

Workshop Manual Audi A8 2003 ➤

8-cylinder direct petrol injection engine (4.2 ltr. 4-valve), mechanics

Engine ID

BVJ

Edition 08.2012



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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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00 – Technical data

1 Engine number

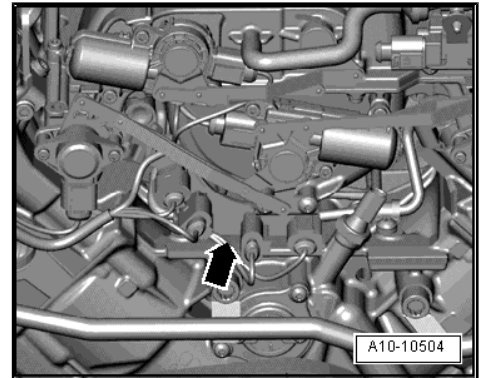
(ARL002997; Edition 08.2012)

- ◆ The engine number (“engine code” and “serial number”) can be found on top of the cylinder block at the front -arrow-.
- ◆ The engine code is also included on the vehicle data sticker.



Note

Pull off engine cover panel (front) to make the engine number visible.



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2 Engine data

Code letters		BVJ
Capacity	ltr.	4.163
Power output	kW at rpm	257/6800
Torque	Nm at rpm	440/3500
Bore	Ø mm	84.5
Stroke	mm	92.8
Compression ratio		12.5
RON		98 ¹⁾
Injection and ignition system		Bosch Motronic
Firing order		1-5-4-8-6-3-7-2
Turbocharging/supercharging		no
Lambda control		4 probes
Variable valve timing		yes
Intake manifold change-over		yes
Secondary air system		yes
Valves per cylinder		4
• ¹⁾ Unleaded premium RON 95 can also be used, but results in reduced power		

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3 Safety precautions

⇒ [“3.1 Working on the fuel supply system”, page 3](#)

⇒ [“3.2 Working on the cooling system”, page 4](#)

⇒ [“3.3 Using testers and measuring instruments during a road test”, page 4](#)

⇒ [“3.4 Working on the exhaust system”, page 4](#)

3.1 Working on the fuel supply system

Please note the following warnings when working on the fuel supply system:



WARNING

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

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

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

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

- ◆ Always switch off the ignition before connecting or disconnecting electrical wiring for the injection or ignition system or tester cables.
- ◆ Always switch off ignition before washing engine.
- ◆ Erase any entries in event memory resulting from testing or repairs ⇒ Vehicle diagnostic tester, Guided Functions, In-terrogate event memory, then Generate readiness code.



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 ⇒ Electrical system; Rep. gr. 27 .

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3.2 Working on the cooling system

When working on the cooling system note the following warnings:



WARNING

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

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

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

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



Caution

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

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

3.3 Using testers and measuring instruments during a road test

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



WARNING

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

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

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

3.4 Working on the exhaust system

When working on the exhaust system please note the following:



Caution

Avoid damage to flexible joint.

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

4 Repair instructions

⇒ [“4.1 Rules for cleanliness”, page 5](#)

⇒ [“4.2 Checking fuel system for leaks”, page 5](#)

⇒ [“4.3 Foreign particles in engine”, page 5](#)

⇒ [“4.4 Contact corrosion”, page 6](#)

⇒ [“4.5 Routing and attachment of pipes, hoses and wiring”, page 6](#)

⇒ [“4.6 Installing radiators and condensers”, page 6](#)

4.1 Rules for cleanliness

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

- ◆ Carefully clean connection points and the surrounding area with engine cleaner or brake cleaner and dry thoroughly before opening.
- ◆ Seal off open pipes/lines and connections immediately with clean plugs, e.g. from engine bung set -VAS 6122- .
- ◆ Place parts that have been removed on a clean surface and cover them over. Use only lint-free cloths.
- ◆ Carefully cover or seal open components if repairs cannot be carried out immediately.
- ◆ Only install clean components; replacement parts should only be unpacked immediately prior to installation. Do not use parts that have not been stored in their packing (e.g. in tool boxes etc.).
- ◆ When the system is open, do not work with compressed air and do not move the vehicle.
- ◆ Make sure that no fuel runs onto the fuel hoses. Should this occur, the fuel hoses must be cleaned again immediately.
- ◆ Protect unplugged electrical connectors against dirt and moisture and make sure connections are dry when attaching.

4.2 Checking fuel system for leaks

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

4.3 Foreign particles in engine

- ◆ When working on the engine, all open inlet and exhaust ports must be sealed with suitable plugs (e.g. from engine bung set -VAS 6122-) to prevent foreign particles from entering the engine.
- ◆ In the event of mechanical damage to one of the cylinder banks, the intake and exhaust systems and combustion cham-

bers of the opposite cylinder bank must always be examined for foreign particles to prevent further damage occurring later.

4.4 Contact corrosion

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

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

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

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

Note the following:

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

4.5 Routing and attachment of pipes, hoses and wiring

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

4.6 Installing radiators and condensers

Even when the radiator and condenser are correctly installed, slight impressions may be visible on the fins of these components. This does not mean that the components are damaged. If the fins are only very slightly distorted, this does not justify renewal of the radiator or the condenser.

10 – Removing and installing engine

1 Removing engine



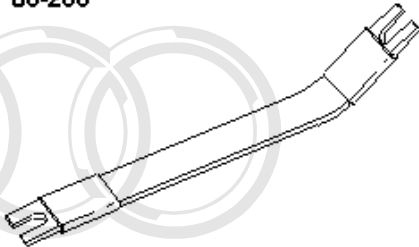
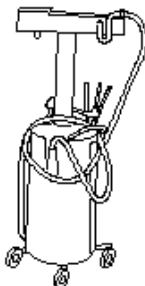
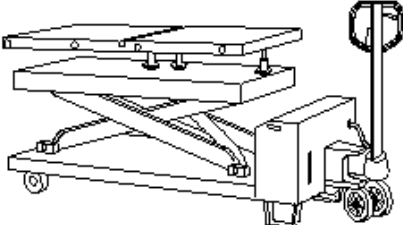
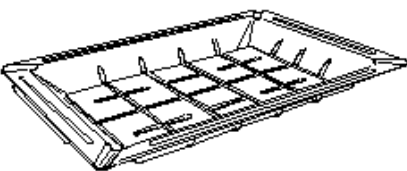
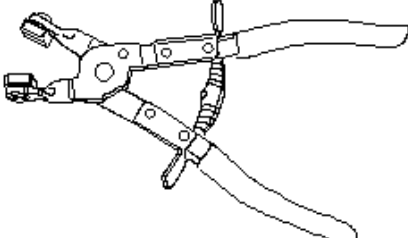
Note

- ◆ *The engine is removed from underneath together with the gearbox and subframe (with lock carrier installed).*
- ◆ *Collect drained coolant in a clean container for re-use or disposal.*
- ◆ *Fit all cable ties in the original positions when installing.*

Special tools and workshop equipment required

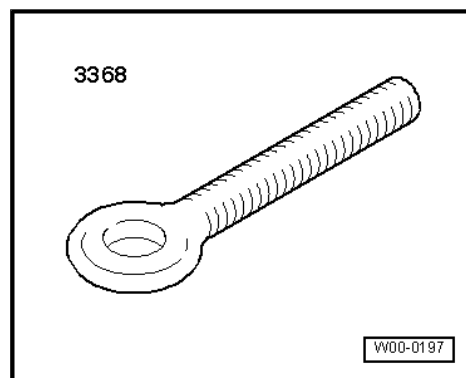
- ◆ Removal lever -80 - 200-
- ◆ Used oil collection and extraction unit -V.A.G 1782-
- ◆ Stepladder -VAS 5085-
- ◆ Scissor-type assembly platform -VAS 6131 A- with support set for Audi -VAS 6131/10- and support set -VAS 6131/11- and -VAS 6131/12-
- ◆ Drip tray for workshop hoist -VAS 6208-
- ◆ Hose clip pliers -VAS 6362-

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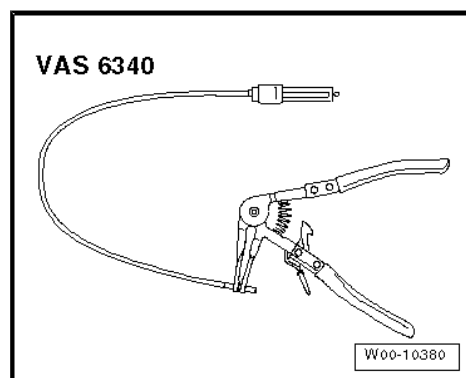
80-200 	V.A.G 1782 
VAS 5085 	VAS 6131 A 
VAS 6208 	VAS 6362  G13-10039



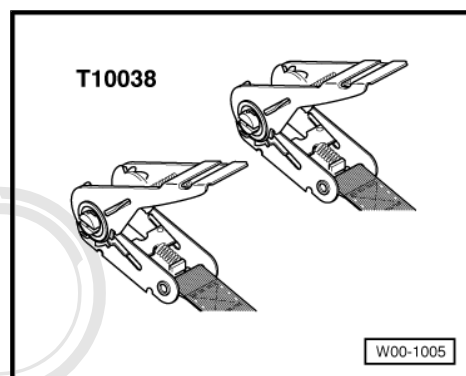
◆ Eye-head bolt -3368-



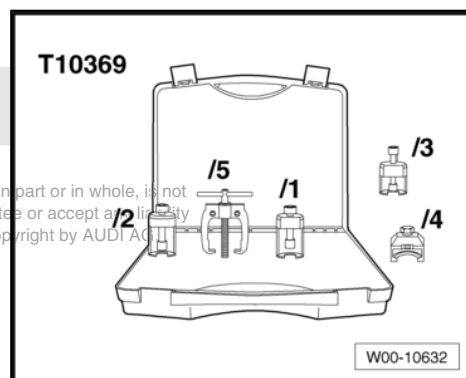
◆ Hose clip pliers -VAS 6340-



◆ Tensioning strap -T10038-



◆ Tool set for wiper arms -T10369-



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Procedure

**WARNING**

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

- ◆ *The fuel pressure in the high-pressure section of the injection system must be reduced to a residual pressure prior to opening the system.*

- Reduce fuel pressure in high-pressure section of injection system ⇒ Rep. gr. 24 .
- Discharge the refrigerant system ⇒ Air conditioner system - with refrigerant R134a .
- Extract hydraulic fluid for power steering from reservoir using used oil collection and extraction unit -V.A.G 1782- .

**Caution**

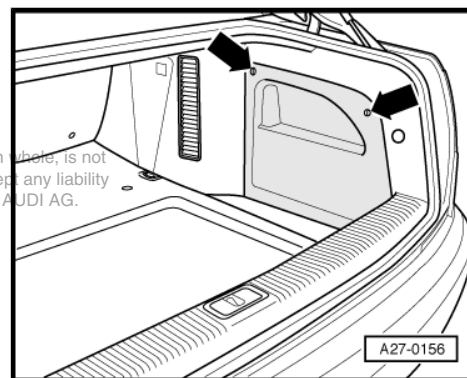
To prevent irreparable damage to the electronic components when disconnecting the battery:

- ◆ *Observe notes on procedure for disconnecting the battery.*

**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.*
- ◆ *The electronic parking brake must be released before disconnecting the battery, so that the propshaft can be turned during removal.*
- Remove luggage compartment side trim cover (right-side) -arrows-.

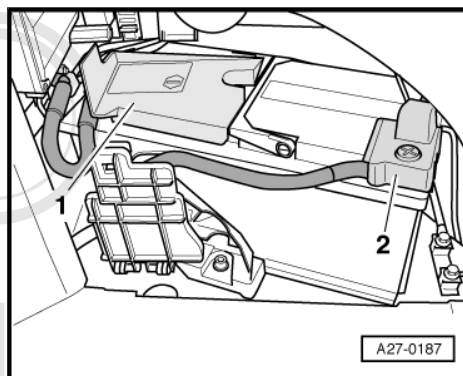
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- Remove cover -1- over battery.

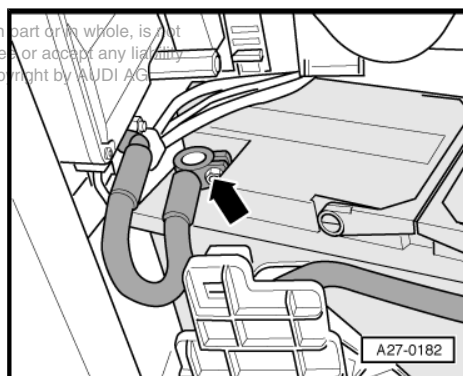

Note

Disregard -item 2-.

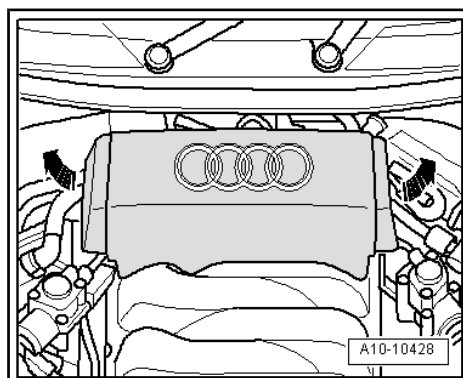


- With ignition switched off, disconnect battery earth cable -arrow-.

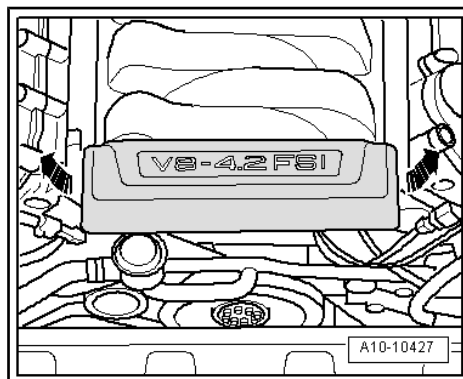
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- Pull off engine cover panel (rear) -arrows-.



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


WARNING

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

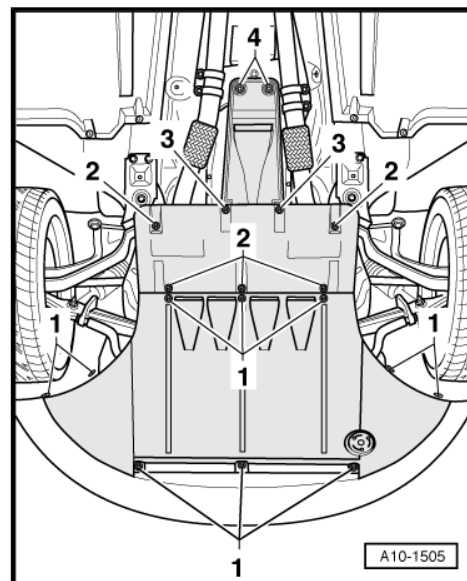
- ◆ *The cooling system is under pressure when the engine is hot.*
- ◆ *To allow pressure to dissipate, cover filler cap on expansion tank with cloth and open carefully.*

- Open filler cap on coolant expansion tank.
- Remove both front wheels.
- Remove front section of front left wheel housing liner ⇒ Rep. gr. 66 .
- Remove front and rear sections of front right wheel housing liner ⇒ Rep. gr. 66 .

- Release fasteners -1, 2, 4- to remove noise insulation panels.

**Note**

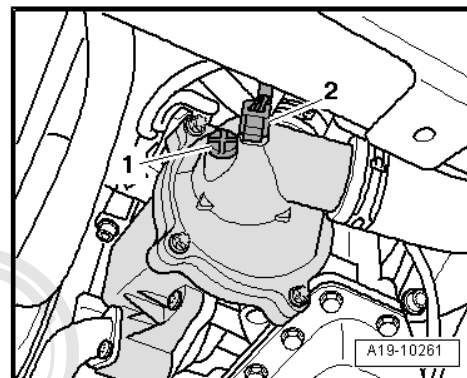
Disregard -item 3-.



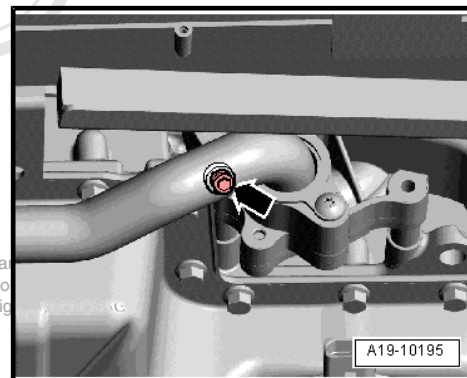
- Place drip tray for workshop hoist -VAS 6208- under engine.
- Remove drain plug -1- at map-controlled engine cooling system thermostat -F265- and drain off coolant.

**Note**

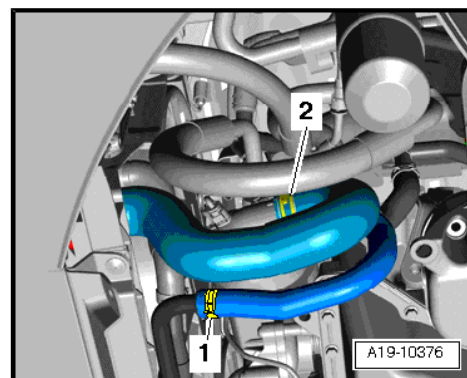
Disregard -item 2-.



- Remove drain plug -arrow- at front coolant pipe and drain off coolant.

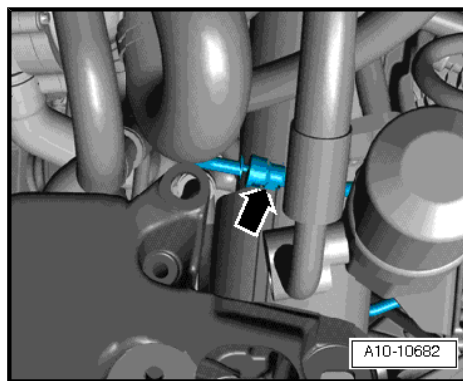


- Disconnect coolant hoses -1 and 2- and drain off coolant.



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- Disconnect vacuum line -arrow-.



Caution

Danger of damage to refrigerant lines and hoses.

- ◆ ***Do NOT stretch, kink or bend refrigerant lines and hoses.***

- Remove bolts -1 and 2-.
- Detach refrigerant lines from AC compressor.



Note

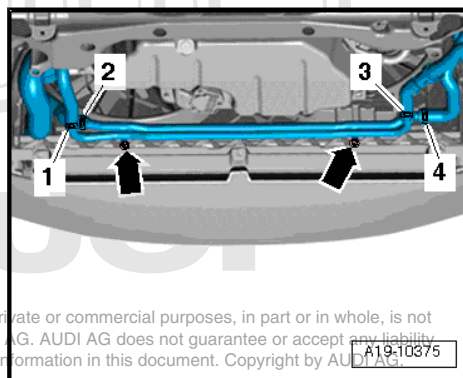
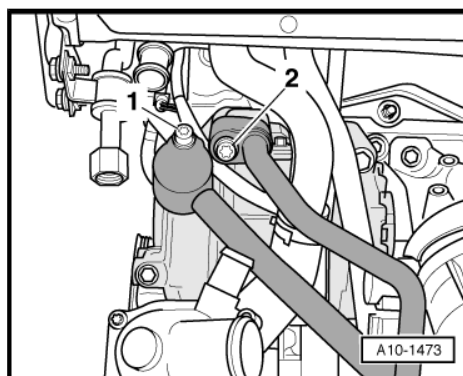
Seal off open pipes/lines and connections with clean plugs or protective caps to prevent dirt and moisture from entering.

- Remove bolts -arrows-.
- Disconnect coolant pipes going to ATF cooler from coolant hoses -2, 3, 4-.



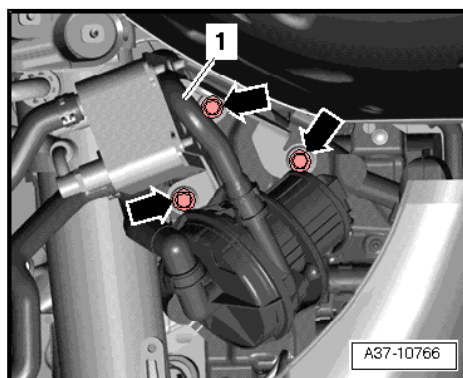
Note

Disregard -item 1-.

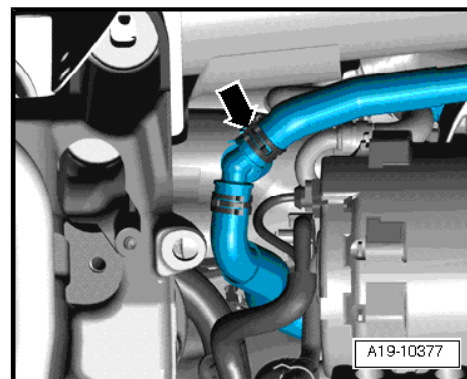


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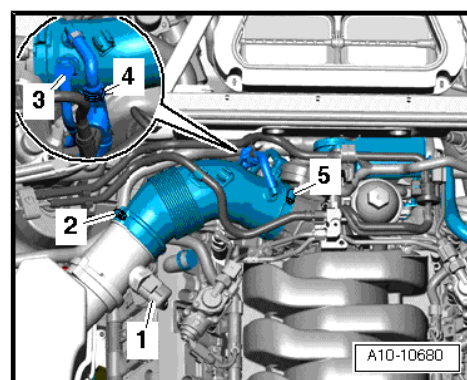
- Move clear air hose -1- for secondary air system at bracket for ATF cooler.
- Remove bolts -arrows-.
- Detach ATF cooler and tie up on engine cross member.



- Place drip tray for workshop hoist -VAS 6208- under engine.
- Disconnect coolant hose (right-side) -arrow- and drain off coolant.



- Move clear fuel line and line going to activated charcoal filter at air pipe.
- Unplug electrical connector -1- at air mass meter -G70- .
- Detach vacuum line -4- leading to air intake hose from suction-jet pump.



Rest-of-world vehicles:

- Disconnect hose -3- for crankcase breather system from air hose by pressing release tabs.
- Release hose clips -2 and 5- and remove air hose.

USA models:

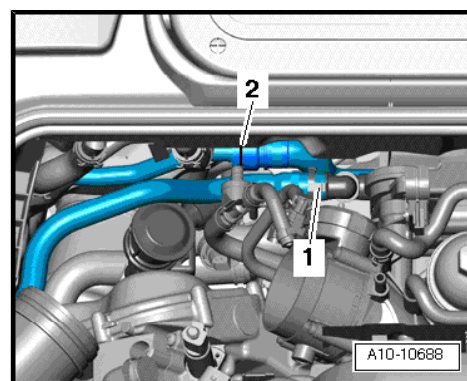


Caution

Risk of violating emission legislation applying to USA models.

- ◆ **Do NOT open hose connection -3-.**

- Release hose clips -2 and 5- and move air hose clear to one side (crankcase breather hose -3- remains connected).
- Detach air hose -1- for secondary air system.
- Detach coolant hose -2-, to do so, pull out clip slightly.



- Unscrew nuts -arrows- and detach bracket for electrical connectors from bulkhead.


Note

Disregard items marked -1 ... 4-.

- Unplug vacuum hose -1-.
- Detach coolant hose -2- from coolant pipe (right-side).
- Remove bolt -3- for torque reaction support.

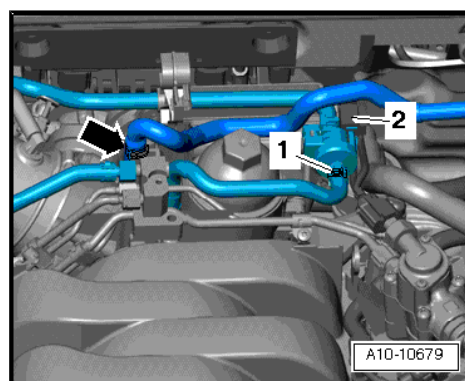
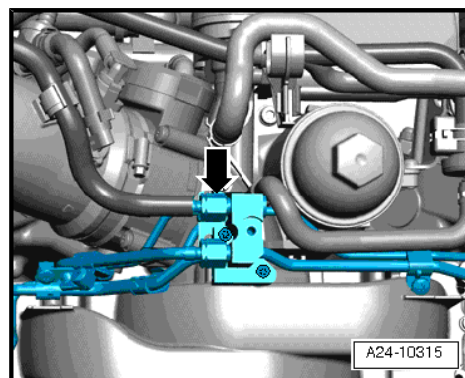
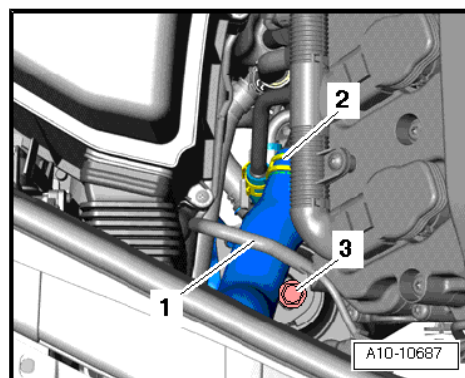
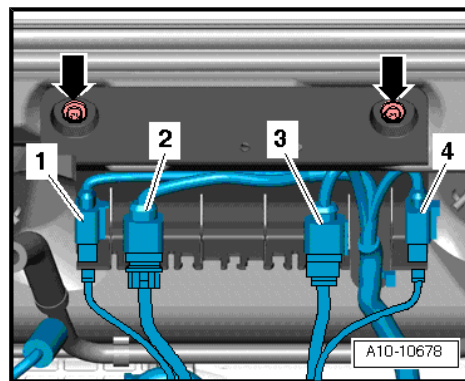
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WARNING

Risk of injury caused by fuel.

- ◆ *To allow the fuel pressure to dissipate, wrap a clean cloth around the connection and carefully loosen the connection before opening the fuel system.*

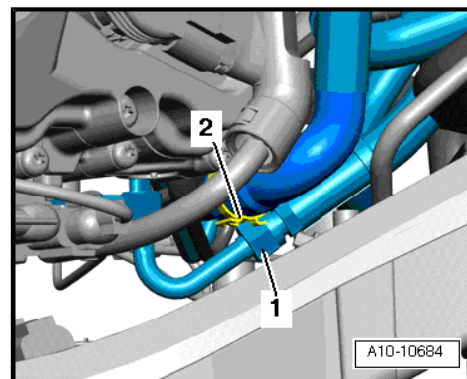
- Disconnect fuel supply line -arrow- at connecting piece.
- Unplug electrical connector -2- at activated charcoal filter solenoid valve 1 -N80- and detach vacuum hose -1-.
- Detach activated charcoal filter solenoid valve 1 -N80- from bracket and move it clear to the side with hose still attached.
- Detach coolant hose -arrow- and move clear to one side.



**Note**

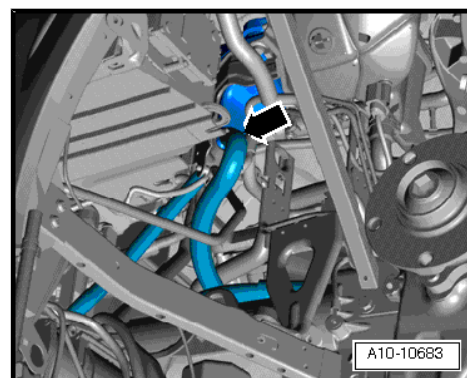
Lay a cloth under the separating point to catch escaping hydraulic fluid.

- Detach hydraulic pressure line -1- for power steering.
- Detach coolant hose -2- from coolant pipe (bottom left).

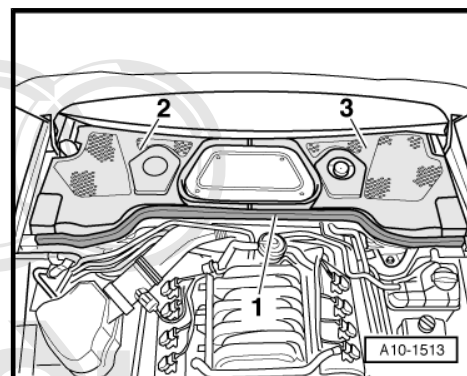
**Note**

Lay a cloth under the separating point to catch escaping hydraulic fluid.

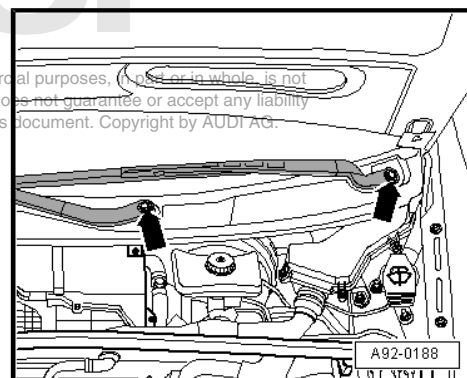
- Disconnect hydraulic hose -arrow- at bottom of hydraulic fluid reservoir.



- Pull off rubber seal -1- and remove plenum chamber covers -2 and 3-.

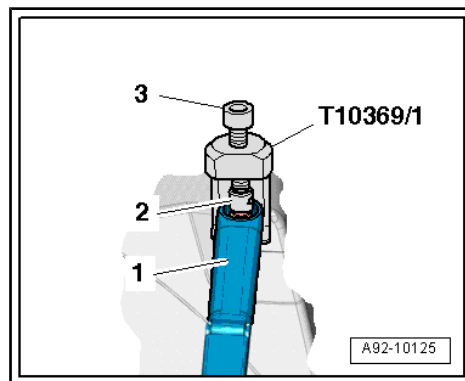


- Lever off caps on windscreen wiper arms with a screwdriver.
- Loosen nuts -arrows- several turns.



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- Apply puller -T10369/1- to wiper arm -1-, as shown in illustration.
- Apply thrust piece -2- onto wiper shaft.
- Turn bolt -3- in clockwise direction until wiper arm is pulled off wiper shaft.
- Remove nuts completely and take off wiper arms.



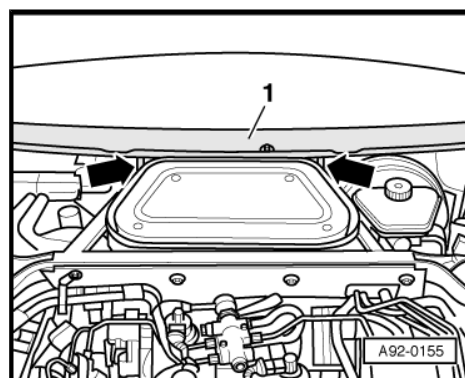
- Remove dust/pollen filter; to do so, open the four quick-release fasteners.



Note

Cover air duct at air conditioner housing with clean cloth to prevent anything falling in.

- Remove bolts -arrows- for cowl panel trim -1- on both sides.

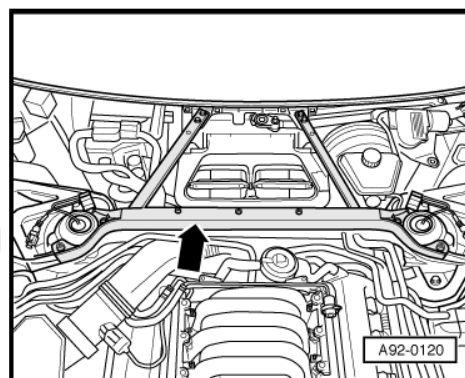


Caution

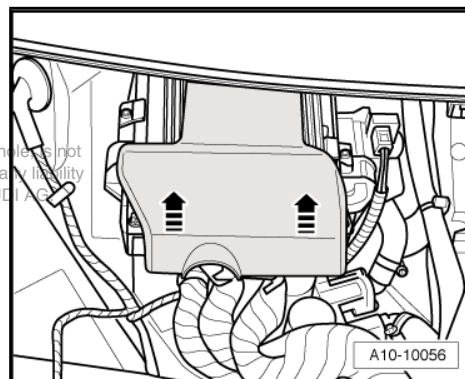
Risk of damage to cowl panel trim.

- ◆ Apply a small quantity of soap solution to transition between windscreen and cowl panel trim -1-. Then, starting at edge of windscreen, carefully pull cowl panel trim vertically upwards off retainer at windscreen.

- Carefully pull cowl panel trim off retainer at windscreen.
- Unscrew body brace -arrow-.



- Detach cover above engine control unit -arrows-.

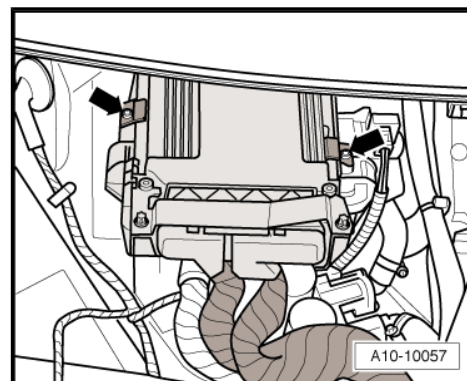


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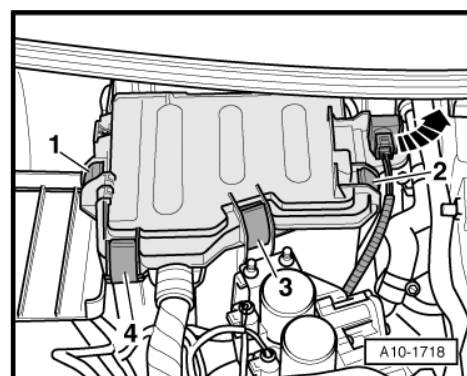
- Remove bolts -arrows-.
- Detach retainers and engine control unit from electronics box (plenum chamber).

**Note**

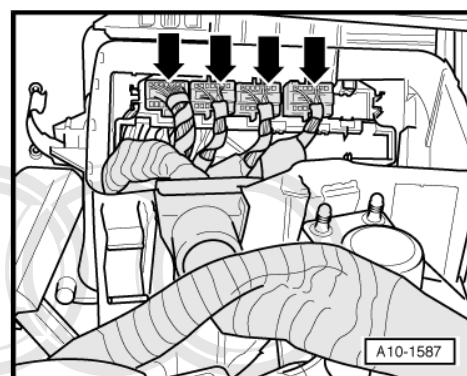
The electrical wires remain connected.



- Turn air quality sensor -G238- approx. 90° anti-clockwise -arrow- and then remove from bracket.
- Release retaining clips -1 ... 4-.
- Open electronics box (plenum chamber) cover slightly and pull off to front.



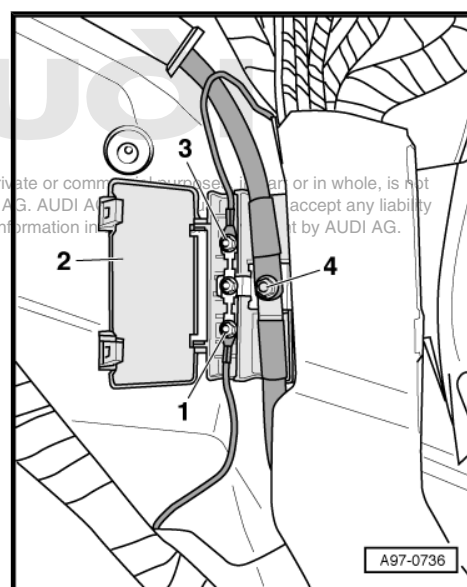
- Disconnect the electrical multi-pin connectors -arrows- using spark plug connector pliers -V.A.G 1922-.
- Detach wiring harness at electronics box and at bulkhead.
- Place engine control unit with wiring harness attached on top of engine.
- Secure the engine control unit to prevent it falling.



- Remove A-pillar trim (bottom right) ⇒ Rep. gr. 70.
- Fold back floor carpet.
- Unbolt protective cover above main fuse holder.
- Fold cover -2- to side.
- Remove nut -4-.
- Detach terminal 30 wire to starter.

**Note**

Disregard -items 1 and 3-.



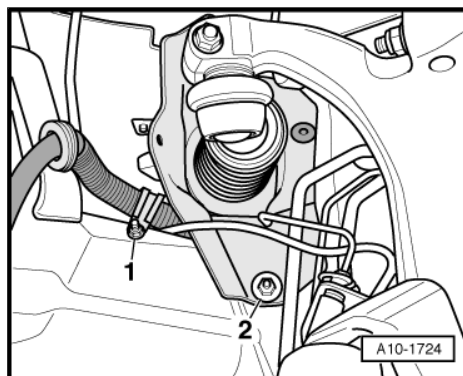
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- Unscrew clamp -1-.

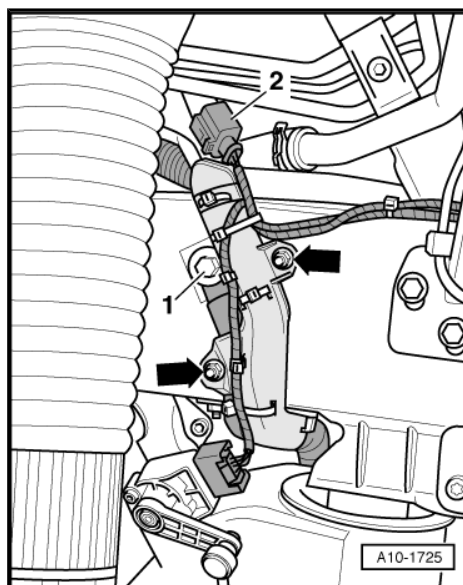


Note

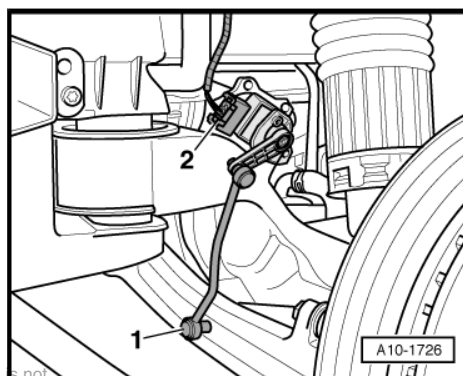
Disregard -item 2-.



- Unplug electrical connector -2-.
- Unbolt earth cable -1- at longitudinal member.
- Unbolt bracket for wiring harness from longitudinal member -arrows-.
- Move electrical wiring harness clear.



- Unplug electrical connector -2- at vehicle level sender.
- Detach coupling rod -1- at track control link.
- Repeat procedure on other side of vehicle.



- Have a second mechanic press the brake pedal.

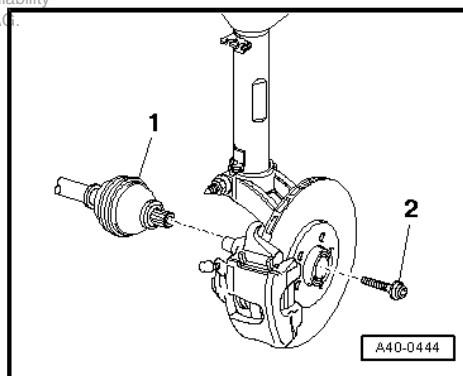


Caution

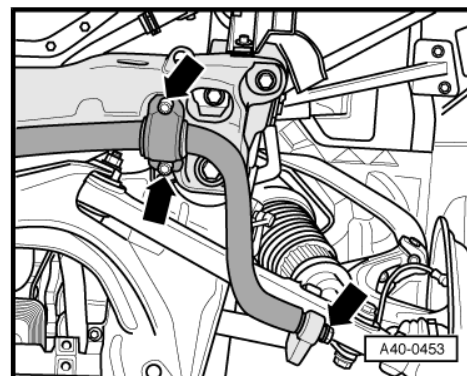
Danger of damage to wheel bearing.

- ◆ **When slackening the flange bolt securing the drive shaft, the 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.



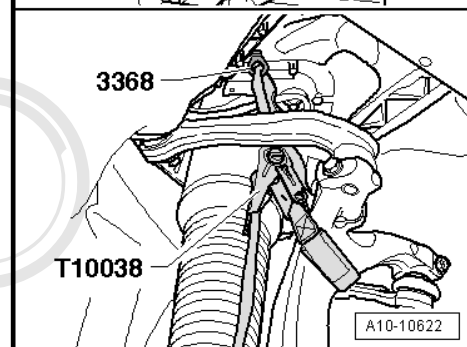
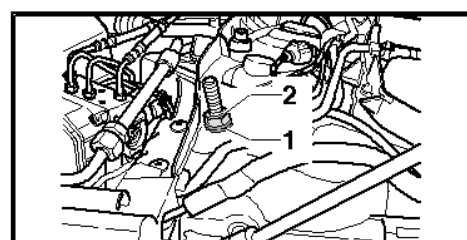
- Fit eye-head bolt -3368- from below in bore on suspension turret on both sides.
- Secure eye-head bolts -3368- with nut -2- and washer -1- (screw down nut several turns but not all the way down).

**Caution**

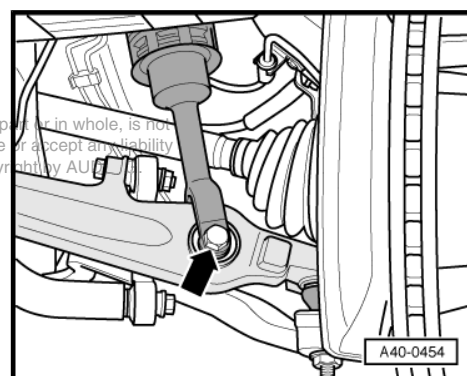
Danger of damage to the swivel joints of the upper links.

◆ *Support wheel bearing housing.*

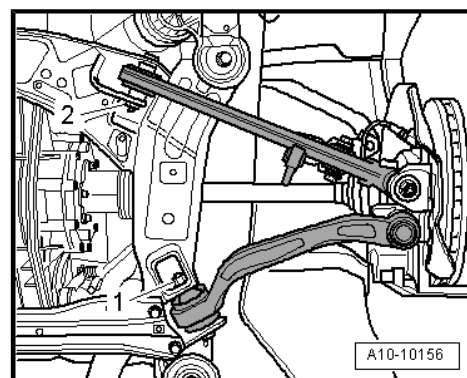
- Tie up wheel bearing housing on both sides using tensioning strap -T10038- as illustrated.



- Unbolt air spring strut from track control link -arrow-.



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



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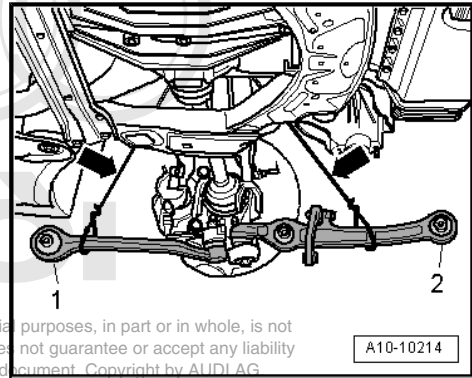
- Pivot guide link -1- and track control link -2- outwards.



Caution

Danger of damage to swivel joints of guide link and track control link.

- ◆ ***Tie up guide link and track control link to wheel bearing housing -arrows-.***



- Unbolt drive shaft from flange shaft on gearbox.

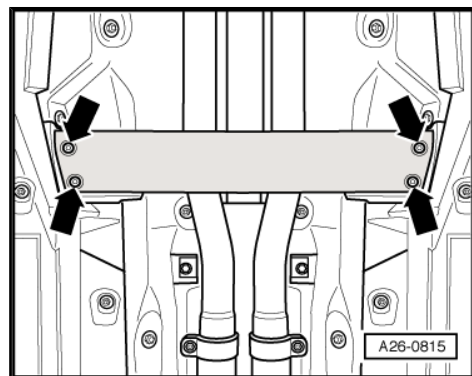


Caution

Danger of damage to brake hose.

- ◆ ***Carefully pivot wheel bearing housing outwards.***

- Remove drive shaft.
- Repeat procedure on other side of vehicle.
- Unbolt cross piece (front) -arrows-.

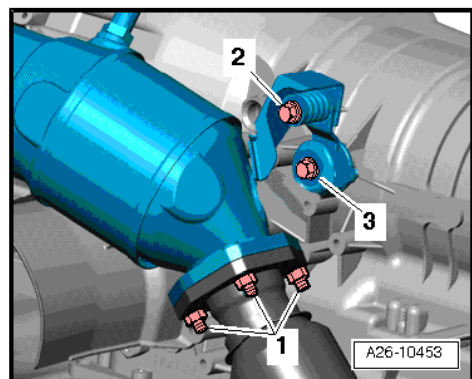


- Unscrew nuts -1- for front silencer (left-side).



Note

Disregard -items 2 and 3-.



- Unscrew nuts -1- for front silencer (right-side).



Note

Disregard -item 2-.



Caution

Risk of damage to flexible joints in front exhaust pipe.

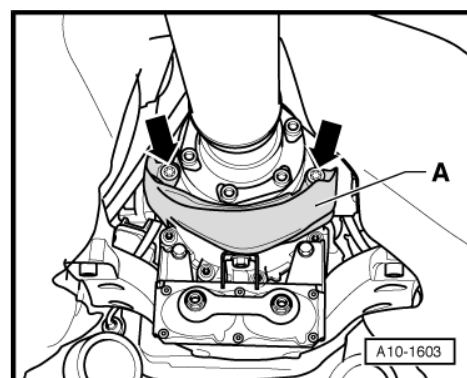
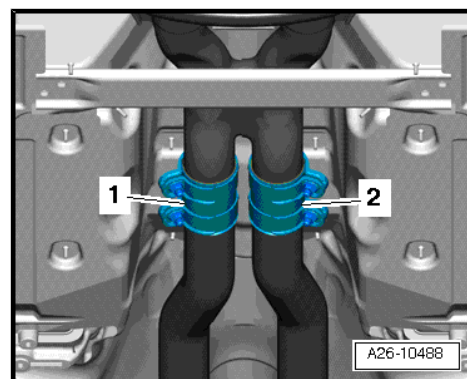
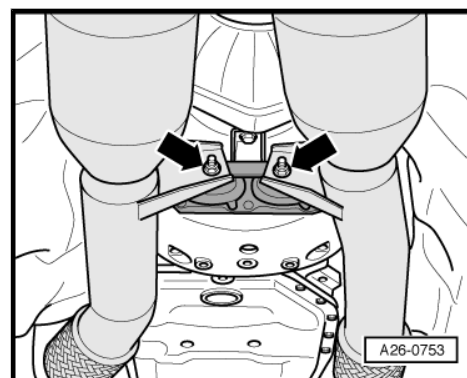
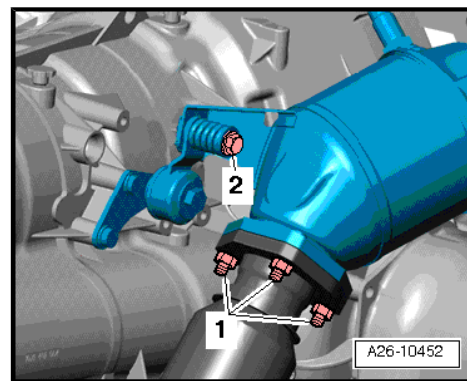
- ◆ *Do NOT bend flexible joints in front exhaust pipe more than 10°.*

- Unscrew nuts -arrows- on mounting brackets for front silencers.

- Disconnect exhaust system at clamps -1 and 2- and detach front silencers.

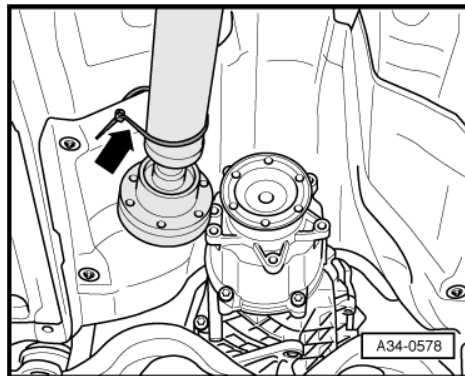
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- If fitted, unscrew heat shield -A- for propshaft -arrows-.
- Unscrew bolts securing propshaft to gearbox.
- Slide rear propshaft together towards rear final drive; the constant velocity joints can be moved axially.

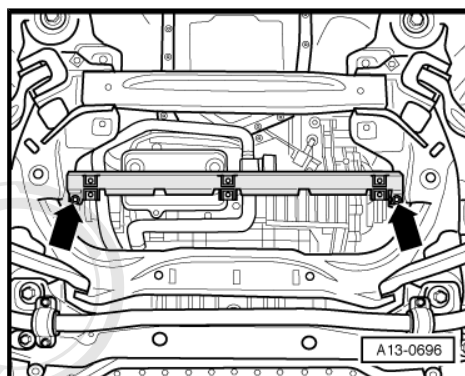




- Tie propshaft up to side of heat shield -arrow-.



- Unbolt bracket for noise insulation -arrows-.

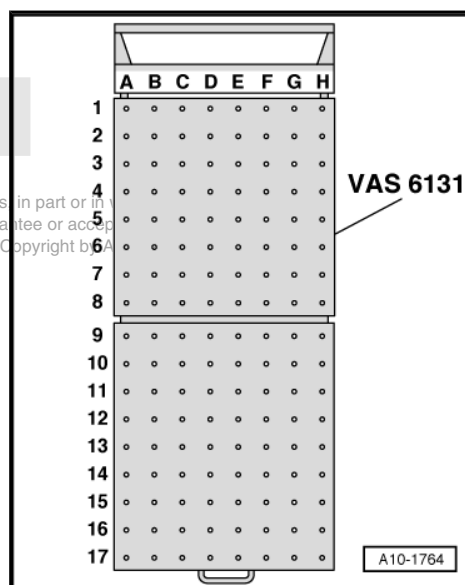


Set up the scissor-type assembly platform as follows:

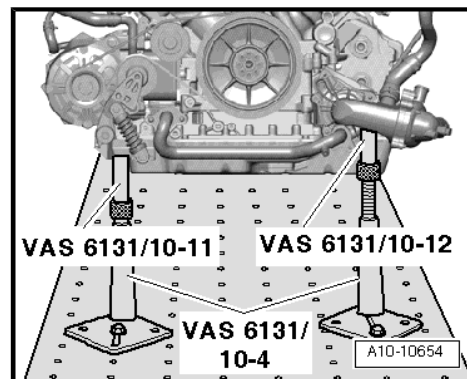
- Set up scissor-type assembly platform -VAS 6131 A- with support set for Audi -VAS 6131/10-, support set -VAS 6131/11- and supplementary set -VAS 6131/12- as follows:

Platform coordinates	Parts of support set for Audi -VAS 6131/10-, support set -VAS 6131/11- and supplementary set -VAS 6131/12-			
B3	/10-1	/10-4	/10-5	/10-12
G3	/10-1	/10-4	/10-5	/10-11
B10	/10-1	/10-2	/10-5	/12-1
G10	/10-1	/10-2	/10-5	/11-3
C14	/10-1	/10-3	/10-5	/10-12
F14	/10-1	/10-3	/10-5	/10-12

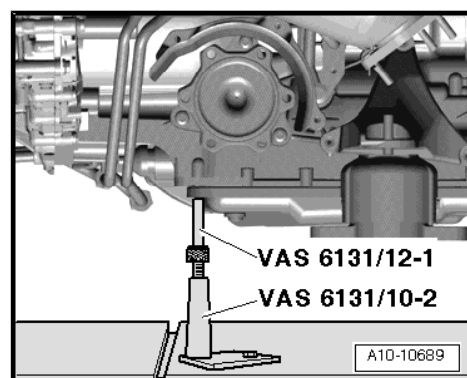
- Initially tighten the support elements on the assembly platform only hand-tight.
- Adjust the scissor-type assembly platform -VAS 6131 A- so that it is horizontal.
 - Take note of spirit level (bubble gauge).
- Place scissor-type assembly platform -VAS 6131 A- under engine/gearbox assembly.



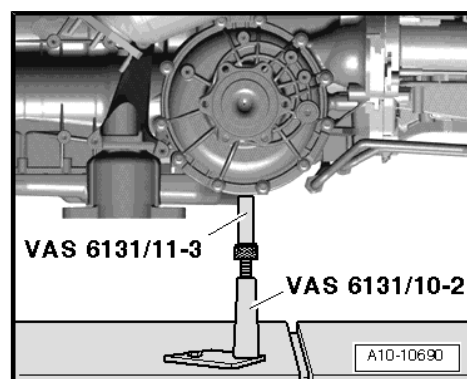
- Position support elements from -VAS 6131/10- at front of engine, as shown in illustration.
- Make sure that threaded spindle (right) at front of engine is screwed in completely.



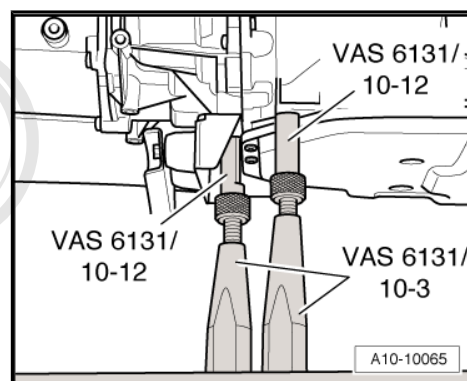
- Position support elements from -VAS 6131/12- at left side of gearbox, as shown in illustration.



- Position support elements from -VAS 6131/11- at right side of gearbox, as shown in illustration.

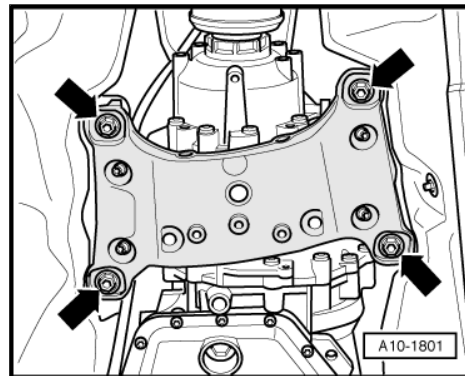


- Position support elements from -VAS 6131/10- at rear of gearbox, as shown in illustration.
- Turn all spindles for the support elements upwards until all locating lugs make contact with the mounting points.
- Tighten base plates for support elements to 20 Nm on scissor-type assembly platform -VAS 6131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

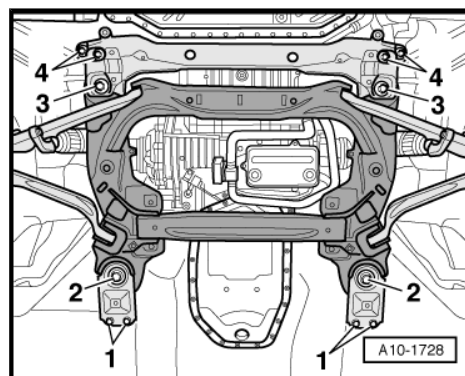


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- Remove bolts -arrows- at tunnel cross member.



- Mark the installation position of subframe with a felt-tip pen on longitudinal member.
- Remove bolts -1 and 4-.
- Unscrew bolts -2 and 3- in diagonal sequence and in stages.



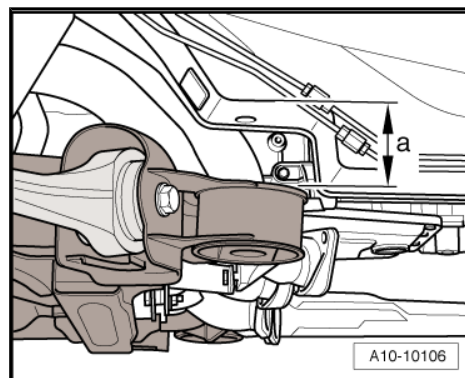
Caution

Danger of damage to hoses, pipes and wiring connections and to engine compartment.

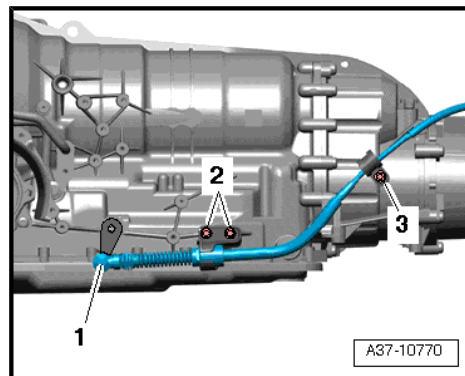
- ◆ Check that all connections between engine, gearbox, sub-frame and body have been detached.
- ◆ Carefully guide out engine/gearbox assembly with sub-frame from engine compartment when lowering.

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- Lower the engine/gearbox assembly using scissor-type assembly platform -VAS 6131 A- initially only as far as distance -a-.
- Dimension -a- = 120 mm (maximum).



- Mark installation position of support bracket for selector lever cable with felt-tip pen for re-installation.
- Pry ball socket -1- of selector lever cable off selector shaft lever using removal lever -80 - 200- .
- Unscrew bolts -2 ... 3- and detach selector lever cable from gearbox.
- Lower engine/gearbox assembly.
- Pull out scissor-type assembly platform -VAS 6131 A- with engine/gearbox assembly from beneath vehicle.



2 Separating engine and gearbox

Special tools and workshop equipment required

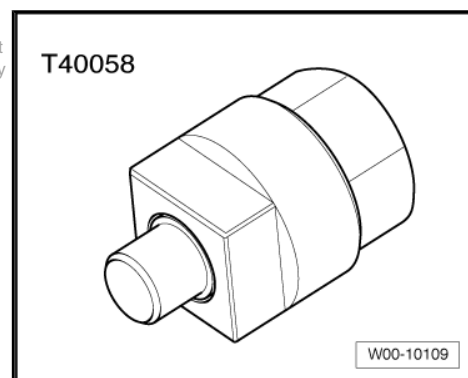
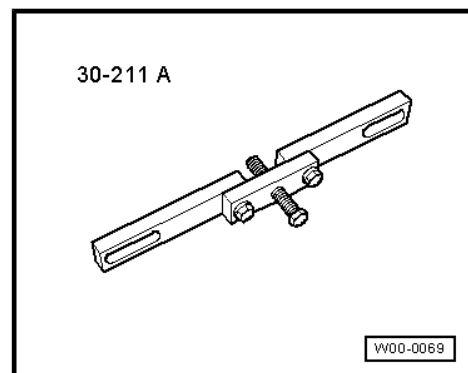
- ◆ Support bridge -30 - 211 A-



- ◆ Adapter -VAS 6131/12-1- (2x)

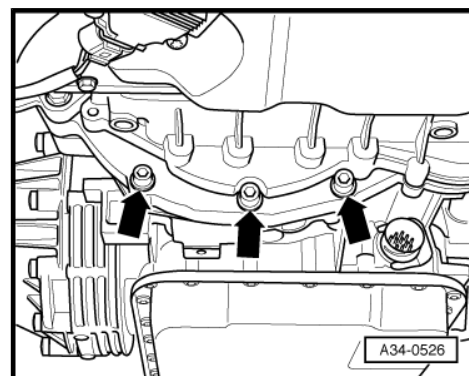
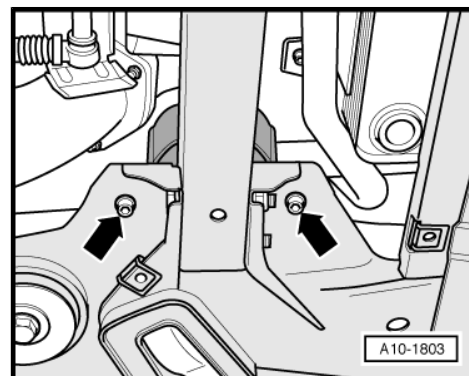
- ◆ Adapter -T40058-

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Procedure

- Engine/gearbox assembly removed and secured to scissor-type assembly platform -VAS 6131 A- .
- Remove bolts (left and right) -arrows- for front gearbox mounting and place subframe down on scissor-type assembly platform.
- Unscrew bottom bolts -arrows- securing engine to gearbox.

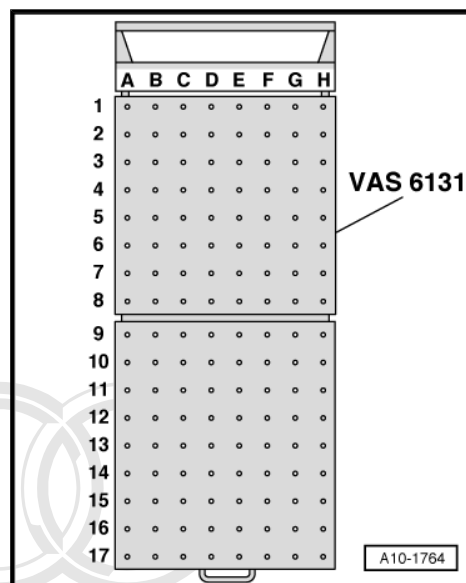




- Set up scissor-type assembly platform -VAS 6131 A- with support set for Audi -VAS 6131/10- and support set -VAS 6131/12- as follows:

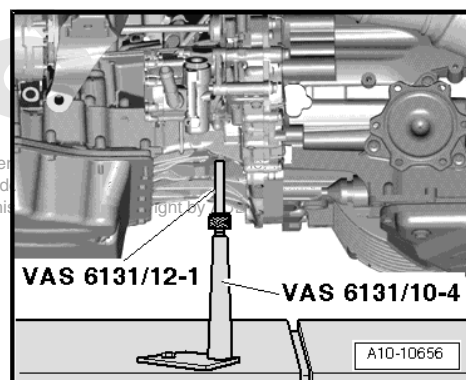
Platform coordinates	Parts of support set for Audi -VAS 6131/10-, support set -VAS 6131/11- and supplementary set -VAS 6131/12-			
B3 ¹⁾	/10-1	/10-4	/10-5	/10-12
G3 ¹⁾	/10-1	/10-4	/10-5	/10-11
C6	/10-1	/10-4	/10-5	/12-1
F6	/10-1	/10-4	/10-5	/12-1
B10 ¹⁾	/10-1	/10-2	/10-5	/12-1
G10 ¹⁾	/10-1	/10-2	/10-5	/11-3
C14 ¹⁾	/10-1	/10-3	/10-5	/10-12
F14 ¹⁾	/10-1	/10-3	/10-5	/10-12

- ¹⁾ Support elements remain unchanged.

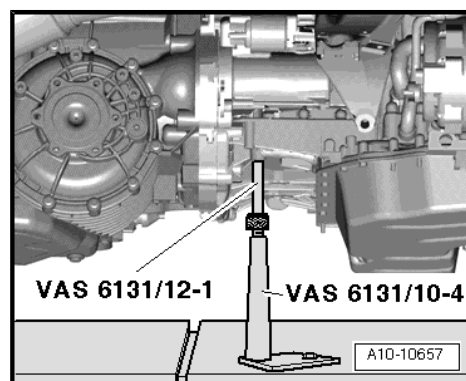


- Position support elements from -VAS 6131/10- and -VAS 6131/12- at left side of engine, as shown in illustration.

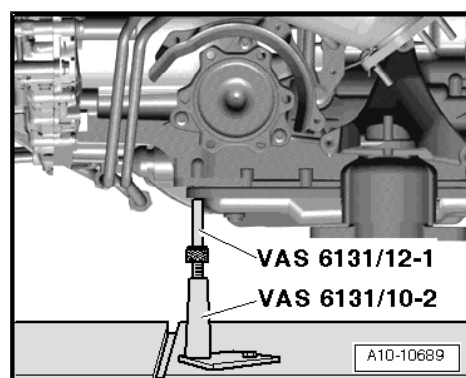
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- Position support elements from -VAS 6131/10- and -VAS 6131/12- at right side of engine, as shown in illustration.
- Turn spindles for the support elements upwards until all locating lugs make contact with the mounting points.
- Tighten base plates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



- Screw spindle for support element at left side of gearbox downwards as far as possible.
- Unscrew base plate for support element (left-side) from scissor-type assembly platform -VAS 6131 A-.

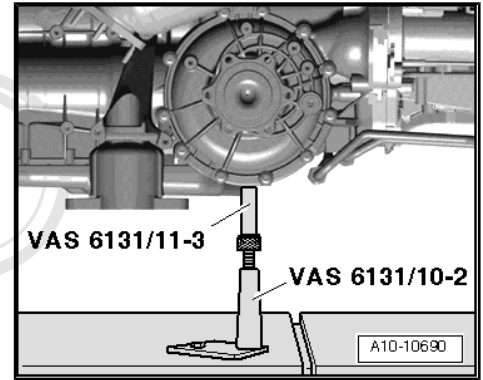


- Screw spindle for support element at right side of gearbox downwards as far as possible.
- Unscrew base plate for support element (right-side) from scissor-type assembly platform -VAS 6131 A-.
- Remove subframe to the side.

**WARNING**

Accident risk from missing support.

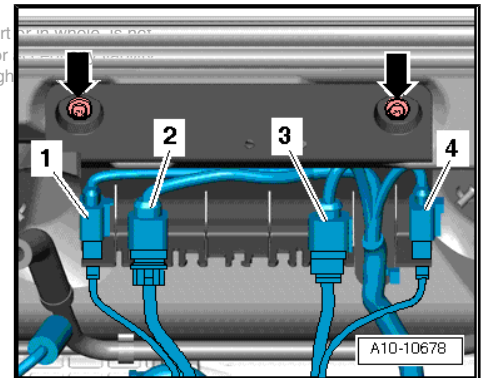
- ◆ *If the subframe has been removed, set up the front gearbox support elements back in their original position.*



- Detach electrical connectors from bracket and unplug connectors:
- 3 - For Lambda probe 2 -G108-
 4 - For Lambda probe 2 -G131- (after catalytic converter)
- Move electrical wiring to Lambda probes clear.

**Note**

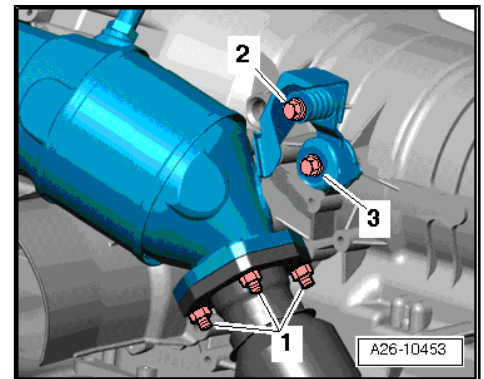
- ◆ *Illustration shows electrical connectors in their installation position.*
- ◆ *Disregard -items 1, 2 and arrows-.*



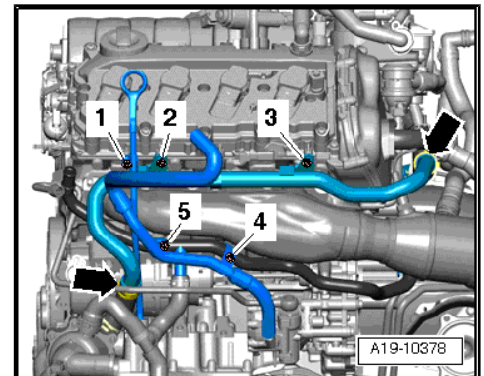
- Remove bolt -2- on bracket for catalytic converter (left-side).

**Note**

- ◆ *Disregard -items 1 and 3-.*



- Remove bolt -1- and lift out guide tube for oil dipstick.
- Unscrew bolts -4 and 5- and swivel hydraulic fluid pipe to one side.
- Unscrew bolts -2 and 3- and detach coolant pipe (left-side) from coolant hoses -arrows-.

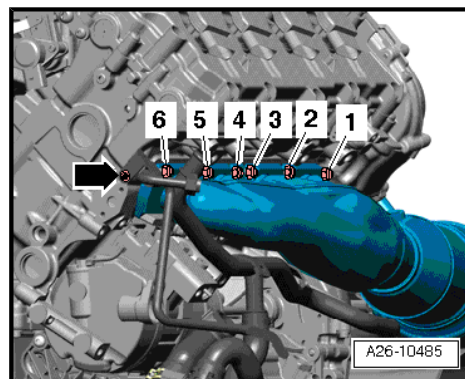




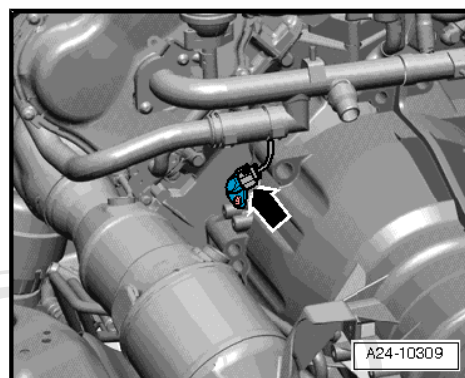
- Unscrew bolt -arrow- and pull pressure pipe for hydraulic fluid slightly towards front.
- Unscrew nuts -6 ... 1- and remove exhaust manifold (left-side) with catalytic converter.

**Note**

The two mounting strips (bottom) remain installed.



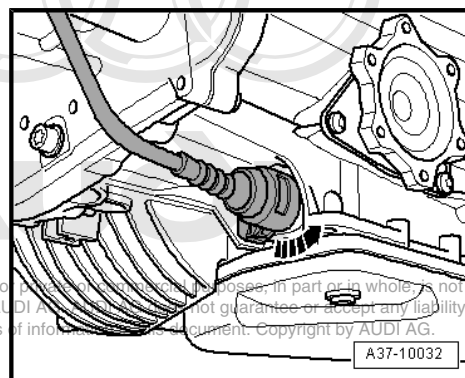
- Unplug electrical connector -arrow- at engine speed sender - G28- .

**Caution**

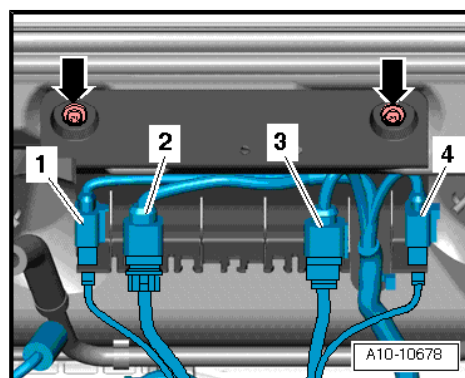
Risk of irreparable damage to gearbox control unit (mechanical unit) because of static discharge.

- ◆ **Do NOT touch connector contacts in gearbox connector with your hands.**

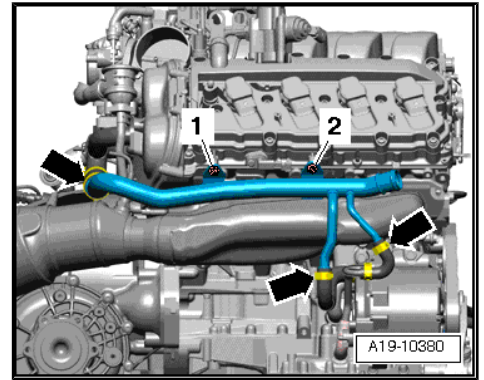
- Touch gearbox housing with your hand (without wearing gloves) to eliminate static charge.
- Turn retainer catch anti-clockwise -arrow- and unplug electrical connector at gearbox.
- Detach electrical connectors from bracket and unplug connectors:
 - 1 - For Lambda probe -G39-
 - 2 - For Lambda probe after catalytic converter -G130-
- Move electrical wiring to Lambda probes clear.

**Note**

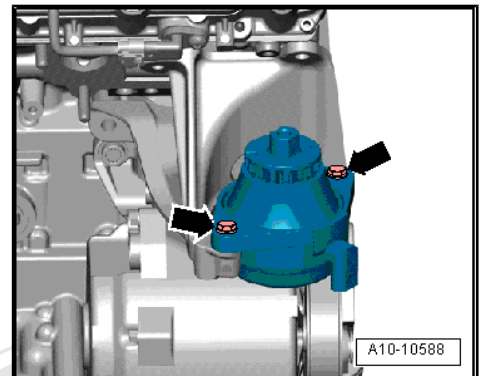
- ◆ *Illustration shows electrical connectors in their installation position.*
- ◆ *Disregard -items 3, 4 and arrows-.*



- Unscrew bolts -1 and 2- and detach coolant pipe (right-side) from coolant hoses -arrows-.



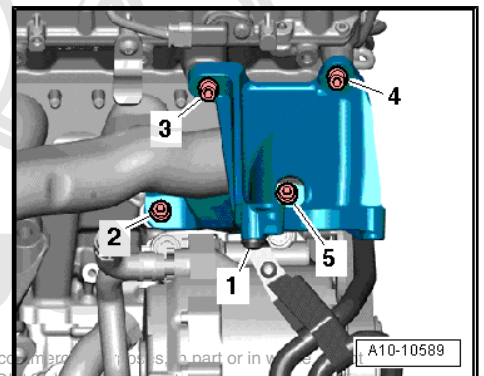
- Unscrew bolts -arrows- and remove mounting for torque reaction support.



- Unscrew bolts -2 ... 5- and remove torque reaction support.

i Note

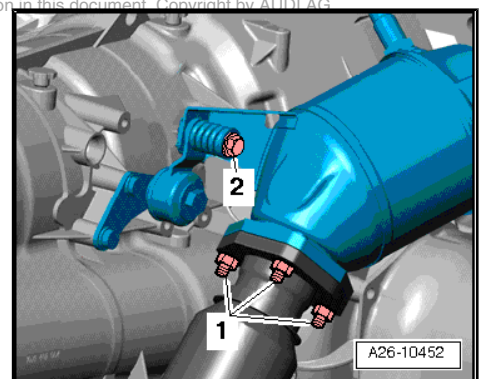
Disregard -item 1-.



- Remove bolt -2- on bracket for catalytic converter (right-side).

i Note

Disregard -item 1-.



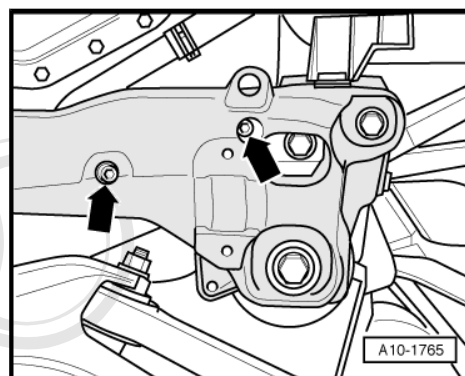
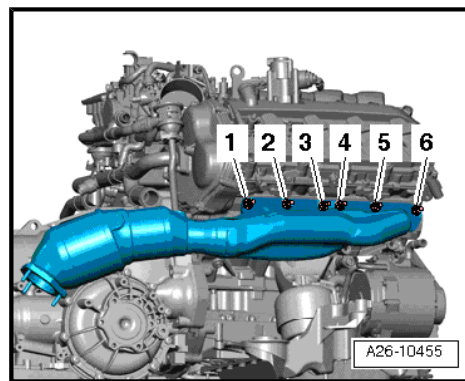
- Unscrew nuts -6 ... 1- and remove exhaust manifold with catalytic converter (right-side).


Note

The two mounting strips (bottom) remain installed.

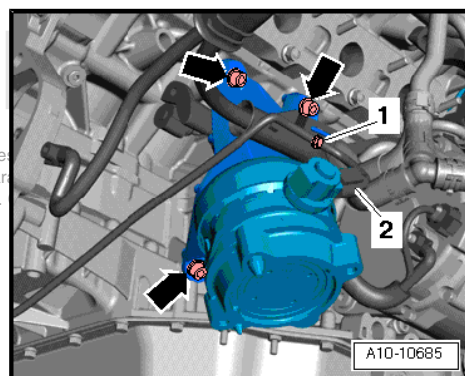
- Move clear ATF cooler at engine cross member and secure it to prevent it falling.

- Remove bolts for engine mountings -arrows- on both sides.
- Take out engine cross member.

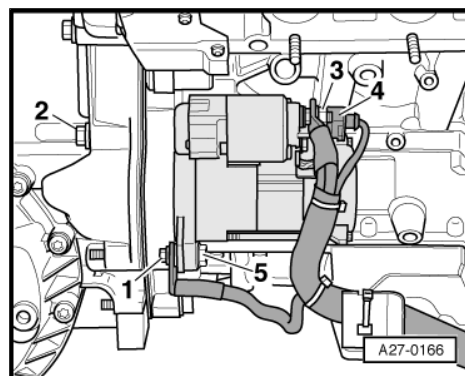


- Unplug electrical connector -2- at engine mounting (right-side).
- Unbolt bracket -1- for wiring from engine support (right-side).
- Remove bolts -arrows- and detach engine support with engine mounting.

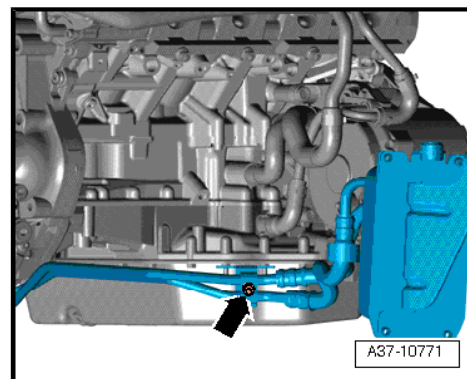
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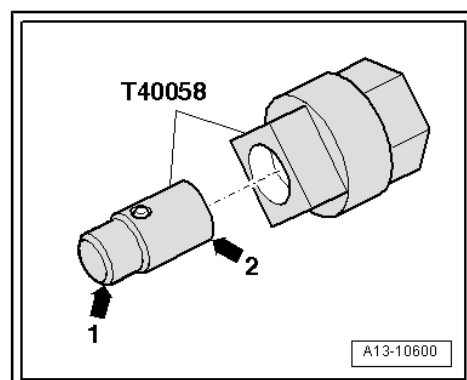
- Disconnect earth cable -1-.
- Detach electrical wiring -3 and 4- at starter.
- Remove bolts -2 and 5- and detach starter.



- Unscrew nut -arrow- and remove ATF lines from bracket.



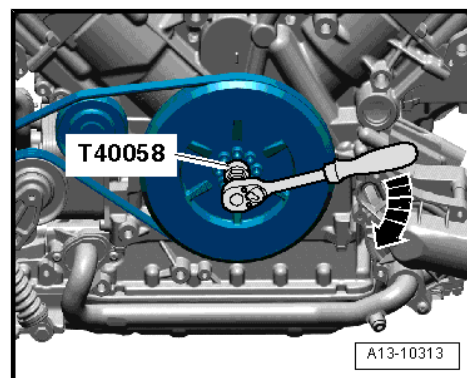
- Insert guide pin of adapter -T40058- as follows:
 - The smaller-diameter section -arrow 1- faces the engine.
 - The larger-diameter section -arrow 2- faces the adapter.



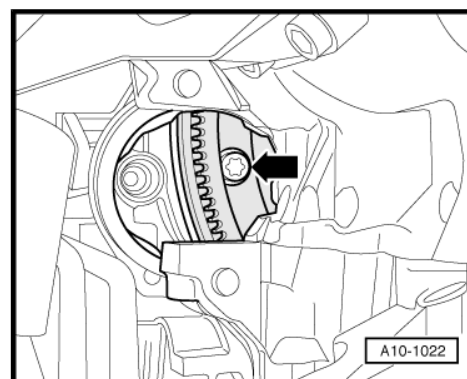
- When loosening torque converter bolts, counterhold crankshaft using adapter -T40058-.

**Note**

Disregard -arrow-.



- Unscrew 3 bolts -arrow- for torque converter, working through opening of removed starter (turn crankshaft $\frac{1}{3}$ turn in direction of engine rotation each time).



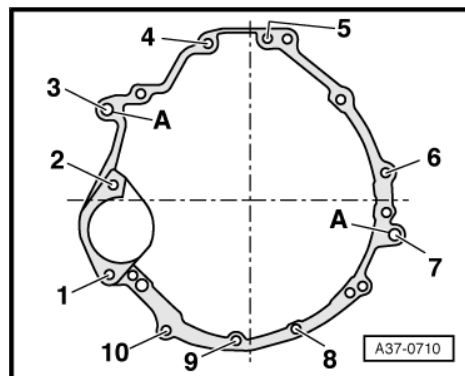
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- Unscrew bolts -3 ... 7- securing engine to gearbox.

**Note**

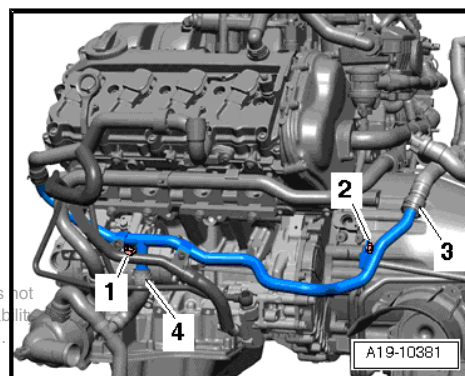
Disregard -item A-.



- Slacken bolt -1- and pivot coolant pipe (bottom left) upwards slightly.

**Note**

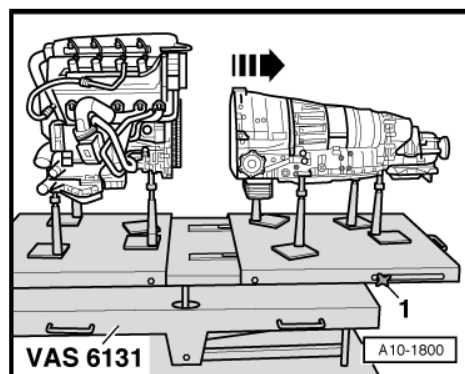
Disregard -items 2, 3, 4-.



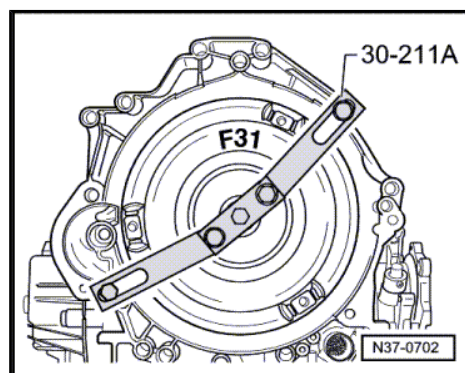
- Watch position of ATF cooler.

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- Loosen clamping bolts -1- on sides of scissor-type assembly platform -VAS 6131 A- and pull rear section of platform together with gearbox towards the rear -arrow-; simultaneously separate the torque converter from the drive plate working through the opening of removed starter.



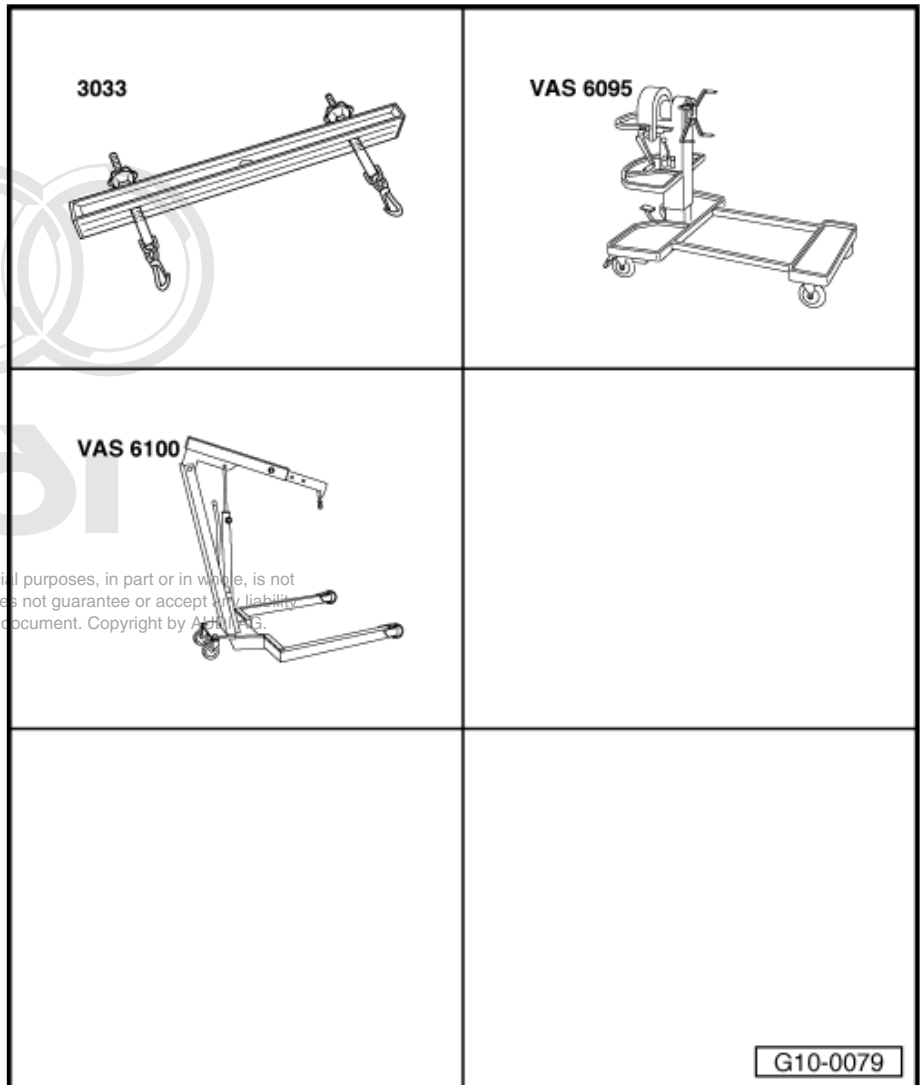
- Secure the torque converter in the gearbox using support bridge -30 - 211 A- to prevent it falling out.



3 Securing engine to engine and gearbox support

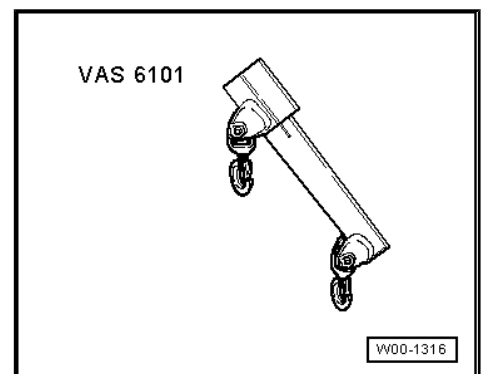
Special tools and workshop equipment required

- ◆ Lifting tackle -3033-
- ◆ Engine and gearbox support -VAS 6095- with bracket -VAS 6095/1-6A-
- ◆ Workshop hoist - VAS 6100-



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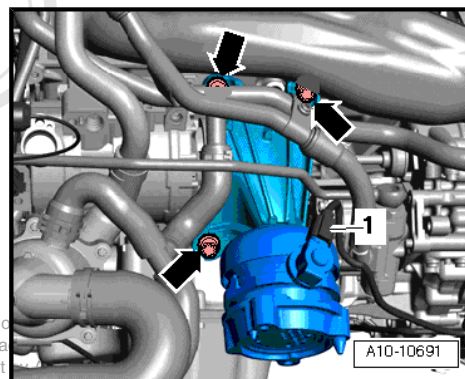
- ◆ Lift arm extension (workshop hoist) -VAS 6101-





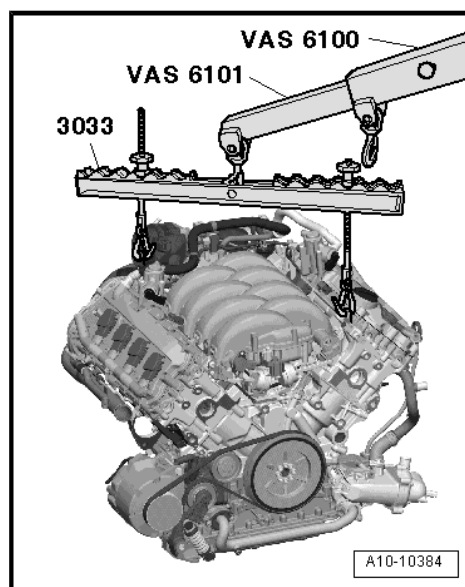
Procedure

- Unplug electrical connector -1- at engine mounting (left-side).
- Remove bolts -arrows- and detach engine support with engine mounting.

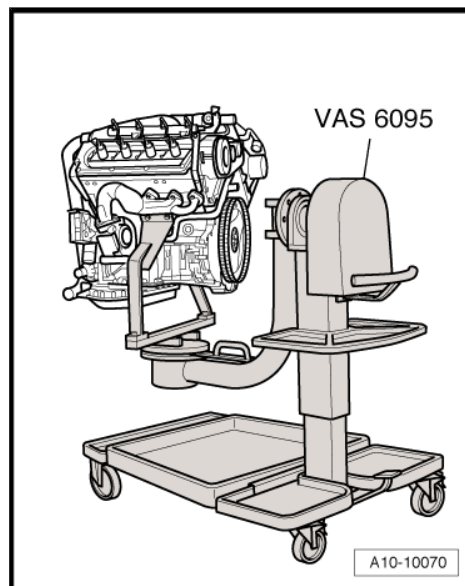


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- Attach the lifting tackle -3033- to engine lifting eyes and workshop hoist -VAS 6100- with lift arm extension (workshop hoist) -VAS 6101- as shown in the illustration.
- Lift engine off the support elements on scissor-type assembly platform -VAS 6131 A- .



- Using bracket -VAS 6095/1-6A- , secure engine to engine and gearbox support -VAS 6095- (tighten to 40 Nm) as shown in the illustration.



4 Installing engine

Tightening torques



Note

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

Tightening torques

- $\Rightarrow$ ["5.1 Assembly mountings - exploded view", page 42](#)
- $\Rightarrow$ ["3.1 Crankshaft - exploded view", page 62](#)

Component	Nm
Bolts/nuts	M6 9
	M8 20
	M10 40
	M12 65
Except for the following:	
Drive plate to torque converter	85 ¹⁾
High-pressure pipe	25
• ¹⁾ Renew bolts $\Rightarrow$ Electronic parts catalogue .	

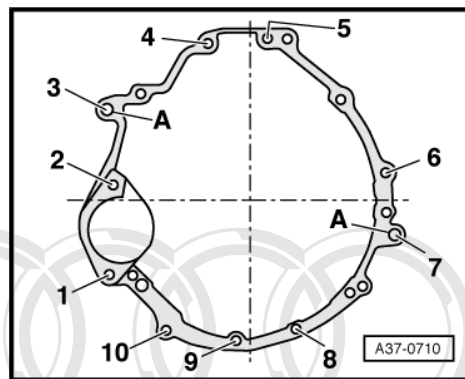
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Securing engine to gearbox

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

• ¹⁾ Property class 10.9.



Procedure

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



Note

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- ◆ *Renew the bolts tightened with specified tightening angle.*
- ◆ *Renew self-locking nuts and bolts as well as seals, gaskets and O-rings.*
- ◆ *Replace bolts for torque converter only with new bolts of the correct type (same as original equipment) ⇒ Electronic parts catalogue .*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- ◆ *Fit all cable ties in the original positions when installing.*
- Check whether dowel sleeves for centring the engine and the gearbox are fitted in the cylinder block; install missing dowel sleeves.

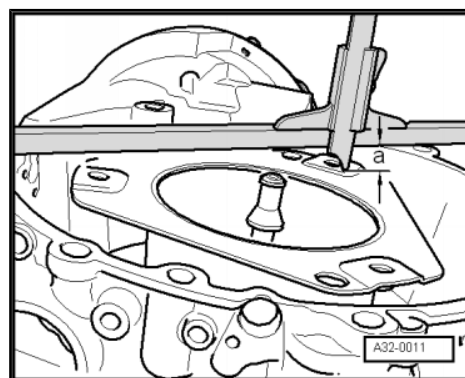


Caution

Risk of damage to drive lug of ATF pump if torque converter is installed incorrectly.

- ◆ *Check installation depth of torque converter.*

If the torque converter has been correctly installed, the distance -a- between the contact surfaces at the threaded holes in the torque converter and the joint surface on the torque converter bell-housing for automatic gearbox 09L is at least 19 mm.



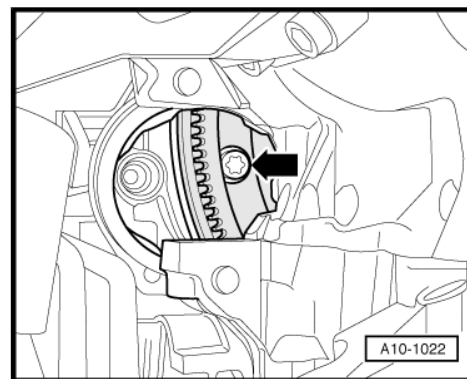
- Before bringing engine and gearbox together, turn torque converter and drive plate on engine so that the holes and the threaded holes are in line with the opening for the removed starter -arrow-.



Caution

Risk of damage to automatic gearbox.

- ◆ *Before and during tightening of bolts securing engine to gearbox, continually check that the torque converter behind the drive plate can be turned. If the torque converter cannot be turned, it must be assumed that it has not been installed correctly.*
- ◆ *Use only new bolts of the correct type (same as original equipment) to secure torque converter on drive plate.*



- Install ATF lines ⇒ Rep. gr. 37 .

- Before installing an exchange engine, check whether the flat-section O-ring -arrow- is fitted in the drive shaft of the power steering pump.

- **Install starter** ⇒ **Electrical system; Rep gr. 27**.

- Install engine supports ⇒ [page 42](#) .

- Install torque reaction support and mounting for torque reaction support ⇒ [page 42](#) .

- Install exhaust manifolds together with catalytic converters: left-side ⇒ [page 236](#) , right-side ⇒ [page 242](#) .

- Install coolant pipe (right-side) ⇒ [page 214](#) .

- Install coolant pipe (left-side) ⇒ [page 204](#) .

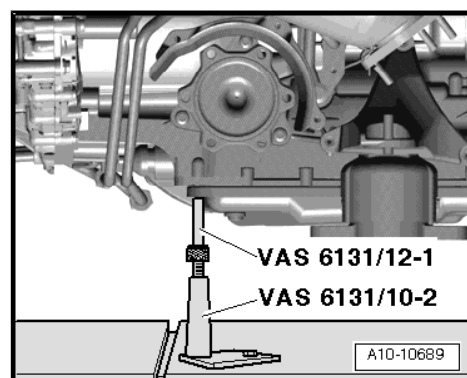
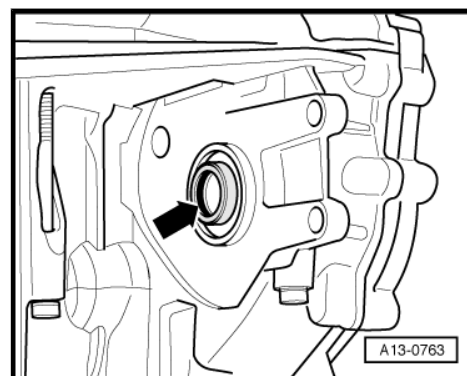
- Install coolant pipe (bottom left) ⇒ [page 207](#) .

- Insert guide tube for oil dipstick with new O-ring into hole in top section of sump.

- The threaded holes in the flange shaft for the propshaft on the gearbox must be cleaned of remaining locking fluid with a thread tap before assembling.

- Screw spindle for support element at front left side of gearbox downwards.

- Unscrew base plate for support element (left-side) from scissor-type assembly platform -VAS 6131 A- .





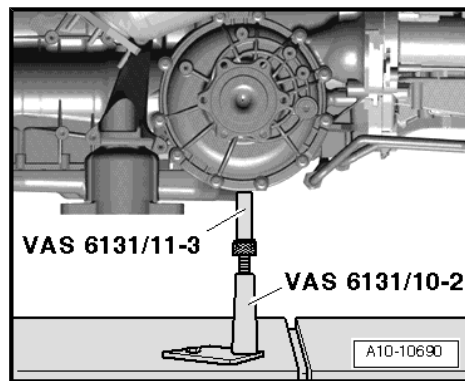
- Screw spindle for support element at front right side of gearbox downwards.
- Unscrew base plate for support element (right-side) from scissor-type assembly platform -VAS 6131 A- .
- Place subframe onto scissor-type assembly platform - VAS 6131 A- .



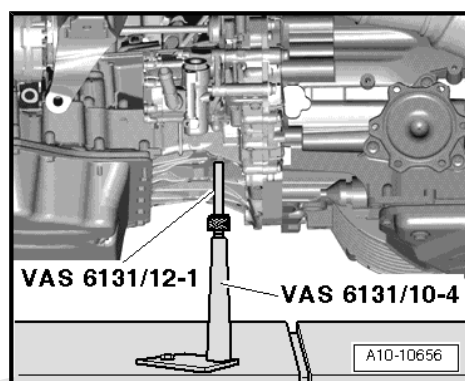
WARNING

Accident risk from missing support.

- ◆ *After placing down the subframe, set up the front gearbox support elements back in their original position.*



- Re-position the front gearbox support elements.
- Screw spindle for support element at rear left of engine downwards.
- Unscrew base plate for support element (left-side) from scissor-type assembly platform -VAS 6131 A- .

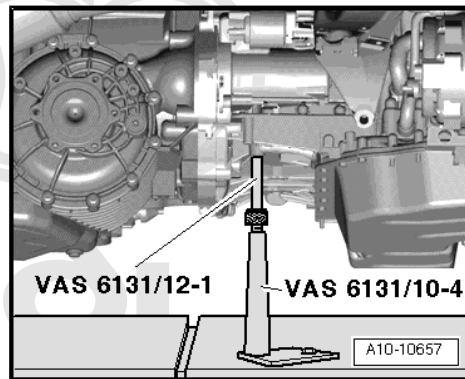


- Screw spindle for support element at rear right of engine downwards.
- Unscrew base plate for support element (right-side) from scissor-type assembly platform -VAS 6131 A- .

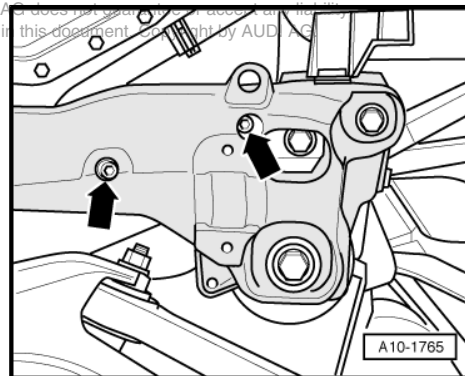


Note

The mounting points for engine (front) and gearbox remain unchanged.

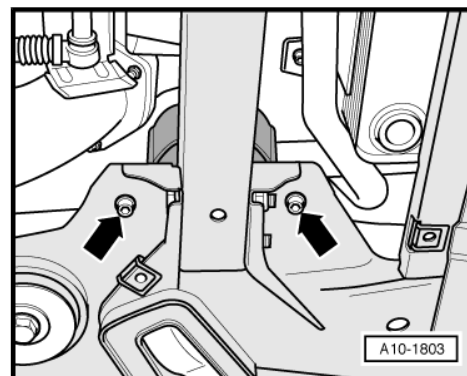


- Install engine cross member -arrows-

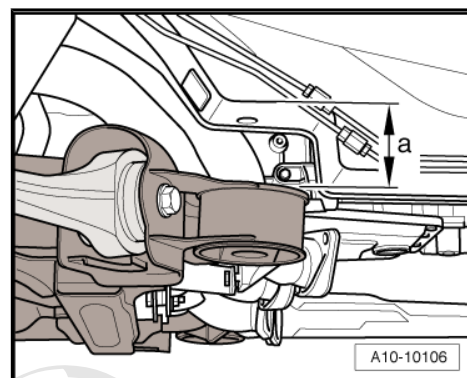


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- Position subframe on engine cross member and tighten gear-box mountings (left and right) -arrows- ⇒ Rep. gr. 37 .



- Guide engine/gearbox assembly together with subframe and engine cross member into the body from below using scissor-type assembly platform -VAS 6131 A- .
- Raise the engine/gearbox assembly using scissor-type assembly platform -VAS 6131 A- until the distance -a- is reached.
- Dimension -a- = min. 120 mm.
- Install selector lever cable and check adjustment ⇒ Rep. gr. 37 .
- Raise the engine/gearbox assembly further using scissor-type assembly platform -VAS 6131 A- .

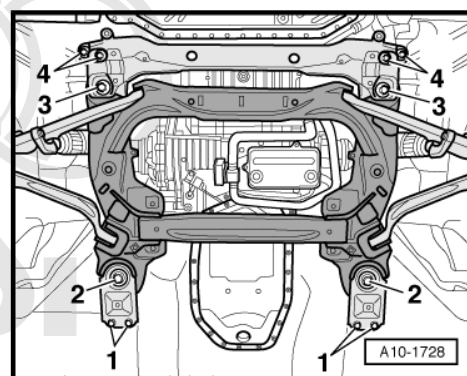


- Adjust the subframe according to the markings previously made on the longitudinal members.
- Tighten bolts for subframe only to the specified torque (do not turn further); tighten bolts to final setting only after performing wheel alignment check ⇒ Rep. gr. 40 .

**WARNING**

Risk of accident because of loose bolt connections.

- ◆ **Do NOT drive the vehicle unless the subframe bolts have been finally tightened.**



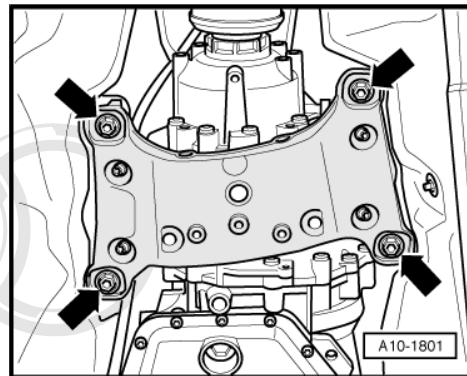
- Tighten bolts -4- for engine cross member ⇒ [page 42](#) .

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- Tighten bolts -arrows- at tunnel cross member ⇒ Rep. gr. 37 .

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

- Install propshaft ⇒ Rear final drive 01R; Rep. gr. 39 .
- Install front silencers: left-side ⇒ [page 229](#) , right-side ⇒ [page 231](#) .
- Align exhaust system so it is free of stress ⇒ [page 232](#) .
- Install drive shafts ⇒ Rep. gr. 40 .
- Install guide links, track control links, anti-roll bar, coupling rods and cross piece (front) ⇒ Rep. gr. 40 .
- Install refrigerant lines ⇒ Rep. gr. 87 .
- Install ATF cooler ⇒ Rep. gr. 37 .
- Install body brace ⇒ Rep. gr. 40 .
- Install mounting for torque reaction support ⇒ [page 47](#) .
- Electrical connections and routing ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- Observe notes on procedures required after connecting battery ⇒ Electrical system; Rep. gr. 27 .
- Install and adjust wiper arms ⇒ Electrical system; Rep. gr. 92 .



Caution

Risk of irreparable damage to control units because of excessive voltage.

- ◆ ***Never use battery charging equipment for boost starting.***

- Before starting engine, top up hydraulic fluid in power steering reservoir ⇒ Rep. gr. 48 .



Note

The power steering pump must not be run when dry.

- Check oil level ⇒ [page 176](#) .
- Fill cooling system ⇒ [page 182](#) .



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.*
- Charge the refrigerant system ⇒ Air conditioner system - with refrigerant R134a .
- Perform wheel alignment check ⇒ Rep. gr. 44 .



WARNING

Risk of accident because of loose bolt connections.

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

- Check ATF level ⇒ Rep. gr. 37 .



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5 Assembly mountings

⇒ ["5.1 Assembly mountings - exploded view", page 42](#)

⇒ ["5.2 Removing and installing engine mounting \(left and right\)", page 43](#)

⇒ ["5.3 Removing and installing mounting for torque reaction support", page 47](#)

5.1 Assembly mountings - exploded view

1 - Torque reaction support

2 - Bolt

- ☐ M8: 23 Nm
- ☐ M10: 40 Nm

3 - Mounting for torque reaction support

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

4 - Bolt

- ☐ 23 Nm

5 - Bracket for torque reaction support

6 - Bolt

- ☐ 40 Nm

7 - Bolt

- ☐ 40 Nm

8 - Bolt

- ☐ 23 Nm

9 - Bolt

- ☐ 68 Nm

10 - Engine cross member

11 - Engine mounting (right-side)

- ☐ Removing and installing ⇒ [page 43](#)

12 - Bolt

- ☐ 40 Nm

13 - Engine support (right-side)

- ☐ Removing and installing ⇒ [page 43](#)

14 - Bolt

- ☐ 40 Nm

15 - Bolt

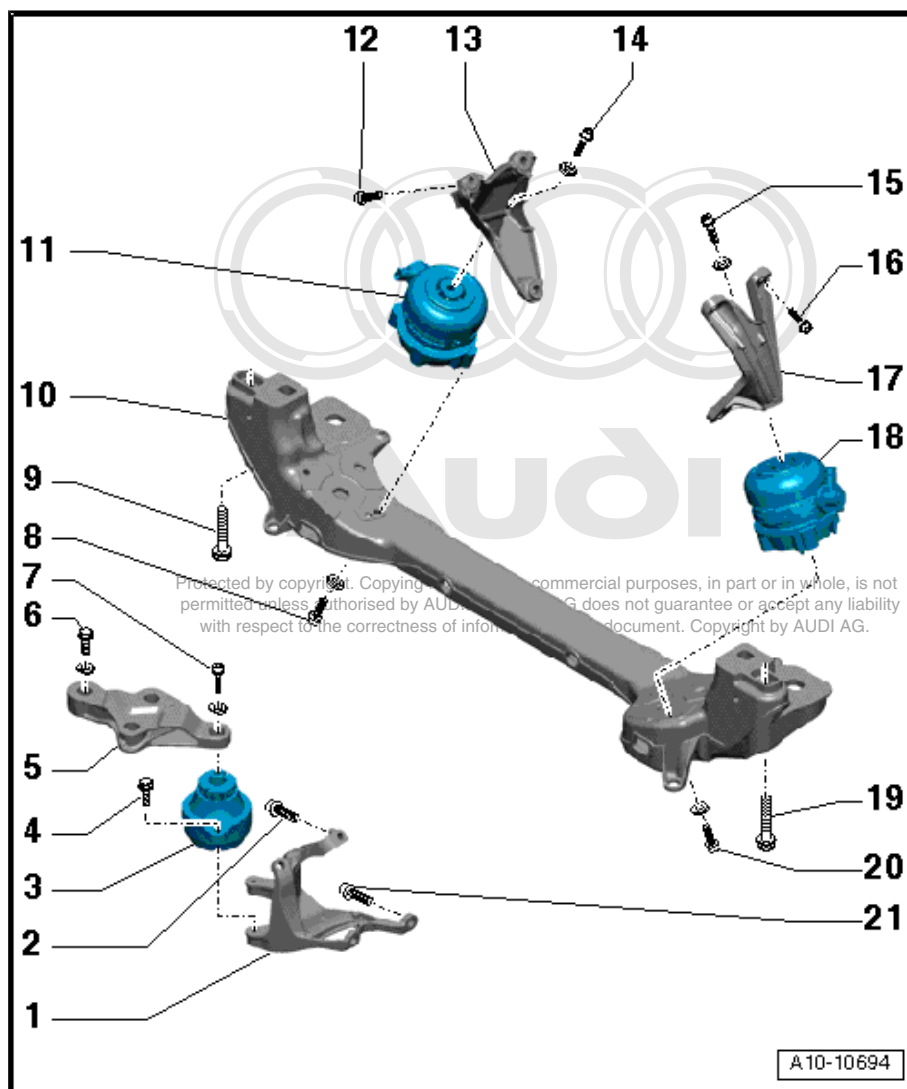
- ☐ 40 Nm

16 - Bolt

- ☐ 40 Nm

17 - Engine support (left-side)

- ☐ Removing and installing ⇒ [page 43](#)



18 - Engine mounting (left-side)

- ☐ Removing and installing ⇒ [page 43](#)

19 - Bolt

- ☐ 68 Nm

20 - Bolt

- ☐ 23 Nm

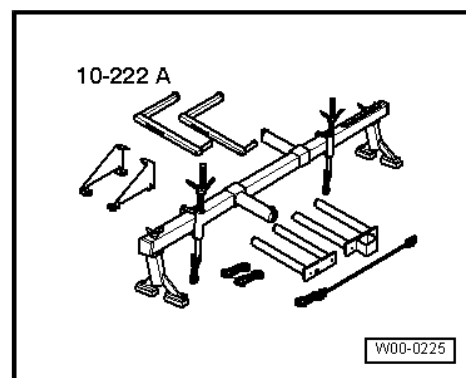
21 - Bolt

- ☐ M8: 23 Nm
- ☐ M10: 40 Nm

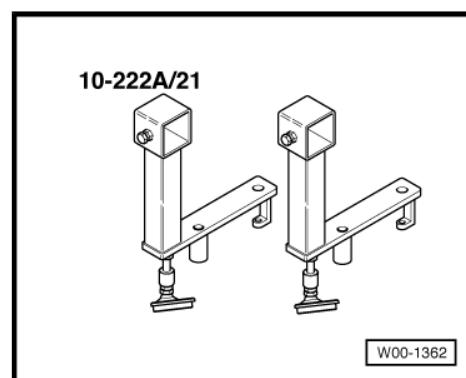
5.2 Removing and installing engine mounting (left and right)

Special tools and workshop equipment required

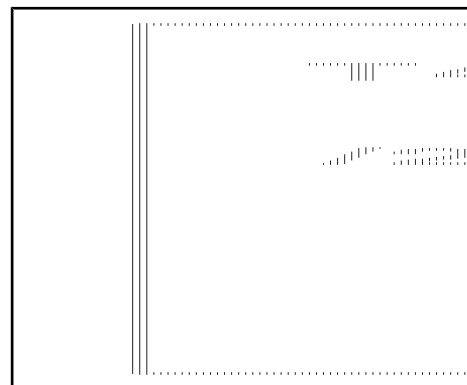
- ◆ Support bracket -10 - 222 A-



- ◆ Adapters -10 - 222 A /21-



- ◆ Engine support bracket (supplementary set) -T40093-

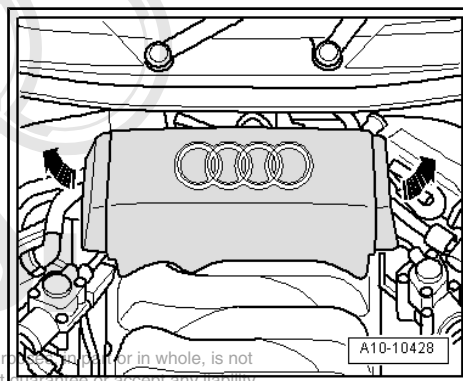


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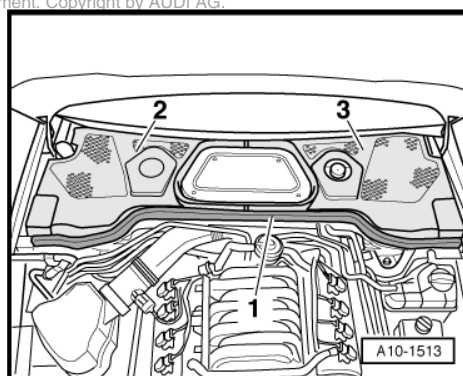


Removing

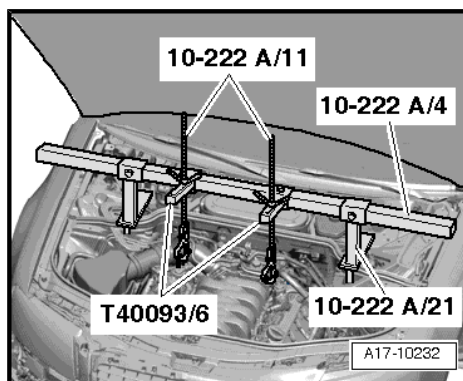
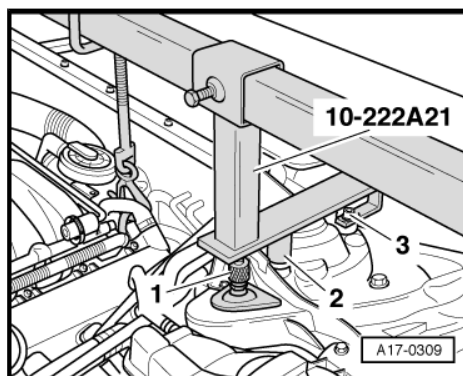
- Pull off engine cover panel (rear) -arrows-.



- Pull off rubber seal -1- and remove plenum chamber covers -2 and 3-.



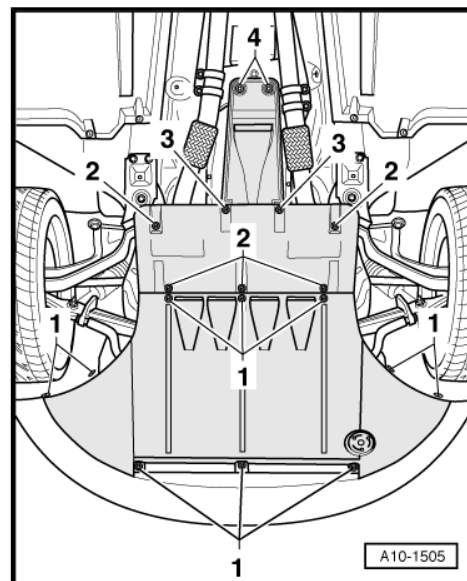
- Unscrew rear bolts -3- for body brace.
- Attach adapters -10 - 222 A /21- without adapter -10 - 222 A /4- onto suspension turrets.
- Supports are marked for left and right side of vehicle.
- The centre resting point -2- of supports is positioned on front bolts for body brace.
- The adapters -10 - 222 A /21- are attached by means of the rear bolts -3- for the body brace.
- The knurled screw -1- must be screwed down until support plate rests on suspension turret.
- Attach adapter -10 - 222 A /4- using adapters -T40093/6- to adapters -10 - 222 A /21- .
- Secure spindles -10 - 222 A /11- to engine lifting eyes.
- Take up weight of engine using spindles of support bracket.



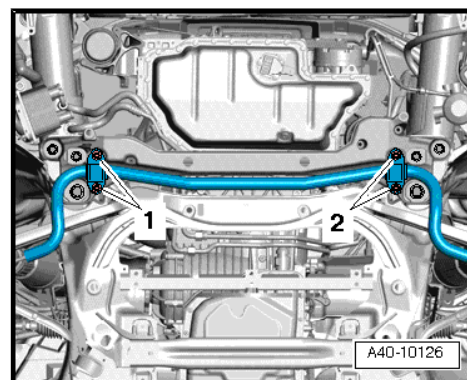
- Release fasteners -1- to remove front noise insulation.

**Note**

Disregard -items 2, 3, 4-.



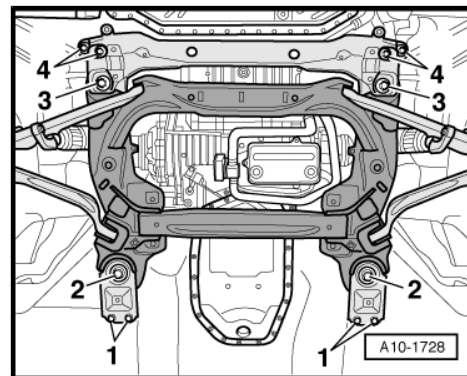
- Remove bolts (left and right) -1 and 2- for anti-roll bar mountings.
- Lower anti-roll bar slightly.



- Remove bolts -3 and 4-.

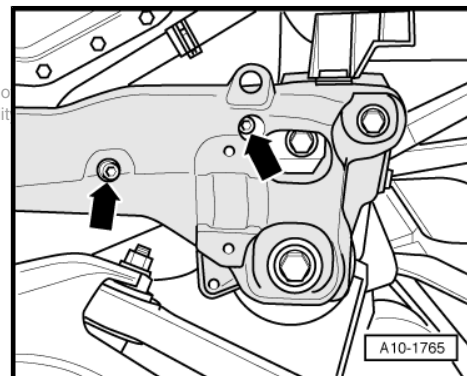
**Note**

Disregard -items 1 and 2-.



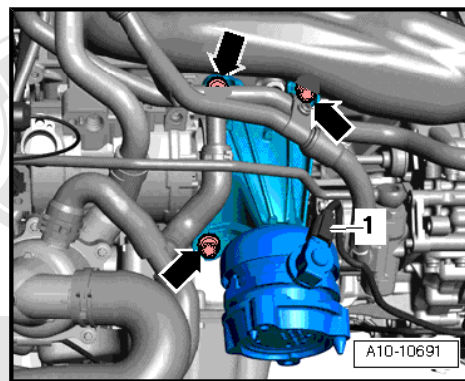
- Remove bolts for engine mountings -arrows- on both sides.
- Take out engine cross member.

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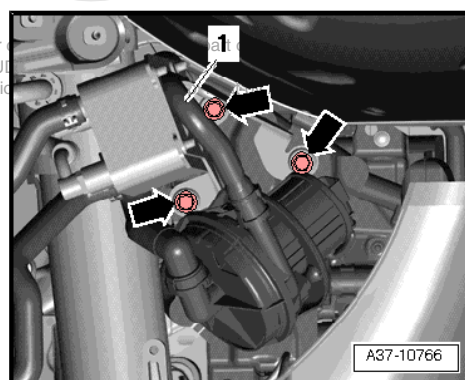
Engine mounting (left-side):

- Unplug electrical connector -1- at engine mounting.
- Remove bolts -arrows- and detach engine support with engine mounting.

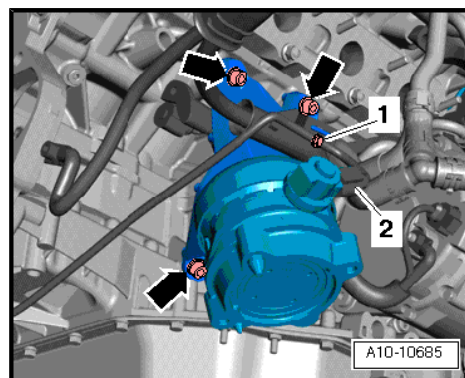


Engine mounting (right-side):

- Move clear air hose -1- for secondary air system at bracket for ATF cooler.
- Unscrew bolts -arrows- and remove ATF cooler.
- Tie up ATF cooler (coolant hoses remain connected) on engine.



- Unplug electrical connector -2- at engine mounting (right-side).
- Unbolt bracket -1- for wiring from engine support (right-side).
- Remove bolts -arrows- and detach engine support with engine mounting.



Continuation for both sides:

- Unscrew bolt -arrow- and remove engine mounting from engine support.

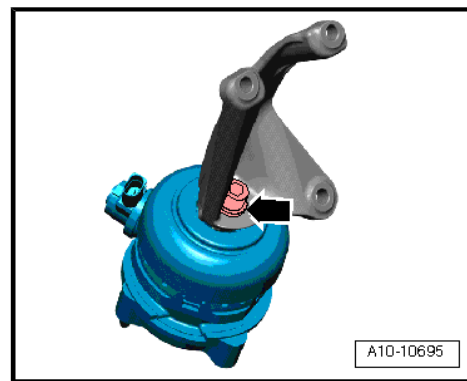
Installing

- Tightening torques
⇒ ["5.1 Assembly mountings - exploded view", page 42](#)

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

**Note**

- ◆ *Renew the bolts tightened with specified tightening angle.*
- ◆ *Fit all cable ties in the original positions when installing.*
- Install subframe ⇒ Rep. gr. 40 .
- Install anti-roll bar ⇒ Rep. gr. 40 .
- Install ATF cooler ⇒ Rep. gr. 37 .
- Install body brace ⇒ Rep. gr. 40 .



5.3 Removing and installing mounting for torque reaction support

Special tools and workshop equipment required

- ◆ Electric drill
- ◆ Stepped centre bit (Ø 24 mm)

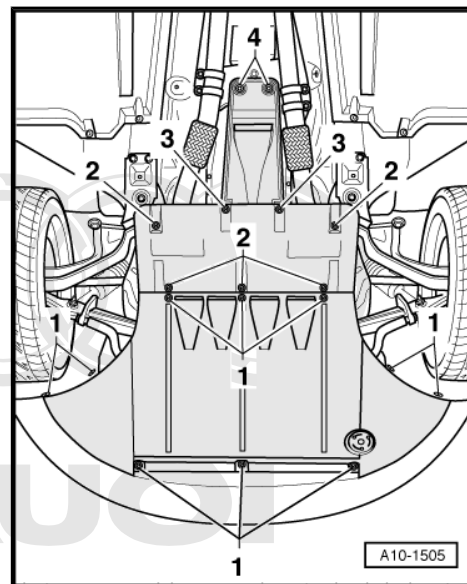
Removing

- Release fasteners -1- to remove front noise insulation.

**Note**

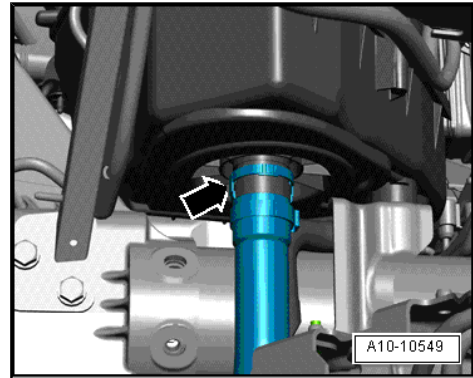
Disregard -items 2, 3, 4-.

- Remove both front wheels.
- Remove front sections of front wheel housing liners (left and right) ⇒ Rep. gr. 66 .
- Remove bumper cover (front) ⇒ Rep. gr. 63 .

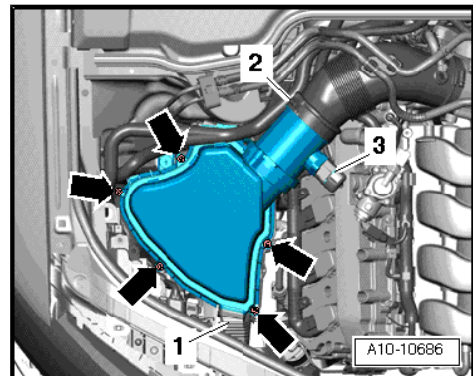


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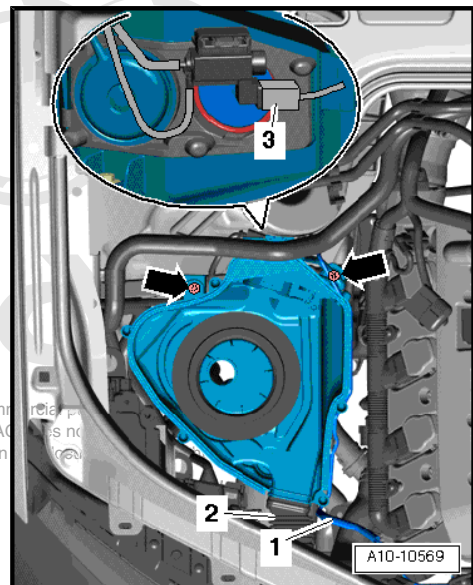
- Disconnect air hose (bottom) from air cleaner housing (bottom section) -arrow-.
- Remove right headlight ⇒ Rep. gr. 94 .



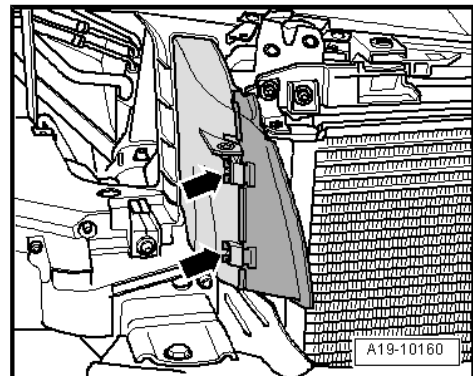
- Unplug electrical connector -3- at air mass meter -G70- .
- Disconnect air intake hose -2- from air pipe.
- Disconnect air duct -1- from air cleaner housing (top section).
- Unscrew bolts -arrows- and detach air cleaner housing (top section).



- Disconnect vacuum hose -1- and remove air duct -2-.
- Remove bolts -arrows-.
- Turn air cleaner housing (bottom section) and unplug electrical connector -3- at variable intake manifold change-over valve -N335- .
- Remove bottom section of air cleaner housing.

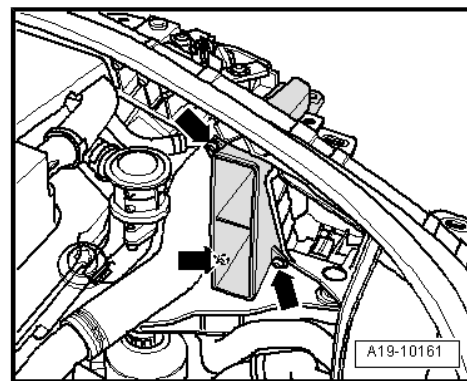


- Compress retainer catches -arrows- and detach air duct from lock carrier (front right).



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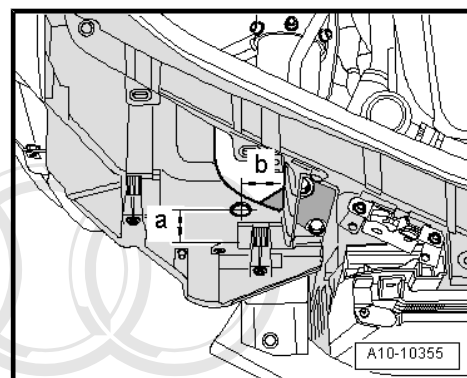
- Remove bolts -arrows-.
- Detach air duct from lock carrier (rear right).



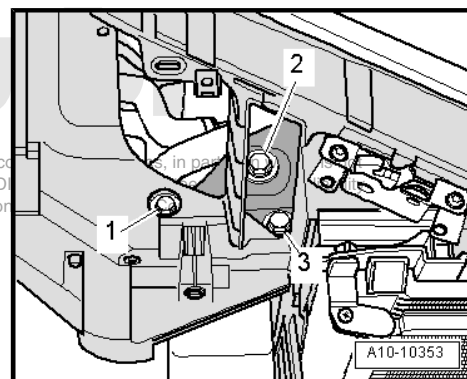
- Mark out drilling on lock carrier as illustrated according to dimensions -a- and b-.
- Distance -a- = 40 mm
- Distance -b- = 55 mm.
- Drill a hole of 24 mm dia.

**Note**

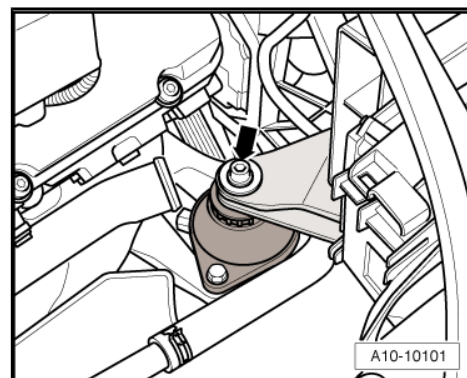
Drill a pilot hole and then drill out to 24 mm dia using the stepped centre bit.



- Remove bolts -1 and 2- on bracket for torque reaction support.
- Slacken bolt -3- a few turns.



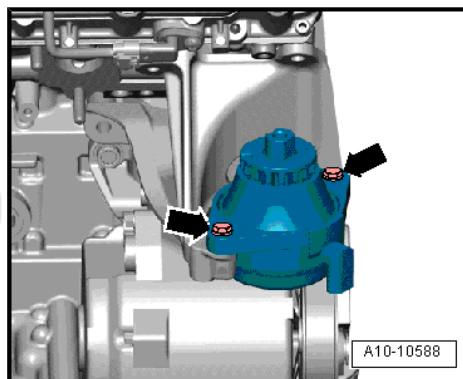
- Remove bolt -arrow- on mounting for torque reaction support.



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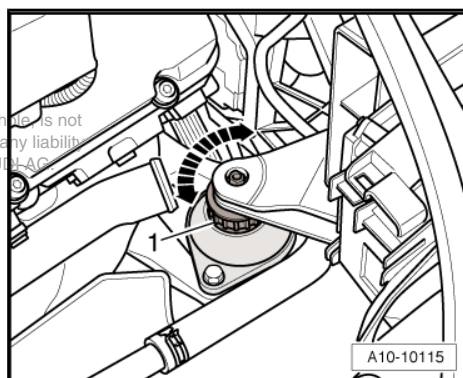


- Unscrew bolts -arrows- and remove mounting for torque reaction support.

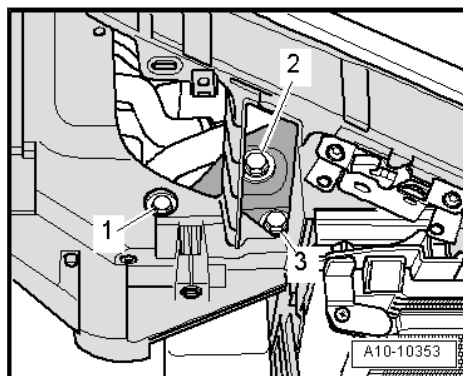


Installing

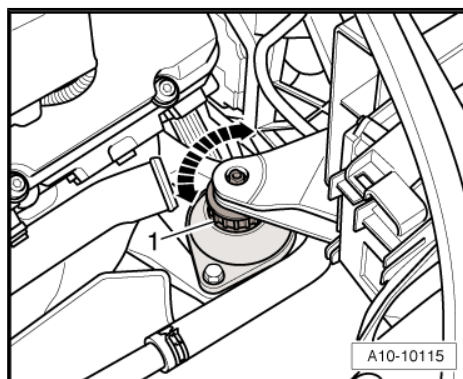
- Tightening torques
⇒ ["5.1 Assembly mountings - exploded view", page 42](#)
- Turn adjuster ring -1- on mounting for torque reaction support clockwise to stop.



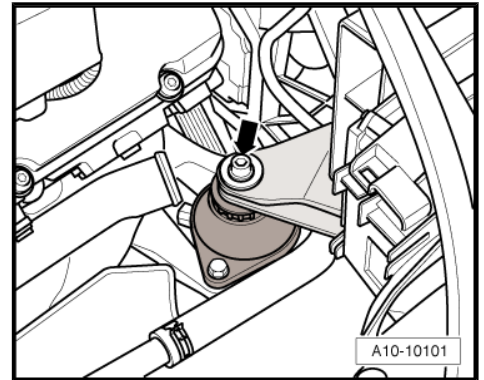
- Tighten bolts -1 and 3- for bracket for torque reaction support.



- Turn adjuster ring -1- by hand anti-clockwise until it comes into contact with bracket for torque reaction support.
- Then turn adjuster ring one turn clockwise.



- Tighten bolt -arrow- on mounting for torque reaction support.
- Installation is carried out in the reverse order; note the following:
- Install headlight ⇒ Rep. gr. 94 .
 - Install bumper cover (front) ⇒ Rep. gr. 63 .
 - Install air cleaner housing ⇒ Rep. gr. 24 .
 - Check headlight adjustment ⇒ Maintenance ; Booklet 404 .



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13 – Crankshaft group

1 Cylinder block (pulley end)

⇒ “1.1 Poly V-belt drive - exploded view”, page 52

⇒ “1.2 Removing and installing poly V-belt”, page 53

⇒ “1.3 Removing and installing tensioner for poly V-belt”, page 54

⇒ “1.4 Removing and installing vibration damper”, page 55

⇒ “1.5 Renewing crankshaft oil seal (pulley end)”, page 56

1.1 Poly V-belt drive - exploded view

1 - Bolt

- ☐ 22 Nm

2 - Bolt

- ☐ 55 Nm

3 - Tensioner for poly V-belt

4 - Poly V-belt

- ☐ Check for wear
- ☐ Do not kink
- ☐ Before removing, mark direction of rotation with chalk or felt-tip pen
- ☐ Removing and installing ⇒ page 53
- ☐ When installing, make sure it is properly seated on pulleys.

5 - Cover cap

6 - Bolt

- ☐ Tightening torque ⇒ Electrical system; Rep. gr. 27

7 - Alternator

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

8 - Bolt

- ☐ M8: 22 Nm
- ☐ M10: 46 Nm

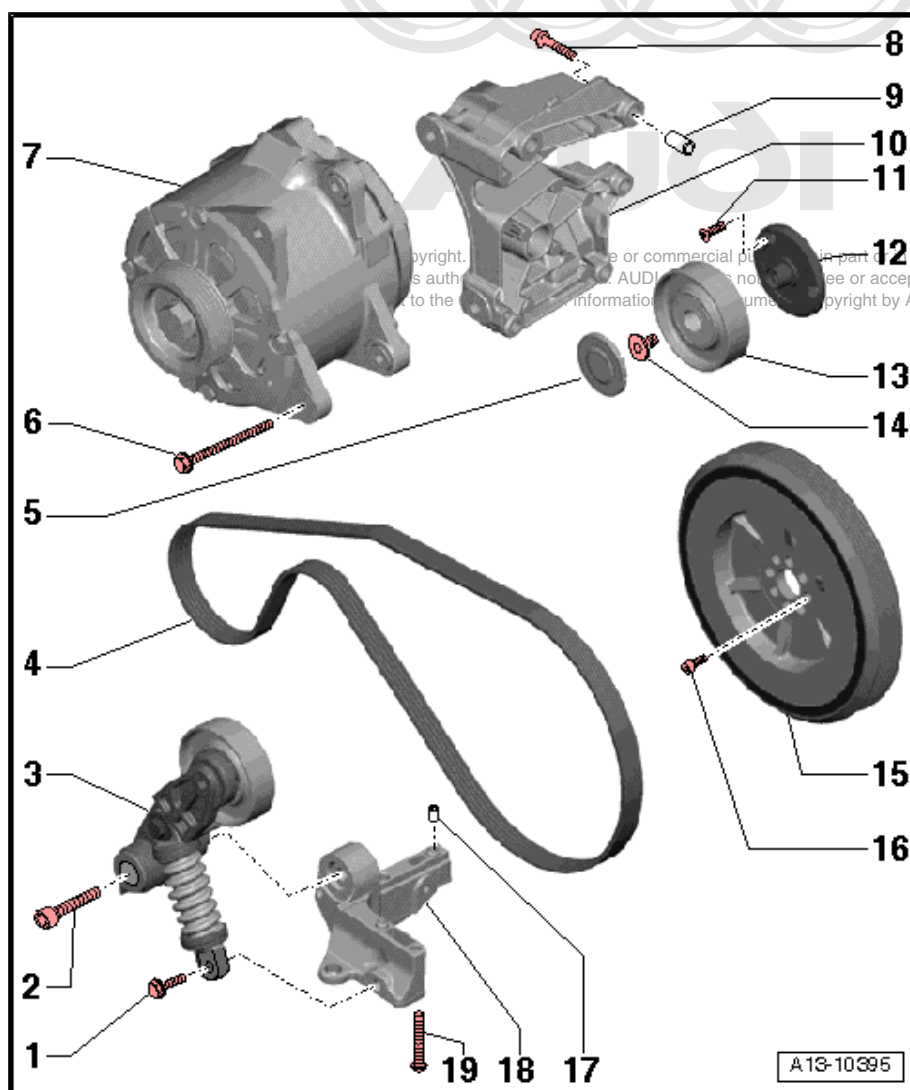
9 - Dowel sleeve

- ☐ For bracket for alternator
- ☐ 2x

10 - Bracket for alternator

11 - Bolt

- ☐ 9 Nm



12 - Bearing bracket

- ☐ For idler roller

13 - Idler roller for poly V-belt**14 - Bolt**

- ☐ 22 Nm

15 - Vibration damper

- ☐ Removing and installing ⇒ [page 55](#)

16 - Bolt

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

17 - Dowel sleeve

- ☐ 2x

18 - Bracket

- ☐ For tensioner for poly V-belt

19 - Bolt

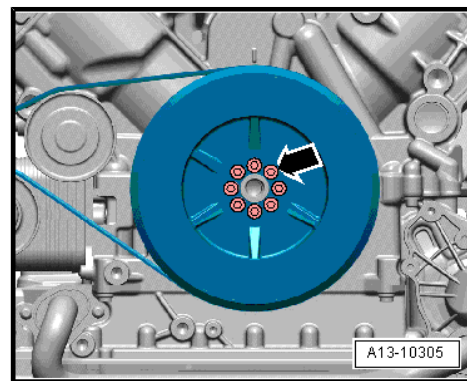
- ☐ Different lengths
- ☐ 9 Nm

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Vibration damper - tightening torque and sequence

- Tighten bolts -arrow- in 3 stages and in diagonal sequence as follows:

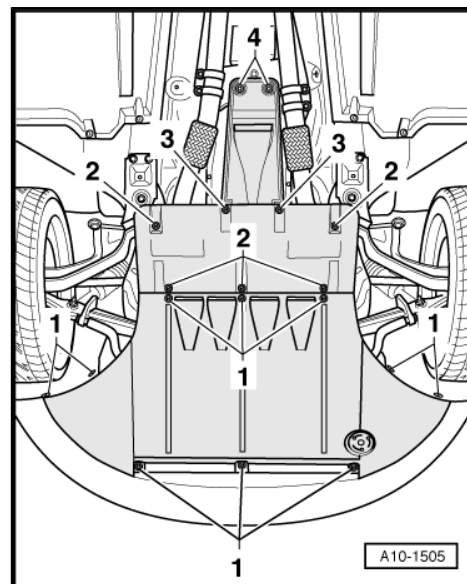
1. Tighten bolts to 15 Nm.
2. Tighten bolts to 22 Nm.
3. Turn bolts 90° ($\frac{1}{4}$ turn) further.

**1.2 Removing and installing poly V-belt****Removing**

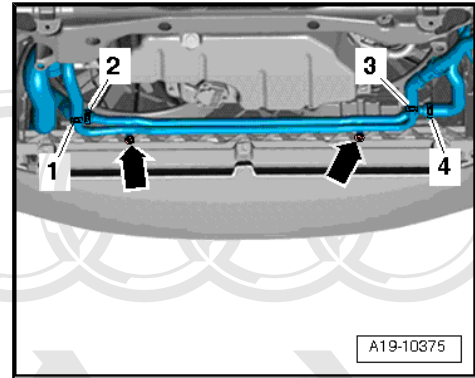
- Release fasteners -1- to remove front noise insulation.

**Note**

Disregard -items 2, 3, 4-.



- Unscrew bolts -arrows- and detach coolant pipes going to ATF cooler with coolant hoses -1 ... 4- attached from lock carrier.



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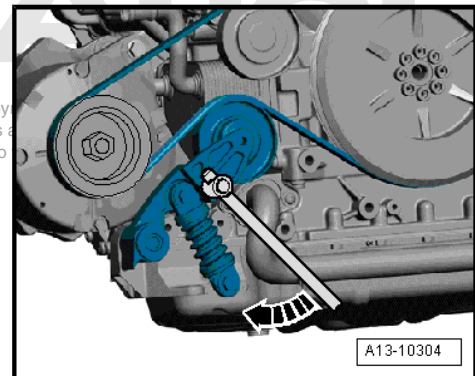


Caution

If a used belt runs in the opposite direction when it is refitted, this can cause breakage.

- ◆ **Before removing, mark direction of rotation of poly V-belt with chalk or felt-tip pen for re-installation.**

- Turn the tensioner in the direction of the -arrow- to slacken the poly V-belt.
- Remove poly V-belt and release pressure from the tensioner.

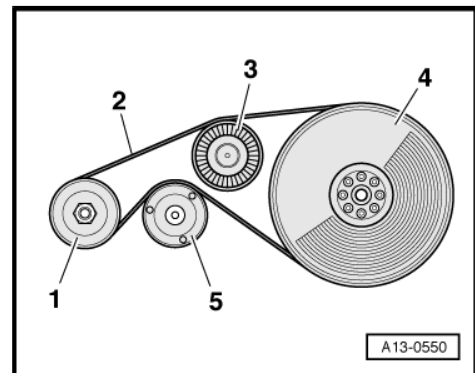


A13-10304

Installing

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

- Fit poly V-belt -2- onto pulleys in the following sequence:
- 1 - Alternator
- 3 - Idler roller
- 4 - Vibration damper
- 5 - Tensioning roller



A13-0550



Note

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

- Start engine and check that belt runs properly.

1.3 Removing and installing tensioner for poly V-belt

Removing

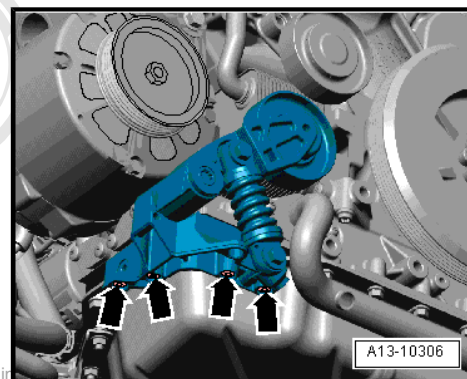
- Remove poly V-belt ⇒ [page 53](#) .

- Remove bolts -arrows-.
- Remove poly V-belt tensioner from top section of sump.

Installing

- Tightening torque
⇒ ["1.1 Poly V-belt drive - exploded view", page 52](#)

Install in reverse order.



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1.4 Removing and installing vibration damper

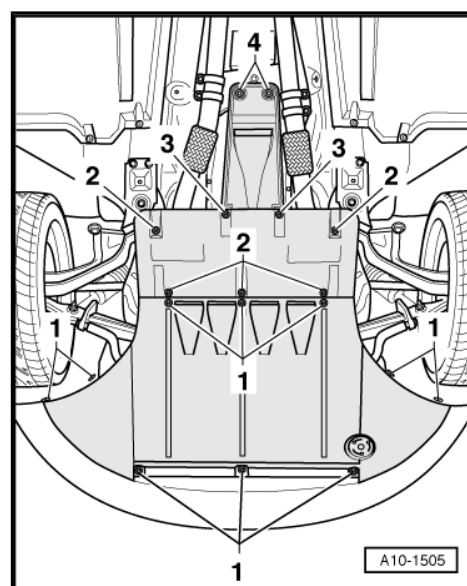
Removing

- Release fasteners -1- to remove front noise insulation.

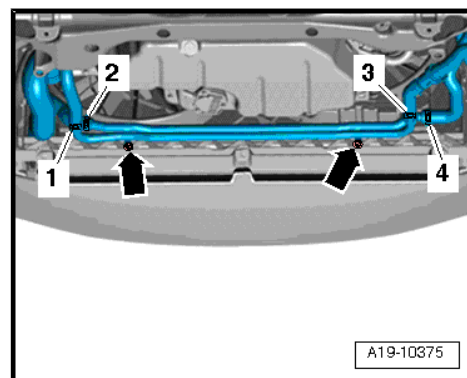


Note

Disregard -items 2, 3, 4-.



- Unscrew bolts -arrows- and detach coolant pipes going to ATF cooler with coolant hoses -1 ... 4- attached from lock carrier.



- Slacken off 8 bolts -arrow- on vibration damper several turns (counterhold with ring spanner on centre nut for alternator pulley).
- Remove poly V-belt ➔ [page 53](#) .
- Unscrew bolts -arrow- and remove vibration damper.

Installing

- Tightening torque
➔ [Fig. "Vibration damper - tightening torque and sequence"](#),
[page 53](#)

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



Note

Renew the bolts tightened with specified tightening angle.

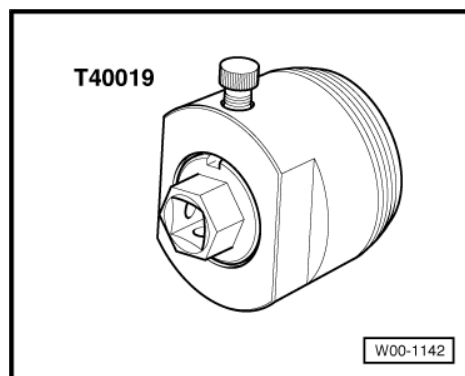
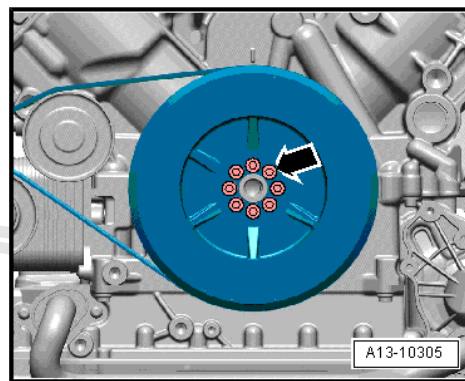
- The vibration damper can only be fitted in one position (note dowel sleeve).
- Install poly V-belt ➔ [page 53](#)

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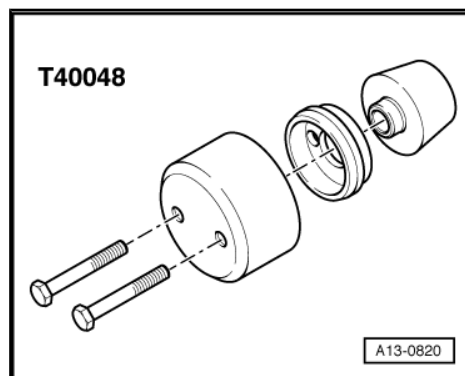
1.5 Renewing crankshaft oil seal (pulley end)

Special tools and workshop equipment required

- ◆ Oil seal extractor -T40019-

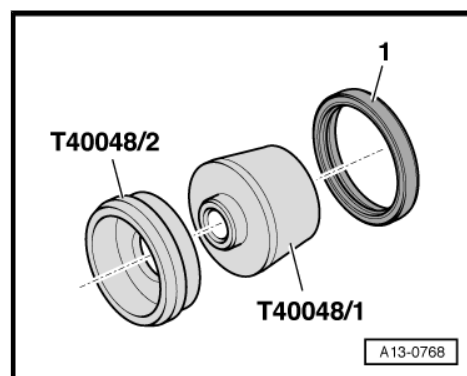
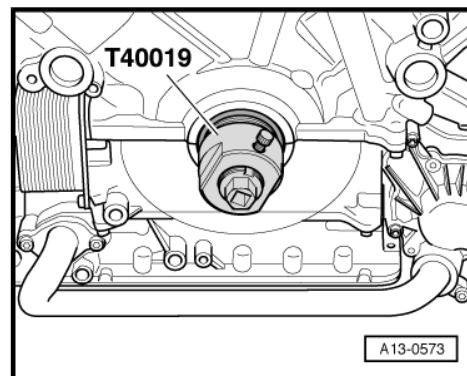


- ◆ Assembly tool -T40048-



Procedure

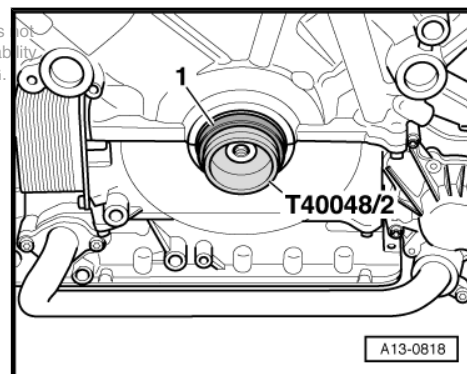
- Remove vibration damper ⇒ [page 55](#) .
- Adjust the inner part of oil seal extractor -T40019- so it is flush with the outer part and lock in position with knurled screw.
- Lubricate threaded head of oil seal extractor, place it in position and screw it into oil seal as far as possible (applying firm pressure).
- Loosen knurled screw and turn inner part against crankshaft until oil seal is pulled out.
- Clamp flats of oil seal extractor in vice.
- Remove oil seal with pliers.
- Clean running 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 cylinder block.

**Note**

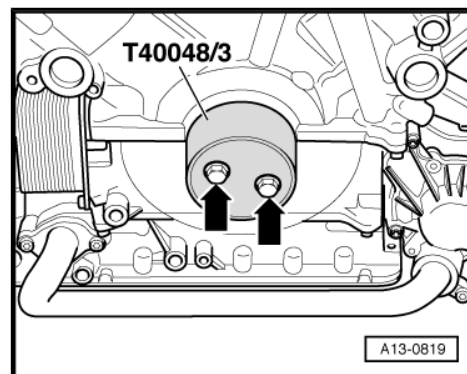
Leave assembly sleeve in position on crankshaft for pressing in seal.



- Apply press sleeve -T40048/3- to crankshaft using two 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.

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

- Install vibration damper ⇒ [page 55](#) .
- Install poly V-belt ⇒ [page 53](#) .



2 Cylinder block (gearbox end)

⇒ "2.1 Drive plate - exploded view", page 58

⇒ "2.2 Removing and installing drive plate", page 58

⇒ "2.3 Renewing crankshaft oil seal (gearbox end)", page 59

2.1 Drive plate - exploded view



Note

When carrying out repairs, secure engine to engine and gearbox support -VAS 6095- using bracket for V8 FSI engine -6095/1-6A- ⇒ [page 33](#) .

1 - Drive plate

- ☐ Removing and installing
⇒ [page 58](#)
- ☐ Mark installation position for re-installation

2 - Bolt

- ☐ Renew
- ☐ 60 Nm + 90° (1/4 turn further)

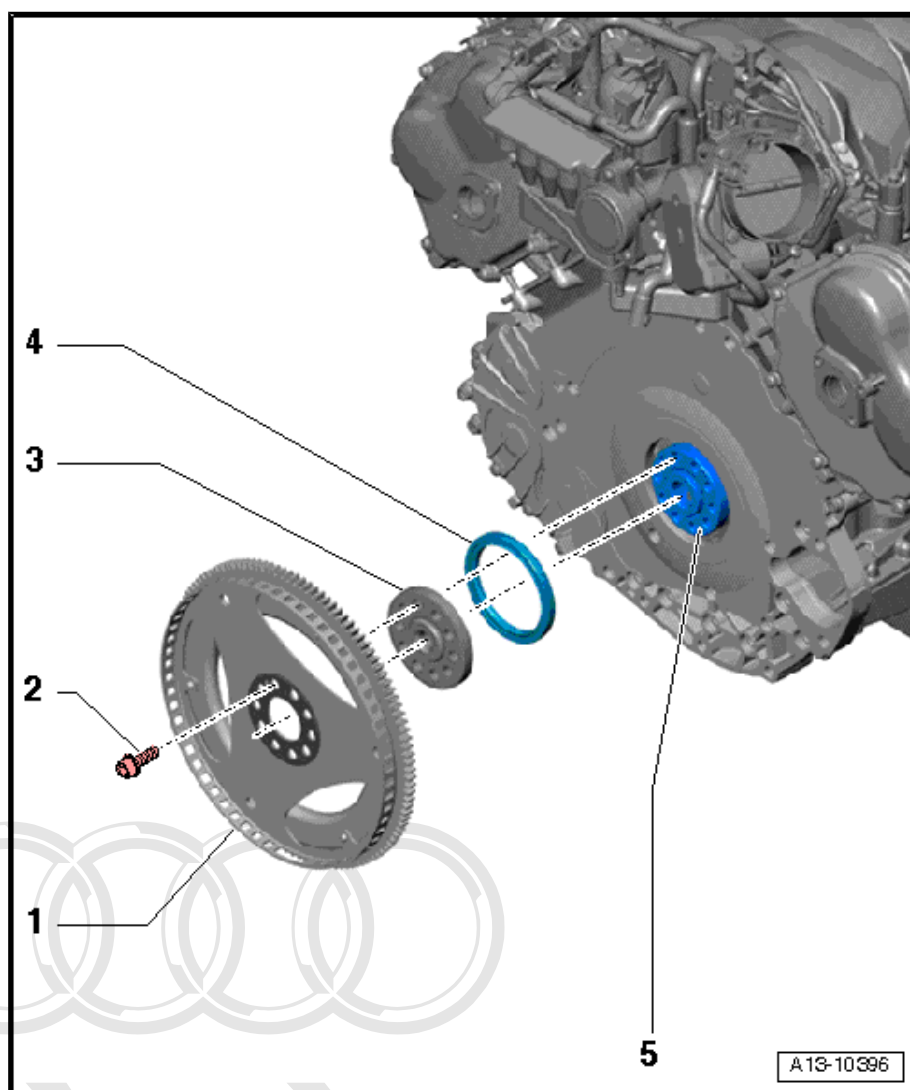
3 - Shim

- ☐ Mark installation position for re-installation

4 - Crankshaft oil seal (gearbox end)

- ☐ Renewing ⇒ [page 59](#)

5 - Crankshaft

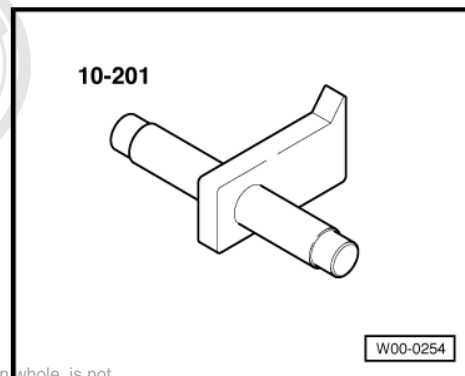


2.2 Removing and installing drive plate

Special tools and workshop equipment required

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◆ Counterhold tool -10 - 201-



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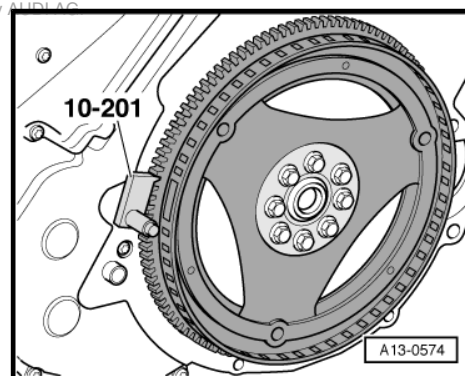
Removing

- Engine or gearbox removed.
- Attach counterhold tool -10 - 201- in order to loosen bolts.
- Mark installation position of drive plate on crankshaft with a felt-tip pen for re-installation.
- Unbolt drive plate.
- Take out shim located behind.

Installing

- Tightening torque
⇒ ["2.1 Drive plate - exploded view", page 58](#)

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

**Note**

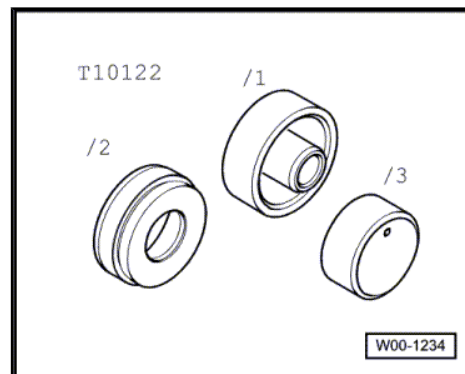
Renew the bolts tightened with specified tightening angle.

- Install drive plate with shim.
- Reverse position of counterhold tool -10 - 201- in order to tighten bolts.

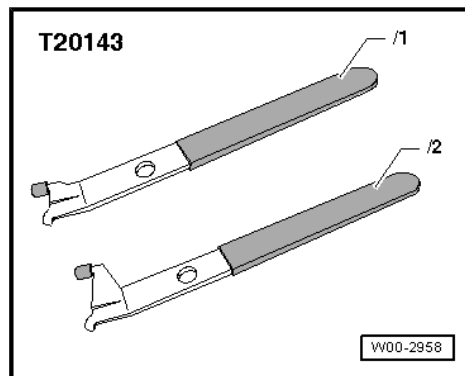
2.3 Renewing crankshaft oil seal (gearbox end)

Special tools and workshop equipment required

- ◆ Fitting tool -T10122-

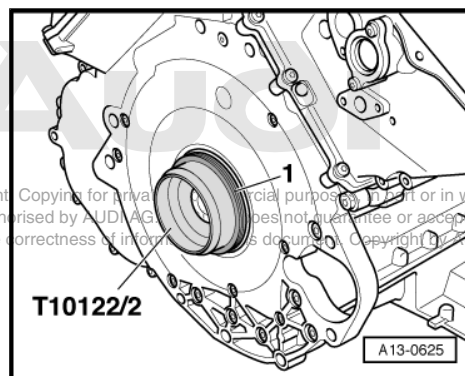
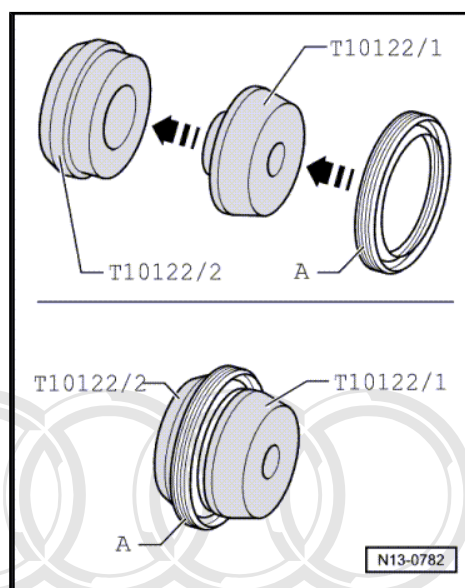
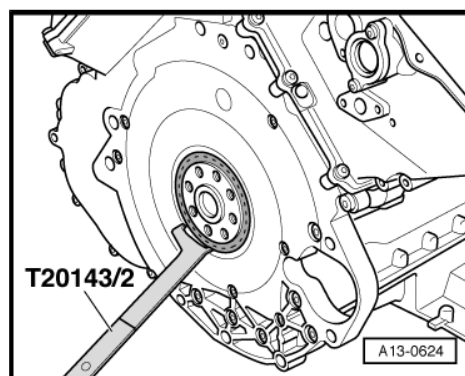


◆ Extractor tool -T20143-



Procedure

- Engine or gearbox removed.
- Remove drive plate ⇒ [page 58](#) .
- Pry out oil seal using extractor tool -T20143/2- .
- Clean running 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.
- Fit the assembly sleeve -T10122/2- with oil seal -1- onto crankshaft.

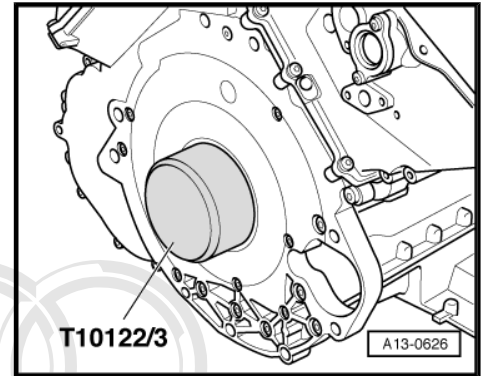


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- Press in the oil seal with press tool -T10122/3- evenly all round until it is flush.

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

- Install drive plate ⇒ [page 58](#) .



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3 Crankshaft

⇒ ["3.1 Crankshaft - exploded view", page 62](#)

⇒ ["3.2 Allocation of main bearing shells for new crankshafts", page 65](#)

⇒ ["3.3 Allocation of main bearing shells on used and machined crankshafts", page 67](#)

⇒ ["3.4 Crankshaft dimensions", page 67](#)

⇒ ["3.5 Measuring axial clearance", page 67](#)

⇒ ["3.6 Measuring radial clearance", page 68](#)

3.1 Crankshaft - exploded view



Note

When carrying out repairs, secure engine to engine and gearbox support -VAS 6095- using bracket for V8 FSI engine -6095/1-6A- ⇒ [page 33](#).

1 - Cylinder block

- ☐ Matched to -item 12-
- ☐ Applying sealant onto cylinder block (for retaining frame)
- ⇒ [page 64](#)

2 - Gaskets

- ☐ Renew

3 - Crankshaft oil seal (pulley end)

- ☐ Renewing ⇒ [page 56](#)

4 - Dowel sleeve

- ☐ 2x
- ☐ Insert in retaining frame
- ☐ Installation position
- ⇒ [page 64](#)

5 - Bolt

- ☐ 9 Nm

6 - Guide tube for oil dipstick

7 - O-ring

- ☐ Renew

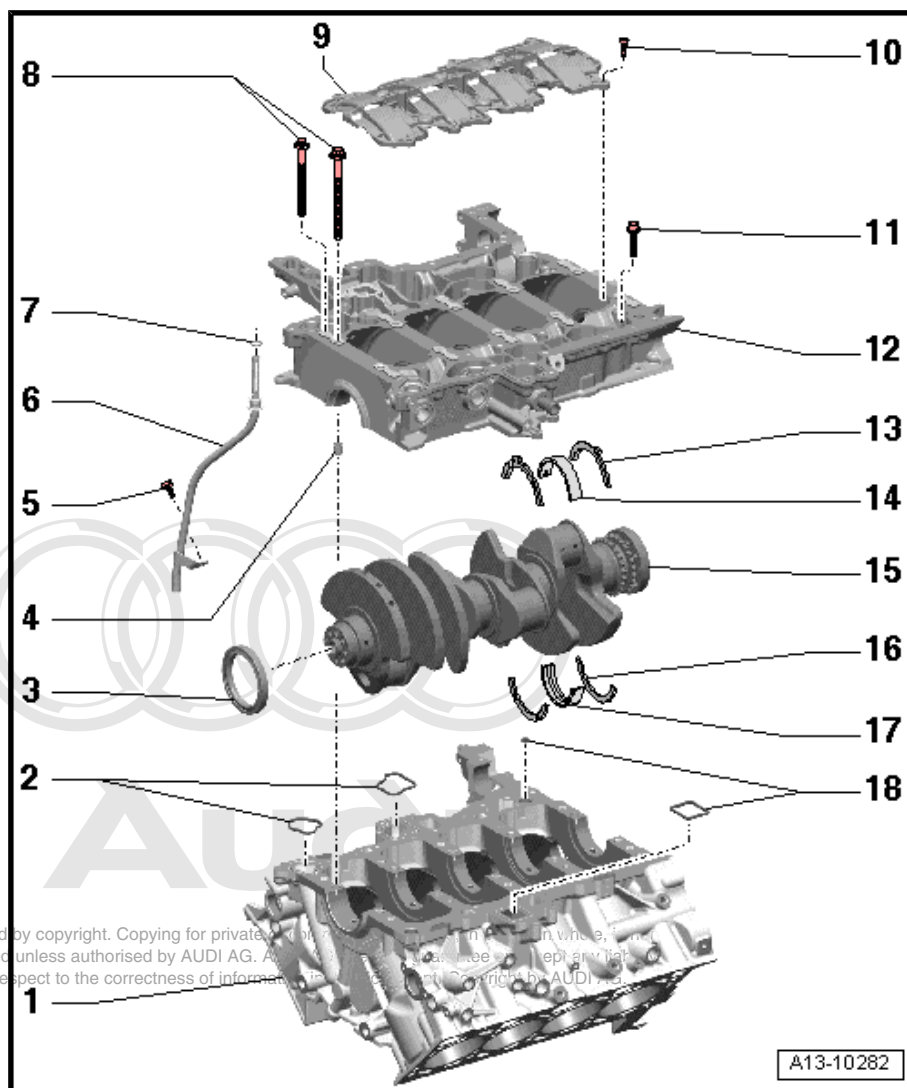
8 - Bolts

- ☐ For retaining frame
- ☐ Renew
- ☐ Different bolt lengths
- ☐ Tightening sequence
- ⇒ [page 65](#)

9 - Baffle plate

10 - Bolt

- ☐ Tightening sequence ⇒ [page 64](#)



11 - Bolt

- ☐ For sealing surfaces: retaining frame to cylinder block
- ☐ Different bolt lengths
- ☐ Tightening sequence ⇒ [page 65](#)

12 - Retaining frame

- ☐ Matched to -item 1-
- ☐ Applying sealant onto cylinder block (for retaining frame) ⇒ [page 64](#)
- ☐ Tightening sequence for bolts ⇒ [page 65](#)

13 - 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 67](#)

14 - Bearing shell

- ☐ For retaining frame (without oil groove)
- ☐ Renew used bearing shells
- ☐ Install new bearing shells for retaining frame with correct coloured markings

New crankshafts ⇒ [page 65](#)

Used or machined crankshafts ⇒ [page 67](#)

15 - Crankshaft

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- ☐ Measuring axial clearance ⇒ [page 67](#)
- ☐ Measuring radial clearance ⇒ [page 68](#)
- ☐ Do not rotate the crankshaft when checking the radial clearance
- ☐ Crankshaft dimensions ⇒ [page 67](#)

16 - Thrust washer

- ☐ Only fitted on 4th crankshaft bearing
- ☐ Oil grooves face outwards
- ☐ Measuring axial clearance of crankshaft ⇒ [page 67](#)

17 - Bearing shell

- ☐ For cylinder block (with oil groove)
- ☐ Renew used bearing shells
- ☐ Install new bearing shells for the cylinder block with the correct coloured markings

New crankshafts ⇒ [page 65](#)

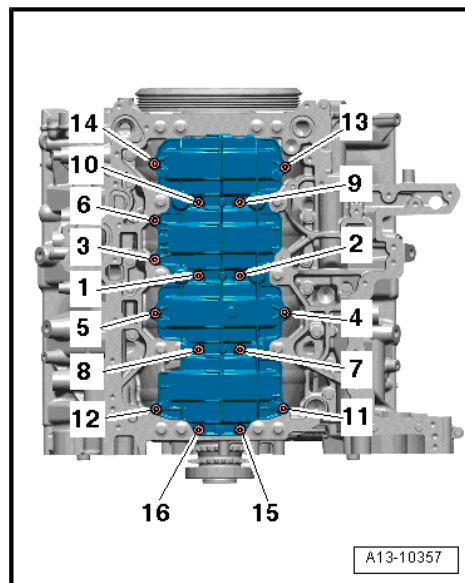
Used or machined crankshafts ⇒ [page 67](#)

18 - Gaskets

- ☐ Renew

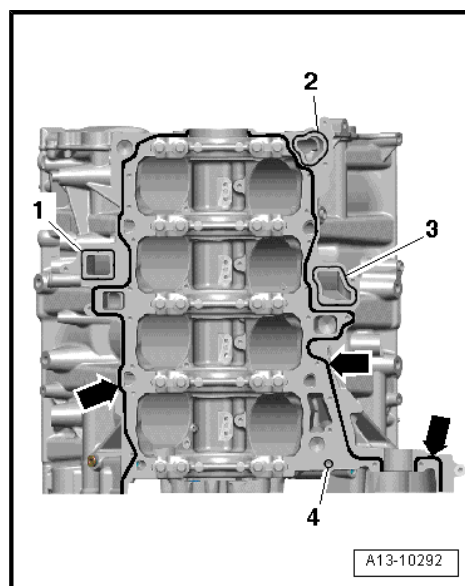
Tightening sequence for baffle plate

- Tighten bolts in the sequence -1 ... 16-.
- 9 Nm



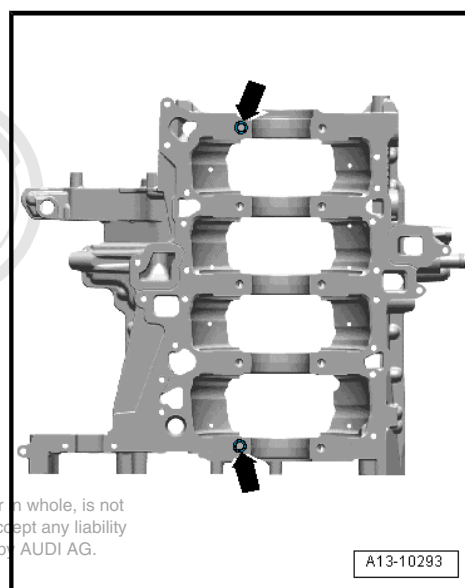
Applying sealant onto cylinder block (for retaining frame)

- Clean sealing surfaces; they must be free of oil and grease.
- Apply beads of sealant -arrows- onto clean sealing surfaces as illustrated.
- Width of beads of sealant: 2.0 mm.
- Fit gaskets -1 ... 4-.



Fitting location of dowel sleeves

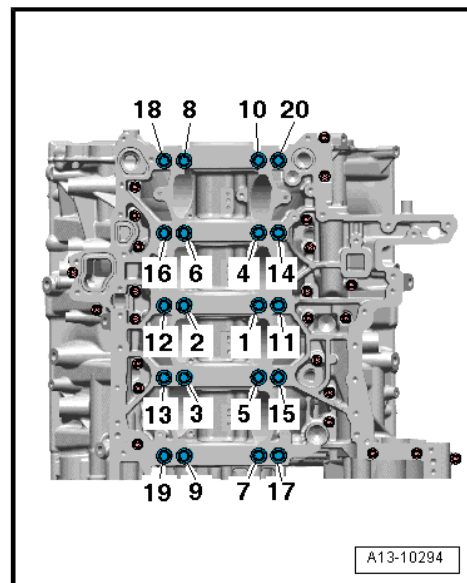
- Check that dowel sleeves -arrows- are inserted in retaining frame at positions shown in illustration.



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Tightening sequence for retaining frame

- Renew bolts -1 ... 20-.
- Tighten bolts in the following sequence:
 1. Tighten bolts -1 ... 10- to 30 Nm.
 2. Tighten bolts -11 ... 20- to 20 Nm.
 3. Tighten bolts -1 ... 10- to 50 Nm.
 4. Tighten bolts -11 ... 20- to 30 Nm.
 5. Turn bolts -1 ... 10- 90° ($\frac{1}{4}$ turn) further.
 6. Turn bolts -11 ... 20- 90° ($\frac{1}{4}$ turn) further.
 7. Tighten bolts for sealing surfaces between retaining frame and cylinder block
(-highlighted in illustration but not numbered-) to 9 Nm in diagonal sequence.



3.2 Allocation of main bearing shells for new crankshafts

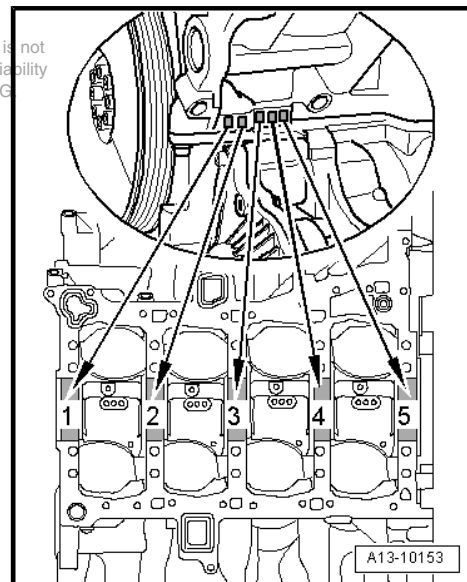
Matching crankshaft bearing shells to bearings in cylinder block

- ◆ 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**

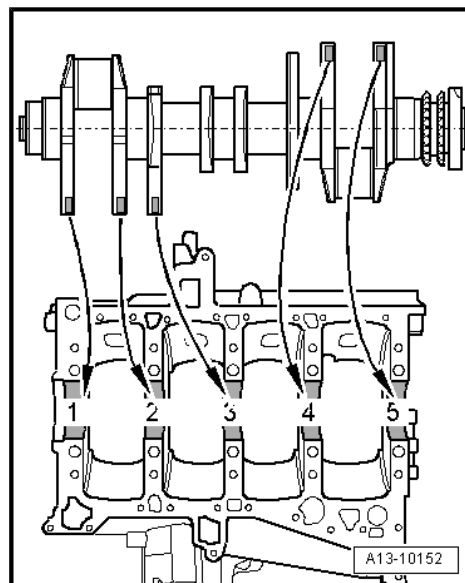
The code letters are also stamped on the retaining frame.



**Allocation of crankshaft bearing shells for retaining frame - version I**

- ◆ 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.

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

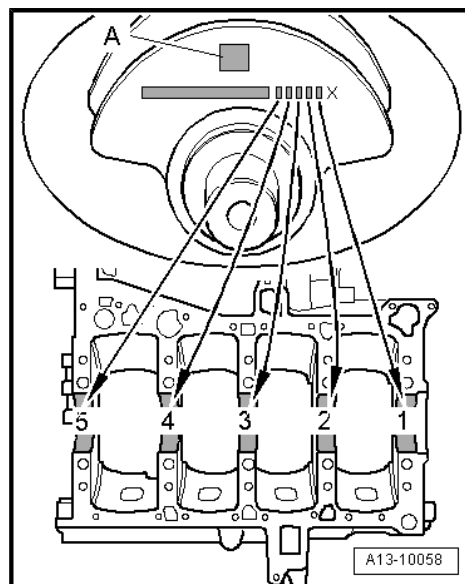
**Allocation of crankshaft bearing shells for retaining frame - version II**

- ◆ 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 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 colour coding for bearing 1 (pulley end).

**Note**

Disregard -item A-.

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



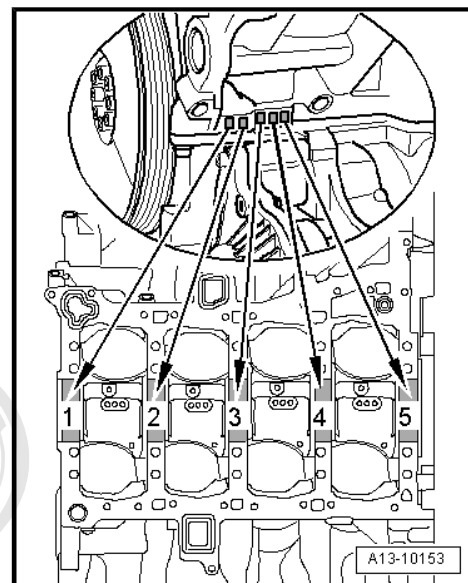
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3.3 Allocation of main bearing shells on used and machined crankshafts

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 to allocate the correct bearing shells.
- ◆ Crankshaft dimensions ⇒ [page 67](#).
- ◆ There are oversized (thicker) bearing shells available for machined crankshafts. These bearing shells have the same coloured marking as the original size bearing shells.

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



Matching crankshaft bearing shells to bearings in retaining frame

- ◆ On used and machined crankshafts, the main bearing journals must be measured to allocate 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 Ø	Colour code of bearing shells for retaining frame		
Dimensions (in mm)	Red	Yellow	Blue
Basic dimension 65.000 ¹⁾	64.978 ... 64.972	64.972 ... 64.965	64.965 ... 64.958
Repair undersize 64.750 ¹⁾	64.728 ... 64.722	64.722 ... 64.715	64.715 ... 64.708

• ¹⁾ The colour codes for oversized (thicker) bearing shells for machined crankshafts are the same as those on bearing shells for new crankshafts.

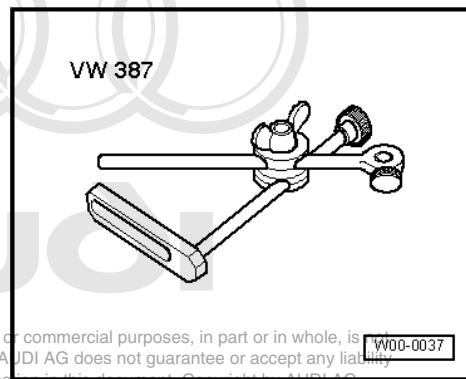
3.4 Crankshaft dimensions

Honing dimension (in mm)	Main bearing journal Ø	Conrod journal Ø
Basic dimension	65.000 – 0.022 – 0.042	54.000 – 0.022 – 0.042
Repair undersize	64.750 – 0.022 – 0.042	53.750 – 0.022 – 0.042

3.5 Measuring axial clearance

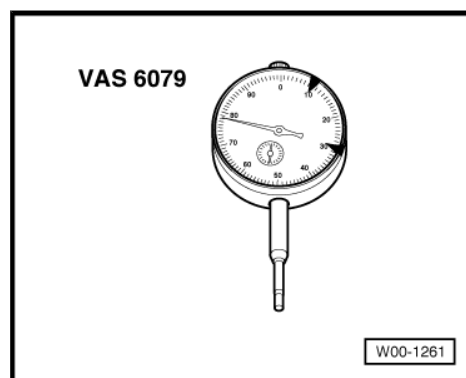
Special tools and workshop equipment required

◆ Universal dial gauge bracket -VW 387-



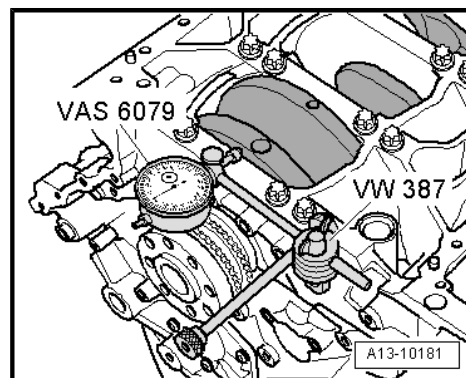
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◆ Dial gauge -VAS 6079-



Procedure

- Secure dial gauge -VAS 6079- with universal dial gauge bracket -VW 387- to cylinder block, as shown in illustration.
- Apply gauge against crank web.
- Push 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



3.6 Measuring radial clearance

Special tools and workshop equipment required

- ◆ Plastigage

Procedure



Note

Renew used bearing shells.

- 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: 0.017 ... 0.044 mm.
- Wear limit: 0.08 mm.



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4 Pistons and conrods

⇒ "4.1 Pistons and conrods - exploded view", page 70

⇒ "4.2 Removing and installing pistons", page 72

⇒ "4.3 Measuring radial clearance of conrods", page 73

⇒ "4.4 Checking pistons and cylinder bores", page 73

4.1 Pistons and conrods - exploded view



Note

Oil spray jet for piston cooling ⇒ [page 72](#).

1 - Bolt

- ☐ Renew
- ☐ Lubricate threads and contact surface
- ☐ 50 Nm + 90° (1/4 turn further)

2 - Conrod bearing cap

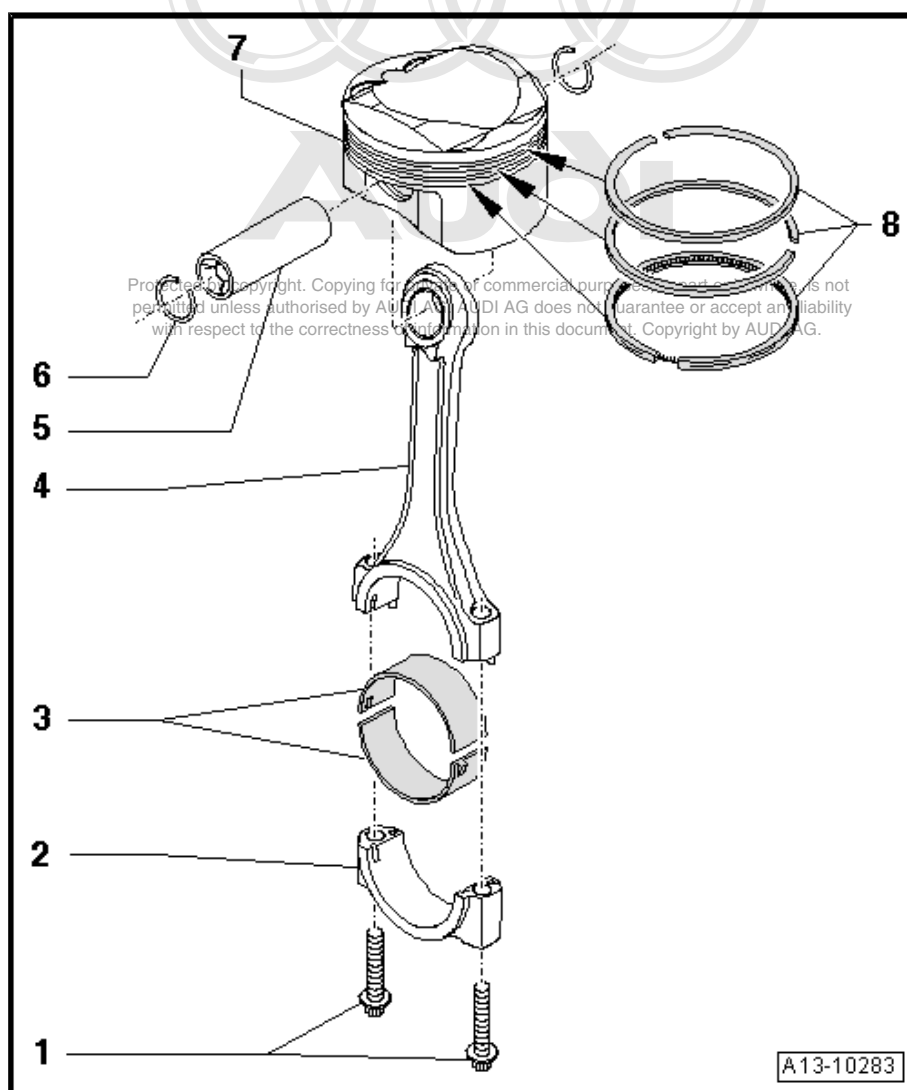
- ☐ Mark installation position for re-installation
- ☐ Mark conrod and cylinder allocation in colour ⇒ [page 71](#)
- ☐ Installation position of conrod pairs ⇒ [page 71](#)

3 - Bearing shells

- ☐ Ensure that retaining lugs are securely seated.
- ☐ Renew used bearing shells
- ☐ Measuring radial clearance ⇒ [page 73](#)
- ☐ There are oversized bearings available for machined crankshaft conrod journals ⇒ Electronic parts catalogue

4 - Conrod

- ☐ Only renew as a complete set
- ☐ Mark conrod bearing cap and cylinder allocation in colour ⇒ [page 71](#)
- ☐ Installation position of conrod pairs ⇒ [page 71](#)
- ☐ Axial clearance for each conrod pair (when new): 0.20 ... 0.27 mm
- ☐ Axial clearance: wear limit: 0.30 mm
- ☐ Measuring radial clearance ⇒ [page 73](#)



5 - Piston pin

- ☐ Removing and installing ⇒ [“4.2 Removing and installing pistons”, page 72](#)

6 - Circlip

- ☐ Renew

7 - Piston

- ☐ Removing and installing ⇒ [page 72](#)
- ☐ Installation position for piston ⇒ [page 71](#)
- ☐ Checking pistons and cylinder bores ⇒ [page 73](#)

8 - Piston rings

- ☐ Measuring ring gap ⇒ [page 74](#)
- ☐ Measuring ring-to-groove clearance ⇒ [page 74](#)
- ☐ Use piston ring pliers to remove and install
- ☐ Marking “TOP” or side with identification mark must face piston crown
- ☐ Offset gaps by 120°

Installation position of pistons

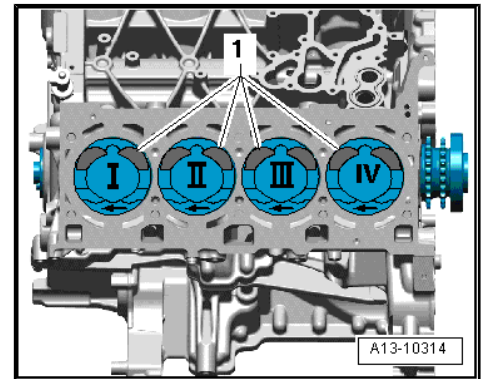
- Use a coloured pen to mark cylinder allocation on piston crown for re-installation.

**Note**

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

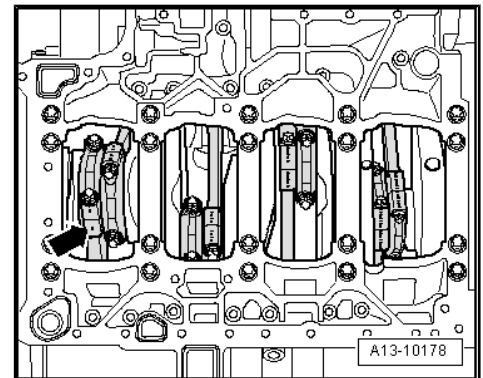
Installation position:

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

**Marking conrods****Note**

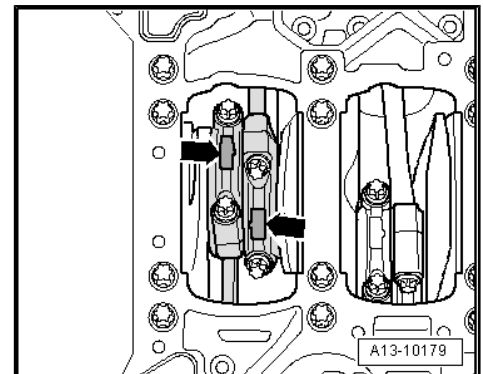
Only renew conrods as a complete set.

- Use a coloured pen to mark matching conrods and conrod bearing caps with cylinder numbers -arrow- for re-installation.

**Conrod installation position**

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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.



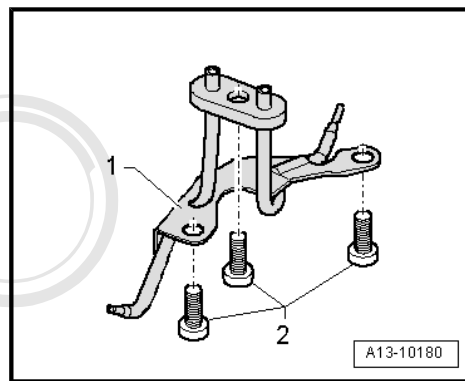
Oil spray jet for piston cooling

- 1 - Oil spray jet
- 2 - Bolts - 9 Nm. Install with locking fluid ⇒ Electronic parts catalogue



Note

- ◆ Do not bend piston cavity oil jets.
- ◆ Always renew bent piston cavity oil jets.

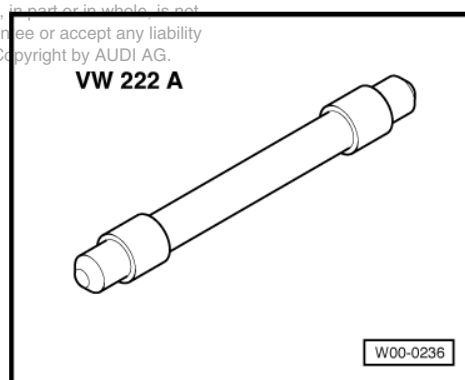


4.2 Removing and installing pistons

Special tools and workshop equipment required

- ◆ Drift -VW 222 A-

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- ◆ Piston ring clamp, commercially available

Removing

- Engine secured to engine and gearbox support -VAS 6095- ⇒ [page 33](#) .
- Remove cylinder head ⇒ [page 120](#) .
- Remove upper section of sump ⇒ [page 162](#) .
- Mark installation position and matching of conrod bearing caps to conrods and to cylinder for reinstallation ⇒ [page 71](#) .
- Unbolt conrod bearing caps.
- Pull out pistons upwards with conrods.



Note

If piston pin is difficult to remove, heat piston to approx. 60 °C.

- Take circlip out of piston pin boss.
- Use drift -VW 222 A- to drive out piston pin.

Installing

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

- Tightening torques
⇒ [“4.1 Pistons and conrods - exploded view”, page 70](#)

**Note**

Renew the bolts tightened with specified tightening angle.

- Oil running surfaces of bearing shells.
- Install pistons using commercially available piston ring clamp.

Installation position:

- Pistons ⇒ [page 71](#)
- Conrods ⇒ [page 71](#)
- Install conrod bearing caps according to markings.
- Install sump (upper section) ⇒ [page 162](#) .
- Install cylinder head ⇒ [page 120](#) .

4.3 Measuring radial clearance of conrods

Special tools and workshop equipment required

- ◆ Plastigage

Procedure

- 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 50 Nm. Do not rotate crankshaft.
- Remove conrod bearing caps once more.
- Compare width of Plastigage with measurement scale:

Radial clearance:

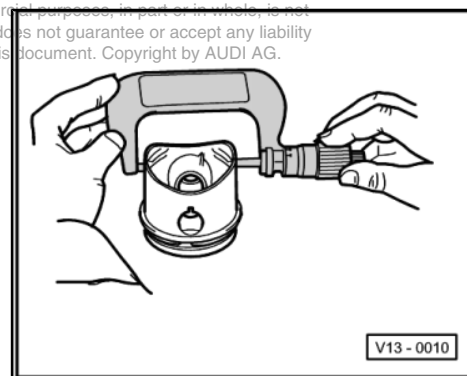
- New: 0.020 ... 0.069 mm.
- Wear limit: 0.120 mm.
- Renew conrod bolts.

4.4 Checking pistons and cylinder bores

Checking piston

- Using a micrometer (75 ... 100 mm), measure approx. 15 mm from the lower edge, perpendicular to the piston pin axis.
- Maximum deviation from nominal dimension: 0.03 mm.

Piston Ø mm	
Nominal piston dimension I	84.490 ¹⁾
Nominal piston dimension II	84.590 ¹⁾
¹⁾ Dimensions including coating (thickness 0.01 mm). The coating will wear down in service.	

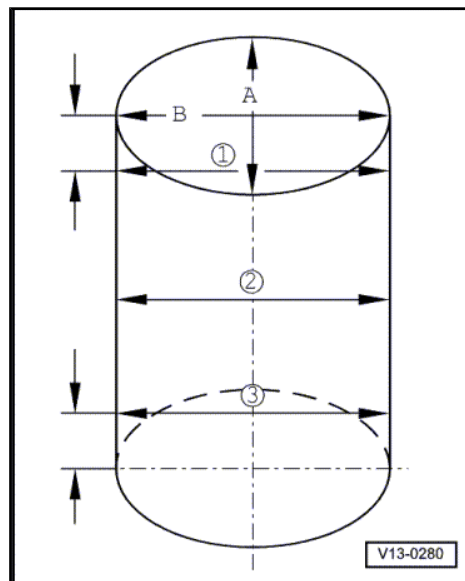




Measuring cylinder bore

- Use a cylinder gauge -VAS 6078- to take measurements at 3 points in transverse direction -A- and in longitudinal direction -B-.
- Maximum deviation from nominal dimension: 0.08 mm.

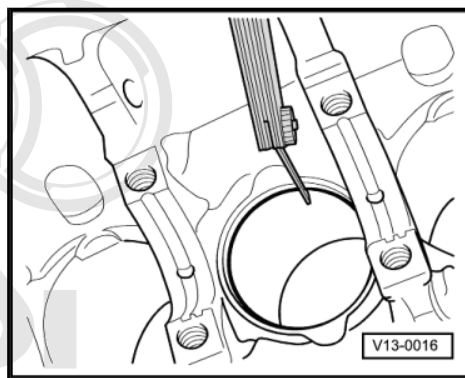
Cylinder bore Ø mm	
Nominal bore dimension I	84.510 ± 0.005
Nominal bore dimension II	84.610 ± 0.005



Measuring piston ring gap

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

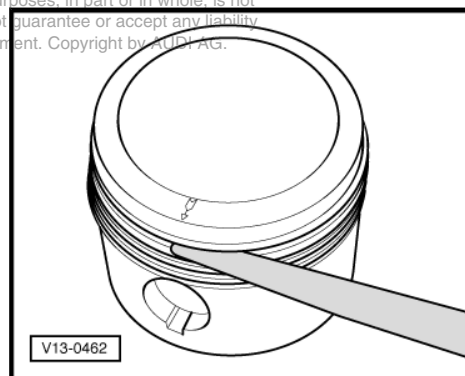
Piston ring Dimensions in mm	New	Wear limit
1st compression ring	0.20 ... 0.35	0.80
2nd compression ring	0.20 ... 0.40	0.80
Oil scraper ring	0.20 ... 0.40	0.80



Measuring ring-to-groove clearance

- Clean groove in piston before checking clearance.

Piston ring Dimensions in mm	New	Wear limit
1st compression ring	0.035 ... 0.085	0.200
2nd compression ring	0.005 ... 0.045	0.150
Oil scraper ring	0.010 ... 0.050	0.200



15 – Cylinder head, valve gear



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1 Chain drive

⇒ "1.1 Timing chain covers - exploded view", page 76

⇒ "1.2 Removing and installing timing chain covers (left and right)", page 78

⇒ "1.3 Removing and installing timing chain cover (bottom)", page 81

⇒ "1.4 Camshaft timing chains - exploded view", page 86

⇒ "1.5 Removing camshaft timing chains from camshafts", page 89

⇒ "1.6 Removing and installing camshaft timing chains", page 96

⇒ "1.7 Drive chain for valve gear - exploded view", page 100

⇒ "1.8 Removing and installing drive chain for valve gear", page 101

⇒ "1.9 Drive chain for auxiliary drives - exploded view", page 104

⇒ "1.10 Removing and installing drive chain for auxiliary drives", page 104

⇒ "1.11 Auxiliary drives - exploded view", page 107

⇒ "1.12 Renewing oil seals for auxiliary drives", page 107

⇒ "1.13 Removing and installing spur gear drive", page 109

1.1 Timing chain covers - exploded view

1 - Bolt

- ☐ Tightening torque and sequence ⇒ [page 78](#)

2 - Crankshaft oil seal (gearbox end)

- ☐ Renewing ⇒ [page 59](#)

3 - Dowel sleeve

- ☐ 2x

4 - Cylinder head gasket (left-side)

5 - Bolt

- ☐ Tightening torque and sequence ⇒ [page 77](#)

6 - Timing chain cover (left-side)

- ☐ Removing and installing ⇒ [page 78](#)

7 - O-ring

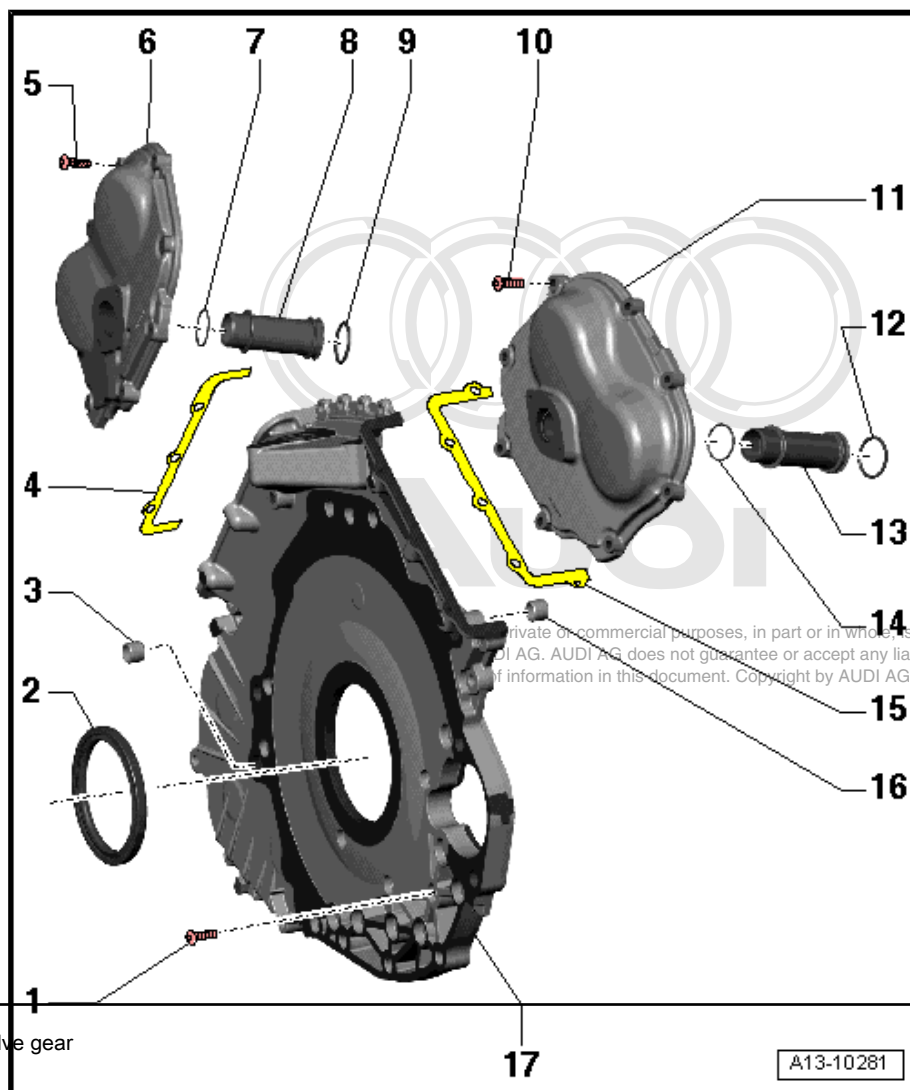
- ☐ Renew

8 - Intermediate coolant pipe (left-side)

- ☐ Drive out with drift

9 - O-ring

- ☐ Renew



10 - Bolt

- ☐ Tightening torque and sequence ⇒ [page 77](#)

11 - Timing chain cover (right-side)

- ☐ Removing and installing ⇒ [page 78](#)

12 - O-ring

- ☐ Renew

13 - Intermediate coolant pipe (right-side)

- ☐ Drive out with drift

14 - O-ring

- ☐ Renew

15 - Cylinder head gasket (right-side)**16 - Dowel sleeve**

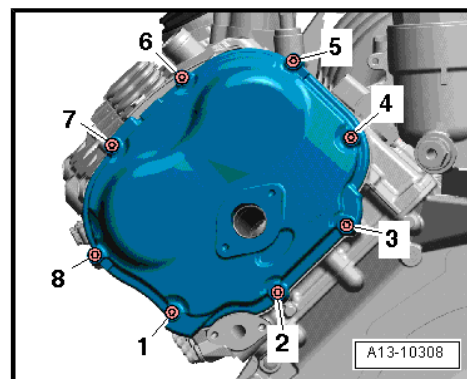
- ☐ 2x

17 - Timing chain cover (bottom)

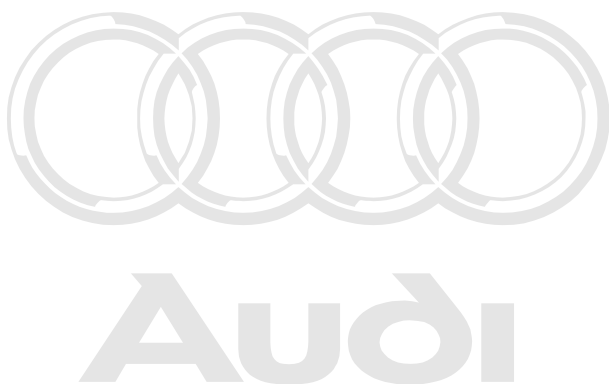
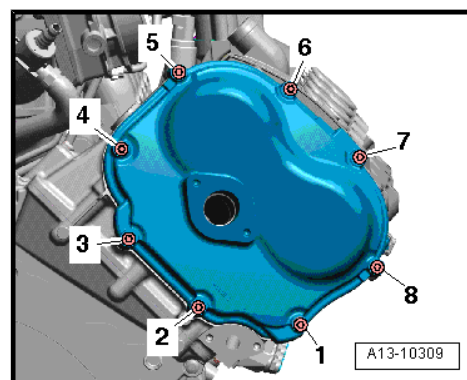
- ☐ Removing and installing ⇒ [page 81](#)

Timing chain cover (left-side) - tightening torque and tightening sequence

- Tighten bolts in the sequence -1 ... 8- to 9 Nm.

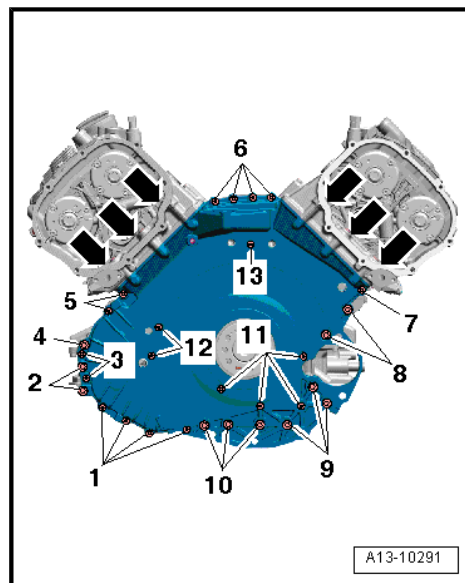
**Timing chain cover (right-side) - tightening torque and tightening sequence**

- Tighten bolts in the sequence -1 ... 8- to 9 Nm.



Timing chain cover (bottom) - tightening torque and tightening sequence

- Renew M6 bolts -1, 3, 5, 6, 7, 11, 12, 13- and -arrows-.
- Tighten bolts in 6 stages as follows:
 1. Apply locking fluid to bolts -arrows- and initially tighten to 5 Nm.
 2. Tighten bolts -1 ... 13- in diagonal sequence to 8 Nm.
 3. Tighten bolts -arrows- to 8 Nm.
 4. Tighten M8 bolts -2, 4, 8, 9, 10- in diagonal sequence to 22 Nm.
 5. Turn M6 bolts -1, 3, 5, 6, 7, 11, 12, 13- in diagonal sequence 90° (1/4 turn) further.
 6. Turn bolts -arrows- 90° (1/4 turn) further.



1.2 Removing and installing timing chain covers (left and right)

Special tools and workshop equipment required

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

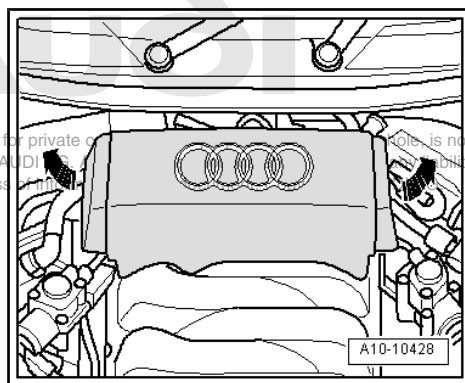
Removing



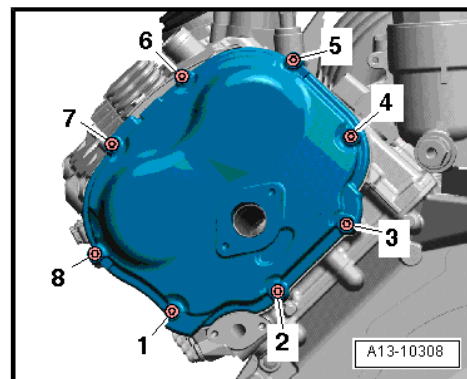
Note

Fit all cable ties in the original positions when installing.

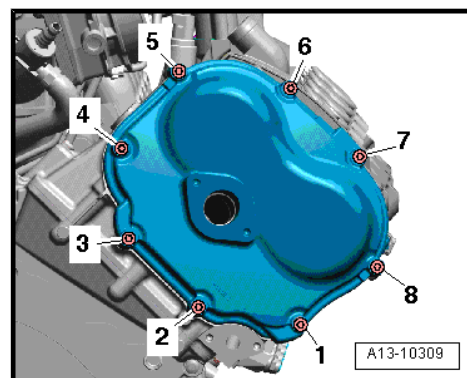
- Pull off engine cover panel (rear) -arrows-.
- Drain off coolant ⇒ [page 181](#) .
- Remove coolant pipe (left-side) ⇒ [page 204](#) .
- Remove coolant pipe (right-side) ⇒ [page 214](#) .
- Remove Lambda probes -G39- and -G108- (before catalytic converter) ⇒ Rep. gr. 24 .
- Remove combination valves for secondary air system: left-side ⇒ [page 253](#) , right-side ⇒ [page 254](#) .
- Remove coolant pipe (rear) ⇒ [page 199](#) .



- Remove bolts -1 ... 8- and detach timing chain cover (left-side).



- Remove bolts -1 ... 8- and detach timing chain cover (right-side).



Installing

Tightening torques

- ⇒ Fig. "Timing chain cover (left-side) - tightening torque and tightening sequence", page 77 .
- ⇒ Fig. "Timing chain cover (right-side) - tightening torque and tightening sequence", page 77 .



Note

- ◆ Renew M6 bolts and O-rings.
- ◆ Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .
- ◆ Fit all cable ties in the original positions when installing.



Caution

Protect lubrication system against contamination.

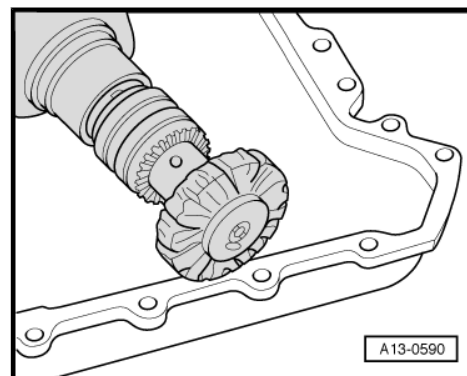
- ◆ Cover exposed parts of the engine.



WARNING

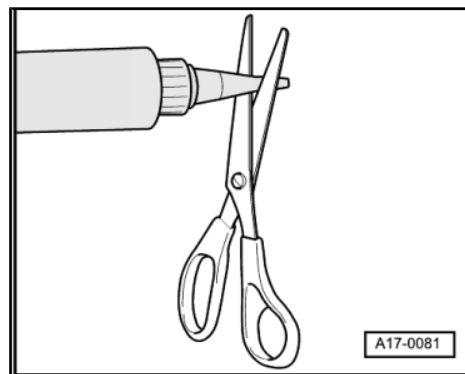
Protect eyes against injuries.

- ◆ Wear safety goggles.



- Remove remaining sealant on timing chain covers and cylinder head using rotating plastic brush or similar.
- Clean sealing surfaces; they must be free of oil and grease.

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



- Use drift to drive intermediate coolant pipe (left-side) -2- out of timing chain cover (left-side).
- Fit new O-rings -1- on intermediate coolant pipe -2-.
- Fit intermediate coolant pipe in timing chain cover (left-side).


Caution

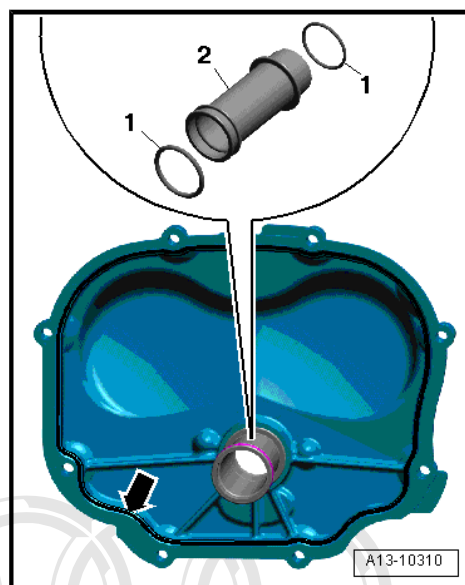
Make sure lubrication system is not clogged by excess sealant.

- ◆ *The bead of sealant must not be thicker than specified.*

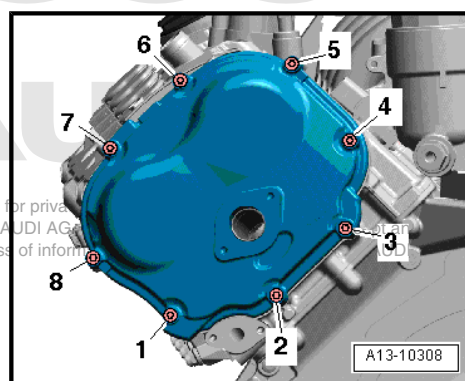
- Apply the bead of sealant -arrow- onto the clean sealing surfaces of the timing chain cover (left-side) as illustrated.
- Width of sealant bead: 2.5 mm.


Note

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



- Fit timing chain cover (left-side) and tighten bolts ⇒ [page 77](#) .



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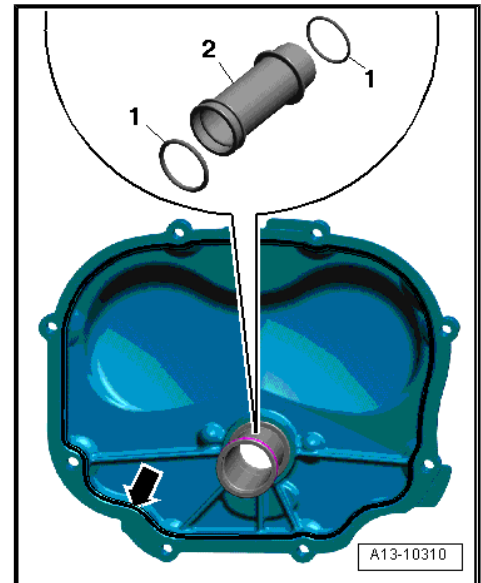
- Use drift to drive intermediate coolant pipe (right-side) -2- out of timing chain cover (right-side).
- Fit new O-rings -1- on intermediate coolant pipe -2-.
- Fit intermediate coolant pipe in timing chain cover (right-side).

**Caution**

Make sure lubrication system is not clogged by excess sealant.

◆ ***The bead of sealant must not be thicker than specified.***

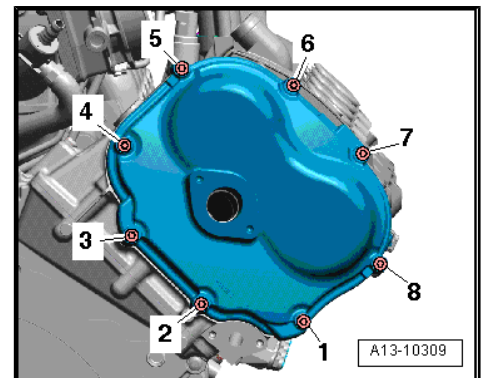
- Apply the bead of sealant -arrow- onto the clean sealing surfaces of the timing chain cover (right-side) as illustrated.
- Width of sealant bead: 2.5 mm.



- Fit timing chain cover (right-side) and tighten bolts
⇒ [page 77](#) .

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

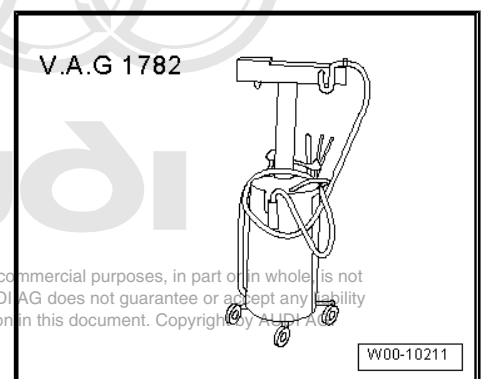
- Install coolant pipe (rear) ⇒ [page 199](#) .
- Install combination valves for secondary air system: left-side ⇒ [page 253](#) , right-side ⇒ [page 254](#) .
- Install Lambda probes -G39- and -G108- ⇒ Rep. gr. 24 .
- Install coolant pipe (left-side) ⇒ [page 204](#) .
- Install coolant pipe (right-side) ⇒ [page 214](#) .
- Fill cooling system ⇒ [page 182](#) .



1.3 Removing and installing timing chain cover (bottom)

Special tools and workshop equipment required

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



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

Removing

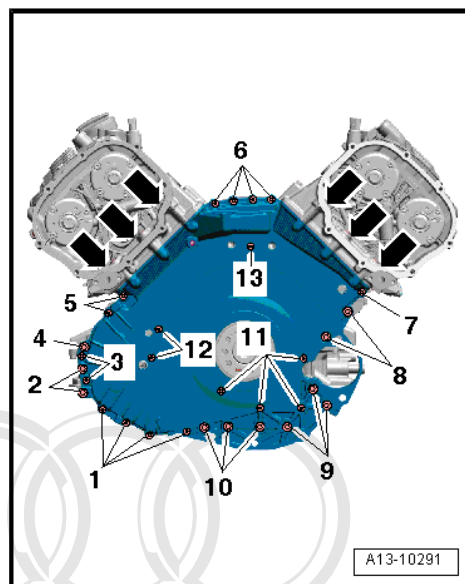
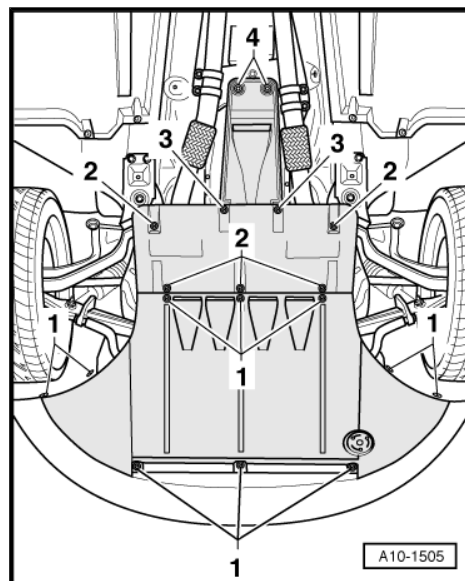
- Release fasteners -1 and 2- and remove rear noise insulation panels.



Note

Disregard -items 3 and 4-.

- Place used oil collection and extraction unit -V.A.G 1782- under engine and drain engine oil.
- Remove automatic gearbox ⇒ Rep. gr. 37 .
- Remove drive plate ⇒ [page 58](#) .
- Remove timing chain covers (left and right) ⇒ [page 78](#) .
- Remove intake manifold ⇒ Rep. gr. 24 .
- Remove oil filter housing ⇒ [page 172](#) .
- Remove bolts -arrows-.
- Remove bolts -1 ... 13- and remove timing chain cover (bottom).
- Press out crankshaft oil seal (gearbox end) from timing chain cover (bottom).



Installing

- Tightening torques
⇒ [Fig. "Timing chain cover \(bottom\) - tightening torque and tightening sequence"](#), [page 78](#)

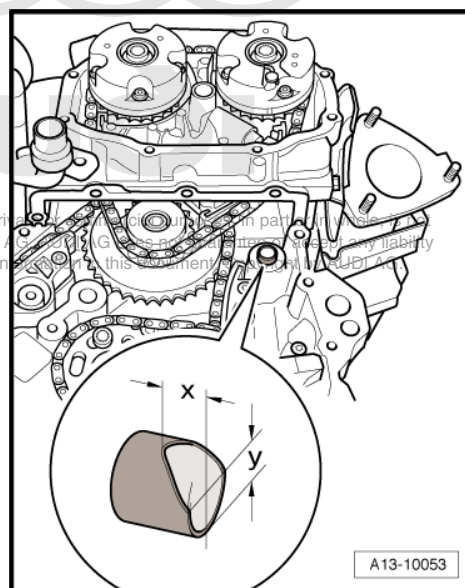
Installation is carried out in the reverse order; note the following:

- Pull dowel sleeve (top right) out of cylinder block.
- Bevel the dowel sleeve with a file, as shown in illustration.
- Dimension -x- = 6.5 mm.
- Dimension -y- = 8 mm.
- Fit dowel sleeve on cylinder block in such a way that the bevelled side points upwards.



Note

Bevelling the dowel sleeve makes it easier to fit the timing chain cover (bottom) with the cylinder head installed.



**Caution**

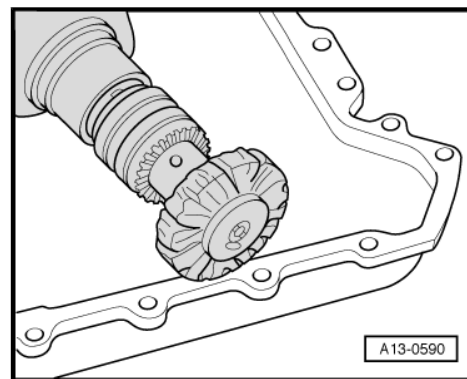
Protect lubrication system against contamination.

- ◆ *Cover exposed parts of the engine.*

**WARNING**

Protect eyes against injuries.

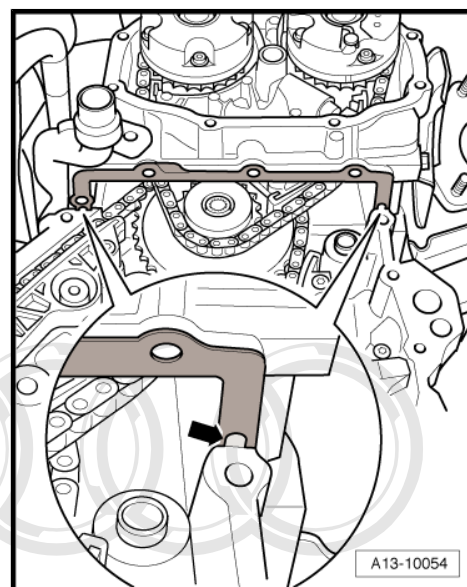
- ◆ *Wear safety goggles.*



- Remove remaining sealant on timing chain cover (bottom) and cylinder block and cylinder head using rotating plastic brush or similar.
- Clean sealing surfaces; they must be free of oil and grease.
- Clean any old sealing compound from the bores -arrow- in the cylinder head gaskets.

**Note**

With the cylinder head installed the holes in the cylinder head gasket are only half visible.

**Caution**

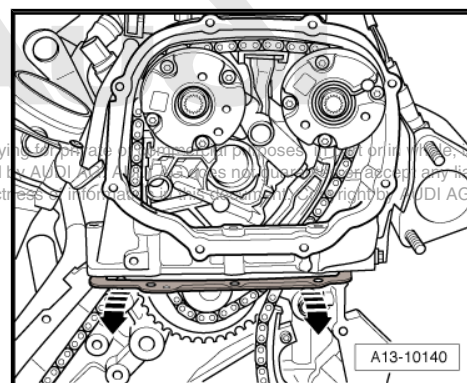
Avoid damage to cylinder head gasket.

- ◆ *Only bend the ends of the cylinder head gaskets **slightly** and do not kink.*

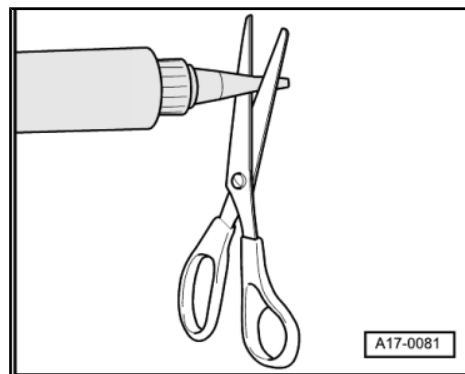
**Note**

If the cylinder head gasket has been bent and kinked it must be renewed.

- Carefully bend the ends of the cylinder head gaskets down very slightly -arrows-, just far enough to be able to clean the upper sealing surface on the gasket and cylinder head.
- Clean both cylinder head gaskets (top and bottom); they must be free of oil and grease.



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



Caution

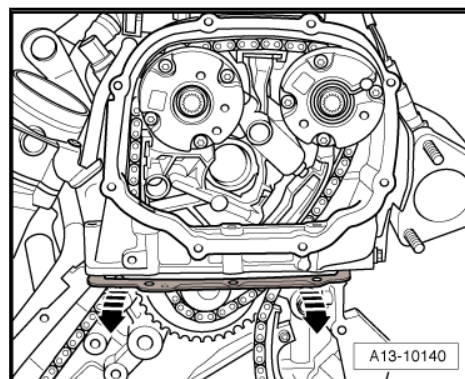
Avoid damage to cylinder head gasket.

- ◆ **Only bend the ends of the cylinder head gaskets slightly and do not kink.**

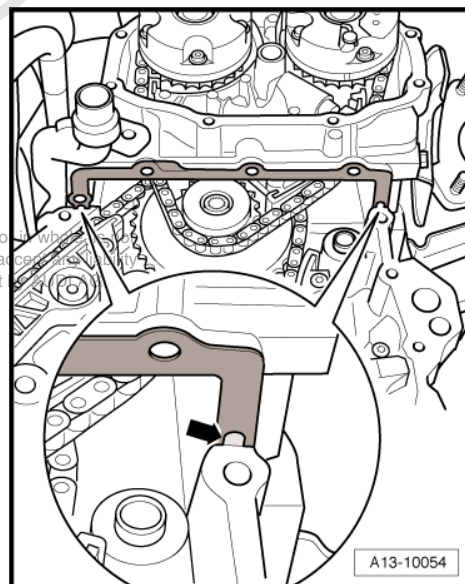


Note

If the cylinder head gasket has been bent and kinked it must be renewed.



- Apply a small amount of sealant to sealing surfaces of cylinder head gaskets (top and bottom). To do so, you again have to bend cylinder head gaskets down very slightly -arrows-.
- Use a flat object (e.g. a feeler gauge) to apply sealant to the area between cylinder head and gasket.
- Clean holes -arrow- in cylinder head gaskets and fill them with sealant.



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**Caution**

Make sure lubrication system is not clogged by excess sealant.

- ◆ ***The beads of sealant must not be thicker than specified.***

- Apply the beads of sealant -1 ... 9- onto the clean sealing surfaces of the timing chain cover (bottom) as illustrated.
- Width of beads of sealant: 2.5 mm.

**Note**

The timing chain cover (bottom) must be installed within 5 minutes after applying the sealant.

- Fit timing chain cover (bottom), guiding it towards the sealing surface on cylinder block and cylinder head at an angle and from below.
- Take care not to damage the cylinder head gaskets when fitting the cover.

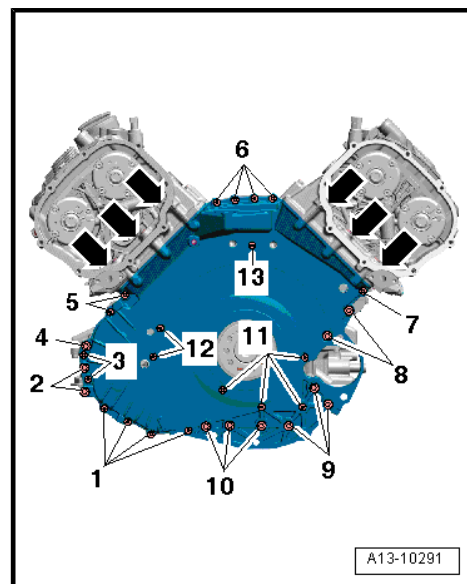
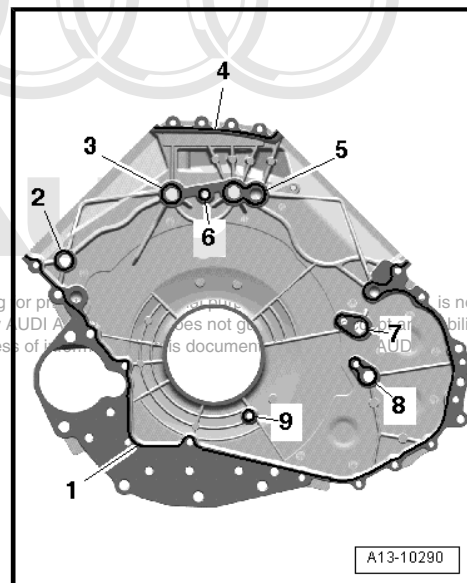
**Note**

If the cylinder head gasket has been damaged it must be renewed.

- Tighten bolts ⇒ [page 78](#) .

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

- Install crankshaft oil seal (gearbox end) ⇒ [page 59](#) .
- Install oil filter housing ⇒ [page 172](#) .
- Install intake manifold ⇒ Rep. gr. 24 .
- Install timing chain covers (left and right) ⇒ [page 79](#) .
- Install drive plate ⇒ [page 58](#) .
- Install automatic gearbox ⇒ Rep. gr. 37 .
- Fill up with engine oil and check oil level ⇒ [page 176](#) .



1.4 Camshaft timing chains - exploded view

Camshaft timing chain (left-side)

1 - Camshaft adjuster for exhaust camshaft

- ☐ Identification "Exhaust"
- ☐ Removing and installing
⇒ ["1.6 Removing and installing camshaft timing chains", page 96](#)

2 - Bolt

- ☐ Renew
- ☐ 80 Nm + 90° (1/4 turn further)

3 - Bolt

- ☐ Renew
- ☐ 80 Nm + 90° (1/4 turn further)

4 - Camshaft adjuster for inlet camshaft

- ☐ Identification "Intake"
- ☐ Removing and installing
⇒ ["1.6 Removing and installing camshaft timing chains", page 96](#)

5 - Camshaft timing chain (left-side)

- ☐ Before removing, mark running direction with paint
- ☐ Removing and installing
⇒ [page 96](#)

6 - Bolt

- ☐ Renew
- ☐ 5 Nm + 90° (1/4 turn further)

7 - Slide

8 - Chain tensioner for camshaft timing chain (left-side)

- ☐ Removing and installing ⇒ ["1.6 Removing and installing camshaft timing chains", page 96](#)

9 - Oil strainer

- ☐ Inserted in chain tensioner
- ☐ Watch position of locking lug on outer circumference

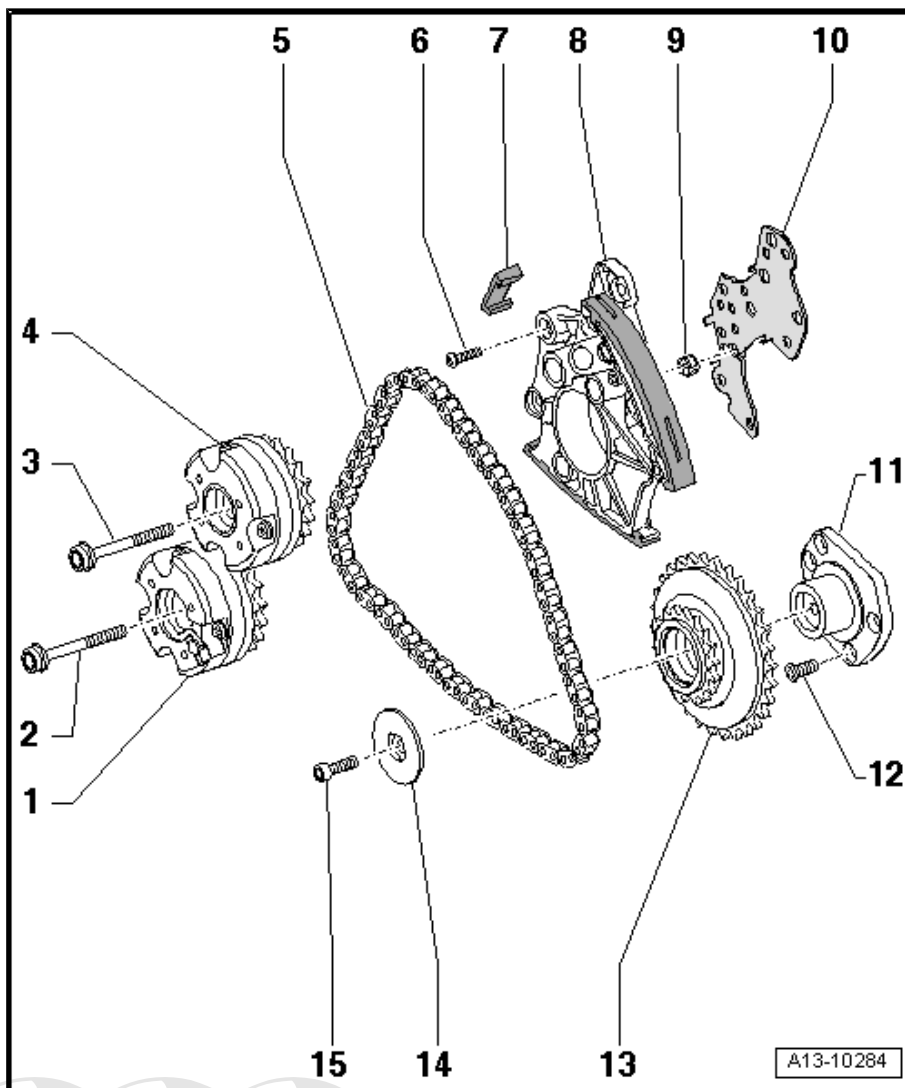
10 - Gasket

- ☐ Renew
- ☐ Clipped onto chain tensioner

11 - Bearing bracket for drive sprocket

12 - Bolt

- ☐ Renew
- ☐ 5 Nm + 90° (1/4 turn further)



13 - Drive chain sprocket for camshaft timing chain (left-side)**14 - Thrust washer for drive sprocket****15 - Bolt**

- ☐ 22 Nm

Camshaft timing chain (right-side)**1 - Bearing mounting for drive sprocket**

- ☐ For camshaft timing chain (right-side)
- ☐ Asymmetric version
- ☐ Installation position
⇒ [page 88](#)

2 - Bolt

- ☐ 42 Nm

3 - Camshaft adjuster for exhaust camshaft

- ☐ Identification "Exhaust"
- ☐ Removing and installing
⇒ ["1.6 Removing and installing camshaft timing chains"](#), [page 96](#)

4 - Bolt

- ☐ Renew
- ☐ 80 Nm + 90° (1/4 turn further)

5 - Bolt

- ☐ Renew
- ☐ 80 Nm + 90° (1/4 turn further)

6 - Camshaft adjuster for inlet camshaft

- ☐ Identification "Intake"
- ☐ Removing and installing
⇒ ["1.6 Removing and installing camshaft timing chains"](#), [page 96](#)

7 - Camshaft timing chain (right-side)

- ☐ Before removing, mark running direction with paint
- ☐ Removing and installing ⇒ [page 96](#)

8 - Chain tensioner for camshaft timing chain (right-side)

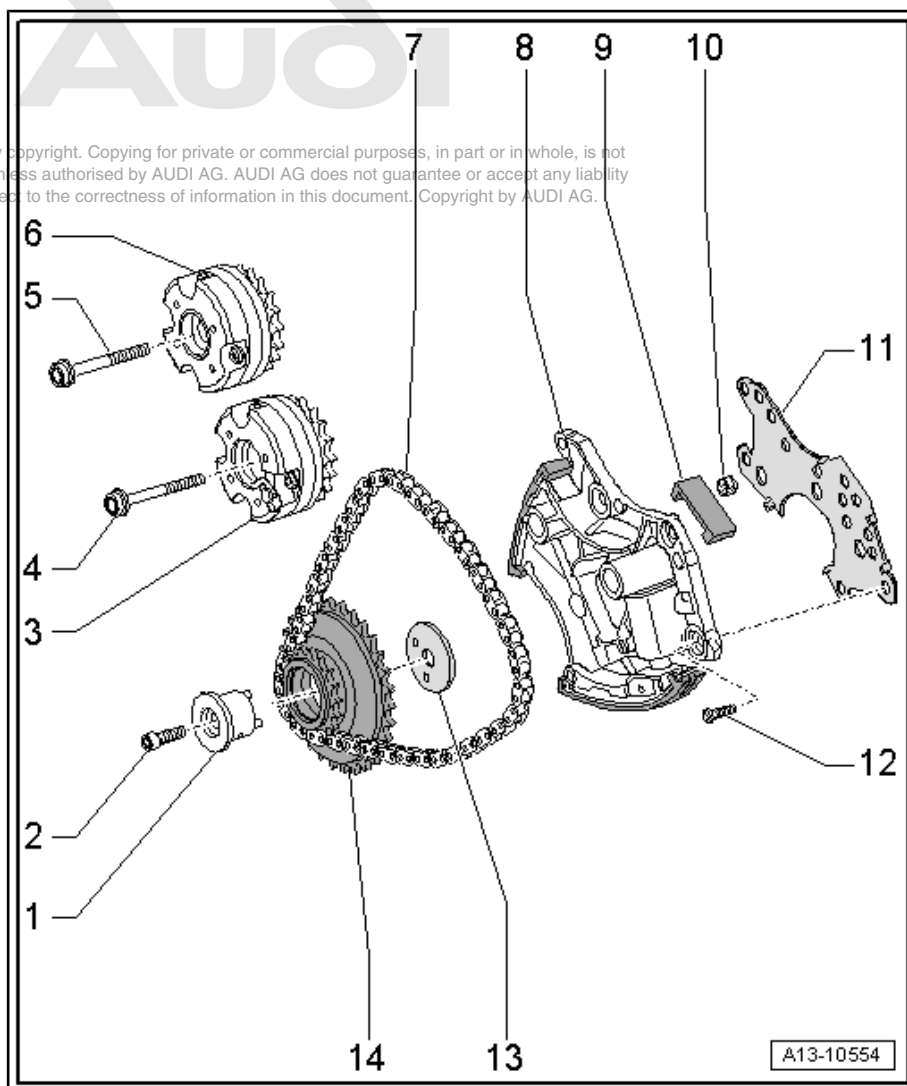
- ☐ Removing and installing ⇒ ["1.6 Removing and installing camshaft timing chains"](#), [page 96](#)

9 - Slide**10 - Oil strainer**

- ☐ Inserted in chain tensioner
- ☐ Installation position: note locating lug on outer circumference

11 - Gasket

- ☐ Renew



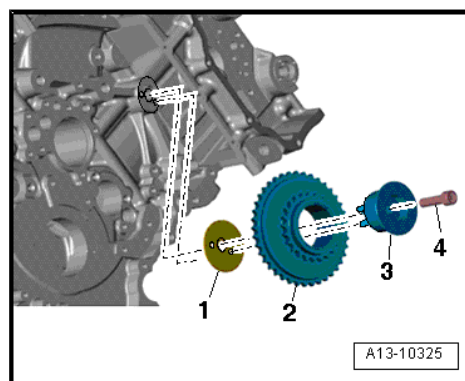
- ☐ Clipped onto chain tensioner

12 - Bolt

- ☐ Renew
- ☐ 5 Nm + 90° (1/4 turn further)

13 - Thrust washer for drive sprocket**14 - Drive chain sprocket for camshaft timing chain (right-side)****Installation position of bearing mounting for drive chain sprocket for camshaft timing chain (right-side)**

- Dowel pins in bearing mounting -3- for drive chain sprocket for camshaft timing chain (right-side) must engage in drillings in thrust washer -1- and in cylinder block drillings.

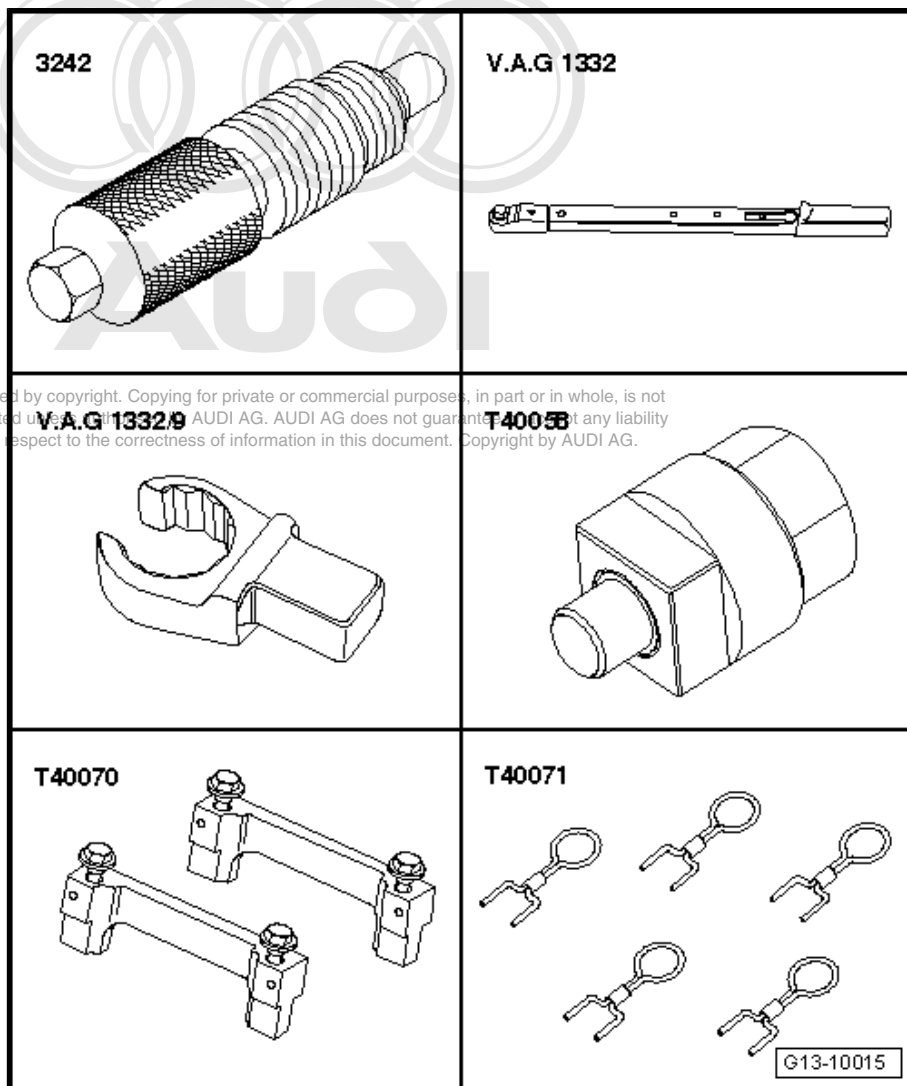
2 - Drive chain sprocket for camshaft timing chain (right-side)**4 - Bolt**

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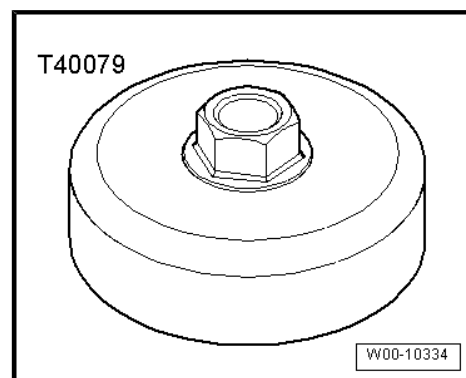
1.5 Removing camshaft timing chains from camshafts

Special tools and workshop equipment required

- ◆ Locking pin -3242- , or alternatively locking pin - T40237-
- ◆ Torque wrench -V.A.G 1332-
- ◆ Open ring spanner insert - V.A.G 1332/9-
- ◆ Adapter -T40058-
- ◆ 2x Camshaft clamp - T40070-
- ◆ 2x Locking pin -T40071-



- ◆ Key -T40079-



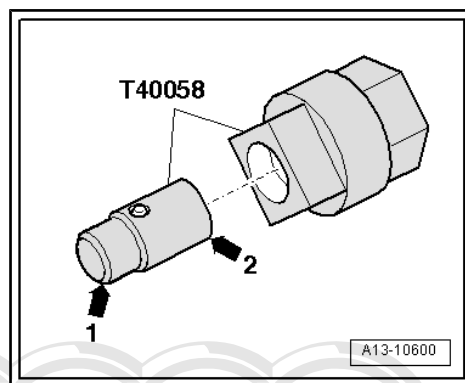
Removing



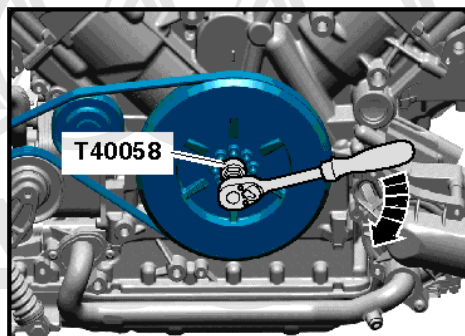
Note

- ◆ *In the following procedure the camshaft timing chains remain on the engine.*
- ◆ *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.*

- Remove cylinder head covers: left-side ➤ [page 116](#) , right-side ➤ [page 117](#) .
- Remove timing chain covers (left and right) ➤ [page 78](#) .
- Insert guide pin of adapter -T40058- as follows:
 - The smaller-diameter section -arrow 1- faces the engine.
 - The larger-diameter section -arrow 2- faces the adapter.

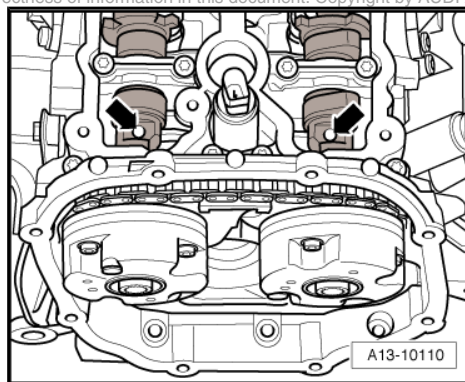


- Using adapter -T40058- turn the crankshaft in the normal direction of rotation -arrow- to “TDC”.

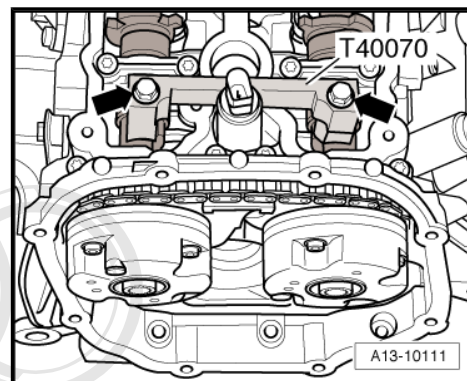


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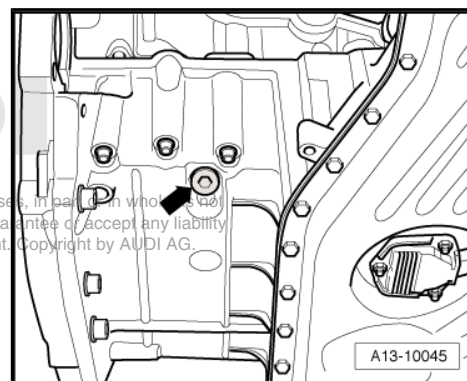
- The threaded holes -arrows- in the camshafts must face upwards.



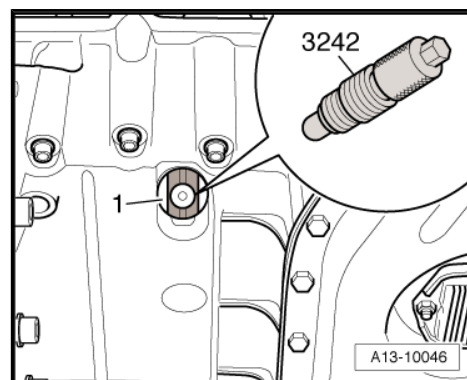
- Fit camshaft clamps -T40070- to both cylinder heads and tighten bolts -arrows- to 25 Nm.
- The camshaft clamp -T40070- is positioned correctly if the holes for the cylinder head bolts remain free.



- Unscrew plug -arrow- from sump (top section).



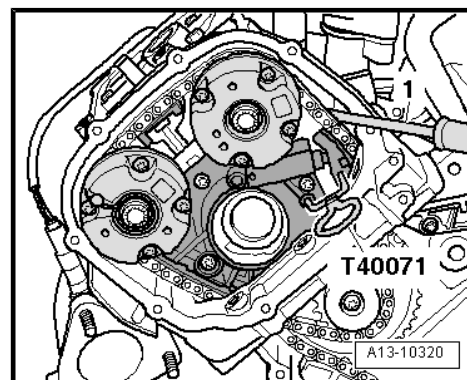
- Screw locking pin -3242- into bore (tightening torque: 20 Nm); if necessary, turn crankshaft backwards and forwards slightly to fully centralise locking pin.



- Press guide rail of chain tensioner for camshaft timing chain (left-side) inwards as far as the stop using a screwdriver -1-. Then lock chain tensioner by inserting locking pin -T40071-.

**Note**

The chain tensioner is oil-damped and can therefore only be compressed slowly by applying constant pressure.



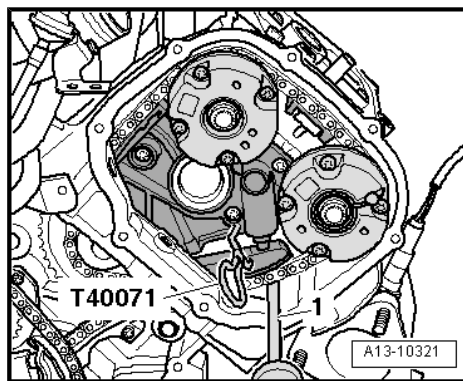


- Press guide rail of chain tensioner for camshaft timing chain (right-side) inwards as far as the stop using a screwdriver -1-. Then lock chain tensioner by inserting locking pin - T40071- .



Note

The chain tensioner is oil-damped and can therefore only be compressed slowly by applying constant pressure.

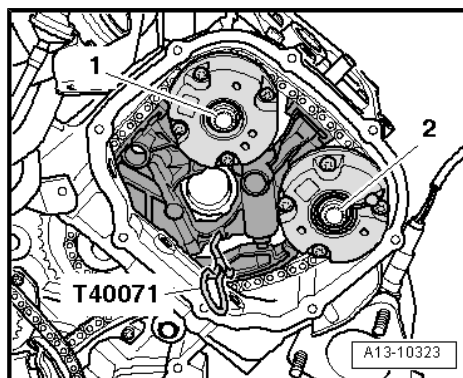
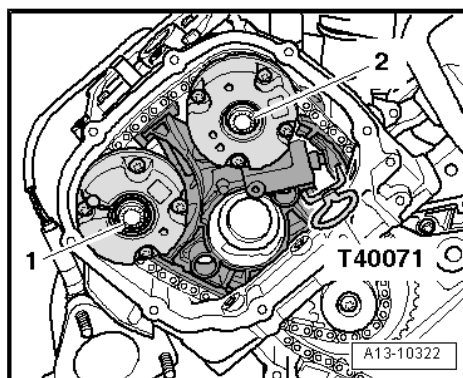


Caution

Risk of irreparable damage to engine.

- ◆ **Block off the opening in the valve timing housing with a clean cloth to prevent small items from dropping into the engine.**

- Unscrew bolts -1 and 2- at cylinder head (left-side) and remove both camshaft adjusters.
- Mark positions of camshaft adjusters with paint for re-installation.
- Unscrew bolts -1 and 2- at cylinder head (right-side) and remove both camshaft adjusters.



Installing

Tightening torques

- ➔ [“1.4 Camshaft timing chains - exploded view”, page 86](#) .
- ➔ [“2.1 Sump \(top section\) - exploded view”, page 161](#) .



Note

- ◆ **Renew the bolts tightened with specified tightening angle.**
- ◆ **Fit new O-ring for screw plug.**



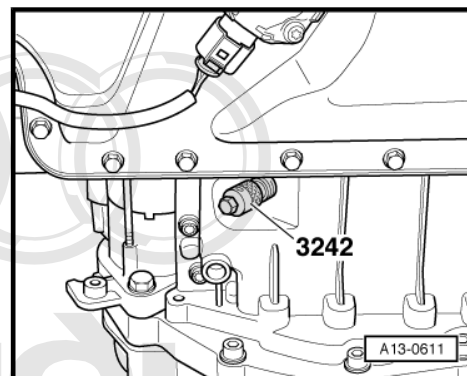
Caution

Avoid damage to valves and piston crowns.

- ◆ **The crankshaft must not be at “TDC” at any cylinder when the camshafts are turned.**

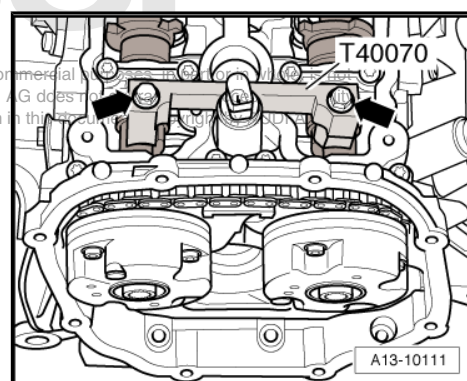
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- Drive chain for valve gear installed ⇒ [page 101](#)
- Crankshaft locked in "TDC" position with locking pin -3242- .

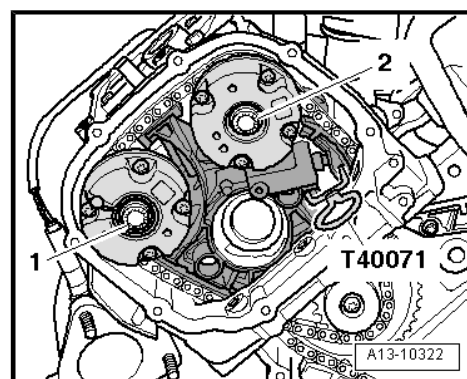


- Camshaft clamps -T40070- installed on both cylinder heads and tightened to 25 Nm -arrows-.

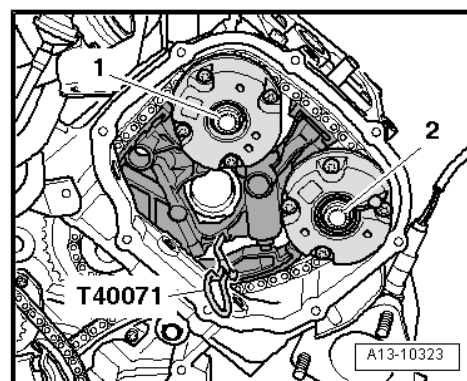
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- Re-install camshaft adjusters on cylinder head (left-side) in the same position as before (pay attention to marks applied when removing).
- Position camshaft timing chain on drive chain sprocket and camshaft adjusters and loosely screw in bolts -1 and 2-.
- It should just be possible to turn both camshaft adjusters on the camshaft without axial movement.
- Remove locking pin -T40071- .

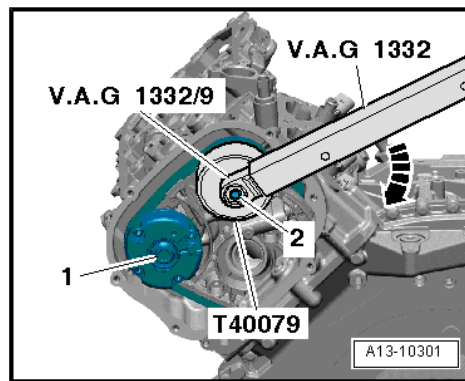


- Re-install camshaft adjusters on cylinder head (right-side) in the same position as before (pay attention to marks applied when removing).
- Position camshaft timing chain on drive chain sprocket and camshaft adjusters and loosely screw in bolts -1 and 2-.
- It should just be possible to turn both camshaft adjusters on the camshaft without axial movement.
- Remove locking pin -T40071- .



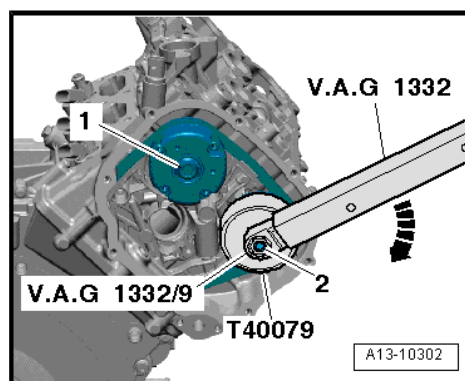
- Fit key -T40079- onto camshaft adjuster of inlet camshaft on cylinder head (left-side).
- Apply torque wrench -V.A.G 1332- with tool insert -V.A.G 1332/9- to key -T40079- .
- Have a 2nd mechanic apply a torque of 40 Nm to camshaft adjuster in direction of -arrow-.
- Tighten bolts as follows while keeping camshaft adjuster under tension:

1. Pre-tighten bolt -1- on exhaust camshaft to 60 Nm.
2. Pre-tighten bolt -2- on inlet camshaft to 60 Nm.

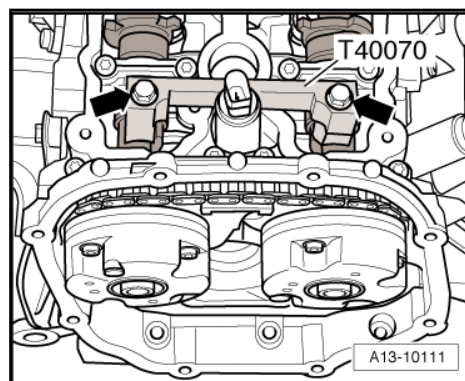


- Fit key -T40079- onto camshaft adjuster of exhaust camshaft on cylinder head (right-side).
- Apply torque wrench -V.A.G 1332- with tool insert -V.A.G 1332/9- to key -T40079- .
- Have a 2nd mechanic apply a torque of 40 Nm to camshaft adjuster in direction of -arrow-.
- Tighten bolts as follows while keeping camshaft adjuster under tension:

1. Pre-tighten bolt -1- on inlet camshaft to 60 Nm.
2. Pre-tighten bolt -2- on exhaust camshaft to 60 Nm.

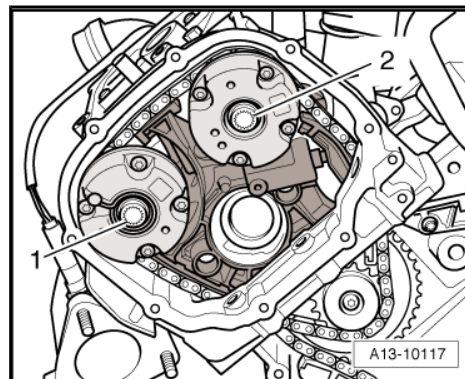


- Detach key -T40079- .
- Remove camshaft clamp -T40070- from both cylinder heads -arrows-.



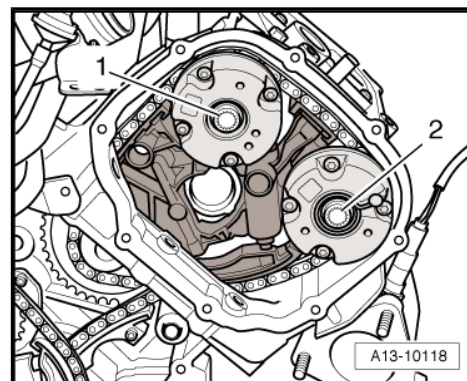
- Tighten camshaft adjuster bolts on cylinder head (left-side) as follows:

1. Tighten bolt -1- on exhaust camshaft to final tightening torque.
2. Tighten bolt -2- on inlet camshaft to final tightening torque.

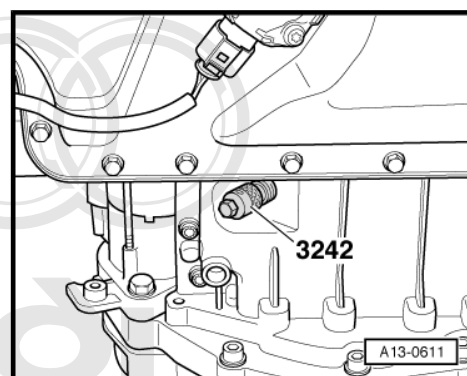


- Tighten camshaft adjuster bolts on cylinder head (right-side) as follows:

1. Tighten bolt -1- on inlet camshaft to final tightening torque.
2. Tighten bolt -2- on exhaust camshaft to final tightening torque.



- Remove locking pin -3242- .

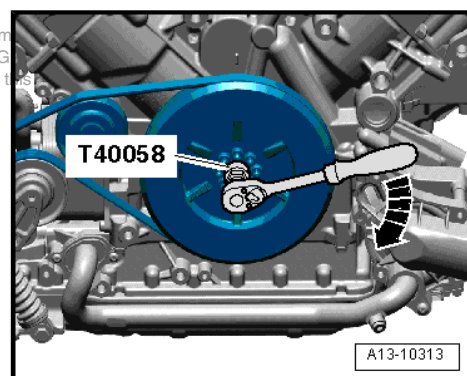


- Using adapter -T40058- , turn crankshaft two rotations in normal direction of rotation -arrow- until crankshaft is at "TDC" again.

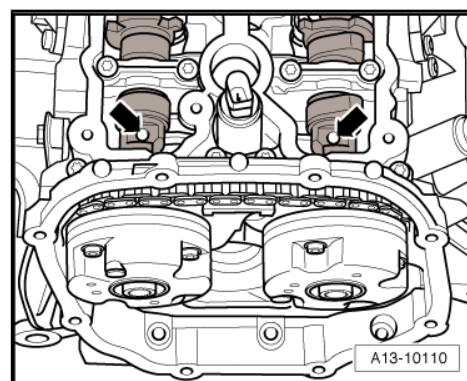


Note

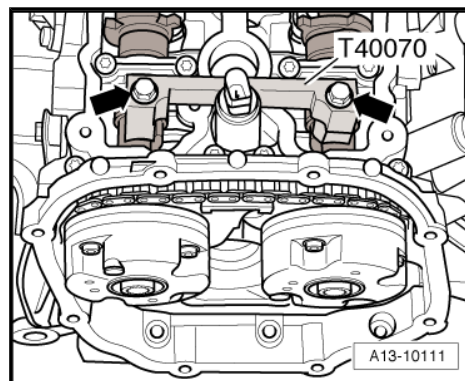
If you turned the crankshaft beyond "TDC", turn it back approx. 30° and set to "TDC" again.



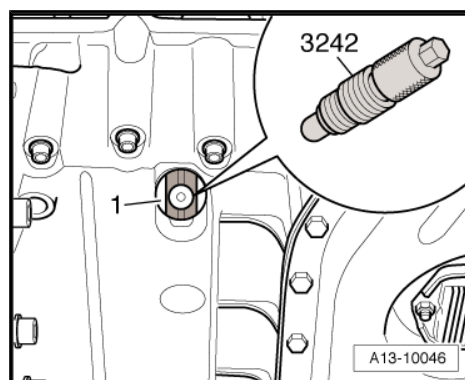
- The threaded holes -arrows- in the camshafts must face upwards.



- Fit camshaft clamps -T40070- to both cylinder heads and tighten bolts -arrows- to 25 Nm.
- The camshaft clamp -T40070- is positioned correctly if the holes for the cylinder head bolts remain free.



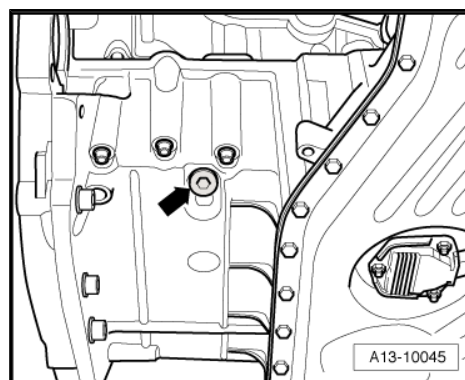
- Screw the locking pin -3242- into the hole (20 Nm).
- The locking pin -3242- must engage in the locating hole in crankshaft -1-. If it does not, reset valve timing.
- Remove camshaft clamps from both cylinder heads.
- Remove locking pin -3242- .



- Secure screw plug for “TDC” marking.

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

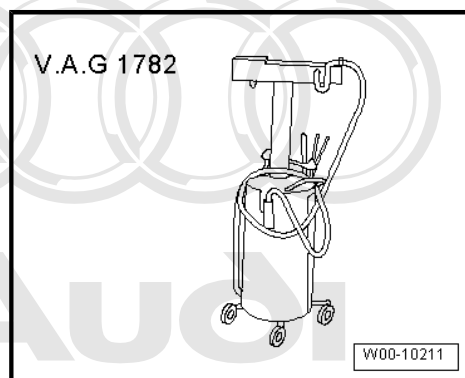
- Install timing chain covers (left and right) ⇒ [page 79](#) .
- Install cylinder head covers: left-side ⇒ [page 116](#) , right-side ⇒ [page 117](#) .



1.6 Removing and installing camshaft timing chains

Special tools and workshop equipment required

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



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Removing



Note

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.

- Release fasteners -1 and 2- and remove rear noise insulation panels.



Note

Disregard -items 3 and 4-.

- Place used oil collection and extraction unit -V.A.G 1782- under engine and drain engine oil.
- Remove automatic gearbox ⇒ Rep. gr. 37 .
- Remove drive plate ⇒ [page 58](#) .
- Remove cylinder head cover: left-side ⇒ [page 116](#) , right-side ⇒ [page 117](#) .
- Remove timing chain covers (left and right) ⇒ [page 78](#) .
- Remove intake manifold ⇒ Rep. gr. 24 .
- Remove oil filter housing ⇒ [page 172](#) .
- Remove timing chain cover (bottom) ⇒ [page 81](#) .
- Detach timing chains from camshafts ⇒ [page 89](#) .

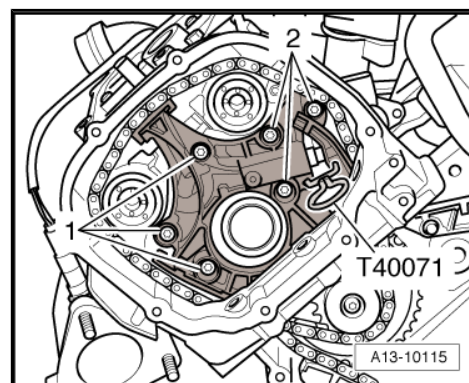
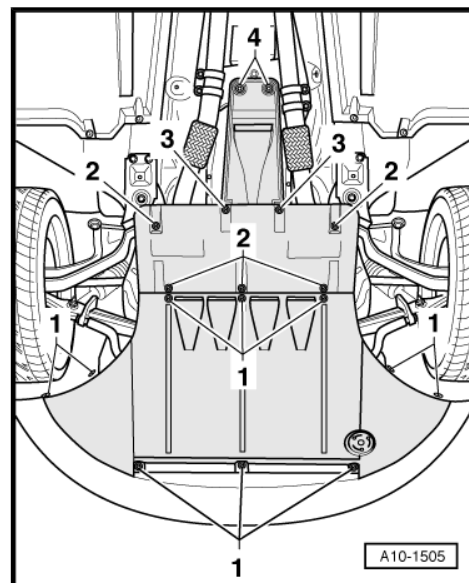


Caution

If a used timing chain rotates in the opposite direction when it is refitted, this can cause breakage.

- ◆ *Mark running direction of timing chain with coloured arrows for re-installation. Do not mark timing chain by means of centre punch, notch or the like.*

- Unscrew bolts -1 and 2- and remove chain tensioner (left-side) and camshaft timing chain (left-side).





- Unscrew bolts -1 and 2- and remove chain tensioner (right-side) and camshaft timing chain (right-side).

Installing

- Tightening torque
⇒ ["1.4 Camshaft timing chains - exploded view", page 86](#)



Note

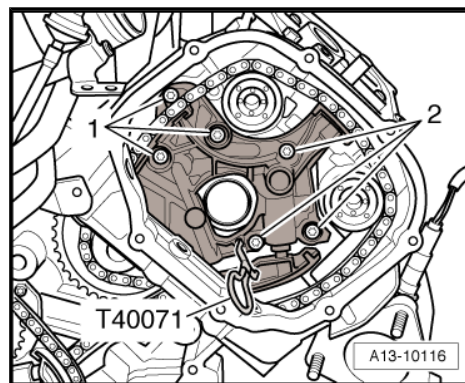
- ♦ *Note the correct installation position if the tensioning element has been removed from the chain tensioner: drilling in base of housing faces chain tensioner and piston faces tensioner rail.*
- ♦ *Renew the bolts tightened with specified tightening angle.*
- ♦ *Renew gasket.*



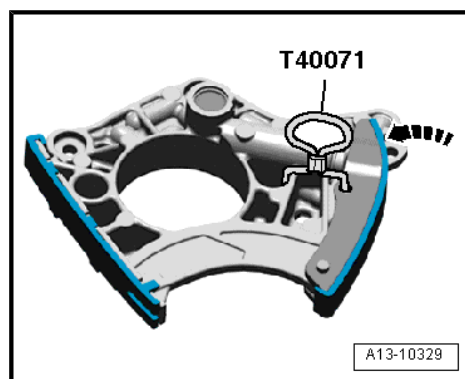
Caution

Avoid damage to valves and piston crowns.

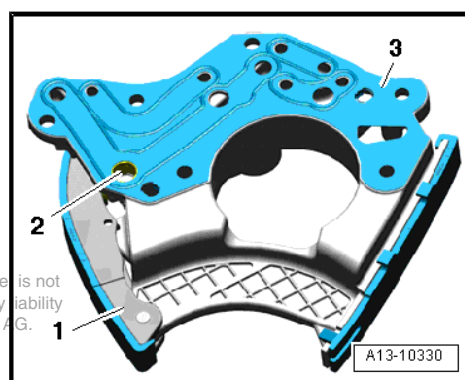
- ♦ **The crankshaft must not be at "TDC" at any cylinder when the camshafts are turned.**



- Press guide rails of chain tensioners for camshaft timing chains (left and right) inwards in direction of -arrow- as far as the stop. Then lock chain tensioners by inserting locking pin - T40071- .

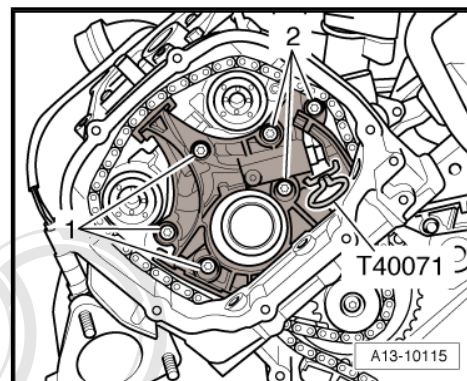


- If necessary, clean oil strainer -2- in both chain tensioners.
- Fit new gasket -3- to rear of chain tensioner -1-.



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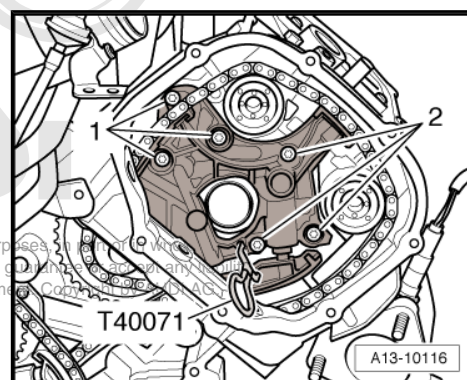
- Install chain tensioner on cylinder head (left-side) and position camshaft timing chain as shown in the illustration (according to marks applied when removing).
- Tighten bolts -1 and 2-.



- Install chain tensioner on cylinder head (right-side) and position camshaft timing chain as shown in the illustration (according to marks applied when removing).
- Tighten bolts -1 and 2-.

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

- Position timing chains on camshafts ⇒ [page 92](#).
- Install timing chain cover (bottom) ⇒ [page 81](#).
- Install crankshaft oil seal (gearbox end) ⇒ [page 59](#).
- Install oil filter housing ⇒ [page 172](#).
- Install intake manifold ⇒ Rep. gr. 24.
- Install timing chain covers (left and right) ⇒ [page 79](#).
- Install cylinder head cover: left-side ⇒ [page 116](#), right-side ⇒ [page 117](#).
- Install drive plate ⇒ [page 58](#).
- Install automatic gearbox ⇒ Rep. gr. 37.
- Fill up with engine oil and check oil level ⇒ [page 176](#).



1.7 Drive chain for valve gear - exploded view

1 - Guide rail

2 - Bolt

- ☐ Renew
- ☐ 17 Nm + 90° (1/4 turn further)

3 - Bolt

- ☐ Tightening torque
⇒ [Item 15 \(page 87\)](#)

4 - Thrust washer for drive sprocket

5 - Drive sprocket for timing chain (left-side)

6 - Bolt

- ☐ Renew
- ☐ 17 Nm + 90° (1/4 turn further)

7 - Drive chain for valve gear

- ☐ Before removing, mark running direction with paint
- ☐ Removing and installing
⇒ [page 101](#)

8 - Guide rail

9 - Bolt

- ☐ Renew
- ☐ 17 Nm + 90° (1/4 turn further)

10 - Bolt

- ☐ Tightening torque
⇒ [Item 12 \(page 86\)](#)

11 - Bearing bracket for drive sprocket

- ☐ For camshaft timing chain (right-side)
- ☐ Asymmetric version
- ☐ Installation position ⇒ [page 101](#)

12 - Thrust washer

13 - Drive sprocket for timing chain (right-side)

14 - Bearing mounting for drive sprocket

15 - Bolt

- ☐ Tightening torque ⇒ [page 86](#)

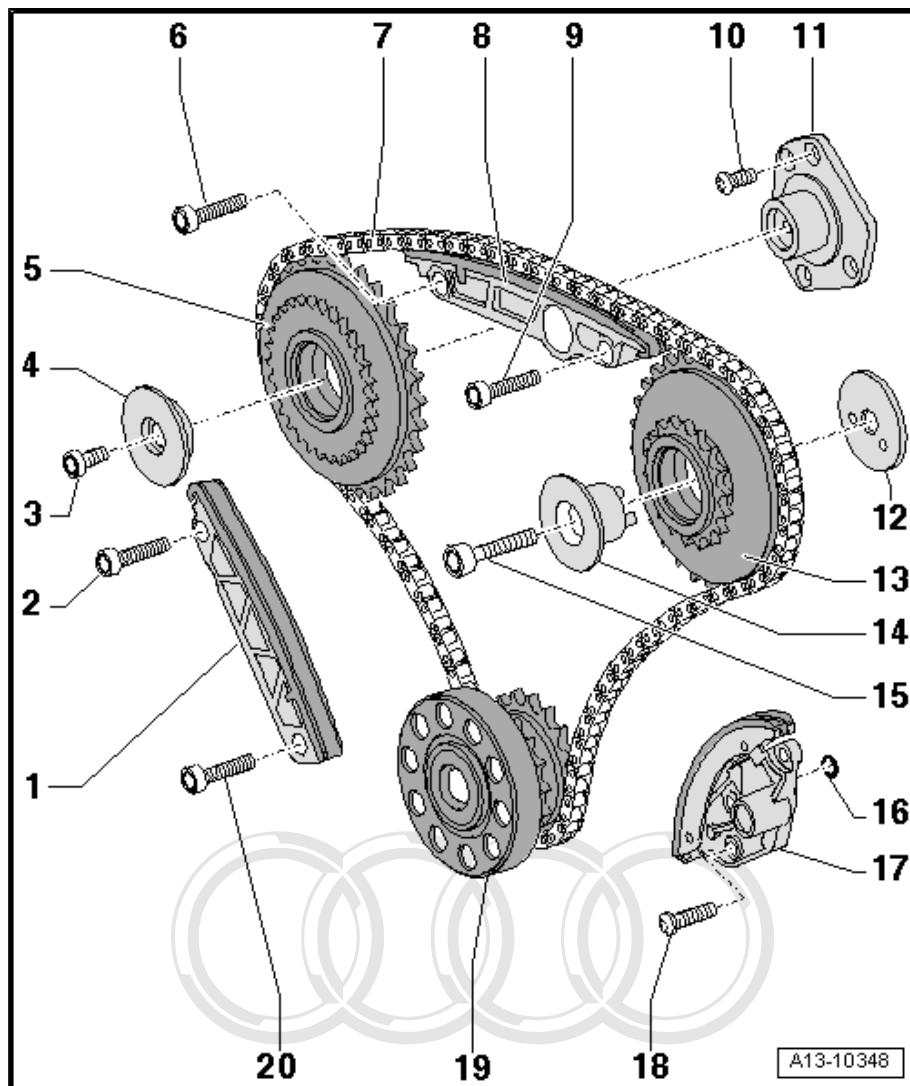
16 - O-ring

- ☐ Renew

17 - Chain tensioner

18 - Bolt

- ☐ Renew
- ☐ 5 Nm + 90° (1/4 turn further)



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19 - Crankshaft**20 - Bolt**

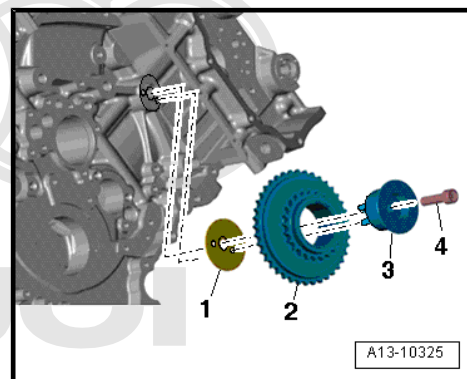
- ☐ Renew
- ☐ 17 Nm + 90° (1/4 turn further)

Installation position of bearing mounting for drive chain sprocket for camshaft timing chain (right-side)

- Dowel pins in bearing mounting -3- for drive chain sprocket for camshaft timing chain (right-side) must engage in drillings in thrust washer -1- and in cylinder block drillings.

2 - Drive chain sprocket for camshaft timing chain (right-side)

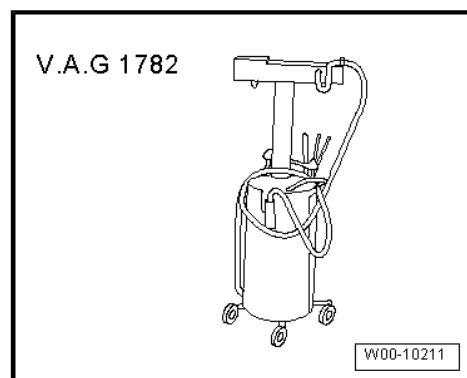
4 - Bolt



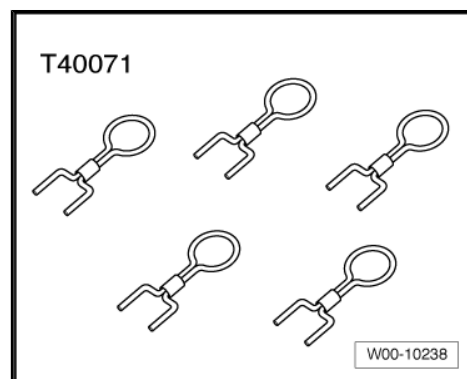
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1.8 Removing and installing drive chain for valve gear**Special tools and workshop equipment required**

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



- ◆ Locking pin -T40071-



Removing

- Release fasteners -1 and 2- and remove rear noise insulation panels.



Note

Disregard -items 3 and 4-.

- Place used oil collection and extraction unit -V.A.G 1782- under engine and drain engine oil.
- Remove automatic gearbox ⇒ Rep. gr. 37 .
- Remove drive plate ⇒ [page 58](#) .
- Remove cylinder head covers: left-side ⇒ [page 116](#) , right-side ⇒ [page 117](#) .
- Remove timing chain covers (left and right) ⇒ [page 78](#) .
- Remove intake manifold ⇒ Rep. gr. 24 .
- Remove oil filter housing ⇒ [page 172](#) .
- Remove timing chain cover (bottom) ⇒ [page 81](#) .
- Remove camshaft timing chains ⇒ [page 96](#) .
- Remove drive chain for auxiliary drives ⇒ [page 104](#) .
- Press guide rail of chain tensioner for drive chain in direction of -arrow- and lock chain tensioner by inserting locking pin - T40071- .



Caution

If a used drive chain rotates in the opposite direction when it is refitted, this can cause breakage.

- ◆ *Mark running direction of drive chain with paint for re-installation. Do not mark drive chain by means of centre punch, notch or the like.*

- Unscrew bolts -1- and remove guide rail.
- Unscrew bolts -2- and remove chain tensioner.
- Detach drive chain for valve gear.

Installing

- Tightening torques
⇒ ["1.7 Drive chain for valve gear - exploded view", page 100](#)

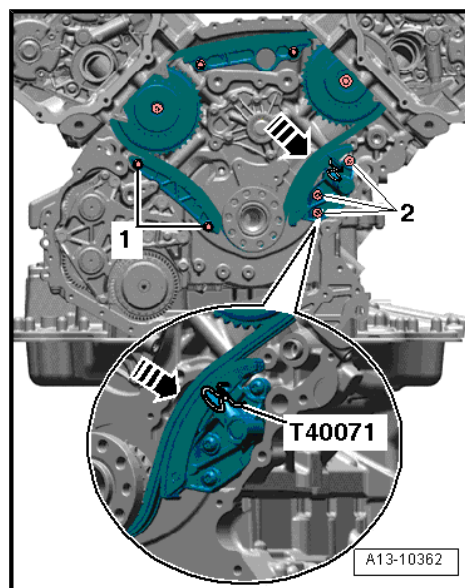
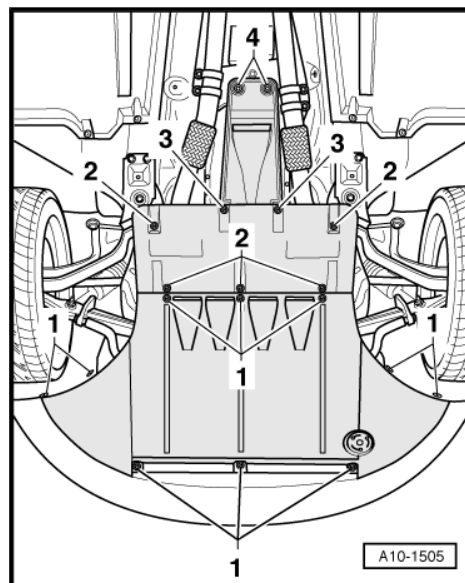
Installation is carried out in the reverse order; note the following:



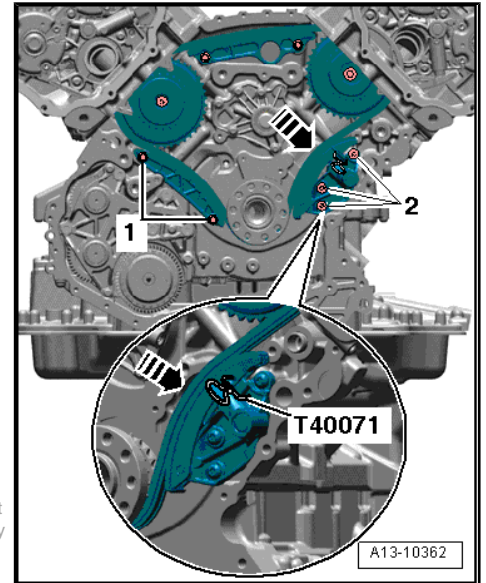
Note

Renew the bolts tightened with specified tightening angle.

- Position drive chain for valve gear onto drive chain sprockets (according to marks applied when removing).



- Install guide rail and tighten bolts -1-.
- Install chain tensioner and tighten bolts -2-.
- Push guide rail of chain tensioner for drive chain in direction of -arrow- and pull locking pin -T40071- out of chain tensioner.
- Install drive chain for auxiliary drives ⇒ [page 104](#) .
- Install camshaft timing chains ⇒ [page 98](#) .
- Install timing chain cover (bottom) ⇒ [page 81](#) .
- Install crankshaft oil seal (gearbox end) ⇒ [page 59](#) .
- Install oil filter housing ⇒ [page 172](#) .
- Install intake manifold ⇒ Rep. gr. 24 .
- Install timing chain covers (left and right) ⇒ [page 79](#) .
- Install cylinder head covers: left-side ⇒ [page 116](#) , right-side ⇒ [page 117](#) .
- Install drive plate ⇒ [page 58](#) .
- Install automatic gearbox ⇒ Rep. gr. 37 .
- Fill up with engine oil and check oil level ⇒ [page 176](#) .



1.9 Drive chain for auxiliary drives - exploded view

1 - Bolt

- ☐ Renew
- ☐ 5 Nm + 90° (1/4 turn further)

2 - Chain tensioner

- ☐ With guide rail

3 - Gasket

- ☐ Renew

4 - Compression spring

5 - Bolt

- ☐ 42 Nm

6 - Bearing mounting for idler sprocket

7 - Idler sprocket for chain of auxiliary drives

8 - Bearing bracket for idler sprocket

9 - Bolt

- ☐ Renew
- ☐ 5 Nm + 90° (1/4 turn further)

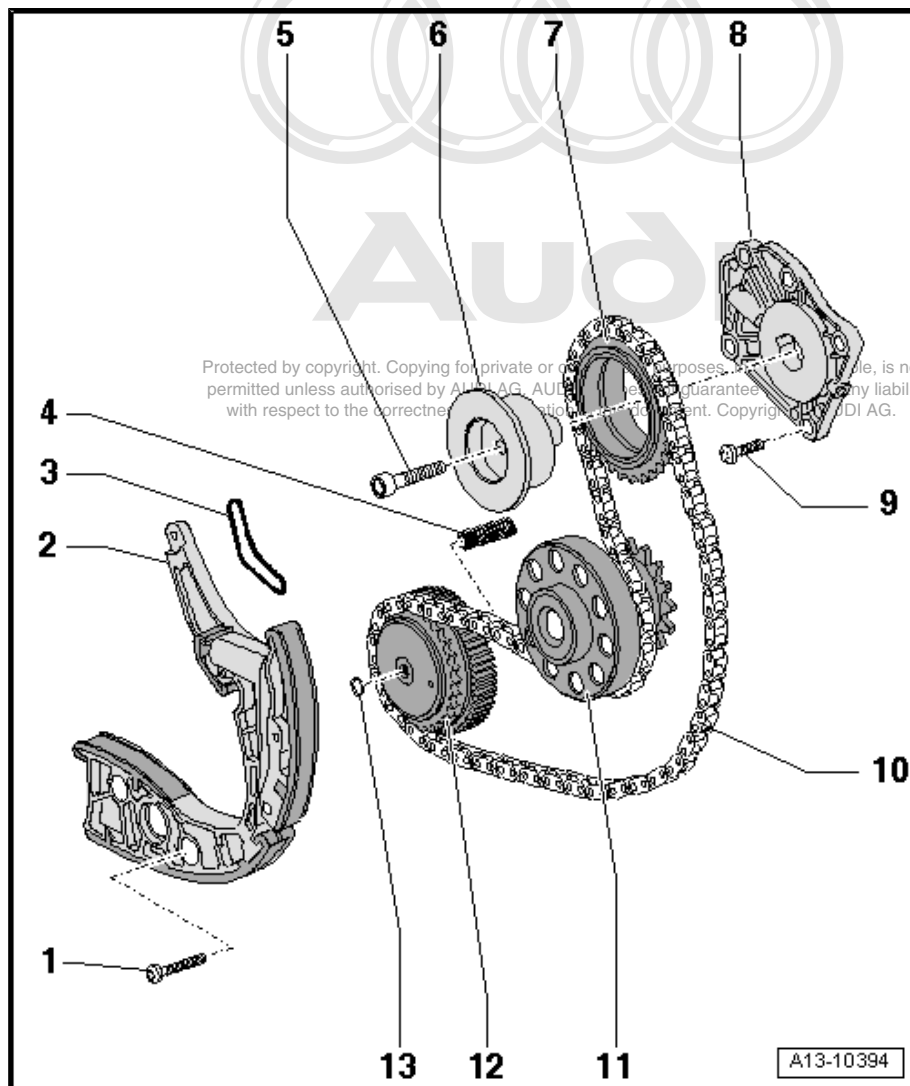
10 - Drive chain for auxiliary drives

- ☐ Before removing, mark running direction with paint
- ☐ Removing and installing
⇒ [page 104](#)

11 - Crankshaft

12 - Drive chain sprocket for auxiliary drives

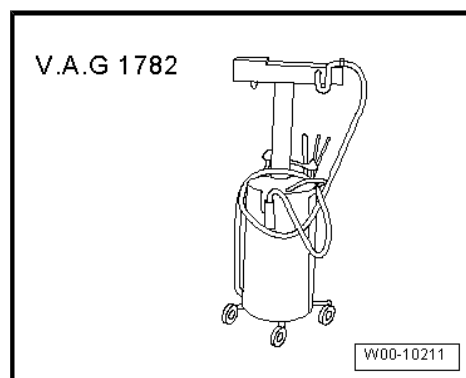
13 - Circlip



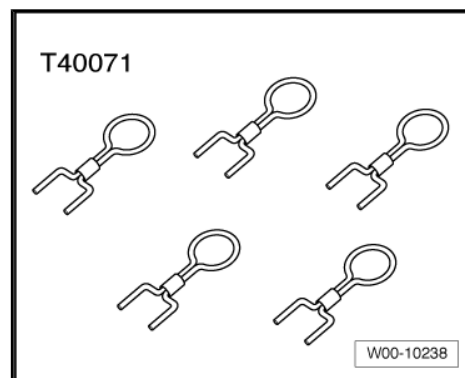
1.10 Removing and installing drive chain for auxiliary drives

Special tools and workshop equipment required

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



◆ Locking pin -T40071-

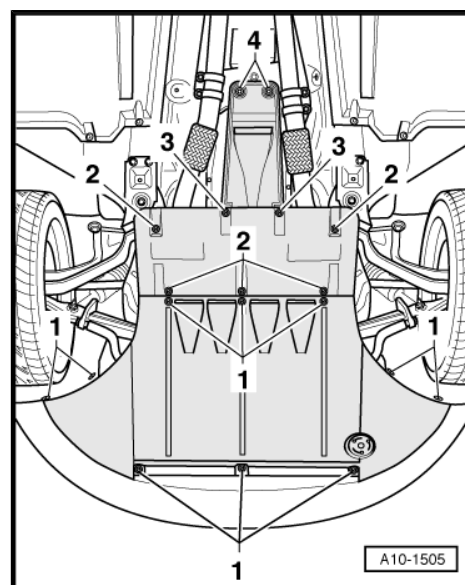
**Removing**

- Release fasteners -1 and 2- and remove rear noise insulation panels.

**Note**

Disregard -items 3 and 4-.

- Place used oil collection and extraction unit -V.A.G 1782- under engine and drain engine oil.
- Remove automatic gearbox ⇒ Rep. gr. 37 .
- Remove drive plate ⇒ [page 58](#) .
- Remove timing chain covers (left and right) ⇒ [page 78](#) .
- Remove intake manifold ⇒ Rep. gr. 24 .
- Remove oil filter housing ⇒ [page 172](#) .



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- Remove timing chain cover (bottom) ⇒ [page 81](#) .



Caution

If a used drive chain rotates in the opposite direction when it is refitted, this can cause breakage.

- ◆ *Mark running direction of drive chain with paint for re-installation. Do not mark drive chain by means of centre punch, notch or the like.*

- Press tensioning rail in direction of -arrow- and lock chain tensioner by inserting locking pin -T40071-.
- Unscrew bolt -1- and remove idler sprocket.
- Unscrew bolts -2 ... 4- and remove chain tensioner.
- Remove drive chain for auxiliary drives.

Installing

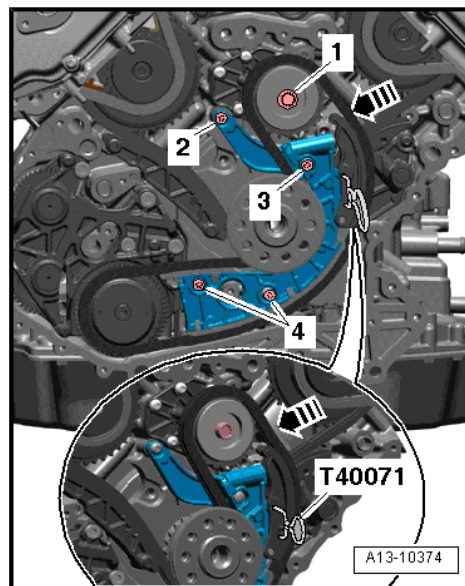
- Tightening torques
⇒ ["1.9 Drive chain for auxiliary drives - exploded view", page 104](#)

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



Note

- ◆ *Renew gasket.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- Install timing chain cover (bottom) ⇒ [page 81](#) .
- Install crankshaft oil seal (gearbox end) ⇒ [page 59](#) .
- Install oil filter housing ⇒ [page 172](#) .
- Install intake manifold ⇒ Rep. gr. 24 .
- Install timing chain covers (left and right) ⇒ [page 78](#) .
- Install drive plate ⇒ [page 58](#) .
- Install automatic gearbox ⇒ Rep. gr. 37 .
- Fill up with engine oil and check oil level ⇒ [page 176](#) .



1.11 Auxiliary drives - exploded view

1 - Circlip

2 - Spur gear drive

- ☐ Do not dismantle
- ☐ Removing and installing
⇒ [page 109](#)
- ☐ With flat-section O-ring
in power steering pump
drive
- ☐ Installation position of
flat-section O-ring
⇒ [page 107](#)

3 - Bolt

- ☐ 22 Nm

4 - Oil seal for air conditioner compressor drive

- ☐ Renewing ⇒ [page 107](#)

5 - Dust cap for air conditioner compressor drive

6 - Clip

7 - Drive shaft for air condition- er compressor

- ☐ 60 Nm

8 - O-ring

- ☐ Renew

9 - Power steering pump

10 - O-ring

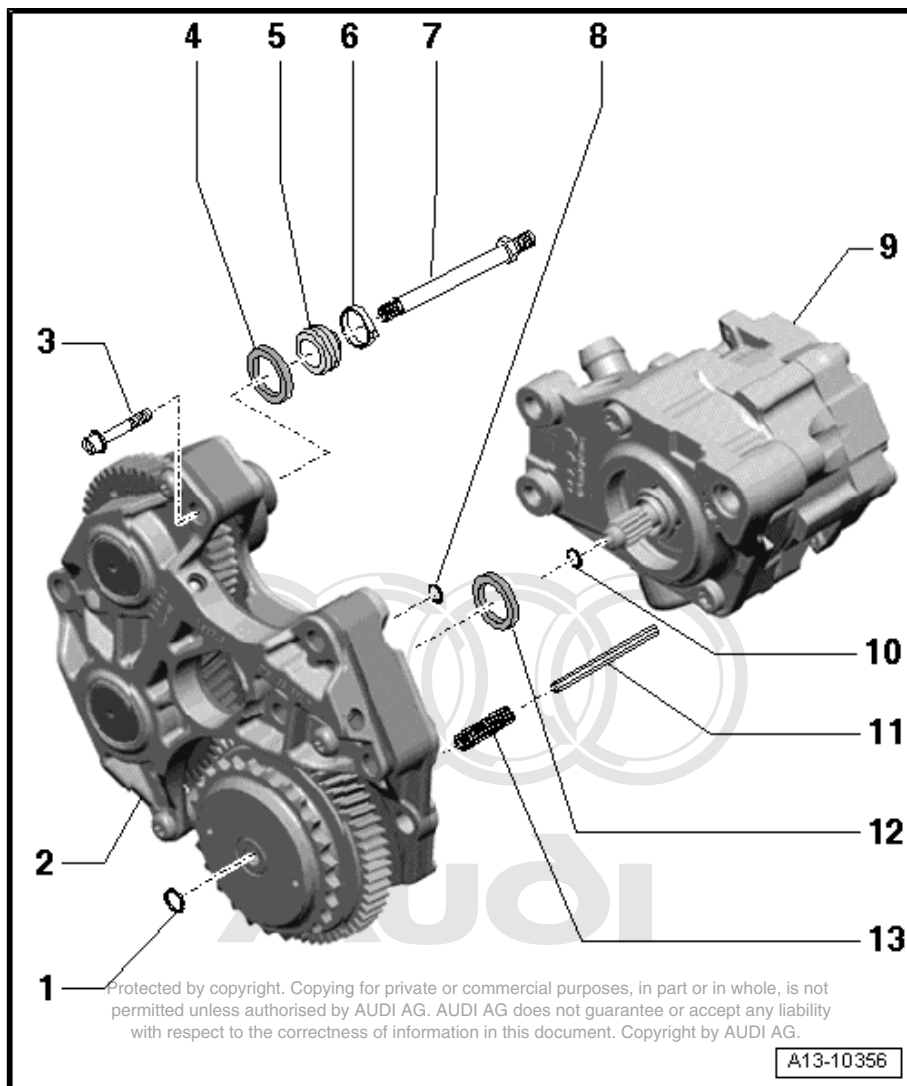
- ☐ Renew

11 - Oil pump drive shaft

12 - Oil seal for power steering pump drive

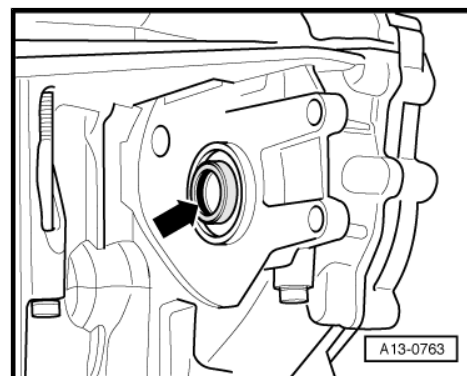
- ☐ Renewing ⇒ [page 107](#)

13 - Compression spring



Installation position of flat-section O-ring

- ◆ In power steering pump drive -arrow-.

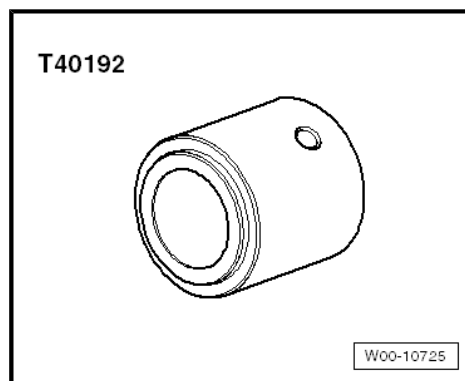


1.12 Renewing oil seals for auxiliary drives

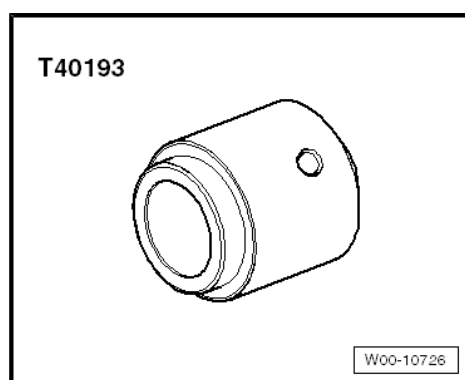
Special tools and workshop equipment required



◆ Thrust piece -T40192-

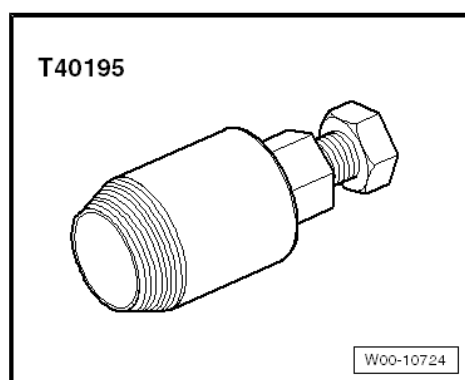


◆ Thrust piece -T40193-



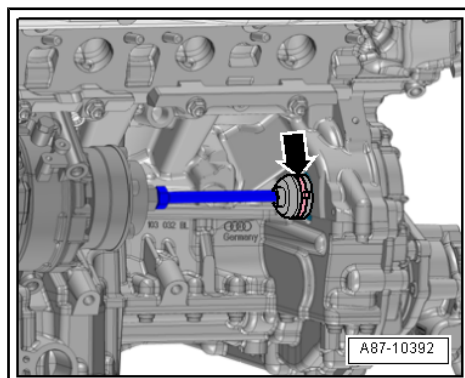
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◆ Oil seal extractor -T40195-



Procedure

- Remove air conditioner compressor ⇒ Rep. gr. 87 .
- Remove power steering pump ⇒ Rep. gr. 48 .
- Remove hose clip on dust cap -arrow-.
- Pull off dust cap together with drive shaft for AC compressor from shaft journal of spur gear for AC compressor drive.



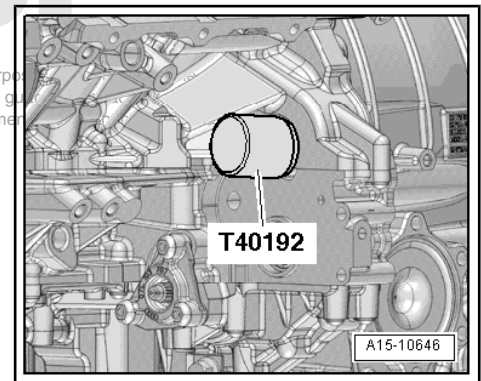
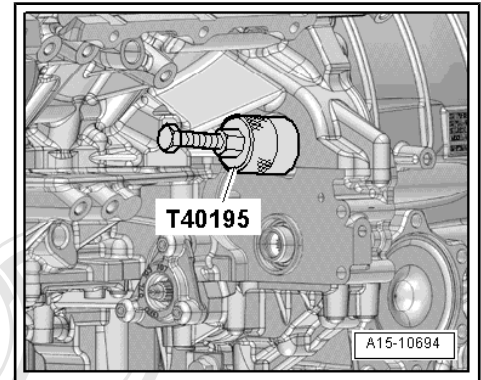
- Screw spindle of oil seal extractor -T40195- all the way out.
- Lubricate threaded head of oil seal extractor, place it in position and screw it as far as possible into oil seal for AC compressor drive and power steering pump drive (applying firm pressure).
- Turn inner part of oil seal extractor against spur gear drive until the oil seal is pulled out.

**Note**

If the sections of the oil seal come apart, apply oil seal extractor again and pull out remaining part of oil seal.

- Clamp hexagon flats of oil seal extractor in vice and use pliers to remove oil seal.
- Clean contact surface and sealing surface.
- Drive in oil seal for air conditioner compressor drive as far as stop using thrust piece -T40192- .

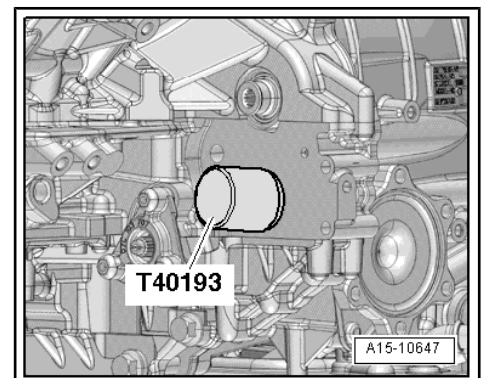
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- Drive in oil seal for power steering pump drive as far as stop using thrust piece -T40193- .

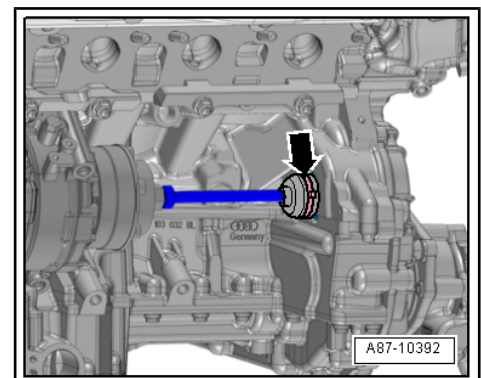
Remaining installation steps are carried out in reverse sequence; note the following:

- Install power steering pump ⇒ Rep. gr. 48 .

**Note**

Secure dust cap with the correct type of hose clip (same as original equipment) ⇒ Electronic parts catalogue .

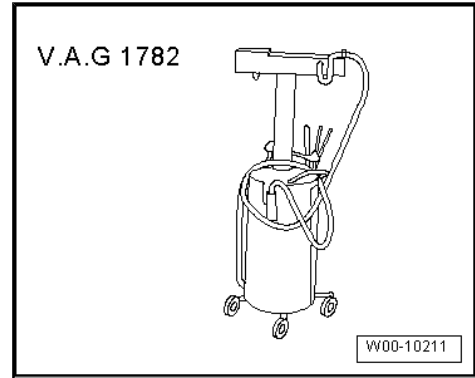
- Press dust cap -arrow- with hose clip fitted onto shaft journal of spur gear for AC compressor drive.
- Install air conditioner compressor ⇒ Rep. gr. 87 .



1.13 Removing and installing spur gear drive

Special tools and workshop equipment required

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



◆ Sealant ⇒ Electronic parts catalogue

Removing

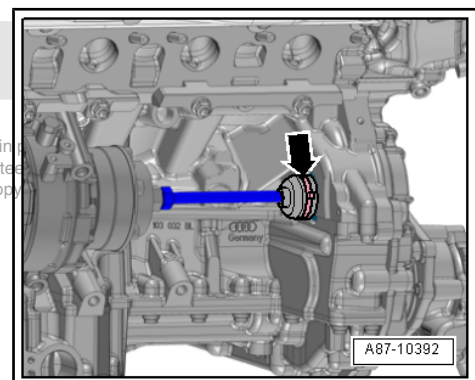
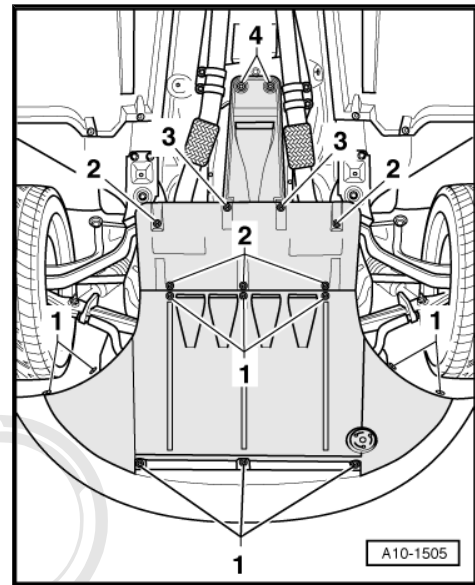
- Release fasteners -1 and 2- and remove rear noise insulation panels.



Note

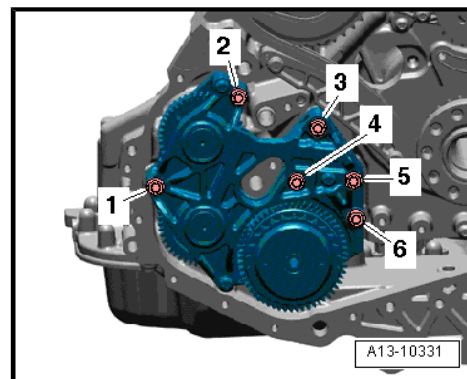
Disregard -items 3 and 4-.

- Place used oil collection and extraction unit -V.A.G 1782- under engine and drain engine oil.
- Remove automatic gearbox ⇒ Rep. gr. 37 .
- Remove drive plate ⇒ [page 58](#) .
- Remove timing chain covers (left and right) ⇒ [page 78](#) .
- Remove intake manifold ⇒ Rep. gr. 24 .
- Remove oil filter housing ⇒ [page 172](#) .
- Remove timing chain cover (bottom) ⇒ [page 81](#) .
- Detach power steering pump from cylinder block.
- Remove hose clip on dust cap -arrow- for air conditioner compressor drive.
- Remove drive chain for auxiliary drives ⇒ [page 104](#) .



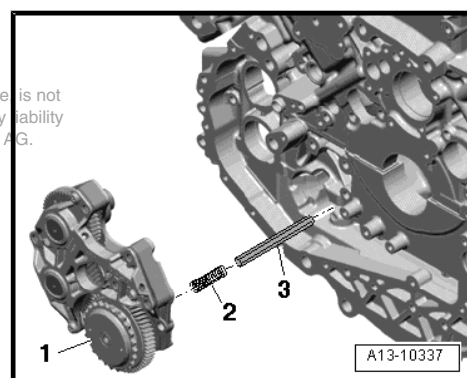
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- Remove bolts -1 ... 6-.
- Remove spur gear drive.



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

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- Remove drive shaft -arrow- for oil pump.

Installing

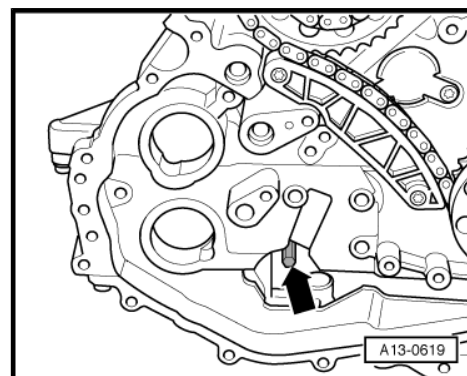
- Tightening torque ⇒ [page 107](#)



Note

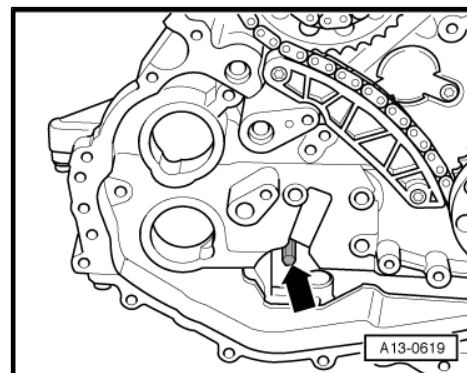
Fit new O-ring.

- Renew oil seals ⇒ [Item 12 \(page 107\)](#) , ⇒ [Item 4 \(page 107\)](#) and flat-section O-ring ⇒ [page 107](#) in power steering pump drive if damaged.
- Remove sealant residue from spur gear drive and cylinder block.
- Clean sealing surfaces; they must be free of oil and grease.
- Insert drive shaft -arrow- for oil pump into guide sleeve at oil pump.

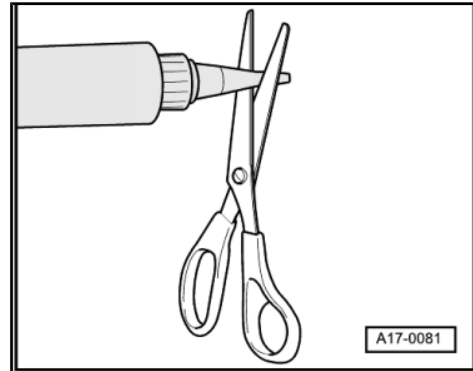


Note

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).



A17-0081



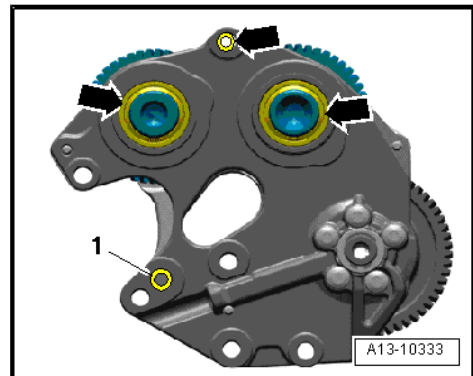
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Make sure lubrication system is not clogged by excess sealant.

- ◆ **The beads of sealant must not be thicker than specified.**

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



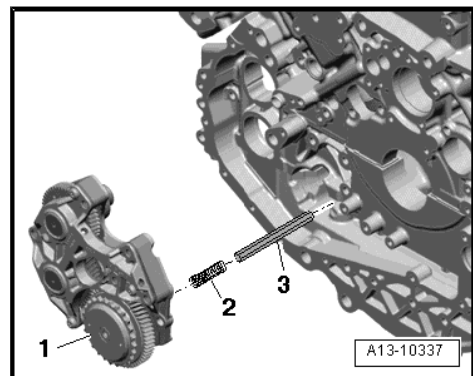
A13-10333



Note

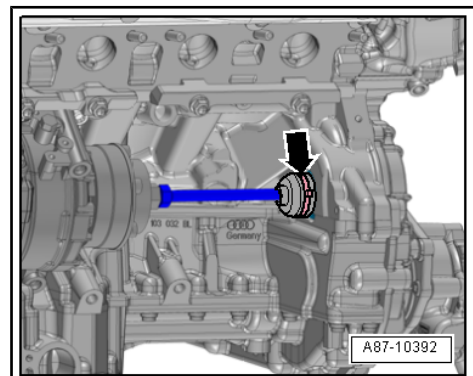
The spur gear drive must be installed within 5 minutes after applying the sealant.

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



A13-10337

- Press dust cap -arrow- with hose clip fitted onto stub shaft of spur gear for air conditioner compressor drive and secure.

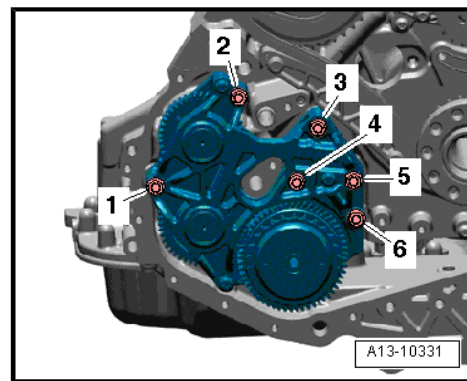


A87-10392

- Fit spur gear drive and tighten bolts -1 ... 6- in diagonal sequence and in stages.
- Install drive chain for auxiliary drives ⇒ [page 104](#) .
- Press power steering pump with new O-ring onto spur gear for power steering pump drive.

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

- Install timing chain cover (bottom) ⇒ [page 81](#) .
- Install crankshaft oil seal (gearbox end) ⇒ [page 59](#) .
- Install oil filter housing ⇒ [page 172](#) .
- Install intake manifold ⇒ Rep. gr. 24 .
- Install timing chain covers (left and right) ⇒ [page 79](#) .
- Install drive plate ⇒ [page 58](#) .
- Install automatic gearbox ⇒ Rep. gr. 37 .
- Fill up with engine oil and check oil level ⇒ [page 176](#) .



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2 Cylinder head

⇒ ["2.1 Cylinder head - exploded view", page 114](#)

⇒ ["2.2 Removing and installing cylinder head cover \(left-side\)", page 116](#)

⇒ ["2.3 Removing and installing cylinder head cover \(right-side\)", page 117](#)

⇒ ["2.4 Removing and installing cylinder head", page 120](#)

⇒ ["2.5 Checking compression pressure", page 128](#)

2.1 Cylinder head - exploded view



Note

The diagram shows the cylinder head on cylinder bank 2 (left-side).

1 - Cylinder head gasket

- ☐ Renewing
⇒ ["2.4 Removing and installing cylinder head", page 120](#)
- ☐ Installation position:
Part No. towards cylinder head
- ☐ If renewed, change engine oil and coolant

2 - Cylinder head

- ☐ Removing and installing
⇒ [page 120](#)
- ☐ Checking for distortion
⇒ [page 116](#)
- ☐ Machining limit
⇒ [page 116](#)
- ☐ If renewed, change engine oil and coolant

3 - Gasket for cylinder head cover

- ☐ Renew if damaged or leaking

4 - Cylinder head cover

- ☐ Removing and installing: left-side
⇒ [page 116](#), right-side
⇒ [page 117](#)

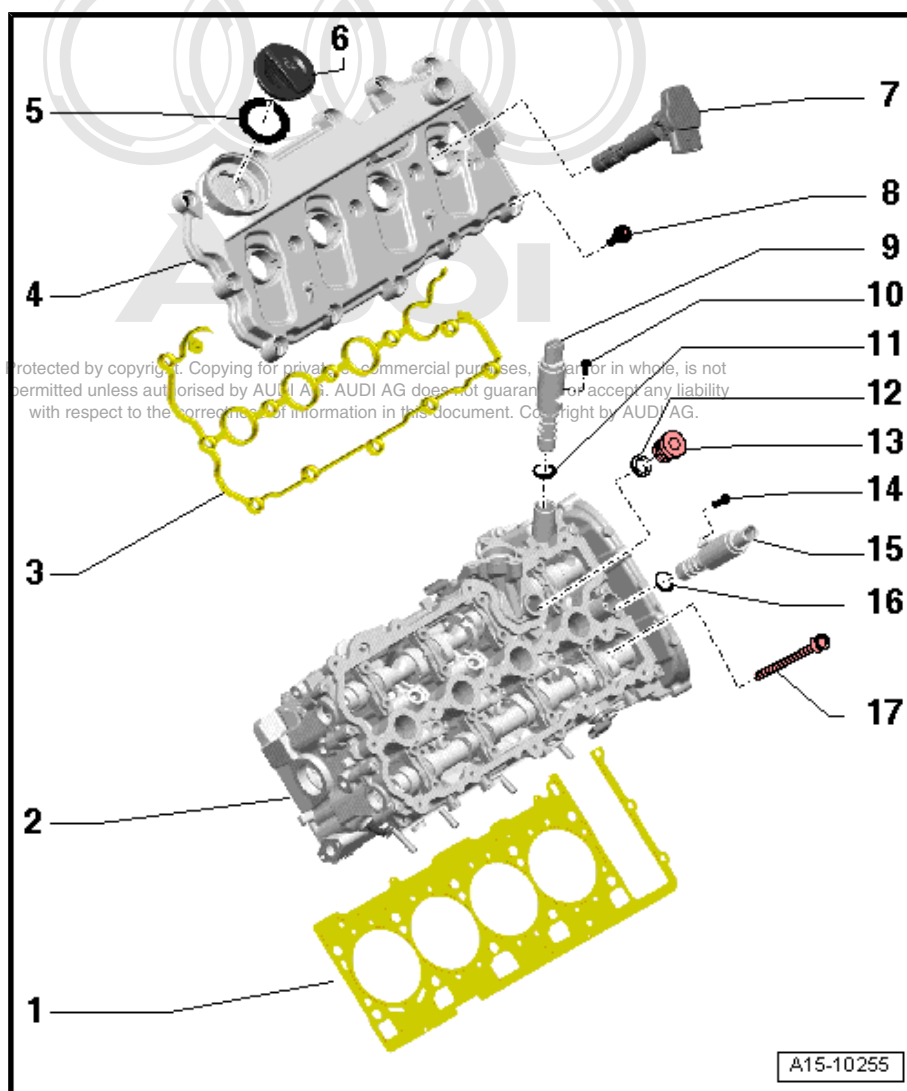
5 - Seal

- ☐ For filler cap
- ☐ Renew if damaged or leaking

6 - Filler cap

7 - Ignition coil

- ☐ Remove using puller -T40039-



8 - Bolt

- ☐ Renew if seal is damaged
- ☐ Tightening torque and tightening sequence: cylinder head cover (left-side) ⇒ [page 115](#) , cylinder head cover (right-side) ⇒ [page 115](#)

9 - Camshaft control valve 2 -N208-**10 - Bolt**

- ☐ 2.4 Nm

11 - O-ring

- ☐ Renew

12 - Seal

- ☐ Renew

13 - Screw plug

- ☐ 35 Nm

14 - Bolt

- ☐ 2.4 Nm

15 - Exhaust camshaft control valve 2 -N319-**16 - O-ring**

- ☐ Renew

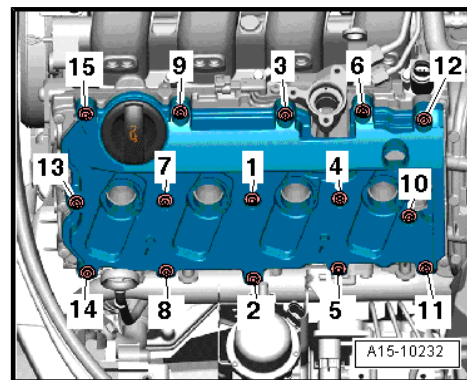
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17 - Bolt

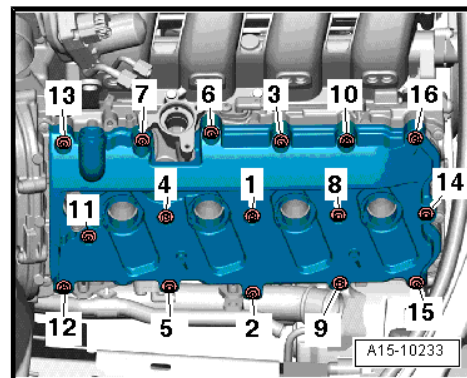
- ☐ Renew
- ☐ Note correct sequence when loosening ⇒ [page 124](#)
- ☐ Tightening torque and sequence ⇒ [page 116](#)

Cylinder head cover (left-side) - tightening torque and sequence

- Tighten bolts in the sequence -1 ... 15- to 9 Nm.

**Cylinder head cover (right-side) - tightening torque and sequence**

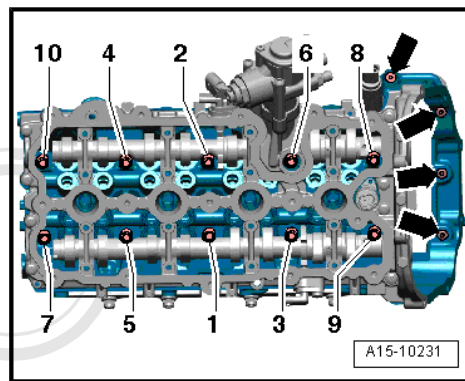
- Tighten bolts in the sequence -1 ... 16- to 9 Nm.



Cylinder head - tightening torque and sequence

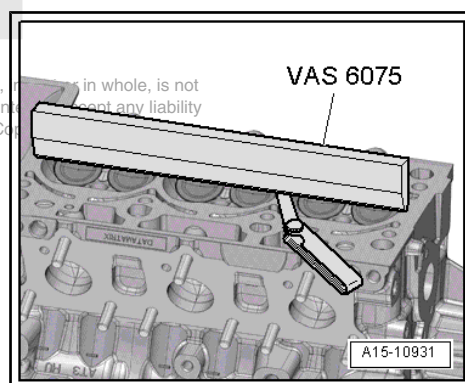
– Tighten bolts in the sequence -1 ... 10- in 5 stages as follows:

1. Screw in bolts by hand until they make contact.
 2. Tighten bolts to 30 Nm.
 3. Tighten bolts to 60 Nm.
 4. Turn bolts 90° (1/4 turn) further.
 5. Turn bolts 90° (1/4 turn) further.
- Apply locking fluid to bolts -arrows- and tighten to 8 Nm; for locking fluid refer to ⇒ Electronic parts catalogue .
- Turn bolts -arrows- 90° (1/4 turn) further.



Checking cylinder head for distortion

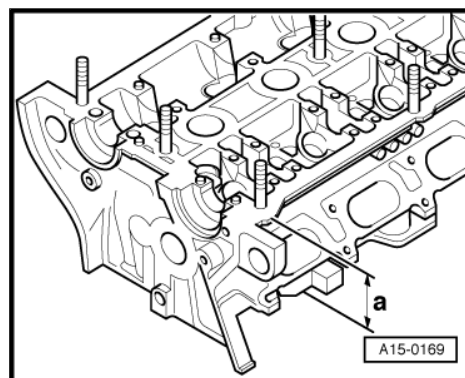
- Use straight edge 500 mm -VAS 6075- and feeler gauge to measure cylinder head for distortion at several points.
- Max. permissible distortion: 0.1 mm.



Cylinder head machining limit

Machining of the cylinder head (surface grinding) is only permissible down to the minimum dimension -a-.

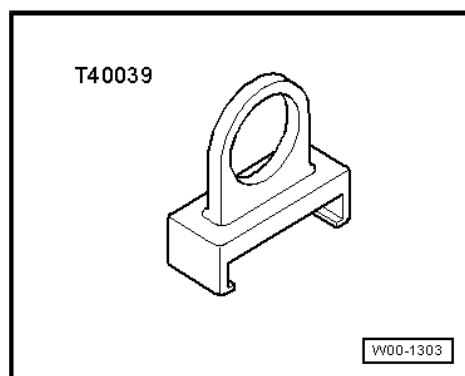
- Minimum dimension: -a- = 139.5 mm



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

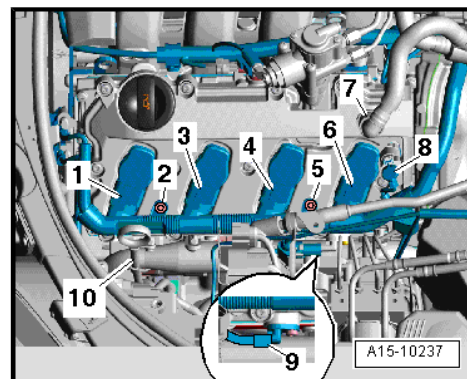
Special tools and workshop equipment required

- ◆ Puller -T40039-

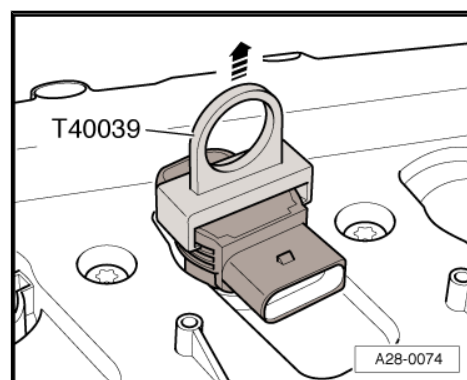


Removing

- Pull dipstick -10- out of guide tube.
- Remove bolts -2 and 5-.
- Unplug electrical connectors -1, 3, 4, 6, 8, 9- and move wiring harness clear.
- Disconnect crankshaft breather hose -7- by pressing release tabs.



- Pull ignition coils out with puller -T40039- .



- Unscrew cylinder head cover bolts (left-side) in the sequence -15 ... 1-.
- Remove cylinder head cover.

Installing

- Tightening torque
⇒ Fig. "Cylinder head cover (left-side) - tightening torque and sequence", page 115

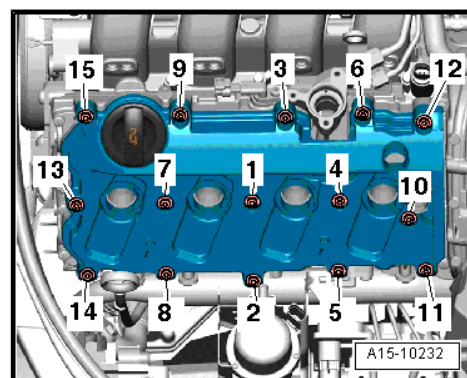
Installation is carried out in the reverse order; note the following:



Note

- ◆ Renew gasket for cylinder head cover if damaged or leaking.
- ◆ Renew cylinder head cover bolts if gasket is damaged.

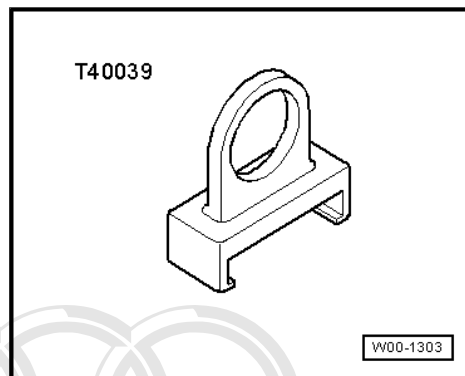
- Clean sealing surfaces; they must be free of oil and grease.
- Tighten cylinder head cover bolts ⇒ page 115



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

Special tools and workshop equipment required

◆ Puller -T40039-

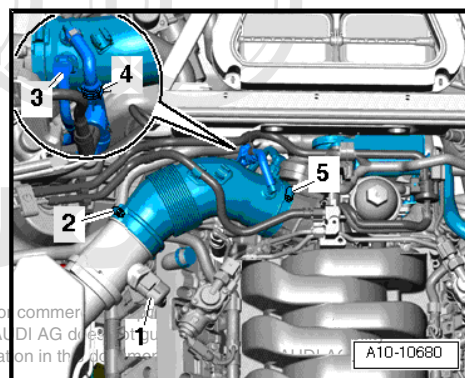


Removing

- Move clear fuel line and line going to activated charcoal filter at air pipe.
- Unplug electrical connector -1- at air mass meter -G70- .
- Detach vacuum line -4- leading to air intake hose from suction-jet pump.

Rest-of-world vehicles:

- Disconnect hose -3- for crankcase breather system from air hose by pressing release tabs.
- Release hose clips -2 and 5- and remove air hose.



USA models:



Caution

Risk of violating emission legislation applying to USA models.

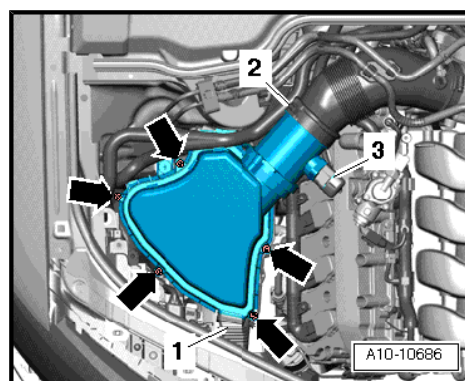
- ◆ ***Do NOT open hose connection -3-.***

- Release hose clips -2 and 5- and move air hose clear to one side (crankcase breather hose -3- remains connected).
- Disconnect air duct -1- from air cleaner housing (top section).
- Unscrew bolts -arrows- and detach air cleaner housing (top section).

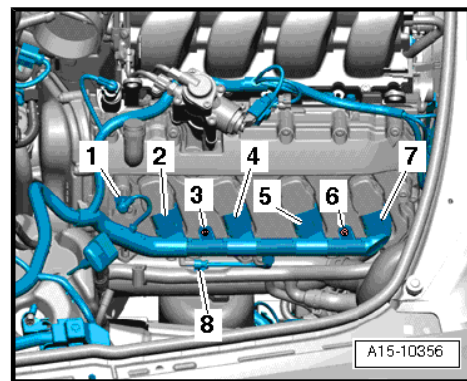


Note

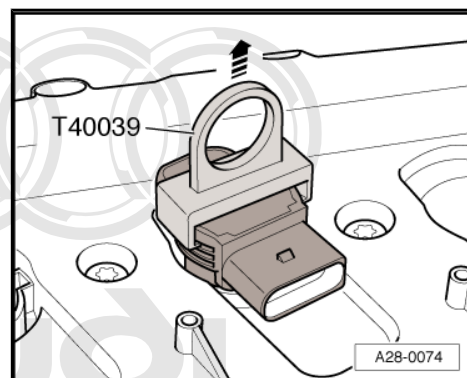
Disregard -items 2 and 3-.



- Unscrew bolts -3 and 6- at cylinder head (right-side).
- Unplug electrical connectors -1, 2, 4, 5, 7, 8- and place connector console to one side.



- Pull ignition coils out with puller -T40039- .



- Unscrew cylinder head cover bolts (right-side) in the sequence -16 ... 1-.
- Remove cylinder head cover.

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Installing

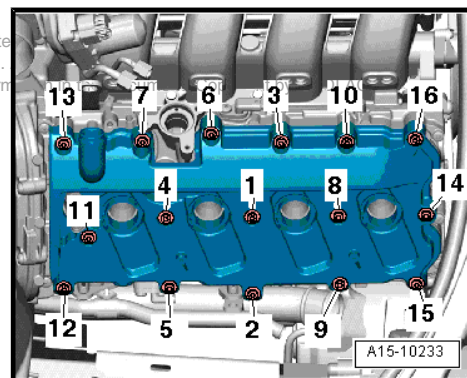
- Tightening torques
⇒ Fig. "Cylinder head cover (right-side) - tightening torque and sequence", page 115

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



Note

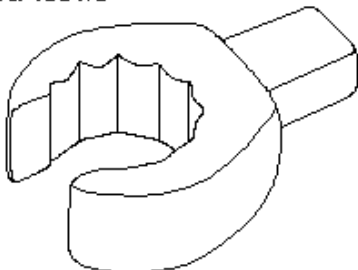
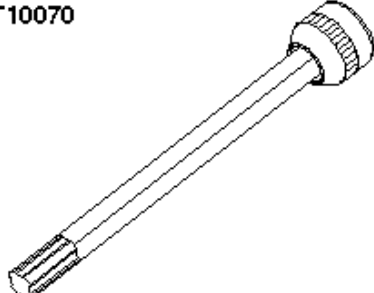
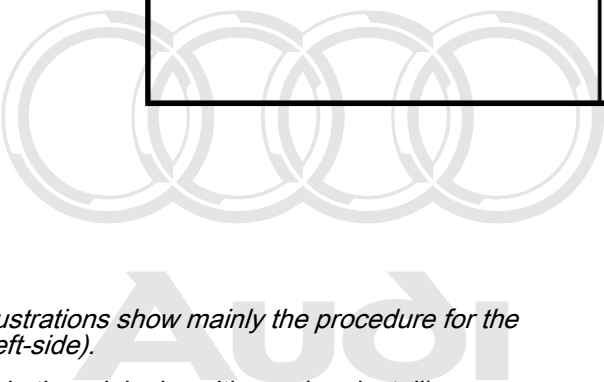
- ◆ Renew gasket for cylinder head cover if damaged or leaking.
- ◆ Renew cylinder head cover bolts if gasket is damaged.
- Clean sealing surfaces; they must be free of oil and grease.
- Tighten cylinder head cover bolts ⇒ page 115 .
- Fit top section of air cleaner housing ⇒ Rep. gr. 24 .



2.4 Removing and installing cylinder head

Special tools and workshop equipment required

- ◆ Torque wrench -V.A.G 1331-
- ◆ Open end spanner insert, AF 17 -V.A.G 1331/6-
- ◆ Socket insert AF 14, flared ring spanner -V.A.G 1331/8-
- ◆ Special wrench, long reach -T10070-

V.A.G 1331 	V.A.G 1331/6 
V.A.G 1331/8 	T10070 
	 G15-10027

Removing



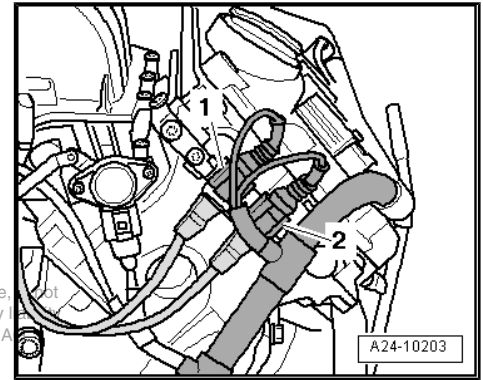
Note

- ◆ *The following illustrations show mainly the procedure for the cylinder head (left-side).*
- ◆ *Fit all cable ties in the original positions when installing.*

- Drain off coolant → page 181

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- Remove electrical connectors -1 and 2- for knock sensors from bracket.
- Remove intake manifold ⇒ Rep. gr. 24 .
- Remove coolant pipe (left-side) ⇒ [page 204](#) .
- Remove coolant pipe (right-side) ⇒ [page 214](#) (for cylinder head right-side).
- Remove secondary air combination valve (left-side) ⇒ [page 253](#) (for cylinder head left-side).
- Remove secondary air combination valve (right-side) ⇒ [page 254](#) .
- Remove coolant pipe (rear) ⇒ [page 199](#) .
- Remove mounting for torque reaction support ⇒ [page 47](#) (for cylinder head right-side).
- Remove cylinder head cover: left-side ⇒ [page 116](#) , right-side ⇒ [page 117](#) .
- Remove appropriate Lambda probe before catalytic converter ⇒ Rep. gr. 24 .
- Remove timing chain covers (left and right) ⇒ [page 78](#) .
- Remove timing chains from camshafts ⇒ [page 89](#) .
- Remove front silencer: left-side ⇒ [page 229](#) , right-side ⇒ [page 231](#) .



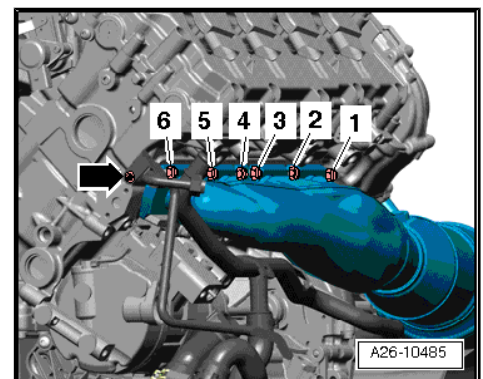
Cylinder head (left-side):

- Remove front left wheel.
- Remove front section of front left wheel housing liner ⇒ Rep. gr. 66 .
- Unscrew bolt -arrow- and pull pressure pipe for hydraulic fluid slightly towards front.
- Unscrew nuts -6 ... 1-.



Note

- ◆ Shown in illustration with engine removed.
- ◆ The two mounting strips (bottom) remain installed.



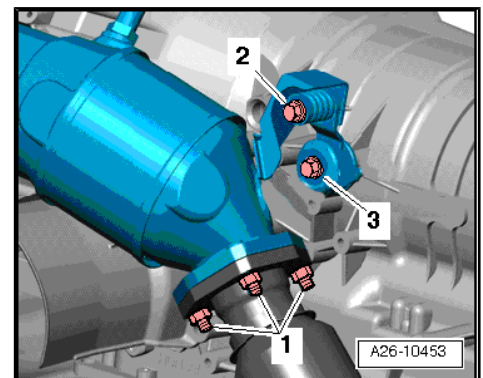
- Remove bolt -2- on bracket for catalytic converter (left-side).



Note

Disregard -items 1 and 3-.

- Pull exhaust manifold (left-side) off cylinder head studs and mounting strips.
- Place exhaust manifold (left-side) with catalytic converter to one side in engine compartment.



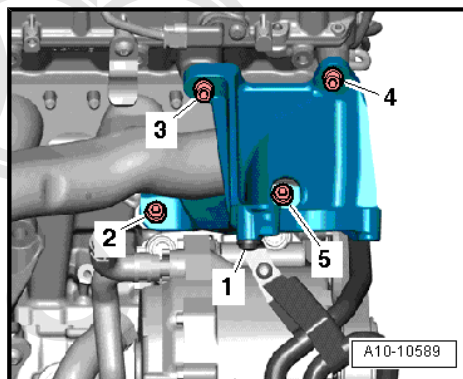
Cylinder head (right-side):

- Unscrew bolts -2 ... 5- and remove torque reaction support.



Note

Disregard -item 1-.

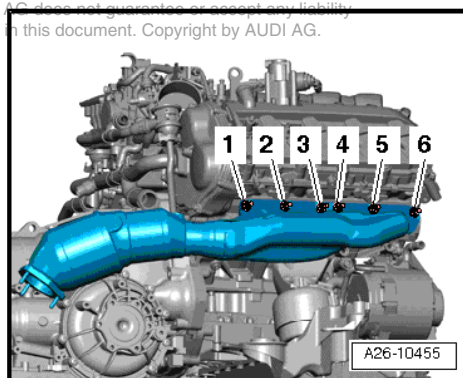


- Unscrew nuts -6 ... 1-.



Note

- ◆ Shown in illustration with engine removed.
- ◆ The two mounting strips (bottom) remain installed.



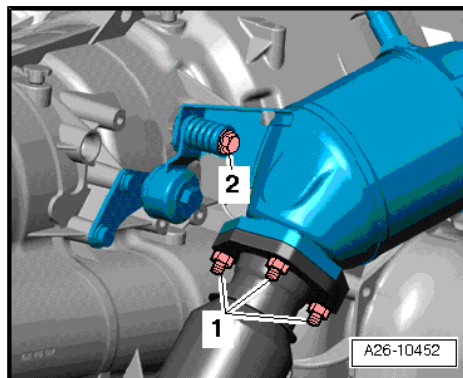
- Remove bolt -2- on bracket for catalytic converter (right-side).



Note

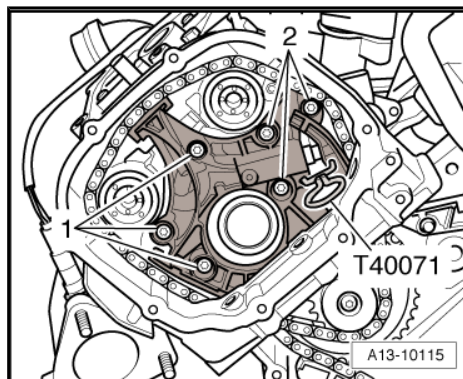
Disregard -item 1-.

- Pull exhaust manifold (right-side) off cylinder head studs and mounting strips.
- Place exhaust manifold (right-side) with catalytic converter to one side in engine compartment.



Continuation for both sides:

- Unscrew bolts -1 and 2- and remove appropriate chain tensioner.

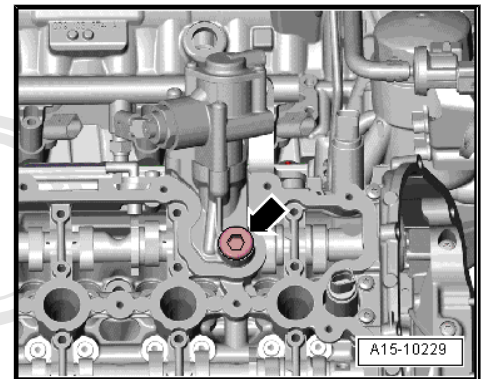
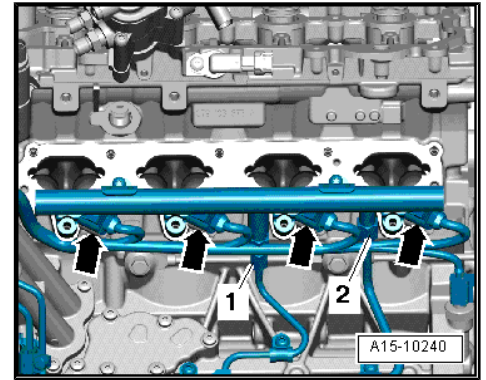


- Unplug electrical connectors -arrows- at injectors.
- Unscrew high-pressure pipe -2- at connection on fuel rail.
- Unscrew high-pressure pipe -1- at connection on fuel rail. To do so, counterhold at hexagon flats with an open-end spanner and slacken union nut.

 Note

Do not attempt to bend high-pressure pipes to a different shape.

- Remove screw plug -arrow-.



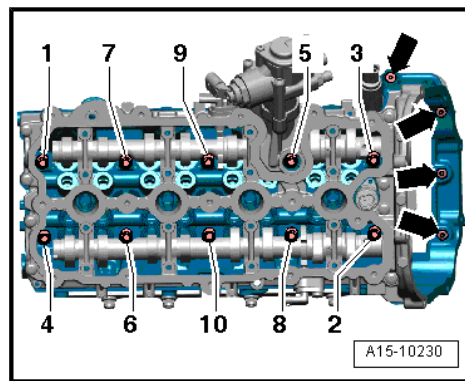
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- Remove bolts -arrows-.
- Use special wrench, long reach -T10070- to loosen cylinder head bolts in the sequence -1 ... 10-.
- Remove bolts and carefully detach cylinder head.
- Place cylinder head onto soft surface (foamed plastic).

Installing

Tightening torques

- ⇒ [“2.1 Cylinder head - exploded view”, page 114](#) .
- ⇒ [Fig. “Cylinder head - tightening torque and sequence””, page 116](#)
- ⇒ [“1.4 Camshaft timing chains - exploded view”, page 86](#) .
- ⇒ [“3.2 Secondary air system - exploded view”, page 250](#) .



Caution

Avoid damage to sealing surfaces.

- ◆ *Carefully remove sealant residue from cylinder head and cylinder block.*
- ◆ *Ensure that no long scores or scratches are made on the surfaces.*

Avoid damage to cylinder block.

- ◆ *No oil or coolant must be allowed to remain in the blind holes for the cylinder head bolts in the cylinder block.*

Risk of leaks at cylinder head gasket.

- ◆ *Carefully remove any remaining emery and abrasive material.*
- ◆ *Do not remove new cylinder head gasket from packaging until it is ready to be fitted.*
- ◆ *Handle the cylinder head gasket very carefully to prevent damage to the silicone coating or the indented area of the gasket.*

Avoid damage to open valves.

- ◆ *When installing an exchange cylinder head, the plastic protectors fitted to protect the open valves should not be removed until the cylinder head is ready to be fitted.*

Avoid damage to valves and piston crowns after working on valve gear.

- ◆ *Turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.*

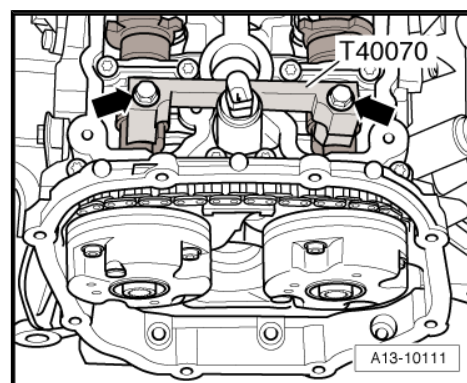
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**Note**

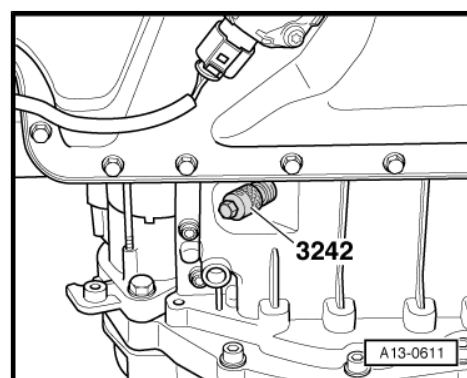
- ◆ *Renew the bolts tightened with specified tightening angle.*
- ◆ *Renew seals, gaskets and self-locking nuts.*
- ◆ *When installing an exchange cylinder head, the contact surfaces between the supporting elements, roller rocker fingers and cams must be oiled before installing the cylinder head cover.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- ◆ *Fit all cable ties in the original positions when installing.*

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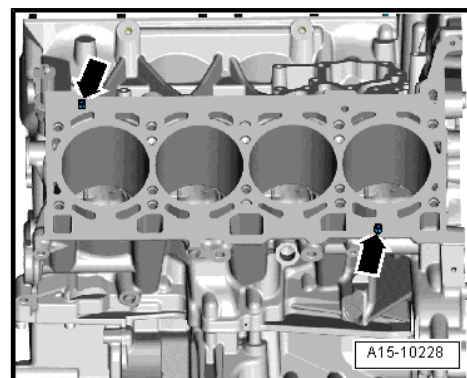
- Check that camshafts on both cylinder heads are positioned at "TDC".
- Camshaft clamps -T40070- must be installed on both cylinder heads and tightened to 25 Nm.



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



- Fit cylinder head gasket.
- 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.

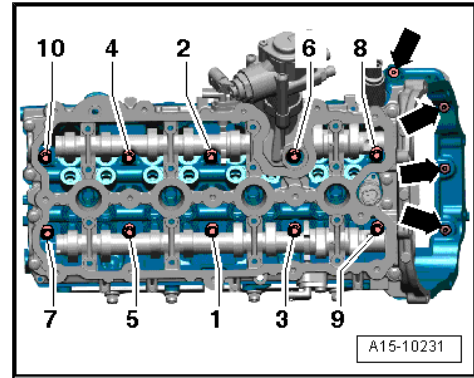


- Tighten cylinder head bolts ⇒ [page 116](#) .

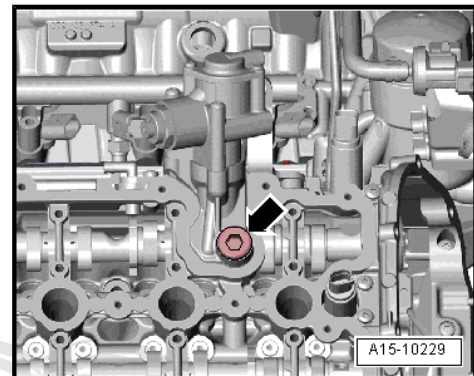


Note

Bolts do not have to be torqued down again later after repair work.



- Tighten screw plug -arrow-.

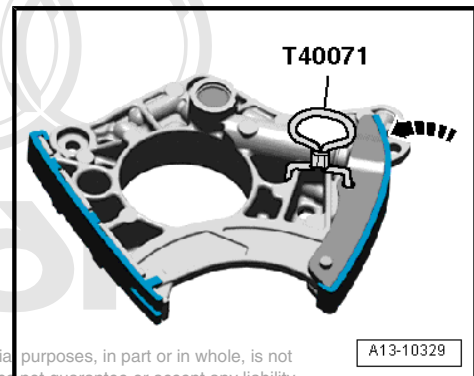


- Make sure that guide rail of chain tensioner for camshaft timing chain is locked with locking pin -T40071- .



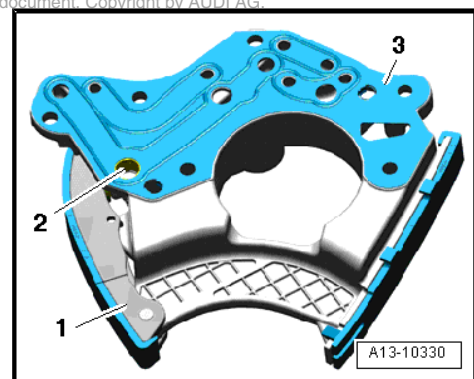
Note

- ♦ *Note the correct installation position if the tensioning element has been removed from the chain tensioner: drilling in base of housing faces chain tensioner and piston faces tensioner rail.*
- ♦ *Disregard -arrow-.*



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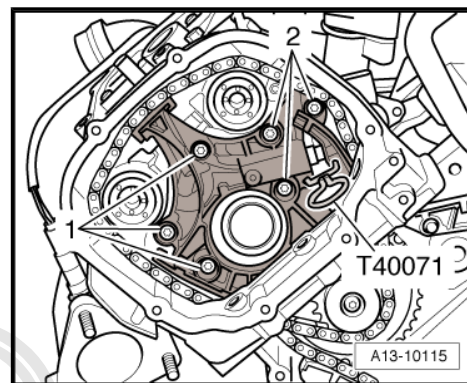
- Clean oil strainer -2- of chain tensioner.
- Fit new gasket -3- to rear of chain tensioner -1-.



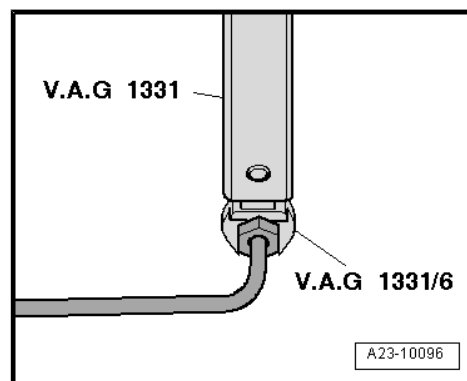
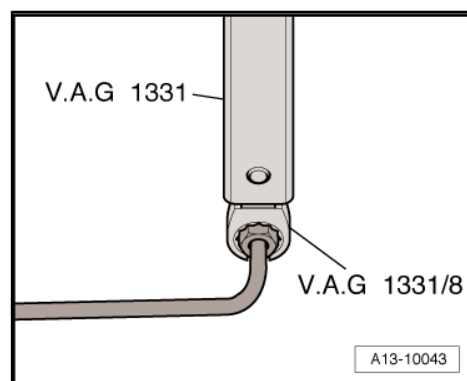
- Install chain tensioner and position camshaft timing chain, as shown in illustration.
- Tighten bolts -1 and 2-.

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

- Install exhaust manifold: left-side ⇒ [page 236](#) , right-side ⇒ [page 242](#) .
- Install torque reaction support and mounting for torque reaction support ⇒ [page 42](#) .
- Install front silencer: left-side ⇒ [page 229](#) , right-side ⇒ [page 231](#) .
- Install camshaft timing chains ⇒ [page 98](#) .
- Install timing chain covers (left and right) ⇒ [page 79](#) .
- Install coolant pipe (rear) ⇒ [page 199](#) .
- Install combination valve for secondary air system: left-side ⇒ [page 253](#) , right-side ⇒ [page 254](#) .
- Install coolant pipe (left-side) ⇒ [page 204](#) .
- Install coolant pipe (right-side) ⇒ [page 214](#) .
- Install cylinder head cover: left-side ⇒ [page 116](#) , right-side ⇒ [page 117](#) .
- Install intake manifold ⇒ Rep. gr. 24 .
- Install headlight ⇒ Rep. gr. 94 .
- Install bumper cover (front) ⇒ Rep. gr. 63 .
- Check headlight adjustment ⇒ Maintenance ; Booklet 404 .
- To secure union nut (14 mm) to fuel rail, use torque wrench - V.A.G 1331- with socket insert AF 14, flared ring spanner - V.A.G 1331/8- ⇒ Rep. gr. 24 .



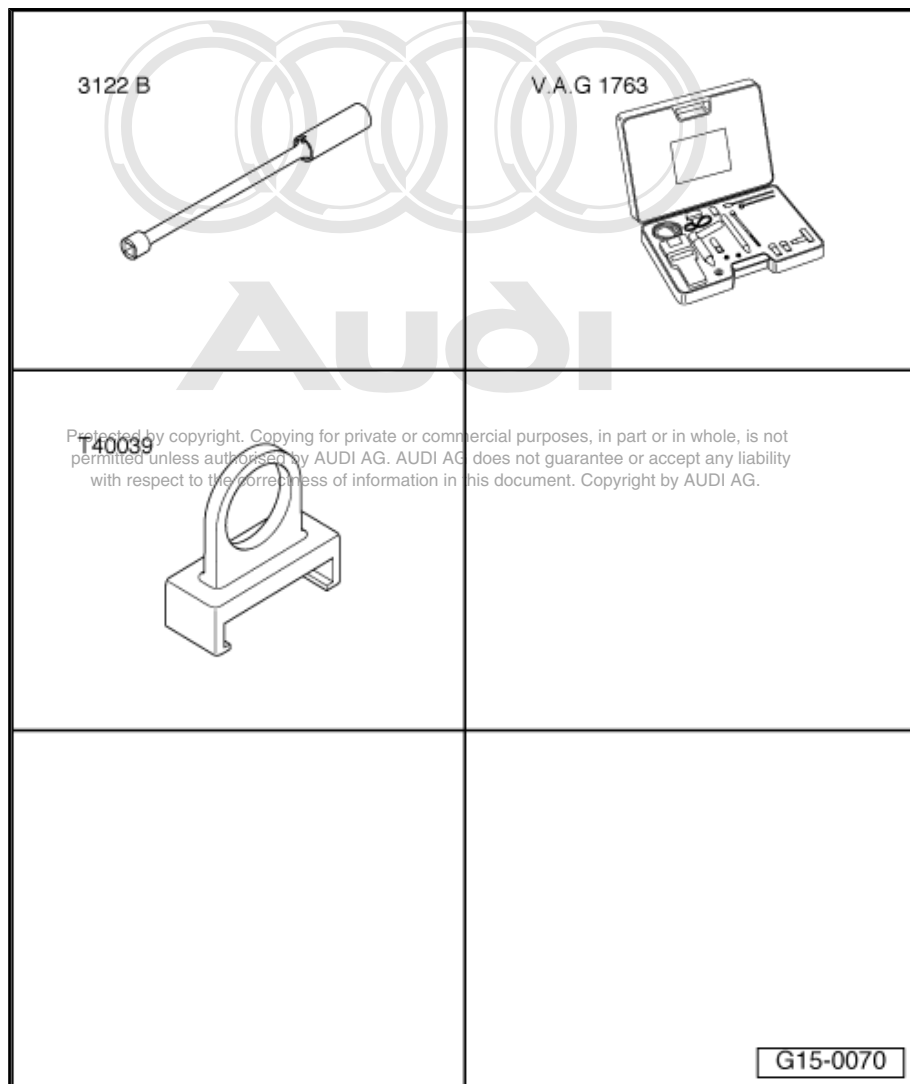
- To secure union nut (17 mm) to fuel rail, use torque wrench - V.A.G 1331- with tool insert AF 17 -V.A.G 1331/6- ⇒ Rep. gr. 24 .
- Align exhaust system so it is free of stress ⇒ [page 232](#) .
- Change engine oil ⇒ Maintenance ; Booklet 404 .
- Fill cooling system with fresh coolant ⇒ [page 181](#) .



2.5 Checking compression pressure

Special tools and workshop equipment required

- ◆ Spark plug socket and extension -3122 B-
- ◆ Compression tester -V.A.G 1763-
- ◆ Puller -T40039-



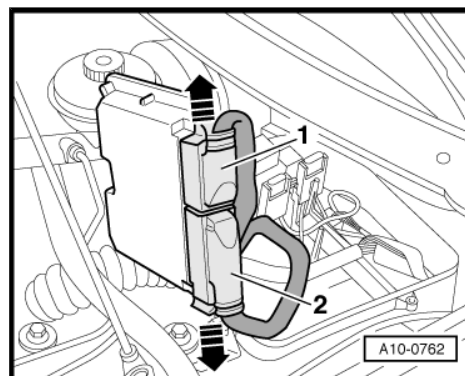
Procedure

- Engine oil temperature at least 30 °C.
- Battery voltage at least 12.5 V.
- Switch off ignition.
- Remove engine control unit -J623- ⇒ Rep. gr. 24 .
- Pull retaining tab -arrow- to unplug only the smaller connector -1- from engine control unit.

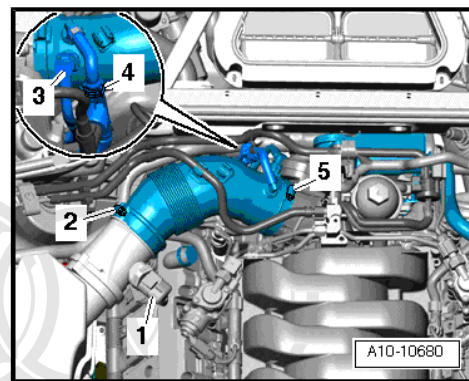


Note

The larger connector -2- remains connected.

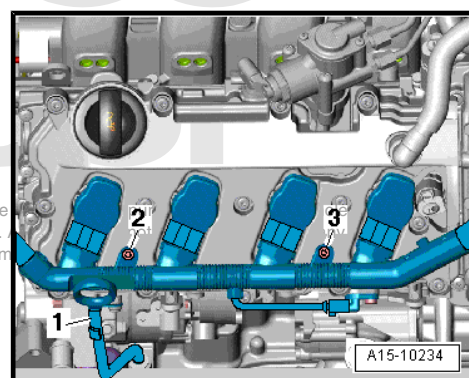


- Move clear fuel line and line going to activated charcoal filter at air pipe.
- Unplug electrical connector -1- at air mass meter -G70- .
- Detach vacuum line -4- leading to air intake hose from suction-jet pump.

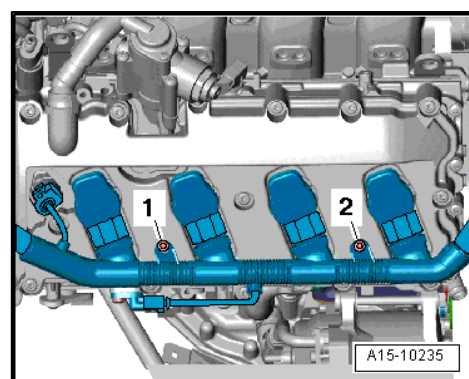


- Pull dipstick -1- out of guide tube.
- Remove bolts -2 and 3-.
- Unplug electrical connectors at ignition coils.
- Push wiring harness to one side.

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- Remove bolts -1 and 2-.
- Unplug electrical connectors at ignition coils.
- Push wiring harness to one side.





- Pull all ignition coils out with puller -T40039- .
- Remove spark plugs with spark plug socket and extension -3122 B- .
- Test the compression pressure with the compression tester - V.A.G 1763- .

**Note**

Using the compression tester ⇒ Operating instructions .

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

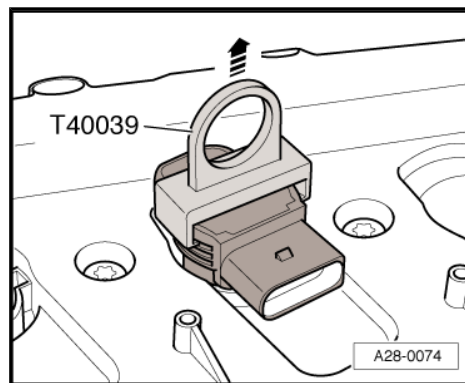
Compression pressure	bar
When new	10.0 ... 14.0
Wear limit	9.0
Maximum difference between cylinders	3.0

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

- Install spark plugs ⇒ Maintenance ; Booklet 404 .
- Install engine control unit -J623- ⇒ Rep. gr. 24 .

Entries are stored in engine control unit because electrical connectors have been unplugged.

- Erase any entries in event memory ⇒ Vehicle diagnostic tester, Guided Functions, Interrogate event memory, then Generate readiness code.



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3 Valve gear

⇒ ["3.1 Valve gear - exploded view", page 132](#)

⇒ ["3.2 Measuring axial clearance of camshafts", page 134](#)

⇒ ["3.3 Removing and installing camshafts", page 136](#)

⇒ ["3.4 Checking supporting elements with hydraulic clearance compensation", page 143](#)

⇒ ["3.5 Renewing valve stem oil seals with cylinder head installed", page 145](#)

⇒ ["3.6 Renewing valve stem oil seals with cylinder head removed", page 149](#)

⇒ ["3.7 Valve dimensions", page 152](#)

⇒ ["3.8 Checking valve guides", page 152](#)

3.1 Valve gear - exploded view



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.*

♦ *The diagram shows the cylinder head on cylinder bank 2 (left-side).*

1 - Sealing plugs

2 - Valve stem oil seal

- ☐ Renewing with cylinder head installed
⇒ [page 145](#)
- ☐ Renewing with cylinder head removed
⇒ [page 149](#)

3 - Valve spring

- ☐ Installation position
⇒ [page 134](#)

4 - Supporting element

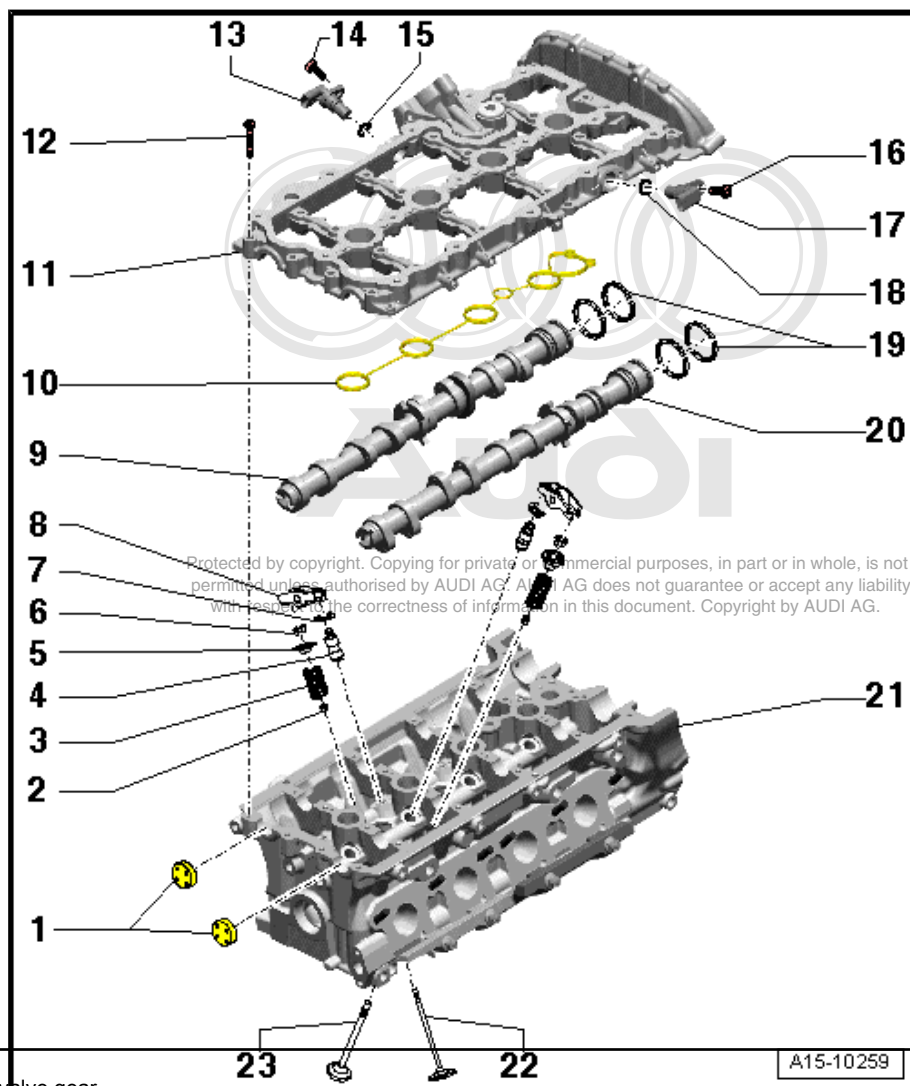
- ☐ With hydraulic valve clearance compensation
- ☐ Clipped into roller rocker finger - item 8-
- ☐ Checking ⇒ [page 143](#)
- ☐ Mark installation position for re-installation
- ☐ Lubricate contact surface

5 - Valve spring plate

6 - Valve cotters

7 - Securing clip

- ☐ Check for firm attachment



8 - Roller rocker finger

- ☐ Mark installation position for re-installation
- ☐ Check roller bearings for ease of movement
- ☐ Lubricate contact surface
- ☐ Assembly: attach to supporting element -item 4- using securing clip -item 7-

9 - Inlet camshaft

- ☐ Removing and installing ⇒ [page 136](#)
- ☐ Measuring axial clearance ⇒ [page 134](#)
- ☐ Check radial clearance with Plastigage (roller rocker fingers removed)
- ☐ Radial clearance when bearing $\varnothing$ is 24 mm: 0.024 ... 0.066 mm
- ☐ Radial clearance when bearing $\varnothing$ is 36 mm: 0.032 ... 0.078 mm
- ☐ Runout: max. 0.04 mm

10 - Gasket

- ☐ Renew

11 - Retaining frame

- ☐ With integrated camshaft bearings
- ☐ Removing and installing ⇒ ["3.3 Removing and installing camshafts", page 136](#)

12 - Bolt

- ☐ Tightening torque and sequence ⇒ [page 134](#)

13 - Hall sender 2 -G163-**14 - Bolt**

- ☐ 9 Nm

15 - O-ring

- ☐ Renew

16 - Bolt

- ☐ 9 Nm

17 - Hall sender 4 -G301-**18 - O-ring**

- ☐ Renew

19 - Rectangular section seals

- ☐ For camshaft adjuster

20 - Exhaust camshaft

- ☐ Removing and installing ⇒ [page 136](#)
- ☐ Measuring axial clearance ⇒ [page 134](#)
- ☐ Check radial clearance with Plastigage (roller rocker fingers removed)
- ☐ Radial clearance when bearing $\varnothing$ is 24 mm: 0.024 ... 0.066 mm
- ☐ Radial clearance when bearing $\varnothing$ is 36 mm: 0.032 ... 0.078 mm
- ☐ Runout: max. 0.04 mm

21 - Cylinder head

- ☐ Checking valve guides ⇒ [page 152](#)

22 - Inlet valve

- ☐ Do not machine, only grinding-in is permitted

- ☐ Mark installation position for re-installation

- ☐ Valve dimensions ⇒ [page 152](#)

- ☐ Checking valve guides ⇒ [page 152](#)

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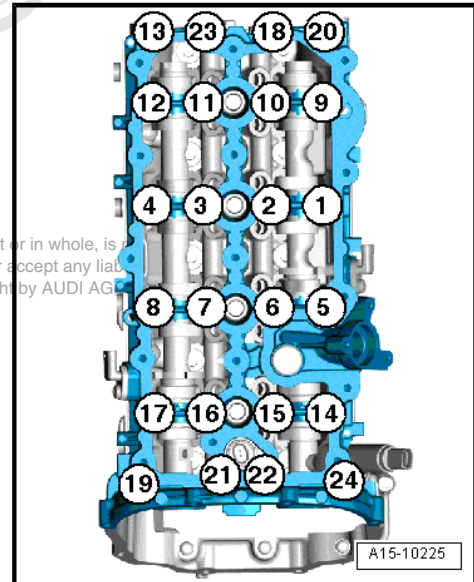
23 - Exhaust valve

- ☐ Do not machine, only grinding-in is permitted
- ☐ Mark installation position for re-installation
- ☐ Valve dimensions ⇒ [page 152](#)
- ☐ Checking valve guides ⇒ [page 152](#)

Tightening torque and sequence for retaining frame

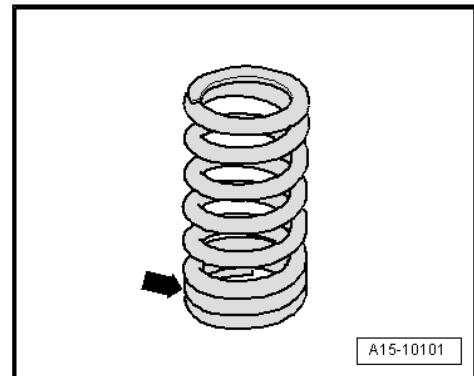
- Tighten bolts in the sequence -1 ... 24- in two stages as follows.
- 1. Screw in bolts by hand until they make contact.
- 2. Tighten bolts to 8 Nm.

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Position of valve spring

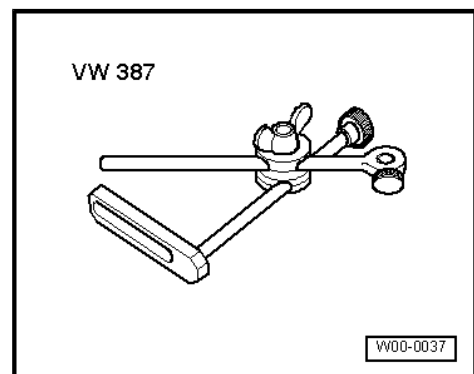
- The closely spaced spring coils -arrow- face the cylinder head.



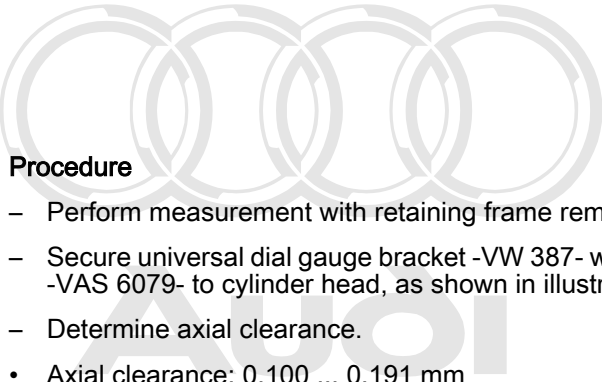
3.2 Measuring axial clearance of camshafts

Special tools and workshop equipment required

- ◆ Universal dial gauge bracket -VW 387-

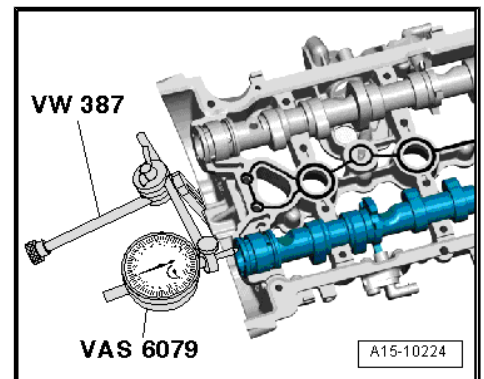
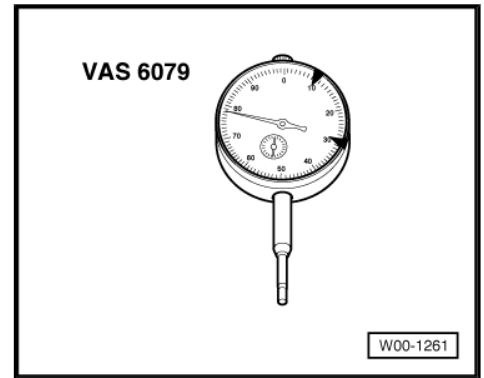


◆ Dial gauge -VAS 6079-

**Procedure**

- Perform measurement with retaining frame removed.
- Secure universal dial gauge bracket -VW 387- with dial gauge -VAS 6079- to cylinder head, as shown in illustration.
- Determine axial clearance.
- Axial clearance: 0.100 ... 0.191 mm

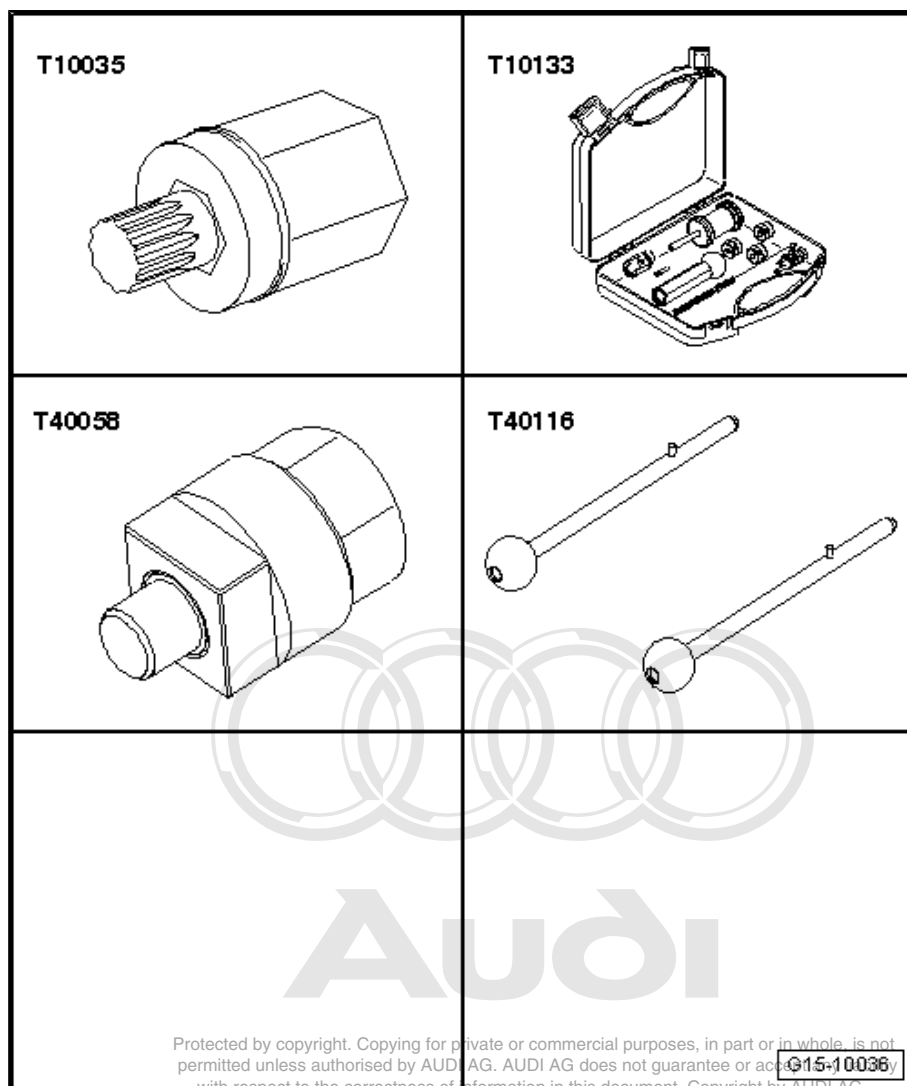
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3.3 Removing and installing camshafts

Special tools and workshop equipment required

- ◆ Special wrench -T10035-
- ◆ Tool set for FSI engines - T10133-
- ◆ Adapter -T40058-
- ◆ Locating pins -T40116-
- ◆ Electric drill with plastic brush attachment
- ◆ Safety goggles
- ◆ Sealant ⇒ Electronic parts catalogue

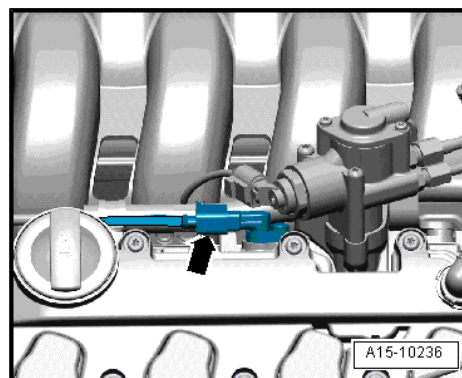


Note

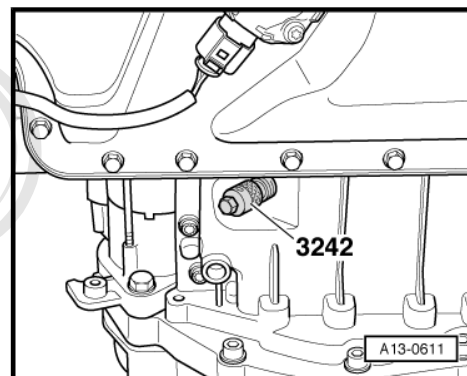
The following description is for removing and installing on cylinder head (left-side).

Removing

- Remove cylinder head cover: left-side ⇒ [page 116](#) , right-side ⇒ [page 117](#) .
- Remove timing chain covers (left and right) ⇒ [page 79](#) .
- Remove timing chains from camshafts ⇒ [page 89](#) .
- Unplug electrical connector at Hall sender for inlet camshaft -arrow-.
- Remove high-pressure pump ⇒ Rep. gr. 24 .

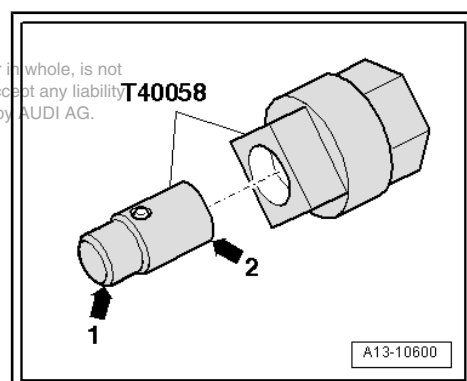


- Unscrew locking pin -3242- from sump (top section).

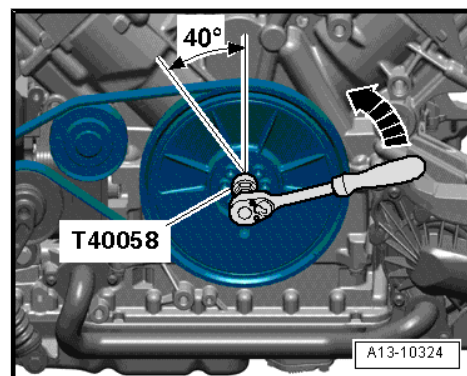


- Insert guide pin of adapter -T40058- as follows:

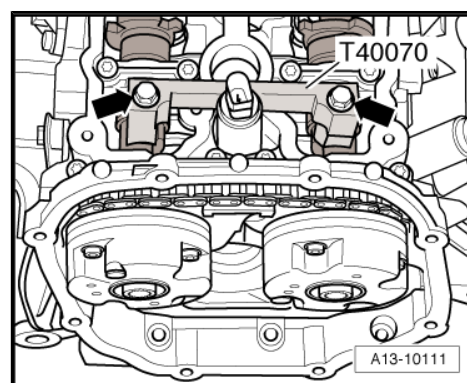
- The smaller-diameter section -arrow 1- faces the engine.
- The larger-diameter section -arrow 2- faces the adapter.



- Using adapter -T40058- turn the crankshaft through 40° out of “TDC” position in opposite direction of normal rotation -arrow-.



- Remove camshaft clamp -T40070- at cylinder head.



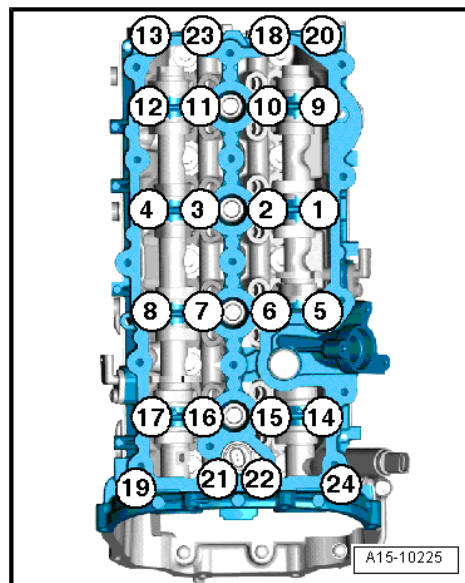
- Slacken retaining frame bolts in the sequence -24 ... 1-.



Note

Perform the same procedure (laterally reversed) on retaining frame (right-side).

- Carefully remove retaining frame.
 - **Mark camshafts for re-installation and then remove.**
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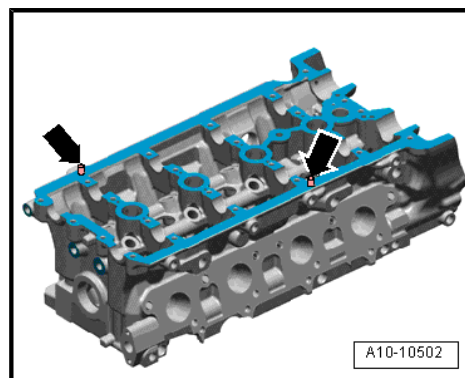


Note

As the special tool cannot be attached when installing, on engines fitted with dowel pins -arrows- for retaining frame, use roll-pin drift to drive out dowel pins.

Installing

- Tightening torque
⇒ [Fig. "Tightening torque and sequence for retaining frame"](#), [page 134](#)



Note

Renew seals and gaskets.



WARNING

Protect eyes against injuries.

- ◆ ***Wear safety goggles.***



Caution

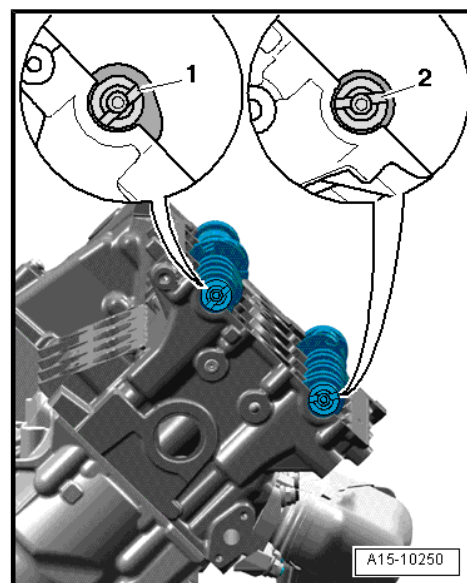
Protect lubrication system and bearings against contamination.

- ◆ ***Cover exposed parts of the engine.***

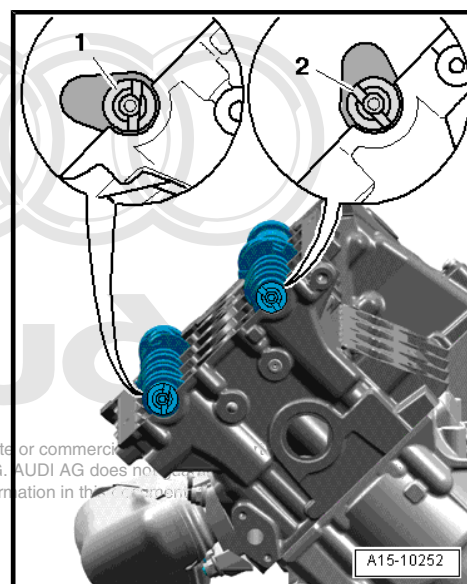
- Remove sealant residue from cylinder head and retaining frame using a rotating plastic brush or similar.
- Clean sealing surfaces; they must be free of oil and grease.
- Lubricate running surfaces of camshafts.
- Insert camshafts in cylinder head; note position of camshafts to make sure retaining frame is fitted free of stress.

Cylinder head (left-side):

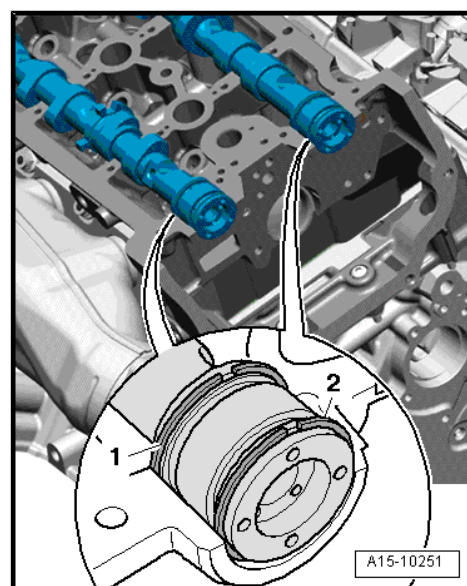
- 1 - Inlet camshaft
- 2 - Exhaust camshaft
- The groove on the end of the shaft must be positioned as shown in the illustration.

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

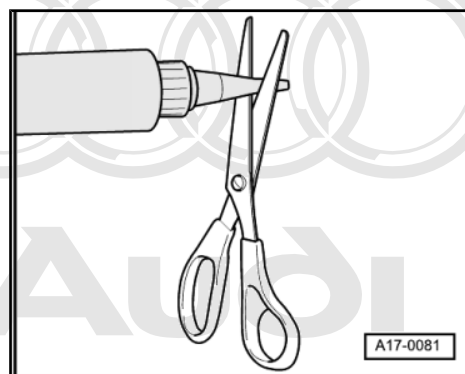
- 1 - Exhaust camshaft
- 2 - Inlet camshaft
- The groove on the end of the shaft must be positioned as shown in the illustration.

**Continuation for both sides:**

- Check position of ends of rectangular section seals.
- The ends of the rectangular section seals -1 and 2- must point up or down, never to the side.



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



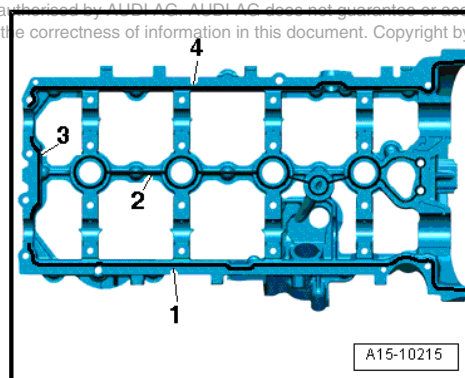
- Fit gasket -2- in grooves on retaining frame.
- Apply the beads of sealant -1, 3, 4- onto the clean sealing surfaces of the retaining frame, as shown in illustration.
- Width of beads of sealant: 2.5 mm.



Caution

Make sure excess sealant does not contaminate camshaft bearings.

- ◆ ***The sealant beads must not be thicker than specified.***



- Fit retaining frame onto cylinder head.



Note

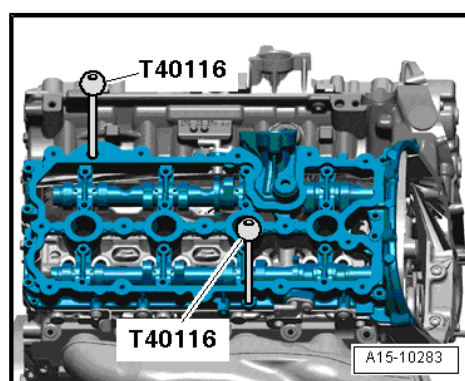
Make sure that camshafts can be inserted into axial bearing of retaining frame without applying force.

- Insert locating pins -T40116- in retaining frame and in cylinder head.

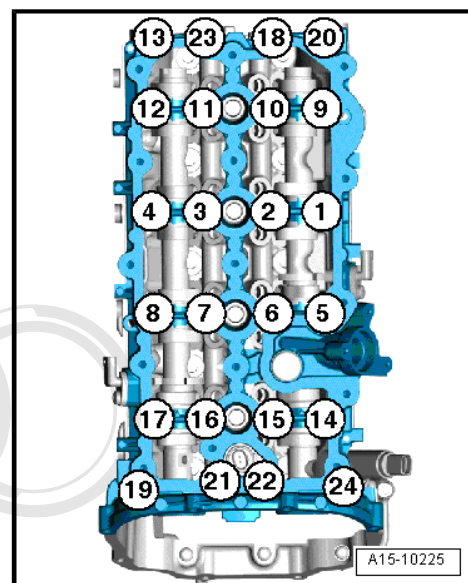


Note

- ◆ ***Fit and secure the retaining frame without delay, as the sealant starts hardening immediately.***
- ◆ ***After installing the retaining frame, the sealant must dry for approx. 30 minutes.***

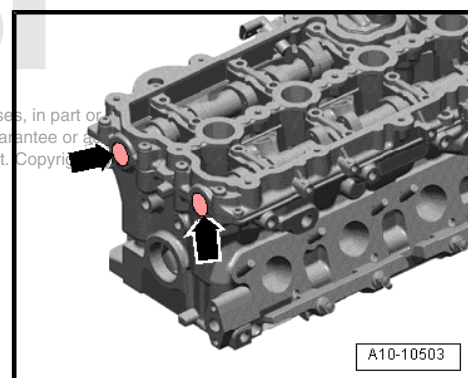


- Tighten bolts for retaining frame ⇒ [page 134](#) .

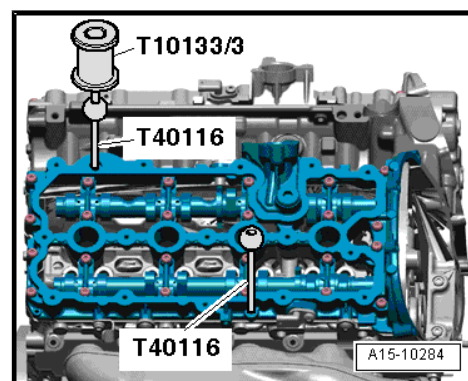


- Knock in sealing plugs -arrows- until flush.

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- Pull out locating pins -T40116- using puller -T10133/3- .

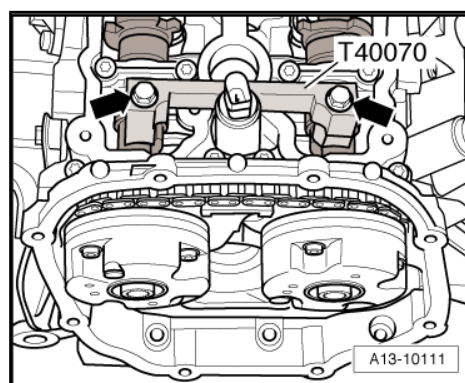
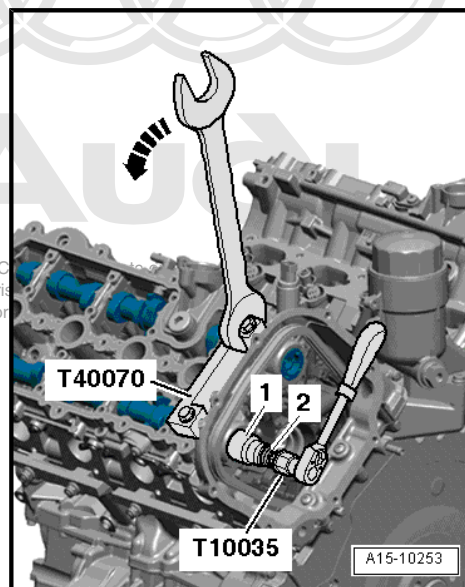
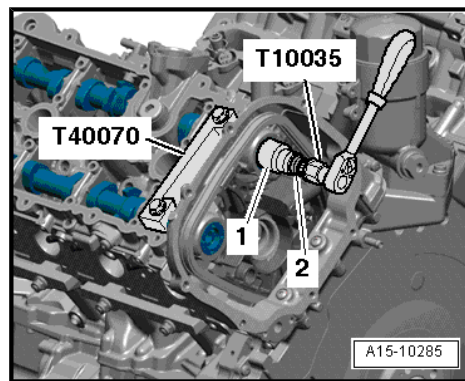


- Turn inlet camshaft to “TDC” position; to do so, fit a socket (24 mm) -item 1- between inlet camshaft and camshaft adjuster bolt -2- and secure camshaft adjuster bolt to camshaft as shown in illustration.


Note

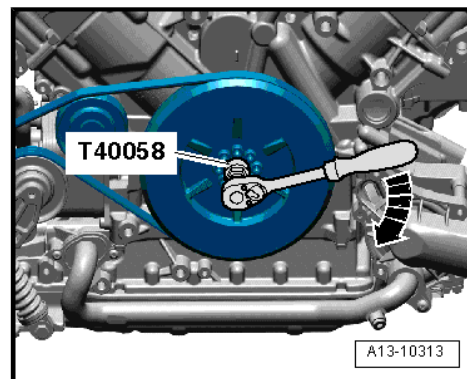
Use pliers to counterhold socket when tightening bolt.

- Apply lever or ratchet with special wrench -T10035- and turn camshaft until threaded hole for camshaft clamp -T40070- points upwards.
- Initially screw bolt for camshaft clamp -T40070- only a few turns into inlet camshaft.
- The camshaft clamp -T40070- is positioned correctly if the holes for the cylinder head bolts remain free.
- Fit camshaft adjuster bolt -2- and socket (24 mm) -item 1- onto exhaust camshaft.
- Turn exhaust camshaft until threaded hole for camshaft clamp -T40070- points upwards.
- At the same time apply open-end spanner (24 mm) to camshaft clamp -T40070- and pivot camshaft clamp -T40070- towards exhaust camshaft -arrow- until camshaft clamp can be fastened.
- Secure camshaft clamp -T40070- to exhaust camshaft **only** hand-tight, to avoid damaging the thread (assistance of 2nd mechanic required).



- Tighten bolts for camshaft clamp -T40070- to 25 Nm.

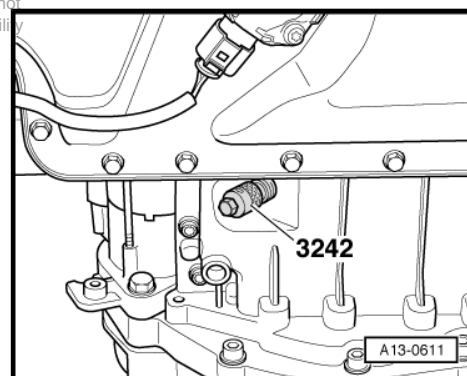
- Using adapter -T40058- turn the crankshaft in the normal direction of rotation -arrow- to “TDC”.



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

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

- Install high-pressure pump ⇒ Rep. gr. 24 .
- Position timing chains on camshafts ⇒ [page 92](#) .
- Install timing chain covers (left and right) ⇒ [page 79](#) .
- Install cylinder head covers: left-side ⇒ [page 116](#) , right-side ⇒ [page 117](#) .



Caution

Avoid damage to valves and piston crowns after working on valve gear.

- ◆ *The hydraulic tappets have to settle; wait for approx. 30 minutes after installing camshafts before starting engine.*
- ◆ *Turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.*

3.4 Checking supporting elements with hydraulic clearance compensation

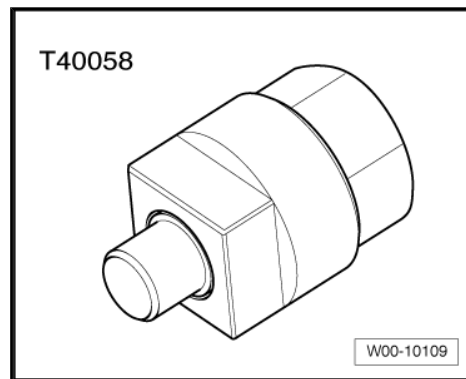


Note

- ◆ *It is not possible to service the supporting elements with hydraulic clearance compensation.*
- ◆ *Irregular valve noises when starting engine are normal.*

Special tools and workshop equipment required

◆ Adapter -T40058-



◆ Feeler gauge

Procedure

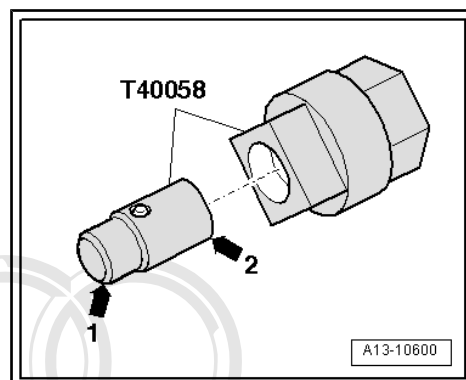
- Start engine and run until radiator fan has started up once.
- Increase engine speed to about 2500 rpm for approx. 2 minutes; perform test drive if necessary.



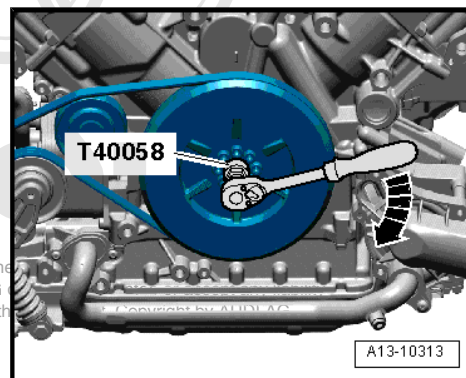
Note

If irregular valve noise disappears but repeatedly re-occurs when travelling short distances, renew oil retention valve. Fitting location of oil retention valve ⇒ [page 168](#).

- If the supporting elements with hydraulic clearance compensation are still noisy, proceed as follows to determine the defective supporting element:
- Remove cylinder head cover: left-side ⇒ [page 116](#), right-side ⇒ [page 117](#).
- Insert guide pin of adapter -T40058- as follows:
 - The smaller-diameter section -arrow 1- faces the engine.
 - The larger-diameter section -arrow 2- faces the adapter.



- Turn crankshaft until cam of supporting element to be tested is facing upwards.

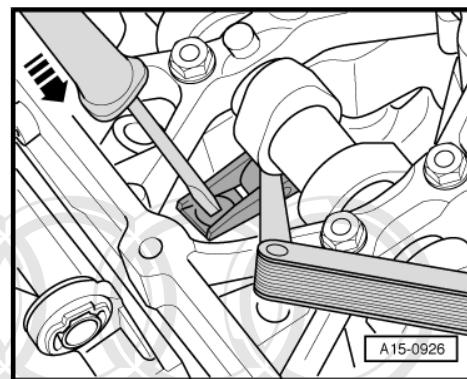


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- Press roller rocker finger down -arrow- to determine clearance between cam and roller rocker finger.
- If it is possible to insert a feeler gauge of 0.20 mm between cam and roller rocker finger, renew supporting element
⇒ [“3.3 Removing and installing camshafts”, page 136](#) .

Additional steps required

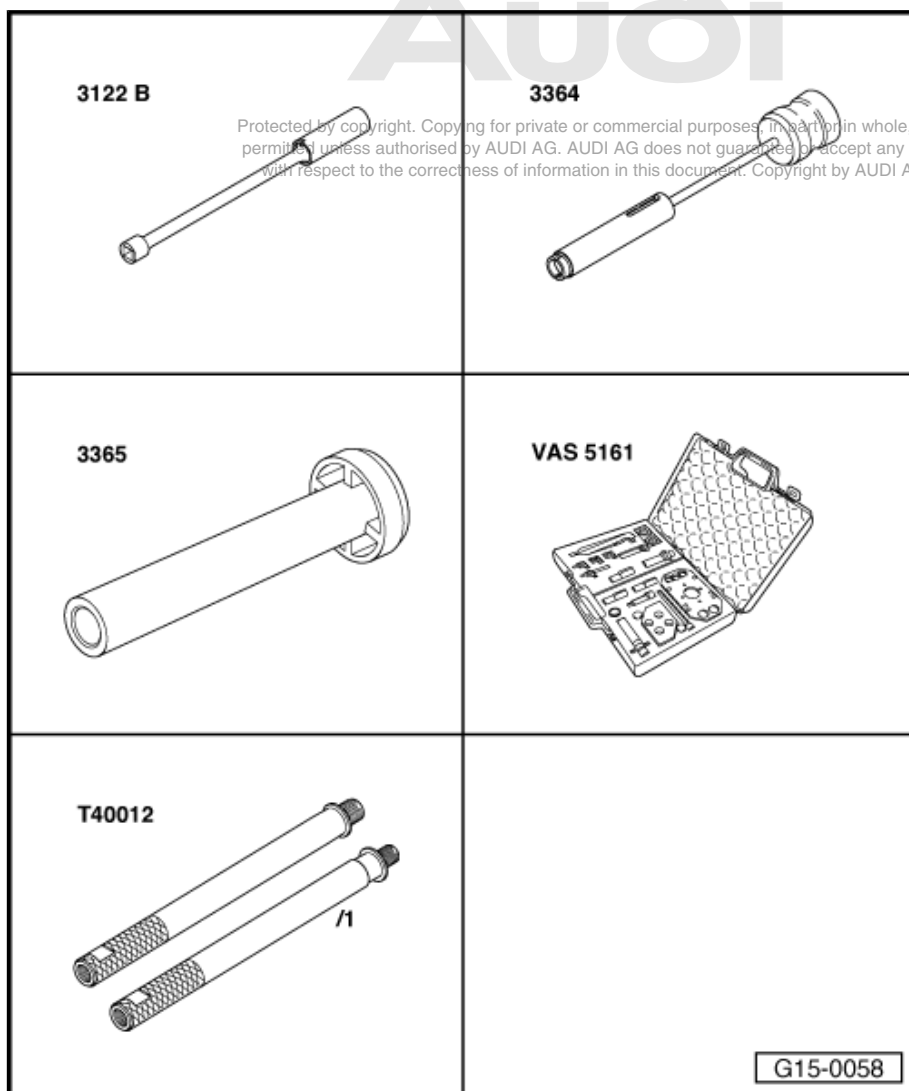
- Install cylinder head cover: left-side ⇒ [page 116](#) , right-side ⇒ [page 117](#) .



3.5 Renewing valve stem oil seals with cylinder head installed

Special tools and workshop equipment required

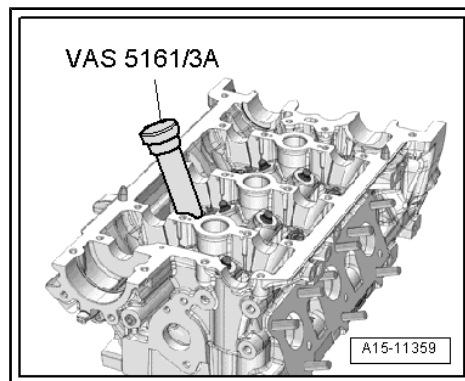
- ◆ Spark plug socket and extension -3122 B-
- ◆ Valve stem seal puller -3364-
- ◆ Valve stem seal fitting tool -3365-
- ◆ Removal and installation device for valve cotters -VAS 5161- with guide plate -VAS 5161/19C-
- ◆ Adapters -T40012-



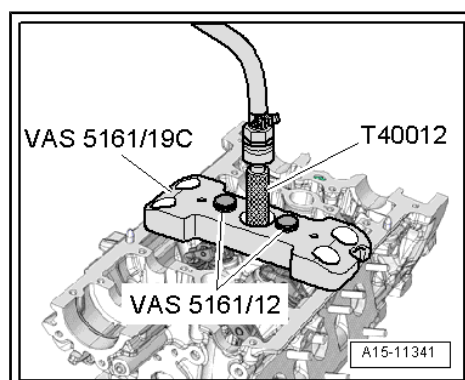
Removing

- Remove timing chains from camshafts ⇒ [page 89](#) .
- Remove camshafts ⇒ [page 136](#) .
- Remove spark plugs with spark plug socket -3122 B- .

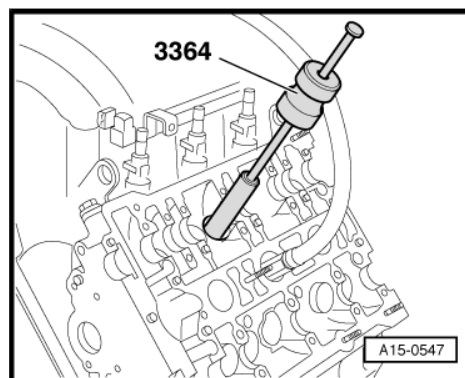
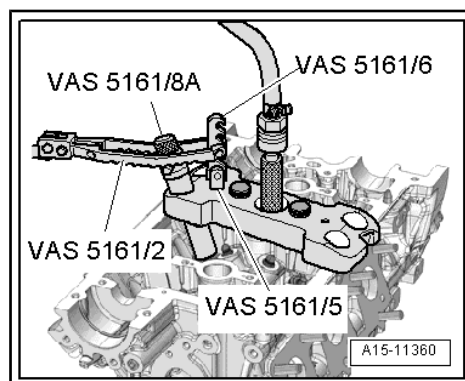
- Apply drift -VAS 5161/3A- to valve spring plate and use plastic-headed hammer to release sticking valve cotters.



- Fit guide plate -VAS 5161/19C- from removal and installation device for valve cotters -VAS 5161- on cylinder head.
- Secure guide plate using knurled screws -VAS 5161/12- .
- Screw adapter -T40012- with seal hand-tight into the corresponding spark plug thread and apply a steady pressure.
- Minimum pressure: 6 bar



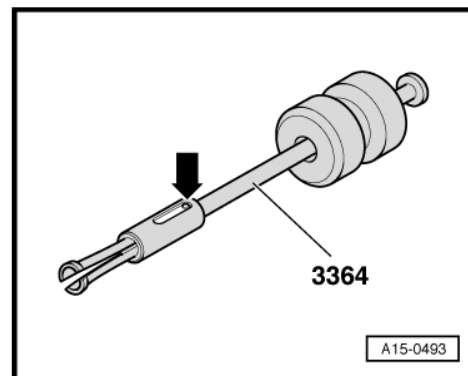
- Screw snap-in device -VAS 5161/6- with engaging fork -VAS 5161/5- into guide plate.
- Insert assembly cartridge -VAS 5161/8A- in guide plate.
- Hook pressure fork -VAS 5161/2- into snap-in device and press assembly cartridge downwards.
- At the same time, turn knurled screw of assembly cartridge clockwise 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 assembly cartridge.
- Release pressure fork.
- Remove assembly cartridge.
- Detach guide plate and turn to one side.
- The compressed air hose remains connected.
- Remove valve spring with valve spring plate.
- Remove valve stem oil seal using the valve stem seal puller -3364- .



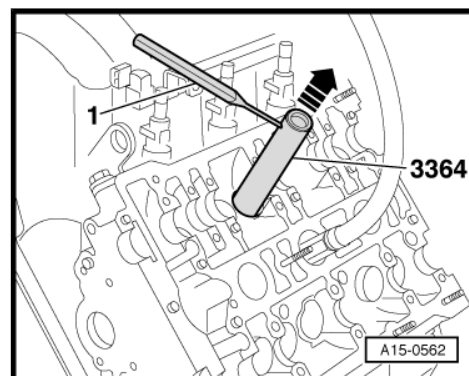
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If the valve stem seal puller -3364- cannot be used on some of the valve stem oil seals due to the confined space, proceed as follows:

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



- Apply lower part of puller to valve stem oil seal.
- Secure puller with a punch -1- or other suitable tool as shown in the illustration.
- Apply assembly lever to puller and pull out valve stem oil seal -arrow-.



Installing

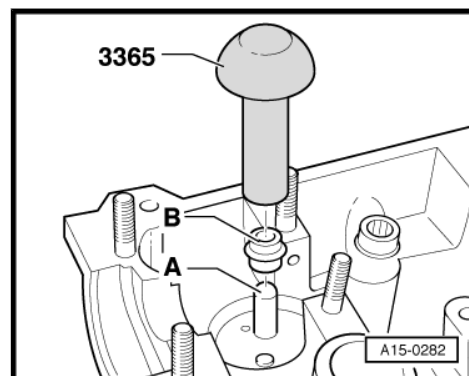


Caution

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

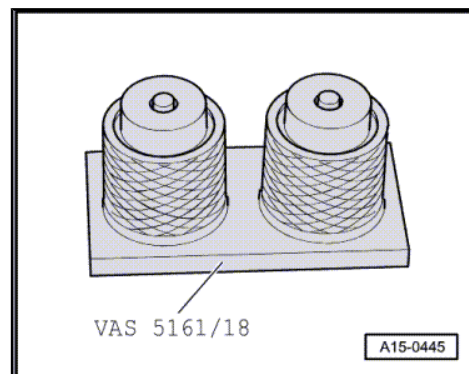
- ◆ ***New valve stem oil seals -B- are supplied with plastic sleeve; fit plastic sleeve -A- onto valve stem.***

- Lightly lubricate sealing lip of valve stem oil seal.
- Slip valve stem oil seal over plastic sleeve.
- Carefully press valve stem oil seal onto valve guide using valve stem seal fitting tool -3365-.
- Remove plastic sleeve.



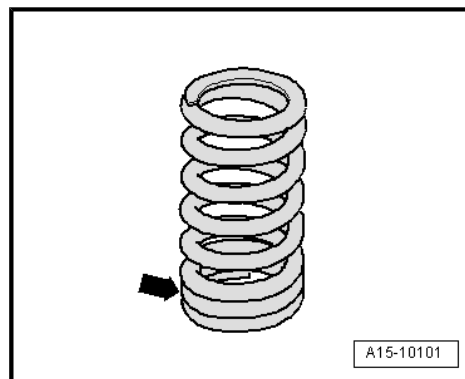
If valve cotters had been removed from assembly cartridge they must first be inserted in insertion device -VAS 5161/18-.

- Larger diameter of valve cotters faces upwards.

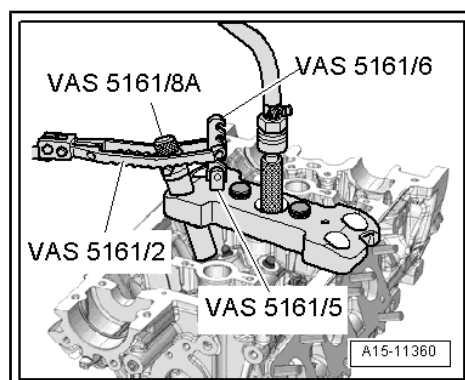


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- Install valve spring and valve spring plate.
- The closely spaced spring coils -arrow- face the cylinder head.



- Screw guide plate back onto cylinder head.
- Insert assembly cartridge into guide plate.
- Push pressure fork down and pull knurled screw upwards while turning screw in both directions - this will insert the valve cotters.
- Release pressure fork with knurled screw still in pulled position.
- Ensure that all roller rocker fingers contact the ends of the valve stems correctly and are clipped onto their respective supporting elements.
- Install spark plugs ⇒ Maintenance ; Booklet 404 .
- Install camshafts ⇒ [page 136](#) .
- Position timing chains on camshafts ⇒ [page 92](#) .
- Install timing chain covers (left and right) ⇒ [page 79](#) .
- Install cylinder head cover: left-side ⇒ [page 116](#) , right-side ⇒ [page 117](#) .



Caution

Avoid damage to valves and piston crowns after working on valve gear.

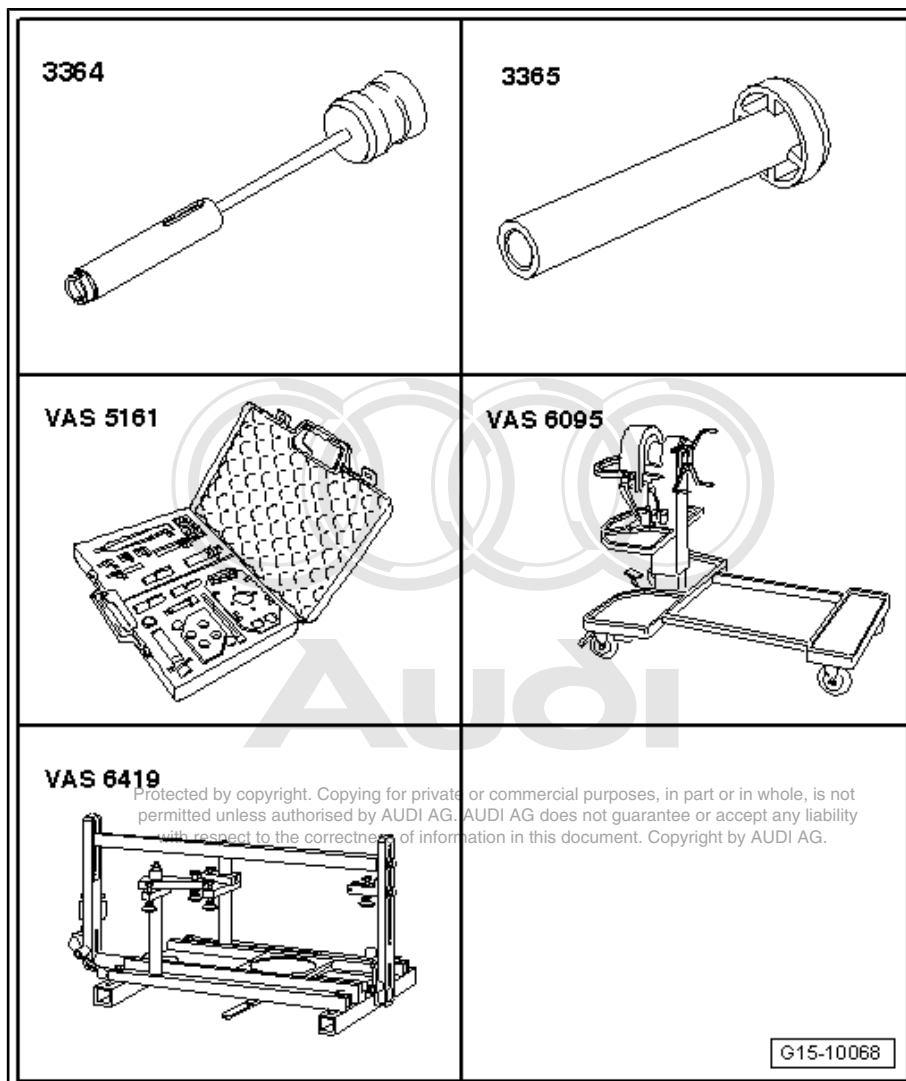
- ◆ **The hydraulic tappets have to settle; wait for approx. 30 minutes after installing camshafts before starting engine.**
- ◆ **Turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.**

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3.6 Renewing valve stem oil seals with cylinder head removed

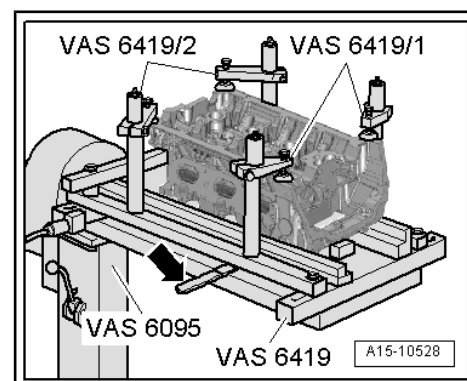
Special tools and workshop equipment required

- ◆ Valve stem seal puller -3364-
- ◆ Valve stem seal fitting tool -3365-
- ◆ Removal and installation device for valve cotters - VAS 5161- with guide plate -VAS 5161/19C-
- ◆ Engine and gearbox support -VAS 6095-
- ◆ Cylinder head tensioning device -VAS 6419-

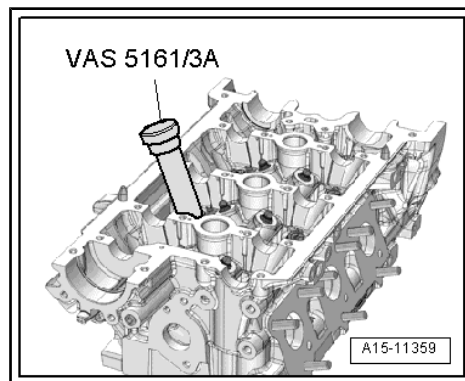


Procedure

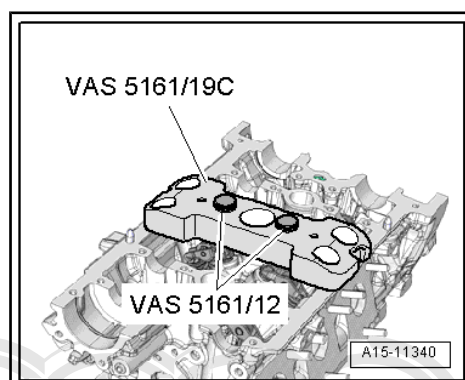
- Remove camshafts ⇒ [page 136](#) .
- Mark original positions of roller rocker fingers and hydraulic compensation elements for reinstallation.
- Remove roller rocker fingers together with hydraulic compensation elements and put down on a clean surface.
- Insert cylinder head tensioning device -VAS 6419- into engine and gearbox support -VAS 6095- .
- Secure cylinder head in cylinder head tensioning device, as shown in illustration.
- Connect cylinder head tensioning device to compressed air.
- Using lever -arrow-, slide air pad under combustion chamber where valve stem oil seal is to be removed.
- Apply just enough compressed air to bring air pad into contact with valve heads.



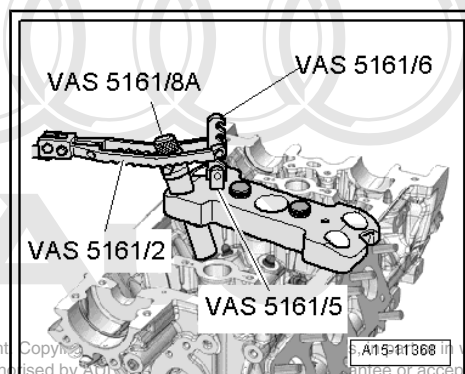
- Apply drift -VAS 5161/3A- to valve spring plate and use plastic-headed hammer to release sticking valve cotters.



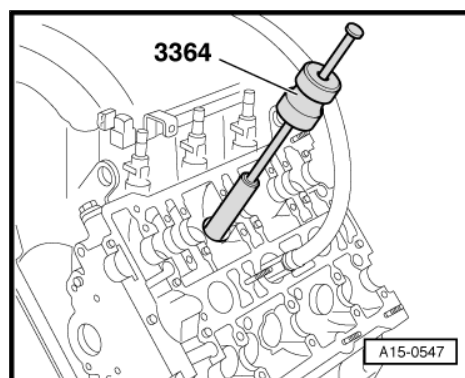
- Fit guide plate -VAS 5161/19C- from removal and installation device for valve cotters -VAS 5161- on cylinder head.
- Secure guide plate with knurled screws -VAS 5161/12- .



- Screw snap-in device -VAS 5161/6- with engaging fork -VAS 5161/5- into guide plate.
- Insert assembly cartridge -VAS 5161/8A- in guide plate.
- Attach pressure fork -VAS 5161/2- to snap-in device 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 assembly cartridge.
- Release pressure fork.
- Take out assembly cartridge.
- Detach guide plate and turn to one side.
- Detach valve spring with valve spring plate.
- Pull off valve stem oil seal with valve stem seal puller -3364- .



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**Caution**

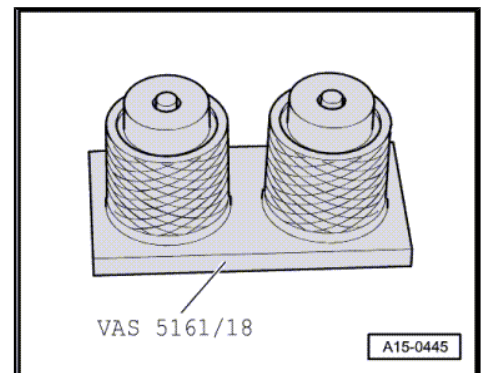
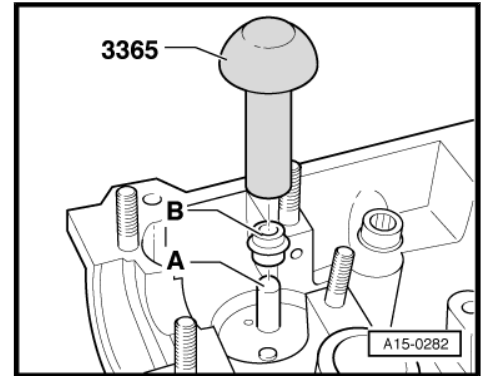
Make sure valve stem oil seals are not damaged when installing.

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

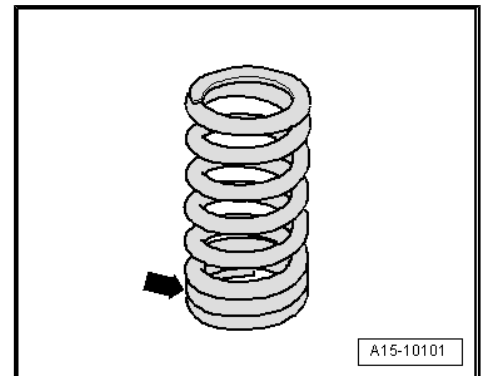
- Lightly oil sealing lip of valve stem oil seal.
- Slide valve stem oil seal onto plastic sleeve.
- Carefully press valve stem oil seal onto valve guide using valve stem seal fitting tool -3365-.
- Take off plastic sleeve.

If valve cotters have been removed from assembly cartridge, they must first be inserted in insertion device -VAS 5161/18-.

- Larger diameter of valve cotters faces upwards.
- Press assembly cartridge onto insertion device from above and take up valve cotters.



- Insert valve spring and valve spring plate.
- Installation position: Closely spaced spring coils -arrow- face towards cylinder head.

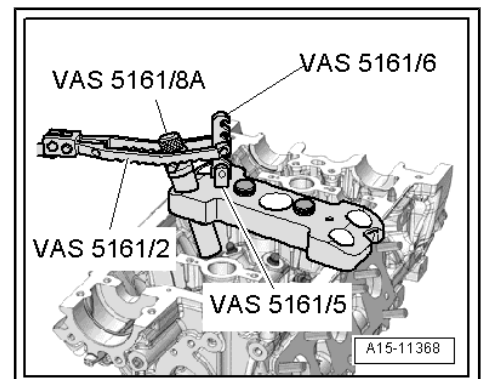


- Secure guide plate back onto cylinder head.
- Insert assembly cartridge in guide plate.
- Press down pressure fork and pull knurled screw upwards while turning screw in both directions - this will insert the valve cotters.
- Release pressure fork with knurled screw still in pulled position.
- Repeat procedure for each valve.

Assembling

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

- Ensure that all roller rocker fingers make contact with the ends of the valve stems correctly and are clipped onto their respective hydraulic compensation elements.
- Install camshafts ⇒ [page 136](#).





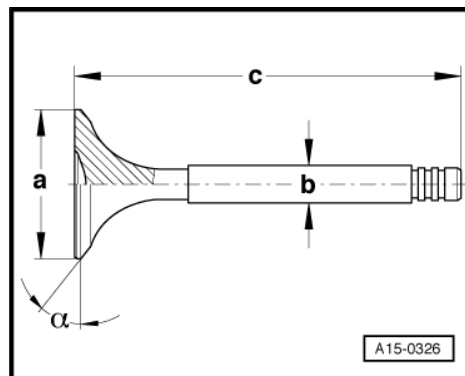
3.7 Valve dimensions



Note

Inlet and exhaust valves must not be machined. Only grinding-in is permitted.

Dimension		Inlet valve	Exhaust valve
Ø a	mm	33.85 ± 0.10	28.0 ± 0.1
Ø b	mm	5.98 ± 0.01	5.96 ± 0.01
c	mm	103.97 ± 0.20	101.9 ± 0.2
α	°	45	45



WARNING

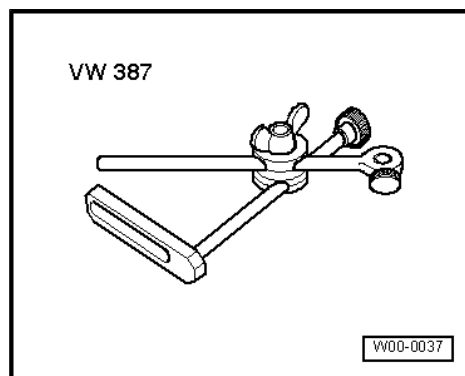
Care must be taken when disposing of old sodium-cooled exhaust valves - risk of injury.

- ♦ *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.*
- ♦ *Then throw a maximum of ten valves into a bucket of water and step away immediately.*
- ♦ *A sudden chemical reaction will occur upon contact with water in which the sodium filling burns.*
- ♦ *After performing these steps the valves can be disposed of in the normal way.*

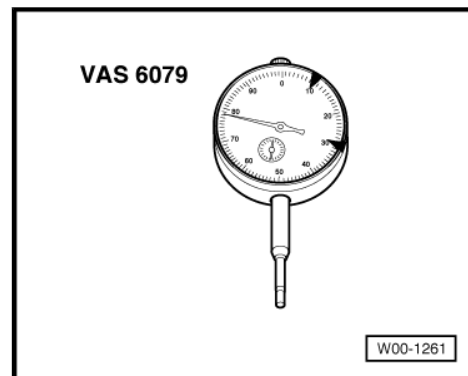
3.8 Checking valve guides

Special tools and workshop equipment required

- ♦ Universal dial gauge bracket -VW 387-



◆ Dial gauge -VAS 6079-

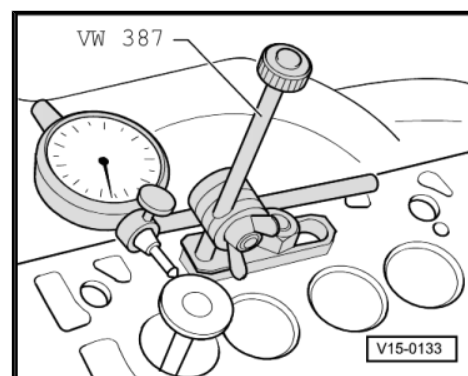


Procedure



Note

- ◆ *If the valve has to be renewed as part of a repair, use a new valve for the measurement.*
- ◆ *Only insert inlet valve into inlet guide and exhaust valve into exhaust guide, as the stem diameters are different.*
- Insert valve into valve guide.
- End of valve stem must be flush with valve guide.
- Determine amount of sideways play.
- Wear limit: 0.8 mm.
- If the wear limit is exceeded, repeat the measurement with new valves.
- Renew cylinder head if wear limit is still exceeded.



Note

Valve guides cannot be renewed.

3.9 Checking valves

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

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17 – Lubrication

1 Oil pump and sump (bottom section)

⇒ [“1.1 Oil pump and sump \(bottom section\) - exploded view”, page 154](#)

⇒ [“1.2 Removing and installing sump \(bottom section\)”, page 156](#)

⇒ [“1.3 Removing and installing oil pump”, page 158](#)

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



Note

If large quantities of metal shavings or abrasion are found when performing engine repairs, this may be an indication of damage to the crankshaft or conrod bearings. To prevent further damage, the following steps are required after completion of repair work: clean the oil galleries carefully and renew the oil spray jets, oil cooler and oil filter.

1 - Bolt

- ☐ Tightening torque and sequence ⇒ [page 155](#)

2 - Sump (bottom section)

- ☐ Removing and installing ⇒ [page 156](#)

3 - Bolt

- ☐ 9 Nm

4 - Oil pipe

5 - Gasket

- ☐ Renew

6 - O-ring

- ☐ Renew

7 - Bolt

- ☐ 9 Nm

8 - Bolt

- ☐ 9 Nm

9 - Housing for oil retention valve

10 - Gasket

- ☐ Renew

11 - Oil retention valve

12 - O-ring

- ☐ Renew

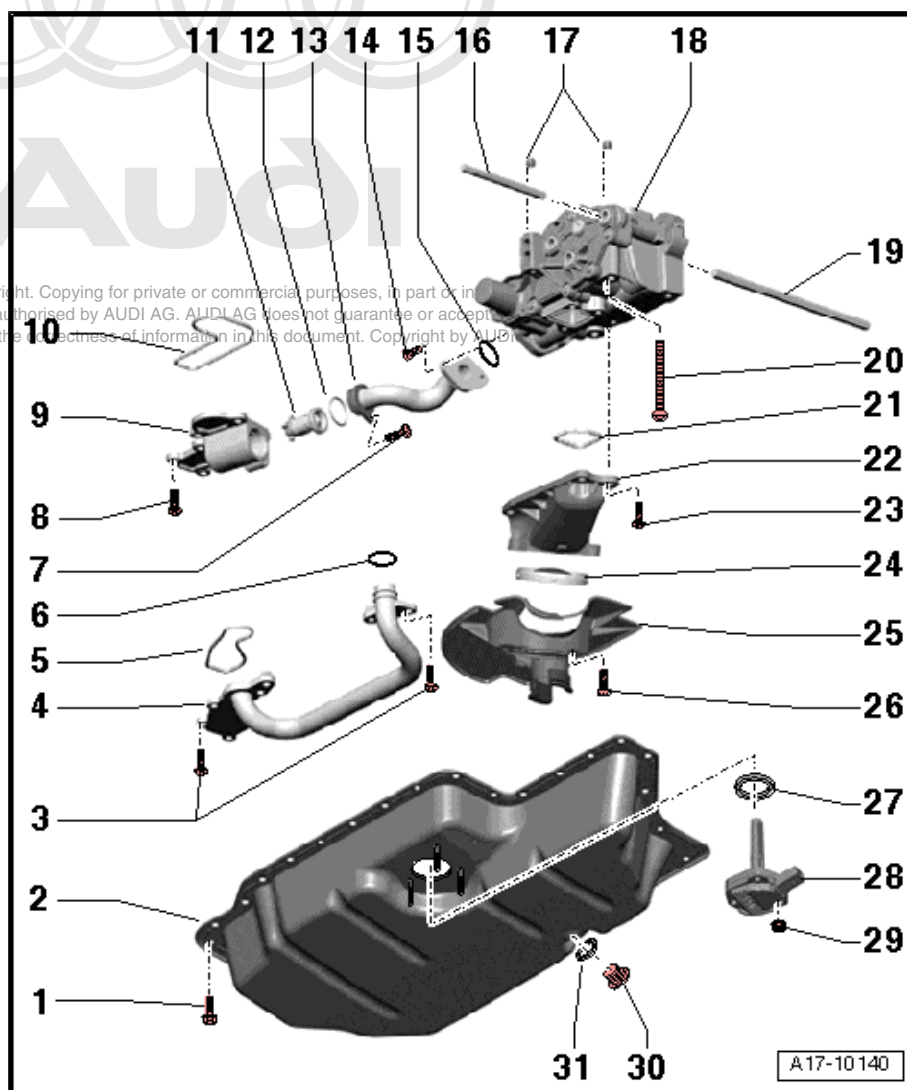
13 - Oil pipe

14 - Bolt

- ☐ 9 Nm

15 - O-ring

- ☐ Renew



16 - Drive shaft for coolant pump**17 - Dowel sleeves**

- ☐ 2x

18 - Oil pump

- ☐ Do not dismantle
- ☐ With pressure control valve: approx. 5.5 bar
- ☐ Removing and installing ⇒ [page 158](#)

19 - Oil pump drive shaft**20 - Bolt**

- ☐ Renew
- ☐ 8 Nm + 90° (1/4 turn further)

21 - Gasket

- ☐ Renew

22 - Intake connecting pipe

- ☐ For oil pump

23 - Bolt

- ☐ Renew
- ☐ 5 Nm + turn +45° further

24 - Oil strainer

- ☐ Clean

25 - Baffle plate**26 - Bolt**

- ☐ Renew
- ☐ 5 Nm + turn +45° further

27 - Seal

- ☐ Renew

28 - Oil level and oil temperature sender -G266-**29 - Nut**

- ☐ 9 Nm

30 - Oil drain plug

- ☐ 25 Nm

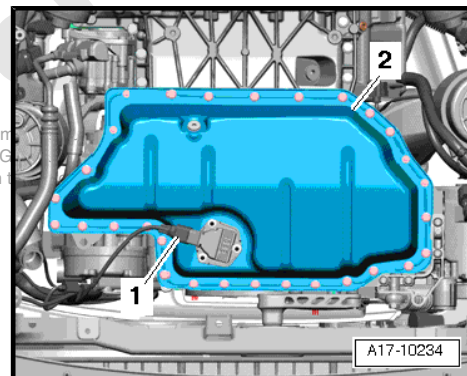
31 - Seal

- ☐ Renew

Tightening torque and sequence for sump (bottom section)

– Tighten bolts in 3 stages as follows:

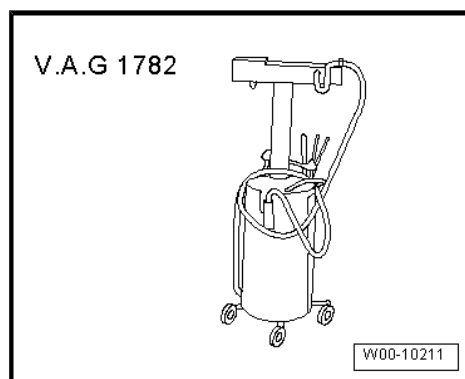
1. Screw in bolts by hand and in diagonal sequence.
2. Pre-tighten bolts to 5 Nm in diagonal sequence.
3. Tighten bolts to 9 Nm in diagonal sequence.



1.2 Removing and installing sump (bottom section)

Special tools and workshop equipment required

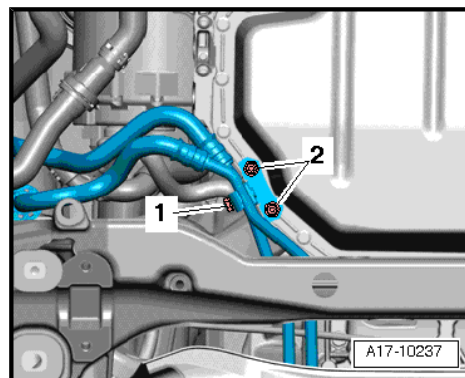
- ♦ Used oil collection and extraction unit -V.A.G 1782-



- ♦ Electric drill with plastic brush attachment
- ♦ Safety goggles
- ♦ Sealant → Electronic parts catalogue

Removing

- Drain off coolant ⇒ [page 181](#) .
- Remove coolant pipe (front) ⇒ [page 198](#) .
- Unscrew nuts -1 and 2-.
- Detach bracket for ATF lines.

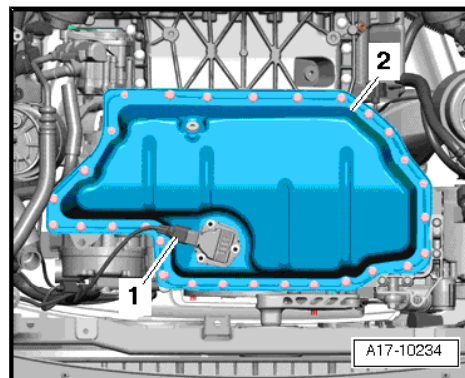


- Unplug electrical connector -1- at oil level and oil temperature sender -G266-.
- Place used oil collection and extraction unit -V.A.G 1782- under engine and drain engine oil.
- Unbolt sump (bottom section) -2- and pry off carefully.



Note

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



Installing

- Tightening torque
⇒ Fig. [“Tightening torque and sequence for sump \(bottom section\)”](#), page 155



Note

Renew seals.



WARNING

Protect eyes against injuries.

- ◆ *Wear safety goggles.*

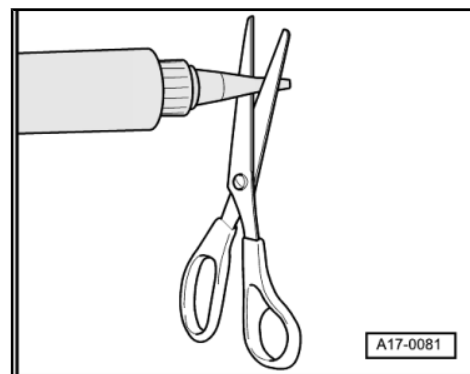
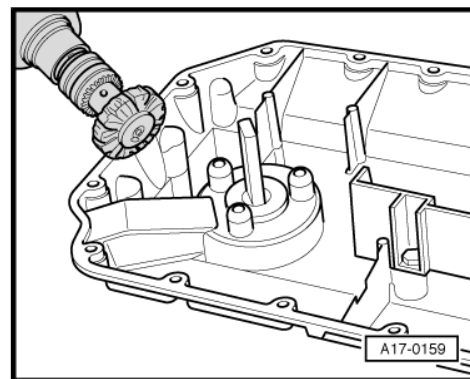


Caution

Protect lubrication system and bearings against contamination.

- ◆ *Cover exposed parts of the engine.*

- Remove sealant residue from bottom and top sections of sump with rotating plastic brush or similar.
- Clean sealing surfaces; they must be free of oil and grease.
- Cut off tube nozzle at front marking (diameter of nozzle approx. 2 mm).



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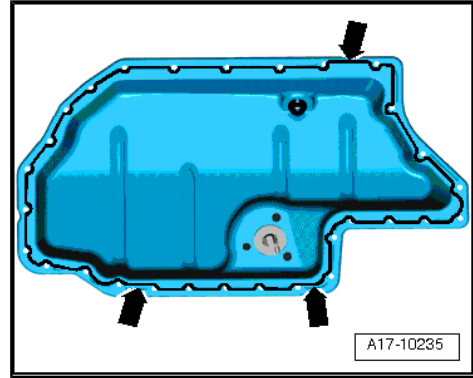
- Apply bead of sealant -arrow- onto clean sealing surface of sump (bottom section) as illustrated.
- Width of sealant bead: 2.5 mm.



Caution

Make sure oil strainer is not clogged by excess sealant.

- ◆ *The bead of sealant must not be thicker than specified.*



Note

The sump (bottom section) must be installed within 5 minutes after applying sealant.

- Fit sump (bottom section) and tighten bolts ⇒ [page 155](#) .

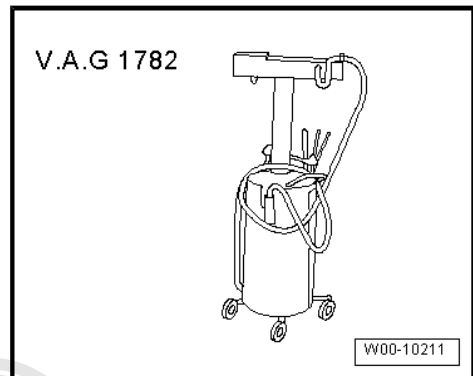
Remaining installation steps are carried out in reverse sequence; note the following:

- Install coolant pipe (front) ⇒ [page 198](#) .
- Fill up with engine oil and check oil level ⇒ [page 176](#) .
- Fill cooling system ⇒ [page 182](#) .

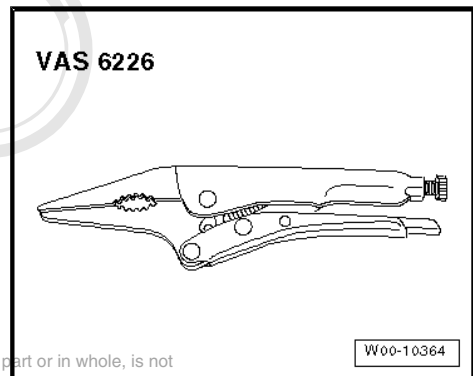
1.3 Removing and installing oil pump

Special tools and workshop equipment required

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

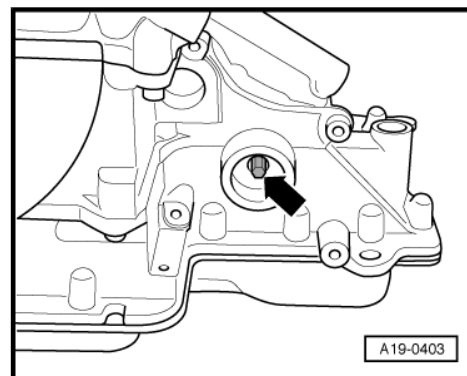


- ◆ Long-nose grip pliers -VAS 6226-



Removing

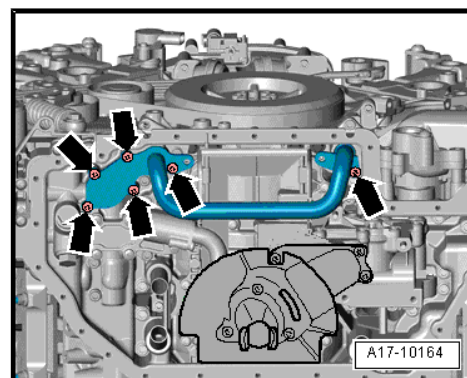
- Drain off coolant ⇒ [page 181](#) .
- Remove coolant pipe (front) ⇒ [page 198](#) .
- Remove coolant pump ⇒ [page 191](#) .
- Remove sump (bottom section) ⇒ [page 156](#) .
- Remove drive shaft -arrow- for coolant pump from the oil pump.



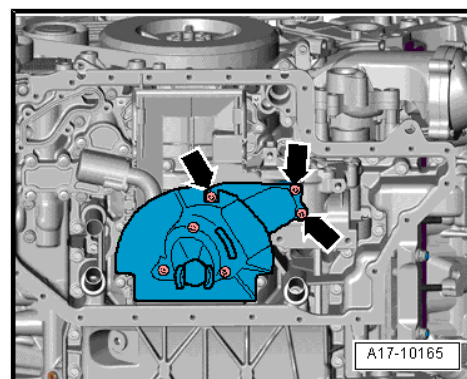
- Place used oil collection and extraction unit -V.A.G 1782- under engine.
- Unscrew bolts -arrows- and remove oil pipe.

**Note**

Some oil will come out when oil pipe is removed.



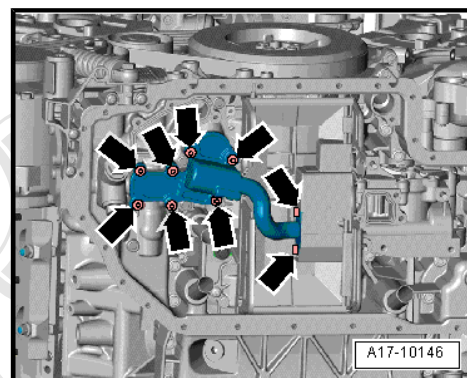
- Unscrew bolts -arrows- and remove intake connecting pipe.



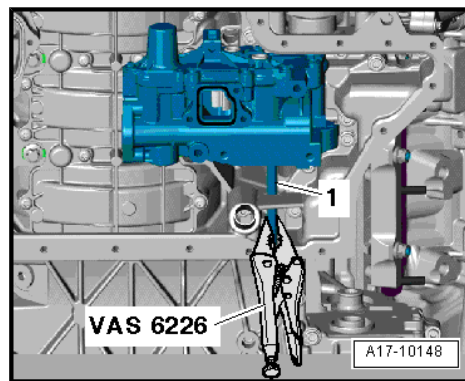
- Remove oil pipe together with oil retention valve housing.

**Note**

Some oil will come out when oil pipe is removed.



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



- Unscrew bolts -arrows- and remove oil pump.

Installing

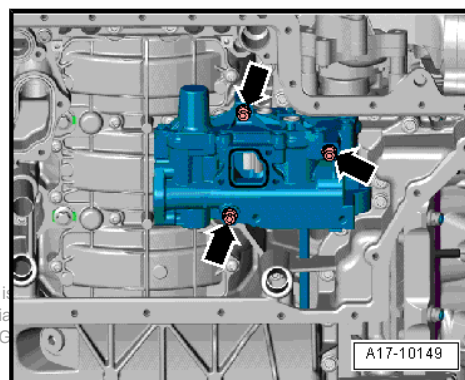
- Tightening torques
⇒ [“1.1 Oil pump and sump \(bottom section\) - exploded view”, page 154](#)



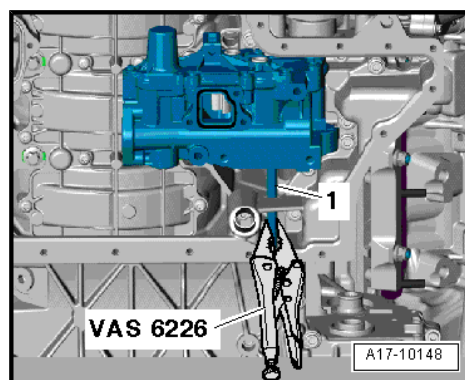
Note

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Renew seals and O-rings.



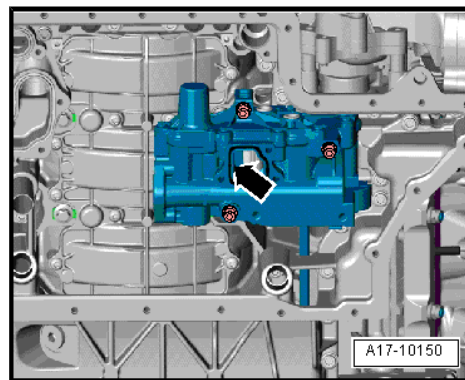
- Check whether the two dowel sleeves are fitted in the cylinder block; install if necessary.
- Secure the oil pump -arrows-.
- Release long-nose grip pliers -VAS 6226- and let drive shaft -1- slide into oil pump.



- 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.

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

- Install coolant pump ⇒ [page 191](#) .
- Install sump (bottom section) ⇒ [page 157](#) .
- Install coolant pipe (front) ⇒ [page 198](#) .
- Fill up with engine oil and check oil level ⇒ [page 176](#) .
- Fill cooling system ⇒ [page 182](#) .



2 Sump (top section)

⇒ "2.1 Sump (top section) - exploded view", page 161

⇒ "2.2 Removing and installing sump (top section)", page 162

2.1 Sump (top section) - exploded view

1 - Gaskets

- ☐ Renew

2 - O-ring

- ☐ Renew

3 - Gaskets

- ☐ Renew

4 - O-ring

- ☐ Renew

5 - Sump (top section)

- ☐ With 2 locating pins
- ☐ Removing and installing
⇒ [page 162](#)

6 - Bolt

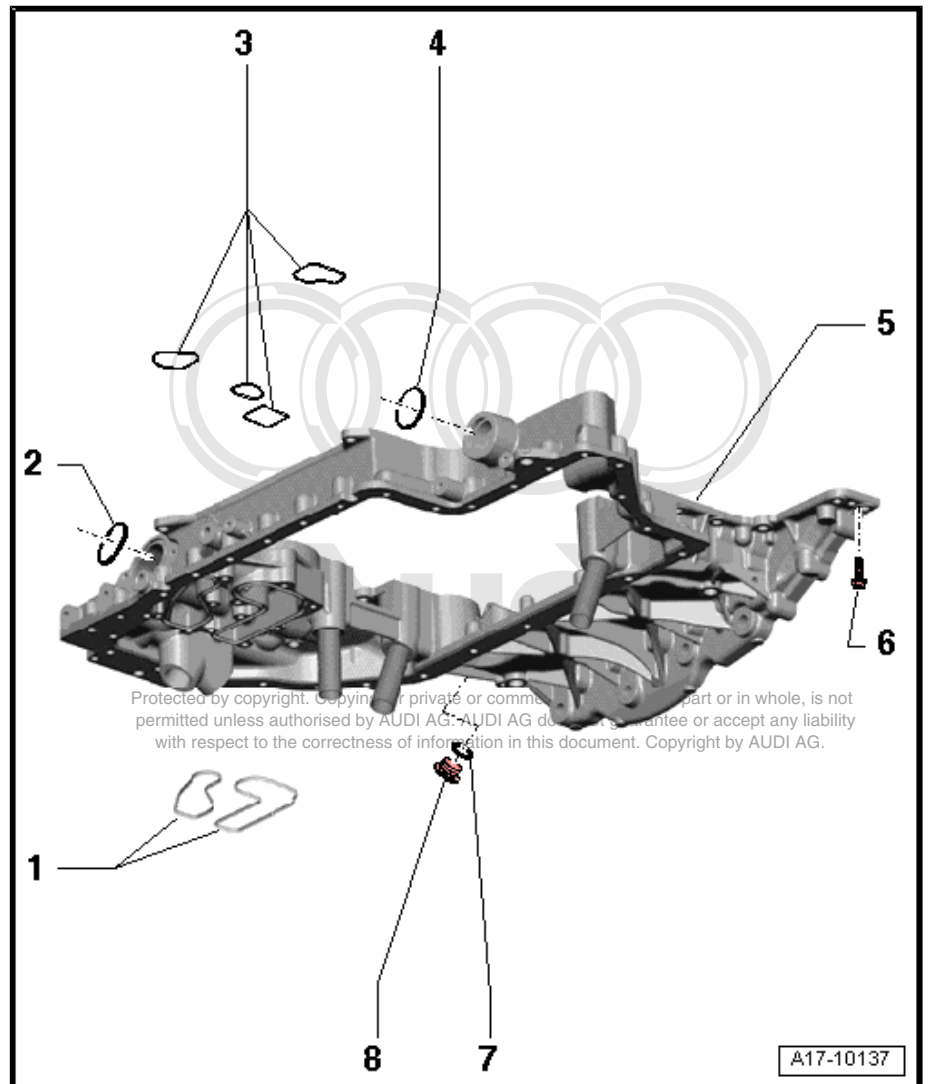
- ☐ Tightening torque and
sequence ⇒ [page 162](#)

7 - Seal

- ☐ Renew

8 - Screw plug

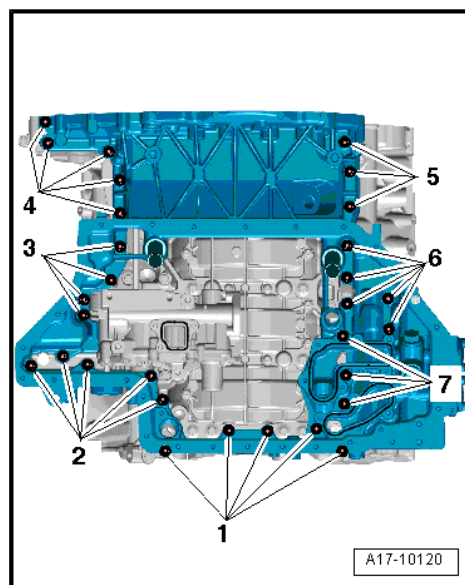
- ☐ 35 Nm



Tightening torque and sequence for sump (top section)

- Tighten bolts -1 ... 7- in 2 stages as follows:

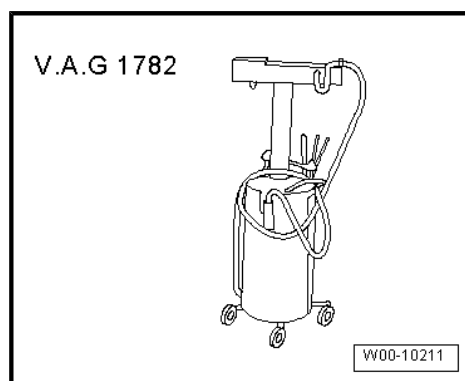
 1. Pre-tighten bolts to 5 Nm in diagonal sequence.
 2. Tighten bolts to 14 Nm in diagonal sequence.



2.2 Removing and installing sump (top section)

Special tools and workshop equipment required

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



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

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Removing

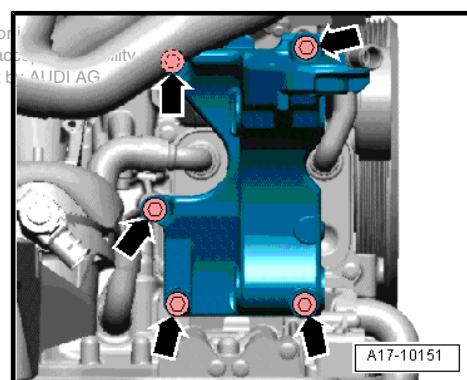
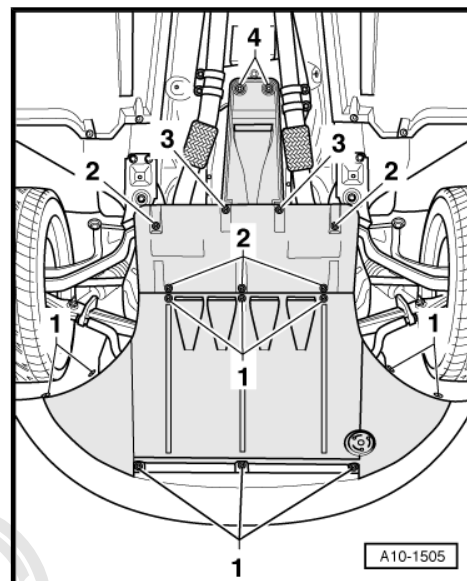
- Release fasteners -1, 2, 4- to remove noise insulation panels.



Note

Disregard -item 3-.

- Place used oil collection and extraction unit -V.A.G 1782- under engine and drain engine oil.
- Remove engine ⇒ [page 7](#) .
- Separate engine from gearbox ⇒ [page 25](#) .
- Secure engine to engine stand ⇒ [page 33](#) .
- Remove drive plate ⇒ [page 58](#) .
- Remove timing chain covers (left and right) ⇒ [page 78](#) .
- Remove intake manifold ⇒ Rep. gr. 24 .
- Remove oil filter housing ⇒ [page 172](#) .
- Remove timing chain cover (bottom) ⇒ [page 81](#) .
- Remove tensioner for poly V-belt ⇒ [page 53](#) .
- Remove coolant pipe (front) ⇒ [page 198](#) .
- Remove coolant pump ⇒ [page 191](#) .
- Remove alternator ⇒ Electrical system; Rep. gr. 27
- Remove bolts ~~-arrows-~~ and detach bracket for alternator.



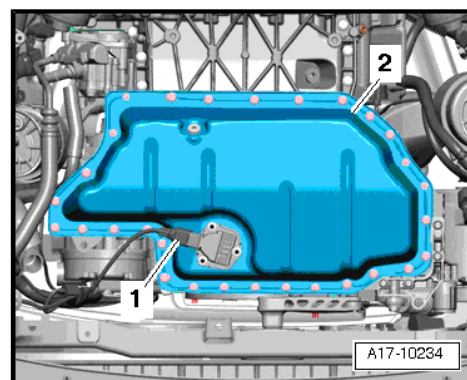
- Unplug electrical connector -1- at oil level and oil temperature sender -G266- .
- Place used oil collection and extraction unit -V.A.G 1782- under engine.



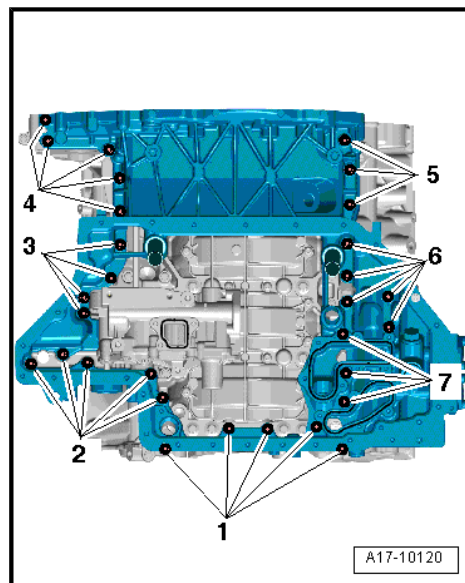
Note

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

- Unbolt sump (bottom section) -2- and pry off carefully.



- Remove oil pump ⇒ [page 158](#) .
- Remove bolts -1 ... 7- for sump (top section).
- Press sump (top section) off spring pins on cylinder block.



Installing

Tightening torques

- ⇒ [“1.1 Poly V-belt drive - exploded view - page 52”](#)
- ⇒ [Fig. ““Tightening torque and sequence for sump \(top section\)””, page 162](#) .



Note

Renew seals and O-rings.

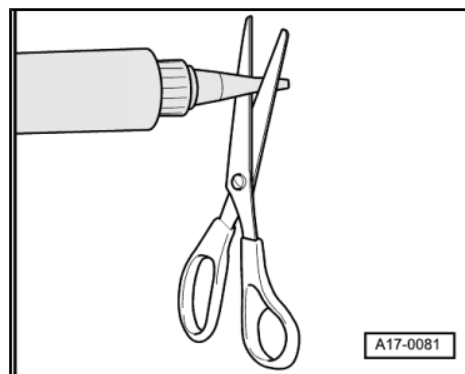
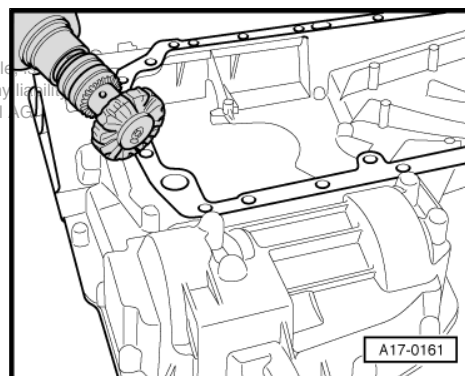


WARNING

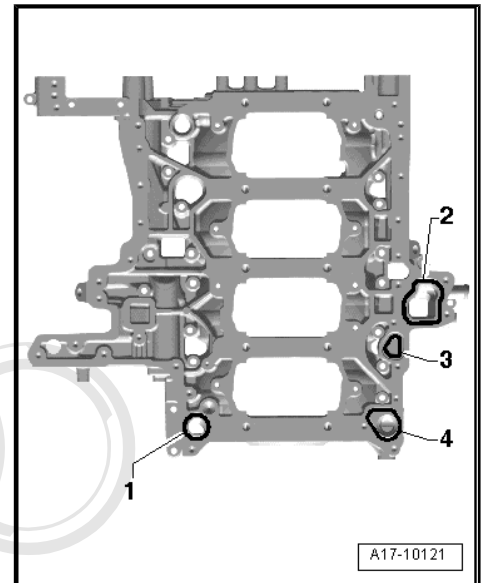
Protect eyes against injuries.

◆ *Wear safety goggles.*

- Remove sealant residue from sump (top section) and cylinder block with rotating plastic brush or similar.
- Clean sealing surfaces; they must be free of oil and grease.
- Cut off tube nozzle at front marking (diameter of nozzle approx. 1 mm).



- Fit new seals -1 ... 4- in grooves on cylinder block.



- Apply beads of sealant -1 and 2- onto clean sealing surface of sump (top section) as illustrated.
- ◆ Width of beads of sealant: 2.5 mm.

**Caution**

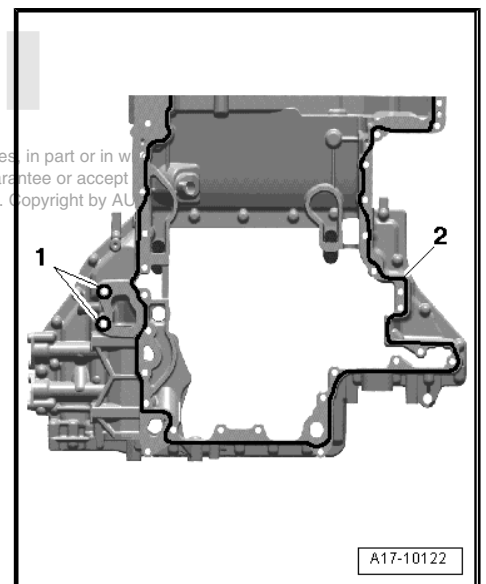
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Make sure oil strainer is not clogged by excess sealant.

◆ ***The sealant bead must not be thicker than specified.***

**Note**

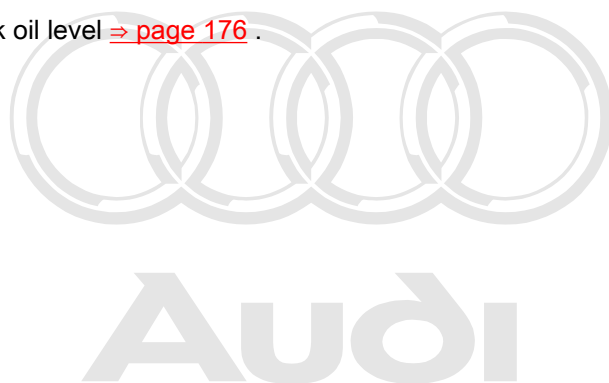
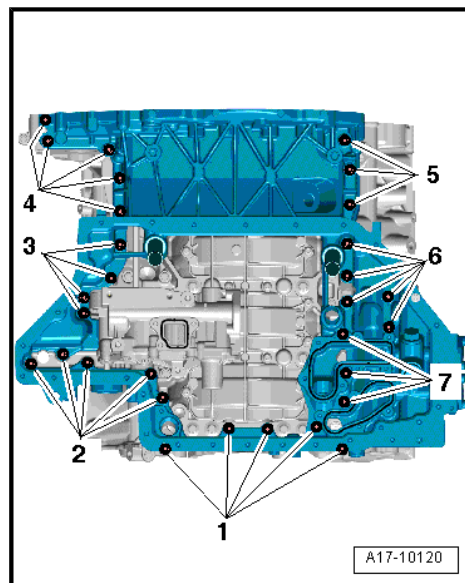
The sump (top section) must be installed within 5 minutes after applying sealant.



- Fit sump (top section) and tighten bolts ⇒ [page 162](#) .

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

- Install oil pump ⇒ [page 158](#) .
- Install coolant pump ⇒ [page 191](#) .
- Install sump (bottom section) ⇒ [page 157](#) .
- Install coolant pipe (front) ⇒ [page 198](#) .
- Install tensioner for poly V-belt ⇒ [page 53](#) .
- Install alternator ⇒ Electrical system; Rep. gr. 27
- Install timing chain cover (bottom) ⇒ [page 81](#) .
- Install crankshaft oil seal (gearbox end) ⇒ [page 59](#) .
- Install oil filter housing ⇒ [page 172](#) .
- Install intake manifold ⇒ Rep. gr. 24 .
- Install timing chain covers (left and right) ⇒ [page 78](#) .
- Install drive plate ⇒ [page 58](#) .
- Install engine ⇒ [page 35](#) .
- Fill up with engine oil and check oil level ⇒ [page 176](#) .



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3 Oil retention valve, spray nozzle valve, oil filter housing, oil cooler, oil pressure switch

⇒ ["3.1 Oil retention valve and spray nozzle valve - exploded view", page 168](#)

⇒ ["3.2 Removing and installing oil retention valve and spray nozzle valve", page 169](#)

⇒ ["3.3 Removing and installing hose for crankcase breather system", page 170](#)

⇒ ["3.4 Oil filter housing - exploded view", page 170](#)

⇒ ["3.5 Removing and installing oil filter housing", page 172](#)

⇒ ["3.6 Removing and installing oil cooler", page 172](#)

⇒ ["3.7 Removing and installing oil pressure switch F1", page 174](#)

⇒ ["3.8 Checking oil pressure and oil pressure switch F1", page 175](#)

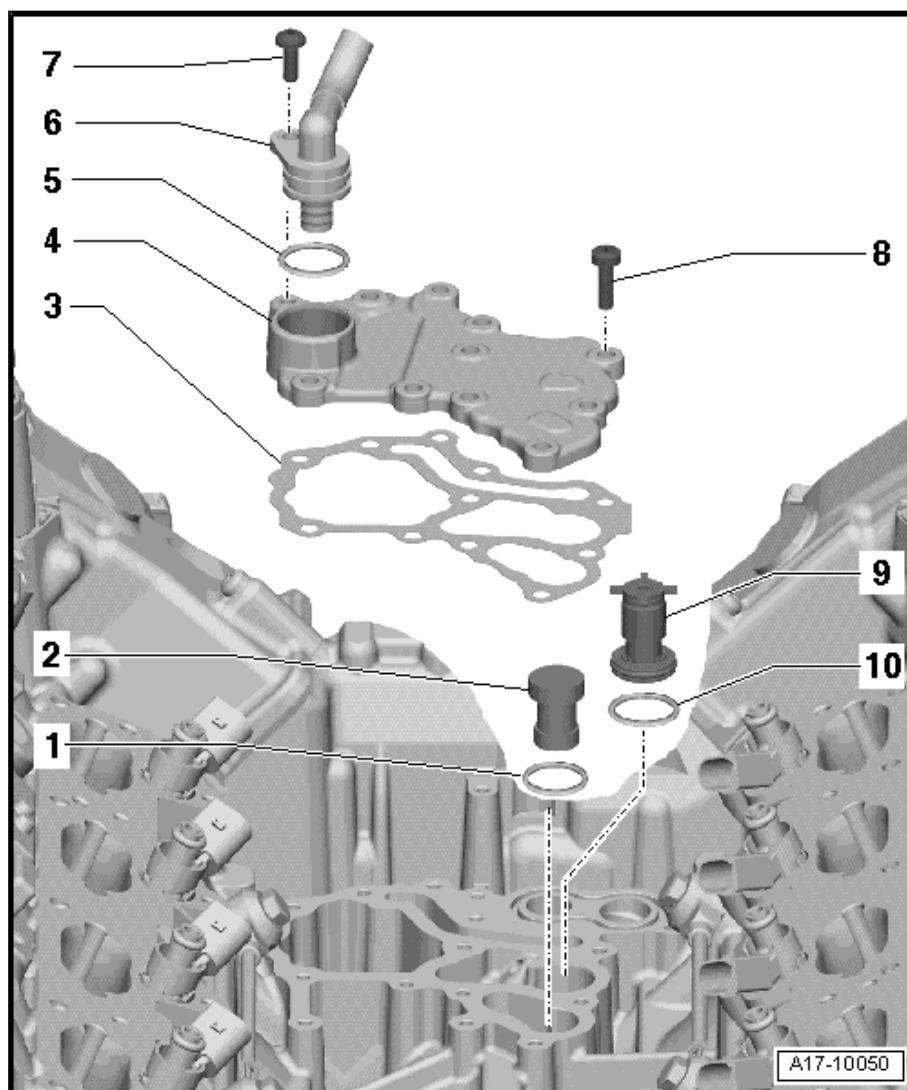
⇒ ["3.9 Engine oil", page 176](#)

⇒ ["3.10 Checking oil level", page 176](#)

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3.1 Oil retention valve and spray nozzle valve - exploded view

- 1 - O-ring
 - ☐ Renew
- 2 - Spray nozzle valve
 - ☐ Removing and installing
⇒ [page 169](#)
- 3 - Gasket
 - ☐ Renew
- 4 - Cover
- 5 - O-ring
 - ☐ Renew
- 6 - Hose
 - ☐ For crankcase breather
- 7 - Bolt
 - ☐ 9 Nm
- 8 - Bolt
 - ☐ 9 Nm
- 9 - Oil retention valve
 - ☐ Removing and installing
⇒ [page 169](#)
- 10 - O-ring
 - ☐ Renew



3.2 Removing and installing oil retention valve and spray nozzle valve

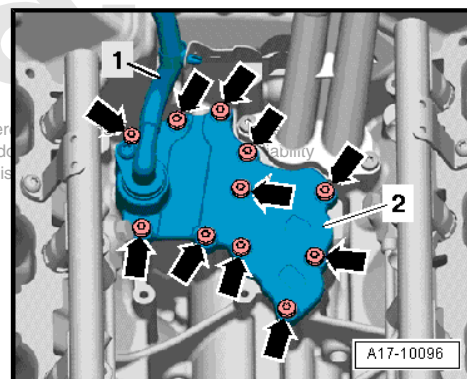
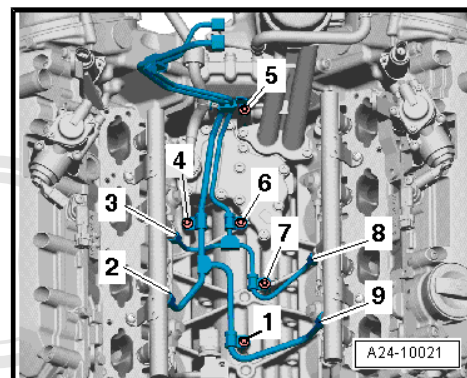


Note

If irregular valve noise disappears after a lengthy drive but repeatedly re-occurs when travelling short distances, renew oil retention valve.

Removing

- Remove intake manifold ⇒ Rep. gr. 24 .
- Remove bolts -1, 4, 5, 6, 7- at retaining clips for high-pressure lines.
- Unplug electrical connectors at injectors.
- Unscrew high-pressure pipes -2 and 9- from connections at fuel rail.
- Unscrew high-pressure pipes -3 and 8- from connections at fuel rail. To do so, counterhold at hexagon flats with an open-end spanner and slacken union nut.
- Detach high-pressure pipes.
- Remove bolts -arrows-.
- Detach cover -2- with hose -1- for crankcase breather system.
- Remove gasket.



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

Installing

- Tightening torques ⇒ [page 168](#)

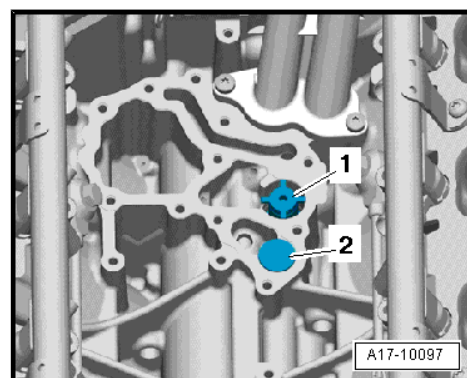
Installation is carried out in the reverse order; note the following:



Note

Renew gaskets, seals and O-rings.

- Install high-pressure lines ⇒ Rep. gr. 24 ; procedure described in "Removing and installing injectors".
- Install intake manifold ⇒ Rep. gr. 24 .



3.3 Removing and installing hose for crankcase breather system

Removing

- Remove intake manifold ⇒ Rep. gr. 24 .
- Remove bolt -arrow- and pull out crankcase breather hose -1- from cover -2-.

Installing

- Tightening torque ⇒ [page 168](#)

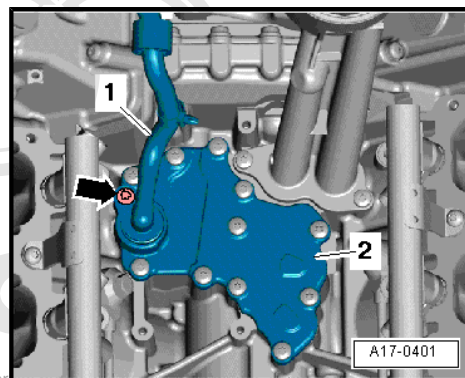
Installation is carried out in the reverse order; note the following:



Note

Fit new O-ring.

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- Install intake manifold ⇒ Rep. gr. 24 .

3.4 Oil filter housing - exploded view

1 - Gasket

- ☐ Renew

2 - Bolt

- ☐ 9 Nm

3 - Oil filter housing

- ☐ With oil filter bypass valve 1.3 bar

4 - Bolt

- ☐ 22 Nm

5 - O-ring

- ☐ Part of oil filter element

6 - Oil filter element

- ☐ Renew O-ring -item 7- when renewing filter
- ☐ Observe change intervals ⇒ Maintenance ; Booklet 404

7 - O-ring

- ☐ Renew

8 - Sealing cap

- ☐ 25 Nm

9 - Bolt

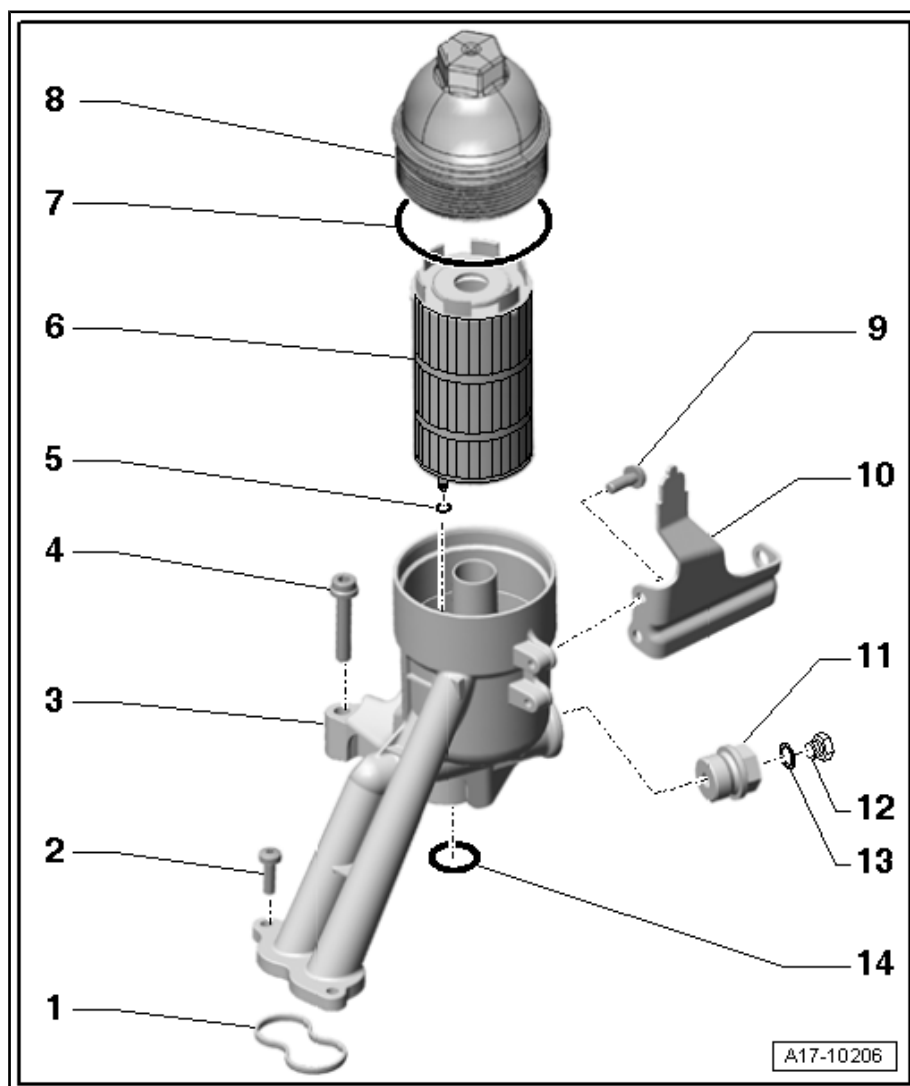
- ☐ 9 Nm

10 - Bracket

- ☐ For activated charcoal filter solenoid valve 1 - N80-

11 - Screw plug

- ☐ 50 Nm



12 - Screw plug

- ☐ 9 Nm

13 - Seal

- ☐ Renew

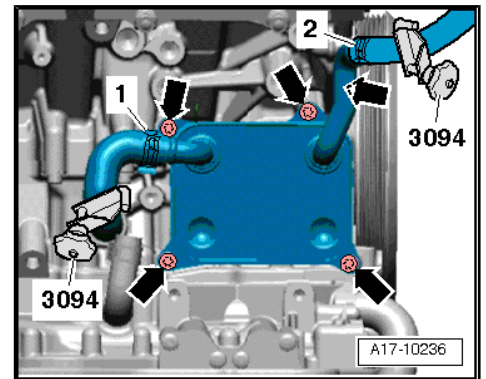
14 - O-ring

- ☐ Renew

Oil cooler

Bolts -arrows-

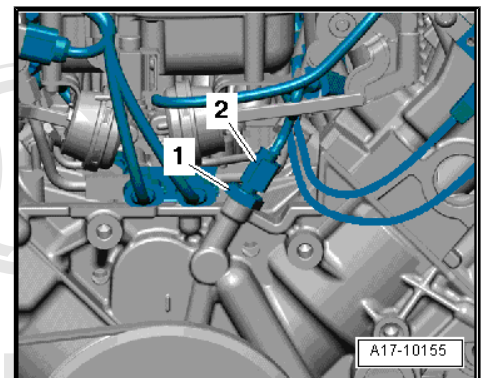
- 9 Nm



Oil pressure switch -F1-

Oil pressure switch -F1- -item 1-

- 20 Nm
- Renew seal



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3.5 Removing and installing oil filter housing

Removing

- Remove intake manifold ⇒ Rep. gr. 24 .



Note

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

- Unscrew sealing cap and remove oil filter element.
- Unscrew bolts -arrows- and remove oil filter housing.

Installing

- Tightening torques ⇒ [page 170](#)

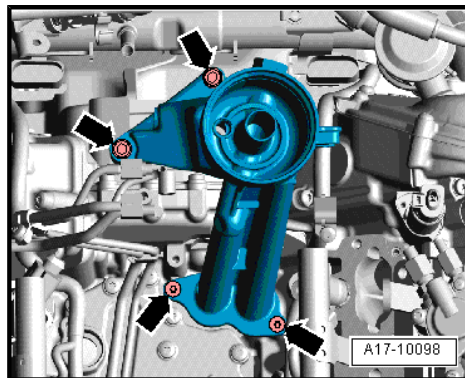
Installation is carried out in the reverse order; note the following:



Note

Renew seals and O-rings.

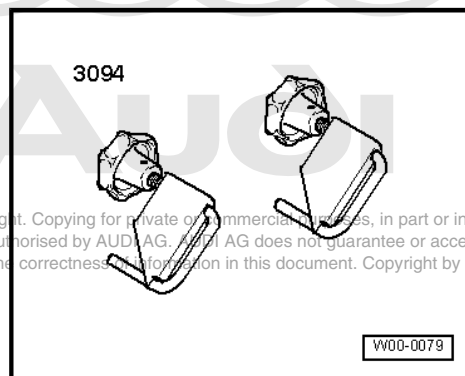
- Install intake manifold ⇒ Rep. gr. 24 .
- Check oil level ⇒ [page 176](#) .



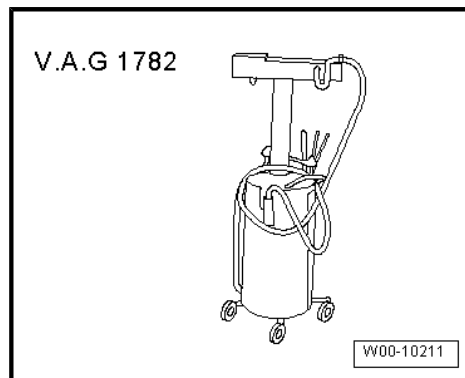
3.6 Removing and installing oil cooler

Special tools and workshop equipment required

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

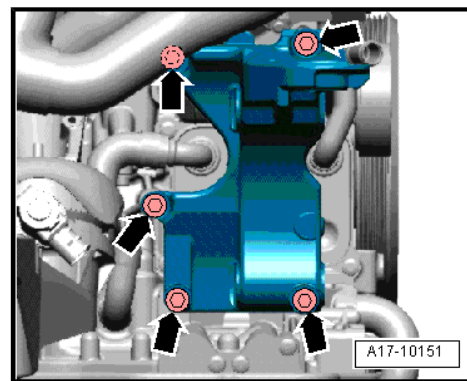


- ◆ Used oil collection and extraction unit -V.A.G 1782-



Removing

- Drain off coolant ⇒ [page 181](#) .
- Remove alternator ⇒ Electrical system; Rep. gr. 27
- Remove bolts -arrows- and detach bracket for alternator.



- Clamp off coolant hoses using hose clamps -3094- as shown in illustration.

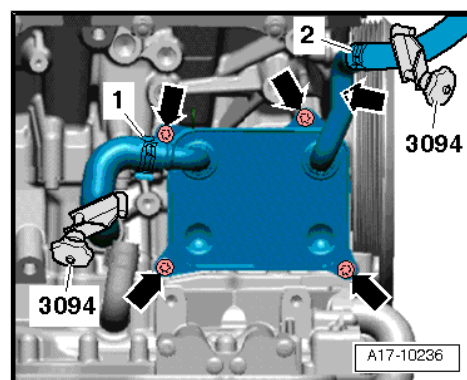


Note

Place a cloth underneath to catch escaping coolant.

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- Detach coolant hoses -1 and 2- at oil cooler.
- Place used oil collection and extraction unit -V.A.G 1782- under engine.
- Unscrew the bolts -arrows- and remove oil cooler.



Installing

- Tightening torques ⇒ [page 52](#) , ⇒ [page 170](#) .

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) ⇒ Electronic parts catalogue .*
- Install alternator ⇒ Electrical system; Rep. gr. 27
- Check coolant level ⇒ [page 182](#) .

3.7 Removing and installing oil pressure switch -F1-

Removing

- Move lock carrier to service position ⇒ Rep. gr. 50 .
- Unplug electrical connector -2- at oil pressure switch -F1- -item 1-.
- Unscrew oil pressure switch -F1- .

Installing

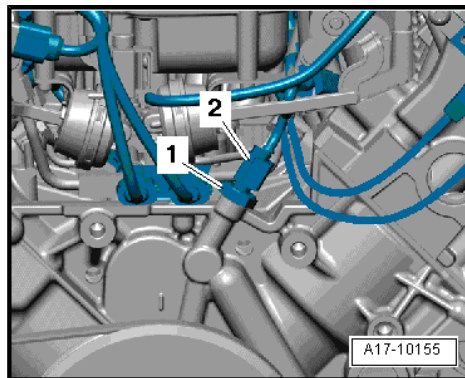
- Tightening torque ⇒ [page 170](#)

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



Note

- ◆ *Renew seal.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- Install lock carrier with attachments ⇒ Rep. gr. 50 .



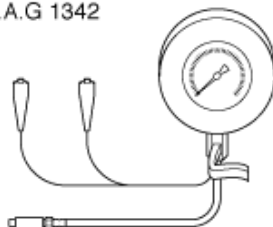
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3.8 Checking oil pressure and oil pressure switch -F1-

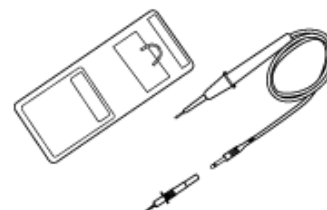
Special tools and workshop equipment required

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

V.A.G 1342



V.A.G 1527 B



V.A.G 1594 C

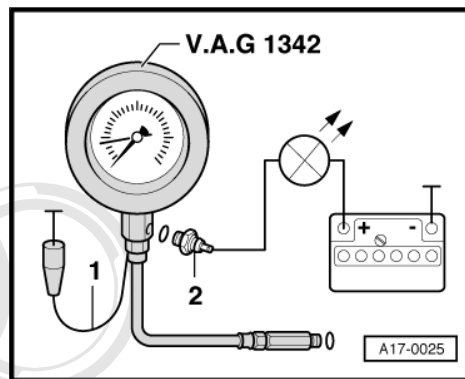


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G17-0023

Procedure

- Oil level OK
- Engine oil temperature approx. 80 °C
- Remove oil pressure switch -F1- ⇒ [page 174](#) .
- Connect oil pressure tester -V.A.G 1342- with adapter -V.A.G 1342/14- to bore for oil pressure switch.
- Screw oil pressure switch -2- into oil pressure tester -V.A.G 1342- .
- Connect brown wire of oil pressure tester to earth (“-”).



Checking oil pressure switch

- Connect voltage tester -V.A.G 1527B- with test leads from auxiliary measuring set -V.A.G 1594C- to oil pressure switch and battery positive (“+”).
- LED should not light up.

If the LED 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.
- Oil pressure at idling speed: at least 1.5 bar.
- Oil pressure at 2000 rpm: at least 3.5 bar.

The pressure relief valve or oil pump is defective if the specifications are not attained.

- Renew oil pump ⇒ [page 158](#) .

Assembling

- Install oil pressure switch -F1- ⇒ [page 174](#) .

3.9 Engine oil

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

3.10 Checking oil level

- Check oil level ⇒ Maintenance ; Booklet 404 .



Caution

Risk of damage to catalytic converter.

- ◆ *The oil level must not be above the "max" mark on the dipstick.*



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19 – Cooling

1 Cooling system

⇒ [“1.1 Diagrams of coolant hose connections”, page 178](#)

⇒ [“1.2 Draining and filling cooling system”, page 181](#)

⇒ [“1.3 Checking cooling system for leaks”, page 187](#)

1.1 Diagrams of coolant hose connections

Vehicles without auxiliary heater

1 - Radiator

- ☐ Removing and installing
⇒ [page 219](#)
- ☐ If renewed, refill system
with fresh coolant

2 - ATF cooler

- ☐ Removing and installing
⇒ [Rep. gr. 37](#)
- ☐ If renewed, refill system
with fresh coolant

3 - Thermostat

- ☐ For ATF cooler

4 - Alternator

5 - Oil cooler

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

6 - Cylinder head and cylinder block

- ☐ If renewed, refill system
with fresh coolant

7 - Coolant temperature sender -G62-

- ☐ Removing and installing
⇒ [page 197](#)

8 - Throttle valve connection

9 - Bleeder screw

- ☐ In coolant hose to heat
exchanger

10 - Heat exchanger

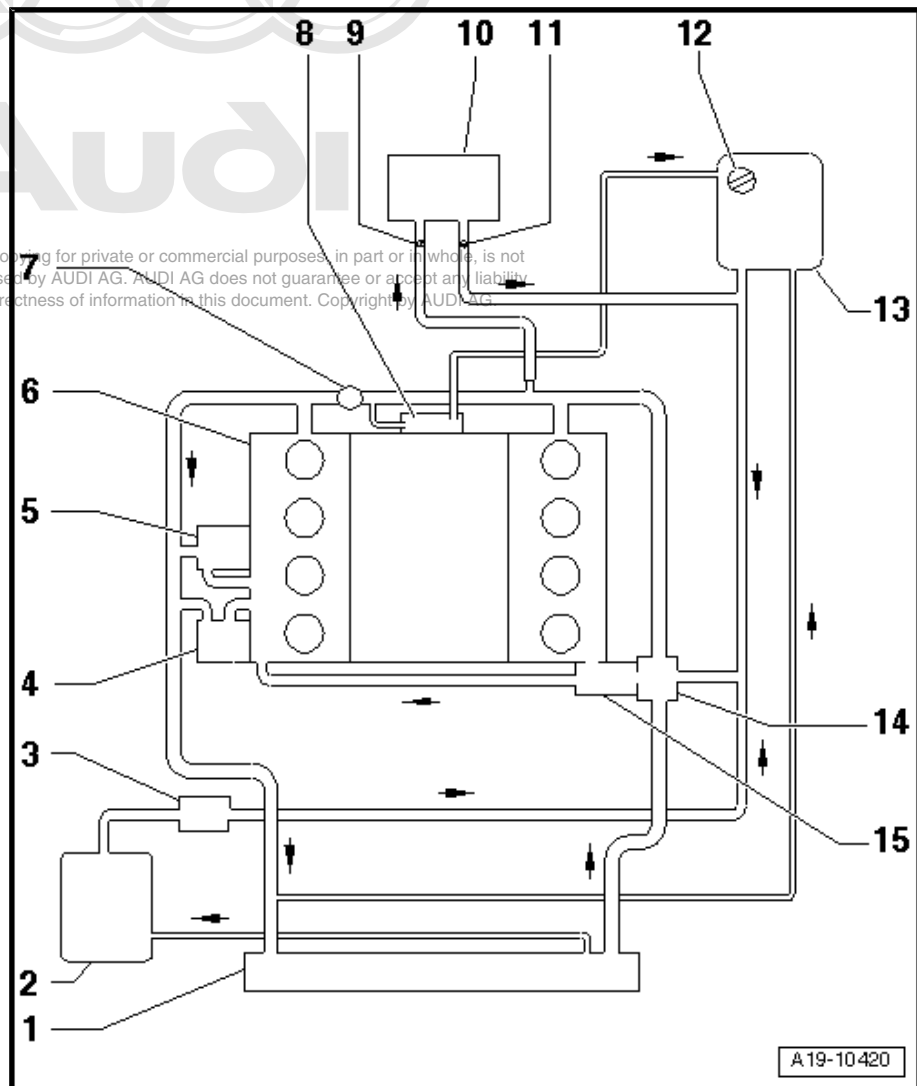
- ☐ If renewed, refill system with fresh coolant

11 - Bleeder screw

- ☐ In coolant hose from heat exchanger

12 - Filler cap

- ☐ Checking pressure relief valve ⇒ [page 188](#)



13 - Expansion tank**14 - Map-controlled engine cooling system thermostat -F265-**

- ☐ Removing and installing ⇒ [page 193](#)

15 - Coolant pump

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

Vehicles with auxiliary heater**1 - Radiator**

- ☐ Removing and installing ⇒ [page 219](#)
- ☐ If renewed, refill system with fresh coolant

2 - ATF cooler

- ☐ Removing and installing ⇒ Rep. gr. 37
- ☐ If renewed, refill system with fresh coolant

3 - Thermostat

- ☐ For ATF cooler

4 - Alternator**5 - Heater coolant shut-off valve -N279-****6 - Circulation pump -V55-**

- ☐ Removing and installing ⇒ Rep. gr. 82

7 - Auxiliary heater**8 - Oil cooler**

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

9 - Coolant temperature sender -G62-

- ☐ Removing and installing ⇒ [page 197](#)

10 - Throttle valve connection**11 - Bleeder screw**

- ☐ In coolant hose to heat exchanger

12 - Heat exchanger

- ☐ If renewed, refill system with fresh coolant

13 - Bleeder screw

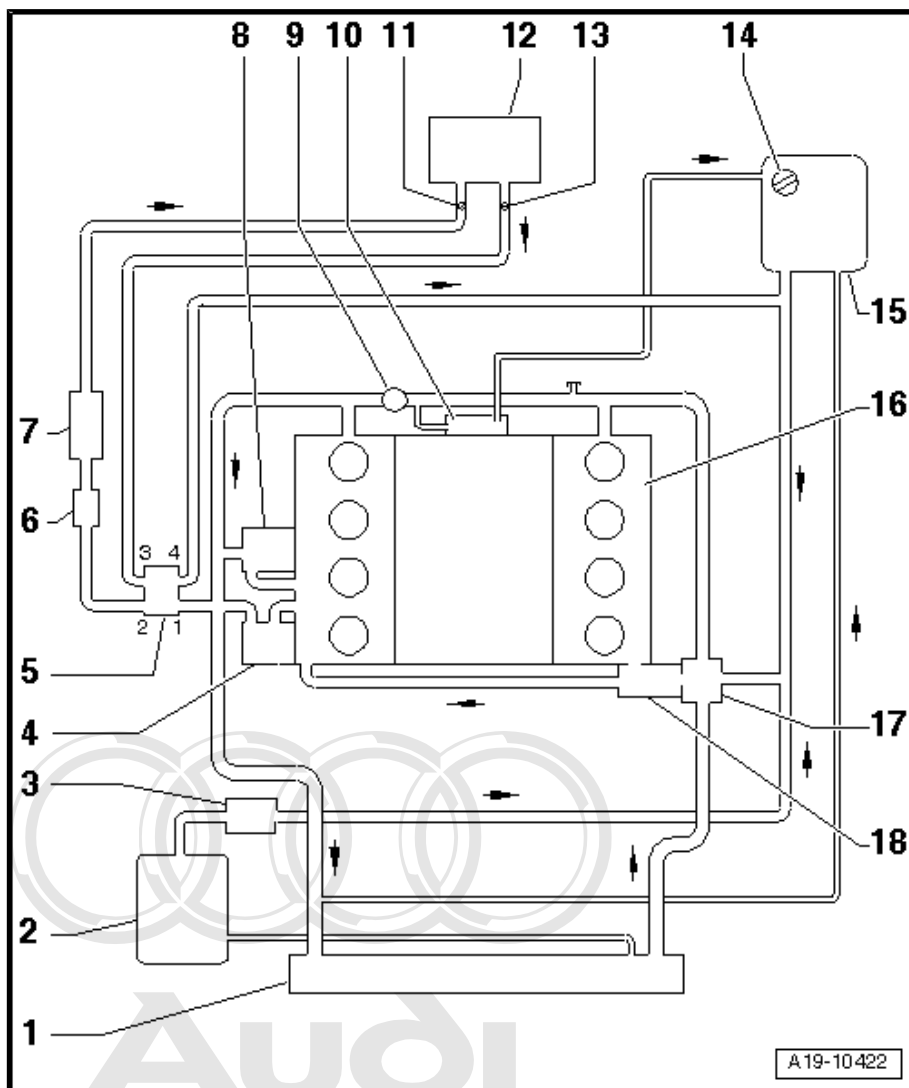
- ☐ In coolant hose from heat exchanger

14 - Filler cap

- ☐ Checking pressure relief valve ⇒ [page 188](#)

15 - Expansion tank**16 - Cylinder head and cylinder block**

- ☐ If renewed, refill system with fresh coolant



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17 - Map-controlled engine cooling system thermostat -F265-

- ☐ Removing and installing ⇒ [page 193](#)

18 - Coolant pump

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

Vehicles with auxiliary radiator

1 - Auxiliary radiator

2 - ATF cooler

- ☐ Removing and installing
⇒ Rep. gr. 37
- ☐ If renewed, refill system
with fresh coolant

3 - Thermostat for ATF cooler and auxiliary radiator

4 - Alternator

5 - Oil cooler

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

6 - Cylinder head and cylinder block

- ☐ If renewed, refill system
with fresh coolant

7 - Coolant temperature sensor -G62-

- ☐ Removing and installing
⇒ [page 197](#)

8 - Throttle valve connection

9 - Bleeder screw

- ☐ In coolant hose to heat
exchanger

10 - Heat exchanger

- ☐ If renewed, refill system
with fresh coolant

11 - Bleeder screw

- ☐ In coolant hose from
heat exchanger

12 - Filler cap

- ☐ Checking pressure relief valve ⇒ [page 188](#)

13 - Expansion tank

14 - Map-controlled engine cooling system thermostat -F265-

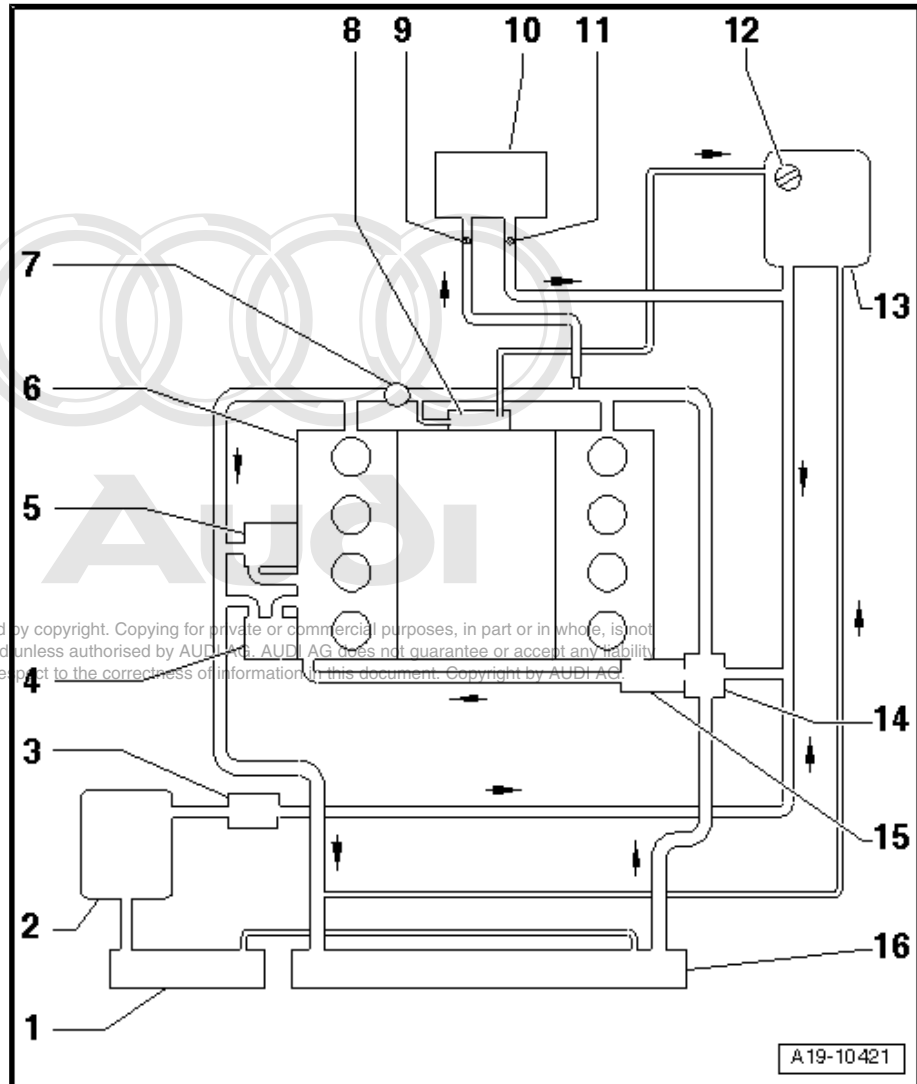
- ☐ Removing and installing ⇒ [page 193](#)

15 - Coolant pump

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

16 - Radiator

- ☐ Removing and installing ⇒ [page 219](#)
- ☐ If renewed, refill system with fresh coolant

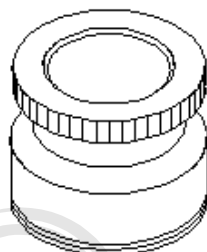


1.2 Draining and filling cooling system

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-
- ◆ Drip tray for workshop hoist -VAS 6208-
- ◆ Cooling system charge unit -VAS 6096-
- ◆ Hose clip pliers -VAS 6362-
- ◆ Refractometer -T10007 A-

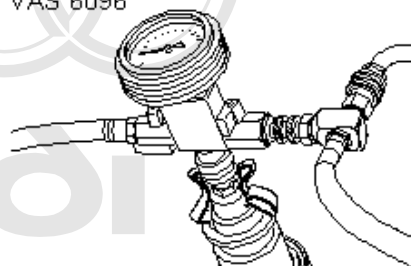
V.A.G 1274/8



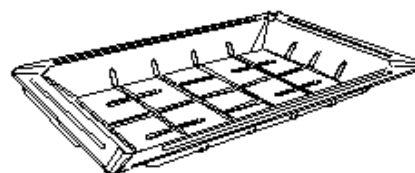
V.A.G 1274/10



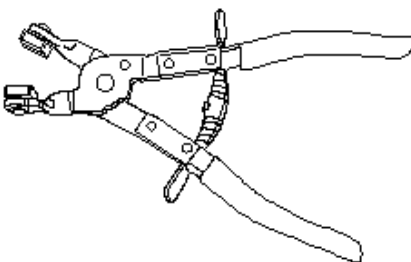
VAS 6096



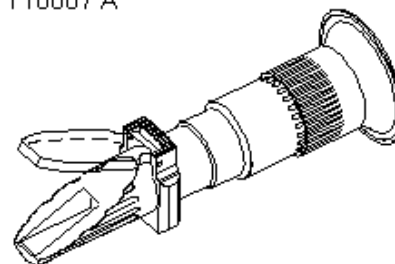
VAS 6208



VAS 6362



T10007 A



G19-10029

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Draining



Note

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



WARNING

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

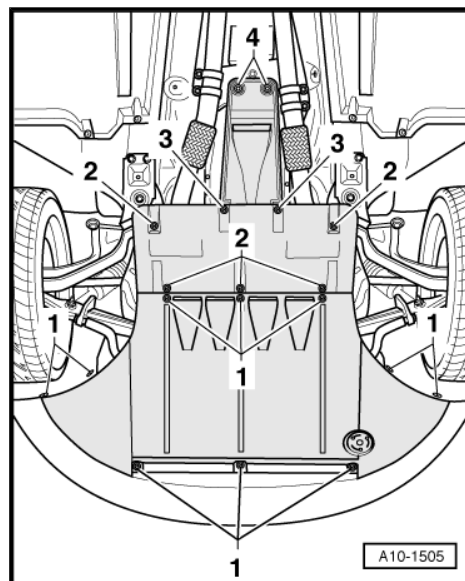
- ◆ *The cooling system is under pressure when the engine is hot.*
- ◆ *To allow pressure to dissipate, cover filler cap on expansion tank with cloth and open carefully.*



- Release fasteners -1- to remove front noise insulation.

**Note**

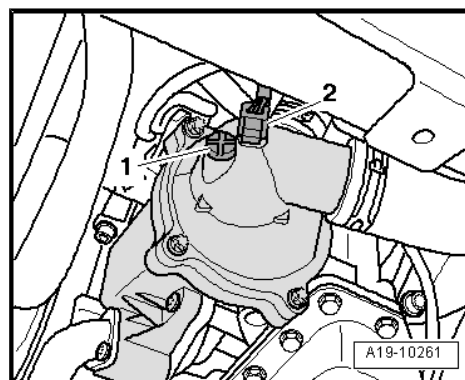
Disregard -items 2, 3, 4-.



- Place drip tray for workshop hoist -VAS 6208- under engine.
- Remove drain plug -1- at map-controlled engine cooling system thermostat -F265- and drain off coolant.

**Note**

Disregard -item 2-.



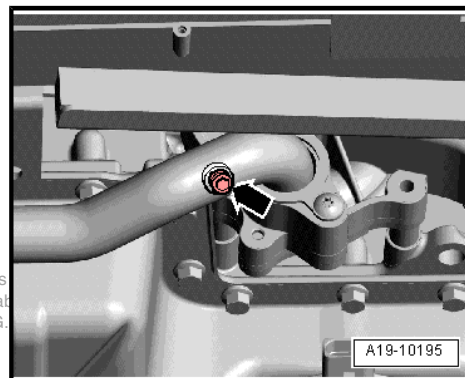
- Remove drain plug -arrow- at front coolant pipe and drain off coolant.

Filling**Tightening torques**

- ⇒ [“2.1 Coolant pump and thermostat - exploded view”, page 190](#).
- ⇒ [“2.5 Coolant pipes - exploded view”, page 194](#).

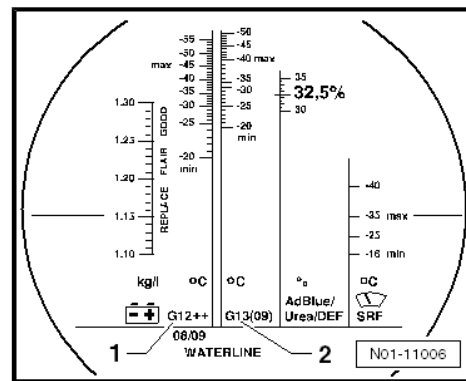
- Ignition off.

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**Note**

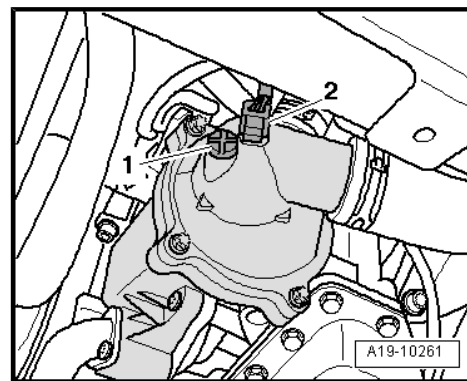
- ◆ The cooling system is filled all year round with a mixture of water and coolant additive. Mixture ratio ⇒ [page 183](#).
- ◆ Use only the coolant additive listed in the ⇒ Electronic parts catalogue. Other coolant additives could seriously impair in particular the anti-corrosion properties. The resulting damage could lead to loss of coolant and consequently to serious engine damage.
- ◆ The specified coolant (based on recommended mixture ratio) ⇒ [page 183](#) prevents frost and corrosion damage and stops scaling. 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 coolant/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 antifreeze can be increased, but only up to 60 % (this gives frost protection to about -40 °C), as otherwise frost protection is reduced again, as is cooling effectiveness.
- ◆ 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.
- ◆ Do not re-use dirty or contaminated coolant.
- ◆ For checking anti-freeze protection in cooling system with coolant generation G13, refractometer -T10007 A- MUST be used.

**Recommended mixture ratio for coolant**

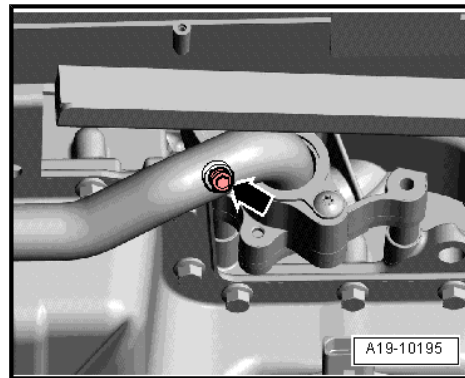
- Coolant (40 %) and water (60 %) for frost protection to -25 °C
- Coolant (50 %) and water (50 %) for frost protection to -35 °C
- Coolant ⇒ Electronic parts catalogue
- Install drain plug -1- with new O-ring on map-controlled engine cooling system thermostat -F265-.

**Note**

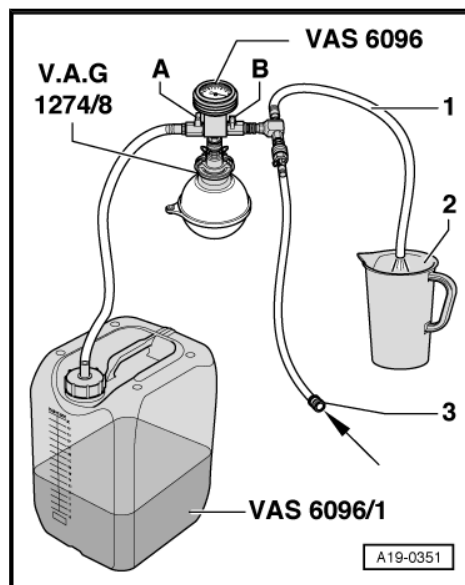
Disregard -item 2-.



- Install drain plug -arrow- with new seal on front coolant pipe.



- Fill reservoir of cooling system charge unit -VAS 6096- with at least 15 litres of premixed coolant (based on recommended ratio):
- Screw adapter -V.A.G 1274/8- onto coolant expansion tank.
- Attach cooling system charge unit -VAS 6096- to 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.



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- Open valve -B- by setting lever in direction of flow.

The suction jet pump generates a partial vacuum in the cooling system.

- The needle on the gauge should move into the green zone.
- Also briefly open valve -A- (turn lever in direction of flow) so that hose on reservoir for cooling system charge unit -VAS 6096- 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.

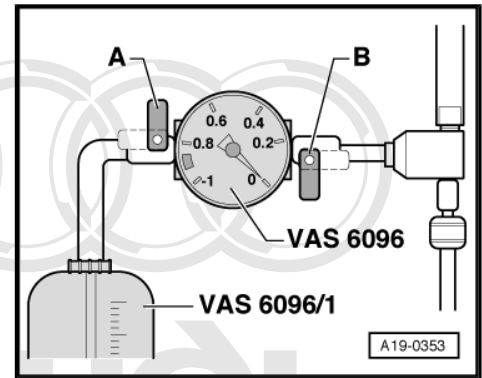
If the needle does not reach the green zone, repeat the process.

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

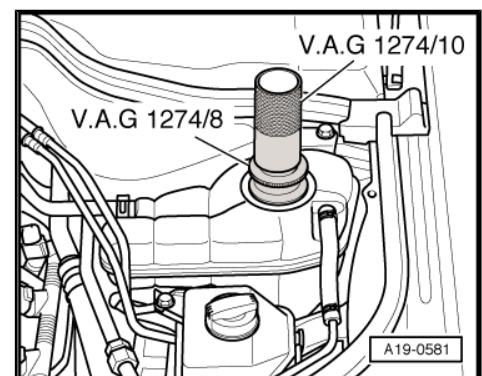
- Detach compressed air hose.
- Open valve -A-.

The vacuum in the cooling system causes the coolant to be drawn out of the reservoir for cooling system charge unit -VAS 6096- ; the cooling system is then filled.

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



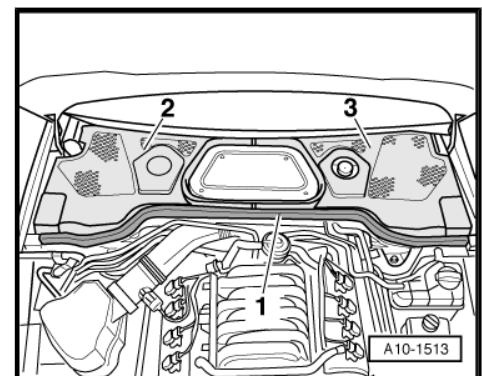
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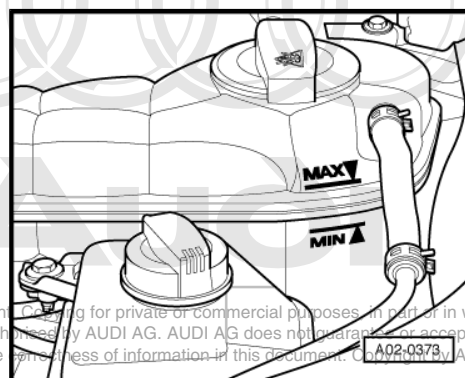
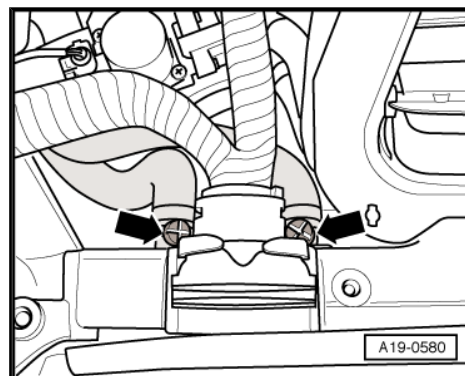
- Pull off rubber seal -1- on plenum chamber covers.
- Detach plenum chamber cover -2-.



Disregard -item 3-.



- Open bleeder screws -arrows-.
- Fill up with coolant until it flows out at bleeder holes in coolant hoses.
- Close the bleeder screws.
- 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 (left and right) to “HI”.
- Run the engine for 3 minutes at 2000 rpm.
- Allow the engine to run at idling speed until the two large coolant hoses at main radiator become warm.
- Run the engine for 1 minute at 2000 rpm.
- Switch off ignition and allow engine to cool down.
- Check coolant level.
- The coolant level must be at the “MAX” marking when the engine is cold.
- The coolant level can be above the “MAX” marking when the engine is warm.

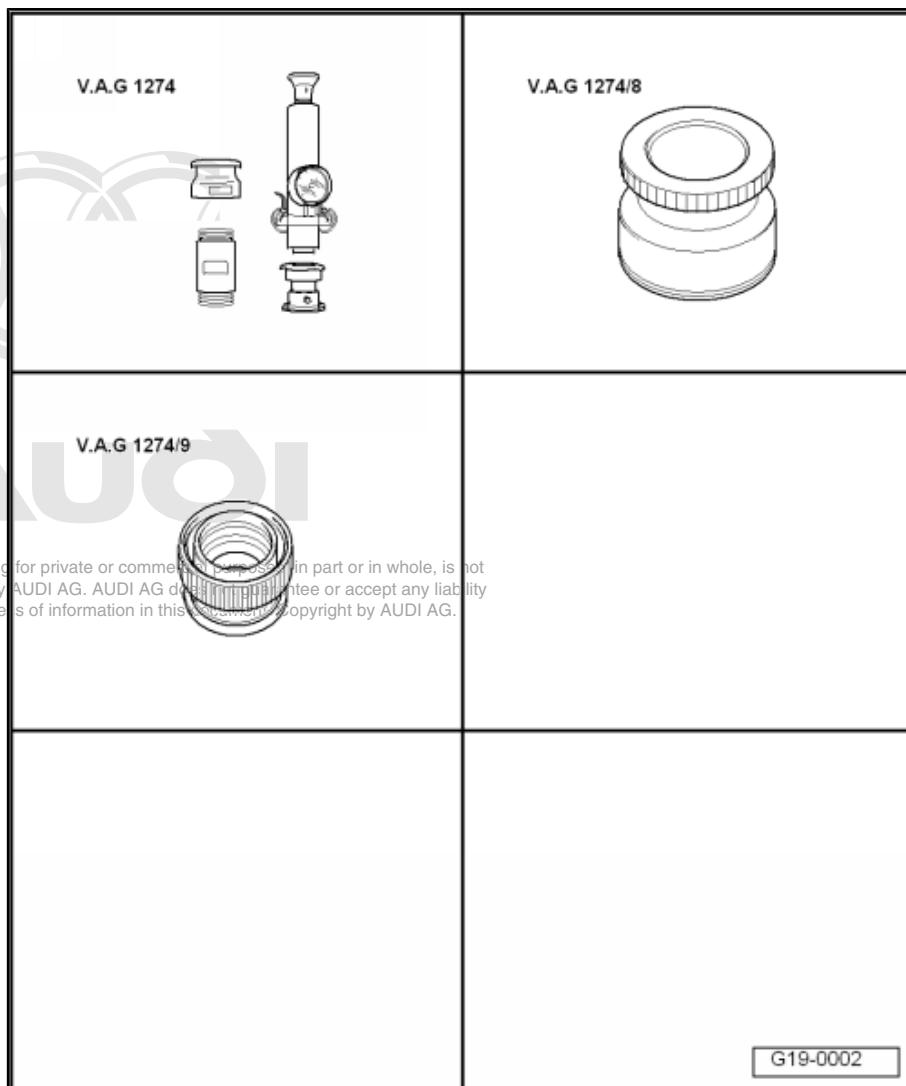


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1.3 Checking cooling system for leaks

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-



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Procedure

- Engine must be warm.



WARNING

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

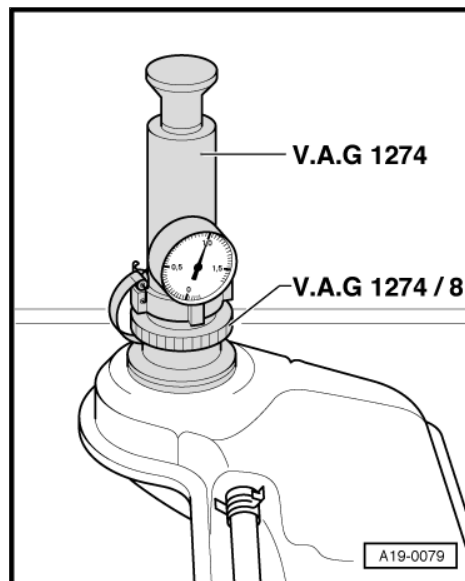
- ◆ *The cooling system is under pressure when the engine is hot.*
- ◆ *To allow pressure to dissipate, cover filler cap on expansion tank with cloth and open carefully.*



- Attach cooling system tester -V.A.G 1274- with adapter - V.A.G 1274/8- to coolant expansion tank.
- Use hand pump on cooling system tester to create a pressure of approx. 1.0 bar.

If the pressure drops:

- Locate leak and eliminate fault.

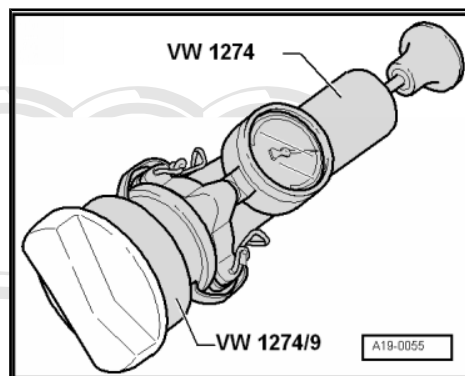


Checking pressure relief valve in filler cap

- Attach cooling system tester -V.A.G 1274- with adapter - V.A.G 1274/9- to filler cap.
- Use hand pump on cooling system tester to create pressure.
- The pressure relief valve should open at a pressure of 1.4 ... 1.6 bar.

If the pressure relief valve does not open as described:

- Renew filler cap.



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2 Coolant pump, thermostat, coolant pipes

⇒ ["2.1 Coolant pump and thermostat - exploded view", page 190](#)

⇒ ["2.2 Removing and installing coolant pump", page 191](#)

⇒ ["2.3 Removing and installing map-controlled engine cooling system thermostat F265", page 193](#)

⇒ ["2.4 Thermostat opening values", page 194](#)

⇒ ["2.5 Coolant pipes - exploded view", page 194](#)

⇒ ["2.6 Removing and installing coolant temperature sender G62", page 197](#)

⇒ ["2.7 Removing and installing coolant pipe \(front\)", page 198](#)

⇒ ["2.8 Removing and installing coolant pipe \(rear\)", page 199](#)

⇒ ["2.9 Removing and installing coolant pipe \(left-side\)", page 204](#)

⇒ ["2.10 Removing and installing coolant pipe \(bottom left\)", page 207](#)

⇒ ["2.11 Removing and installing coolant pipe \(right-side\)", page 214](#)

2.1 Coolant pump and thermostat - exploded view

1 - Seal

- ☐ Renew

2 - Housing for coolant pump

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

3 - Bolt

- ☐ Tightening torque
⇒ [page 194](#)

4 - Coolant pipe (front)

- ☐ Removing and installing
⇒ [page 198](#)

5 - O-ring

- ☐ Renew

6 - Seal

- ☐ Renew

7 - Coolant pump

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

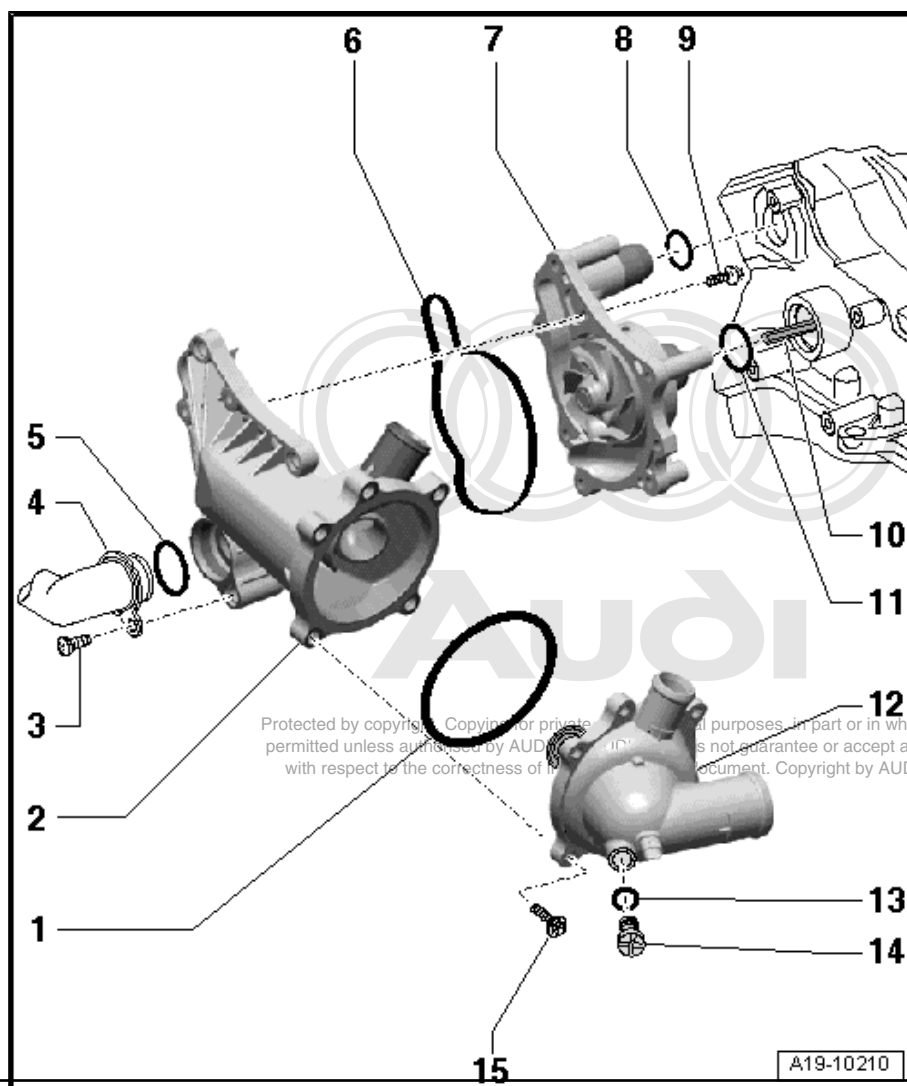
8 - O-ring

- ☐ Renew

9 - Bolt

- ☐ 9 Nm

10 - Drive shaft for coolant



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A19-10210

pump**11 - O-ring**

- ☐ Renew

12 - Map-controlled engine cooling system thermostat -F265-

- ☐ Removing and installing ⇒ [page 193](#)
- ☐ Thermostat opening values ⇒ [page 194](#)

13 - O-ring

- ☐ Renew

14 - Drain plug

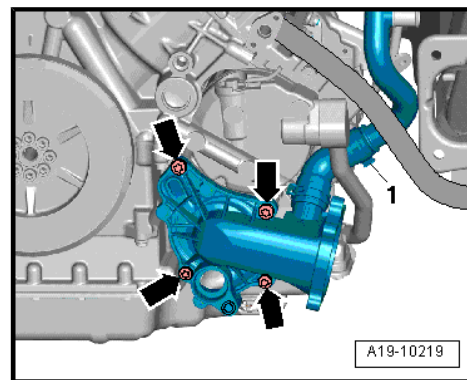
- ☐ 4 Nm

15 - Bolt

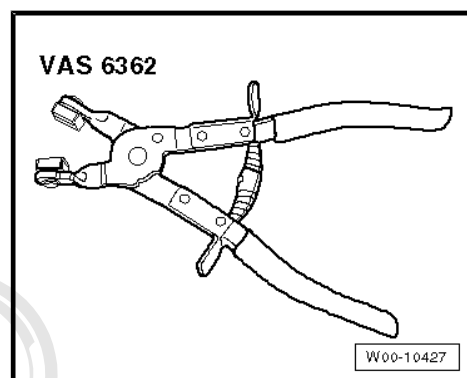
- ☐ 9 Nm

Tightening torque for coolant pump

- Tighten bolts -arrows- to 9 Nm.

**2.2 Removing and installing coolant pump****Special tools and workshop equipment required**

- ◆ Hose clip pliers -VAS 6362-

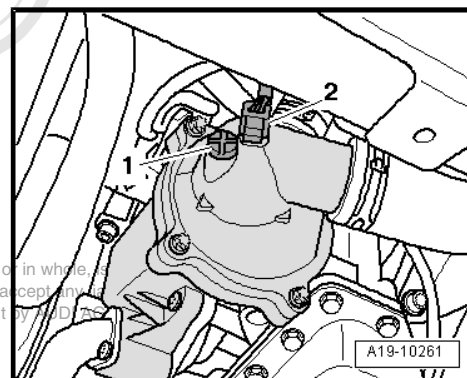
**Removing**

- Remove coolant pipe (front) ⇒ [page 198](#) .
- Unplug connector -2- at map-controlled engine cooling thermostat -F265- .

**Note**

Disregard -item 1-

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- Detach coolant hoses -1 and 2- from map-controlled engine cooling system thermostat -F265- .



Note

Disregard -arrows-.

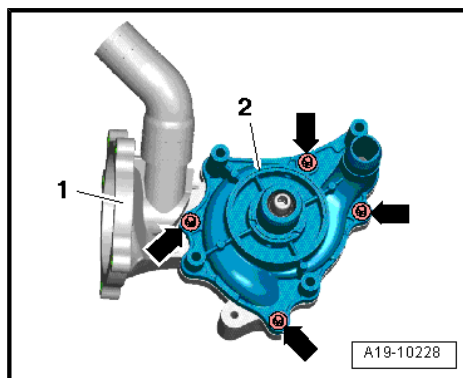
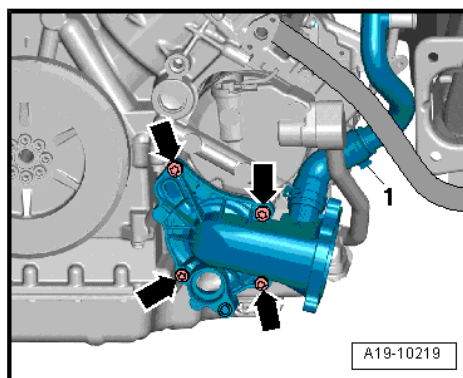
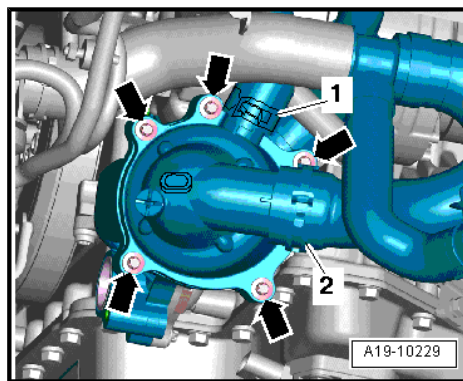
- Slacken hose clip -1- on coolant hose.
- Remove bolts -arrows-.
- Pull off coolant pump housing forwards (note the drive shaft for coolant pump).



Note

The coolant hose can only be disconnected when the coolant pump is removed.

- Unscrew bolts -arrows- and remove coolant pump -2- from housing -1-.



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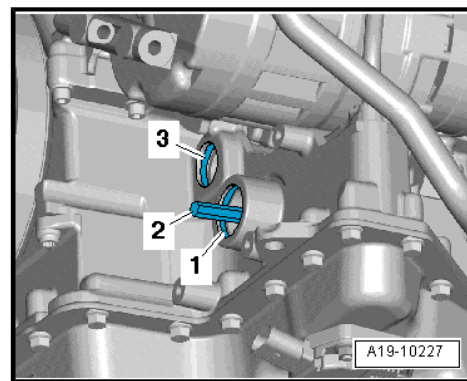
Installing

- Tightening torques
⇒ ["2.1 Coolant pump and thermostat - exploded view", page 190](#)



Note

- ◆ *Renew seals and O-rings.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ [Electronic parts catalogue](#) .*
- Fit new O-rings -1 and 3-.
- Insert drive shaft -2- for coolant pump in mounting for oil pump as far as stop.
- 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.

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

- Install coolant pipe (front) ⇒ [page 198](#) .
- Fill cooling system ⇒ [page 182](#) .

2.3 Removing and installing map-controlled engine cooling system thermostat - F265-

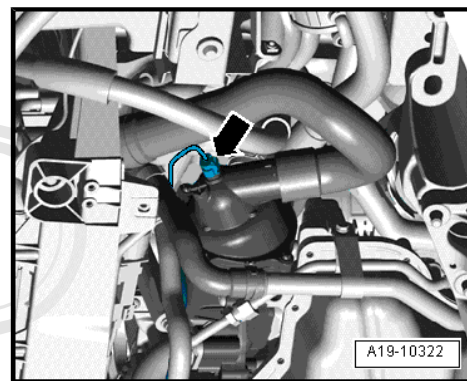
Removing

- Drain off coolant ⇒ [page 181](#) .
- Unplug electrical connector -arrow- at map-controlled engine cooling system thermostat -F265- .



Note

Disregard -item 1-.



- Detach coolant hoses -1 and 2- from map-controlled engine cooling system thermostat -F265- and drain off coolant.
- Remove bolts -arrows- and detach map-controlled engine cooling system thermostat -F265- .

Installing

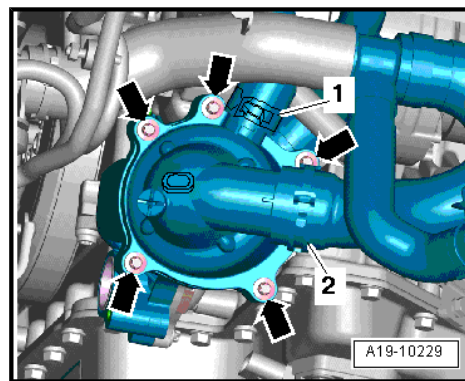
- Tightening torque
⇒ [“2.1 Coolant pump and thermostat - exploded view”](#),
[page 190](#)

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



Note

- ◆ *Renew seals and O-rings.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ [Electronic parts catalogue](#) .*
- Fill cooling system ⇒ [page 182](#) .



2.4 Thermostat opening values

Starts to open	Fully open	Opening travel	Voltage measured at thermostat
approx. 105 °C	approx. 117 °C	at least 8 mm	0 V
–	approx. 105 °C	at least 8 mm	14 V



Note

The thermostat cannot be tested with workshop equipment.

2.5 Coolant pipes - exploded view



Note

The arrow markings on coolant pipes and on ends of hoses must align.

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1 - Coolant pipe (front)

- ☐ Removing and installing
⇒ [page 198](#)

2 - Bolt

- ☐ Renew
- ☐ 8 Nm + 90° (1/4 turn further)

3 - O-ring

- ☐ Renew

4 - Bolt
☐ 9 Nm

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5 - Coolant pipe (right-side)

- ☐ Removing and installing
⇒ [page 214](#)

6 - Coolant hose**7 - O-ring**

- ☐ Renew

8 - Coolant temperature sender -G62-

- ☐ Removing and installing
⇒ [page 197](#)

9 - O-ring

- ☐ Renew

10 - Retaining clip**11 - Bolt**

- ☐ 9 Nm

12 - Coolant pipe (rear)

- ☐ Removing and installing
⇒ [page 199](#)

13 - Bolt

- ☐ 9 Nm

14 - Bolt

- ☐ 9 Nm

15 - O-ring

- ☐ Renew

16 - Coolant hose**17 - Bolt**

- ☐ 9 Nm

18 - Bolt

- ☐ Tightening torque ⇒ [page 35](#)

19 - Coolant pipe (left-side)

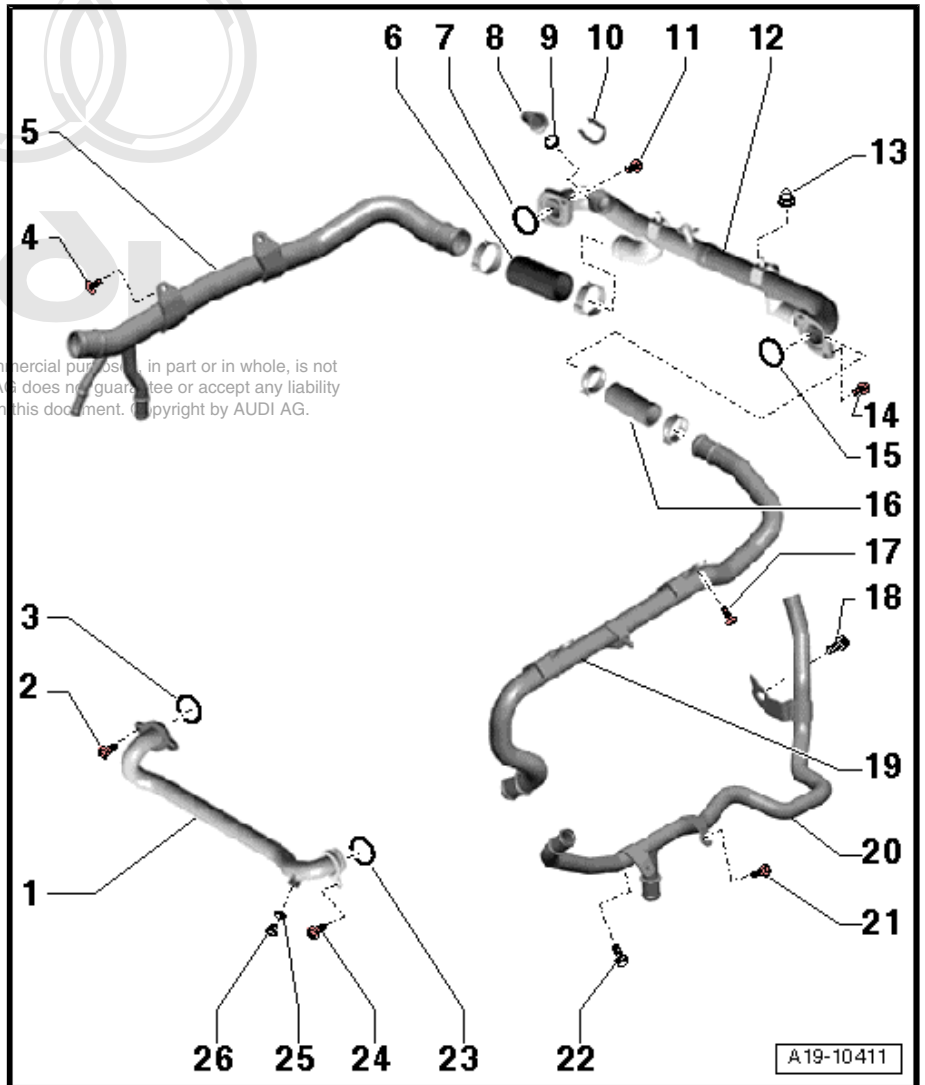
- ☐ Removing and installing ⇒ [page 204](#)

20 - Coolant pipe (bottom left)

- ☐ Removing and installing ⇒ [page 207](#)

21 - Bolt

- ☐ 9 Nm



22 - Bolt

- ☐ Tightening torque ⇒ Rep. gr. 87

23 - O-ring

- ☐ Renew

24 - Bolt

- ☐ Renew
- ☐ 8 Nm + 90° (1/4 turn further)

25 - Seal

- ☐ Renew

26 - Drain plug

- ☐ 10 Nm

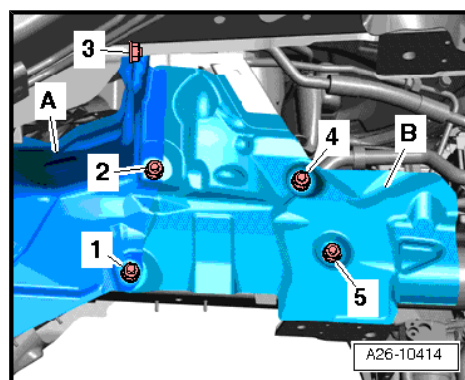
Heat shields -A and B- (left-side)

Nuts -1, 3, 4, 5-

- 2.5 Nm

Nut -2-

- 4.5 Nm



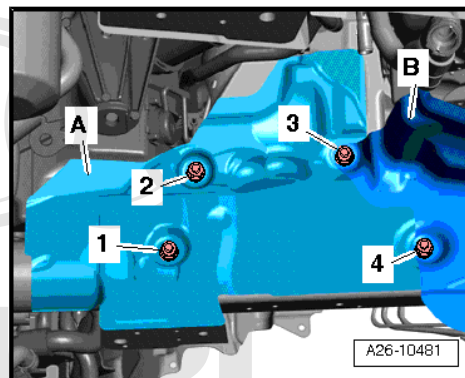
Heat shields -A and B- (right-side)

Nuts -1 and 3-

- 4.5 Nm

Nuts -2 and 4-

- 2.5 Nm

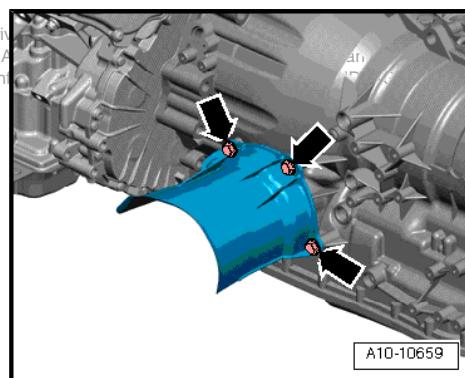


Heat shield for drive shaft (left-side)

Bolts -arrows-

- 23 Nm

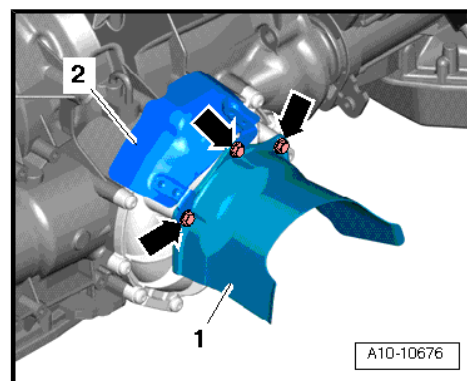
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Heat shield for drive shaft (right-side)

Bolts -arrows-

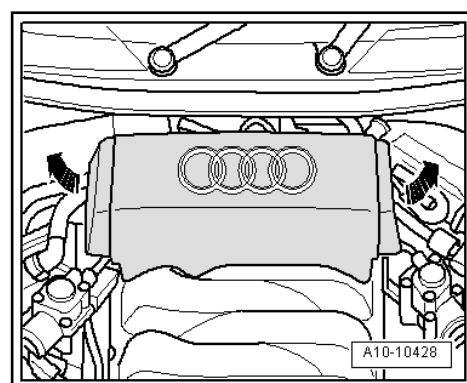
- 23 Nm



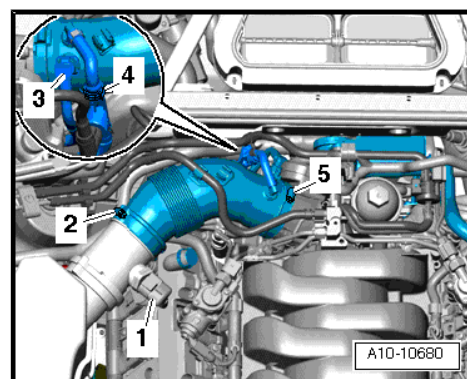
2.6 Removing and installing coolant temperature sender -G62-

Removing

- Engine cold.
- Open filler cap on coolant expansion tank briefly and allow residual pressure in cooling system to dissipate.
- Pull off engine cover panel (rear).



- Move clear fuel line and line going to activated charcoal filter at air pipe.
- Release hose clips -2 and 5- and remove air hose.
- Move air intake hose to one side, with lines -3 and 4- connected.

**Note***Disregard -item 1-.*

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

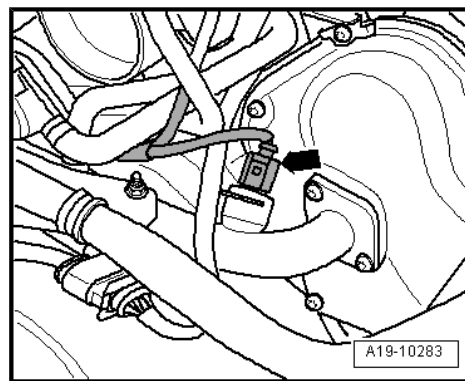

Note

Place a cloth underneath to catch escaping coolant.

- Detach retaining clip and remove coolant temperature sender -G62- .


Note

Shown in illustration with engine removed.


Installing

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


Note

- ◆ *Fit new O-ring.*
- ◆ *Insert new coolant temperature sender -G62- immediately into connection to avoid loss of coolant.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) → **Electronic parts catalogue**.*

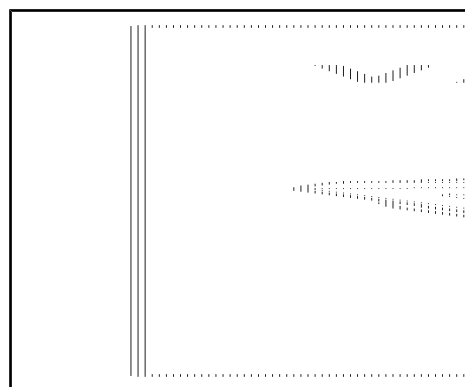
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- Check coolant level ⇒ [page 182](#) .

2.7 Removing and installing coolant pipe (front)

Special tools and workshop equipment required

- ◆ Drip tray for workshop hoist -VAS 6208-



Removing

- Drain off coolant ⇒ [page 181](#) .
- Remove bolts -arrows-.
- Detach coolant pipes going to ATF cooler from lock carrier.



Note

Disregard items marked -1 ... 4-.

- Place drip tray for workshop hoist -VAS 6208- under engine.
- Remove bolts -arrows-.
- Detach front coolant pipe from engine and coolant pump.

Installing

- Tightening torques
⇒ ["2.5 Coolant pipes - exploded view", page 194](#)

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



Note

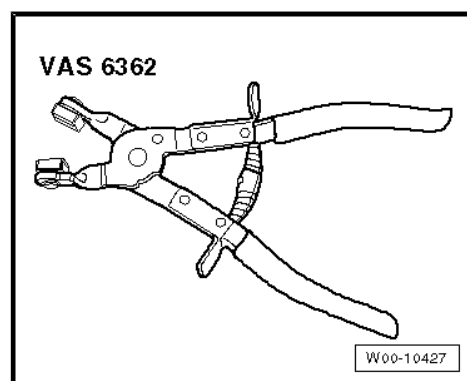
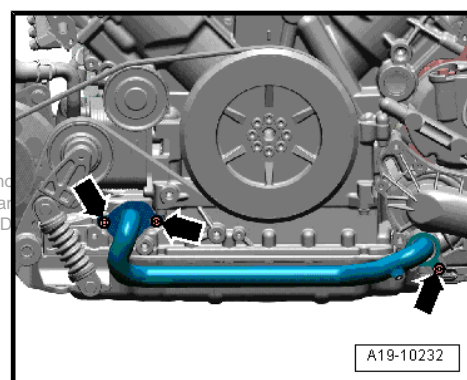
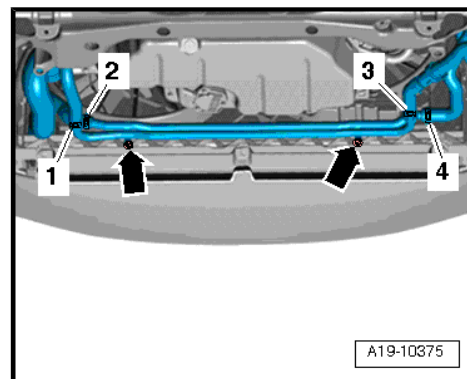
Renew O-rings.

- Fill cooling system ⇒ [page 182](#) .

2.8 Removing and installing coolant pipe (rear)

Special tools and workshop equipment required

- ◆ Hose clip pliers -VAS 6362-



Removing



Note

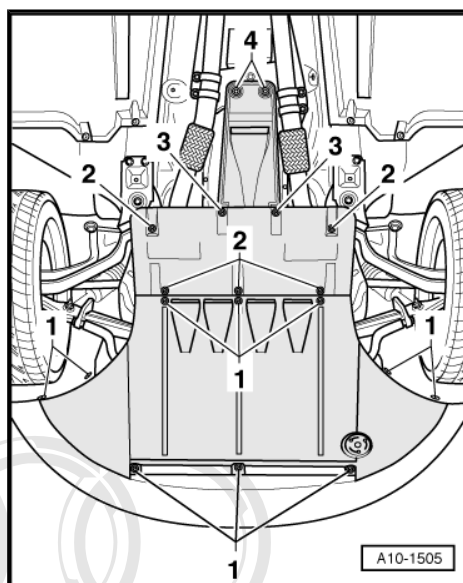
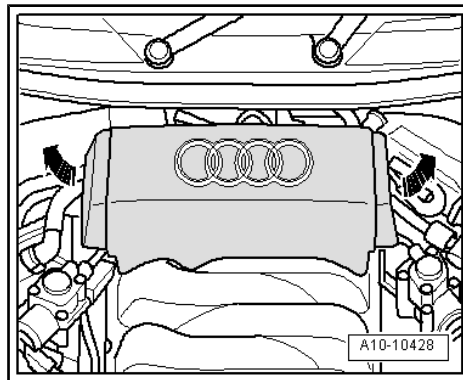
Fit all cable ties in the original positions when installing.

- Pull off engine cover panel (rear) -arrows-.
- Drain off coolant ⇒ [page 181](#) .
- Remove secondary air combination valve (right-side) ⇒ [page 254](#) .
- Release fasteners -2 and 4- and remove rear noise insulation panels.

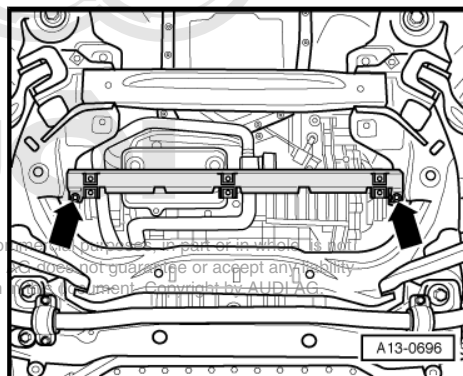


Note

Disregard -items 1 and 3-.



- Unbolt bracket for noise insulation -arrows-.

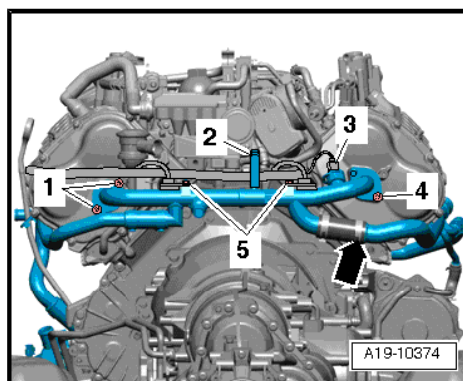


- Slacken hose clip -arrow-.



Note

- ◆ Disregard items marked -1 ... 5-.
- ◆ Shown from rear with engine removed for illustration purposes.

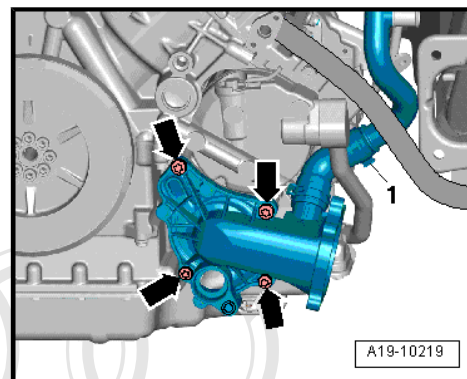


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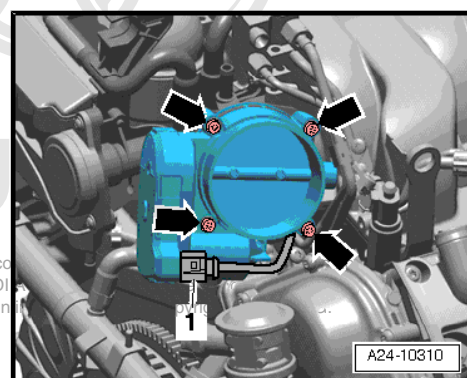
- Slacken hose clip -1- on coolant hose.

**Note**

Disregard -arrows-.



- Unplug electrical connector -1- at throttle valve module - J338- .
- Unscrew bolts -arrows- and remove throttle valve module - J338- .

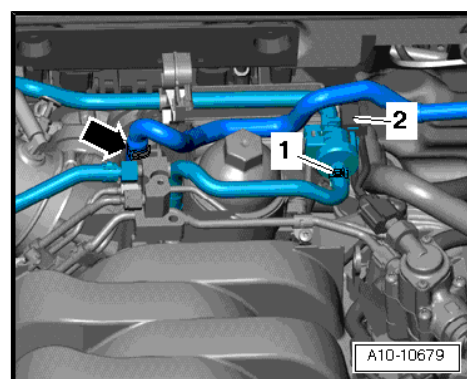


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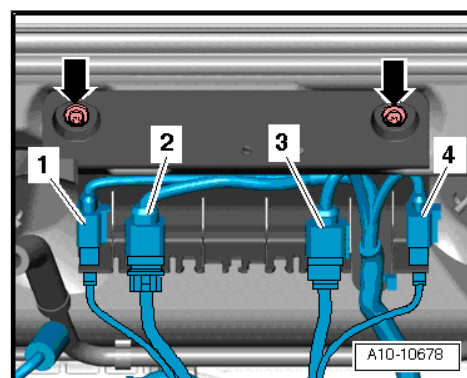
- Unplug electrical connector -2- at activated charcoal filter solenoid valve 1 -N80- and detach vacuum hose -1-.
- Detach activated charcoal filter solenoid valve 1 -N80- from bracket and move it clear to the side with hose still attached.

**Note**

Disregard -arrow-.



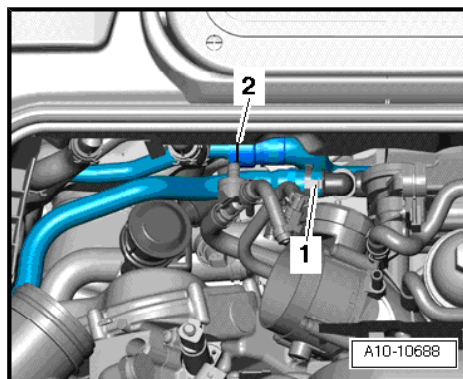
- Remove electrical connectors -1 ... 4- from bracket.
- Unscrew nuts -arrows- and detach bracket for electrical connectors from bulkhead.



- Detach coolant hose -2-, to do so, pull out clip slightly.


Note

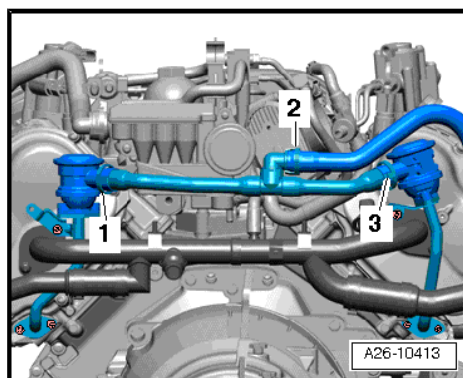
Disregard -item 1-.



- Detach air hose -1-.


Note

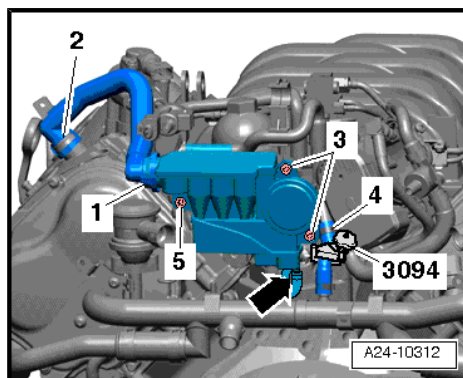
- ◆ *Disregard -items 2 and 3-.*
- ◆ *Shown from rear with engine removed for illustration purposes.*



- Remove crankcase breather hose -1 and 2-.
- Unscrew bolts -3 and 5- and remove pressure control valve for crankcase breather system from throttle valve housing.
- Remove oil drain hose -arrow-.


Note

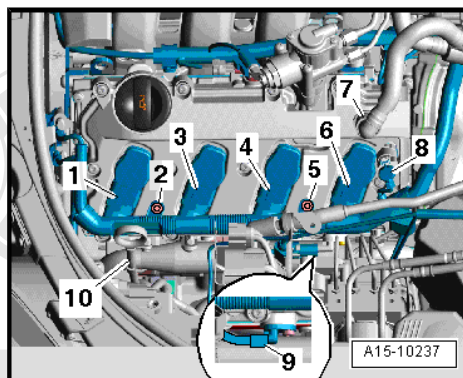
- ◆ *Disregard -item 4- and -3094-.*
- ◆ *Shown from rear with engine removed for illustration purposes.*



- Pull dipstick -10- out of guide tube.
- Remove bolts -2 and 5-.
- Unplug electrical connectors -1, 3, 4, 6, 8- and move wiring harness clear.
- Remove Hall sender -9-.
- Place wiring harness on top of engine.


Note

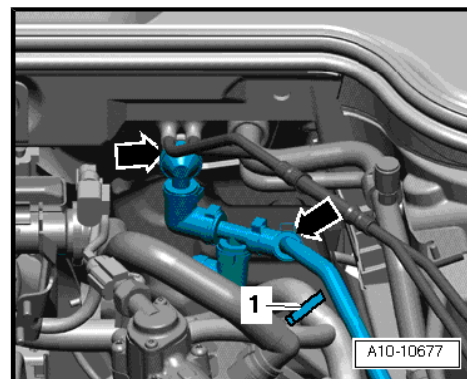
Disregard -item 7-.



- Detach vacuum lines -arrows- going to brake servo.
- Move vacuum lines clear to one side.

**Note**

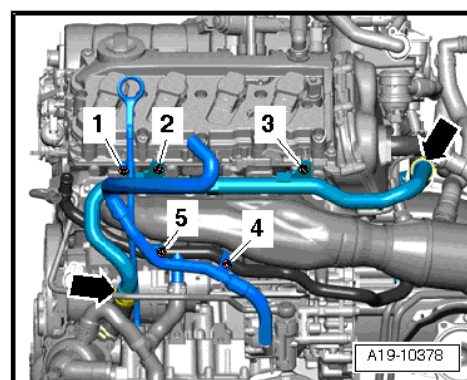
Disregard -item 1-.



- Remove bolt -1- and lift out guide tube for oil dipstick.
- Unscrew bolts -2 and 3- and detach coolant pipe (left-side) from coolant hoses -arrows-.
- Move coolant pipe slightly towards rear.

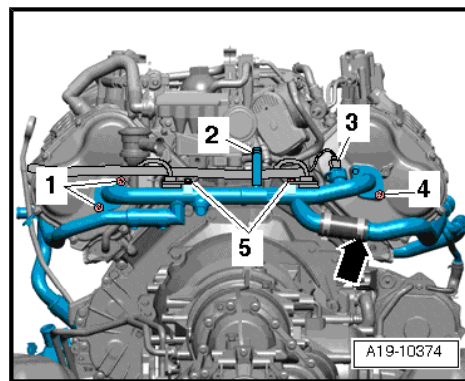
**Note**

Disregard -items 4 and 5-.



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- Detach coolant hose -2- going to intake manifold.
- Unplug electrical connector -3- at coolant temperature sender -G62- .
- Remove nuts -5-.
- Detach brackets with electrical connectors and wiring harness from coolant pipe (rear).
- Remove bolts -1 and 4-.
- Detach coolant pipe (rear) from coolant pipe (right-side) -arrow-.
- Remove coolant pipe (rear) towards right side of vehicle.



Note

Shown from rear with engine removed for illustration purposes.

Installing

- Tightening torques
⇒ ["2.5 Coolant pipes - exploded view", page 194](#)

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



Note

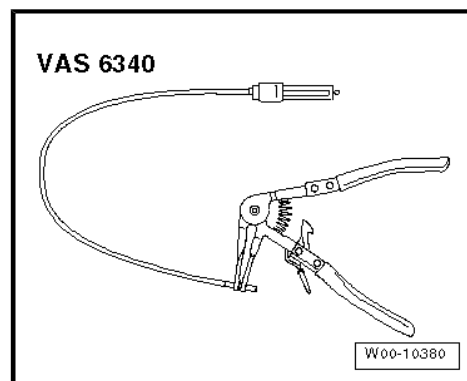
- ◆ *Renew O-rings.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ [Electronic parts catalogue](#) .*
- ◆ *Fit all cable ties in the original positions when installing.*
- Clean and smoothen sealing surfaces for O-rings as required.
- Install secondary air combination valve (right-side)
⇒ [page 254](#) .
- Install coolant pipe (left-side) ⇒ [page 204](#) .
- Install Hall sender ⇒ [page 132](#) .
- Install throttle valve module -J338- ⇒ Rep. gr. 24 .
- Install pressure control valve for crankcase breather system
⇒ Rep. gr. 24 .
- Fill cooling system ⇒ [page 182](#) .

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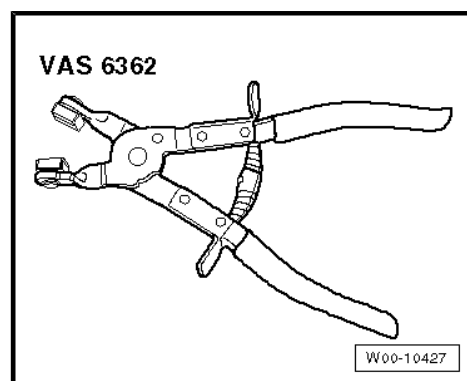
2.9 Removing and installing coolant pipe (left-side)

Special tools and workshop equipment required

- ◆ Hose clip pliers -VAS 6340-



- ◆ Hose clip pliers -VAS 6362-



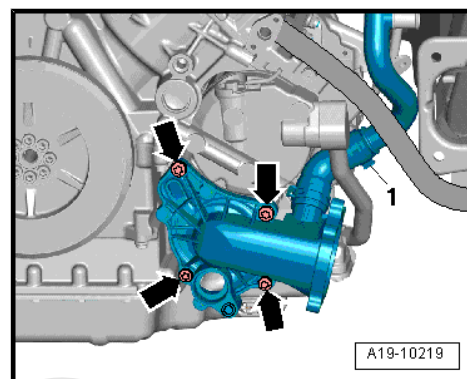
Removing

- Drain off coolant ⇒ [page 181](#) .
- Slacken hose clip -1- on coolant hose.



Note

Disregard -arrows-.

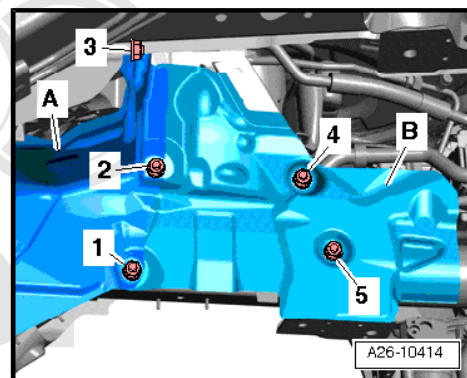


- Unscrew nuts -1 and 5- (accessible from below).



Note

Nuts -2, 3 and 4- are removed at a later stage.



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- Detach vacuum lines -arrows- going to brake servo.
- Move vacuum lines clear to one side.


Note

Disregard -item 1-.

- Remove cylinder head cover (left-side) ⇒ [page 116](#) .

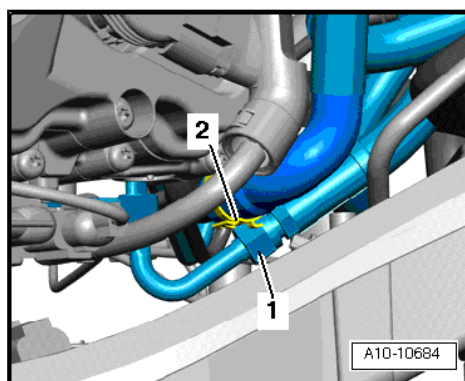
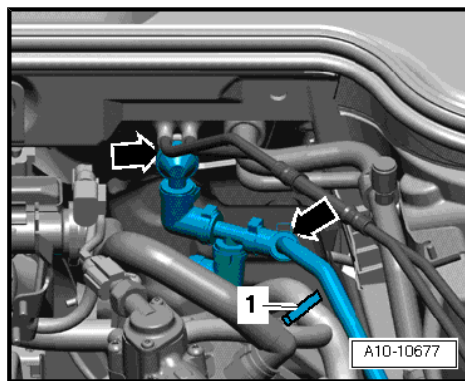

Note

Cover cylinder head with a clean cloth to prevent anything falling in.

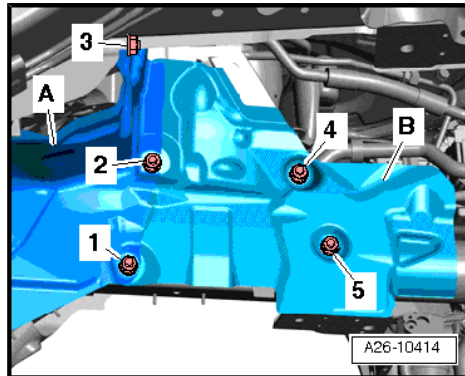
- Detach front coolant hose -2- from coolant pipe (bottom left).


Note

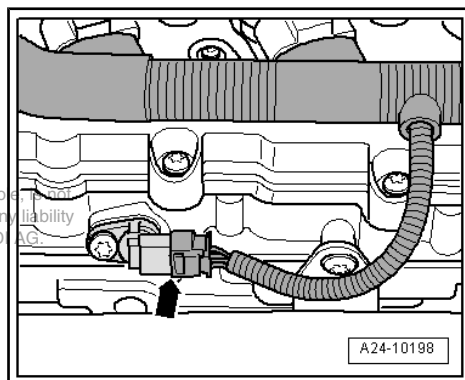
Disregard -item 1-.



- Unscrew nuts -2 ... 4- (accessible from above).
- Detach heat shield -A- from studs.
- Lift off heat shield -B-.



- Remove Hall sender 4 -G301- -arrow- (left cylinder bank).



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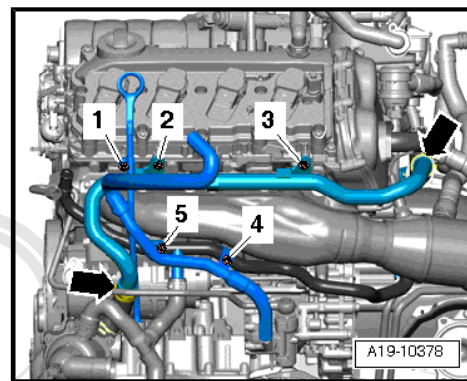
- Remove bolt -1- and lift out guide tube for oil dipstick.
- Unscrew bolts -4 and 5- and swivel hydraulic fluid pipe to one side.
- Unscrew bolts -2 and 3- and detach coolant pipe (left-side) from coolant hoses -arrows-.

Installing

Tightening torques

- ⇒ [“2.5 Coolant pipes - exploded view”, page 194](#).
- ⇒ [Fig. “Heat shields -A and B- \(left-side\)”, page 196](#).

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



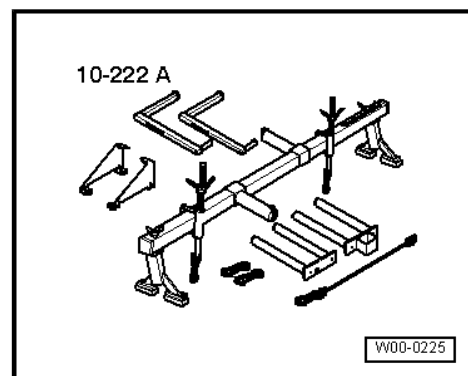
Note

- ◆ *Fit new O-ring to guide tube for oil dipstick.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ [Electronic parts catalogue](#).*
- Insert guide tube for oil dipstick into hole in top section of sump.
- Install Hall sender 4 -G301- (left cylinder bank) ⇒ Rep. gr. 24.
- Install cylinder head cover (left-side) ⇒ [page 116](#).
- Fill cooling system ⇒ [page 182](#).

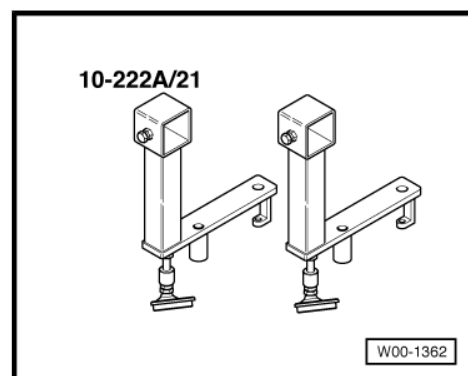
2.10 Removing and installing coolant pipe (bottom left)

Special tools and workshop equipment required

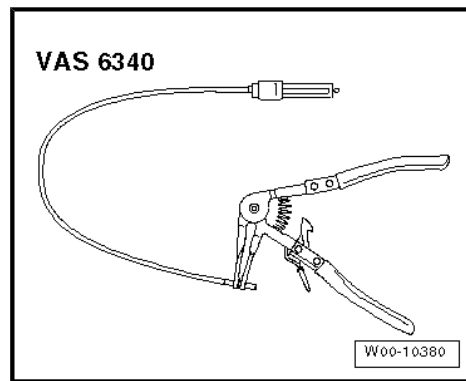
- ◆ Support bracket -10 - 222 A-



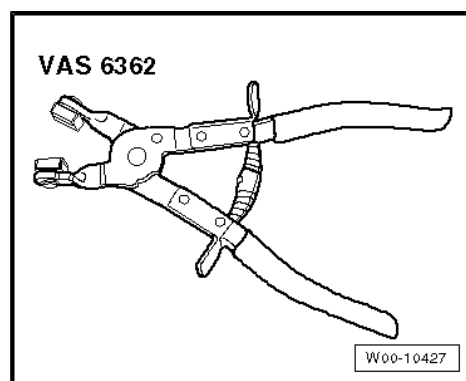
- ◆ Adapters -10 - 222 A /21-



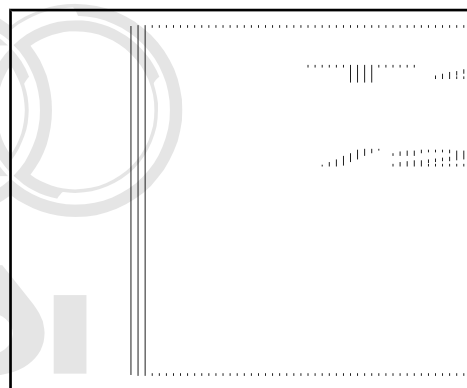
- ◆ Hose clip pliers -VAS 6340-



- ◆ Hose clip pliers -VAS 6362-



- ◆ Engine support bracket (supplementary set) -T40093-



Removing

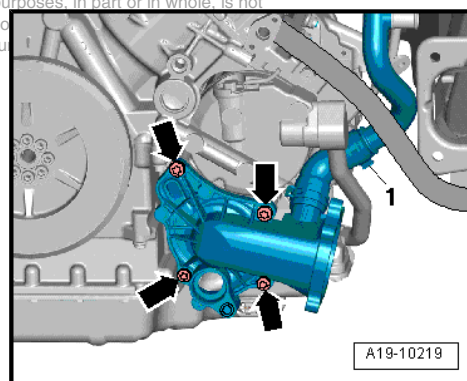
- Drain off coolant ⇒ [page 181](#) .
- Slacken hose clip -1- on coolant hose.



Note

Disregard -arrows-.

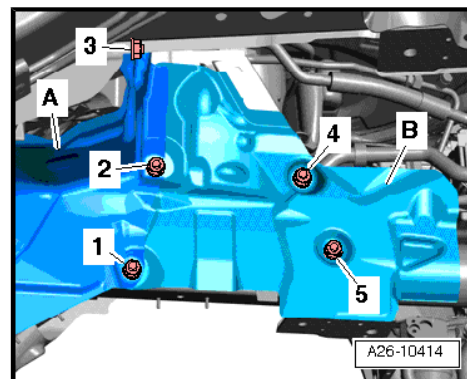
- Remove front silencer (left-side) ⇒ [page 229](#) .



- Unscrew nuts -1 and 5- (accessible from below).

**Note**

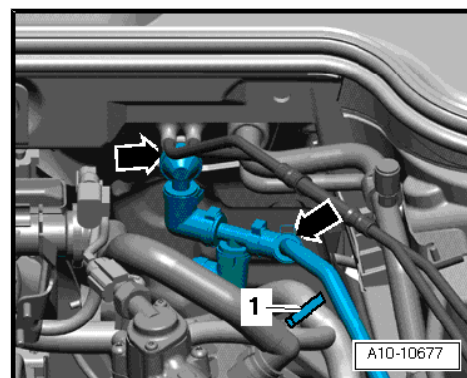
Nuts -2, 3 and 4- are removed at a later stage.



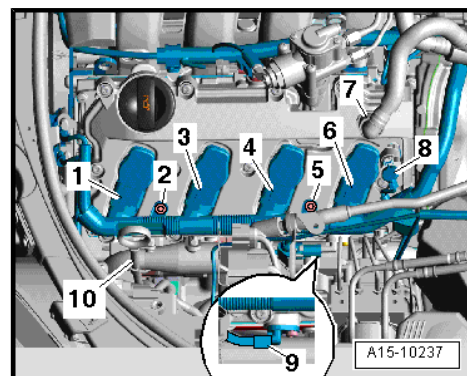
- Detach vacuum lines -arrows- going to brake servo.
- Move vacuum lines clear to one side.

**Note**

Disregard -item 1-.



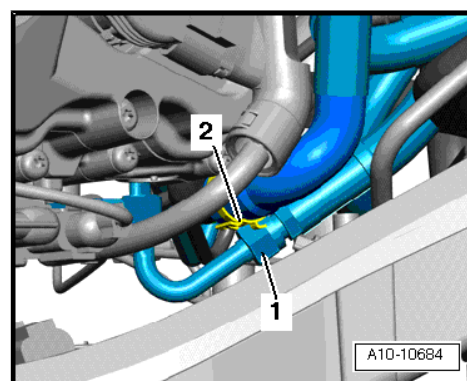
- Pull dipstick -10- out of guide tube.
- Remove bolts -2 and 5-.
- Unplug electrical connectors -1, 3, 4, 6, 8- and move wiring harness clear.
- Remove Hall sender -9-.
- Disconnect crankshaft breather hose -7- by pressing release tabs.
- Place wiring harness on top of engine.



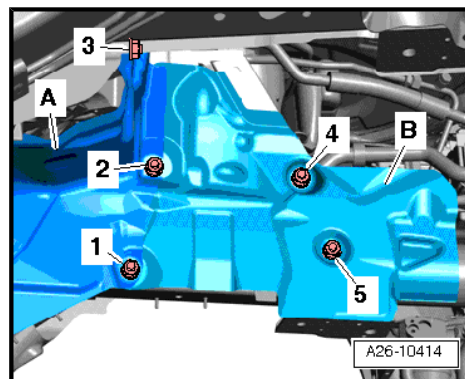
- Detach front coolant hose -2- from coolant pipe (bottom left).

**Note**

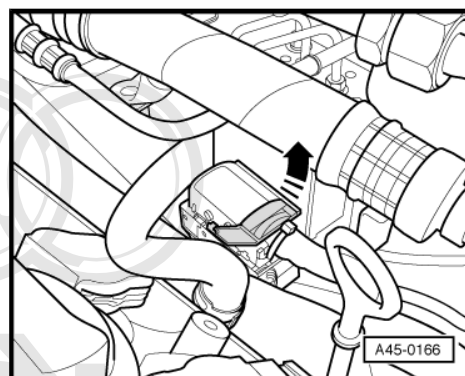
Disregard -item 1-.



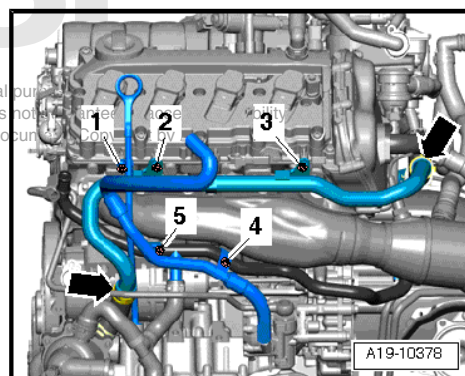
- Unscrew nuts -2 ... 4- (accessible from above).
- Detach heat shield -A- from studs.
- Lift off heat shield -B-.



- Unplug electrical connector at ABS control unit -arrow- ⇒ Rep. gr. 45 .



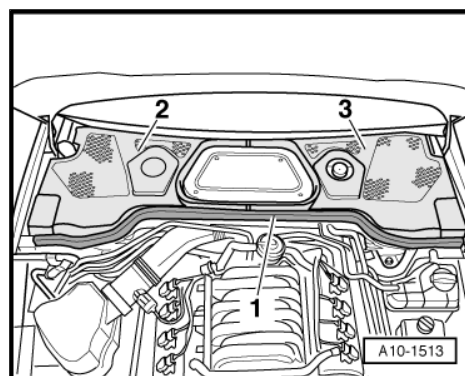
- Remove bolt -1- and lift out guide tube for oil dipstick.
- Unscrew bolts -4 and 5- and swivel hydraulic fluid pipe to one side.
- Unscrew bolts -2 and 3- and detach coolant pipe (left-side) from coolant hose -left arrow-.
- Pivot coolant pipe (left-side) upwards slightly.



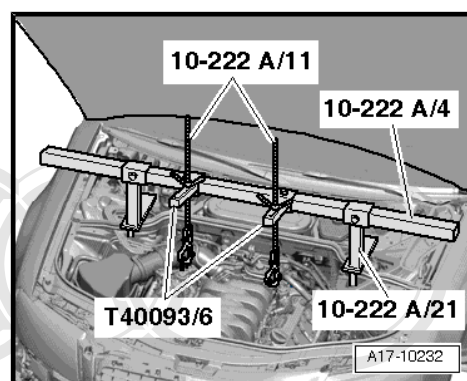
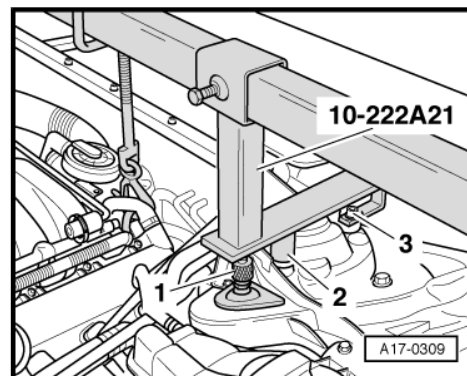
Note

Disregard -arrow- on right-side of illustration.

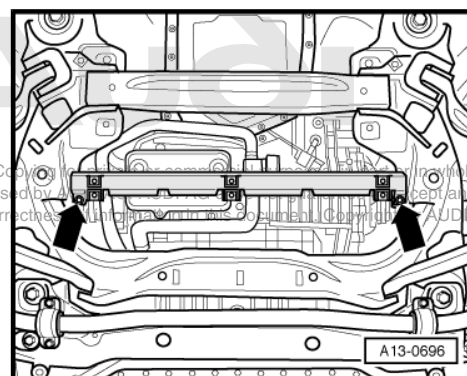
- Pull off rubber seal -1- and remove plenum chamber covers -2 and 3-.



- Unscrew rear bolts -3- for body brace.
- Attach adapters -10 - 222 A /21- without adapter -10 - 222 A /4- onto suspension turrets.
- Supports are marked for left and right side of vehicle.
- The centre resting point -2- of supports is positioned on front bolts for body brace.
- The adapters -10 - 222 A /21- are attached by means of the rear bolts -3- for the body brace.
- The knurled screw -1- must be screwed down until support plate rests on suspension turret.
- Attach adapter -10 - 222 A /4- using adapters -T40093/6- to adapters -10 - 222 A /21- .
- Secure spindles -10 - 222 A /11- to engine lifting eyes.
- Take up weight of engine using spindles of support bracket.



- Remove front left wheel.
- Unbolt bracket for noise insulation -arrows-.

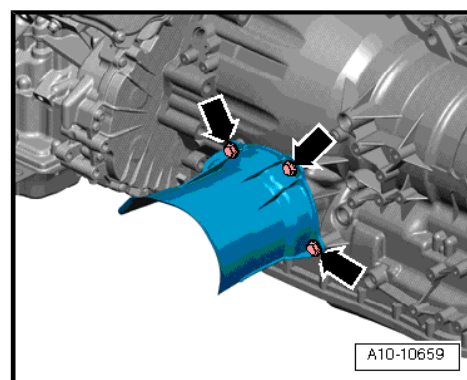


- Unbolt heat shield for drive shaft from gearbox -arrows-.

**Note**

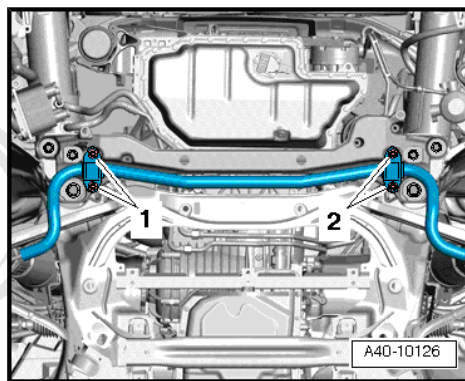
Shown in illustration with engine removed.

- Detach drive shaft (left-side) from flange shaft.





- Remove bolts (left and right) -1 and 2- for anti-roll bar mountings.



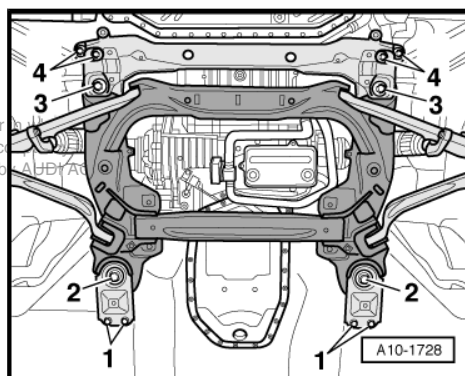
- Remove bolts -3 and 4-.



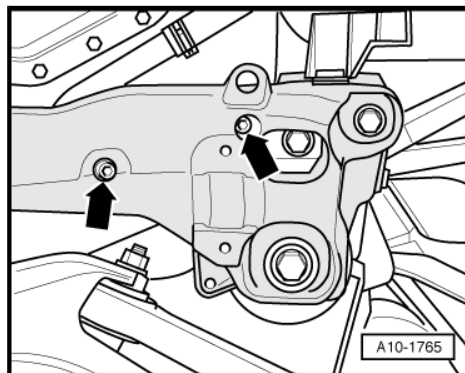
Note

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Disregard -items 1 and 2-



- Remove bolts for engine mountings -arrows- on both sides.
- Take out engine cross member.

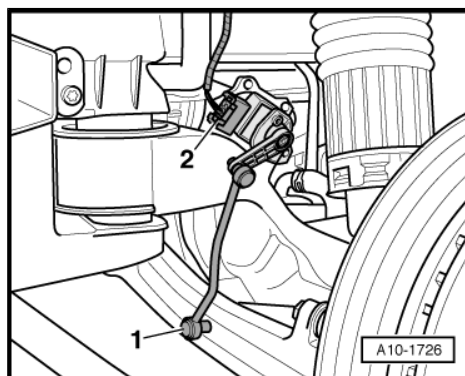


- Unplug electrical connector -2- at vehicle level sender (left and right).

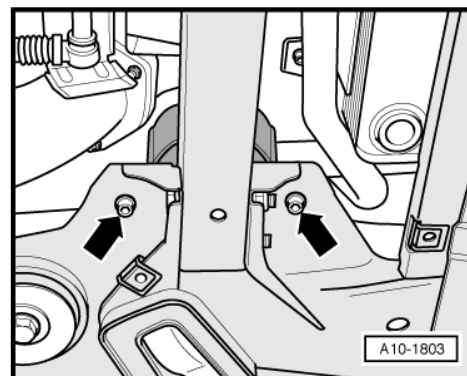


Note

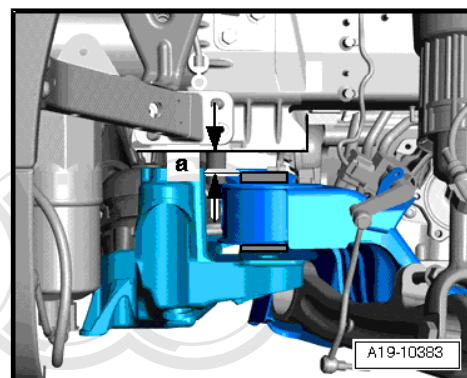
Disregard -item 1-



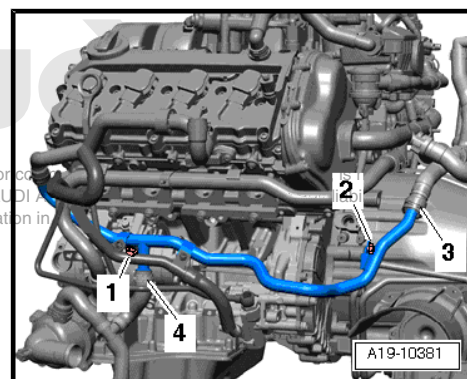
- Remove bolts (left and right) -arrows- for front gearbox mounting.



- Turn spindles -10 - 222 A /11- to lower subframe by dimension -a-.
- Dimension -a- = at least 80 mm



- Detach coolant hose -3-, to do so, pull out clip slightly.
- Detach coolant hose -4- from coolant pipe (bottom left).
- Remove bolts -1 and 2-.
- Remove coolant pipe (bottom left).



Installing

Tightening torques

- ⇒ [“2.5 Coolant pipes - exploded view”, page 194](#) .
- ⇒ [Fig. “Heat shield for drive shaft \(left-side\)”, page 196](#) .

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



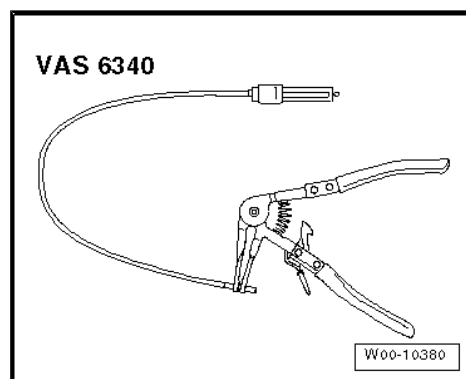
Note

- ◆ *Fit new O-ring to guide tube for oil dipstick.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ [Electronic parts catalogue](#) .*
- Install subframe and engine cross member ⇒ Rep. gr. 40 .
- Install drive shaft (left-side) ⇒ Rep. gr. 40 .
- Install anti-roll bar ⇒ Rep. gr. 40 .
- Install front silencer (left-side) ⇒ [page 229](#) .
- Align exhaust system so it is free of stress ⇒ [page 232](#) .
- Install coolant pipe (left-side) ⇒ [page 204](#) .
- Install Hall sender ⇒ [page 132](#) .
- Fill cooling system ⇒ [page 182](#) .

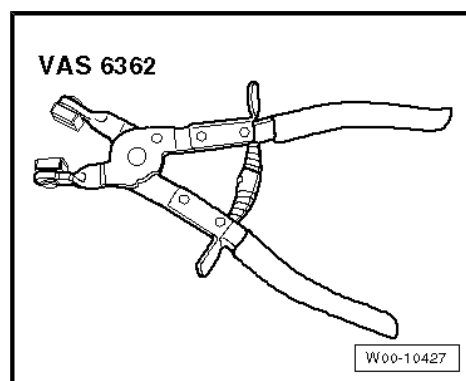
2.11 Removing and installing coolant pipe (right-side)

Special tools and workshop equipment required

- ◆ Hose clip pliers -VAS 6340-

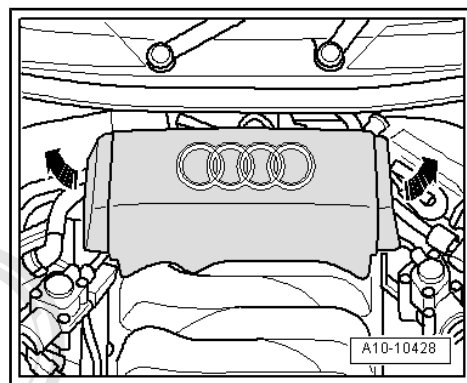


- ◆ Hose clip pliers -VAS 6362-



Removing

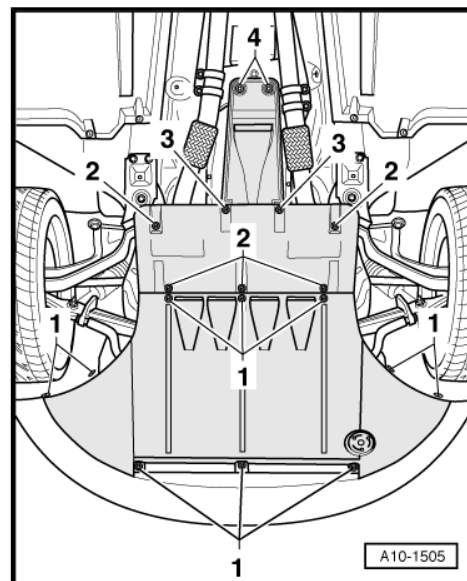
- Pull off engine cover panel (rear) -arrows-.
- Drain off coolant ⇒ [page 181](#) .
- Remove cylinder head cover (right-side) ⇒ [page 117](#) .



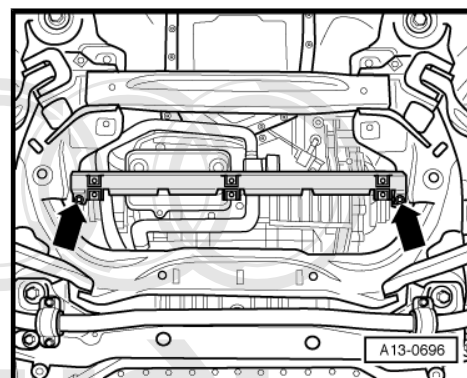
- Release fasteners -2 and 4- and remove rear noise insulation panels.

**Note**

Disregard -items 1 and 3-.



- Unbolt bracket for noise insulation -arrows-.

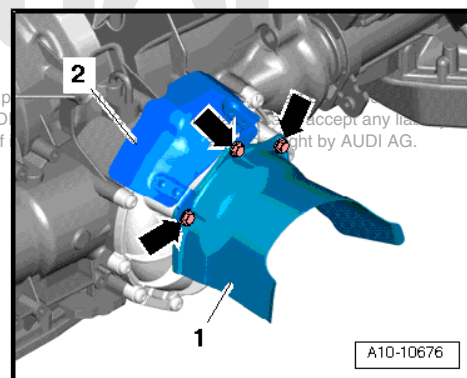


- Unbolt heat shield -1- for drive shaft from gearbox -arrows-.

**Note**

Disregard -item 2-.

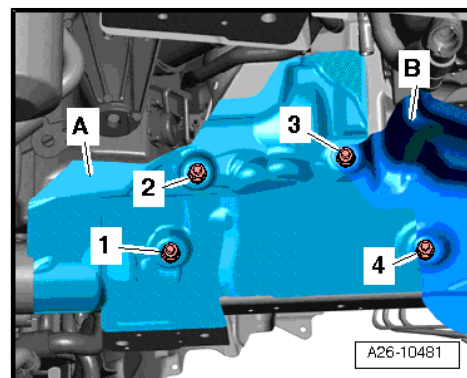
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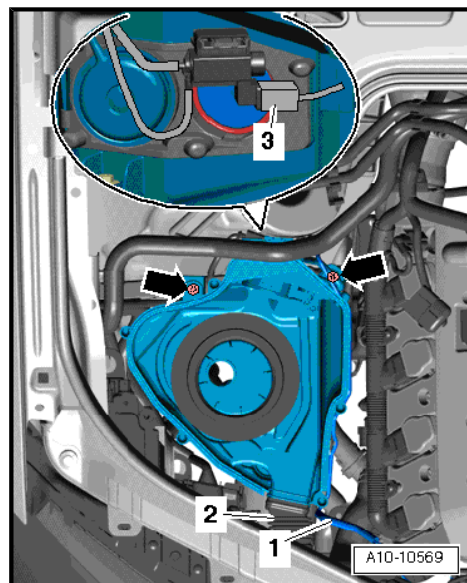
- Unscrew nuts -1 and 4- (accessible from below).

**Note**

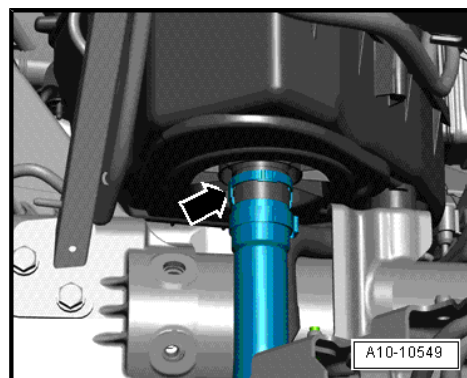
Nuts -2 and 3- are removed at a later stage.



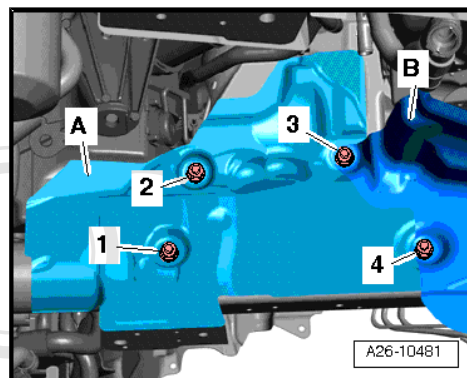
- Disconnect vacuum hose -1- and remove air duct -2-.
- Remove bolts -arrows-.
- Turn air cleaner housing (bottom section) and unplug electrical connector -3- at variable intake manifold change-over valve - N335- .
- Remove bottom section of air cleaner housing.



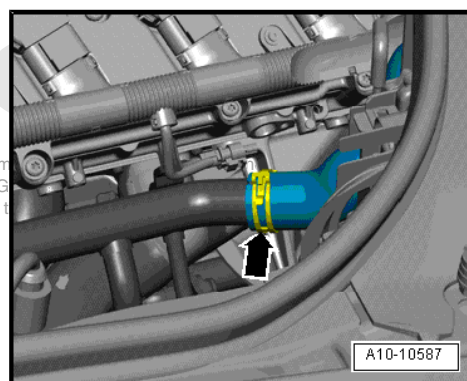
- Disconnect air hose (bottom) from air cleaner housing (bottom section) -arrow-.



- Unscrew nuts -2 and 3- (accessible from above).
- Detach heat shield -B- from studs.
- Lift off heat shield -A-.



- Detach coolant hose -arrow- from coolant pipe (right-side).



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- Remove bolts -1 and 2-
- Detach coolant pipe (right-side) from coolant hoses -arrows-

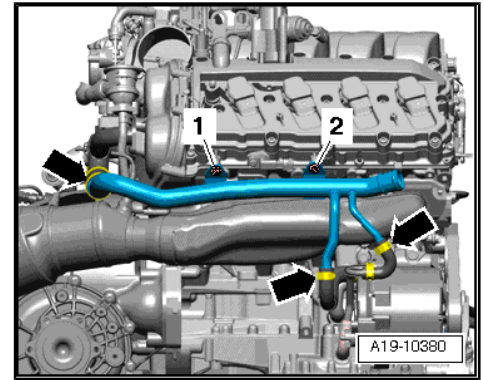
Installing

Tightening torques

- ⇒ [“2.5 Coolant pipes - exploded view”, page 194](#) .
- ⇒ Fig. [“Heat shields -A and B- \(right-side\)”, page 196](#) .
- ⇒ Fig. [“Heat shield for drive shaft \(right-side\)”, page 197](#) .

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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) ⇒ [Electronic parts catalogue](#) .*
- ◆ *Fit all cable ties in the original positions when installing.*
- Install cylinder head cover (right-side) ⇒ [page 117](#) .
- Install air cleaner housing ⇒ Rep. gr. 24 .
- Fill cooling system ⇒ [page 182](#) .

3 Radiator and radiator fans

⇒ ["3.1 Radiator and radiator fans - exploded view", page 218](#)

⇒ ["3.2 Removing and installing radiator", page 219](#)

⇒ ["3.3 Removing and installing radiator cowl", page 221](#)

⇒ ["3.4 Removing and installing radiator fans", page 222](#)

3.1 Radiator and radiator fans - exploded view

1 - Coolant hose

- ☐ To detach, release re-
taining clip

2 - O-ring

- ☐ Renew

3 - Bolt

- ☐ Renew
- ☐ 10 Nm

4 - Radiator cowl

- ☐ Removing and installing
⇒ [page 221](#)

5 - Rubber buffer

- ☐ Use screwdriver to re-
lease and pull off

6 - Retaining pin

7 - Radiator fan -V7-

- ☐ With radiator fan control
unit -J293-
- ☐ Removing and installing
⇒ [page 222](#)

8 - Radiator

- ☐ Removing and installing
⇒ [page 219](#)
- ☐ If renewed, change
coolant in entire system

9 - Bolt

- ☐ 6 Nm

10 - Mounting for radiator

11 - Radiator fan 2 -V177-

- ☐ With radiator fan control
unit 2 -J671-
- ☐ Removing and installing ⇒ [page 222](#)

12 - O-ring

- ☐ Renew

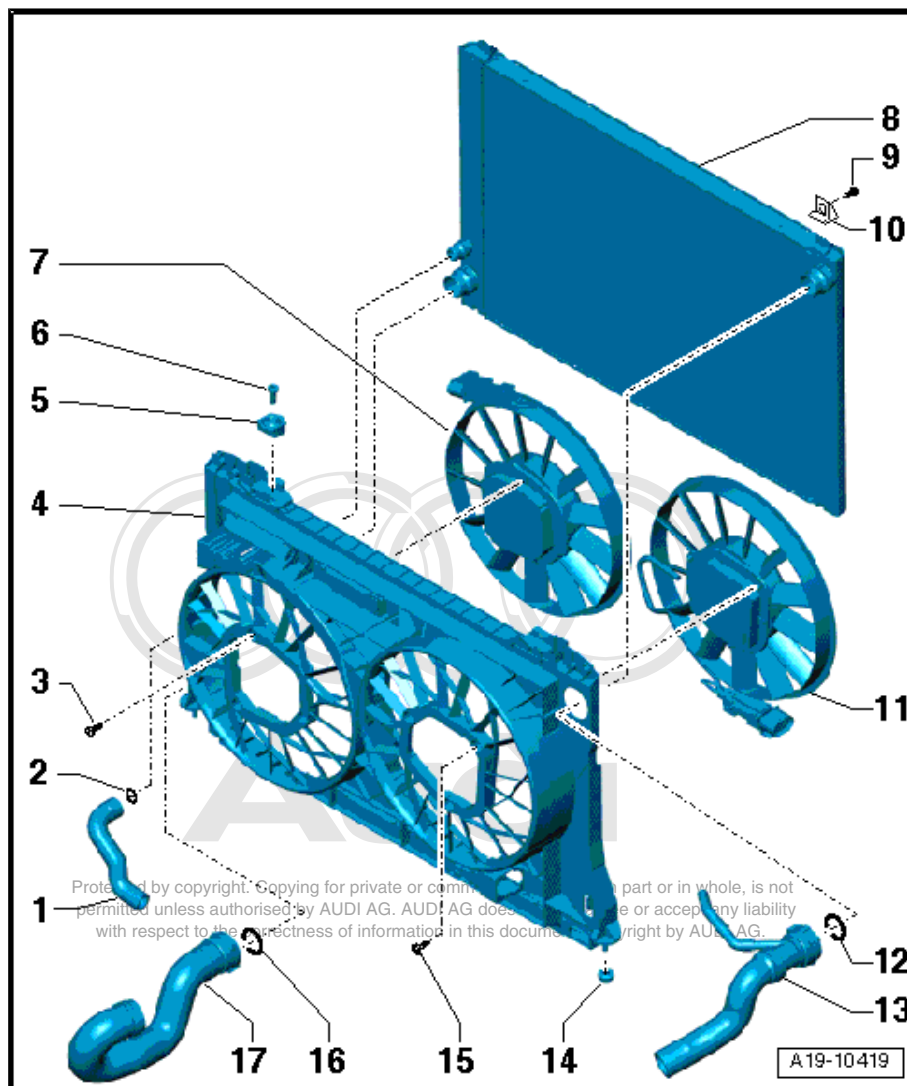
13 - Coolant hose

- ☐ To detach, release retaining clip

14 - Rubber bush

15 - Bolt

- ☐ 10 Nm



16 - O-ring

- ☐ Renew

17 - Coolant hose

- ☐ To detach, release retaining clip

3.2 Removing and installing radiator**Removing**

- Release fasteners -1- to remove front noise insulation.

**Note**

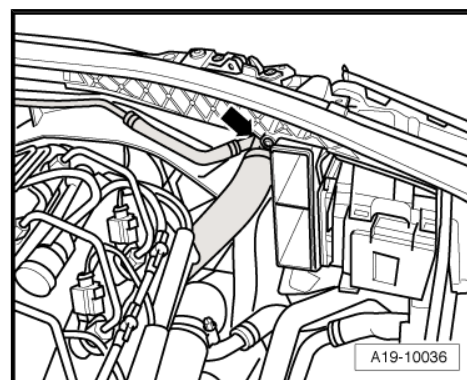
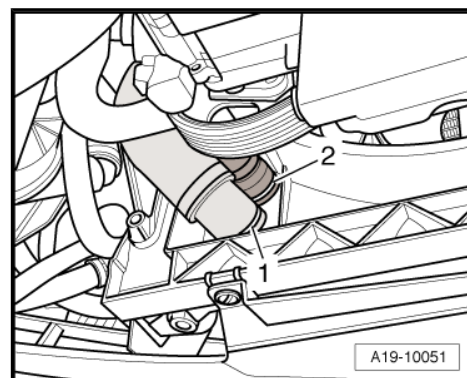
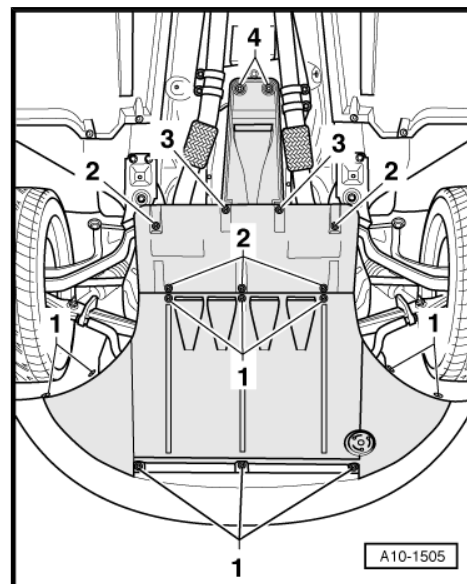
Disregard -items 2, 3, 4-.

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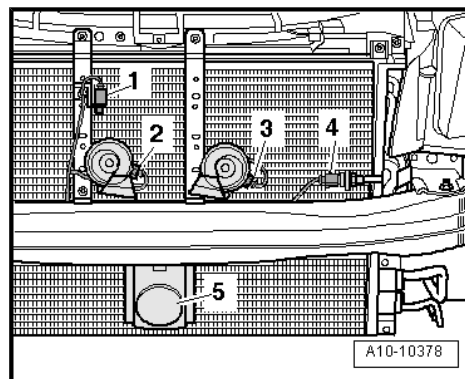
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- Pull clips out slightly and remove coolant hoses -1 and 2- from radiator.

- Pull clips out slightly and remove top coolant hose from radiator -arrow-.



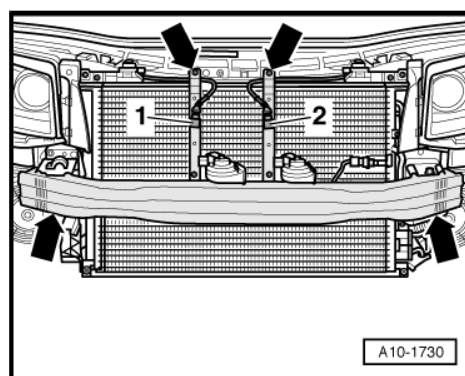
- Detach ambient temperature sensor -G17- -item 4-.
- Unplug electrical connectors -1, 2, 3-.
- Move electrical wiring harness clear.
- On vehicles with adaptive cruise control, unplug electrical connector at adaptive cruise control unit -J428- -item 5-.



- Unscrew bolts -arrows- and remove bumper together with struts.


Note

Disregard -items 1 and 2-.


WARNING

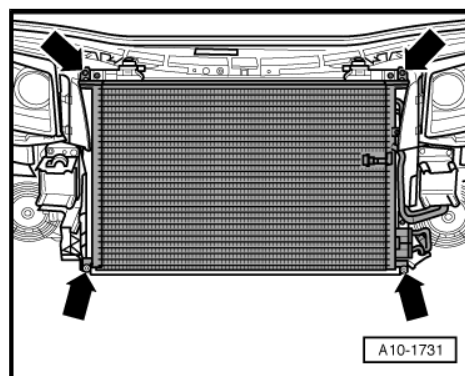
Risk of injury caused by refrigerant.

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

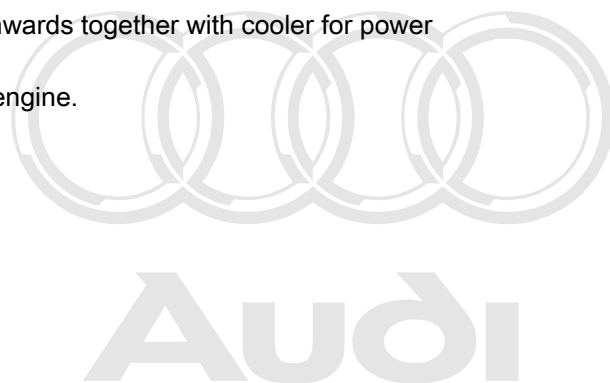

Caution

Make sure that condenser and refrigerant pipes and hoses are not damaged.

- ◆ *Do NOT stretch, kink or bend refrigerant lines and hoses.*



- Remove bolts -arrows-.
- Pivot condenser downwards together with cooler for power steering.
- Tie up condenser on engine.



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- Remove the two brackets for radiator -arrows-.
- Tilt top of radiator forwards slightly and lift out of lock carrier.

Installing

- Tightening torques
⇒ ["3.1 Radiator and radiator fans - exploded view", page 218](#)

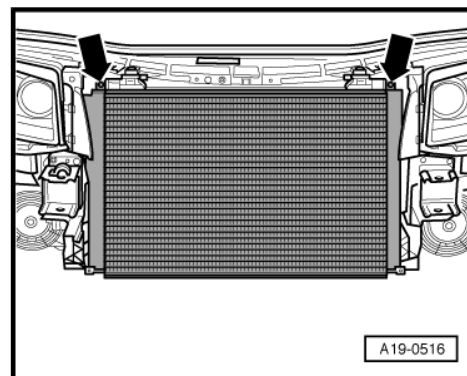
Installation is carried out in the reverse order; note the following:

- Install bumper cover (front) ⇒ Rep. gr. 63 .
- Fill cooling system ⇒ [page 182](#) .



Note

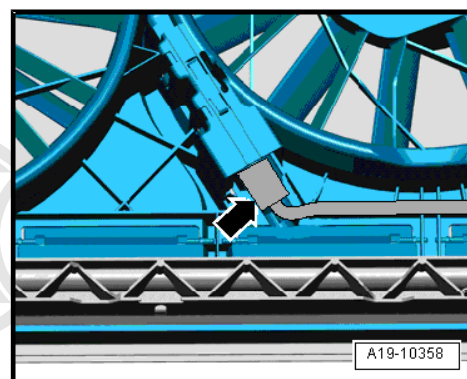
The coolant in the entire system must be changed if the radiator is renewed.



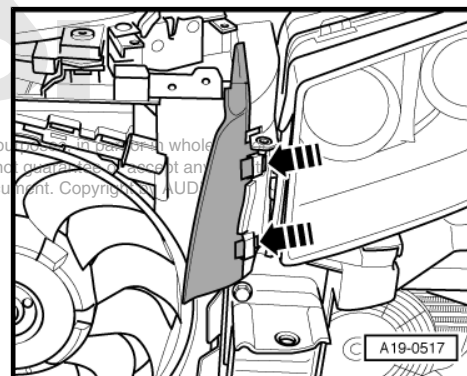
3.3 Removing and installing radiator cowl

Removing

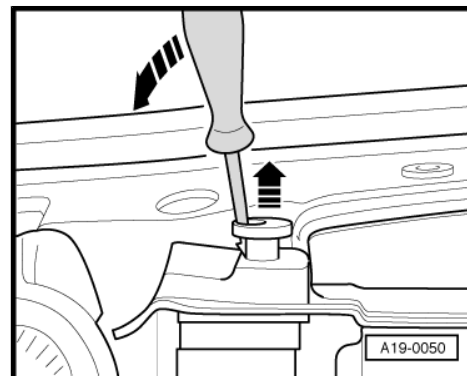
- Drain off coolant ⇒ [page 181](#) .
- Remove radiator ⇒ [page 219](#) .
- Unplug electrical connector -arrow- going to radiator fan.



- Remove air duct (left and right) -arrows-.



- Release both retaining pins for radiator cowl and pull out upwards -arrows-.
- Tilt top edge of radiator cowl forwards.



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**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.*

- Reach behind radiator cowl and unplug electrical connector -arrow- for radiator fans.
- Remove radiator cowl.

Installing

- Tightening torques
⇒ [“3.1 Radiator and radiator fans - exploded view”, page 218](#)

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

- Install radiator ⇒ [page 219](#) .
- Fill cooling system ⇒ [page 182](#) .

3.4 Removing and installing radiator fans

Removing

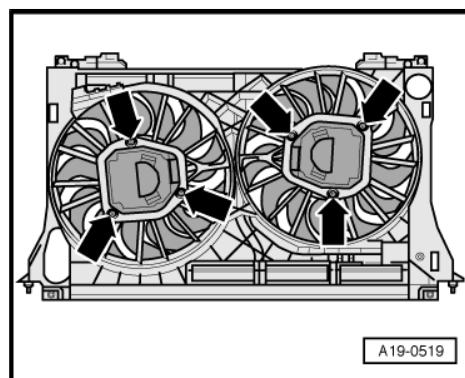
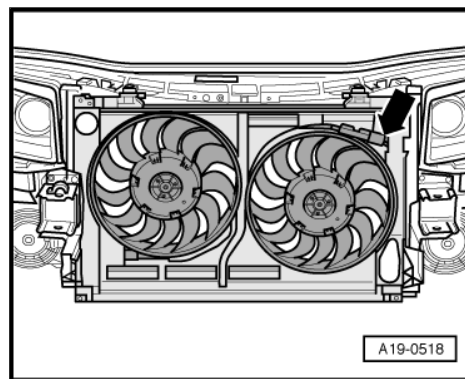
- Drain off coolant ⇒ [page 181](#) .
- Remove radiator ⇒ [page 219](#) .
- Remove radiator cowl ⇒ [page 221](#) .
- Remove bolts -arrows-.
- Unclip electrical connectors and lay wiring aside.
- Remove radiator fans.

Installing

- Tightening torques
⇒ [“3.1 Radiator and radiator fans - exploded view”, page 218](#)

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

- Install radiator cowl ⇒ [page 221](#) .
- Install radiator ⇒ [page 219](#) .
- Fill cooling system ⇒ [page 182](#) .



26 – Exhaust system

1 Silencers

⇒ [“1.1 Silencers - exploded view”, page 223](#)

⇒ [“1.2 Separating front exhaust pipe and front silencer”, page 226](#)

⇒ [“1.3 Separating centre and rear silencers”, page 227](#)

⇒ [“1.4 Renewing tailpipe”, page 228](#)

⇒ [“1.5 Removing and installing front silencer \(left-side\)”, page 229](#)

⇒ [“1.6 Removing and installing front silencer \(right-side\)”, page 231](#)

⇒ [“1.7 Stress-free alignment of exhaust system”, page 232](#)

⇒ [“1.8 Aligning tailpipes”, page 233](#)

1.1 Silencers - exploded view

1 - Centre silencer

- ☐ Combined in one unit with rear silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting point
⇒ [page 227](#)
- ☐ Align exhaust system so it is free of stress
⇒ [page 232](#)

2 - Rubber mounting

- ☐ Check preload
⇒ [“1.7 Stress-free alignment of exhaust system”, page 232](#)

3 - Nut

- ☐ 23 Nm

4 - Bolt

5 - Nut

- ☐ Renew
- ☐ 25 Nm

6 - Gasket

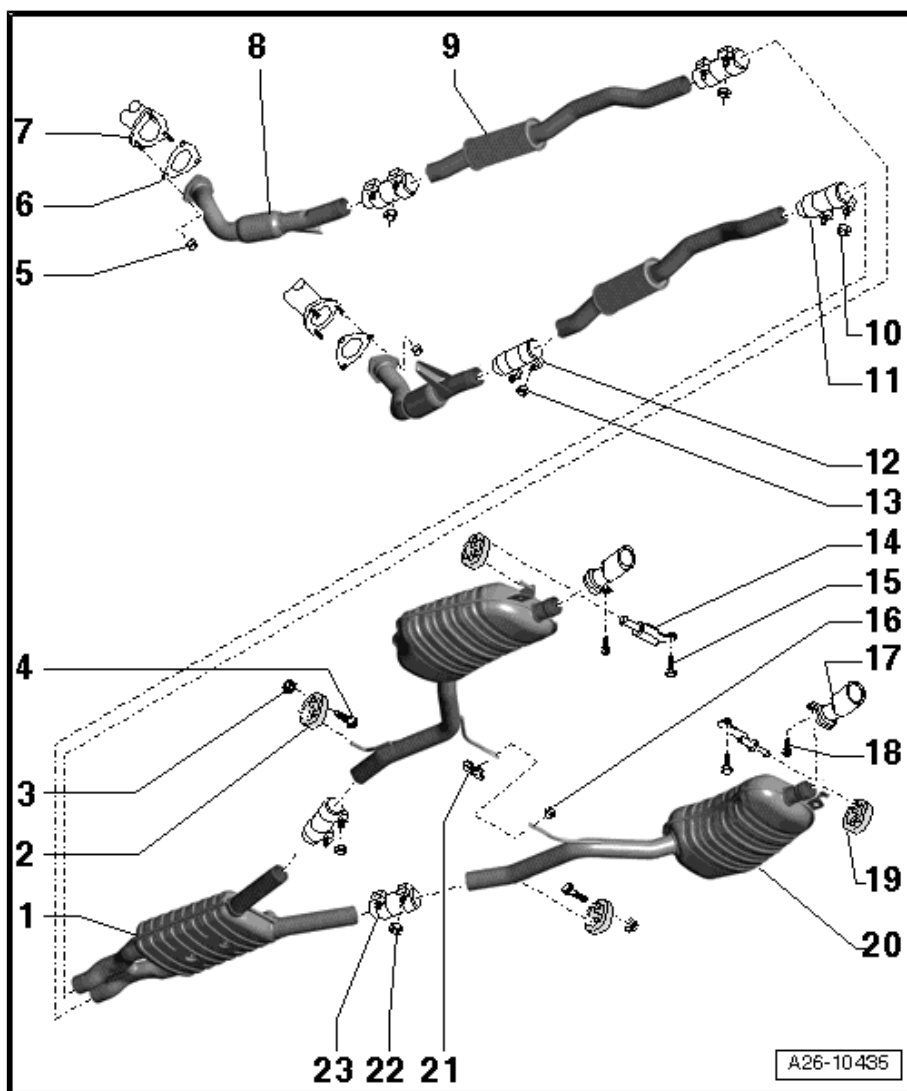
- ☐ Renew

7 - Exhaust manifold with catalytic converter

- ☐ Protect against knocks and impact
- ☐ Removing and installing: left-side
⇒ [page 236](#), right-side
⇒ [page 242](#)

8 - Front exhaust pipe

- ☐ With flexible joint



**Caution**

Risk of damage to flexible joints in front exhaust pipe.

Do NOT bend flexible joints in front exhaust pipe more than 10°.

- ☐ Combined with front silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Removing and installing: left-side ⇒ [page 229](#) , right-side ⇒ [page 231](#)
- ☐ Cutting point ⇒ [page 226](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 232](#)

9 - Front silencer

- ☐ Combined in one unit with front exhaust pipe as original equipment. Can be renewed individually for repair purposes
- ☐ Removing and installing: left-side ⇒ [page 229](#) , right-side ⇒ [page 231](#)
- ☐ Cutting point ⇒ [page 226](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 232](#)

10 - Nut

- ☐ 23 Nm

11 - Clamp (centre)

- ☐ Position clamp so that it aligns with centre of cutting location
- ☐ Installation position ⇒ [page 225](#)
- ☐ Before tightening bolt connections, align exhaust system so it is free of stress ⇒ [page 232](#)
- ☐ Tighten bolt connections evenly

12 - Clamp (front)

- ☐ To enable individual renewal of front exhaust pipe and front silencer
- ☐ Position clamp so that it aligns with centre of cutting location
- ☐ Installation position ⇒ [page 225](#)
- ☐ Before tightening bolt connections, align exhaust system so it is free of stress ⇒ [page 232](#)
- ☐ Tighten bolt connections evenly

13 - Nut

- ☐ 23 Nm

14 - Mounting**15 - Bolt**

- ☐ 22 Nm

16 - Nut

- ☐ Renew
- ☐ 23 Nm

17 - Tailpipe

- ☐ Combined in one unit with rear silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting point ⇒ [page 228](#)
- ☐ Aligning ⇒ [page 233](#)

18 - Bolt

- ☐ 23 Nm

19 - Rubber mounting

- ☐ Check preload ⇒ ["1.7 Stress-free alignment of exhaust system", page 232](#)

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20 - Rear silencer

- ☐ Combined in one unit with centre silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting point [⇒ page 227](#)
- ☐ Align exhaust system so it is free of stress [⇒ page 232](#)

21 - Connecting bracket**22 - Nut**

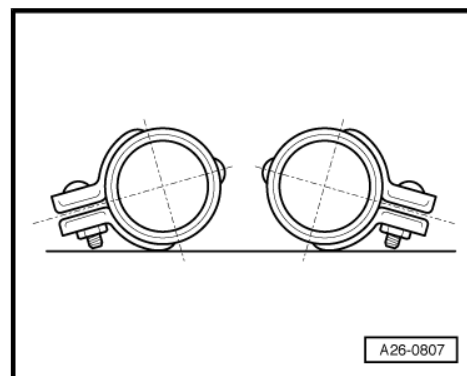
- ☐ 23 Nm

23 - Clamp (rear)

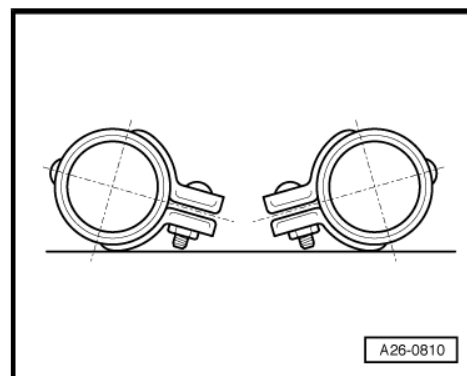
- ☐ For separate replacement of centre and rear silencers
- ☐ Position clamp so that it aligns with centre of cutting location
- ☐ Installation position [⇒ page 225](#)
- ☐ Before tightening bolt connections, align exhaust system so it is free of stress [⇒ page 232](#)
- ☐ Tighten bolt connections evenly

Installation position of front and centre clamps

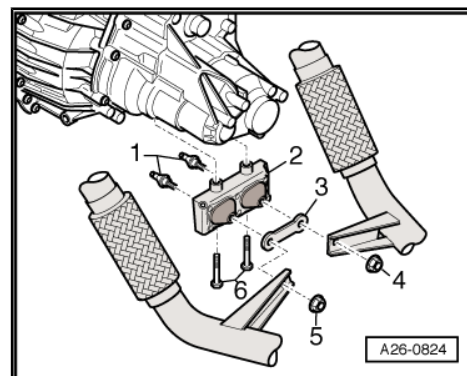
- Fit clamps so that ends of bolts do not protrude beyond bottom of clamps.
- Bolt connections face outwards.

**Installation position of rear clamps**

- Fit clamps so that ends of bolts do not protrude beyond bottom of clamps.
- Bolt connections face one another.

**Components of bracket (centre)**

- 1 - Studs
- 2 - Bracket
- 3 - Bracket
- 4 - Nut, self-locking, 25 Nm
- 5 - Nut, self-locking, 25 Nm
- 6 - Bolts - 25 Nm

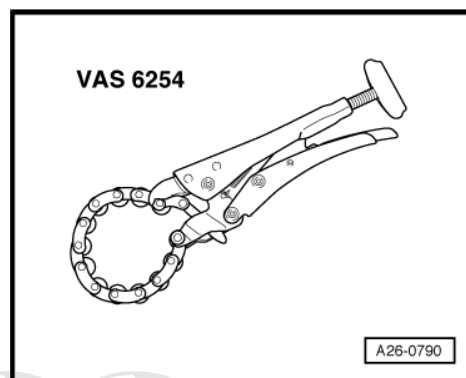


1.2 Separating front exhaust pipe and front silencer

- ◆ A cutting point is provided in order to renew the front exhaust pipe or the front silencer separately.
- ◆ The cutting point is marked by an indentation on the circumference of the front exhaust pipe.

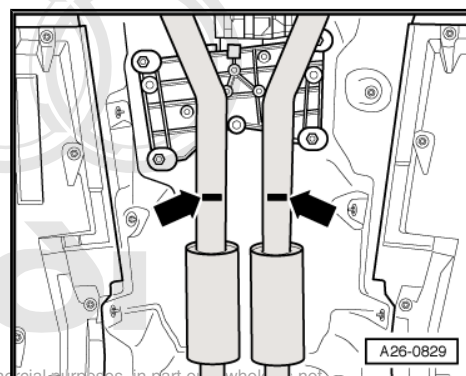
Special tools and workshop equipment required

- ◆ Chain pipe cutter -VAS 6254-

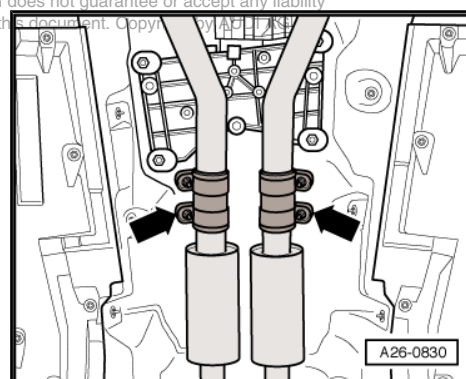


Procedure

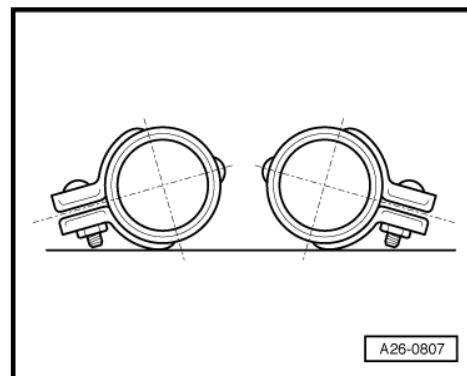
- Cut through exhaust pipes at a right angle at cutting point -arrows- using chain pipe cutter -VAS 6254- .



- When reassembling, position the clamps -arrows- centrally over the cutting point.



- Fit clamps so that ends of bolts do not protrude beyond bottom of clamps.
- Bolt connections face outwards.
- Align exhaust system so it is free of stress ⇒ [page 232](#) .

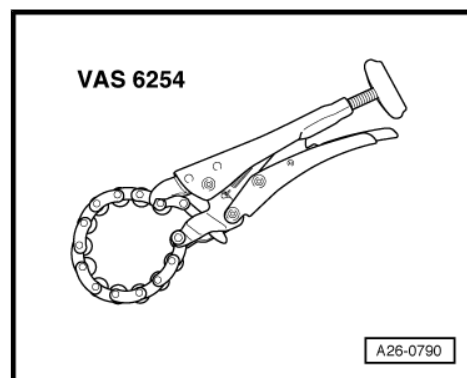


1.3 Separating centre and rear silencers

- ◆ The connecting pipe can be cut through at the cutting location in order to renew the centre or rear silencer separately.
- ◆ The cutting point is marked by an indentation on the circumference of the exhaust pipe.

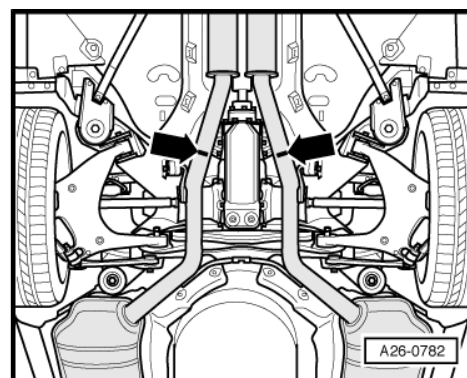
Special tools and workshop equipment required

- ◆ Chain pipe cutter -VAS 6254-

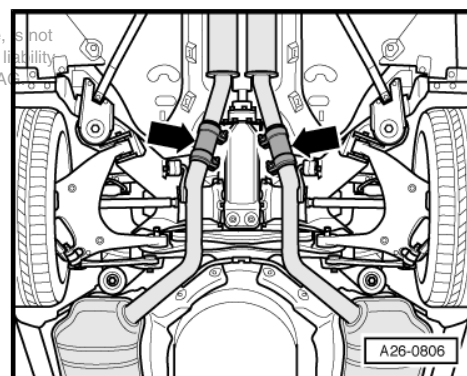


Procedure

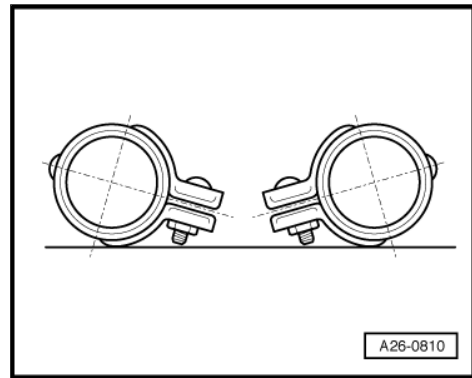
- Cut through exhaust pipes at a right angle at cutting point -arrows- using chain pipe cutter -VAS 6254- .



- When reassembling, position the clamps -arrows- centrally over the cutting point.



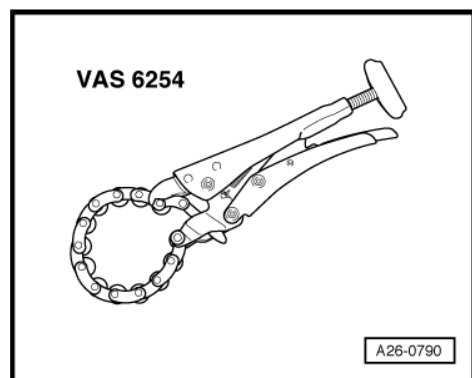
- Fit clamps so that ends of bolts do not protrude beyond bottom of clamps.
- Threads of bolts point inwards.
- Align exhaust system so it is free of stress ⇒ [page 232](#) .



1.4 Renewing tailpipe

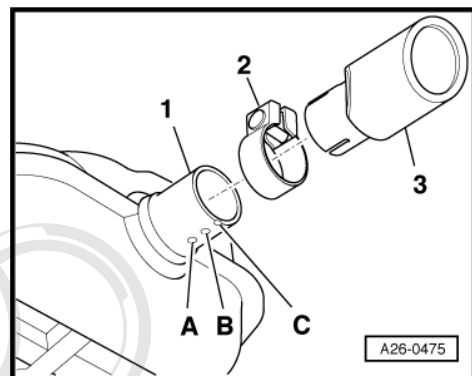
Special tools and workshop equipment required

- ◆ Chain pipe cutter -VAS 6254-



Procedure

- Tightening torque
⇒ ["1.1 Silencers - exploded view", page 223](#)
- Cut through tailpipe -1- with chain-type pipe cutter -VAS 6254- at the position marked -C-.
- Push new tailpipe -3- onto tailpipe as far as marking -A-. Slot on tailpipe should align with marking -B-.
- Tighten nut for clamp -2-.



1.5 Removing and installing front silencer (left-side)

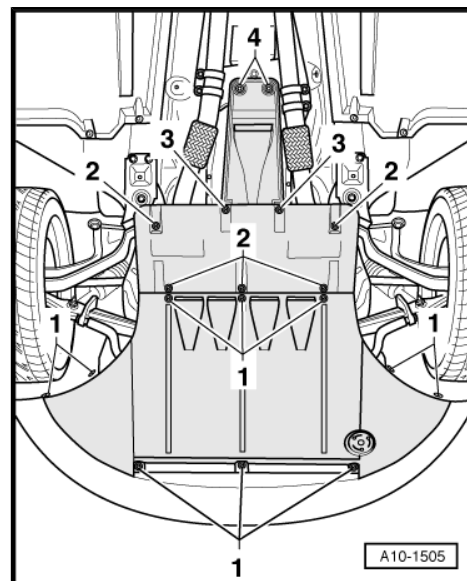
Removing

- Release fasteners -2 and 4- and remove rear noise insulation panels.

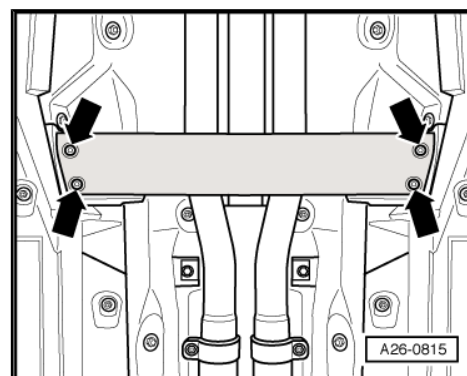


Note

Disregard -items 1 and 3-.



- Unbolt cross piece (front) -arrows-.

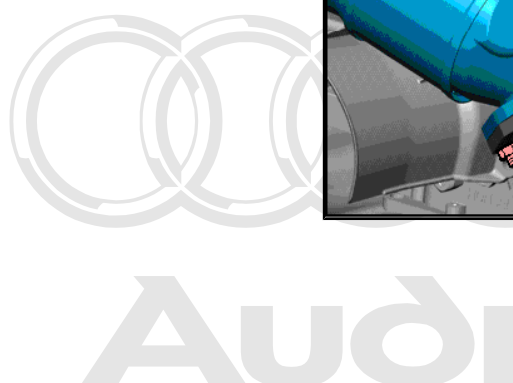
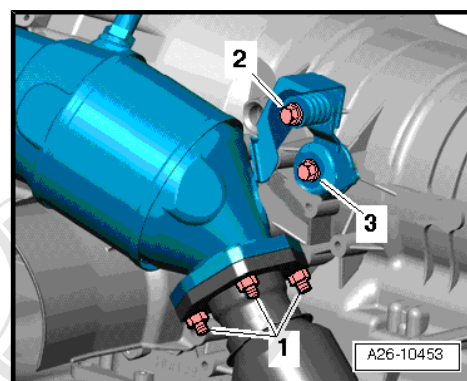


- Unscrew nuts -1- for front silencer (left-side).



Note

Disregard -items 2 and 3-.



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Caution

Risk of damage to flexible joint in front exhaust pipe.

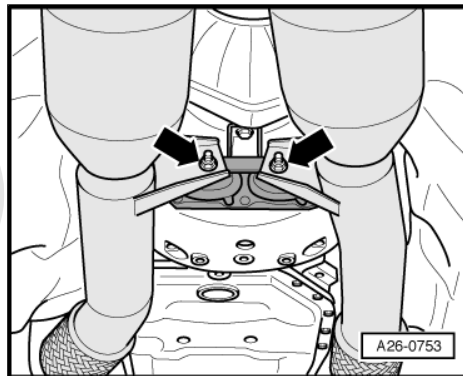
- ◆ **Do NOT bend flexible joint in front exhaust pipe more than 10°.**

- Unscrew nut -left arrow- at mounting bracket for front silencer (left-side).



Note

Disregard -arrow- on right-side of illustration.



- Disconnect exhaust system at clamp (left-side) - 1- and detach front silencer (left-side).



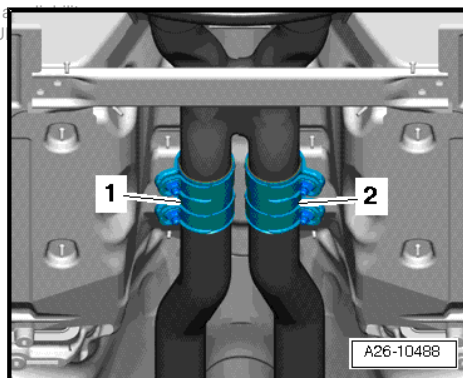
Note

Disregard -item 2-.

Installing

- Tightening torque
⇒ ["1.1 Silencers - exploded view", page 223](#)

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



Note

Renew gaskets and self-locking nuts.

- Install cross piece (front) ⇒ Rep. gr. 40 .
- Align exhaust system so it is free of stress ⇒ [page 232](#) .

1.6 Removing and installing front silencer (right-side)

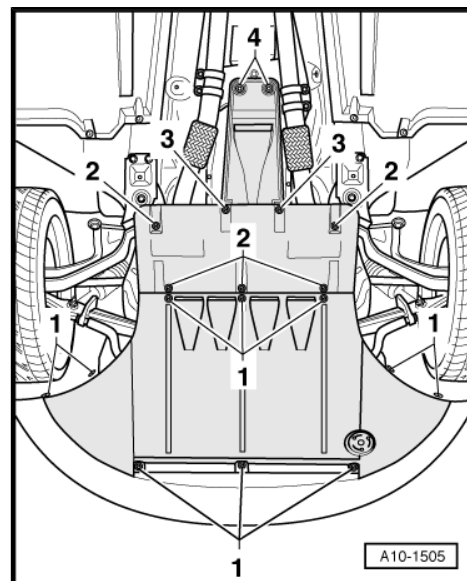
Removing

- Release fasteners -2 and 4- and remove rear noise insulation panels.

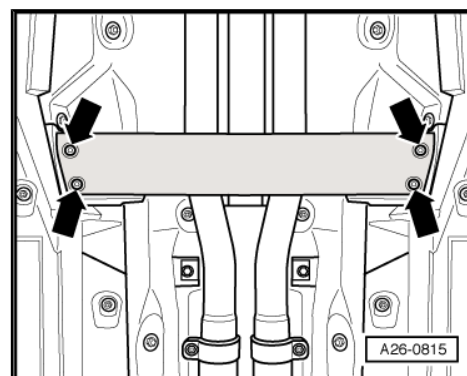


Note

Disregard -items 1 and 3-.



- Unbolt cross piece (front) -arrows-.

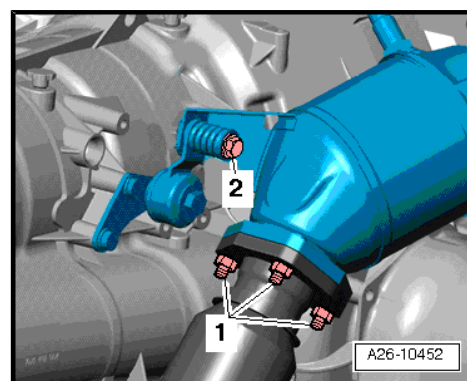


- Unscrew nuts -1- for front silencer (right-side).



Note

Disregard -item 2-.



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Caution

Risk of damage to flexible joints in front exhaust pipe.

- ◆ **Do NOT bend flexible joints in front exhaust pipe more than 10°.**

- Unscrew nut -right arrow- at mounting bracket for front silencer (right-side).



Note

Ignore -arrow on left side of illustration-.

- Disconnect exhaust system at clamp (right-side) -2- and detach front silencer (right-side).



Note

Disregard -item 1-.

Installing

- Tightening torque
⇒ ["1.1 Silencers - exploded view", page 223](#)

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



Note

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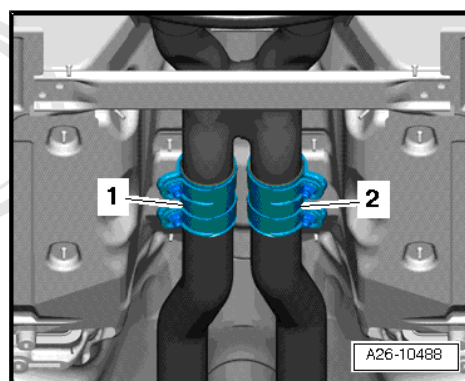
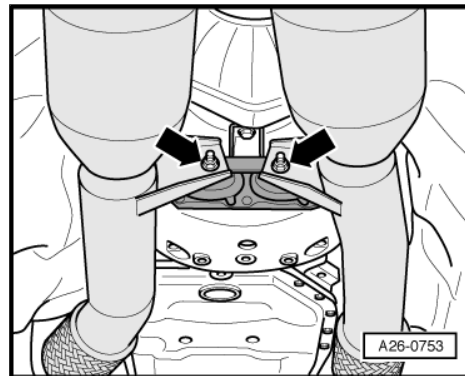
Renew gaskets and self-locking nuts.

- Install cross piece (front) ⇒ Rep. gr. 40 .
- Align exhaust system so it is free of stress ⇒ [page 232](#) .

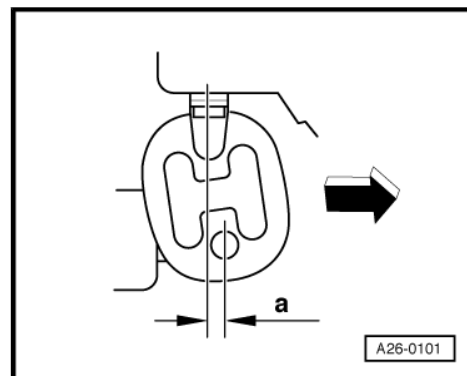
1.7 Stress-free alignment of exhaust system

Procedure

- The exhaust system must be aligned when it is cool.
- Tightening torques
⇒ ["1.1 Silencers - exploded view", page 223](#)
- Align front section of exhaust system including front silencer and clamps ⇒ [Item 12 \(page 224\)](#) .
- Loosen bolts for clamps ⇒ [Item 11 \(page 224\)](#) .



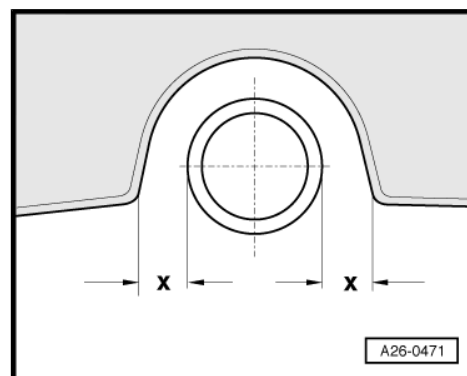
- Push exhaust system towards front of vehicle -arrow-, so that rubber mountings [⇒ Item 2 \(page 223\)](#) are pre-loaded by dimension -a-.
- Distance -a- = 11 mm
- Tighten bolt connections on clamps evenly.
- Align tailpipes [⇒ page 233](#).



1.8 Aligning tailpipes

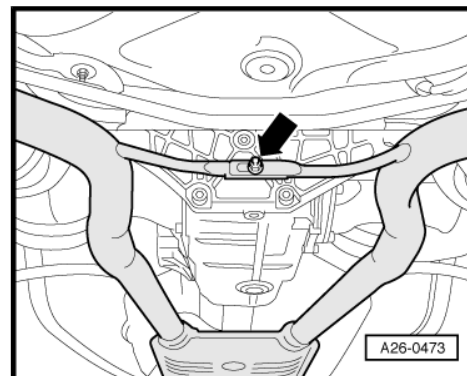
Procedure

- Tightening torque
[⇒ "1.1 Silencers - exploded view", page 223](#)
- Check clearance between tailpipes and bumper on both sides.
- Dimension -x- (left-side) = dimension -x- (right-side)

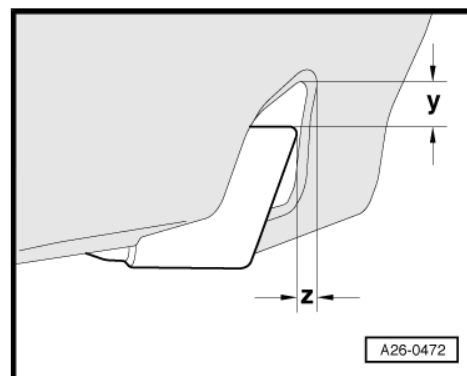


If necessary, correct dimension -x- as follows.

- Slacken bolt connection -arrow- on brace between exhaust pipes.
- Adjust the distance between the rear silencers.
- Tighten bolt connection.



- Check distances -y- and -z- between tailpipes and bumper.
- Dimension -y- = 13 ... 17 mm.
- Dimension -z- = 8 ... 12 mm.
- If tailpipes cannot be aligned, check whether exhaust system is aligned free of stress [⇒ page 232](#).



2 Exhaust manifolds

⇒ [“2.1 Exhaust manifold - exploded view”, page 234](#)

⇒ [“2.2 Removing and installing exhaust manifold \(left-side\) with catalytic converter”, page 236](#)

⇒ [“2.3 Removing and installing exhaust manifold \(right-side\) with catalytic converter”, page 242](#)

2.1 Exhaust manifold - exploded view

1 - Nut

- ☐ Renew
- ☐ Coat with high-temperature paste; for high-temperature paste refer to ⇒ [Electronic parts catalogue](#)
- ☐ Tightening sequence: exhaust manifold (left-side) ⇒ [page 235](#), exhaust manifold (right-side) ⇒ [page 235](#)

2 - Exhaust manifold with catalytic converter

- ☐ Mounting components: left-side ⇒ [page 235](#), right-side ⇒ [page 235](#)
- ☐ Removing and installing: left-side ⇒ [page 236](#), right-side ⇒ [page 242](#)

3 - Gasket

- ☐ Renew

4 - Mounting strip

- ☐ Remains installed when exhaust manifold is removed

5 - Nut

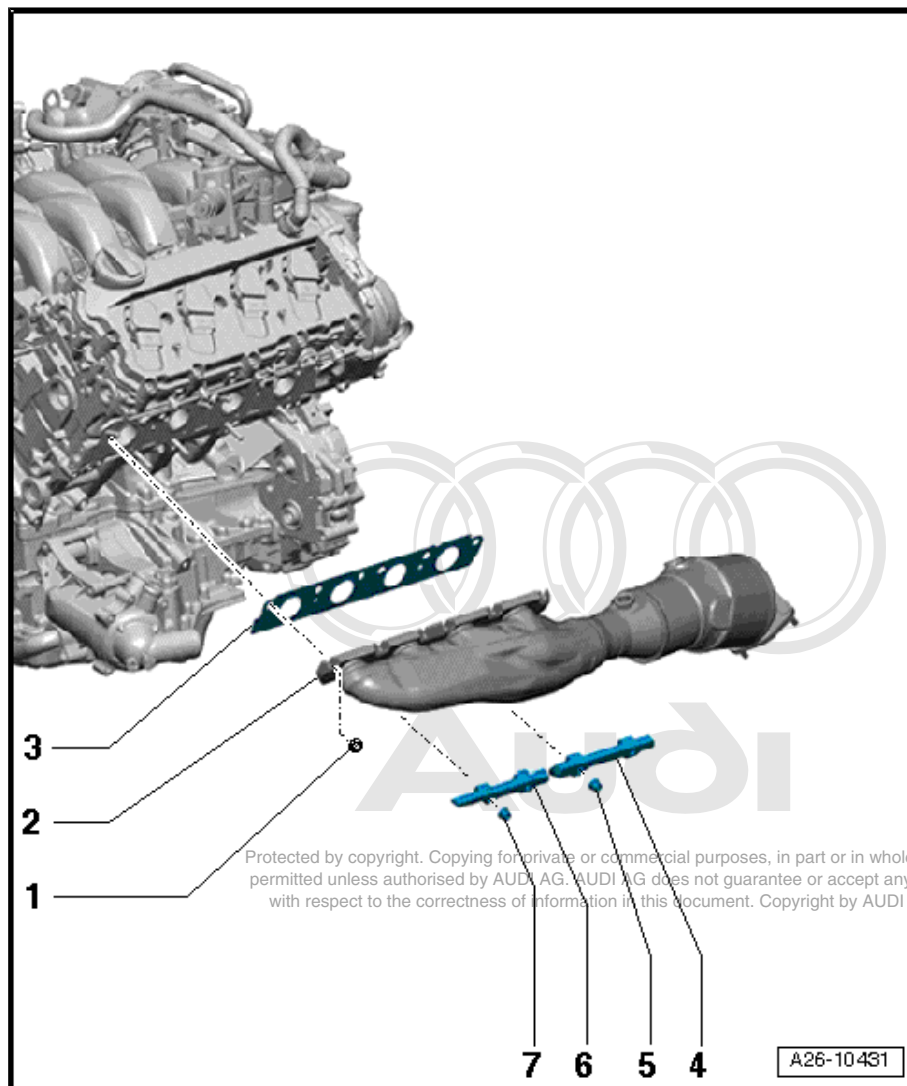
- ☐ Renew
- ☐ Coat with high-temperature paste; for high-temperature paste refer to ⇒ [Electronic parts catalogue](#)
- ☐ 25 Nm

6 - Mounting strip

- ☐ Remains installed when exhaust manifold is removed

7 - Nut

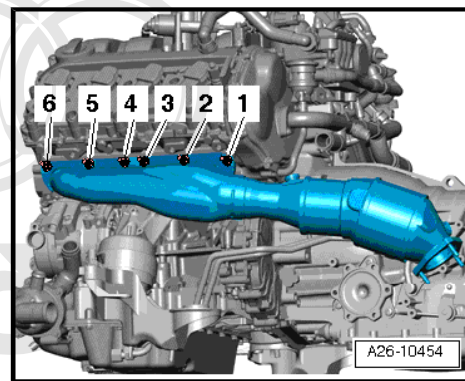
- ☐ Renew
- ☐ Coat with high-temperature paste; for high-temperature paste refer to ⇒ [Electronic parts catalogue](#)
- ☐ 25 Nm



Tightening sequence for exhaust manifold (left-side)

– Tighten nuts in the sequence -1 ... 6- in 3 stages as follows:

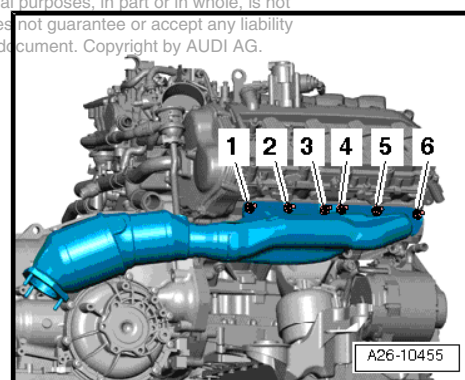
1. Screw in nuts hand-tight.
2. Initially tighten nuts to 20 Nm.
3. Tighten nuts to 30 Nm.



Tightening sequence for exhaust manifold (right-side)

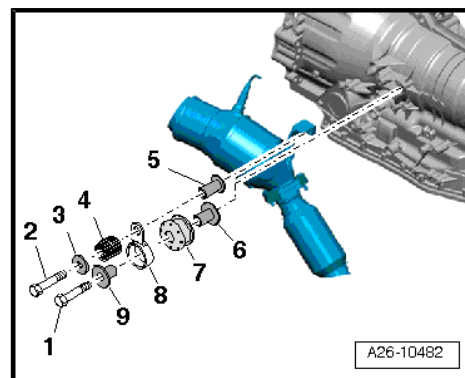
– Tighten nuts in the sequence -1 ... 6- in 3 stages as follows:

1. Screw in nuts hand-tight.
2. Initially tighten nuts to 20 Nm.
3. Tighten nuts to 30 Nm.



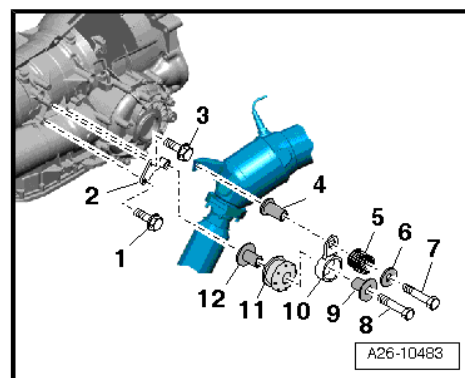
Components of exhaust pipe mountings (left-side)

- 1 - Bolt, 23 Nm
- 2 - Bolt, 23 Nm
- 3 - Washer
- 4 - Compression spring
- 5 - Spacer sleeve
- 6 - Spacer sleeve
- 7 - Buffer
- 8 - Bracket
- 9 - Spacer sleeve



Components of exhaust pipe mountings (right-side)

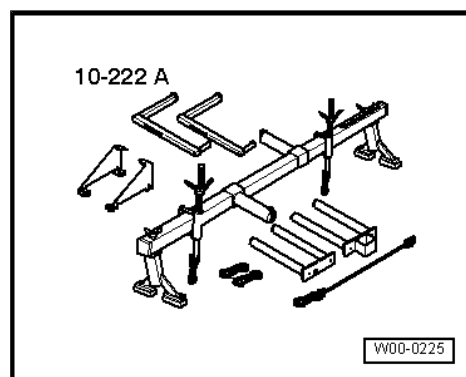
- 1 - Bolt, 23 Nm
- 2 - Bracket
- 3 - Bolt, 23 Nm
- 4 - Spacer sleeve
- 5 - Compression spring
- 6 - Washer
- 7 - Bolt, 23 Nm
- 8 - Bolt, 23 Nm
- 9 - Spacer sleeve
- 10 - Bracket
- 11 - Buffer
- 12 - Spacer sleeve



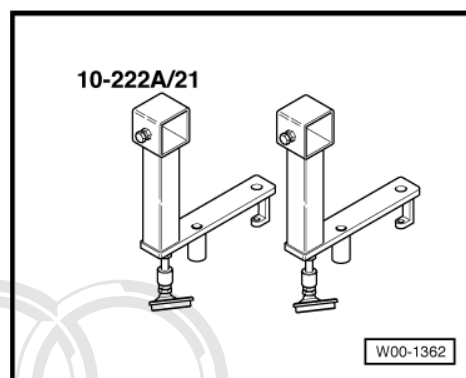
2.2 Removing and installing exhaust manifold (left-side) with catalytic converter

Special tools and workshop equipment required

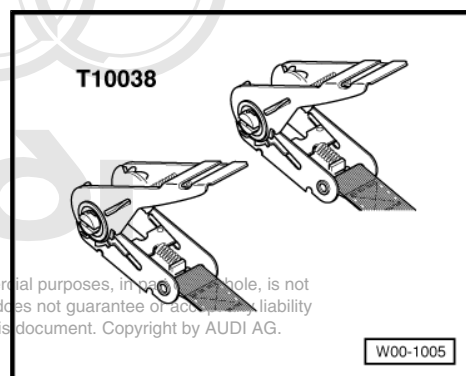
- ◆ Support bracket -10 - 222 A-



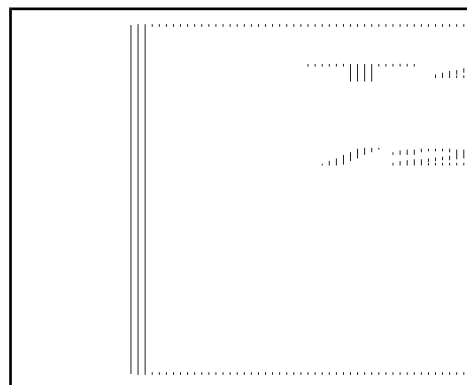
- ◆ Adapters -10 - 222 A /21-



- ◆ Tensioning strap -T10038-



- ◆ Engine support bracket (supplementary set) -T40093-



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Removing



Note

Fit all cable ties in the original positions when installing.

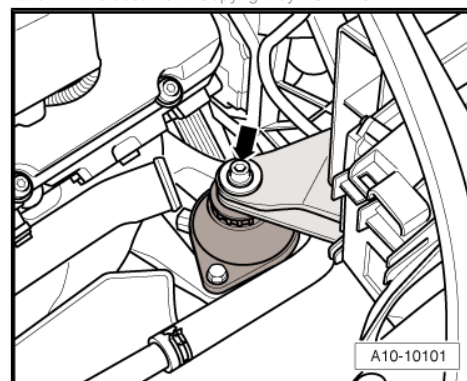
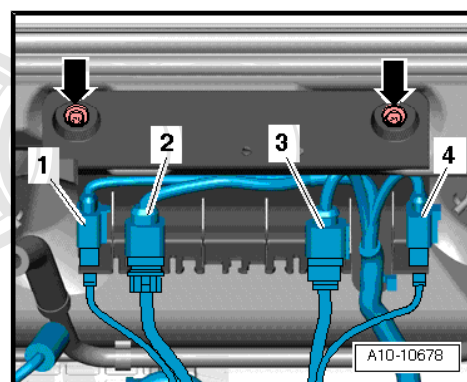
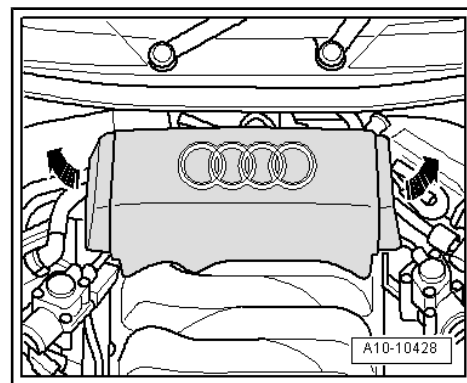
- Pull off engine cover panel (rear) -arrows-.
- Drain off coolant ⇒ [page 181](#) .
- Remove coolant pipe (left-side) ⇒ [page 204](#) .
- Remove front silencer (left-side) ⇒ [page 229](#) .
- Detach electrical connectors from bracket and unplug connectors:
- 3 - For Lambda probe 2 -G108-
- 4 - For Lambda probe 2 -G131- (after catalytic converter)
- Move electrical wiring to Lambda probes clear.



Note

Disregard -items 1 and 2-.

- Remove front left wheel.
- Remove front section of front left wheel housing liner ⇒ Rep. gr. 66 .
- Remove bolt -arrow- on mounting for torque reaction support.

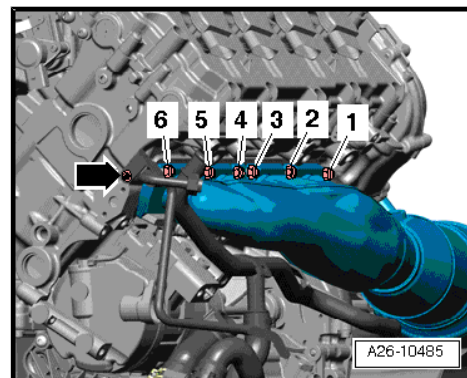


- Unscrew bolt -arrow- and pull pressure pipe for hydraulic fluid slightly towards front.
- Unscrew nuts -6 ... 1-.



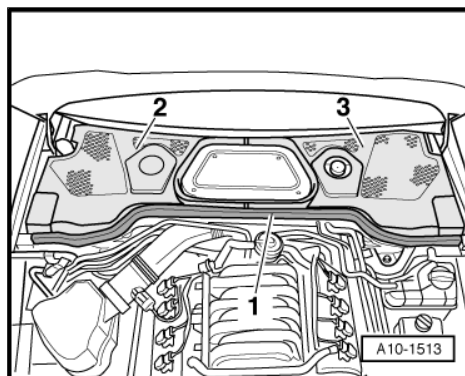
Note

- ◆ *Shown in illustration with engine removed.*
- ◆ *Nut -1- is accessible from wheel housing.*

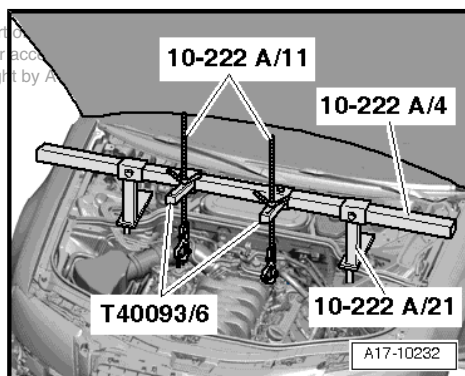
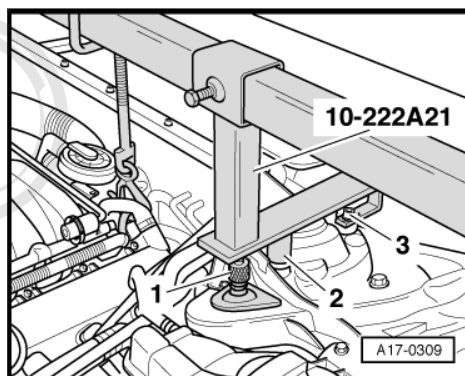




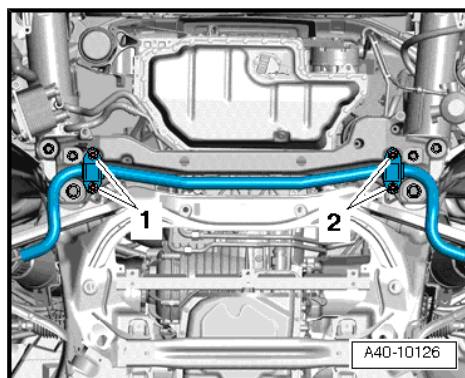
- Pull off rubber seal -1- and remove plenum chamber covers -2 and 3-.



- Unscrew rear bolts -3- for body brace.
- Attach adapters -10 - 222 A /21- without adapter -10 - 222 A / 4- onto suspension turrets.
- Supports are marked for left and right side of vehicle.
- The centre resting point -2- of supports is positioned on front bolts for body brace.
- The adapters -10 - 222 A /21- are attached by means of the rear bolts -3- for the body brace.
- The knurled screw -1- must be screwed down until support plate rests on suspension turret.
- Attach adapter -10 - 222 A /4- using adapters -T40093/6- to adapters -10 - 222 A /21-.
- Secure spindles -10 - 222 A /11- to engine lifting eyes.
- Take up weight of engine using spindles of support bracket.



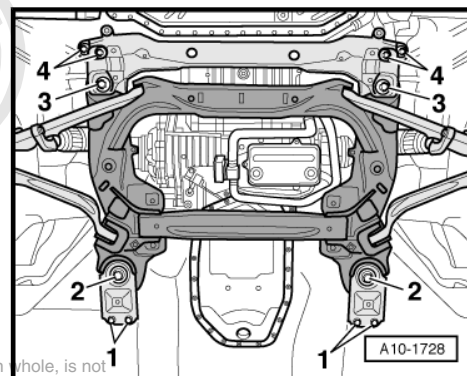
- Remove bolts (left and right) -1 and 2- for anti-roll bar mountings.



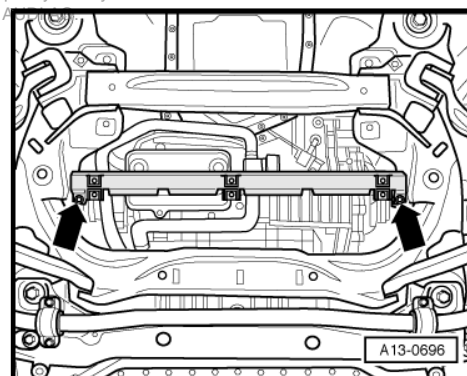
- Remove bolts -3 and 4-.

**Note**

Disregard -items 1 and 2-.



- Unbolt bracket for noise insulation -arrows-.

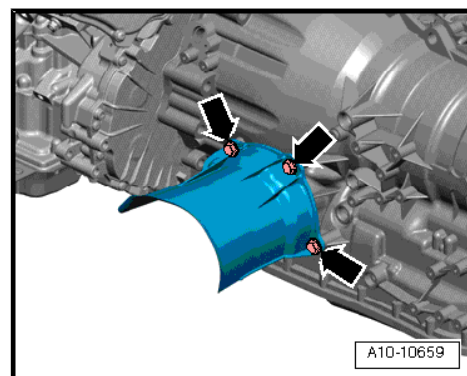


- Unbolt heat shield for drive shaft from gearbox -arrows-.

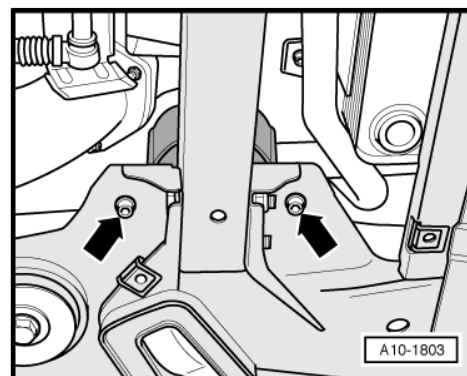
**Note**

Shown in illustration with engine removed.

- Detach drive shaft (left-side) from flange shaft on gearbox.

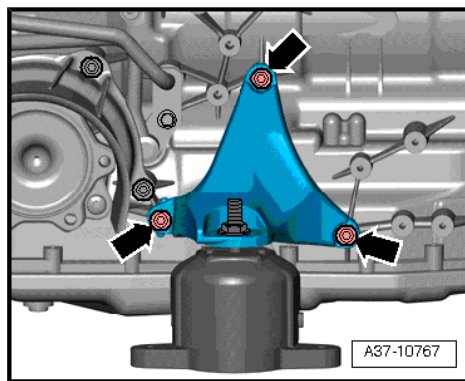


- Remove bolts (left and right) -arrows- for front gearbox mounting.





- Remove bolts -arrows- and take off gearbox support with gearbox mounting.

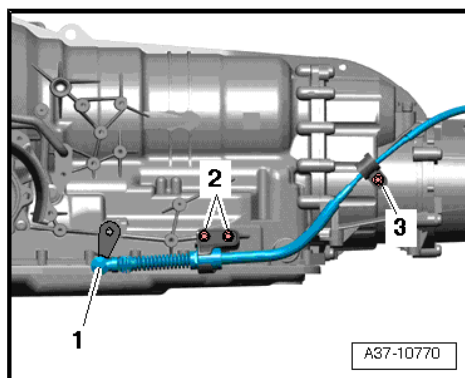


- Mark installation position of support bracket for selector lever cable with felt-tip pen for re-installation.
- Pry ball socket -1- of selector lever cable off selector shaft lever using removal lever -80 - 200- .
- Remove bolts -2- and move selector lever cable clear to one side.



Note

Disregard -item 3-.

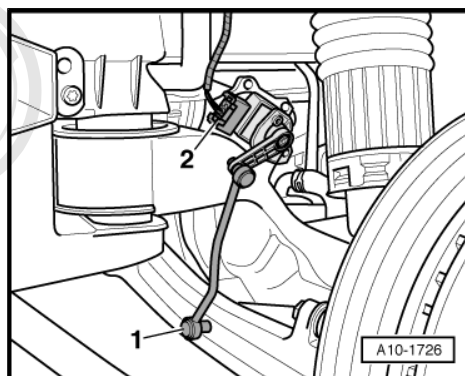


- Unplug electrical connector -2- at vehicle level sender (left and right).



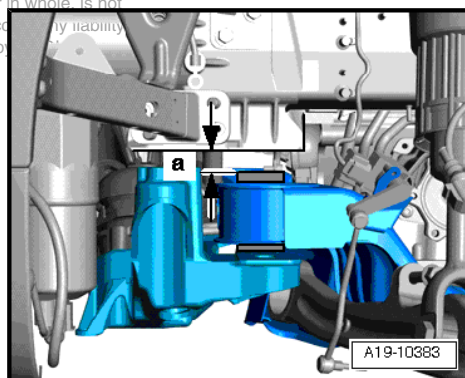
Note

Disregard -item 1-.



- Turn spindles -10- 222 A/11- to lower engine/gearbox as assembly by dimension -a-.

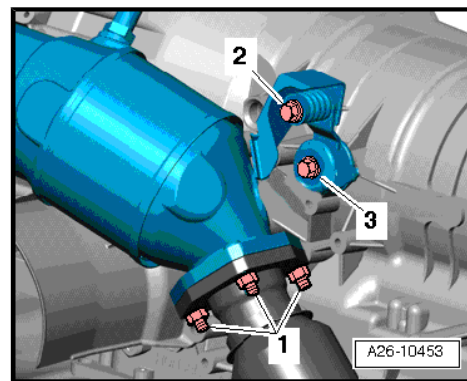
- Dimension -a- = 80 mm (maximum).



- Remove bolts - 2 and 3- and detach bracket.

**Note**

Disregard -item 1-.

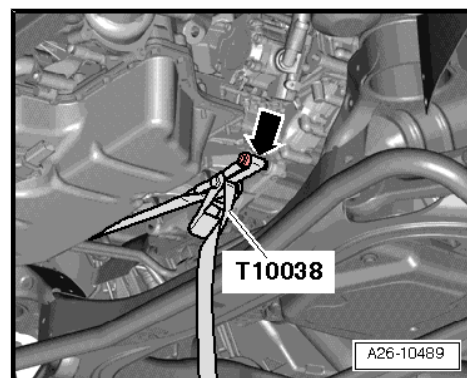


- Swivel front of engine/gearbox assembly slightly to right.
- To do so, unscrew one bolt -arrow- securing engine to gearbox approx. 2 turns and wrap tensioning strap -T10038- around bolt and strut on longitudinal member (right-side).

**Caution**

Risk of damage to drive shaft boot.

- ◆ *Guide exhaust manifold (left-side) with catalytic converter carefully when taking out.*



- Remove exhaust manifold (left-side) with catalytic converter towards rear.

Installing**Tightening torques**

- ⇒ [“4 Installing engine”, page 35](#) .
- ⇒ [“2.1 Exhaust manifold - exploded view”, page 234](#) .
- ⇒ [Fig. ““Tightening sequence for exhaust manifold \(left-side\)””, page 235](#) .
- ⇒ [Fig. ““Components of exhaust pipe mountings \(left-side\)””, page 235](#) .
- ⇒ [Fig. ““Heat shield for drive shaft \(left-side\)””, page 196](#) .

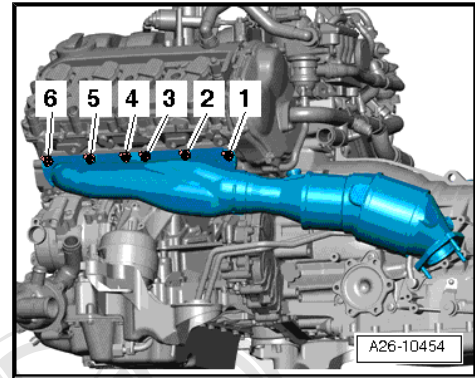
Installation is carried out in the reverse order; note the following:

**Note**

Renew gasket and self-locking nuts.

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- Fit new gasket onto studs.
- Fit exhaust manifold in mounting strips and tighten [⇒ page 235](#).
- Install drive shaft (left-side) ⇒ Rep. gr. 40.
- Install gearbox mounting ⇒ Rep. gr. 37.
- Install mounting for torque reaction support [⇒ page 42](#).
- Install subframe ⇒ Rep. gr. 40.
- Install anti-roll bar ⇒ Rep. gr. 40.
- Install coolant pipe (left-side) [⇒ page 204](#).
- Install front silencer (left-side) [⇒ page 229](#).
- Align exhaust system so it is free of stress [⇒ page 232](#).
- Fill cooling system [⇒ page 182](#).

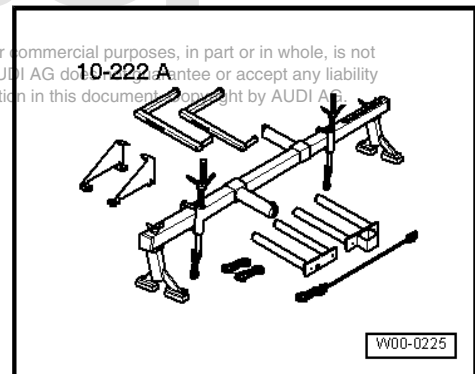


2.3 Removing and installing exhaust manifold (right-side) with catalytic converter

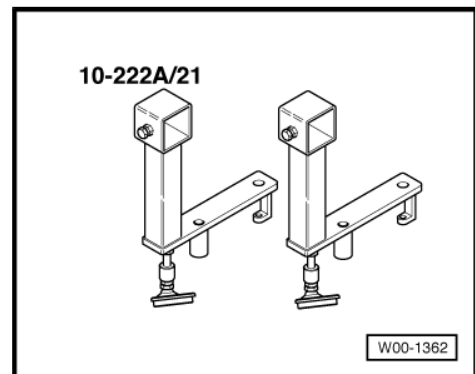
Special tools and workshop equipment required

- ◆ Support bracket -10 - 222 A-

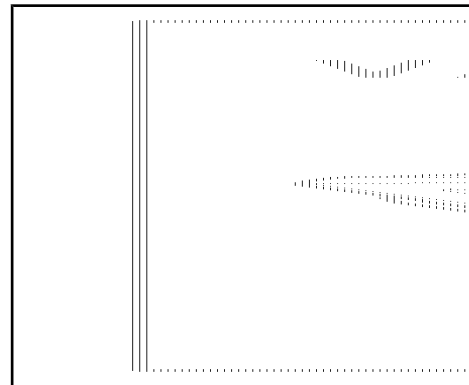
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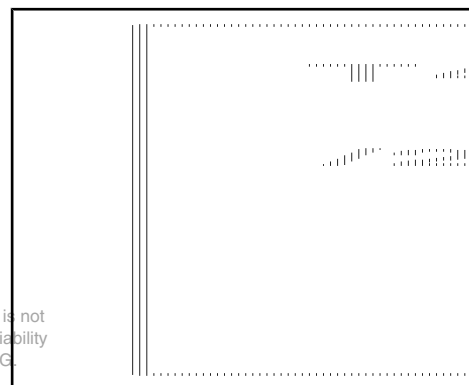
- ◆ Adapters -10 - 222 A /21-



- ◆ Drip tray for workshop hoist -VAS 6208-



- ◆ Engine support bracket (supplementary set) -T40093-



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Removing



Note

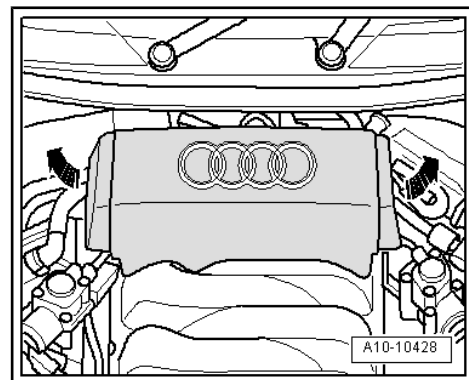
Fit all cable ties in the original positions when installing.



Caution

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

- ◆ ***Observe notes on procedure for disconnecting the battery.***



- With ignition switched off, disconnect earth cable at battery ⇒ Electrical system; Rep. gr. 27 .
- Pull off engine cover panel (rear).
- Drain off coolant ⇒ [page 181](#) .
- Remove coolant pipe (right-side) ⇒ [page 214](#) .
- Remove poly V-belt ⇒ [page 53](#) .
- Remove alternator ⇒ Electrical system; Rep. gr. 27
- Remove front silencer (right-side) ⇒ [page 231](#) .

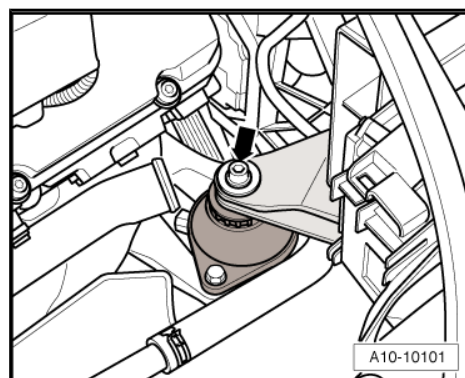
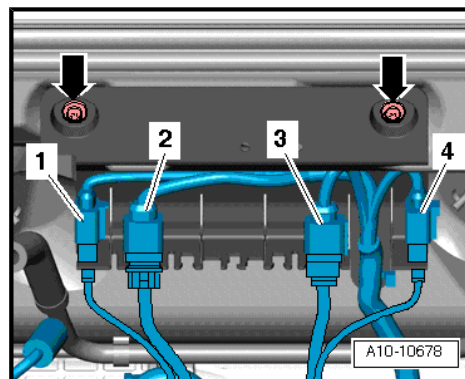
- Detach electrical connectors from bracket and unplug connectors:

- 1 - For Lambda probe -G39-
 - 2 - For Lambda probe after catalytic converter -G130-
- Move electrical wiring to Lambda probes clear.

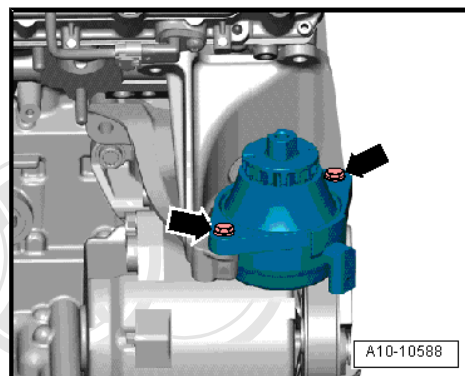

Note

Disregard -items 3 and 4-.

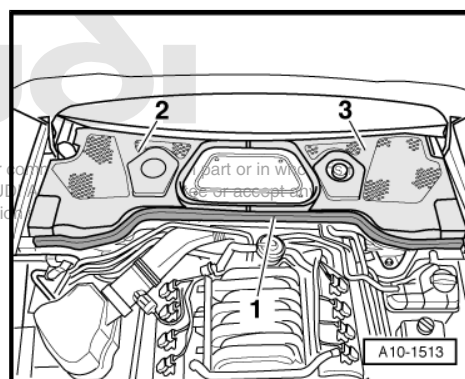
- Remove bolt -arrow- on mounting for torque reaction support.



- Remove bolts -arrows-.

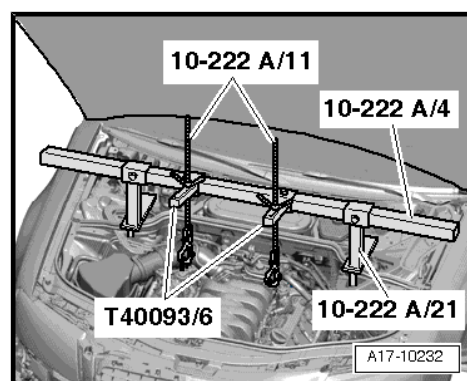
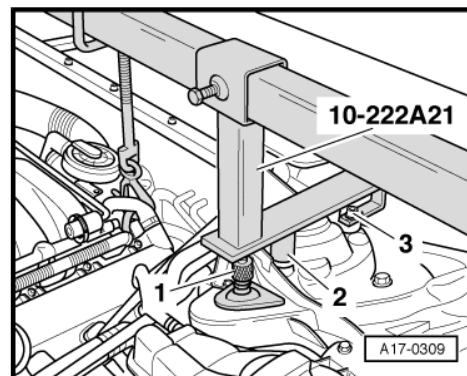


- Pull off rubber seal -1- and remove plenum chamber covers -2 and 3-.

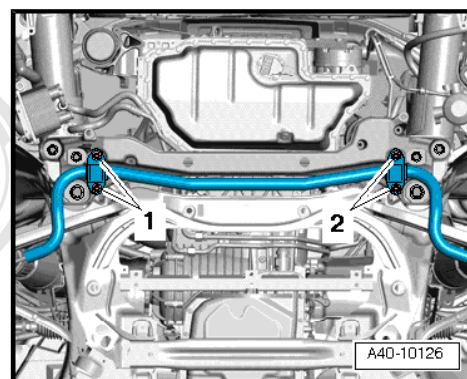


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- Unscrew rear bolts -3- for body brace.
- Attach adapters -10 - 222 A /21- without adapter -10 - 222 A /4- onto suspension turrets.
- Supports are marked for left and right side of vehicle.
- The centre resting point -2- of supports is positioned on front bolts for body brace.
- The adapters -10 - 222 A /21- are attached by means of the rear bolts -3- for the body brace.
- The knurled screw -1- must be screwed down until support plate rests on suspension turret.
- Attach adapter -10 - 222 A /4- using adapters -T40093/6- to adapters -10 - 222 A /21- .
- Secure spindles -10 - 222 A /11- to engine lifting eyes.
- Take up weight of engine using spindles of support bracket.



- Remove bolts (left and right) -1 and 2- for anti-roll bar mountings.

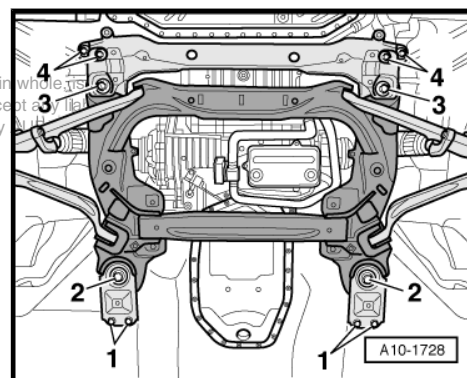


- Remove bolts -3 and 4-.

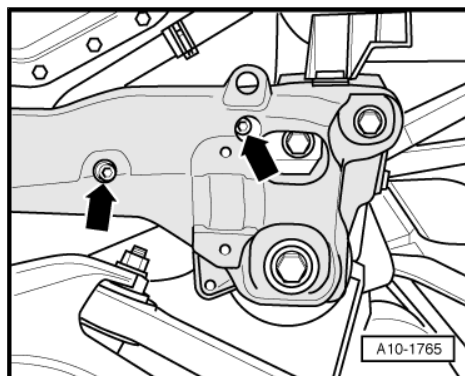
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Disregard -items 1 and 2-.



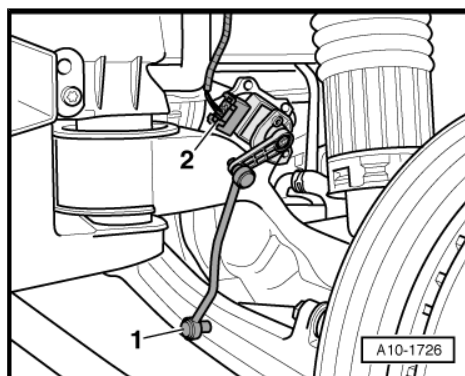
- Remove bolts for engine mountings -arrows- on both sides.
- Take out engine cross member.



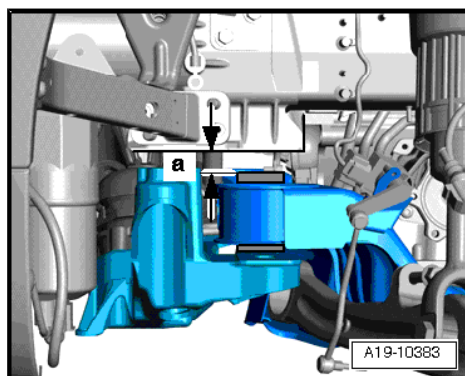
- Unplug electrical connector -2- at vehicle level sender (left and right).


Note

Disregard -item 1-.



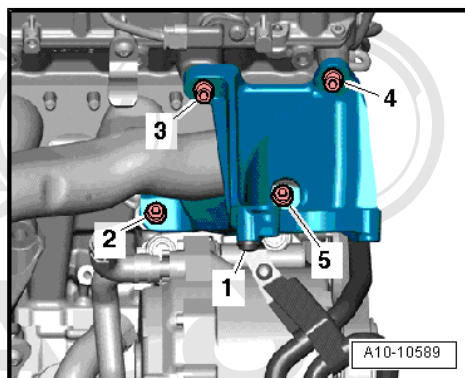
- Turn spindles -10 - 222 A /11- to lower engine/gearbox assembly as far as dimension -a-.
- Dimension -a- = 30 mm (maximum).



- Take out mounting for torque reaction support.
- Remove bolts -2 ... 5-.
- Remove torque reaction support.

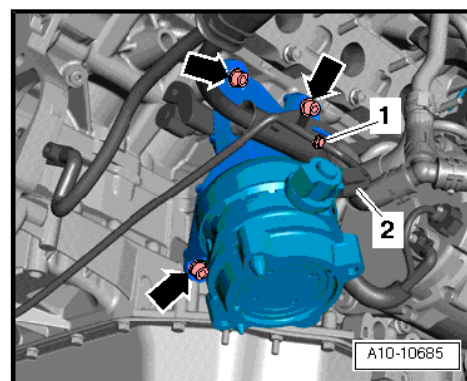

Note

Disregard -item 1-.

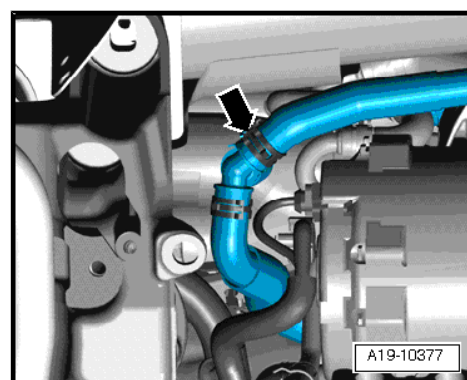


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- Unplug electrical connector -2- at engine mounting (right-side).
- Unbolt bracket for wiring from engine support (right-side) -1-.
- Remove bolts -arrows- and detach engine support with engine mounting.



- Place drip tray for workshop hoist -VAS 6208- under engine.
- Disconnect coolant hose (right-side) -arrow- and drain off coolant.



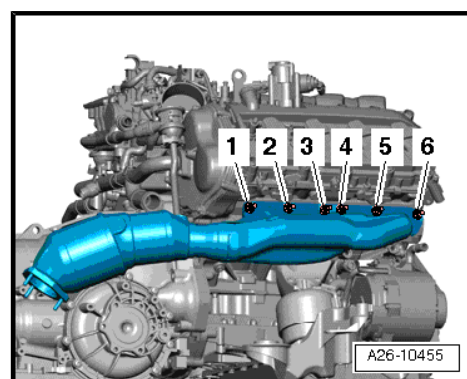
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- Unscrew nuts -6 ... 1-.



Note

The mounting strips (bottom) remain installed.



- Unscrew bolt -2- and remove exhaust manifold (right-side) with catalytic converter (accessible from below) towards front.



Note

Disregard -item 1-.

Installing

Tightening torques

- ⇒ [“2.1 Exhaust manifold - exploded view”, page 234](#) .
- ⇒ Fig. [““Tightening sequence for exhaust manifold \(left-side\)””, page 235](#) .
- ⇒ Fig. [““Components of exhaust pipe mountings \(right-side\)””, page 235](#) .

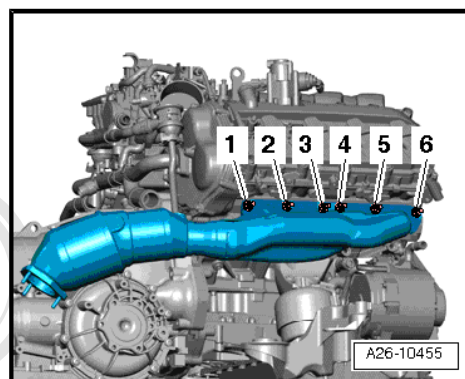
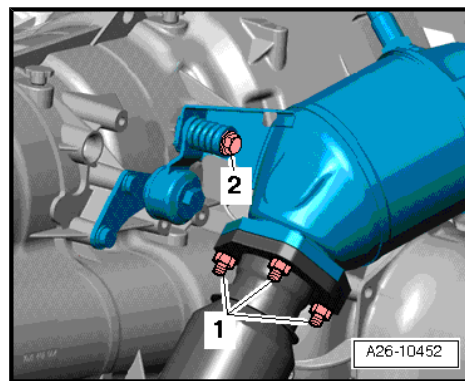
Installation is carried out in the reverse order; note the following:



Note

Renew gasket and self-locking nuts.

- Fit new gasket onto studs.
- Fit exhaust manifold in mounting strips and tighten ⇒ [page 235](#) .
- Install torque reaction support and mounting for torque reaction support ⇒ [page 42](#) .
- Install front silencer (right-side) ⇒ [page 231](#) .
- Install engine support with engine mounting ⇒ [page 42](#) .
- Install alternator ⇒ Electrical system; Rep. gr. 27
- Install poly V-belt ⇒ [page 53](#) .
- Install subframe and engine cross member ⇒ Rep. gr. 40 .
- Install anti-roll bar ⇒ Rep. gr. 40 .
- Install coolant pipe (right-side) ⇒ [page 214](#) .
- Align exhaust system so it is free of stress ⇒ [page 232](#) .
- Observe notes on procedures required after connecting battery ⇒ Electrical system; Rep. gr. 27 .
- Fill cooling system ⇒ [page 182](#) .



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3 Secondary air system - country-specific version 1

⇒ [“3.1 Principle and function”, page 249](#)

⇒ [“3.2 Secondary air system - exploded view”, page 250](#)

⇒ [“3.3 Removing and installing secondary air pump”, page 251](#)

⇒ [“3.4 Checking combination valves for secondary air system for correct operation and leakage”, page 252](#)

⇒ [“3.5 Removing and installing combination valve for secondary air system \(left-side\)”, page 253](#)

⇒ [“3.6 Removing and installing combination valve for secondary air system \(right-side\)”, page 254](#)

3.1 Principle and function

Principle

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.

Function

In the warm-up phase, the engine control unit activates the secondary air pump via the secondary air pump relay. The stream of air from the secondary air pump opens the combination valves for secondary air and permits air to flow into the exhaust system upstream of the catalytic converter.



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3.2 Secondary air system - exploded view

1 - Secondary air pump motor -V101-

- ☐ Fitting location: At front right in engine compartment below longitudinal member
- ☐ Removing and installing ⇒ [page 251](#)
- ☐ Checking in "Guided Fault Finding" mode ⇒ Vehicle diagnostic tester

2 - Bonded rubber mounting

3 - Bracket

- ☐ For secondary air pump motor -V101-

4 - Nut

- ☐ 9 Nm

5 - Bracket

- ☐ For secondary air pump motor -V101- and ATF cooler

6 - Bolt

- ☐ 9 Nm

7 - Air hoses

- ☐ Between secondary air pump motor -V101- and combination valves for secondary air system

8 - Combination valve for secondary air system (right-side)

- ☐ Fitting location: At rear of cylinder head (right-side)
- ☐ Checking ⇒ [page 252](#)
- ☐ Removing and installing ⇒ [page 254](#)

9 - Air hose

- ☐ To combination valves for secondary air inlet

10 - Combination valve for secondary air system (left-side)

- ☐ Fitting location: At rear of cylinder head (left-side)
- ☐ Checking ⇒ [page 252](#)
- ☐ Removing and installing ⇒ [page 253](#)

11 - Gasket

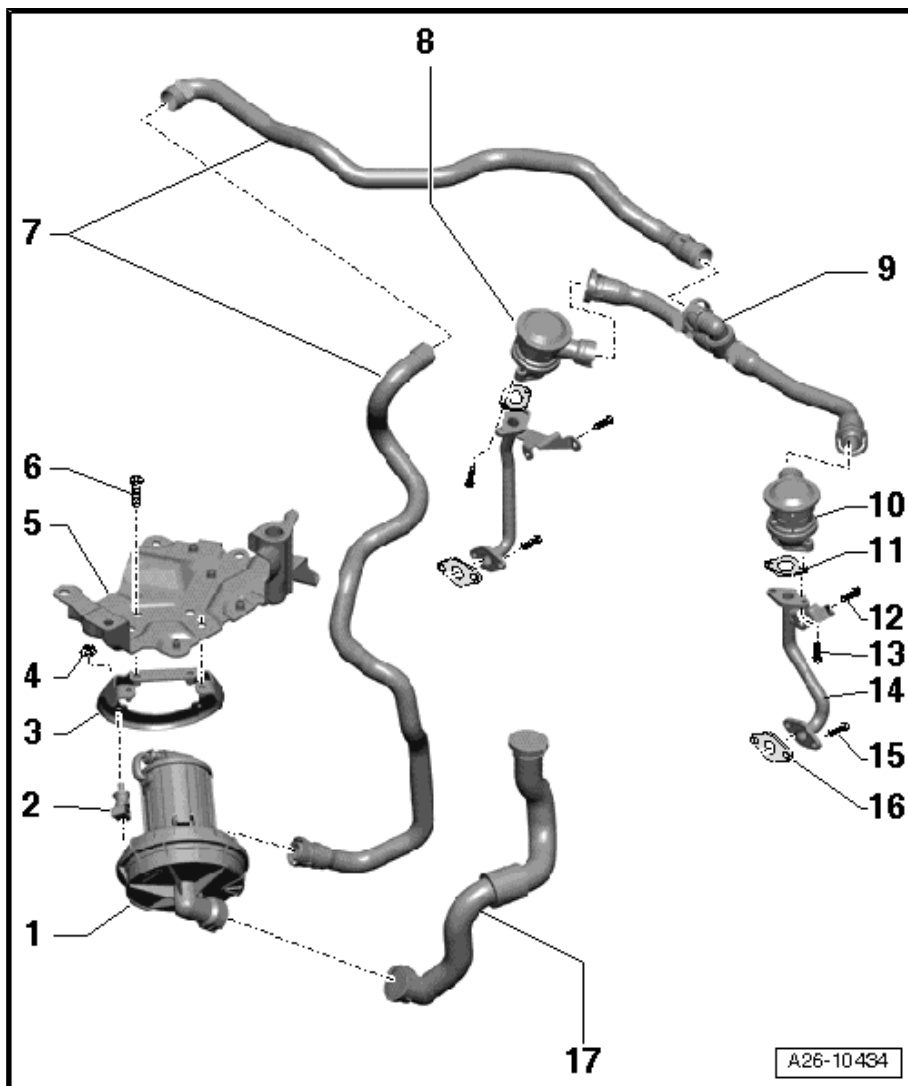
- ☐ Renew

12 - Bolt

- ☐ 9 Nm

13 - Bolt

- ☐ 9 Nm



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14 - Connecting pipe

- ☐ To cylinder head

15 - Bolt

- ☐ 9 Nm

16 - Gasket

- ☐ Renew

17 - Air hose

- ☐ From air cleaner housing

3.3 Removing and installing secondary air pump

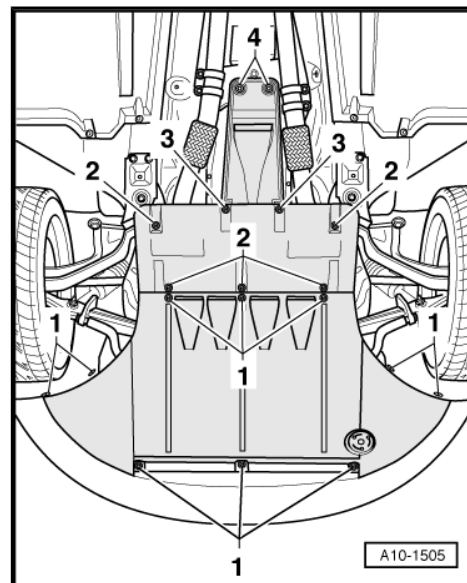
Removing

- Release fasteners -1- to remove front noise insulation.

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**Note**

Disregard -items 2, 3, 4-.

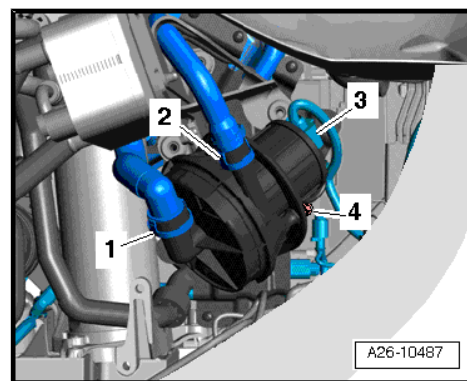


- Disconnect air hoses -1 and 2-.
- Unplug electrical connector -3-.
- Unscrew the 3 nuts -4- and detach secondary air pump from bracket.

Installing

- Tightening torque
⇒ ["3.2 Secondary air system - exploded view", page 250](#)

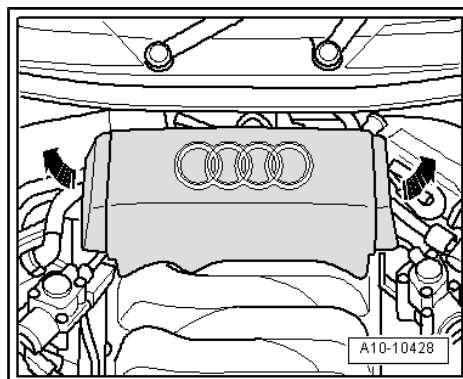
Install in reverse order.



3.4 Checking combination valves for secondary air system for correct operation and leakage

Procedure

- No leaks in hose connections.
- Pull off engine cover panel (rear) -arrows-.

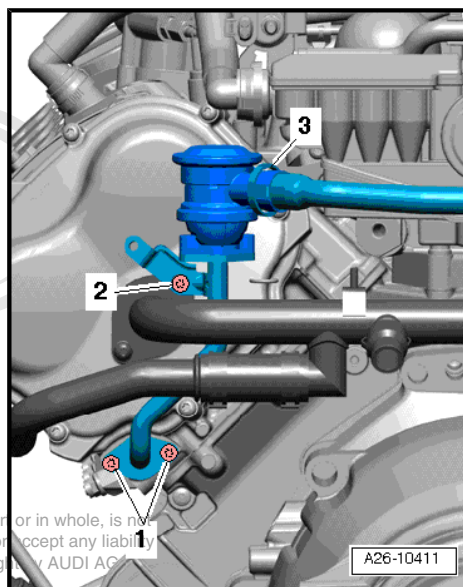


- Detach air intake hose -3- from combination valve for secondary air system.



Note

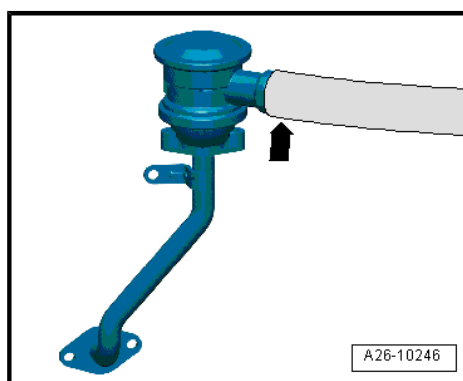
- ◆ The illustration shows the left-side combination valve for secondary air system.
- ◆ Disregard -items 1 and 2-.



- Connect test hose -arrow- to combination valve for secondary air system.
- Blow lightly into test hose with your mouth (do not use compressed air).
- The combination valve for secondary air system should be closed; it should not be possible to blow through the hose.
- Blow into test hose with your mouth using more force (do not use compressed air).
- The combination valve for secondary air system should open; it should now be possible to blow through the hose.

If you cannot determine the switching point:

- Renew combination valve for secondary air system: on left-side ➔ [page 253](#) , on right-side ➔ [page 254](#) .



3.5 Removing and installing combination valve for secondary air system (left-side)

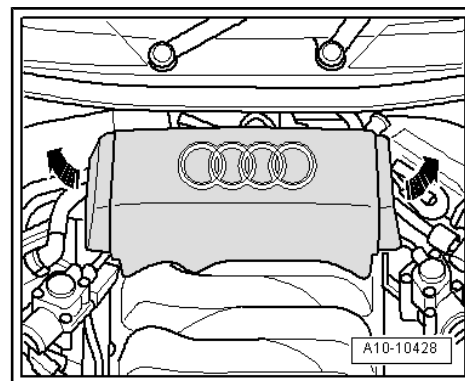
Removing



Note

Fit all cable ties in the original positions when installing.

- Pull off engine cover panel (rear) -arrows-.
- Drain off coolant ⇒ [page 181](#) .
- Remove coolant pipe (left-side) ⇒ [page 204](#) .
- Remove Lambda probe 2 -G108- (before catalytic converter) ⇒ Rep. gr. 24 .
- Detach air hose -3- at combination valve for secondary air system by pressing release tabs.
- Remove bolts -1 and 2-.
- Move electrical wiring clear at combination valve for secondary air system.
- Detach combination valve for secondary air system.



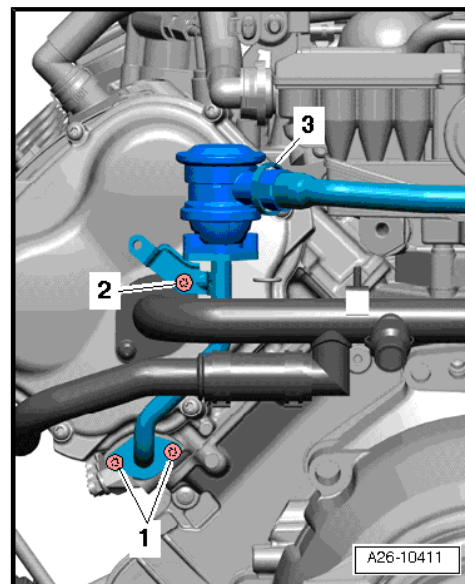
Note

Engine is shown from rear for illustration purposes.

Installing

- Tightening torque
⇒ ["3.2 Secondary air system - exploded view", page 250](#)

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) ⇒ Electronic parts catalogue .*
- ◆ *Fit all cable ties in the original positions when installing.*
- Install Lambda probe 2 -G108- (before catalytic converter) ⇒ Rep. gr. 24 .
- Install coolant pipe (left-side) ⇒ [page 204](#) .
- Fill cooling system ⇒ [page 182](#) .

3.6 Removing and installing combination valve for secondary air system (right-side)

Removing



Note

Fit all cable ties in the original positions when installing.

- Pull off engine cover panel (rear) -arrows-.
- Move clear fuel line and line going to activated charcoal filter at air pipe.
- Detach vacuum line -4- leading to air intake hose from suction-jet pump.

Rest-of-world vehicles:

- Disconnect hose -3- for crankcase breather system from air hose by pressing release tabs.
- Release hose clips -2 and 5- and remove air hose.

USA models:



Caution

Risk of violating emission legislation applying to USA models.

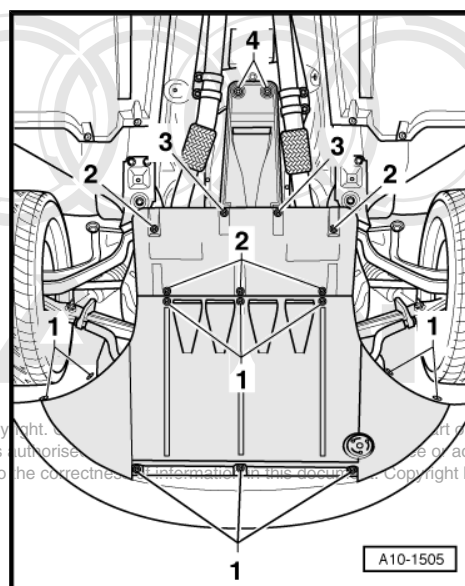
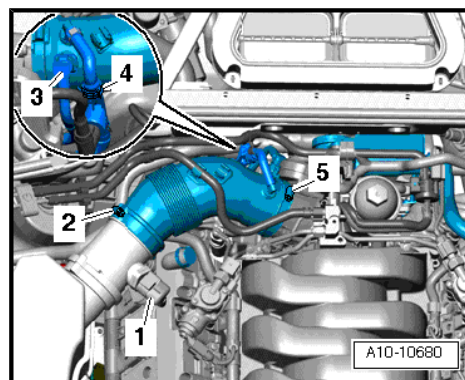
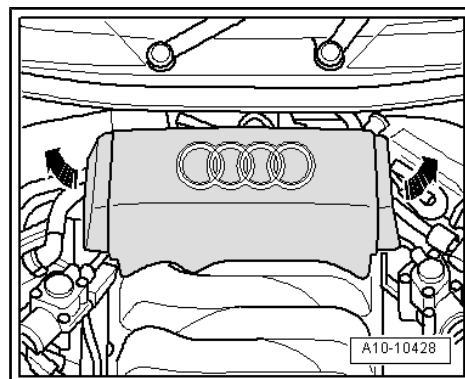
- ◆ **Do NOT open hose connection -2-.**

- Release hose clips -2 and 5- and move air hose clear to one side (crankcase breather hose -3- remains connected).
- Release fasteners -1, 2, 4- to remove noise insulation panels.



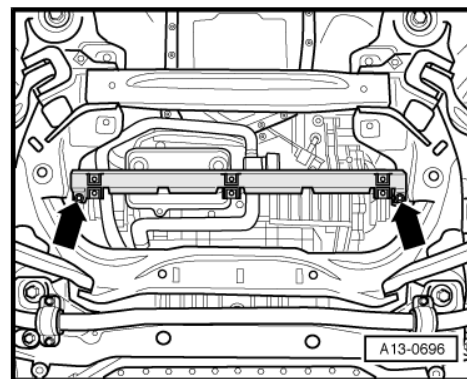
Note

Disregard -item 3-.



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- Unbolt bracket for noise insulation -arrows-.



- Unscrew bolts -1- from below.
- Detach air hoses -3 and 4- from above and place to one side.
- Unscrew bolt -2- and move electrical wiring at combination valve for secondary air system clear.
- Detach combination valve for secondary air system.

**Note**

Engine is shown from rear for illustration purposes.

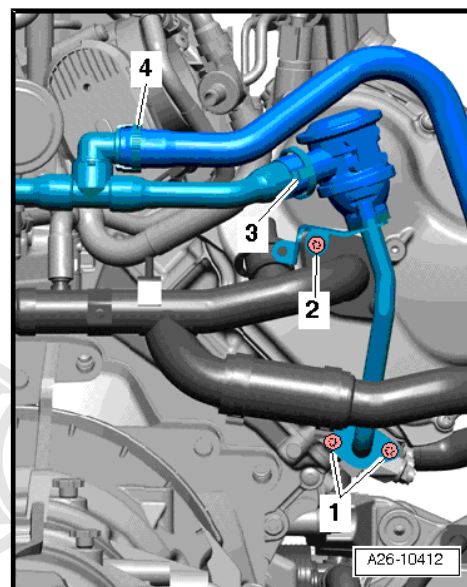
Installing

- Tightening torque
⇒ ["3.2 Secondary air system - exploded view", page 250](#)

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) ⇒ [Electronic parts catalogue](#).*
- ◆ *Fit all cable ties in the original positions when installing.*



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4 Secondary air system - country-specific version 2

⇒ [“4.1 Principle and function”, page 256](#)

⇒ [“4.2 Secondary air system - exploded view”, page 257](#)

⇒ [“4.3 Removing and installing secondary air pump”, page 259](#)

⇒ [“4.4 Checking combination valves for secondary air system for correct operation and leakage”, page 259](#)

⇒ [“4.5 Removing and installing combination valve for secondary air system \(left-side\)”, page 261](#)

⇒ [“4.6 Removing and installing combination valve for secondary air system \(right-side\)”, page 262](#)

⇒ [“4.7 Removing and installing sender 1 for secondary air pressure G609”, page 263](#)

4.1 Principle and function

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.

Principle

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.

Function

- ◆ In the warm-up phase, the engine control unit activates the secondary air pump via the secondary air pump relay. Air is routed to the secondary air combination valves.
- ◆ In parallel to this, the secondary air inlet valve is activated and allows vacuum to pass to the secondary air combination valves. In this way, the combination valve opens a passage for the secondary air system to supply air to the exhaust ports in the cylinder head.



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4.2 Secondary air system - exploded view

1 - Secondary air pump motor -V101-

- ☐ Fitting location: At front right in engine compartment below longitudinal member
- ☐ Removing and installing ⇒ [page 259](#)
- ☐ Checking in "Guided Fault Finding" mode ⇒ Vehicle diagnostic tester

2 - Bonded rubber mounting

3 - Bracket

- ☐ For secondary air pump motor -V101-

4 - Nut

- ☐ 9 Nm

5 - Bolt

- ☐ 9 Nm

6 - Bracket

- ☐ For secondary air pump motor -V101- and ATF cooler

7 - Air hose

- ☐ Between secondary air pump motor -V101- and combination valves for secondary air system

8 - Combination valve for secondary air system (right-side)

- ☐ Fitting location: At rear of cylinder head (right-side)
- ☐ Checking ⇒ [page 259](#)
- ☐ Removing and installing ⇒ [page 262](#)

9 - Vacuum hose

- ☐ From secondary air inlet valve -N112-

10 - Sender 1 for secondary air pressure -G609-

- ☐ Removing and installing ⇒ [page 263](#)

11 - O-ring

- ☐ Renew

12 - Air hose

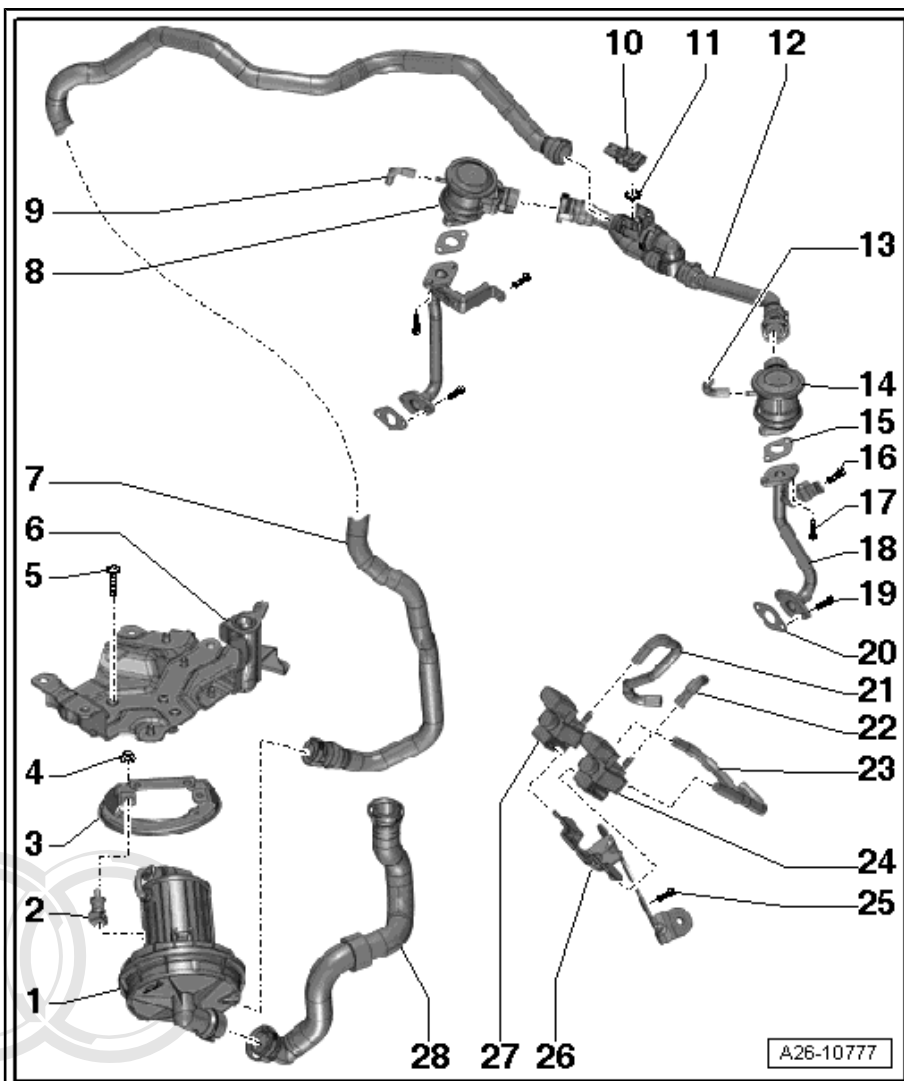
- ☐ To combination valves for secondary air inlet

13 - Vacuum hose

- ☐ From secondary air inlet valve 2 -N320-

14 - Combination valve for secondary air system (left-side)

- ☐ Fitting location: At rear of cylinder head (left-side)
- ☐ Checking ⇒ [page 259](#)



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- ☐ Removing and installing ⇒ [page 261](#)

15 - Gasket

- ☐ Renew

16 - Bolt

- ☐ 9 Nm

17 - Bolt

- ☐ 9 Nm

18 - Connecting pipe

- ☐ To cylinder head

19 - Bolt

- ☐ 9 Nm

20 - Gasket

- ☐ Renew

21 - Vacuum hose

- ☐ To combination valve for secondary air system (left-side)

22 - Vacuum hose

- ☐ To combination valve for secondary air system (right-side)

23 - Vacuum hose

- ☐ With T piece
- ☐ Vacuum supply from intake manifold

24 - Secondary air inlet valve -N112-

- ☐ Fitting location ⇒ [page 258](#)

25 - Bolt

- ☐ 40 Nm

26 - Bracket

- ☐ For secondary air inlet valves
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27 - Secondary air inlet valve 2 -N320-

- ☐ Fitting location ⇒ [page 258](#)

28 - Air hose

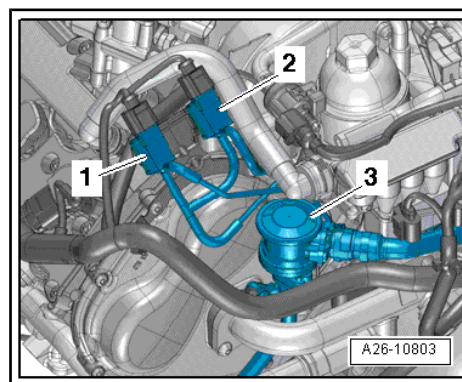
- ☐ From air cleaner housing

Fitting location of secondary air inlet valves

- ◆ At rear of cylinder head (left-side).

1 - Secondary air inlet valve -N112-

2 - Secondary air inlet valve 2 -N320-



4.3 Removing and installing secondary air pump

Removing

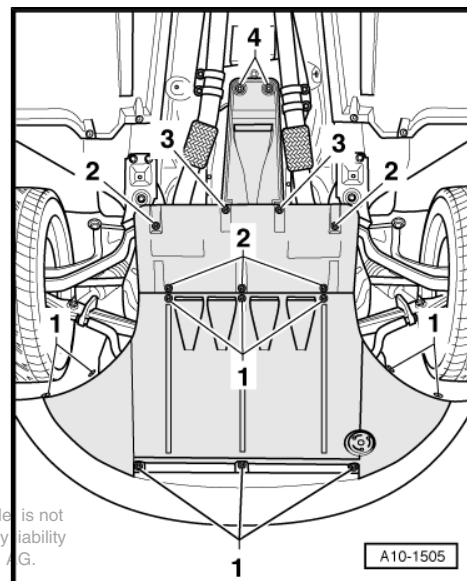
- Release fasteners -1- to remove front noise insulation.



Note

Disregard -items 2, 3, 4-.

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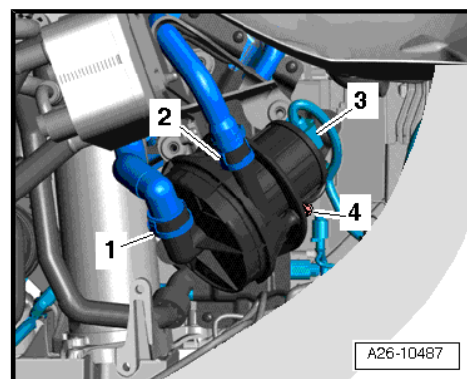


- Disconnect air hoses -1 and 2-.
- Unplug electrical connector -3-.
- Unscrew the 3 nuts -4- and detach secondary air pump from bracket.

Installing

- Tightening torque
⇒ ["4.2 Secondary air system - exploded view", page 257](#)

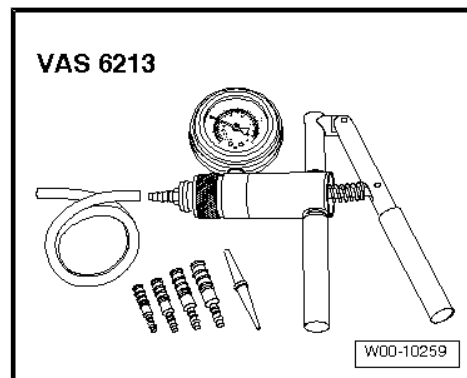
Install in reverse order.



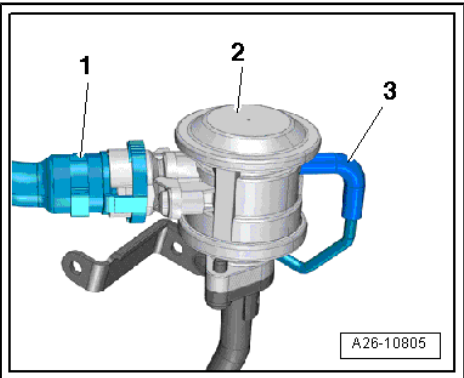
4.4 Checking combination valves for secondary air system for correct operation and leakage

Special tools and workshop equipment required

- ◆ Hand vacuum pump -VAS 6213-

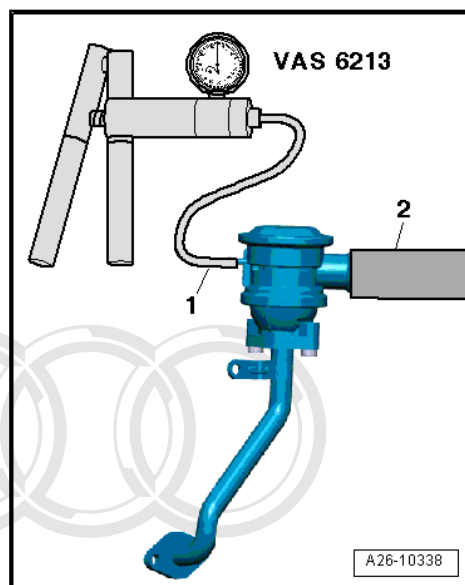


Procedure

- Pull off engine cover panel (rear) -arrows-.
- 
- Detach vacuum hose -3- from combination valve -2- for secondary air system.
 - Press release tabs and disconnect secondary air hose -1-.
- 
- Connect hand vacuum pump -VAS 6213- to vacuum connection -1- on relevant combination valve for secondary air system.
 - Connect a suitable test hose -2- onto combination valve for secondary air system.
 - Blow lightly into test hose with your mouth (do not use compressed air).
 - The combination valve for secondary air system should be closed; it should not be possible to blow through the hose.
 - Operate hand vacuum pump to produce a vacuum.
 - The combination valve for secondary air system should open; it should now be possible to blow through the hose.
 - Renew combination valve for secondary air system if valve does not react as described: left-side ⇒ [page 261](#) , right-side ⇒ [page 262](#) .

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

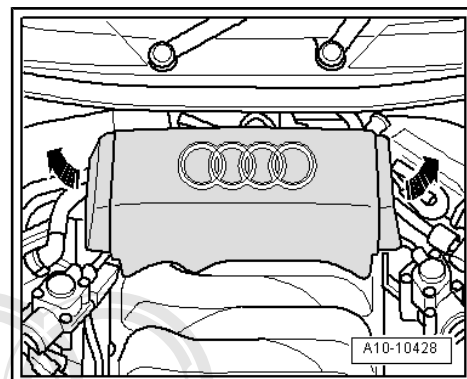
- Install engine compartment trim panel ⇒ Rep. gr. 53 .



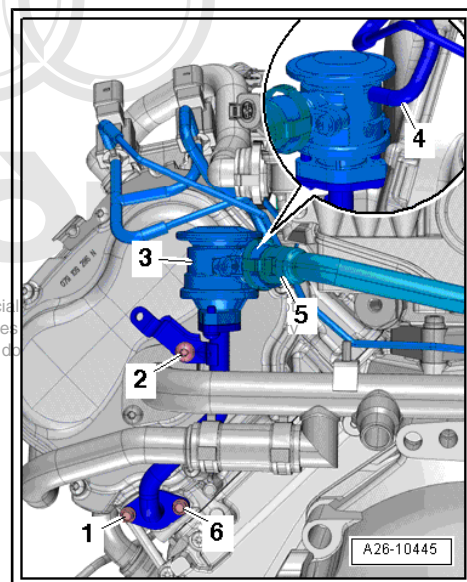
4.5 Removing and installing combination valve for secondary air system (left-side)

Removing

- Pull off engine cover panel (rear) -arrows-.
- Drain off coolant ⇒ [page 181](#) .
- Remove coolant pipe (left-side) ⇒ [page 204](#) .
- Remove Lambda probe 2 -G108- (before catalytic converter) ⇒ Rep. gr. 24 .



- Detach vacuum hose -4- from combination valve for secondary air system.
- Detach air hose -5- at combination valve for secondary air system by pressing release tabs.
- Unscrew bolts -1, 2, 6-.
- Move electrical wiring clear at combination valve for secondary air system.
- Detach combination valve -3- for secondary air system.



Note

Engine is shown from rear for illustration purposes.

Installing

- Tightening torque
⇒ ["4.2 Secondary air system - exploded view", page 257](#)

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



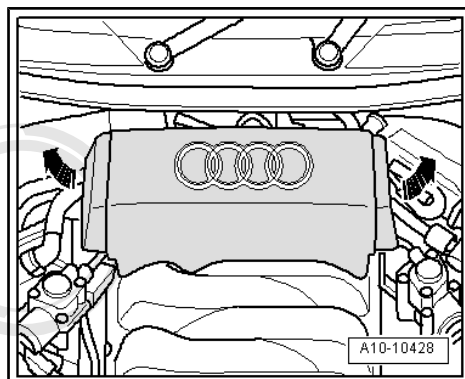
Note

- ◆ *Renew gaskets, seals and O-rings.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ [Electronic parts catalogue](#) .*
- ◆ *Fit all cable ties in the original positions when installing.*
- Install Lambda probe 2 -G108- (before catalytic converter) ⇒ Rep. gr. 24 .
- Install coolant pipe (left-side) ⇒ [page 204](#) .
- Fill cooling system ⇒ [page 182](#) .

4.6 Removing and installing combination valve for secondary air system (right-side)

Removing

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



- Move clear fuel line and line going to activated charcoal filter at air pipe.
- Detach vacuum line -4- leading to air intake hose from suction-jet pump.

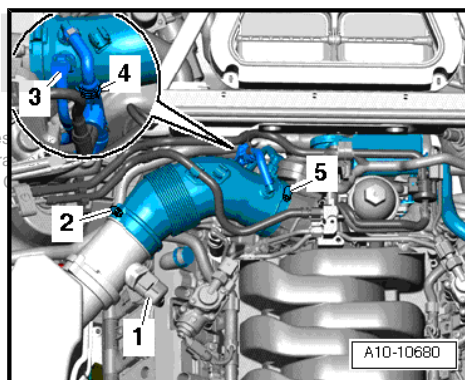
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Caution

Risk of infringement against emission legislation.

- ◆ **Do NOT open hose connection -2-.**

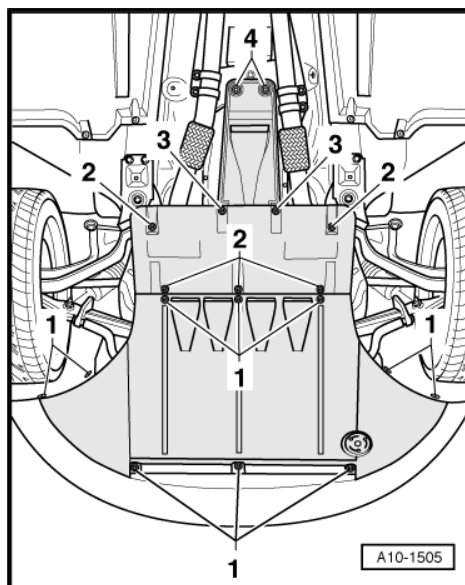


- Release hose clips -2 and 5- and move air hose clear to one side (crankcase breather hose -3- remains connected).
- Release fasteners -1, 2, 4- to remove noise insulation panels.

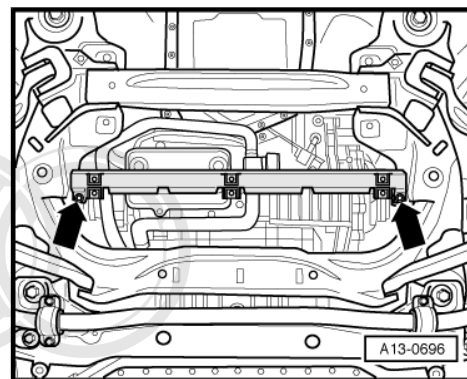


Note

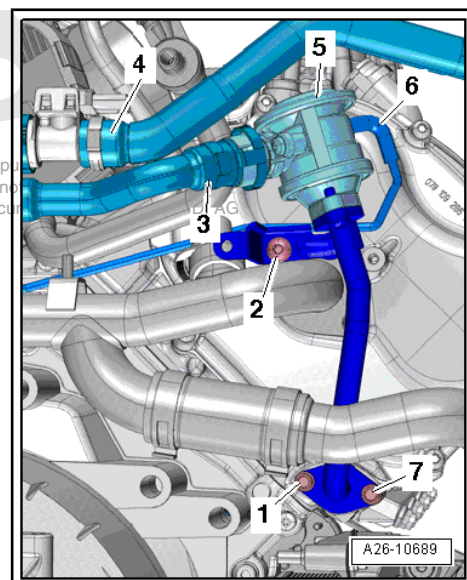
Disregard -item 3-.



- Unbolt bracket for noise insulation -arrows-.



- Detach vacuum hose -6- from combination valve for secondary air system.
- Remove bolts -1- and -7- from below.
- Press release tabs and detach air hoses -3 and 4- from above.
- Place air hoses to one side.
- Unscrew bolt -2- and move electrical wiring at combination valve for secondary air system clear.
- Detach combination valve -5- for secondary air system.

**Note**

Engine is shown from rear for illustration purposes.

Installing

- Tightening torque
⇒ ["4.2 Secondary air system - exploded view", page 257](#)

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

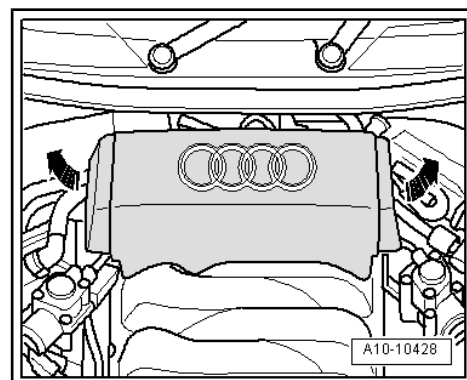
**Note**

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

4.7 Removing and installing sender 1 for secondary air pressure -G609-

Removing

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





- Unplug electrical connector -2-.
- Carefully press retaining clips outwards -arrows- and detach sender 1 for secondary air pressure -G609- -item 1-.

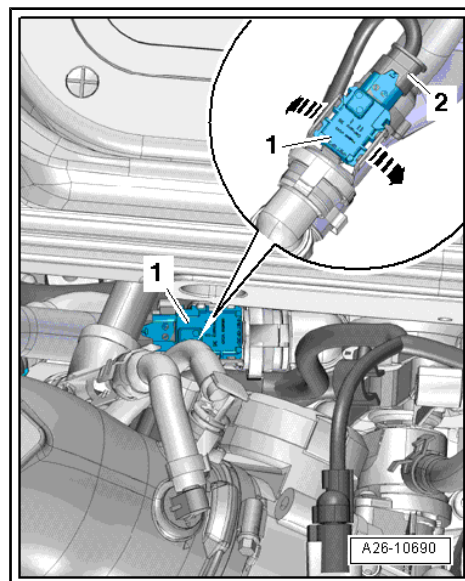
Installing

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



Note

Fit new O-ring.



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