Workshop Manual
Audi A8 2003 ➤

10-cylinder direct petrol injection engine (5.2 ltr. 4-valve), mechanics									
Engine ID	BSM								

Edition 10.2013

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

Repair Group

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.

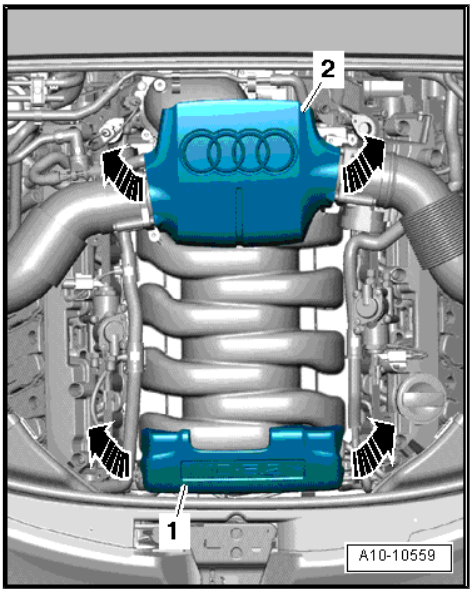
Contents

00 – Technical data

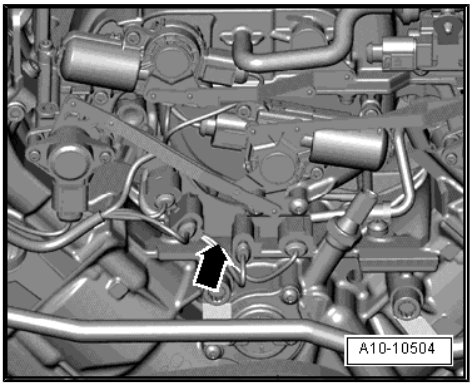
1 Engine number

(ARL003517; Edition 10.2013)

– Pull off engine cover panel (front) -1- -arrows-.



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



Note

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

2 Engine data

Code letters		BSM
Capacity	ltr.	5.204
Power output	kW at rpm	331/7000
Torque	Nm at rpm	540/3500
Bore	∅ mm	84.5
Stroke	mm	92.8
Compression ratio		12.5
RON		98 [1)]
Injection/ignition system		Bosch Motronic
Firing order		1-6-5-10-2-7-3-8-4-9
Exhaust gas recirculation		no
Turbocharging/supercharging		no
Knock control		4 sensors
Lambda control		2 probes before catalytic converter 2 probes after catalytic converter
Variable valve timing		Inlet Exhaust
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

3 Safety precautions

When working on the fuel system note the following warnings:

WARNING

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

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

– 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 installation ⇒ Vehicle diagnostic tester, `Interrogate 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 .

When working on the cooling system note the following warnings:

WARNING

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

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

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

WARNING

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

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.*

3.1 Procedure before opening high-pressure section of injection system

WARNING

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

4 General repair instructions

4.1 Rules for cleanliness when working on fuel supply system and injection system

Even small amounts of dirt can cause malfunctions. When working on the fuel supply system and injection system, it is therefore important to observe the following basic rules:

- 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. Do not use fluffy 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 been previously unpacked and stored away loose (e.g. in toolboxes, etc.).
- When the system is open: Do not work with compressed air. Do not move the vehicle unless absolutely necessary.
- Protect unplugged electrical connectors against dirt and moisture and make sure connections are dry when attaching.

4.2 Checking for leaks in the fuel system

- 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 chambers of the opposite cylinder bank must always be examined 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 hydraulic lines, vacuum lines and electrical wiring before removal so they can be re-installed in the original positions and correctly connected. Make sketches or take photographs if necessary.

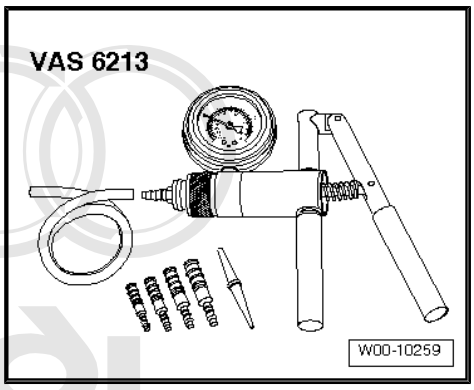
4.6 Installing radiators and condensers

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.

4.7 Checking vacuum system

Special tools and workshop equipment required

- Hand vacuum pump - VAS 6213-



Procedure

– Check all vacuum lines in the complete vacuum system for:
- Cracks
- Traces of animal bites
- Kinked or crushed lines
- Lines porous or leaking

– Check vacuum line to solenoid valve and from solenoid valve to corresponding component.

– If a fault is stored in the event memory, check the vacuum lines leading to the corresponding component and also check the remaining vacuum lines in the system.

– If it is not possible to build up a vacuum with the hand vacuum pump - VAS 6213- or if the vacuum pressure drops again im-

mediately, check the hand vacuum pump and connecting hoses for leaks.

10 – Removing and installing engine

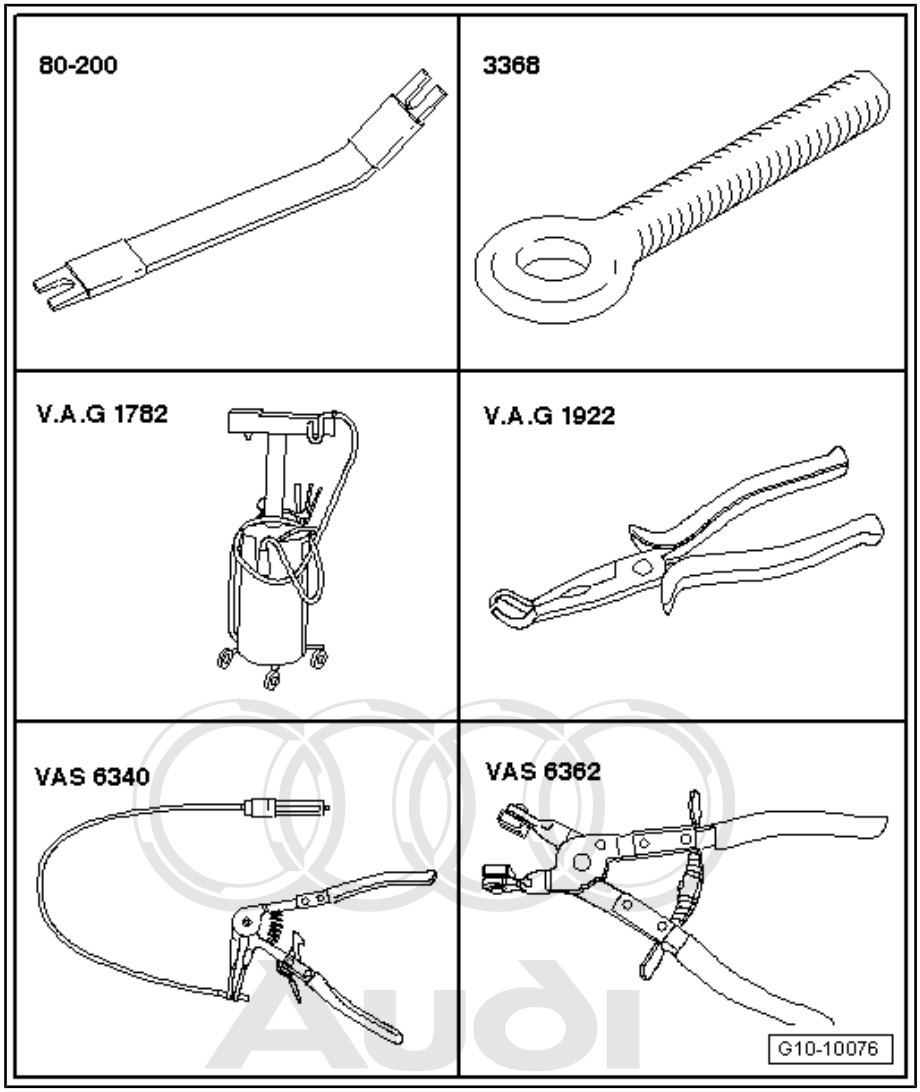
1 Removing engine

Note

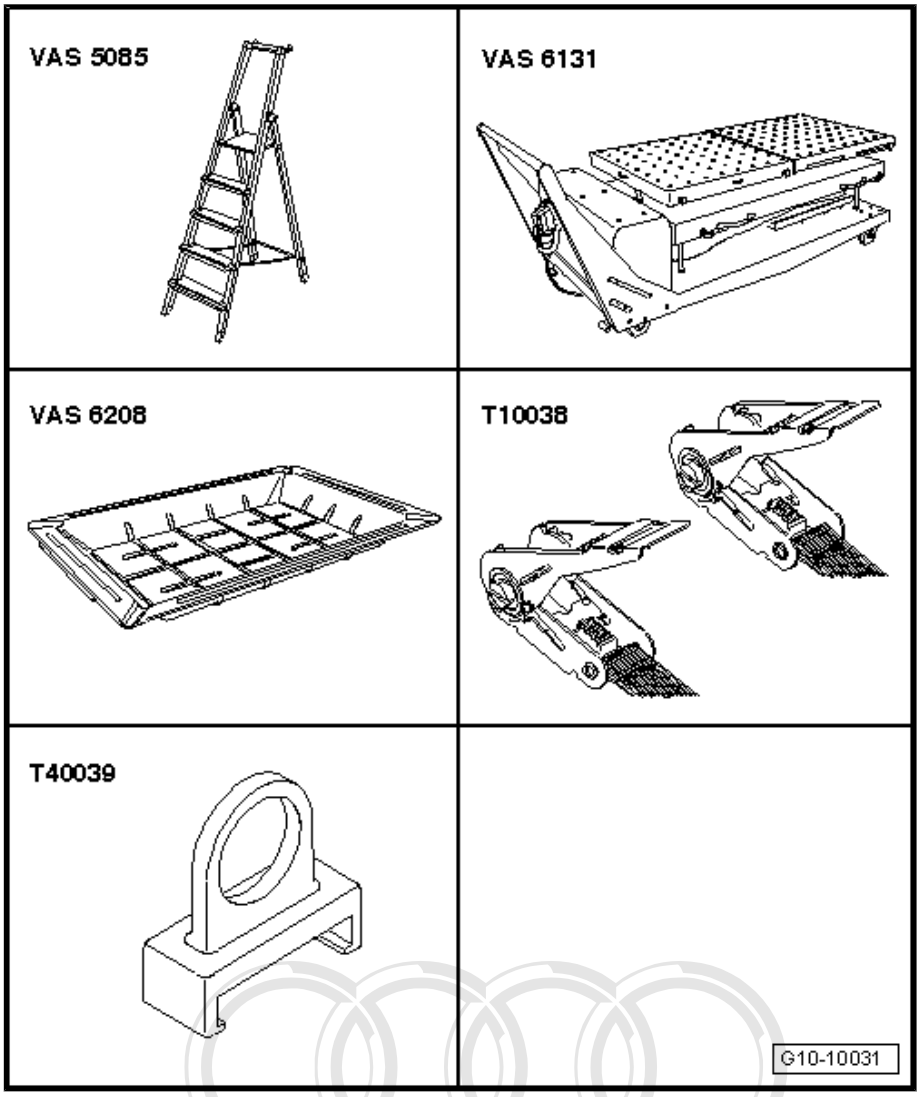
- *The engine is removed from underneath together with the gearbox and subframe (with lock carrier installed).*
- *Collect drained coolant in a clean container for re-use or disposal.*
- *Fit all heat shields and heat insulation sleeves in the original positions when installing.*
- *All cable ties which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

Special tools and workshop equipment required

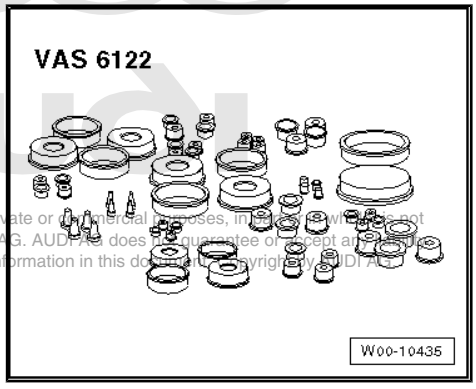
- Removal lever - 80 - 200-
- Eye-head bolt - 3368-
- Used oil collection and extraction unit - V.A.G 1782-
- Spark plug connector pliers - V.A.G 1922-
- Hose clip pliers - VAS 6340-
- Hose clip pliers - VAS 6362-



- Stepladder - VAS 5085-
- Scissor-type assembly platform - VAS 6131 A- with support set for Audi - VAS 6131/10-
- Drip tray for workshop hoist - VAS 6208-
- Tensioning strap - T10038- (2x)
- Puller - T40039-



- Engine bung set - VAS 6122-



Procedure

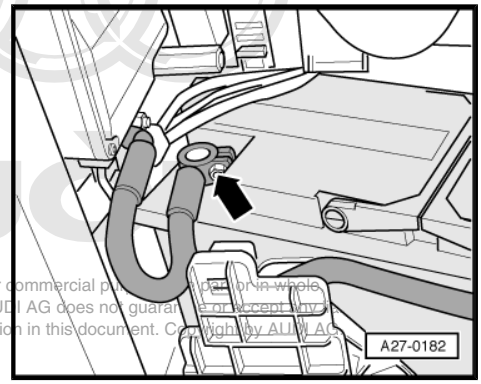
> **Caution**
>
> *Observe notes on procedure for disconnecting the battery ⇒ Electrical system; Rep. gr. 27 .*

Note

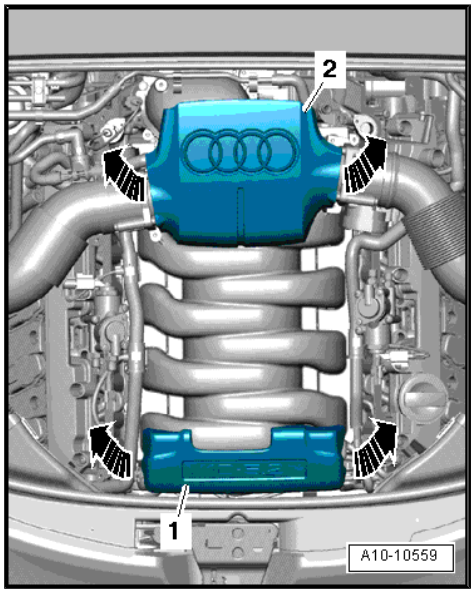
- *To make sure you can still move the front wheels when the battery has been disconnected, only disconnect the battery with the ignition key inserted.*
- *The electromechanical parking brake must be released before disconnecting the battery so that the propshaft can be turned during removal.*

– With ignition switched off, disconnect earth cable -arrow- at battery ⇒ Electrical system; Rep. gr. 27 .

– Discharge the refrigerant system ⇒ Air conditioner system - with refrigerant R134a .



– Pull off engine cover panels at front -1- and at rear -2- -arrows-.

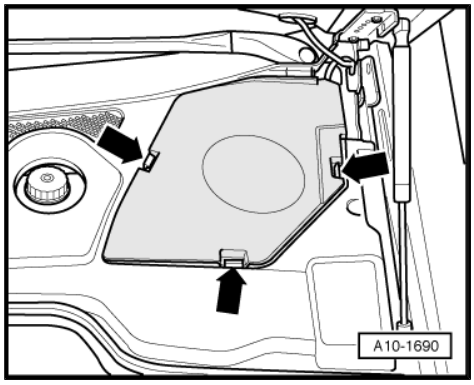


– Remove cover above coolant expansion tank -arrows-.

WARNING

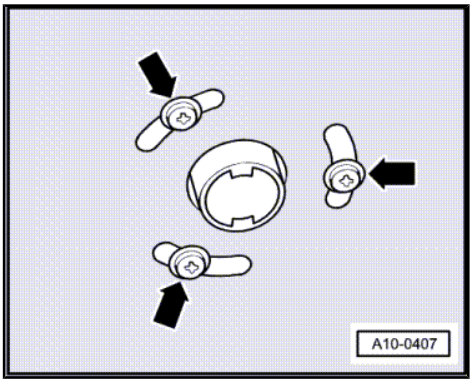
Hot steam or hot coolant can escape when coolant expansion tank is opened; cover filler cap with cloth and open carefully.

– Open filler cap on coolant expansion tank.



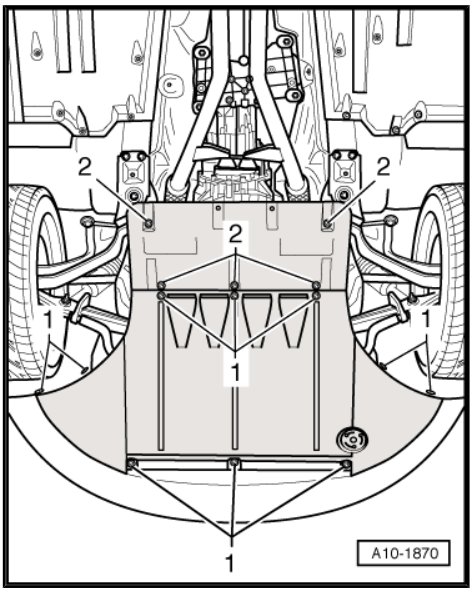
– Remove both front wheels ⇒ Rep. gr. 44 .

– Vehicles with auxiliary heater: remove bolts -arrows- securing exhaust pipe for auxiliary/additional heater to noise insulation.



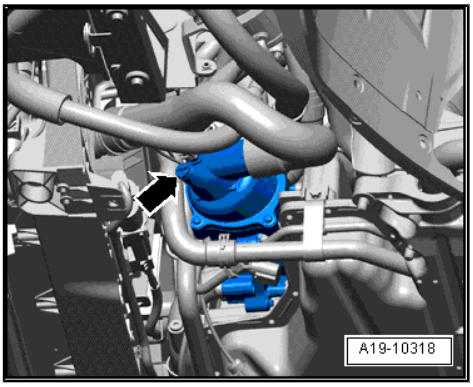
– Release quick-release fasteners -1- and -2- and take off noise insulation panels.

– Remove front and rear sections of front wheel housing liners (left and right) ⇒ Rep. gr. 66 .

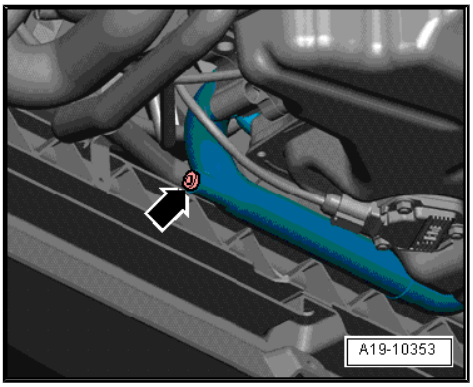


– Place drip tray for workshop hoist - VAS 6208- under engine.

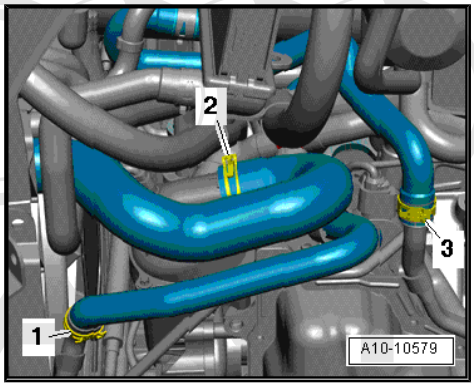
– Unscrew drain plug -arrow- at thermostat housing and drain off coolant.



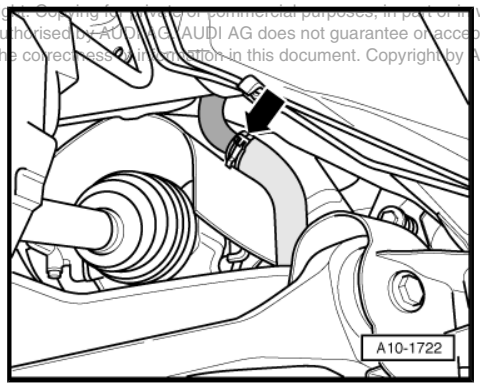
– Remove drain plug -arrow- at front coolant pipe and drain off coolant.



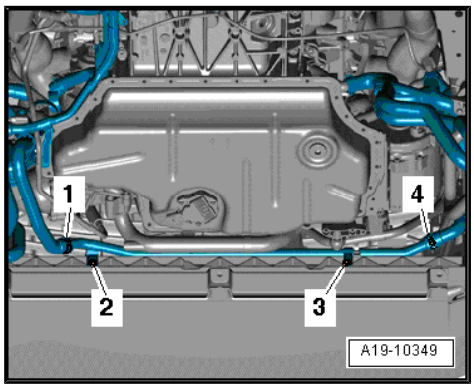
– Disconnect coolant hoses -1 ... 3- and drain off coolant.



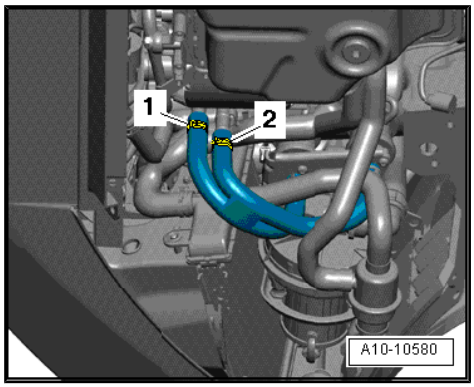
– Disconnect coolant hose next to drive shaft (left-side) from coolant pipe -arrow- and drain off coolant.



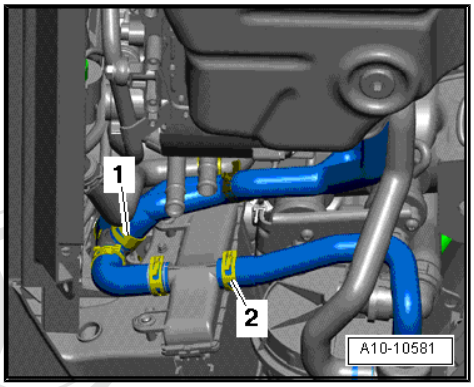
– Remove bolts -2- and -3-.
– Detach bottom front coolant pipe from hoses -1- and -4-.



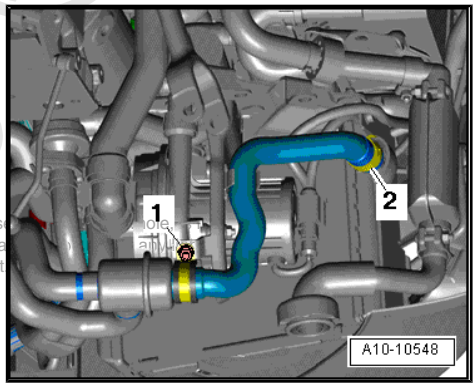
– Disconnect hoses -1- and -2- from connecting pipes for secondary air.



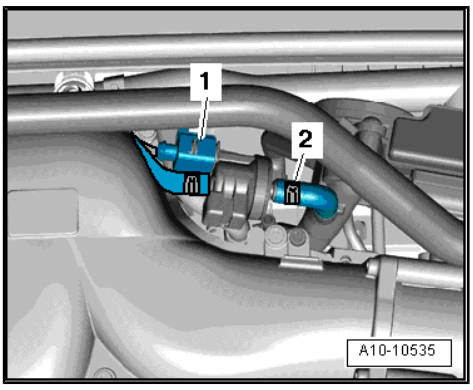
– Disconnect coolant hoses -1- and -2- from auxiliary radiator (right-side) and drain off remaining coolant.



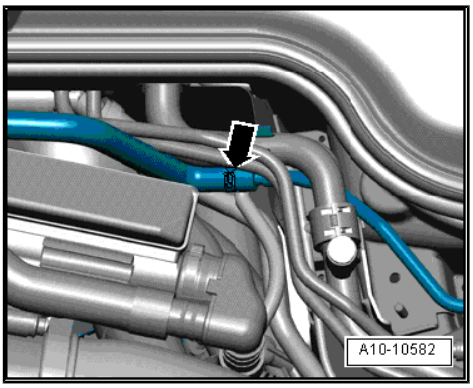
– Unscrew nut -1- and remove coolant hose -2- from auxiliary radiator (right-side).



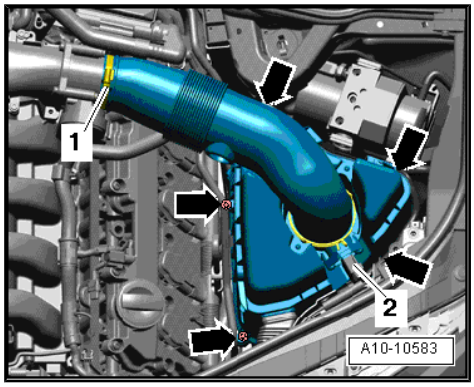
– Unplug electrical connector -1- at activated charcoal filter solenoid valve 1 - N80- and detach vacuum hose -2-.
– Detach activated charcoal filter solenoid valve 1 - N80- from bracket and move it clear to the side with hose still attached.



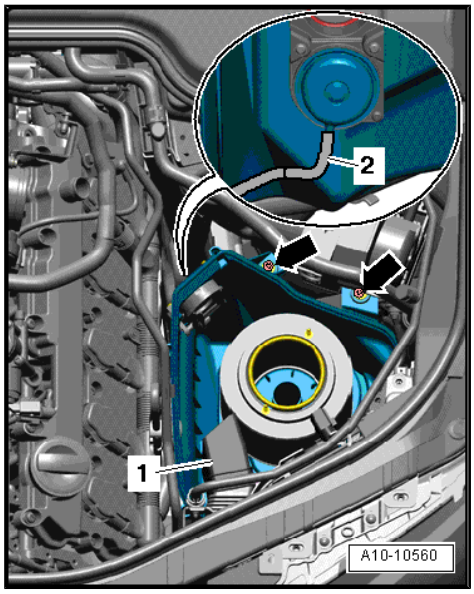
– Detach coolant hose -arrow- leading from coolant pipe to coolant expansion tank.



– Detach electrical connector -2- for air mass meter 2 - G246- .
– Remove air hose -1- from intake manifold.
– Unscrew bolts -arrows- and remove top section of air cleaner (left-side).



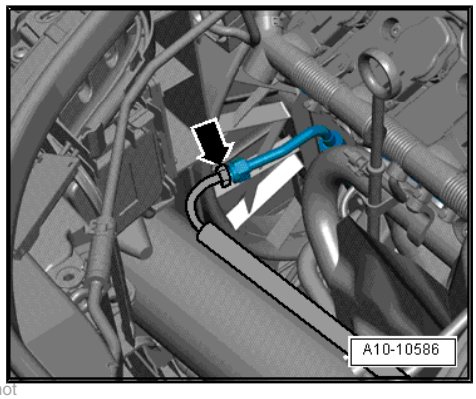
– Remove air duct -1-.
– Remove bolts -arrows-.
– Turn over bottom section of air cleaner and detach vacuum hose for air flap.
– Remove bottom section of air cleaner (left-side).



– Extract hydraulic fluid for power steering from reservoir using used oil collection and extraction unit - V.A.G 1782- .

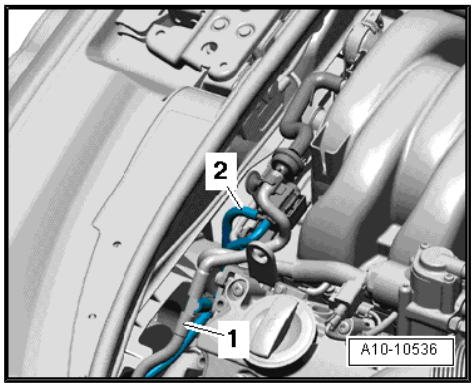
Note

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



– Disconnect hydraulic pressure line for power steering -arrow- at front left of engine.
– Seal off open pipes/lines and connections with clean plugs from engine bung set - VAS 6122- .

– Pull bonnet seal away from lock carrier and wing panels.
– Detach vacuum hoses -1- and -2- and move clear.



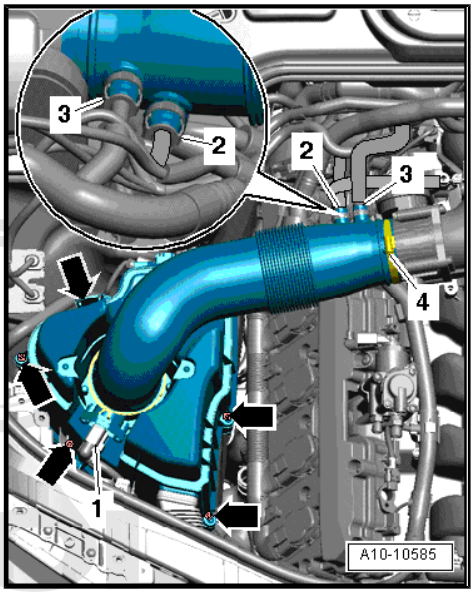
– Detach electrical connector -1- for air mass meter - G70- .
– Detach vacuum line -2- from air hose.

Rest-of-world vehicles:

– Detach crankcase breather hose -3- from air hose.
– Remove air hose -4- from intake manifold.

USA models:

– Open hose clips and move air hose -4- to one side.

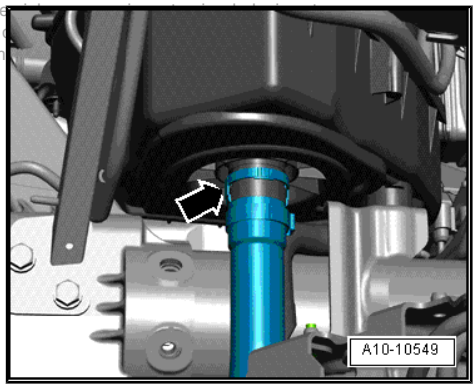


> **Caution**
>
> *Do not open hose connection -3- on USA models.*

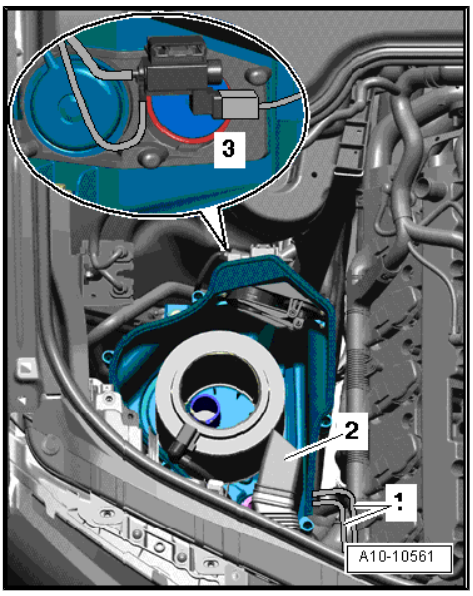
All vehicles:

– Unscrew bolts -arrows- and remove top section of air cleaner (right-side).

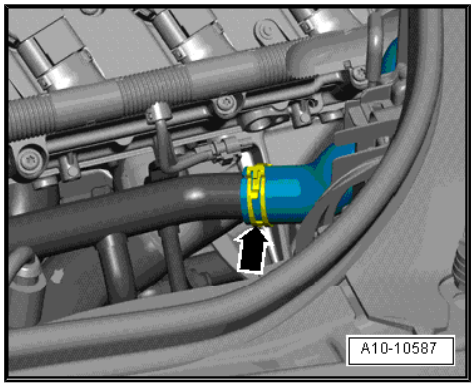
– Disconnect air hose -arrow- at bottom of bottom section of air cleaner (right-side).



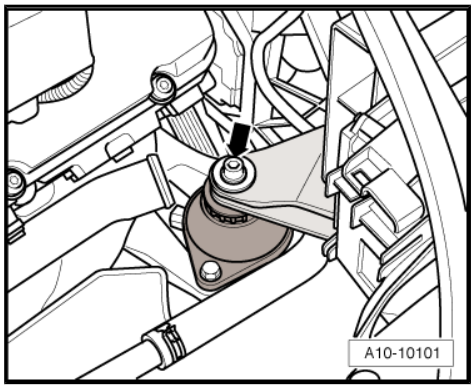
– Disconnect both vacuum hoses -1-.
– Remove air duct -2-.
– Remove bolts -arrows-.
– Turn over bottom section of air cleaner and unplug electrical connector -3- at variable intake manifold change-over valve - N335- .
– Remove bottom section of air cleaner (right-side).



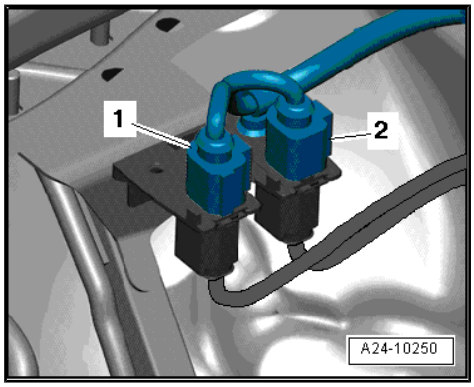
– Detach coolant hose (right-side) -arrow- at engine.



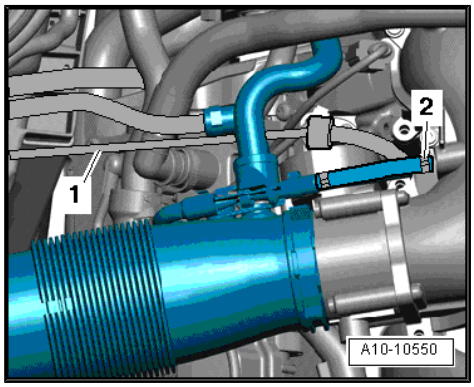
– Remove bolt -arrow- on mounting for torque reaction support.



– Remove electrical connectors for Lambda probes -1- and -2- from bracket on right of engine compartment.

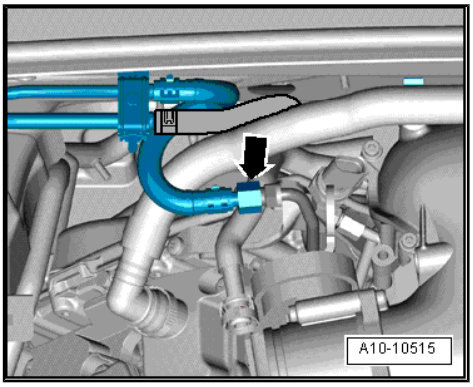


– Detach vacuum hoses -1- and -2- and move clear.



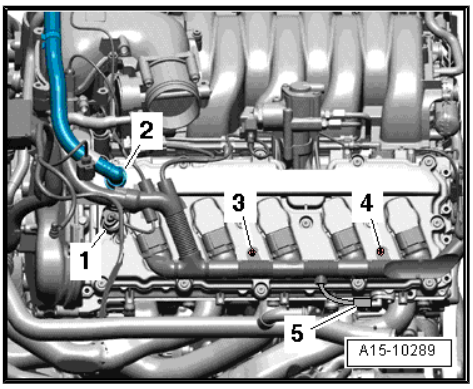
WARNING

The fuel system is pressurised. Before opening the system place a clean cloth around the connection. Then release pressure by carefully loosening the connection.

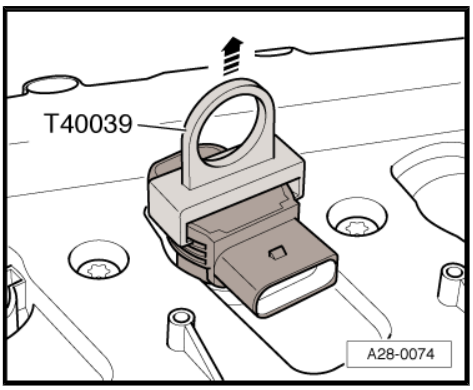


– Disconnect fuel supply line -arrow- at connecting piece.
– Seal off open pipes/lines and connections with clean plugs from engine bung set - VAS 6122- .

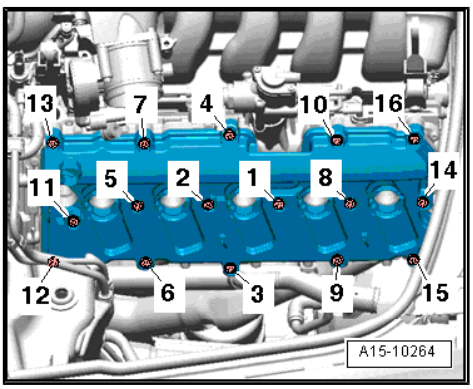
– Remove crankcase breather hose -2-.
– Unplug electrical connectors -1- and -5-.
– Remove bolts -3- and -4-.
– Unplug connectors for ignition coils of cylinder bank 1 (right-side) and move wiring clear.



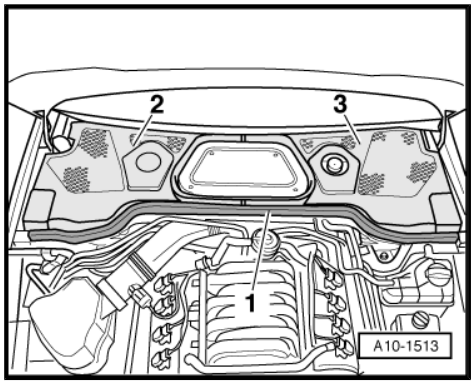
– Pull ignition coils out with puller - T40039- .



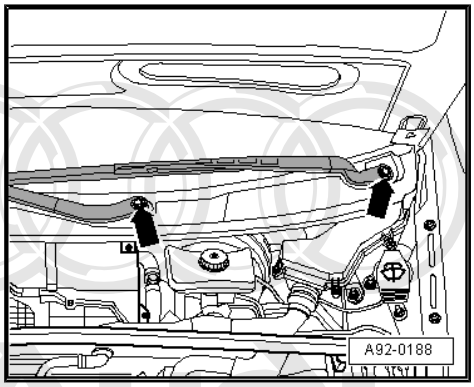
– Slacken bolts in the sequence: -16 ... 1- and remove bolts.
– Remove cylinder head cover (right-side).
– Cover exposed valve gear with a clean cloth.



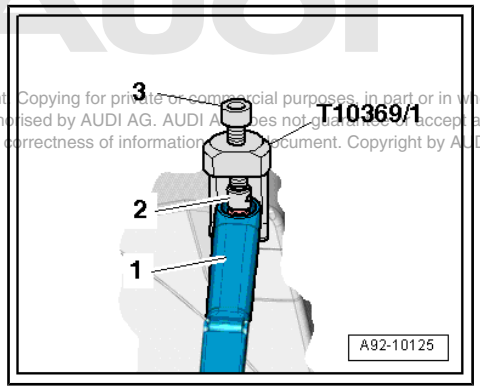
– Pull off rubber seal -1- and remove plenum chamber covers -2- and -3-.



– Use screwdriver to pry off caps on wiper arms and slacken off nuts -arrows- several turns.



– Remove wiper arms ⇒ Electrical system; Rep. gr. 92 .

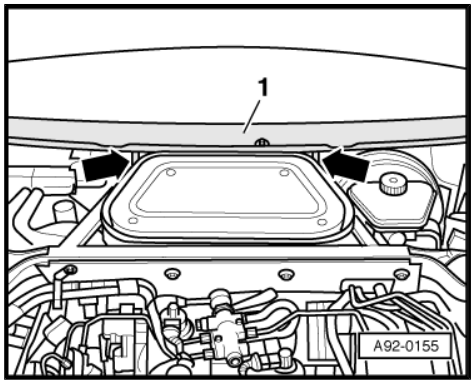


– Remove dust/pollen filter; to do so, open the four quick-release fasteners.

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.

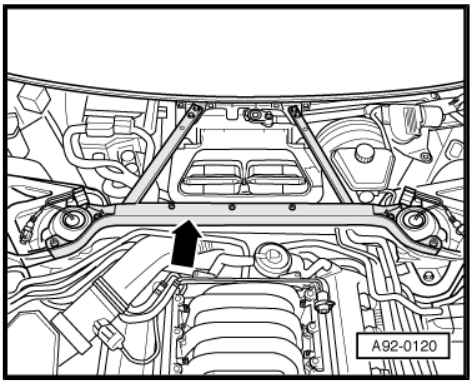


Caution

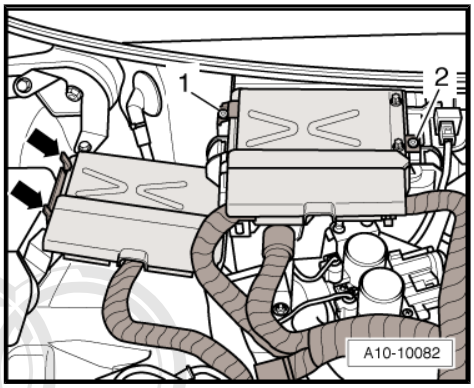
To avoid cracking the cowl panel trim during removal, apply a small amount of soap solution to the joint between the windscreen and the cowl panel trim and pull the trim vertically up out of the fastening strip, starting from the edge of the windscreen.

– Carefully pull cowl panel trim off retainer at windscreen.

– Unbolt cross piece for suspension strut -arrow-.



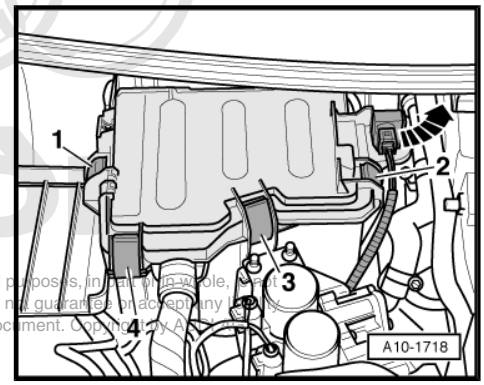
– Unscrew bolts -1- and -2- and detach retaining clips.
– Release retaining tabs -arrows- and detach both engine control units.



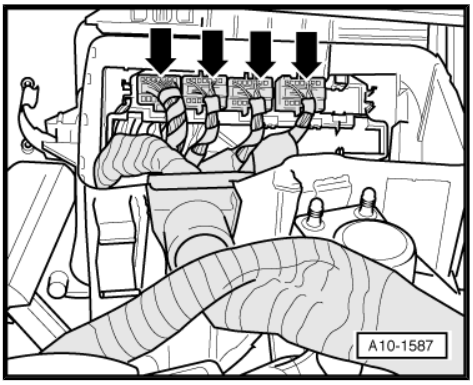
Note

The electrical wires remain connected.

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



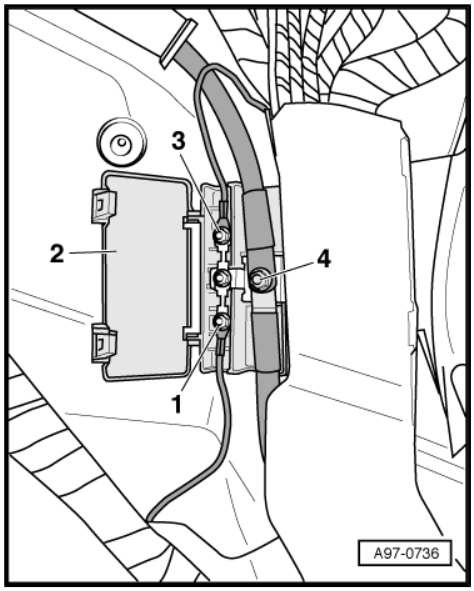
– Disconnect the electrical multi-pin connectors -arrows- using spark plug connector pliers - V.A.G 1922- .
– Detach engine wiring harness at electronics box and at bulkhead.
– Place engine control units with wiring harness attached on top of engine.



Note

Secure the engine control units to prevent them falling.

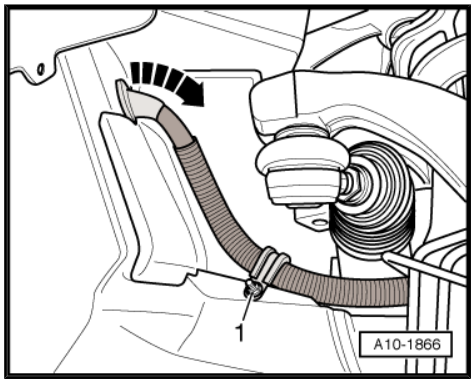
– Remove A-pillar trim (right-side) ⇒ Rep. gr. 70 .
– Fold back floor covering.
– Unbolt protective cover above main fuse holder.
– Fold cover -2- to side.
– Remove nut -4-.
– Detach terminal 30 wire to starter.



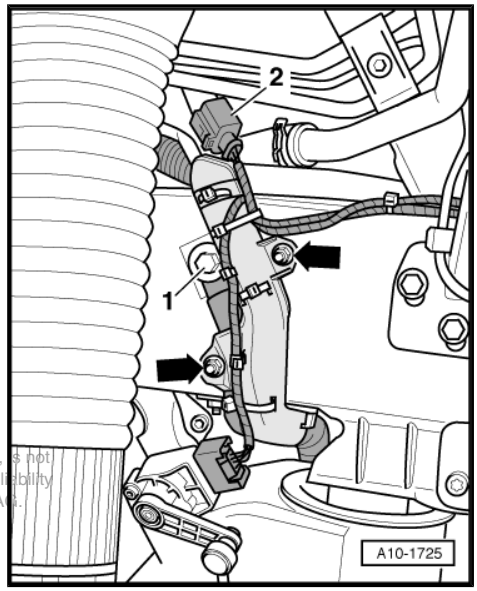
Note

Disregard items -1- and -3-.

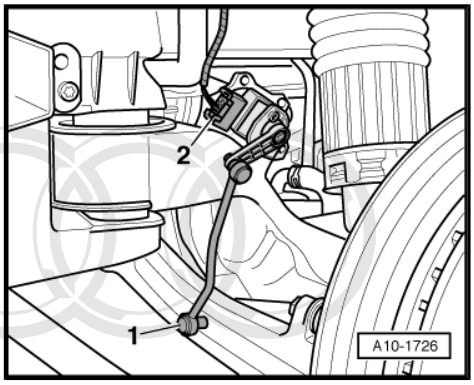
– Unscrew wiring clamp -1- in wheel housing (front right).
– Pull wiring harness out from interior -arrow-.



– 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.



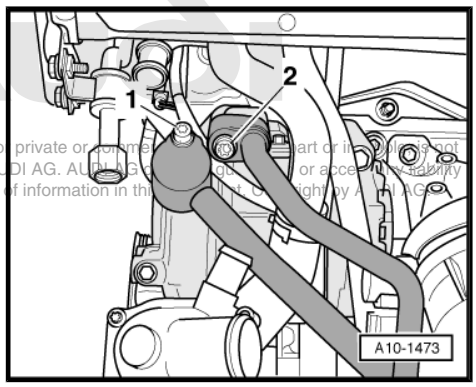
– Unplug electrical connector -2- at vehicle level sender.
– Detach coupling rod -1- at track control link.
– Repeat procedure on other side of vehicle.



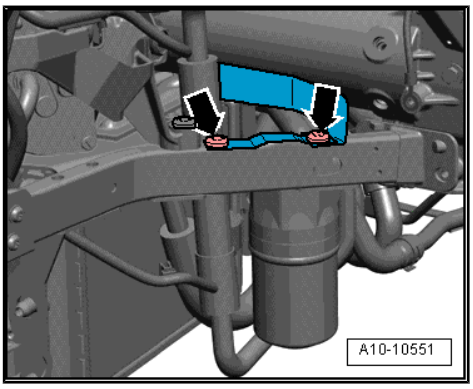
Note

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

– Remove bolts -1- and -2-.
– Detach refrigerant lines from AC compressor.
– Seal off open pipes/lines and connections with clean plugs from engine bung set - VAS 6122- .



– Remove bolts -arrows- at bracket for air conditioner reservoir.



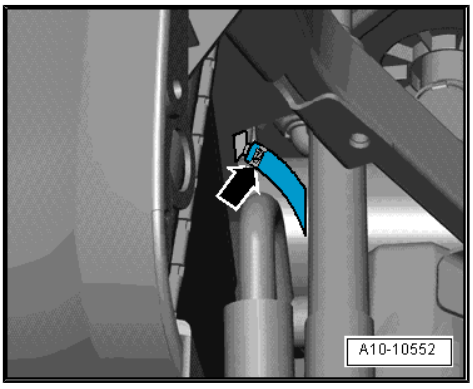
Note

The air conditioner reservoir remains installed.

Note

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

– Disconnect hydraulic hose -arrow- at power steering fluid reservoir.
– Seal off open pipes/lines and connections with clean plugs from engine bung set - VAS 6122- .

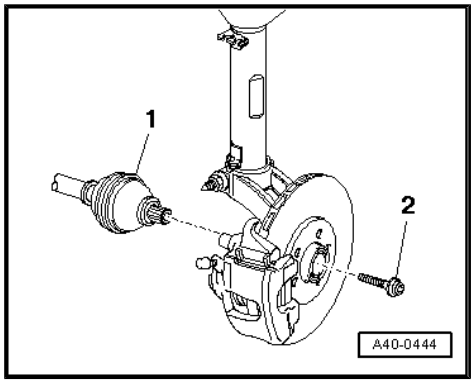


– Have a 2nd mechanic press the brake pedal.

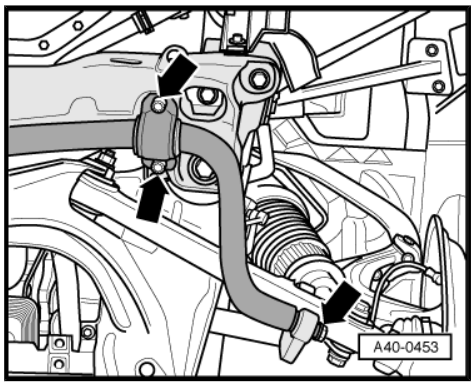
Caution

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

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



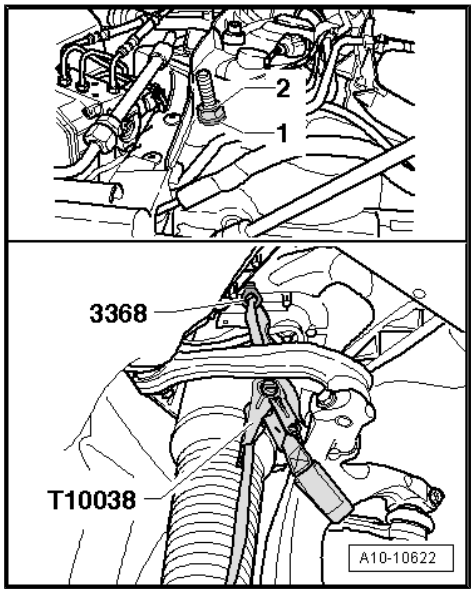
– Unscrew bolts (left and right) -arrows- evenly.
– Take out anti-roll bar.



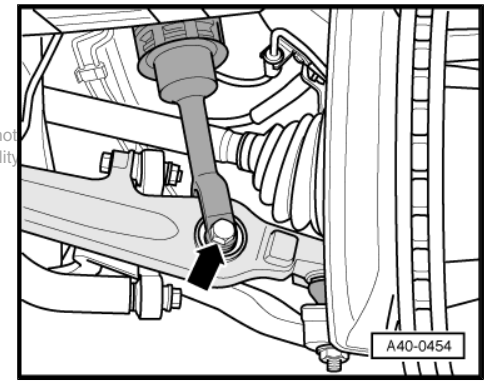
– Fit eye-head bolt - 3368- from below in bore on suspension turret on both sides.
– Secure eye-head bolts - 3368- with nut -2- and washer -1- (screw down nut several turns but not all the way down).
– Tie up wheel bearing housing on each side using tensioning strap - T10038- as illustrated.

Caution

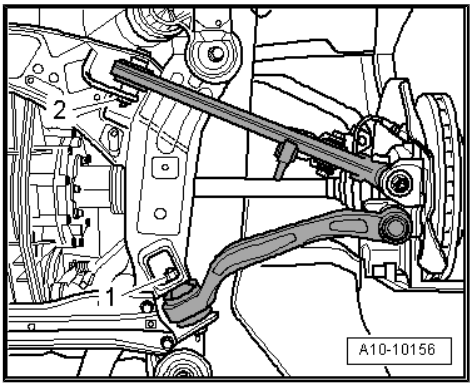
To prevent damage to the joints on the upper links, the weight of the wheel bearing housings must be supported before slackening the bottom securing bolts for the suspension struts.



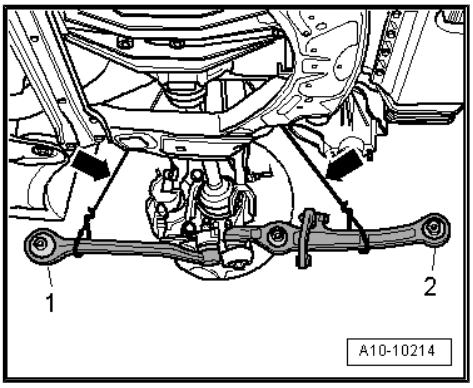
– Unbolt air spring strut from track control link -arrow-.



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



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



Caution

The guide link and track control link must not be allowed to hang down without support. Tie up both links to wheel bearing housing as illustrated -arrows-.

– Repeat procedure on other side of vehicle.

– Unbolt drive shaft from flange shaft on gearbox.

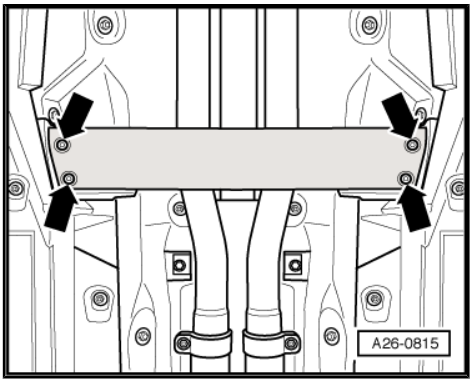
Caution

Take care not to damage brake hose.

– Pivot wheel bearing housing outwards and remove drive shaft.

– Repeat procedure on other side of vehicle.

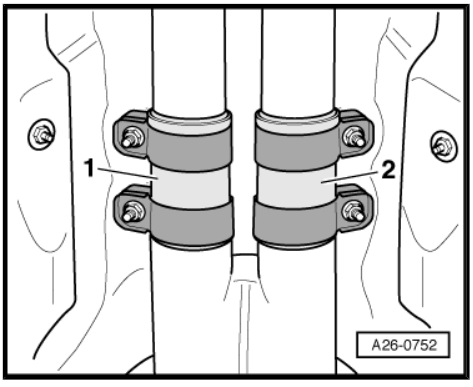
– Unbolt cross piece (front) -arrows-.



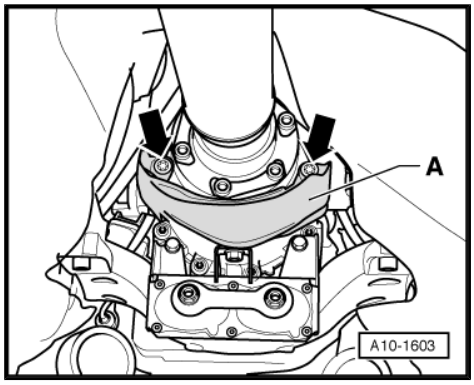
Note

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

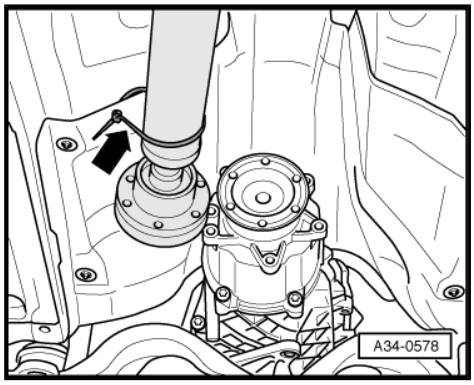
– Loosen clamps -1- and -2-.



– Unscrew heat shield -A- for propshaft -arrows-.
– Unscrew bolts at gearbox/propshaft flange.
– Slide rear propshaft together towards rear final drive; the constant velocity joints can be moved axially.



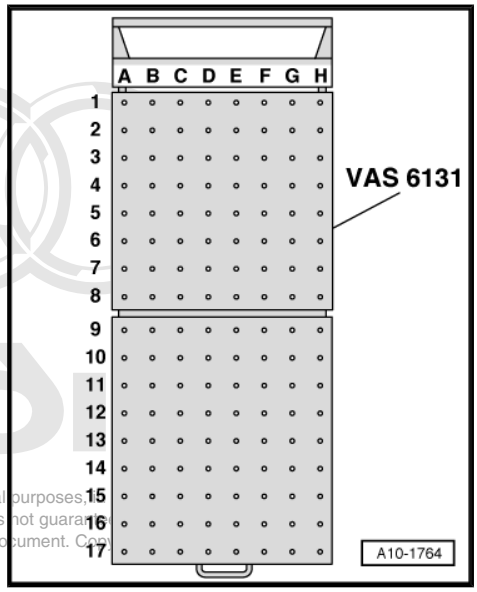
– Tie propshaft up to side of heat shield -arrow-.



Set up the scissor-type assembly platform as follows:

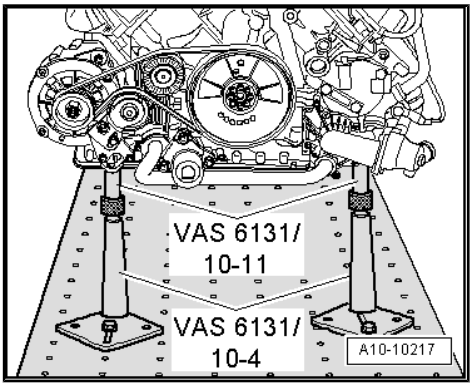
– Set up scissor-type assembly platform - VAS 6131 A- with support set for Audi - VAS 6131/10- as follows:

Platform coordinates	Parts from support set for Audi - VAS 6131/10-			
B3	/10-1	/10-4	/10-5	/10-11
G3	/10-1	/10-4	/10-5	/10-11
B6	/10-1	/10-3	/10-5	/10-7
G6	/10-1	/10-3	/10-5	/10-7
B10	/10-1	/10-2	/10-5	/10-8
G10	/10-1	/10-2	/10-5	/10-8
D16	/10-1	/10-2	/10-5	/10-12

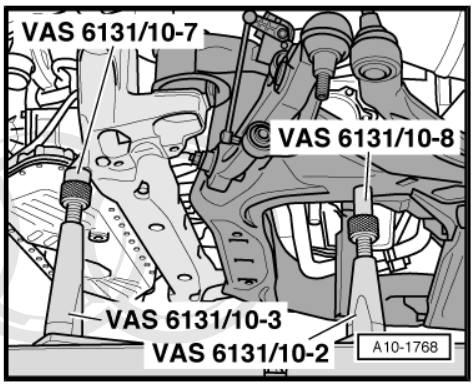


– Initially tighten the support elements on the assembly platform only hand-tight.
– Adjust the scissor-type assembly platform - VAS 6131 A- so that it is horizontal.
• Take note of spirit level (bubble gauge).
– Place scissor-type assembly platform - VAS 6131 A- under engine/gearbox assembly.

– Position support elements from -VAS 6131/10- at front of engine, as shown in illustration.



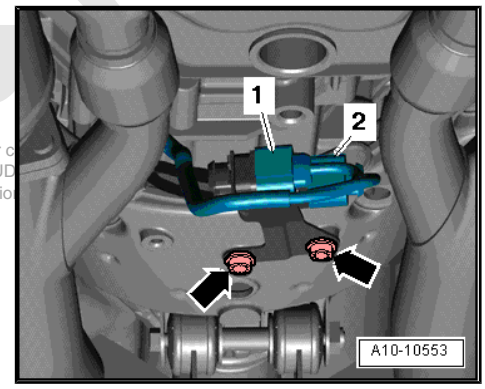
– Position support elements from -VAS 6131/10- on engine cross member and subframe (left and right), as shown in illustration.



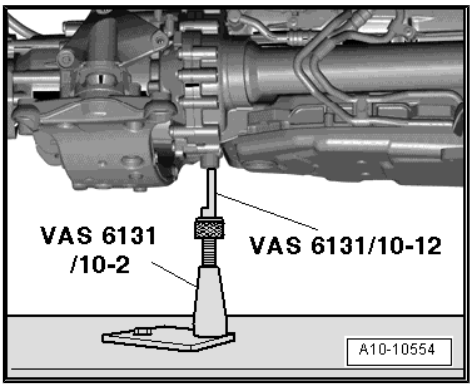
– Remove bracket for electrical connectors -1- and -2- for Lambda probes from tunnel cross member -arrows-.

Note

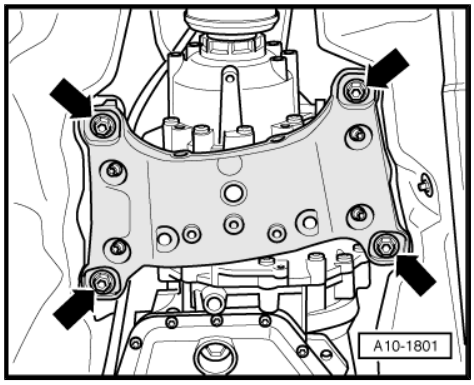
The electrical connectors remain attached.



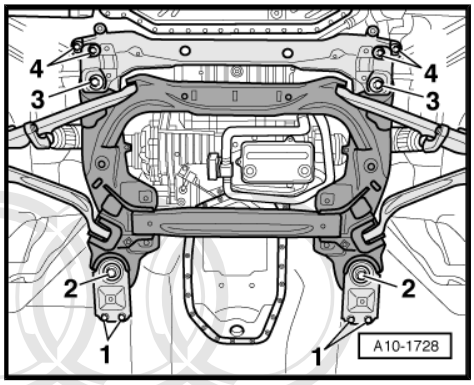
– Position support element from -VAS 6131/10- at rear of gearbox, as shown in the illustration.
– Turn all spindles for the support elements upwards until all locating lugs make contact with the mounting points.
– When all support elements make contact, raise assembly platform until load is taken off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



– Remove bolts -arrows- at tunnel cross member.



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

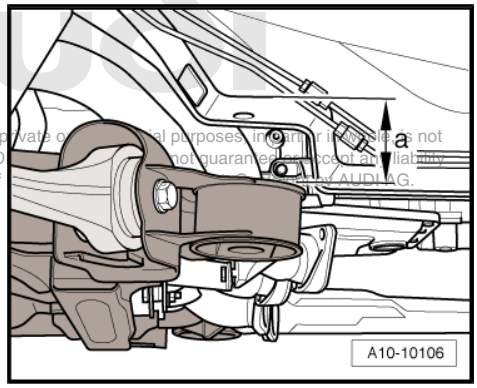


Note

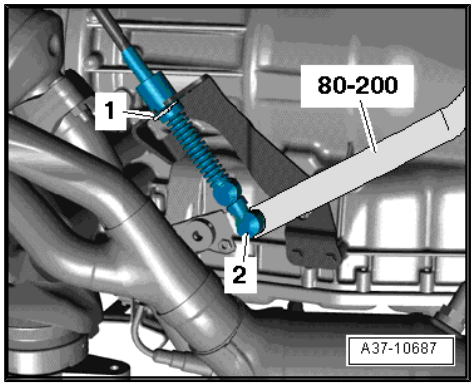
- *Check that all hoses and wiring connections between engine, gearbox, subframe and body have been detached.*
- *Carefully guide out engine/gearbox assembly with subframe from engine compartment when lowering to avoid damage.*

– Lower the engine/gearbox assembly using scissor-type assembly platform - VAS 6131 A- initially only as far as distance -a-.

• Dimension -a- = approx. 300 mm.



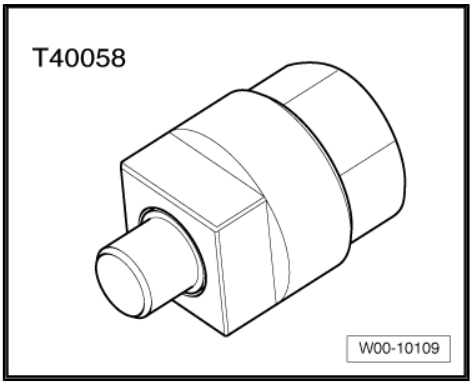
– Push ball socket -2- of selector lever cable off gearbox selector lever using removal lever - 80 - 200- .
– Unclip retaining clip -1- at support bracket for selector lever cable.
– Detach selector lever cable.
– Lower engine/gearbox assembly.
– Pull out scissor-type assembly platform - VAS 6131 A- with engine/gearbox assembly from beneath vehicle.



2 Separating engine and gearbox

Special tools and workshop equipment required

- Adapter - VAS 6131/10-12- (2x)
- Adapter - T40058-

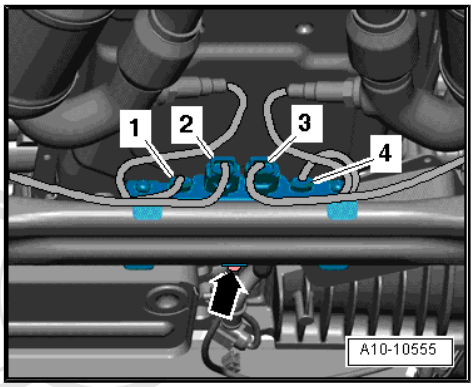


Procedure

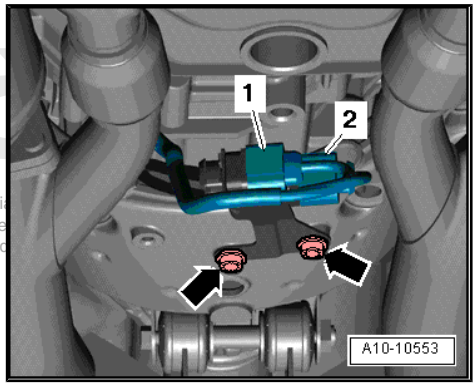
- Engine/gearbox assembly removed and secured to scissor-type assembly platform - VAS 6131 A- .

– Remove bracket for electrical connectors -1 ... 4- for Lambda probes from subframe -arrow-.

– Detach electrical connectors from bracket and unplug connectors.



– Take electrical connectors -1- and -2- for Lambda probes out of bracket and unplug connectors.



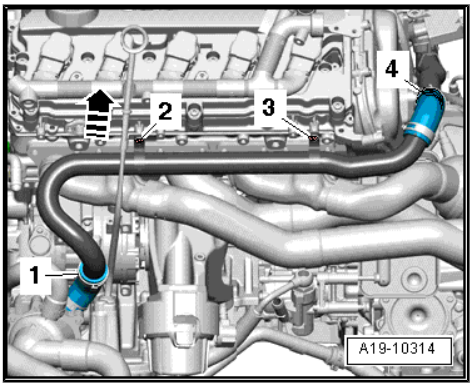
Note

Disregard -arrows-.

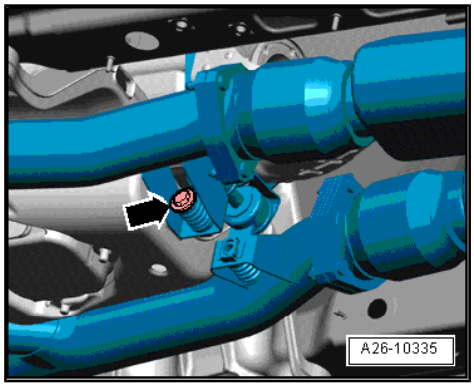
– Remove bolts -2- and -3-.

– Pull the guide tube for oil dipstick out upwards -arrow-.

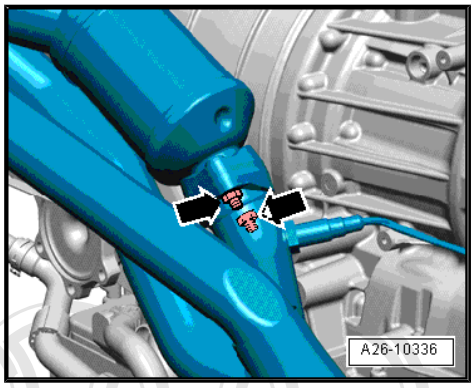
– Loosen hose clips -1- and -4- and detach coolant pipe (left-side) from coolant hoses.



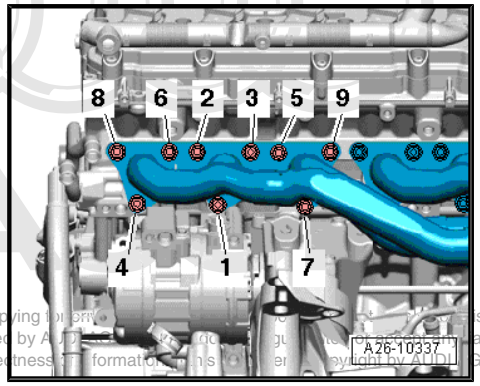
– Unscrew bolt -arrow- at bracket for exhaust pipes (left-side).



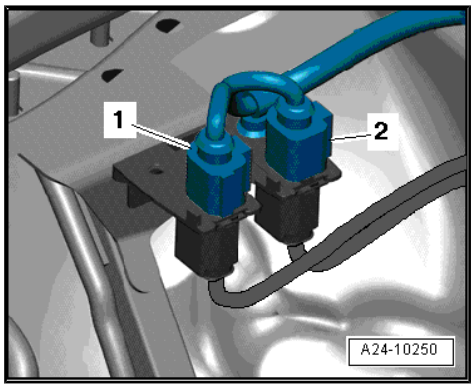
– Unscrew nuts -arrows-.



– Unscrew nuts in the sequence -9 ... 1- and remove front left exhaust manifold with catalytic converter.



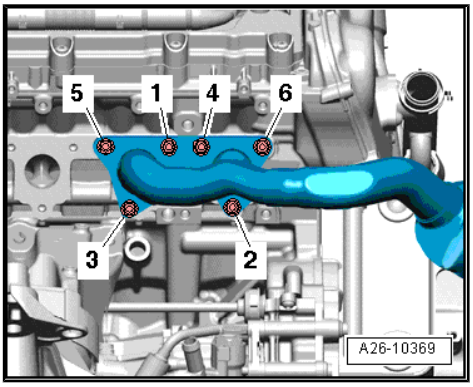
– Unplug electrical connectors -1- and -2- for Lambda probes.



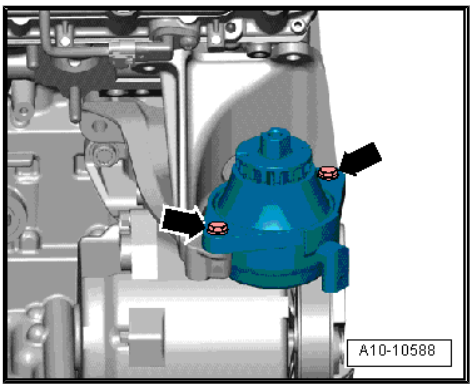
Note

Illustration shows electrical connectors in their installation position.

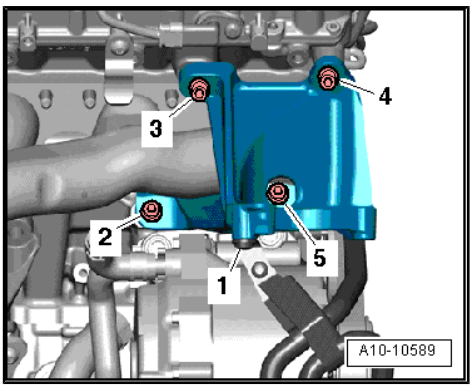
– Unscrew nuts in the sequence -6 ... 1- and remove rear left exhaust manifold with catalytic converter.



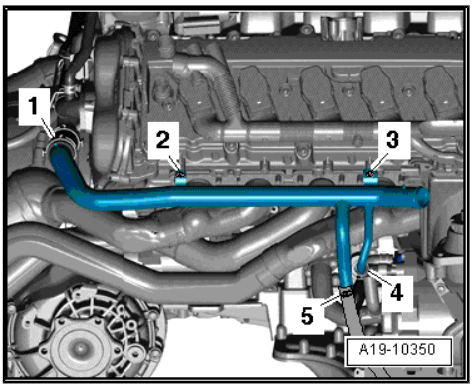
– Unscrew bolts -arrows- and remove mounting for torque reaction support.



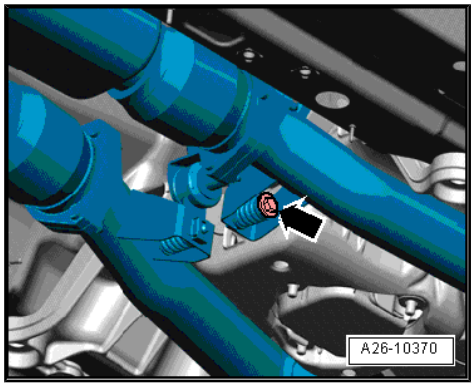
– Unscrew bolts -1 … 5- and remove bracket for torque reaction support.



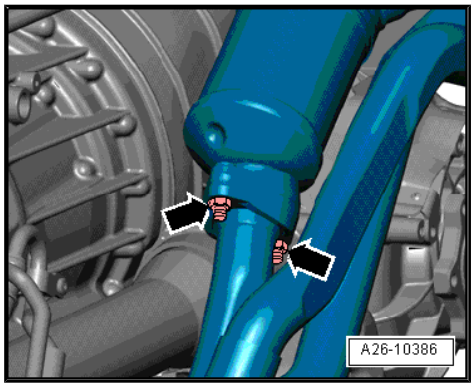
– Remove bolts -2- and -3-.
– Loosen hose clips -1, 4, 5- and detach coolant pipe (right-side) from coolant hoses.



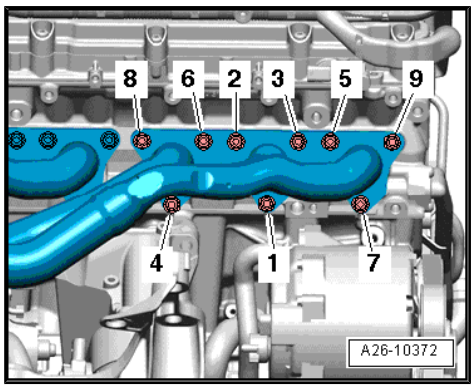
– Unscrew bolt -arrow- at bracket for exhaust pipes (right-side).



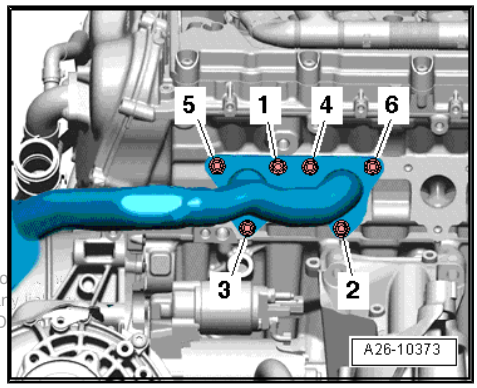
– Unscrew nuts -arrows-.



– Unscrew nuts in the sequence -9 ... 1- and remove front right exhaust manifold with catalytic converter.



– Unscrew nuts in the sequence -6 ... 1- and remove rear right exhaust manifold with catalytic converter.

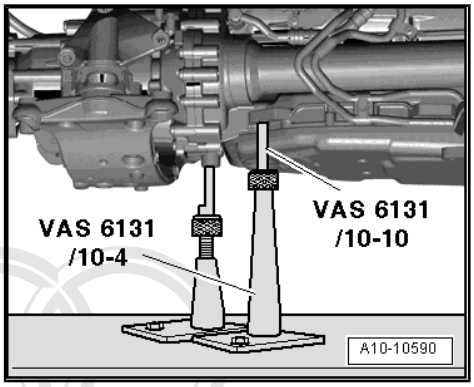


– Additionally position support elements from support set - VAS 6131/10- at rear right of gearbox, as illustrated.

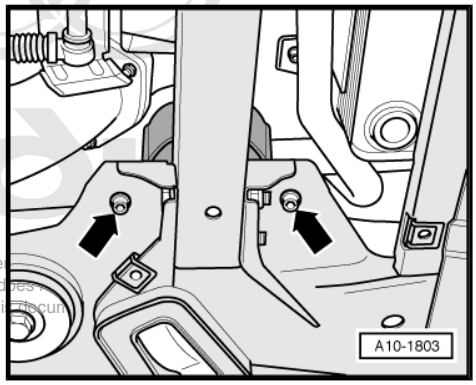
• Attachment point on scissor-type assembly platform - VAS 6131 A- : “G15”.

– Turn spindle for the support element upwards until the locating lug makes contact with the mounting point.

– Tighten base plate for support element to 20 Nm on scissor-type assembly platform - VAS 6131 A- .



– Remove bolts -arrows- for front gearbox mountings (left and right).



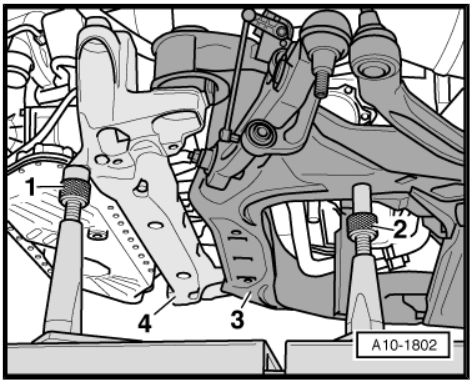
– Screw down spindles of support elements -2- (left and right) at subframe as far as possible.

– Remove locating lugs from spindles.

– Unscrew the two base plates for support elements (for subframe) on scissor-type assembly platform - VAS 6131 A- .

– Take out subframe -3- from the side.

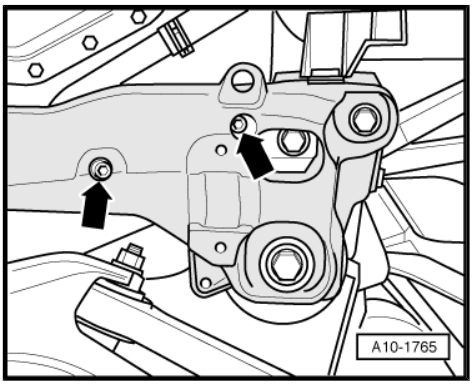
– Screw down spindles of support elements -1- (left and right) at engine cross member -4- as far as possible.



– Remove bolts for engine mountings -arrows- on both sides.

– Take out engine cross member.

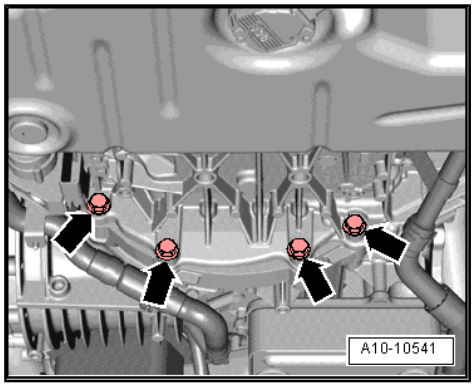
– Unscrew the two base plates for support elements (for subframe) on scissor-type assembly platform - VAS 6131 A- .



Note

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

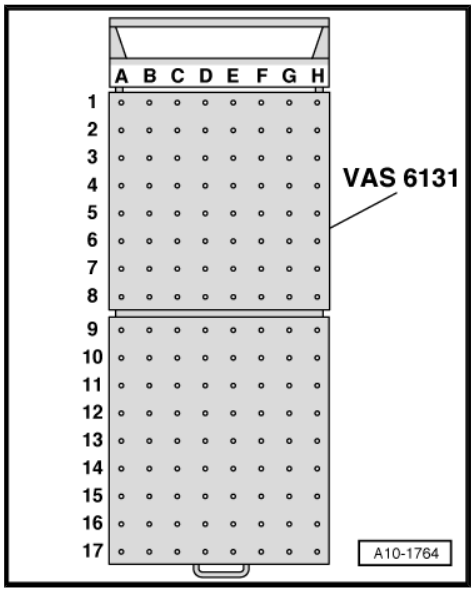
– Remove bottom engine/gearbox securing bolts -arrows-.



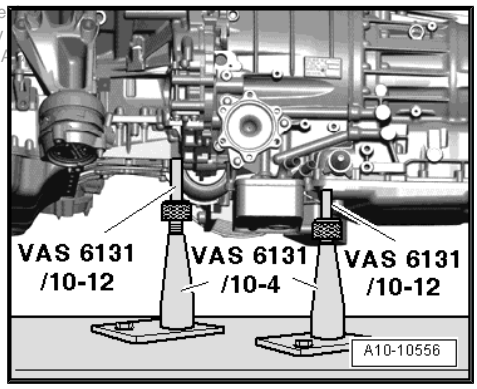
– Set up scissor-type assembly platform - VAS 6131 A- with support set for Audi - VAS 6131/10- and (3x) adapter - VAS 6131/10-12- as follows:

Platform coordinates	Parts from support set for Audi - VAS 6131/10-			
B3 1)	/10-1	/10-4	/10-5	/10-11
G3 1)	/10-1	/10-4	/10-5	/10-11
C7	/10-1	/10-4	/10-5	/10-12
F7	/10-1	/10-4	/10-5	/10-12
B11	/10-1	/10-4	/10-5	/10-12
G11	/10-1	/10-3	/10-5	/10-13
G15 1)	/10-1	/10-4	/10-5	/10-10
D16 1)	/10-1	/10-2	/10-5	/10-12

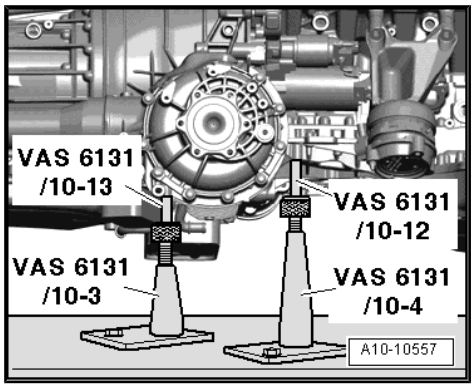
• 1) Support elements remain unchanged.



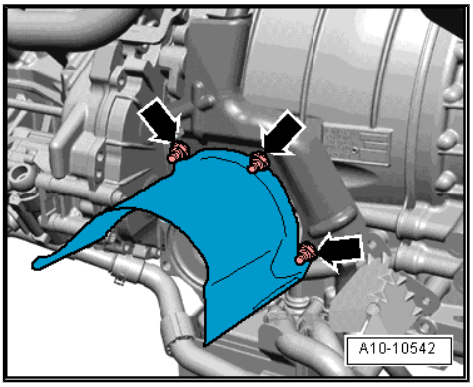
– Position support elements from -VAS 6131/10- at left of engine/gearbox assembly, as shown in illustration.



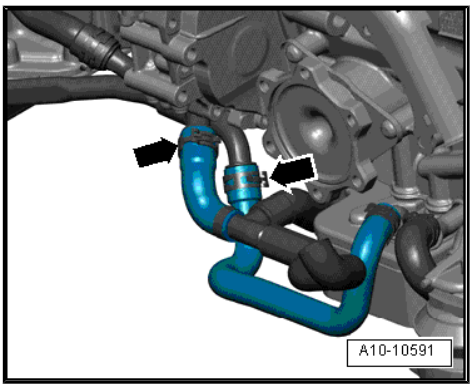
– Position support elements from -VAS 6131/10- at right of engine/gearbox assembly, as shown in illustration.



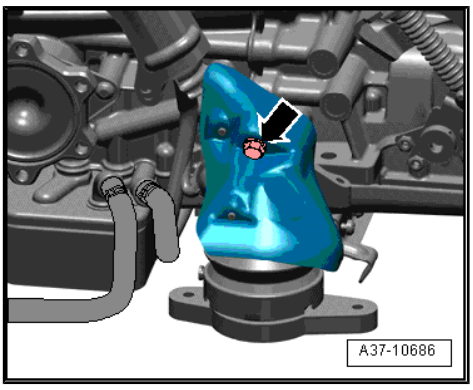
– Unbolt heat shield for drive shaft (left-side) from gearbox -arrows-.



– Disconnect coolant hoses -arrows-.



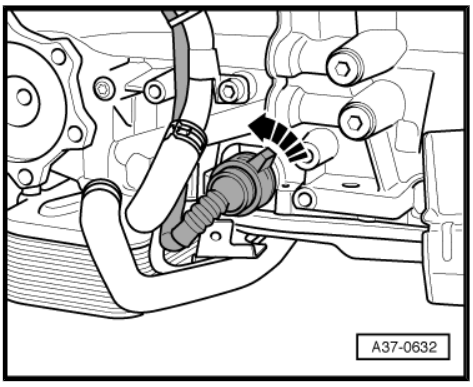
– Unbolt heat shield for gearbox mounting (left-side) -arrow-.



– Touch gearbox housing with your hand (without wearing gloves) to eliminate static charge.

Caution

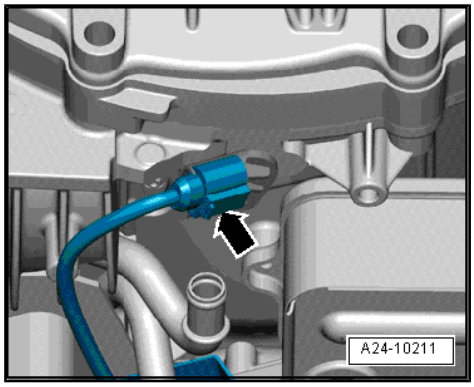
- *Before touching mechatronic unit, discharge static by touching earthed component (e.g. touch gearbox housing).*
- *Do NOT touch connector contacts in 16-pin connector with your hands as static discharge might damage the control unit and the mechatronic unit irreparably.*



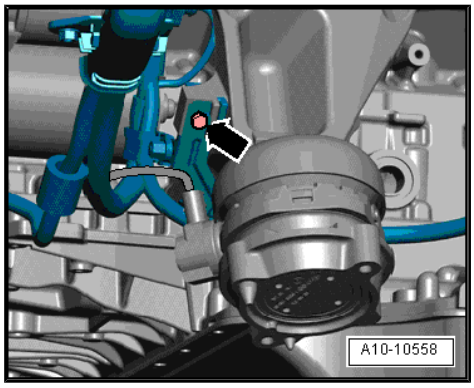
– Turn retainer catch anti-clockwise -arrow- and unplug electrical connector on left of gearbox.

– Move electrical wiring harness clear.

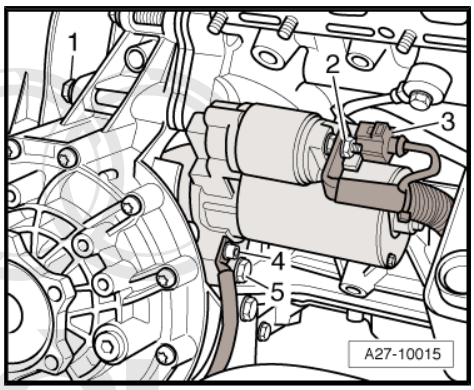
– Unplug electrical connector -arrow- at engine speed sender -G28- .
– Move wiring clear.



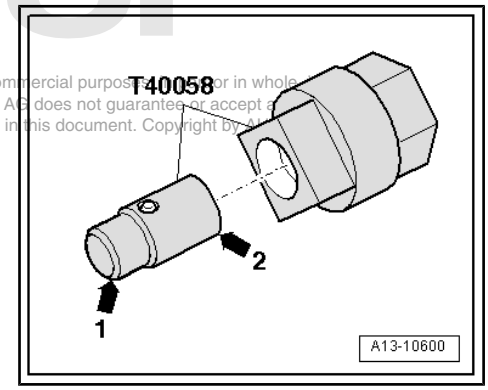
– Unbolt bracket for wiring from engine support (right-side) -arrow-.



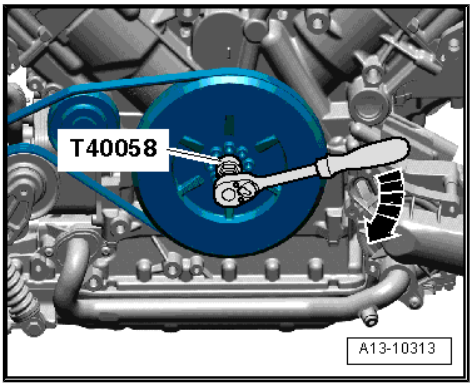
– Unbolt earth cable -4- at starter.
– Detach electrical wiring -2- and -3- at starter.
– Remove bolts -1- and -5- and detach starter.



– 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.



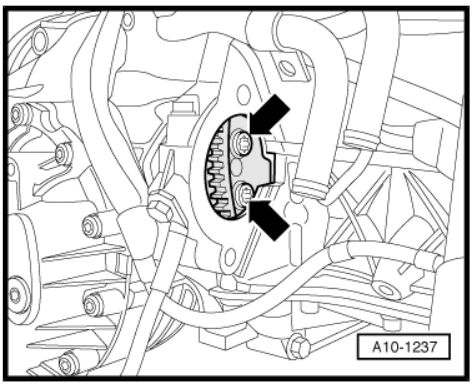
– When loosening torque converter bolts, counterhold crankshaft using adapter - T40058- .



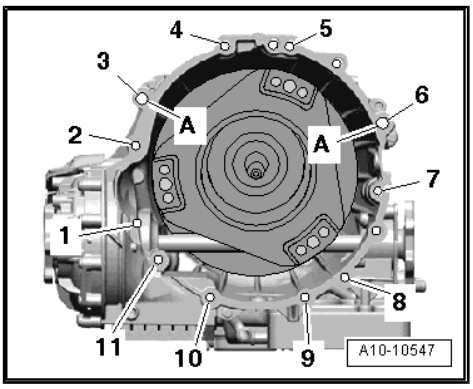
Note

When performing the next step, turn the crankshaft only in the normal direction of rotation -arrow-.

– Unscrew 6 bolts -arrows- for torque converter, working through opening of removed starter (turn crankshaft $^{1}/_{3}$ turn in direction of engine rotation each time).



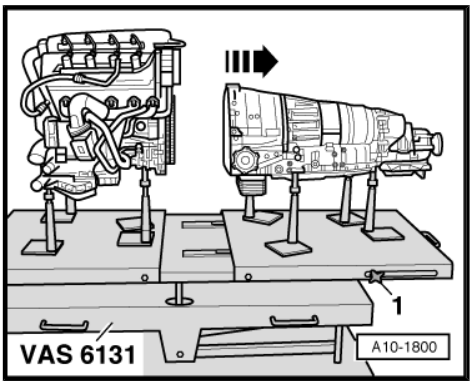
– Remove engine/gearbox securing bolts -3 ... 7-.



Note

Disregard -item A-.

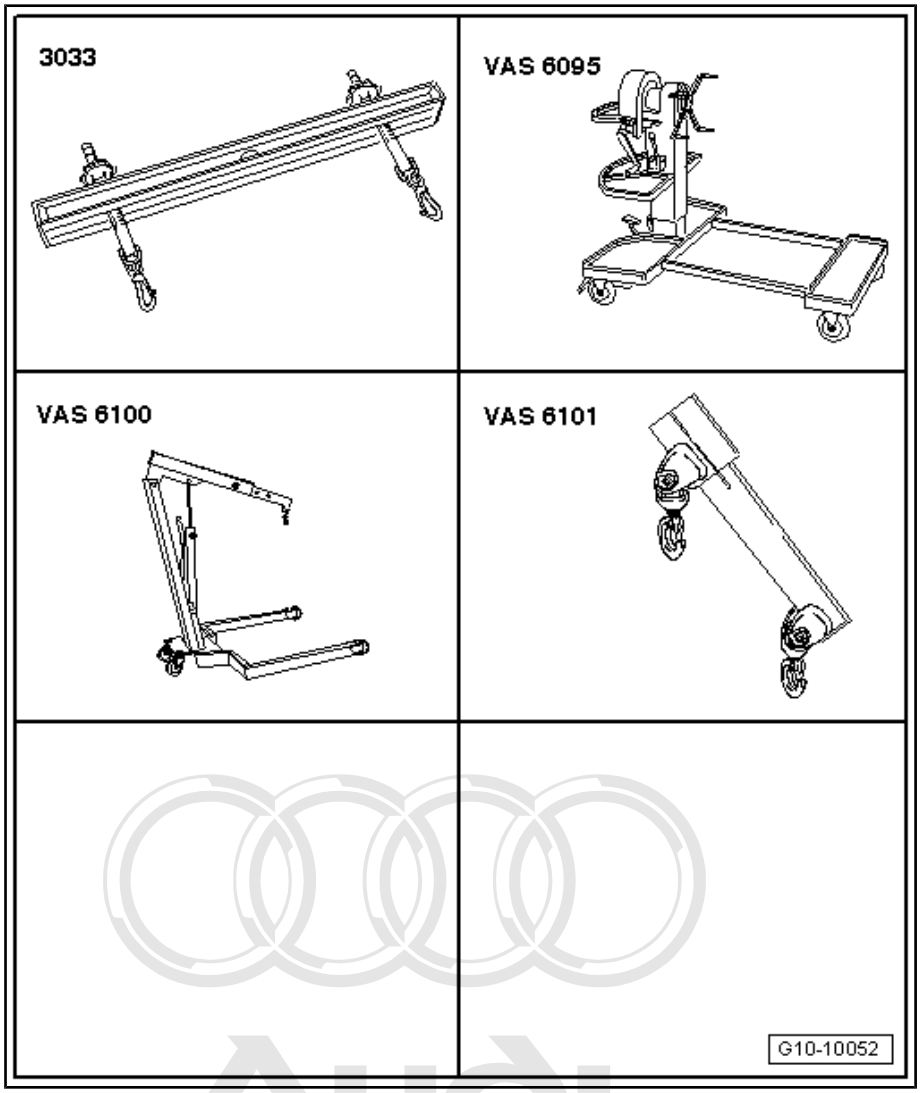
– Loosen clamping bolts -1- on sides of scissor-type assembly platform - VAS 6131 A- and pull rear section of platform together with gearbox towards the rear -arrow-; simultaneously separate the torque converter from the drive plate through the opening.



3 Securing engine to engine and gearbox support

Special tools and workshop equipment required

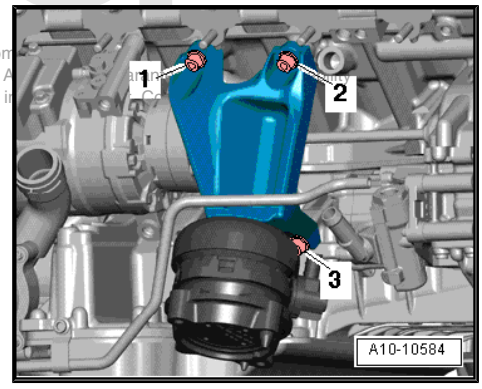
- Lifting tackle - 3033-
- Engine and gearbox support - VAS 6095- with bracket -VAS 6095/1-7-
- Workshop hoist - VAS 6100-
- Lift arm extension (workshop hoist) - VAS 6101-



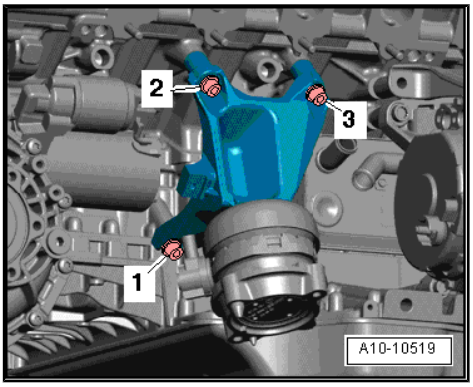
Procedure

– Unplug electrical connector -arrow- at engine mounting (left-side).

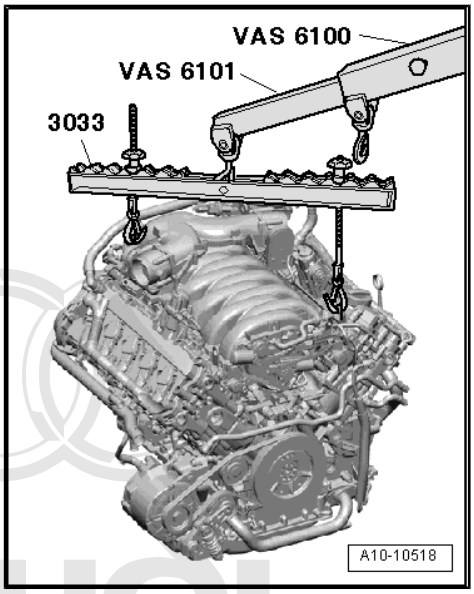
– Remove bolts -1 ... 4- and detach engine support with engine mounting.



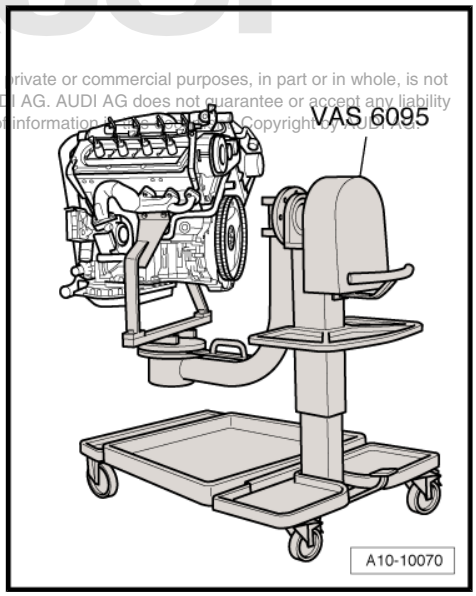
– Unplug electrical connector -arrow- at engine mounting (right-side).
– Remove bolts -1, 2, 3- and detach engine support with engine mounting.



– 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 6095/1-7- , secure engine to engine and gearbox support - VAS 6095- as shown in the illustration.
Tightening torque: 42 Nm.



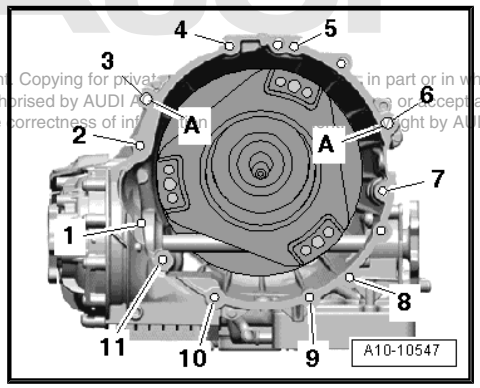
4 Installing engine

Note

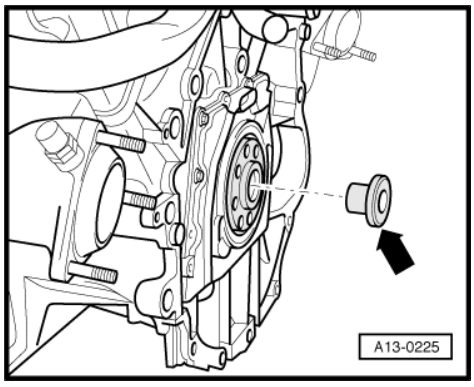
- *Renew self-locking nuts and bolts when performing assembly work.*
- *Renew bolts which are tightened to a specified angle as well as seals, gaskets and O-rings.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- *Fit all heat shields and heat insulation sleeves in the original positions when installing.*
- *Fit all cable ties in the original positions when installing.*

– Install engine supports (left and right) ⇒ page 45 .

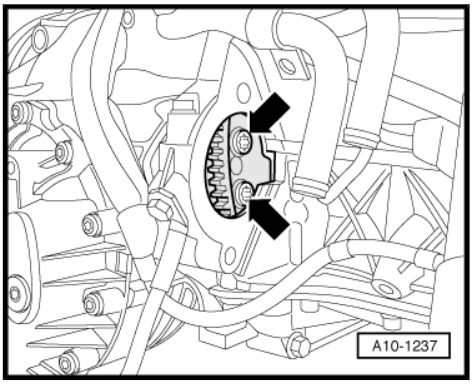
– Check whether dowel sleeves -A- for centring engine and gearbox are fitted in cylinder block; install missing dowel sleeves.



– Check whether centring sleeve -arrow- for torque converter is fitted in rear of crankshaft; drive in centring sleeve if necessary.



– 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 -arrows-.
– Use new ribbed bolts of the correct type (same as original equipment) to secure torque converter on drive plate ⇒ Electronic parts catalogue ⇒ Rep. gr. 37 .
– Bolt gearbox to engine.



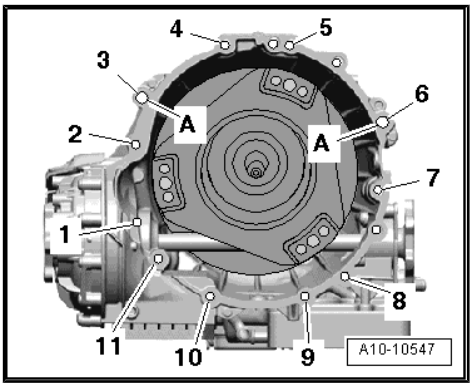
Note

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

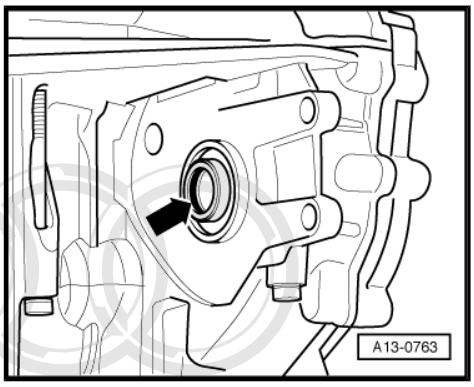
Securing engine to gearbox

Item	Bolt	Nm
1	M10x40	45
2	M10x135 1)	65
3	M12x105	65
4, 5	M12x100	65
6, 8, 9, 10, 11	M12x75	65
7	M12x155	65
A	Dowel sleeves for centralising	

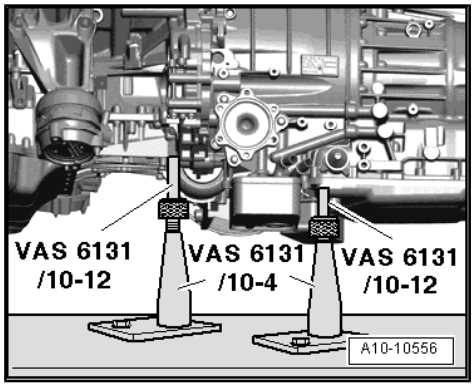
• 1) Property class 10.9.



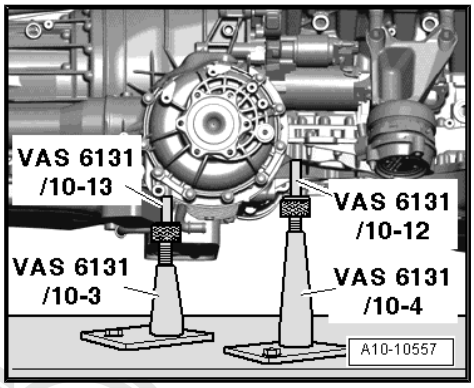
– Before installing an exchange engine, check whether the flat-section O-ring -arrow- is fitted in the drive shaft of the power steering pump.
– Install starter ⇒ Electrical system; Rep. gr. 27 .
– The threaded holes in the flange shaft for the propshaft on the gearbox must be cleaned of remaining locking fluid with a thread tap before assembling.



– Screw down spindles of support elements on left side of engine/gearbox assembly.
– Unscrew base plates for support elements (left-side) at scissor-type assembly platform - VAS 6131 A- .



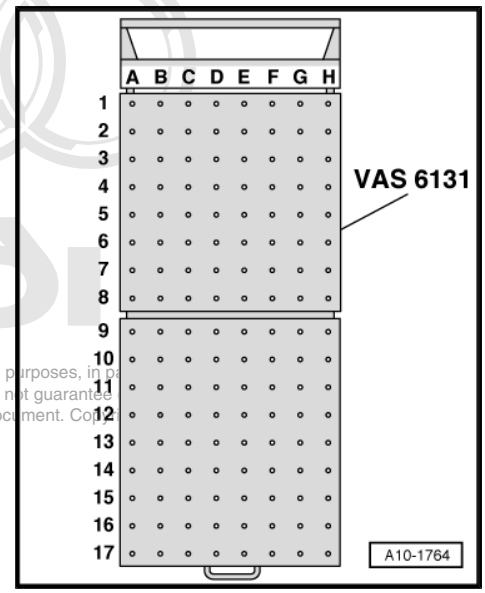
– Screw down spindles of support elements on right side of engine/gearbox assembly.
– Unscrew base plates for support elements (right-side) at scissor-type assembly platform - VAS 6131 A- .



Note

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

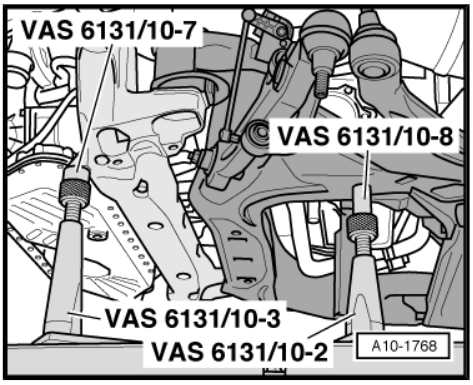
– Set up scissor-type assembly platform - VAS 6131 A- with support set for Audi - VAS 6131/10- as follows:



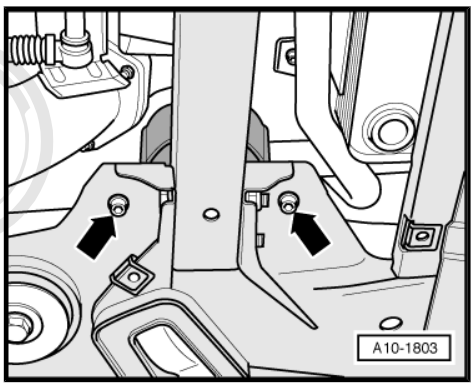
Platform coordinates	Parts from support set for Audi - VAS 6131/10-			
B3 1)	/10-1	/10-4	/10-5	/10-11
G3 1)	/10-1	/10-4	/10-5	/10-11
B6	/10-1	/10-3	/10-5	/10-7
C6	/10-1	/10-3	/10-5	/10-7
B10	/10-1	/10-2 2)	/10-5 2)	/10-8 2)
G10	/10-1	/10-2 2)	/10-5 2)	/10-8 2)
G15 1)	/10-1	/10-4	/10-5	/10-10
D16 1)	/10-1	/10-2	/10-5	/10-12

- 1) Support elements remain unchanged.
- 2) Secure support elements only after installing the subframe.

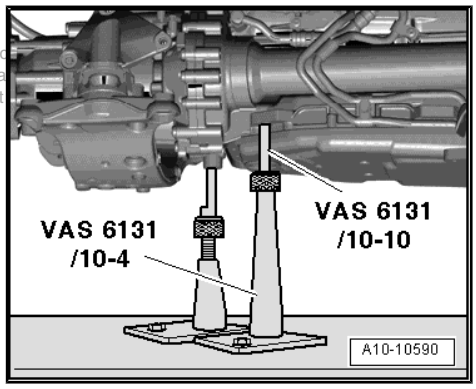
– Fit subframe onto the two support elements -VAS 6131/10-8- .
– Screw up the spindles for support elements on both sides.
– Tighten base plates for support elements to 20 Nm on scissor-type assembly platform - VAS 6131 A- .



– Tighten bolts for gearbox mountings -arrows- on both sides ⇒ Rep. gr. 37 .



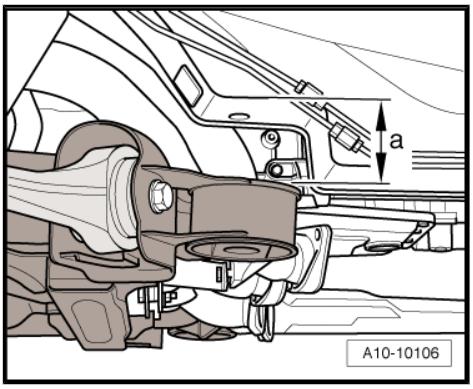
– Detach the additional support element -VAS 6131/10-10- with -VAS 6131/10-4- from rear right of gearbox.
– Fit wiring harness and coolant hoses to engine/gearbox assembly.
– Install heat shield for drive shaft (left-side).
– Install exhaust pipes (left-side) ⇒ page 230 .
– Install exhaust pipes (right-side) ⇒ page 233 .
– Install coolant pipe (left-side) ⇒ page 207 .
– Install coolant pipe (right-side) ⇒ page 211 .
– Carefully guide engine/gearbox assembly together with subframe 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- = max. 300 mm.

– Install selector lever cable and check adjustment if necessary ⇒ Rep. gr. 37 .



Caution

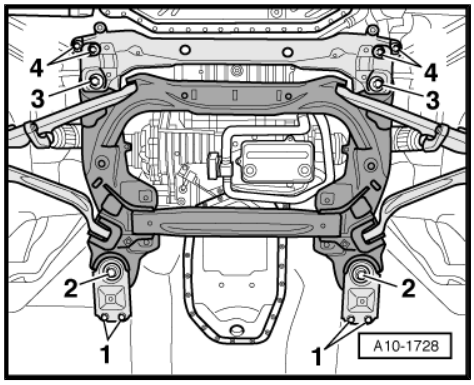
Make sure that the selector lever cable does not become trapped at the rear left gearbox support.

– Adjust the subframe according to the markings previously made on the longitudinal members.
– Tighten subframe bolts only to specified torque (do not turn further). Do not tighten bolts to final setting until after wheel alignment check has been performed ⇒ Rep. gr. 40 .

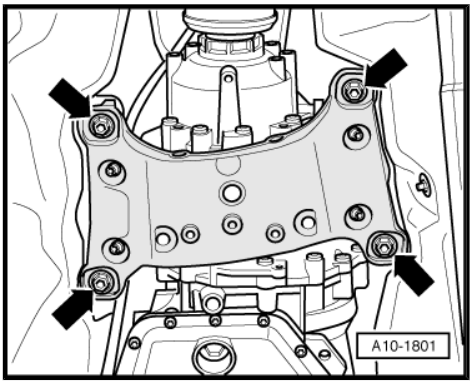
WARNING

The vehicle must not be driven at this stage.

– Tighten bolts -4- securing engine cross member ⇒ page 45 .



– 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 .
– Align exhaust system so it is free of stress ⇒ page 240 .
– Install drive shafts ⇒ Rep. gr. 40 .
– Install heat shield for drive shaft ⇒ Rep. gr. 37 .
– Install guide links, track control links, anti-roll bar and cross member (front) ⇒ Rep. gr. 40 .
– Install refrigerant lines ⇒ Rep. gr. 87 .
– Install cylinder head cover (right-side) ⇒ page 123 .
– Install fuel supply line ⇒ Rep. gr. 24 .
– Install cross piece for suspension strut ⇒ Rep. gr. 40 .
– Install mounting for torque reaction support and adjust ⇒ page 50 .
– 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. 92 .
– Install and adjust wiper arms ⇒ Electrical system; Rep. gr. 92 .

Caution

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

– 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 ⇒ Maintenance ; Booklet 404 .
– Fill cooling system ⇒ page 190 .

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 .
– Fit front wheels and perform wheel alignment ⇒ Rep. gr. 44 .

WARNING

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

Tightening torques

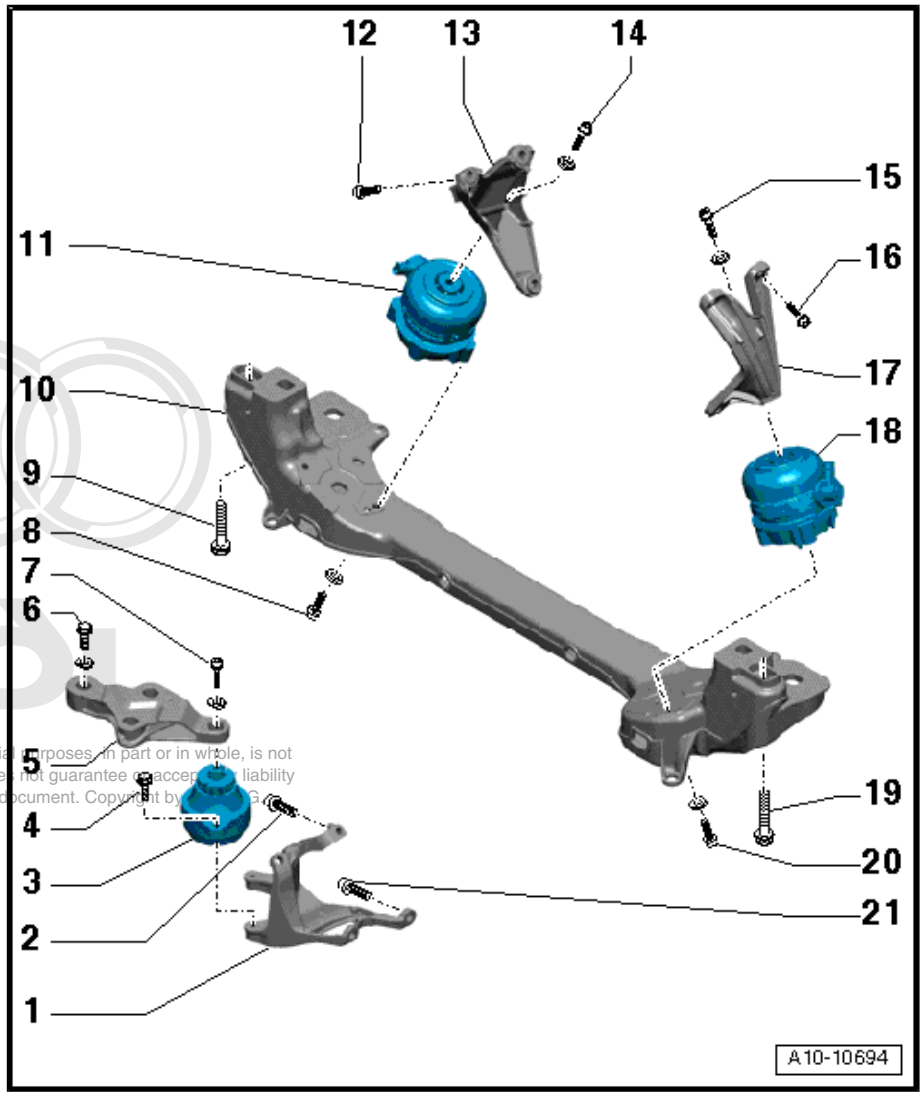
Note

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

Component		Nm
Bolts/nuts	M6	9
	M8	20
	M10	40
	M12	65

5 Assembly mountings

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, installing and adjusting ⇒ page 50

4 - 23 Nm

5 - Bracket for torque reaction support

6 - 40 Nm

7 - 40 Nm

8 - 23 Nm

9 - 68 Nm

10 - Engine cross member

11 - Engine mounting (right-side)

- ❑ With right electrohydraulic engine mounting solenoid valve - N145-
- ❑ Removing and installing ⇒ page 46

12 - 42 Nm

13 - Engine support (right-side)

- ❑ Version fitted in vehicle may differ from illustration
- ❑ Removing and installing ⇒ page 46

14 - 40 Nm

15 - 40 Nm

16 - 42 Nm

17 - Engine support (left-side)

- ❑ Version fitted in vehicle may differ from illustration
- ❑ Removing and installing ⇒ page 46

18 - Engine mounting (left-side)

- ❑ With left electrohydraulic engine mounting solenoid valve - N144-
- ❑ Removing and installing ⇒ page 46

19 - 68 Nm

20 - 23 Nm

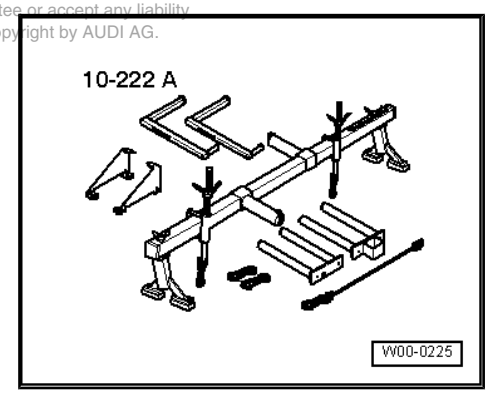
21 - Bolt

- ❑ M8: 23 Nm
- ❑ M10: 40 Nm

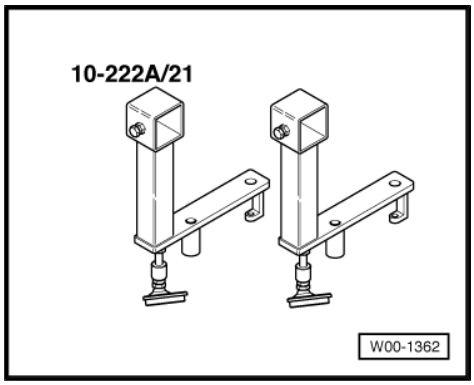
5.2 Removing and installing engine mounting (left and right)

Special tools and workshop equipment required

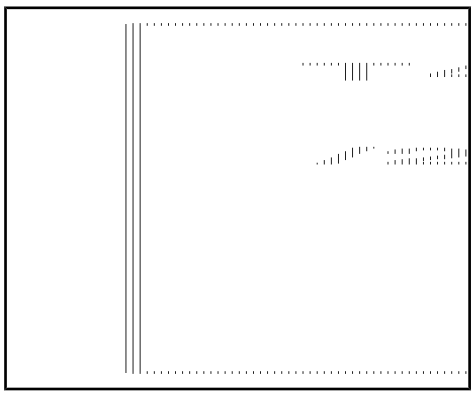
- ♦ Support bracket - 10 - 222 A-



- ♦ Adapters - 10 - 222 A /21-



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

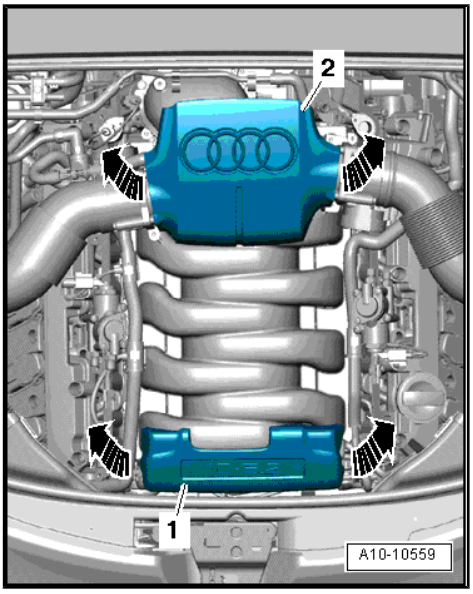


Removing

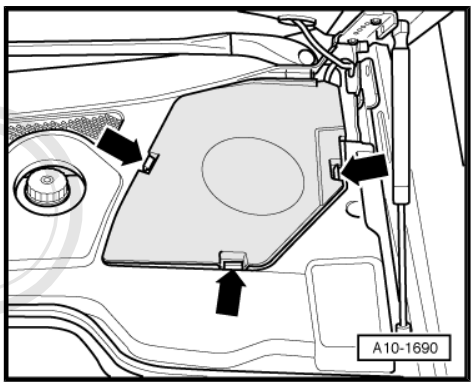
Note

Fit all cable ties in the original positions when installing.

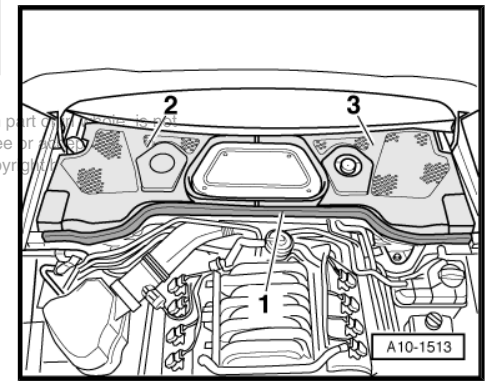
– Pull off engine cover panel (rear) -2- -arrows-.



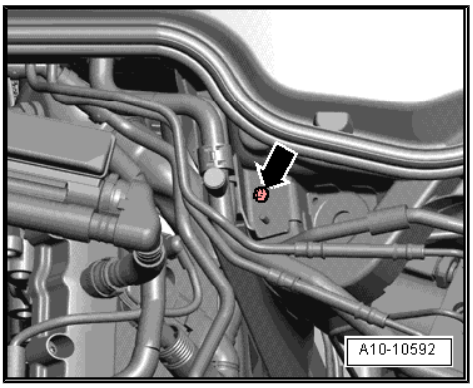
– Remove cover above coolant expansion tank -arrows-.



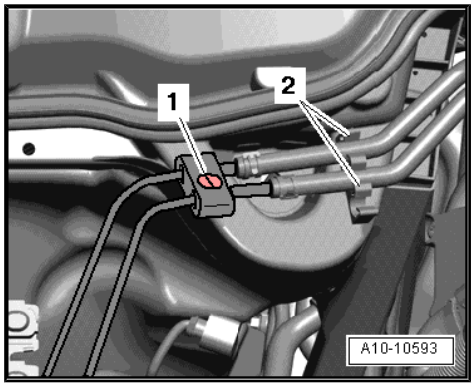
– Pull off rubber seal -1- and remove plenum chamber covers -2- and -3-.



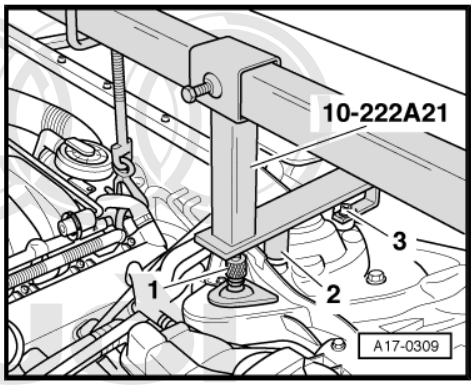
– Unbolt bracket (left-side) for refrigerant line from suspension turret -arrow-.



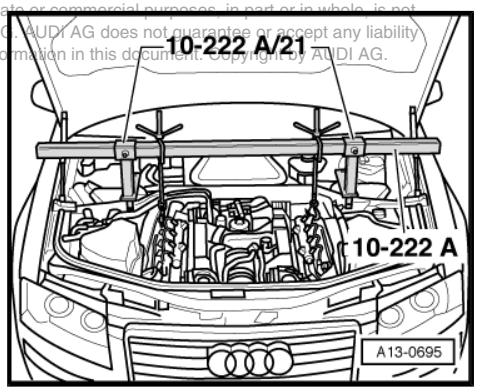
– Detach clip (right-side) -1-.
– Unclip fuel line and vacuum pump from retainer -2- on suspension turret.



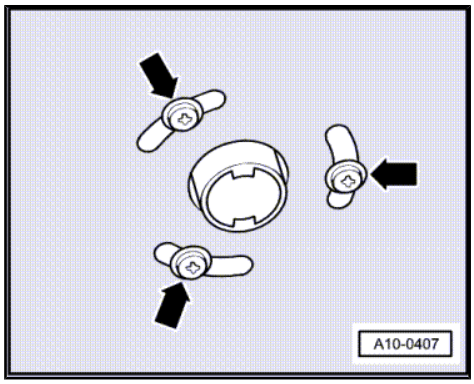
– Unscrew rear securing bolts -3- for cross piece for suspension strut.
– Attach support bracket - 10 - 222 A- with adapters - 10 - 222 A /21- onto suspension turrets.
• Adapters are marked for left and right-side of vehicle.
• The centre support point -2- of the adapters is located on front bolts for cross piece for suspension strut.
• The adapters are attached by means of the rear securing bolts -3- for the cross piece for suspension strut.
• The knurled screw -1- must be screwed down until support plate rests on suspension turret.



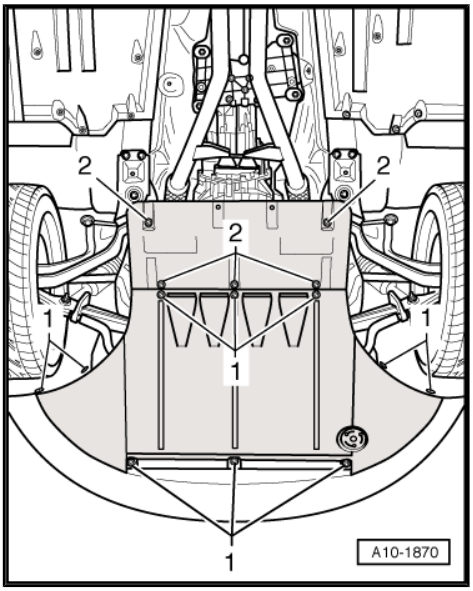
– Secure spindles of support bracket - 10 - 222 A- to rear engine lifting eyes.
– Take up weight of engine using spindles of support bracket.



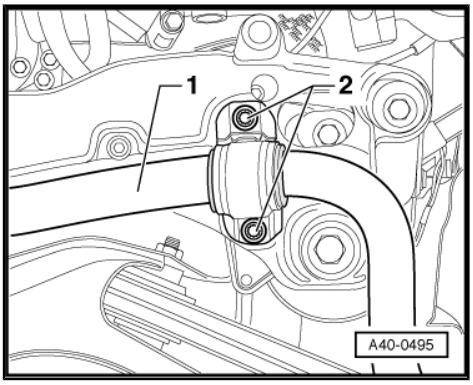
– Vehicles with auxiliary heater: remove bolts -arrows- securing exhaust pipe for auxiliary/additional heater to noise insulation.



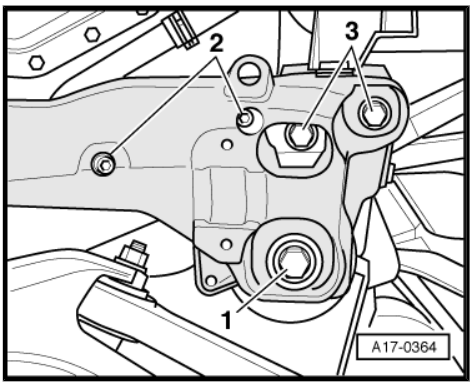
– Release quick-release fasteners -1- and -2- and take off noise insulation panels.



– Unscrew bolts -2- on retaining clamps (left and right) for anti-roll bar and move anti-roll bar -1- downwards.



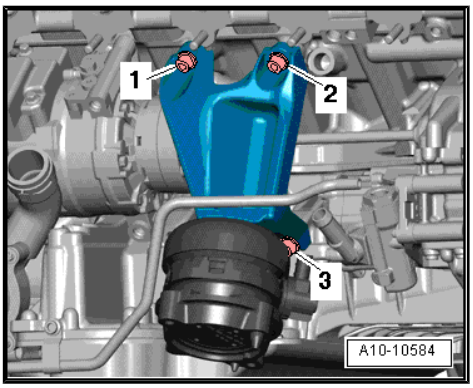
– Remove bolts -1, 2, 3- on left and right and detach engine cross member.



Engine mounting (left-side):

– Unplug electrical connector -arrow- on left electrohydraulic engine mounting solenoid valve - N144- .

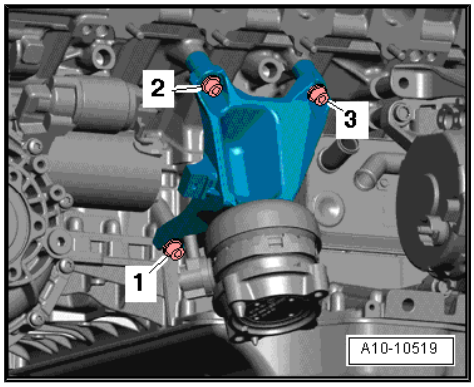
– Remove bolts -1 ... 4- and detach engine support with engine mounting.



Engine mounting (right-side):

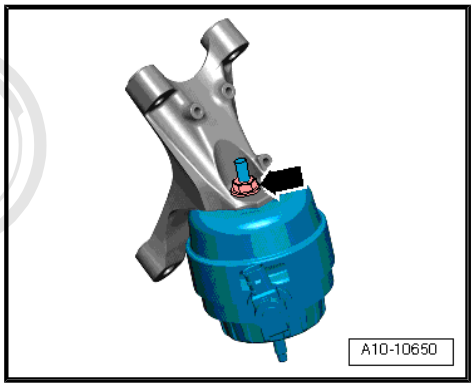
– Unplug electrical connector -arrow- on right electrohydraulic engine mounting solenoid valve - N145- .

– Remove bolts -1 ... 4- and detach engine support with engine mounting.



Continuation for both sides:

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



Installing

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

– Install subframe ⇒ Rep. gr. 40 .

– Install anti-roll bar ⇒ Rep. gr. 40 .

Tightening torques

♦ ⇒ “5.1 Assembly mountings - exploded view”, page 45

5.3 Removing, installing and adjusting mounting for torque reaction support

Special tools and workshop equipment required

♦ Electric drill

♦ Stepped centre bit (∅ 24 mm)

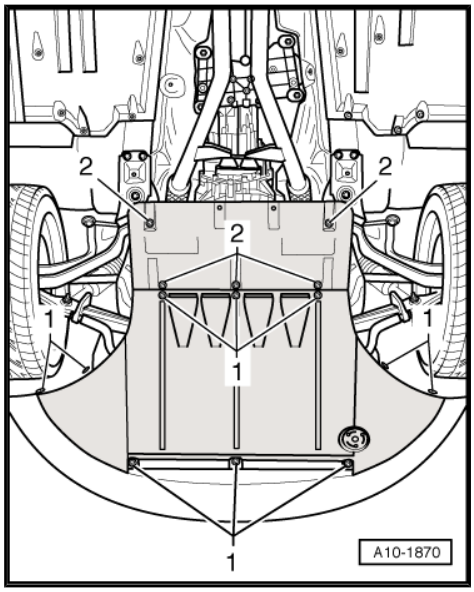
Removing

– Open quick-release fasteners -1- and remove noise insulation (front).

– Remove both front wheels ⇒ Rep. gr. 44 .

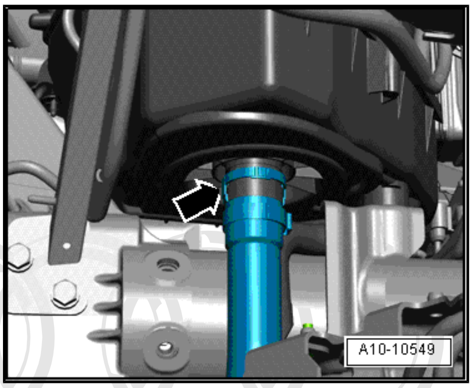
– Remove front sections of front wheel housing liners (left and right) ⇒ Rep. gr. 66 .

– Remove bumper cover (front) ⇒ Rep. gr. 63 .



– Remove bottom air hose from bottom section of air cleaner -arrow-.

– Remove headlight (right-side) ⇒ Electrical system; Rep. gr. 94 .



– Detach electrical connector -1- for air mass meter - G70- .

– Detach vacuum line -2- from air hose.

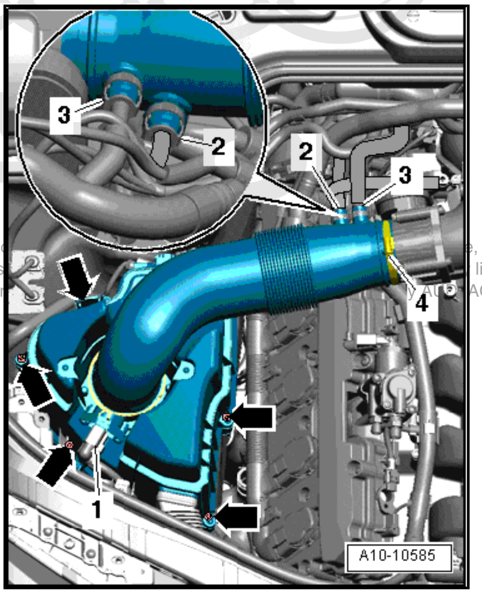
Rest-of-world vehicles:

– Detach crankcase breather hose -3- from air hose.

– Remove air hose -4- from intake manifold.

USA models:

– Open hose clips and move air hose -4- to one side.



> ⚠ Caution
>
> *Do not open hose connection -3- on USA models.*

All vehicles:

– Unscrew bolts -arrows- and remove top section of air cleaner (right-side).

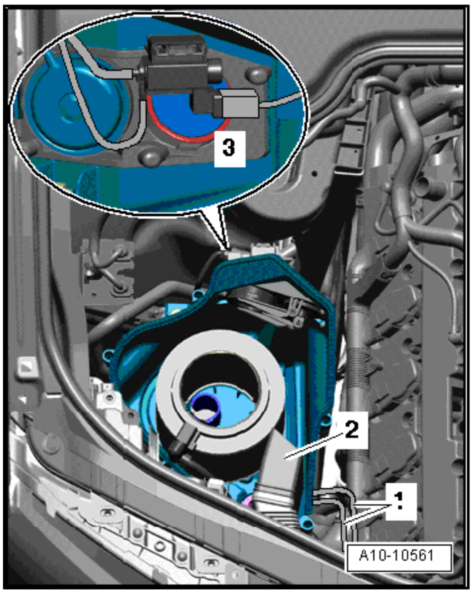
– Disconnect both vacuum hoses -1-.

– Remove air duct -2-.

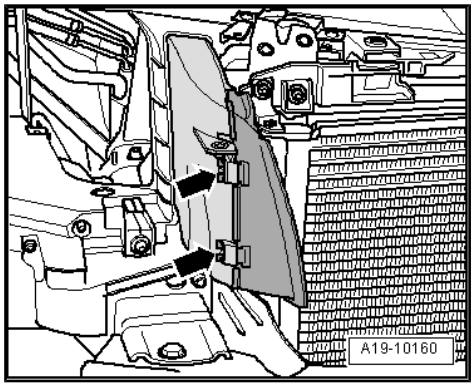
– Remove bolts -arrows-.

– Turn over bottom section of air cleaner and unplug electrical connector -3- at variable intake manifold change-over valve - N335- .

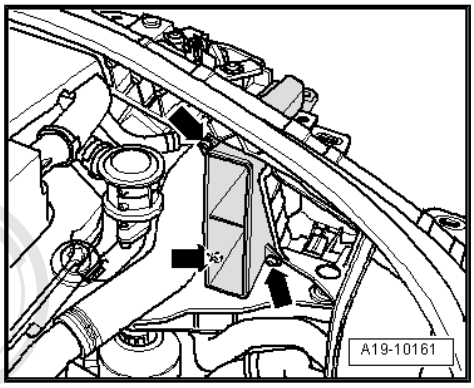
– Remove bottom section of air cleaner (right-side).



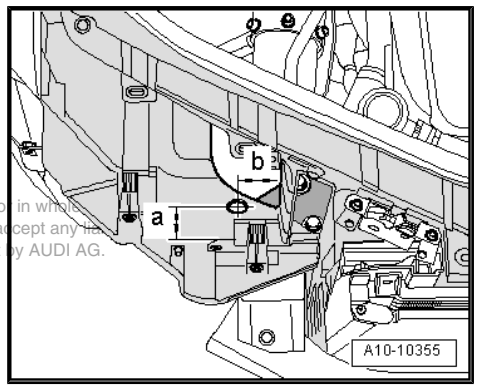
– Compress retainer catches -arrows- and detach air duct from lock carrier (front right).



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



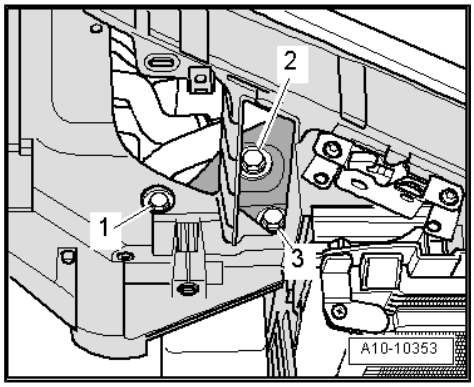
– Mark out drilling on lock carrier as illustrated according to dimensions -a- and -b-.
• Distance -a- = 40 mm.
• Distance -b- = 55 mm.
– Drill a hole of 24 mm dia.



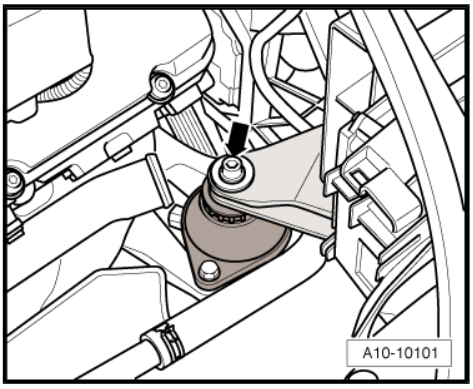
Note

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

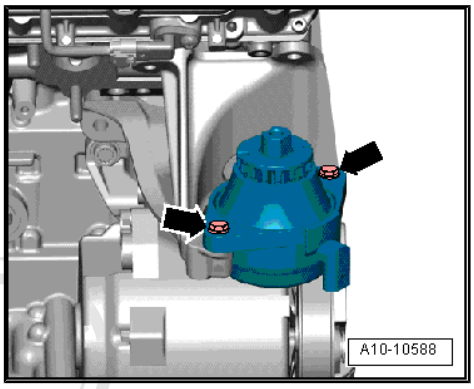
– Remove bolts -1- and -2- on bracket for torque reaction support.
– Slacken bolt -3- a few turns.



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

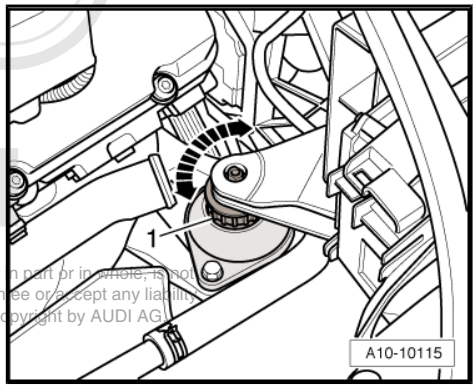


– Unscrew bolts -arrows- and remove mounting for torque reaction support.

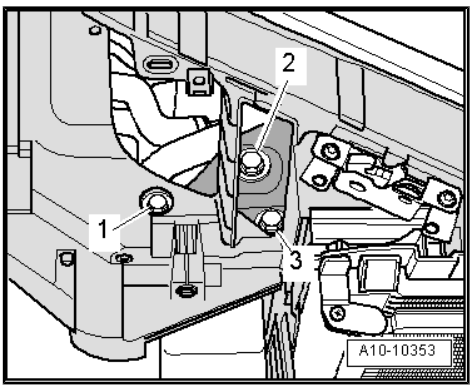


Installing

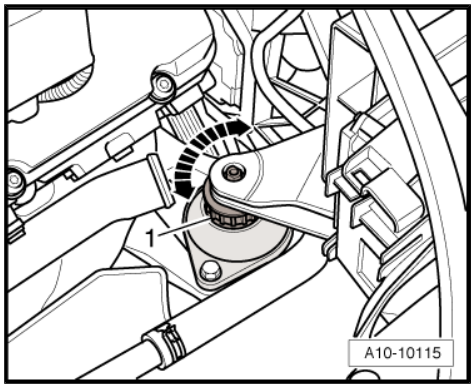
– Turn adjuster ring -1- on mounting for torque reaction support clockwise to stop.



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



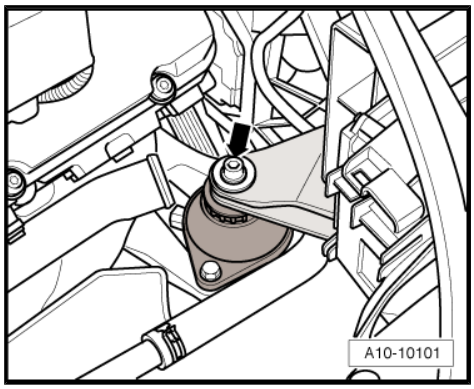
– Turn adjuster ring -1- by hand anti-clockwise until it comes into contact with bracket for torque reaction support.
– Then turn adjuster ring one turn clockwise.



– Tighten bolt -arrow- on mounting for torque reaction support.

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

– Install headlight ⇒ Electrical system; Rep. gr. 94
– Install bumper cover (front) ⇒ Rep. gr. 63 .
– Install air cleaner housing ⇒ Rep. gr. 24 .
– Fit front wheels ⇒ Rep. gr. 44 .
– Check headlight adjustment ⇒ Maintenance ; Booklet 404 .



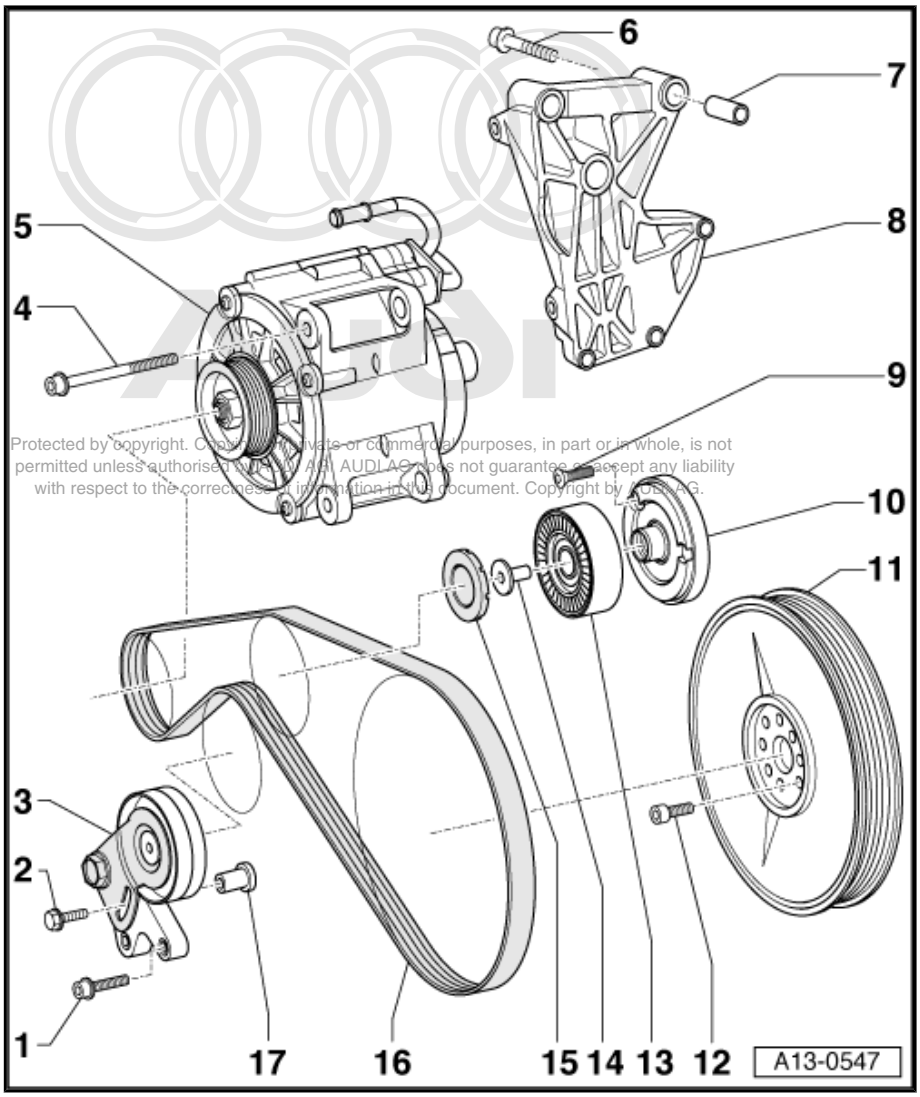
Tightening torques

◆ ⇒ “5.1 Assembly mountings - exploded view”, page 45

13 – Crankshaft group

1 Cylinder block (pulley end)

1.1 Poly V-belt drive - exploded view



1 - 25 Nm

2 - 25 Nm

3 - Tensioner for poly V-belt

4 - 22 Nm

5 - Alternator

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

6 - Bolt

- ❑ M8 - 25 Nm
- ❑ M10 - 46 Nm

7 - Dowel sleeve

- ❑ For bracket for alternator
- ❑ 2x

8 - Bracket for alternator

9 - 9 Nm

10 - Bracket for idler roller

11 - Vibration damper

- ❑ Removing and installing ⇒ page 59

12 - Bolt

- ❑ Renew
- ❑ Only use genuine bolts (same as original equipment): property class 12.9
- ❑ Apply locking fluid when installing non-self-locking bolts; for locking fluid, refer to ⇒ Electronic parts catalogue
- ❑ Tightening torque and sequence ⇒ page 56

13 - Idler roller for poly V-belt

14 - 22 Nm

15 - Cap

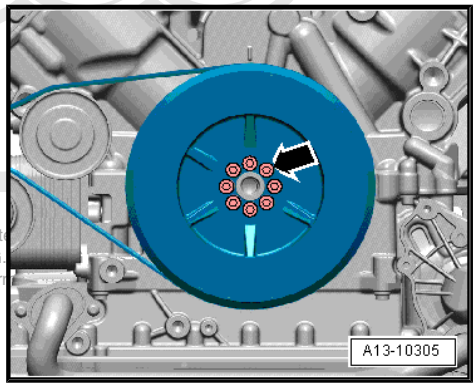
16 - Poly V-belt

- ❑ Check for wear
- ❑ Do not kink
- ❑ Before removing, mark direction of rotation with chalk or felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.
- ❑ Removing and installing ⇒ page 56

❑ Check that the belt is properly fitted on the pulleys when installing.

17 - Threaded bush

Vibration damper - tightening torque and sequence



Note

Renew the bolts tightened with specified tightening angle.

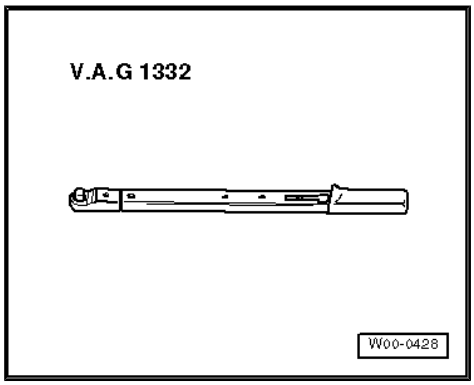
– Tighten bolts in 4 stages as follows:

Stage	Bolts	Tightening torque/angle specification
1.	-arrow-	15 Nm in diagonal sequence
2.	-arrow-	22 Nm in diagonal sequence
3.	-arrow-	Turn 90° further in diagonal sequence
4.	-arrow-	Turn 90° further in diagonal sequence

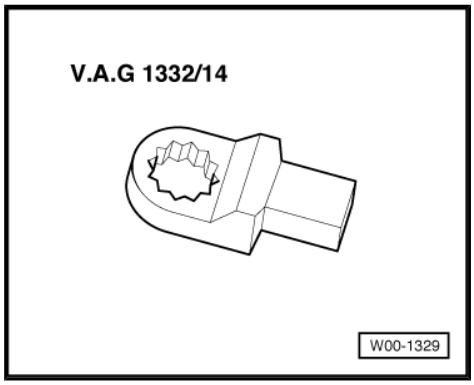
1.2 Removing and installing poly V-belt

Special tools and workshop equipment required

♦ Torque wrench - V.A.G 1332-

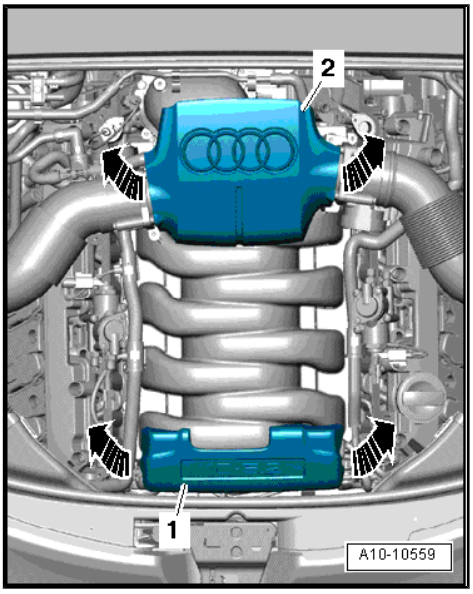


♦ Ring spanner insert AF 16 - V.A.G 1332/14-



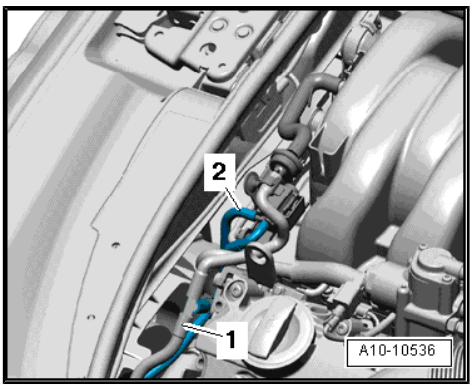
Removing

– Pull off engine cover panel (front) -1- -arrows-.

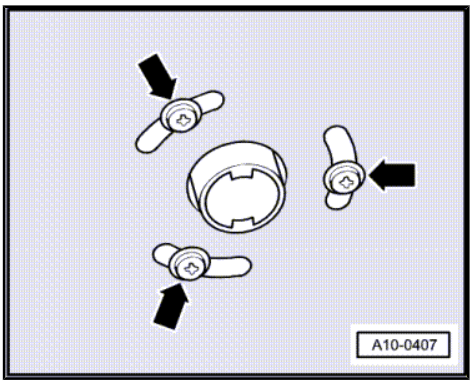


– Pull bonnet seal away from lock carrier and wing panels.

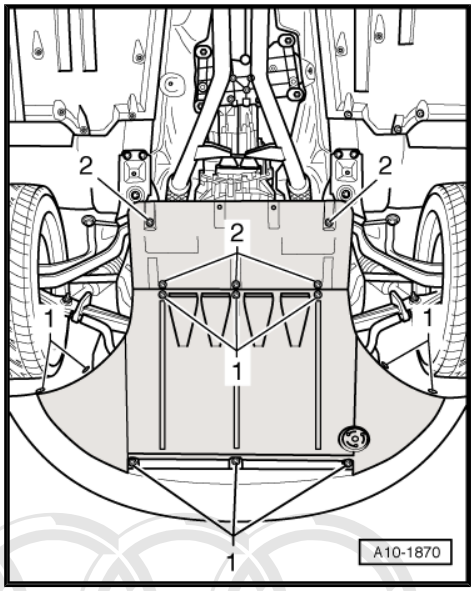
– Detach vacuum hoses -1- and -2- and move clear.



– Vehicles with auxiliary heater: remove bolts -arrows- securing exhaust pipe for auxiliary/additional heater to noise insulation.



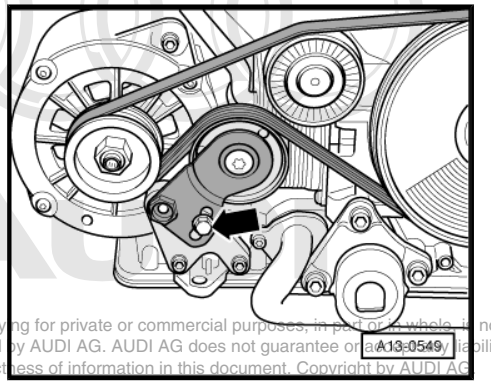
– Open quick-release fasteners -1- and remove noise insulation (front).



Note

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

– Unscrew tensioning bolt -arrow- and remove poly V-belt.



Installing

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

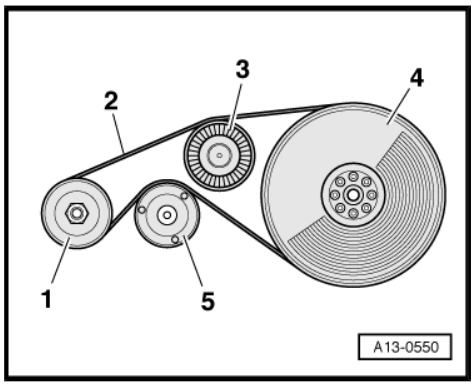
– Fit poly V-belt -2- onto pulleys in the following sequence:

1 - Alternator

3 - Idler roller

4 - Vibration damper

5 - Tensioning roller



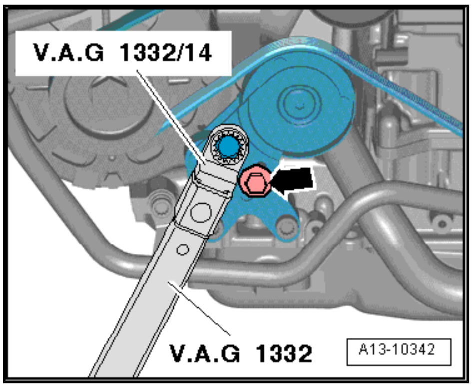
Note

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

– Apply torque wrench with ring spanner insert AF 16 - V.A.G 1332/14- to hexagon flats on tensioning roller and tension poly V-belt to 70 Nm.

– At the same time tighten tensioning bolt -arrow-.

– Start engine and check that belt runs properly.



Tightening torques

♦ ⇒ “1.1 Poly V-belt drive - exploded view”, page 55

1.3 Removing and installing vibration damper

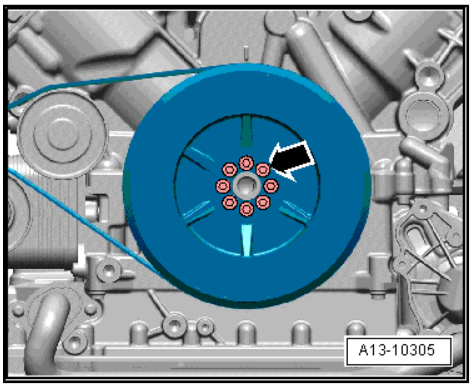
Removing

– Drain off coolant ⇒ page 187 .

– Remove radiator ⇒ page 214 .

– Remove radiator cowl ⇒ page 220 .

– Slacken off 8 bolts -arrow- on vibration damper several turns (counterhold with ring spanner on centre nut for alternator pulley).

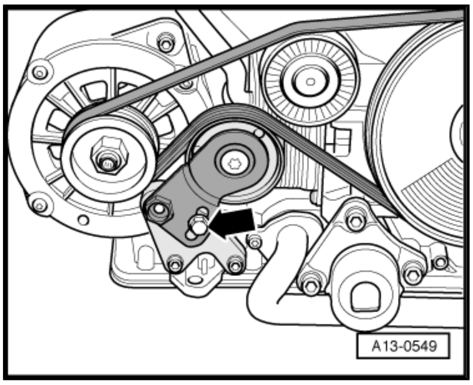


Note

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

– Unscrew tensioning bolt -arrow- and remove poly V-belt.

– Remove vibration damper.



Installing

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

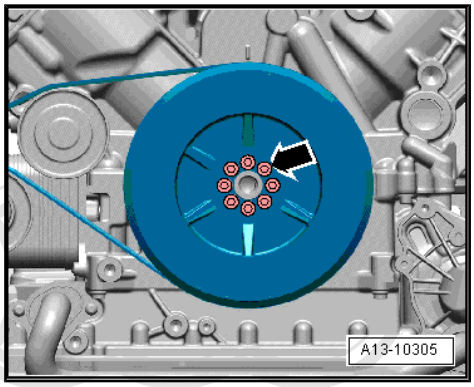
Note

♦ *Replace vibration damper bolts with new bolts of the correct type (same as original equipment) ⇒ Electronic parts catalogue .*

♦ *Apply locking fluid when installing non-self-locking bolts; for locking fluid, refer to ⇒ Electronic parts catalogue .*

• The vibration damper can only be fitted in one position (note dowel sleeve).

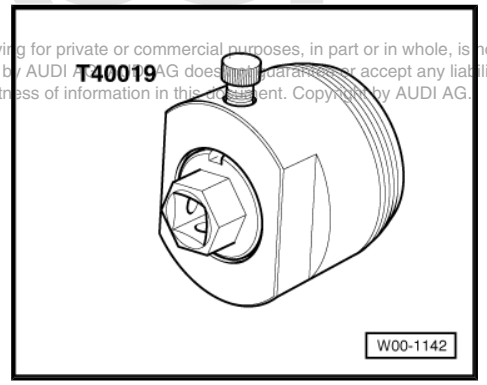
– Tighten bolts for vibration damper ⇒ page 56 .
– Install poly V-belt ⇒ page 56 .
– Install radiator cowl ⇒ page 220 .
– Install radiator ⇒ page 214 .
– Fill cooling system ⇒ page 190 .



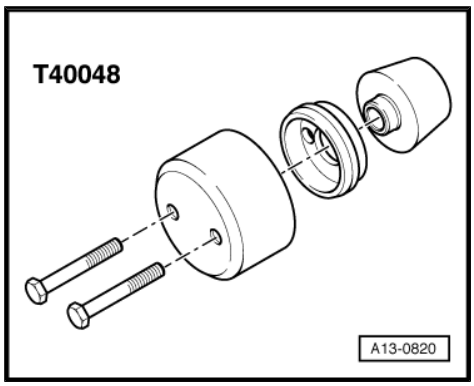
1.4 Renewing crankshaft oil seal (pulley end)

Special tools and workshop equipment required

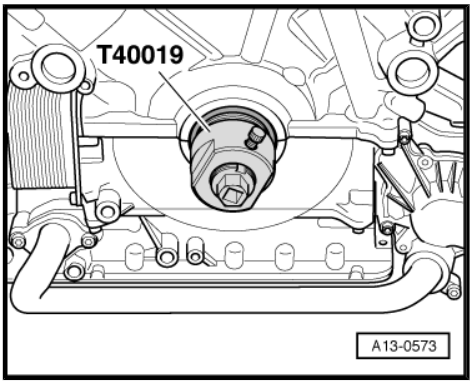
♦ Oil seal extractor - T40019-



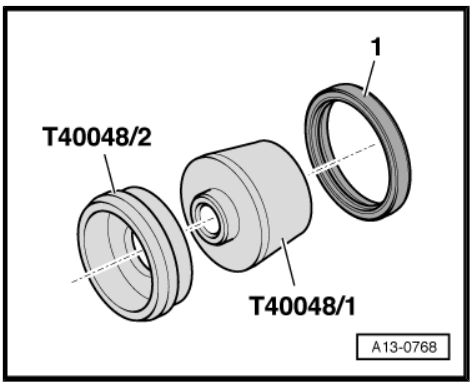
♦ Assembly tool - T40048-



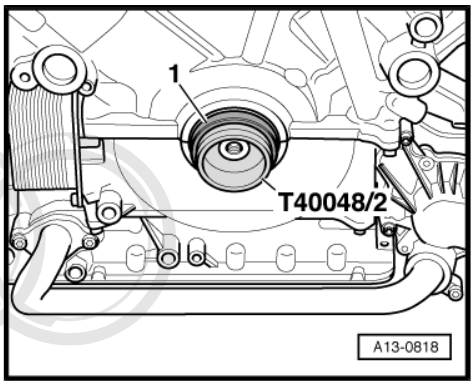
Procedure



- Drain off coolant ⇒ page 187 .
- Remove radiator ⇒ page 214 .
- Remove radiator cowl ⇒ page 220 .
- Remove vibration damper ⇒ page 59 .
- Adjust inner section of oil seal extractor - T40019- so it is flush with the outer section 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 the oil seal is pulled out.
- Clamp flats of oil seal extractor in vice. Remove oil seal with pliers.
- Clean running surface and sealing surface.



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

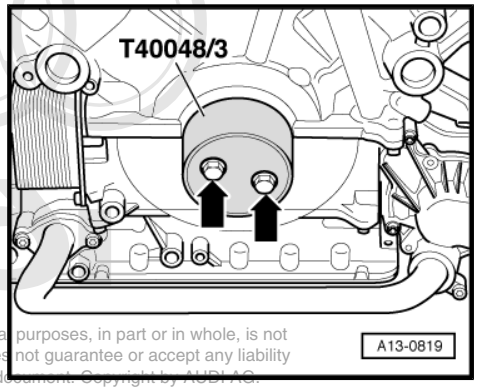


- Fit assembly sleeve - T40048/2- on crankshaft and slide oil seal -1- into sealing surface on engine.

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, $^1/_2$ 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 59 .
– Install poly V-belt ⇒ page 56 .
– Install radiator cowl ⇒ page 220 .
– Install radiator ⇒ page 214 .
– Fill cooling system ⇒ page 190 .

2 Cylinder block (gearbox end)

2.1 Drive plate - exploded view

1 - Drive plate
- ❑ Removing and installing ⇒ page 63
- ❑ Mark installation position for re-installation

2 - Washer
- ❑ 3.4 mm thick
- ❑ Mark installation position for re-installation

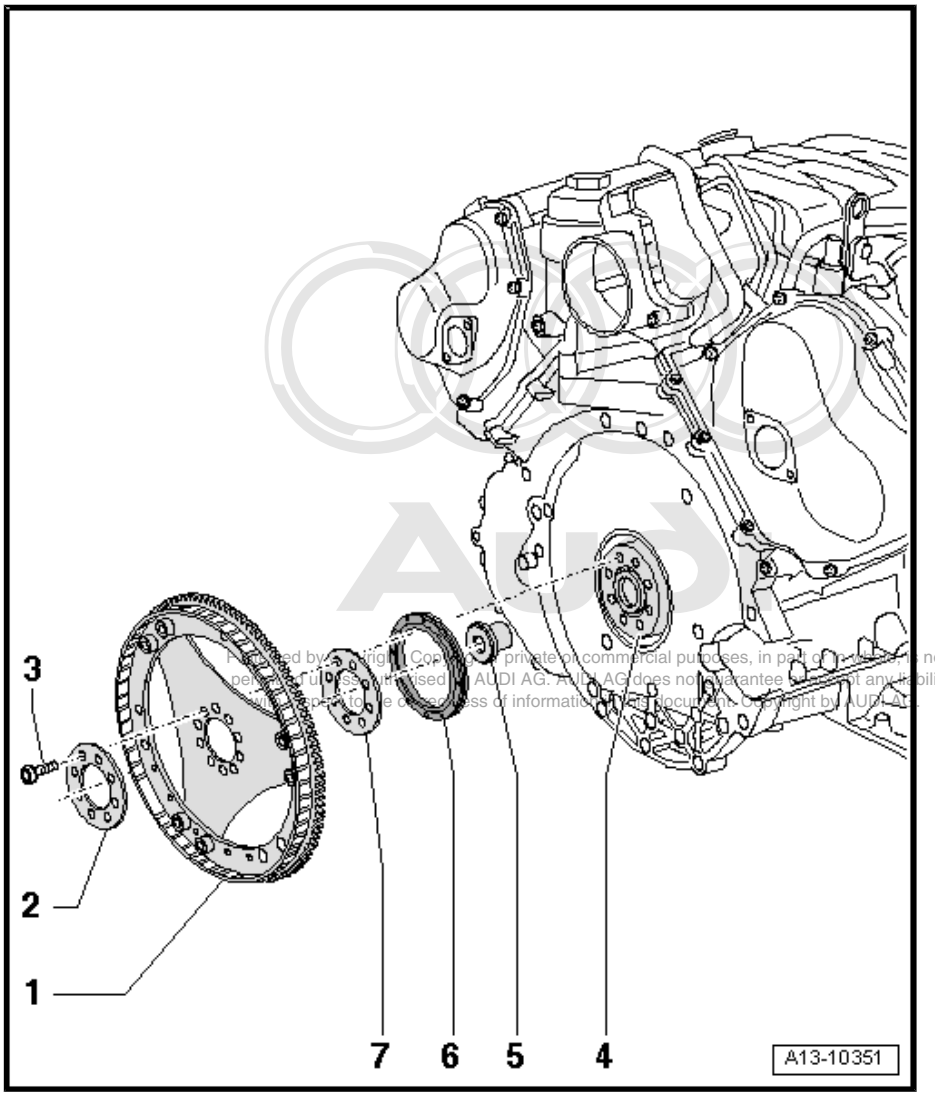
3 - 60 Nm + turn 90° further
- ❑ Renew

4 - Crankshaft

5 - Centring sleeve
- ❑ For torque converter
- ❑ Check whether fitted

6 - Crankshaft oil seal (gearbox end)
- ❑ Renewing ⇒ page 64

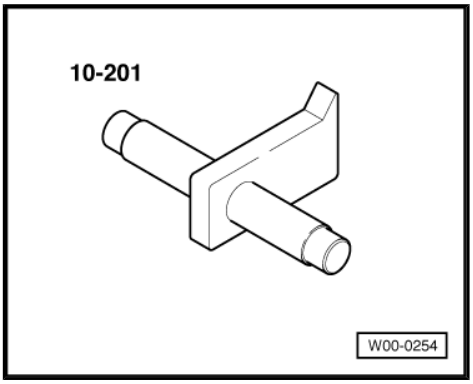
7 - Spacer
- ❑ 1.5 mm thick
- ❑ Mark installation position for re-installation



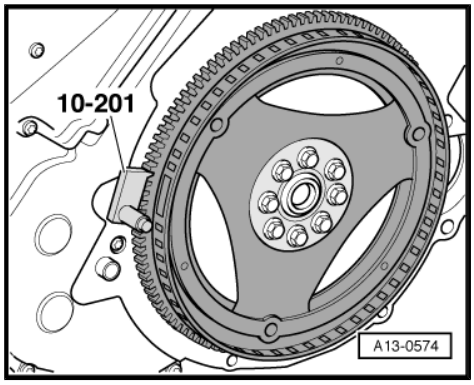
2.2 Removing and installing drive plate

Special tools and workshop equipment required

♦ Counterhold tool - 10 - 201-



Removing



- Engine separated from gearbox ⇒ page 27 , engine attached to scissor-type assembly platform - VAS 6131 A- or secured to engine and gearbox support ⇒ page 36 .

– Attach counterhold tool - 10 - 201- in order to loosen bolts.

– Mark installation position of drive plate on crankshaft with a felt-tip pen.

– Unbolt drive plate.

– Take out shim located behind.

Installing

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

– Install drive plate with shim.

– Use new securing bolts.

– Reverse position of counterhold tool - 10 - 201- in order to tighten bolts.

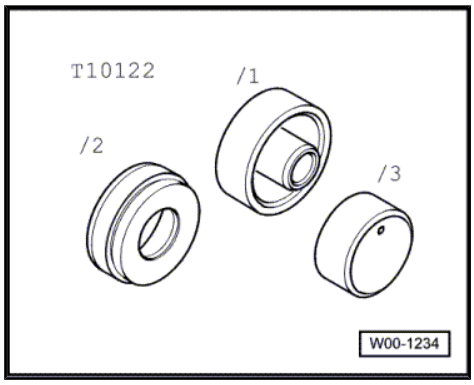
Tightening torques

♦ ⇒ “2.1 Drive plate - exploded view”, page 63

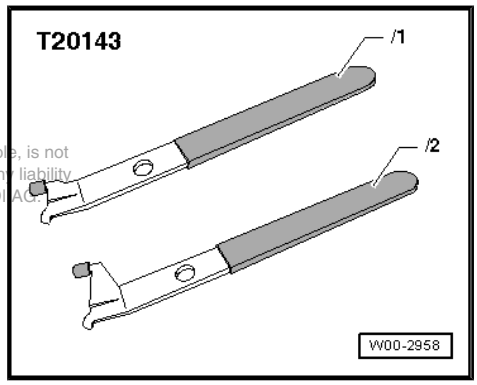
2.3 Renewing crankshaft oil seal (gearbox end)

Special tools and workshop equipment required

♦ Fitting tool - T10122-



♦ Extractor tool - T20143-



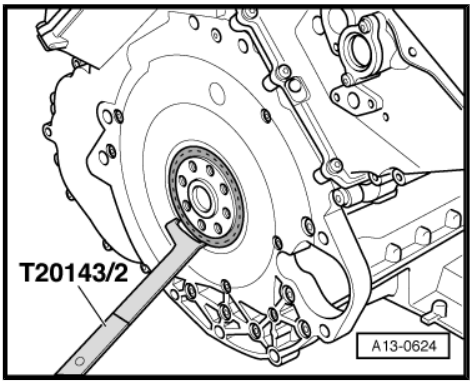
Procedure

- Engine separated from gearbox ⇒ page 27 , engine attached to scissor-type assembly platform - VAS 6131 A- or secured to engine and gearbox support ⇒ page 36 .

– Remove drive plate ⇒ page 63 .

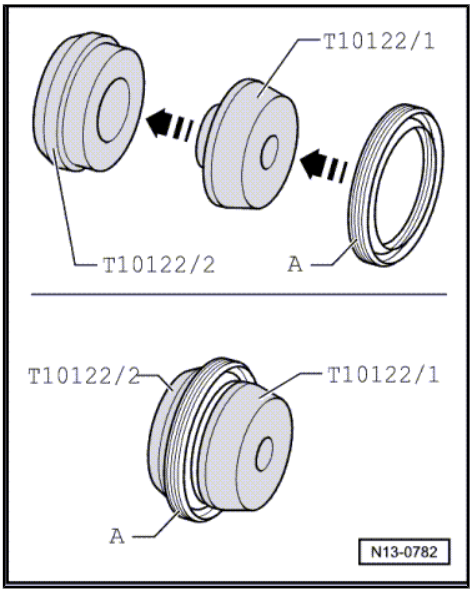
– Pry out oil seal using extractor tool -T20143/2- .

– Clean running surface and sealing surface.

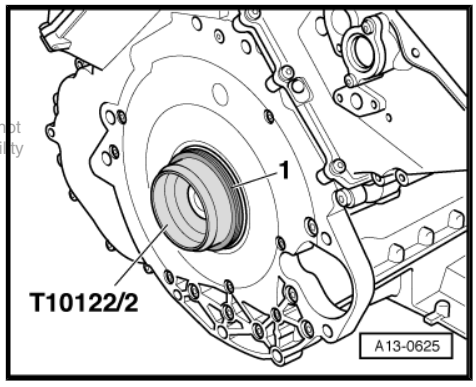


– Fit assembly aid -T10122/1- onto assembly sleeve -T10122/2- and slide oil seal -A- onto assembly sleeve.

– Take off assembly aid.



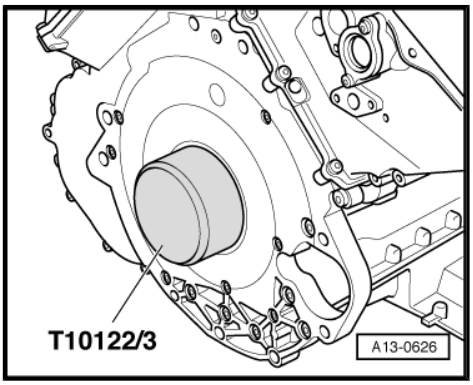
– Fit assembly sleeve -T10122/2- with oil seal -1- onto crankshaft.



– Press in oil seal with thrust sleeve -T10122/3- evenly so that it is flush all round.

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

– Install drive plate ⇒ page 63 .

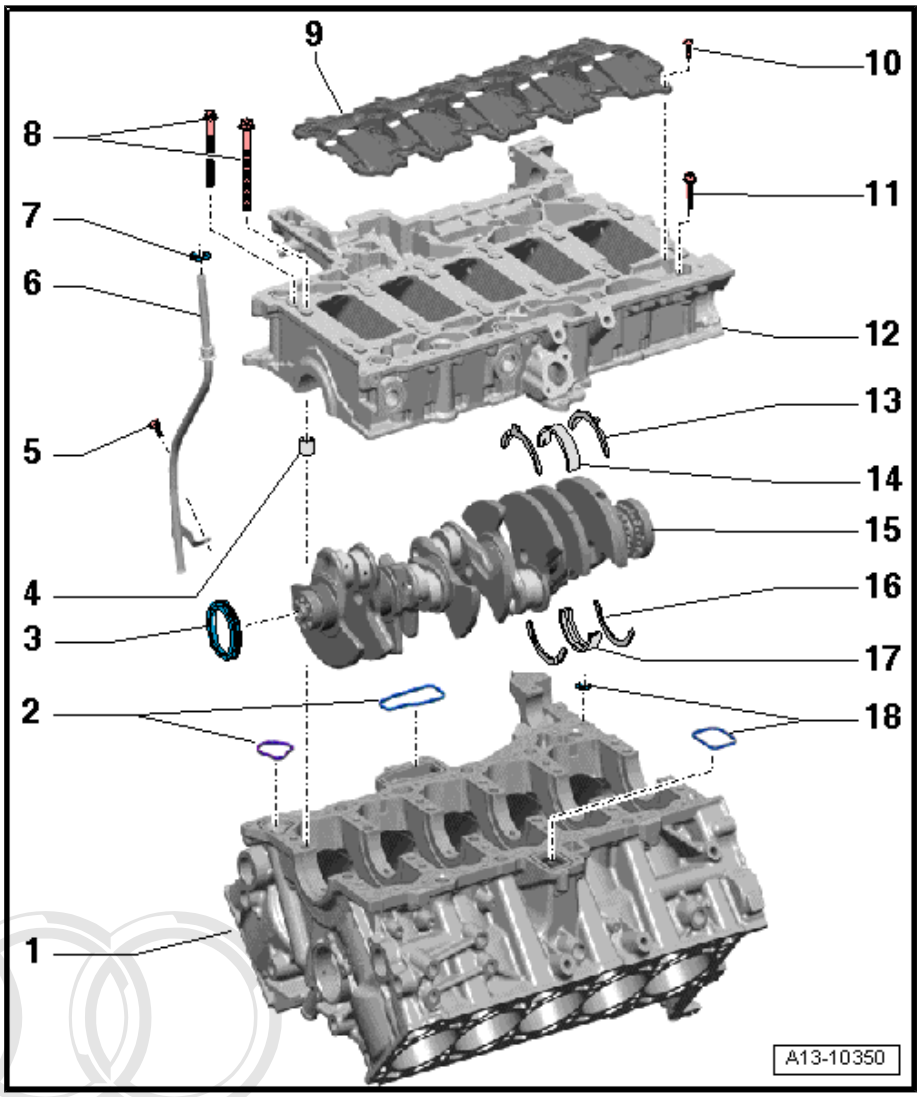


3 Crankshaft

Note

When carrying out repairs, secure engine with bracket - VAS 6095/1-7- to engine and gearbox support - VAS 6095- ⇒ page 36 .

3.1 Crankshaft - exploded view



1 - Cylinder block
- ❑ Matched to -item 12-
- ❑ Applying sealant onto cylinder block (for retaining frame) ⇒ page 68

2 - Gaskets
- ❑ Renew

3 - Oil seal for crankshaft (pulley end)
- ❑ Renewing ⇒ page 60

4 - Dowel sleeve
- ❑ 3x
- ❑ Insert in retaining frame
- ❑ Installation position ⇒ page 68

5 - 9 Nm

6 - Guide tube for oil dipstick

7 - O-ring
- ❑ Renew

8 - Bolts
- ❑ For retaining frame
- ❑ Renew
- ❑ Use old bolts when measuring radial clearance
- ❑ Different bolt lengths
- ❑ Tightening sequence ⇒ page 68

9 - Baffle plate

10 - Bolt
- ❑ Tightening torque and sequence ⇒ page 67

11 - Bolt
- ❑ For sealing surfaces: cylinder block/retaining frame
- ❑ Different bolt lengths
- ❑ Tightening torques and sequence ⇒ page 68

12 - Retaining frame
- ❑ Matched to -item 1-
- ❑ Applying sealant onto cylinder block (for retaining frame) ⇒ page 68

- ❑ Tightening sequence ⇒ page 68

13 - Thrust washer

- ❑ Only fitted on 4th crankshaft bearing
- ❑ Oil groove faces outwards
- ❑ Make sure it engages in retaining frame
- ❑ Measuring axial clearance of crankshaft ⇒ page 71

14 - Bearing shell

- ❑ For retaining frame (without oil groove)
- ❑ Renew used bearing shells
- ❑ Fit new bearing shells for retaining frame with the correct colour coding: for new crankshafts ⇒ page 69 , for used and machined crankshafts ⇒ page 70

15 - Crankshaft

- ❑ Measuring axial clearance ⇒ page 71
- ❑ Measuring radial clearance ⇒ page 72
- ❑ Crankshaft dimensions ⇒ page 71

16 - Thrust washer

- ❑ Only fitted on 4th crankshaft bearing
- ❑ Oil groove faces outwards
- ❑ Measuring axial clearance of crankshaft ⇒ page 71

17 - Bearing shell

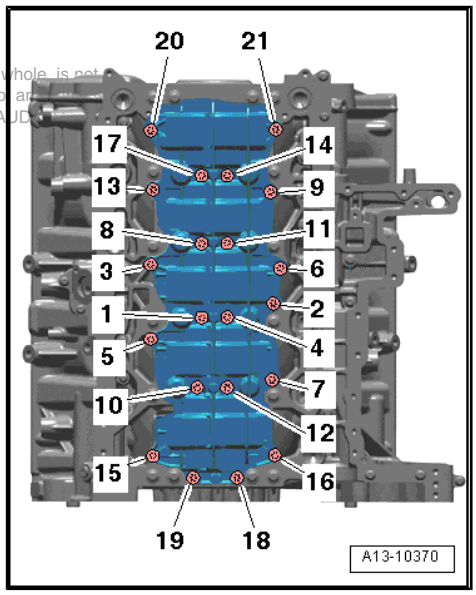
- ❑ For cylinder block (with oil groove)
- ❑ Renew used bearing shells
- ❑ Fit new bearing shells for cylinder block with the correct colour coding: for new crankshafts ⇒ page 69 , for used and machined crankshafts ⇒ page 70

18 - Gaskets

- ❑ Renew

Baffle plate - tightening torque and sequence

– Tighten bolts to 9 Nm in the sequence -1 ... 21-.



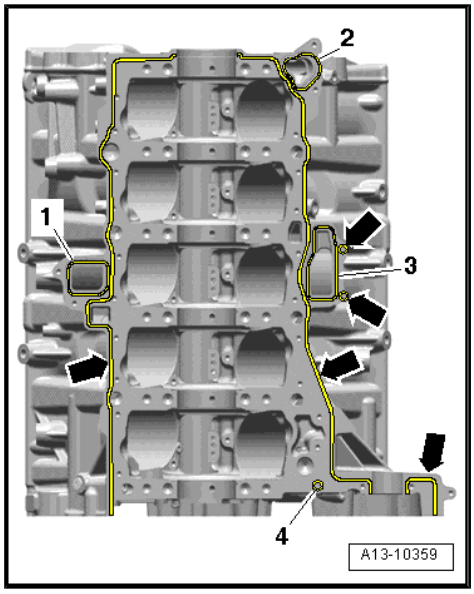
Applying sealant onto cylinder block (for retaining frame)

– Clean sealing surfaces; they must be free of oil and grease.

– Apply the beads of sealant -arrows- onto the clean sealing surfaces of the retaining frame as illustrated.

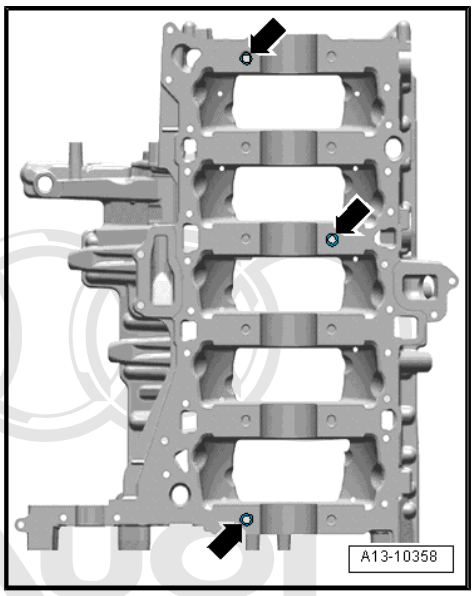
• Width of beads of sealant: 2.0 mm.

– Fit gaskets -1 … 4-.



Fitting location of dowel sleeves

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



Installing retaining frame

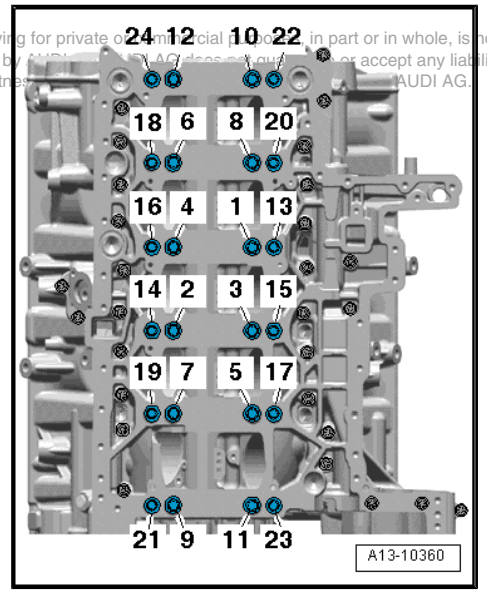
Note

Renew the bolts tightened with specified tightening angle.

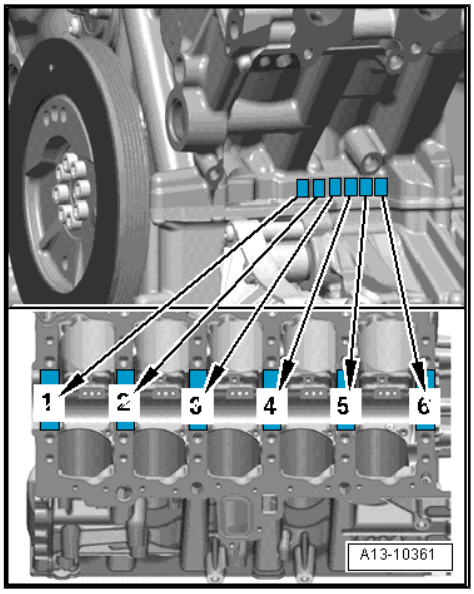
– Tighten bolts in 5 stages in the sequence shown:

Stage	Bolts	Tightening torque/tightening angle
1.	-1 … 12-	30 Nm
2.	-13 … 24-	20 Nm
3.	-1 … 12-	50 Nm
4.	-13 … 24-	30 Nm
5.	-1 … 24-	Turn 90° further

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



3.2 Allocation of main bearing shells for new crankshaft



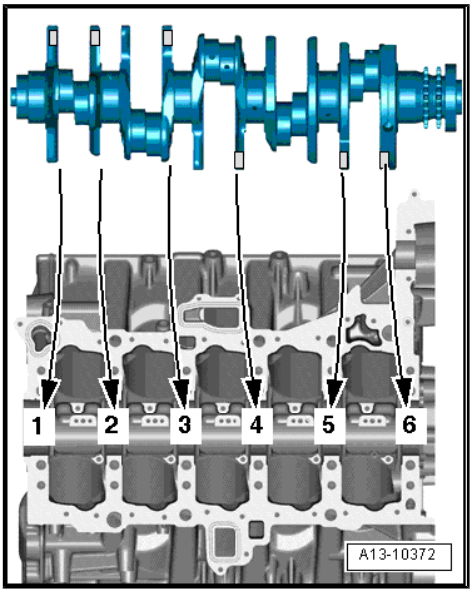
Matching crankshaft bearing shells to bearings in cylinder block

- 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

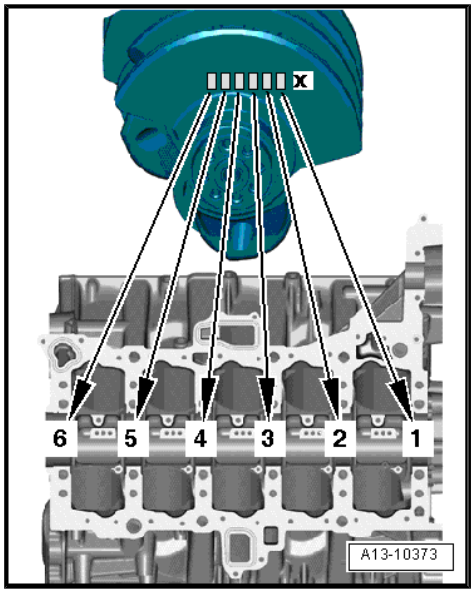
- Bearing shells of the correct thickness are matched to the bearings in the retaining frame at the factory. Coloured dots on the side of the bearing shells are used to identify the bearing shell thickness.
- The allocation of the bearing shells to the retaining frame is indicated by colour codings on 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).

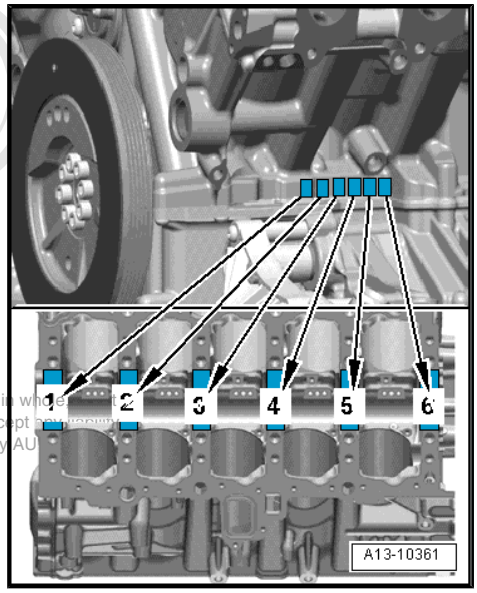
Letter on crankshaft	Colour coding of bearing
R =	Red
G =	Yellow
B =	Blue



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 a used or machined crankshaft, the main bearing journals must be measured in order to allocate the correct bearing shells.
- Basic dimension for main bearing journal = ∅ 65.00 mm
- Repair undersize for main bearing journal = ∅ 64.75 mm
- 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 a used or machined crankshaft, the main bearing journals must be measured in order 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 ∅	Colour code of bearing shells for retaining frame		
Dimensions (in mm)	**Red**	**Yellow**	**Blue**
Basic dimension 65.000	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

Main bearing journal ∅	Colour code of bearing shells for retaining frame		
Dimensions (in mm)	**Red**	**Yellow**	**Blue**

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

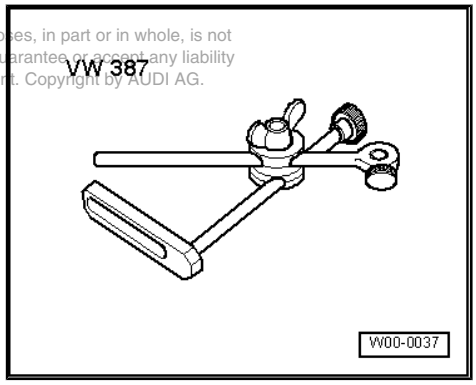
3.4 Crankshaft dimensions

Honing dimension	Crankshaft bearing journal ∅ mm	Crankshaft conrod journal ∅ mm
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

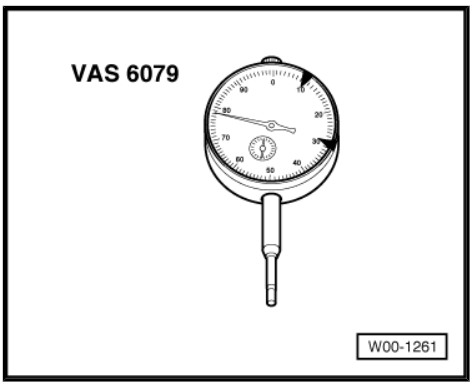
3.5 Measuring axial clearance of crankshaft

Special tools and workshop equipment required

- Universal dial gauge bracket - VW 387-



- Dial gauge - VAS 6079-



Procedure

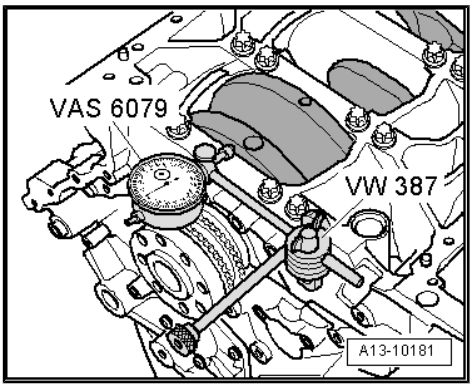
– Secure dial gauge - VAS 6079- with universal dial gauge bracket - VW 387- to cylinder block as shown in illustration.

– 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 ... 0.158 mm



3.6 Measuring radial clearance of crankshaft

Special tools and workshop equipment required

♦ Plastigage

Procedure

– 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 secure with old bolts ⇒ page 68 without rotating 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.

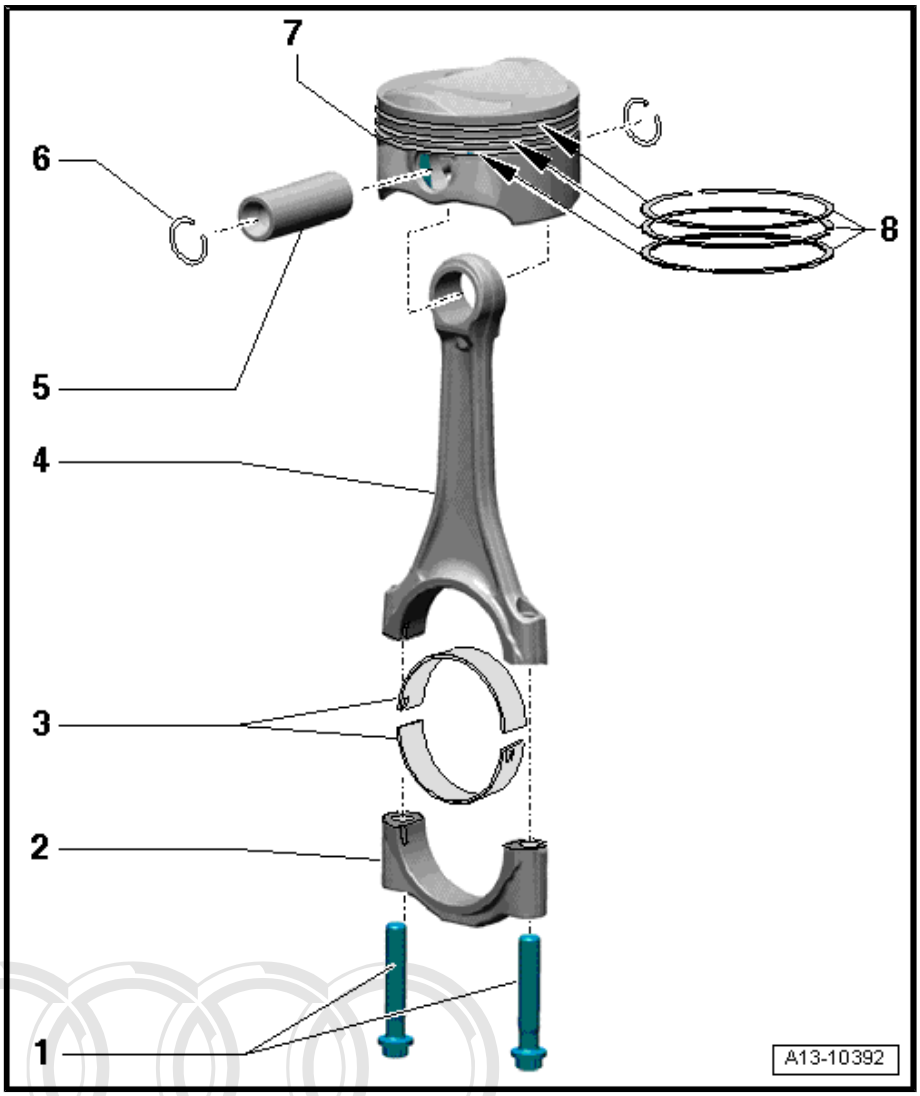
– When carrying out final assembly, renew bolts.

4 Pistons and conrods

Note

Oil spray jet for piston cooling ⇒ page 76 .

4.1 Pistons and conrods - exploded view



1 - Conrod bolt, 50 Nm + turn 90° further

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

2 - Conrod bearing cap

- ❑ Do not interchange
- ❑ Mark cylinder allocation in colour ⇒ page 75
- ❑ Installation position of conrod pairs ⇒ page 75

3 - Bearing shells

- ❑ Ensure that retaining lugs are securely seated.
- ❑ Renew used bearing shells
- ❑ There are oversized bearings available for machined crankshaft conrod journals ⇒ Electronic parts catalogue

4 - Conrod

- ❑ Only renew as a complete set
- ❑ Mark cylinder allocation in colour ⇒ page 75
- ❑ Installation position of conrod pairs ⇒ page 75
- ❑ Axial clearance for each conrod pair (when new): 0.20 … 0.38 mm
- ❑ Measuring radial clearance ⇒ page 76

5 - Piston pin

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

6 - Circlip

- ❑ Renew

7 - Piston

- ❑ Installation position for piston ⇒ page 75
- ❑ Piston and cylinder dimensions, piston allocation for cylinder bore ⇒ page 76
- ❑ Checking ⇒ page 74

- ❑ Install using piston ring clamp
- ❑ Measuring cylinder bore ⇒ page 75

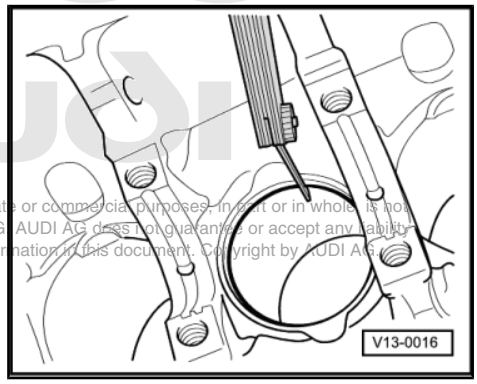
8 - Piston rings

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

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.

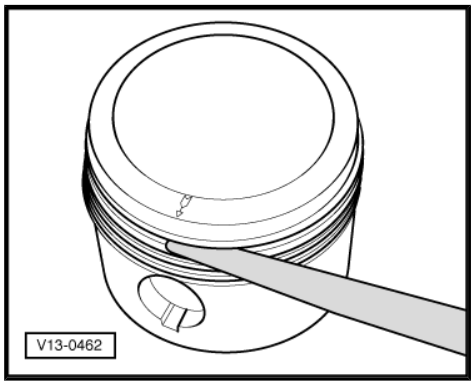


Piston ring	new mm	Wear limit mm
1st compression ring	0.20 … 0.35	0.80
2nd compression ring	0.20 … 0.40	0.80
Oil scraper ring	0.20 … 0.40	– 1)

• 1) Specification not yet available.

Measuring ring-to-groove clearance

– Clean groove in piston before checking clearance.

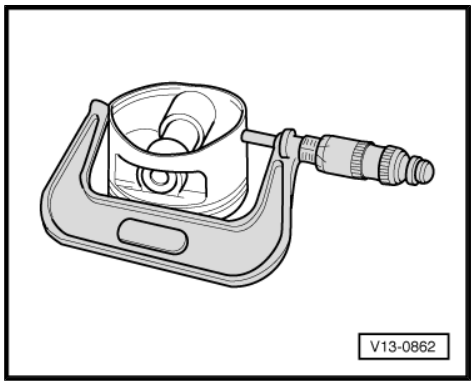


Piston ring	new mm	Wear limit mm
1st compression ring	0.035 … 0.085	0.200
2nd compression ring	0.005 … 0.045	0.200
Oil scraper ring	0.01 … 0.05	0.15

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.



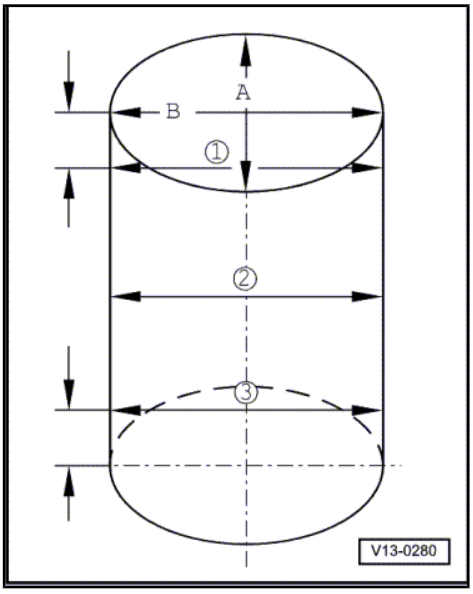
Nominal dimension
⇒ “4.2 Piston and cylinder dimensions”, page 76 .

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.

Nominal dimension
⇒ “4.2 Piston and cylinder dimensions”, page 76 .



Installation position of pistons

– Mark cylinder allocation in colour on piston crown.

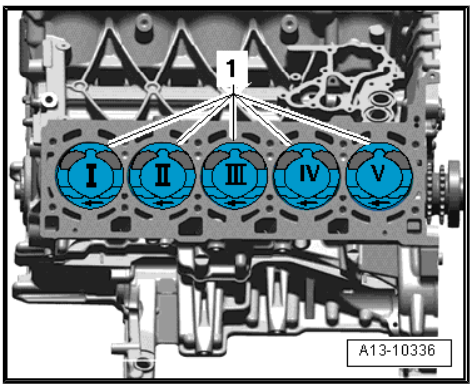
Note

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

Installation position:

• Arrows on piston crowns point to pulley end.

• Large valve recesses -1- point to centre of engine.



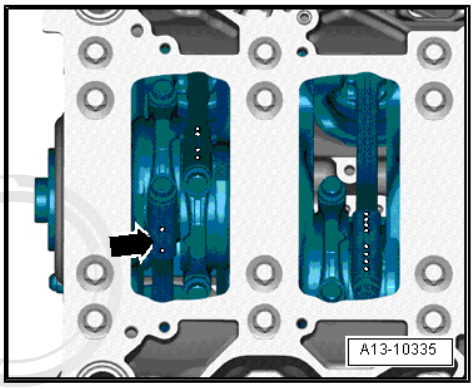
Marking conrods

Note

♦ *Only renew conrods as a complete set.*

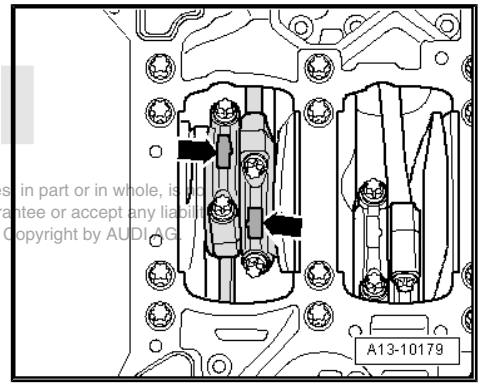
♦ *Do not interchange conrod bearings.*

– Prior to removal, use a coloured pen to mark matching conrods and conrod bearing caps with cylinder numbers -arrow-.



Conrod installation position

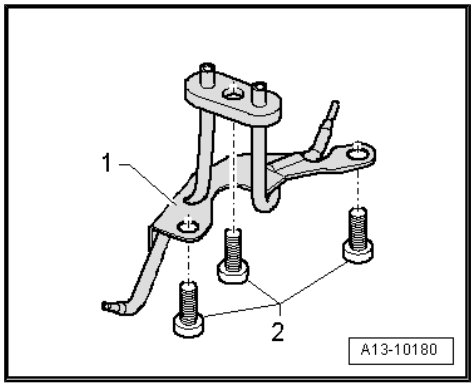
• The cast lugs -arrows- on the ground surfaces of conrod pairs 1 and 2; 3 and 4; 5 and 6; 7 and 8; 9 and 10 must face one another.



Oil spray jet for piston cooling

1 - Oil spray jet

2 - Bolts, 9 Nm. Apply locking fluid when installing; for locking fluid, refer to ⇒ Electronic parts catalogue



Caution

- *Do not bend oil spray jets.*
- *Always renew bent oil spray jets.*

4.2 Piston and cylinder dimensions

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

Cylinder bore ∅ mm	Piston ∅ mm
84.510 ± 0.005	84.490 [1)]
84.610 ± 0.005	84.590 [1)]

• [1)] Dimensions including coating (thickness 0.01 mm). The coating will wear down in service.

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 caps and secure with old bolts ⇒ Item 1 (page 73) without rotating crankshaft.

– Remove conrod bearing caps once more.

– Compare width of Plastigage with measurement scale:

Radial clearance:

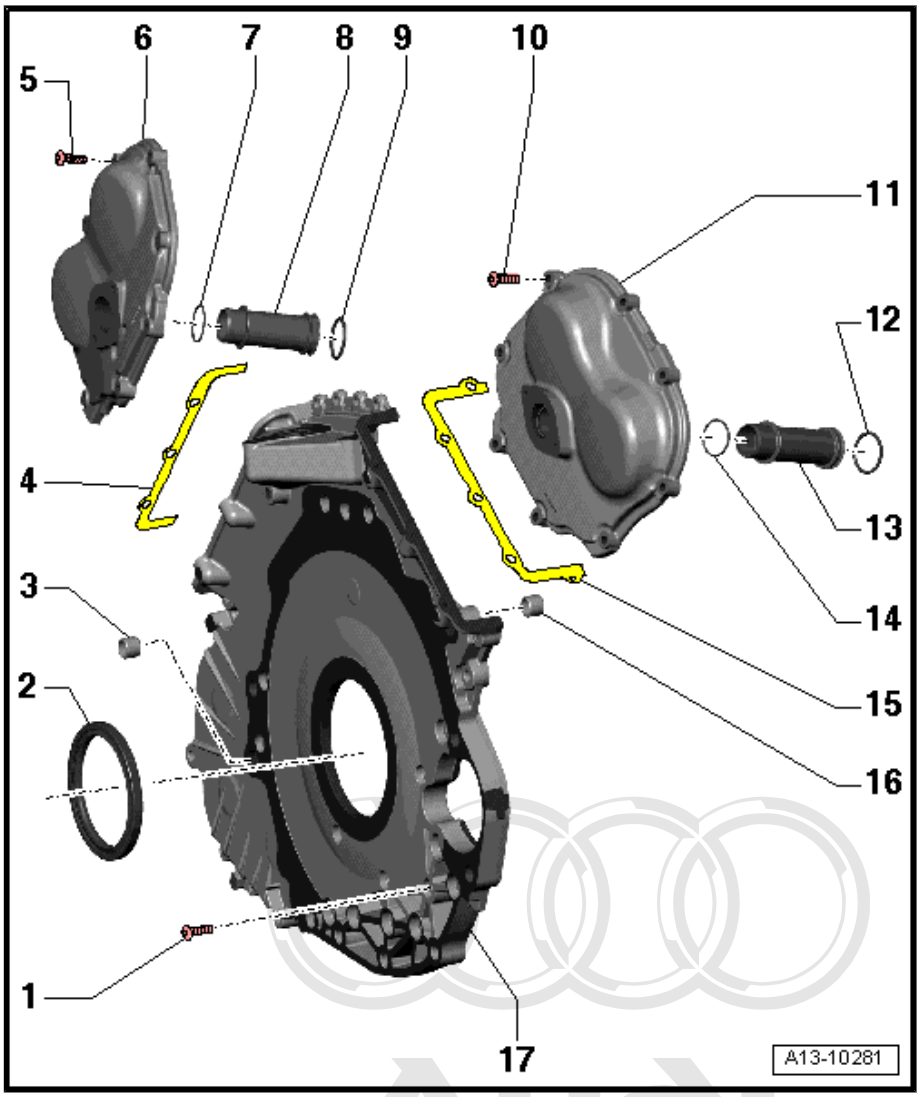
- New: 0.020 ... 0.069 mm.
- Wear limit: 0.120 mm.

– When carrying out final assembly, renew bolts.

15 – Cylinder head, valve gear

1 Chain drive

1.1 Timing chain covers - exploded view



1 - Bolt
- ❑ Renew M6 bolts
- ❑ Tightening torque and sequence ⇒ page 78

2 - Crankshaft oil seal (gearbox end)
- ❑ Renewing ⇒ page 64

3 - Dowel sleeve
- ❑ 2x

4 - Cylinder head gasket (left-side)

5 - Bolt
- ❑ Tightening torque and sequence ⇒ page 78

6 - Timing chain cover (left-side)
- ❑ Removing and installing ⇒ page 78

7 - O-ring
- ❑ Renew

8 - Intermediate coolant pipe (left-side)
- ❑ Use suitable drift to drive out

9 - O-ring
- ❑ Renew

10 - Bolt
- ❑ Tightening torque and sequence ⇒ page 78

11 - Timing chain cover (right-side)
- ❑ Removing and installing ⇒ page 78

12 - O-ring
- ❑ Renew

13 - Intermediate coolant pipe (right-side)
- ❑ Use suitable drift to drive out

14 - O-ring
- ❑ Renew

15 - Cylinder head gasket (right-side)

16 - Dowel sleeve
- ❑ 2x

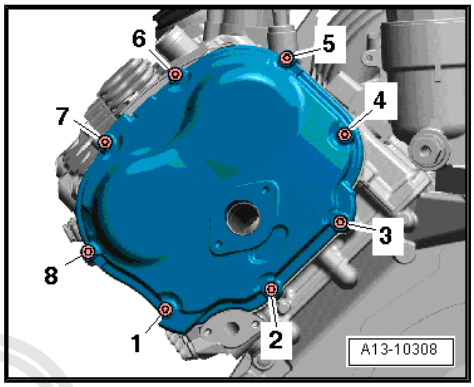
17 - Timing chain cover (bottom)

❑ Removing and installing ⇒ page 82

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

– Tighten bolts in 2 stages in the sequence shown:

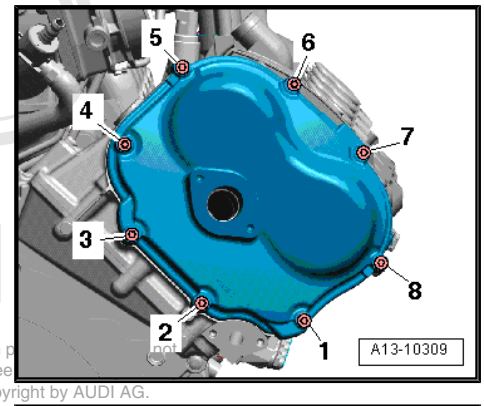
Stage	Bolts	Tightening torque
1.	-1 … 8-	Screw in by hand until contact is made
2.	-1 … 8-	9 Nm



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

– Tighten bolts in 2 stages in the sequence shown:

Stage	Bolts	Tightening torque
1.	-1 … 8-	Screw in by hand until contact is made
2.	-1 … 8-	9 Nm



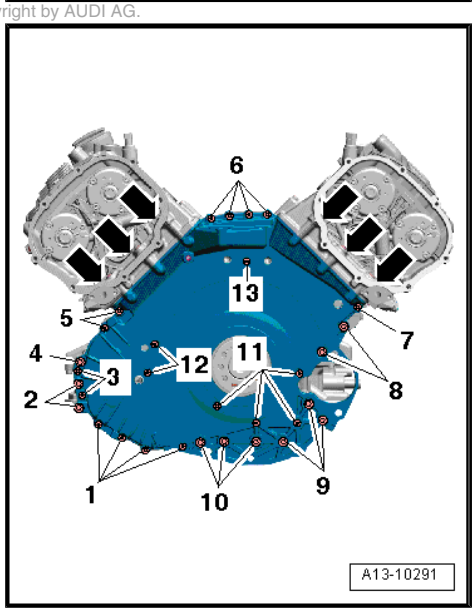
Timing chain cover (bottom) - tightening torque and sequence

Note

Renew the bolts tightened with specified tightening angle.

– Tighten bolts for timing chain cover (bottom) in 6 stages as follows:

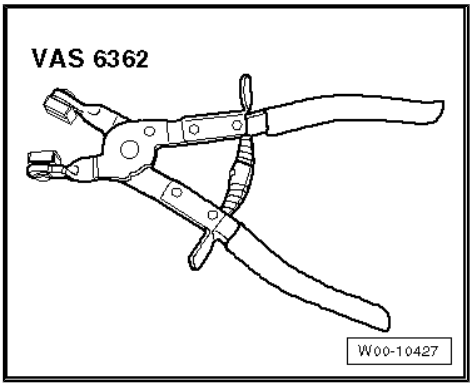
Stage	Bolts	Tightening torque/angle specification
1.	-arrows-	5 Nm
2.	-1 … 11-	8 Nm in diagonal sequence
3.	-arrows-	11 Nm
4.	-2, 7, 8-	22 Nm
5.	-1, 3, 4, 5, 6, 9, 10, 11-	Turn 90° further
6.	-arrows-	Turn 90° further



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

Special tools and workshop equipment required

♦ Hose clip pliers - VAS 6362-



♦ Electric drill with plastic brush attachment

♦ Safety goggles

♦ Sealant ⇒ Electronic parts catalogue

Removing

• Engine removed and in position on scissor-type assembly platform - VAS 6131 A- with gearbox attached.

Note

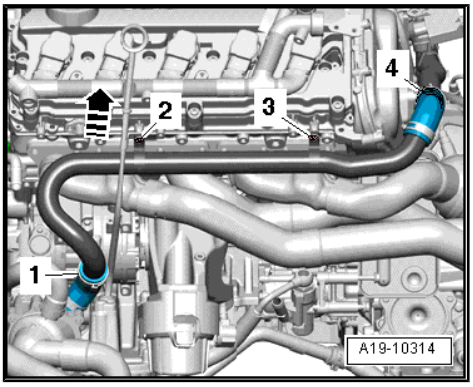
♦ *Fit all heat shields and heat insulation sleeves in the original positions when installing.*

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

– Remove bolts -2- and -3-.

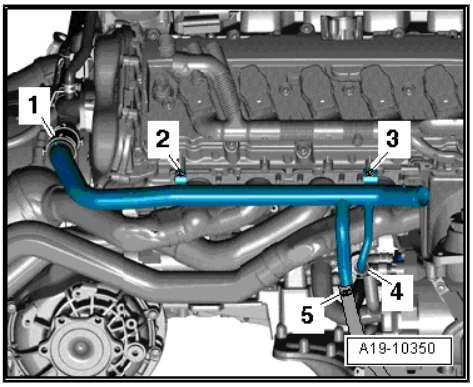
– Pull the guide tube for oil dipstick out upwards -arrow-.

– Loosen hose clips -1- and -4- and detach coolant pipe (left-side) from coolant hoses.

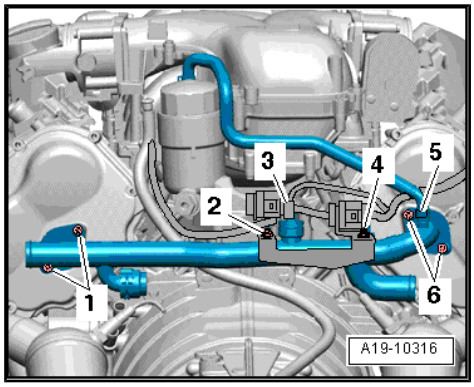


– Remove bolts -2- and -3-.

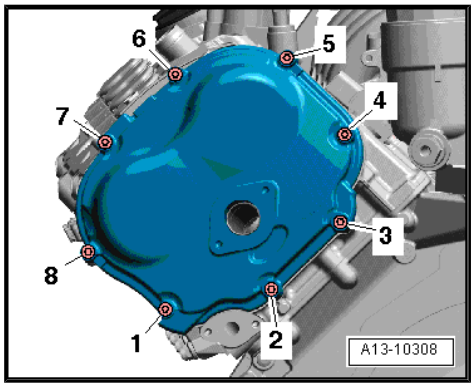
– Loosen hose clips -1, 4, 5- and detach coolant pipe (right-side) from coolant hoses.



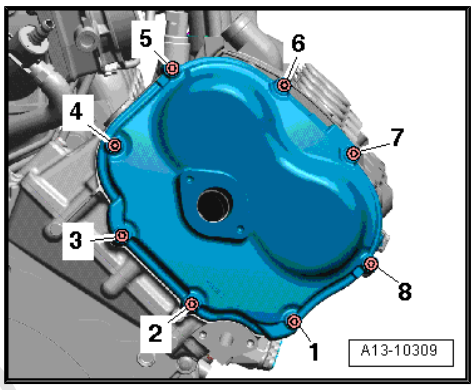
– Unscrew nuts -2- and -4- and detach bracket for electrical connectors on coolant pipe (rear).
– Release engine wiring harness at coolant pipe (rear).
– Unplug electrical connector -3- at coolant temperature sender - G62- .
– Detach coolant hose -5- from coolant pipe (rear).
– Remove bolts -1- and -6- and detach coolant pipe (rear).



– Remove bolts -1 ... 8- and carefully release timing chain cover (left-side) from bonded joint.



– Remove bolts -1 ... 8- and carefully release timing chain cover (right-side) from bonded joint.



Installing

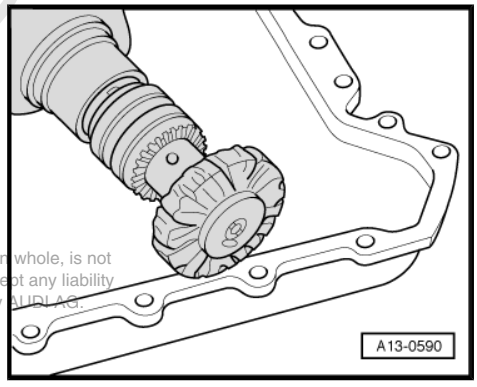
Note

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

WARNING

Wear safety goggles.

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



Caution

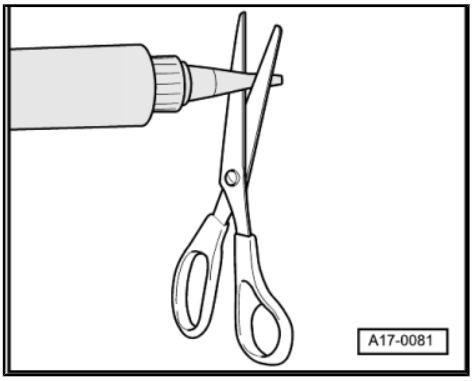
Make sure that no sealant residue gets into the engine.

– Clean sealing surfaces; they must be free of oil and grease.

Note

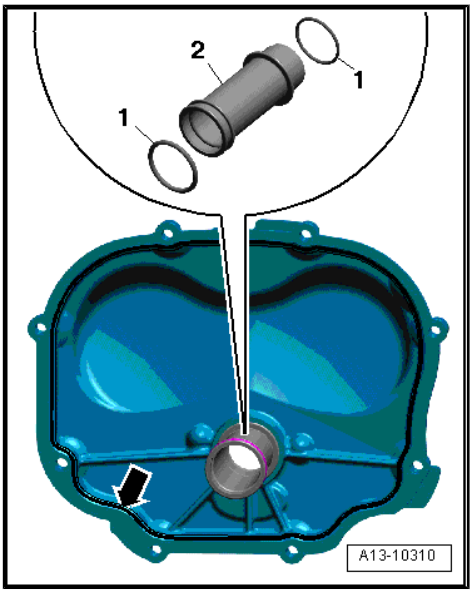
Note the use-by date of the sealant.

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



– Use suitable drift to drive intermediate coolant pipe -2- out of timing chain cover.
– Fit new O-rings -1- on intermediate coolant pipe -2-.
– Fit intermediate coolant pipe in timing chain cover.
– Apply bead of sealant -arrow- onto clean sealing surfaces of timing chain cover, as shown in illustration.

• Width of sealant bead: 2.5 mm.

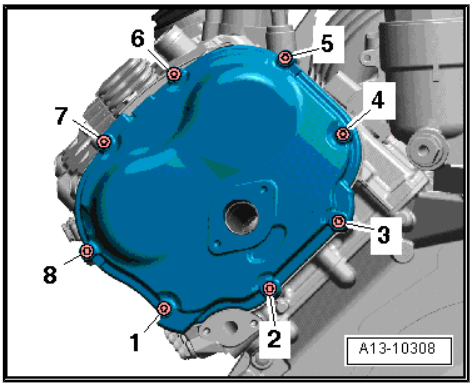


Note

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

– Fit timing chain cover and tighten bolts.

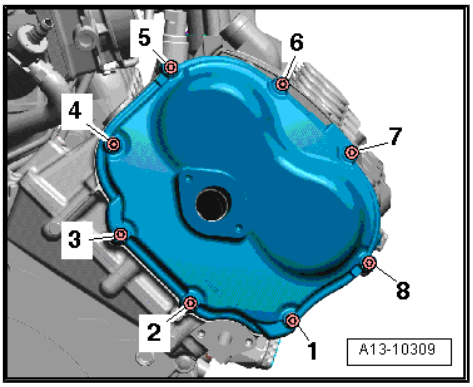
♦ Timing chain cover (left-side) ⇒ page 78



♦ Timing chain cover (right-side) ⇒ page 78

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

– Install coolant pipe (rear) ⇒ page 212 .
– Install coolant pipe (left-side) ⇒ page 207 .
– Install coolant pipe (right-side) ⇒ page 211 .



1.3 Removing and installing timing chain cover (bottom)

Special tools and workshop equipment required

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

Removing

- Engine separated from gearbox ⇒ page 27 , engine attached to scissor-type assembly platform - VAS 6131 A- or secured to engine and gearbox support ⇒ page 36 .
- Engine oil drained ⇒ Maintenance ; Booklet 404 .

– Remove drive plate ⇒ page 63 .

– Remove timing chain covers (left and right) ⇒ page 78 .

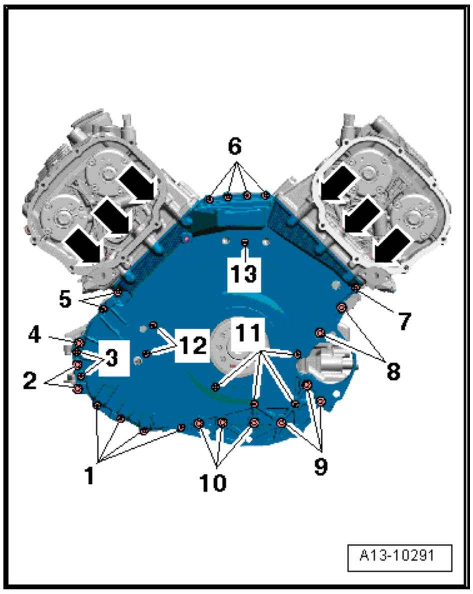
– Remove intake manifold ⇒ Rep. gr. 24 .

– Remove oil filter housing ⇒ page 177 .

– Remove bolts -arrows-.

– Remove bolts -1 ... 13- and release timing chain cover (bottom) from bonded joint.

– Press crankshaft oil seal (gearbox end) out of timing chain cover (bottom).



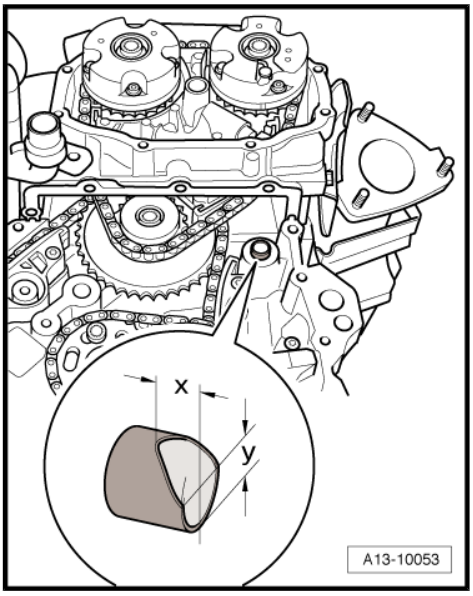
Installing

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

Note

Renew the bolts tightened with specified tightening angle.

– Pull dowel sleeve (top right) out of cylinder block.
– Bevel the dowel sleeve with a file, as illustrated.
• 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.



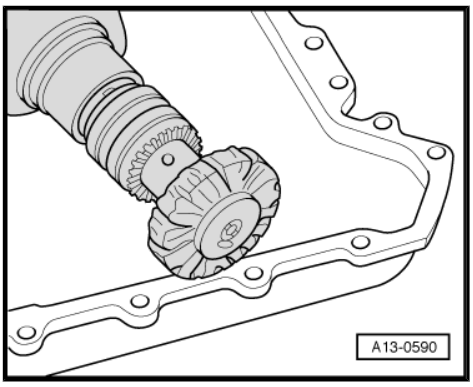
Note

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

WARNING

Wear safety goggles.

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



Caution

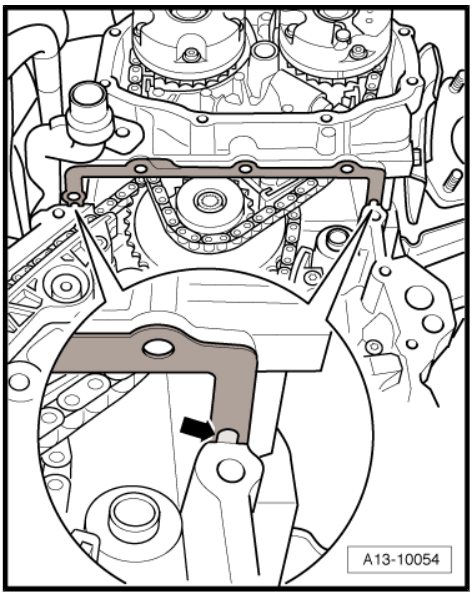
Make sure that no sealant residue gets into the engine.

– 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.

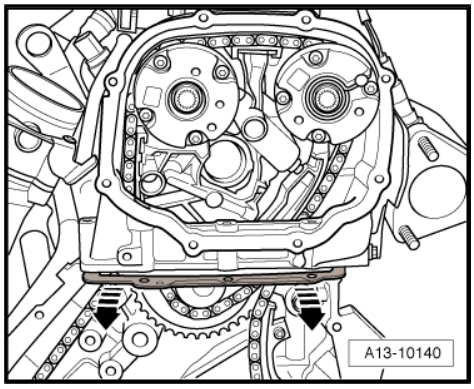
Note

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



Caution

The cylinder head gasket must not to be bent more than a small amount. If the cylinder head gasket has been bent and kinked it must be renewed.

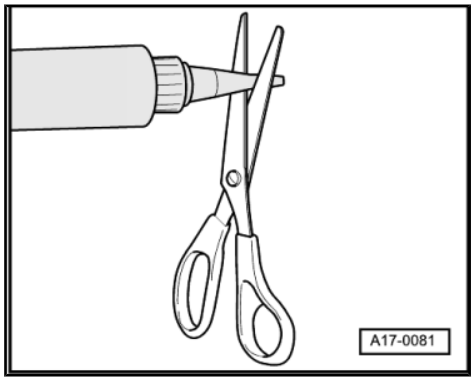


– Carefully bend the ends of the cylinder head gaskets down very slightly -arrows-, just far enough to be able to clean the upper sealing surface on the gasket and cylinder head.

– Clean both cylinder head gaskets (top and bottom); they must be free of oil and grease.

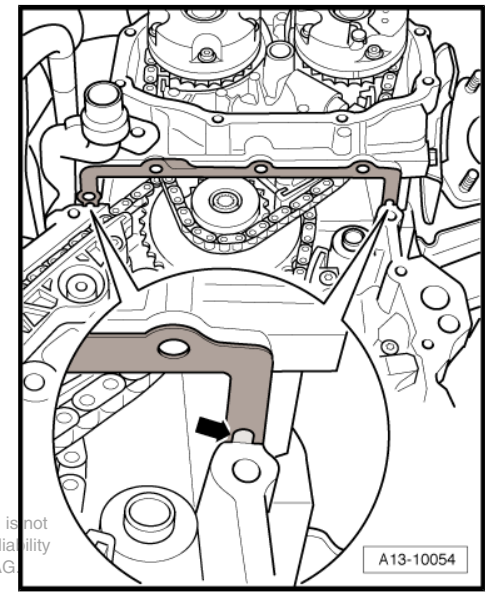
Note

Note the use-by date of the sealant.



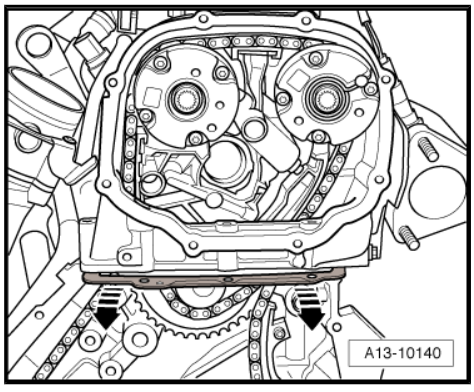
– Cut off tube nozzle at front marking (diameter of nozzle approx. 2 mm).

– Clean holes -arrow- in cylinder head gaskets and fill them with sealant.



Caution

The cylinder head gasket must not to be bent more than a small amount. If the cylinder head gasket has been bent and kinked it must be renewed.

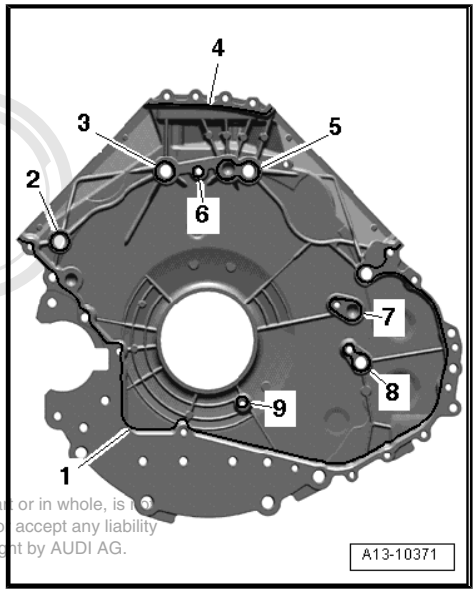


– Apply a small amount of sealant to sealing surfaces of cylinder head gaskets (top and bottom). To do so, you again have to bend cylinder head gaskets down very slightly -arrows-.

– Use a flat object (e.g. a feeler gauge) to apply sealant to area between cylinder head and gasket.

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

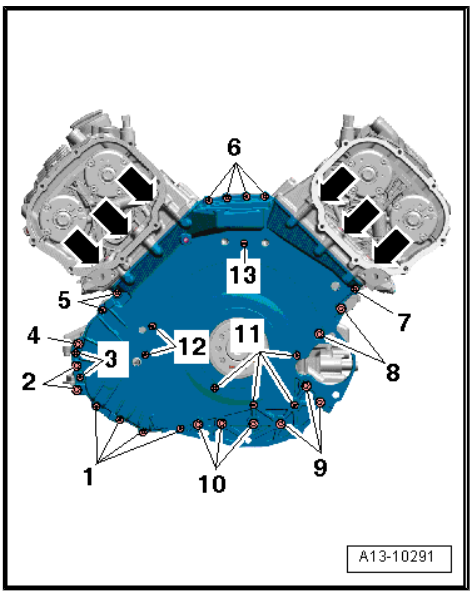
• Width of beads of sealant: 2.5 mm.



Note

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

– Position timing chain cover (bottom), guiding it towards sealing surface on cylinder block and cylinder head at an angle and from below.



Caution

Take care not to damage the cylinder head gaskets when fitting the cover. If the cylinder head gasket has been damaged it must be renewed.

– Tighten bolts for timing chain cover (bottom) ⇒ page 78 .

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

– Install crankshaft oil seal (gearbox end) ⇒ page 64 .

– Install oil filter housing ⇒ page 177 .

– Install intake manifold ⇒ Rep. gr. 24 .

– Install timing chain covers (left and right) ⇒ page 80 .

– Install drive plate ⇒ page 63 .

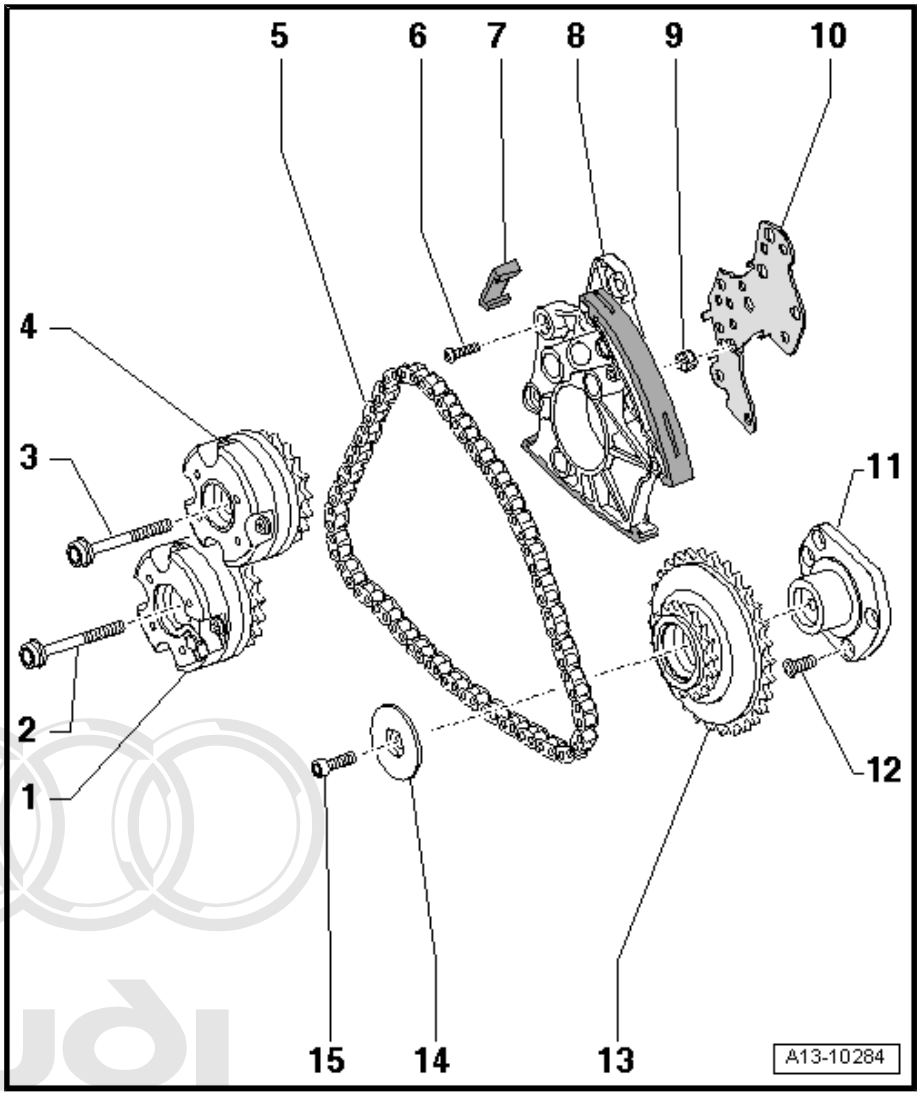
– After installing engine, fill up with engine oil and check oil level ⇒ Maintenance ; Booklet 404 .

Tightening torques

♦ ⇒ Fig. ""Timing chain cover (bottom) - tightening torque and sequence"" , page 78

1.4 Camshaft timing chain - exploded view

Camshaft timing chain (left-side)



1 - Camshaft adjuster for exhaust camshaft

- ❑ Identification “Exhaust”
- ❑ Removing and installing ⇒ “1.5 Removing timing chain from camshafts”, page 89

2 - Bolt for camshaft

- ❑ Renew
- ❑ Pre-tightening torque: 60 Nm
- ❑ Final tightening torque: 80 Nm + 90°

3 - Bolt for camshaft

- ❑ Renew
- ❑ Pre-tightening torque: 60 Nm
- ❑ Final tightening torque: 80 Nm + 90°

4 - Camshaft adjuster for inlet camshaft

- ❑ Identification “Intake”
- ❑ Removing and installing ⇒ “1.5 Removing timing chain from camshafts”, page 89

5 - Camshaft timing chain (left-side)

- ❑ Before removing, mark running direction with paint. If a used chain rotates in the opposite direction when it is refitted, this can cause breakage.
- ❑ Removing from camshafts ⇒ page 89
- ❑ Removing and installing ⇒ page 96

6 - 5 Nm + turn 90° further

- ❑ Renew

7 - Slide

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

- ❑ Removing and installing ⇒ page 98

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

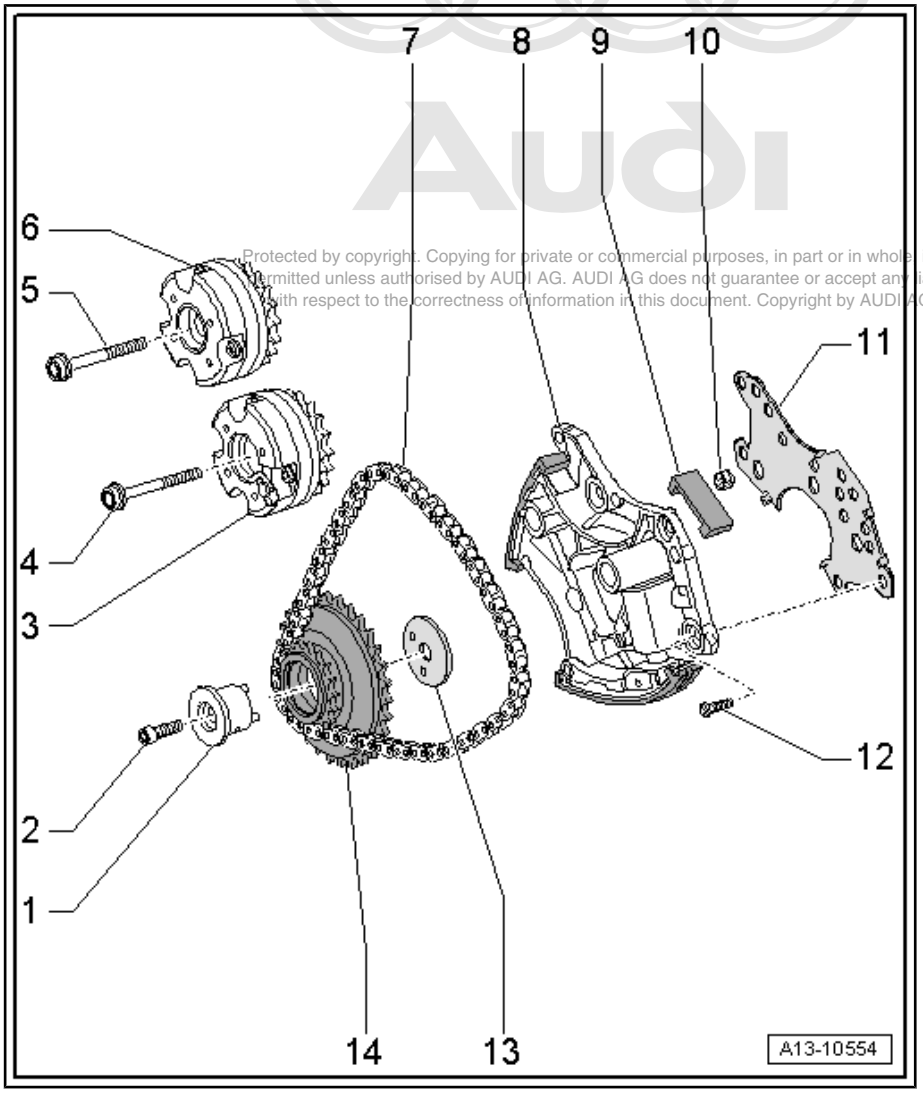
12 - 9 Nm

13 - Drive sprocket for camshaft timing chain (left-side)

14 - Thrust washer for drive sprocket

15 - 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 - 42 Nm

3 - Camshaft adjuster for exhaust camshaft

- ❑ Identification “Exhaust”
- ❑ Removing and installing ⇒ “1.5 Removing timing chain from camshafts”, page 89

4 - Bolt for camshaft

- ❑ Renew
- ❑ Pre-tightening torque: 60 Nm
- ❑ Final tightening torque: 80 Nm + 90°

5 - Bolt for camshaft

- ❑ Renew
- ❑ Pre-tightening torque: 60 Nm
- ❑ Final tightening torque: 80 Nm + 90°

6 - Camshaft adjuster for inlet camshaft

- ❑ Identification “Intake”
- ❑ Removing and installing ⇒ “1.5 Removing timing chain from camshafts”, page 89

7 - Camshaft timing chain (right-side)

- ❑ Before removing, mark running direction with paint. If a used chain rotates in the opposite direction when it is refitted, this can cause breakage.
- ❑ Removing from camshafts ⇒ page 89
- ❑ Removing and installing ⇒ page 96

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

- ❑ Removing and installing ⇒ page 98

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 - 5 Nm + turn 90° further

- ❑ Renew

13 - Thrust washer for drive sprocket

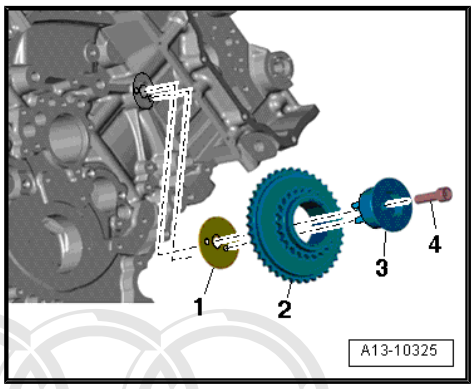
14 - Drive sprocket for camshaft timing chain (right-side)

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

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

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

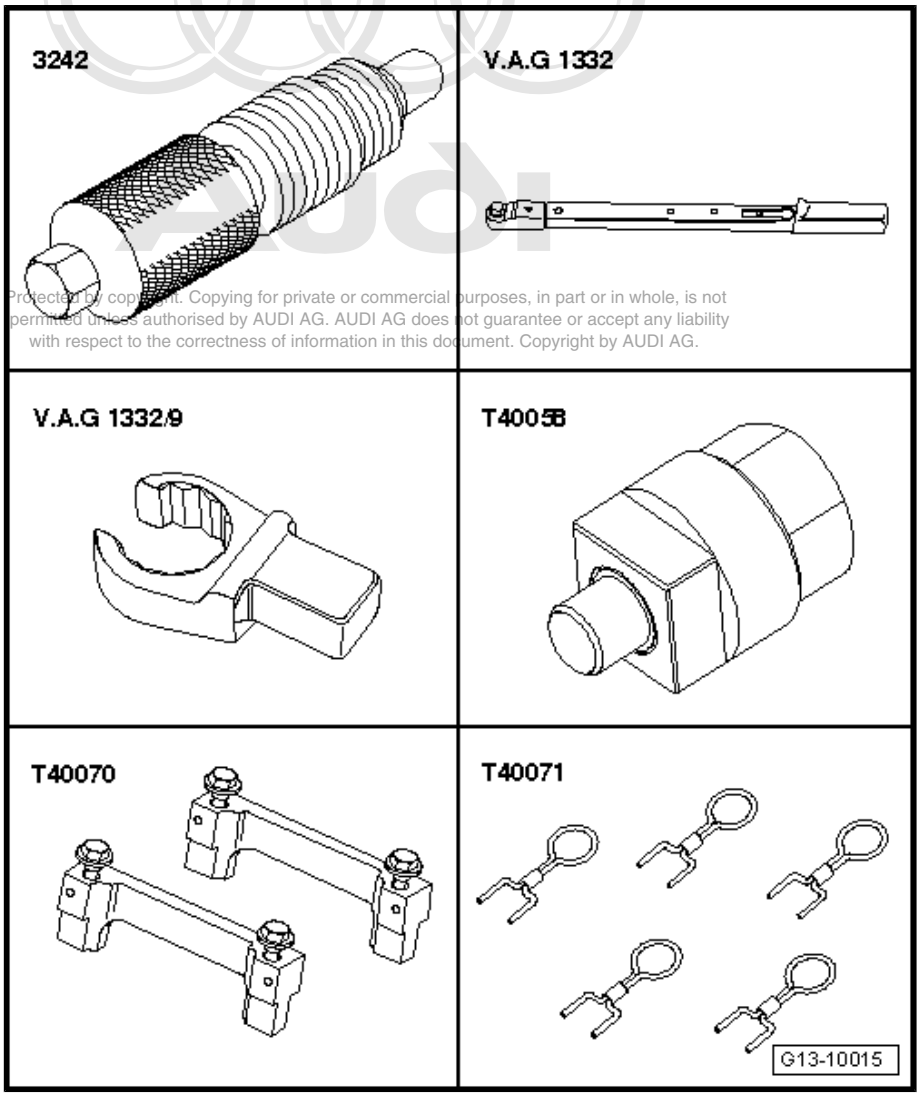
4 - Bolt, 42 Nm



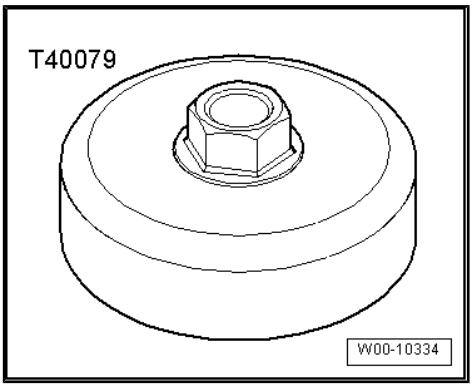
1.5 Removing timing chain from camshafts

Special tools and workshop equipment required

- Locking pin - 3242-
- Torque wrench - V.A.G 1332-
- Open ring spanner insert - V.A.G 1332/9-
- Adapter - T40058-
- Camshaft clamp - T40070- (2x)
- Locking pin - T40071- (2x)



- Key - T40079-



Removing

- Engine removed and in position on scissor-type assembly platform - VAS 6131 A- with gearbox attached.

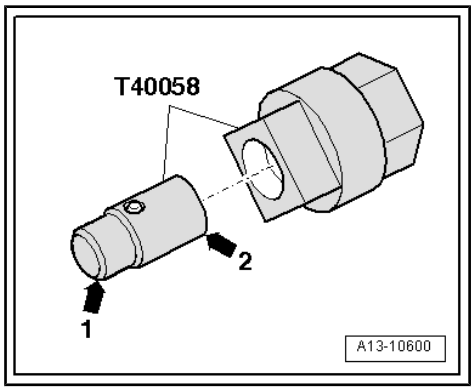
Note

In the following procedure the camshaft timing chains remain on the engine.

– Remove cylinder head cover: left-side ⇒ page 120 , right-side ⇒ page 123 .

– Remove timing chain covers (left and right) ⇒ page 78 .

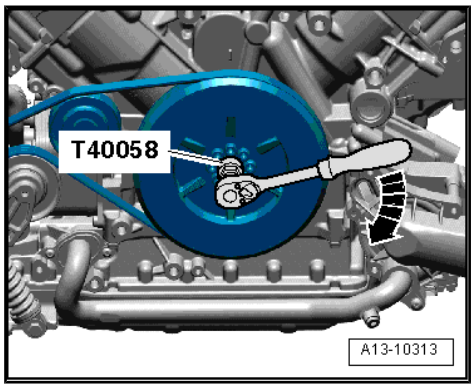
– Insert guide pin of adapter -T40058- as follows:



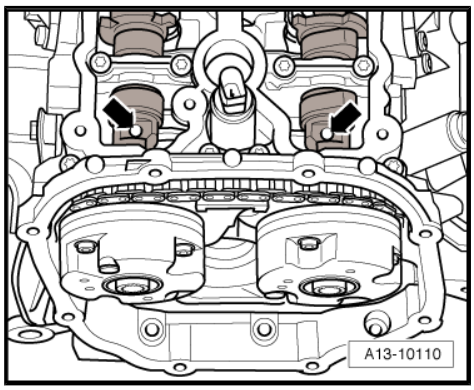
• The smaller-diameter section -arrow 1- faces the engine.

• The larger-diameter section -arrow 2- faces the adapter.

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

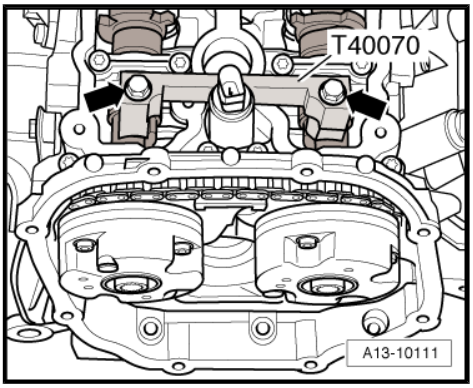


• The threaded holes -arrows- in the camshafts must face upwards.

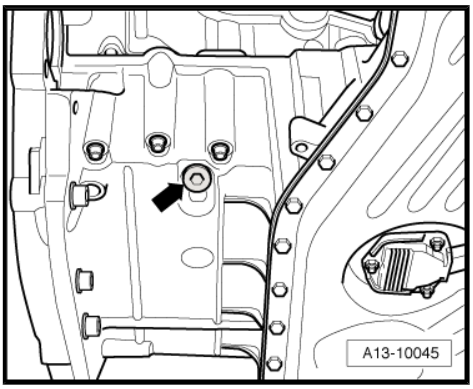


– Fit camshaft clamps - T40070- to both cylinder heads and tighten bolts -arrows- to 25 Nm.

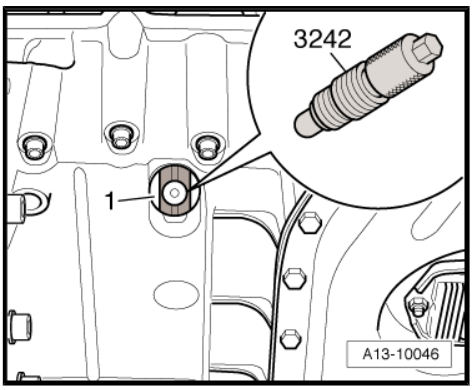
• The camshaft clamp - T40070- is positioned correctly if the holes for the cylinder head bolts remain free.



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



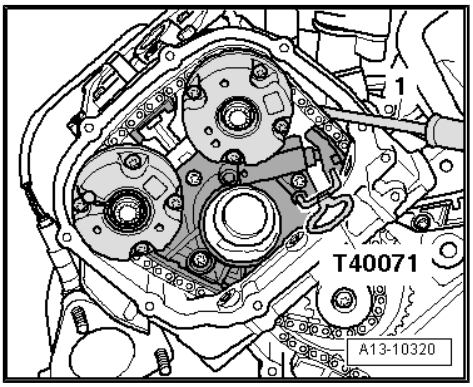
– Screw locking pin - 3242- into bore or groove in crankshaft (tightening torque: 20 Nm); if necessary, turn crankshaft backwards and forwards slightly to fully centralise locking pin.



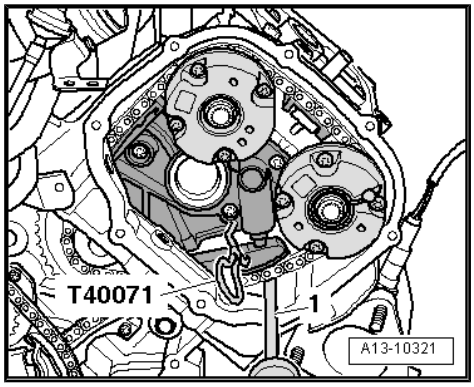
– Press guide rail of chain tensioner for camshaft timing chain (left-side) inwards as far as the stop using a screwdriver -1-. Then lock chain tensioner by inserting locking pin - T40071- .

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

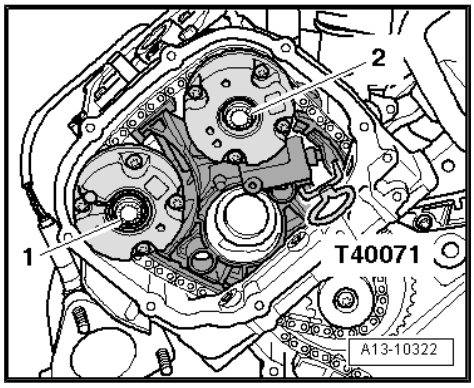
The chain tensioner is oil-damped and can therefore only be compressed slowly by applying constant pressure.

– Mark positions of camshaft adjusters with paint for re-installation.

Caution

Risk of irreparable damage to engine.

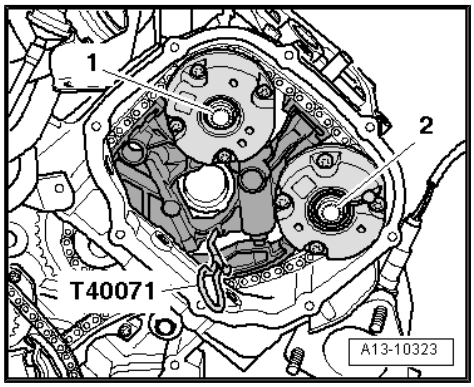
- ***Block off the opening in the valve timing housing with a clean cloth to prevent small items from dropping into the engine.***



– 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

Note

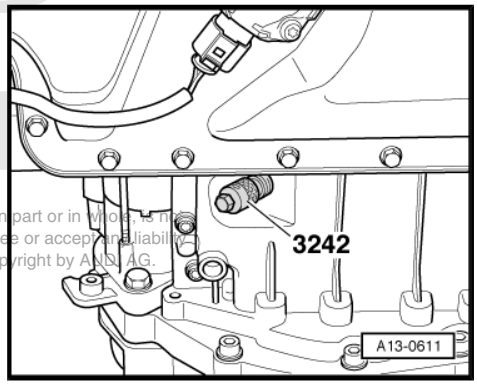
Renew the bolts tightened with specified tightening angle.

Caution

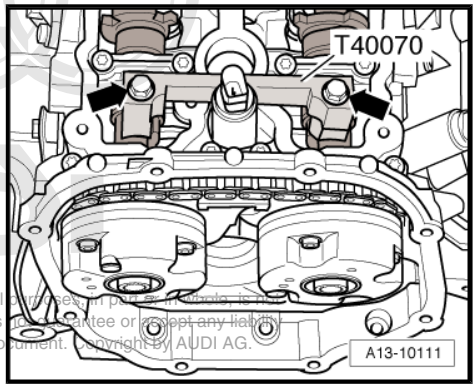
Avoid damage to valves and piston crowns.

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

- 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-.



Note

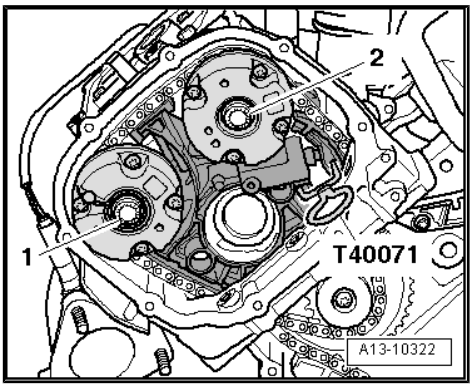
Re-install camshaft adjuster (left-side) in the same position as before (pay attention to marks applied when removing).

– Renew the camshaft bolts.

– 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- .



Note

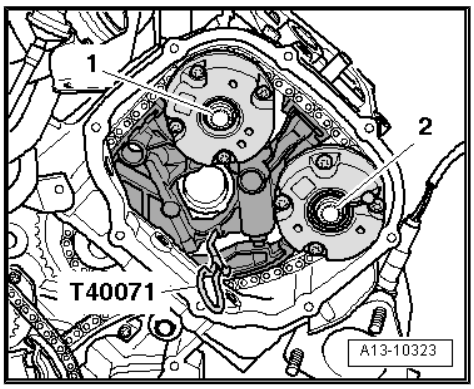
Re-install camshaft adjuster (right-side) in the same position as before (pay attention to marks applied when removing).

– Renew the camshaft bolts.

– 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- .



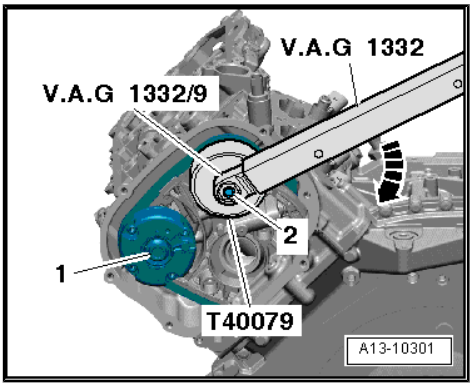
Note

A second mechanic is required for the following work steps.

– Fit key - T40079- onto camshaft adjuster of inlet camshaft on cylinder head (left-side).

– Have a second mechanic apply a torque of 40 Nm to camshaft adjuster in direction of -arrow-.

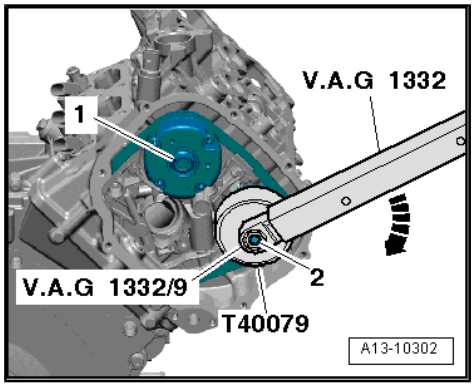
– Tighten bolts as follows while keeping camshaft adjuster under tension:



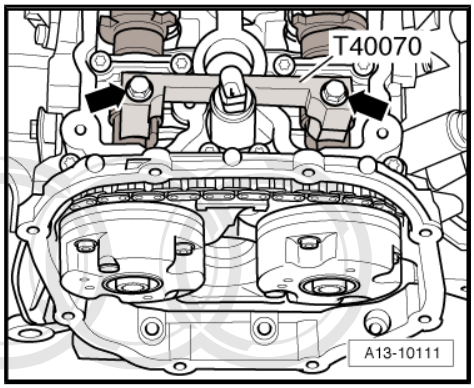
Stage	Bolt	Tightening torque
1.	-1-	On exhaust camshaft: 60 Nm
1.	-2-	On inlet camshaft: 60 Nm

– Fit key - T40079- onto camshaft adjuster of exhaust camshaft on cylinder head (right-side).
– Have a second mechanic apply a torque of 40 Nm to camshaft adjuster in direction of -arrow-.
– Tighten bolts as follows while keeping camshaft adjuster under tension:

Stage	Bolt	Tightening torque
1.	-1-	On inlet camshaft: 60 Nm
1.	-2-	On exhaust camshaft: 60 Nm

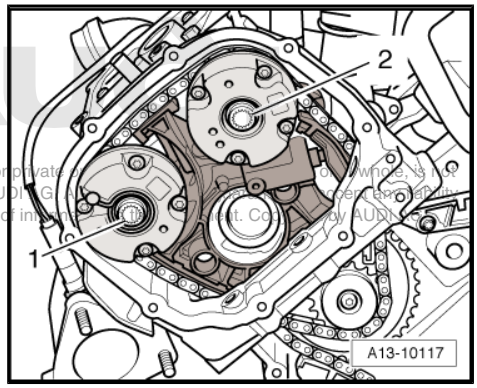


– Detach key - T40079- .
– Remove camshaft clamp - T40070- from both cylinder heads -arrows-.



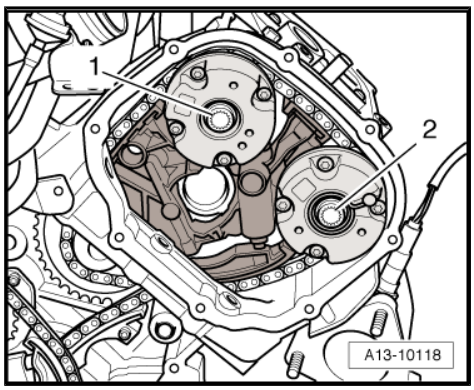
– Tighten camshaft adjuster bolts on cylinder head (left-side) as follows:

Stage	Bolt	Tightening torque
2.	-1-	Tighten on exhaust camshaft to final tightening torque ⇒ Item 2 (page 86)
2.	-2-	Tighten on inlet camshaft to final tightening torque ⇒ Item 3 (page 86)

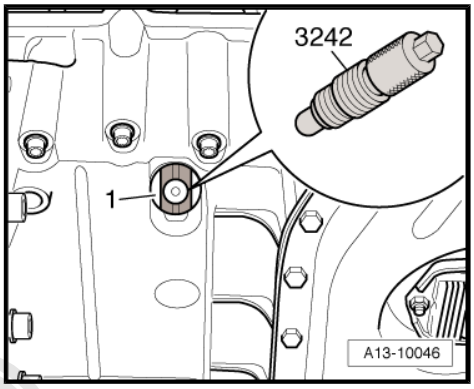


– Tighten camshaft adjuster bolts on cylinder head (right-side) as follows:

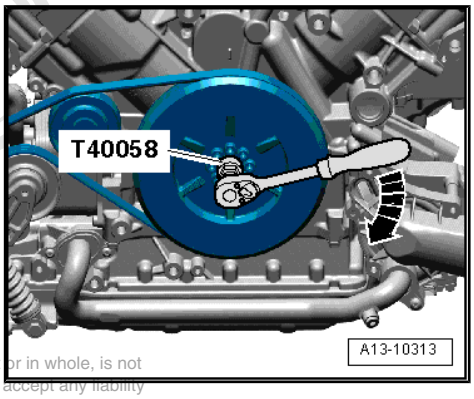
Stage	Bolt	Tightening torque
2.	-1-	Tighten on inlet camshaft to final tightening torque ⇒ Item 5 (page 87)
2.	-2-	Tighten on exhaust camshaft to final tightening torque ⇒ Item 4 (page 87)



– Remove locking pin - 3242- .



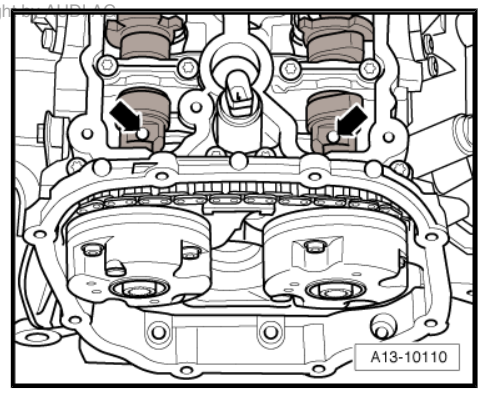
– Using adapter - T40058- , turn crankshaft two rotations in normal direction of rotation -arrow- until crankshaft is at “TDC” again.



Note

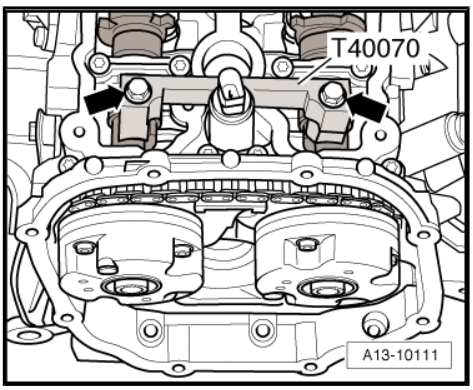
If you turned the crankshaft beyond “TDC”, turn it back approx. 30° and set to “TDC” again.

- 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.



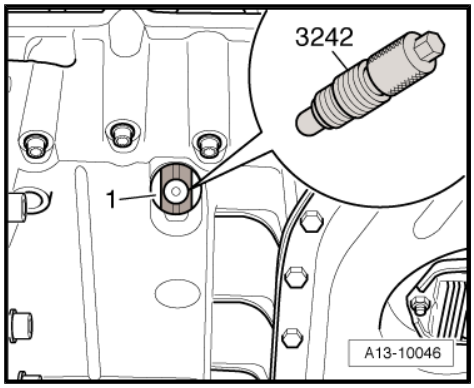
– Screw locking pin - 3242- into bore or groove (20 Nm).

• The locking pin - 3242- must engage in the locating bore or groove in the crankshaft -1-. If it does not, reset valve timing.

– Remove camshaft clamps from both cylinder heads.

– Remove locking pin - 3242- .

– Secure screw plug for crankshaft “TDC” marking in sump (top section) and tighten ⇒ Item 6 (page 169) .



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

– Install timing chain covers (left and right) ⇒ page 80 .

– Install cylinder head cover: left-side ⇒ page 120 , right-side ⇒ page 123 .

1.6 Removing and installing camshaft timing chains

Removing

• Engine separated from gearbox ⇒ page 27 , engine attached to scissor-type assembly platform - VAS 6131 A- or secured to engine and gearbox support ⇒ page 36 .

• Engine oil drained ⇒ Maintenance ; Booklet 404 .

– Remove drive plate ⇒ page 63 .

– Remove cylinder head cover: left-side ⇒ page 120 , right-side ⇒ page 123 .

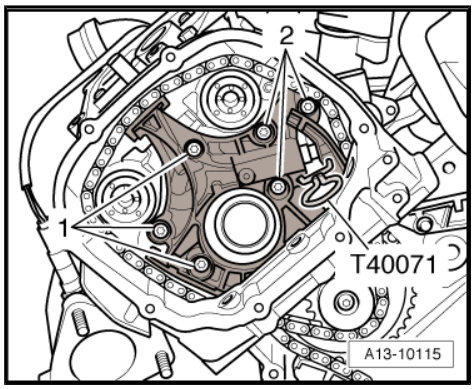
– Remove timing chain covers (left and right) ⇒ page 78 .

– Remove intake manifold ⇒ Rep. gr. 24 .

– Remove oil filter housing ⇒ page 177 .

– Remove timing chain cover (bottom) ⇒ page 82 .

– Remove camshaft timing chains from camshafts ⇒ page 89 .



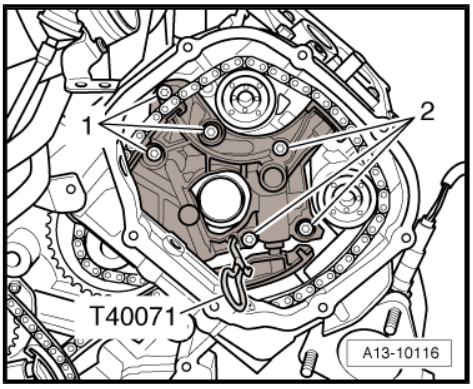
Caution

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 attempt to mark the timing chain with a centre punch or by making a notch or similar.*

– 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

Note

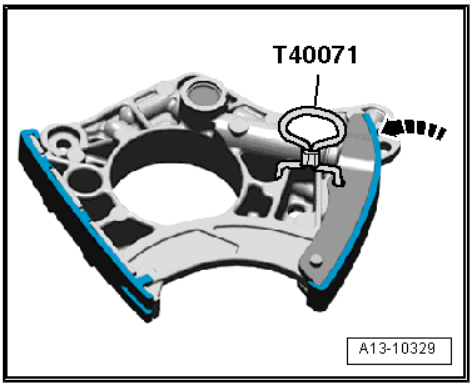
- *Note the correct installation position if the tensioning element has been removed from the chain tensioner: drilling in base of housing faces chain tensioner and piston faces tensioner rail.*
- *Renew bolts which are tightened to a specified angle as well as seal.*

Caution

Avoid damage to valves and piston crowns.

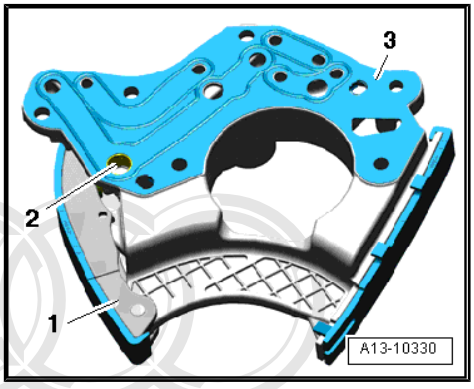
- ***The crankshaft must not be at "TDC" at any cylinder when the camshafts are turned.***

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



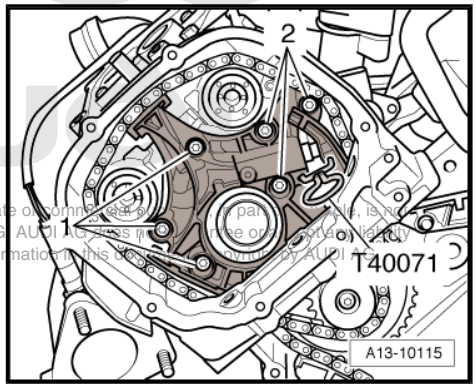
– If necessary, clean oil strainer -2- in both chain tensioners.

– Fit new gasket -3- to rear of chain tensioner -1-.



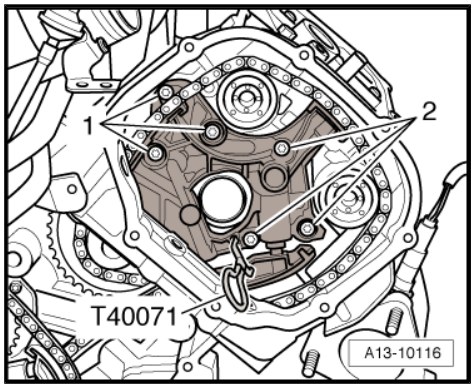
– Install chain tensioner on cylinder head (left-side) and position camshaft timing chain as shown in illustration (according to marks applied when removing).

– 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 82 .

– Install crankshaft oil seal (gearbox end) ⇒ page 64 .

– Install oil filter housing ⇒ page 177 .

– Install intake manifold ⇒ Rep. gr. 24 .

– Install timing chain covers (left and right) ⇒ page 80 .

– Install cylinder head cover: left-side ⇒ page 120 , right-side ⇒ page 123 .

– Install drive plate ⇒ page 63 .

– After installing engine, fill up with engine oil and check oil level ⇒ Maintenance ; Booklet 404 .

Tightening torques

◆ ⇒ “1.4 Camshaft timing chain - exploded view”, page 85

1.7 Removing and installing chain tensioner for camshaft timing chain

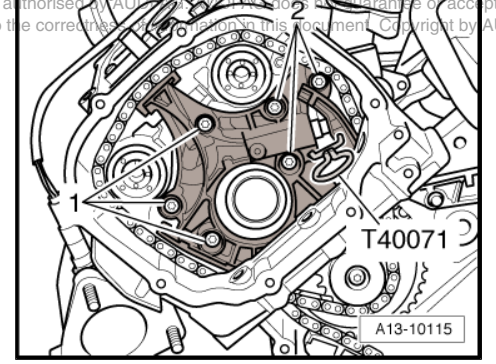
Removing

– Remove camshaft timing chains from camshafts ⇒ page 89 .

Caution

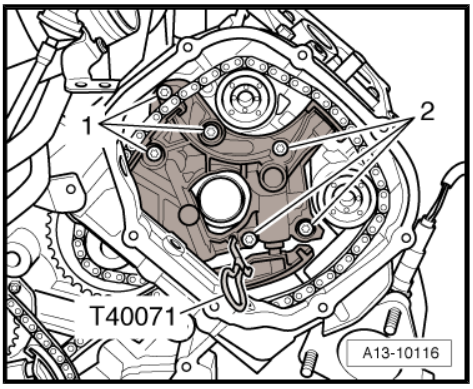
If a used timing chain rotates in the opposite direction when it is refitted, this can cause breakage.

◆ *Mark running direction of timing chain with coloured arrows for re-installation. Do not attempt to mark the timing chain with a centre punch or by making a notch or similar.*



– 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

Note

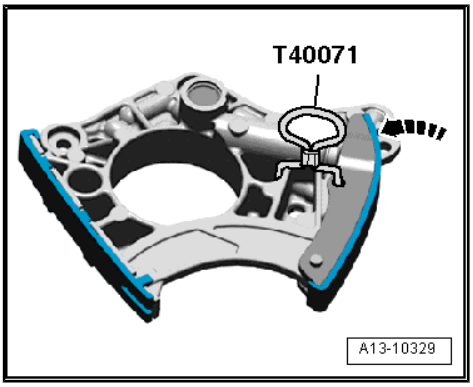
- *Note the correct installation position if the tensioning element has been removed from the chain tensioner: drilling in base of housing faces chain tensioner and piston faces tensioner rail.*
- *Renew bolts which are tightened to a specified angle as well as seal.*

Caution

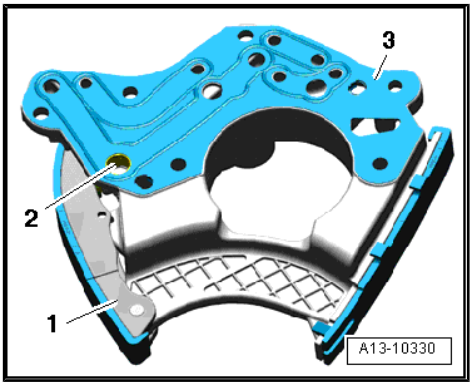
Avoid damage to valves and piston crowns.

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

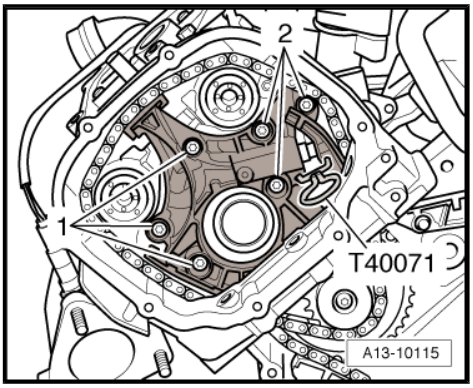
– Press guide rails of chain tensioners for camshaft timing chains (left and right) inwards in direction of -arrow- as far as stop. Then lock chain tensioners by inserting locking pin - T40071- .



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



– Install chain tensioner on cylinder head (left-side) and position camshaft timing chain as shown in 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).

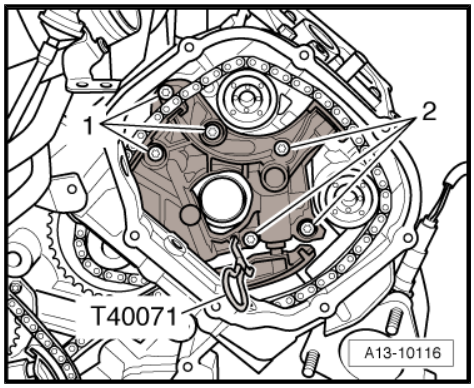
– Tighten bolts -1- and -2-.

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

– Fit timing chains on camshafts ⇒ page 89 .

Tightening torques

◆ ⇒ “1.4 Camshaft timing chain - exploded view”, page 85



1.8 Drive chain for valve gear - exploded view

1 - Guide rail

2 - 17 Nm + turn 90° further
- ❑ Renew

3 - 22 Nm

4 - Thrust washer for drive sprocket

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

6 - 17 Nm + turn 90° further
- ❑ Renew

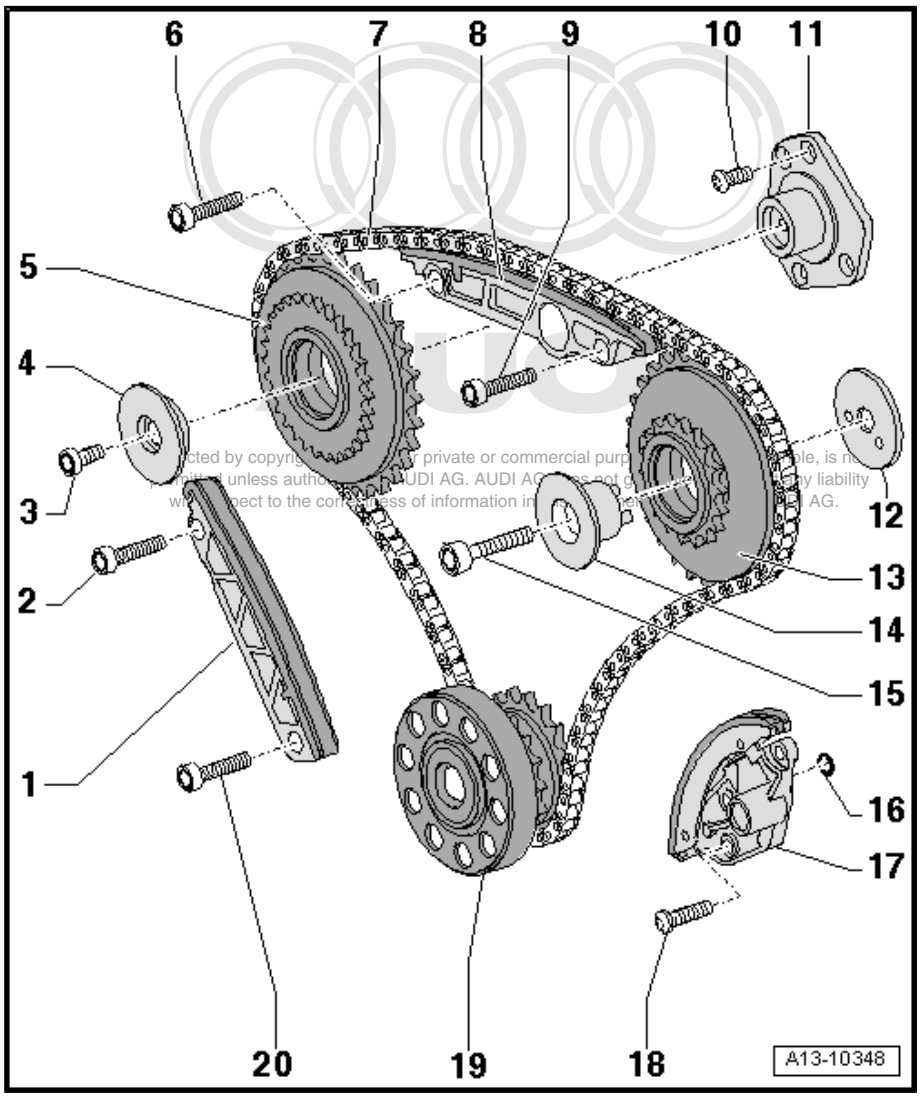
7 - Drive chain for valve gear
- ❑ Before removing, mark running direction with paint. If a used drive chain rotates in the opposite direction when it is refitted, this can cause breakage.
- ❑ Removing and installing ⇒ page 101

8 - Guide rail

9 - 17 Nm + turn 90° further
- ❑ Renew

10 - 5 Nm + turn 90° further
- ❑ Renew

11 - Bearing mounting 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 - 42 Nm

16 - O-ring

❑ Renew

17 - Chain tensioner

18 - 5 Nm + turn 90° further

❑ Renew

19 - Crankshaft

20 - 17 Nm + turn 90° further

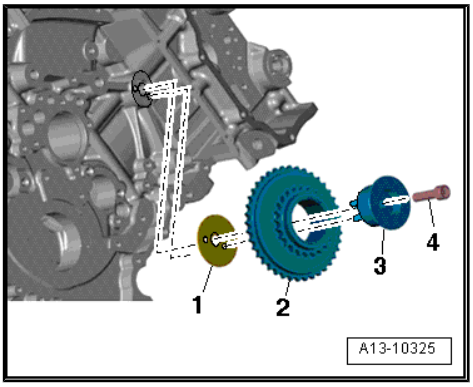
❑ Renew

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

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

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

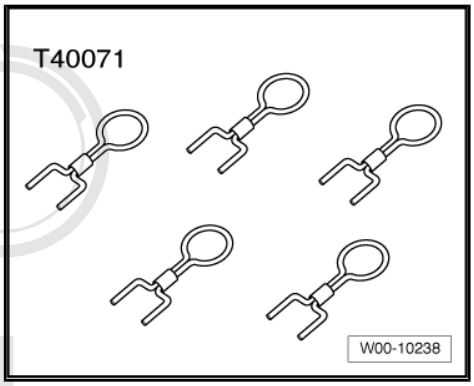
4 - Bolt, 42 Nm



1.9 Removing and installing drive chain for valve gear

Special tools and workshop equipment required

♦ Locking pin - T40071-



Removing

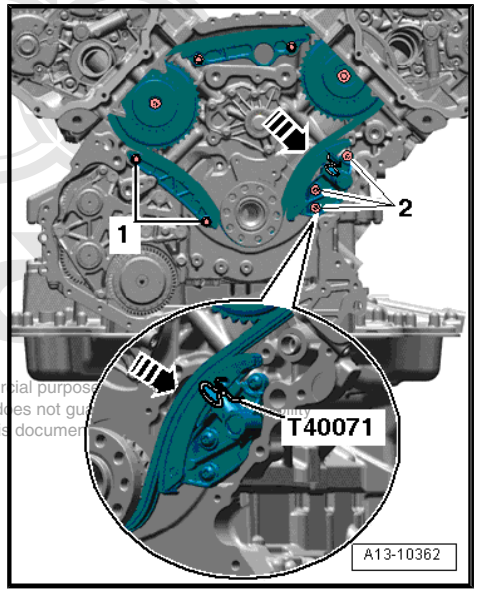
- Engine separated from gearbox ⇒ page 27 , engine attached to scissor-type assembly platform - VAS 6131 A- or secured to engine and gearbox support ⇒ page 36 .
- Engine oil drained ⇒ Maintenance ; Booklet 404 .

– Remove drive plate ⇒ page 63 .

– Remove cylinder head cover: left-side ⇒ page 120 , right-side ⇒ page 123 .

– Remove timing chain covers (left and right) ⇒ page 78 .

– Remove intake manifold ⇒ Rep. gr. 24 .
– Remove oil filter housing ⇒ page 177 .
– Remove timing chain cover (bottom) ⇒ page 82 .
– Remove camshaft timing chains ⇒ page 96 .
– Remove drive chain for auxiliary drives ⇒ page 103 .
– 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 attempt to mark the drive chain with a centre punch or by making a notch or similar.*

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

Installing

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 103 .
– Install camshaft timing chains ⇒ page 97 .
– Install timing chain cover (bottom) ⇒ page 82 .
– Install crankshaft oil seal (gearbox end) ⇒ page 64 .
– Install oil filter housing ⇒ page 177 .
– Install intake manifold ⇒ Rep. gr. 24 .
– Install timing chain covers (left and right) ⇒ page 80 .
– Install cylinder head cover: left-side ⇒ page 120 , right-side ⇒ page 123 .
– Install drive plate ⇒ page 63 .
– After installing engine, fill up with engine oil and check oil level ⇒ Maintenance ; Booklet 404 .

Tightening torques

◆ ⇒ “1.8 Drive chain for valve gear - exploded view”, page 100

1.10 Drive chain for auxiliary drives - exploded view

1 - 5 Nm + turn 90° further
- ❑ Renew

2 - Chain tensioner
- ❑ With guide rail

3 - Gasket
- ❑ Renew

4 - Compression spring

5 - 64 Nm

6 - Chain sprocket for balance shaft

7 - Bearing cap

8 - Balance shaft
- ❑ Removing and installing ⇒ page 116

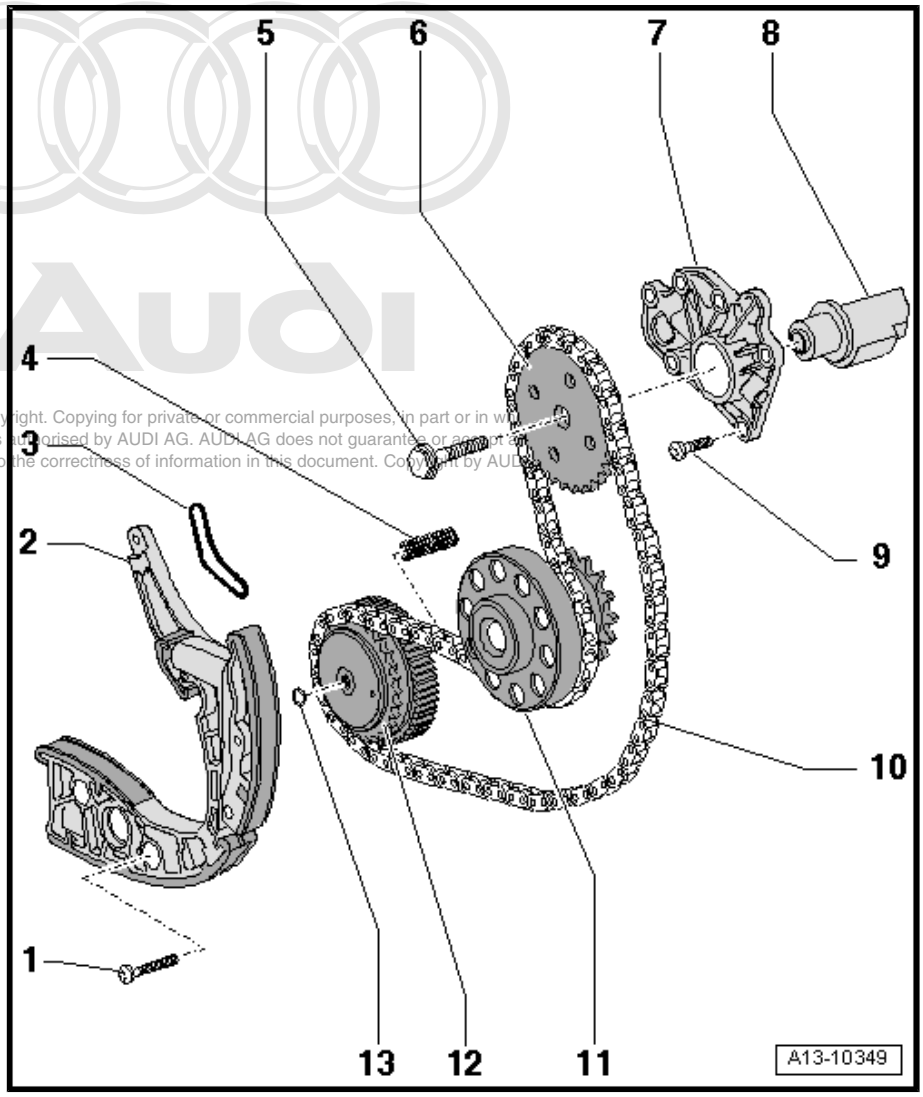
9 - Bolt
- ❑ Tightening torque ⇒ Item 2 (page 116)

10 - Drive chain for auxiliary drives
- ❑ Before removing, mark running direction with paint. If a used drive chain rotates in the opposite direction when it is refitted, this can cause breakage.
- ❑ Removing and installing ⇒ page 103

11 - Crankshaft

12 - Drive chain sprocket for auxiliary drives

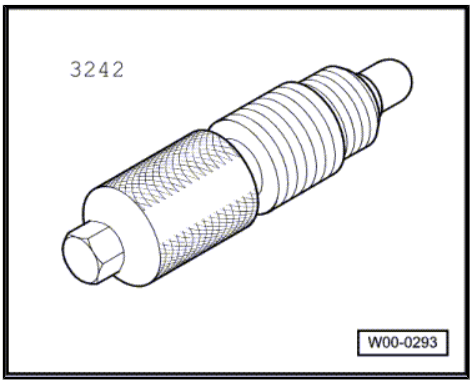
13 - Circlip



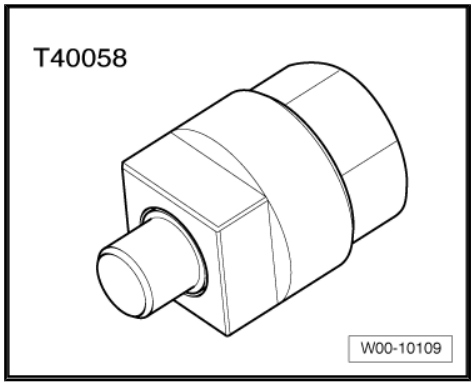
1.11 Removing and installing drive chain for auxiliary drives

Special tools and workshop equipment required

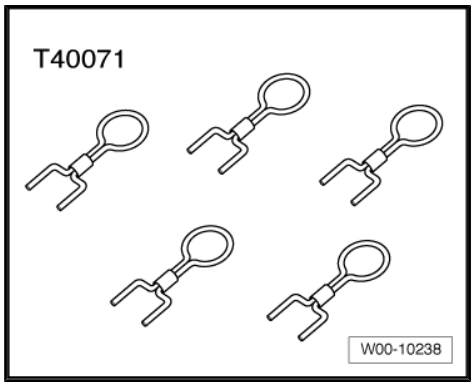
- ♦ Locking pin - 3242-



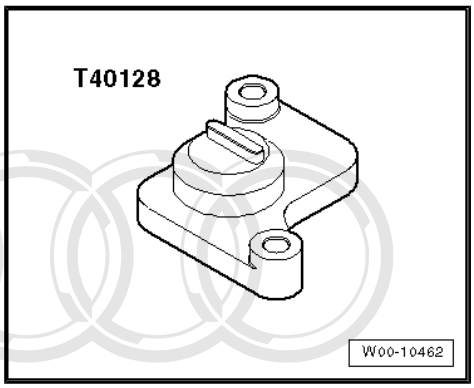
♦ Adapter - T40058-



♦ Locking pin - T40071-

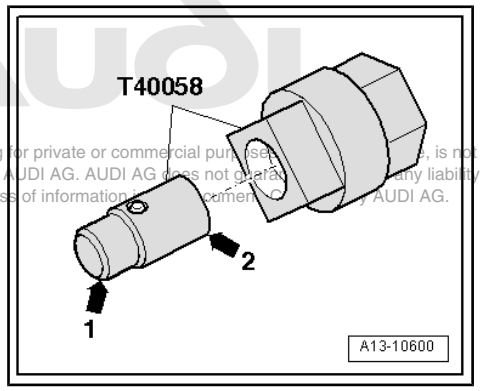


♦ Setting tool - T40128-

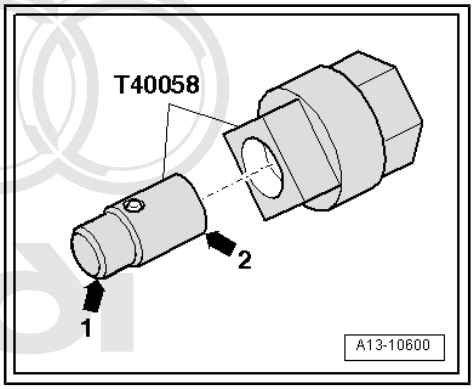


Removing

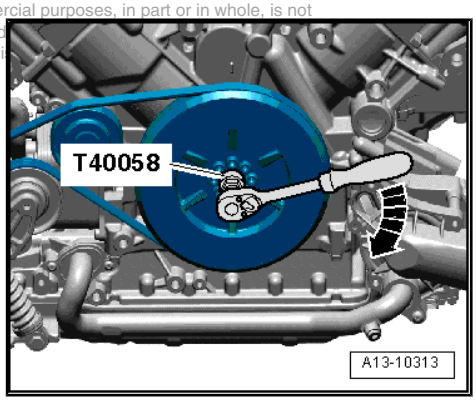
- Engine separated from gearbox ⇒ page 27 , engine attached to scissor-type assembly platform - VAS 6131 A- or secured to engine and gearbox support ⇒ page 36 .
- Engine oil drained ⇒ Maintenance ; Booklet 404 .



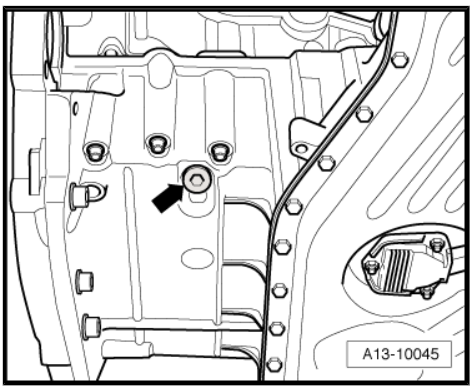
– Insert guide pin of adapter -T40058- as follows:
• The smaller-diameter section -arrow 1- faces the engine.
• The larger-diameter section -arrow 2- faces the adapter.



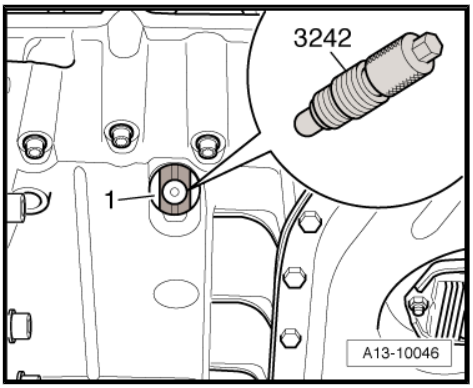
– Using adapter - T40058- turn the crankshaft in the normal direction of rotation -arrow- to “TDC”.



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



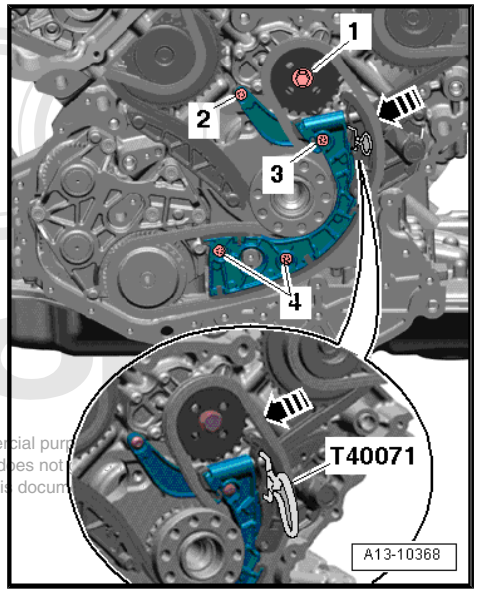
– Screw locking pin - 3242- into bore or groove in crankshaft (tightening torque: 20 Nm); if necessary, turn crankshaft backwards and forwards slightly to fully centralise locking pin.
– Remove vibration damper ⇒ page 59 .
– Remove drive plate ⇒ page 63 .
– Remove timing chain covers (left and right) ⇒ page 78 .
– Remove intake manifold ⇒ Rep. gr. 24 .
– Remove oil filter housing ⇒ page 177 .
– Remove timing chain cover (bottom) ⇒ page 82 .



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 attempt to mark the drive chain with a centre punch or by making a notch or similar.*



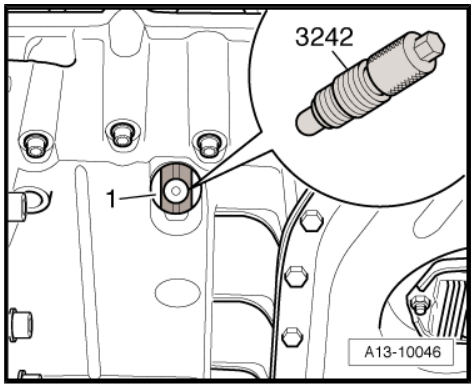
– Press tensioning rail in direction of -arrow- and lock chain tensioner by inserting locking pin - T40071- .
– Unscrew bolt -1- and remove chain sprocket for balance shaft.
– Unscrew bolts -2, 3, 4- and remove chain tensioner.
– Remove drive chain for auxiliary drives.

Installing

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

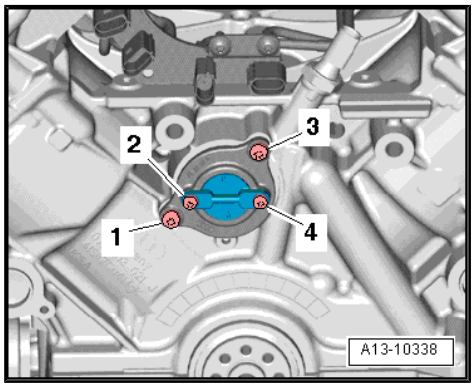
Note

Renew bolts which are tightened to a specified angle as well as seals, gasket and O-rings.



- Crankshaft -1- locked in “TDC” position with locking pin - 3242- .

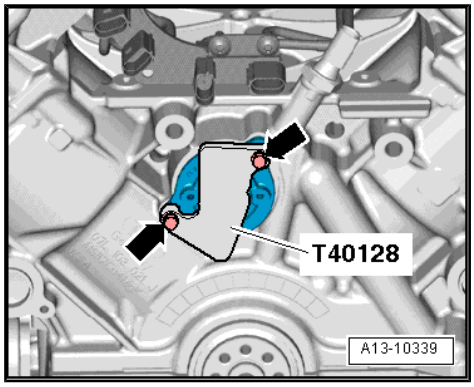
– Remove bolts -2- and -4-.
– Remove cover for balance shaft.
– Remove bolts -1- and -3-.



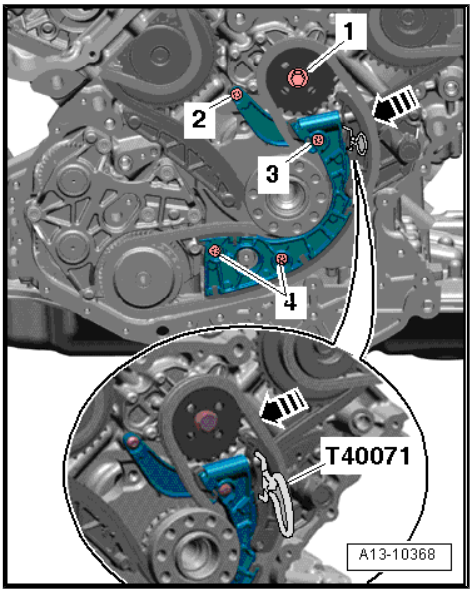
Note

The front bearing cover for the balance shaft remains installed.

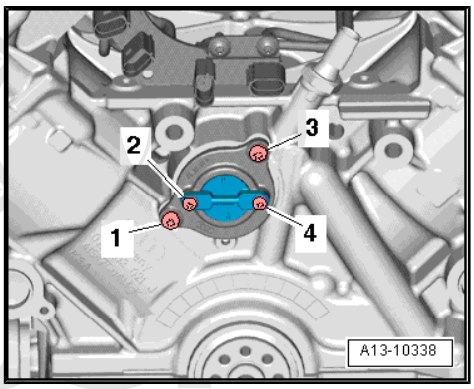
– Fit setting tool -T40128- to front bearing cover for balance shaft.
- The projection on the setting tool -T40128- must engage in the groove in the balance shaft.
– Secure setting tool -T40128- to cylinder block -arrows- using 2 bolts M6x30.



– Fit drive chain for auxiliary drives according to marks applied when removing.
– Install chain tensioner and tighten the bolts -2, 3, 4-.
– Fit drive chain onto chain sprocket for balance shaft and tighten bolt -1-.



– Remove setting tool -T40128- .
– Tighten bolts -1- and -3-.
– Renew O-ring in cover for balance shaft.
– Tighten bolts -2- and -4- on cover for balance shaft.



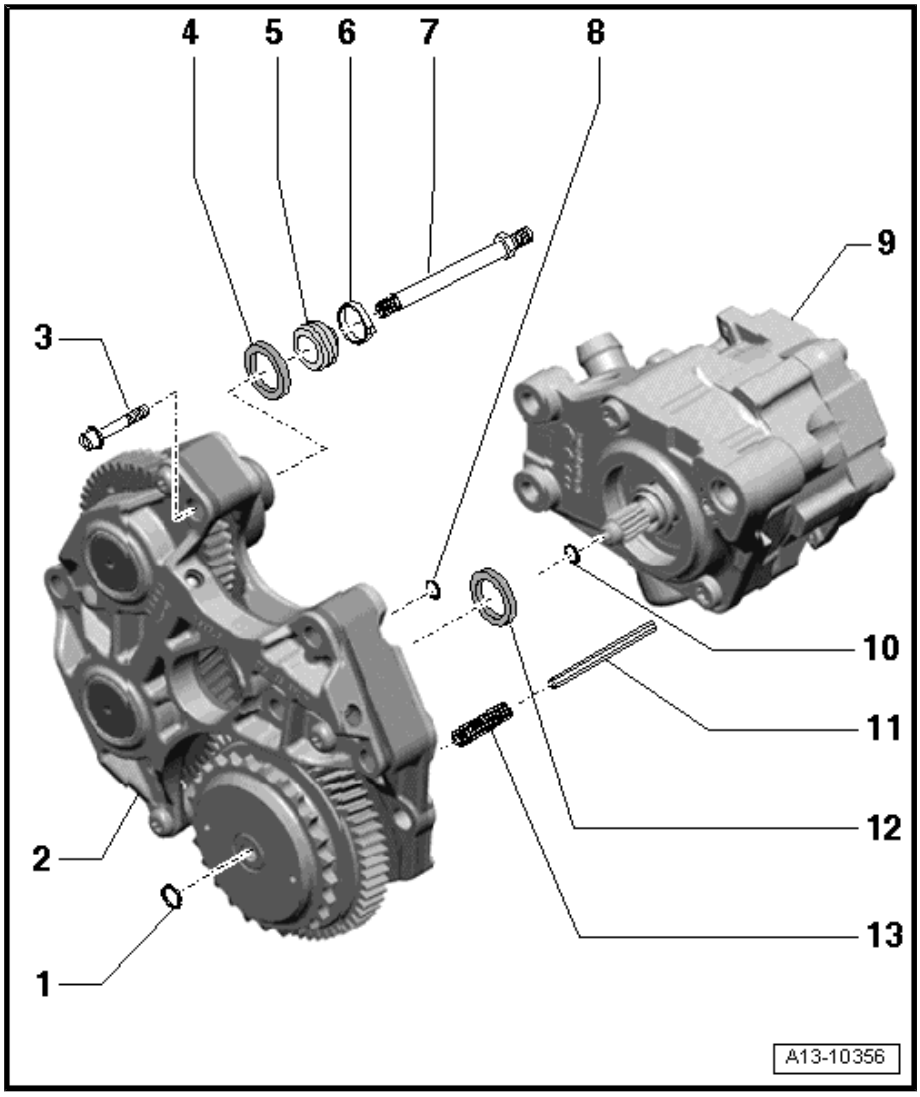
Remaining installation steps are carried out in reverse sequence; note the following:

– Install timing chain cover (bottom) ⇒ page 82 .
– Install crankshaft oil seal (gearbox end) ⇒ page 64 .
– Install oil filter housing ⇒ page 177 .
– Install intake manifold ⇒ Rep. gr. 24 .
– Install timing chain covers (left and right) ⇒ page 80 .
– Install drive plate ⇒ page 63 .
– Install vibration damper ⇒ page 59 .
– After installing engine, fill up with engine oil and check oil level ⇒ Maintenance ; Booklet 404 .

Tightening torques

- ⇒ “1.10 Drive chain for auxiliary drives - exploded view”, page 103
- ⇒ “1.16 Balance shaft - exploded view”, page 115

1.12 Auxiliary drives - exploded view



1 - Circlip

2 - Spur gear drive

- ❑ Do not dismantle
- ❑ Removing and installing ⇒ page 111

3 - 22 Nm

4 - Oil seal for air conditioner compressor drive

- ❑ Renewing ⇒ page 108

5 - Dust cap for air conditioner compressor drive

6 - Clip

- ❑ Use correct type of clip (as original equipment) ⇒ Electronic parts catalogue

7 - Drive shaft for air conditioner compressor

- ❑ Tighten to 60 Nm

8 - O-ring

- ❑ Renew

9 - Power steering pump

10 - Flat-section O-ring

- ❑ Renew if damaged
- ❑ Installation position in power steering pump drive ⇒ page 108

11 - Oil pump drive shaft

12 - Oil seal for power steering pump drive

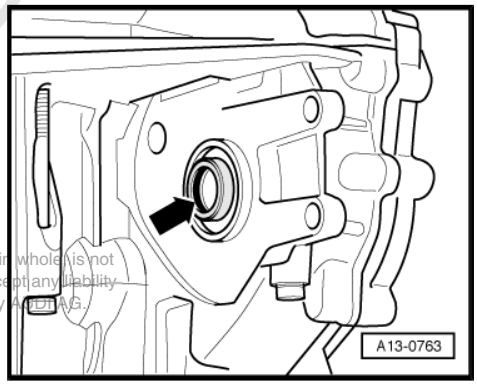
- ❑ Renewing ⇒ page 110

13 - Compression spring

- ❑ Only up to engine number BSM 006 225

Installation position of flat-section O-ring

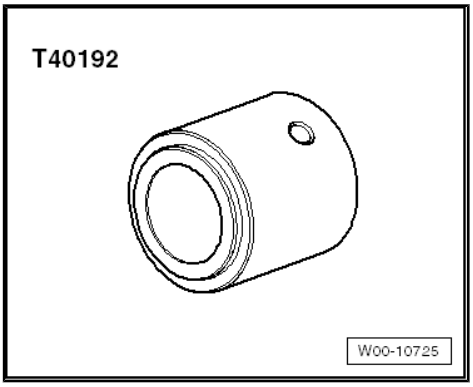
♦ In power steering pump drive -arrow-.



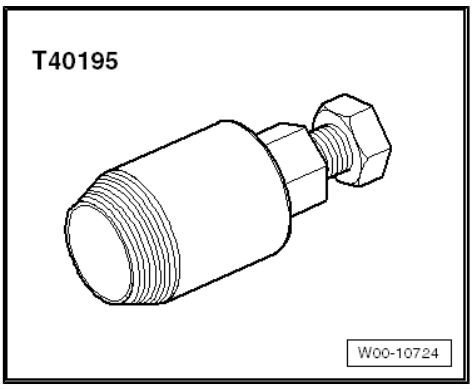
1.13 Renewing oil seal for air conditioner compressor drive

Special tools and workshop equipment required

♦ Thrust piece - T40192-



♦ Oil seal extractor -T40195-



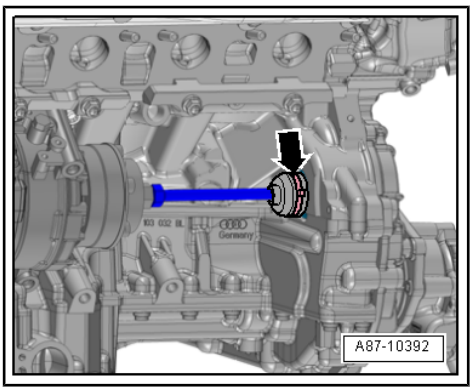
Procedure

- Engine removed and in position on scissor-type assembly platform - VAS 6131 A- with gearbox attached.

– Remove air conditioner compressor ⇒ Rep. gr. 87 .

– Detach hose clip on dust cap -arrow- for air conditioner compressor drive.

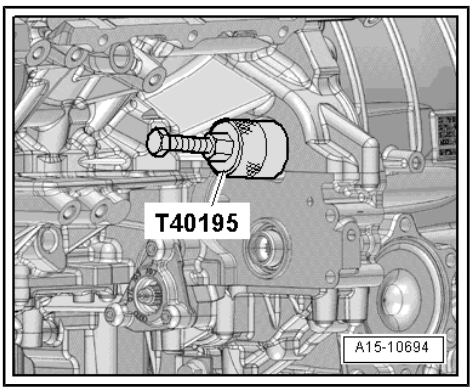
– Pull off dust cap together with drive shaft for air conditioner compressor from stub shaft of spur gear for air conditioner compressor drive.



– 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 into oil seal as far as possible (applying firm pressure).

– Turn inner part of oil seal extractor against spur gear drive until the oil seal is pulled out.



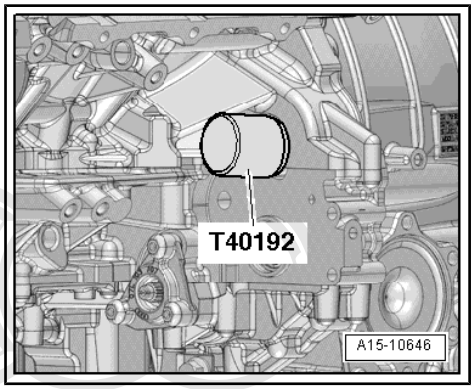
Note

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.

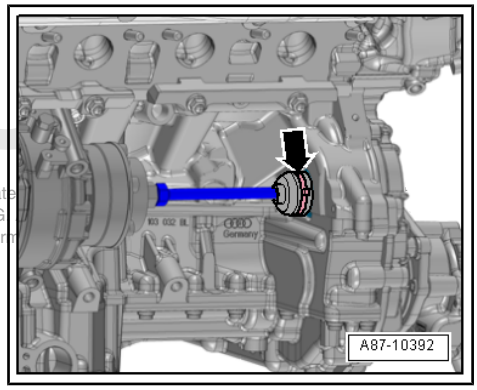
– Drive oil seal for AC compressor drive in onto stop with thrust piece -T40192- .



Note

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

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

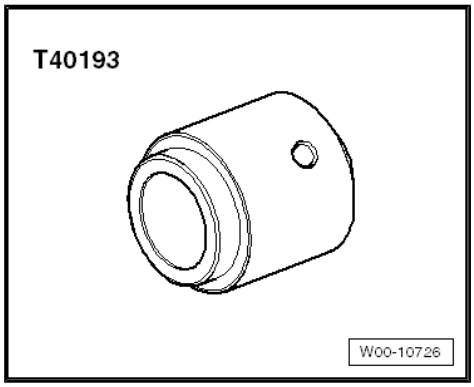


– Install air conditioner compressor ⇒ Rep. gr. 87 .

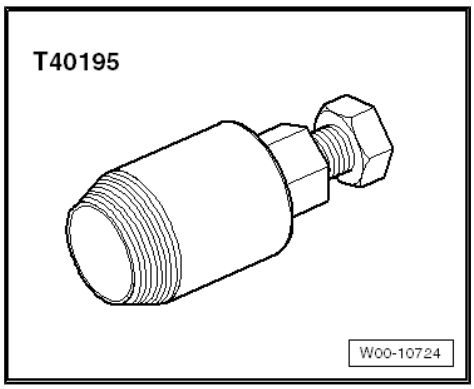
1.14 Renewing oil seal for power steering pump drive

Special tools and workshop equipment required

♦ Thrust piece - T40193-



♦ Oil seal extractor -T40195-



Procedure

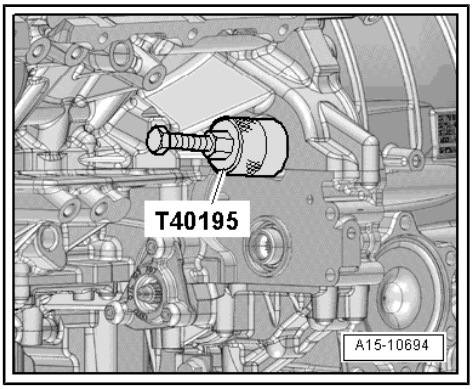
- Engine removed and in position on scissor-type assembly platform - VAS 6131 A- with gearbox attached.

– Remove power steering pump ⇒ Rep. gr. 48 .

– 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 into oil seal as far as possible (applying firm pressure).

– Turn inner part of oil seal extractor against spur gear drive until the oil seal is pulled out.



Note

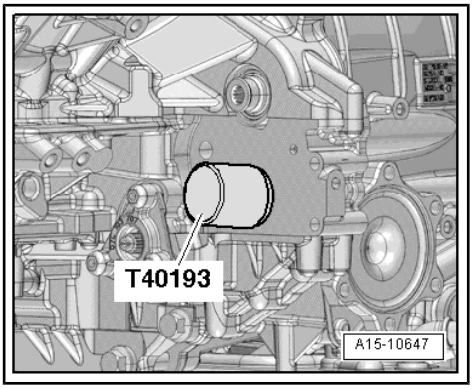
If the sections of the oil seal come apart, apply oil seal extractor again and pull out remaining part of oil seal.

– Clamp hexagon flats of oil seal extractor in vice and use pliers to remove oil seal.

– Clean contact surface and sealing surface.

– Drive oil seal for power steering pump drive in onto stop with thrust piece -T40193- .

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



1.15 Removing and installing spur gear drive

Special tools and workshop equipment required

♦ Sealant ⇒ Electronic parts catalogue

Removing

- Engine separated from gearbox ⇒ page 27 , engine attached to scissor-type assembly platform - VAS 6131 A- or secured to engine and gearbox support ⇒ page 36 .
- Engine oil drained ⇒ Maintenance ; Booklet 404 .

– Remove drive plate ⇒ page 63 .

– Remove timing chain covers (left and right) ⇒ page 78 .

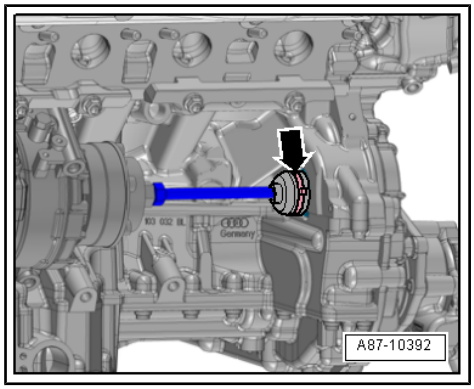
– Remove intake manifold ⇒ Rep. gr. 24 .

– Remove oil filter housing ⇒ page 177 .

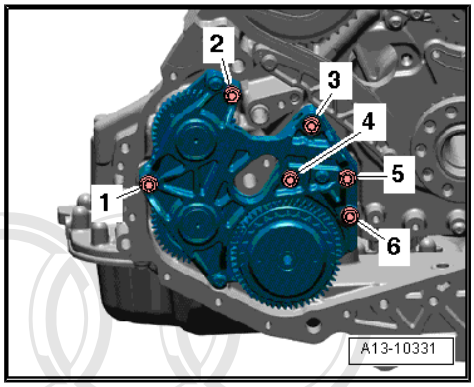
– Remove timing chain cover (bottom) ⇒ page 82 .

– Detach power steering pump from cylinder block.

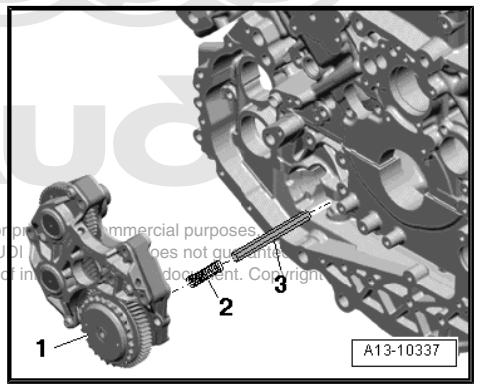
– Remove hose clip on dust cap -arrow- for air conditioner compressor drive.
– Remove drive chain for auxiliary drives ⇒ page 103 .



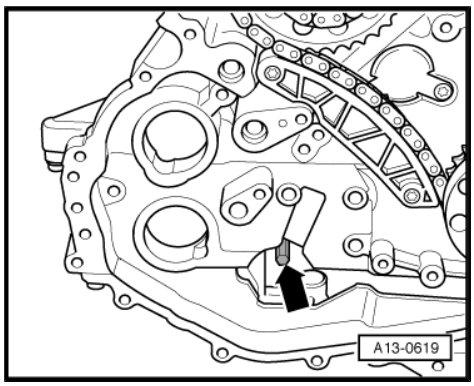
– Remove bolts -1 ... 6-.
– Release spur gear drive from bonded joint.



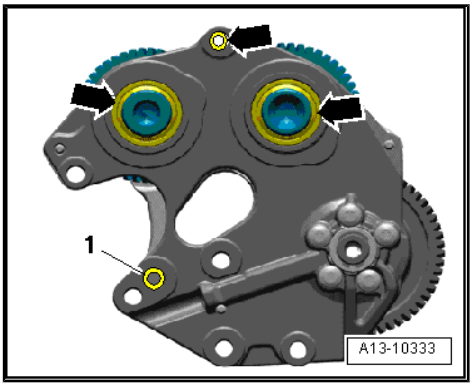
– Up to engine number BSM 006 225: Remove spring -2- between spur gear drive -1- and drive shaft -3- for oil pump.



– Remove drive shaft -arrow- for oil pump.



Installing



Note

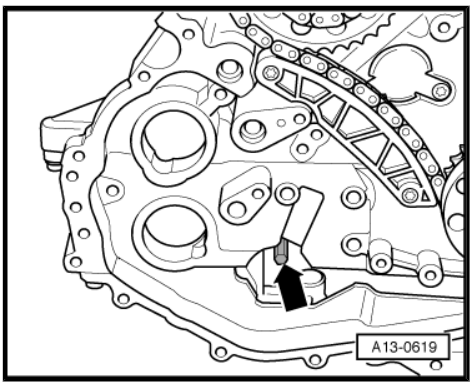
Renew O-ring.

– Renew oil seals ⇒ Item 4 (page 108) , ⇒ Item 12 (page 108) and flat-section O-ring ⇒ page 108 in power steering pump drive if damaged.

– Remove O-ring -1-.

– Remove sealant residue from spur gear drive and cylinder block.

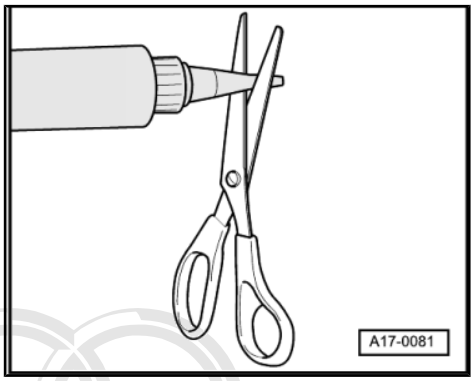
– Clean sealing surfaces; they must be free of oil and grease.



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

Note

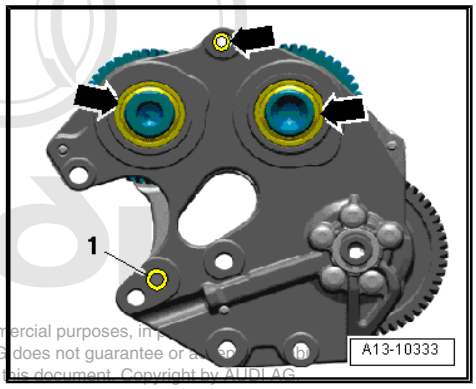
To ensure that drive shaft engages correctly in oil pump, insert drive shaft separately into oil pump (NOT together with spur gear drive).



Note

Note the use-by date of the sealant.

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



– Apply beads of sealant -arrows- onto clean sealing surfaces of spur gear drive (front) as illustrated.

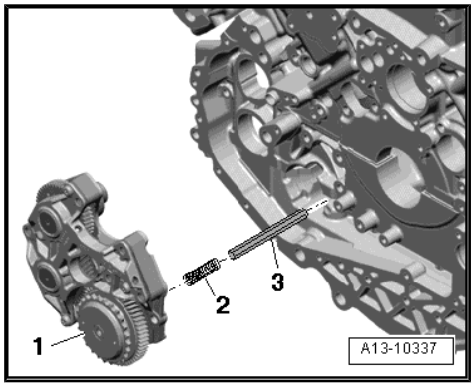
• Width of beads of sealant: 2.0 mm.

– Apply a small amount of grease to O-ring -1- and fit in position.

Note

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

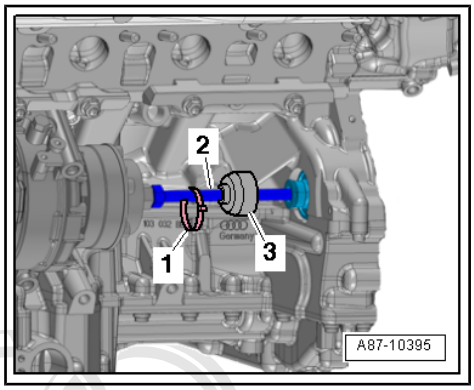
– Up to engine number BSM 006 225: Insert spring -2- for drive shaft -3- in spur gear drive -1-.



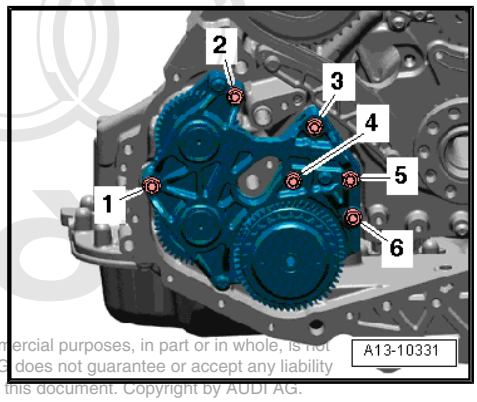
Note

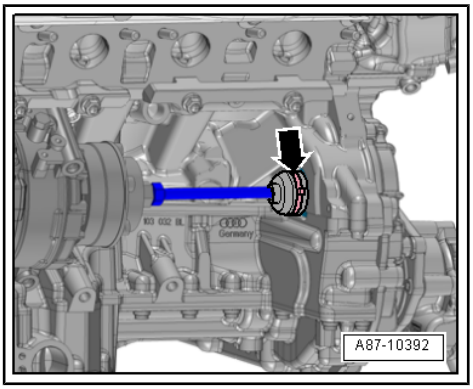
Secure with correct type of hose clip (same as original equipment) ⇒ Electronic parts catalogue .

– The new hose clip -1- must be guided through the hole in the retaining frame and over the dust cap -3- onto the air conditioner compressor drive shaft -2- while the spur gear drive is still removed.



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





– Press dust cap -arrow- with hose clip fitted onto stub shaft of spur gear for air conditioner compressor drive and secure.
– Install drive chain for auxiliary drives ⇒ page 103 .
– Slide power steering pump 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 82 .
– Install crankshaft oil seal (gearbox end) ⇒ page 64 .
– Install oil filter housing ⇒ page 177 .
– Install intake manifold ⇒ Rep. gr. 24 .
– Install timing chain covers (left and right) ⇒ page 80 .
– Install drive plate ⇒ page 63 .
– After installing engine, fill up with engine oil and check oil level ⇒ Maintenance ; Booklet 404 .

Tightening torques

♦ ⇒ “1.12 Auxiliary drives - exploded view”, page 107

1.16 Balance shaft - exploded view

1 - Balance shaft
- ❑ Removing and installing ⇒ page 116

2 - 5 Nm + turn 90° further
- ❑ Renew

3 - Bearing cover (rear)
- ❑ For balance shaft

4 - Seals
- ❑ For bearing cover (rear) for balance shaft
- ❑ Renew

5 - O-rings
- ❑ Renew

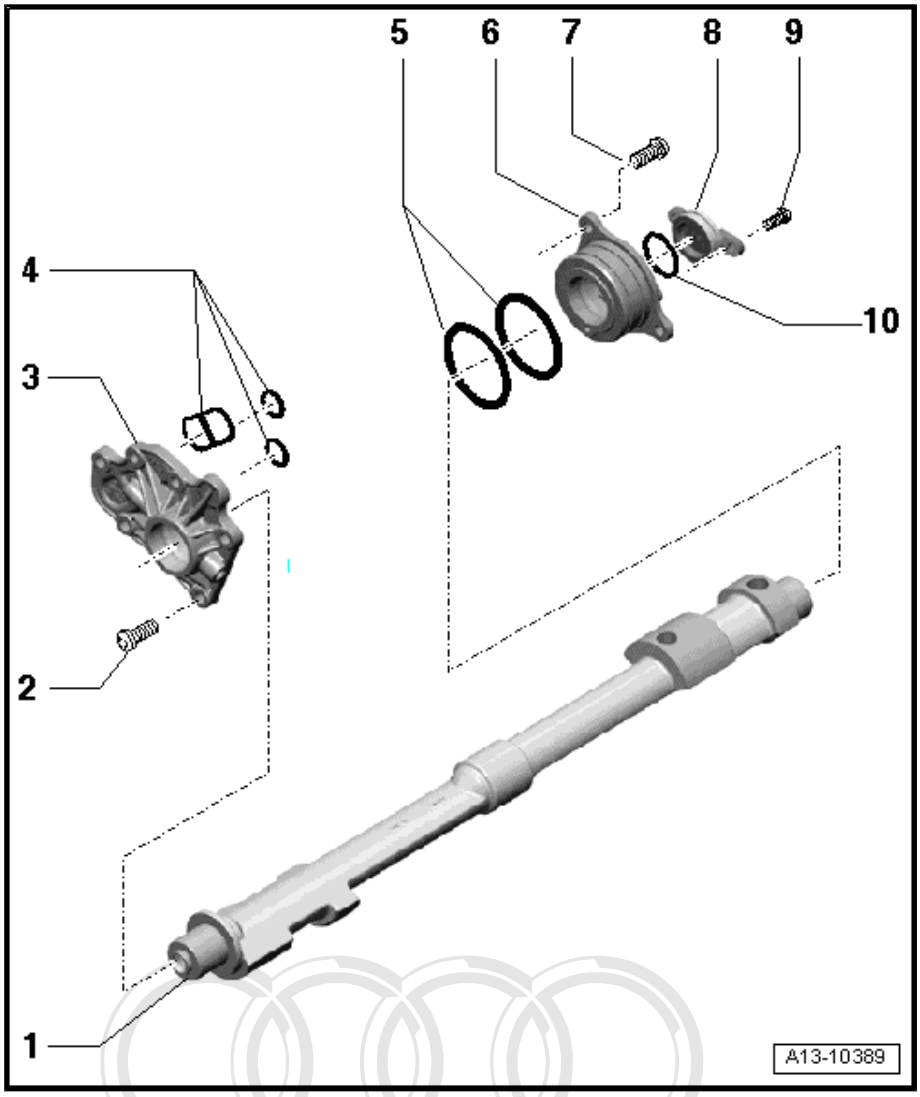
6 - Bearing cover (front)
- ❑ For balance shaft

7 - 5 Nm + turn 90° further
- ❑ Renew

8 - Cover
- ❑ For balance shaft

9 - 5 Nm

10 - O-ring
- ❑ Renew

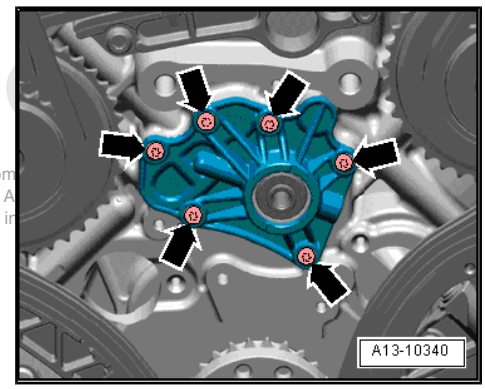


1.17 Removing and installing balance shaft

Removing

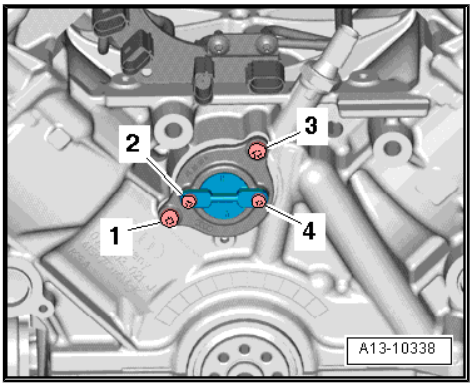
– Remove drive chain for auxiliary drives ⇒ page 103 .

– Unscrew bolts -arrows- and detach bearing cover (rear) for balance shaft.



– Remove bolts -2- and -4- and take out cover for balance shaft.

– Remove bolts -1- and -3- and take out bearing cover (front) for balance shaft.



Caution

Take care not to damage the oil spray jets when pulling out the balance shaft.

– Carefully pull balance shaft out of cylinder block.

Installing

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

Note

Renew seals and O-rings.

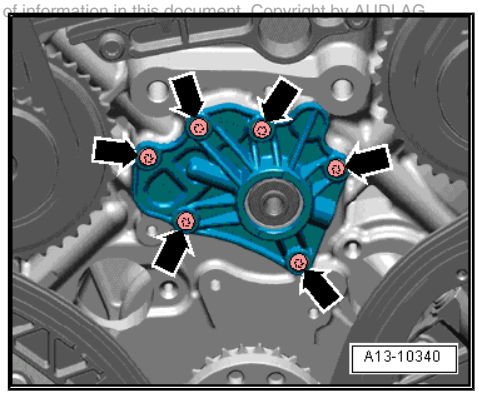
Caution

Take care not to damage the oil spray jets when inserting the balance shaft.

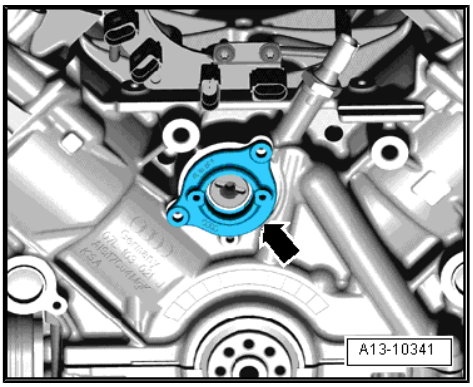
– Carefully insert balance shaft into cylinder block.

– Secure bearing cover (rear) for balance shaft -arrows-.

– Insert balance shaft into bearing cover (rear).



– Install bearing cover (front) -arrow- for balance shaft.



Note

- *The bolts securing bearing cover (front) for balance shaft are fitted at a later stage after performing adjustment of balance shaft.*
- *Adjustment of balance shaft*
  ⇒ “1.11 Removing and installing drive chain for auxiliary drives”, page 103 .

– Install drive chain for auxiliary drives ⇒ page 103 .

Tightening torques

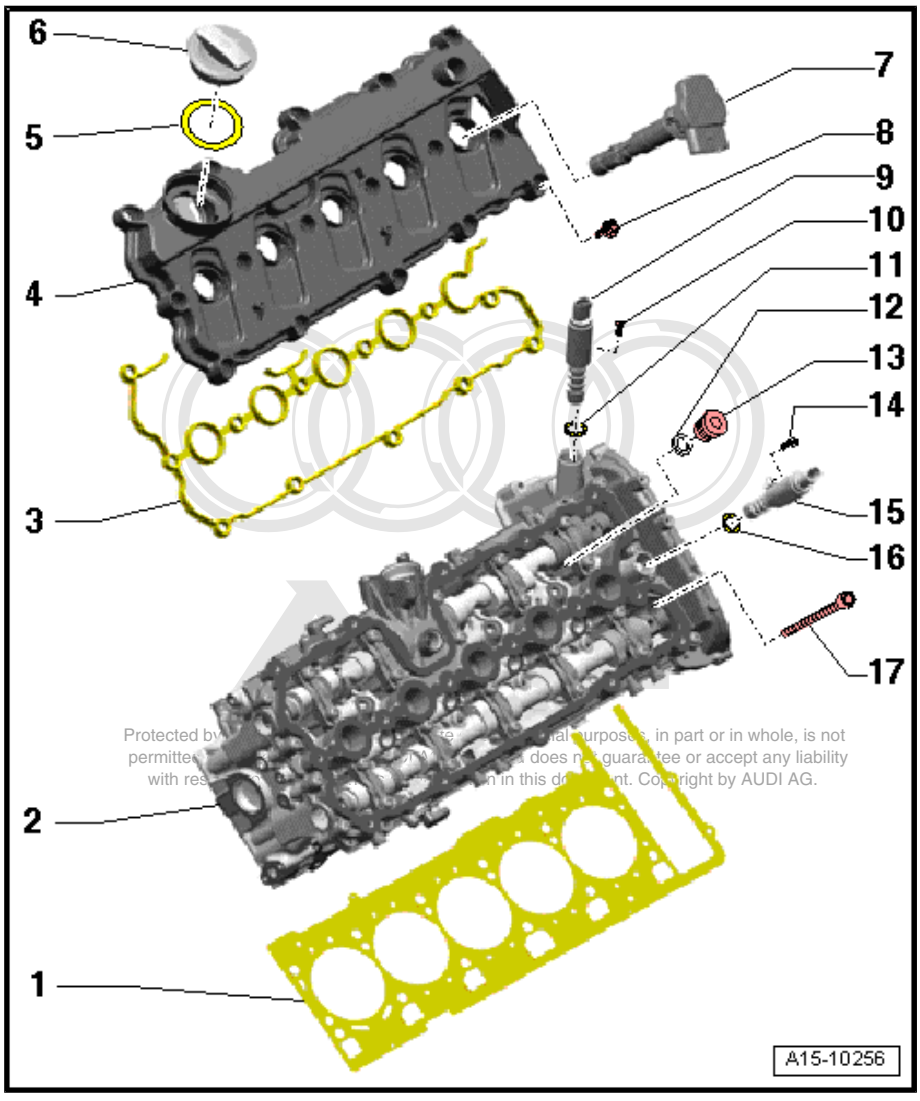
- ⇒ “1.16 Balance shaft - exploded view”, page 115

2 Cylinder head

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 125
- ❑ Installation position: part number must face cylinder head
- ❑ If renewed, change coolant and engine oil

2 - Cylinder head

- ❑ Removing and installing ⇒ page 125
- ❑ Checking for distortion ⇒ page 120
- ❑ Machining limit ⇒ page 120
- ❑ If renewed, change coolant and engine oil

3 - Gasket for cylinder head cover

- ❑ Renew if damaged or leaking

4 - Cylinder head cover

- ❑ Removing and installing: left-side ⇒ page 120 , right-side ⇒ page 123

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
- ❑ Cylinder head cover (left-side) - tightening torque and sequence ⇒ page 119
- ❑ Cylinder head cover (right-side) - tightening torque and sequence ⇒ page 119

9 - Camshaft control valve

- ❑ Cylinder bank 1 (right-side): camshaft control valve 1 - N205-
- ❑ Cylinder bank (left-side): camshaft control valve 2 - N208-

10 - 2.4 Nm

11 - O-ring

- ❑ Renew

12 - Seal

- ❑ Renew

13 - Screw plug, 35 Nm

14 - 2.4 Nm

15 - Exhaust camshaft control valve

- ❑ Cylinder bank 1 (right-side): exhaust camshaft control valve 1 - N318-
- ❑ Cylinder bank (left-side): exhaust camshaft control valve 2 - N319-

16 - O-ring

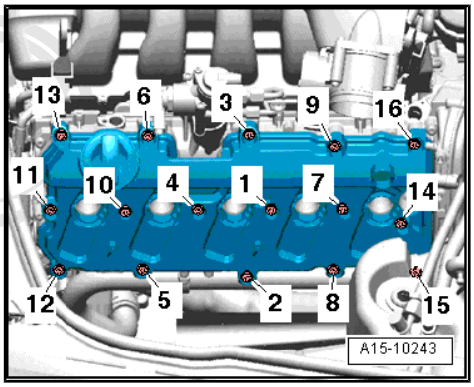
- ❑ Renew

17 - Bolt

- ❑ Renew
- ❑ Note correct sequence when loosening ⇒ page 128
- ❑ Tightening torque and sequence ⇒ page 120

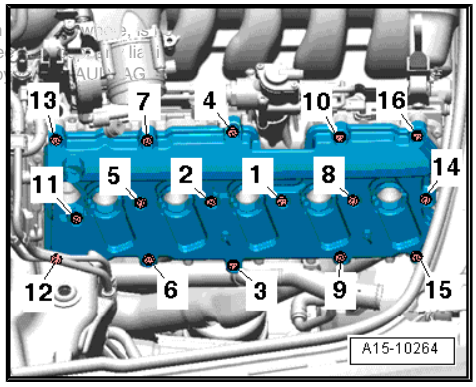
Cylinder head cover (left-side) - tightening torque and sequence

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

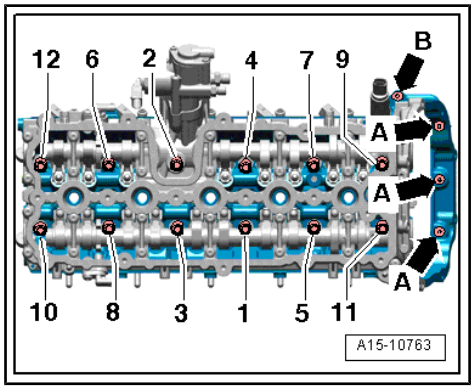


Cylinder head cover (right-side) - tightening torque and sequence

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



Cylinder head - tightening torque and sequence



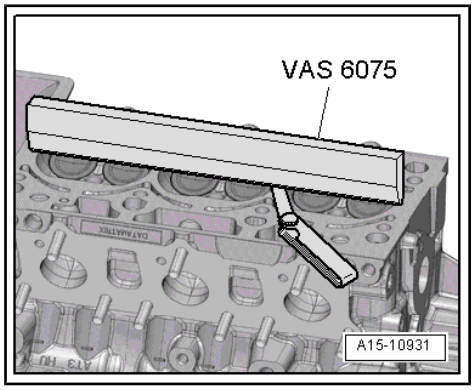
Note

Renew the bolts tightened with specified tightening angle.

– Tighten bolts in 6 stages in the sequence shown:

Stage	Bolts	Tightening torque/angle specification
1.	-1 … 12-	30 Nm
2.	-1 … 12-	60 Nm
3.	-1 … 12-	Turn 90° further
4.	-1 … 12-	Turn 90° further
5.	-Arrows A, B-	11 Nm
6.	-Arrows A-	Turn 90° further

Checking cylinder head for distortion

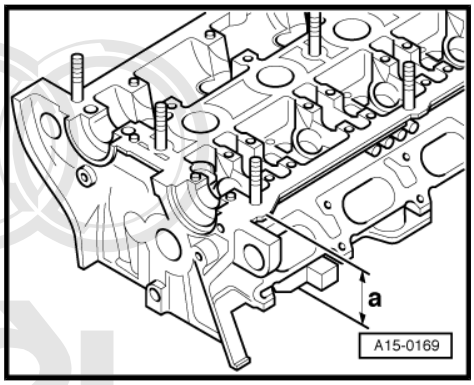


– Use straight edge 500 mm - VAS 6075- and feeler gauge to measure cylinder head for distortion at several points.

• 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-.

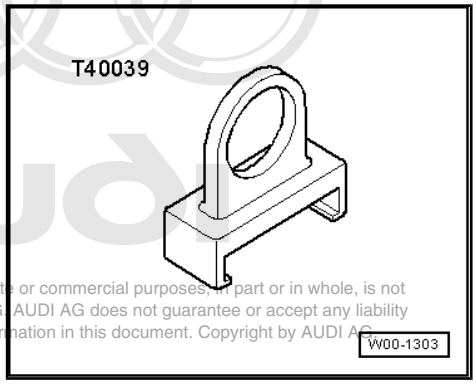


♦ Minimum dimension: -a- = 139.5 mm

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

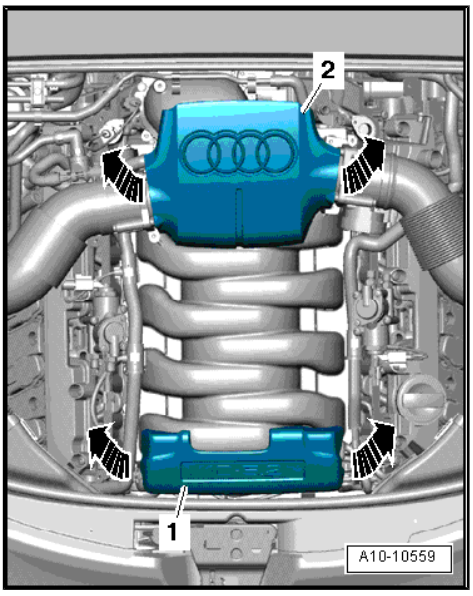
Special tools and workshop equipment required

♦ Puller - T40039-

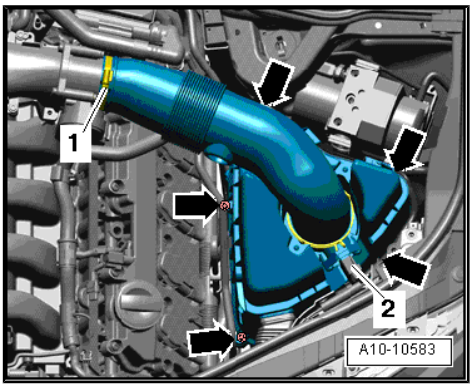


Removing

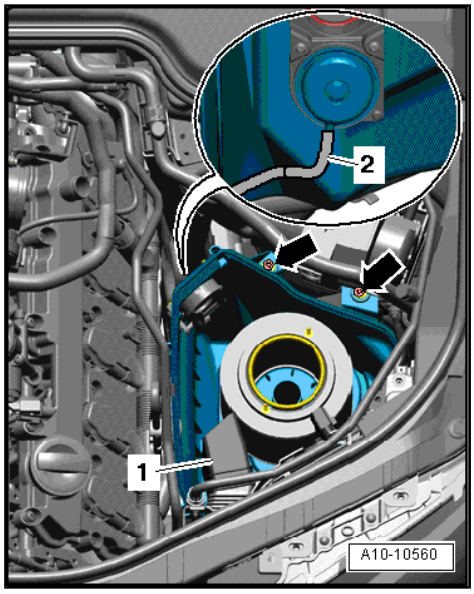
– Pull off engine cover panels at front -1- and at rear -2- -arrows-.



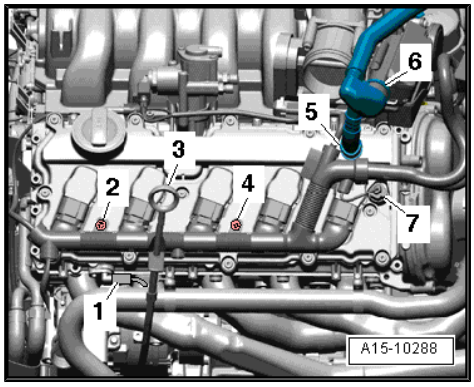
– Detach electrical connector -2- for air mass meter 2 - G246- .
– Remove air hose -1- from intake manifold.
– Unscrew bolts -arrows- and remove top section of air cleaner (left-side).



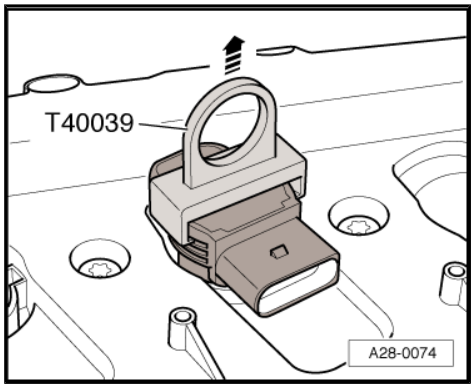
– Remove air duct -1-.
– Remove bolts -arrows-.
– Turn over bottom section of air cleaner and detach vacuum hose for air flap.
– Remove bottom section of air cleaner (left-side).



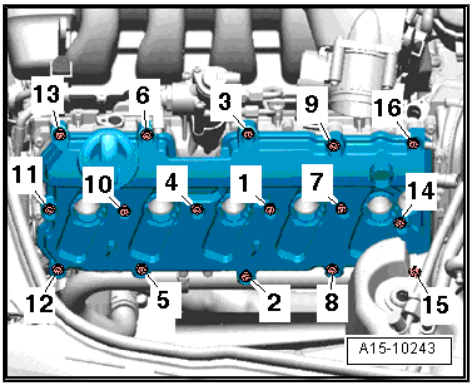
– Detach crankcase breather hose from oil separator -6- and from cylinder head cover -5-.
– Pull dipstick -3- out of guide tube.
– Unplug electrical connectors -1- and -7-.
– Remove bolts -2- and -4-.
– Unplug electrical connectors for ignition coils.
– Move wiring harness clear (unbolt bracket for wiring harness).



– Pull ignition coils out with puller - T40039- .



– Slacken bolts in the sequence: -16 ... 1- and remove bolts.
– Remove cylinder head cover (left-side).



Installing

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 119 .
– Install wiring guide for ignition coils ⇒ Rep. gr. 28 .
– Install air cleaner housing (left-side) ⇒ Rep. gr. 24 .

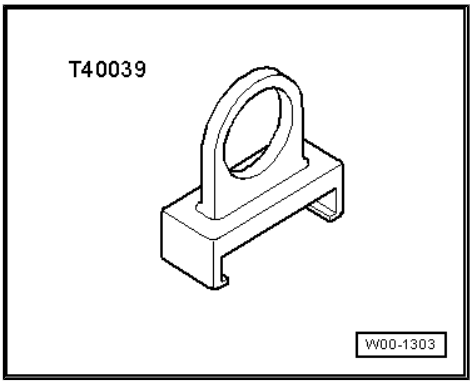
Tightening torques

- ⇒ Fig. ""Cylinder head cover (left-side) - tightening torque and sequence"" , page 119

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

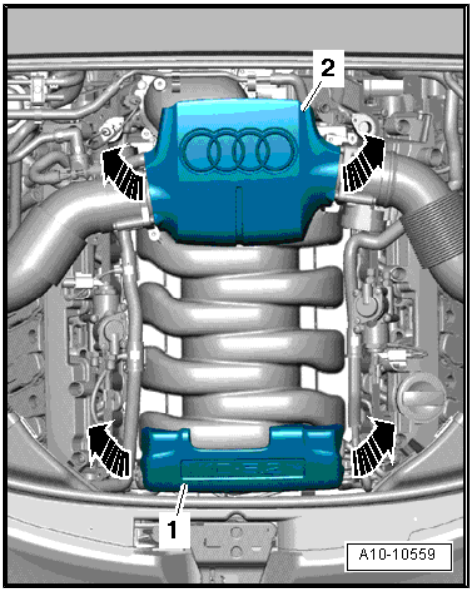
Special tools and workshop equipment required

- Puller - T40039-



Removing

– Pull off engine cover panels at front -1- and at rear -2- -arrows-.



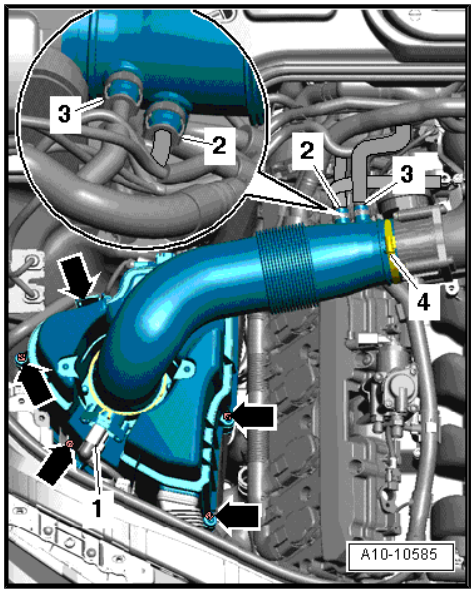
– Detach electrical connector -1- for air mass meter - G70- .
– Detach vacuum line -2- from air hose.

Rest-of-world vehicles:

– Detach crankcase breather hose -3- from air hose.
– Remove air hose -4- from intake manifold.

USA models:

– Open hose clips and move air hose -4- to one side.

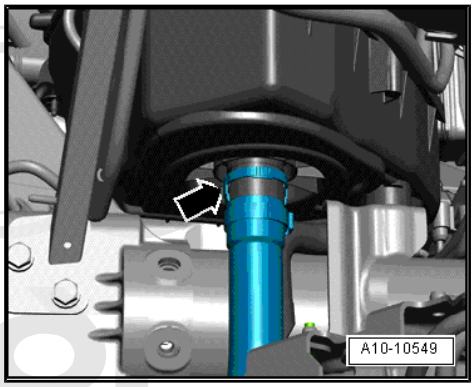


> **Caution**
>
> *Do not open hose connection -3- on USA models.*

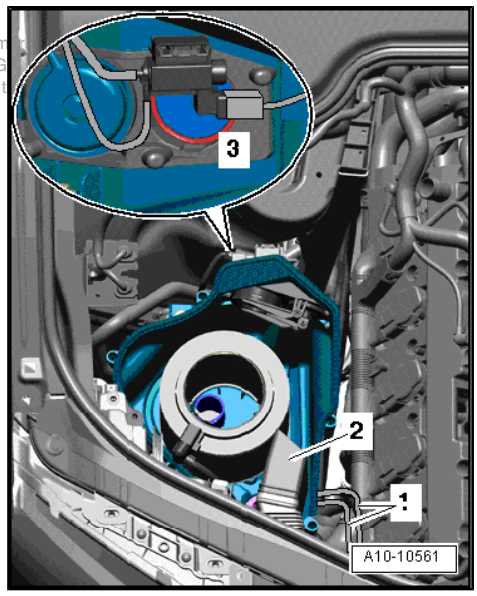
All vehicles:

– Unscrew bolts -arrows- and remove top section of air cleaner (right-side).
– Remove front section of front right wheel housing liner ⇒ Rep. gr. 66 .

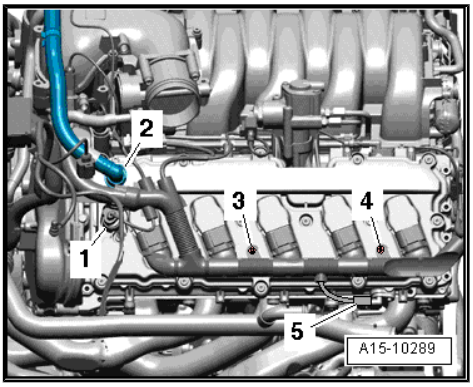
– Disconnect air hose -arrow- at bottom of bottom section of air cleaner (right-side).



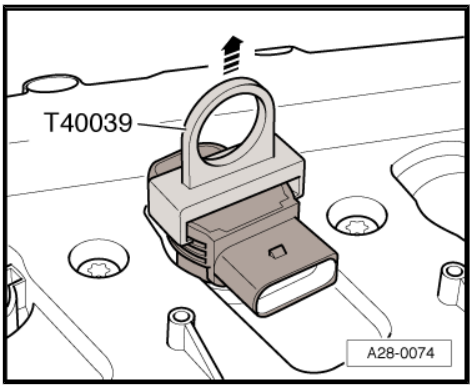
– Disconnect both vacuum hoses -1-.
– Remove air duct -2-.
– Remove bolts -arrows-.
– Turn over bottom section of air cleaner and unplug electrical connector -3- at variable intake manifold change-over valve - N335- .
– Remove bottom section of air cleaner (right-side).



– Remove crankcase breather hose -2-.
– Unplug electrical connectors -1- and -5-.
– Remove bolts -3- and -4-.
– Unplug electrical connectors for ignition coils.
– Move wiring harness clear (unbolt bracket for wiring harness).



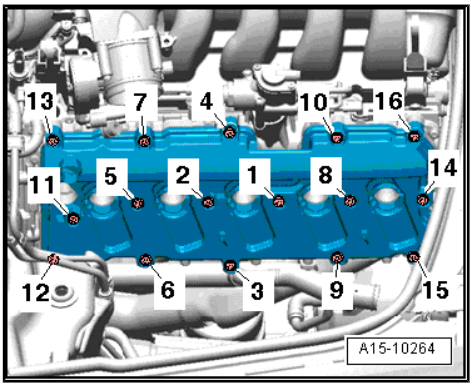
– Pull ignition coils out with puller - T40039- .



– Slacken bolts in the sequence: -16 ... 1- and remove bolts.
– Remove cylinder head cover.

Installing

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



Note

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

– Clean sealing surfaces; they must be free of oil and grease.
– Tighten bolts for cylinder head cover ⇒ page 119 .
– Install wiring guide for ignition coils ⇒ Rep. gr. 28 .
– Install air cleaner housing (right-side) ⇒ Rep. gr. 24 .

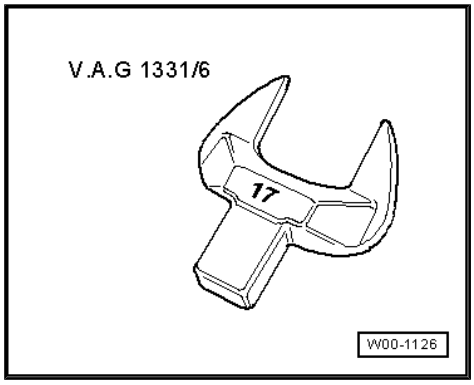
Tightening torques

- ⇒ Fig. ""Cylinder head cover (right-side) - tightening torque and sequence"" , page 119

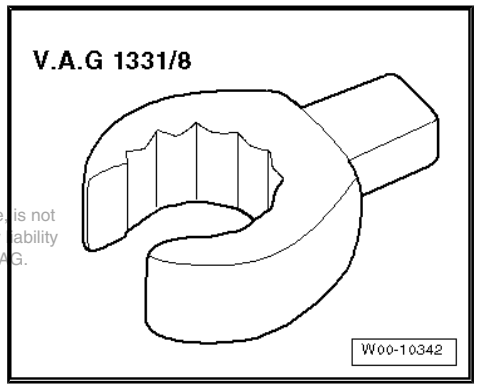
2.4 Removing and installing cylinder head

Special tools and workshop equipment required

♦ Open end spanner insert, AF 17 - V.A.G 1331/6-



♦ Socket insert AF 14, flared ring spanner - V.A.G 1331/8-



♦ Socket XZN M12 (at least 140 mm), commercially available

Removing

- Engine removed and in position on scissor-type assembly platform - VAS 6131 A- with gearbox attached.

Note

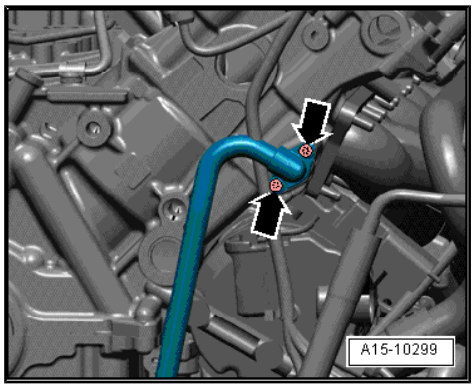
♦ *All cable ties which are released or cut open when removing must be fitted in the same position when installing.*

♦ *The following description shows the removal and installation of the cylinder head (left-side). The procedure for the other side is identical.*

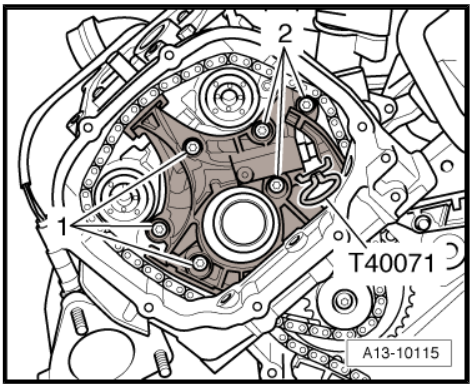
– Remove exhaust pipes: left-side ⇒ page 230 , right-side ⇒ page 233 .

– Unbolt connection for secondary air from front of cylinder head -arrows-.

– Remove intake manifold ⇒ Rep. gr. 24 .



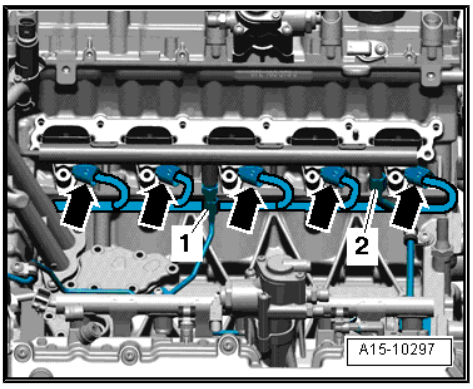
– Remove camshaft timing chains from camshafts ⇒ page 89 .
– Unscrew bolts -1- and -2- and remove chain tensioner (left-side).



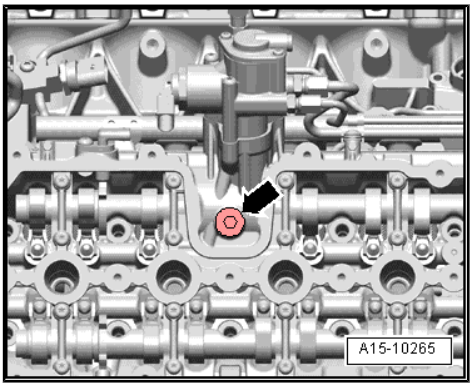
– Unplug electrical connectors -arrows- at injectors.
– Unscrew high-pressure pipe -2- at connection on fuel rail.
– Unscrew high-pressure pipe -1- at connection on fuel rail. To do so, counterhold at hexagon flats with an open-end spanner and slacken union nut.

Note

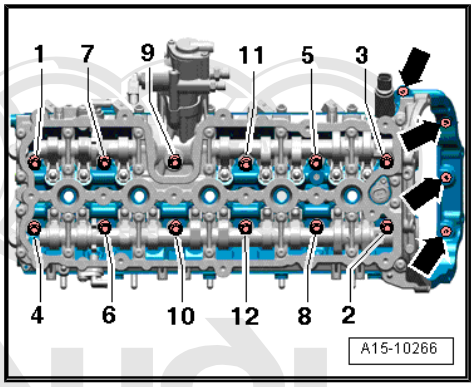
Do not attempt to bend high-pressure pipes to a different shape.



– Remove screw plug -arrow-.



– Remove bolts -arrows-.
– Slacken cylinder head bolts in the sequence: -1 ... 12- and remove bolts.
– Take off cylinder head and place it on a soft surface (such as foam plastic).



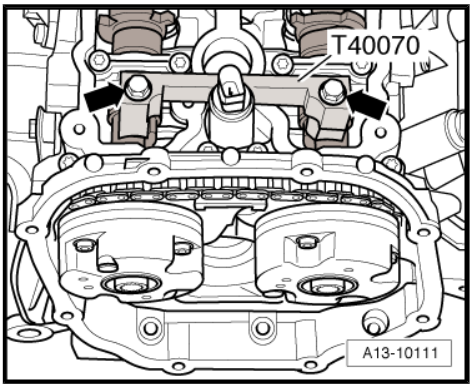
Installing

Note

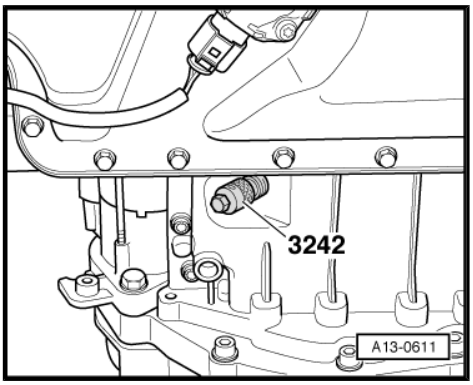
- *Renew the bolts tightened with specified tightening angle.*
- *Renew seals, gaskets and self-locking nuts and bolts.*
- *Carefully remove any sealant residue from the cylinder head and cylinder block. Ensure that no long scores or scratches are made on the surfaces.*
- *Carefully remove any remaining emery and abrasive material.*
- *No oil or coolant must be allowed to remain in the blind holes for the cylinder head bolts in the cylinder block.*
- *Do not remove new cylinder head gasket from packaging until it is ready to be fitted.*
- *Handle gasket very carefully. Damage to the silicone coating or the indented area will lead to leaks.*
- *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.*
- *When installing an exchange cylinder head with fitted camshafts, the contact surfaces between the roller rocker fingers and cams must be oiled after installing the cylinder head.*
- *The plastic protectors fitted to protect the open valves should not be removed until the cylinder head is ready to be fitted.*
- *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.*
- *After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.*
- *After fitting a new cylinder head or cylinder head gasket, change the engine oil and the coolant in the entire cooling system.*

– Check that camshafts on both cylinder heads are positioned at “TDC”.

• Camshaft clamps - T40070- must be attached on both cylinder heads and tightened to 25 Nm -arrows-.



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



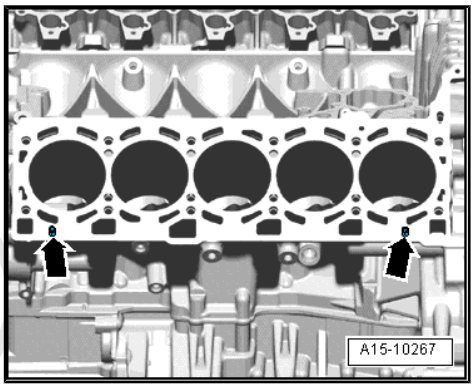
– Fit cylinder head gasket.

• Pay attention to dowel sleeves -arrows- in cylinder block.

• Note installation position of cylinder head gasket: the word “oben” (top) or the part number should face towards the cylinder head.

– Fit cylinder head.

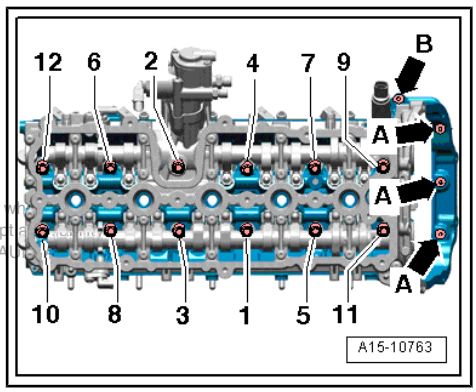
– Insert new cylinder head bolts and tighten hand-tight.



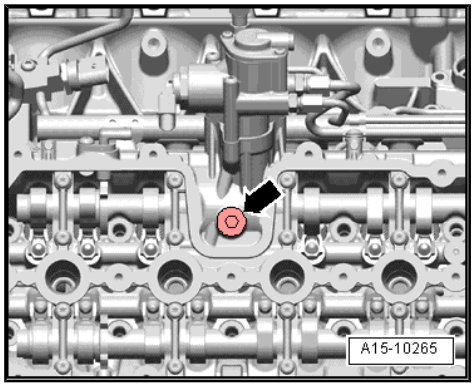
– Tighten cylinder head bolts ⇒ page 120 .

Note

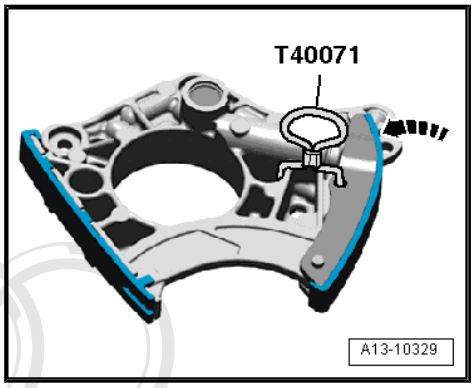
Cylinder head bolts do not have to be torqued down again later after repair work.



– Tighten screw plug -arrow-.



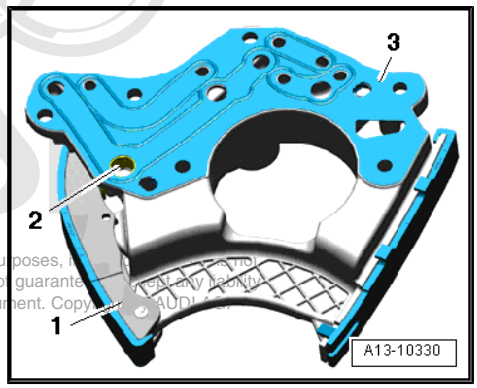
– Make sure that guide rail of chain tensioner for camshaft timing chain is locked with locking pin - T40071- .



Note

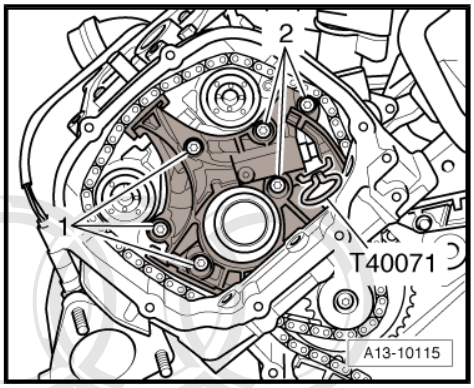
- *Note the correct installation position if the tensioning element has been removed from the chain tensioner: drilling in base of housing faces chain tensioner and piston faces tensioner rail.*
- *Disregard -arrow-.*

– If necessary, 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 camshaft timing chains ⇒ page 97 .

– Install timing chain covers (left and right) ⇒ page 80 .

– Install cylinder head cover: left-side ⇒ page 120 , right-side ⇒ page 123 .

– Install intake manifold and high-pressure pipes ⇒ Rep. gr. 24 .

– Install connection for secondary air ⇒ page 242 .

– Install exhaust pipes: left-side ⇒ page 230 , right-side ⇒ page 233 .

– After installing engine, change engine oil ⇒ Maintenance ; Booklet 404 .

– Fill cooling system with fresh coolant ⇒ page 187 .

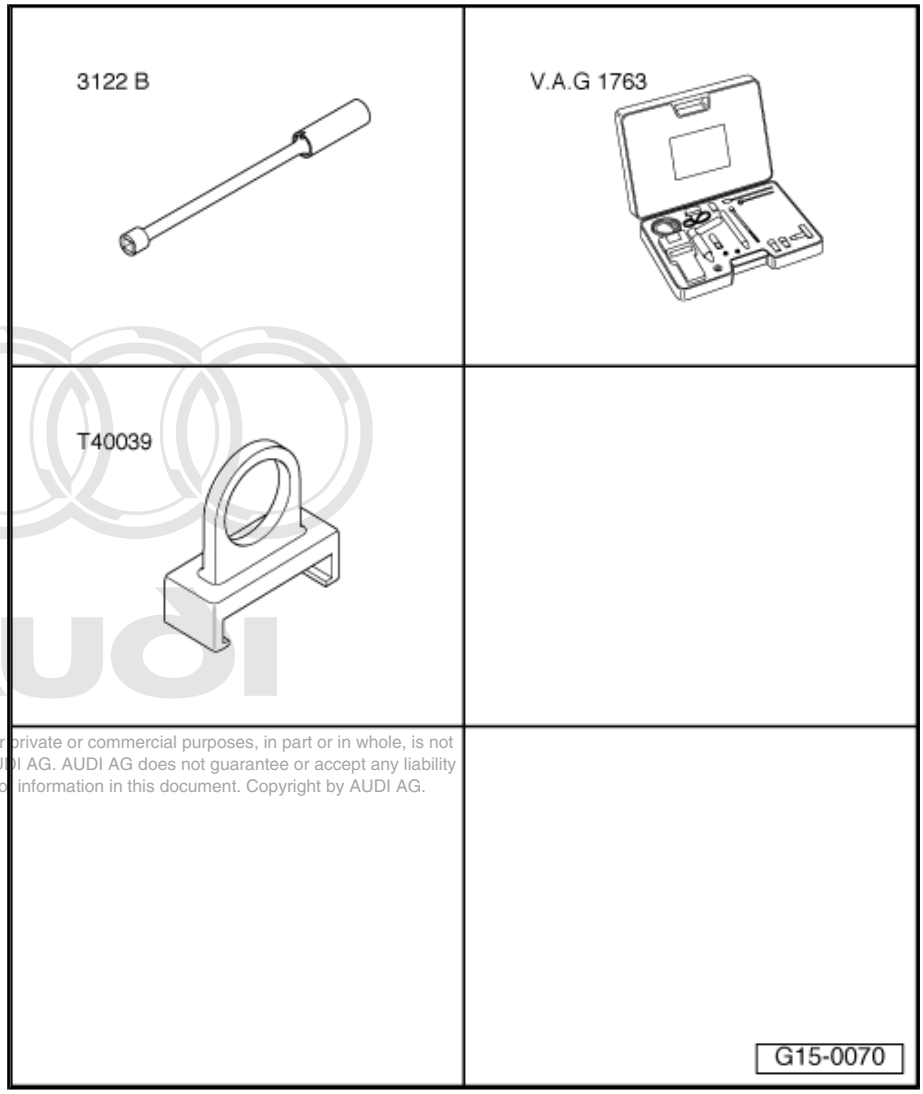
Tightening torques

- ⇒ “2.1 Cylinder head - exploded view”, page 118
- ⇒ Fig. ““Cylinder head - tightening torque and sequence”“ , page 120

2.5 Checking compression

Special tools and workshop equipment required

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

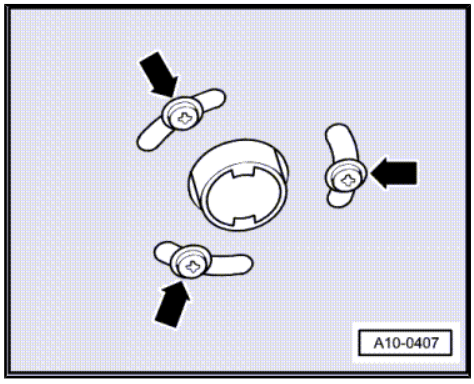


Procedure

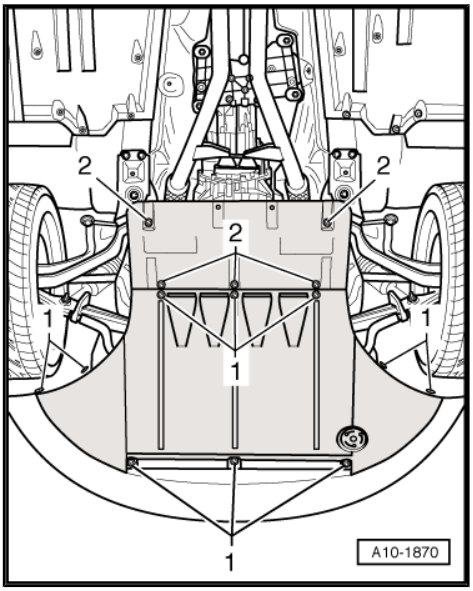
- Engine oil temperature at least 30 °C.
- Battery voltage at least 12.5 V.

– Switch off ignition.

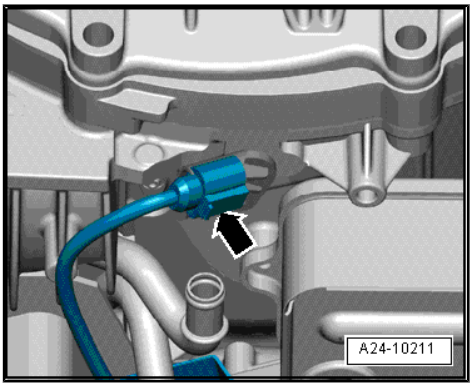
– Vehicles with auxiliary heater: remove bolts -arrows- securing exhaust pipe for auxiliary/additional heater to noise insulation.



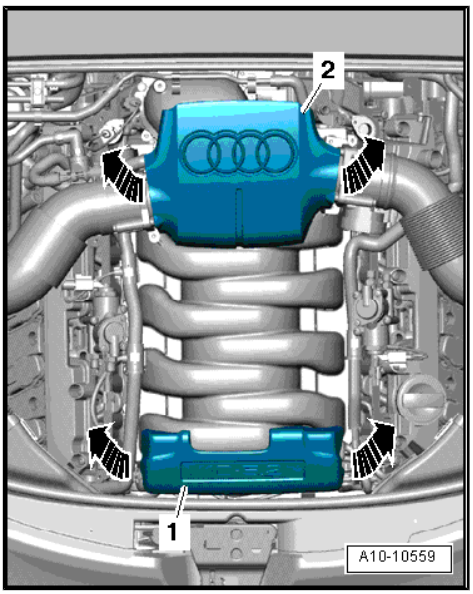
– Open quick-release fasteners -1- and remove noise insulation (front).



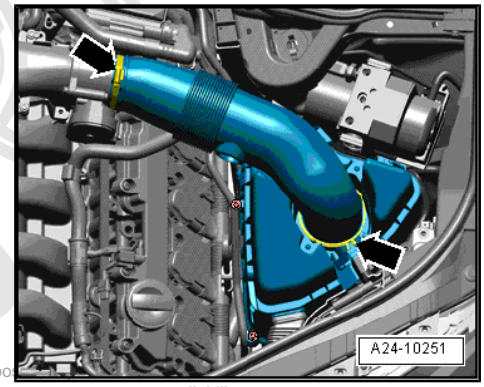
– Unplug electrical connector at engine speed sender - G28- -arrow- at bottom of gearbox.



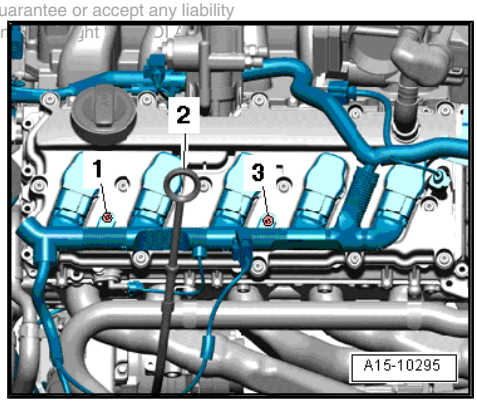
– Pull off engine cover panels at front -1- and at rear -2- -arrows-.



– Remove air hose (left-side) -arrows-.



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

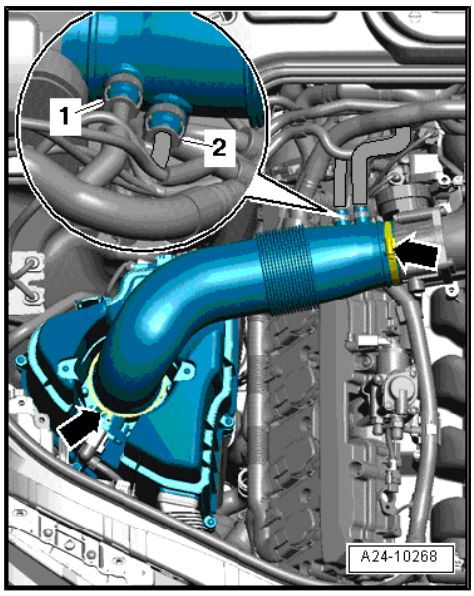


Rest-of-world vehicles:

– Detach vacuum line -2- at air intake hose.
– Disconnect hose -1- for crankcase breather system from air hose by pressing release tabs.
– Open hose clips -arrows- and disconnect air intake hose.

USA models:

– Detach vacuum line -2- from air hose.
– Open hose clips -arrows- and move air intake hose to one side.

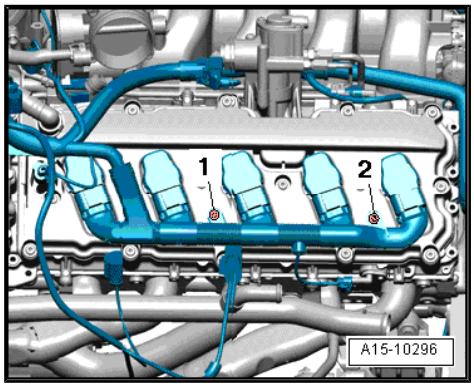


Caution

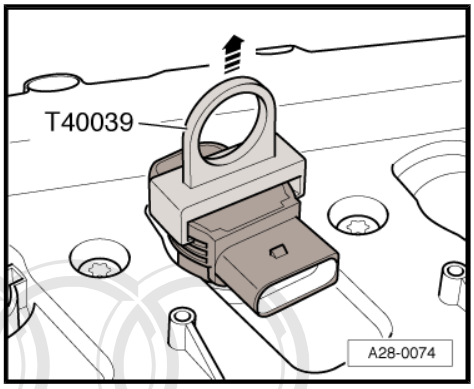
Do not open hose connection -1- on USA models.

All vehicles:

– Remove bolts -1- and -2-.
– Unplug electrical connectors for ignition coils and push wiring harness to one side.



– Pull all ignition coils out with puller - T40039- .
– Remove spark plugs with spark plug socket - 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.
– Repeat procedure on each cylinder.

Compression pressure	bar
When new	10.0 … 14.0
Wear limit	9.0
Difference between cylinders	3.0 (maximum)

Assembling

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

– Install spark plugs ⇒ Maintenance ; Booklet 404 .
– Install wiring guide for ignition coils ⇒ Rep. gr. 28 .
– Erase any entries in event memory resulting from testing ⇒ Vehicle diagnostic tester, `Guided Functions`, `Interrogate event memory`, then `Generate readiness code`.

3 Valve gear

Note

- *Cylinder heads which have cracks between the valve seats or between a valve seat insert and the spark plug thread can be re-installed without reducing service life, provided the cracks are only slight and do not exceed a maximum of 0.3 mm in width, and no more than the first 4 turns of the spark plug threads are cracked.*
- *After working on the valve gear, turn the engine carefully at least 2 rotations by hand to ensure that none of the valves make contact when the starter is operated.*

3.1 Valve gear - exploded view

Note

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

1 - Sealing plugs
- ❑ Apply sealant when installing; refer to ⇒ Electronic parts catalogue for sealant

2 - Valve stem oil seal
- ❑ Renewing (cylinder head installed) ⇒ page 145
- ❑ Renewing (cylinder head removed) ⇒ page 149

3 - Valve spring
- ❑ Installation position ⇒ page 138

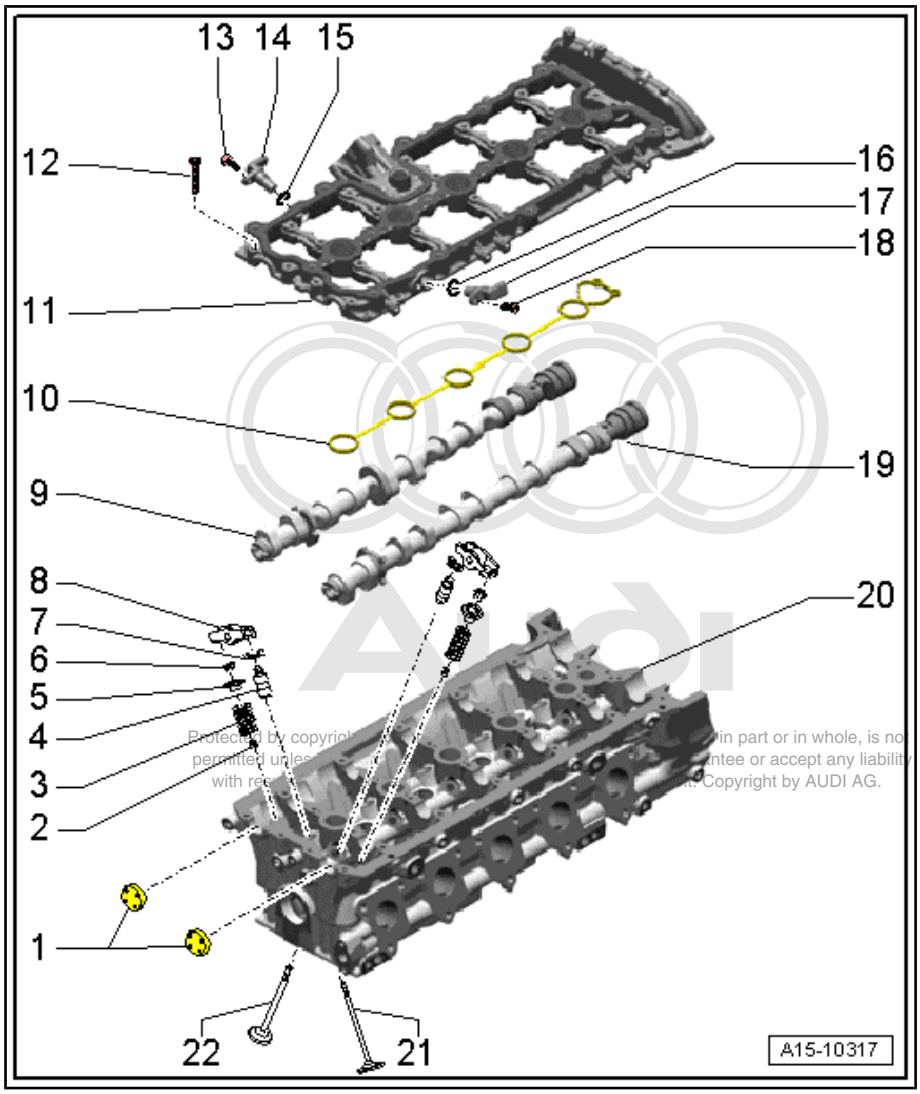
4 - Hydraulic valve compensation element
- ❑ Clipped into roller rocker finger -item 8-
- ❑ Checking ⇒ page 153
- ❑ Do not interchange
- ❑ Lubricate contact surface

5 - Valve spring plate

6 - Valve cotters

7 - Securing clip
- ❑ Not supplied separately
- ❑ Check for firm attachment

8 - Roller rocker finger
- ❑ Do not interchange



- ❑ Check roller bearings for ease of movement
- ❑ Lubricate contact surface
- ❑ Assembly: attach to hydraulic compensation element -item 4- using securing clip -item 7-

9 - Inlet camshaft

- ❑ Removing and installing ⇒ page 140
- ❑ Measuring axial clearance ⇒ page 138
- ❑ Measuring radial clearance ⇒ page 139
- ❑ Runout: max. 0.04 mm

10 - Gasket

- ❑ Renew

11 - Retaining frame

- ❑ With integrated camshaft bearings
- ❑ Removing and installing ⇒ “3.4 Removing and installing camshafts”, page 140

12 - Bolt

- ❑ Renew
- ❑ Use old bolts when measuring radial clearance
- ❑ To avoid damage to retaining frame for camshafts, refer to tightening torque and sequence ⇒ page 144

13 - 9 Nm

14 - Hall sender for inlet camshaft

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

15 - O-ring

- ❑ Renew

16 - O-ring

- ❑ Renew

17 - Hall sender for exhaust camshaft

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

18 - 9 Nm

19 - Exhaust camshaft

- ❑ Removing and installing ⇒ page 140
- ❑ Measuring axial clearance ⇒ page 138
- ❑ Measuring radial clearance ⇒ page 139
- ❑ Runout: max. 0.04 mm

20 - Cylinder head

- ❑ Checking valve guides ⇒ page 154

21 - Inlet valve

- ❑ Do not machine, only grinding-in is permitted
- ❑ Mark installation position for re-installation
- ❑ Valve dimensions ⇒ page 154
- ❑ Checking valve guides ⇒ page 154

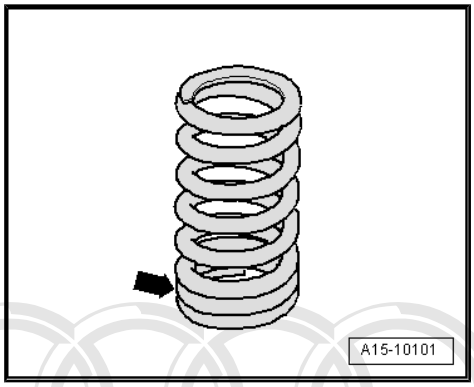
22 - Exhaust valve

- ❑ Do not machine, only grinding-in is permitted
- ❑ Mark installation position for re-installation
- ❑ Valve dimensions ⇒ page 154

❑ Checking valve guides ⇒ page 154

Position of valve spring

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



Retaining frame for camshafts - tightening torque and sequence

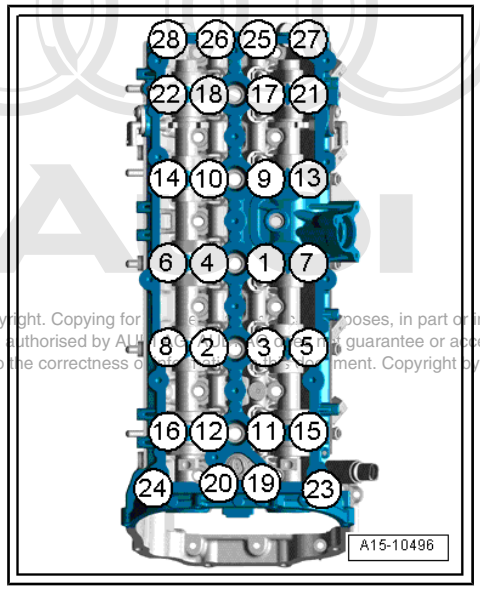
Note

- *The illustration shows the retaining frame for camshafts on cylinder head (left-side).*
- *Renew the bolts tightened with specified tightening angle.*

Caution

Risk of damage to retaining frame for camshafts.

- ***It is important to tighten the bolts securing the retaining frame as described below.***



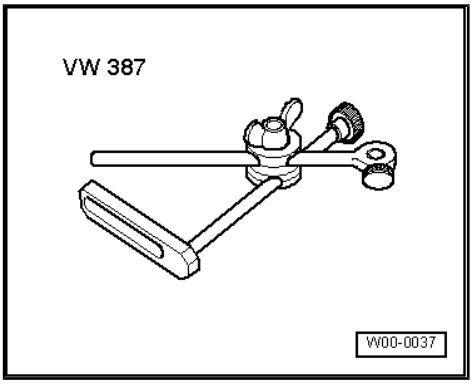
– Tighten bolts in 4 stages in the sequence shown:

Stage	Bolts	Tightening torque/angle specification
1.	-1 … 28-	Screw in by hand until bolt heads make contact with retaining frame
2.	-1 … 28-	Continue tightening 1 turn at a time in several stages until retaining frame makes full contact with cylinder head and a torque of 8 Nm is reached
3.	-1 … 28-	8 Nm
4.	-1 … 28-	Turn 90° further

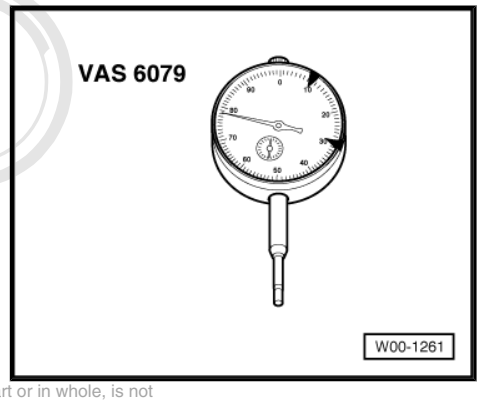
3.2 Measuring axial clearance of camshafts

Special tools and workshop equipment required

♦ Universal dial gauge bracket - VW 387-



♦ Dial gauge - VAS 6079-



Test sequence

– Remove retaining frame
⇒ “3.4 Removing and installing camshafts”, page 140 .

– Fit camshaft to be tested in retaining frame.

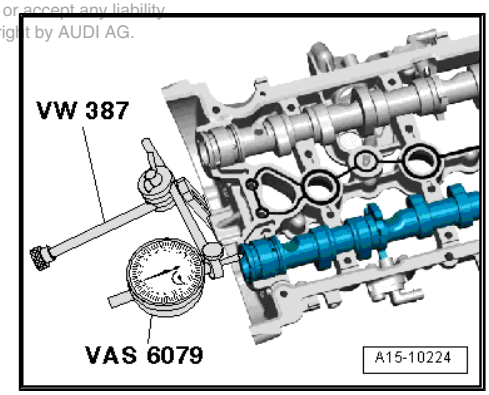
– Attach dial gauge - VAS 6079- with universal dial gauge bracket - VW 387- to retaining frame.

– Press camshaft against dial gauge by hand.

– Set dial gauge to “0”.

– Press camshaft away from dial gauge and read off value:

• Axial clearance: 0.100 ... 0.191 mm



3.3 Measuring radial clearance of camshafts

Special tools and workshop equipment required

♦ Plastigage

Procedure

– Remove roller rocker fingers
⇒ “3.4 Removing and installing camshafts”, page 140 .

– Clean bearings and bearing journals.

– Place a length of Plastigage corresponding to the width of the bearing on the bearing journal or bearing shell to be measured.

• The Plastigage must be positioned in the centre of the bearing.

– Fit retaining frame and secure with old bolts ⇒ page 138 without rotating camshafts.

– Remove retaining frame again.

– Compare width of Plastigage with measurement scale.

Radial clearance:

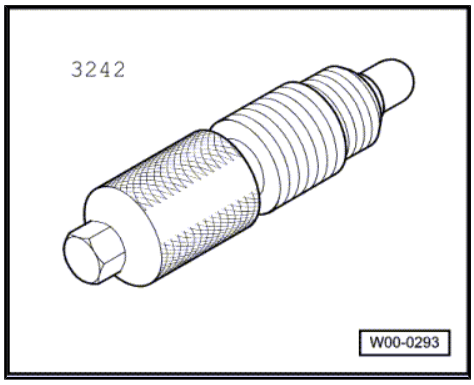
- 24 mm bearing diameter: 0.024 ... 0.066 mm.
- 36 mm bearing diameter: 0.100 ... 0.325 mm.

– When carrying out final assembly, renew bolts.

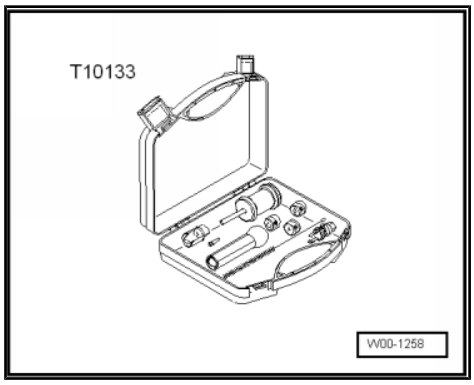
3.4 Removing and installing camshafts

Special tools and workshop equipment required

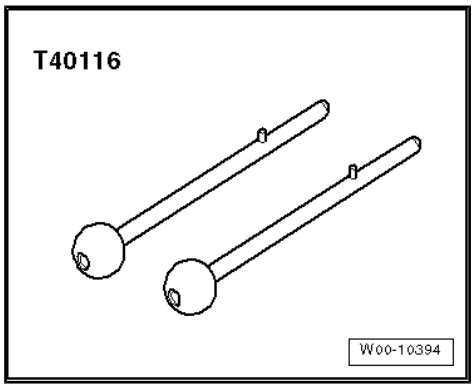
♦ Locking pin - 3242-



♦ Impact extractor attachment -T10133/3- from tool set for FSI engines - T10133-



♦ 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

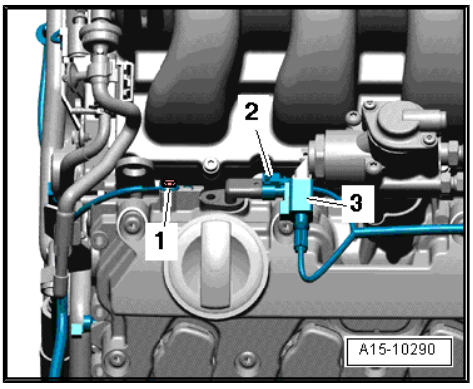
- Engine removed and in position on scissor-type assembly platform - VAS 6131 A- with gearbox attached.

– Remove camshaft timing chains from camshafts ⇒ page 89 .

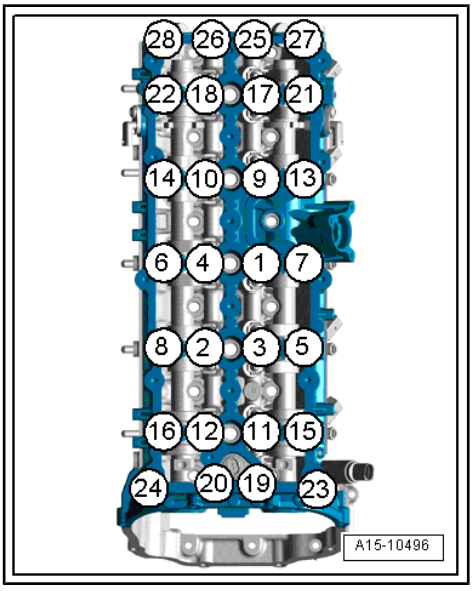
– Unscrew earth wire -1- from retaining frame.

– Unplug electrical connectors -2- and -3-.

– Remove high-pressure pump ⇒ Rep. gr. 24 .



– Slacken retaining frame bolts in the sequence -28 ... 1-.



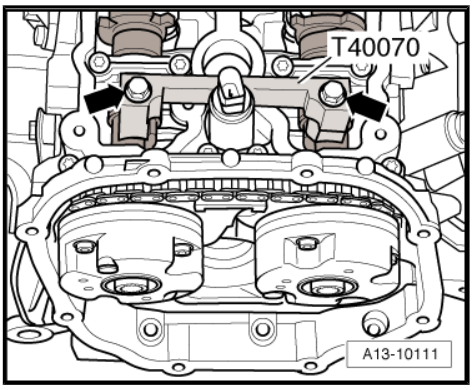
Note

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

– Carefully release retaining frame from bonded joint and set it down on a soft surface on workbench.

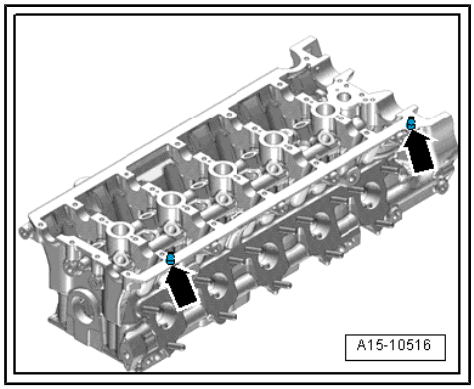
– Remove camshaft clamp - T40070- at left cylinder head.

– Mark and remove camshafts.



Caution

On engines fitted with dowel pins -arrows- for retaining frames, use roll-pin drift to drive out dowel pins.

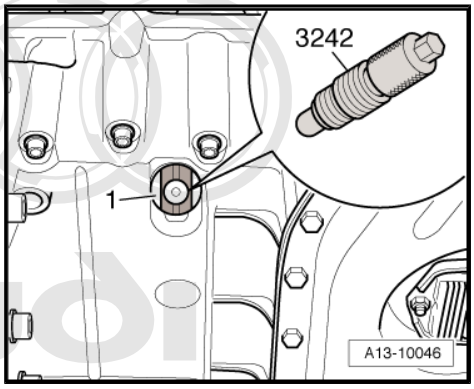


Installing

Note

- *Renew the bolts tightened with specified tightening angle.*
- *Renew gaskets and seals.*

- Crankshaft -1- locked in position with locking pin - 3242- .



WARNING

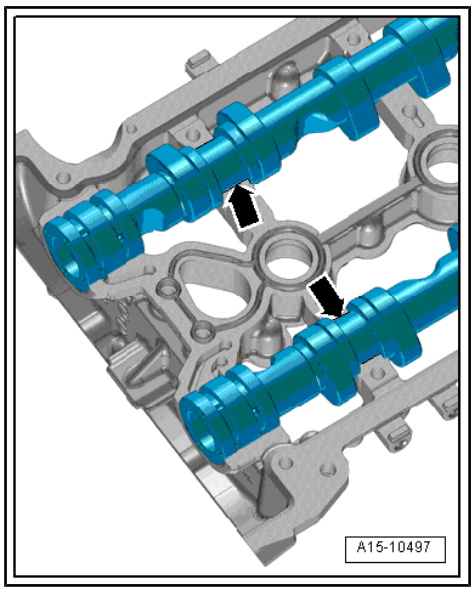
Wear safety goggles.

Caution

Make sure that no sealant residue gets into the cylinder head or the bearings.

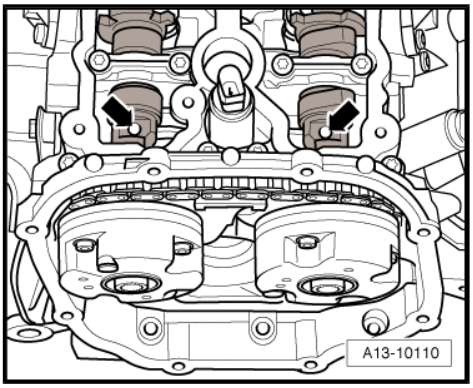
– Remove sealant residue from cylinder head and retaining frame using a rotating plastic brush or similar.
– Clean sealing surfaces; they must be free of oil and grease.
– Lubricate running surfaces of camshafts.

– Insert camshafts into retaining frame.
- Camshafts must be in correct position in axial bearings -arrows- in retaining frame.
– Turn retaining frame upside down with camshafts fitted, keeping hold of the camshafts in the retaining frame.

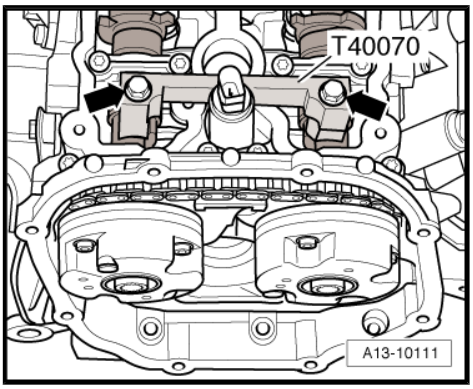


– Turn the camshafts until the threaded holes -arrows- point upwards.

– Check that camshafts are still in correct position in axial bearings in retaining frame.



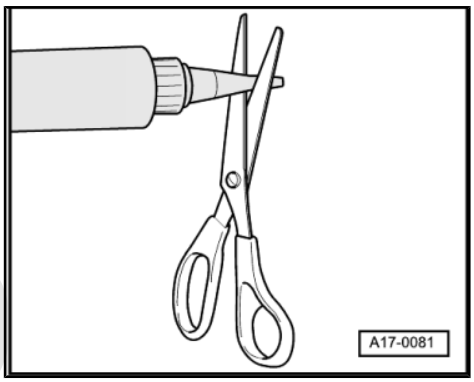
– Fit camshaft clamp - T40070- to inlet camshaft and exhaust camshaft as shown in illustration and tighten bolts to 25 Nm.



Note

Note the use-by date of the sealant.

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



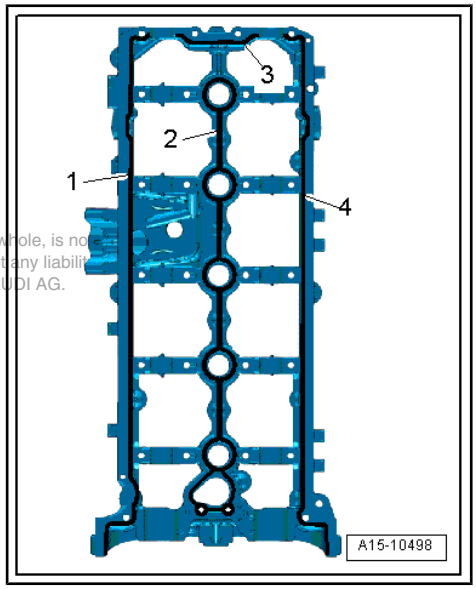
– Turn retaining frame back up.

– Fit new gasket -2- in grooves on retaining frame.

Note

The sealant beads must not be thicker than specified, otherwise excess sealant could enter the camshaft bearings.

– Apply the beads of sealant -1, 3, 4- onto the clean sealing surfaces of the retaining frame as illustrated.



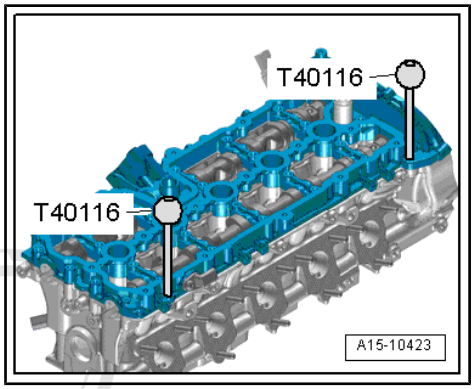
- Width of beads of sealant: 2.5 mm.

Note

The retaining frame must be installed within 5 minutes after applying the sealant.

– Fit retaining frame onto cylinder head.

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



Note

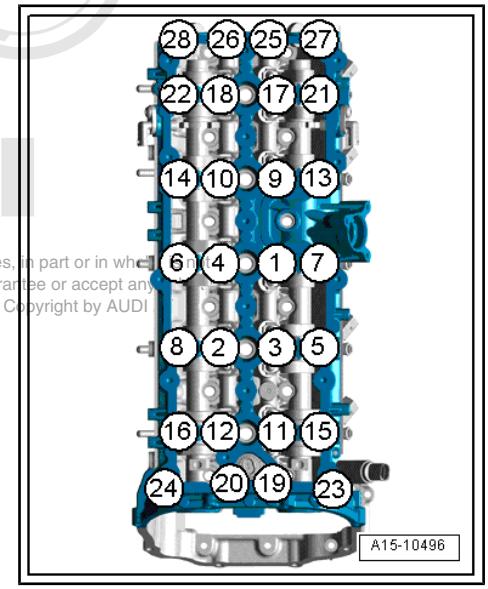
After installing the retaining frame, wait about 30 minutes for the sealant to dry.

– Renew bolts securing retaining frame for camshafts.

Caution

Risk of damage to retaining frame for camshafts.

- ***It is important to tighten the bolts securing the retaining frame as described.***

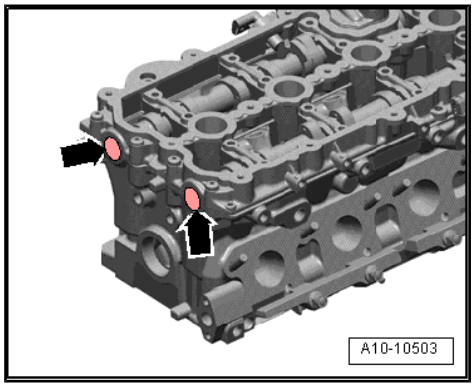


– Tighten bolts securing retaining frame for camshafts ⇒ page 138 .

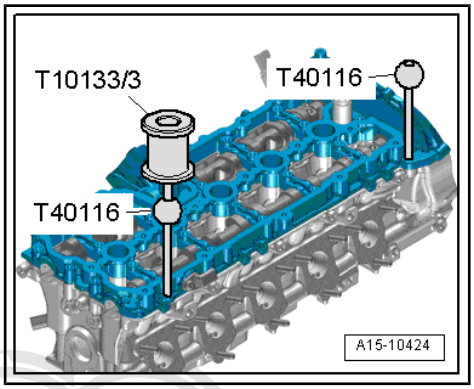
– Clean bores for sealing plugs in cylinder head; they must be free of oil and grease.

– Coat outer circumference of sealing plugs -arrows- with sealant; refer to ⇒ Electronic parts catalogue for sealant.

– Knock in sealing plugs until flush.



– Use impact extractor attachment -T40116- to pull out locating pins -T10133/3- .



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 80 .
– Install cylinder head cover: left-side ⇒ page 120 , right-side ⇒ page 123 .

Note

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

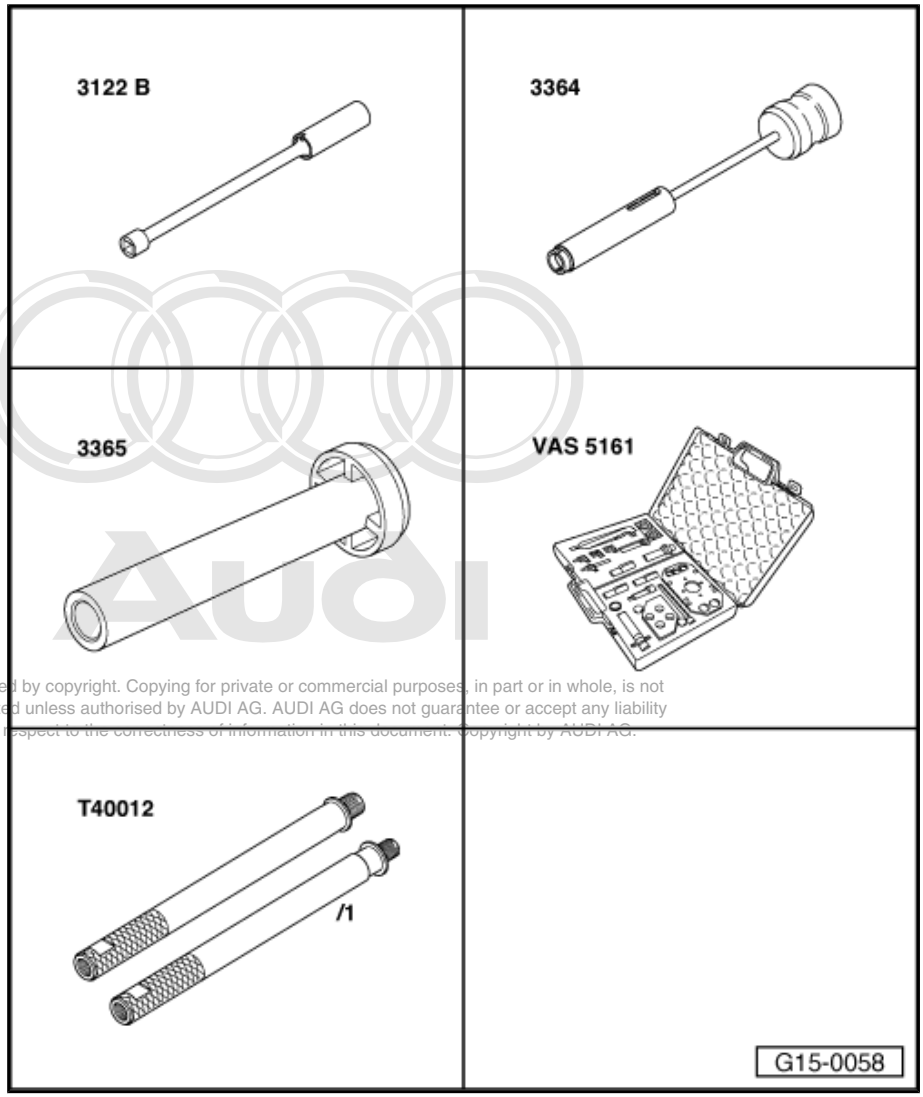
Tightening torques

◆ ⇒ Fig. ""Retaining frame for camshafts - tightening torque and sequence"" , page 138

3.5 Renewing valve stem oil seals (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 5161/19B-
- Adapters - T40012-



Removing

- Engine removed and in position on scissor-type assembly platform - VAS 6131 A- with gearbox attached.

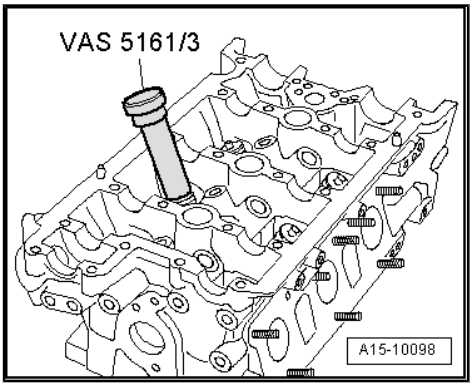
– Remove camshafts ⇒ page 140 .

– 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.

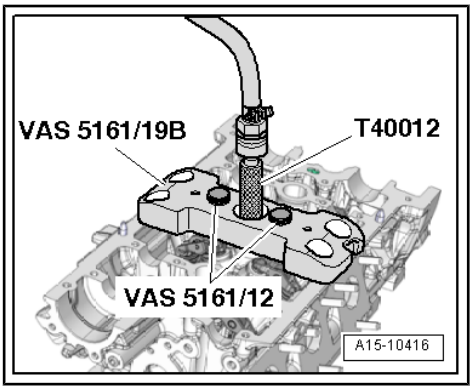
– Remove spark plugs with spark plug socket - 3122 B- .

– Apply drift - VAS 5161/3- to valve spring plate and knock valve cotters loose using a plastic hammer.



– Fit guide plate -VAS 5161/19B- onto cylinder head.
– Secure guide plate with knurled screws -VAS 5161/12- .
– Screw adapter - T40012- with seal hand-tight into the corresponding spark plug thread and apply a steady pressure.

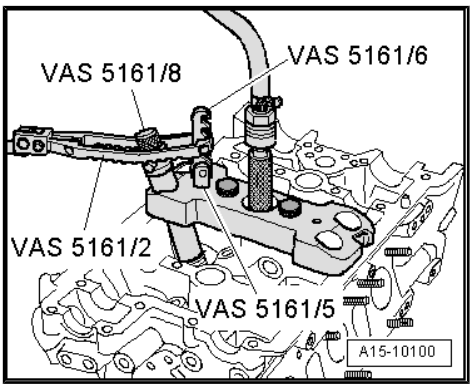
• Minimum pressure: 6 bar



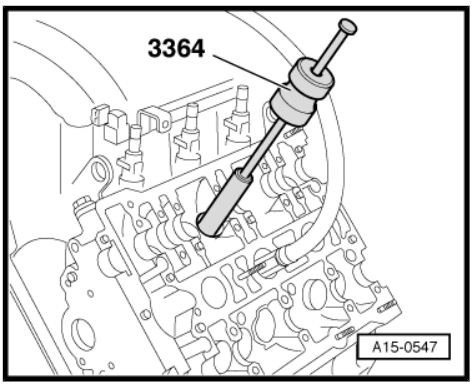
– Screw snap-in device - VAS 5161/6- with engaging fork - VAS 5161/5- into guide plate.
– Insert assembly cartridge - VAS 5161/8- into guide plate.
– Attach pressure fork - VAS 5161/2- to snap-in device and push assembly cartridge down.
– At the same time, turn knurled screw of assembly cartridge clockwise 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.
– Remove assembly cartridge.
– Detach guide plate and turn to one side.

• The compressed air hose remains connected.

– Remove valve spring with valve spring plate.

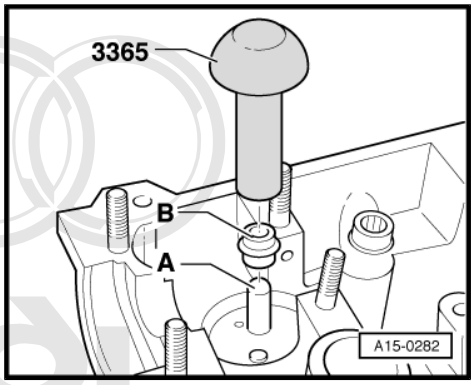


– Remove valve stem oil seals using the valve stem seal puller - 3364- .



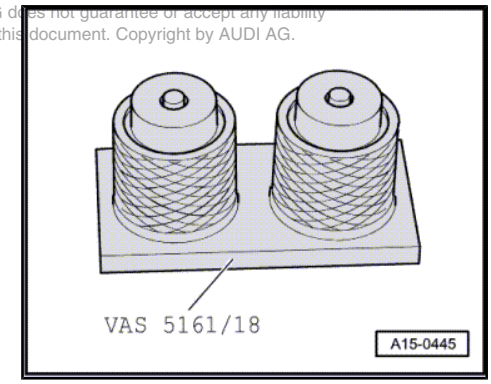
Note

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



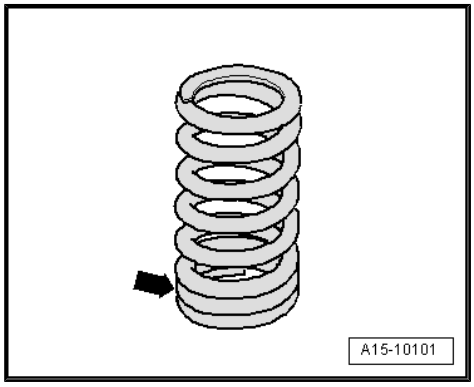
- Fit plastic sleeve -A- onto the valve stem to prevent damage to the new valve stem oil seal -B-.
- Lightly lubricate sealing lip of valve stem oil seal.
- Slip valve stem oil seal over plastic sleeve.
- Carefully press the valve stem oil seal onto valve guide using fitting tool -3365- .
- Remove plastic sleeve.

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



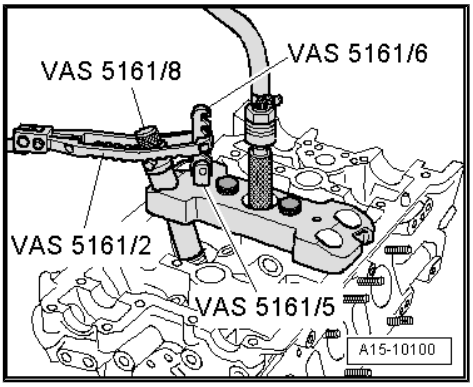
- Larger diameter of valve cotters faces upwards.

- 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 to left and right – 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 contact the ends of the valve stems correctly and are clipped onto their respective hydraulic compensation elements.
– Install camshafts ⇒ page 140 .
– Install spark plugs ⇒ Maintenance ; Booklet 404 .

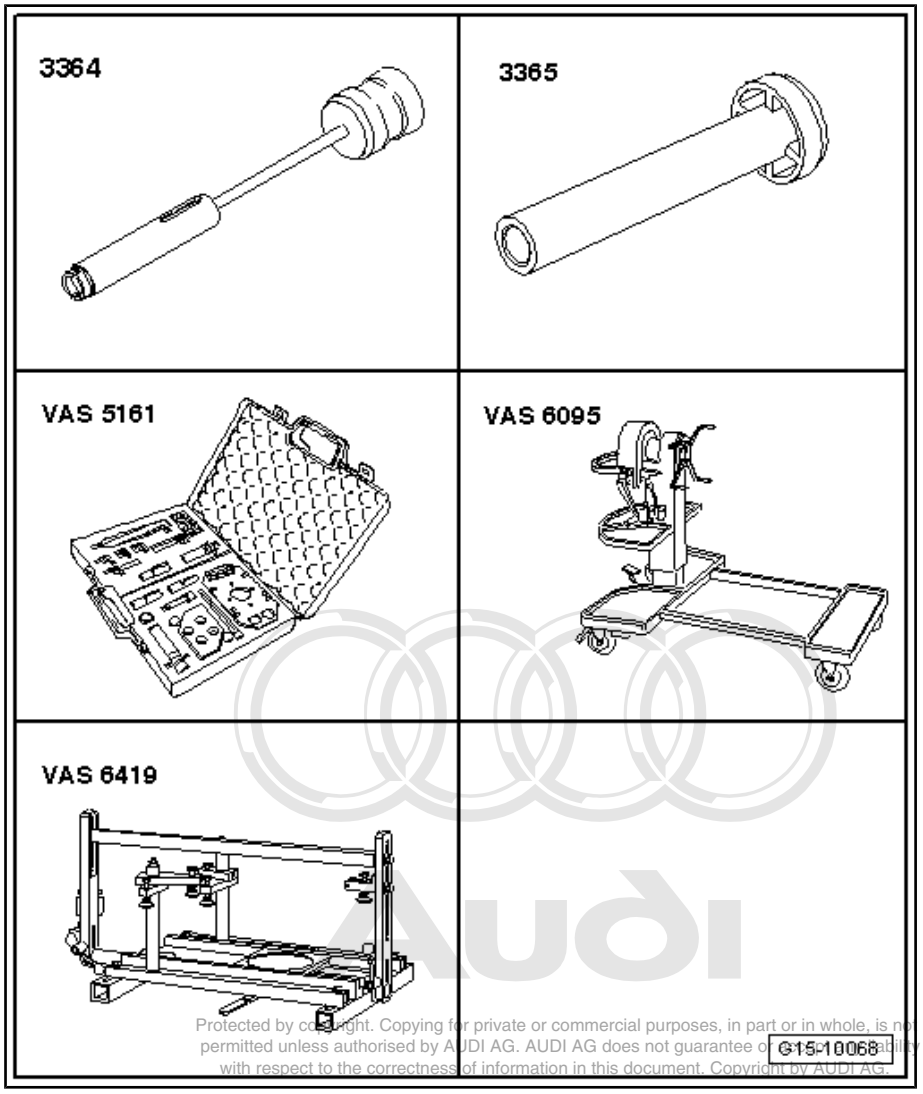
Note

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

3.6 Renewing valve stem oil seals (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 5161/19B-
- Engine and gearbox support - VAS 6095-
- Cylinder head tensioning device - VAS 6419-



Procedure

– Remove camshafts ⇒ page 140 .

– 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.

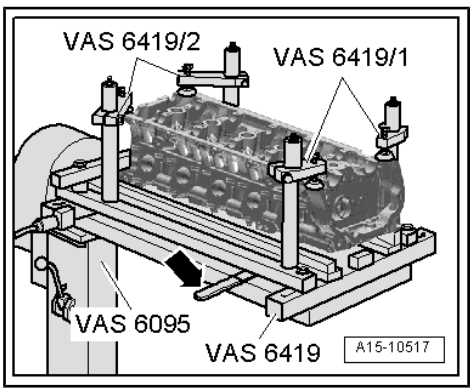
– Insert cylinder head tensioning device - VAS 6419- into engine and gearbox support - VAS 6095- .

– Secure cylinder head in cylinder head tensioning device, as illustrated.

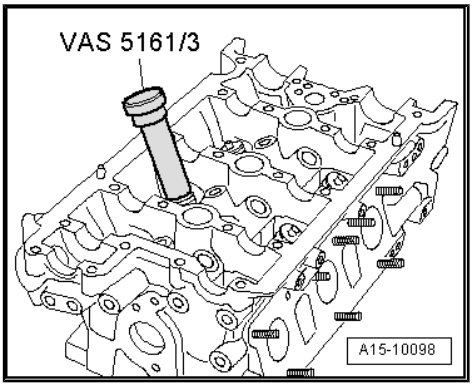
– Connect cylinder head tensioning device to compressed air.

– Using lever -arrow-, slide air pad under combustion chamber where valve stem oil seal is to be removed.

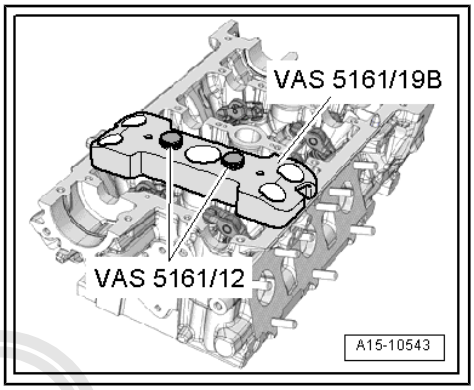
– Apply just enough compressed air to bring air pad into contact with valve heads.



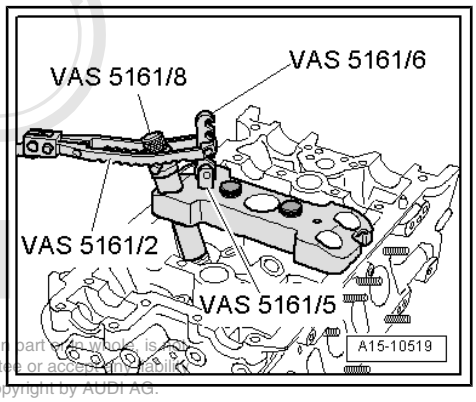
– Apply drift - VAS 5161/3- to valve spring plate and knock valve cotters loose using a plastic hammer.



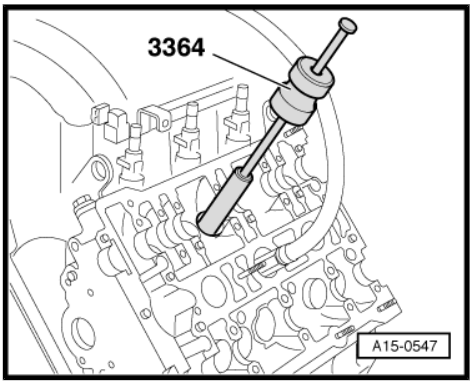
– Fit guide plate -VAS 5161/19B- onto cylinder head.
– Secure guide plate with knurled screws -VAS 5161/12- .



– Screw snap-in device - VAS 5161/6- with engaging fork - VAS 5161/5- into guide plate.
– Insert assembly cartridge - VAS 5161/8- into 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.
– Remove assembly cartridge.
– Detach guide plate and turn to one side.
– Remove valve spring with valve spring plate.

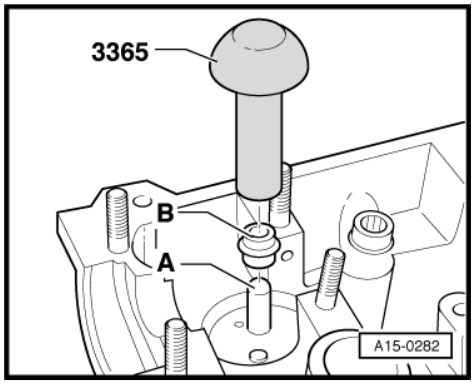


– Remove valve stem oil seals using the valve stem seal puller - 3364- .



Note

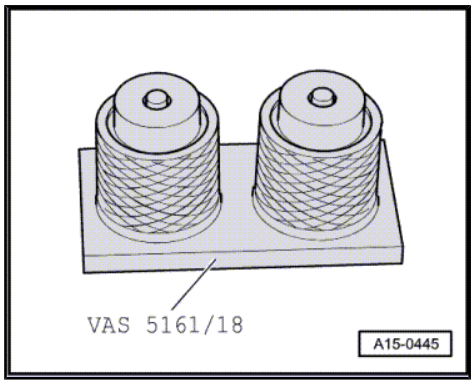
A plastic sleeve -A- is included with the new valve stem oil seals.



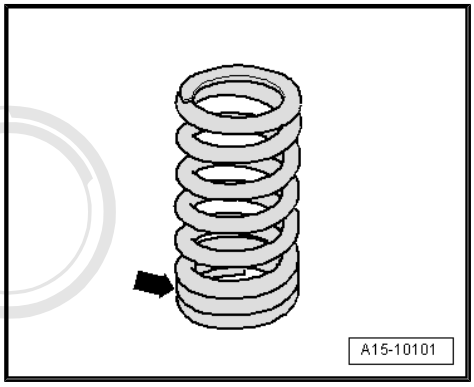
- Fit plastic sleeve -A- onto the valve stem to prevent damage to the new valve stem oil seal -B-.
- Lightly lubricate sealing lip of valve stem oil seal.
- Slip valve stem oil seal over plastic sleeve.
- Carefully press the valve stem oil seal onto valve guide using fitting tool -3365- .
- Remove plastic sleeve.

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

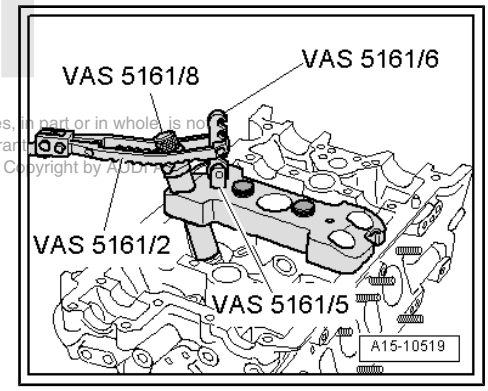
- Larger diameter of valve cotters faces upwards.



- 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 to left and right – 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 contact the ends of the valve stems correctly and are clipped onto their respective hydraulic compensation elements.
- Install camshafts ⇒ page 140 .

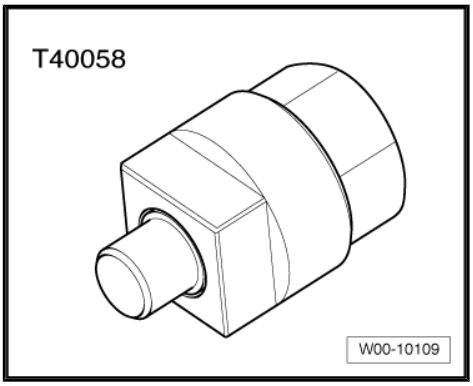
3.7 Checking hydraulic valve compensation elements

Note

- *The hydraulic compensation elements cannot be serviced.*
- *Irregular valve noises when starting engine are normal.*

Special tools and workshop equipment required

- Adapter - T40058-



- Feeler gauge

Procedure

– Start engine and let it run until the radiator fan has switched on once.

– Increase engine speed to approx. 2500 rpm for 2 minutes (perform road test if necessary).

Note

If the irregular valve noise disappears but repeatedly re-occurs when travelling short distances, renew the oil retention valve ⇒ page 174 .

If the hydraulic compensation elements are still noisy, locate the defective element as follows:

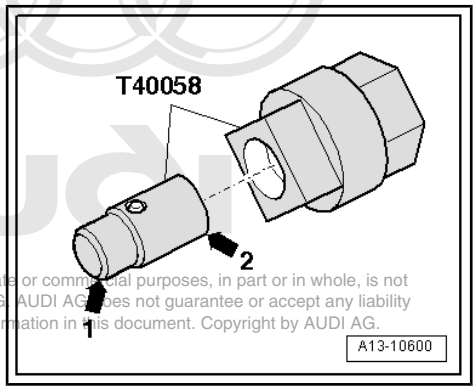
– Remove cylinder head cover: left-side ⇒ page 120 , right-side ⇒ page 123 .

– Remove radiator cowl ⇒ page 220 .

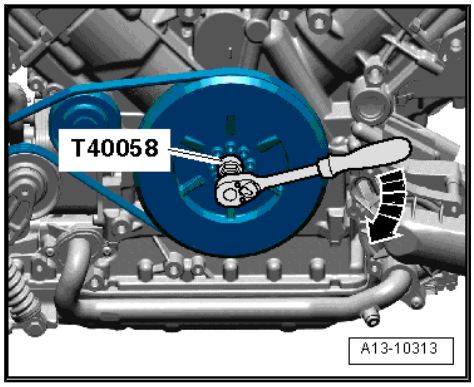
– Insert guide pin of adapter -T40058- as follows:

• The smaller-diameter section -arrow 1- faces the engine.

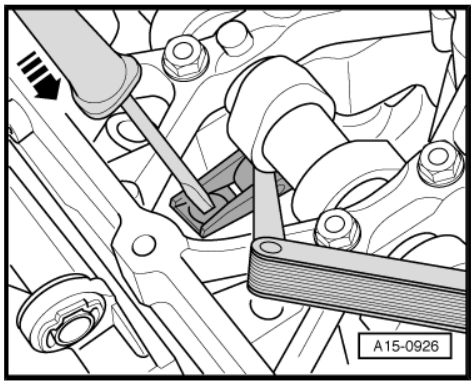
• The larger-diameter section -arrow 2- faces the adapter.



– Using adapter - T40058- , turn crankshaft in direction of engine rotation -arrow- until cam of hydraulic compensation element to be checked faces upwards.



– Push roller rocker finger down using a screwdriver -arrow- and measure clearance between roller rocker finger and cam.



If it is possible to insert a feeler gauge of 0.20 mm between camshaft and roller rocker finger:

– Renew hydraulic compensation element
⇒ “3.4 Removing and installing camshafts”, page 140 .

Additional steps required

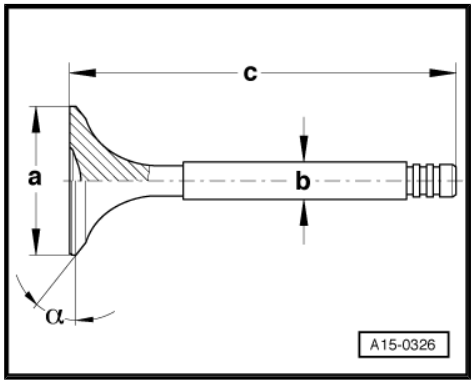
– Install radiator cowl ⇒ page 220 .

– Install cylinder head cover: left-side ⇒ page 120 , right-side ⇒ page 123 .

3.8 Valve dimensions

Note

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



Dimension		Inlet valve	Exhaust valve
∅ a	mm	33.85 ± 0.10	28.0 ± 0.1
∅ b	mm	5.980 ± 0.007	5.965 ± 0.007
c	mm	103.97 ± 0.20	101.87 ± 0.20
α	∠°	45	45

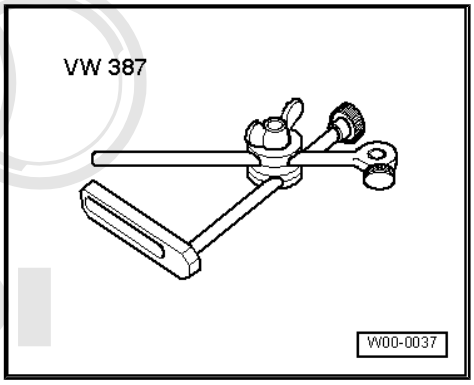
WARNING

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

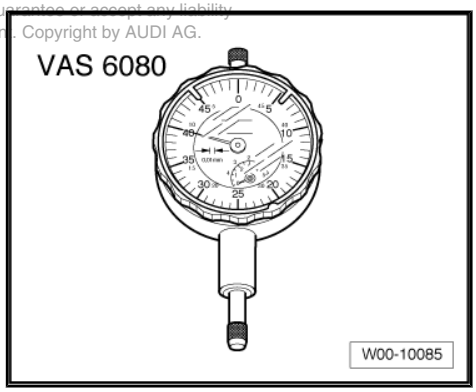
3.9 Checking valve guides

Special tools and workshop equipment required

♦ Universal dial gauge bracket - VW 387-



♦ Dial gauge - VAS 6080-



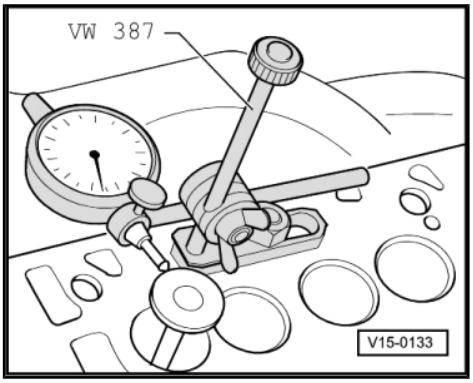
Test sequence

– Insert valve into valve guide. Only insert inlet valve into inlet valve guide and exhaust valve into exhaust valve guide, as the stem diameters are different.

• End of valve stem must be flush with valve guide.

– Determine amount of sideways play.

• Wear limit: 0.8 mm.



Note

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

♦ *If the wear limit is exceeded, repeat the measurement with new valves. Renew cylinder head if wear limit is still exceeded.*

3.10 Checking valves

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

If scoring is clearly visible:

– Renew the relevant valve.

17 – Lubrication

1 Lubrication system

Note

- *If large quantities of metal shavings or particles are found in the engine oil when repairing the engine, the oil passages, oil lines and hoses must be cleaned carefully, and the engine oil cooler must be renewed in order to prevent further damage occurring later.*
- *The oil level must not be above max. mark on dipstick – danger of damage to catalytic converter.*
- *Refer to ⇒ Maintenance tables for engine oil capacity, oil specifications and viscosity grades.*

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

1 - Sump (bottom section)
- ❑ With oil level and oil temperature sender - G266-
- ❑ Removing and installing sump (bottom section) ⇒ page 158
- ❑ Removing and installing oil level and oil temperature sender - G266- ⇒ page 158

2 - Bolt
- ❑ Tightening torque and sequence ⇒ page 158

3 - 9 Nm

4 - 9 Nm

5 - Oil pipe

6 - Gasket
- ❑ Renew

7 - O-ring
- ❑ Renew

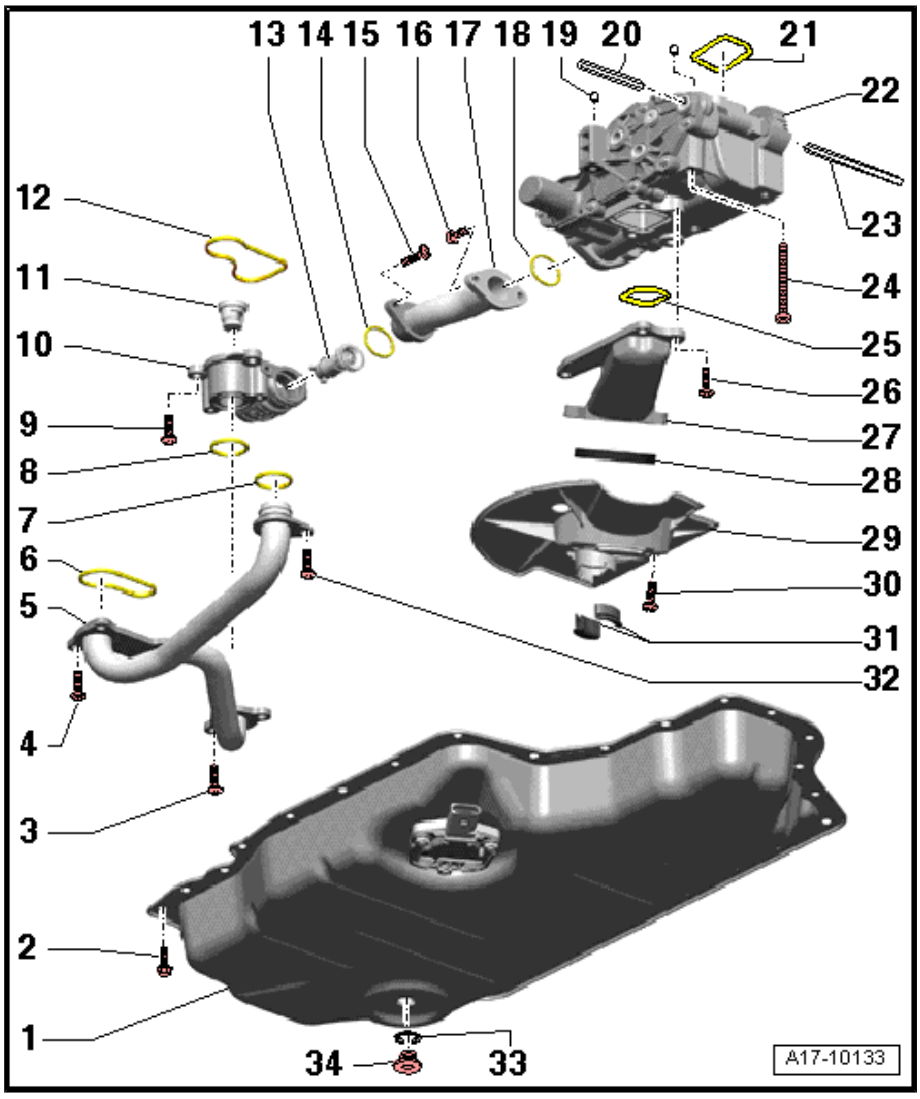
8 - O-ring
- ❑ Renew

9 - 9 Nm

10 - Housing
- ❑ For oil cooler bypass valve

11 - Oil cooler bypass valve

12 - Gasket
- ❑ Renew



13 - Oil retention valve

14 - O-ring

- ❑ Renew

15 - 9 Nm

16 - 9 Nm

17 - Oil pipe

18 - O-ring

- ❑ Renew

19 - Dowel sleeve

- ❑ 2x

20 - Drive shaft for coolant pump

21 - Gasket

- ❑ Renew

22 - Oil pump

- ❑ Do not dismantle
- ❑ With pressure control valve: approx. 5.5 bar
- ❑ Removing and installing ⇒ page 163

23 - Oil pump drive shaft

24 - 8 Nm + turn 90° further

- ❑ Renew

25 - Gasket

- ❑ Renew

26 - 9 Nm

27 - Intake connecting pipe

- ❑ For oil pump

28 - Oil strainer

- ❑ Clean

29 - Baffle plate

30 - 5 Nm + turn +45° further

- ❑ Renew

31 - Rubber buffer

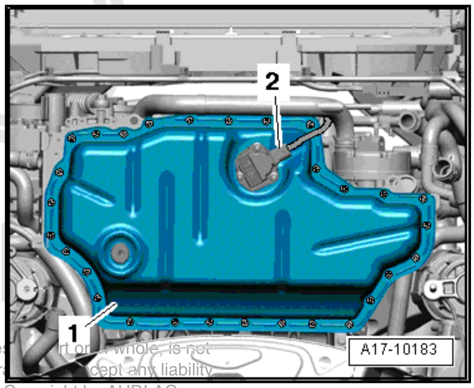
32 - 9 Nm

33 - Seal

- ❑ Renew

34 - Oil drain plug, 25 Nm

Sump (bottom section) - tightening torque and sequence; oil level and oil temperature sender - G266- - tightening torque

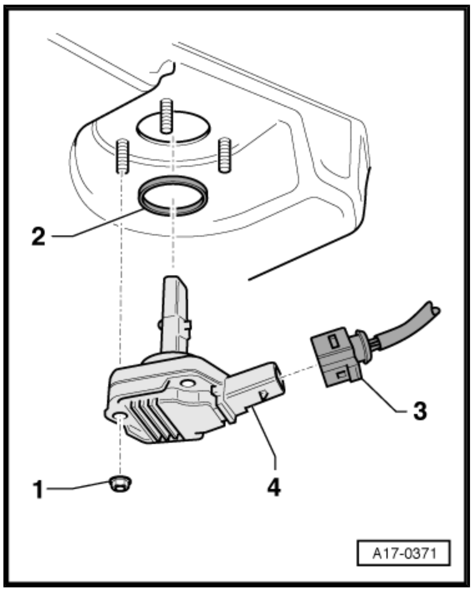


– Tighten bolts for sump (bottom section) -1- in 3 stages as follows:

Stage	Tightening torque
1.	Screw in by hand until contact is made
2.	5 Nm in diagonal sequence
3.	9 Nm in diagonal sequence

– Tighten nuts for oil level and oil temperature sender - G266- -item 2- to 9 Nm.

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



Removing

– Drain off engine oil ⇒ Maintenance ; Booklet 404 .

– Unplug electrical connector -3-.

– Remove nuts -1- and detach oil level and oil temperature sender - G266- -item 4-.

Installing

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

Note

Renew seal -2-.

– Fill with engine oil and check oil level ⇒ Maintenance ; Booklet 404 .

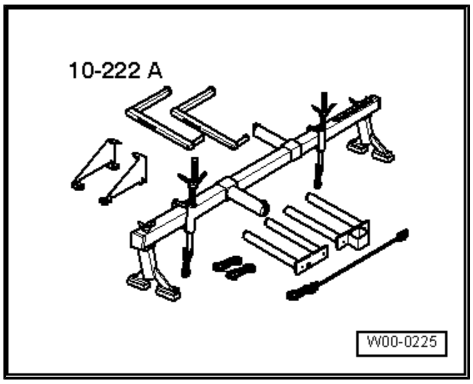
Tightening torques

♦ ⇒ Fig. ““Sump (bottom section) - tightening torque and sequence; oil level and oil temperature sender -G266- - tightening torque”“ , page 158

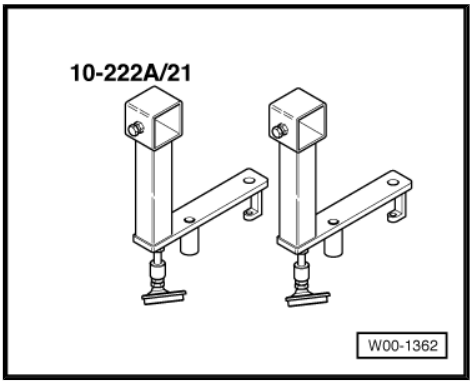
1.3 Removing and installing sump (bottom section)

Special tools and workshop equipment required

♦ Support bracket - 10 - 222 A-



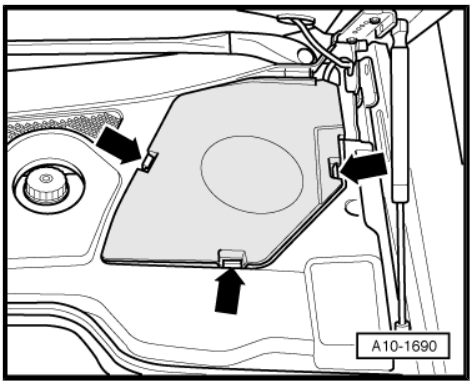
- Adapters - 10 - 222 A /21-



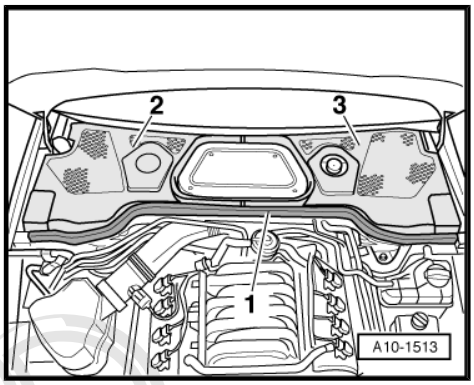
- Electric drill with plastic brush attachment
- Safety goggles
- Sealant ⇒ Electronic parts catalogue

Removing

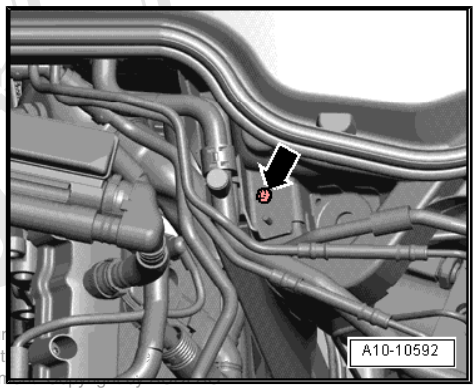
– Remove cover above coolant expansion tank -arrows-.



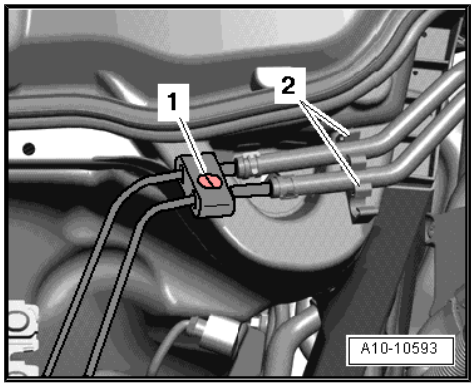
– Pull off rubber seal -1- and remove plenum chamber covers -2- and -3-.



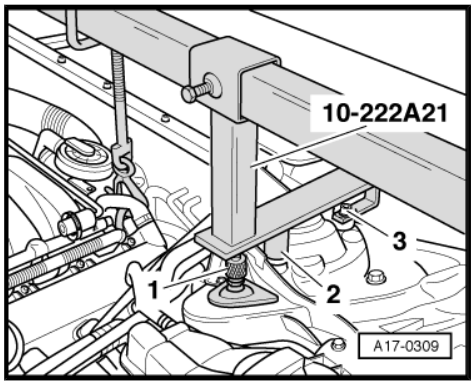
– Unbolt bracket (left-side) for refrigerant line from suspension turret -arrow-.



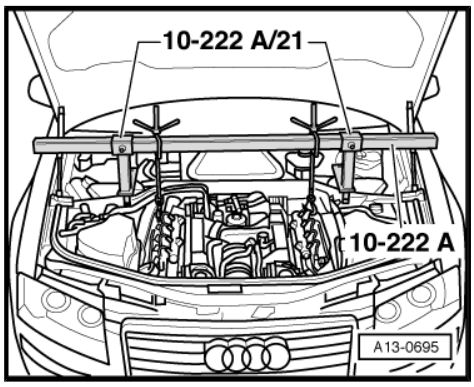
– Detach clip (right-side) -1-.
– Unclip fuel line and vacuum pump from retainer -2- on suspension turret.



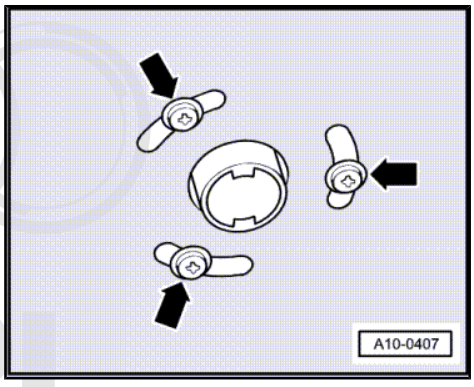
– Unscrew rear securing bolts -3- for cross piece for suspension strut.
– Attach support bracket - 10 - 222 A- with adapters - 10 - 222 A /21- onto suspension turrets.
• Adapters are marked for left and right-side of vehicle.
• The centre support point -2- of the adapters is located on front bolts for cross piece for suspension strut.
• The adapters are attached by means of the rear securing bolts -3- for the cross piece for suspension strut.
• The knurled screw -1- must be screwed down until support plate rests on suspension turret.



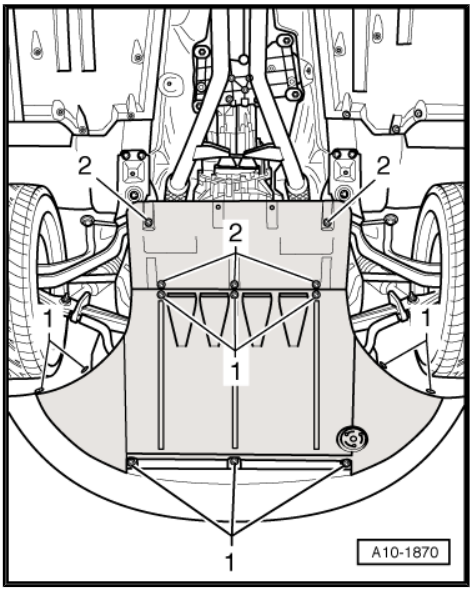
– Secure spindles of support bracket - 10 - 222 A- to rear engine lifting eyes.
– Take up weight of engine using spindles of support bracket.



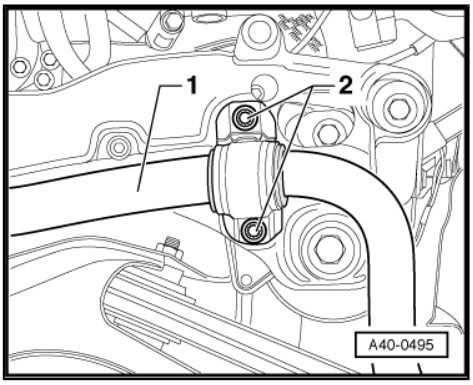
– Vehicles with auxiliary heater: remove bolts -arrows- securing exhaust pipe for auxiliary/additional heater to noise insulation.



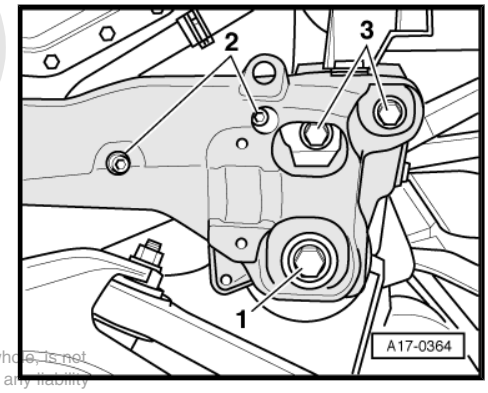
– Release quick-release fasteners -1- and -2- and take off noise insulation panels.



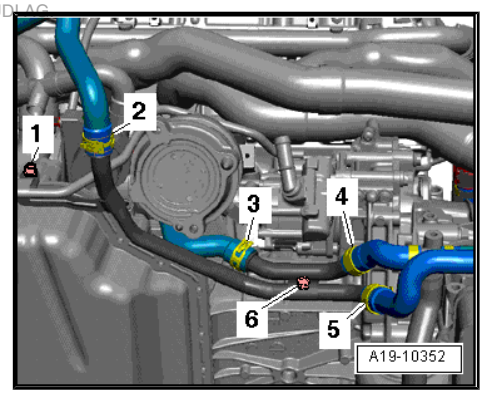
– Unscrew bolts -2- on retaining clamps (left and right) for anti-roll bar and move anti-roll bar -1- downwards.



– Remove bolts -1, 2, 3- on left and right and detach engine cross member.



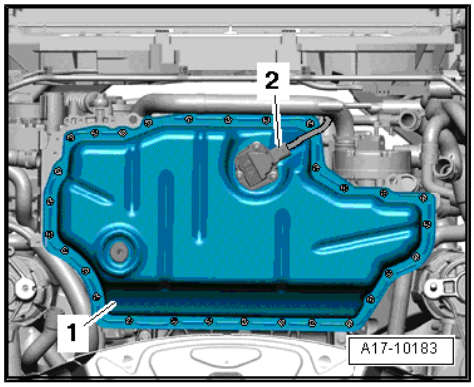
– Remove nut -1- and bolt -6- at coolant pipe (bottom left).



Note

Disregard items marked -2 ... 5-.

– Unplug electrical connector -2- at oil level and oil temperature sender - G266- .
– Drain off engine oil ⇒ Maintenance ; Booklet 404 .
– Unbolt sump (bottom section) -1- and carefully release it from bonded joint.



Note

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

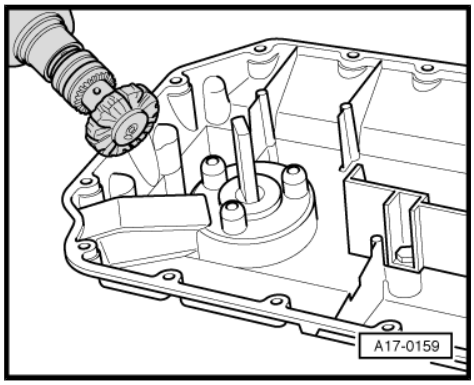
Installing

Note

Renew seals.

WARNING

Wear safety goggles.

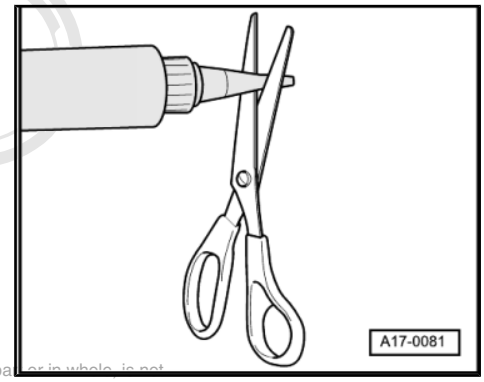


– Remove sealant residue from bottom and top sections of sump with rotating plastic brush or similar.
– Clean sealing surfaces; they must be free of oil and grease.

Note

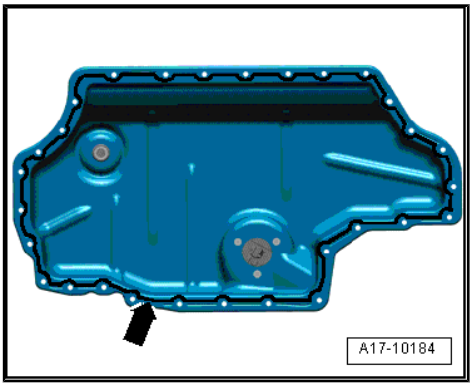
Note the use-by date of the sealant.

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



– Apply bead of sealant -arrow- onto clean sealing surface of sump (bottom section) as illustrated.

• Width of sealant bead: 2.5 mm.



Note

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

– Fit sump (bottom section) and tighten all bolts hand-tight.

– Tighten bolts for sump (bottom section) -1- ⇒ page 158 .

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

– Install engine cross member ⇒ Rep. gr. 40 .

– Install anti-roll bar ⇒ Rep. gr. 40 .

– Fill with engine oil and check oil level ⇒ Maintenance ; Booklet 404 .

Tightening torques

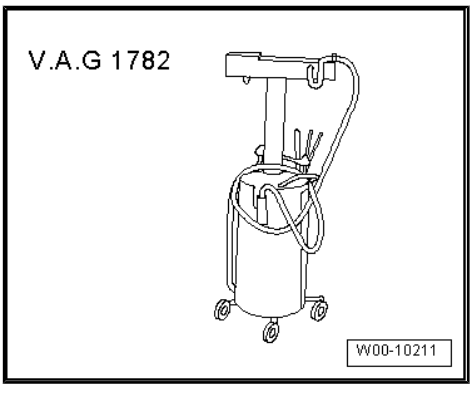
- ⇒ Fig. ""Sump (bottom section) - tightening torque and sequence; oil level and oil temperature sender -G266- - tightening torque"" , page 158
- ⇒ "5.1 Assembly mountings - exploded view", page 45
- ⇒ "1.12 Coolant pipes - exploded view", page 202

1.4 Removing and installing oil pump

1.4.1 Removing and installing oil pump - up to engine number BSM 006 225

Special tools and workshop equipment required

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



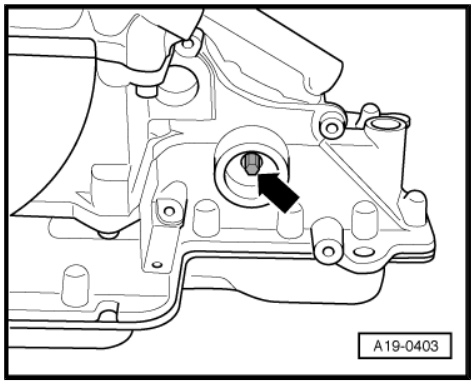
- Water pump pliers (commercially available)

Removing

– Remove coolant pump ⇒ page 196 .

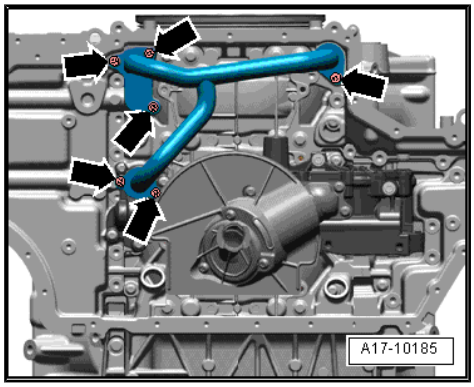
– Remove drive shaft -arrow- for coolant pump from the oil pump.

– Remove sump (bottom section) ⇒ page 158 .



– Position used oil collection and extraction unit - V.A.G 1782- below engine.

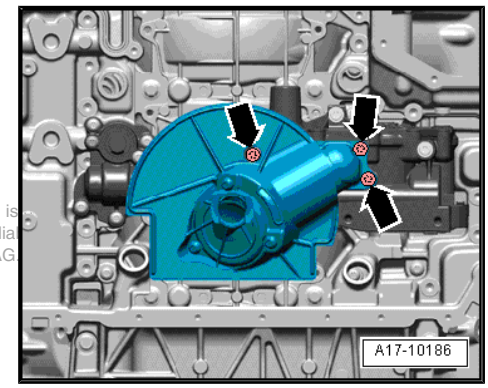
– Unscrew bolts -arrows- and remove oil pipe.



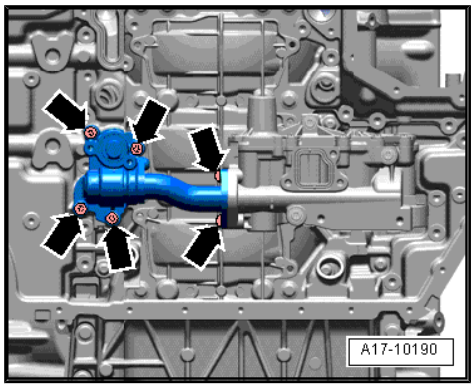
Note

Some oil will come out when oil pipe is removed.

– Unscrew bolts -arrows- and remove intake connecting pipe with baffle plate.



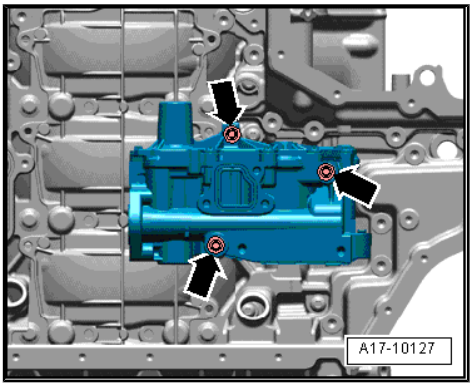
– Unscrew bolts -arrows- and remove oil pipe together with housing for oil cooler bypass valve.



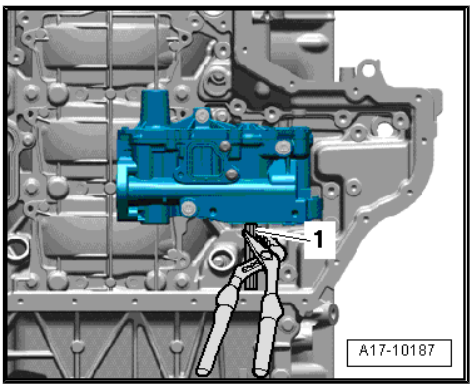
Note

Some oil will come out when oil pipe is removed.

– Remove bolts -arrows- and support oil pump by hand.



– Using water pump pliers, pull back drive shaft -1- for oil pump against spring pressure and remove oil pump.



Installing

Note

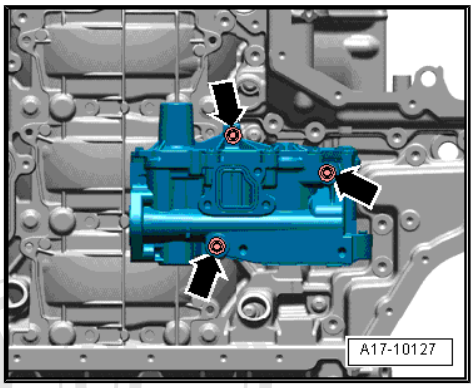
- *Renew the bolts tightened with specified tightening angle.*
- *Renew seals and O-rings.*

– Check whether the two dowel sleeves are fitted in the cylinder block; install if necessary.

– Press back drive shaft -1- for oil pump using water pump pliers and fit oil pump on cylinder block.

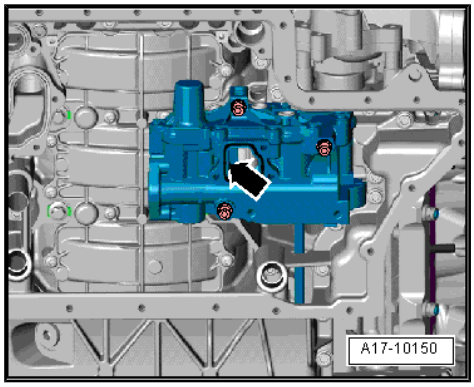
– Release water pump pliers and let drive shaft -1- slide into oil pump.

– Secure the oil pump -arrows-.



– 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 sump (bottom section) ⇒ page 162 .

– Install coolant pump ⇒ page 196 .

– Fill with engine oil and check oil level ⇒ Maintenance ; Booklet 404 .

– Fill cooling system ⇒ page 190 .

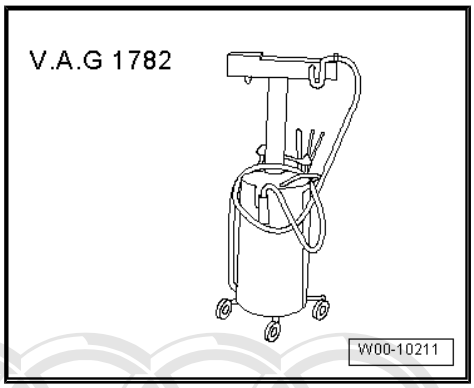
Tightening torques

♦ ⇒ “1.1 Oil pump, sump (bottom section) - exploded view”, page 156 .

1.4.2 Removing and installing oil pump - from engine number BSM 006 226 onwards

Special tools and workshop equipment required

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



Removing

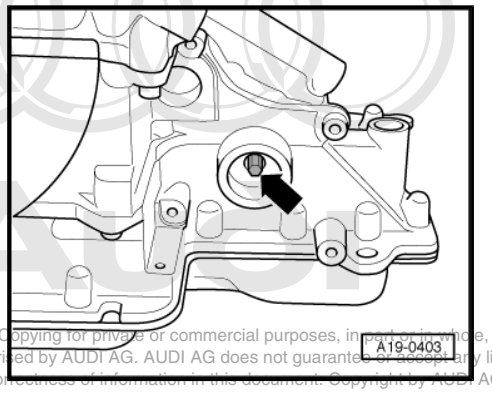
• Engine separated from gearbox ⇒ page 27 , engine attached to scissor-type assembly platform - VAS 6131 A- or secured to engine and gearbox support ⇒ page 36 .

– Remove spur gear drive ⇒ page 111 .

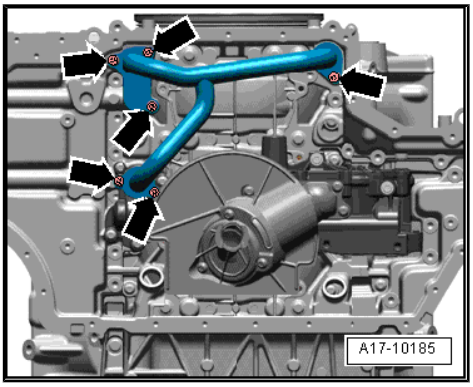
– Remove coolant pump ⇒ page 196 .

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

– Remove sump (bottom section) ⇒ page 158 .



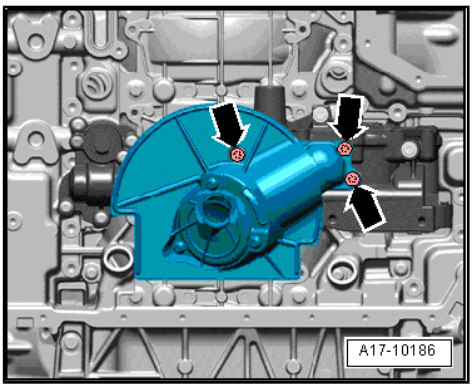
– Position used oil collection and extraction unit - V.A.G 1782- below engine.
– Unscrew bolts -arrows- and remove oil pipe.



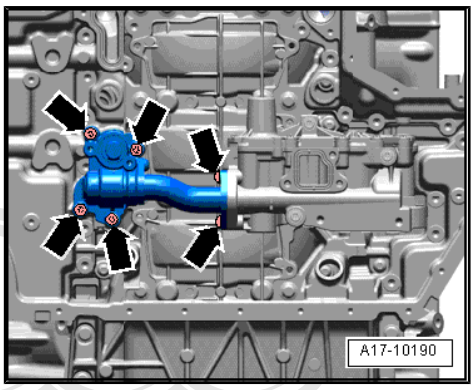
Note

Some oil will come out when oil pipe is removed.

– Unscrew bolts -arrows- and remove intake connecting pipe with baffle plate.



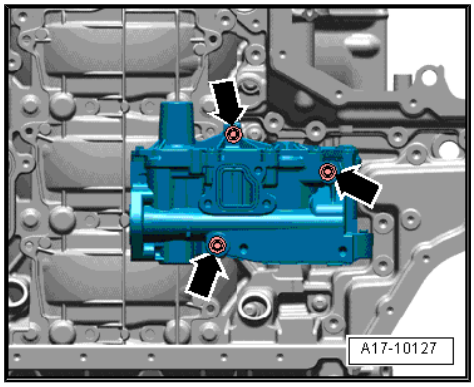
– Unscrew bolts -arrows- and remove oil pipe together with housing for oil cooler bypass valve.



Note

Some oil will come out when oil pipe is removed.

– Remove bolts -arrows- and remove oil pump.



Installing

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

Note

- *Renew the bolts tightened with specified tightening angle.*
- *Renew seals and O-rings.*

– Check whether the two dowel sleeves are fitted in the cylinder block; install if necessary.

– Install sump (bottom section) ⇒ page 162 .

– Install coolant pump ⇒ page 196 .

– Install spur gear drive ⇒ page 111 .

– After installing engine, fill up with engine oil and check oil level ⇒ Maintenance ; Booklet 404 .

Tightening torques

- ⇒ “1.1 Oil pump, sump (bottom section) - exploded view”, page 156

1.5 Sump (top section) - exploded view

1 - Sump (top section)

- ❑ Removing and installing ⇒ page 170
- ❑ Fitting location of dowel sleeves ⇒ page 169

2 - Seals

- ❑ Renew

3 - O-ring

- ❑ Renew

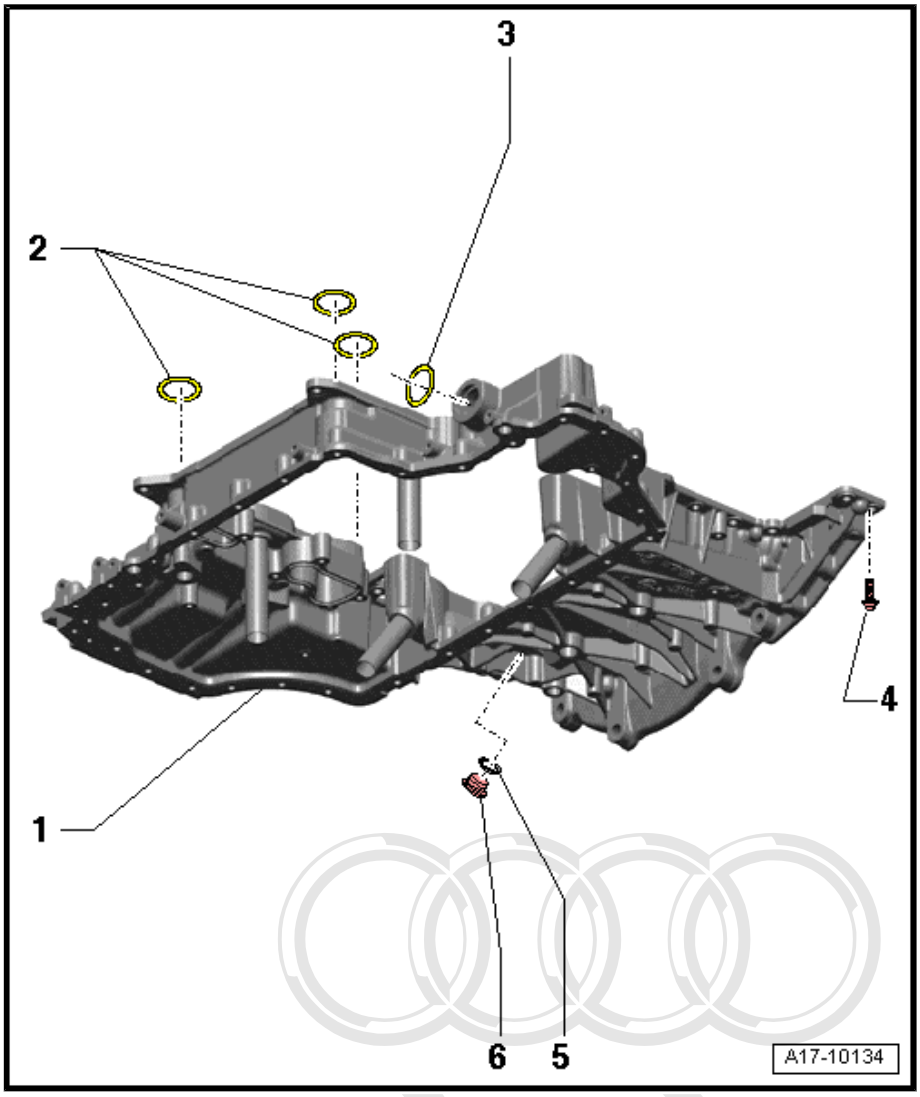
4 - Bolt

- ❑ Renew
- ❑ Tightening torque and sequence ⇒ page 170

5 - Seal

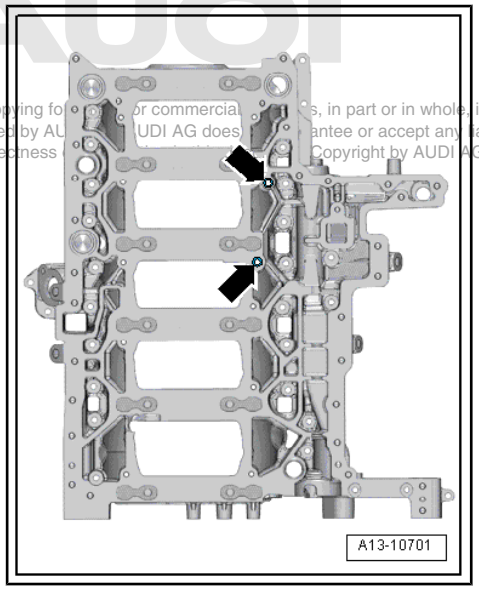
- ❑ Renew

6 - Screw plug, 35 Nm

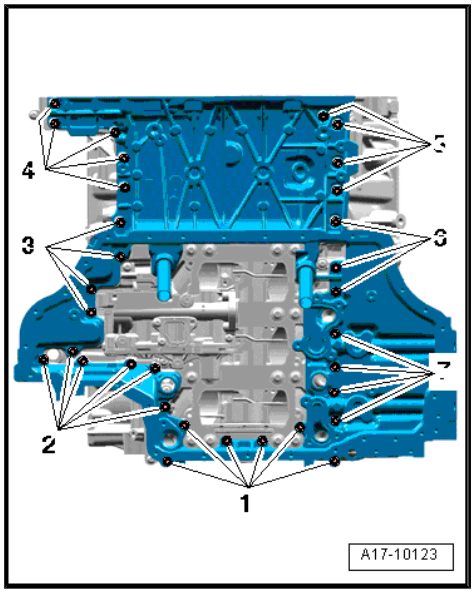


Fitting location of dowel sleeves for sump (top section)

– Check whether dowel sleeves -arrows- for centring sump (top section) are fitted in retaining frame; insert missing dowel sleeves.



Sump (top section) - tightening torque and sequence



Note

Renew the bolts tightened with specified tightening angle.

– Tighten bolts in 3 stages as follows:

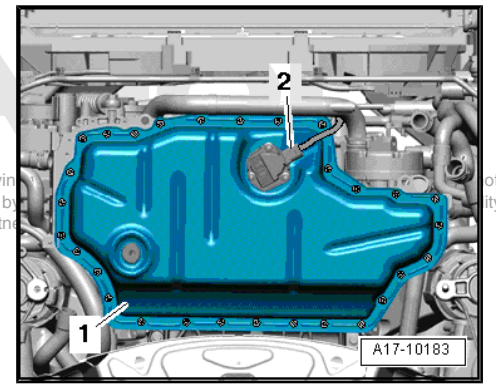
Stage	Bolts	Tightening torque
1.	-1 … 7-	Screw in by hand until contact is made
2.	-1 … 7-	5 Nm in diagonal sequence
3.	-1 … 7-	Turn 90° further in diagonal sequence

1.6 Removing and installing sump (top section)

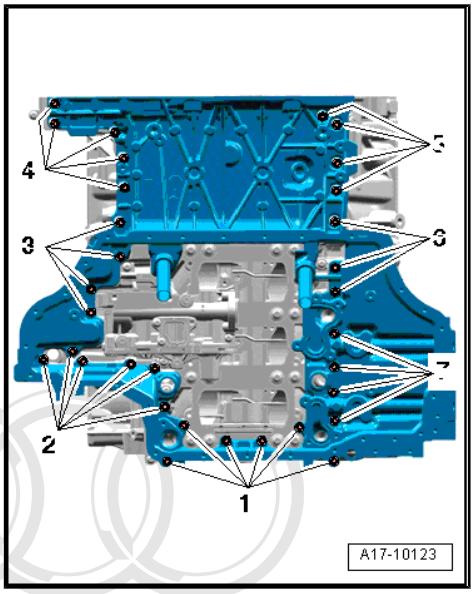
Removing

- Engine separated from gearbox ⇒ page 27 , engine secured to engine and gearbox support ⇒ page 36 .
- Engine oil drained ⇒ Maintenance ; Booklet 404 .

– Remove drive plate ⇒ page 63 .
– Remove timing chain covers (left and right) ⇒ page 78 .
– Remove intake manifold ⇒ Rep. gr. 24 .
– Remove oil filter housing ⇒ page 177 .
– Remove timing chain cover (bottom) ⇒ page 82 .
– Remove alternator ⇒ Electrical system; Rep. gr. 27
– Remove coolant pipe (front) ⇒ page 205 .
– Remove coolant pump ⇒ page 196 .
– Unplug electrical connector -2- at oil level and oil temperature sender - G266- .
– Unbolt sump (bottom section) -1- and carefully release it from bonded joint.
– Remove oil pump ⇒ page 163 .



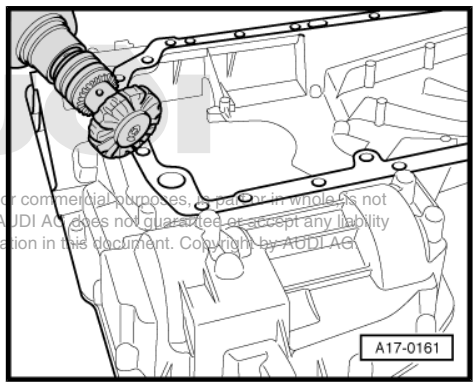
– Remove bolts -1 … 7- for sump (top section).
– Carefully release sump (top section) from bonded joint and pry sump off dowel pins on cylinder block.



Installing

Note

Renew bolts which are tightened to a specified angle as well as seals and O-rings.



WARNING

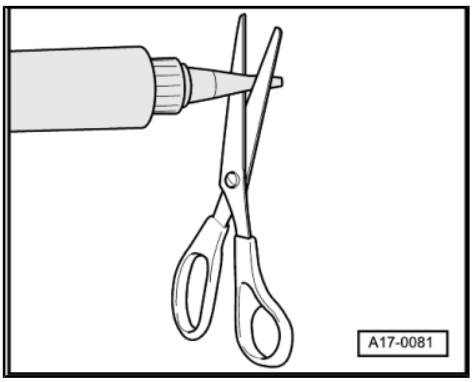
Wear safety goggles.

– 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.

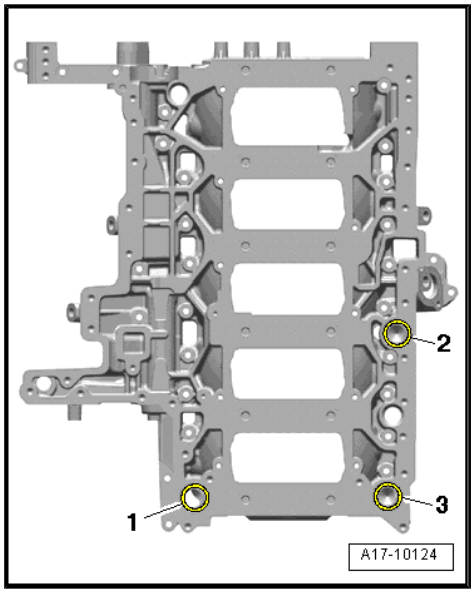
Note

Note the use-by date of the sealant.

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

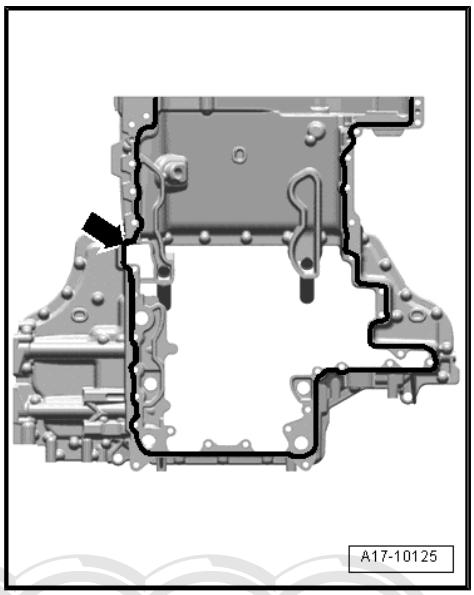


– Fit new seals -1, 2, 3- in grooves on cylinder block.



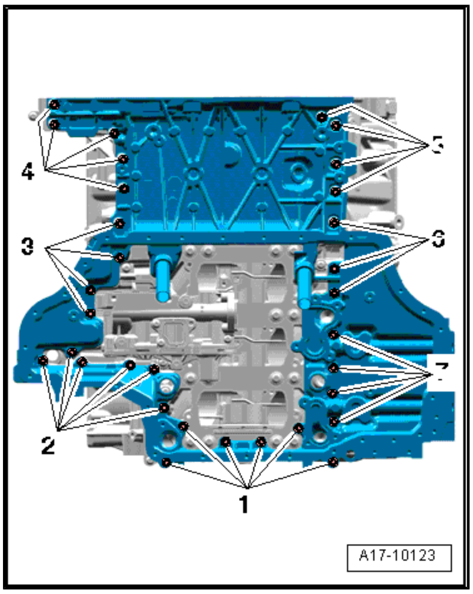
– Apply bead of sealant -arrow- onto clean sealing surface of sump (top section) as illustrated.

• Width of beads of sealant: 2.5 mm.



Note

- *The bead of sealant must not be thicker than specified, otherwise excess sealant can enter the sump and obstruct the strainer in the oil intake pipe.*
- *The sump (top section) must be installed within 5 minutes after applying sealant.*



- Renew bolts for sump (top section).
- Fit sump (top section) paying attention to dowel sleeves and hand-tighten all bolts ⇒ page 169 .
- Tighten bolts -1 ... 7- in two stages as follows.

1. Tighten bolts in diagonal sequence to 5 Nm.
2. Turn bolts 90° further in diagonal sequence.

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

- Install oil pump ⇒ page 163 .
- Install sump (bottom section) ⇒ page 162 .
- Install coolant pump ⇒ page 196 .
- Install coolant pipe (front) ⇒ page 205 .
- Install alternator ⇒ Electrical system; Rep. gr. 27
- Install timing chain cover (bottom) ⇒ page 82 .
- Install crankshaft oil seal (gearbox end) ⇒ page 64 .
- Install oil filter housing ⇒ page 177 .
- Install intake manifold ⇒ Rep. gr. 24 .
- Install timing chain covers (left and right) ⇒ page 80 .
- Install drive plate ⇒ page 63 .
- After installing engine, fill up with engine oil and check oil level ⇒ Maintenance ; Booklet 404 .

Tightening torques

- ⇒ Fig. ""Sump (top section) - tightening torque and sequence"", page 170

1.7 Oil retention valve and spray nozzle valve - exploded view

1 - O-ring
- ❑ Renew

2 - Spray nozzle valve
- ❑ Removing and installing ⇒ page 174

3 - Gasket
- ❑ Renew

4 - Cover

5 - O-ring
- ❑ Renew

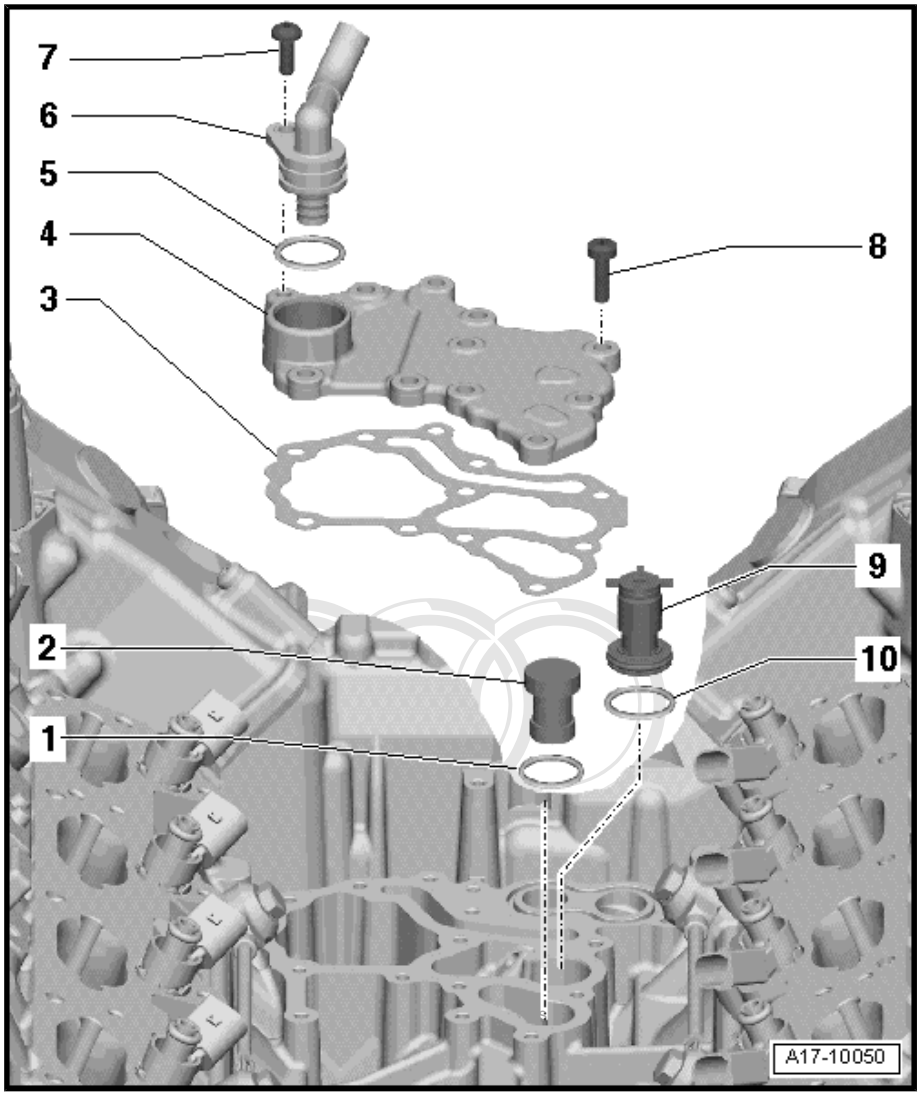
6 - Hose
- ❑ For crankcase breather

7 - 9 Nm

8 - 5 Nm + turn 90° further
- ❑ Renew

9 - Oil retention valve
- ❑ Removing and installing ⇒ page 174

10 - O-ring
- ❑ Renew



1.8 Removing and installing oil retention valve and spray nozzle valve

Note

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

Removing

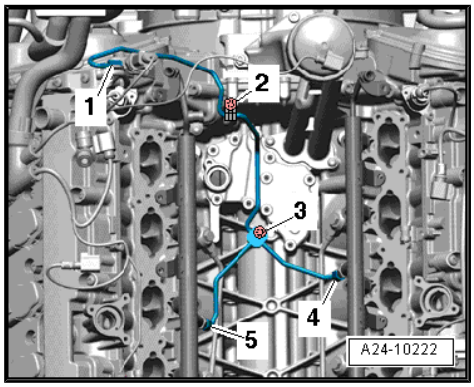
– Remove intake manifold ⇒ Rep. gr. 24 .

– Remove bolts -2- and -3-.

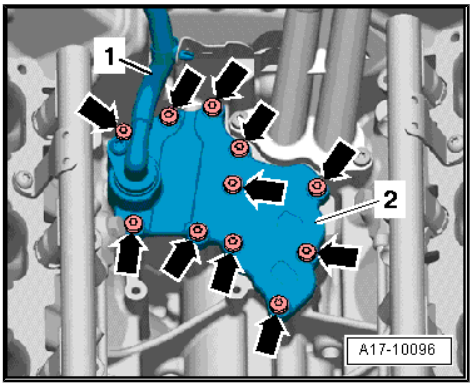
– Detach high-pressure pipe -1- from fuel rail.

– Unscrew high-pressure pipe at connections -4- and -5- on fuel rail. To do so, counterhold at hexagon flats with an open-end spanner and slacken union nut.

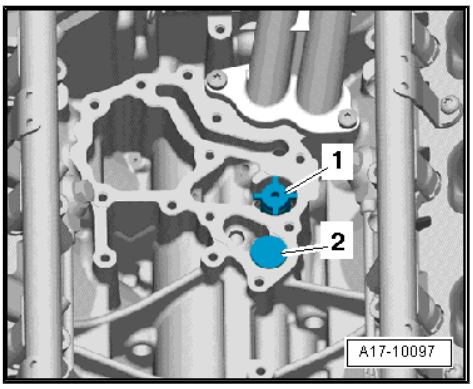
– Detach high-pressure pipes.



– Remove bolts -arrows-.
– Detach cover -2- with hose -1- for crankcase breather system.



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



Installing

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

Note

- *Renew the bolts tightened with specified tightening angle.*
- *Renew gaskets and O-rings.*

– Install high-pressure pipes ⇒ Rep. gr. 24 ; Removing and installing injectors .
– Install intake manifold ⇒ Rep. gr. 24 .

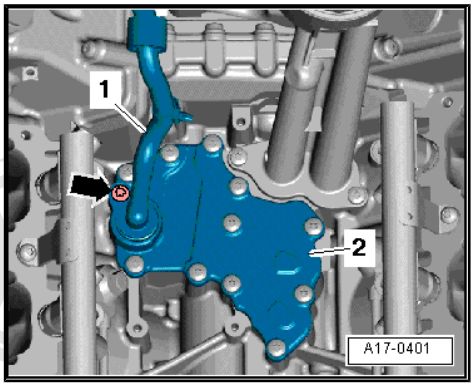
Tightening torques

- ⇒ “1.7 Oil retention valve and spray nozzle valve - exploded view”, page 173

1.9 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

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

Note

Renew O-ring.

– Install intake manifold ⇒ Rep. gr. 24 .

Tightening torques

- ⇒ “1.7 Oil retention valve and spray nozzle valve - exploded view”, page 173

1.10 Oil filter housing - exploded view

1 - Gasket
- ❑ Renew

2 - 9 Nm

3 - Oil filter housing
- ❑ With oil filter bypass valve 1.3 bar

4 - 22 Nm

5 - O-ring
- ❑ Part of oil filter element

6 - Oil filter element
- ❑ Removing and installing ⇒ Maintenance ; Booklet 404

7 - O-ring
- ❑ Renew

8 - Sealing cap, 25 Nm

9 - Not fitted

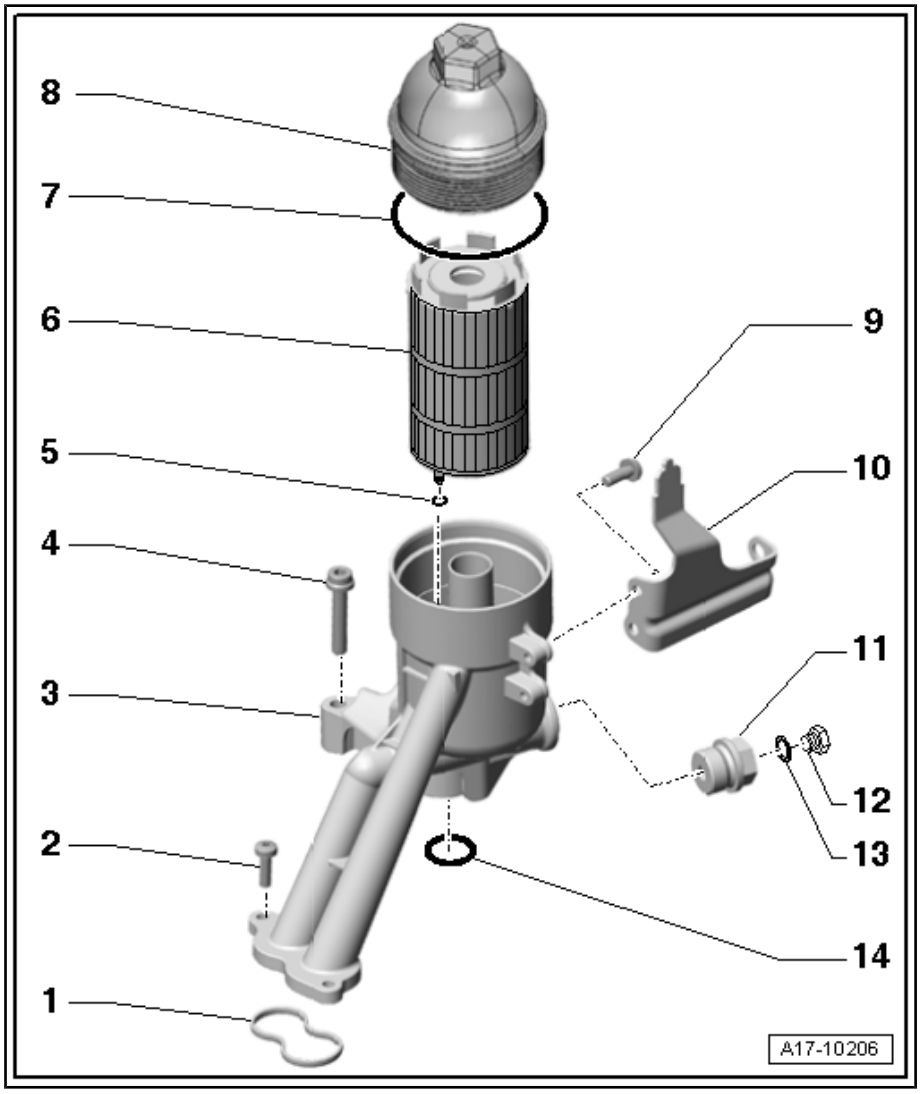
10 - Not fitted

11 - Screw plug, 50 Nm

12 - Screw plug, 9 Nm

13 - Seal
- ❑ Renew

14 - O-ring
- ❑ Renew



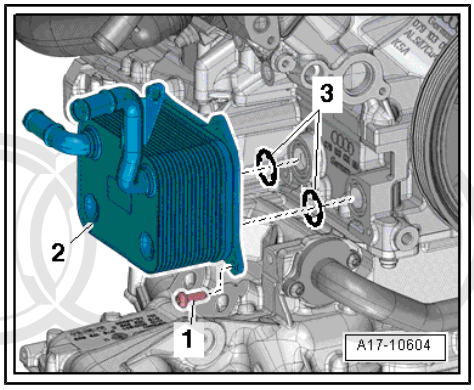
Engine oil cooler - tightening torque and sequence

Note

Renew gaskets -3- for engine oil cooler -2-.

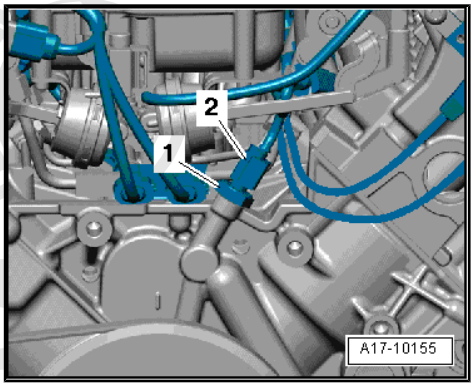
– Tighten bolts in 2 stages as follows:

Stage	Bolts	Tightening torque
1.	-1-	3 Nm
2.	-1-	9 Nm



Oil pressure switch - F1- - tightening torque

– Tighten oil pressure switch - F1- to 20 Nm.



1.11 Removing and installing oil filter housing

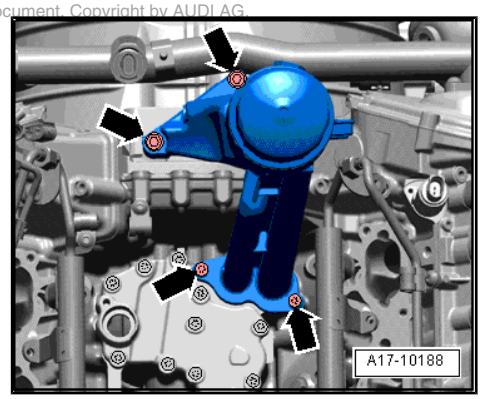
Removing

– Remove intake manifold ⇒ Rep. gr. 24 .

Note

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

– Unscrew bolts -arrows- and remove oil filter housing.



Installing

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 ⇒ Maintenance ; Booklet 404 .

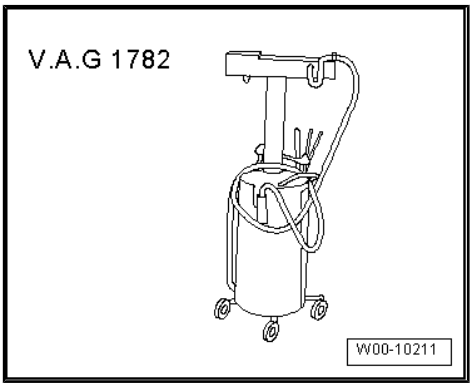
Tightening torques

♦ ⇒ “1.10 Oil filter housing - exploded view”, page 175

1.12 Removing and installing engine oil cooler

Special tools and workshop equipment required

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

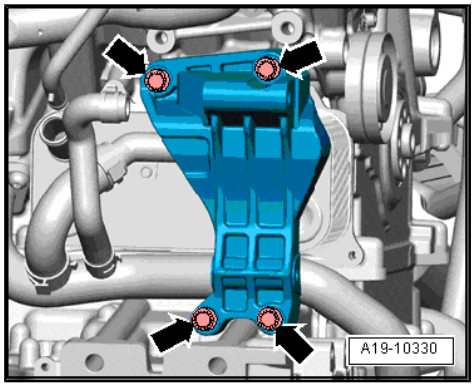


Removing

– Drain off coolant ⇒ page 187 .

– Remove alternator ⇒ Electrical system; Rep. gr. 27

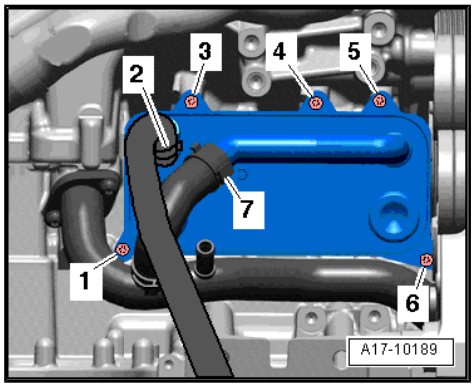
– Remove bolts -arrows- and detach bracket for alternator.



– Detach coolant hoses -2- and -7- at engine oil cooler.

– Position used oil collection and extraction unit - V.A.G 1782- below engine.

– Remove bolts -1, 3, 4, 5, 6- and detach engine oil cooler.



Installing

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

Note

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

– Install bracket for alternator ⇒ page 55 .

– Install alternator ⇒ Electrical system; Rep. gr. 27

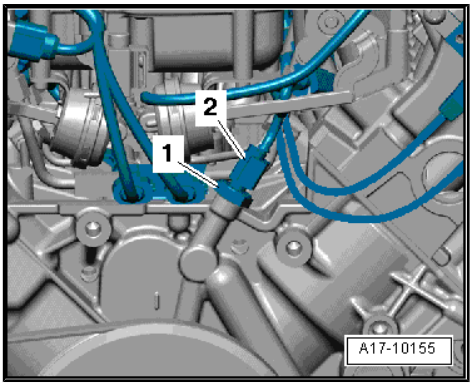
– Check oil level ⇒ Maintenance ; Booklet 404 .

– Fill cooling system ⇒ page 190 .

Tightening torques

- ⇒ Fig. ""Engine oil cooler - tightening torque and sequence"" , page 176

1.13 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.

Installing

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

Note

Renew seal.

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

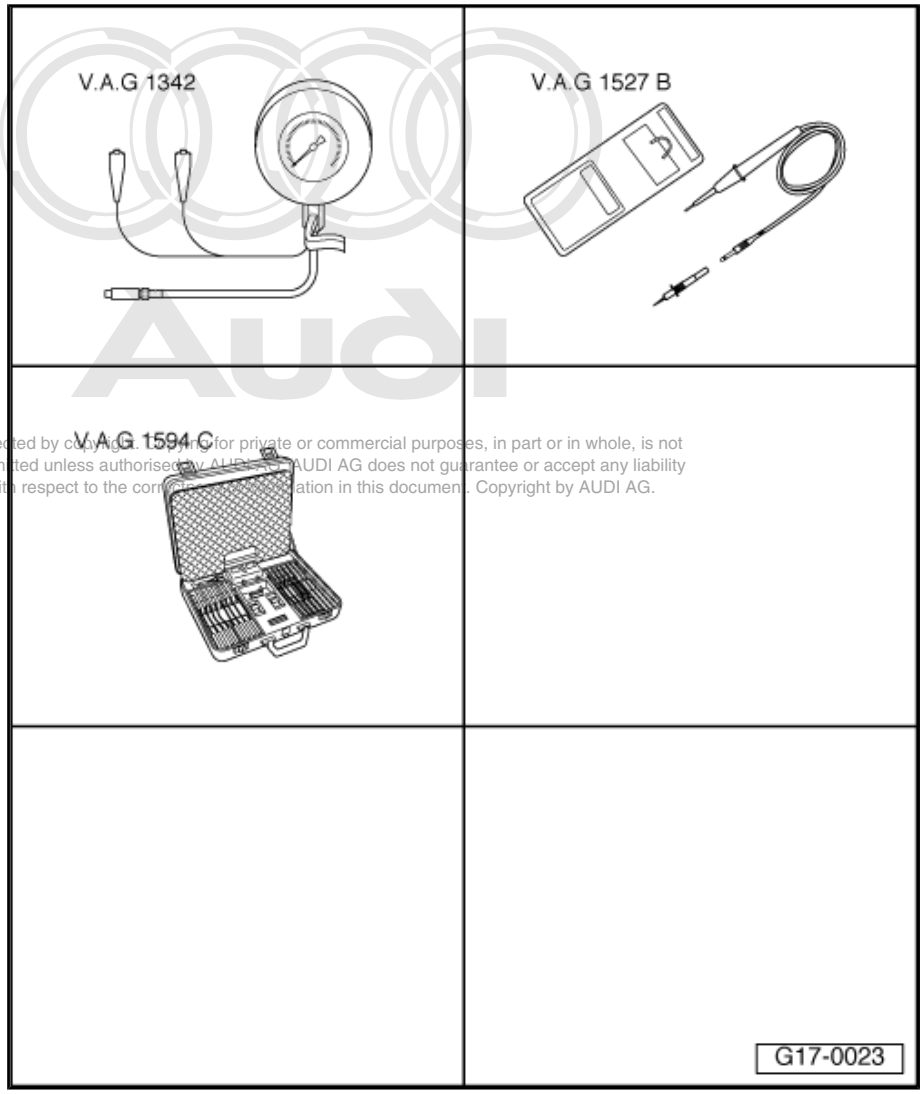
Tightening torques

♦ ⇒ Fig. "" Oil pressure switch -F1- - tightening torque"" , page 177

1.14 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-



Procedure

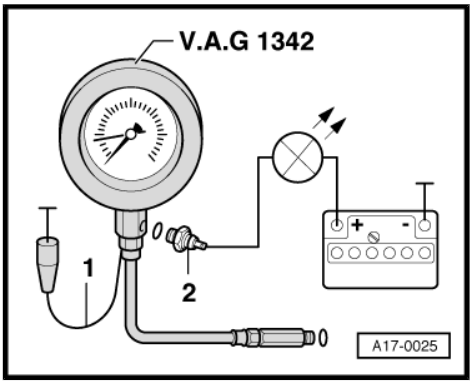
- Oil level OK
- Engine oil temperature approx. 80 °C

– Remove oil pressure switch - F1- ⇒ page 179 .

– Connect oil pressure tester - V.A.G 1342- with adapter - V.A.G 1342/14- to hole for oil pressure switch.

– Screw oil pressure switch -2- into oil pressure tester - V.A.G 1342- .

– 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.

Note

Observe tester and LED while starting, as switching point of oil pressure switch may already be exceeded when starting.

- LED should light up at 1.2 ... 1.6 bar.

If LED does not light up:

– Renew oil pressure switch.

Checking oil pressure

– Start engine.

- Minimum oil pressure at idling speed: 1.5 bar.
- Minimum oil pressure at 2000 rpm: 3.5 bar.

Assembling

– Install oil pressure switch - F1- ⇒ page 179 .

1.15 Engine oil

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

1.16 Checking oil level

Check oil level ⇒ Maintenance ; Booklet 404 .

19 – Cooling

1 Cooling system

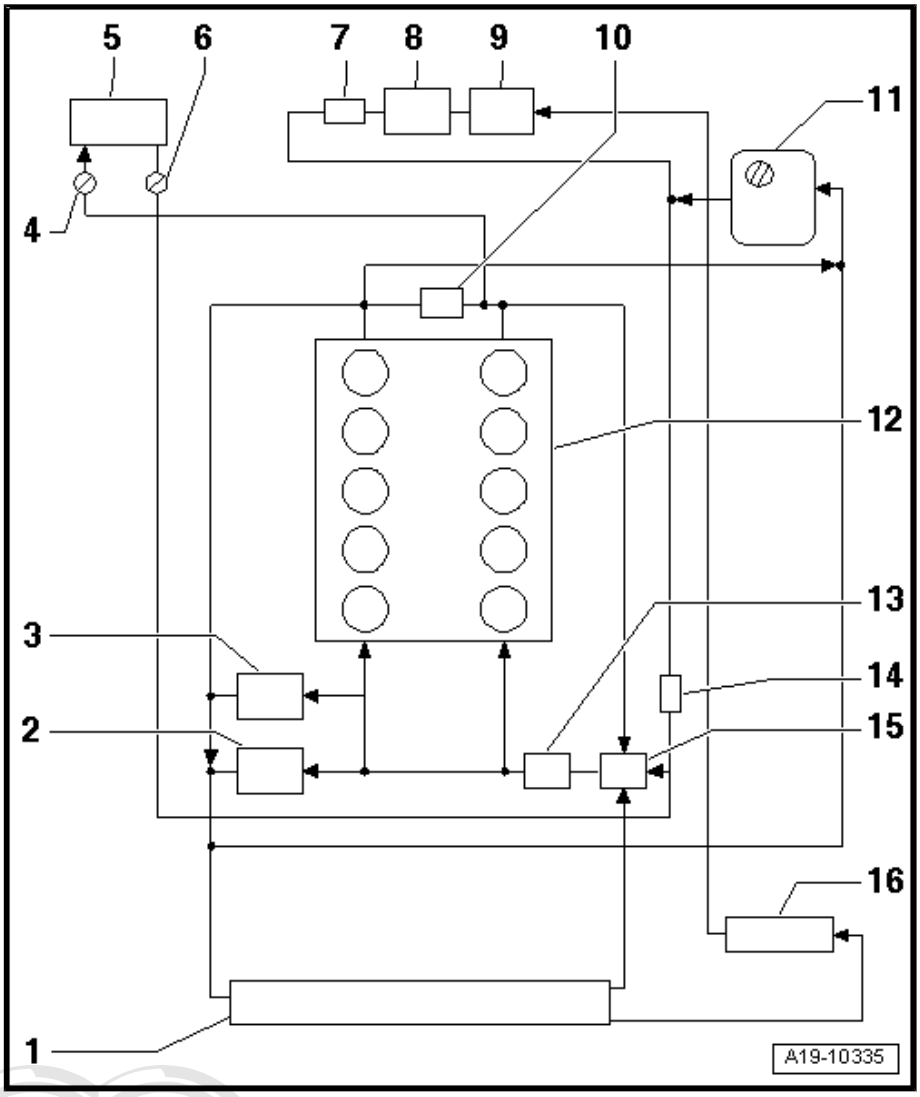
WARNING

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

Note

- *The cooling system is under pressure when the engine is hot. If necessary, relieve pressure before commencing repair work.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- *Renew gaskets, seals and O-rings.*
- *The arrow markings on coolant pipes and on ends of hoses must align.*
- *Fit all heat shields and heat insulation sleeves in the original positions when installing.*

1.1 Connection diagram for coolant hoses - vehicles without auxiliary heater



1 - Radiator

- ❑ Removing and installing ⇒ page 214
- ❑ If renewed, refill system with fresh coolant

2 - Alternator

3 - Engine oil cooler

- ❑ Removing and installing ⇒ page 177
- ❑ If renewed, refill system with fresh coolant

4 - Bleeder screw

5 - Heat exchanger for heater

- ❑ If renewed, refill system with fresh coolant

6 - Bleeder screw

7 - Thermostat

- ❑ For gear oil cooler and ATF cooler

8 - Gear oil cooler

9 - ATF cooler

10 - Coolant temperature sender - G62-

11 - Coolant expansion tank

- ❑ Checking pressure relief valve in filler cap ⇒ page 223

12 - Cylinder head/cylinder block

- ❑ If renewed, refill system with fresh coolant

13 - Coolant pump

- ❑ Removing and installing ⇒ page 196

14 - Continued coolant circulation pump - V51-

- ❑ Removing and installing ⇒ page 200

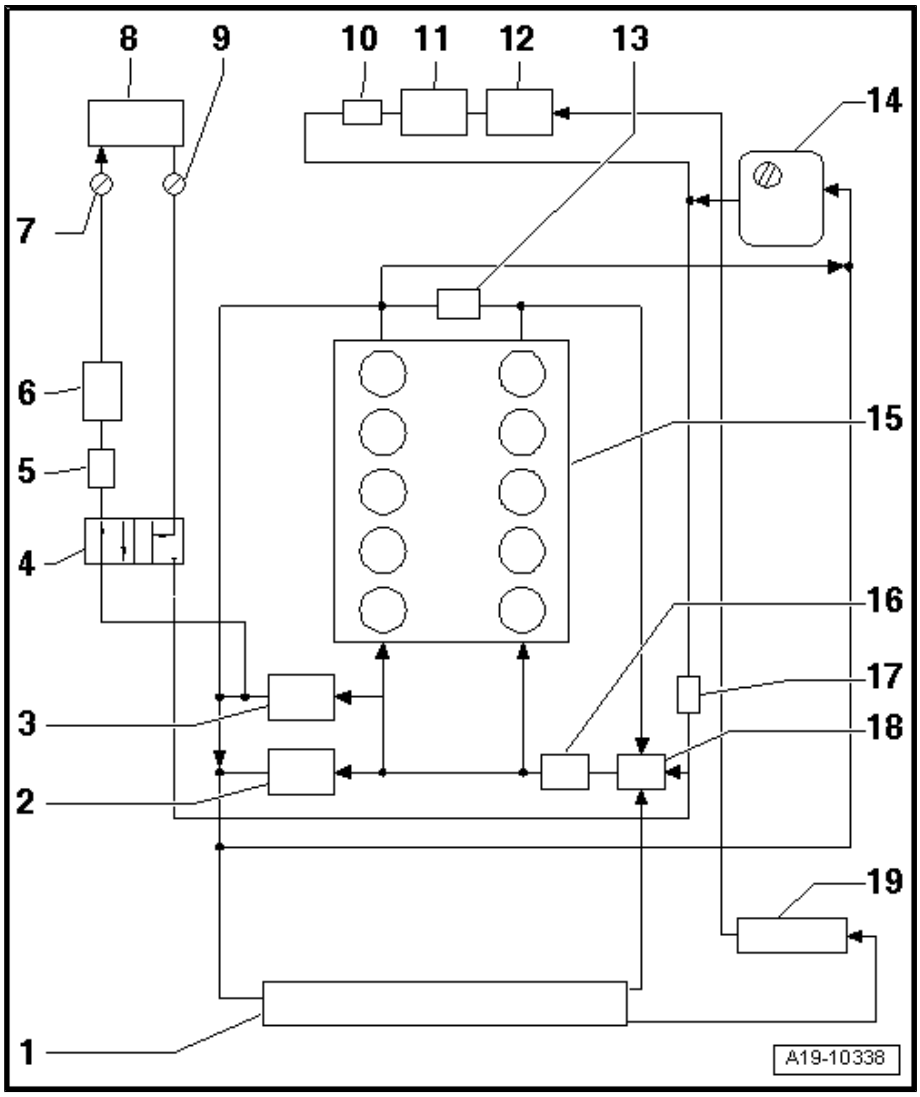
15 - Thermostat

- ❑ Removing and installing ⇒ page 197

16 - Auxiliary radiator

- ❑ Removing and installing ⇒ page 217
- ❑ If renewed, refill system with fresh coolant

1.2 Connection diagram for coolant hoses - vehicles with auxiliary heater



1 - Radiator

- ❑ Removing and installing ⇒ page 214
- ❑ If renewed, refill system with fresh coolant

2 - Alternator

3 - Engine oil cooler

- ❑ Removing and installing ⇒ page 177
- ❑ If renewed, refill system with fresh coolant

4 - Heater coolant shut-off valve - N279-

5 - Circulation pump - V55-

6 - Auxiliary heater

7 - Bleeder screw

8 - Heat exchanger for heater

- ❑ If renewed, refill system with fresh coolant

9 - Bleeder screw

10 - Thermostat

- ❑ For gear oil cooler and ATF cooler

11 - Gear oil cooler

12 - ATF cooler

13 - Coolant temperature sender - G62-

14 - Coolant expansion tank

- ❑ Checking pressure relief valve in filler cap ⇒ page 223

15 - Cylinder head/cylinder block

- ❑ If renewed, refill system with fresh coolant

16 - Coolant pump

- ❑ Removing and installing ⇒ page 196

17 - Continued coolant circulation pump - V51-

- ❑ Removing and installing ⇒ page 200

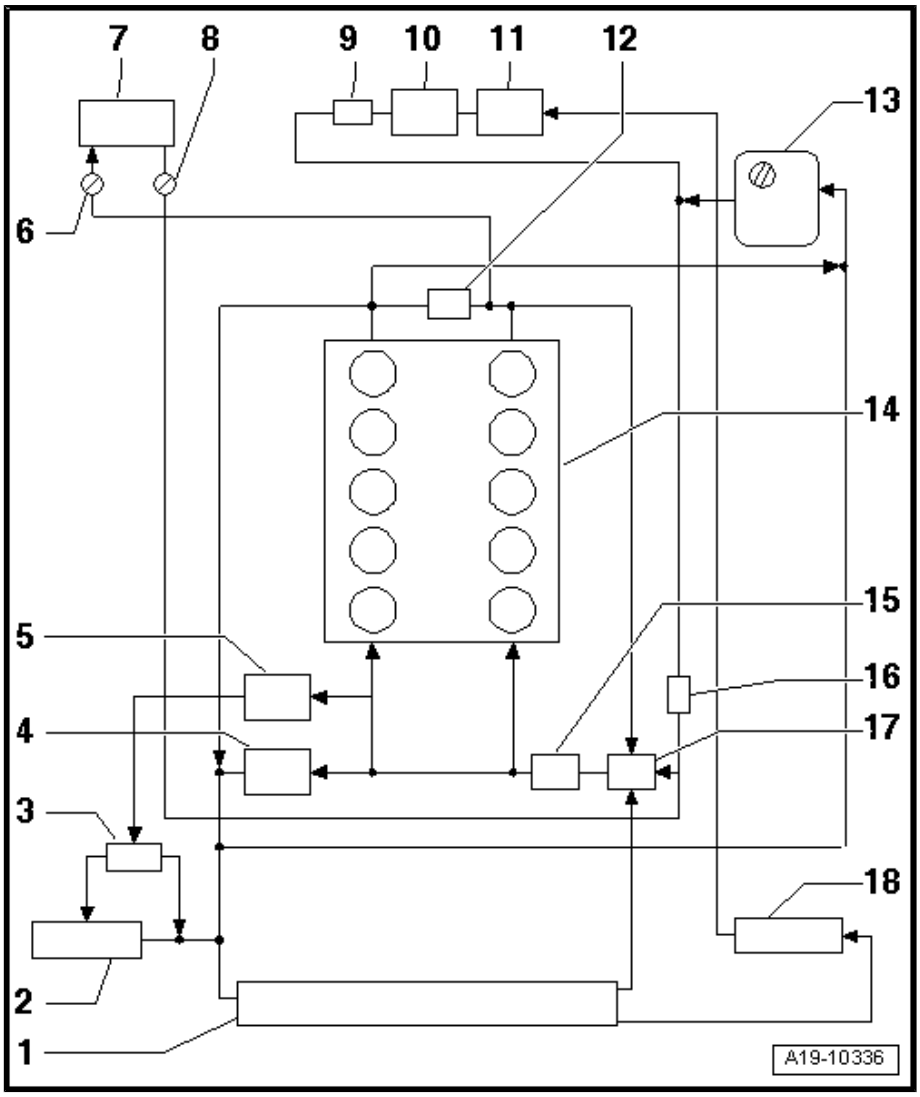
18 - Thermostat

- ❑ Removing and installing ⇒ page 197

19 - Auxiliary radiator

- ❑ Removing and installing ⇒ page 217
- ❑ If renewed, refill system with fresh coolant

1.3 Connection diagram for coolant hoses - vehicles for hot countries without auxiliary heater



1 - Radiator

- ❑ Removing and installing ⇒ page 214
- ❑ If renewed, refill system with fresh coolant

2 - Auxiliary radiator (right-side)

- ❑ Removing and installing ⇒ page 218
- ❑ If renewed, refill system with fresh coolant

3 - Thermostat for auxiliary radiator

4 - Alternator

5 - Engine oil cooler

- ❑ Removing and installing ⇒ page 177
- ❑ If renewed, refill system with fresh coolant

6 - Bleeder screw

7 - Heat exchanger for heater

- ❑ If renewed, refill system with fresh coolant

8 - Bleeder screw

9 - Thermostat

- ❑ For gear oil cooler and ATF cooler

10 - Gear oil cooler

11 - ATF cooler

12 - Coolant temperature sender - G62-

13 - Coolant expansion tank

- ❑ Checking pressure relief valve in filler cap ⇒ page 223

14 - Cylinder head/cylinder block

- ❑ If renewed, refill system with fresh coolant

15 - Coolant pump

- ❑ Removing and installing ⇒ page 196

16 - Continued coolant circulation pump - V51-

- ❑ Removing and installing ⇒ page 200

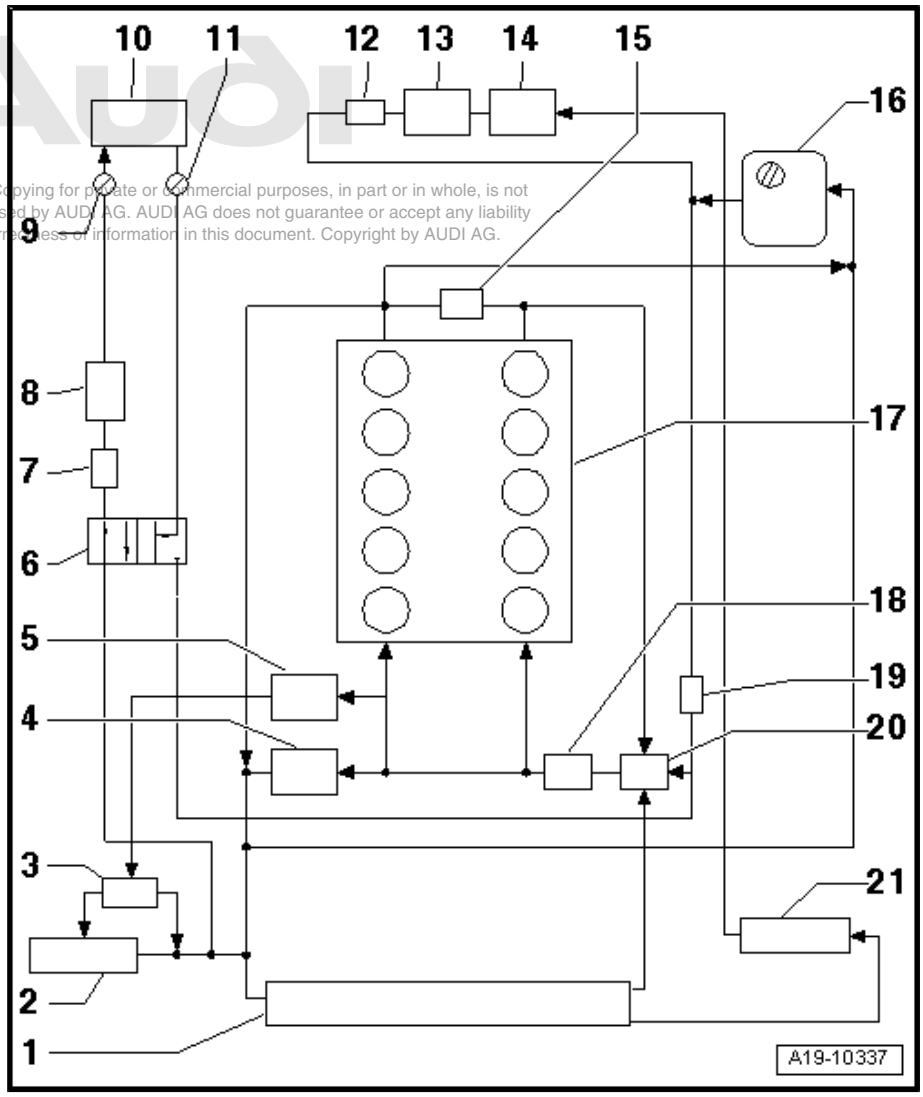
17 - Thermostat

- ❑ Removing and installing ⇒ page 197

18 - Auxiliary radiator (left-side)

- ❑ Removing and installing ⇒ page 217
- ❑ If renewed, refill system with fresh coolant

1.4 Connection diagram for coolant hoses - vehicles for hot countries with auxiliary heater



1 - Radiator

- ❑ Removing and installing ⇒ page 214
- ❑ If renewed, refill system with fresh coolant

2 - Auxiliary radiator (right-side)

- ❑ Removing and installing ⇒ page 218
- ❑ If renewed, refill system with fresh coolant

3 - Thermostat for auxiliary radiator

4 - Alternator

5 - Engine oil cooler

- ❑ Removing and installing ⇒ page 177
- ❑ If renewed, refill system with fresh coolant

6 - Heater coolant shut-off valve - N279-

7 - Circulation pump - V55-

8 - Auxiliary heater

9 - Bleeder screw

10 - Heat exchanger for heater

- ❑ If renewed, refill system with fresh coolant

11 - Bleeder screw

12 - Thermostat

- ❑ For gear oil cooler and ATF cooler

13 - Gear oil cooler

14 - ATF cooler

15 - Coolant temperature sender - G62-

16 - Coolant expansion tank

- ❑ Checking pressure relief valve in filler cap ⇒ page 223

17 - Cylinder head/cylinder block

- ❑ If renewed, refill system with fresh coolant

18 - Coolant pump

- ❑ Removing and installing ⇒ page 196

19 - Continued coolant circulation pump - V51-

- ❑ Removing and installing ⇒ page 200

20 - Thermostat

- ❑ Removing and installing ⇒ page 197

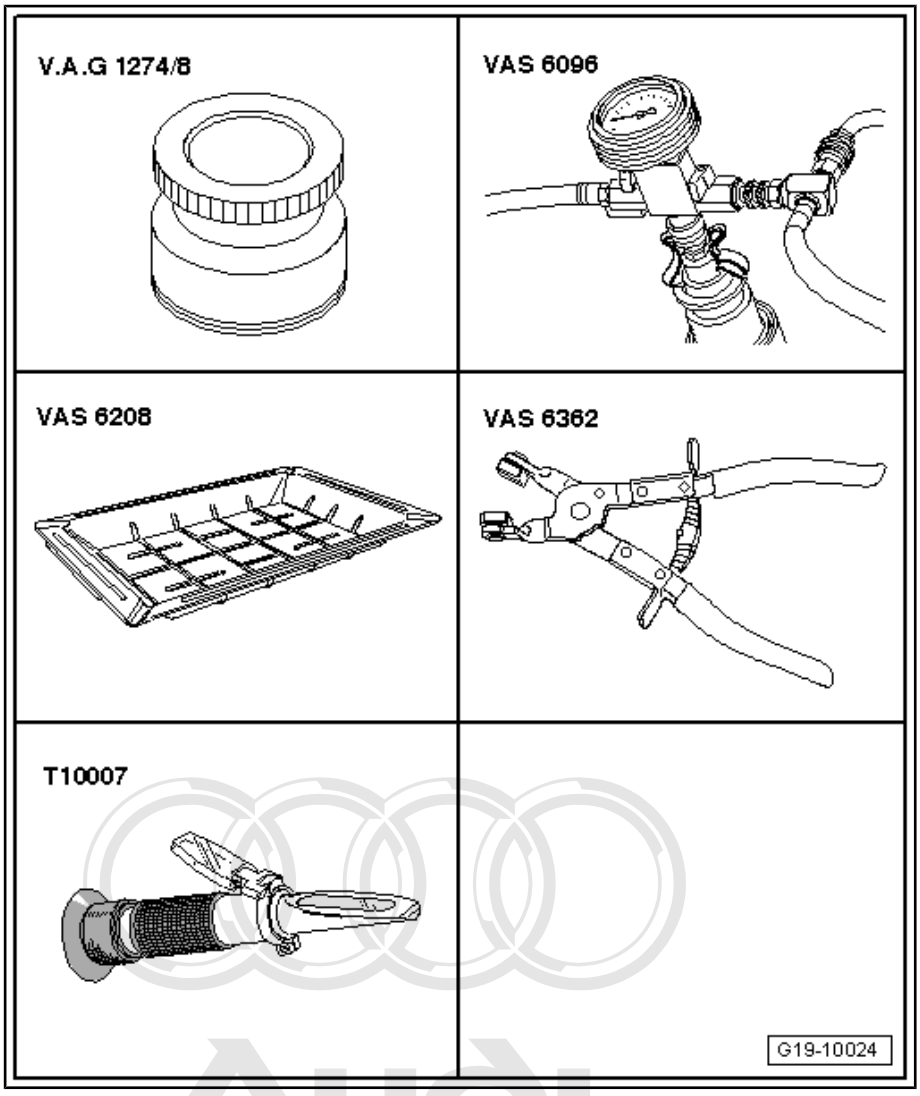
21 - Auxiliary radiator (left-side)

- ❑ Removing and installing ⇒ page 217
- ❑ If renewed, refill system with fresh coolant

1.5 Draining and filling cooling system

Special tools and workshop equipment required

- ♦ Adapter for cooling system tester - V.A.G 1274/8-
- ♦ Cooling system charge unit - VAS 6096-
- ♦ Drip tray for workshop hoist - VAS 6208-
- ♦ Hose clip pliers - VAS 6362-
- ♦ Refractometer - T10007-

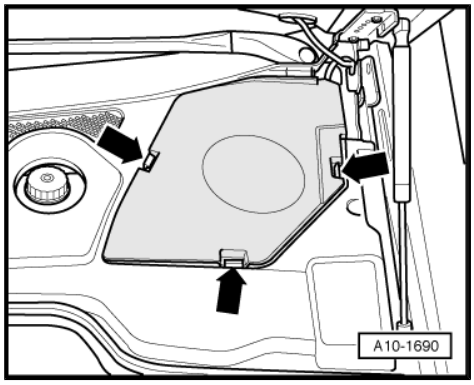


Draining

Note

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

– Remove cover above coolant expansion tank -arrows-.

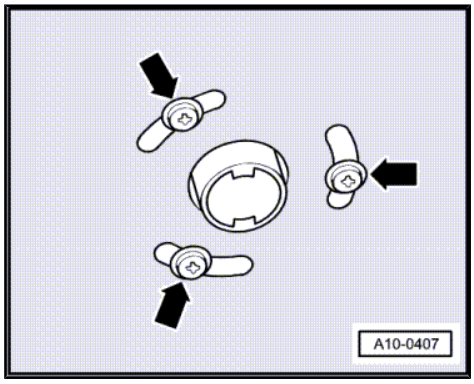


WARNING

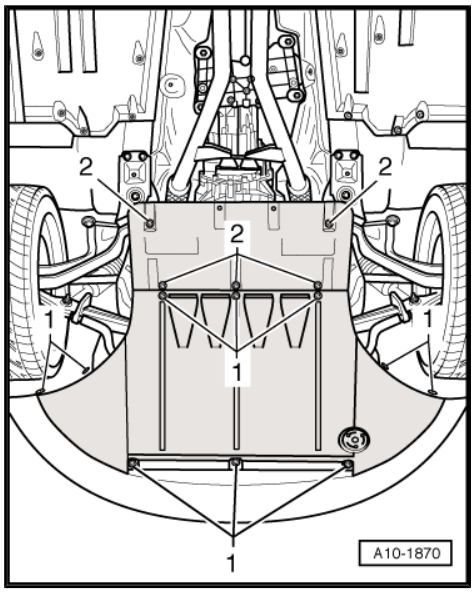
Hot steam or hot coolant can escape when coolant expansion tank is opened; cover filler cap with cloth and open carefully.

– Open filler cap on coolant expansion tank.

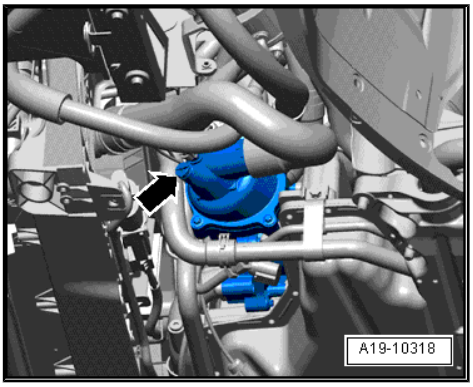
– Vehicles with auxiliary heater: remove bolts -arrows- securing exhaust pipe for auxiliary/additional heater to noise insulation.



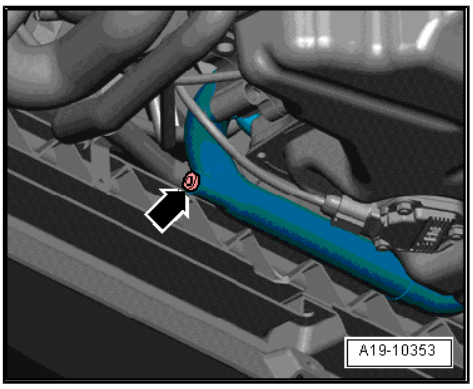
– Open quick-release fasteners -1- and remove noise insulation (front).



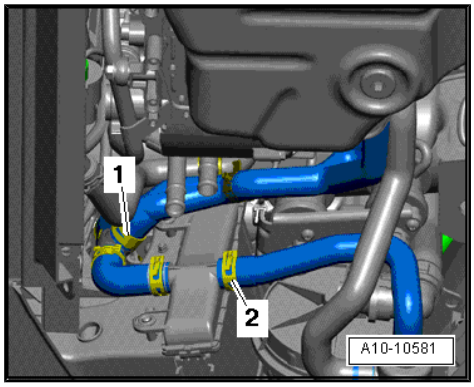
– Place drip tray for workshop hoist - VAS 6208- under engine.
– Unscrew drain plug -arrow- at thermostat housing and drain off coolant.



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



– Disconnect coolant hose (bottom) -2- from auxiliary radiator (right-side) and drain off remaining coolant.



Note

Disregard -item 1-.

Filling

- Ignition off.

Caution

Always use cooling system charge unit - VAS 6096- when filling the cooling system. Otherwise, the automatic gearbox could malfunction.

Note

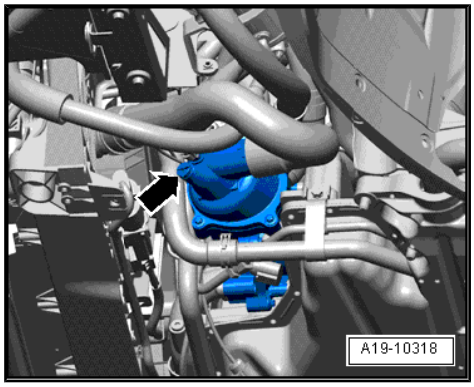
- *The effectiveness of the coolant is greatly influenced by the quality of the water with which it is mixed. Because water may contain different substances depending on the country or even the region, the water quality to be used for cooling systems has been specified. Distilled water meets all the requirements and is therefore recommended for use when topping up or filling up with coolant (also applies to all older models).*
- *Use only coolant additives 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.*
- *Coolant with the recommended mixture ratio ⇒ page 191 prevents frost and corrosion damage and stops scaling. At the same time it raises the boiling point of the fluid in the system. For this reason the cooling system must be filled all year round with the correct coolant 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 -36 °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 55 %, as otherwise the cooling efficiency is impaired and frost protection decreases again.*
- *The refractometer - T10007 A- must be used to determine the current anti-freeze density.*
- *Read off the level of frost protection on the scale for the relevant coolant additive.*
- *The temperature indicated on the refractometer - T10007 A- corresponds to the temperature at which the first ice crystals can form in the coolant.*
- *Do not reuse coolant.*
- *Only use water/coolant additive as a lubricant for coolant hoses.*
- *Secure all hose connections with correct type of hose clips (as original equipment) ⇒ Electronic parts catalogue .*

Recommended mixture ratio for coolant

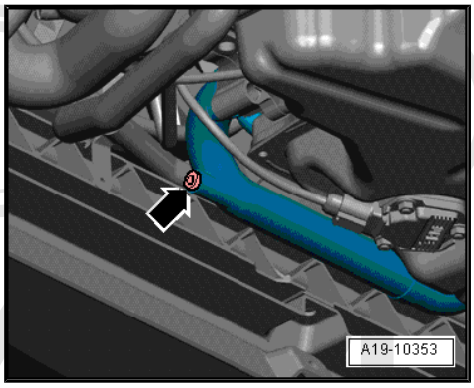
- Coolant (40 %) and water (60 %) for frost protection to -25 °C
- Coolant (50 %) and water (50 %) for frost protection to -35 °C
- Coolant ⇒ Electronic parts catalogue

Procedure

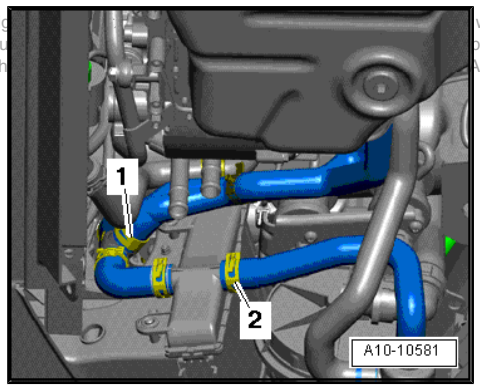
– Fit drain plug -arrow- with new O-ring on thermostat housing.



– Install drain plug -arrow- with new seal on front coolant pipe.



– Attach coolant hose (bottom) -2- at auxiliary radiator (right-side) -arrow-.



– Fill reservoir of cooling system charge unit - VAS 6096- with at least 15 litres of premixed coolant (based on recommended ratio):

- Radiator antifreeze/anti-corrosion agent (40 %) and water (60 %) for frost protection to -25 °C.
- Radiator antifreeze/anti-corrosion agent (50 %) and water (50 %) for frost protection to -35 °C.
- Radiator antifreeze/anti-corrosion agent (60 %) and water (40 %) for frost protection to -40 ℃.
- Radiator antifreeze/anti-corrosion agent ⇒ Electronic parts catalogue

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

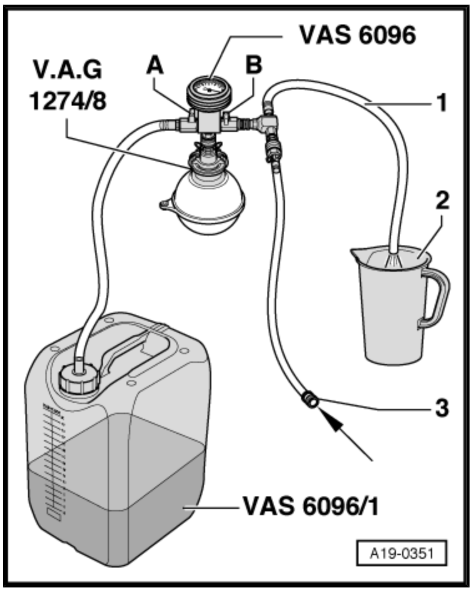
– Attach cooling system charge unit - VAS 6096- to adapter - V.A.G 1274/8- .

– 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.



– 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.

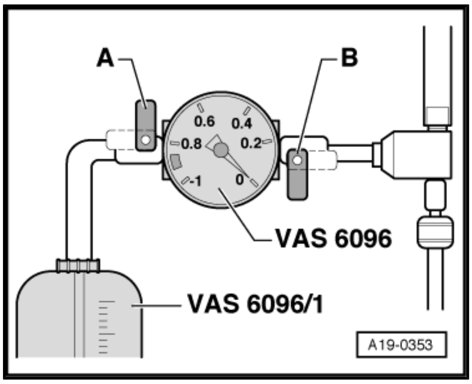
If the needle does not reach the green zone, repeat the process.

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

– Detach compressed air hose.

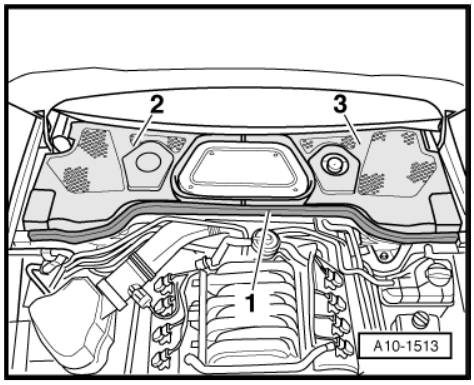
– Open valve -A-.

The partial vacuum in the cooling system causes the coolant to be drawn up out of the reservoir; the cooling system is then filled.



– Detach cooling system charge unit - VAS 6096- from adapter -V.A.G 1274/8- on coolant expansion tank.

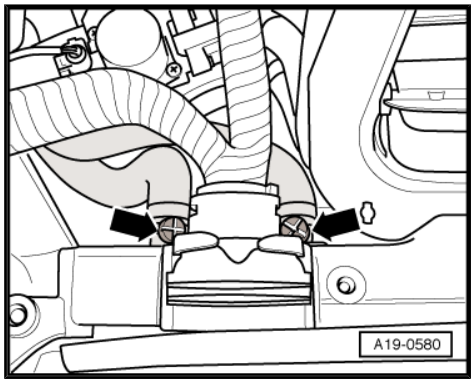
– Pull off rubber seal -1- and remove plenum chamber cover -2-.



Note

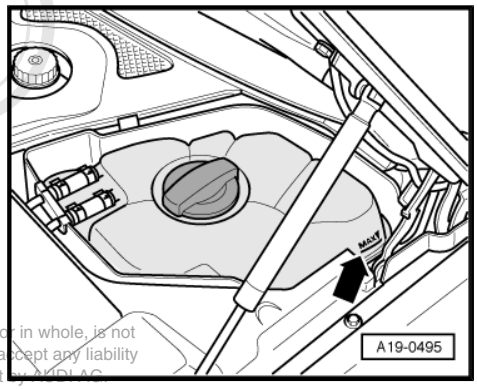
Disregard -item 3-.

– Open bleeder screws -arrows-.
– Fill up with coolant until it flows out at bleeder holes in coolant hoses.
– Close the bleeder screws.
– Tighten filler cap on expansion tank.
– On vehicles with auxiliary heater, switch heater on (for about 30 seconds) and then off again.
– Start engine.
– Set temperature to “HI” in all zones.
– Switch off air conditioner compressor (press ECON button).
– 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.



Tightening torques

- ⇒ “1.6 Coolant pump and thermostat - exploded view”, page 194
- ⇒ “1.12 Coolant pipes - exploded view”, page 202

1.6 Coolant pump and thermostat - exploded view

1 - Seal
- ❑ Renew

2 - Housing for coolant pump
- ❑ Removing and installing ⇒ page 196

3 - Bolt
- ❑ Tightening torque ⇒ Item 4 (page 203)

4 - Coolant pipe (front)
- ❑ Removing and installing ⇒ page 205

5 - O-ring
- ❑ Renew

6 - Seal
- ❑ Renew

7 - Coolant pump
- ❑ Removing and installing ⇒ page 196

8 - O-ring
- ❑ Renew

9 - 9 Nm

10 - Drive shaft for coolant pump

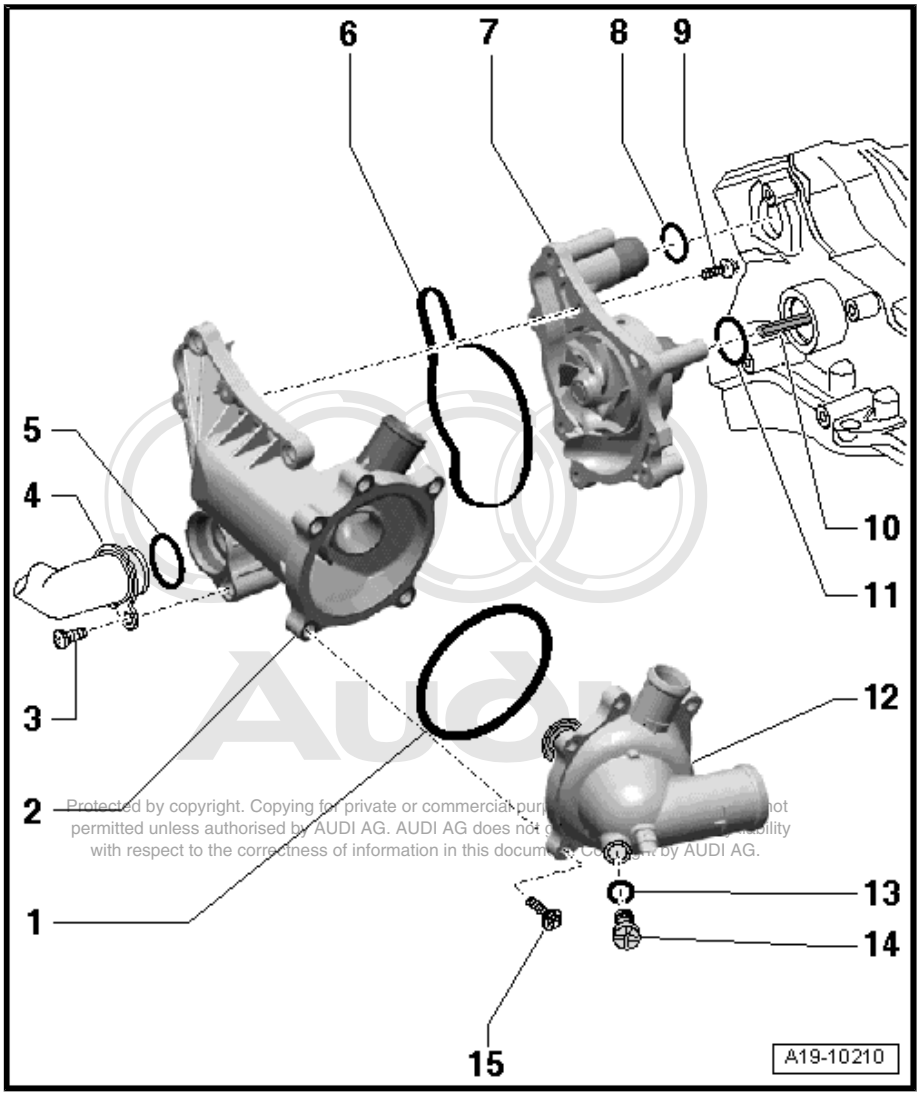
11 - O-ring
- ❑ Renew

12 - Thermostat housing
- ❑ Removing and installing ⇒ page 197
- ❑ Thermostat opening values ⇒ page 198

13 - O-ring
- ❑ Renew

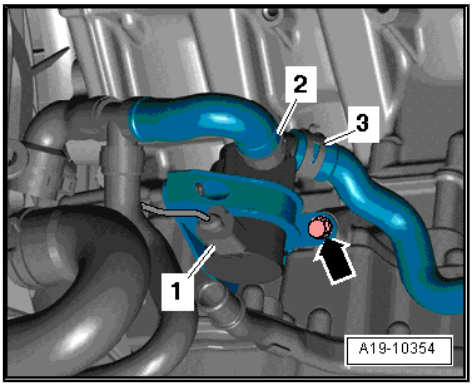
14 - Drain plug, 4 Nm

15 - 9 Nm



Continued coolant circulation pump - V51- - tightening torque

– Tighten bolt -arrow- to 9 Nm.

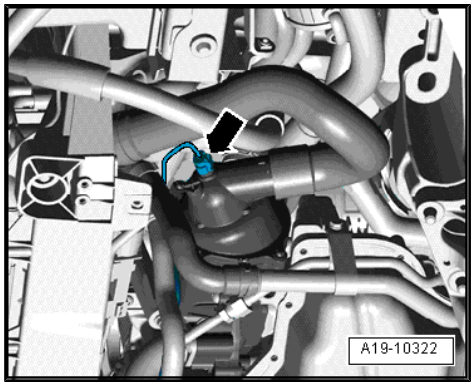


1.7 Removing and installing coolant pump

Removing

– Remove coolant pipe (front) ⇒ page 205 .

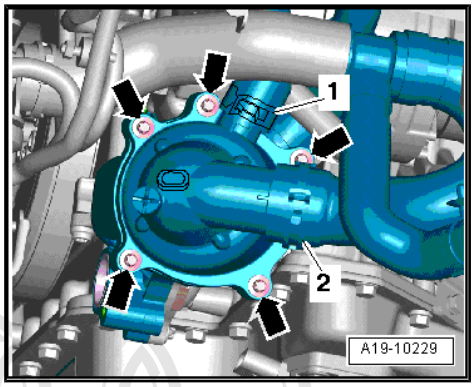
– Unplug electrical connector -arrow- at radiator outlet coolant temperature sender - G83- .



– Detach coolant hose -2- (bottom) from thermostat housing.

– Remove bolts -arrows-.

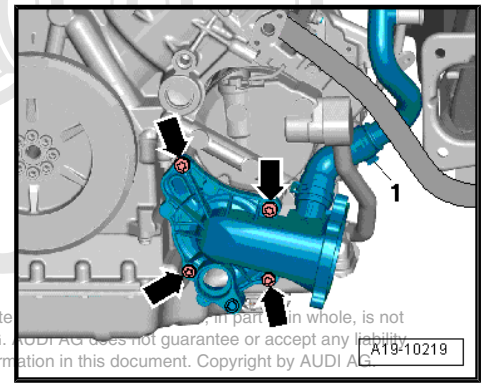
– Remove thermostat housing and detach coolant hose -1- (top) from thermostat housing.



– Slacken hose clip -1- on coolant hose.

– Remove bolts -arrows-.

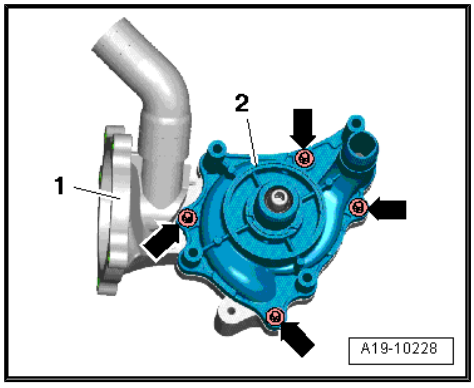
– Pull off coolant pump housing forwards (note the drive shaft for coolant pump).



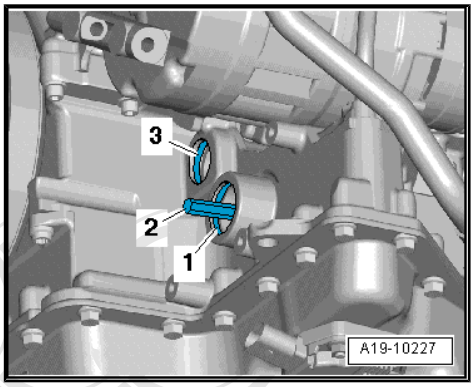
Note

The coolant hose can only be disconnected when the coolant pump is removed.

– Unscrew bolts -arrows- and remove coolant pump -2- from housing -1-.



Installing



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 thermostat housing ⇒ page 197 .

– Install coolant pipe (front) ⇒ page 205 .

– Fill cooling system ⇒ page 190 .

Tightening torques

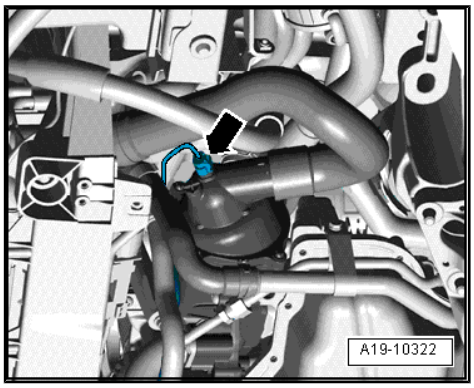
- ⇒ “1.6 Coolant pump and thermostat - exploded view”, page 194

1.8 Removing and installing thermostat housing

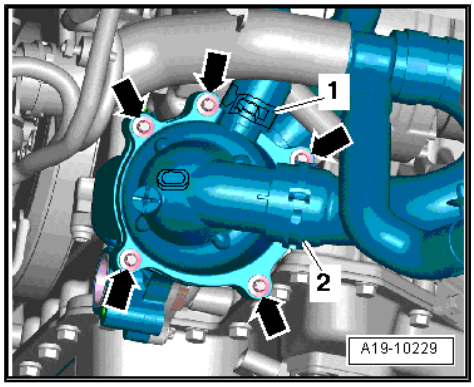
Removing

– Drain off coolant ⇒ page 187 .

– Unplug electrical connector -arrow- at radiator outlet coolant temperature sender - G83- .



– Disconnect coolant hose -2- (bottom) from thermostat housing and drain off remaining coolant.
– Remove bolts -arrows-.
– Remove thermostat housing and detach coolant hose -1- (top) from thermostat housing.



Installing

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

Note

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

– Fill cooling system ⇒ page 190 .

Tightening torque

- ⇒ “1.6 Coolant pump and thermostat - exploded view”, page 194

1.9 Thermostat opening values [1)]

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

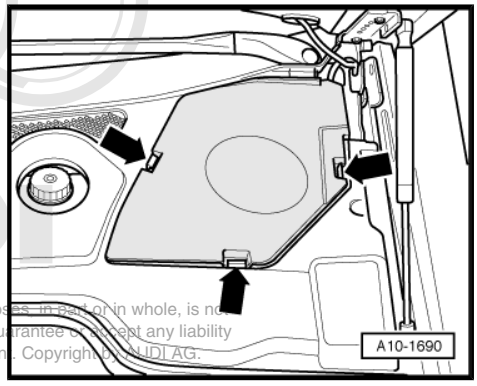
• [1)] Cannot be tested with workshop equipment.

1.10 Removing and installing coolant temperature sender - G62-

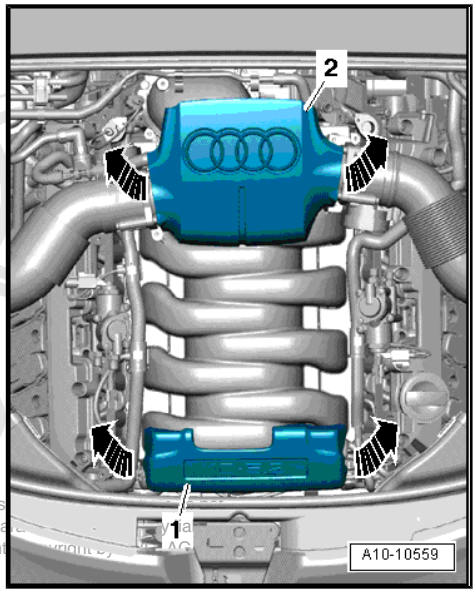
Removing

- Engine cold

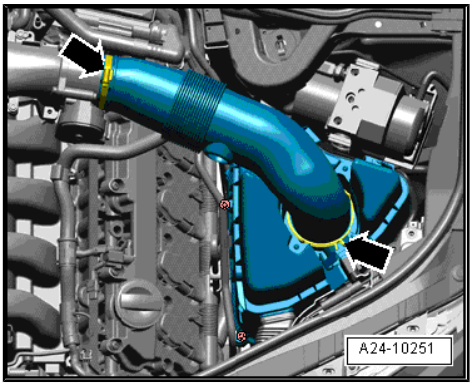
– Remove cover above coolant expansion tank -arrows-.
– Open filler cap on coolant expansion tank briefly to release residual pressure in cooling system.



– Pull off engine cover panel (rear) -2- -arrows-.



– Remove air hose (left-side) -arrows-.



Rest-of-world vehicles:

– Detach vacuum line -2- at air intake hose.

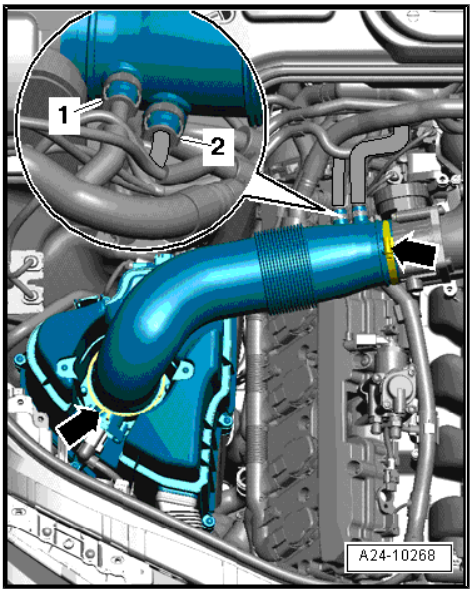
– Disconnect hose -1- for crankcase breather system from air hose by pressing release tabs.

– Open hose clips -arrows- and disconnect air intake hose.

USA models:

– Detach vacuum line -2- from air hose.

– Open hose clips -arrows- and move air intake hose to one side.



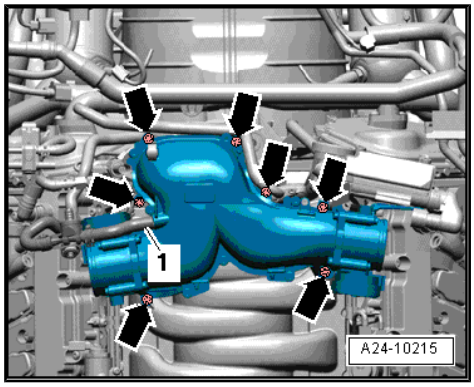
Caution

Do not open hose connection -1- on USA models.

All vehicles:

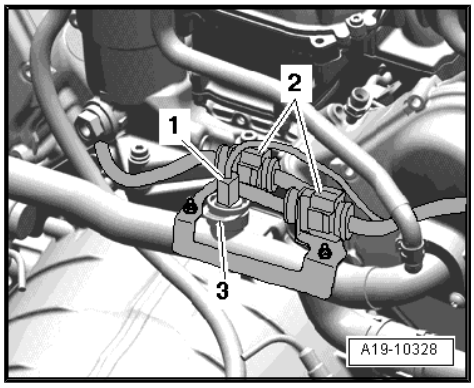
– Detach vacuum hose -1- from intake manifold.

– Unscrew bolts -arrows- and remove air duct.



– Remove electrical connectors -2- from bracket.

– Unplug electrical connector -1- at coolant temperature sender - G62- .



Note

Lay a cloth under the connection to catch escaping coolant.

– Detach retaining clip -3- and remove coolant temperature sender - G62- .

Installing

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

Note

- *To avoid loss of coolant, insert new coolant temperature sender - G62- immediately and secure with retaining clip.*
- *Renew O-ring.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*

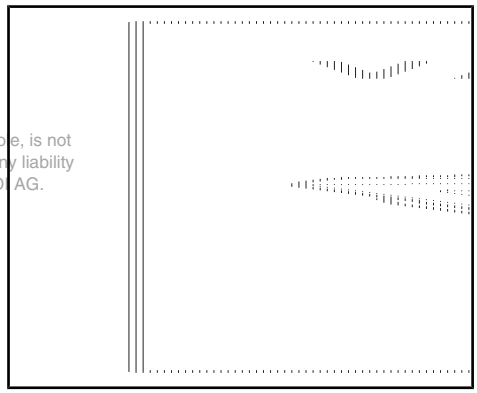
– Install air duct ⇒ Rep. gr. 24 .

– Fill cooling system ⇒ page 190 .

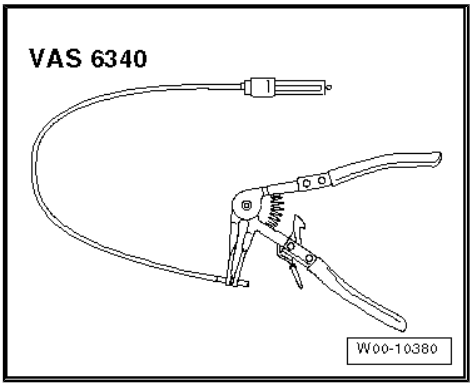
1.11 Removing and installing continued coolant circulation pump - V51-

Special tools and workshop equipment required

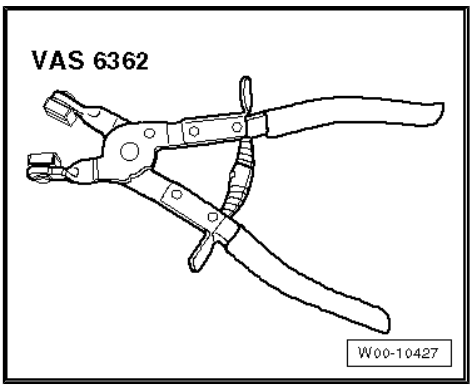
- Drip tray for workshop hoist - VAS 6208-



♦ Hose clip pliers - VAS 6340-



♦ Hose clip pliers - VAS 6362-

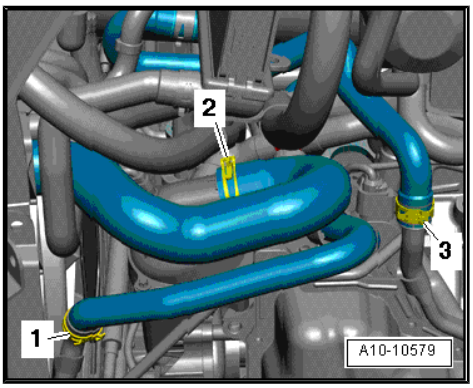


Removing

– Drain off coolant ⇒ page 187 .

– Place drip tray for workshop hoist - VAS 6208- under continued coolant circulation pump - V51- .

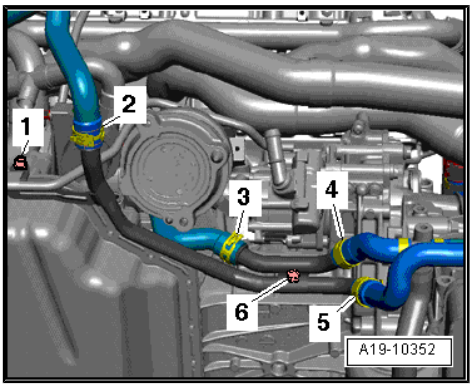
– Disconnect coolant hoses -1, 2, 3- and drain off coolant.



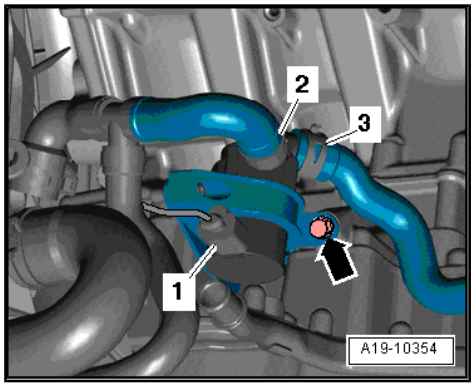
– Remove nut -1- and bolt -6- at coolant pipe (bottom left).

Note

Disregard items marked -2 ... 5-.



– Unplug electrical connector -1-.
– Detach coolant hose -2-.
– Remove bolt -arrow-.
– Pivot continued coolant circulation pump - V51- and detach pump from coolant hose -3-.



Installing

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

Note

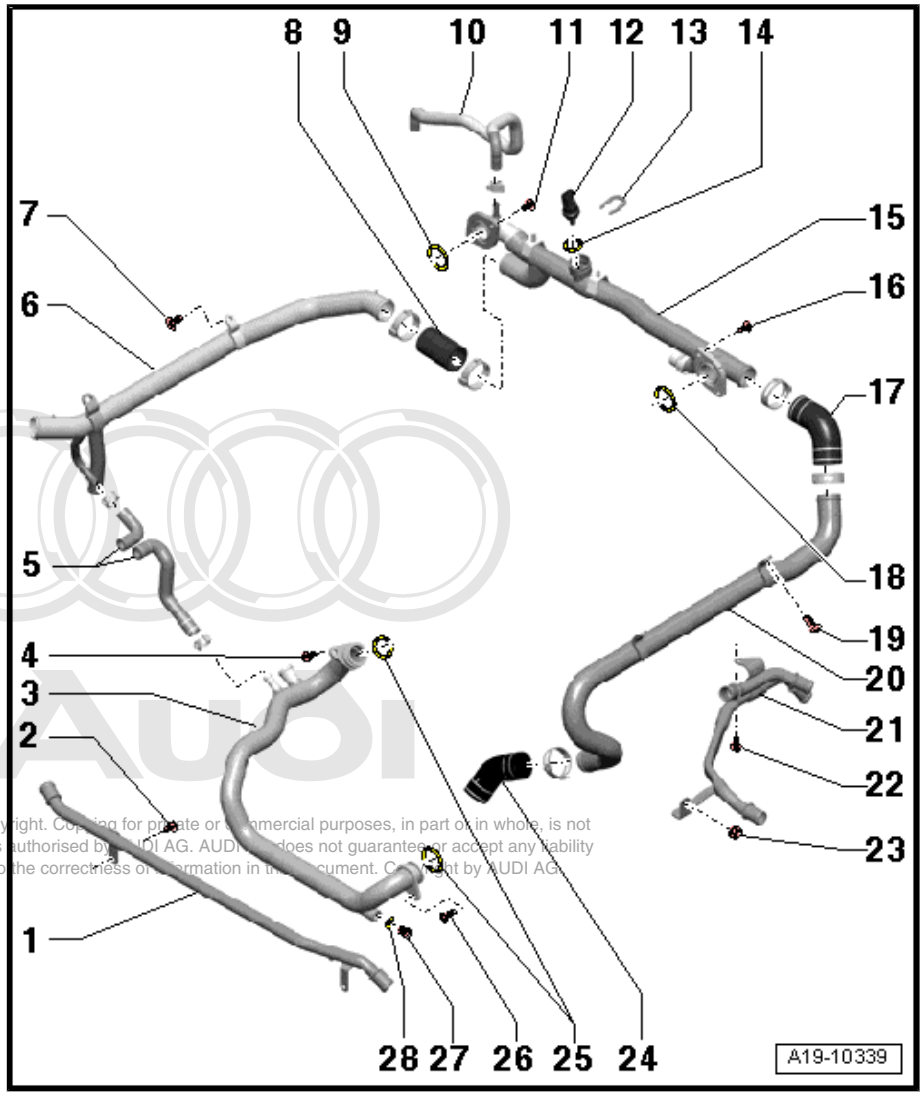
Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .

– Install coolant pipe (bottom left) ⇒ page 208 .
– Fill cooling system ⇒ page 190 .

Tightening torques

◆ ⇒ Fig. “ Continued coolant circulation pump -V51- - tightening torque” , page 195

1.12 Coolant pipes - exploded view



1 - Coolant pipe (bottom front)
- ❑ Removing and installing ⇒ page 204

2 - 9 Nm

3 - Coolant pipe (front)
- ❑ Removing and installing ⇒ page 205

4 - 8 Nm + turn 90° further
- ❑ Renew

5 - Coolant hoses
- ❑ To alternator

6 - Coolant pipe (right-side)
- ❑ Removing and installing ⇒ page 211

7 - 9 Nm

8 - Coolant hose

9 - O-ring
- ❑ Renew

10 - Coolant hose
- ❑ To intake manifold

11 - 9 Nm

12 - Coolant temperature sender - G62-
- ❑ Removing and installing ⇒ page 198

13 - Retaining clip

14 - O-ring
- ❑ Renew

15 - Coolant pipe (rear)
- ❑ Removing and installing ⇒ page 212

16 - 9 Nm

17 - Coolant hose

18 - O-ring
- ❑ Renew

19 - 9 Nm

20 - Coolant pipe (left-side)
- ❑ Removing and installing ⇒ page 207

21 - Coolant pipe (bottom left)
- ❑ Removing and installing ⇒ page 208

22 - 9 Nm

23 - 9 Nm

24 - Coolant hose
- ❑ To coolant pump housing

25 - O-rings
- ❑ Renew

26 - 8 Nm + turn 90° further

- ❑ Renew

27 - Drain plug, 10 Nm

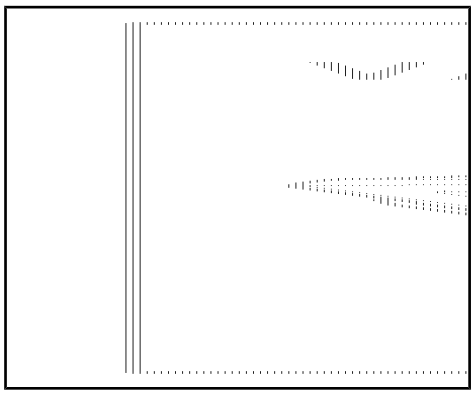
28 - Seal

- ❑ Renew

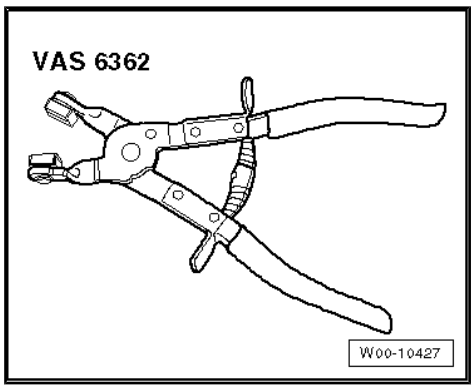
1.13 Removing and installing coolant pipe (bottom front)

Special tools and workshop equipment required

- ♦ Drip tray for workshop hoist - VAS 6208-



- ♦ Hose clip pliers - VAS 6362-



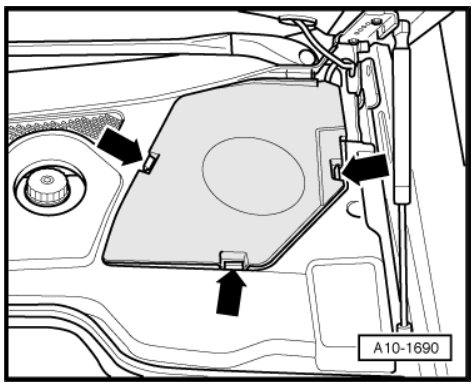
Removing

– Remove cover above coolant expansion tank -arrows-.

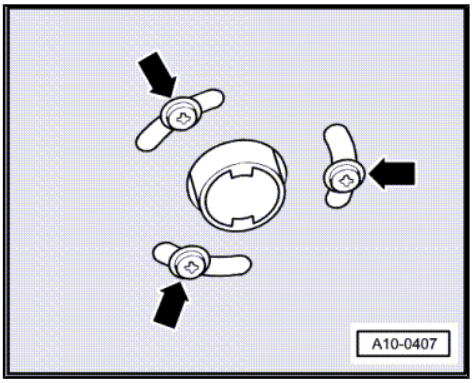
WARNING

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

– Open filler cap on coolant expansion tank.

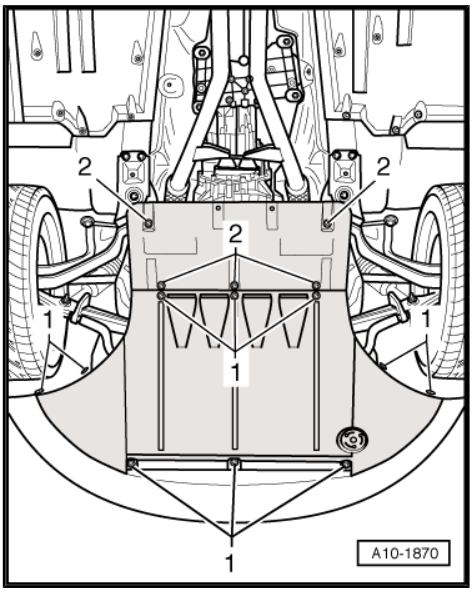


– Vehicles with auxiliary heater: remove bolts -arrows- securing exhaust pipe for auxiliary/additional heater to noise insulation.

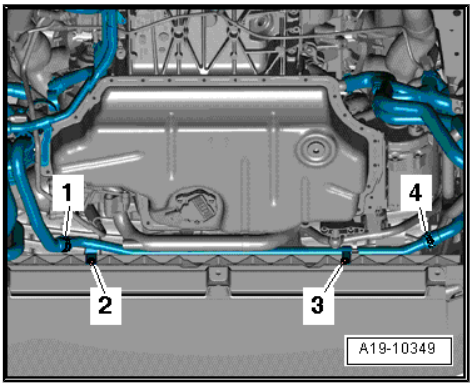


– Open quick-release fasteners -1- and remove noise insulation (front).

– Place drip tray for workshop hoist - VAS 6208- under coolant pipe (bottom front)



– Unscrew bolts -2- and -3- and detach coolant pipe (bottom front) from coolant hoses -1- and -4-.



Installing

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

Note

- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- *Fit all cable ties in the original positions when installing.*

– Fill cooling system ⇒ page 190 .

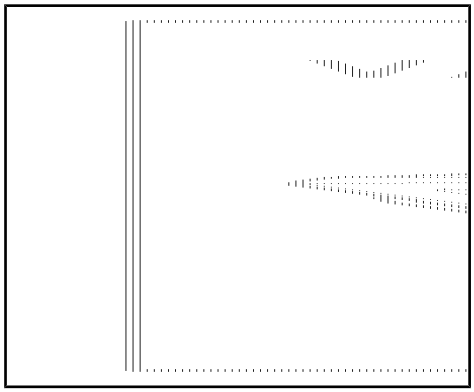
Tightening torques

- ⇒ “1.12 Coolant pipes - exploded view”, page 202

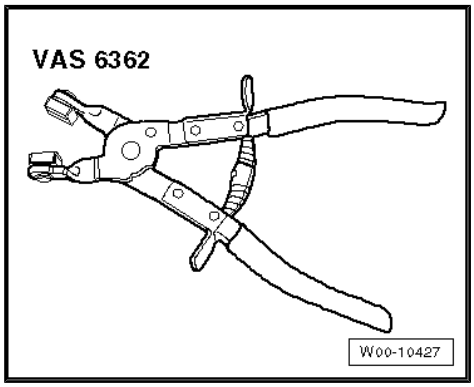
1.14 Removing and installing coolant pipe (front)

Special tools and workshop equipment required

♦ Drip tray for workshop hoist - VAS 6208-



♦ Hose clip pliers - VAS 6362-

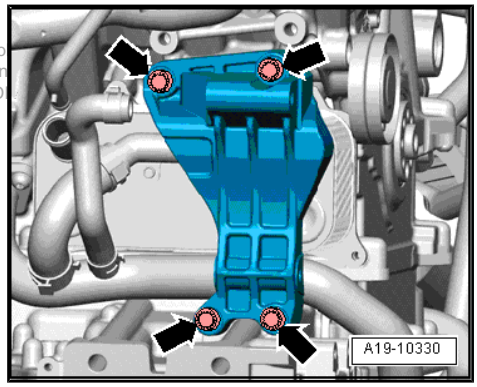


Removing

– Drain off coolant ⇒ page 187

– Remove alternator ⇒ Electrical system; Rep. gr. 27

– Remove bolts -arrows- and detach bracket for alternator.

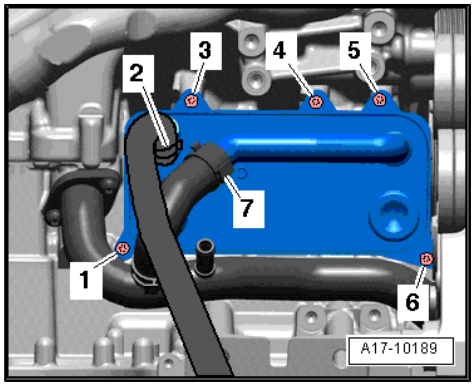


Note

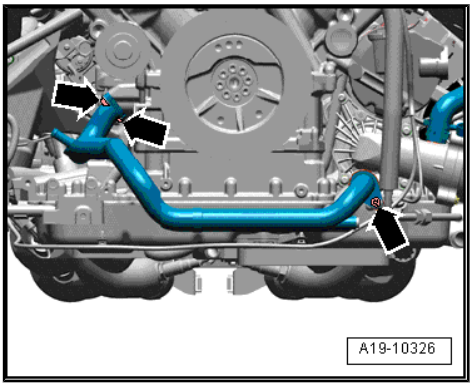
Lay a cloth under the connection to catch escaping oil.

– Detach coolant hoses -2- and -7-.

– Remove bolts -1, 3, 4, 5, 6- and detach engine oil cooler.



– Place drip tray for workshop hoist - VAS 6208- under engine.
– Unscrew bolts -arrows- and remove coolant pipe (front).



Installing

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

Note

Renew seals and O-rings.

– Install engine oil cooler ⇒ page 177 .
– Install bracket for alternator ⇒ page 55 .
– Install alternator ⇒ Electrical system; Rep. gr. 27
– Fill cooling system ⇒ page 190 .

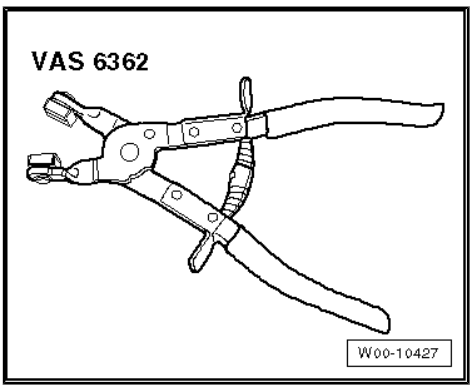
Tightening torques

◆ ⇒ “1.12 Coolant pipes - exploded view”, page 202

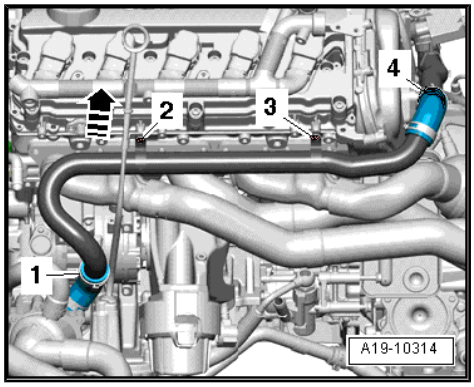
1.15 Removing and installing coolant pipe (left-side)

Special tools and workshop equipment required

◆ Hose clip pliers - VAS 6362-



Removing



- Engine removed and in position on scissor-type assembly platform - VAS 6131 A- with gearbox attached.

– Remove bolts -2- and -3-.

– Pull the guide tube for oil dipstick out upwards -arrow-.

– Loosen hose clips -1- and -4- and detach coolant pipe (left-side) from coolant hoses.

Installing

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

Note

- *Renew O-ring.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*

– Renew O-ring on guide tube for oil dipstick and insert guide tube into hole in top section of sump.

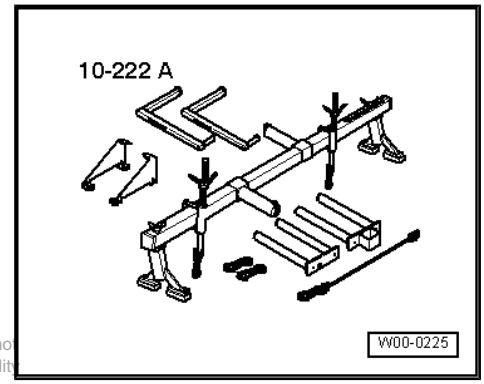
Tightening torques

- ⇒ “1.12 Coolant pipes - exploded view”, page 202

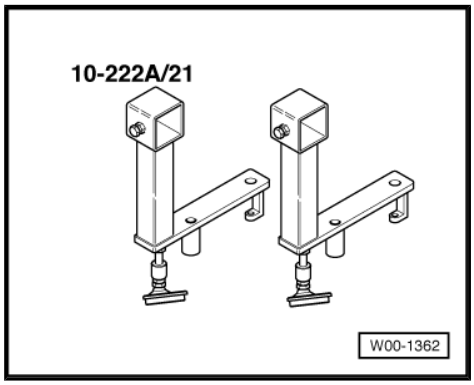
1.16 Removing and installing coolant pipe (bottom left)

Special tools and workshop equipment required

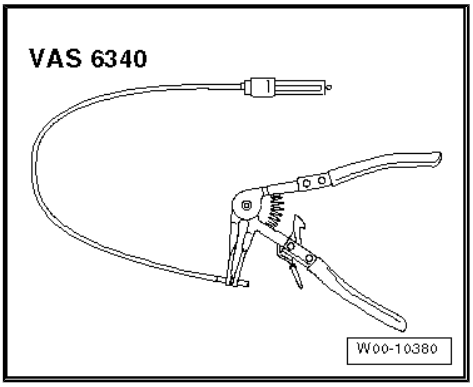
- Support bracket - 10 - 222 A-



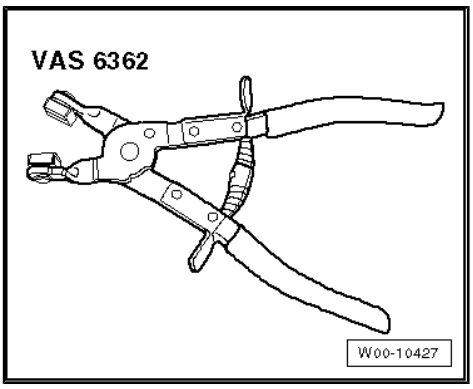
- Adapters - 10-222 A /21-



♦ Hose clip pliers - VAS 6340-



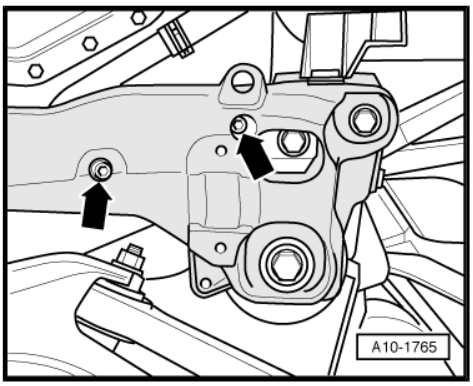
♦ Hose clip pliers - VAS 6362-



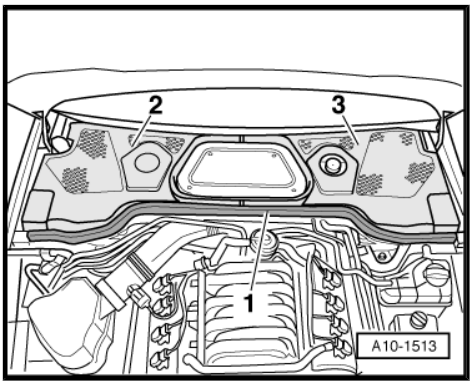
Removing

– Drain off coolant ⇒ page 187 .

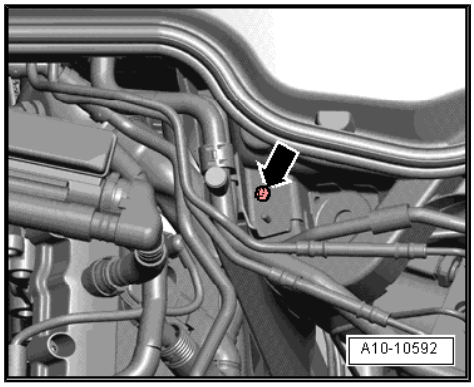
– Remove bolts for engine mountings -arrows- on both sides.



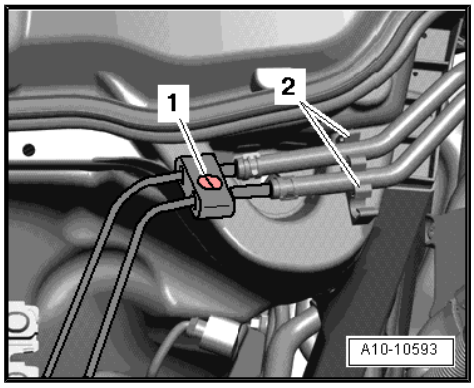
– Pull off rubber seal -1- and remove plenum chamber covers -2- and -3-.



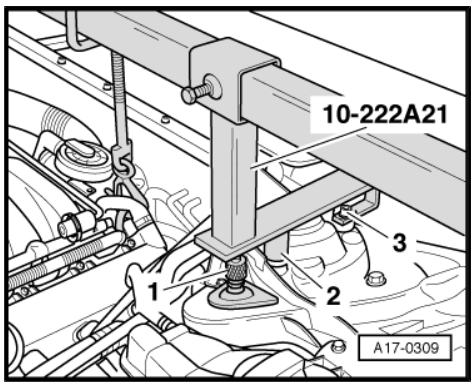
– Unbolt bracket (left-side) for refrigerant line from suspension turret -arrow-.



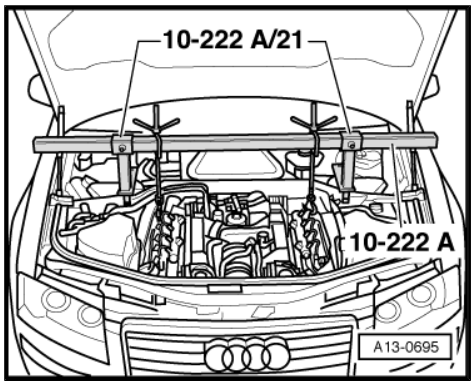
– Detach clip (right-side) -1-.
– Unclip fuel line and vacuum pump from retainer -2- on suspension turret.



– Unscrew rear securing bolts -3- for cross piece for suspension strut.
– Attach support bracket - 10 - 222 A- with adapters - 10 - 222 A /21- onto suspension turrets.
• Supports are marked for left and right side of vehicle.
• The centre bracing point -2- of the supports is positioned on front bolts for cross piece for suspension strut.
• The adapters - 10 - 222 A /21- are attached by means of the rear securing bolts -3- for the cross piece for suspension strut.
• The knurled screw -1- must be screwed down until support plate rests on suspension turret.

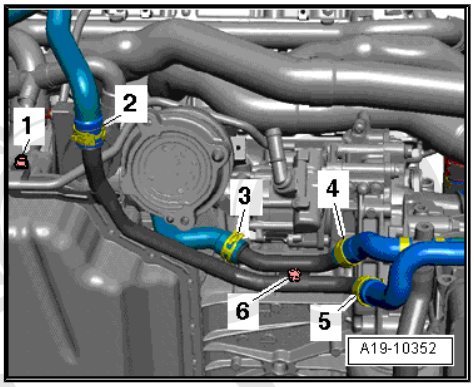


– Secure spindles of support bracket - 10 - 222 A- to rear engine lifting eyes.
– Take up weight of engine using spindles of support bracket.



– Remove nut -1- and bolt -6-.

– Detach coolant pipe (bottom left) from coolant hoses -2 ... 5-.



Installing

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

Note

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

– Fill cooling system ⇒ page 190 .

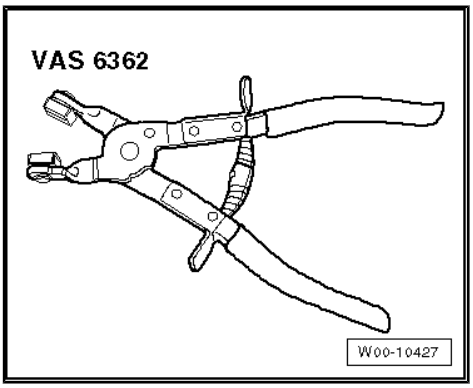
Tightening torques

- ⇒ “1.12 Coolant pipes - exploded view”, page 202
- ⇒ “5.1 Assembly mountings - exploded view”, page 45

1.17 Removing and installing coolant pipe (right-side)

Special tools and workshop equipment required

- Hose clip pliers - VAS 6362-

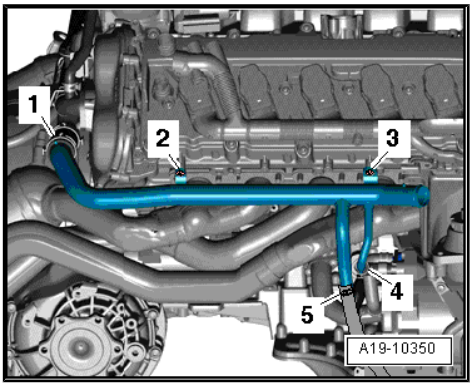


Removing

- Engine removed and in position on scissor-type assembly platform - VAS 6131 A- with gearbox attached.

– Remove bolts -2- and -3-.

– Loosen hose clips -1, 4, 5- and detach coolant pipe (right-side) from coolant hoses.



Installing

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

Note

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

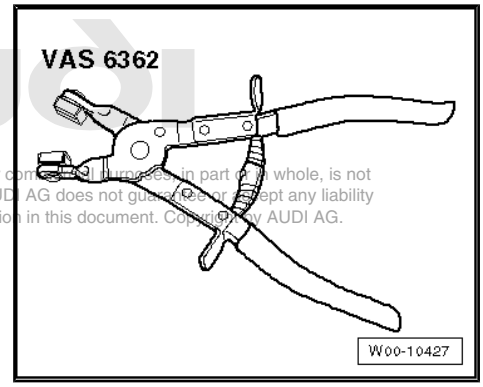
Tightening torques

- ⇒ “1.12 Coolant pipes - exploded view”, page 202

1.18 Removing and installing coolant pipe (rear)

Special tools and workshop equipment required

- Hose clip pliers - VAS 6362-



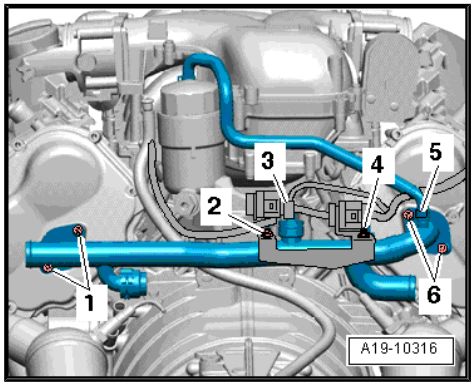
Removing

- Engine removed and in position on scissor-type assembly platform - VAS 6131 A- with gearbox attached.

Note

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

– Remove coolant pipe (left-side) ⇒ page 207 .
– Remove coolant pipe (right-side) ⇒ page 211 .
– Unscrew nuts -2- and -4- and detach bracket for electrical connectors on coolant pipe (rear).
– Release engine wiring harness at coolant pipe (rear).
– Unplug electrical connector -3- at coolant temperature sender - G62- .
– Detach coolant hose -5- from coolant pipe (rear).
– Remove bolts -1- and -6- and detach coolant pipe (rear).



Installing

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

Note

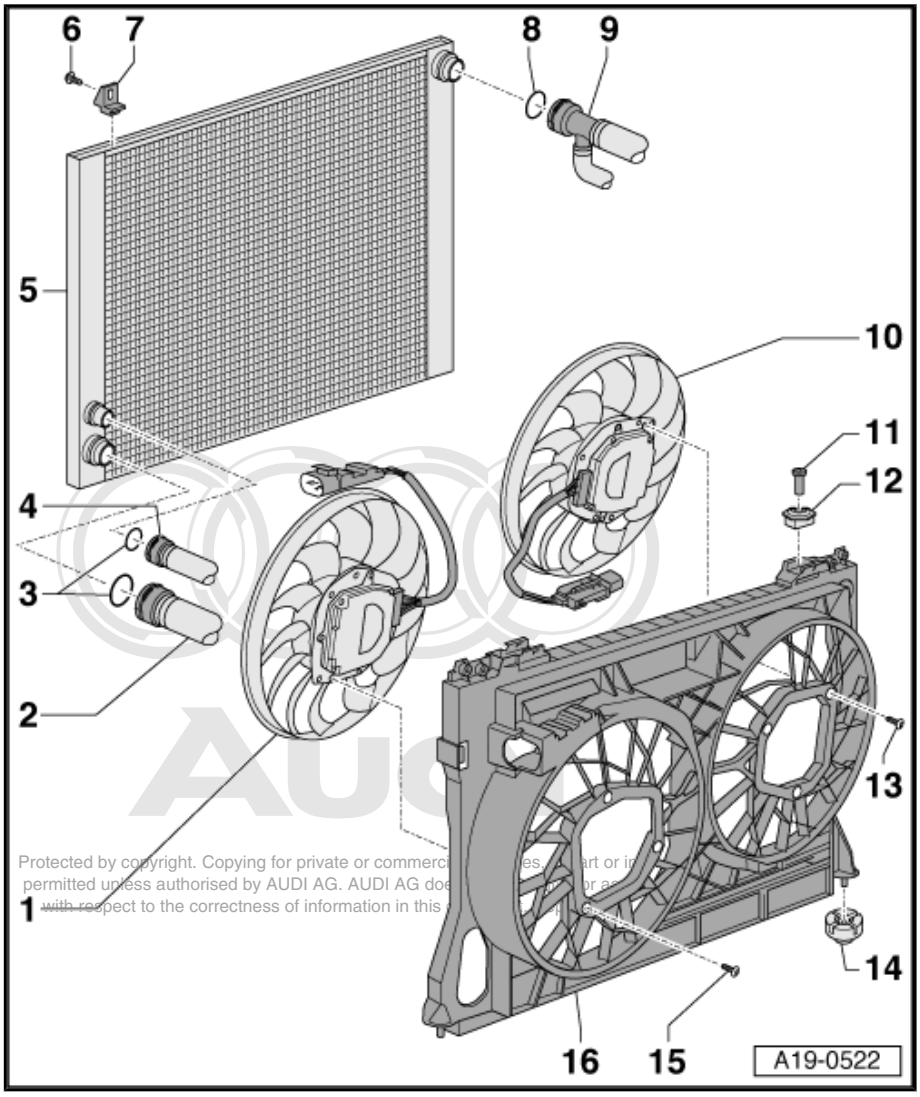
- *Renew O-rings.*
- *Fit all cable ties in the original positions when installing.*

– Clean and smoothen sealing surfaces for O-rings as required.
– Install coolant pipe (left-side) ⇒ page 207 .
– Install coolant pipe (right-side) ⇒ page 211 .

Tightening torques

- ⇒ “1.12 Coolant pipes - exploded view”, page 202

1.19 Radiator and radiator fans - exploded view



1 - Radiator fan - V7-

- ❑ With radiator fan control unit - J293-
- ❑ Removing and installing ⇒ page 221

2 - Coolant hose

- ❑ To detach, release retaining clip
- ❑ Connecting to radiator ⇒ page 214

3 - O-ring

- ❑ Renew

4 - Coolant hose

- ❑ To detach, release retaining clip
- ❑ Connecting to radiator ⇒ page 214

5 - Radiator

- ❑ Removing and installing ⇒ page 214
- ❑ If renewed, change coolant in entire system

6 - 6 Nm

7 - Mounting for radiator

8 - O-ring

- ❑ Renew

9 - Coolant hose

- ❑ To detach, release retaining clip
- ❑ Connecting to radiator ⇒ page 214

10 - Radiator fan 2 - V177-

- ❑ With radiator fan control unit 2 - J671-
- ❑ Removing and installing ⇒ page 221

11 - Retaining pin

12 - Rubber buffer

- ❑ Use screwdriver to release and pull off

13 - 10 Nm

14 - Rubber bush

15 - 10 Nm

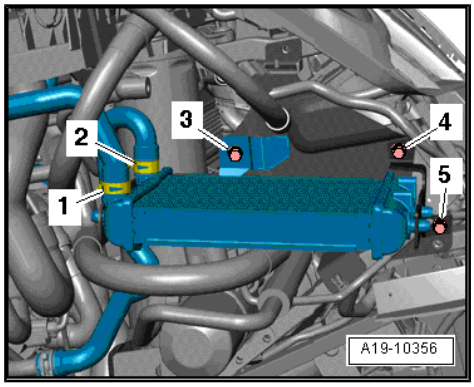
- ❑ Renew

16 - Radiator cowl

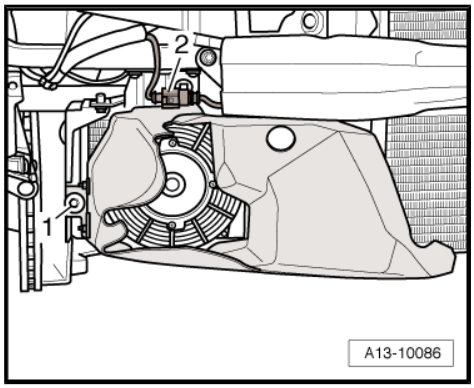
- ❑ Removing and installing ⇒ page 220

Auxiliary radiator - tightening torques

– Tighten bolts -3, 4, 5- to 9 Nm.

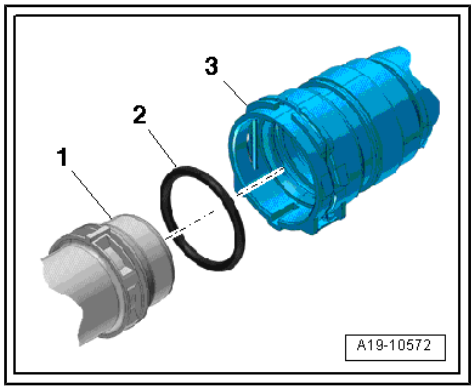


Air duct for auxiliary radiator - tightening torque



Connecting coolant hose with plug-in connector

– Remove old O-ring -2- from coolant hose -3-.
– Lubricate new O-ring with coolant additive and fit O-ring in coolant hose.
– Press coolant hose onto connection -1- until it engages audibly.
– Press coolant hose in again and then pull to check that plug-in connector is correctly engaged.



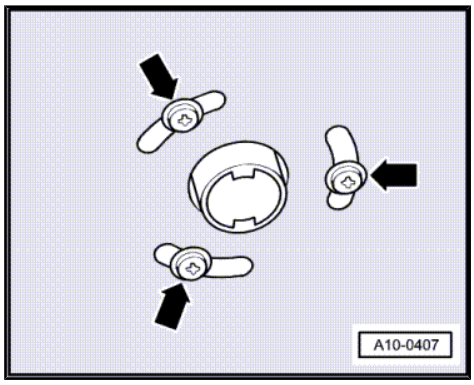
1.20 Removing and installing radiator

Removing

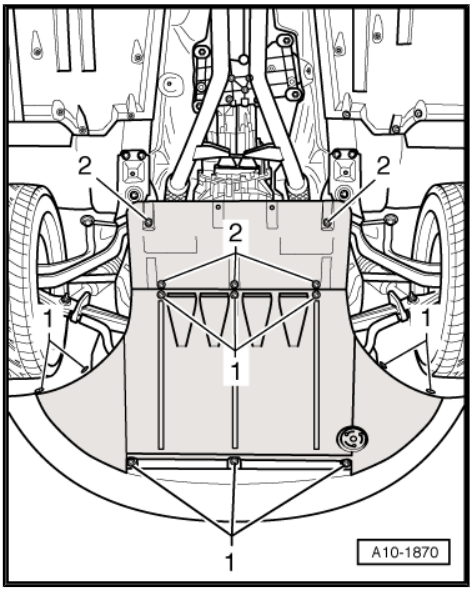
Note

If there are slight impressions on the fins, refer to ⇒ page 6 .

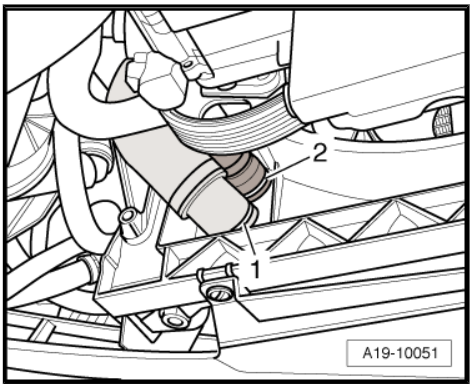
– Vehicles with auxiliary heater: remove bolts -arrows- securing exhaust pipe for auxiliary/additional heater to noise insulation.



– Open quick-release fasteners -1- and remove noise insulation (front).
– Remove bumper cover (front) ⇒ Rep. gr. 63 .
– Drain off coolant ⇒ page 187 .
– Remove coolant pipe (bottom front) ⇒ page 204 .



– Detach coolant hoses -1- and -2- from radiator.



– Detach electrical connector -1- for air mass meter - G70- .
– Detach vacuum hoses -2- and -3- from air intake hose.

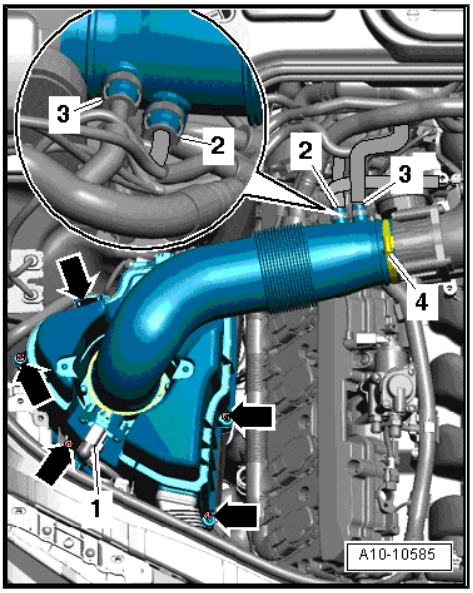
USA models:

– Detach vacuum line -2- from air hose.

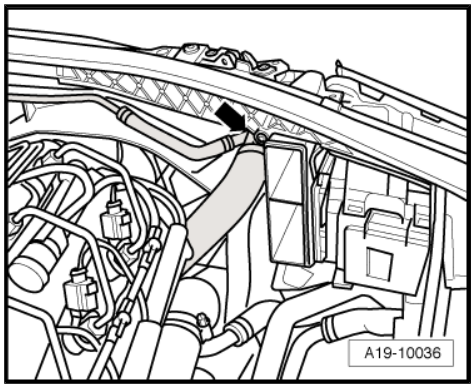
> **Caution**
>
> *Do not open vacuum hose -3- on USA models.*

All vehicles:

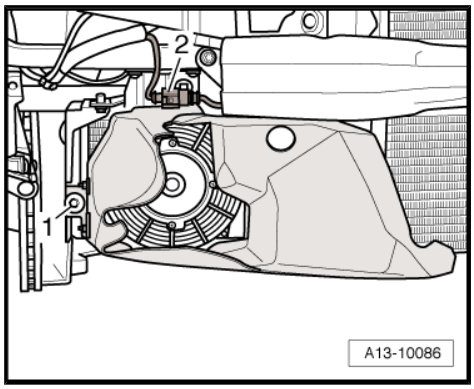
– Remove air hose -4- from intake manifold.
– Unscrew bolts -arrows- and remove top section of air cleaner (right-side).



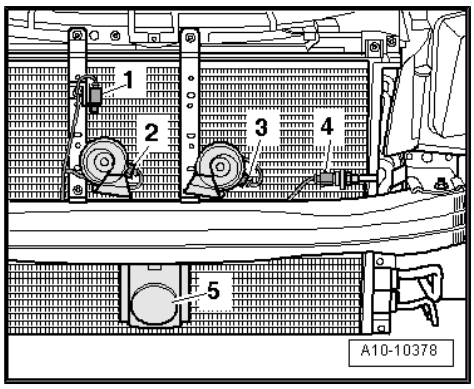
– Disconnect coolant hose (top) -arrow- from radiator.



– Unplug electrical connector -2- and move wiring clear.
– Unscrew bolt -1- and detach air duct for auxiliary radiator with auxiliary radiator fan.



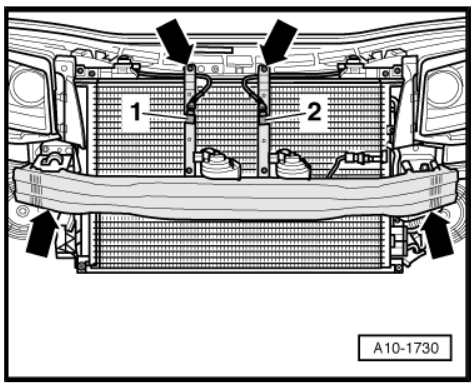
– Detach ambient temperature sensor - G17- -item 4-.
– Unplug electrical connectors -1, 2, 3-.
– Move electrical wiring harness clear.



Note

Disregard -item 5-.

– Unscrew bolts -arrows- and remove bumper together with struts.
– Detach electrical connector from adaptive cruise control unit - J428- (if fitted).



Note

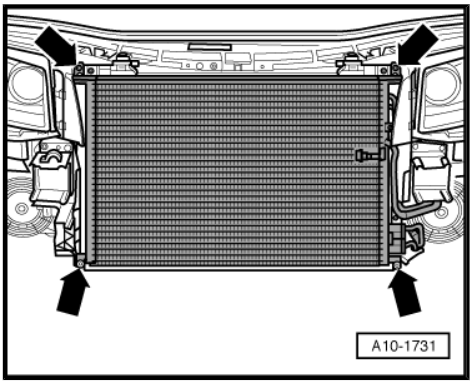
Disregard items -1- and -2-.

WARNING

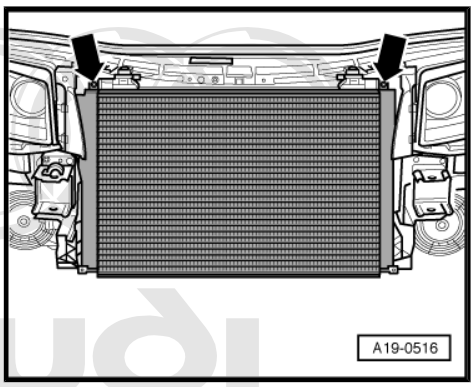
The air conditioner refrigerant circuit must not be opened.

Note

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



– Remove bolts -arrows-.
– Pivot condenser downwards together with cooler for power steering.
– Tie up condenser on engine.



– Remove the two brackets for radiator -arrows-.
– Tilt top of radiator forwards slightly and lift out of lock carrier.

Installing

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

– Connect coolant hoses to radiator ⇒ page 214 .
– Install condenser ⇒ Rep. gr. 87 .
– Install bumper and bumper cover (front) ⇒ Rep. gr. 63 .
– Fill cooling system ⇒ page 190 .

Note

The coolant in the entire system must be changed if the radiator is renewed

Tightening torques

- ⇒ “1.19 Radiator and radiator fans - exploded view”, page 212
- ⇒ Fig. ““Air duct for auxiliary radiator - tightening torque”“ , page 214

1.21 Removing and installing auxiliary radiator (left-side)

Removing

Note

If there are slight impressions on the fins, refer to ⇒ page 6 .

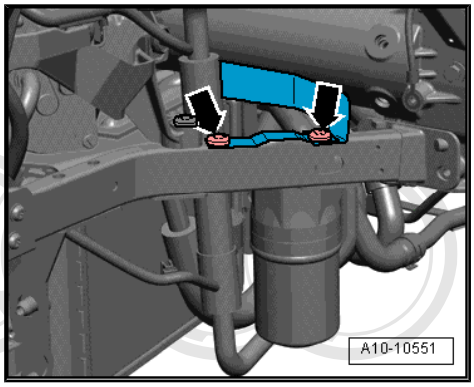
– Drain off coolant ⇒ page 187 .
– Remove front section of front left wheel housing liner ⇒ Rep. gr. 66 .

Note

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

WARNING

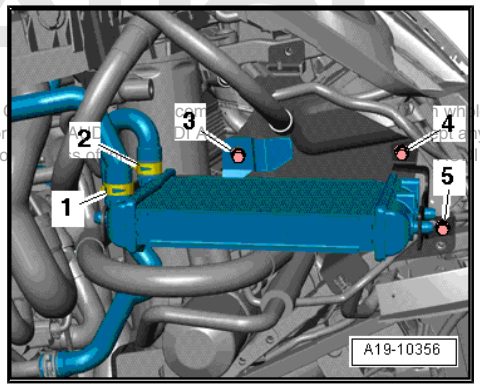
The air conditioner refrigerant circuit must not be opened.



– Unbolt reservoir for air conditioning system from carrier -arrows- (reservoir remains suspended).

– Remove coolant hoses -1- and -2-.

– Remove bolts -3, 4, 5-, detach auxiliary radiator from bracket and remove.



Installing

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

Note

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

– Install reservoir for air conditioning system ⇒ Rep. gr. 87 .

– Install front section of front left wheel housing liner ⇒ Rep. gr. 66 .

– Fill cooling system ⇒ page 190 .

Note

The coolant in the entire system must be changed if the radiator is renewed

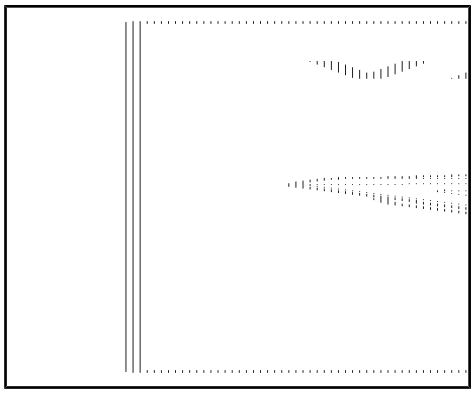
Tightening torques

♦ ⇒ Fig. ""Auxiliary radiator - tightening torques"" , page 214

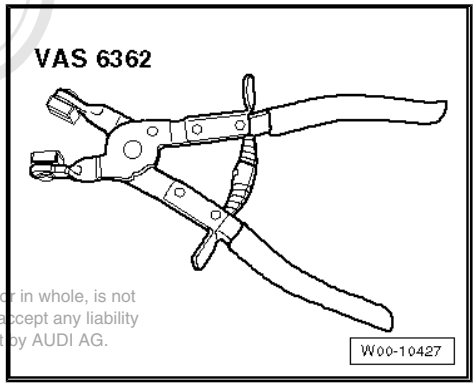
1.22 Removing and installing auxiliary radiator (right-side)

Special tools and workshop equipment required

♦ Drip tray for workshop hoist - VAS 6208-



♦ Hose clip pliers - VAS 6362-



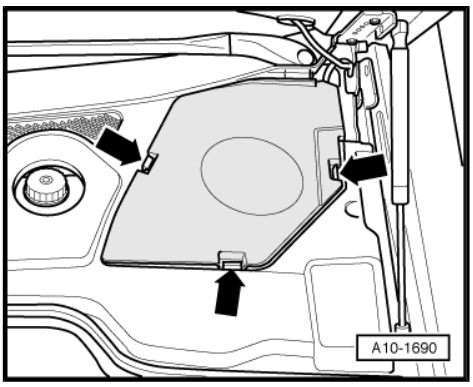
Removing

Note

If there are slight impressions on the fins, refer to ⇒ page 6 .

– Remove bumper cover (front) ⇒ Rep. gr. 63 .

– Remove cover above coolant expansion tank -arrows-.



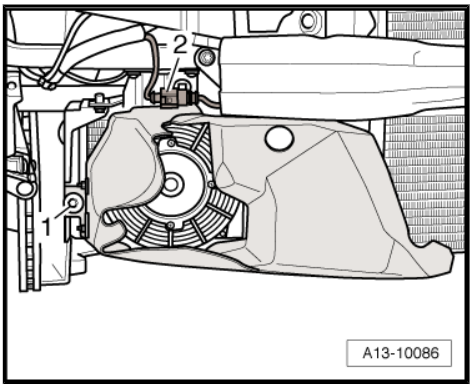
WARNING

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

– Open filler cap on coolant expansion tank.

– Unplug electrical connector -2- and move wiring clear.

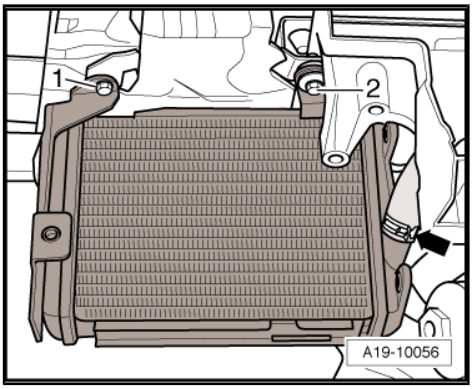
– Unscrew bolt -1- and detach air duct for auxiliary radiator with auxiliary radiator fan.



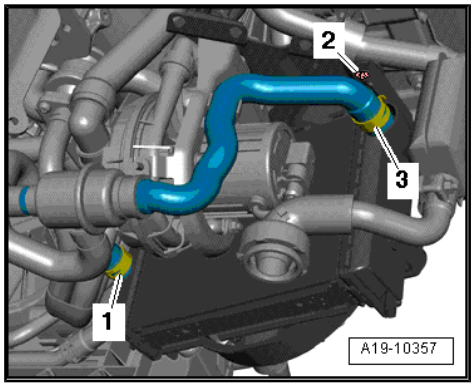
– Place drip tray for workshop hoist - VAS 6208- under engine.

– Disconnect coolant hose (front) from auxiliary radiator -arrow- and drain off coolant.

– Remove bolts -1- and -2-.



– Detach coolant hoses -1- and -3-.
– Unscrew bolt -2- and remove auxiliary radiator.



Installing

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

Note

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

– Install bumper cover (front) ⇒ Rep. gr. 63 .
– Fill cooling system ⇒ page 190 .

Note

The coolant in the entire system must be changed if the radiator is renewed

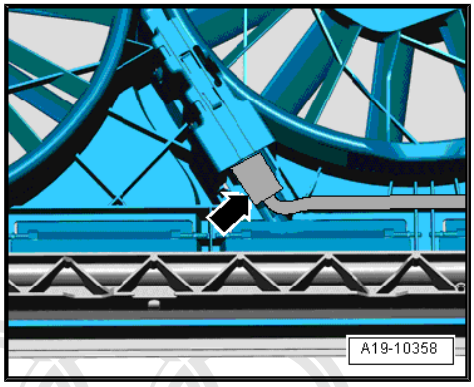
Tightening torques

- ⇒ Fig. ""Auxiliary radiator - tightening torques"" , page 214
- ⇒ Fig. ""Air duct for auxiliary radiator - tightening torque"" , page 214

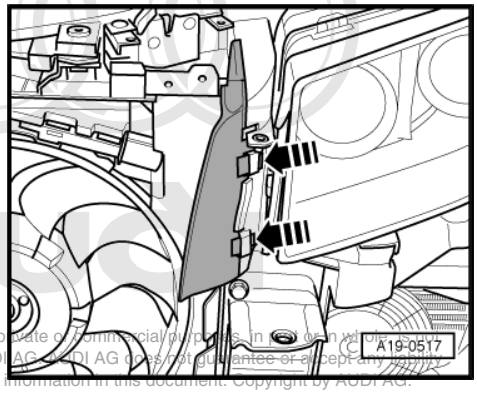
1.23 Removing and installing radiator cowl

Removing

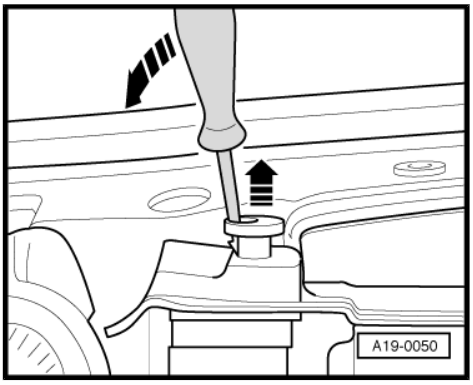
– Drain off coolant ⇒ page 187 .
– Remove radiator ⇒ page 214 .
– Unplug electrical connector -arrow- going to radiator fan.



– 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.

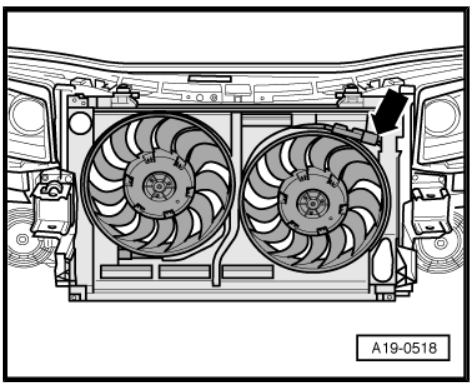


– Reach behind radiator cowl and unplug electrical connector -arrow- for radiator fans.
– Remove radiator cowl.

Installing

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

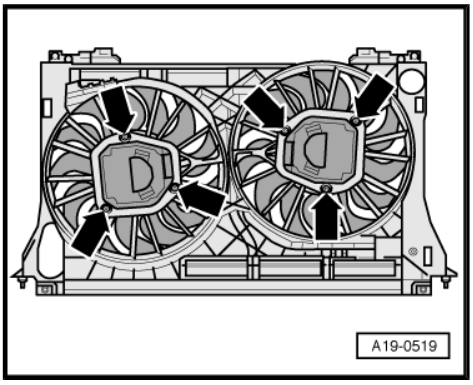
– Install radiator ⇒ page 214 .
– Fill cooling system ⇒ page 190 .



1.24 Removing and installing radiator fans

Removing

– Drain off coolant ⇒ page 187 .
– Remove radiator ⇒ page 214 .
– Remove radiator cowl ⇒ page 220 .
– Remove bolts -arrows-.
– Unclip electrical connectors and lay wiring aside.
– Remove radiator fans.



Installing

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

– Install radiator cowl ⇒ page 220 .
– Install radiator ⇒ page 214 .
– Fill cooling system ⇒ page 190 .

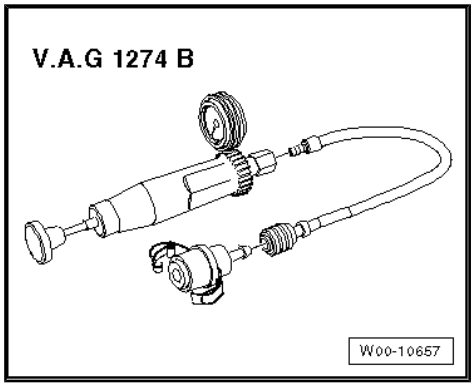
Tightening torques

◆ ⇒ “1.19 Radiator and radiator fans - exploded view”, page 212

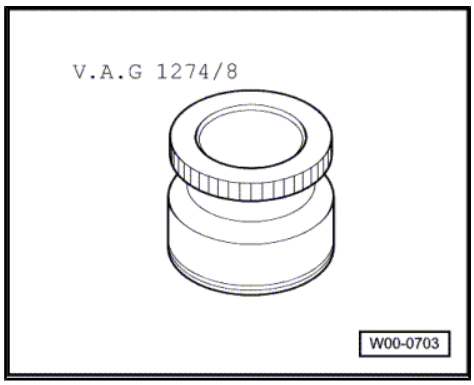
1.25 Checking cooling system for leaks

Special tools and workshop equipment required

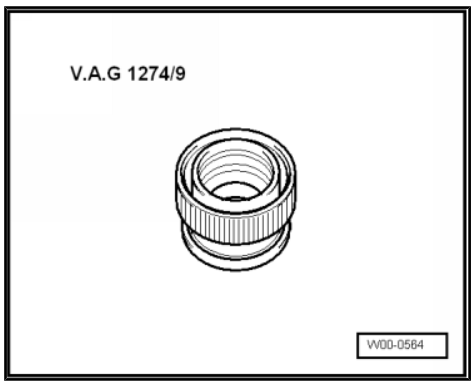
♦ Cooling system tester - V.A.G 1274 B-



♦ Adapter for cooling system tester - V.A.G 1274/8-



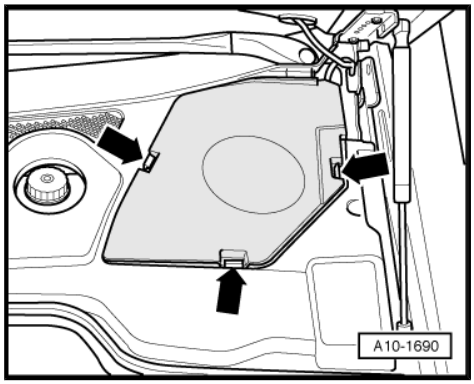
♦ Adapter for cooling system tester - V.A.G 1274/9-



Procedure

- Engine must be warm.

– Remove cover above coolant expansion tank -arrows-.



WARNING

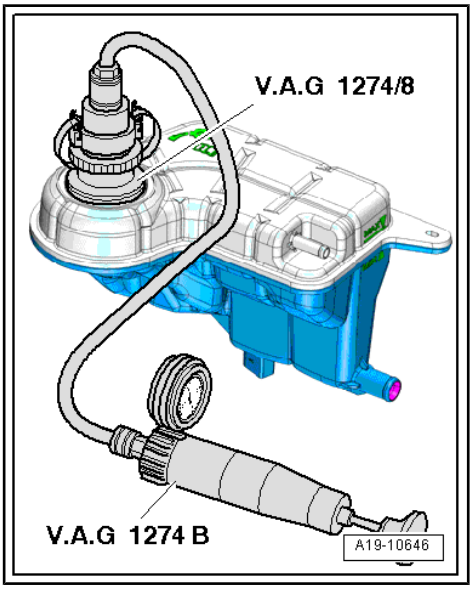
Hot steam or hot coolant can escape when coolant expansion tank is opened; cover filler cap with cloth and open carefully.

– Open filler cap on coolant expansion tank.

– Attach cooling system tester - V.A.G 1274 B- 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.

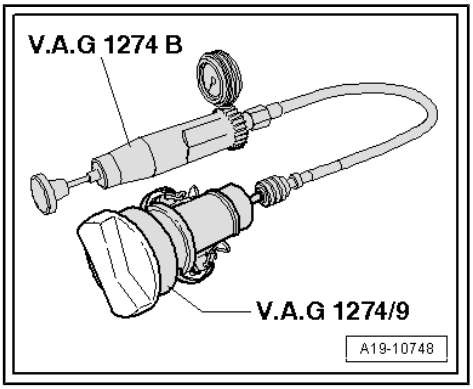


Checking pressure relief valve in filler cap

– Attach cooling system tester - V.A.G 1274 B- with adapter - V.A.G 1274/9- to filler cap.
– Use hand pump on cooling system tester to create pressure.
• The pressure relief valve should open at a pressure of 1.4 ... 1.6 bar.

If the pressure relief valve does not open as described:

– Renew filler cap.



26 – Exhaust system

1 Exhaust system

Note

After working on the exhaust system, ensure that the system is not under stress and that it has sufficient clearance from the body. If necessary, loosen clamps and align silencers and exhaust pipes so that sufficient clearance is maintained to the body at all points and the mountings are evenly loaded.

1.1 Exhaust system - exploded view

Exhaust system (front)

Note

The illustration shows the exhaust system (front) for cylinder bank 1 (right-side).

1 - Nut
- ❑ Renew
- ❑ Tightening torque and sequence: left-side ⇒ page 225 , right-side ⇒ page 226

2 - Gasket
- ❑ Renew

3 - 23 Nm
- ❑ Renew

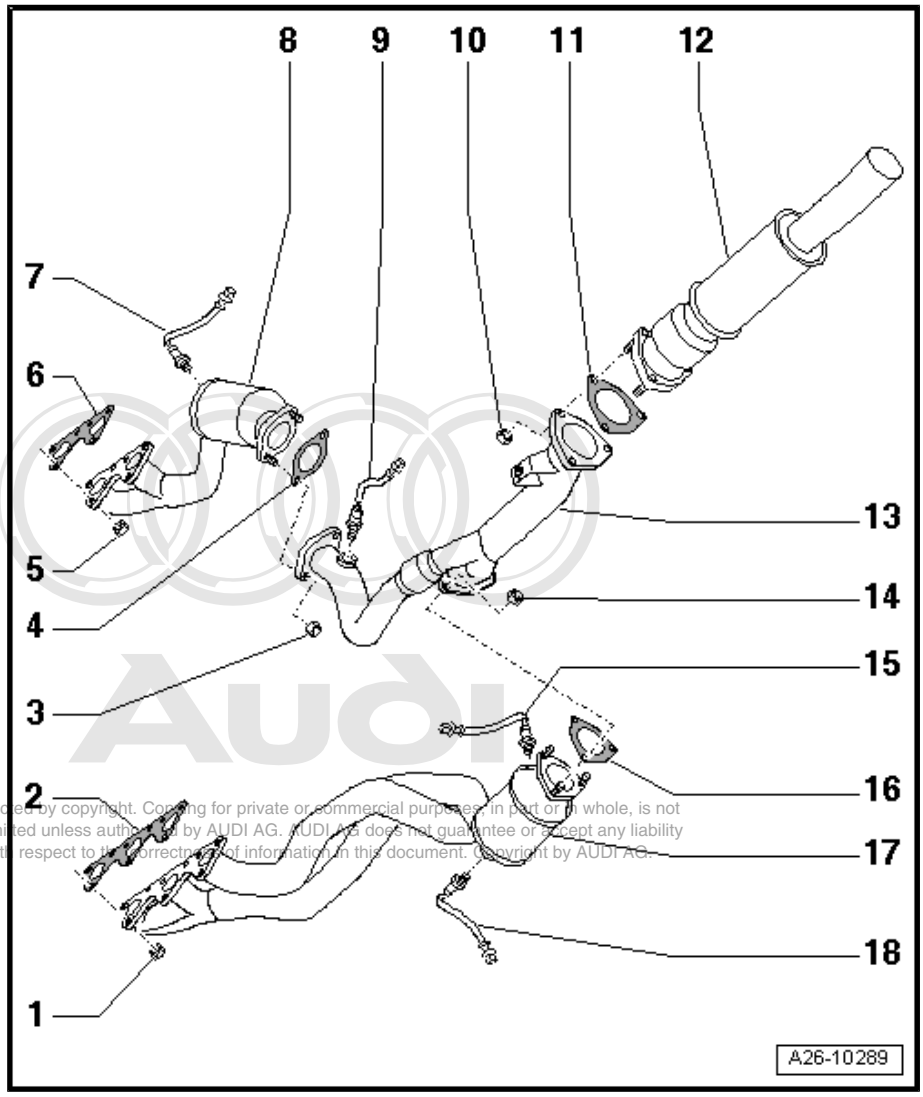
4 - Gasket
- ❑ Renew

5 - Nut
- ❑ Renew
- ❑ Tightening torque and sequence: left-side ⇒ page 226 , right-side ⇒ page 226

6 - Gasket
- ❑ Renew

7 - Lambda probe 2 - G108- (before catalytic converter)
- ❑ For exhaust bank II (cylinders 4, 5)
- ❑ Removing and installing ⇒ Rep. gr. 24

8 - Exhaust manifold (rear) with catalytic converter
- ❑ For exhaust bank II (cylinders 4, 5)
- ❑ Protect against knocks and impact



- ❑ Removing and installing: left-side ⇒ page 230 , right-side ⇒ page 233

9 - Lambda probe after catalytic converter - G131-

- ❑ For exhaust bank II (cylinders 4, 5)
- ❑ Removing and installing ⇒ Rep. gr. 24

10 - 23 Nm

- ❑ Renew

11 - Gasket

- ❑ Renew

12 - Front silencer

- ❑ With flexible joint
- ❑ Do not bend flexible joint more than 10° – otherwise it can be damaged
- ❑ Removing and installing: left-side ⇒ page 239 , right-side ⇒ page 239
- ❑ Align exhaust system so it is free of stress ⇒ page 240

13 - Y-pipe

- ❑ With flexible joint
- ❑ Do not bend flexible joint more than 10° – otherwise it can be damaged
- ❑ Removing and installing: left-side ⇒ page 236 , right-side ⇒ page 238
- ❑ Align exhaust system so it is free of stress ⇒ page 240

14 - 23 Nm

- ❑ Renew

15 - Lambda probe after catalytic converter - G130-

- ❑ For exhaust bank I (cylinders 1, 2, 3)
- ❑ Removing and installing ⇒ Rep. gr. 24

16 - Gasket

- ❑ Renew

17 - Exhaust manifold (front) with catalytic converter

- ❑ For exhaust bank I (cylinders 1, 2, 3)
- ❑ Protect against knocks and impact
- ❑ Removing and installing: left-side ⇒ page 230 , right-side ⇒ page 233

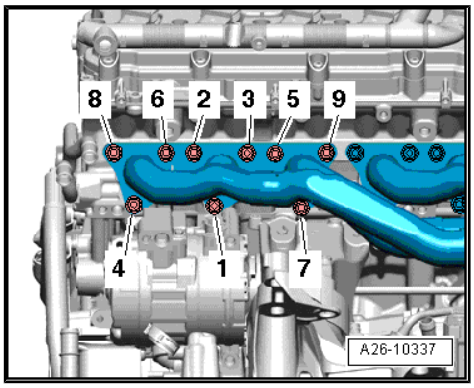
18 - Lambda probe - G39- (before catalytic converter)

- ❑ For exhaust bank I (cylinders 1, 2, 3)
- ❑ Removing and installing ⇒ Rep. gr. 24

Exhaust manifold (front left) - tightening torque and sequence

– Tighten nuts in 3 stages in the sequence shown:

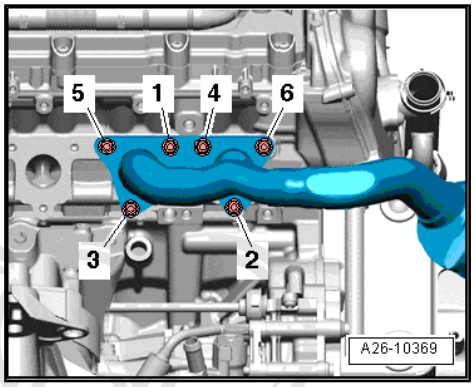
Stage	Nuts	Tightening torque
1.	-1 … 9-	Screw in by hand until nuts make contact with exhaust manifold
2.	-1 … 9-	10 Nm
3.	-1 … 9-	25 Nm



Exhaust manifold (rear left) - tightening torque and sequence

– Tighten nuts in 3 stages in the sequence shown:

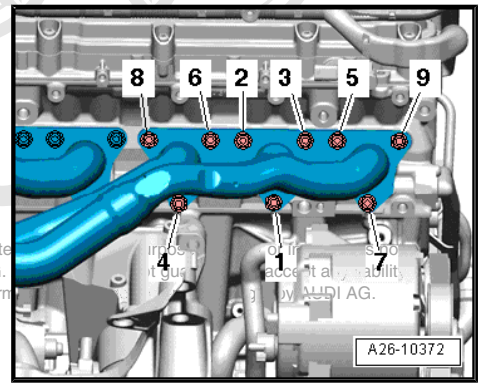
Stage	Nuts	Tightening torque
1.	-1 … 6-	Screw in by hand until nuts make contact with exhaust manifold
2.	-1 … 6-	10 Nm
3.	-1 … 6-	25 Nm



Exhaust manifold (front right) - tightening torque and sequence

– Tighten nuts in 3 stages in the sequence shown:

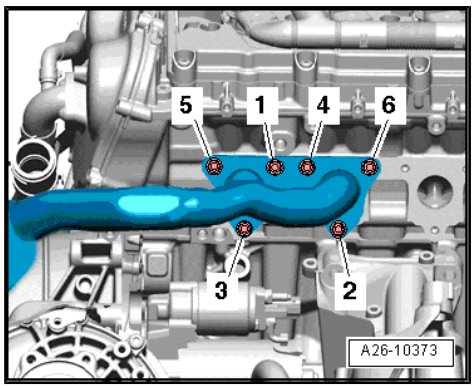
Stage	Nuts	Tightening torque
1.	-1 … 9-	Screw in by hand until nuts make contact with exhaust manifold
2.	-1 … 9-	10 Nm
3.	-1 … 9-	25 Nm



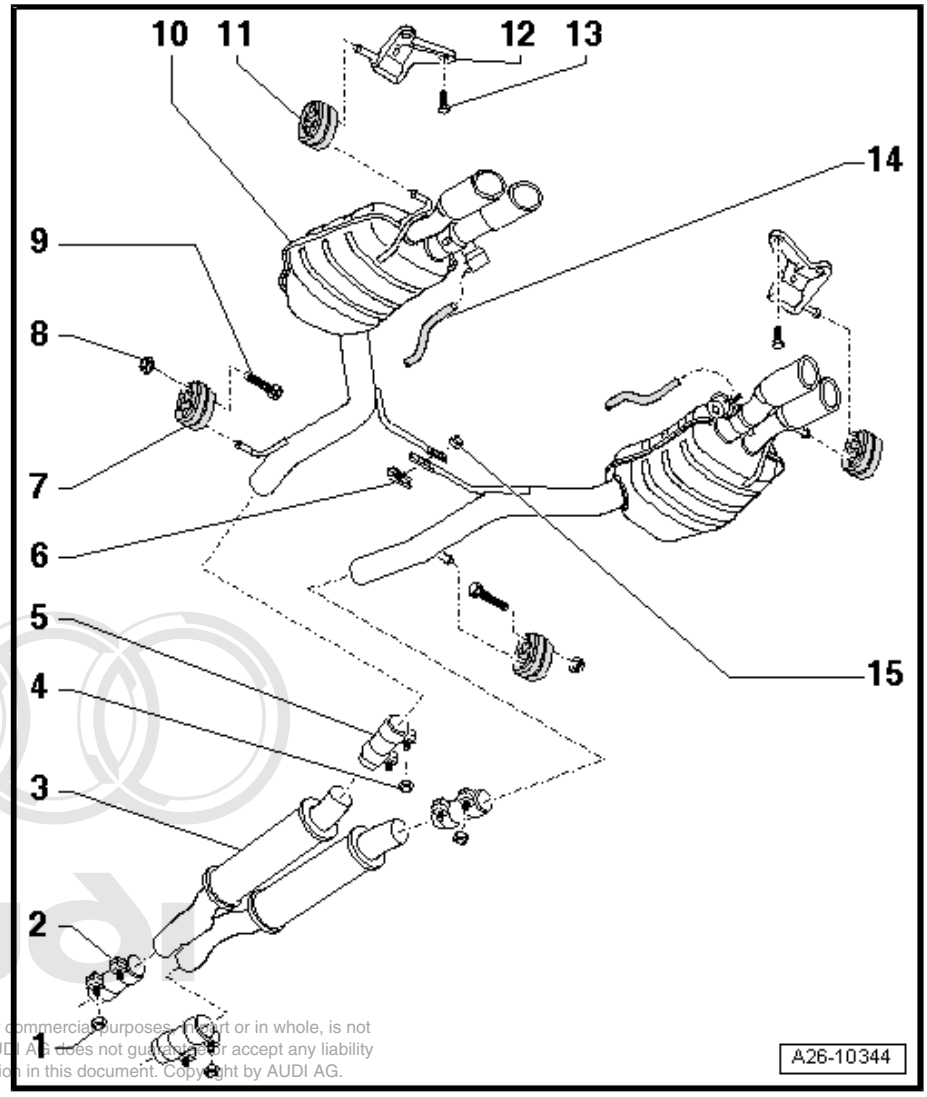
Exhaust manifold (rear right) - tightening torque and sequence

– Tighten nuts in 3 stages in the sequence shown:

Stage	Nuts	Tightening torque
1.	-1 … 6-	Screw in by hand until nuts make contact with exhaust manifold
2.	-1 … 6-	10 Nm
3.	-1 … 6-	25 Nm



Exhaust system (rear)



1 - 23 Nm

2 - Clamp (front)

- ❑ Installation position ⇒ page 228
- ❑ Before tightening, align exhaust system so it is free of stress ⇒ page 240
- ❑ Tighten bolt connections evenly

3 - Centre silencer

- ❑ Combined in one unit with rear silencer as original equipment. Can be renewed individually for repair purposes
- ❑ Cutting locations ⇒ page 229
- ❑ Align exhaust system so it is free of stress ⇒ page 240

4 - 23 Nm

5 - Clamp (rear)

- ❑ For separate replacement of centre and rear silencers
- ❑ Installation position ⇒ page 229
- ❑ Before tightening, align exhaust system so it is free of stress ⇒ page 240
- ❑ Tighten bolt connections evenly

6 - Connecting bracket

7 - Rubber mounting

- ❑ Renew if damaged

8 - 23 Nm

9 - Bolt

10 - Rear silencer

- ❑ With exhaust flap
- ❑ Checking vacuum unit for exhaust flap ⇒ page 246
- ❑ Combined in one unit with centre silencer as original equipment. Can be renewed individually for repair purposes
- ❑ Cutting locations ⇒ page 229
- ❑ Align exhaust system so it is free of stress ⇒ page 240

11 - Rubber mounting

- ❑ Renew if damaged

12 - Mounting

- ❑ Renew if damaged

13 - 22 Nm

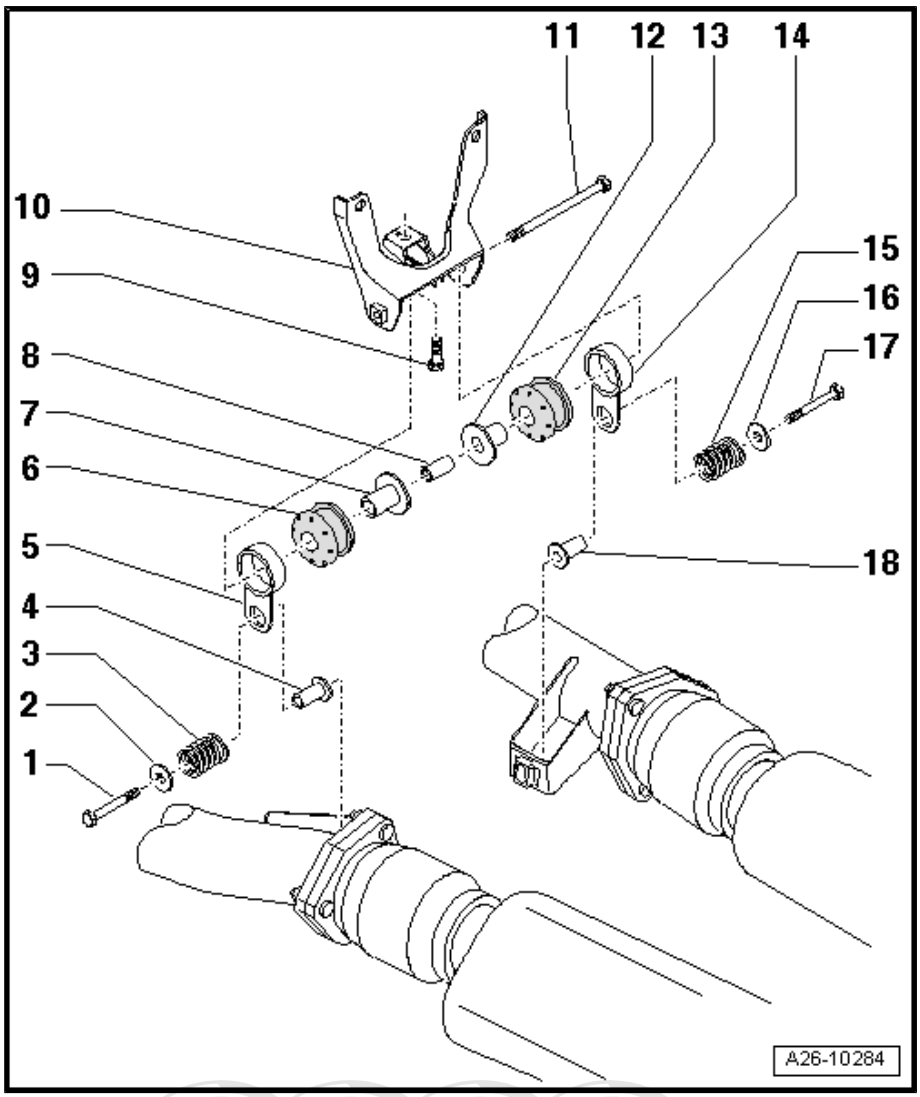
14 - Vacuum hose for exhaust flap

- ❑ From exhaust flap valve

15 - 23 Nm
- ❑ Renew

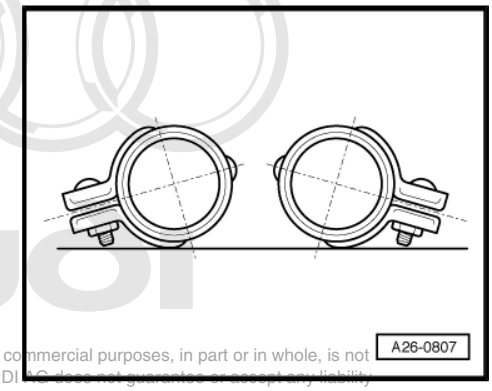
Mounting components

1 - 23 Nm
2 - Washer
3 - Compression spring
4 - Spacer sleeve
5 - Bracket
6 - Buffer
7 - Spacer sleeve
8 - Sleeve
9 - 23 Nm
10 - Bracket
11 - 23 Nm
12 - Spacer sleeve
13 - Buffer
14 - Bracket
15 - Compression spring
16 - Washer
17 - 23 Nm
18 - Spacer sleeve



Installation position of front clamps

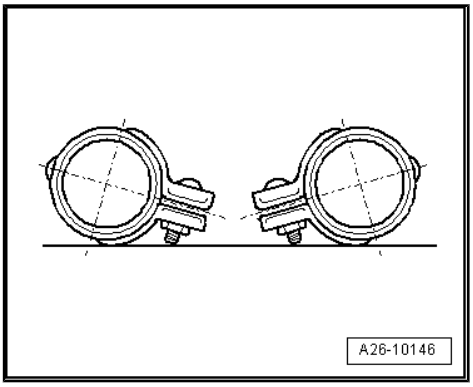
– Fit clamps so that ends of bolts do not protrude beyond bottom of clamp.
• Bolt connections face outwards.



Installation position of rear clamps

– Fit clamps so that ends of bolts do not protrude beyond bottom of clamp.

• Bolt connections face one another.



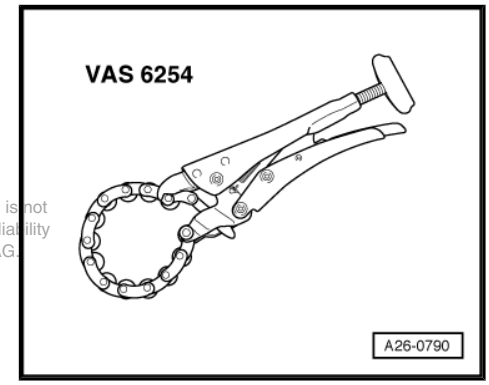
1.2 Separating centre and rear silencers

♦ The connecting pipe can be cut through at the cutting point in order to renew the centre and rear silencers separately.

♦ The cutting point is marked by an indentation on the circumference of the exhaust pipe.

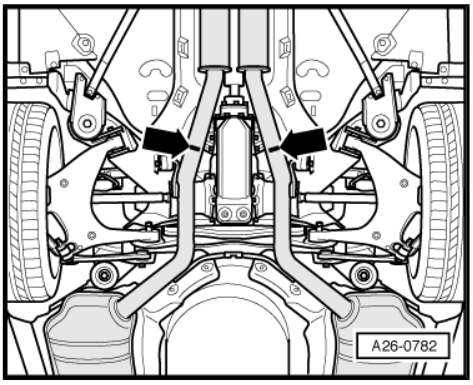
Special tools and workshop equipment required

♦ Chain pipe cutter - VAS 6254-

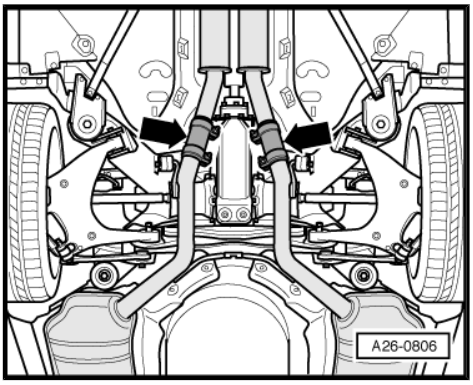


Procedure

– Cut through exhaust pipes at a right angle at cutting points -arrows- using chain pipe cutter - VAS 6254- .



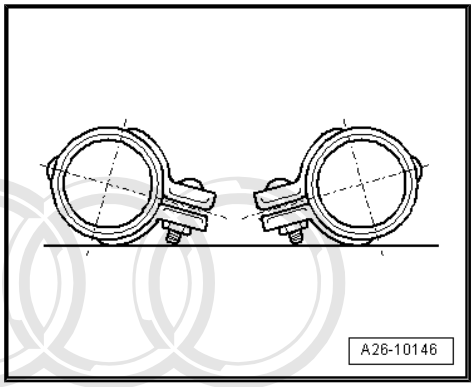
– Position clamps -arrows- centrally over cutting points.



– Fit clamps so that ends of bolts do not protrude beyond bottom of clamp.

• Bolt connections face one another.

– Align exhaust system so it is free of stress ⇒ page 240 .



1.3 Removing and installing exhaust pipes (left-side)

Removing

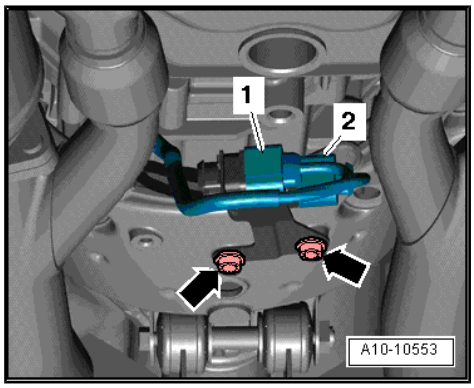
• Engine removed and in position on scissor-type assembly platform - VAS 6131 A- with gearbox attached.

Note

♦ *Fit all heat shields and heat insulation sleeves in the original positions when installing.*

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

– Take electrical connector -1- for Lambda probe 3 after catalytic converter - G287- out of bracket and unplug it.

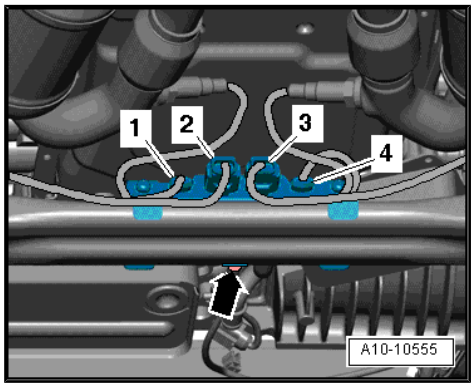


Note

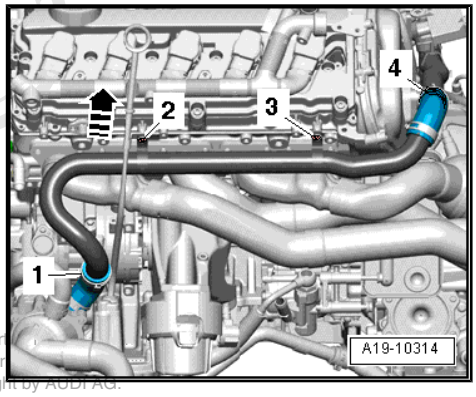
Ignore items marked -2- and -arrows-.

– Remove bracket for electrical connectors -1 ... 4- for Lambda probes from subframe -arrow-.

– Take electrical connectors -1- for Lambda probe 4 after catalytic converter - G288- and -2- for Lambda probe 3 - G285- (before catalytic converter) out of bracket on gearbox and unplug.



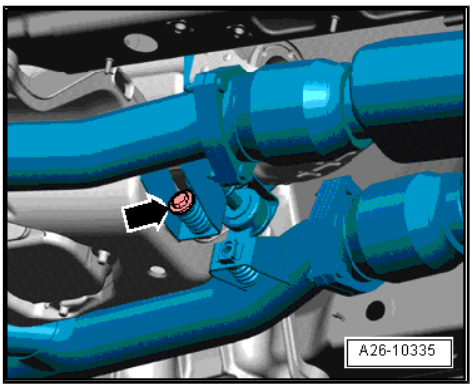
– Remove bolts -2- and -3-.
– Pull the guide tube for oil dipstick out upwards -arrow-.



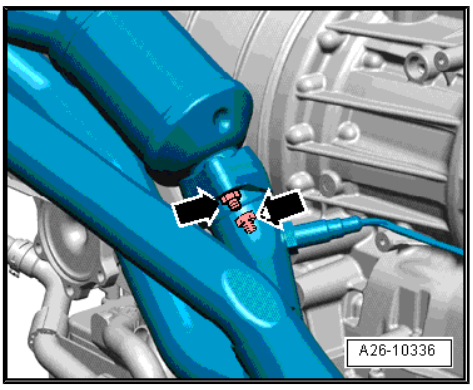
Note

Disregard items -1- and -4-.

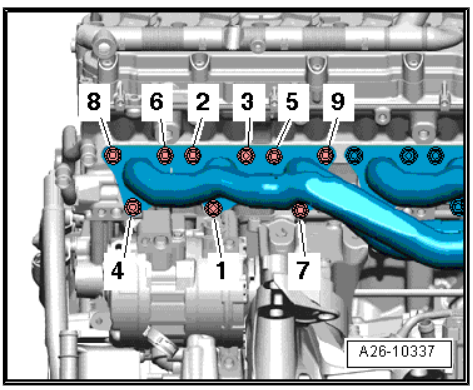
– Unscrew bolt -arrow- at bracket for exhaust pipes (left-side).



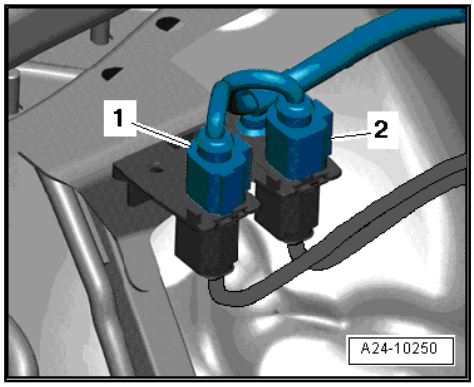
– Unscrew nuts -arrows-.



– Unscrew nuts in the sequence -9 ... 1- and remove front left exhaust manifold with catalytic converter.



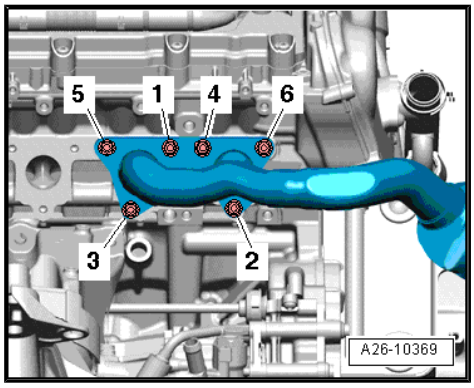
– Unplug electrical connector -1- for Lambda probe 4 - G286- and move Lambda probe wiring clear.



Note

Disregard -item 2-.

– Unscrew nuts in the sequence -6 ... 1- and remove rear left exhaust manifold with catalytic converter.



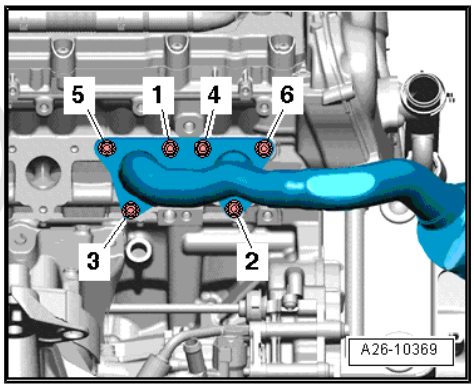
Installing

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

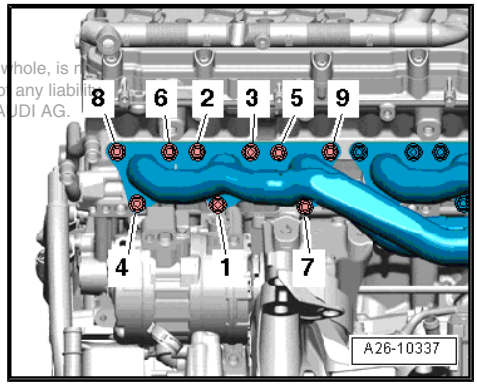
Note

- *Renew seals, self-locking nuts and O-rings.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- *Fit all heat shields and heat insulation sleeves in the original positions when installing.*
- *Fit all cable ties in the original positions when installing.*

– Fit exhaust manifold (rear left) with catalytic converter to cylinder head and tighten nuts ⇒ page 226 .



– Fit exhaust manifold (front left) with catalytic converter to cylinder head and tighten nuts ⇒ page 225 .
– Install coolant pipe (left-side) ⇒ page 202 .
– Align exhaust system free of stress after installing engine ⇒ page 240 .



Tightening torques

- ⇒ “1.1 Exhaust system - exploded view”, page 224
- ⇒ Fig. ““Exhaust manifold (front left) - tightening torque and sequence”“ , page 225
- ⇒ Fig. ““Exhaust manifold (rear left) - tightening torque and sequence”“ , page 226

1.4 Removing and installing exhaust pipes (right-side)

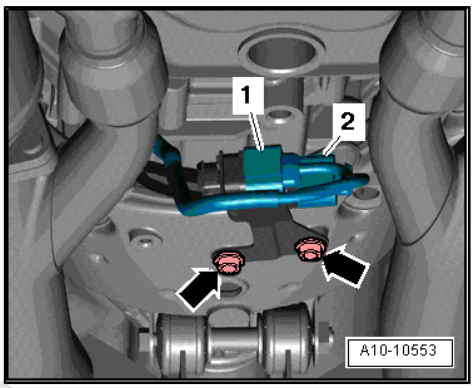
Removing

- Engine removed and in position on scissor-type assembly platform - VAS 6131 A- with gearbox attached.

Note

- ♦ *Fit all heat shields and heat insulation sleeves in the original positions when installing.*
- ♦ *All cable ties which are released or cut open when removing must be fitted in the same position when installing.*

– Take electrical connector -2- for Lambda probe 3 after catalytic converter - G130- out of bracket and unplug it.

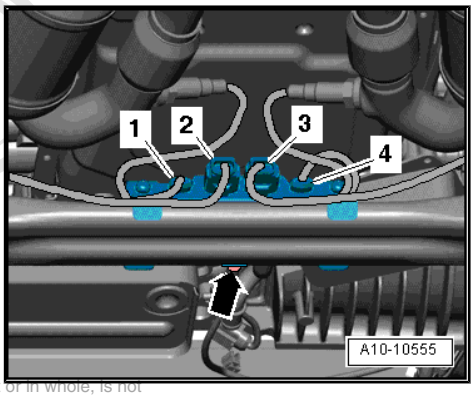


Note

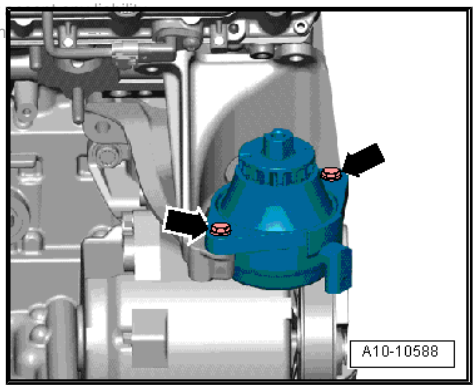
Ignore items marked -1- and -arrows-.

– Remove bracket for electrical connectors -1 ... 4- for Lambda probes from subframe -arrow-.

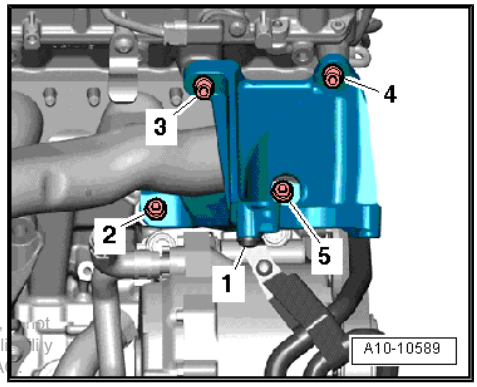
– Take electrical connectors -3- for Lambda probe - G39- and -4- for Lambda probe 2 after catalytic converter - G131- out of bracket on gearbox and unplug.



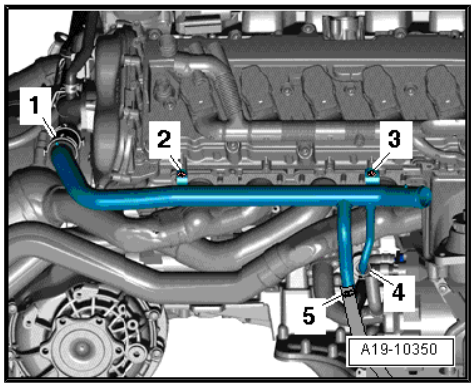
– Unscrew bolts -arrows- and remove mounting for torque reaction support.



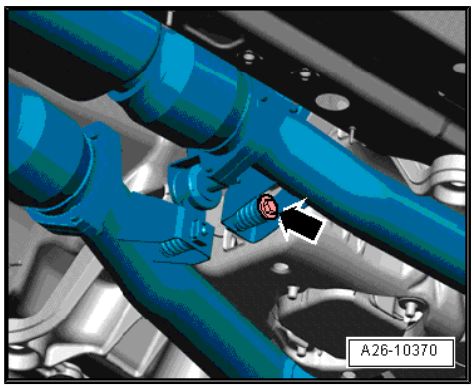
– Unscrew bolts -1 … 5- and remove bracket for torque reaction support.



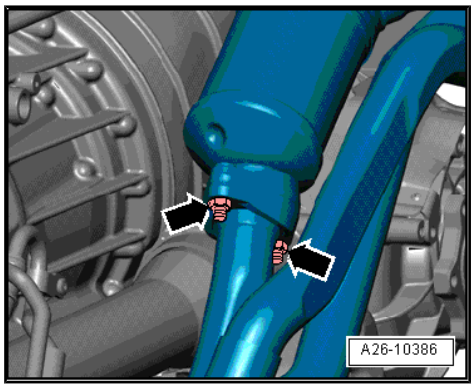
– Remove bolts -2- and -3-.
– Loosen hose clips -1, 4, 5- and detach coolant pipe (right-side) from coolant hoses.



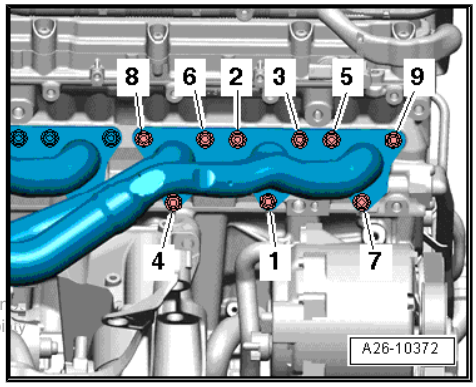
– Unscrew bolt -arrow- at bracket for exhaust pipes (right-side).



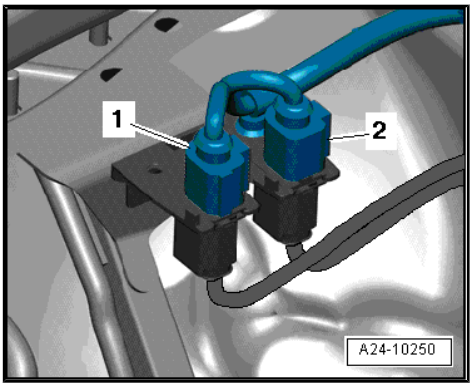
– Unscrew nuts -arrows-.



– Unscrew nuts in the sequence -9 ... 1- and remove front right exhaust manifold with catalytic converter.



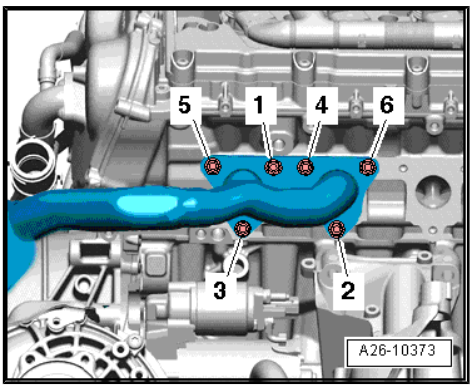
– Unplug electrical connector -2- for Lambda probe 2 - G108- and move Lambda probe wiring clear.



Note

Disregard -item 1-.

– Unscrew nuts in the sequence -6 ... 1- and remove rear right exhaust manifold with catalytic converter.



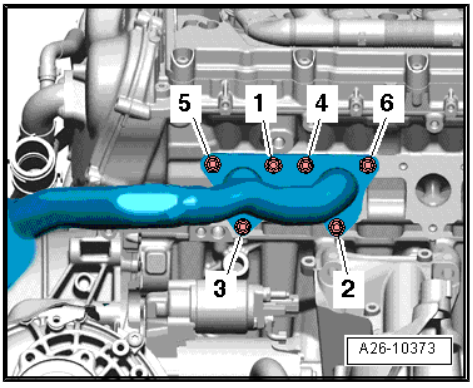
Installing

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

Note

- *Renew gaskets and self-locking nuts.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- *Fit all heat shields and heat insulation sleeves in the original positions when installing.*
- *Fit all cable ties in the original positions when installing.*

– Fit exhaust manifold (rear right) with catalytic converter to cylinder head and tighten nuts ⇒ page 226 .



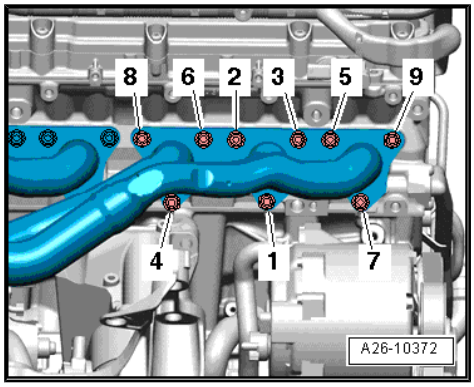
– Fit exhaust manifold (front right) with catalytic converter to cylinder head and tighten nuts ⇒ page 226 .

– Install coolant pipe (right-side) ⇒ page 202 .

– Align exhaust system free of stress after installing engine ⇒ page 240 .

Tightening torques

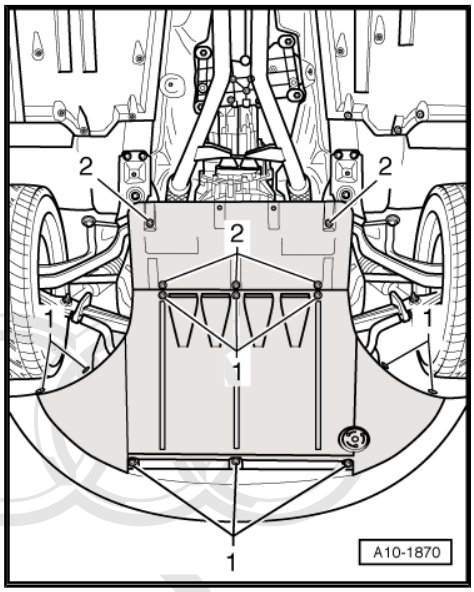
- ⇒ “1.1 Exhaust system - exploded view”, page 224
- ⇒ Fig. ““Exhaust manifold (front right) - tightening torque and sequence”“ , page 226
- ⇒ Fig. ““Exhaust manifold (rear right) - tightening torque and sequence”“ , page 226



1.5 Removing and installing Y-pipe (left-side)

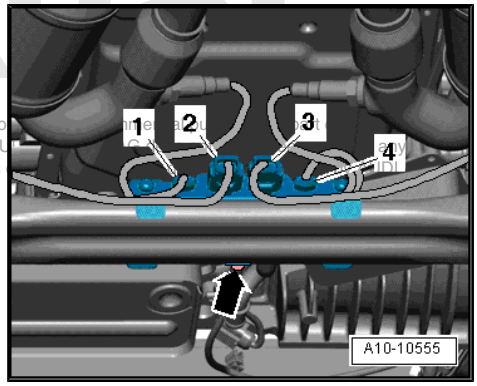
Removing

– Open quick-release fasteners -2- and remove rear noise insulation.

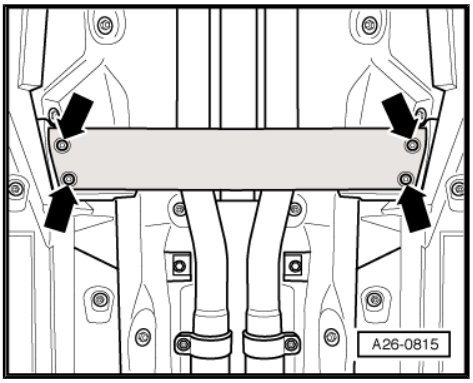


– Remove bracket for electrical connectors -1 ... 4- for Lambda probes from subframe -arrow-.

– Take electrical connector -1- for Lambda probe 4 after catalytic converter - G288- out of bracket on gearbox and unplug it.



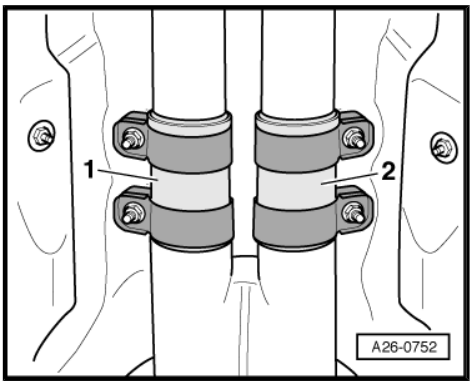
– Unbolt cross piece (front) -arrows-.



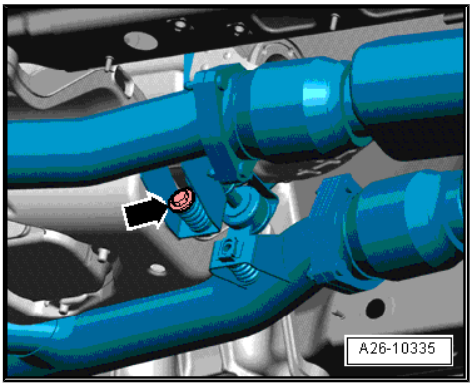
Note

The flexible joint in the front silencer must not be bent more than 10° - damage can otherwise occur.

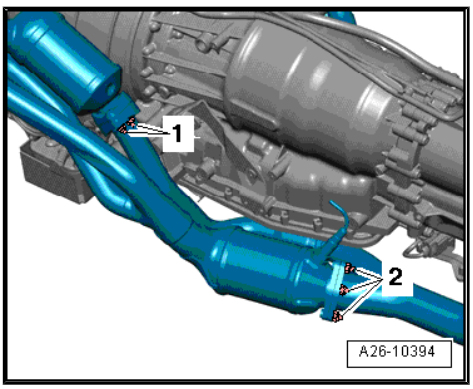
– Slacken clamp -2-.



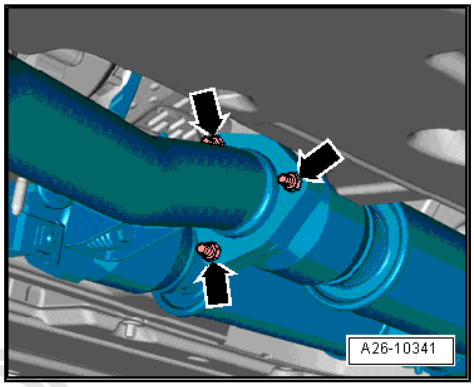
– Unscrew bolt -arrow- at bracket for exhaust pipes (left-side).



– Remove nuts -1- and -2- and detach Y-pipe together with front silencer.



– Remove nuts -arrows- and detach front silencer (left-side) from Y-pipe.



Note

Shown in illustration when installed.

Installing

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

Note

Renew gaskets and self-locking nuts.

– Install front cross member ⇒ Rep. gr. 40 .
– Align exhaust system so it is free of stress ⇒ page 240 .

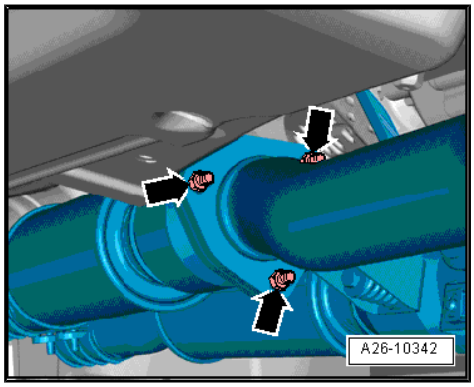
Tightening torques

◆ ⇒ “1.1 Exhaust system - exploded view”, page 224

1.6 Removing and installing Y-pipe (right-side)

Removing

• Engine removed and in position on scissor-type assembly platform - VAS 6131 A- with gearbox attached.
– Remove exhaust pipes (right-side) ⇒ page 233 .
– Remove nuts -arrows- and detach front silencer (right-side) from Y-pipe.



Note

Shown in illustration when installed.

Installing

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

Note

Renew gaskets and self-locking nuts.

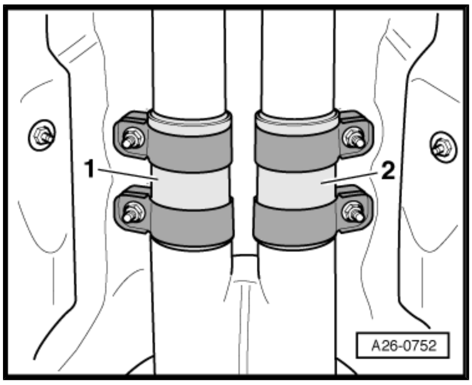
– Install exhaust pipes (right-side) ⇒ page 233 .
– Align exhaust system free of stress after installing engine ⇒ page 240 .

Tightening torques

◆ ⇒ “1.1 Exhaust system - exploded view”, page 224

1.7 Removing and installing front silencer (left-side)

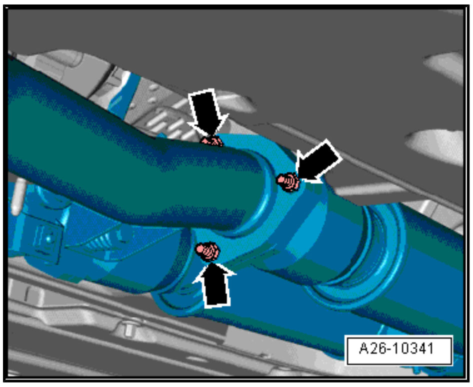
Removing



Note

The flexible joint in the front silencer must not be bent more than 10° - damage can otherwise occur.

– Loosen clamp (left-side) -2-.



– Remove nuts -arrows- and detach front silencer (left-side) from Y-pipe.

Installing

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

Note

Renew gaskets and self-locking nuts.

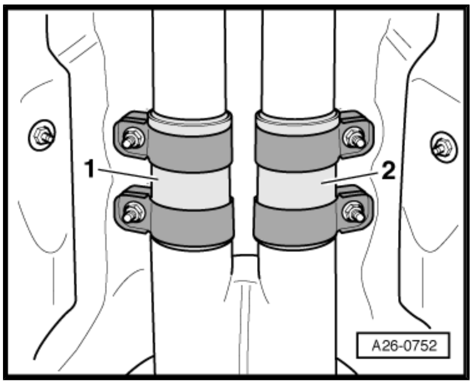
– Align exhaust system so it is free of stress ⇒ page 240 .

Tightening torques

- ⇒ “1.1 Exhaust system - exploded view”, page 224

1.8 Removing and installing front silencer (right-side)

Removing

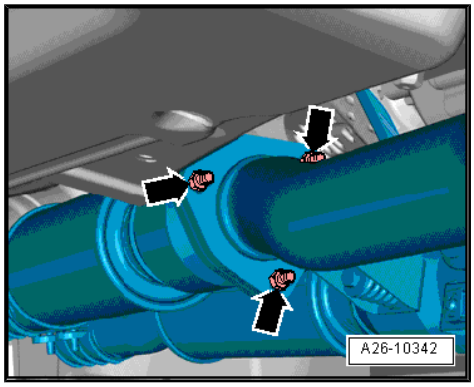


Note

The flexible joint in the front silencer must not be bent more than 10° - damage can otherwise occur.

– Loosen clamp (right-side) -1-.

– Remove nuts -arrows- and detach front silencer (right-side) from Y-pipe.



Installing

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

Note

Renew gaskets and self-locking nuts.

– Align exhaust system so it is free of stress ⇒ page 240 .

Tightening torques

◆ ⇒ "1.1 Exhaust system, exploded view", page 224

1.9 Stress-free alignment of exhaust system

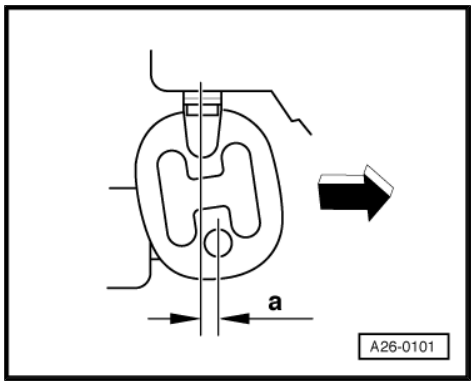
- The exhaust system must be aligned when it is cool.

– Loosen bolt connections of all exhaust system clamps.

– Press rear silencer to front -arrow- until the rubber mountings are pre-loaded to the specified dimensions:

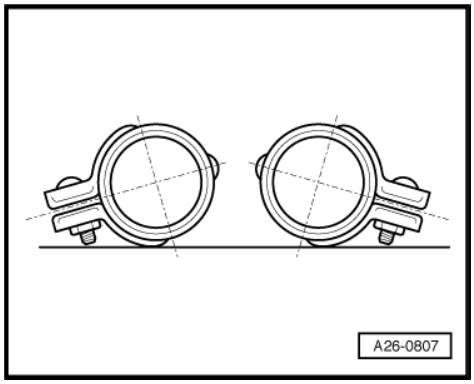
- Rubber mounting (front): -a- = 11 mm.
- Rubber mounting (rear): -a- = 14 mm.

– Align rear silencer horizontally.



– Position clamps so that they align with centre of cutting locations.

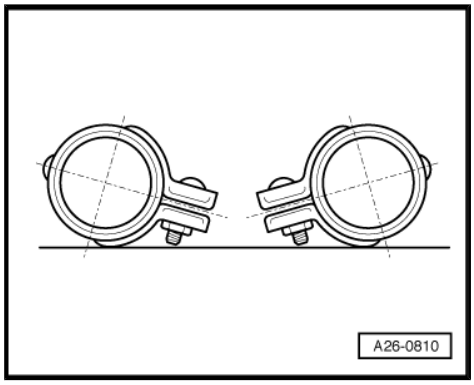
– Align front clamps so that ends of bolts do not protrude beyond bottom of clamps.



– Align rear clamps so that ends of bolts do not protrude beyond bottom of clamps.

– Tighten bolt connections on clamps evenly.

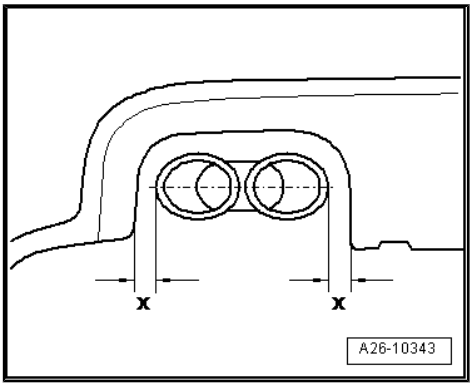
– Align tailpipes.



Aligning tailpipes

– Check clearance between tailpipes (left and right) and bumper cover:

• Dimension -x- (left-side) = dimension -x- (right-side)

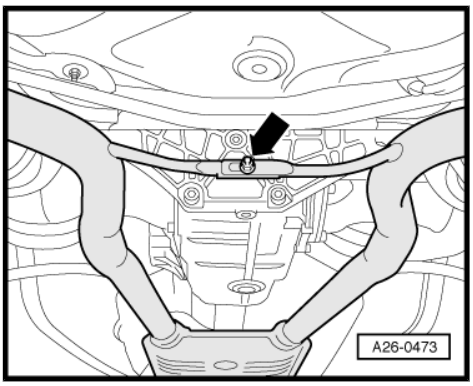


If necessary, correct dimension “x” as follows:

– Slacken bolt connection -arrow- on brace between exhaust pipes.

– Adjust the distance between the rear silencers.

– Tighten connection.



Tightening torques

◆ ⇒ “1.1 Exhaust system - exploded view”, page 224

2 Servicing secondary air system

2.1 Principle and function

Because of the over-enrichment of the mixture in the cold start phase, the proportion of unburned hydrocarbons in the exhaust gas is higher. The secondary air system improves the afterburning (oxidation) process in the catalytic converter, and thus reduces toxic emissions. The heat generated by oxidisation accelerates the "light off" of the catalytic converter and significantly improves exhaust gas quality during warm-up.

- 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.

2.2 Secondary air system - exploded view

1 - Air hose
- ❑ To engine

2 - 9 Nm

3 - Bracket

4 - Retaining bracket

5 - 9 Nm

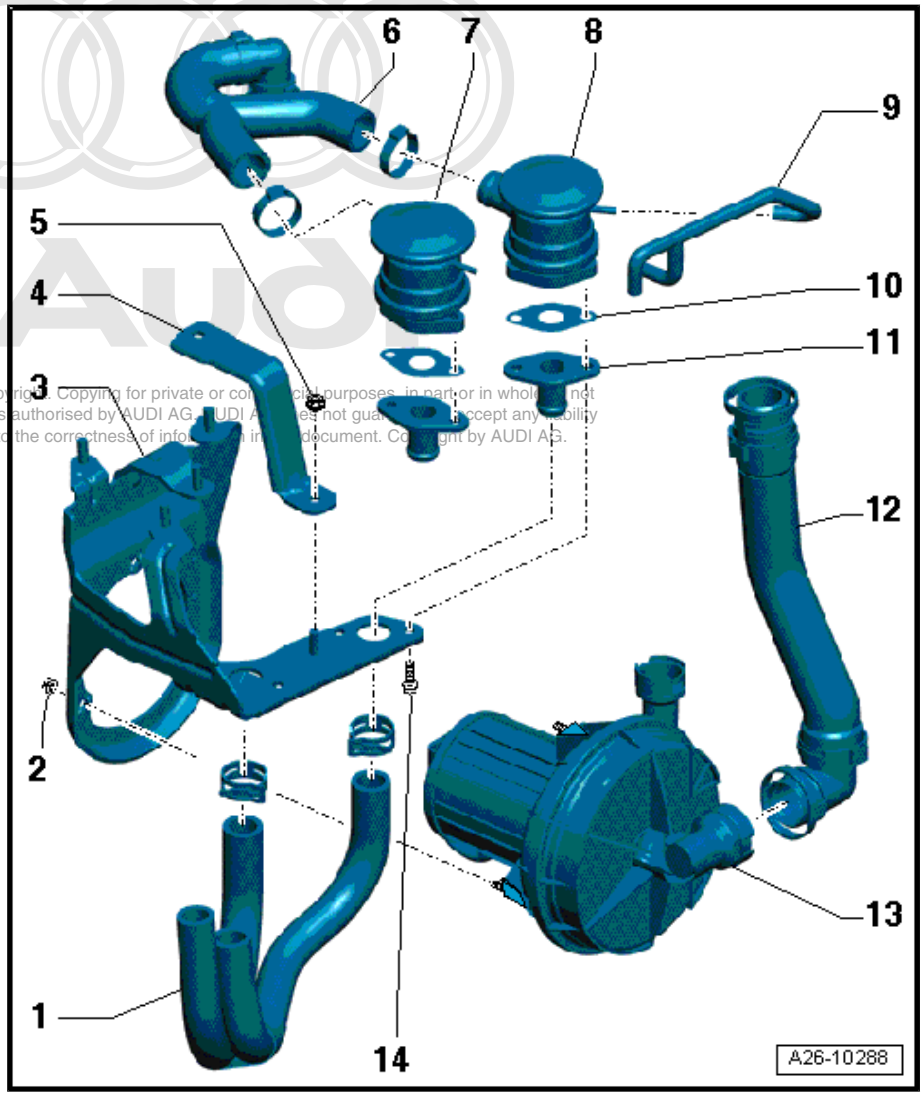
6 - Air hose
- ❑ Between secondary air pump motor - V101- and combination valves for secondary air system

7 - Combination valve for secondary air system
- ❑ Fitting location: front right of engine compartment
- ❑ Checking ⇒ page 243
- ❑ Removing and installing ⇒ page 244

8 - Combination valve for secondary air system
- ❑ Fitting location: front right of engine compartment
- ❑ Checking ⇒ page 243
- ❑ Removing and installing ⇒ page 244

9 - Vacuum hoses

10 - Gasket
- ❑ Renew



11 - Connection

12 - Air hose

- ❑ From air cleaner

13 - Secondary air pump motor - V101-

- ❑ Fitting location: At front right in engine compartment below longitudinal member
- ❑ Removing and installing ⇒ page 245
- ❑ Checking in “Guided Fault Finding” mode ⇒ Vehicle diagnostic tester

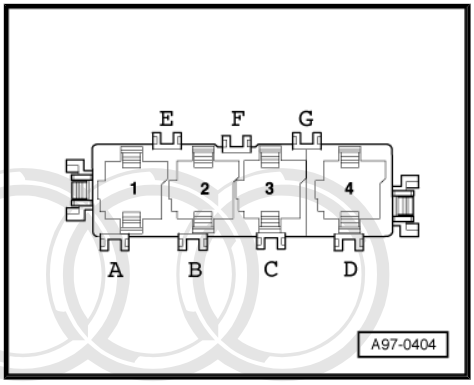
14 - 9 Nm

Fitting location of secondary air pump relay - J299- and secondary air pump fuse - S130-

- ♦ In electronics box (plenum chamber, passenger's side).

1 - Secondary air pump relay - J299-

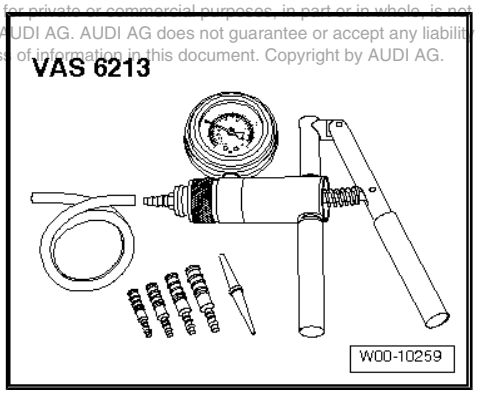
B - Secondary air pump fuse - S130- (50 amp)



2.3 Checking combination valves for secondary air system for correct operation and leakage

Special tools and workshop equipment required

- ♦ Hand vacuum pump - VAS 6213-



Procedure

- No leaks in hose connections.

– Remove relevant combination valve for secondary air ⇒ page 244 .

– Connect hand vacuum pump - VAS 6213- to vacuum connection -1- of combination valve for secondary air.

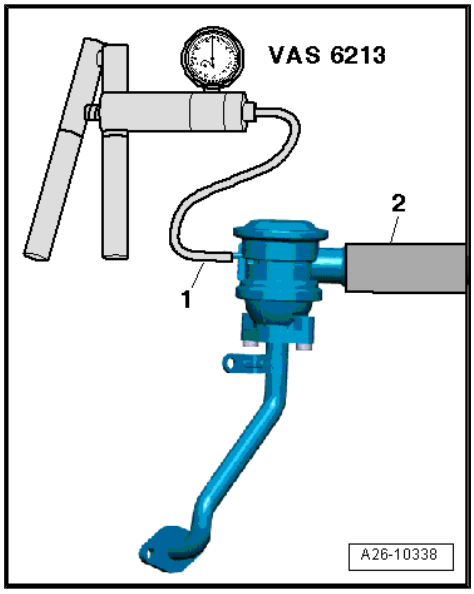
– Connect suitable test hose -2- to combination valve for secondary air.

– Blow lightly into test hose -2- 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.

- The combination valve for secondary air system should open; it should now be possible to blow through the hose.



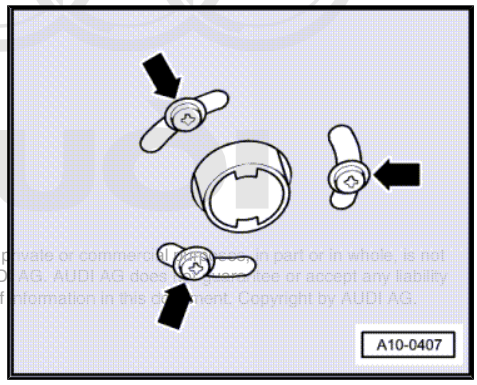
If combination valve for secondary air does not open:

– Renew relevant secondary air combination valve ⇒ page 244 .

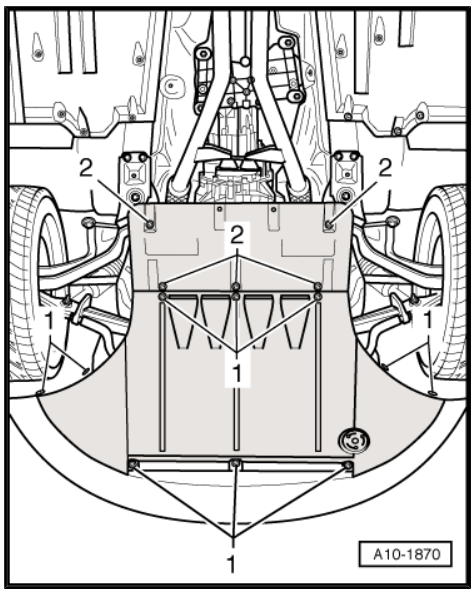
2.4 Removing and installing combination valves for secondary air system

Removing

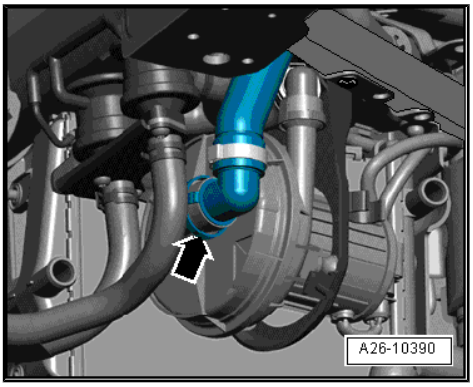
– Vehicles with auxiliary heater: remove bolts -arrows- securing exhaust pipe for auxiliary/additional heater to noise insulation.



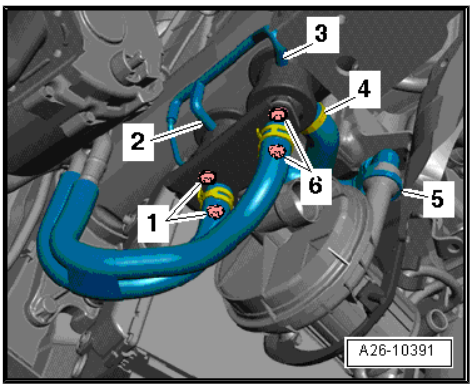
– Open quick-release fasteners -1- and remove noise insulation (front).



– Disconnect air hose -arrow- at secondary air pump.



– Disconnect vacuum hoses -2- and -3-.
– Unscrew bolts -1- and -6- and remove hose connections.
– Disconnect air hoses -4- and -5-.
– Detach relevant combination valve for secondary air.



Installing

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

Note

Renew seals and gaskets.

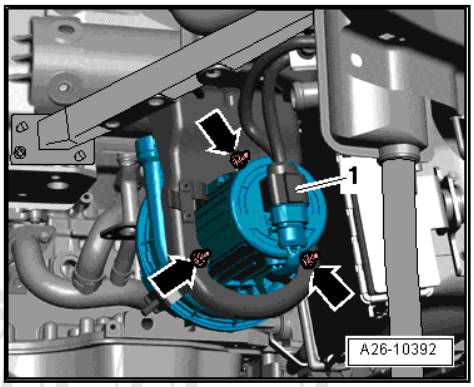
Tightening torques

◆ ⇒ “2.2 Secondary air system - exploded view”, page 242

2.5 Removing and installing secondary air pump

Removing

– Remove combination valves for secondary air ⇒ page 244 .
– Unplug electrical connector -1-.
– Unscrew nuts -arrows- and remove secondary air pump.



Installing

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

– Install combination valves for secondary air ⇒ page 244 .

Tightening torques

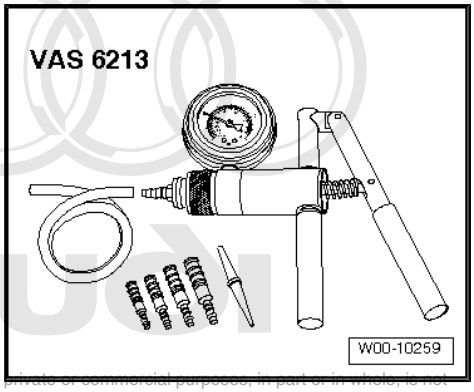
◆ ⇒ “2.2 Secondary air system - exploded view”, page 242

3 Exhaust flaps

3.1 Checking vacuum unit for exhaust flap

Special tools and workshop equipment required

- Hand vacuum pump - VAS 6213-



Procedure

– Disconnect hose at vacuum unit for exhaust flap on rear silencer.

– Connect hand vacuum pump to vacuum unit.

– Use hand vacuum pump to generate vacuum.

• The linkage should move upwards.

– Vent hand vacuum pump.

• Linkage should move downwards.

If the linkage does not move:

– Check linkage for ease of movement and check vacuum unit for leaks.