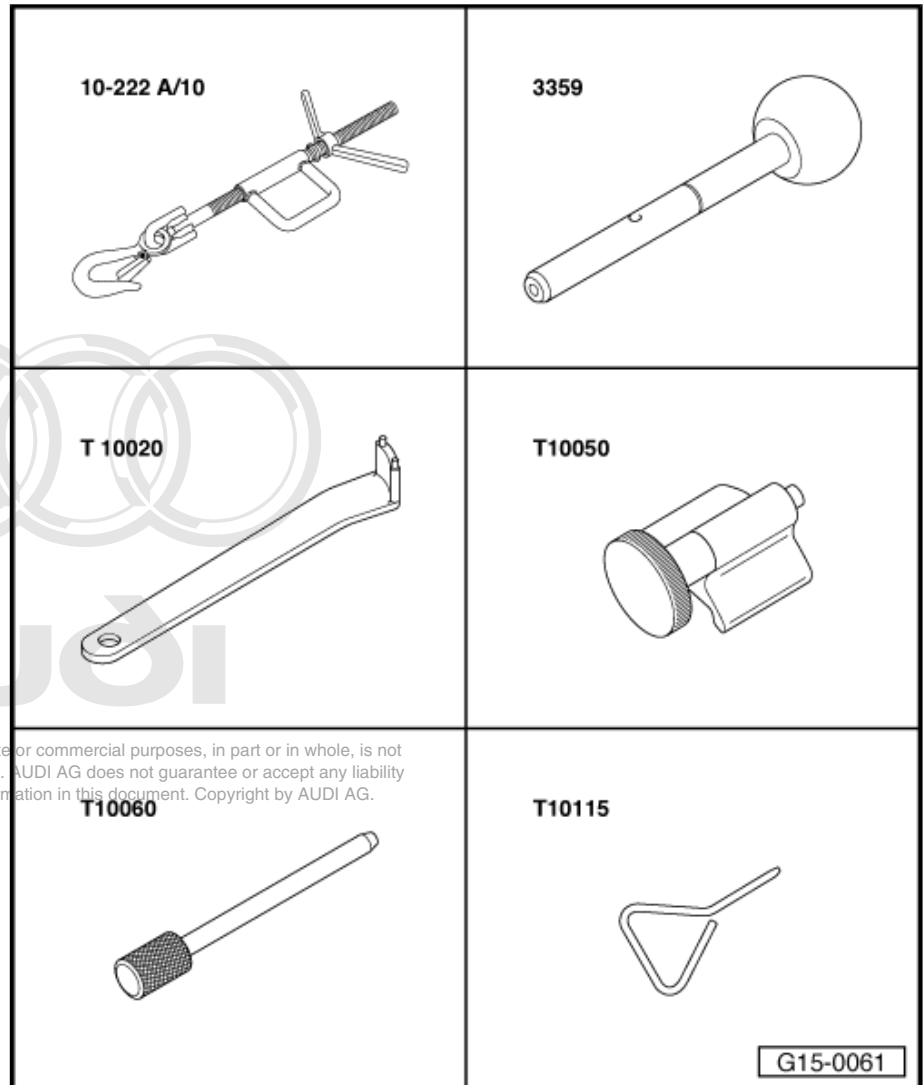
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### Special tools and workshop equipment required

- ◆ Support bracket -10-222 A-
- ◆ Drip tray for workshop hoist -VAS 6208- or -V.A.G 1306-
- ◆ Hose clip pliers -VAS 6340- or -VAS 5024 A-
- ◆ Retainer -T10014-
- ◆ Counterhold tool -T10051-
- ◆ Puller -T10052-

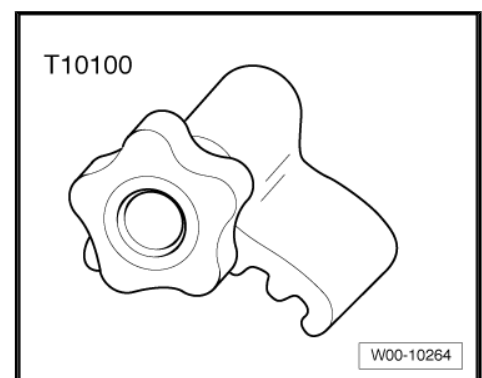


- ◆ Hook (with spindle) -10-222 A/10-
- ◆ Diesel injection pump locking pin -3359-
- ◆ Pin wrench -T10020-
- ◆ Crankshaft stop -T10050- for engines with circular crankshaft sprocket
- ◆ Locking pin -T10060 A- or -T10060-
- ◆ Locking pin -T10115-



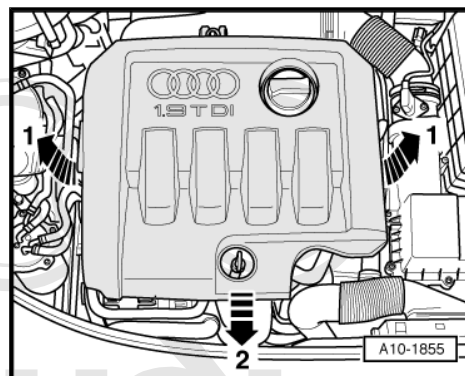
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- ◆ Crankshaft stop -T10100- for engines with oval crankshaft sprocket



## Procedure

- Lift engine cover panel at sides -arrows 1- and pull off towards front -arrow 2-.



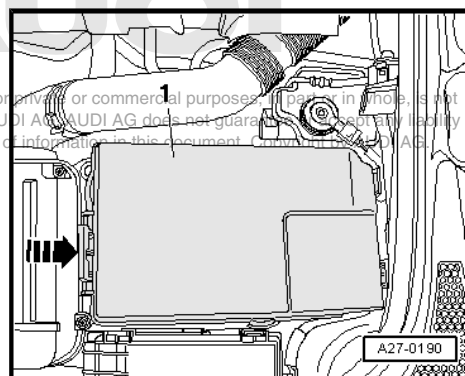
- Remove cover -1- over battery; to do so, press release tab -arrow-.



### Caution

*Observe notes on procedure for disconnecting the battery ⇒ Rep. gr. 27.*

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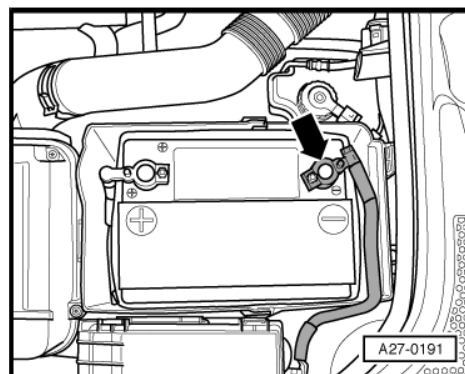


- With ignition switched off, disconnect battery earth cable -arrow-.



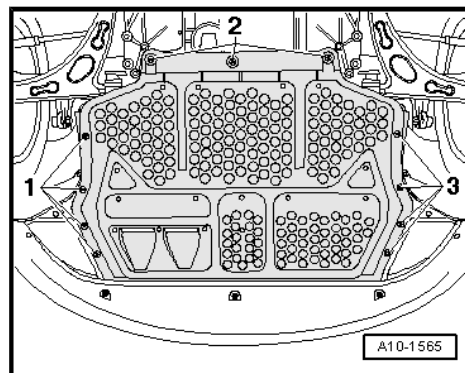
### WARNING

*Hot steam or hot coolant can escape when expansion tank is opened; cover filler cap with cloth and open carefully.*

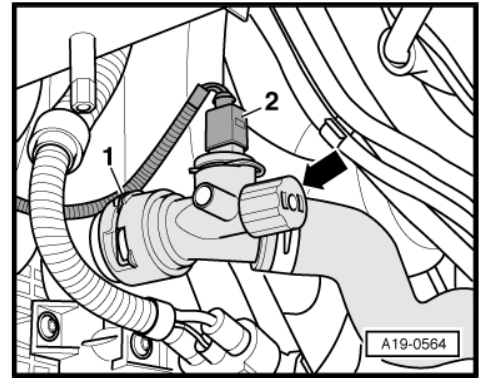


- Open filler cap on coolant expansion tank.

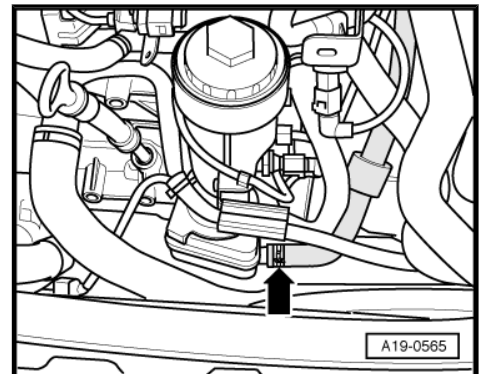
- Remove centre noise insulation -fasteners 1 ... 3-.



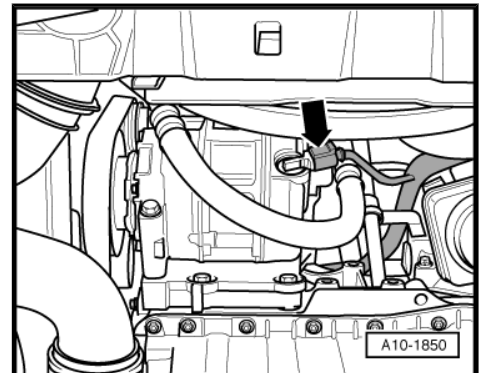
- Unplug electrical connector -2- from coolant temperature sender - radiator outlet -G83- .
- Place drip tray for workshop hoist -VAS 6208- under engine.
- Turn drain plug -arrow- on radiator anti-clockwise, if necessary fit drain hose to connection.
- Detach lower coolant hose -1-; to do so, pull out retaining clip.



- Disconnect coolant hose at bottom of oil cooler -arrow- and drain off remaining coolant.



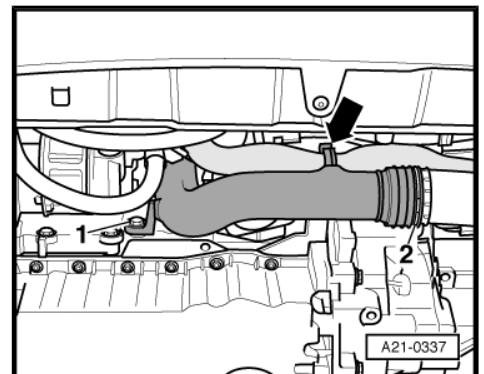
- Unplug electrical connector -arrow- for magnetic clutch of air conditioner compressor.



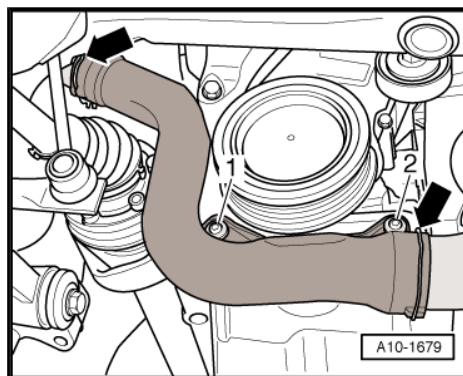
- Detach lower air intake hose (left-side) from front air pipe by lifting retaining clip -2- slightly.
- Remove bolt -1-.

**Note**

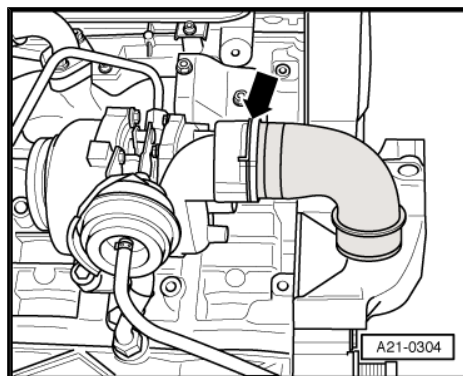
*The coolant hose remains attached to bracket -arrow-.*



- Remove bolts -1- and -2-.
- Remove air pipe (right-side) by lifting retaining clips -arrows- slightly.



- Detach air intake hose from turbocharger by lifting retaining clip -arrow- slightly.



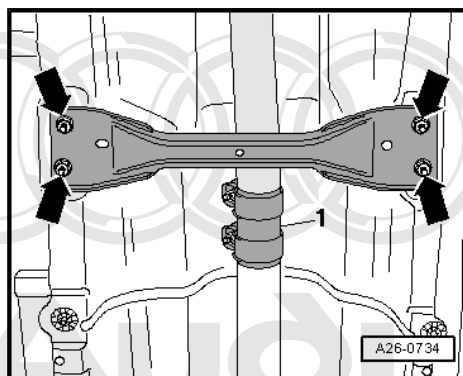
- Remove front cross-piece for underbody -arrows-.



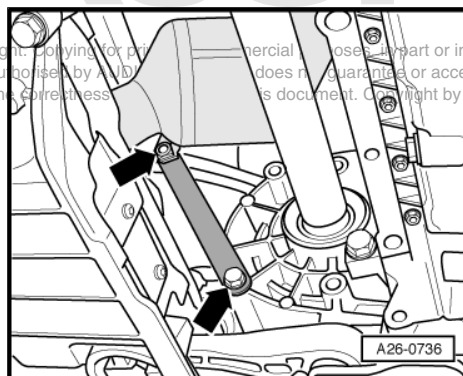
### Note

*To avoid damage, the flexible joints in the front exhaust pipe must not be bent more than 10°.*

- Loosen nuts on clamp -1-.

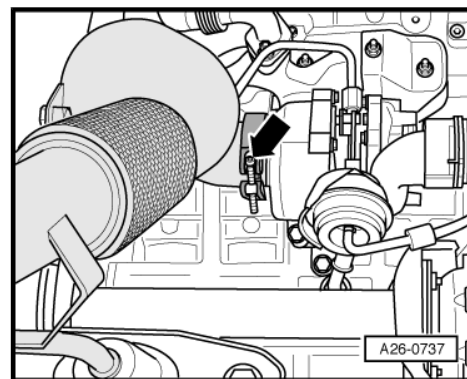


- Unbolt support for front exhaust pipe -arrows-.

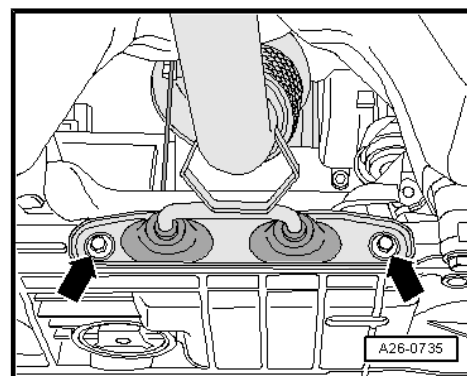


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- Open clamp -arrow- and detach front exhaust pipe from turbocharger.



- Unbolt bracket for exhaust system -arrows-.
- Push the clamp back and remove the front exhaust pipe.



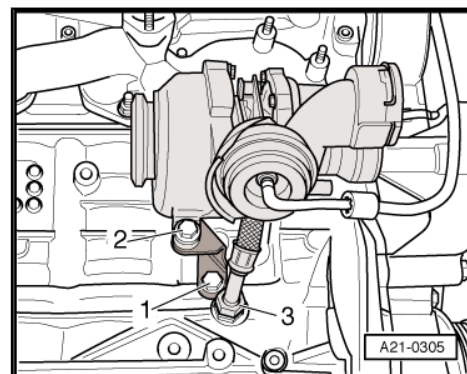
- Remove bolts -1- and -2- and detach bracket for turbocharger.



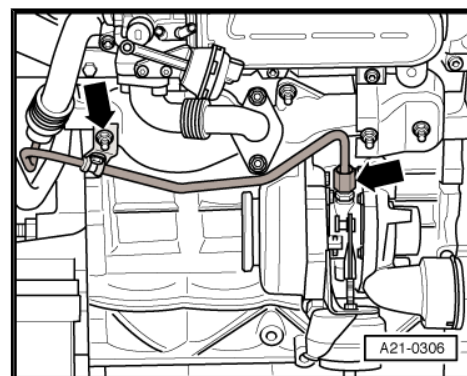
#### Note

*Place a cloth underneath to catch any escaping oil.*

- Remove oil return line -3- at cylinder block.

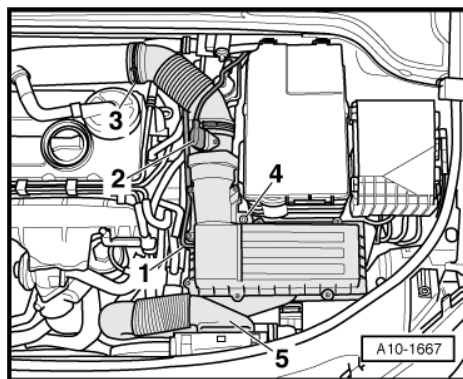


- Unscrew oil supply line at turbocharger and at exhaust manifold -arrows- and move to one side.

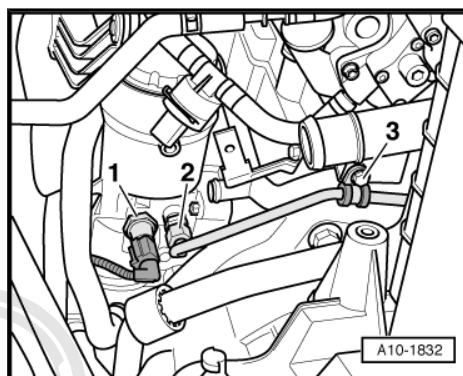


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- Unplug electrical connector -2- at air mass meter -G70- .
- Detach vent hose -1- and air hoses -3- and -5-.
- Unscrew bolt -4- and remove air cleaner housing.



- Unplug electrical connector -1- at oil pressure switch -F1- .
- Unscrew oil pressure switch -2-.
- Detach oil supply line at oil filter bracket -3- and at coolant pipe -4-.



- Detach coolant hose -1- and move clear.



# WARNING

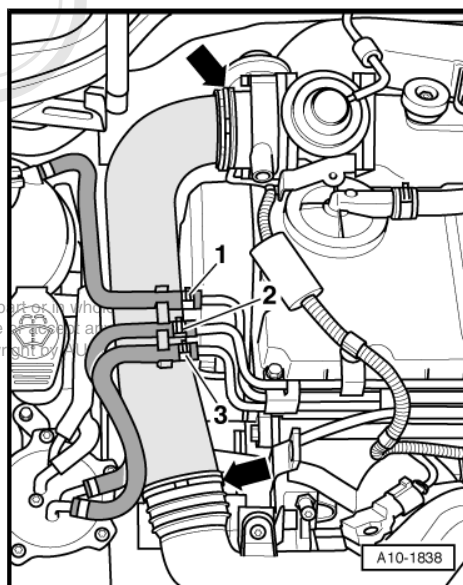
- ◆ *In extreme cases the fuel lines and the fuel can reach a temperature of 100 °C on vehicles with unit injector engine. Allow the fuel to cool down before disconnecting the lines - danger of scalding.*

- ◆ *Wear protective gloves.*

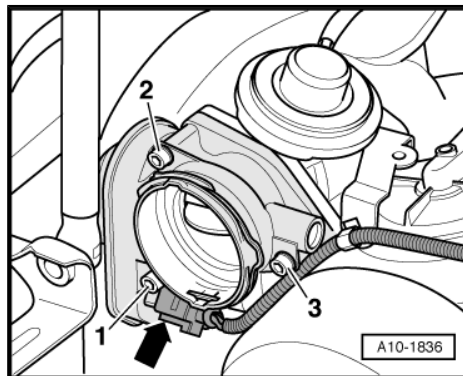
- ◆ *Wear safety goggles.*

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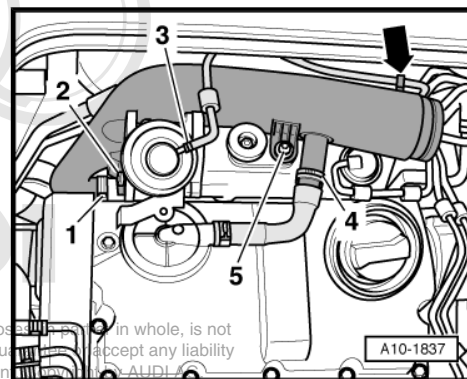
- Disconnect fuel supply line -3- and fuel return line -2- and move lines clear.
- Remove air pipe by lifting retaining clips -arrows- slightly.



- Detach electrical connector -arrow- at intake manifold flap motor -V157- .
- Unscrew bolts -1 ... 3- and remove intake manifold flap motor -V157- .

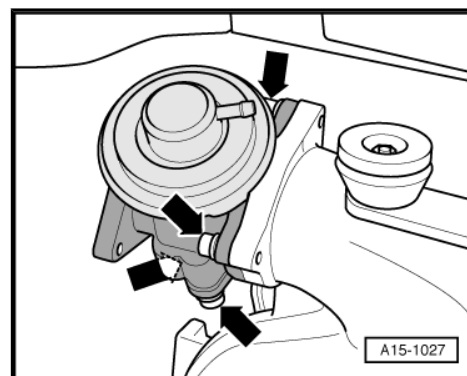


- Disconnect vacuum hose -3- at exhaust gas recirculation valve -N18- .
- Detach pipe -4- for crankcase breather at air pipe.
- Release hose clip -1- at turbocharger using hose clip pliers -VAS 6340- .
- Move the vacuum hoses clear -arrow-.
- Unscrew bolts -2- and -5- and remove air pipe.

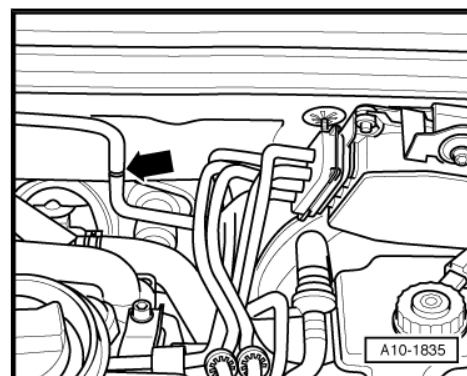


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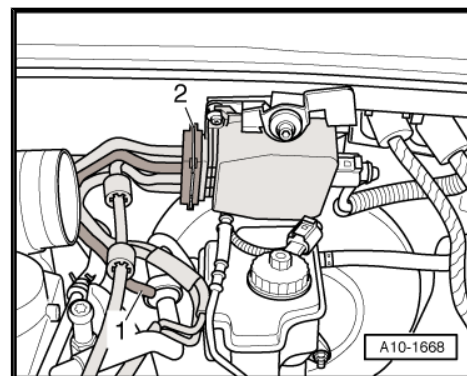
- Unscrew mechanical exhaust gas recirculation valve -arrows-.



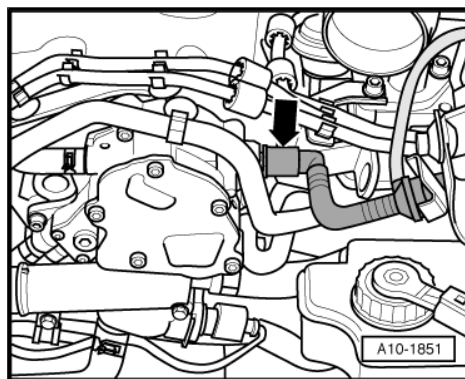
- Disconnect hose going to vacuum unit for charge pressure control at separating point -arrow-.



- Detach hose connection carrier -2- at solenoid valve block by releasing retaining tab.
- Detach vacuum hose -1- at non-return valve for brake servo.



- Detach vacuum hose -arrow- going to brake servo at tandem pump.

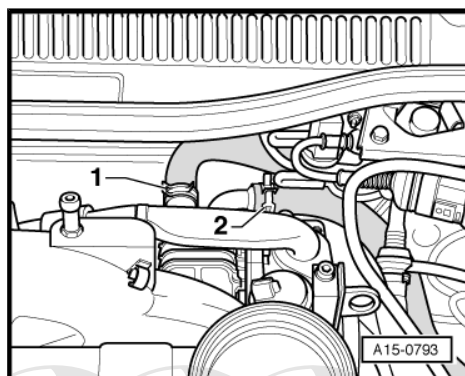


- Detach coolant hose -1- at cooler for exhaust gas recirculation.

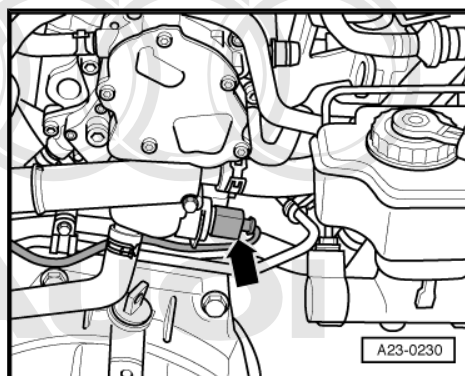


### Note

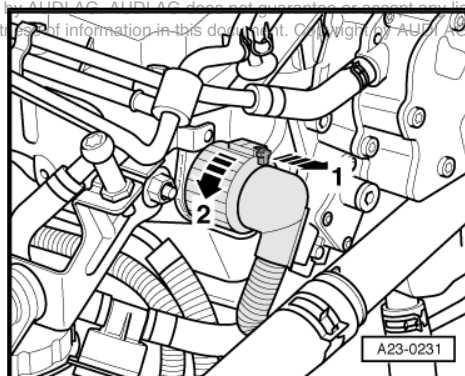
Leave coolant hose -2- connected.



- Detach electrical connector -arrow- at coolant temperature sender -G62- and move wire clear.

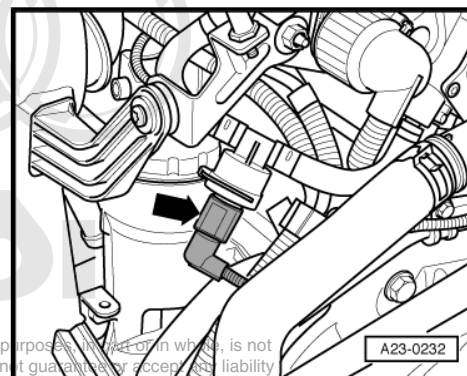


- Pull the release pin -arrow 1- and unscrew knurled nut -arrow 2-.
- Disconnect main connector for unit injectors and move wiring harness clear.



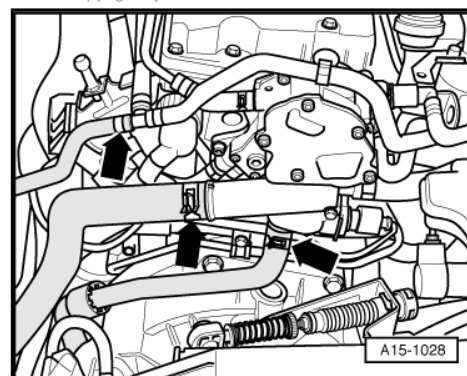
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- Unplug electrical connector -arrow- at fuel temperature sender -G81- .

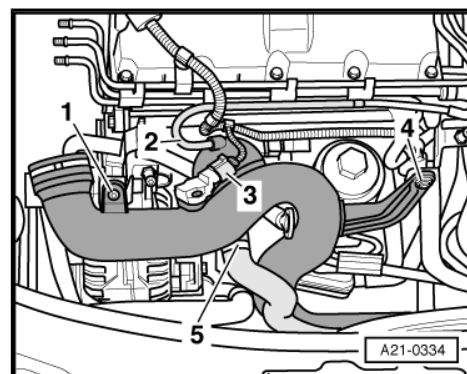


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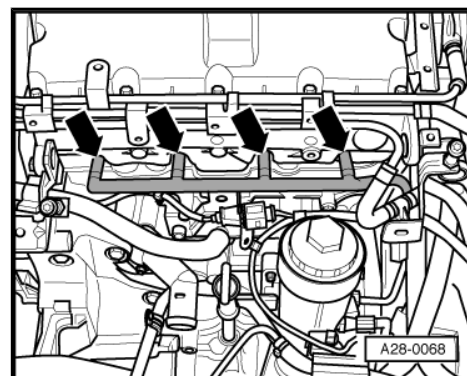
- Detach coolant hoses at the connections indicated -arrows-.



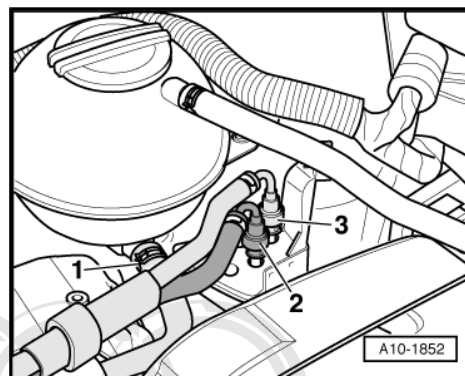
- Detach vacuum pipe -2- at vacuum reservoir.
- Unplug electrical connector -3- at charge pressure sender -G31- .
- Detach coolant hose -5-.
- Unscrew bolts -1- and -4- and remove air pipe together with coolant hose.



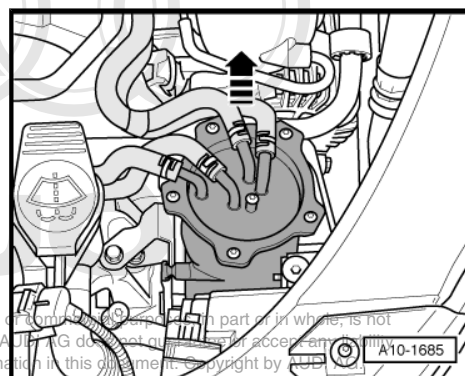
- Detach connector rail from glow plugs -arrows-.



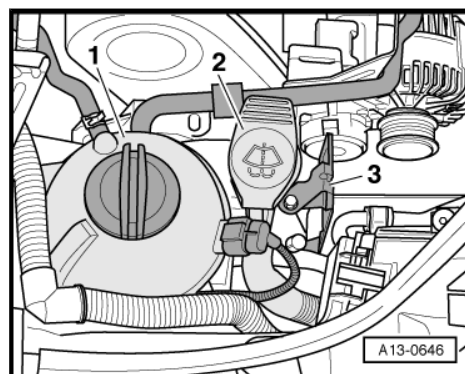
- Disconnect fuel supply line -3- and fuel return line -2- by pulling release tabs.
- Disconnect coolant hose -1- at expansion tank.



- Release catches and pull fuel filter upwards out of bracket -arrow-.



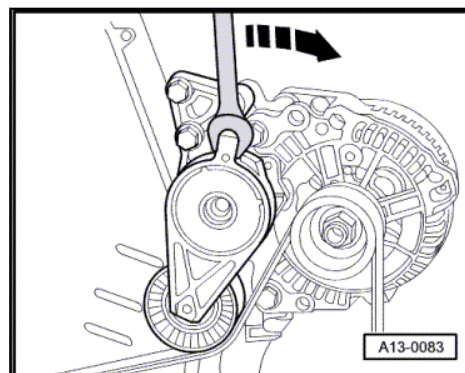
- Unscrew bracket -3- for fuel filter.
- Unscrew bolt at filler neck -2- for washer fluid reservoir.
- Detach electrical connector at coolant expansion tank.
- Unbolt coolant expansion tank -1- and remove.



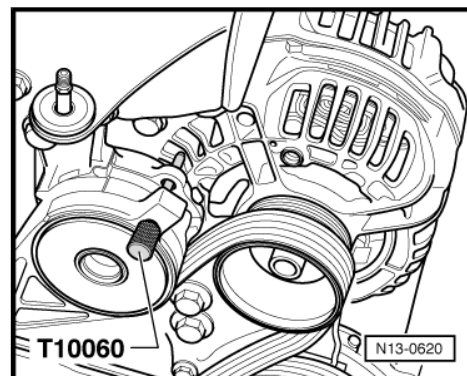
### Note

Before removing, mark direction of rotation of poly V-belt with chalk or felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.

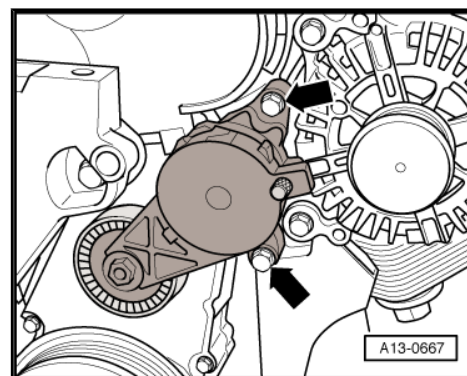
- To slacken the poly V-belt, turn the tensioner in the direction of the -arrow-.



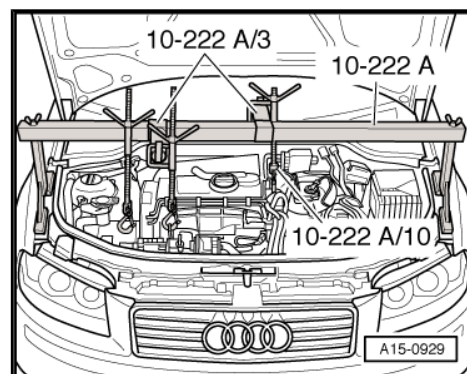
- Lock tensioner for poly V-belt in position with locking pin - T10060 A- or -T10060- .
- Remove poly V-belt.



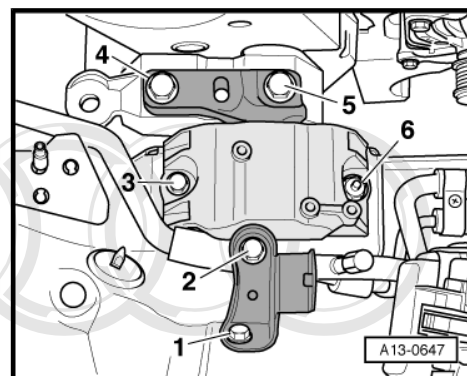
- Remove tensioner for poly V-belt -arrows-.



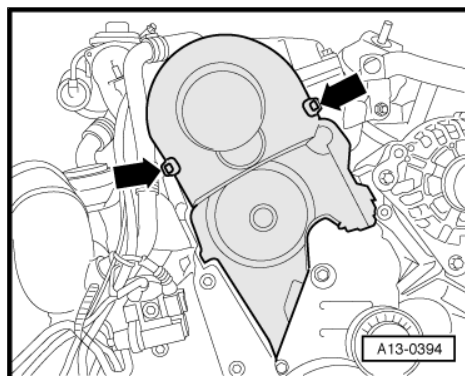
- Set up support bracket -10-222 A- with adapters -10-222 A/3- and a total of 3 spindles on wing panel flanges as illustrated.
- Attach hooks of spindles to lifting eyes; the remaining spindle on the right side should not yet be attached.
- Take up weight of engine evenly with both spindles (but do not raise engine).



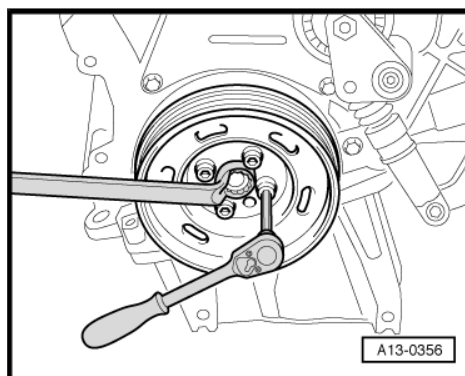
- Remove bolts -1- and -2- and detach connecting bracket.
- Remove bolts -3 ... 6- and detach engine mounting.



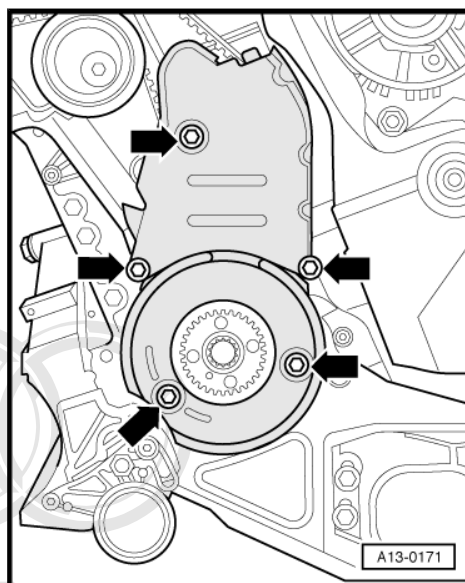
- Remove top toothed belt cover by releasing retaining clips -arrows-.



- Remove cover cap for vibration damper.
- Unbolt vibration damper; counterhold on centre bolt with ring spanner.



- Unbolt lower and centre toothed belt covers -arrows-.



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- Remove bolts -1 ... 3- for engine support.

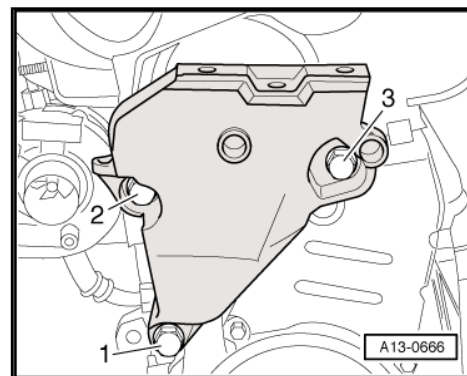
**Note**

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

- Raise engine/gearbox assembly slightly with spindles and remove engine support.
- Lower the engine/gearbox assembly again.

**Caution**

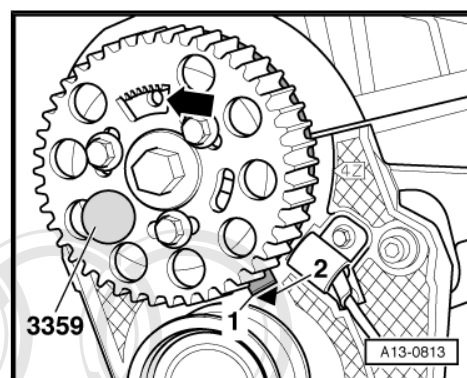
*The engine must only be turned at the crankshaft, in the direction of normal engine rotation (clockwise).*



- Turn the crankshaft to TDC for cylinder No. 1.
- Toothed segment -arrow- in camshaft sprocket must face upwards.
- The lug -1- on sender wheel for camshaft must align with the marking -2- on rear toothed belt cover (not fitted on all versions).

**Note**

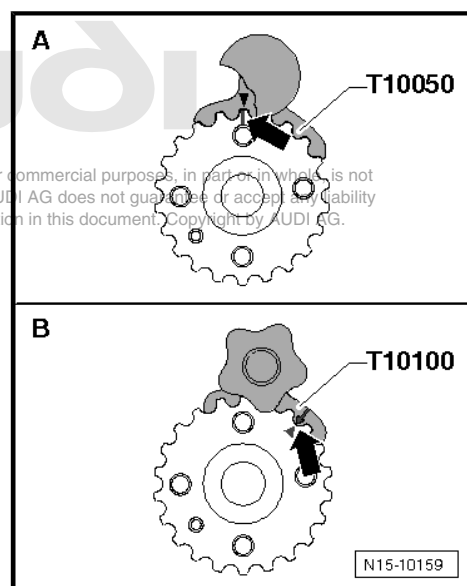
*Camshaft sprocket is shown in illustration with toothed belt removed.*



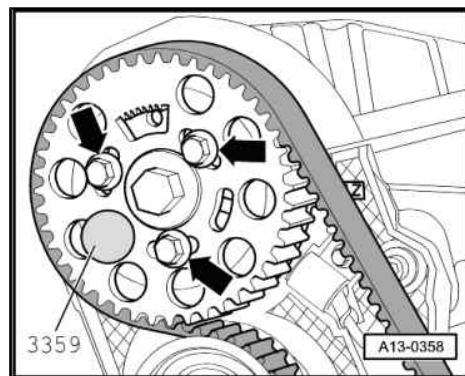
- Lock hub on camshaft with locking pin -3359-.
- Lock crankshaft sprocket using crankshaft stop -T10050- for engines with circular crankshaft sprocket, or crankshaft stop -T10100- for engines with oval crankshaft sprocket.
- The markings on the toothed belt sprocket and the crankshaft stop must align -arrow-. The lug of the crankshaft stop must engage in the bore in the sealing flange.

**Note**

*The crankshaft stop can only be pushed onto the sprocket from the front face of the teeth.*



- Mark direction of rotation of toothed belt with chalk or felt-tip pen.
- Loosen securing bolts for camshaft sprocket -arrows-.

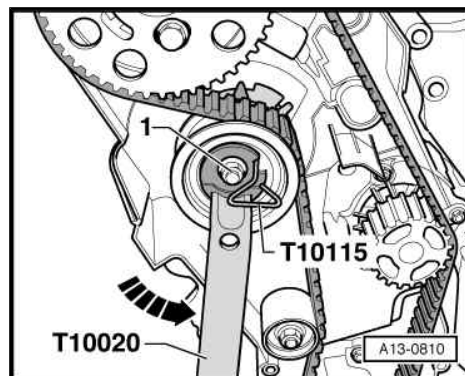


- Loosen securing nut -1- for tensioning roller.
- Turn the eccentric adjuster with the pin wrench -T10020- anti-clockwise until the tensioning roller can be secured with the locking pin -T10115-.

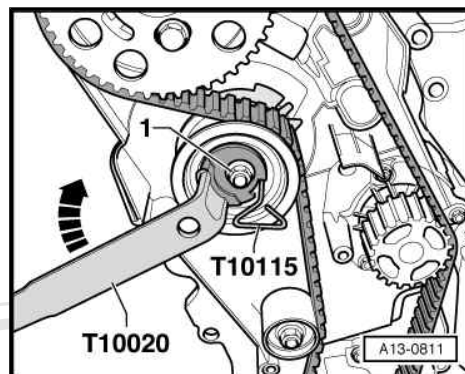


### Note

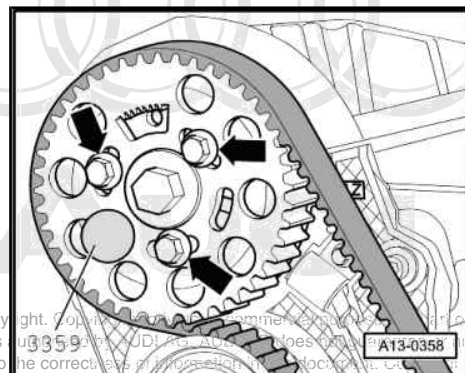
Instead of using the pin wrench -T10020-, you can also use the 2-hole pin wrench -3387-.



- Turn pin wrench -T10020- clockwise until stop and tighten securing nut -1- finger-tight.
- Take off toothed belt first from coolant pump and then from the remaining sprockets.

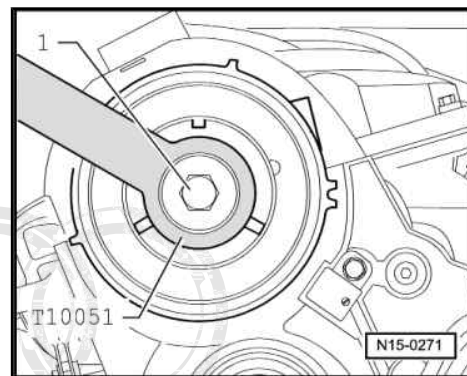


- Remove locking pin -3359-.
- Unscrew bolts -arrows- for camshaft sprocket and remove camshaft sprocket from hub.

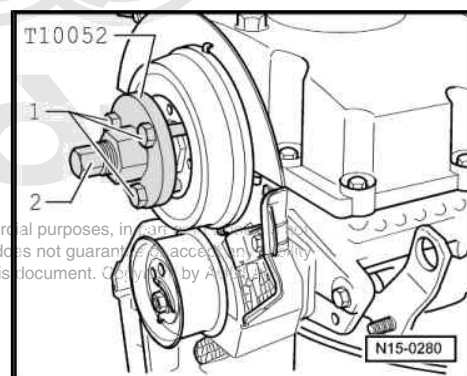


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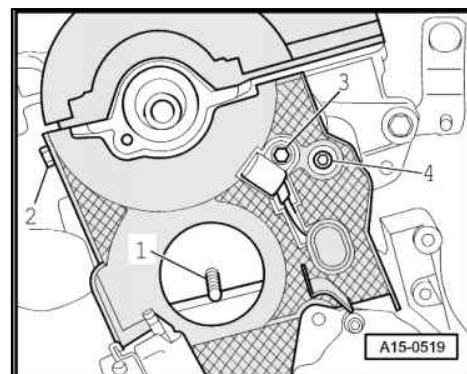
- Loosen securing bolt for hub; use counterhold tool -T10051- .
- Then unscrew bolt approx. 2 turns.



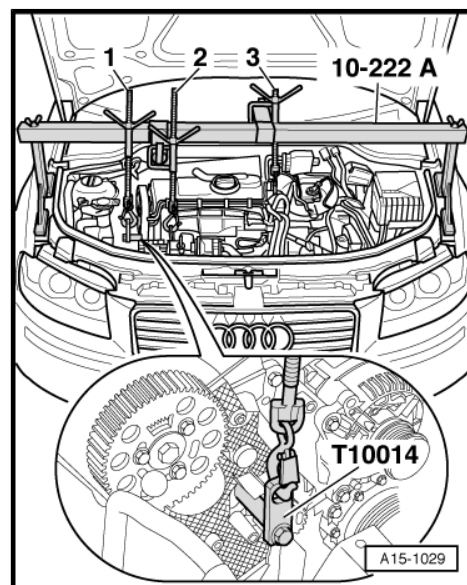
- Apply puller -T10052- and screw bolts -1- into hub.
- Remove hub by screwing in bolt -2- while counterholding at hexagon flats (30 mm) of puller.



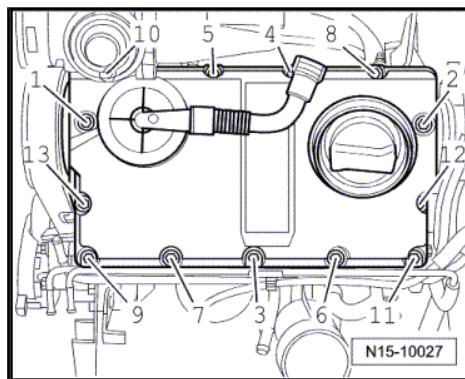
- Remove toothed belt tensioning roller.
- Remove bolts -2- and -4-.
- Unscrew bolt -3- and remove Hall sender -G40- from cylinder head.
- Unscrew stud -1- using two M8 lock nuts.



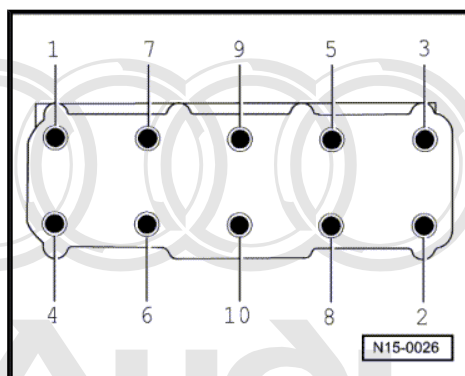
- Screw in bracket -T10014- into threaded hole above coolant pump.
- Attach spindle -1- of support bar -10-222 A- to bracket -T10014- .
- Lift engine using spindle -1- until spindles -2- and -3- are no longer carrying a load.
- Unhook spindles -2- and -3- and move to side.



- Remove cylinder head cover bolts in the sequence -13 ... 1-.
- Remove cylinder head cover.
- Unbolt engine lifting eye at front on cylinder head.



- Follow the sequence for loosening the cylinder head bolts.
- Remove the cylinder head with the assistance of a 2nd mechanic.



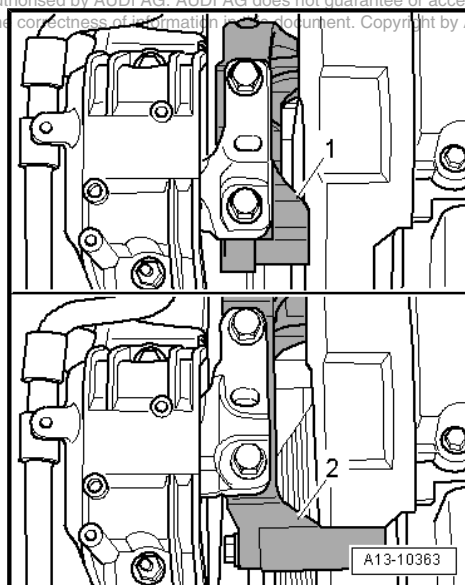
## 1.4 Removing cylinder head - vehicles from approx. 06.2005 onwards



### Note

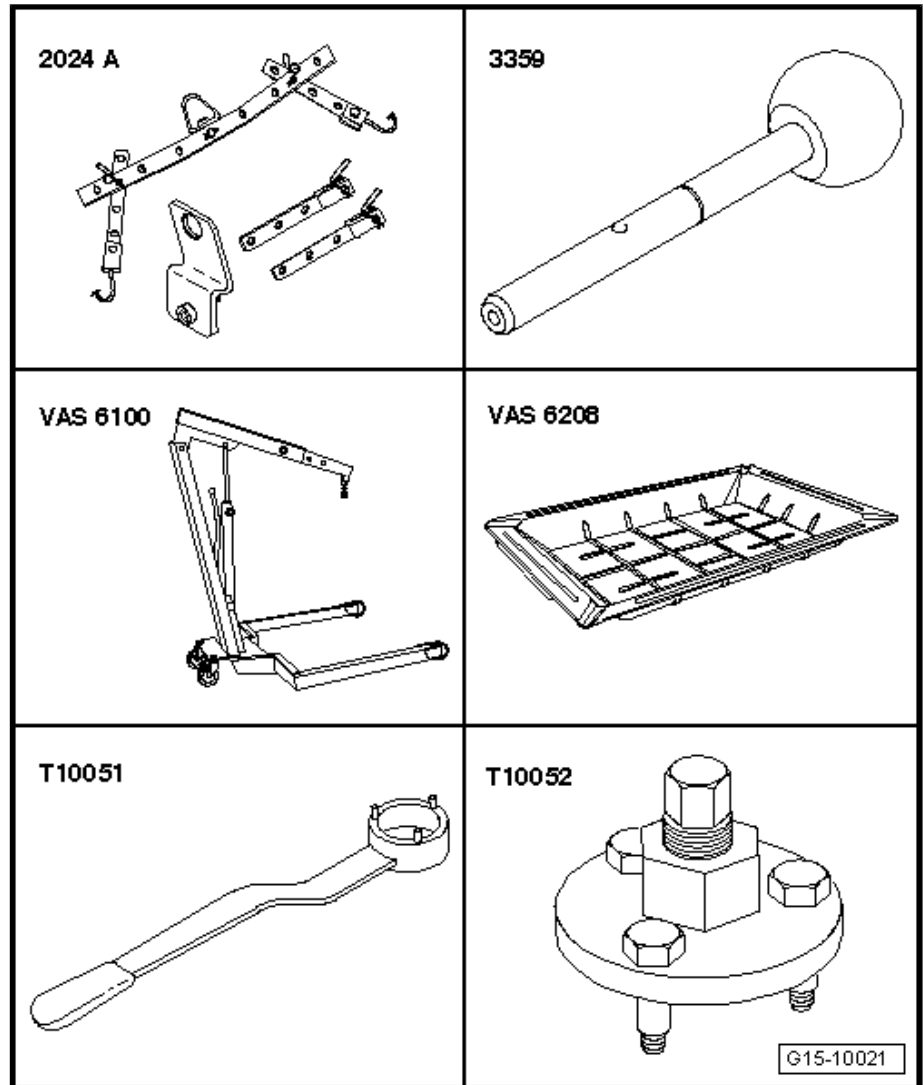
On vehicles from approx. 06.2005 onwards (can be identified by engine support -version 2-), the engine support does not have to be removed before removing the cylinder head.

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### Special tools and workshop equipment required

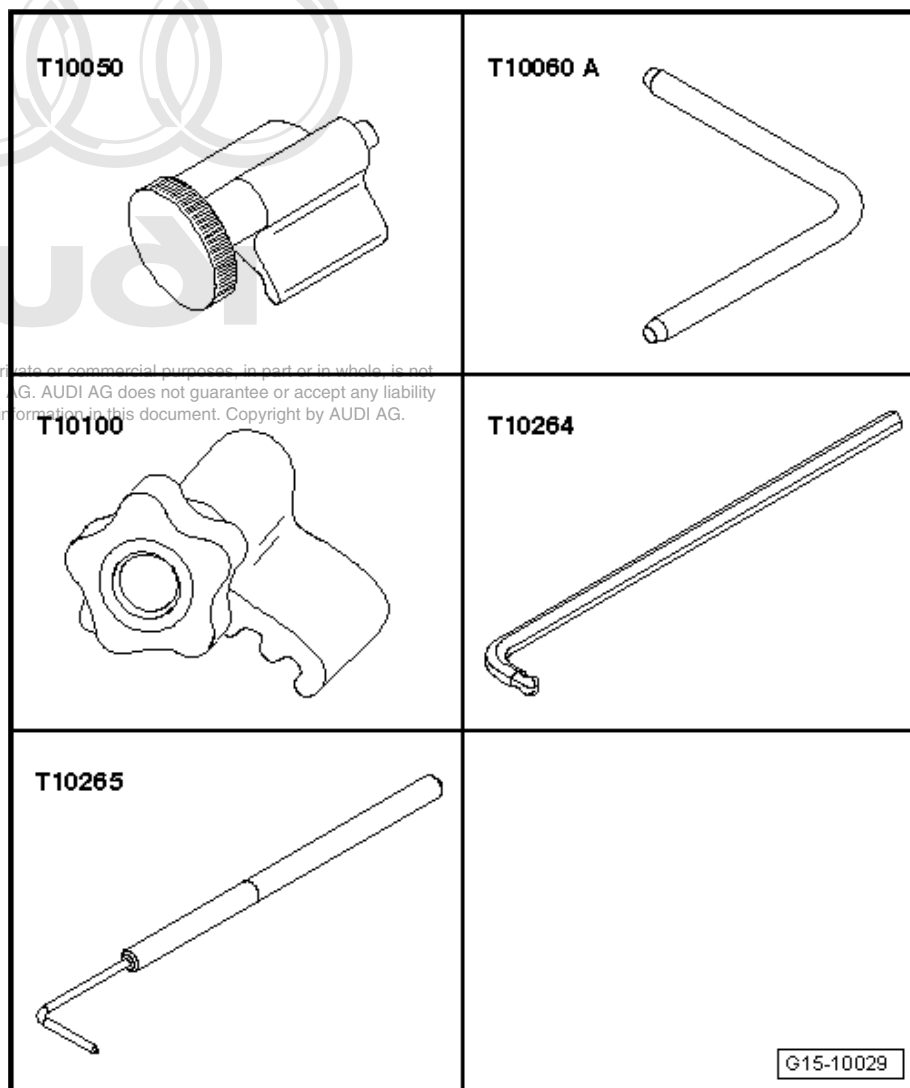
- ◆ Lifting tackle -2024 A-
- ◆ Diesel injection pump locking pin -3359-
- ◆ Workshop hoist -VAS 6100-
- ◆ Drip tray for workshop hoist -VAS 6208-
- ◆ Counterhold tool -T10051-
- ◆ Puller -T10052-



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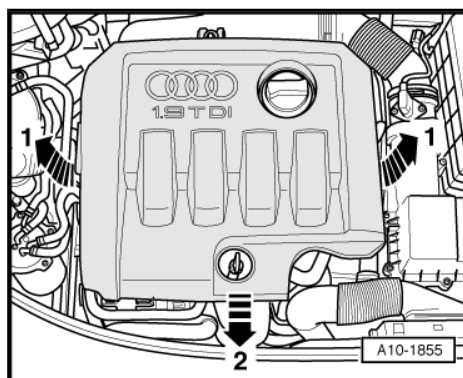
- ◆ Crankshaft stop -T10050-  
for engines with circular  
crankshaft sprocket
- ◆ Locking pin -T10060 A- or -  
T10060-
- ◆ Crankshaft stop -T10100-  
for engines with oval crank-  
shaft sprocket
- ◆ Angle driver -T10264-
- ◆ Locking tool -T10265-

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### Procedure

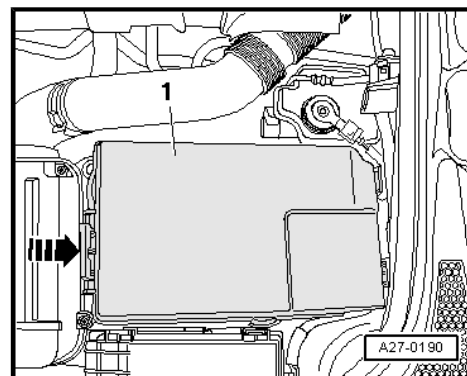
- Lift engine cover panel at sides -arrows 1- and pull off towards front -arrow 2-.



- Remove cover -1- over battery; to do so, press release tab -arrow-.

**Caution**

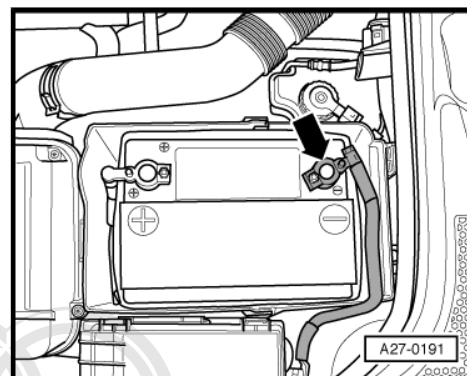
*Observe notes on procedure for disconnecting the battery ⇒ Rep. gr. 27.*



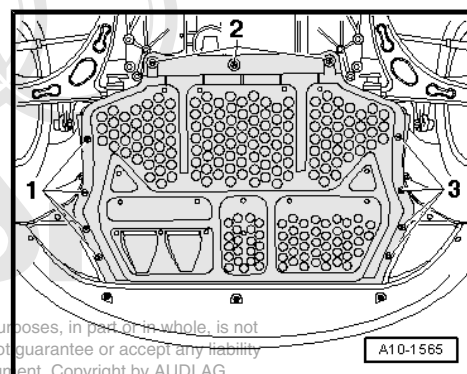
- With ignition switched off, disconnect battery earth cable -arrow-.

**WARNING**

*Hot steam or hot coolant can escape when expansion tank is opened; cover filler cap with cloth and open carefully.*

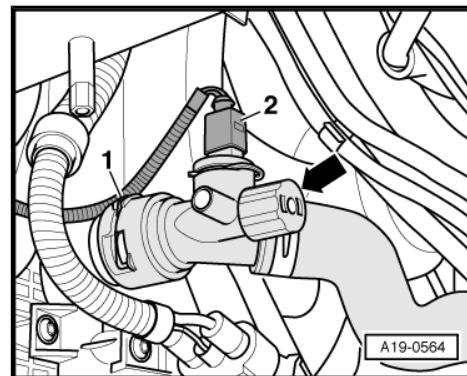


- Open filler cap on coolant expansion tank.
- Remove centre noise insulation -fasteners 1 ... 3-.

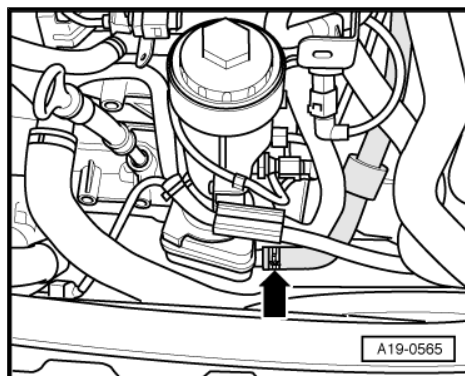


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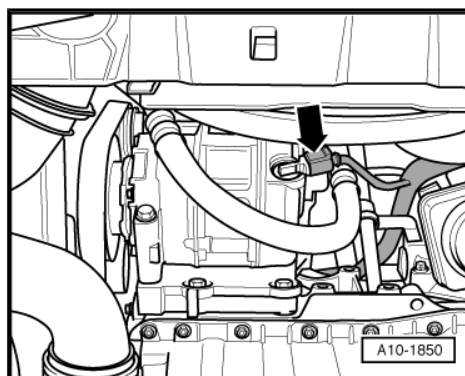
- Unplug electrical connector -2- from coolant temperature sender - radiator outlet -G83- .
- Place drip tray for workshop hoist -VAS 6208- under engine.
- Turn drain plug -arrow- on radiator anti-clockwise, if necessary fit drain hose to connection.
- Detach lower coolant hose -1-; to do so, pull out retaining clip.



- Disconnect coolant hose at bottom of oil cooler -arrow- and drain off remaining coolant.



- Unplug electrical connector -arrow- for magnetic clutch of air conditioner compressor.

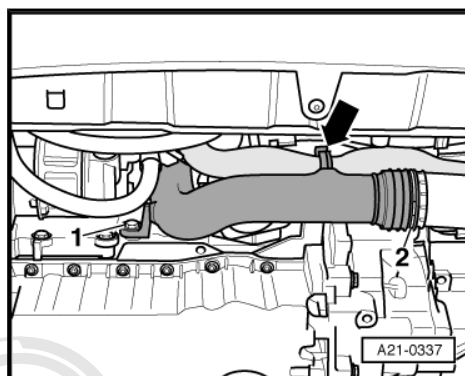


- Detach lower air intake hose (left-side) from front air pipe by lifting retaining clip -2- slightly.
- Remove bolt -1-.

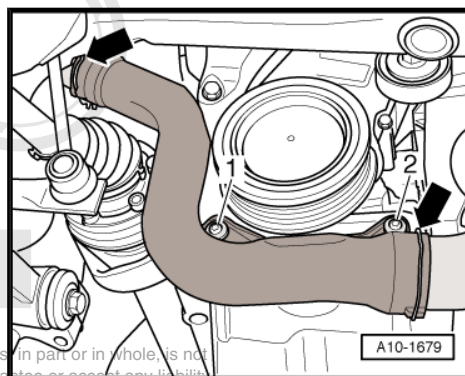


### Note

The coolant hose remains attached to bracket -arrow-.

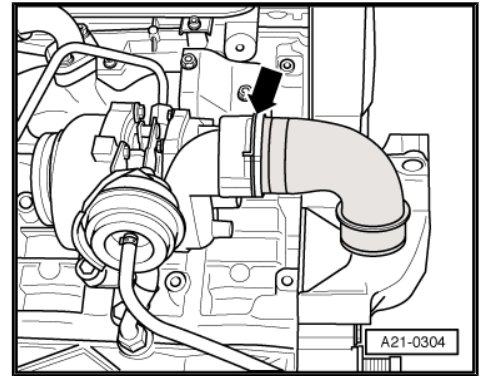


- Remove bolts -1- and -2-.
- Remove air pipe (right-side) by lifting retaining clips -arrows- slightly.



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- Detach air intake hose from turbocharger by lifting retaining clip -arrow- slightly.



- Remove front cross-piece for underbody -arrows-.

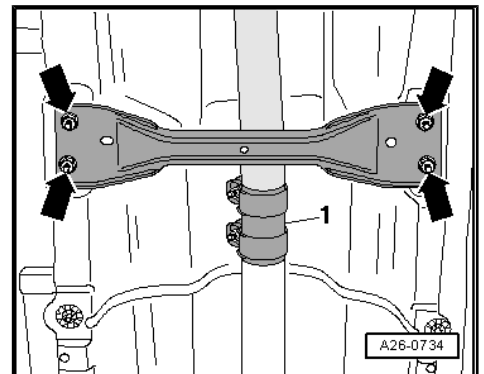


Note

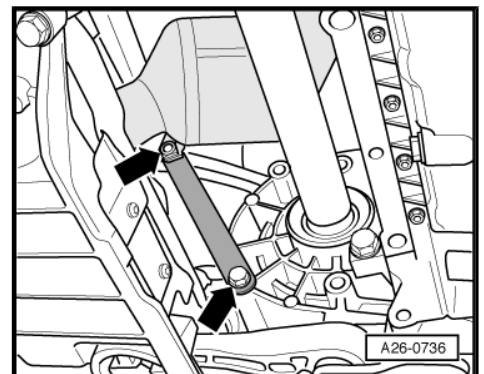
*To avoid damage, the flexible joints in the front exhaust pipe must not be bent more than 10°.*

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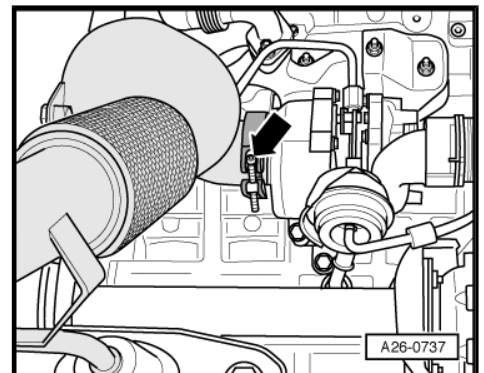
- Loosen nuts on clamp -1-.



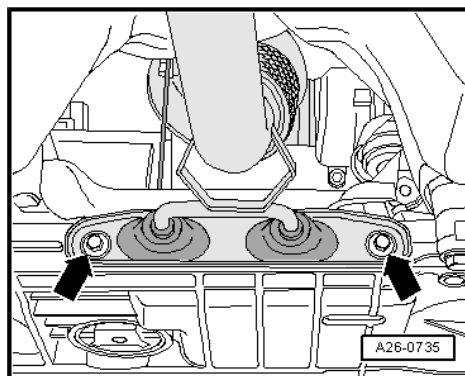
- Unbolt support for front exhaust pipe -arrows-.



- Open clamp -arrow- and detach front exhaust pipe from turbocharger.



- Unbolt bracket for exhaust system -arrows-.
- Push the clamp back and remove the front exhaust pipe.



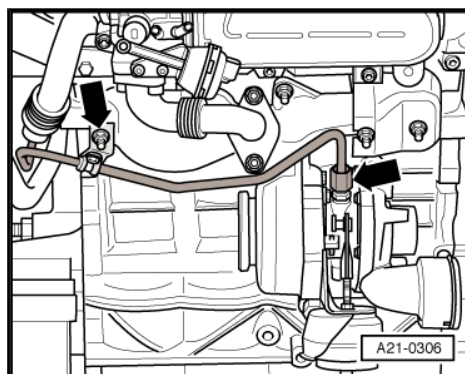
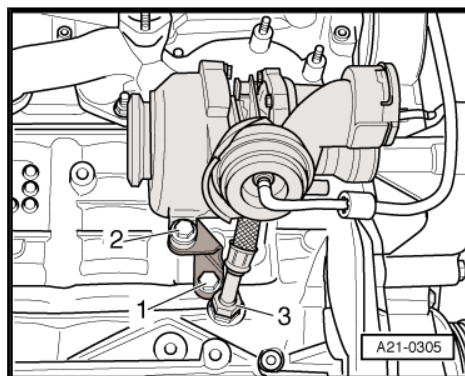
- Remove bolts -1- and -2- and detach bracket for turbocharger.



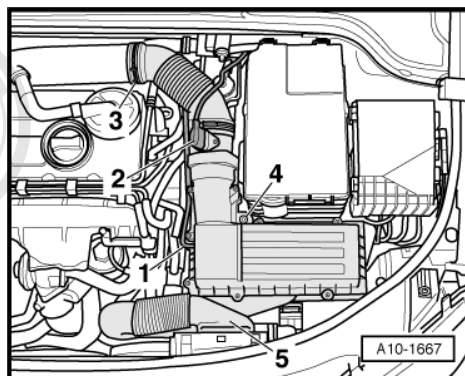
### Note

*Place a cloth underneath to catch any escaping oil.*

- Remove oil return line -3- at cylinder block.
- Unscrew oil supply line at turbocharger and at exhaust manifold -arrows- and move to one side.

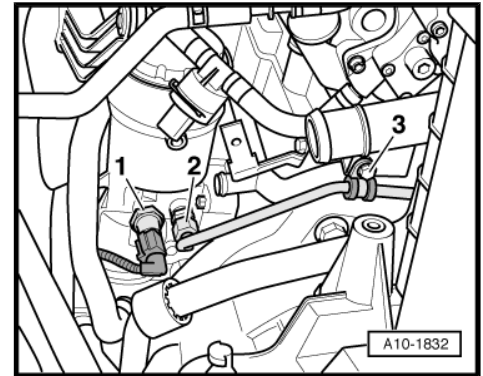


- Unplug electrical connector -2- at air mass meter -G70-.
- Detach vent hose -1- and air hoses -3- and -5-.
- Unscrew bolt -4- and remove air cleaner housing.



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- Unplug electrical connector -1- at oil pressure switch -F1- .
- Unscrew oil pressure switch -2-.
- Detach oil supply line at oil filter bracket -3- and at coolant pipe -4-.

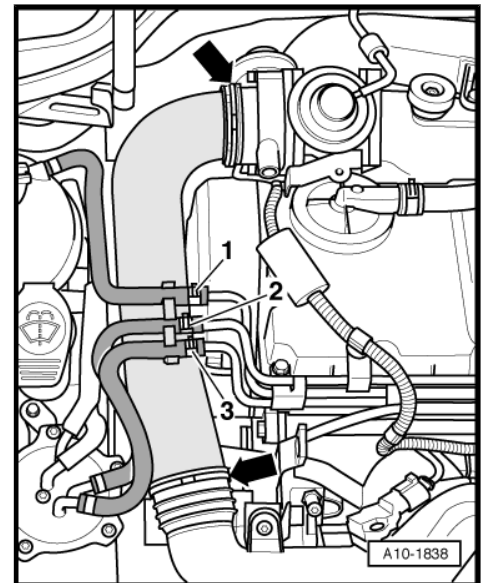


- Detach coolant hose -1- and move clear.

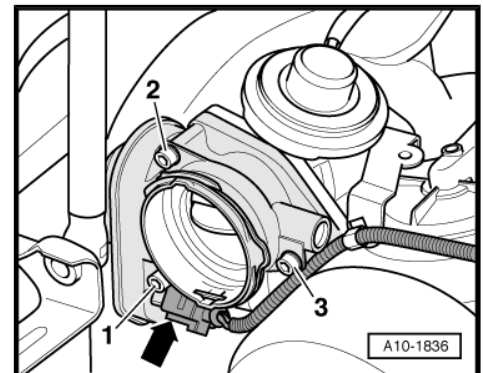
**WARNING**

- ◆ *In extreme cases the fuel lines and the fuel can reach a temperature of 100 °C on vehicles with unit injector engine. Allow the fuel to cool down before disconnecting the lines - danger of scalding.*
- ◆ *Wear protective gloves.*
- ◆ *Wear safety goggles.*

- Disconnect fuel supply line -3- and fuel return line -2- and move lines clear.
- Remove air pipe by lifting retaining clips -arrows- slightly.

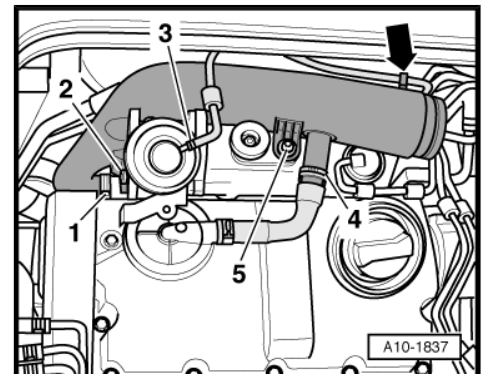


- Detach electrical connector -arrow- at intake manifold flap motor -V157- .
- Unscrew bolts -1 ... 3- and remove intake manifold flap motor -V157- .

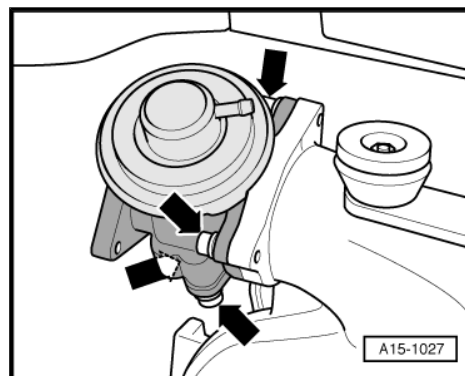


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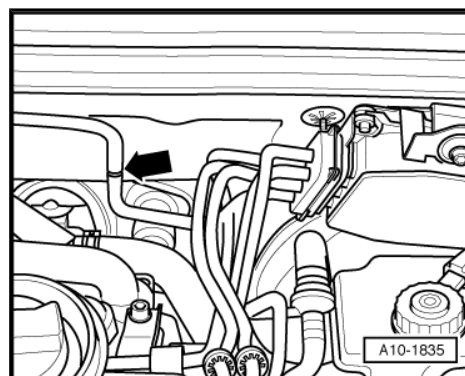
- Disconnect vacuum hose -3- at exhaust gas recirculation valve -N18- .
- Detach pipe -4- for crankcase breather at air pipe.
- Release hose clip -1- at turbocharger using hose clip pliers -VAS 6340- .
- Move the vacuum hoses clear -arrow-.
- Unscrew bolts -2- and -5- and remove air pipe.



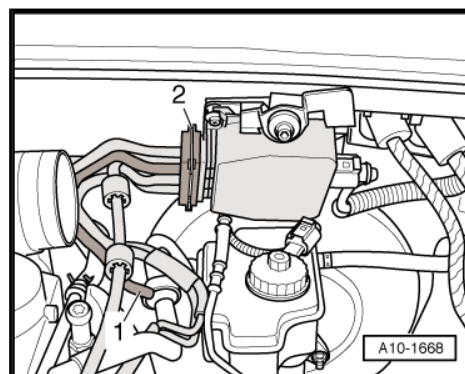
- Unscrew mechanical exhaust gas recirculation valve -arrows-.



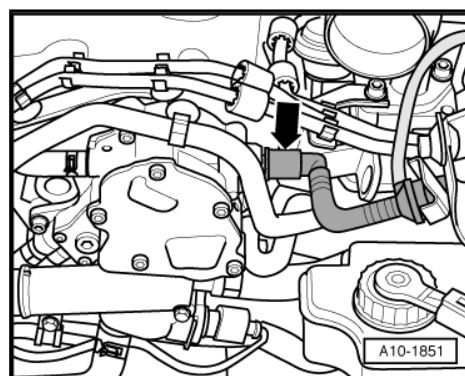
- Disconnect hose going to vacuum unit for charge pressure control at separating point -arrow-.



- Detach hose connection carrier -2- at solenoid valve block by releasing retaining tab.
- Detach vacuum hose -1- at non-return valve for brake servo.



- Detach vacuum hose -arrow- going to brake servo at tandem pump.



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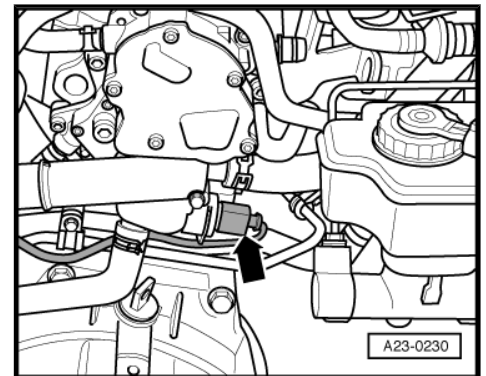
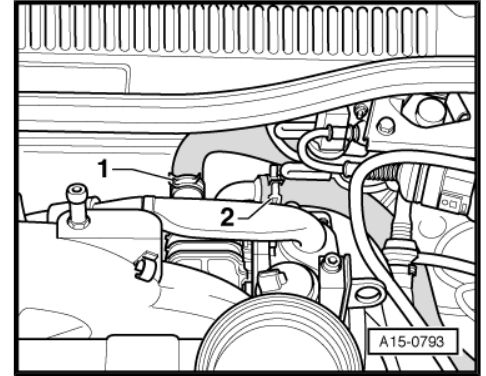
- Detach coolant hose -1- at cooler for exhaust gas recirculation.



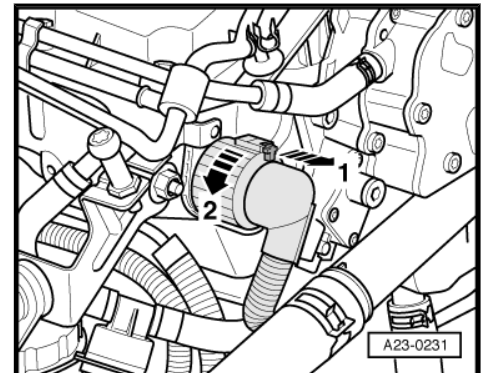
**Note**

*Leave coolant hose -2- connected.*

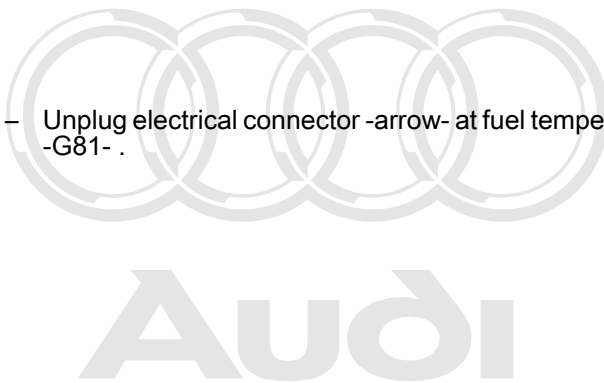
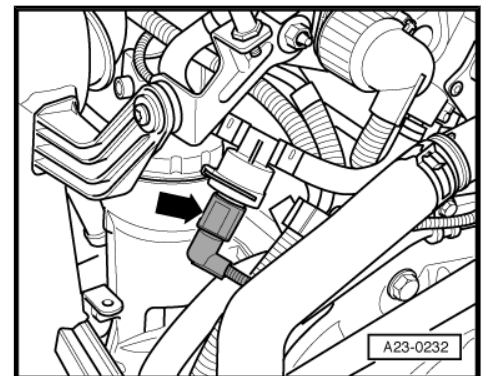
- Detach electrical connector -arrow- at coolant temperature sender -G62- and move wire clear.



- Pull the release pin -arrow 1- and unscrew knurled nut -arrow 2-.
- Disconnect main connector for unit injectors and move wiring harness clear.

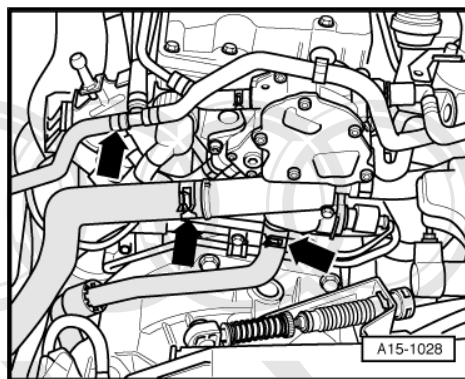


- Unplug electrical connector -arrow- at fuel temperature sender -G81-.

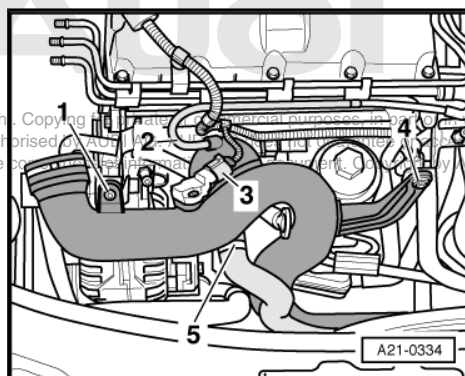


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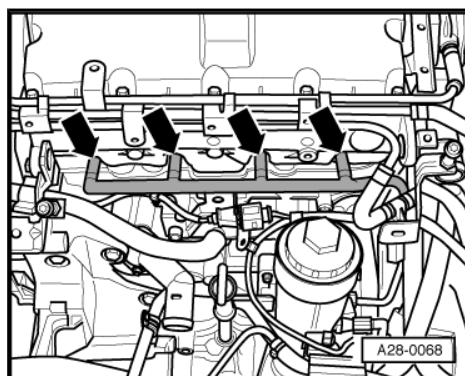
- Detach coolant hoses at the connections indicated -arrows-.



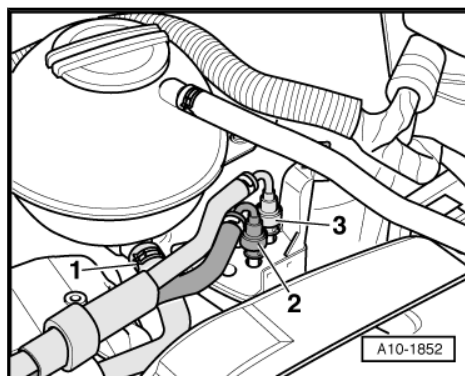
- Detach vacuum pipe -2- at vacuum reservoir.
- Unplug electrical connector -3- at charge pressure sender -G31-.
- Detach coolant hose -5-.
- Unscrew bolts -1- and -4- and remove air pipe together with coolant hose.



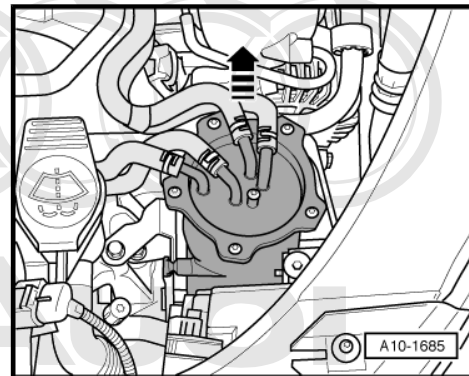
- Detach connector rail from glow plugs -arrows-.



- Disconnect fuel supply line -3- and fuel return line -2- by pulling release tabs.
- Disconnect coolant hose -1- at expansion tank.

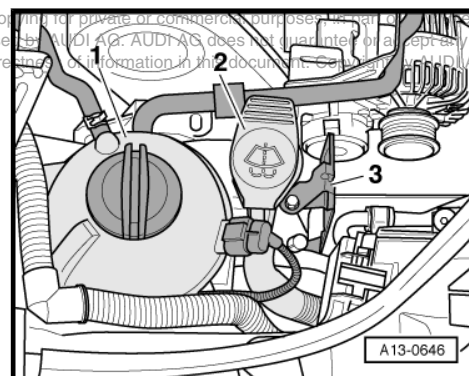


- Release catches and pull fuel filter upwards out of bracket -arrow-.



- Unscrew bracket -3- for fuel filter.
- Unscrew bolt at filler neck -2- for washer fluid reservoir.
- Detach electrical connector at coolant expansion tank.
- Unbolt coolant expansion tank -1- and remove.

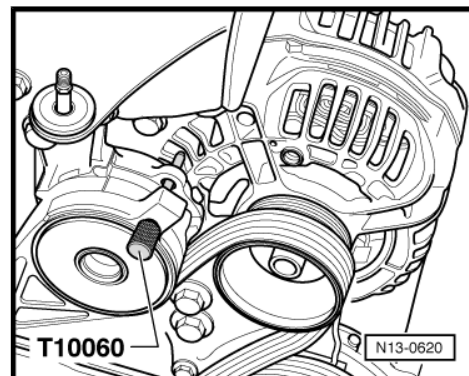
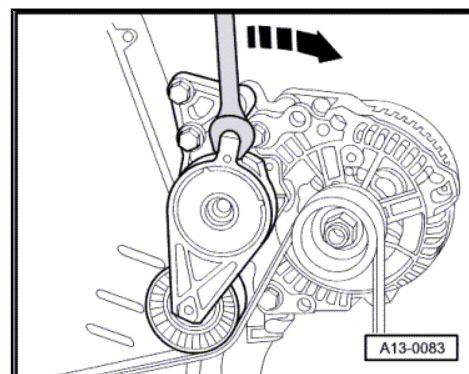
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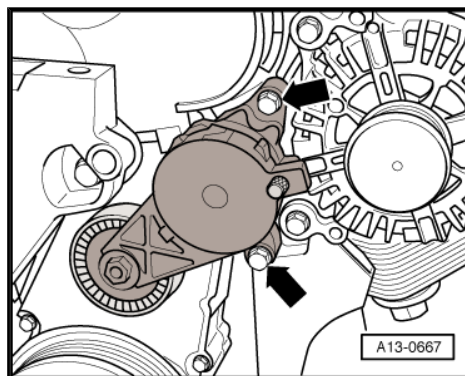
#### Note

*Before removing, mark direction of rotation of poly V-belt with chalk or felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.*

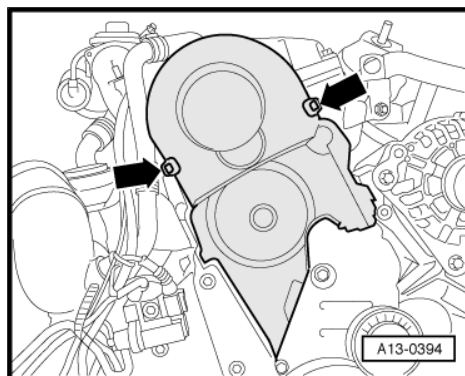
- To slacken the poly V-belt, turn the tensioner in the direction of the -arrow-.
- Lock tensioner for poly V-belt in position with locking pin - T10060 A- or -T10060- .
- Remove poly V-belt.



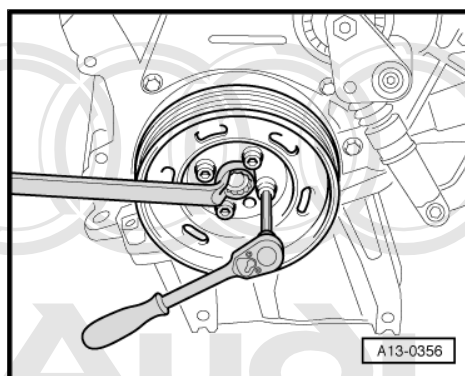
- Remove tensioner for poly V-belt -arrows-.



- Remove top toothed belt cover by releasing retaining clips -arrows-.



- Remove cover cap for vibration damper.
- Unbolt vibration damper; counterhold on centre bolt with ring spanner.

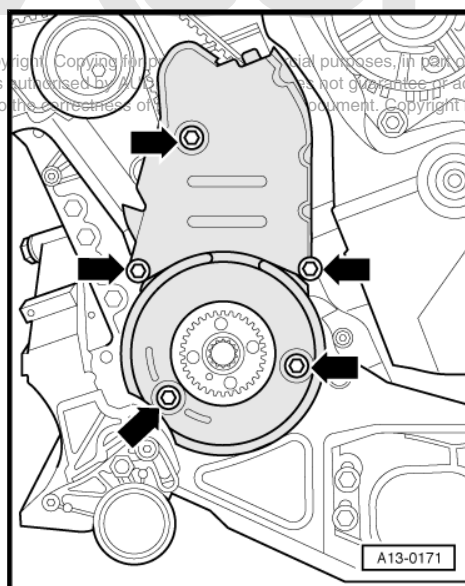


- Unbolt lower and centre toothed belt covers -arrows-.



### Caution

*The engine must only be turned at the crankshaft, in the direction of normal engine rotation (clockwise).*

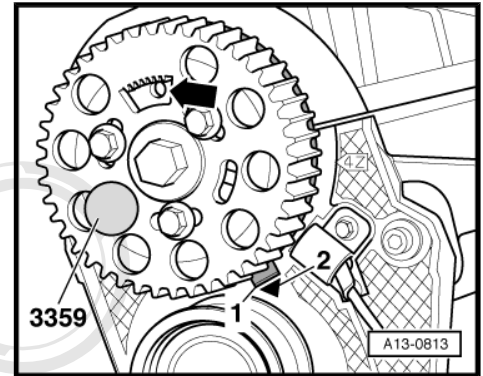


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- Turn the crankshaft to TDC for cylinder No. 1.
- Toothed segment -arrow- in camshaft sprocket must face upwards.
- The lug -1- on sender wheel for camshaft must align with the marking -2- on rear toothed belt cover.

**i Note**

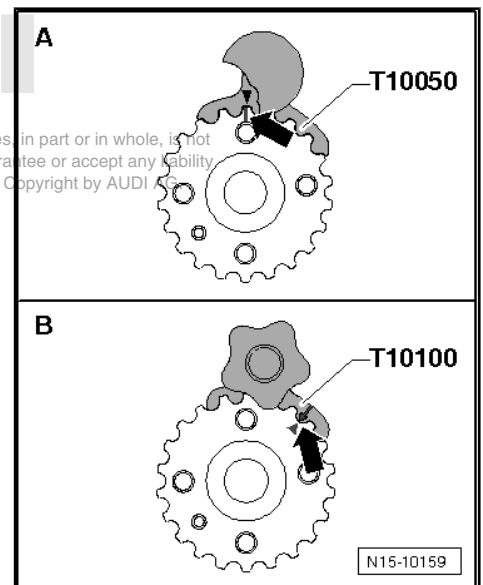
*Camshaft sprocket is shown in illustration with toothed belt removed.*



- Lock hub on camshaft with locking pin -3359- .
- Lock crankshaft sprocket using crankshaft stop -T10050- for engines with circular crankshaft sprocket, or crankshaft stop -T10100- for engines with oval crankshaft sprocket.
- The markings on the toothed belt sprocket and the crankshaft stop must align -arrow-. The lug of the crankshaft stop must engage in the bore in the sealing flange.

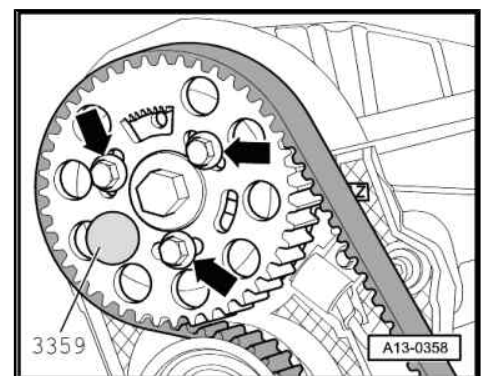
**i Note**

*The crankshaft stop can only be pushed onto the sprocket from the front face of the teeth.*

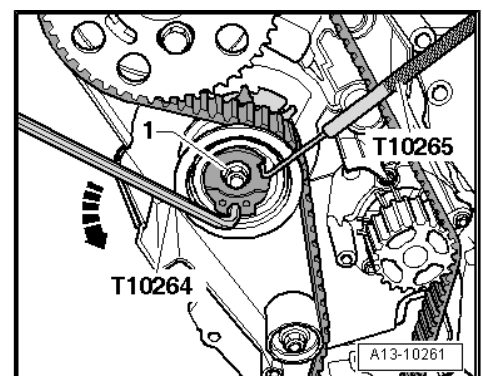


- Mark direction of rotation of toothed belt with chalk or felt-tip pen.

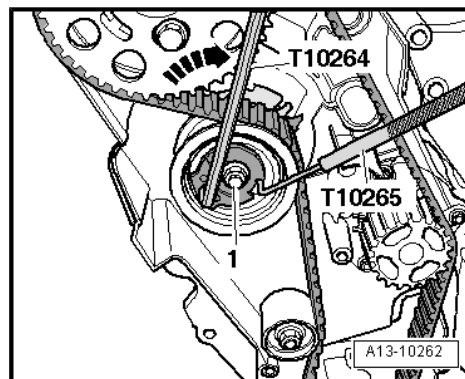
- Loosen securing bolts for camshaft sprocket -arrows-.



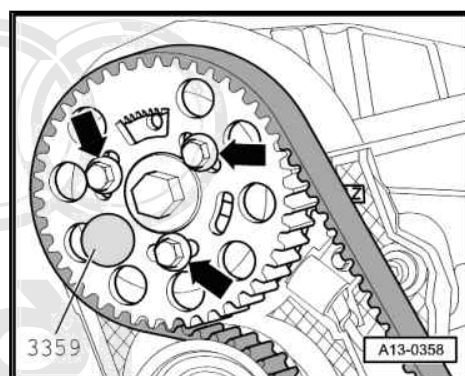
- Loosen securing nut -1- for tensioning roller.
- Turn the eccentric adjuster with the angle driver -T10264- anti-clockwise -arrow- until the tensioning roller can be secured with the locking tool -T10265- .



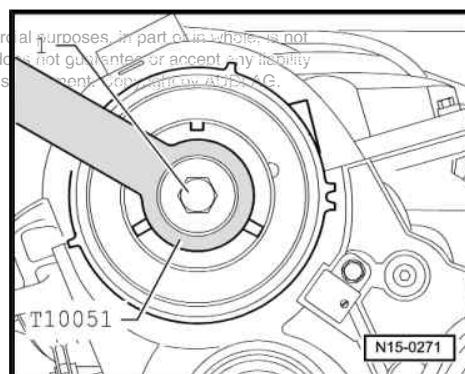
- Now turn eccentric adjuster of tensioning roller clockwise -arrow- until stop and tighten securing nut -1- finger-tight.
- Take off toothed belt first from coolant pump and then from the remaining sprockets.



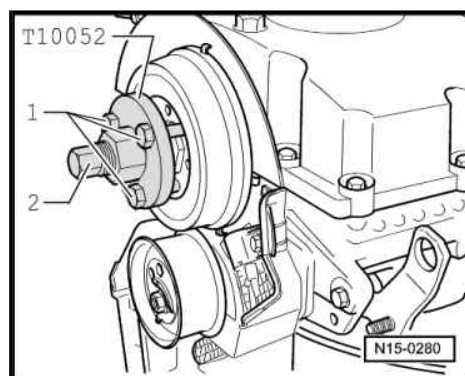
- Remove locking pin -3359- .
- Unscrew bolts -arrows- for camshaft sprocket and remove camshaft sprocket from hub.



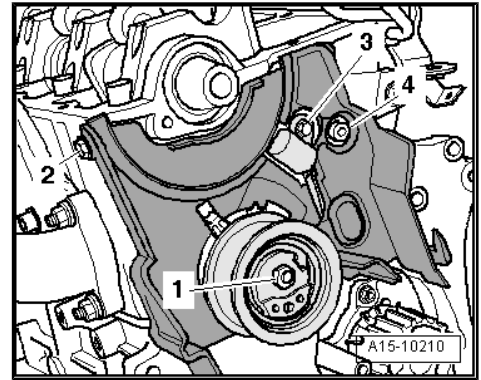
- Loosen securing bolt for hub; use counterhold tool -T10051- .
- Then unscrew bolt approx. 2 turns.



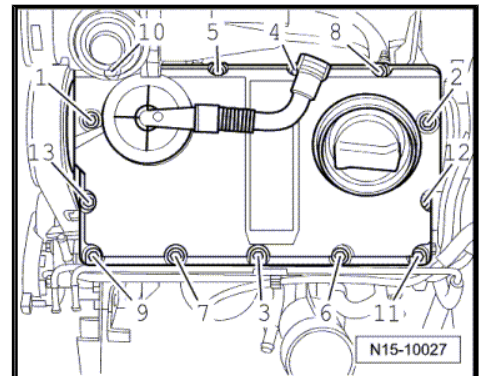
- Apply puller -T10052- and screw bolts -1- into hub.
- Remove hub by screwing in bolt -2- while counterholding at hexagon flats (30 mm) of puller.



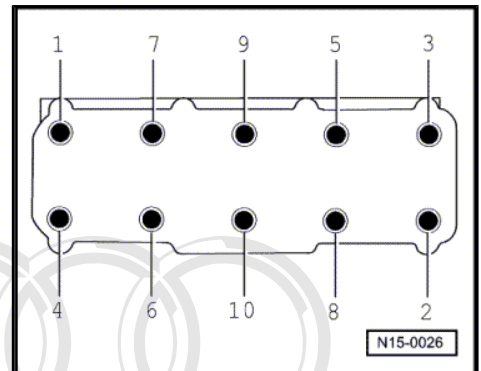
- Unscrew nut -1- for tensioning roller.
- Remove locking tool -T10265- from tensioning roller.
- Remove bolts -2- and -4-.
- Unscrew bolt -3- and remove Hall sender -G40- from cylinder head.



- Remove cylinder head cover bolts in the sequence -13 ... 1-.
- Remove cylinder head cover.



- Follow the sequence for loosening the cylinder head bolts.



- Attach lifting tackle -2024 A- at cylinder head.

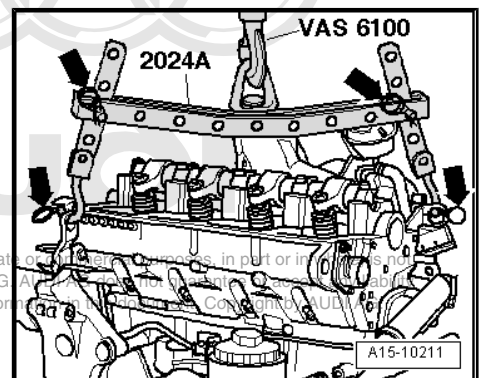
**WARNING**

*The support hooks and retaining pins on the lifting tackle must be secured with locking pins -arrows-.*

**Note**

*Also tie up intake manifold to eye of lifting tackle to maintain the centre of gravity in one position.*

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- Slightly lift cylinder head using workshop hoist -VAS 6100- .
- Swivel cylinder head to left out of toothed belt cover (rear) and remove tensioning roller at the same time.
- Lay cylinder head aside on a clean surface with the combustion chamber side facing upwards.

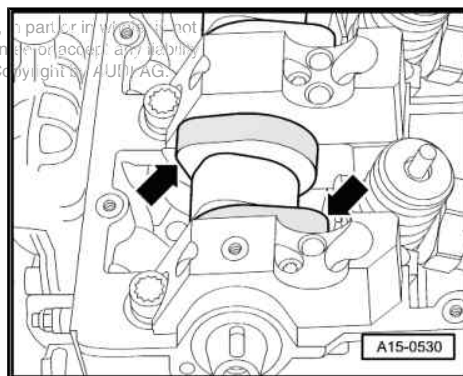
## 1.5 Installing cylinder head



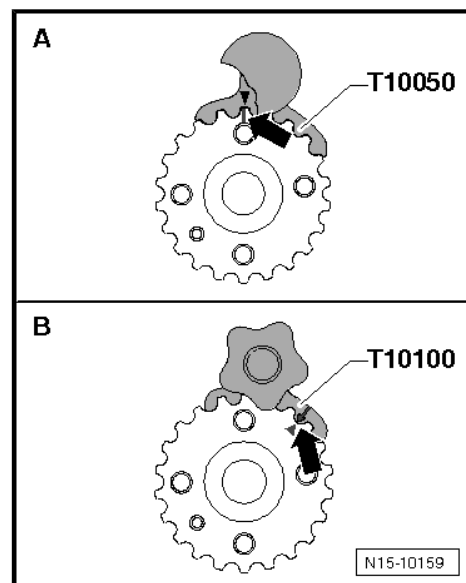
### Note

- ◆ *Renew the cylinder head bolts.*
- ◆ *Renew self-locking nuts and bolts when performing assembly work.*
- ◆ *Renew bolts which are tightened to a specified angle as well as oil seals and gaskets.*
- ◆ *If repairing, carefully remove any remaining gasket material from the cylinder head and cylinder block. Ensure that no long scores or scratches are made on the surfaces.*
- ◆ *Carefully remove any remaining emery and abrasive material.*
- ◆ *No oil or coolant must be allowed to remain in the blind holes for the cylinder head bolts in the cylinder block.*
- ◆ *Cylinder heads with cracks between the valve seats may be used without reducing engine life, provided the cracks are small and not more than 0.5 mm wide.*
- ◆ *The cylinder heads of diesel engines must not be machined.*
- ◆ *When installing a replacement cylinder head with fitted camshaft, the contact surfaces between hydraulic tappets and cam running surfaces must be oiled after installing the cylinder head.*
- ◆ *The plastic protectors fitted to protect the open valves should not be removed until the cylinder head is ready to be fitted.*
- ◆ *Do not remove new cylinder head gasket from packaging until it is ready to be fitted.*
- ◆ *Handle gasket very carefully. Damage to the silicone coating or the indented area will lead to leaks.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- ◆ *After fitting a new cylinder head or cylinder head gasket, change the coolant and engine oil.*
- ◆ *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.*

- Check whether the camshaft and the crankshaft are positioned at TDC:
- The cams for cylinder 1 must point upwards evenly on camshaft -arrows-.



- The crankshaft sprocket must be locked using crankshaft stop -T10050- for engines with circular crankshaft sprocket, or crankshaft stop -T10100- for engines with oval crankshaft sprocket.
- The markings on the toothed belt sprocket and the crankshaft stop must align -arrow-. The lug of the crankshaft stop must engage in the bore in the sealing flange.



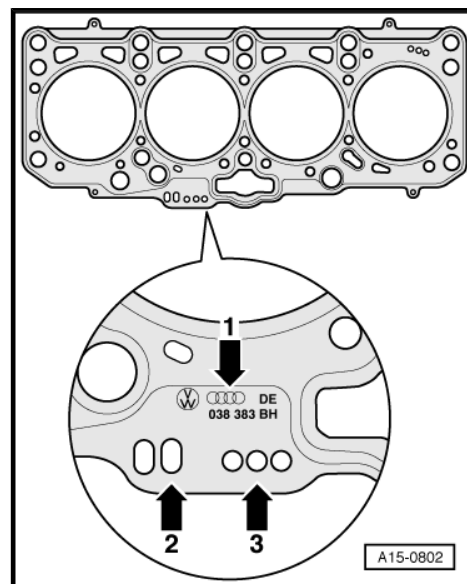
– Note identification markings on cylinder head gasket.

- 1 - Part No.
- 2 - Production code (can be disregarded)
- 3 - Holes



#### Note

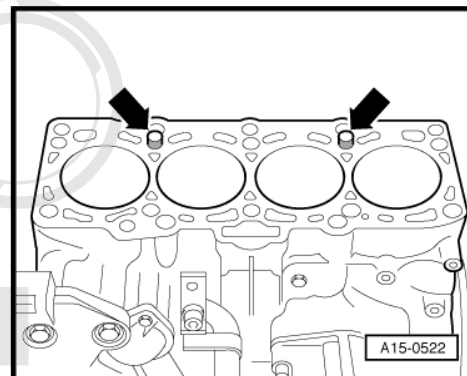
- ◆ If the cylinder head gasket or cylinder head is renewed, be sure to install a gasket with the same identification.
- ◆ If parts of the crankshaft drive have been renewed, the new cylinder head gasket must be selected by measuring the piston projection at TDC ⇒ [page 85](#).



- Fit cylinder head gasket.
- Note centring sleeves -arrows- in cylinder block.
- Check installation position of cylinder head gasket: the word "oben" (top) or the Part No. should face towards the cylinder head.

#### Vehicles up to approx. 05.2005:

- Fit cylinder head.



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### Vehicles from approx. 06.2005 onwards:

- Attach lifting tackle -2024 A- at cylinder head.



#### WARNING

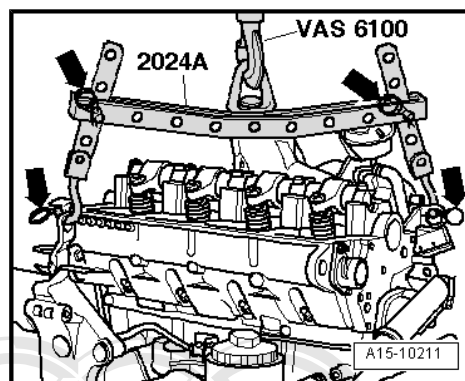
*The support hooks and retaining pins on the lifting tackle must be secured with locking pins -arrows-.*



#### Note

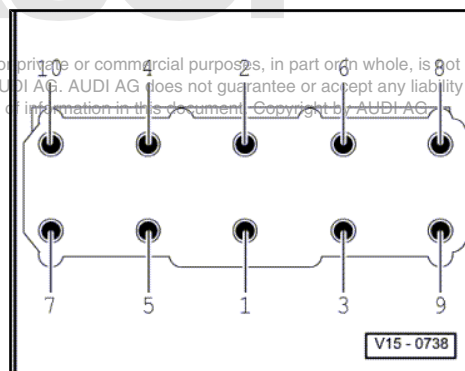
*Also tie up intake manifold to eye of lifting tackle to maintain the centre of gravity in one position.*

- Slightly lift cylinder head using workshop hoist -VAS 6100-.
- Swivel cylinder head so that stud for toothed belt tensioner is inserted into aperture in toothed belt cover (rear) and attach tensioning roller at the same time.
- Fit cylinder head onto cylinder block.



### All vehicles:

- Insert new cylinder head bolts and tighten hand-tight.
- Tighten cylinder head bolts in the sequence -1 ... 10- in 4 stages as follows:
  1. Tighten with torque wrench to 40 Nm.
  2. Tighten with torque wrench to 60 Nm.
  3. Turn 90° (1/4 turn) further using a rigid wrench.
  4. Turn 90° (1/4 turn) further using a rigid wrench.

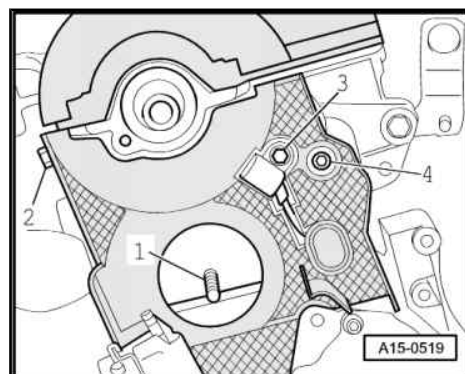


#### Note

*Cylinder head bolts do not have to be torqued down again later after repair work.*

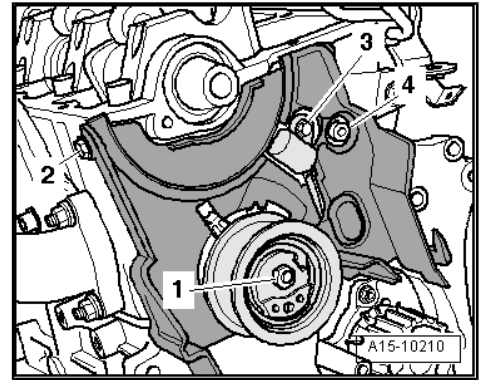
### Vehicles up to approx. 05.2005:

- Secure the engine lifting eye at front on cylinder head.
- Apply locking fluid to bolts -2 ... 4- and tighten; for locking fluid refer to ⇒ Parts catalogue .
- Screw in stud -1-.

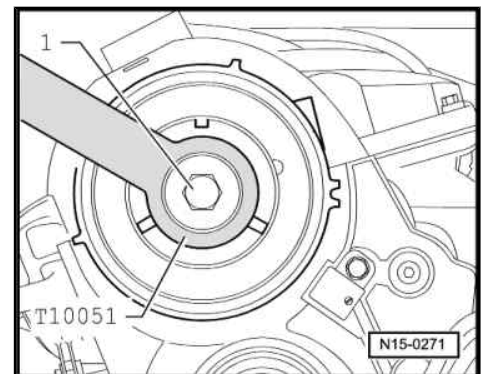


**Vehicles from approx. 06.2005 onwards:**

- Apply locking fluid to bolts -2 ... 4- and tighten; for locking fluid refer to ⇒ Parts catalogue .
- Screw nut -1- for toothed belt tensioner onto stud for toothed belt tensioner.

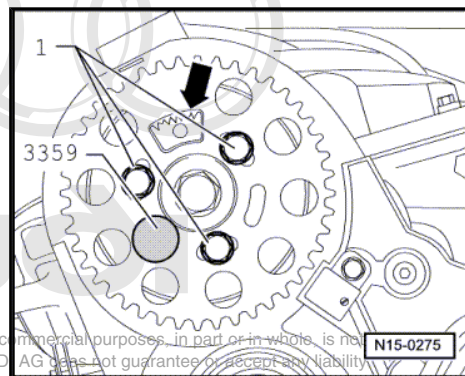
**All vehicles:**

- Attach hub to camshaft.
- Tighten securing bolt -1- to 100 Nm (use counterhold tool - T10051- ).



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- Push camshaft sprocket onto hub.
- Toothed segment -arrow- in camshaft sprocket must face up-wards.
- Screw in bolts -1- finger-tight.
- Lock hub on camshaft with locking pin -3359- .
- Fit toothed belt (adjust valve timing):
- ◆ Vehicles up to approx. 05.2005 ⇒ [page 49](#)
- ◆ Vehicles from approx. 06.2005 onwards ⇒ [page 59](#)
- Install cylinder head cover ⇒ [page 92](#) .



Perform further installation in reverse order, paying attention to the following:

- Install exhaust system and align it free of stress  
⇒ [page 212](#) .
- Connect battery. Procedures required ⇒ Rep. gr. 27 .
- Change engine oil ⇒ Maintenance ; Booklet 808 .
- Fill cooling system with fresh coolant ⇒ [page 174](#) .

#### Tightening torques

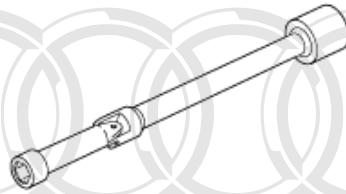
| Component                                                                                                                                                                                     | Nm                     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Rear toothed belt cover to cylinder head                                                                                                                                                      | 10 <sup>1)</sup>       |
| Hall sender to cylinder head                                                                                                                                                                  | 10 <sup>1)</sup>       |
| Stud to cylinder head                                                                                                                                                                         | 15                     |
| Hub to camshaft                                                                                                                                                                               | 100                    |
| Oil pressure switch to oil filter bracket                                                                                                                                                     | 20                     |
| Oil supply line to:                                                                                                                                                                           |                        |
| Turbocharger                                                                                                                                                                                  | 22                     |
| Oil filter bracket                                                                                                                                                                            | 22                     |
| Oil return line to cylinder block                                                                                                                                                             | 30                     |
| Bracket for turbocharger to:                                                                                                                                                                  |                        |
| Turbocharger                                                                                                                                                                                  | 20                     |
| Cylinder block                                                                                                                                                                                | 40                     |
| Front air pipe                                                                                                                                                                                |                        |
| Cylinder block                                                                                                                                                                                | 15                     |
| Bracket                                                                                                                                                                                       | 8                      |
| Tensioning roller for toothed belt to cylinder head                                                                                                                                           | 20 + 45° <sup>2)</sup> |
| Engine lifting eye to cylinder head                                                                                                                                                           | 22                     |
| <ul style="list-style-type: none"> <li>• <sup>1)</sup> Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue .</li> <li>• <sup>2)</sup> 45° = one eighth turn.</li> </ul> |                        |

## 1.6 Checking compression

### Special tools and workshop equipment required

- ◆ Jointed spanner -3220-
- ◆ Compression tester - V.A.G 1763-
- ◆ Adapter -V.A.G 1381/12-

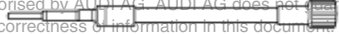
3220



V.A.G 1763



V.A.G 1381/12



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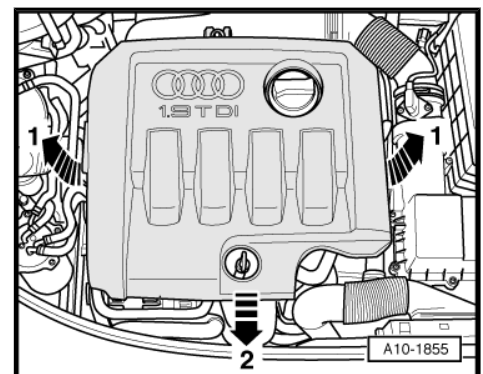
G15-0002

### Test conditions

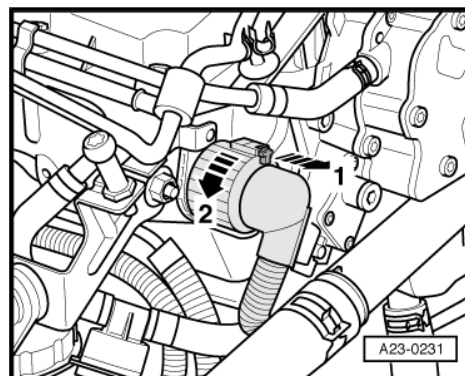
- Engine oil temperature at least 30 °C
- Battery voltage at least 12.7 V

### Procedure

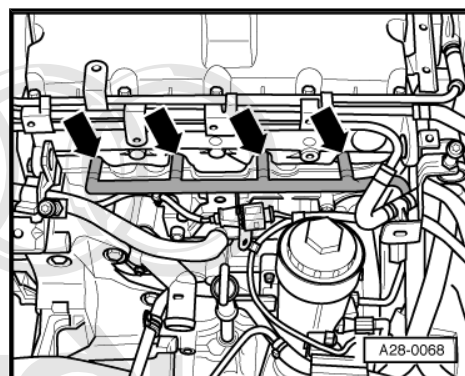
- Lift engine cover panel at sides -arrows 1- and pull off towards front -arrow 2-.



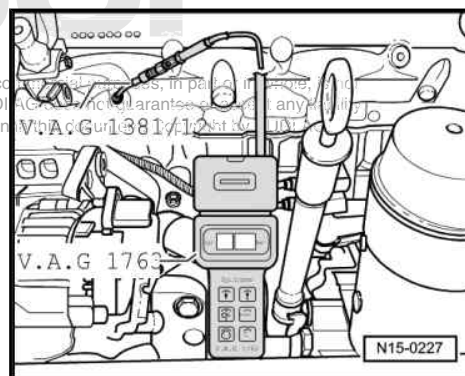
- Pull the release pin -arrow 1- and unscrew knurled nut -arrow 2-.
- Disconnect main connector for unit injectors.



- Detach connector rail from glow plugs -arrows-.
- Unscrew all glow plugs using jointed spanner -3220-.



- Screw in adapter -V.A.G 1381/12- in place of the glow plug in each cylinder.
- Test the compression pressure with the compression tester V.A.G 1763-.



### Note

Using the compression tester ⇒ operating instructions.

- Have a 2nd mechanic operate starter until tester shows no further pressure increase.

| Compression pressure         | bar           |
|------------------------------|---------------|
| When new                     | 25.0 ... 31.0 |
| Wear limit                   | 19.0          |
| Difference between cylinders | 5.0 (maximum) |

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

After the compression test the following step must be carried out:

- Install glow plugs ⇒ Rep. gr. 28.
- Interrogate and erase the fault memory for engine control unit, as faults are stored when the electrical connectors are unplugged ⇒ Vehicle diagnostic tester.

## 2 Servicing valve gear



### Note

- ◆ After installing the camshaft, the engine must NOT be started for about 30 minutes. The hydraulic tappets 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.
- ◆ Renew seals and gaskets.
- ◆ Removing and installing tandem pump ⇒ Rep. gr. 20.

### 2.1 Valve gear - exploded view

#### 1 - Cylinder head

- ☐ Machining valve seats  
⇒ [page 150](#)

#### 2 - Bearing shell

- ☐ Note installation position
- ☐ Do not interchange used bearing shells (mark positions)
- ☐ Make sure that the retaining lugs are correctly seated in the bearing caps and the cylinder head
- ☐ Fit new bearing shells if camshaft is being renewed.

#### 3 - Camshaft

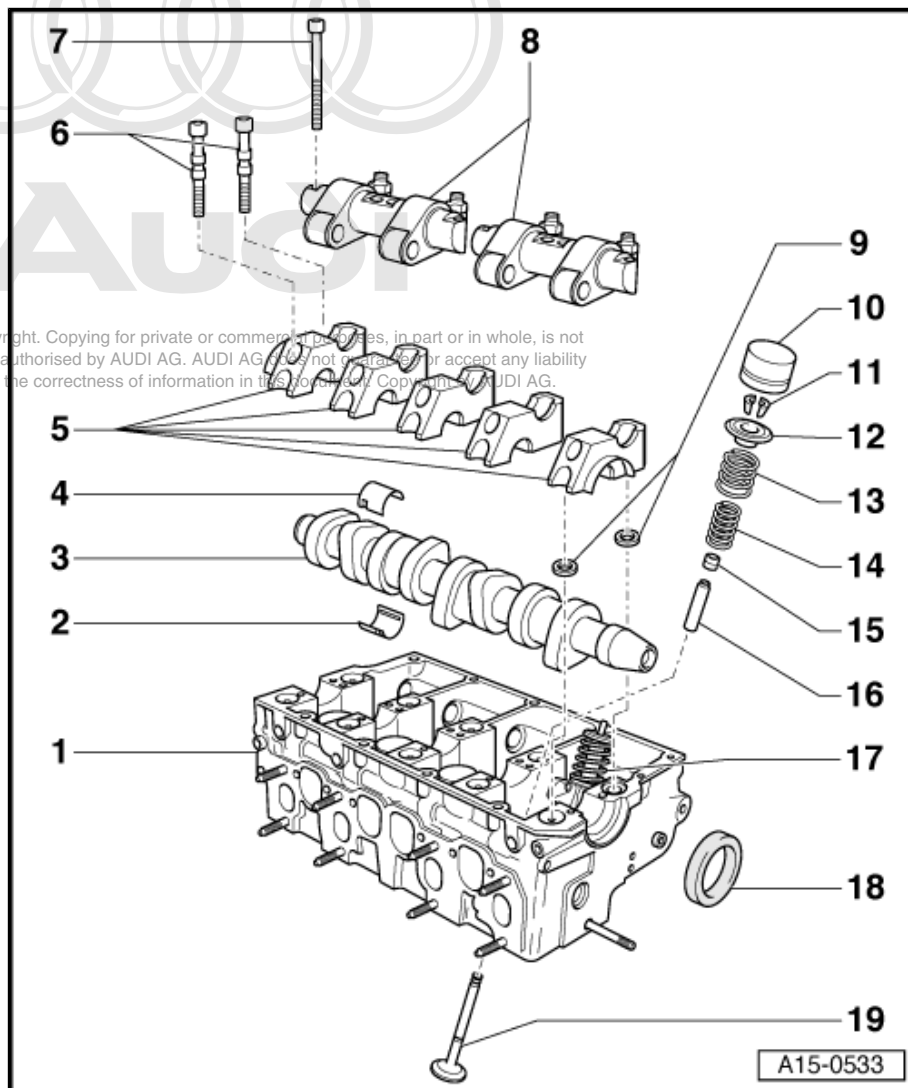
- ☐ Check radial clearance with Plastigage
- ☐ Radial clearance: wear limit: 0.11 mm
- ☐ Runout: max. 0.04 mm
- ☐ Checking axial clearance ⇒ [page 135](#)
- ☐ Removing and installing ⇒ [page 139](#)

#### 4 - Bearing shell

- ☐ Note installation position
- ☐ Do not interchange used bearing shells (mark positions)
- ☐ Make sure that the retaining lugs are correctly seated in the bearing caps and the cylinder head
- ☐ Fit new bearing shells if camshaft is being renewed.

#### 5 - Bearing caps

- ☐ Installation sequence ⇒ ["2.4 Removing and installing camshaft", page 139](#)
- ☐ Apply sealant to bearing caps 1 and 5 ⇒ [page 135](#)



**Caution**

*Before installation,  
check that washers  
-item 9- are fitted.*

**6 - 8 Nm + 90° (1/4 turn) further**

- ☐ Renew

**7 - 20 Nm + 90° (1/4 turn) further**

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- ☐ Renew
- ☐ Note correct sequence for loosening and tightening  
⇒ [“2.4 Removing and installing camshaft”, page 139](#)

**8 - Rocker arm shaft**

- ☐ Mark allocation of rocker arms
- ☐ Do not interchange
- ☐ Removing and installing ⇒ [“2.4 Removing and installing camshaft”, page 139](#)
- ☐ Before installing, check that all ball studs and O-rings are inserted in the unit injectors ⇒ [page 135](#)

**9 - Washers**

- ☐ For cylinder head bolts

**Caution**

*Fit in cylinder head be-  
fore installing bearing  
caps -item 5-*

**10 - Hydraulic bucket tappet**

- ☐ Checking ⇒ [page 144](#)
- ☐ Removing and installing ⇒ [“2.6 Renewing valve stem oil seals”, page 145](#)
- ☐ Do not interchange (mark allocation)
- ☐ Place down with contact surface facing downwards
- ☐ Check axial clearance of camshaft before installing ⇒ [page 135](#)
- ☐ Lubricate contact surface

**11 - Valve cotters****12 - Valve spring plate****13 - Valve spring (outer)**

- ☐ Removing and installing with cylinder head installed ⇒ [“2.6 Renewing valve stem oil seals”, page 145](#)
- ☐ Remove and install with cylinder head removed using valve spring compressor -2037-

**14 - Valve spring (inner)**

- ☐ Removing and installing with cylinder head installed ⇒ [“2.6 Renewing valve stem oil seals”, page 145](#)
- ☐ Remove and install with cylinder head removed using valve spring compressor -2037-

**15 - Valve stem oil seal**

- ☐ Renewing ⇒ [page 145](#)

**16 - Valve guide**

- ☐ Checking ⇒ [page 149](#)

**17 - Unit injector**

- ☐ Removing and installing ⇒ Rep. gr. 23

**18 - Oil seal**

- ☐ Renewing ⇒ [page 136](#)

## 19 - Valves

- ☐ Checking ⇒ [page 152](#)
- ☐ Valve dimensions ⇒ [page 149](#)
- ☐ Do not machine; only grinding in is permitted

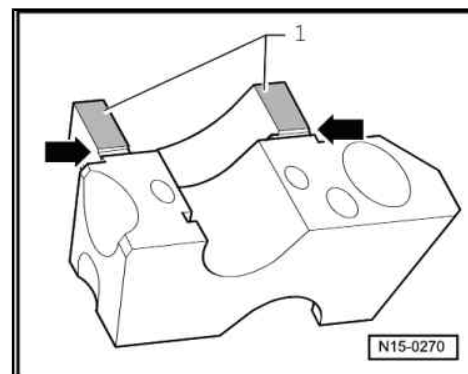
### Applying sealant to bearing caps 1 and 5

- Apply a thin and even coat of sealant to surfaces -1-; sealant ⇒ Parts catalogue .



#### Note

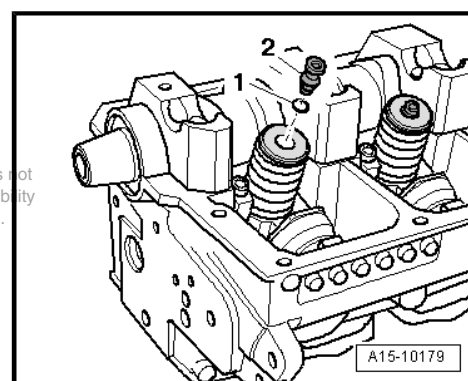
*Make sure no sealant gets into the grooves -arrows- or onto the other surfaces.*



### Ball stud for rocker arm shaft

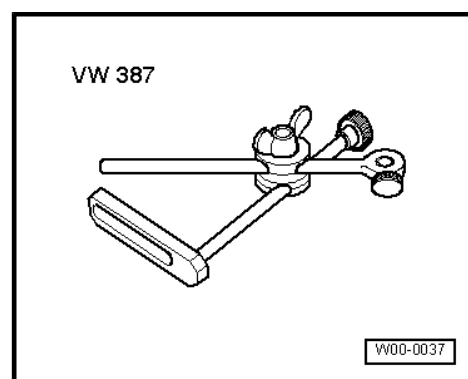
- Before inserting rocker arm shaft, check that all ball studs -2- and O-rings -1- have been installed in unit injectors.

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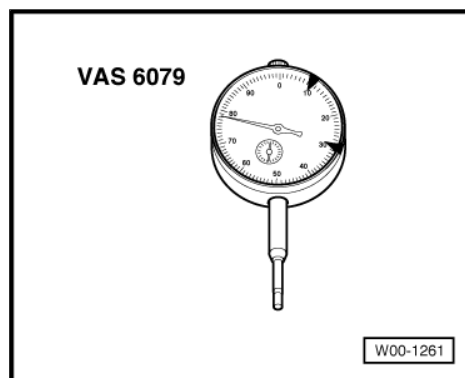


## 2.2 Checking axial clearance of camshaft

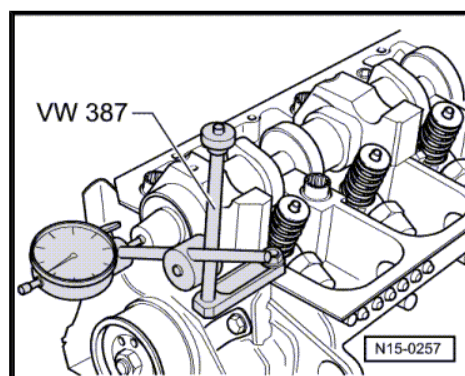
- ◆ Universal dial gauge bracket -VW 387-



## ◆ Dial gauge -VAS 6079-

**Procedure**

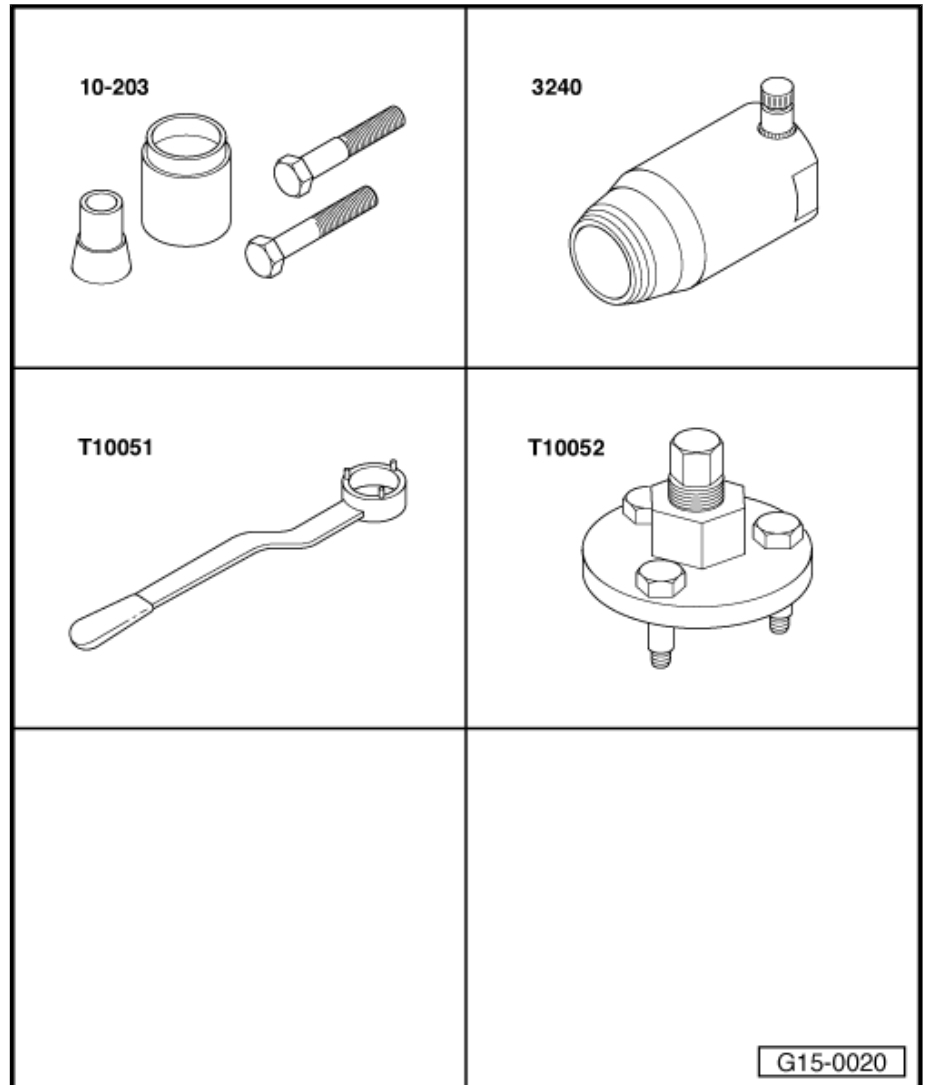
- Measure with bucket tappets removed and with first and last bearing caps fitted.
- Secure universal dial gauge bracket -VW 387- with dial gauge -VAS 6079- to cylinder head.
- Determine axial clearance.
- Wear limit: 0.15 mm.

**2.3      Renewing camshaft oil seal**

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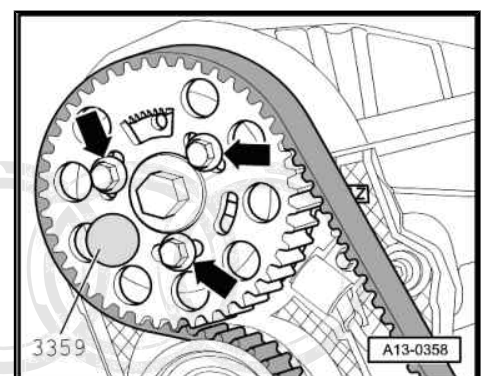
### Special tools and workshop equipment required

- ◆ Fitting tool -10-203-
- ◆ Oil seal extractor -3240-
- ◆ Counterhold tool -T10051-
- ◆ Puller -T10052-
- ◆ Bolt M12x65



### Removing

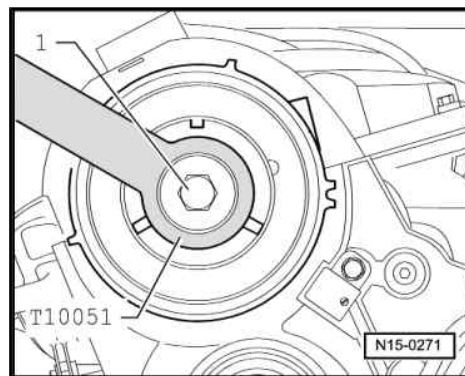
- Cylinder head installed.
- Remove toothed belt:
- ◆ Vehicles up to approx. 05.2005 ⇒ [page 41](#)
- ◆ Vehicles from approx. 06.2005 onwards ⇒ [page 53](#)
- Remove locking pin -3359- .
- Unscrew bolts -arrows- for camshaft sprocket.
- Detach camshaft sprocket from hub.



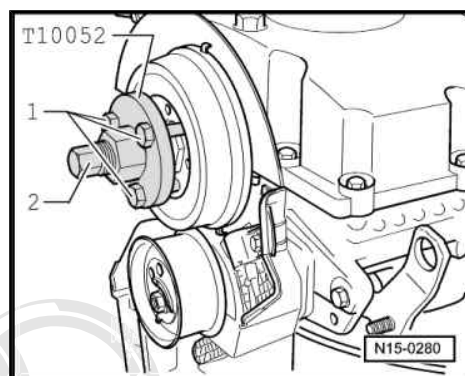
# Audi

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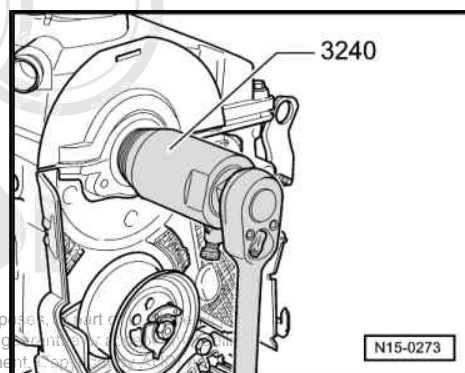
- Loosen securing bolt for hub; use counterhold tool -T10051- .
- Then unscrew bolt approx. 2 turns.



- Fit puller -T10052- on hub and screw bolts -1- into hub.
- Remove hub by screwing in bolt -2- while counterholding at hexagon flats (30 mm) of puller.



- Adjust inner part of oil seal extractor -3240- so that it is level with the outer part and lock in position with knurled screw.
- Lubricate threaded head of oil seal extractor, place it in position and, exerting firm pressure, screw it into camshaft oil seal as far as possible.
- Loosen knurled screw and turn inner section against camshaft until oil seal is pulled out.
- Clamp flats of oil seal extractor in vice.
- Remove oil seal with pliers.
- Clean running surface and sealing surface.



## Installing

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

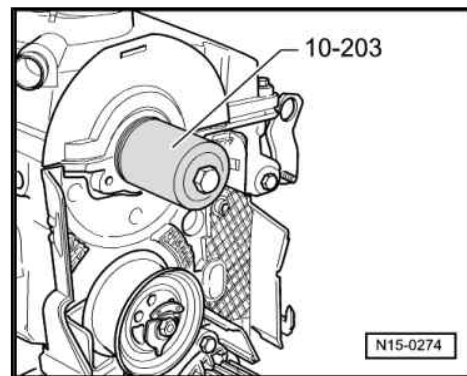


### Note

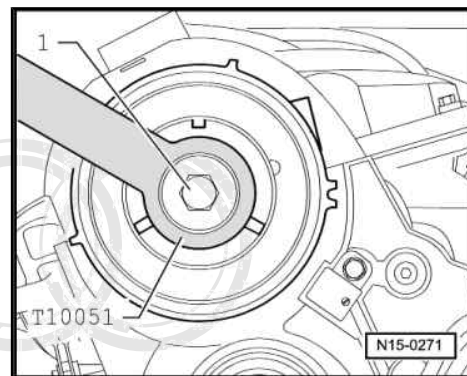
*The sealing lip of the oil seal must not be additionally oiled or greased.*

- Remove oil residue on camshaft journal with a clean cloth.
- Tape off groove on taper of camshaft with adhesive tape.

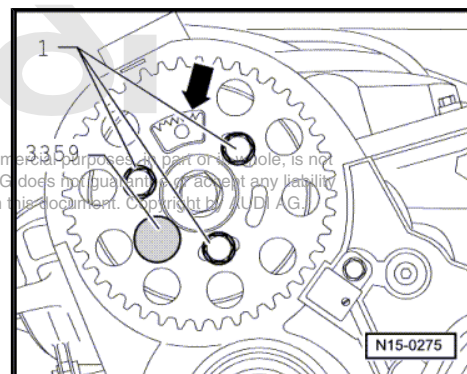
- Carefully position oil seal on camshaft.
- Press in oil seal with press piece of fitting tool -10-203- and bolt M12×65 as far as the stop.



- Attach hub to camshaft.
- Tighten securing bolt -1- to 100 Nm (use counterhold tool - T10051- ).



- Push camshaft sprocket onto hub.
- Toothed segment -arrow- in camshaft sprocket must face upwards.
- Screw in bolts -1- finger-tight.
- Lock hub on camshaft with locking pin -3359-.
- Fit toothed belt (adjust valve timing):
- ◆ Vehicles up to approx. 05.2005 ⇒ [page 49](#)
- ◆ Vehicles from approx. 06.2005 onwards ⇒ [page 59](#)



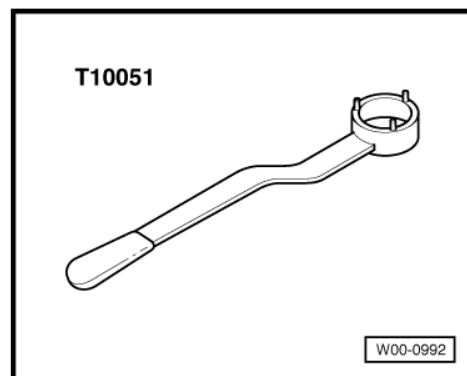
#### Tightening torque

| Component       | Nm  |
|-----------------|-----|
| Hub to camshaft | 100 |

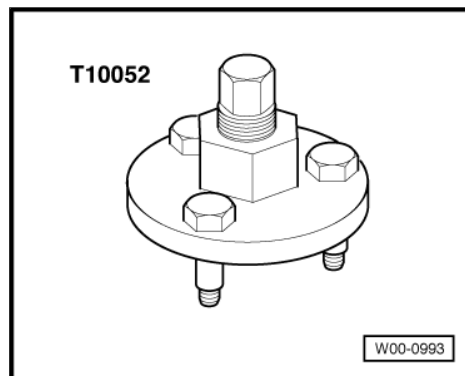
## 2.4 Removing and installing camshaft

### Special tools and workshop equipment required

- ◆ Counterhold tool -T10051-



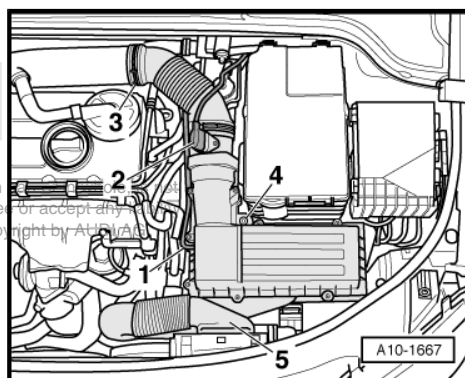
# ◆ Puller -T10052-



# ◆ Sealant ⇒ Parts catalogue

## Removing

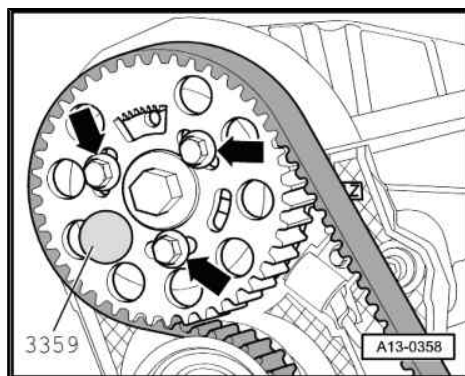
- Cylinder head installed.
- Remove toothed belt:
- ◆ Vehicles up to approx. 05.2005 ⇒ [page 41](#)
- ◆ Vehicles from approx. 06.2005 onwards ⇒ [page 53](#)
- Unplug electrical connector -2- at air mass meter -G70- .
- Detach vent hose -1- and air hoses -3- and -5-.
- Unscrew bolt -4- and remove air cleaner housing.
- Remove tandem pump ⇒ Rep. gr. 20 .



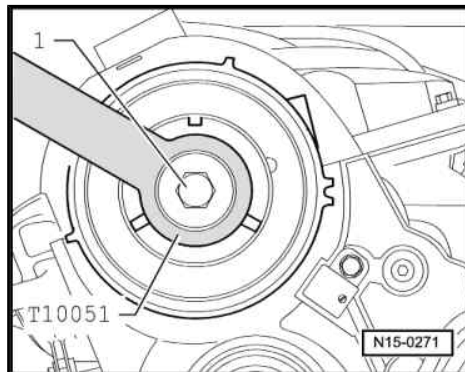
## Note

*The hoses can remain attached to the tandem pump.*

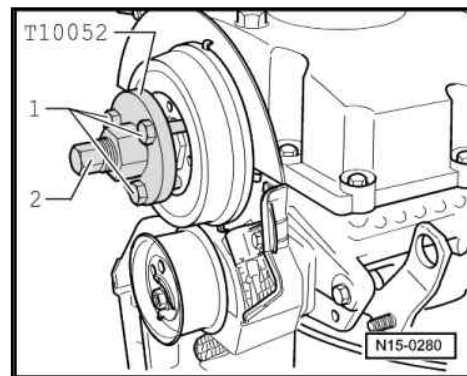
- Remove locking pin -3359- .
- Unscrew bolts -arrows- for camshaft sprocket and remove camshaft sprocket from hub.



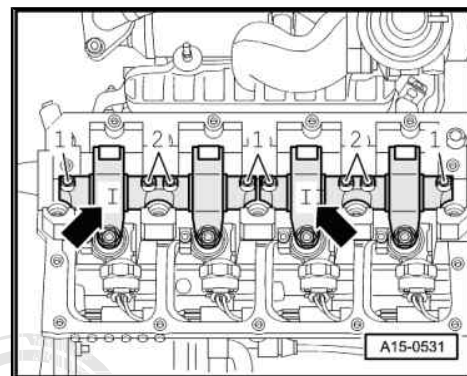
- Loosen securing bolt for hub; use counterhold tool -T10051- .
- Then unscrew bolt approx. 2 turns.



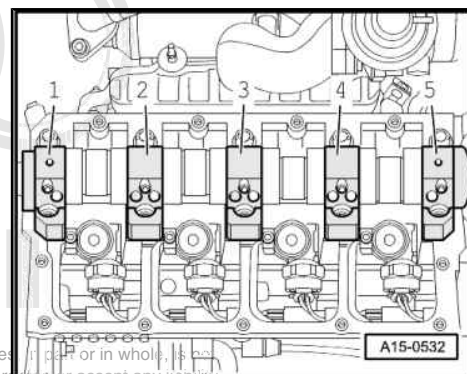
- Apply puller -T10052- and screw bolts -1- into hub.
- Remove hub by screwing in bolt -2- while counterholding at hexagon flats (30 mm) of puller.
- Remove cylinder head cover ⇒ [page 90](#).



- Mark rocker arm shafts with waterproof felt-tip pen to make sure that they are reinstalled in the previous position and to avoid performing a basic setting of the unit injectors -arrows-.
- First loosen the two outer bolts -1- on the rocker arm shafts, then the inner bolts -2-.
- Remove the rocker arm shafts.



- First remove the bearing caps -1-, -3- and -5-.
- Then loosen bearing caps -2- and -4- alternately in diagonal sequence.



### Note

- ♦ Make sure that the camshaft bearing shells are not interchanged.
- ♦ Mark allocation of camshaft bearing shells on rear with a waterproof felt-tip pen.

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- Remove camshaft.

## Installing

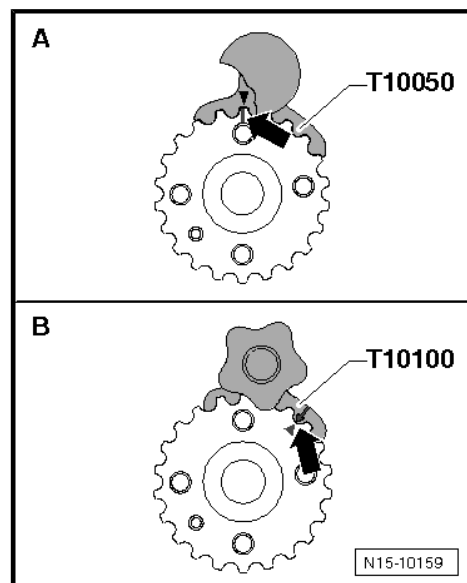
Installation is carried out in the reverse order; note the following:

- Crankshaft sprocket is locked using crankshaft stop -T10050- for engines with circular crankshaft sprocket, or crankshaft stop -T10100- for engines with oval crankshaft sprocket.

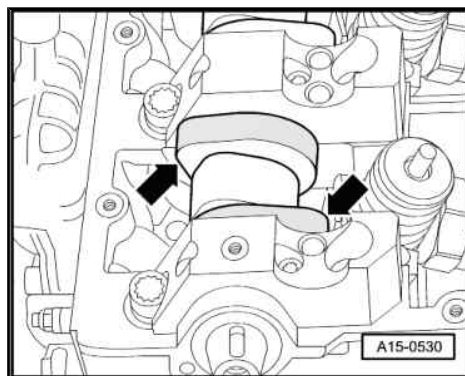


### Note

- ♦ Make sure that the used camshaft bearing shells are not interchanged (note marking).
- ♦ When installing the camshaft, make sure that the retaining lugs on the bearing shells are correctly seated in the bearing caps and the cylinder head.



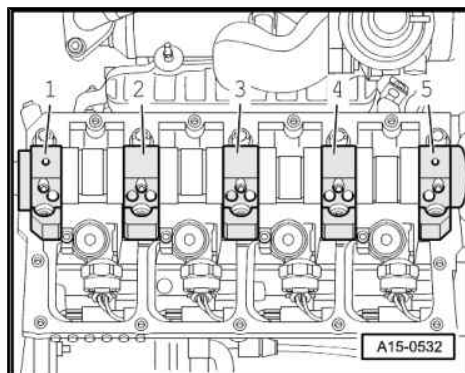
- Lubricate contact surfaces of camshaft.
- Install camshaft in TDC position for cylinder 1:
- The cams for cylinder 1 must point upwards on camshaft -arrows-.



### Note

If the bearing caps are fitted with the cylinder head removed, the washers for the cylinder head bolts ⇒ [Item 9 \(page 134\)](#) must first be fitted.

- Tighten bearing caps -2- and -4- alternately in diagonal sequence.

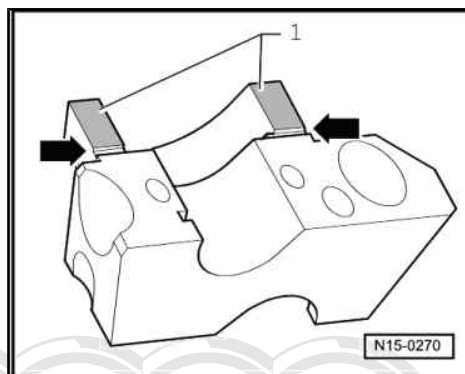


- Apply a thin and even coat of sealant to surfaces -1- of bearing caps 1 and 5; sealant ⇒ Parts catalogue .

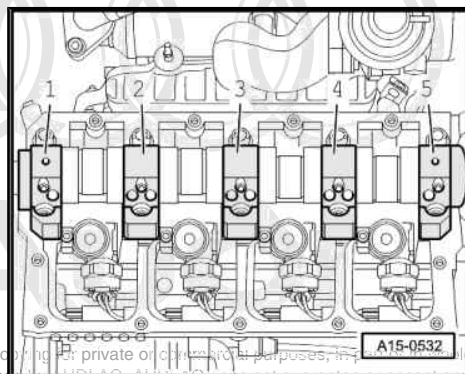


### Note

Make sure no sealant gets into the grooves -arrows- or onto the other surfaces.

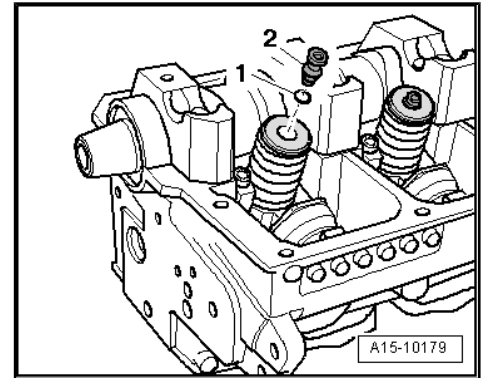


- Install bearing caps -1-, -3- and -5- and tighten.
- Bearing cap 5 must be flush with the outer edge of the cylinder head, otherwise the tandem pump may leak.
- Install camshaft oil seal ⇒ [page 138](#) .

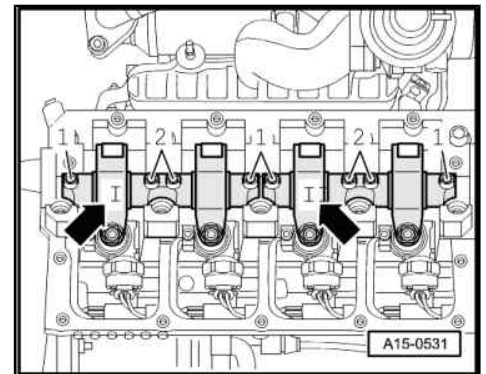


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- Before inserting rocker arm shaft, check that all ball studs -2- and O-rings -1- have been installed in unit injectors.

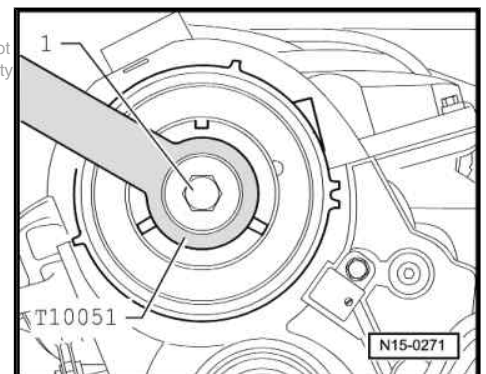


- Install rocker arm shafts. When doing so, note the markings made on removal -arrows-.
- First tighten inner bolts -2- and then outer bolts -1- in several stages.

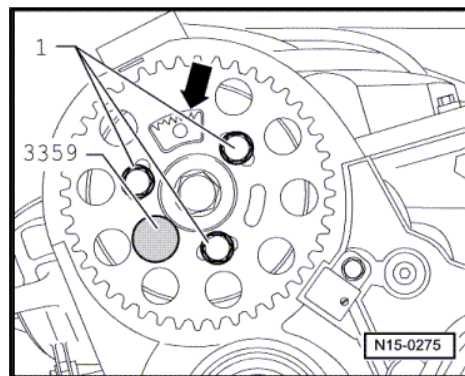


- Attach hub to camshaft.

- Tighten securing bolt -1- (use counterhold -T10051-).



- Push camshaft sprocket onto hub.
- Toothed segment -arrow- in camshaft sprocket must face upwards.
- Screw in bolts -1- finger-tight.
- Lock hub on camshaft with locking pin -3359- .
- Fit toothed belt (adjust valve timing):
- ◆ Vehicles up to approx. 05.2005 ⇒ [page 49](#)
- ◆ Vehicles from approx. 06.2005 onwards ⇒ [page 59](#)
- Install tandem pump ⇒ Rep. gr. 20 .
- If the rocker arm shafts or ball studs and adjuster screws were renewed, the unit injectors must be adjusted ⇒ Rep. gr. 23 .
- Install cylinder head cover ⇒ [page 92](#) .



### Note

- ◆ *After installing the camshaft, the engine must NOT be started for about 30 minutes. The hydraulic tappets 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 torques

| Component                                                                                                 | Nm            |
|-----------------------------------------------------------------------------------------------------------|---------------|
| Bearing cap to cylinder head                                                                              | 8 + 90° 1)2)  |
| Rocker arm shaft to cylinder head                                                                         | 20 + 90° 1)2) |
| Hub to camshaft                                                                                           | 100           |
| <ul style="list-style-type: none"> <li>• 1) Renew bolts.</li> <li>• 2) 90° = one quarter turn.</li> </ul> |               |

## 2.5 Checking hydraulic bucket tappets

### Special tools and workshop equipment required

- ◆ Feeler gauge
- ◆ Wooden/plastic wedge

### Procedure



### Note

- ◆ *Hydraulic bucket tappets cannot be serviced.*
- ◆ *Irregular valve noises when starting engine are normal.*
- Start engine and allow to run until radiator fan switches on.
- Increase engine speed to about 2500 rpm for approx. 2 minutes; perform test drive if necessary.

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**Note**

*If the irregular valve noise stops but repeatedly re-occurs when driving short distances, then the oil retention valve is defective. Fitting location: in oil filter bracket ⇒ [Item 7 \(page 160\)](#). The oil retention valve cannot be renewed separately.*

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

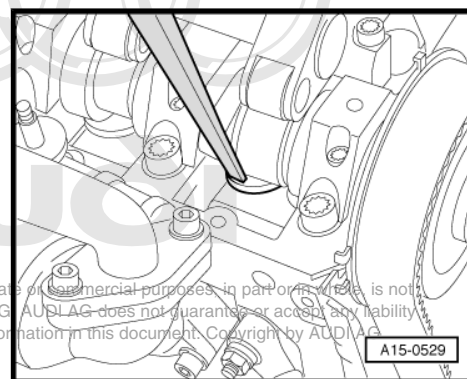
- Remove cylinder head cover ⇒ [page 90](#).
- Turn crankshaft until cam of the bucket tappet to be checked faces upwards; to do so, push vehicle forwards with 4th gear engaged and ignition switched off.
- Determine clearance between cam and bucket tappet:
- Push tappet down with a wooden or plastic wedge.

If it is possible to insert a feeler gauge of 0.20 mm between camshaft and bucket tappet:

- Renew hydraulic bucket tappet  
⇒ [“2.4 Removing and installing camshaft”, page 139](#).

**Note**

- ◆ *After installing the camshaft, the engine must NOT be started for about 30 minutes. The hydraulic tappets 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.*

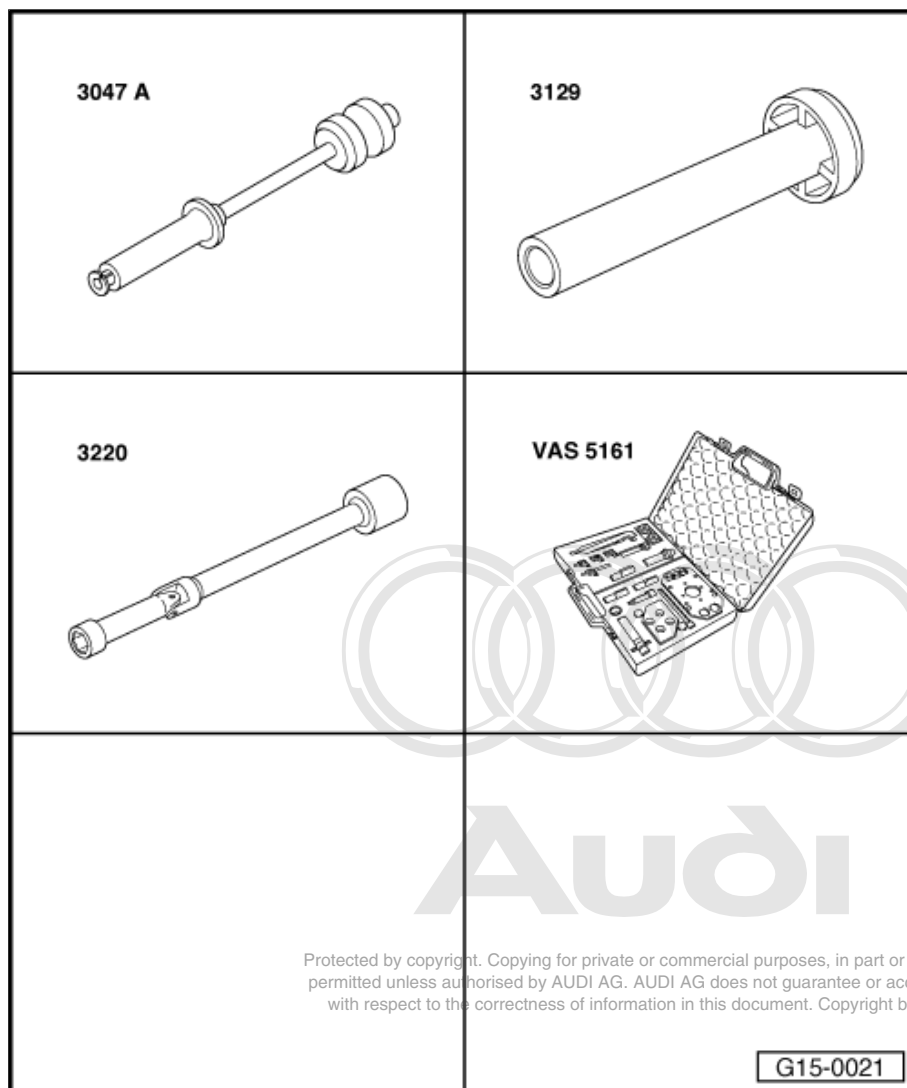


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## 2.6 Renewing valve stem oil seals

### Special tools and workshop equipment required

- ◆ Puller -3047 A-
- ◆ Fitting tool -3129-
- ◆ U/J extension and socket, 10 mm -3220-
- ◆ Removal and installation device -VAS 5161-



### Procedure

- Cylinder head installed.



#### Note

*If cylinder head is removed, the valve stem oil seals can be renewed using valve spring compressor -2037-.*

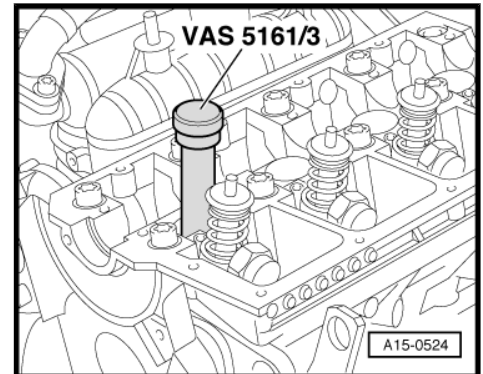
- Remove the camshaft ⇒ [page 139](#).
- Remove camshaft bearing shells from cylinder head.



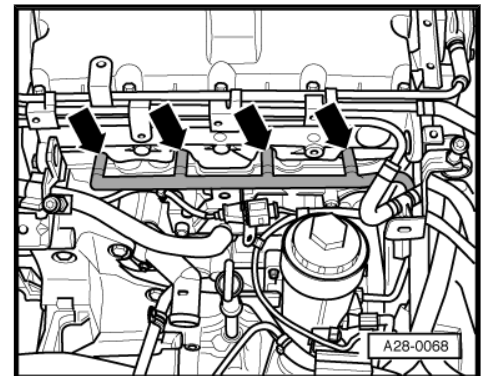
#### Note

- ◆ *Make sure that the used camshaft bearing shells are not interchanged (note marking).*
- ◆ *When installing the camshaft, make sure that the retaining lugs on the bearing shells are correctly seated in the bearing caps and the cylinder head.*
- ◆ *Make sure that the hydraulic bucket tappets are not interchanged; mark allocation on rear with a waterproof felt-tip pen.*

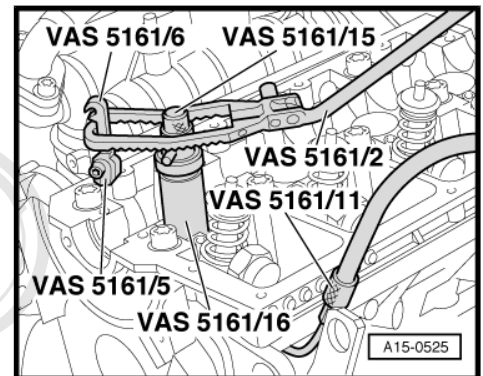
- Remove bucket tappets out of guides.
- Place bucket tappets down on a clean surface with contact surface facing downwards in the order in which they were removed.
- Insert punch -VAS 5161/3- into bucket tappet guide.
- Knock valve cotters loose on all valves using a plastic hammer.



- Detach connector rail from glow plugs -arrows-.
- Unscrew all glow plugs using jointed spanner -3220-.
- Set piston of the respective cylinder to "bottom dead centre".



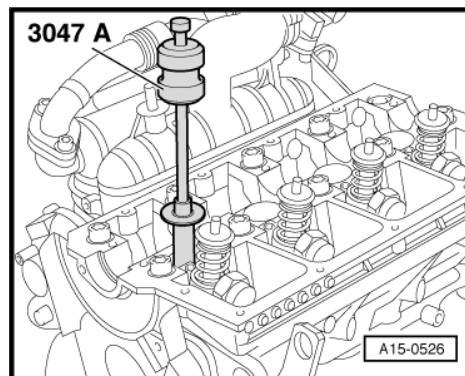
- Screw adapter -VAS 5161/11- finger-tight into the glow plug hole of the relevant cylinder.
- Screw snap-in device -VAS 5161/6- with interlocking fork (M6) -VAS 5161/5- into threaded hole on cylinder head.
- Push guide bush -VAS 5161/16- as far as it will go into bucket tappet guide for valve to be removed.
- Installation position of guide bush: hatched areas are perpendicular to driving direction.
- Insert assembly cartridge -VAS 5161/15- into guide bush.
- Connect adapter -VAS 5161/11- to compressed air supply using a commercially available connection piece.



- Minimum pressure: 6 bar
- Attach pressure fork -VAS 5161/2- to snap-in device -VAS 5161/6- and push assembly cartridge down.
- At the same time, turn knurled screw of assembly cartridge clockwise until tips engage in valve cotters.
- Move knurled screw back and forth slightly; the valve cotters are thus forced apart and taken up by the cartridge.
- Release pressure fork.
- Remove assembly cartridge and guide bush.
- Remove valve spring plate and valve springs.

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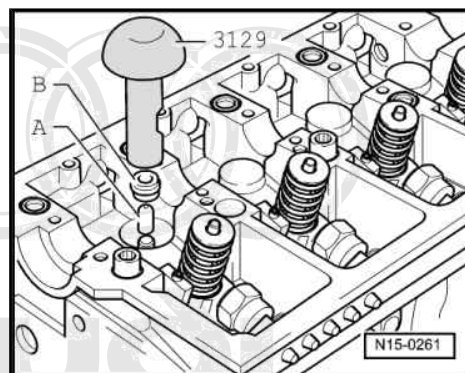
- Detach valve stem oil seals using puller -3047 A- .



### Note

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

- Insert plastic sleeve -A- onto the valve stem to prevent damage to the new valve stem oil seal -B-.
- Lightly lubricate sealing lip of valve stem oil seal.
- Slip valve stem oil seal over plastic sleeve.
- Carefully press valve stem oil seal down onto valve guide using fitting tool -3129- .
- Remove plastic sleeve.
- If valve cotters have been removed from assembly cartridge, they need to be put into insertion device -VAS 5161/18- first.



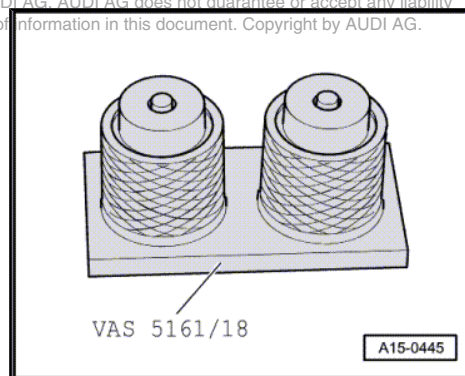
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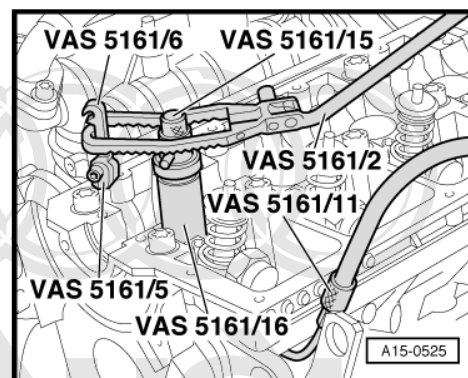
### Note

*Larger diameter of valve cotters faces upwards.*

- Press assembly cartridge -VAS 5161/15- onto insertion device from above and pick up valve cotters.
- Insert valve springs and valve spring plate.



- Reinstall the assembly cartridge -VAS 5161/15- into guide bush -VAS 5161/16- .
- Push pressure fork down and pull knurled screw upwards, while turning screw in both directions – this will insert the valve cotter.
- Release pressure fork with knurled screw still in pulled position.
- Insert bucket tappets.
- Install camshaft ➔ [page 139](#) .
- Install glow plugs ➔ Rep. gr. 28 .

**Note**

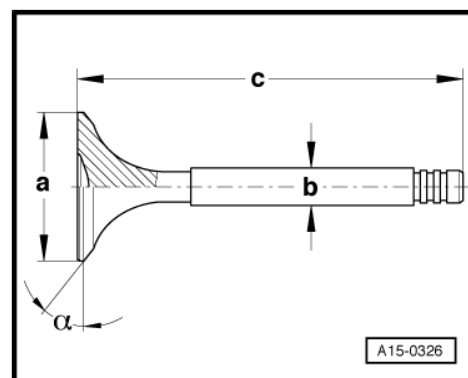
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- ◆ *After installing the camshaft, the engine must **NOT** be started for about 30 minutes. The hydraulic tappets have to settle (otherwise valves will strike pistons).*
  - ◆ *After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.*

## 2.7 Valve dimensions

| Dimension |    | Inlet valve | Exhaust valve |
|-----------|----|-------------|---------------|
| Ø a       | mm | 35.95       | 31.45         |
| Ø b       | mm | 6.980       | 6.956         |
| c         | mm | 89.95       | 89.95         |
| α         | °  | 45          | 45            |

**Note**

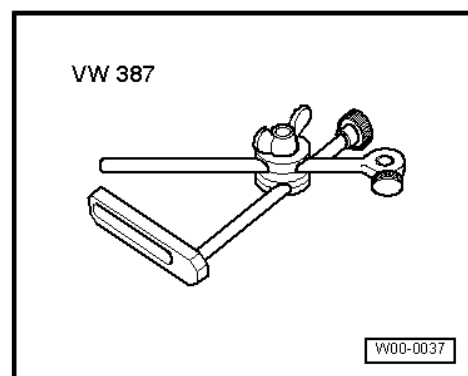
*Valves must not be machined. Only grinding is permitted.*



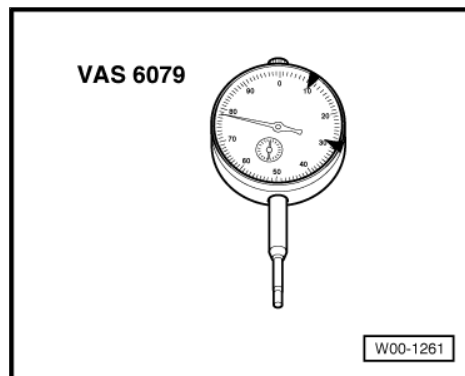
## 2.8 Checking valve guides

### Special tools and workshop equipment required

- ◆ Universal dial gauge bracket -VW 387-



- ◆ Dial gauge -VAS 6079-

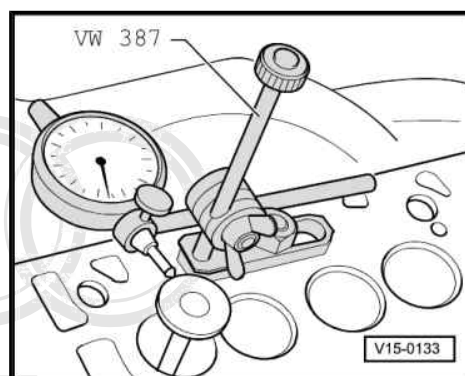


### Procedure

- Insert valve into valve guide.
- End of valve stem must be flush with guide.
- Determine amount of sideways play.
- Wear limit (sideways play): 1.3 mm.

### Note

- ◆ *If the wear limit is exceeded, repeat the measurement with new valves. Renew cylinder head if wear limit is still exceeded. Valve guides cannot be renewed.*
- ◆ *If the valve has to be renewed as part of a repair, use a new valve for the measurement.*



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## 2.9 Machining valve seats

### Special tools and workshop equipment required

- ◆ Depth gauge
- ◆ Valve seat machining tool

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

### Note

- ◆ *When servicing engines with leaking valves, it is not sufficient to machine (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 149](#).*
- ◆ *Valve seats should only be machined to the extent required to give a proper seating pattern.*
- ◆ *The maximum permissible machining dimension must be calculated before starting work.*
- ◆ *If the machining dimension is exceeded, the function of the hydraulic valve clearance compensation can no longer be ensured and the cylinder head must be renewed.*

### Calculating maximum permissible machining dimension

- Insert valve and press firmly against valve seat.

### Note

*If the valve has to be renewed as part of a repair, use a new valve for the measurement.*

- Measure distance -a- between end of valve stem and upper cylinder head surface with a depth gauge.
- Calculate the maximum permissible machining dimension using the measured distance and the minimum dimension.

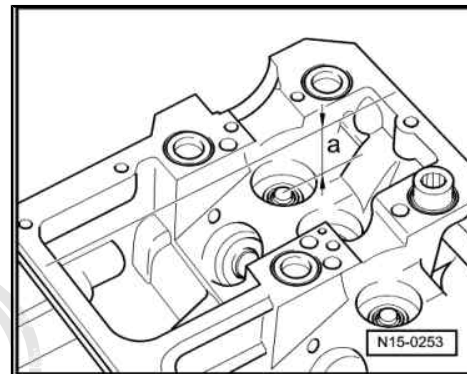
♦ Minimum dimension for inlet valve: 43.4 mm

♦ Minimum dimension for exhaust valve: 43.2 mm

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

#### Example for inlet valve:

|                                         |           |
|-----------------------------------------|-----------|
| Measured distance                       | 44.1 mm   |
| Minimum dimension                       | – 43.4 mm |
| Maximum permissible machining dimension | = 0.7 mm  |



### Note

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

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#### Machining inlet valve seat

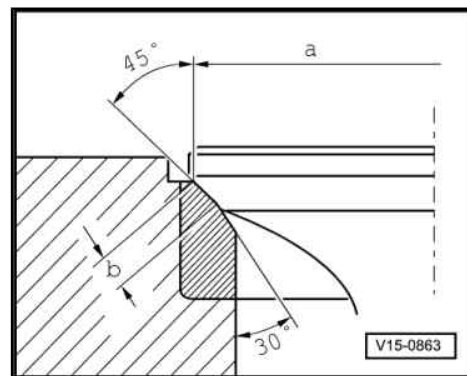
a - Ø 35.7 mm

b - 1.6 mm

45° - Valve seat angle

### Note

- ♦ Calculating maximum permissible machining dimension  
⇒ [page 150](#).
- ♦ The 30° lower valve seat chamfer is necessary to ensure that the inlet channel flow characteristics are maintained.



#### Machining exhaust valve seat

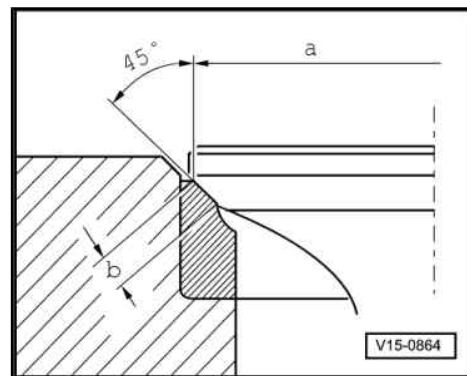
a - Ø 31.4 mm

b - 2.7 mm

45° - Valve seat angle

### Note

Calculating maximum permissible machining dimension  
⇒ [page 150](#).





## 2.10 Checking valves

- Visually inspect for scoring on valve stem and on seating surface.

If scoring is clearly visible:

- Renew the relevant valve.



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## 17 – Lubrication

### 1 Removing and installing parts of lubrication system



#### Note

- ◆ *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.*
- ◆ *The oil level must not be above MAX mark on dipstick - danger of damage to catalytic converter.*
- ◆ *Oil spray jet and pressure relief valve ⇒ [page 155](#)*
- ◆ *Removing and installing the oil level/temperature sender - G266- ⇒ [page 155](#).*

Viscosity grades and oil specifications ⇒ Maintenance ; Booklet 808.

Oil capacities ⇒ Maintenance tables .

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#### 1.1 Sump, oil pump - exploded view

# 1 - Oil pump

- ☐ With pressure relief valve (12 bar)
- ☐ Removing and installing ⇒ [page 159](#)
- ☐ Before installing, check that the two dowel sleeves ⇒ [Item 9 \(page 154\)](#) for centring oil pump/cylinder block are fitted.
- ☐ Renew if running surfaces and gears are scored
- ☐ 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

- ☐ Renew

# 4 - Drive chain for oil pump

- ☐ Mark direction of rotation before removing
- ☐ Check for wear

# 5 - Sealing flange (pulley end)

- ☐ Apply sealant prior to installing ⇒ [page 66](#)
- ☐ Renewing crankshaft oil seal on pulley end ⇒ [page 64](#)

# 6 - 15 Nm

# 7 - Chain tensioner

- ☐ Tighten to 16 Nm
- ☐ Do not dismantle
- ☐ Note installation position
- ☐ When installing, pre-tension spring and engage
- ☐ If the spring is broken, renew chain tensioner as complete unit

# 8 - Drive chain sprocket for oil pump

- ☐ Removing and installing ⇒ [page 80](#)

# 9 - Dowel sleeves

- ☐ 2x

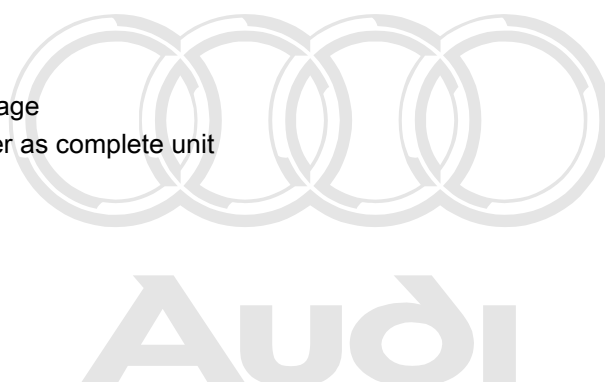
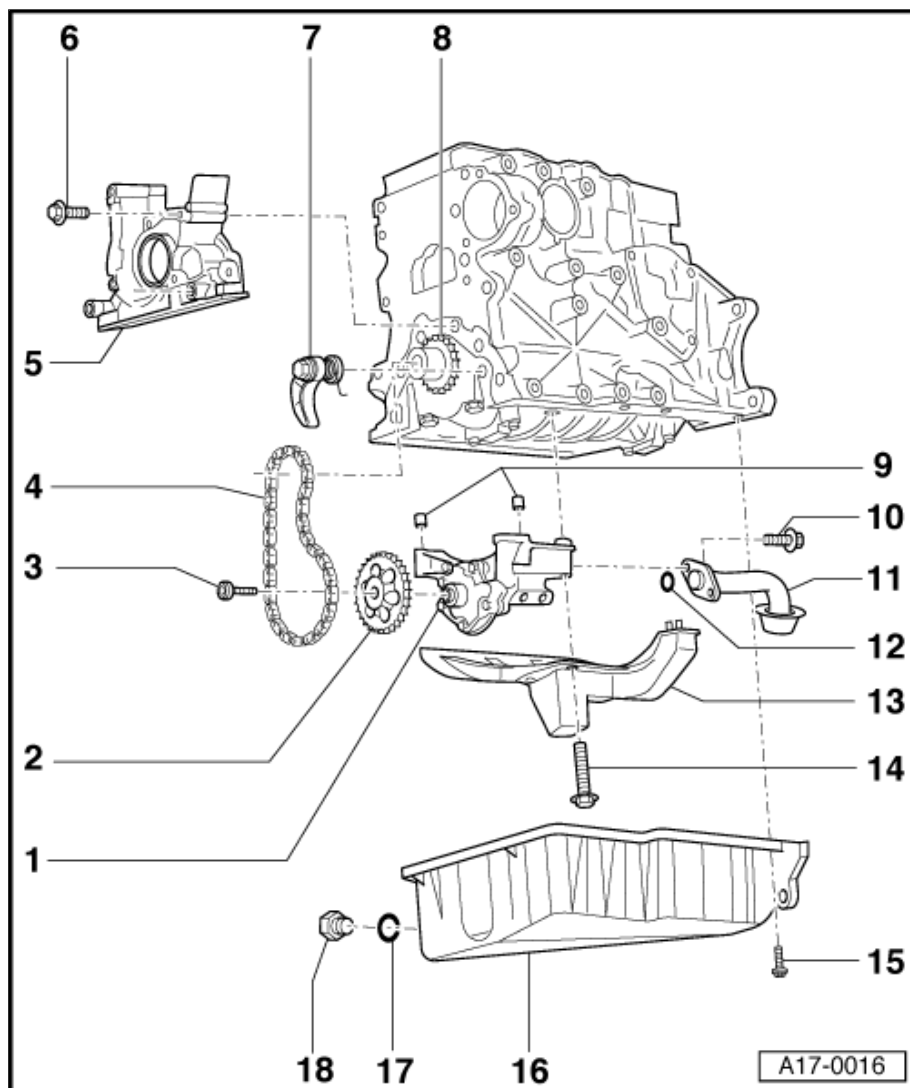
# 10 - 15 Nm

# 11 - Suction pipe

- ☐ Clean strainer if dirty

# 12 - O-ring

- ☐ Renew



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### 13 - Baffle plate

14 - 16 Nm

15 - 15 Nm

### 16 - Sump

- ☐ Removing and installing ⇒ [page 155](#)

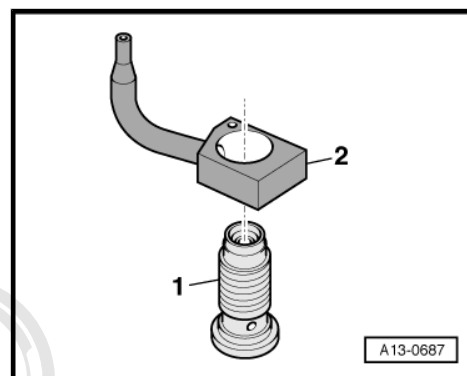
### 17 - Seal

- ☐ Renew

### 18 - Oil drain plug, 30 Nm

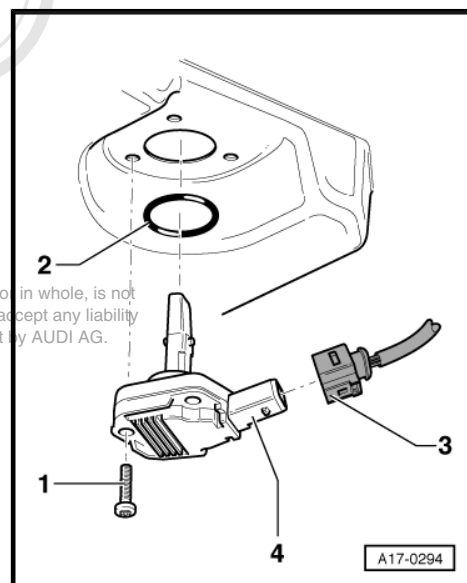
### Oil spray jet and pressure relief valve

- 1 - Oil spray jet (for cooling of pistons)
- 2 - Bolt with pressure relief valve, 27 Nm



### Removing and installing oil level/temperature sender -G266-

- 1 - Bolt, 10 Nm (self-locking); renew
- 2 - Seal; renew
- 3 - Electrical connector
- 4 - Oil level and oil temperature sender -G266-

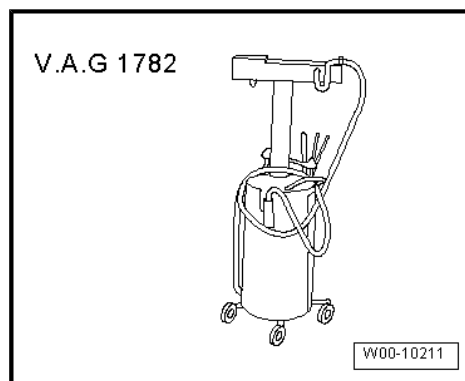


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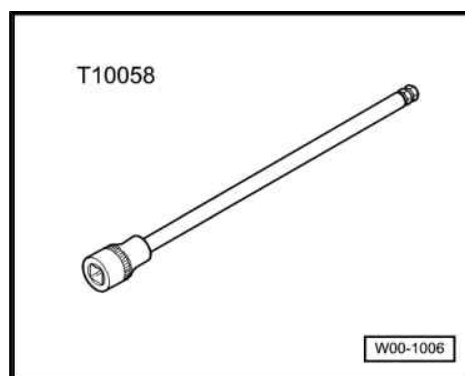
## 1.2 Removing and installing sump

Special tools and workshop equipment required

- ◆ Used oil collection and extraction unit -V.A.G 1782-



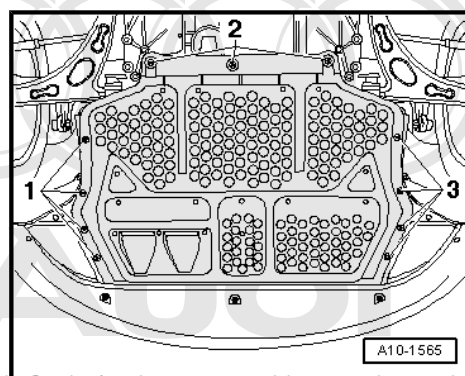
- ◆ Allen key, long reach -T10058-



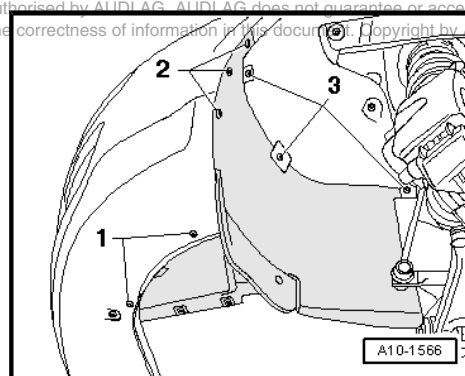
- ◆ Electric drill with plastic brush attachment
- ◆ Sealant ⇒ Parts catalogue
- ◆ Safety goggles

### Removing

- Remove centre noise insulation -fasteners 1 ... 3-

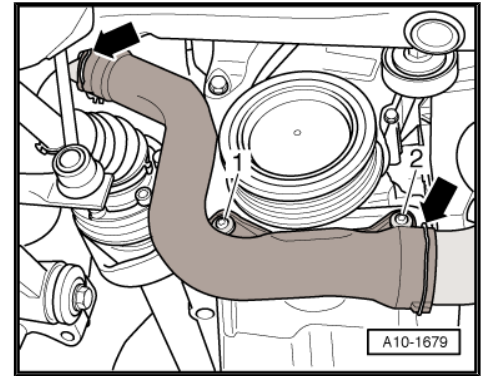


- Remove noise insulation (right-side) -fasteners 1 ... 3-



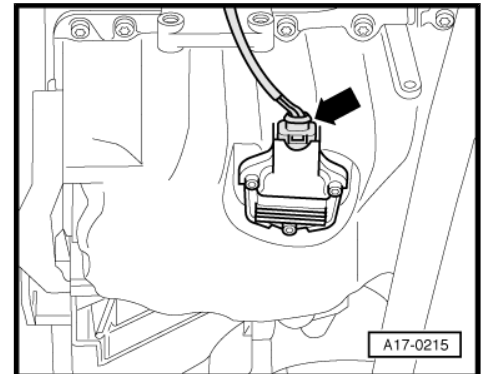
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- Remove bolts -1- and -2-.
- Remove air pipe (right-side) by lifting retaining clips -arrows- slightly.

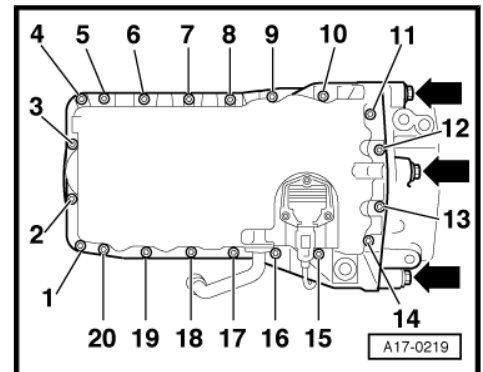


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- Unplug electrical connector -arrow- at oil level and oil temperature sender -G266-.
- Drain off engine oil.

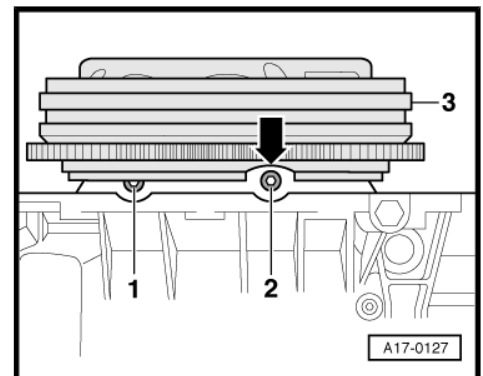


- Unscrew sump/gearbox bolts -arrows-.
- Slacken bolts -1 ... 20- in diagonal sequence and remove.



#### Note

- ◆ The two rear sump bolts -1- and -2- are accessible via the recess -arrow- on the flywheel -3- (turn the flywheel as required).
- ◆ The bolts can be unscrewed using Allen key (long reach) -T10058-.
- Take off sump: if necessary loosen it by striking lightly with a rubber hammer.



## Installing

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



### Note

*Renew seal.*

- Remove sealant residue from sump and cylinder block with rotating plastic brush or similar.



### WARNING

*Wear safety goggles.*

- Clean sealing surfaces; they must be free of oil and grease.
- Cut off tube nozzle at front marking (diameter of nozzle approx. 3 mm).

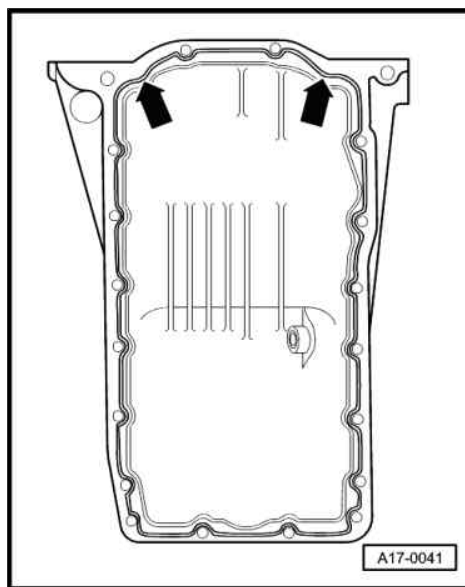
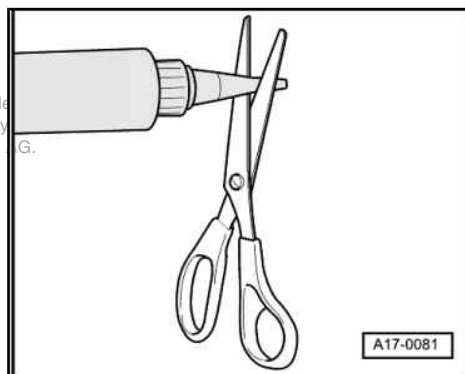
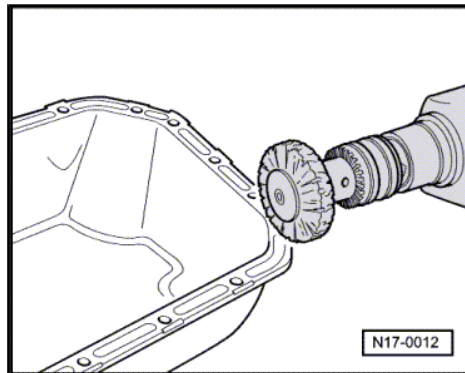
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- Apply bead of sealant onto the clean sealing surface of the sump as shown in the illustration.
- Thickness of sealant bead: 2 ... 3 mm



### Note

- ◆ *Sealant bead must not be wider than 3 mm, otherwise excess sealant could ingress into sump and clog strainer in oil intake pipe.*
- ◆ *Take particular care when applying sealant bead in area of sealing flange (flywheel end) -arrows-.*
- ◆ *The sump must be installed within 5 minutes after applying the silicone sealant.*



- Immediately install sump and tighten bolts in the following sequence:

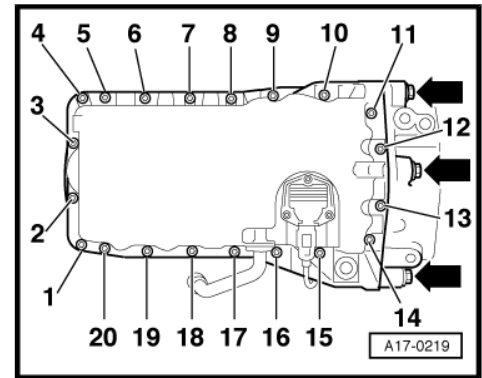
  1. Tighten bolts -1 ... 20- securing sump to cylinder block in diagonal sequence initially to 5 Nm.
  2. Tighten sump/gearbox bolts -arrows- to 45 Nm.
  3. Tighten bolts -1 ... 20- in diagonal sequence to 15 Nm.

### Note

- ◆ *When installing sump with engine removed from vehicle, ensure that sump is positioned flush with cylinder block at fly-wheel end.*
  - ◆ *After fitting sump assembly, the sealant must dry for approx. 30 minutes. Then (and only then) fill the engine with engine oil.*
- Install air pipes/hoses with plug-in connectors ⇒ [page 196](#) .
  - Fill up with engine oil and check oil level ⇒ [page 168](#) .

### Tightening torques

| Component      |                | Nm |
|----------------|----------------|----|
| Sump to:       | Cylinder block | 15 |
|                | Gearbox        | 40 |
| Oil drain plug |                | 30 |



## 1.3 Removing and installing oil pump

### Removing

- Remove sump and baffle plate ⇒ [page 155](#) .
- Remove bolt -2-.
- Pull chain sprocket off oil pump shaft.
- Unscrew bolts -1- and -3- and remove oil pump.

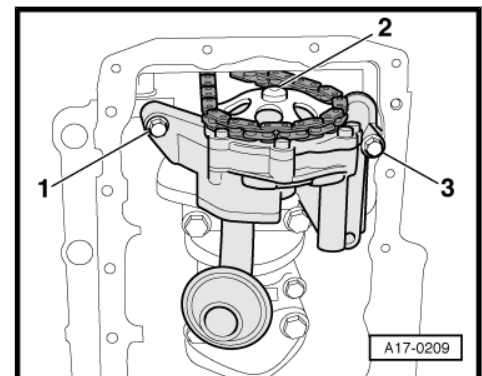
### Installing

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

- Insert dowel sleeves ⇒ [Item 9 \(page 154\)](#) at top of oil pump.
- Chain sprocket can only be fitted in one position on oil pump shaft.
- Install sump ⇒ [page 158](#) .

### Tightening torques

| Component                                                                                                | Nm            |
|----------------------------------------------------------------------------------------------------------|---------------|
| Chain sprocket to oil pump shaft                                                                         | 20 + 90° 1)2) |
| Oil pump to cylinder block                                                                               | 16            |
| <ul style="list-style-type: none"> <li>• 1) Renew bolt.</li> <li>• 2) 90° = one quarter turn.</li> </ul> |               |



## 1.4 Oil filter bracket with oil cooler - exploded view

**1 - Screw plug, 25 Nm**
**2 - Seal**

- ☐ Renew

**3 - Oil cooler**

- ☐ See note ⇒ [page 153](#)
- ☐ Diagram of coolant hose connections ⇒ [page 170](#)

**4 - Gasket**

- ☐ Renew
- ☐ Installation position ⇒ [page 161](#)

**5 - 14 Nm + 90° (1/4 turn) further**

- ☐ Renew
- ☐ Tighten in diagonal sequence

**6 - Gasket**

- ☐ Renew

**7 - Oil filter bracket**

- ☐ With oil retention valve
- ☐ The oil retention valve cannot be renewed separately

**8 - Seal**

- ☐ Renew

**9 - Oil pressure switch -F1- - 20 Nm**

- ☐ 0.7 bar - brown
- ☐ Checking ⇒ [page 166](#)

**10 - Sealing cap - 25 Nm**
**11 - O-ring**

- ☐ Renew

**12 - Oil filter element**

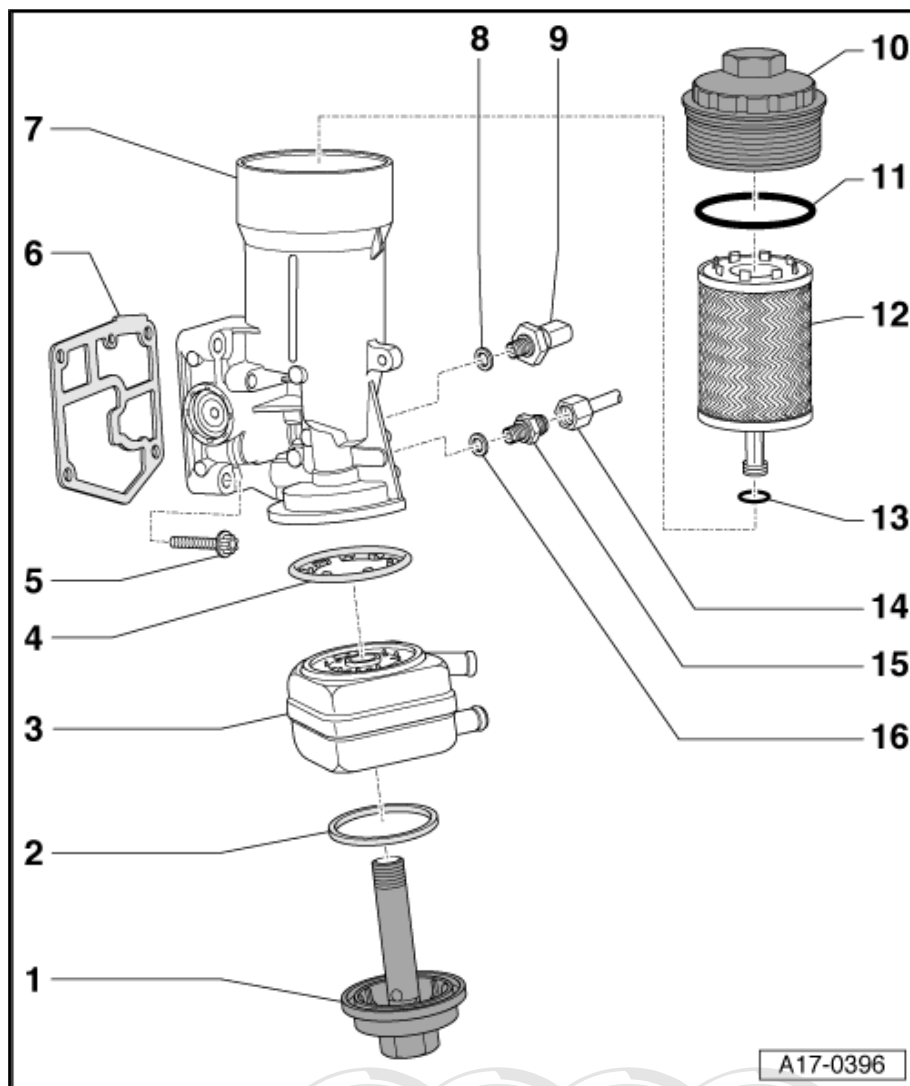
- ☐ Detach from sealing cap ⇒ [Item 10 \(page 160\)](#)
- ☐ When changing filter, renew O-rings ⇒ [Item 11 \(page 160\)](#) and ⇒ [Item 13 \(page 160\)](#)
- ☐ Note installation position
- ☐ Observe change intervals ⇒ Maintenance ; Booklet 808

**13 - O-ring**

- ☐ Renew

**14 - Oil supply line**

- ☐ To turbocharger
- ☐ Note installation sequence:
  - First attach both ends of pipe loosely.
  - Then tighten connections on ends of pipe to 22 Nm.
  - Finally, secure bracket.



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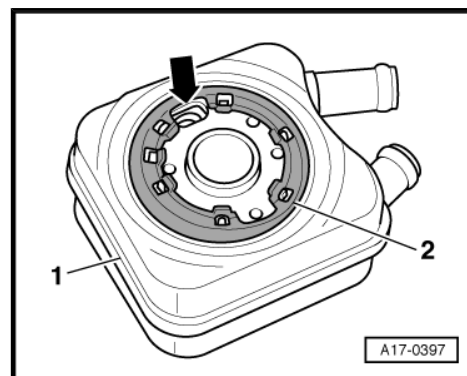
## 15 - Connecting piece

## 16 - Seal

- ☐ Renew

### Installation position of seal for oil cooler

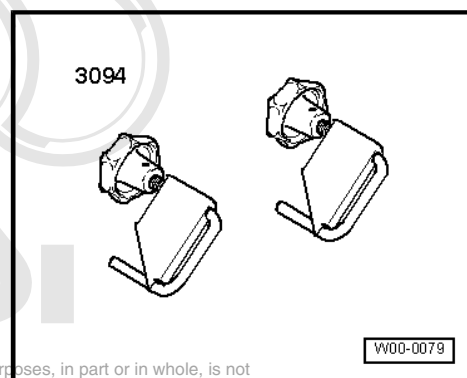
- Insert the seal -2- so that it can be attached to all tabs on the oil cooler -1-.
- The oil drilling -arrow- must not be covered by the seal.



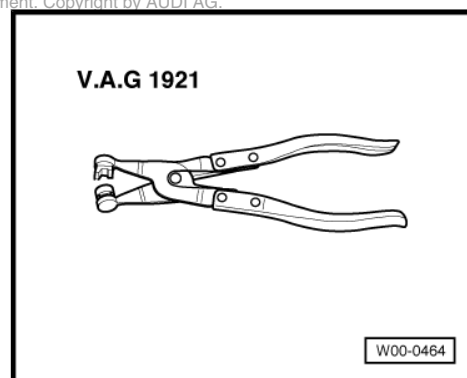
## 1.5 Removing and installing oil filter bracket with oil cooler

### Special tools and workshop equipment required

- ◆ Hose clamps up to Ø 25 mm -3094-



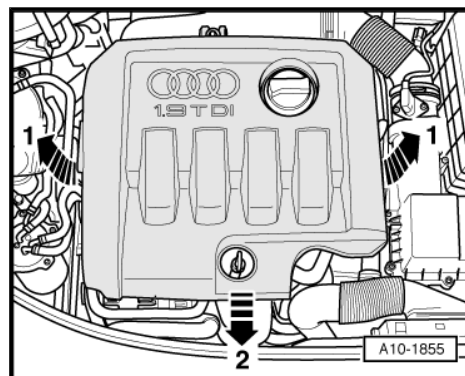
- ◆ Hose clip pliers -V.A.G 1921-



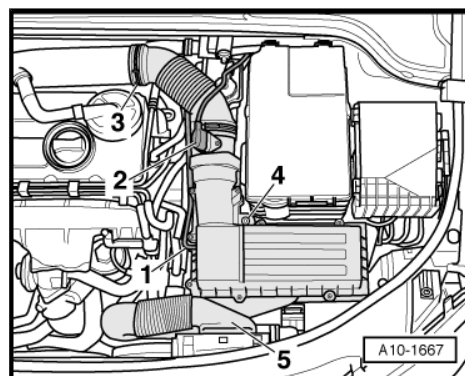
- ◆ Drip tray

## Removing

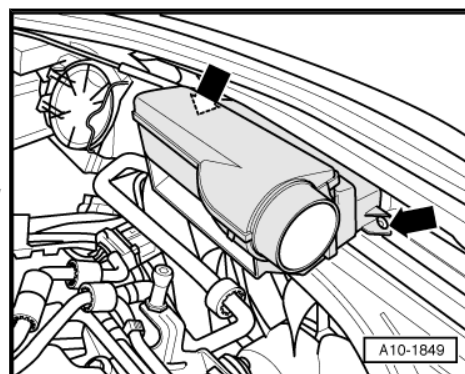
- Lift engine cover panel at sides -arrows 1- and pull off towards front -arrow 2-.



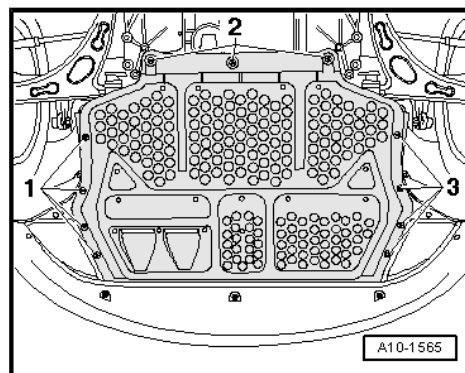
- Unplug electrical connector -2- at air mass meter -G70- .
- Detach vent hose -1- and air hoses -3- and -5-.
- Unscrew bolt -4- and remove air cleaner housing.



- Unscrew air duct at lock carrier -arrows-.

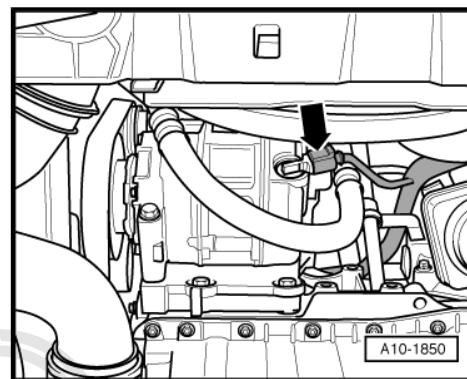


- Remove centre noise insulation -fasteners 1 ... 3-.

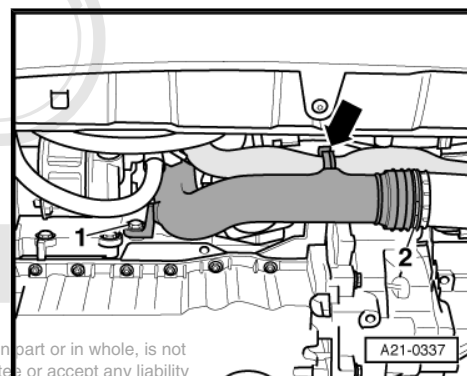


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- Unplug electrical connector -arrow- for magnetic clutch of air conditioner compressor.

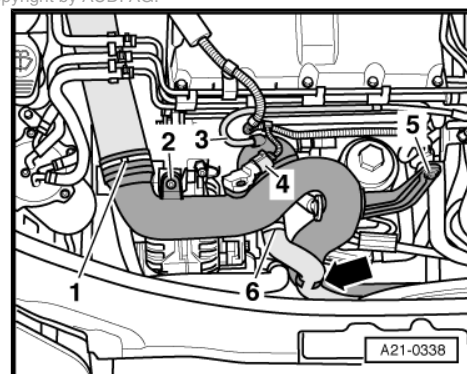


- Detach lower air intake hose (left-side) from front air pipe by lifting retaining clip -2- slightly.
- Remove bolt -1-.
- Unclip coolant hose from air pipe.

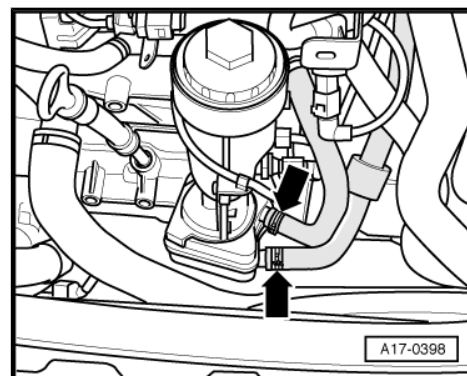


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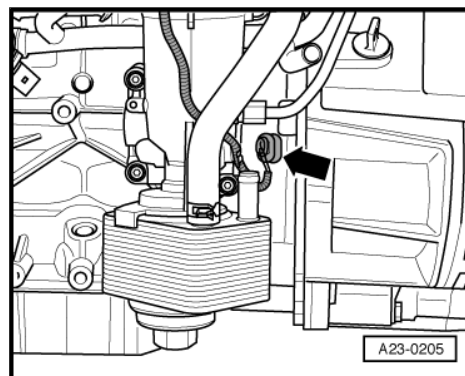
- Detach vacuum pipe -3- at vacuum reservoir.
- Unplug electrical connector -4- at charge pressure sender - G31- .
- Unclip coolant hose -6- from air pipe -arrow-.
- Remove bolts -2- and -5-.
- Remove air pipe by lifting retaining clip -1- slightly.



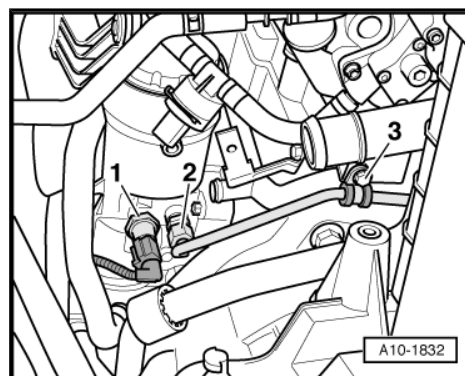
- Clamp off coolant hoses at oil cooler with hose clamps -3094- and detach -arrows-.



- Unplug electrical connector -arrow- at engine speed sender - G28- .
- Move wiring at wiring bracket clear.



- Unplug electrical connector at oil pressure switch -F1- .
- Unscrew oil pressure switch -1-.
- Detach oil supply line going to turbocharger at bracket -3- and at oil filter bracket -2-.



- Remove bolts -arrows-.
- Remove oil filter bracket.

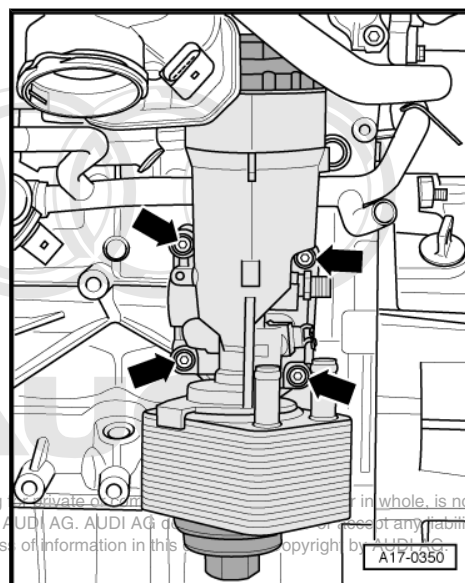
### Installing

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



#### Note

- ◆ *Renew gaskets, seals and O-rings.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- Install air pipes/hoses with plug-in connectors ⇒ [page 196](#) .
- Fill up cooling system (or change coolant if the oil cooler has been renewed) ⇒ [page 174](#) .
- Fill up with engine oil and check oil level.



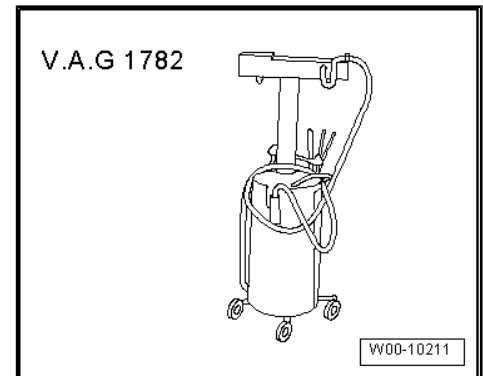
### Tightening torques

| Component                                                                                                 | Nm            |
|-----------------------------------------------------------------------------------------------------------|---------------|
| Oil filter bracket to cylinder block                                                                      | 14 + 90° 1)2) |
| Oil pressure switch to oil filter bracket                                                                 | 20            |
| Oil supply line to oil filter bracket                                                                     | 22            |
| Air pipe (lower) to cylinder block                                                                        | 15            |
| Air pipe (upper) to bracket                                                                               | 8             |
| <ul style="list-style-type: none"> <li>• 1) Renew bolts.</li> <li>• 2) 90° = one quarter turn.</li> </ul> |               |

## 1.6 Removing and installing oil pressure switch -F1-

### Special tools and workshop equipment required

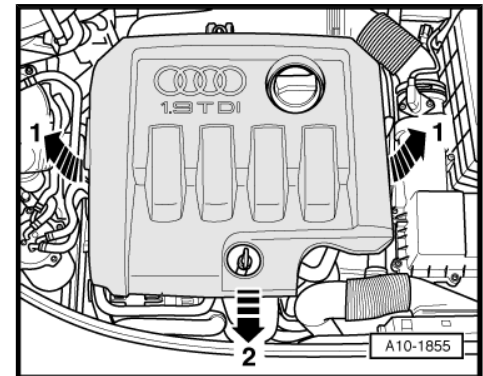
- ◆ Used oil collection and extraction unit -V.A.G 1782-



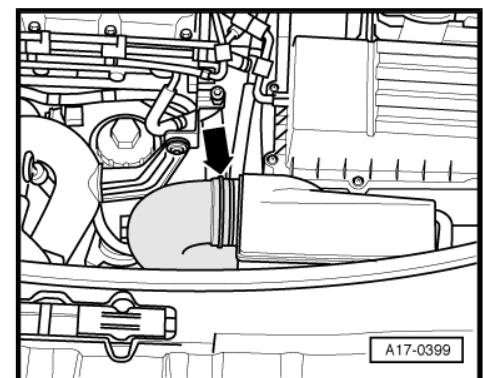
### Removing

- Lift engine cover panel at sides -arrows 1- and pull off towards front -arrow 2-.

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- Remove air intake hose -arrow- from between lock carrier and air cleaner housing.





### Note

Place a cloth below the oil filter housing to catch escaping oil.

- Unplug electrical connector at oil pressure switch -F1-  
-arrow-.
- Unscrew oil pressure switch.

### Installing

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



### Note

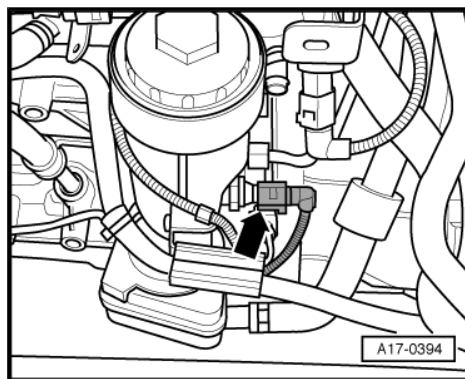
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Renew seal.

- Check oil level and fill up with engine oil if necessary  
⇒ [page 168](#) .

### Tightening torque

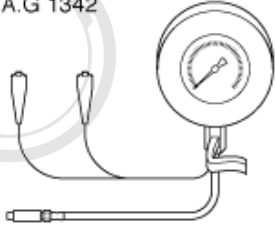
| Component                                 | Nm |
|-------------------------------------------|----|
| Oil pressure switch to oil filter bracket | 20 |



## 1.7 Checking oil pressure and oil pressure switch

### Special tools and workshop equipment required

- ◆ Oil pressure tester - V.A.G 1342-
- ◆ Voltage tester -V.A.G 1527 B-
- ◆ Auxiliary measuring set - V.A.G 1594 C-

|                                                                                                       |                                                                                                         |
|-------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| <p>V.A.G 1342</p>    | <p>V.A.G 1527 B</p>  |
| <p>V.A.G 1594 C</p>  |                                                                                                         |
|                                                                                                       | <p>G17-0023</p>                                                                                         |

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### Procedure

- Oil level OK
- Engine oil temperature approx. 80 °C
- Remove oil pressure switch ⇒ [page 165](#) .

- Connect oil pressure tester -V.A.G 1342- to threaded hole for oil pressure switch.
- Screw oil pressure switch -2- into oil pressure tester - V.A.G 1342- .

### Checking oil pressure switch

- Connect brown wire -1- of oil pressure tester to earth (-).
- Connect voltage tester -V.A.G 1527 B- with test leads from auxiliary measuring set -V.A.G 1594 C- to oil pressure switch and battery positive (+).
- LED should not light up.

If LED lights up now:

- Renew oil pressure switch.
- Start engine.



### Note

*Observe tester and LED while starting, as switching point of oil pressure switch may already be exceeded when starting.*

- LED should light up at 0.55 ... 0.85 bar.

If LED does not light up:

- Renew oil pressure switch.

### Checking oil pressure

- Start engine.
- Minimum oil pressure at idling speed: 0.8 bar
- Minimum oil pressure at 2000 rpm: 2.0 bar

### Assembling

- Install oil pressure switch ⇒ [page 165](#) .

## 1.8 Engine oil

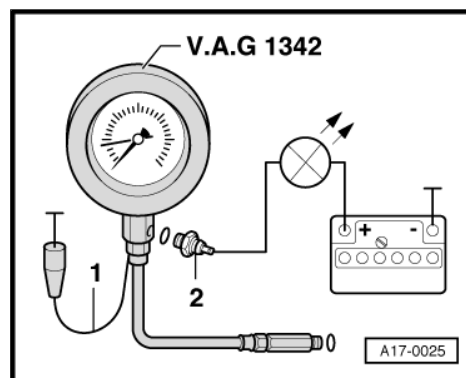
### Viscosity grades and oil specifications

⇒ Maintenance ; Booklet 808 .

## 1.9 Checking oil level

### Procedure

- 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 off with a clean cloth and insert it again as far as it will go.
- Pull out the dipstick again and read off the oil level.



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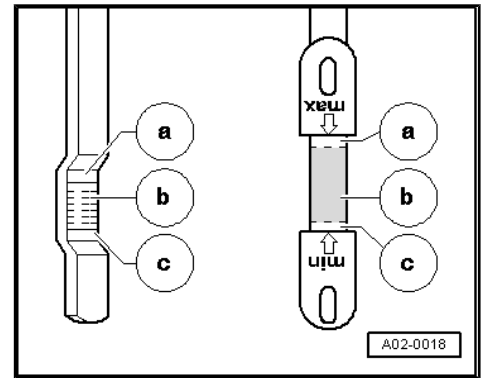
Markings on oil dipstick:

- a - Do not top up oil.
- b - Oil may be topped up.
- c - Oil must be topped up.



**Note**

*The oil level must not be above the MAX marking -a- and not below the MIN marking -c-.*



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## 19 – Cooling

### 1 Removing and installing parts of cooling system



#### WARNING

*Hot steam or hot coolant can escape when expansion tank is opened; cover filler cap with cloth and open carefully.*



#### Note

- ◆ *The cooling system is under pressure when the engine is hot. If necessary, relieve pressure before commencing repair work.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- ◆ *Hose clip pliers -V.A.G 1921- are recommended for fitting spring-type hose clips.*
- ◆ *Renew gaskets and seals.*
- ◆ *The arrow markings on coolant pipes and on ends of hoses must align.*

#### 1.1 Diagram of coolant hose connections

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#### Note

*The illustration shows a connection diagram for a vehicle with manual gearbox and no auxiliary heater.*

**1 - Radiator**

- ☐ Removing and installing  
⇒ [page 188](#)
- ☐ If renewed, refill system  
with fresh coolant

**2 - Oil cooler**

- ☐ If renewed, refill system  
with fresh coolant
- ☐ Removing and installing  
⇒ ["1.5 Removing and installing oil filter bracket with oil cooler"](#),  
[page 161](#)

**3 - Thermostat**

- ☐ Removing and installing  
⇒ [page 177](#)
- ☐ Checking ⇒ [page 181](#)

**4 - Coolant pump**

- ☐ Removing and installing  
⇒ [page 176](#)

**5 - Cylinder head/cylinder block**

- ☐ If renewed, refill system  
with fresh coolant

**6 - Expansion tank**

- ☐ With filler cap
- ☐ Checking pressure relief valve in filler cap  
⇒ [page 193](#)

**7 - Exhaust gas recirculation cooler**

- ☐ If renewed, refill system  
with fresh coolant

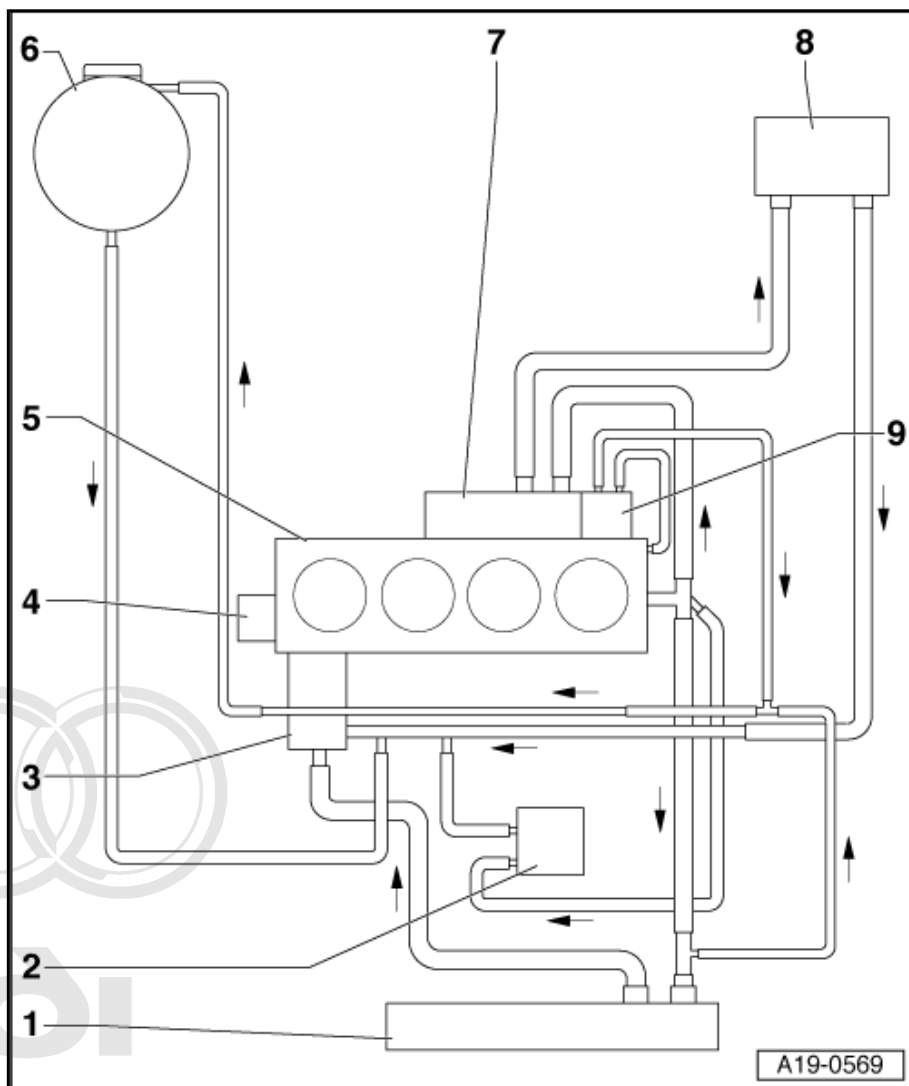
- ☐ Removing and installing ⇒ [page 217](#)

**8 - Heat exchanger for heater**

- ☐ If renewed, refill system with fresh coolant

**9 - Changeover flap for exhaust gas recirculation cooler****10 - ATF cooler**

- ☐ For vehicles with automatic gearbox
- ☐ If renewed, refill system with fresh coolant

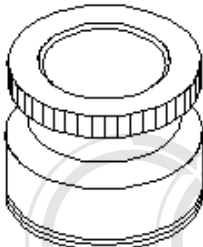
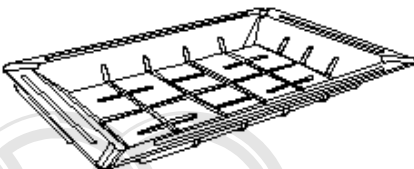
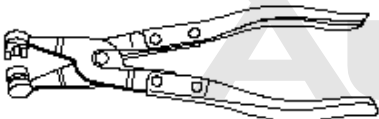
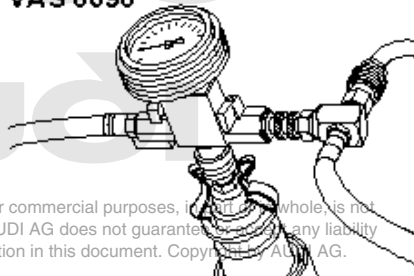
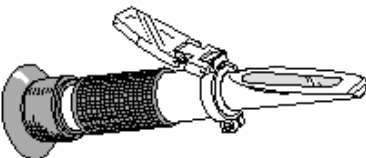


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## 1.2 Draining and filling cooling system

### Special tools and workshop equipment required

- ◆ Adapter for cooling system tester -V.A.G 1274/8-
- ◆ Hose clip pliers - V.A.G 1921-
- ◆ Cooling system charge unit -VAS 6096-
- ◆ Drip tray for workshop hoist -VAS 6208-
- ◆ Refractometer -T10007-

|                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                           |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| <p><b>V.A.G 1274/8</b></p>                                                                                                                                                                                                                                                                               | <p><b>VAS 6208</b></p>  |
| <p><b>V.A.G 1921</b></p>  <p>Protected by copyright. Copying for private or commercial purposes, in whole or in part, is not permitted unless authorised by AUDI AG. AUDI AG does not guarantee any liability with respect to the correctness of information in this document. Copyright by AUDI AG.</p> | <p><b>VAS 6096</b></p>  |
| <p><b>T10007</b></p>                                                                                                                                                                                                                                                                                   | <p>G19-10005</p>                                                                                          |

### Draining



#### Note

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

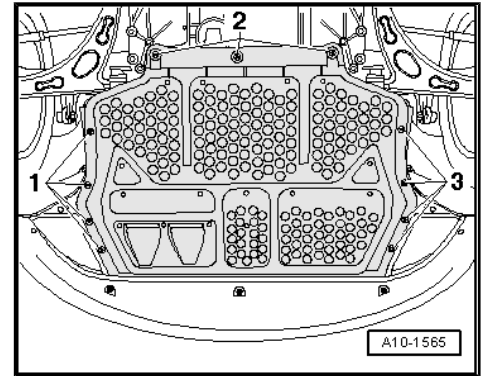


#### WARNING

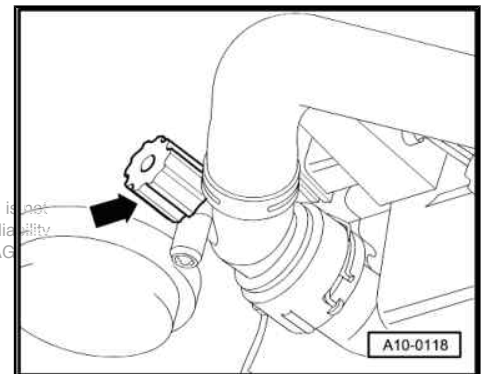
**Hot steam or hot coolant can escape when expansion tank is opened; cover filler cap with cloth and open carefully.**

- Open filler cap on coolant expansion tank.

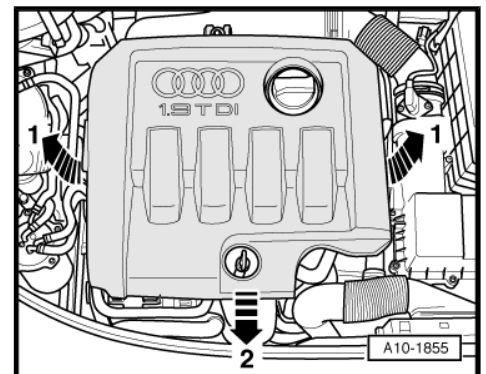
- Remove centre noise insulation -fasteners 1 ... 3-.



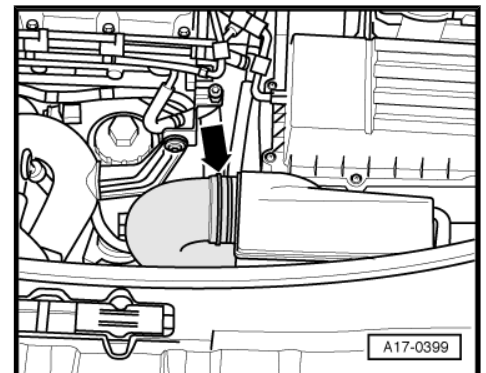
- Place drip tray for workshop hoist -VAS 6208- under engine.
- Turn drain plug -arrow- on radiator anti-clockwise, if necessary fit drain hose to connection.



- Lift engine cover panel at sides -arrows 1- and pull off towards front -arrow 2-.



- Remove air intake hose -arrow- from between lock carrier and air cleaner housing.



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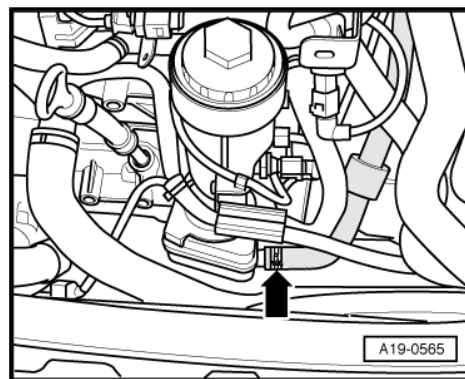
- Disconnect coolant hose at bottom of oil cooler -arrow- and drain off remaining coolant.

## Filling

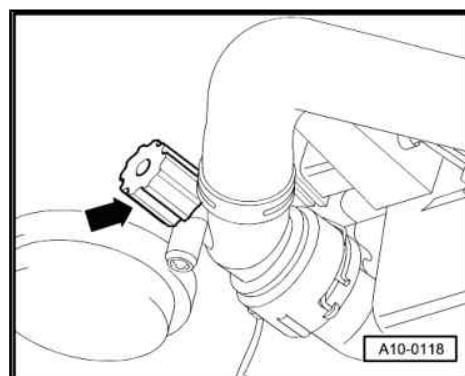


### Note

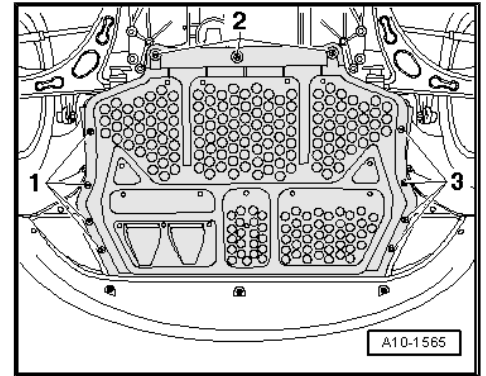
- ◆ The cooling system is filled all year round with a mixture of water and radiator antifreeze/anti-corrosion agent.
- ◆ It is important to use only coolant additive Plus -G 012 A8F A1- (also designated as »G12+«) "meeting specification TL VW 774 F". Other coolant additives could seriously impair in particular the anti-corrosion properties. The resulting damage could lead to loss of coolant and consequently to serious engine damage.
- ◆ Coolant additive »G12+« may be mixed with additives »G11« and »G12«.
- ◆ »G12+« and coolant additives marked "Conforming with specification TL VW 774 F" prevent frost and corrosion damage and stop scale from forming. Such additives also raise the boiling point of the coolant. For these reasons the cooling system must be filled all year round with the correct antifreeze and anticorrosion additive.
- ◆ Because of its high boiling point, the coolant improves engine reliability under heavy loads, particularly in countries with tropical climates.
- ◆ Frost protection is required down to about -25 °C (in countries with arctic climate: down to about -35 °C).
- ◆ The coolant concentration must not be reduced by adding water even in warmer seasons and in warmer countries. The antifreeze concentration must be at least 40 %.
- ◆ If greater frost protection is required in very cold climates, the amount of »G12+« can be increased, but only up to 60% (this gives frost protection to about -40 °C). If antifreeze concentration exceeds 60%, frost protection decreases again and cooling efficiency is also impaired.
- ◆ Use only clean tap water for mixing coolant.
- ◆ If radiator, heat exchanger, cylinder head, cylinder head gasket or cylinder block have been renewed, do not re-use old coolant.
- ◆ Contaminated or dirty coolant must not be used again.
- ◆ To check frost protection level of coolant additive »G12+« you must use a refractometer -T10007-.



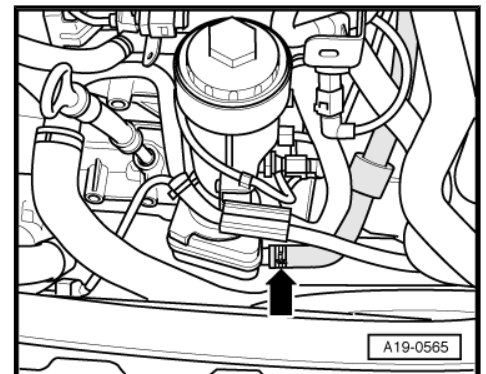
- Close drain plug -arrow-.



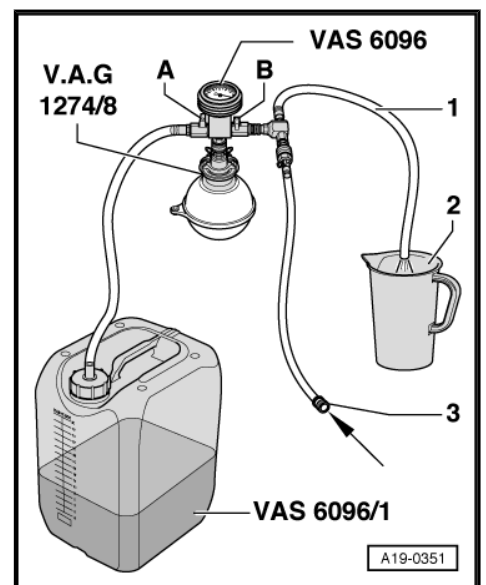
- Install centre noise insulation -fasteners 1 ... 3-.



- Connect coolant hose at bottom of oil cooler -arrow-.



- Fill reservoir -VAS 6096/1- with at least 8 litres of premixed coolant (based on recommended ratio):
  - »G12+« (40 %) and water (60 %) for frost protection to -25 °C
  - »G12+« (50 %) and water (50 %) for frost protection to -35 °C
  - »G12+« (60 %) and water (40 %) for frost protection to -40 °C
- Screw adapter for cooling system tester -V.A.G 1274/8- onto coolant expansion tank.
- Attach cooling system charge unit -VAS 6096- onto adapter -V.A.G 1274/8- .
- Run vent hose -1- into a small container -2-. (The vented air draws along a small amount of coolant, which should be collected.)
- Close the two valves -A- and -B- by setting lever at right angle to direction of flow.
- Connect hose -3- to compressed air.
- Pressure: 6 ... 10 bar.



- Open valve -B- by setting lever in direction of flow.

The suction jet pump generates a partial vacuum in the cooling system.

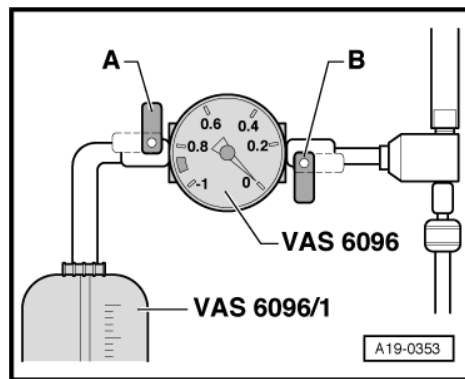
- The needle on the gauge should move into the green zone.
- Also briefly open valve -A- (turn lever in direction of flow) so that hose on reservoir -VAS 6096/1- can fill with coolant.
- Close valve -A- again.
- Leave valve -B- open for another 2 minutes.
- The suction jet pump will continue generating a vacuum in the cooling system.
- The needle on the gauge should remain in the green zone.
- Close valve -B-.
- The needle on the gauge should stop in the green zone. The vacuum level in the cooling system is then sufficient for subsequent filling.

If the needle does not reach the green zone, repeat the process.

If the vacuum level drops, there is a leak in the cooling system.

- Detach compressed air hose.
- Open valve -A-.

The partial vacuum in the cooling system causes the coolant to be drawn up out of the reservoir -VAS 6096/1- ; the cooling system is then filled.

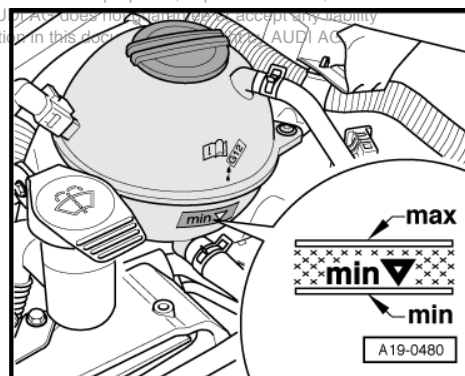


- Check the coolant level and top up coolant as far as the max mark.
- On vehicles with auxiliary heater, switch heater on (for about 30 seconds) and then off again.
- Start engine, run for 2 minutes (maximum) at approx. 1500 rpm and top up coolant to overflow hole on expansion tank with engine running.
- Tighten filler cap on expansion tank.
- Run engine until radiator fan cuts in.



#### WARNING

*Hot steam or hot coolant can escape when expansion tank is opened; cover filler cap with cloth and open carefully.*



- Check coolant level and top up if necessary.
- When the engine is at normal operating temperature, coolant level must be at MAX mark, when engine is cold it must be between MIN and MAX marks.
- Switch engine off.

## 1.3 Removing and installing coolant pump

### Removing

- Drain off coolant ⇒ [page 172](#) .
- Remove toothed belt:
- ♦ Vehicles up to approx. 05.2005 ⇒ [page 41](#)

- ◆ Vehicles from approx. 06.2005 onwards ⇒ [page 53](#)
- Unscrew bolts -1- for coolant pump and remove coolant pump -2-.
- Remove O-ring -3-.

### Installing

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



### Note

*Renew O-ring.*

- Clean and smoothen sealing surface for O-ring as required.
- Lubricate new O-ring -3- with coolant additive »G12+«.
- Fit coolant pump -2-.
- Installation position: Sealing plug in housing faces downwards.
- Tighten bolts -1- for coolant pump.
- Fit toothed belt (adjust valve timing):

◆ Vehicles up to approx. 05.2005 ⇒ [page 49](#)

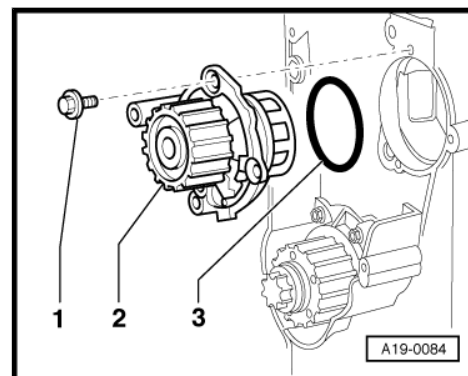
◆ Vehicles from approx. 06.2005 onwards ⇒ [page 59](#)

- Install poly V-belt ⇒ [page 30](#) .
- Fill cooling system ⇒ [page 174](#) .

### Tightening torque

| Component                      | Nm |
|--------------------------------|----|
| Coolant pump to cylinder block | 15 |

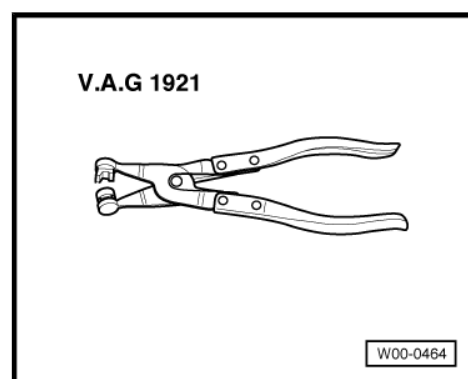
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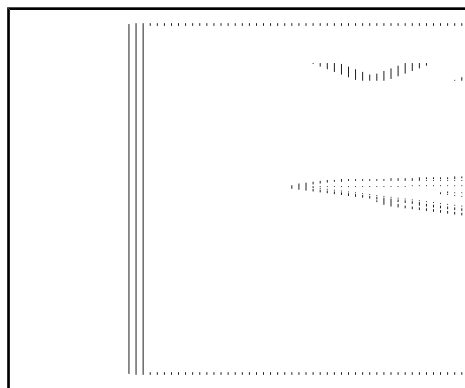
## 1.4 Removing and installing thermostat

### Special tools and workshop equipment required

- ◆ Hose clip pliers -V.A.G 1921-



# ◆ Drip tray for workshop hoist -VAS 6208-



## Removing



### Note

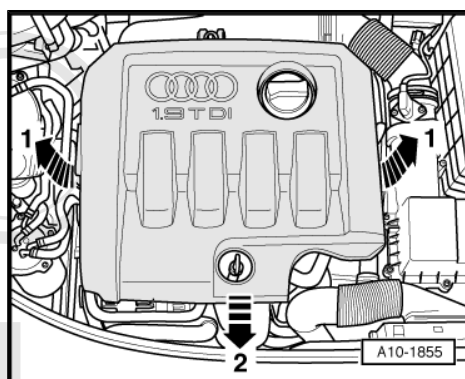
Collect drained coolant in a clean container for re-use or disposal.



### WARNING

**Hot steam or hot coolant can escape when expansion tank is opened; cover filler cap with cloth and open carefully.**

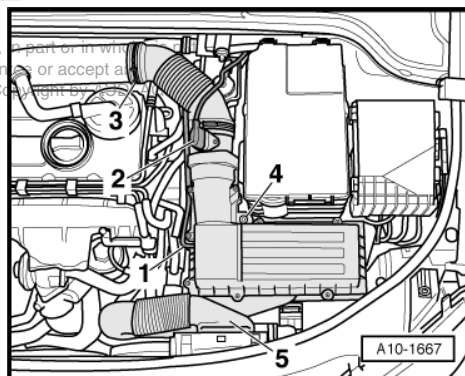
- Open filler cap on coolant expansion tank.
- Lift engine cover panel at sides -arrows 1- and pull off towards front -arrow 2-.



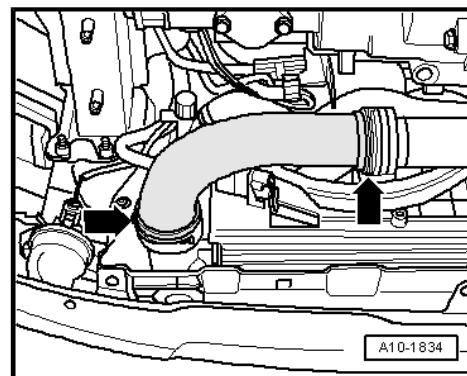
- Unplug electrical connector -2- at air mass meter -G70- .

- Detach vent hose -1- and air hoses -3- and -5-.

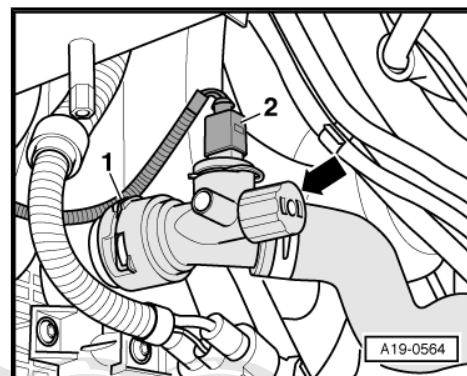
- Unscrew bolt -4- and remove air cleaner housing.



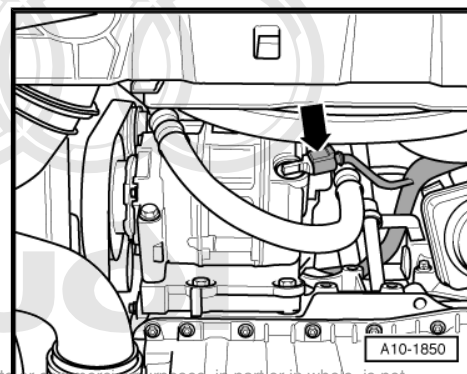
- Remove air intake hose (left-side) by lifting retaining clips -arrows- slightly.



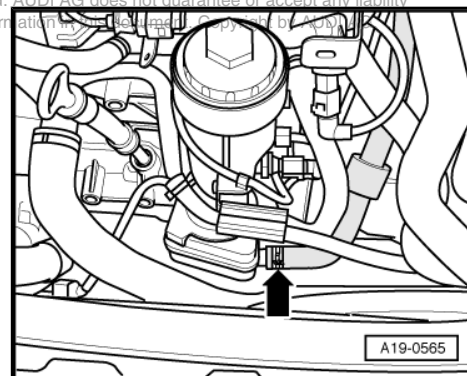
- Unplug electrical connector -2- from coolant temperature sender - radiator outlet -G83- .
- Place drip tray for workshop hoist -VAS 6208- under engine.
- Turn drain plug -arrow- on radiator anti-clockwise, if necessary fit drain hose to connection.
- Detach lower coolant hose -1-; to do so, pull out retaining clip.



- Unplug electrical connector -arrow- for magnetic clutch of air conditioner compressor.

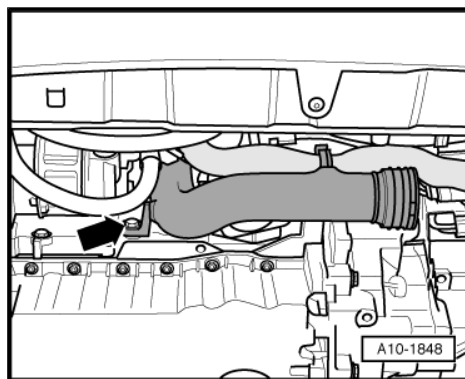


- Disconnect coolant hose at bottom of oil cooler -arrow- and drain off remaining coolant.

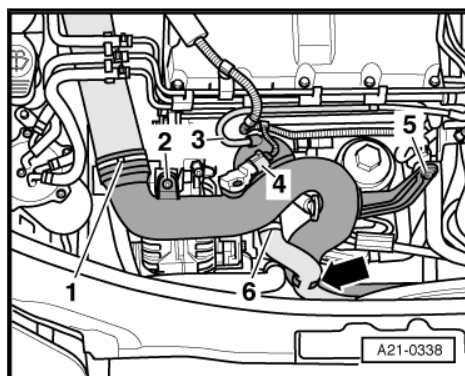


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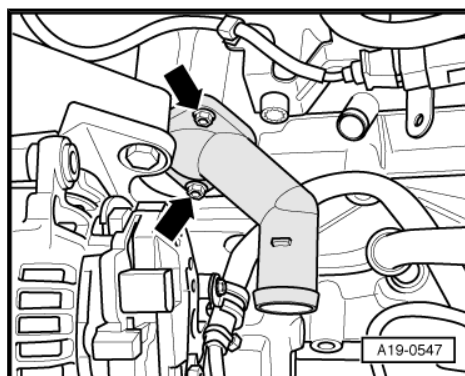
- Remove securing bolt -arrow- for front air pipe.



- Detach vacuum pipe -3- at vacuum reservoir.
- Unplug electrical connector -4- at charge pressure sender - G31- .
- Disconnect coolant hose -6-.
- Unscrew bolts -2- and -5- and remove air pipe together with coolant hose.
- Remove air pipe by lifting retaining clip -1- slightly.



- Unscrew bolts -arrows- and remove connection.



- Turn thermostat -item 2- approx. 90° (1/4 turn) anti-clockwise -arrow- and remove it from hose connection.
- Remove O-ring -1-.

### Installing

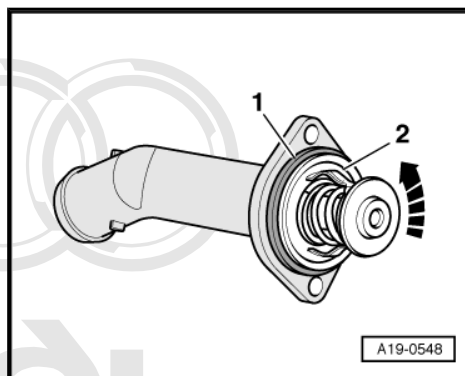
Installation is carried out in the reverse order; note the following:



#### Note

*Renew O-ring.*

- Clean and smoothen sealing surface for O-ring as required.

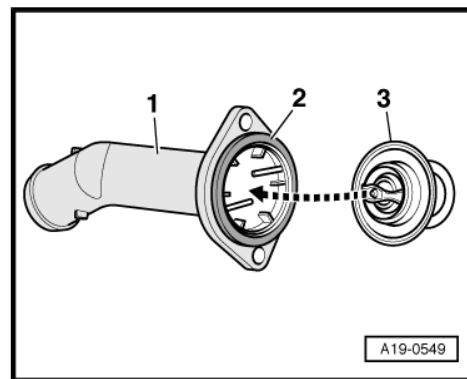


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- Insert thermostat -3- with new O-ring -2- into hose connection -1-.
- When inserting, the cross-piece on the thermostat should be horizontal as shown in the illustration.
- Lubricate new O-ring with coolant additive »G12+«.
- Turn thermostat anti-clockwise through approx. 90° (1/4 turn).
- Fill cooling system ➔ [page 174](#).

#### Tightening torque

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



### 1.5 Checking thermostat

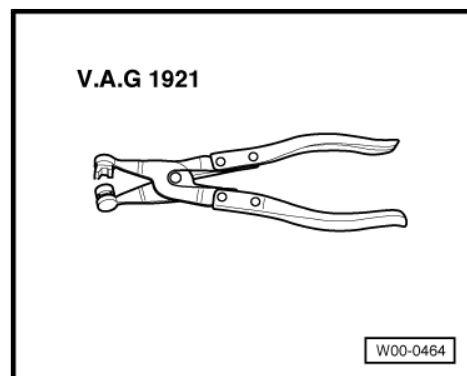
- Heat removed thermostat in water bath.

| Starts to open                    | Fully open                  | Opening travel |
|-----------------------------------|-----------------------------|----------------|
| approx. 87°C                      | approx. 102°C <sup>1)</sup> | at least 8 mm  |
| • <sup>1)</sup> Cannot be tested. |                             |                |

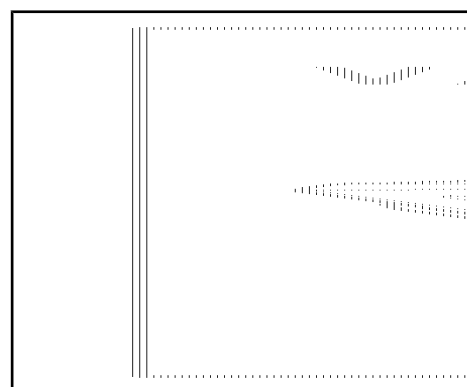
### 1.6 Removing and installing coolant pipe

#### Special tools and workshop equipment required

- ◆ Hose clip pliers -V.A.G 1921-

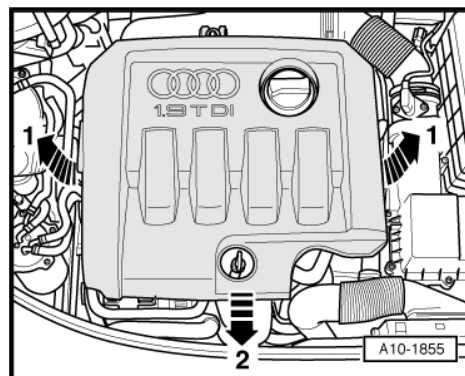


- ◆ Drip tray for workshop hoist -VAS 6208-



## Removing

- Lift engine cover panel at sides -arrows 1- and pull off towards front -arrow 2-.

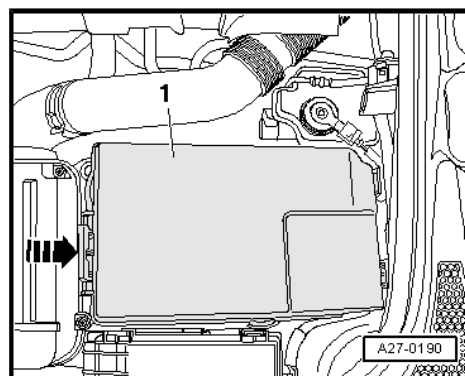


- Remove cover -1- over battery; to do so, press release tab -arrow-.



### Caution

*Observe notes on procedure for disconnecting the battery ⇒ Rep. gr. 27.*

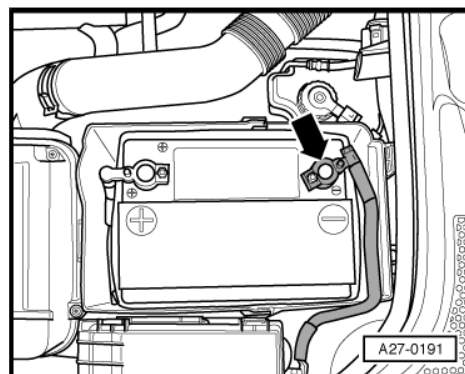


- With ignition switched off, disconnect battery earth cable -arrow-.



### WARNING

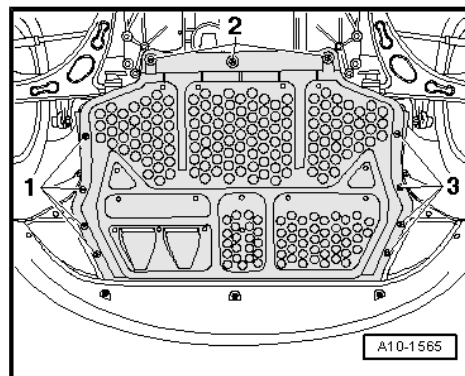
*Hot steam or hot coolant can escape when expansion tank is opened; cover filler cap with cloth and open carefully.*



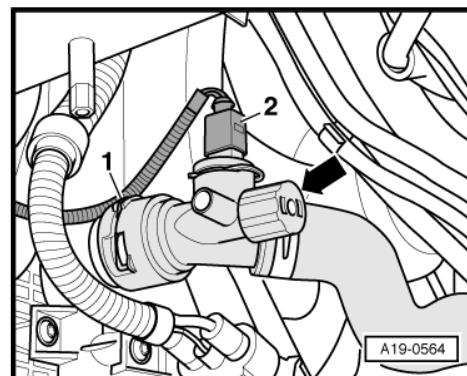
- Open filler cap on coolant expansion tank.

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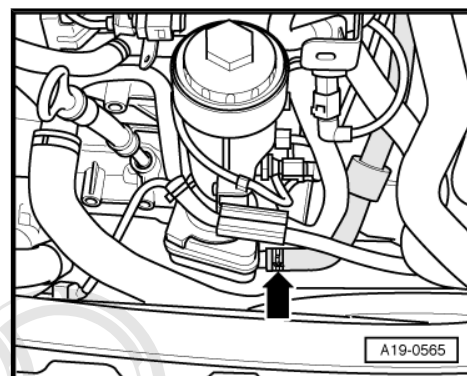
- Remove centre noise insulation -fasteners 1 ... 3-.



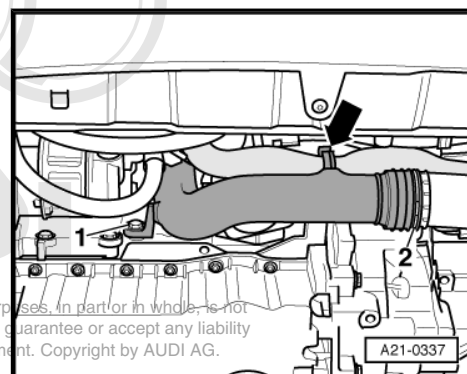
- Unplug electrical connector -2- from coolant temperature sender - radiator outlet -G83- .
- Place drip tray for workshop hoist -VAS 6208- under engine.
- Turn drain plug -arrow- on radiator anti-clockwise, if necessary fit drain hose to connection.
- Detach lower coolant hose -1-; to do so, pull out retaining clip.



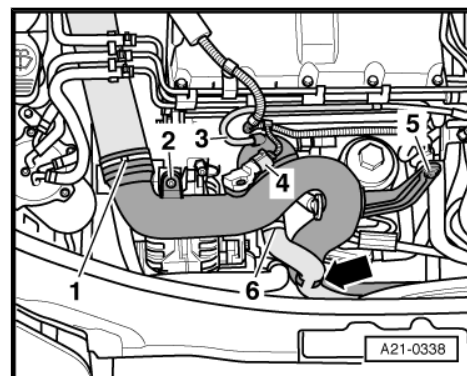
- Disconnect coolant hose at bottom of oil cooler -arrow- and drain off remaining coolant.



- Detach lower air intake hose (left-side) from front air pipe by lifting retaining clip -2- slightly.
- Remove bolt -1-.
- Unclip coolant hose from air pipe -arrow-.

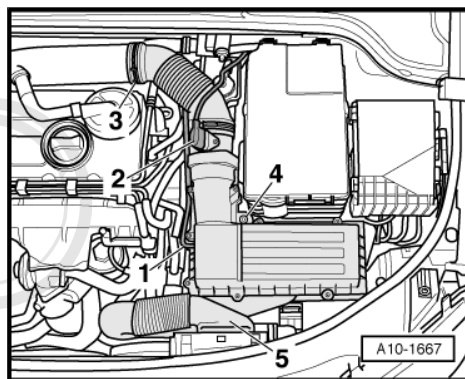


- Detach vacuum pipe -3- at vacuum reservoir.
- Unplug electrical connector -4- at charge pressure sender - G31- .
- Unclip coolant hose -6- from air pipe -arrow-.
- Remove bolts -2- and -5-.
- Remove air pipe by lifting retaining clip -1- slightly.



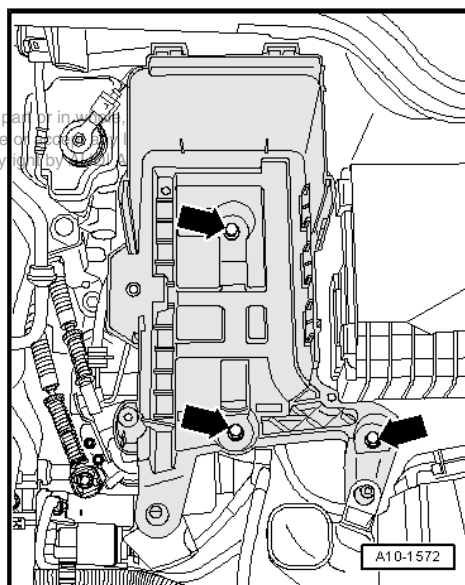
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- Unplug electrical connector -2- at air mass meter -G70- .
- Detach vent hose -1- and air hoses -3- and -5-.
- Unscrew bolt -4- and remove air cleaner housing.

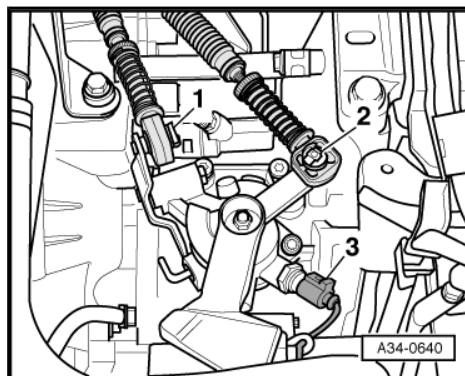


- Remove battery ⇒ Rep. gr. 27 .
- Remove battery tray -arrows-.

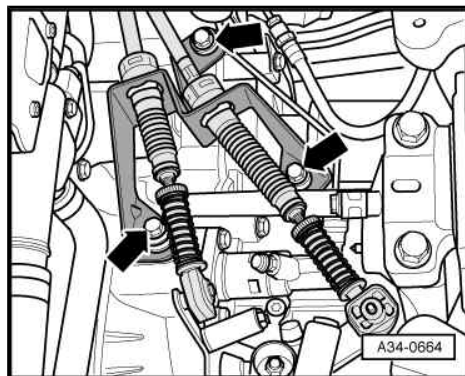
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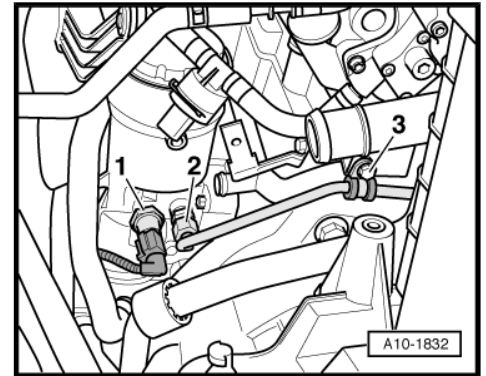
- Unclip securing clips -1- and -2- on both selector cables.
- Pull off selector cable end-pieces from gearbox selector lever and relay lever.



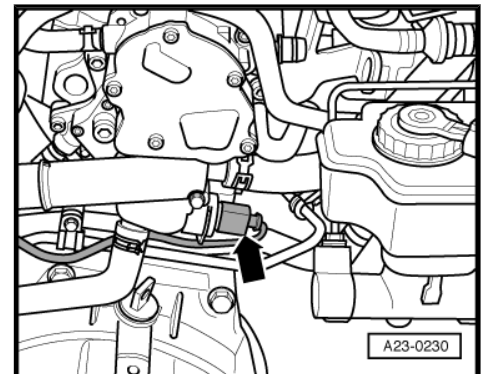
- Detach cable support bracket from gearbox -arrows- and place to one side.



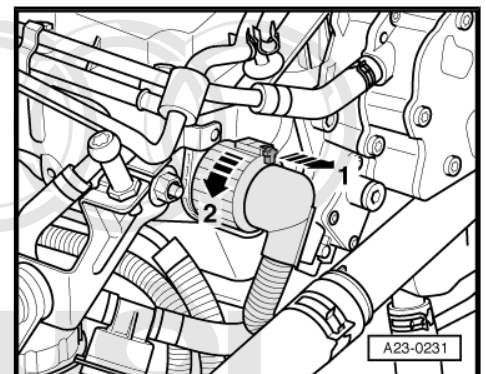
- Unplug electrical connector -1- at oil pressure switch -F1- .
- Unscrew oil pressure switch -2-.
- Detach oil supply line at bracket -3-.



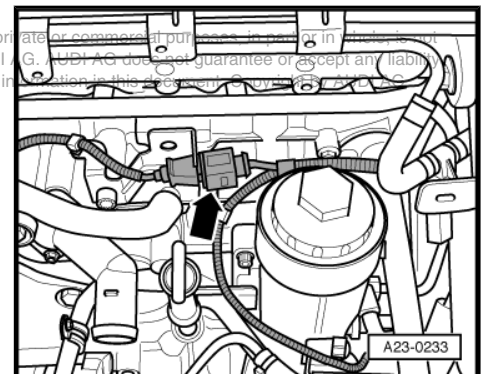
- Detach electrical connector -arrow- at coolant temperature sender -G62- and move wire clear.



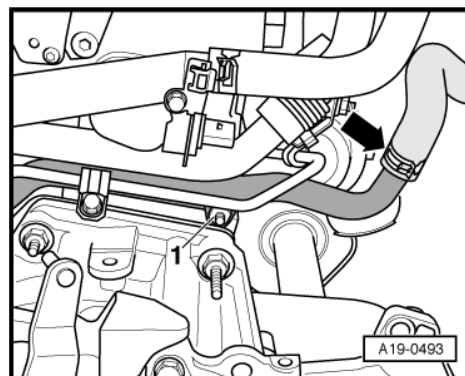
- Pull the release pin -arrow 1- and unscrew knurled nut -arrow 2-.
- Detach main connector for unit injectors and move clear wiring harness.



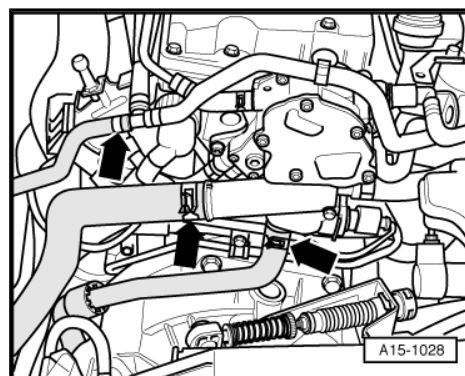
- Remove electrical connector -arrow- for Hall sender -G40- from bracket and unplug.



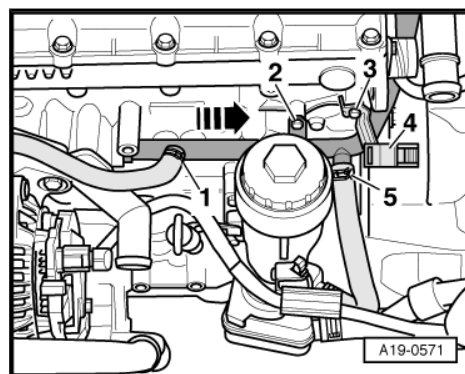
- Disconnect coolant hose -arrow- (leading to heat exchanger) from coolant pipe.
- Unscrew securing bolt -1- on coolant pipe.



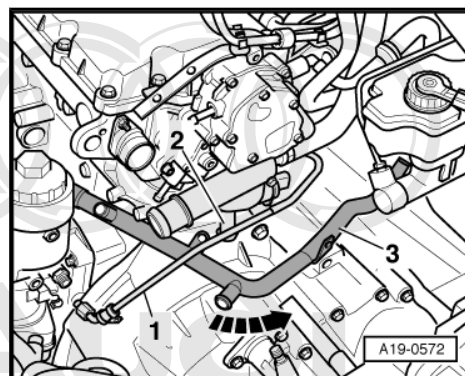
- Detach coolant hoses at the connections indicated -arrows-.



- Detach coolant hoses -1- and -5-.
- Unscrew bolts -2- and -3- and swing bracket -4- forwards.
- Pull coolant pipe out of connection at cylinder block -arrow-.



- Guide oil supply line -1- carefully behind the connection -2- at coolant flange (left-side) on cylinder head.
- First guide coolant pipe -3- to rear towards the bulkhead -arrow-.
- Then pull coolant pipe towards the front and remove.



### Installing

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



#### Note

- ◆ *Renew gaskets, seals and O-rings.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*

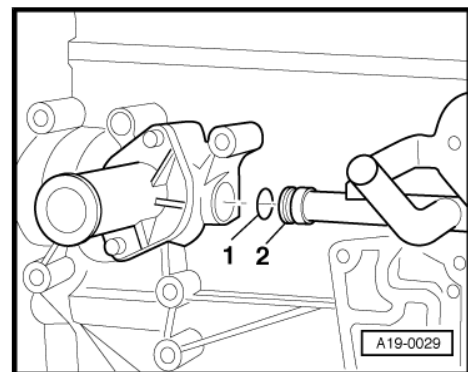
- Clean and smoothen sealing surface for O-ring as required.

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- Lubricate new O-ring -1- with »G 12+« and push onto coolant pipe -2-.
- Push coolant pipe into bore on cylinder block.
- Attach and adjust selector mechanism at gearbox ⇒ Rep. gr. 34 .
- Install air pipes/hoses with plug-in connectors ⇒ [page 196](#) .
- Install battery ⇒ Rep. gr. 27 .
- Fill cooling system ⇒ [page 174](#) .

**Tightening torques**

| Component                                   |     | Nm |
|---------------------------------------------|-----|----|
| Coolant pipe to cylinder block              | M7  | 15 |
|                                             | M10 | 25 |
| Oil supply line to oil filter flange        |     | 25 |
| Bracket for oil supply line to coolant pipe |     | 10 |



## 1.7 Radiator and radiator fan - exploded view of components

**1 - Radiator fan -V7-**

- ☐ With radiator fan control unit -J293-
- ☐ Removing and installing ⇒ [page 193](#)

**2 - 5 Nm****3 - Radiator cowl****4 - Coolant hose (bottom)**

- ☐ To hose connection on thermostat

**5 - Retaining clip****6 - Radiator outlet coolant temperature sender -G83-****7 - O-ring**

- ☐ Renew if damaged

**8 - Coolant hose (top)**

- ☐ To connection at cylinder head

**9 - O-ring**

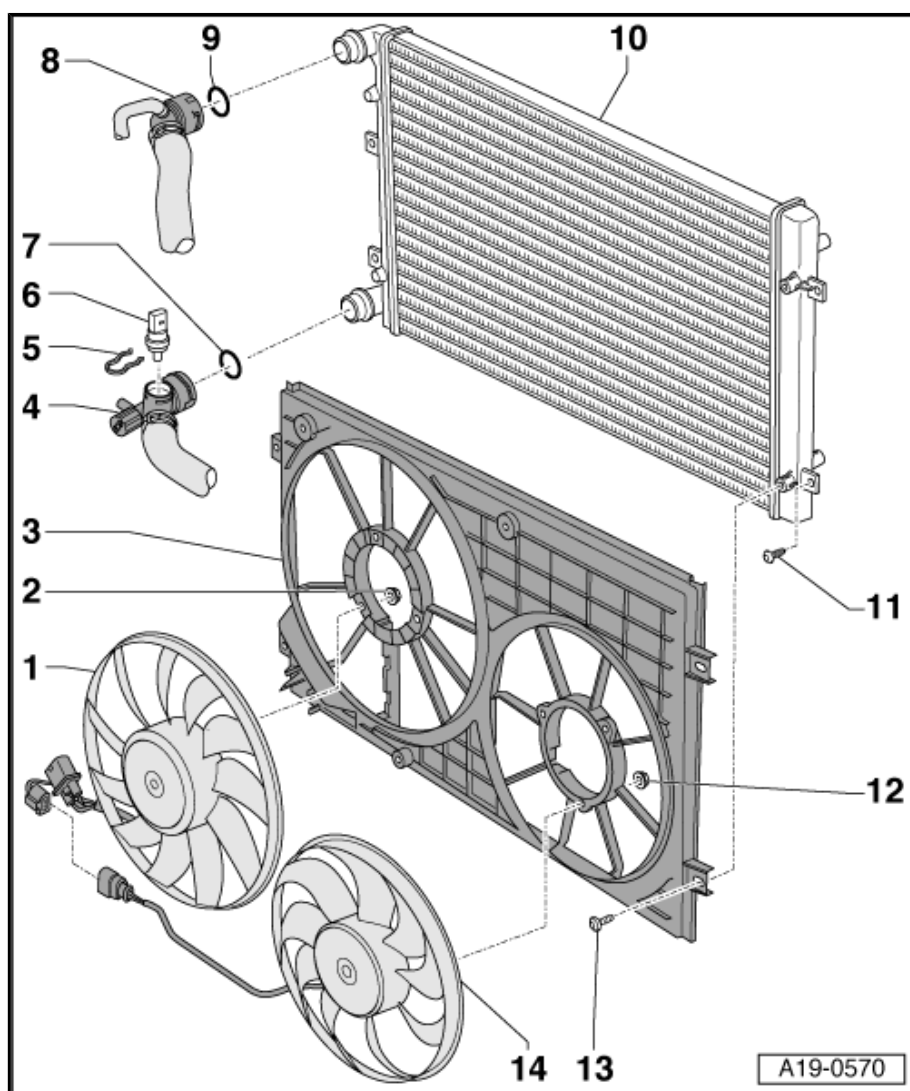
- ☐ Renew if damaged

**10 - Radiator**

- ☐ Removing and installing ⇒ [page 188](#)
- ☐ If renewed, change coolant in entire system

**11 - 5 Nm****12 - 5 Nm****13 - 5 Nm****14 - Radiator fan -2- -V177-**

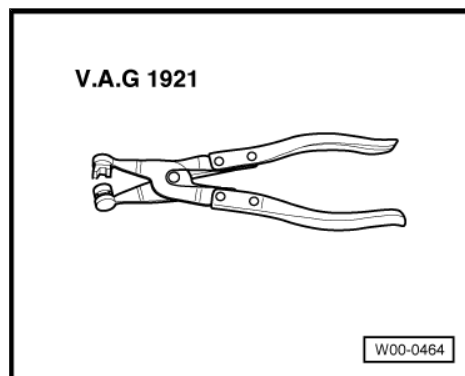
- ☐ Removing and installing ⇒ [page 193](#)



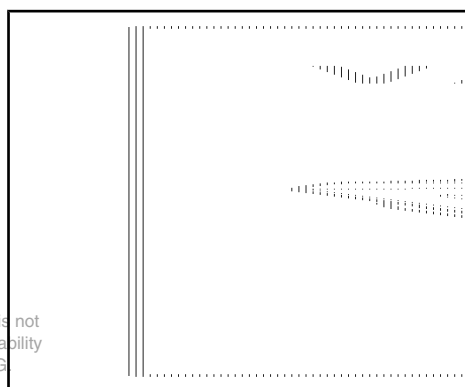
## 1.8 Removing and installing radiator

### Special tools and workshop equipment required

- ◆ Hose clip pliers -V.A.G 1921-



- ◆ Drip tray for workshop hoist -VAS 6208-



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### Removing



#### Note

- ◆ *Even when the radiator and condenser are correctly installed, slight impressions may be visible on the fins of these components. This does not mean that the components are damaged. If the fins are only very slightly distorted, this does not justify renewal of the radiator or the condenser.*
- ◆ *Collect drained coolant in a clean container for re-use or disposal.*

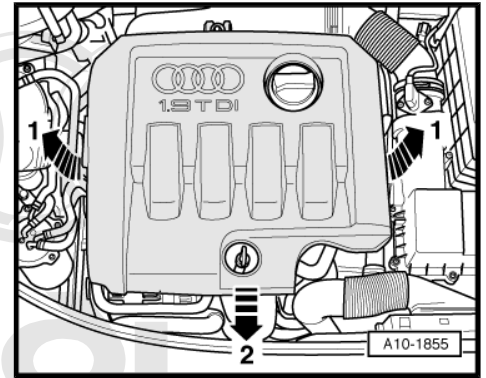


#### WARNING

***Hot steam or hot coolant can escape when expansion tank is opened; cover filler cap with cloth and open carefully.***

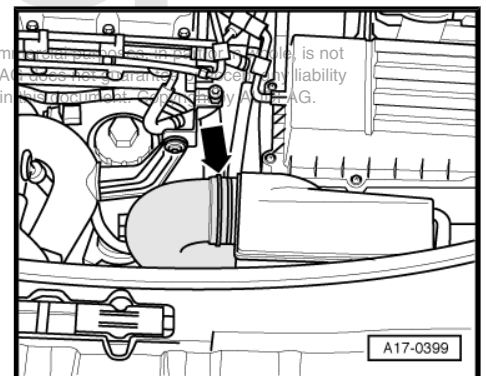
- Open filler cap on coolant expansion tank.

- Lift engine cover panel at sides -arrows 1- and pull off towards front -arrow 2-.

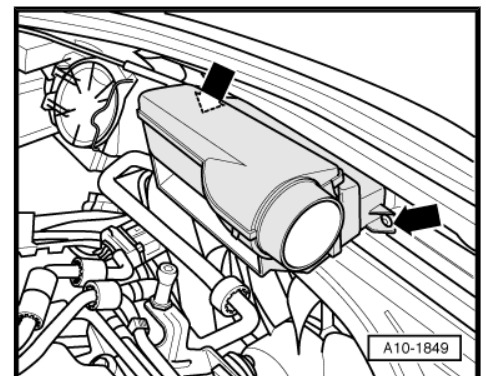


- Remove air intake hose -arrow- from between lock carrier and air cleaner housing.

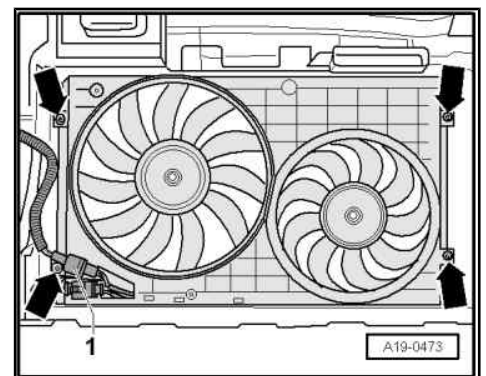
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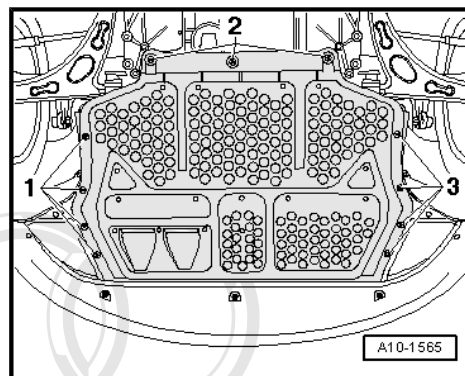
- Unscrew air duct at lock carrier -arrows-.



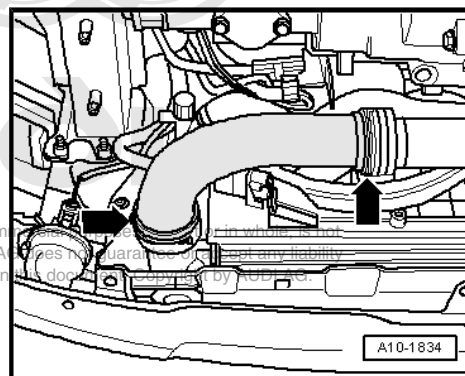
- Unscrew upper securing bolts -upper arrows- for radiator cowl.



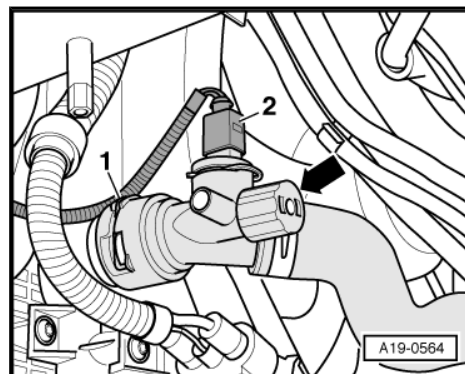
- Remove centre noise insulation -fasteners 1 ... 3-.



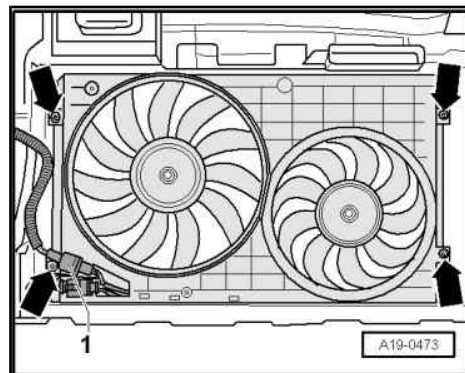
- Remove air intake hose (left-side) by lifting retaining clips -arrows- slightly.



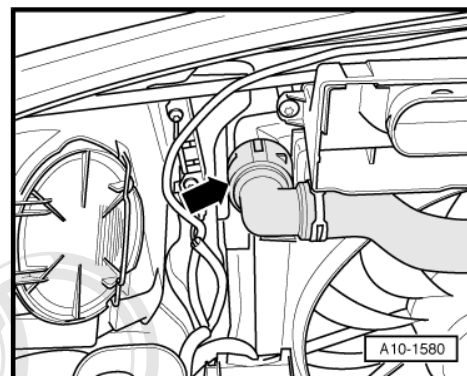
- Unplug electrical connector -2- from coolant temperature sender - radiator outlet -G83- .
- Place drip tray for workshop hoist -VAS 6208- under engine.
- Turn drain plug -arrow- on radiator anti-clockwise, if necessary fit drain hose to connection.
- Detach lower coolant hose -1-; to do so, pull out retaining clip.



- Unplug electrical connector -1-.
- Unscrew lower securing bolts -lower arrows- for radiator cowl and remove it from below.



- Detach top coolant hose from radiator -arrow-.



- Unscrew bolts -arrows- on backside of radiator.
- Lift up radiator slightly and remove from below.

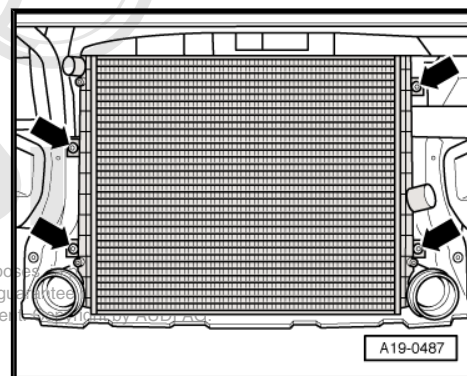
### Installing

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



#### Note

- ◆ *Renew seals and O-rings.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*



- Install air pipes/hoses with plug-in connectors ⇒ [page 196](#) .
- Fill cooling system ⇒ [page 174](#) .

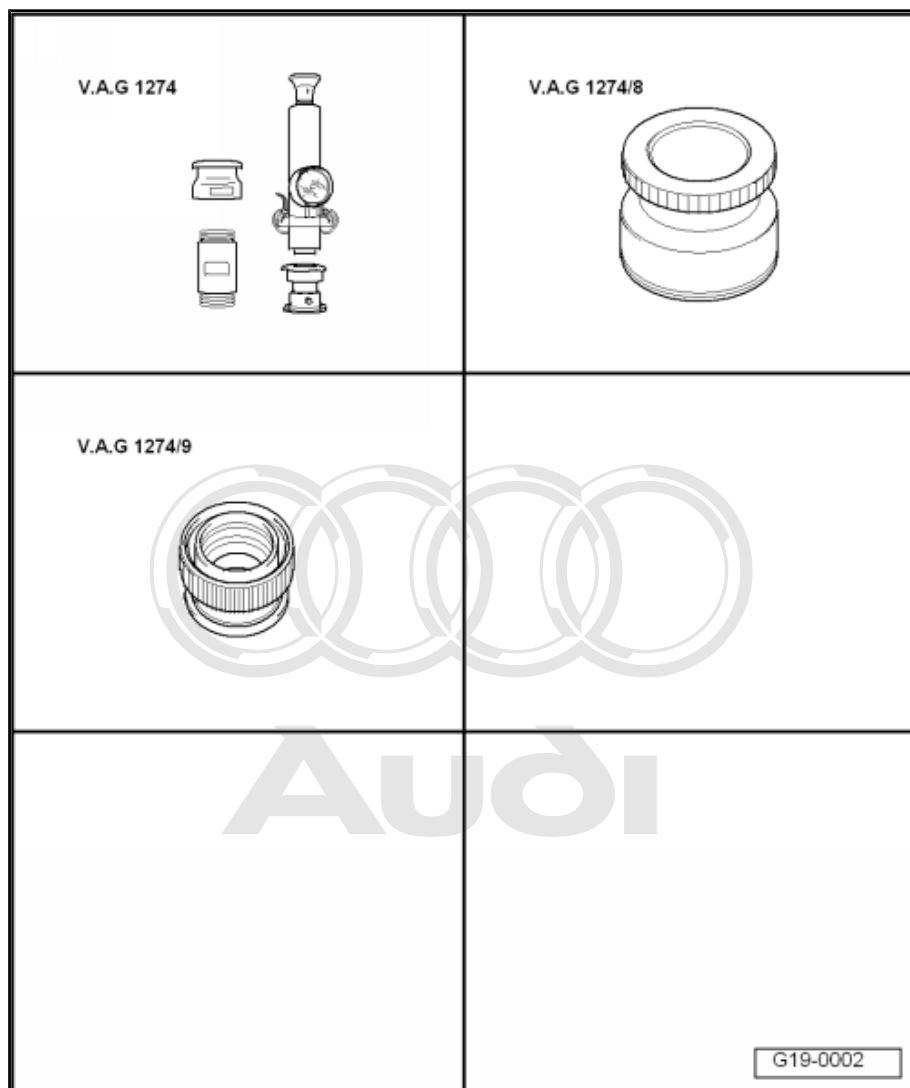
### Tightening torques

| Component                     | Nm |
|-------------------------------|----|
| Radiator to charge air cooler | 5  |
| Radiator cowl to radiator     | 5  |

## 1.9 Checking cooling system for leaks

### Special tools and workshop equipment required

- ◆ Cooling system tester - V.A.G 1274-
- ◆ Adapter for cooling system tester -V.A.G 1274/8-
- ◆ Adapter for cooling system tester -V.A.G 1274/9-



### Procedure

- Engine must be warm.



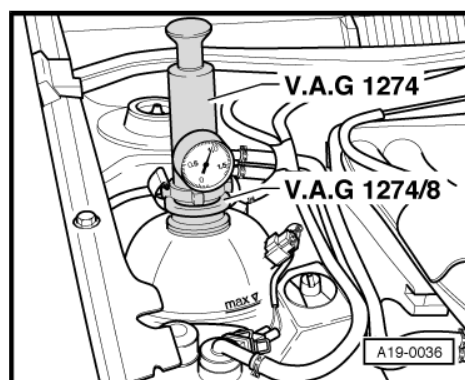
#### WARNING

*Hot steam or hot coolant can escape when expansion tank is opened; cover filler cap with cloth and open carefully.*

- Open filler cap on coolant expansion tank.
- Attach cooling system tester -V.A.G 1274- with adapter - V.A.G 1274/8- to expansion tank.
- Use hand pump on cooling system tester to create a pressure of approx. 1.0 bar.

If the pressure drops:

- Trace leak and repair.

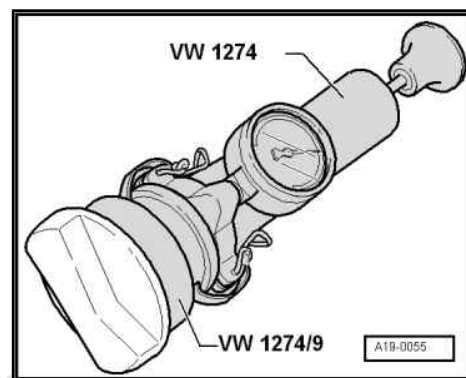


### Checking pressure relief valve in filler cap

- Attach cooling system tester -V.A.G 1274- with adapter - V.A.G 1274/9- to filler cap.
- Use hand pump on cooling system tester to create pressure.
- The pressure relief valve should open at a pressure of 1.4 ... 1.6 bar.

If the pressure relief valve does not open as described:

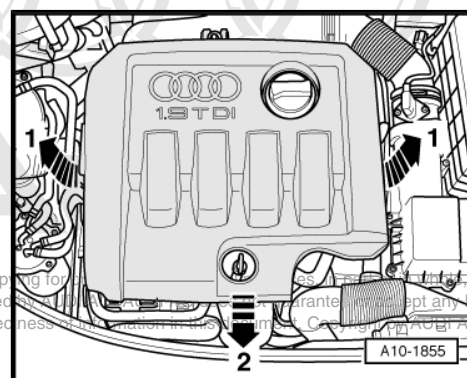
- Renew filler cap.



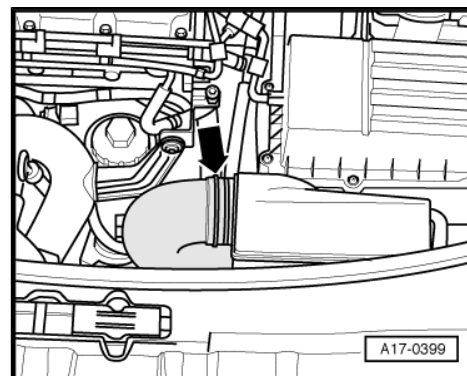
## 1.10 Removing and installing electrical radiator fan -V7- and radiator fan 2 -V177-

### Removing

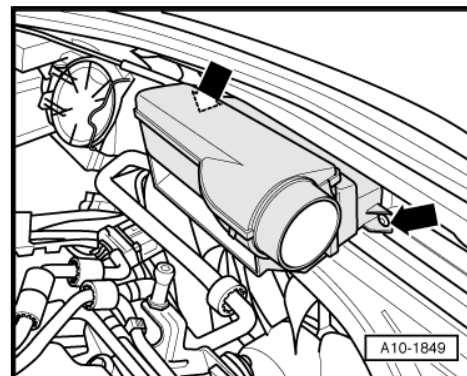
- Lift engine cover panel at sides -arrows 1- and pull off towards front -arrow 2-.



- Remove air intake hose -arrow- from between lock carrier and air cleaner housing.



- Unscrew air duct at lock carrier -arrows-.

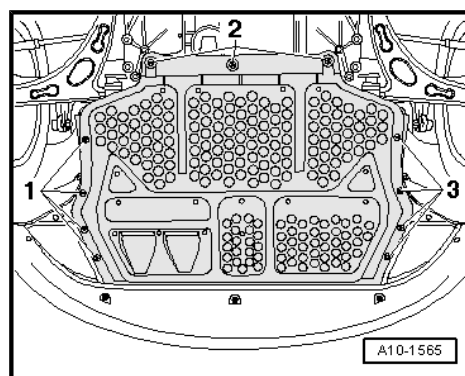
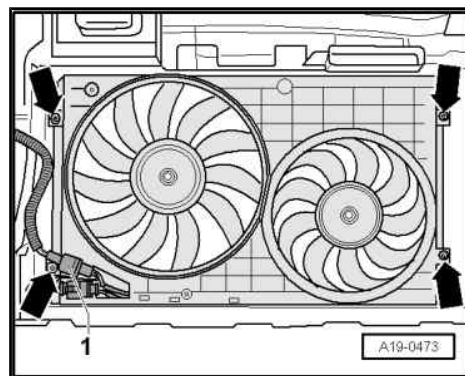


- Unscrew upper securing bolts -upper arrows- for radiator cowl.

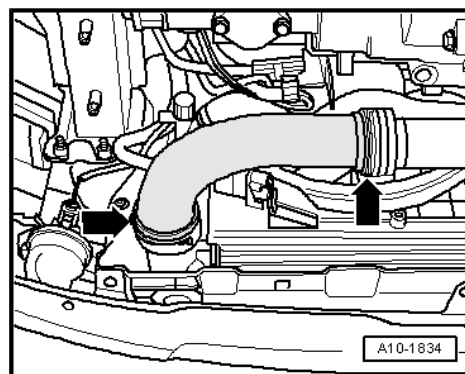


- Remove centre noise insulation -fasteners 1 ... 3-.

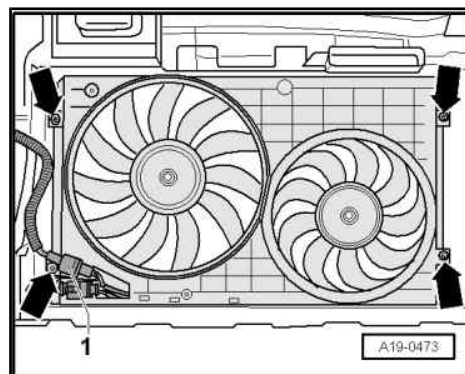
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- Remove air intake hose (left-side) by lifting retaining clips -arrows- slightly.



- Unplug electrical connector -1-.
- Unscrew lower securing bolts -lower arrows- for radiator cowl and remove it from below.



- Unplug electrical connector -1-.
- Move wiring clear.
- Unscrew nuts -arrows- and remove fans.

### Installing

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



#### Note

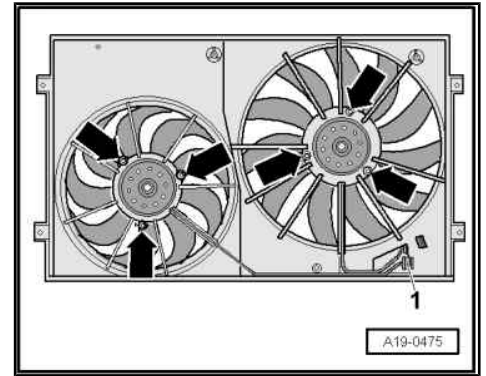
*Renew seal.*

- Install air pipes/hoses with plug-in connectors ⇒ [page 196](#) .

### Tightening torques

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| Component                     | Nm |
|-------------------------------|----|
| Radiator fan to radiator cowl | 5  |
| Radiator cowl to radiator     | 5  |



## 21 – Turbocharging/supercharging

### 1 Servicing charge air system with turbocharger

#### 1.1 Removing and installing air pipes and hoses with plug-in connectors

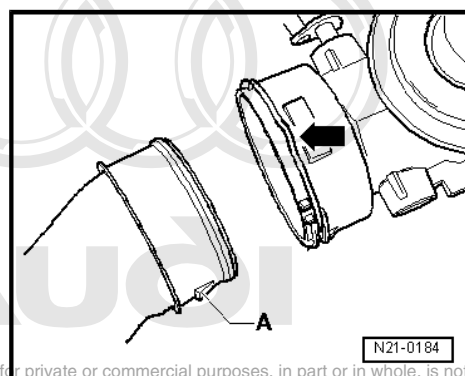


#### Note

- ◆ Check all air pipes and hoses and vacuum lines for correct fitting and leakage before carrying out tests or repairs.
- ◆ Hose connections and air pipes and hoses must be free of oil and grease before assembly.

#### Removing

- Release tab -A- on plug-in connector by pulling retaining clip -arrow-.
- Disconnect air pipes and hoses by hand (do not use a tool).

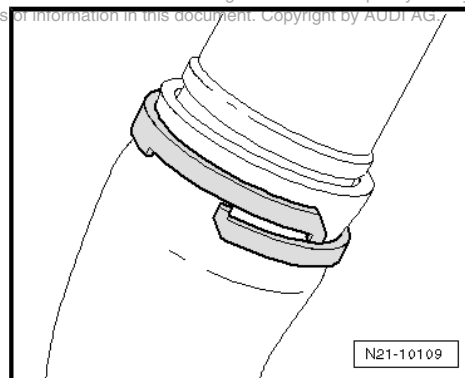


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#### Caution

- ◆ Charge air pipes and hoses may only be disconnected at the connection points provided (with retaining clip). The spring-type ring shown in the illustration must NOT be opened.
- ◆ However, if this spring-type ring should have to be opened for any reason, it must be destroyed and replaced with a suitable spring-type hose clip ⇒ Parts catalogue .



## Installing

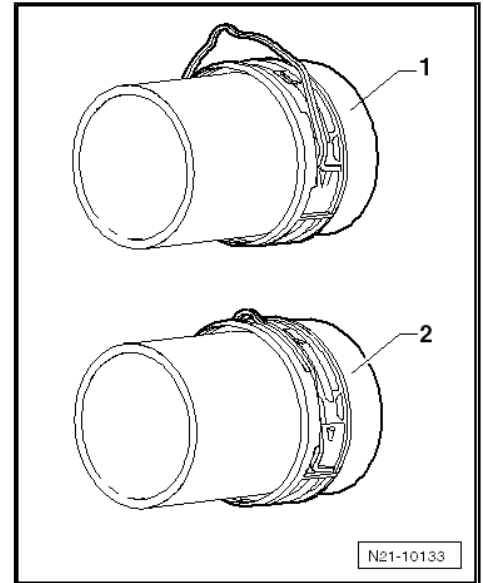


## Note

- ◆ *Renew seal if damaged.*
- ◆ *Make sure that the seal is correctly seated in the groove on the complete circumference of the air pipe/hose.*
- ◆ *Apply a thin coating of silicon-free lubricant to the sealing area and the seal.*

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- Pull retaining clip into release position -1-.
- Push air pipe/hose in as far as stop and press retaining clip to lock -2-.
- Press air pipe/hose again and pull again to check that plug-in connector is correctly engaged.



## 1.2 Hose connection diagram for charge pressure control

### 1 - Vacuum reservoir

### 2 - Mechanical exhaust gas re-circulation valve

### 3 - To vacuum unit for charge pressure control

### 4 - To vacuum unit for EGR cooler change-over function

### 5 - Solenoid valve block

- ☐ With valve 1 for exhaust gas recirculation -N18-
- ☐ With charge pressure control solenoid valve -N75-
- ☐ With exhaust gas recirculation cooler change-over valve -N345-
- ☐ Connection diagram [⇒ page 198](#)

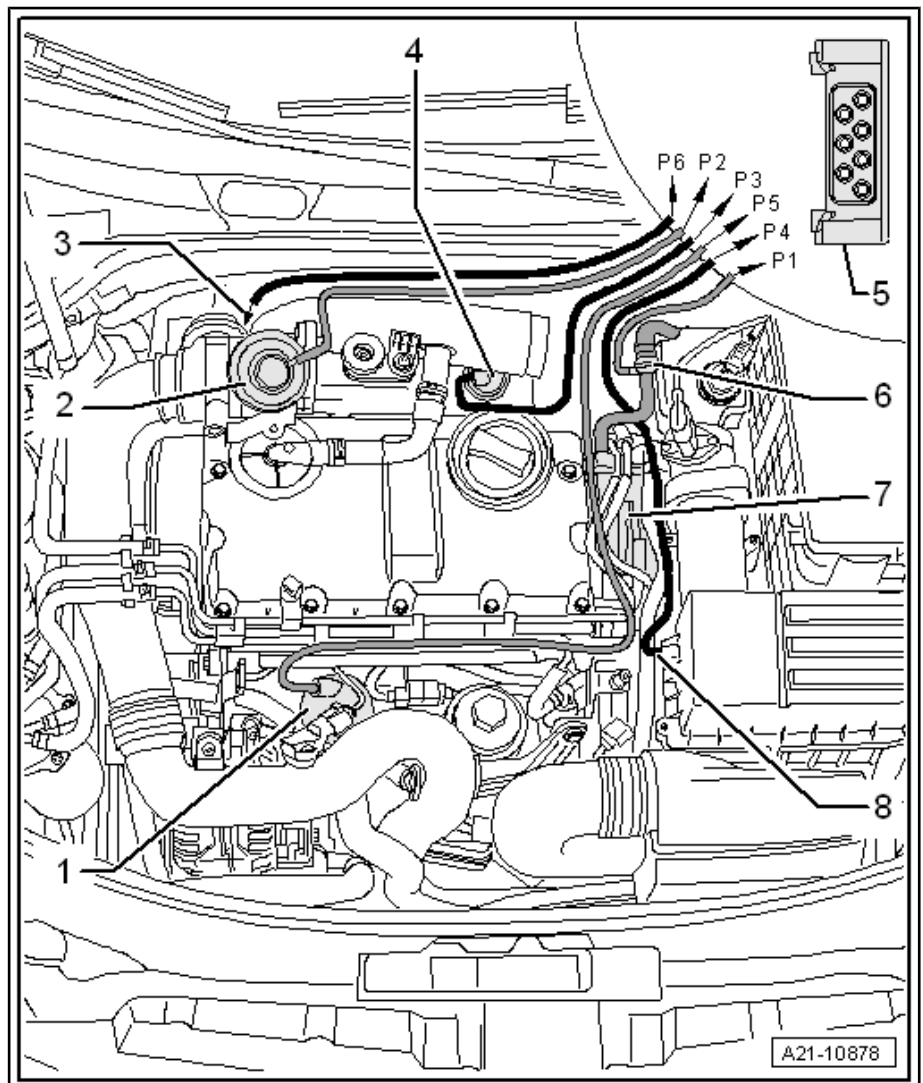
### 6 - Vacuum supply line

- ☐ From tandem pump to solenoid valve block

### 7 - Tandem pump

### 8 - Vent hose

- ☐ To air cleaner



### 1.3 Connection diagram for solenoid valve block

P1 - Vacuum supply hose from tandem pump

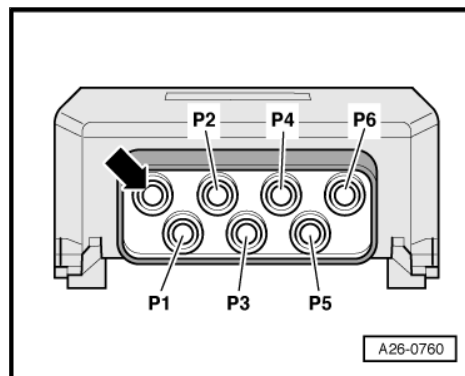
P2 - To mechanical exhaust gas recirculation valve

P3 - To vacuum unit for EGR cooler change-over function

P4 - Vent hose to air cleaner

P5 - To vacuum reservoir

P6 - To vacuum unit for charge pressure control



#### Note

The vacuum connection marked with an -arrow- is not used and is plugged with a cap.

### 1.4 Turbocharger - exploded view

#### 1 - Gasket

- ☐ Renew

#### 2 - To bypass flap

#### 3 - 25 Nm

- ☐ Renew

#### 4 - Connecting pipe

- ☐ To exhaust gas recirculation cooler

#### 5 - Bracket

- ☐ For oil supply line

#### 6 - 10 Nm

#### 7 - Oil supply line

- ☐ Check that the oil supply line is not obstructed before installing
- ☐ Before installing, fill turbocharger with engine oil at connection for oil supply line

#### 8 - Union nut - 22 Nm

#### 9 - Union nut - 22 Nm

#### 10 - Connecting piece - 30 Nm

#### 11 - Seal

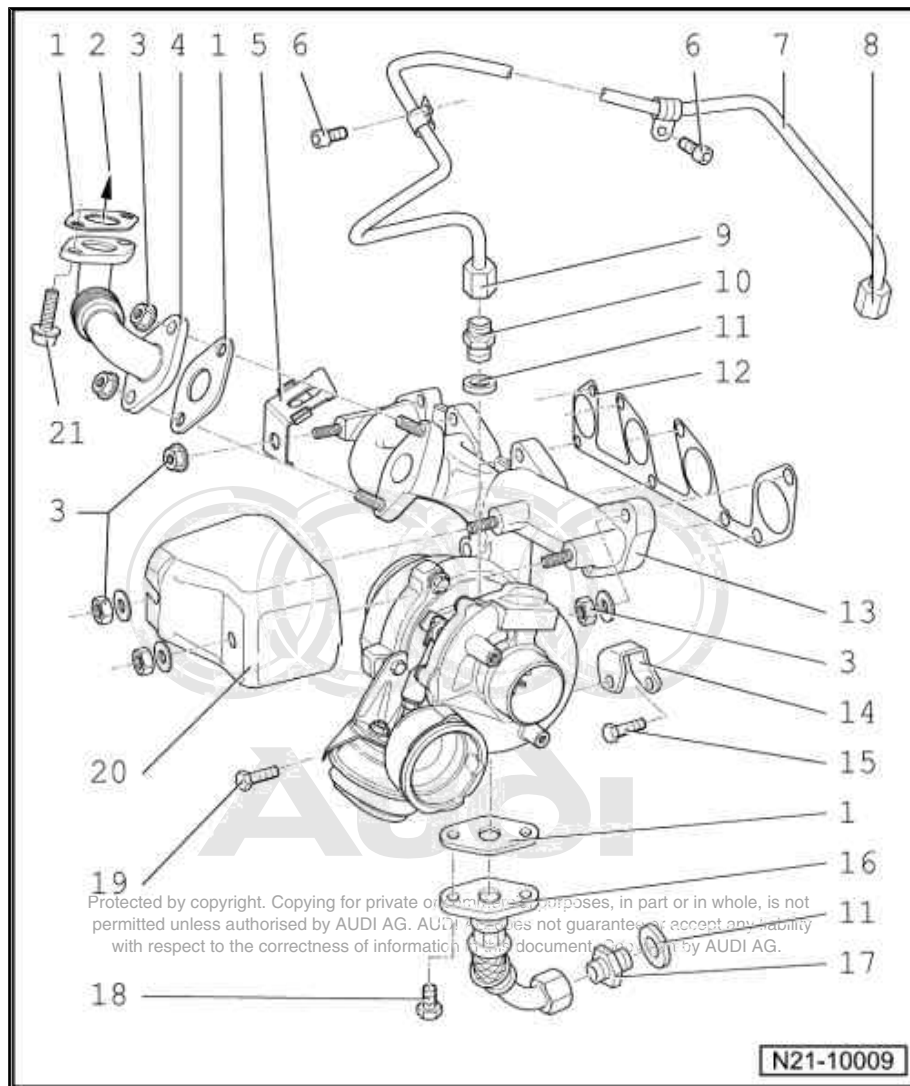
- ☐ Renew

#### 12 - Gasket

- ☐ Renew
- ☐ Note installation position

#### 13 - Turbocharger

- ☐ Can only be renewed together with exhaust manifold and vacuum unit as one unit
- ☐ Removing and installing ⇒ [page 199](#)



#### 14 - Support

- ☐ Between turbocharger and cylinder block

#### 15 - 40 Nm

- ☐ First hand-tighten all bolts

#### 16 - Oil return line

- ☐ To cylinder block
- ☐ Tighten union nut to 30 Nm

#### 17 - Connecting piece - 40 Nm

#### 18 - 17 Nm

#### 19 - 20 Nm

- ☐ First hand-tighten all bolts

#### 20 - Heat shield

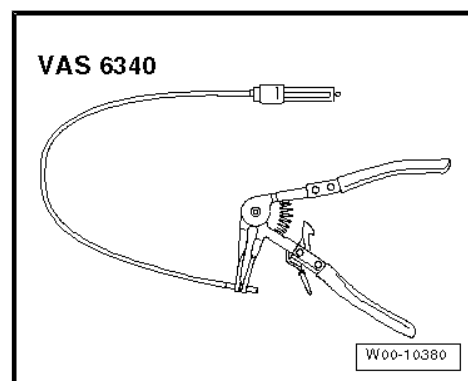
#### 21 - 20 Nm

## 1.5 Removing and installing turbocharger

### Special tools and workshop equipment required

- ◆ Hose clip pliers -VAS 6340-

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### Removing

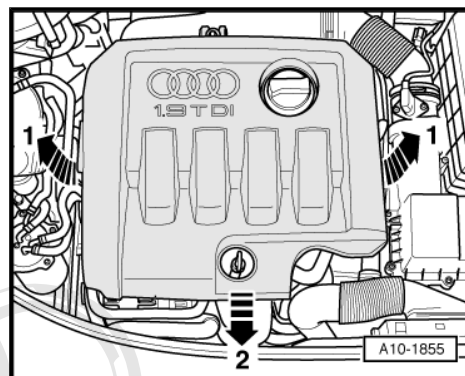


#### Caution

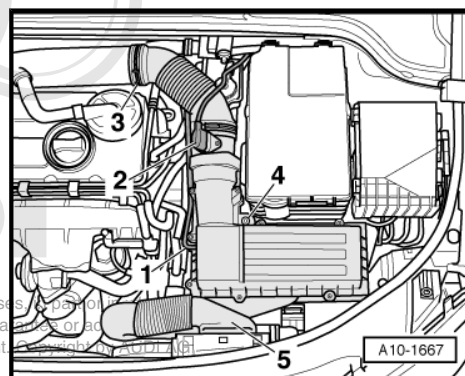
*If the turbocharger has suffered mechanical damage (e.g. damaged compressor wheel), it is not sufficient merely to fit a new turbocharger. The following work must be performed in order to avoid further damage:*

- ◆ *Check air cleaner housing, air filter element and air hoses for dirt and foreign particles.*
- ◆ *Check the entire charge air system (including the charge air cooler) for foreign matter.*
- ◆ *If foreign matter is found in the charge air system, clean all relevant ducts and hoses and renew charge air cooler if necessary.*

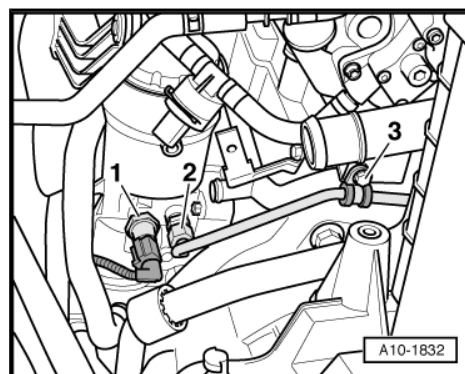
- Lift engine cover panel at sides -arrows 1- and pull off towards front -arrow 2-.



- Unplug electrical connector -2- at air mass meter -G70- .
- Detach vent hose -1- and air hoses -3- and -5-.
- Unscrew bolt -4- and remove air cleaner housing.



- Unplug electrical connector -1- at oil pressure switch -F1- .
- Remove oil pressure switch -2-.
- Detach oil supply line at bracket -3-.

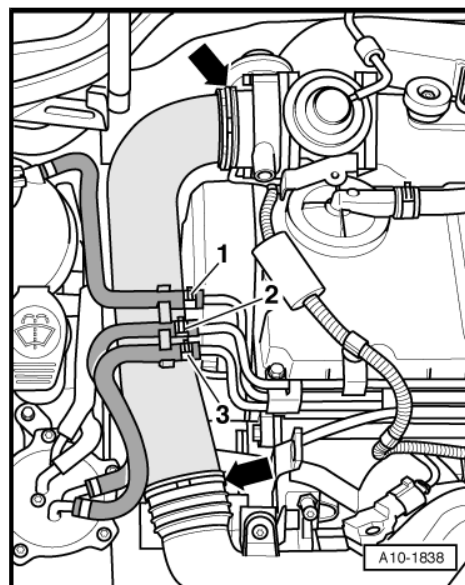


- Detach the hoses/lines -1 ... 3- from air pipe.
- Remove air pipe by lifting retaining clips -arrows- slightly.

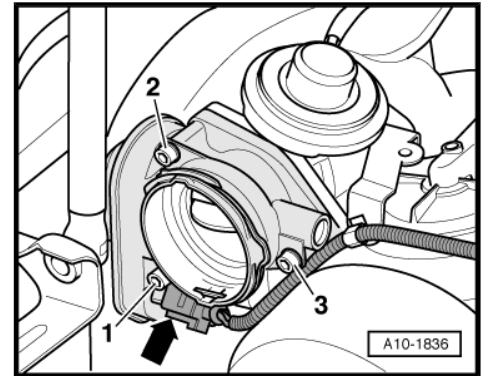


### Note

Leave coolant hose -1- and fuel lines -2- and -3- connected.

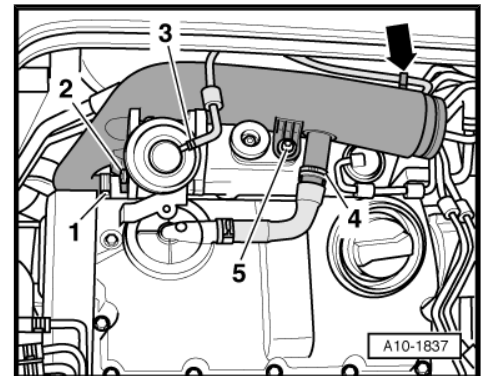


- Detach electrical connector -arrow- at intake manifold flap motor -V157- .
- Unscrew bolts -1 ... 3- and remove intake manifold flap motor -V157- .

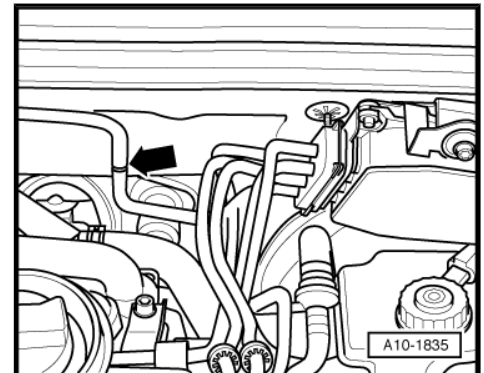


- Disconnect vacuum hose -3- at exhaust gas recirculation valve -N18- .
- Detach pipe -4- for crankcase breather at air pipe.
- Release hose clip -1- at turbocharger using hose clip pliers -VAS 6340- .
- Move the vacuum hoses clear -arrow- .
- Unscrew bolts -2- and -5- and remove air pipe.

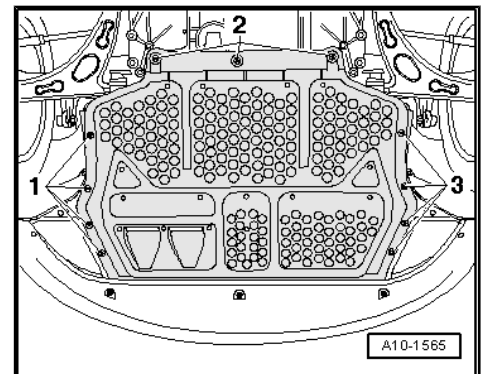
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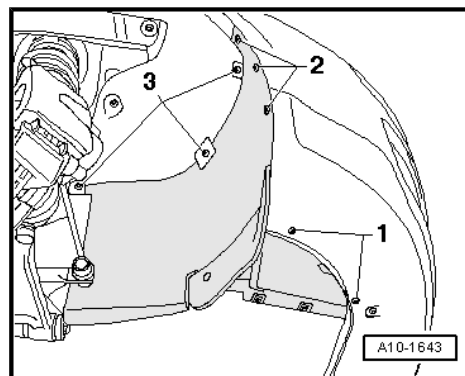
- Disconnect hose going to vacuum unit for charge pressure control at separating point -arrow-.



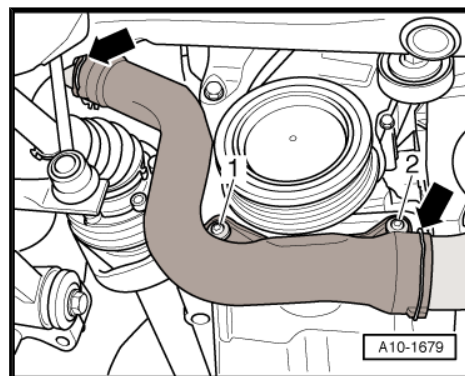
- Remove centre noise insulation -fasteners 1 ... 3-.



- Remove noise insulation (right-side) -fasteners 1 ... 3-.



- Remove bolts -1- and -2-.
- Remove air pipe (right-side) by lifting retaining clips -arrows- slightly.
- Unbolt drive shaft (right-side) from gearbox flange.
- Remove front exhaust pipe ⇒ [page 211](#) .

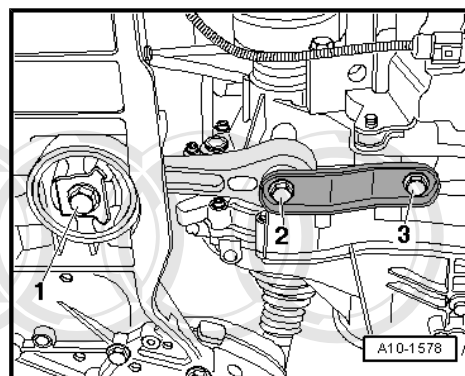


- Unscrew bolts -2- and -3- at pendulum support.

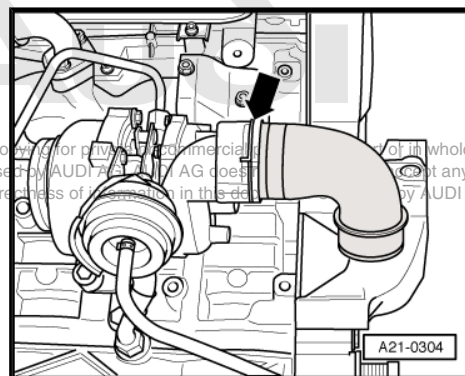


### Note

*Bolt -1- remains tightened.*

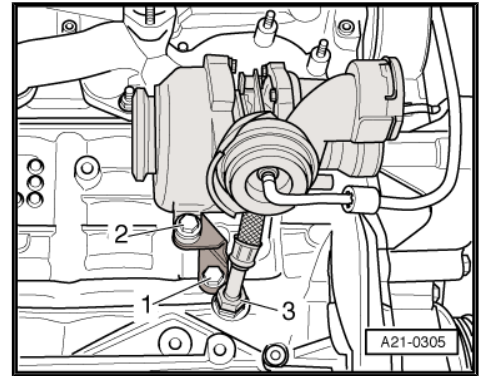


- Detach air intake hose from turbocharger by lifting retaining clip -arrow- slightly.

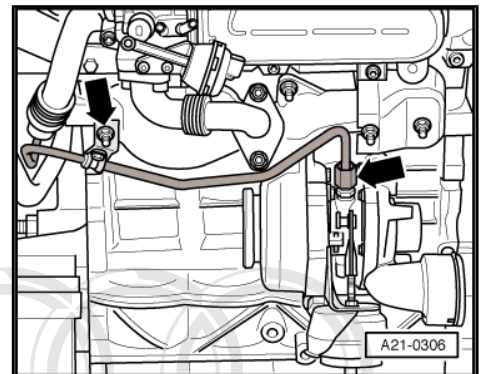


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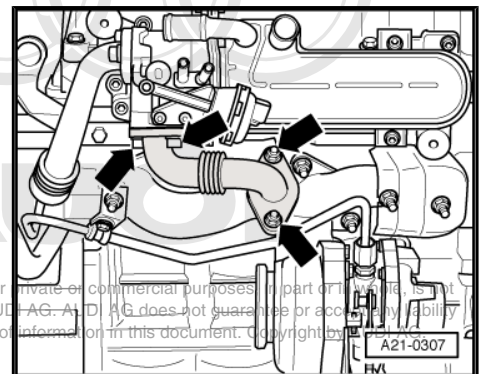
- Remove bolts -1- and -2- and detach bracket for turbocharger.
- Remove oil return line -3- at cylinder block.



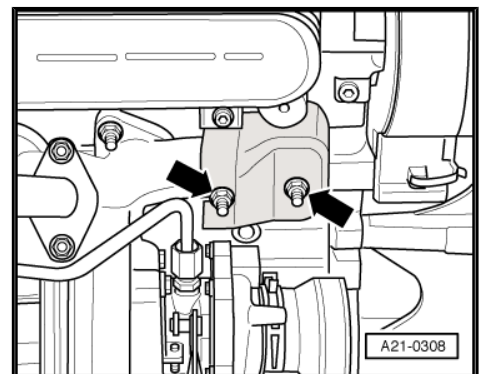
- Unscrew oil supply line at turbocharger and at exhaust manifold -arrows- and move to one side.



- Remove connecting pipe for exhaust gas recirculation -arrows-.



- Remove heat shield from exhaust manifold -arrows-.



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- Unscrew nuts -arrows-.
- Push the engine forwards and remove the exhaust manifold/turbocharger between subframe and body.

### Installing

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



#### Note

- ◆ *Renew seals, gaskets and self-locking nuts.*
- ◆ *Fill turbocharger with engine oil at connection for oil supply line.*
- ◆ *Charge air system must be free of leaks.*
- ◆ *Hose connections and hoses for charge air system must be free of oil and grease before assembly.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*

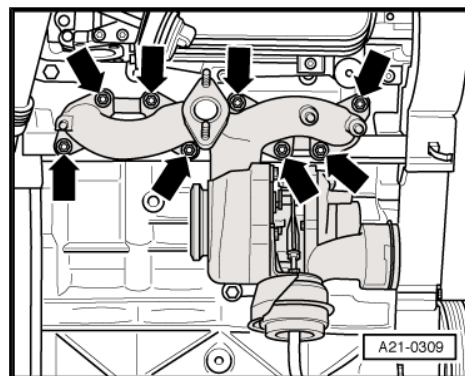
- Install exhaust system and align it free of stress  
⇒ [page 212](#).
- Install air pipes/hoses with plug-in connectors ⇒ [page 196](#).
- Check oil level ⇒ [page 168](#).

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#### Note

*After installing turbocharger, allow engine to idle for approx. 1 minute and do not rev up immediately to ensure turbocharger is supplied with oil.*



## Tightening torques

| Component                                                                                                                                                            | Nm                        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| Exhaust manifold/turbocharger to cylinder head                                                                                                                       | 25 <sup>1)</sup>          |
| Heat shield to exhaust manifold/turbocharger                                                                                                                         | 25 <sup>1)</sup>          |
| EGR connecting pipe to: Change-over flap                                                                                                                             | 20                        |
| Exhaust manifold                                                                                                                                                     | 25 <sup>1)</sup>          |
| Oil supply line to turbocharger                                                                                                                                      | 22                        |
| Bracket for oil supply line to exhaust manifold                                                                                                                      | 25 <sup>1)</sup>          |
| Bracket for turbocharger to: Cylinder block                                                                                                                          | 40                        |
| Turbocharger                                                                                                                                                         | 20                        |
| Oil return line to cylinder block                                                                                                                                    | 30                        |
| Charge air pipe (right-side) to sump                                                                                                                                 | 10                        |
| Charge air pipe (rear) to bracket                                                                                                                                    | 10                        |
| Oil supply line to oil filter bracket                                                                                                                                | 22                        |
| Oil pressure switch to oil filter bracket                                                                                                                            | 20                        |
| Pendulum support to gearbox                                                                                                                                          | 50 + 90° <sup>2)3)</sup>  |
| Pendulum support to subframe                                                                                                                                         | 100 + 90° <sup>2)3)</sup> |
| Bolted connection for drive shaft                                                                                                                                    | ⇒ Rep. gr. 40             |
| <ul style="list-style-type: none"> <li>• <sup>1)</sup> Renew nuts.</li> <li>• <sup>2)</sup> Renew bolts.</li> <li>• <sup>3)</sup> 90° = one quarter turn.</li> </ul> |                           |

## 1.6 Charge air cooler - exploded view

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1 - 5 Nm

2 - Bracket

- Note installation position

3 - Charge air cooler

- Removing and installing  
⇒ [page 207](#)

4 - Air hose

- Must be free of oil and grease when installing.

5 - 8 Nm

6 - To turbocharger

7 - Air pipe

- Must be free of oil and grease when installing.

8 - To intake manifold flap motor -V157-

9 - Vacuum reservoir

10 - 15 Nm

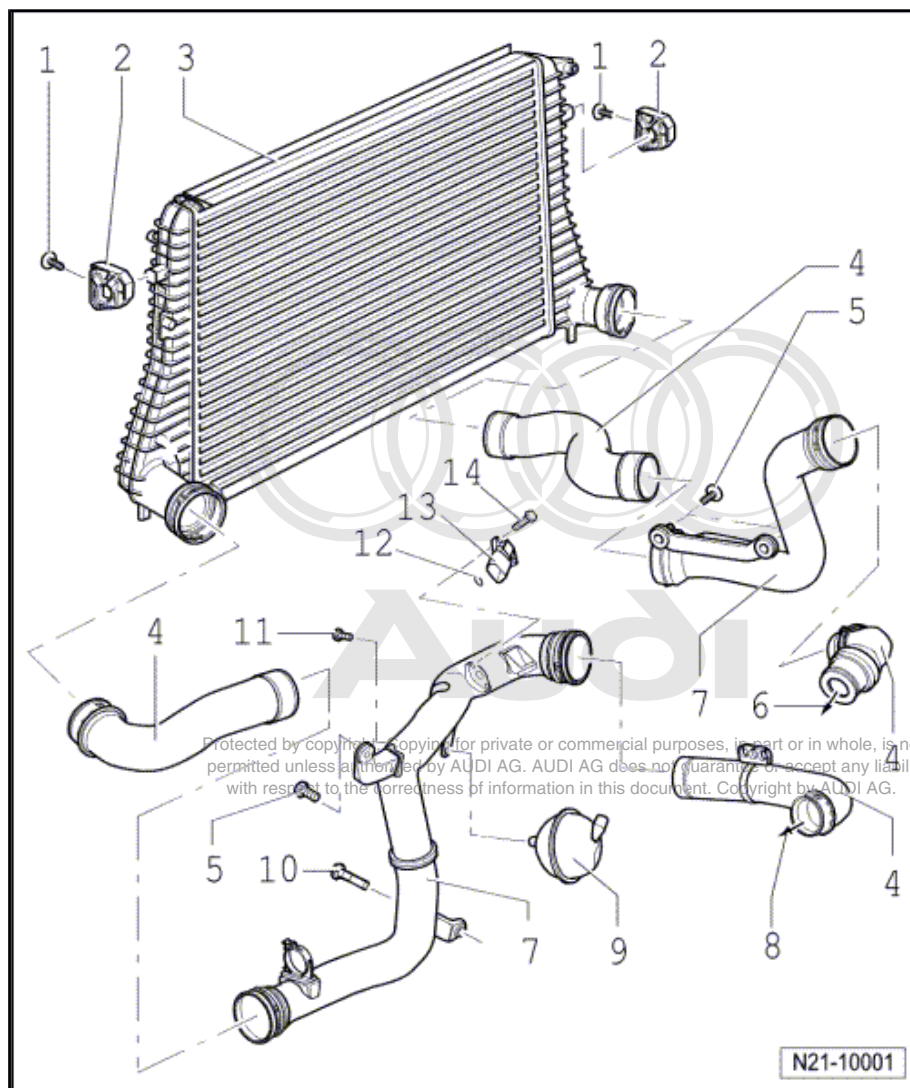
11 - 8 Nm

12 - O-ring

- Renew

13 - Charge pressure sender - G31- / intake air temperature sender -G42-

14 - 3 Nm



## 1.7 Removing and installing parts of charge air cooler



### Note

- ◆ Check all hoses and pipes for correct fitting and leakage before carrying out tests or repairs.
- ◆ Hose connections and hoses for charge air system must be free of oil and grease before assembly.
- ◆ Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ *Parts catalogue*.

## 1.8 Removing and installing charge air cooler

### Removing



#### Note

*Check all hoses and pipes for correct fitting and leakage before carrying out tests or repairs.*

- Remove radiator ⇒ [page 188](#) .
- Remove bumper cover (front) ⇒ Rep. gr. 63 .
- Remove air ducts on left and right at charge air cooler.



#### Caution

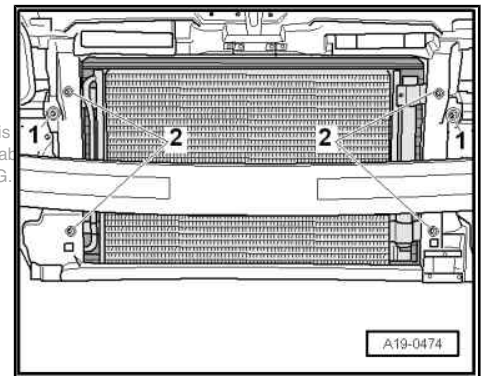
***The air conditioner refrigerant circuit must not be opened.***



#### 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 -2- for the condenser.
- Unscrew bolts -1- at charge air cooler.
- Swing charge air cooler slightly to rear.
- Detach charge air cooler upwards and remove from below.



### Installing

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



#### Note

- ◆ *Renew seal.*
- ◆ *Charge air system must be free of leaks.*
- ◆ *Hose connections and hoses for charge air system must be free of oil and grease before assembly.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- Install bumper cover (front) ⇒ Rep. gr. 63 .
- Install air pipes/hoses with plug-in connectors ⇒ [page 196](#) .
- Install radiator ⇒ [page 188](#) .

### Tightening torques

| Component                         | Nm |
|-----------------------------------|----|
| Charge air cooler to lock carrier | 5  |
| Condenser to charge air cooler    | 5  |

## 26 – Exhaust system

### 1 Removing and installing parts of exhaust system



#### Note

- ◆ Renew 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 body. If necessary, loosen clamp and align silencers and exhaust pipe so that sufficient clearance is maintained to the body at all points and the mountings are evenly loaded.
- ◆ The flexible joint in front exhaust pipe must not be bent more than 10° - damage can otherwise occur.
- ◆ Use screwdriver to unfasten and tighten lock washers for heat shields. Tightening torque: 2 Nm.

#### 1.1 Exhaust system - exploded view

##### 1 - Rear tunnel cross-piece

##### 2 - Centre silencer

- ☐ Combined in one unit with rear silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting point  
⇒ [page 210](#)
- ☐ Align exhaust system so it is free of stress  
⇒ [page 212](#)

##### 3 - Rubber mounting

- ☐ Renew if damaged

##### 4 - Mounting

- ☐ Renew if damaged

##### 5 - 23 Nm

##### 6 - Mounting

- ☐ Renew if damaged

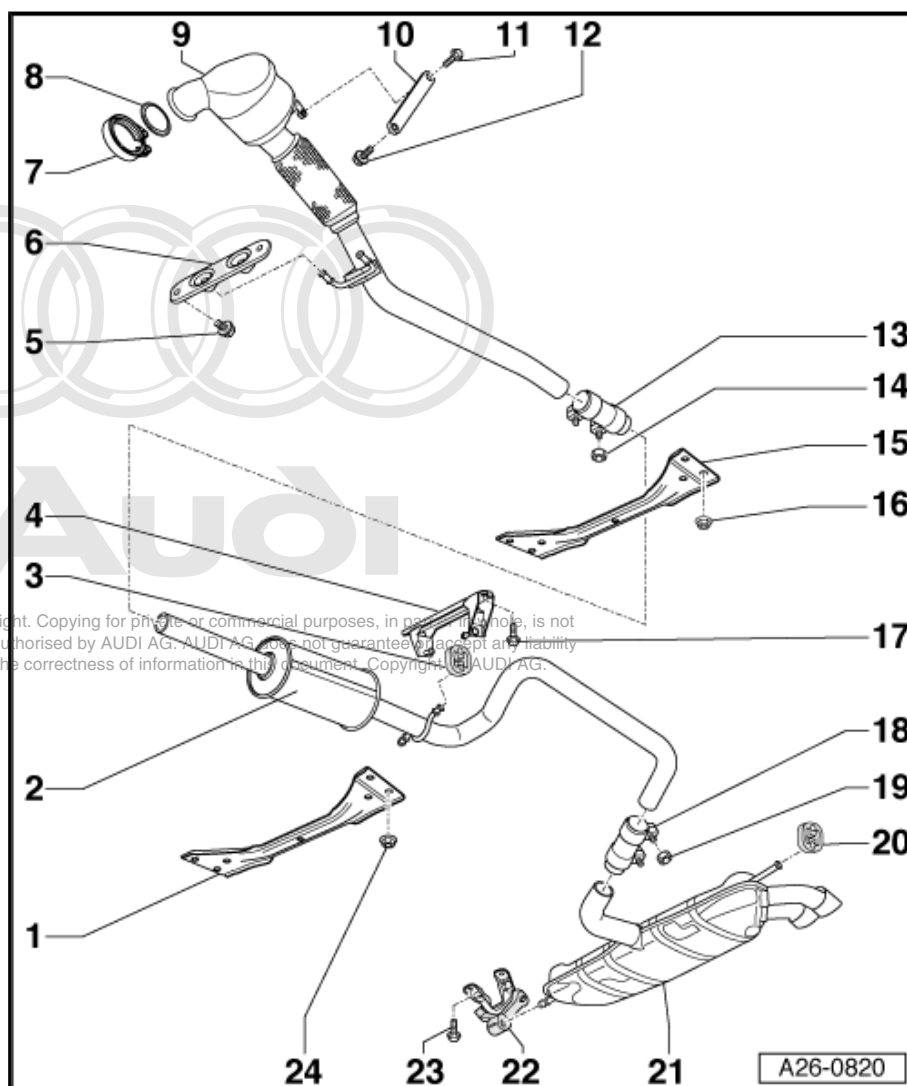
##### 7 - Securing clamp, 7 Nm

- ☐ Renew

##### 8 - Seal

##### 9 - Front exhaust pipe

- ☐ With catalytic converter
- ☐ Protect against knocks and impact
- ☐ With flexible joint
- ☐ Do not bend flexible joint more than 10° – otherwise it can be damaged



- ☐ Removing and installing  
⇒ [page 211](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 212](#)

#### 10 - Support

11 - 40 Nm

12 - 40 Nm

#### 13 - Clamp (front)

- ☐ Align exhaust system so it is free of stress before tightening clamp ⇒ [page 212](#)
- ☐ Installation position ⇒ [page 209](#)
- ☐ Tighten bolt connections evenly.

14 - 25 Nm

#### 15 - Front tunnel cross-piece

16 - 23 Nm

17 - 23 Nm

#### 18 - Clamp (rear)

- ☐ For separate replacement of centre and rear silencers
- ☐ Installation position ⇒ [page 210](#)
- ☐ Tighten bolt connections evenly.

19 - 25 Nm

#### 20 - Rubber mounting

- ☐ Renew if damaged

#### 21 - Rear silencer

- ☐ Combined in one unit with centre silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting point ⇒ [page 210](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 212](#)

#### 22 - Mounting

- ☐ Renew if damaged

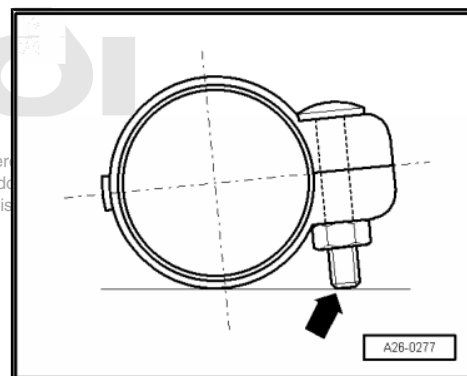
23 - 23 Nm

24 - 23 Nm

#### Installation position of front clamp

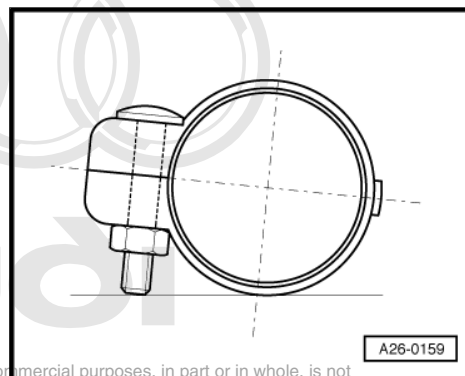
- Install clamp so that ends of bolts do not protrude beyond bottom of clamp.
- Bolt connection faces to right.

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### Installation position of rear clamp

- Install clamp so that ends of bolts do not protrude beyond bottom of clamp.
- Bolt connection faces to rear



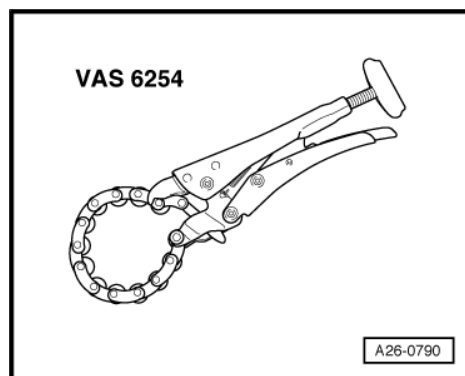
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## 1.2 Separating centre and rear silencers

- ◆ The connecting pipe can be cut through at the cutting point provided in order to renew the centre and rear silencers separately.
- ◆ The cutting point is marked by an indentation on the outside of the exhaust pipe.

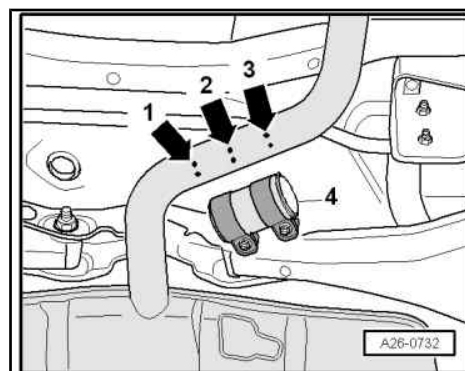
### Special tools and workshop equipment required

- ◆ Chain pipe cutter -VAS 6254-

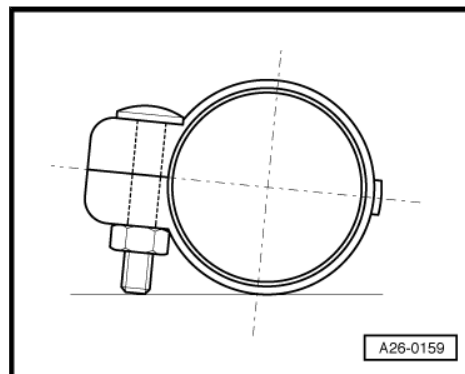


### Procedure

- Cut through exhaust pipe at a right angle at cutting point -arrow 2- using chain-type pipe cutter -VAS 6254- .
- When installing, position clamp -4- at marks -arrow 1- and -arrow 3- on side of exhaust pipe.



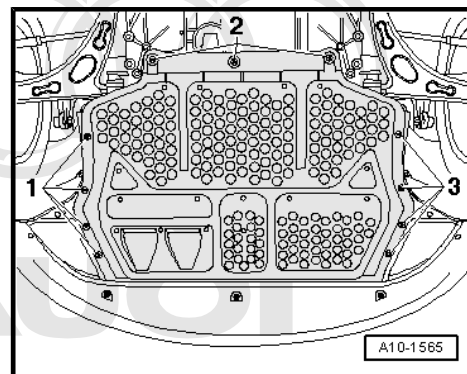
- Install clamp so that ends of bolts do not protrude beyond bottom of clamp.
- Bolt connection faces to rear
- Align exhaust system so it is free of stress ⇒ [page 212](#) .



### 1.3 Removing and installing front exhaust pipe with catalytic converter

#### Removing

- Remove centre noise insulation -fasteners 1 ... 3-.



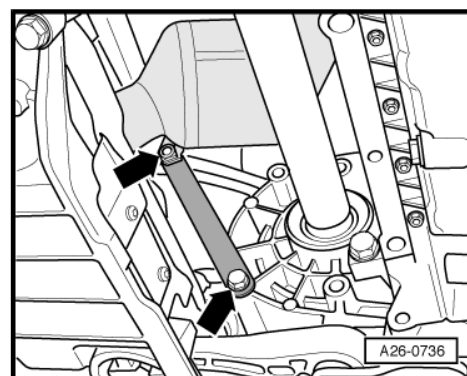
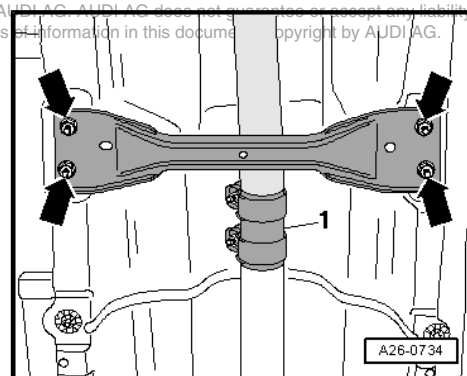
- Remove front cross-piece for underbody -arrows-.



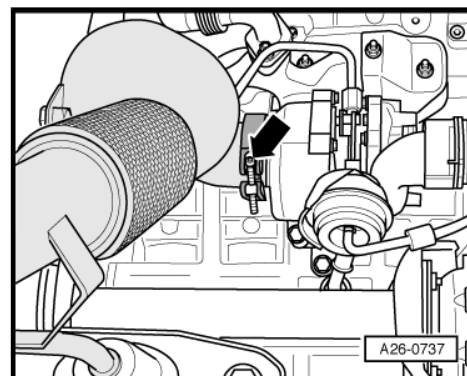
#### Note

*To avoid damage, the flexible joints in the front exhaust pipe must not be bent more than 10°.*

- Loosen nuts on clamp -1-.
- Unbolt support for front exhaust pipe -arrows-.



- Open clamp -arrow- and detach front exhaust pipe from turbocharger.



- Unbolt bracket for exhaust system -arrows-.
- Push the clamp back and remove the front exhaust pipe.

### Installing

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



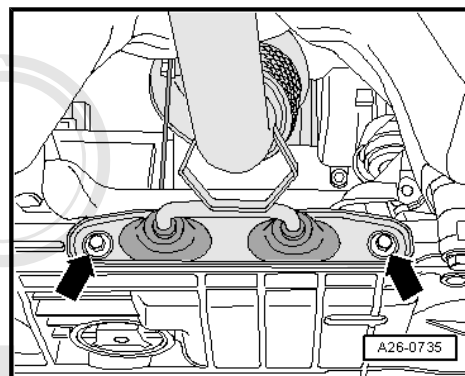
#### Note

*Renew seals and gaskets.*

- Align exhaust system so it is free of stress ⇒ [page 212](#).

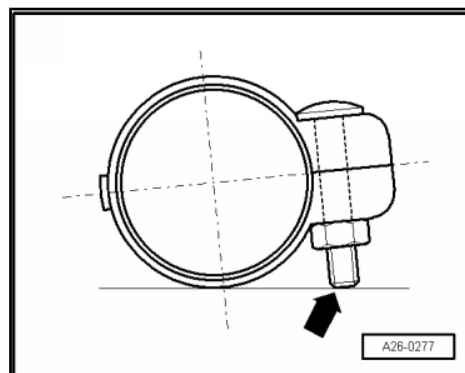
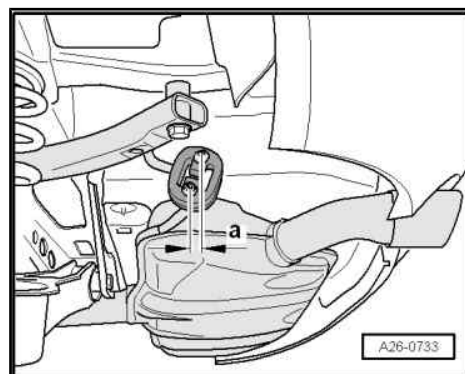
### Tightening torques

| Component                              | Nm |
|----------------------------------------|----|
| Front exhaust pipe to turbocharger     | 7  |
| Bracket for exhaust system to subframe | 23 |
| Support for front exhaust pipe to:     |    |
| Gearbox                                | 40 |
| Front exhaust pipe                     | 40 |
| Underbody cross member (front) to body | 23 |



## 1.4 Stress-free alignment of exhaust system

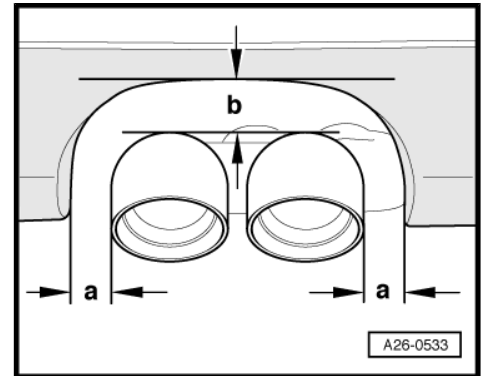
- The exhaust system must be aligned when it is cool.
- Loosen bolt connections of front clamp  
⇒ [Item 13 \(page 209\)](#).
- Push exhaust system towards front of vehicle -arrow- so that mounting for rear silencer is preloaded by -a- = 15 ... 17 mm.
- Install clamp so that ends of bolts do not protrude beyond bottom of clamp.
- Bolt connection faces to right.
- Tighten bolt connections on clamp evenly to 25 Nm.



## 1.5 Aligning tailpipes

### Procedure

- Align rear silencer so that there is an equal distance -a- and -b- between the cut-out in the bumper and the pipe ends.
- If necessary, loosen mounting for rear silencer to adjust the tailpipes.



## 1.6 Checking exhaust system for leaks

- Start engine and run at idling speed.
- Plug the tailpipe (e. g. with rags or stopper) and leave plugged until the check is complete.
- Listen for noise at the connection points of cylinder head/exhaust manifold, turbocharger/front exhaust pipe etc. to locate any leaks.
- Repair any leaks that are found.



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## 2 Exhaust gas recirculation system



### Note

- ◆ *The exhaust gas recirculation system is actuated by the engine control unit -J248- via the exhaust gas recirculation valve -N18- and the mechanical exhaust gas recirculation valve.*
  - ◆ *The tapered plunger in the mechanical exhaust gas recirculation valve varies the opening cross section according to valve travel.*
  - ◆ *Pulsed actuation makes it possible to obtain any required valve position.*
  - ◆ *The exhaust gas recirculation is switched off after approx. 2 minutes at idling speed.*
  - ◆ *Restart engine or briefly increase engine speed above 1500 rpm when longer checks are necessary. Then repeat measurement.*
  - ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ **Parts catalogue.***
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### 2.1 Hose connection diagram for exhaust gas recirculation

**1 - Vacuum reservoir****2 - Mechanical exhaust gas recirculation valve**

- ☐ Checking ⇒ [page 215](#)

**3 - To vacuum unit for charge pressure control****4 - To vacuum unit for EGR cooler change-over function****5 - Solenoid valve block**

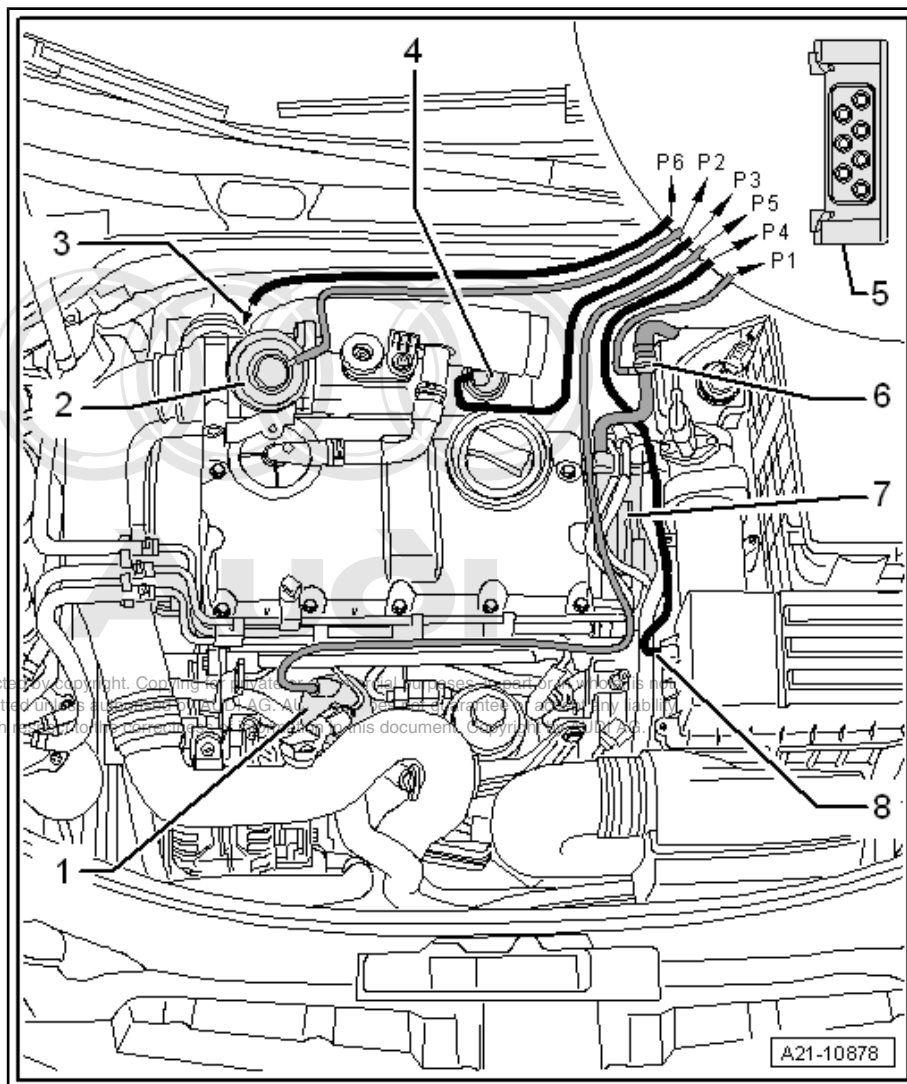
- ☐ With valve 1 for exhaust gas recirculation -N18-
- ☐ With charge pressure control solenoid valve -N75-
- ☐ With exhaust gas recirculation cooler change-over valve -N345-
- ☐ Connection diagram ⇒ [page 215](#)

**6 - Vacuum supply line**

- ☐ From tandem pump to solenoid valve block

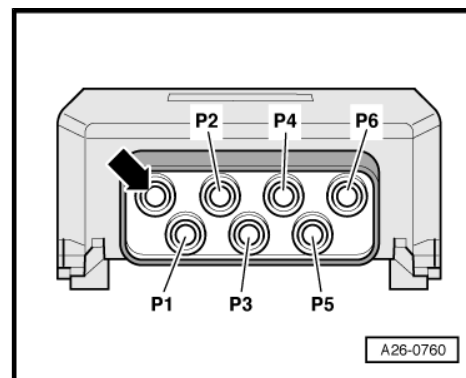
**7 - Tandem pump****8 - Vent hose**

- ☐ To air cleaner



## 2.2 Connection diagram for solenoid valve block

- P1 - Vacuum supply hose from tandem pump
- P2 - To mechanical exhaust gas recirculation valve
- P3 - To vacuum unit for EGR cooler change-over function
- P4 - Vent hose to air cleaner
- P5 - To vacuum reservoir
- P6 - To vacuum unit for charge pressure control

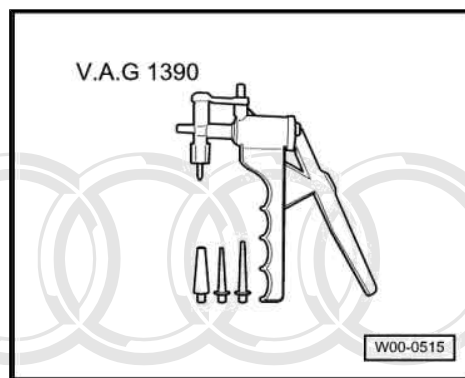
**Note**

The upper vacuum connection marked with an -arrow- is not used and is plugged with a cap.

## 2.3 Checking mechanical exhaust gas recirculation valve

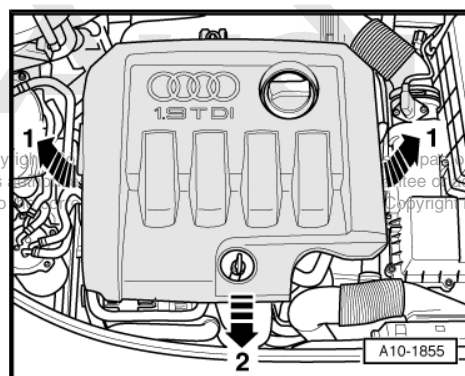
Special tools and workshop equipment required

- ◆ Hand vacuum pump with attachments -V.A.G 1390- or hand vacuum pump -VAS 6213-



### Procedure

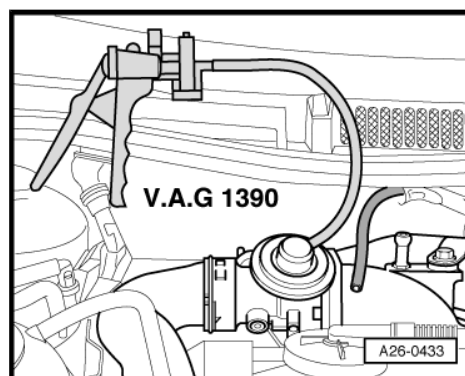
- Final control diagnosis carried out.
- Lift engine cover panel at sides -arrows 1- and pull off towards front -arrow 2-.



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- Detach vacuum hose at mechanical exhaust gas recirculation valve.
- Connect hand vacuum pump -V.A.G 1390- or -VAS 6213- to valve.
- Use hand vacuum pump to generate vacuum.
- Detach hose of hand vacuum pump at exhaust gas recirculation valve.
- The closing of the valve should be clearly audible. The diaphragm rod should move towards intake manifold



## 2.4 Cooling for exhaust gas recirculation

### Function

To improve the exhaust emission values, the exhaust gas recirculation system is equipped with a cooler that is connected into the engine cooling system.

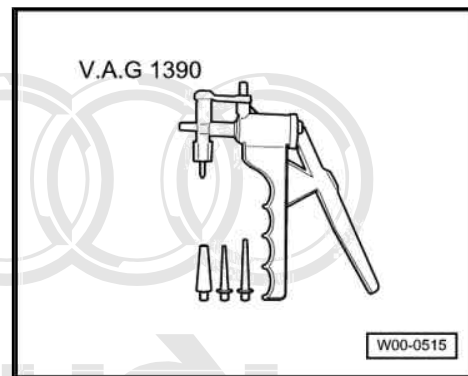
Under certain operating conditions, the flow of exhaust gas that is recirculated to the combustion chamber is routed via this cooler. The exhaust gas temperature is thereby reduced, further lowering the combustion temperature and improving the exhaust emission values.

The engine control unit determines when the recirculated exhaust gas is routed via the cooler. The control unit actuates a vacuum unit via the exhaust gas cooler change-over valve -N345- which in turn operates the exhaust gas recirculation change-over flap.

## 2.5 Checking exhaust gas recirculation change-over

Special tools and workshop equipment required

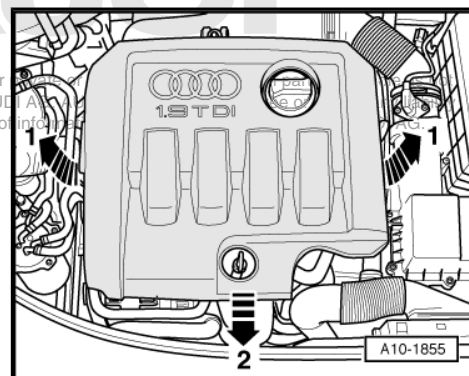
- ◆ Hand vacuum pump with attachments -V.A.G 1390- or hand vacuum pump -VAS 6213-



### Procedure

- Final control diagnosis carried out.
- Lift engine cover panel at sides -arrows 1- and pull off towards front -arrow 2-.

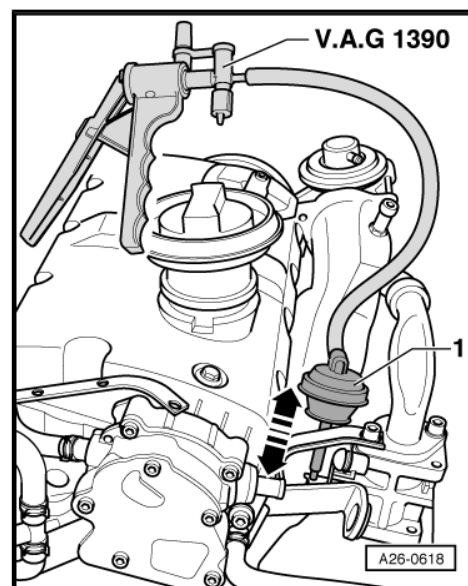
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- Detach vacuum hose at vacuum unit for exhaust gas recirculation -1-.
- Connect hand vacuum pump -V.A.G 1390- or -VAS 6213- to valve.
- Use hand vacuum pump to generate vacuum.
- The linkage of the exhaust gas recirculation change-over should move -arrow-.

If the linkage does not move or only moves jerkily:

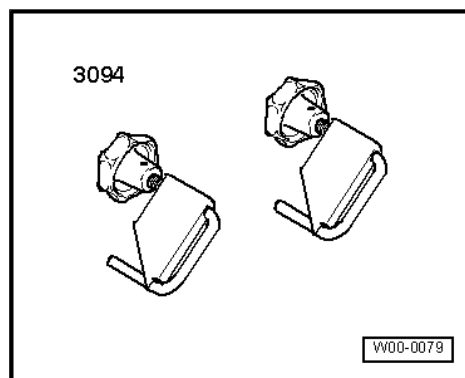
- ◆ The vacuum unit is defective
- ◆ If the change-over flap for exhaust gas recirculation is sticking



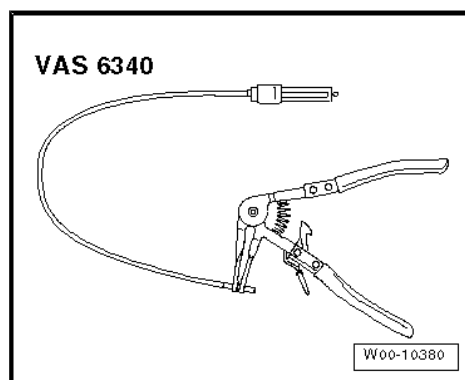
## 2.6 Removing and installing exhaust gas recirculation cooler

Special tools and workshop equipment required

- ◆ Hose clamps up to Ø 25 mm -3094-

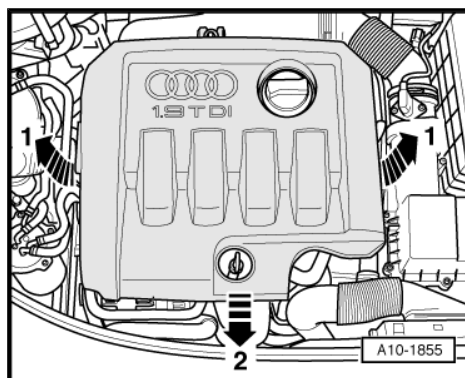


- ◆ Hose clip pliers -VAS 6340-



## Removing

- Lift engine cover panel at sides -arrows 1- and pull off towards front -arrow 2-.

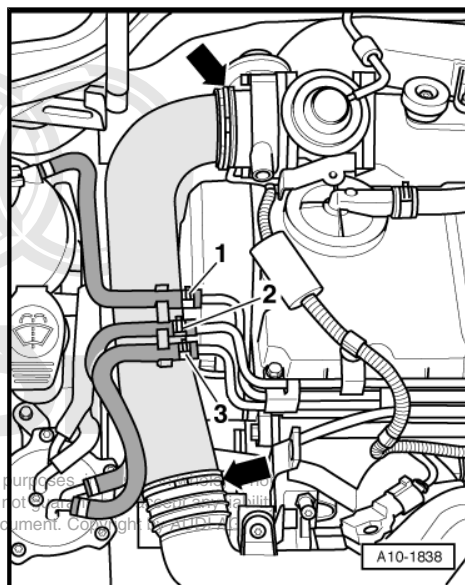


- Detach the hoses/lines -1 ... 3- from air pipe.
- Remove air pipe by lifting retaining clips -arrows- slightly.



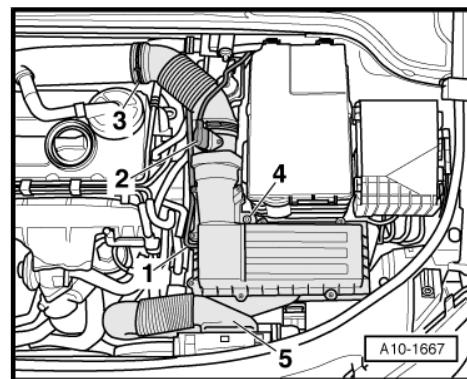
## Note

Leave coolant hose -1- and fuel lines -2- and -3- connected.

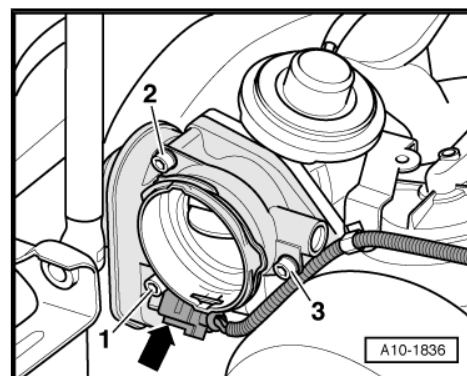


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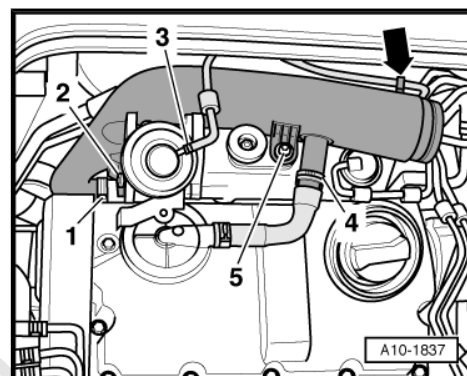
- Unplug electrical connector -2- at air mass meter -G70- .
- Detach vent hose -1- and air hose -3-.



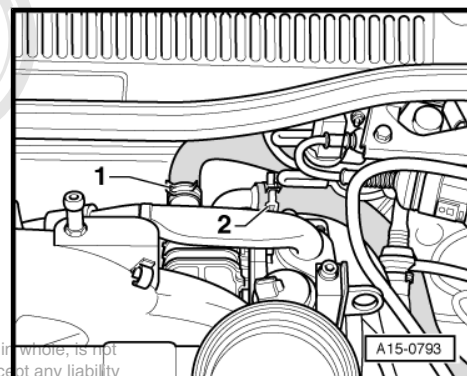
- Detach electrical connector -arrow- at intake manifold flap motor -V157- .
- Unscrew bolts -1 ... 3- and remove intake manifold flap motor -V157- .



- Disconnect vacuum hose -3- at exhaust gas recirculation valve -N18- .
- Detach pipe -4- for crankcase breather at air pipe.
- Release hose clip -1- at turbocharger using hose clip pliers -VAS 6340- .
- Move the vacuum hoses clear -arrow-.
- Unscrew bolts -2- and -5- and remove air pipe.

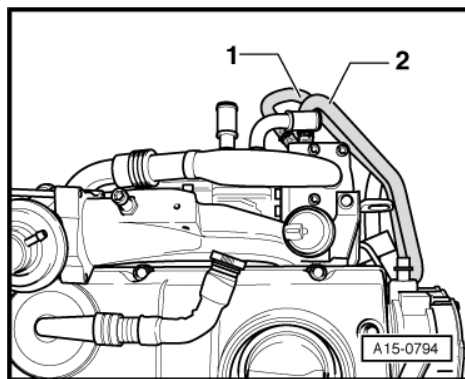


- Clamp off coolant hoses -1- and -2- at exhaust gas recirculation cooler using hose clamps -3094- and detach.

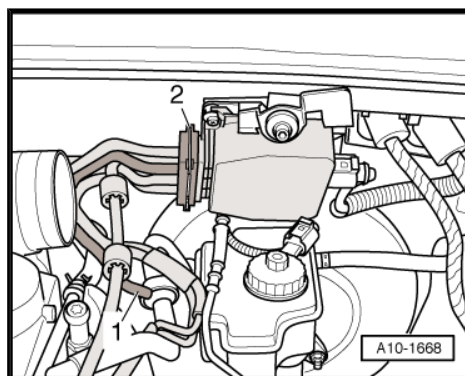


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- Clamp off coolant hoses -1- and -2- using hose clamps -3094- and detach.

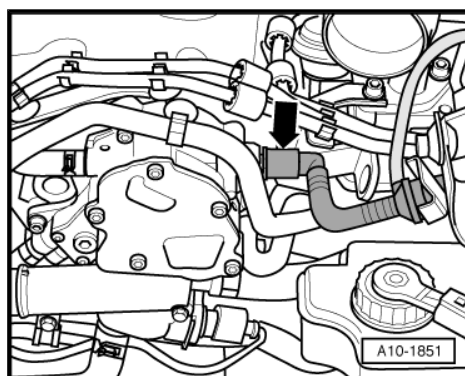


- Detach hose connection carrier -2- at solenoid valve block by releasing retaining tab.
- Detach vacuum hose -1- at non-return valve for brake servo.

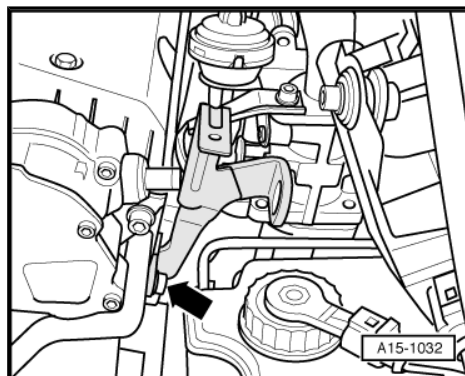


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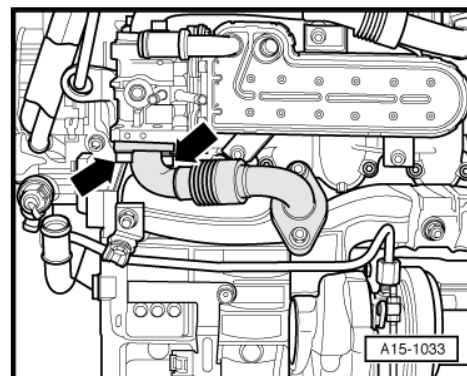
- Detach vacuum hose -arrow- going to brake servo at tandem pump.



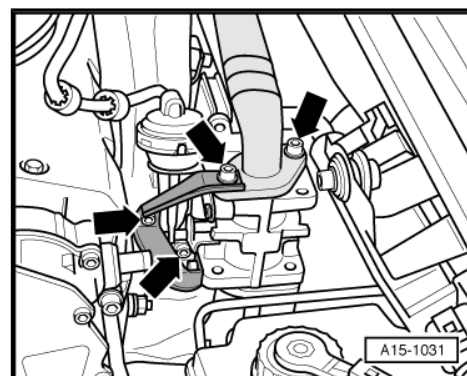
- Unbolt engine lifting eye at rear on cylinder head -arrow-.



- Unbolt connecting pipe beneath change-over flap for exhaust gas recirculation -arrows-.



- Remove bolts -arrows-.



- Unbolt exhaust gas recirculation cooler (with change-over flap) from intake manifold -arrows- and remove.

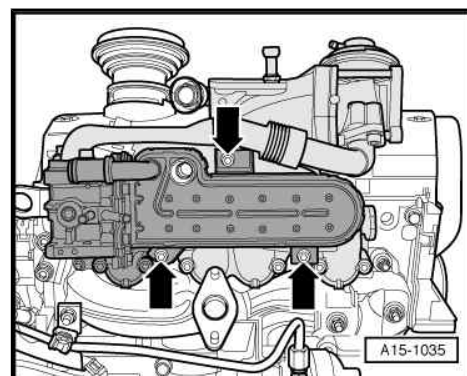
### Installing

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



#### Note

- ◆ *Renew gaskets, seals and self-locking nuts.*
- ◆ *Note the installation position of intake manifold gasket.*
- ◆ *Charge air system must be free of leaks.*
- ◆ *Hose connections and hoses for charge air system must be free of oil and grease before assembly.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) → Parts catalogue.*



- Install air pipes/hoses with plug-in connectors → [page 196](#) .
- Fill cooling system → [page 174](#) .

### Tightening torques

| Component                                                         | Nm |
|-------------------------------------------------------------------|----|
| Exhaust gas recirculation cooler to intake manifold               | 10 |
| Bracket to intake manifold                                        | 10 |
| Connecting pipe for exhaust gas recirculation to change-over flap | 22 |
| Intake manifold flap motor -V157- to intake manifold              | 10 |
| Engine lifting eye to cylinder head                               | 22 |