

## Workshop Manual Audi A6 2005 ➤

**6-cylinder injection engine (3.0 ltr. 5-valve), mechanics**

Engine ID

**BBJ**

Edition 12.2009



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## List of Workshop Manual Repair Groups

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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 A6 2005 ►

6-cylinder injection engine (3.0 ltr. 5-valve), mechanics - Edition 12.2009

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## 00 – Technical data

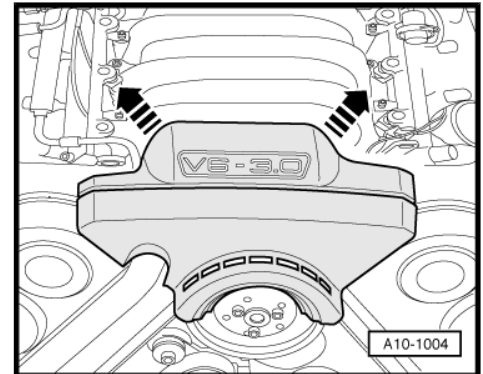
### 1 Technical data

#### 1.1 Engine number

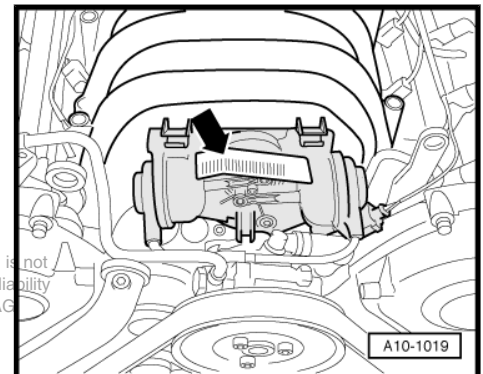


*A number of steps are required to make the engine number visible.*

- Pull off engine cover panel (front) -arrows-.

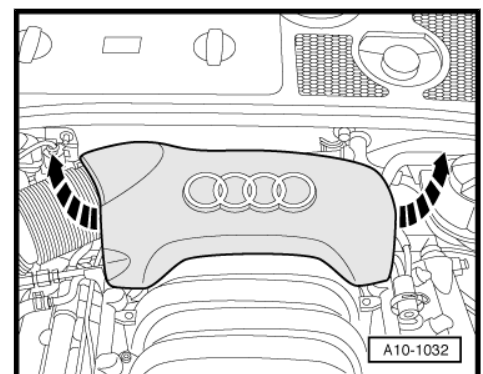


There is a sticker on the vacuum unit housing for intake manifold change-over function indicating the “Engine code” and “Serial number” -arrow-.



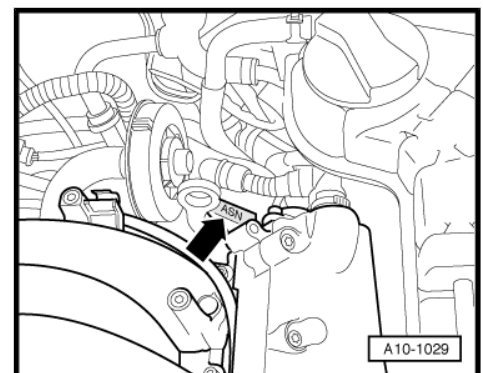
If the sticker is missing, perform the following work steps to read off the “Engine code”:

- Pull off engine cover panel (rear) -arrows-.



The engine code is stamped on the rear of the cylinder head (left-side) -arrow-.

The engine code is also included on the vehicle data sticker.





## 1.2 Engine data

| Code letters                |           | BBJ              |
|-----------------------------|-----------|------------------|
| Capacity                    | ltr.      | 2.976            |
| Power output                | kW at rpm | 160/6300         |
| Torque                      | Nm at rpm | 290/3200         |
| Bore                        | Ø in mm   | 82.5             |
| Stroke                      | mm        | 92.8             |
| Compression ratio           |           | 10.3             |
| RON                         | at least  | 95 <sup>1)</sup> |
| Injection/ignition system   |           | Bosch Motronic   |
| Firing order                |           | 1-5-3-6-2-4      |
| Exhaust gas recirculation   |           | no               |
| Turbocharging/supercharging |           | no               |
| Knock control               |           | yes              |
| Variable valve timing       |           | yes              |
| Intake manifold change-over |           | yes              |
| Secondary air system        |           | yes              |

1) Unleaded premium RON 91 can also be used, but results in reduced power

## 2 Safety precautions

### 2.1 Working on the fuel system

When working on the fuel system note the following warnings:



#### WARNING

*The fuel system operates at extremely high pressure. This can cause injury.*

- ◆ *The fuel pressure in the high-pressure section of the injection system must be reduced to a residual pressure prior to opening the system.*
- ◆ *Wrap a clean cloth around the connection and carefully loosen the connection to allow the residual pressure to dissipate.*

- Procedure before opening high-pressure section of injection system ⇒ Rep. Gr. 24 .

Observe the following to prevent injuries to persons and damage to the injection and ignition system:

- ◆ Always switch off the ignition before connecting or disconnecting electrical wiring for the injection or ignition system or tester cables.
- ◆ Always switch off ignition before washing engine.
- ◆ Faults are stored in engine control units if electrical connectors were unplugged and engine was started: "Generate readiness code" in "Guided Functions" ⇒ Vehicle diagnostic tester .



#### Caution

*To prevent 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.*

- Disconnect battery ⇒ Rep. Gr. 27 .

### 2.2 Procedure before opening high-pressure section of injection system



#### WARNING

- ◆ *The injection system consists of a high-pressure section (maximum approx. 120 bar) and a low-pressure section (approx. 6 bar).*
- ◆ *The fuel pressure in the high-pressure section must be reduced to a residual pressure of approx. 6 bar prior to opening the system. Procedure ⇒ Rep. Gr. 24 .*

## 2.3 Working on the cooling system

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.*



### Caution

*Overheating can occur if the filler cap is not fitted properly.*

- ◆ *The filler cap must engage positively and audibly when it is closed.*

## 2.4 Using testers and measuring instruments during a road test

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



### WARNING

*Accidents can be caused if the driver is distracted by test equipment while road-testing, or if test equipment is not properly secured.*

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

- *The use of test equipment while driving causes distraction.*
- *There is an increased risk of injury if test equipment is not secured.*
- ◆ *Test equipment must always be secured on the rear seat with a strap and operated from the rear seat by a second person.*

## 2.5 Working on the exhaust system

When working on the exhaust system please note the following:



### Caution

*Avoid damage to flexible joint.*

- ◆ *Do not bend flexible joint more than 10°.*
- ◆ *Install flexible joint so that it is not under tension.*
- ◆ *Take care not to damage wire mesh on flexible joint.*

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## 3 General repair instructions

### 3.1 Rules for cleanliness when working on fuel supply system, injection system and turbocharger

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

- ◆ Carefully clean connection points and the surrounding area with engine cleaner or brake cleaner and dry thoroughly before opening.
- ◆ Seal off open pipes/lines and connections immediately with clean plugs, e.g. from engine bung set -VAS 6122- .
- ◆ Place parts that have been removed on a clean surface and cover them over. Use only lint-free cloths.
- ◆ Carefully cover or seal open components if repairs cannot be carried out immediately.
- ◆ Only install clean components; replacement parts should only be unpacked immediately prior to installation. Do not use parts that have not been stored in their packing (e.g. in tool boxes etc.).
- ◆ When the system is open, do not work with compressed air and do not move the vehicle.
- ◆ Protect unplugged electrical connectors against dirt and moisture and make sure connections are dry when attaching.

### 3.2 Checking fuel system for leaks

- Allow engine to run for several minutes at moderate rpm.
- Switch off ignition.
- Check complete fuel system for leaks.
- If leaks are found although the connections have been tightened to the correct torque, the relevant component must be renewed.
- Road-test vehicle and accelerate with full throttle at least once.
- Then inspect high-pressure section of fuel system again for leaks.

### 3.3 Foreign particles in engine

- ◆ When performing assembly work on engine, all open passages in the intake and exhaust systems must be sealed with suitable plugs (e.g. from engine bung set -VAS 6122- ) to prevent foreign particles from entering the engine.
- ◆ In the event of mechanical damage to one of the cylinder banks, the intake and exhaust systems and combustion chambers of the opposite cylinder bank must always be examined for foreign particles to prevent further damage occurring later.

### 3.4 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 ⇒ Electronic 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.

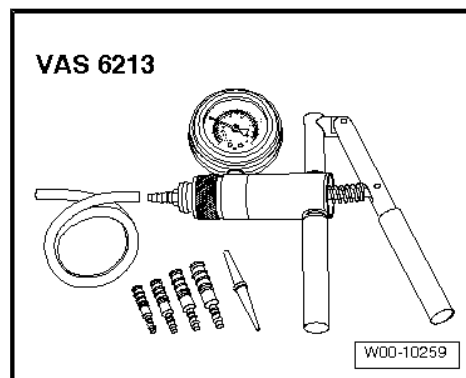
### 3.5 Routing and attachment of pipes, hoses and wiring

- ◆ Mark fuel lines, hydraulic lines, vacuum lines, lines for activated charcoal filter system and electrical wiring etc. before removal so they can be re-installed in the original positions and correctly connected. Make sketches or take photographs if necessary.
- ◆ To prevent damaging pipes, hoses and wiring, ensure sufficient clearance from all moving or hot components in engine compartment (little space in engine compartment).

### 3.6 Checking vacuum system

**Special tools and workshop equipment required**

- ◆ Hand vacuum pump -VAS 6213-



**Procedure**

- Check all vacuum lines in the complete vacuum system for:
  - ◆ Cracks
  - ◆ Traces of animal bites
  - ◆ Kinked or crushed lines
  - ◆ Lines porous or leaking
- Check vacuum line to solenoid valve and from solenoid valve to corresponding component.
- If a fault is stored in the fault memory, check the vacuum lines leading to the corresponding component and also check the remaining vacuum lines in the system.
- If it is not possible to build up a vacuum with the hand vacuum pump -VAS 6213- or if the vacuum pressure drops again immediately, check the hand vacuum pump and connecting hoses for leaks.

### 3.7 Installing radiators and condensers

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.



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## 10 – Removing and installing engine

### 1 Removing and installing engine

#### 1.1 Removing and installing engine

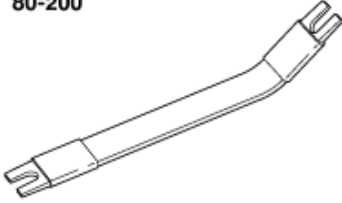
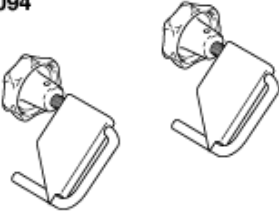
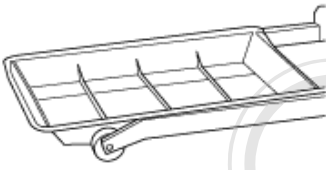
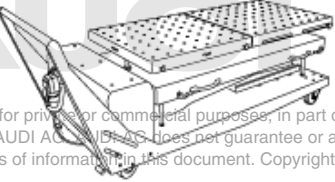


#### Note

- ◆ *The engine is removed from underneath together with the gearbox and subframe (with lock carrier installed).*
- ◆ *All cable ties which are released or cut open when removing must be fitted in the same position when installing.*
- ◆ *Collect drained coolant in a clean container for re-use or disposal.*

#### Special tools and workshop equipment required

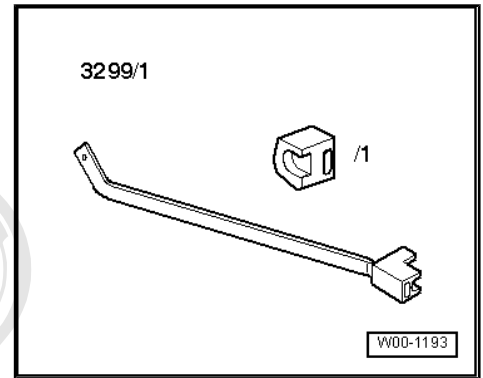
- ◆ Removal lever -80-200-
- ◆ Hose clamps for hoses up to 25 mm Ø -3094-
- ◆ Drip tray -V.A.G 1306- or drip tray for workshop hoist -VAS 6208-
- ◆ Hose clip pliers -V.A.G 1921-
- ◆ Stepladder -VAS 5085-
- ◆ Scissor-type assembly platform -VAS 6131- with support set -VAS 6131/10-

|                                                                                                              |                                                                                                                |
|--------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|
| <p><b>80-200</b></p>       | <p><b>3094</b></p>         |
| <p><b>V.A.G 1306</b></p>  | <p><b>V.A.G 1921</b></p>  |
| <p><b>VAS 5085</b></p>    | <p><b>VAS 6131</b></p>    |

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- ◆ Poly V-belt lever -3299- with bracket -3299/1-



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

## 1.2 Removing engine



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*The following procedure describes how to remove the engine on vehicles with multitronic automatic gearbox 01J (continuously variable transmission).*



### WARNING

***Before removing the engine secure the vehicle against tipping over. To do so, the luggage compartment must be empty.***



### Caution

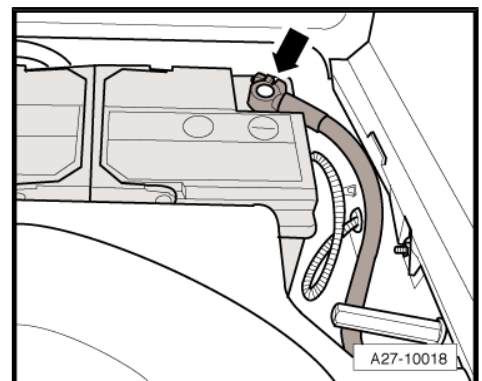
***Observe notes on procedure for disconnecting the battery → Electrical system; Rep. Gr. 27.***



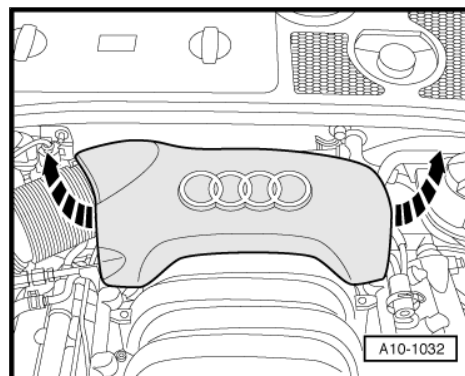
### Note

*To make sure you can still move the front wheels when the battery has been disconnected, only disconnect the battery with the ignition key inserted.*

- Take out luggage compartment floor trim.
- Disconnect earth cable -arrow- at battery.

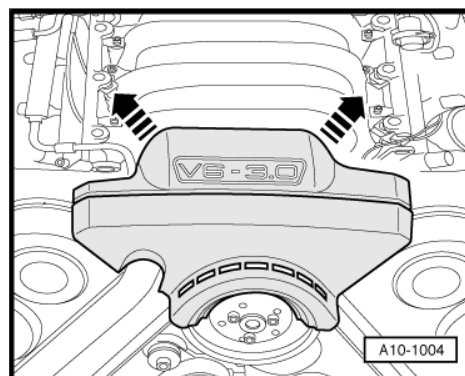


- Pull off engine cover panel (rear) -arrows-.



- Pull off engine cover panel (front) -arrows-.

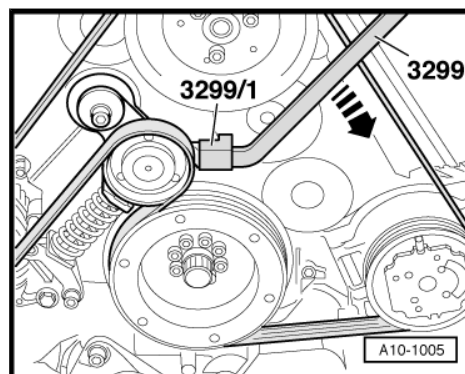
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#### Note

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

- To slacken the tensioner for poly V-belt, apply pressure to tensioner by moving poly V-belt lever -3299- and bracket -3299/1- in the direction of the arrow.
- Remove poly V-belt from power steering pump pulley.



#### WARNING

*Hot steam/hot coolant may escape when opening expansion tank; cover filler cap with cloth and open carefully.*

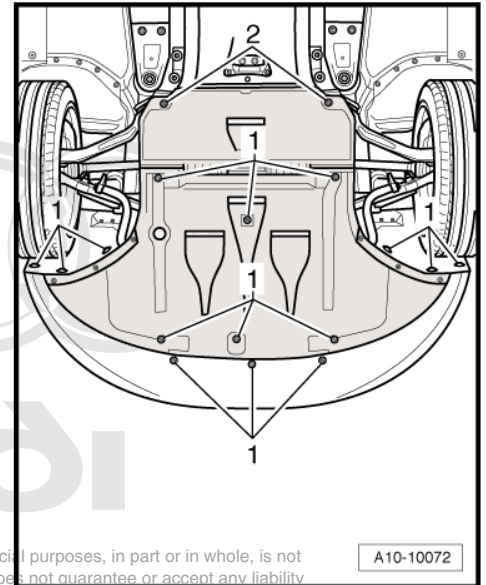
- Open filler cap on coolant expansion tank.
- Remove both front wheels.



#### Note

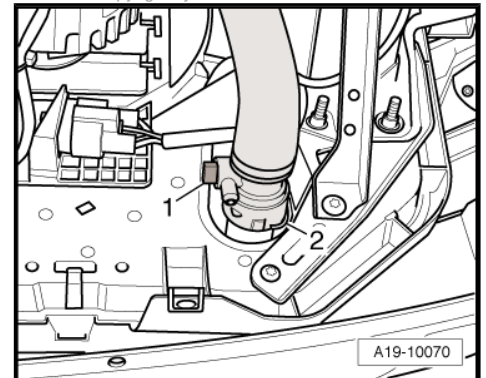
*Secure brake discs with wheel bolts.*

- Release quick-release fasteners -1- and -2- and take off noise insulation panels.

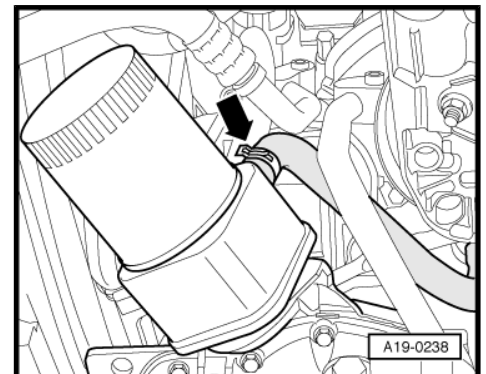


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- Place drip tray -V.A.G 1306- or drip tray for workshop hoist -VAS 6208- under engine.
- Open drain plug -1- and let coolant drain.
- Then disconnect coolant hose -2- from radiator.



- Also disconnect coolant hose at oil cooler -arrow-, and drain off remaining coolant.



- Place used oil collection and extraction unit -V.A.G 1782- under engine.
- Drain off engine oil.
- Remove oil filter -2-.
- Place drip tray -V.A.G 1306- or drip tray for workshop hoist - VAS 6208- under engine.
- Remove coolant hose -3- at oil cooler.



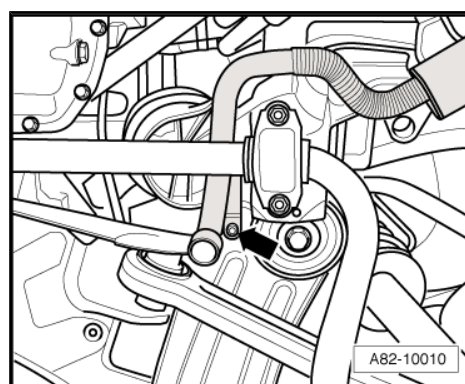
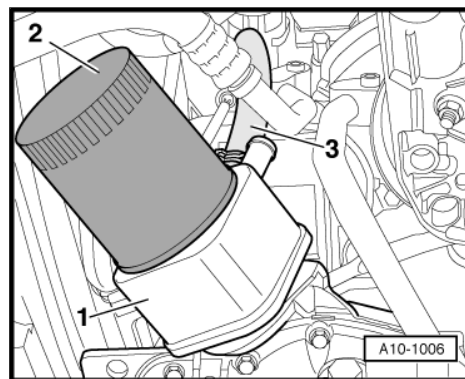
### Note

*On vehicles with auxiliary heater, also detach coolant hose -3- in front of front coolant pipe.*

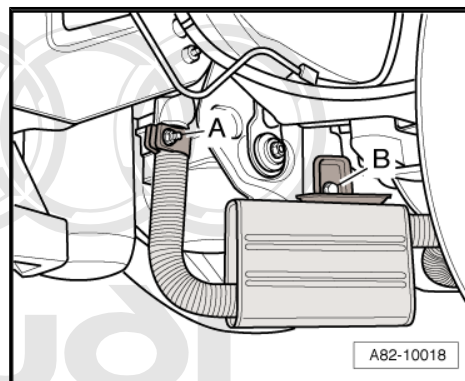
- Remove oil cooler -1-.

### Vehicles with auxiliary heater:

- Remove front left wheel housing liner ⇒ General body repairs, exterior; Rep. Gr. 66 .
- Remove bolt -arrow- for corrugated exhaust pipe.



- Loosen nut -A- at clamp for corrugated exhaust pipe.
- Unscrew bolt -B- and remove silencer together with corrugated exhaust pipes.



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**All vehicles:**

- Unplug electrical connector -1- for magnetic clutch on air conditioner compressor.



**Caution**

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

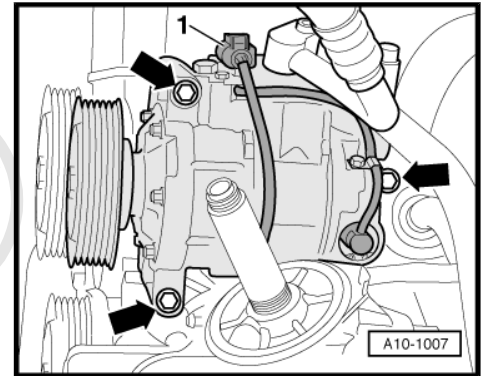
- Unscrew air conditioner compressor from bracket -arrows-.



**Note**

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

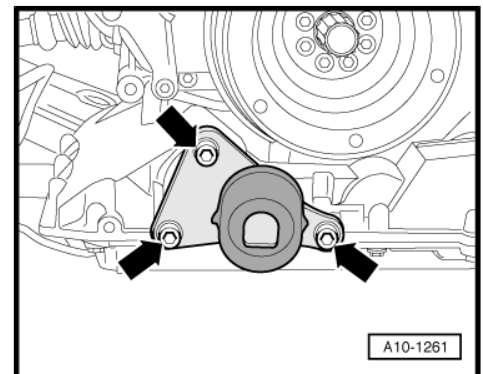
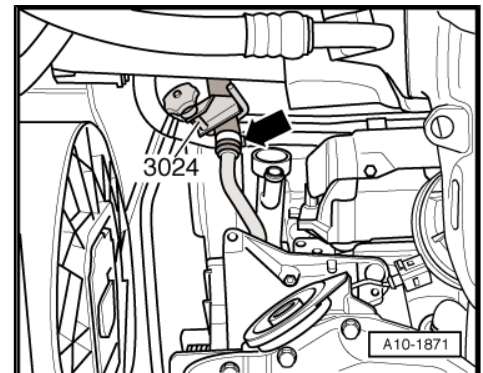
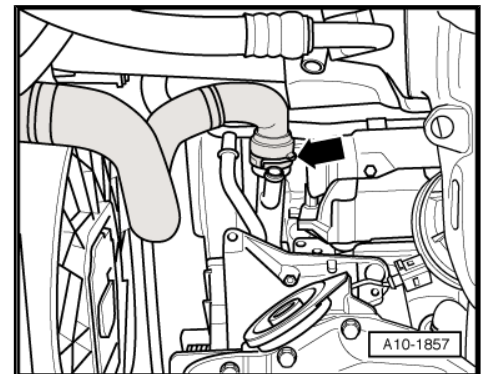
- Tie up air conditioner compressor with lines attached to left-side of vehicle.
- Detach coolant hose from engine by releasing retaining clip -arrow-.



**Note**

*Lay a cloth under the hydraulic pipe to catch any escaping hydraulic fluid.*

- Use hose clamp -3094- to clamp off hydraulic hose for vane pump.
- Detach hydraulic hose at the connection indicated -arrow-.
- Unscrew bolts -arrows- and remove torque reaction support from engine.

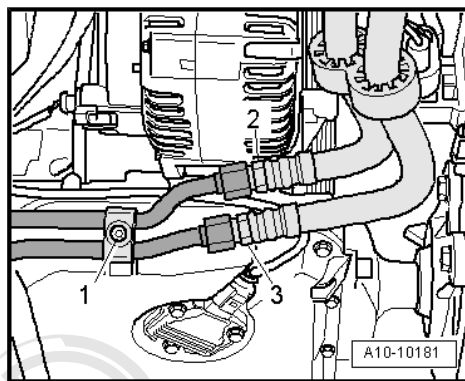




# Note

*Note the rules for cleanliness when working on the automatic gearbox ⇒ multitronic 01J, front-wheel drive; Rep. Gr. 37.*

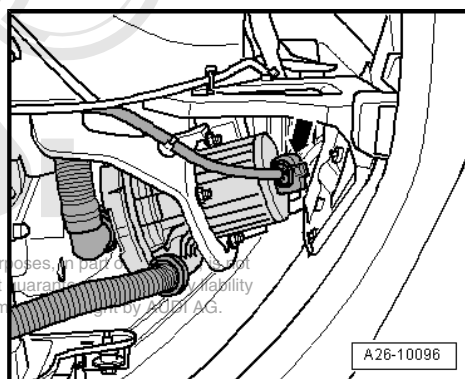
- Place used oil collection and extraction unit -V.A.G 1782- under engine.
- Unscrew union nuts -2- and -3- and disconnect ATF pipes.



# Note

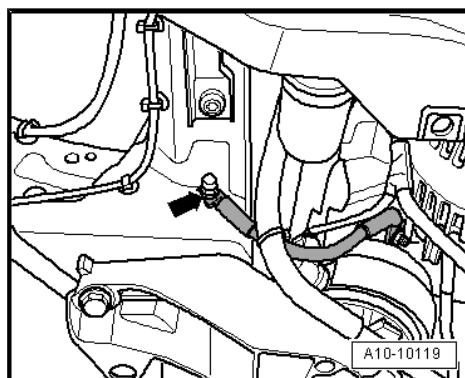
*Disregard -item 1-.*

- Unplug electrical connector -arrow- at secondary air pump motor -V101-.
- Move wiring clear.

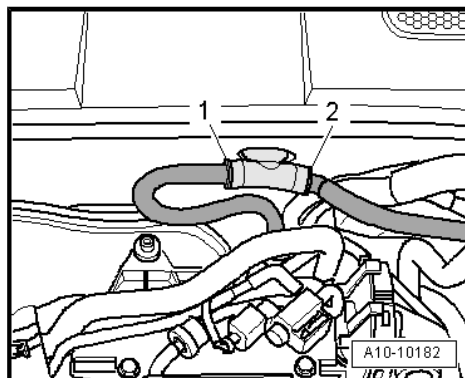


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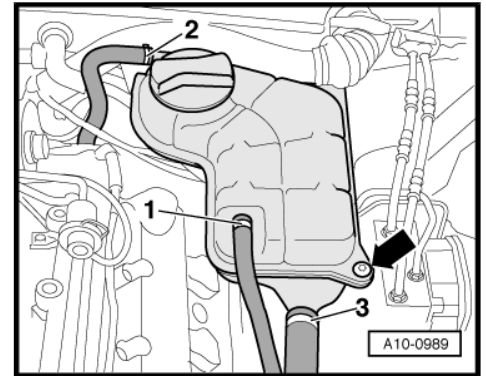
- Unbolt earth cable -arrow- at longitudinal member (right-side).



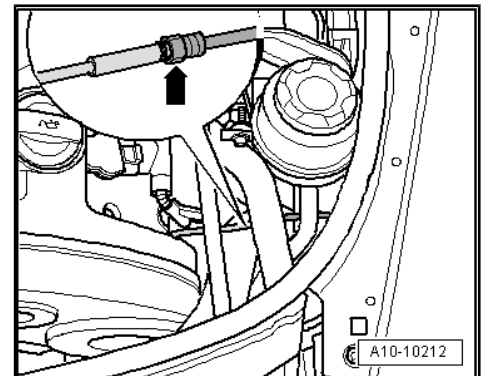
- Pull off vacuum hoses -1- and -2- from T-piece at bulkhead.



- Detach coolant hose -2- at expansion tank.
- Unbolt coolant expansion tank -arrow- and disconnect electrical connector for coolant shortage indicator switch -F66- at bottom of coolant expansion tank.
- Lay aside coolant expansion tank with coolant hoses -1- and -3- connected.



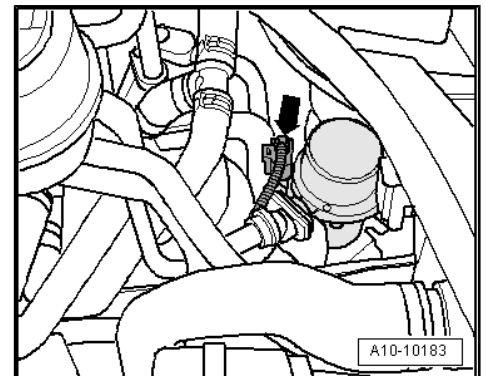
- Disconnect vacuum hose -arrow- going to vacuum reservoir.



- Unplug electrical connector -arrow- leading to vacuum pump for brakes -V192- .
- Move wiring clear.

**Note**

*Shown in illustration with headlight removed.*



- Detach vacuum hose -arrow- leading to activated charcoal filter at rear of air cleaner housing and move it clear.

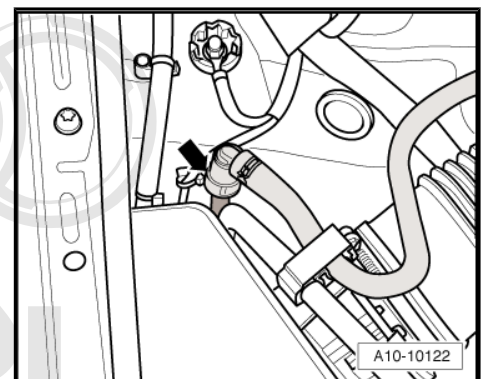
**Caution**

**Rules for cleanliness when working on the injection system**  
⇒ **page 5**.

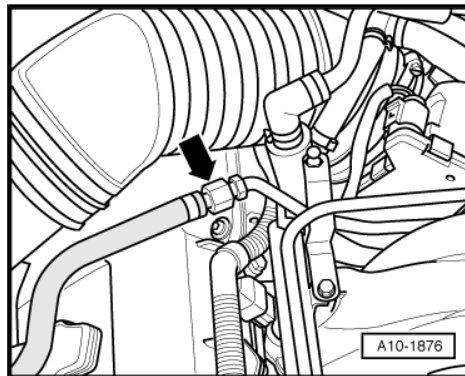
**WARNING**

**The fuel system is pressurised. Wrap a cloth around the connection before opening the system. Then release pressure by carefully loosening the connection.**

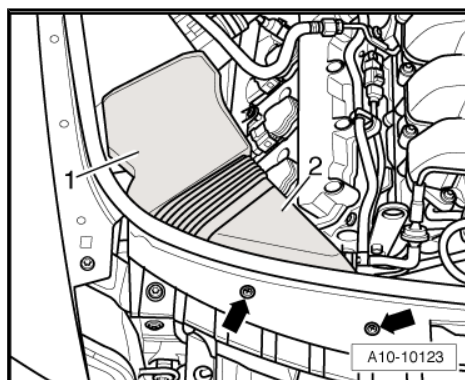
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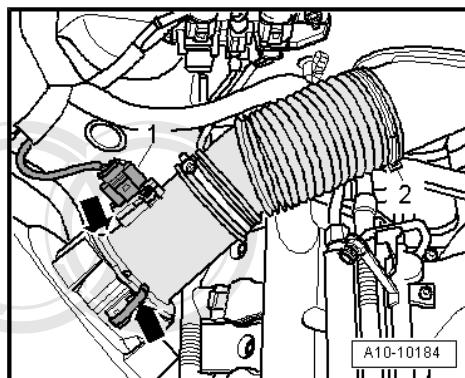
- Disconnect fuel line -arrow- and move it clear.



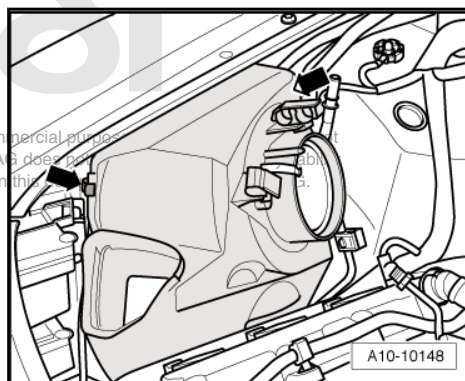
- Remove bolts -arrows-.
- Remove air ducts -1- and -2-.



- Unplug electrical connector -1- at air mass meter -G70- .
- Remove air intake hose. To do so, release hose clip -2- and clamps -arrows-.

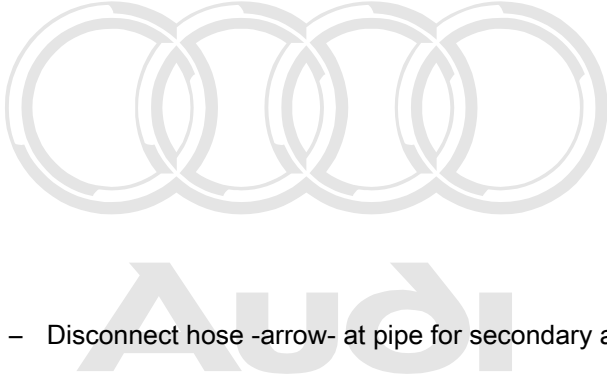


- Loosen clamps -arrows- and detach top section of air cleaner housing.



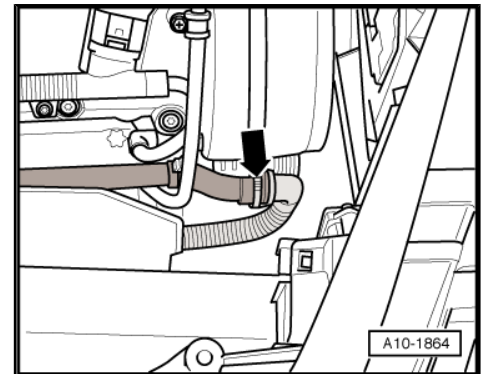
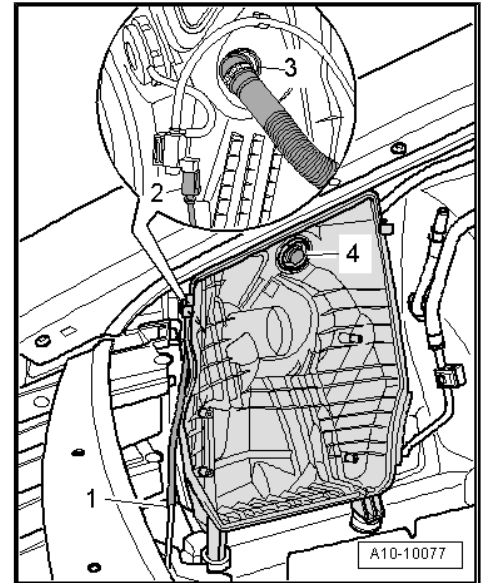
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- Disconnect vacuum pipe -1-.
- Pull out pin of fastener -4-.
- Remove air cleaner housing (bottom section) and unplug electrical connector on reverse side -2- at variable intake manifold change-over valve -N335-.
- Disconnect hose -3- leading to secondary air pump.
- Remove bottom section of air cleaner housing.



- Disconnect hose -arrow- at pipe for secondary air.

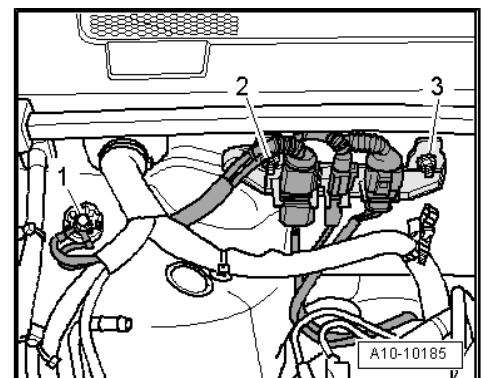
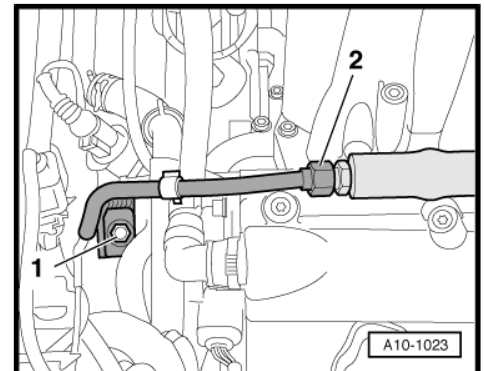
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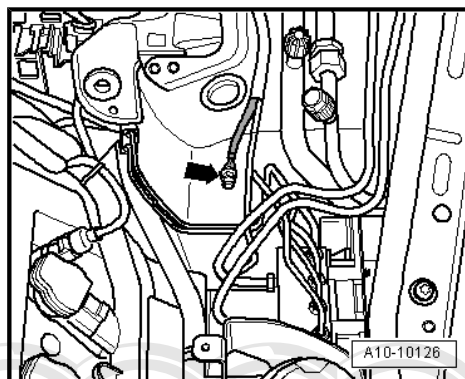
### Note

*Lay a cloth under the hydraulic pressure pipe to catch any escaping hydraulic fluid.*

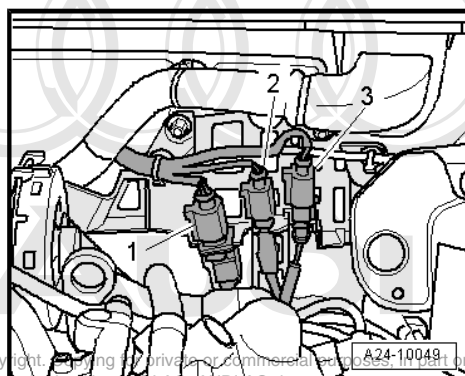
- Unbolt hydraulic pressure line for power-assisted steering at rear coolant pipe -1- and disconnect line near cylinder head (right-side) -2-.
- Unscrew nuts -2- and -3- and remove bracket for connectors (right-side) from bulkhead.
- Unbolt earth cable -1- at suspension turret (right-side).



- Unbolt earth cable -arrow- at suspension turret (left-side).

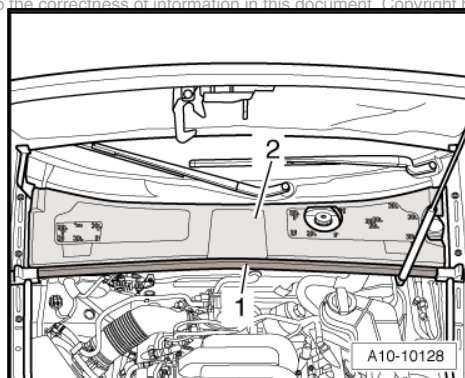


- Unscrew bracket (left-side) for electrical connectors -1 ... 3- from bulkhead.

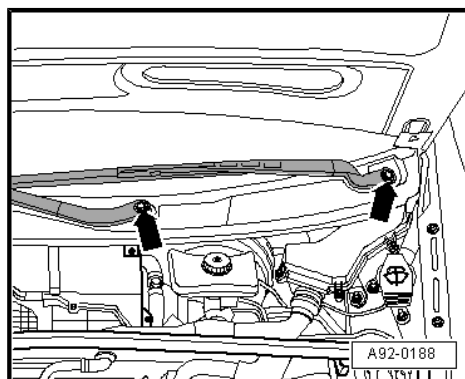


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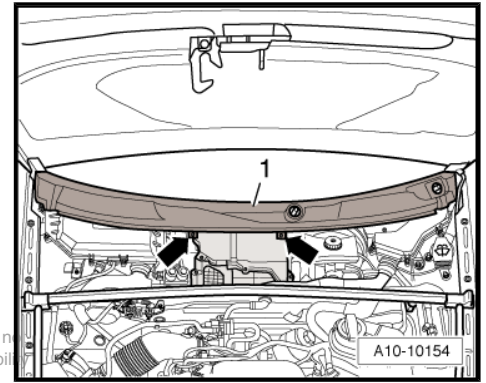
- Pull off rubber seal -1- on plenum chamber cover.
- Detach plenum chamber cover -2-.



- Lever off caps on windscreen wiper arms with a screwdriver.
- Loosen hexagon nuts -arrows- several turns.
- Loosen wiper arms from wiper shafts by tilting slightly, remove nuts and take off wiper arms.

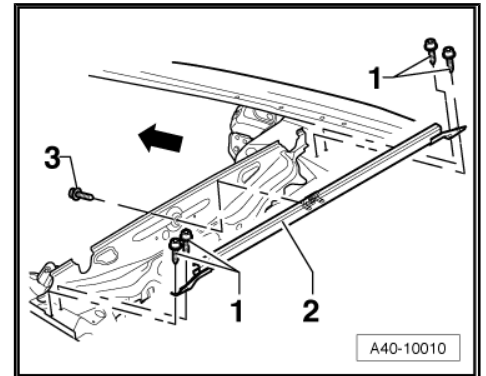


- Remove bolts -arrows- for cowl panel grille -1-.
- Pull cowl panel grille off windscreen.

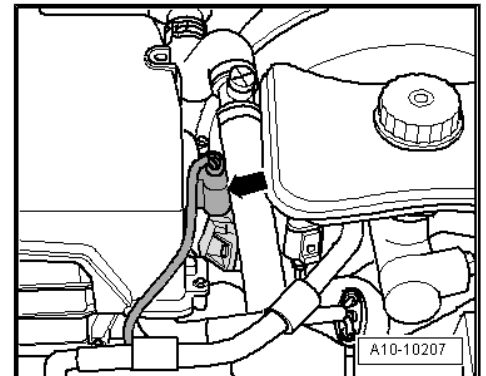


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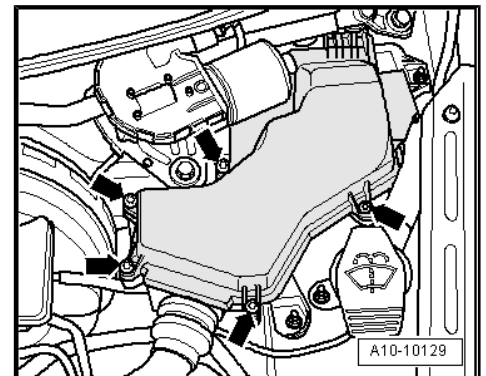
- If fitted, unscrew bolts -1- and -3- and remove body brace -2-.



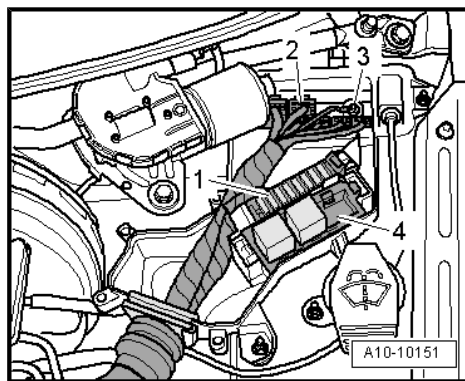
- Unplug electrical connector -arrow- at brake servo pressure sensor -G294-.



- Unscrew bolts -arrows- and take off cover for electronics box in engine compartment (left-side).



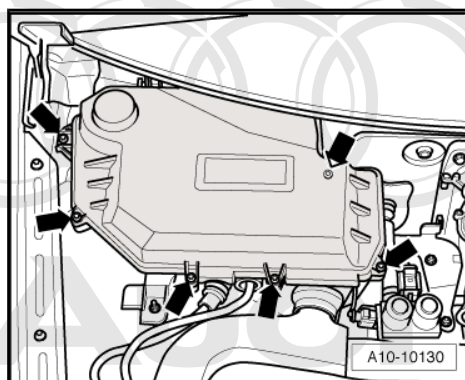
- Release retainers and lift off fuse holder -1- and then 3-position relay carrier -4-.
- Unscrew electrical wiring -3-.
- Unplug all connectors -2- at rear of connector console.
- Disengage engine wiring harness at electronics box and move it clear.



- Unscrew bolts -arrows- and take off cover for electronics box in engine compartment (right-side).


**WARNING**

*The pump valve unit for heating system (left in front of electronics box) gets very hot – risk of burns!*

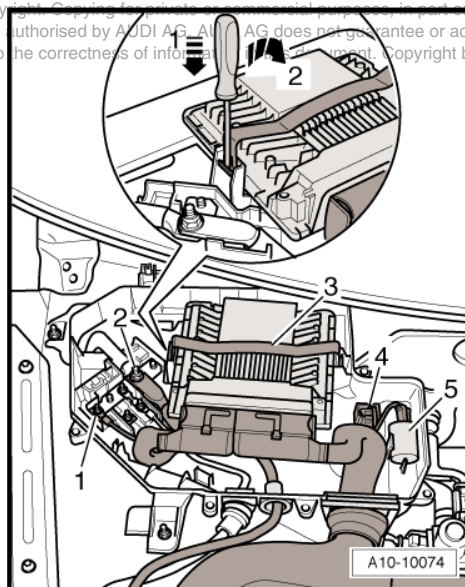


- Carefully lever out the retaining strap -3- using a screwdriver -arrows 1 and 2- and remove the engine control unit from the electronics box.

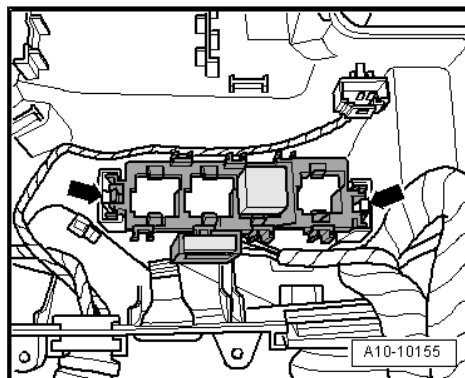

**Note**

*The engine control unit remains connected to the wiring harness.*

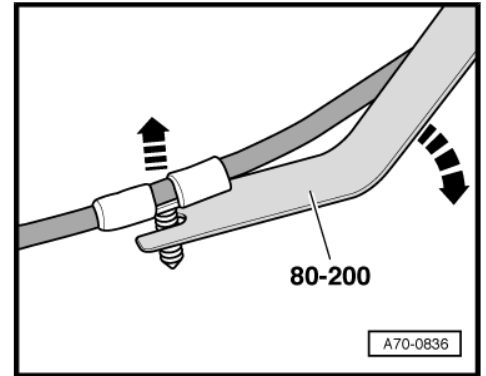
- Unclip suppressor capacitor -5- and take out of retainer in electronics box.
- Unplug electrical connector -4- at rear of connector console.
- Unscrew electrical wiring connections -1- and -2-.



- Release retainers -arrows- and remove the relay carrier upwards.



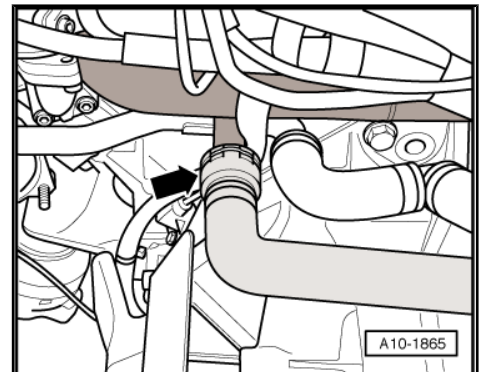
- Release electrical wiring up to the alternator using removal lever -80-200- .
- Place both wiring harnesses on top of engine and secure the engine control unit to prevent it falling.



- On vehicles without auxiliary heater, detach coolant hose (rear left) -arrow- at engine.

 **Note**

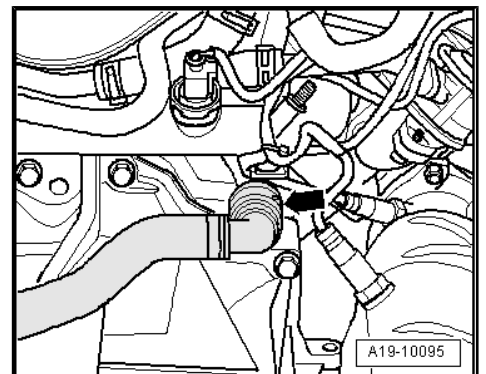
*Shown from rear with engine removed for illustration purposes.*



- Detach coolant hose (rear right) -arrow- at engine.

 **Note**

*Shown from rear with engine removed for illustration purposes.*



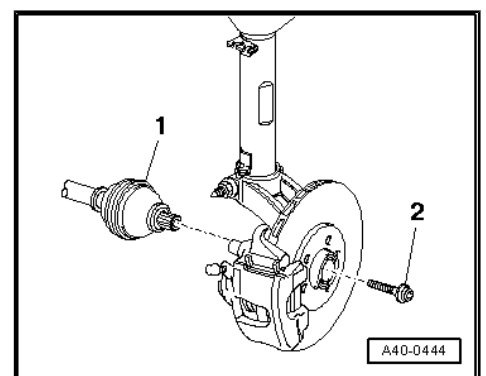
- Have a 2nd mechanic press the brake pedal.



**Caution**

***When slackening the flange bolt securing the drive shaft, the wheel bearing must not be under load (vehicle must not be standing on its wheels).***

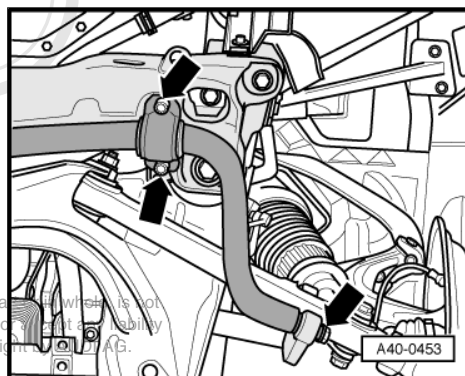
- Unscrew flange bolt -2- from drive shaft -1- (left and right).



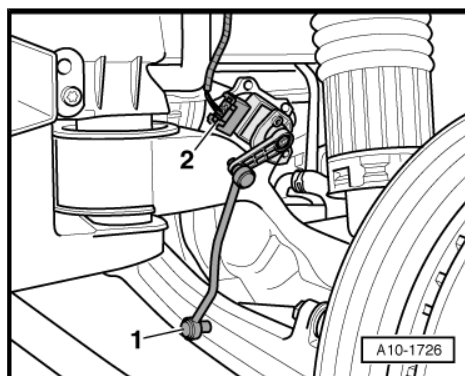


- Unscrew bolts -arrows- evenly on both sides of vehicle.
- Take out anti-roll bar.

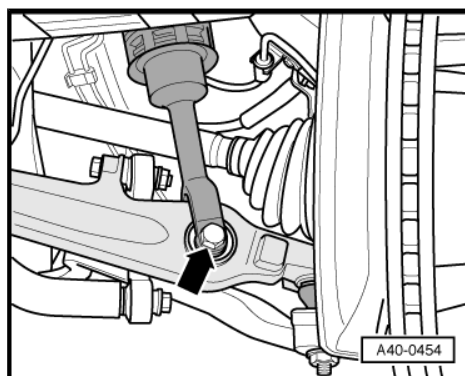
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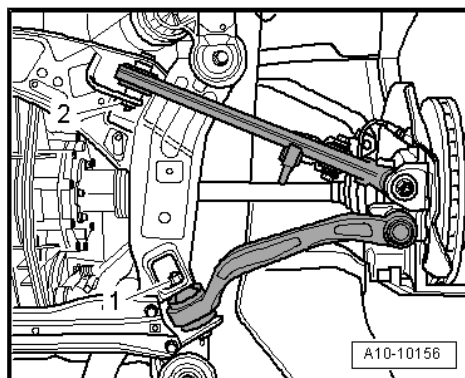
- Unplug electrical connector -2- at vehicle level sender.
- Detach coupling rod -1- at track control link.



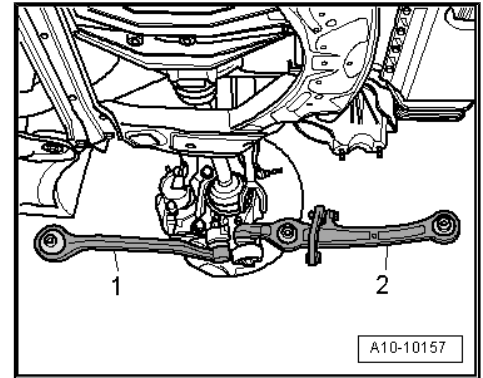
- Unbolt suspension strut from track control link -arrow-.



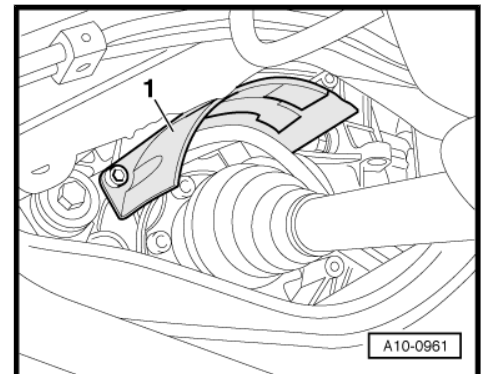
- Unbolt guide link -1- and track control link -2- at subframe.



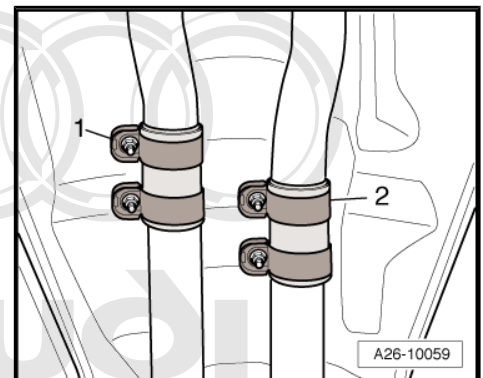
- Pivot guide link -1- and track control link -2- outwards.
- Repeat procedure on other side of vehicle.



- Unbolt heat shield -1- for drive shaft (left-side).
- Unbolt drive shaft from flange shaft on gearbox.
- Pivot wheel bearing housing (left-side) outwards and remove drive shaft.
- Repeat procedure on other side of vehicle.

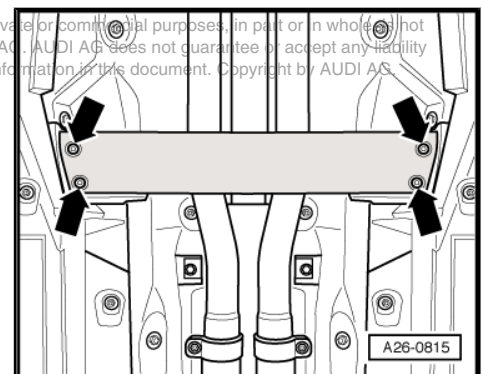


- Loosen clamps -1- and -2-.



- Unbolt cross piece (front) -arrows-.

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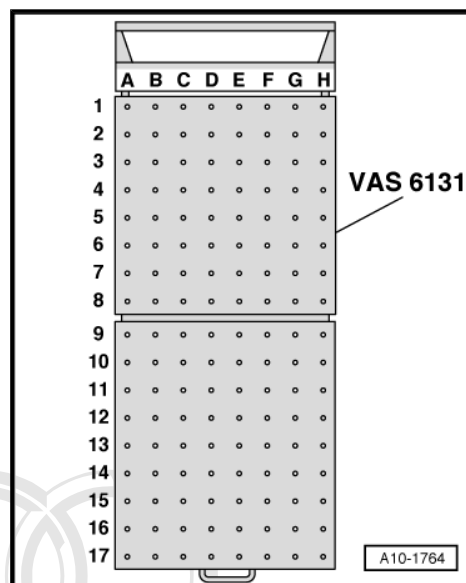


# Set up the scissor-type assembly platform as follows:

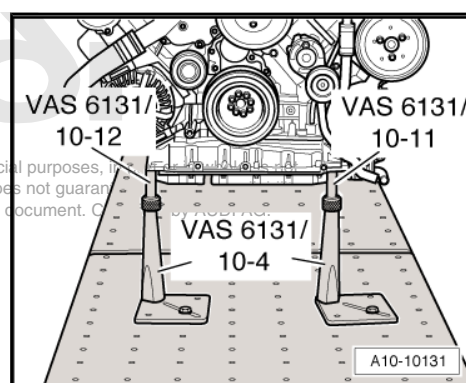
- Set up scissor-type assembly platform -VAS 6131- with support set -VAS 6131/10- as follows:

| Platform co-ordinates | Parts of support set -VAS 6131/10- |       |       |        |
|-----------------------|------------------------------------|-------|-------|--------|
| B4                    | /10-1                              | /10-4 | /10-5 | /10-11 |
| G4                    | /10-1                              | /10-4 | /10-5 | /10-12 |
| B11                   | /10-1                              | /10-2 | /10-5 | /10-8  |
| G11                   | /10-1                              | /10-2 | /10-5 | /10-8  |
| E13                   | /10-1                              | /10-3 | /10-5 | /10-6  |
| C15                   | /10-1                              | /10-3 | /10-5 | /10-6  |

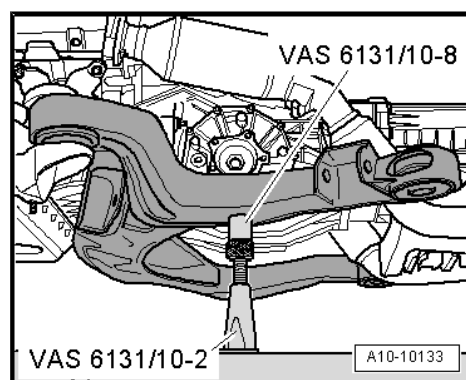
- Initially tighten the support elements on the assembly platform only hand-tight.
- Adjust the scissor-type assembly platform -VAS 6131- so that it is horizontal.
- Take note of spirit level (bubble gauge).
- Place scissor-type assembly platform -VAS 6131- under engine/gearbox assembly.
- Position support elements from -VAS 6131/10- at front of engine, as shown in illustration.



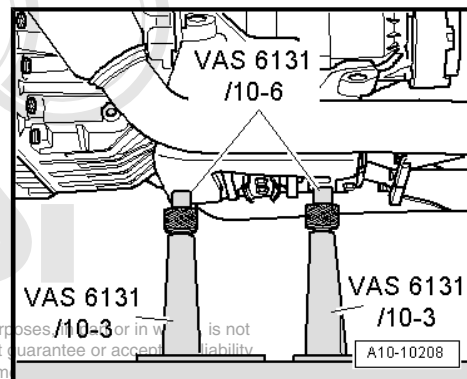
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- Position support elements from -VAS 6131/10- at left and right of subframe, as shown in the illustration.

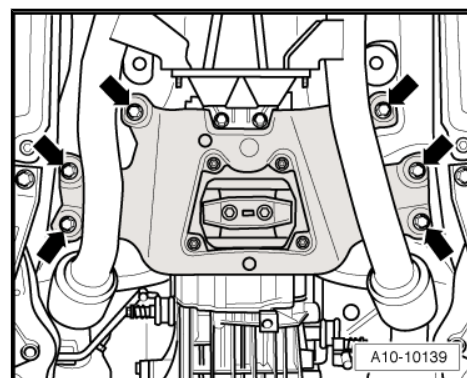


- Position support elements from -VAS 6131/10- at rear of tunnel cross member, as shown in the illustration.
- Turn all spindles for the support elements upwards until all locating lugs make contact with the mounting points.
- Tighten base plates for support elements to 20 Nm on scissor-type assembly platform -VAS 6131-.



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- Remove bolts -arrows- at tunnel cross member.

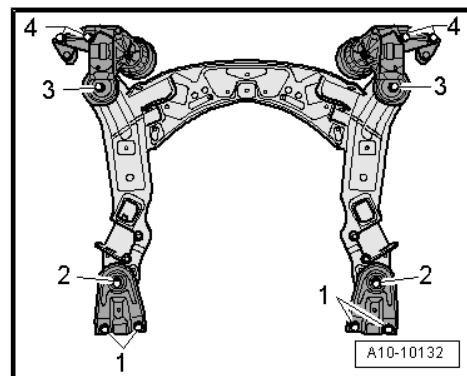


- Remove bolts -1-.
- Mark the installation position of the subframe and the two consoles for engine mountings on the longitudinal members with felt-tip pen.
- Unscrew bolts -2-, -3- and -4- in a diagonal sequence and in stages.



#### Note

- ◆ Check that all hoses and wiring connections between engine, gearbox, subframe and body have been detached.
- ◆ Carefully guide out engine/gearbox assembly with subframe from engine compartment when lowering to avoid damage.



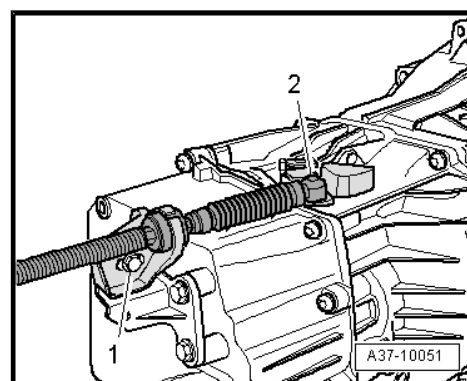
- Lower engine/gearbox assembly gradually (approx. 10 cm).
- Mark the installation position of the support bracket for selector lever cable.
- Unscrew bolt -1- for support bracket for selector lever cable.
- Push ball socket -2- of selector lever cable off selector shaft lever.



#### Note

Take care not to bend or kink selector lever cable.

- Lower the scissor-type assembly platform -VAS 6131- completely and pull it out together with engine/gearbox assembly from beneath the vehicle.



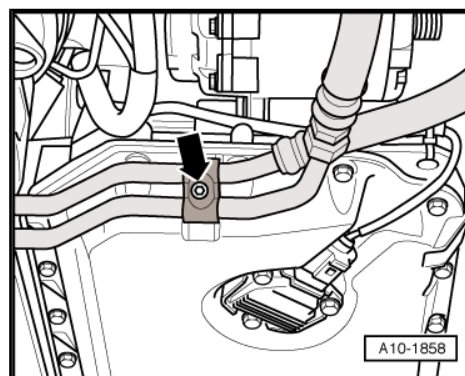
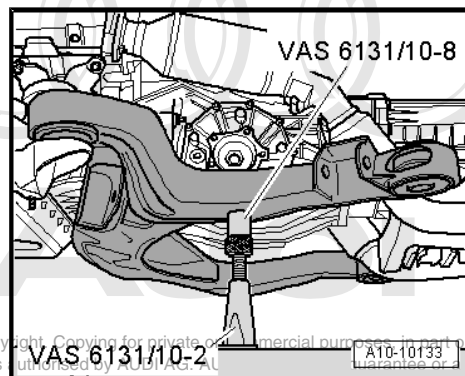
## 1.3 Separating engine and gearbox

### Special tools and workshop equipment required

- ◆ Support sets -VAS 6131/10- , -VAS 6131/11- and -VAS 6131/12-

### Procedure

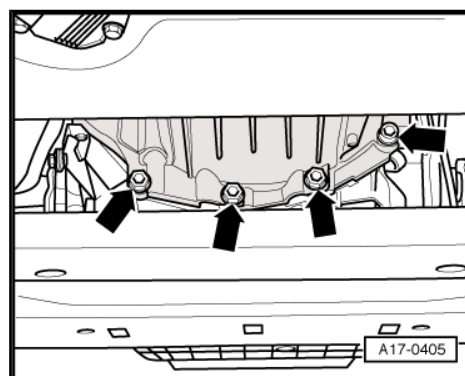
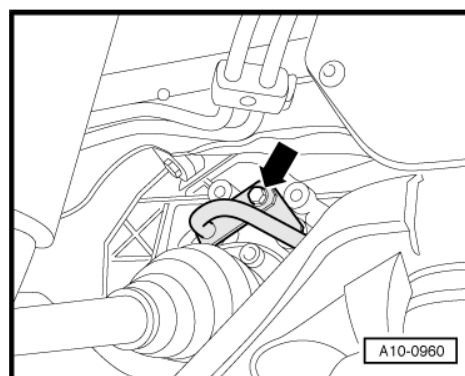
- Engine/gearbox assembly removed and secured to scissor-type assembly platform -VAS 6131- .
- Screw down spindles of support elements from -VAS 6131/10- (left and right) at subframe as far as possible.
- Remove locating lugs from spindles.
- Remove subframe to the side.
- Unscrew the two base plates for support elements (for subframe) on scissor-type assembly platform -VAS 6131- .
- Remove bracket -arrow- for ATF lines.



### Note

*Note the rules for cleanliness when working on the automatic gearbox ⇒ multitronic 01J, front-wheel drive; Rep. Gr. 37 .*

- Unscrew bolt -arrow- and detach ATF pipes from gearbox.
- Unscrew bolts -arrows- securing engine to gearbox near sump (top section).



**Note**

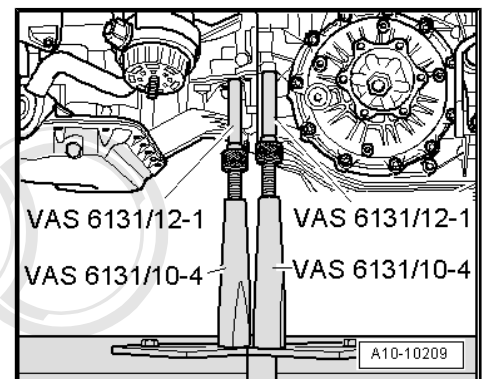
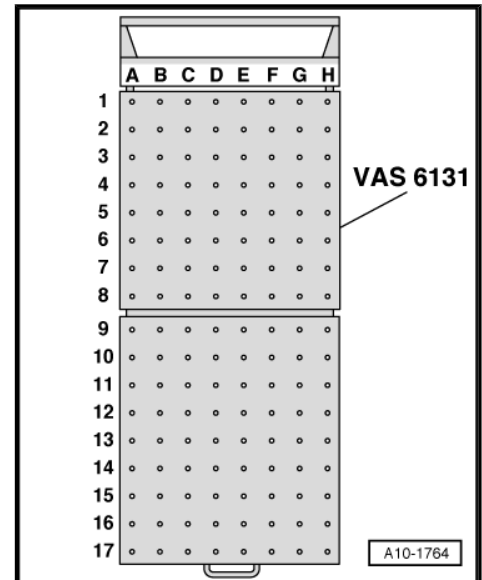
The mounting points for engine (front) and tunnel cross member remain unchanged.

- Set up scissor-type assembly platform -VAS 6131- with support set -VAS 6131/10- , -VAS 6131/11- and -VAS 6131/12- as follows:

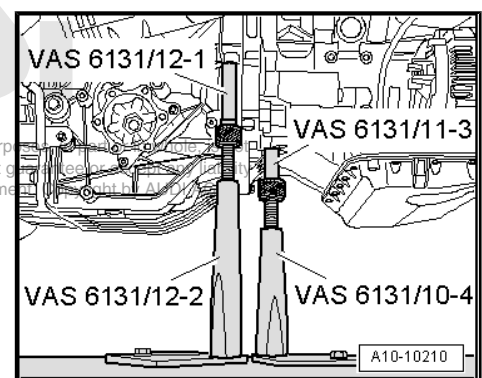
| Platform co-ordinates | Parts of support set -VAS 6131/10- , -VAS 6131/11- and -VAS 6131/12- |       |       |        |
|-----------------------|----------------------------------------------------------------------|-------|-------|--------|
| B4 <sup>2)</sup>      | /10-1                                                                | /10-4 | /10-5 | /10-11 |
| G4 <sup>2)</sup>      | /10-1                                                                | /10-4 | /10-5 | /10-12 |
| C7                    | /10-1                                                                | /10-4 | /10-5 | /12-1  |
| F7                    | /10-1                                                                | /10-4 | /10-5 | /11-3  |
| C10                   | /10-1                                                                | /10-4 | /10-5 | /12-1  |
| F10                   | /10-1                                                                | /12-2 | /10-5 | /12-1  |
| E13 <sup>2)</sup>     | /10-1                                                                | /10-3 | /10-5 | /10-6  |
| C15 <sup>2)</sup>     | /10-1                                                                | /10-3 | /10-5 | /10-6  |

2) Support elements remain unchanged.

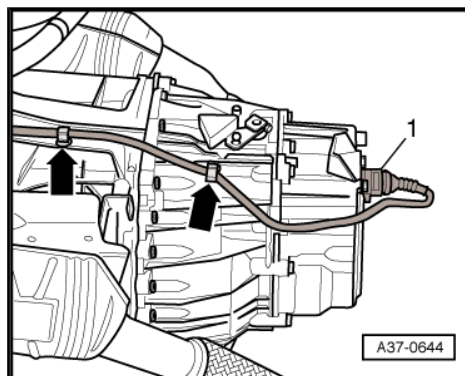
- Position support elements from -VAS 6131/10- and -VAS 6131/12- on left side of engine/gearbox assembly, as shown in illustration.



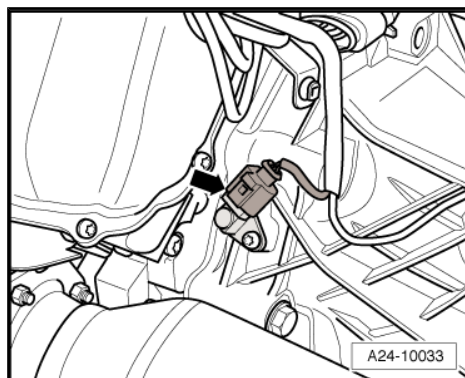
- Place support elements from -VAS 6131/10- , -VAS 6131/11- and -VAS 6131/12- at right of engine/gearbox assembly, as shown in illustration.
- Turn spindles for the support elements upwards until all locating lugs make contact with the mounting points.
- Tighten base plates for support elements to 20 Nm on scissor-type assembly platform -VAS 6131- .



- Release electrical connector -1- and detach from gearbox.
- Move wiring harness going to engine clear -arrows-.



- Unplug electrical connector -arrow- for engine speed sender - G28- .

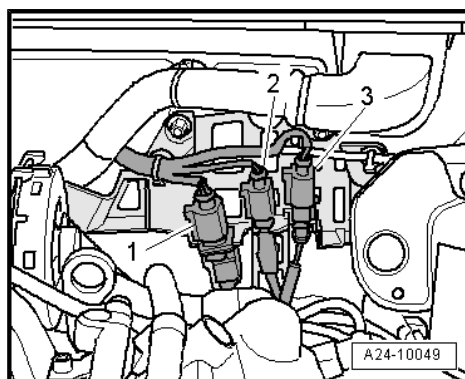


- Unplug the electrical connectors -1- and -3- for Lambda probes (left-side of engine) and move wiring clear.



#### Note

- ◆ *Illustration shows electrical connectors when installed.*
- ◆ *Disregard -item 2-.*



#### Note

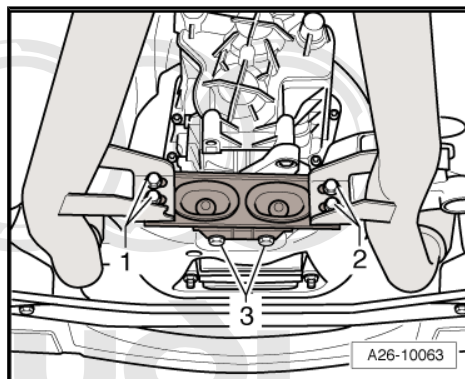
*To avoid any damage, the flexible joint in the front exhaust pipe must not be bent more than 10°.*

- Remove bolts -1- on bracket (rear) for exhaust system.



#### Note

*Disregard items marked -2- and -3-.*

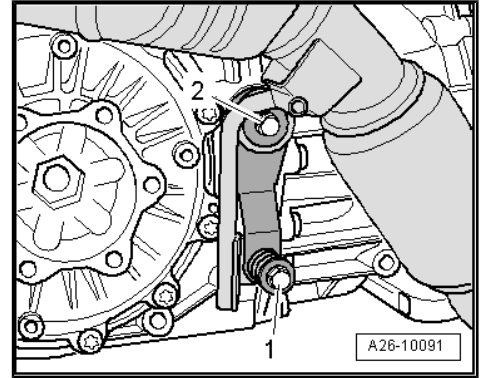


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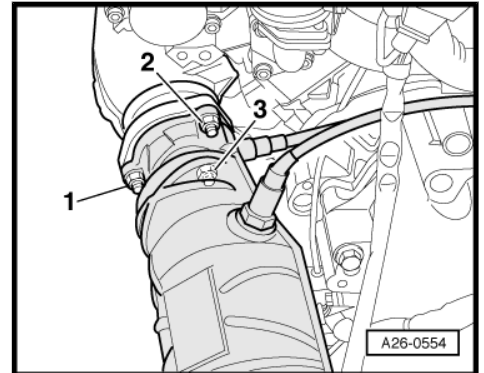
- Remove bolt -1- on bracket (left-side) for front exhaust pipe.

 **Note**

*Disregard -item 2-.*



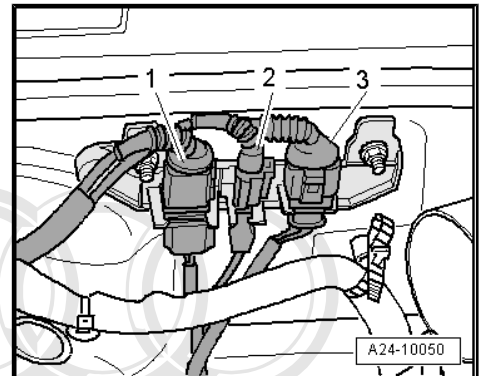
- Unscrew nuts -1 ... 3-.
- Detach front exhaust pipe (left-side) with catalytic converter.



- Unplug the electrical connectors -1- and -3- for Lambda probes (right-side of engine) and move wiring clear.

 **Note**

- ◆ *Illustration shows electrical connectors when installed.*
- ◆ *Disregard -item 2-.*



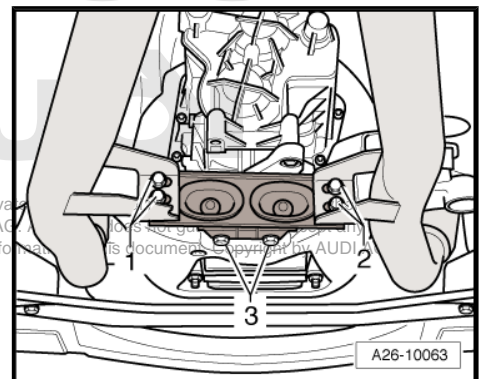
 **Note**

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

- Remove bolts -2- on bracket (rear) for exhaust system.

 **Note**

*Disregard items marked -1- and -3-.*

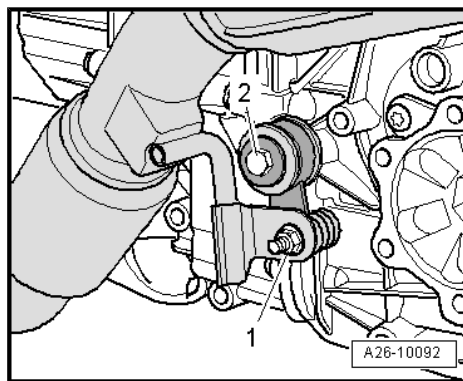


- Remove nut -1- on bracket (right-side) for front exhaust pipe.

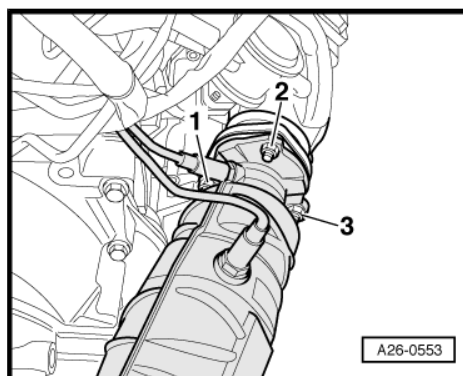


### Note

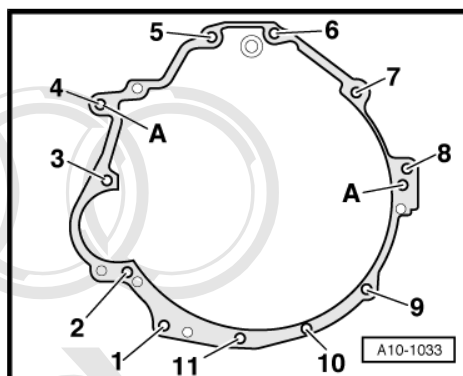
Disregard -item 2-.



- Unscrew nuts -1 ... 3-.
- Detach front exhaust pipe (right-side) with catalytic converter.

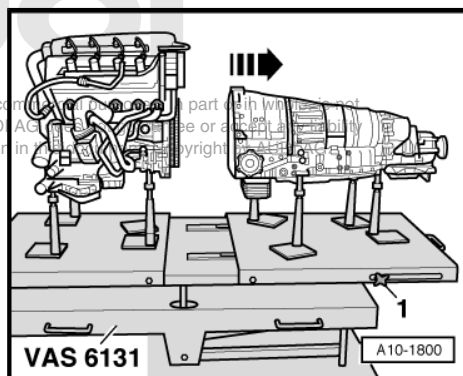


- Remove engine/gearbox securing bolts -2 ... 8-.



- Loosen clamping bolts -1- on sides of scissor-type assembly platform -VAS 6131- and pull rear section of platform together with gearbox towards rear -arrow-.

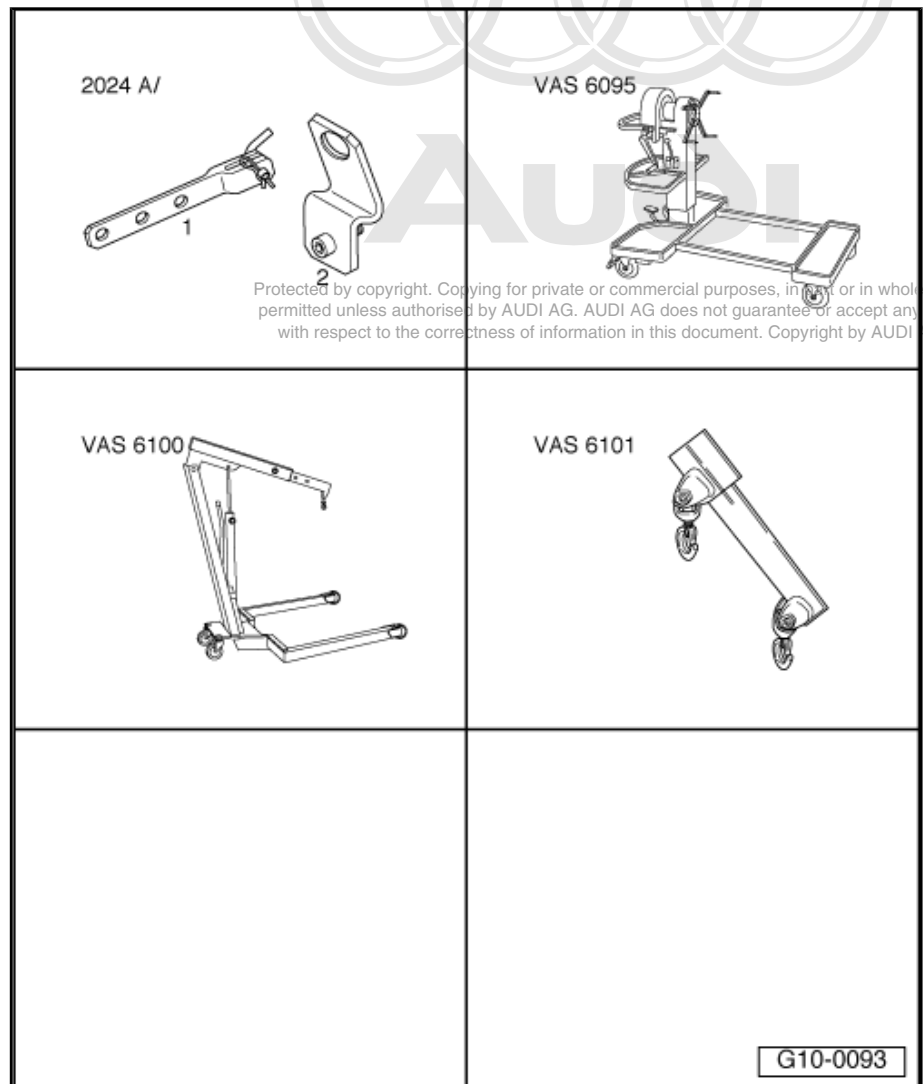
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## 1.4 Securing engine to assembly stand

### Special tools and workshop equipment required

- ◆ Lifting tackle -2024 A-
- ◆ Engine and gearbox support -VAS 6095- with adapter set -VAS 6095/6-
- ◆ Workshop hoist - VAS 6100-
- ◆ Lift arm extension (workshop hoist) -VAS 6101-



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### Procedure

- Engine separated from gearbox ⇒ [page 26](#) .
- Attach the lifting tackle -2024 A- to engine and workshop hoist -VAS 6100- with lift arm extension (workshop hoist) - VAS 6101- as shown in the illustration.



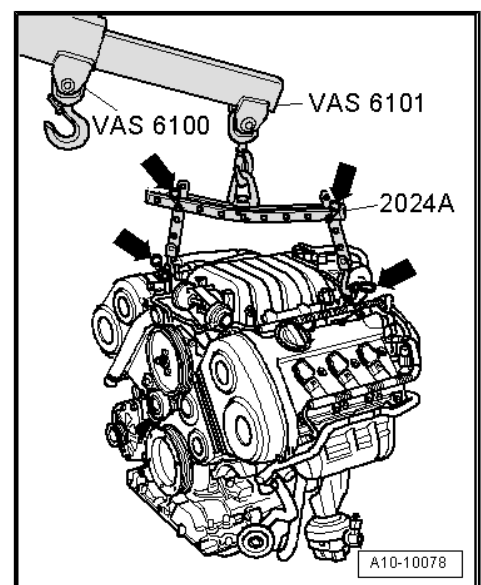
#### Note

*To adjust to the centre of gravity of the assembly, the perforated rails of the support hooks must be positioned as shown.*



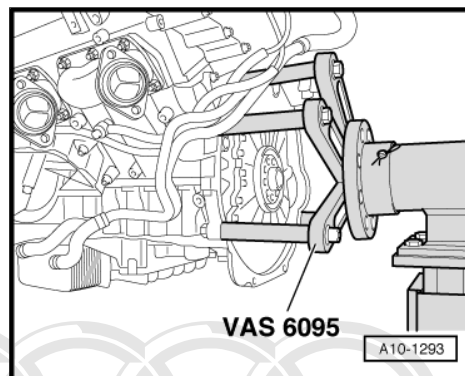
#### WARNING

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



A10-10078

- Secure the engine to engine and gearbox support -VAS 6095- as shown in the illustration.



## 1.5 Installing engine



### 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, gaskets and O-rings.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- ◆ *Fit all cable ties in the original positions when installing.*
- ◆ *Clean input shaft splines and splines of damper unit on fly-wheel; remove corrosion and apply only a very thin coating of grease -G 000 100- to the splines. Remove any excess grease.*
- Check whether dowel sleeves for centring the engine/gearbox assembly are fitted in the cylinder block; install dowel sleeves if necessary.
- Bolt gearbox to engine (use new bolts).



### 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  $\pm 15\%$ .*

## Securing engine to gearbox

| Item            | Bolt <sup>3)</sup> | Nm |
|-----------------|--------------------|----|
| 1, 10, 11       | M10×45             | 45 |
| 2 <sup>4)</sup> | M10×80             | 65 |
| 3               | M12×100            | 65 |
| 4, 8            | M12×67             | 65 |
| 5, 6            | M12×75             | 65 |
| 7               | M10×90             | 45 |
| 9               | M10×60             | 45 |

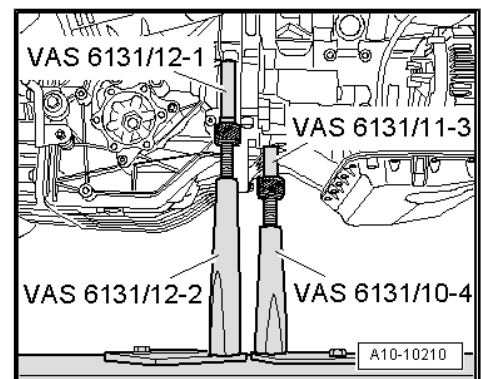
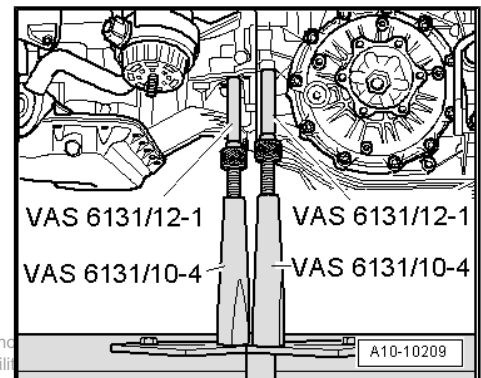
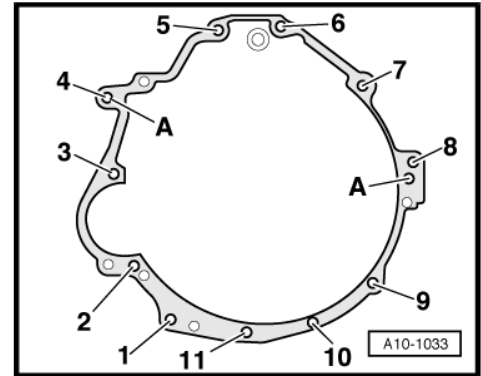
3) Renew bolts for securing engine/gearbox.

4) Property class 10.9

A - Dowel sleeves for centralising

Remaining installation steps are carried out in reverse sequence; note the following:

- Install front exhaust pipes together with catalytic converter: left-side ⇒ [page 183](#) , right-side ⇒ [page 188](#) .
- Secure the ATF pipes ⇒ multitronic gearbox 01J, front-wheel drive; Rep. Gr. 37 .
- Screw down the spindles for support elements (left-side) at engine/gearbox assembly.
- Unscrew both base plates for support elements (left-side) at scissor-type assembly platform -VAS 6131- .



### Note

The mounting points for engine (front) and tunnel cross member remain unchanged.

- Set up scissor-type assembly platform -VAS 6131- with support set -VAS 6131/10- as follows:

| Platform coordinates | Parts of support set -VAS 6131/10- |       |       |                     |
|----------------------|------------------------------------|-------|-------|---------------------|
| B4 <sup>5)</sup>     | /10-1                              | /10-4 | /10-5 | /10-11              |
| G4 <sup>5)</sup>     | /10-1                              | /10-4 | /10-5 | /10-12              |
| B11                  | /10-1                              | /10-2 | /10-5 | /10-8 <sup>6)</sup> |
| G11                  | /10-1                              | /10-2 | /10-5 | /10-8 <sup>6)</sup> |
| F13 <sup>5)</sup>    | /10-1                              | /10-3 | /10-5 | /10-6               |
| C15 <sup>5)</sup>    | /10-1                              | /10-3 | /10-5 | /10-6               |

5) Support elements remain unchanged.

6) Secure support elements only after installing the subframe.

- Fit subframe onto the two support elements -VAS 6131/10-8- .
- Screw up the spindles for support elements on both sides.
- Tighten base plates for support elements to 20 Nm on scissor-type assembly platform -VAS 6131- .
- Slowly guide engine gearbox assembly together with subframe into the body from below using scissor-type assembly platform -VAS 6131- .

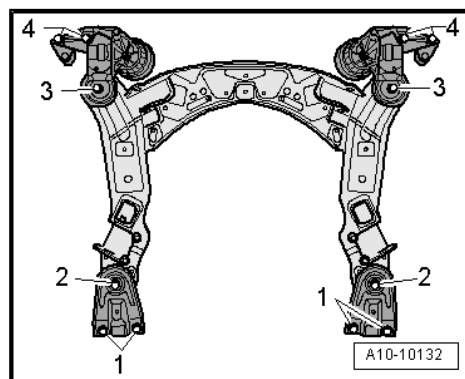
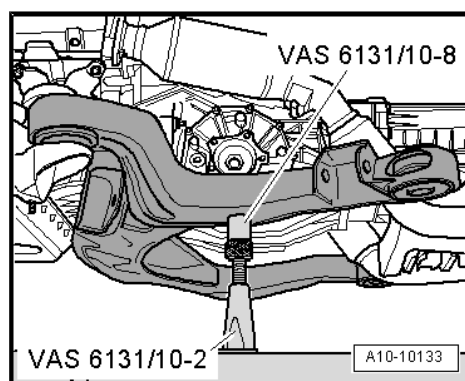
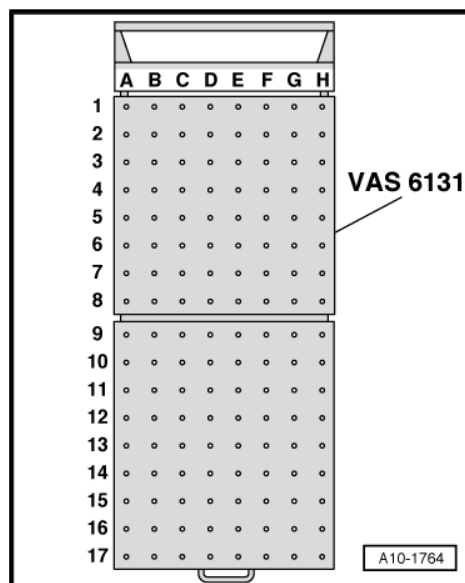
- Adjust the subframe and consoles for engine mountings according to the markings made on the longitudinal members during removal.
- Only tighten bolts for subframe and consoles for engine mountings to the specified torque (do not turn further); tighten bolts only after performing wheel alignment check.

- 1 - 50 Nm
- 2 - 150 Nm
- 3 - 150 Nm
- 4 - 75 Nm



# WARNING

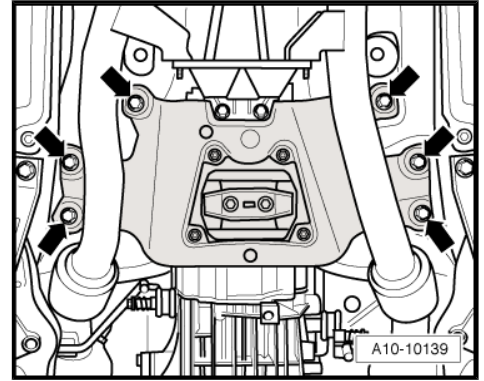
*The vehicle must not be driven at this stage.*



- Tighten bolts -arrows- at tunnel cross member.

Remaining installation steps are carried out in reverse sequence; note the following:

- Install selector lever cable; check adjustment if necessary ⇒ multitronic gearbox 01J, front-wheel drive; Rep. Gr. 37
- Install drive shafts ⇒ Running gear, front-wheel drive and four-wheel drive; Rep. Gr. 40 .
- Install guide link, track control link, anti-roll bar and suspension strut ⇒ Running gear, front-wheel drive and four-wheel drive; Rep. Gr. 40 .
- Align exhaust system so it is free of stress ⇒ [page 195](#) .
- Install cross piece (front) ⇒ General body repairs, exterior; Rep. Gr. 50 .
- Install air conditioner compressor ⇒ Air conditioning system; Rep. Gr. 87 .
- Install poly V-belt ⇒ [page 39](#) .



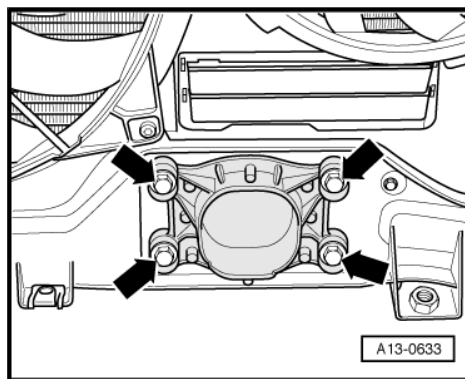
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- Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight and tighten bolts -arrows-.
- Electrical connections and routing ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- Observe notes on procedures required after connecting battery ⇒ Electrical system; Rep. Gr. 27 .



### Caution

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



- Install and adjust wiper arms ⇒ Electrical system; Rep. Gr. 92 .
- Fill up with engine oil and check oil level ⇒ [page 152](#) .
- Fill cooling system ⇒ [page 158](#) .



### 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.*
- Top up power steering fluid and bleed steering system; Running gear, front-wheel drive and four-wheel drive; Rep. Gr. 48
- Check ATF level ⇒ multitronic gearbox 01J, front-wheel drive; Rep. Gr. 37 .
- Adjust subframe and the two consoles for engine mountings ⇒ Running gear, front-wheel drive and four-wheel drive; Rep. Gr. 40 .
- Perform wheel alignment check ⇒ Running gear, front-wheel drive and four-wheel drive; Rep. Gr. 44 .



### WARNING

**Tighten bolts for subframe to final setting after performing wheel alignment check.**

## 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 %.*

| Component                                          |               | Nm |
|----------------------------------------------------|---------------|----|
| Bolts/nuts                                         | M6            | 9  |
|                                                    | M8            | 20 |
|                                                    | M10           | 40 |
|                                                    | M12           | 65 |
| Except for the following:                          |               |    |
| Console for engine mounting to longitudinal member |               | 75 |
| Tunnel cross member to body                        |               | 40 |
| Pressure line for power steering to:               | Pressure hose | 40 |
|                                                    | Coolant pipe  | 20 |
| Fuel supply line to fuel rail                      |               | 23 |
| Oil cooler to sump (top section)                   |               | 30 |
| Oil filter to oil cooler                           |               | 20 |
| Torque reaction support to engine                  |               | 40 |
| Stop for torque reaction support to lock carrier   |               | 23 |

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## 13 – Crankshaft group

### 1 Servicing work on pulley end

#### 1.1 Poly V-belt drive for power steering pump, alternator and air conditioner compressor - exploded view

##### 1 - Poly V-belt

- ☐ Before removing, mark direction of rotation with chalk or felt-tipped pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.
- ☐ Removing and installing ⇒ [page 39](#)
- ☐ Check for wear

##### 2 - Alternator

- ☐ Removing and installing ⇒ Electrical system; Rep. Gr. 27

##### 3 - 23 Nm

##### 4 - 23 Nm

##### 5 - Bracket for alternator

##### 6 - 40 Nm

##### 7 - Tensioner for poly V-belt

- ☐ Removing and installing ⇒ [page 40](#)

##### 8 - 23 Nm

##### 9 - Poly V-belt pulley for power steering pump

- ☐ To remove and install: counterhold with pin wrench -3212-
- ☐ Marked "Vorne/Front"

##### 10 - Seals

- ☐ Renew

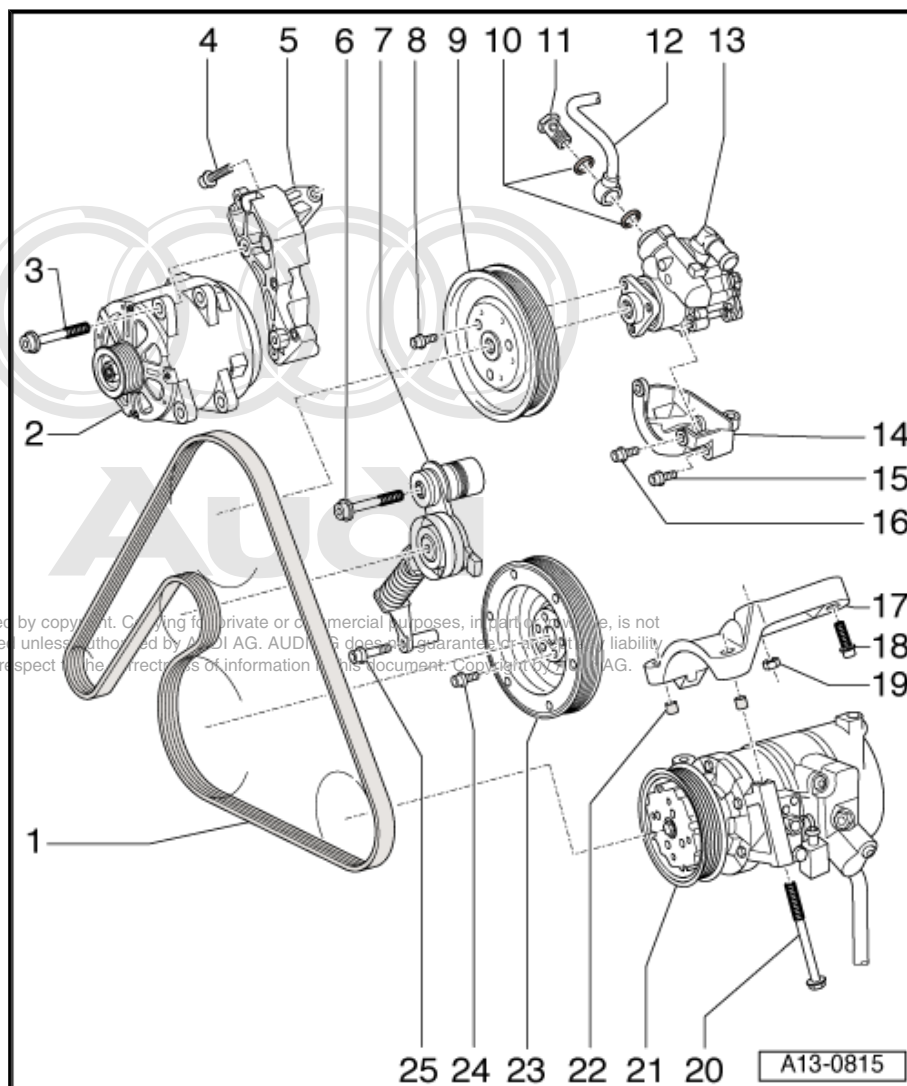
##### 11 - Banjo bolt, 47 Nm

##### 12 - Pressure line

- ☐ To power-assisted steering

##### 13 - Power steering pump

- ☐ Removing and installing ⇒ Running gear, front-wheel drive and four-wheel drive; Rep. Gr. 48



**14 - Bracket for power steering pump**

15 - 23 Nm

16 - 23 Nm

**17 - Bracket for air conditioner compressor**

18 - 23 Nm

19 - 23 Nm

20 - 25 Nm

**21 - Air conditioner compressor**

- ☐ Do not unscrew or disconnect refrigerant hoses or pipes.
- ☐ After detaching compressor from mountings, secure it to body with wire or similar. Do not leave it suspended from refrigerant pipes.

**22 - Bush for air conditioner compressor**

- ☐ 2x

**23 - Vibration damper**

- ☐ Depending on version, thrust washer is fitted between vibration damper and toothed belt sprocket  
⇒ [page 42](#)
- ☐ Removing and installing ⇒ [page 42](#)

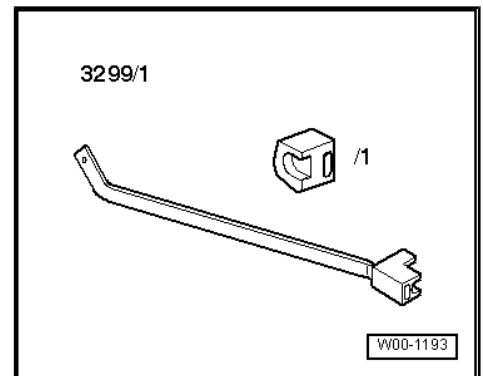
24 - 23 Nm

25 - 23 Nm

## 1.2 Removing and installing poly V-belt

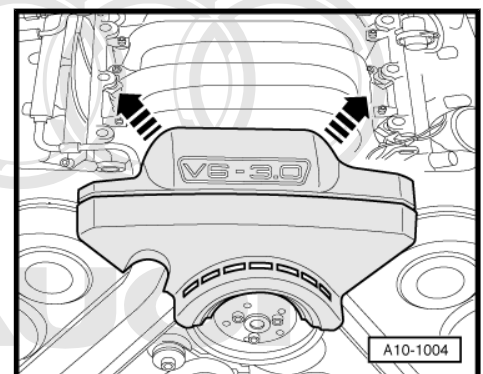
### Special tools and workshop equipment required

- ◆ Poly V-belt lever -3299- with bracket -3299/1-



### Removing

- Pull off engine cover panel (front) -arrows-.



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### Note

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

- To slacken poly V-belt, apply pressure to tensioner by moving poly V-belt lever -3299- and bracket -3299/1- in the direction of the -arrow-.
- Remove poly V-belt from power steering pump pulley.

### Installing

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

- First place poly V-belt over crankshaft pulley. Then push belt onto tensioning roller.

### Routing of poly V-belt

- 1 - Alternator
- 2 - Poly V-belt
- 3 - Power steering pump
- 4 - Air conditioner compressor
- 5 - Crankshaft
- 6 - Tensioning roller



### Note

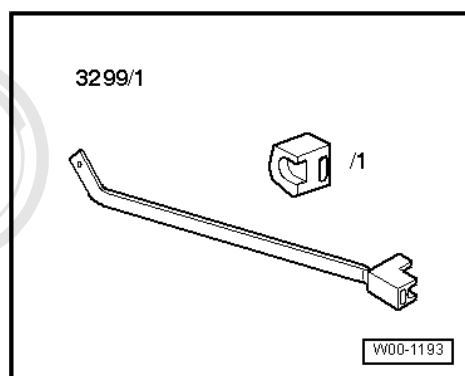
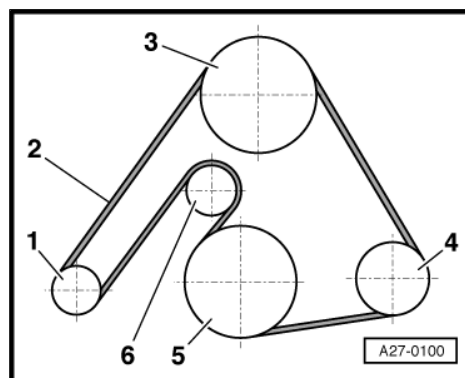
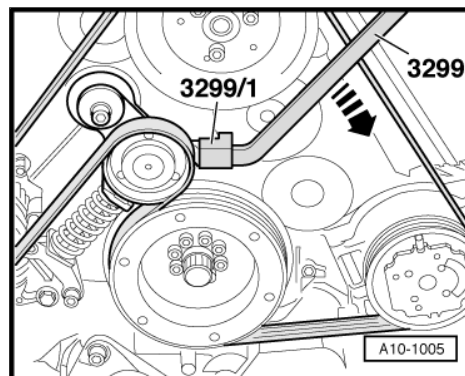
When installing poly V-belt, make sure it is properly seated on pulleys.

- Start engine and check that belt runs properly.

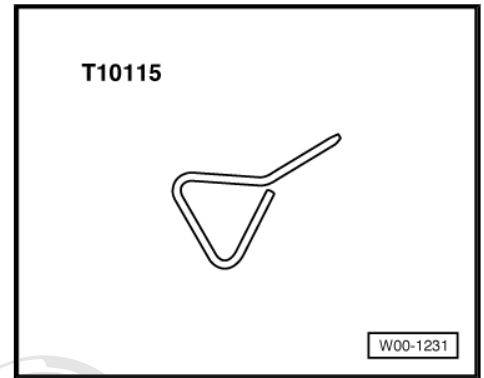
## 1.3 Removing and installing tensioner for poly V-belt

### Special tools and workshop equipment required

- ♦ Poly V-belt lever -3299- with bracket -3299/1-

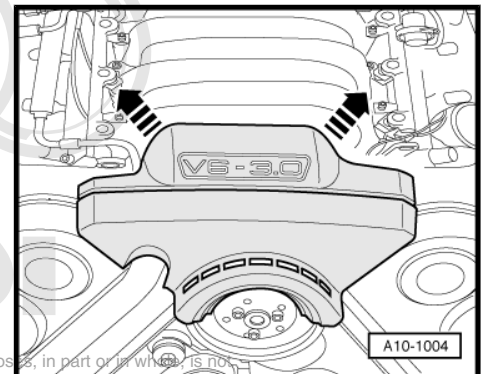


◆ Locking pin -T10115-



### Removing

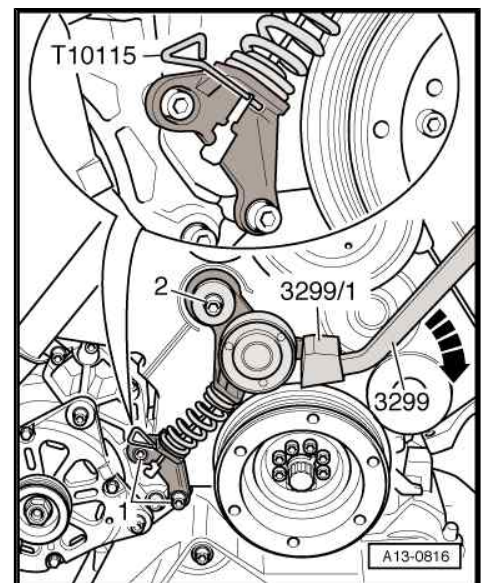
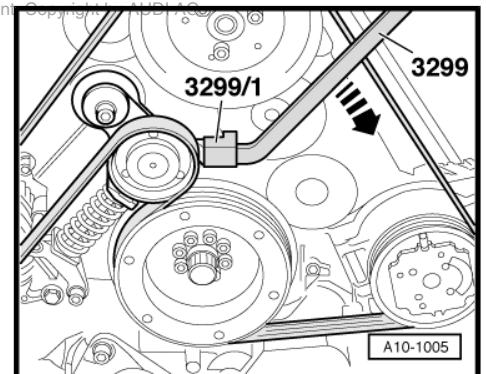
- Pull off engine cover panel (front) -arrows-.



### Note

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

- To slacken poly V-belt, apply pressure to tensioner by moving poly V-belt lever -3299- and bracket -3299/1- in the direction of the -arrow-.
- Remove poly V-belt from power steering pump pulley.
- To lock the tensioner for poly V-belt, apply pressure to tensioner by moving poly V-belt lever -3299- and bracket -3299/1- in the direction of the -arrow-, lock tensioner into place using locking pin -T10115- and release pressure.
- Unscrew bolts -1- and -2- and remove tensioner for poly V-belt (tensioner remains locked).



### Installing

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

- Install poly V-belt → [page 39](#) .

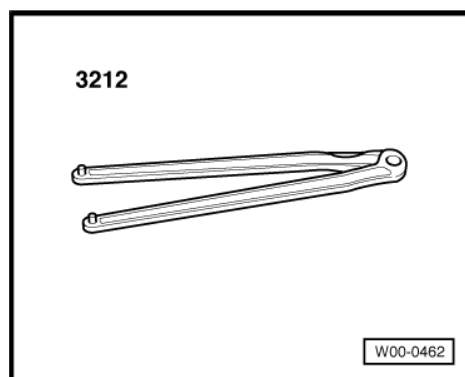
### Tightening torques

| Component                                           | Nm |
|-----------------------------------------------------|----|
| Tensioner for poly V-belt to bracket for alternator | 23 |
| Tensioner for poly V-belt to cylinder block         | 40 |

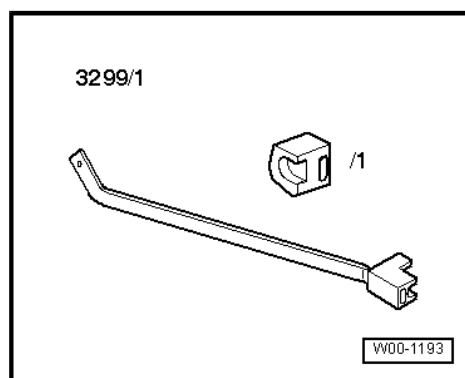
## 1.4 Removing and installing vibration damper

### Special tools and workshop equipment required

- ◆ Pin wrench -3212-



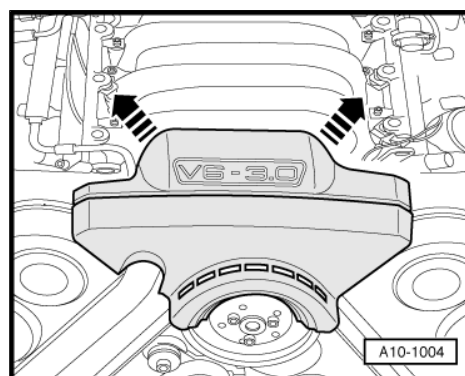
- ◆ Poly V-belt lever -3299- with bracket -3299/1-



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### Removing

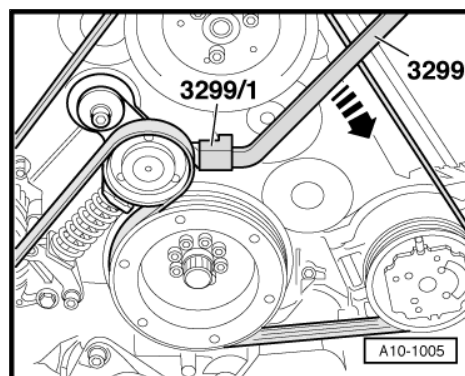
- Pull off engine cover panel (front) -arrows-.



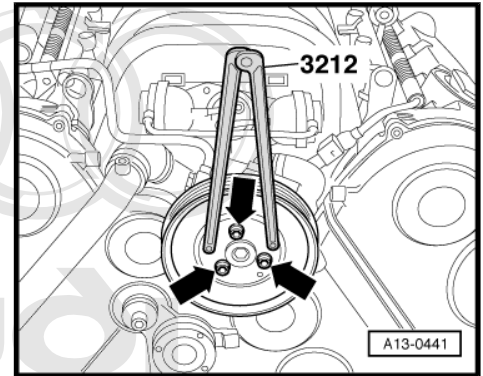
### Note

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

- To slacken poly V-belt, apply pressure to tensioner by moving poly V-belt lever -3299- and bracket -3299/1- in the direction of the -arrow-.
- Remove poly V-belt from power steering pump pulley.



- Unbolt poly V-belt pulley at power steering pump -arrows-, using pin wrench -3212- as a counterhold.



- Unscrew the 8 bolts -1-.
- Remove vibration damper -2- and thrust washer -3-.



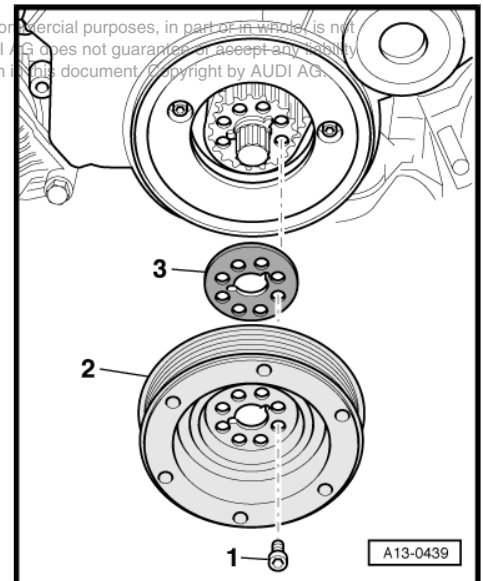
#### Note

*The thrust washer -3- is only fitted in conjunction with toothed belt sprocket -06C 105 063 A-. If toothed belt sprocket -06C 105 063 B- is fitted, do NOT install thrust washer.*

#### Installing

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

- Install the thrust washer so that the curved rim faces towards the vibration damper.

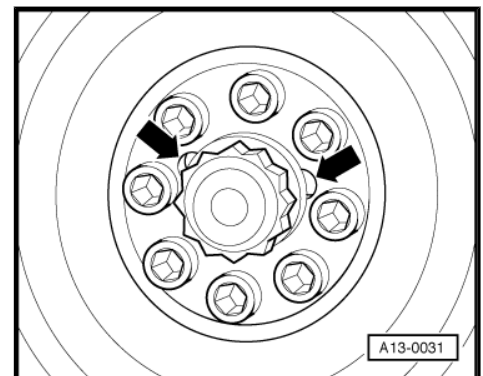


- When installing vibration damper, ensure that notches -arrows- in vibration damper are aligned with locating lugs on toothed belt sprocket.

- Install poly V-belt ⇒ [page 39](#) .

#### Tightening torques

| Component                                             | Nm |
|-------------------------------------------------------|----|
| Vibration damper to crankshaft                        | 23 |
| Pulley for power steering pump to power steering pump | 23 |



## 2 Removing and installing sealing flange, damper unit / flywheel

1 - 10 Nm

2 - 30 Nm

- ☐ Self-locking
- ☐ Renew

3 - Crankshaft oil seal

- ☐ Removing and installing  
⇒ [page 45](#)

4 - Screw plug, 10 Nm

5 - Seal

- ☐ Renew

6 - O-ring

- ☐ Renew

7 - Chain tensioner

- ☐ Removing and installing  
⇒ [page 148](#)

8 - Washer

9 - 12 Nm

10 - O-ring

- ☐ Renew

11 - 40 Nm

12 - Torque reaction support

13 - Sump (top section)  
☐ Removing and installing  
⇒ [page 141](#)

14 - 45 Nm

15 - M7 = 16 Nm; M8 = 22 Nm

16 - Special bolt

- ☐ Renew
- ☐ Tightening torque ⇒ [page 53](#)

17 - Bolt

- ☐ Loosening and tightening ⇒ multitronic 01J, front-wheel drive; Rep. Gr. 13

18 - Damper unit for multitronic gearbox

- ☐ Removing and installing ⇒ multitronic 01J, front-wheel drive; Rep. Gr. 13

19 - Flywheel

- ☐ Removing and installing ⇒ [page 52](#)

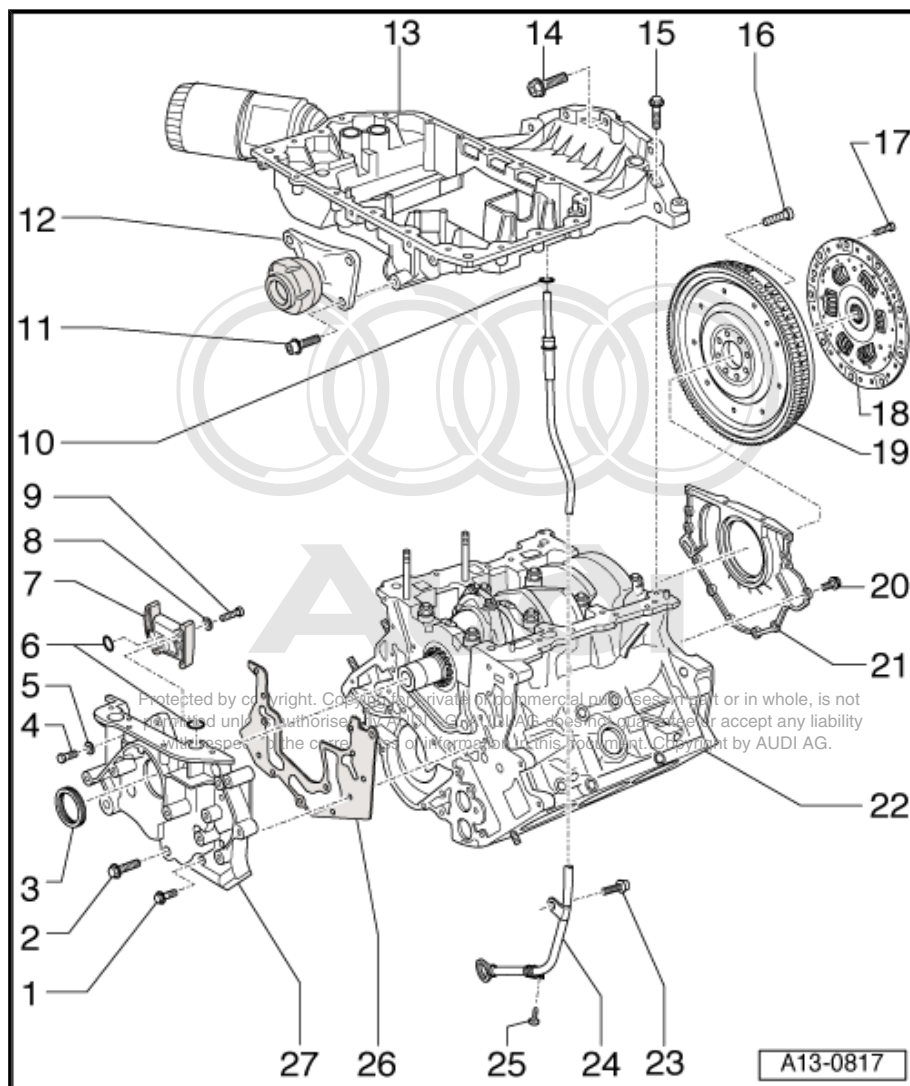
20 - 10 Nm

21 - Sealing flange (rear) with oil seal

- ☐ Removing and installing ⇒ [page 50](#)
- ☐ Lubricate sealing lip of oil seal lightly
- ☐ To install, push guide sleeve from installation kit onto crankshaft

22 - Cylinder block

- ☐ Removing and installing crankshaft ⇒ [page 54](#)
- ☐ Dismantling and assembling pistons and conrods ⇒ [page 60](#)



23 - 10 Nm

24 - Guide tube for oil dipstick

25 - Panel bolt

26 - Gasket

☐ Renew

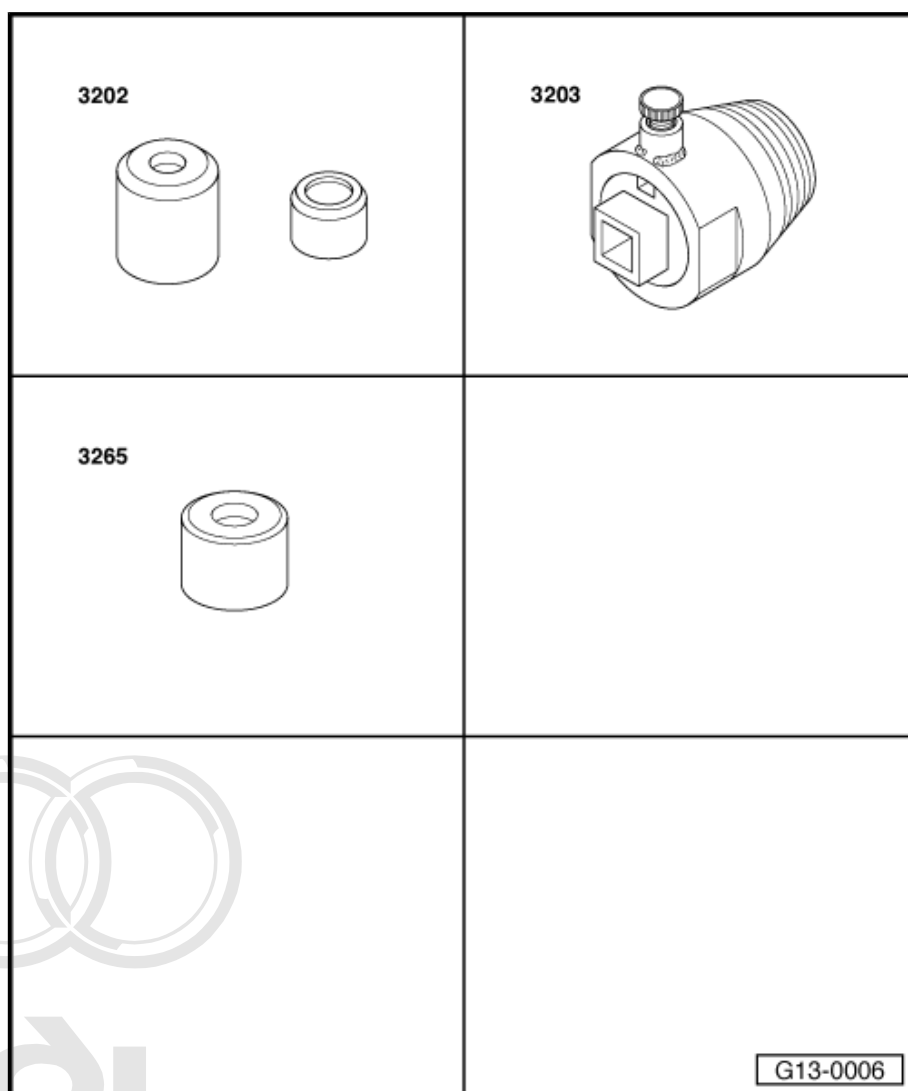
27 - Sealing flange (front)

☐ Removing and installing ⇒ [page 47](#)

## 2.1 Renewing crankshaft oil seal (pulley end)

### Special tools and workshop equipment required

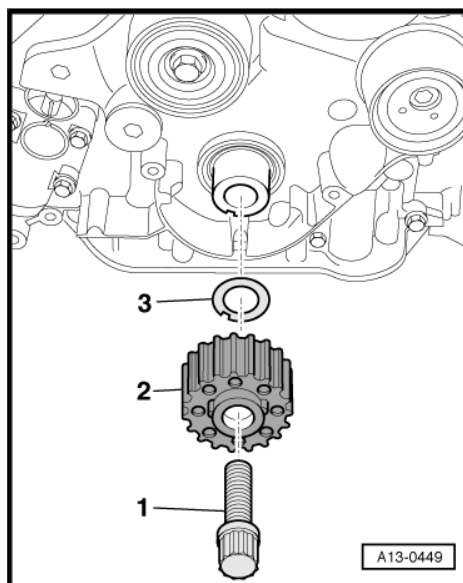
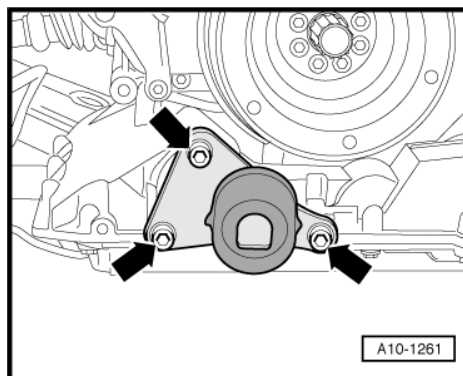
- ◆ Fitting sleeve -3202/1-
- ◆ Oil seal extractor -3203-
- ◆ Fitting sleeve -3265-



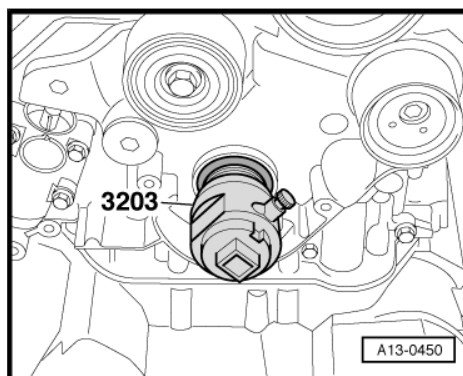
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## Removing

- Remove toothed belt ⇒ [page 67](#) .
- Unscrew bolts -arrows- and remove torque reaction support from engine.
- Unscrew central bolt -1- for crankshaft toothed belt sprocket -2- and remove sprocket.
- Remove diamond-coated washer -3- from toothed belt sprocket.



- Unscrew inner section of oil seal extractor -3203- 6 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.



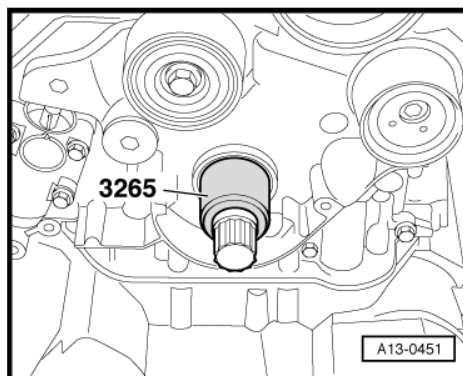
## Installing



### Note

*Do not lubricate sealing lip and external edge of oil seal before pressing in.*

- Clean running surface and sealing surface.
- Push on oil seal using fitting sleeve -3202/1- .
- Press oil seal on as far as the stop using fitting sleeve -3265- and central bolt.



- Install crankshaft toothed belt sprocket -2- with new diamond-coated washer -3- and new central bolt -1-.

**i Note**

- ◆ *The contact surfaces between toothed belt sprocket, diamond-coated washer and crankshaft must be free of oil.*
- ◆ *Do not additionally lubricate bolt for crankshaft toothed belt sprocket.*

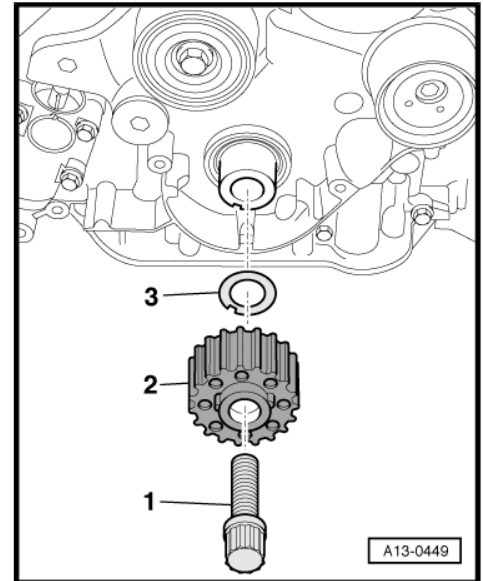
- Install toothed belt (adjust valve timing) ⇒ [page 75](#) .

**Tightening torques**

| Component                           | Nm                          |
|-------------------------------------|-----------------------------|
| Toothed belt sprocket to crankshaft | 200 + 180° <sup>7) 8)</sup> |
| Torque reaction support to engine   | 40                          |

7) Renew bolt.

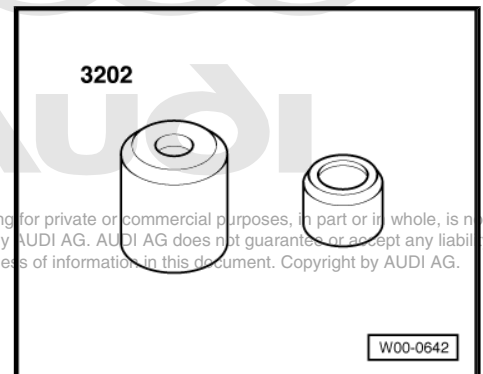
8) 180° = one half turn.



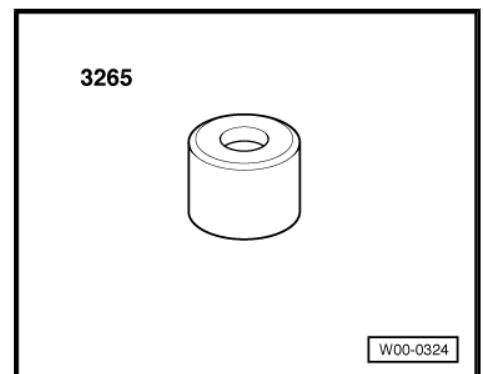
## 2.2 Removing and installing sealing flange (front)

**Special tools and workshop equipment required**

- ◆ Fitting sleeve -3202/1-



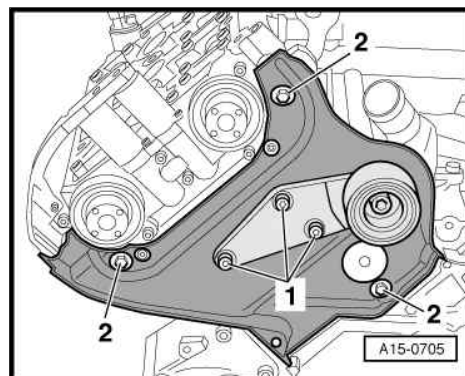
- ◆ Fitting sleeve -3265-



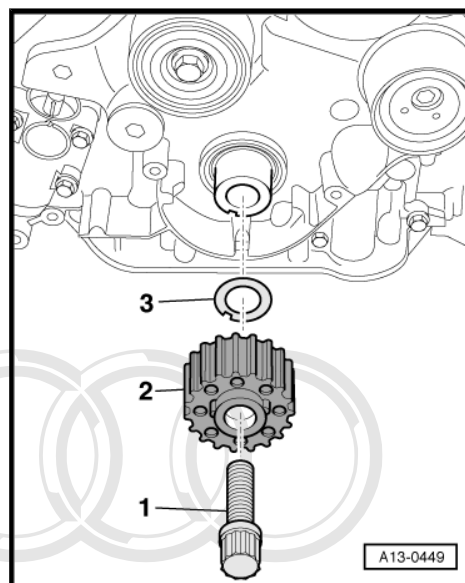
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## Removing

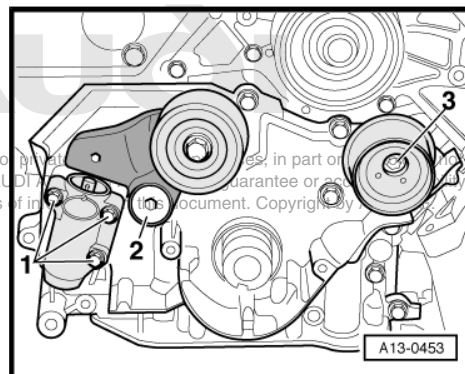
- Remove toothed belt ⇒ [page 67](#) .
- Remove camshaft sprockets (right-side).
- Remove bolts -1- and take off bracket with idler roller.
- Remove bolts -2- and take off toothed belt cover (rear right).
- Remove top section of sump ⇒ [page 141](#) .



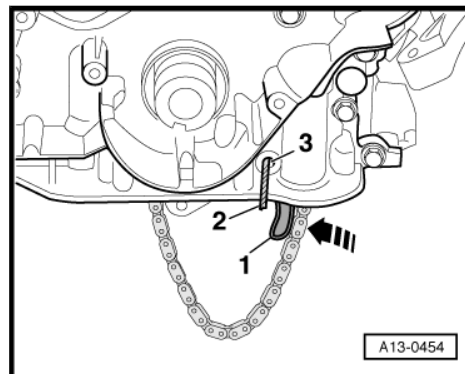
- Unscrew central bolt -1- for toothed belt sprocket -2- on crankshaft.
- Remove toothed belt sprocket and diamond-coated washer -3-.



- Unbolt eccentric adjuster -3-, tensioning lever -2- with tensioning roller and tensioner -1-.



- Unscrew plug from access hole -3-.
- Press chain tensioner -1- in direction of -arrow- until a 3 mm Ø drill bit -2- can be inserted in the access holes in the sealing flange and the chain tensioner.



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- Remove bolts -1- and -2-.
- Pull off sealing flange (front).
- Drive out oil seal with flange removed.

**i Note**

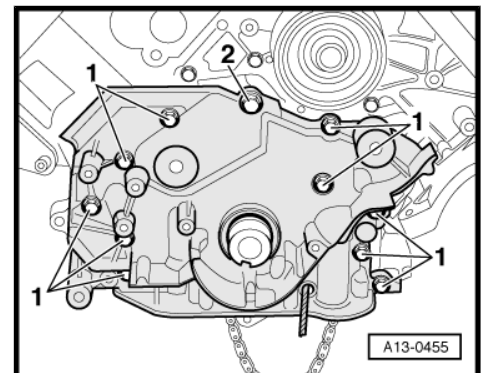
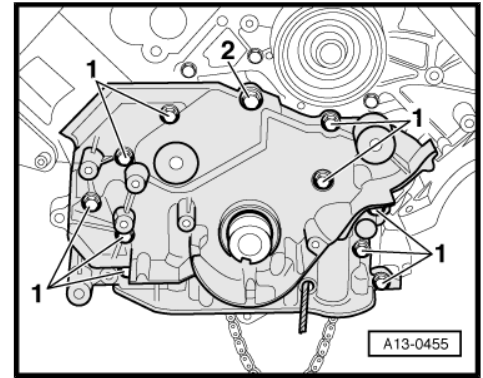
*The chain tensioner must be removed if the sealing flange is renewed ⇒ [page 148](#).*

**Installing**

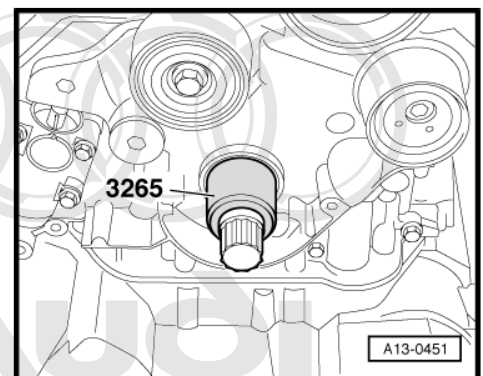
Installation is carried out in the reverse order; note the following:

**i Note**

- ◆ *Renew gaskets, seals and self-locking bolts.*
- ◆ *Do not lubricate sealing lip and external edge of oil seal before pressing in.*
- Clean sealing surfaces before installing sealing flange.
- Install sealing flange (front) with chain tensioner locked in position.
- Renew bolt -2-.
- Tighten bolts -1- to 10 Nm and bolt -2- to 30 Nm.



- Push on oil seal using fitting sleeve -3202/1-.
- Press oil seal on as far as the stop using fitting sleeve -3265- and central bolt.



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- Install eccentric adjuster -3-, but do not tighten yet.

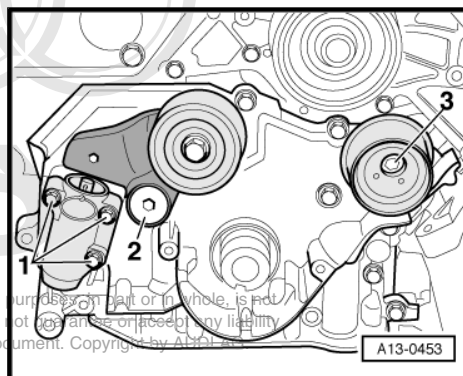


### Note

Note washer fitted under tensioning lever -2-.

- Install tensioning lever -2- with tensioning roller and tensioner -1-.

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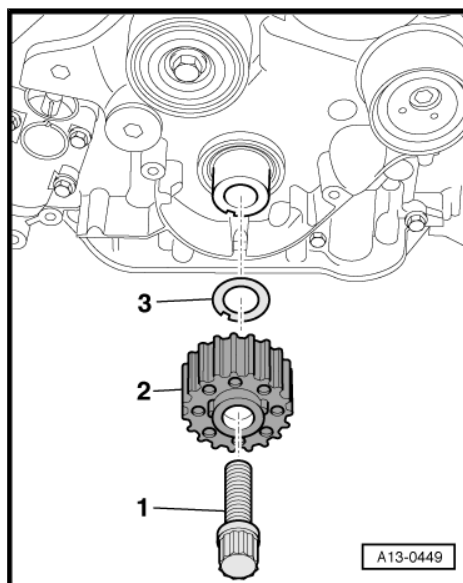


- Install crankshaft toothed belt sprocket -2- with new diamond-coated washer -3- and new central bolt -1-.



### Note

- ◆ The contact surfaces between toothed belt sprocket, diamond-coated washer and crankshaft must be free of oil.
- ◆ Do not additionally lubricate bolt for crankshaft toothed belt sprocket.
- Install sump (top section) ⇒ [page 146](#) .
- After installing oil pump, pull drill bit out of access hole and screw in sealing plug with a new seal.
- Install toothed belt (adjust valve timing) ⇒ [page 75](#) .



### Tightening torques

| Component                                              |    | Nm                                      |
|--------------------------------------------------------|----|-----------------------------------------|
| Sealing flange (front) to                              | M6 | 10                                      |
| Cylinder block                                         | M8 | 30 <sup>9)</sup>                        |
| Tensioning lever to sealing flange (front)             |    | 30 + 90° <sup>9)</sup> <sup>10)</sup>   |
| Tensioner to sealing flange (front)                    |    | 10                                      |
| Crankshaft sprocket to crankshaft                      |    | 200 + 180° <sup>9)</sup> <sup>11)</sup> |
| Sealing plug for access hole to sealing flange (front) |    | 10                                      |

9) Renew bolts.

10) 90° equals a 1/4 turn.

11) 180° = one half turn.

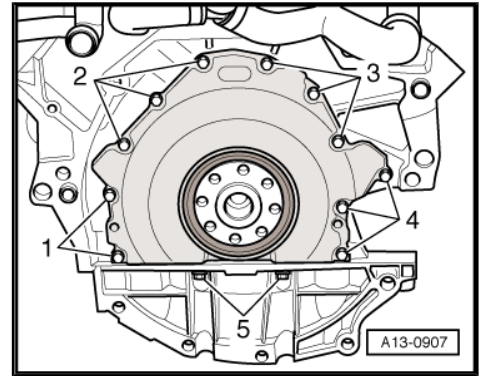
## 2.3 Removing and installing sealing flange (rear)

### Special tools and workshop equipment required

- ◆ Electric drill with plastic brush attachment
- ◆ Safety goggles
- ◆ Sealant ⇒ Parts catalogue
- ◆ Assembly sleeve -T20097-

## Removing

- Engine or gearbox removed.
- Remove damper unit ⇒ multitronic gearbox 01J, front-wheel drive; Rep. Gr. 13.
- Remove flywheel ⇒ [page 52](#).
- Unscrew bolts -1 ... 5- and remove sealing flange.



## Installing

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

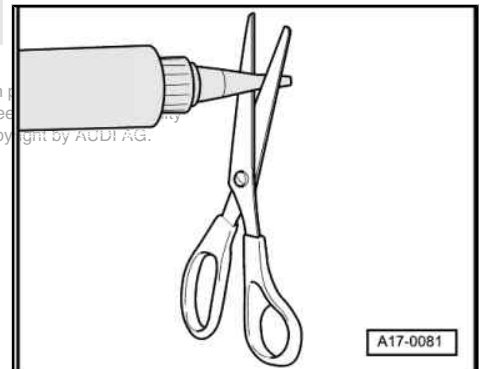
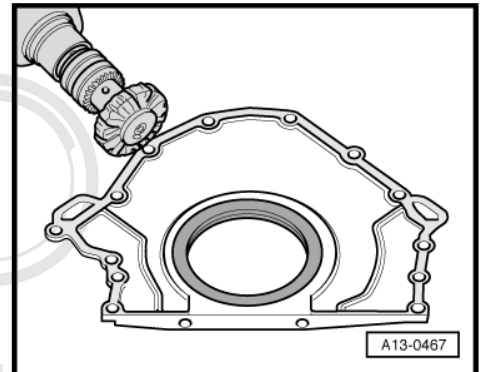
- Remove remaining sealant on rear sealing flange and cylinder block using rotating plastic brush or similar.



### WARNING

*Wear safety goggles.*

- Clean sealing surfaces; they must be free of oil and grease.
- Cut off nozzle of tube at front marking (Ø of nozzle approx. 1 mm).

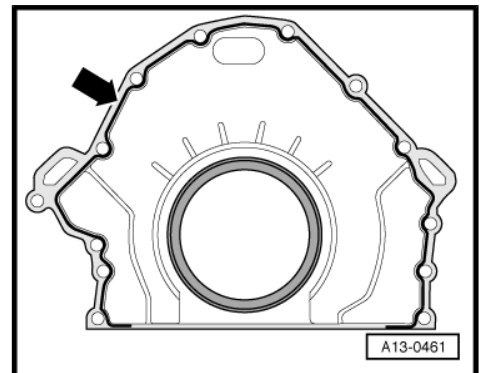


- Apply the bead of sealant onto the clean sealing surface of the sealing flange as illustrated.
- The bead of sealant should be approx. 1.5 mm wide -arrow-.

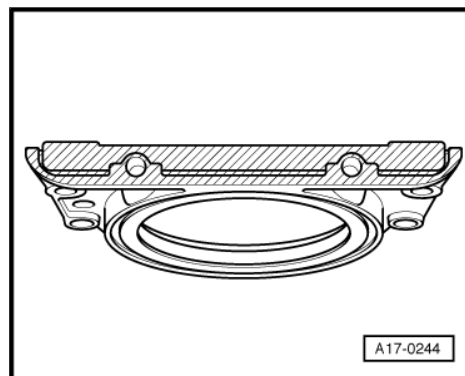


### Note

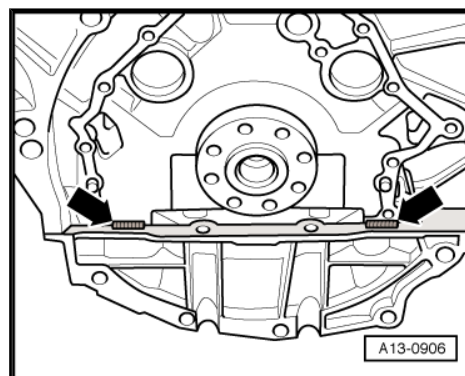
- ◆ *The sealant bead must not be thicker than specified, otherwise excess sealant could enter the sump and clog the strainer in the oil pump.*
- ◆ *The sealing flange (rear) must be installed within 5 minutes after applying sealant.*



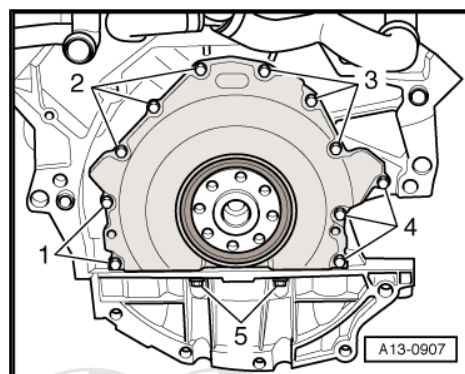
- Coat the lower sealing surface on the sealing flange lightly with sealant -hatched area-.
- To install, push guide sleeve from assembly kit onto crankshaft.



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



- Fit assembly sleeve -T20097- onto crankshaft journal.
- Push the sealing flange carefully onto the dowel sleeves on the cylinder block.
- Tighten bolts -1 ... 4- to 10 Nm and bolts -5- to 14 Nm.
- Install flywheel ⇒ [page 52](#) .
- Install damper unit ⇒ multitronic gearbox 01J, front-wheel drive; Rep. Gr. 13 .



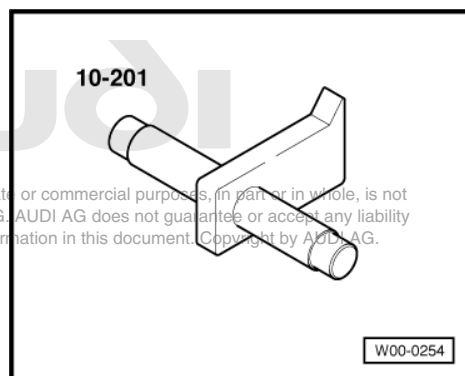
#### Tightening torques

| Component                                    | Nm |
|----------------------------------------------|----|
| Sealing flange (rear) to cylinder block      | 10 |
| Sealing flange (rear) to top section of sump | 14 |

## 2.4 Removing and installing flywheel

### Special tools and workshop equipment required

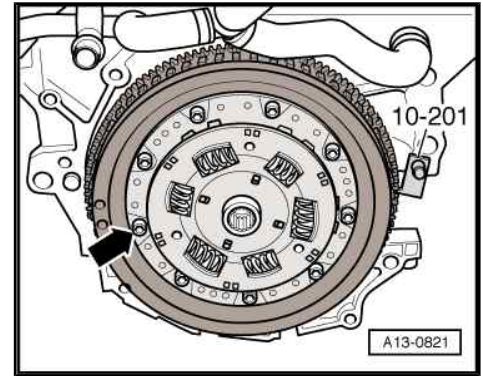
- ◆ Counterhold tool -10-201-



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## Removing

- Engine or gearbox removed.
- Remove the damper unit -arrow- ⇒ multitronic gearbox 01J, front-wheel drive; Rep. Gr. 13 .

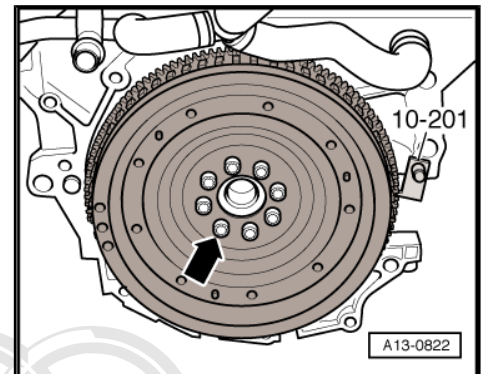


- Mark installation position of flywheel on engine -arrow-.
- Attach counterhold tool -10-201- in order to loosen bolts.
- Unbolt flywheel.

## Installing

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

- Use new securing bolts.
- Reverse position of counterhold tool -10-201- in order to tighten bolts.
- Install damper unit ⇒ multitronic gearbox 01J, front-wheel drive; Rep. Gr. 13 .



## Tightening torque

| Component              |                        | Nm                                     |
|------------------------|------------------------|----------------------------------------|
| Flywheel to crankshaft | Bolt length<br>22.5 mm | 60 + 90° <sup>12)</sup> <sup>13)</sup> |

12) 90° equals a 1/4 turn.

13) Renew bolts.

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### 3 Removing and installing crankshaft



#### Note

When carrying out repairs, secure engine to assembly stand with engine and gearbox support -VAS 6095- ⇒ [page 30](#) .

#### 1 - Bolt

- ☐ For bearing cap
- ☐ Renew
- ☐ Tightening sequence ⇒ [page 56](#)

#### 2 - Dowel sleeve

- ☐ Insert in cylinder block

#### 3 - Drive chain sprocket for oil pump

- ☐ Removing and installing ⇒ [page 58](#)

#### 4 - Bearing cap

- ☐ Note marking ⇒ [page 55](#)
- ☐ Removing ⇒ [page 55](#)
- ☐ Installing ⇒ [page 56](#)

#### 5 - Nut

- ☐ For bearing cap
- ☐ Renew
- ☐ Tightening sequence ⇒ [page 56](#)

#### 6 - Thrust washer

- ☐ Only fitted on 4th crankshaft bearing
- ☐ Oil grooves face outwards
- ☐ Note location
- ☐ Measuring axial clearance of crankshaft ⇒ [page 57](#)

#### 7 - Bearing shell

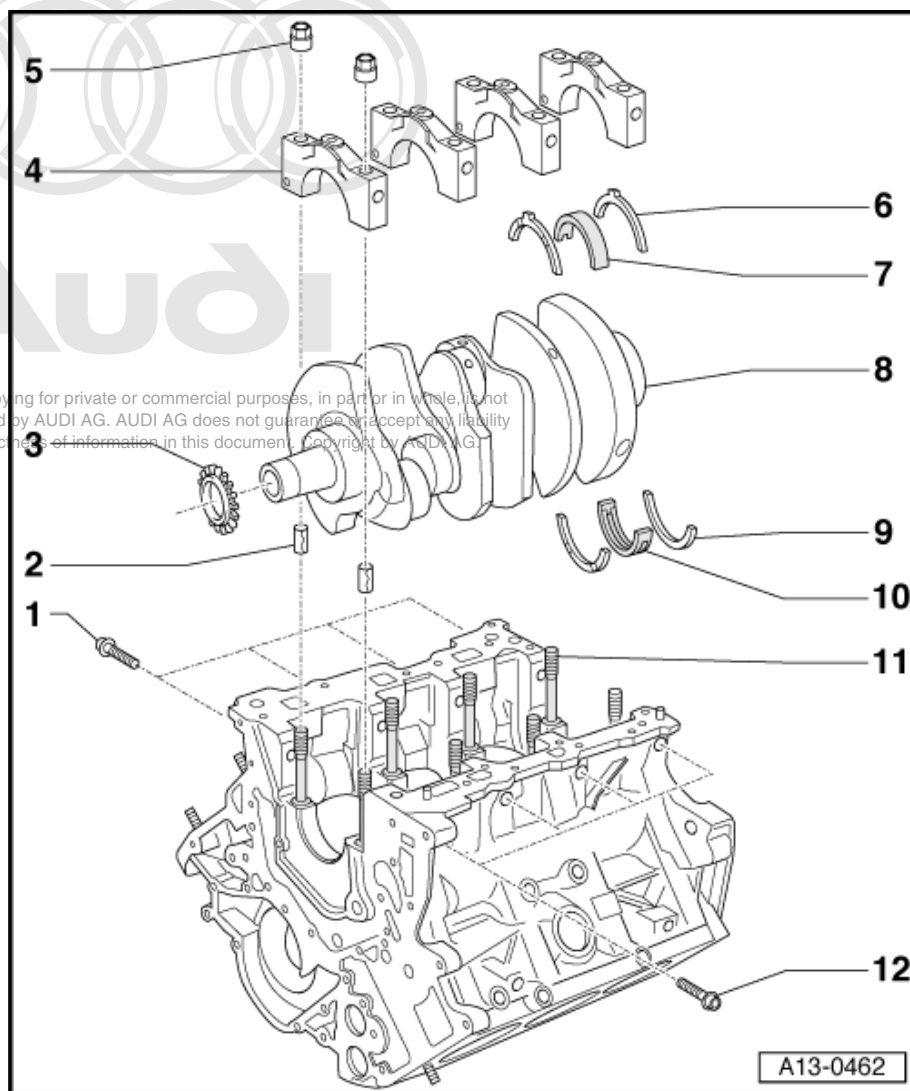
- ☐ For bearing cap (without oil groove)
- ☐ Do not interchange used bearing shells (mark positions)
- ☐ Install new bearing shells for the bearing caps with the correct coloured markings ⇒ [page 56](#)

#### 8 - Crankshaft

- ☐ Measuring axial clearance ⇒ [page 57](#)
- ☐ Measuring radial clearance ⇒ [page 57](#)
- ☐ Do not rotate the crankshaft when checking the radial clearance
- ☐ Crankshaft dimensions ⇒ [page 57](#)

#### 9 - Thrust washer

- ☐ Only fitted on 4th crankshaft bearing
- ☐ Oil grooves face outwards



- ☐ Measuring axial clearance of crankshaft ⇒ [page 57](#)

#### 10 - Bearing shell

- ☐ For cylinder block (with oil groove)
- ☐ Do not interchange used bearing shells (mark positions)
- ☐ Install new bearing shells for the cylinder block with the correct coloured markings ⇒ [page 56](#)

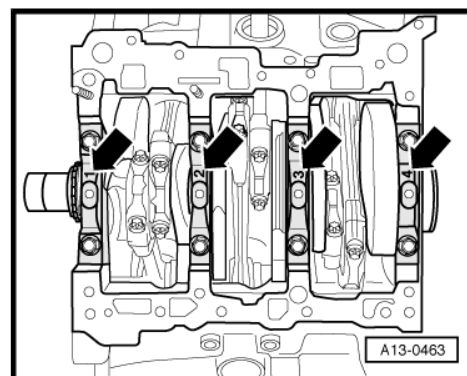
#### 11 - Stud

#### 12 - Bolt

- ☐ For bearing cap
- ☐ Renew
- ☐ Tightening sequence ⇒ [page 56](#)

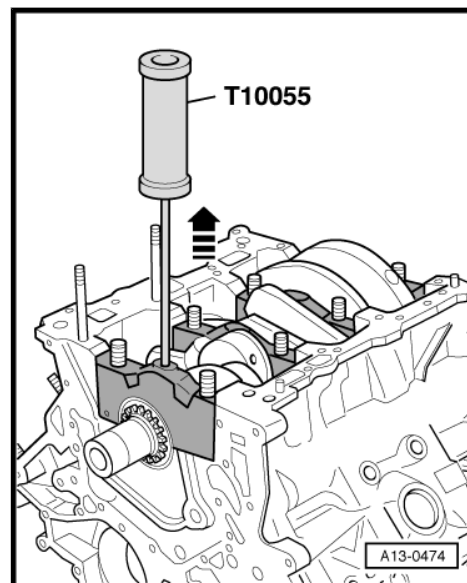
#### Markings on crankshaft bearing caps

- Bearing 1 is on pulley end.



#### Removing crankshaft bearing caps

- Remove bolts and nuts for crankshaft bearing caps.
- Pull crankshaft bearing caps off cylinder block using puller - T10055- .



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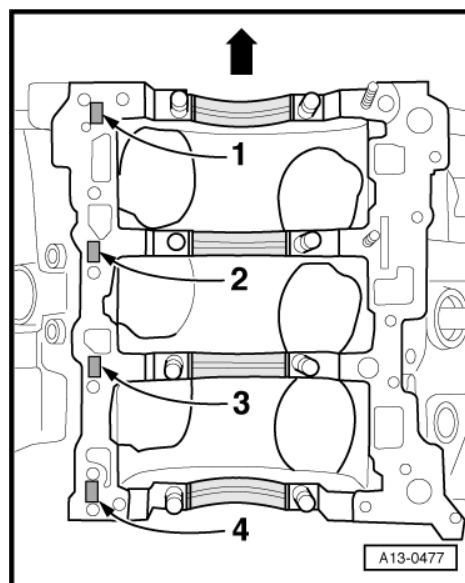
## Matching crankshaft bearing shells to bearings in cylinder block

Bearing shells of the correct thickness are matched to the bearings in the cylinder block at the factory. Coloured dots on the bearing shells are used to identify the bearing shell thickness.

- The -arrow- points to pulley end.

The allocation of the bearing shells to the cylinder block is identified by a code letter next to the relevant bearing.

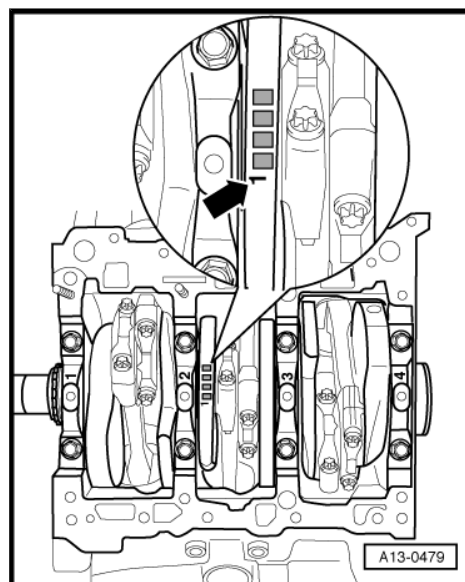
| Letter on cylinder block | Colour coding of bearing |
|--------------------------|--------------------------|
| G =                      | Yellow                   |
| B =                      | Blue                     |
| S =                      | Black                    |



## Matching crankshaft bearing shells to bearing caps

- ◆ Bearing shells of the correct thickness are assigned to the bearing caps at the factory. Coloured dots on the bearing shells are used to identify the bearing shell thickness.
- ◆ The correct allocation of bearing shells to crankshaft is indicated by a sequence of letters on the crankshaft web. The number "1" -arrow- preceding the sequence of letters indicates the colour code for No. 1 bearing.

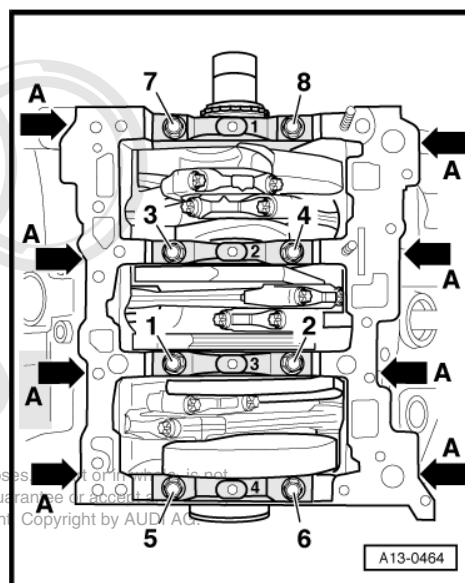
| Letter on crankshaft | Colour coding of bearing |
|----------------------|--------------------------|
| G =                  | Yellow                   |
| B =                  | Blue                     |
| S =                  | Black                    |



## Installing crankshaft bearing caps

- Renew bolts -A- and nuts -1 ... 8-
- Insert dowel sleeves in cylinder block.
- Tighten bearing cap nuts and bolts in following sequence:

| Stage | Tighten                                                            |
|-------|--------------------------------------------------------------------|
| I     | – Screw in bolts -A- hand-tight.                                   |
| II    | – Tighten nuts -1 ... 8- to 35 Nm using torque wrench.             |
| III   | – Turn nuts -1 ... 8- 90° further (1/4 turn) using a rigid wrench. |
| IV    | – Tighten bolts -A- to 20 Nm.                                      |
| V     | – Turn bolts -A- 90° further (1/4 turn) using a rigid wrench.      |



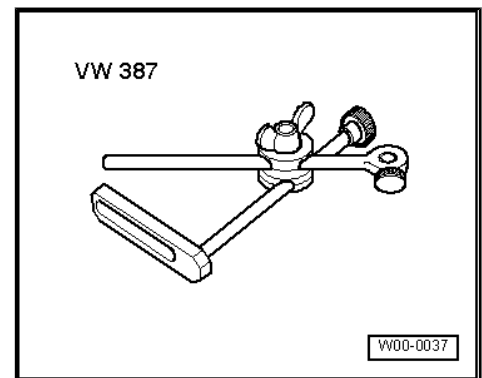
### 3.1 Crankshaft dimensions

| Honing dimension in (mm) | Crankshaft main bearing journal Ø | Crankshaft conrod journal Ø |
|--------------------------|-----------------------------------|-----------------------------|
| Basic dimension          | 65.00 - 0.022<br>- 0.042          | 54.00 - 0.022<br>- 0.042    |
| 1st undersize            | 64.75 - 0.022<br>- 0.042          | 53.75 - 0.022<br>- 0.042    |
| 2nd undersize            | 64.50 - 0.022<br>- 0.042          | 53.50 - 0.022<br>- 0.042    |
| 3rd undersize            | 64.25 - 0.022<br>- 0.042          | 53.25 - 0.022<br>- 0.042    |

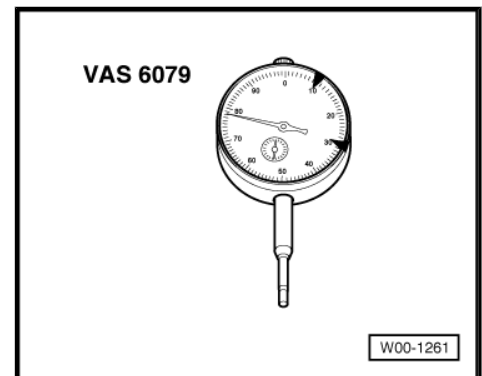
### 3.2 Measuring axial clearance

#### Special tools and workshop equipment required

- ◆ Universal dial gauge bracket -VW 387-

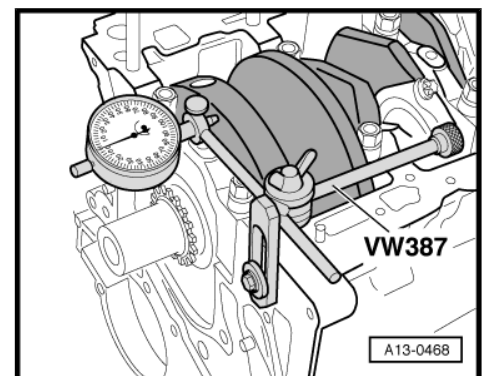


- ◆ Dial gauge -VAS 6079-



#### Procedure

- Bolt dial gauge -VAS 6079- with dial gauge bracket -VW 387- onto cylinder block and set it against crank web.
- Press crankshaft against dial gauge by hand and set gauge to -0-.
- Push crankshaft away from dial gauge and read off value:
  - Axial clearance (new): 0.07 ... 0.23 mm
  - Wear limit (axial clearance): 0.25 mm.



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### 3.3 Measuring radial clearance

#### Special tools and workshop equipment required

# ◆ Plastigage

## Procedure



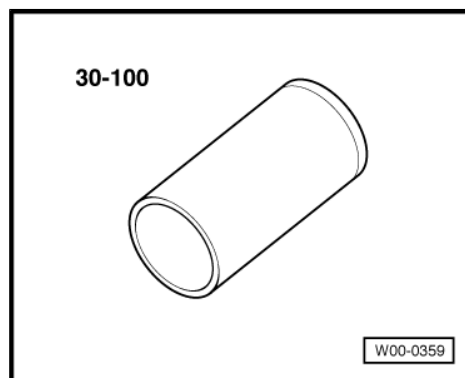
## Note

- ◆ *Do not interchange used bearings.*
- ◆ *Bearing shells worn down to nickel layer must be renewed.*
- Remove main bearing cap. Clean bearing cap and bearing journal.
- Place a length of Plastigage corresponding to the width of the bearing on the bearing journal or bearing shell.
- The Plastigage must be positioned in the centre of the bearing shell
- Mount main bearing cap and tighten to 30 Nm. Do not rotate crankshaft.
- Remove main bearing cap again.
- Compare width of Plastigage with measurement scale:
- Radial clearance (new): 0.018 ... 0.045 mm
- Wear limit (radial clearance): 0.08 mm

## 3.4 Removing and installing drive chain sprocket for oil pump

### Special tools and workshop equipment required

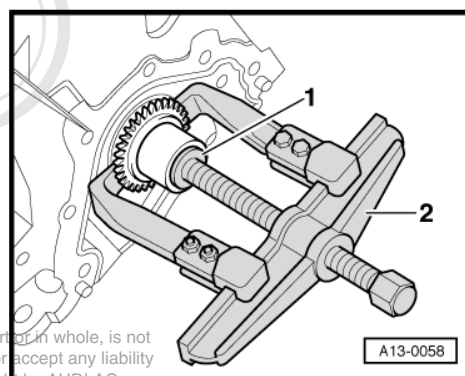
- ◆ Drift sleeve -30-100-



- ◆ Protective gloves

### Removing

- Engine removed
- Sealing flange (front) removed
- Pull chain sprocket off crankshaft with a puller -2- (normal commercial type); use a suitable washer -1- to protect end of crankshaft.



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### Installing

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

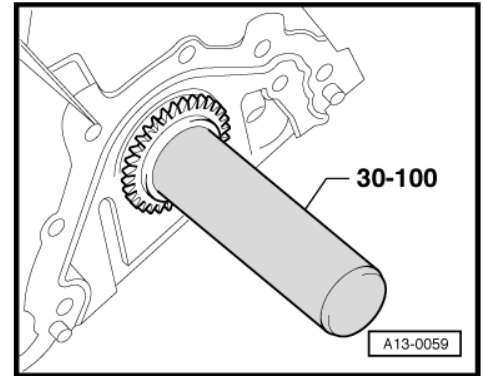
- Heat chain sprocket in oven for approx. 15 minutes to 220°C.



#### WARNING

*Wear protective gloves.*

- Fit chain sprocket on end of crankshaft using pliers, and press onto crankshaft as far as the stop using drift sleeve -30-100- .



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## 4 Dismantling and assembling pistons and conrods



### Note

Oil spray jet for piston cooling ⇒ [page 63](#) .

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

- ☐ Renew
- ☐ Lubricate threads and contact surface
- ☐ To measure radial clearance, tighten to 30 Nm but do not turn further

#### 2 - Conrod bearing cap

- ☐ Do not interchange
- ☐ Mark cylinder allocation with a coloured pen -B- ⇒ [page 62](#)
- ☐ When installing the bearing cap, the projections on the side of the conrod must be on the same side -A-
- ☐ Installation position of conrod pairs ⇒ [page 62](#)

#### 3 - Bearing shell

- ☐ Note installation position
- ☐ Do not interchange used bearing shells (mark positions)
- ☐ Measuring radial clearance ⇒ [page 63](#)
- ☐ To measure radial clearance, tighten bolts ⇒ [Item 1 \(page 60\)](#) to 30 Nm but do not turn further

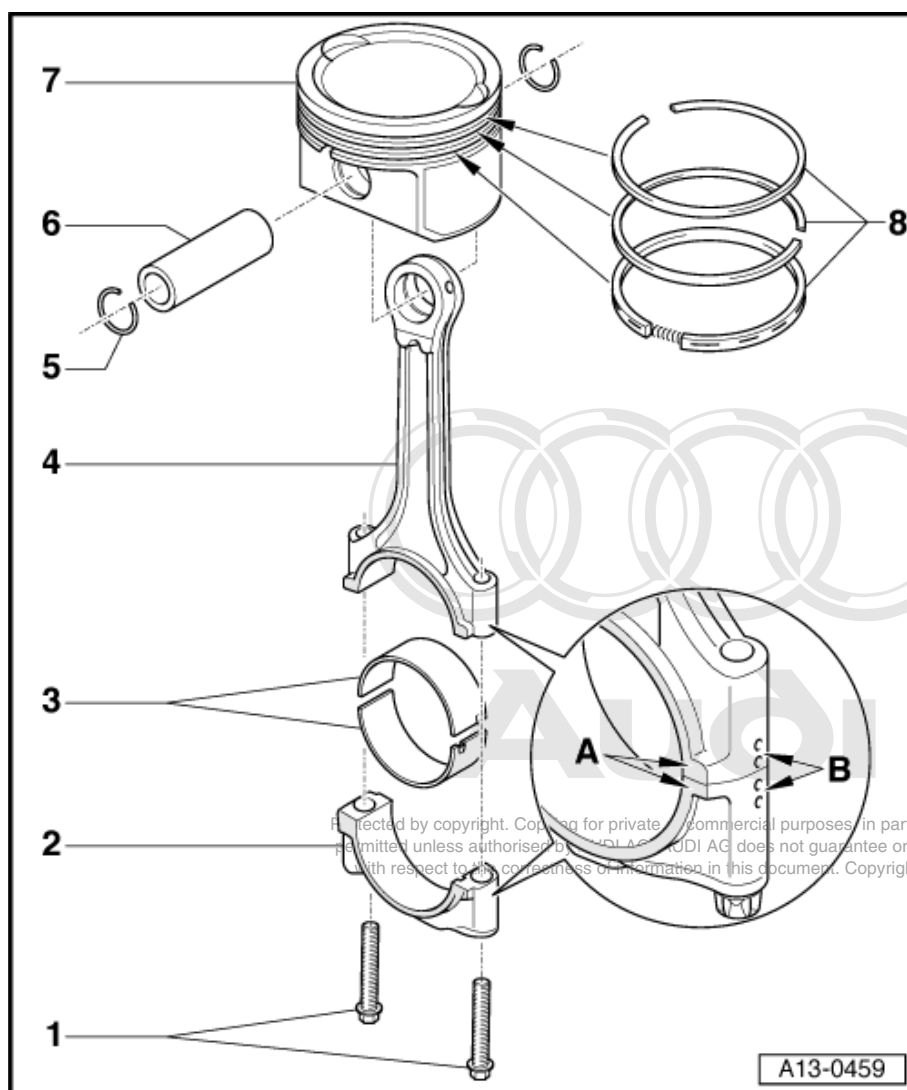
#### 4 - Conrod

- ☐ Only renew as a complete set
- ☐ Mark cylinder allocation with a coloured pen -B- ⇒ [page 62](#)
- ☐ Measuring radial clearance ⇒ [page 63](#)
- ☐ When installing the bearing cap, the projections on the side of the conrod must be on the same side -A-
- ☐ Installation position of conrod pairs ⇒ [page 62](#)

#### 5 - Circlip

#### 6 - Piston pin

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



## 7 - Piston

- ☐ Installation position and allocation of piston/cylinder ⇒ [page 62](#)
- ☐ Arrow on piston crown points to pulley end
- ☐ Checking ⇒ [page 61](#)
- ☐ Install using piston ring clamp
- ☐ Piston and cylinder dimensions ⇒ [page 63](#)
- ☐ Checking cylinder bore ⇒ [page 62](#)

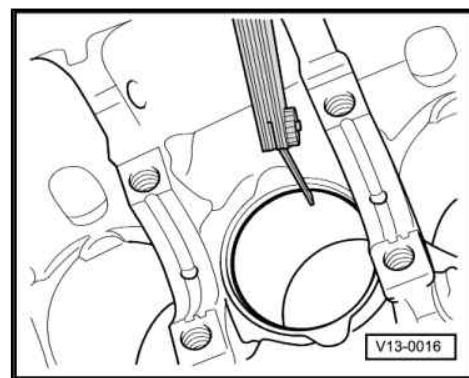
## 8 - Piston rings

- ☐ Offset gaps by 120°
- ☐ Use piston ring pliers to remove and install
- ☐ Marking "TOP" or side with identification mark must face piston crown
- ☐ Checking ring gap ⇒ [page 61](#)
- ☐ Checking ring-to-groove clearance ⇒ [page 61](#)

### 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.

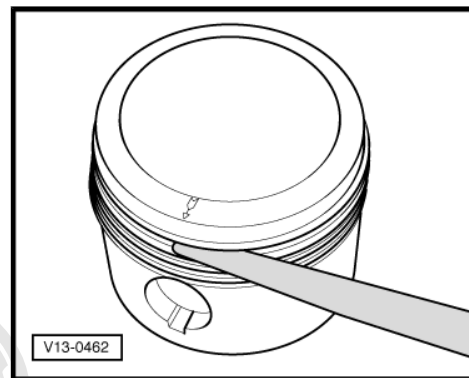
| Piston ring<br>(in mm) | New           | Wear limit |
|------------------------|---------------|------------|
| 1st compression ring   | 0.35 ... 0.50 | 0.8        |
| 2nd compression ring   | 0.60 ... 0.80 | 1.0        |
| Oil scraper ring       | 0.25 ... 0.50 | 0.8        |



### Checking ring-to-groove clearance

- Clean groove in piston before checking clearance.

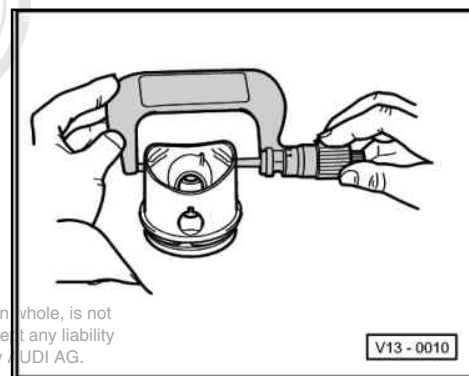
| Piston ring<br>(in mm) | New           | Wear limit |
|------------------------|---------------|------------|
| Compression rings      | 0.02 ... 0.08 | 0.20       |
| Oil scraper ring       | 0.02 ... 0.08 | 0.15       |



### Checking piston

- Using a micrometer (75 ... 100 mm), measure approx. 10 mm from the lower edge, perpendicular to the piston pin axis.
- Max. deviation from nominal dimension: 0.04 mm.

Nominal dimension ⇒ [page 63](#).

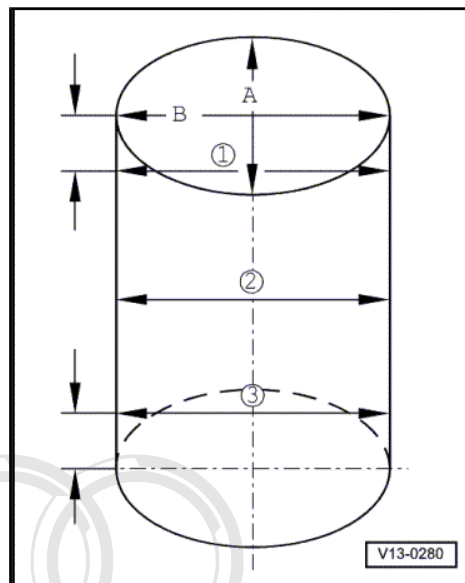


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## Checking cylinder bore

- Use 50 ... 100 mm internal dial gauge to take measurements at 3 points in transverse direction -A- and longitudinal direction -B-.
- Max. deviation from nominal dimension: 0.08 mm.

Nominal dimension ⇒ [page 63](#) .



## Piston installation position and piston/cylinder allocation

- Use chalk or waterproof felt-tip pen to mark installation position and cylinder allocation on piston crown.

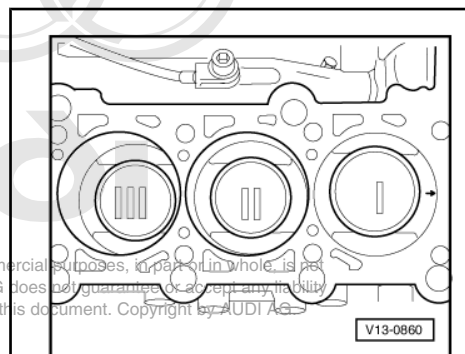


### Note

*Do not use a centre punch or scriber, as this would damage the coating of the piston crown.*

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- Installation position: Arrow on piston crown points to pulley end.

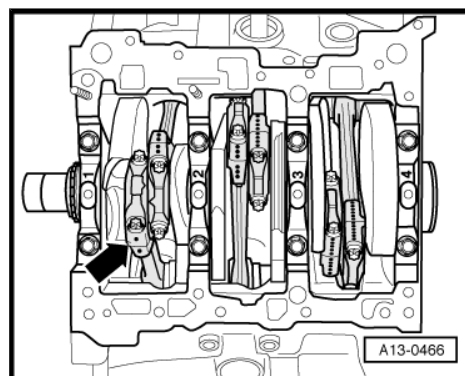


## Marking conrods



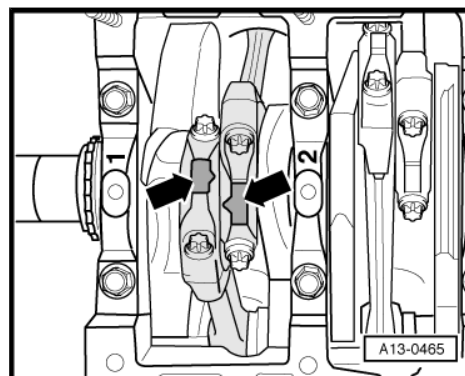
### Note

- ◆ Only renew conrods as a complete set.
- ◆ Do not interchange conrod bearings.
- Prior to removal, use a coloured pen to mark conrod and conrod bearing cap relative to one another, as well as to cylinder -arrow-.



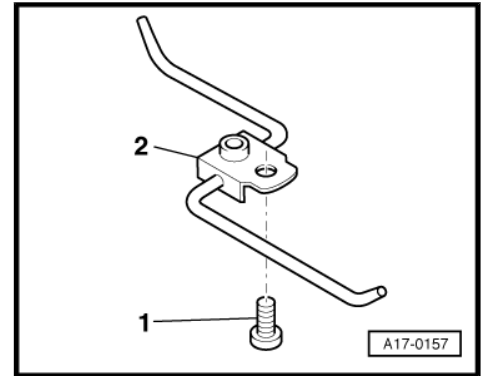
## Conrod installation position

- The cast lugs -arrows- at ground surfaces of conrod pairs 1 and 2, 3 and 4, and 5 and 6 must face one another.



### Oil spray jet for piston cooling

- 1 - Bolt, 10 Nm
- 2 - Oil spray jet for piston cooling



## 4.1 Piston and cylinder dimensions

| Honing dimension (mm) | Piston Ø              | Cylinder bore Ø |
|-----------------------|-----------------------|-----------------|
| Basic dimension       | 82.455 <sup>14)</sup> | 82.51           |
| Repair oversize       | 82.955 <sup>14)</sup> | 83.01           |

14) Dimensions not including graphite coating (thickness 0.02 mm). The graphite coating will wear down in service.

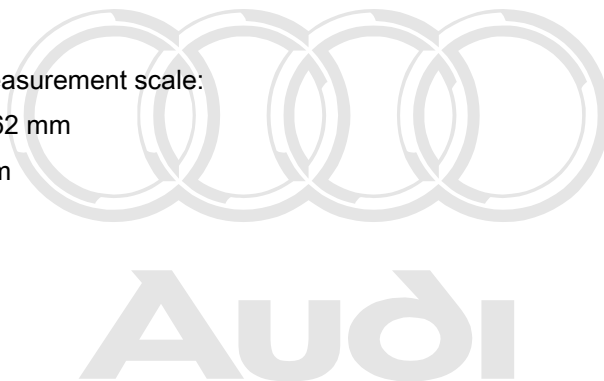
## 4.2 Measuring radial clearance of conrods

### Special tools and workshop equipment required

- ◆ Plastigage

### Procedure

- Remove conrod bearing cap. Clean bearing cap and bearing journal.
- Place a length of Plastigage corresponding to the width of the bearing on the bearing journal or bearing shell.
- Fit conrod bearing cap and tighten to 30 Nm. Do not rotate crankshaft.
- Remove conrod bearing cap again.
- Compare width of Plastigage with measurement scale:
  - Radial clearance (new): 0.015 ... 0.062 mm
  - Wear limit (radial clearance): 0.12 mm
- Renew bolts for conrod bearings.



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## 15 – Cylinder head, valve gear

### 1 Toothed belt drive

#### 1.1 Toothed belt covers - exploded view

1 - 10 Nm

2 - 10 Nm

##### 3 - Coolant pipe (front)

- ☐ To remove bottom toothed belt cover, only unscrew bolts  
⇒ [Item 1 \(page 64\)](#) and  
⇒ [Item 2 \(page 64\)](#)
- ☐ The coolant hoses remain connected to coolant pipe

##### 4 - Toothed belt cover (front right)

##### 5 - Toothed belt cover (front left)

##### 6 - Bush

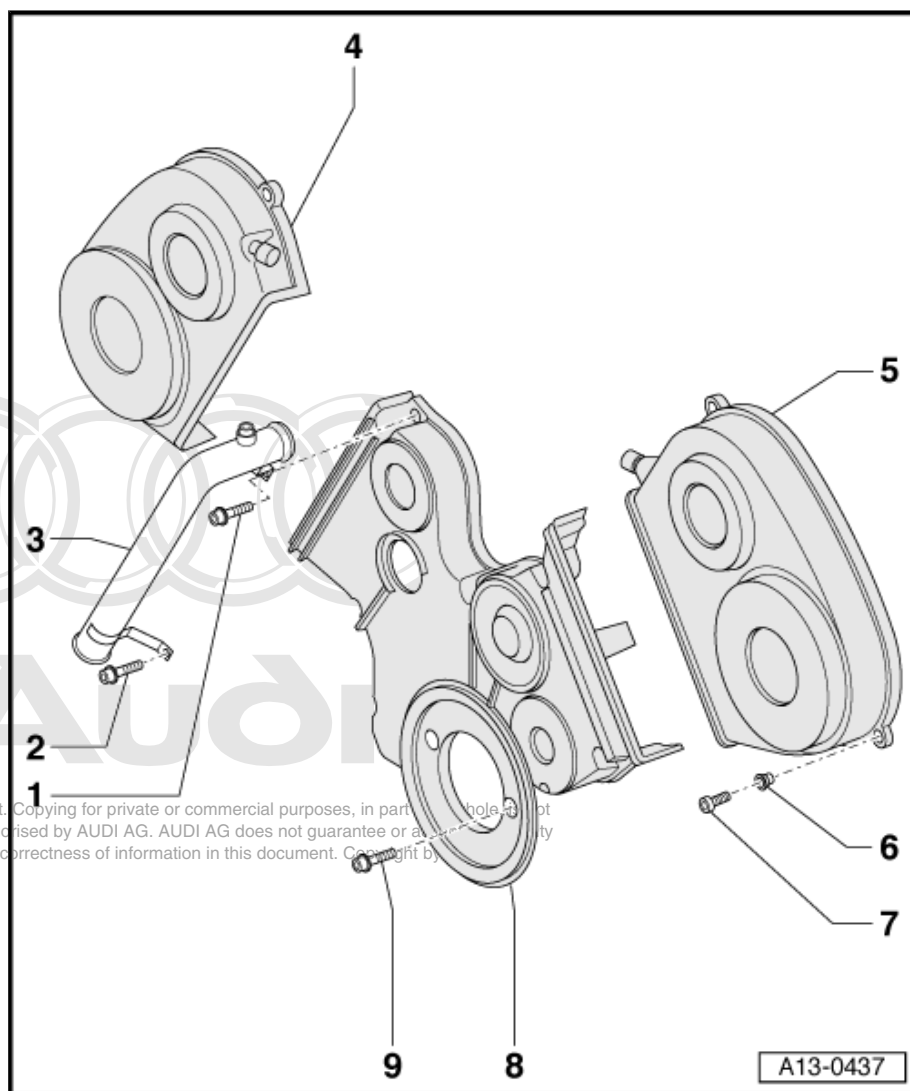
7 - 6 Nm

- ☐ Self-locking
- ☐ Renew

##### 8 - Toothed belt cover (bottom)

9 - 10 Nm

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A13-0437

## 1.2 Toothed belt drive - exploded view

1 - 30 Nm + 90° (1/4 turn) further

- ☐ Renew

2 - Washer

3 - 45 Nm

- ☐ Self-locking
- ☐ Renew

4 - Tensioning roller

5 - Tensioning lever

- ☐ Fit washer  
⇒ Item 6 (page 65) underneath

6 - Washer for tensioning lever

7 - Toothed belt

- ☐ Before removing, mark direction of rotation with chalk or felt-tipped pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.
- ☐ Check for wear
- ☐ Removing ⇒ page 67
- ☐ Installing (adjusting valve timing)  
⇒ page 75

8 - 45 Nm

9 - Toothed belt sprocket (exhaust camshaft)

- ☐ For cylinder bank 1 (right-side), with damper
- ☐ With camshaft adjuster
- ☐ Identification: "Auslass" (exhaust)

10 - Toothed belt sprocket (inlet camshaft)

- ☐ For cylinder bank 1 (right-side)
- ☐ With camshaft adjuster
- ☐ Identification: "Einlass" (inlet)

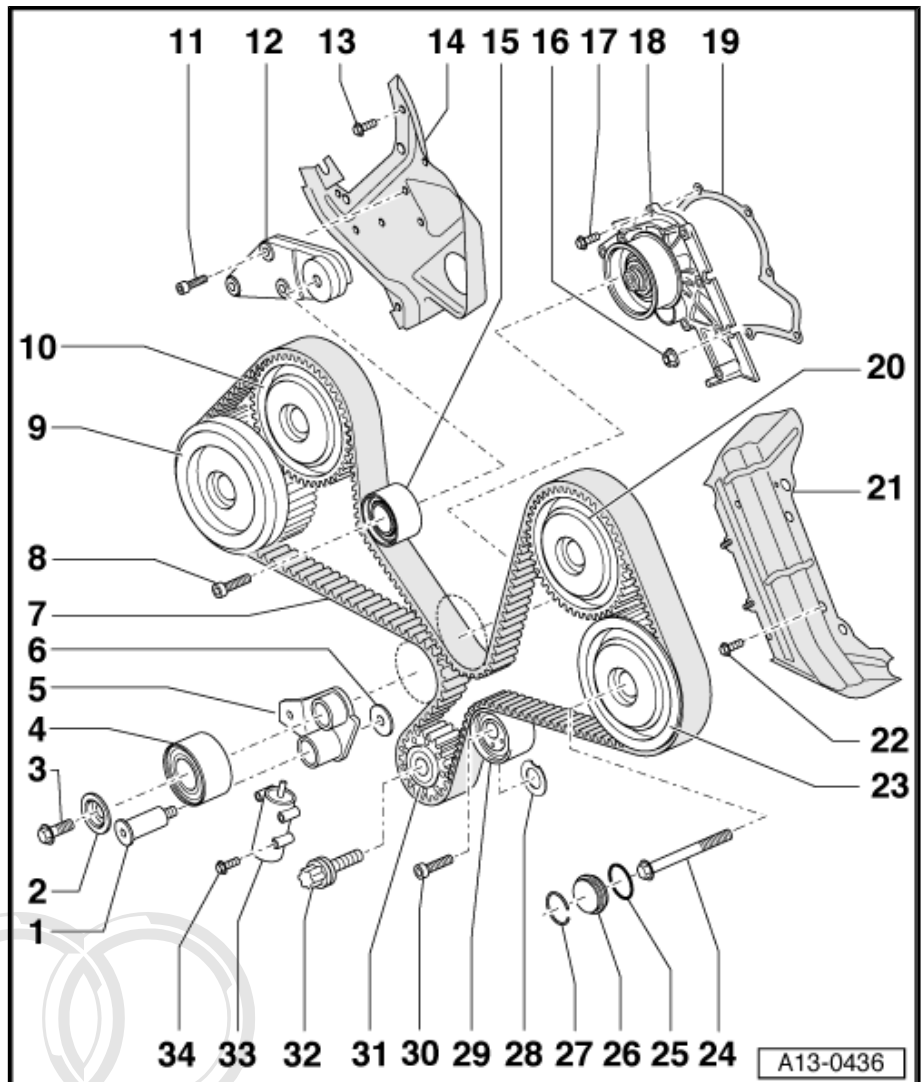
11 - 10 Nm

- ☐ Self-locking
- ☐ Renew

12 - Bracket for idler roller

13 - 10 Nm

- ☐ Self-locking
- ☐ Renew



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**14 - Toothed belt cover (rear right)****15 - Idler roller****16 - 10 Nm****17 - 10 Nm****18 - Coolant pump**

- ☐ Removing and installing ⇒ [page 162](#)

**19 - Gasket**

- ☐ Renew

**20 - Toothed belt sprocket (inlet camshaft)**

- ☐ For cylinder bank 2 (left-side)
- ☐ With camshaft adjuster
- ☐ Identification: "Einlass" (inlet)

**21 - Toothed belt cover (rear left)****22 - 10 Nm**

- ☐ Self-locking
- ☐ Renew

**23 - Toothed belt sprocket (exhaust camshaft)**

- ☐ For cylinder bank 2 (left-side), without damper
- ☐ With camshaft adjuster
- ☐ Identification: "Auslass" (exhaust)

**24 - 100 Nm**

- ☐ Use counterhold tool -T40030- to loosen and tighten

**25 - O-ring**

- ☐ Renew

**26 - Sealing cap****27 - Circlip****28 - Diamond-coated washer for toothed belt sprocket**

- ☐ Renew washer if toothed belt sprocket is removed

**29 - Eccentric adjuster****30 - 45 Nm****31 - Crankshaft sprocket****32 - Central bolt: 200 Nm + 180° (1/2 turn) further**

- ☐ Renew
- ☐ Do not additionally lubricate
- ☐ Use locking pin -T40026- when loosening and tightening
- ☐ Screwing in locking pin -T40026- ⇒ [page 74](#)
- ☐ Renew diamond-coated washer ⇒ [Item 28 \(page 66\)](#) if removed
- ☐ Contact surfaces between toothed belt sprocket, diamond-coated washer and crankshaft must be free of oil
- ☐ Can only be installed in one position
- ☐ Depending on version: with or without thrust washer. See note ⇒ [page 42](#)

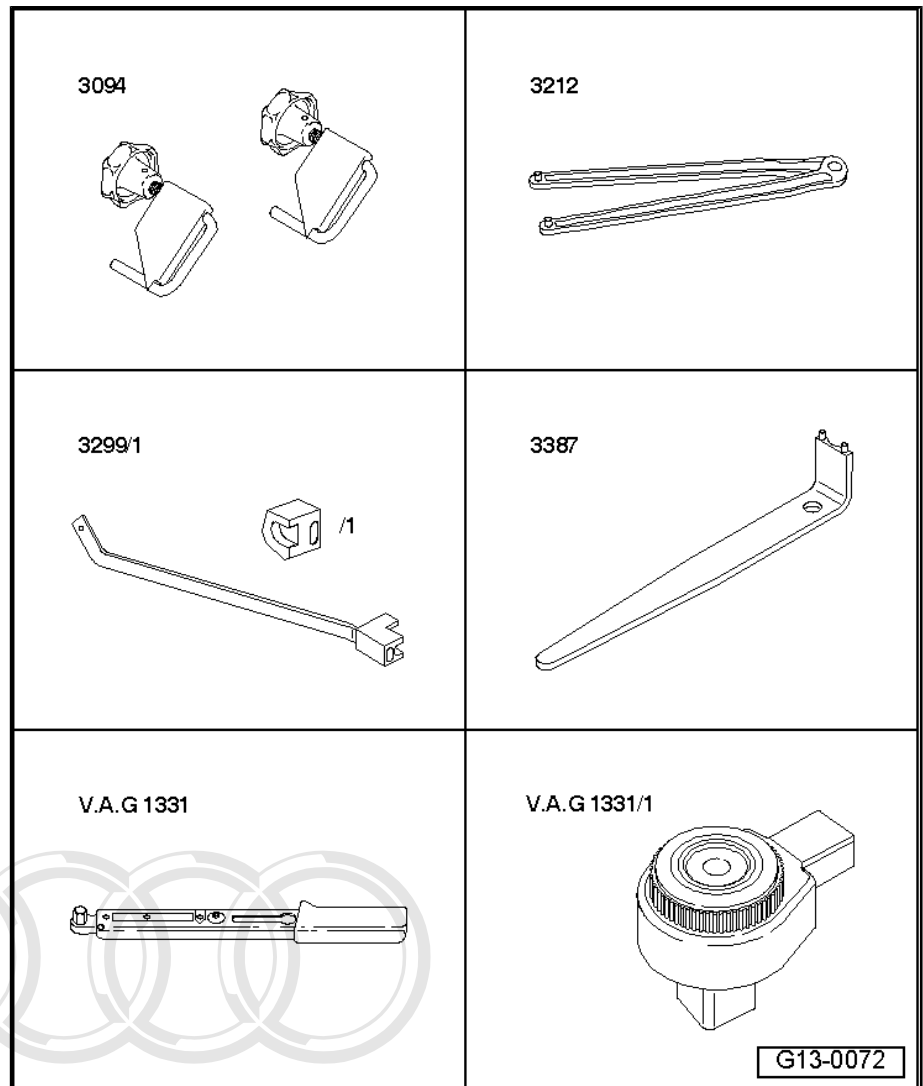
**33 - Tensioner for toothed belt****34 - 10 Nm**

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## 1.3 Removing and installing toothed belt

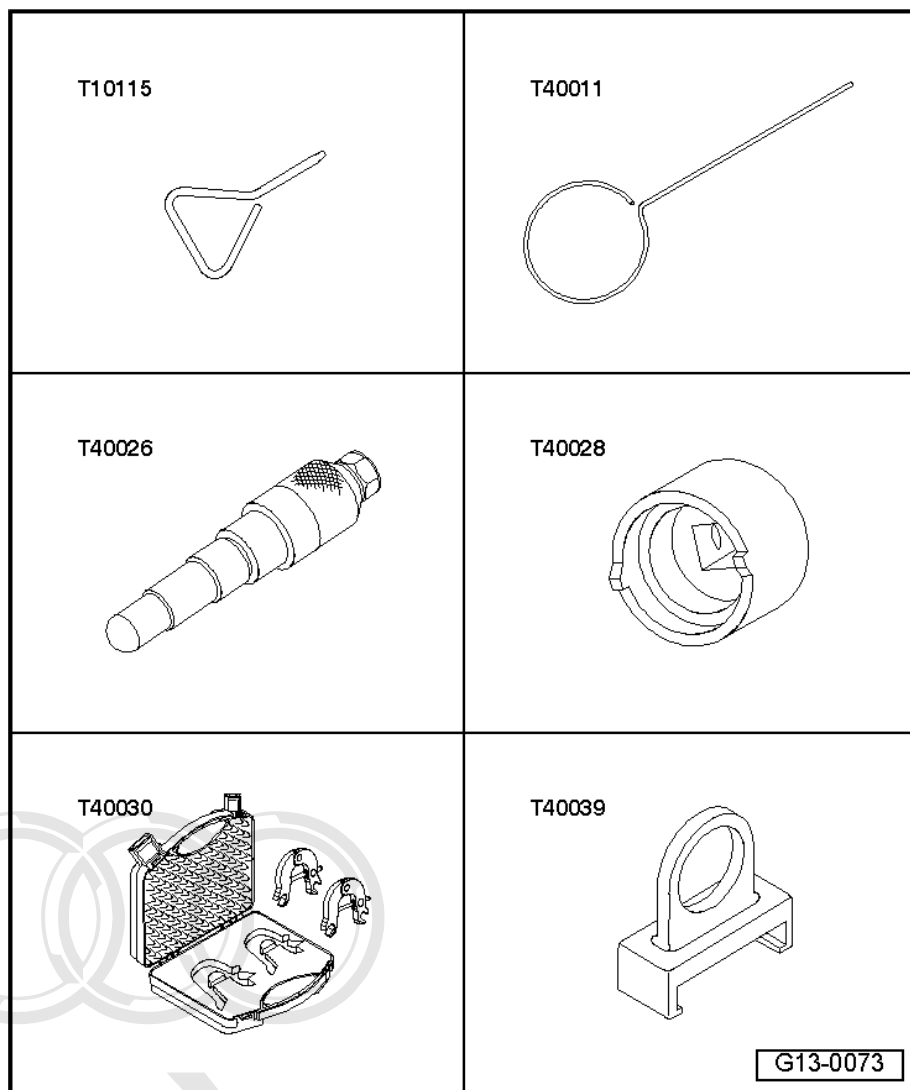
### Special tools and workshop equipment required

- ◆ Hose clamps for hoses up to 25 mm Ø -3094-
- ◆ Pin wrench -3212-
- ◆ Poly V-belt lever -3299- with bracket -3299/1-
- ◆ Pin wrench -3387-
- ◆ Torque wrench -V.A.G 1331-
- ◆ Ratchet -V.A.G 1331/1-



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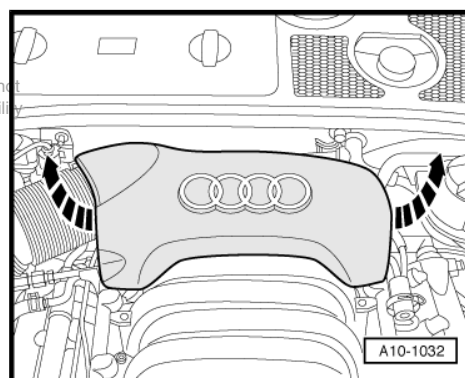
- ◆ Locking pin -T10115-
- ◆ Locking pin -T40011-
- ◆ Locking pin -T40026-
- ◆ Socket -T40028-
- ◆ Counterhold tool -T40030-
- ◆ Puller -T40039-



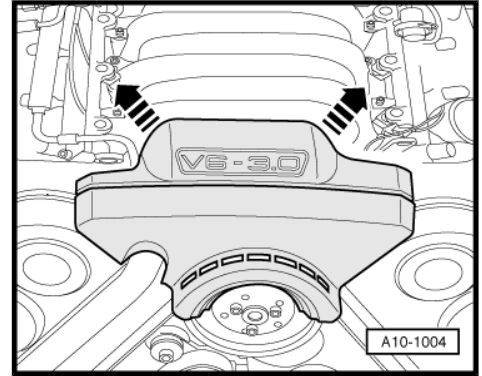
## Removing

- Pull off engine cover panel (rear) -arrows-

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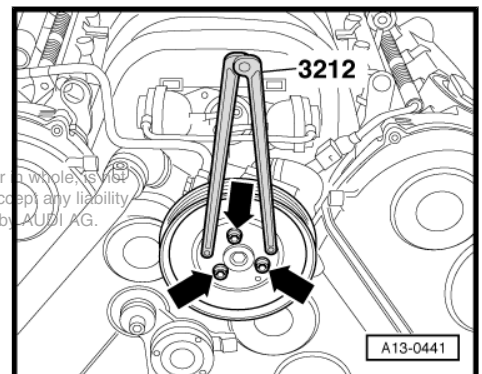
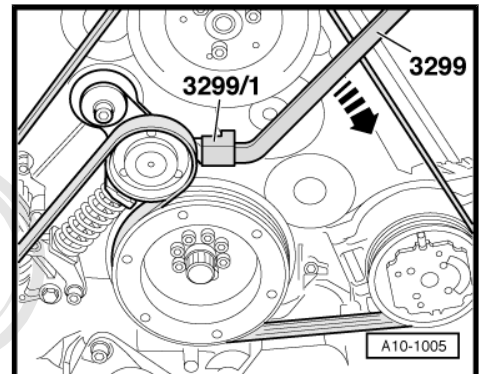
- Pull off engine cover panel (front) -arrows-.



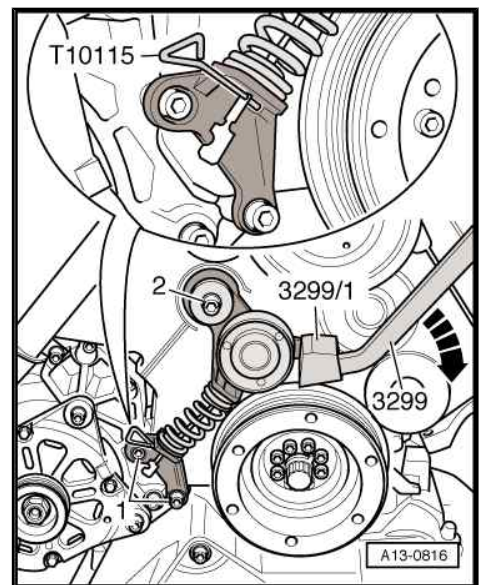
 **Note**

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

- To slacken poly V-belt, apply pressure to tensioner by moving poly V-belt lever -3299- and bracket -3299/1- in the direction of the -arrow-.
- Remove poly V-belt from power steering pump pulley.
- Unbolt poly V-belt pulley at power steering pump -arrows-, using pin wrench -3212- as a counterhold.



- To lock the tensioner for poly V-belt, apply pressure to tensioner by moving poly V-belt lever -3299- and bracket -3299/1- in the direction of the -arrow-, lock tensioner into place using locking pin -T10115- and release pressure.
- Unscrew bolts -1- and -2- and remove tensioner for poly V-belt (tensioner remains locked).



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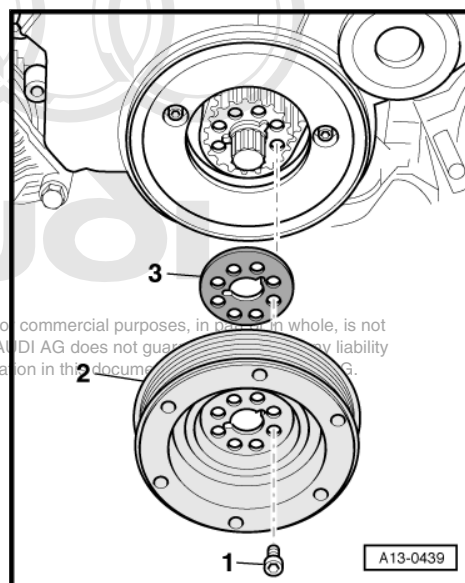
- Unscrew the 8 bolts -1-.
- Remove vibration damper -2- and thrust washer -3-.



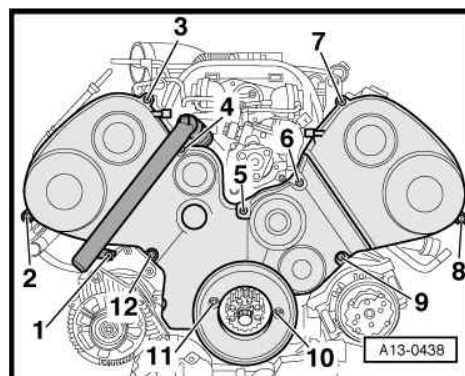
# Note

The thrust washer -3- is only fitted in conjunction with toothed belt sprocket -06C 105 063 A-. If toothed belt sprocket -06C 105 063 B- is fitted, do NOT install thrust washer.

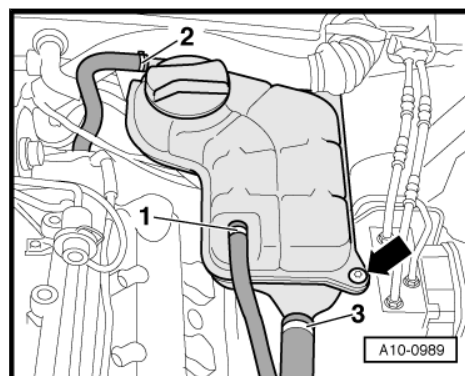
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- Unscrew bolts -1 ... 12- and remove toothed belt covers.



- Clamp off coolant hose -2- using a hose clamp -3094- .
- Pull off coolant hose at coolant expansion tank and plug the opening.
- Unbolt coolant expansion tank -arrow- and disconnect electrical connector for coolant shortage indicator switch -F66- at bottom of coolant expansion tank.
- Lay aside coolant expansion tank with coolant hoses -1- and -3- connected.

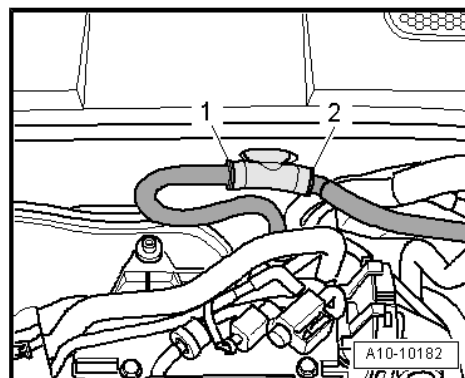


- Pull off vacuum hose -2- from T-piece at bulkhead.

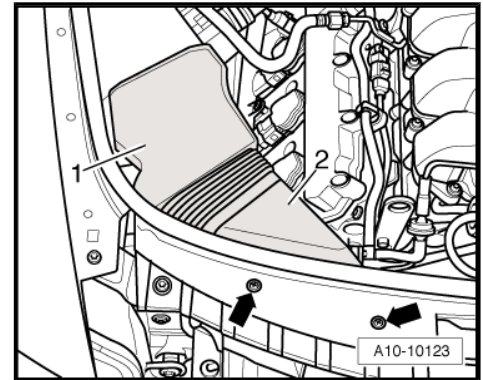


# Note

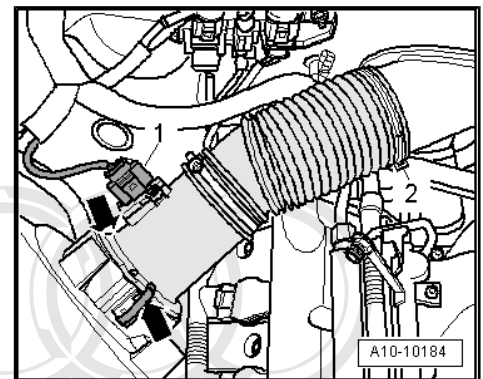
Disregard -item 1-.



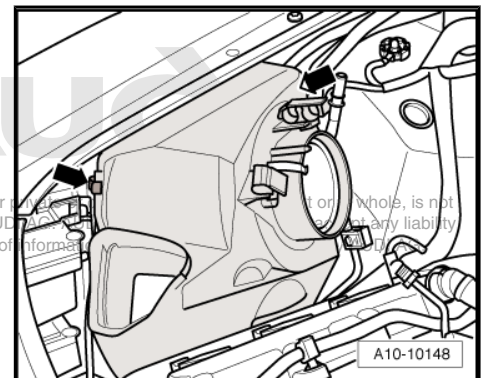
- Remove bolts -arrows-.
- Remove air ducts -1- and -2-.



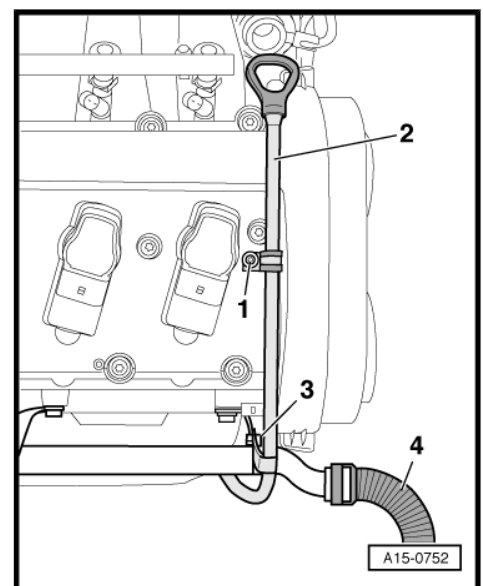
- Unplug electrical connector -1- at air mass meter -G70- .
- Remove air intake hose. To do so, release hose clip -2- and clamps -arrows-.



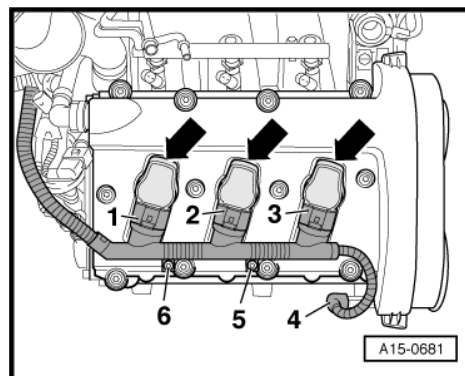
- Loosen clamps -arrows- and detach top section of air cleaner housing.



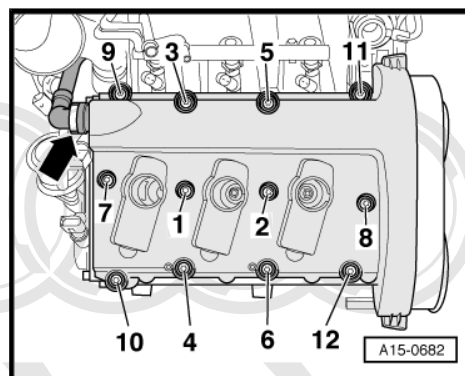
- Remove bolts -1- and -3-.
- Disconnect hose -4- at pipe for secondary air.
- Pull guide tube -2- for oil dipstick upwards out of top section of sump and fold forwards.



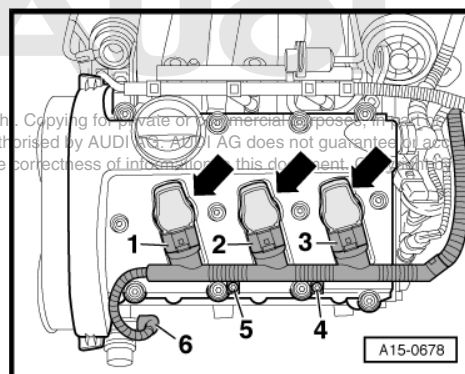
- Unscrew bolts -5- and -6- on cylinder head cover (right-side).
- Unplug electrical connectors -1 ... 4-.
- Pull out ignition coils -arrows- using puller -T40039- .



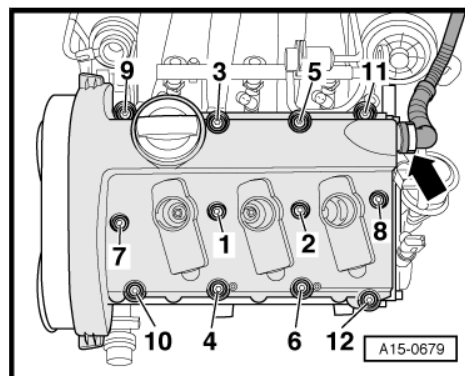
- Detach crankcase breather hose -arrow-.
- Unscrew bolts for cylinder head cover (right-side) in the sequence -12 ... 1- and remove cylinder head cover.



- Unscrew bolts -4- and -5- on cylinder head cover (left-side).
- Unplug electrical connectors -1 ... 3- and -6-.
- Pull out ignition coils -arrows- using puller -T40039-



- Detach crankcase breather hose -arrow-.
- Unscrew bolts for cylinder head cover (left-side) in the sequence -12 ... 1- and remove cylinder head cover.


**WARNING**

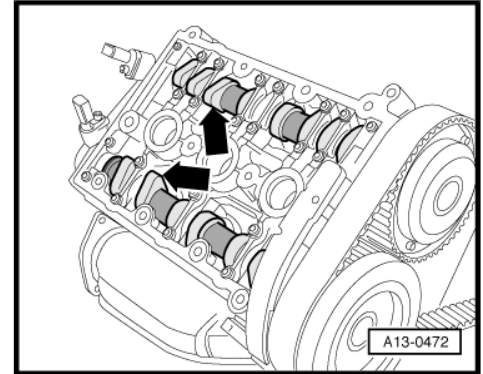
*The engine must only be turned at the crankshaft, in the direction of normal engine rotation (clockwise).*

- Turn engine until cams -arrows- of intake and exhaust camshafts at cylinder No. 3 (right-side cylinder bank) point upwards at equal angles.



**Note**

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

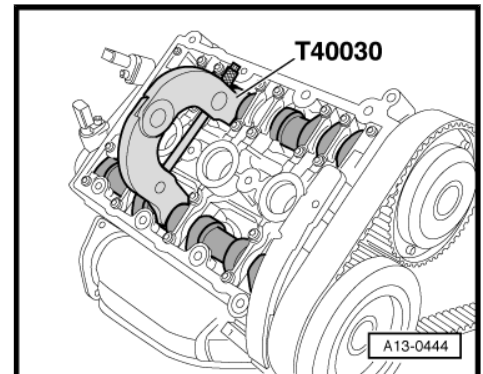


- Attach counterhold tool -T40030- to camshafts on cylinder head (right-side).

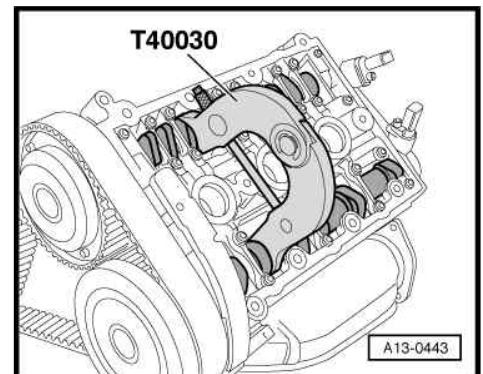


**Note**

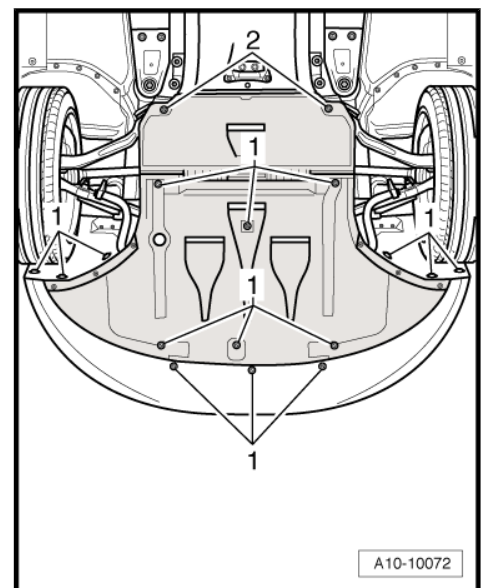
*Turn the crankshaft slightly backwards and forwards so that the claws of the counterhold tool -T40030- can engage properly in the camshafts.*



- Expand counterhold tool -T40030- by means of the threaded spindle (tightening torque max. 10 Nm) until it is seated with zero play.
- Attach counterhold tool -T40030- on cylinder head (left-side) in the same way.

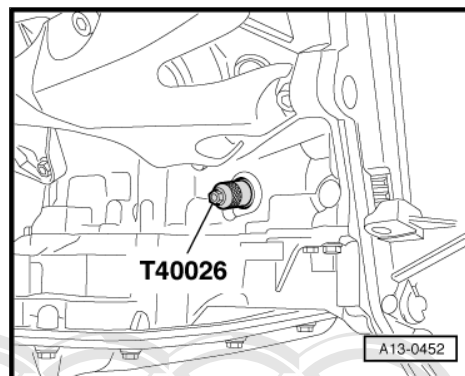


- Release quick-release fasteners -1- and -2- and take off noise insulation panels.



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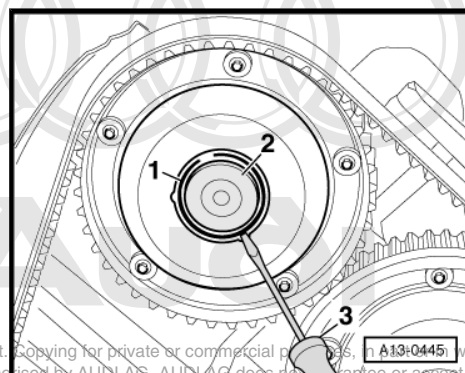
- Unscrew plug for TDC marking from cylinder block.
- Screw in locking pin -T40026- in the hole for the plug and tighten; if necessary, turn the crankshaft backwards and forwards slightly.



### Note

*Catch escaping oil with a cloth.*

- Pry off circlips -1- for sealing caps -2- on all camshaft sprockets using a screwdriver -3-.



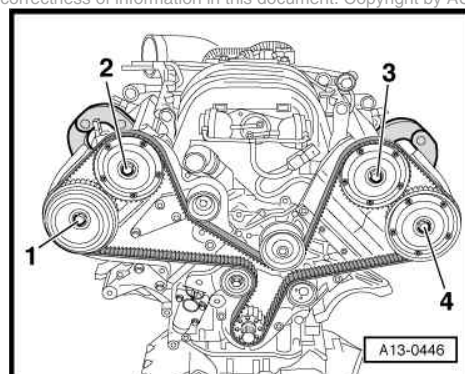
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- Loosen securing bolts -1 ... 4- for camshaft sprockets.



### Note

*Leave bolts screwed in loosely.*

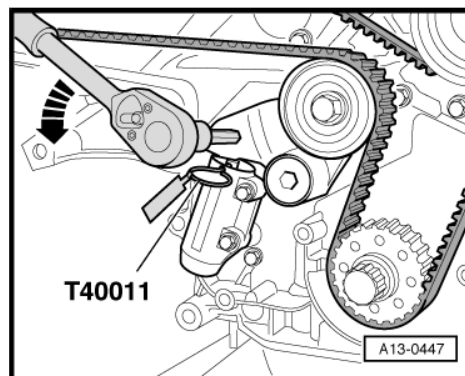


- Turn toothed belt tensioning roller in direction of the arrow using an 8 mm hexagon key until tensioning lever compresses tensioner far enough to allow locking pin -T40011- to be inserted into the holes in the piston and the housing.



### Note

- ◆ *The toothed belt tensioning element is oil-damped and can therefore only be compressed slowly by applying constant pressure.*
- ◆ *Mark rotation direction of toothed belt. Running in opposite direction can cause breakage.*



- Loosen bolt -arrow- for eccentric adjuster.
- Remove toothed belt.

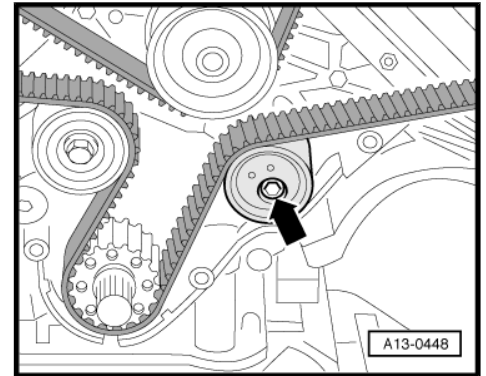
#### Installing (adjusting valve timing)

- Camshafts locked in position with counterhold tool -T40030- .
- Crankshaft locked in position with locking pin -T40026- .
- Camshaft sprockets free to turn.

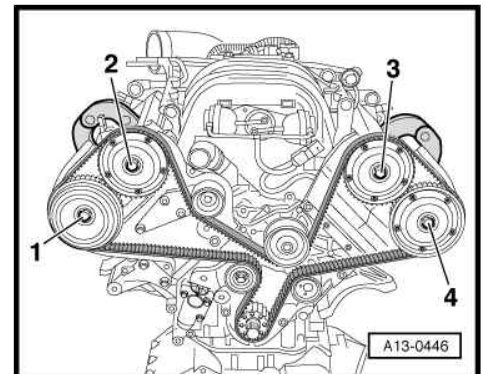


#### Note

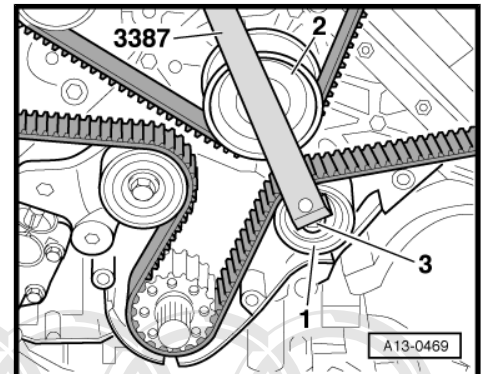
- ◆ *Renew gaskets, O-rings and self-locking bolts.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- ◆ *The crankshaft must not be at TDC at any cylinder when the camshaft is turned. Otherwise, there is a risk of damage to valves and piston crowns.*



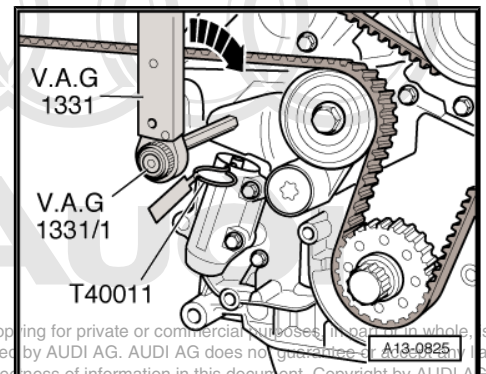
- Tighten the camshaft sprocket bolts until the sprockets -1 ... 4- can still just be turned, but do not move axially.
- Fit toothed belt as illustrated.
- To ensure accurate valve timing adjustment, the toothed belt must be exactly in line with the front edge of all belt sprockets.



- Using pin wrench -3387- , turn the eccentric adjuster -1- clockwise until the handle of the pin wrench is exactly over the centre axis of coolant pump pulley -2-.
- Hold pin wrench in this position and tighten bolt -3- to 45 Nm.

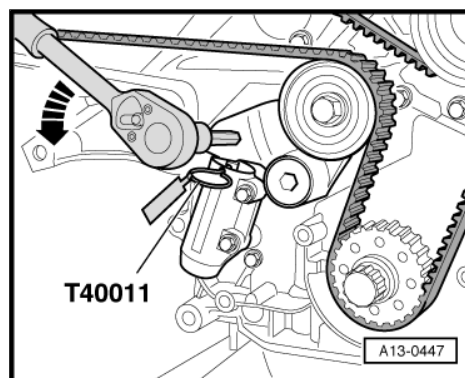


- Apply torque wrench -V.A.G 1331- vertically to hexagon socket of tensioning lever.
- Pre-tension toothed belt by applying a torque of 45 Nm in the direction indicated by the -arrow-.



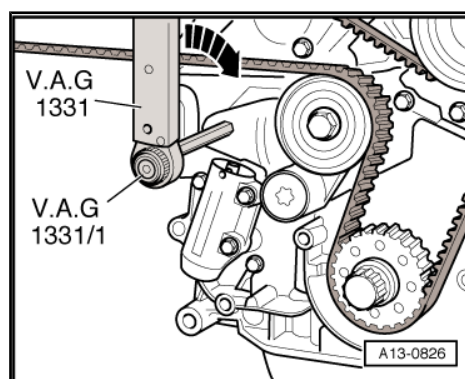
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- Turn toothed belt tensioning roller in direction of the -arrow- using an 8 mm hexagon key until the locking pin -T40011- can be removed.

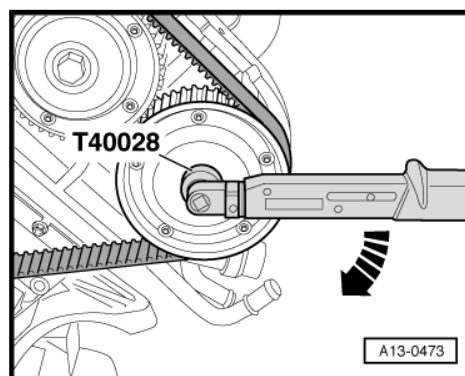


- Apply torque wrench -V.A.G 1331- vertically to hexagon socket of tensioning lever.
- Tension toothed belt by applying a torque of 25 Nm in the direction indicated by the arrow.

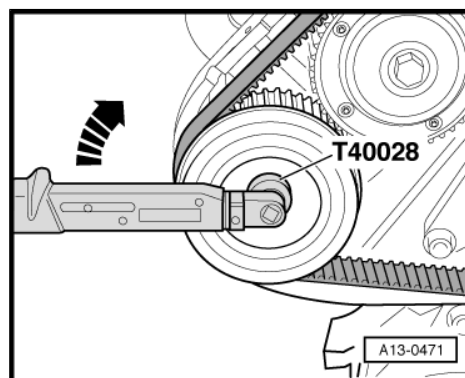
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- Apply socket -T40028- to camshaft adjuster for exhaust camshaft on cylinder bank (left-side).
- Turn rotor of camshaft adjuster clockwise as far as it will go -arrow- with a torque of 10 Nm.



- Turn rotor of camshaft adjuster on cylinder bank (right-side) clockwise as far as it will go -arrow- with a torque of 10 Nm.
- Tighten camshaft sprockets to 100 Nm.



- Insert protective caps -2- with new O-rings into camshaft sprockets and secure with circlip -1-.



#### Note

Disregard -item 3-.

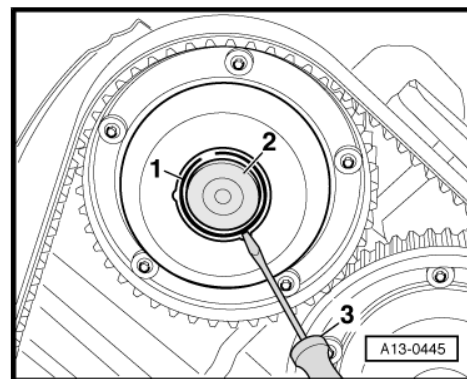
- Remove counterhold tool -T40030- .
- Remove locking pin -T10026- and screw sealing plug for TDC marking into cylinder block with new O-ring seal.

Remaining installation steps are carried out in reverse sequence; note the following:

- Install cylinder head cover: left-side ⇒ [page 80](#) , right-side ⇒ [page 82](#) .
- Install toothed belt covers ⇒ [page 64](#) .
- Install vibration damper ⇒ [page 42](#) .
- Install tensioner for poly V-belt ⇒ [page 40](#) .
- Install poly V-belt ⇒ [page 39](#) .

#### Tightening torques

| Component                                  | Nm  |
|--------------------------------------------|-----|
| Eccentric adjuster to front sealing flange | 45  |
| Camshaft sprocket to camshaft              | 100 |
| Sealing plug in cylinder block             | 25  |



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## 2 Removing and installing cylinder head

### 2.1 Cylinder head - exploded view

#### 1 - Cylinder head gasket

- ☐ Renewing  
⇒ ["2.4 Removing cylinder head \(left-side\)", page 85](#)
- ☐ Installation position:  
Part No. towards cylinder head
- ☐ If renewed, refill system with fresh coolant

#### 2 - Cylinder head

- ☐ Removing cylinder head (left-side) ⇒ [page 85](#)
- ☐ Removing cylinder head (right-side) ⇒ [page 89](#)
- ☐ Checking for distortion  
⇒ [page 79](#)
- ☐ Machining dimension  
⇒ [page 80](#)
- ☐ Driving sealing cap into cylinder head  
⇒ [page 80](#)
- ☐ Installing ⇒ [page 93](#)
- ☐ If renewed, refill system with fresh coolant

#### 3 - Lifting eye

#### 4 - 23 Nm

#### 5 - Cylinder head bolt

- ☐ Renew
- ☐ Note correct sequence when loosening  
⇒ [page 89](#) and  
⇒ [page 92](#)
- ☐ Note correct sequence when tightening ⇒ [page 95](#)

#### 6 - Centring pin for intake manifold

#### 7 - Special bolt, 10 Nm

- ☐ Renew if damaged or leaking
- ☐ Note sequence when tightening ⇒ [page 82](#) and ⇒ [page 85](#)

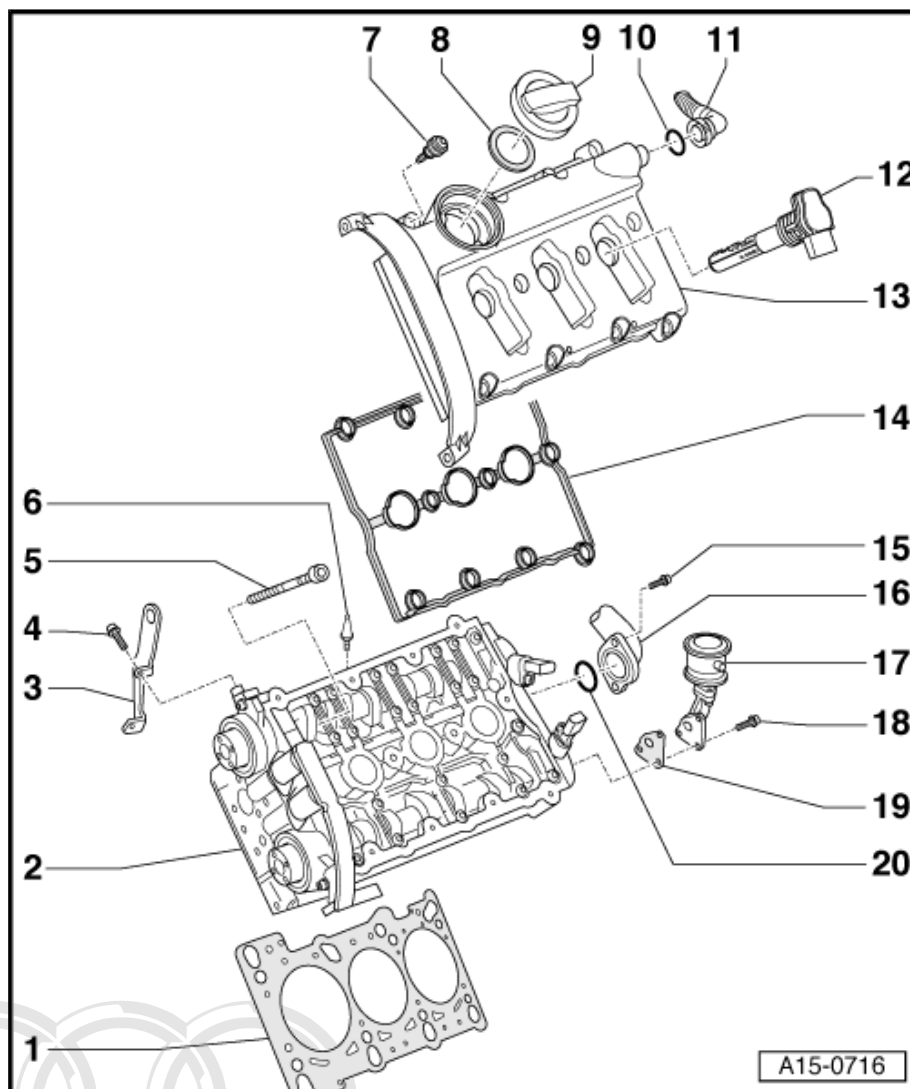
#### 8 - Seal

- ☐ Renew if damaged or leaking

#### 9 - Filler cap

#### 10 - O-ring

- ☐ Renew



## 11 - Crankcase breather hose

## 12 - Ignition coil

- ☐ Pull out of cylinder head ⇒ [page 79](#)

## 13 - Cylinder head cover

- ☐ Removing and installing: left-side ⇒ [page 80](#) , right-side ⇒ [page 82](#)

## 14 - Gasket for cylinder head cover

- ☐ Renew if damaged or leaking

## 15 - 10 Nm

## 16 - Coolant pipe (rear)

## 17 - Combination valve for secondary air system

## 18 - 10 Nm

## 19 - Seal

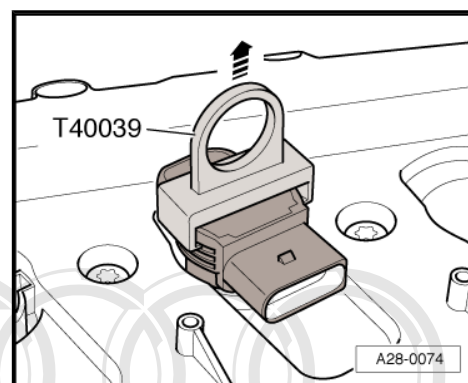
- ☐ Renew

## 20 - O-ring

- ☐ Renew

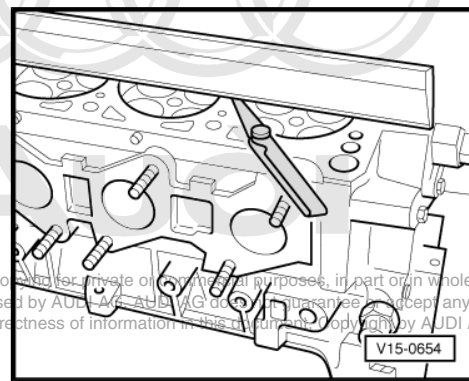
### Pull ignition coil out of cylinder head

- Pull ignition coil out with puller -T40039- .



### Checking cylinder head for distortion

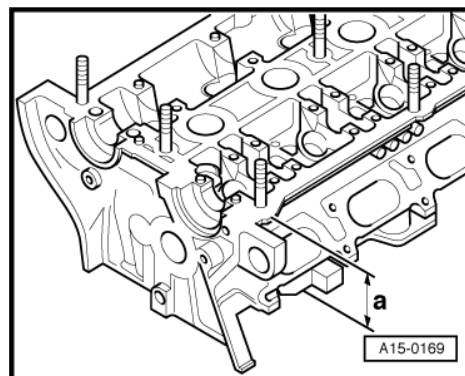
- Use straight edge and feeler gauge to measure for distortion at several points.
- Max. permissible distortion: 0.1 mm



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### Cylinder head machining limit

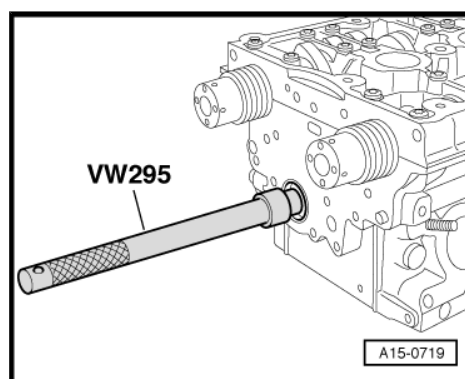
- Machining of the cylinder head (surface grinding) is only permissible down to the minimum dimension a.
- Minimum dimension: -a- = 139.25 mm



### Driving sealing cap into cylinder head

Replacement cylinder heads can be used on both the left and right-side and must be fitted with a sealing cap on the appropriate front side.

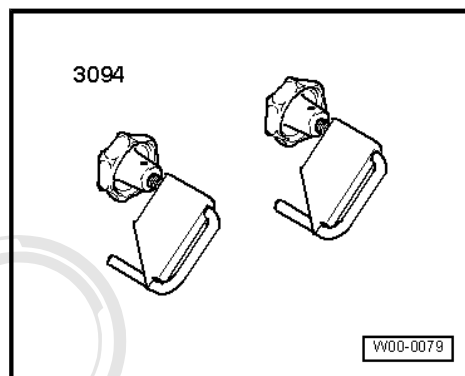
- Coat edge of sealing cap with sealant; sealant ⇒ Parts catalogue
- Use drift -VW 295- to drive sealing cap into cylinder head until flush.



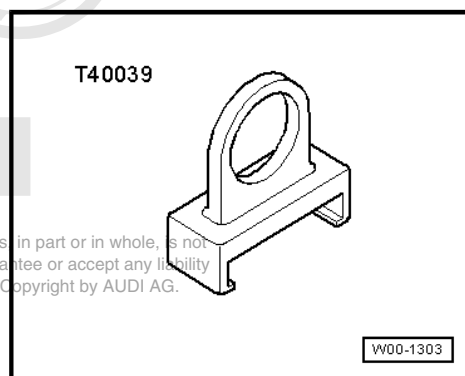
## 2.2 Removing and installing cylinder head cover (left-side)

### Special tools and workshop equipment required

- ◆ Hose clamps for hoses up to 25 mm Ø -3094-



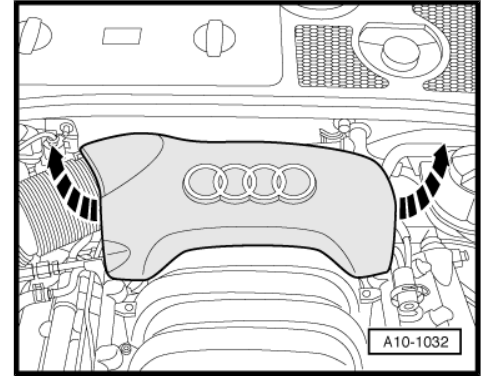
- ◆ Puller -T40039-



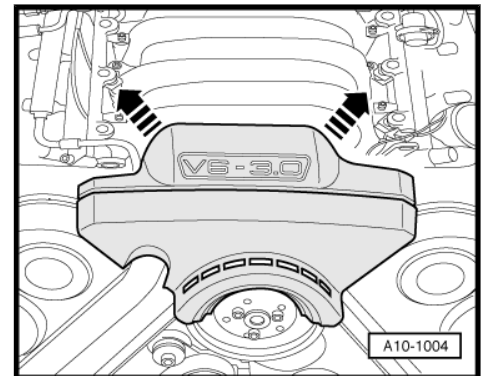
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## Removing

- Pull off engine cover panel (rear) -arrows-.



- Pull off engine cover panel (front) -arrows-.

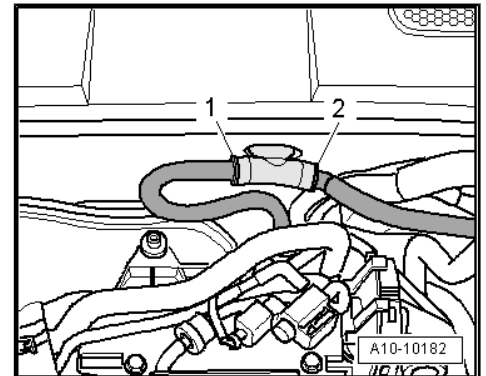


- Pull off vacuum hoses -2- from T-piece at bulkhead.



### Note

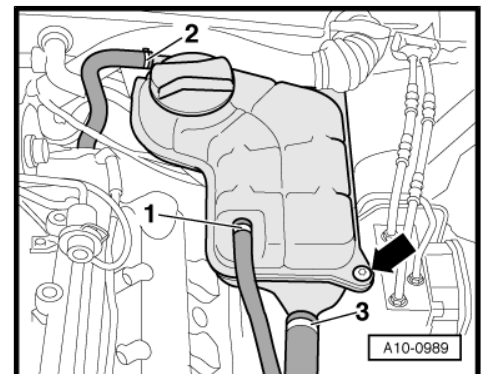
Disregard -item 1-.



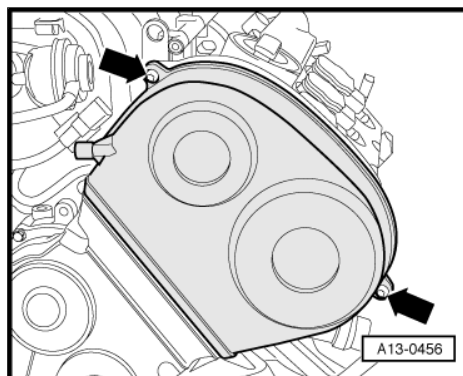
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- Clamp off coolant hose -2- using a hose clamp -3094-.

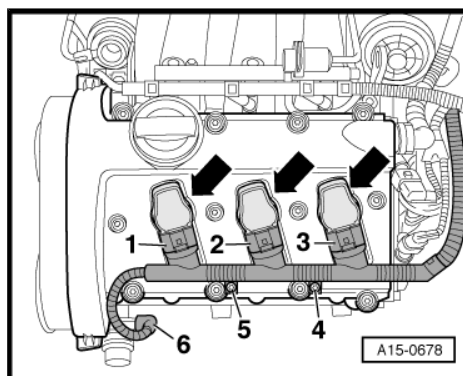
- Pull off coolant hose at coolant expansion tank and plug the opening.
- Unbolt coolant expansion tank -arrow- and disconnect electrical connector for coolant shortage indicator switch -F66- at bottom of coolant expansion tank.
- Lay aside coolant expansion tank with coolant hoses -1- and -3- connected.



- Unbolt toothed belt cover (front left) from cylinder head cover -arrows-.



- Remove bolts -4- and -5-.
- Unplug electrical connectors -1... 3- and -6-.
- Pull out ignition coils -arrows- using puller -T40039-.



- Detach crankcase breather hose -arrow-.
- Unscrew bolts for cylinder head cover (left-side) in the sequence -12 ... 1- and remove cylinder head cover.

### Installing

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



#### Note

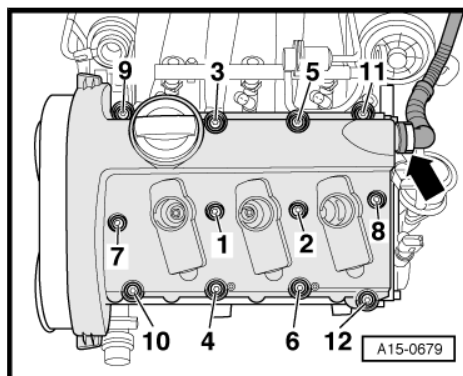
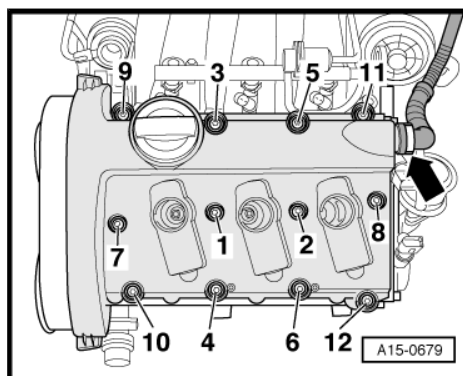
- ◆ Renew self-locking bolts.
- ◆ Renew gasket for cylinder head cover if damaged.
- ◆ Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.

- Tighten bolts for cylinder head cover in the sequence -1 ... 12-.

### Tightening torques

| Component                                         | Nm               |
|---------------------------------------------------|------------------|
| Cylinder head cover to cylinder head              | 10               |
| Toothed belt cover (front) to cylinder head cover | 6 <sup>15)</sup> |

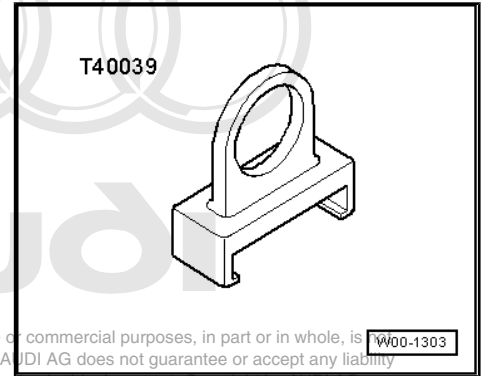
15) Renew bolts.



## 2.3 Removing and installing cylinder head cover (right-side)

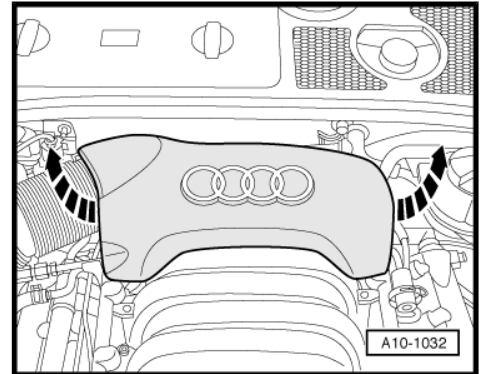
### Special tools and workshop equipment required

◆ Puller -T40039-

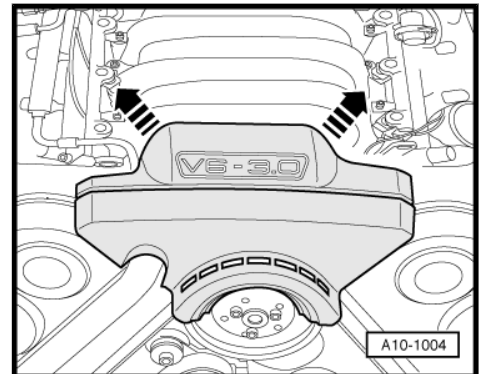


**Removing**

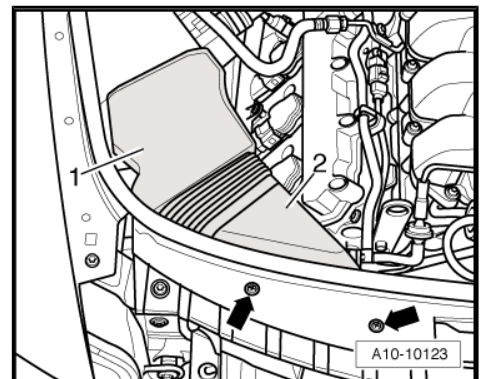
- Pull off engine cover panel (rear) -arrows-.



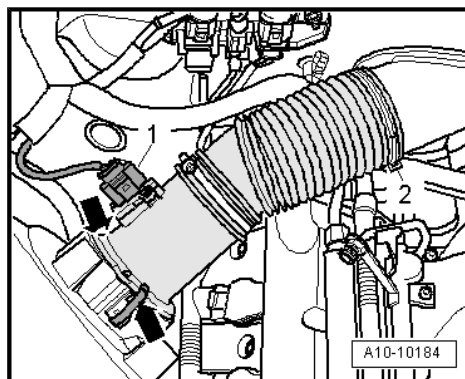
- Pull off engine cover panel (front) -arrows-.



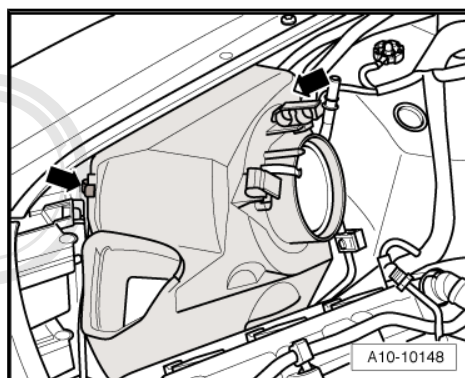
- Remove bolts -arrows-.
- Remove air ducts -1- and -2-.



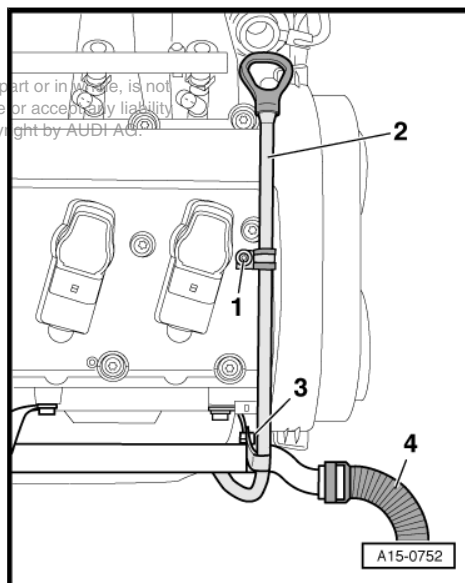
- Unplug electrical connector -1- at air mass meter -G70- .
- Remove air intake hose. To do so, release hose clip -2- and clamps -arrows-.



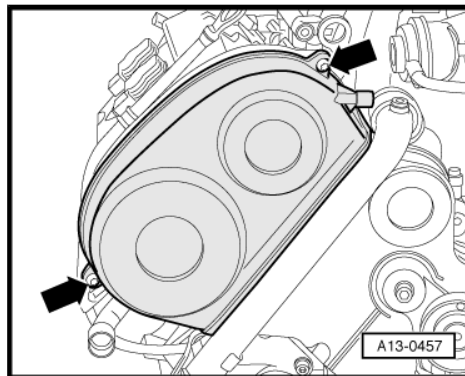
- Loosen clamps -arrows- and detach top section of air cleaner housing.



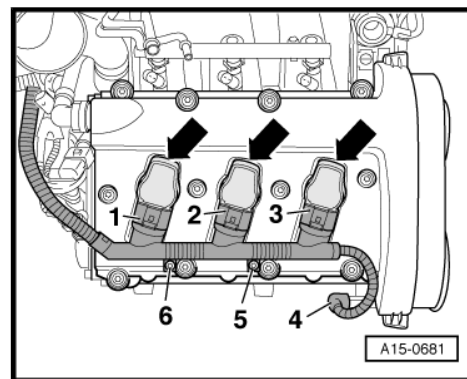
- Remove bolts -1- and -3-.
- Disconnect hose -4- at pipe for secondary air.
- Pull guide tube -2- for oil dipstick upwards out of top section of sump and fold forwards.



- Unscrew toothed belt cover (front right) from cylinder head cover -arrows-.



- Remove bolts -5- and -6-.
- Unplug electrical connectors -1 ... 4-.
- Pull out ignition coils -arrows- using puller -T40039-.



- Detach crankcase breather hose -arrow-.
- Unscrew bolts for cylinder head cover (right-side) in the sequence -12 ... 1- and remove cylinder head cover.

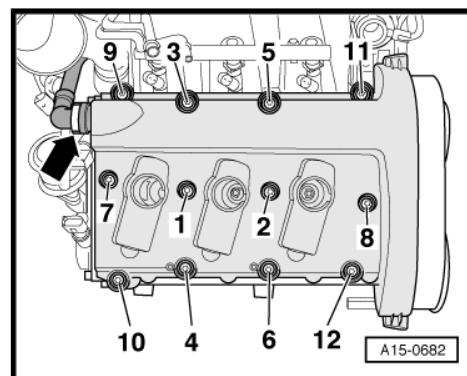
### Installing

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



#### Note

- ◆ Renew self-locking bolts.
- ◆ Renew gasket for cylinder head cover if damaged.
- ◆ Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.

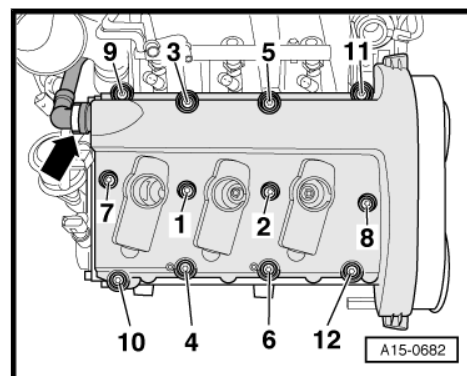


- Tighten bolts for cylinder head cover in the sequence -1 ... 12-.
- Renew O-ring on guide tube for oil dipstick and insert guide tube into hole in top section of sump.

### Tightening torques

| Component                                         | Nm               |
|---------------------------------------------------|------------------|
| Cylinder head cover to cylinder head              | 10               |
| Toothed belt cover (front) to cylinder head cover | 6 <sup>16)</sup> |
| Guide tube for dipstick to cylinder head          | 23               |

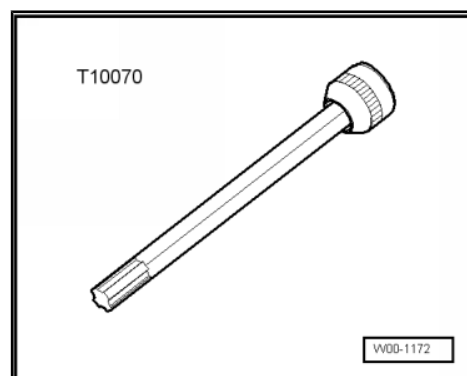
16) Renew bolts



## 2.4 Removing cylinder head (left-side)

### Special tools and workshop equipment required

- ◆ Special wrench (Polydrive) -T10070-



## Removing

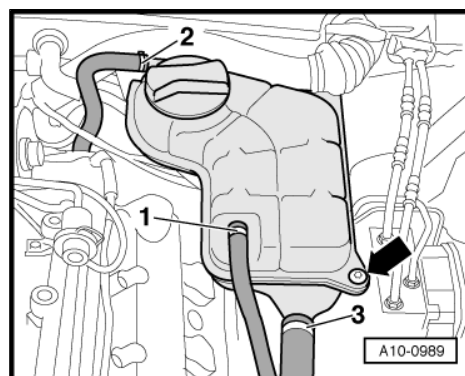
- Engine in vehicle.



### Note

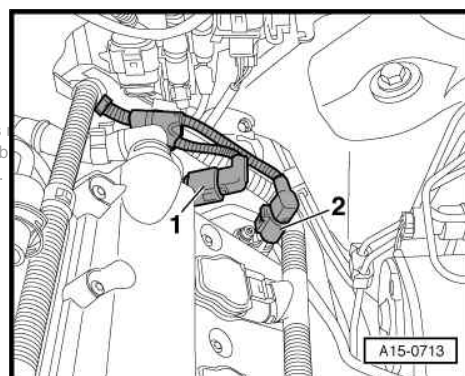
*All cable ties which are released or cut open when removing must be fitted in the same position when installing.*

- Remove intake manifold ⇒ [page 100](#) .
- Detach coolant hose -2- at expansion tank.
- Unbolt coolant expansion tank -arrow-.
- Detach electrical connector at coolant shortage indicator switch -F66- on coolant expansion tank (bottom).
- Lay aside coolant expansion tank with coolant hoses -1- and -3- connected.

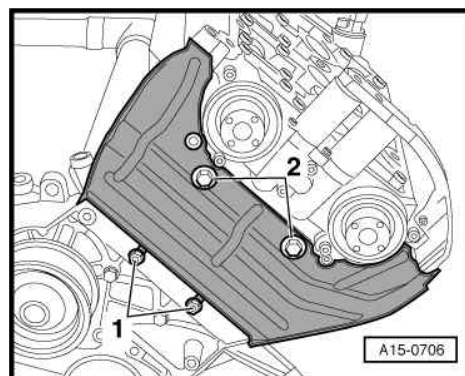


- Unplug electrical connectors -1- and -2- at Hall senders - G163- and -G301- .
- Unbolt earth wire at rear of cylinder head.

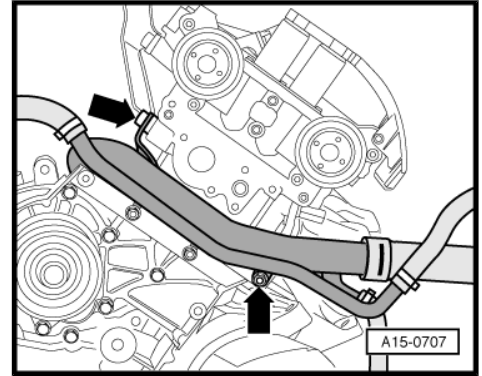
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- Remove toothed belt ⇒ [page 67](#) .
- Remove camshaft sprockets on cylinder head (left-side).
- Unscrew bolts -1- and -2- and remove toothed belt cover (rear left).



- Unbolt front coolant pipe from cylinder head -arrows-.

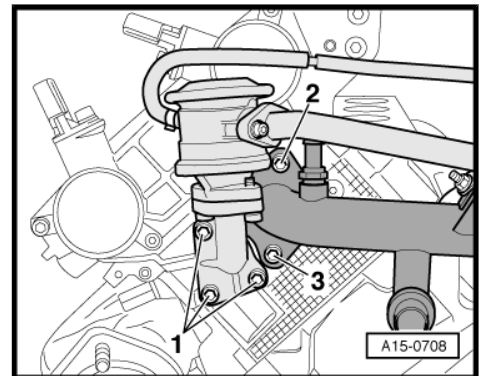


- Unscrew bolts -1- on flange of combination valve for secondary air system.
- Detach rear coolant pipe from cylinder head by unscrewing bolts -2- and -3-.



#### Note

- ◆ *The coolant pipe and combination valve for secondary air system do not have to be removed.*
- ◆ *Shown from rear with engine removed for illustration purposes.*

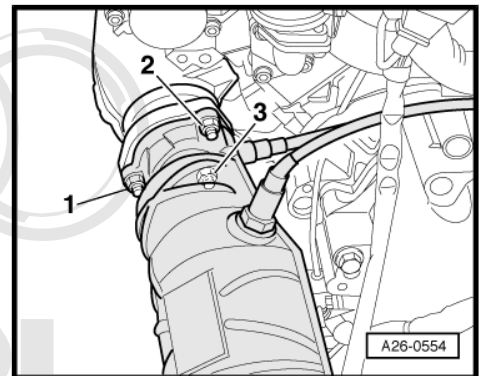


- Unscrew nut -2- (accessible from above) securing front exhaust pipe to exhaust manifold (left-side).



#### Note

*Shown in illustration with engine removed.*

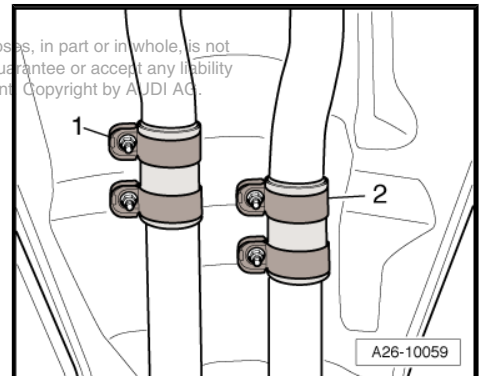


- Loosen clamp (left-side) -1-.



#### Note

*Disregard -item 2-.*



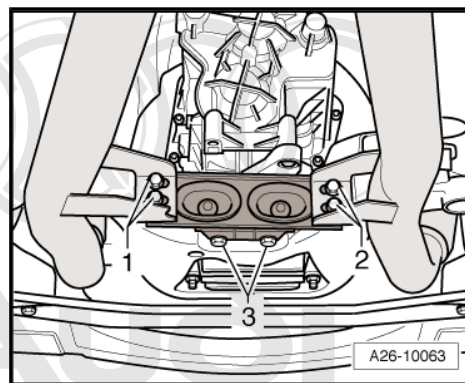
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- Unscrew bolts -1- at mounting bracket for front exhaust pipe (left-side).



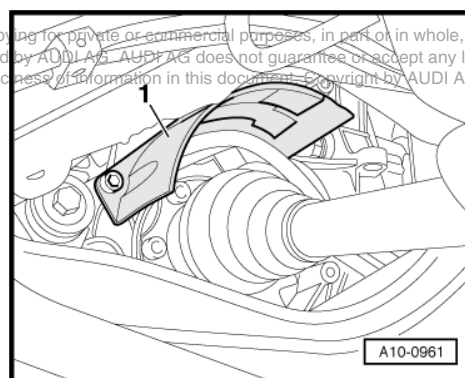
### Note

Disregard items marked -2- and -3-.



- Unbolt heat shield -1- for drive shaft (left-side) from gearbox.

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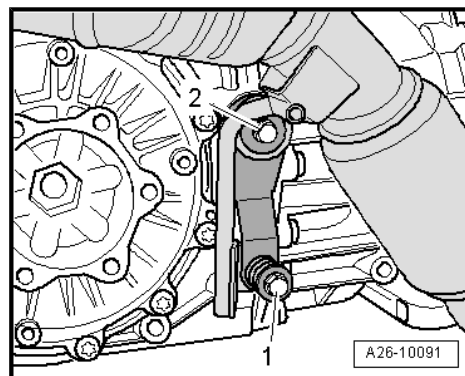


- Remove bolt -1- on bracket (left-side) for exhaust system.



### Note

Disregard -item 2-.



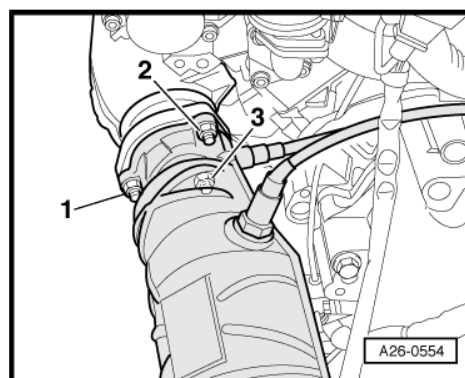
- Remove nuts -1- and -3- (accessible from below) securing front exhaust pipe to exhaust manifold (left-side).



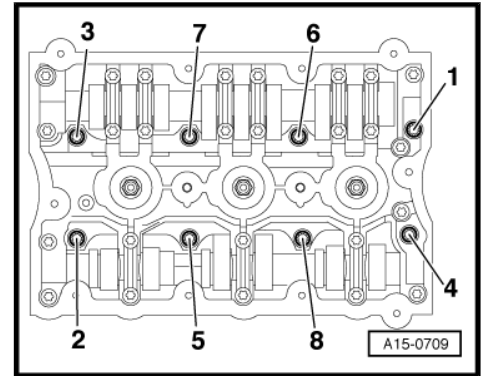
### Note

Shown in illustration with engine removed.

- Detach front exhaust pipe from exhaust manifold.



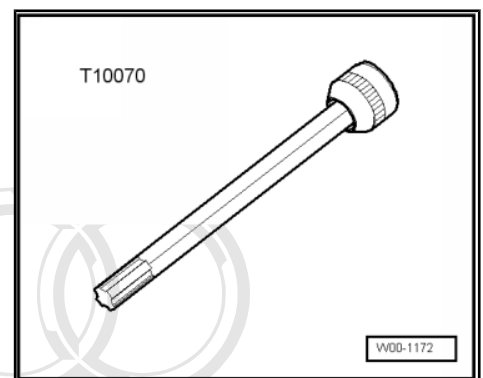
- Loosen cylinder head bolts in the sequence -1 ... 8-.
- Carefully remove cylinder head.



## 2.5 Removing cylinder head (right-side)

Special tools and workshop equipment required

- ◆ Special wrench (Polydrive) -T10070-



### Removing

- Engine in vehicle.



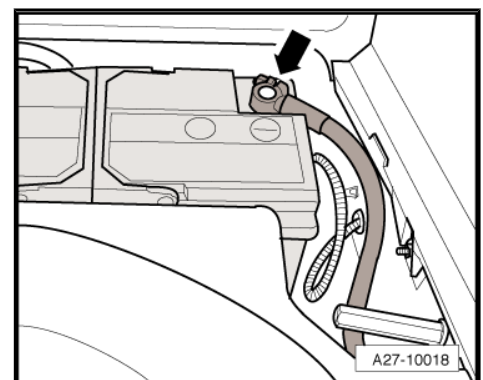
*All cable ties which are released or cut open when removing must be fitted in the same position when installing.*



### Caution

*Observe notes on procedure for disconnecting the battery → Electrical system; Rep. Gr. 27.*

- Take out luggage compartment floor trim.
- Disconnect earth cable -arrow- at battery.
- Remove intake manifold ⇒ [page 100](#).

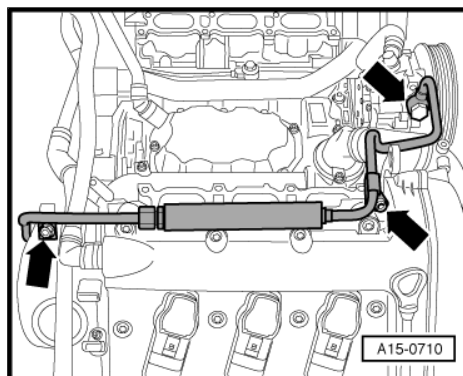




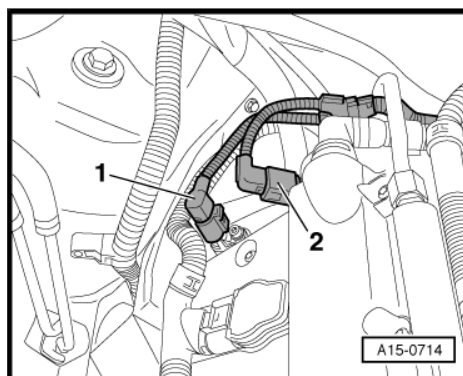
# Note

Lay a cloth under the hydraulic pressure pipe to catch any escaping hydraulic fluid.

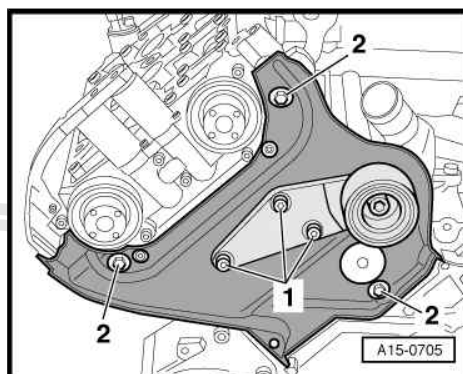
- Remove pressure pipe for power steering at power steering pump, cylinder head and rear coolant pipe -arrows- and move to the side.



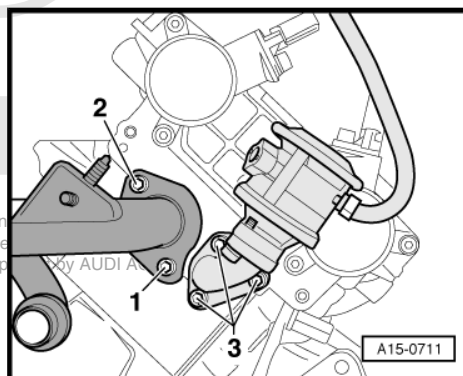
- Unplug electrical connectors -1- and -2- at Hall sensors -G40- and -G300- .



- Remove toothed belt ⇒ [page 67](#) .
- Remove camshaft sprockets on cylinder head (right-side).
- Remove bolts -1- and take off bracket with idler roller.
- Remove bolts -2- and take off toothed belt cover (rear right).



- Unscrew bolts -3- and detach combination valve for secondary air system (together with flange) from cylinder head.
- Detach coolant pipe (rear) from cylinder head by unscrewing the bolts -1- and -2-.



# Note

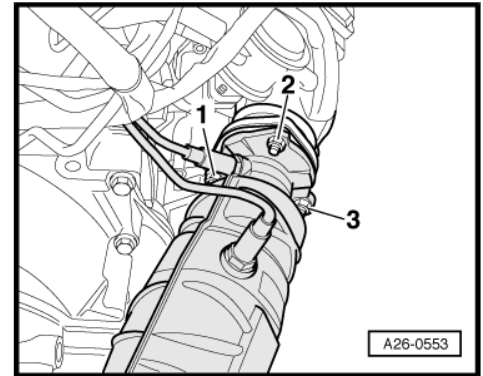
- The coolant pipe remains installed.
- Shown from rear with engine removed for illustration purposes.

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- Unscrew nut -2- (accessible from above) securing front exhaust pipe to exhaust manifold (right-side).



*Shown in illustration with engine removed.*

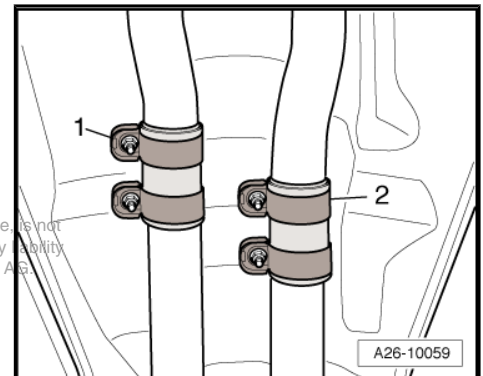


- Loosen clamp (right-side) -2-.



*Disregard -item 1-.*

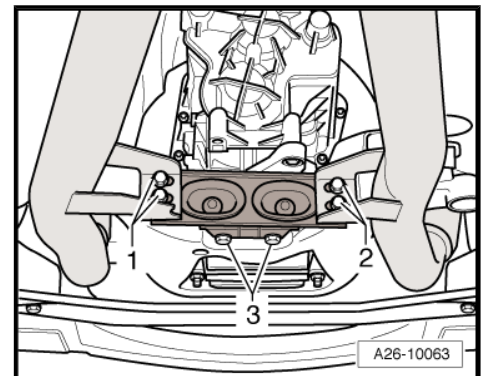
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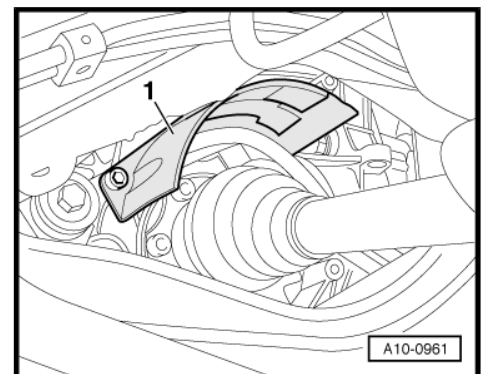
- Unscrew bolt -2- at mounting bracket for front exhaust pipe (right-side).



*Disregard items marked -1- and -3-.*



- Unbolt heat shield -1- for drive shaft (right-side) from gearbox.

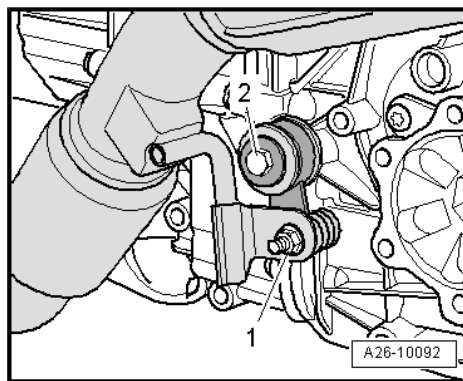


- Remove bolt -1- on bracket (right-side) for exhaust system.



# Note

Disregard -item 2-.



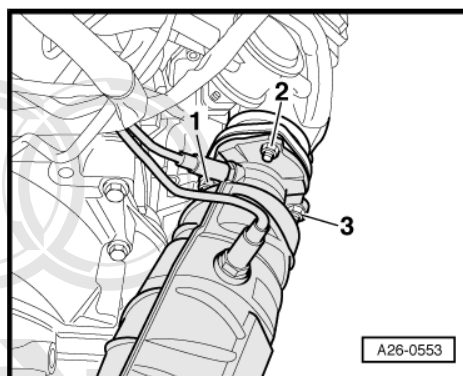
- Remove nuts -1- and -3- (accessible from below) securing front exhaust pipe to exhaust manifold (right-side).



# Note

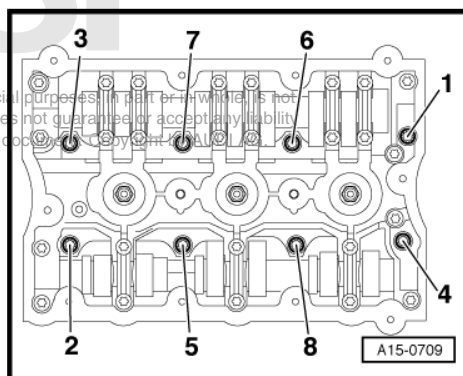
Shown in illustration with engine removed.

- Detach front exhaust pipe from exhaust manifold.



- Loosen cylinder head bolts in the sequence -1 ... 8-.
- Carefully remove cylinder head.

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## 2.6 Installing cylinder head



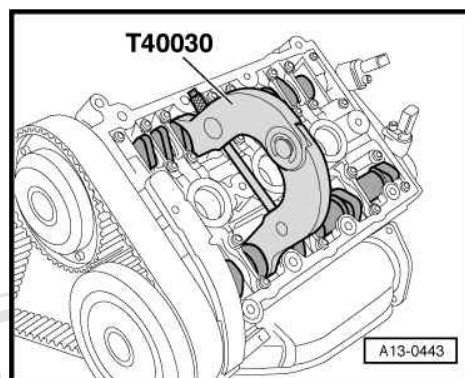
### Note

- ◆ *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.*
- ◆ *Cylinder heads which have cracks between the valve seats or between a valve seat insert and the spark plug thread can be re-installed without reducing service life, provided the cracks are only slight and do not exceed a maximum of 0.3 mm in width, and no more than the first 4 turns of the spark plug threads are cracked.*
- ◆ *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.*
- ◆ *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.*
- ◆ *Position cylinder head gasket on dowel sleeves. The word "oben" (top) or the Part No. should face towards cylinder head.*
- ◆ *When installing an exchange cylinder head with fitted camshafts, the contact surfaces between bucket tappets and cams must be oiled after installing the head.*
- ◆ *The plastic protectors fitted to protect the open valves should not be removed until the cylinder head is ready to be fitted.*
- ◆ *When renewing a cylinder head, a sealing cap must be driven into the front of the cylinder head ⇒ [page 80](#).*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- ◆ *Fit all cable ties in the original positions when installing.*
- ◆ *When fitting a new cylinder head or cylinder head gasket, drain off all the old coolant and refill with new coolant.*

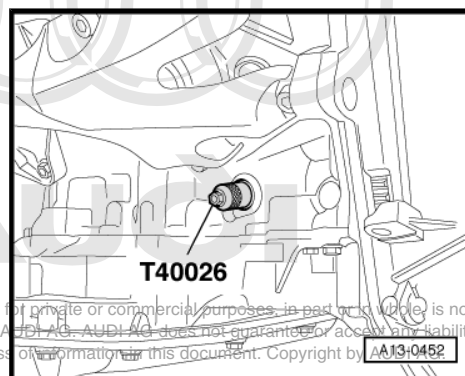
Installation is carried out in the reverse order; note the following:

- Before fitting cylinder head, set crankshaft and camshafts to TDC for cylinder 3:

- The counterhold tool -T40030- must be attached to both cylinder heads.

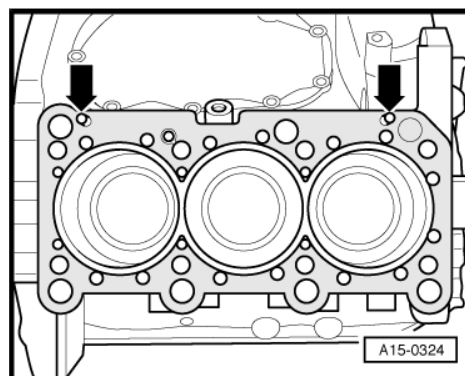


- The locking pin -T40026- must be screwed into the crankshaft.



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- Fit cylinder head gasket.
- Note position of centring pins -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.
- Fit cylinder head.



- Insert new cylinder head bolts and tighten hand-tight.
- Tighten cylinder head in 3 stages in the following sequence:

| Stage | Tighten                                             |
|-------|-----------------------------------------------------|
| I     | – Tighten with torque wrench to 40 Nm.              |
| II    | – Turn 90° (1/4 turn) further using a rigid wrench. |
| III   | – Turn 90° (1/4 turn) further using a rigid wrench. |



#### Note

Cylinder head bolts do not have to be torqued down again later after repairs.

- Install toothed belt (adjust valve timing) ➤ [page 75](#) .



#### Note

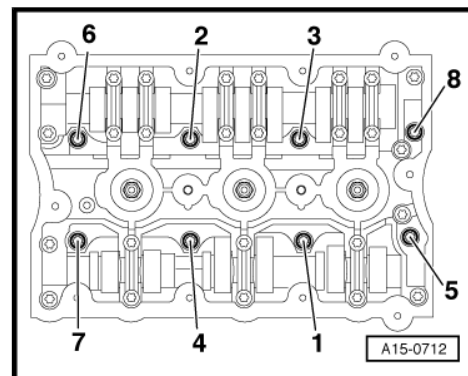
After working on the valve gear, turn the engine carefully at least 2 rotations by hand to ensure that none of the valves make contact when the starter is operated.

- Install front exhaust pipe together with catalytic converter: left-side ➤ [page 183](#) , right-side ➤ [page 188](#) .
- Align exhaust system so it is free of stress ➤ [page 195](#) .
- Screw in centring pin for intake manifold.
- Install intake manifold ➤ [page 100](#) .
- Connect battery. Procedures required ➤ Electrical system; Rep. Gr. 27 .
- Fill cooling system with fresh coolant ➤ [page 158](#) .
- Top up power steering fluid and bleed steering system: ➤ Running gear, front-wheel drive and four-wheel drive; Rep. Gr. 48

#### Tightening torques

| Component                                                        | Nm                |
|------------------------------------------------------------------|-------------------|
| Coolant pipe (rear) to cylinder head                             | 10                |
| Combination valve for secondary air system to cylinder head      | 10                |
| Toothed belt cover (rear) to cylinder head/ cylinder block       | 10 <sup>17)</sup> |
| Bracket for idler roller to cylinder head                        | 10 <sup>17)</sup> |
| Coolant pipe (front) M6                                          | 10                |
| to cylinder head M8                                              | 23                |
| Pressure pipe for power-assisted steering to hydraulic pump      | 47                |
| Pressure pipe for power-assisted steering to cylinder head       | 20                |
| Pressure pipe for power-assisted steering to coolant pipe (rear) | 20                |

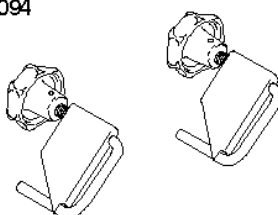
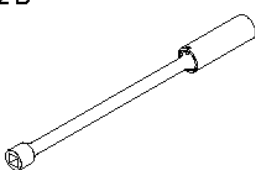
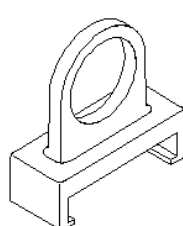
17) Renew bolts.



## 2.7 Checking compression

### Special tools and workshop equipment required

- ◆ Hose clamps for hoses up to 25 mm Ø -3094-
- ◆ Spark plug socket and extension -3122 B-
- ◆ Compression tester - V.A.G 1763-
- ◆ Puller -T40039-

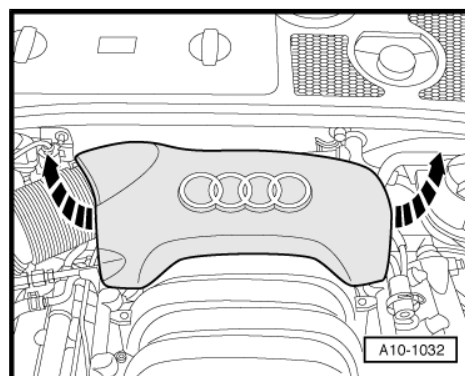
|                                                                                                     |                                                                                                   |
|-----------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| <p>3094</p>        | <p>3122 B</p>  |
| <p>V.A.G 1763</p>  | <p>T40039</p>  |
|                                                                                                     | <p>G15-0073</p>                                                                                   |

### Test conditions

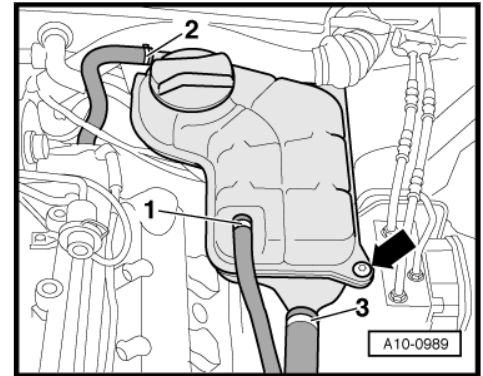
- Engine oil temperature at least 30 °C.
- Battery voltage at least 12.5 V.

### Test sequence

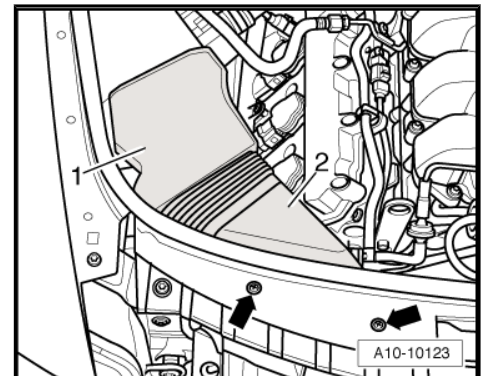
- Pull off engine cover panel (rear) -arrows-.



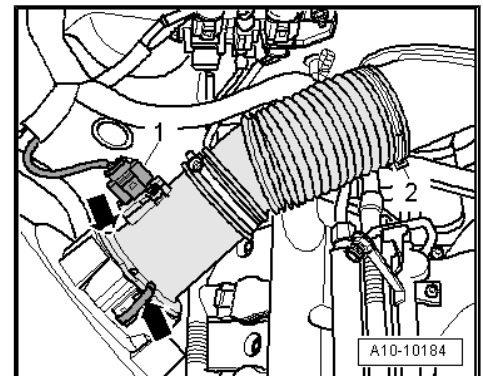
- Clamp off coolant hose -2- using a hose clamp -3094- .
- Pull off coolant hose at coolant expansion tank and plug the opening.
- Unbolt coolant expansion tank -arrow- and disconnect electrical connector for coolant shortage indicator switch -F66- at bottom of coolant expansion tank.
- Lay aside coolant expansion tank with coolant hoses -1- and -3- connected.



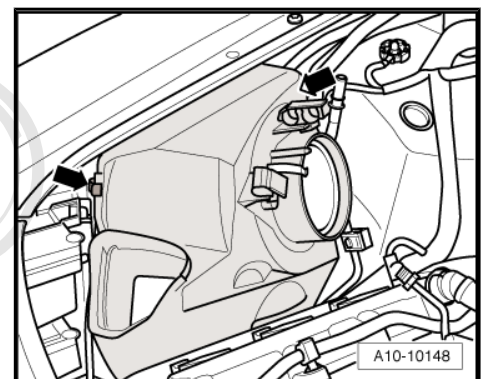
- Remove bolts -arrows-.
- Remove air ducts -1- and -2-.



- Unplug electrical connector -1- at air mass meter -G70- .
- Remove air intake hose. To do so, release hose clip -2- and clamps -arrows-.

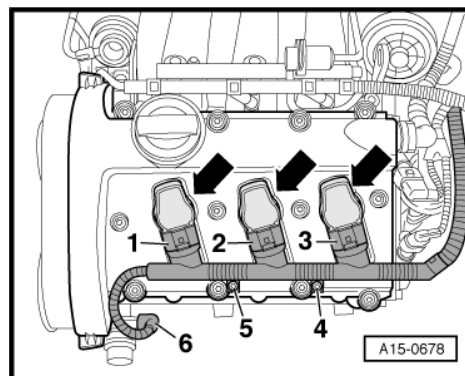


- Loosen clamps -arrows- and detach top section of air cleaner housing.

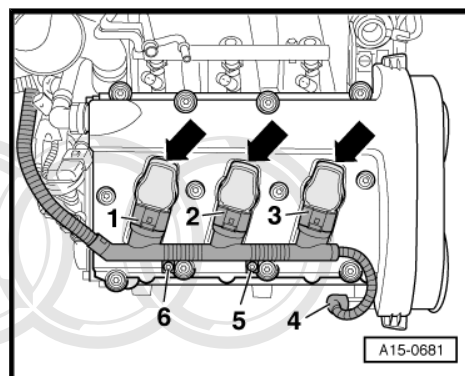


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- Unscrew bolts -4- and -5- at cylinder head (left-side).
- Unplug electrical connectors -1 ... 3- and -6-.
- Pull out ignition coils -arrows- using puller -T40039- .



- Unscrew bolts -5- and -6- at cylinder head (right-side).
- Unplug electrical connectors -1 ... 4-.
- Pull out ignition coils -arrows- using puller -T40039- .
- Remove spark plugs with spark plug socket -3122 B- .



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- Unplug all electrical connectors at all injectors; to do so, release connectors on underside -arrow-.
- Test the compression pressure with the compression tester - V.A.G 1763- .



**Note**

*Using the compression tester ⇒ Operating instructions .*

- Have a 2nd mechanic press down the accelerator pedal completely and simultaneously operate the starter until the pressure no longer increases on the tester display.

**Compression pressure:**

| New           | Wear limit | Difference between cylinders |
|---------------|------------|------------------------------|
| bar           | bar        | bar                          |
| 10.0 ... 14.0 | 9.0        | 3.0 (maximum)                |

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



**Note**

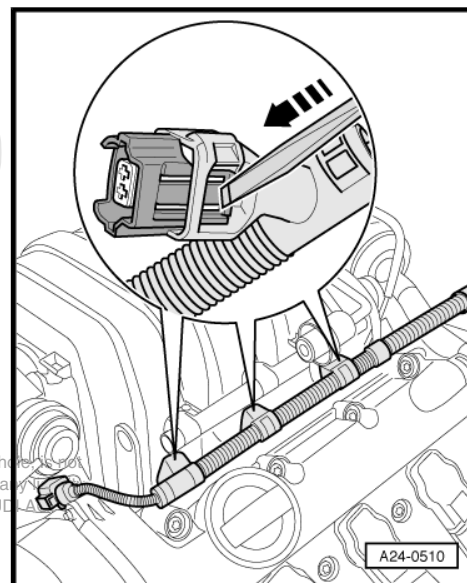
*Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*

- Interrogate and erase the fault memory for engine control unit, as faults are stored when the electrical connectors are unplugged.

**For this purpose, use vehicle diagnostic, testing and information system -VAS 5051 A- .**

**Tightening torque**

| Component                    | Nm |
|------------------------------|----|
| Spark plugs in cylinder head | 30 |



### 3 Removing and installing intake manifold

#### 3.1 Intake manifold - exploded view

##### 1 - Intake manifold

- ☐ Removing and installing  
⇒ [page 100](#)

##### 2 - Resonator

##### 3 - 10 Nm

##### 4 - O-rings

##### 5 - Fuel pipe

- ☐ Tighten union nut to 25 Nm

##### 6 - Bush

##### 7 - 10 Nm

##### 8 - Fuel rail

##### 9 - Air duct

##### 10 - 10 Nm

##### 11 - O-ring

- ☐ Renew

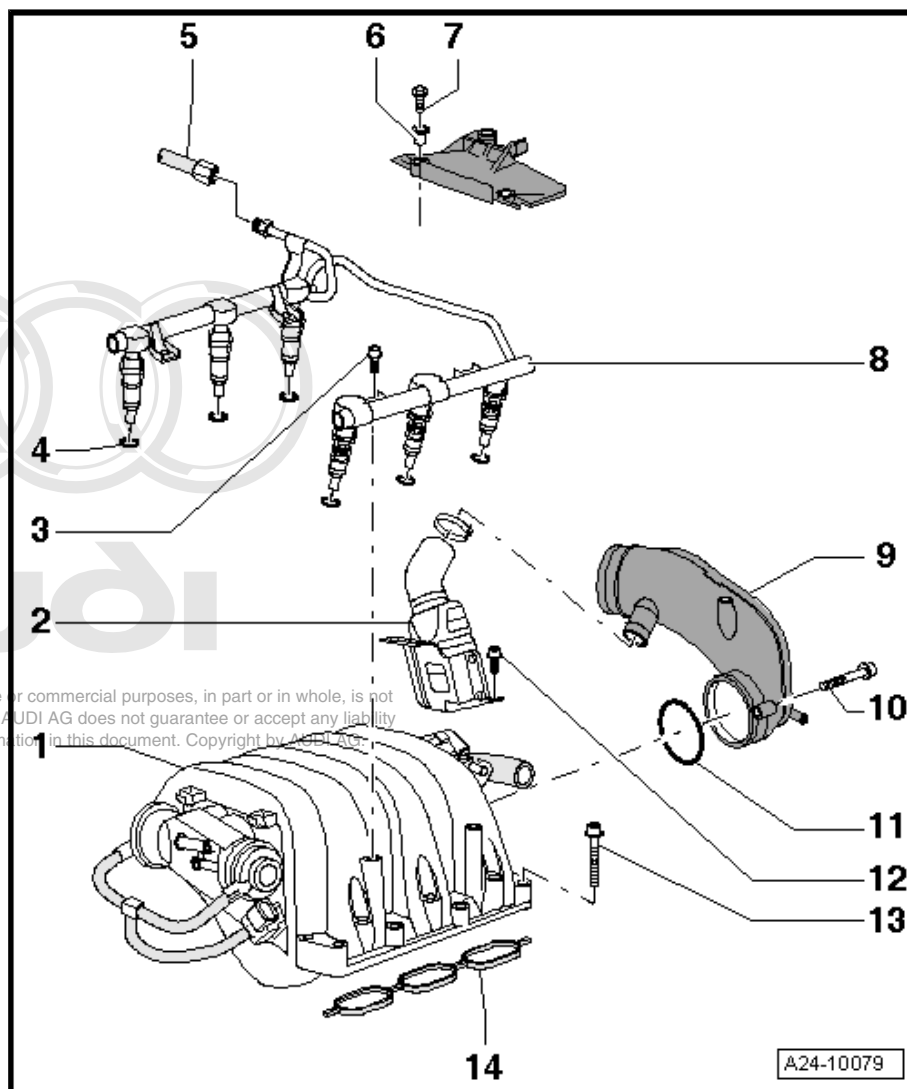
##### 12 - 10 Nm

##### 13 - 10 Nm

- ☐ Tighten in stages and in diagonal sequence

##### 14 - Intake manifold gasket

- ☐ Renew



#### 3.2 Removing and installing intake manifold

##### Removing

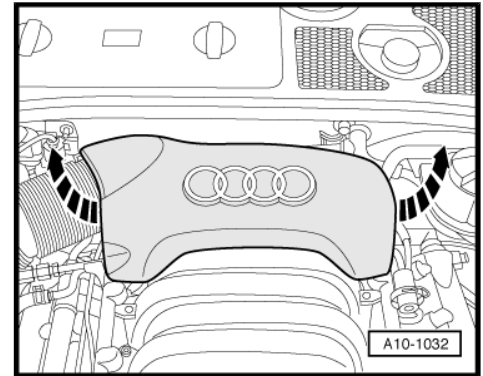


##### Note

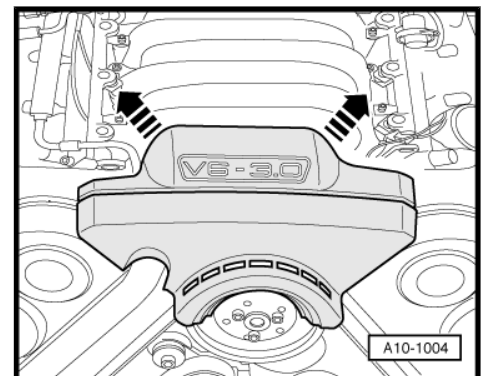
All cable ties which are released or cut open when removing must be fitted in the same position when installing.

- Drain off coolant ⇒ [page 156](#) .

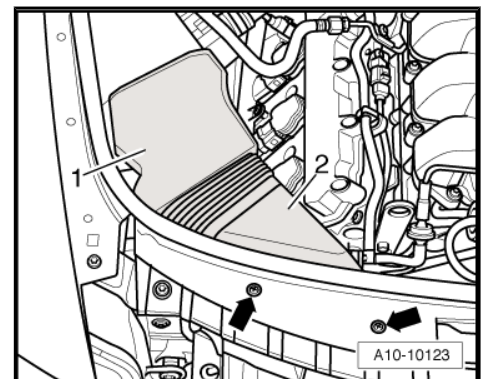
- Pull off engine cover panel (rear) -arrows-.



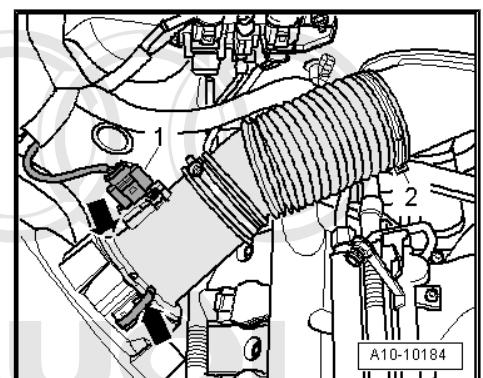
- Pull off engine cover panel (front) -arrows-.



- Remove bolts -arrows-.
- Remove air ducts -1- and -2-.

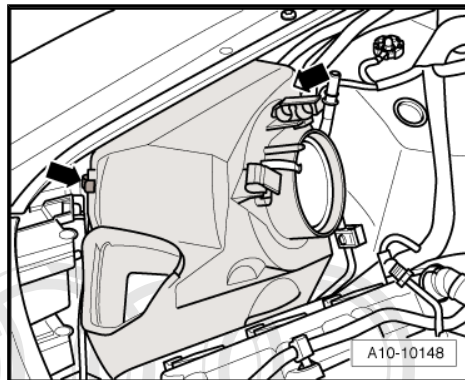


- Unplug electrical connector -1- at air mass meter -G70- .
- Remove air intake hose. To do so, release hose clip -2- and clamps -arrows-.

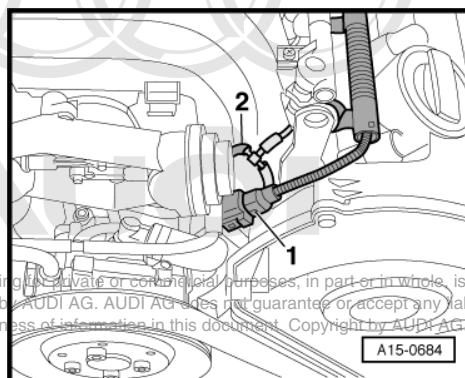


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- Loosen clamps -arrows- and detach top section of air cleaner housing.

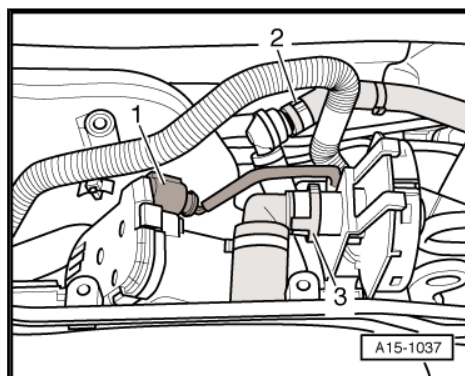
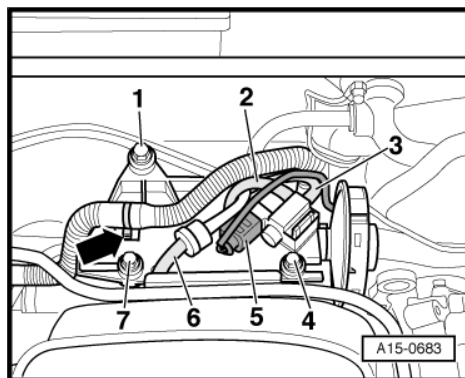


- Unplug electrical connector -1-.
- Detach vacuum hose -2- from T piece.



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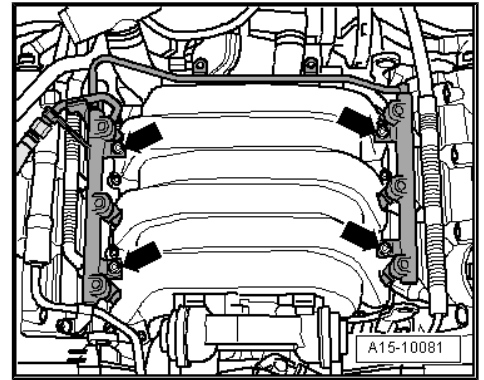
- Disconnect vacuum hoses -2- and -3- at intake manifold change-over valve -N156- .
- Disconnect vacuum hose -6- from non-return valve.
- Unplug electrical connector -5-.
- Move the crankcase breather hose -arrow- clear.
- Unscrew and remove bolts -1-, -4- and -7- on retaining plate for solenoid valves.
- Detach retaining plate for solenoid valves from intake manifold.
- On underside of retaining plate, pull vacuum hose off T piece.
- Unplug electrical connector -1- at throttle valve module - J338- .
- Disconnect vacuum hoses -2- and -3-.



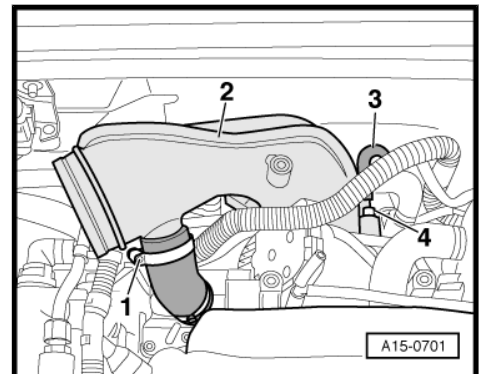
- Unplug electrical connectors at all injectors.
- Unscrew bolts -arrows- for fuel rail.
- Pull fuel rail together with injectors off intake manifold (pull off evenly from the top) and place it on a clean cloth in the engine compartment.

**i** Note

*Make sure the removed injectors do not become soiled.*



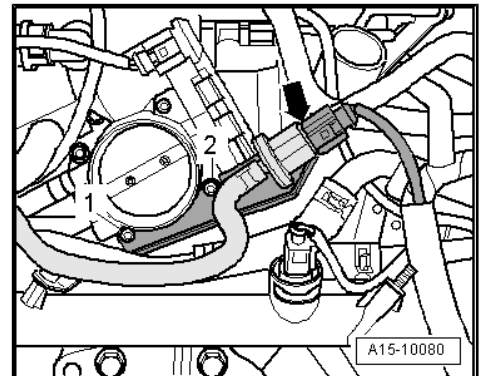
- Pull hose -1- off air duct.
- Unscrew bolt -4- and pull air duct -2- off throttle valve module -J338- .
- If fitted, pull vacuum hose -3- off at lower part of air duct.



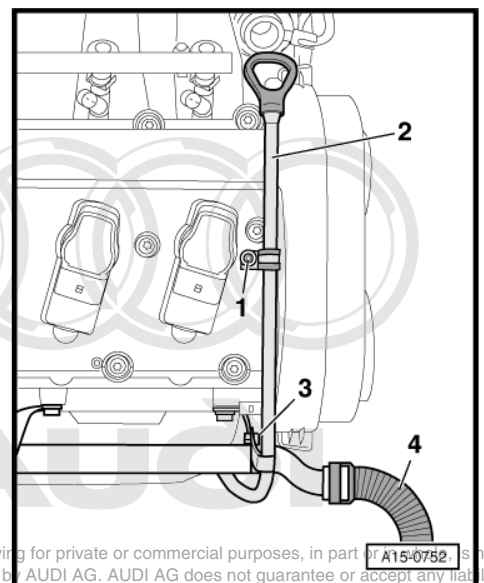
- Detach solenoid valve 1 for activated charcoal filter -N80- -arrow- at bracket.
- Remove bolts -1- and -2-.
- Detach bracket from throttle valve module -J338- .

**i** Note

*Shown from rear with engine removed for illustration purposes.*



- Remove bolts -1- and -3-.
- Disconnect hose -4- at pipe for secondary air.
- Pull guide tube -2- for oil dipstick upwards out of top section of sump and fold forwards.



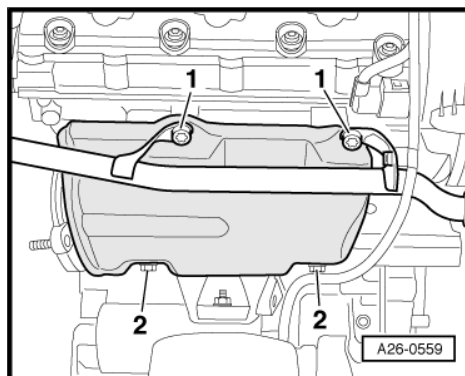
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- On right side of engine, unscrew and remove bolts -1- at secondary air pipe.

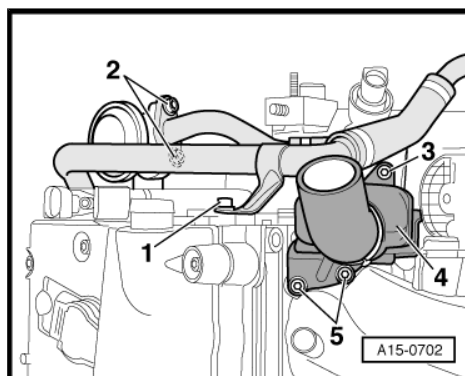


### Note

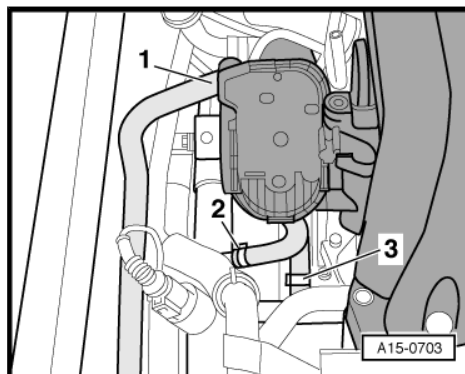
Disregard -item 2-.



- Unscrew bolts -1- and -2- at secondary air pipes.
- Unscrew bolts -3- and -5- and remove resonator -4-.



- Detach vacuum hose -1- leading to solenoid valve 1 for activated charcoal filter system -N80-.
- Detach coolant hoses -2- and -3-.



- Unscrew and remove intake manifold -arrows-.



### Note

Seal intake ports on cylinder heads with clean cloths.

### Installing

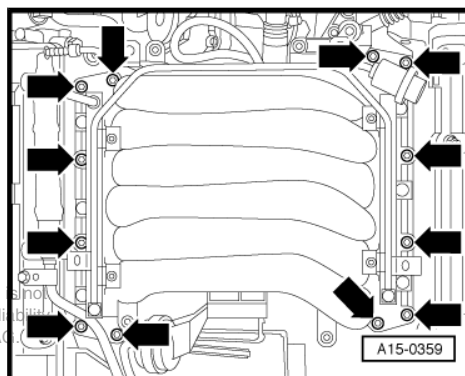
Installation is carried out in the reverse order; note the following:

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### Note

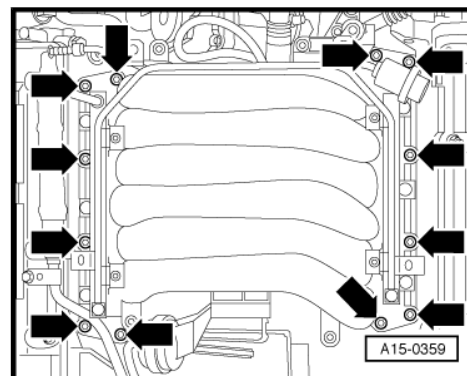
- ◆ Renew gaskets, seals and O-rings.
- ◆ See the notes regarding installation of the fuel rail ⇒ Motronic injection and ignition system (6-cyl., 3.0 ltr. 5V); Rep. Gr. 24 ..
- ◆ Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.
- ◆ Fit all cable ties in the original positions when installing.



- Tighten bolts on intake manifold in stages and in diagonal sequence -arrows-.
- Renew O-ring on guide tube for oil dipstick and insert guide tube into hole in top section of sump.
- Fill cooling system => [page 158](#) .

#### Tightening torques

| Component                                                                                               |    | Nm |
|---------------------------------------------------------------------------------------------------------|----|----|
| Intake manifold to cylinder head                                                                        |    | 10 |
| Bracket for solenoid valve 1 for activated charcoal filter system -N80- to throttle valve module -J338- |    | 10 |
| Guide tube for oil dipstick to secondary air pipe                                                       |    | 10 |
| Resonator to coolant pipe / to cylinder head                                                            |    | 10 |
| Secondary air pipe to cylinder head                                                                     | M6 | 10 |
|                                                                                                         | M8 | 23 |
| Secondary air pipe to combination valve for secondary air system                                        |    | 10 |
| Air duct to intake manifold                                                                             |    | 10 |
| Retaining plate for solenoid valves to intake manifold / air duct                                       |    | 10 |



## 4 Servicing valve gear



### Note

- ◆ *Cylinder heads which have cracks between the valve seats or between a valve seat insert and the spark plug thread can be re-installed without reducing service life, provided the cracks are only slight and do not exceed a maximum of 0.3 mm in width, and no more than the first 4 turns of the spark plug threads are cracked.*
- ◆ *After installing camshafts, wait for approx. 30 minutes before starting engine. Hydraulic valve compensation elements have to settle (otherwise valves will strike pistons).*
- ◆ *After working on the valve gear, turn the engine carefully at least 2 rotations by hand to ensure that none of the valves make contact when the starter is operated.*
- ◆ *The following illustration shows the left-side cylinder head.*

### 4.1 Valve gear - exploded view

1 - 10 Nm

2 - Oil seals

- ☐ Renewing ⇒ [page 110](#)

3 - Housing for camshaft control valves

4 - Gasket

- ☐ Renew

5 - Exhaust camshaft

- ☐ Measuring axial clearance ⇒ [page 110](#)
- ☐ Removing and installing ⇒ [page 112](#)
- ☐ Check radial clearance with Plastigage (bucket tappet removed)
- ☐ Wear limit (radial clearance): 0.1 mm
- ☐ Runout: max. 0.01 mm

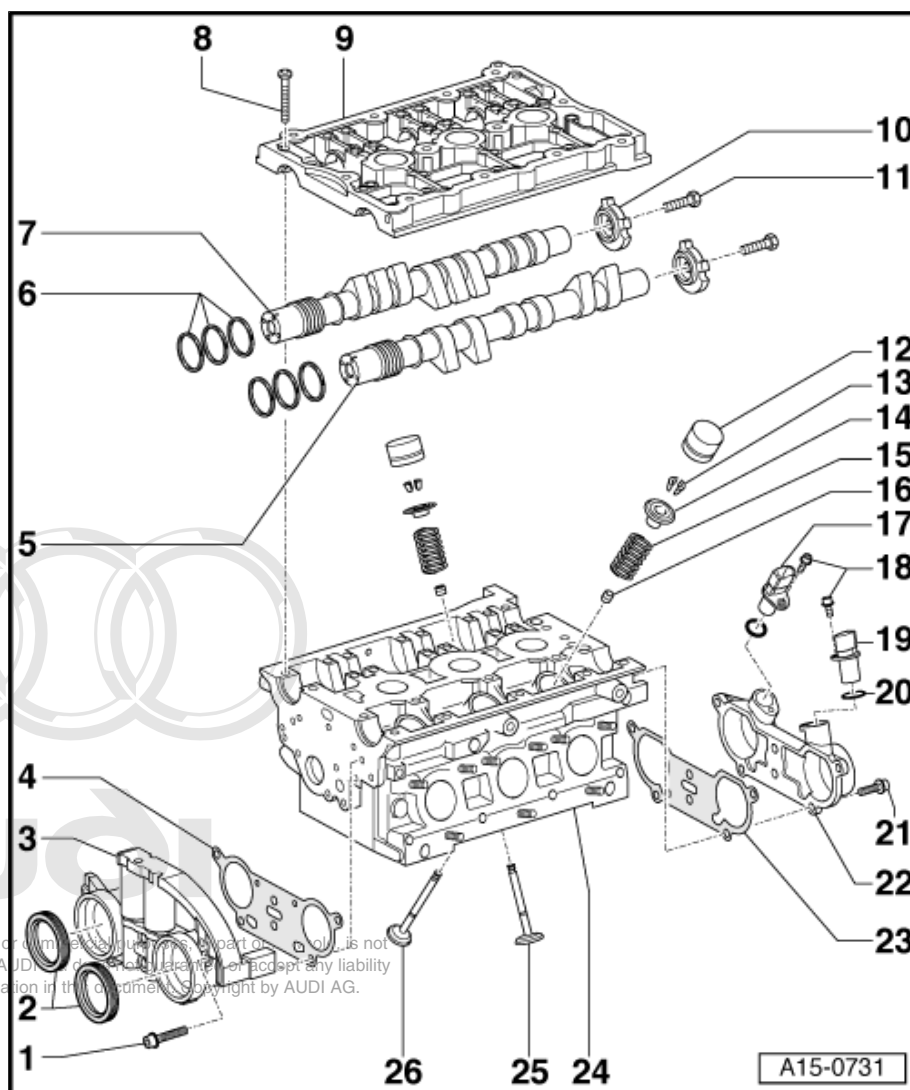
6 - Compression rings for camshaft adjuster

7 - Inlet camshaft

- ☐ Measuring axial clearance ⇒ [page 110](#)
- ☐ Removing and installing ⇒ [page 112](#)
- ☐ Check radial clearance with Plastigage (bucket tappet removed)
- ☐ Wear limit (radial clearance): 0.1 mm
- ☐ Runout: max. 0.01 mm

8 - 10 Nm

- ☐ Tighten in several stages, working from inside to outside



## 9 - Retaining frame

- ☐ With integrated camshaft bearings
- ☐ Removing and installing ⇒ ["4.5 Removing and installing camshafts and camshaft adjusters", page 112](#)

## 10 - Rotor for Hall sender

- ☐ Note installation position (notch on camshaft)

## 11 - 23 Nm

## 12 - Hydraulic bucket tappets

- ☐ Checking ⇒ [page 119](#)
- ☐ Removing and installing ⇒ ["4.5 Removing and installing camshafts and camshaft adjusters", page 112](#)
- ☐ Do not interchange (mark allocation)
- ☐ Place down with contact surface facing downwards
- ☐ Check axial clearance of camshaft before installing ⇒ [page 110](#)
- ☐ Lubricate contact surface

## 13 - Valve cotters

## 14 - Valve spring

## 15 - Valve spring plate

## 16 - Valve stem oil seal

- ☐ Renewing with cylinder head installed ⇒ [page 120](#)
- ☐ Renewing with cylinder head removed ⇒ [page 124](#)

## 17 - Hall sender for inlet camshaft

- ☐ Cylinder bank 1 (right-side): Hall sender -G40-
- ☐ Cylinder bank 2 (left-side): Hall sender 2 -G163-

## 18 - 10 Nm

## 19 - Hall sender for exhaust camshaft

- ☐ Cylinder bank 1 (right-side): Hall sender 3 -G300-
- ☐ Cylinder bank 2 (left-side): Hall sender 4 -G301-

## 20 - O-ring

- ☐ Renew

## 21 - 10 Nm

## 22 - Hall sender housing

## 23 - Gasket

- ☐ Renew

## 24 - Cylinder head

- ☐ See note ⇒ [page 106](#)
- ☐ Checking valve guides, grinding-in valve seats ⇒ [page 128](#)
- ☐ Machining valve seats ⇒ [page 129](#)

## 25 - Inlet valve

- ☐ Do not machine, only grinding-in is permitted
- ☐ Mark installation position for re-installation

☐ Valve dimensions ⇒ [page 108](#)  
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- ☐ Checking valve guides, grinding-in valve seats ⇒ [page 128](#)

## 26 - Exhaust valve

- ☐ Do not machine, only grinding-in is permitted
- ☐ Mark installation position for re-installation
- ☐ Valve dimensions ⇒ [page 108](#)
- ☐ Checking valve guides, grinding-in valve seats ⇒ [page 128](#)

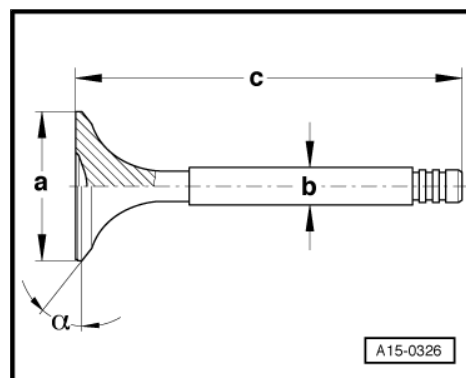
## Valve dimensions



### Note

Valves are not to be machined. Only grinding-in is permitted.

| Dimension |    | Inlet valve       | Exhaust valve     |
|-----------|----|-------------------|-------------------|
| Ø a       | mm | 26.80 ... 27.00   | 29.80 ... 30.00   |
| Ø b       | mm | 5.96 ... 5.97     | 5.94 ... 5.95     |
| c         | mm | 104.84 ... 105.34 | 103.64 ... 104.14 |
| α         | °  | 45                | 45                |



### WARNING

- ◆ Care must be taken when disposing of old sodium-cooled exhaust valves.
- ◆ The valves must be sawn in two with a metal saw between the centre of the stem and valve head. When doing so, the valves must not come into contact with water. After preparing the valves, throw a maximum of ten into a bucket of water. Then step away immediately, since a chemical reaction will occur in which the sodium filling burns.
- ◆ After performing these steps the valves can be disposed of in the normal way.

## 4.2 Camshaft adjustment - exploded view



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**1 - Oil seals**

- ☐ Renewing ⇒ [page 110](#)

**2 - Housing for camshaft control valves****3 - O-rings**

- ☐ Green
- ☐ Between solenoid valves and solenoid valve housing
- ☐ Renew

**4 - O-rings**

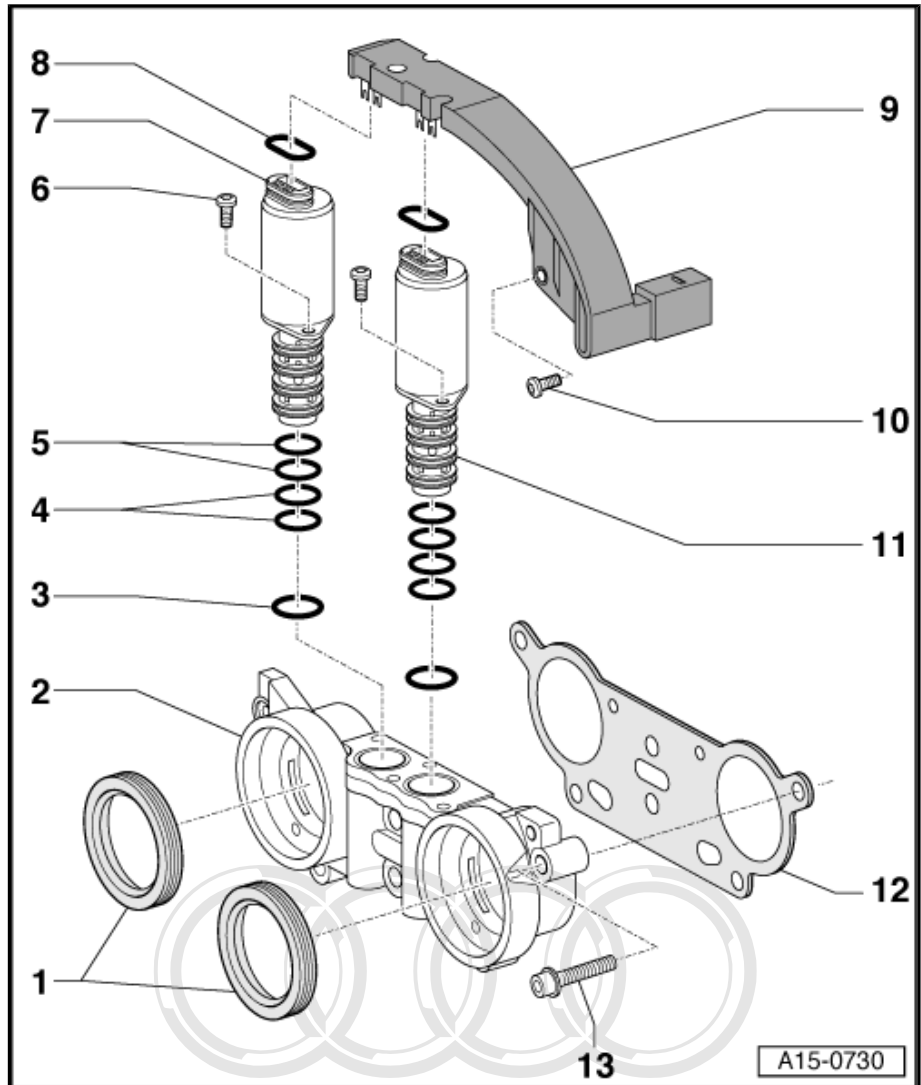
- ☐ Black
- ☐ Renew

**5 - O-rings**

- ☐ Green
- ☐ Renew

**6 - 4 Nm****7 - Camshaft control valve - inlet side**

- ☐ Cylinder bank 1 (right-side) - camshaft control valve -N205-
- ☐ Cylinder bank 2 (left-side): camshaft control valve 2 -N208-
- ☐ Do not install camshaft control valve for exhaust side on inlet side
- ☐ Note identification marking: "12. 100 338"
- ☐ Check using vehicle diagnosis, testing and information system -VAS 5051 A- in the function "Guided Fault Finding"

**8 - Gasket**

- ☐ Renew if damaged

**9 - Connector adapter**

- ☐ Adapter must be renewed if it has been disconnected from camshaft control valves
- ☐ Push carefully onto connectors on camshaft control valves until it engages

**10 - 4 Nm****11 - Camshaft control valve - exhaust side**

- ☐ Cylinder bank 1 (right-side) - exhaust camshaft control valve 1 -N318-
- ☐ Cylinder bank 2 (left-side) - exhaust camshaft control valve 2 -N319-
- ☐ Do not install camshaft control valve for inlet side on exhaust side
- ☐ Note identification marking: "12. 100 339"
- ☐ Check using vehicle diagnosis, testing and information system -VAS 5051 A- in the function "Guided Fault Finding"

**12 - Gasket**

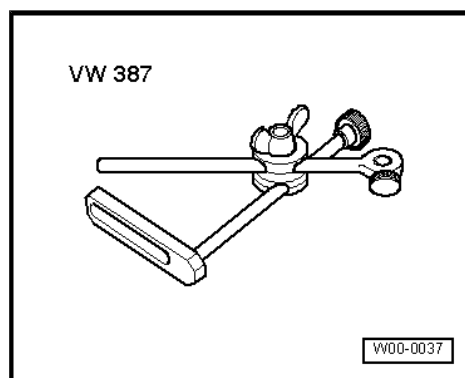
- ☐ Renew

**13 - 10 Nm**

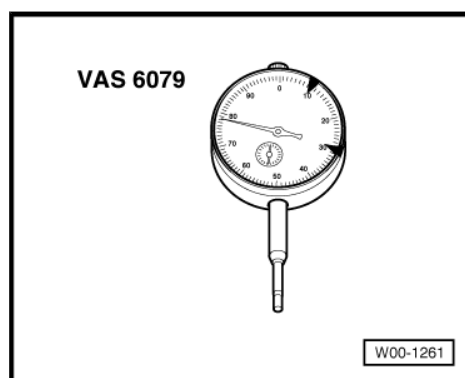
### 4.3 Measuring axial clearance of camshafts

#### Special tools and workshop equipment required

- ◆ Universal dial gauge bracket -VW 387-

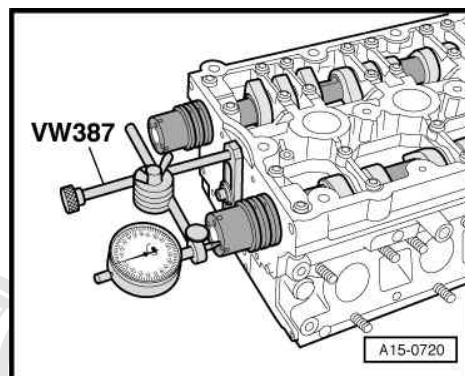


- ◆ Dial gauge -VAS 6079-



#### Test sequence

- Remove camshafts ⇒ [page 112](#) .
- Remove bucket tappets.
- Fit camshafts in cylinder head and install retaining frame.
- Attach dial gauge -VAS 6079- with dial gauge bracket -VW 387- to cylinder head.
- Press the camshaft that is to be checked against the dial gauge by hand.
- Set dial gauge to "0".
- Press camshaft away from dial gauge and read off value:
  - Radial clearance (new): 0.08 ... 0.16 mm
  - Wear limit (radial clearance): 0.20 mm

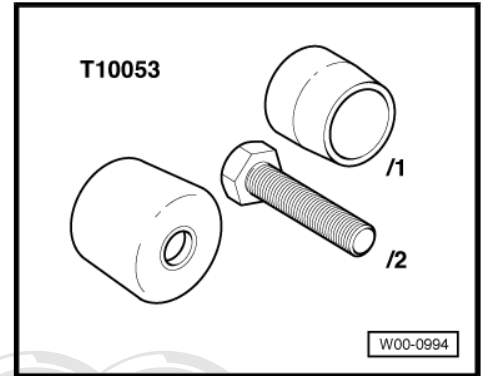


### 4.4 Renewing camshaft oil seals

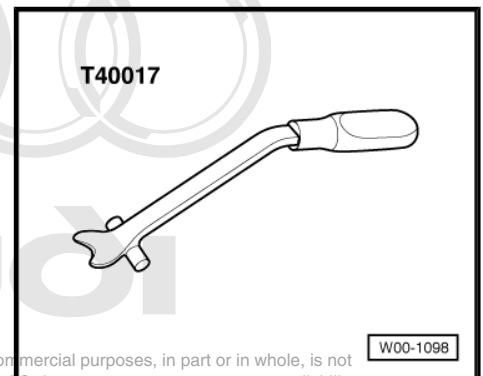
#### Special tools and workshop equipment required

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◆ Assembly tool -T10053-



◆ Lever -T40017-



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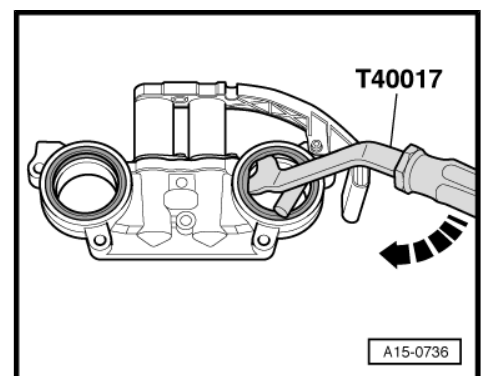
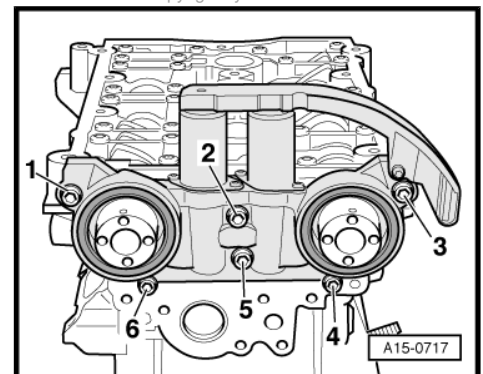
## Removing



### Note

*If one of the oil seals is leaking, renew seals on both cylinder heads.*

- Remove toothed belt ⇒ [page 67](#) .
- Mark positions of camshaft sprockets for re-installation.
- Remove camshaft sprockets.
- Unscrew bolts -1 ... 6- and remove housing for camshaft control valves.
- Remove oil seals for camshafts using lever -T40017- .



## Installing



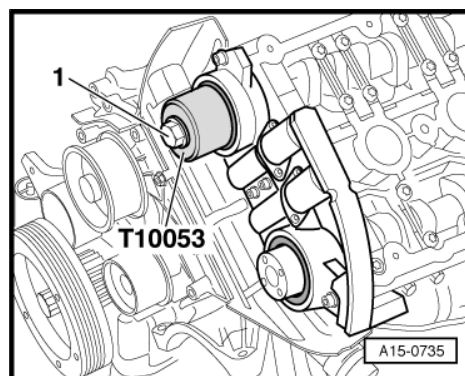
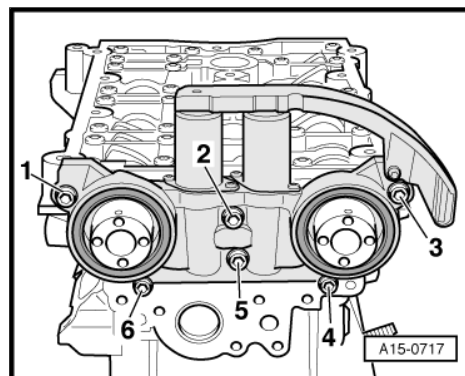
### Note

Renew seal.

- Check whether the compression rings ⇒ [Item 6 \(page 106\)](#) are installed on the camshafts before installing the housing for the camshaft control valves.
- Install housing for camshaft control valves and tighten bolts -1 ... 6-.
- Using the assembly tool -T10053- and bolt -1-, press the new oil seals for camshafts in until they are flush with the housing.

Remaining installation steps are carried out in reverse sequence; note the following:

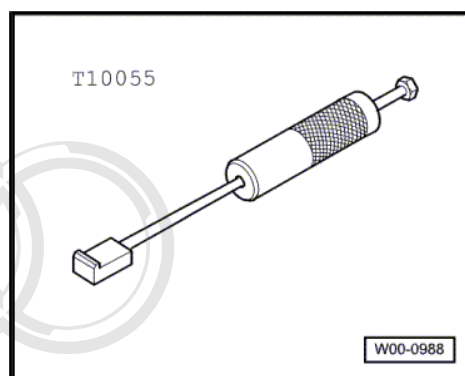
- Install toothed belt (adjust valve timing) ⇒ [page 75](#) .



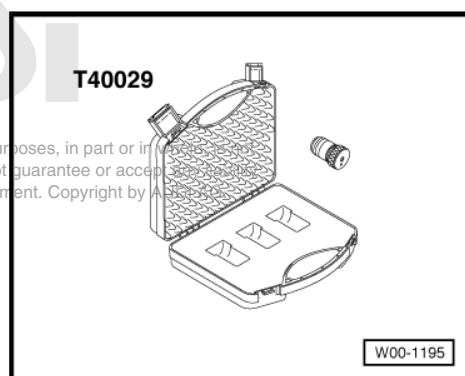
## 4.5 Removing and installing camshafts and camshaft adjusters

### Special tools and workshop equipment required

- ◆ Puller -T10055-



- ◆ Mandrel -T40029-



- ◆ Electric drill with plastic brush attachment
- ◆ Safety goggles

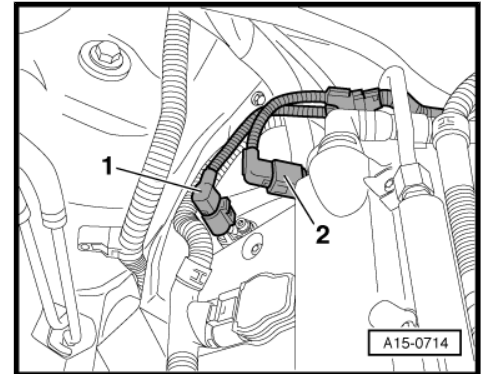
◆ Sealant ⇒ Parts catalogue

### Removing

- Remove toothed belt ⇒ [page 67](#) .
- Remove camshaft sprockets on respective cylinder head.
- Remove combination valve for secondary air system: left-side ⇒ [page 203](#) , right-side ⇒ [page 205](#) .

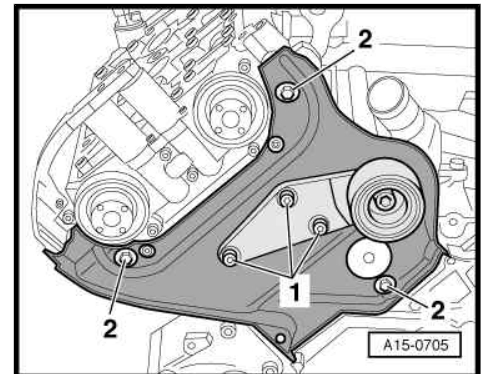
### Cylinder head (right-side):

- Unplug electrical connectors -1- and -2- at Hall senders -G40- and -G300- .



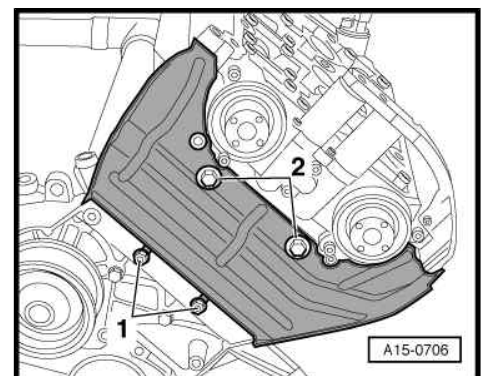
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- Remove bolts -1- and take off bracket with idler roller.
- Remove bolts -2- and take off toothed belt cover (rear right).



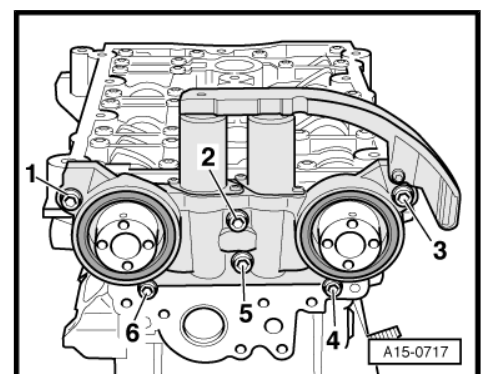
### Cylinder head (left-side):

- Remove bolts -1- and -2- and take off toothed belt cover (rear left).

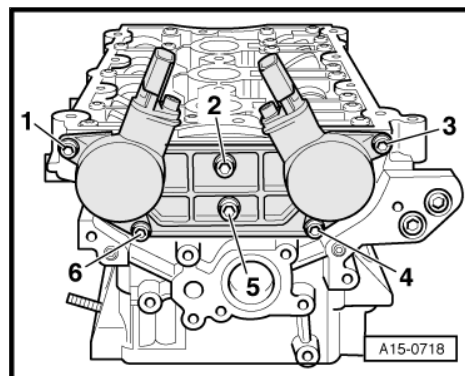


### Continuation for both sides:

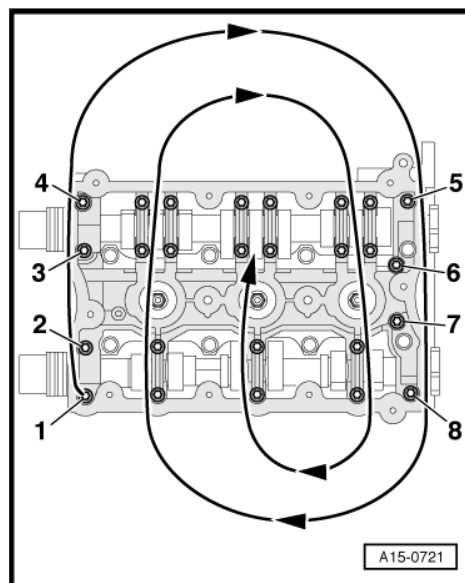
- Remove counterhold tool -T40030- from camshafts.
- Unscrew bolts -1 ... 6- and remove housing for camshaft control valves.



- Unscrew bolts -1 ... 6- and remove housing for Hall sender.



- Loosen bolts on retaining frame in the sequence shown by the numbers and then following the arrows.



- Press off retaining frame using M6 bolts -arrows-.
- Carefully remove retaining frame.

### Installing



#### Note

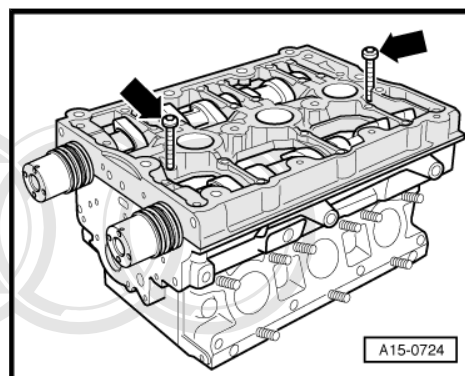
*Renew gaskets and seals.*

- Crankshaft locked in position with locking pin -T40026-.



#### WARNING

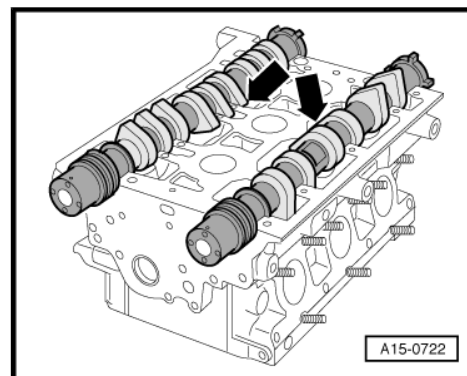
***Wear safety goggles.***



- Remove remaining sealant from cylinder head and retaining frame using rotating plastic brush or similar.
- Clean sealing surfaces; they must be free of oil and grease.
- Lubricate running surfaces of camshafts.

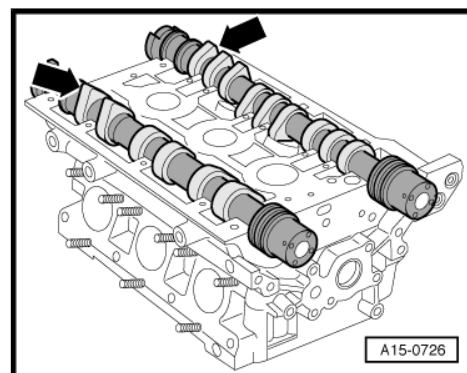
### Cylinder head (left-side):

- Position camshafts in cylinder head as illustrated.
- The cams of No. 5 cylinder point downwards at equal angles -arrows-.



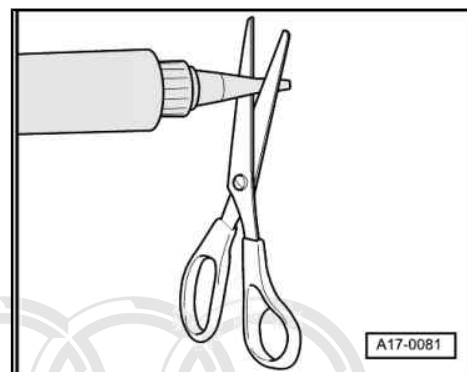
### Cylinder head (right-side):

- Position camshafts in cylinder head as illustrated.
- The cams of No. 3 cylinder point upwards at equal angles -arrows-.



### Continuation for both sides:

- Cut off nozzle of tube at front marking ( $\varnothing$  of nozzle approx. 1 mm).

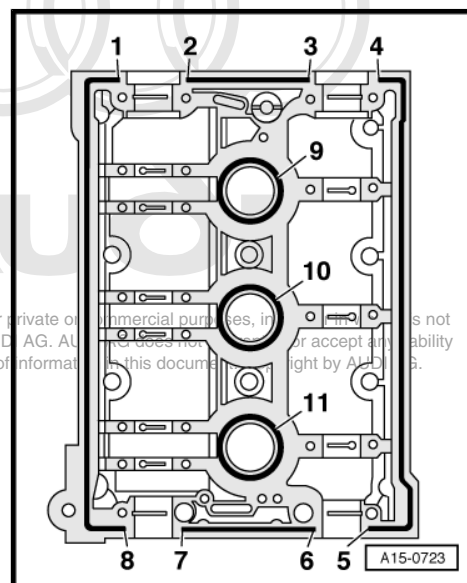


- Apply sealant to the clean sealing surface on the retaining frame as illustrated.
- The bead of sealant should be approx. 1.2 mm wide.
- The sealant bead must be at least 5 mm away from the camshaft bearings at the points -1 ... 8- in the illustration.
- Additionally apply a ring of sealant on the sealing surface around each spark plug hole -9 ... 11-.



### Note

*The bead of sealant must be applied exactly according to these instructions, otherwise excess sealant can get into the camshaft bearings.*

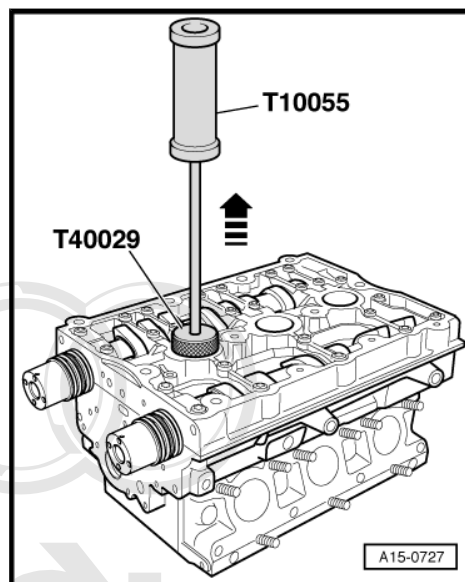
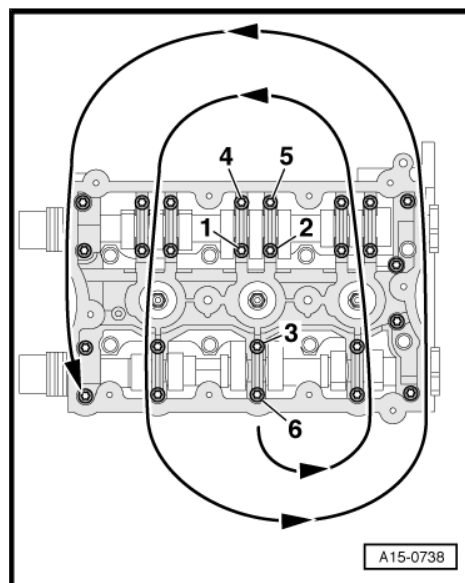
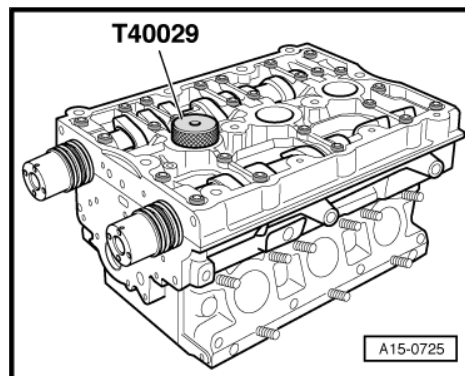


- Fit retaining frame immediately and fix in position using mandrel -T40029- .



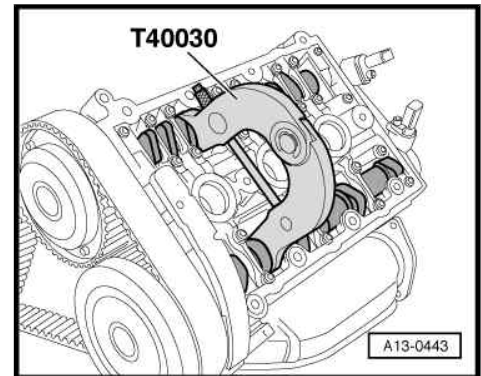
### Note

- ◆ *The retaining frame should be fitted and secured without delay, as the sealant starts hardening immediately.*
- ◆ *After installing the retaining frame, wait about 30 minutes for the sealant to dry.*
- Tighten bolts on retaining frame at first only hand-tight in the sequence shown by the numbers, and then following the arrows.
- The retaining frame should make contact with the cylinder head over the full surface.
- Tighten bolts securing retaining frame to final torque (10 Nm).
- Pull mandrel -T40029- out of cylinder head and retaining frame using puller -T10055- .

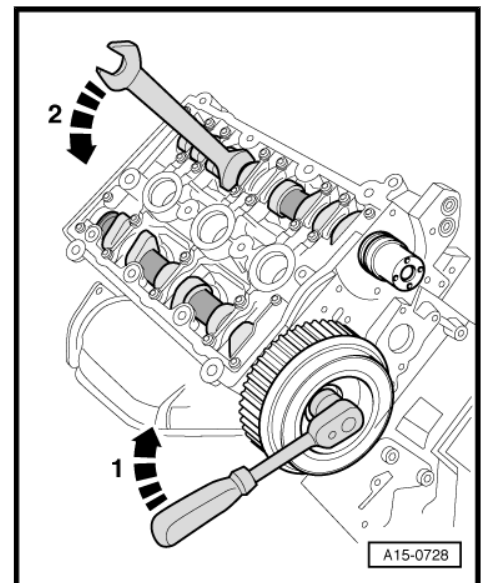


**Cylinder head (left-side):**

- Attach counterhold tool -T40030- to camshafts.
- Expand counterhold tool -T40030- by means of the threaded spindle (tightening torque max. 10 Nm) until it is seated with zero play.

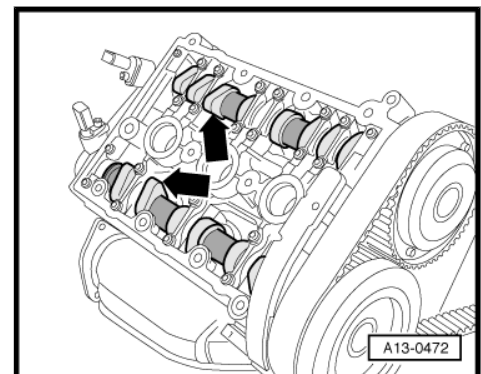
**Cylinder head (right-side):**

- Install camshaft sprocket on exhaust camshaft.
- Rotate exhaust camshaft -arrow 1- and inlet camshaft -arrow 2- 30° in direction of -arrows-.

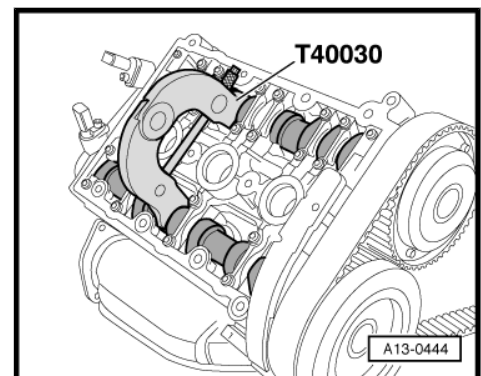


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- The cams -arrows- at No. 3 cylinder on inlet and exhaust camshafts must be positioned as shown in illustration.

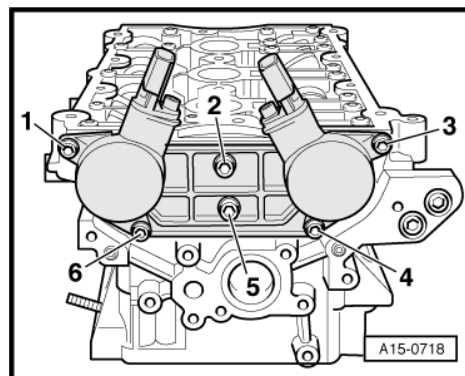


- Attach counterhold tool -T40030- to camshafts.
- Remove camshaft sprocket from exhaust camshaft again.



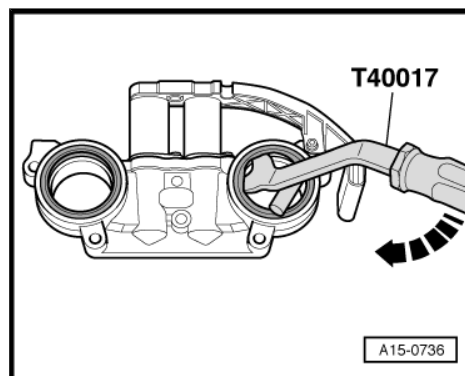
# Continuation for both sides:

- Install housing for Hall sender and tighten bolts -1 ... 6-.



## Note

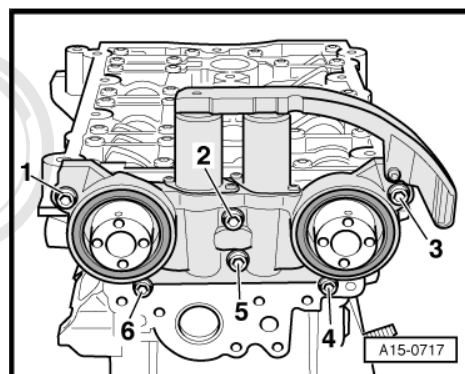
If camshaft oil seals are being renewed, they must be pried out using lever -T40017- before installing housing for camshaft control valves. Installing camshaft oil seals ⇒ [page 110](#).



- Check whether the compression rings ⇒ [Item 6 \(page 106\)](#) are installed on the camshafts before installing the housing for the camshaft control valves.
- Install housing for camshaft control valves and tighten bolts -1 ... 6-.

Remaining installation steps are carried out in reverse sequence; note the following:

- Install combination valve for secondary air system: left-side ⇒ [page 203](#), right-side ⇒ [page 205](#).
- Install toothed belt (adjust valve timing) ⇒ [page 75](#).



## Note

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

## Tightening torques

| Component                                                  | Nm                |
|------------------------------------------------------------|-------------------|
| Retaining frame to cylinder head                           | 10                |
| Hall sender housing to cylinder head                       | 10                |
| Housing for camshaft control valves to cylinder head       | 10                |
| Toothed belt cover (rear) to cylinder head/ cylinder block | 10 <sup>18)</sup> |

18) Renew bolts.

## 4.6 Checking hydraulic bucket tappets

### Special tools and workshop equipment required

- ◆ Feeler gauge
- ◆ Wooden/plastic wedge



#### Note

- ◆ *Hydraulic bucket tappets cannot be serviced.*
- ◆ *Irregular valve noise during starting is normal.*

### Test sequence

- Start engine and run until coolant temperature reaches approx. 80 °C.
- Increase engine speed to approx. 2500 rpm for 2 minutes (perform road test if necessary).

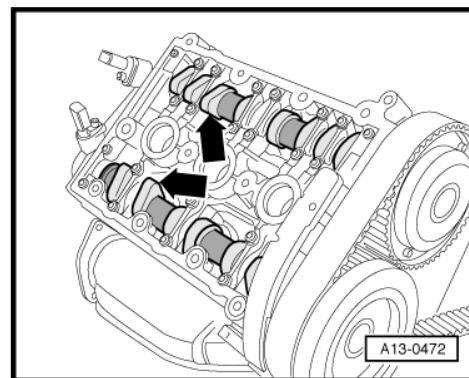


#### Note

*If the irregular valve noises stop but occur again on short trips, a new oil retention valve must be fitted. Fitting location of oil retention valve: beneath cover on intake manifold ⇒ [page 149](#).*

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

- Remove cylinder head cover: left-side ⇒ [page 80](#), right-side ⇒ [page 82](#).
- Rotate crankshaft clockwise at central bolt for toothed belt sprocket until cams of cylinder to be checked are pointing upwards -arrows-.



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- Determine clearance between cam and bucket tappet by pressing down bucket tappet with a suitable wood or plastic wedge.

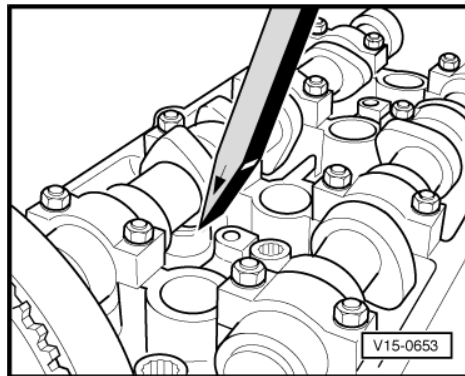
If it is possible to insert a feeler gauge of 0.20 mm between camshaft and bucket tappet:

- Renew the bucket tappet; see Removing and installing camshafts and camshaft adjuster ⇒ [page 112](#).



#### Note

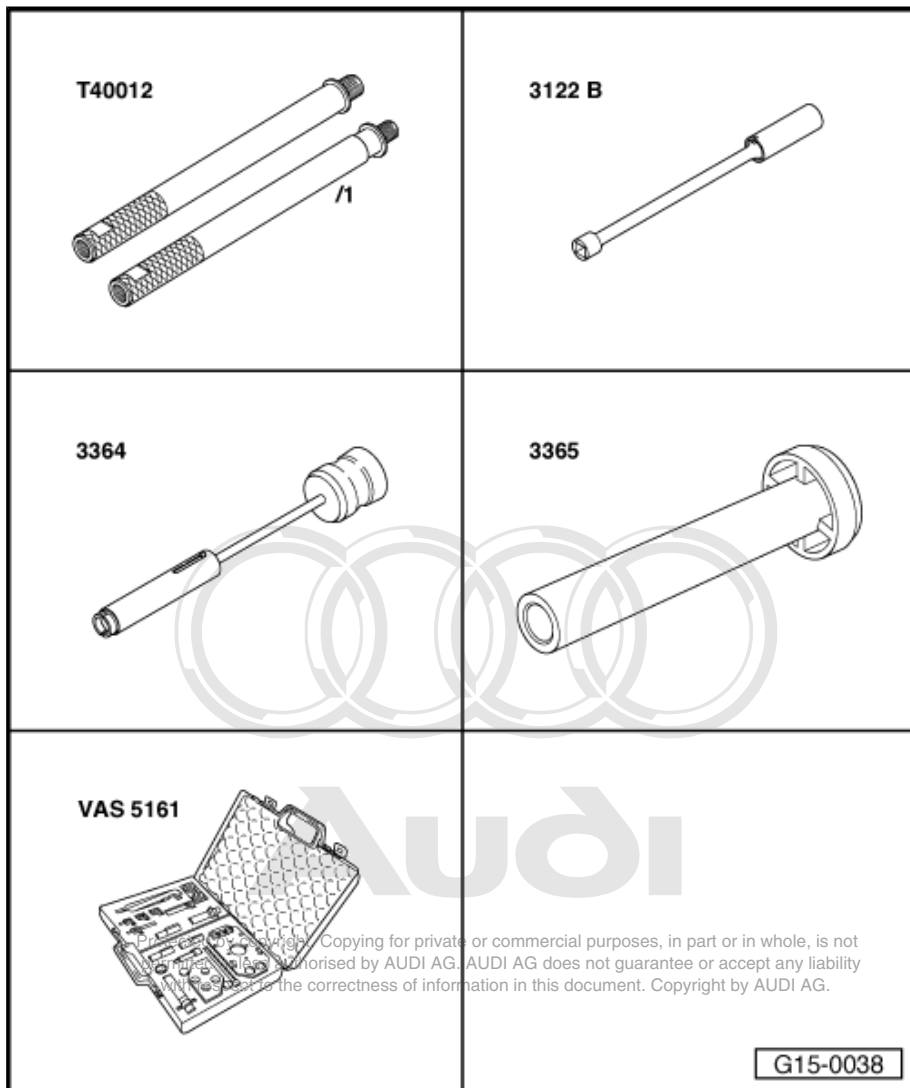
- ◆ After installing camshafts, wait for approx. 30 minutes before starting engine. Hydraulic valve compensation elements have to settle (otherwise valves will strike pistons).
- ◆ After working on the valve gear, turn the engine carefully at least 2 rotations by hand to ensure that none of the valves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



## 4.7 Renewing valve stem oil seals with cylinder head installed

### Special tools and workshop equipment required

- ◆ Adapter -T40012-
- ◆ Spark plug socket and extension -3122 B-
- ◆ Valve stem seal puller -3364-
- ◆ Valve stem seal fitting tool -3365-
- ◆ Removal and installation device -VAS 5161-



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## Removing

- Cylinder head installed.
- Remove camshafts ⇒ [page 112](#) .



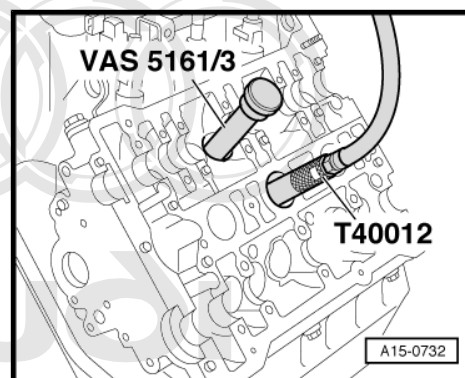
### Note

*Make sure that the hydraulic bucket tappets are not interchanged; mark allocation on rear with a waterproof felt-tipped pen.*

- Remove the bucket tappets out of the guides.
- Place the bucket tappets down on a clean surface with the contact surface facing downwards in the order that they were removed.
- Remove spark plugs with spark plug socket -3122 B- .
- Set piston of the respective cylinder to “bottom dead centre”.

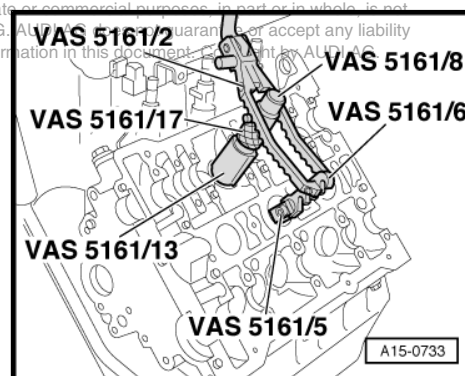
Screw adapter -T40012- with seal hand-tight into the corresponding spark plug thread, connect to compressed air hose and apply a steady pressure.

- Air pressure: at least 6 bar
- Insert punch -VAS 5161/3- into bucket tappet guide.
- Knock valve cotters on all five valves loose using a plastic hammer.

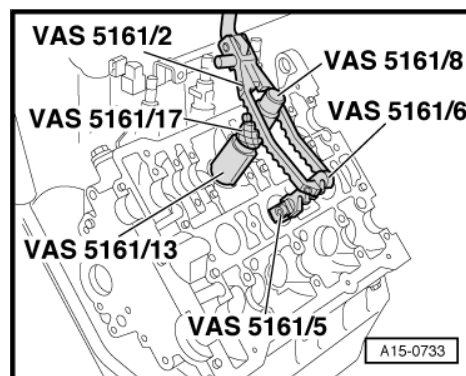


### Inlet side:

- Screw snap-in device -VAS 5161/6- with interlocking fork -VAS 5161/5- into threaded hole on cylinder head.
- Push guide bush -VAS 5161/13- as far as it will go into bucket tappet guide for valve to be removed.
- Installation position: knurled surfaces face perpendicular to direction of travel.
- Slide knurled spacer ring -VAS 5161/17- onto assembly cartridge -VAS 5161/8- .
- Insert assembly cartridge into guide bush.
- 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.

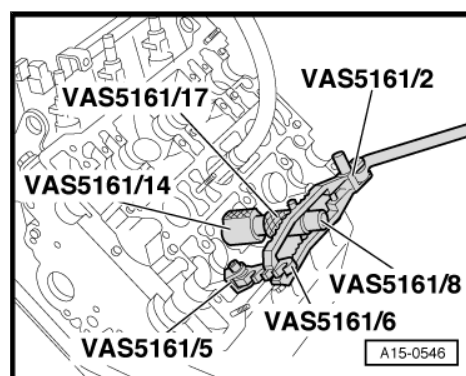


- Release the pressure fork.
- Take out assembly cartridge with spacer ring, guide bush, valve spring plate and valve spring.



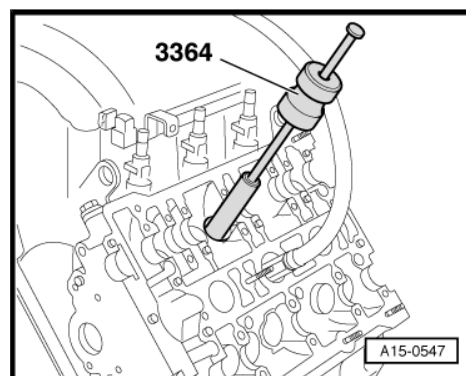
#### Exhaust side:

- Screw snap-in device -VAS 5161/6- with interlocking fork -VAS 5161/5- into threaded hole on cylinder head.
- Push guide bush -VAS 5161/14- as far as it will go into bucket tappet guide for valve to be removed.
- Installation position: knurled surfaces face perpendicular to direction of travel.
- Slide knurled spacer ring -VAS 5161/17- onto assembly cartridge -VAS 5161/8-.
- Insert assembly cartridge into guide bush.
- 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 the pressure fork.
- Take out assembly cartridge with spacer ring, guide bush, valve spring plate and valve spring.



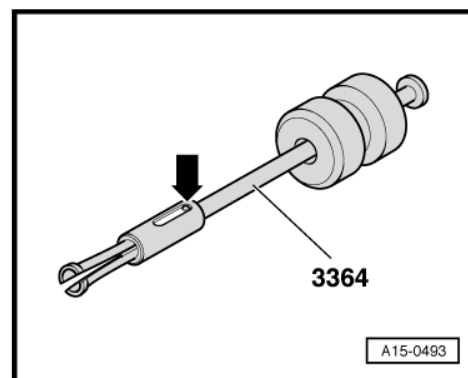
#### Continuation for both sides:

- Pull off valve stem oil seal with valve stem seal puller -3364-.

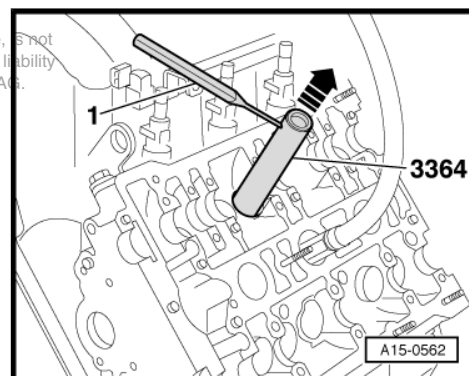


If the puller -3364- cannot be used on some of the valve stem oil seals due to the confined space, proceed as follows:

- Knock pin -arrow- of puller -3364- out using a drift and remove the extractor attachment.



- Attach lower part of puller -3364- to valve stem oil seal.
- Secure puller -3364- with drift or roll-pin drift -1- as shown in the illustration.
- Apply an assembly lever to puller -3364- and pull out valve stem oil seal -arrow-.



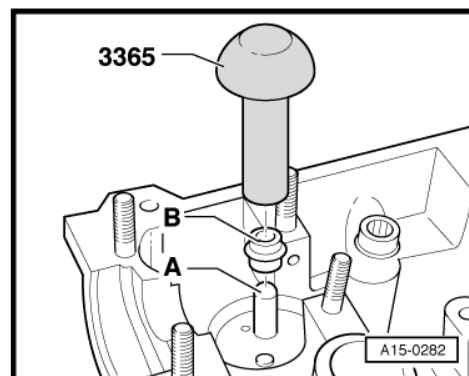
## Installing



### Note

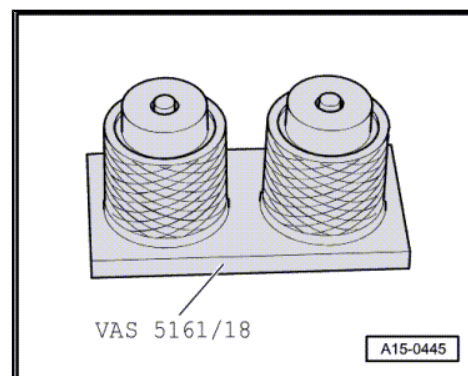
*A plastic sleeve -A- is included with the new valve stem oil seals.*

- Fit 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 -3365-.
- Remove plastic sleeve.

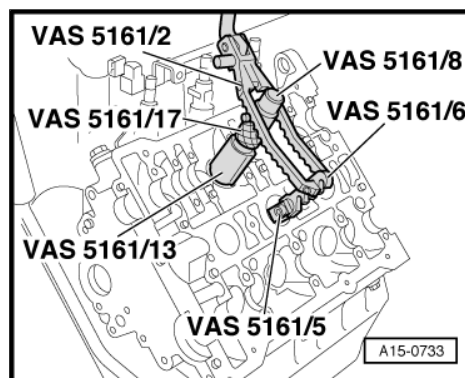


If valve cotters have been removed from assembly cartridge, they need to be put into insertion device -VAS 5161/18- first.

- The large diameter of the valve cotters points upwards.
- Press assembly cartridge -VAS 5161/8- onto insertion device from above and pick up valve cotters.



- Reinstall assembly cartridge -VAS 5161/8- in guide bush - VAS 5161/13- and -VAS 5161/14- .
- Push pressure fork down and pull knurled screw upwards, while turning screw in both directions – this will insert the valve cotteners.
- Release pressure fork with knurled screw still in pulled position.
- Insert bucket tappet.
- Install camshafts ⇒ [page 114](#) .



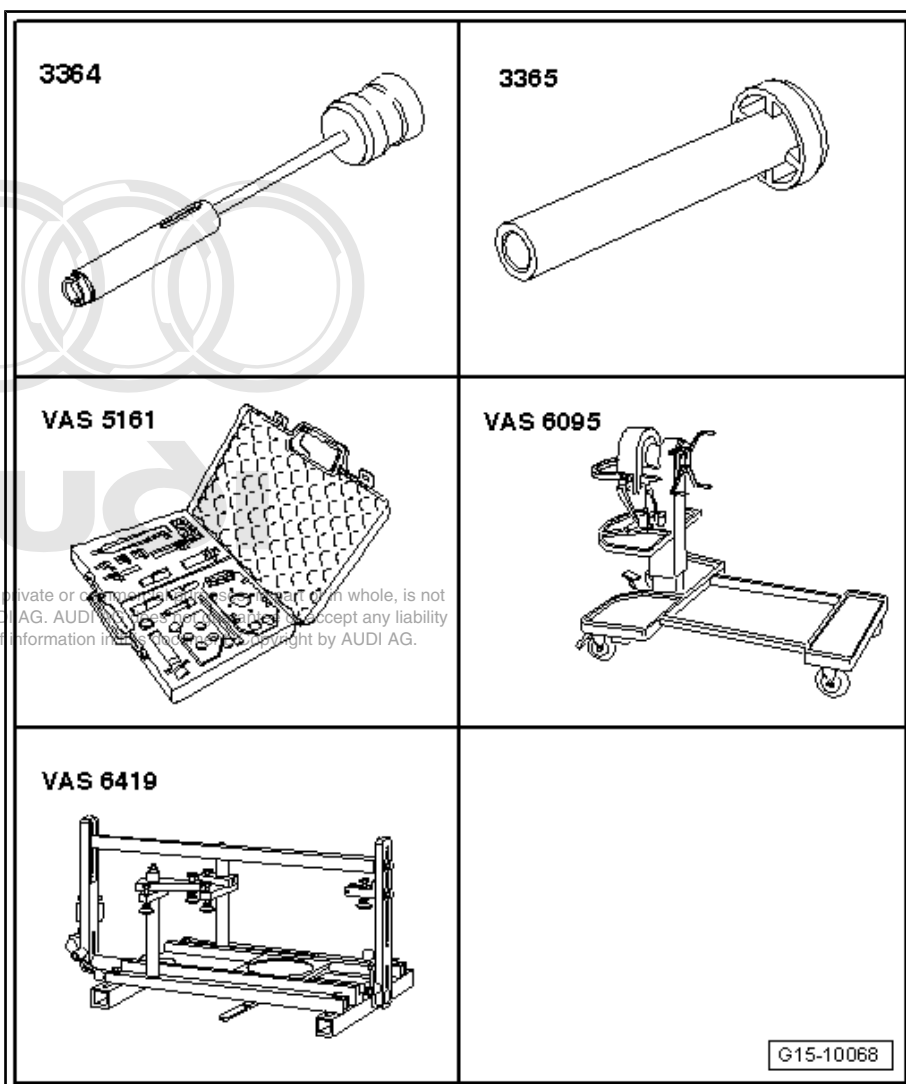
### Note

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

## 4.8 Renewing valve stem oil seals with cylinder head removed

### Special tools and workshop equipment required

- ◆ Valve stem seal puller -3364-
- ◆ Valve stem seal fitting tool -3365-
- ◆ Removal and installation device for valve cotteners - VAS 5161-
- ◆ Engine and gearbox support -VAS 6095-
- ◆ Cylinder head tensioning device -VAS 6419-



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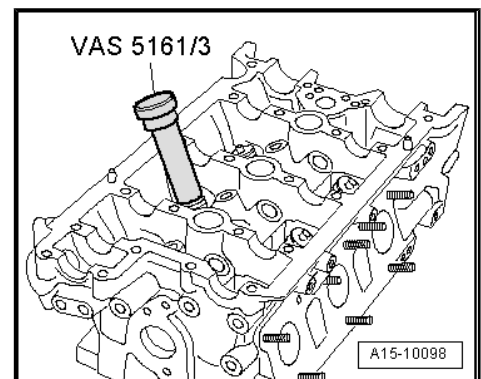
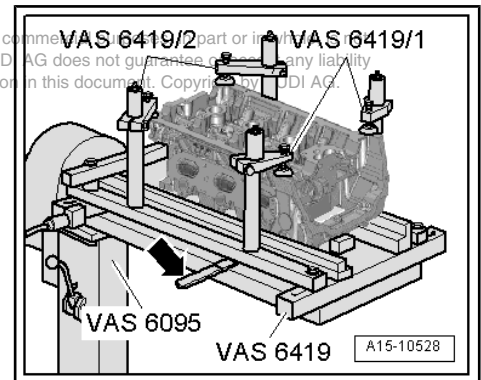
## Removing

- Cylinder head installed.
- Remove camshafts ⇒ [page 112](#).

### Note

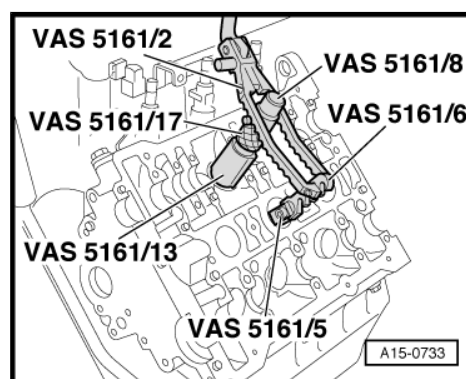
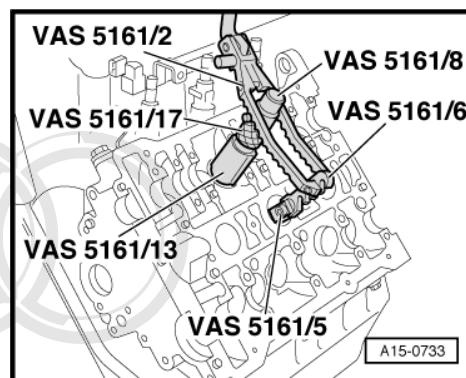
*Make sure that the hydraulic bucket tappets are not interchanged; mark allocation on rear with a waterproof felt-tipped pen.*

- Remove the bucket tappets out of the guides.
- Place the bucket tappets down on a clean surface with the contact surface facing downwards in the order that they were removed.
- Insert cylinder head tensioning device -VAS 6419- into engine and gearbox support -VAS 6095-.
- Secure cylinder head in cylinder head tensioning device, as shown in illustration.
- Connect cylinder head tensioning device to compressed air.
- Using lever -arrow-, slide air pad under combustion chamber where valve stem oil seal is to be removed.
- Apply just enough compressed air to bring air pad into contact with valve heads.
- Apply drift -VAS 5161/3- to valve spring plate and use plastic-headed hammer to release sticking valve cotters.



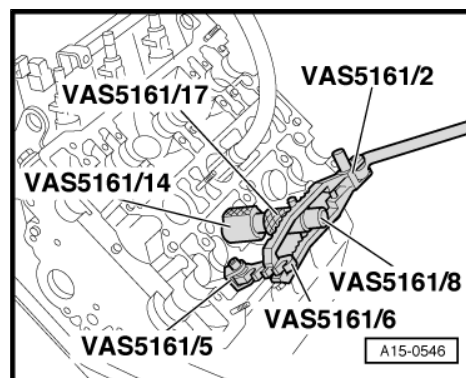
# Inlet side:

- Screw snap-in device -VAS 5161/6- with interlocking fork - VAS 5161/5- into threaded hole on cylinder head.
- Push guide bush -VAS 5161/13- as far as it will go into bucket tappet guide for valve to be removed.
- Installation position: knurled surfaces face perpendicular to direction of travel.
- Slide knurled spacer ring -VAS 5161/17- onto assembly cartridge -VAS 5161/8- .
- Insert assembly cartridge into guide bush.
- 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 the pressure fork.
- Take out assembly cartridge with spacer ring, guide bush, valve spring plate and valve spring.



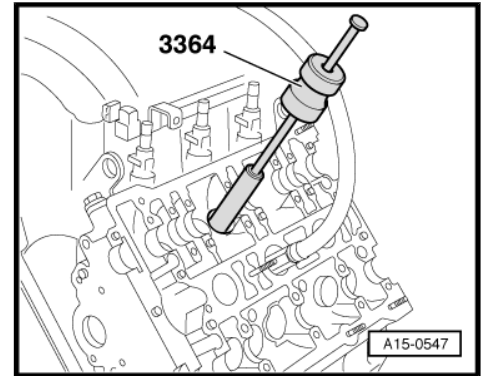
# Exhaust side:

- Screw snap-in device -VAS 5161/6- with interlocking fork - VAS 5161/5- into threaded hole on cylinder head.
- Push guide bush -VAS 5161/14- as far as it will go into bucket tappet guide for valve to be removed.
- Installation position: knurled surfaces face perpendicular to direction of travel.
- Slide knurled spacer ring -VAS 5161/17- onto assembly cartridge -VAS 5161/8- .
- Insert assembly cartridge into guide bush.
- 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 the pressure fork.
- Take out assembly cartridge with spacer ring, guide bush, valve spring plate and valve spring.



#### Continuation for both sides:

- Pull off valve stem oil seal with valve stem seal puller -3364- .



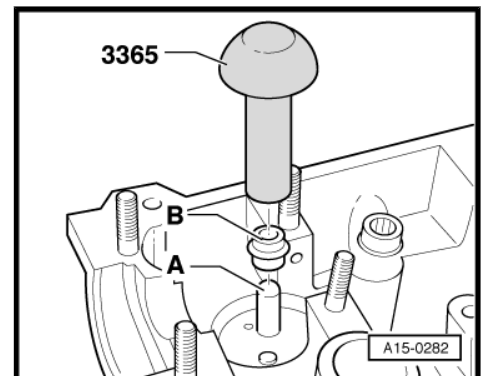
#### Installing



#### Caution

***Make sure valve stem oil seals are not damaged when installing.***

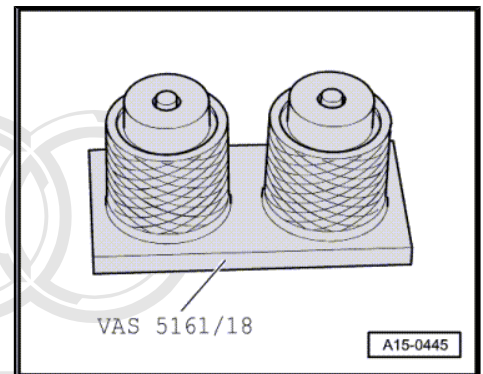
- ◆ ***New valve stem oil seals -B- are supplied with plastic sleeve; fit plastic sleeve -A- onto valve stem.***



- 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 -3365- .
- Remove plastic sleeve.

If valve cotters have been removed from assembly cartridge, they need to be put into insertion device -VAS 5161/18- first.

- The large diameter of the valve cotters points upwards.
- Press assembly cartridge -VAS 5161/8- onto insertion device from above and pick up valve cotters.



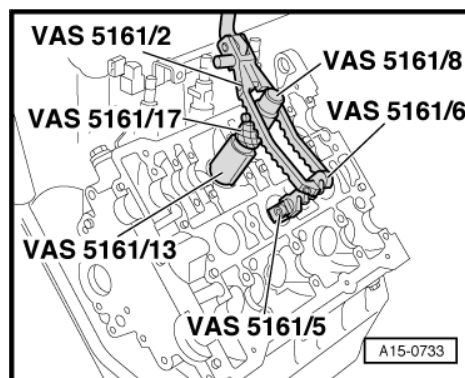
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- Reinstall assembly cartridge -VAS 5161/8- in guide bush - VAS 5161/13- and -VAS 5161/14- .
- Push pressure fork down and pull knurled screw upwards while turning to left and right — this will insert valve cotters.
- Release pressure fork with knurled screw still in pulled position.
- Insert bucket tappet.
- Install camshafts ⇒ [page 112](#) .



### Note

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

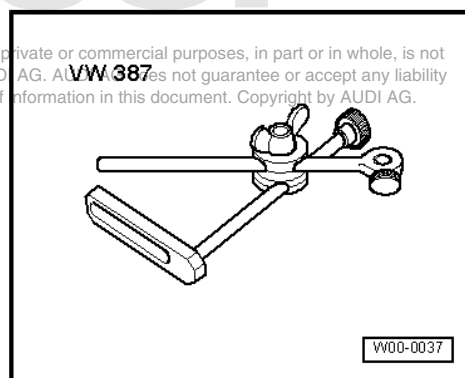


## 4.9 Checking valve guides

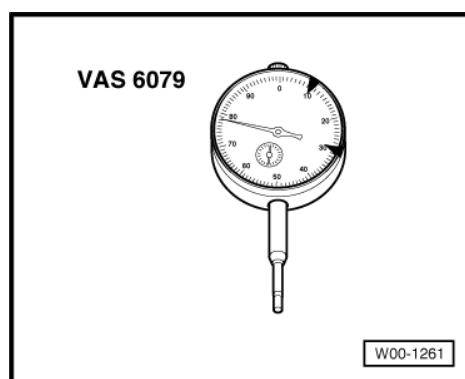
### Special tools and workshop equipment required

- ◆ Universal dial gauge bracket -VW 387-

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- ◆ Dial gauge -VAS 6079-



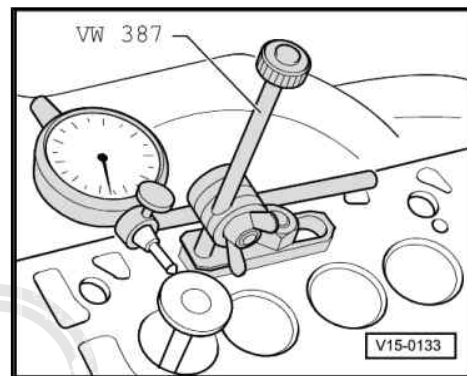
### Test sequence

- Insert valve into valve guide. Only insert inlet valve into inlet guide and exhaust valve into exhaust guide, as the stem diameters are different.
- End of valve stem must be flush with valve guide.
- Determine amount of sideways play.
- Wear limit (sideways play): 0.8 mm.



#### Note

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



## 4.10 Checking valves

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

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If scoring is clearly visible:

- Renew the relevant valve.

## 4.11 Machining valve seats



#### Note

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

#### Special tools and workshop equipment required

- ◆ Depth gauge
- ◆ Valve seat machining tool



#### 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 128](#).*
- ◆ *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 proper functioning of the hydraulic valve clearance compensation cannot be ensured. Renew the cylinder head.*

## 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 valve stem end (upper edge) and upper cylinder head surface with a depth gauge.
- Calculate the maximum permissible machining dimension using the measured distance and the minimum dimension.

| Minimum dimensions  |                      |                |
|---------------------|----------------------|----------------|
| Inlet valve (outer) | Inlet valve (centre) | Exhaust valves |
| 31.0 mm             | 32.2 mm              | 31.9 mm        |

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

### Example for inlet valve (outer):

|                                        |           |
|----------------------------------------|-----------|
| Measured distance                      | 31.4 mm   |
| – Minimum dimension                    | – 31.0 mm |
| = Max. permissible machining dimension | = 0.4 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.

## Machining valve seats

### Inlet valve seat

Ø a - 26.2 mm

b - 1.5 ... 1.8 mm

Z - Lower edge of cylinder head

α - 45° valve seat angle

β - 30° upper correction angle

γ - 60° lower correction angle

### Exhaust valve seat

Ø a - 29.0 mm

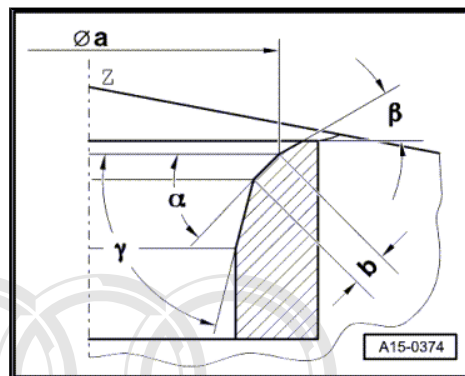
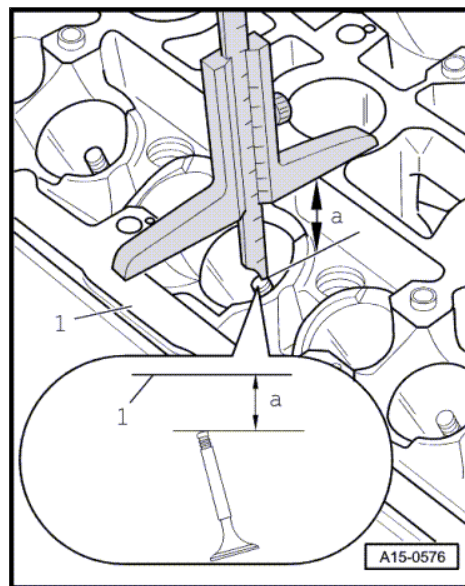
b - 1.8 mm

Z - Lower edge of cylinder head

α - 45° valve seat angle

β - 30° upper correction angle

γ - 60° lower correction angle



## 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 for piston cooling ⇒ [page 141](#).

Viscosity grades and oil specifications ⇒ Maintenance ; Booklet 4F.

Oil capacities ⇒ Data sheets for exhaust emission test.

#### 1.1 Sump (bottom section), oil pump - exploded view

##### 1 - Seal

- ☐ Renew

##### 2 - 10 Nm

- ☐ Tighten in stages and in diagonal sequence

##### 3 - Sump (bottom section)

- ☐ Removing and installing  
⇒ [page 132](#)

##### 4 - 10 Nm

##### 5 - Baffle plate (front)

##### 6 - 22 Nm

- ☐ Renew

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

- ☐ Renew
- ☐ When installing, fit new diamond-coated washer ⇒ [Item 9 \(page 131\)](#) between gear and chain sprocket

##### 8 - Drive gear for balance shaft

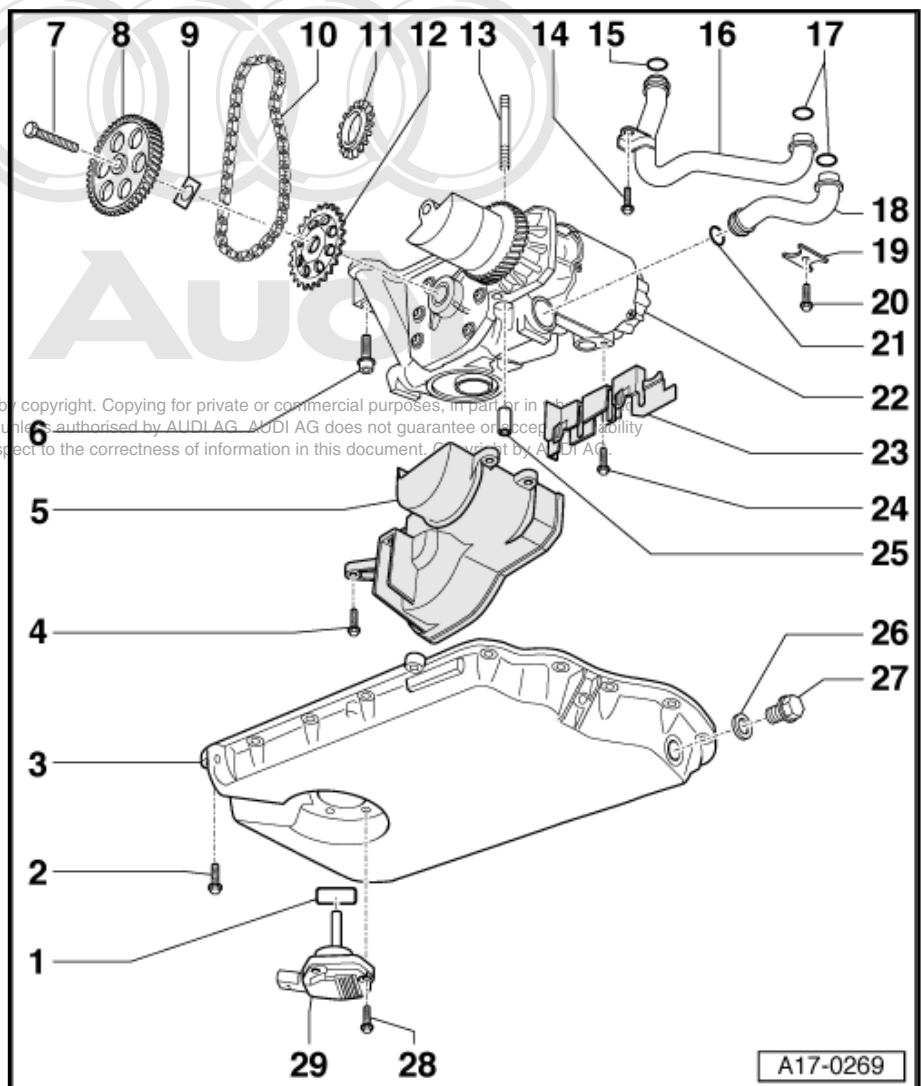
- ☐ When installing, fit new diamond-coated washer ⇒ [Item 9 \(page 131\)](#) between gear and chain sprocket

##### 9 - Diamond-coated washer

- ☐ Renew

##### 10 - Drive chain for oil pump

- ☐ Removing and installing





⇒ [page 148](#)

- ☐ Chain tensioner for drive chain ⇒ [Item 14 \(page 140\)](#)

#### 11 - Drive chain sprocket for oil pump

- ☐ Removing and installing ⇒ [page 148](#)

#### 12 - Chain sprocket for oil pump

- ☐ Installation position: Inscription faces to the rear
- ☐ When installing, fit new diamond-coated washer ⇒ [Item 9 \(page 131\)](#) between gear and chain sprocket
- ☐ Removing and installing ⇒ [page 135](#)

#### 13 - Stud

- ☐ Self-locking
- ☐ Shorter thread goes into cylinder block

#### 14 - 10 Nm

#### 15 - O-ring

- ☐ Renew

#### 16 - Oil pipe

#### 17 - O-rings

- ☐ Renew

#### 18 - Oil pipe

#### 19 - Bracket for oil pipes

#### 20 - 10 Nm

#### 21 - O-ring

- ☐ Renew

#### 22 - Oil pump

- ☐ With balance shaft
- ☐ Removing and installing ⇒ [page 135](#)

#### 23 - Baffle plate (rear)

#### 24 - 10 Nm

- ☐ Self-locking
- ☐ Renew

#### 25 - 20 Nm + 120° (1/3 turn) further

- ☐ Renew
- ☐ Apply locking fluid when fitting
- ☐ Locking fluid ⇒ Parts catalogue

#### 26 - Seal

- ☐ Renew

#### 27 - Oil drain plug, 30 Nm

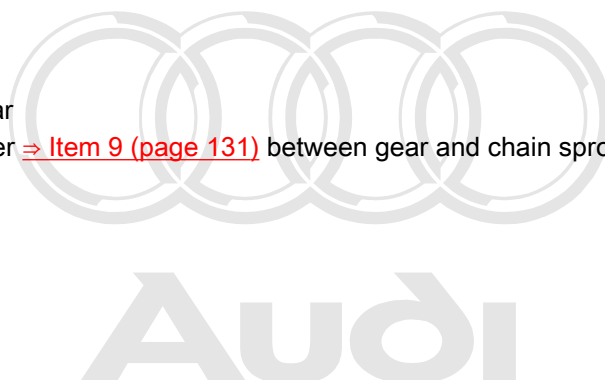
#### 28 - 10 Nm

#### 29 - Oil level and oil temperature sender -G266-

## 1.2 Removing and installing sump (bottom section)

### Special tools and workshop equipment required

- ◆ Used oil collection and extraction unit -V.A.G 1782-
- ◆ Electric drill with plastic brush attachment

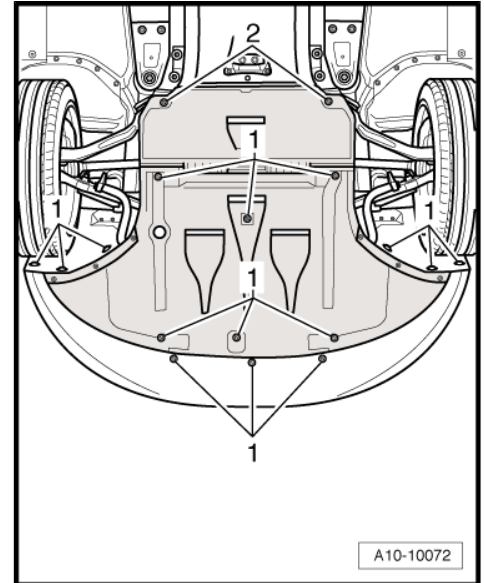


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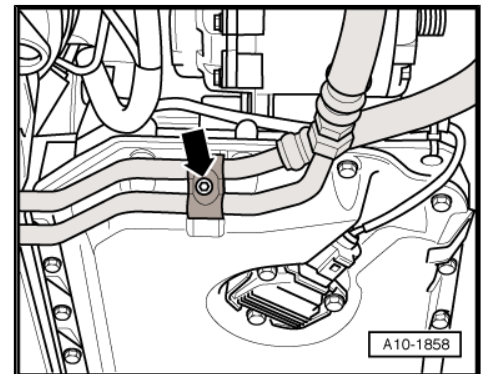
- ◆ Safety goggles
- ◆ Sealant ⇒ Parts catalogue

### Removing

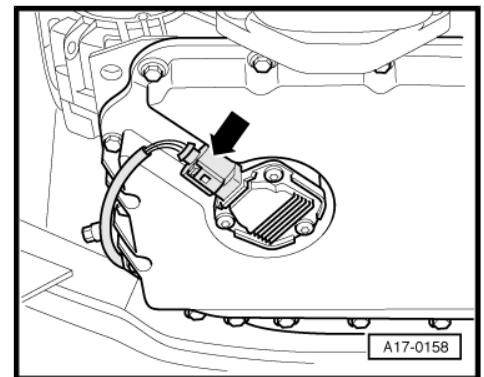
- Release quick-release fasteners -1- and -2- and take off noise insulation panels.
- Place used oil collection and extraction unit -V.A.G 1782- under engine.
- Drain off engine oil.



- Unscrew bracket for ATF line (right-side) at bottom section of sump -arrow-.

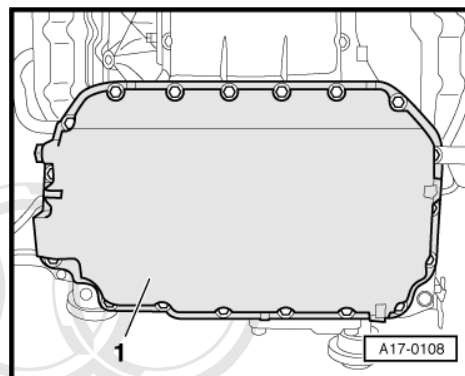


- Unplug electrical connector at oil level and oil temperature sender -G266- -arrow- and move wire clear.



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- Place used oil collection and extraction unit -V.A.G 1782- under engine, because oil will drain out again.
- Unbolt sump (bottom section) -1- and carefully remove.



### Installing

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



#### Note

*Renew gaskets and seals.*

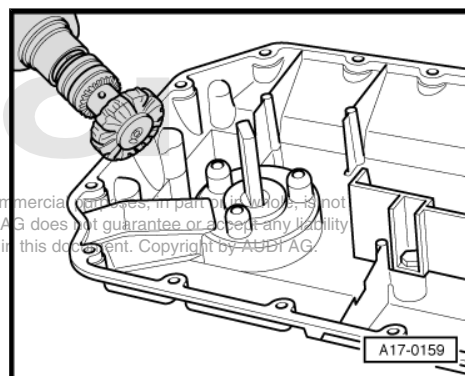
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- Remove remaining sealant on bottom and top section of sump with a rotating plastic brush or similar.

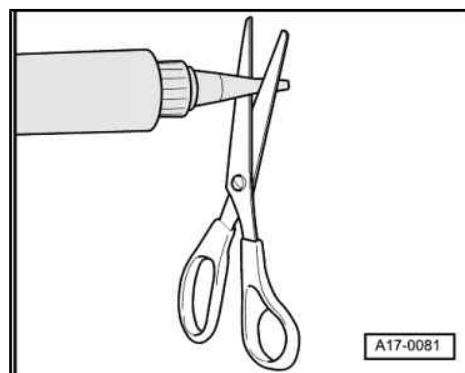


#### WARNING

*Wear safety goggles.*



- Clean sealing surfaces; they must be free of oil and grease.
- Cut off nozzle of tube at front marking ( $\varnothing$  of nozzle approx. 1 mm).



- Apply bead of sealant onto clean sealing surface of sump (bottom section) as illustrated.
- The bead of sealant should be approx. 1.5 mm wide -arrow-.

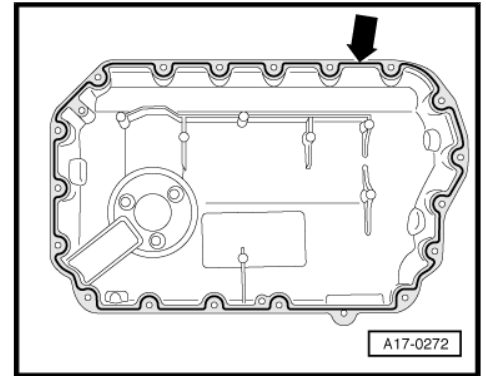
**i Note**

- ◆ *The sealant bead must not be thicker than specified, otherwise excess sealant could enter the sump and clog the strainer in the oil pump.*
- ◆ *The sump (bottom section) must be installed within 5 minutes after applying sealant.*

- Fit sump (bottom section) and tighten all bolts initially to 5 Nm in diagonal sequence.
- Tighten bolts securing sump (bottom section) to 10 Nm in diagonal sequence.
- Fill up with engine oil and check oil level ⇒ [page 152](#) .

**Tightening torques**

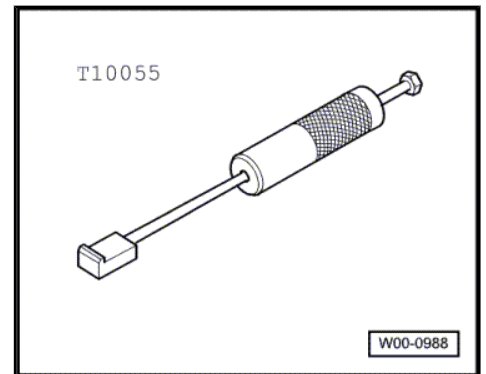
| Component                                   | Nm |
|---------------------------------------------|----|
| Sump (bottom section) to sump (top section) | 10 |
| Oil drain plug                              | 30 |



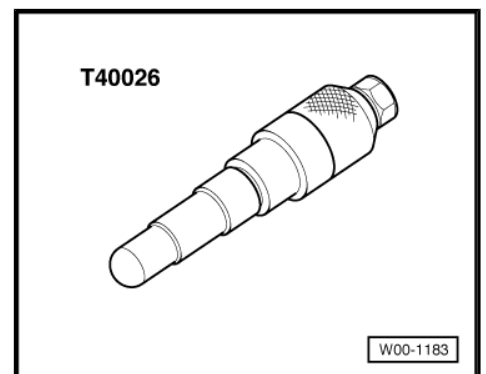
### 1.3 Removing and installing oil pump

**Special tools and workshop equipment required**

- ◆ Used oil collection and extraction unit -V.A.G 1782-
- ◆ Puller -T10055-



- ◆ Locking pin -T40026-



- ◆ Drill bit, Ø 3 mm

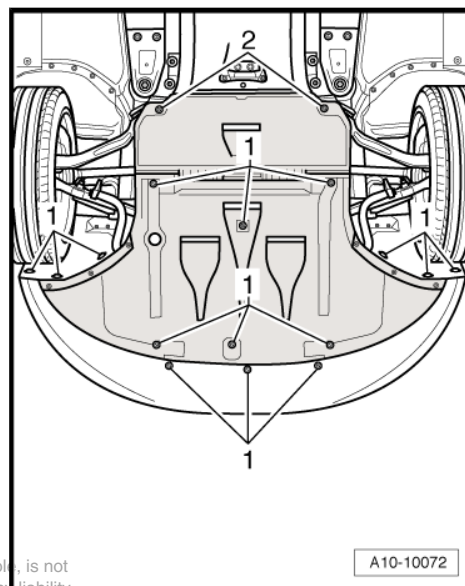
- ◆ Sealant ⇒ Parts catalogue

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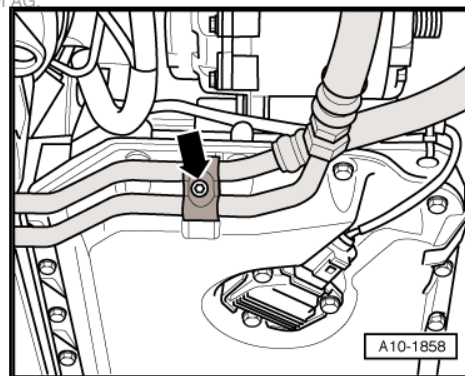
# ◆ Locking fluid ⇒ Parts catalogue

## Removing

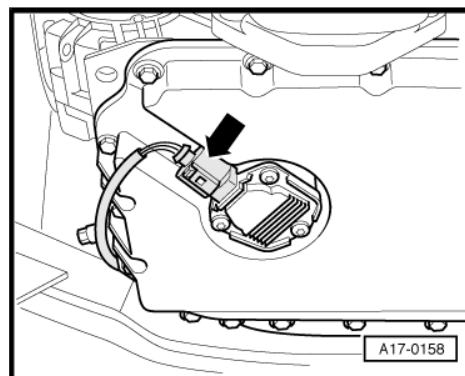
- Release quick-release fasteners -1- and -2- and take off noise insulation panels.
- Place used oil collection and extraction unit -V.A.G 1782- under engine.
- Drain off engine oil.



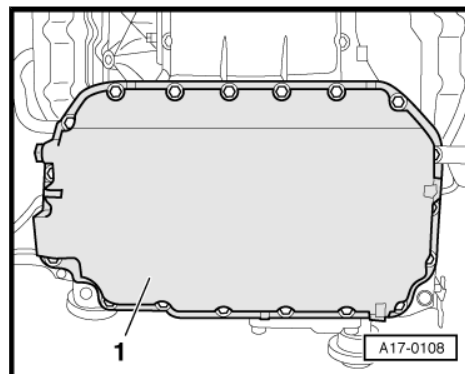
- Unscrew bracket for ATF line (right-side) at bottom section of sump -arrow-.



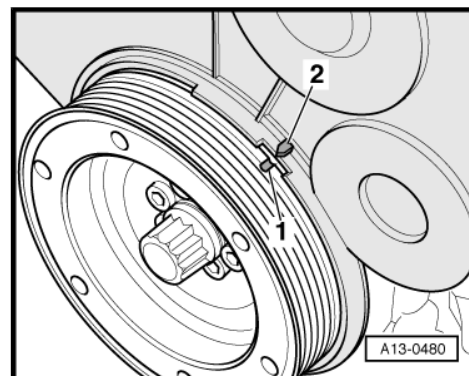
- Unplug electrical connector at oil level and oil temperature sender -G266- -arrow- and move wire clear.



- Place used oil collection and extraction unit -V.A.G 1782- under engine, because oil will drain out again.
- Unbolt sump (bottom section) -1- and carefully remove.



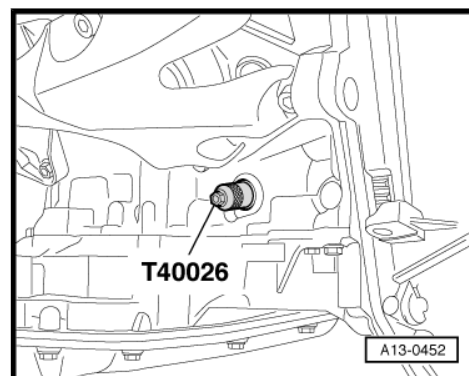
- Set crankshaft to markings for TDC of No. 3 cylinder by turning central bolt on crankshaft sprocket in normal direction of rotation.
- Notch -1- should align with marking -2-.



- Unscrew plug for TDC marking from cylinder block.
- Screw locking pin -T40026- into hole where plug has been removed and tighten.

**Note**

*If necessary, turn crankshaft slightly backwards and forwards.*

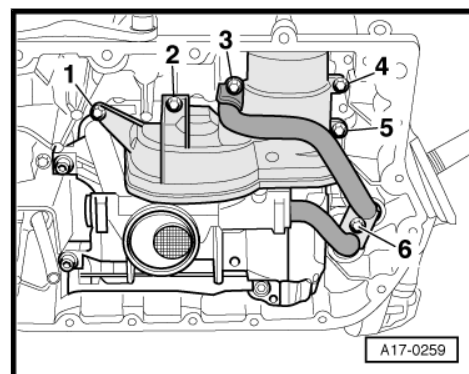


- Unscrew bolts -3- and -6- and remove oil pipes.

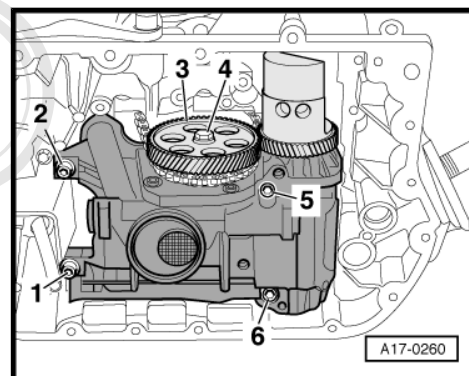
**Note**

*Some oil will come out when oil pipes are removed.*

- Unscrew bolts -1-, -2-, -4- and -5- and remove baffle plate (front).

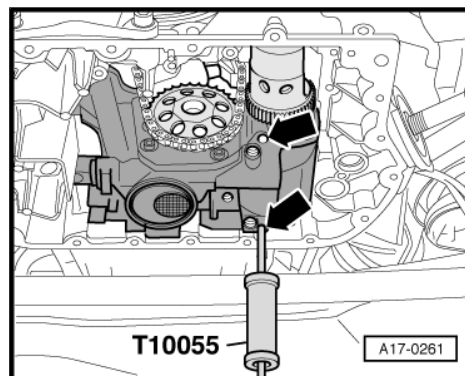


- Unscrew bolt -4- and remove drive gear -3- for balance shaft.
- Remove diamond-coated washer from drive gear.
- Unscrew bolts -1- and -2- and nuts -5- and -6-.



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- Screw puller -T10055- into M8 holes -arrows- on oil pump in alternating sequence and pull oil pump off of cylinder block.



## Installing

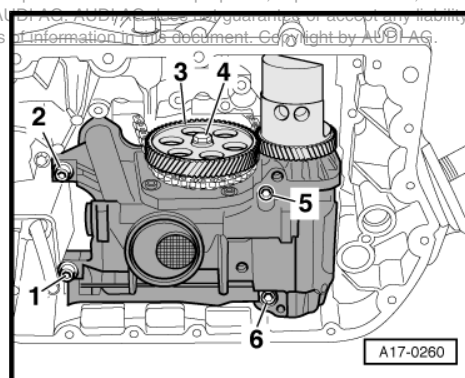
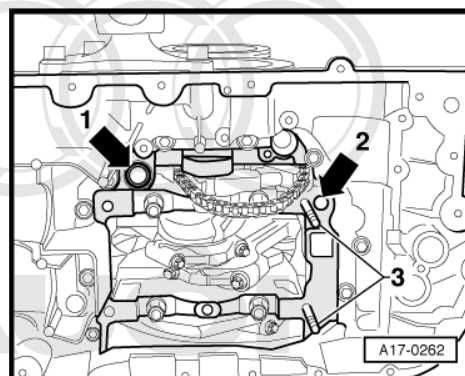
Installation is carried out in the reverse order; note the following:



### Note

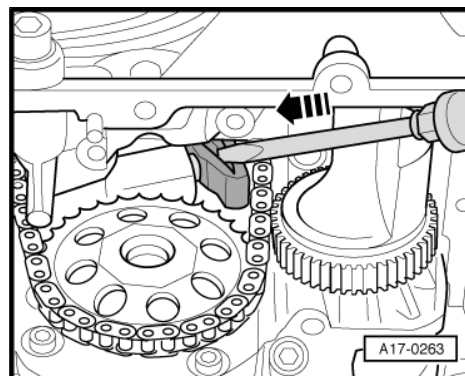
*Renew gaskets, seals and O-rings.*

- Clean remaining locking fluid off threads of studs -3-.
- Renew O-ring -arrow 1-.
- Apply sealant around hole -arrow 2-.
- Renew bolts -1- and -2- and nuts -5- and -6- securing oil pump.
- Apply locking fluid to nuts -5- and -6- before installing.
- Tighten all four oil pump mountings uniformly to ensure that dowel pin goes in squarely.
- Tighten mountings to final torque.
- Renew diamond-coated washer on drive gear for balance shaft -3-.
- Insert flange of drive gear (for balance shaft) through chain sprocket and onto oil pump shaft.
- Screw in bolt -4- but do not tighten.

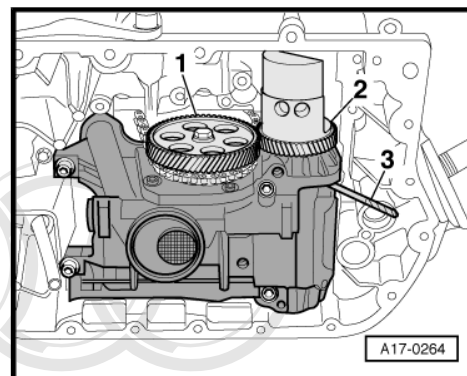


### Note

*To install drive gear, press back piston of chain tensioner using a screwdriver -arrow-.*



- Turn balance shaft -2- until a  $\varnothing$  5 mm pin -item 3- (e.g. drill bit or similar) can be inserted in locating hole.
- Tighten bolt for gear -1-.
- Pull pin (drill bit) out of locating hole.
- Remove locking pin -T10026- and screw plug for TDC marking into cylinder block together with new O-ring.



- Install baffle plate (front): bolts -1-, -2-, -4- and -5-.
- Install oil pipes: bolts -3- and -6-.
- Install sump (bottom section)  $\Rightarrow$  page 134 .

#### Tightening torques

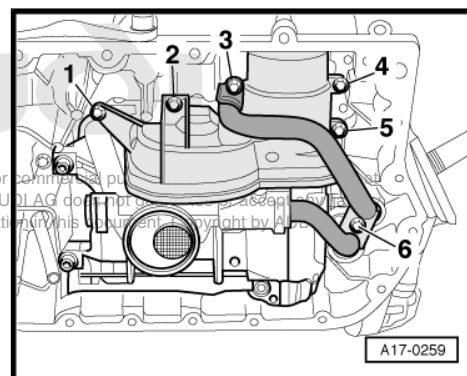
| Component                                  |       | Nm                           |
|--------------------------------------------|-------|------------------------------|
| Oil pump to                                | Nuts  | 20 + 120° <sup>19)</sup> 20) |
| Cylinder block                             | Bolts | 22 <sup>21)</sup>            |
| Drive gear for balance shaft to oil pump   |       | 20 + 90° <sup>21)</sup> 22)  |
| Baffle plate (front) to sump (top section) |       | 10                           |
| Oil pressure pipe to sump (top section)    |       | 10                           |
| Sealing plug in cylinder block             |       | 25                           |

19) 120° equals 1/3 of a turn.

20) Apply locking fluid to nuts; locking fluid  $\Rightarrow$  Parts catalogue .

21) Renew bolts.

22) 90° equals a 1/4 turn.



## 1.4 Sump (top section), oil filter - exploded view

# 1 - Torque reaction support

2 - 40 Nm

## 3 - Seal

- ☐ Renew

## 4 - Oil pressure switch -

F1-, 1.4 bar -25 Nm-

- ☐ Black insulation
- ☐ Checking ⇒ [page 150](#)
- ☐ Renew seal

5 - 12 Nm

## 6 - Washer

## 7 - O-rings

- ☐ Renew

## 8 - Seal

- ☐ Renew

9 - Screw plug, 10 Nm

## 10 - Seal

- ☐ For crankshaft
- ☐ Removing and installing ⇒ [page 45](#)

11 - 10 Nm

12 - 30 Nm

- ☐ Self-locking
- ☐ Renew

## 13 - Sealing flange (front)

- ☐ Removing and installing ⇒ [page 47](#)

## 14 - Chain tensioner

- ☐ Removing and installing ⇒ [page 148](#)
- ☐ Insert Ø 3 mm drill bit to hold in position

## 15 - Gasket

- ☐ Renew

## 16 - Panel bolt

## 17 - Guide tube for oil dipstick

18 - 10 Nm

## 19 - O-ring

- ☐ Renew

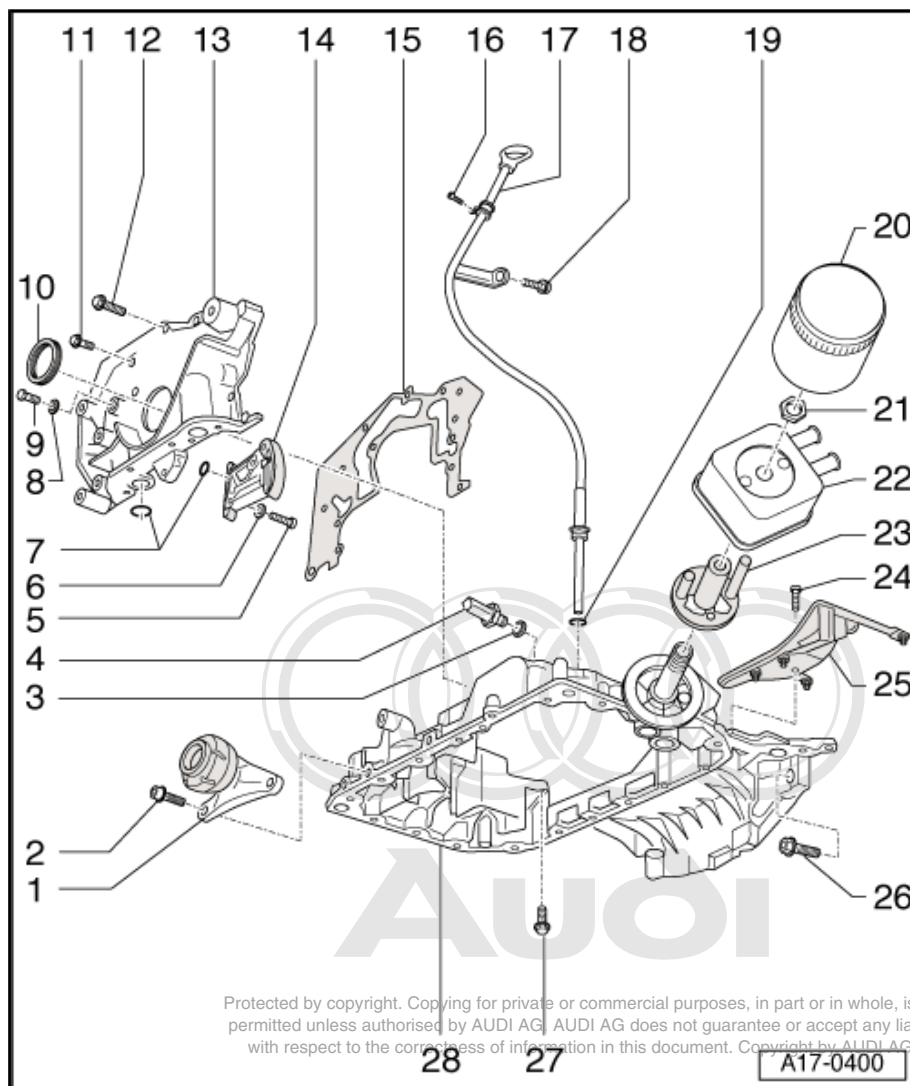
## 20 - Oil filter

- ☐ Observe change intervals ⇒ Maintenance ; Booklet 4F
- ☐ Loosen with oil filter wrench -3417-
- ☐ Observe installation instructions on oil filter
- ☐ Tighten to 20 Nm

21 - 30 Nm

## 22 - Oil cooler

- ☐ See note ⇒ [page 131](#)



### 23 - Guide piece

- ☐ With seal
- ☐ Renew

### 24 - 10 Nm

- ☐ Self-locking
- ☐ Renew

### 25 - Baffle plate (top)

### 26 - 45 Nm

### 27 - M7 = 16 Nm; M8 = 22 Nm

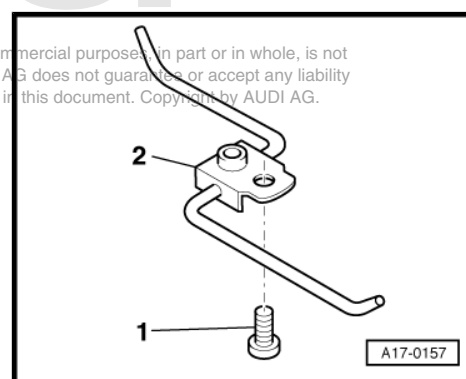
### 28 - Sump (top section)

- ☐ Removing and installing ⇒ [page 141](#)

### Oil spray jet for piston cooling

- 1 - Bolt, 10 Nm
- 2 - Oil spray jet for piston cooling

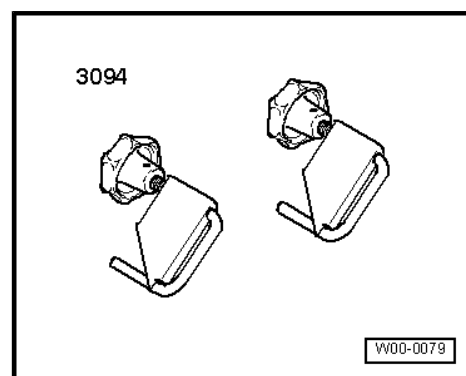
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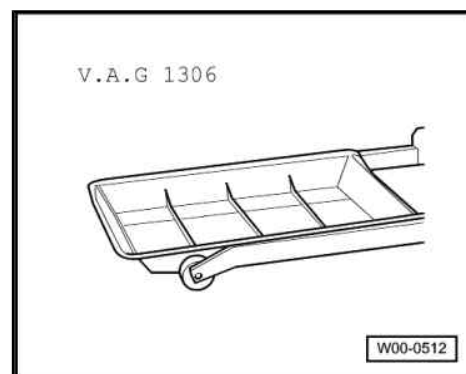
## 1.5 Removing and installing sump (top section)

### Special tools and workshop equipment required

- ◆ Hose clamps for hoses up to 25 mm Ø -3094-



- ◆ Drip tray -V.A.G 1306- or drip tray for workshop hoist -VAS 6208-



- ◆ Used oil collection and extraction unit -V.A.G 1782-
- ◆ Electric drill with plastic brush attachment
- ◆ Safety goggles
- ◆ Sealant → Parts catalogue

## Removing



### Note

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



### Caution

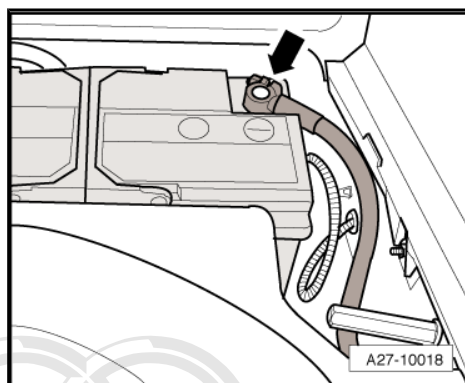
***Observe notes on procedure for disconnecting the battery → Electrical system; Rep. Gr. 27 .***



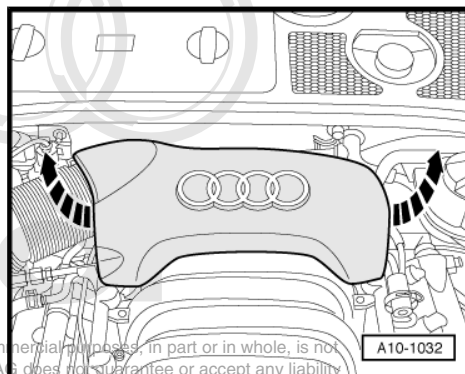
### Note

*To make sure you can still move the front wheels when the battery has been disconnected, only disconnect the battery with the ignition key inserted.*

- Take out luggage compartment floor trim.
- Disconnect earth cable -arrow- at battery.

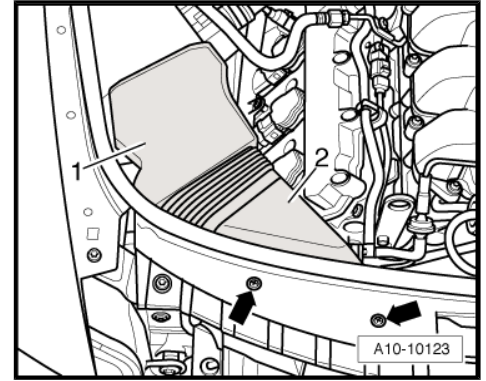


- Pull off engine cover panel (rear) -arrows-.

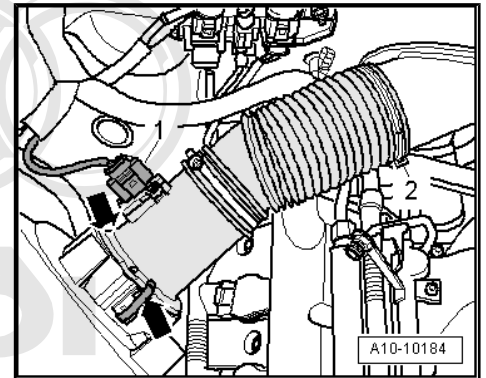


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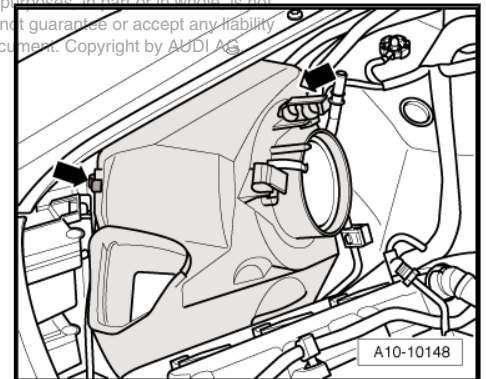
- Remove bolts -arrows-.
- Remove air ducts -1- and -2-.



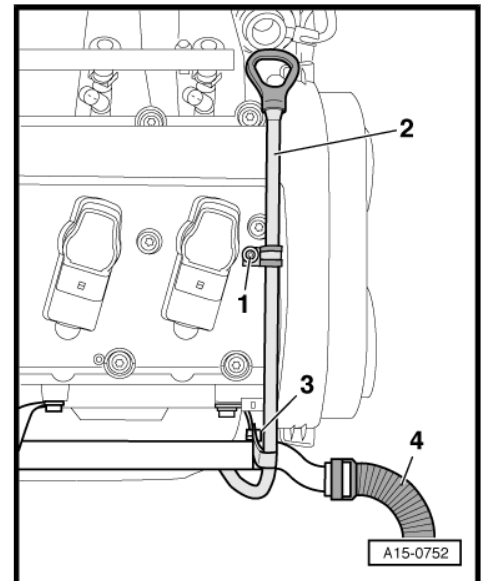
- Unplug electrical connector -1- at air mass meter -G70-.
- Remove air intake hose. To do so, release hose clip -2- and clamps -arrows-.



- Loosen clamps -arrows- and detach top section of air cleaner housing.



- Remove bolts -1- and -3-.
- Disconnect hose -4- at pipe for secondary air.
- Pull guide tube -2- for oil dipstick upwards out of top section of sump and fold forwards.



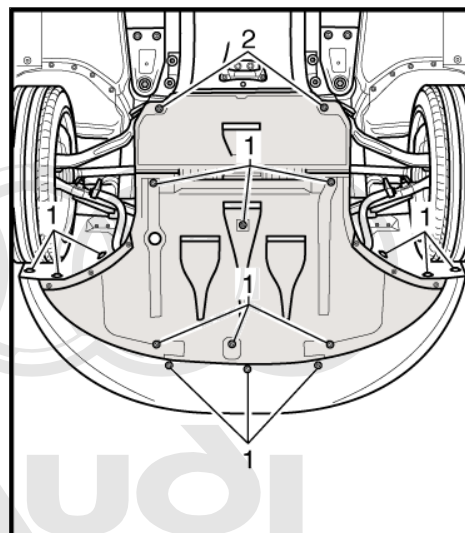
- Remove both front wheels.



# Note

Secure brake discs with wheel bolts.

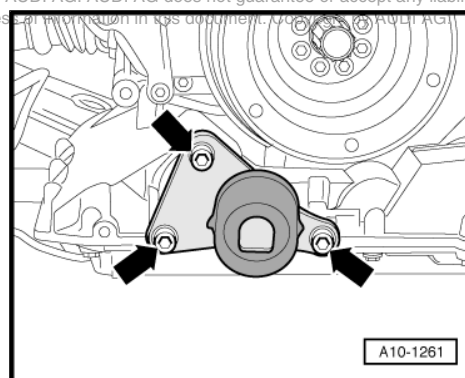
- Release quick-release fasteners -1- and -2- and take off noise insulation panels.



A10-10072

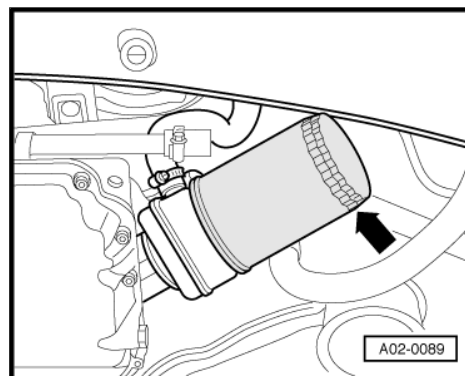
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- Remove bolts -arrows-.
- Remove torque reaction support.



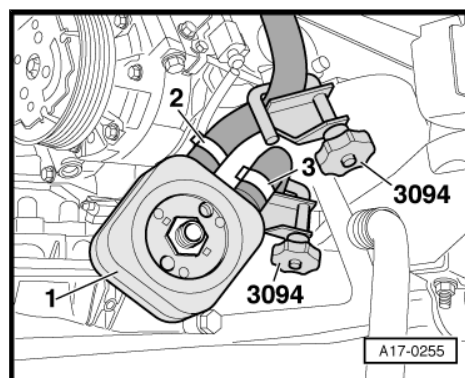
A10-1261

- Place used oil collection and extraction unit -V.A.G 1782- under engine.
- Drain off engine oil.
- Loosen oil filter -arrow-.



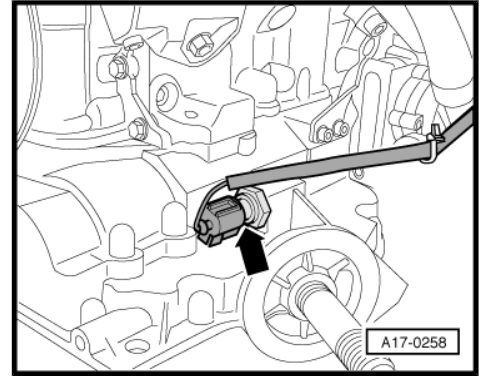
A02-0089

- Place drip tray -V.A.G 1306- or drip tray for workshop hoist -VAS 6208- under engine.
- Clamp off coolant hoses -2- and -3- using hose clamps -3094-.
- Disconnect coolant hoses from oil cooler -1-.
- Remove oil cooler.

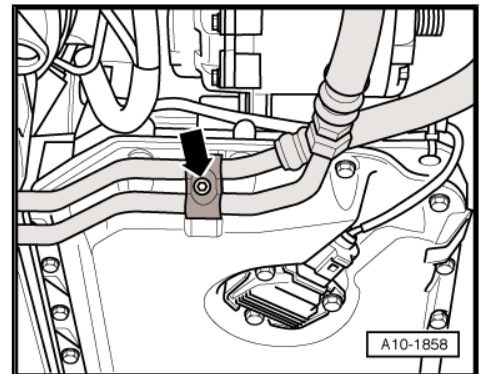


A17-0255

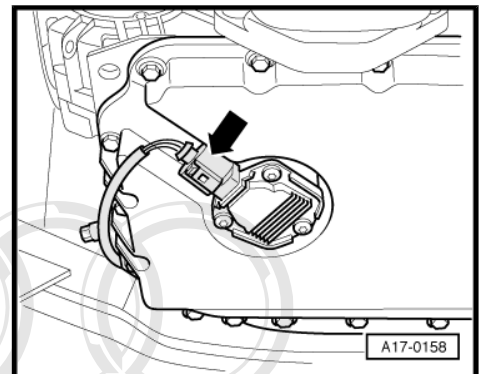
- Unplug electrical connector -arrow- at oil pressure switch -F1- .



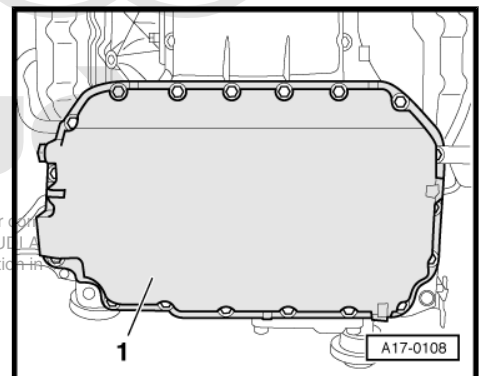
- Unscrew bracket for ATF line (right-side) at bottom section of sump -arrow-.



- Unplug electrical connector -arrow- at oil level and oil temperature sender -G266- and move wire clear.

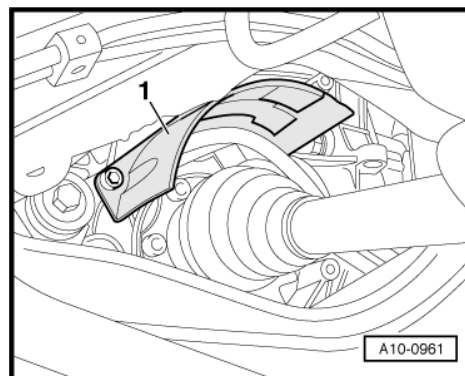


- Place used oil collection and extraction unit -V.A.G 1782- under engine, because oil will drain out again.
- Unbolt sump (bottom section) -1- and carefully remove.
- Remove oil pump ⇒ [page 135](#) .



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- Unbolt heat shield -1- for drive shaft (right-side).
- Unbolt drive shaft from flange shaft on gearbox.

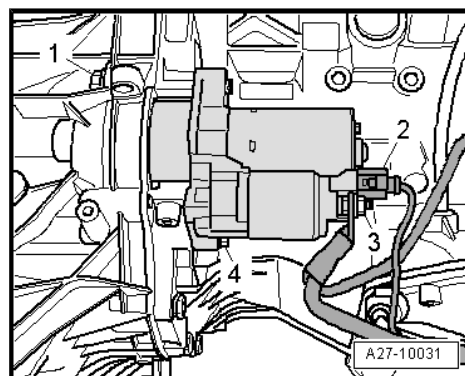


- Detach electrical wires -2- and -3- at starter.
- Remove bolts -1- and -4- and detach starter.

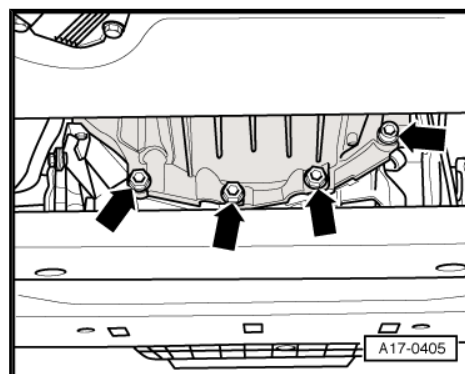


### Note

*Shown in illustration with engine support removed.*



- Unscrew bolts -arrows- securing engine to gearbox near sump (top section).



- Unscrew bolts -1- and -2- for sump (top section).
- Press sump (top section) off spring pins on cylinder block.

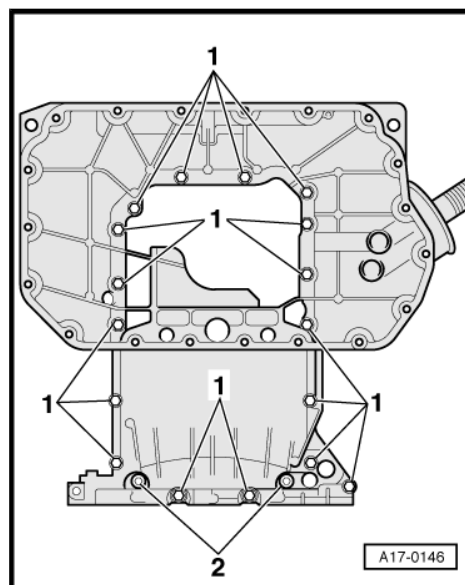
### Installing

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



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- ◆ *Renew gaskets, seals and O-rings.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- ◆ *Fit all cable ties in the original positions when installing.*

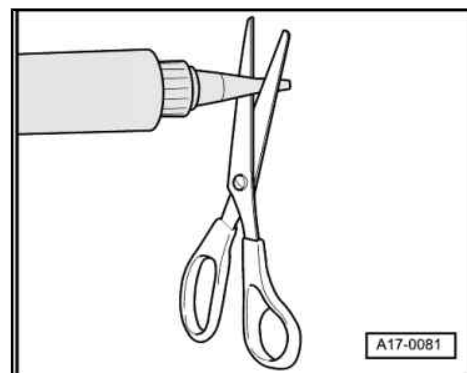
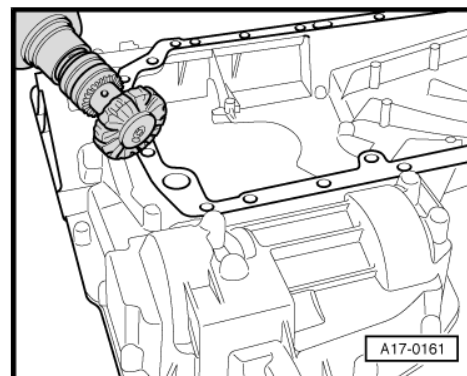


- Remove remaining sealant on sump (top section) and cylinder block using rotating plastic brush or similar.

**WARNING**

*Wear safety goggles.*

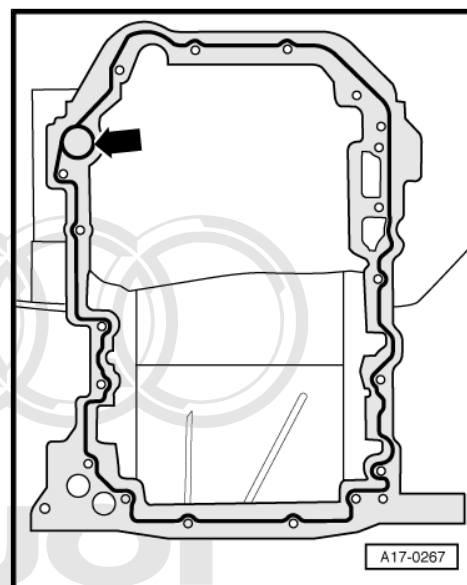
- Clean sealing surfaces; they must be free of oil and grease.
- Cut off nozzle of tube at front marking ( $\varnothing$  of nozzle approx. 1 mm).



- Apply bead of sealant -arrow- onto clean sealing surface of sump (top section) as illustrated.
- The bead of sealant should be approx. 1.5 mm wide.

**Note**

- ◆ *The sealant bead must not be thicker than specified, otherwise excess sealant could enter the sump and clog the strainer in the oil pump.*
- ◆ *Apply sealant with particular care around hole -arrow- in cylinder block.*
- ◆ *The sump (top section) must be installed within 5 minutes after applying sealant.*
- Fit sump (top section) and tighten all bolts securing sump (top section) to cylinder block initially to 5 Nm in diagonal sequence.
- Tighten bolts securing sump (top section) to gearbox to 45 Nm.

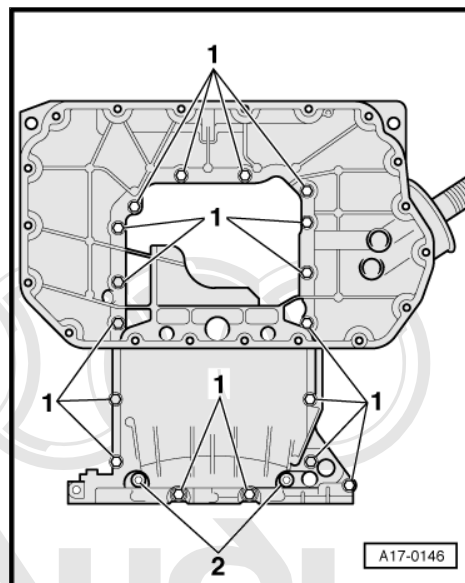


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- Tighten bolts -1- to 16 Nm and bolts -2- to 22 Nm in a diagonal sequence.
- Install oil pump ⇒ [page 135](#) .
- Install sump (bottom section) ⇒ [page 132](#) .
- Install starter ⇒ Electrical system; Rep. Gr. 27
- Renew O-ring on guide tube for oil dipstick and insert guide tube into hole in top section of sump.
- Fill up with engine oil and check oil level ⇒ [page 152](#) .
- Connect battery. Procedures required ⇒ Electrical system; Rep. Gr. 27 .
- Fill cooling system ⇒ [page 158](#) .

#### Tightening torques

| Component                                         |    | Nm |
|---------------------------------------------------|----|----|
| Sump (top section) to:                            | M7 | 16 |
| Cylinder block and sealing flanges                | M8 | 22 |
| Sump (top section) to gearbox                     |    | 45 |
| Oil filter to sump (top section)                  |    | 20 |
| Torque reaction support to engine                 |    | 40 |
| Guide tube for oil dipstick to secondary air pipe |    | 10 |
| Heat shield to gearbox                            |    | 22 |



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## 1.6 Removing and installing drive chain and chain tensioner for oil pump

#### Removing

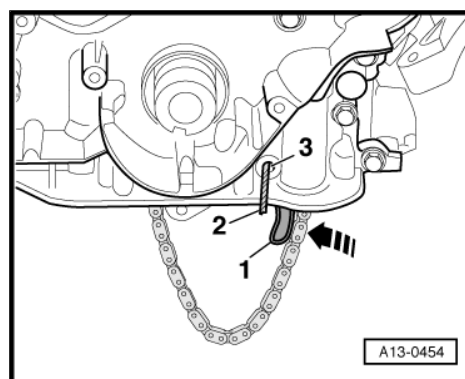
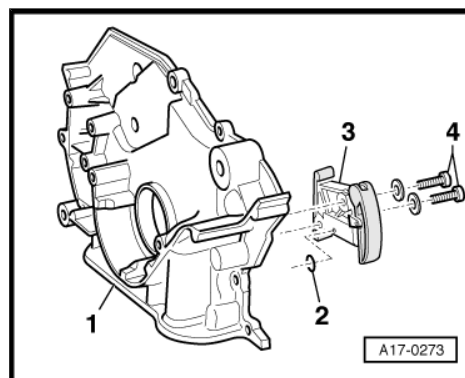
- Remove top section of sump ⇒ [page 141](#) .
- Remove sealing flange (front) ⇒ [page 47](#) .
- Remove bolts -4- and detach chain tensioner -3- from front sealing flange -1-.
- Take chain off drive sprocket.

#### Installing

- Fit new O-ring -2-.
- Install chain tensioner -3- with bolts -4- (and washers) on front sealing flange -1-.
- Unscrew plug from access hole -3-.
- Press chain tensioner -1- in direction of arrow until a  $\varnothing 3$  mm drill bit -2- can be inserted into locating holes in sealing flange and chain tensioner.
- Install sealing flange (front) ⇒ [page 47](#) .
- Install sump (top section) ⇒ [page 146](#) .

#### Tightening torque

| Component                                 | Nm |
|-------------------------------------------|----|
| Chain tensioner to sealing flange (front) | 12 |

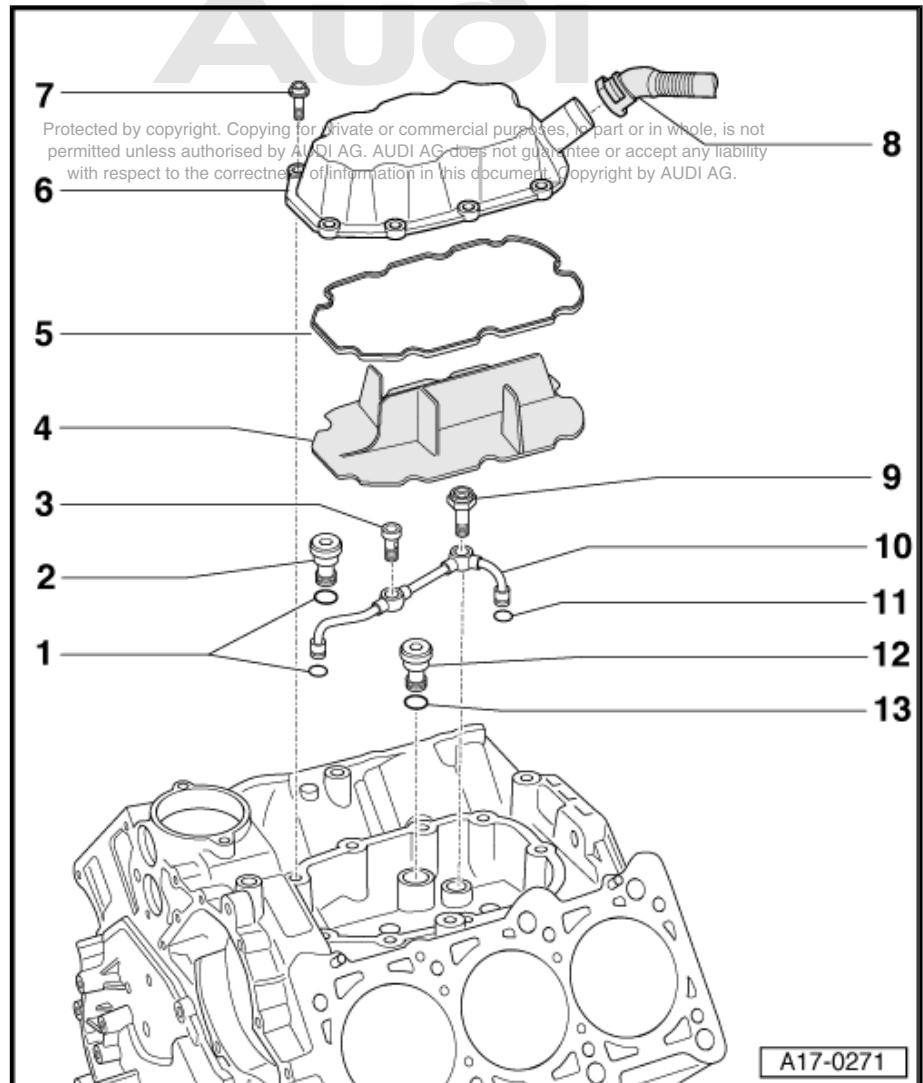


## 1.7 Oil retention valve and spray nozzle valve - exploded view



*If irregular valve noise occurs repeatedly during short journeys and disappears after extended driving, the oil retention valves must be renewed.*

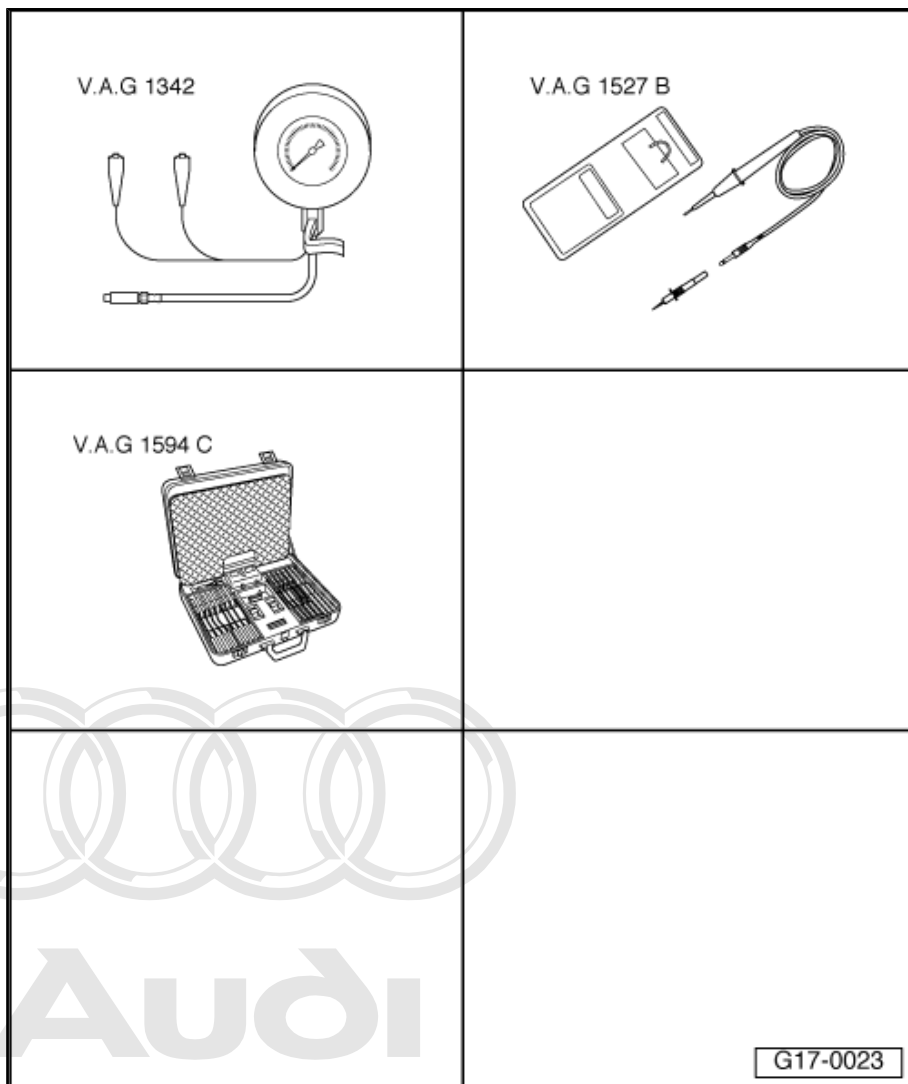
- 1 - O-rings**
  - ☐ Renew
- 2 - Oil retention valve, 20 Nm**
  - ☐ For oil supply to cylinder head (left-side)
- 3 - Banjo bolt, 15 Nm**
- 4 - Baffle plate**
- 5 - Gasket**
  - ☐ Renew
- 6 - Cover**
  - ☐ With connection for crankcase breather
  - ☐ To remove, see Removing and installing intake manifold ⇒ [page 100](#)
- 7 - 10 Nm**
- 8 - Hose**
  - ☐ To pressure control valve for crankcase breather
- 9 - Spray nozzle valve, 25 Nm**
  - ☐ For piston cooling
- 10 - Oil pipe**
  - ☐ Renew
- 11 - O-ring**
- 12 - Oil retention valve, 20 Nm**
  - ☐ For oil supply to cylinder head (right-side)
- 13 - O-ring**
  - ☐ Renew



## 1.8 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-



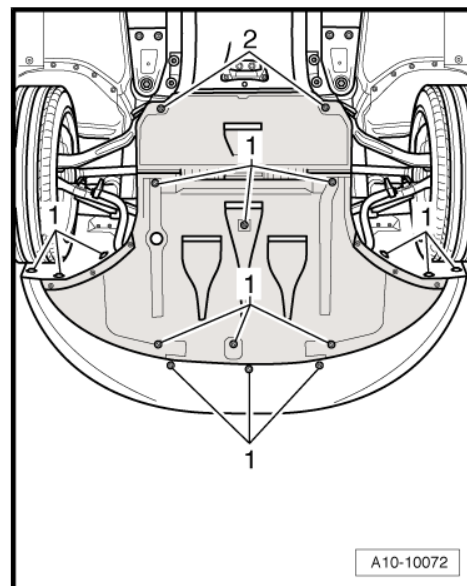
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### Test conditions

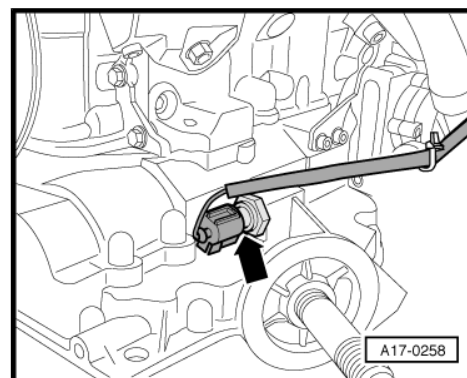
- Oil level OK
- Engine oil temperature approx. 80 °C

### Preparation for test

- Release quick-release fasteners -1- and -2- and take off noise insulation panels.



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



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- 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 1.2 ... 1.6 bar.

If LED does not light up:

- Renew oil pressure switch.

#### Checking oil pressure

- Start engine.
- Minimum oil pressure at idling speed: 1.5 bar
- Minimum oil pressure at 2000 rpm: 3.0 bar

#### Assembling

Assemble in reverse order.

#### Tightening torque

| Component                                 | Nm |
|-------------------------------------------|----|
| Oil pressure switch to sump (top section) | 25 |

## 1.9 Engine oil

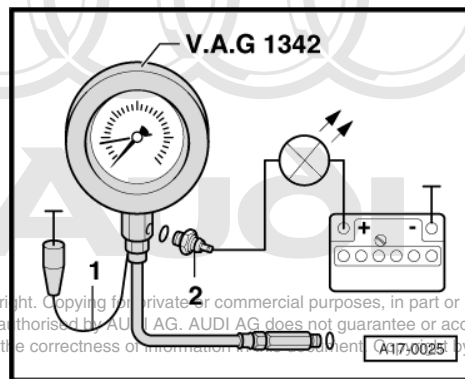
### Viscosity grades and oil specifications

⇒ Maintenance ; Booklet 4F .

## 1.10 Checking oil level

### Test conditions

- 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.



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### Test sequence

- 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.

Markings on oil dipstick:

a - Oil must be topped up. It is sufficient if the oil level is somewhere in area -b- (grooved area on dipstick) after topping up.

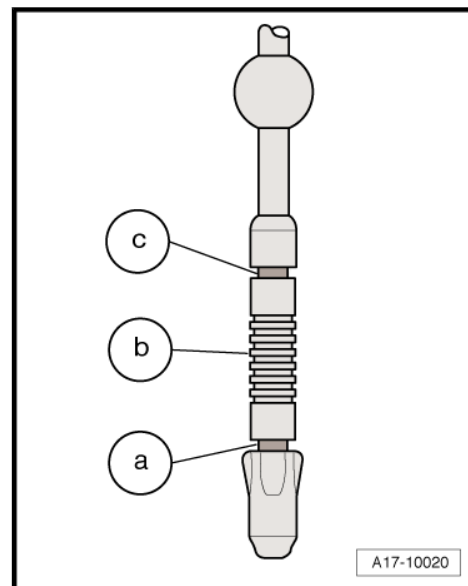
b - Oil may be topped up. The oil level may rise as far as area -a- after topping up.

c - Do not top up oil.



### Note

*The oil level must not be above the MAX marking -c- and not below the MIN marking -a-.*



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## 19 – Cooling

### 1 Removing and installing parts of cooling system



#### WARNING

*Hot steam/hot coolant may escape when opening expansion tank; 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.*
- ◆ *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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# 1 - Radiator

- ☐ Removing and installing  
⇒ [page 172](#)
- ☐ If renewed, refill system  
with fresh coolant

# 2 - Bleeder screw, 15 Nm

# 3 - Thermostat

- ☐ Removing and installing  
⇒ [page 163](#)
- ☐ Checking ⇒ [page 166](#)

# 4 - Cylinder head/cylinder block

- ☐ If renewed, refill system  
with fresh coolant

# 5 - Throttle valve module - J338-

# 6 - Bleeder hole

- ☐ On coolant hose to heat  
exchanger

# 7 - Heat exchanger for heater

- ☐ If renewed, refill system  
with fresh coolant

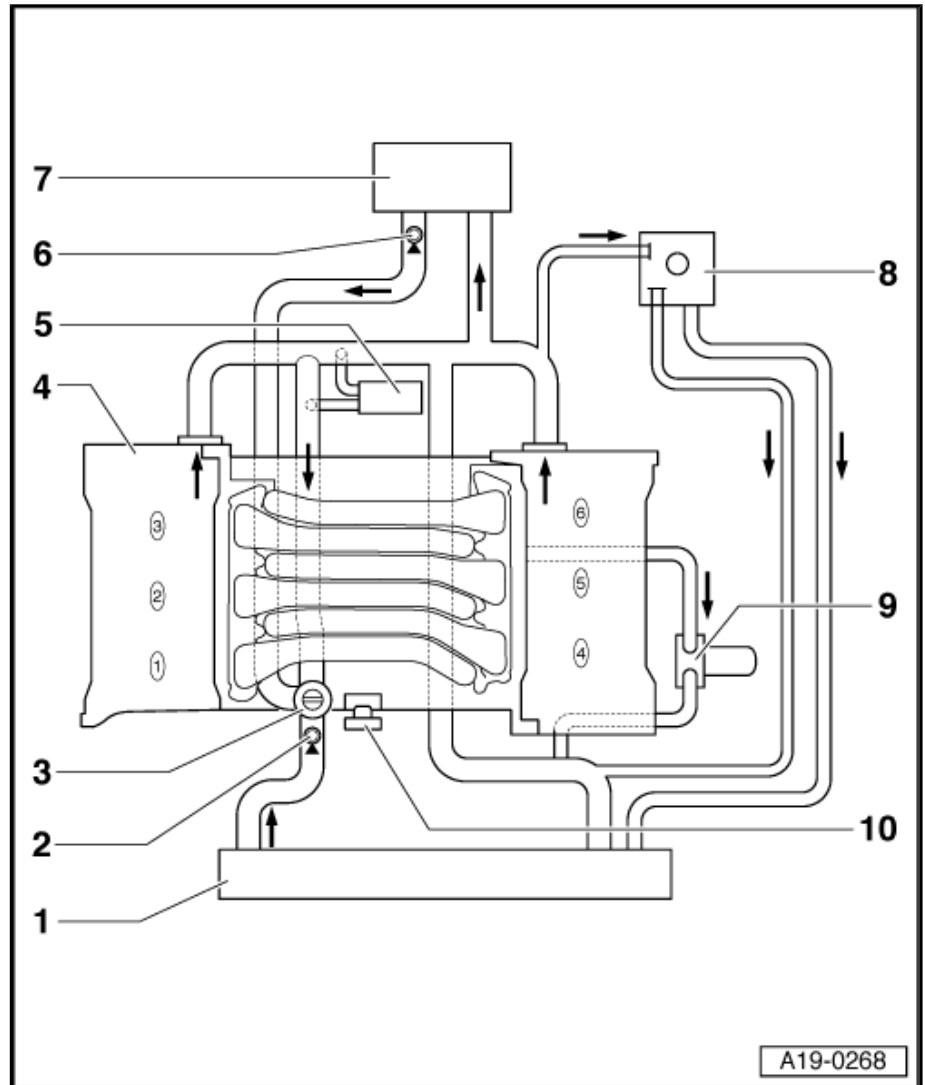
# 8 - Expansion tank

- ☐ With filler cap
- ☐ Checking pressure re-  
lief valve in filler cap  
⇒ [page 178](#)

# 9 - Oil cooler

# 10 - Coolant pump

- ☐ Removing and installing  
⇒ [page 162](#)

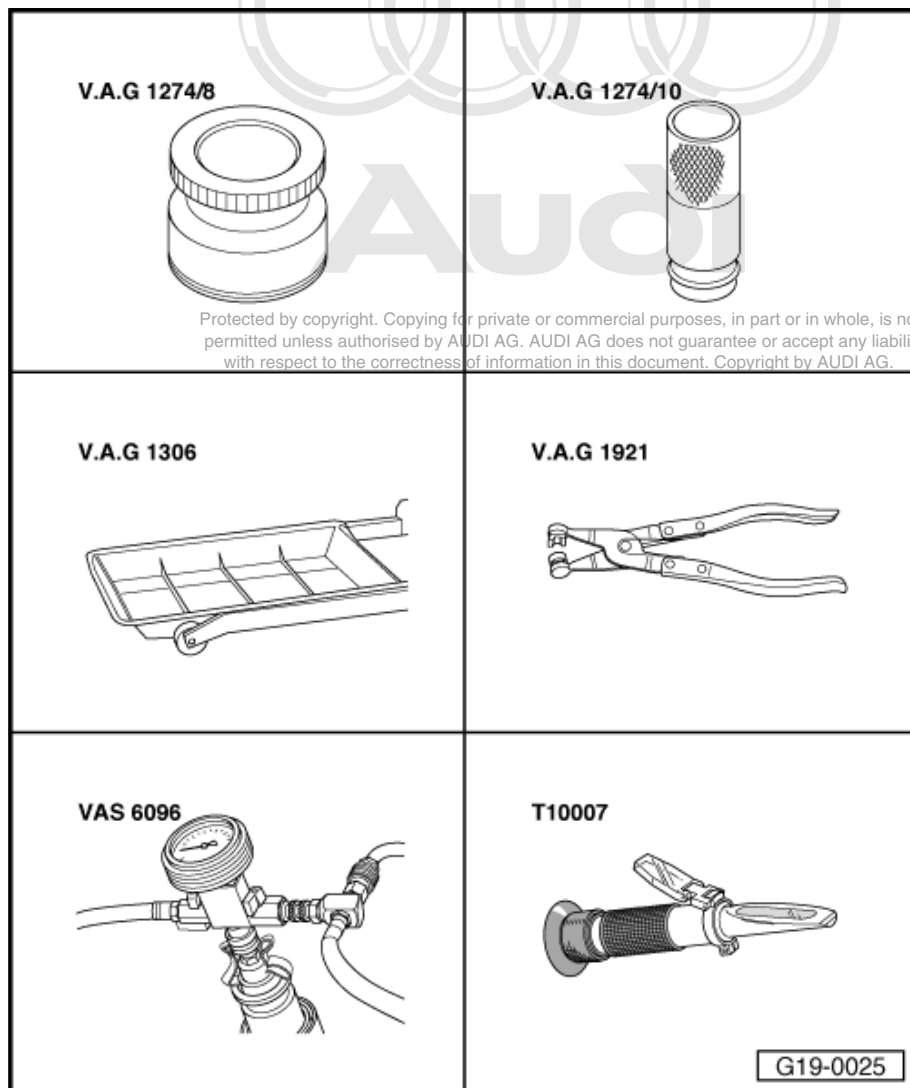


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## 1.2 Draining and filling cooling system

### Special tools and workshop equipment required

- ◆ Adapter -V.A.G 1274/8-
- ◆ Pipe -V.A.G 1274/10-
- ◆ Drip tray -V.A.G 1306- or drip tray for workshop hoist -VAS 6208-
- ◆ Hose clip pliers - V.A.G 1921-
- ◆ Cooling system charge unit -VAS 6096-
- ◆ Refractometer -T10007-



### Draining



#### Note

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



#### WARNING

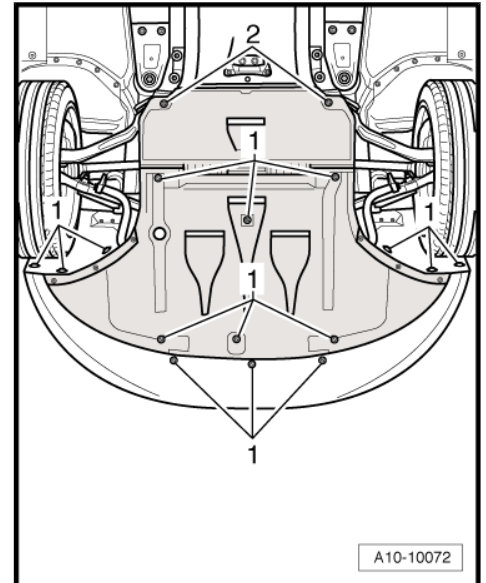
*Hot steam/hot coolant may escape when opening expansion tank; cover filler cap with cloth and open carefully.*

- Open filler cap on coolant expansion tank.

- Release quick-release fasteners -1- and -2- and take off noise insulation panels.

# Audi

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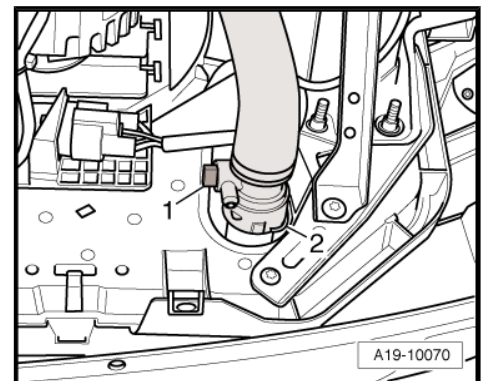


- Place drip tray -V.A.G 1306- or drip tray for workshop hoist -VAS 6208- under engine.
- Open drain plug -1- and let coolant drain.



## Note

*Disregard -item 2-.*



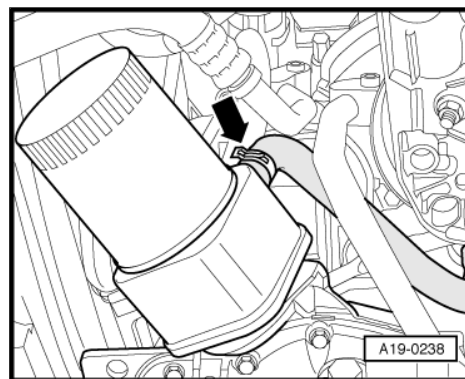
- Also detach coolant hose from oil cooler -arrow-, and drain off remaining coolant.

## 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 "Meets 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  $-25^{\circ}\text{C}$  (in countries with arctic climate: down to about  $-35^{\circ}\text{C}$ ).
- ◆ 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 "G 12+" can be increased, but only up to 60% (this gives frost protection to about  $-40^{\circ}\text{C}$ ). If the antifreeze percentage 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-.
- ◆ Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.



## Procedure

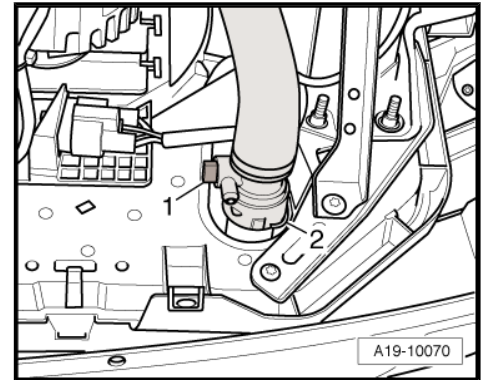
- Close drain plug -1-.



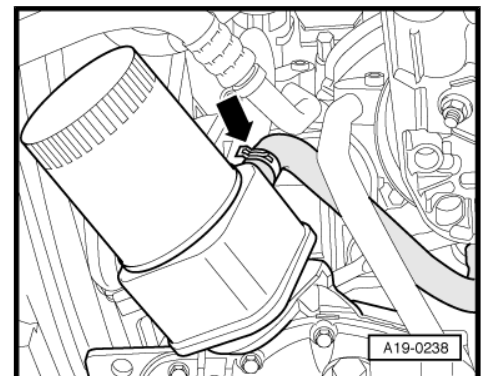
### Note

*Disregard -item 2-.*

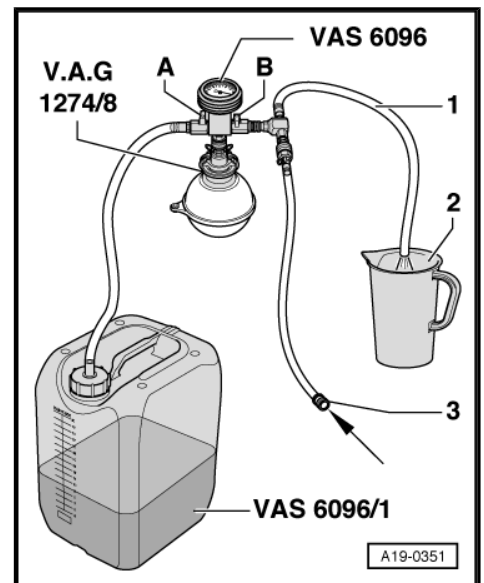
- Connect coolant hose (bottom left) to radiator -arrow-.



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



- Fill reservoir -VAS 6096/1- with at least 12 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 both valves -A- and -B- (turn lever perpendicular to direction of flow).
- Connect hose -3- to compressed air.
- Pressure: 6 ... 10 bar.



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- 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 must stop in the green zone. The vacuum level in the cooling system is then sufficient for subsequent filling.

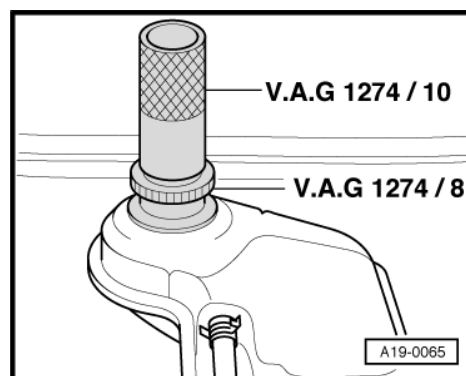
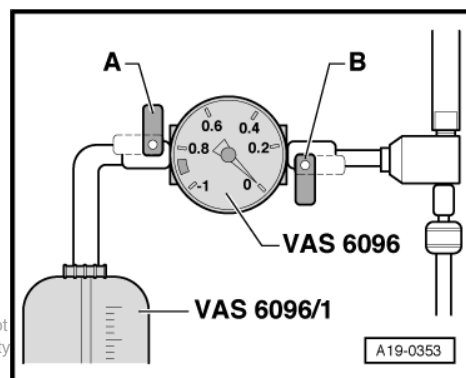
If the needle does not reach the green zone, repeat the process.

If the vacuum level drops, there is a leak in the cooling system.

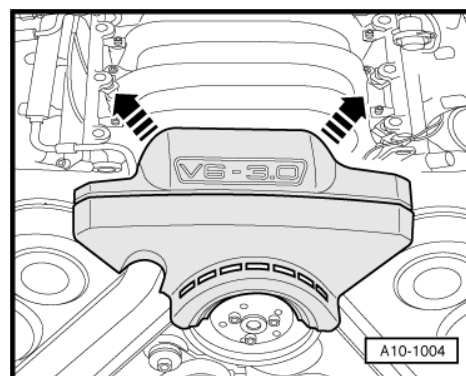
- Detach compressed air hose.
- Open valve -A-.

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.

- Detach cooling system charge unit -VAS 6096- from expansion tank.
- Fit pipe -V.A.G 1274/10- onto adapter -V.A.G 1274/8- .



- Pull off engine cover panel (front) -arrows-.

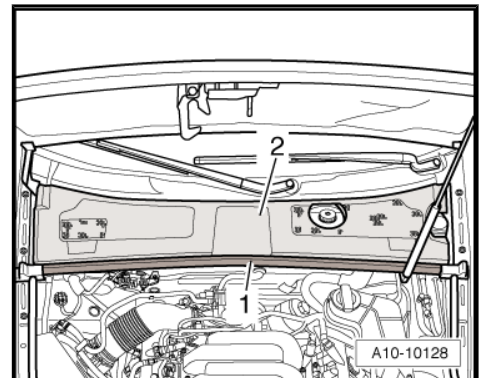
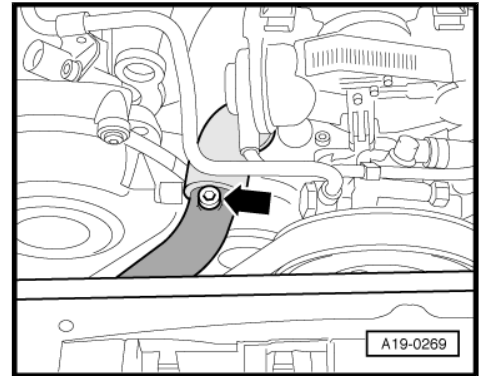


- Unscrew bleeder screw -arrow-.
- Fill up with coolant until it flows out at bleeder hole in coolant pipe.
- Tighten bleeder screw to 15 Nm.

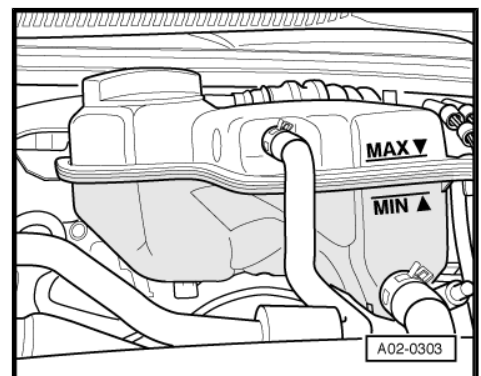
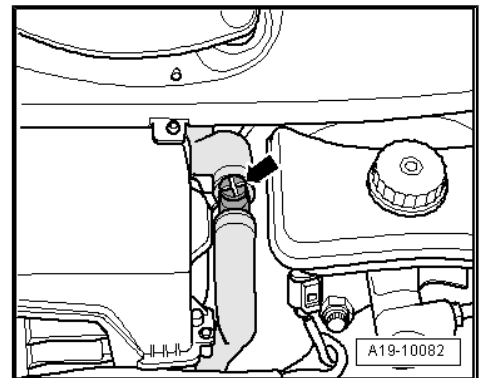
**Note**

*Renew seal.*

- Pull off rubber seal 1 on plenum chamber cover.
- Detach plenum chamber cover 2.



- Open bleeder screw -arrow-.
- Fill up with coolant until it flows out at bleeder hole in coolant hose.
- Close the bleeder screw.
- On vehicles with auxiliary heater, switch heater on (for about 30 seconds) and then off again.
- Tighten filler cap on expansion tank.
- Start engine.
- Set heater/air conditioner on both sides to "HI".
- Run the engine for 3 minutes at 2000 rpm.
- Allow the engine to run at idling speed until the two large coolant hoses at main radiator become warm.
- Run the engine for 1 minute at 2000 rpm.
- Switch off ignition and allow engine to cool down.
- Check coolant level.
  - The coolant level must be at the MAX marking when the engine is cold.
  - The coolant level can be above the MAX marking when the engine is warm.



### 1.3 Coolant pump and thermostat

1 - 10 Nm

2 - 10 Nm

3 - Coolant pump

- ☐ Removing and installing  
⇒ [page 162](#)

4 - Gasket

- ☐ Renew

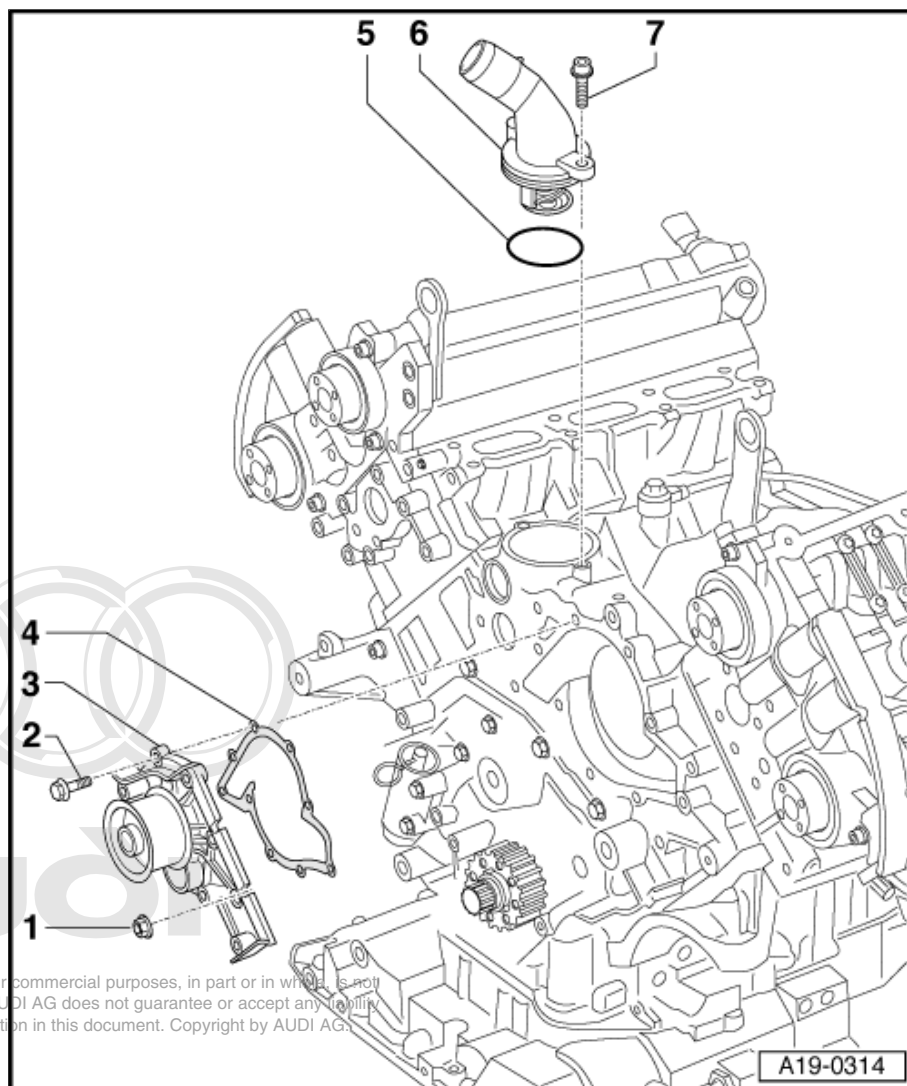
5 - O-ring

- ☐ Renew

6 - Thermostat with hose connection

- ☐ Can only be renewed as complete unit
- ☐ Removing and installing  
⇒ [page 163](#)
- ☐ Checking ⇒ [page 166](#)

7 - 10 Nm

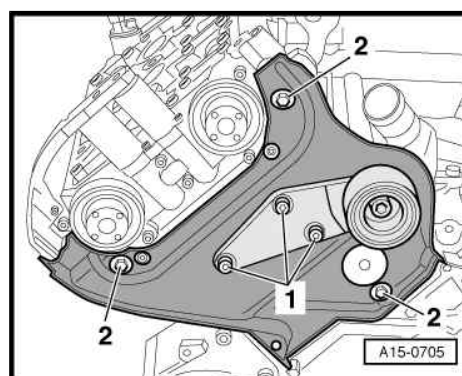


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## 1.4 Removing and installing coolant pump

### Removing

- Drain off coolant ⇒ [page 156](#) .
- Remove power steering pump ⇒ Running gear, front-wheel drive and four-wheel drive; Rep. Gr. 48 .
- Remove toothed belt ⇒ [page 67](#) .
- Remove camshaft sprockets on cylinder head (right-side).
- Remove bolts -1- and take off bracket with idler roller.
- Remove bolts -2- and take off toothed belt cover (rear right).
- Remove eccentric adjuster for toothed belt.



- Unscrew nuts -2- securing toothed belt cover (rear left).
- Unscrew bolts -1- securing coolant pump and detach coolant pump.

### Installing

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



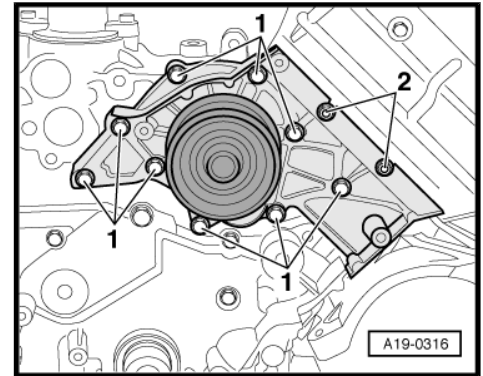
*Renew gaskets and seals.*

- Install toothed belt (adjust valve timing) ⇒ [page 75](#) .
- Install power steering pump ⇒ Running gear, front-wheel drive and four-wheel drive; Rep. Gr. 48 .
- Fill cooling system ⇒ [page 158](#) .

### Tightening torques

| Component                                 | Nm                |
|-------------------------------------------|-------------------|
| Coolant pump to cylinder block            | 10                |
| Toothed belt cover (rear) to coolant pump | 10                |
| Toothed belt cover (rear right) to engine | 10 <sup>23)</sup> |
| Bracket for idler roller to cylinder head | 10 <sup>23)</sup> |

23) Renew bolt.



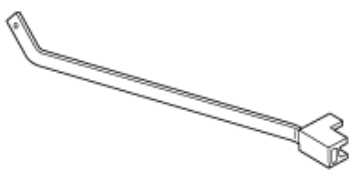
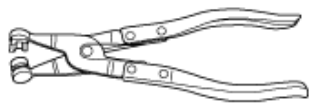
## 1.5 Removing, installing and checking thermostat

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### Special tools and workshop equipment required

- ◆ Pin wrench -3212-
- ◆ Poly V-belt lever -3299-  
with bracket - 3299/1-
- ◆ Hose clip pliers -  
V.A.G 1921-

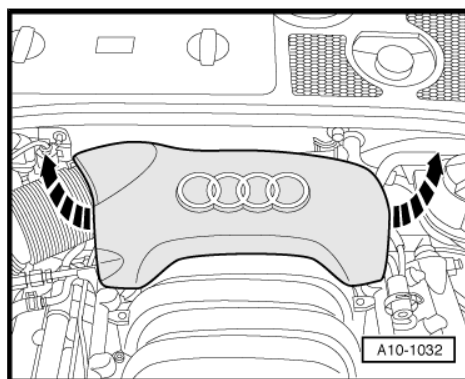
|                                                                                                        |                                                                                                   |
|--------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| <b>3212</b><br>       | <b>3299</b><br> |
| <b>V.A.G 1921</b><br> |                                                                                                   |
|                                                                                                        | <b>G19-0024</b>                                                                                   |

### Removing

- Drain off coolant ⇒ [page 156](#) .
- Pull off engine cover panel (rear) -arrows-.

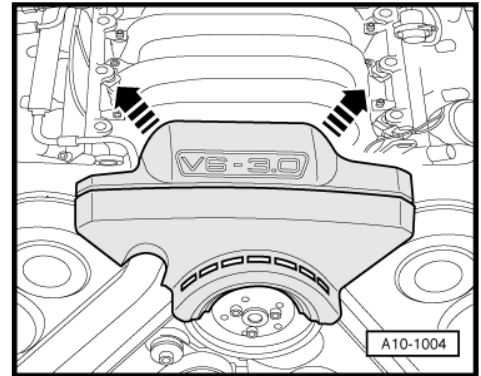


# Audi



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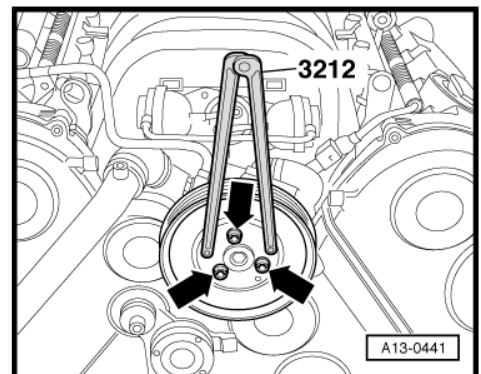
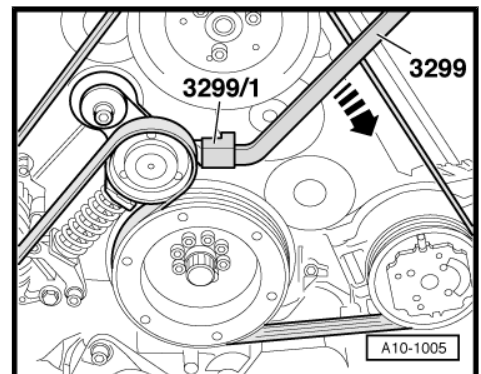
- Pull off engine cover panel (front) -arrows-.



**i** Note

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

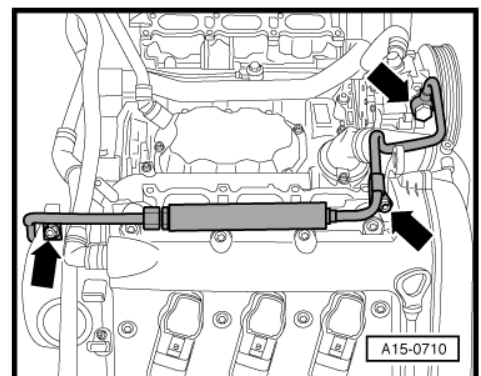
- To slacken poly V-belt, apply pressure to tensioner by moving poly V-belt lever -3299- and bracket -3299/1- in the direction of the -arrow-.
- Remove poly V-belt from power steering pump pulley.
- Unbolt poly V-belt pulley at power steering pump -arrows-, using pin wrench -3212- as a counterhold.



**i** Note

*Lay a cloth under the hydraulic pressure pipe to catch any escaping hydraulic fluid.*

- Remove pressure pipe for power steering at power steering pump, cylinder head and rear coolant pipe -arrows on right- and move to the side.

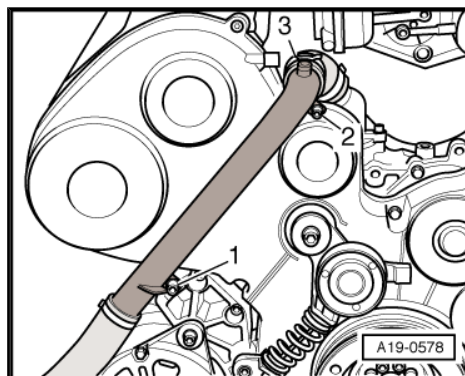


**i** Note

*Ignore -arrow on left side of illustration-.*

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- Unscrew bolts -1- and -2- for coolant pipe.
- Release clip -3- and detach coolant pipe from coolant hose connection.



### Note

Place a cloth underneath to catch any escaping coolant.

- Remove bolts -arrows-.
- Detach thermostat with hose connection.

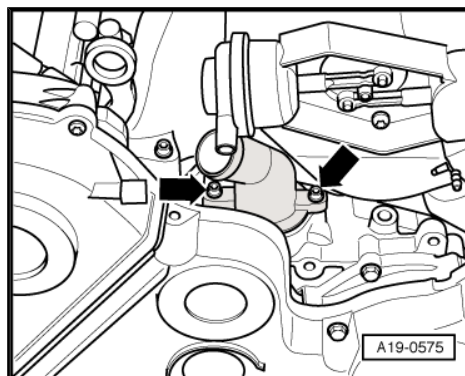
### Installing

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



### Note

- ◆ Renew seals and O-ring.
- ◆ Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.
- Before installing, clean and smoothen sealing surface for O-ring.
- Install poly V-belt ⇒ [page 39](#).
- Fill cooling system ⇒ [page 158](#).
- Top up power steering fluid and bleed steering system: ⇒ Running gear, front-wheel drive and four-wheel drive; Rep. Gr. 48



### Tightening torques

| Component                                        | Nm |
|--------------------------------------------------|----|
| Hose connection for thermostat to cylinder block | 10 |
| Coolant pipe to engine                           | 10 |
| Banjo bolt to power steering pump                | 47 |
| Hydraulic pipe to cylinder head                  | 22 |
| Pulley to power steering pump                    | 23 |

### Checking thermostat

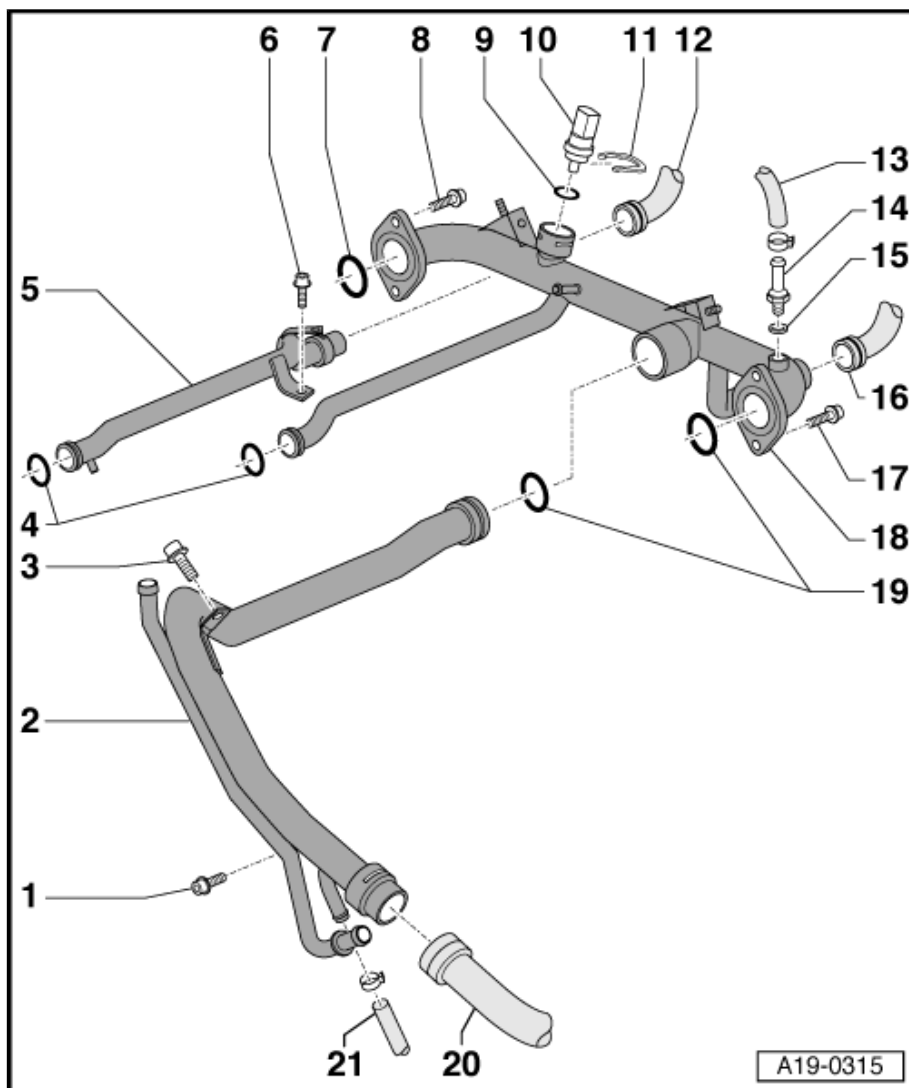
- Heat thermostat in water bath.

| Starts to open | Fully open                    | Opening travel |
|----------------|-------------------------------|----------------|
| approx. 87 °C  | approx. 102 °C <sup>24)</sup> | at least 8 mm  |

24) Cannot be tested.

## 1.6 Coolant pipes - exploded view

- 1 - 10 Nm
- 2 - Coolant pipe (front)
  - ☐ Removing and installing  
⇒ [page 167](#)
- 3 - 10 Nm
- 4 - O-rings
  - ☐ Renew
- 5 - Coolant pipe (right-side)
  - ☐ Removing and installing  
⇒ [page 170](#)
- 6 - 10 Nm
- 7 - O-ring
  - ☐ Renew
- 8 - 10 Nm
- 9 - O-ring
  - ☐ Renew
- 10 - Coolant temperature sender -G2- / Coolant temperature sender -G62-
- 11 - Retaining clip
- 12 - Coolant hose
  - ☐ To heat exchanger
- 13 - Coolant hose
  - ☐ To expansion tank
- 14 - Connection
  - ☐ Tighten to 15 Nm
- 15 - Seal
  - ☐ Renew
- 16 - Coolant hose
  - ☐ To heat exchanger
- 17 - 10 Nm
- 18 - Coolant pipe (rear)
  - ☐ Removing and installing ⇒ [page 170](#)
- 19 - O-rings
  - ☐ Renew
- 20 - Coolant hose
  - ☐ To top of radiator
- 21 - Coolant hose
  - ☐ To oil cooler

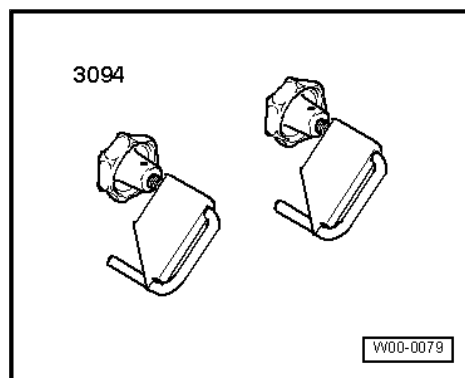


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## 1.7 Removing and installing coolant pipe (front)

Special tools and workshop equipment required

- ◆ Hose clamps for hoses up to 25 mm Ø -3094-



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

### Removing

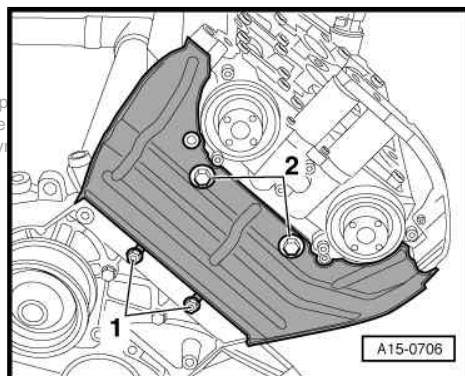


#### Note

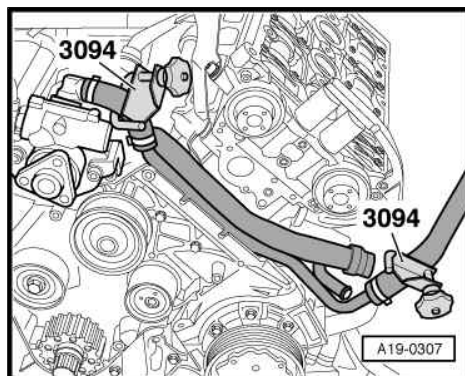
*All cable ties which are released or cut open when removing must be fitted in the same position when installing.*

- Remove intake manifold ⇒ [page 100](#) .
- Remove toothed belt ⇒ [page 67](#) .
- Remove camshaft sprockets on cylinder head (left-side).
- Remove bolts -1- and -2- and take off toothed belt cover (rear left).

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- Place used oil collection and extraction unit -V.A.G 1782- under engine.
- Use hose clamps -3094- to pinch off both hoses at hydraulic fluid supply pipe.
- Disconnect both hydraulic hoses from supply pipe.
- Disconnect coolant hoses from coolant pipe (front).



- Unscrew bolts -1- and -2- and move connecting pipes clear of coolant pipe.
- Pull coolant pipe off from front -arrow-.

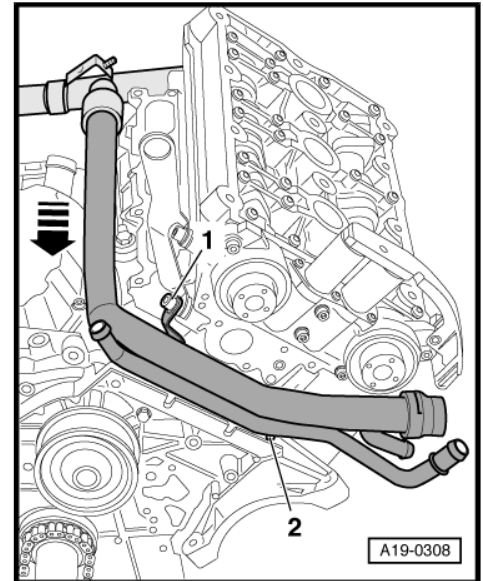
### Installing

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



#### Note

- ◆ *Renew O-rings.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- ◆ *Fit all cable ties in the original positions when installing.*
- Before installing, clean and smoothen sealing surface for O-ring.
- Lubricate new O-ring with “G12+” and slide onto coolant pipe.
- Push front coolant pipe into opening in rear coolant pipe.
- Install intake manifold ⇒ [page 100](#) .
- Install toothed belt (adjust valve timing) ⇒ [page 75](#) .
- Fill cooling system ⇒ [page 158](#) .
- Top up power steering fluid and bleed steering system: ⇒  
Running gear, front-wheel drive and four-wheel drive; Rep.  
Gr. 48



### Tightening torques

| Component                                                  |    | Nm                |
|------------------------------------------------------------|----|-------------------|
| Coolant pipe (front)                                       | M6 | 10                |
| to cylinder head                                           | M8 | 22                |
| Toothed belt cover (rear) to cylinder head/ cylinder block |    | 10 <sup>25)</sup> |

25) Renew bolts.

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## 1.8 Removing and installing coolant pipe (right-side)

### Removing

- Remove intake manifold ⇒ [page 100](#) .
- Disconnect rear coolant hose -2- from coolant pipe (right-side).
- Remove bolt -1-.
- Pull coolant pipe (right-side) out of cylinder block towards the rear -arrow-.
- Take out coolant pipe from the top.

### Installing

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



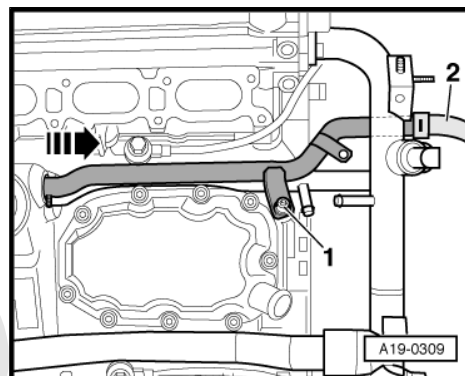
#### Note

*Renew O-rings.*

- Before installing, clean and smoothen sealing surface for O-ring.
- Lubricate new O-ring with "G12+" and slide onto coolant pipe.
- Slide coolant pipe into bore in cylinder block.
- Install intake manifold ⇒ [page 100](#) .
- Fill cooling system ⇒ [page 158](#) .

### Tightening torque

| Component                                   | Nm |
|---------------------------------------------|----|
| Coolant pipe (right-side) to cylinder block | 10 |



## 1.9 Removing and installing coolant pipe (rear)

### Removing

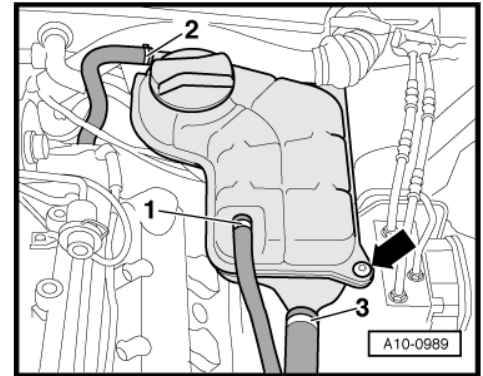


#### Note

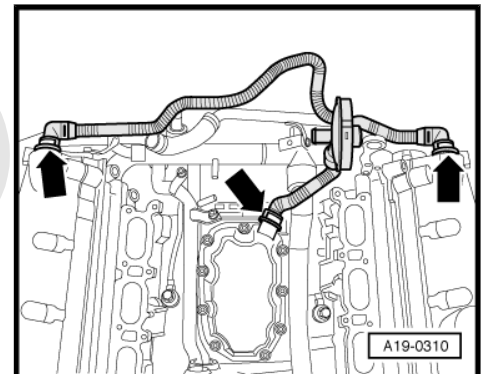
*All cable ties which are released or cut open when removing must be fitted in the same position when installing.*

- Remove intake manifold ⇒ [page 100](#) .
- Remove coolant pipe (right-side) ⇒ [page 170](#) .

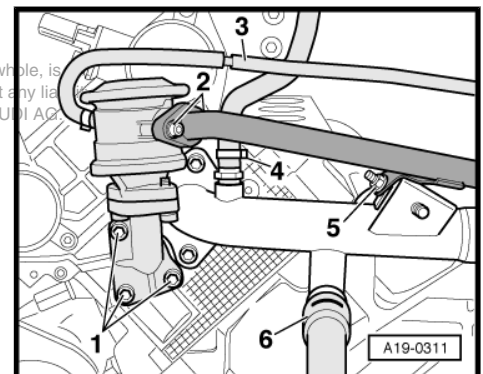
- Detach coolant hose -2- at expansion tank.
- Unbolt coolant expansion tank -arrow- and disconnect electrical connector for coolant shortage indicator switch -F66- at bottom of coolant expansion tank.
- Lay aside coolant expansion tank with coolant hoses -1- and -3- connected.



- Move pipes clear of crankcase breather hose.
- Remove crankcase breather hose -arrows-.

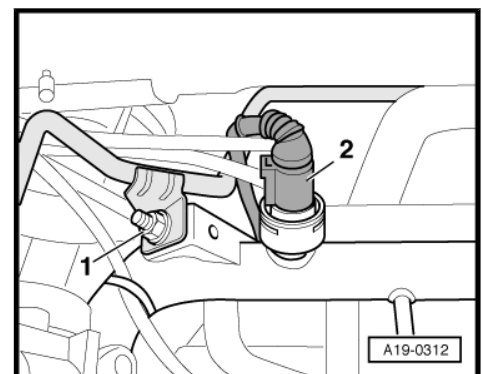


- Disconnect coolant hose -4-.
- Unscrew bolts -2- and nut -5- and detach secondary air pipe.
- Disconnect vacuum hose -3- leading to combination valve for secondary air system.
- Unscrew bolts -1- and take off combination valve for secondary air system.
- Disconnect coolant hose -6-.

**Note**

*Shown from rear with engine removed for illustration purposes.*

- Unplug electrical connector -2- from coolant temperature sender -G2- / coolant temperature sender -G62- .
- Unscrew power steering hydraulic pipe at coolant pipe (rear) -1-.
- Move electrical wiring at coolant pipe (rear) clear.



- Remove bolts -1- and -2-.
- Pull coolant pipe off towards rear.

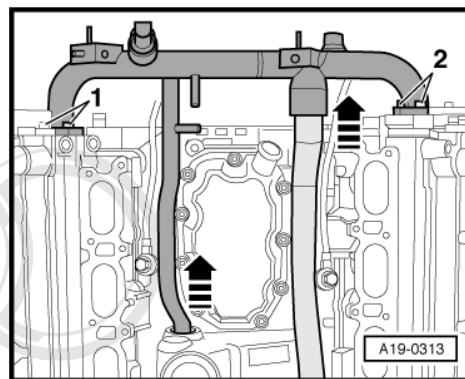
### Installing

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.*
- ◆ *Fit all cable ties in the original positions when installing.*
- Before installing, clean and smooth down sealing surfaces for O-rings as required.
- Lubricate new O-rings with “G12” and slide onto coolant pipe
- Install coolant pipe (right-side) ⇒ [page 170](#) ⇒ [page 170](#)
- Install combination valve for secondary air system (left-side) ⇒ [page 203](#) .
- Install intake manifold ⇒ [page 100](#) .
- Fill cooling system ⇒ [page 158](#) .



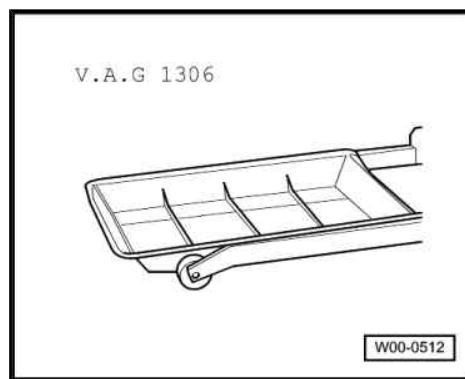
### Tightening torques

| Component                                    | Nm |
|----------------------------------------------|----|
| Coolant pipe (rear) to cylinder head         | 10 |
| Power steering pressure pipe to coolant pipe | 20 |

## 1.10 Removing and installing radiator

### Special tools and workshop equipment required

- ◆ Drip tray -V.A.G 1306- or drip tray for workshop hoist -VAS 6208-



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

### Removing

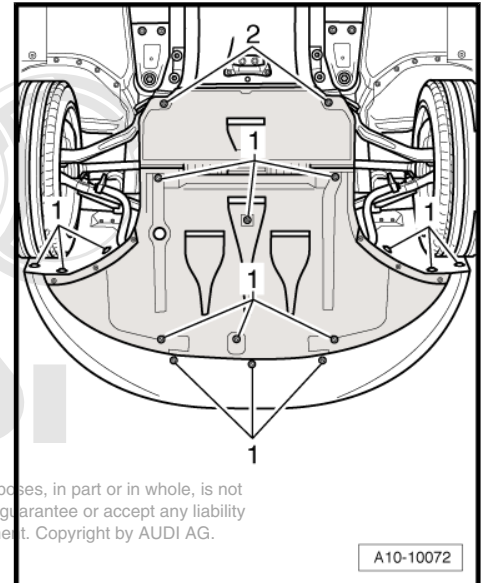


#### WARNING

*Hot steam/hot coolant may escape when opening expansion tank; cover filler cap with cloth and open carefully.*

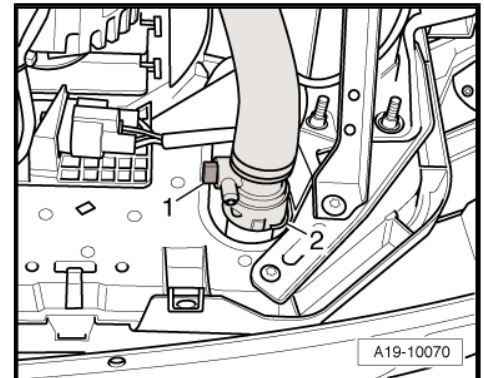
- Open filler cap on coolant expansion tank.

- Release quick-release fasteners -1- and -2- and take off noise insulation panels.
- Remove wheel housing liners (left and right) ⇒ General body repairs, exterior; Rep. Gr. 66 .
- Remove front bumper cover ⇒ General body repairs, exterior; Rep. Gr. 63 .

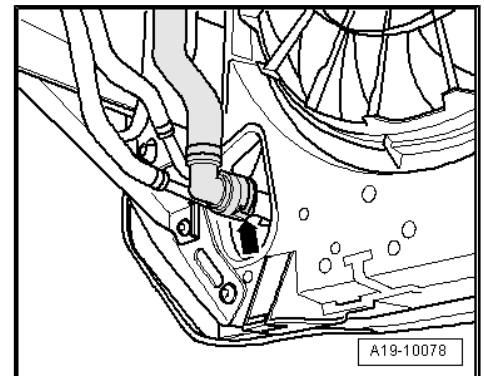


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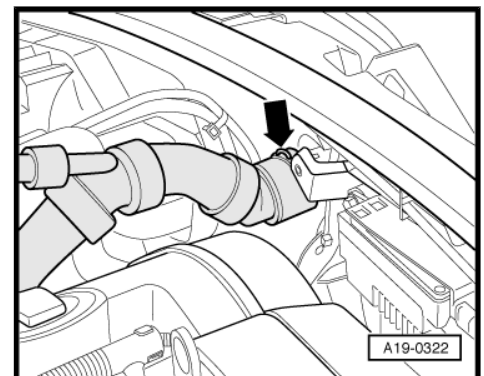
- Place drip tray -V.A.G 1306- or drip tray for workshop hoist -VAS 6208- under engine.
- Open drain plug -1- and let coolant drain.
- Then disconnect coolant hose -2- from radiator.



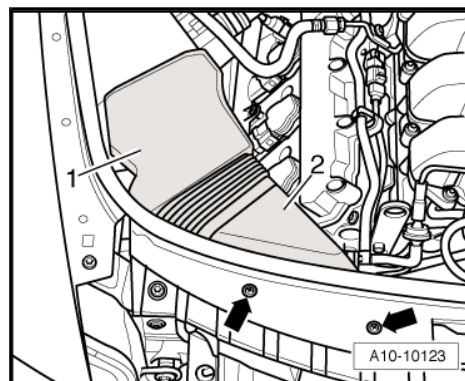
- Detach coolant hose -arrow- at bottom left of radiator.



- Detach coolant hose (top) -arrow- from radiator (left-side).



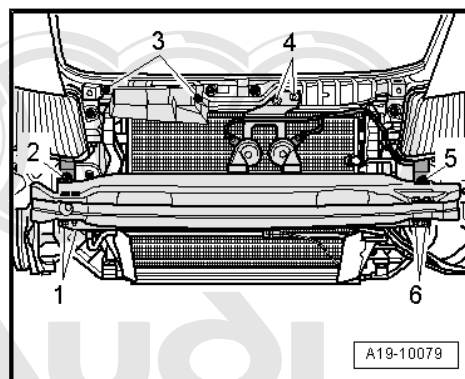
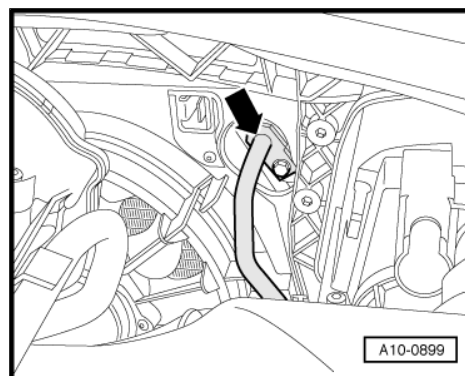
- Remove bolts -arrows-.
- Remove air ducts -1- and -2-.



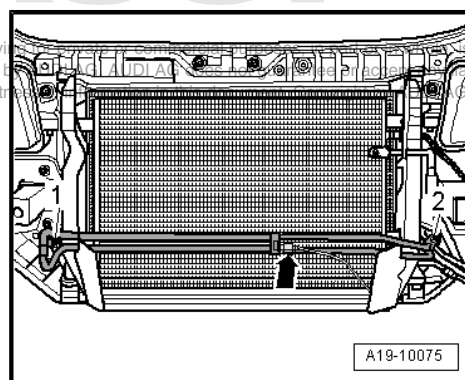
### Note

*Note the rules for cleanliness when working on the automatic gearbox ⇒ multitronic 01J, front-wheel drive; Rep. Gr. 37 .*

- Place used oil collection and extraction unit -V.A.G 1782- under engine.
- Remove ATF pipes (top -arrow- and bottom) from radiator: ⇒ multitronic 01J, front-wheel drive; Rep. Gr. 37 .
- Tie ATF pipes up onto longitudinal member to prevent fluid escaping.
- Unscrew bolts -3- and detach air duct.
- Unscrew bolts -4- and remove bracket for horns; electrical wiring remains attached.
- Unscrew brackets -2- and -5- for headlights.
- Unbolt nuts -1- and -6- and remove bumper.



- Unclip ambient temperature sensor -G17- -arrow- from bracket.
- Unscrew bolts -1- and -2- for power steering cooling pipe; the hydraulic hoses remain attached.
- Remove both air ducts at radiator.



- Unplug electrical connector -1-.



#### Caution

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

- Remove bolts -arrows-.



#### 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.*

- Pivot condenser downwards with pipes/hoses attached.
- Release two retaining pins for radiator and pull out upwards -arrows-.
- Swivel radiator forwards and lift off.

#### Installing

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

- Secure the ATF pipes ⇒ multitronic gearbox 01J, front-wheel drive; Rep. Gr. 37 .
- Install front bumper cover ⇒ General body repairs, exterior; Rep. Gr. 63 .
- Install wheel housing liners (left and right) ⇒ General body repairs, exterior; Rep. Gr. 66 .
- Fill cooling system ⇒ [page 158](#) .



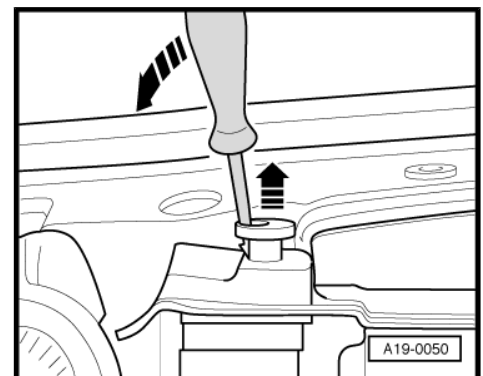
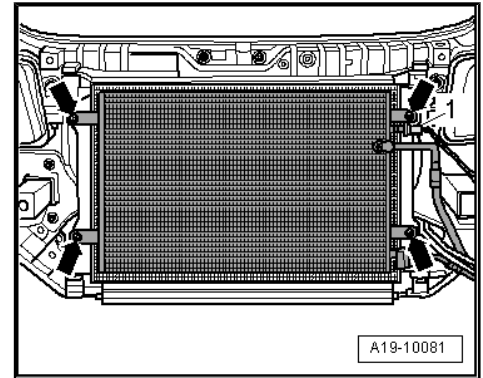
#### Note

*The coolant in the entire system must be changed if the radiator is renewed.*

- Check ATF level ⇒ multitronic gearbox 01J, front-wheel drive; Rep. Gr. 37 .

#### Tightening torque

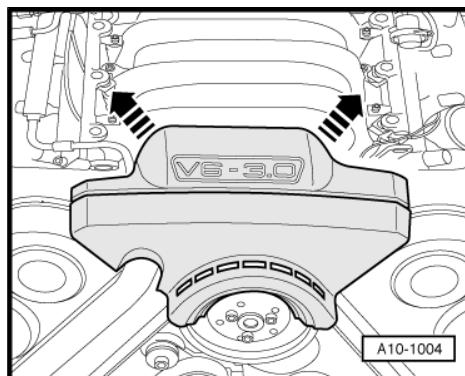
| Component                                | Nm |
|------------------------------------------|----|
| Condenser to lock carrier                | 6  |
| Power steering cooling pipe to condenser | 9  |
| Bracket for horns to lock carrier        | 8  |



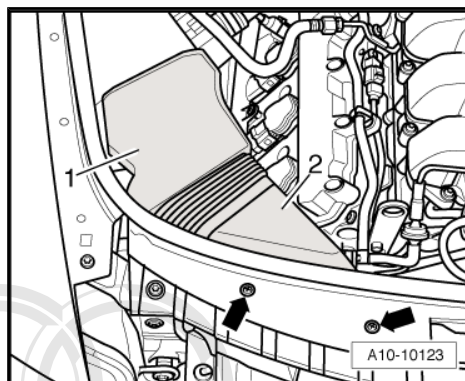
## 1.11 Removing and installing radiator cowl

### Removing

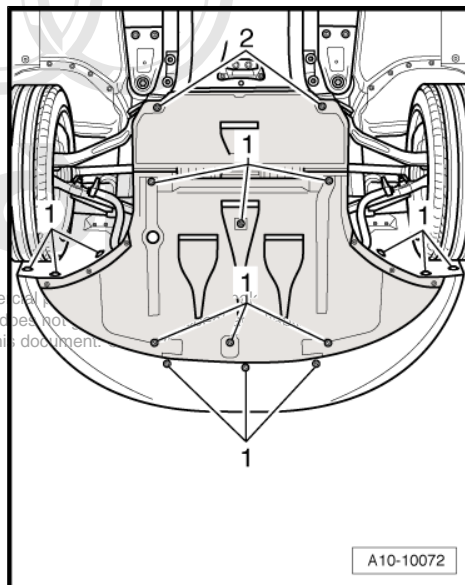
- Pull off engine cover panel (front) -arrows-.



- Remove bolts -arrows-.
- Remove air ducts -1- and -2-.



- Release quick-release fasteners -1- and -2- and take off noise insulation panels.



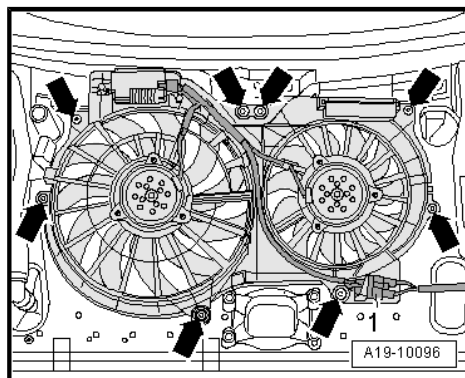
- Unplug electrical connector -1- for radiator fan.
- Unscrew bolts -arrows- and lift out radiator cowl.

### Installing

Install in reverse order.

### Tightening torques

| Component        |            | Nm |
|------------------|------------|----|
| Radiator cowl to | M6         | 11 |
| Lock carrier     | Panel bolt | 2  |



## 1.12 Removing and installing radiator fan

### Removing

- Remove radiator cowl ⇒ [page 176](#) .
- Remove bolts -1 ... 8-.
- Move wiring clear.
- Remove radiator fan with control unit.

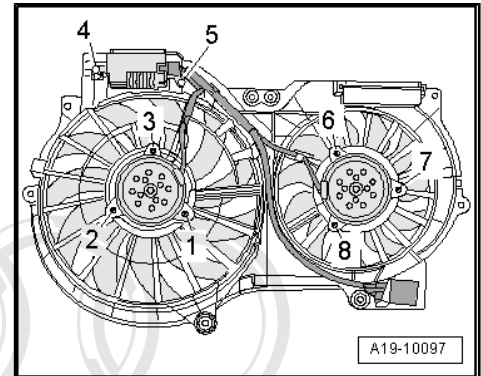
### Installing

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

- Install radiator cowl ⇒ [page 176](#) .

### Tightening torque

| Component                        |            | Nm  |
|----------------------------------|------------|-----|
| Radiator fan<br>to radiator cowl | Single fan | 3   |
|                                  | Dual fan   | 4.5 |

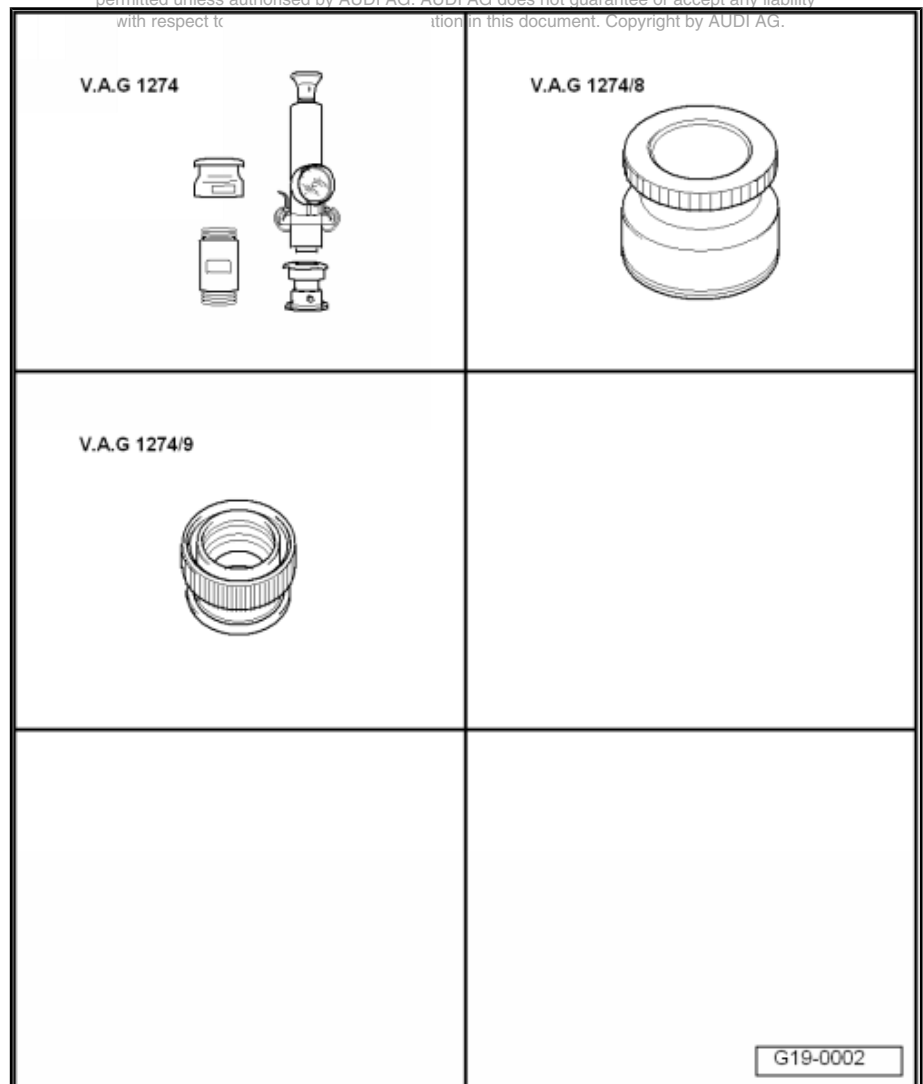


## 1.13 Checking cooling system for leaks

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### 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-



## Test condition

- Engine must be warm.

## Test sequence



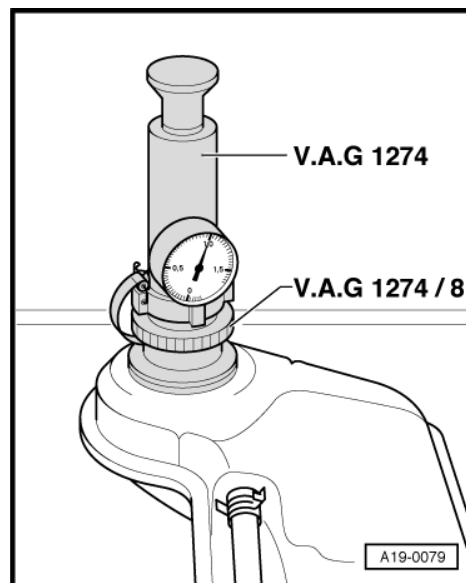
### WARNING

*Hot steam/hot coolant may escape when opening expansion tank; 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.

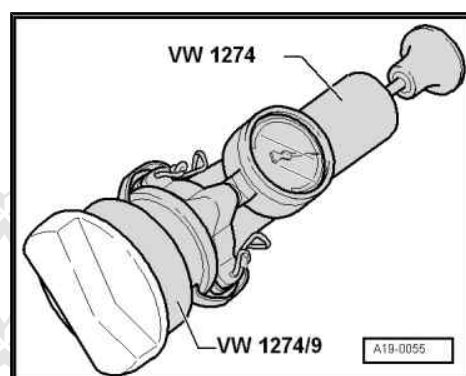


## Checking pressure relief valve in filler cap

- 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.



## 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 clamps and align silencers and exhaust pipes so that sufficient clearance is maintained to the body at all points and the mountings are evenly loaded.*
- ◆ *To avoid any damage, the flexible joint in the front exhaust pipe must not be bent more than 10°.*

#### 1.1 Exhaust system - exploded view

1 - 23 Nm

#### 2 - Mounting

- ☐ Renew if damaged

#### 3 - Centre silencer

- ☐ Combined in one unit with rear silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting point  
⇒ [page 183](#)
- ☐ Align exhaust system so it is free of stress  
⇒ [page 195](#)

4 - 23 Nm

- ☐ Renew

#### 5 - Exhaust manifold

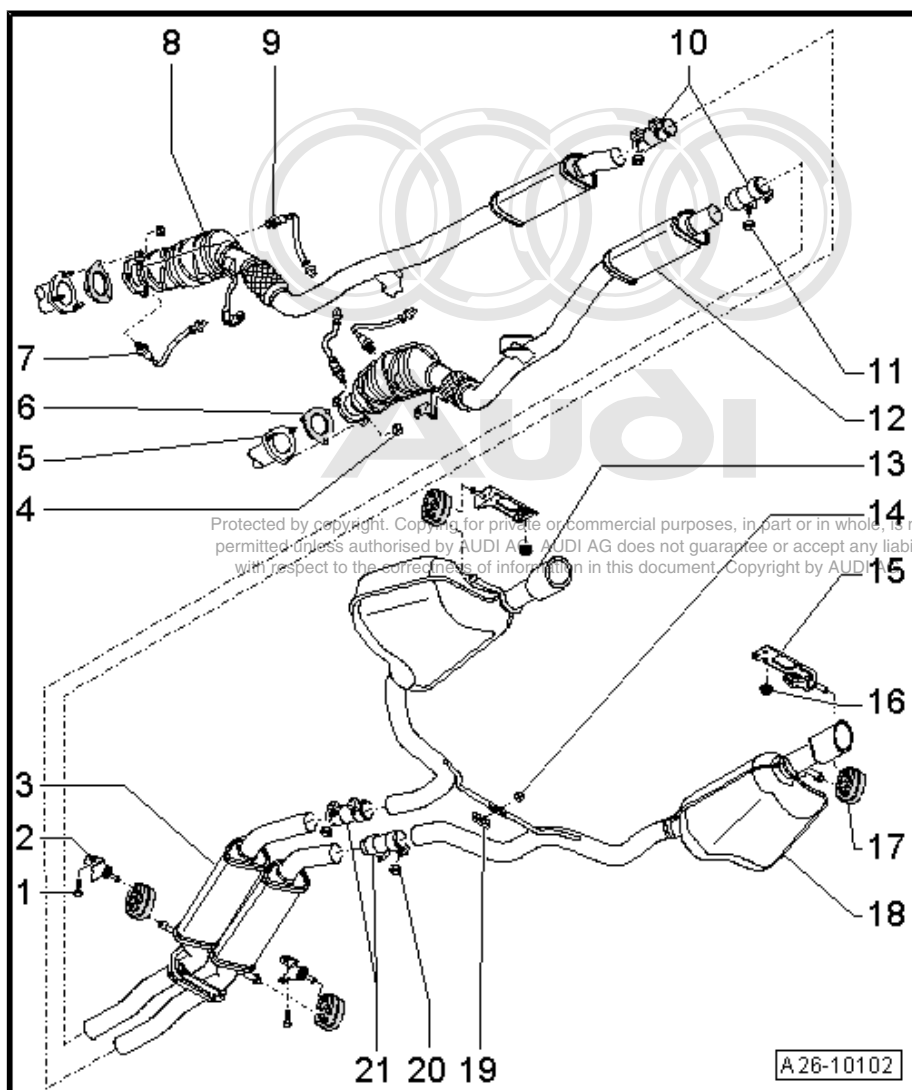
- ☐ Removing and installing: left-side  
⇒ [page 193](#), right-side  
⇒ [page 193](#)

#### 6 - Gasket

- ☐ Renew

#### 7 - Lambda probe before catalytic converter

- ☐ Threads of new Lambda probes are already greased with assembly paste; the paste must not get into the slots on the probe body
- ☐ When re-using the old lambda probe, grease thread with high-temperature lubricant; the paste must not get into the slots of the probe body; High-temperature lubricant ⇒ Parts catalogue



- ☐ Removing and installing ⇒ Motronic injection and ignition system (6-cyl., 3.0 ltr. 5V); Rep. Gr. 24
- ☐ Tighten to 55 Nm

#### 8 - Front exhaust pipe with catalytic converter and front silencer

- ☐ For cylinder bank 2 (left-side)
- ☐ With flexible joint; do not bend flexible joint more than 10° - otherwise it can be damaged
- ☐ Protect from damage by knocks and impacts
- ☐ Removing and installing ⇒ [page 183](#)
- ☐ Mounting components ⇒ [page 181](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 195](#)

#### 9 - Lambda probe after catalytic converter

- ☐ Threads of new Lambda probes are already greased with assembly paste; the paste must not get into the slots on the probe body
- ☐ When re-using the old lambda probe, grease thread with high-temperature lubricant; the paste must not get into the slots of the probe body; High-temperature lubricant ⇒ Parts catalogue
- ☐ Removing and installing ⇒ Motronic injection and ignition system (6-cyl., 3.0 ltr. 5V); Rep. Gr. 24
- ☐ Tighten to 55 Nm

#### 10 - Clamps (front)

- ☐ Installation position ⇒ [page 181](#)
- ☐ Before tightening bolt connections, align exhaust system so it is free of stress ⇒ [page 195](#)
- ☐ Tighten bolt connections evenly

#### 11 - 23 Nm

#### 12 - Front exhaust pipe with catalytic converter and front silencer

- ☐ For cylinder bank 1 (right-side)
- ☐ With flexible joint; do not bend flexible joint more than 10° - otherwise it can be damaged
- ☐ Protect from damage by knocks and impacts
- ☐ Removing and installing ⇒ [page 188](#)
- ☐ Mounting components ⇒ [page 182](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 195](#)

#### 13 - Rear silencer

- ☐ Left side of vehicle
- ☐ Combined in one unit with centre silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting point ⇒ [page 183](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 195](#)

#### 14 - 23 Nm

- ☐ Renew

#### 15 - Mounting

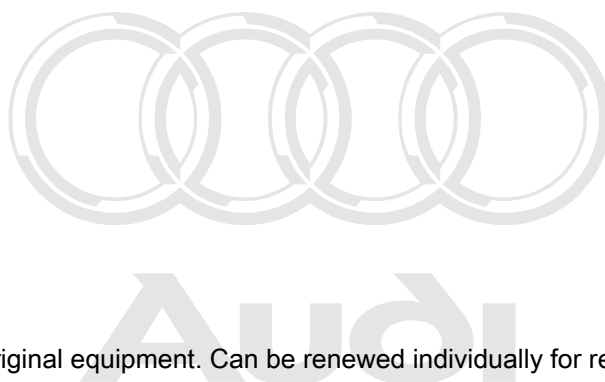
#### 16 - 23 Nm

#### 17 - Mounting

- ☐ Renew if damaged

#### 18 - Rear silencer

- ☐ Right side of vehicle
- ☐ Combined in one unit with centre silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting location: vehicles with front-wheel drive ⇒ [page 183](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 195](#)



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## 19 - Bracket

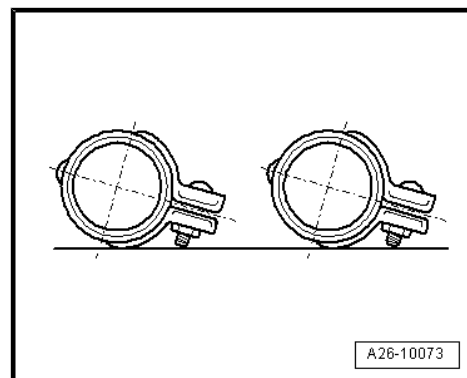
20 - 23 Nm

## 21 - Clamps (rear)

- ☐ For separate replacement of centre and rear silencers
- ☐ Position clamp so that it aligns with centre of cutting location
- ☐ Installation position ⇒ [page 181](#)
- ☐ Before tightening bolt connections, align exhaust system so it is free of stress ⇒ [page 195](#)
- ☐ Tighten bolt connections evenly

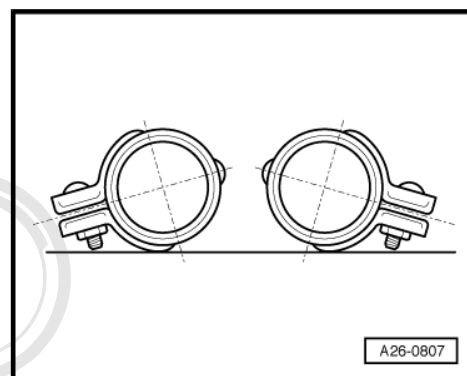
### Installation position of front clamps

- Install clamps so that the bolt ends do not protrude beyond bottom of clamp.
- Bolt connections face to right.



### Installation position of rear clamps

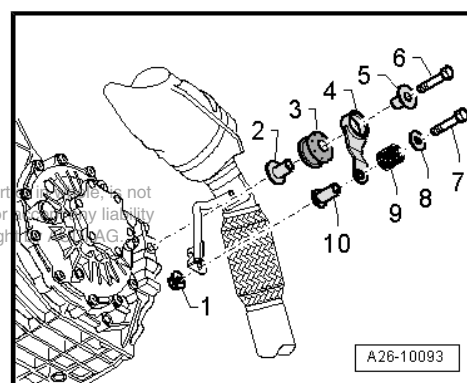
- Install clamps so that the bolt ends do not protrude beyond bottom of clamp.
- Bolt connections face outwards.



### Components of exhaust pipe mountings (left-side)

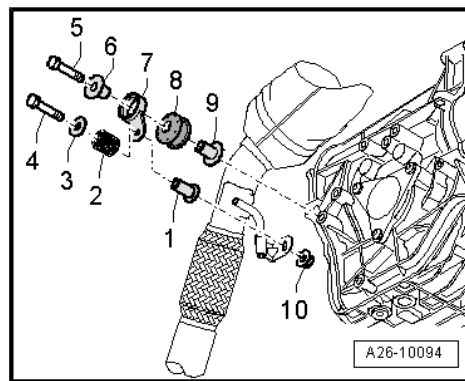
- 1 - Nut, 23 Nm
- 2 - Spacer sleeve
- 3 - Buffer
- 4 - Bracket
- 5 - Spacer sleeve
- 6 - Bolt, 23 Nm
- 7 - Bolt
- 8 - Washer
- 9 - Compression spring
- 10 - Spacer sleeve

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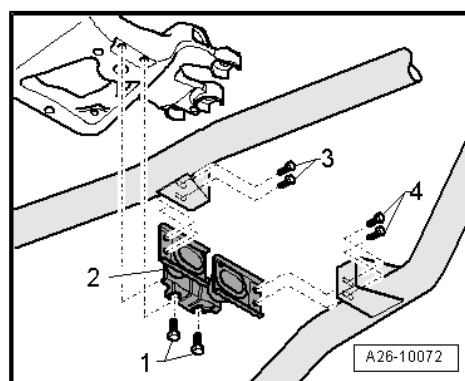
## Components of exhaust pipe mountings (right-side)

- 1 - Spacer sleeve
- 2 - Compression spring
- 3 - Washer
- 4 - Bolt
- 5 - Bolt, 23 Nm
- 6 - Spacer sleeve
- 7 - Bracket
- 8 - Buffer
- 9 - Spacer sleeve
- 10 - Nut, 23 Nm



## Mounting components for centre bracket for front exhaust pipes

- 1 - 23 Nm
- 2 - Bracket
- 3 - 23 Nm
- 4 - 23 Nm



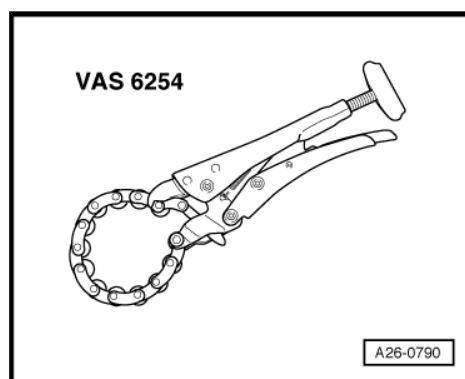
## 1.2 Separating centre and rear silencers

The connecting pipe can be cut through at the cutting point 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.

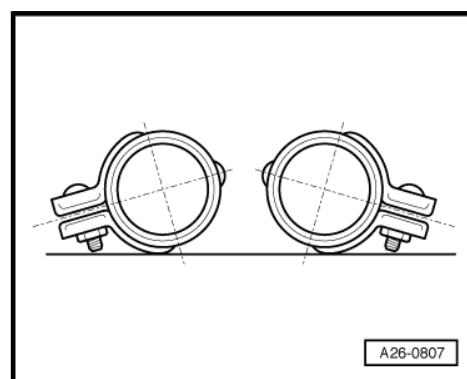
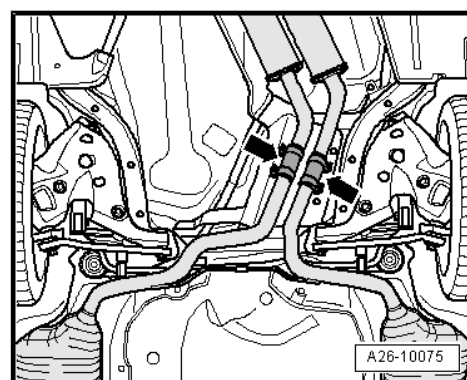
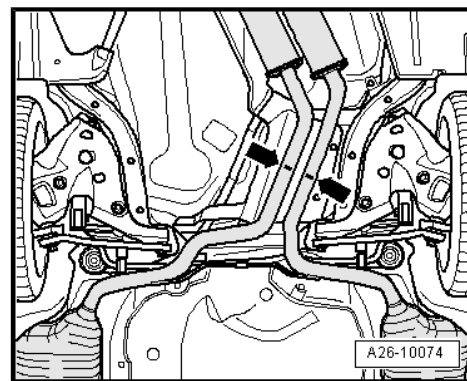
### Special tools and workshop equipment required

- ◆ Chain pipe cutter -VAS 6254-



## Procedure

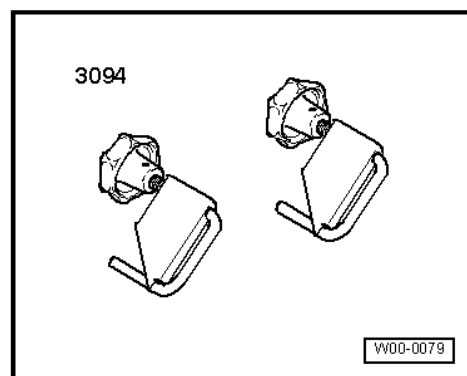
- Cut through exhaust pipes at a right angle at cutting point -arrows- using chain pipe cutter -VAS 6254- .
- When installing, position centre of clamps -arrows- over cutting location.
- Install clamps so that the bolt ends do not protrude beyond bottom of clamp.
- Bolt connections face outwards.
- Align exhaust system so it is free of stress ⇒ [page 195](#) .



## 1.3 Removing and installing front exhaust pipe (left-side) with catalytic converter

### Special tools and workshop equipment required

- ◆ Hose clamps for hoses up to 25 mm Ø -3094-



## Removing



### Note

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

- Pull off engine cover panel (rear) -arrows-.
- Clamp off coolant hose -2- using a hose clamp -3094- .
- Pull off coolant hose at coolant expansion tank and plug the opening.
- Unbolt coolant expansion tank -arrow- and disconnect electrical connector for coolant shortage indicator switch -F66- at bottom of coolant expansion tank.
- Lay aside coolant expansion tank with coolant hoses -1- and -3- connected.
- Remove electrical connectors -1- and -3- from bracket.
- Unplug the electrical connectors and move wiring clear downwards.



### Note

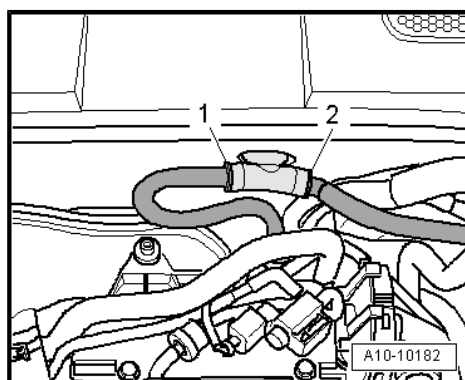
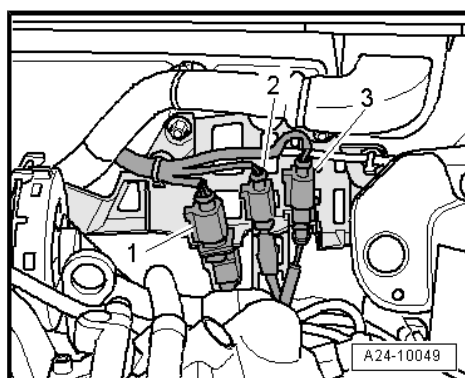
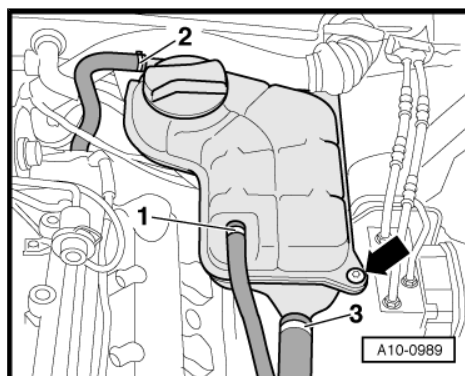
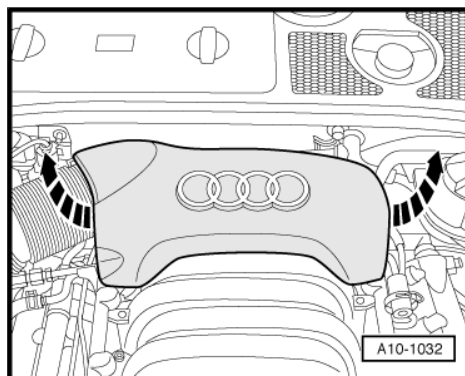
Disregard -item 2-.

- Pull off vacuum hose -2- from T-piece at bulkhead.



### Note

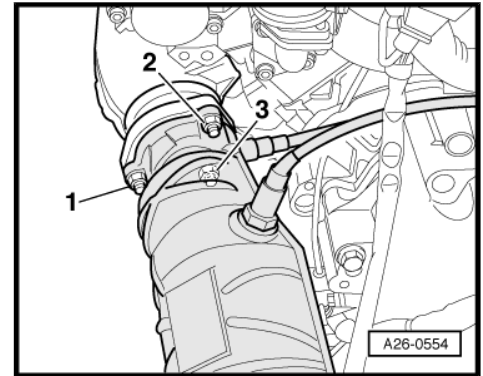
Disregard -item 1-.



- Unscrew nut -2- (accessible from above) connecting front ex-haust pipe to exhaust manifold.

 **Note**

*Shown from rear with engine removed for illustration purposes.*

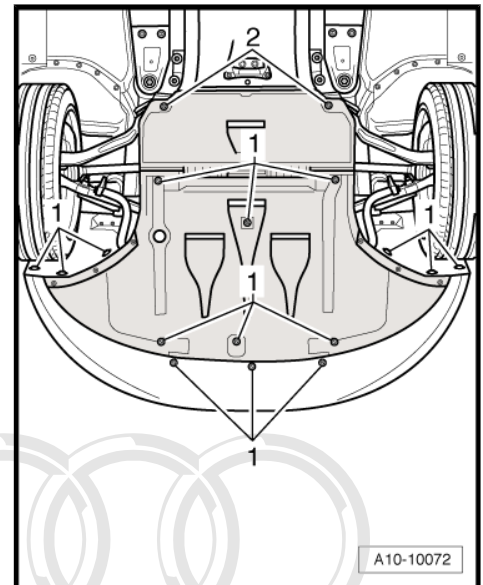


- Remove front left wheel.

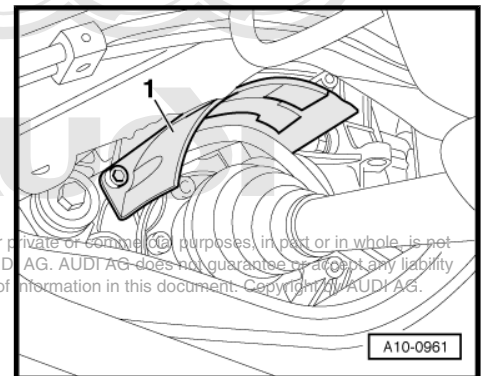
 **Note**

*Secure brake disc with one wheel bolt.*

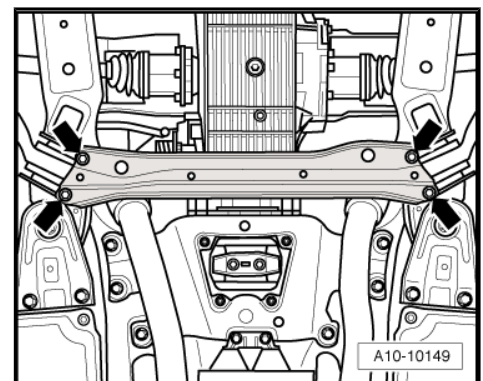
- Release quick-release fasteners -1- and -2- and take off noise insulation panels.



- Unbolt heat shield -1- for drive shaft (left-side).

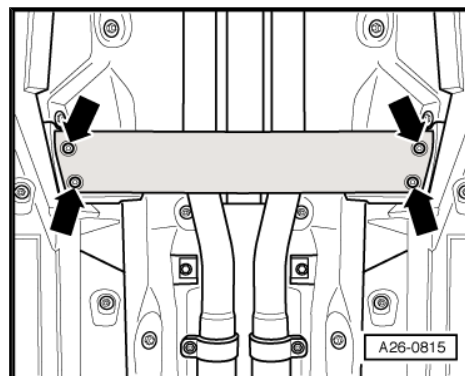


- Unbolt cross piece from subframe -arrows-.



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- Remove front cross piece -arrows-.

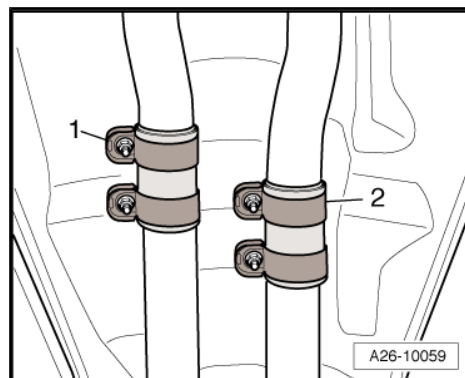


Disconnect exhaust system at clamp (left-side) -2-.



# Note

Disregard -item 1-.



# Note

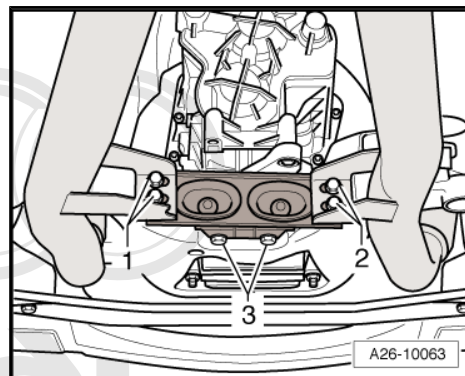
To avoid any damage, the flexible joint in the front exhaust pipe must not be bent more than 10°.

- Remove bolts -1- on bracket (rear) for front exhaust pipe.

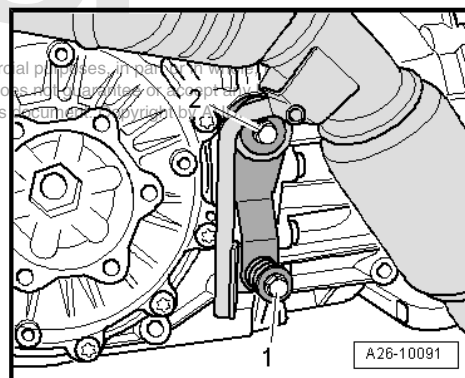


# Note

Disregard items marked -2- and -3-.



- Remove bolts -1- and -2-.
- Remove bracket (left-side) for front exhaust pipe.



- Move Lambda probe wires clear.
- Unscrew nuts -1- and -3- (accessible from below) connecting front exhaust pipe to exhaust manifold.



#### Note

*Shown in illustration with engine removed.*

- Remove front exhaust pipe with catalytic converter.

#### Installing

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



#### Note

- ◆ *Renew gaskets and self-locking nuts.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- ◆ *Fit all cable ties in the original positions when installing.*
- ◆ *When installing, the Lambda probe wire must always be reattached at the same locations to prevent it from coming into contact with the exhaust pipe.*
- Install cross piece for subframe ⇒ Running gear, front-wheel drive and four-wheel drive; Rep. Gr. 40 .
- Install cross piece (front) ⇒ General body repairs, exterior; Rep. Gr. 50 .
- Align exhaust system so it is free of stress ⇒ [page 195](#) .



#### Note

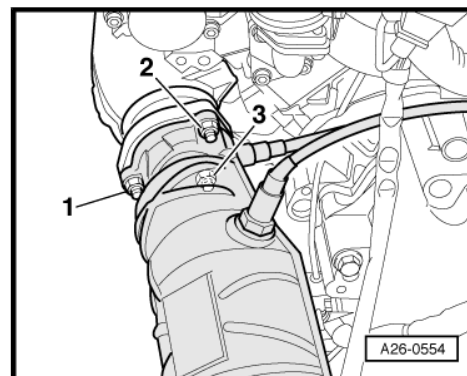
*Mounting components for exhaust system ⇒ [page 181](#) .*

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#### Tightening torque

| Component                                                       | Nm                |
|-----------------------------------------------------------------|-------------------|
| Front exhaust pipe with catalytic converter to exhaust manifold | 23 <sup>26)</sup> |
| Mounting plate to front exhaust pipe                            | 23                |
| Mounting plate to gearbox                                       | 23                |
| Front exhaust pipe to gearbox bracket                           | 23                |
| Drive shaft heat shield to gearbox                              | 23                |

26) Renew nuts.



## 1.4 Removing and installing front exhaust pipe (right-side) with catalytic converter

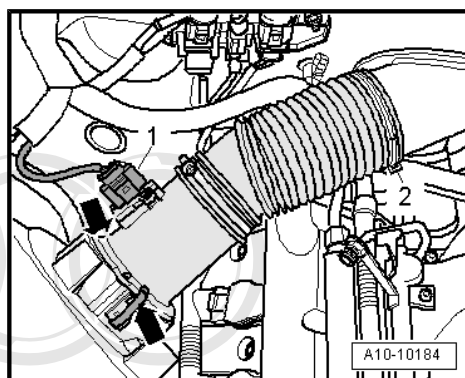
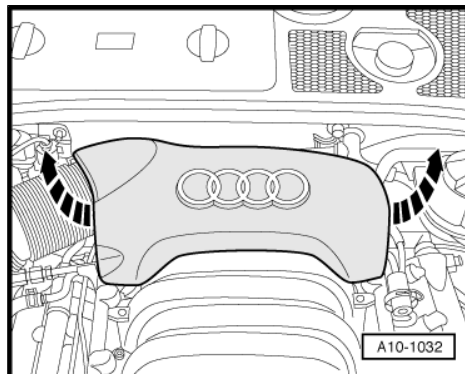
### Removing



#### Note

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

- Pull off engine cover panel (rear) -arrows-.
- Unplug electrical connector -1- at air mass meter -G70- .
- Remove air intake hose. To do so, release hose clip -2- and clamps -arrows-.



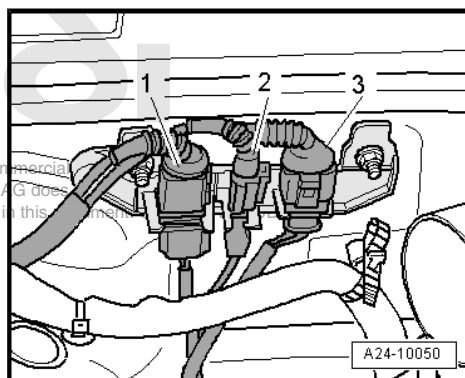
- Remove electrical connectors -1- and -3- from bracket.



#### Note

*Disregard -item 2-.*

- Unplug the electrical connectors and move wiring clear downwards.

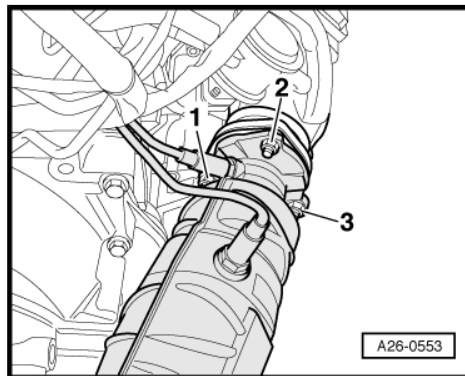


- Unscrew nut -2- (accessible from above) connecting front exhaust pipe to exhaust manifold.



#### Note

*Shown from rear with engine removed for illustration purposes.*



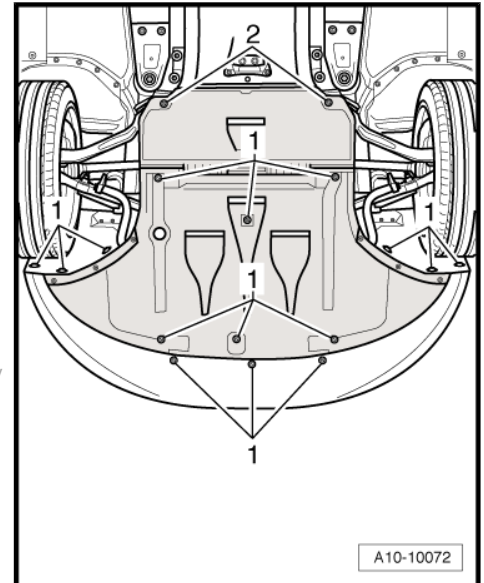
- Remove front right wheel.

**Note**

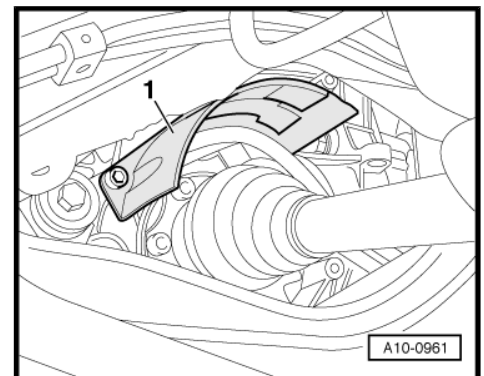
*Secure brake disc with one wheel bolt.*

- Release quick-release fasteners -1- and -2- and take off noise insulation panels.

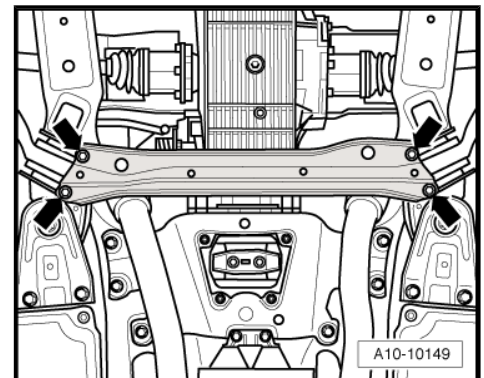
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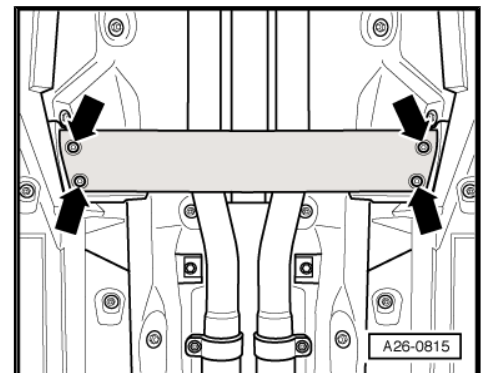
- Unbolt heat shield -1- for drive shaft (right-side).



- Unbolt cross piece from subframe -arrows-.



- Remove front cross piece -arrows-.

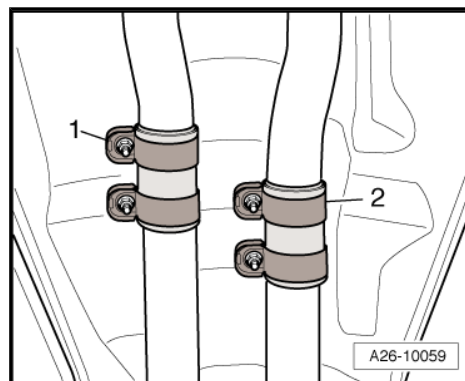


Disconnect exhaust system at clamp (right-side) -1-.



### Note

Disregard -item 2-.



### Note

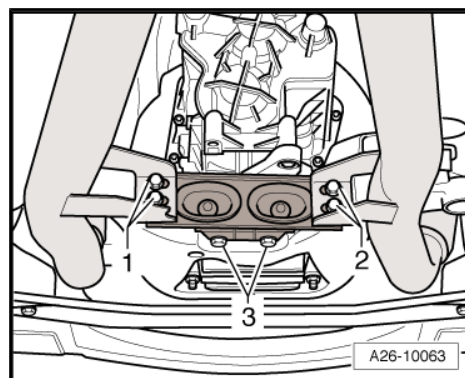
To avoid any damage, the flexible joint in the front exhaust pipe must not be bent more than 10°.

- Remove bolts -2- on bracket (rear) for front exhaust pipe.

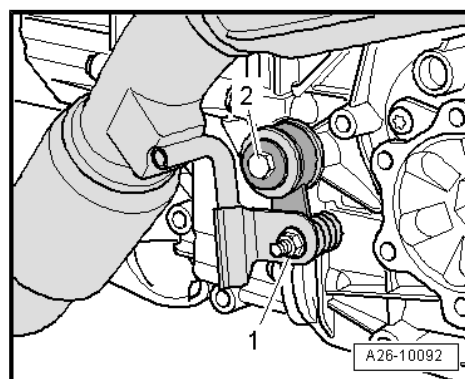


### Note

Disregard items marked -1- and -3-.



- Remove bolts -1- and -2-.
- Remove bracket (right-side) for front exhaust pipe.



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- Move Lambda probe wires clear.
- Unscrew nuts -1- and -3- (accessible from below) connecting front exhaust pipe to exhaust manifold.

 **Note**

*Shown in illustration with engine removed.*

- Remove front exhaust pipe with catalytic converter.

**Installing**

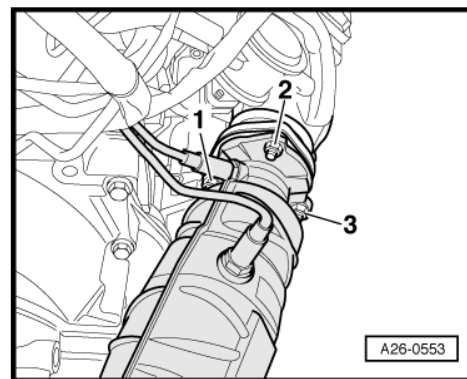
Installation is carried out in the reverse order; note the following:

 **Note**

- ◆ *Renew gaskets and self-locking nuts.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- ◆ *Fit all cable ties in the original positions when installing.*
- ◆ *When installing, the Lambda probe wire must always be reattached at the same locations to prevent it from coming into contact with the exhaust pipe.*
- Install cross piece for subframe ⇒ Running gear, front-wheel drive and four-wheel drive; Rep. Gr. 40 .
- Install cross piece (front) ⇒ General body repairs, exterior; Rep. Gr. 50 .
- Align exhaust system so it is free of stress ⇒ [page 195](#) .

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*Mounting components for exhaust system ⇒ [page 182](#) .*



**Tightening torques**

| Component                                                       | Nm                |
|-----------------------------------------------------------------|-------------------|
| Front exhaust pipe with catalytic converter to exhaust manifold | 23 <sup>27)</sup> |
| Mounting plate to front exhaust pipe                            | 23                |
| Mounting plate to gearbox                                       | 23                |
| Front exhaust pipe to gearbox bracket                           | 23                |
| Drive shaft heat shield to gearbox                              | 23                |

<sup>27)</sup> Renew nuts.

## 1.5 Exhaust manifold - exploded view

# 1 - Bracket for heat shield

## 2 - Exhaust manifold

- ❑ Removing and installing: left-side  
⇒ [page 193](#), right-side  
⇒ [page 193](#)

## 3 - Gasket

- ❑ Renew

## 4 - Heat shield

## 5 - 22 Nm

## 6 - Front exhaust pipe with catalytic converter

- ❑ With flexible joint; do not bend flexible joint more than 10° - otherwise it can be damaged
- ❑ Protect from damage by knocks and impacts
- ❑ Removing and installing: left-side  
⇒ [page 183](#), right-side  
⇒ [page 188](#)
- ❑ Mounting components  
⇒ [page 181](#)
- ❑ Align exhaust system so it is free of stress  
⇒ [page 195](#)

## 7 - 23 Nm

- ❑ Renew
- ❑ Coat with high-temperature paste; for high-temperature paste refer to  
⇒ Parts catalogue

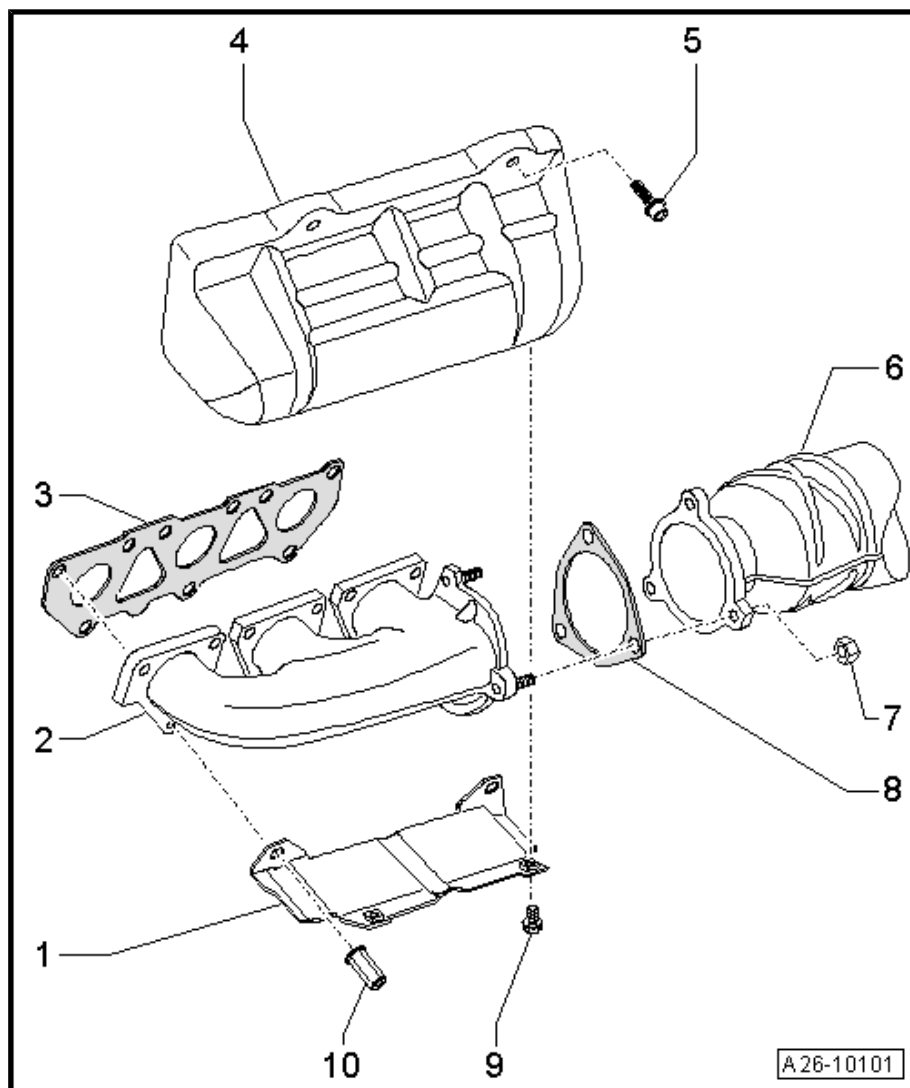
## 8 - Gasket

- ❑ Renew

## 9 - 10 Nm

## 10 - 25 Nm

- ❑ Renew
- ❑ Coat with high-temperature paste; for high-temperature paste refer to ⇒ Parts catalogue

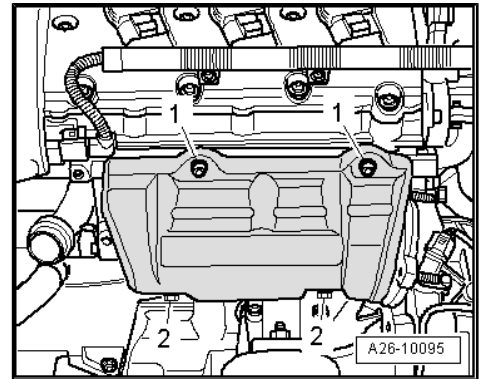


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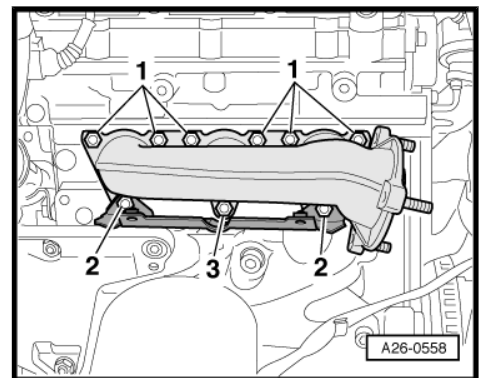
## 1.6 Removing and installing exhaust manifold (left-side)

### Removing

- Remove front exhaust pipe (left-side) together with catalytic converter ⇒ [page 183](#) .
- Unscrew bolts -1- and -2- and remove heat shield.



- Unscrew bolts -1- (accessible from above) on exhaust manifold.
- Unscrew nuts -2- (accessible from below) and detach bracket for heat shield.
- Unscrew nut -3- and detach exhaust manifold.



### Installing

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



#### Note

*Renew gaskets and self-locking nuts.*

- Install front exhaust pipe (left-side) together with catalytic converter ⇒ [page 183](#) .

**Align exhaust system so it is free of stress** ⇒ [page 195](#) is not permitted unless authorised by AUDI AG. AUDI AG does not guarantee or accept any liability for the correctness of information in this document. Copyright by AUDI AG.

### Tightening torques

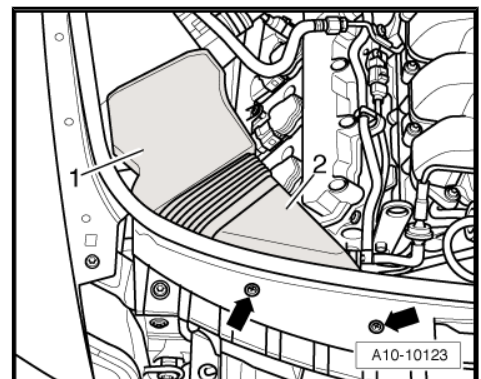
| Component                         |    | Nm                |
|-----------------------------------|----|-------------------|
| Exhaust manifold to cylinder head |    | 25 <sup>28)</sup> |
| Heat shield                       | M6 | 10                |
| For exhaust manifold              | M8 | 22                |

28) Renew nuts.

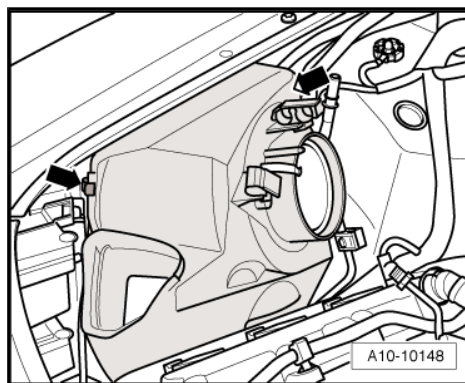
## 1.7 Removing and installing exhaust manifold (right-side)

### Removing

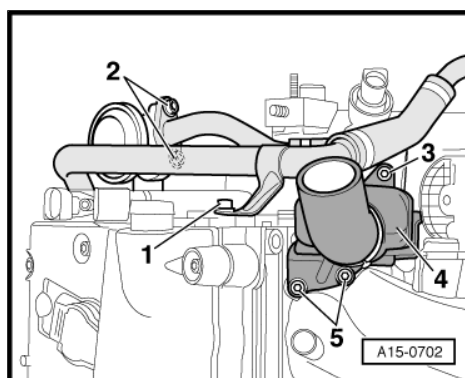
- Remove front exhaust pipe (right-side) together with catalytic converter ⇒ [page 188](#) .
- Remove bolts -arrows-.
- Remove air ducts -1- and -2-.
- Remove air intake hose. To do so, release hose clip -2- and clamps -arrows-.



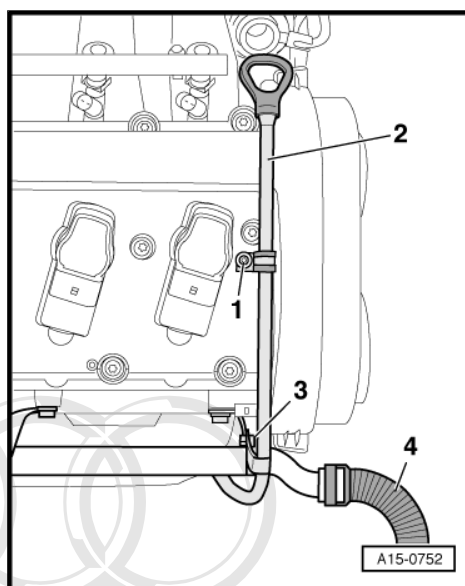
- Loosen clamps -arrows- and detach top section of air cleaner housing.



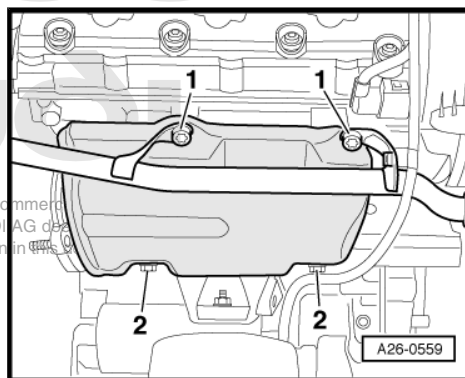
- Unscrew bolts -1- and -2- at secondary air pipes.
- Unscrew bolts -3- and -5- and remove resonator -4-.



- Remove bolts -1- and -3-.
- Disconnect hose -4- at pipe for secondary air.
- Pull guide tube -2- for oil dipstick upwards out of top section of sump and fold forwards.



- Remove bolts -1- and -2-.
- Remove the heat shield.



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- Unscrew nuts -1- and remove bracket for heat shield.
- Unscrew nuts -2- and detach exhaust manifold.

### Installing

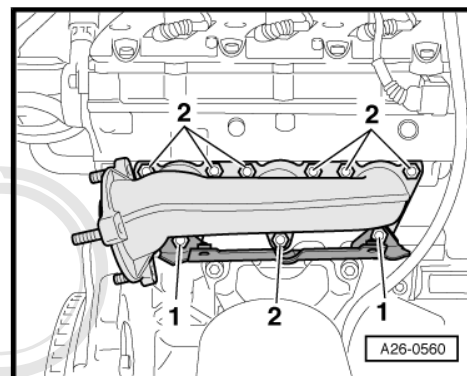
Installation is carried out in the reverse order; note the following:



#### Note

*Renew gaskets, O-rings and self-locking nuts.*

- Install front exhaust pipe (right-side) together with catalytic converter ⇒ [page 188](#).
- Align exhaust system so it is free of stress ⇒ [page 195](#).



### Tightening torques

| Component                                         |    | Nm                |
|---------------------------------------------------|----|-------------------|
| Exhaust manifold to cylinder head                 |    | 25 <sup>29)</sup> |
| Heat shield to bracket for heat shield            |    | 10                |
| Heat shield                                       | M6 | 10                |
| For exhaust manifold                              | M8 | 22                |
| Guide tube for oil dipstick to secondary air pipe |    | 10                |

29) Renew nuts.

## 1.8 Stress-free alignment of exhaust system



#### Note

*The exhaust system must be aligned when it is cool.*

### Vehicles without clamps between centre silencer and rear silencer

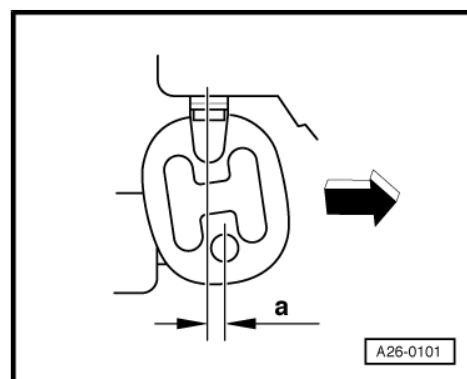
- Loosen bolt connections for clamps ⇒ [Item 10 \(page 180\)](#).
- Push exhaust system towards front of vehicle -arrow-, so that mountings (right-side) for rear silencers are preloaded by -a- = 5 ... 9 mm.
- Tighten bolt connections for clamps evenly to 23 Nm.
- Align tailpipes ⇒ [page 196](#).

### Vehicles with clamps between centre silencer and rear silencer



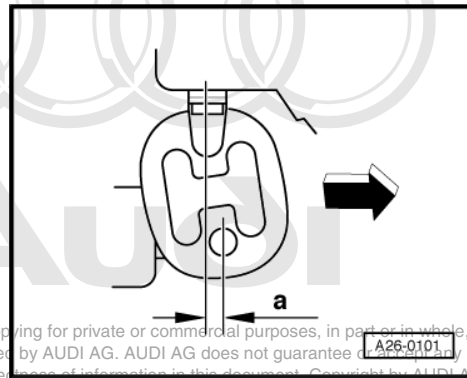
#### Note

*On vehicles with clamps fitted between centre silencer and rear silencer, it is also necessary to align the centre silencer.*



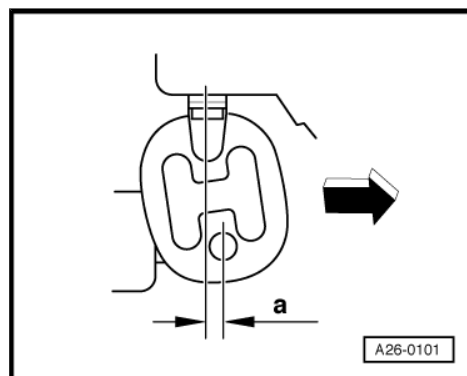
- Loosen bolts on clamps ⇒ [Item 10 \(page 180\)](#) and ⇒ [Item 21 \(page 181\)](#).

- Push front section of exhaust system towards front of vehicle -arrow-, so that mountings for centre silencer are preloaded by -a- = 5 ... 9 mm.
- Tighten bolt connections for clamps (front)  
⇒ [Item 10 \(page 180\)](#) evenly to 23 Nm.



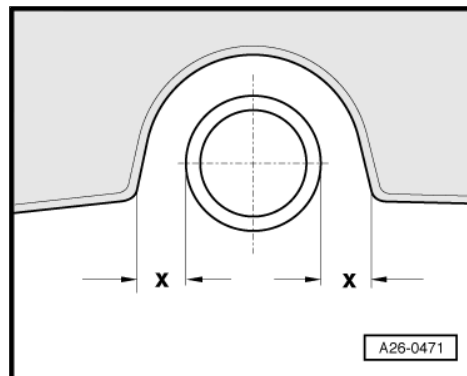
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- Push rear section of exhaust system towards front of vehicle -arrow-, so that mountings (rear) for rear silencers are preloaded by -a- = 5 ... 9 mm.
- Align rear silencer so it is horizontal.
- Tighten bolt connections for rear clamps  
⇒ [Item 21 \(page 181\)](#) evenly to 23 Nm.
- Align tailpipes ⇒ [page 196](#) .



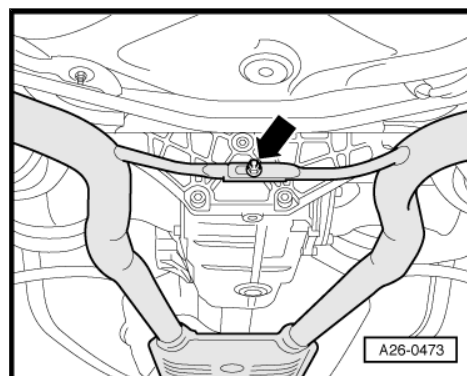
### 1.8.1 Aligning tailpipes

- Check distance between left and right-side tailpipes and bumper.
- Dimension -x- (left-side) = dimension -x- (right-side)

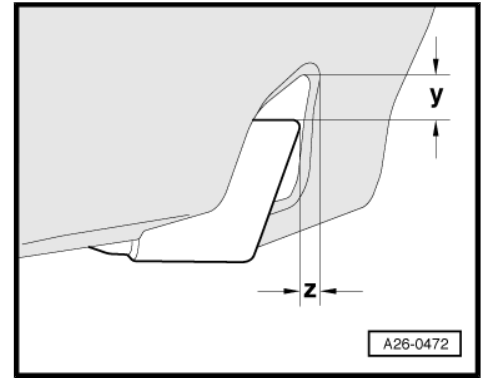


If necessary, correct dimension -x- as follows:

- Loosen bolts and nuts -arrows- on cross piece between exhaust pipes.
- Adjust the distance between the rear silencers.
- Tighten bolts and nuts to 25 Nm.

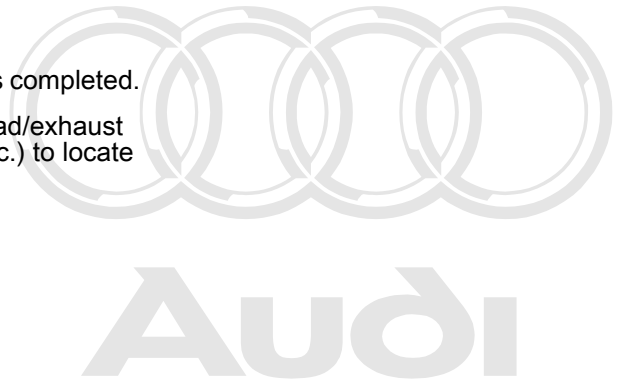


- Check distances -y- and -z- between tailpipes and bumper.
- Dimension -y- = 17 ... 19 mm.
- Dimension -z- =  $0 \pm 2$  mm.
- If necessary, check whether the exhaust system is aligned free of stress  $\Rightarrow$  [page 195](#) .



## 1.9 Checking exhaust system for leaks

- Start engine and run at idling speed.
- Plug tailpipes with cloths or stoppers until check is completed.
- Listen for noise at connection points (cylinder head/exhaust manifold, exhaust manifold/front exhaust pipe, etc.) to locate any leaks.
- Repair any leaks that are found.

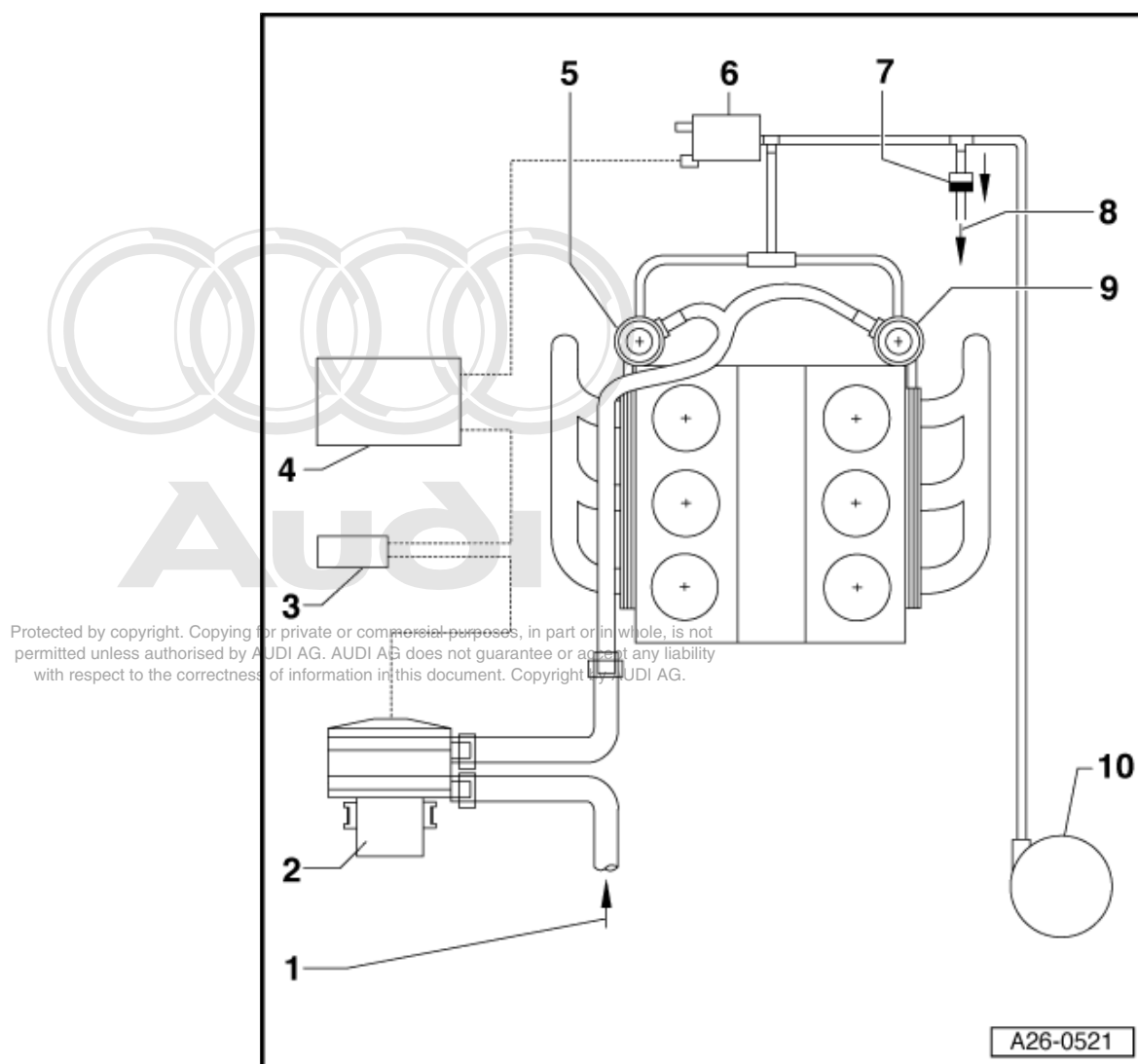


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## 2 Servicing secondary air system

### 2.1 Principle and function

Because of the over-enrichment of the mixture in the cold start phase, the proportion of unburned hydrocarbons in the exhaust gas is higher. The secondary air system improves the afterburning (oxidation) process in the catalytic converter, and thus reduces toxic emissions. The heat generated by oxidation accelerates the "light off" of the catalytic converter and significantly improves exhaust gas quality during warm-up.



**1 - From air cleaner housing**

**2 - Secondary air pump motor -V101-**

- ☐ Fitting location  
⇒ [page 200](#)
- ☐ Removing and installing  
⇒ [page 201](#)
- ☐ Check using vehicle diagnosis, testing and information system - VAS 5051 A- in the function "Guided Fault Finding"

**3 - Secondary air pump relay - J299-**

- ☐ Fitting location  
⇒ [page 200](#)
- ☐ Check using vehicle diagnosis, testing and information system - VAS 5051 A- in the function "Guided Fault Finding"

**4 - Engine control unit -J623-**

**5 - Combination valve for secondary air system (right-side)**

- ☐ Fitting location  
⇒ [page 200](#)
- ☐ Checking ⇒ [page 201](#)
- ☐ Removing and installing  
⇒ [page 205](#)

**6 - Secondary air inlet valve - N112-**

- ☐ Fitting location  
⇒ [page 200](#)

- ☐ Check using vehicle diagnosis, testing and information system - VAS 5051 A- in the function "Guided Fault Finding"

**7 - Non-return valve**

- ☐ Installation position (light side/dark side) as shown in illustration. Arrow indicates direction of flow.

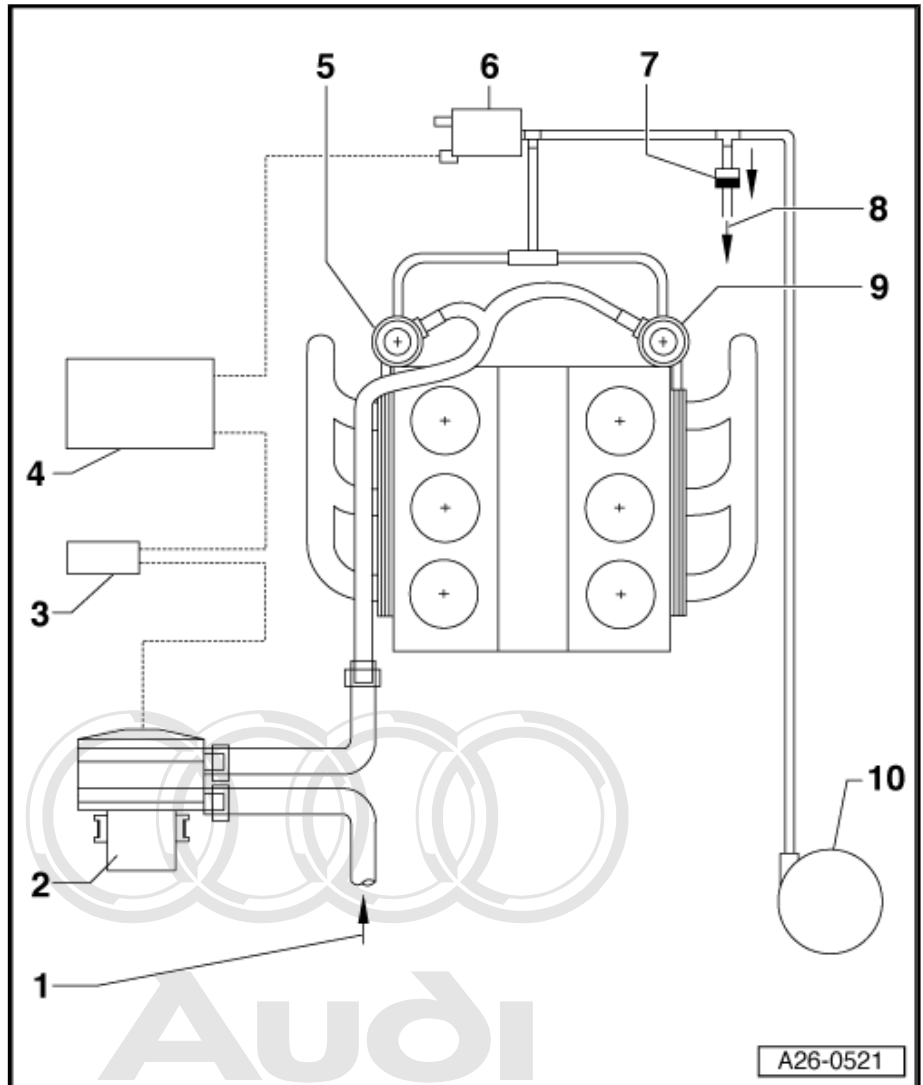
**8 - To intake manifold**

**9 - Combination valve for secondary air system (left-side)**

- ☐ Fitting location ⇒ [page 200](#)
- ☐ Checking ⇒ [page 201](#)
- ☐ Removing and installing ⇒ [page 203](#)

**10 - Vacuum reservoir**

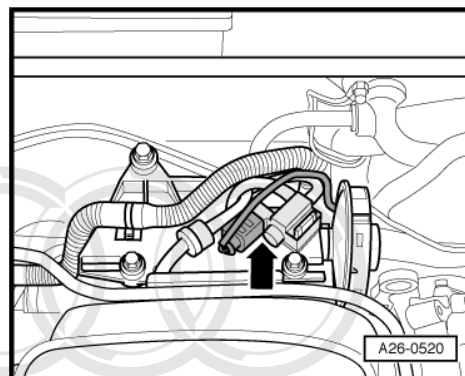
- ☐ Fitting location: in front left wheel housing beneath liner



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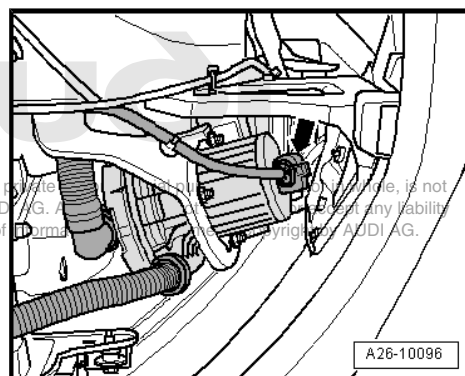
### Fitting location of secondary air inlet valve -N112-

- ◆ Inserted on retainer plate for solenoid valves at rear of engine -arrow-.



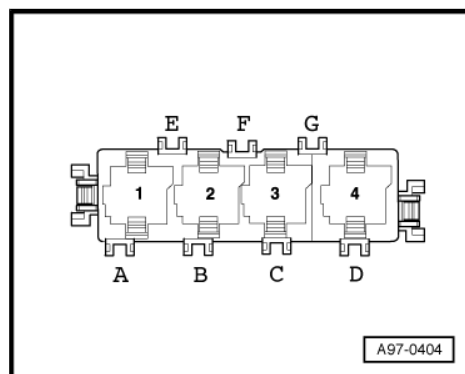
### Fitting location of secondary air pump motor -V101-

- ◆ On longitudinal member (right-side, bottom) -arrow-.



### Fitting location of secondary air pump relay -J299- and secondary air pump fuse -S130-

- ◆ In electronics box (plenum chamber, passenger's side).
- 1 - Secondary air pump relay -J299-
- B - Secondary air pump fuse -S130- (50 amp)



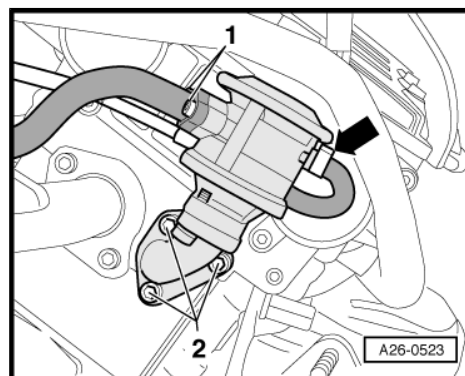
### Combination valve for secondary air system

- ◆ At rear of cylinder heads.



#### Note

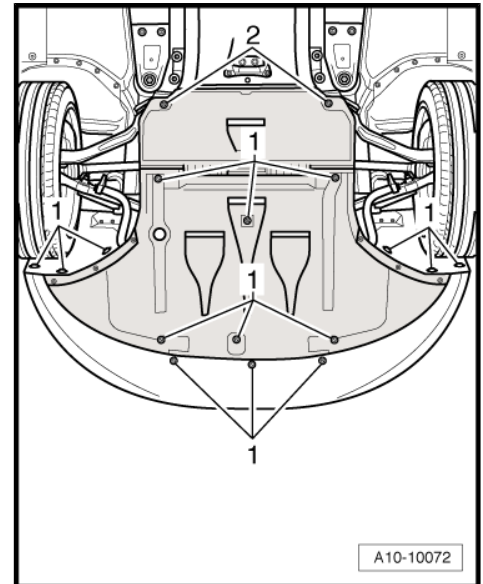
*Illustration shows valve on right side.*



## 2.2 Removing and installing secondary air pump motor -V101-

### Removing

- Release quick-release fasteners -1- and -2- and take off noise insulation panels.



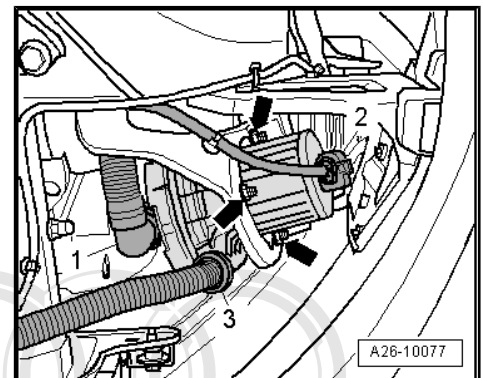
- Detach air hoses -1- and -3-.
- Unplug electrical connector -2-.
- Unscrew nuts -arrows- and remove secondary air pump motor -V101- from bracket.

### Installing

Install in reverse order.

### Tightening torques

| Component                                  | Nm |
|--------------------------------------------|----|
| Secondary air pump motor -V101- to bracket | 10 |

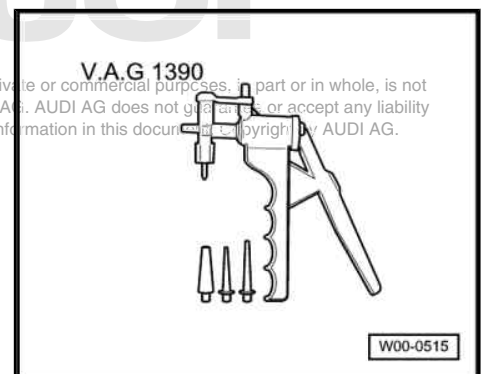


## 2.3 Checking combination valves for secondary air system for correct operation and leakage

### Special tools and workshop equipment required

- ◆ Hand vacuum pump -V.A.G 1390-

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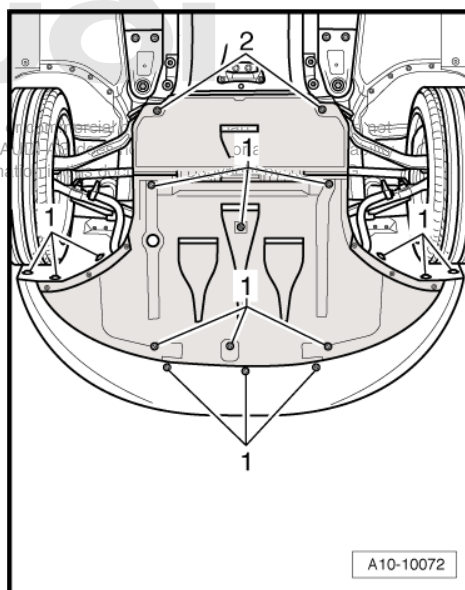
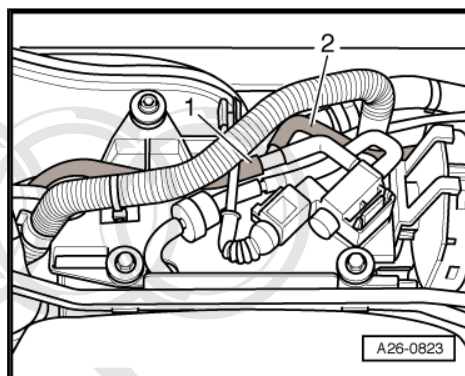
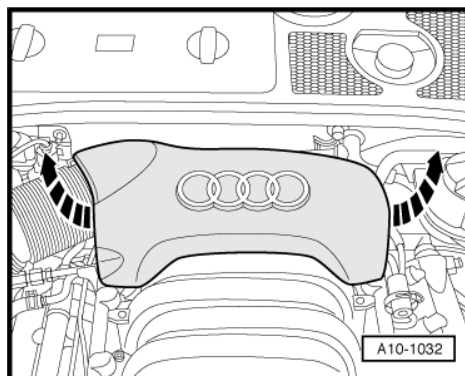


### Test conditions

- Vacuum hoses and hose connections do not leak.
- Vacuum hoses are not clogged.

## Test sequence

- Pull off engine cover panel (rear) -arrows-.
- Disconnect vacuum hose -1- or -2- (at Y-piece) from combination valve for secondary air system you want to test.
- Connect the hand vacuum pump -V.A.G 1390- to vacuum hose of combination valve for secondary air system you want to test.
- Release quick-release fasteners -1- and -2- and take off noise insulation panels.



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- Detach pressure hose -3- from secondary air pump motor - V101- and blow into it with light pressure (do not use compressed air).

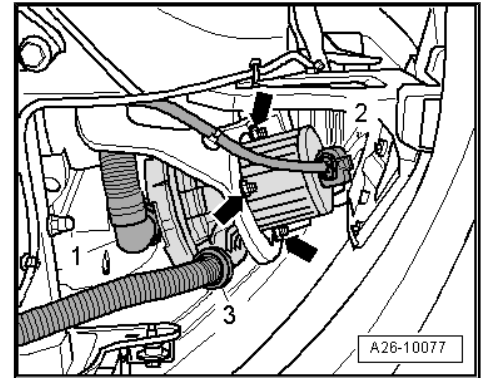
 **Note**

*Disregard items marked -1-, -2- and -arrows-.*

- Both combination valves for secondary air must be closed and it must not be possible to blow through the hose.
- Operate hand vacuum pump.
- The relevant combination valve for secondary air system should open; it should now be possible to blow through the hose.

If combination valve does not open:

- Renew combination valve for secondary air system: on left-side ⇒ [page 203](#) , on right-side ⇒ [page 205](#) .



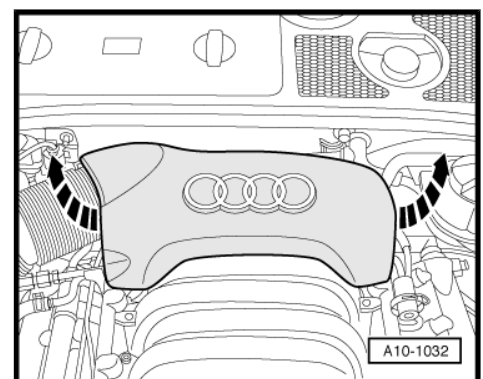
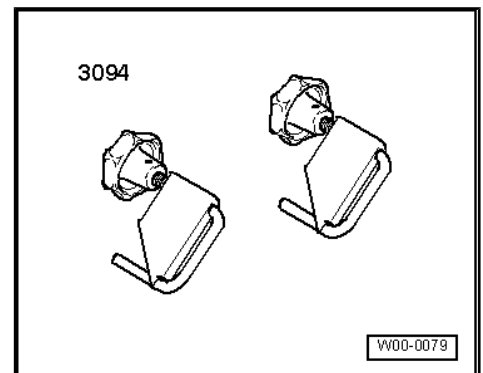
## 2.4 Removing and installing combination valve for secondary air system (left-side)

**Special tools and workshop equipment required**

- ◆ Hose clamps for hoses up to 25 mm Ø -3094-

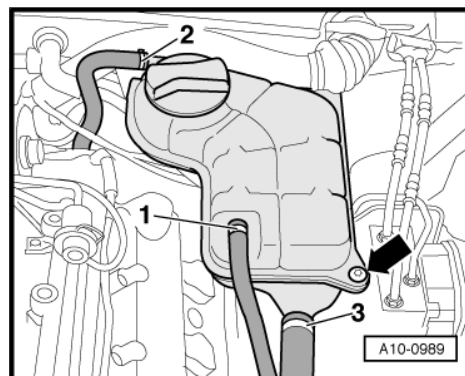
### Removing

- Pull off engine cover panel (rear) -arrows-.



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- Clamp off coolant hose -2- using a hose clamp -3094- .
- Pull off coolant hose at coolant expansion tank and plug the opening.
- Unbolt coolant expansion tank -arrow- and disconnect electrical connector for coolant shortage indicator switch -F66- at bottom of coolant expansion tank.
- Lay aside coolant expansion tank with coolant hoses -1- and -3- connected.

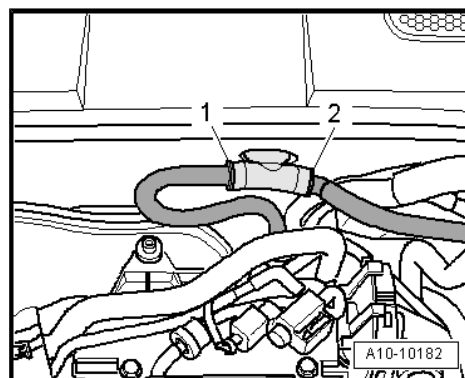


- Pull off vacuum hose -2- from T-piece at bulkhead.

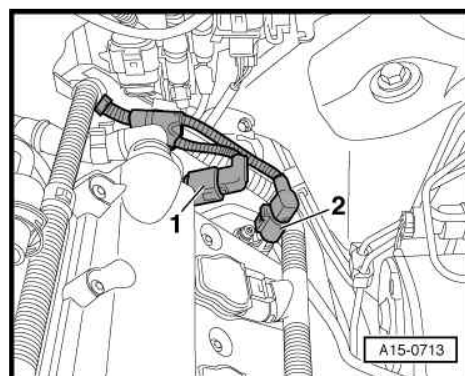


### Note

Disregard -item 1-.



- Unplug electrical connectors -1- and -2- at Hall senders - G163- and -G301- .
- Remove crankcase breather hose from cylinder head cover.

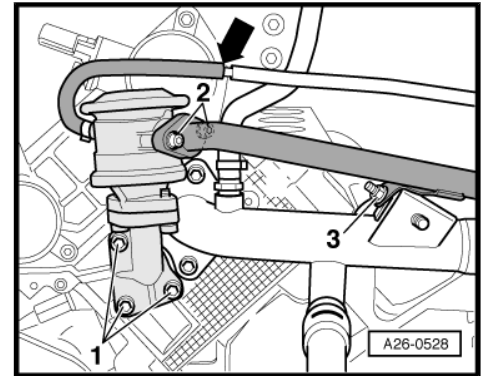


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- Unscrew bolts -1- on flange of combination valve for secondary air system.
- Slacken nut -3- a few turns.
- Unscrew bolts -2- and detach vacuum hose -arrow-.
- Detach combination valve for secondary air system.



*Shown from rear with engine removed for illustration purposes.*



### Installing

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



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

### Tightening torques

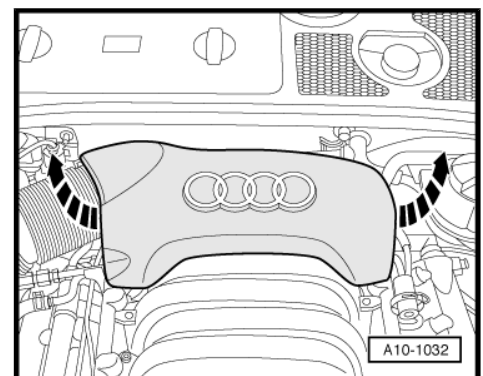
| Component                                                   |                                            | Nm |
|-------------------------------------------------------------|--------------------------------------------|----|
| Combination valve for secondary air system to cylinder head |                                            | 10 |
| Connecting pipe                                             | Combination valve for secondary air system | 10 |
| to:                                                         | Coolant pipe                               | 10 |

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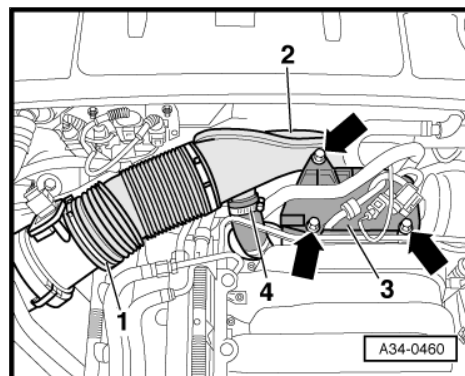
## 2.5 Removing and installing combination valve for secondary air system (right-side)

### Removing

- Pull off engine cover panel (rear) -arrows-.



- Unscrew bolts for solenoid valve retaining plate -3- (-arrows-).
- Detach air intake hose -1- at air mass meter -G70- .
- Pull hose -4- off air duct -2-.

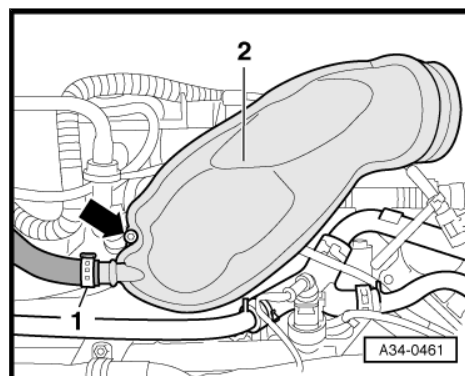


- Unscrew bolt -arrow- and pull air duct -2- off throttle valve module -J338- .
- If fitted, pull hose -1- off at air duct.



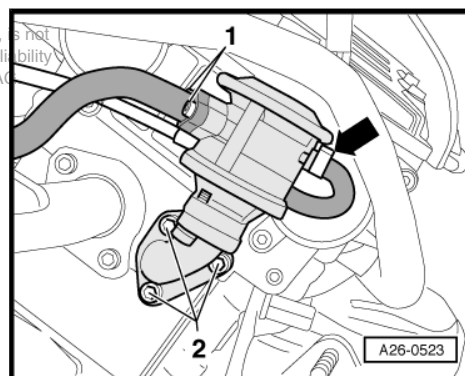
### Note

For illustration purposes, the air duct is shown from rear and with engine removed.



- Remove bolts -1- and -2- and detach combination valve for secondary air system.

- Disconnect vacuum hose -arrow-.



### 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.

### Tightening torques

| Component                                                   | Nm |
|-------------------------------------------------------------|----|
| Combination valve for secondary air system to cylinder head | 10 |
| Connecting pipe to combination valve                        | 10 |
| Air duct to throttle valve module -J338-                    | 10 |