

Workshop Manual Audi A6 2005 ➤

**8-cylinder engine (4.2 ltr. 5-valve with timing chains),
mechanics**

Engine ID	BAT	BNK	Protected by copyright. Copying for private or commercial purposes, in part or in whole, is not permitted unless authorized by Audi AG. Audi AG does not guarantee or accept any liability for errors or omissions. Copyright © 2011 Audi AG			
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Edition 03.2011

List of Workshop Manual Repair Groups

Repair Group

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



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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 ►

8-cylinder engine (4.2 ltr. 5-valve with timing chains), mechanics - Edition 03.2011



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00 – Technical data

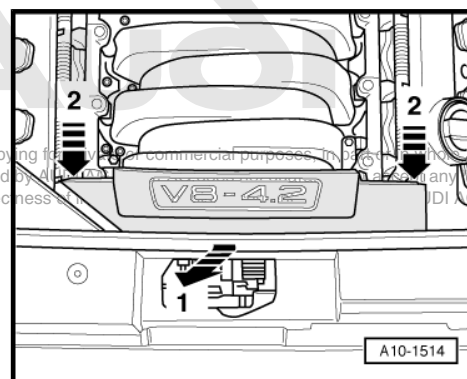
1 Engine number



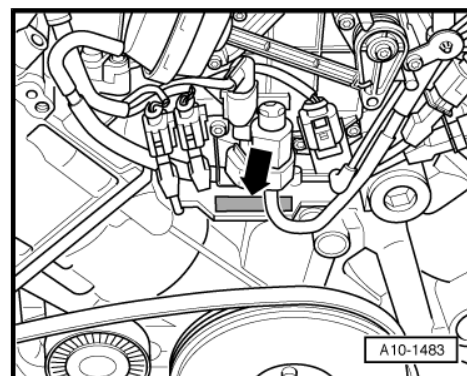
Note

- ◆ *There is a sticker on the cylinder head cover (right-side) indicating the „engine code“ and „serial number“.*
 - ◆ *The engine code is also included on the vehicle data sticker.*
 - ◆ *A number of steps are required to make the engine number visible.*
- Detach the front engine cover panel -arrow 1- and -arrows 2-.

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The engine number („engine code“ and „serial number“) can be found on top of the cylinder block at the front -arrow-.





2 Engine data

Code letters		BAT	BNK
Capacity	ltr.	4.163	4.163
Power output	kW at rpm	246/6500	246/6500
Torque	Nm at rpm	410/3500	410/3500
Bore	Ø in mm	84.5	84.5
Stroke	mm	92.8	92.8
Compression ratio		11.5	11.5
RON		98 ¹⁾	98 ¹⁾
Injection/ignition system		MPI Bosch Motronic	MPI Bosch Motronic
Firing order		1-5-4-8-6-3-7-2	1-5-4-8-6-3-7-2
Knock control		yes	yes
Exhaust gas recirculation		no	no
Intake manifold change-over		yes	yes
Variable valve timing		yes	yes
Secondary air system		yes	yes

1) Unleaded premium RON 95 can also be used, but results in reduced power



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3 Safety precautions

When working on the fuel system note the following warnings:



WARNING

Risk of injury - fuel system operates under high pressure.

- ◆ *To reduce the pressure in the fuel system, wrap a clean cloth around the connection and carefully loosen the connection.*

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 unit if electrical connectors have been unplugged:
 - Connect vehicle diagnostic, testing and information system - VAS 5051B- .
 - Start „Guided Functions“ mode.
 - Generate readiness code in engine control unit.



Caution

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

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

- Disconnect battery ⇒ Rep. gr. 27 .

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 coolant expansion tank with cloth and open carefully.*



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

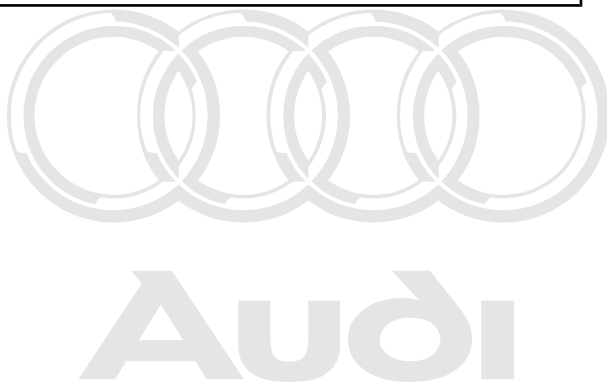


WARNING

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

Injuries can also be caused if the passenger's airbag is triggered in a collision.

- *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.*



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4 General repair instructions

4.1 Rules for cleanliness when working on the injection system

Even small amounts of dirt can cause faults in the injection system. When working on the fuel supply/injection system, pay careful attention to the following basic rules:

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

4.2 Checking for leaks in the fuel system

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

4.3 Contact corrosion!

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

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

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

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

Note the following:

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

10 – Removing and installing engine

1 Removing and installing engine

1.1 Removing engine

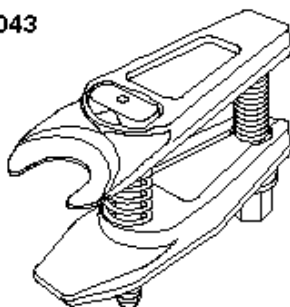
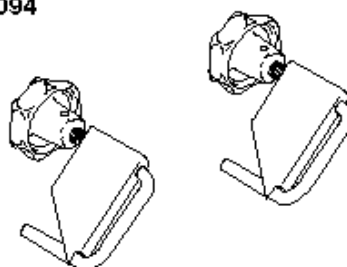
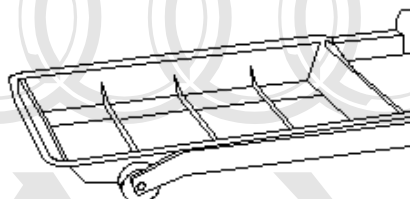
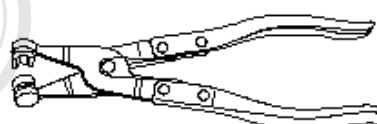
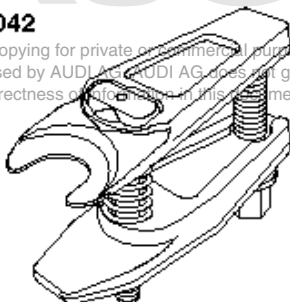
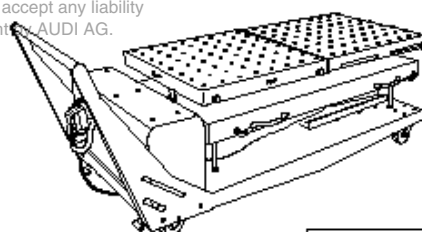


Note

- ◆ The engine is removed from below together with the gearbox and subframe.
- ◆ Renew all cable ties which are released or cut open when removing the engine. Refit in the same position when installing the engine.
- ◆ Collect drained coolant in a clean container for re-use or disposal.

Special tools and workshop equipment required

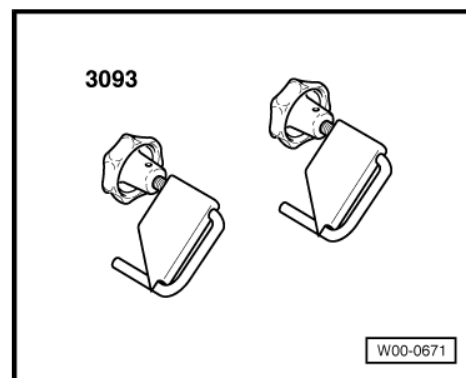
- ◆ Ball joint puller -T40043-
- ◆ Hose clamps up to Ø 25 mm -3094-
- ◆ Drip tray for workshop hoist -VAS 6208- or -V.A.G 1306-
- ◆ Hose clip pliers -V.A.G 1921-
- ◆ Ball joint puller -T40042-
- ◆ Scissor-type assembly platform -VAS 6131 A- with support set for Audi -VAS 6131/10-

T40043

3094

V.A.G 1306

V.A.G 1921

T40042

VAS 6131


G10-10002

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- ◆ Hose clamps up to Ø 40 mm -3093-



Procedure



WARNING

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



Caution

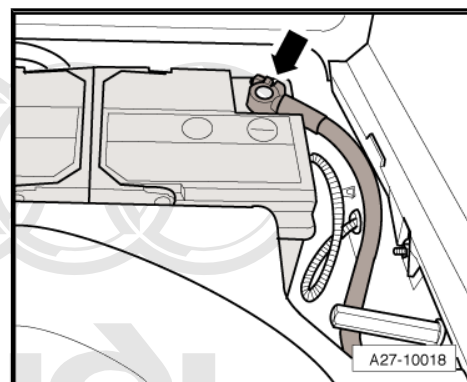
Observe notes on procedure for disconnecting the battery → Rep. gr. 27.



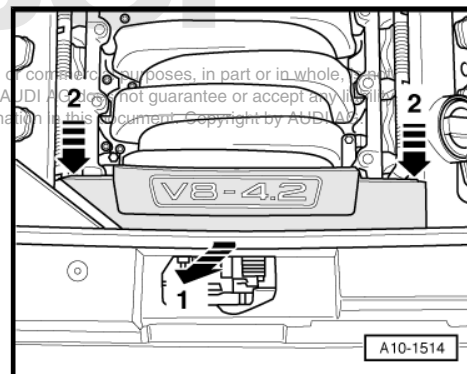
Note

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.



- Detach the front engine cover panel -arrow 1- and -arrows 2-.



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



WARNING

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

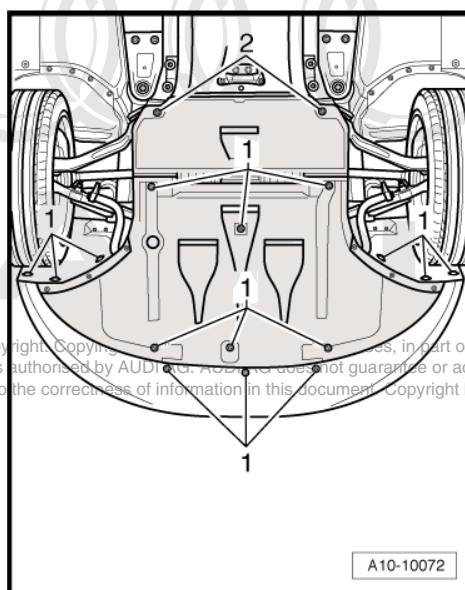
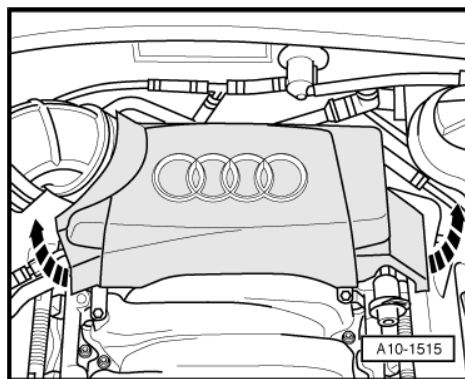
- Open filler cap on coolant expansion tank.
- Remove both front wheels.



Note

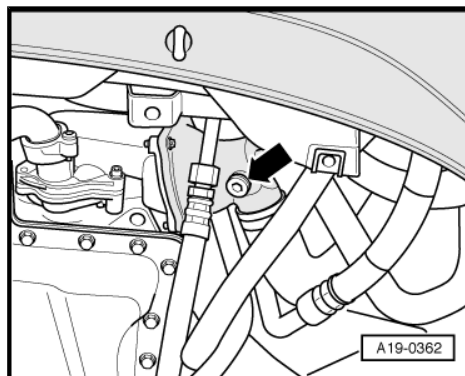
Secure brake discs with wheel bolts.

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

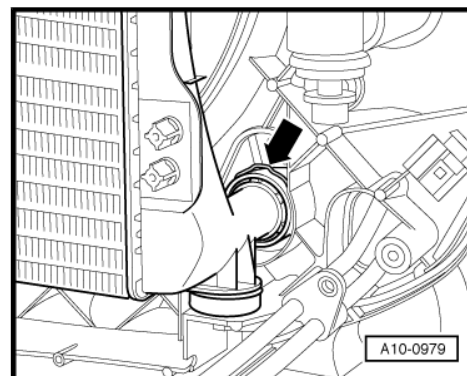


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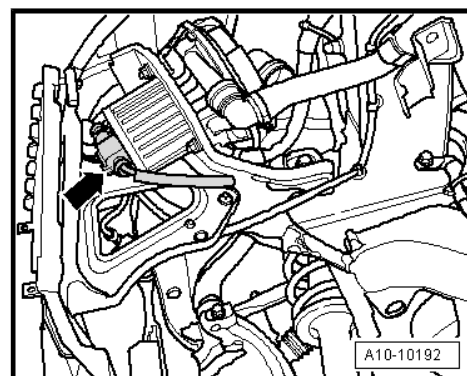
- Place drip tray for workshop hoist -VAS 6208- under engine.
- Unscrew drain plug -arrow- at thermostat housing and drain off coolant at engine.



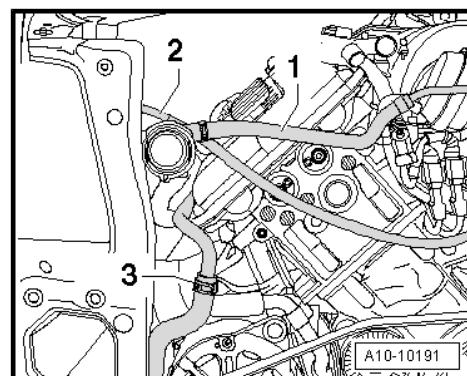
- Disconnect coolant hose (bottom) at radiator -arrow- and drain off remaining coolant.
- Remove bumper ⇒ Rep. gr. 63 .
- Remove front end ⇒ Rep. gr. 50 .



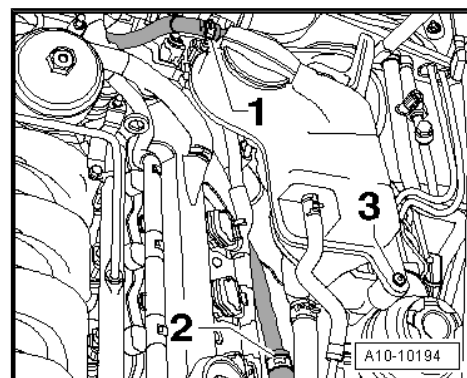
- Unplug electrical connector -arrow- from secondary air pump and move wiring clear.



- Detach coolant hose for permanent breather -1-.
- Detach hose -2- for intake manifold change-over.
- Disconnect hose -3- leading to secondary air pump.
- Unscrew AC line -1-.
- Detach coolant hose -2- from thermostat housing.

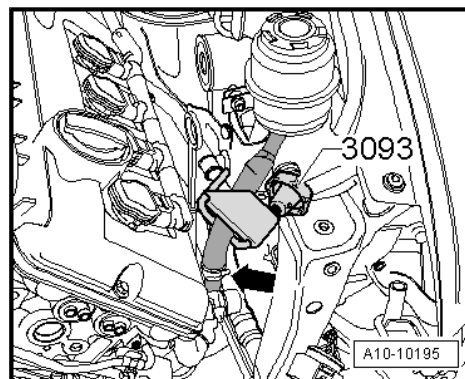


- Detach coolant hose -1- for permanent breather at expansion tank.
- Pull hose -2- off coolant pipe.
- Unbolt coolant expansion tank -3-.
- Disconnect electrical connector at coolant shortage indicator switch -F66- at coolant expansion tank (bottom).

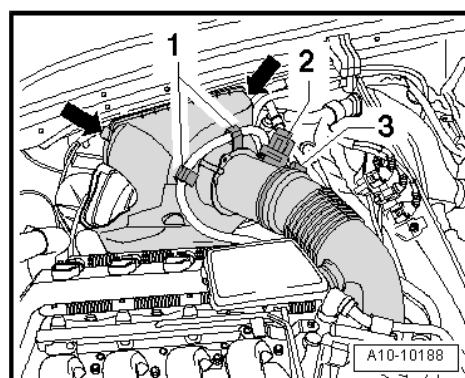


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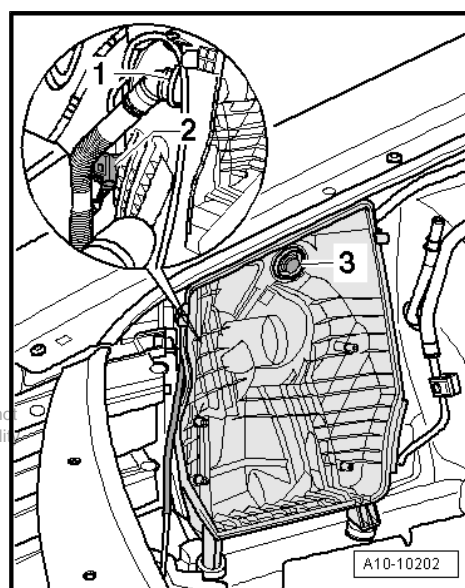
- Clamp off fluid hose from expansion tank for power steering fluid using hose clamps (up to Ø 40 mm) -3093- .
- Detach hose for power steering -arrow-.



- Unclip fuel hose -1-.
- Unplug electrical connector -2- from air mass meter.
- Detach air mass meter from air intake hose -3-.
- Remove top section of air cleaner together with air mass meter -arrows-.



- Detach hose -1- for secondary air.
- Unplug electrical connector -2- at air flap positioner -V63- .
- Pull out pin of fastener -3- and remove bottom section of air cleaner housing.



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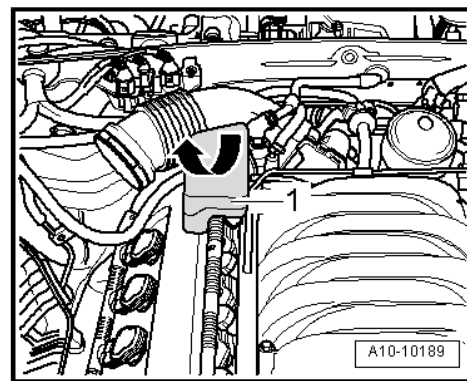
- Pull the resonator -1- upwards -arrow- and unclip.

**Caution**

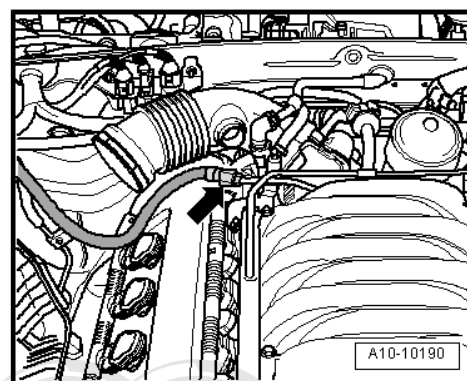
*Rules for cleanliness when working on the injection system
⇒ page 5 .*

**WARNING**

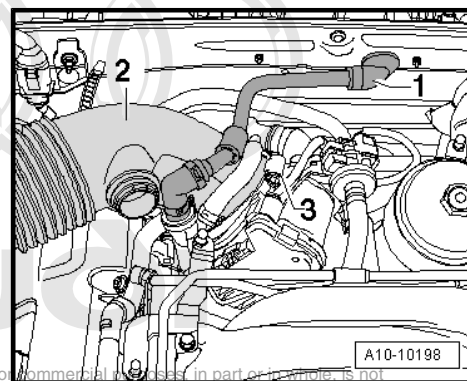
The fuel system is pressurised. Before opening the low-pressure part of the injection system a clean cloth must be wrapped around the connection and the residual pressure dissipated by carefully loosening the connection.



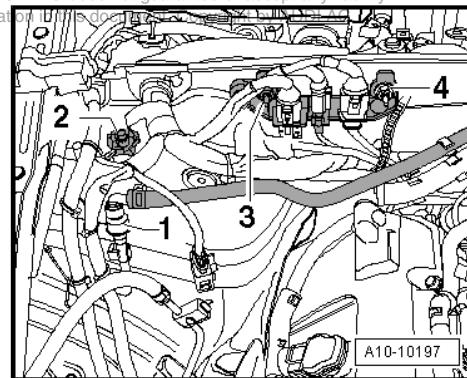
- Disconnect fuel line -arrow-.



- Detach vacuum hose -1- for brake servo at bulkhead.
- Remove air intake hose -2- by loosening screw-type clip -3-.

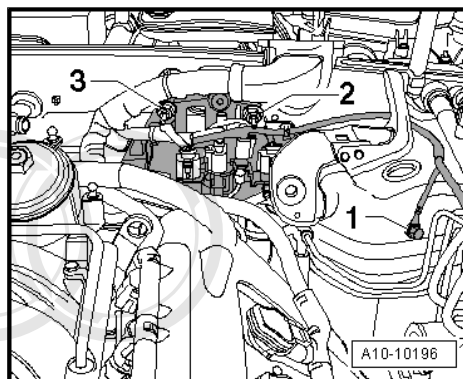


- Detach vacuum hose -1- to activated charcoal filter.
- Unbolt earth cable -2- at suspension turret (right-side).
- Unscrew nuts -1 and 2- and remove bracket for connectors (right-side) from bulkhead.

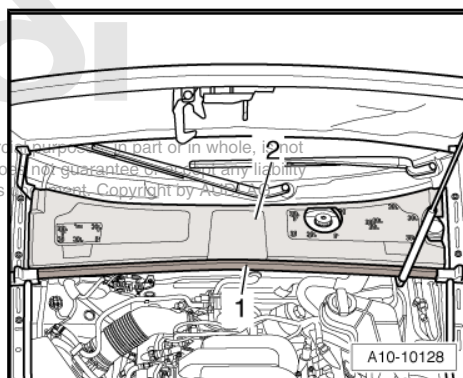


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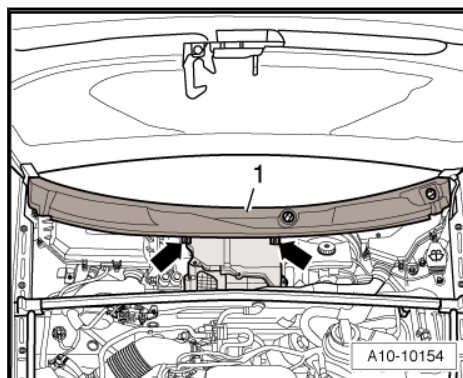
- Unbolt earth cable -1- at suspension turret (left-side).
- Unscrew nuts -2 and 3- and remove bracket for connectors (left-side) from bulkhead.



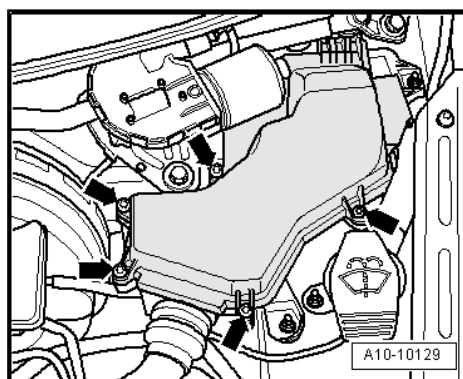
- Pull off rubber seal -1- on plenum chamber cover.
- Detach plenum chamber cover -2-.
- Use screwdriver to pry off cover caps on wiper arms and unscrew hexagon nuts.
- Pull wiper arms off wiper shafts and remove.



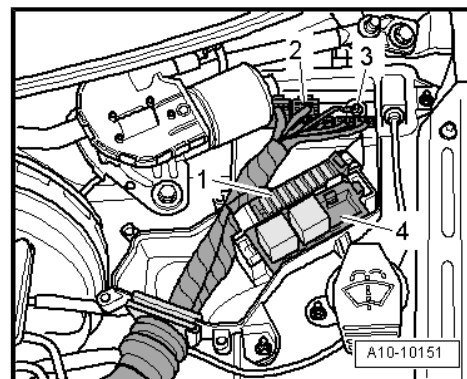
- Remove bolts -arrows- for cowl panel grille -1-.
- Pull cowl panel grille off windscreen.



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



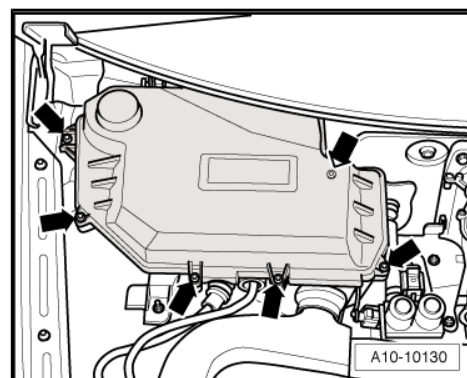
- Release retainers and lift off fuse holder -1-; then lift off 3-position relay carrier -4-.
- Unscrew electrical wiring -3-.
- Unplug all connectors -2- at rear of connector console.
- Disengage engine wiring harness at electronics box and move it clear.



- 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!

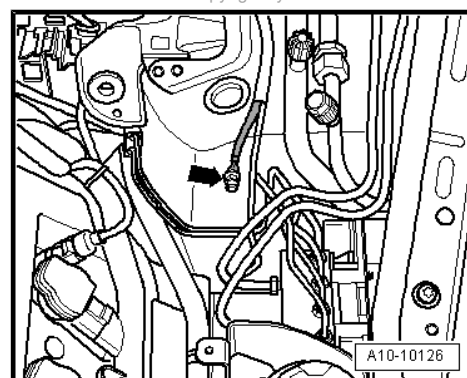
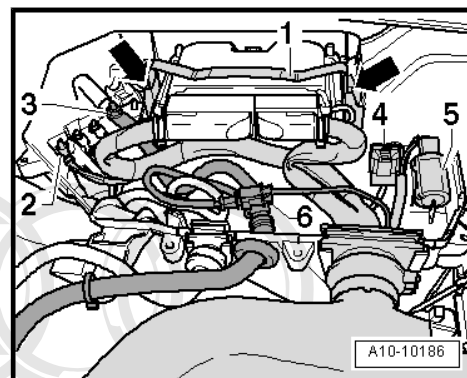


- Carefully lever out the retaining strap -1- using a screwdriver -arrows- and remove the engine control unit from the electronics box.

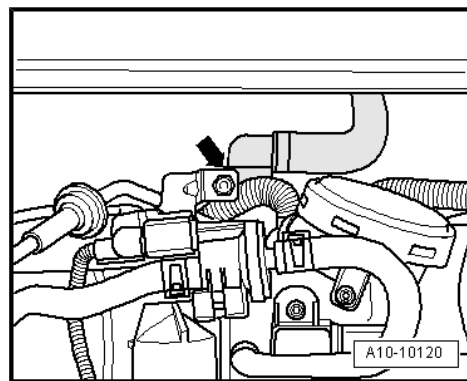
**Note**

The engine control unit remains connected to the wiring harness.

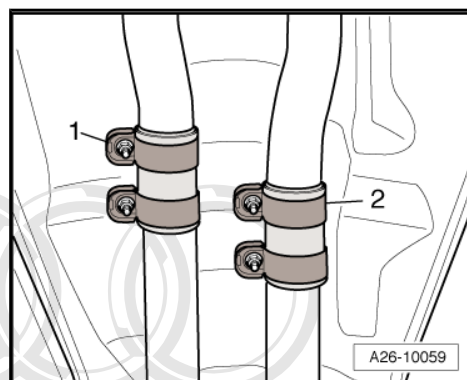
- Unscrew electrical wiring connections -2- and -3-.
- Unplug electrical connector -4- at rear of connector console.
- Unclip suppressor capacitor -5- from retainer in electronics box.
- Unplug electrical connector -6-.
- Unclip relay carrier in the electronics box.
- Move wiring up to alternator clear.
- Place both wiring harnesses on top of engine and secure the engine control unit to prevent it falling.
- Unbolt earth cable -arrow- at suspension turret (left-side).



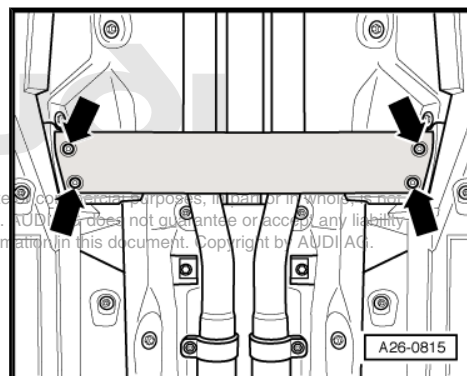
- Disconnect coolant hose -arrow- leading to heat exchanger for heater at rear of engine.



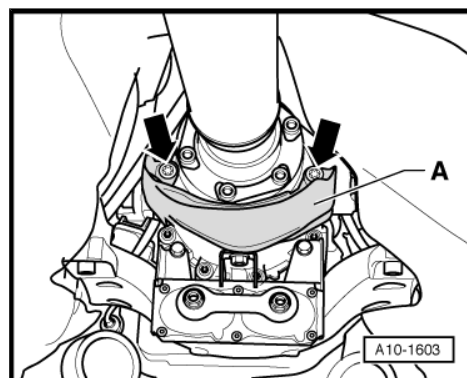
- Loosen clamps -1- and -2-.



- Unbolt cross piece (front) -arrows-.

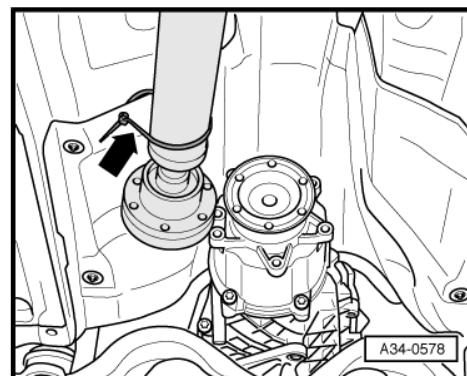


- Unscrew heat shield -A- for propshaft -arrows-.
- Unscrew bolts at gearbox/propshaft flange.
- Push propshaft back towards rear final drive. The constant velocity joints can be moved axially.

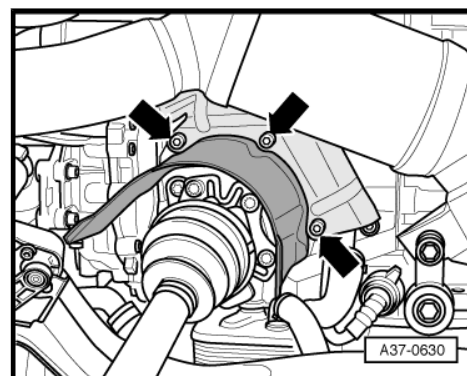


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- Tie propshaft up to side of heat shield -arrow-.



- Unbolt heat shield for drive shaft (left-side) -arrows-.
- Unbolt drive shafts (left and right) from gearbox.



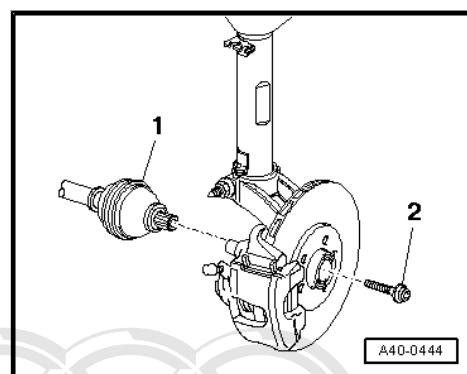
- Have a 2nd mechanic press the brake pedal.



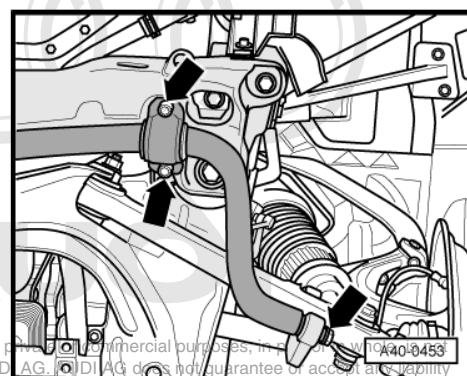
Caution

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).

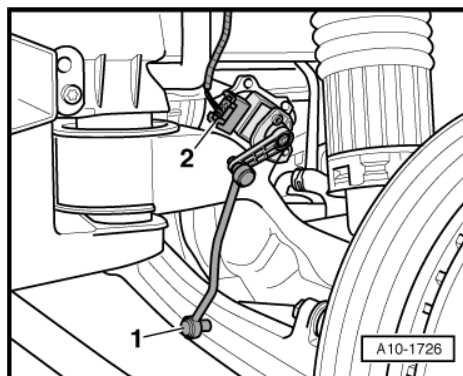


- Unscrew bolts (left and right) -arrows- evenly.
- Take out anti-roll bar.

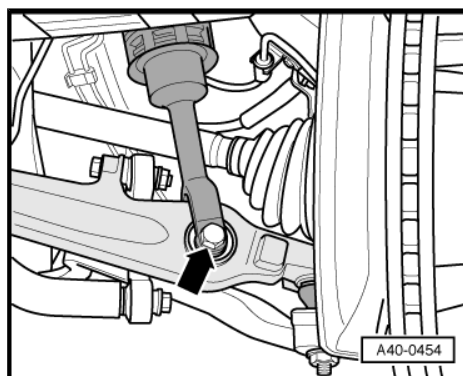


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- Unplug electrical connector -2- at vehicle level sender.
- Detach coupling rod -1- at track control link.



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

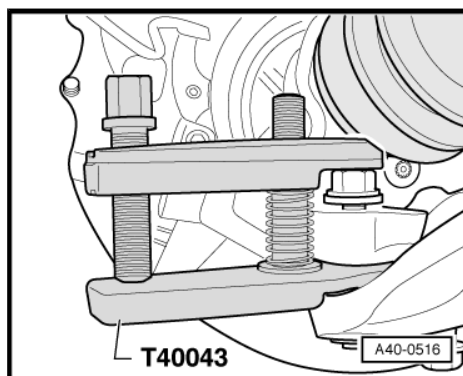


- Unscrew nut for joint stud at guide link until it is flush with the end of the threads.



Note

- ◆ Take care not to damage drive shaft boot when pressing off.
- ◆ Make sure that both lever arms of the ball joint puller are parallel to each other when exerting force.
- ◆ Secure the ball joint puller to prevent it falling.
- Press the joint stud for guide link from the ball seat using ball joint puller -T40043-.
- Counterhold on joint stud if necessary using a hexagon key (6 mm).
- Remove nut and take joint stud out of guide link.



Audi

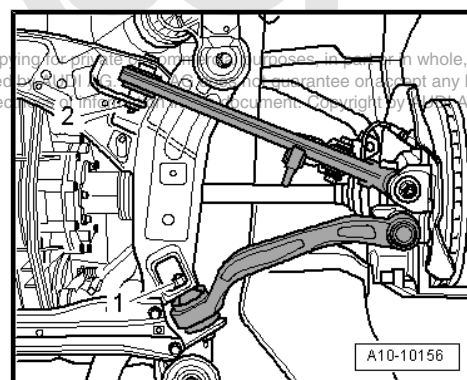
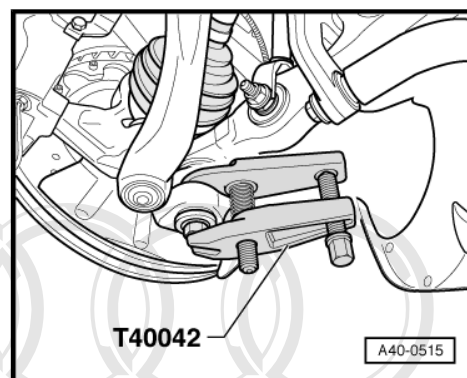
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- Unscrew nut for joint stud at track control link until it is flush with the end of the threads.

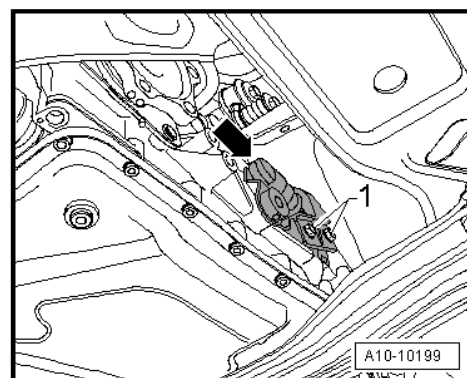
**Note**

- ◆ *Take care not to damage drive shaft boot when pressing off.*
- ◆ *Make sure that both lever arms of the ball joint puller are parallel to each other when exerting force.*
- ◆ *Secure the ball joint puller to prevent it falling.*

- Press the joint stud for track control link from the ball seat using ball joint puller -T40042- .
- Counterhold on joint stud if necessary using a hexagon key (6 mm).
- Remove nut and take joint stud out of track control link.
- Unbolt guide link -1- and track control link -2- at subframe and remove.
- Repeat procedure on other side of vehicle.



- Unscrew bolts -1- for support bracket from gearbox.
- Detach selector lever cable -arrow-.

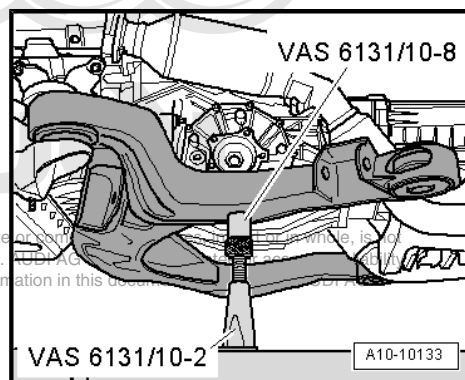
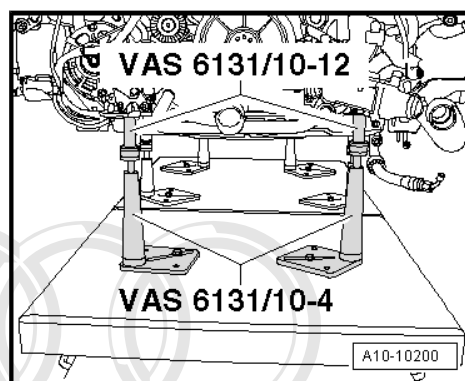
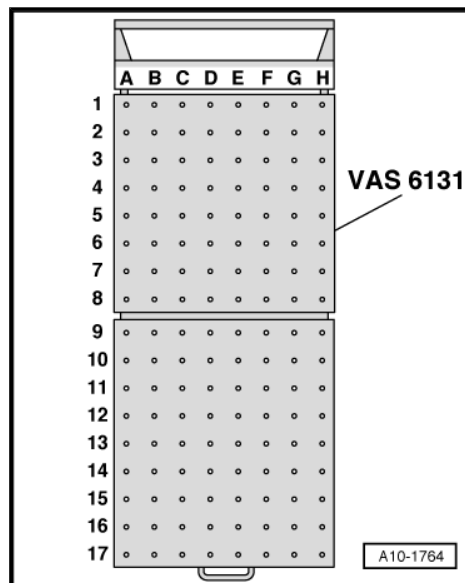


Set up the scissor-type assembly platform as follows:

- Set up scissor-type assembly platform -VAS 6131 A- with support set for Audi -VAS 6131/10- and -VAS 6131/11- as follows:

Platform co-ordinates	Parts from support set for Audi -VAS 6131/10-			
B4	/10-1	/10-4	/10-5	/10-12
F4	/10-1	/10-4	/10-5	/10-12
B10	/10-1	/10-2	/10-5	/10-8
G10	/10-1	/10-2	/10-5	/10-8
B15	/10-1	/10-4	/10-5	/11-1
G15	/10-1	/10-4	/10-5	/11-1

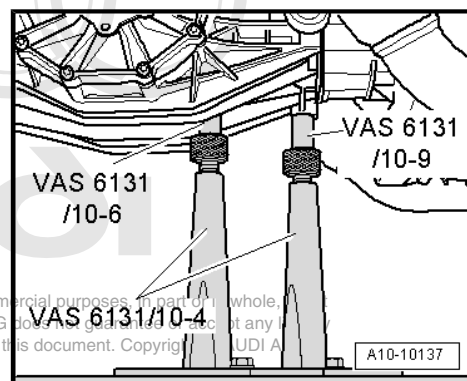
- Initially tighten the support elements on the assembly platform only hand-tight.
- Adjust the scissor-type assembly platform -VAS 6131 A- so that it is horizontal.
- Take note of spirit level (bubble gauge).
- Place scissor-type assembly platform -VAS 6131 A- under engine/gearbox assembly.
- Position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



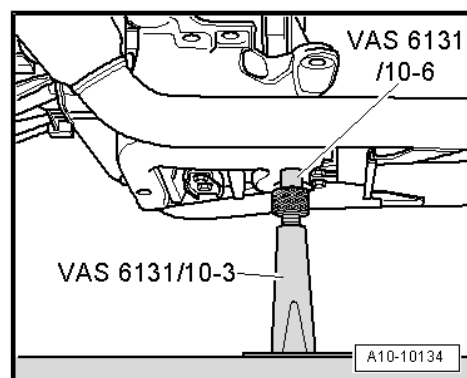
- Position support elements from -VAS 6131/10- at left and right of subframe, as shown in the illustration.

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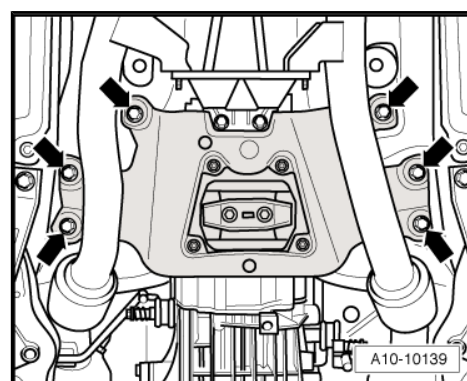
- Position support elements from -VAS 6131/10- at rear of gear-box, as shown in illustration.



- 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 A-.



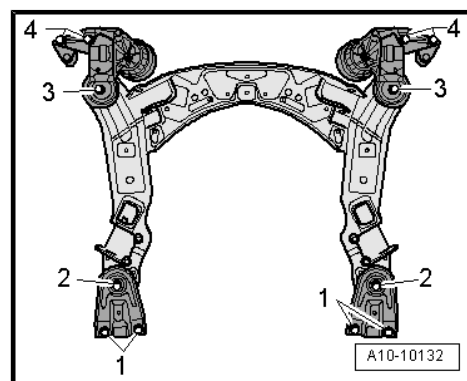
- Remove bolts -arrows- at tunnel cross member.



- 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**

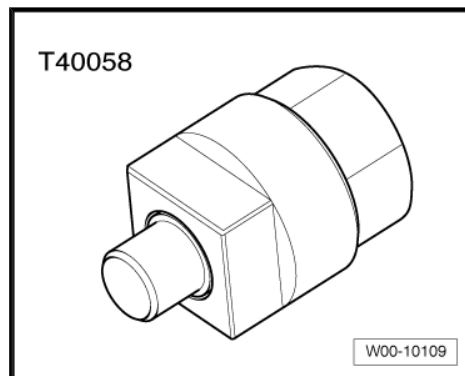
- ◆ Check that all hoses and wiring connections between engine, gearbox, subframe and body have been detached.
- ◆ Carefully guide out engine/gearbox assembly with subframe from engine compartment when lowering to avoid damage.
- Lower engine/gearbox assembly gradually.
- Pull out scissor-type assembly platform -VAS 6131 A- from under the vehicle.



1.2 Separating engine and gearbox

Special tools and workshop equipment required

- ◆ Support set -VAS 6131/11- and supplementary set - VAS 6131/12-
- ◆ Adapter -T40058-



Procedure

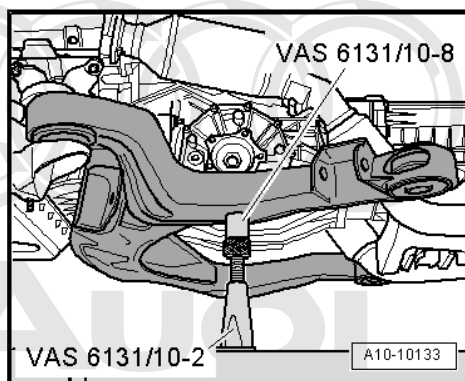
- Engine/gearbox assembly removed and secured to scissor-type assembly platform -VAS 6131 A- .
- Screw down spindles of support elements from -VAS 6131/10- (left and right) at subframe as far as possible.
- Remove locating lugs from spindles.
- Remove subframe to the side.



Note

A second mechanic is required for removing the subframe.

- Loosen the two base plates for support elements (for subframe) at scissor-type assembly platform -VAS 6131 A- .



Note

The mounting points for engine (front), gearbox (rear) and tunnel cross members remain unchanged.

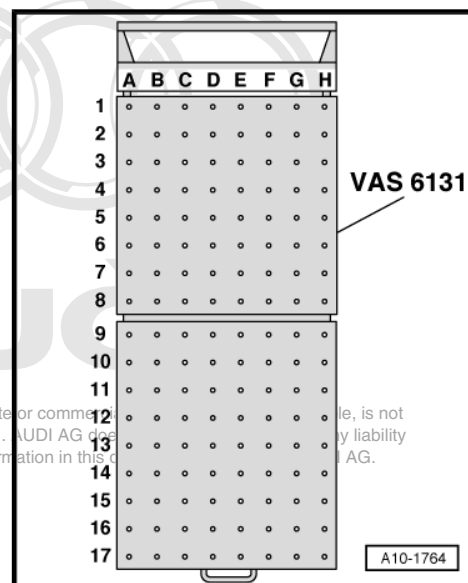
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- Set up scissor-type assembly platform -VAS 6131 A- with support set for Audi -VAS 6131/10-, -VAS 6131/11- and -VAS 6131/12- as follows:

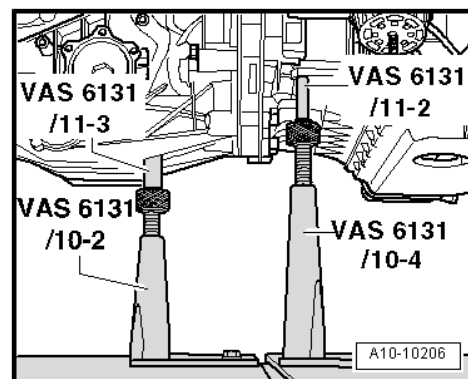
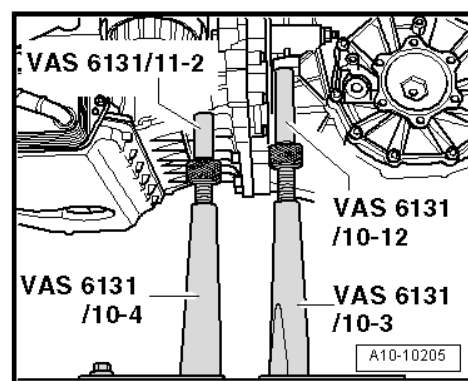
Platform co-ordinates	Parts of support set for Audi -VAS 6131/10-, -VAS 6131/11- and -VAS 6131/12-			
B4 ²⁾	/10-1	/10-4	/10-5	/10-12
F4 ²⁾	/10-1	/10-4	/10-5	/10-12
C6	/10-1	/10-4	/10-5	/11-2
F6	/10-1	/10-4	/10-5	/11-2
C10	/10-1	/10-3	/10-5	/10-12
G10	/10-1	/10-2	/10-5	/11-3
B15 ²⁾	/10-1	/10-4	/10-5	/11-1
G15 ²⁾	/10-1	/10-4	/10-5	/11-1

2) Support elements remain unchanged.

- Position support elements from -VAS 6131/11- and -VAS 6131/10- on left side of engine/gearbox assembly, as shown in illustration.



- Position support elements from -VAS 6131/11- 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 A-.

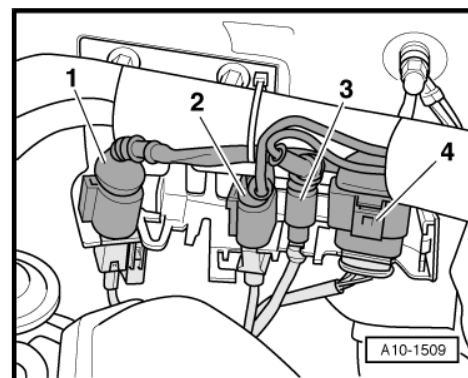


- Unplug electrical connectors -1-, -2- and -4-.
- Move wiring clear.



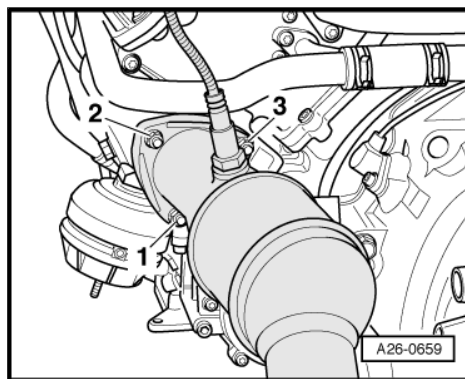
Note

Illustration shows electrical connectors in their installation position.





- Unbolt front exhaust pipe from exhaust manifold (left-side):
-nuts 1 to 3-.

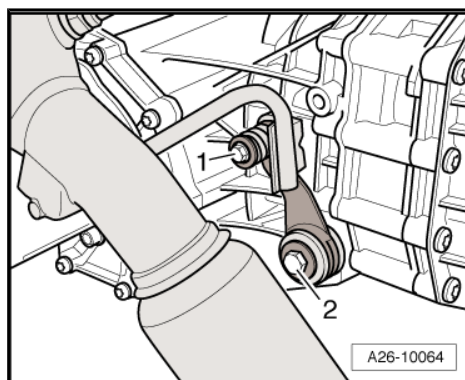


- Remove bolt -1- on bracket (left-side) for front exhaust pipe.



Note

Disregard -item 2-.



Note

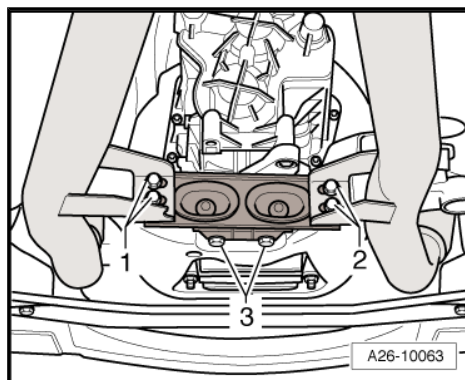
To avoid any damage, the flexible joint in the front exhaust pipe must not be bent more than 10°.

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

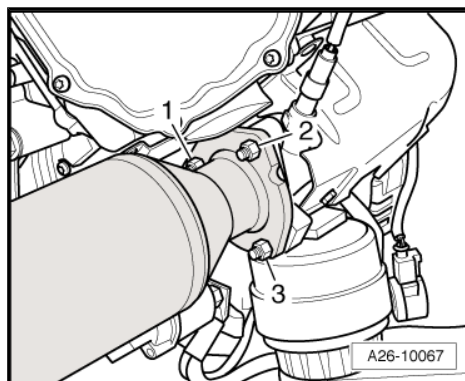


Note

Disregard items marked -2- and -3-.



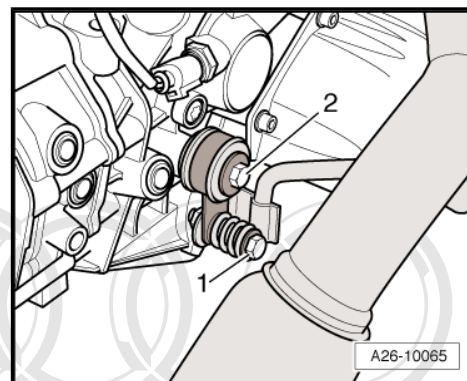
- Detach front exhaust pipe (left-side) with catalytic converter.
- Unscrew nuts -1 ... 3-.



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

**Note**

Disregard -item 2-.

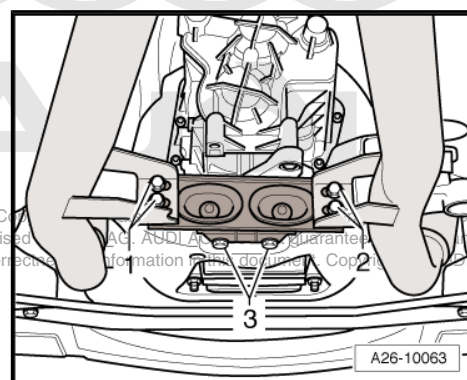
**Note**

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

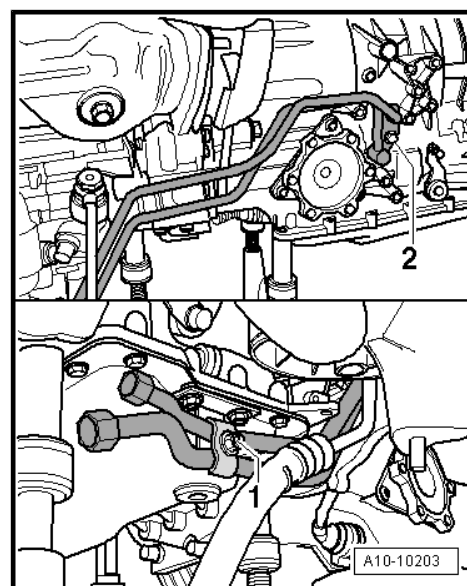
- Remove bolts -2- on bracket (rear) for exhaust system.

**Note**

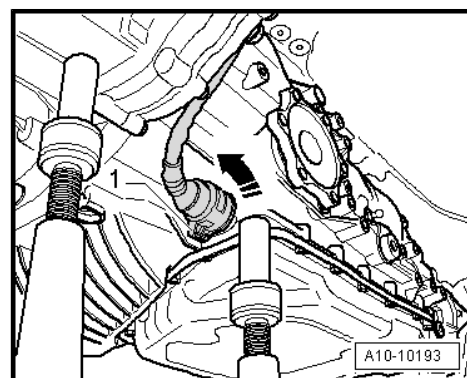
Disregard items marked -1- and -3-.



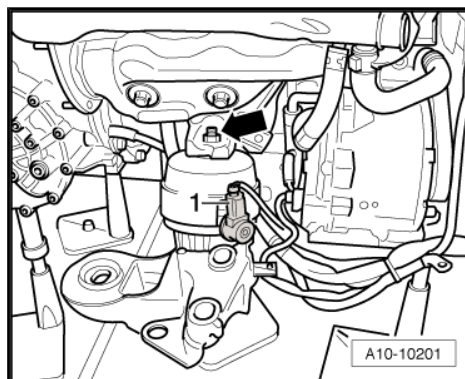
- Loosen oil pipes -2- at gearbox.
- Unscrew gearbox oil pipes from engine and remove.



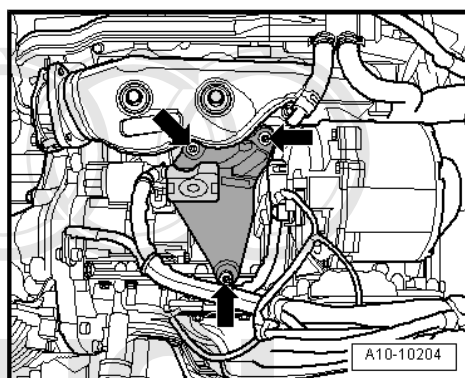
- Unplug electrical connector -1- by turning in direction of -arrow-.



- Unplug electrical connector -1-.
- Unscrew nut -arrow- and remove engine mounting (right-side).

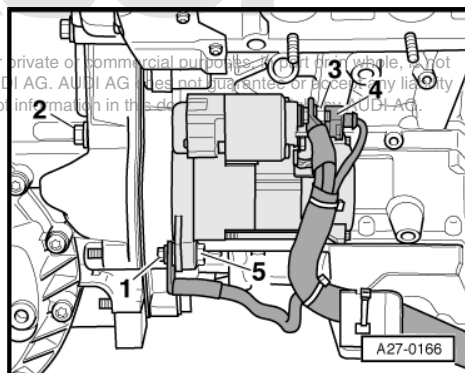


- Remove bolts -arrows- and take off engine support.

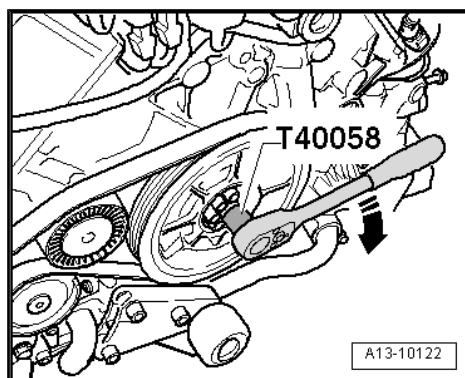


- Disconnect earth cable -1-.
- Detach electrical wiring -3- and -4-.
- Unscrew bolts -2 and 5- and remove starter.

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- Rotate engine in normal direction of rotation -arrow- using adapter -T40058- until . . .

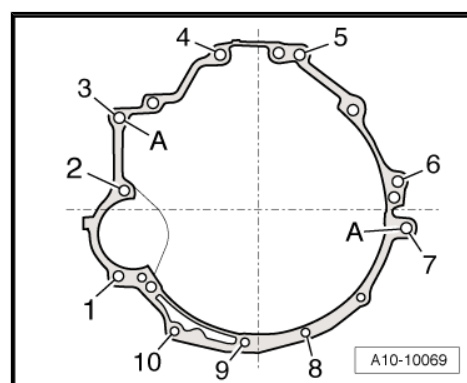
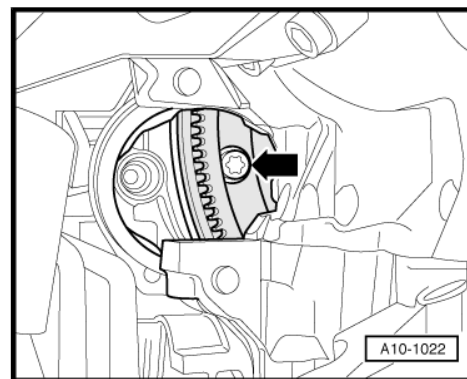


- ... you can remove the 3 TORX bolts -arrow- for the torque converter through the opening for the starter. (Turn crankshaft $\frac{1}{3}$ of a turn each time using adapter -T40058-.)

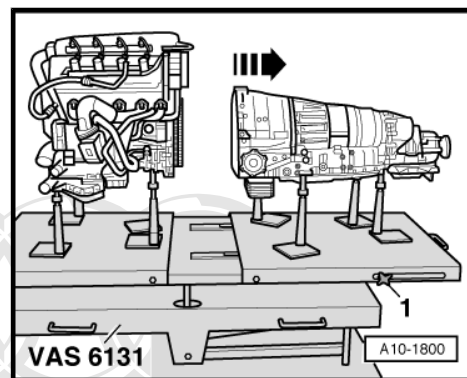
**Note**

Counterhold using adapter -T40058- when loosening bolts for torque converter.

- First unscrew the bottom engine/gearbox securing bolts, then the top bolts.
- Push the torque converter from the drive plate through the opening for starter in the bell housing; at the same time detach the engine from the gearbox.
- Secure torque converter in gearbox to prevent it falling out.
- Remove engine/gearbox securing bolts -1 ... 10-.



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

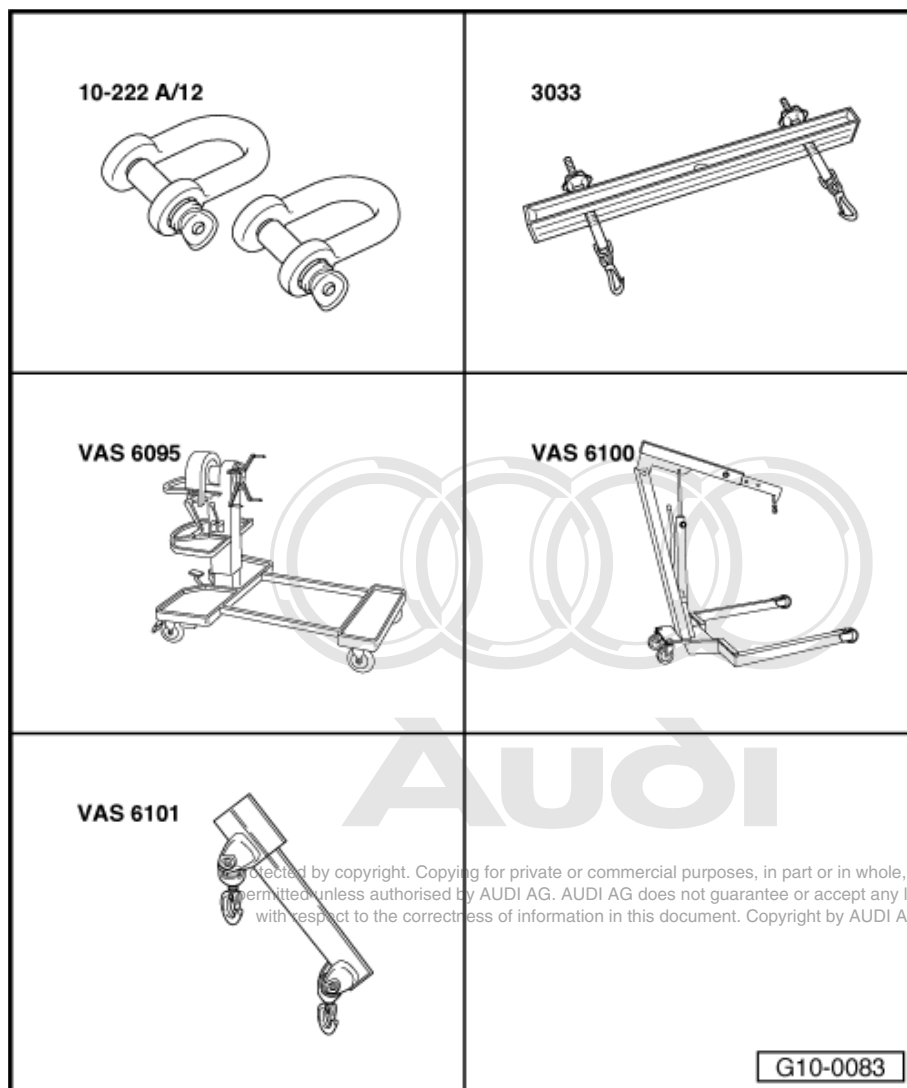


1.3 Securing engine to assembly stand

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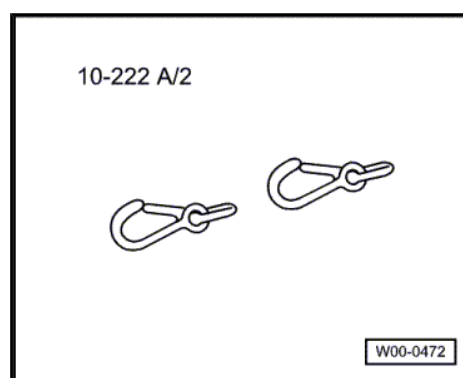
Special tools and workshop equipment required

- ◆ Shackle -10-222 A/12-
- ◆ Lifting tackle -3033-
- ◆ Engine and gearbox support -VAS 6095- with support bracket for V8 engine - VAS 6095/1-6- or -VAS 6095/1-6A-
- ◆ Workshop hoist - VAS 6100-
- ◆ Lift arm extension (workshop hoist) -VAS 6101-



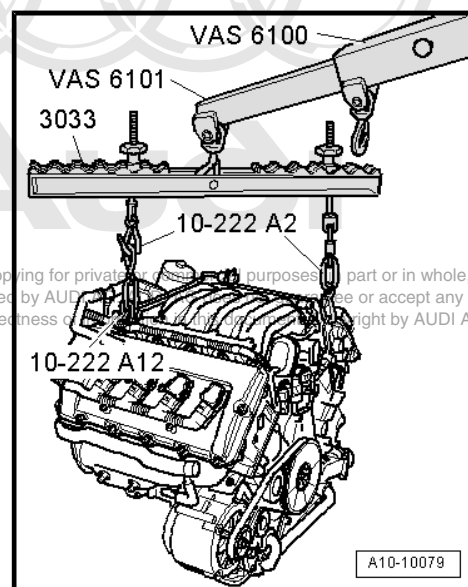
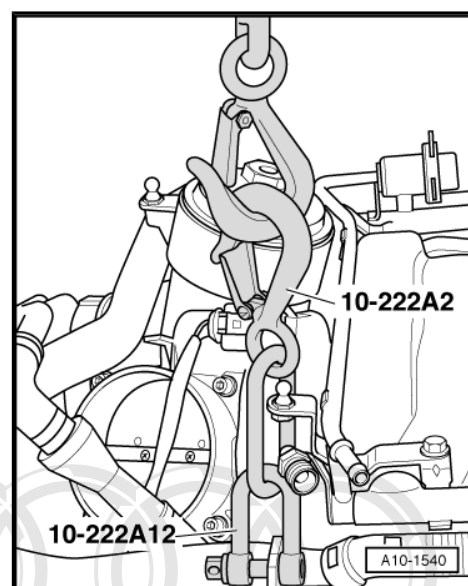
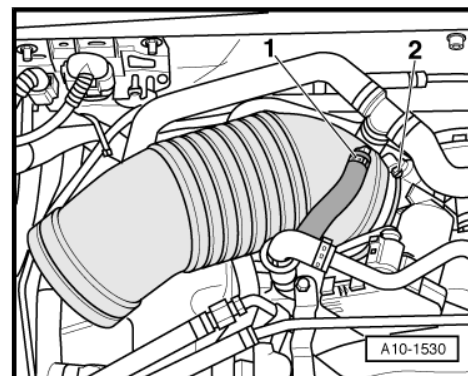
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- ◆ Hooks -10-222 A/2-



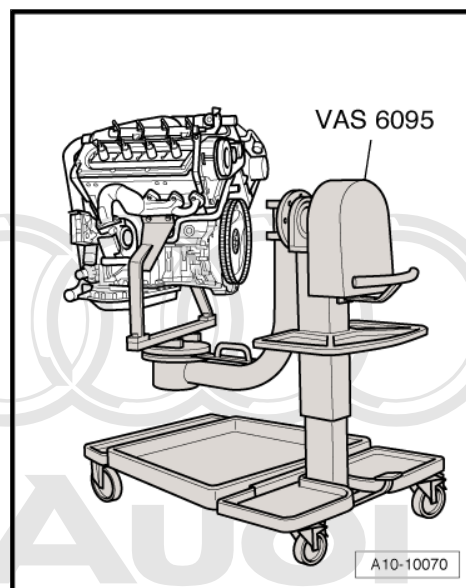
Procedure

- Detach vacuum hose -1-.
 - Detach air intake hose -2- from throttle valve module.
-
- Attach the shackle -10-222 A/12- to the engine lifting eye (rear right).
 - Attach hook -10-222 A/2- to shackle -10-222 A/12- .
-
- Attach the lifting tackle -3033- to hook -10-222 A/2- and workshop hoist -VAS 6100- with lift arm extension (workshop hoist) -VAS 6101- as shown in the illustration.
 - Lift engine off the support elements on scissor-type assembly platform -VAS 6131- .
 - Remove engine mounting with engine support (left-side).



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- Using support bracket for V8 engine -VAS 6095/1-6- or -VAS 6095/1-6A- , secure engine to engine and gearbox support - VAS 6095- as shown in the illustration.



1.4 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.*

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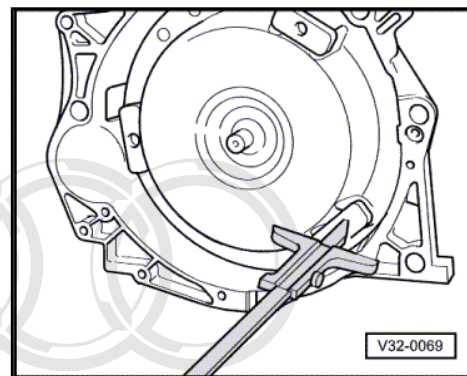
Checking installation depth of torque converter

If the torque converter has been correctly installed, the distance between the bottom contact surfaces at the threaded holes in the torque converter and the contact surface on the torque converter bell housing (with automatic gearbox 09L) is approx. 19 mm.



WARNING

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



- 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.



WARNING

Before and during tightening of bolts on engine/gearbox flange, continually check that the torque converter behind the drive plate can be turned. If the converter cannot be turned, it must be assumed that it has not been installed correctly and the drive lugs for the ATF pump and consequently the gearbox will be damaged during final tightening of bolt connections.

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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	Nm
1	M10x80	65 ³⁾
2	M12x90	65
3	M12x105	65
4, 5	M12x100	65
6	M12x125	65
7	M12x170	65
8, 9, 10	M10x60	45
A	Dowel sleeves for centralising	

3) Property class 10.9

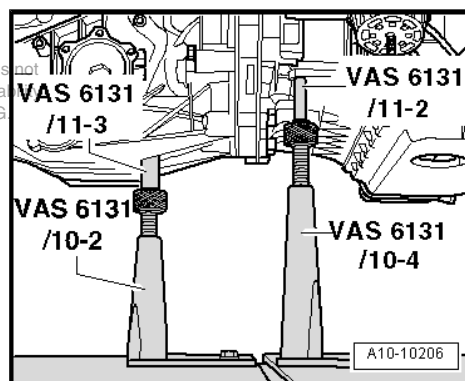
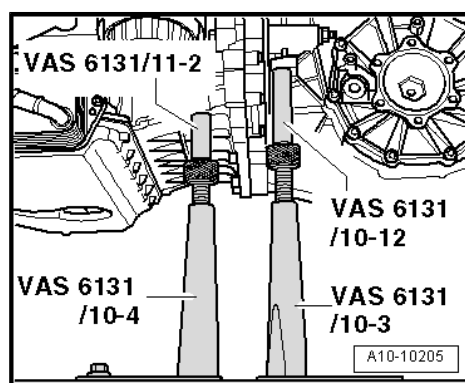
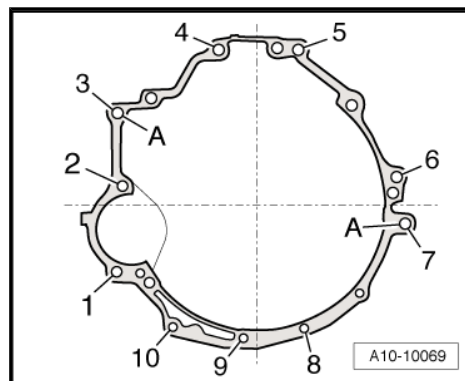
Perform further installation in reverse order, paying attention to the following:

- Install front exhaust pipes: left-side ⇒ [page 200](#) , right-side ⇒ [page 204](#) .
- Prior to assembly, always use a thread tap to remove remaining locking fluid from the tapped holes in the flange shaft for the propshaft on the gearbox.
- 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 A- .
- Screw down the spindles for support elements (right-side) at engine/gearbox assembly.
- Unscrew both base plates for support elements (left-side) at scissor-type assembly platform -VAS 6131 A- .



Note

The mounting points for engine (front), gearbox (rear) and tunnel cross members remain unchanged.



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

Platform coordinates	Parts from support set for Audi -VAS 6131/10-			
B4 ⁴⁾	/10-1	/10-4	/10-5	/10-12
F4 ⁴⁾	/10-1	/10-4	/10-5	/10-12
B10	/10-1	/10-2	/10-5	/10-8 ⁵⁾
G10	/10-1	/10-2	/10-5	/10-8 ⁵⁾
B15 ⁴⁾	/10-1	/10-4	/10-5	/11-1
G15 ⁴⁾	/10-1	/10-4	/10-5	/11-1

4) Support elements remain unchanged.

5) Secure support elements only after installing the subframe.



Note

A second mechanic is required for positioning the subframe on the support elements.

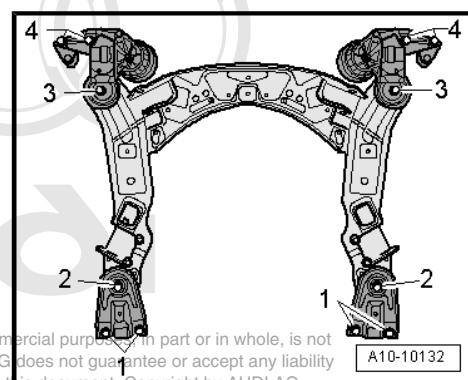
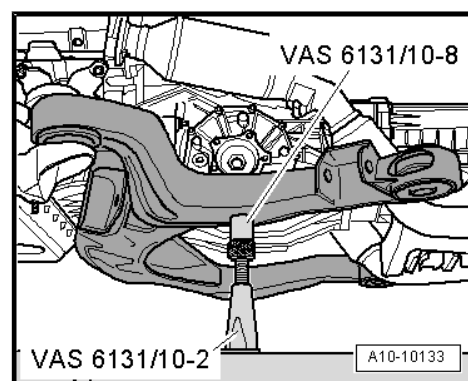
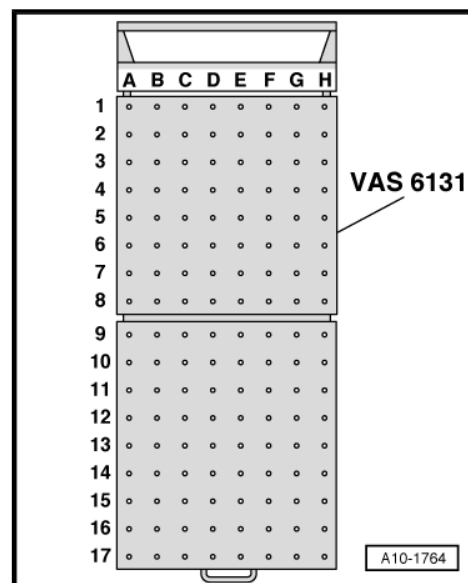
- Fit subframe onto the two support elements -VAS 6131/10-8-.
- Screw up the spindles for support elements on both sides.
- Tighten base plates for support elements to 20 Nm on scissor-type assembly platform -VAS 6131 A-.
- Slowly guide engine gearbox assembly together with subframe into the body from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

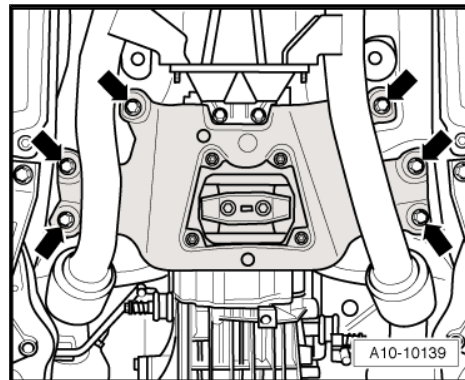


WARNING

The vehicle must not be driven at this stage.

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- Tighten bolts -arrows- for tunnel cross member.
- Install selector lever cable and check adjustment if necessary
⇒ Rep. gr. 37 .
- Install propshaft ⇒ Rep. gr. 39 .
- Secure ATF lines ⇒ Rep. gr. 37 .
- Install drive shafts ⇒ Rep. gr. 40 .
- Install guide link, track control link and anti-roll bar ⇒ Rep. gr. 40 .
- Install power steering fluid lines ⇒ Rep. gr. 48 .
- Install refrigerant lines ⇒ Rep. gr. 87 .
- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Install front bumper ⇒ Rep. gr. 63 .
- Adjust headlights ⇒ Rep. gr. 94 .
- Electrical connections and routing ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.



WARNING

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



Note

- ◆ *When the battery is reconnected, please ensure that the vehicle equipment (e.g. radio, radio/navigation system, clock, electric window lifters) is activated as described in the operating instructions.*
- ◆ *Deactivate service mode of telematics control unit ⇒ Rep. gr. 91 .*
- ◆ *For further operations after reconnecting power supply, refer to ⇒ Rep. gr. 24 .*
- Charge the refrigerant system ⇒ Air conditioner system - with refrigerant R134a .
- Check oil level before starting engine.
- Before starting the engine for the first time, fill up the power steering reservoir with hydraulic fluid; the power steering pump must not run dry.
- Fill up with coolant ⇒ [page 170](#) .



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 ⇒ Rep. gr. 48 .
- Check ATF level ⇒ Rep. gr. 37 .

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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:		
Battery plus (+) cable to starter		16
Earth cable to starter		22
Engine support (right-side) to cylinder block		42
Engine mounting to:	Engine support	23
	Console for engine mounting	23
Hydraulic pressure line to power steering pump		47
Gearbox mounting to subframe		23
Heat shield for selector lever cable		22
Bracket for front exhaust pipe (left-side) to gearbox		25
Bracket for front exhaust pipe (left-side) to front exhaust pipe		25
Heat shield to gearbox		23
Fuel supply line to fuel rail		25
Earth cable to body		22
Stop for torque reaction support to lock carrier		40
Hose clips for coolant hoses		2

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13 – Crankshaft group

1 Dismantling and assembling engine

1.1 Poly V-belt drive for alternator

1 - 22 Nm

2 - 22 Nm

3 - Tensioner for poly V-belt

4 - 22 Nm

5 - Alternator

- ☐ Removing and installing
⇒ Rep. gr. 27

6 - M8: 22 Nm; M10: 46 Nm

7 - Dowel sleeve

- ☐ For bracket for alternator
- ☐ 2x

8 - Bracket

- ☐ For alternator

9 - 10 Nm

10 - Bracket

- ☐ For idler roller

11 - Vibration damper

- ☐ Removing and installing
⇒ [page 36](#)

12 - 22 Nm + 45° (1/8 turn) further

- ☐ Renew

13 - Idler roller

- ☐ For poly V-belt

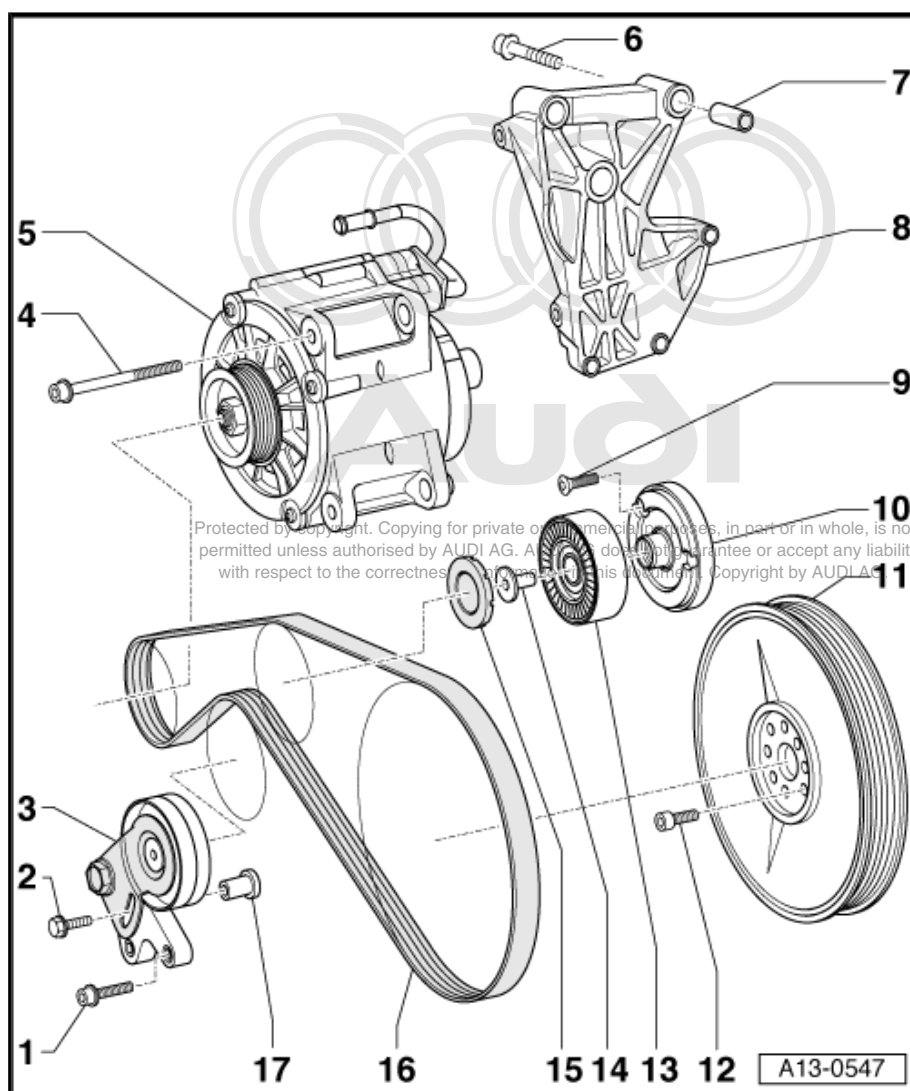
14 - 22 Nm

15 - Cap

16 - Poly V-belt

- ☐ Check for wear
- ☐ Do not kink
- ☐ Before removing, mark direction of rotation with chalk or felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.
- ☐ Removing and installing ⇒ [page 34](#)

17 - Threaded bush



1.2 Removing and installing poly V-belt

Special tools and workshop equipment required

◆ Torque wrench -V.A.G 1332-

Removing

- Move lock carrier to service position ⇒ Rep. gr. 50 .



Note

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

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- Unscrew clamping bolt -arrow- and remove poly V-belt.

Installing

- Position poly V-belt over pulleys in the following sequence:

- 1 - Alternator
- 2 - Poly V-belt
- 3 - Idler roller
- 4 - Vibration damper
- 5 - Tensioning roller



Note

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

- Attach torque wrench at hexagon flats of tensioning roller and pretension to 70 Nm.
- Simultaneously tighten securing bolt -arrow- to 22 Nm.

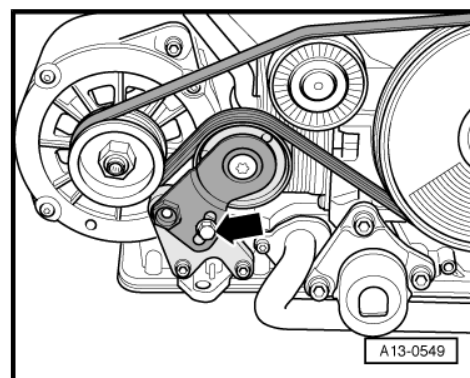
Perform further installation in reverse order, paying attention to the following:

- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Start engine and check that belt runs properly.

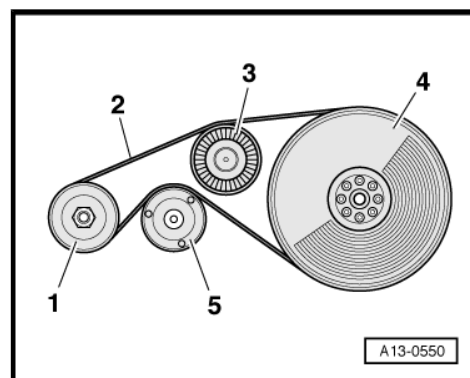
V.A.G 1332



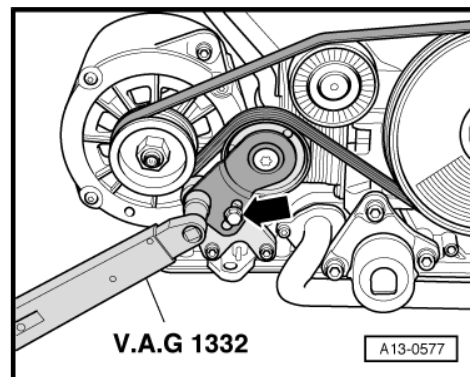
W00-0428



A13-0549



A13-0550



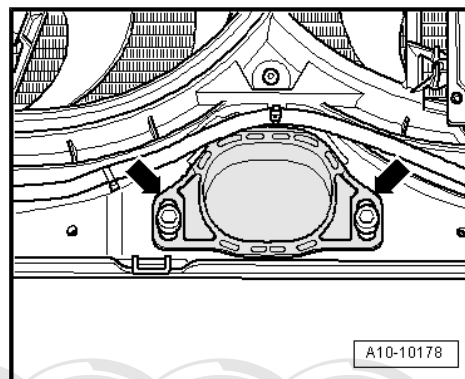
V.A.G 1332

A13-0577

- Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight and tighten bolts -arrows-.
- Install front bumper ⇒ Rep. gr. 63 .
- Adjust headlights ⇒ Maintenance ; Booklet 405 .

Tightening torques

Component	Nm
Securing bolt for tensioning roller	22
Stop for torque reaction support to lock carrier	40



1.3 Removing and installing vibration damper

Removing

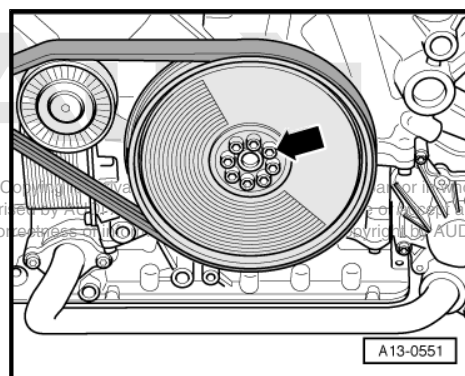
- Move lock carrier to service position ⇒ Rep. gr. 50 .



Note

To loosen and tighten the vibration damper, counterhold with ring spanner on centre bolt for alternator pulley.

- Loosen the 8 securing bolts -arrow- at vibration damper several turns.



Note

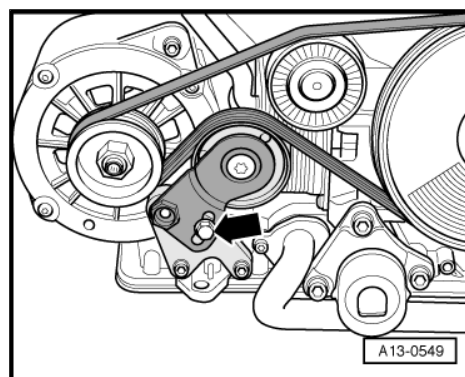
Before removing, mark direction of rotation of poly V-belt with chalk or felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.

- Unscrew clamping bolt -arrow- and remove poly V-belt.
- Remove vibration damper.

Installing

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

- When installing the vibration damper, use only genuine bolts (same as original equipment): ⇒ Parts catalogue .
- The vibration damper can only be fitted in one position (note dowel sleeve).
- Install poly V-belt ⇒ [page 34](#) .
- Install lock carrier with attachments ⇒ Rep. gr. 50 .



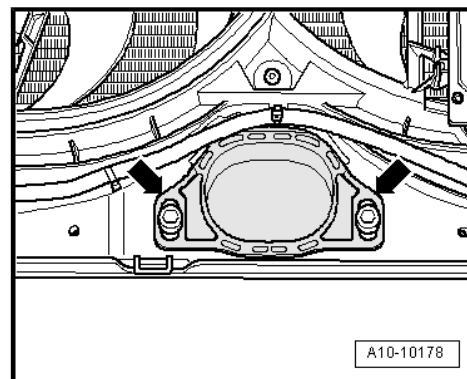
- Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight and tighten bolts -arrows-.
- Install front bumper ⇒ Rep. gr. 63 .
- Adjust headlights ⇒ Maintenance ; Booklet 405 .

Tightening torques

Component	Nm
Vibration damper to crankshaft	22 + 45° ⁶⁾ ⁷⁾
Stop for torque reaction support to lock carrier	40

6) 45° equals one eighth of a turn.

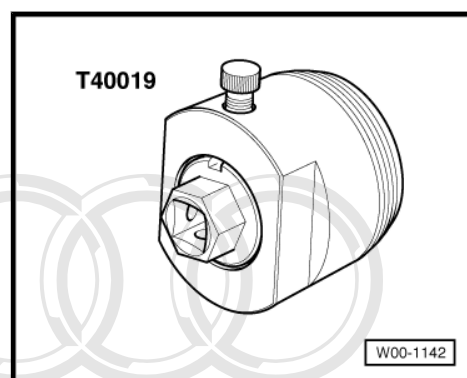
7) Renew bolts.



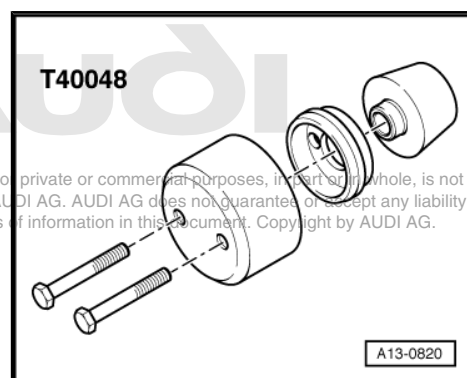
1.4 Renewing crankshaft oil seal (pulley end)

Special tools and workshop equipment required

- ◆ Oil seal extractor -T40019-



- ◆ Assembly tool -T40048-



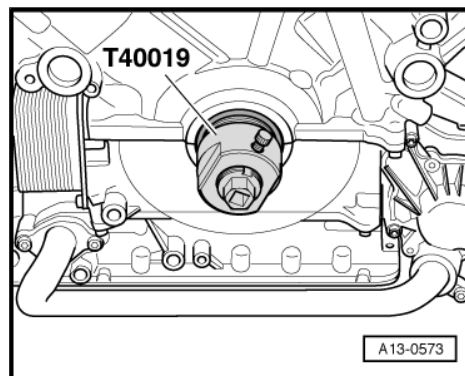
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- ◆ Bolt M8x55

Removing

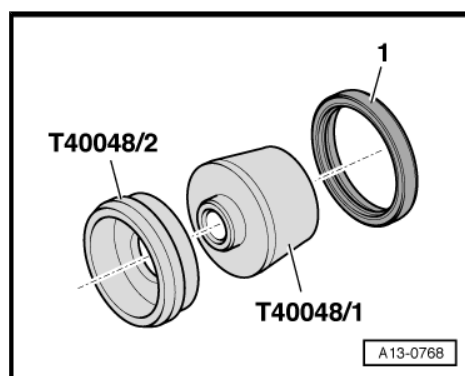
- Move lock carrier to service position ⇒ Rep. gr. 50 .
- Remove vibration damper ⇒ [page 36](#) .
- Adjust inner part of oil seal extractor -T40019- so it is level with the outer part and lock in position with knurled screw.

- Lubricate threaded head of oil seal extractor, place it in position and exerting firm pressure screw it into oil seal as far as possible.
- Loosen knurled screw and turn inner part against crankshaft until the oil seal is pulled out.
- Clamp flats of oil seal extractor in vice. Remove oil seal with pliers.



Installing

- Clean contact surface and sealing surface.
- Fit assembly aid -T40048/1- onto assembly sleeve -T40048/2- and slide oil seal -1- onto assembly sleeve.
- Take off assembly aid.

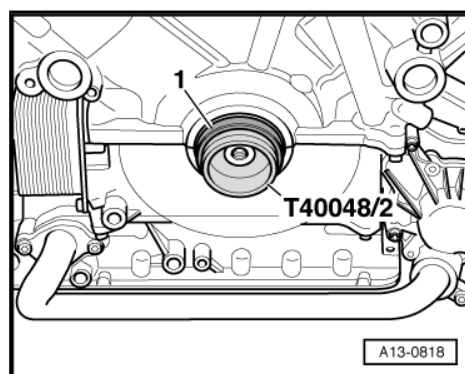


- Fit assembly sleeve -T40048/2- on crankshaft and slide oil seal -1- into sealing surface in engine.



Note

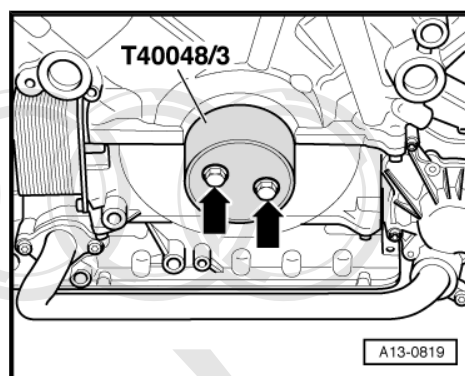
Leave assembly sleeve -T40048/2- in position on crankshaft for pressing on seal.



- Apply press sleeve -T40048/3- to crankshaft using M8×55 mm bolts -arrows-.
- Screw in bolts hand-tight to start with.
- Tighten bolts alternately, $\frac{1}{2}$ turn at a time, to press in oil seal onto stop.

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

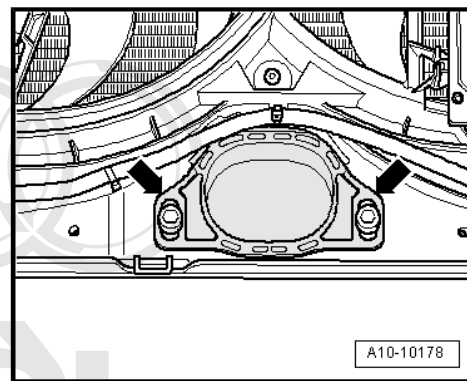
- Install vibration damper ⇒ [page 36](#) .
- Install lock carrier with attachments ⇒ Rep. gr. 50 .



- Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight and tighten bolts -arrows-.
- Install front bumper ⇒ Rep. gr. 63 .
- Adjust headlights ⇒ Maintenance ; Booklet 405 .

Tightening torques

Component	Nm
Stop for torque reaction support to lock carrier	40



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2 Removing and installing drive plate

2.1 Drive plate - exploded view

1 - Drive plate

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

2 - Washer

- ☐ Mark installation position for re-installation

3 - 30 Nm + 90° (1/4 turn) further

- ☐ Renew

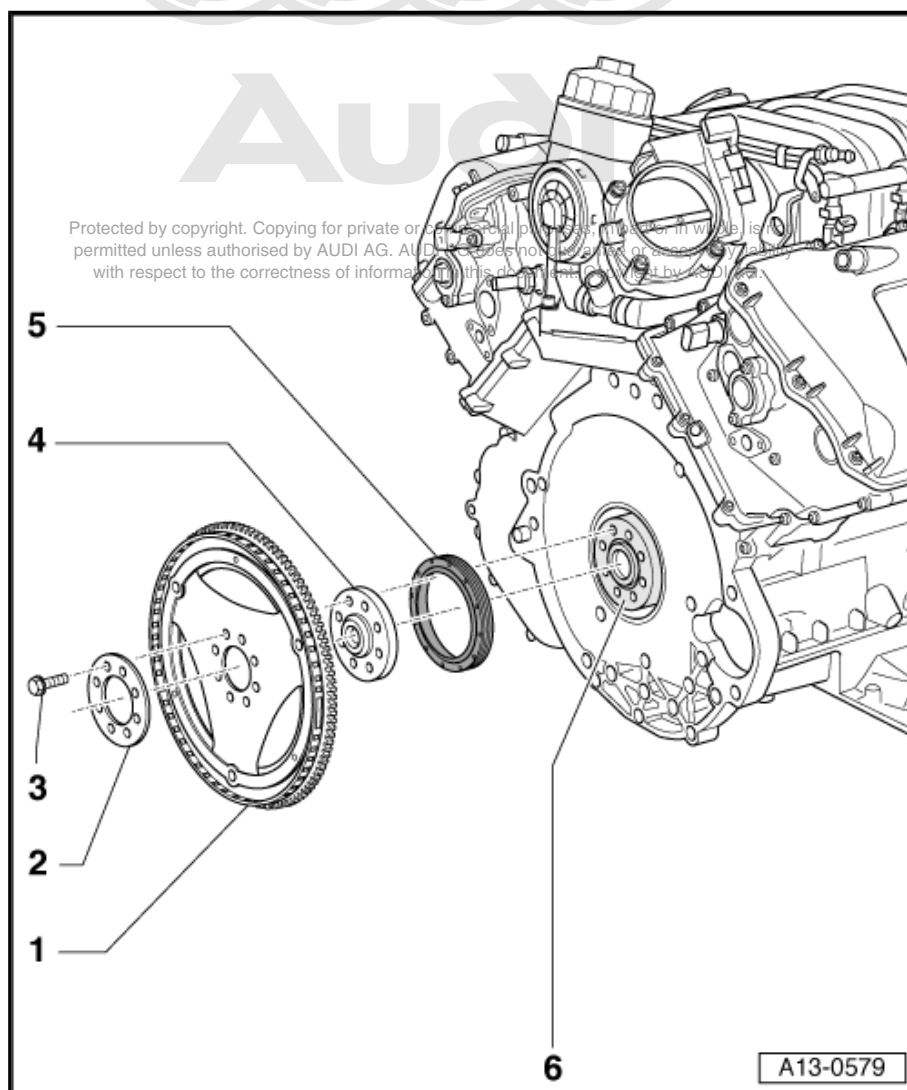
4 - Shim

- ☐ Mark installation position for re-installation

5 - Oil seal

- ☐ For crankshaft (timing chain end)
- ☐ Removing and installing
⇒ [page 41](#)

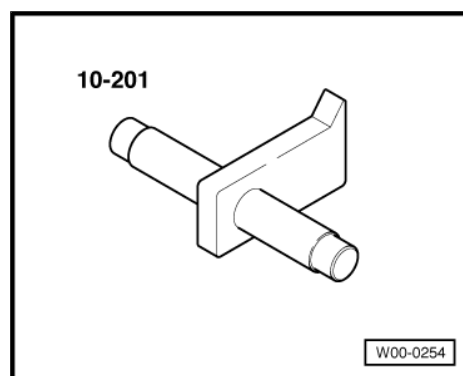
6 - Crankshaft



2.2 Removing and installing drive plate

Special tools and workshop equipment required

- ◆ Counterhold tool -10-201-



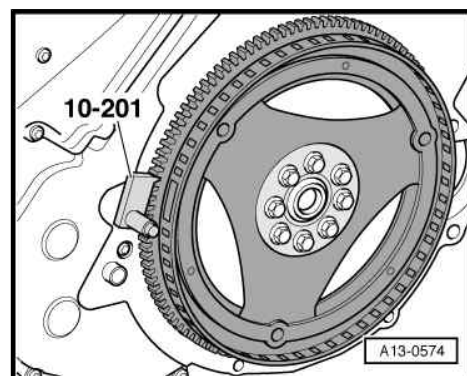
Removing

- Remove engine ⇒ [page 6](#) .
- Separate engine from gearbox ⇒ [page 20](#) .
- Mark position of drive plate and washer relative to engine.
- Remove drive plate ⇒ [page 40](#) .
- Insert counterhold tool -10-201- to slacken bolts.
- Unbolt drive plate.

Installing

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

- Install drive plate with washer.
- Use new securing bolts.
- Fit counterhold tool -10-201- the other way round to tighten bolts.
- Bolt gearbox to engine and install engine/gearbox assembly ⇒ [page 28](#) .



Tightening torque

Component	Nm
Drive plate to crankshaft	30 + 90° ⁸⁾ 9)

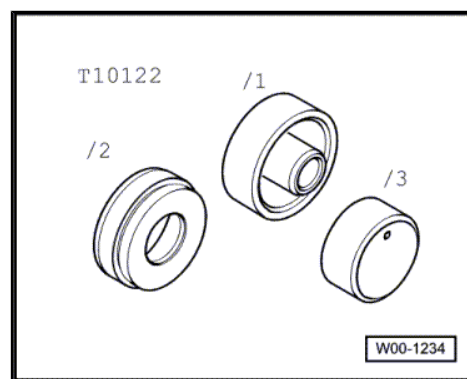
8) 90° = a quarter of a turn.

9) Renew bolts.
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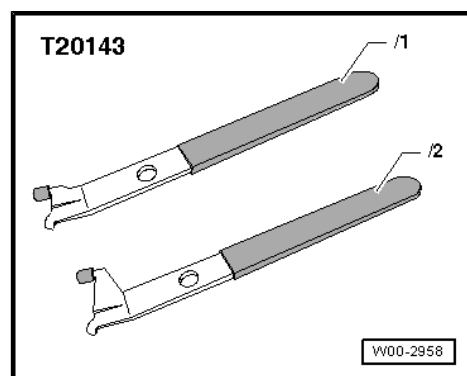
2.3 Renewing crankshaft oil seal (timing chain end)

Special tools and workshop equipment required

- ◆ Fitting tool -T10122-

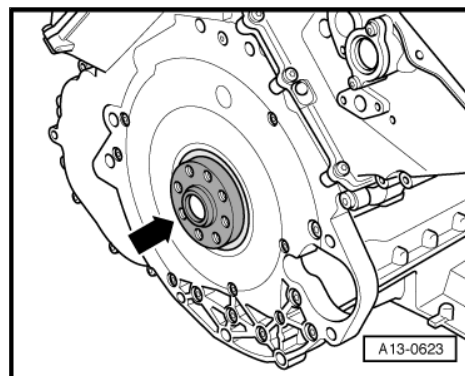


- ◆ Oil seal extractor lever -T20143/2-



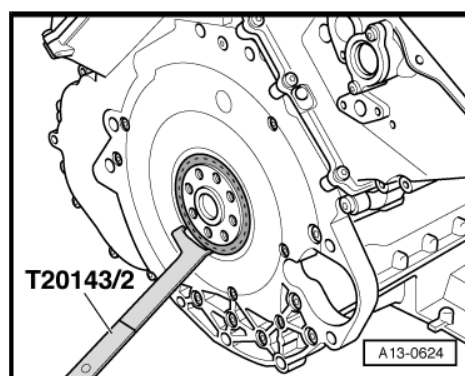
Removing

- Remove engine ⇒ [page 6](#) .
- Separate engine from gearbox ⇒ [page 20](#) .
- Remove drive plate ⇒ [page 40](#) .
- Pull shim -arrow- off crankshaft.



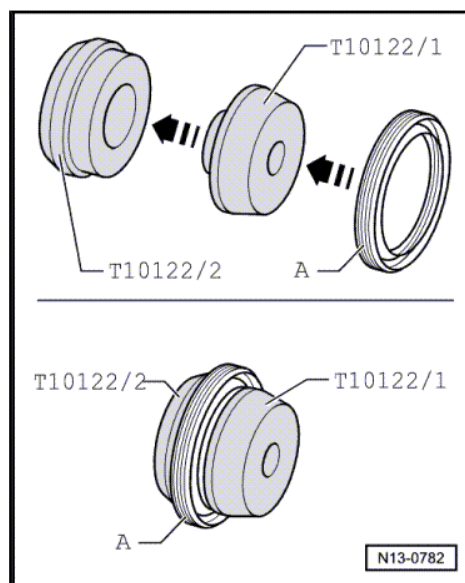
- Pry out the oil seal using the oil seal extractor lever - T20143/2- .

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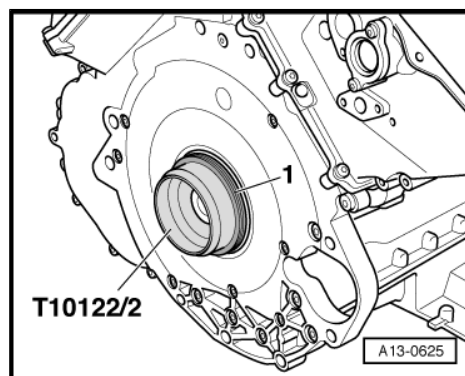


Installing

- Clean contact surface and sealing surface.
- Fit assembly aid -T10122/1- onto assembly sleeve -T10122/2- and slide oil seal -A- onto assembly sleeve.
- Take off assembly aid -T10122/1- .



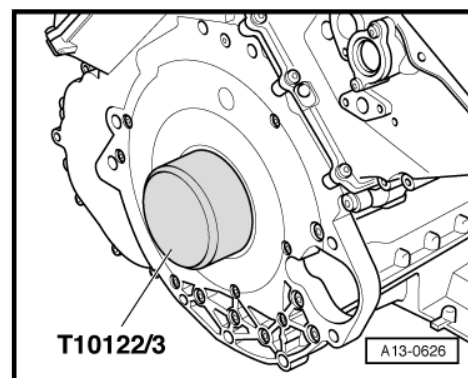
- Press new oil seal -1- onto assembly sleeve -T10122/2- .
- Fit assembly sleeve -T10122/2- onto crankshaft.



- Press in oil seal uniformly until flush all round using press sleeve -T10122/3- .

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

- Install drive plate ⇒ [page 40](#) .
- Bolt gearbox to engine and install engine/gearbox assembly ⇒ [page 28](#) ⇒ [page 28](#) .



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3 Timing chain covers

3.1 Timing chain covers - exploded view of components

1 - M6: 10 Nm; M8: 22 Nm

- ☐ Note correct sequence when tightening
⇒ [page 54](#)

2 - Oil seal

- ☐ For crankshaft (timing chain end)
- ☐ Removing and installing
⇒ [page 41](#)

3 - Shim

4 - Dowel sleeve

- ☐ 2x

5 - 10 Nm

- ☐ Note correct sequence when tightening
⇒ [page 55](#)

6 - Heat shield

7 - 10 Nm

8 - Oil seal

- ☐ Renew

9 - 10 Nm

10 - Sealing flange

11 - 10 Nm

12 - Hall sender 2 -G163-

13 - O-ring

- ☐ Renew

14 - 10 Nm

- ☐ Note correct sequence when tightening
⇒ [page 55](#)

15 - 10 Nm

- ☐ Note correct sequence when tightening ⇒ [page 55](#)

16 - Cover (left-side)

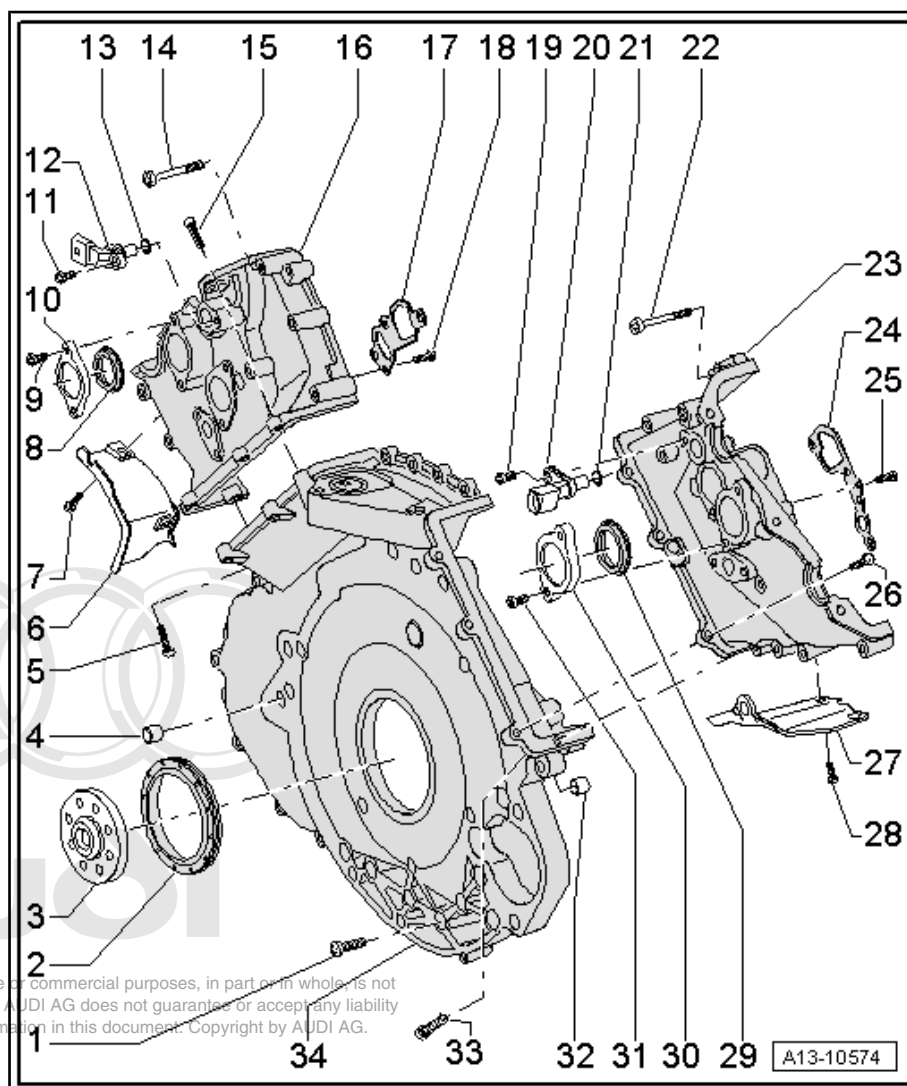
- ☐ For timing chain

17 - Gasket

- ☐ Renew

18 - 4 Nm

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



19 - 10 Nm

20 - Hall sender -G40-

21 - O-ring

- ☐ Renew

22 - 10 Nm

- ☐ Note correct sequence when tightening ⇒ [page 56](#)

23 - Cover (right-side)

- ☐ For timing chain

24 - Gasket

- ☐ Renew

25 - 4 Nm

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

26 - 10 Nm

- ☐ Note correct sequence when tightening ⇒ [page 56](#)

27 - Heat shield

28 - 10 Nm

29 - Oil seal

- ☐ Renew

30 - Sealing flange

31 - 10 Nm

32 - Dowel sleeve

- ☐ 2x

33 - 10 Nm

- ☐ Note correct sequence when tightening ⇒ [page 56](#)

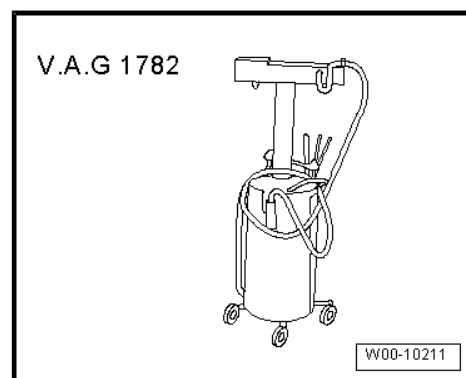
34 - Cover (bottom)

- ☐ For timing chain

3.2 Removing and installing all timing chain covers

Special tools and workshop equipment required

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



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

Removing

- Drain off engine oil ⇒ Maintenance ; Booklet 405 .
- Remove engine ⇒ [page 6](#) .
- Separate engine from gearbox ⇒ [page 20](#) .
- Remove drive plate ⇒ [page 40](#) .
- Unplug electrical connector -1- at throttle valve module - J338- .
- Disconnect hose -3- for crankcase breather system at intake manifold.

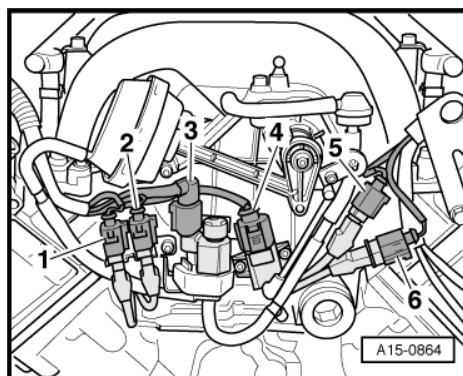
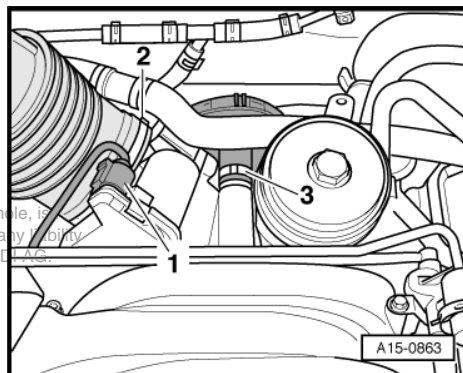


Note

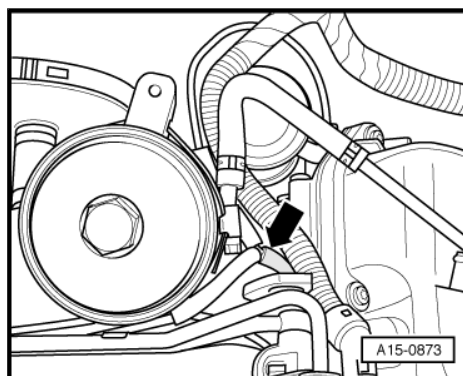
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Disregard -item 2-.

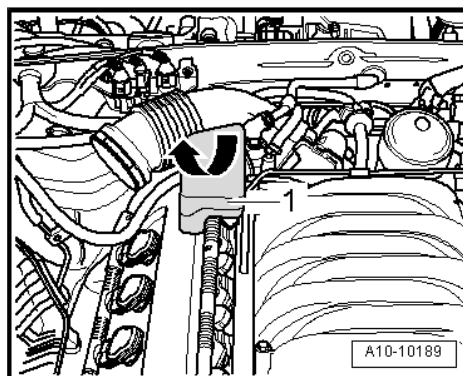
- Detach electrical connectors -1-, -2-, -5- and -6- forwards from brackets on intake manifold.
- Unplug electrical connectors -3- and -4-.



- Detach vacuum hose -arrow- from T-piece.



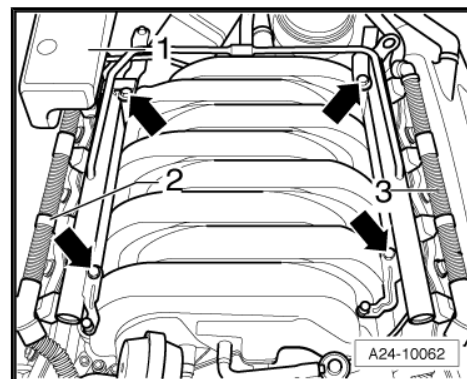
- Pull the resonator -1- upwards -arrow- and unclip.



- Unplug connector rails -2- and -3- at 8 injectors.
- Unscrew bolts -arrows- securing 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.

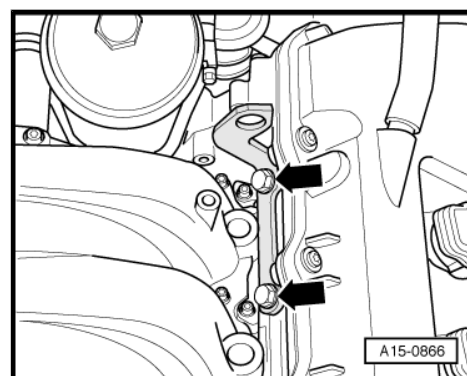
**Note**

Make sure the removed injectors do not become soiled.



- Unscrew engine lifting eye (rear left) -arrows-.

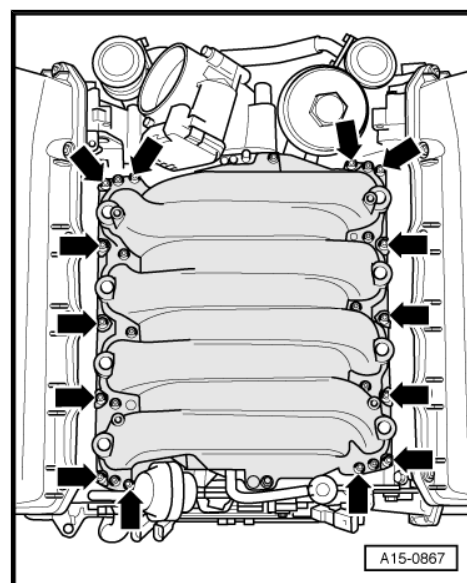
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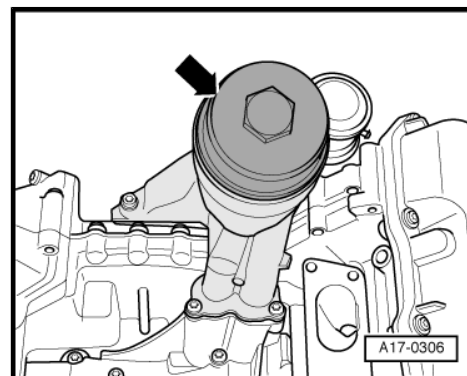
- Unscrew and remove intake manifold -arrows-.

**Note**

Seal intake ports on cylinder heads with clean cloths.



- Unscrew sealing cap -arrow- for oil filter housing.
- Remove oil filter element.
- Extract engine oil from oil filter housing using used oil collection and extraction unit -V.A.G 1782- .

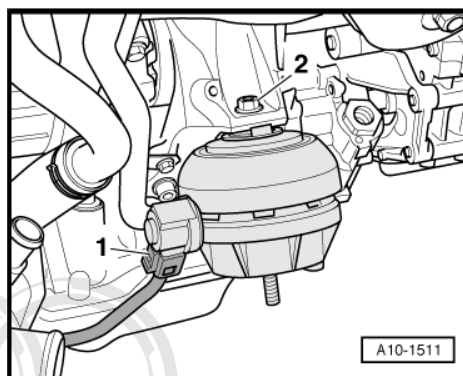
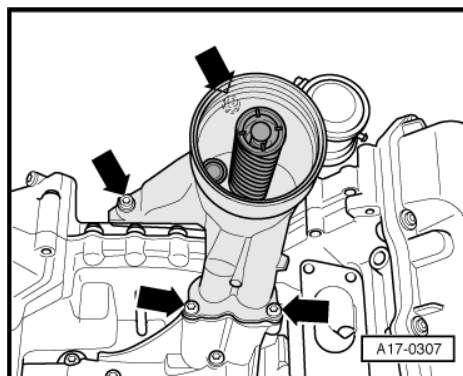




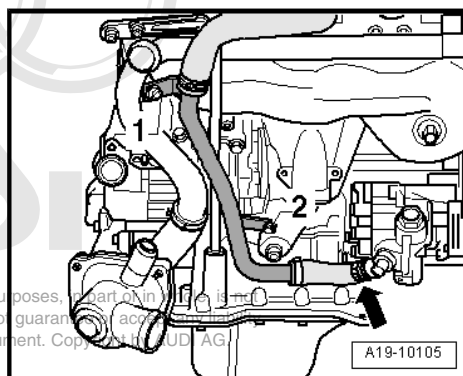
Note

Place a cloth around the oil filter housing to catch any escaping oil.

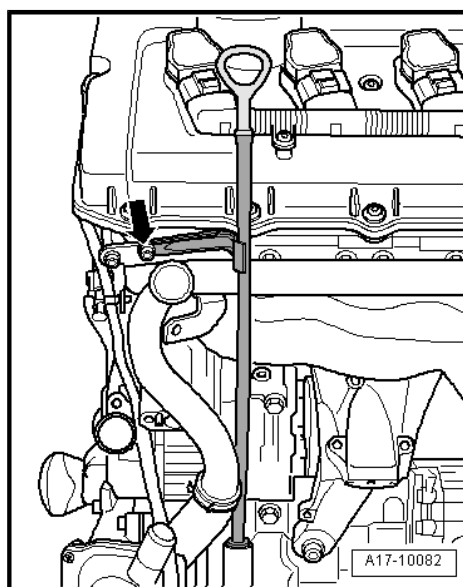
- Remove bolts -arrows-.
- Remove oil filter housing.
- Unplug electrical connector -1- at engine mounting (left-side).
- Unscrew nut -2- and remove engine mounting.



- Remove bolts -1- and -2-.
- Detach return line from power steering pump -arrow-.

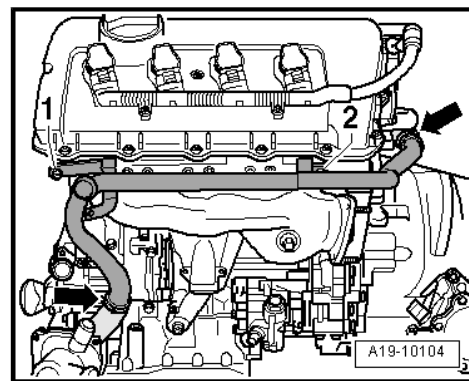


- Unbolt dipstick guide tube on cylinder head -arrow- and lift out upwards.

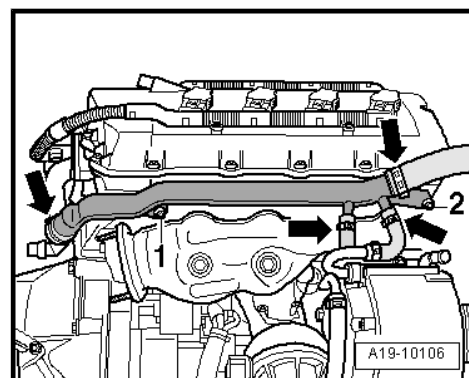


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- Remove bolts -1- and -2-.
- Loosen hose clips -arrows- and detach coolant pipe (left-side) from coolant hoses.

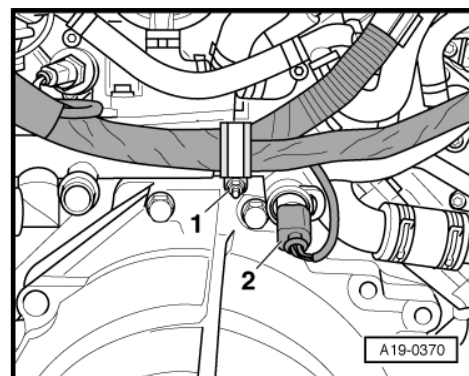


- Remove bolts -1- and -2-.
- Loosen hose clips -arrows- and detach coolant pipe (right-side) from coolant hoses.



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- Unplug electrical connector -2- at coolant temperature sender -G62-.
- Unscrew nut -1- and detach electrical wiring harness at coolant pipe (rear).

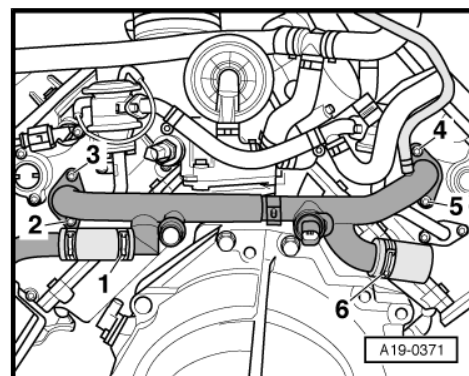


- Remove bolts -2 ... 5-.
- Detach coolant pipe (rear).

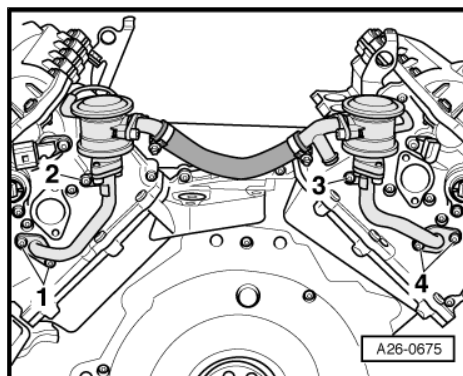


Note

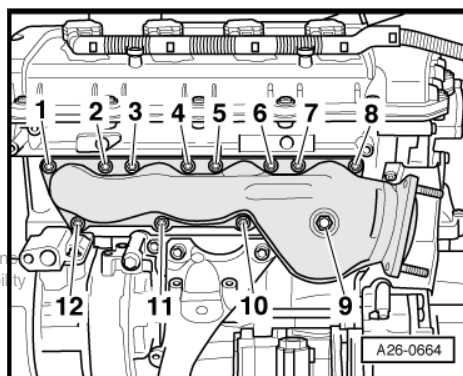
Disregard items marked -1- and -6-.



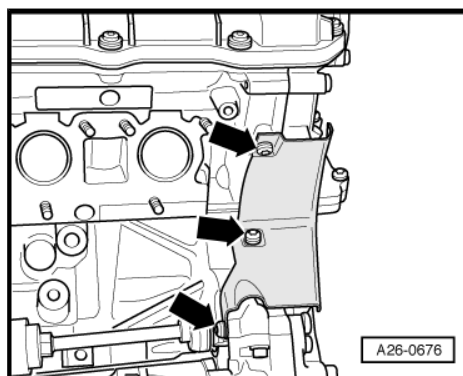
- Unscrew securing bolts -1 ... 4- for combination valves for secondary air system.



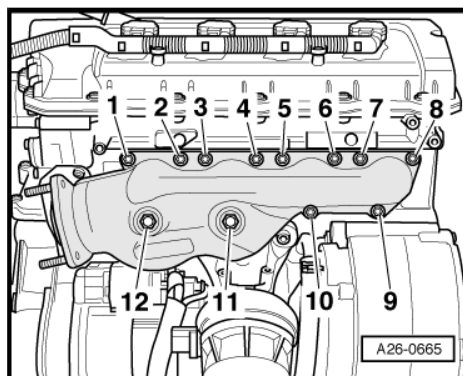
- Unscrew nuts -1 ... 12- and remove exhaust manifold (left-side).



- Detach heat shield (left-side) -arrows-.

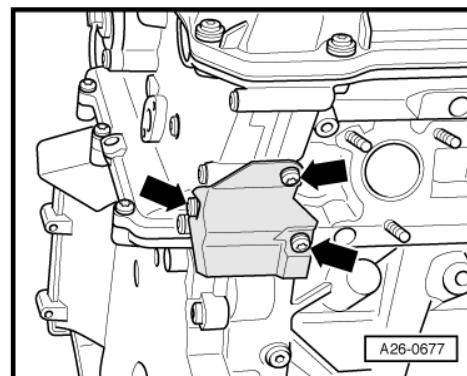


- Unscrew nuts -1 ... 12- and remove exhaust manifold (right-side).



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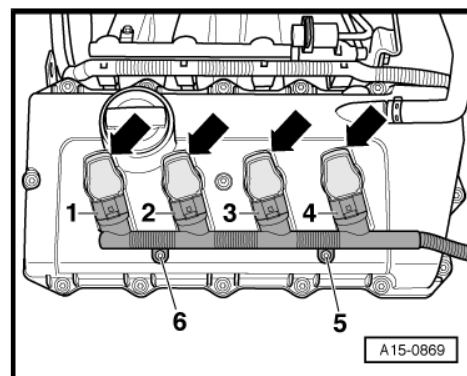
- Detach heat shield (right-side) -arrows-.



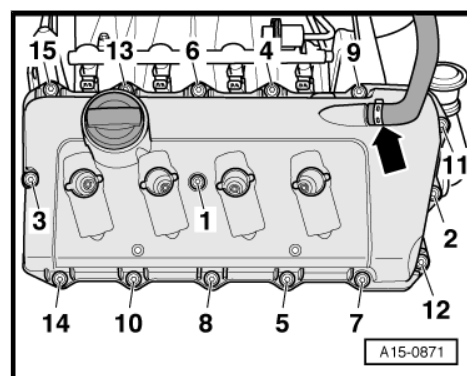
- Unscrew bolts -5- and -6- at cylinder head (left-side).
- Unplug electrical connectors -1 ... 4-.
- Pull out ignition coils -arrows-.

**Note**

Use puller -T10094- to remove.



- Detach crankcase breather hose -arrow-.
- Unscrew cylinder head cover bolts (left-side) in the sequence -15 ... 1-.
- Remove cylinder head cover.

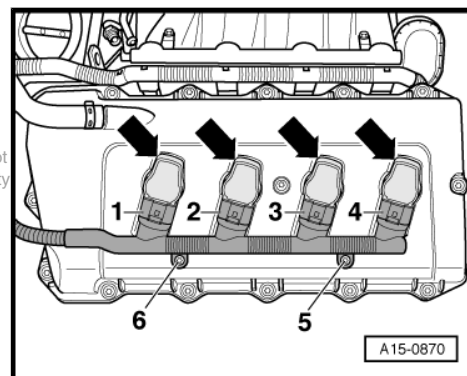


- Unscrew bolts -5- and -6- at cylinder head (right-side).
- Unplug electrical connectors -1 ... 4-.
- Pull out ignition coils -arrows-.

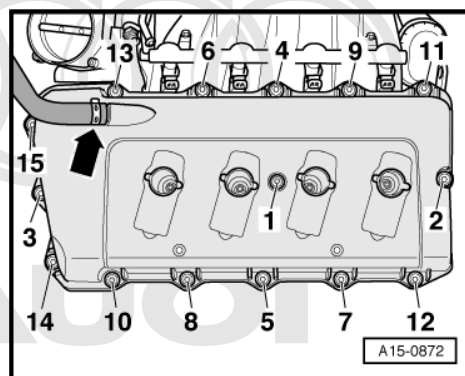
**Note**

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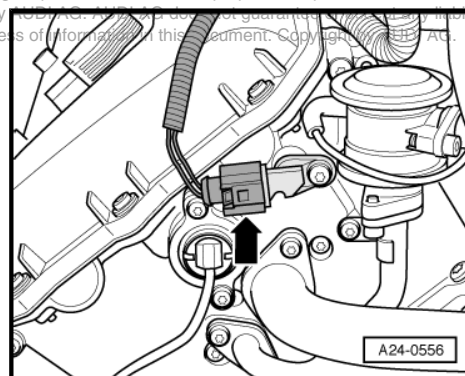
Use puller -T10094- to remove.



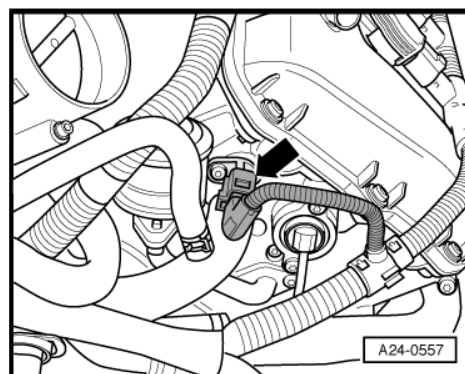
- Detach crankcase breather hose -arrow-.
- Unscrew cylinder head cover bolts (right-side) in the sequence -15 ... 1-.
- Remove cylinder head cover.



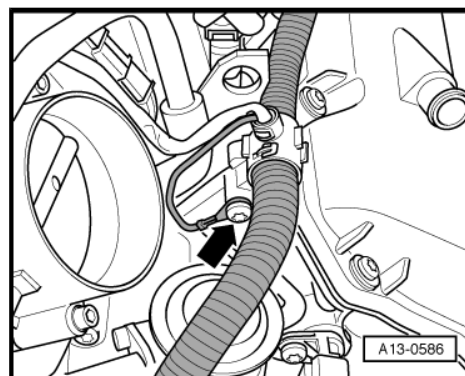
- Unplug electrical connector -arrow- for Hall sender 2 -G163- at cylinder head (left-side).



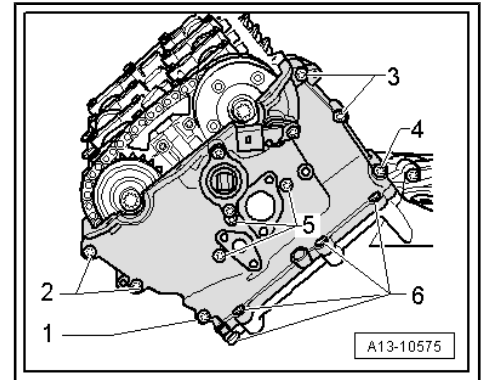
- Unplug electrical connector -arrow- for Hall sender -G40- at cylinder head (right-side).



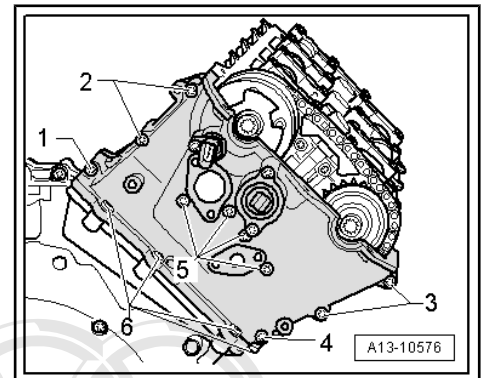
- Unscrew earth cable at cylinder head (right-side) -arrow-.
- Move wiring harness clear.



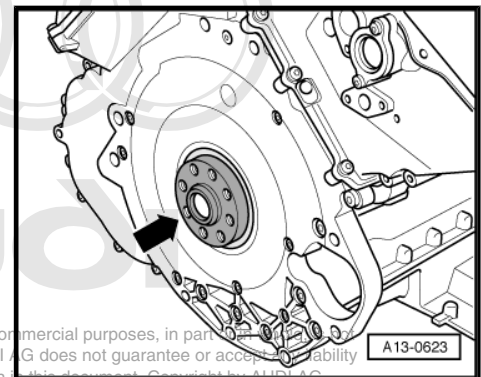
- Remove bolts -1 ... 6- and detach timing chain cover (left-side).



- Remove bolts -1 ... 6- and detach timing chain cover (right-side).



- Pull shim -arrow- off crankshaft.



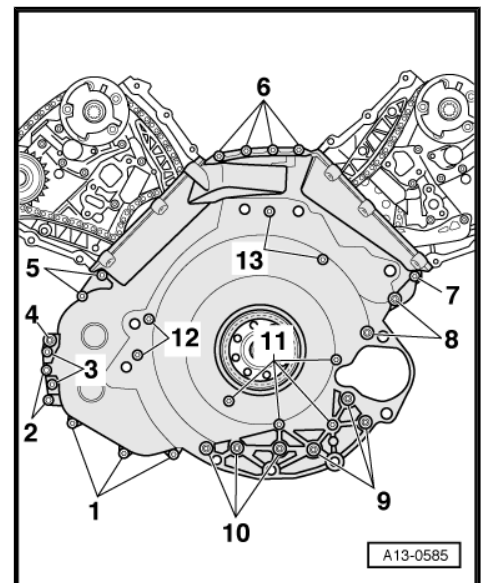
- Unscrew bolts -1 ... 13- and remove timing chain cover (bottom).
- Press out crankshaft oil seal (rear) from timing chain cover.

Installing



Note

Renew gaskets, seals and O-rings.



- Remove remaining sealant on timing chain covers and cylinder block / cylinder head using rotating plastic brush or similar.


WARNING

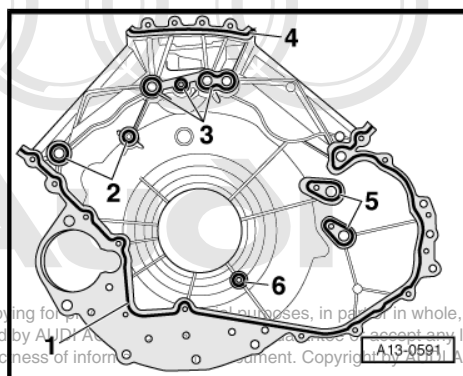
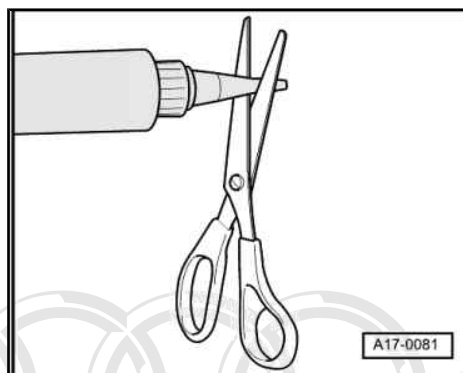
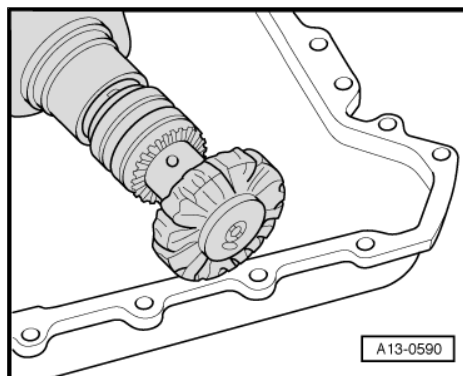
Wear safety goggles.

- 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).


Note

The timing chain covers must be installed within 5 minutes after applying sealant.

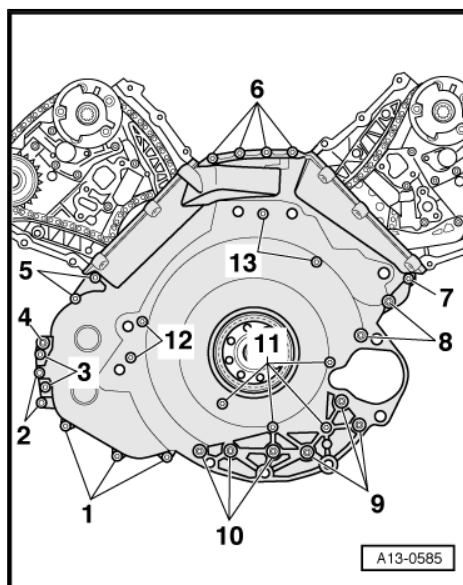
- Apply sealant beads -1 ... 6- onto clean sealing surfaces of timing chain cover (bottom) as illustrated.
- Thickness of sealant bead: 1.5 ... 2.0 mm
- Check whether the two dowel sleeves are fitted in the cylinder block; install if necessary.



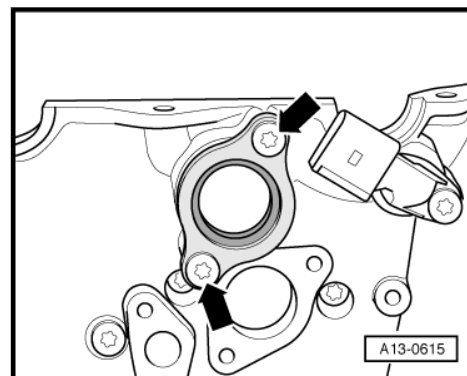
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- Fit timing chain cover (bottom) and tighten bolts as follows:

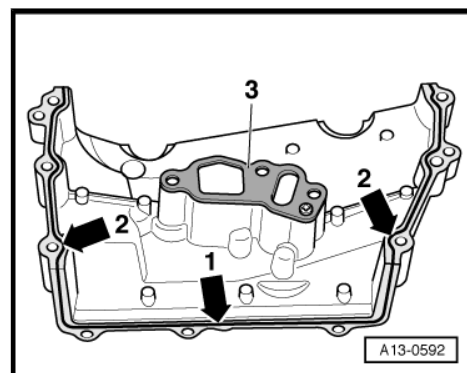
Tightening sequence	Bolt	Nm
I	11, 12, 13	10
II	1, 3, 4, 5, 6, 7, 8, 9, 10	10
III	4, 8, 9, 10	22
IV	2 for power steering pump	22



- Unbolt sealing flanges for camshaft adjuster at timing chain covers (left and right) -arrows-.

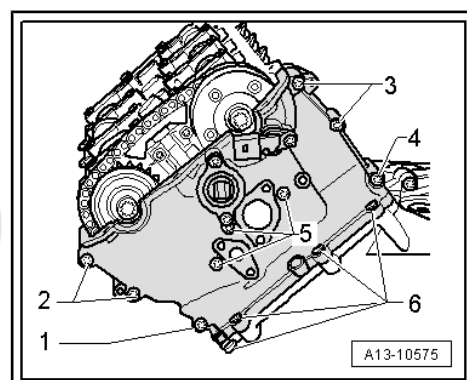


- Apply sealant bead -arrow- onto clean sealing surfaces of timing chain cover (left-side) as illustrated.
- The groove on the bottom sealing surface -arrow 1- must be completely filled with sealant. The bead of sealant must project 1.5 ... 2.0 mm above the sealing surface.
- The bead of sealant on the front sealing surface -arrow 2- must be 1.5 ... 2.0 mm wide.
- Secure new gasket -3- with bolt on timing chain cover (left-side).

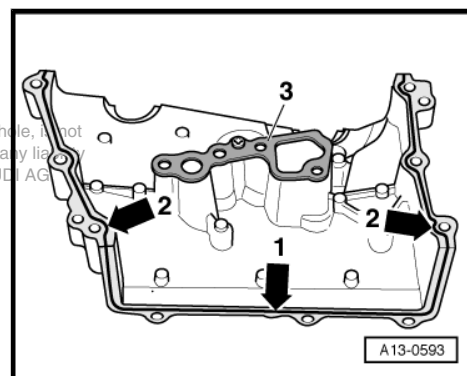


- Fit timing chain cover (left-side) and tighten bolts as follows:

Tightening sequence	Bolt	Nm
I	1 ... 4	5
II	6	10
III	5	10
IV	1 ... 4	10

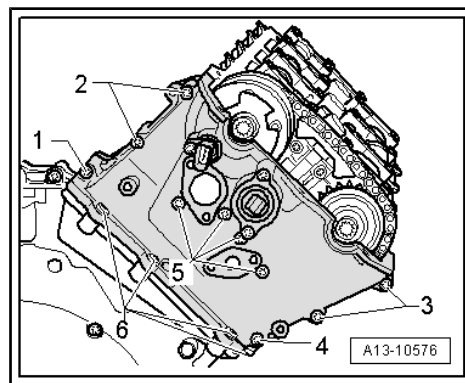


- Apply sealant bead -arrow- onto clean sealing surfaces of timing chain cover (right-side) as illustrated.
- The groove on the bottom sealing surface -arrow 1- must be completely filled with sealant. The bead of sealant must project 1.5 ... 2.0 mm above the sealing surface.
- The bead of sealant on the front sealing surface -arrow 2- must be 1.5 ... 2.0 mm wide.
- Secure new gasket -3- on timing chain cover (right-side).



- Fit timing chain cover (right) and tighten bolts as follows:

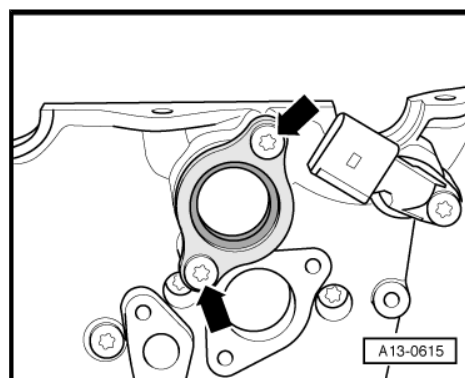
Tightening sequence	Bolt	Nm
I	1 ... 4	5
II	6	10
III	5	10
IV	1 ... 4	10



- Install sealing flanges for camshaft adjusters with new oil seals at timing chain covers (left and right) -arrows-.

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

- Install crankshaft oil seal (timing chain end) ⇒ [page 41](#) .
- Install cylinder head cover: left-side ⇒ [page 116](#) , right-side ⇒ [page 118](#) .
- Install exhaust manifold: left-side ⇒ [page 208](#) , right-side ⇒ [page 209](#) .
- Install combination valve for secondary air system: left-side ⇒ [page 219](#) , right-side ⇒ [page 221](#) .
- Install coolant pipe (rear) ⇒ [page 181](#) .
- Install coolant pipe (left-side) ⇒ [page 184](#) .
- Install oil filter housing ⇒ [page 160](#) .
- Install intake manifold ⇒ [page 127](#) .
- Install drive plate ⇒ [page 40](#) .
- Bolt gearbox to engine and install engine/gearbox assembly ⇒ [page 28](#) .
- Fill up with engine oil and check oil level ⇒ Maintenance ; Booklet 405 .



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Tightening torques

Component	Nm
Cover (bottom) for Power steering pump	22
timing chain to Engine M6	10
M8	22
Gasket to timing chain cover	4 ¹⁰⁾
Timing chain covers (left and right) to engine	10
Sealing flange to timing chain cover	10
Hall sender to timing chain cover	10
Earth cable to cylinder head	10
Heat shield to engine	10

10) Install using locking fluid; locking fluid ⇒ Parts catalogue .

4 Camshaft drive



Note

The crankshaft and camshafts must only be turned with the chain drive mechanism fully installed. Otherwise the valves may strike the pistons, causing damage to valves and piston crowns.

4.1 Camshaft timing chains - exploded view

Camshaft timing chain (left-side)



Note

Mark rotation direction of chain with paint before removing. If a used chain rotates in the opposite direction when it is refitted, this can cause breakage.

1 - Mounting pin, 10 Nm

2 - 5 Nm + 90° (1/4 turn) further

- ☐ Renew

3 - Washer

- ☐ Note installation position

4 - Bolt for camshaft

- ☐ Renew
- ☐ Pre-tightening torque: 40 Nm
- ☐ Final tightening torque: 100 Nm + 90° (1/4 turn) further

5 - Chain sprocket

- ☐ For exhaust camshaft

6 - Bolt for camshaft

- ☐ Renew
- ☐ Pre-tightening torque: 40 Nm
- ☐ Final tightening torque: 100 Nm + 90° (1/4 turn) further

7 - Rotor for Hall sender

- ☐ When installing, adjust using setting tool - T40047- => [page 66](#)

8 - Camshaft adjuster

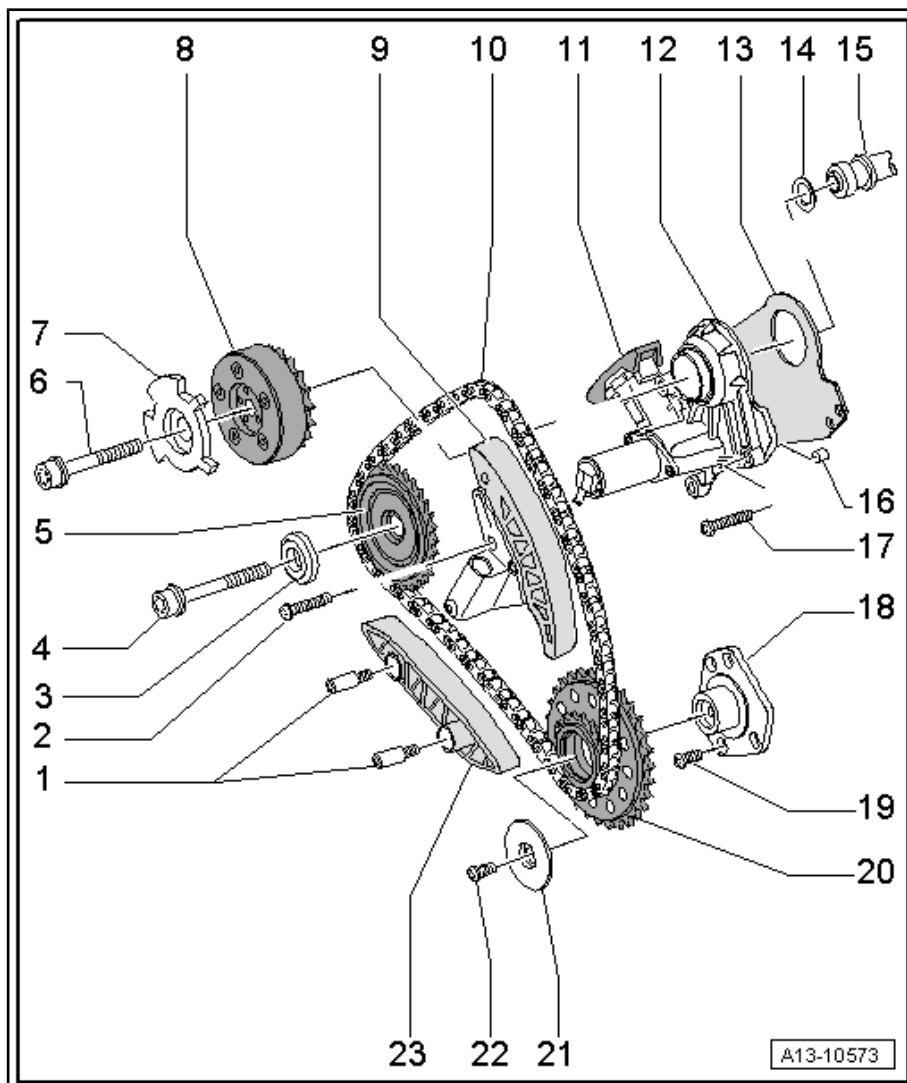
- ☐ For inlet camshaft

9 - Chain tensioner

- ☐ For timing chain (left-side)

10 - Camshaft timing chain (left-side)

- ☐ Removing and installing => [page 60](#)





11 - Guide rail

- ☐ Can be renewed individually

12 - Valve timing housing

- ☐ For camshaft adjuster

13 - Gasket

- ☐ Renew

14 - Diamond-coated washer

- ☐ Renew

15 - Camshaft

16 - Dowel sleeve

- ☐ 2x

17 - 5 Nm + 90° (1/4 turn) further

- ☐ Renew

18 - Bearing bracket

- ☐ For drive chain sprocket

19 - 10 Nm

20 - Drive chain sprocket

- ☐ For timing chain (left-side)

21 - Thrust washer

- ☐ For drive chain sprocket

22 - 5 Nm + 90° (1/4 turn) further

- ☐ Renew

23 - Guide rail



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Camshaft timing chain (right-side)



Note

Mark rotation direction of chain with paint before removing. If a used chain rotates in the opposite direction when it is refitted, this can cause breakage.

1 - Chain tensioner

- ☐ For timing chain (right-side)

2 - 5 Nm + 90° (1/4 turn) further

- ☐ Renew

3 - Bearing mounting

- ☐ For drive chain sprocket

4 - Washer**5 - 42 Nm****6 - Bolt for camshaft**

- ☐ Renew
- ☐ Pre-tightening torque: 40 Nm
- ☐ Final tightening torque: 100 Nm + 90° (1/4 turn) further

7 - Rotor for Hall sender

- ☐ When installing, adjust using setting tool - T40047- [⇒ page 66](#)

8 - Camshaft adjuster

- ☐ For inlet camshaft

9 - Mounting pin, 10 Nm**10 - Guide rail****11 - Thrust washer**

- ☐ For drive chain sprocket

12 - Camshaft timing chain (right-side)

- ☐ Removing and installing [⇒ page 60](#)

13 - Valve timing housing

- ☐ For camshaft adjuster

14 - Gasket

- ☐ Renew

15 - Diamond-coated washer

- ☐ Renew

16 - Camshaft**17 - Dowel sleeve**

- ☐ 2x

18 - Guide rail

- ☐ Can be renewed individually

19 - 5 Nm + 90° (1/4 turn) further

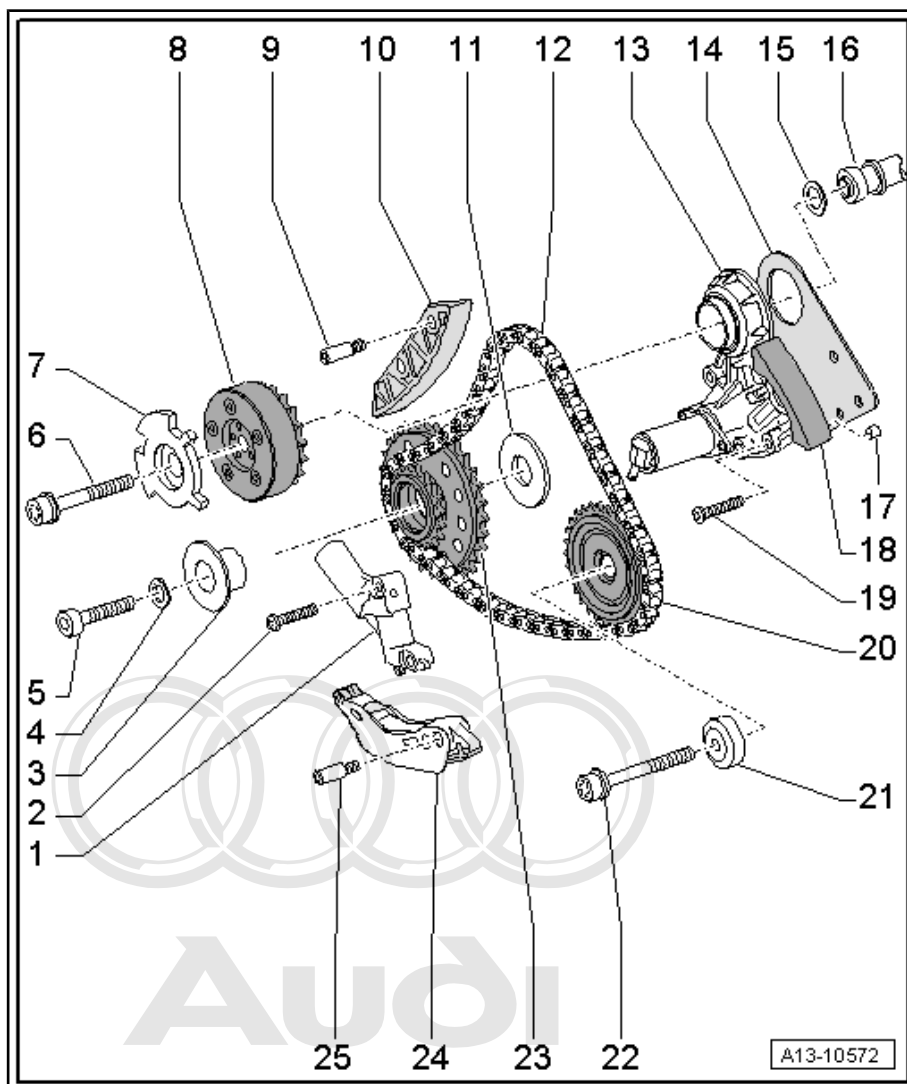
- ☐ Renew

20 - Chain sprocket

- ☐ For exhaust camshaft

21 - Washer

- ☐ Note installation position



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22 - Bolt for camshaft

- ☐ Renew
- ☐ Pre-tightening torque: 40 Nm
- ☐ Final tightening torque: 100 Nm + 90° (1/4 turn) further

23 - Drive chain sprocket

- ☐ For timing chain (right-side)

24 - Guide rail

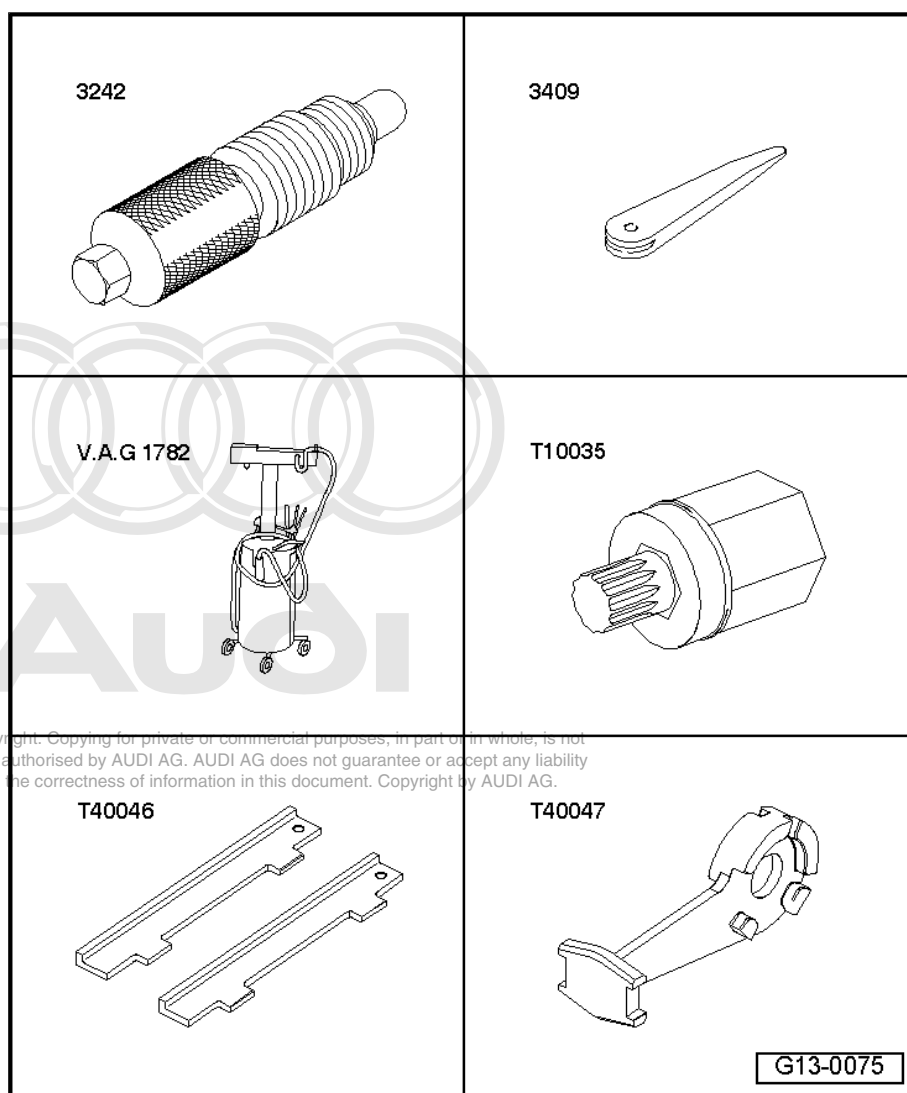
- ☐ For chain tensioner

25 - Mounting pin, 10 Nm

4.2 Removing and installing camshaft timing chains

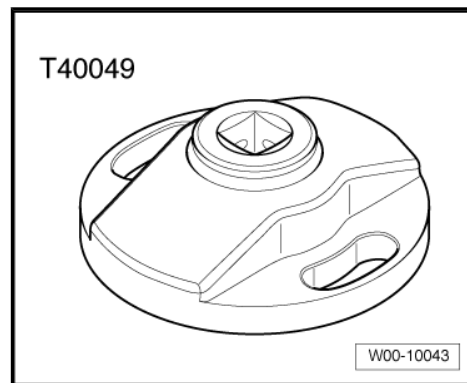
Special tools and workshop equipment required

- ◆ Locking pin -3242-
- ◆ Removal wedge -3409- (2x)
- ◆ Used oil collection and extraction unit -V.A.G 1782-
- ◆ Special wrench -T10035-
- ◆ Camshaft clamp -T40046- (2x)
- ◆ Setting tool -T40047-



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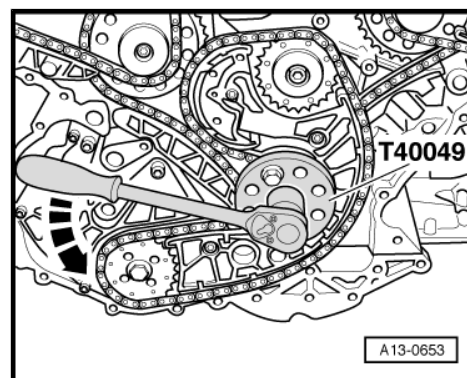
◆ Special wrench -T40049-



◆ Drill bit 3.3 mm Ø (2x)

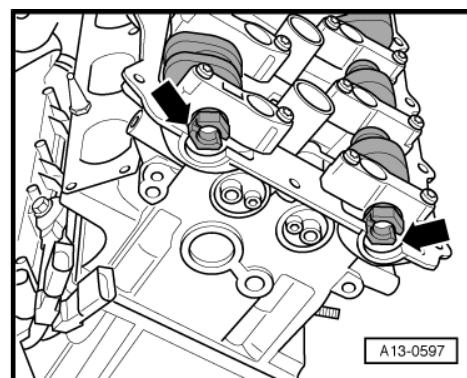
Removing

- Drain off engine oil ⇒ Maintenance ; Booklet 405 .
- Remove engine ⇒ [page 6](#) .
- Separate engine from gearbox ⇒ [page 20](#) .
- Remove timing chain covers ⇒ [page 45](#) .
- Attach special wrench -T40049- at rear end of crankshaft using two old securing bolts for drive plate.
- Turn crankshaft in normal direction of rotation -arrow- to TDC position:

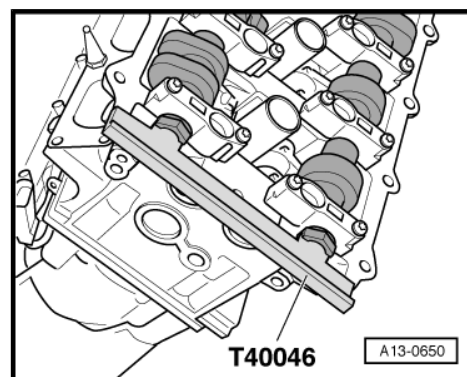


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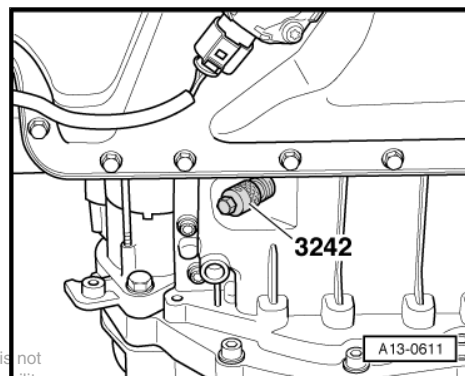
The slits -arrows- at front of the camshafts must be parallel to and at the same height as the top edge of cylinder head.



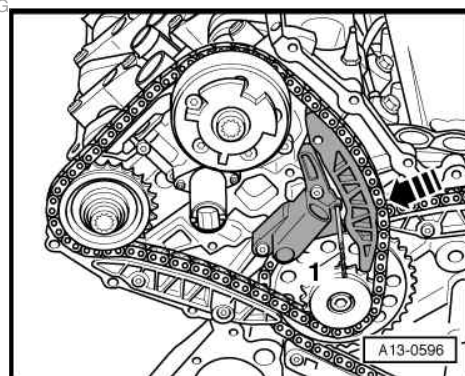
- If necessary, turn the camshafts at hexagon flats back and forth slightly until camshaft clamp -T40046- can be attached.
- If the camshaft clamp -T40046- cannot be attached, turn crankshaft 1 full turn (360°) in normal rotation direction.
- Remove the camshaft clamp again.
- Unscrew plug from sump (top section).



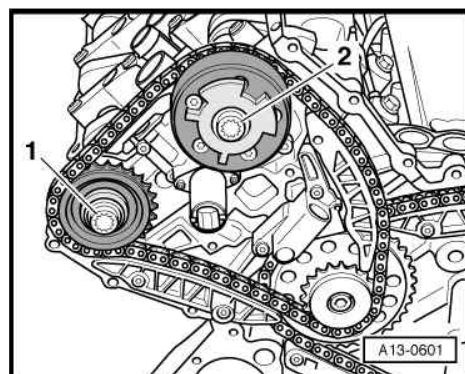
- Screw locking pin -3242- into bore (20 Nm); if necessary, turn crankshaft backwards and forwards slightly to fully centralise locking pin.



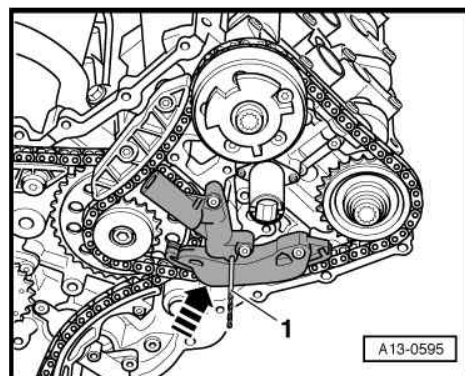
- Press guide rail of chain tensioner for timing chain (left-side) in direction of -arrow- and lock chain tensioner by inserting a 3.3 mm Ø drill bit -item 1-.
- Mark running direction of timing chain (left-side) with paint.



- Unscrew bolts -1- and -2- for camshaft chain sprocket and camshaft adjuster using special wrench -T10035-.
- Take off camshaft sprocket, camshaft adjuster and timing chain.



- Press guide rail of chain tensioner for timing chain (right-side) in direction of -arrow- and lock chain tensioner by inserting a 3.3 mm Ø drill bit -item 1-.
- Mark running direction of timing chain (right-side) with paint.



- Unscrew bolts -1- and -2- for camshaft chain sprocket and camshaft adjuster using special wrench -T10035- .
- Take off camshaft sprocket, camshaft adjuster and timing chain.

Installing

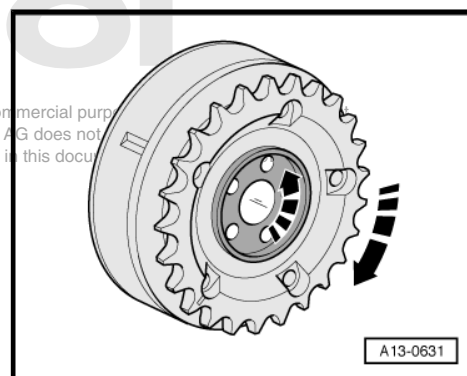
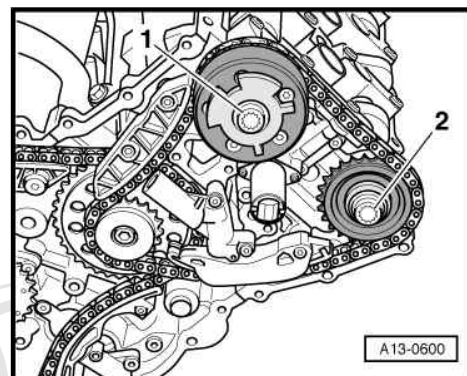
- Crankshaft locked in TDC position with locking pin -3242- .
- Drive chain for valve gear installed ⇒ [page 90](#)



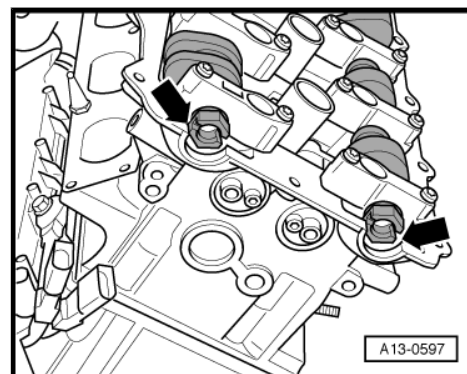
Note

- ◆ *Renew bolts which are tightened to a specified angle as well as oil seals and gaskets.*
- ◆ *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.*

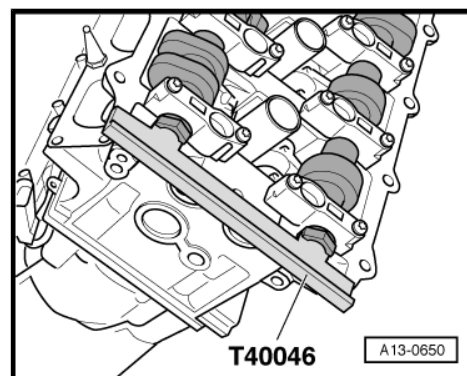
- Turn inner section and outer section of both camshaft adjusters in opposite directions until they engage -arrows-.
- It should not be possible to turn inner and outer sections in opposite directions once they have engaged (however, a small amount of play is normal).



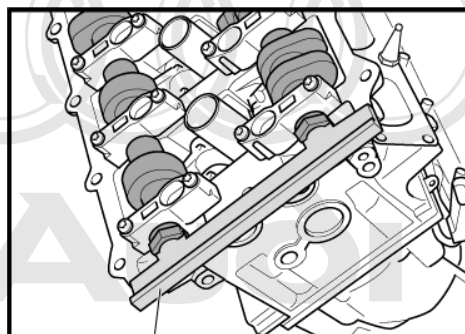
- Check that camshafts on both cylinder heads are positioned at TDC.
- The slits -arrows- at front of the camshafts must be parallel to and at the same height as the top edge of cylinder head.



- Insert camshaft clamp -T40046- in camshafts of left-side cylinder head (if necessary, turn camshafts back and forth slightly at hexagon flats).

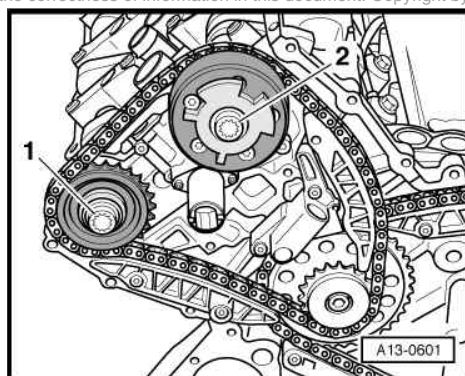


- Insert camshaft clamp -T40046- in camshafts of right-side cylinder head (if necessary, turn camshafts back and forth slightly at hexagon flats).
- Renew all four camshaft bolts.

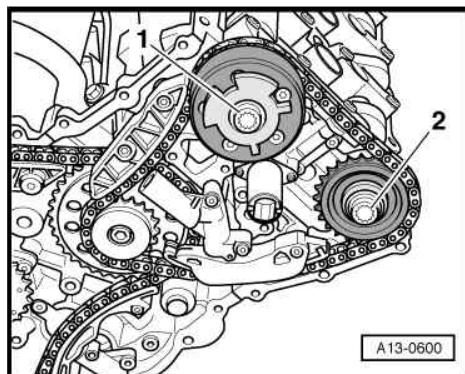


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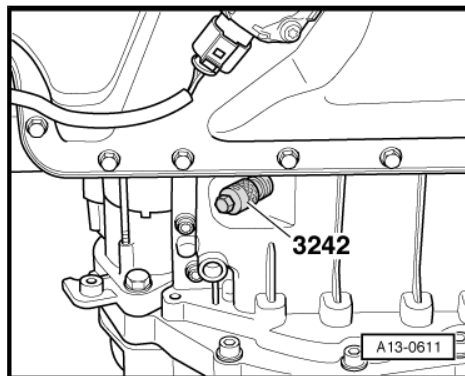
- Renew diamond-coated washer ⇒ [Item 14 \(page 58\)](#) between camshaft and camshaft adjuster on cylinder head (left-side).
- Install timing chain (left-side) with camshaft sprocket and camshaft adjuster.
- Screw in bolts -1- and -2- finger-tight.
- It should just be possible to turn the sprocket and camshaft adjuster on the camshaft without axial movement.



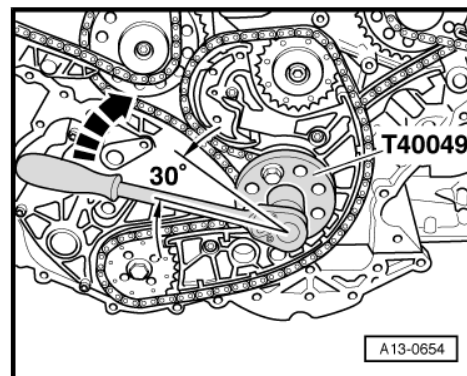
- Renew diamond-coated washer ⇒ [Item 15 \(page 59\)](#) between camshaft and camshaft adjuster on cylinder head (right-side).
- Install timing chain (right-side) with camshaft sprocket and camshaft adjuster.
- Screw in bolts -1- and -2- finger-tight.
- It should just be possible to turn the sprocket and camshaft adjuster on the camshaft without axial movement.



- Remove locking pin -3242- .



- Turn crankshaft 30° in opposite direction of normal rotation -arrow- using special wrench -T40049- .
- Pull drill bit from locating hole, this releases the chain tensioner (left-side).



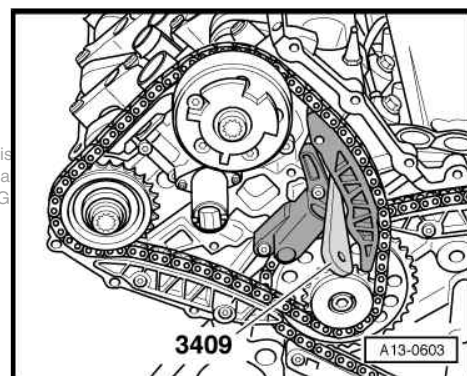
- Insert removal wedge -3409- as shown in illustration and use it to bring chain tensioner into contact.

**Note**

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Do NOT press too far beyond once contact is made; max. 0.5 mm.

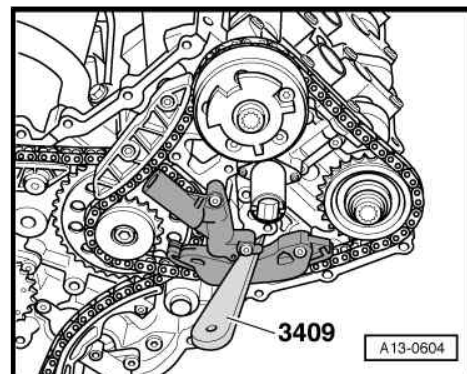
- Pull drill bit from locating hole, this releases the chain tensioner (right-side).



- Insert removal wedge -3409- as shown in illustration and use it to bring chain tensioner into contact.

**Note**

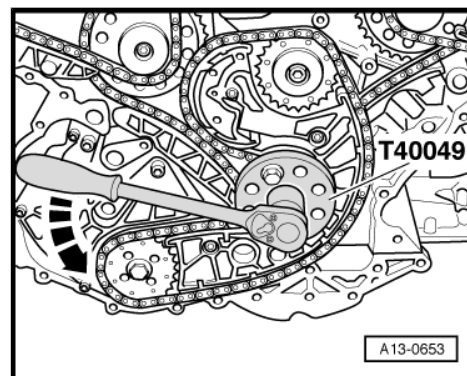
Do NOT press too far beyond once contact is made; max. 0.5 mm.



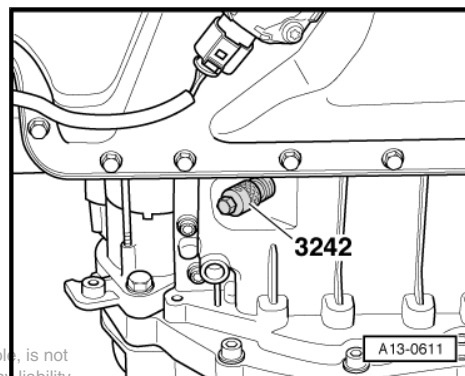
- Using special wrench -T40049- , turn crankshaft in normal direction of rotation -arrow- to TDC.

**Note**

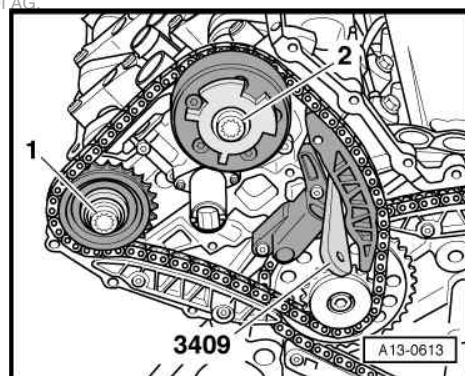
If you turned the crankshaft beyond TDC, turn it back approx. 30° and set to TDC again.



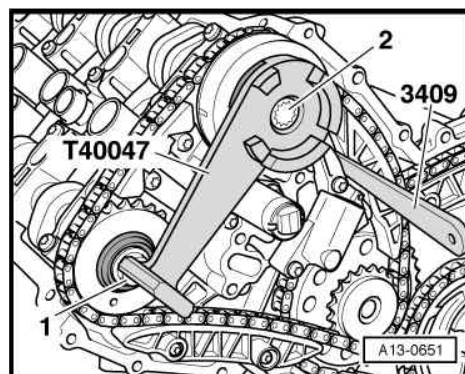
- Screw locking pin -3242- into bore; if necessary, turn crankshaft backwards and forwards slightly to fully centralise locking pin. Tightening torque: 20 Nm.



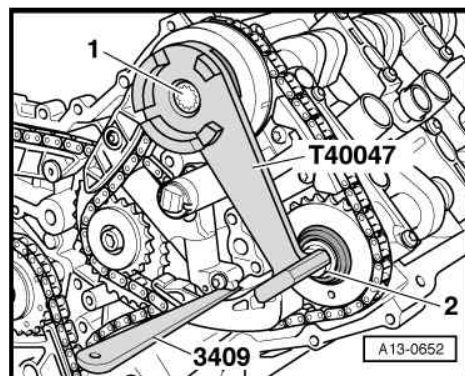
- Pre-tighten camshaft bolt -1- at exhaust camshaft on cylinder head (left-side). Tightening torque: 40 Nm.



- Lock the Hall sender rotor at camshaft adjuster for inlet camshaft on cylinder head (left-side) using setting tool -T40047-.
- Apply setting tool -T40047- at bolt -1-.
- Pre-tighten camshaft bolt -2- at inlet camshaft. Tightening torque: 40 Nm



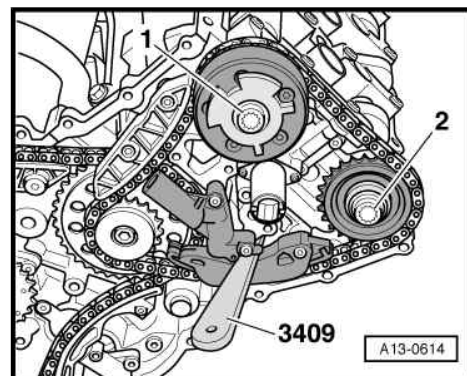
- Lock the Hall sender rotor at camshaft adjuster for inlet camshaft on cylinder head (right-side) using setting tool -T40047-.
- Apply setting tool -T40047- at bolt -2-.
- Pre-tighten camshaft bolt -1- at inlet camshaft. Tightening torque: 40 Nm.
- Remove the setting tool.



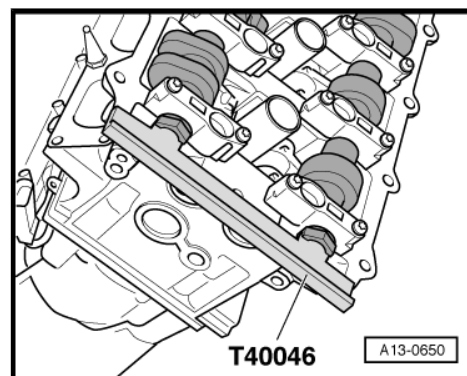
- Pre-tighten camshaft bolt -2- at exhaust camshaft on cylinder head (right-side). Tightening torque: 40 Nm.

**Note**

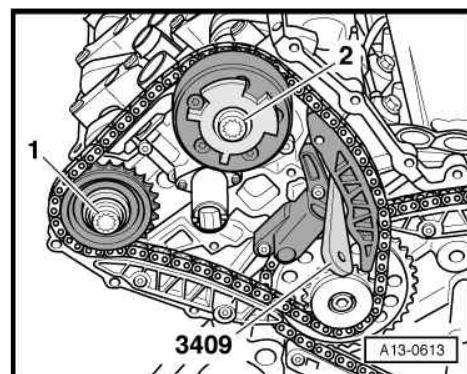
The camshaft clamps -T40046- must not be used as counterholds when tightening camshaft bolts to final torque.



- Remove camshaft clamps -T40046- from both cylinder heads.

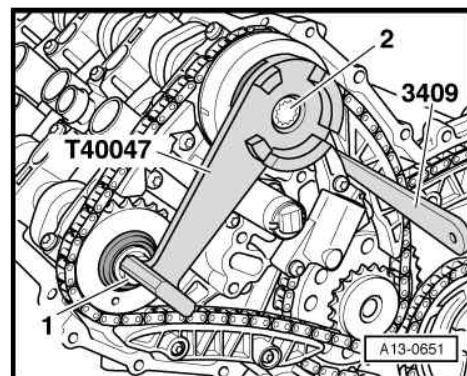


- Tighten camshaft bolt -1- at exhaust camshaft on cylinder head (left-side) to final torque. Tightening torque: 100 Nm + 90° (1/4 turn further).

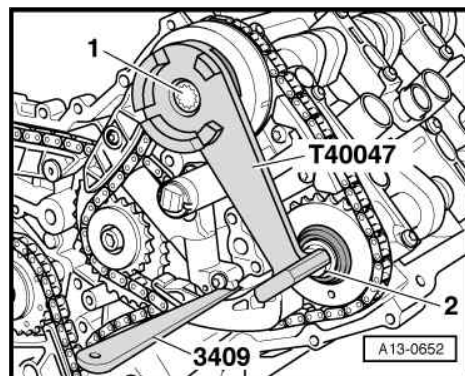


- Lock the Hall sender rotor at camshaft adjuster for inlet camshaft on cylinder head (left-side) using setting tool -T40047-.
- Apply setting tool -T40047- at bolt -1-.

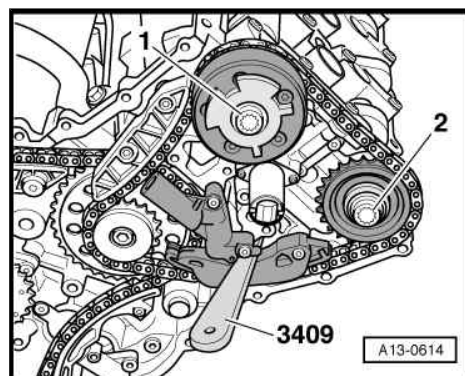
- Tighten camshaft bolt -2- at inlet camshaft to final torque. Tightening torque: 100 Nm + 90° (1/4 turn further).



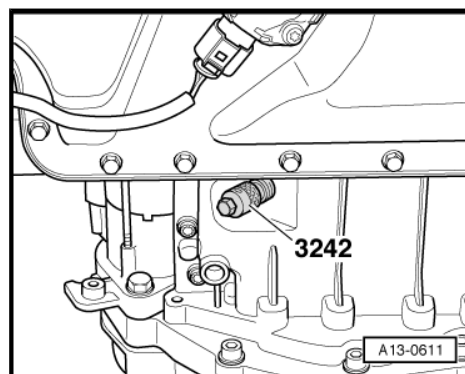
- Lock the Hall sender rotor at camshaft adjuster for inlet camshaft on cylinder head (right-side) using setting tool -T40047- .
- Apply setting tool -T40047- at bolt -2-.
- Tighten camshaft bolt -1- at inlet camshaft to final torque. Tightening torque: 100 Nm + 90° (1/4 turn further).
- Remove the setting tool.



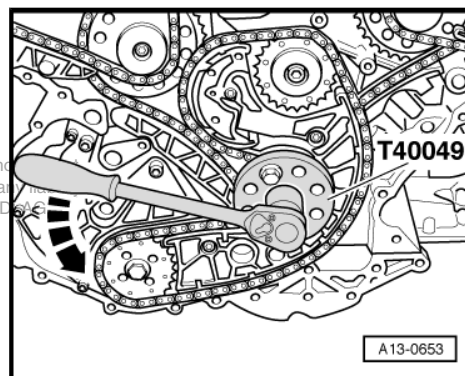
- Tighten camshaft bolt -2- at exhaust camshaft on cylinder head (right-side) to final torque. Tightening torque: 100 Nm + 90° (1/4 turn further).



- Remove locking pin -3242- .

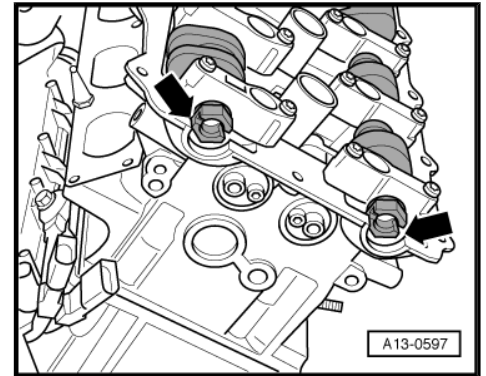


- Using special wrench -T40049- , turn crankshaft two rotations in normal direction of rotation -arrow- until crankshaft is at TDC again.

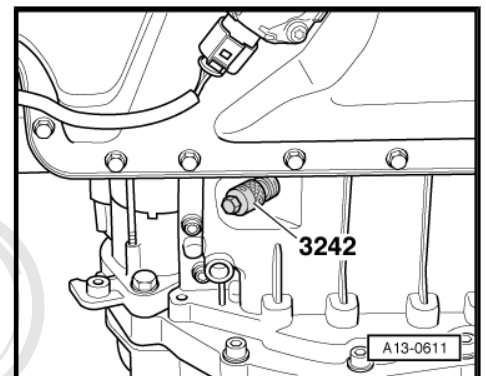


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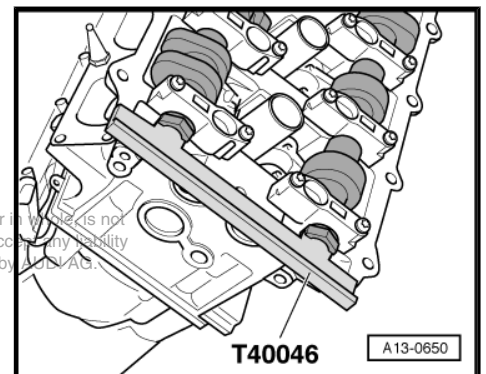
- The slits -arrows- at front of the camshafts must be parallel to and at the same height as the top edge of cylinder head.



- Screw locking pin -3242- into bore (20 Nm); if necessary, turn crankshaft backwards and forwards slightly to fully centralise locking pin.



- Attach camshaft clamp -T40046- on camshafts at cylinder head (left-side).



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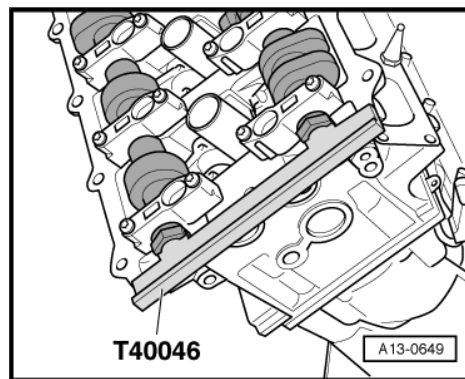
- Apply camshaft clamp -T40046- to camshafts on cylinder head (right-side).



Note

If it is not possible to insert camshaft holders, repeat adjustment.

- Take out removal wedge -3409- .
- Remove camshaft clamps -T40046- from both cylinder heads.
- Remove locking pin -3242- .
- Secure screw plug for the TDC mark into the top section of the sump with a new seal.



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

- Install timing chain covers ⇒ [page 53](#) .
- Install drive plate ⇒ [page 40](#) .
- Bolt gearbox to engine and install engine/gearbox assembly ⇒ [page 28](#) .

Tightening torques

Component	Nm
Camshaft bolts	100 + 90° ¹¹⁾ ¹²⁾
Screw plug in top section of sump	35

11) 90° = a quarter of a turn.

12) Renew bolts.

4.3 Detaching camshaft timing chains from camshafts



Note

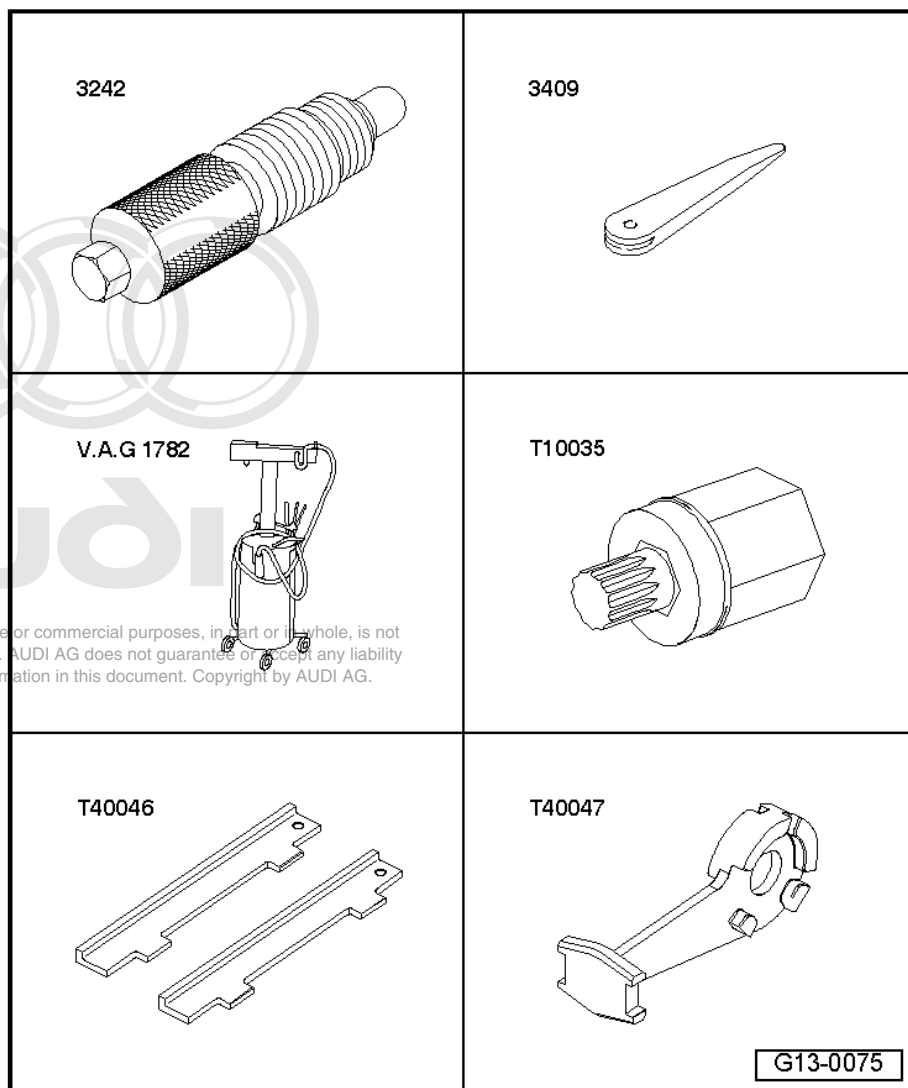
- ◆ *To remove the cylinder head or camshafts, it is sufficient to remove the timing chains from the camshafts only. The timing chains remain on engine; the engine/gearbox assembly is not separated.*
- ◆ *You must adhere to the described procedures even if you are only working on one of the cylinder heads, since the timing adjustment must be performed for both cylinder heads when work is completed.*

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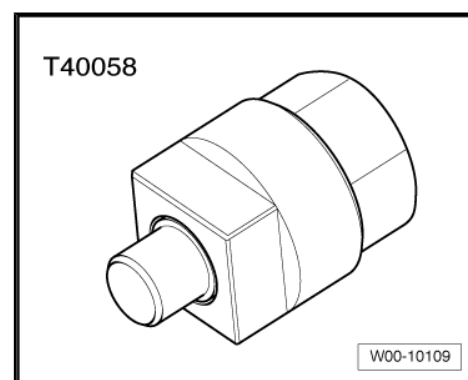
Special tools and workshop equipment required

- ◆ Locking pin -3242-
- ◆ Removal wedge -3409- (2x)
- ◆ Used oil collection and extraction unit -V.A.G 1782-
- ◆ Special wrench -T10035-
- ◆ Camshaft clamp -T40046- (2x)
- ◆ Setting tool -T40047-
- ◆ Drill bit 3.3 mm $\varnothing$ (2x)

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- ◆ Adapter -T40058-

**Procedure**

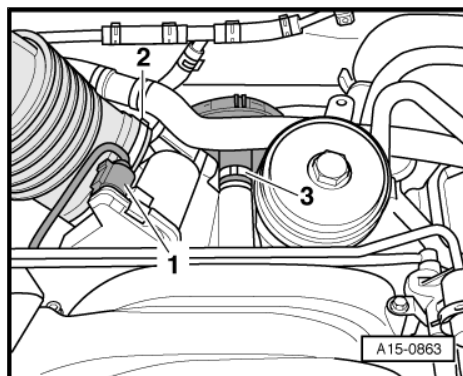
- Remove engine $\Rightarrow$ [page 6](#) .
- Separate engine from gearbox $\Rightarrow$ [page 20](#) .

- Unplug electrical connector -1- at throttle valve module - J338- .
- Disconnect hose -3- for crankcase breather system at intake manifold.

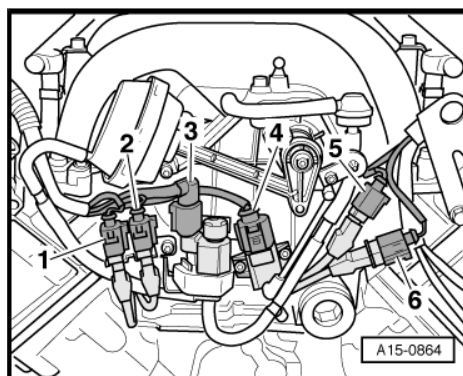


Note

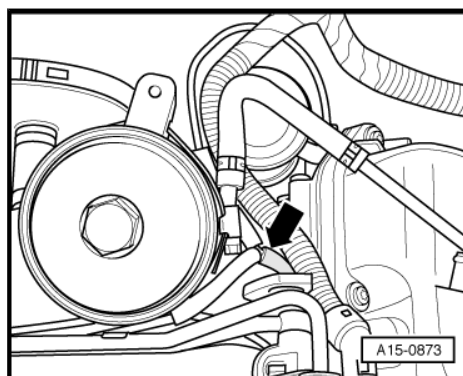
Disregard -item 2-.



- Detach electrical connectors -1-, -2-, -5- and -6- forwards from brackets on intake manifold.
- Unplug electrical connectors -3- and -4-.



- Detach vacuum hose -arrow- from T-piece.

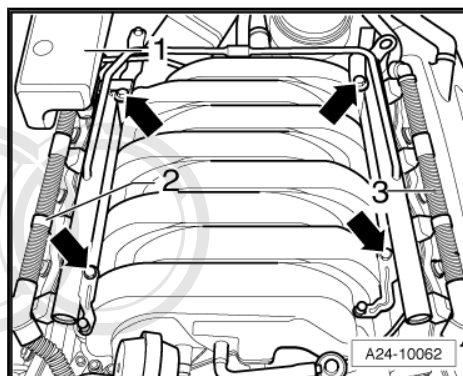


- Unplug connector rails -2- and -3- at 8 injectors.
- Unscrew bolts -arrows- securing fuel rail.
- Pull fuel rail together with injectors off intake manifold (pull off evenly from the top) and place it on a clean cloth in the engine compartment.

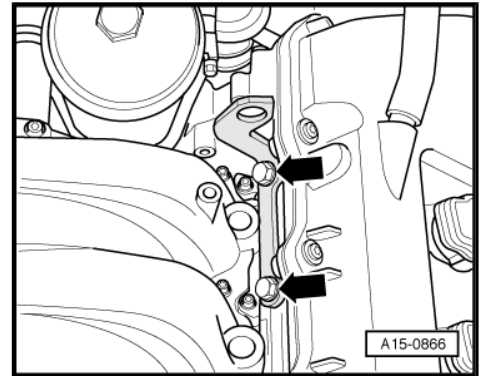


Note

Make sure the removed injectors do not become soiled.



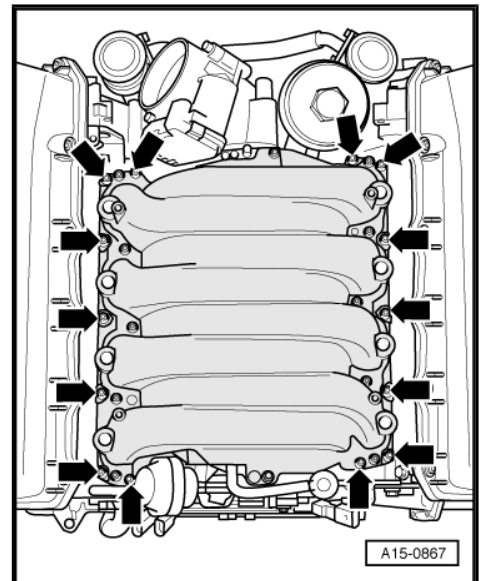
- Unscrew engine lifting eye (rear left) -arrows-.



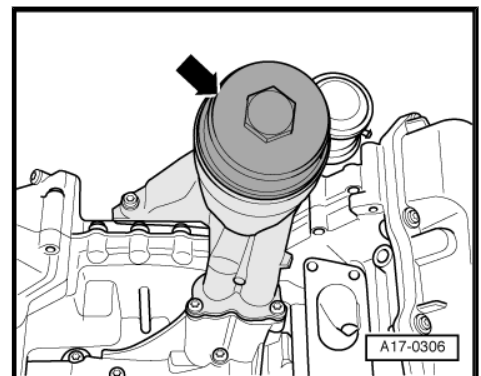
- Unscrew and remove intake manifold -arrows-.

**Note**

Seal intake ports on cylinder heads with clean cloths.

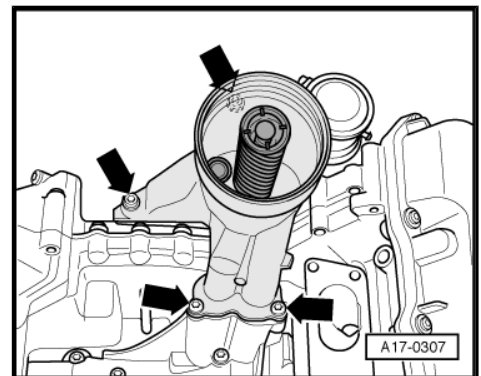


- Unscrew sealing cap -arrow- for oil filter housing.
- Remove oil filter element.
- Extract engine oil from oil filter housing using used oil collection and extraction unit -V.A.G 1782- .

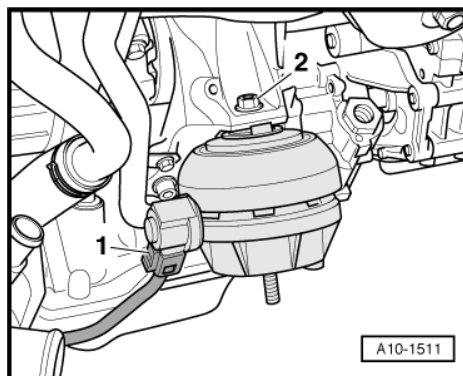
**Note**

Place a cloth around the oil filter housing to catch any escaping oil.

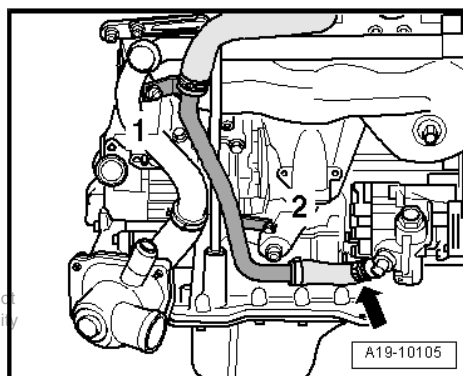
- Remove bolts -arrows-.
- Remove oil filter housing.



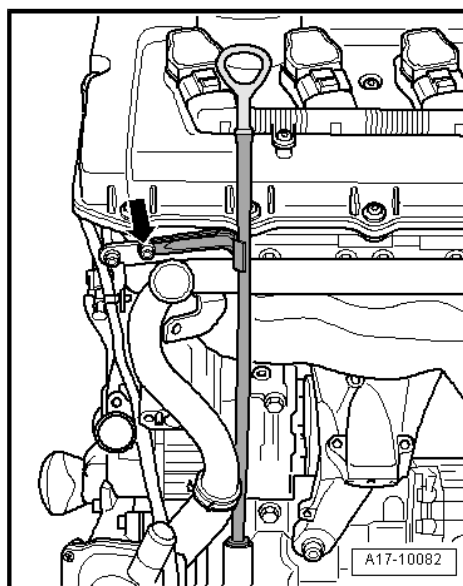
- Unplug electrical connector -1- at engine mounting (left-side).
- Unscrew nut -2- and remove engine mounting.



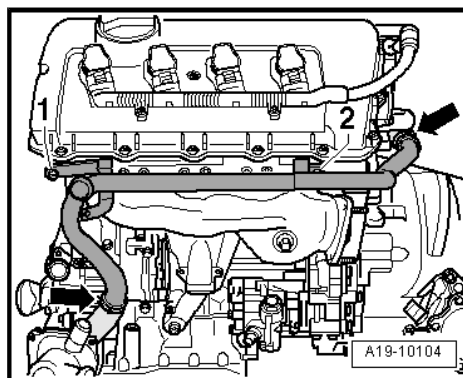
- Remove bolts -1- and -2-.
- Detach return line from power steering pump -arrow-.



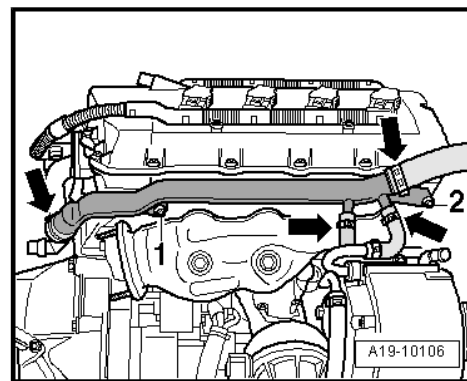
- Unbolt dipstick guide tube on cylinder head -arrow- and lift out upwards.



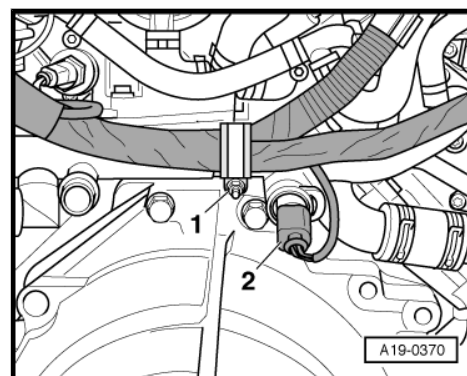
- Remove bolts -1- and -2-.
- Loosen hose clips -arrows- and detach coolant pipe (left-side) from coolant hoses.



- Remove bolts -1- and -2-.
- Loosen hose clips -arrows- and detach coolant pipe (right-side) from coolant hoses.



- Unplug electrical connector -2- at coolant temperature sender -G62-.
- Unscrew nut -1- and detach electrical wiring harness at coolant pipe (rear).

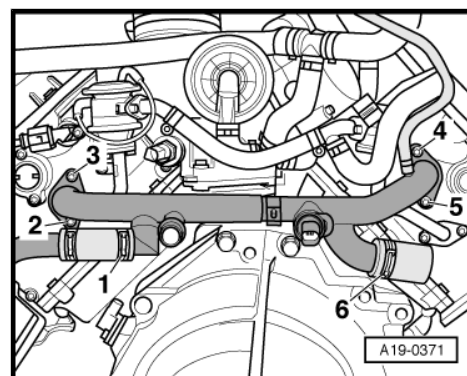


- Remove bolts -2 ... 5-.
- Detach coolant pipe (rear).

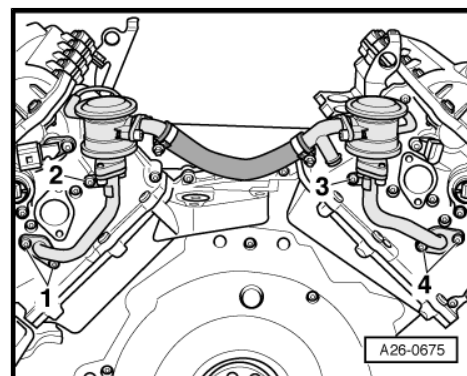
**Note**

Disregard items marked -1- and -6-.

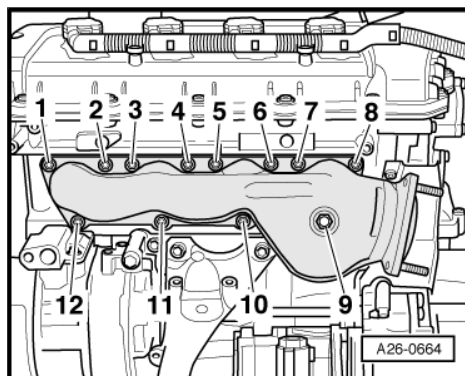
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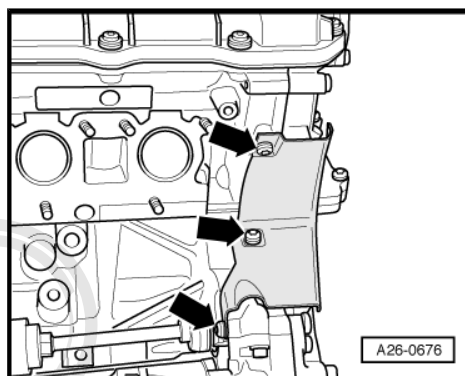
- Unscrew securing bolts -1 ... 4- for combination valves for secondary air system.



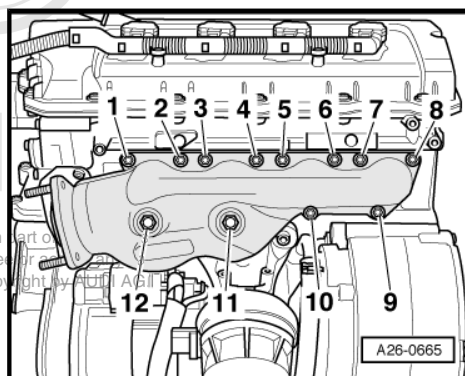
- Unscrew nuts -1 ... 12- and remove exhaust manifold (left-side).



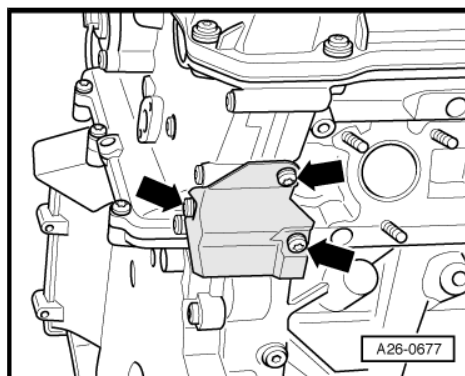
- Detach heat shield (left-side) -arrows-.



- Unscrew nuts -1 ... 12- and remove exhaust manifold (right-side).



- Detach heat shield (right-side) -arrows-.

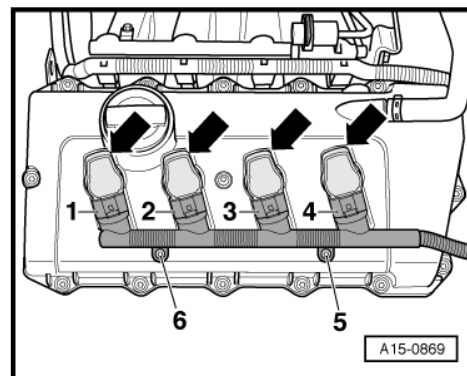


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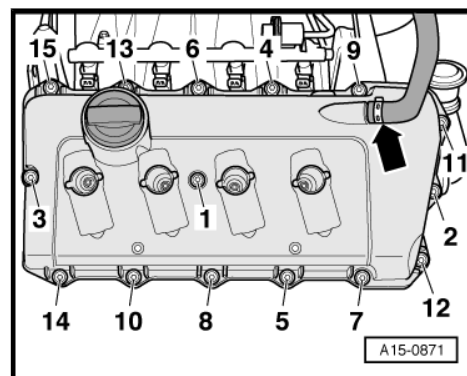
- Unscrew bolts -5- and -6- at cylinder head (left-side).
- Unplug electrical connectors -1 ... 4-.
- Pull out ignition coils -arrows-.

**Note**

Use puller -T10094- to remove.



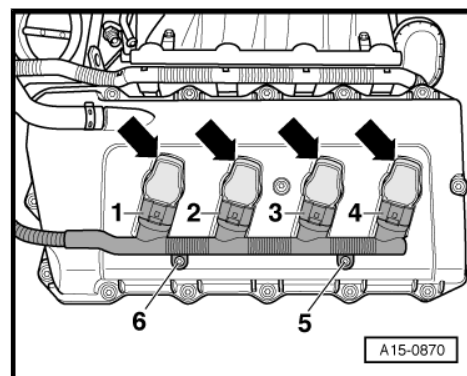
- Detach crankcase breather hose -arrow-.
- Unscrew cylinder head cover bolts (left-side) in the sequence -15 ... 1-.
- Remove cylinder head cover.



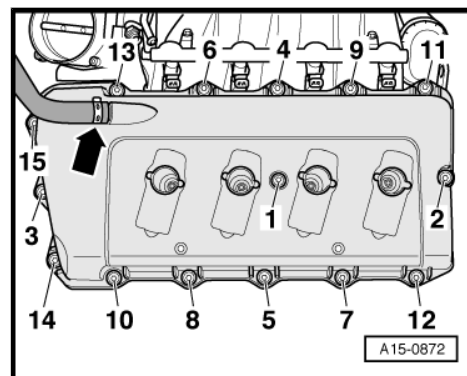
- Unscrew bolts -5- and -6- at cylinder head (right-side).
- Unplug electrical connectors -1 ... 4-.
- Pull out ignition coils -arrows-.

**Note**

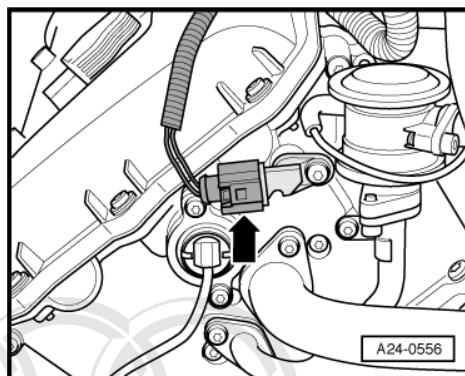
Use puller -T10094- to remove.



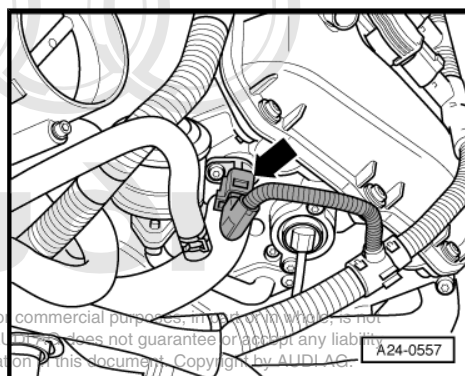
- Detach crankcase breather hose -arrow-.
- Unscrew cylinder head cover bolts (right-side) in the sequence -15 ... 1-.
- Remove cylinder head cover.



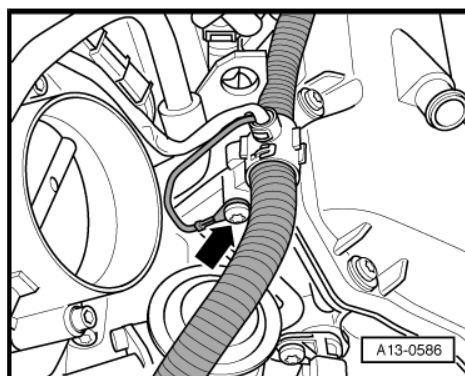
- Unplug electrical connector -arrow- for Hall sender 2 -G163- at cylinder head (left-side).



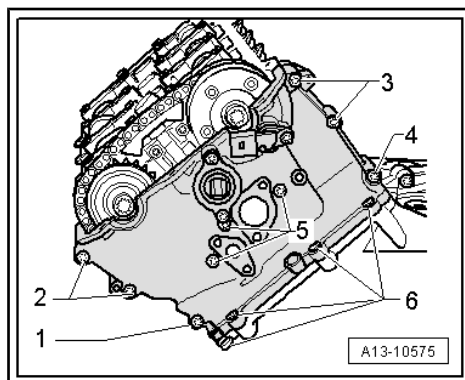
- Unplug electrical connector -arrow- for Hall sender -G40- at cylinder head (right-side).



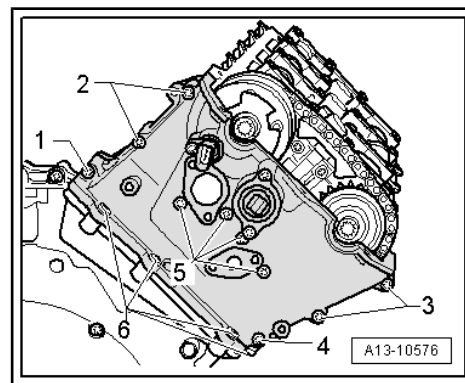
- Unscrew earth cable at cylinder head (right-side) -arrow-.
- Move wiring harness clear.



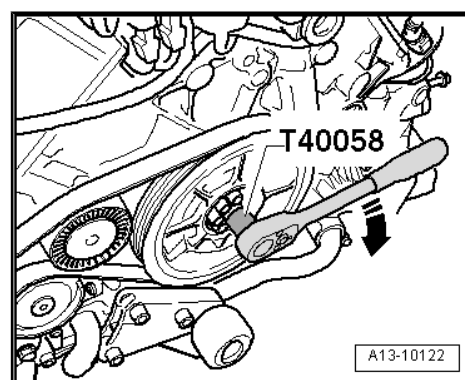
- Remove bolts -1 ... 6- and detach timing chain cover (left-side).



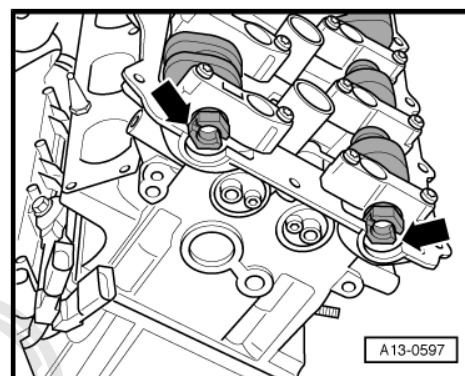
- Remove bolts -1 ... 6- and detach timing chain cover (right-side).



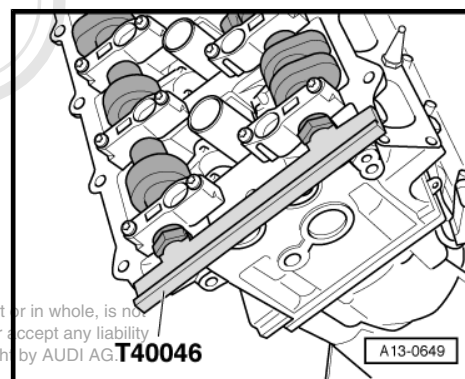
- Using adapter -T40058-, turn crankshaft in normal direction of rotation -arrow- to TDC.



- The slits -arrows- at front of the camshafts must be parallel to and at the same height as the top edge of cylinder head.

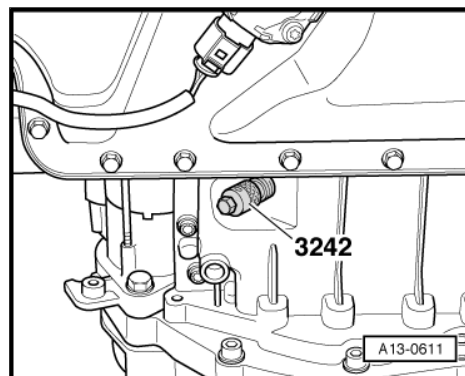


- If necessary, turn the camshafts at hexagon flats back and forth slightly until camshaft clamp -T40046- can be attached.
- If the camshaft clamp -T40046- cannot be attached, turn crankshaft 1 full turn (360°) in normal rotation direction.
- Remove the camshaft clamp again.
- Unscrew plug from sump (top section).



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- Screw locking pin -3242- into bore; if necessary, turn crankshaft backwards and forwards slightly to fully centralise locking pin. Tightening torque: 20 Nm.

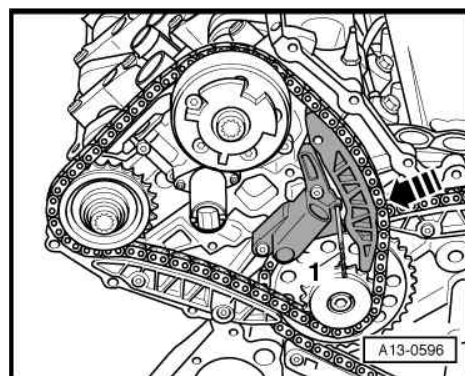


- Press guide rail of chain tensioner for timing chain (left-side) in direction of -arrow- and lock chain tensioner by inserting a 3.3 mm Ø drill bit -item 1-.



Note

The following illustrations show the timing drive with the covers completely removed.

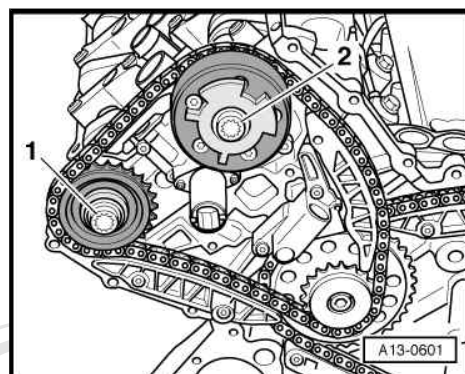


- Unscrew bolts -1- and -2- for camshaft chain sprocket and camshaft adjuster using special wrench -T10035-.
- Remove camshaft sprocket and camshaft adjuster.

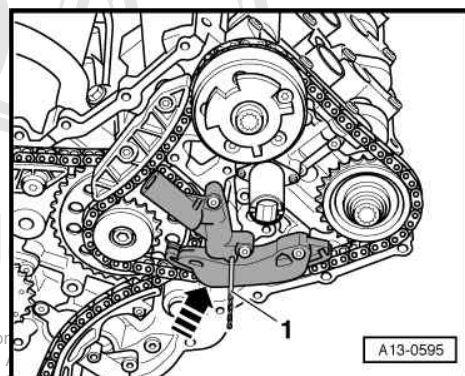


Note

- ♦ The camshaft timing chain remain on engine.
- ♦ Even if you only need to remove one of the cylinder heads, you will still need to loosen the bolts for camshaft sprockets on both cylinder heads.



- Press guide rail of chain tensioner for timing chain (right-side) in direction of -arrow- and lock chain tensioner by inserting a 3.3 mm Ø drill bit -item 1-.

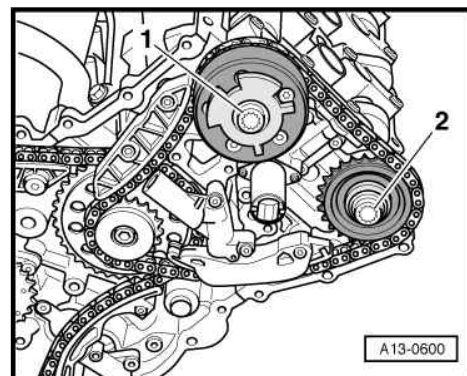


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- Unscrew bolts -1- and -2- for camshaft chain sprocket and camshaft adjuster using special wrench -T10035- .
- Remove camshaft sprocket and camshaft adjuster.

**Note**

- ◆ *The camshaft timing chain remain on engine.*
- ◆ *Even if you only need to remove one of the cylinder heads, you will still need to loosen the bolts for camshaft sprockets on both cylinder heads.*

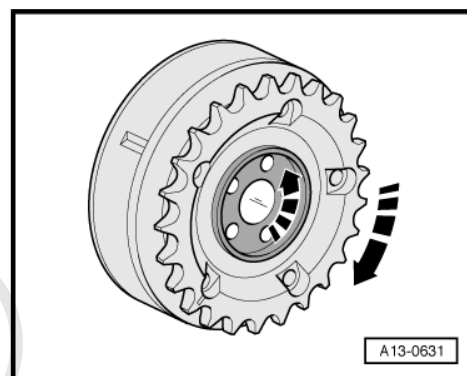
**Installing**

- Crankshaft locked in TDC position with locking pin -3242- .

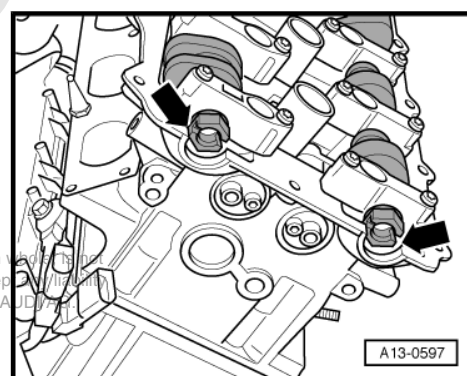
**Note**

- ◆ *Renew self-locking nuts and bolts when performing assembly work.*
- ◆ *Renew bolts which are tightened to a specified angle as well as oil seals and gaskets.*
- ◆ *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.*

- Turn inner section and outer section of both camshaft adjusters in opposite directions until they engage -arrows-.
- It should not be possible to turn inner and outer sections in opposite directions once they have engaged (however, a small amount of play is normal).

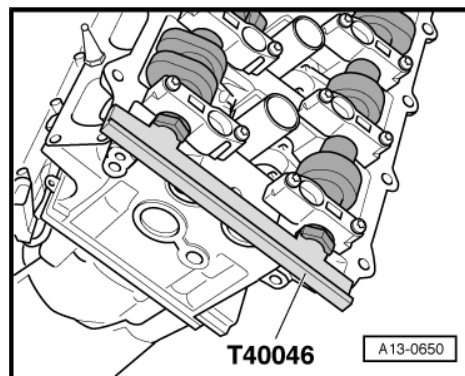


- Check that camshafts on both cylinder heads are positioned at TDC.
- The slits -arrows- at front of the camshafts must be parallel to and at the same height as the top edge of cylinder head.

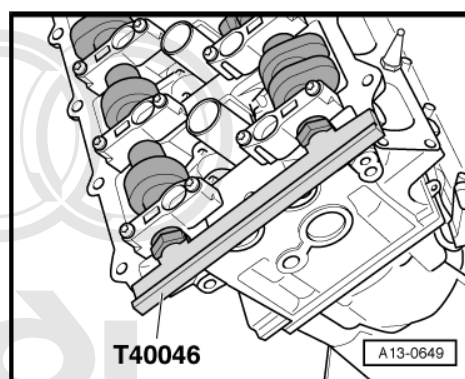


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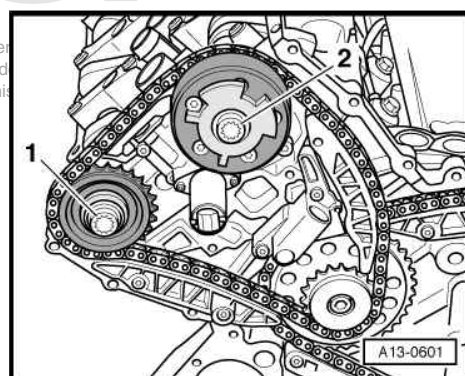
- Insert camshaft clamp -T40046- in camshafts of left-side cylinder head (if necessary, turn camshafts back and forth slightly at hexagon flats).



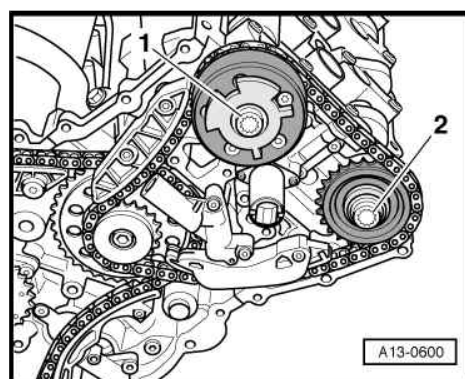
- Insert camshaft clamp -T40046- in camshafts of right-side cylinder head (if necessary, turn camshafts back and forth slightly at hexagon flats).
- Renew all four camshaft bolts.



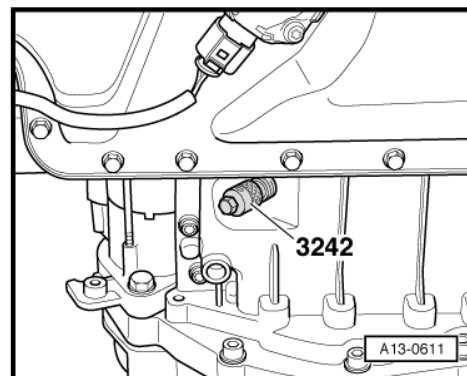
- Install timing chain (left-side) with camshaft sprocket and camshaft adjuster.
- Screw in bolts -1- and -2- finger-tight.
- It should just be possible to turn the sprocket and camshaft adjuster on the camshaft without axial movement.



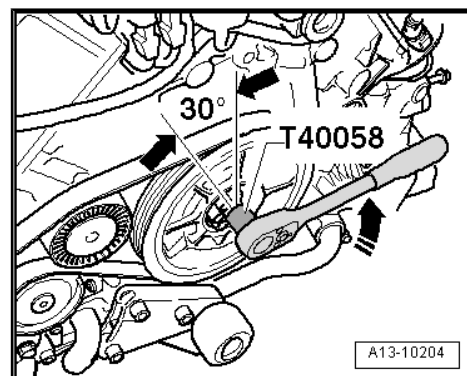
- Install timing chain (right-side) with camshaft sprocket and camshaft adjuster.
- Screw in bolts -1- and -2- finger-tight.
- It should just be possible to turn the sprocket and camshaft adjuster on the camshaft without axial movement.



- Remove locking pin -3242- .



- Turn crankshaft 30° in opposite direction of normal rotation -arrow- using adapter -T40058- .
- Pull drill bit from locating hole, this releases the chain tensioner (left-side).

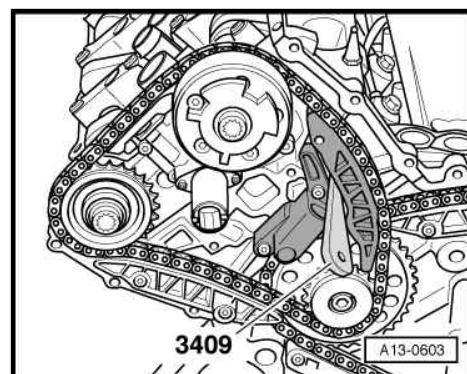


- Insert removal wedge -3409- as shown in illustration and use it to bring chain tensioner into contact.

**Note**

Do NOT press too far beyond once contact is made; max. 0.5 mm.

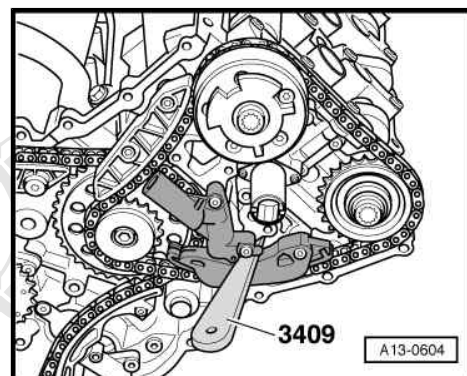
- Pull drill bit from locating hole, this releases the chain tensioner (right-side).



- Insert removal wedge -3409- as shown in illustration and use it to bring chain tensioner into contact.

**Note**

Do NOT press too far beyond once contact is made; max. 0.5 mm.

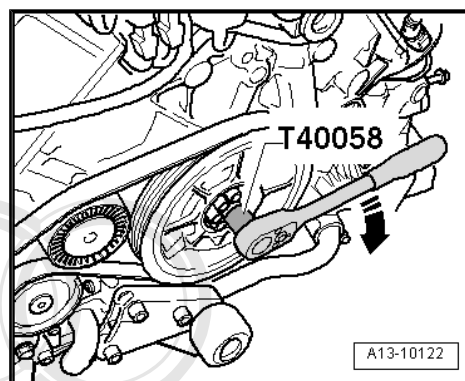


- Using adapter -T40058- , turn crankshaft in normal direction of rotation -arrow- to TDC.



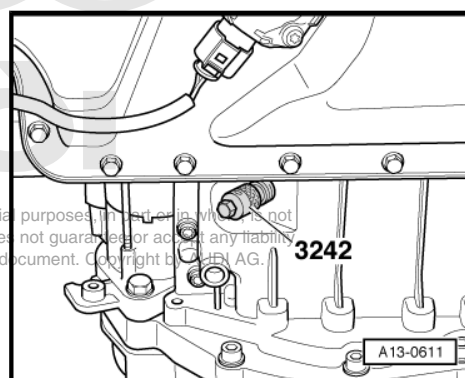
Note

If you turned the crankshaft beyond TDC, turn it back approx. 30° and set to TDC again.

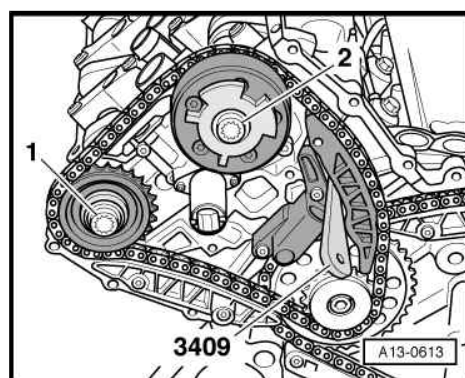


- Screw locking pin -3242- into bore; if necessary, turn crankshaft backwards and forwards slightly to fully centralise locking pin. Tightening torque: 20 Nm.

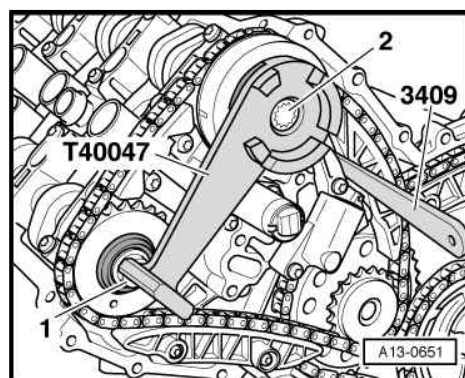
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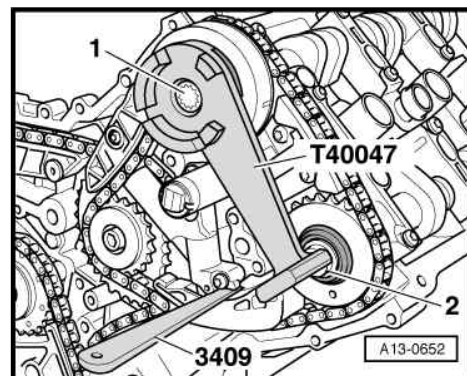
- Pre-tighten camshaft bolt -1- at exhaust camshaft on cylinder head (left-side). Tightening torque: 40 Nm.



- Lock the Hall sender rotor at camshaft adjuster for inlet camshaft on cylinder head (left-side) using setting tool -T40047- .
- Apply setting tool -T40047- at bolt -1-.
- Pre-tighten camshaft bolt -2- at inlet camshaft. Tightening torque: 40 Nm.



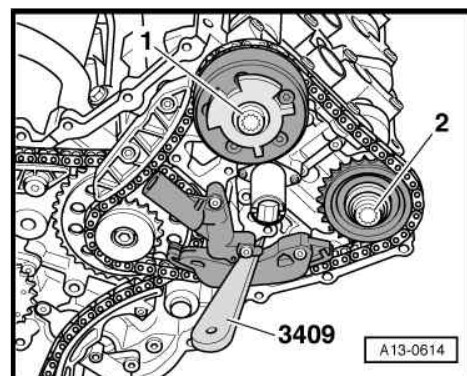
- Lock the Hall sender rotor at camshaft adjuster for inlet camshaft on cylinder head (right-side) using setting tool -T40047-.
- Apply setting tool -T40047- at bolt -2-.
- Pre-tighten camshaft bolt -1- at inlet camshaft. Tightening torque: 40 Nm.
- Remove the setting tool.



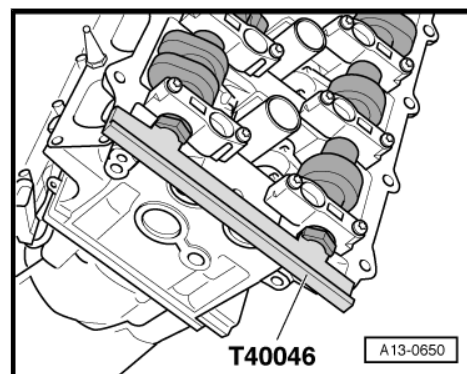
- Pre-tighten camshaft bolt -2- at exhaust camshaft on cylinder head (right-side). Tightening torque: 40 Nm.

**Note**

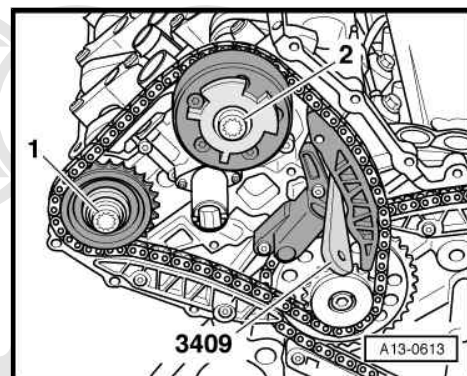
The camshaft clamps -T40046- must not be used as counterholds when tightening camshaft bolts to final torque.



- Remove camshaft clamps -T40046- from both cylinder heads.

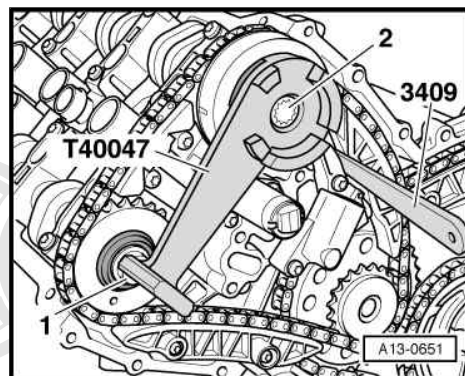


- Tighten camshaft bolt -1- at exhaust camshaft on cylinder head (left-side) to final torque. Tightening torque: 100 Nm + 90° (1/4 turn further).

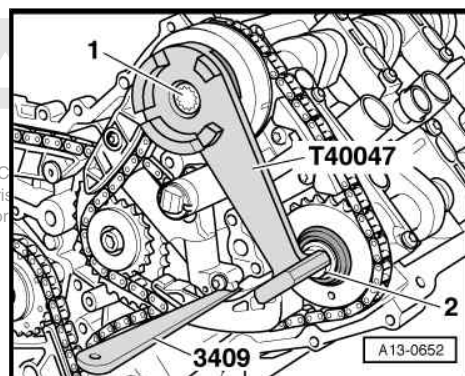


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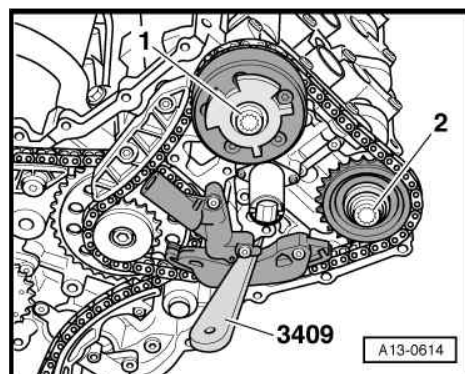
- Lock the Hall sender rotor at camshaft adjuster for inlet camshaft on cylinder head (left-side) using setting tool -T40047- .
- Apply setting tool -T40047- at bolt -1-.
- Tighten camshaft bolt -2- at inlet camshaft to final torque. Tightening torque: 100 Nm + 90° (1/4 turn further).



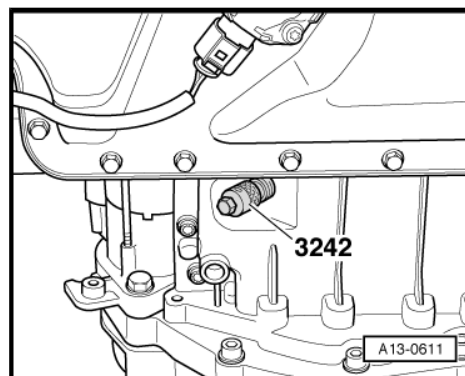
- Lock the Hall sender rotor at camshaft adjuster for inlet camshaft on cylinder head (right-side) using setting tool -T40047- .
- Apply setting tool -T40047- at bolt -2-.
- Tighten camshaft bolt -1- at inlet camshaft to final torque. Tightening torque: 100 Nm + 90° (1/4 turn further).
- Remove the setting tool.



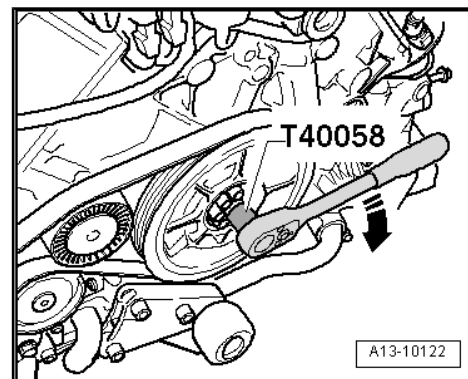
- Tighten camshaft bolt -2- at exhaust camshaft on cylinder head (right-side) to final torque. Tightening torque: 100 Nm + 90° (1/4 turn further).



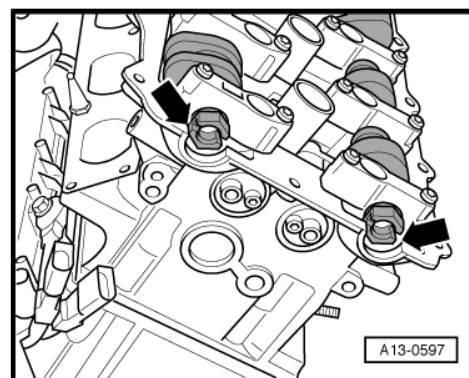
- Remove locking pin -3242- .



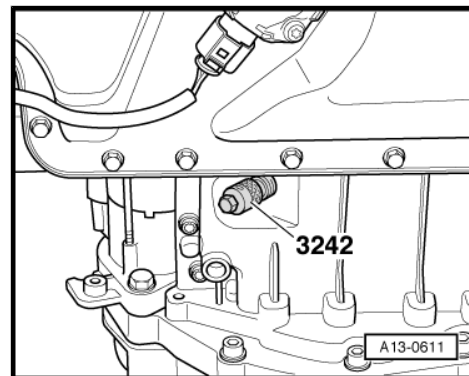
- Using adapter -T40058- , turn crankshaft two rotations in normal direction of rotation -arrow- until crankshaft is at TDC again.



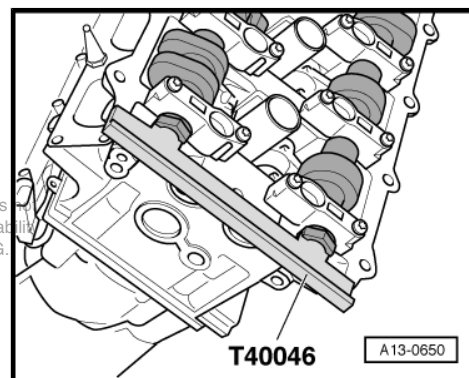
- The slits -arrows- at front of the camshafts must be parallel to and at the same height as the top edge of cylinder head.



- Screw locking pin -3242- into bore (20 Nm); if necessary, turn crankshaft backwards and forwards slightly to fully centralise locking pin.



- Attach camshaft clamp -T40046- on camshafts at cylinder head (left-side).



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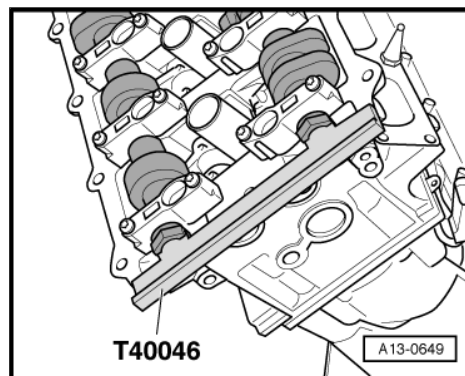
- Apply camshaft clamp -T40046- to camshafts on cylinder head (right-side).



Note

If it is not possible to insert the camshaft clamps -T40046-, repeat adjustment.

- Take out removal wedge -3409- .
- Remove camshaft clamps -T40046- from both cylinder heads.
- Remove locking pin -3242- .
- Secure screw plug for the TDC mark into the top section of the sump with a new seal.



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

- Install timing chain covers ⇒ [page 53](#) .
- Bolt gearbox to engine and install engine/gearbox assembly ⇒ [page 28](#) .

Tightening torques

Component	Nm
Camshaft bolts	100 + 90° ¹³⁾ ¹⁴⁾
Screw plug in top section of sump	35

13) 90° = a quarter of a turn.

14) Renew bolts.

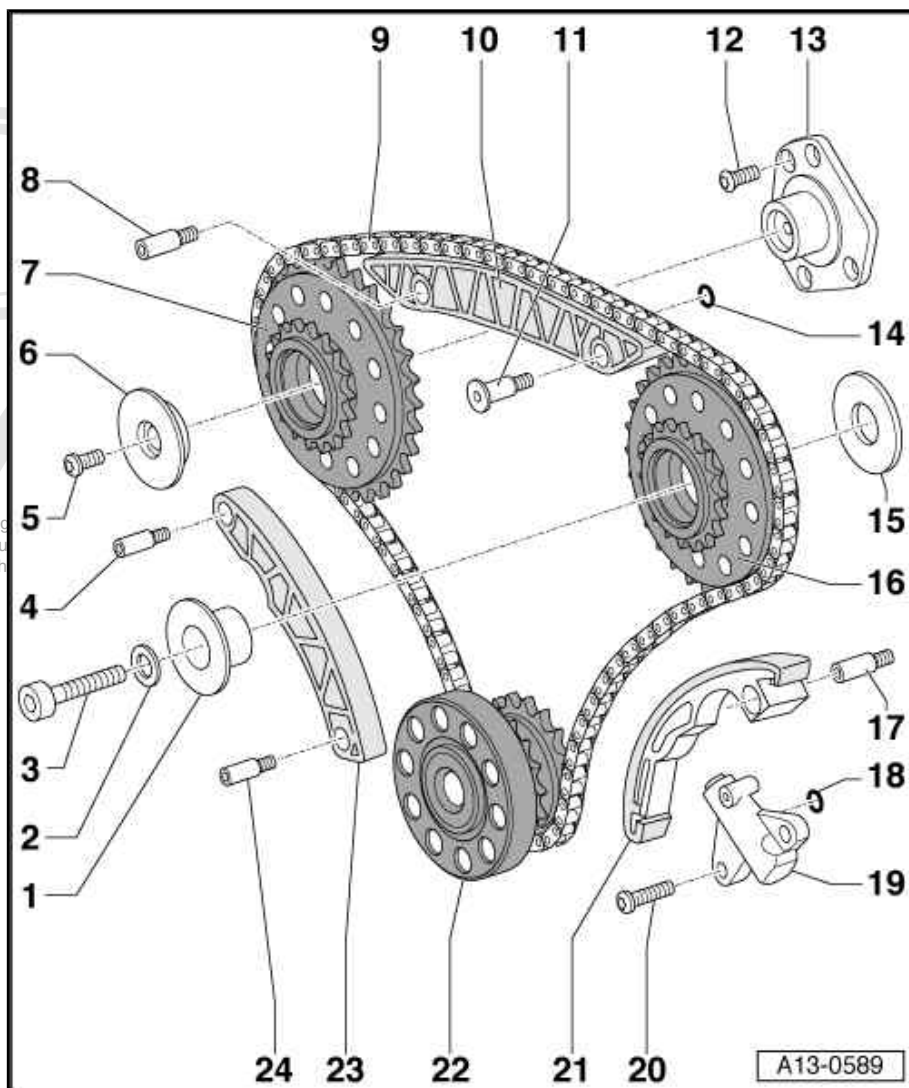
4.4 Drive chain for valve gear - exploded view



Note

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Mark rotation direction of chain with paint before removing. If a used chain rotates in the opposite direction when it is refitted, this can cause breakage.

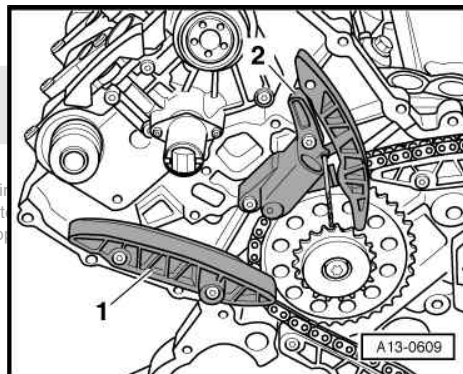
- 1 - Bearing mounting**
 - ☐ For drive chain sprocket
- 2 - Washer**
- 3 - 42 Nm**
- 4 - Mounting pin, 10 Nm**
- 5 - 5 Nm + 90° (1/4 turn) further**
 - ☐ Renew
- 6 - Thrust washer**
 - ☐ For drive chain sprocket
- 7 - Drive chain sprocket**
 - ☐ For timing chain (left-side)
- 8 - Mounting pin, 10 Nm**
- 9 - Drive chain**
 - ☐ For timing drive
- 10 - Guide rail**
- 11 - Mounting pin, 10 Nm**
- 12 - 10 Nm**
- 13 - Bearing bracket**
 - ☐ For drive chain sprocket
- 14 - O-ring**
 - ☐ Renew
- 15 - Thrust washer**
- 16 - Drive chain sprocket**
 - ☐ For timing chain (right-side)
- 17 - Mounting pin, 10 Nm**
- 18 - O-ring**
 - ☐ Renew
- 19 - Chain tensioner**
- 20 - 10 Nm**
- 21 - Guide rail**
 - ☐ For chain tensioner
- 22 - Crankshaft**
- 23 - Guide rail**
- 24 - Mounting pin, 10 Nm**



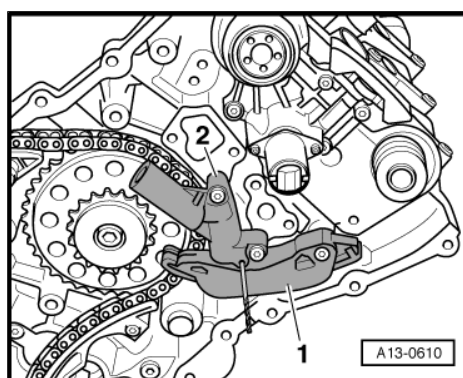
4.5 Removing and installing drive chain for valve gear

Removing

- Remove camshaft timing chains ⇒ [page 60](#) .
- Remove chain for auxiliary drives ⇒ [page 92](#) .
- Detach guide rail -1- at cylinder head (left-side).
- Unbolt chain tensioner -2-



- Detach guide rail -1- at cylinder head (right-side).
- Unbolt chain tensioner -2-.



- Press guide rail of chain tensioner for drive chain in direction of -arrow- and lock chain tensioner by inserting a 3.3 mm Ø drill bit -item 4-.
- Mark running direction of chain with paint.
- Remove bolts -2- and -3- and detach chain sprockets together with drive chain and guide rail -1-.

Installing

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



Note

Renew the bolts tightened with specified tightening angle.

- Install chain for auxiliary drives ⇒ [page 92](#) .
- Install camshaft timing chains ⇒ [page 81](#) .

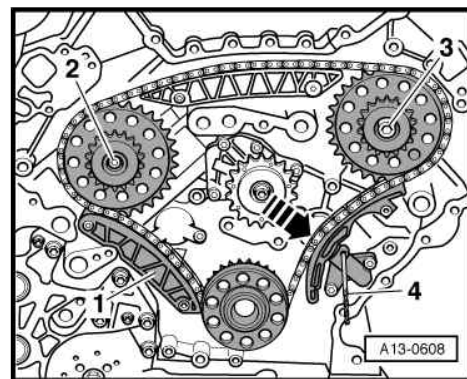
Tightening torques

Component	Nm
Drive chain sprocket (left-side) to bearing bracket	5 + 90° ¹⁵⁾ ¹⁶⁾
Drive chain sprocket (right-side) to cylinder block	42
Chain tensioner for camshaft timing chain (left-side) to cylinder head	5 + 90° ¹⁵⁾ ¹⁶⁾
Chain tensioner for camshaft timing chain (right-side) to cylinder head	5 + 90° ¹⁵⁾ ¹⁶⁾

15) 90° = a quarter of a turn.

16) Renew bolts.

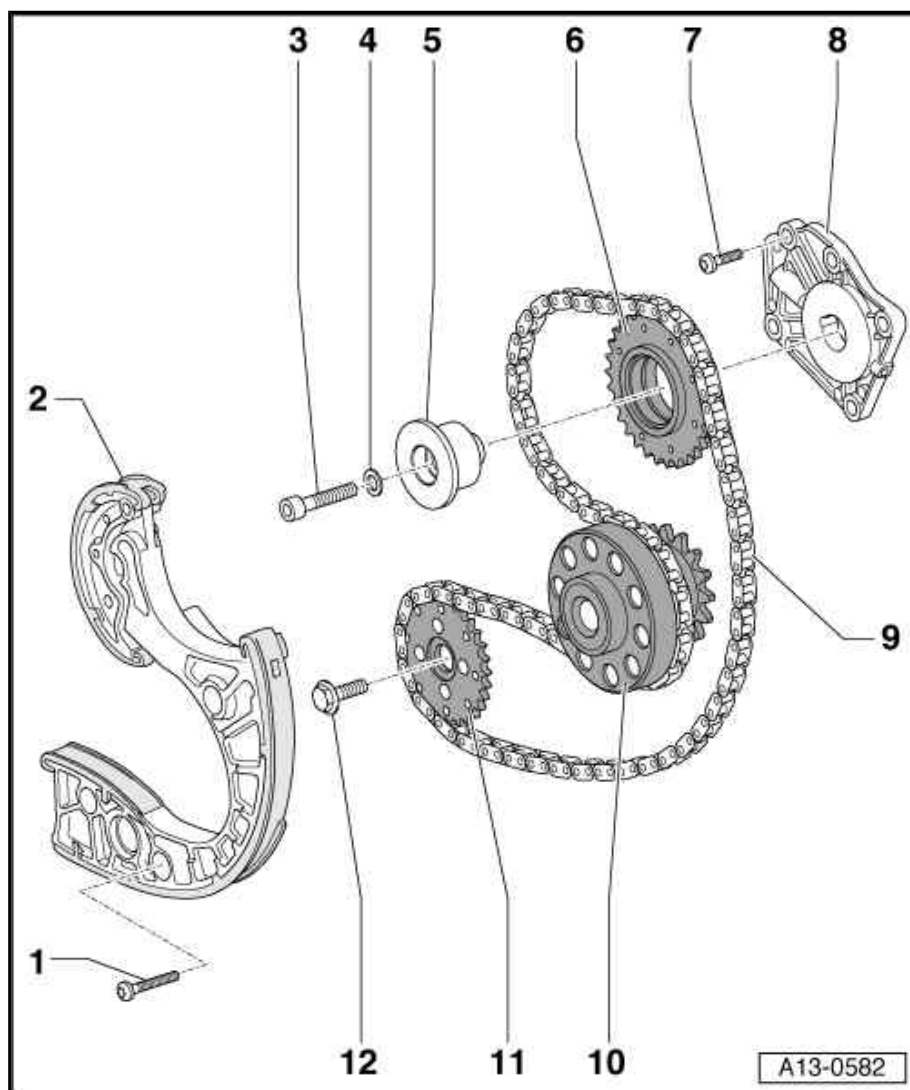
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5 Auxiliary drives

5.1 Chain for auxiliary drives - exploded view

- 1 - 10 Nm
- 2 - Chain tensioner
 - ☐ With guide rail
- 3 - 42 Nm
- 4 - Washer
- 5 - Bearing mounting
 - ☐ For idler sprocket
- 6 - Idler sprocket
 - ☐ For chain of auxiliary drives
- 7 - 10 Nm
- 8 - Bearing bracket
 - ☐ For idler sprocket
- 9 - Chain
 - ☐ For auxiliary drives
 - ☐ Removing and installing
⇒ [page 92](#)
- 10 - Crankshaft
- 11 - Drive chain sprocket
 - ☐ For auxiliary drives
- 12 - 62 Nm



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5.2 Removing and installing chain for auxiliary drives

Removing

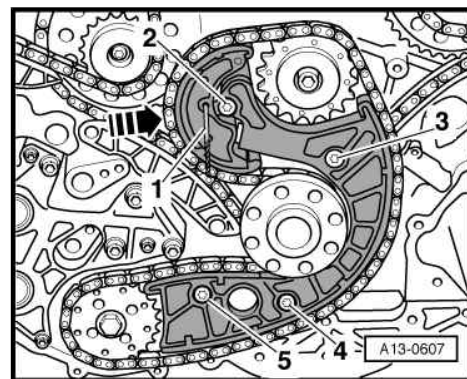
- Drain off engine oil ⇒ Maintenance ; Booklet 405 .
- Remove engine ⇒ [page 6](#) .
- Separate engine from gearbox ⇒ [page 20](#) .
- Remove timing chains from camshafts ⇒ [page 70](#) .
- Remove drive plate ⇒ [page 40](#) .
- Remove timing chain covers ⇒ [page 45](#) .

- Press guide rail of chain tensioner in direction of -arrow- and lock chain tensioner by inserting a 3.3 mm Ø drill bit -item 1-.

 Note

Should you need to remove the chain sprocket for auxiliary drives, you must first loosen the securing bolt before removing the chain.

- Mark running direction of chain for auxiliary drives with paint.
- Unscrew bolts -2 ... 5- and remove chain tensioner.
- Remove chain for auxiliary drives.



Installing

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

 Note

Renew the bolts tightened with specified tightening angle.

- First fit chain for auxiliary drives.
- Fit chain tensioner (starting at top) onto engine.
- Install timing chain covers ⇒ [page 53](#) .
- Install drive plate ⇒ [page 40](#) .
- Bolt gearbox to engine and install engine/gearbox assembly ⇒ [page 28](#) .

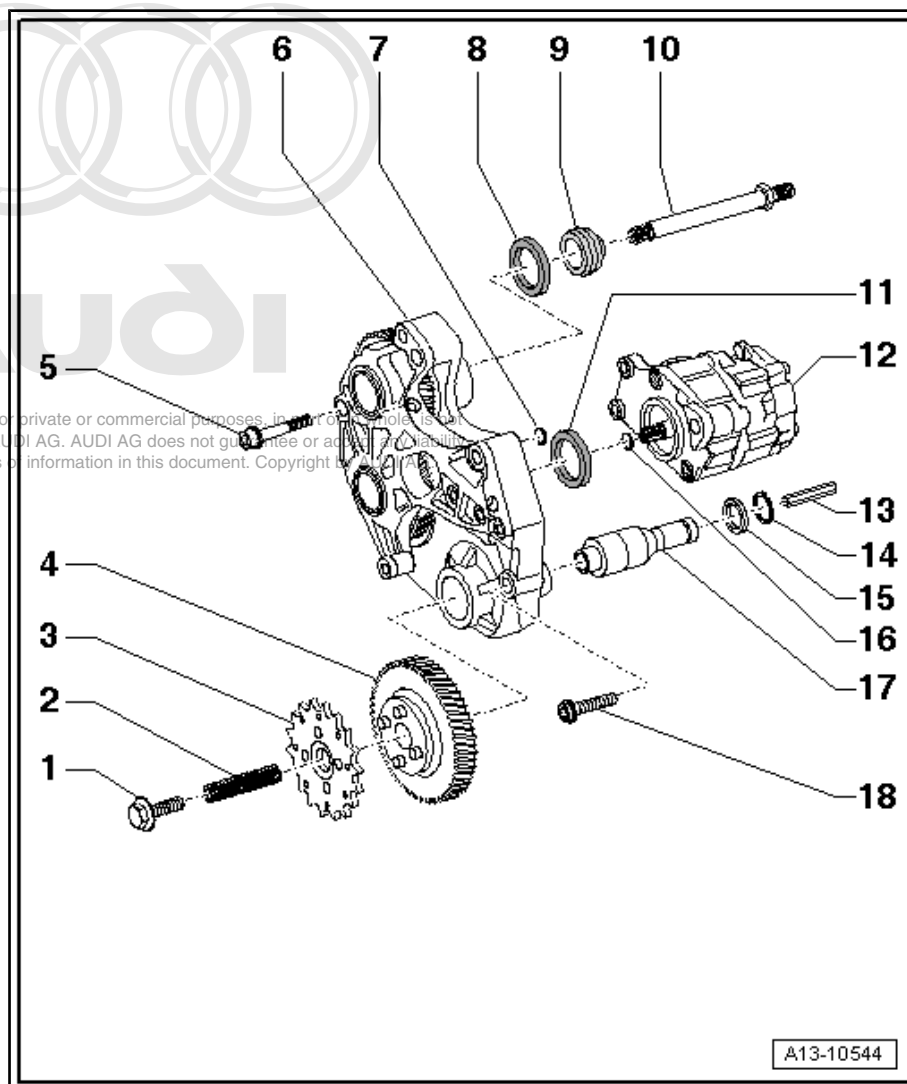
Tightening torque

Component	Nm
Chain tensioner to cylinder block	10

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5.3 Auxiliary drives - exploded view

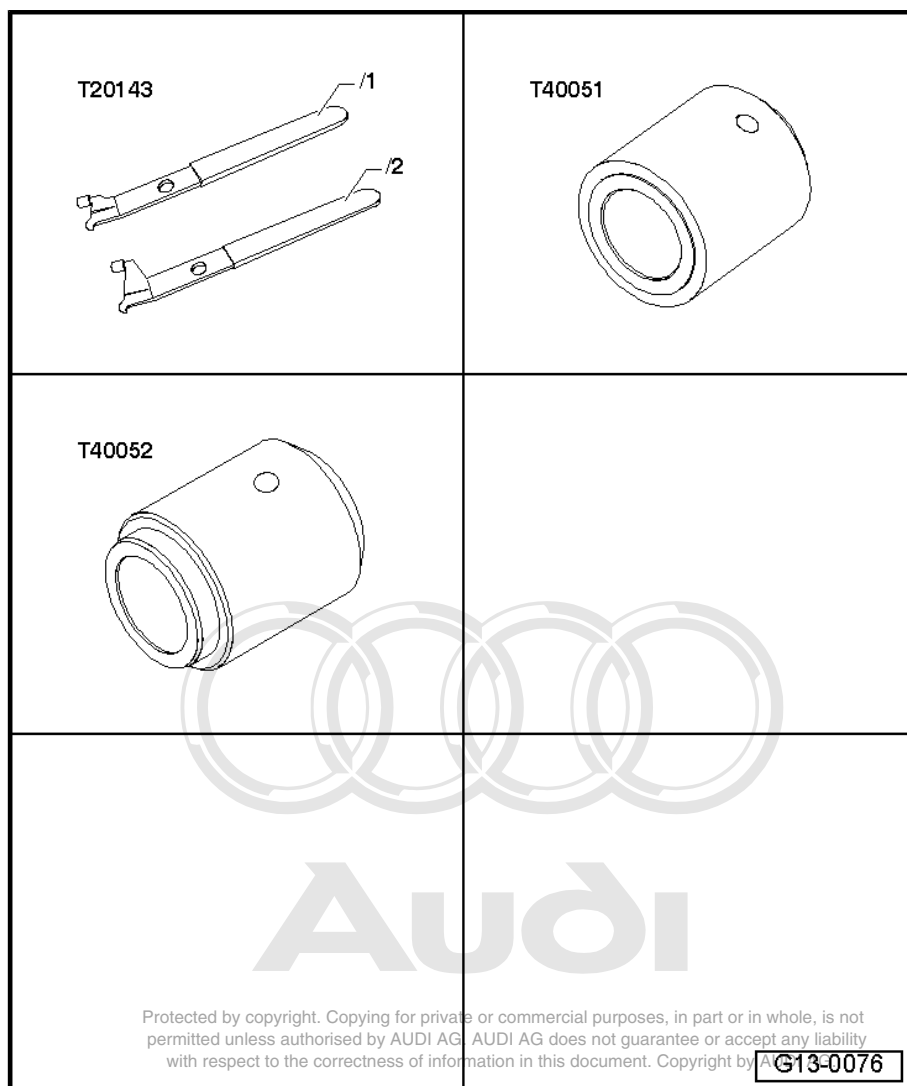
- 1 - 62 Nm
- 2 - Compression spring
- 3 - Drive chain sprocket
 - ☐ For auxiliary drives
- 4 - Drive spur gear
 - ☐ For auxiliary drives
- 5 - 22 Nm
- 6 - Spur gear drive
- 7 - O-ring
 - ☐ Renew
- 8 - Oil seal
 - ☐ For AC compressor drive
 - ☐ Renewing ⇒ [page 95](#)
- 9 - Dust cap
 - ☐ For AC compressor drive
- 10 - Drive shaft
 - ☐ For air conditioner compressor
 - ☐ Tighten to 60 Nm
- 11 - Oil seal
 - ☐ For power steering pump drive
 - ☐ Renewing ⇒ [page 95](#)
- 12 - Power steering pump
- 13 - Drive shaft
 - ☐ For oil pump
- 14 - Circlip
- 15 - Thrust washer
- 16 - O-ring
 - ☐ Renew
- 17 - Shaft for drive spur gear
- 18 - Fitted bolt, 22 Nm



5.4 Renewing oil seals for auxiliary drives

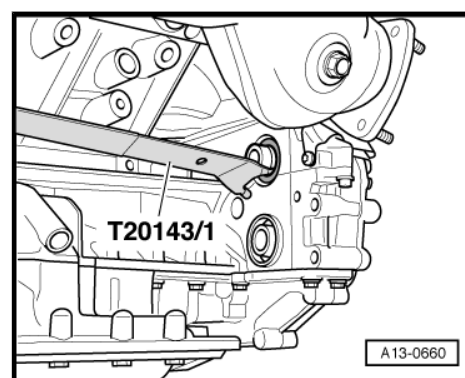
Special tools and workshop equipment required

- ◆ Extractor tool -T20143/1-
- ◆ Thrust piece -T40051-
- ◆ Thrust piece -T40052-

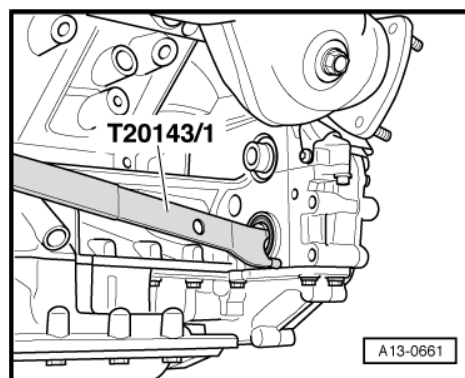


Procedure

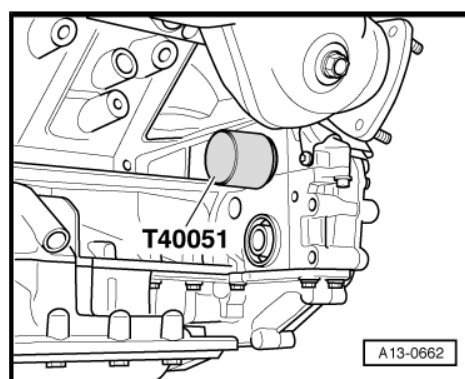
- Remove air conditioner compressor ⇒ Rep. gr. 87 .
- Remove power steering pump ⇒ Rep. gr. 48 .
- Pry out the oil seal for AC compressor drive using the oil seal extractor lever -T20143/1- .



- Pry out oil seal for power steering pump drive using oil seal extractor lever -T20143/1- .



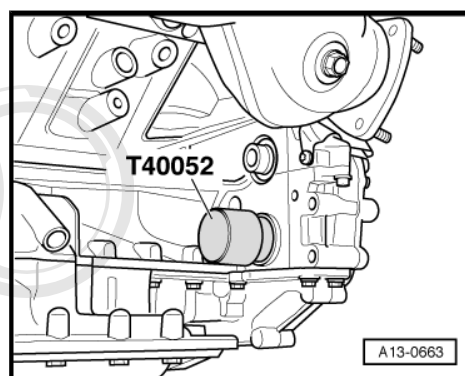
- Drive in the oil seal for AC compressor drive using assembly tool -T40051- .



- Drive in the oil seal for power steering pump drive using assembly tool -T40052- .

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

- Install power steering pump ⇒ Rep. gr. 48 .
- Install air conditioner compressor ⇒ Rep. gr. 87 .

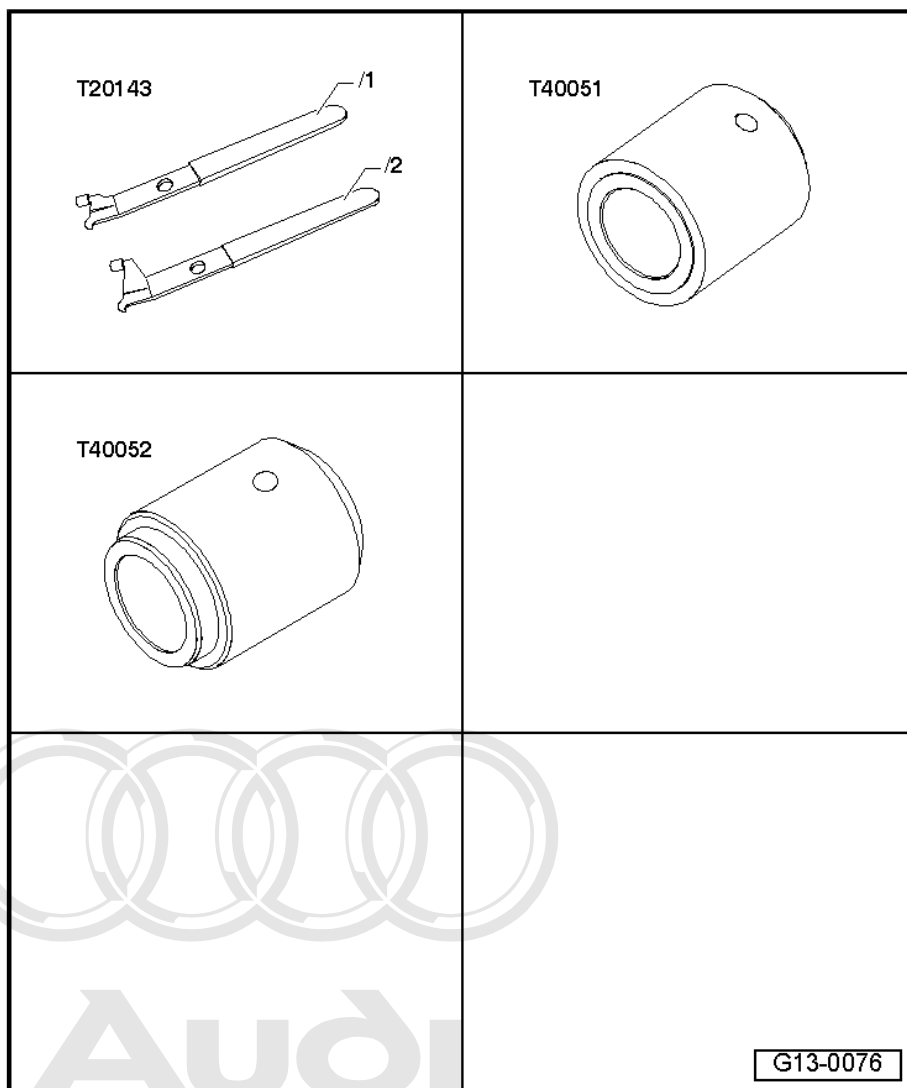


5.5 Removing and installing spur gear drive

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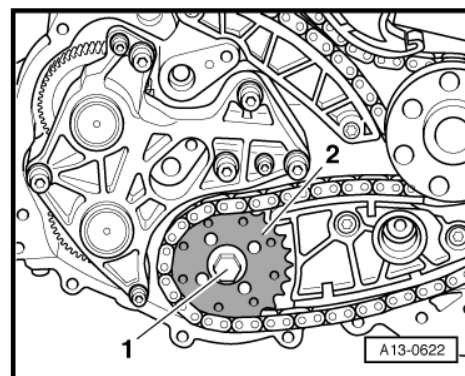
Special tools and workshop equipment required

- ◆ Extractor tool -T20143-
- ◆ Thrust piece -T40051-
- ◆ Thrust piece -T40052-
- ◆ Sealant ⇒ Parts catalogue

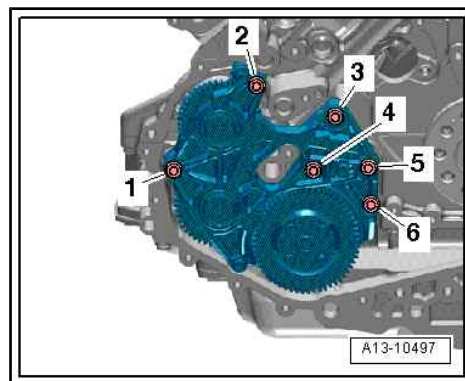

Removing

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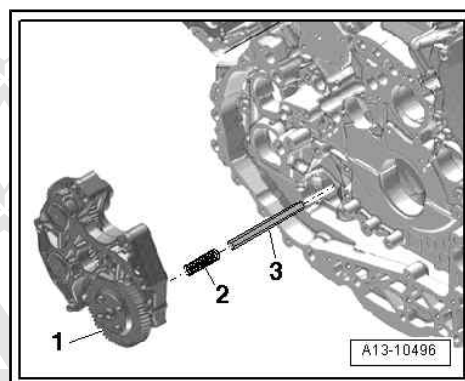
- Drain off engine oil ⇒ Maintenance ; Booklet 405 .
- Remove engine ⇒ [page 6](#) .
- Separate engine from gearbox ⇒ [page 20](#) .
- Remove drive plate ⇒ [page 40](#) .
- Remove timing chain covers ⇒ [page 45](#) .
- Detach power steering pump from cylinder block.
- Unscrew bolt -1- at drive chain sprocket -2- several turns.
- Remove chain for auxiliary drives ⇒ [page 92](#) .
- Unbolt drive chain sprocket for auxiliary drives.



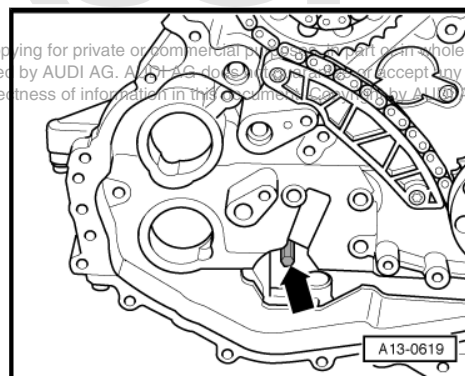
- Remove bolts -1 ... 6-.
- Remove spur gear drive.



- Remove spring -2- between spur gear drive -1- and drive shaft -3- for oil pump.



- Remove drive shaft -arrow- for oil pump.



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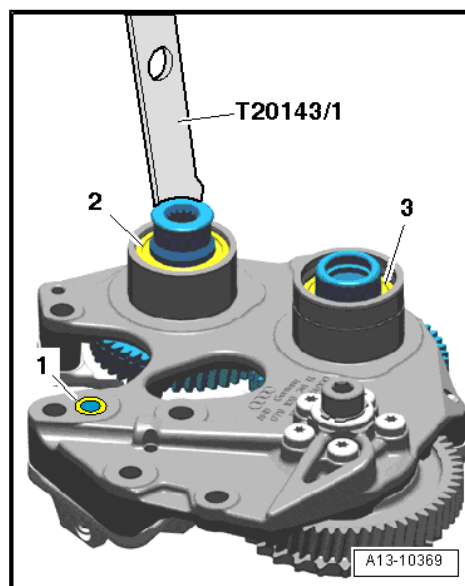
Installing



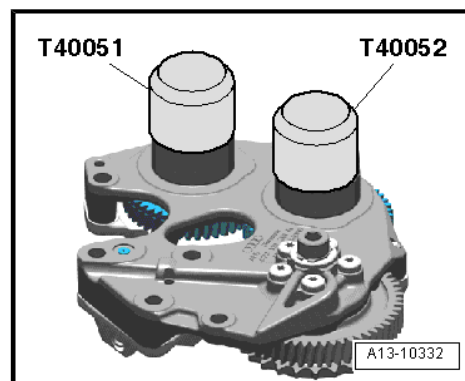
Note

Renew seals and O-rings.

- Pull out oil seals -2- (for AC compressor drive) and -3- (for power steering pump drive) using extractor tool -T20143/1-.
- Remove O-ring -1-.
- Remove sealant residue from spur gear drive and cylinder block.
- Clean sealing surfaces; they must be free of oil and grease.



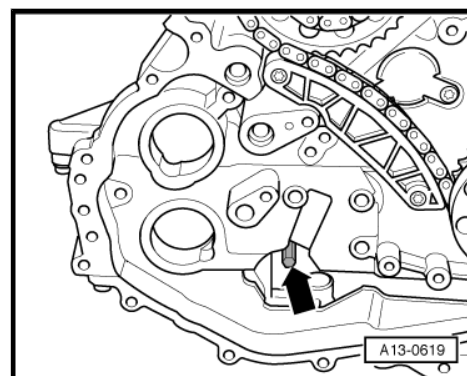
- Drive in the oil seal for AC compressor drive using thrust piece -T40051- .
- Drive in the oil seal for power steering pump drive using thrust piece -T40052- .



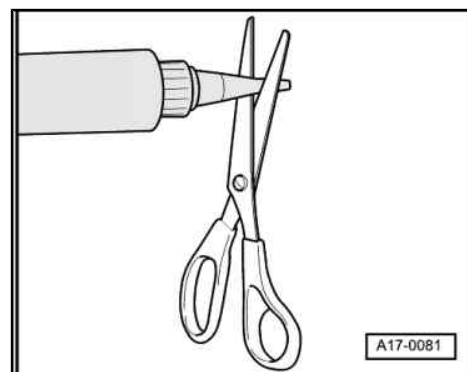
- Insert drive shaft -arrow- for oil pump into guide sleeve at oil pump.

**Note**

To ensure that drive shaft engages correctly in oil pump, insert drive shaft separately into oil pump (NOT together with spur gear drive).



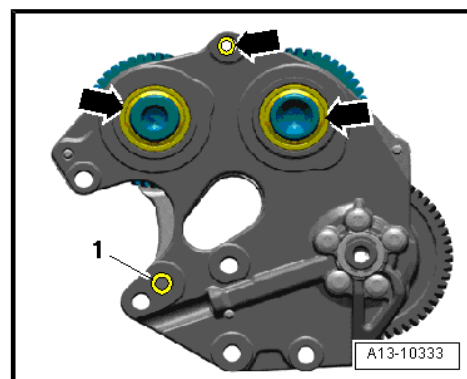
- Cut off tube nozzle at front marking (diameter of nozzle approx. 1.5 mm).



- Apply the beads of sealant -arrows- onto clean sealing surfaces of spur gear drive, as shown in illustration.
 - Width of sealant beads: 2.0 mm.
- Apply a small amount of grease to O-ring -1- and fit in position.

**Note**

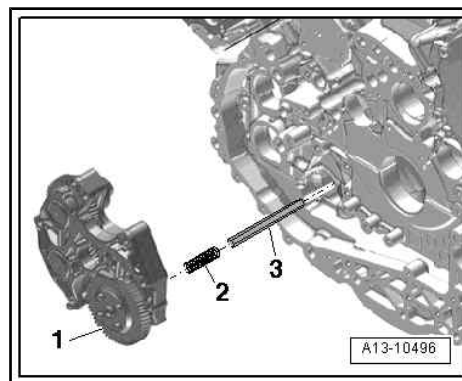
The spur gear drive must be installed within 5 minutes after applying the sealant.



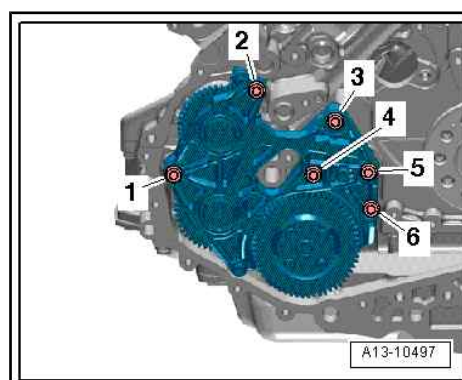
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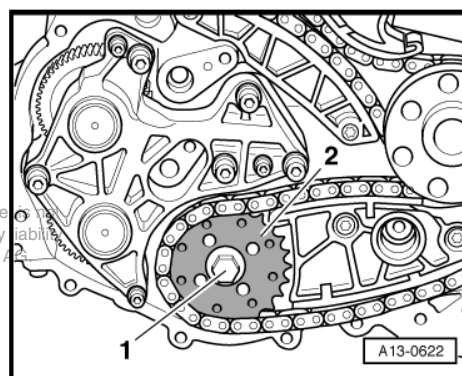
- Insert spring -2- for drive shaft -3- in spur gear drive -1-.



- Fit spur gear drive and tighten bolts -1 ... 6- in diagonal sequence and in stages.



- Fit drive chain sprocket -2- for auxiliary drives and tighten bolt hand-tight.
- Install chain for auxiliary drives ⇒ [page 92](#) .
- Tighten bolt -1- on drive chain sprocket for auxiliary drives to final torque.
- Press power steering pump with new O-ring onto spur gear for power steering pump drive.



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

- Install timing chain covers ⇒ [page 53](#) .
- Install drive plate ⇒ [page 40](#) .
- Bolt gearbox to engine and install engine/gearbox assembly ⇒ [page 28](#) .
- Fill up with engine oil and check oil level ⇒ Maintenance ; Booklet 405 .

Tightening torques

Component	Nm
Spur gear drive to cylinder block	22
Drive chain sprocket for auxiliary drives to shaft	62

6 Removing and installing crankshaft

6.1 Crankshaft - exploded view



Note

When carrying out repairs, secure engine to engine and gearbox support -VAS 6095- using bracket for V8 engine -VAS 6095/1-6- or -VAS 6095/1-6A- [⇒ page 25](#).

1 - Seals

- ☐ Renew

2 - Crankshaft oil seal (pulley end)

- ☐ Renewing [⇒ page 37](#)

3 - Dowel sleeve

- ☐ 3x
- ☐ Insert in retaining frame
- ☐ Installation position [⇒ page 102](#)

4 - Bolts

- ☐ For retaining frame
- ☐ Renew
- ☐ Different bolt lengths
- ☐ Tightening sequence [⇒ page 103](#)

5 - Bolt

- ☐ For sealing surfaces: cylinder block/retaining frame
- ☐ Different bolt lengths
- ☐ Tightening sequence [⇒ page 103](#)

6 - Retaining frame

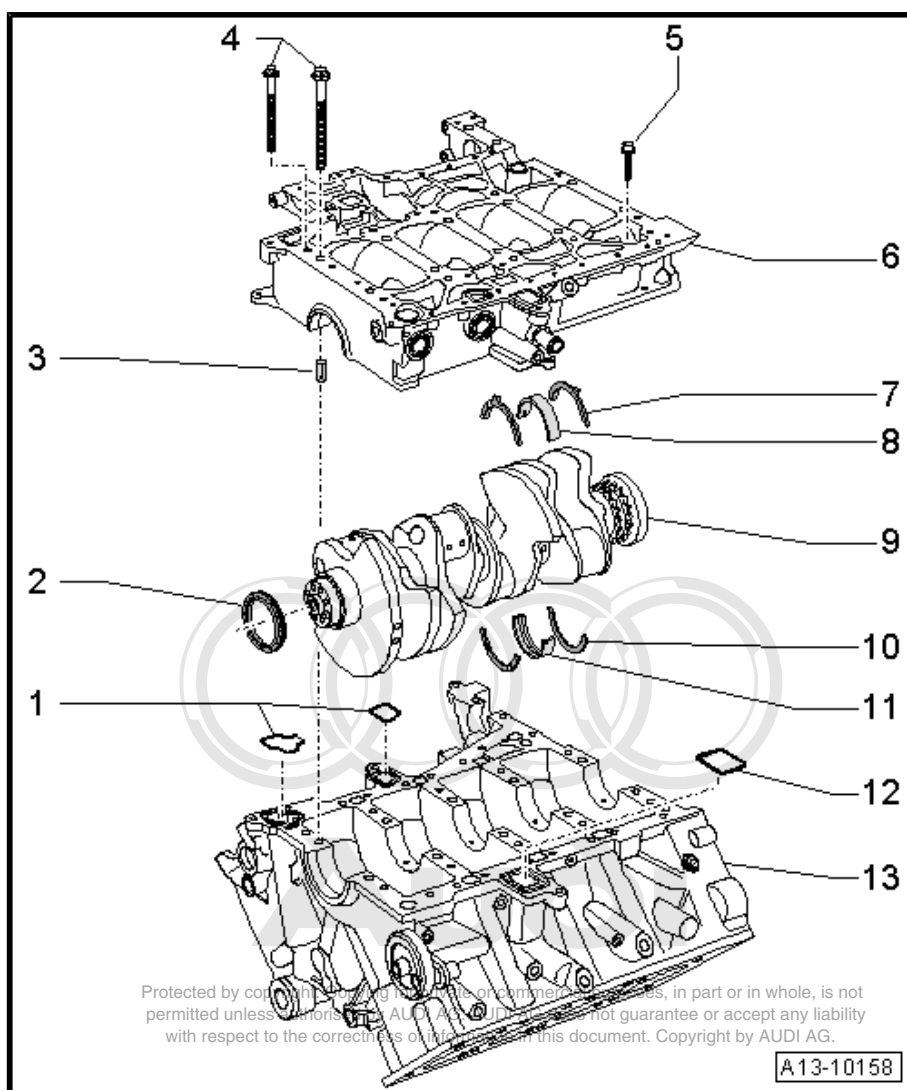
- ☐ Matched to [⇒ Item 13 \(page 102\)](#)
- ☐ Applying sealant onto cylinder block (for retaining frame) [⇒ page 102](#)
- ☐ Tightening sequence for securing bolts [⇒ page 103](#)

7 - Thrust washer

- ☐ Only fitted on 4th crankshaft bearing
- ☐ Oil grooves face outwards
- ☐ Make sure it engages in retaining frame
- ☐ Measuring axial clearance of crankshaft [⇒ page 106](#)

8 - Bearing shell

- ☐ For retaining frame (without oil groove)



- ☐ Do not interchange used bearing shells (mark positions)
- ☐ Install new bearing shells for retaining frame with correct coloured markings ⇒ [page 104](#) or ⇒ [page 105](#)

9 - Crankshaft

- ☐ Measuring axial clearance ⇒ [page 106](#)
- ☐ Measuring radial clearance ⇒ [page 107](#)
- ☐ Do not rotate the crankshaft when checking the radial clearance
- ☐ Crankshaft dimensions ⇒ [page 106](#)

10 - Thrust washer

- ☐ Only fitted on 4th crankshaft bearing
- ☐ Oil grooves face outwards
- ☐ Measuring axial clearance of crankshaft ⇒ [page 106](#)

11 - Bearing shell

- ☐ For cylinder block (with oil groove)
- ☐ Do not interchange used bearing shells (mark positions)
- ☐ Install new bearing shells for cylinder block with correct coloured markings ⇒ [page 104](#) or ⇒ [page 105](#)

12 - Seal

- ☐ Renew

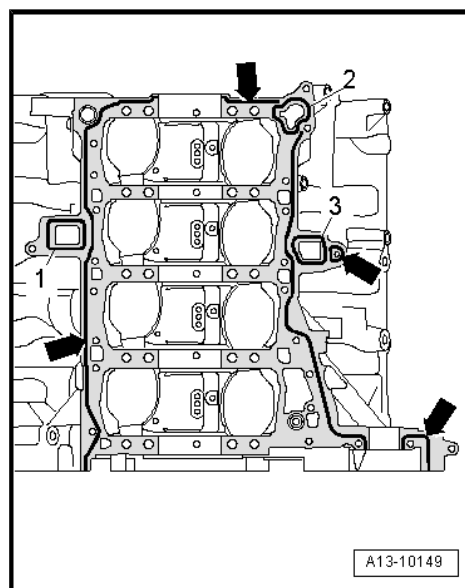
13 - Cylinder block

- ☐ Matched to ⇒ [Item 6 \(page 101\)](#)
- ☐ Applying sealant onto cylinder block (for retaining frame) ⇒ [page 102](#)

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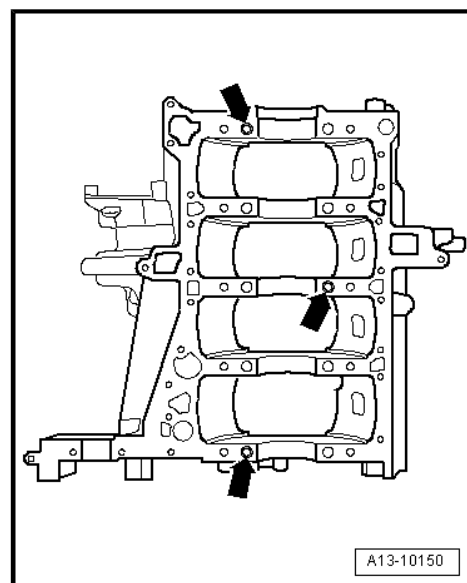
Applying sealant onto cylinder block (for retaining frame)

- Clean sealing surfaces; they must be free of oil and grease.
- Apply the beads of sealant -arrows- onto the clean sealing surfaces of the retaining frame as illustrated.
- Thickness of sealant beads: 1.5 ... 2.0 mm.
- Fit seals -1 ... 3-.



Fitting location of dowel sleeves

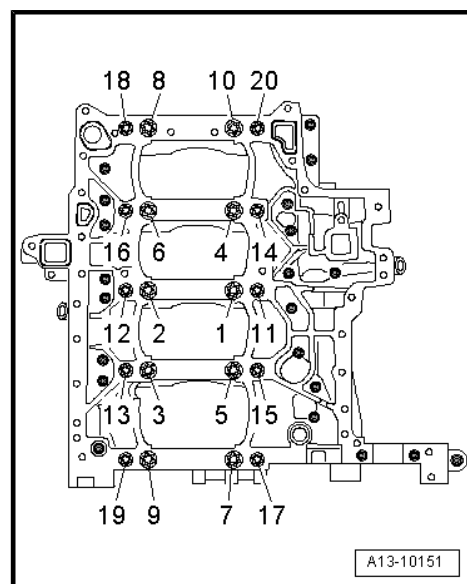
- Check that dowel sleeves -arrows- are inserted in retaining frame at positions shown in illustration.

**Installing retaining frame**

- Renew bolts -1 ... 20-.
- Tighten bolts for retaining frame as follows:
 1. Tighten bolts -1 ... 10- to 30 Nm using torque wrench.
 2. Tighten bolts -11 ... 20- to 20 Nm using torque wrench.
 3. Tighten bolts -1 ... 10- to 50 Nm using torque wrench.
 4. Tighten bolts -11 ... 20- to 30 Nm using torque wrench.
 5. Turn bolts -1 ... 10- 90° further ($\frac{1}{4}$ turn) using a rigid wrench.
 6. Turn bolts -11 ... 20- 90° further ($\frac{1}{4}$ turn) using a rigid wrench.

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7. Tighten bolts for sealing surfaces between cylinder block and retaining frame -shaded dark in illustration- to 9 Nm in diagonal sequence.



6.2 Allocation of main bearing shells for new crankshafts

Matching crankshaft bearing shells to bearings in cylinder block

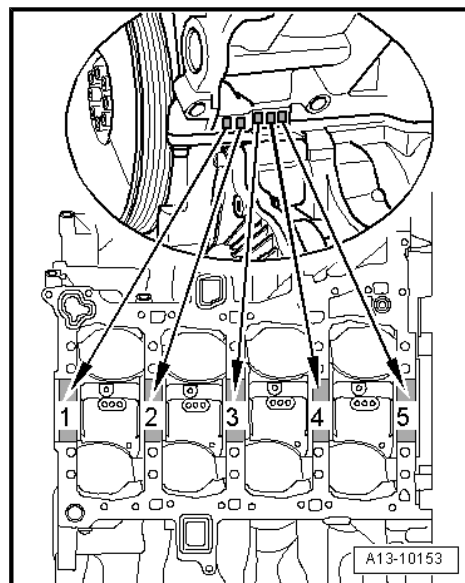
- ◆ Bearing shells of the correct thickness are matched to the bearings in the cylinder block at the factory. Coloured dots on the side of the bearing shells are used to identify the bearing shell thickness.
- ◆ The allocation of the bearing shells to the cylinder block is indicated by letters on the front left of the cylinder block (legible from outside), as shown in illustration.

Letter on cylinder block	Colour coding of bearing
R =	Red
G =	Yellow
B =	Blue



Note

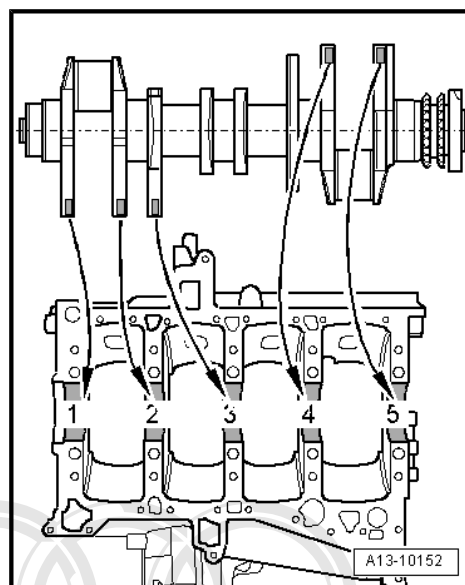
The code letters are also stamped on the retaining frame.



Allocation of crankshaft bearing shells for retaining frame (crankshaft manufacturer: Alfing)

- ◆ Bearing shells of the correct thickness are matched to the bearings in the retaining frame at the factory. Coloured dots on the side of the bearing shells are used to identify the bearing shell thickness.
- ◆ The allocation of the bearing shells to the retaining frame is indicated by colour codings on the crankshaft webs, as shown in the illustration.
- ◆ Crankshafts manufactured by Alfing do NOT have a manufacturer's code indicated on the crankshaft.

Coloured marking on crankshaft	Colour coding of bearing
Red	Red
Yellow	Yellow
Blue	Blue



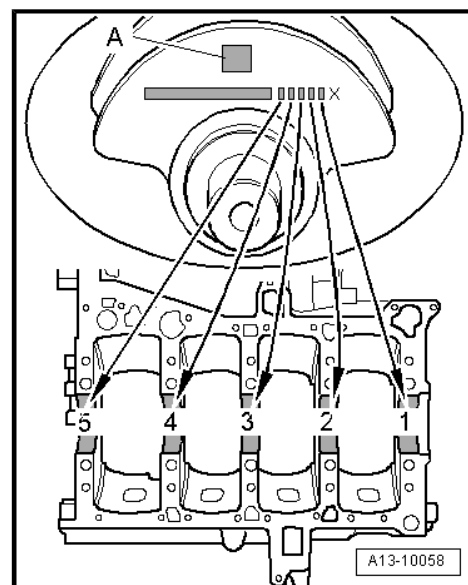
Allocation of crankshaft bearing shells for retaining frame (crankshaft manufacturer: Weber)

- ◆ Bearing shells of the correct thickness are matched to the bearings in the retaining frame at the factory. Coloured dots on the side of the bearing shells are used to identify the bearing shell thickness.
- ◆ The allocation of the bearing shells on retaining frame is indicated by letters on the front crankshaft web, as shown in illustration. The „X“ indicates the end of the row of letters and is next to the coloured marking for bearing 1 (pulley end).
- ◆ Crankshafts manufactured by Weber have the manufacturer's code -A- on the front of the crank web.

**Note**

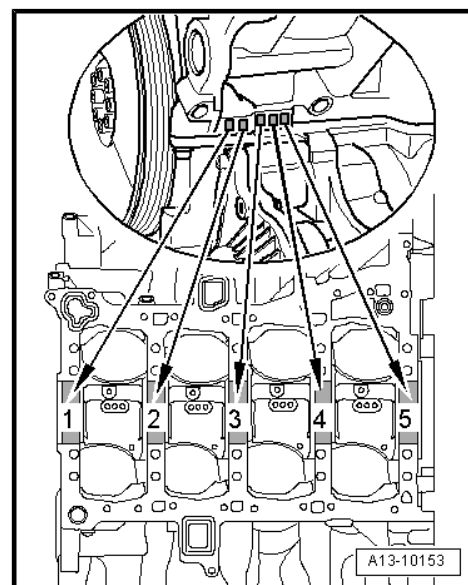
The row of letters begins on the left with bearing 5 (flywheel end).

Letter on crankshaft	Colour coding of bearing
R =	Red
G =	Yellow
B =	Blue

**6.3 Allocation of main bearing shells on used and machined crankshafts****Matching crankshaft bearing shells to bearings in cylinder block**

- ◆ Bearing shells are allocated to the cylinder block according to the colour codes stamped on the cylinder block.
- ◆ On used and machined crankshafts, the main bearing journals must be measured in order to select the correct bearing shells.
- ◆ Basic dimension for main bearing journal = $\varnothing$ 65 mm
- ◆ Repair undersize for main bearing journal = $\varnothing$ 64.75 mm
- ◆ There are oversized (thicker) bearing shells available for machined crankshafts. However, these bearing shells have the same colour coding as the original-size bearing shells.

Letter on cylinder block	Colour coding of bearing
R =	Red
G =	Yellow
B =	Blue



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Matching crankshaft bearing shells to bearings in retaining frame

- ◆ On used and machined crankshafts, the main bearing journals must be measured in order to select the correct bearing shells.
- ◆ Any markings still visible on a machined crankshaft are invalid.
- ◆ Allocate the bearing shells according to the measured diameter of the crankshaft main bearing journals as follows:

Main bearing journal $\varnothing$	Colour code of bearing shells for retaining frame		
Dimensions (in mm)	Red	Yellow	Blue
Basic dimension 65 ¹⁷⁾	64.978 ... 64.972	64.972 ... 64.965	64.965 ... 64.958

Main bearing journal $\varnothing$	Colour code of bearing shells for retaining frame		
Dimensions (in mm)	Red	Yellow	Blue
Repair undersize 64.75 ¹⁷⁾	64.728 ... 64.722	64.722 ... 64.715	64.715 ... 64.708

17) The colour coding of the bearing shells does not indicate whether the bearing shells are for a new crankshaft or for a machined crankshaft.

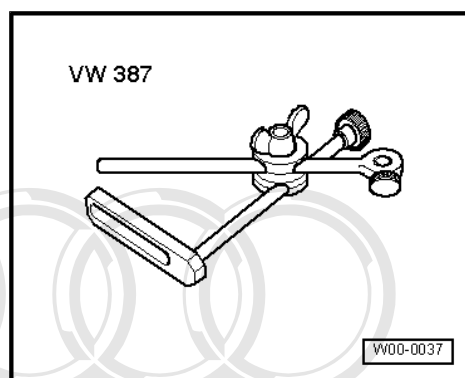
6.4 Crankshaft dimensions

Honing dimension (in mm)	Crankshaft main bearing journal $\varnothing$	Crankshaft conrod journal $\varnothing$
Basic dimension	65.00 – 0.022 – 0.042	54.00 – 0.022 – 0.042
Repair undersize	64.75 – 0.022 – 0.042	53.75 – 0.022 – 0.042

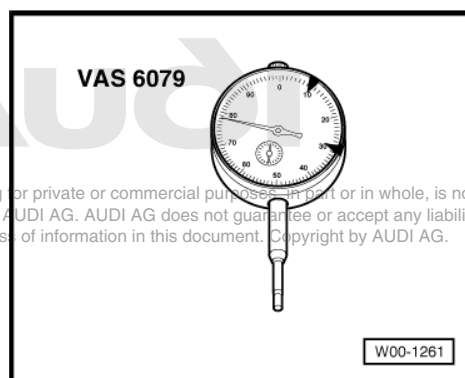
6.5 Measuring axial clearance

Special tools and workshop equipment required

- ◆ Universal dial gauge bracket -VW 387-



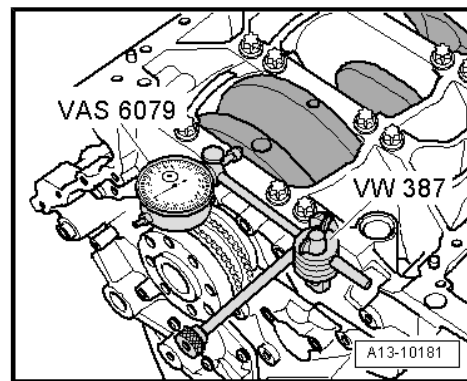
- ◆ Dial gauge -VAS 6079-



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Procedure

- Bolt dial gauge -VAS 6079- with universal 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: 0.090 ... 0.251 mm



6.6 Measuring radial clearance

Special tools and workshop equipment required

- ◆ Plastigage

Procedure



Note

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- ◆ *Do not interchange used bearings.*
- ◆ *Bearing shells worn down to nickel layer must be renewed.*
- Remove retaining frame and clean bearing journals.
- Place Plastigage onto bearing journal or into bearing shells (length of Plastigage should correspond to width of bearing).
- The Plastigage must be positioned in the centre of the bearing shell
- Fit retaining frame and tighten to 30 Nm. Do not rotate crankshaft.
- Remove retaining frame once more.
- Compare width of Plastigage with measurement scale:
 - Radial clearance (new): 0.010 ... 0.039 mm
 - Radial clearance (wear limit): 0.08 mm.

7 Dismantling and assembling pistons and conrods

7.1 Pistons and conrods - exploded view



Note

Oil spray jet for piston cooling ⇒ [page 111](#).

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 110](#)
- ☐ Note when fitting bearing cap: the wide contact shoulder -A- must point towards same side on conrod and conrod bearing cap
- ☐ Installation position of conrod pairs ⇒ [page 111](#)

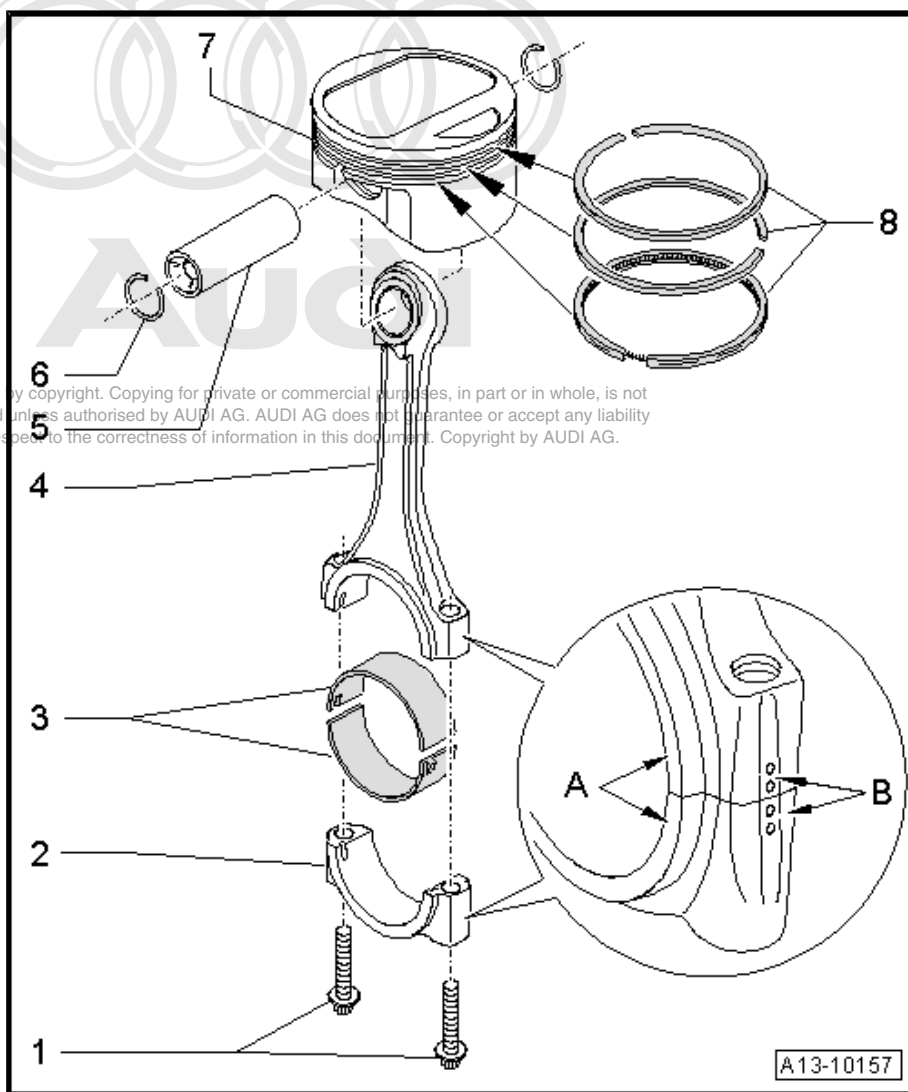
3 - Bearing shells

- ☐ Ensure that retaining lugs are securely seated.
- ☐ Do not interchange used bearing shells (mark accordingly, but not on the running surface)
- ☐ Measuring radial clearance ⇒ [page 111](#)
- ☐ To measure radial clearance, tighten bolts ⇒ [Item 1 \(page 108\)](#) to 30 Nm but do not turn further

- ☐ There are oversized bearings available for machined crankshaft conrod journals ⇒ Parts catalogue

4 - Conrod

- ☐ Only renew as a complete set
- ☐ Mark cylinder allocation in colour -B- ⇒ [page 110](#)
- ☐ Note when fitting bearing cap: the wide contact shoulder -A- must point towards same side on conrod and conrod bearing cap
- ☐ Installation position of conrod pairs ⇒ [page 111](#)
- ☐ Axial clearance for each conrod pair (when new): 0.20 ... 0.38 mm



- ☐ Axial clearance: wear limit: 0.60 mm
- ☐ Measuring radial clearance [⇒ page 111](#)

5 - Piston pin

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

6 - Circlip

7 - Piston

- ☐ Installation position for piston [⇒ page 110](#)
- ☐ Piston and cylinder dimensions [⇒ page 111](#)
- ☐ Checking [⇒ page 110](#)
- ☐ Install using piston ring clamp
- ☐ Measuring cylinder bore [⇒ page 110](#)

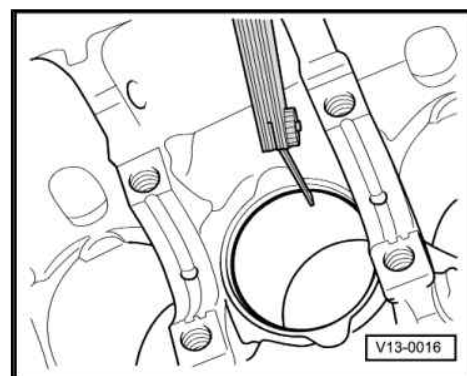
8 - Piston rings

- ☐ Offset gaps by 120°
- ☐ Use piston ring pliers to remove and install
- ☐ Marking „TOP“ or side with identification mark must face piston crown
- ☐ Measuring ring gap [⇒ page 109](#)
- ☐ Measuring ring-to-groove clearance [⇒ page 109](#)

Measuring 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. To do so, use a piston without rings.

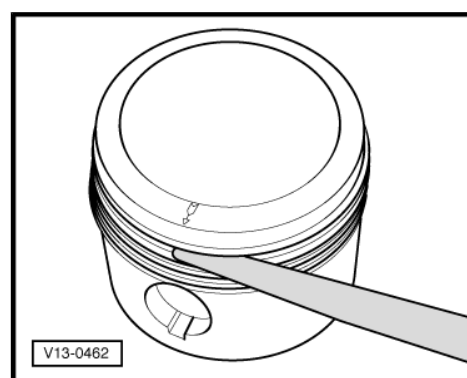
Piston ring Dimensions in mm	New	Wear limit
1st compression ring	0.25 ... 0.40	0.8
2nd compression ring	0.20 ... 0.40	0.8
Oil scraper ring	–	0.4



Measuring ring-to-groove clearance

- Clean groove in piston before checking clearance.

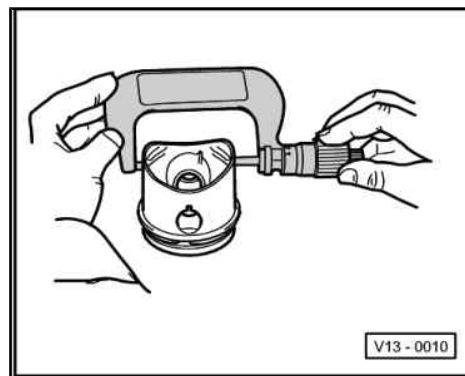
Piston ring Dimensions in mm	New	Wear limit
1st compression ring	0.04 ... 0.08	0.20
2nd compression ring	0.005 ... 0.045	0.20
Oil scraper ring	0.01 ... 0.05	0.15



Checking piston

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

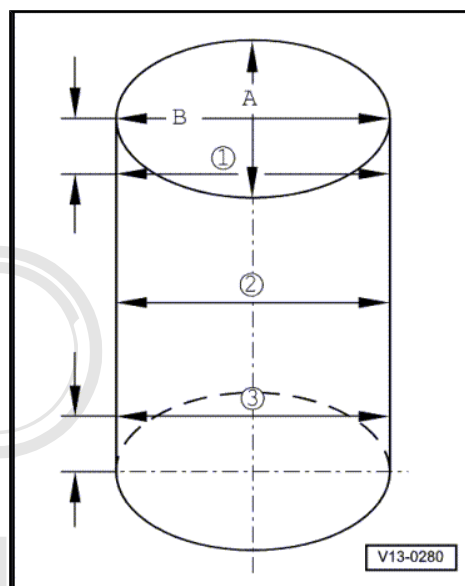
Nominal dimension ⇒ [page 111](#) .



Measuring cylinder bore

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

Nominal dimension ⇒ [page 111](#) .



Installation position of pistons

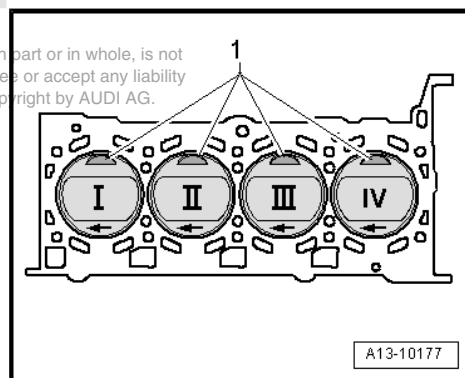
- Use chalk or waterproof felt-tip pen to mark cylinder allocation on piston crown.

Note

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

Installation position:

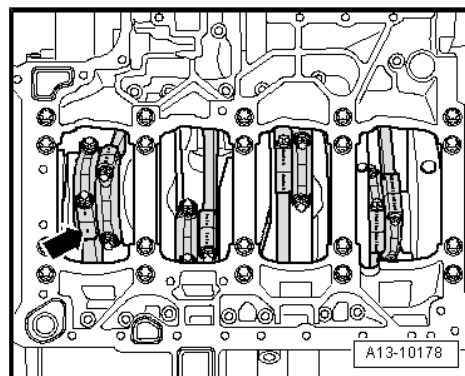
- Arrows on piston crowns point to pulley end.
- Valve recesses -1- point to centre of engine.



Marking conrods

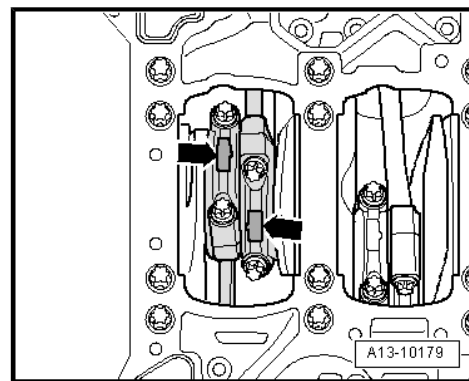
Note

- ◆ 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-.



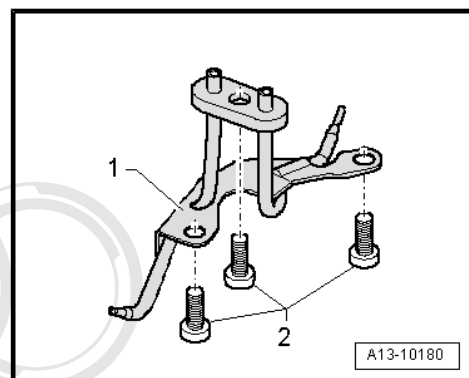
Conrod installation position

- The cast lugs -arrows- on the ground surfaces of conrod pairs 1 and 2, 3 and 4, 5 and 6, and 7 and 8 must face one another.



Oil spray jet for piston cooling

- Oil spray jet (opening pressure: 2 ... 2.4 bar)
- Bolts, 9 Nm. Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue



7.2 Piston and cylinder dimensions

There are different piston sizes specifically matched to the varying bore dimensions for cylinder block.

Cylinder bore Ø mm	Piston Ø mm
84.510 ± 0.005	84.490 ± 0.010 ¹⁸⁾
84.610 ± 0.005	84.590 ± 0.010 ¹⁸⁾
84.710 ± 0.005	84.690 ± 0.010 ¹⁸⁾

¹⁸⁾ Dimensions including coating (thickness 0.01 mm). The coating will wear down in service.

7.3 Measuring radial clearance of conrods

Special tools and workshop equipment required

- ◆ Plastigage

Test sequence

- Remove conrod bearing caps.
- Clean bearing caps and bearing journals.
- Place Plastigage onto bearing journal or into bearing shells corresponding to width of bearing.
- Fit conrod bearing cap and tighten to 30 Nm. Do not rotate crankshaft.
- Remove conrod bearing caps once more.
- Compare width of Plastigage with measurement scale:

Radial clearance

- New: 0.028 ... 0.077 mm.
- Wear limit: 0.12 mm.
- Renew bolts for conrod bearings.

15 – Cylinder head, valve gear

1 Removing and 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.*
- ◆ *When installing an exchange cylinder head with fitted camshafts, the contact surfaces between roller rocker fingers 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 fitting a new cylinder head or cylinder head gasket, drain off all the old coolant and refill with new coolant.*
- ◆ *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.*

1.1 Cylinder head - exploded view

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Note

Illustration shows right-side cylinder head.

1 - Cylinder head gasket

- ☐ Renewing
⇒ [1.4 Removing and installing cylinder head](#),
[page 119](#)
- ☐ Installation position:
Part No. towards cylinder head
- ☐ If renewed, change engine oil and coolant

2 - Lifting eye**3 - 22 Nm****4 - Seal**

- ☐ Renew if damaged or leaking

5 - Gasket for cylinder head cover

- ☐ Renew if damaged or leaking

6 - Cylinder head cover

- ☐ Removing and installing cylinder head cover (left-side) ⇒ [page 114](#)
- ☐ Removing and installing cylinder head cover (right-side) ⇒ [page 117](#)

7 - Ignition coil**8 - Special bolt, 10 Nm**

- ☐ Renew if damaged or leaking
- ☐ Note correct sequence when tightening
⇒ [page 116](#)

9 - Seals for cylinder head cover

- ☐ Renew if damaged or leaking

10 - Seal for cylinder head cover

- ☐ Renew if damaged or leaking

11 - Semi-circular seal

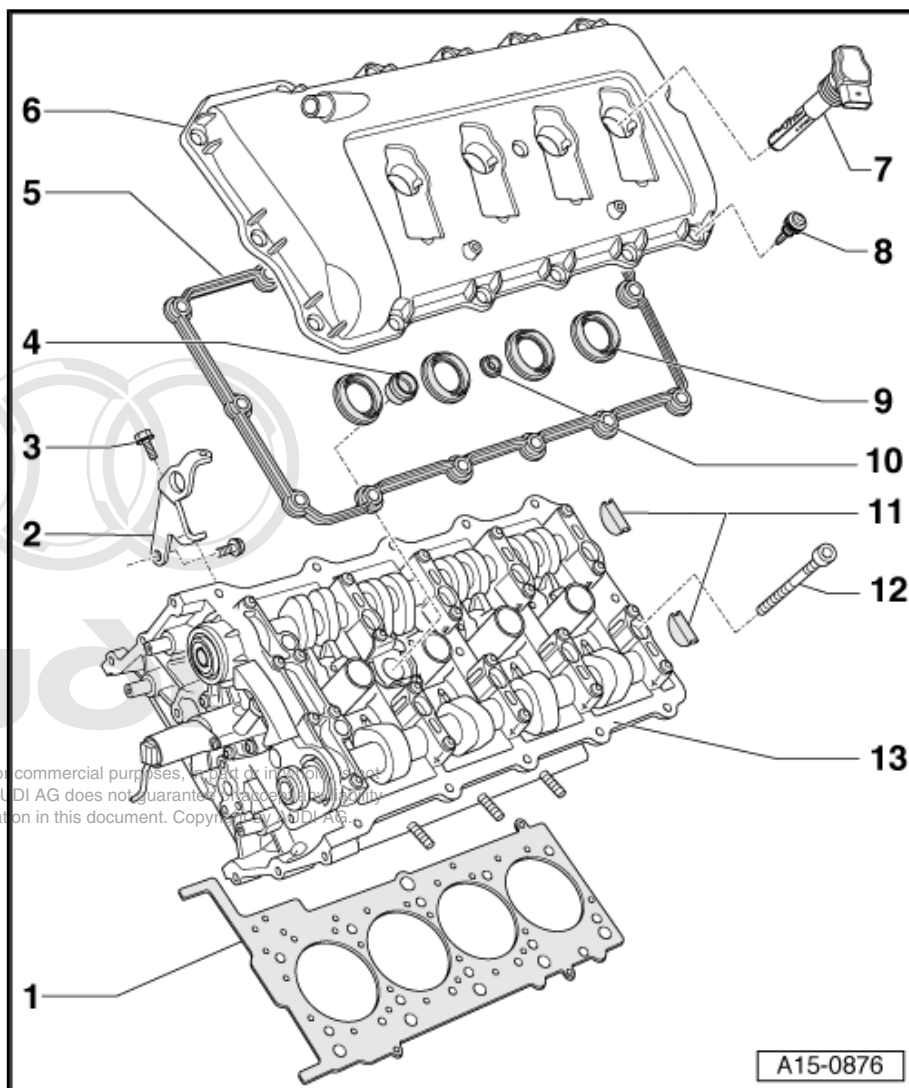
- ☐ Renew if damaged or leaking

12 - Cylinder head bolt

- ☐ Renew
- ☐ Note correct sequence when loosening ⇒ [page 120](#)
- ☐ Note correct sequence when tightening ⇒ [page 122](#)

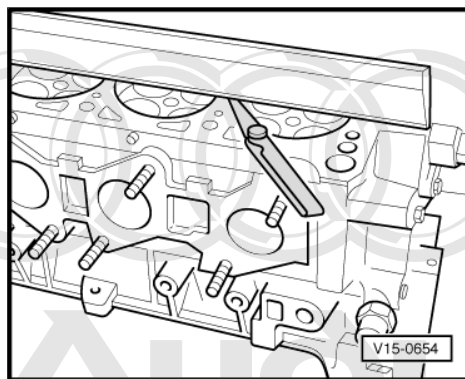
13 - Cylinder head

- ☐ Removing and installing ⇒ [page 119](#)
- ☐ Checking for distortion ⇒ [page 114](#)
- ☐ Machining limit ⇒ [page 114](#)
- ☐ If renewed, change engine oil and coolant



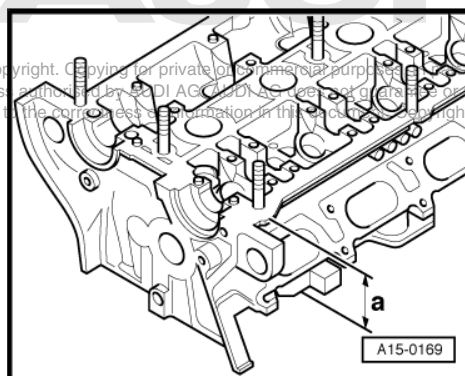
Checking cylinder head for distortion

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



Cylinder head machining limit

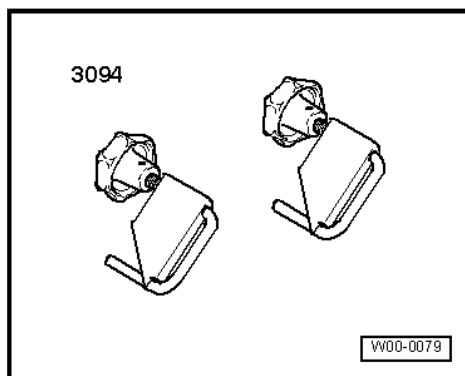
- Machining of the cylinder head (surface grinding) is only permissible down to the minimum dimension -a-.
- Minimum dimension: -a- = 139.25 mm



1.2 Removing and installing cylinder head cover (left-side)

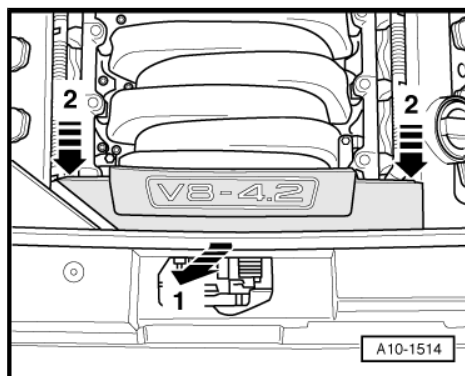
Special tools and workshop equipment required

- ◆ Hose clamps up to Ø 25 mm -3094-

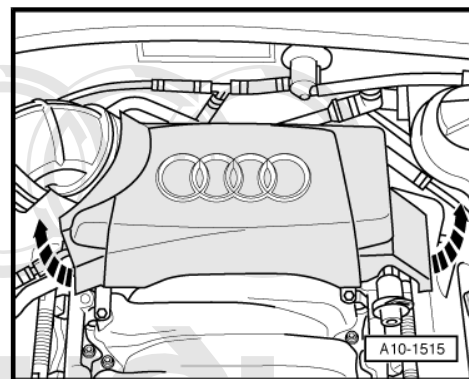


Removing

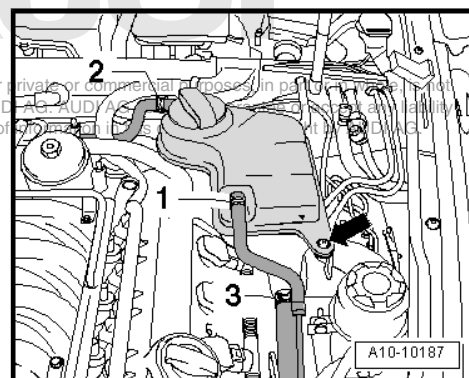
- Detach the front engine cover panel -arrow 1- and -arrows 2-.



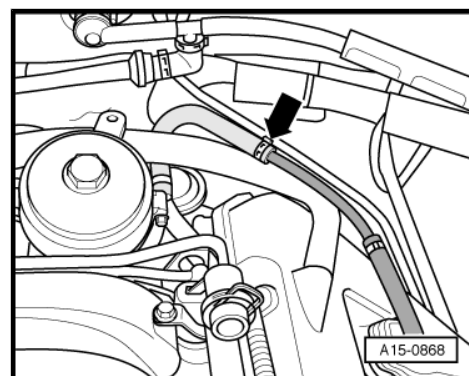
- Pull off rear engine cover panel -arrows-.



- Clamp off coolant hose -2- using hose clamps -3094- and detach from coolant expansion tank.
- Unbolt coolant expansion tank -arrow-.
- Detach electrical wiring for coolant shortage indicator switch - F66- at bottom of coolant expansion tank and move expansion tank to one side with coolant hoses -1 and 3- attached.
- Seal off connection with a suitable plug if necessary.



- Disconnect vacuum hose at the position marked with an -arrow-.

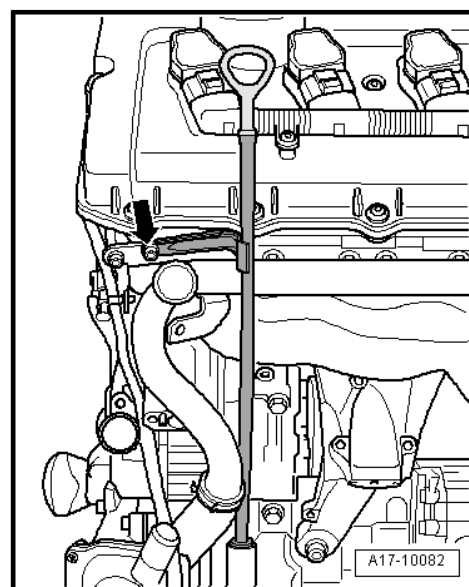


- Remove bolt -arrow- at guide tube for oil dipstick.



Note

The guide tube remains in top section of sump.

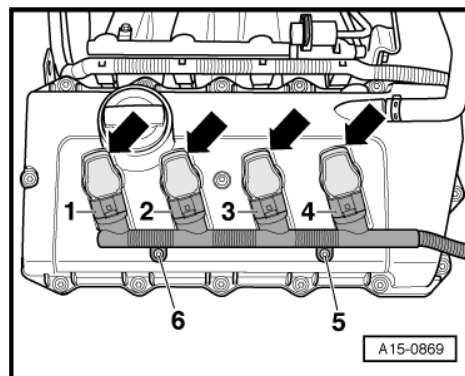


- Remove bolts -5- and -6-.
- Unplug electrical connectors -1 ... 4-.
- Pull out ignition coils -arrows-.



Note

Use puller -T10094- to remove.



- Detach crankcase breather hose -arrow-.
- Unscrew cylinder head cover bolts (left-side) in the sequence -15 ... 1-.
- Remove cylinder head cover.

Installing

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

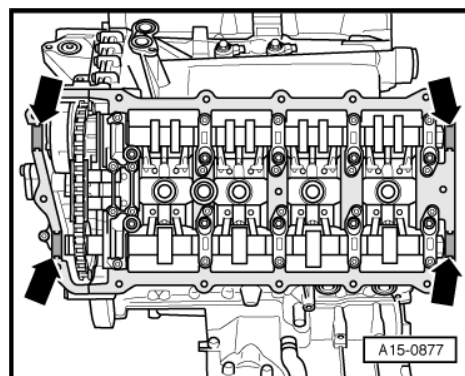
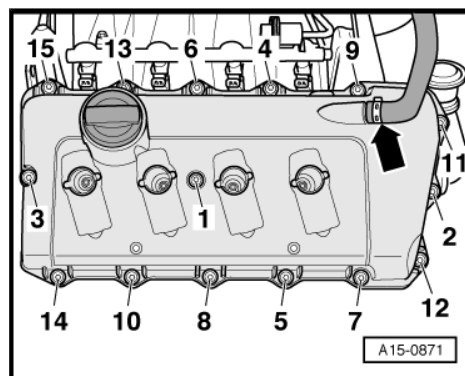


Note

- ◆ Renew cylinder head cover gaskets if damaged.
- ◆ Renew cylinder head cover bolts if gasket is damaged.

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- Clean sealing surfaces; they must be free of oil and grease.
- Slightly coat semi-circular seals -arrows- with oil and insert.

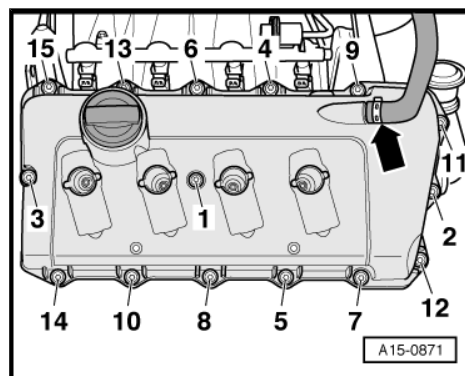


- Tighten bolts for cylinder head cover in the sequence -1 ... 15-.

Tightening torques

Component	Nm
Cylinder head cover to cylinder head	10
Wiring guide for ignition coils to cylinder head cover	5 ¹⁹⁾
Guide tube for dipstick to cylinder head	10

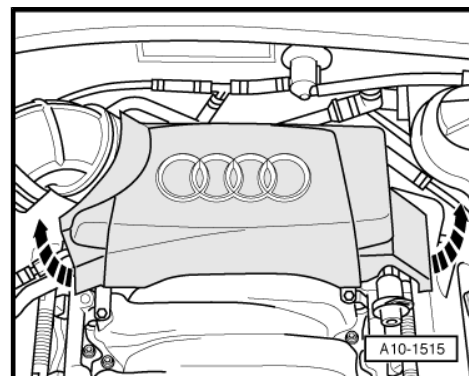
19) Install using locking fluid; locking fluid ⇒ Parts catalogue .



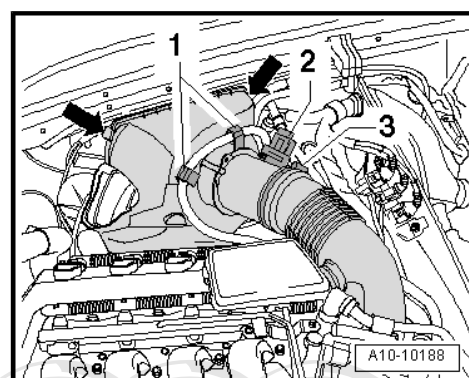
1.3 Removing and installing cylinder head cover (right-side)

Removing

- Pull off rear engine cover panel -arrows-.



- Unclip fuel hose -1-.
- Unplug electrical connector -2- from air mass meter.
- Detach air mass meter from air intake hose -3-.
- Remove top section of air cleaner together with air mass meter -arrows-.



- Pull the resonator -1- upwards -arrow- and unclip.



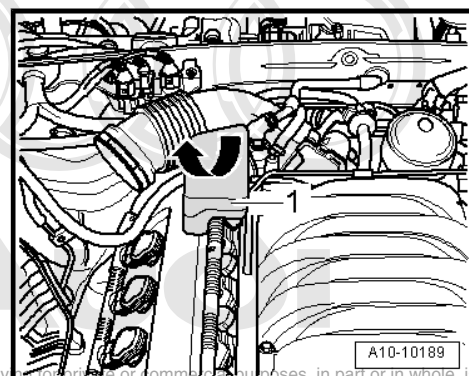
Caution

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

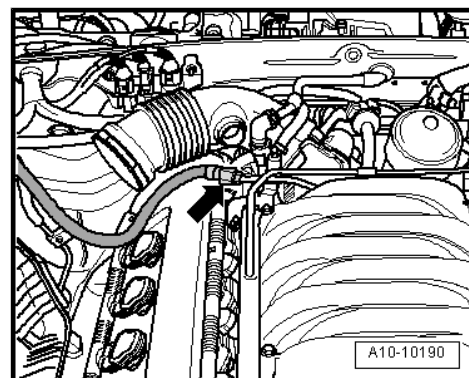


WARNING

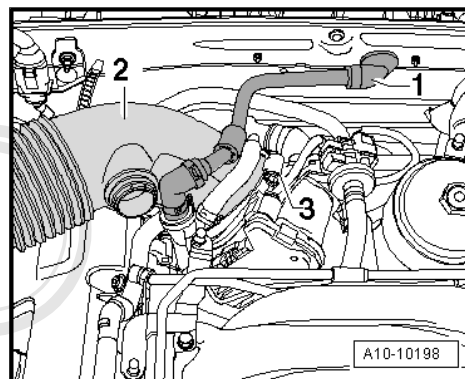
The fuel system is pressurised. Before opening the low-pressure part of the injection system a clean cloth must be wrapped around the connection and the residual pressure dissipated by carefully loosening the connection.



- Disconnect fuel line -arrow-.



- Detach vacuum hose -1- for brake servo at bulkhead.
- Remove air intake hose -2- by loosening screw-type clip -3-.



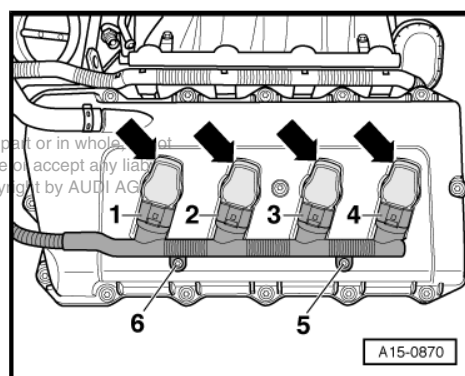
- Unscrew bolts -5- and -6- at cylinder head (right-side).
- Unplug electrical connectors -1 ... 4-.
- Pull out ignition coils -arrows-.

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Note

Use puller -T10094- to remove.



- Detach crankcase breather hose -arrow-.
- Unscrew cylinder head cover bolts (right-side) in the sequence -15 ... 1-.
- Remove cylinder head cover.

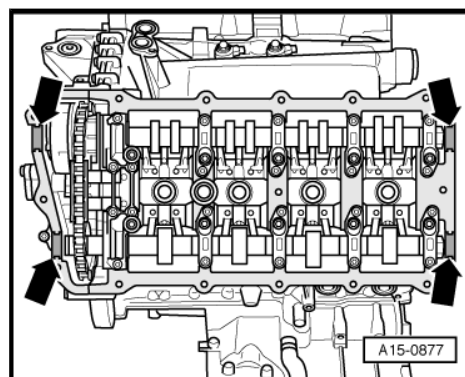
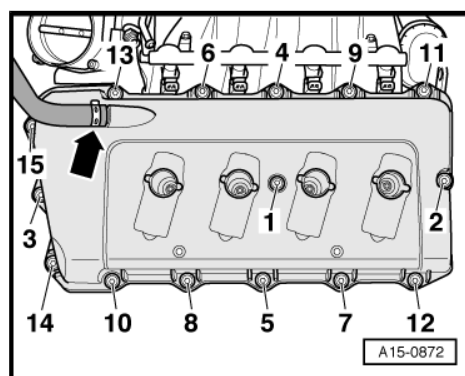
Installing

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



Note

- ◆ Renew cylinder head cover gaskets if damaged.
- ◆ Renew cylinder head cover bolts if gasket is damaged.
- Clean sealing surfaces; they must be free of oil and grease.
- Slightly coat semi-circular seals -arrows- with oil and insert.

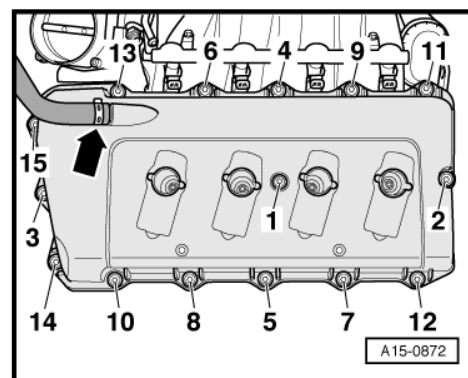


- Tighten bolts for cylinder head cover to final setting in the sequence -1 ... 15-.

Tightening torques

Component	Nm
Cylinder head cover to cylinder head	10
Wiring guide for ignition coils to cylinder head cover	5 ²⁰⁾

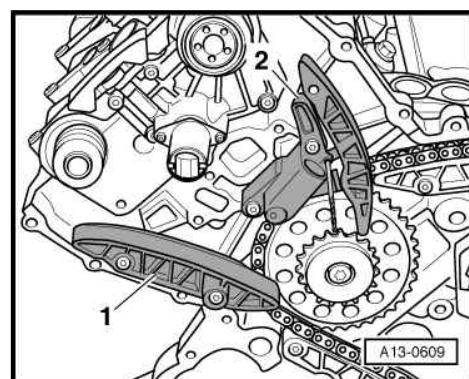
20) Install using locking fluid; for locking fluid refer to → Parts catalogue



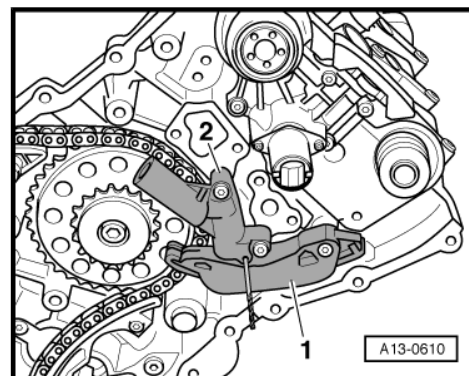
1.4 Removing and installing cylinder head

Removing

- Remove engine ⇒ [page 6](#) .
- Remove timing chains from camshafts ⇒ [page 70](#) .
- Detach guide rail -1- at cylinder head (left-side).
- Unbolt chain tensioner -2-.



- Detach guide rail -1- at cylinder head (right-side).
- Unbolt chain tensioner -2-.



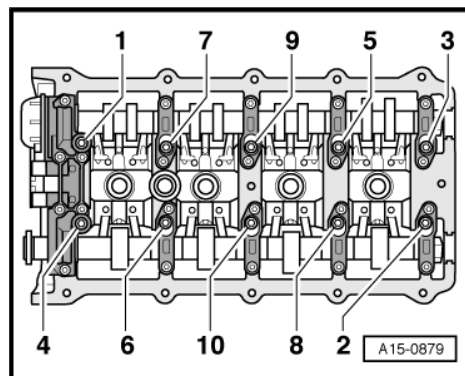
- Loosen cylinder head bolts in the sequence -1 ... 10-.
- Take off cylinder head and place it on a soft surface (such as foam plastic).

Installing

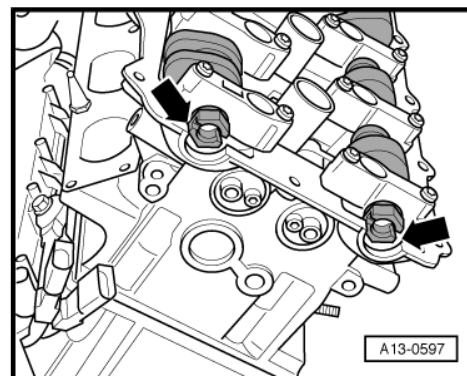


Note

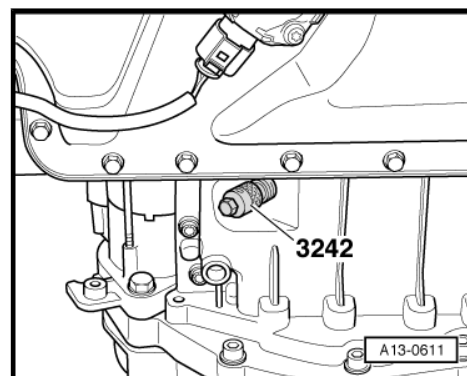
- ◆ Renew the cylinder head bolts.
- ◆ Renew self-locking nuts and bolts when performing assembly work.
- ◆ Renew bolts which are tightened to a specified angle as well as oil seals and gaskets.
- ◆ If repairing, carefully remove any remaining gasket material from the cylinder head and cylinder block. Ensure that no long scores or scratches are made on the surfaces.
- ◆ Carefully remove any remaining emery and abrasive material.
- ◆ No oil or coolant must be allowed to remain in the blind holes for the cylinder head bolts in the cylinder block.
- ◆ When installing an exchange cylinder head with fitted camshafts, the contact surfaces between roller rocker fingers 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.
- ◆ After fitting a new cylinder head or cylinder head gasket, change the engine oil and coolant.
- ◆ 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.
- ◆ 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. must face towards cylinder head.
- ◆ Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ *Parts catalogue*.
- ◆ 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.
- ◆ All cable ties which are released or cut open when removing must be refitted in the same position when installing.



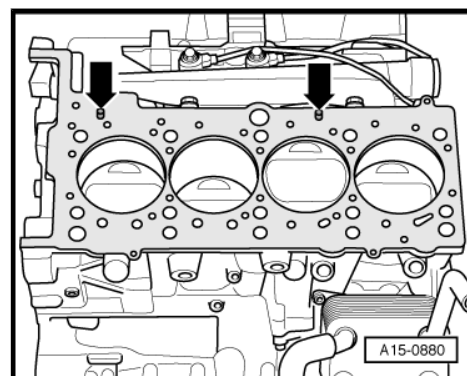
- Check that camshafts on both cylinder heads are positioned at TDC.
- The slits -arrows- at front of the camshafts must be parallel to and at the same height as the top edge of cylinder head.



- The locking pin -3242- must be screwed in.



- Place cylinder head gasket in position.
- Pay attention to dowel sleeves -arrows- in cylinder block.
- Check installation position of cylinder head gasket: the word „oben“ (top) or the Part No. should face towards the cylinder head.
- Fit cylinder head.
- Insert new cylinder head bolts and tighten hand-tight.



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- Secure cylinder head as follows in four stages in sequence shown:

Stage	Tightening
I	– Tighten with torque wrench to 30 Nm.
II	– Tighten with torque wrench to 60 Nm.
III	– Turn 90° (1/4 turn) further using a rigid wrench.
IV	– Turn 90° (1/4 turn) further using a rigid wrench.

**Note**

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

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

- Install camshaft timing chains ⇒ [page 81](#) .
- Install engine ⇒ [page 28](#) .
- Change engine oil ⇒ Maintenance ; Booklet 405 .
- Fill cooling system with fresh coolant ⇒ [page 170](#) .

Tightening torque

Component	Nm
Chain tensioner to cylinder head	5 + 90° ²¹⁾ 22)

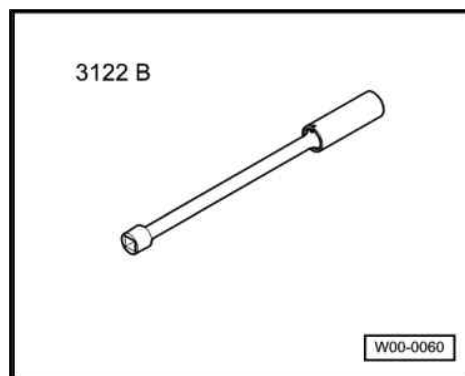
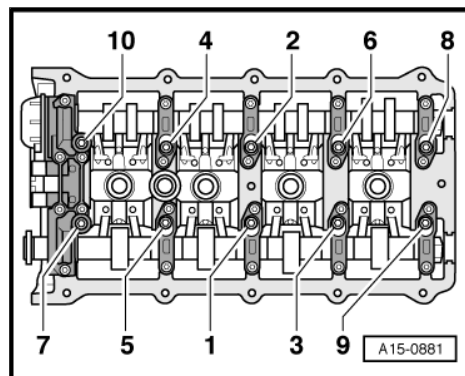
21) 90° = a quarter of a turn.

22) Renew bolts.

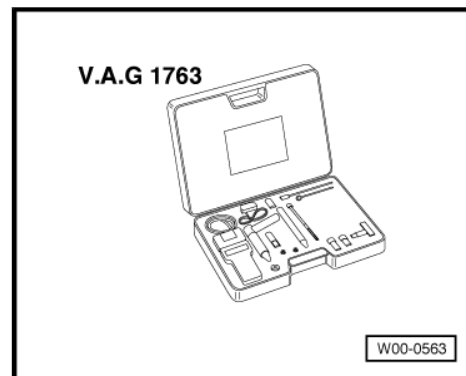
1.5 Checking compression

Special tools and workshop equipment required

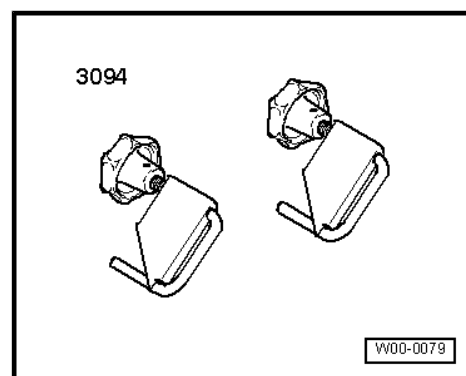
- ♦ Spark plug socket and extension -3122 B-



◆ Compression tester -V.A.G 1763-



◆ Hose clamps up to Ø 25 mm -3094-

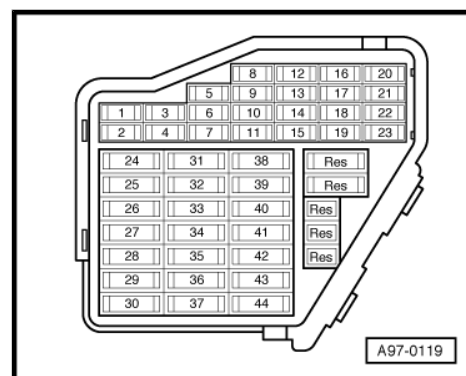


Test conditions

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

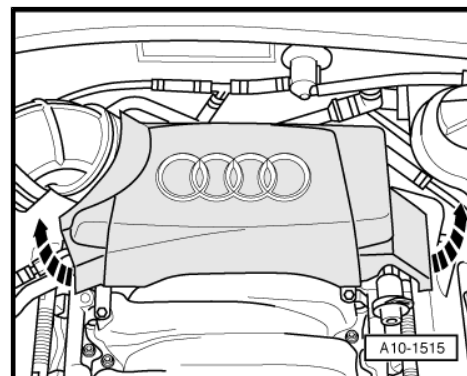
Test sequence

- Switch off ignition.
- Remove fuel pump fuse from slot No. „28“.

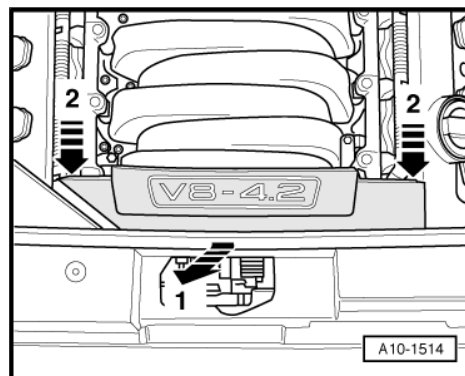


- Pull off rear engine cover panel -arrows-

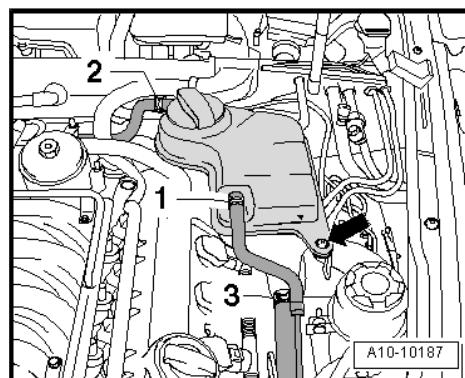
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- Detach the front engine cover panel -arrow 1- and -arrows 2-.



- Clamp off coolant hose -2- using hose clamps -3094- and detach from coolant expansion tank.
- Unbolt coolant expansion tank -arrow-.
- Detach electrical wiring for coolant shortage indicator switch -F66- at bottom of coolant expansion tank and move expansion tank to one side with coolant hoses -1 and 3- attached.
- Seal off connection with a suitable plug if necessary.

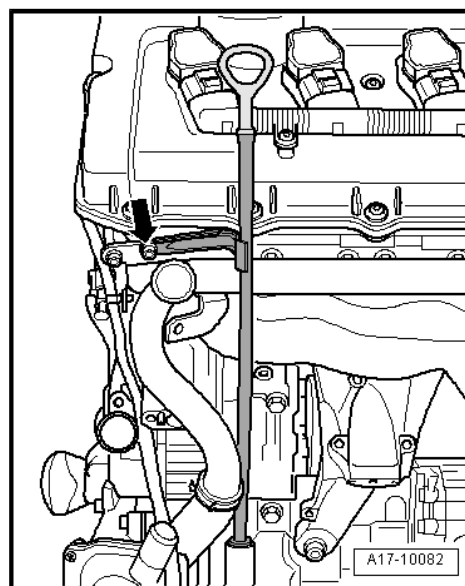


- Remove bolt -arrow- at guide tube for oil dipstick.



Note

The guide tube remains in top section of sump.

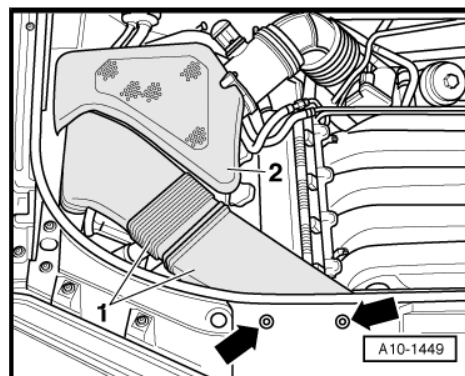


- Remove air cleaner cover -2-.
- Remove air duct -1-.

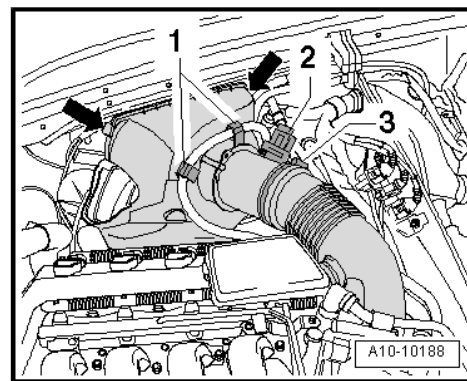


Note

- ◆ Use removal lever -80-200- to lever out clips -arrows-.
- ◆ To ease removal, use silicon-free lubricant if necessary.



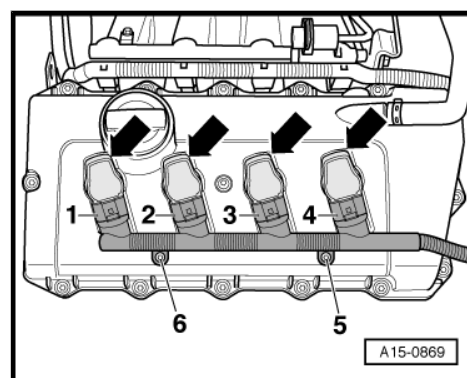
- Unclip fuel hose -1-.
- Unplug electrical connector -2- from air mass meter.
- Detach air mass meter from air intake hose -3-.
- Remove top section of air cleaner together with air mass meter -arrows-.



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

**Note**

Use puller -T10094- to remove.



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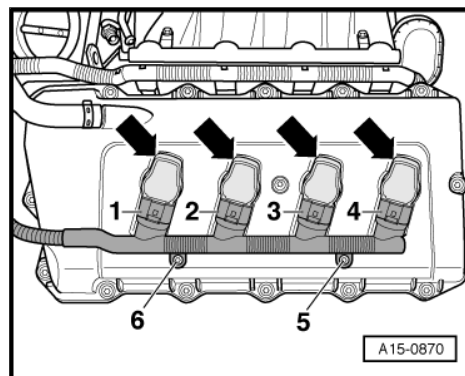
- Unscrew bolts -5- and -6- at cylinder head (right-side).
- Unplug electrical connectors -1 ... 4-.
- Pull out ignition coils -arrows-.



Note

Use puller -T10094- to remove.

- Remove spark plugs with spark plug socket -3122 B- .
- Open throttle valve fully.
- Check compression pressure with compression tester -V.A.G 1763- .



Note

Using the compression tester ⇒ operating instructions .

- Operate starter until pressure reading on tester no longer rises.

Compression pressure:

New pressure in bar	Wear limit bar	Permissible difference between cylinders bar
10.0 ... 14.0	9.0	3.0 (maximum)

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

- Install spark plugs ⇒ Maintenance ; Booklet 405 .

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

- Finally, interrogate and erase the fault memory of the engine control unit ⇒ Vehicle diagnostic tester as faults are stored when the fuse is removed.

Tightening torques

Component	Nm
Wiring guide for ignition coils to cylinder head cover	5 ²³⁾
Guide tube for dipstick to cylinder head	10

23) Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue

2 Removing and installing intake manifold

2.1 Intake manifold - exploded view

1 - Intake manifold

- ☐ Removing and installing
⇒ [page 127](#)

2 - O-rings

- ☐ For injectors
- ☐ Renew

3 - 10 Nm

4 - Fuel supply line

- ☐ Tighten union nut to 25 Nm

5 - Fuel rail

6 - Pressure control valve

- ☐ For crankcase breather

7 - 10 Nm

- ☐ Tighten in stages and in diagonal sequence

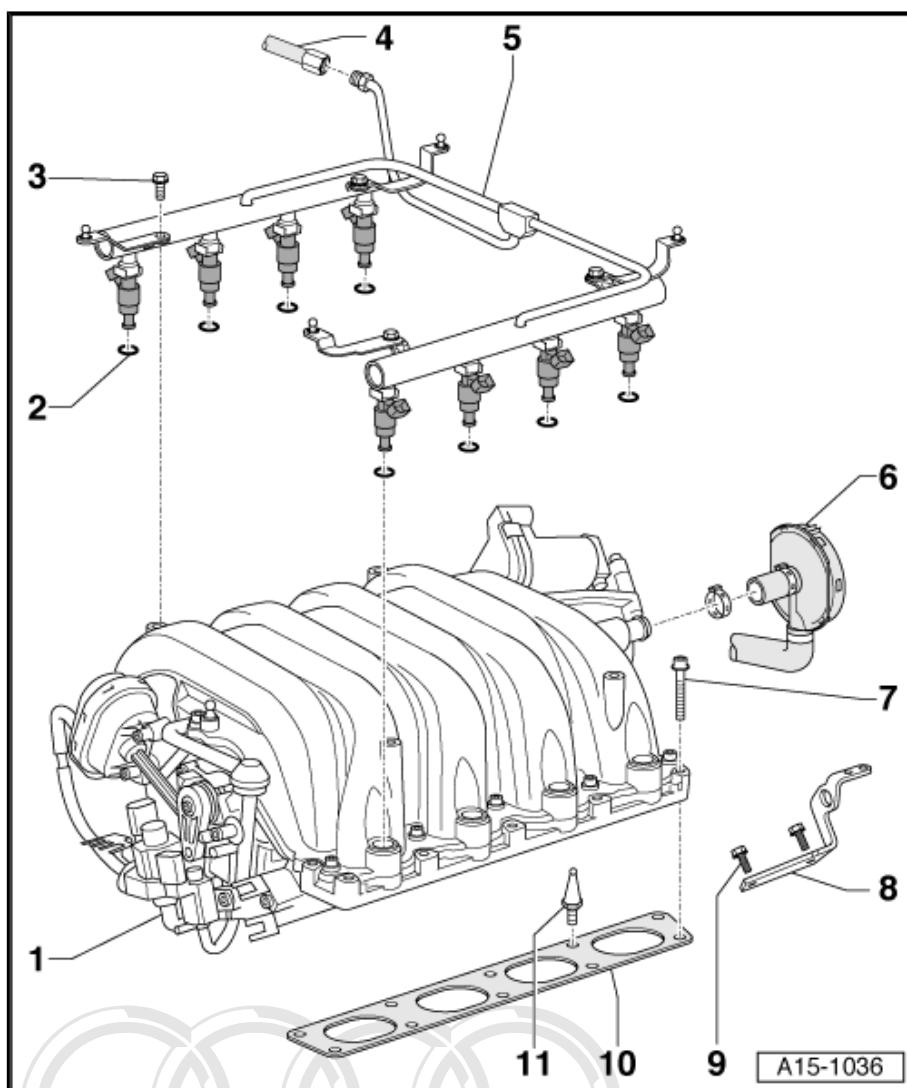
8 - Lifting eye

9 - 23 Nm

10 - Gasket

- ☐ For intake manifold
- ☐ Renew

11 - Locking pin, 0.6 Nm



2.2 Removing and installing intake manifold

Removing



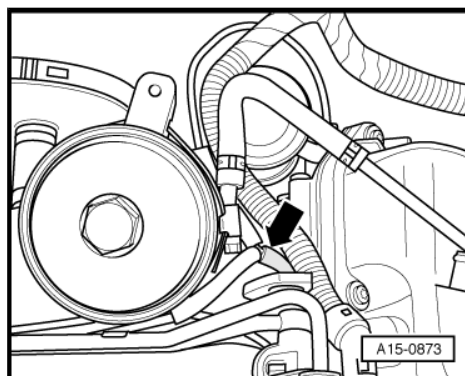
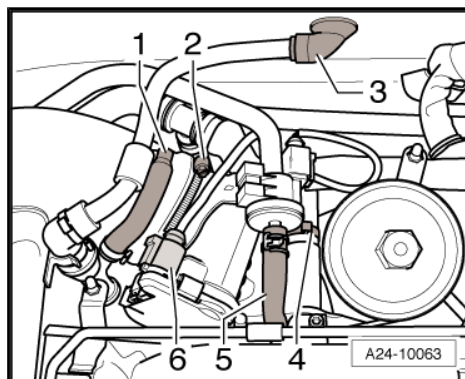
Note

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

- Pull off the engine cover.

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- Disconnect vacuum hose -3- leading to brake servo at bulk-head.
- Detach vacuum hose -1-.
- Unplug electrical connector -6- at throttle valve module - J338- .
- Open hose clip -2- and pull out air intake hose.
- Disconnect vacuum hose -4- for crankcase breather system at intake manifold.
- Detach vacuum hose -5- from intake manifold.
- Detach vacuum hose -arrow- from T-piece.



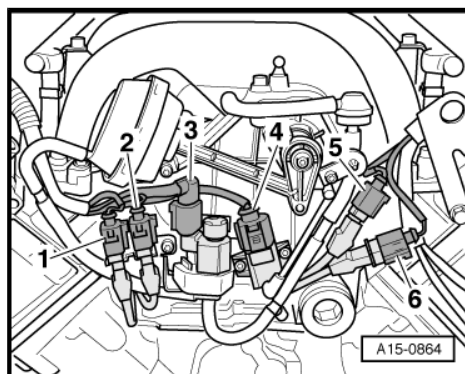
- Pull electrical connectors -1 to 4- forwards out of brackets on intake manifold.



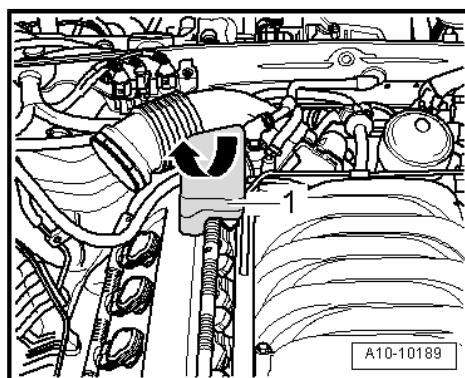
Note

Do not unplug electrical connectors.

- Unplug connector rails -2- and -3- at 8 injectors.



- Pull the resonator -1- upwards -arrow- and unclip.

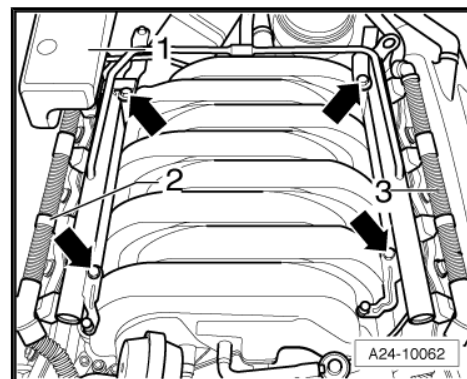


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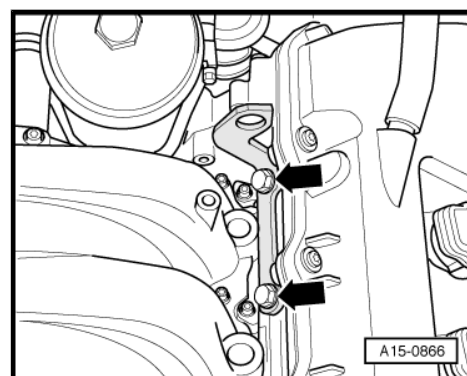
- Unscrew bolts -arrows- securing fuel rail.
- Pull fuel rail together with injectors off intake manifold (pull off evenly from the top) and place it on a clean cloth in the engine compartment.

**Note**

Make sure the removed injectors do not become soiled.



- Unscrew engine lifting eye (rear left) -arrows-.



- Unscrew and remove intake manifold -arrows-.

**Note**

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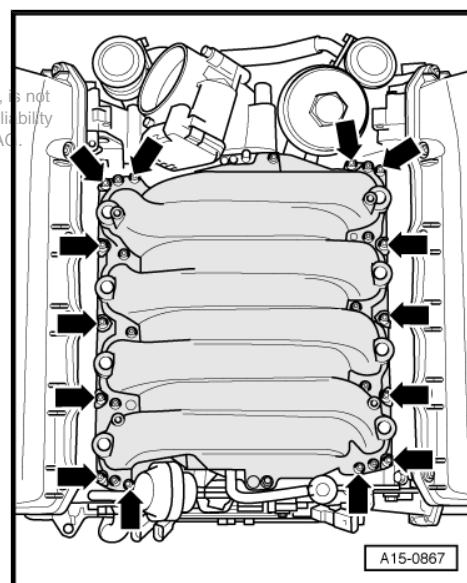
Seal intake ports on cylinder heads with clean cloths.

Installing

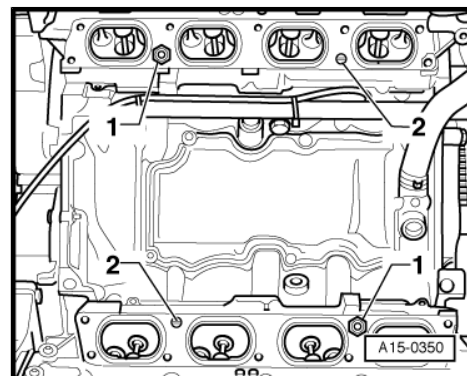
Installation is carried out in the reverse order; note the following:

**Note**

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



- Remove securing bolts -1- to renew gaskets for intake manifold.
- Observe locating pins -2- when fitting intake manifold.

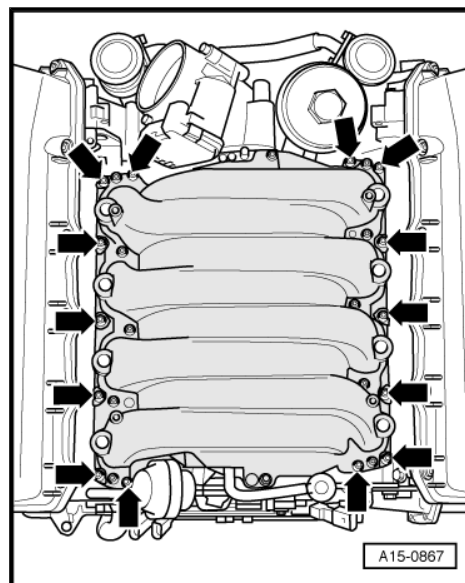




- Tighten bolts on intake manifold in stages and in diagonal sequence -arrows-.
- Reconnect all vacuum hoses.
- Ensure secure fit of electrical connections.
- Bleed the fuel system ⇒ Rep. gr. 24 .

Tightening torques

Component	Nm
Securing bolt to cylinder head	0.6
Intake manifold to cylinder head	10
Engine lifting eye to cylinder head	22
Fuel rail to intake manifold	10



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3 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.*
- ◆ *Renew gaskets, seals and O-rings.*

3.1 Valve gear - exploded view

1 - 5 Nm + 90° (1/4 turn) further

- ☐ Renew

2 - Housing for camshaft control valve

3 - Gasket

- ☐ Renew

4 - Diamond-coated washer

- ☐ Renew

5 - Valve stem oil seal

- ☐ Renewing ⇒ [page 135](#)

6 - Valve spring

7 - Valve spring plate

8 - Valve cotters

9 - Hydraulic tappet

☐ Pressed into roller rocker finger
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- ☐ Cannot be removed without damaging

10 - Roller rocker finger

- ☐ With hydraulic tappet ⇒ [Item 9 \(page 131\)](#)
- ☐ Removing and installing ⇒ [page 135](#)

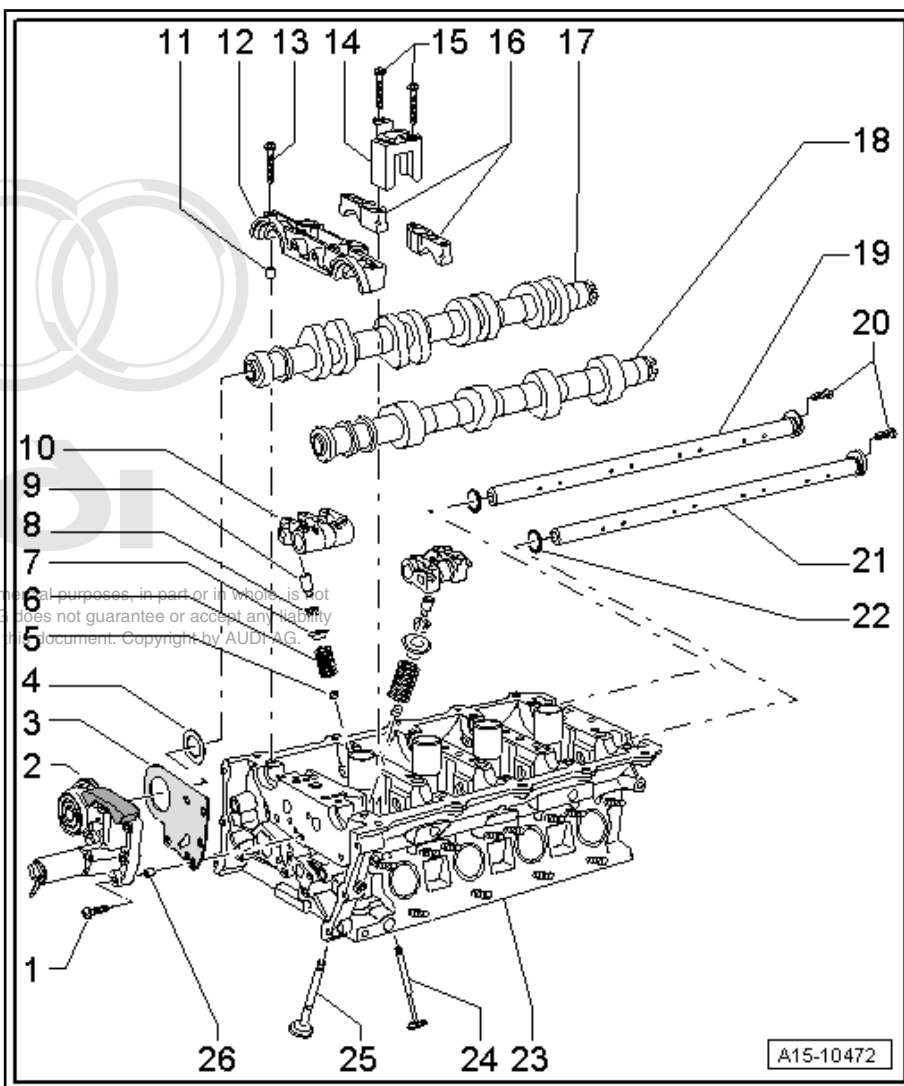
11 - Dowel sleeve

- ☐ 2x

12 - Double bearing cap

13 - 5 Nm + 90° (1/4 turn) further

- ☐ Renew





14 - Oil deflector

- ☐ On right-side cylinder head between bearing cap E4 and A4
- ☐ On left-side cylinder head between bearing caps E2 and A2

15 - 5 Nm + 90° (1/4 turn) further

- ☐ Renew

16 - Bearing cap

- ☐ Note installation position and allocation ⇒ [page 134](#)

17 - Inlet camshaft

- ☐ Removing and installing ⇒ [page 133](#)
- ☐ Checking axial clearance ⇒ [page 134](#)
- ☐ Check radial clearance with Plastigage (roller rocker fingers removed)
- ☐ Radial clearance: wear limit: 0.1 mm
- ☐ Radial clearance/run-out: max. 0.01 mm

18 - Exhaust camshaft

- ☐ Removing and installing ⇒ [page 133](#)
- ☐ Checking axial clearance ⇒ [page 134](#)
- ☐ Check radial clearance with Plastigage (roller rocker fingers removed)
- ☐ Radial clearance: wear limit: 0.1 mm
- ☐ Radial clearance/run-out: max. 0.01 mm

19 - Shaft for rocker fingers, inlet side

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

20 - 10 Nm

21 - Shaft for rocker fingers, exhaust side

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

22 - O-ring

- ☐ For shaft of roller rocker finger
- ☐ Renew

23 - Cylinder head

- ☐ See note ⇒ [page 131](#)
- ☐ Checking valve guides, grinding-in valve seats ⇒ [page 138](#)
- ☐ Machining valve seats ⇒ [page 140](#)

24 - Inlet valve

- ☐ Do not machine, only grinding-in is permitted
- ☐ Valve dimensions ⇒ [page 140](#)
- ☐ Checking valve guides, grinding-in valve seats ⇒ [page 138](#)

25 - Exhaust valve

- ☐ Do not machine, only grinding-in is permitted
- ☐ Valve dimensions ⇒ [page 140](#)
- ☐ Checking valve guides, grinding-in valve seats ⇒ [page 138](#)

26 - Dowel sleeve

- ☐ 2x

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3.2 Removing and installing camshafts

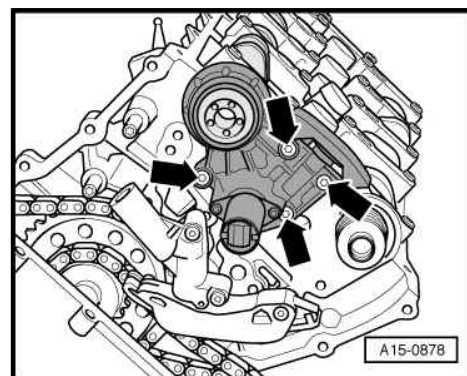
Removing



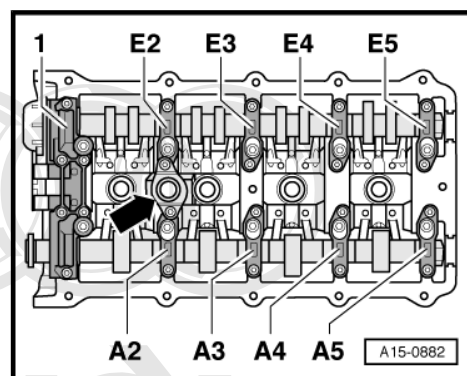
Note

The following description is for removing and installing on right-side cylinder head.

- Remove engine ➔ [page 6](#) .
- Separate engine from gearbox ➔ [page 20](#) .
- Remove timing chains from camshafts ➔ [page 70](#) .
- Remove housing for camshaft control valves -arrows-.
- Remove diamond-coated washer.



- Unscrew bearing caps -1-, -E3-, -E5-, -A3- and -A5-.
- Remove oil deflector -arrow-.
- Loosen bearing caps -E2-, -E4-, -A2- and -A4- on inlet and exhaust camshaft in stages in diagonal sequence and remove.
- Remove the inlet and exhaust camshaft.



Installing

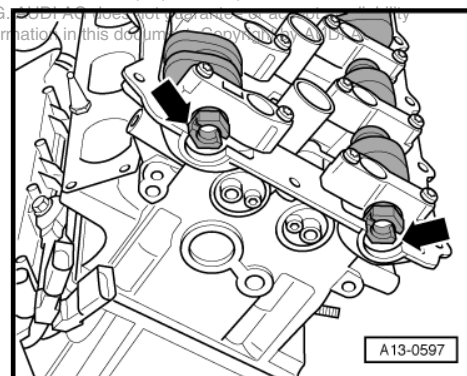
- Crankshaft locked in TDC position with locking pin -3242- .



Note

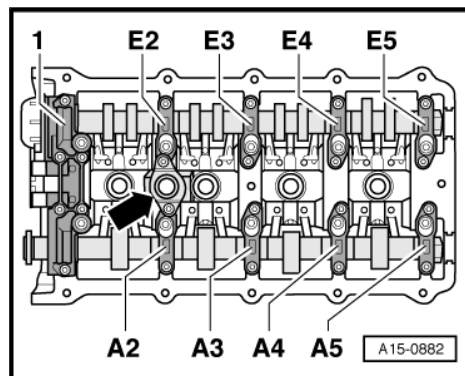
Renew bolts which are tightened to a specified angle as well as oil seals and gaskets.

- Install camshafts in cylinder head in TDC position.
- The slits -arrows- at front of the camshafts must be parallel to and at the same height as the top edge of cylinder head.



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- Fit bearing caps -E2-, -E4-, -A2- and -A4-.
- Install oil deflector -arrow-:
- On right-side cylinder head between bearing caps -E4- and -A4-.
- On left-side cylinder head between bearing caps -E2- and -A2-.
- Tighten bearing caps -E2-, -E4-, -A2- and -A4- on inlet and exhaust camshafts in stages in diagonal sequence.
- Tighten the remaining bearing caps in diagonal sequence.



Note

Note the dowel sleeves on bearing cap -1-.

- Fit new diamond-coated washer ⇒ [Item 4 \(page 131\)](#) on camshaft.
- Install housing for camshaft control valves.

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

- Install camshaft timing chains ⇒ [page 81](#) .
- Install engine ⇒ [page 28](#) .

Tightening torques

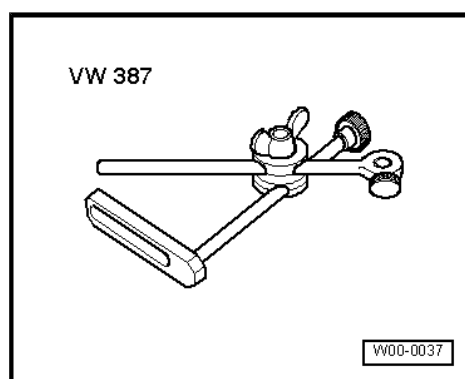
Component	Nm
Bearing cap to cylinder head	5 + 90° ²⁴⁾ ²⁵⁾
Housing for camshaft control valve	5 + 90° ²⁴⁾ ²⁵⁾

24) 90° equals a quarter of a turn
 25) Renew bolts

3.3 Checking axial clearance of camshafts

Special tools and workshop equipment required

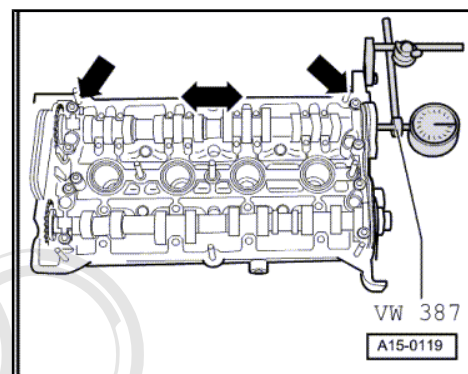
- ◆ Universal dial gauge bracket -VW 387-



- ◆ Dial gauge

Test sequence

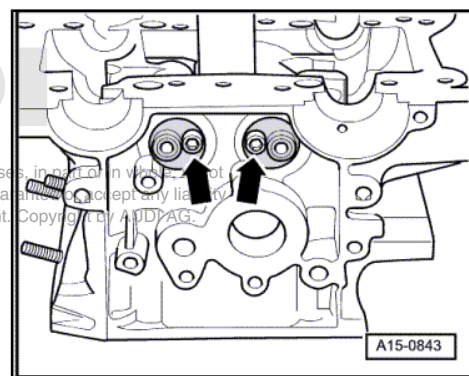
- Camshafts removed ⇒ [page 133](#) .
- Roller rocker fingers removed ⇒ [page 135](#) .
- Insert camshafts in cylinder head and secure with outer bearing caps -arrows-.
- Attach dial gauge bracket -VW 387- with dial gauge to cylinder head:
- Wear limit for inlet and exhaust camshaft: max. 0.20 mm.



3.4 Removing and installing roller rocker fingers

Removing

- Remove engine ⇒ [page 6](#) .
- Remove camshafts ⇒ [page 133](#) .
- Mark the assignment of the roller rocker fingers and their shafts ready for refitting.
- Remove bolts -arrows-.
- Screw an M6 bolt into the hole in the roller rocker finger shaft.
- Pull the shaft out of the cylinder head and detach the roller rocker fingers.



Installing

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



Note

Renew O-rings.

- Oil bearing points of roller rocker fingers prior to installing.
- Install camshafts ⇒ [page 133](#) .
- Install engine ⇒ [page 28](#) .

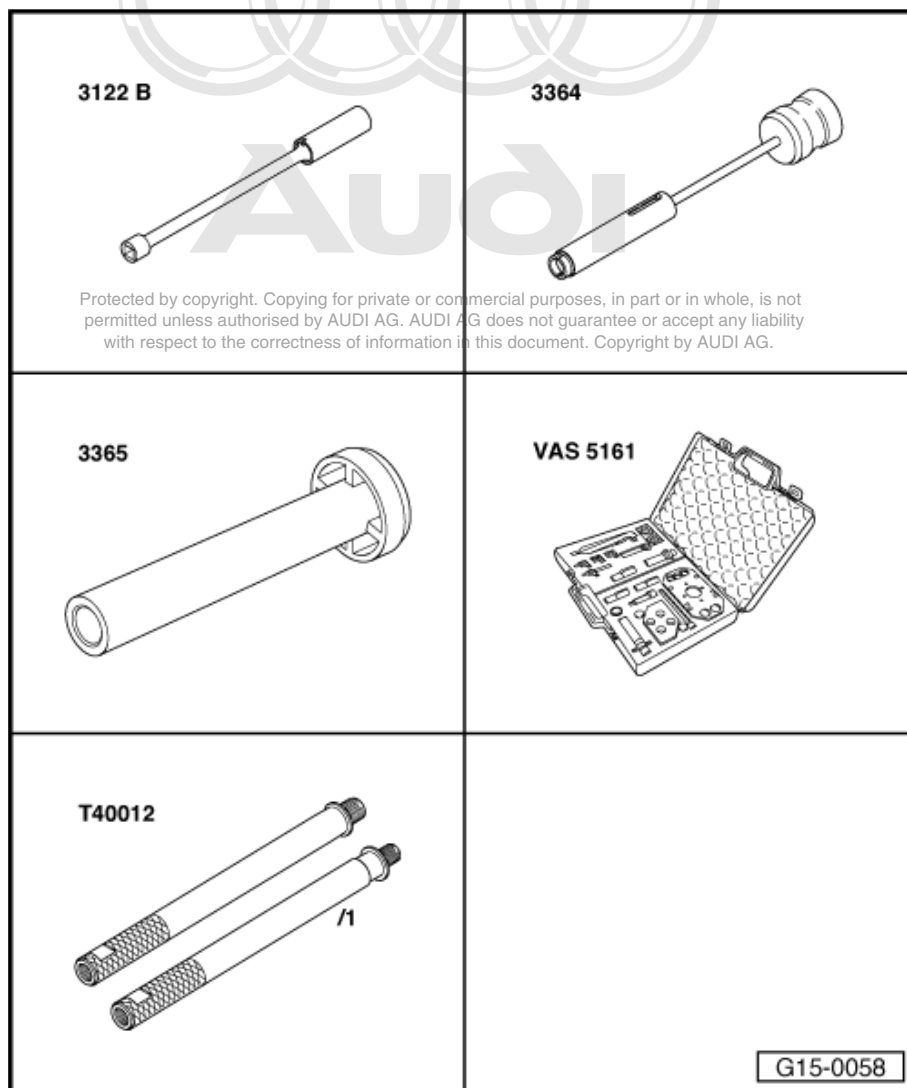
Tightening torque

Component	Nm
Roller rocker finger shaft to cylinder head	10

3.5 Renewing valve stem oil seals

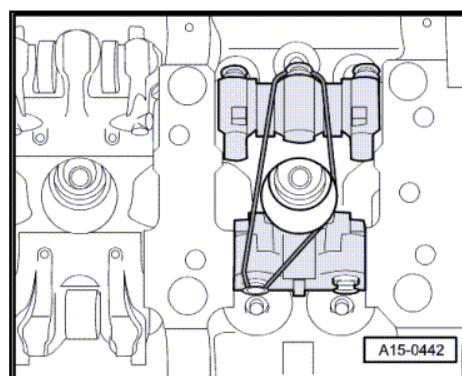
Special tools and workshop equipment required

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



Procedure

- Remove engine ⇒ [page 6](#) .
- Remove camshafts ⇒ [page 133](#) .
- Remove spark plugs with spark plug socket -3122 B- .
- Rotate roller rocker fingers upwards and secure them with a rubber band.

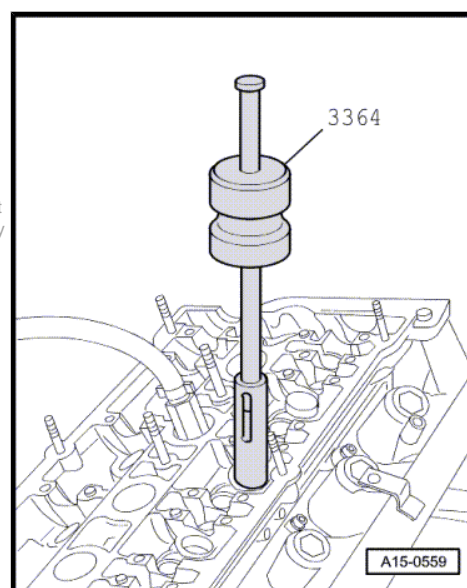
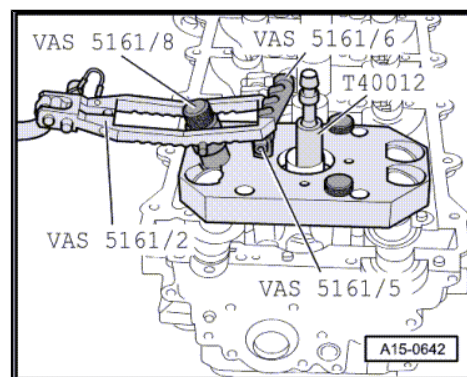
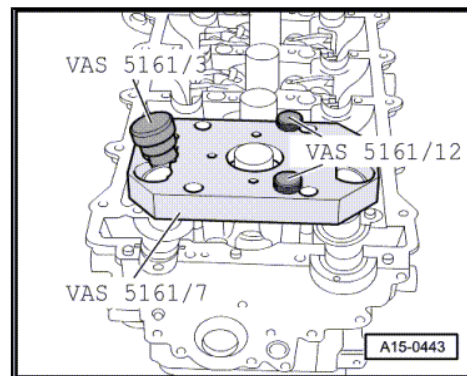


- Fit guide plate -VAS 5161/7- from -VAS 5161- onto cylinder head.
- Secure guide plate -VAS 5161/7- using the knurled screws -VAS 5161/12-.

**Note**

If you cannot screw on the guide plate, drill out securing holes approx. 0.5 mm.

- Insert drift -VAS 5161/3- into guide plate and knock valve cot-
ters loose using a plastic hammer.
- Screw snap-in device -VAS 5161/6- with -VAS 5161/5- into
guide plate -VAS 5161/7-.
- Insert assembly cartridge -VAS 5161/8- into guide plate -
VAS 5161/7-.
- Screw adapter -T40012- with seal hand-tight into the corre-
sponding spark plug thread and apply a steady pressure.
- Minimum pressure: 6 bar
- Attach pressure fork -VAS 5161/2- to snap-in device -
VAS 5161/6- and push assembly cartridge down.
- At the same time, turn knurled screw of assembly cartridge
clockwise until tips engage in valve cotters.
- Move knurled screw back and forth slightly; the valve cotters
are thus forced apart and taken up by the cartridge.
- Release pressure fork.
- Remove assembly cartridge.
- Unscrew guide plate.
- The compressed air hose remains connected.
- Remove valve spring with valve spring plate.
- Pull off valve stem seals with extractor -3364-.

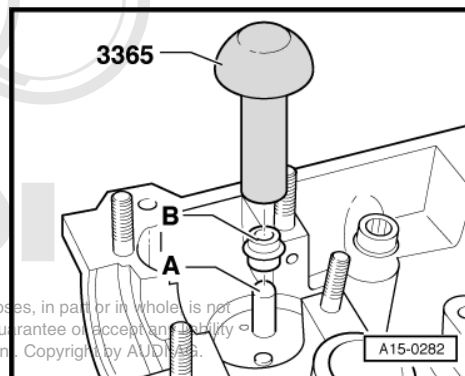


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Note

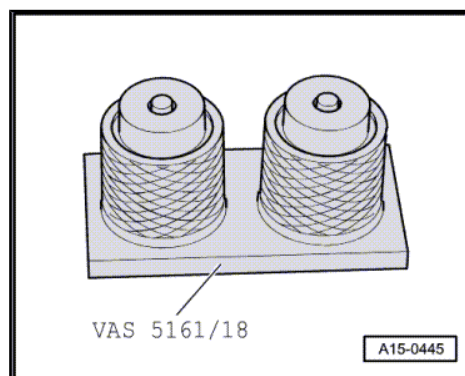
- ◆ To press on the valve stem seals from the current product range, fitting tool -3365- must be drilled out to $\varnothing$ 10.5 mm.
- ◆ A plastic sleeve -A- is included with the new valve stem oil seals.
- To prevent damage to the new valve stem seals -B-, attach plastic sleeve -A- to valve stem.
- Lightly oil 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.



Note

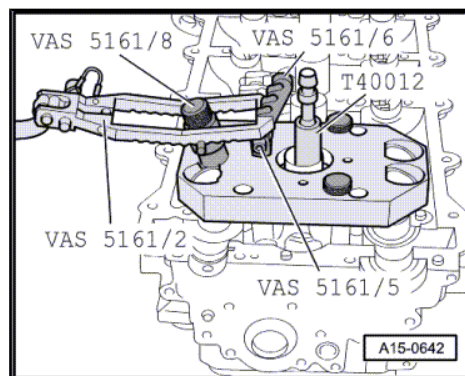
Larger diameter of valve cotters faces upwards.

- Insert valve spring and valve spring plate.
- Screw guide plate -VAS 5161/7- back onto cylinder head.
- Insert assembly cartridge -VAS 5161/8- into guide plate.
- Press down pressure fork and pull up knurled screw, thus inserting the valve cotters.
- Release pressure fork with knurled screw still in pulled position.
- Install camshafts ⇒ [page 133](#).
- Install engine ⇒ [page 28](#).



Note

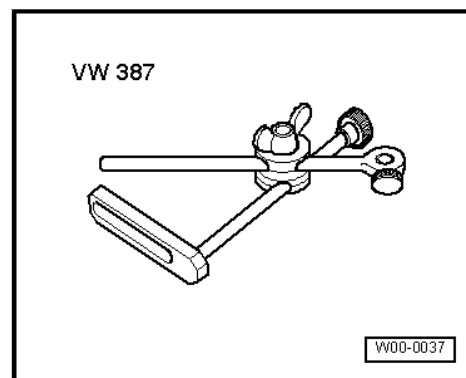
- ◆ After installing the camshaft, the engine must NOT be started for about 30 minutes. Hydraulic valve compensation elements have to settle (otherwise valves will strike pistons).
- ◆ After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make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



3.6 Checking valve guides

Special tools and workshop equipment required

◆ Universal dial gauge bracket -VW 387-



◆ Dial gauge

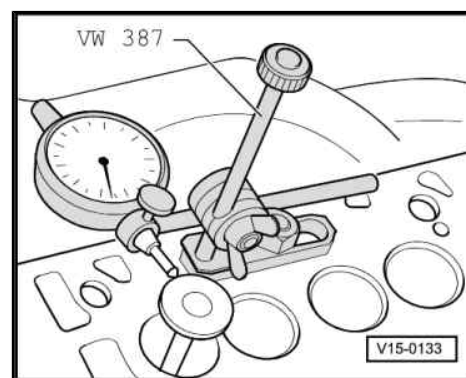
Test sequence

- Insert valve into guide. End of valve stem must be flush with guide. Only insert inlet valve into inlet guide and exhaust valve into exhaust guide, as the stem diameters are different.
- Measure the amount of sideways play.
- Wear limit for inlet and exhaust valve guide: max. 0.80 mm.



Note

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



3.7 Checking valves

- Visually inspect for scoring on valve stems and valve seat surfaces. Renew valves if severe scoring is visible.

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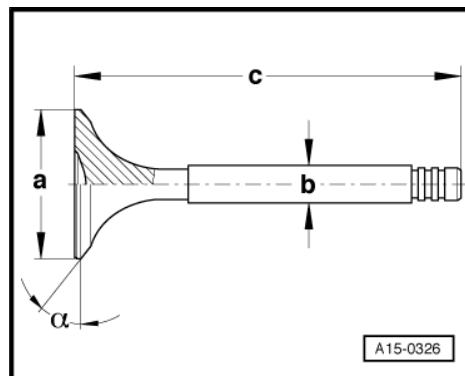
3.8 Valve dimensions



Note

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

Dimension	Inlet valve	Exhaust valve
a = $\varnothing$ mm	26.8 ... 27.0	29.8 ... 30.0
b = $\varnothing$ mm	5.956 ... 5.970	5.936 ... 5.950
c = mm	96.39 ... 96.59	94.79 ... 94.99
$\alpha = \angle^\circ$	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.

3.9 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 138](#).
- ◆ Valve seats should only be machined to the extent required to give a proper seating pattern.
- ◆ Calculate the maximum permissible machining dimension before machining.
- ◆ If the maximum machining dimension is exceeded, the hydraulic valve clearance compensation will not work properly and the cylinder head will have to be renewed.

Calculating maximum permissible machining dimension

- Insert valve and press firmly against valve seat.

i Note

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

- Measure distance -a- between end of valve stem and centre axis of camshaft (centre axis of camshaft is level with top edge of cylinder head).
- Calculate max. permissible machining dimension from measured distance and minimum dimension.

Minimum dimensions		
Inlet valves (outer)	Inlet valve (centre)	Exhaust valves
39.3 mm	41.0 mm	39.9 mm

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

Example for inlet valve (outer):

Measured gap -a-	39.7 mm
- Minimum dimension	- 39.3 mm
= Max. permissible machining dimension	= 0.4 mm

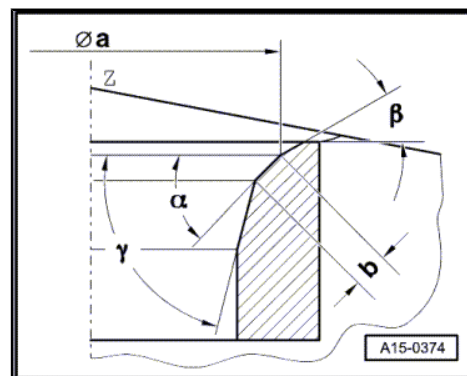
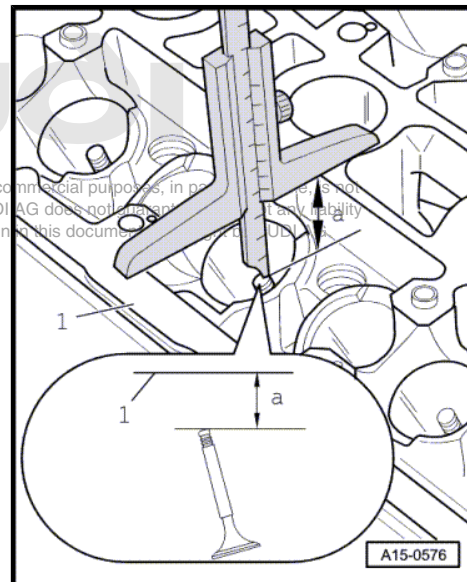
i Note

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
a = $\varnothing$ 26.6 mm
b = approx. 1.0 mm
Z = Bottom surface of cylinder head
α = 45° valve seat angle
β = 30° upper correction angle
γ = 60° lower correction angle

Exhaust valve seat
a = $\varnothing$ 26.0 mm
b = approx. 1.0 mm
Z = Bottom surface 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 must be renewed in order to prevent further damage occurring later.
- ◆ The oil level must not be above the max. mark – otherwise the catalytic converter can be damaged.
- ◆ Refer to ⇒ Maintenance tables for engine oil capacity, oil specifications and viscosity grades.

1.1 Oil pump, sump (bottom section) - exploded view

1 - 10 Nm

2 - Sump (bottom section)

- ☐ Removing and installing
⇒ [page 143](#)
- ☐ With oil level and oil temperature sender - G266-
- ☐ Removing and installing oil level and oil temperature sender -G266-
⇒ [page 143](#)

3 - 10 Nm

4 - Intake connecting pipe

- ☐ With oil strainer

5 - Seal

- ☐ Renew

6 - O-ring

- ☐ Renew

7 - 10 Nm

8 - Oil pipe

9 - Seal

- ☐ Renew

10 - 10 Nm

11 - Oil pipe

12 - O-rings

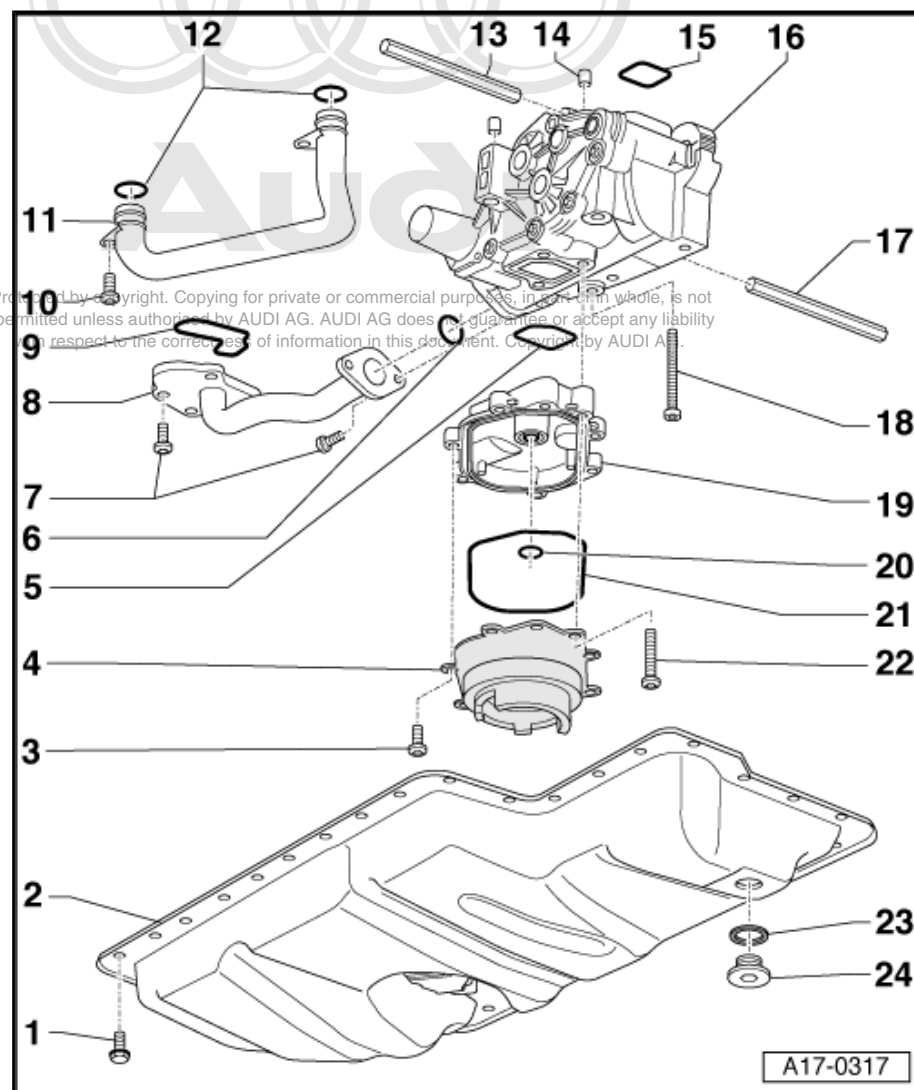
- ☐ Renew

13 - Drive shaft

- ☐ For coolant pump

14 - Dowel sleeves

- ☐ 2x



15 - Seal

- ☐ Renew

16 - Oil pump

- ☐ Do not dismantle
- ☐ With pressure control valve: approx. 4 bar
- ☐ Removing and installing ⇒ [page 147](#)

17 - Drive shaft

- ☐ For oil pump

18 - 10 Nm**19 - Housing for intake connecting pipe****20 - O-ring**

- ☐ Renew

21 - Seal

- ☐ Renew

22 - 10 Nm**23 - Seal**

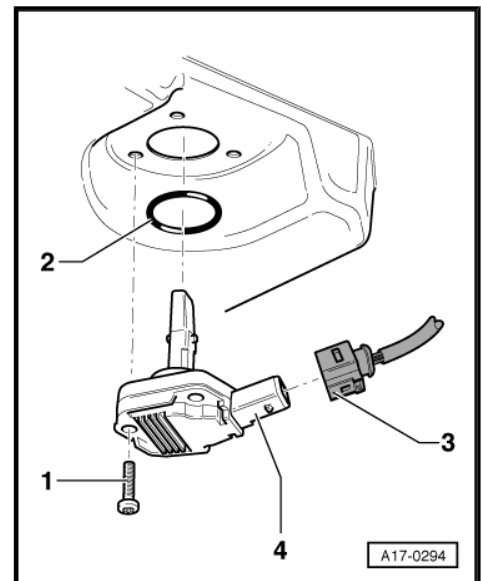
- ☐ Renew

24 - Oil drain plug, 50 Nm

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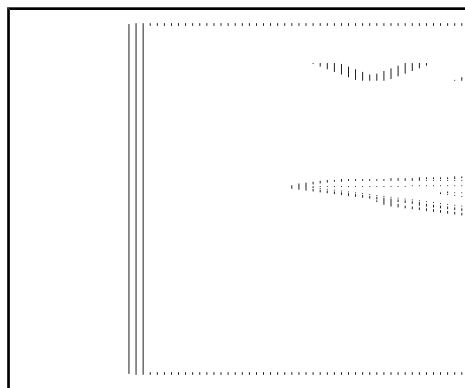
Removing and installing oil level and oil temperature sender - G266-

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

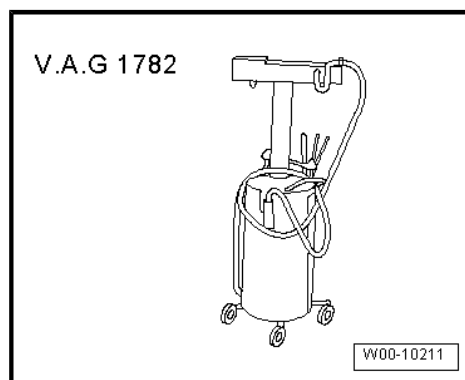
**1.2 Removing and installing sump (bottom section)**

Special tools and workshop equipment required

- ◆ Drip tray for workshop hoist -VAS 6208-



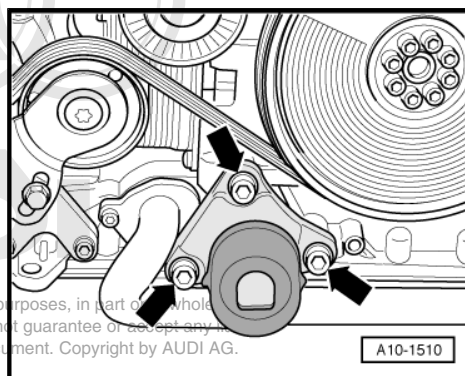
- ◆ Used oil collection and extraction unit -V.A.G 1782-



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

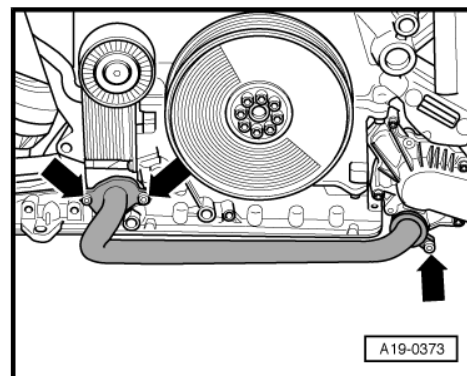
Removing

- Drain coolant ⇒ [page 168](#) .
- Drain off engine oil ⇒ Maintenance ; Booklet 405 .
- Move lock carrier to service position ⇒ Rep. gr. 50 .
- Unscrew bolts -arrows- and remove torque reaction support from engine.

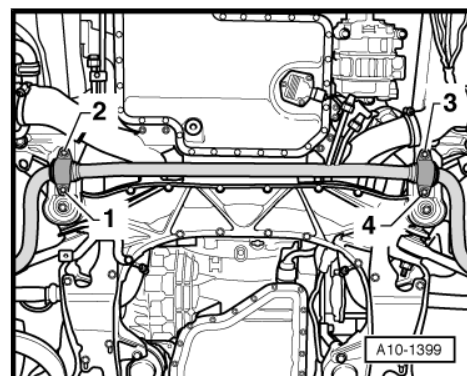


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- Place drip tray for workshop hoist -VAS 6208- beneath engine.
- Unbolt coolant pipe (front) from engine -arrows-.

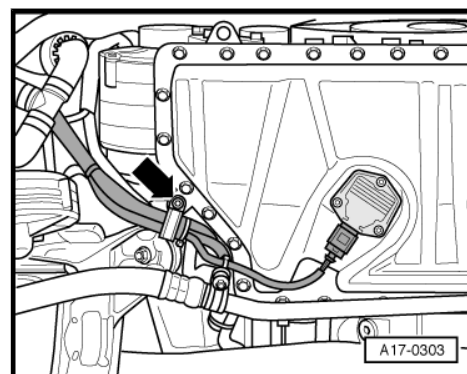


- Unscrew nuts -1 ... 4- for anti-roll bar mountings (left and right).

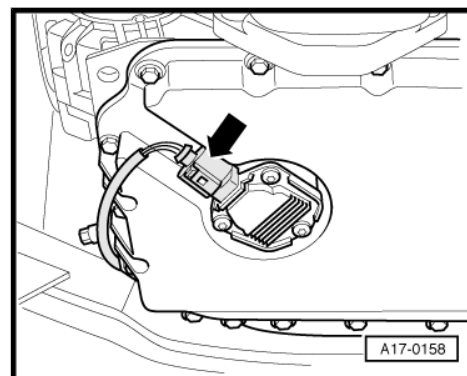


Unscrew wire clamp -arrow- on sump (bottom section).

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





- Place used oil collection and extraction unit -V.A.G 1782- under engine.
- Unbolt sump (bottom section) -1- and pry off carefully.



Note

There will still be some oil in the sump (bottom section).

Installing



Note

Renew seals.

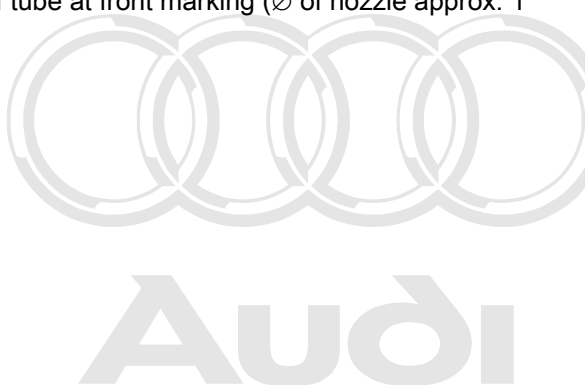
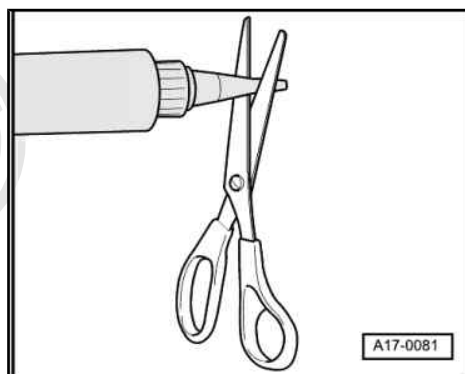
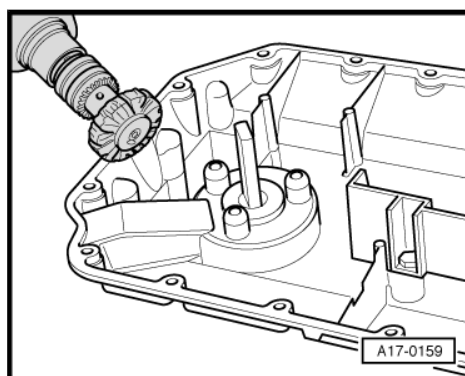
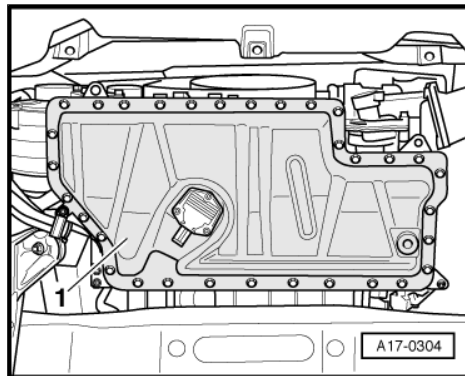
- Remove remaining sealant on bottom and top section of sump with a rotating plastic brush or similar.



WARNING

Wear safety goggles.

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

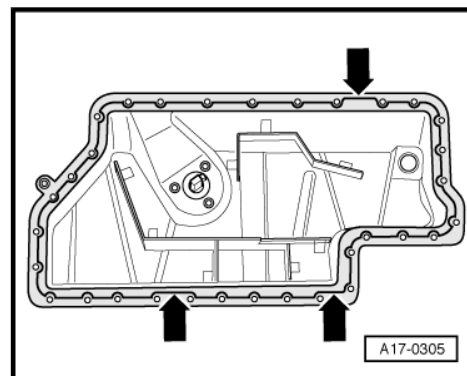


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- Apply the bead of sealant onto the clean sealing surface of the sump (bottom section) as illustrated.
- Thickness of sealant bead: 1.5...2.0 mm

**Note**

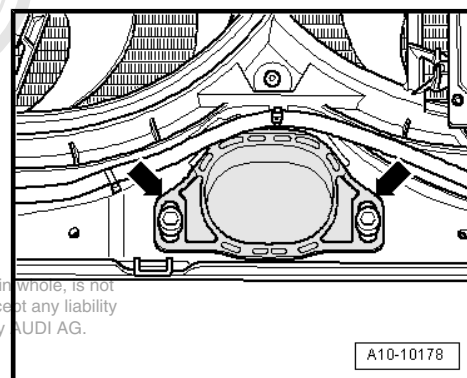
- ◆ *Note the position of sealant at the points marked with -arrows-.*
- ◆ *The sump (bottom section) must be installed within 5 minutes after applying sealant.*
- ◆ *The bead of sealant must not be thicker than specified, otherwise excess sealant can enter the sump (bottom section) and obstruct the strainer in the oil intake pipe.*



- 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.

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

- Install anti-roll bar ⇒ Rep. gr. 40 .
- Install coolant pipe (front) ⇒ [page 179](#) .
- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight and tighten bolts -arrows-.
- Install front bumper ⇒ Rep. gr. 63 .
- Fill up with engine oil and check oil level ⇒ Maintenance ; Booklet 405 .
- Fill up with coolant ⇒ [page 170](#) .
- Adjust headlights ⇒ Maintenance ; Booklet 405 .

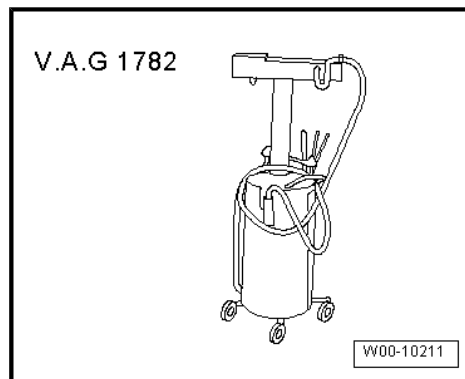
**Tightening torques**

Component	Nm
Sump (bottom section) to sump (top section)	10
Oil drain plug	50
Stop for torque reaction support to lock carrier	40

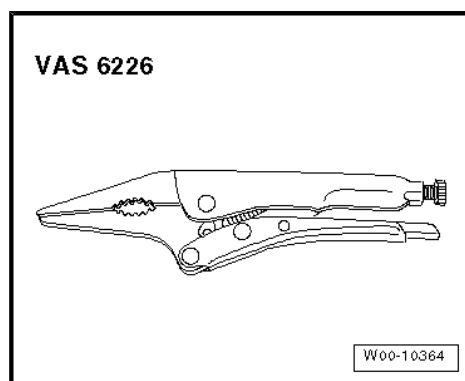
1.3 Removing and installing oil pump

Special tools and workshop equipment required

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



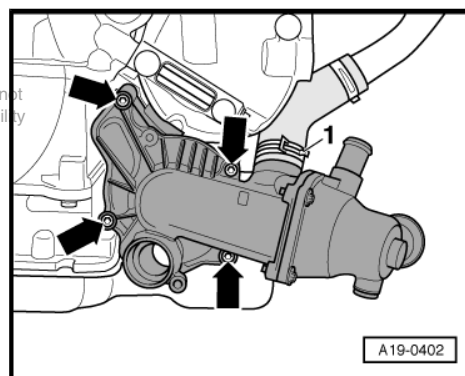
- ◆ Long-nose grip pliers -VAS 6226-



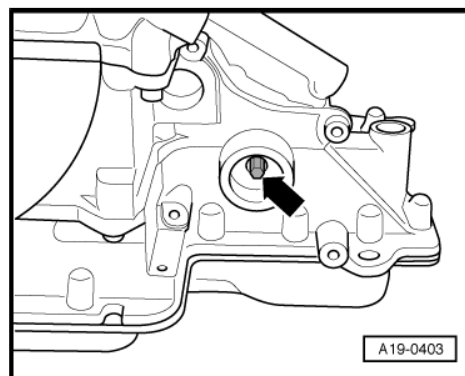
Removing

- Remove sump (bottom section) ⇒ [page 143](#) .

- Disconnect coolant hose -1-.
- Unbolt coolant pump -arrows-.



- Remove drive shaft -arrow- for coolant pump from the oil pump.



- Place used oil collection and extraction unit -V.A.G 1782- underneath.
- Unscrew bolts and remove oil pipes -1- and -2-.

**Note**

Some oil will come out when oil pipes are removed.

- Remove bolts -1 ... 3- and remove intake pipe together with housing.

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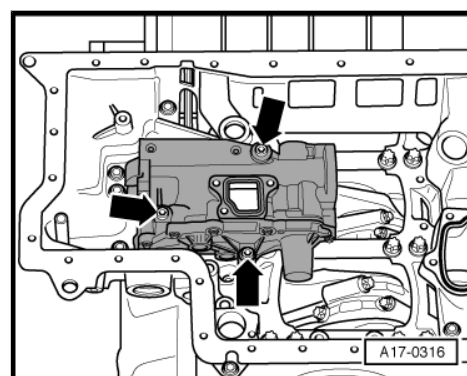
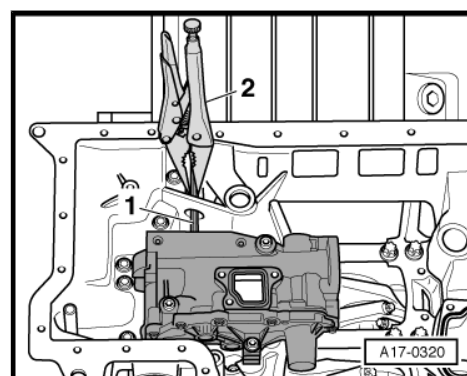
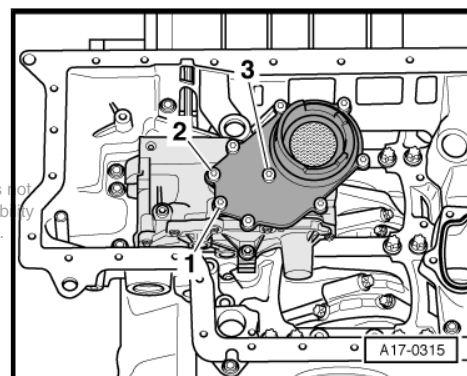
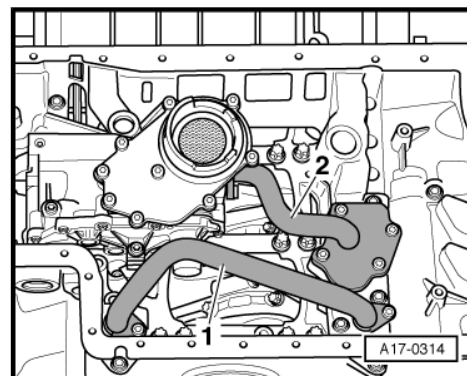
- Press oil pump drive shaft -1- back against spring pressure and hold firmly with long-nose grip pliers -VAS 6226- -2-.

- Unscrew bolts -arrows- and remove oil pump.

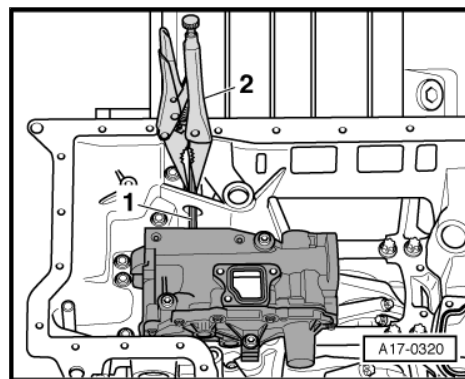
Installing**Note**

Renew seals and O-rings.

- Check whether the two dowel sleeves are fitted in the cylinder block; install if necessary.
- Secure the oil pump -arrows-.



- Release the grip pliers -2- and let the drive shaft -1- slide into oil pump.



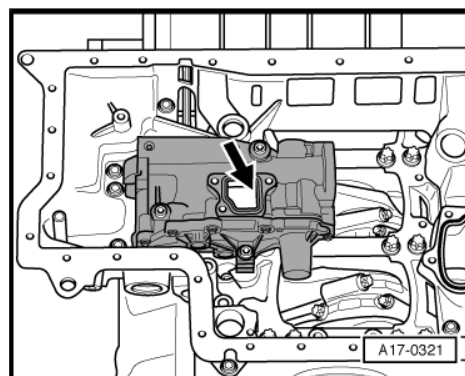
- Check to ensure that the drive shaft is positively engaged in the oil pump. Try to turn the oil pump gears by reaching into the opening in the intake pipe -arrow- of oil pump.
- You should not be able to turn the gears.

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

- Install coolant pump ⇒ [page 175](#) .
- Install sump (bottom section) ⇒ [page 143](#) .

Tightening torques

Component	Nm
Oil pump to cylinder block	10
Housing for intake pipe to oil pump	10
Oil pipe to sump (top section) and oil pump	10



1.4 Sump (top section) - exploded view



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1 - Sump (bottom section)

- ☐ Removing and installing
⇒ [page 143](#)
- ☐ With oil level and oil temperature sender - G266-
- ☐ Removing and installing oil level and oil temperature sender -G266-
⇒ [page 143](#)

2 - 10 Nm**3 - 10 Nm****4 - Oil pipe****5 - Seal**

- ☐ Renew

6 - 10 Nm**7 - Oil pipe****8 - O-rings**

- ☐ Renew

9 - Sump (top section)

- ☐ Removing and installing
⇒ [page 151](#)

10 - Seal

- ☐ Renew

11 - Seal

- ☐ Renew

12 - O-ring

- ☐ Renew

13 - 15 Nm**14 - 10 Nm****15 - Guide tube for oil dipstick****16 - O-ring**

- ☐ Renew

17 - Seal Protected by copyright. Copying for private or commercial purposes, in part or in whole, is not permitted unless authorised by AUDI AG. AUDI AG does not guarantee or accept any liability with respect to the correctness of information in this document. Copyright by AUDI AG.

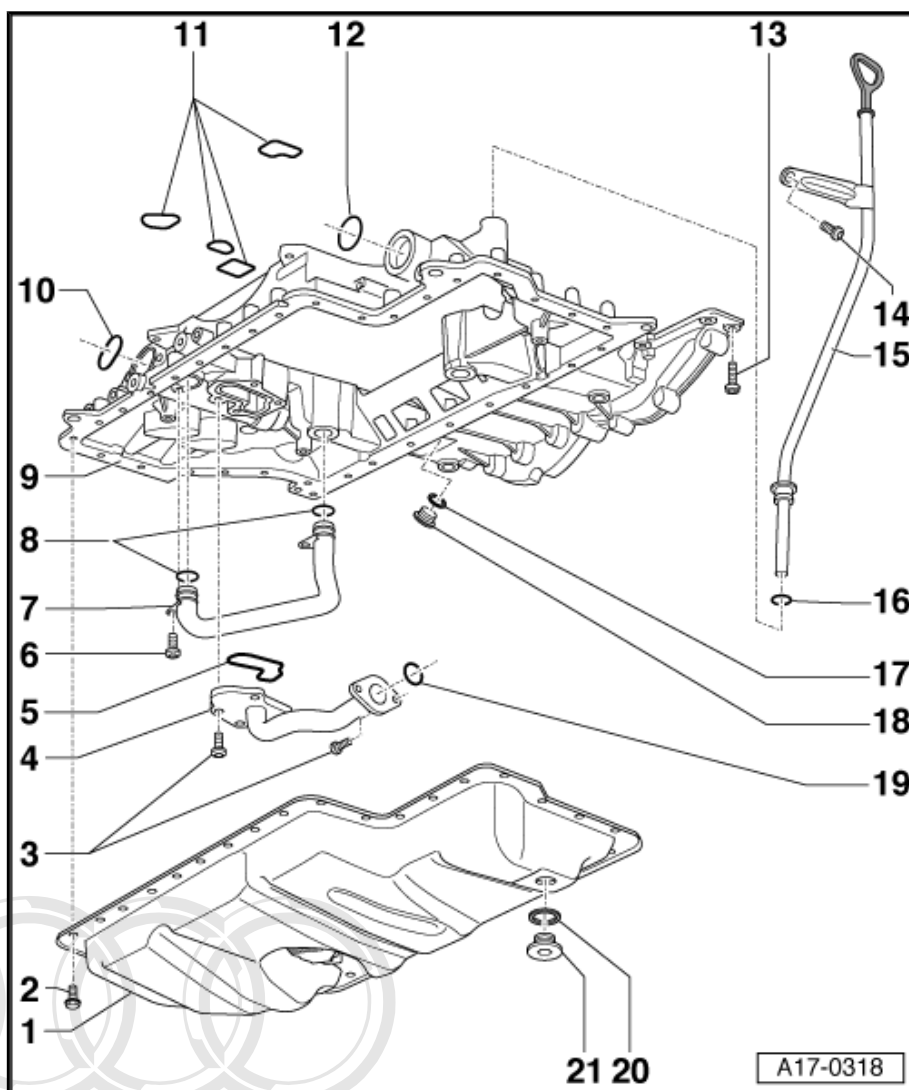
- ☐ Renew

18 - Screw plug, 35 Nm**19 - O-ring**

- ☐ Renew

20 - Seal

- ☐ Renew

21 - Oil drain plug, 50 Nm

1.5 Removing and installing sump (top section)

Special tools and workshop equipment required

- ◆ Safety goggles



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

Removing

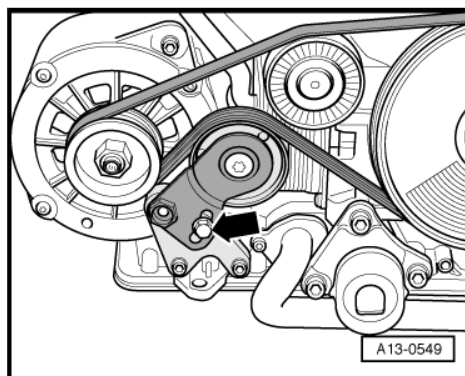
- Drain off engine oil ⇒ Maintenance ; Booklet 405 .
- Remove engine ⇒ [page 6](#) .
- Separate engine from gearbox ⇒ [page 20](#) .
- Remove timing chain covers ⇒ [page 45](#) .



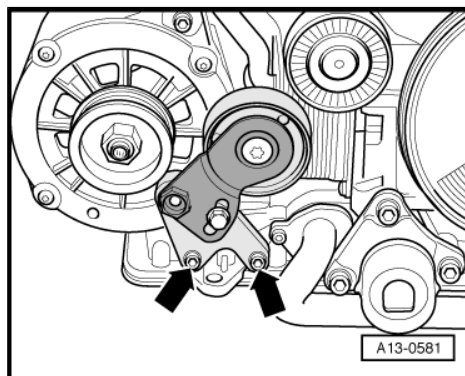
Note

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

- Unscrew clamping bolt -arrow- and remove poly V-belt.



- Remove tensioning roller -arrows-.

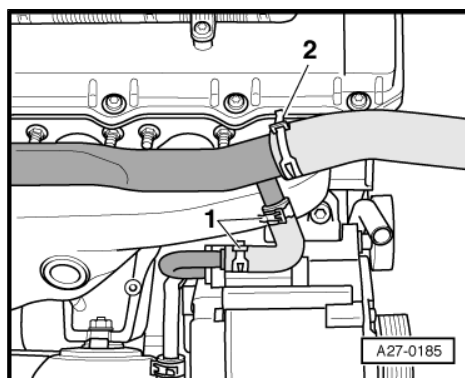


- Loosen hose clips -1- and disconnect coolant hose.



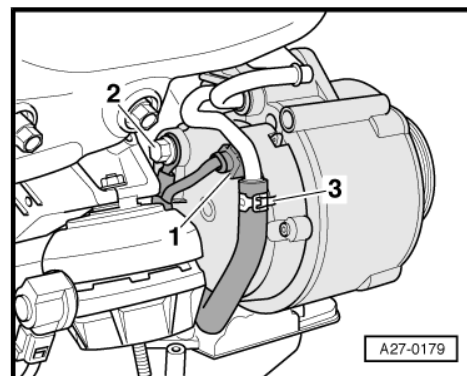
Note

Disregard -item 2-.



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- Remove coolant hose -3- at alternator.
- Unplug electrical connector -1-.
- Unscrew wire -2- at alternator.

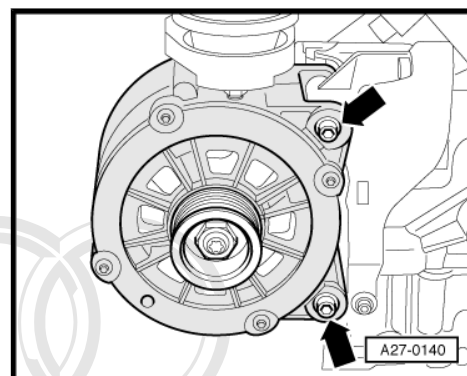


- Remove bolts -arrows-.

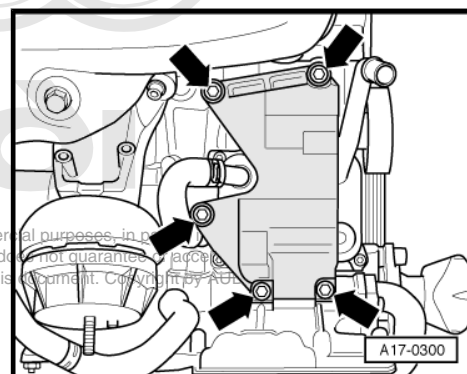
**Note**

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

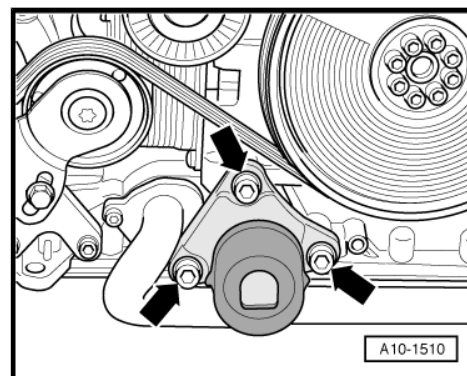
- Remove alternator.



- Remove bolts -arrows-.
- Remove bracket for alternator.

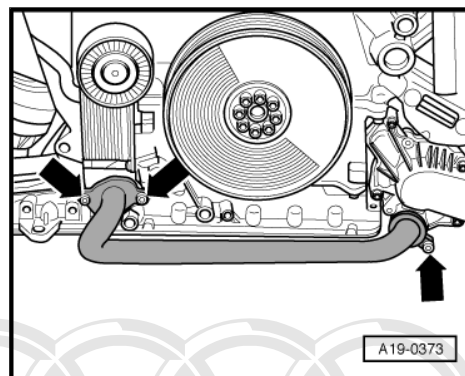


- Unscrew bolts -arrows- and remove torque reaction support from engine.

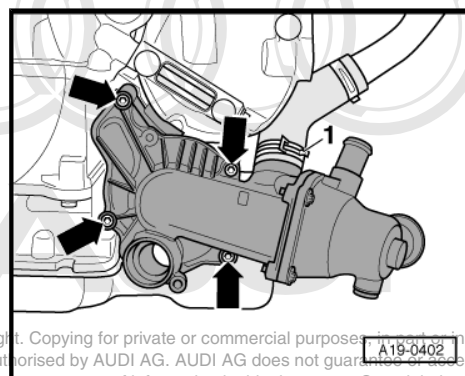


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- Unbolt coolant pipe (front) from engine -arrows-.

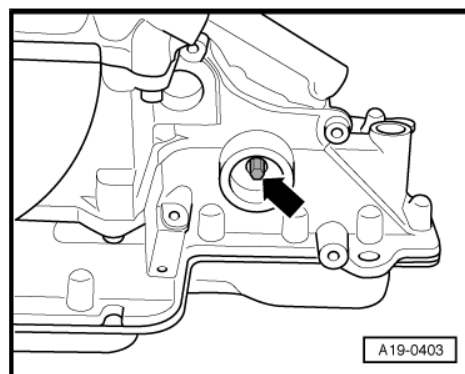


- Disconnect coolant hose -1-.
- Unbolt coolant pump -arrows-.

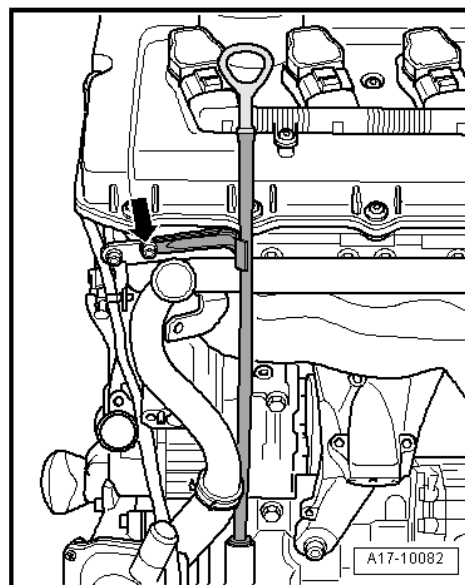


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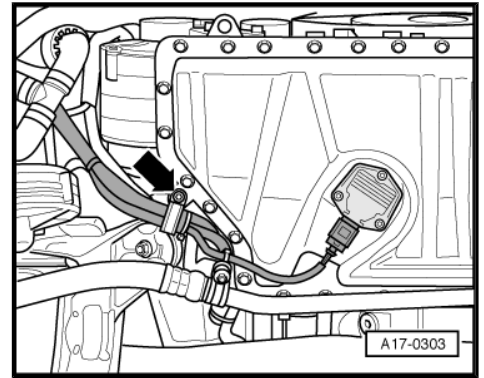
- Remove drive shaft -arrow- for coolant pump from the oil pump.



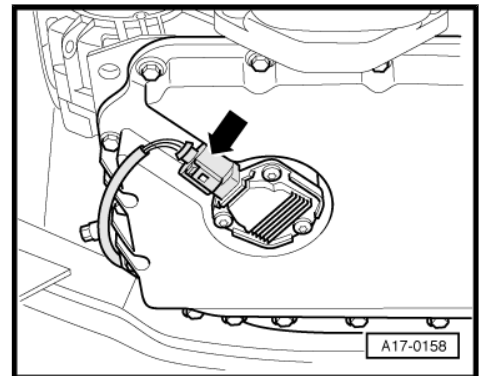
- Unbolt dipstick guide tube on cylinder head -arrow- and lift out upwards.



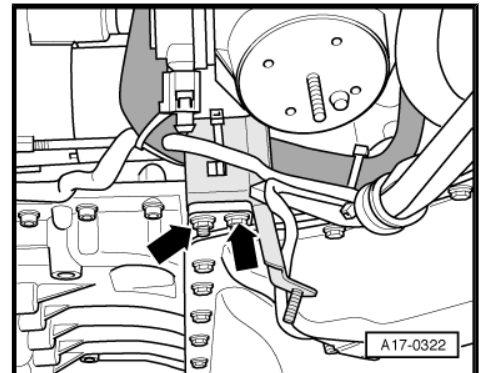
- Unscrew wire clamp -arrow- on sump (bottom section).



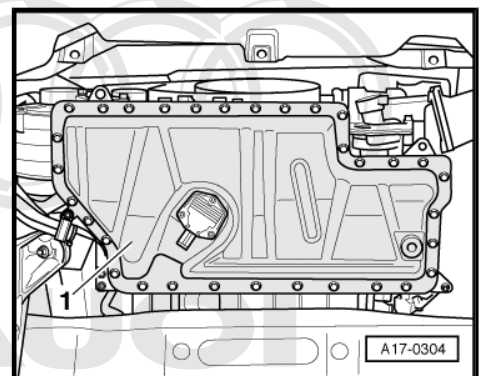
- Unplug electrical connector at oil level and oil temperature sender -G266- -arrow- and move wiring clear.



- Unbolt bracket for wiring harness -arrows- at sump (top section).

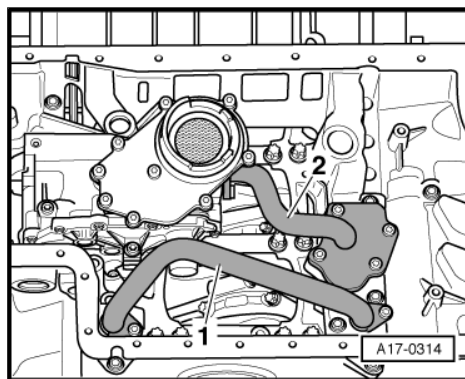


- Unbolt sump (bottom section) -1- and pry off carefully.



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- Unscrew bolts and remove oil pipes -1- and -2-.



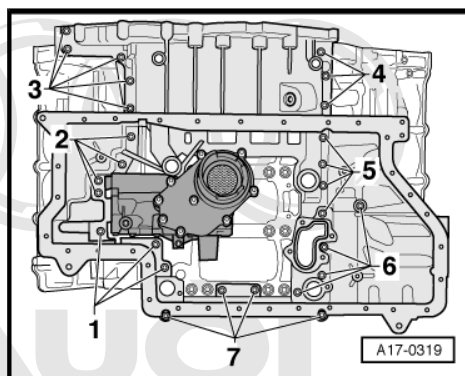
- Remove bolts -1 ... 7- for sump (top section).
- Press sump (top section) off spring pins on cylinder block.

Installing



Note

Renew seals and O-rings.



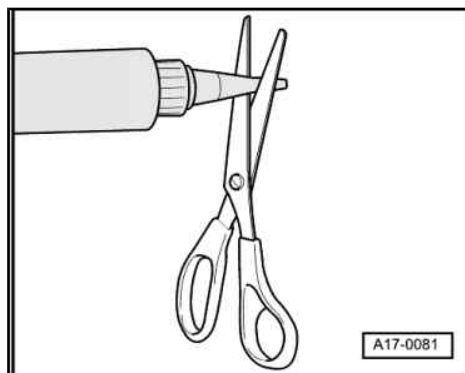
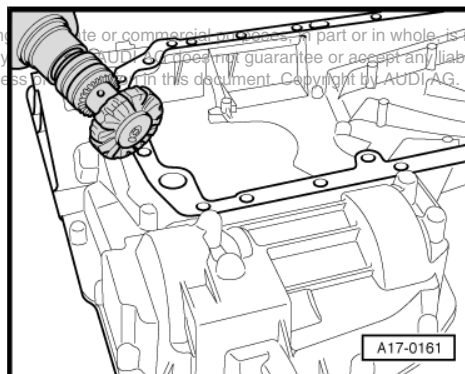
- Remove remaining sealant on sump (top section) and cylinder block using rotating plastic brush or similar.



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).



- Fit new seals -1 ... 4- in the grooves on cylinder block.
- Apply beads of sealant -arrows- onto clean sealing surface of cylinder block as illustrated.
- Thickness of sealant bead: 1.5 ... 2.0 mm

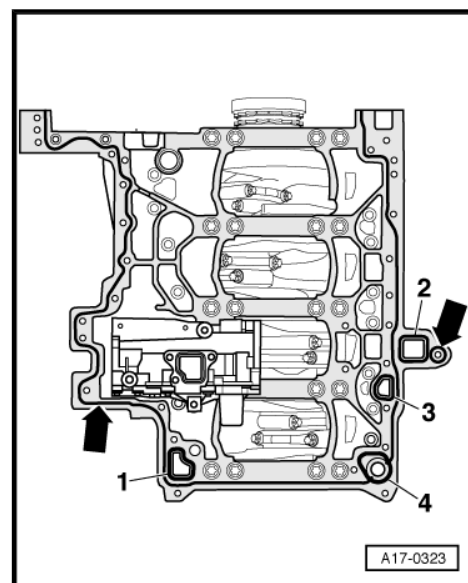


Note

- ◆ The sump (top section) must be installed within 5 minutes after applying sealant.

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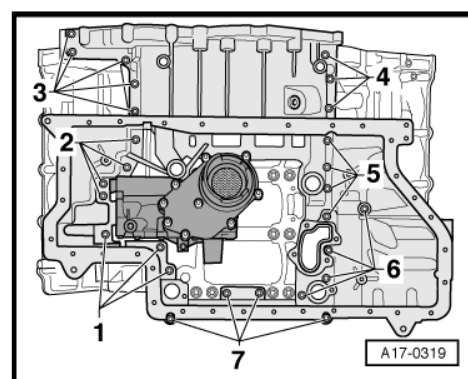
◆ The bead of sealant must not be thicker than specified, otherwise excess sealant can enter the sump and obstruct the strainer in the oil intake pipe.



- Fit sump (top section) with help of another mechanic and tighten bolts -1 ... 7- initially to 5 Nm.
- Tighten bolts -1 ... 7- in diagonal sequence to 15 Nm.

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

- Install sump (bottom section) ⇒ [page 146](#) .
- Renew O-ring on guide tube for oil dipstick and insert guide tube into hole in top section of sump.
- Bolt gearbox to engine and install engine/gearbox assembly ⇒ [page 28](#) .
- Make sure the two dowel sleeves are positioned correctly when installing the alternator bracket.
- Install poly V-belt ⇒ [page 34](#) .
- Fill up with engine oil and check oil level ⇒ Maintenance ; Booklet 405 .



Tightening torques

Component	Nm
Oil pipes to sump (top section)	10
Coolant pump housing to sump (top section)	10
Guide tube for dipstick to cylinder head	10
Coolant pipe	Coolant pump
(front) to	Sump (top section)
Torque reaction support to top section of sump	42
Bracket for alternator	M8
to engine	M10
Alternator to bracket for alternator	23
Terminal 30/B+ to alternator	16

1.6 Oil retention valve and spray nozzle valve - exploded view



Note

In the event of irregular valve noise which disappears after a lengthy drive but repeatedly re-occurs when travelling short distances, the oil retention valves must be renewed.

1 - O-ring

- ☐ Renew

2 - Oil retention valve

- ☐ Removing and installing
⇒ [page 158](#)

3 - Breather pipe

4 - 10 Nm

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

5 - 10 Nm

6 - Hose

- ☐ To pressure control valve for crankcase breather

7 - Cover

8 - Gasket

- ☐ Renew

9 - Spray nozzle valve

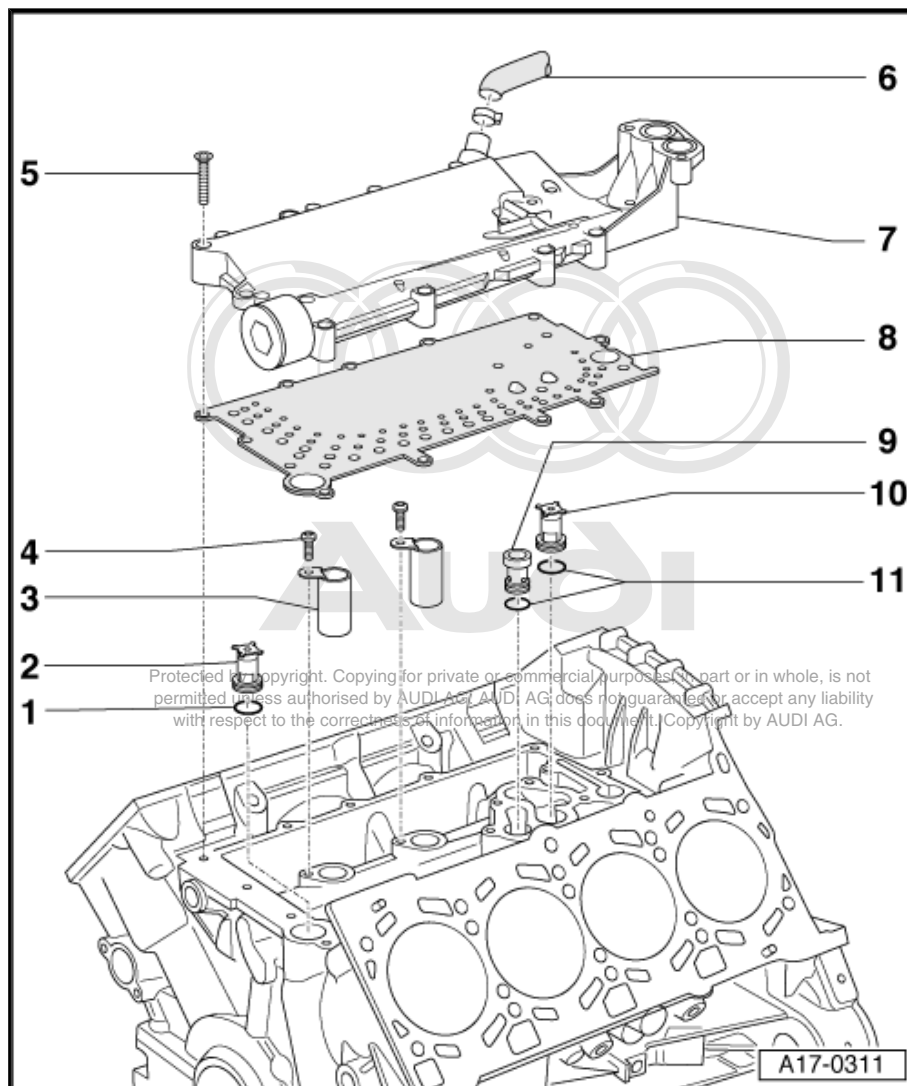
- ☐ Removing and installing
⇒ [page 158](#)

10 - Oil retention valve

- ☐ Removing and installing
⇒ [page 158](#)

11 - O-rings

- ☐ Renew



1.7 Removing and installing oil retention valves and spray nozzle valve

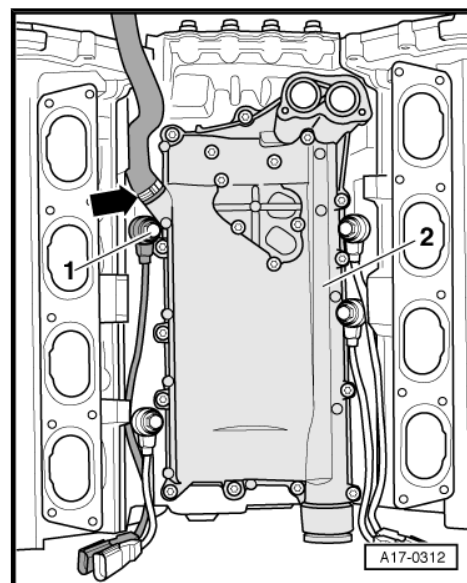


Note

In the event of irregular valve noise which disappears after a lengthy drive but repeatedly re-occurs when travelling short distances, the oil retention valves must be renewed.

Removing

- Remove intake manifold ⇒ [page 127](#) .
- Remove oil filter housing ⇒ [page 160](#) .
- Remove knock sensor (rear right) by unscrewing bolt -1-.
- Remove crankcase breather hose -arrow-.
- Unbolt cover -2- for oil retention valves.
- Remove gasket.



- Pull out oil retention valves -1- and -3-.
- Pull out spray nozzle valve -2-.

Installing

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



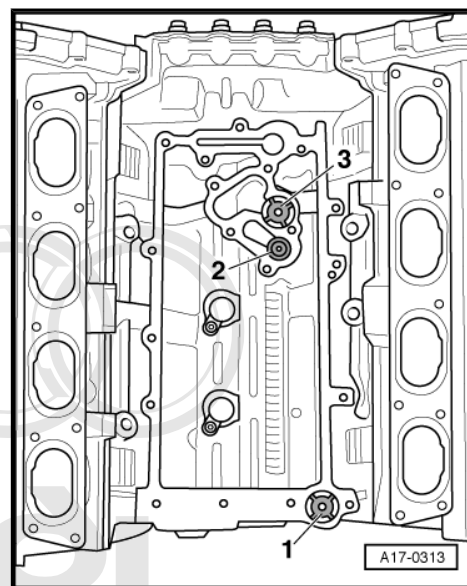
Note

- ◆ *Renew gaskets, seals and O-rings.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- Install oil filter housing ⇒ [page 160](#) .
- Install intake manifold ⇒ [page 127](#) .

Tightening torques

Component	Nm
Cover for oil retention valves to cylinder block	10
Knock sensor to cylinder block	25 ²⁶⁾

26) Do not lubricate bolt.



1.8 Oil filter housing - exploded view of components

1 - Seal

- ☐ Renew

2 - 10 Nm

3 - 22 Nm

4 - Oil filter housing

5 - Oil filter element

- ☐ Renew O-ring
⇒ **Item 6 (page 160)**
when changing filter
- ☐ Observe change inter-
vals ⇒ maintenance ta-
ble

6 - O-ring

- ☐ Renew

7 - Sealing cap, 25 Nm

- ☐ Loosen and tighten with
36 mm socket

8 - Seal

- ☐ Renew

9 - Screw plug, 50 Nm

10 - Seal

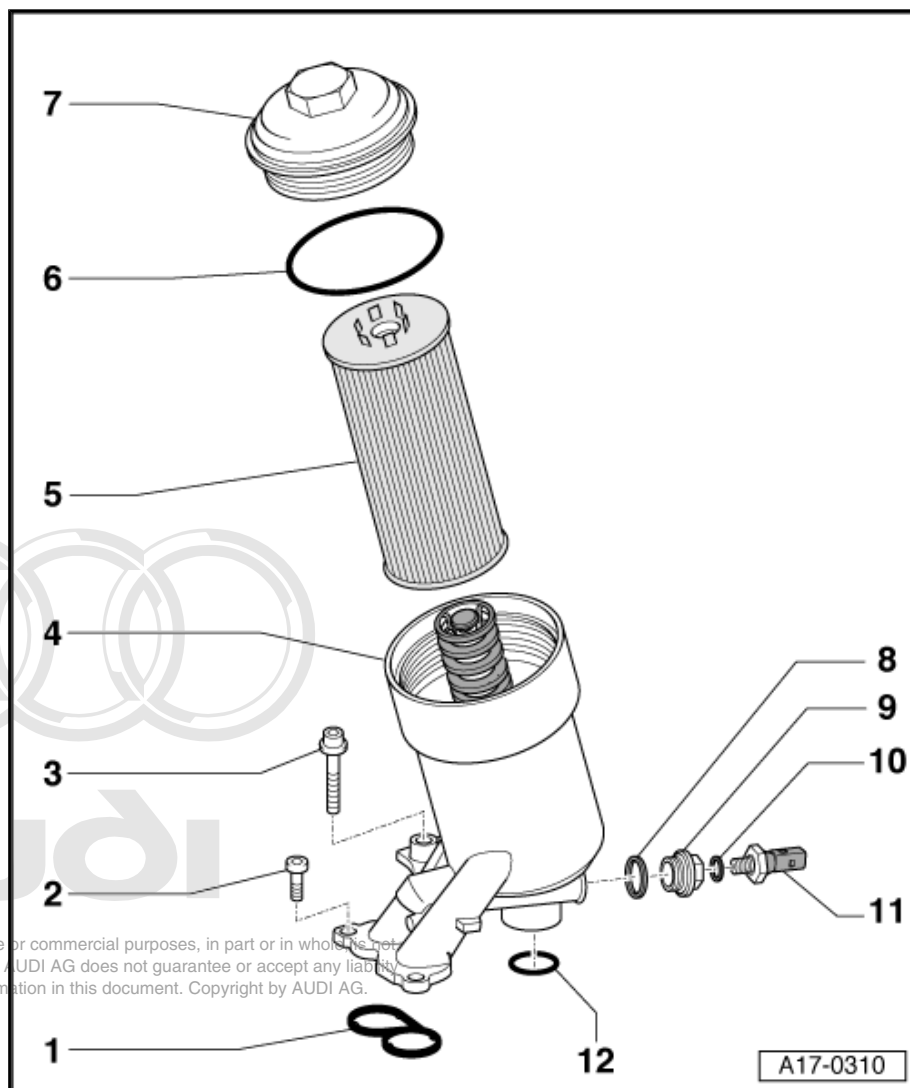
- ☐ Renew

11 - Oil pressure switch - F1-, 1.4 bar, 25 Nm

- ☐ Black insulation
- ☐ Checking ⇒ **page 162**

12 - O-ring

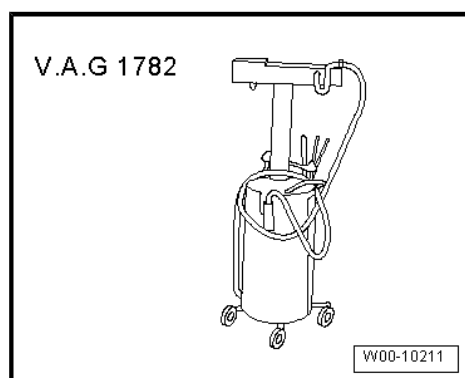
- ☐ Renew



1.9 Removing and installing oil filter housing

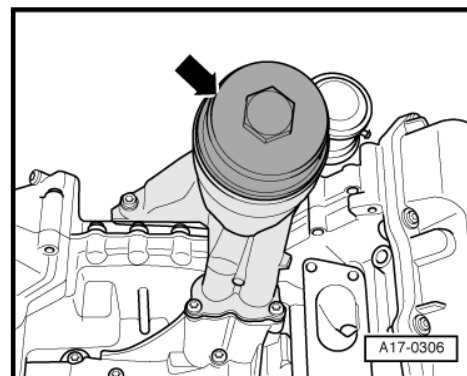
Special tools and workshop equipment required

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



Removing

- Remove intake manifold ⇒ [page 127](#) .
- Unscrew sealing cap -arrow- for oil filter housing.
- Remove oil filter element.
- Extract engine oil from oil filter housing using used oil collection and extraction unit -V.A.G 1782- .



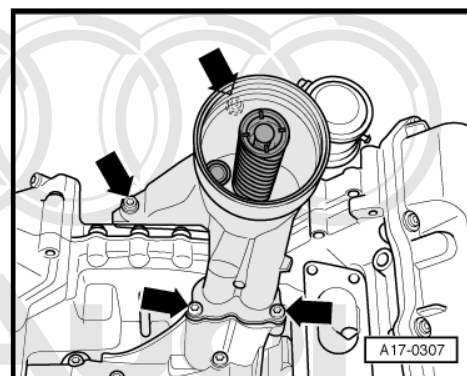
Note

Place a cloth around the oil filter housing to catch any escaping oil.

- Remove bolts -arrows-.
- Remove oil filter housing.

Installing

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



Note

Renew seals and O-rings.

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- Install intake manifold ⇒ [page 127](#) .
- Fill up with engine oil and check oil level ⇒ Maintenance ; Booklet 405 .

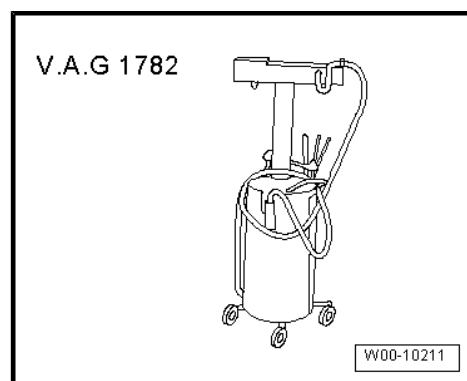
Tightening torques

Component		Nm
Oil filter housing to:	Cylinder block	10
	Timing chain cover	22
Cap on oil filter housing		25

1.10 Removing and installing oil cooler

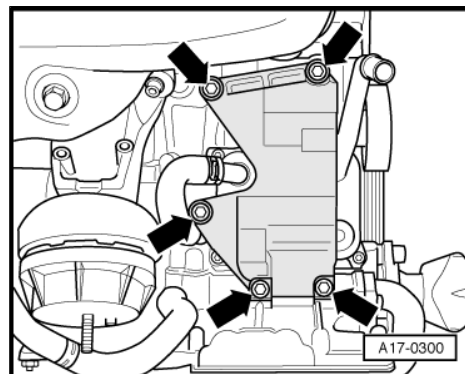
Special tools and workshop equipment required

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



Removing

- Remove alternator ⇒ Rep. gr. 27 .
- Remove bolts -arrows-.
- Remove bracket for alternator.



- Place used oil collection and extraction unit -V.A.G 1782- underneath.
- Detach coolant hose -1- at oil cooler.
- Unscrew the bolts -arrows- and remove oil cooler.

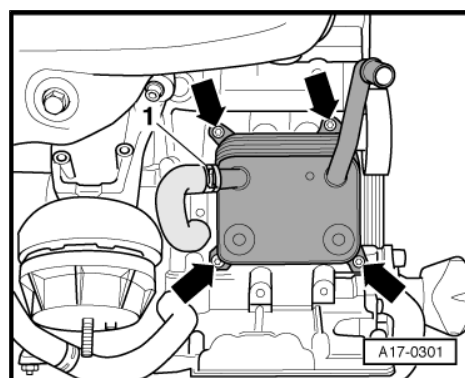
Installing

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.*
- Make sure the two dowel sleeves are positioned correctly when installing the alternator bracket.
- Install alternator ⇒ Rep. gr. 27 .



Tightening torques

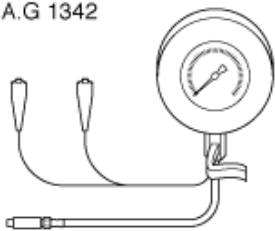
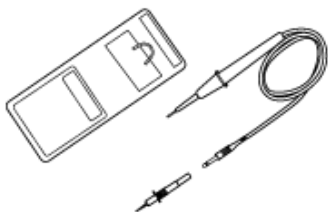
Component		Nm
Oil cooler to cylinder block		10
Bracket for alternator to engine	M8	22
	M10	45

1.11 Checking oil pressure and oil pressure switch

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Special tools and workshop equipment required

- ◆ Oil pressure tester -V.A.G 1342- with adapter - V.A.G 1342/14-
- ◆ Voltage tester -V.A.G 1527 B-
- ◆ Auxiliary measuring set - V.A.G 1594 C-

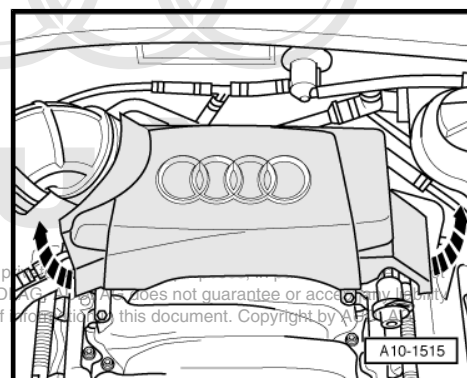
V.A.G 1342 	V.A.G 1527 B 
V.A.G 1594 C 	
	G17-0023

Test conditions

- Oil level OK
- Engine oil temperature approx. 90 °C

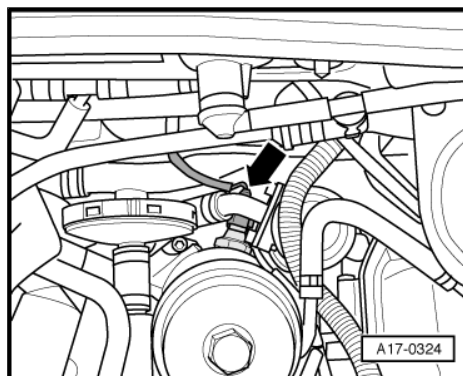
Test sequence

- Pull off rear engine cover panel -arrows-.



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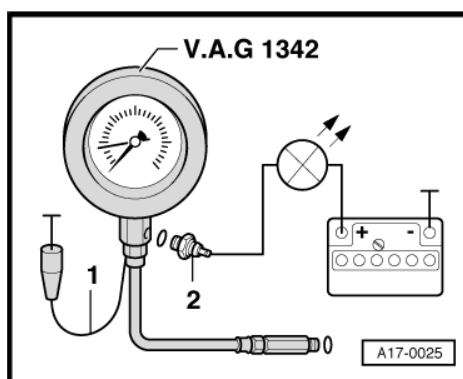
- Unplug electrical connector -arrow- at oil pressure switch.
- Unscrew oil pressure switch.



- Connect oil pressure tester -V.A.G 1342- with adapter -V.A.G 1342/14- to 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 tester to earth („-“).
- Connect voltage tester -V.A.G 1527 B- with adapter leads from auxiliary measuring set -V.A.G 1594 C- to oil pressure switch and battery positive („+“).
- Test lamp should NOT light up
- If test lamp lights up, renew oil pressure switch.
- Start engine.



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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 (engine oil temperature approx. 90°C).
- Minimum oil pressure at 2000 rpm: 2.0 bar
- Minimum oil pressure at 3500 rpm: 3.5 bar



Note

Renew seal when installing oil pressure switch.

Tightening torque

Component	Nm
Oil pressure switch to oil filter housing	25

1.12 Engine oil

Refer to ⇒ Maintenance tables for engine oil capacity, oil specifications and viscosity grades.

1.13 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.

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 - Do not top up oil.

b - Oil may be topped up.

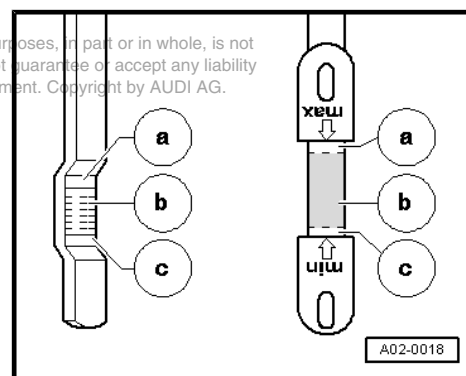
c - Oil must be topped up. It is sufficient if the oil level is somewhere in area -b- (grooved area on dipstick) after topping up.



Note

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

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19 – Cooling

1 Removing and installing parts of cooling system



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



Note

- ◆ *The cooling system is under pressure when the engine is hot. If necessary, relieve pressure before commencing repair work.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- ◆ *Renew gaskets and seals.*
- ◆ *The arrow markings on coolant pipes and on ends of hoses must align.*

1.1 Diagram of coolant hose connections

1 - Bleeder screw

- ☐ Tighten hand-tight

2 - Filler cap

- ☐ Checking pressure relief valve in filler cap
⇒ [page 193](#)

3 - Expansion tank**4 - Radiator**

- ☐ Removing and installing
⇒ [page 186](#)
- ☐ If renewed, refill system with fresh coolant

5 - Thermostat

- ☐ Removing and installing
⇒ [page 177](#)
- ☐ Checking ⇒ [page 178](#)

6 - Coolant pump

- ☐ Removing and installing
⇒ [page 175](#)

7 - Alternator**8 - Oil cooler**

- ☐ Removing and installing
⇒ [page 161](#)

9 - Cylinder head/cylinder block

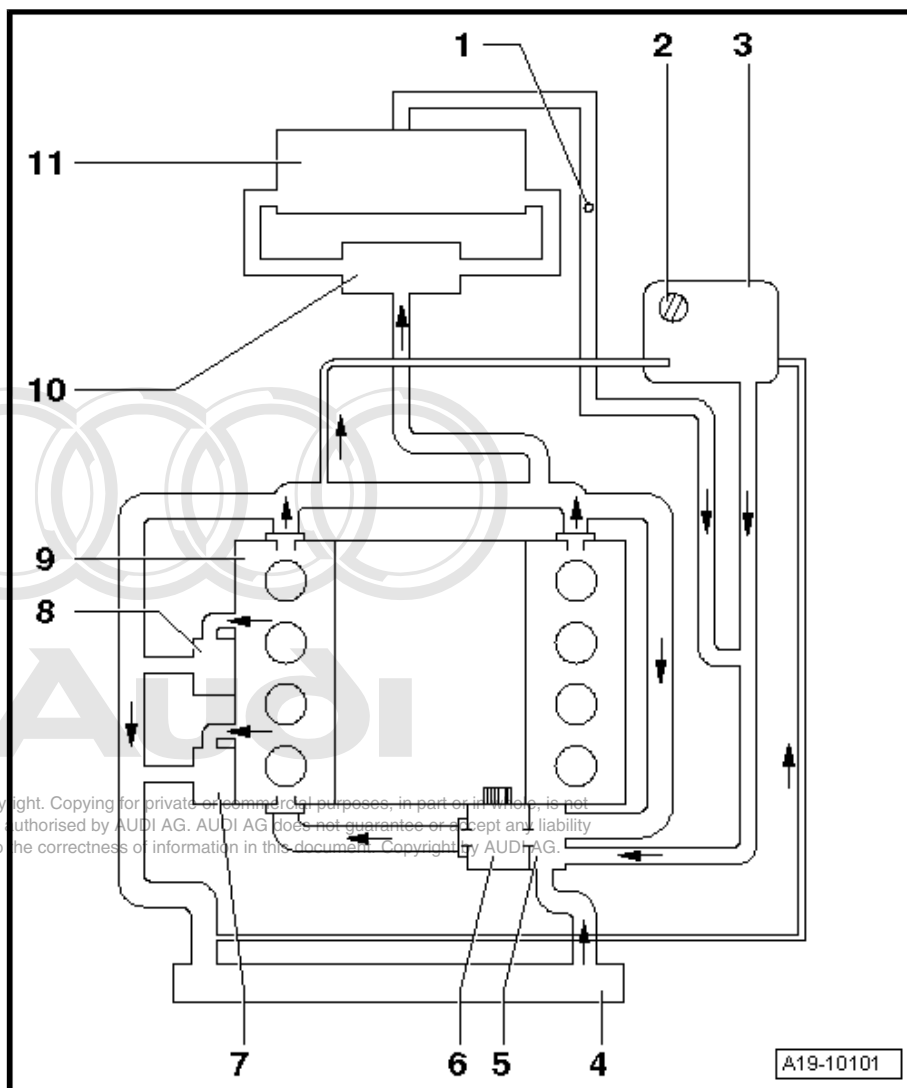
- ☐ If renewed, refill system with fresh coolant

10 - Pump/valve unit

- ☐ Removing, installing and checking ⇒ Rep. gr. 87

11 - Heat exchanger for heater

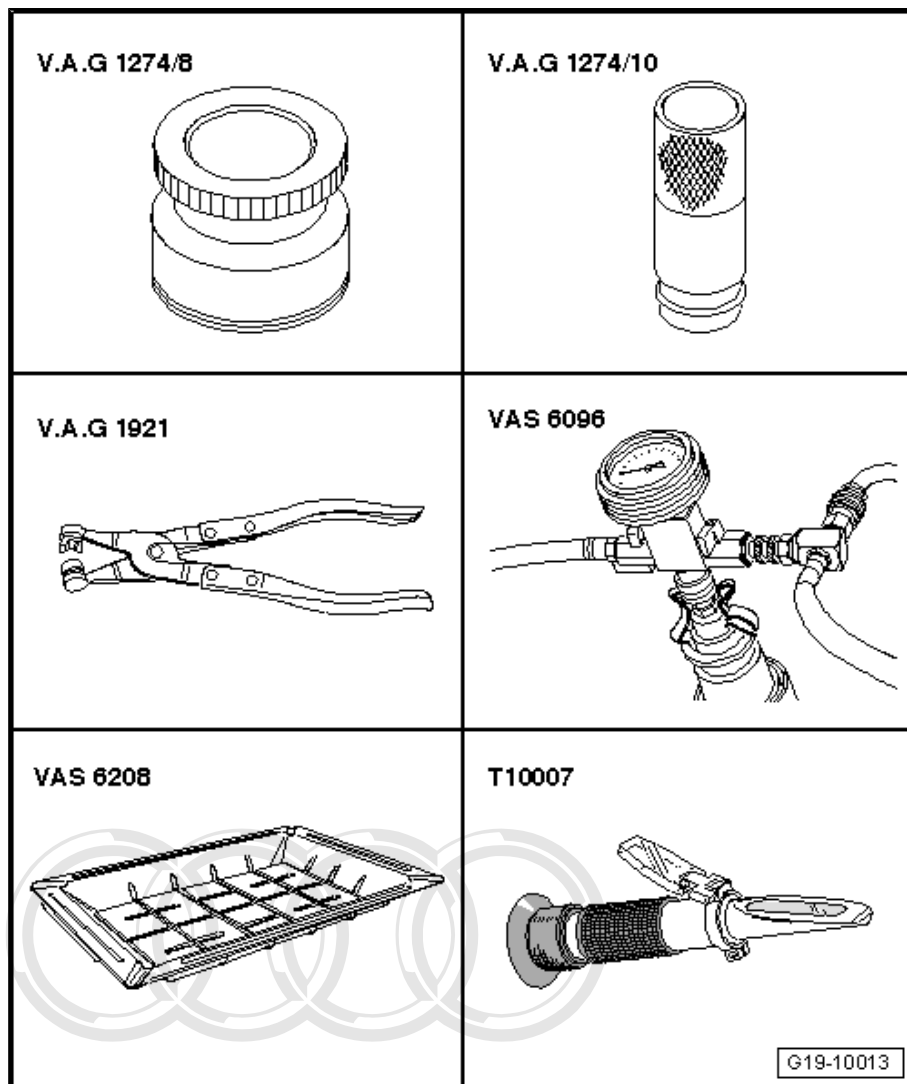
- ☐ If renewed, refill system with fresh coolant



1.2 Draining and filling cooling system

Special tools and workshop equipment required

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



Draining



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

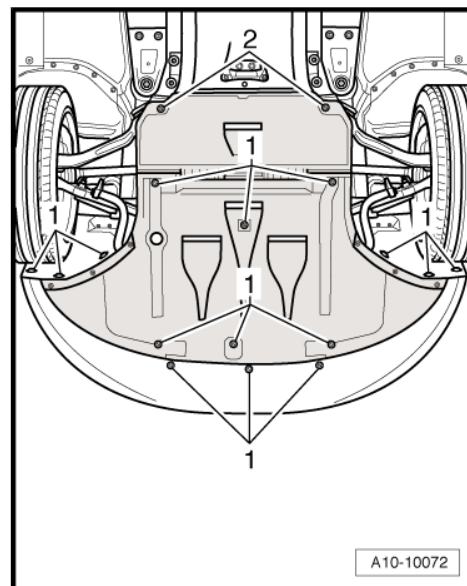


WARNING

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

- Open filler cap on coolant expansion tank.

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



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- Place drip tray for workshop hoist -VAS 6208- beneath engine.
- Unscrew drain plug -arrow- at thermostat housing and drain off coolant at engine.

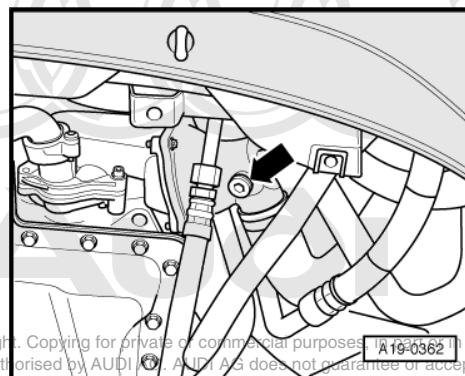
Filling

- Ignition off.



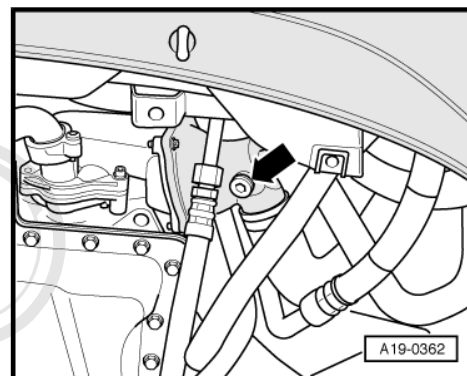
Note

- ◆ *The cooling system is filled all year round with a mixture of water and radiator antifreeze/anti-corrosion agent.*
- ◆ *It is important to use only coolant additive Plus -G 012 A8F A1- (also designated as »G12+«) „meeting specification TL VW 774 F“. Other coolant additives could seriously impair in particular the anti-corrosion properties. The resulting damage could lead to loss of coolant and consequently to serious engine damage.*
- ◆ *Coolant additive »G12+« may be mixed with additives »G11« and »G12«.*
- ◆ *»G12+« and coolant additives marked „Conforming with specification TL VW 774 F“ prevent frost and corrosion damage and stop scale from forming. Such additives also raise the boiling point of the coolant. For these reasons the cooling system must be filled all year round with the correct antifreeze and anticorrosion additive.*
- ◆ *Because of its high boiling point, the coolant improves engine reliability under heavy loads, particularly in countries with tropical climates.*
- ◆ *Frost protection is required down to about -25 °C (in countries with arctic climate: down to about -35 °C).*
- ◆ *The coolant concentration must not be reduced by adding water even in warmer seasons and in warmer countries. The antifreeze concentration must be at least 40 %.*
- ◆ *If greater frost protection is required in very cold climates, the amount of »G12+« can be increased, but only up to 60% (this gives frost protection to about -40 °C). If antifreeze concentration exceeds 60%, frost protection decreases again and cooling efficiency is also impaired.*
- ◆ *Use only clean tap water for mixing coolant.*
- ◆ *If radiator, heat exchanger, cylinder head, cylinder head gasket or cylinder block have been renewed, do not re-use old coolant.*
- ◆ *Contaminated or dirty coolant must not be used again.*
- ◆ *To check frost protection level of coolant additive »G12+« you must use a refractometer -T10007- .*



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- Install drain plug -arrow- with new seal.



- 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 -V.A.G 1274/8- onto coolant expansion tank.

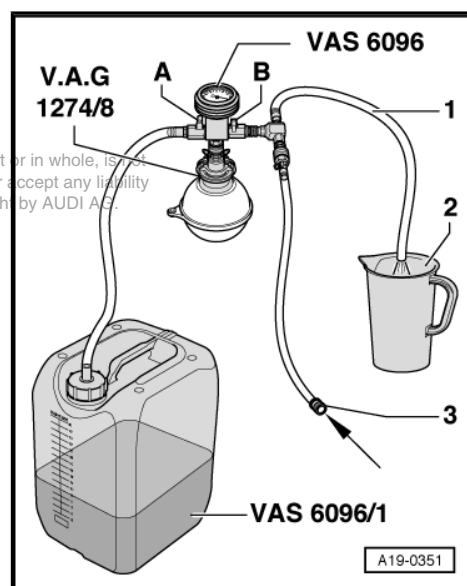
- Attach cooling system charge unit -VAS 6096- onto adapter -V.A.G 1274/8- .

- Run vent hose -1- into a small container -2-. (The vented air draws along a small amount of coolant, which should be collected.)

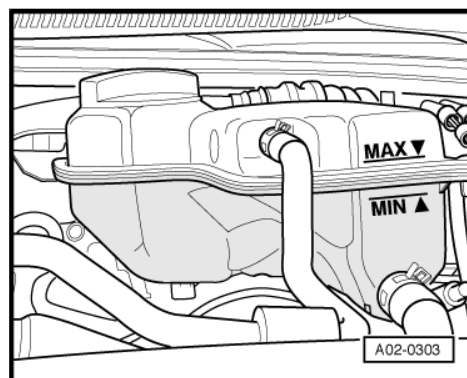
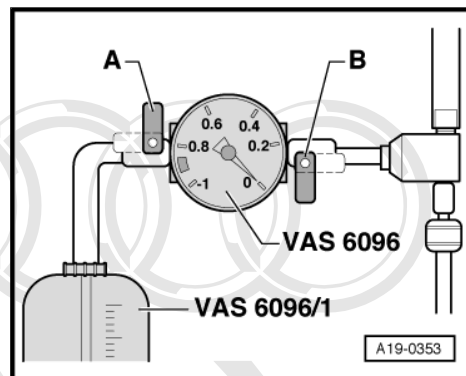
- Close the two valves -A- and -B- by setting lever at right angle to direction of flow.

- Connect hose -3- to compressed air.

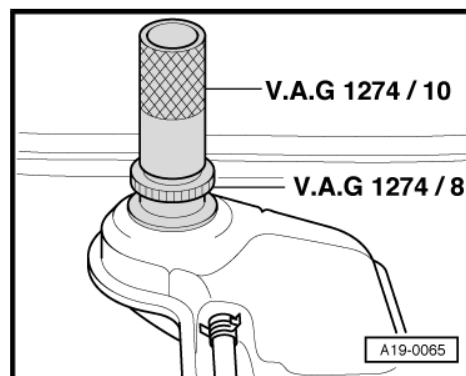
- Pressure: 6 ... 10 bar.



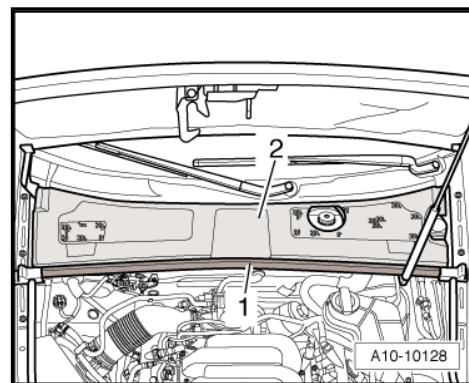
- Open valve -B- by setting lever in direction of flow.
- The suction jet pump generates a partial vacuum in the cooling system.
- The needle on the gauge should move into the green zone.
- Also briefly open valve -A- (turn lever in direction of flow) so that hose on reservoir -VAS 6096/1- can fill with coolant.
- Close valve -A- again.
- Leave valve -B- open for another 2 minutes.
- The suction jet pump will continue generating a vacuum in the cooling system.
- The needle on the gauge should remain in the green zone.
- Close valve -B-.
- The needle on the gauge should stop in the green zone. The vacuum level in the cooling system is then sufficient for subsequent filling.
- If the needle does not reach the green zone, repeat the process.
- If the vacuum level drops, there is a leak in the cooling system.
- Detach compressed air hose.
- Open valve -A-.
- The partial vacuum in the cooling system causes the coolant to be drawn up out of the reservoir -VAS 6096/1- ; the cooling system is then filled.
- Check the coolant level and top up coolant as far as the MAX mark.



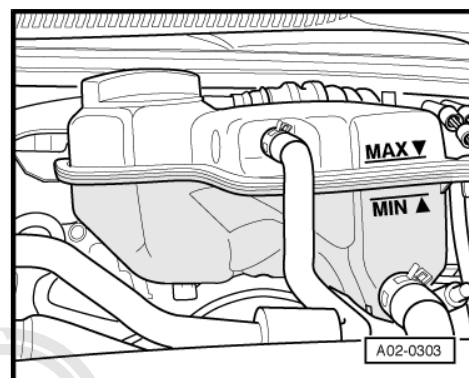
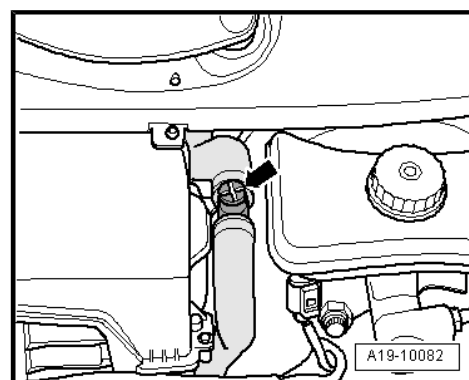
- Screw adapter -V.A.G 1274/8- onto coolant expansion tank.
- Fit pipe -V.A.G 1274/10- onto adapter.



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



- Open bleeder screw -arrow- in coolant hose.
- Top up the coolant until it emerges from the bleeder screw in the coolant hose without bubbles.
- Close bleeder screw in coolant hose.
- 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.
- It should be possible to feel warm air from the heater as soon as the needle of the coolant temperature gauge begins to move.
- Switch off engine.
- Check coolant level.
- The coolant level can be above the MAX marking when the engine is warm.



1.3 Coolant pump and thermostat - exploded view

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1 - Housing

- ☐ For coolant pump
- ☐ Removing and installing
⇒ [page 175](#)

2 - 10 Nm

3 - Coolant pipe (front)

- ☐ Removing and installing
⇒ [page 179](#)

4 - O-ring

- ☐ Renew

5 - 10 Nm

6 - Seal

- ☐ Renew

7 - Coolant pump

- ☐ Removing and installing
⇒ [page 175](#)

8 - O-ring

- ☐ Renew

9 - 10 Nm

10 - Drive shaft

- ☐ For oil pump

11 - O-ring

- ☐ Renew

12 - Seal

- ☐ Renew

13 - Thermostat

- ☐ Removing and installing
⇒ [page 177](#)
- ☐ Installation position ⇒ [page 175](#)
- ☐ Checking ⇒ [page 178](#)

14 - Housing

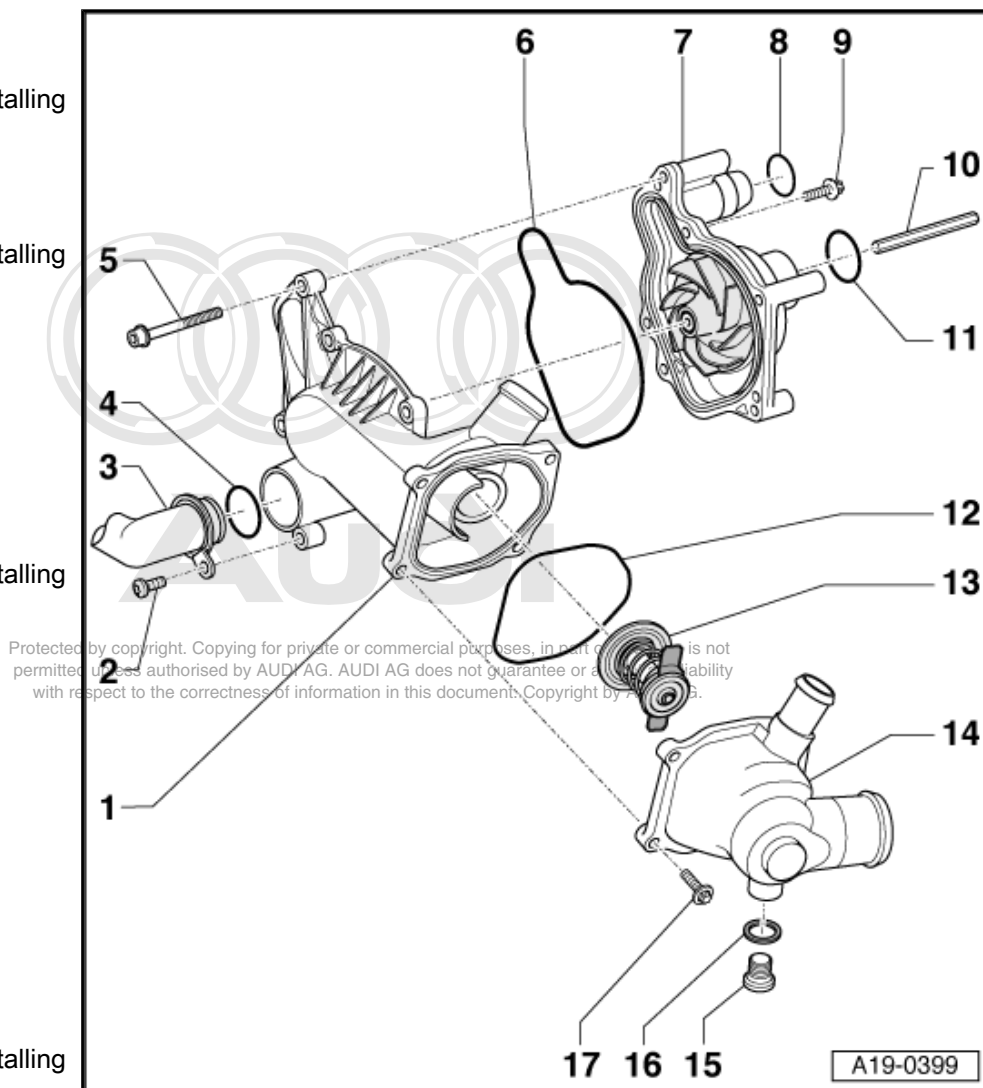
- ☐ For thermostat
- ☐ Removing and installing ⇒ [page 177](#)

15 - Drain plug, 25 Nm

16 - Seal

- ☐ Renew

17 - 10 Nm



Installation position of thermostat

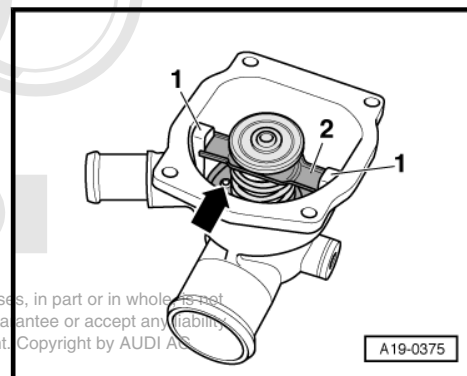
- Vent valve -arrow- faces upwards.



Note

Disregard items marked -1- and -2-.

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1.4 Removing and installing coolant pump

Removing

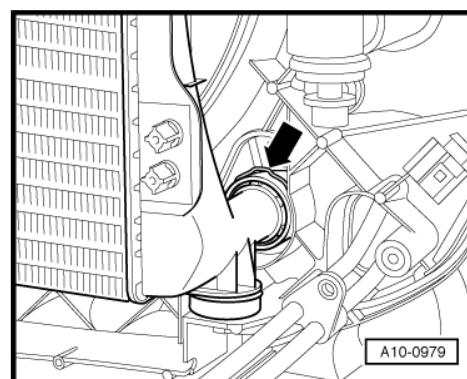
- Move lock carrier to service position ⇒ Rep. gr. 50 .
- Remove coolant pipe (front) ⇒ [page 179](#) .
- Disconnect coolant hose (bottom) at radiator -arrow- and drain off remaining coolant.



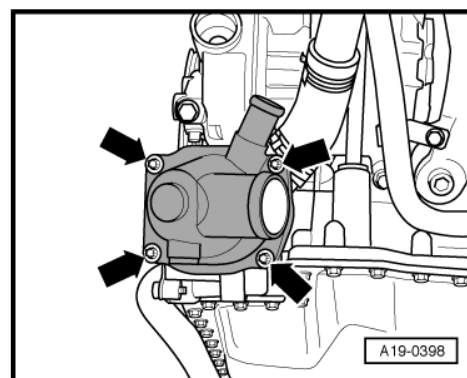
Note

After the coolant hose has been detached, the lock carrier can be pulled further forward.

- Disconnect the coolant hoses at thermostat housing.



- Remove bolts -arrows-.
- Remove thermostat housing.

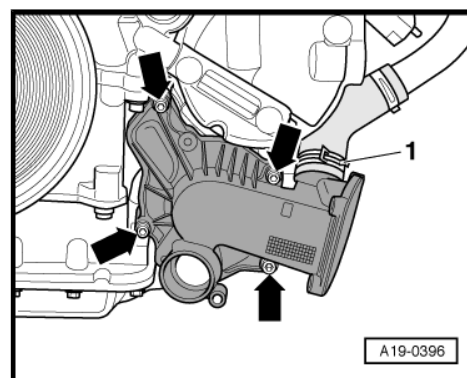


- Disconnect coolant hose -1-.
- Remove bolts -arrows-.
- Pull off coolant pump housing forwards (note the drive shaft for coolant pump).

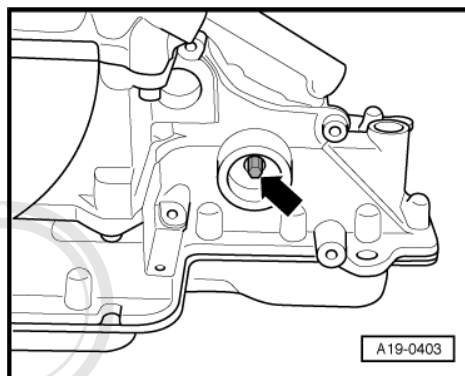


Note

Shown in illustration with lock carrier removed.



- Remove drive shaft -arrow- for coolant pump from the guide on oil pump.



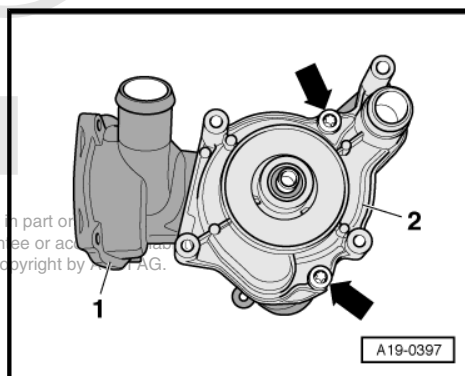
- Remove bolts -arrows-.
- Remove coolant pump -2- from housing -1-.

Installing



Note

- ◆ *Renew seals and O-rings.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*

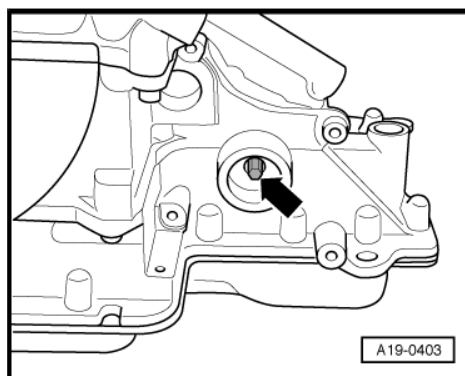


- Insert drive shaft -arrow- for coolant pump in the mounting for the oil pump on engine.
- Fit coolant pump in mounting on sump (top section).



Note

To fit the drive flange onto the hexagon flats of the drive shaft, use your finger to turn the impeller (access through the bottom pipe connection of coolant pump) until the coolant pump can be pressed on all the way.

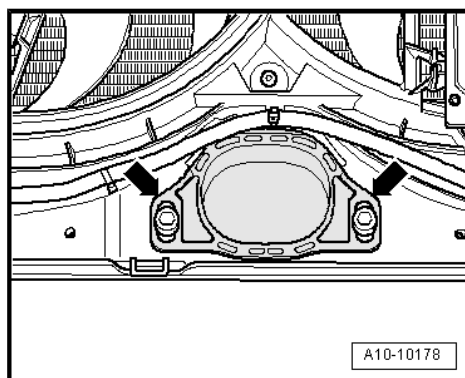


Perform further installation in reverse order, paying attention to the following:

- Install thermostat ⇒ [page 177](#) .
- Install coolant pipe (front) ⇒ [page 179](#) .
- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight and tighten bolts -arrows-.
- Install front bumper ⇒ Rep. gr. 63 .
- Fill up with coolant ⇒ [page 170](#) .
- Adjust headlights ⇒ Maintenance ; Booklet 405 .

Tightening torques

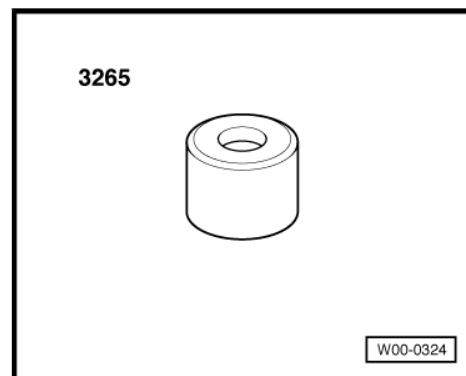
Component	Nm
Coolant pump to housing	10
Coolant pump housing to sump (top section)	10
Stop for torque reaction support to lock carrier	40



1.5 Removing and installing thermostat

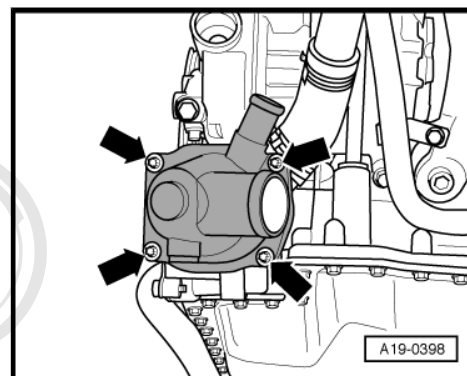
Special tools and workshop equipment required

- ◆ Fitting sleeve -3265-



Removing

- Drain coolant ⇒ [page 168](#) .
- Disconnect the coolant hoses at thermostat housing.
- Remove bolts -arrows-.
- Remove thermostat housing.



- Press the retaining clip down using the fitting sleeve -3265- and turn the retaining clip clockwise.

Installing

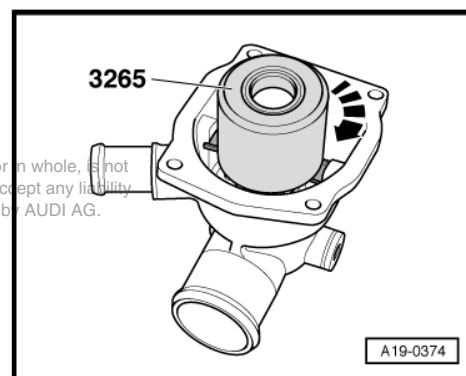
Installation is carried out in the reverse order; note the following:

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Note

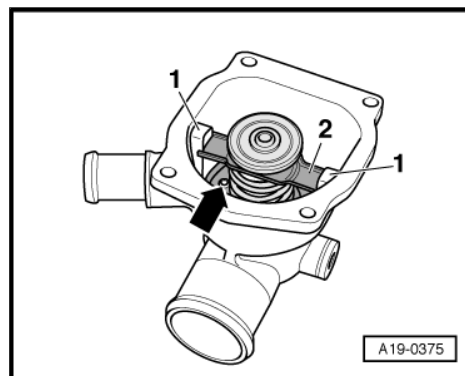
- ◆ *Renew seals.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- Clean and smoothen sealing surface.



- Note installation position of thermostat.
- Installation position: Vent valve -arrow- faces upwards.
- Press down retaining clip -2- using fitting sleeve -3265- and turn.
- The retaining clip must be secured beneath the lugs -1- on connecting piece.
- Fill up with coolant ⇒ [page 170](#) .

Tightening torque

Component	Nm
Thermostat housing to coolant pump housing	10



1.6 Checking thermostat

- Heat removed thermostat in water bath.

Starts to open	Fully open	Opening travel
approx. 87 °C	approx. 102 °C ¹⁾	at least 8 mm
• ¹⁾ Cannot be tested.		

1.7 Coolant pipes - exploded view



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1 - Coolant pipe (front)

- ☐ Removing and installing
⇒ [page 179](#)

2 - 10 Nm**3 - Seal**

- ☐ Renew

4 - Coolant hose

- ☐ To oil cooler

5 - Coolant hose

- ☐ To alternator

6 - 10 Nm**7 - Coolant hose**

- ☐ To top of radiator

8 - Coolant pipe (right-side)**9 - O-ring**

- ☐ Renew

10 - 10 Nm**11 - Coolant hose**

- ☐ To expansion tank

12 - Coolant pipe (rear)

- ☐ Removing and installing
⇒ [page 181](#)

13 - O-ring

- ☐ Renew

14 - Coolant temperature sender -G62-**15 - Retaining clip****16 - Coolant hose**

- ☐ To heat exchanger for heater

17 - 10 Nm**18 - Plug****19 - Coolant pipe (left-side)**

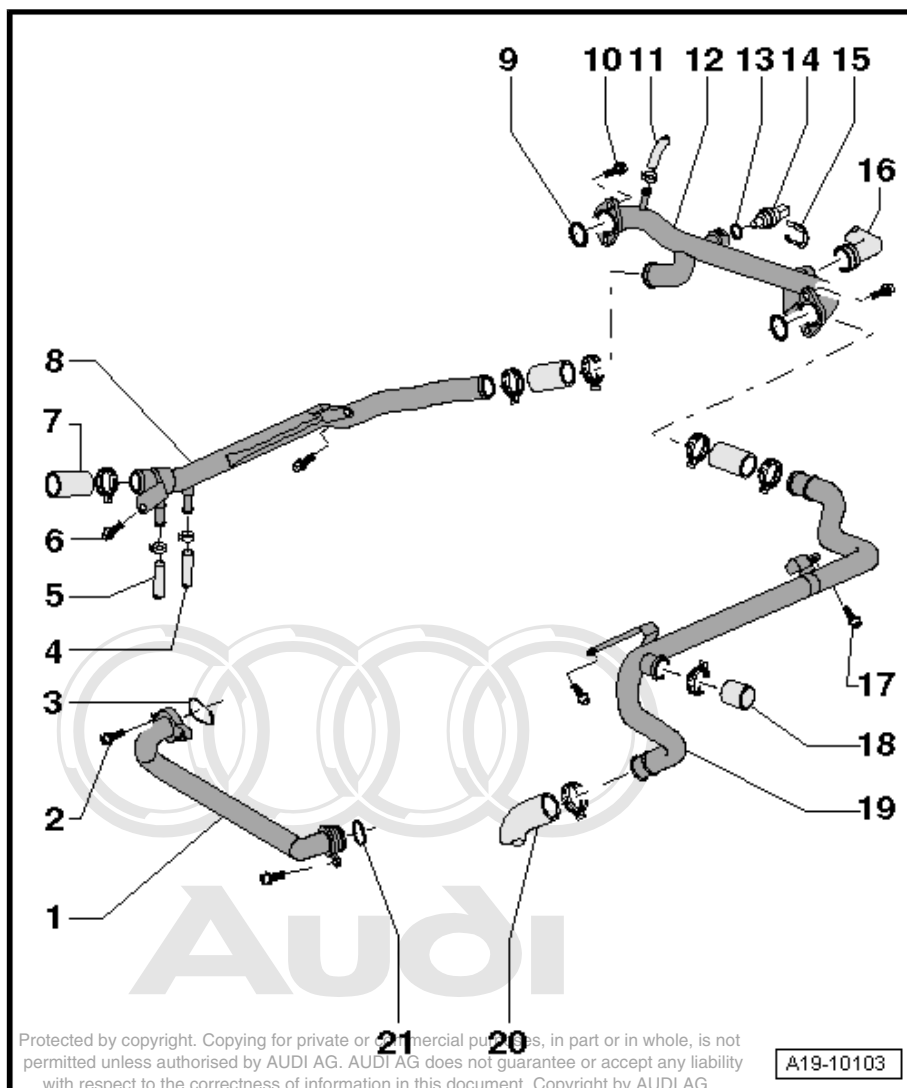
- ☐ Removing and installing ⇒ [page 184](#)

20 - Coolant hose

- ☐ To thermostat housing

21 - O-ring

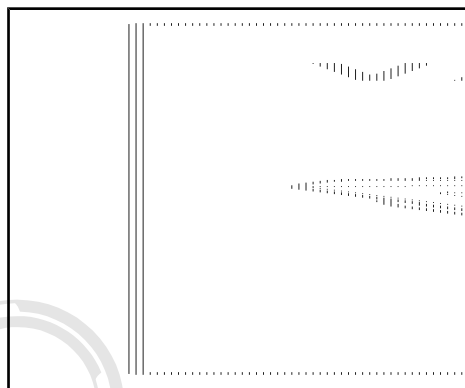
- ☐ Renew



1.8 Removing and installing coolant pipe (front)

Special tools and workshop equipment required

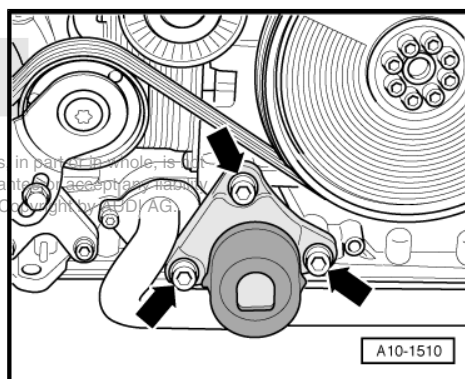
◆ Drip tray for workshop hoist -VAS 6208-



Removing

- Drain coolant ⇒ [page 168](#) .
- Move lock carrier to service position ⇒ Rep. gr. 50 .
- Unscrew bolts -arrows- and remove torque reaction support from engine.

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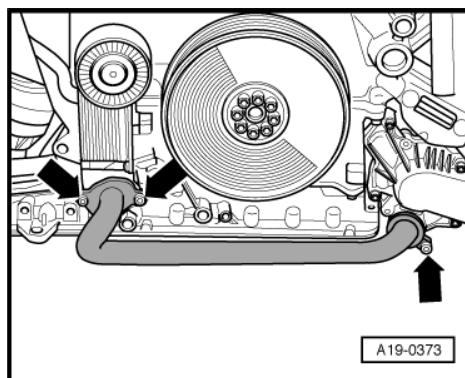
- Place drip tray for workshop hoist -VAS 6208- beneath engine.
- Unbolt coolant pipe (front) from engine -arrows-.

Installing

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

***i** Note*

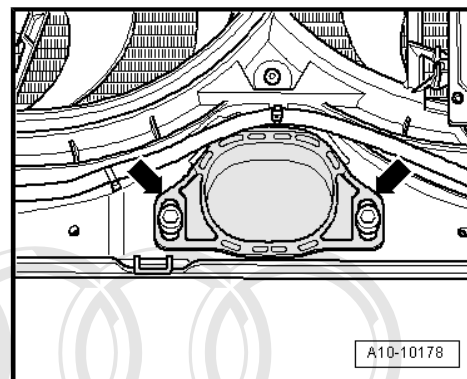
- ◆ *Renew seals and O-rings.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- Install lock carrier with attachments ⇒ Rep. gr. 50 .



- Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight and tighten bolts -arrows-.
- Install front bumper ⇒ Rep. gr. 63 .
- Fill up with coolant ⇒ [page 170](#) .
- Adjust headlights ⇒ Maintenance ; Booklet 405 .

Tightening torques

Component		Nm
Coolant pipe (front) to	Coolant pump	10
	Sump (top section)	10
Torque reaction support to top section of sump		40
Stop for torque reaction support to lock carrier		40

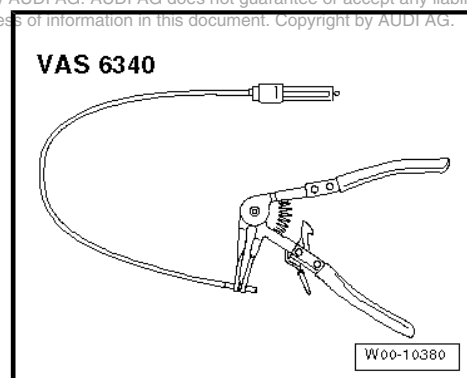


1.9 Removing and installing coolant pipe (rear)

Special tools and workshop equipment required

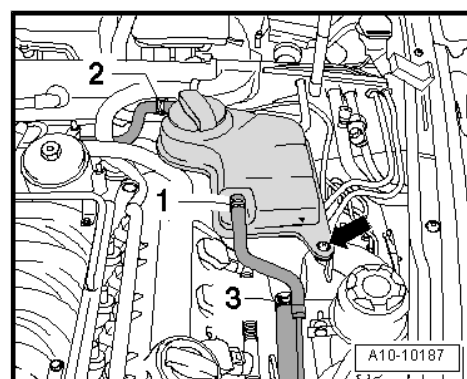
- ◆ Hose clip pliers -VAS 6340-

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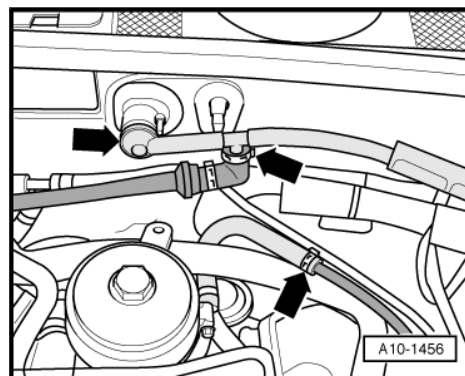
**Removing****Note**

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

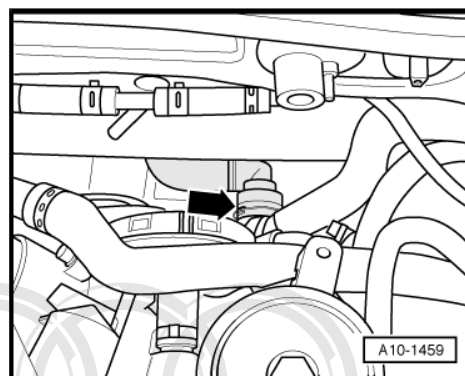
- Drain coolant ⇒ [page 168](#) .
- Remove coolant pipe (right-side).
- Detach coolant hoses -1- to -3-.
- Unbolt coolant expansion tank -arrow-.
- Disconnect electrical wiring for coolant shortage indicator switch -F66- at coolant expansion tank (bottom).



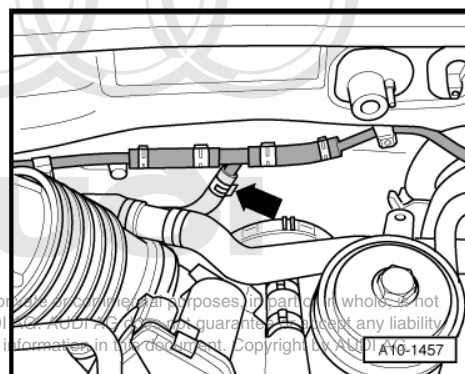
- Disconnect the vacuum hoses at the points marked with -arrows-.



- Disconnect coolant hose going to heat exchanger at coolant pipe (rear) on engine -arrow-.



- Disconnect coolant hose from Y piece -arrow-.

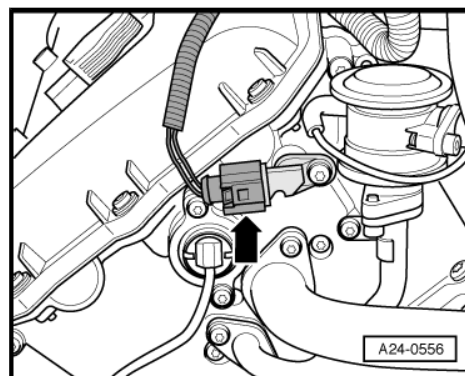


- Unplug electrical connector -arrow- for Hall sender 2 -G163- at cylinder head (left-side).



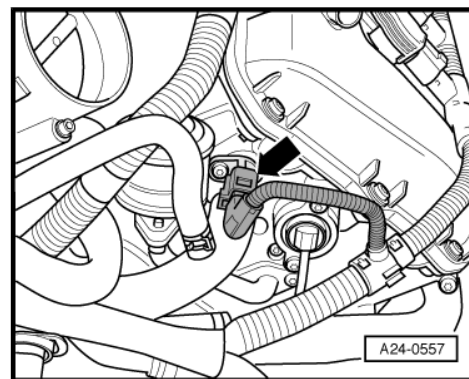
Note

In the following illustrations shown from rear with engine removed.

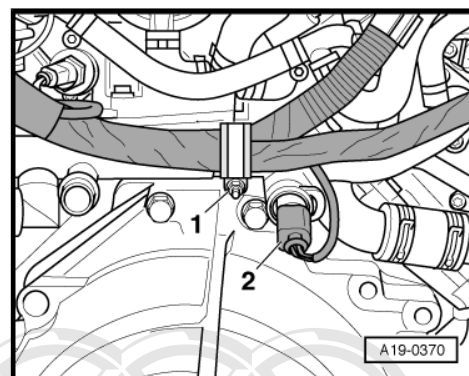


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- Unplug electrical connector -arrow- for Hall sender -G40- at cylinder head (right-side).



- Unplug electrical connector -2- at coolant temperature sender -G62- .
- Unscrew nut -1- and detach electrical wiring harness at coolant pipe (rear).



- Release hose clips -1- and -6- using hose clip pliers -VAS 6340- .
- Disconnect the coolant hoses at the coolant pipe.
- Remove bolts -2 ... 5-.
- Detach coolant pipe (rear).

Installing

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

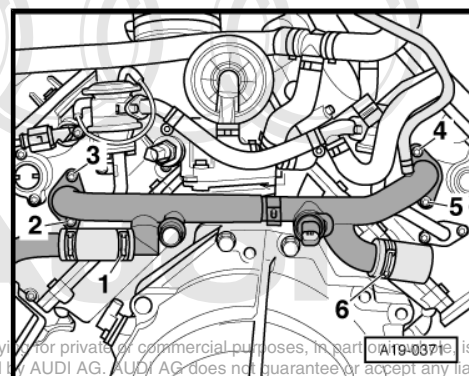


Note

- ◆ *Renew O-rings.*
- ◆ *Reinstall all cable ties in the same locations when assembling.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- Before installing, clean and smooth down sealing surfaces for O-rings as required.
- Coat new O-rings with acid-free grease (vaseline), fit coolant pipe (rear) and tighten.
- Install coolant pipe (right-side).
- Fill up with coolant ⇒ [page 170](#) .

Tightening torques

Component	Nm
Coolant pipe (rear) to cylinder head	10
Clips to coolant pipe (rear)	10

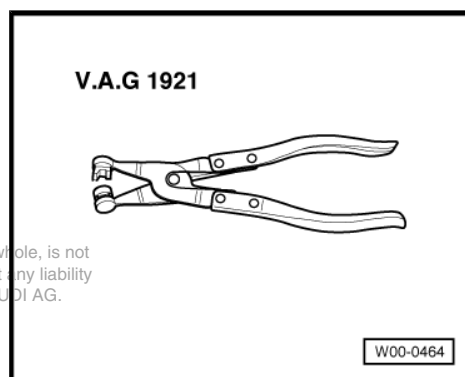


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1.10 Removing and installing coolant pipe (left-side)

Special tools and workshop equipment required

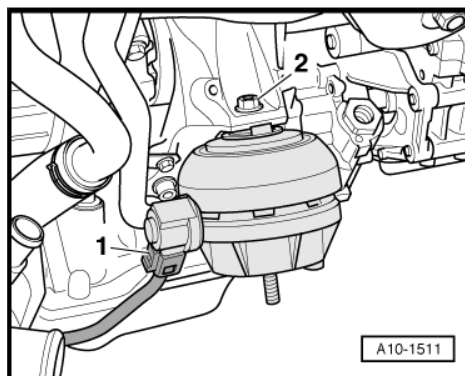
- ◆ Hose clip pliers -V.A.G 1921-



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Removing

- Remove engine ⇒ [page 6](#).
- Unplug electrical connector -1- at engine mounting (left-side).
- Unscrew nut -2- and remove engine mounting.

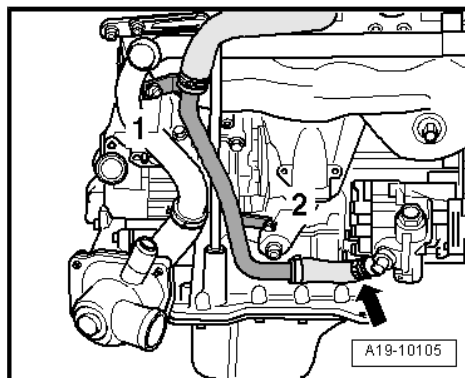


- Remove bolts -1- and -2-.

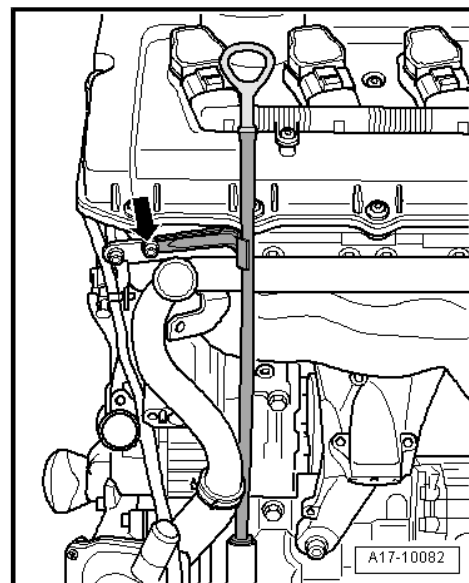


Note

To prevent fluid from escaping, the hose -arrow- remains attached to the power steering.



- Unbolt dipstick guide tube on cylinder head -arrow- and lift out upwards.



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- Remove bolts 1 and 2.
 - Loosen hose clips -arrows- and detach coolant pipe (right-side) from coolant hoses.

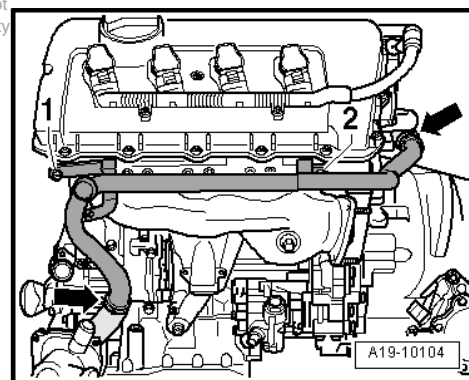
Installing

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



Note

- ◆ Renew O-ring.
- ◆ Secure all hose connections with the correct type of hose clips (same as original equipment) → Parts catalogue.
- Renew O-ring on guide tube for oil dipstick and insert guide tube into hole in top section of sump.
- Install engine → [page 28](#) .



Tightening torques

Component		Nm
Coolant pipe (left-side) to cylinder head		10
Guide tube for dipstick to cylinder head		10
Return line for power steering to:	Bracket	10
	Engine support	10

1.11 Radiator and radiator fans - exploded view

1 - Radiator fan -V7-

- ☐ With radiator fan control unit -J293-
- ☐ Removing and installing ⇒ [page 193](#)

2 - 5 Nm

3 - 3.5 Nm

4 - Fan wheel

- ☐ Not supplied separately

5 - Radiator cowl

- ☐ Removing and installing ⇒ [page 191](#)

6 - Coolant hose

- ☐ To detach, release retaining clip

7 - Coolant hose

- ☐ To detach, release retaining clip

8 - O-rings

- ☐ Renew

9 - Radiator

- ☐ Removing and installing ⇒ [page 186](#)
- ☐ If renewed, change coolant in entire system

10 - Retaining pin

11 - Rubber buffer

- ☐ Use screwdriver to release and pull off

12 - Rubber bush

13 - 4.5 Nm

14 - 3.5 Nm

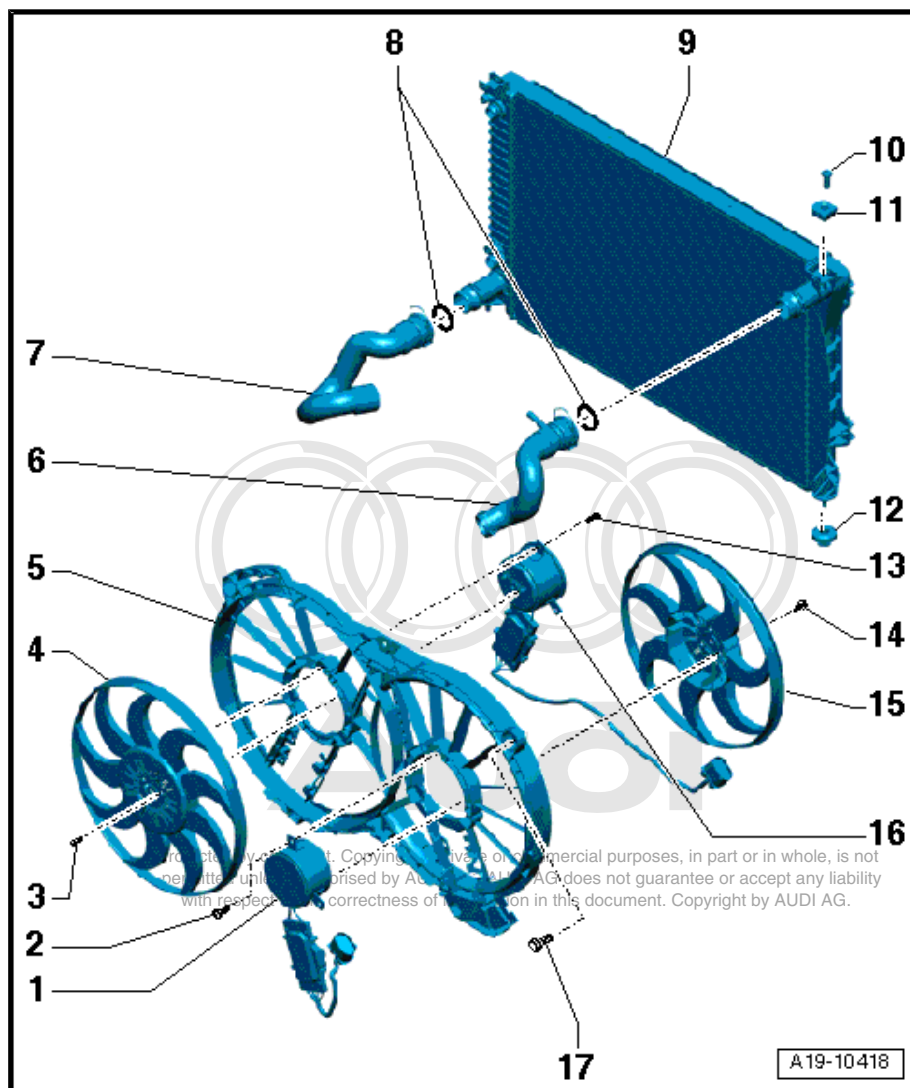
15 - Fan wheel

- ☐ Not supplied separately

16 - Radiator fan 2 -V177-

- ☐ With radiator fan control unit 2 -J671-
- ☐ Removing and installing ⇒ [page 193](#)

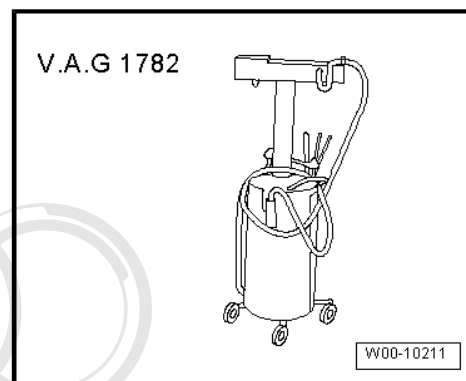
17 - 2 Nm



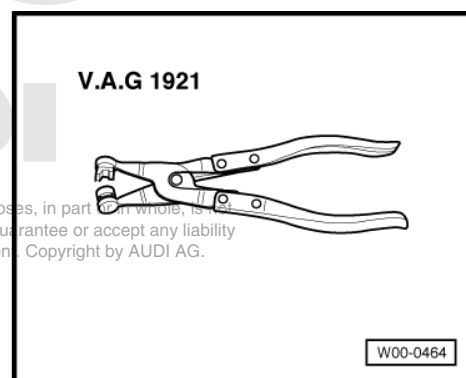
1.12 Removing and installing radiator

Special tools and workshop equipment required

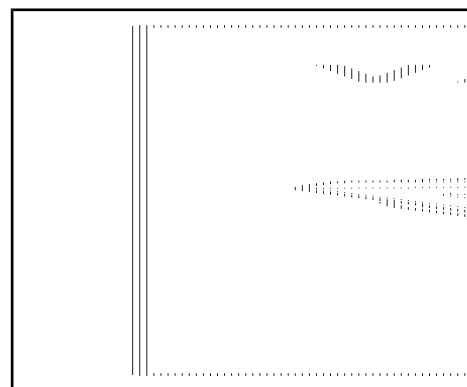
- ◆ Used oil collection and extraction unit -V.A.G 1782-



- ◆ Hose clip pliers -V.A.G 1921-



- ◆ Drip tray for workshop hoist -VAS 6208-



Removing



Note

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

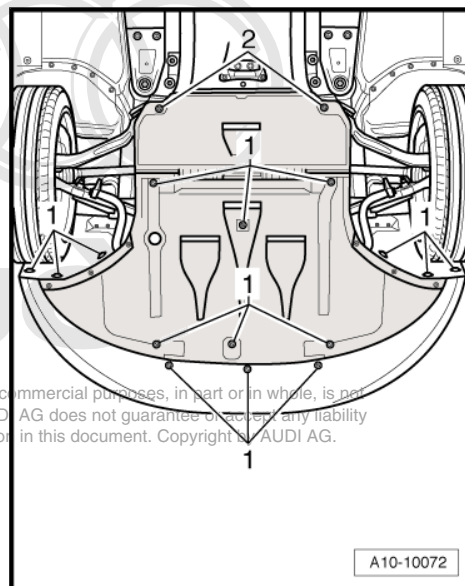


WARNING

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

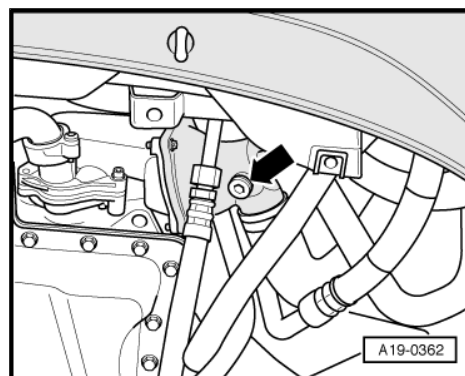
- Open filler cap on coolant expansion tank.

- Release quick-release fasteners -1- and -2- and take off noise insulation panels.
- Remove front wheel housing liners (right and left) ⇒ Rep. gr. 66 .
- Remove front bumper ⇒ Rep. gr. 63 .

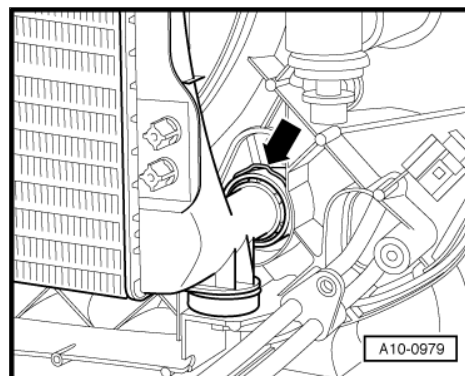


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- Place drip tray for workshop hoist -VAS 6208- beneath engine.
- Unscrew drain plug -arrow- at thermostat housing and drain off coolant at engine.



- Disconnect coolant hose (bottom) at radiator -arrow- and drain off remaining coolant.



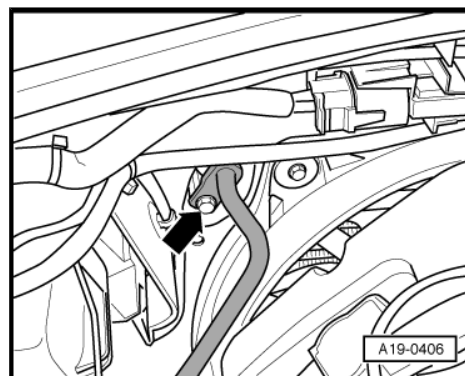
- Place used oil collection and extraction unit -V.A.G 1782- under engine.



Note

Observe rules for cleanliness when working on automatic gear-box ⇒ Rep. gr. 00 .

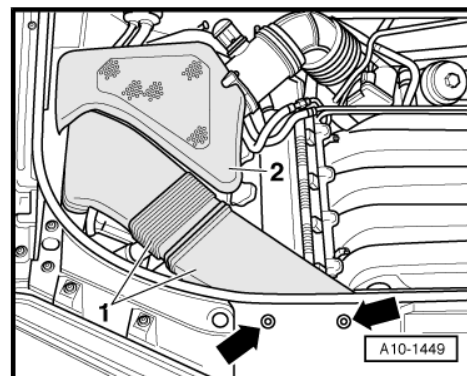
- Unbolt ATF lines from bottom and top of radiator -arrow- ⇒ Rep. gr. 37 .



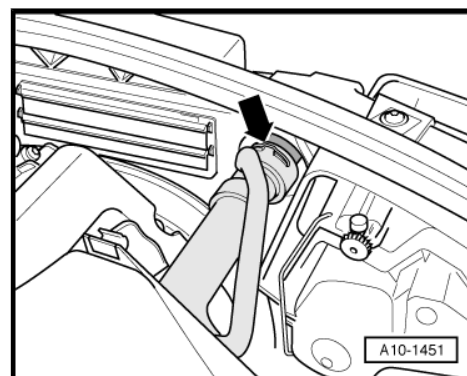
- Remove air cleaner cover -2-.
- Remove air duct -1-.

**Note**

- ◆ Use removal lever -80-200- to lever out clips -arrows-.
- ◆ To ease removal, use silicon-free lubricant if necessary.



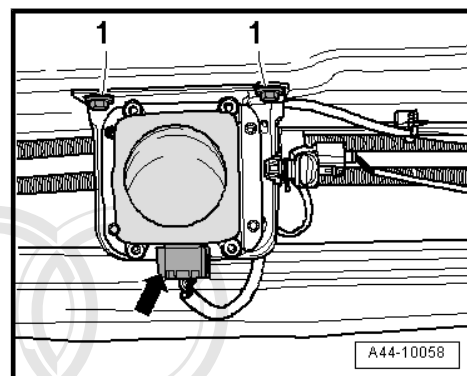
- Disconnect coolant hose (top) -arrow- from radiator.



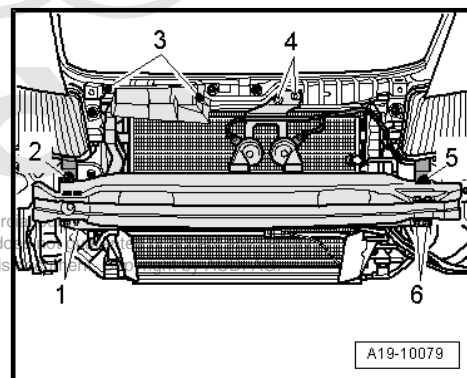
- On vehicles with adaptive cruise control, unplug electrical connector -arrow- at adaptive cruise control unit -J428-.

**Note**

Disregard -item 1-.



- 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.
- Unscrew nuts -1- and -6- and remove bumper.



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- Unclip ambient temperature sensor -G17- -arrow- from bracket.
- Unscrew bolts -1- and -2- for power steering cooling pipe; the hydraulic hoses remain attached.



Caution

The air conditioner refrigerant circuit must not be opened.

- Unplug electrical connector -1-.
- 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 by its top edge and remove upwards.

Installing

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

- Fill up with coolant ⇒ [page 170](#) .



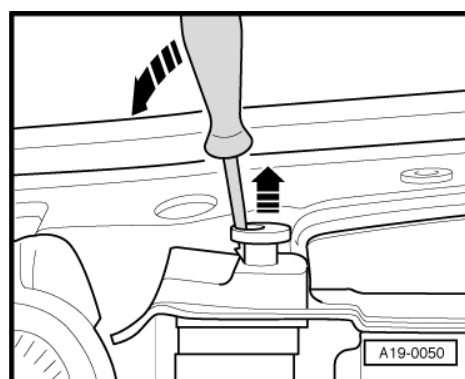
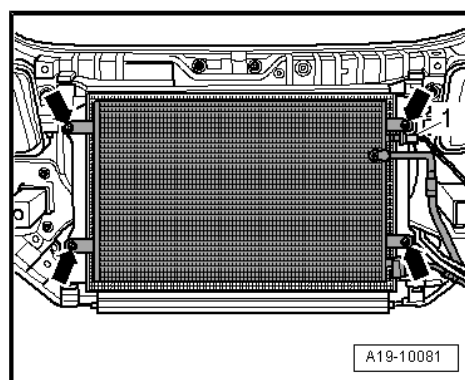
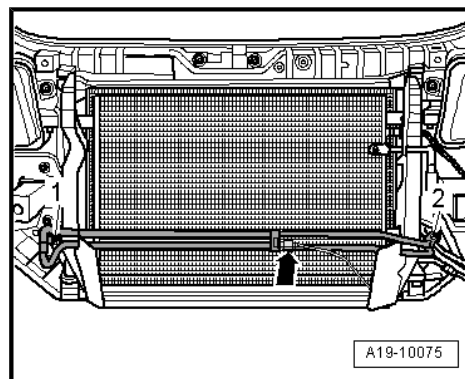
Note

- ♦ *The coolant in the entire system must be changed if the radiator is renewed*
- ♦ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*

- Secure ATF lines ⇒ Rep. gr. 37 .
- Install front bumper ⇒ Rep. gr. 63 .
- Check ATF level ⇒ Rep. gr. 37 .
- Adjustment must be performed in „Guided Functions“ after renewing adaptive cruise control unit -J428- ⇒ Rep. gr. 44 and ⇒ Vehicle diagnostic tester.

Tightening torques

Component	Nm
Condenser to radiator	10
Cooling pipe to radiator	10



1.13 Removing and installing radiator cowl

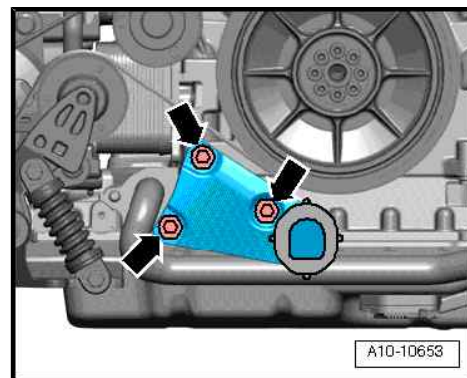
Removing

- Move lock carrier to service position ⇒ Rep. gr. 50 .
- Remove bolts -arrows- for torque reaction support.



Note

Torque reaction support remains in installation position.

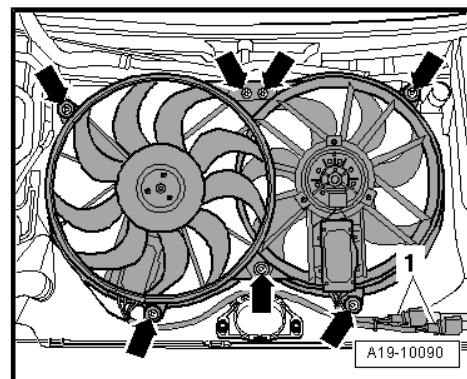


WARNING

Risk of injury as the radiator fans may start up automatically.

- ◆ *Unplug electrical connectors before starting to work in the area of radiator cowl.*

- Unplug electrical connectors -1- for radiator fans.
- Unscrew bolts -arrows- and lift out radiator cowl.



Installing

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.

- Install lock carrier with attachments ⇒ Rep. gr. 50 .

Tightening torques

Component	Nm
Radiator cowl to radiator	2
Torque reaction support to top section of sump	40

1.14 Checking cooling system for leaks

Special tools and workshop equipment required

- ◆ Cooling system tester - V.A.G 1274-
- ◆ Adapter for cooling system tester -V.A.G 1274/8-
- ◆ Adapter for cooling system tester -V.A.G 1274/9-

V.A.G 1274 	V.A.G 1274/8 
V.A.G 1274/9 	
	G19-0002

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Test condition

- Engine must be warm.

Test sequence

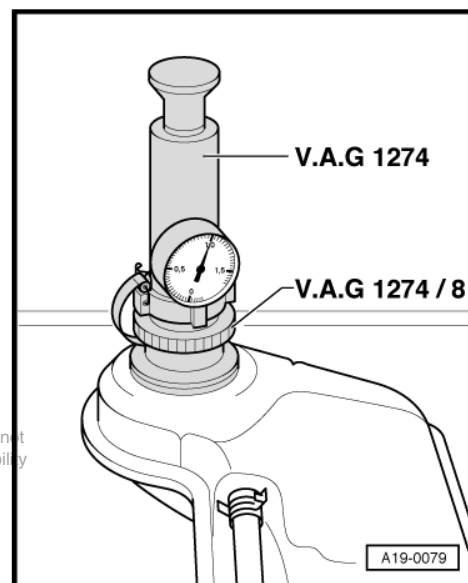


WARNING

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

- Open filler cap on coolant expansion tank.

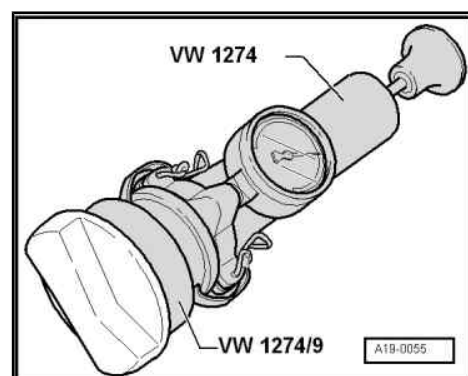
- Fit cooling system tester -V.A.G 1274- with adapter - V.A.G 1274/8- onto expansion tank.
- Using hand pump on tester, build up a pressure of approx. 1.0 bar.
- If this pressure is not maintained, locate and rectify leaks.



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Checking pressure relief valve in filler cap

- Fit cooling system tester -V.A.G 1274- with adapter - V.A.G 1274/9- onto filler cap.
- Operate hand pump.
- The pressure relief valve should open at a pressure of 1.4 ... 1.6 bar.



1.15 Removing and installing radiator fans

Removing



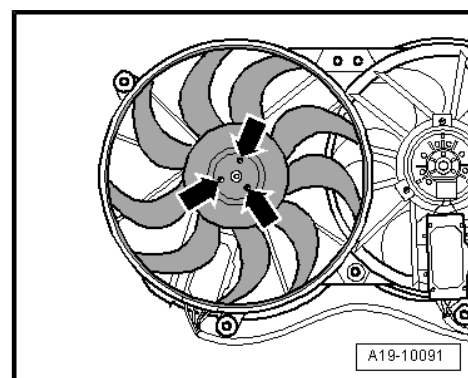
Note

Fit all cable ties in the original positions when installing.

- Move lock carrier to service position ⇒ Rep. gr. 50 .
- Remove radiator cowl ⇒ [page 191](#) .

Radiator fan -V7- (left-side):

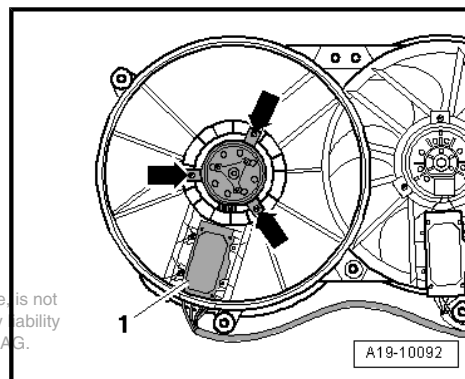
- Unscrew bolts -arrows- and remove fan wheel.





- Remove bolts -arrows-.
- Unclip radiator fan control unit -J293- -item 1- and remove radiator fan and radiator fan control unit.

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Radiator fan 2 -V177- (right-side):

- Remove bolts -arrows-.
- Unclip radiator fan control unit 2 -J671- -item 1- and remove radiator fan and radiator fan control unit.

Installing

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

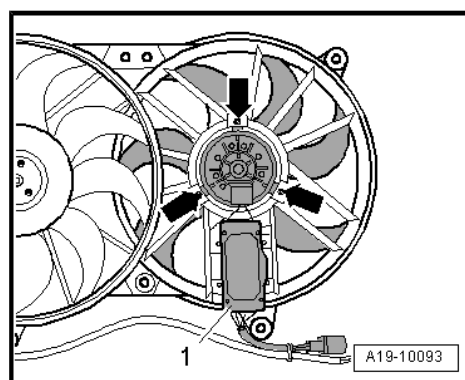


Note

- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- ◆ *Fit all cable ties in the original positions when installing.*
- Install radiator cowl ⇒ [page 191](#) .
- Install lock carrier with attachments ⇒ Rep. gr. 50 .

Tightening torques

Component	Nm
Radiator fan -V7- to radiator cowl	5
Radiator fan 2 -V177- to radiator cowl	4.5
Fan wheel to viscous coupling	3.5



26 – Exhaust system

1 Removing and installing parts of exhaust system



Note

- ◆ Renew gaskets and self-locking nuts.
- ◆ After working on the exhaust system, ensure that the system is not under stress and that it has sufficient clearance from the body. If necessary, loosen 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°.
- ◆ The illustration shows the exhaust system on a vehicle with four-wheel drive. The exhaust system on vehicles with front-wheel drive only differs very slightly.

1.1 Exhaust system - exploded view

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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 location: vehicles with front-wheel drive ⇒ [page 199](#), vehicles with four-wheel drive ⇒ [page 199](#).
- ☐ Align exhaust system so it is free of stress ⇒ [page 211](#)

4 - Exhaust manifold

- ☐ Removing and installing: left-side ⇒ [page 208](#), right-side ⇒ [page 209](#)

5 - Gasket

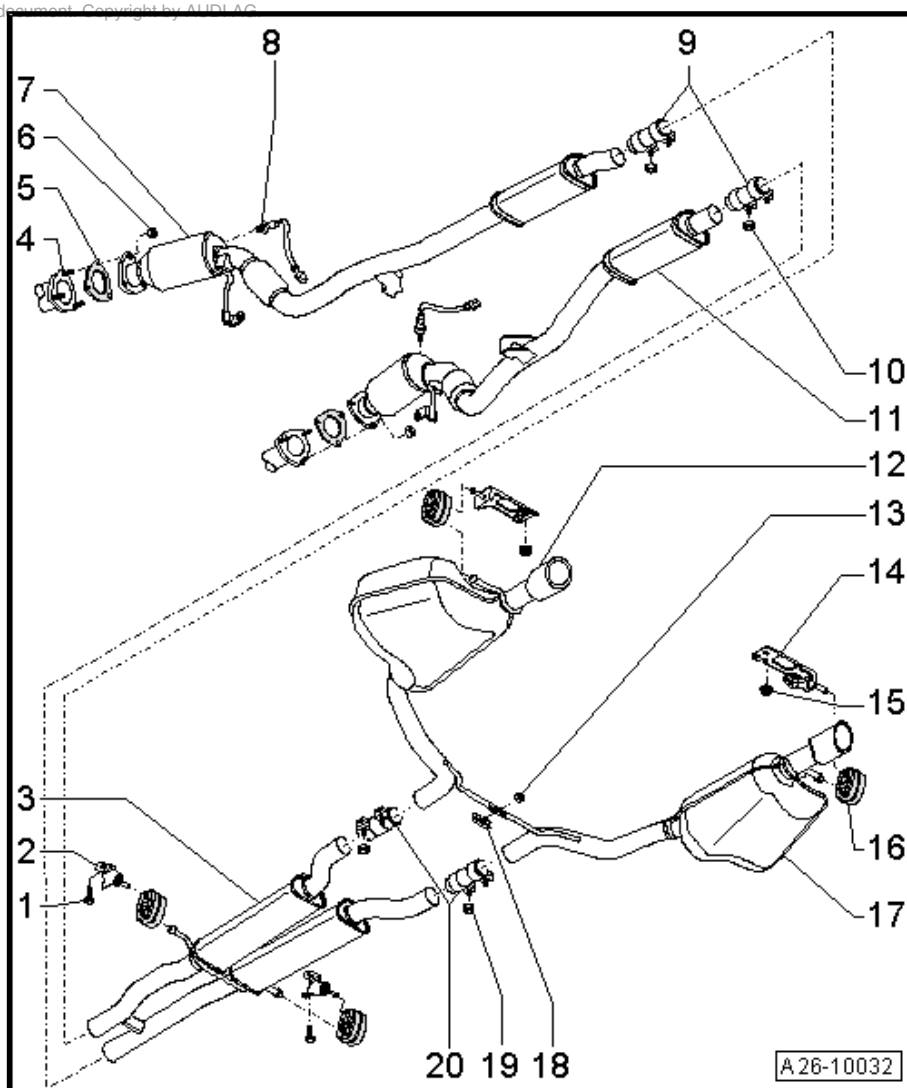
- ☐ Renew

6 - 23 Nm

- ☐ Renew

7 - 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 against knocks and impact
- ☐ Removing and installing ⇒ [page 200](#)
- ☐ Mounting components ⇒ [page 197](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 211](#)

8 - 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 ⇒ Rep. gr. 24
- ☐ Tighten to 55 Nm

9 - Clamps (front)

- ☐ Installation position ⇒ [page 197](#)
- ☐ Before tightening bolt connections, align exhaust system so it is free of stress ⇒ [page 211](#)
- ☐ Tighten bolt connections evenly

10 - 23 Nm

11 - 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 against knocks and impact
- ☐ Removing and installing ⇒ [page 204](#)
- ☐ Mounting components ⇒ [page 198](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 211](#)

12 - Rear silencer with tailpipe

- ☐ Left side of vehicle
- ☐ Combined as one unit with centre silencer as original equipment
- ☐ Centre silencer, rear silencer and tailpipe can be renewed separately as required
- ☐ Cutting point: centre silencer / rear silencer (front-wheel drive) ⇒ [page 199](#) ; four-wheel drive ⇒ [page 199](#) .
- ☐ Cutting point: rear silencer / tailpipe ⇒ [page 200](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 211](#)

13 - 23 Nm

- ☐ Renew

14 - Mounting

15 - 23 Nm

16 - Mounting

- ☐ Renew if damaged

17 - Rear silencer with tailpipe

- ☐ Right side of vehicle
- ☐ Combined as one unit with centre silencer as original equipment
- ☐ Centre silencer, rear silencer and tailpipe can be renewed separately as required
- ☐ Cutting point: centre silencer / rear silencer (front-wheel drive) ⇒ [page 199](#) ; four-wheel drive ⇒ [page 199](#) .
- ☐ Cutting point: rear silencer / tailpipe ⇒ [page 200](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 211](#)

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18 - Bracket**19 - 23 Nm****20 - Clamps (rear)**

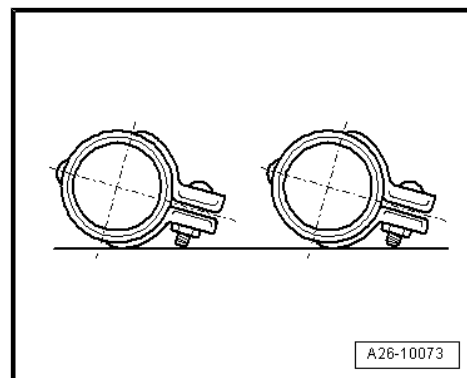
- ☐ For separate replacement of centre and rear silencers
- ☐ Position clamp so that it aligns with centre of cutting location
- ☐ Installation position ⇒ [page 197](#)
- ☐ Before tightening bolt connections, align exhaust system so it is free of stress ⇒ [page 211](#)
- ☐ Tighten bolt connections evenly

Installation position of front clamps

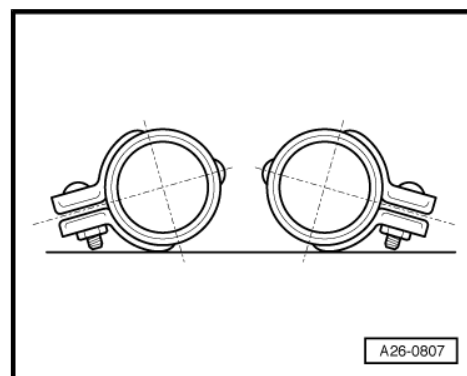
- Install clamps so that the bolt ends do not protrude beyond bottom of clamp.

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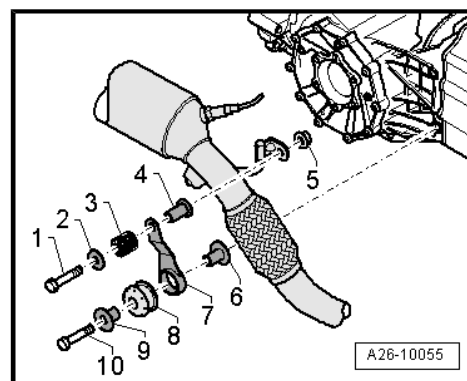
- Bolt connections face to right.

**Installation position of rear clamps**

- Install clamps so that the bolt ends do not protrude beyond bottom of clamp.
- Bolt connections face outwards.

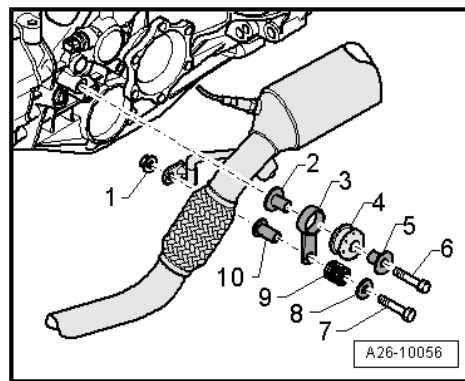
**Components of exhaust pipe mountings (left-side)**

- 1 - Bolt
- 2 - Washer
- 3 - Compression spring
- 4 - Spacer sleeve
- 5 - Nut, 23 Nm
- 6 - Spacer sleeve
- 7 - Bracket
- 8 - Buffer
- 9 - Spacer sleeve
- 10 - Bolt, 23 Nm



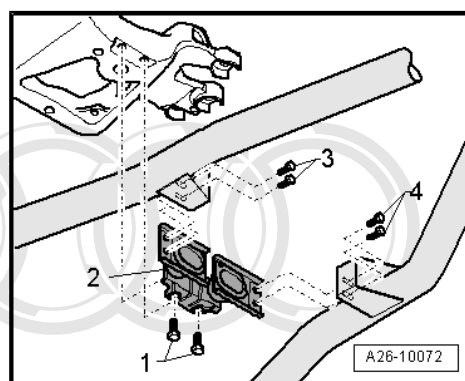
Components of exhaust pipe mountings (right-side)

- 1 - Nut, 23 Nm
- 2 - Spacer sleeve
- 3 - Bracket
- 4 - Buffer
- 5 - Spacer sleeve
- 6 - Bolt, 23 Nm
- 7 - Bolt
- 8 - Washer
- 9 - Compression spring
- 10 - Spacer sleeve



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

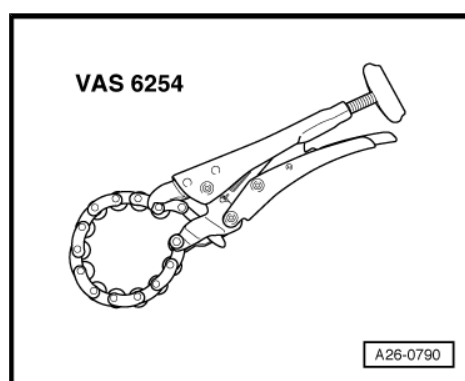
The connecting pipe can be cut through at the cutting point provided in order to renew the centre and rear silencers separately.

The cutting point is marked by an indentation on the outside of the exhaust pipe.

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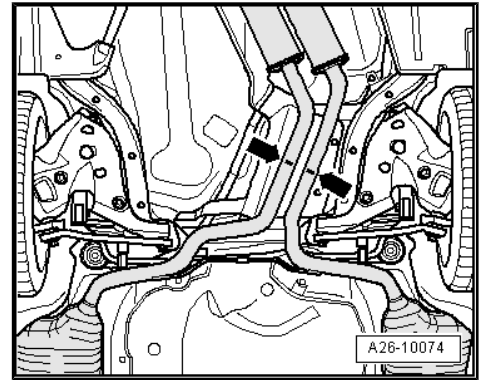
Special tools and workshop equipment required

- ◆ Chain pipe cutter -VAS 6254-



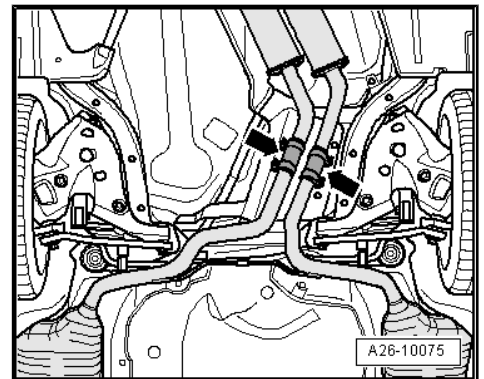
Procedure - vehicles with front-wheel drive:

- Cut through exhaust pipes at right angles at the position marked -arrow- using chain-type pipe cutter -VAS 6254-

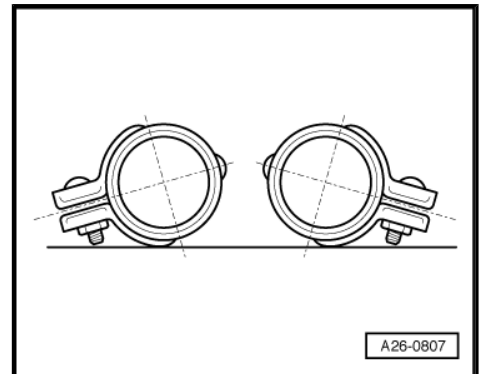


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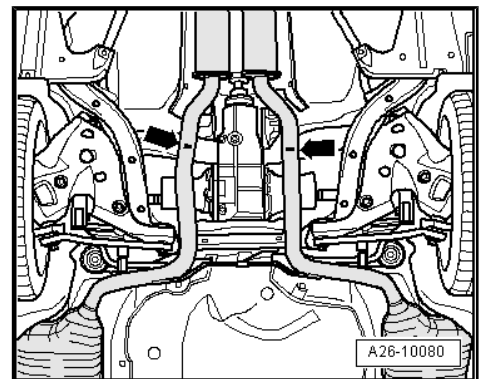
- When installing, position centre of clamps -arrows- over cutting location.



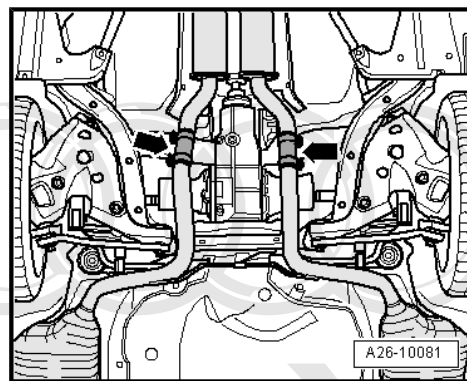
- Install clamps so that the bolt ends do not protrude beyond bottom of clamp.
- Bolt connections face outwards.
- Align exhaust system so it is free of stress ⇒ [page 211](#) .

**Procedure - vehicles with four-wheel drive:**

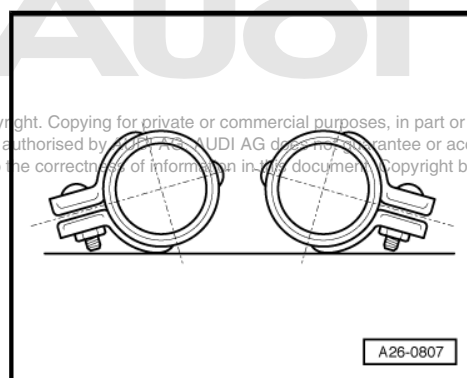
- Cut through exhaust pipes at right angles at the position marked -arrow- using chain-type pipe cutter -VAS 6254-



- 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 211](#)

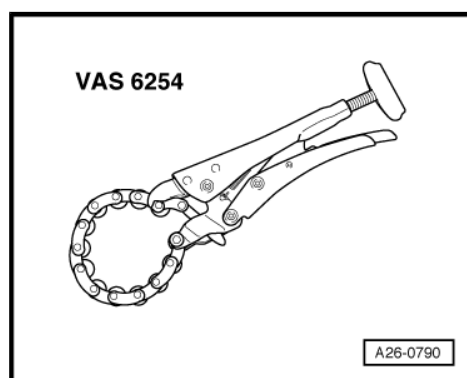


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1.3 Renewing tailpipe

Special tools and workshop equipment required

- ◆ Chain pipe cutter -VAS 6254-

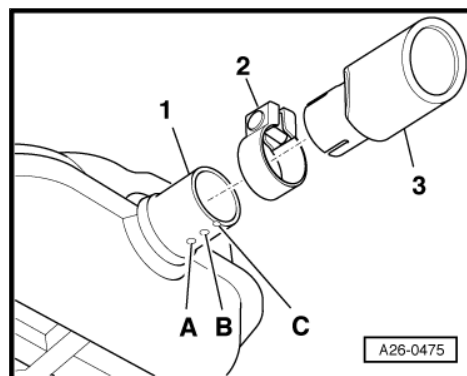


Procedure

- Cut through old tailpipe -1- at a right angle at cutting point -C- using chain pipe cutter -VAS 6254-.
- Push on new tailpipe -3- as far as marking -A-. Slot on tailpipe should align with marking -B-.
- Fit clamp -2-.

Tightening torque

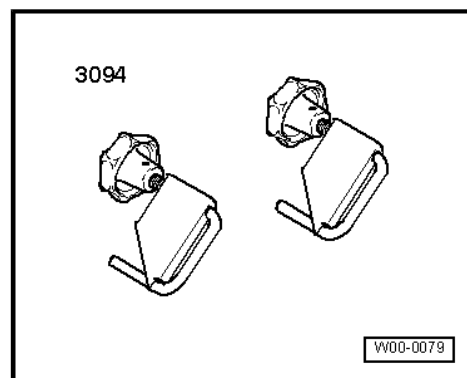
Component	Nm
Clamp	25



1.4 Removing and installing front exhaust pipe (left-side) with catalytic converter

Special tools and workshop equipment required

- ◆ Hose clamps up to Ø 25 mm -3094-



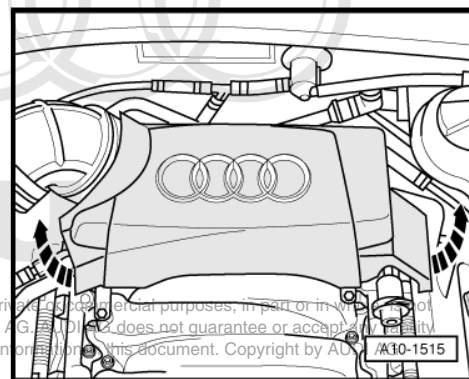
Removing



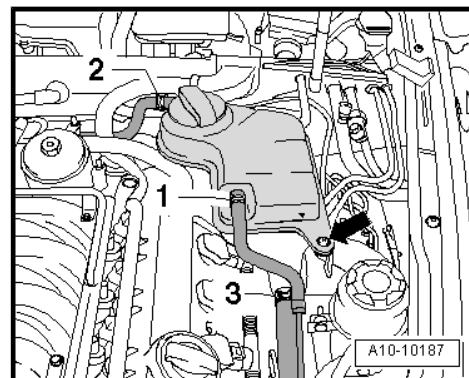
Note

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

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



- Clamp off coolant hose -2- using hose clamps -3094- and detach from coolant expansion tank.
- Unbolt coolant expansion tank -arrow-.
- Detach electrical wiring for coolant shortage indicator switch - F66- at bottom of coolant expansion tank and move expansion tank to one side with coolant hoses -1 and 3- attached.
- Seal off connection with a suitable plug if necessary.

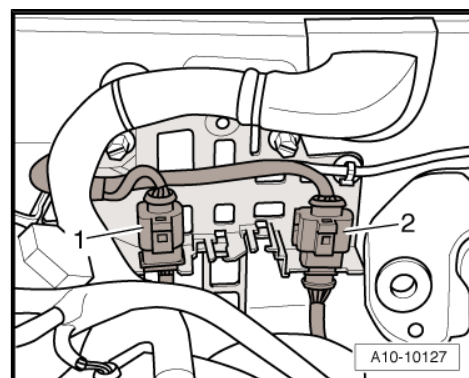


- Unplug electrical connector -2- for Lambda probe 2 after catalytic converter -G131- and move wiring clear (downwards).



Note

Disregard -item 1-.



- Unscrew nut -2- (accessible from above) connecting front exhaust pipe to exhaust manifold.



Note

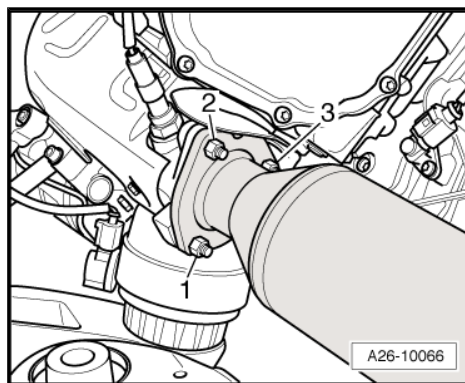
Shown from rear with engine removed for illustration purposes.

- Remove front left wheel.

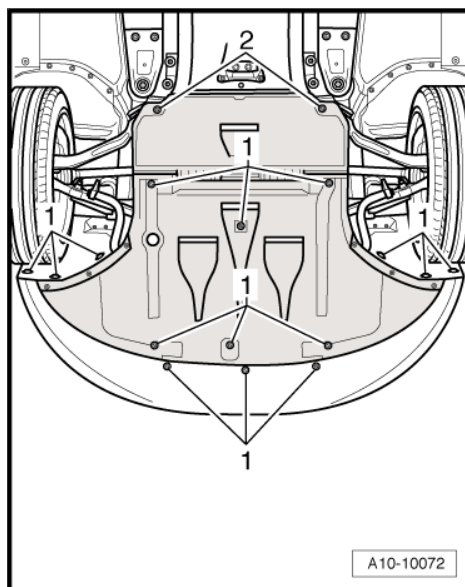


Note

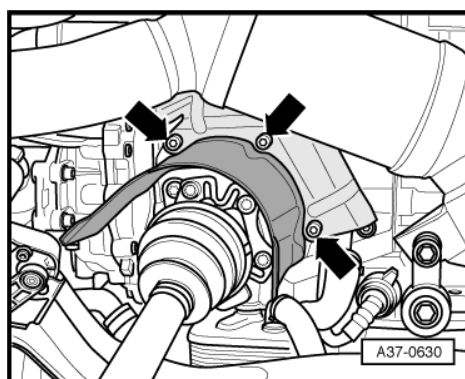
Secure brake disc with one wheel bolt.



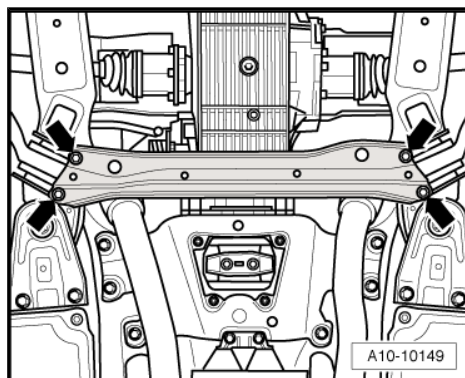
- Release quick-release fasteners -1- and -2- and take off noise insulation panels.



- Unbolt heat shield -arrows- for drive shaft (left-side).

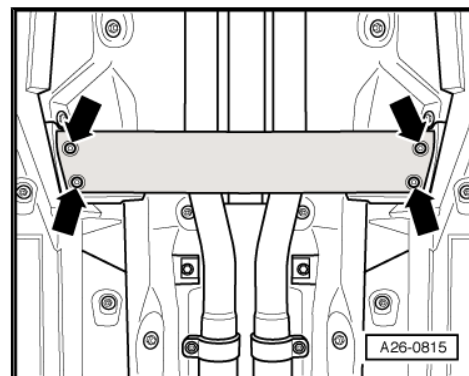


- Unbolt cross piece for subframe -arrows-.



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- Unbolt cross piece (front) -arrows-.

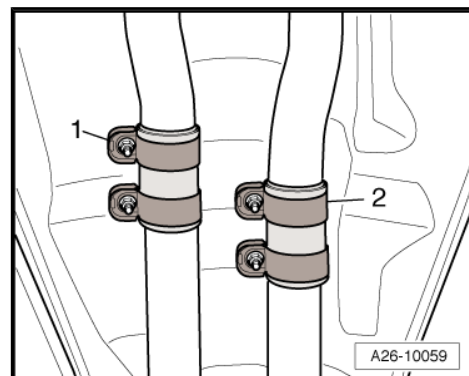


Disconnect exhaust system at clamp (left-side) -2-.



Note

Disregard -item 1-.



Note

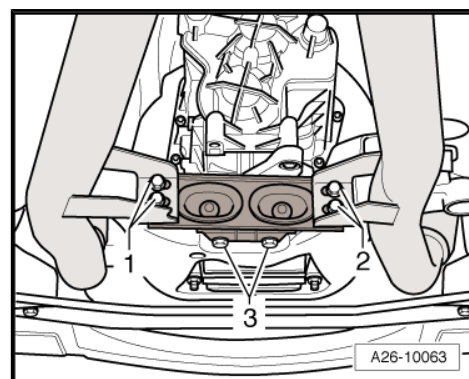
To avoid any damage, the flexible joint in the front exhaust pipe must not be bent more than 10°.

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



Note

Disregard items marked -2- and -3-.

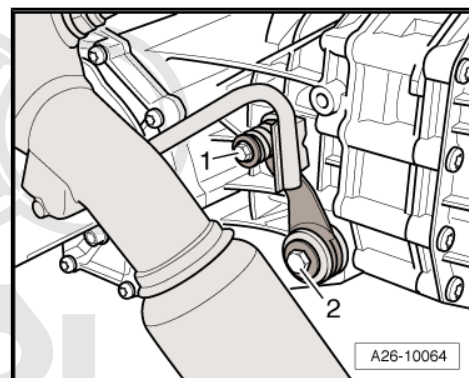


- Remove bolt -1- on bracket (left-side) for front exhaust pipe.



Note

Disregard -item 2-.



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- Unscrew nuts -1- and -3- (accessible from below) connecting front exhaust pipe to exhaust manifold.



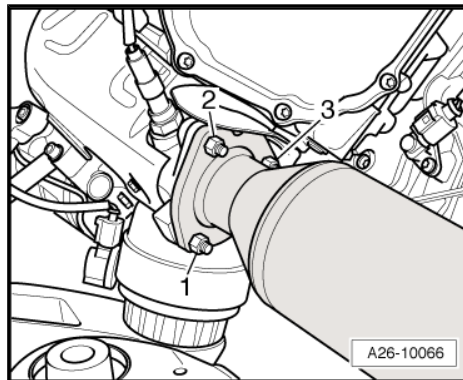
Note

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.*
- ◆ *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 ⇒ Rep. gr. 40 .
- Install cross piece (front) ⇒ Rep. gr. 50 .
- Align exhaust system so it is free of stress ⇒ [page 211](#) .



Note

Mounting components for exhaust system ⇒ [page 197](#) .

Tightening torque

Component	Nm
Front exhaust pipe with catalytic converter to exhaust manifold	23 ²⁷⁾
Mounting plate to front exhaust pipe	23
Front exhaust pipe to bracket	23
Drive shaft heat shield to gearbox	23

27) Renew nuts and bolts.

1.5 Removing and installing front exhaust pipe (right-side) with catalytic converter

Removing

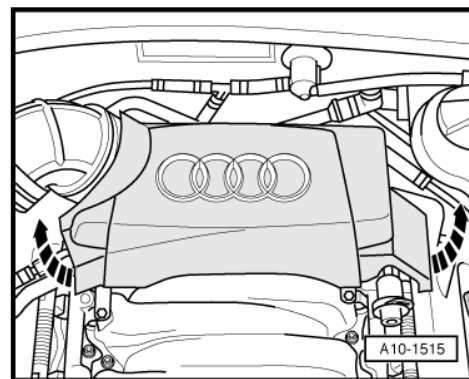


Note

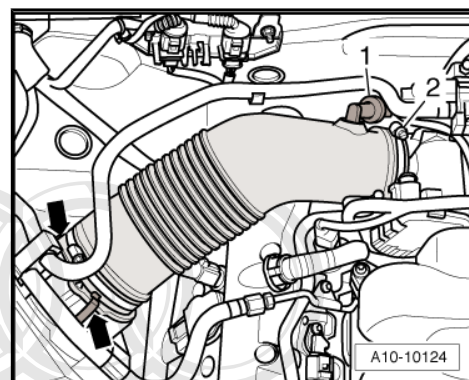
All cable ties which are released or cut open when removing must be refitted in the same position when installing.

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



- Pull non-return valve -1- off air intake hose.
- Remove air intake hose. To do so, release hose clip -2- and clamps -arrows-.

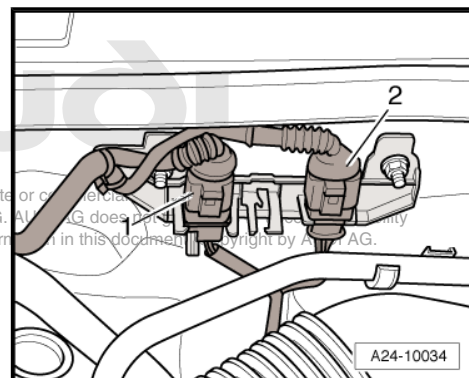


- Unplug electrical connector -2- for Lambda probe after catalytic converter -G130- and move wiring clear (downwards).

**Note**

Disregard -item 1-.

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- Unscrew nut -2- (accessible from above) connecting front exhaust pipe to exhaust manifold.

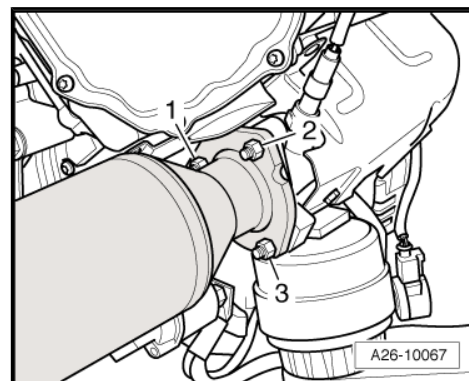
**Note**

Shown from rear with engine removed for illustration purposes.

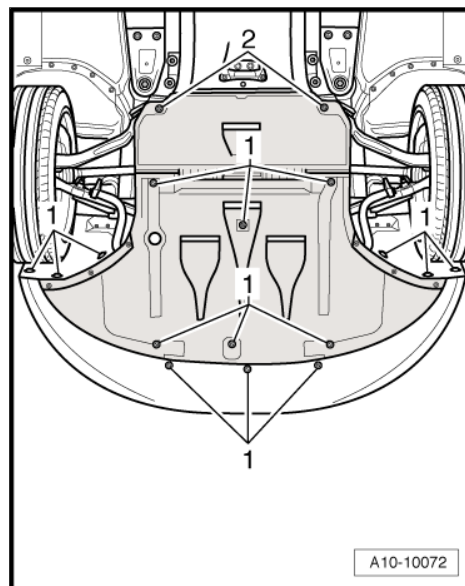
- Remove front right wheel.

**Note**

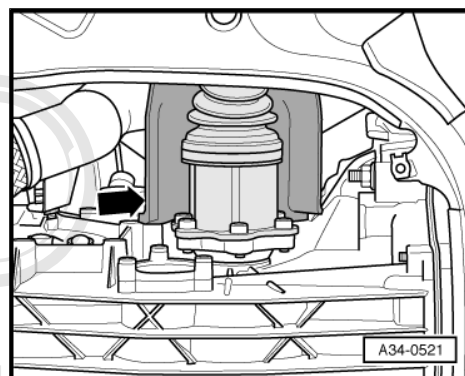
Secure brake disc with one wheel bolt.



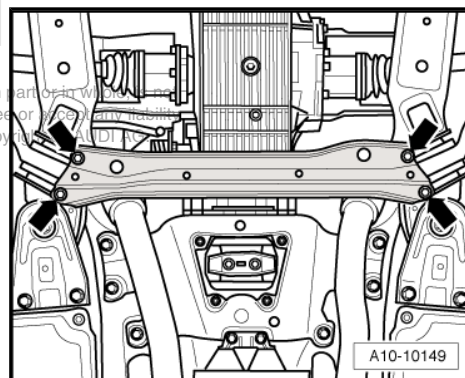
- Release quick-release fasteners -1- and -2- and take off noise insulation panels.



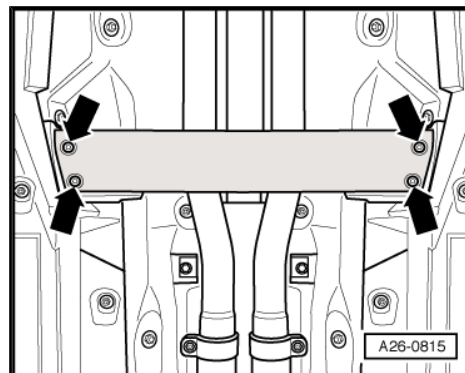
- Unbolt heat shield -arrow- for drive shaft (right-side).



- Unbolt cross piece for subframe -arrows-.



- Unbolt cross piece (front) -arrows-.



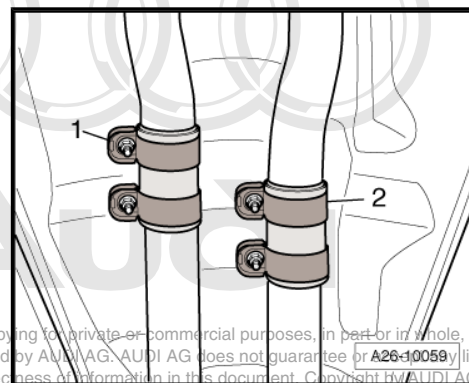
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Disconnect exhaust system at clamp (right-side) -1-.



Note

Disregard -item 2-.



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Note

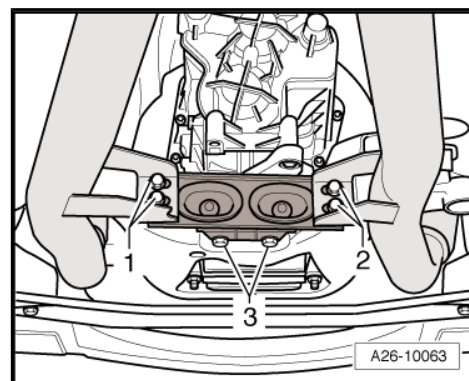
The flexible joint in front exhaust pipe must not be bent more than 10° – damage can otherwise occur.

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



Note

Disregard items marked -1- and -3-.

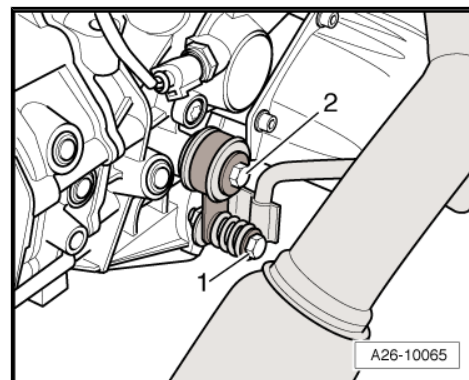


- Remove bolt -1- on bracket (right-side) for front exhaust pipe.



Note

Disregard -item 2-.



- 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, O-ring 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.

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- Install cross piece for subframe ⇒ Rep. gr. 40 .
- Install cross piece (front) ⇒ Rep. gr. 50 .
- Align exhaust system so it is free of stress ⇒ [page 211](#) .



Note

Mounting components for exhaust system ⇒ [page 198](#) .

Tightening torques

Component	Nm
Front exhaust pipe with catalytic converter to exhaust manifold	23 ²⁸⁾
Mounting plate to front exhaust pipe	23
Front exhaust pipe to bracket	23
Drive shaft heat shield to gearbox	23
Hose clips (9 mm wide)	3

28) Renew nuts and bolts.

1.6 Removing and installing exhaust manifold (left-side)

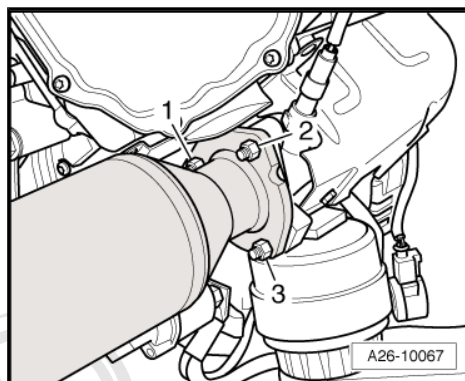
Removing

- Remove engine ⇒ [page 6](#) .



Note

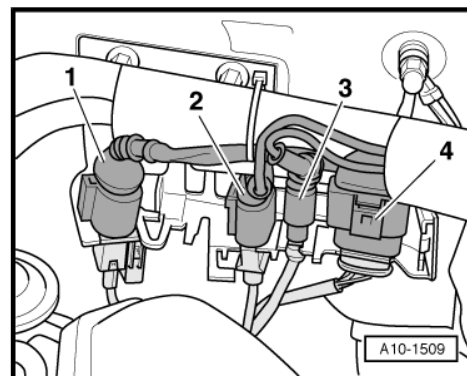
All cable ties which are released or cut open when removing must be refitted in the same position when installing.



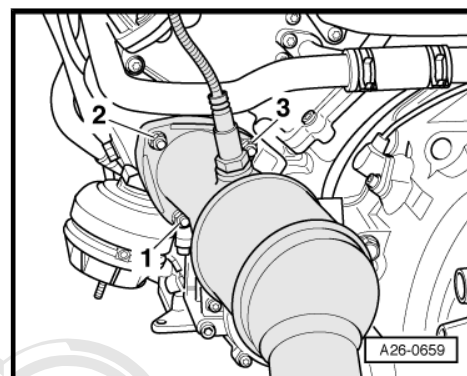
- Unplug electrical connectors -1- and -4- for Lambda probes.
- Move wiring clear.

**Note**

Illustration shows electrical connectors in their installation position.



- Unbolt front exhaust pipe from exhaust manifold (left-side): -nuts 1 to 3-.
- Remove coolant pipe (left-side) ⇒ [page 184](#) .



- Unscrew nuts -1 ... 12- and remove exhaust manifold (left-side).

Installing

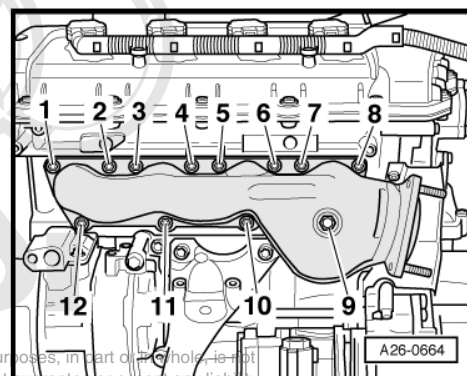
Installation is carried out in the reverse order; note the following:

**Note**

- ◆ *Renew gaskets and self-locking nuts.*
- ◆ *Reinstall all cable ties in the same locations when assembling.*

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- Install coolant pipe (left-side) ⇒ [page 184](#) .
- Install front exhaust pipe (left-side) with starter and main catalytic converter ⇒ [page 200](#) .
- Install engine ⇒ [page 28](#) .

**Tightening torque**

Component	Nm
Exhaust manifold to cylinder head	25 ²⁹⁾

29) Renew nuts

1.7 Removing and installing exhaust manifold (right-side)

Removing**Note**

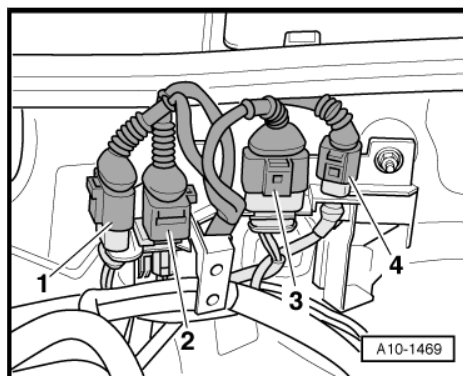
All cable ties which are released or cut open when removing must be refitted in the same position when installing.

- Remove engine ⇒ [page 6](#) .
- Unplug electrical connectors -1- and -2- for Lambda probes.
- Move wiring clear.

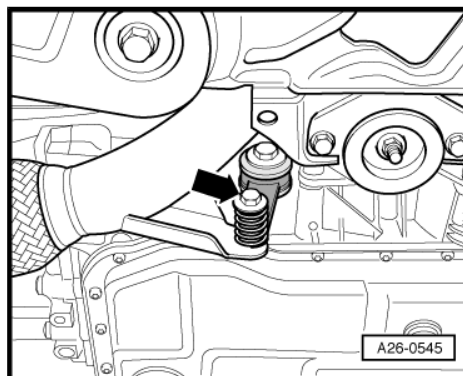


Note

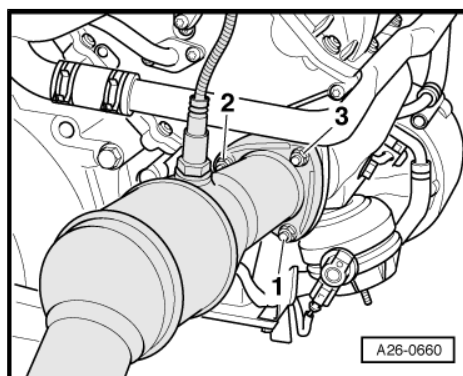
Illustration shows electrical connectors in their installation position.



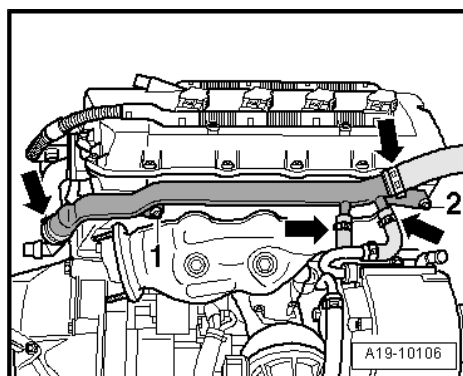
- Unscrew bolt -arrow- at bracket for front exhaust pipe (right-side).



- Unbolt front exhaust pipe from exhaust manifold (right-side): -nuts 1 to 3-.



- Remove bolts -1- and -2-.
- Loosen hose clips -arrows- and detach coolant pipe (right-side) from coolant hoses.



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- Unscrew nuts -1 ... 12- and remove exhaust manifold (right-side).

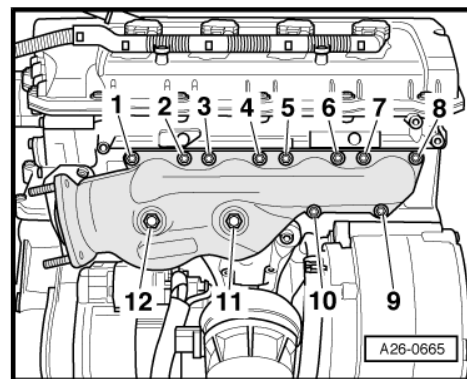
Installing

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



Note

- ◆ *Renew gaskets and self-locking nuts.*
- ◆ *Reinstall all cable ties in the same locations when assembling.*
- Install coolant pipe (right-side).
- Install front exhaust pipe (right-side) with starter and main catalytic converter ⇒ [page 204](#) .
- Install engine ⇒ [page 28](#) .



Tightening torques

Component	Nm
Exhaust manifold to cylinder head	25 ³⁰⁾

30) 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 9 \(page 196\)](#) .
- 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 of clamps evenly to 23 Nm.
- Align tailpipes ⇒ [page 212](#) .

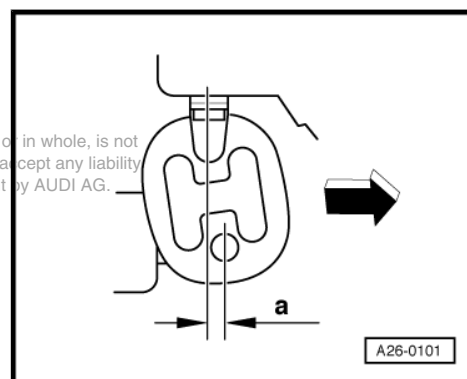
Vehicles with clamps between centre silencer and rear silencer



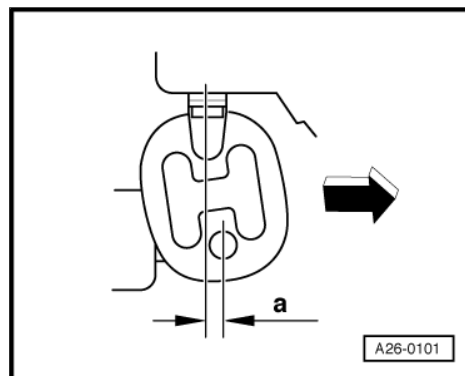
Note

On vehicles with clamps fitted between centre silencer and rear silencer, it is also necessary to align the centre silencer.

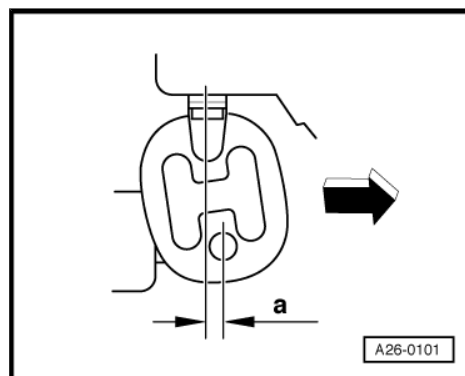
- Loosen bolts on clamps ⇒ [Item 9 \(page 196\)](#) and ⇒ [Item 20 \(page 197\)](#) .



- Push front section of exhaust system towards front of vehicle -arrow- until mountings for centre silencer are preloaded by -a- = 5 ... 9 mm.
- Tighten bolt connections for clamps (front)
⇒ [Item 9 \(page 196\)](#) evenly to 23 Nm.

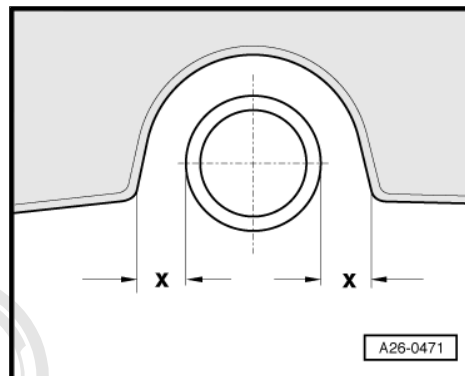


- Push rear section of exhaust system towards front of vehicle -arrow-, so that mountings (rear) for rear silencers are preloaded by -a- = 5 ... 9 mm.
- Align rear silencers so they are horizontal.
- Tighten bolt connections for clamps (rear)
⇒ [Item 20 \(page 197\)](#) evenly to 23 Nm.
- Align tailpipes ⇒ [page 212](#) .



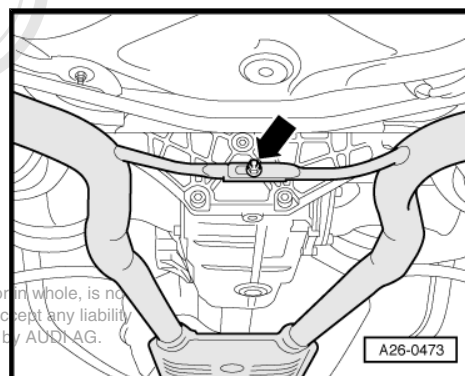
1.9 Aligning tailpipes

- Check clearance between tailpipes and bumper on both sides.
- Dimension -x- (left-side) = dimension -x- (right-side)



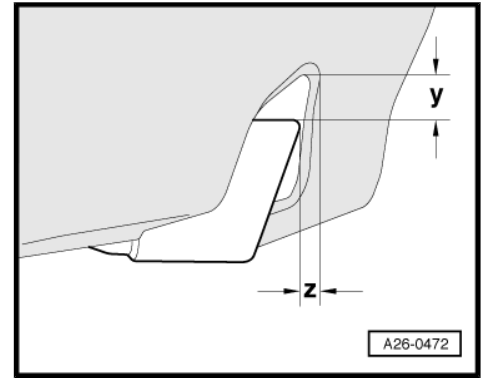
If necessary, correct dimension -x- as follows:

- Slacken bolt connection -arrow- on brace between exhaust pipes.
- Adjust the distance between the rear silencers.
- Tighten bolt connection to 25 Nm.



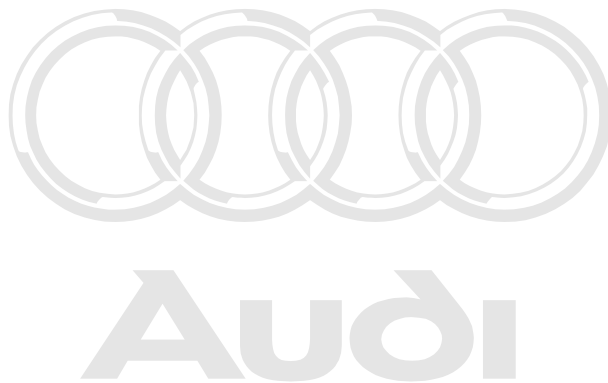
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- Check distances -y- and -z- between tailpipes and bumper.
- Dimension -y- = 17 ... 19 mm.
- Dimension -z- = 0 ± 2 mm.
- If necessary, check whether the exhaust system is aligned free of stress $\Rightarrow$ [page 211](#) .



1.10 Checking exhaust system for leaks

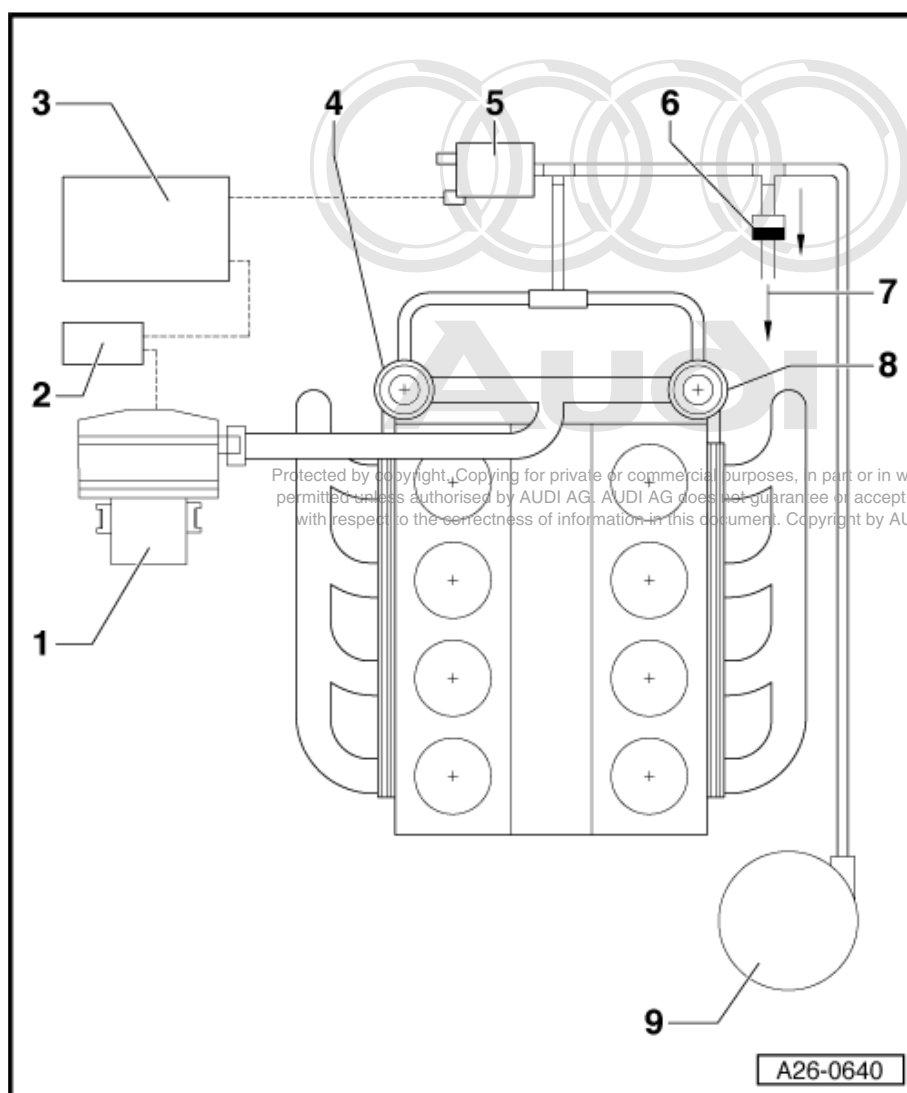
- Start engine and run at idling speed.
- Plug tailpipes during leak test (e.g. with cloth or plug).
- Listen for noise at connection points (cylinder head/exhaust manifold, exhaust manifold/front exhaust pipe, etc.) to locate any leaks.
- Repair any leaks that are found.



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2 Servicing secondary air system

- ◆ The secondary air system is designed to enable the catalytic converter to heat up and reach its operating temperature more quickly after a cold start.
- ◆ 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.



2.1 Secondary air system - overview

1 - Secondary air pump motor -V101-

- ☐ Fitting location
⇒ [page 216](#)
- ☐ Removing and installing
⇒ [page 217](#)

2 - Secondary air pump relay - J299-

- ☐ Fitting location
⇒ [page 216](#)

3 - Motronic control unit -J220-

4 - Combination valve for secondary air system (right-side)

- ☐ Fitting location
⇒ [page 216](#)
- ☐ Checking ⇒ [page 217](#)
- ☐ Removing and installing
⇒ [page 221](#)

5 - Secondary air inlet valve - N112-

- ☐ Fitting location
⇒ [page 215](#)

6 - Non-return valve

- ☐ Installation position: as shown in illustration, the arrow points in direction of flow

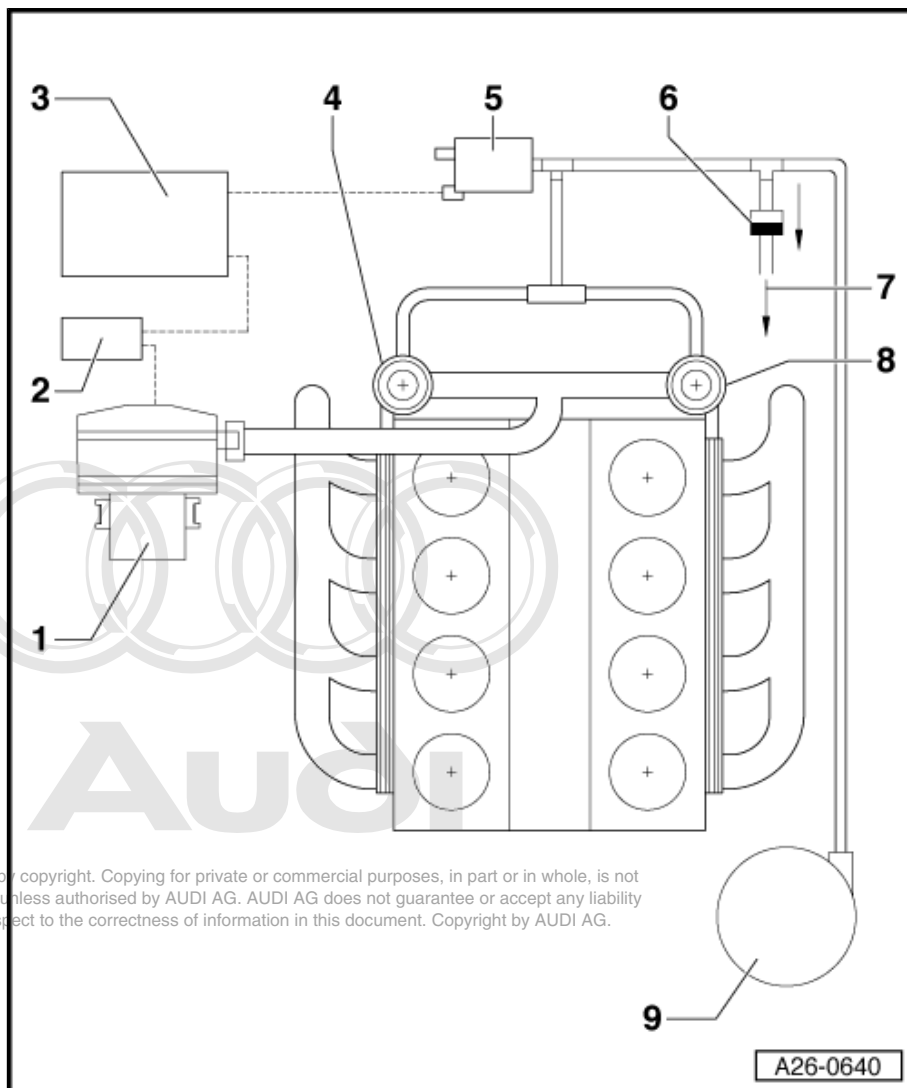
7 - To intake manifold

8 - Combination valve for secondary air system (left-side)

- ☐ Fitting location
⇒ [page 216](#)
- ☐ Checking ⇒ [page 217](#)
- ☐ Removing and installing ⇒ [page 219](#)

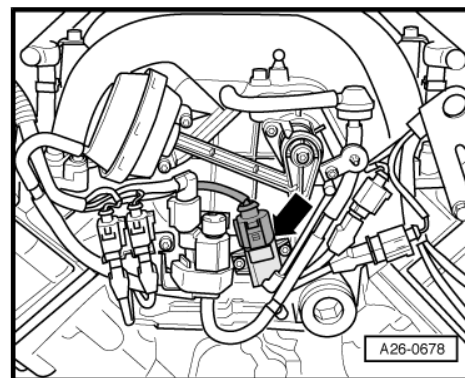
9 - Vacuum reservoir

- ☐ Fitting location: in front left wheel housing beneath liner



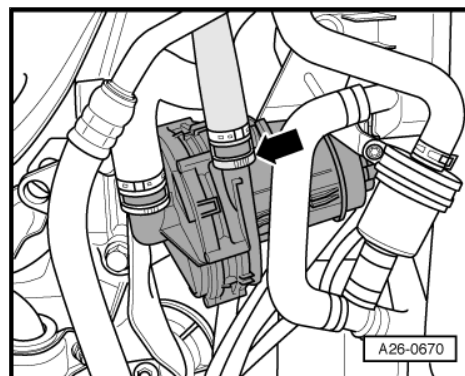
Fitting location of secondary air inlet valve -N112-

- ◆ At front on intake manifold -arrow-.



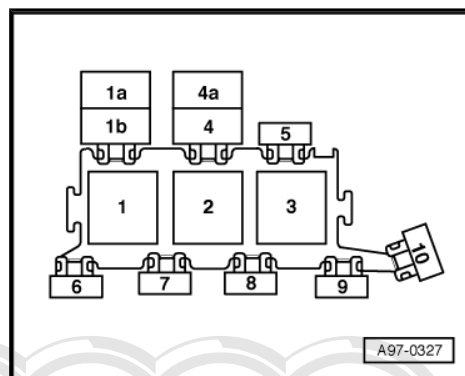
Fitting location of secondary air pump motor -V101-

- ◆ At front right in engine compartment below longitudinal member



Fitting location of secondary air pump relay -J299-

- ◆ Position 2 in 3-position relay carrier in plenum chamber electronics box.



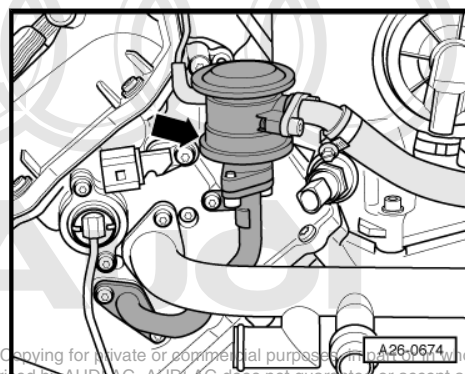
Combination valve for secondary air system

- ◆ At rear on cylinder heads.



Note

In the illustration the left-side valve is shown.

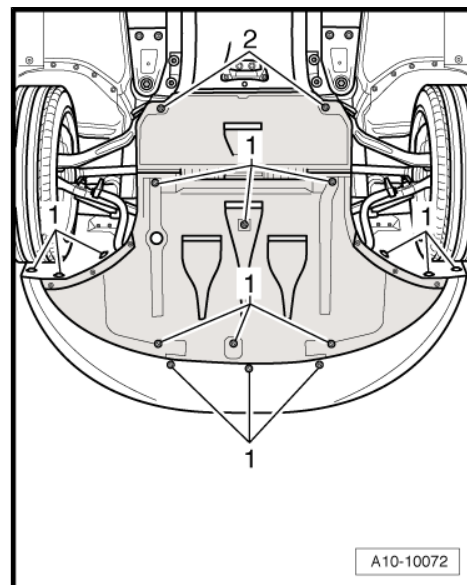


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2.2 Removing and installing secondary air pump motor -V101-

Removing

- Release quick-release fasteners -1- and -2- and take off front noise insulation.
- Remove front bumper ⇒ Rep. gr. 63 .

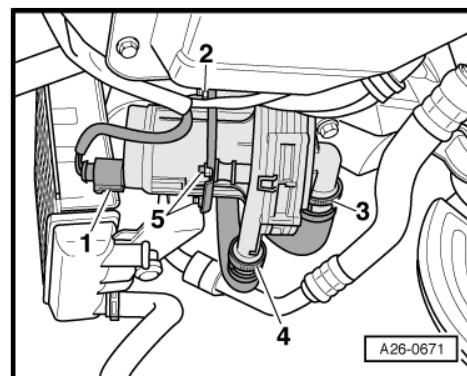


- Disconnect hoses -3- and -4- from secondary air pump motor -V101- .
- Unplug electrical connector -1-.
- Unscrew nuts -2- and -5- and remove secondary air pump motor -V101- from bracket.

Installing

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

- Install front bumper ⇒ Rep. gr. 63 .



Tightening torque

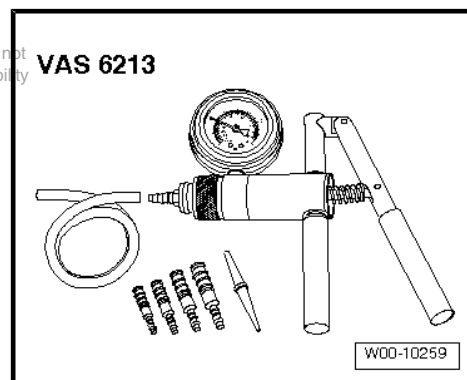
Component	Nm
Secondary air pump to bracket	10

2.3 Checking combination valve for secondary air system for proper operation and leakage

Special tools and workshop equipment required

- ◆ Hand vacuum pump -VAS 6213-

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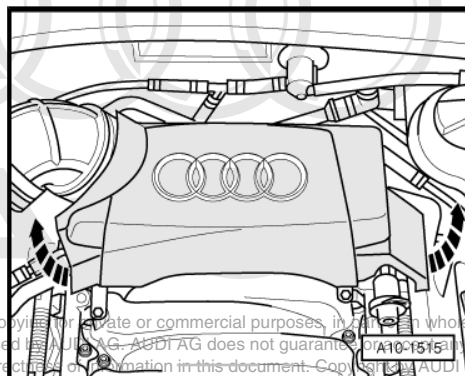


Test conditions

- Vacuum hoses and hose connections do not leak.
- Vacuum hoses are not clogged.

Test sequence

- Pull off rear engine cover panel -arrows-.



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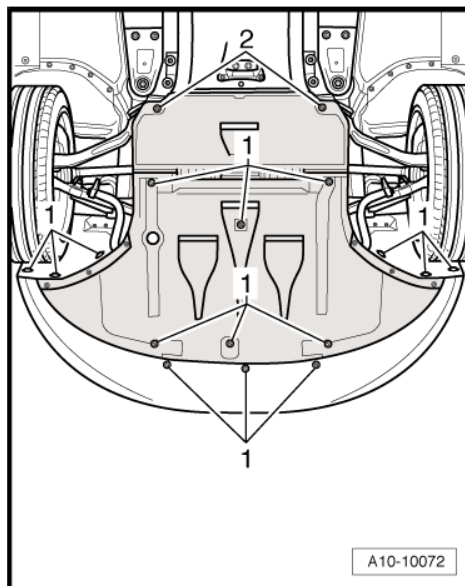
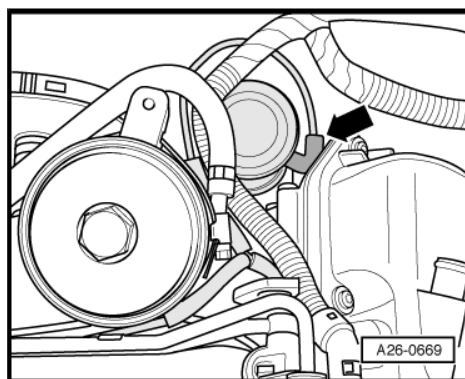
- Disconnect vacuum hose -arrow- from combination valve which is to be tested.



Note

In the illustration shows the left-side combination valve.

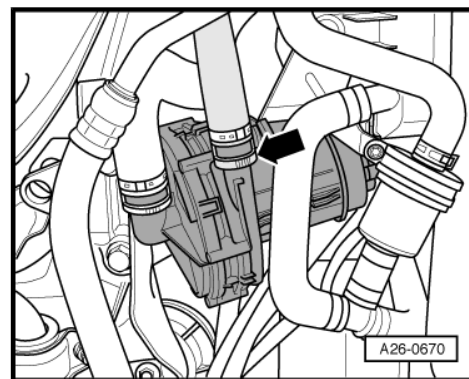
- Connect the hand vacuum pump -VAS 6213- to vacuum hose of combination valve you want to check.
- Release quick-release fasteners -1- and -2- and take off front noise insulation.



- Detach pressure hose -arrow- at secondary air pump motor - V101- .
- Blow gently into pipe (do not use compressed air).
- Both combination valves must be closed and it must not be possible to blow through the hose.
- Operate hand vacuum pump.
- The combination valve should open; it should now be possible to blow through the hose.

If the relevant combination valve does not open:

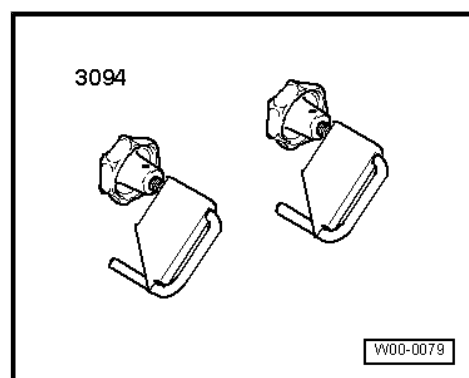
- Renew combination valve ⇒ [page 219](#) and ⇒ [page 221](#) .



2.4 Removing and installing combination valve for secondary air system (left-side)

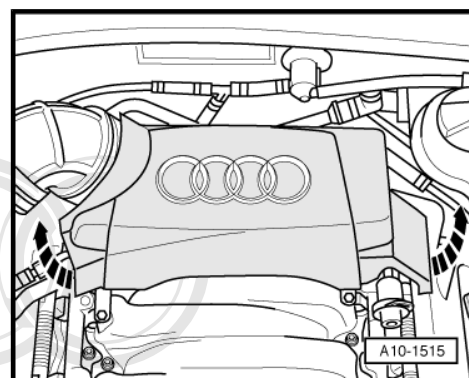
Special tools and workshop equipment required

- ◆ Hose clamps up to Ø 25 mm -3094-

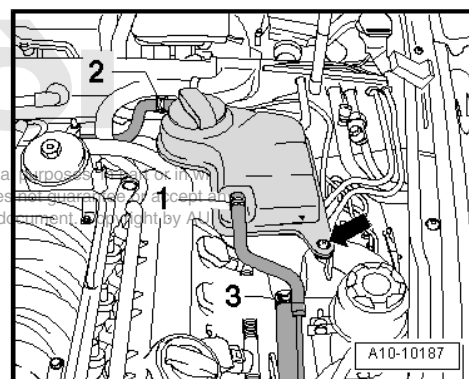


Removing

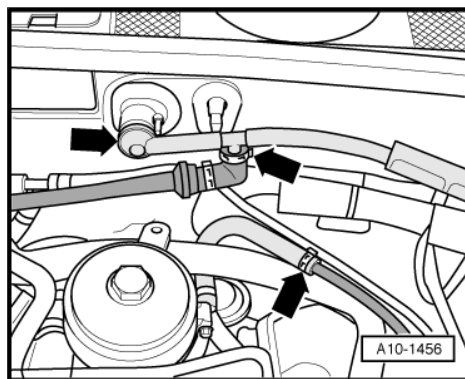
- Pull off rear engine cover panel -arrows-.



- Clamp off coolant hose -2- using hose clamps -3094- and detach from coolant expansion tank.
- Unbolt coolant expansion tank -arrow-.
- Detach electrical wiring for coolant shortage indicator switch - F66- at bottom of coolant expansion tank and move expansion tank to one side with coolant hoses -1- and 3- attached.
- Seal off connection with a suitable plug if necessary.



- Disconnect the vacuum hoses at the points marked with -arrows-.
- Remove crankcase breather hose from cylinder head cover (left-side).

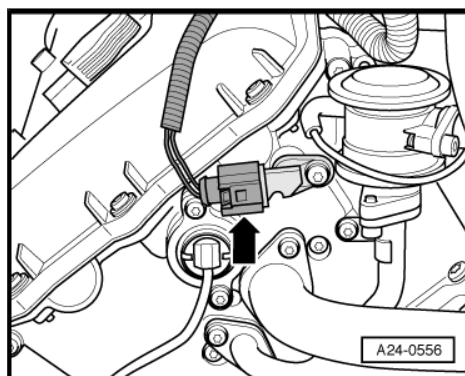


- Unplug electrical connector -arrow- for Hall sender 2 -G163- at cylinder head (left-side).

**Note**

Illustration shows engine from rear.

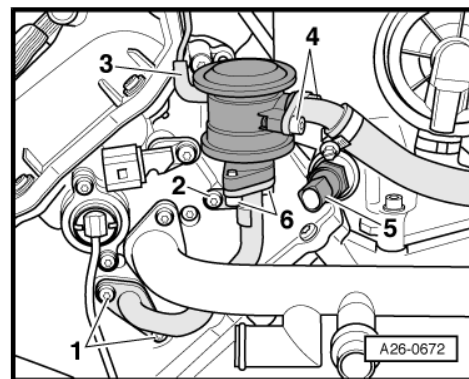
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- Detach vacuum hose -3-.
- Remove bolts -4-.
- Unplug electrical connector -5- at oil pressure switch.
- Remove oil pressure switch.
- Remove bolts -1- and -2-.
- Pivot the combination valve and unscrew bolts -6-.
- Remove combination valve and connecting pipe.

**Note**

Illustration shows engine from rear.

**Installing**

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

**Note**

- ◆ *Renew gaskets and seals.*
- ◆ *Note installation position of gasket between cylinder head and connecting pipe.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*

- Check coolant level ⇒ [page 170](#) .

Tightening torques

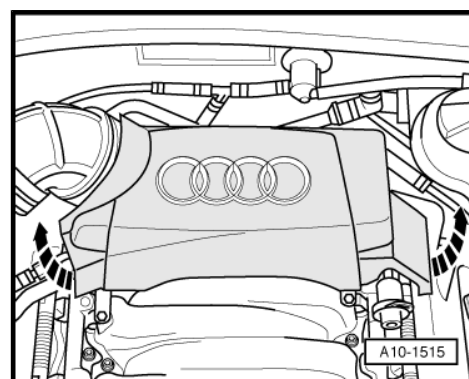
Component		Nm
Connecting pipe to:	Cylinder head	10
	Combina- tion valve	10
Oil pressure switch to oil filter housing		25

2.5 Removing and installing combination valve for secondary air system (right-side)

Removing

- Pull off rear engine cover panel -arrows-.

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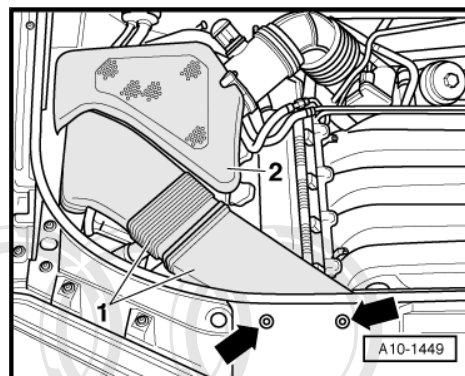


- Remove air cleaner cover -2-.
- Remove air duct -1-.

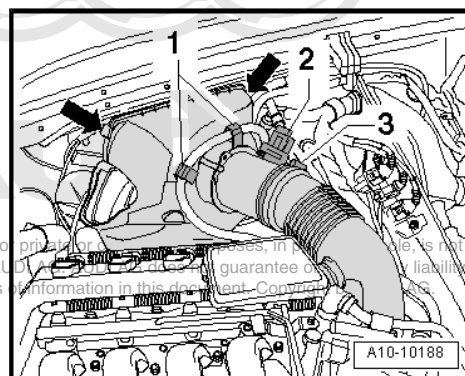


Note

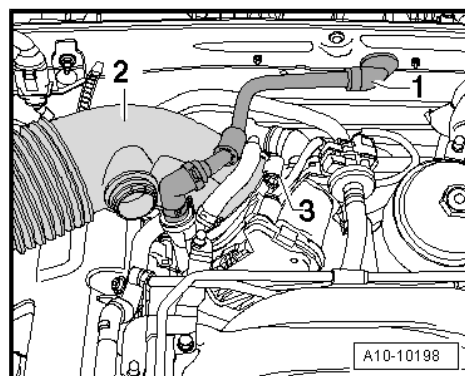
- ◆ Use removal lever -80-200- to lever out clips -arrows-.
- ◆ To ease removal, use silicon-free lubricant if necessary.



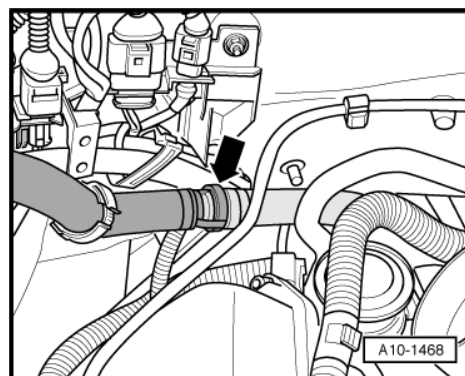
- Unclip fuel hose -1-.
- Unplug electrical connector -2- from air mass meter.
- Detach air mass meter from air intake hose -3-.
- Remove top section of air cleaner together with air mass meter -arrows-.



- Remove air intake hose -2- by loosening screw-type clip -3-.



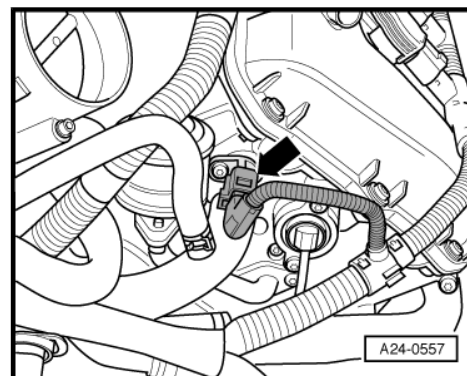
- Detach hose -arrow- leading to combination valves for secondary air system.



- Unplug electrical connector -arrow- for Hall sender -G40- at cylinder head (right-side).

**Note**

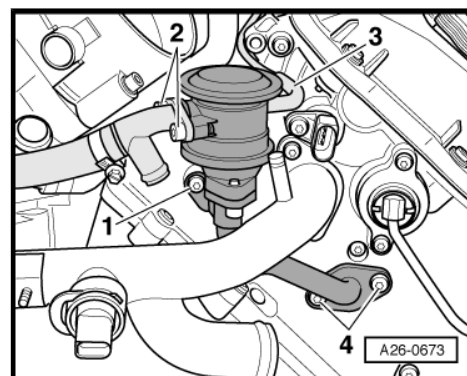
Illustration shows engine from rear.



- Detach vacuum hose -3-.
- Unscrew bolts -1-, -2- and -4- and remove combination valve.

**Note**

Illustration shows engine from rear.

**Installing**

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

**Note**

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

Tightening torques

Component		Nm
Connecting pipe to:	Cylinder head	10
	Combina- tion valve	10



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