Workshop Manual

Audi A6 2005 ➢

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

Edition 12.2008

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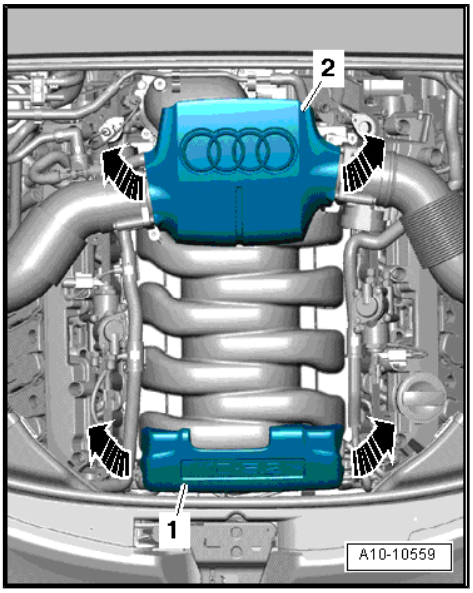
Technical information should always be available to the foremen and mechanics, because their careful and constant adherence to the instructions is essential to ensure vehicle road-worthiness and safety. In addition, the normal basic safety precautions for working on motor vehicles must, as a matter of course, be observed.

Contents

00 – Technical data

1 Engine number

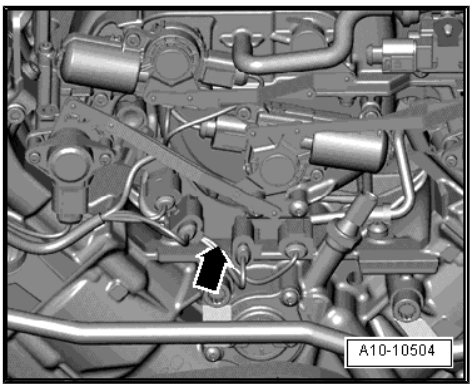
– Pull off engine cover panel (front) -1- -arrows-.



Note

Disregard -item 2-.

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		BXA
Capacity	ltr.	5.204
Power output	kW at rpm	320/6800
Torque	Nm at rpm	540/30000 … 4000
Bore	∅ in mm	84.5
Stroke	mm	92.8
Compression ratio		12.5
RON		98 1)
Injection system/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.
- Faults are stored in engine control units if electrical connectors were unplugged and engine was started: “Generate readiness code” in “Guided Functions” ⇒ Vehicle diagnosis, testing and information system VAS 5051.

Caution

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

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

– Disconnect battery ⇒ Rep. Gr. 27 .

When working on the cooling system note the following warnings:

WARNING

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

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

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

WARNING

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. Use only lint-free cloths.
- Carefully cover or seal open components if repairs cannot be carried out immediately.
- Only install clean components; replacement parts should only be unpacked immediately prior to installation. Do not use parts that have 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 performing assembly work on engine, all open passages in the intake and exhaust systems must be sealed with suitable plugs (e.g. from engine bung set -VAS 6122-) to prevent foreign particles from entering the engine.
- In the event of mechanical damage to one of the cylinder banks, the intake and exhaust systems and combustion chambers of the opposite cylinder bank must always be examined 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.

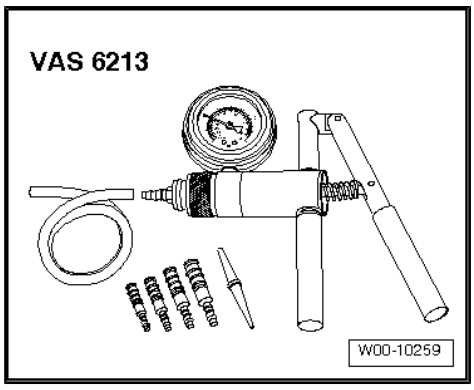
4.6 Installing radiators and condensers

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 fault memory, check the vacuum lines leading to the corresponding component and also check the remaining vacuum lines in the system.

– If it is not possible to build up pressure with the hand vacuum pump -VAS 6213- or if the pressure drops again immediately, check the hand vacuum pump and connecting hoses for leaks.

10 – Removing and installing engine

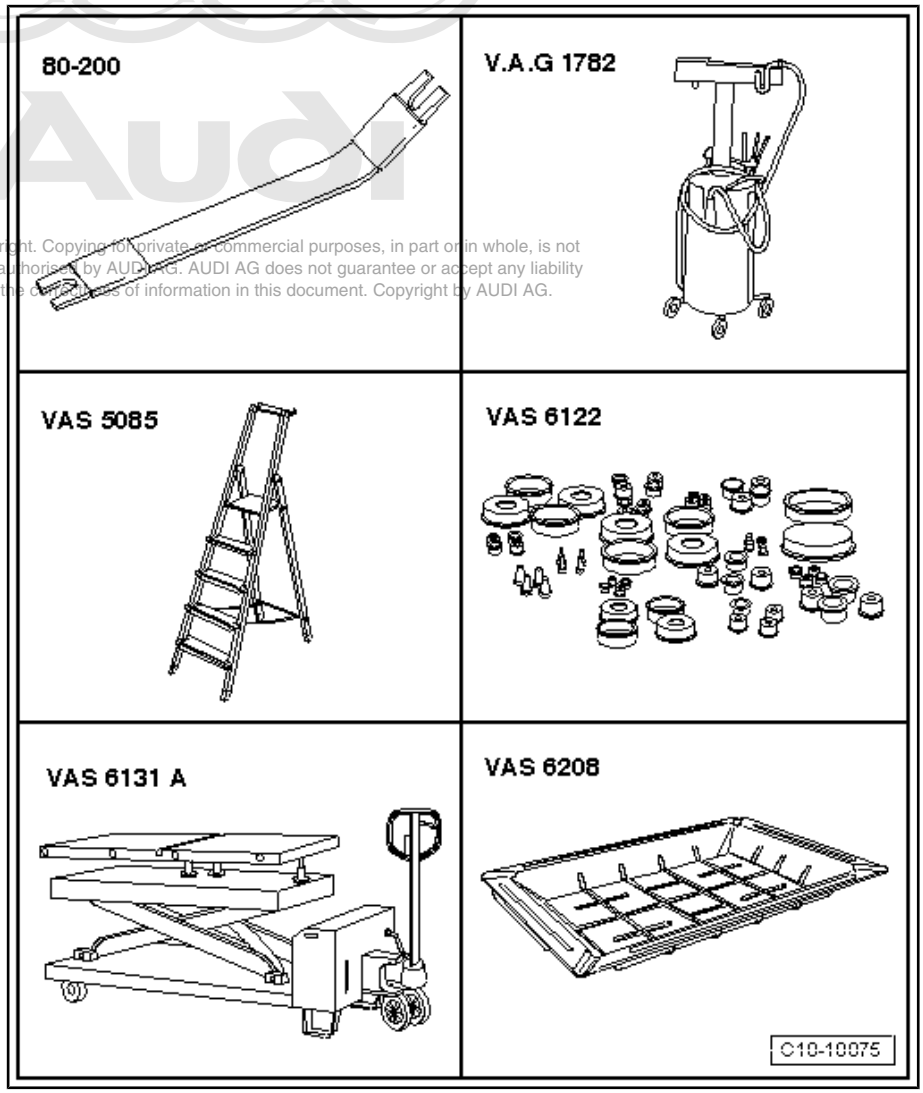
1 Removing engine

Note

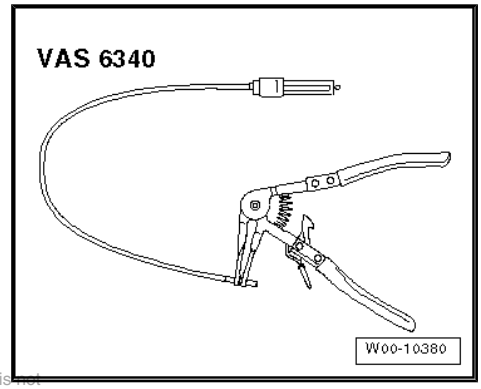
- *The engine is removed from underneath together with the gearbox and subframe (with lock carrier installed).*
- *Collect drained coolant in a clean container for re-use or disposal.*
- *Fit all heat shields and heat insulation sleeves in the original positions when installing.*
- *All cable ties which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

Special tools and workshop equipment required

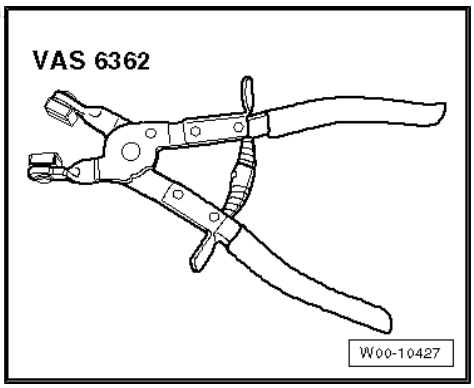
- Removal lever -80 - 200-
- Used oil collection and extraction unit -V.A.G 1782-
- Stepladder -VAS 5085-
- Engine bung set -VAS 6122-
- Scissor-type assembly platform -VAS 6131 A- with support set for Audi -VAS 6131/10- and adapter -VAS 6131/10-12- (2x)
- Drip tray for workshop hoist -VAS 6208-



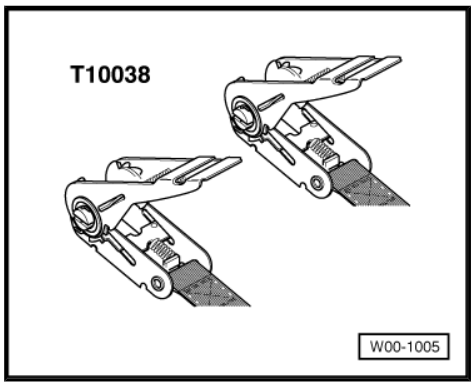
- Hose clip pliers -VAS 6340-



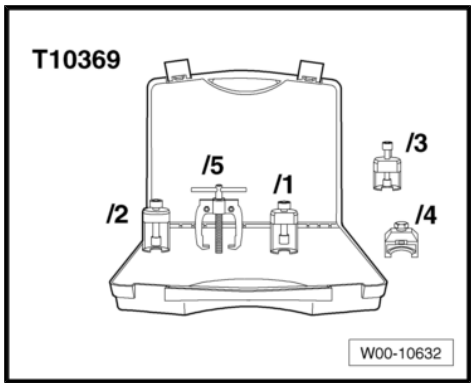
- Hose clip pliers -VAS 6362-



- Tensioning strap -T10038-



- Puller -T10369-



Procedure

WARNING

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

Caution

Observe notes on procedure for disconnecting the battery.

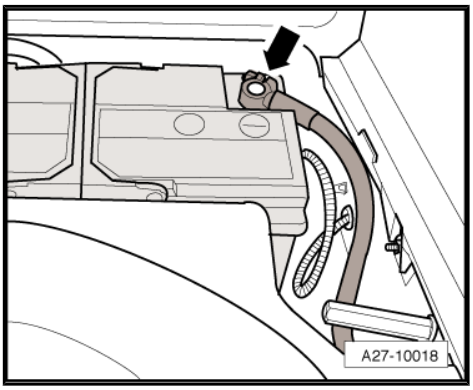
Note

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

– With ignition switched off, disconnect earth cable -arrow- at battery ⇒ Rep. Gr. 27 .

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

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

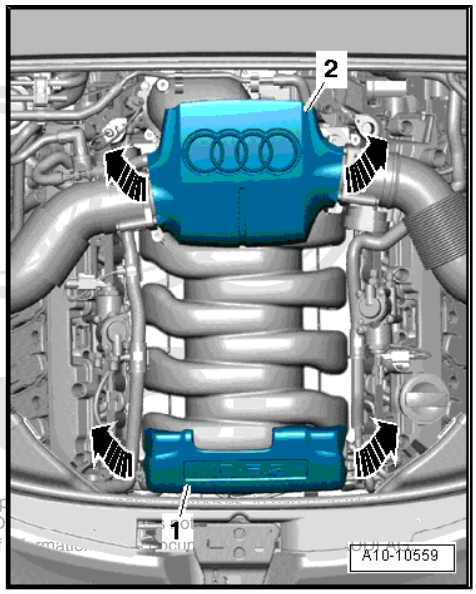


– Pull off engine cover panels at front -1- and at rear -2- -arrows-.

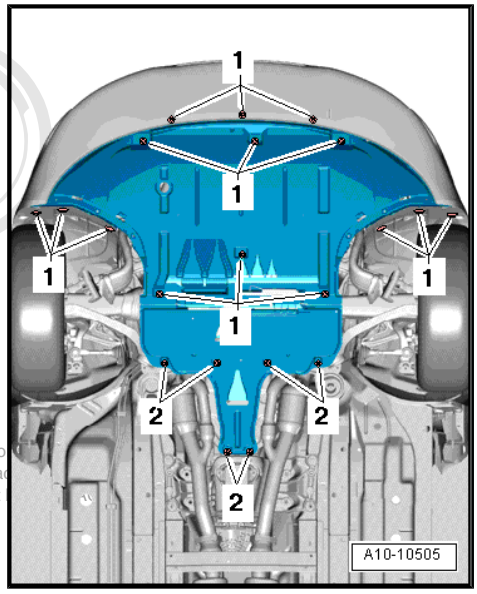
WARNING

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

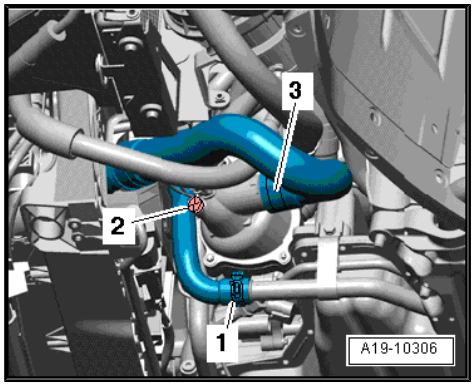
– Open filler cap on coolant expansion tank.



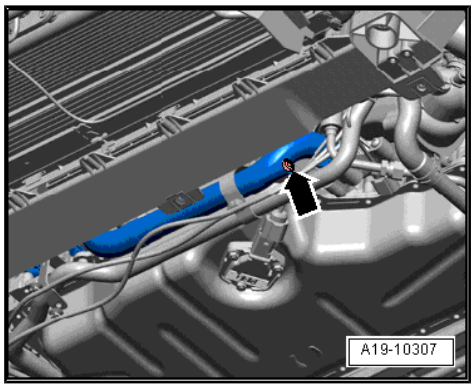
– Remove both front wheels ⇒ Rep. Gr. 44 .
– Release quick-release fasteners -1- and -2- and take off noise insulation panels.



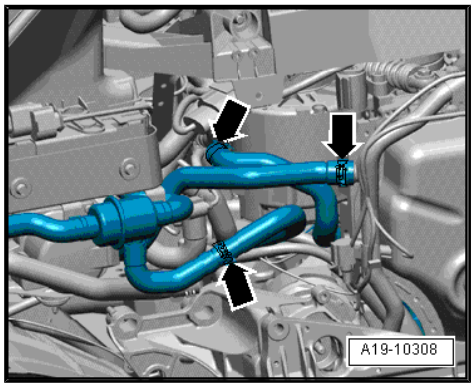
– Place drip tray for workshop hoist -VAS 6208- under engine.
– Unscrew drain plug -2- at thermostat housing and drain off coolant.
– Detach coolant hoses -1- and -3-.



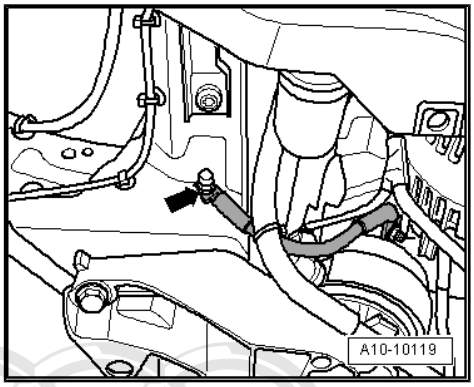
– Remove drain plug -arrow- at front coolant pipe and drain off coolant.



– Disconnect the coolant hoses at the points marked with -arrows-.
– Drain remaining coolant.



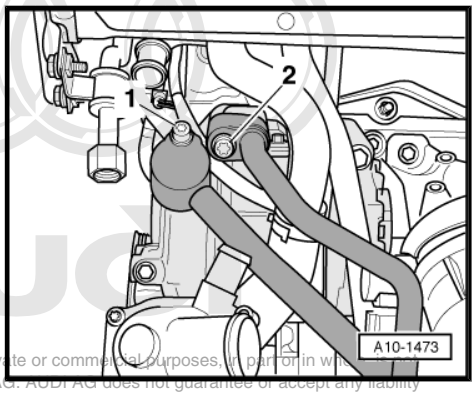
– Unbolt earth cable -arrow- at longitudinal member (right-side).



Note

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

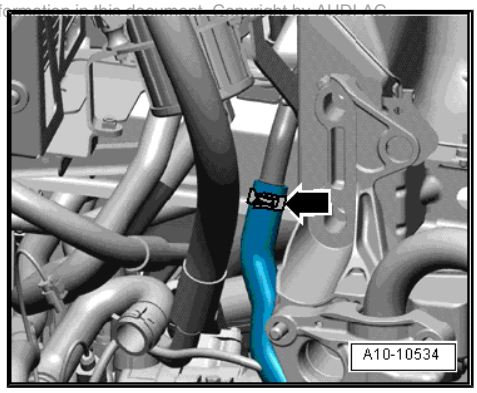
– Remove bolts -1- and -2-.
– Detach refrigerant lines from AC compressor.
– Seal the open connections at AC compressor using clean plugs.



Note

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

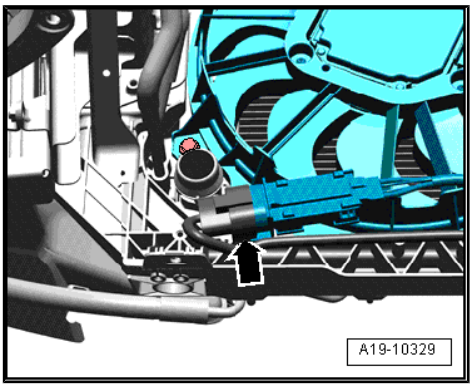
– Detach hydraulic hose -arrow- from pipe at longitudinal member (left-side).
– Seal off open pipes/lines and connections with clean plugs from engine bung set -VAS 6122- .



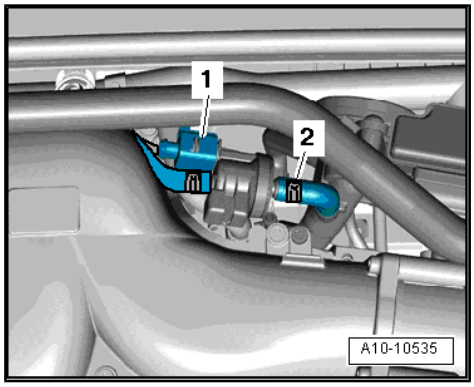
– Take electrical connector -arrow- out of bracket at left of lock carrier.

Note

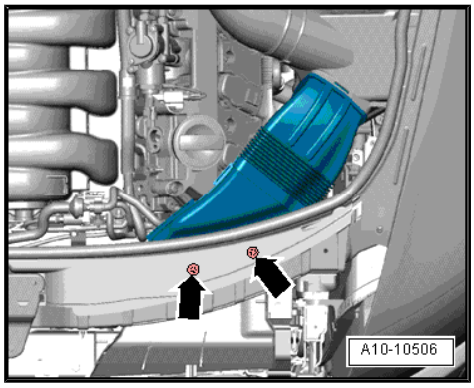
Do not unplug electrical connector.



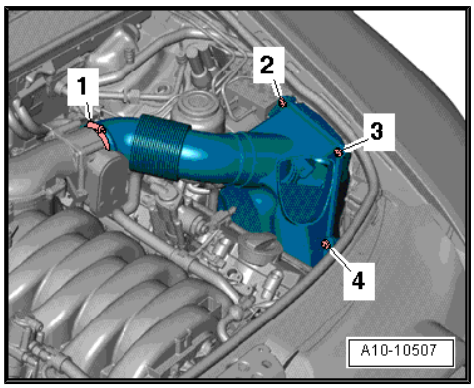
– Unplug electrical connector -1- at activated charcoal filter system solenoid valve 1 -N80- and detach vacuum hose -2-.
– Detach active charcoal filter system solenoid valve 1 -N80- from bracket and move it clear to the side with hose still attached.



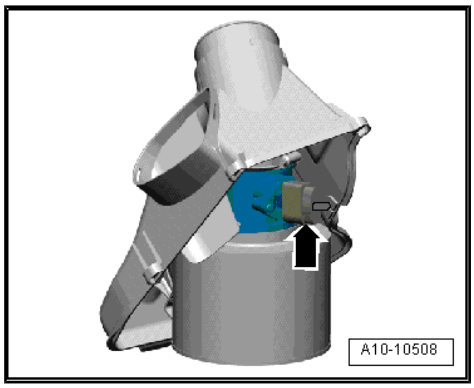
– Remove bolts -arrows- and remove air duct (left-side).



– Loosen hose clip -1- and remove bolts -2, 3, 4-.
– Remove top section of air cleaner (left-side).

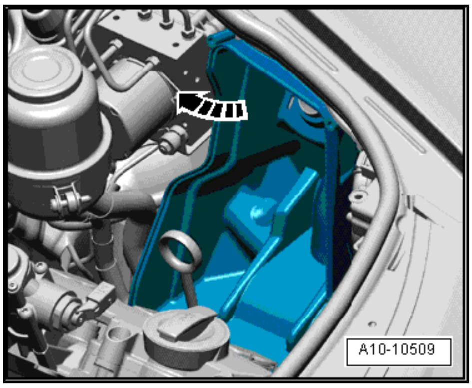


– Unplug electrical connector -arrow- at air mass meter 2 - G246- .



– Pull bottom section of air cleaner away from connection on side.

– Pivot bottom section of air cleaner upwards -arrow- and remove.

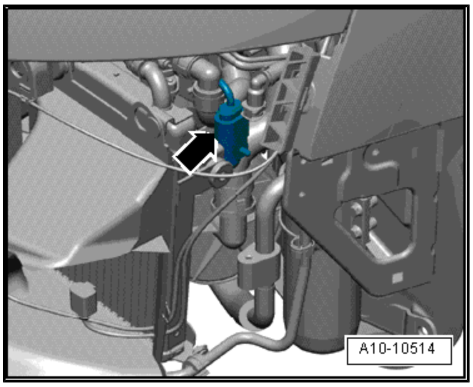


– Unplug electrical connector -arrow- for secondary air pump beneath headlight.

– Move wiring clear.

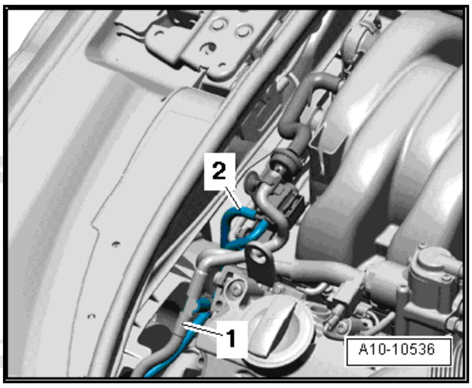
Note

Shown in illustration with bumper cover removed.



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

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

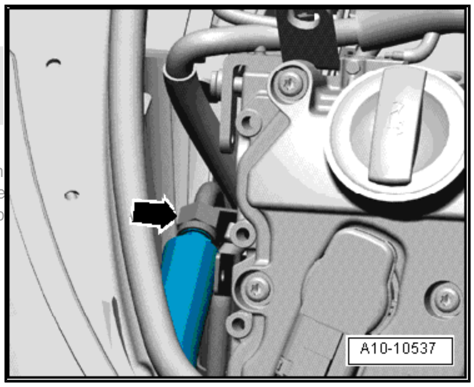


Note

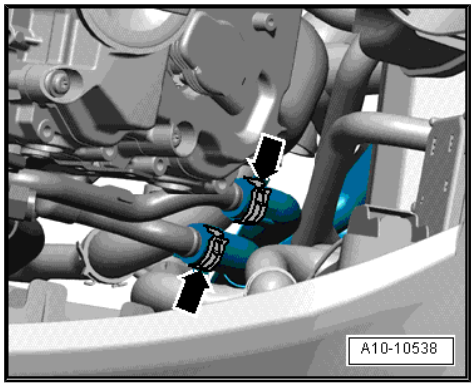
Lay a cloth under the separating point to catch escaping hydraulic fluid.

– Disconnect hydraulic pressure line for power steering -arrow- at front left of engine.

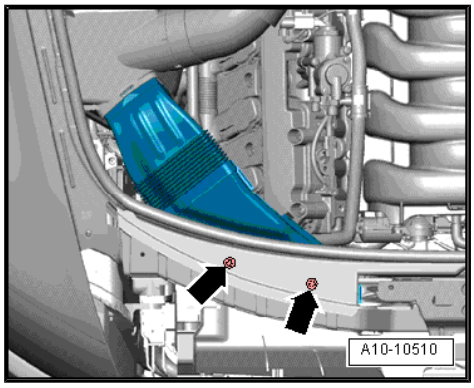
– Seal off open pipes/lines and connections with clean plugs from engine bung set -VAS 6122- .



– Detach air intake hoses -arrows- leading to combination valves for secondary air system.



– Remove bolts -arrows- and remove air duct (right-side).



– Detach vacuum line -5- from air intake hose.

Rest-of-world vehicles:

– Detach crankcase breather hose -4- from air intake hose.

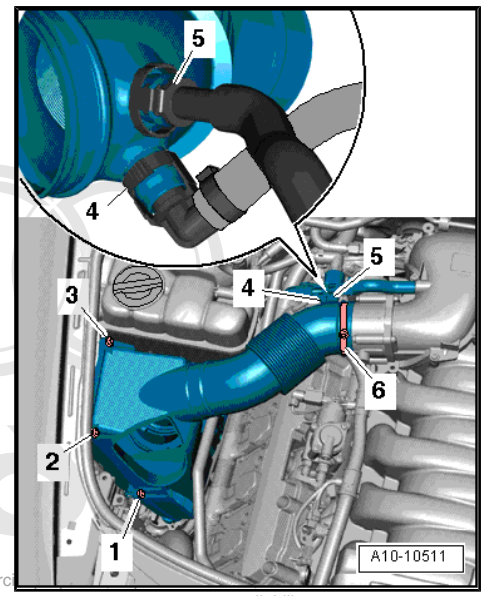
USA models:

> **Caution**
>
> ***Do not open hose connection -4- on USA models. Move top section of air cleaner (right-side) clear to one side (crankcase breather hose remains connected).***

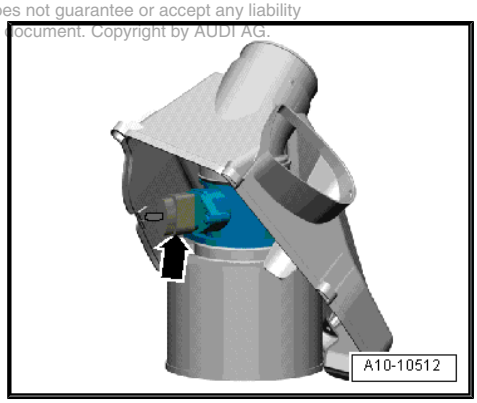
All vehicles:

– Loosen hose clip -6- and remove bolts -1, 2, 3-.

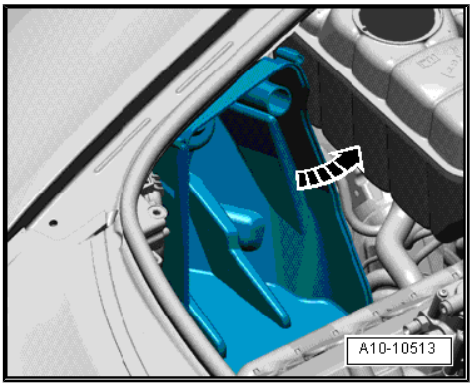
– Detach top section of air cleaner (right-side).



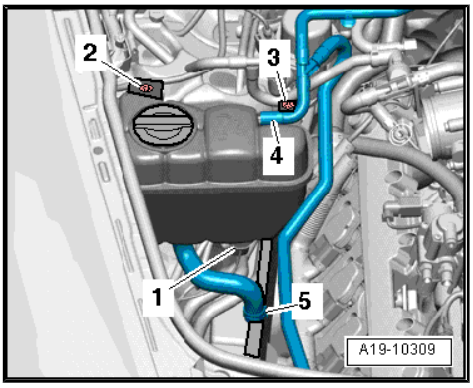
– Unplug electrical connector -arrow- at air mass meter -G70-.



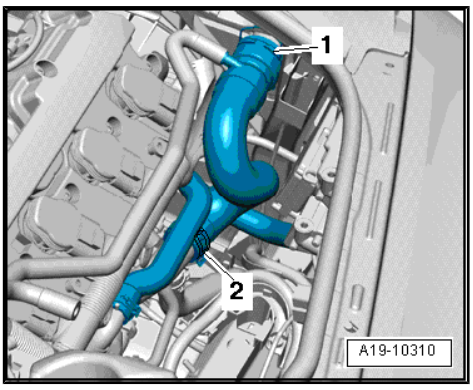
– Pull bottom section of air cleaner away from connection on side.
– Pivot bottom section of air cleaner upwards -arrow- and remove.



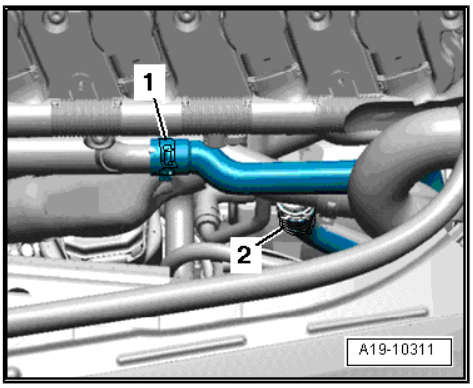
– Disconnect coolant hoses -4- and -5- from coolant expansion tank and coolant pipe.
– Unplug electrical connector -1- on coolant shortage indicator switch -F66- at bottom of expansion tank.
– Remove bolts -2- and -3- and detach coolant expansion tank.



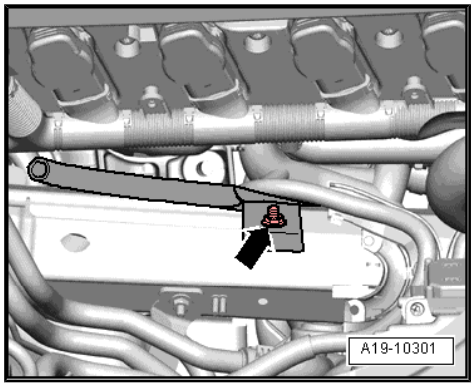
– Detach coolant hose -1- from radiator and from coolant pipe (right-side) -2-.
– Place coolant hose on top of engine.



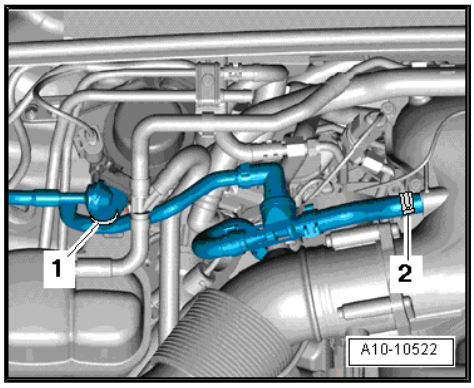
– Detach coolant hoses -1- and -2- from coolant pipe (right-side).



– Unscrew nut -arrow- and detach coolant pipe from longitudinal member (right-side).

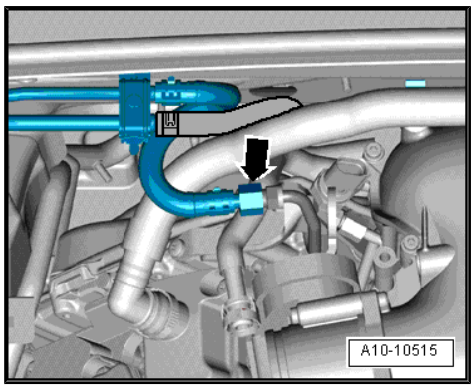


– Disconnect vacuum hoses -1- and -2-.



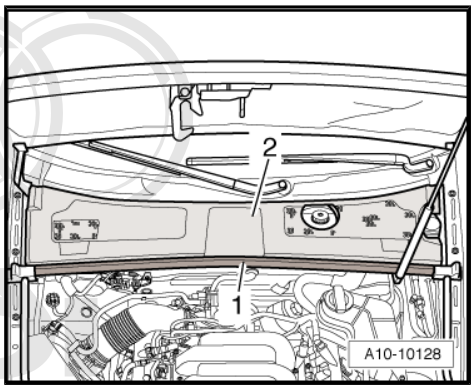
WARNING

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

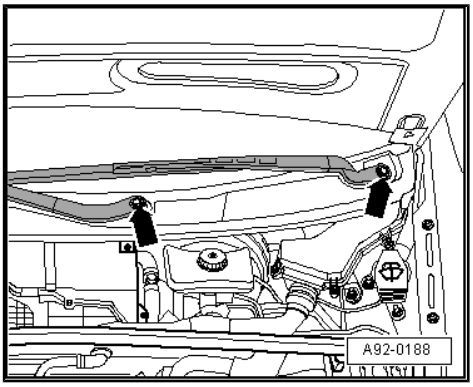


– Disconnect fuel supply pipe -arrow- at connecting piece.
– Seal off open pipes/lines and connections with clean plugs from engine bung set -VAS 6122- .

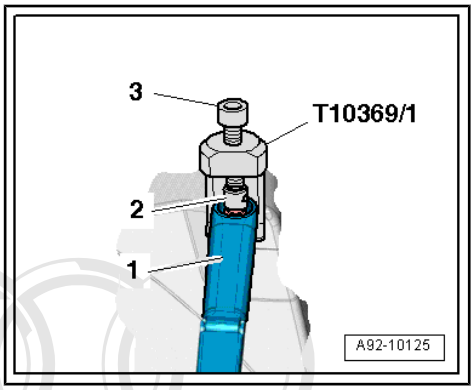
– Pull off rubber seal -1- and remove plenum chamber cover -2-.



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



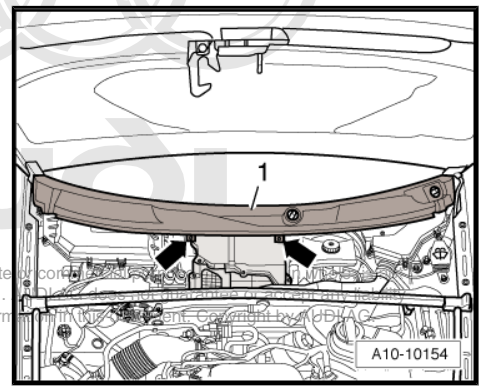
– Apply puller -T10369/1- to wiper arm -1-, as shown in illustration.
– Apply thrust piece -2- onto wiper shaft.
– Turn bolt -3- in clockwise direction until wiper arm is pulled off wiper shaft.
– Remove nuts completely and take off wiper arms.



– Unscrew bolts -arrows- for cowl panel trim -1-.

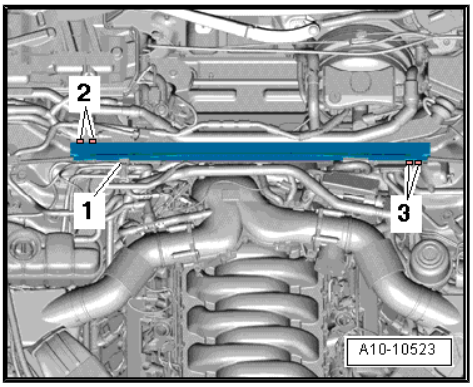
Caution

To avoid cracking the cowl panel trim -1- 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 windscreen surround, starting from the edge of the windscreen.

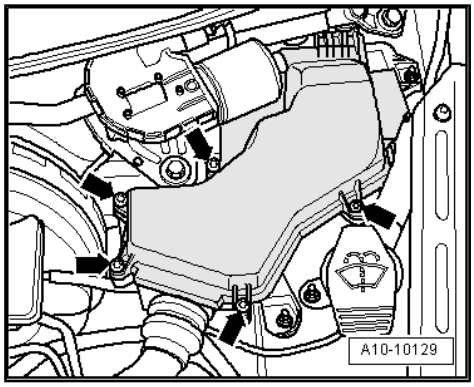


– Pull cowl panel trim off windscreen.

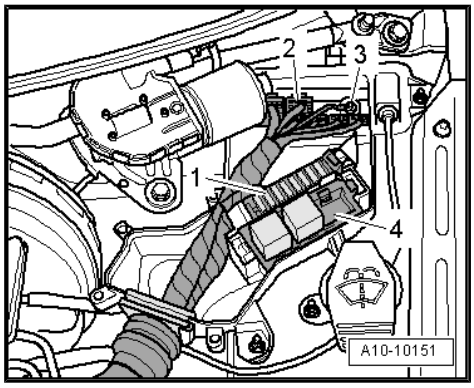
– Unbolt bracket -1- from cross piece for suspension strut.
– Remove bolts -2- and -3- and detach cross piece for suspension strut.



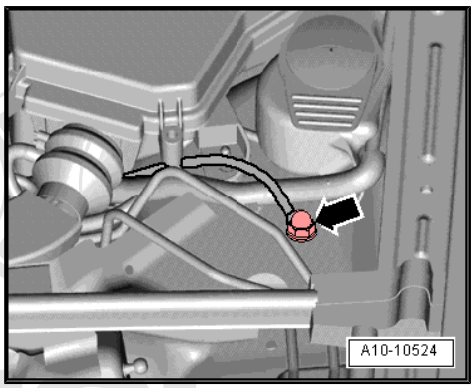
– Unscrew bolts -arrows- and take off cover for electronics box in engine compartment (left-side).



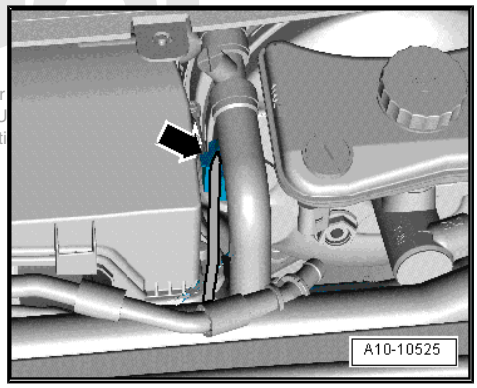
– Release retainers and lift off fuse holder -1-; then lift off 3-position relay carrier -4-.
– Unscrew electrical wiring -3-.
– Unplug all connectors -2- at rear of connector console.
– Disengage engine wiring harness at electronics box and move it clear.



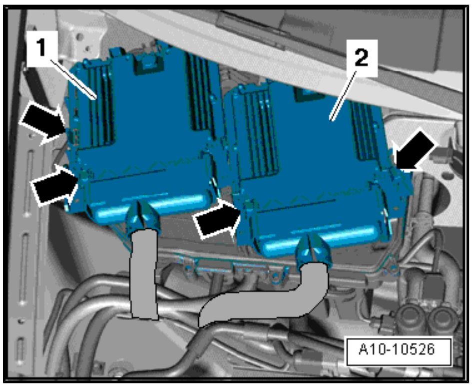
– Unbolt earth cable -arrow- on left of plenum chamber



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



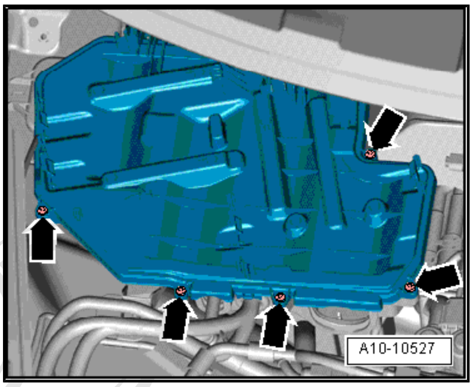
– Release retaining clips -arrows- and detach engine control units -1- and -2-.



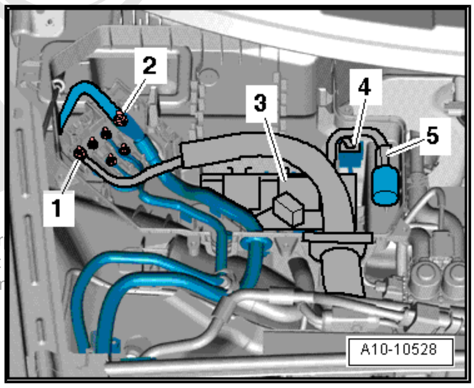
Note

The engine control units remain connected to the wiring harness.

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



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



– Unclip suppressor capacitor -5- and take out of retainer in electronics box.

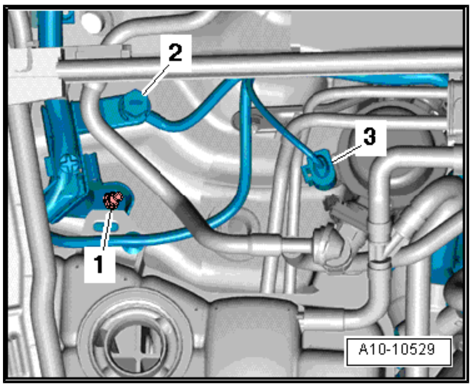
– Unplug electrical connector -4- at rear of connector console.

– Unscrew electrical wiring connections -1- and -2-.

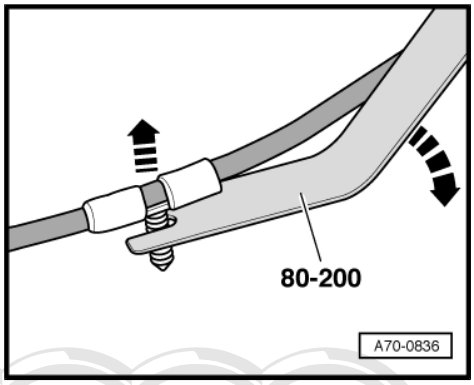
– Unclip relay carrier -3- and take out of retainer in electronics box.

– Remove bolts -1- and -2-.

– Unplug electrical connector -3- at vacuum pump for brakes -V192- .



– Release electrical wiring up to the alternator using removal lever -80-200- .



Note

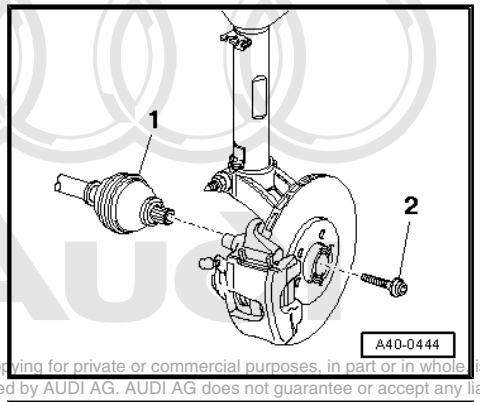
To ease removal of wiring clips, use silicon-free lubricant if necessary.

– Place wiring harnesses on top of engine and secure engine control units to prevent them falling.

– Have a 2nd mechanic press the brake pedal.

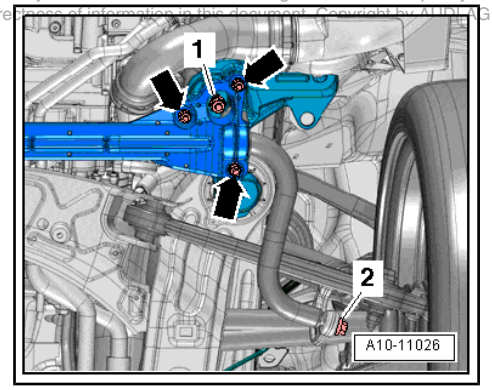
Caution

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).

– Remove nuts -arrows- and bolt -2- on both sides and take off cross member with anti-roll bar.



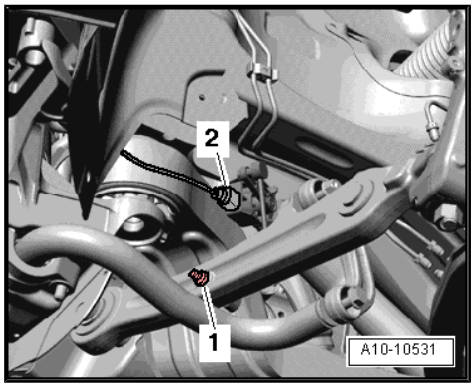
Note

Disregard -item 1-.

– Detach anti-roll bar with cross piece.

– Unplug electrical connector -2- at vehicle level sender.

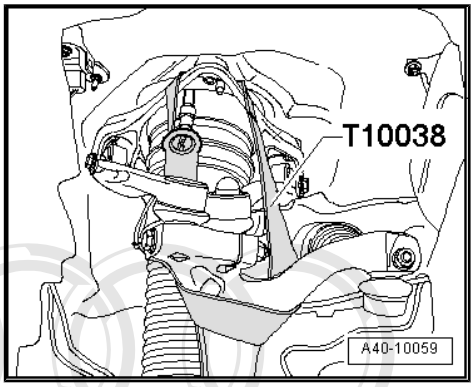
– Detach coupling rod -1- at track control link.



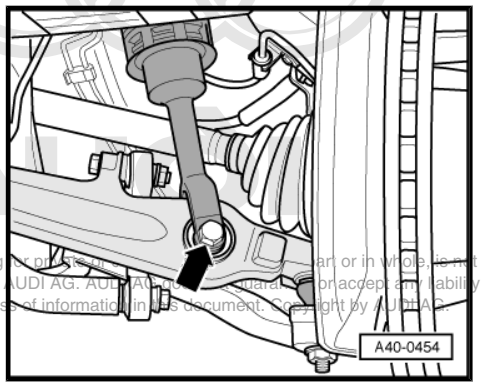
Caution

The weight of the wheel bearing housings must be supported in order to prevent damage to the joints of the upper links.

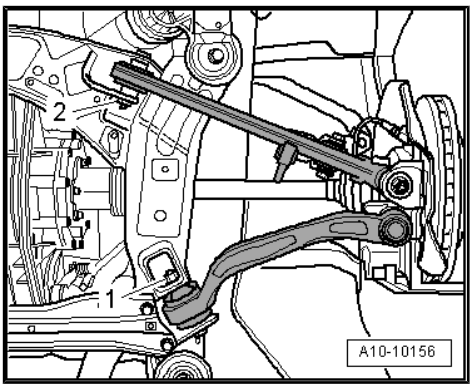
– Tie up wheel bearing housing using tensioning strap -T10038- as illustrated.



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

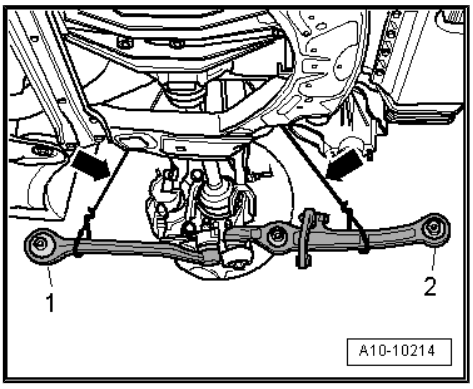


– Unbolt guide link -1- and track control link -2- at subframe.



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-.



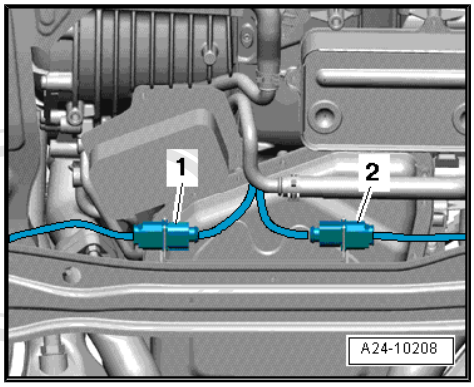
– Pivot guide link -1- and track control link -2- outwards.
– Repeat procedure on other side of vehicle.
– Unbolt drive shaft from flange shaft on gearbox.

Caution

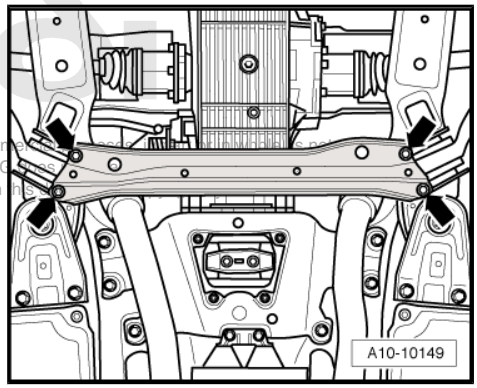
Take care not to damage brake hose.

– Pivot wheel bearing housing outwards and remove drive shaft.
– Repeat procedure on other side of vehicle.

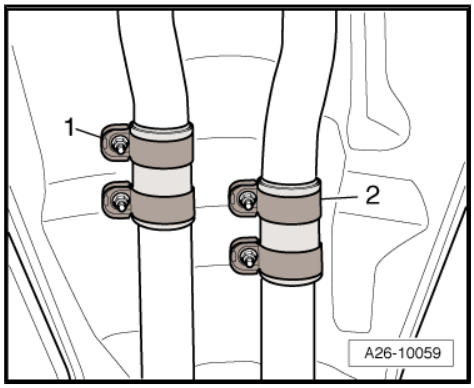
– Detach electrical connectors -1- for Lambda probe -G39- and -2- for Lambda probe 3 -G285- from bracket.



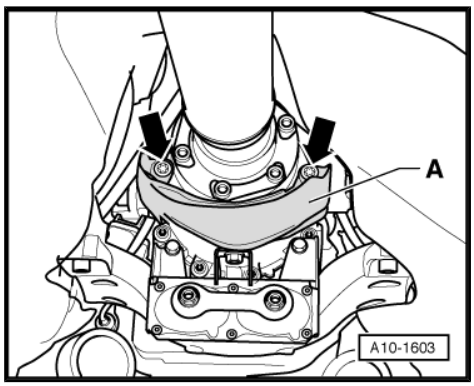
– Unbolt cross piece from subframe -arrows-.



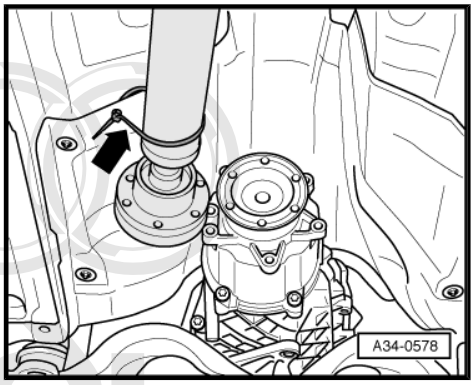
– Loosen clamps -1- and -2- and move clamps towards rear of vehicle.



– 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.

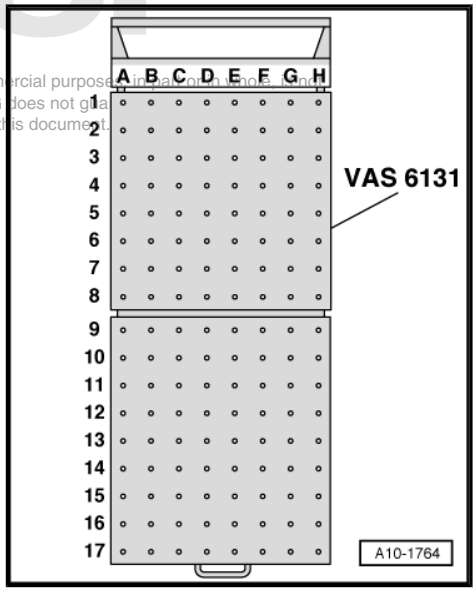


– Tie propshaft up to side of heat shield -arrow-.



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
A11	/10-1	/10-2	/10-5	/10-8
H11	/10-1	/10-2	/10-5	/10-8
F10	/10-1	/10-3	/10-5	/10-13
D11	/10-1	/10-3	/10-5	/10-12
D16	/10-1	/10-2	/10-5	/10-12

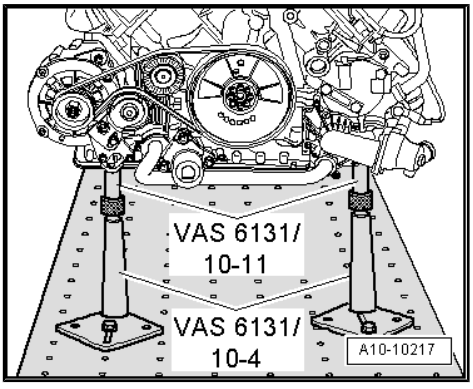
– Initially tighten the support elements on the assembly platform only hand-tight.

– Adjust the scissor-type assembly platform -VAS 6131 A- so that it is horizontal.

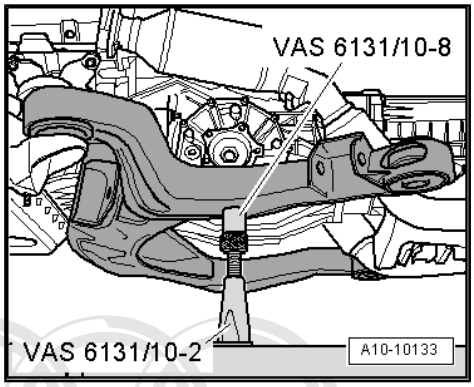
• Take note of spirit level (bubble gauge).

– Place scissor-type assembly platform -VAS 6131 A- under engine/gearbox assembly.

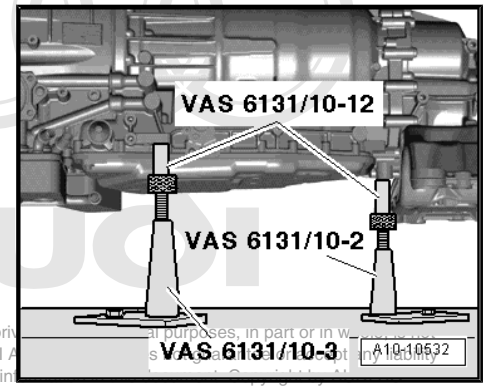
– Position support elements from -VAS 6131/10- at front of engine, as shown in illustration.



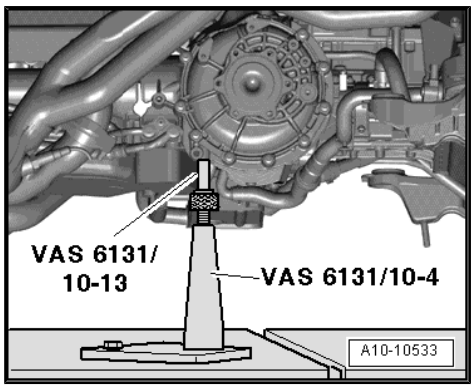
– Position support elements from -VAS 6131/10- at left and right of subframe, as shown in the illustration.



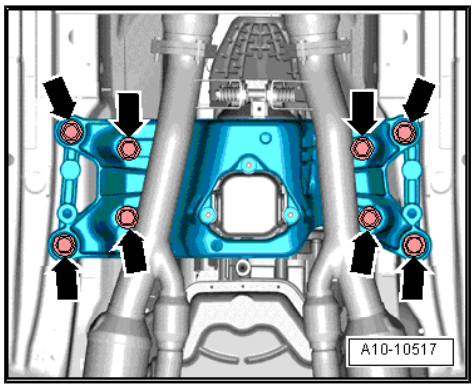
– Position the support elements from -VAS 6131/10- at left and rear of gearbox, as shown in the illustration.



– Position support element from -VAS 6131/10- at right 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.
– Tighten base plates for support elements to 20 Nm on scissor-type assembly platform -VAS 6131 A- .



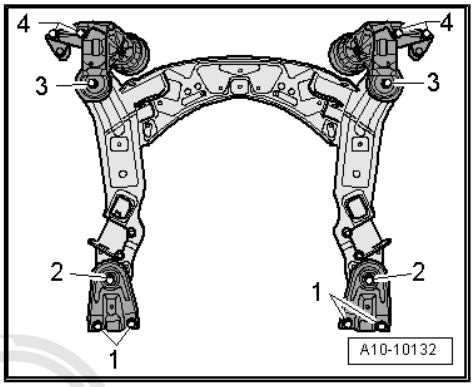
– Remove bolts -arrows- at tunnel cross member.



– Remove bolts -1-.

– Mark the installation position of the subframe and the two consoles for engine mountings on the longitudinal members with a felt-tip pen.

– Unscrew bolts -2, 3, 4- in diagonal sequence and in stages.

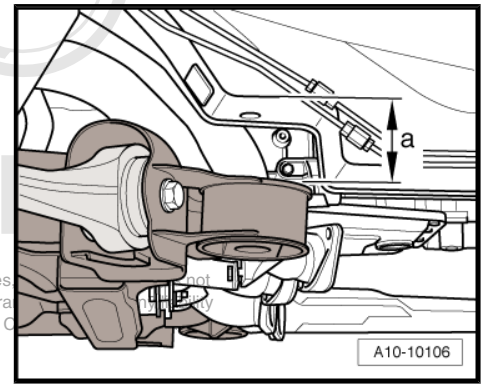


Note

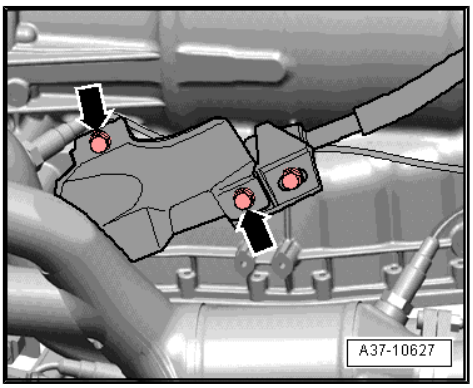
- ♦ *Check that all hoses and wiring connections between engine, gearbox, subframe and body have been detached.*
- ♦ *Carefully guide out engine/gearbox assembly with subframe from engine compartment when lowering to avoid damage.*

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

• Dimension -a- = max. 100 mm.



– Unscrew bolts -arrows- and remove heat shield for selector lever cable.



Note

Mark installation position of support bracket for selector lever cable with a felt-tip pen.

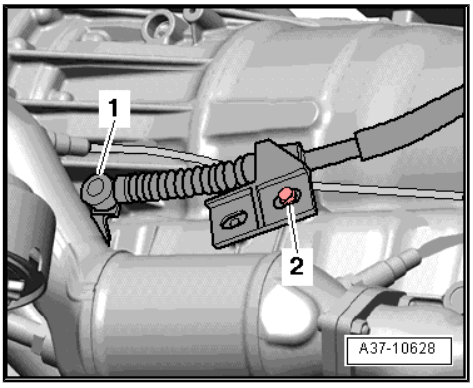
– Push ball socket -1- of selector lever cable off gearbox selector lever.

– Unbolt cable support bracket -2- from gearbox.

– Move selector lever cable clear.

– Lower engine/gearbox assembly.

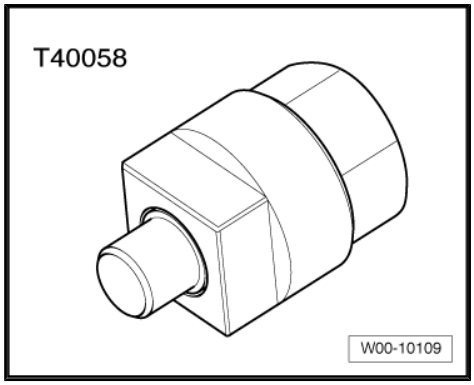
– Pull out scissor-type assembly platform -VAS 6131 A- with engine/gearbox assembly from beneath vehicle.



2 Separating engine and gearbox

Special tools and workshop equipment required

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



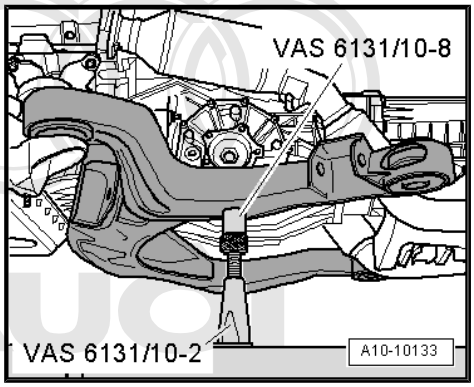
Procedure

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

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

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

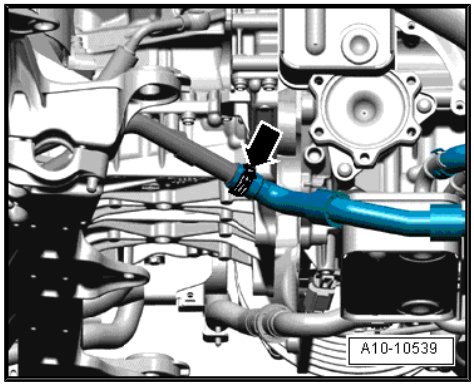
– Remove subframe to the side.



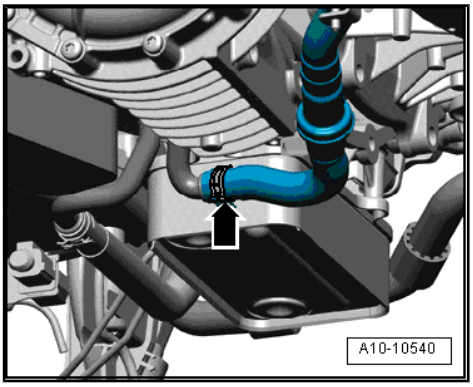
Note

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

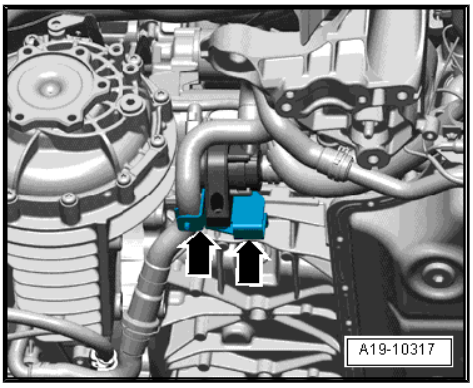
– Detach coolant hose from coolant pipe (left-side) on engine -arrow-.



– Detach coolant hose from ATF cooler at bottom of gearbox -arrow-.



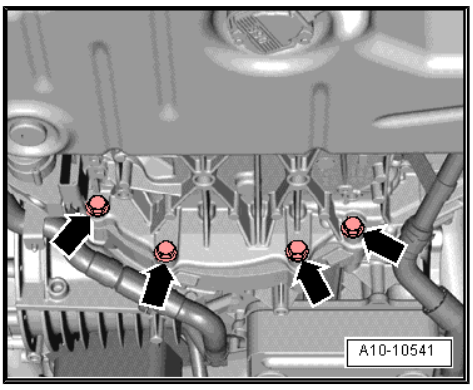
– Detach continued circulation coolant pump -V51- -arrows-.



Note

The coolant hoses and the electrical connector remain attached.

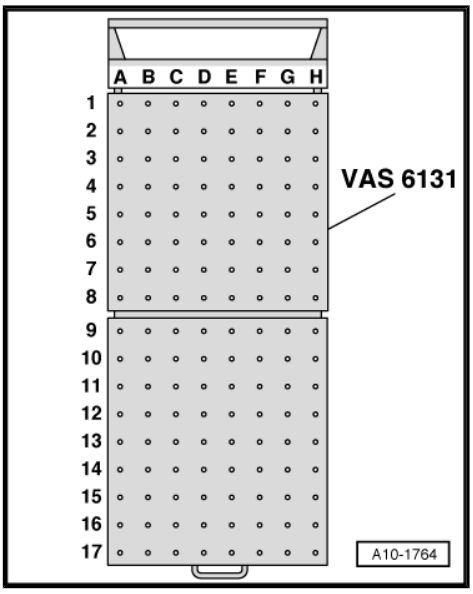
– Remove bottom engine/gearbox securing bolts -arrows-.



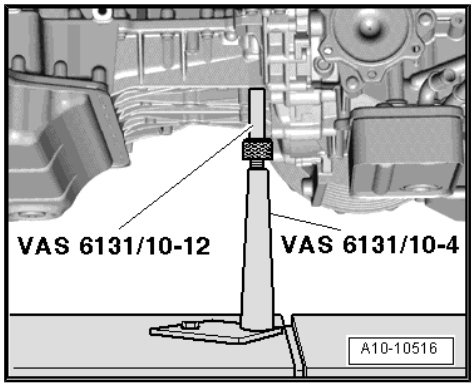
– Set up scissor-type assembly platform -VAS 6131 A- with support set for Audi -VAS 6131/10- and (2x) adapter -VAS 6131/10-12- as follows:

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
F10 1)	/10-1	/10-3	/10-5	/10-13
D11 1)	/10-1	/10-3	/10-5	/10-12
D16 1)	/10-1	/10-2	/10-5	/10-12

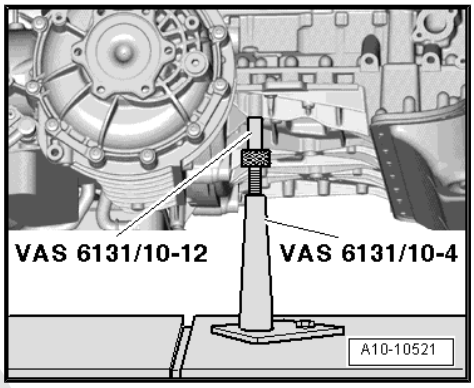
- 1) Support elements remain unchanged.



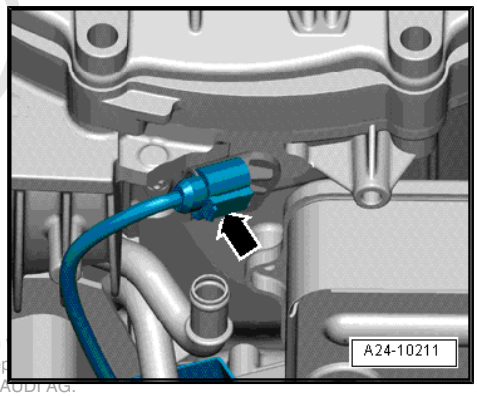
– Position support elements from -VAS 6131/10- on left side of engine, as shown in illustration.



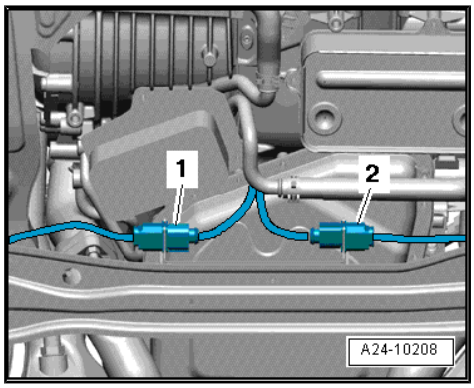
– Position support elements from -VAS 6131/10- on right side of engine, as shown in illustration.
– Turn spindles for the support elements upwards until all locating lugs make contact with the mounting points.
– Tighten base plates for support elements to 20 Nm on scissor-type assembly platform -VAS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



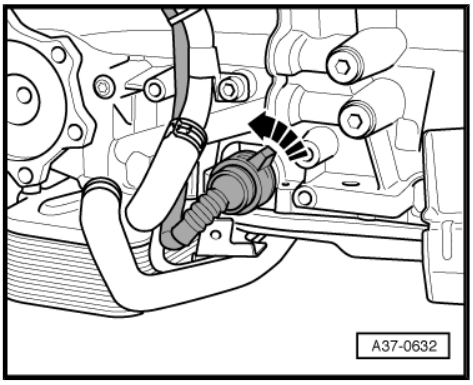
– Unplug electrical connector -arrow- at engine speed sender -G28- .



– Unplug electrical connectors -1- for Lambda probe -G39- and -2- for Lambda probe 3 -G285- .



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



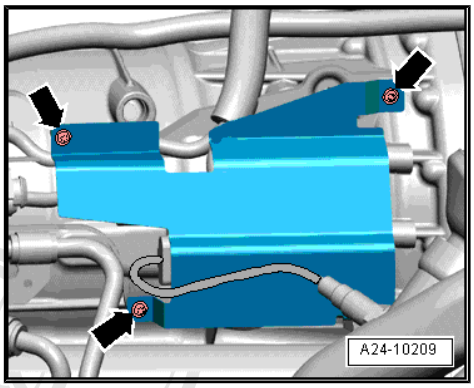
Caution

- *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.

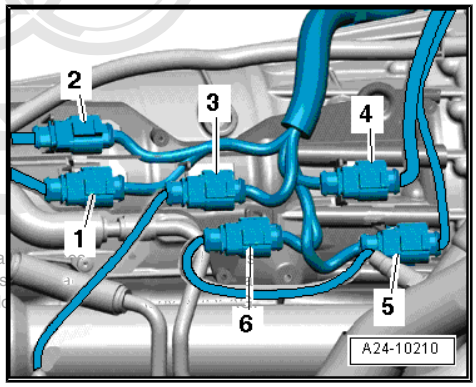
– Move wiring clear.

– Unbolt heat shield for electrical connectors for Lambda probes (right-side) from gearbox -arrows-.



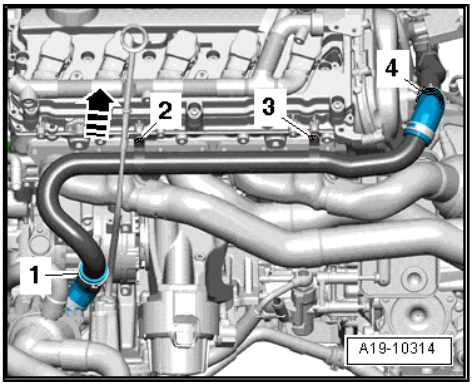
– Remove electrical connectors -1 ... 6- for Lambda probes from bracket on gearbox.

– Unplug electrical connectors.

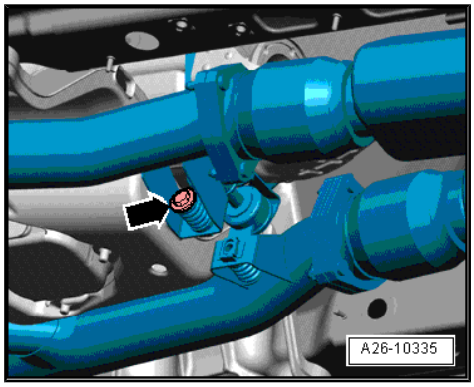


– Remove bolts -2- and -3- and lift out guide tube for oil dipstick -arrow-.

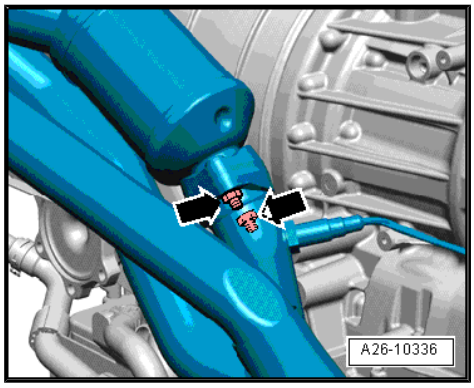
– Loosen hose clips -1- and -4- and detach coolant pipe (left-side) from coolant hoses.



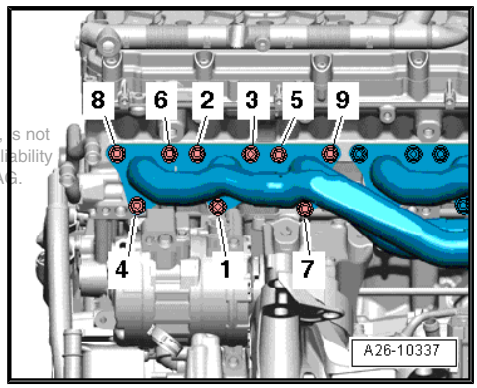
– Unscrew bolt -arrow- at bracket for exhaust pipes (left-side).



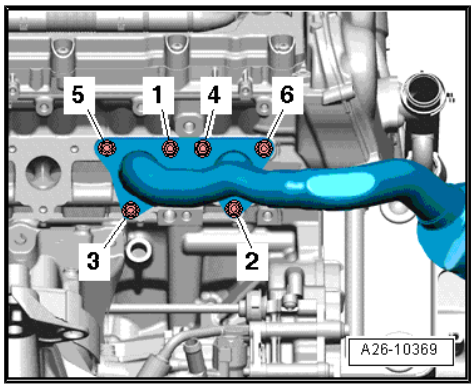
– Unscrew nuts -arrows-.



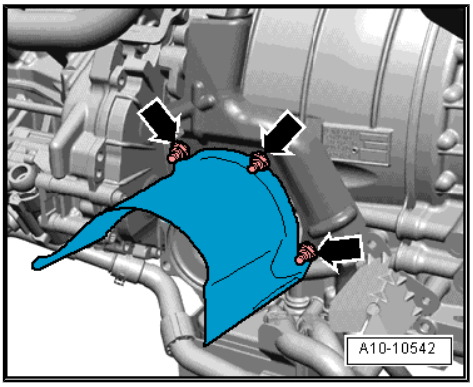
– Unscrew nuts in the sequence -9 ... 1- and remove front left exhaust manifold with catalytic converter.



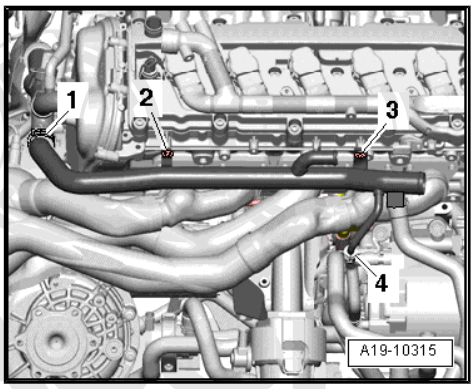
– Unscrew nuts in the sequence -6 ... 1- and remove rear left exhaust manifold with catalytic converter.



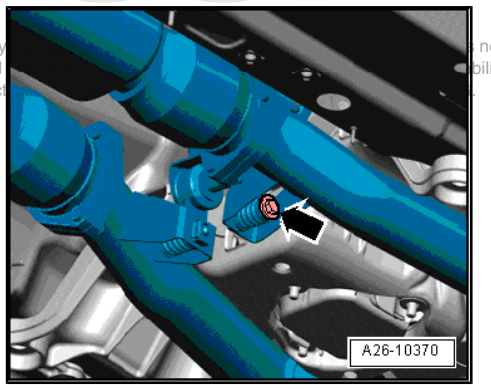
– Unbolt heat shield for drive shaft (left-side) from gearbox -arrows-.



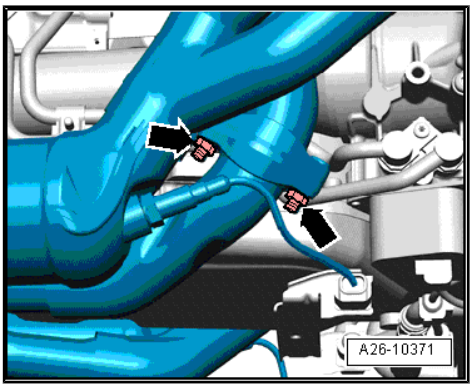
– Remove bolts -2- and -3-.
– Loosen hose clips -1- and -4- and detach coolant pipe (right-side) from coolant hoses.



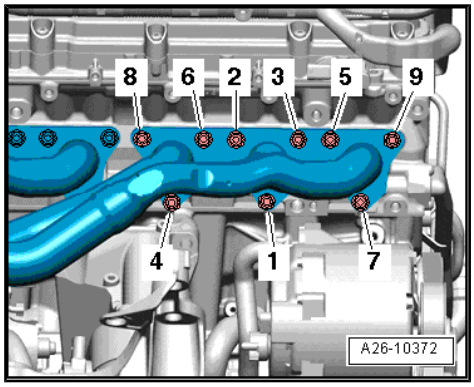
– Unscrew bolt -arrow- at bracket for exhaust pipes (right-side).



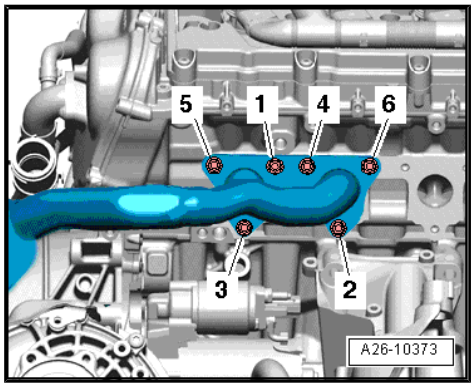
– Unscrew nuts -arrows-.



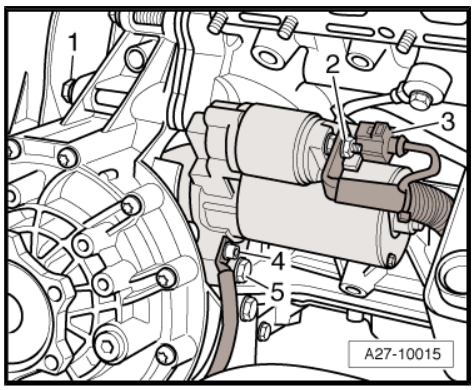
– Unscrew nuts in the sequence -9 ... 1- and remove front right exhaust manifold with catalytic converter.



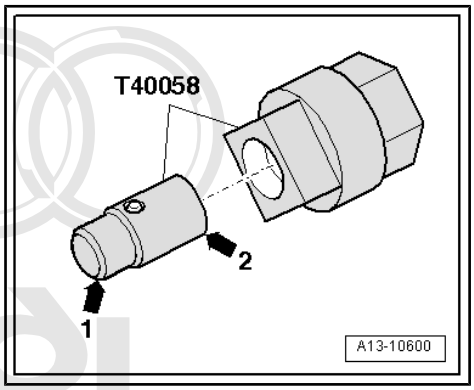
– Unscrew nuts in the sequence -6 ... 1- and remove rear right exhaust manifold with catalytic converter.



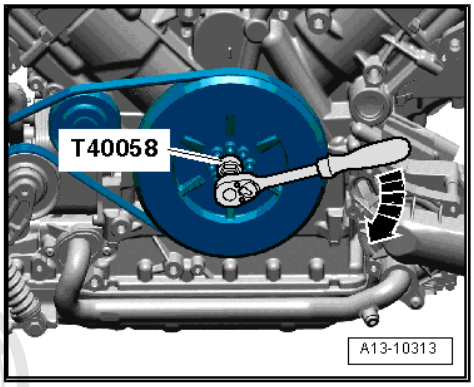
– Unbolt earth cable -4- at starter.
– Detach electrical wires -2- and -3- from starter.
– Remove bolts -1- and -5- and detach starter.



– 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.



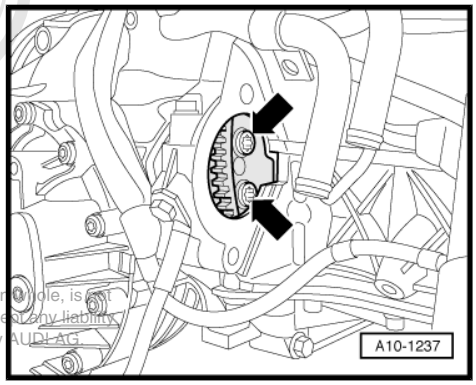
– When loosening torque converter bolts, counterhold crankshaft using adapter -T40058- .



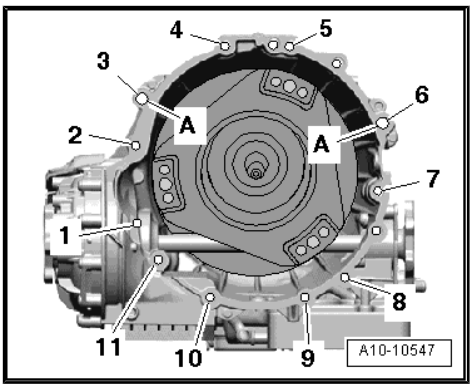
Note

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).



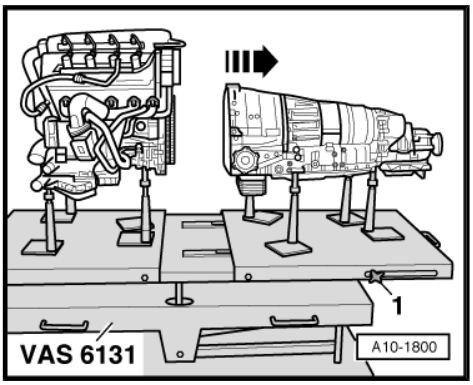
– Remove engine/gearbox securing bolts -3 ... 7-.



Note

Disregard -item A-.

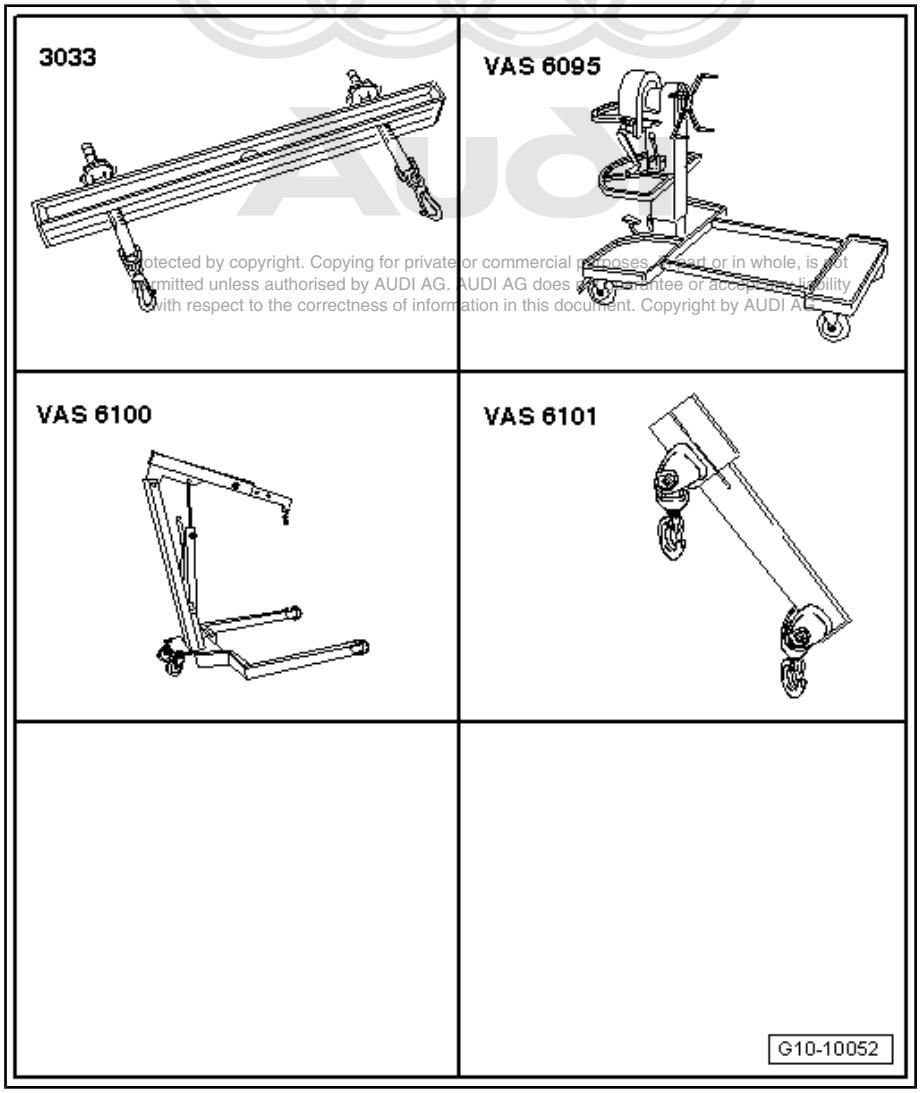
– Loosen clamping bolts -1- on sides of scissor-type assembly platform -VAS 6131 A- and pull rear section of platform together with gearbox towards the rear -arrow-; simultaneously separate the torque converter from the drive plate through the opening.



3 Securing engine to engine and gearbox support

Special tools and workshop equipment required

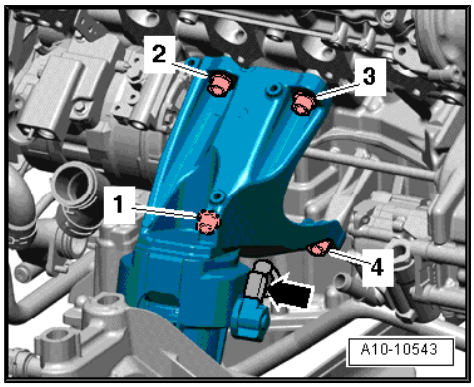
- Lifting tackle -3033-
- Engine and gearbox support -VAS 6095- with bracket -VAS 6095/1-7-
- Workshop hoist - VAS 6100-
- Lift arm extension (workshop hoist) -VAS 6101-



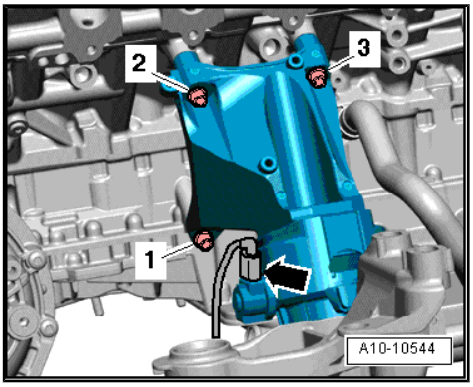
Procedure

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

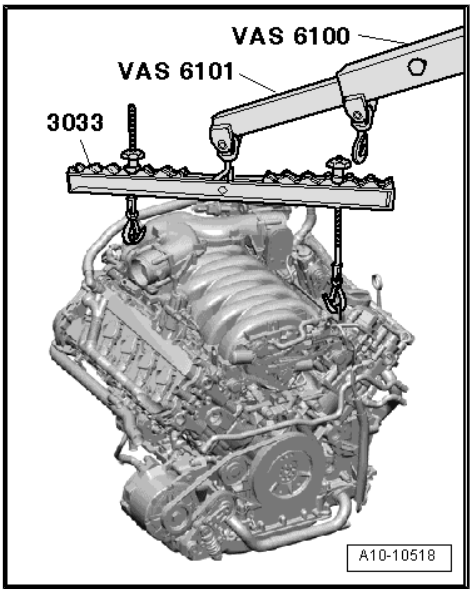
– Remove bolts -1 ... 4- and detach engine support with engine mounting.



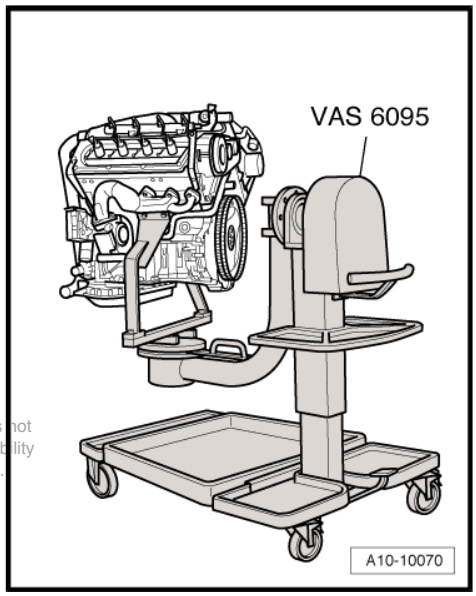
– Unplug electrical connector -arrow- at engine mounting (right-side).
– Remove bolts -1, 2, 3- and detach engine support with engine mounting.



– 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: 40 Nm).



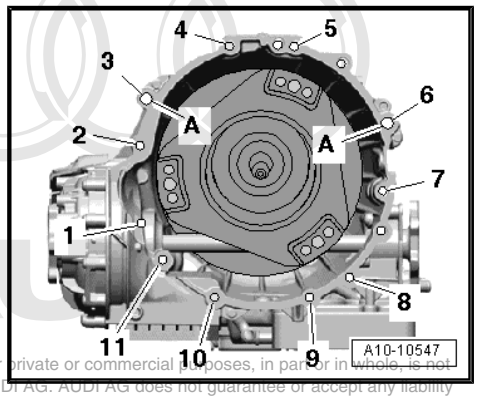
4 Installing engine

Note

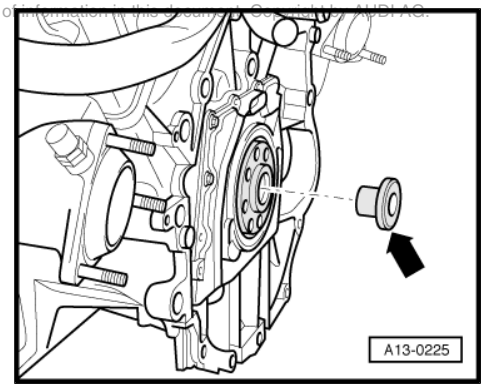
- *Renew self-locking nuts and bolts when performing assembly work.*
- *Renew bolts which are tightened to a specified angle as well as seals, gaskets and O-rings.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- *Fit all 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 42 .

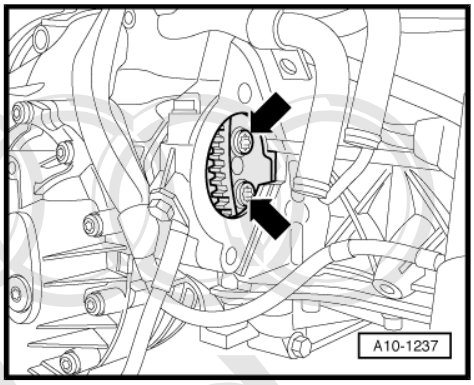
– Check whether dowel sleeves -A- for centring engine and gearbox are fitted in cylinder block; install missing dowel sleeves.



– 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-.



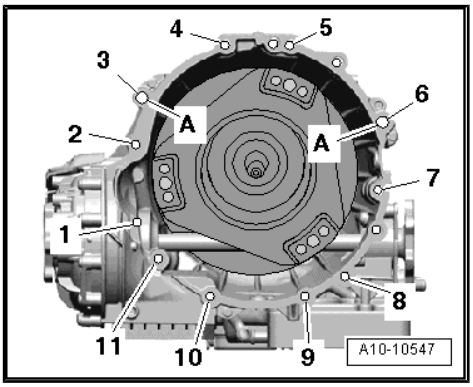
– To secure torque converter on drive plate, use only new ribbed bolts of the correct type (same as original equipment) as specified in ⇒ Electronic parts catalogue .

– 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%.*

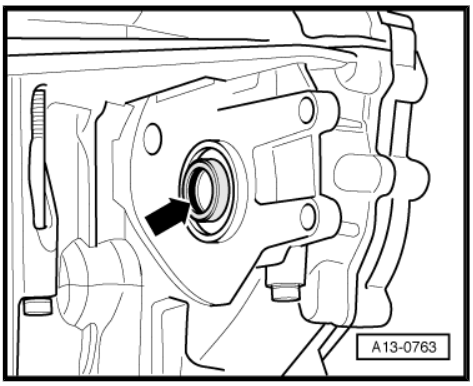
Securing engine to gearbox



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) Bolt strength rating 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 ⇒ Rep. Gr. 27 .

– Install exhaust pipes (left-side) ⇒ page 206 .

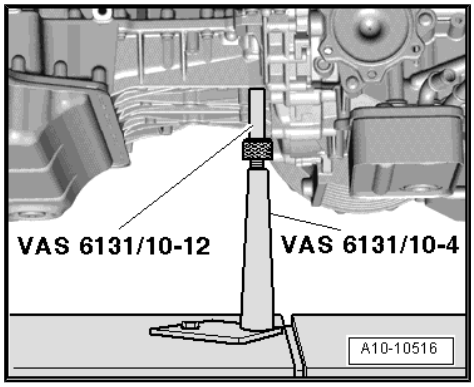
– Install exhaust pipes (right-side) ⇒ page 209 .

– Install coolant pipe (left-side) ⇒ page 189 .

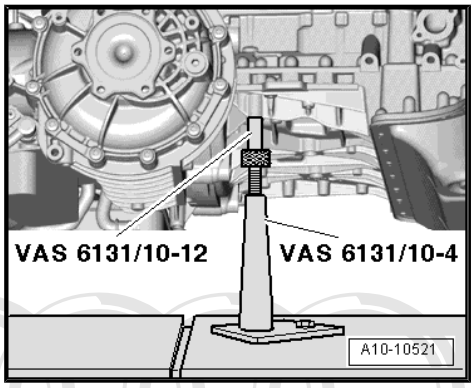
– Install coolant pipe (right-side) ⇒ page 190 .

– 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 spindle of support element on left side of engine/ gearbox assembly.
– Unscrew base plate for support element (left-side) from scissor-type assembly platform -VAS 6131 A- .



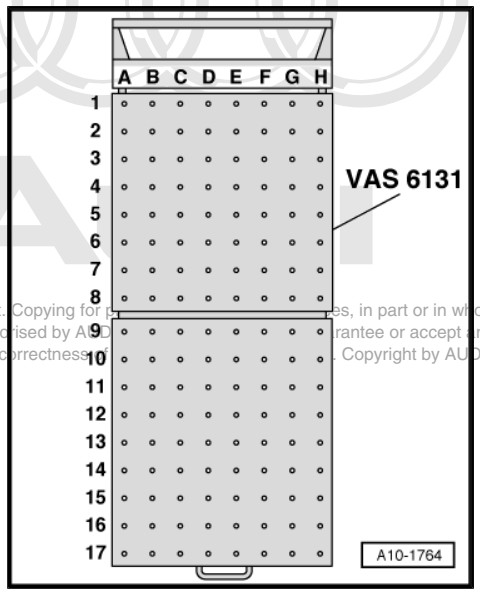
– Screw down spindle of support element on right side of engine/ gearbox assembly.
– Unscrew base plate for support element (right-side) from scissor-type assembly platform -VAS 6131 A- .



Note

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

– 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
A11	/10-1	/10-2 2)	/10-5 2)	/10-8 2)
H11	/10-1	/10-2 2)	/10-5 2)	/10-8 2)
F10 1)	/10-1	/10-3	/10-5	/10-13
D11 1)	/10-1	/10-3	/10-5	/10-12
D16 1)	/10-1	/10-2	/10-5	/10-12

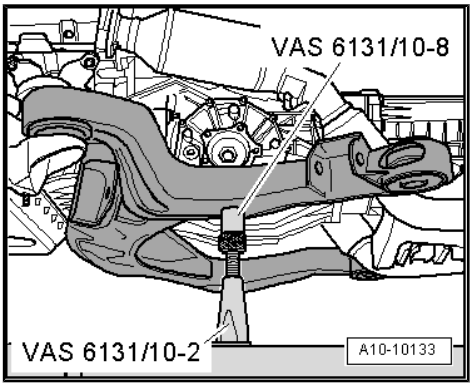
- 1) Support elements remain unchanged.
- 2) Secure support elements only after installing the subframe.

– 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- .

– Carefully guide engine/gearbox assembly together with subframe into the body from below using scissor-type assembly platform -VAS 6131 A- .

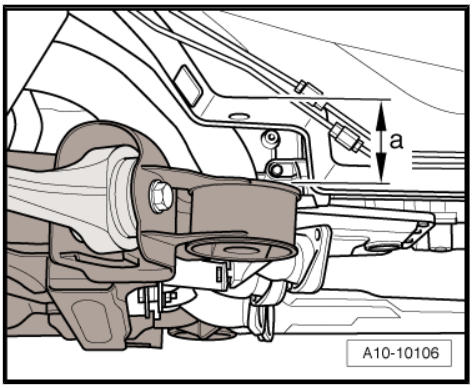


– Raise the engine/gearbox assembly using scissor-type assembly platform -VAS 6131 A- until the distance -a- is reached.

• Dimension -a- = max. 100 mm.

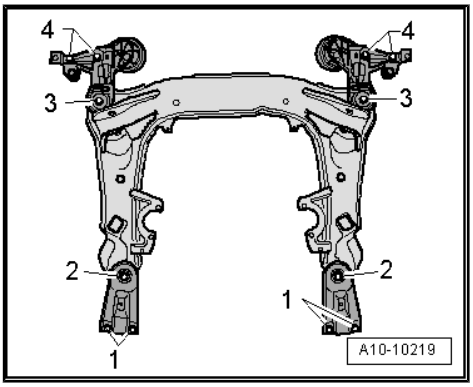
– Install selector lever cable and check adjustment if necessary ⇒ Rep. Gr. 37 .

– Raise engine/gearbox assembly together with subframe further using scissor-type assembly platform -VAS 6131 A- .



– Adjust the subframe and consoles for engine mountings according to the markings made on the longitudinal members during removal.

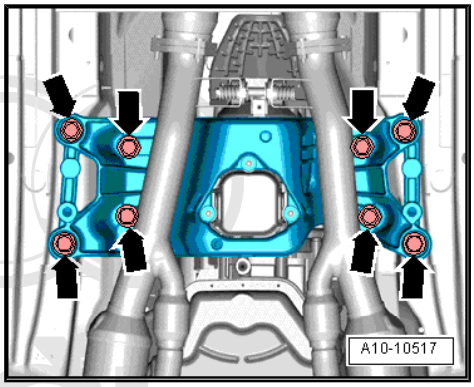
– Tighten bolts for subframe and consoles for engine mounting only to the specified torque (do not turn further); tighten bolts to final setting only after performing wheel alignment check ⇒ Rep. Gr. 40 .



WARNING

The vehicle must not be driven at this stage.

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



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

– Install drive shafts ⇒ Rep. Gr. 40 .
– Install guide links, track control links, anti-roll bar, coupling rods, suspension struts and cross piece for subframe ⇒ Rep. Gr. 40 .
– Install propshaft ⇒ Rear final drive 01R; Rep. Gr. 39 .
– Align exhaust system so it is free of stress ⇒ page 216 .
– Install refrigerant lines ⇒ Rep. Gr. 87 .
– Install air cleaner housing (left and right) ⇒ Rep. Gr. 24 .
– Electrical connections and routing ⇒ Current flow diagrams, Electrical fault finding and Fitting locations; tightening torques ⇒ Rep. Gr. 97 .
– Observe notes on procedures required after connecting battery ⇒ Rep. Gr. 27 .

Caution

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

– Install cross piece for suspension strut ⇒ Rep. Gr. 40 .
– Install and adjust wiper arms ⇒ Rep. Gr. 92 .
– Check oil level ⇒ Maintenance ; Booklet 405 .
– 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.

– Fill cooling system ⇒ page 172 .

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 .
– Adjust subframe and the two consoles for engine mountings ⇒ Rep. Gr. 40 .
– 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

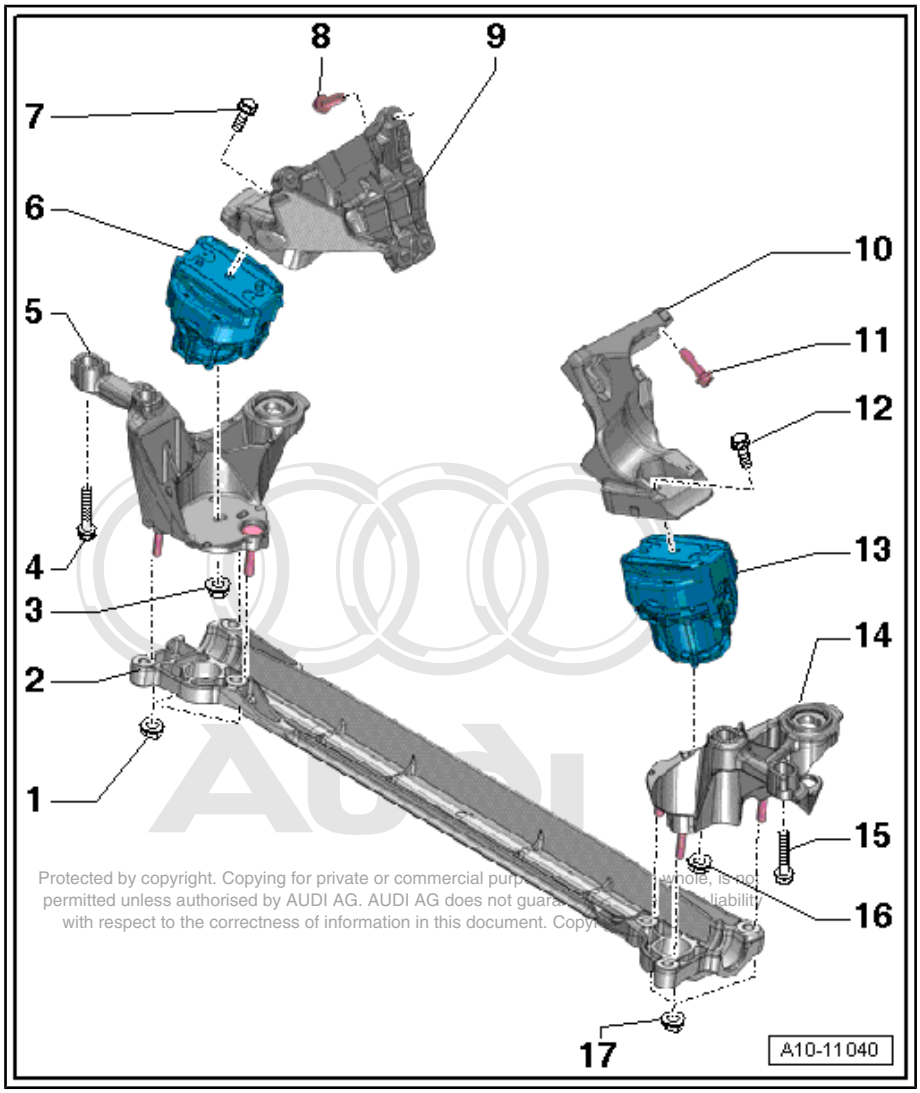
- *Tightening torques apply only to lightly greased, oiled, phosphated or black-finished nuts and bolts.*
- *Additional lubricants such as engine or gearbox oil may be used, but do not use lubricants containing graphite.*
- *Do not use degreased parts.*
- *Tolerance for tightening torques ± 15 %.*

Component		Nm
Bolts/nuts	M6	9
	M8	20
	M10	40
	M12	65
Except for the following:		
Drive plate to torque converter		⇒ Rep. Gr. 37 [1)]
Terminal B+ to starter		16
Drive shaft heat shield to gearbox		23
Fuel supply pipe to connecting piece		25

- [1)] Renew bolts; use only genuine bolts (same as original equipment) ⇒ Electronic parts catalogue .

5 Assembly mountings

5.1 Assembly mountings - exploded view



1 - Nut

- ❑ Tightening torque ⇒ Rep. Gr. 40

2 - Cross member

- ❑ Removing and installing ⇒ Rep. Gr. 40

3 - 40 Nm

- ❑ Self-locking
- ❑ Renew

4 - 75 Nm

5 - Console for engine mounting (right-side)

6 - Engine mounting (right-side)

- ❑ With right electrohydraulic engine mounting solenoid valve -N145-
- ❑ Removing and installing ⇒ page 43

7 - 40 Nm

8 - 40 Nm

9 - Engine support (right-side)

- ❑ Version fitted in vehicle may differ from illustration

10 - Engine support (left-side)

- ❑ Version fitted in vehicle may differ from illustration

11 - 40 Nm

12 - 40 Nm

13 - Engine mounting (left-side)

- ❑ With left electrohydraulic engine mounting solenoid valve -N144-
- ❑ Removing and installing ⇒ page 43

14 - Console for engine mounting (left-side)

15 - 75 Nm

16 - 40 Nm

- ❑ Self-locking
- ❑ Renew

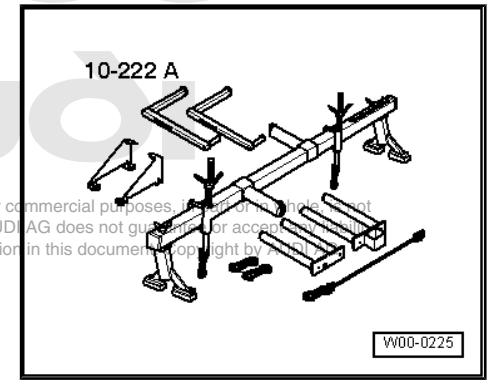
17 - Nut

- ❑ Tightening torque ⇒ Rep. Gr. 40

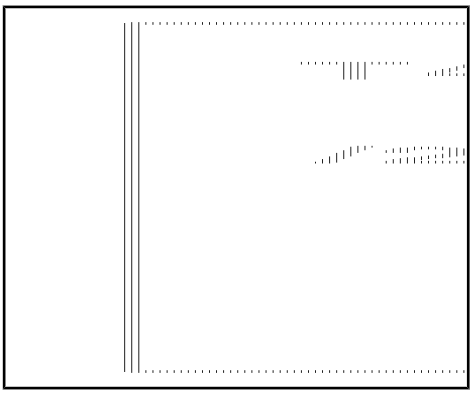
5.2 Removing and installing engine mounting (left and right)

Special tools and workshop equipment required

- Support bracket -10 - 222 A-



- Engine support bracket (supplementary set) -T40093-

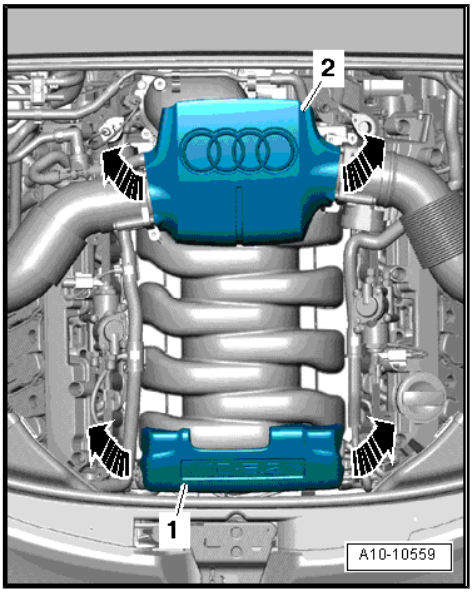


Removing

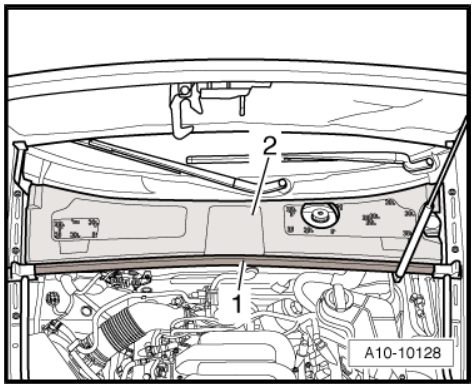
Note

Fit all cable ties in the original positions when installing.

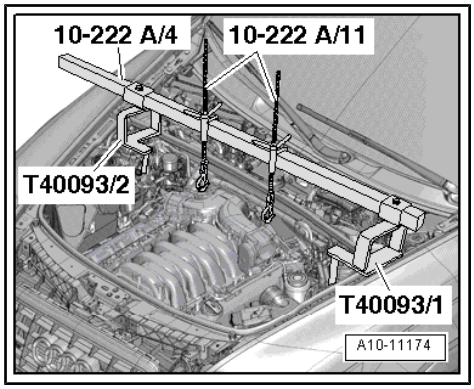
– Pull off engine cover panel (rear) -2- -arrows-.



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



– Set up adapter -10 - 222 A /4- with spindle -10 - 222 A /11- (2x) and supports -T40093/1- and -T40093/2- on suspension turrets (left and right) as illustrated.



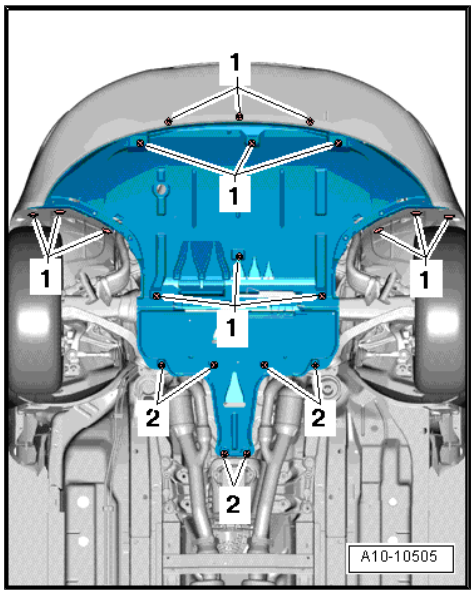
Note

Supports are marked for left and right side of vehicle.

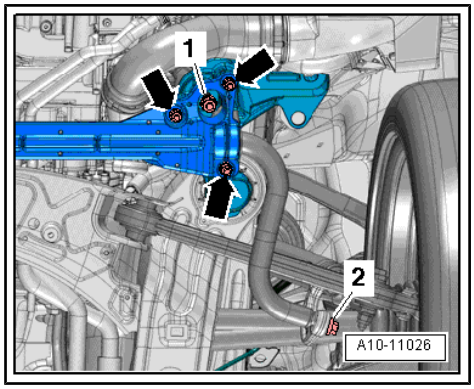
– Engage hooks -10 - 222 A /10- at rear engine lifting eyes.

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

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



– Remove nuts -1, arrows- and bolt -2- on both sides and take off cross member with anti-roll bar.

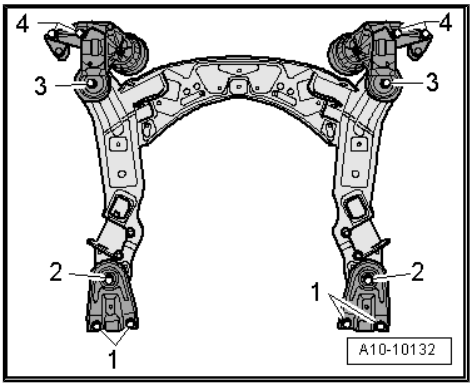


WARNING

Risk of accident - do not slacken bolts -2- and -3- securing subframe.

– Remove bolts -3- and -4- and detach consoles for engine mountings.

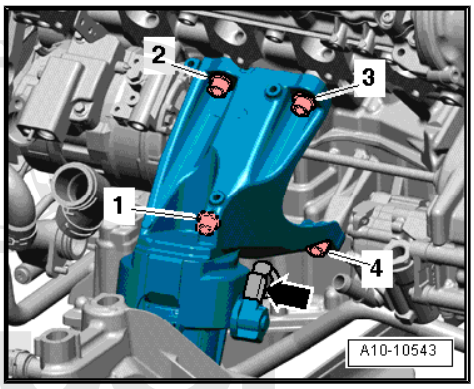
– Lower subframe at the front.



Engine mounting (left-side):

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

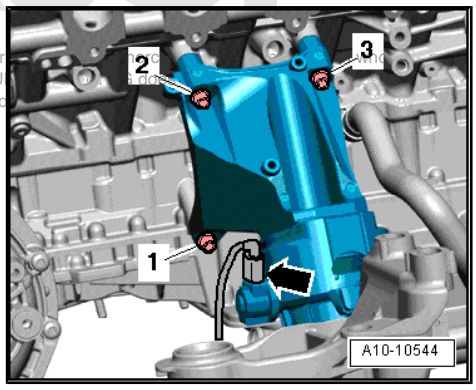
– Remove bolts -1 ... 4- and detach engine support with engine mounting.



Engine mounting (right-side):

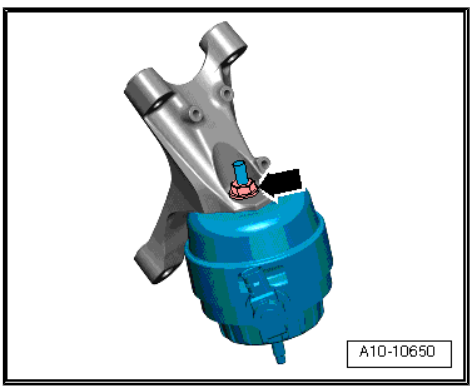
– Unplug electrical connector -arrow- on right electrohydraulic engine mounting solenoid valve -N145- .

– 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 .

– Fit front wheels ⇒ Rep. Gr. 44 .

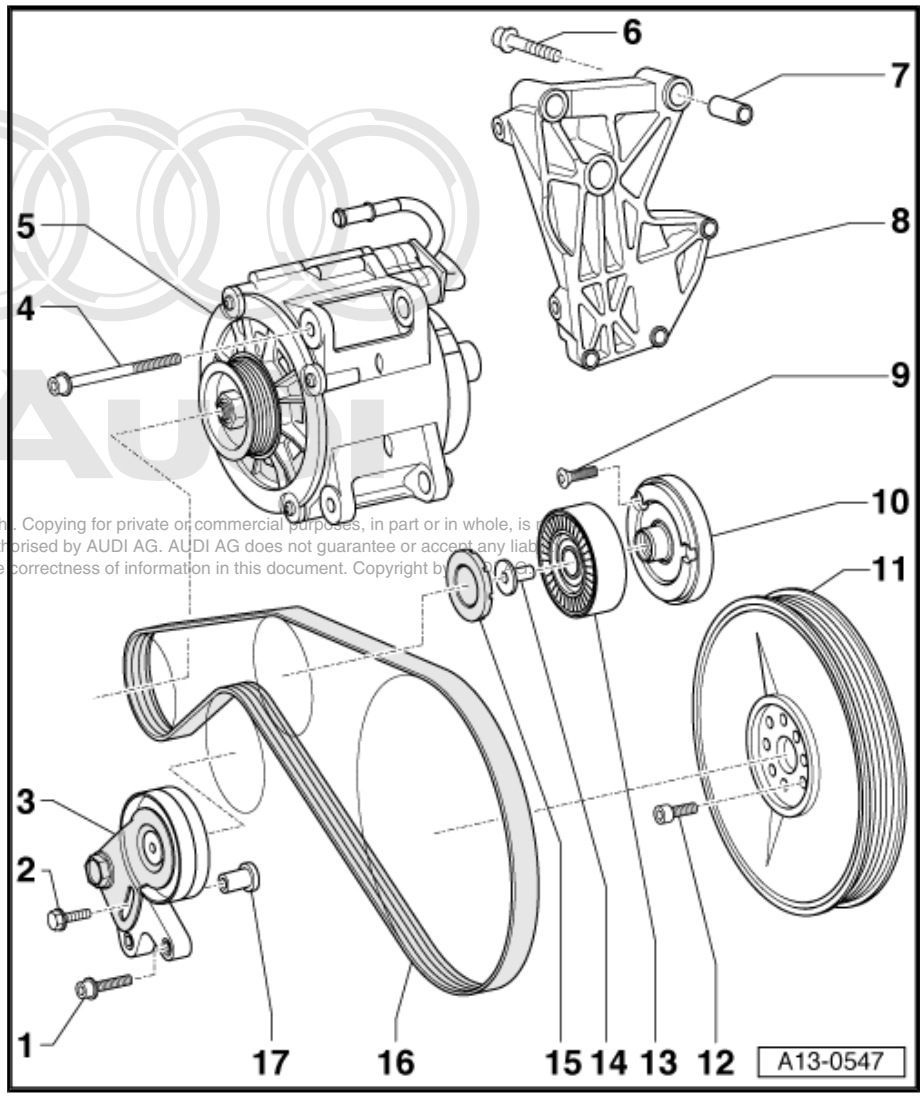
Tightening torques

Component	Nm
Engine support to cylinder block	40
Console for engine mounting to longitudinal member	75
Engine mounting to console for engine mounting	40

13 – Crankshaft group

1 Cylinder block (pulley end)

1.1 Poly V-belt drive - exploded view



1 - 22 Nm

2 - 22 Nm

3 - Tensioner for poly V-belt

4 - 22 Nm

5 - Alternator

- ❑ Removing and installing ⇒ Rep. Gr. 27

6 - M8: 22 Nm; M10: 46 Nm

7 - Dowel sleeve

- ❑ For bracket for alternator
- ❑ 2 x

8 - Bracket for alternator

9 - 10 Nm

10 - Bracket for idler roller

11 - Vibration damper

- ❑ Removing and installing ⇒ page 48

12 - Bolt

- ❑ Renew
- ❑ Only use genuine bolts (same as original equipment): bolt strength 12.9
- ❑ Apply locking fluid when installing non-self-locking bolts; refer to ⇒ Electronic parts catalogue for locking fluid
- ❑ Tightening torque and sequence ⇒ page 49

13 - Idler roller for poly V-belt

14 - 22 Nm

15 - Cover cap

16 - Poly V-belt

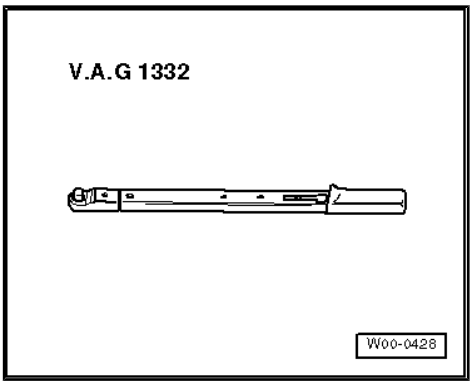
- ❑ Check for wear
- ❑ Do not kink
- ❑ Before removing, mark direction of rotation with chalk or felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.
- ❑ Removing and installing ⇒ page 47
- ❑ Check that the belt is properly fitted on the pulleys when installing.

17 - Threaded bush

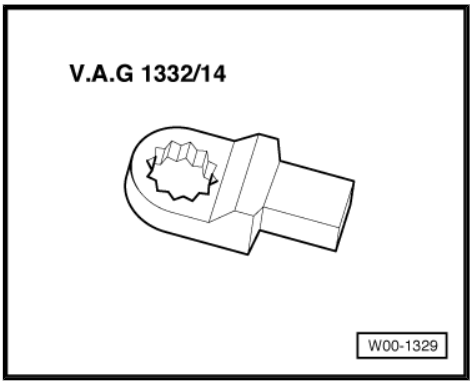
1.2 Removing and installing poly V-belt

Special tools and workshop equipment required

- Torque wrench -V.A.G 1332-

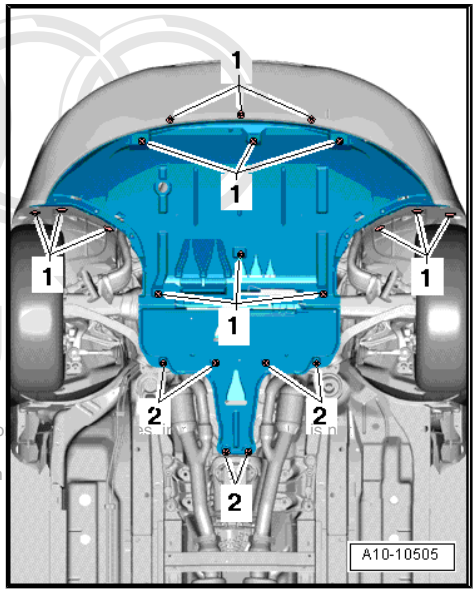


- Ring spanner insert AF 16 -V.A.G 1332/14-



Removing

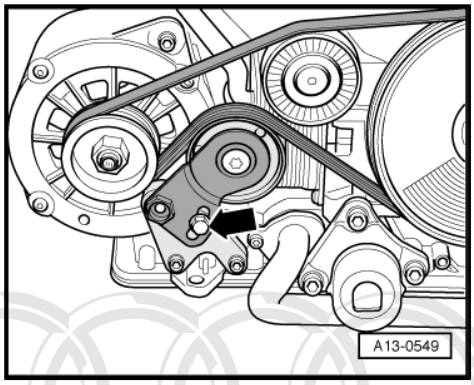
– Open quick-release fasteners -1- and remove noise insulation (front).



Note

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

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

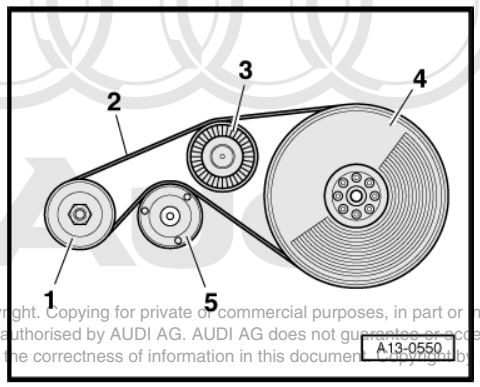


Installing

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

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

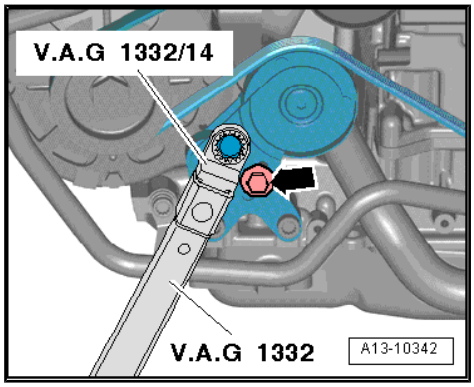
1 - Alternator
2 - Poly V-belt
3 - Idler roller
4 - Vibration damper
5 - Tensioning roller



Note

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

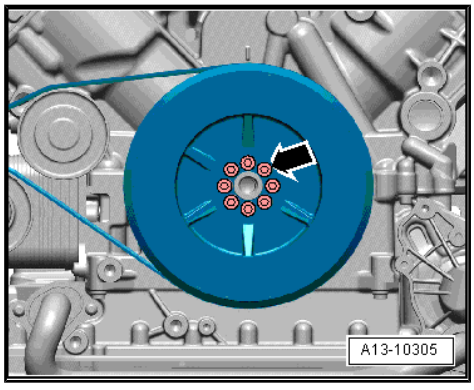
– Apply torque wrench with ring spanner insert AF 16 -V.A.G 1332/14- to hexagon flats on tensioning roller and tension poly V-belt to 70 Nm.
– At the same time tighten clamping bolt -arrow- to 25 Nm.
– Start engine and check that belt runs properly.



1.3 Removing and installing vibration damper

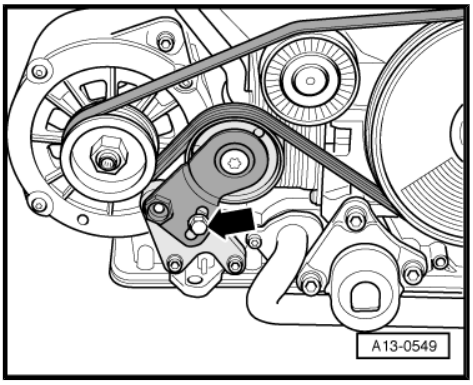
Removing

– Drain off coolant ⇒ page 170 .
– Remove radiator ⇒ page 191 .
– 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-tipped pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.



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

Installing

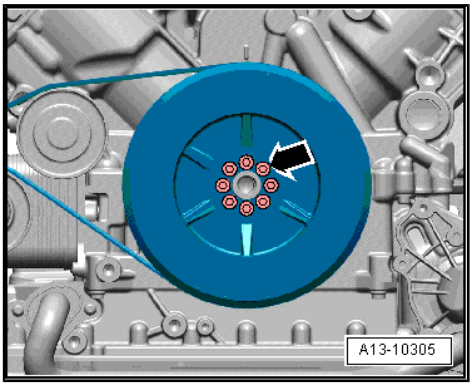
Installation is carried out in the reverse order; note the following:

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; refer to ⇒ Electronic parts catalogue for locking fluid*

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

– Tighten bolts for vibration damper in 4 stages:



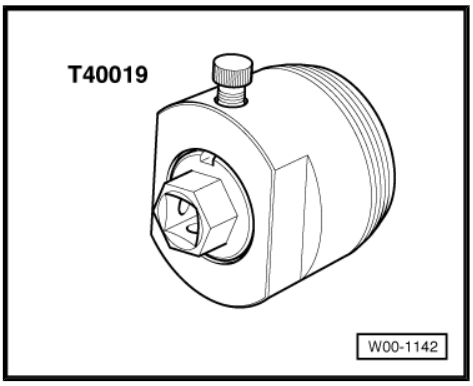
Stage	Bolts	Tightening torque/tightening angle
1.	-arrow-	15 Nm in diagonal sequence
2.	-arrow-	22 Nm in diagonal sequence
3.	-arrow-	Turn 90° further in diagonal sequence
4.	-arrow-	Turn 90° further in diagonal sequence

– Install poly V-belt ⇒ page 47 .
– Install radiator ⇒ page 191 .
– Fill cooling system ⇒ page 172 .

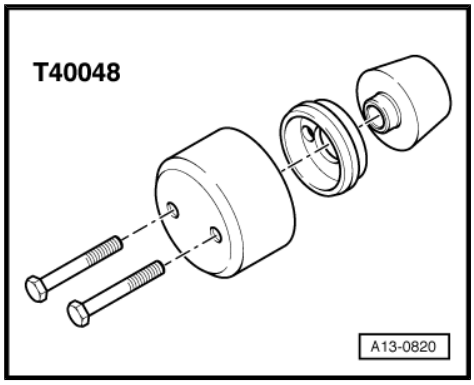
1.4 Renewing crankshaft oil seal (pulley end)

Special tools and workshop equipment required

- Oil seal extractor -T40019-



♦ Assembly tool -T40048-



Procedure

– Drain off coolant ⇒ page 170 .

– Remove radiator ⇒ page 191 .

– Remove vibration damper ⇒ page 48 .

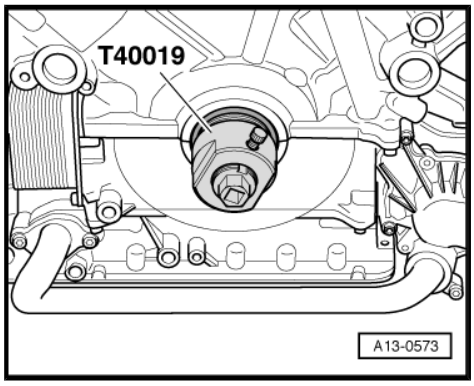
– Adjust inner section of oil seal extractor -T40019- so it is flush with the outer section and lock in position with knurled screw.

– 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.

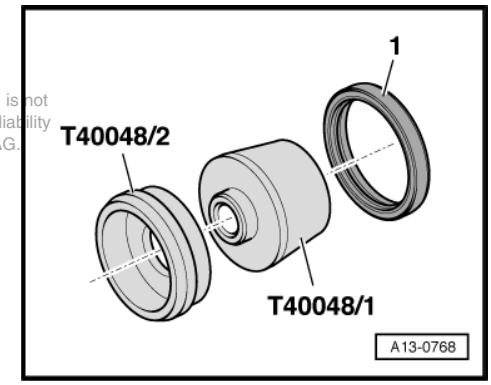
– Clamp flats of oil seal extractor in vice. Remove oil seal with pliers.

– Clean running surface and sealing surface.



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

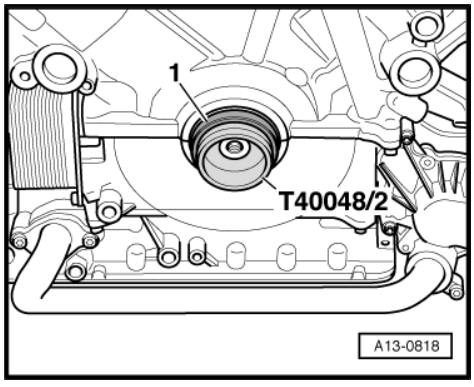
– Take off assembly aid.



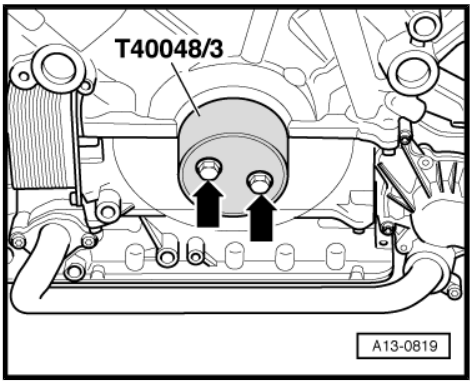
– Fit assembly sleeve -T40048/2- on crankshaft and slide oil seal -1- into sealing surface on engine.

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 48 .
– Install poly V-belt ⇒ page 47 .
– Install radiator ⇒ page 191 .
– Fill cooling system ⇒ page 172 .

2 Cylinder block (gearbox end)

2.1 Drive plate - exploded view

1 - Drive plate
- ❑ Removing and installing ⇒ page 52
- ❑ Mark installation position for re-installation

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

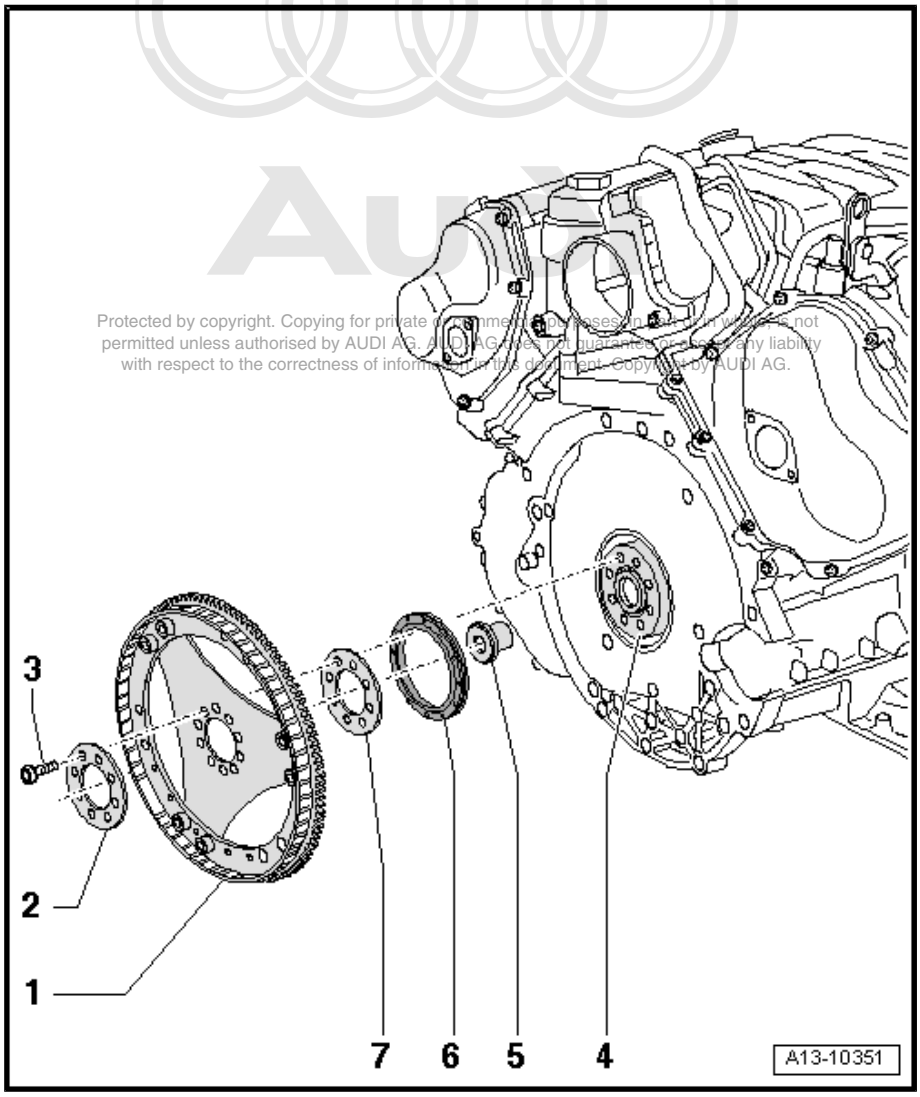
3 - 60 Nm + 90° further
- ❑ Renew

4 - Crankshaft

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

6 - Crankshaft oil seal (gearbox end)
- ❑ Renewing ⇒ page 53

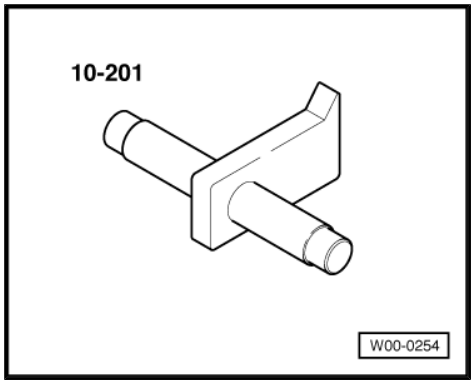
7 - Shim
- ❑ 1.5 mm thick
- ❑ Mark installation position for re-installation



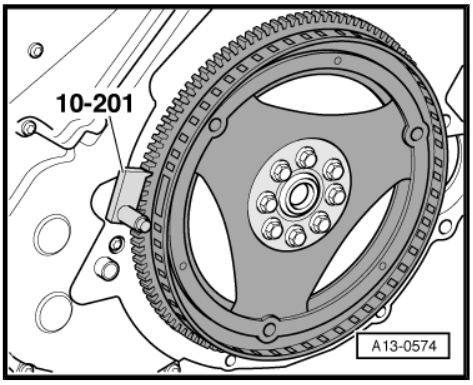
2.2 Removing and installing drive plate

Special tools and workshop equipment required

♦ Counterhold tool -10 - 201-



Removing



- Engine separated from gearbox ⇒ page 26 , engine attached to scissor-type assembly platform -VAS 6131 A- or secured to engine and gearbox support ⇒ page 34 .
- 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.

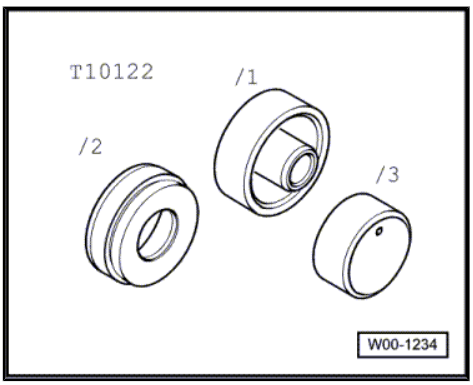
Tightening torque

Component	Nm
Drive plate to crankshaft	60 +90° 1)
• 1) Renew bolts.	

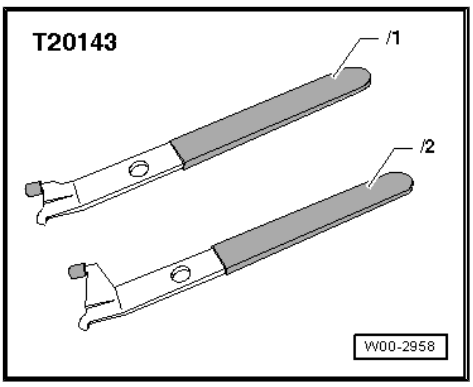
2.3 Renewing crankshaft oil seal (gearbox end)

Special tools and workshop equipment required

♦ Fitting tool -T10122-



♦ Extractor tool -T20143-



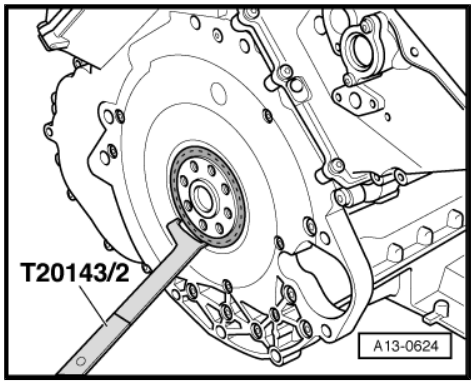
Procedure

- Engine separated from gearbox ⇒ page 26 , engine attached to scissor-type assembly platform -VAS 6131 A- or secured to engine and gearbox support ⇒ page 34 .

– Remove drive plate ⇒ page 52 .

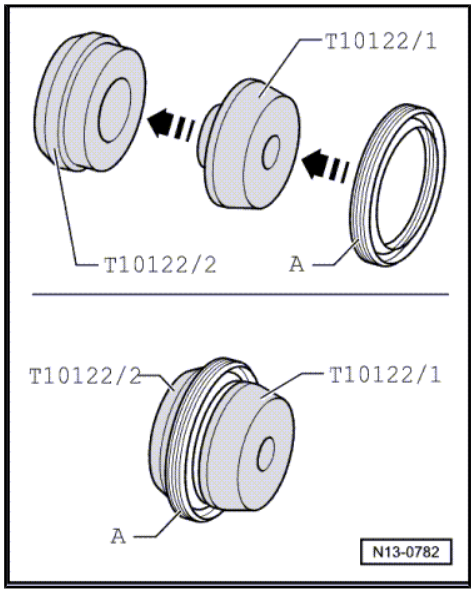
– Pry out oil seal using extractor tool -T20143/2- .

– Clean running surface and sealing surface.

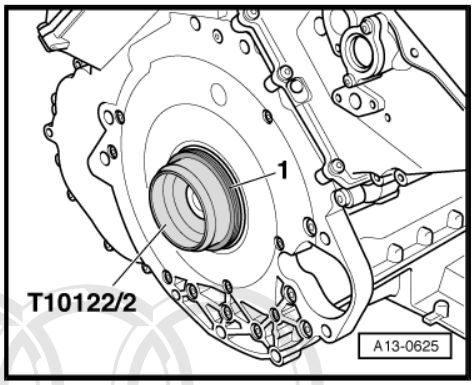


– Fit assembly aid -T10122/1- onto assembly sleeve -T10122/2- and slide oil seal -A- onto assembly sleeve.

– Take off assembly aid.



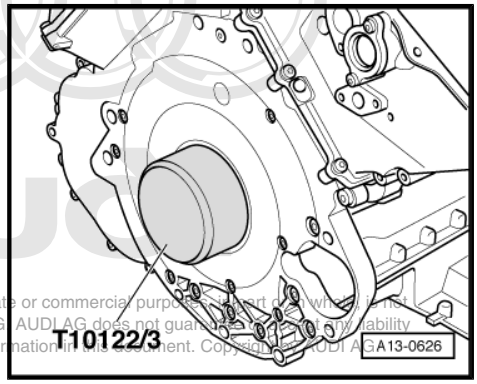
– Fit the assembly sleeve -T10122/2- with oil seal -1- onto crankshaft.



– Press in the oil seal with -T10122/3- until flush (make sure that oil seal is pressed in evenly at all points).

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

– Install drive plate ⇒ page 52 .

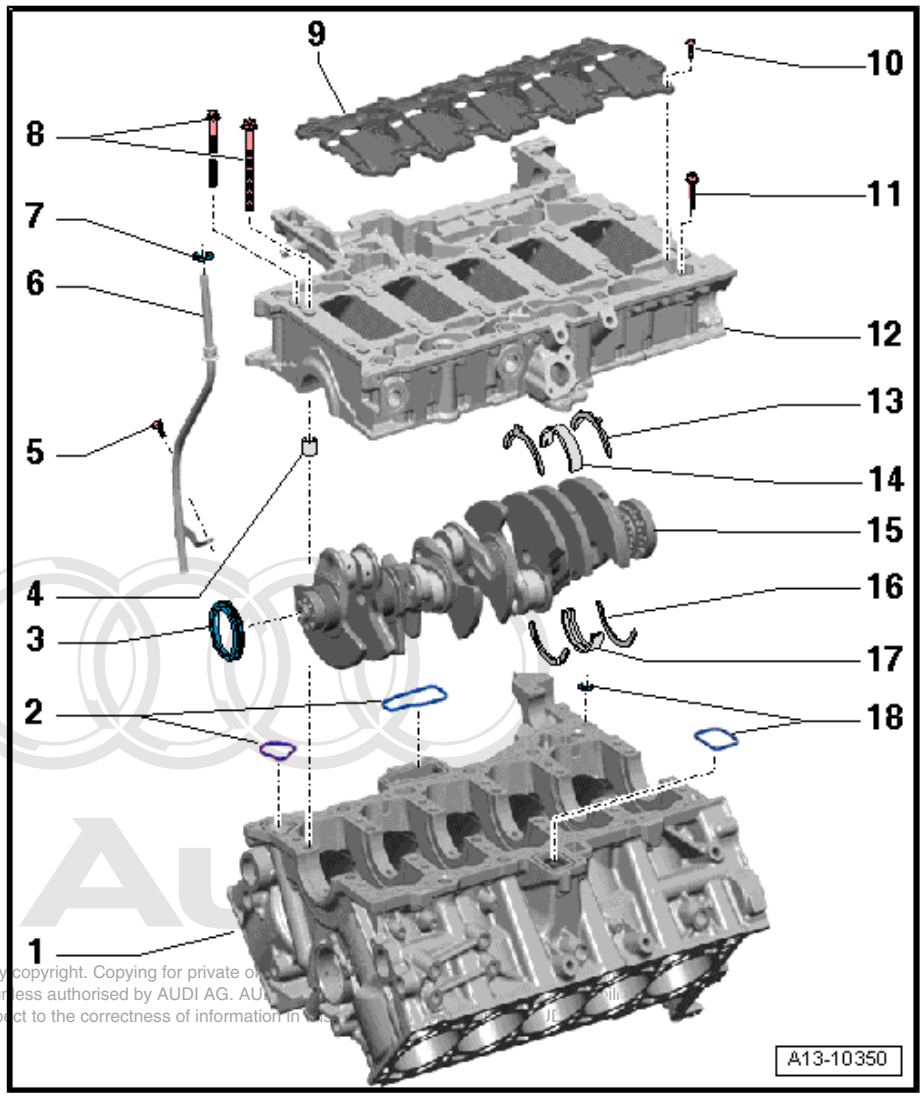


3 Crankshaft

Note

When carrying out repairs, secure engine to engine and gearbox support -VAS 6095- with bracket -VAS 6095/1-7- ⇒ page 34 .

3.1 Crankshaft - exploded view



1 - Cylinder block
- ❑ Matched to -item 12-
- ❑ Applying sealant onto cylinder block (for retaining frame) ⇒ page 57

2 - Gaskets
- ❑ Renew

3 - Oil seal for crankshaft (pulley end)
- ❑ Renewing ⇒ page 49

4 - Dowel sleeve
- ❑ 3x
- ❑ Insert in retaining frame
- ❑ Installation position ⇒ page 57

5 - 9 Nm

6 - Guide tube for oil dipstick

7 - O-ring
- ❑ Renew

8 - Bolts
- ❑ For retaining frame
- ❑ Renew
- ❑ Different bolt lengths
- ❑ Tightening sequence ⇒ page 57

9 - Baffle plate

10 - 9 Nm
- ❑ Tightening sequence ⇒ page 56

11 - Bolt
- ❑ For sealing surfaces: cylinder block/retaining frame
- ❑ Different bolt lengths
- ❑ Tightening torques and tightening sequence ⇒ page 57

12 - Retaining frame
- ❑ Matched to -item 1-
- ❑ Applying sealant onto cylinder block (for retaining frame) ⇒ page 57
- ❑ Tightening sequence ⇒ page 57

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 60

14 - Bearing shell

- ❑ For retaining frame (without oil groove)
- ❑ Mark used bearing shells for re-installation but not on bearing surface
- ❑ Bearing shells worn down to the base layer must be renewed
- ❑ Install new bearing shells for retaining frame with correct coloured markings

New crankshafts ⇒ page 58

Used or machined crankshafts ⇒ page 59

15 - Crankshaft

- ❑ Measuring axial clearance ⇒ page 60
- ❑ Measuring radial clearance ⇒ page 61
- ❑ Crankshaft dimensions ⇒ page 60

16 - Thrust washer

- ❑ Only fitted on 4th crankshaft bearing
- ❑ Oil groove faces outwards
- ❑ Measuring axial clearance of crankshaft ⇒ page 60

17 - Bearing shell

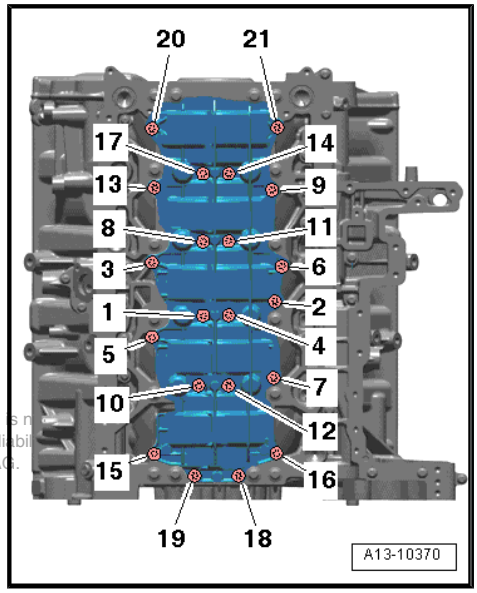
- ❑ For cylinder block (with oil groove)
- ❑ Mark used bearing shells for re-installation but not on bearing surface
- ❑ Bearing shells worn down to the base layer must be renewed
- ❑ Fit new bearing shells for cylinder block with the correct colour coding: for new crankshafts ⇒ page 58 , for used and machined crankshafts ⇒ page 59

18 - Gaskets

- ❑ Renew

Tightening sequence for baffle plate

– Tighten bolts in the sequence -1 ... 21-.



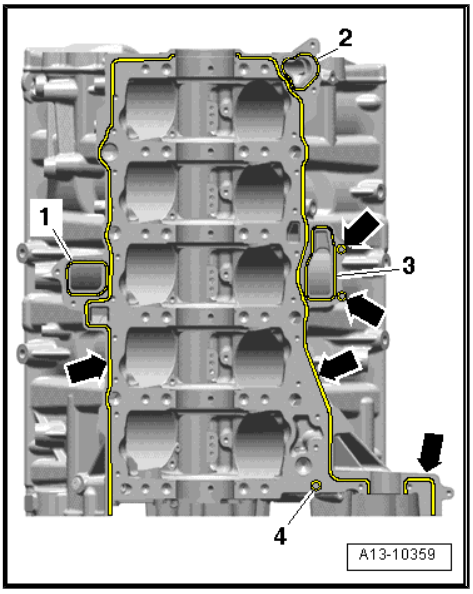
Applying sealant onto cylinder block (for retaining frame)

– 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.

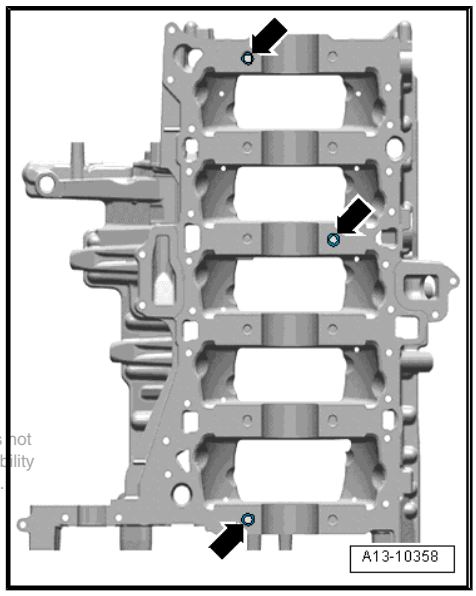
• Width of sealant beads: 2.0 mm.

– Fit gaskets -1 … 4-.



Fitting location of dowel sleeves

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



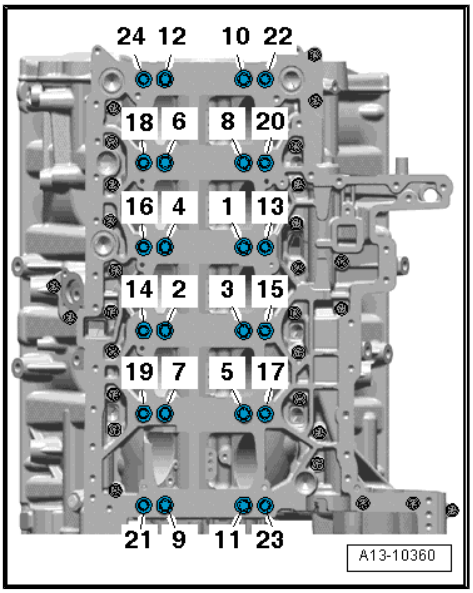
Installing retaining frame

– Renew bolts -1 … 24- for retaining frame.

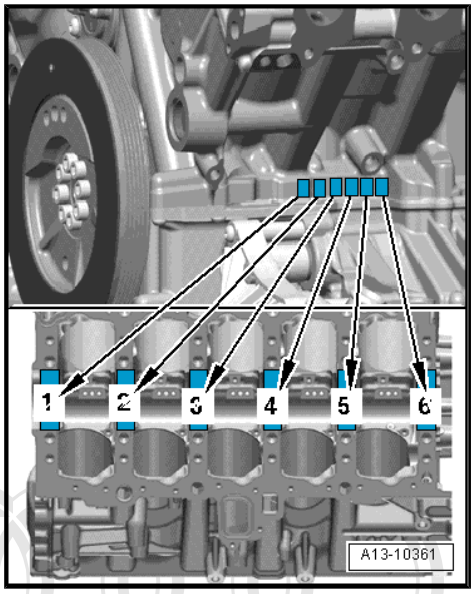
– Tighten bolts in 5 stages as follows:

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 crankshafts



Matching crankshaft bearing shells to bearings in cylinder block

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

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

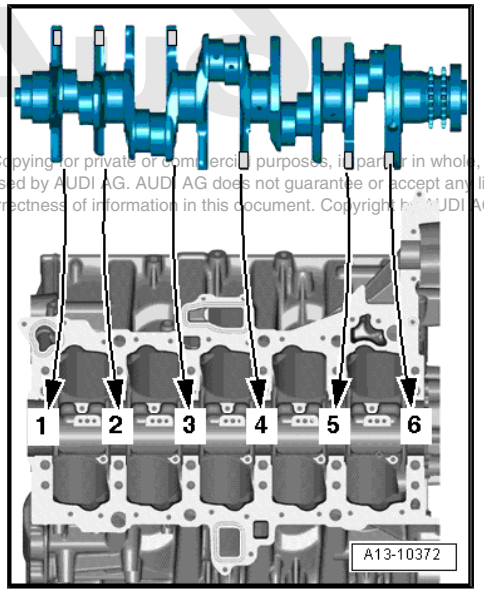
Note

The code letters are also stamped on the retaining frame.

Allocation of crankshaft bearing shells for retaining frame - version I

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

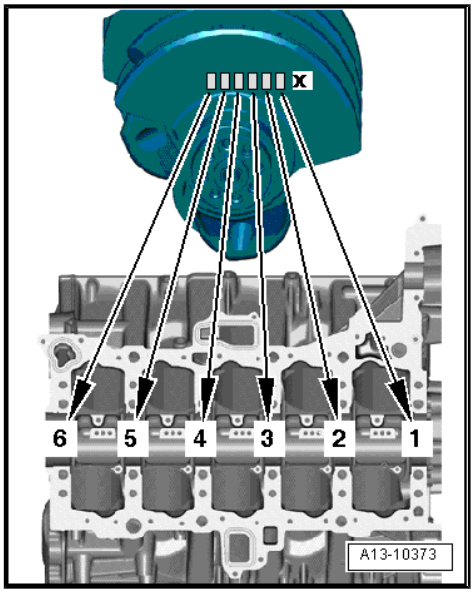
Coloured marking on crankshaft	Colour coding of bearing
Red	Red
Yellow	Yellow
Blue	Blue



Allocation of crankshaft bearing shells for retaining frame - version II

- Bearing shells of the correct thickness are matched to the bearings in the retaining frame at the factory. Coloured dots on the side of the bearing shells are used to identify the bearing shell thickness.
- The allocation of the bearing shells to the retaining frame is indicated by letters on the front crankshaft web, as shown in illustration. The “X” indicates the end of the row of letters and is next to the colour coding for bearing 1 (pulley end).

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

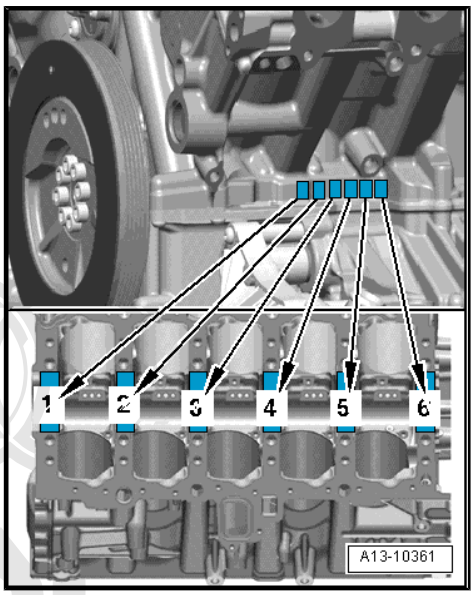


3.3 Allocation of main bearing shells on used and machined crankshafts

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.

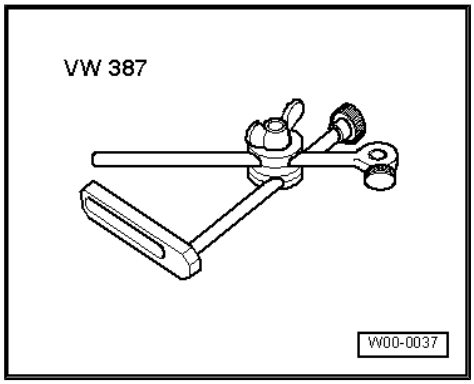
3.4 Crankshaft dimensions

Honing dimension	Crankshaft main 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

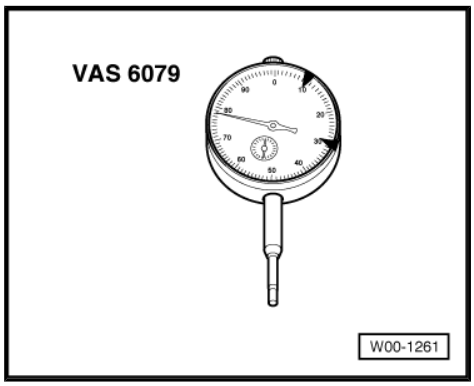
3.5 Measuring axial clearance of crankshaft

Special tools and workshop equipment required

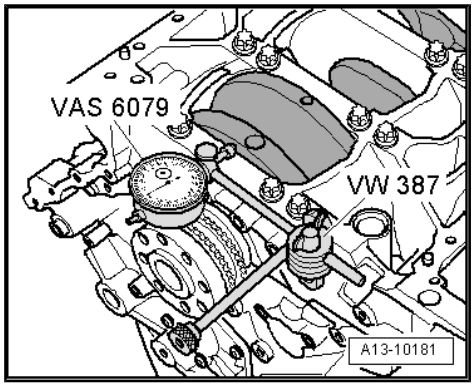
- Universal dial gauge bracket -VW 387-



- 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

Note

- *Mark used bearing shells for re-installation, but not on bearing surface.*
- *Bearing shells worn down to the base layer must be renewed.*

– Remove retaining frame and clean bearing journals.

– Place Plastigage onto bearing journal or into bearing shells (length of Plastigage should correspond to width of bearing).

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

– Fit retaining frame and tighten to 30 Nm. Do not rotate crankshaft.

– Remove retaining frame once more.

– Compare width of Plastigage with measurement scale:

Radial clearance:

• New: 0.017 ... 0.044 mm.

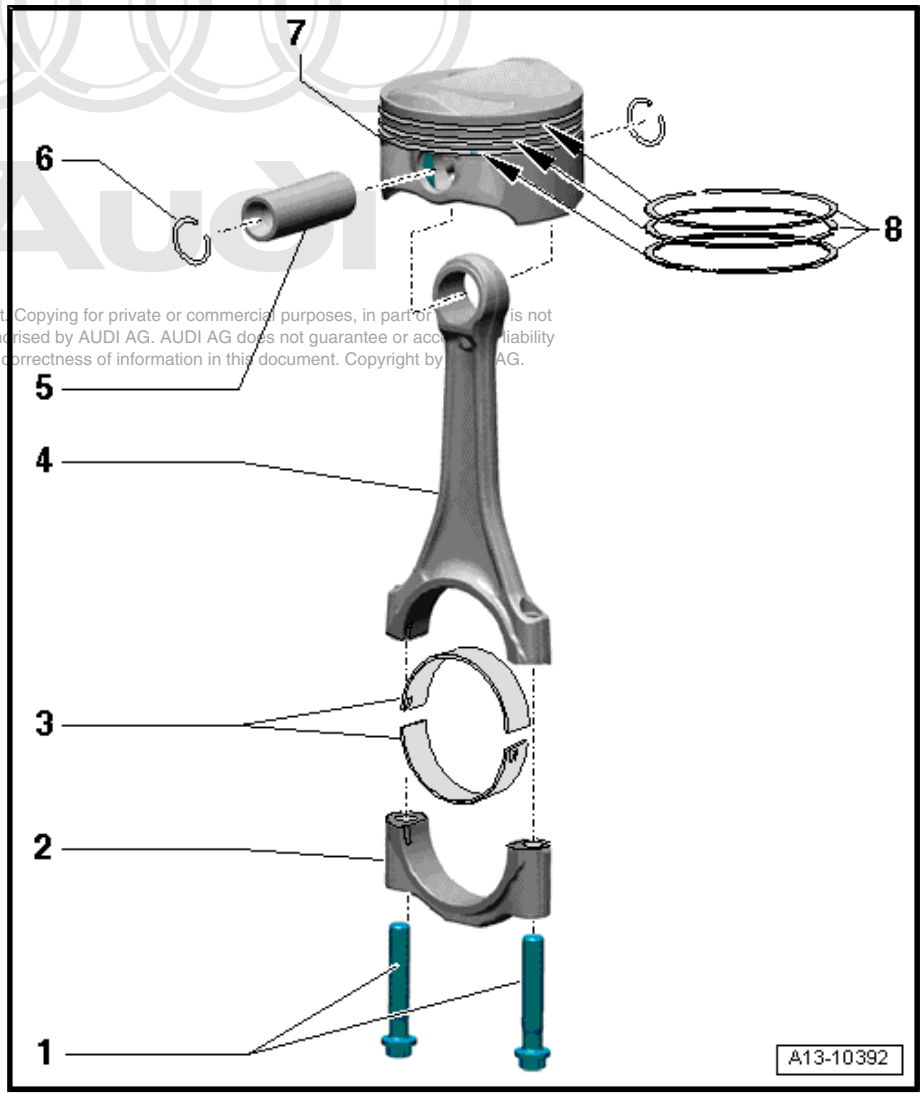
• Wear limit: 0.08 mm.

4 Pistons and conrods

Note

Oil spray jet for piston cooling ⇒ page 65 .

4.1 Pistons and conrods - exploded view



1 - Conrod bolt, 50 Nm + 90° further

- ❑ Renew
- ❑ Lubricate threads and contact surface

2 - Conrod bearing cap

- ❑ Do not interchange
- ❑ Mark cylinder allocation in colour ⇒ page 64
- ❑ Installation position of conrod pairs ⇒ page 64

3 - Bearing shells

- ❑ Ensure that retaining lugs are securely seated.
- ❑ Mark used bearing shells for re-installation but not on bearing surface
- ❑ Bearing shells worn down to the base layer must be renewed
- ❑ 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 64
- ❑ Installation position of conrod pairs ⇒ page 64
- ❑ Axial clearance for each conrod pair (when new): 0.20 … 0.38 mm
- ❑ Measuring radial clearance ⇒ page 65

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 64
- ❑ Piston and cylinder dimensions, piston allocation for cylinder bore ⇒ page 65

- ❑ Checking ⇒ page 63
- ❑ Install using piston ring clamp
- ❑ Measuring cylinder bore ⇒ page 64

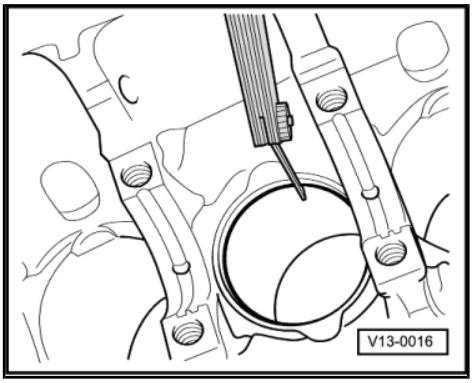
8 - Piston rings

- ❑ 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 63
- ❑ Measuring ring-to-groove clearance ⇒ page 63

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.

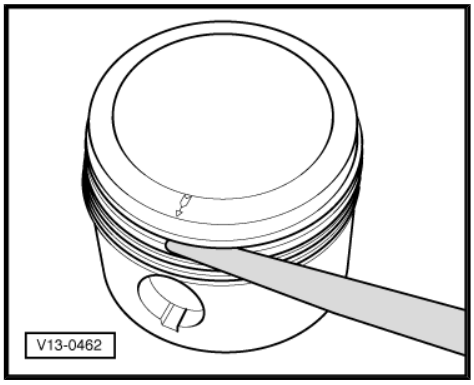


Piston ring	new mm	Wear limit mm
1st compression ring	0.20 … 0.35	0.80
2nd compression ring	0.20 … 0.40	0.80
Oil scraper ring	0.20 … 0.40	– 1)

• 1) Specification not yet available.

Measuring ring-to-groove clearance

– Clean groove in piston before checking clearance.

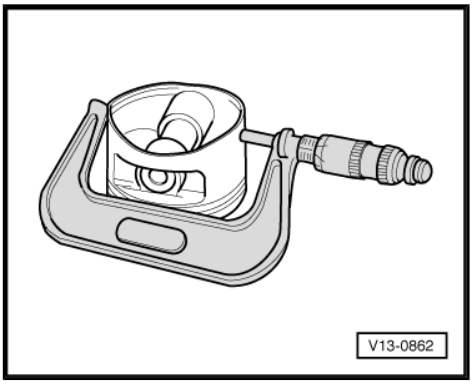


Piston ring	new mm	Wear limit mm
1st compression ring	0.035 … 0.085	0.200
2nd compression ring	0.005 … 0.045	0.200
Oil scraper ring	0.01 … 0.05	0.15

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.



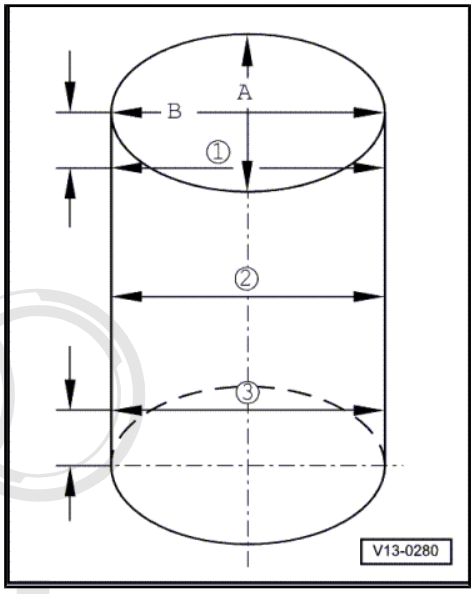
Nominal dimension
⇒ “4.2 Piston and cylinder dimensions”, page 65 .

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 65 .



Installation position of pistons

– Mark cylinder allocation in colour on piston crown.

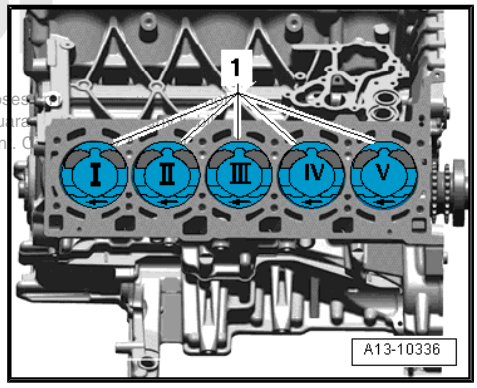
Note

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.



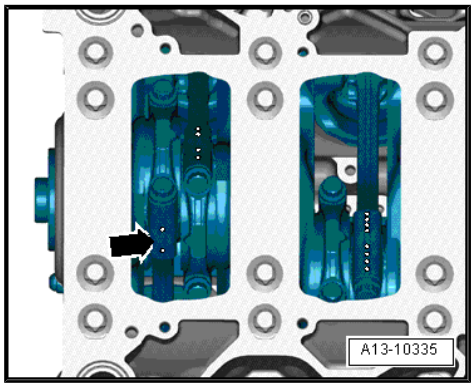
Marking conrods

Note

♦ *Only renew conrods as a complete set.*

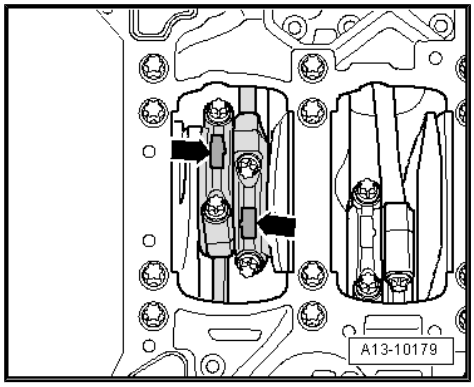
♦ *Do not interchange conrod bearings.*

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



Conrod installation position

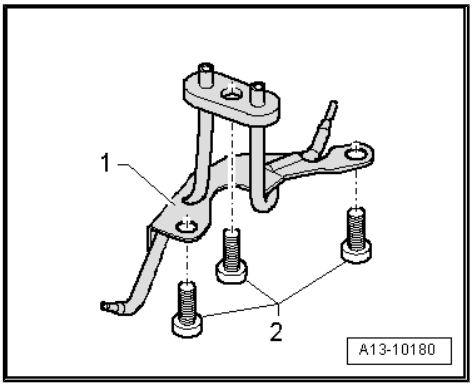
• The cast lugs -arrows- on the ground surfaces of conrod pairs 1 and 2; 3 and 4; 5 and 6; 7 and 8; 9 and 10 must face one another.



Oil spray jet for piston cooling

1 - Oil spray jet

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



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 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 cap and tighten to 50 Nm, but do not turn further. Do not rotate crankshaft.

– Remove conrod bearing caps once more.

– Compare width of Plastigage with measurement scale:

Radial clearance:

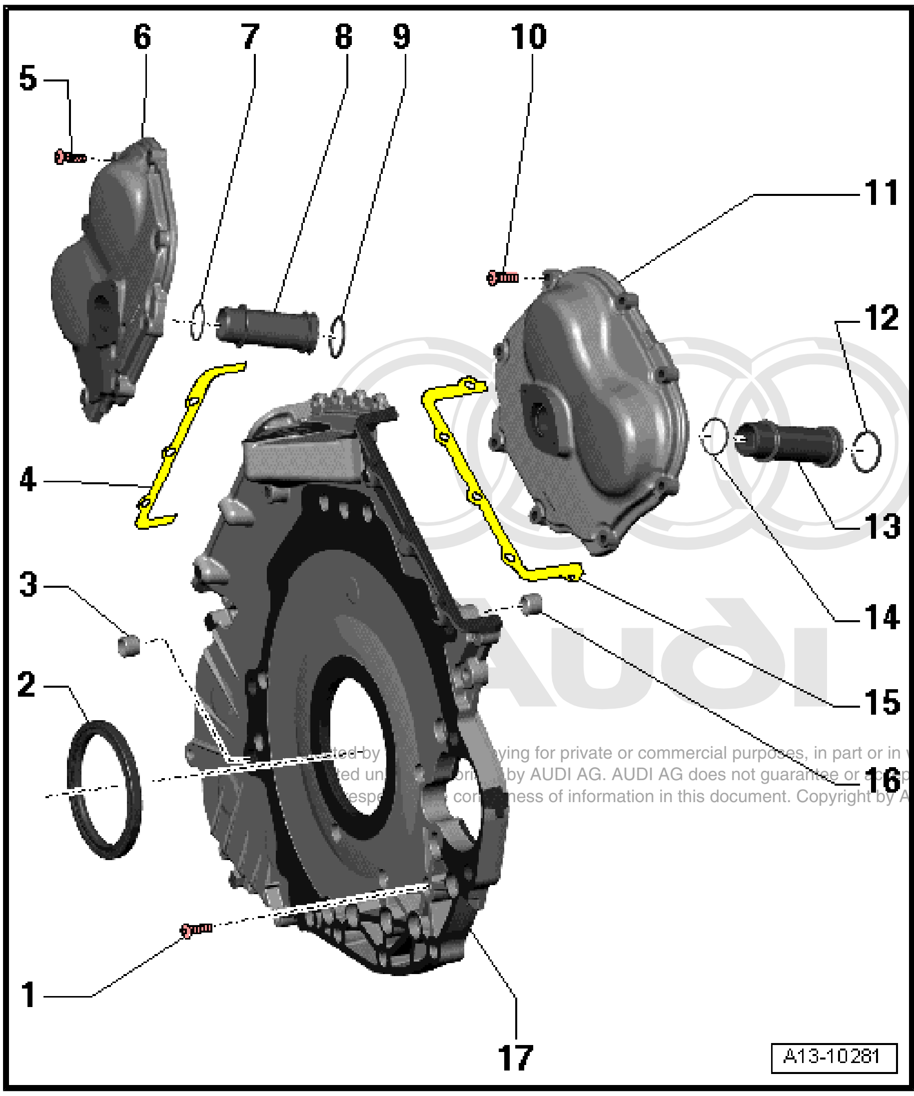
- New: 0.020 ... 0.069 mm.
- Wear limit: 0.120 mm.

– Renew bolts for conrod bearings.

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 75

2 - Crankshaft oil seal (gearbox end)

- ❑ Renewing ⇒ page 53

3 - Dowel sleeve

- ❑ 2 x

4 - Cylinder head gasket (left-side)

5 - 9 Nm

- ❑ Note correct sequence when tightening: left-side ⇒ page 70 ; right-side ⇒ page 70

6 - Timing chain cover (left-side)

- ❑ Removing and installing ⇒ page 67

7 - O-ring

- ❑ Renew

8 - Intermediate coolant pipe (left-side)

- ❑ Use suitable drift to drive out

9 - O-ring

- ❑ Renew

10 - 9 Nm

- ❑ Note correct sequence when tightening ⇒ page 70

11 - Timing chain cover (right-side)

- ❑ Removing and installing ⇒ page 67

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

❑ 2 x

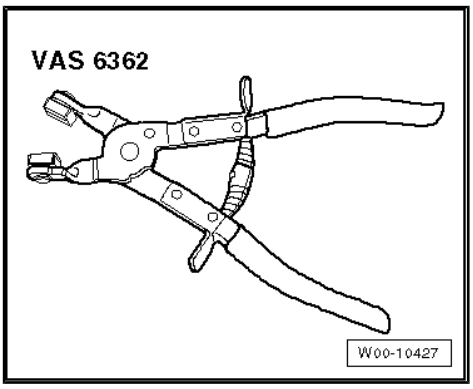
17 - Timing chain cover (bottom)

❑ Removing and installing ⇒ page 70

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.

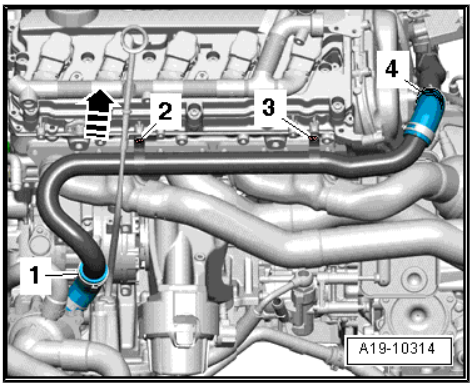
Note

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

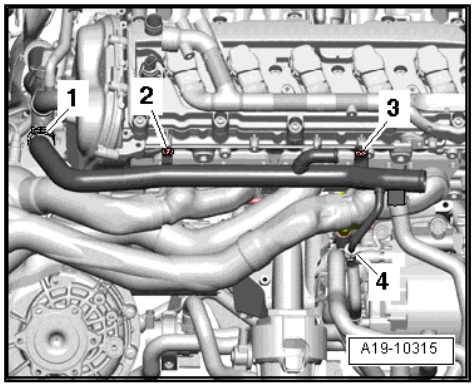
♦ *All cable ties which are released or cut open when removing must be fitted in the same position when installing.*

– Remove bolts -2- and -3- and lift out guide tube for oil dipstick -arrow-.

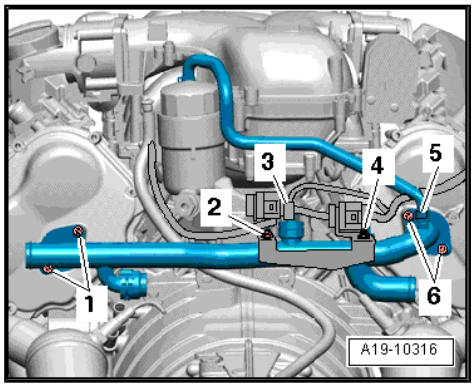
– Loosen hose clips -1- and -4- and detach coolant pipe (left-side) from coolant hoses.



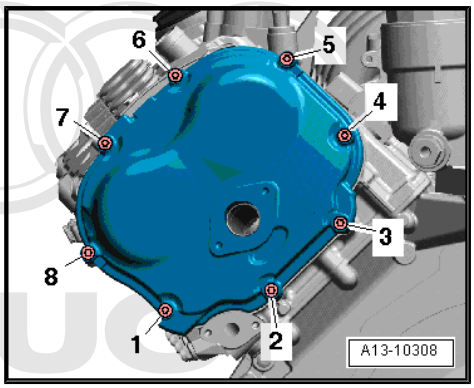
– Remove bolts -2- and -3-.
– Loosen hose clips -1- and -4- and detach coolant pipe (right-side) from coolant hoses.



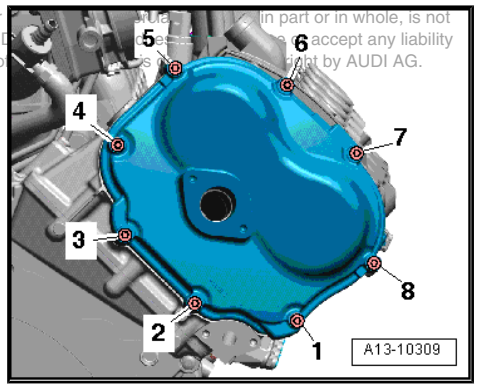
– Unscrew nuts -2- and -4- and detach bracket for electrical connectors on coolant pipe (rear).
– Release engine wiring harness at coolant pipe (rear).
– Unplug electrical connector -3- at coolant temperature sender -G62- .
– Detach coolant hose -5- from coolant pipe (rear).
– Remove bolts -1- and -6-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

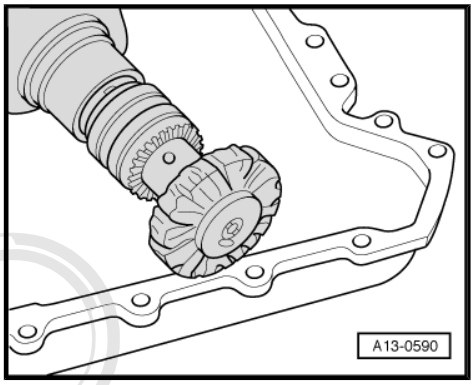
Note

- *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

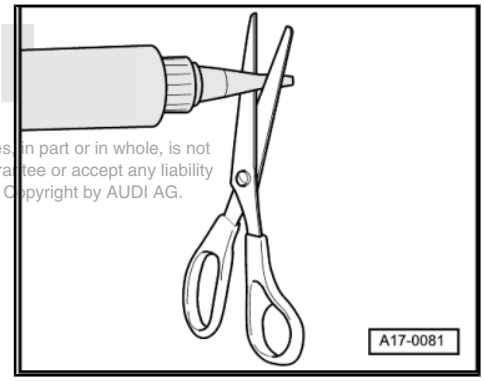
Make sure that no sealant residue gets into the engine.

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

Note

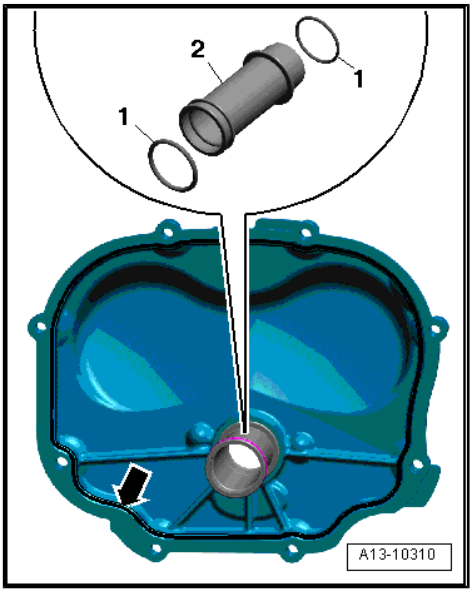
Note the use-by date of the sealant.

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



– Use suitable drift to drive intermediate coolant pipe (left-side) -2- out of timing chain cover (left-side).
– Fit new O-rings -1- on intermediate coolant pipe -2-.
– Fit intermediate coolant pipe in timing chain cover (left-side).
– Apply the bead of sealant -arrow- onto the clean sealing surfaces of the timing chain cover (left-side) as illustrated.

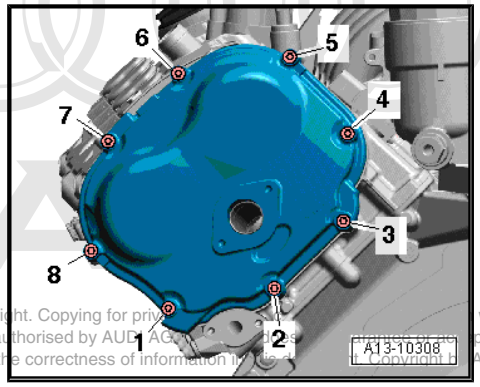
• Width of sealant bead: 2.5 mm.



Note

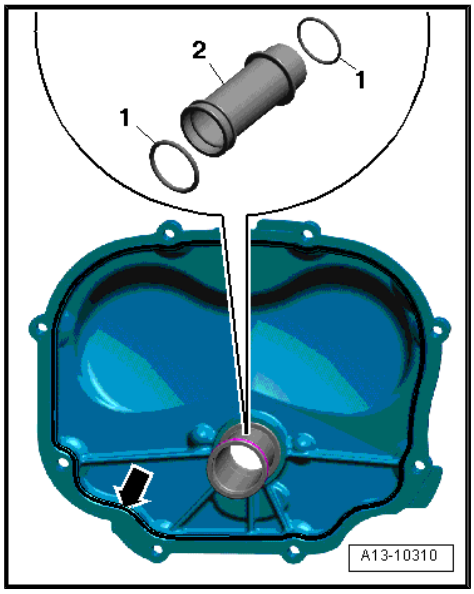
The timing chain covers must be installed within 5 minutes after applying sealant.

– Fit timing chain cover (left-side) and tighten bolts in sequence -1 ... 8-.



– Use suitable drift to drive intermediate coolant pipe (right-side) -2- out of timing chain cover (right-side).
– Fit new O-rings -1- on intermediate coolant pipe -2-.
– Fit intermediate coolant pipe in timing chain cover (right-side).
– Apply the bead of sealant -arrow- onto the clean sealing surfaces of the timing chain cover (right-side) as illustrated.

• Width of sealant bead: 2.5 mm.



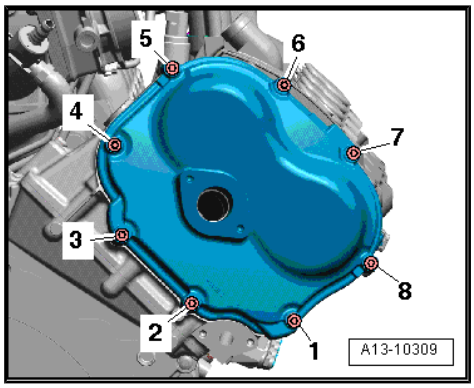
– Fit timing chain cover (right-side) and tighten bolts in sequence -1 ... 8-.

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

– Install coolant pipe (rear) ⇒ page 187 .
– Install coolant pipe (left-side) ⇒ page 189 .
– Install coolant pipe (right-side) ⇒ page 190 .

Tightening torque

Component	Nm
Timing chain covers (left and right) to engine	9



1.3 Removing and installing timing chain cover (bottom)

Special tools and workshop equipment required

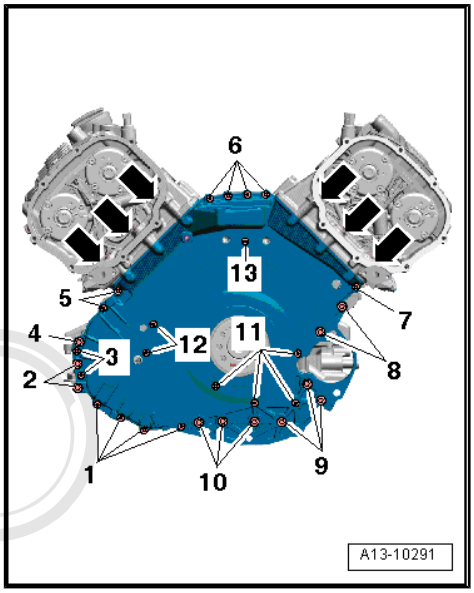
♦ Electric drill with plastic brush attachment
♦ Safety goggles
♦ Sealant ⇒ Electronic parts catalogue

Removing

• Engine separated from gearbox ⇒ page 26 , engine attached to scissor-type assembly platform -VAS 6131 A- or secured to engine and gearbox support ⇒ page 34 .

- Engine oil drained ⇒ Maintenance ; Booklet 405 .

– Remove drive plate ⇒ page 52 .
– Remove timing chain covers (left and right) ⇒ page 67 .
– Remove intake manifold ⇒ Rep. Gr. 24 .
– Remove oil filter housing ⇒ page 163 .
– 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).



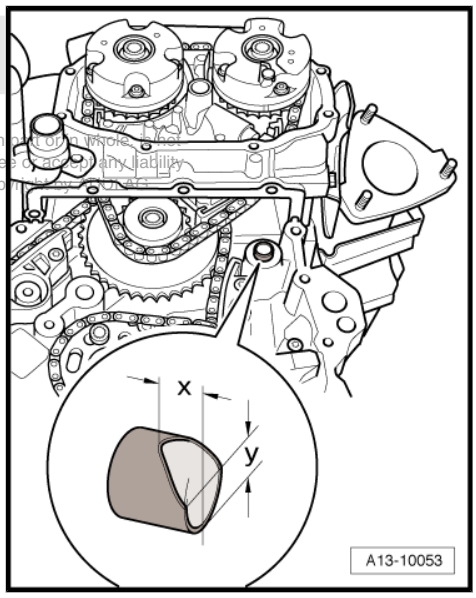
Installing

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

– 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.



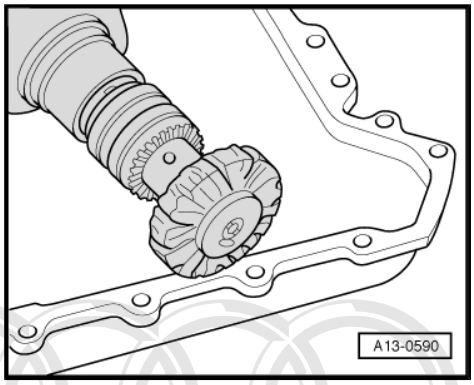
Note

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

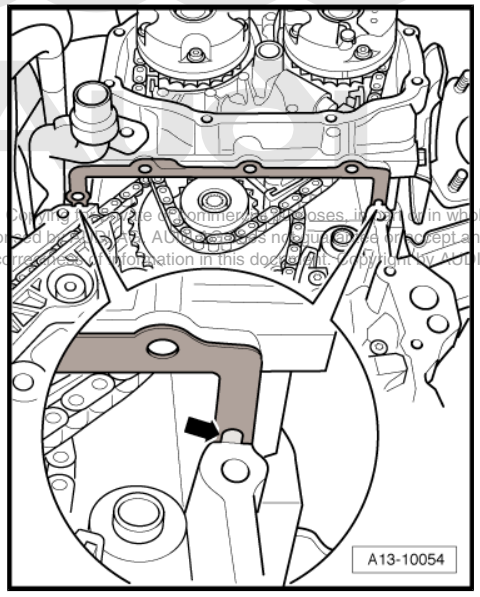
Make sure that no sealant residue gets into the engine.

– 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.

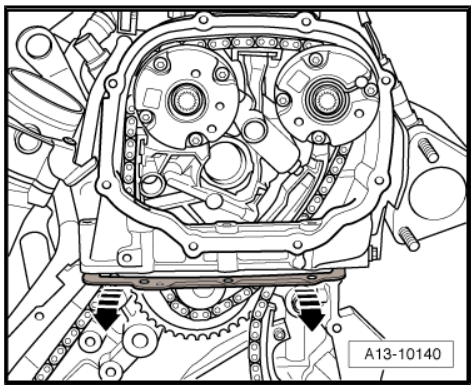


Caution

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.

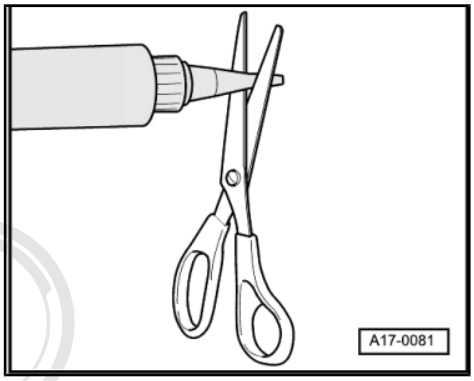
– Clean both cylinder head gaskets (top and bottom); they must be free of oil and grease.



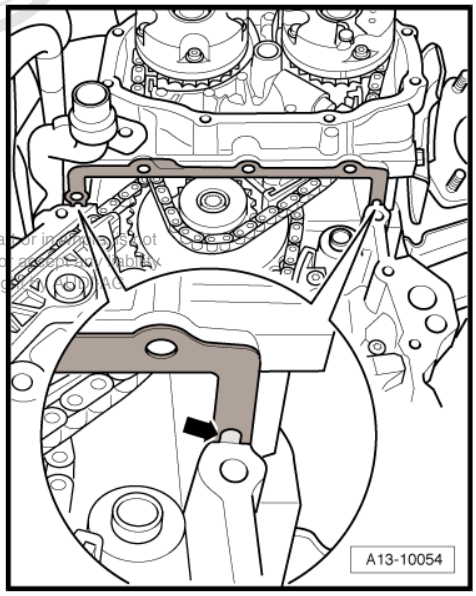
Note

Note the use-by date of the sealant.

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



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

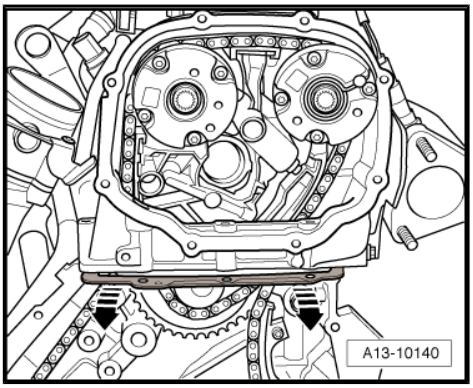


Caution

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.

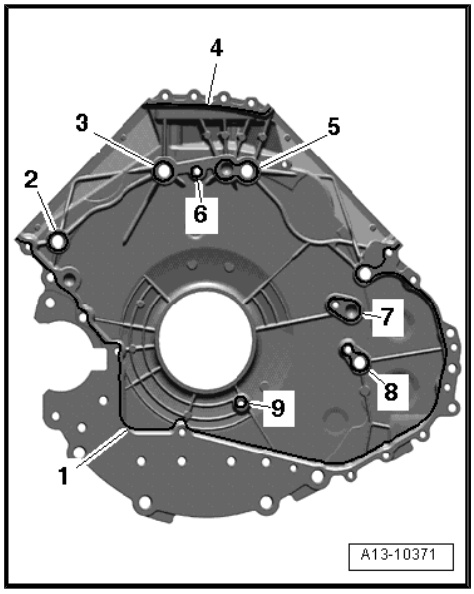
– Apply a small amount of sealant to sealing surfaces of cylinder head gaskets (top and bottom). To do so, you again have to bend cylinder head gaskets down very slightly -arrows-.

– 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 sealant beads: 2.5 mm.



Note

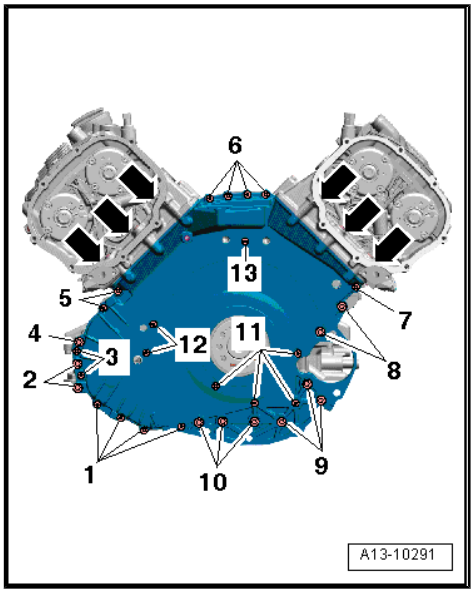
The timing chain cover must be installed within 5 minutes after applying sealant.

– Remove bolts -1, 3, 5, 6, 7, 11, 12, 13- and -arrows-.

– Fit timing chain cover (bottom), guiding it towards the 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 in 6 stages as follows:

Stage	Bolts	Tightening torque/tightening angle
1.	-arrows-	5 Nm
2.	-1 … 13-	8 Nm in diagonal sequence
3.	-arrows-	11 Nm
4.	-1, 3, 5, 6, 7, 11, 12, 13-	Turn 90° further in diagonal sequence
5.	-2, 4, 8, 9, 10-	22 Nm
6.	-arrows-	turn 90° further

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

– Install crankshaft oil seal (gearbox end) ⇒ page 53 .

– Install oil filter housing ⇒ page 163 .

– Install intake manifold ⇒ Rep. Gr. 24 .

– Install timing chain covers (left and right) ⇒ page 68 .

– Install drive plate ⇒ page 52 .

– After installing engine, fill up with engine oil and check oil level ⇒ Maintenance ; Booklet 405 .

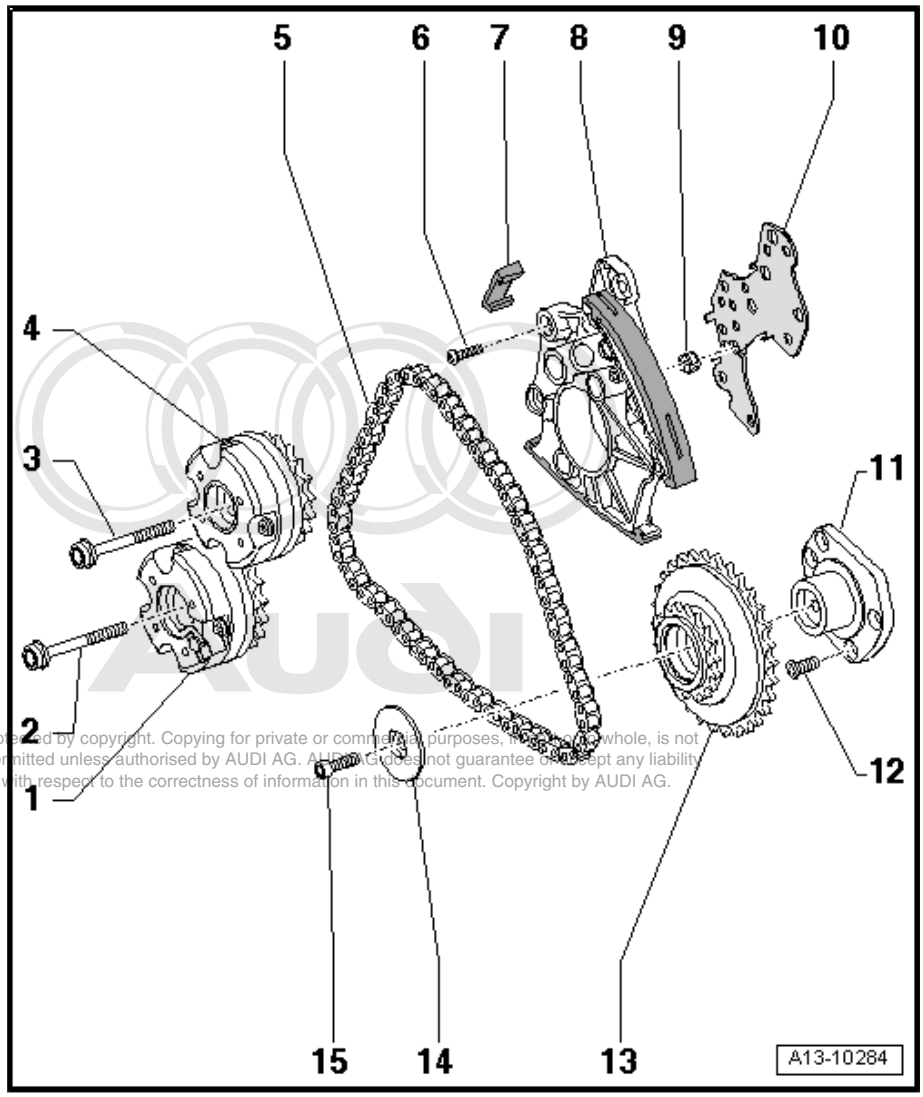
Tightening torques

Component			Nm
Timing chain cover (bottom) to:	Cylinder head		11 +90° 1)
	Cylinder block	M6	8 +90° 1)
		M8	22

• 1) Renew bolts.

1.4 Camshaft timing chains - exploded view

Camshaft timing chain (left-side)



1 - Camshaft adjuster for exhaust camshaft

- ❑ Identification “Exhaust”
- ❑ Removing and installing ⇒ “1.6 Removing and installing camshaft timing chains”, page 86

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 ⇒ “1.6 Removing and installing camshaft timing chains”, page 86

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 79
- ❑ Removing and installing ⇒ page 86

6 - 5 Nm + 90° further

- ❑ Renew

7 - Slide

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

- ❑ Removing and installing ⇒ “1.6 Removing and installing camshaft timing chains”, page 86

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

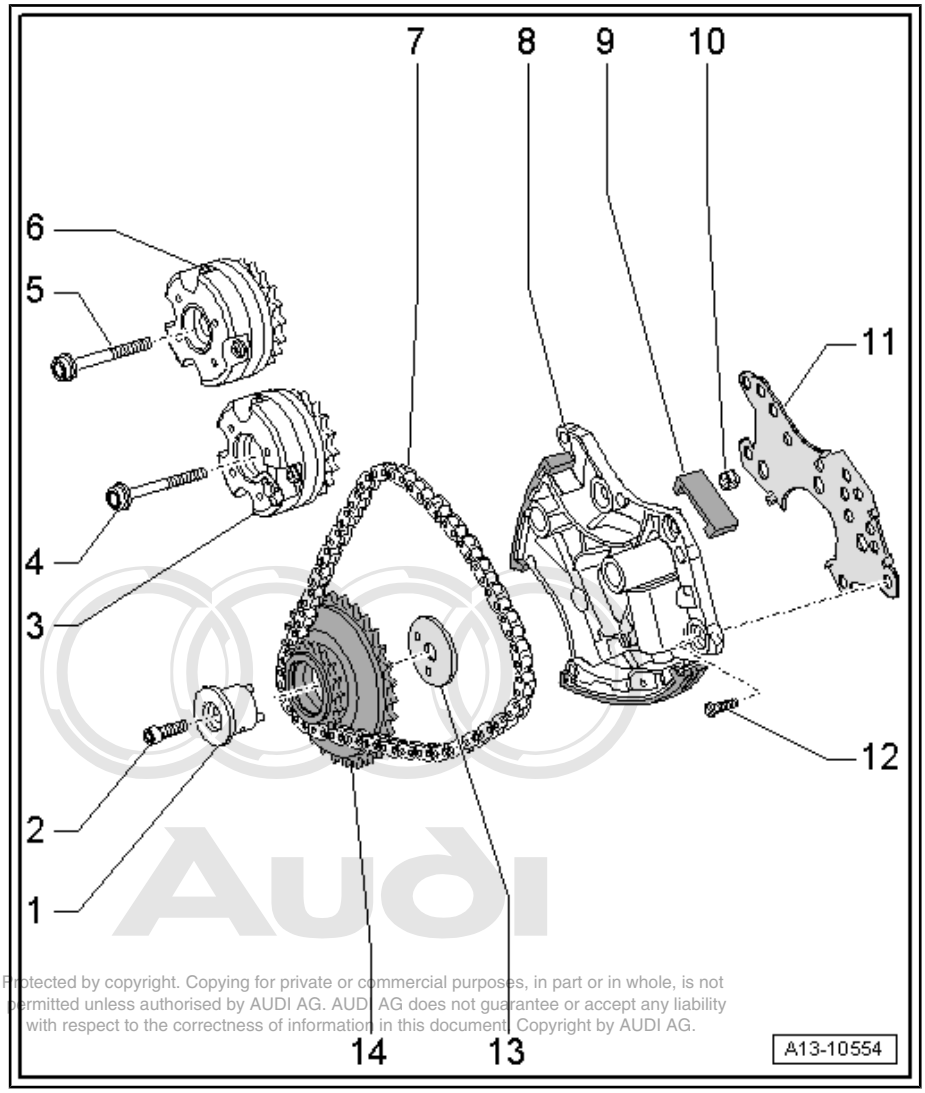
12 - 9 Nm

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 78

2 - 42 Nm

3 - Camshaft adjuster for exhaust camshaft

- Identification “Exhaust”
- Removing and installing ⇒ “1.6 Removing and installing camshaft timing chains”, page 86

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 ⇒ “1.6 Removing and installing camshaft timing chains”, page 86

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 79
- Removing and installing ⇒ page 86

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

- Removing and installing ⇒ “1.6 Removing and installing camshaft timing chains”, page 86

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 + 90° further

- ❑ Renew

13 - Thrust washer for drive sprocket

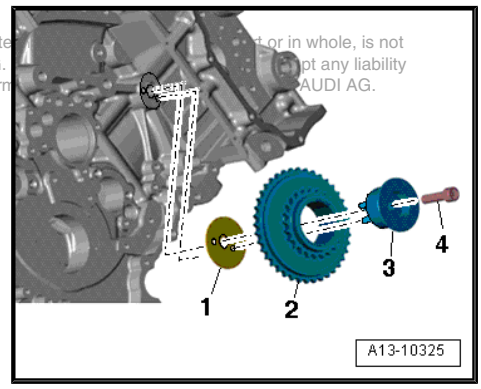
14 - Drive sprocket for camshaft timing chain (right-side)

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

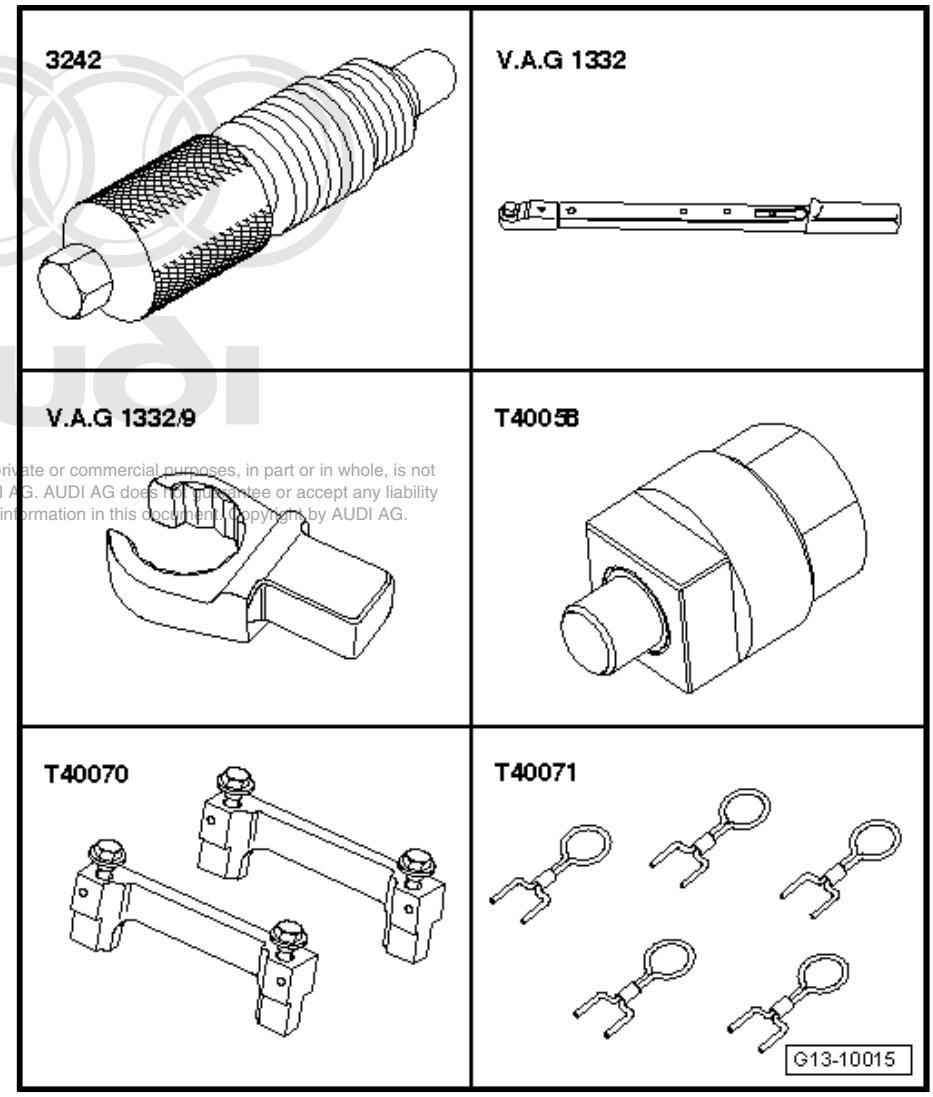
4 - Bolt, 42 Nm



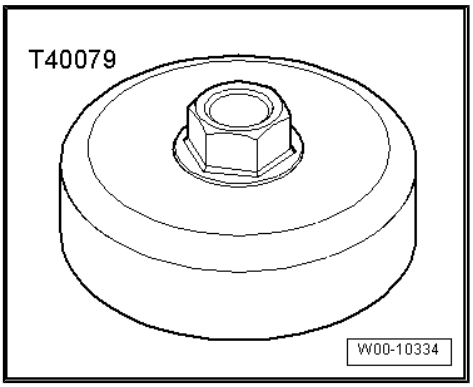
1.5 Removing timing chains from camshafts

Special tools and workshop equipment required

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



- Adapter -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.

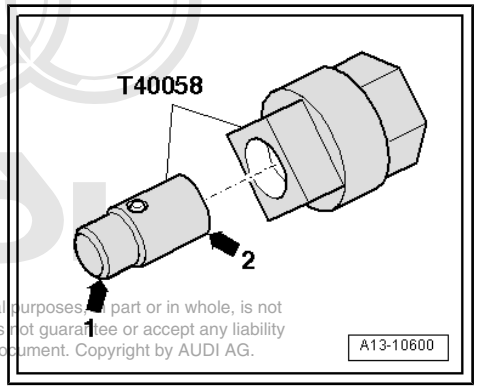
– Remove cylinder head cover: left-side ⇒ page 109 , right-side ⇒ page 112 .

– Remove timing chain covers (left and right) ⇒ page 67 .

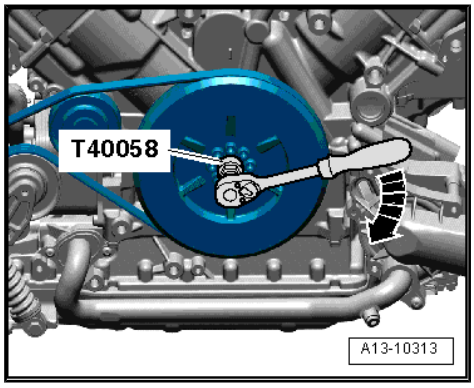
– Insert guide pin of adapter -T40058- as follows:

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

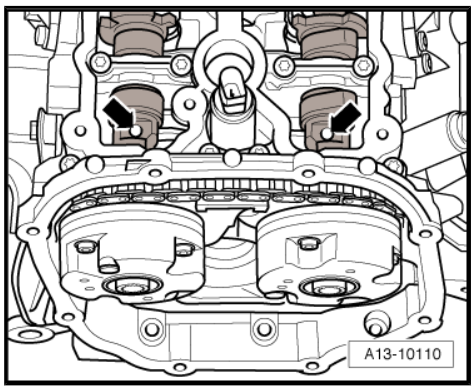
• The larger-diameter section -arrow 2- faces the adapter.



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

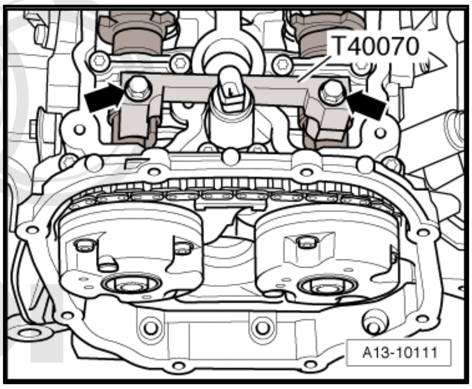


• The threaded holes -arrows- in the camshafts must face upwards.

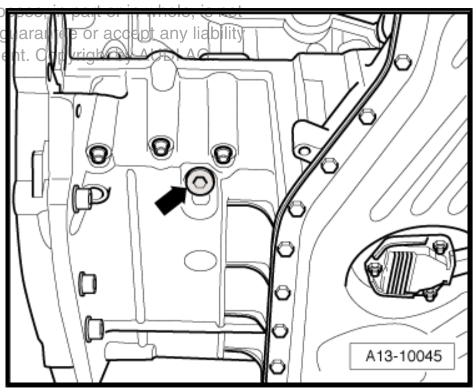


– Fit camshaft clamps -T40070- to both cylinder heads and tighten bolts -arrows- to 25 Nm.

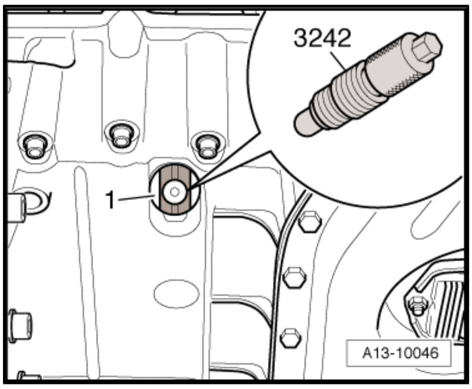
• The camshaft clamp -T40070- is positioned correctly if the holes for the cylinder head bolts remain free.



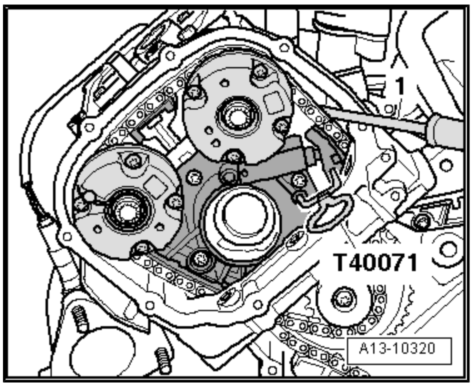
– Unscrew plug -arrow- from sump (top section).



– 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.



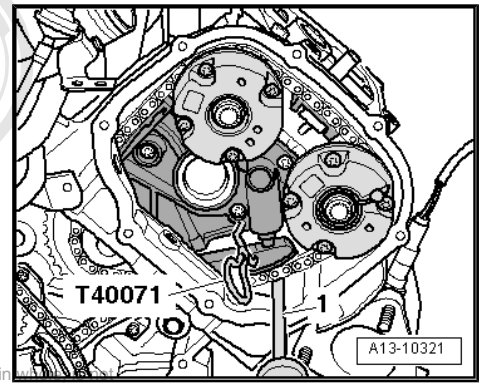
– Press guide rail of chain tensioner for camshaft timing chain (left-side) inwards as far as the stop using a screwdriver -1-. Then lock chain tensioner by inserting locking pin -T40071- .



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

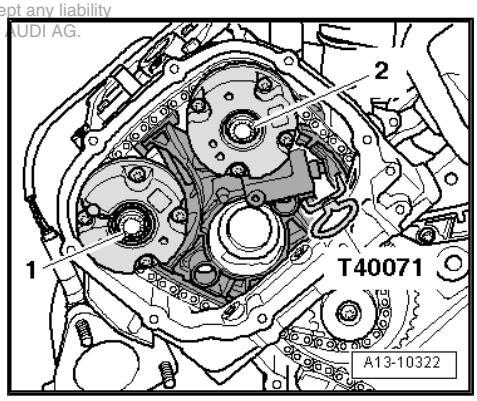
The chain tensioner is oil-damped and can therefore only be compressed slowly by applying constant pressure.

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

Caution

Risk of damage to engine.

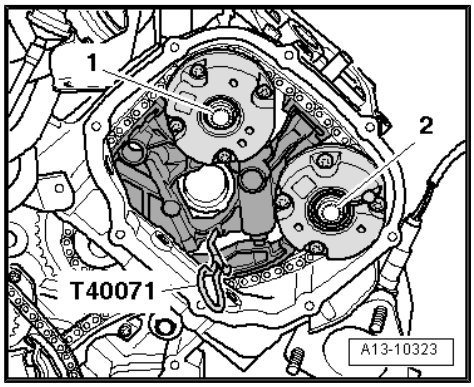
- *Block off the opening in the valve timing housing with a clean cloth to prevent small items from dropping into the engine.*



– 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

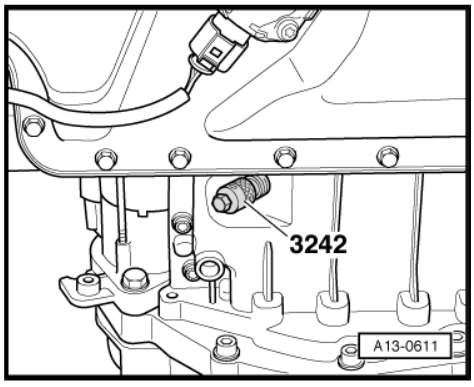
Renew the bolts tightened with specified tightening angle.

Caution

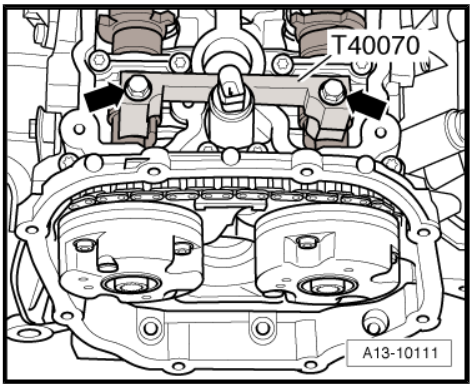
Avoid damage to valves and piston crowns.

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

- Drive chain for valve gear installed ⇒ page 90
- Crankshaft locked in "TDC" position with locking pin -3242- .



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



Note

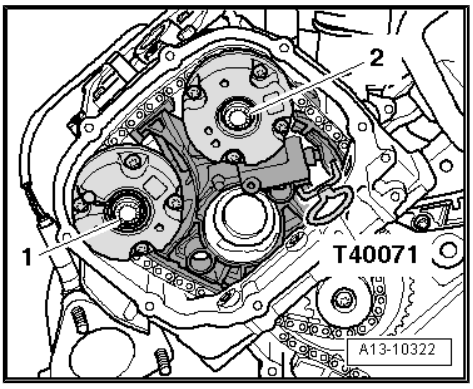
Re-install camshaft adjuster (left-side) in the same position as before (pay attention to marks applied when removing).

– 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

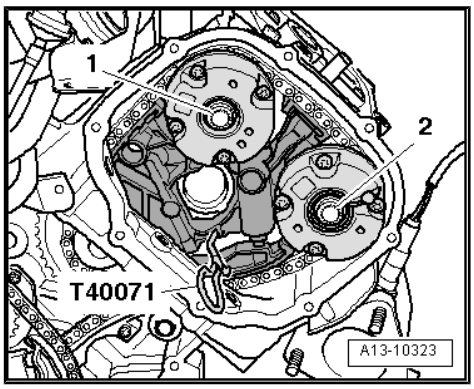
Re-install camshaft adjuster (right-side) in the same position as before (pay attention to marks applied when removing).

– Renew the camshaft bolts.

– Position camshaft timing chain on drive chain sprocket and camshaft adjusters and loosely screw in bolts -1- and -2-.

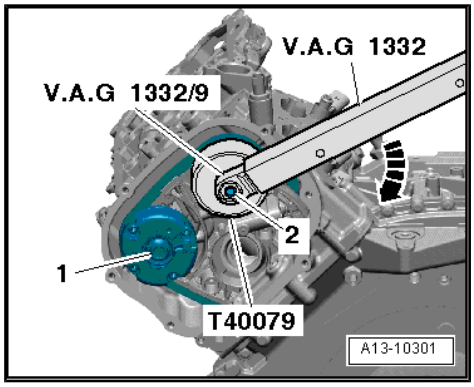
- It should just be possible to turn both camshaft adjusters on the camshaft without axial movement.

– Remove locking pin -T40071- .

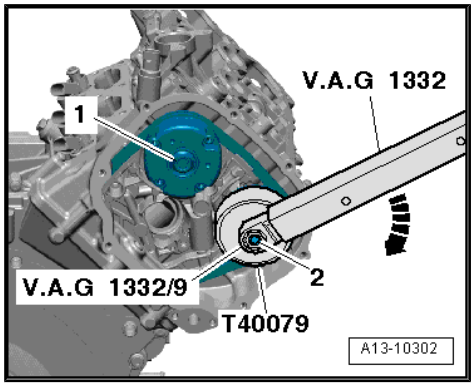


Note

A second mechanic is required for the following work steps.

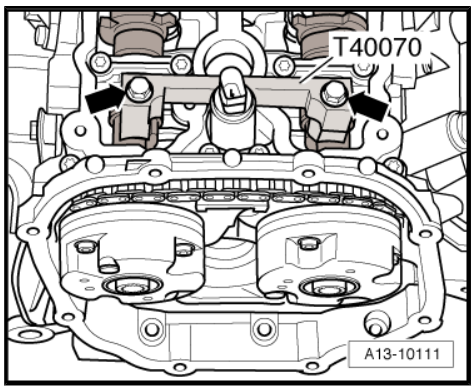


– Fit adapter -T40079- onto camshaft adjuster of inlet camshaft on cylinder head (left-side).
– Apply torque wrench -V.A.G 1332- with tool insert -V.A.G 1332/9- to adapter -T40079- .
– Tension camshaft adjuster by applying a torque of 40 Nm in direction of -arrow- and maintain tension.
– At the same time pre-tighten bolt -1- on exhaust camshaft.
• Tightening torque: 60 Nm.
– Maintain tension on inlet camshaft and pre-tighten bolt -2- on inlet camshaft.
• Tightening torque: 60 Nm.

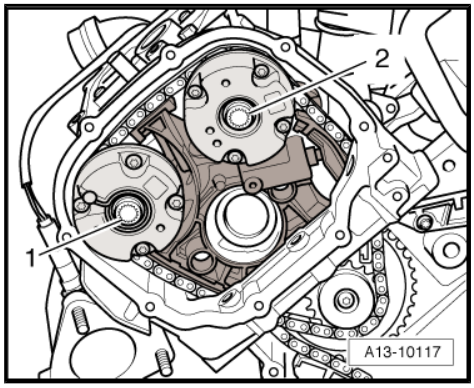


– Fit adapter -T40079- onto camshaft adjuster of exhaust camshaft on cylinder head (right-side).
– Apply torque wrench -V.A.G 1332- with tool insert -V.A.G 1332/9- to adapter -T40079- .
– Tension camshaft adjuster by applying a torque of 40 Nm in direction of -arrow- and maintain tension.
– At the same time pre-tighten bolt -1- on inlet camshaft.
• Tightening torque: 60 Nm.
– Maintain tension on exhaust camshaft and pre-tighten bolt -2- on exhaust camshaft.
• Tightening torque: 60 Nm.

– Detach adapter -T40079- .
– Remove camshaft clamps -T40070- from both cylinder heads -arrows-.

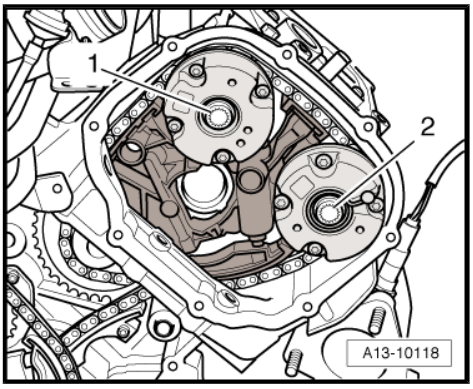


– First tighten camshaft bolt -1- and then camshaft bolt -2- on cylinder head (left-side) to final torque.
• Tightening torque: 80 Nm + turn 90° further.

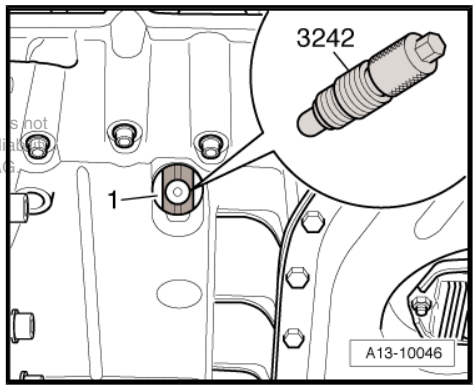


– First tighten camshaft bolt -1- and then camshaft bolt -2- on cylinder head (right-side) to final torque.

• Tightening torque: 80 Nm + turn 90° further.



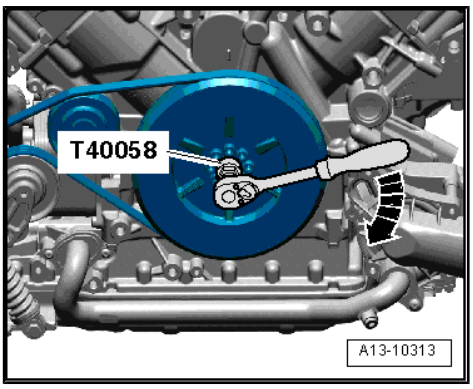
– Remove locking pin -3242- .



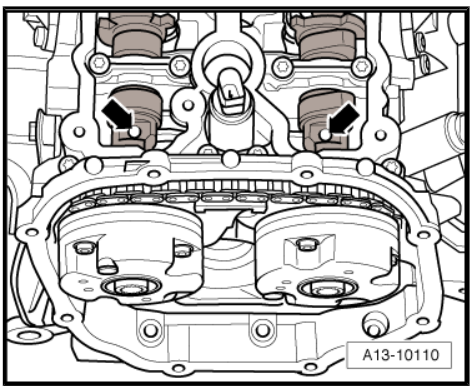
– Using adapter -T40058- , turn crankshaft 2 rotations in normal direction of rotation -arrow- until crankshaft is at “TDC” again.

Note

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

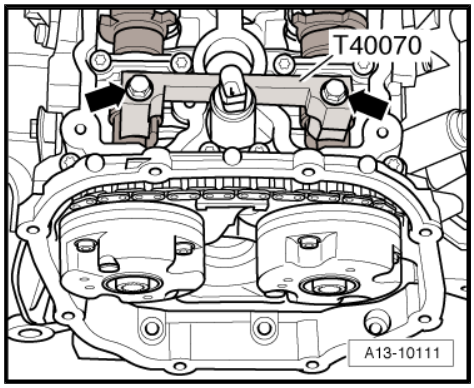


• The threaded holes -arrows- in the camshafts must face upwards.



– 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.



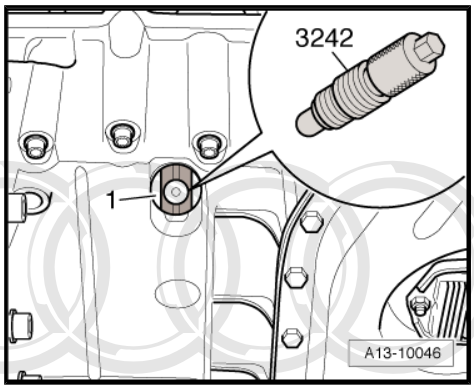
– Screw locking pin -3242- into bore or groove (20 Nm).

• 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 the “TDC” mark into the top section of the sump with a new seal.



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

– Install timing chain covers (left and right) ⇒ page 68 .

– Install cylinder head cover: left-side ⇒ page 109 , right-side ⇒ page 112 .

Tightening torques

Component	Nm
Camshaft bolts	80 +90° 1)2)
Screw plug in top section of sump	35 3)

• 1) Renew bolts.

• 2) Tighten in two stages.

• 3) Install with new seal.

1.6 Removing and installing camshaft timing chains

Removing

• Engine separated from gearbox ⇒ page 26 , engine attached to scissor-type assembly platform -VAS 6131 A- or secured to engine and gearbox support ⇒ page 34 .

• Engine oil drained ⇒ Maintenance ; Booklet 405 .

– Remove drive plate ⇒ page 52 .

– Remove cylinder head cover: left-side ⇒ page 109 , right-side ⇒ page 112 .

– Remove timing chain covers (left and right) ⇒ page 67 .

– Remove intake manifold ⇒ Rep. Gr. 24 .

– Remove oil filter housing ⇒ page 163 .

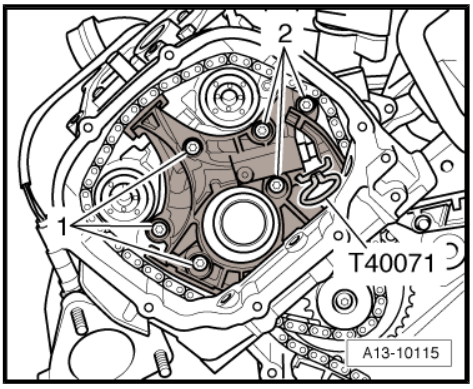
– Remove timing chain cover (bottom) ⇒ page 70 .

– Remove camshaft timing chains from camshafts ⇒ page 79 .

Caution

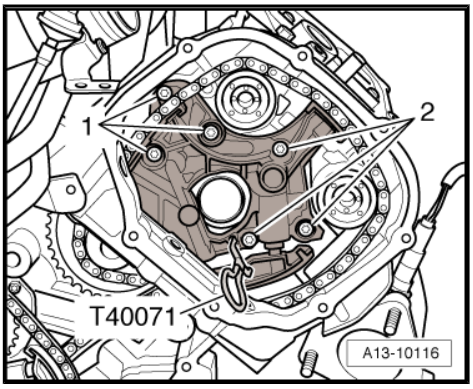
If a used camshaft timing chain rotates in the opposite direction when it is refitted, this can cause breakage.

- *Mark running direction of camshaft 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

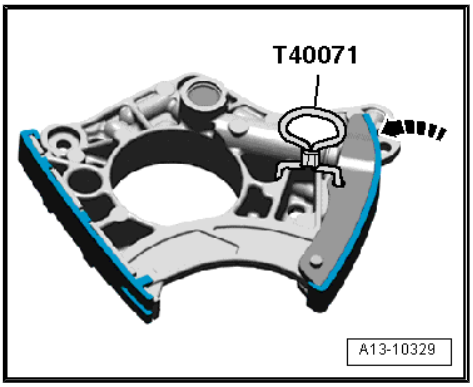
- *Note the correct installation position if the tensioning element has been removed from the chain tensioner: drilling in base of housing faces chain tensioner and piston faces tensioner rail.*
- *Renew bolts which are tightened to a specified angle as well as seal.*

Caution

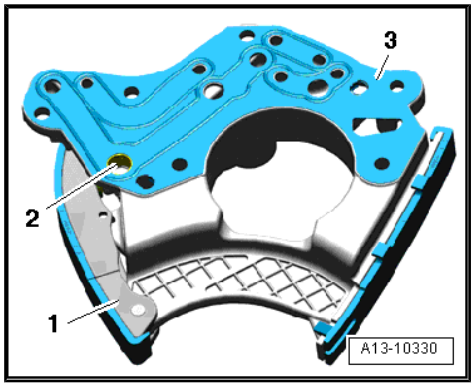
Avoid damage to valves and piston crowns.

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

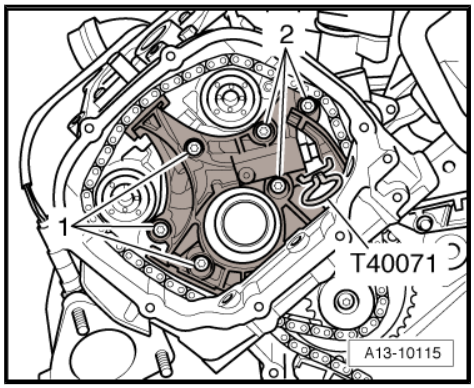
– Press guide rails of chain tensioners for camshaft timing chains (left and right) inwards in direction of -arrow- as far as the stop. Then lock chain tensioners by inserting locking pin -T40071- .



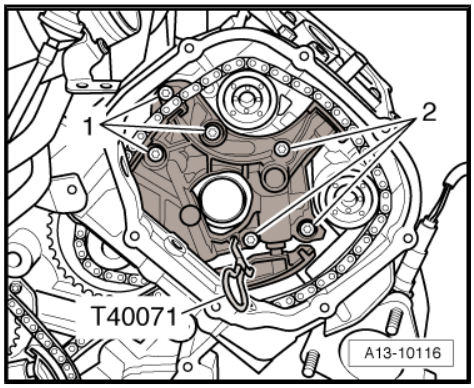
– If necessary, clean oil strainer -2- in both chain tensioners.
– Fit new gasket -3- to rear of chain tensioner -1-.



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



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



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

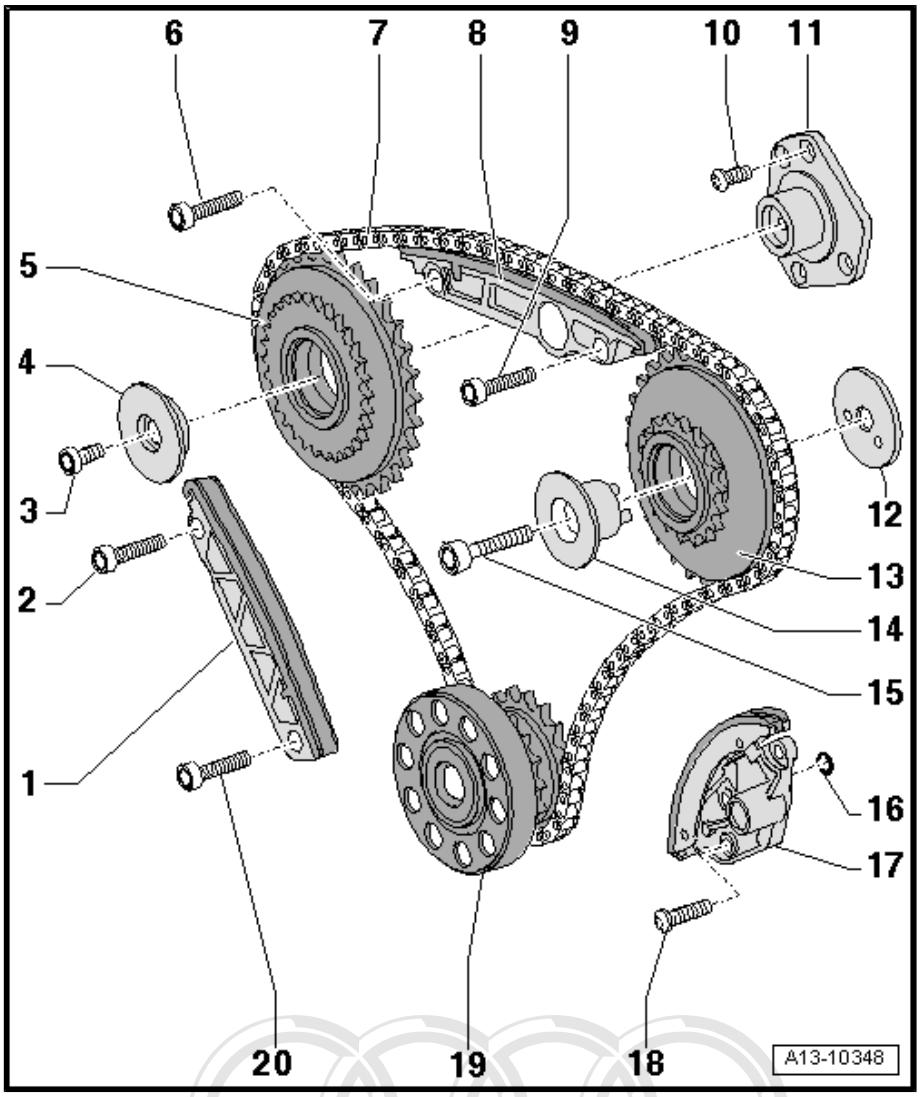
– Position timing chains on camshafts ⇒ page 82 .
– Install timing chain cover (bottom) ⇒ page 70 .
– Install crankshaft oil seal (gearbox end) ⇒ page 53 .
– Install oil filter housing ⇒ page 163 .
– Install intake manifold ⇒ Rep. Gr. 24 .
– Install timing chain covers (left and right) ⇒ page 68 .
– Install cylinder head cover: left-side ⇒ page 109 , right-side ⇒ page 112 .
– Install drive plate ⇒ page 52 .
– After installing engine, fill up with engine oil and check oil level ⇒ Maintenance ; Booklet 405 .

Tightening torque

Component	Nm
Chain tensioner to cylinder head	5 +90° 1)

• 1) Renew bolts.

1.7 Drive chain for valve gear - exploded view



1 - Guide rail

2 - 17 Nm + 90° further

- ❑ Renew

3 - 24 Nm

4 - Thrust washer for drive sprocket

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

6 - 17 Nm + 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 90

8 - Guide rail

9 - 17 Nm + 90° further

- ❑ Renew

10 - 9 Nm

11 - Bearing mounting for drive sprocket

- ❑ For camshaft timing chain (right-side)
- ❑ Asymmetric version
- ❑ Installation position ⇒ page 90

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 + 90° further

- ❑ Renew

19 - Crankshaft

20 - 17 Nm + 90° further

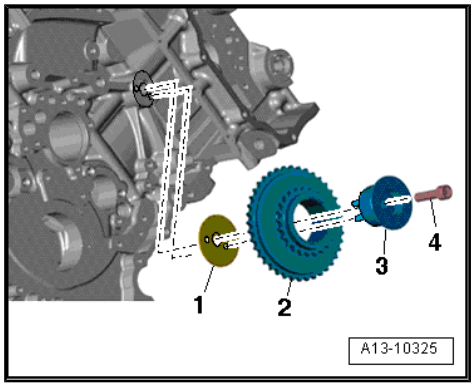
- ❑ Renew

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

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

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

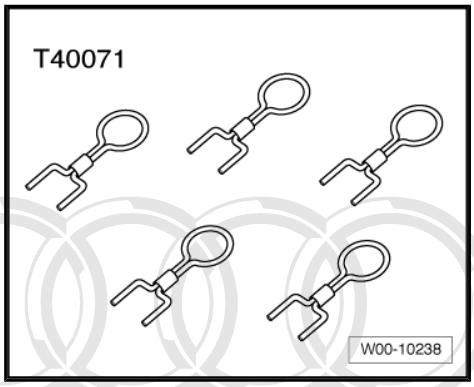
4 - Bolt, 42 Nm



1.8 Removing and installing drive chain for valve gear

Special tools and workshop equipment required

♦ Locking pin -T40071-



Removing

- Engine separated from gearbox ⇒ page 26 , engine attached to scissor-type assembly platform -VAS 6131 A- or secured to engine and gearbox support ⇒ page 34 .
- Engine oil drained ⇒ Maintenance ; Booklet 405 .

– Remove drive plate ⇒ page 52 .

– Remove cylinder head cover: left-side ⇒ page 109 , right-side ⇒ page 112 .

– Remove timing chain covers (left and right) ⇒ page 67 .

– Remove intake manifold ⇒ Rep. Gr. 24 .

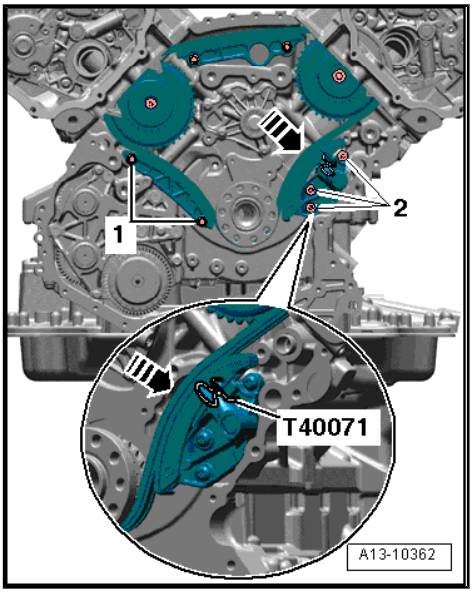
– Remove oil filter housing ⇒ page 163 .

– Remove timing chain cover (bottom) ⇒ page 70 .

– Remove camshaft timing chains ⇒ page 86 .

– Remove drive chain for auxiliary drives ⇒ page 92 .

– 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 92 .
– Install camshaft timing chains ⇒ page 87 .
– Install timing chain cover (bottom) ⇒ page 70 .
– Install crankshaft oil seal (gearbox end) ⇒ page 53 .
– Install oil filter housing ⇒ page 163 .
– Install intake manifold ⇒ Rep. Gr. 24 .
– Install timing chain covers (left and right) ⇒ page 68 .
– Install cylinder head cover: left-side ⇒ page 109 , right-side ⇒ page 112 .
– Install drive plate ⇒ page 52 .
– After installing engine, fill up with engine oil and check oil level ⇒ Maintenance ; Booklet 405 .

Tightening torques

Component	Nm
Guide rail to cylinder block	17 +90° 1)
Chain tensioner to cylinder block	5 +90° 1)
• 1) Renew bolts.	

1.9 Drive chain for auxiliary drives - exploded view

1 - 5 Nm + 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 cover

8 - Balance shaft
- ❑ Removing and installing ⇒ page 105

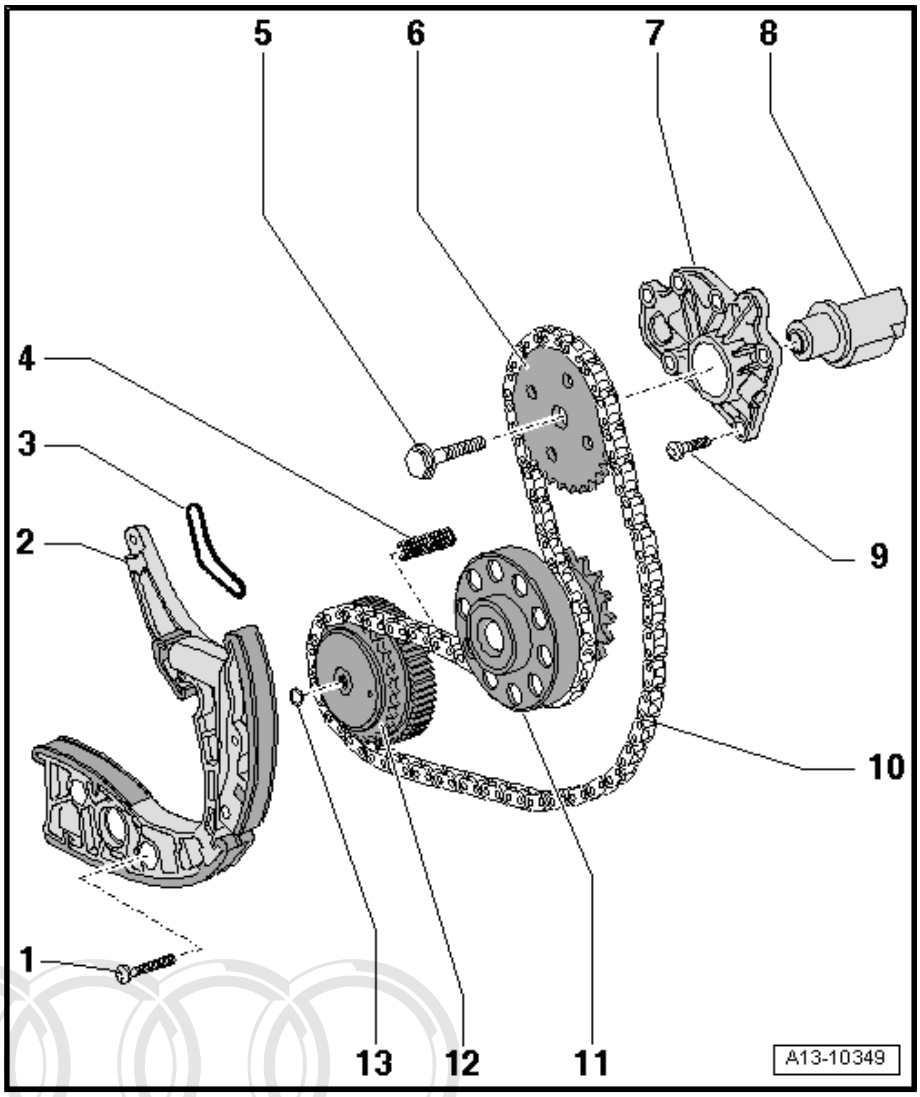
9 - 5 Nm + 90° further
- ❑ Renew

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 92

11 - Crankshaft

12 - Drive chain sprocket for auxiliary drives

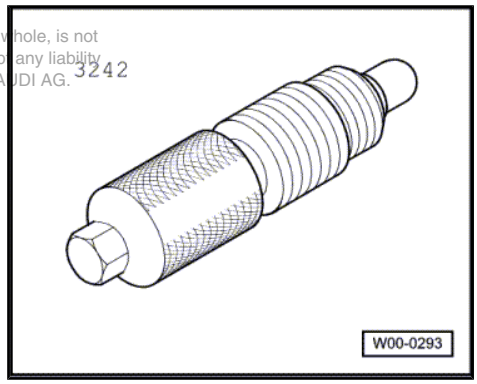
13 - Circlip



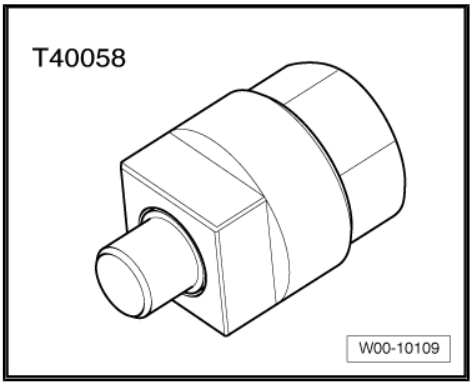
1.10 Removing and installing drive chain for auxiliary drives

Special tools and workshop equipment required

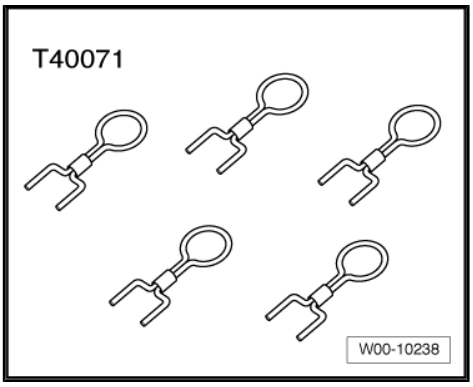
♦ Locking pin -3242-



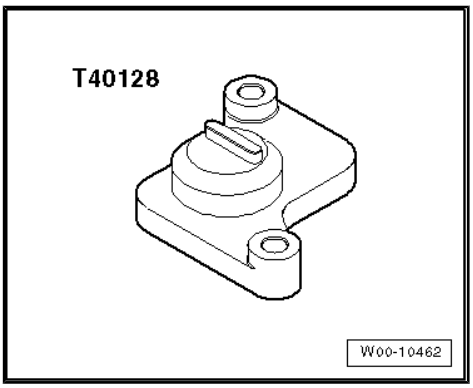
♦ Adapter -T40058-



♦ Locking pin -T40071-



♦ Setting tool -T40128-

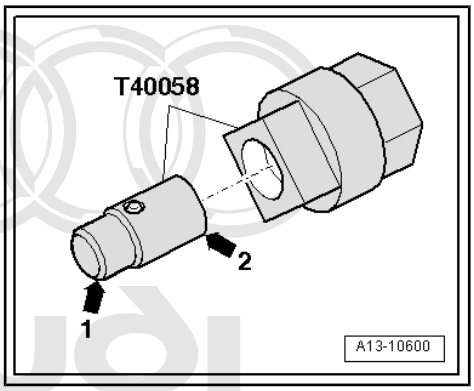


Removing

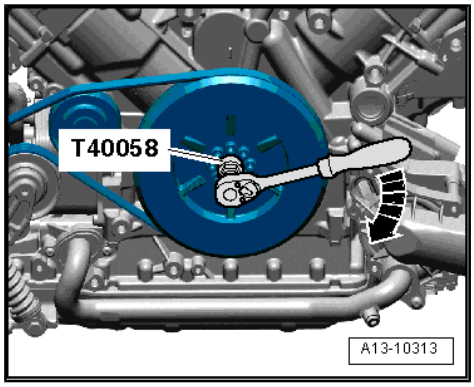
- Engine separated from gearbox ⇒ page 26 , engine attached to scissor-type assembly platform -VAS 6131 A- or secured to engine and gearbox support ⇒ page 34 .
- Engine oil drained ⇒ Maintenance ; Booklet 405 .

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

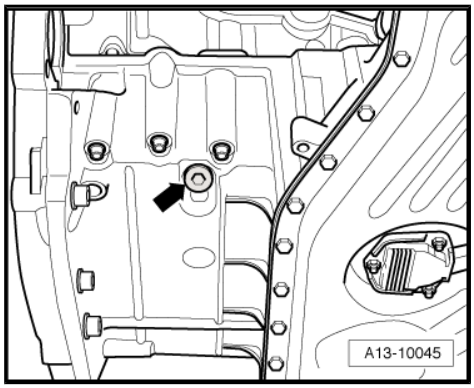
- The smaller-diameter section -arrow 1- faces the engine.
- The larger-diameter section -arrow 2- faces the adapter.



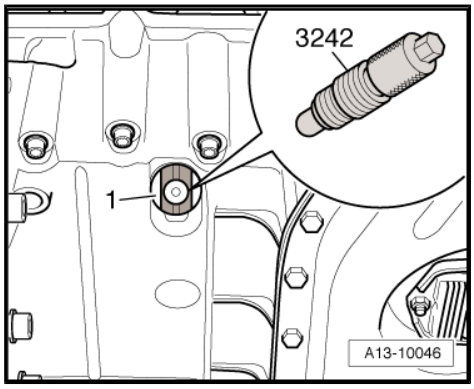
– Using adapter -T40058- turn the crankshaft in the normal direction of rotation -arrow- to “TDC”.



– 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.

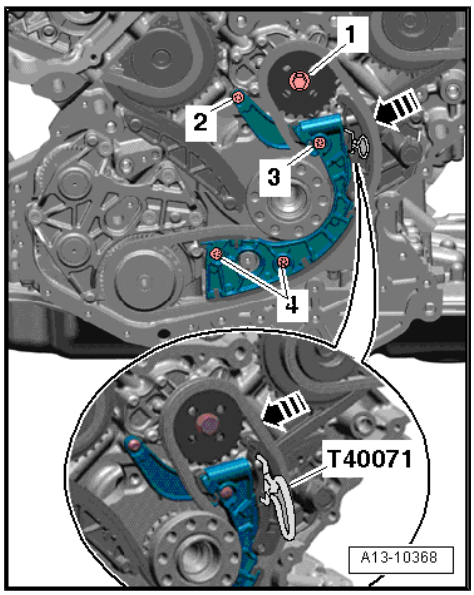


– Remove vibration damper ⇒ page 48 .
– Remove drive plate ⇒ page 52 .
– Remove timing chain covers (left and right) ⇒ page 67 .
– Remove intake manifold ⇒ Rep. Gr. 24 .
– Remove oil filter housing ⇒ page 163 .
– Remove timing chain cover (bottom) ⇒ page 70 .

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 … 4- and remove chain tensioner.
– Remove drive chain for auxiliary drives.

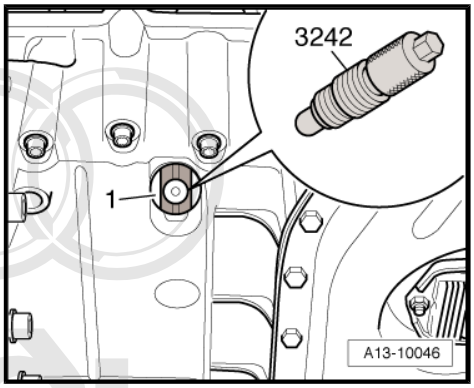
Installing

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

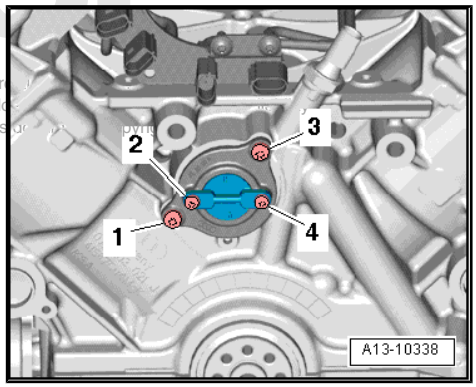
Note

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- .



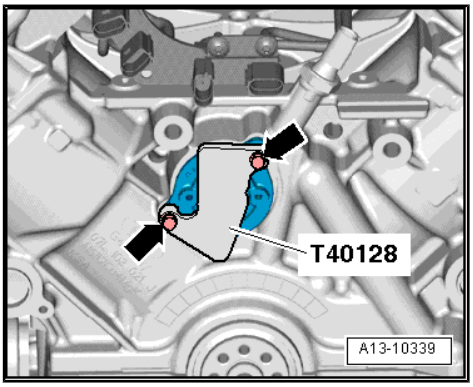
– Remove bolts -2- and -4-.
– Remove cover for balance shaft.
– Remove bolts -1- and -3-.



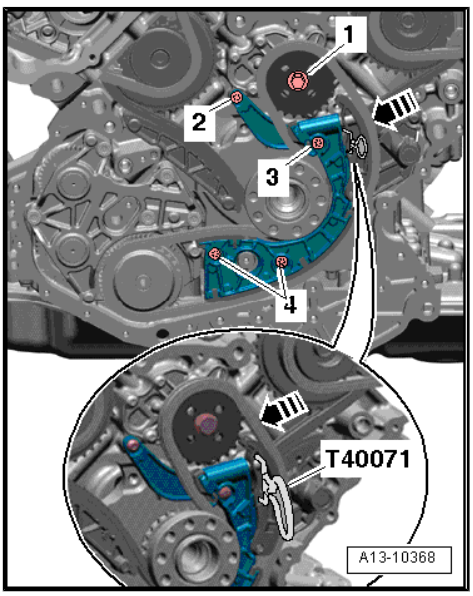
Note

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.



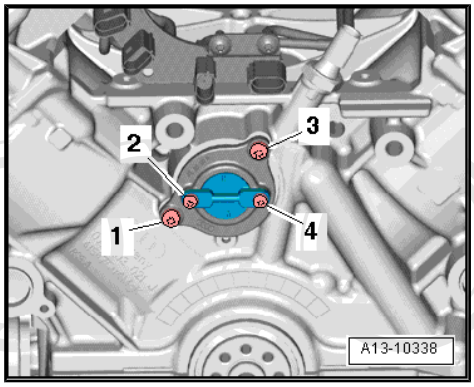
– Fit drive chain for auxiliary drives according to marks applied when removing.
– Install chain tensioner and tighten bolts -2 ... 4-.
– Fit drive chain onto chain sprocket for balance shaft and tighten bolt -1-.



– 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 70 .
– Install crankshaft oil seal (gearbox end) ⇒ page 53 .
– Install oil filter housing ⇒ page 163 .
– Install intake manifold ⇒ Rep. Gr. 24 .
– Install timing chain covers (left and right) ⇒ page 68 .
– Install drive plate ⇒ page 52 .
– Install vibration damper ⇒ page 48 .
– After installing engine, fill up with engine oil and check oil level ⇒ Maintenance ; Booklet 405 .



Tightening torques

Component	Nm
Chain tensioner to cylinder block	5 +90° 1)
Chain sprocket to balance shaft	64
Front bearing cover for balance shaft to cylinder block	5 +90° 1)
Cover for balance shaft to front bearing cover for balance shaft	5
Screw plug in top section of sump	35 2)

- 1) Renew bolts.
- 2) Renew seal.

1.11 Auxiliary drives - exploded view

1 - Circlip

2 - Spur gear drive

- ❑ Do not dismantle
- ❑ Removing and installing ⇒ page 100

3 - 22 Nm

4 - Oil seal for AC compressor drive

- ❑ Renewing ⇒ page 97

5 - Dust cap for AC compressor drive

6 - Clip

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

7 - Drive shaft for AC compressor

- ❑ Tighten to 60 Nm

8 - O-ring

- ❑ Renew

9 - Power steering pump

10 - Flat-section O-ring

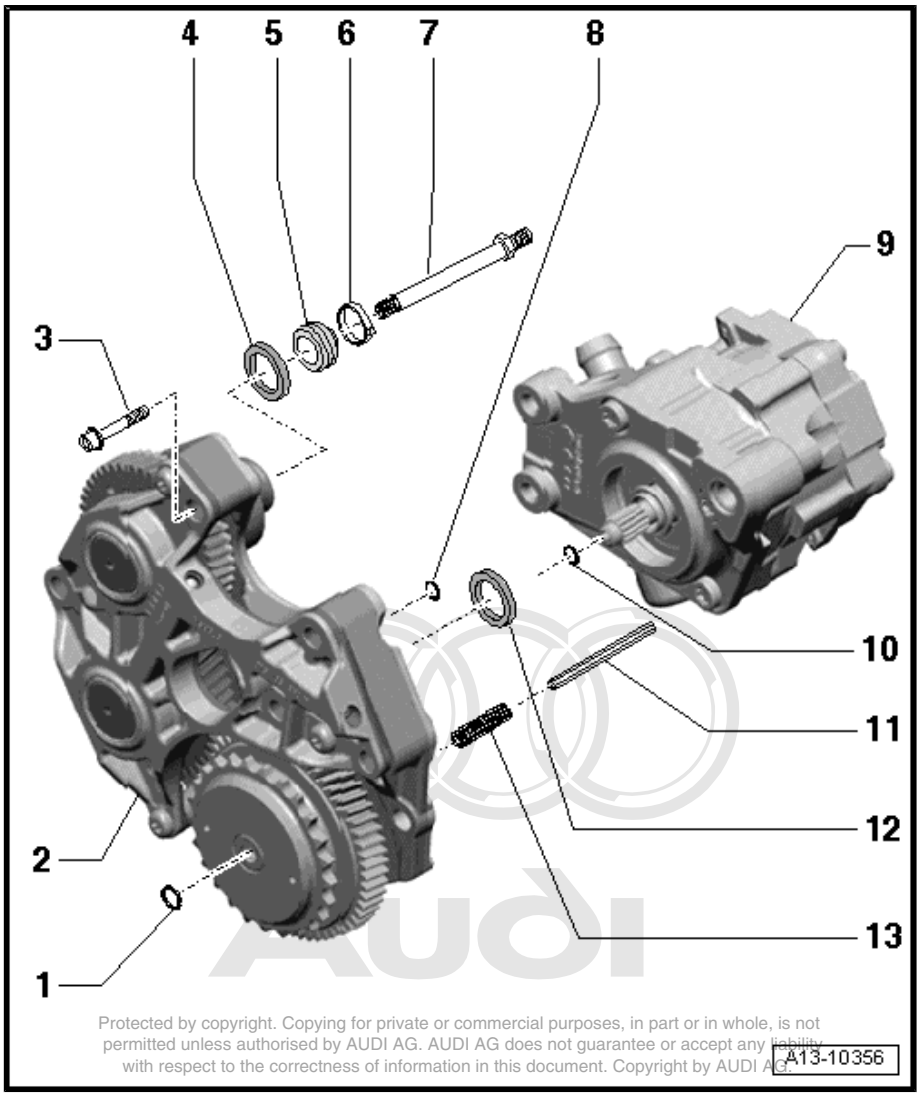
- ❑ Renew if damaged
- ❑ Installation position in power steering pump drive ⇒ page 97

11 - Oil pump drive shaft

12 - Oil seal for power steering pump drive

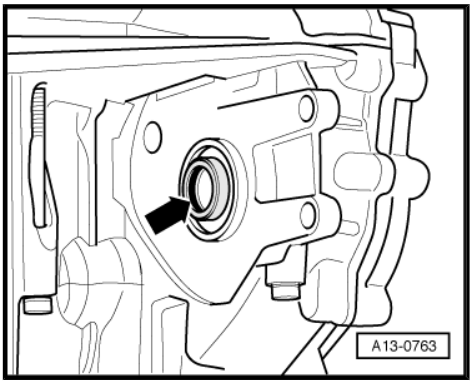
- ❑ Renewing ⇒ page 99

13 - Compression spring



Installation position of flat-section O-ring

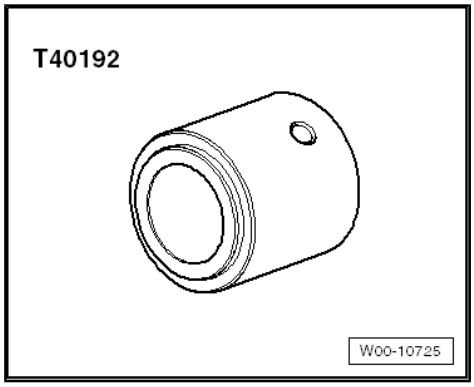
♦ In power steering pump drive -arrow-.



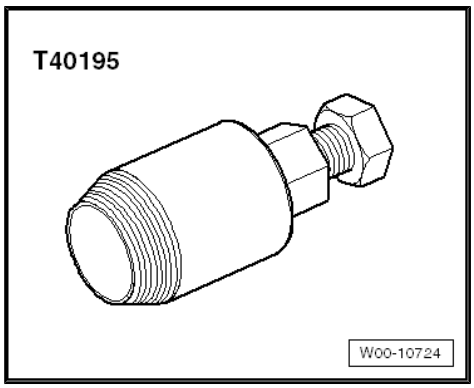
1.12 Renewing oil seal for AC compressor drive

Special tools and workshop equipment required

♦ Thrust piece -T40192-



♦ Oil seal extractor -T40195-



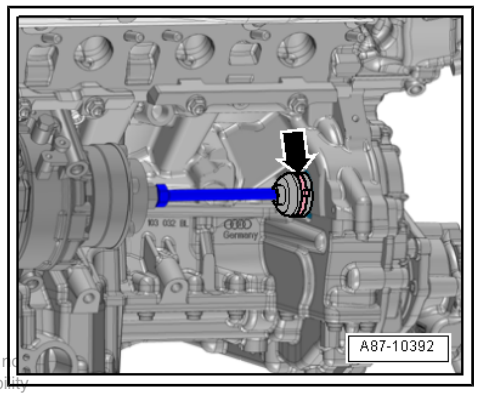
Procedure

- 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 AC compressor drive.

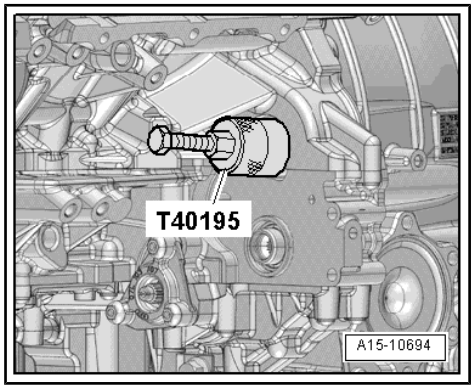
– Pull off dust cap together with drive shaft for AC compressor from stub shaft of spur gear for AC compressor drive.



– Screw spindle of oil seal extractor -T40195- all the way out.

– Lubricate threaded head of oil seal extractor, place it in position and screw it 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.



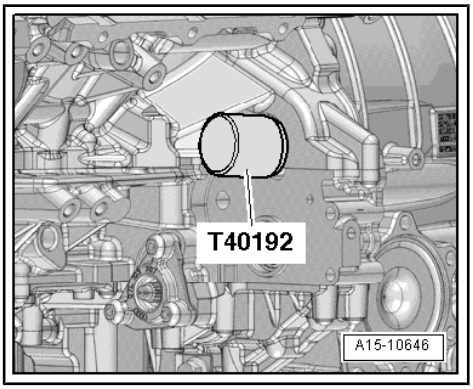
Note

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- .

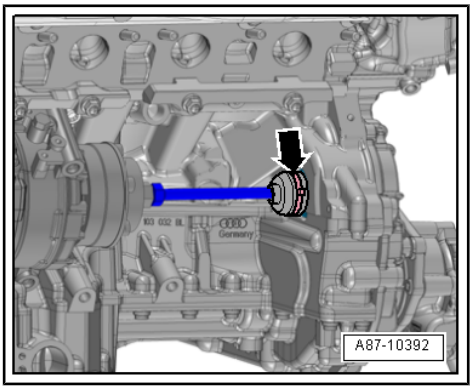


Note

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 AC compressor drive and secure.

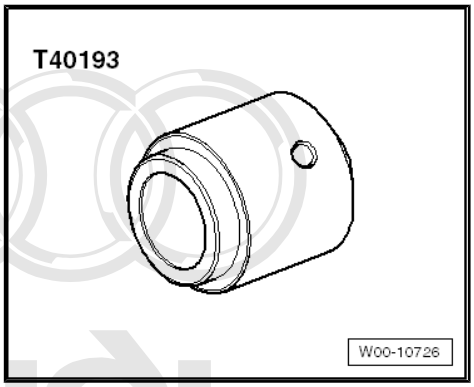
– Install air conditioner compressor ⇒ Rep. Gr. 87 .



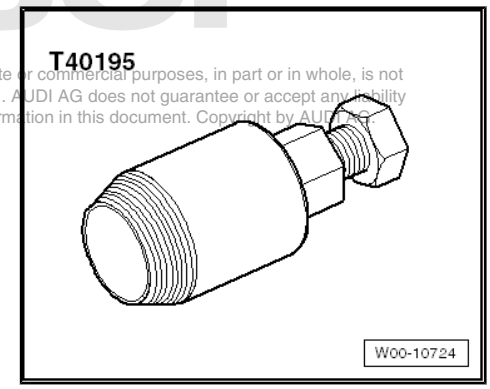
1.13 Renewing oil seal for power steering pump drive

Special tools and workshop equipment required

♦ Thrust piece -T40193-



♦ Oil seal extractor -T40195-



Procedure

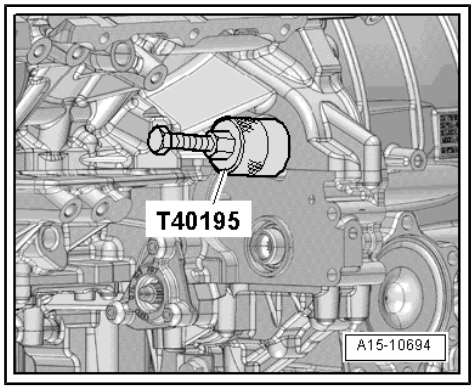
- Engine removed and in position on scissor-type assembly platform -VAS 6131 A- with gearbox attached.

– 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

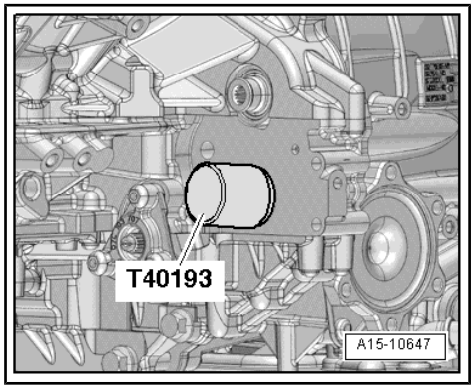
If the sections of the oil seal come apart, apply oil seal extractor again and pull out remaining part of oil seal.

– 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 .



1.14 Removing and installing spur gear drive

Special tools and workshop equipment required

♦ Sealant ⇒ Electronic parts catalogue

Removing

- Engine separated from gearbox ⇒ page 26 , engine attached to scissor-type assembly platform -VAS 6131 A- or secured to engine and gearbox support ⇒ page 34 .
- Engine oil drained ⇒ Maintenance ; Booklet 405 .

– Remove drive plate ⇒ page 52 .

– Remove timing chain covers (left and right) ⇒ page 67 .

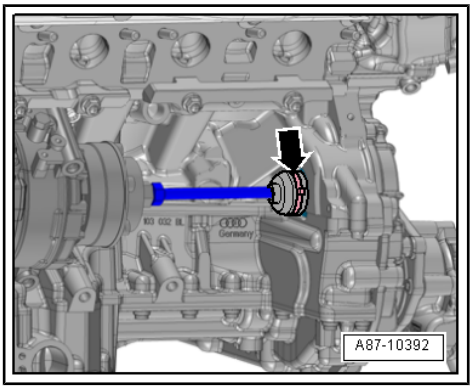
– Remove intake manifold ⇒ Rep. Gr. 24 .

– Remove oil filter housing ⇒ page 163 .

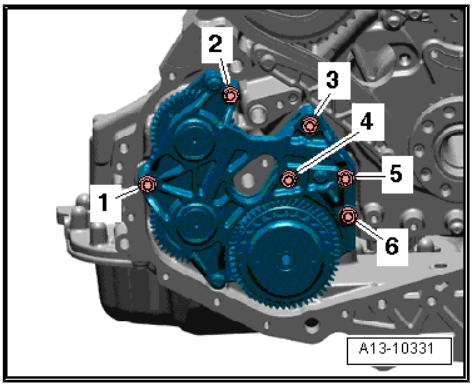
– Remove timing chain cover (bottom) ⇒ page 70 .

– Detach power steering pump from cylinder block.

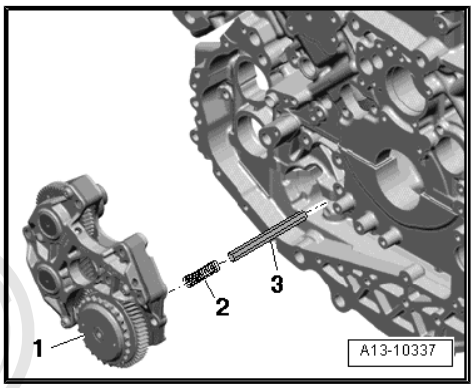
– Remove hose clip on dust cap -arrow- for air conditioner compressor drive.
– Remove drive chain for auxiliary drives ⇒ page 92 .



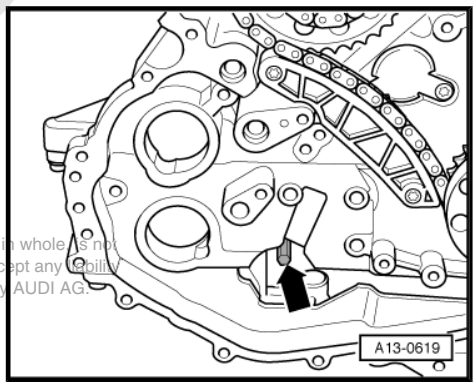
– Remove bolts -1 ... 6-.
– Release spur gear drive from bonded joint.



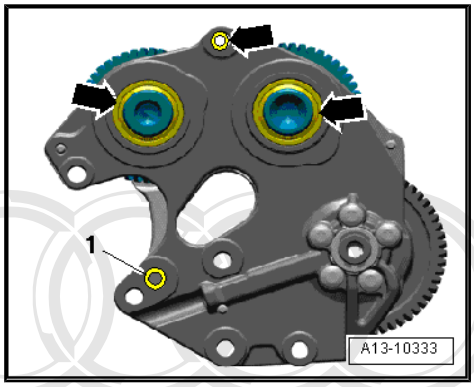
– Remove spring -2- between spur gear drive -1- and drive shaft -3- for oil pump.



– Remove drive shaft -arrow- for oil pump.



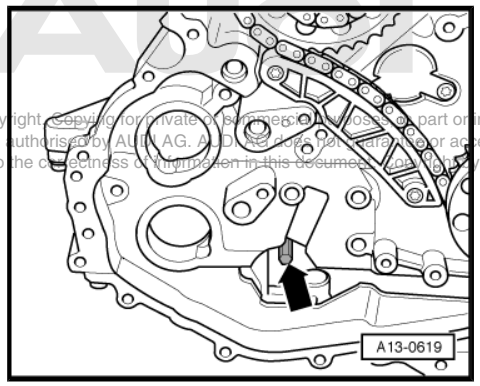
Installing



Note

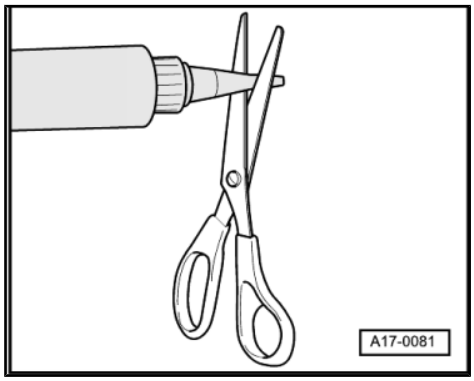
Renew O-ring.

- Renew oil seals ⇒ Item 4 (page 97) , ⇒ Item 12 (page 97) and flat-section O-ring ⇒ page 97 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

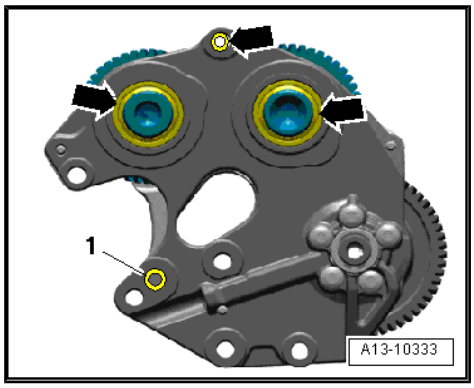
To ensure that drive shaft engages correctly in oil pump, insert drive shaft separately into oil pump (NOT together with spur gear drive).



Note

Note the use-by date of the sealant.

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

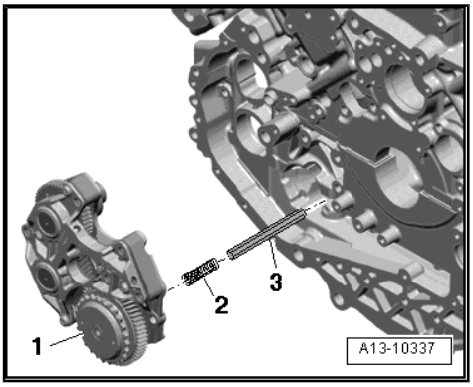


- Apply beads of sealant -arrows- onto clean sealing surfaces of spur gear drive (front) as illustrated.
- Width of sealant beads: 2.0 mm.
- Apply a small amount of grease to O-ring -1- and fit in position.

Note

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

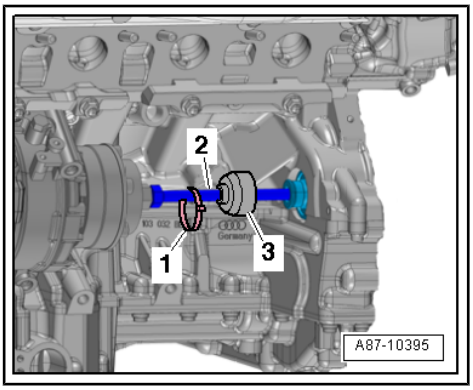
– Insert spring -2- for drive shaft -3- in spur gear drive -1-.



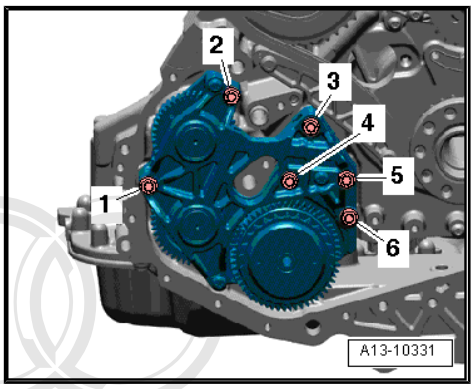
Note

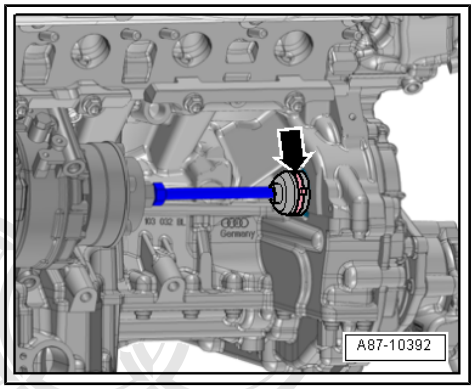
Secure with correct type of hose clip (same as original equipment) ⇒ Electronic parts catalogue .

– The new hose clip -1- must be guided through the hole in the retaining frame and over the dust cap -3- onto the AC 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 AC compressor drive and secure.
– Install drive chain for auxiliary drives ⇒ page 92 .
– 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 70 .
– Install crankshaft oil seal (gearbox end) ⇒ page 53 .
– Install oil filter housing ⇒ page 163 .
– Install intake manifold ⇒ Rep. Gr. 24 .
– Install timing chain covers (left and right) ⇒ page 68 .
– Install drive plate ⇒ page 52 .
– After installing engine, fill up with engine oil and check oil level ⇒ Maintenance ; Booklet 405 .

Tightening torque

Component	Nm
Spur gear drive to cylinder block	22

1.15 Balance shaft - exploded view

1 - Balance shaft
- ❑ Removing and installing ⇒ page 105

2 - 5 Nm + 90° further
- ❑ Renew

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

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

5 - O-rings
- ❑ Renew

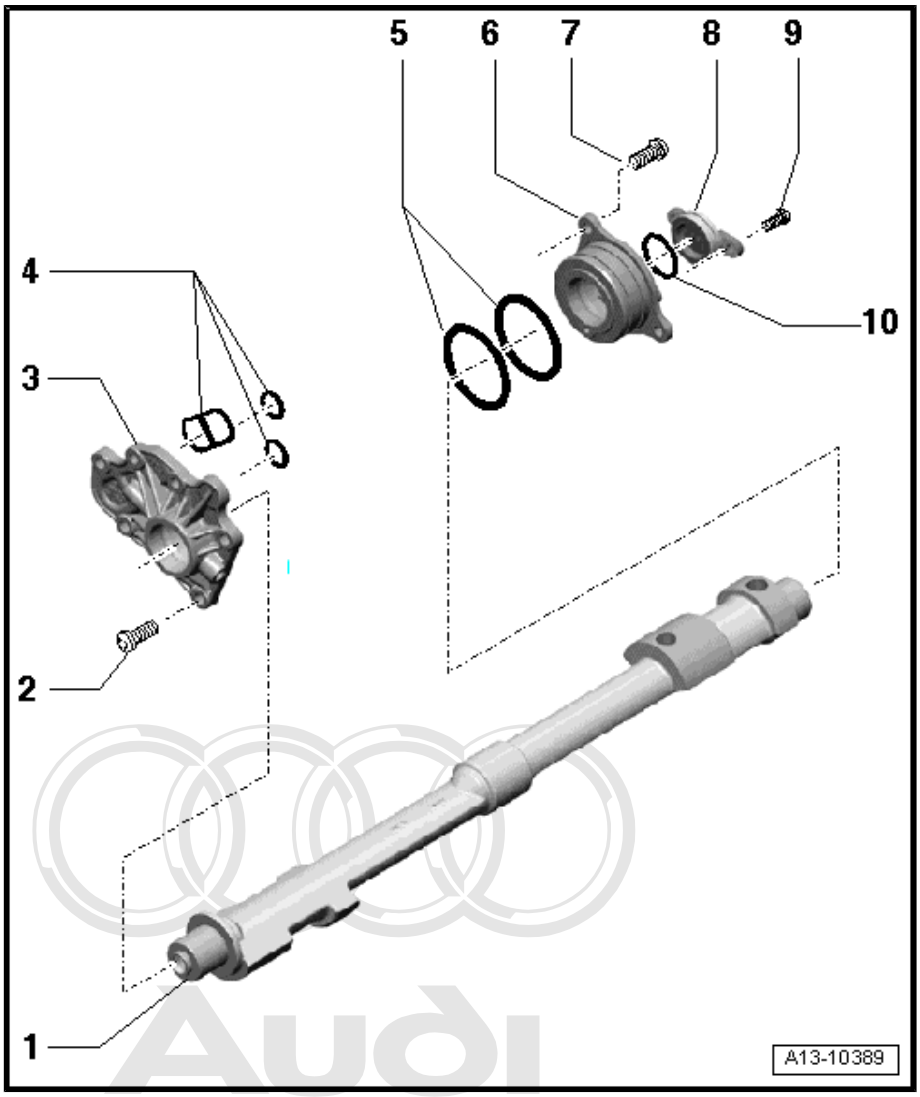
6 - Bearing cover (front)
- ❑ For balance shaft

7 - 5 Nm + 90° further
- ❑ Renew

8 - Cover
- ❑ For balance shaft

9 - 5 Nm
- ❑ Renew

10 - O-ring
- ❑ Renew



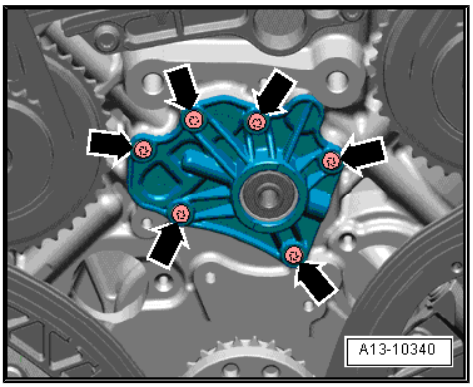
1.16 Removing and installing balance shaft

Removing

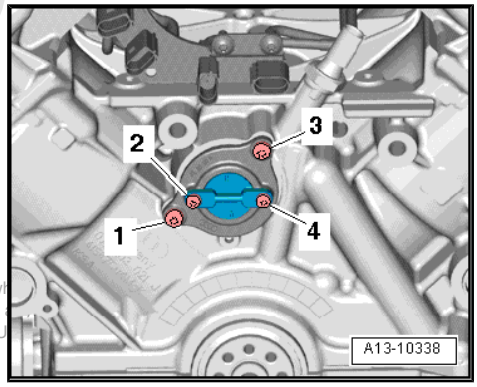
– Remove drive chain for auxiliary drives ⇒ page 92 .

– Remove bolts -arrows-.

– Remove bearing cover (rear) for balance shaft.



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

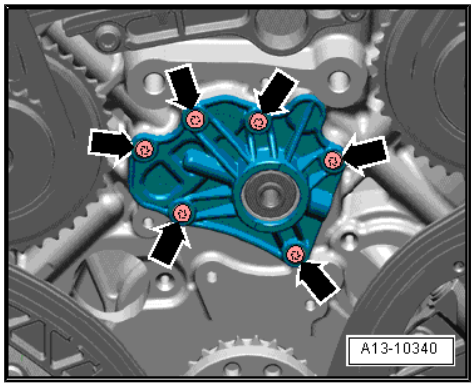
Note

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

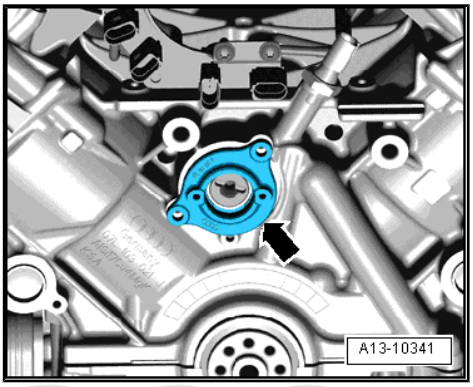
Caution

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*
  ⇒ "1.10 Removing and installing drive chain for auxiliary drives", page 92 .

– Install drive chain for auxiliary drives ⇒ page 92 .

Tightening torque

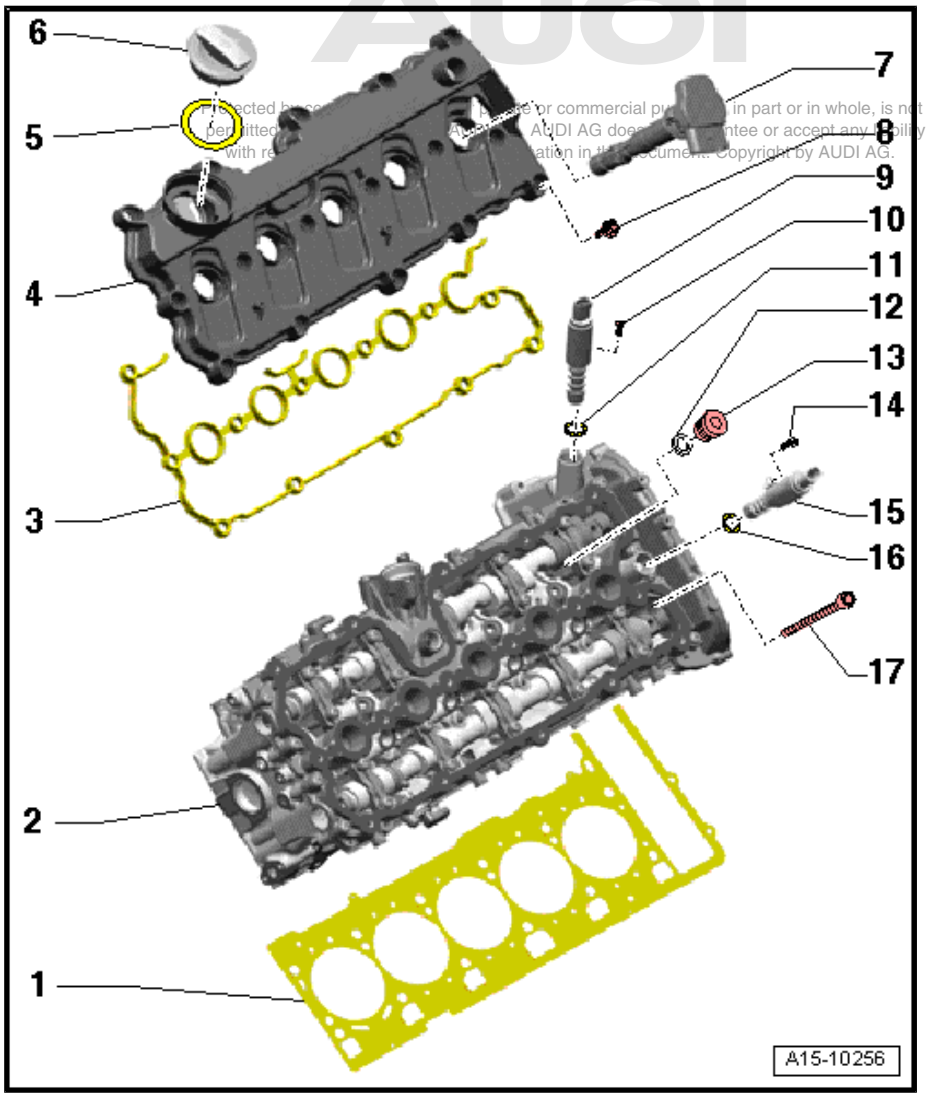
Component	Nm
Bearing cover (rear) for balance shaft to cylinder block	5 +90° 1)
• 1) Renew bolts.	

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 116
- ❑ Installation position: Part No. towards cylinder head
- ❑ If renewed, change coolant and engine oil

2 - Cylinder head

- ❑ Removing and installing ⇒ page 116
- ❑ Checking for distortion ⇒ page 109
- ❑ Machining limit ⇒ page 109
- ❑ 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 109 , right-side ⇒ page 112

5 - Seal

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

6 - Filler cap

7 - Ignition coil

- ❑ Remove using puller -T40039-

8 - Special bolt, 9 Nm

- ❑ Renew if seal is damaged
- ❑ Note correct sequence when tightening ⇒ page 112

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

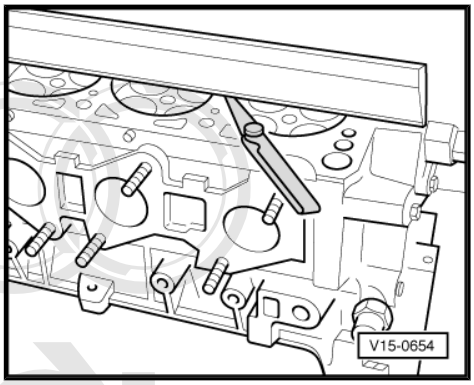
17 - Cylinder head bolt

- ❑ Renew
- ❑ Note correct sequence when loosening ⇒ page 119
- ❑ Note correct sequence when tightening ⇒ page 120

Checking cylinder head for distortion

– Use straight edge and feeler gauge to measure for distortion at several points.

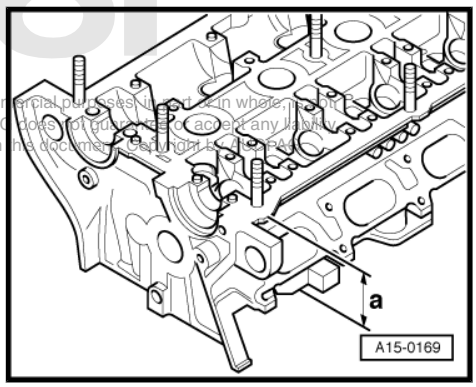
• Max. permissible distortion: 0.1 mm



Cylinder head machining limit

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

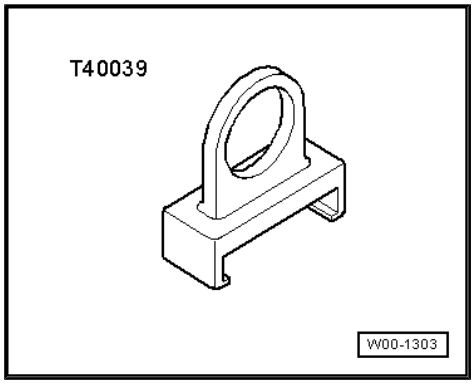
♦ Minimum dimension: -a- = 139.5 mm



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

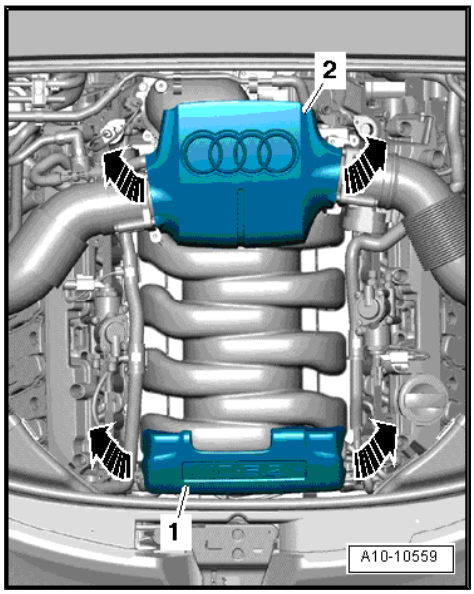
Special tools and workshop equipment required

♦ Puller -T40039-

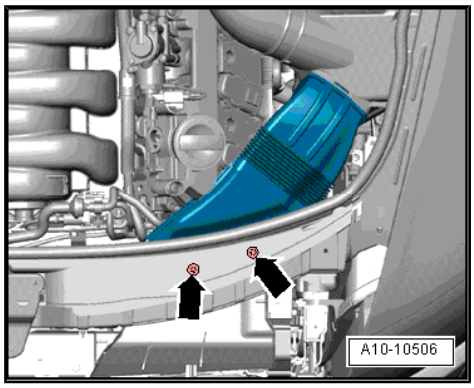


Removing

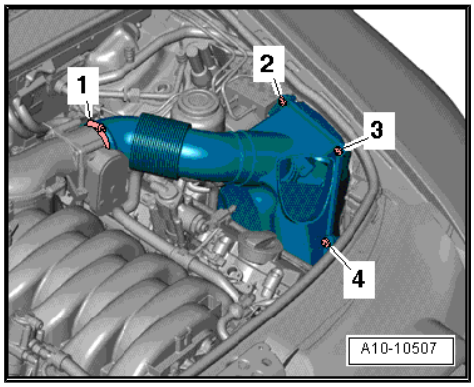
– Pull off engine cover panels at front -1- and at rear -2- -arrows-.



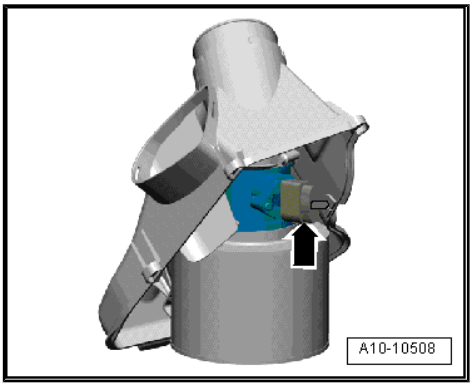
– Remove bolts -arrows- and remove air duct (left-side).



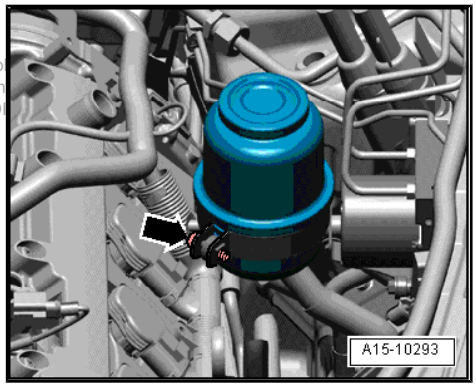
– Loosen hose clip -1- and remove bolts -2 ... 4-.
– Remove top section of air cleaner (left-side).



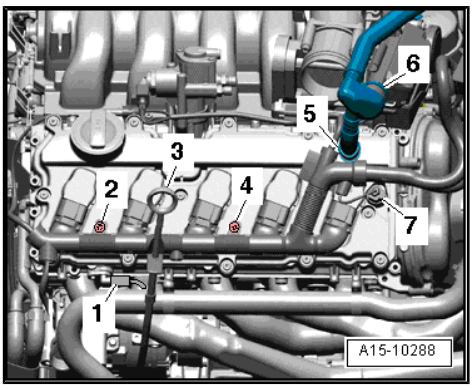
– Unplug electrical connector -arrow- at air mass meter 2 - G246- .



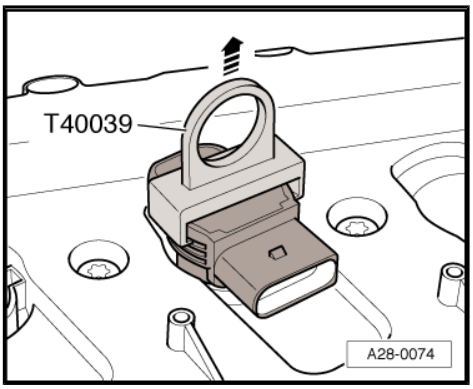
– Unscrew bolt -arrow- and remove power steering reservoir from bracket; hydraulic hoses remain attached.



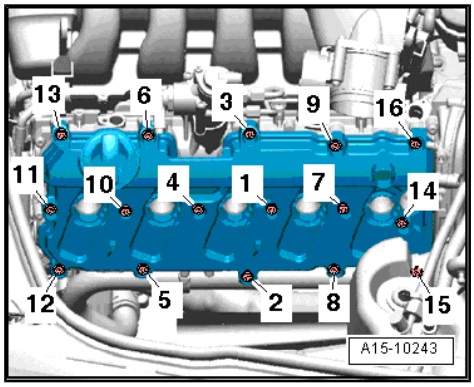
– Detach crankcase breather hose from oil separator -5- and from cylinder head cover -6-.
– Pull dipstick -3- out of guide tube.
– Unplug electrical connectors -1- and -7-.
– Remove bolts -2- and -4-.
– Unplug electrical connectors for ignition coils.
– Move wiring harness clear (unbolt bracket for wiring 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 bolts for cylinder head cover in the sequence -1 ... 16-.
– Install top section of air cleaner (left-side) ⇒ Rep. Gr. 24 .

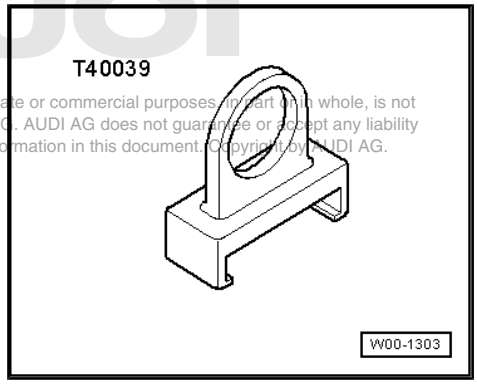
Tightening torques

Component	Nm
Cylinder head cover to cylinder head	9
Wiring guide for ignition coils to cylinder head cover	5

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

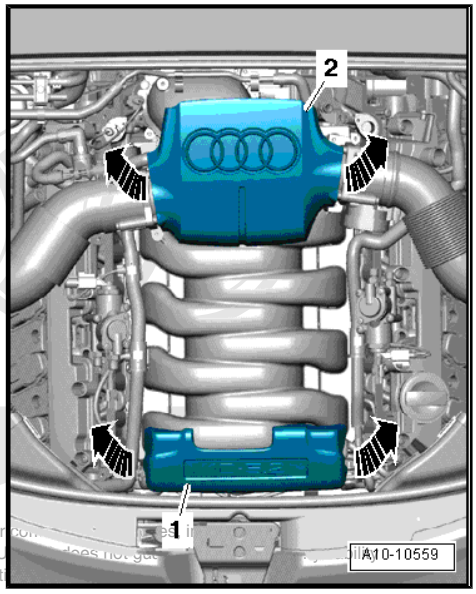
Special tools and workshop equipment required

- Puller -T40039-

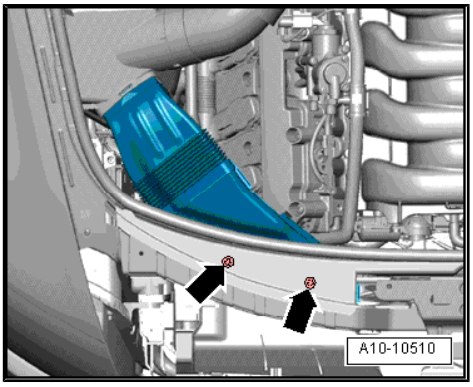


Removing

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



– Remove bolts -arrows- and remove air duct (right-side).



– Detach vacuum line -5- from air intake hose.

Rest-of-world vehicles:

– Detach crankcase breather hose -4- from air intake hose.

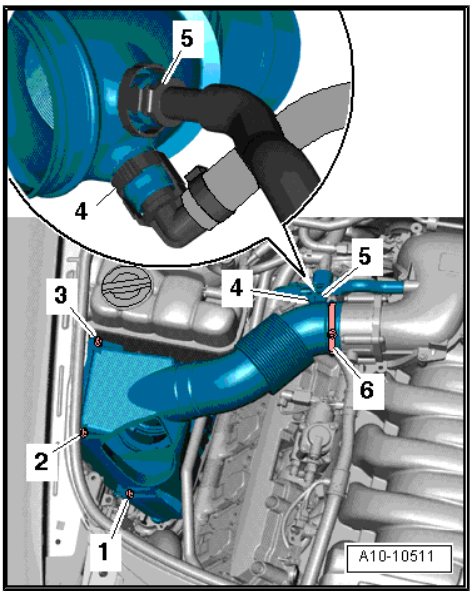
USA models:

> **Caution**
>
> ***Do not open hose connection -4- on USA models. Move top section of air cleaner (right-side) clear to one side (crankcase breather hose remains connected).***

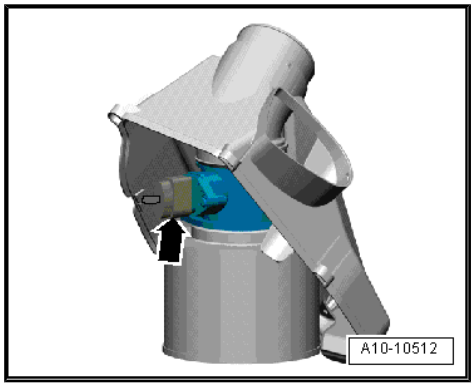
All vehicles:

– Loosen hose clip -6- and remove bolts -1, 2, 3-.

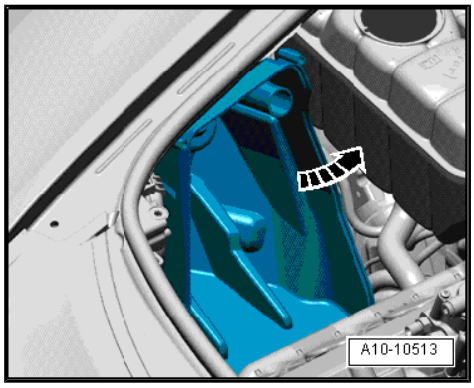
– Detach top section of air cleaner (right-side).



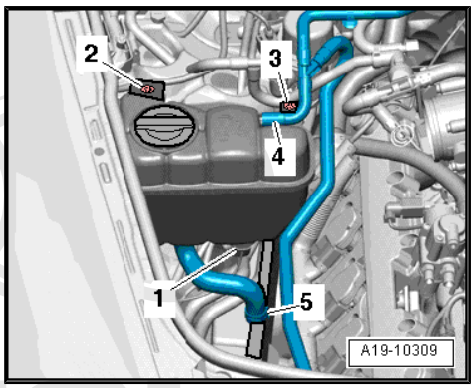
– Unplug electrical connector -arrow- at air mass meter -G70- .



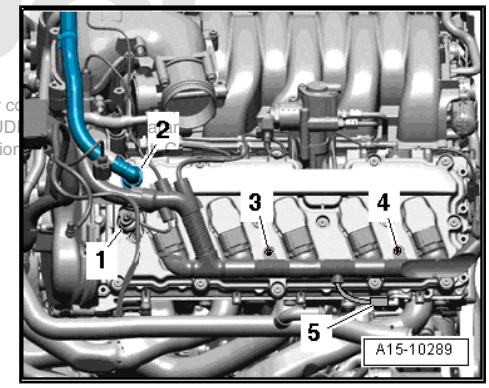
– Pull bottom section of air cleaner away from connection on side.
– Pivot bottom section of air cleaner upwards -arrow- and remove.



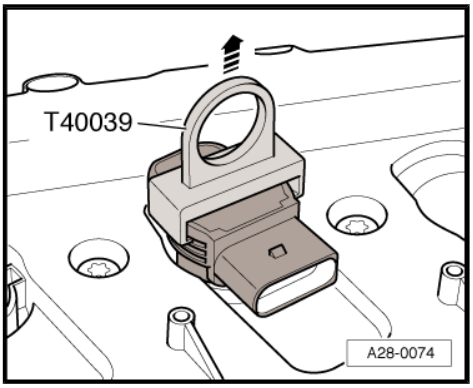
– Unplug electrical connector -1- on coolant shortage indicator switch -F66- at bottom of expansion tank.
– Remove bolts -2- and -3- and move expansion tank to the side with coolant hoses -4- and -5- still attached.



– 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.

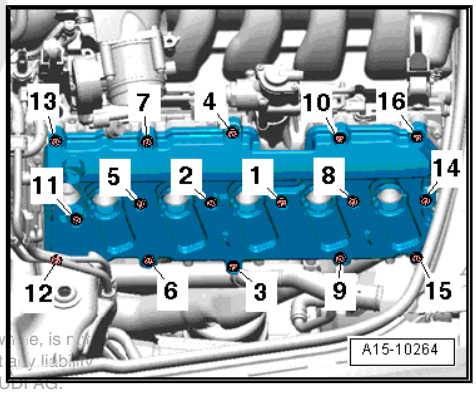
– Remove cylinder head cover.

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 to final setting in the sequence -1 ... 16-.

– Install air cleaner housing (right-side) ⇒ Rep. Gr. 24 .

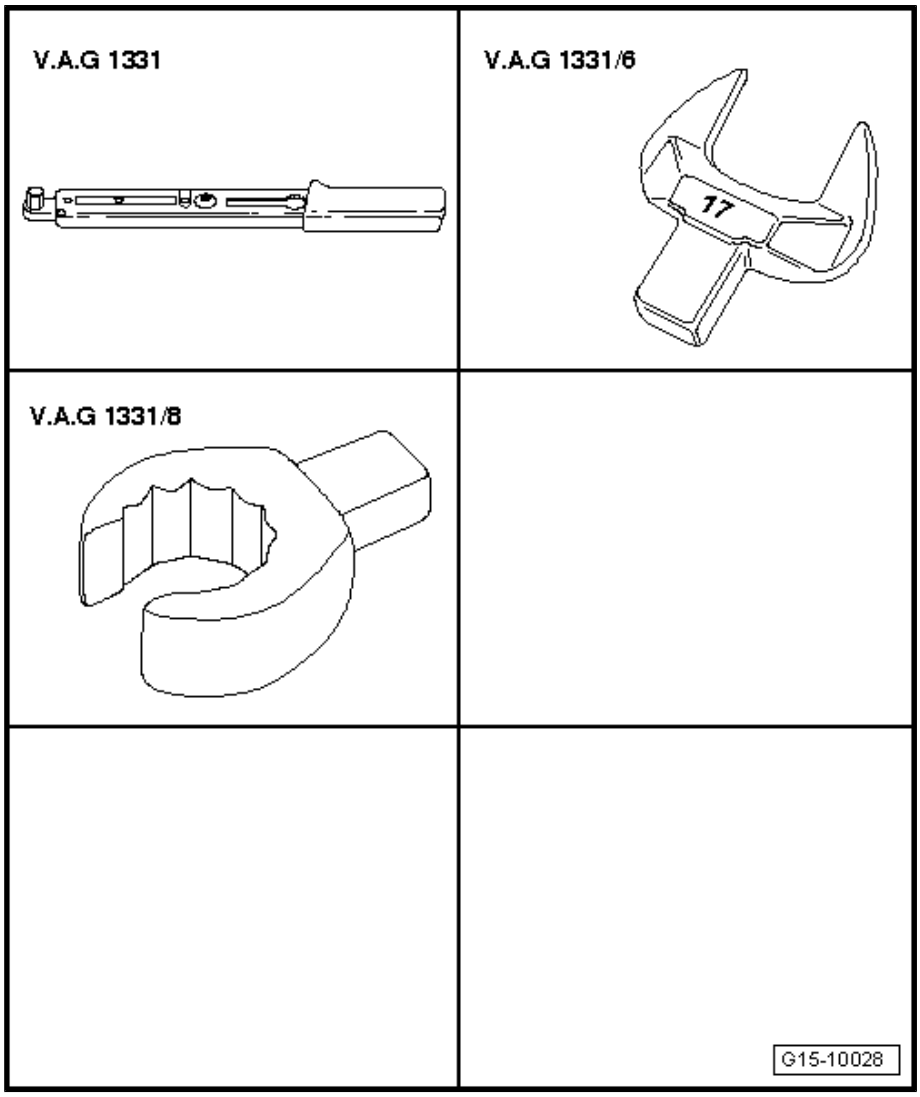
Tightening torques

Component	Nm
Cylinder head cover to cylinder head	9
Wiring guide for ignition coils to cylinder head cover	5

2.4 Removing and installing cylinder head

Special tools and workshop equipment required

- Torque wrench -V.A.G 1331-
- Tool 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



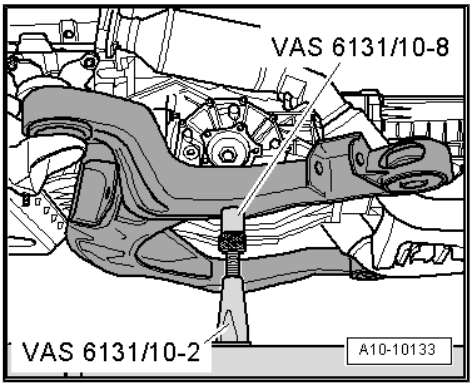
Removing

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

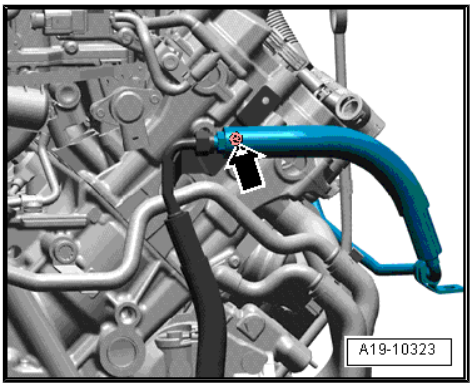
Note

- *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.*

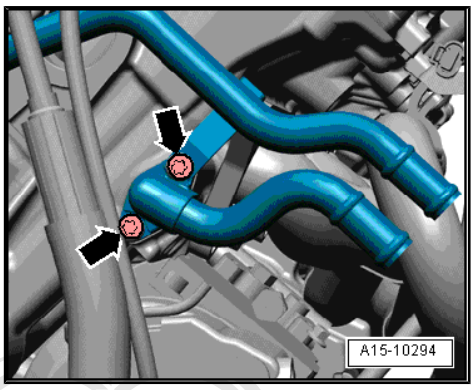
– Screw down spindles of the support elements (left and right) at subframe as far as possible.
– Unbolt tapered mounting pins -VAS 6131/10-2- from scissor-type assembly platform -VAS 6131 A- .
– Remove subframe to the side.
– Remove exhaust pipes: left-side ⇒ page 206 , right-side ⇒ page 209 .



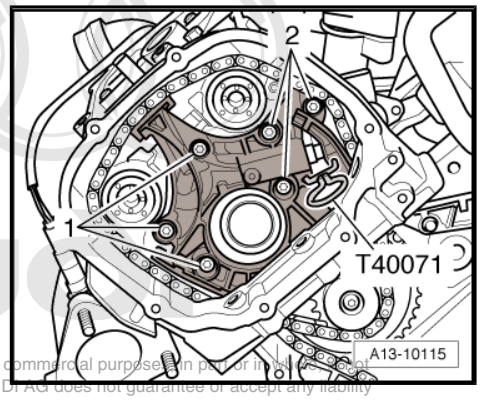
– Unbolt bracket for power steering pressure pipe on front of cylinder head -arrow-.



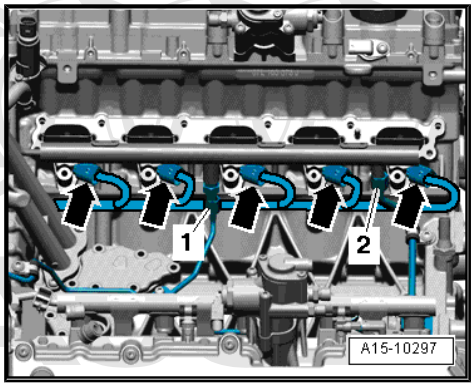
– Unbolt connection for secondary air from front of cylinder head -arrows-.
– Remove intake manifold ⇒ Rep. Gr. 24 .
– Remove camshaft timing chains from camshafts ⇒ page 79 .



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



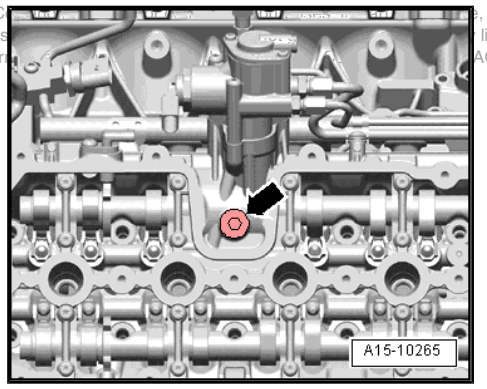
– Unplug electrical connectors -arrows- at injectors.
– Unscrew high-pressure pipe -2- at connection on fuel rail.
– Unscrew high-pressure pipe -1- at connection on fuel rail. To do so, counterhold at hexagon flats with an open-end spanner and slacken union nut.



Note

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

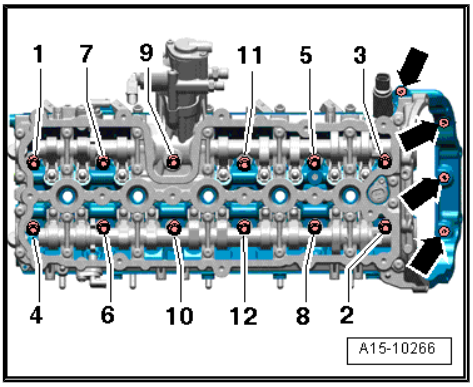
– Remove screw plug -arrow-.



– 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).



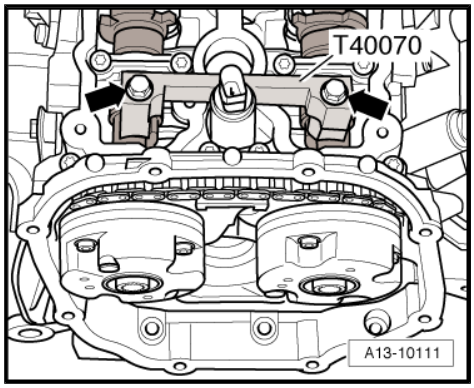
Installing

Note

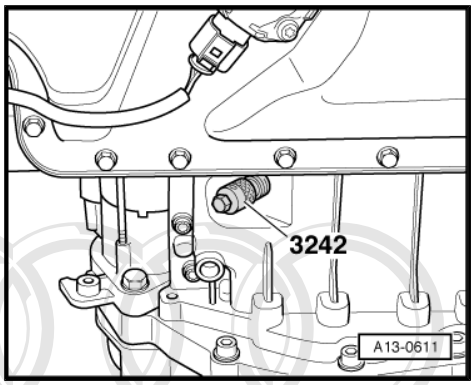
- *Renew the cylinder head bolts.*
- *Renew self-locking nuts and bolts.*
- *Renew bolts which are tightened to a specified angle as well as seals and gaskets.*
- *Carefully remove any sealant residue from the cylinder head and cylinder block. Ensure that no long scores or scratches are made on the surfaces.*
- *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.



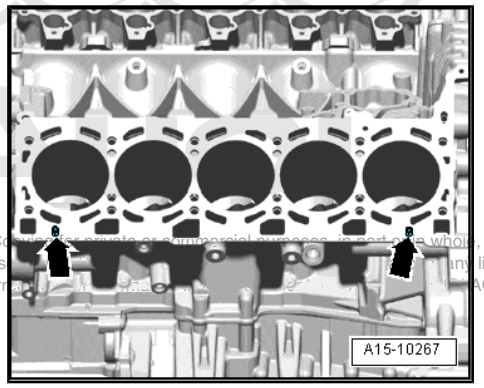
– Fit cylinder head gasket.

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

• Check installation position of cylinder head gasket: the word “oben” (top) or the Part No. should face towards the cylinder head.

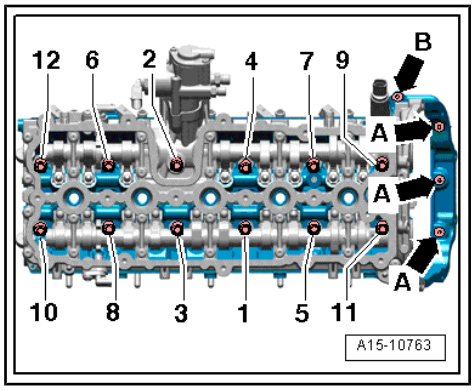
– Fit the cylinder head.

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



– Tighten bolts in 6 stages in the sequence shown:

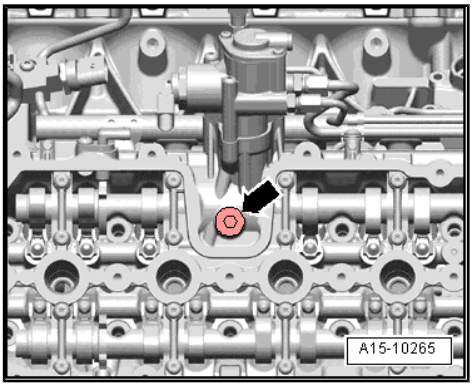
Stage	Bolts	Tightening torque/tightening angle
1.	-1 … 12-	30 Nm
2.	-1 … 12-	60 Nm
3.	-1 … 12-	turn 90° further
4.	-1 … 12-	turn 90° further
5.	-Arrows A and B-	11 Nm
6.	-Arrows A-	turn 90° further



Note

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

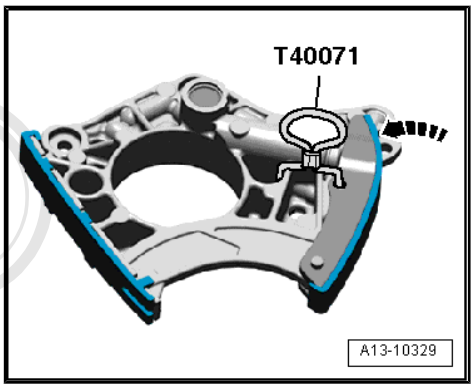
– Tighten screw plug -arrow-.



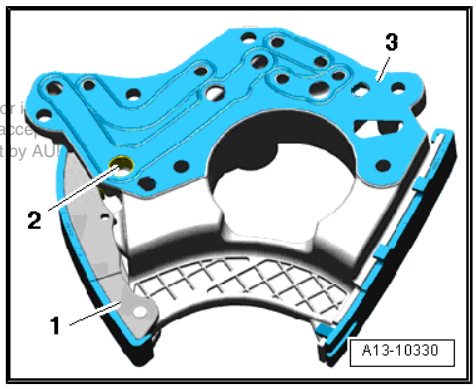
– Make sure that guide rail of chain tensioner for camshaft timing chain is locked with locking pin -T40071- .

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.*
- *Ignore -arrow-.*



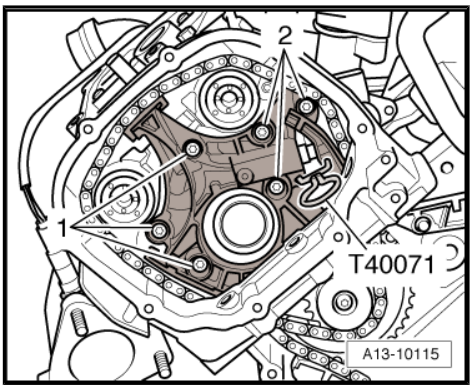
– If necessary, clean oil strainer -2- of chain tensioner.
– Fit new gasket -3- to rear of chain tensioner -1-.



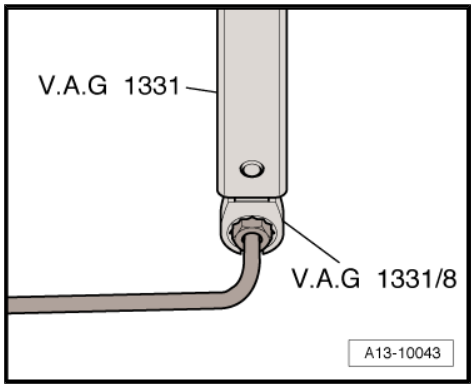
– Install chain tensioner and position camshaft timing chain as shown in the illustration.
– Tighten bolts -1- and -2-.

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

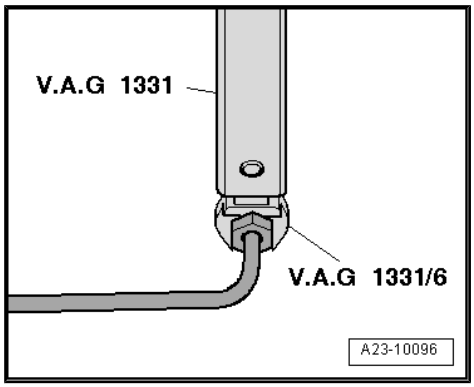
– Install camshaft timing chains ⇒ page 87 .
– Install timing chain covers (left and right) ⇒ page 68 .
– Install cylinder head cover: left-side ⇒ page 109 , right-side ⇒ page 112 .



– To secure union nut (14 mm) to fuel rail, use torque wrench - V.A.G 1331- with socket insert AF 14, flared ring spanner - V.A.G 1331/8- .



– To secure union nut (17 mm) to fuel rail, use torque wrench - V.A.G 1331- with tool insert AF 17 -V.A.G 1331/6- .



– Install intake manifold ⇒ Rep. Gr. 24 .
– Install exhaust pipes: left-side ⇒ page 206 , right-side ⇒ page 209 .
– After installing engine, change engine oil ⇒ Maintenance ; Booklet 405 .
– Fill cooling system with fresh coolant ⇒ page 170 .

Tightening torques

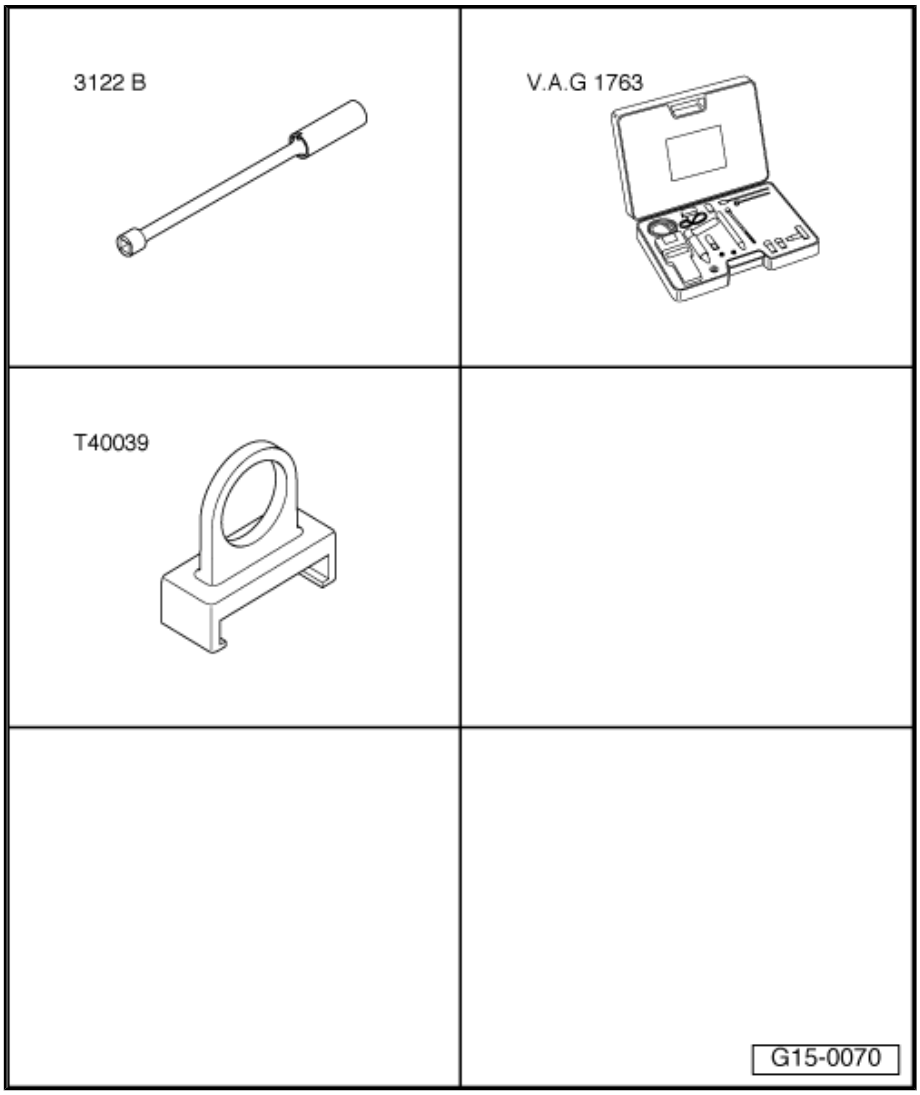
Component	Nm
Screw plug to retaining frame	35
High-pressure pipes to fuel rail	25
Chain tensioner to cylinder head	5 +90° 1)
Connection for secondary air to cylinder head	9
Bracket for power steering pressure pipe to cylinder head	9

• 1) Renew bolts.

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-

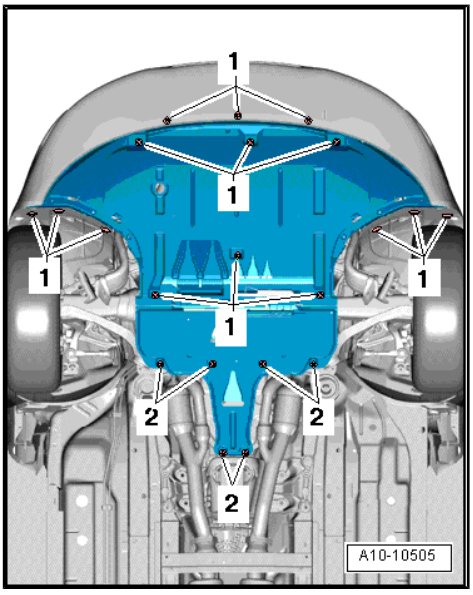


Procedure

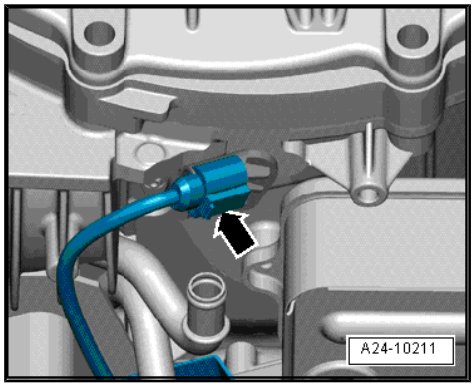
- Engine oil temperature at least 30 °C.
- Battery voltage at least 12.5 V.

– Switch off ignition.

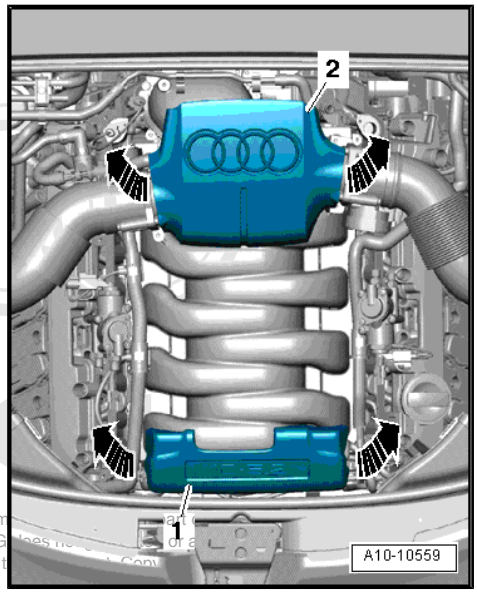
– Open quick-release fasteners -1- and remove noise insulation (front).



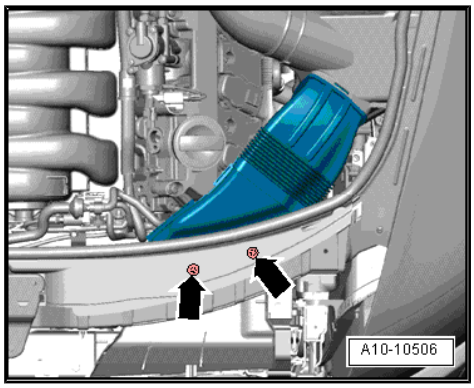
– Unplug electrical connector at engine speed sender -G28- -arrow- at bottom of gearbox.



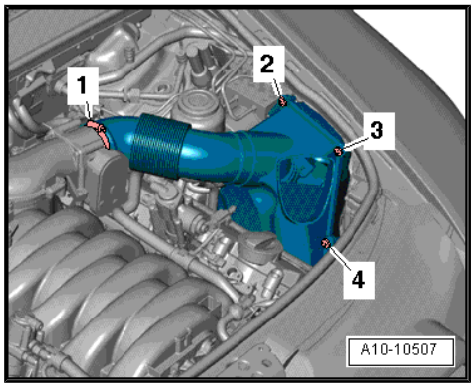
– Pull off engine cover panels at front -1- and at rear -2- -arrows-.



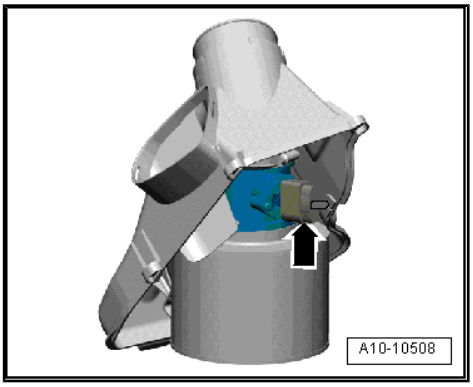
– Remove bolts -arrows- and remove air duct (left-side).



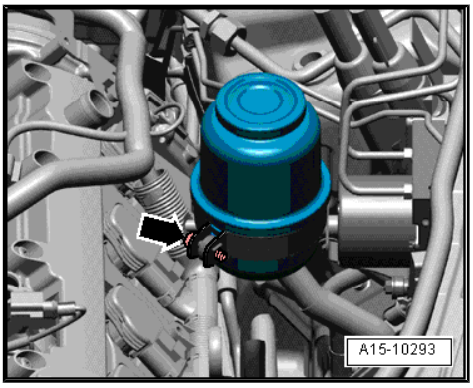
– Loosen hose clip -1- and remove bolts -2, 3, 4-.
– Remove top section of air cleaner (left-side).



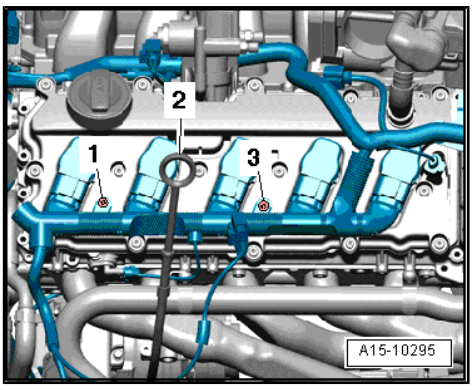
– Unplug electrical connector -arrow- at air mass meter 2 - G246- .



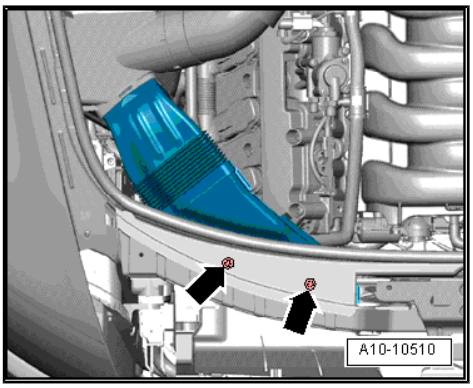
– Unscrew bolt -arrow- and remove power steering reservoir from bracket; hydraulic hoses remain attached.



– 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.



– Remove bolts -arrows- and remove air duct (right-side).



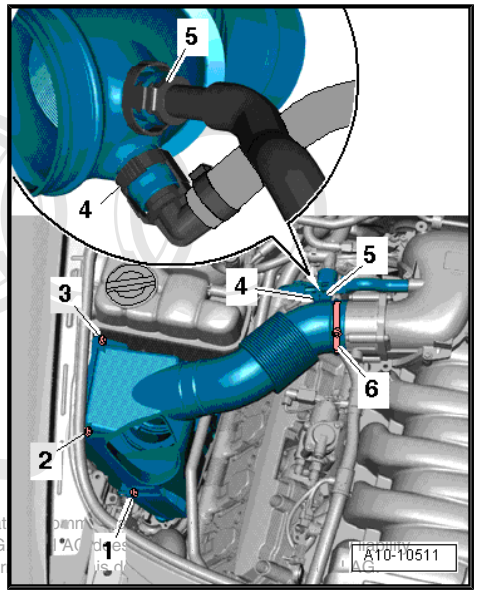
– Detach vacuum line -5- from air intake hose.

Rest-of-world vehicles:

– Detach crankcase breather hose -4- from air intake hose.

USA models:

> **Caution**
>
> *Do not open hose connection -4- on USA models. Move top section of air cleaner (right-side) clear to one side (crankcase breather hose remains connected).*

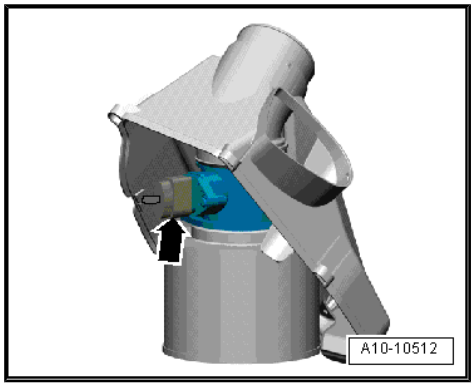


All vehicles:

– Loosen hose clip -6- and remove bolts -1, 2, 3-.

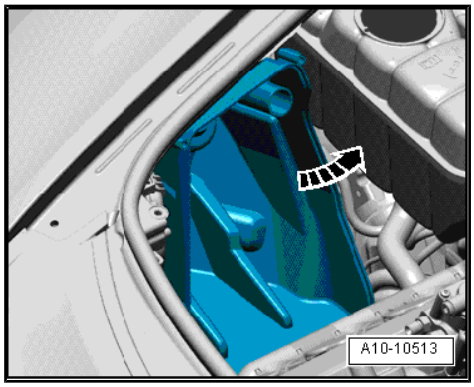
– Detach top section of air cleaner (right-side).

– Unplug electrical connector -arrow- at air mass meter -G70- .



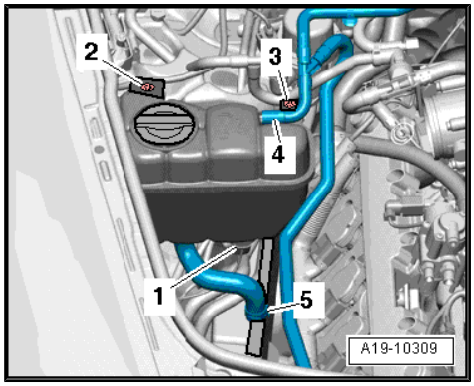
– Pull bottom section of air cleaner away from connection on side.

– Pivot bottom section of air cleaner upwards -arrow- and remove.

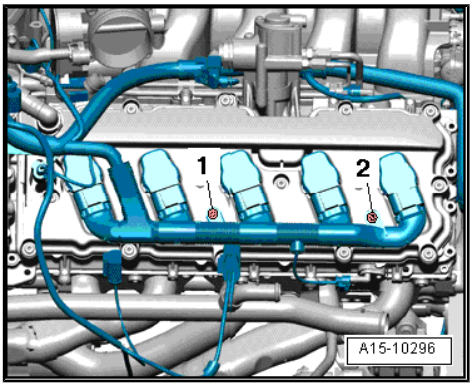


– Unplug electrical connector -1- on coolant shortage indicator switch -F66- at bottom of expansion tank.

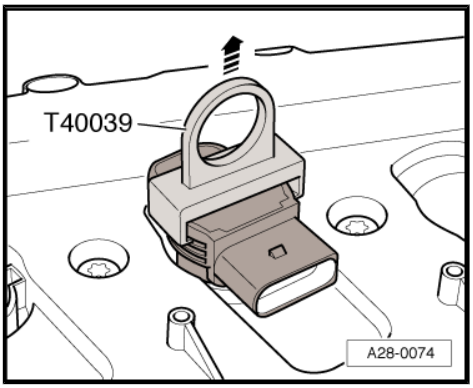
– Remove bolts -2- and -3- and move expansion tank to the side with coolant hoses -4- and -5- still attached.



– 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 top section of air cleaner (left-side) and air cleaner housing (right-side) ⇒ Rep. Gr. 24 .
– Install spark plugs ⇒ Maintenance ; Booklet 405 .
– Faults are stored in engine control units because connectors were unplugged: “Generate readiness code” in “Guided Functions” ⇒ Vehicle diagnosis, testing and information system VAS 5051.

Tightening torque

Component	Nm
Wiring guide for ignition coils to cylinder head cover	5

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 137
- ❑ Renewing (cylinder head removed) ⇒ page 141

3 - Valve spring
- ❑ Installation position ⇒ page 130

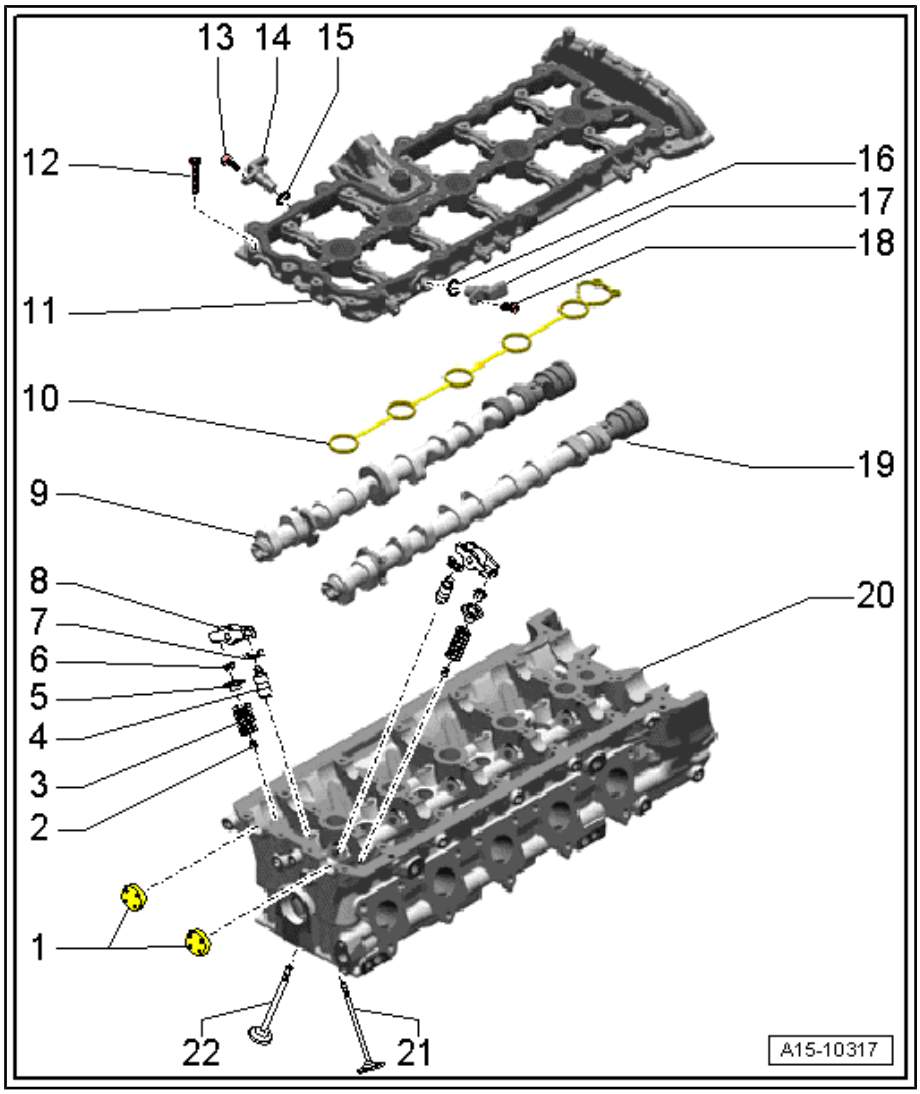
4 - Hydraulic valve compensation element
- ❑ Clipped into roller rocker finger -item 8-
- ❑ Checking ⇒ page 144
- ❑ Do not interchange
- ❑ Lubricate contact surface

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 131
- ❑ Measuring axial clearance ⇒ page 130
- ❑ Measuring radial clearance ⇒ page 131
- ❑ 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 131

12 - Bolt

- ❑ Renew
- ❑ To avoid damage to retaining frame for camshafts, refer to tightening torque and sequence ⇒ page 135

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 131
- ❑ Measuring axial clearance ⇒ page 130
- ❑ Measuring radial clearance ⇒ page 131
- ❑ Runout: max. 0.04 mm

20 - Cylinder head

- ❑ Checking valve guides ⇒ page 145

21 - Inlet valve

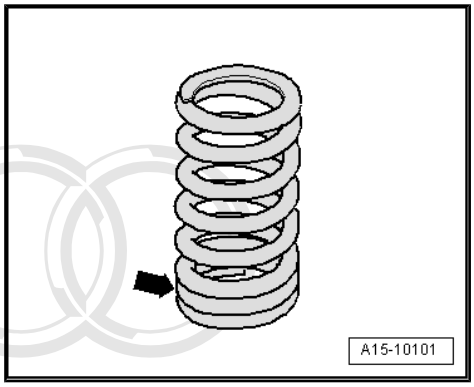
- ❑ Do not machine, only grinding-in is permitted
- ❑ Mark installation position for re-installation
- ❑ Valve dimensions ⇒ page 145
- ❑ Checking valve guides ⇒ page 145

22 - Exhaust valve

- ❑ Do not machine, only grinding-in is permitted
- ❑ Mark installation position for re-installation
- ❑ Valve dimensions ⇒ page 145
- ❑ Checking valve guides ⇒ page 145

Position of valve spring

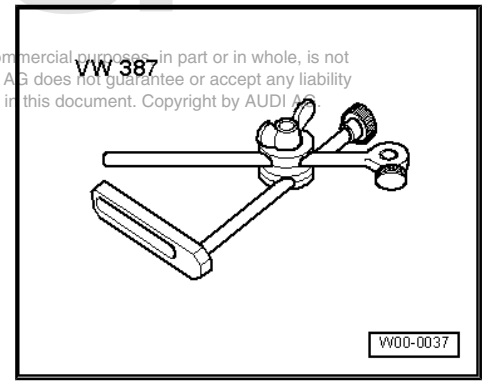
- The closely spaced spring coils -arrow- face the cylinder head.



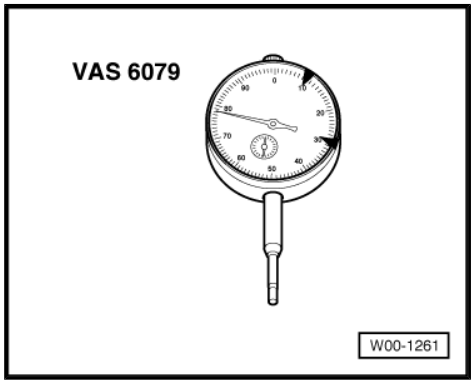
3.2 Measuring axial clearance of camshafts

Special tools and workshop equipment required

♦ Universal dial gauge bracket -VW 387-



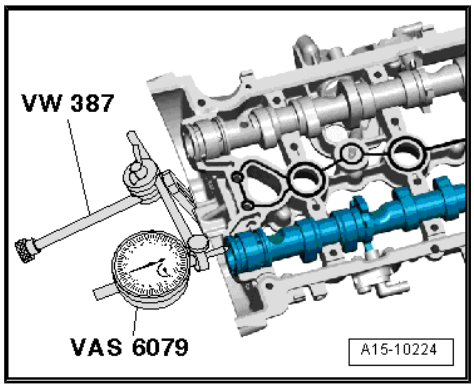
♦ Dial gauge -VAS 6079-



Test sequence

– Remove retaining frame
⇒ “3.4 Removing and installing camshafts”, page 131 .
– 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 131 .

– Clean bearing and bearing journal.

– 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 tighten to torque (do not turn further) without rotating camshafts ⇒ page 135 .

– Remove retaining frame again.

– Compare width of Plastigage with measurement scale.

Radial clearance:

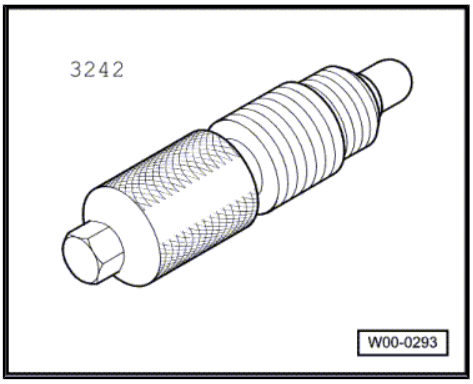
• Bearing (∅ 24 mm): 0.024 ... 0.066 mm.

• Bearing (∅ 36 mm): 0.100 ... 0.325 mm.

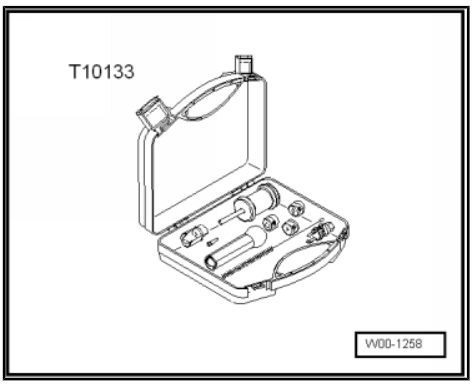
3.4 Removing and installing camshafts

Special tools and workshop equipment required

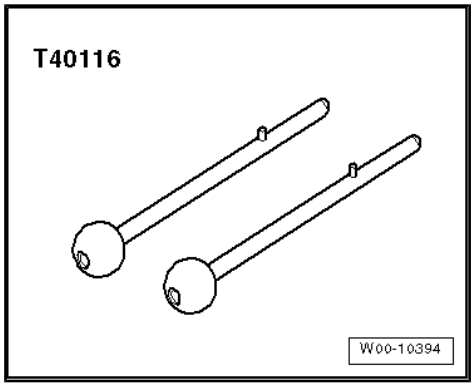
♦ Locking pin -3242-



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



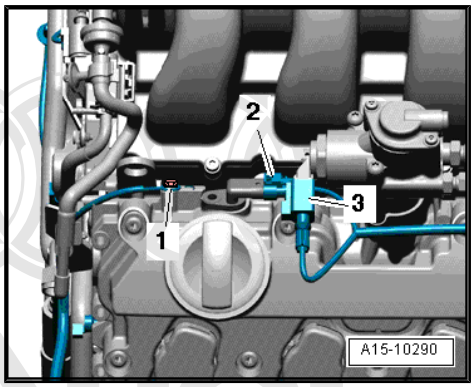
- Locating pins -T40116-



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

Removing

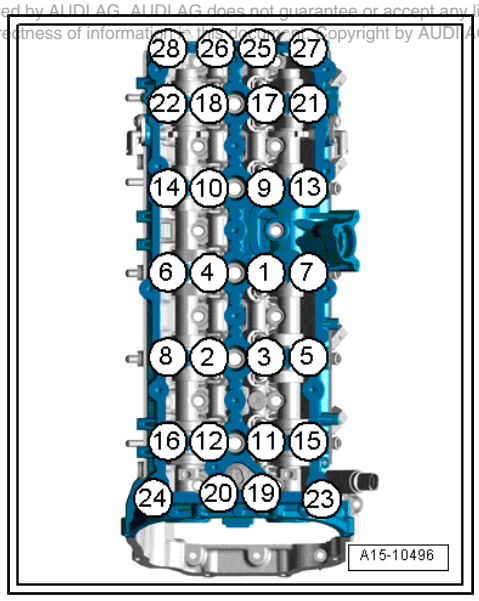
- Engine removed and in position on scissor-type assembly platform -VAS 6131 A- with gearbox attached.



Note

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

– Remove camshaft timing chains from camshafts ⇒ page 79 .
– 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-

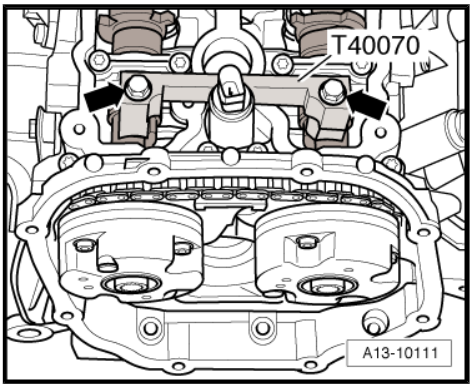


Note

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

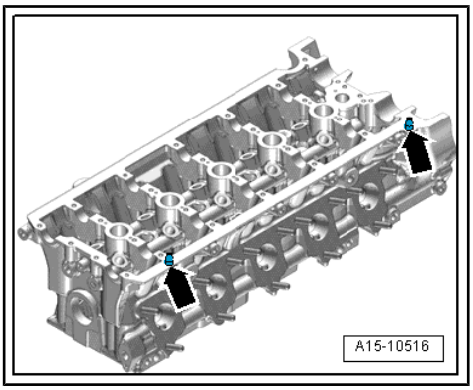
– Carefully release retaining frame from bonded joint and set it down on a soft surface on workbench.

– 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.

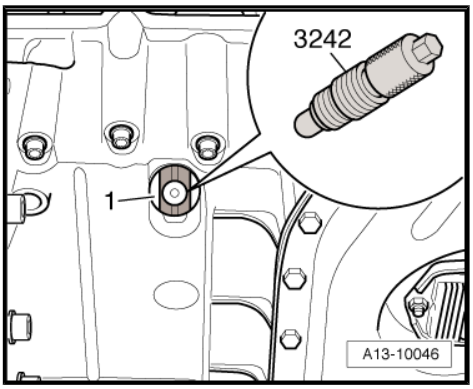


Installing

Note

Renew gaskets and seals.

- Crankshaft -1- locked in position with locking pin -3242- .
- Hydraulic compensation elements and roller rocker fingers installed.



WARNING

Wear safety goggles.

Caution

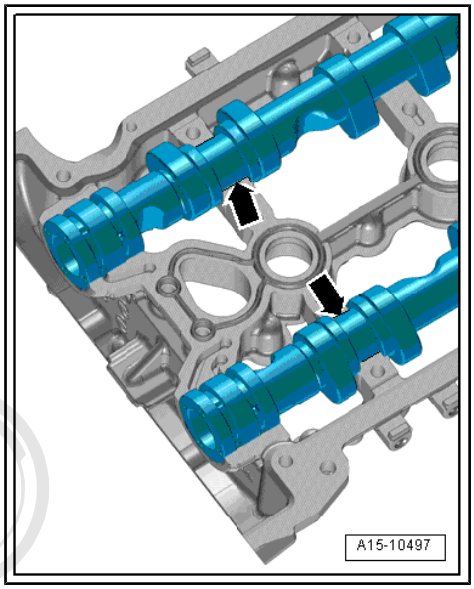
Make sure that no sealant residue gets into the cylinder head or the bearings.

– 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.

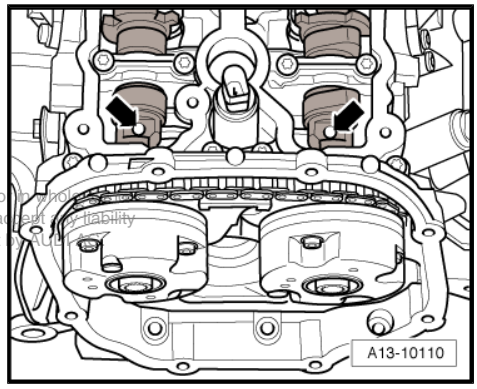
• Camshafts must be in correct position in axial bearings -arrows- in retaining frame.

– Turn retaining frame upside down with camshafts fitted, keeping hold of the camshafts in the retaining frame.

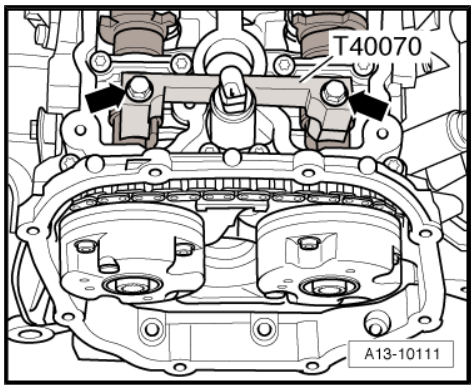


– Turn the camshafts until the threaded holes -arrows- point upwards.

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



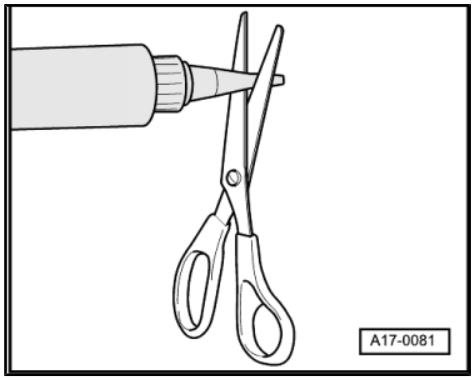
– Fit camshaft clamp -T40070- to inlet camshaft and exhaust camshaft as shown in illustration and tighten bolts to 25 Nm.



Note

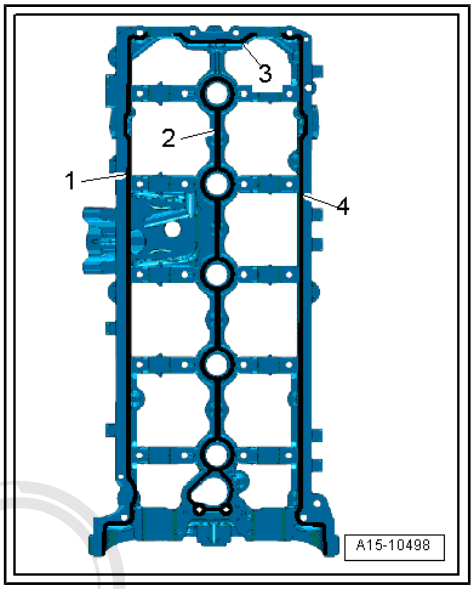
Note the use-by date of the sealant.

– Cut off tube nozzle at front marking (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.

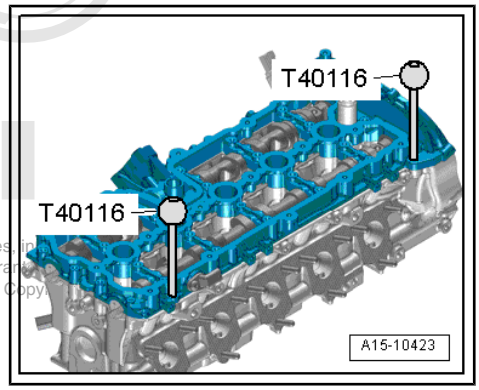
• Width of sealant beads: 2.5 mm.

Note

Fit and secure the retaining frame without delay, as the sealant starts hardening immediately.

– Fit retaining frame onto cylinder head.

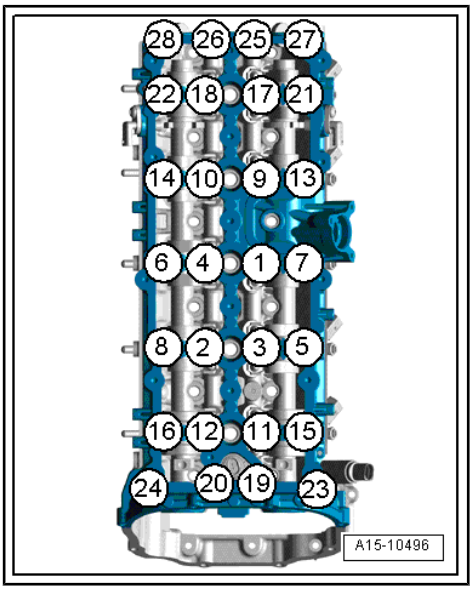
– Insert locating pins -T40116- in retaining frame and in cylinder head.



Note

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

– Renew bolts -1 … 28- for retaining frame for camshafts.



Caution

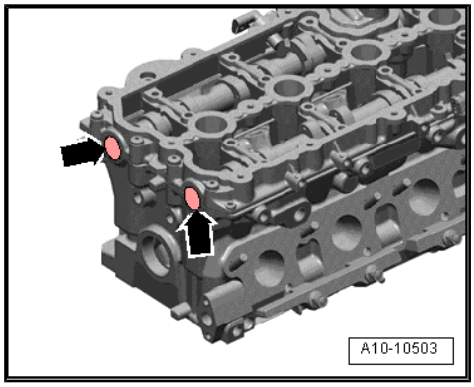
Risk of damage to retaining frame for camshafts.

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

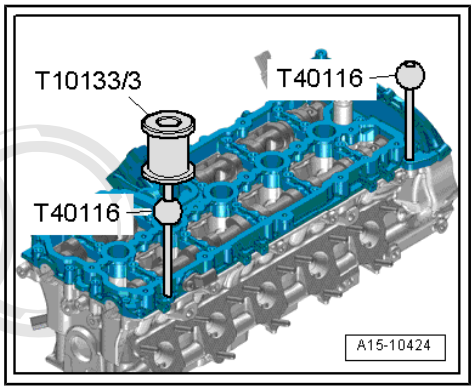
– Tighten bolts in 4 stages as follows:

Stage	Bolts	Tightening torque
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

– 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 -T10133/3- to pull out locating pins -T40116- .



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 82 .
– Install timing chain covers (left and right) ⇒ page 68 .
– Install cylinder head cover: left-side ⇒ page 109 , right-side ⇒ page 112 .

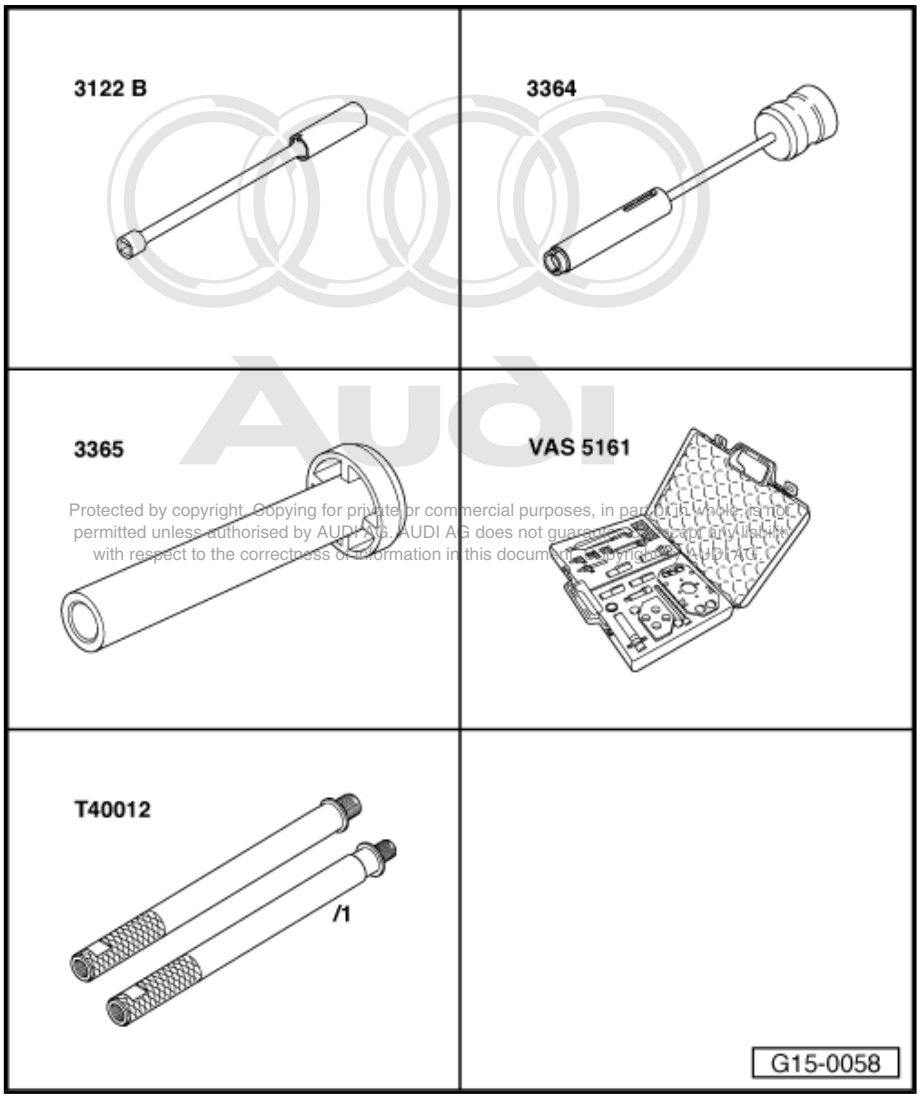
Note

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.

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 / installing device for valve cotters -VAS 5161-
- Adapter -T40012-



Removing

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

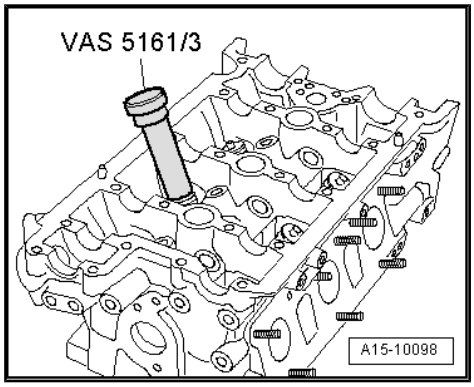
– Remove camshafts ⇒ page 131 .

– Mark original positions of roller rocker fingers and hydraulic compensation elements for reinstallation.

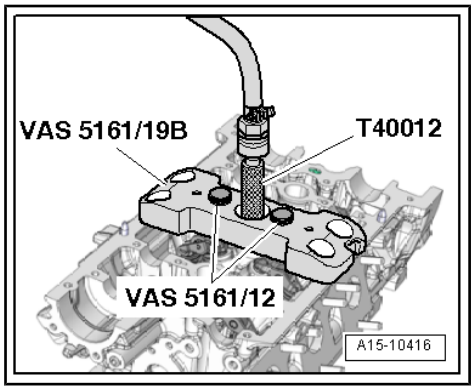
– Remove roller rocker fingers together with hydraulic compensation elements and put down on a clean surface.

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

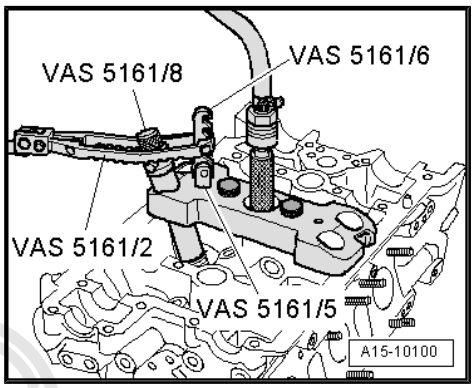
– Apply drift -VAS 5161/3- to valve spring plate and knock valve cotters loose using a plastic hammer.



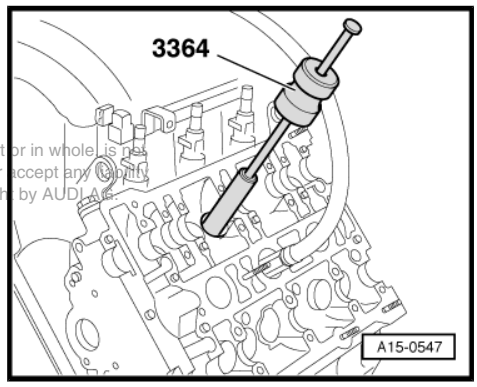
– Fit guide plate -VAS 5161/19B- onto cylinder head.
– Secure guide plate with knurled screws -VAS 5161/12- .
– Screw adapter -T40012- with seal hand-tight into the corresponding spark plug thread and apply a steady pressure.
• Air pressure: at least 6 bar



– 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 the 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.



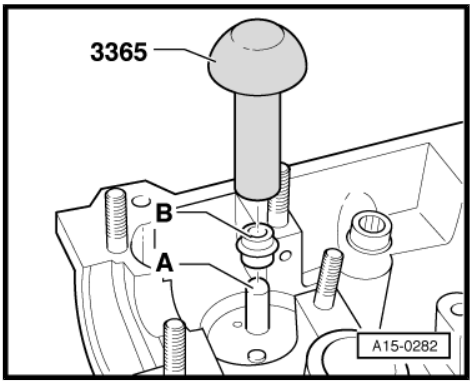
– Remove valve stem oil seals using the valve stem seal puller -3364- .



Note

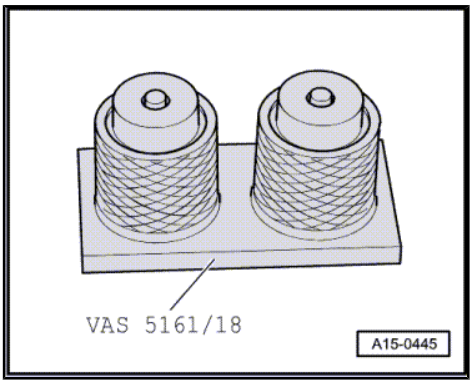
A plastic sleeve -A- is included with the new valve stem oil seals.

– 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 the plastic sleeve.



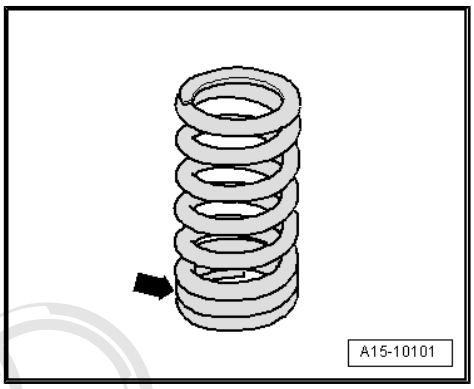
If valve cotters have been removed from assembly cartridge, they need to be put into insertion device -VAS 5161/18- first.

• Larger diameter of valve cotters faces upwards.

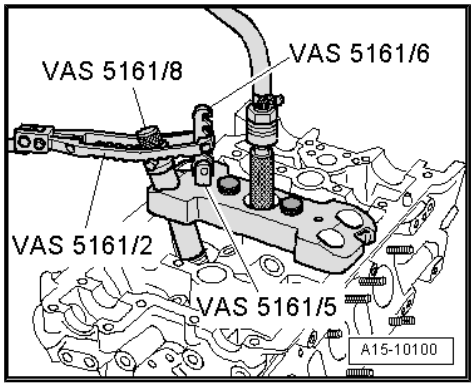


– Install valve spring and valve spring plate.

• 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 the 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 131 .
– Install spark plugs ⇒ Maintenance ; Booklet 405 .

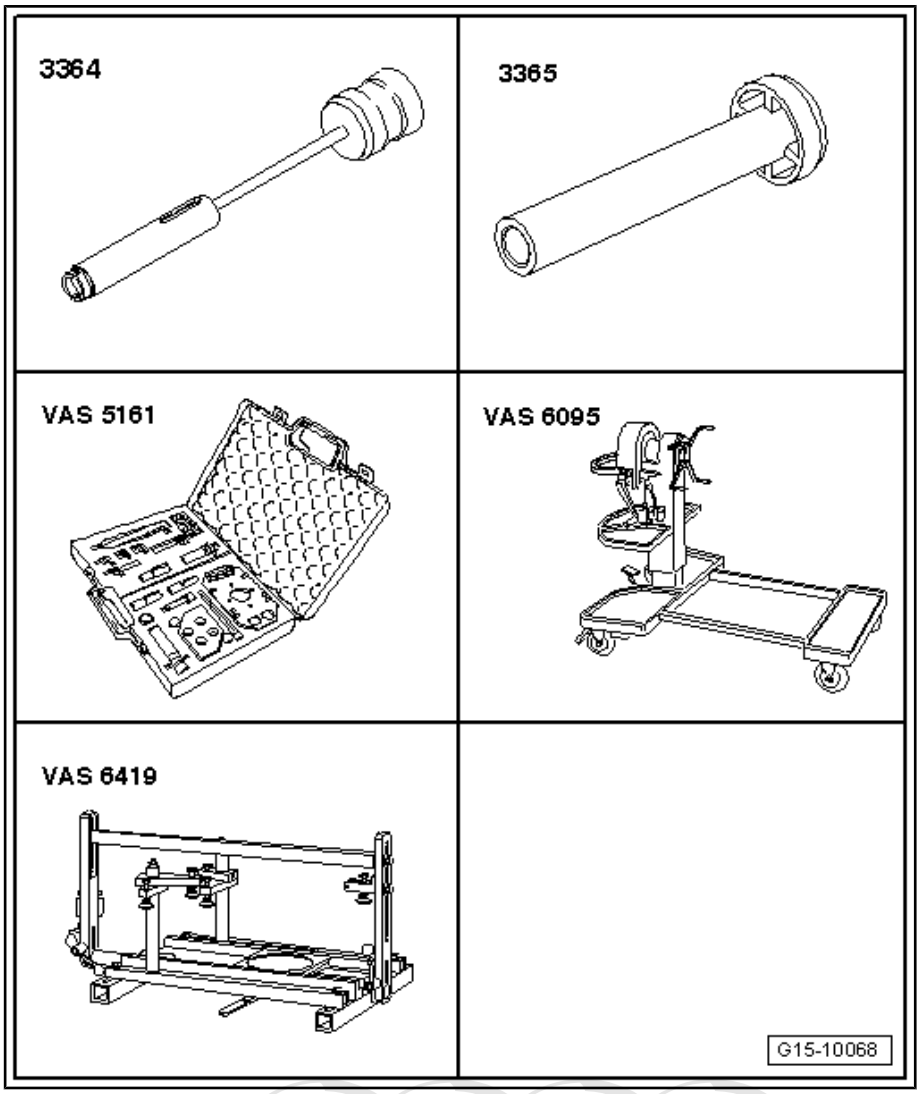
Note

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 / installing device for valve cotters -VAS 5161-
- Engine and gearbox support -VAS 6095-
- Cylinder head tensioning device -VAS 6419-



Procedure

– Remove camshafts ⇒ page 131 .

– 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.

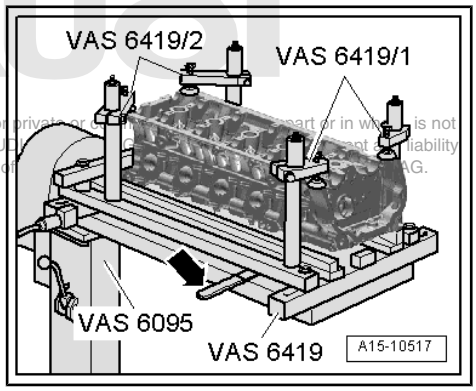
– Insert cylinder head tensioning device -VAS 6419- into engine and gearbox support -VAS 6095- .

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

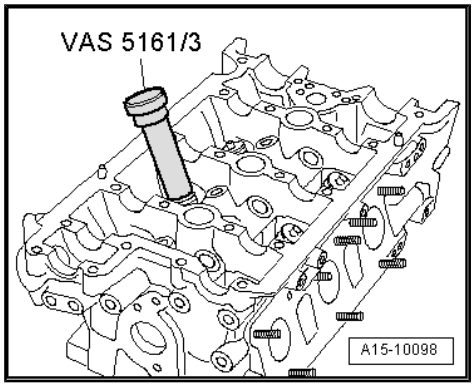
– Connect cylinder head tensioning device to compressed air.

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

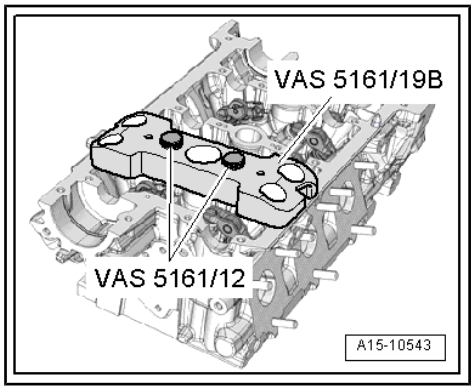
– Apply just enough compressed air to bring air pad into contact with valve heads.



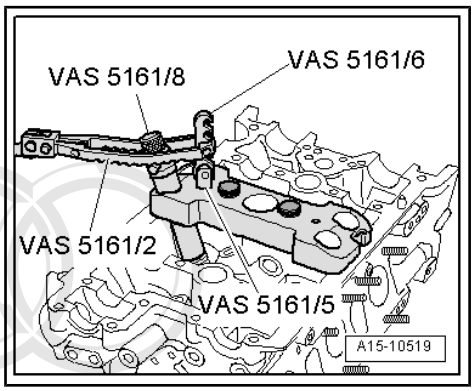
– Apply drift -VAS 5161/3- to valve spring plate and knock valve cotters loose using a plastic hammer.



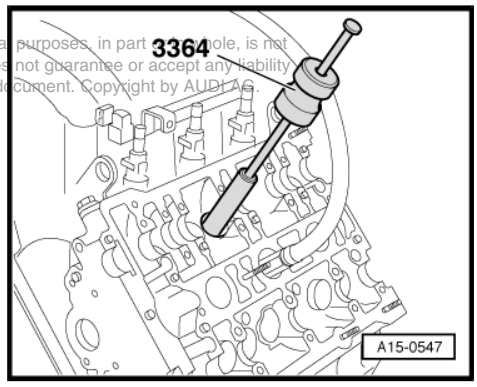
– Fit guide plate -VAS 5161/19B- onto cylinder head.
– Secure guide plate with knurled screws -VAS 5161/12- .



– 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 the pressure fork.
– Remove assembly cartridge.
– Detach guide plate and turn to one side.
– Remove valve spring with valve spring plate.

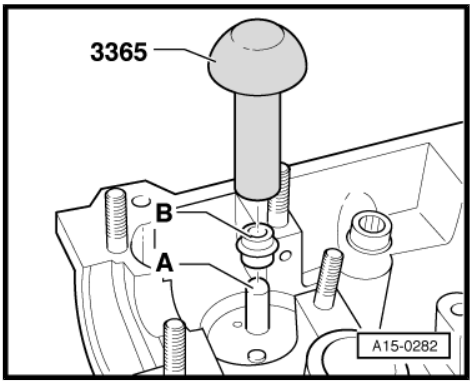


– Remove valve stem oil seals using the valve stem seal puller -3364- .



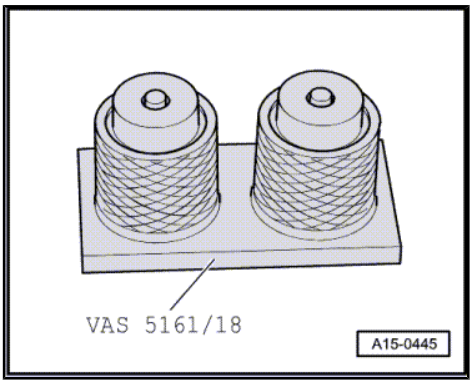
Note

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



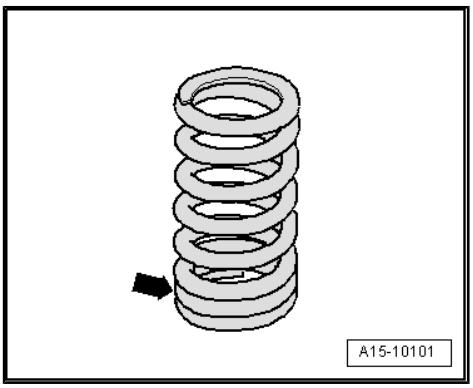
– Fit plastic sleeve -A- onto the valve stem to prevent damage to the new valve stem oil seal -B-.
– Lightly lubricate sealing lip of valve stem oil seal.
– Slip valve stem oil seal over plastic sleeve.
– Carefully press the valve stem oil seal onto valve guide using fitting tool -3365- .
– Remove the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

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



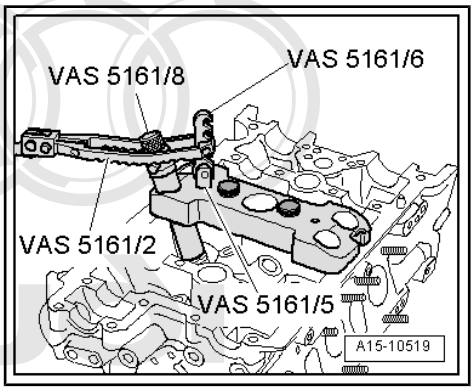
• Larger diameter of valve cotters faces upwards.

– 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 the 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 131 .

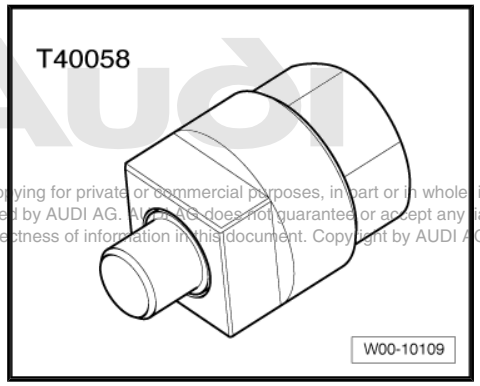
3.7 Checking hydraulic valve compensation elements

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 159* *.*

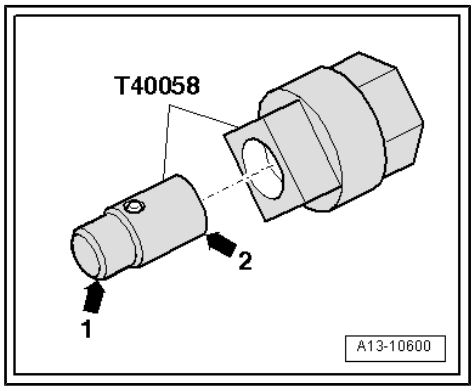
If the hydraulic compensation elements are still noisy, locate the defective element as follows:

– Move lock carrier to service position ⇒ Rep. Gr. 50 .

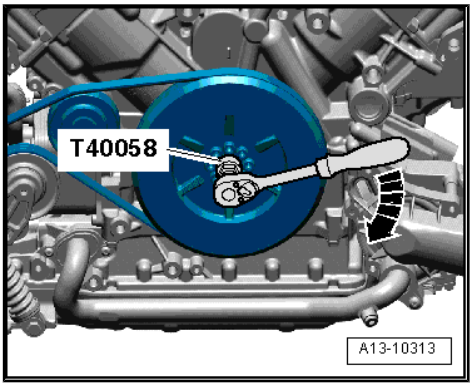
– Remove cylinder head cover: left-side ⇒ page 109 , right-side ⇒ page 112 .

– 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.



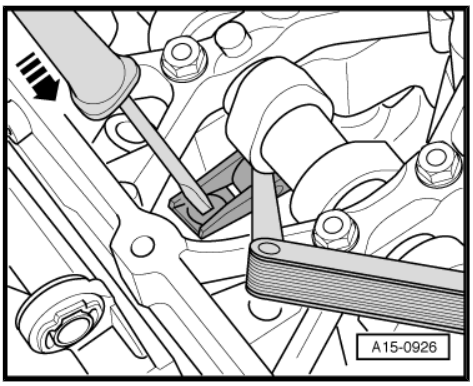
– Using adapter -T40058- , turn crankshaft in direction of engine rotation -arrow- until cam of hydraulic compensation element to be checked faces upwards.



– 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 131 .



Additional steps required

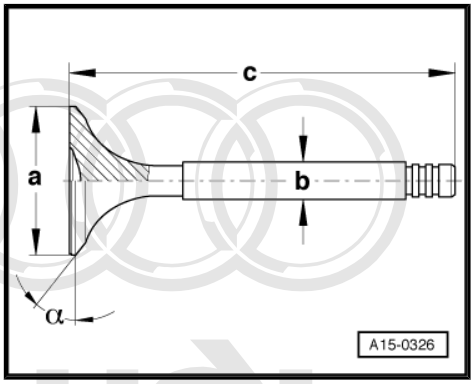
– Install cylinder head cover: left-side ⇒ page 109 , right-side ⇒ page 112 .

– Install lock carrier with attachments ⇒ Rep. Gr. 50 .

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

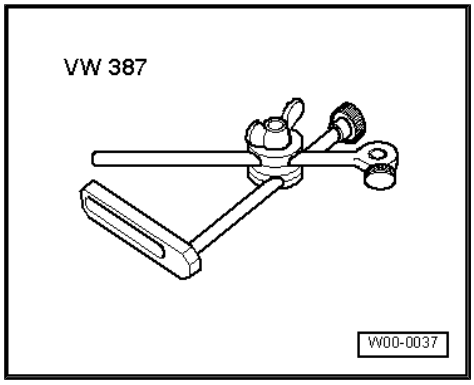
WARNING

- *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.*

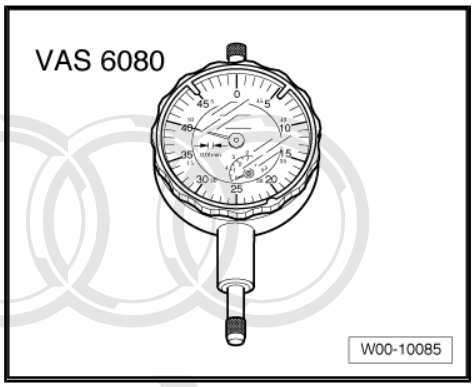
3.9 Checking valve guides

Special tools and workshop equipment required

- Universal dial gauge bracket -VW 387-



- Dial gauge -VAS 6080-



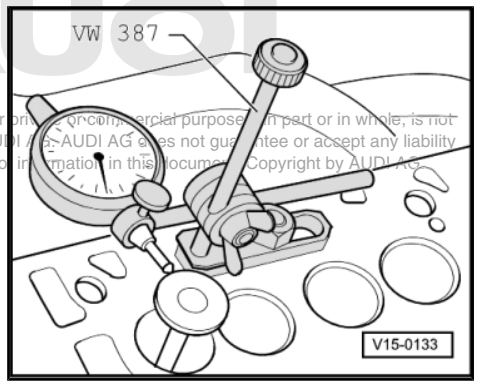
Test sequence

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

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

– Determine amount of sideways play.

• Wear limit: 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 surface of seat.

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 pipes 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 149
- ❑ Removing and installing oil level and oil temperature sender -G266- ⇒ page 149

2 - 9 Nm
- ❑ Tighten in 2 stages and in diagonal sequence ⇒ page 151

3 - 9 Nm

4 - 9 Nm

5 - Oil pipe

6 - Gasket
- ❑ Renew

7 - O-ring
- ❑ Renew

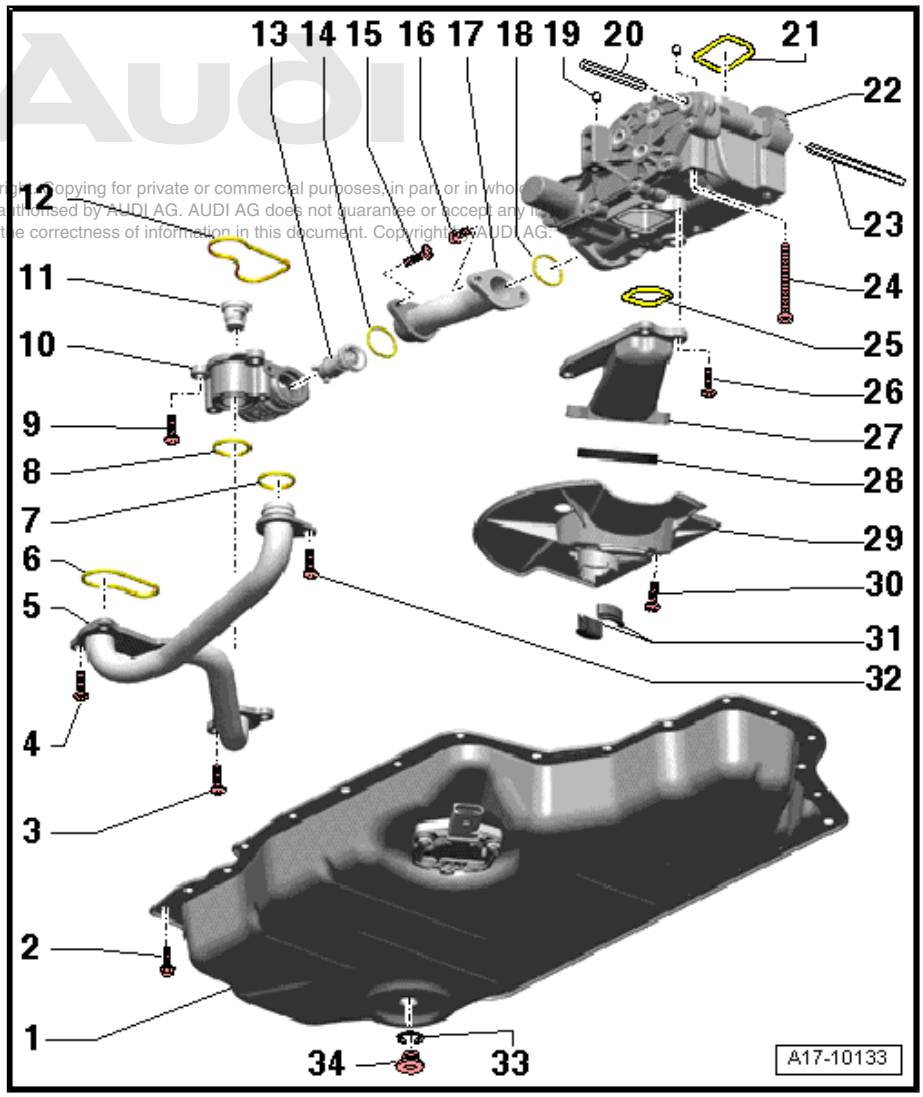
8 - O-ring
- ❑ Renew

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 151

23 - Oil pump drive shaft

24 - 8 Nm + 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 + +45° further

- ❑ Renew

31 - Rubber buffer

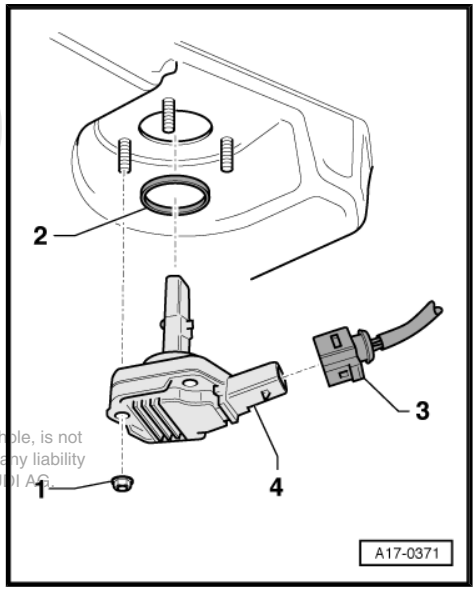
32 - 9 Nm

33 - Seal

- ❑ Renew

34 - Oil drain plug, 25 Nm

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



Removing

– Drain off engine oil ⇒ Maintenance ; Booklet 405 .

– 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 405 .

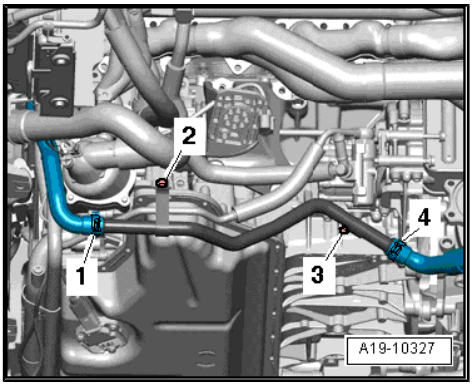
Tightening torque

Component	Nm
Oil level and oil temperature sender -G266- to sump (bottom section)	9

1.3 Removing and installing sump (bottom section)

Special tools and workshop equipment required

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



Removing

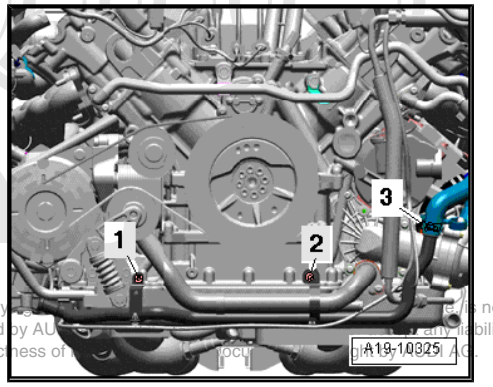
– Remove anti-roll bar ⇒ Rep. Gr. 40 .

– Remove nut -2- and bolt -3- at coolant pipe (bottom left).

Note

Disregard items marked -1- and -4-.

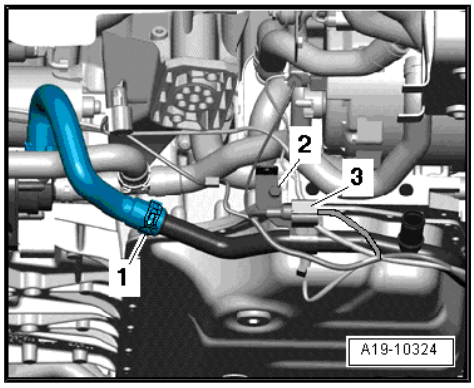
– Unscrew bolts -1- and -2- at coolant pipe (bottom front).



Note

Disregard -item 3-.

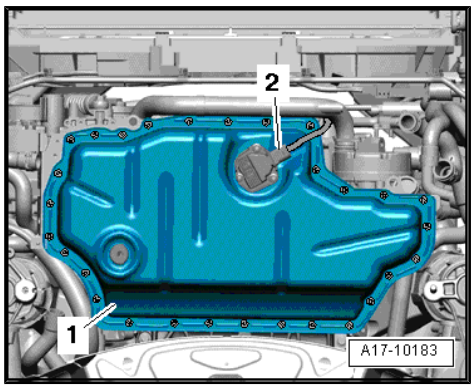
– Unscrew bolt -2- at coolant pipe (bottom front).



Note

Disregard items marked -1- and -3-.

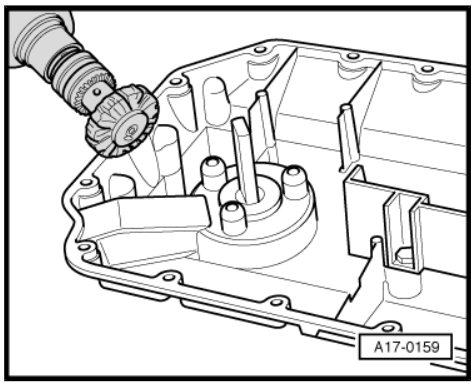
– Unplug electrical connector -2- at oil level and oil temperature sender -G266- .
– Drain off engine oil ⇒ Maintenance ; Booklet 405 .
– Unbolt sump (bottom section) -1- and carefully release it from bonded joint.



Note

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

Installing



Note

Renew seals.

WARNING

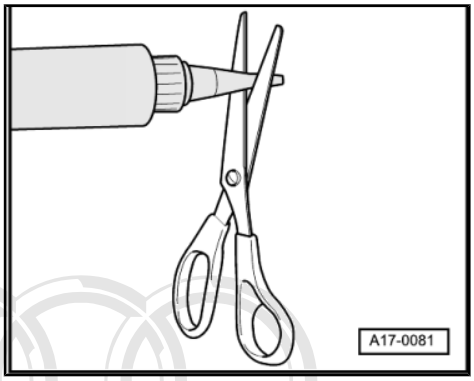
Wear safety goggles.

– 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

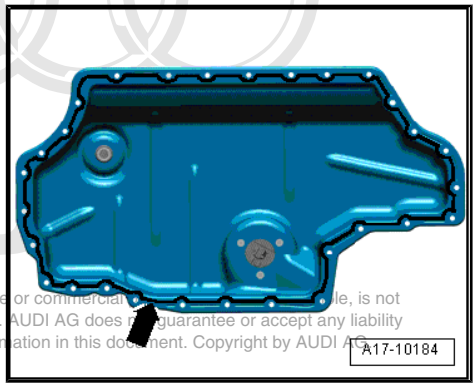
Note the use-by date of the sealant.

– Cut off tube nozzle at front marking (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) in 2 stages as follows.

1. Tighten all bolts to an initial torque of 5 Nm in diagonal sequence.
2. Tighten all bolts to 9 Nm in diagonal sequence.

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

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

– Fill with engine oil and check oil level ⇒ Maintenance ; Booklet 405 .

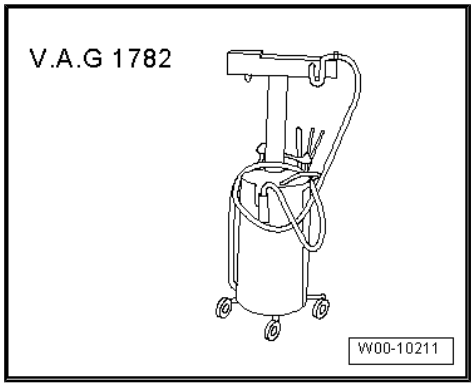
Tightening torques

Component	Nm
Sump (bottom section) to sump (top section)	9 1)
Oil drain plug	25
Coolant pipe (bottom left) to sump (top section)	9
Engine mounting to engine cross member	23
• 1) Tighten in two stages.	

1.4 Removing and installing oil pump

Special tools and workshop equipment required

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

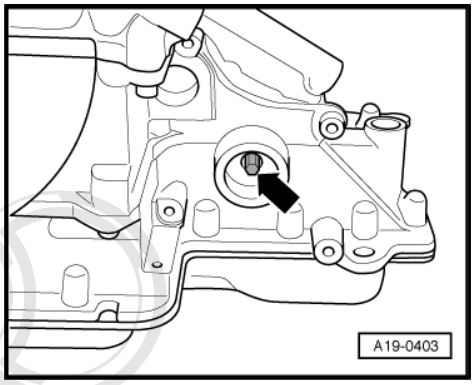


Removing

– Remove coolant pump ⇒ page 177 .

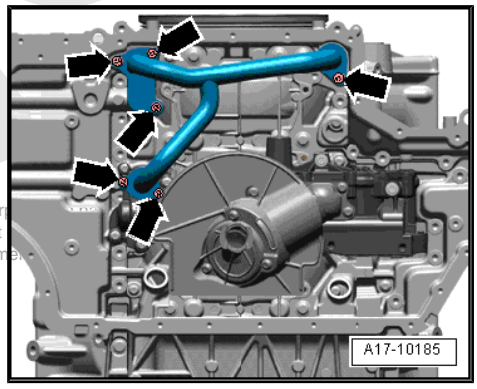
– Remove drive shaft -arrow- for coolant pump from the oil pump.

– Remove sump (bottom section) ⇒ page 149 .



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

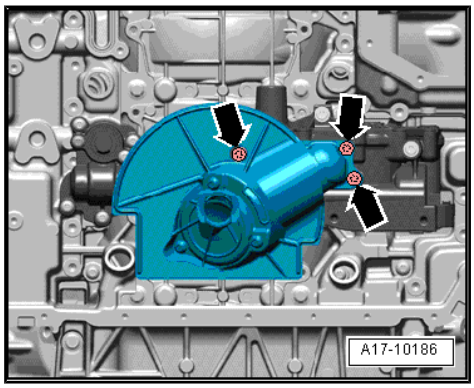
– Unscrew bolts -arrows- and remove oil pipe.



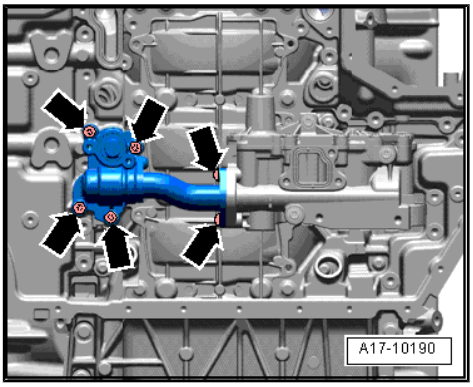
Note

Some oil will come out when oil pipe is removed.

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



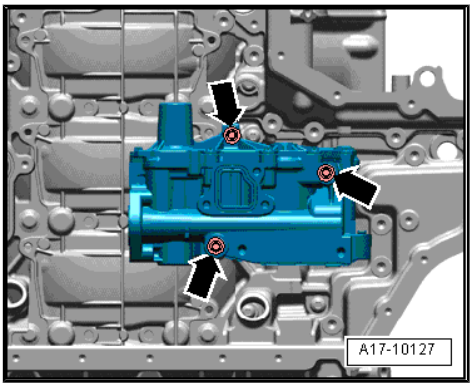
– Unscrew bolts -arrows- and remove oil pipe together with housing for oil cooler bypass valve.



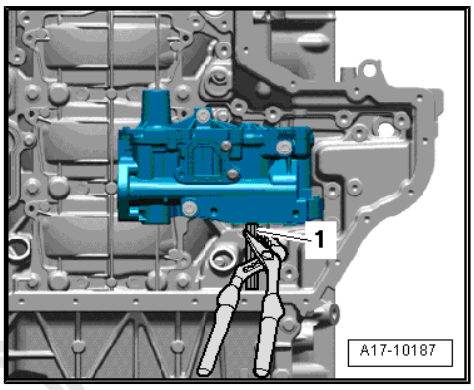
Note

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.



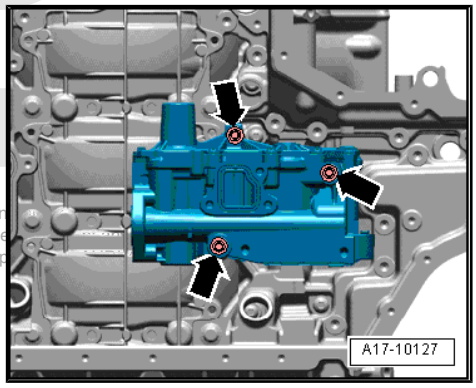
Installing

Note

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

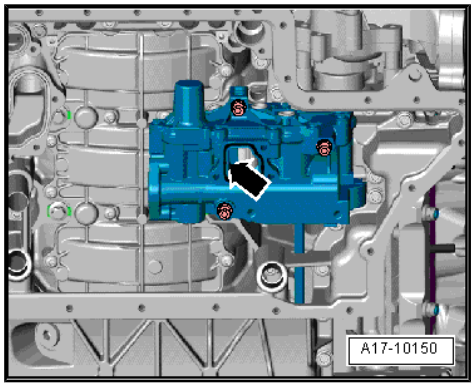
– Check whether the two dowel sleeves are fitted in the cylinder block; install if necessary.
– Press back drive shaft -1- for oil pump using water pump pliers and fit oil pump on cylinder block.
– Release water pump pliers and let drive shaft -1- slide into oil pump.

– 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 150 .

– Install coolant pump ⇒ page 177 .

– Fill with engine oil and check oil level ⇒ Maintenance ; Booklet 405 .

– Fill cooling system ⇒ page 172 .

Tightening torques

Component	Nm
Oil pump to cylinder block	8 +90° 1)
Housing for intake pipe to oil pump	9
Oil pipe to sump (top section) and oil pump	9
• 1) Renew bolts.	

1.5 Sump (top section) - exploded view

1 - Sump (top section)
- ❑ Removing and installing ⇒ page 156
- ❑ Fitting location of dowel sleeves ⇒ page 155

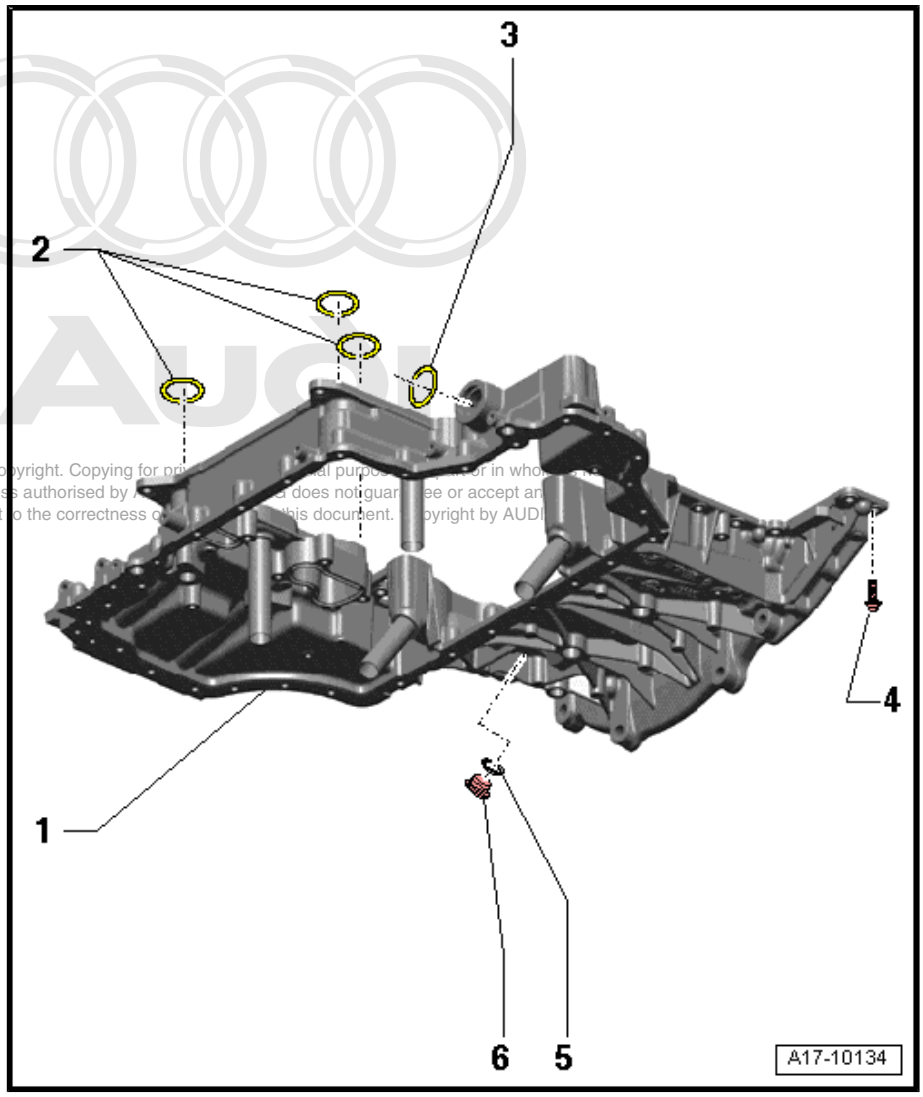
2 - Seals
- ❑ Renew

3 - O-ring
- ❑ Renew

4 - 5 Nm + 90° further
- ❑ Renew

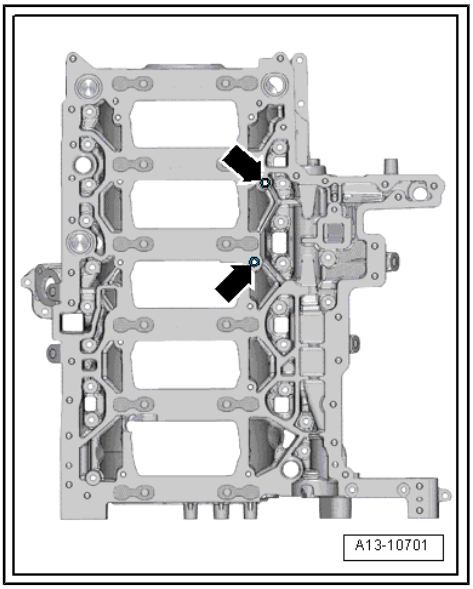
5 - Seal
- ❑ Renew

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.



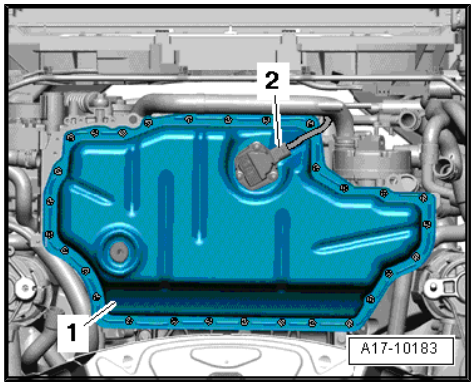
1.6 Removing and installing sump (top section)

Special tools and workshop equipment required

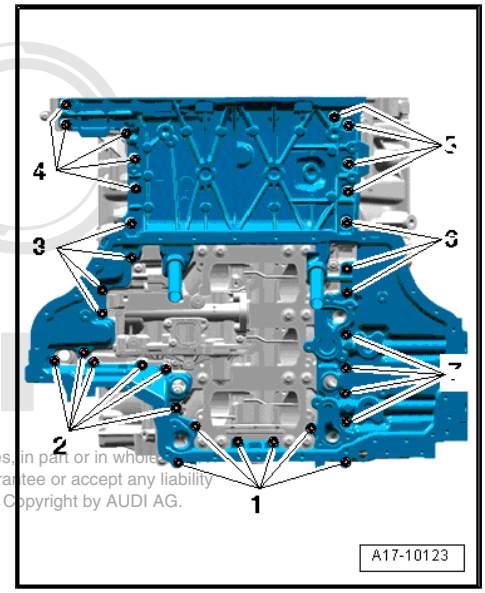
- Safety goggles
- Electric drill with plastic brush attachment
- Sealant ⇒ Electronic parts catalogue

Removing

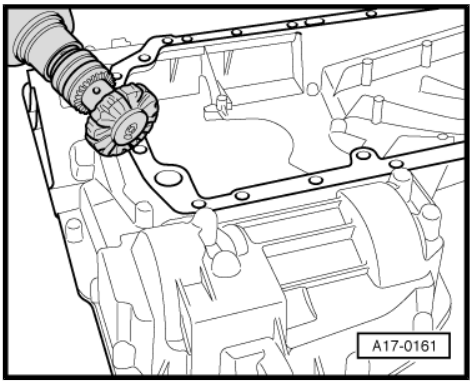
- Engine separated from gearbox ⇒ page 26 , engine secured to engine and gearbox support ⇒ page 34 .
- Engine oil drained ⇒ Maintenance ; Booklet 405 .
- Remove drive plate ⇒ page 52 .
- Remove timing chain covers (left and right) ⇒ page 67 .
- Remove intake manifold ⇒ Rep. Gr. 24 .
- Remove oil filter housing ⇒ page 163 .
- Remove timing chain cover (bottom) ⇒ page 70 .
- Remove alternator ⇒ Rep. Gr. 27 .
- Remove coolant pipe (front) ⇒ page 186 .
- Remove coolant pump ⇒ page 177 .
- 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 151 .
- 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.

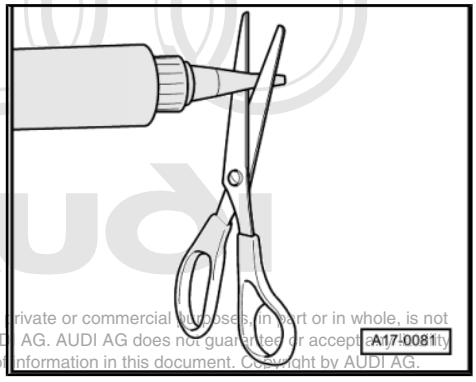
– Remove sealant residue from sump (top section) and cylinder block with rotating plastic brush or similar.

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

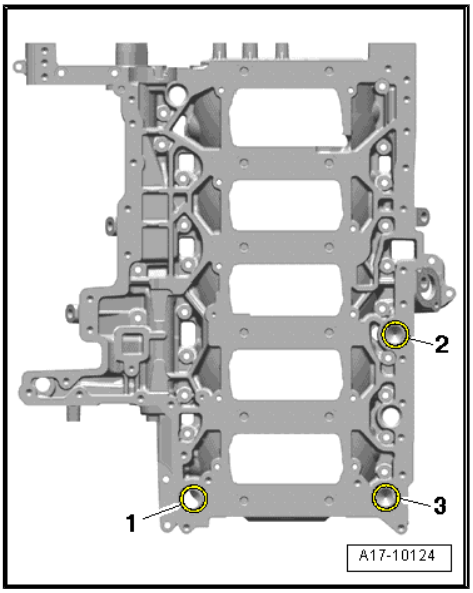
Note

Note the use-by date of the sealant.

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

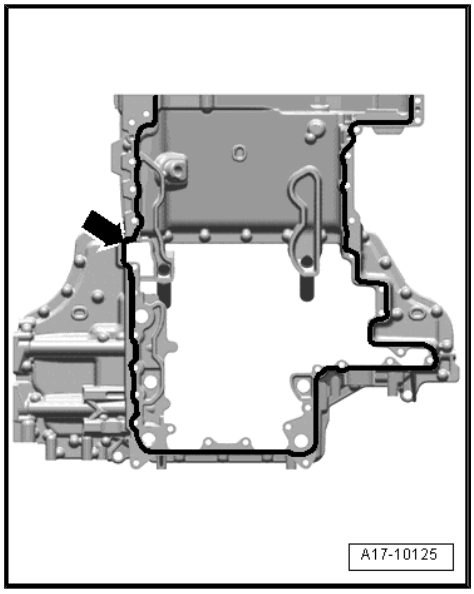


– Fit new seals -1, 2, 3- in grooves on cylinder block.



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

• Width of sealant beads: 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.*

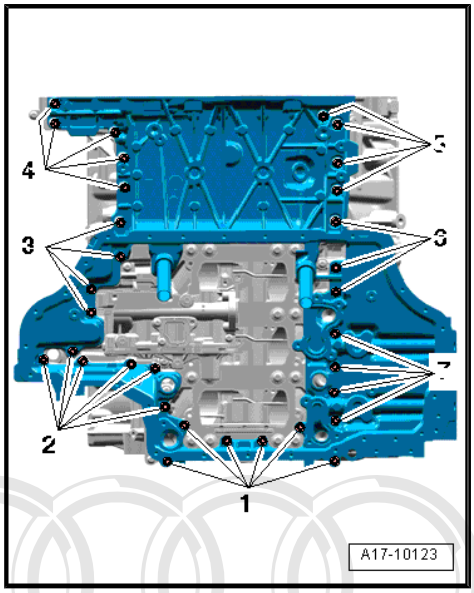
♦ *The sump (top section) must be installed within 5 minutes after applying sealant.*

– Renew bolts for sump (top section).

– Fit sump (top section) paying attention to dowel sleeves and hand-tighten all bolts ⇒ page 155 .

– 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 151 .

– Install sump (bottom section) ⇒ page 150 .

– Install coolant pump ⇒ page 177 .

– Install coolant pipe (front) ⇒ page 186 .

– Install alternator ⇒ Rep. Gr. 27 .

– Install timing chain cover (bottom) ⇒ page 70 .

– Install crankshaft oil seal (gearbox end) ⇒ page 53 .

– Install oil filter housing ⇒ page 163 .

– Install intake manifold ⇒ Rep. Gr. 24 .

– Install timing chain covers (left and right) ⇒ page 68 .

– Install drive plate ⇒ page 52 .

– After installing engine, fill up with engine oil and check oil level ⇒ Maintenance ; Booklet 405 .

Tightening torque

Component	Nm
Sump (top section) to cylinder block	5 +90° 1)
• 1) Renew bolts.	

1.7 Oil retention valve and spray nozzle valve - exploded view

1 - O-ring
- ❑ Renew

2 - Spray nozzle valve
- ❑ Removing and installing ⇒ page 159

3 - Gasket
- ❑ Renew

4 - Cover

5 - O-ring
- ❑ Renew

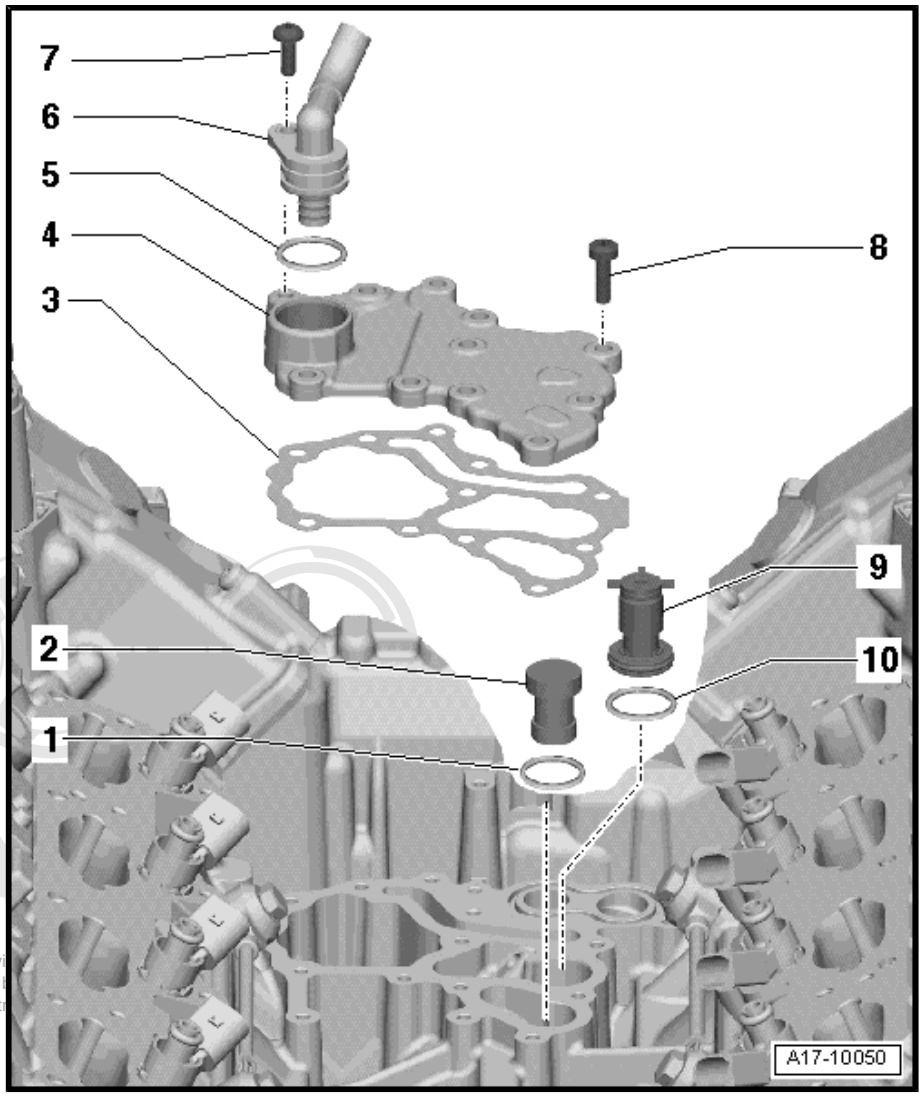
6 - Hose
- ❑ For crankcase breather

7 - 9 Nm

8 - 5 Nm + 90° further
- ❑ Renew

9 - Oil retention valve
- ❑ Removing and installing ⇒ page 159

10 - O-ring
- ❑ Renew

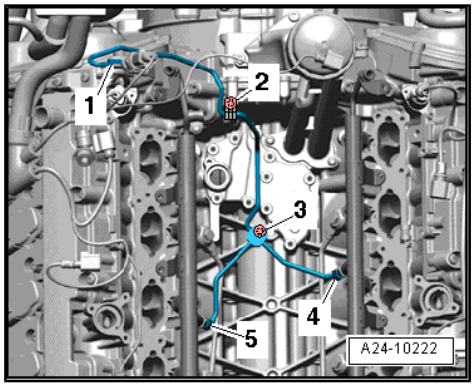


1.8 Removing and installing oil retention valve and spray nozzle valve

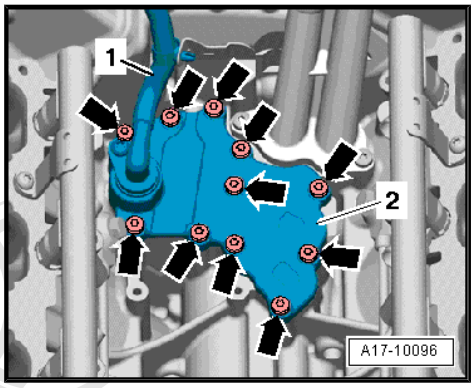
Note

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.

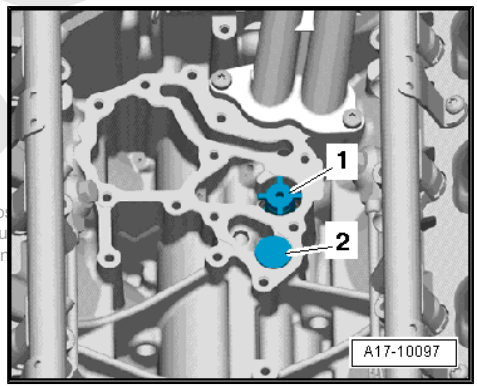
Removing



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

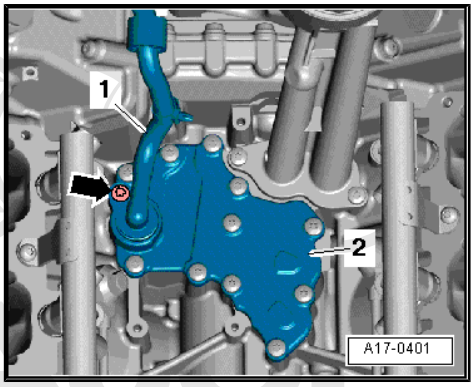
– Install high-pressure pipes ⇒ Rep. Gr. 24 ; Removing and installing injectors .
– Install intake manifold ⇒ Rep. Gr. 24 .

Tightening torque

Component	Nm
Cover to cylinder block	5 +90° 1)
• 1) Renew bolts.	

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 torque

Component	Nm
Crankcase breather hose to cover	9

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 405

7 - O-ring
- ❑ Renew

8 - Sealing cap, 25 Nm

9 - Not fitted

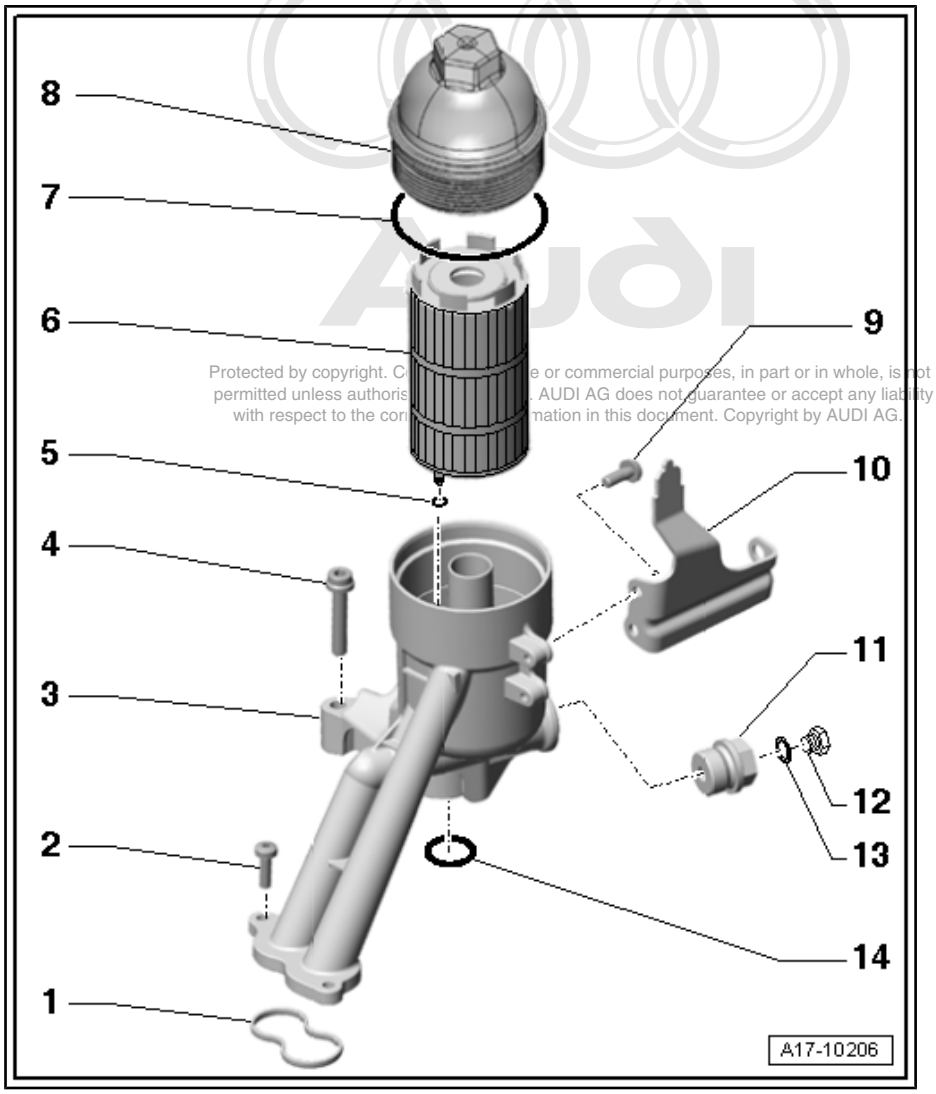
10 - Not fitted

11 - Screw plug, 50 Nm

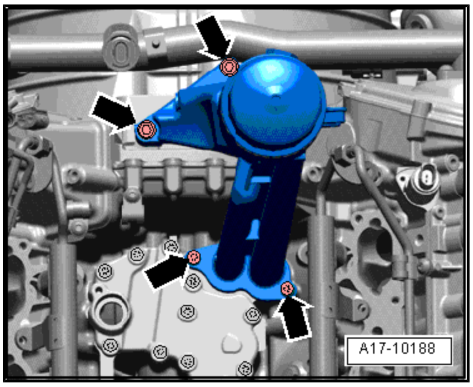
12 - Screw plug, 9 Nm

13 - Seal
- ❑ Renew

14 - O-ring
- ❑ Renew



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 405 .

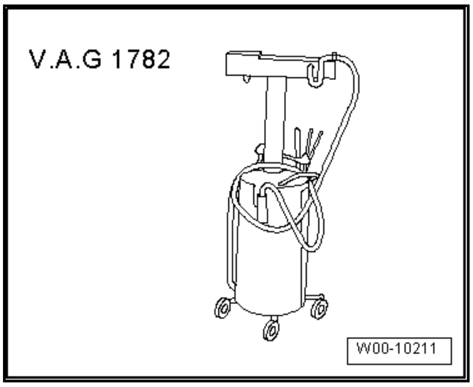
Tightening torques

Component		Nm
Oil filter housing to cylinder block	M8	9
	M10	22
Sealing cap on oil filter housing		25

1.12 Removing and installing engine oil cooler

Special tools and workshop equipment required

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

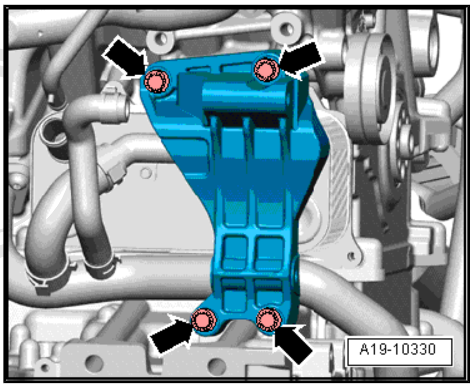


Removing

– Drain off coolant ⇒ page 170 .

– Remove alternator ⇒ Rep. Gr. 27 .

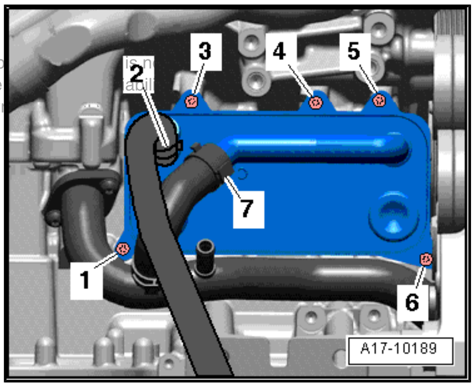
– Remove bolts -arrows- and detach bracket for alternator.



– 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 alternator ⇒ Rep. Gr. 27 .

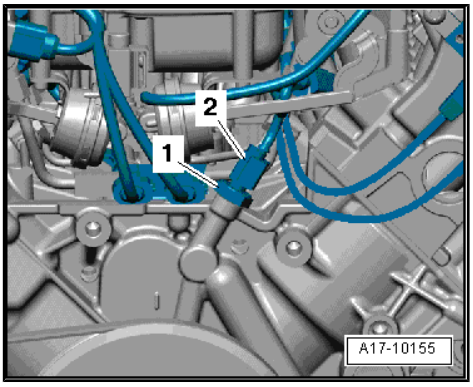
– Check oil level ⇒ Maintenance ; Booklet 405 .

– Fill cooling system ⇒ page 172 .

Tightening torques

Component		Nm
Engine oil cooler to cylinder block		9
Bracket for alternator to engine	M8	22
	M10	46

1.13 Removing and installing oil pressure switch -F1-



Removing

– Move lock carrier to service position ⇒ Rep. Gr. 50 .

– Unplug electrical connector at oil pressure switch -F1- -item 2-.

– Unscrew oil pressure switch -1-.

Installing

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

– Install lock carrier with attachments ⇒ Rep. Gr. 50 .

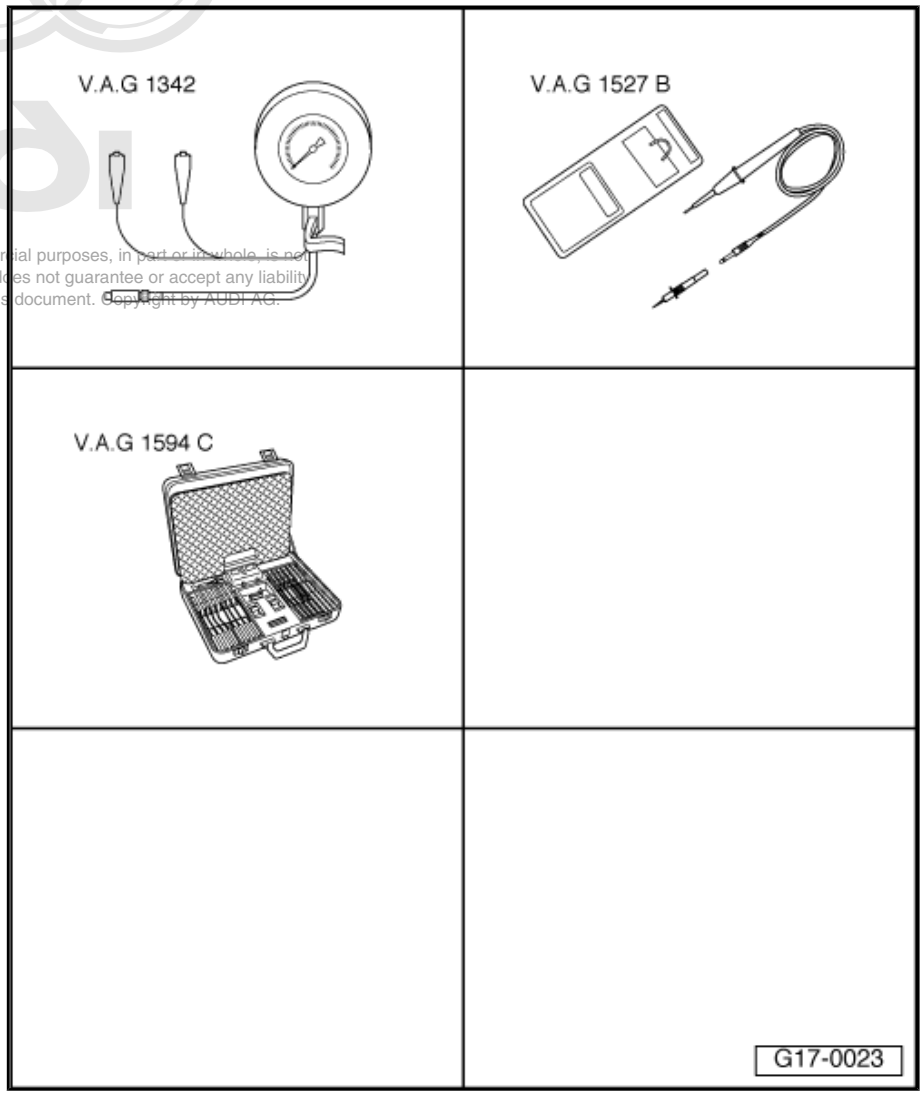
Tightening torque

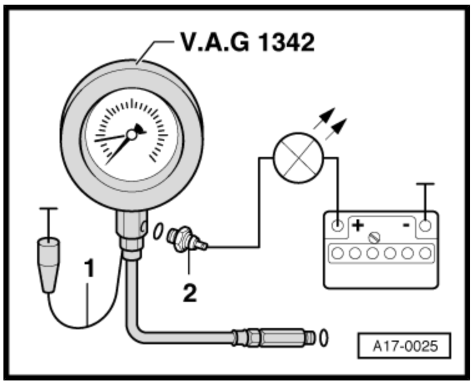
Component	Nm
Oil pressure switch to cylinder block	20 1)
• 1) Renew seal.	

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 1527 B-
- Auxiliary measuring set - V.A.G 1594 C-





Procedure

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

– Remove oil pressure switch -F1- ⇒ page 165 .

– Connect oil pressure tester -V.A.G 1342- with adapter -V.A.G 1342/14- to bore for oil pressure switch.

– Screw oil pressure switch -2- into oil pressure tester -V.A.G 1342- .

– Connect brown wire of oil pressure tester to earth ("–").

Checking oil pressure switch

– Connect voltage tester -V.A.G 1527 B- with test leads from auxiliary measuring set -V.A.G 1594 C- to oil pressure switch and battery positive ("+").

- LED should not light up.

If 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 165 .

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 405 .

19 – Cooling

1 Cooling system

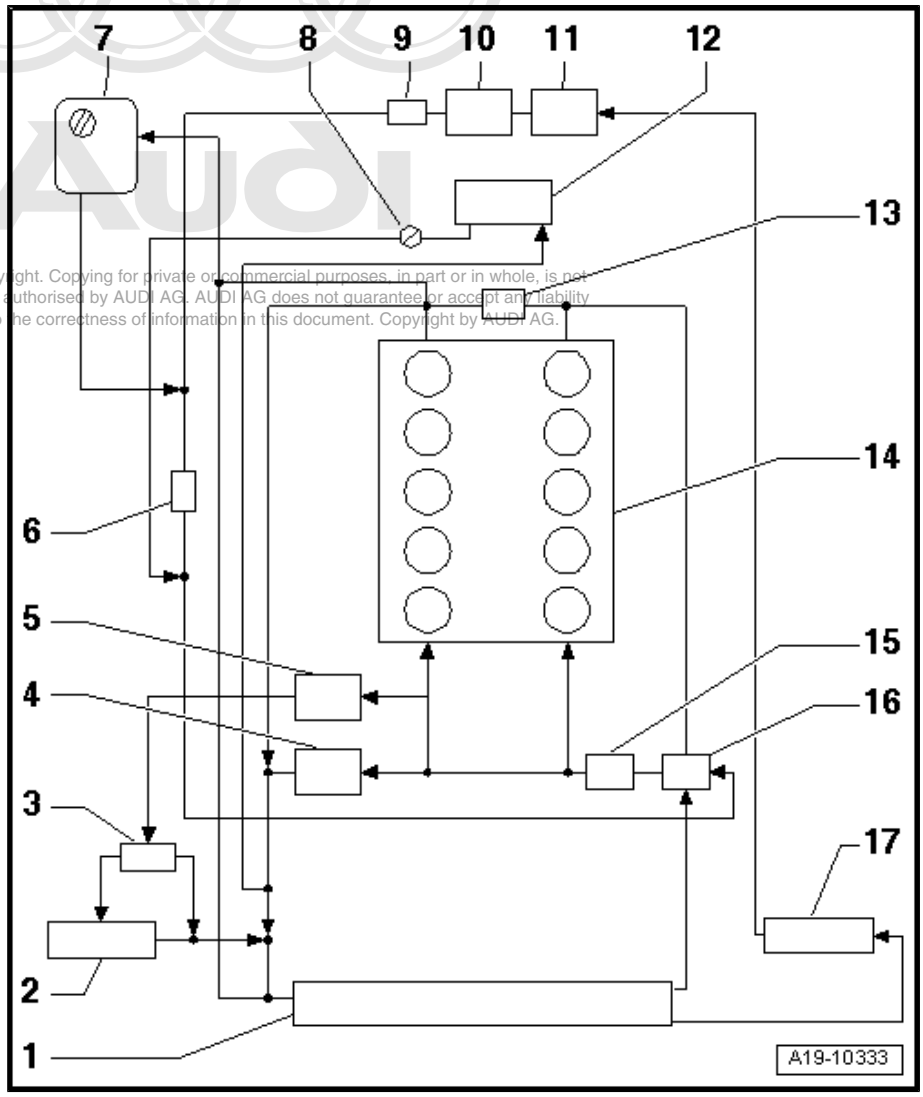
WARNING

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

Note

- *The cooling system is under pressure when the engine is hot. If necessary, relieve pressure before commencing repair work.*
- *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 191
- ❑ If renewed, refill system with fresh coolant

2 - Auxiliary radiator (right-side)

- ❑ Removing and installing ⇒ page 196
- ❑ If renewed, refill system with fresh coolant

3 - Thermostat for auxiliary radiator

4 - Alternator

5 - Engine oil cooler

- ❑ Removing and installing ⇒ page 163
- ❑ If renewed, refill system with fresh coolant

6 - Continued coolant circulation pump -V51-

- ❑ Removing and installing ⇒ page 181

7 - Expansion tank

- ❑ Checking pressure relief valve in filler cap ⇒ page 200

8 - Bleed hole

- ❑ On coolant hose to heat exchanger

9 - Thermostat

- ❑ For gear oil cooler and ATF cooler

10 - Gearbox oil cooler

11 - ATF cooler

12 - Heat exchanger

- ❑ If renewed, refill system with fresh coolant

13 - Coolant temperature sender -G62-

14 - Cylinder head/cylinder block

- ❑ If renewed, refill system with fresh coolant

15 - Coolant pump

- ❑ Removing and installing ⇒ page 177

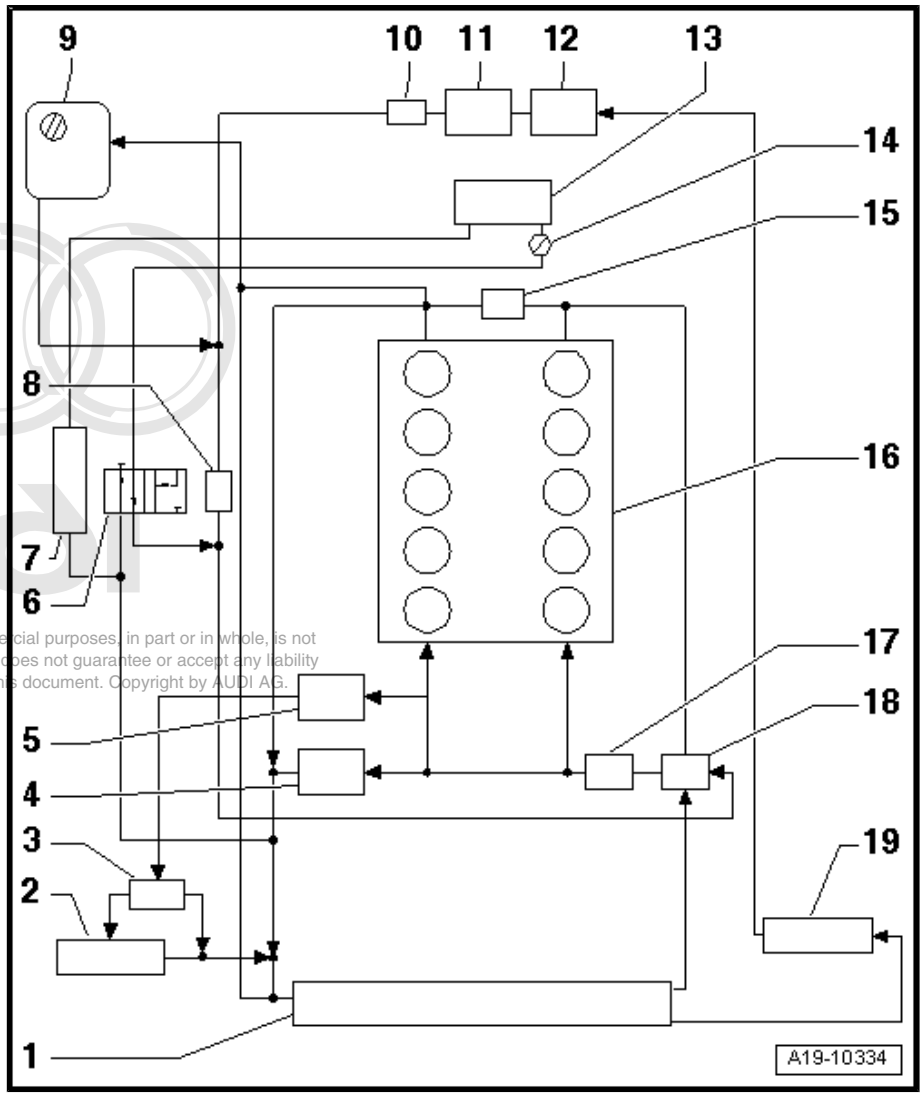
16 - Thermostat

- ❑ Removing and installing ⇒ page 179

17 - Auxiliary radiator (left-side)

- ❑ Removing and installing ⇒ page 195
- ❑ If renewed, refill system with fresh coolant

1.2 Connection diagram for coolant hoses - vehicles with auxiliary heater



1 - Radiator

- ❑ Removing and installing ⇒ page 191
- ❑ If renewed, refill system with fresh coolant

2 - Auxiliary radiator (right-side)

- ❑ Removing and installing ⇒ page 196
- ❑ If renewed, refill system with fresh coolant

3 - Thermostat for auxiliary radiator

4 - Alternator

5 - Engine oil cooler

- ❑ Removing and installing ⇒ page 163
- ❑ If renewed, refill system with fresh coolant

6 - Heater coolant shut-off valve -N279-

7 - Auxiliary heater

8 - Continued coolant circulation pump -V51-

- ❑ Removing and installing ⇒ page 181

9 - Expansion tank

- ❑ Checking pressure relief valve in filler cap ⇒ page 200

10 - Thermostat

- ❑ For gear oil cooler and ATF cooler

11 - Gearbox oil cooler

12 - ATF cooler

13 - Heat exchanger

- ❑ If renewed, refill system with fresh coolant

14 - Bleed hole

- ❑ On coolant hose to heat exchanger

15 - Coolant temperature sender -G62-

16 - Cylinder head/cylinder block

- ❑ If renewed, refill system with fresh coolant

17 - Coolant pump

- ❑ Removing and installing ⇒ page 177

18 - Thermostat

- ❑ Removing and installing ⇒ page 179

19 - Auxiliary radiator (left-side)

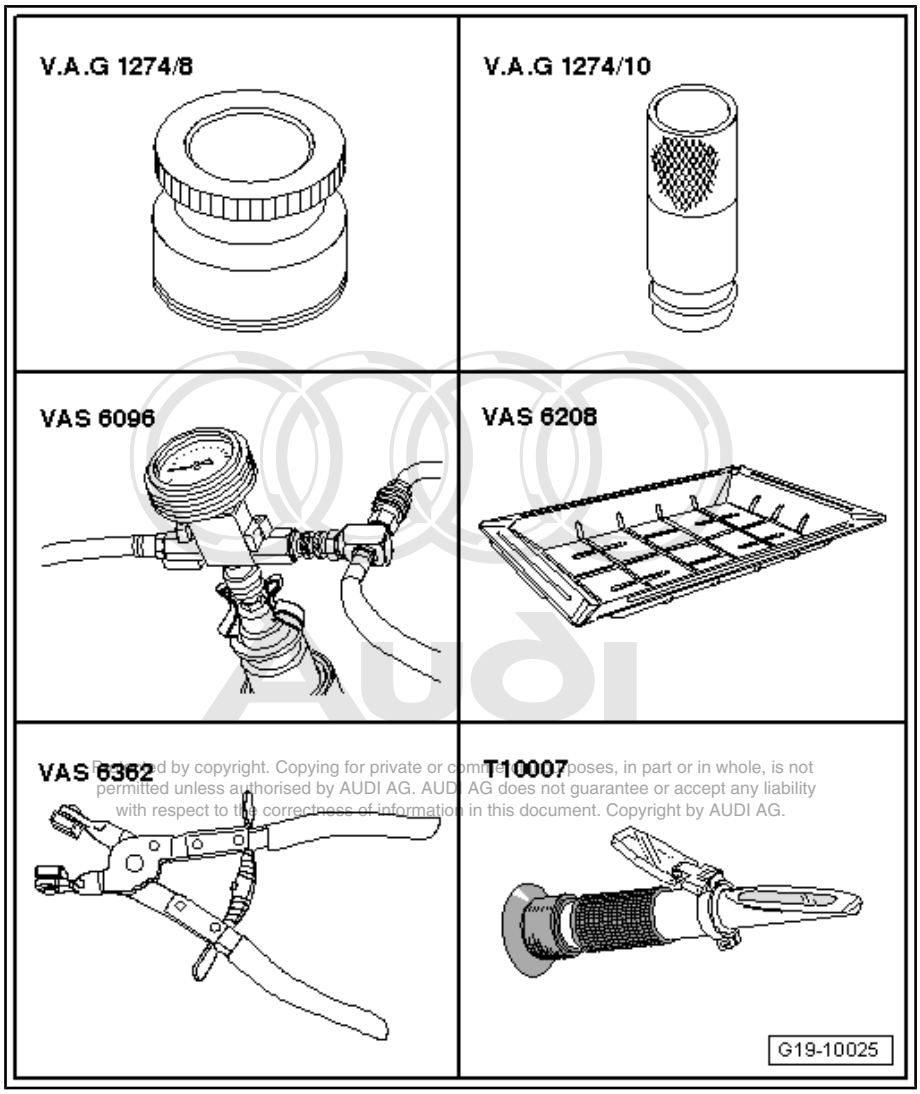
- ❑ Removing and installing ⇒ page 195

❑ If renewed, refill system with fresh coolant

1.3 Draining and filling cooling system

Special tools and workshop equipment required

- Adapter for cooling system tester -V.A.G 1274/8-
- Pipe for cooling system tester -V.A.G 1274/10-
- Cooling system charge unit -VAS 6096-
- Drip tray for workshop hoist -VAS 6208-
- Hose clip pliers -VAS 6362-
- Refractometer -T10007-



Draining

Note

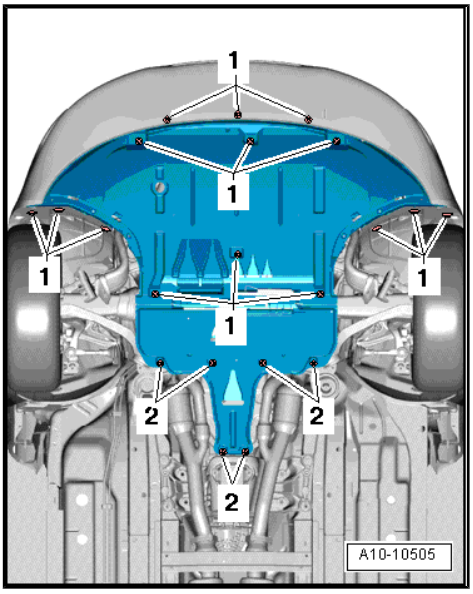
Collect drained coolant in a clean container for re-use or disposal.

WARNING

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

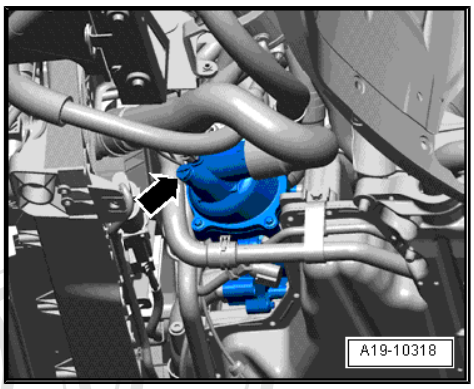
– Open filler cap on coolant expansion tank.

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

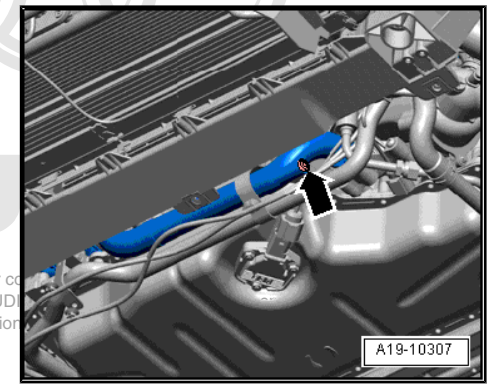


– Place drip tray for workshop hoist -VAS 6208- under engine.

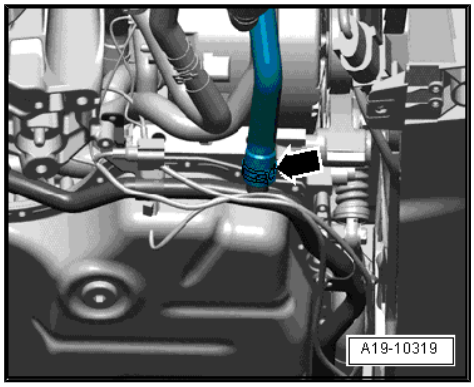
– Unscrew drain plug -arrow- at thermostat housing and drain off coolant.



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



– Disconnect coolant hose from coolant pipe (bottom front) -arrow- and drain off remaining coolant.



Filling

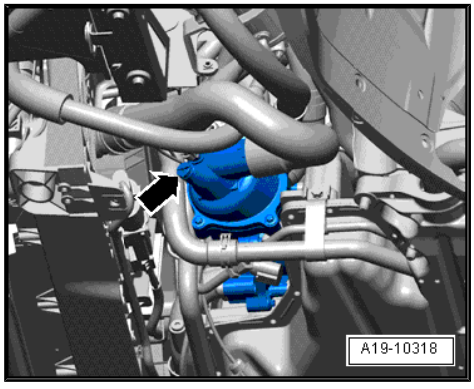
- Ignition off.

Note

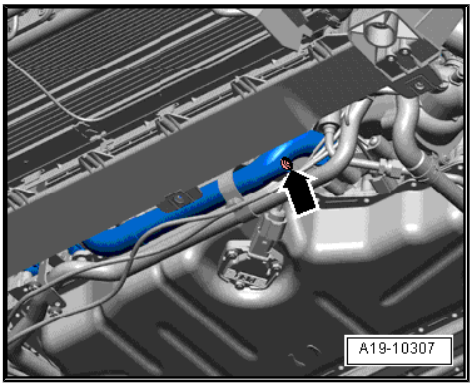
- *The cooling system is filled all year round with a mixture of water and radiator antifreeze/anti-corrosion agent.*
- *Use only the radiator antifreeze/anti-corrosion agent approved for this engine ⇒ Electronic parts catalogue . Other coolant additives could seriously impair in particular the anticorrosion properties. The resulting damage could lead to loss of coolant and consequently to serious engine damage.*
- *The specified radiator antifreeze/anti-corrosion agent prevents frost and corrosion damage and stops scaling. Such additives also raise the boiling point of the coolant. For these reasons the cooling system must be filled all year round with the correct antifreeze and anticorrosion additive.*
- *Because of its high boiling point, the coolant improves engine reliability under heavy loads, particularly in countries with tropical climates.*
- *Frost protection is required down to about –25 °C (in countries with arctic climate: down to about –35 °C).*
- *The coolant concentration must not be reduced by adding water even in warmer seasons and in warmer countries. The antifreeze concentration must be at least 40 %.*
- *If greater frost protection is required in very cold climates, the concentration of radiator antifreeze/anti-corrosion agent can be increased, but only up to 60% (this gives frost protection to about –40 °C). If the concentration exceeds 60%, frost protection decreases again and cooling efficiency is also impaired.*

- *Use only clean tap water for mixing coolant.*
- *Do not use drained coolant again if:*
- *the radiator, heat exchanger for heater, cylinder head, cylinder head gasket or cylinder block have been renewed.*
- *the coolant is contaminated or dirty.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- *For checking anti-freeze protection in cooling system, use refractometer -T10007- .*

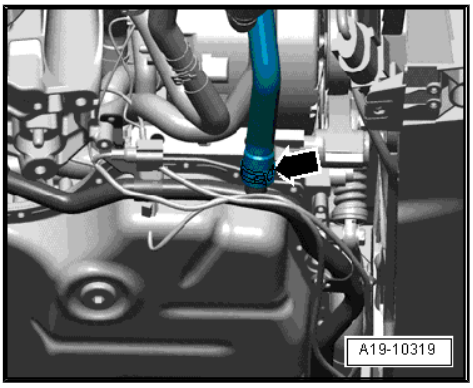
– Fit drain plug -arrow- with new O-ring on thermostat housing.



– Install drain plug -arrow- with new seal on front coolant pipe.



– Attach coolant hose at coolant pipe (bottom front) -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 °C.
- Radiator antifreeze/anti-corrosion agent ⇒ Electronic parts catalogue

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

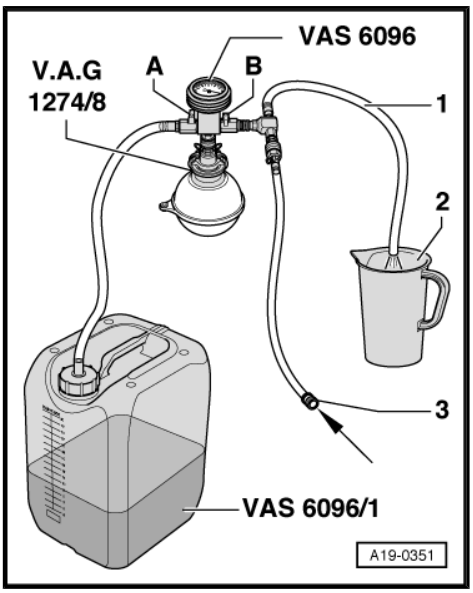
– Attach cooling system charge unit -VAS 6096- onto adapter -V.A.G 1274/8- .

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

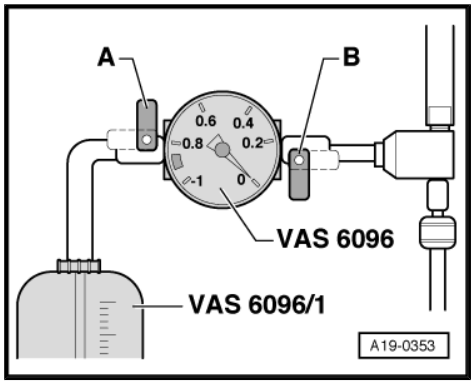
– Close the two valves -A- and -B- by setting lever at right angle to direction of flow.

– Connect hose -3- to compressed air.

- Pressure: 6 ... 10 bar.



– Open valve -B- by setting lever in direction of flow.



The suction jet pump generates a partial vacuum in the cooling system.

- The needle on the gauge should move into the green zone.

– Also briefly open valve -A- (turn lever in direction of flow) so that hose on reservoir 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.

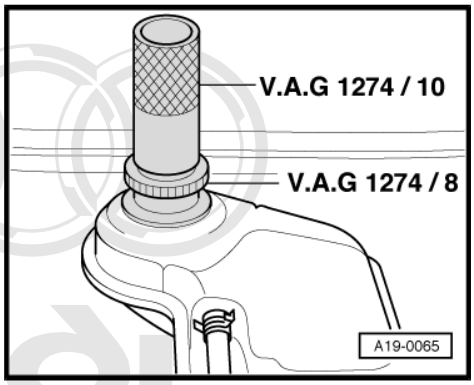
– Detach compressed air hose.

– Open valve -A-.

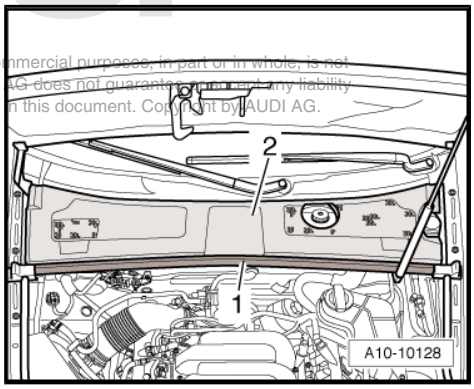
The partial vacuum in the cooling system causes the coolant to be drawn up out of the reservoir -VAS 6096/1- ; the cooling system is then filled.

– Detach cooling system charge unit -VAS 6096- from adapter -V.A.G 1274/8- on expansion tank.

– Fit pipe for cooling system tester -V.A.G 1274/10- onto adapter.



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



– Open bleeder screw -arrow-.

– Fill up with coolant until it flows out at bleeder hole in coolant hose.

– Close the bleeder screw.

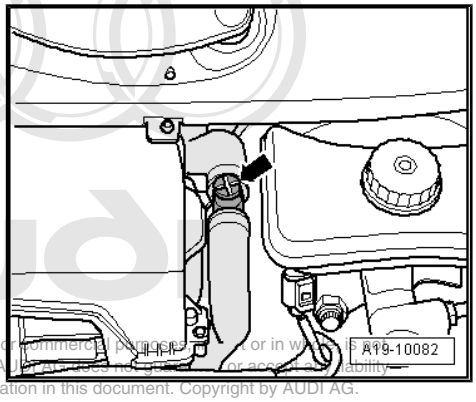
– On vehicles with auxiliary heater, switch heater on (for about 30 seconds) and then off again.

– Tighten filler cap on expansion tank.

– Start engine.

– Set temperature to “HI” in all zones.

– Switch off air conditioner compressor (press ECON button).



– Run the engine for 3 minutes at 2000 rpm.

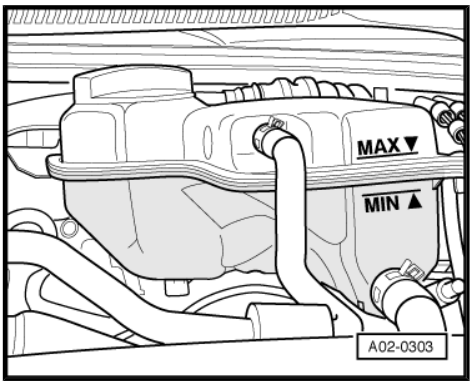
– Allow the engine to run at idling speed until the two large coolant hoses at main radiator become warm.

– Run the engine for 1 minute at 2000 rpm.

– Switch off ignition and allow engine to cool down.

– Check coolant level.

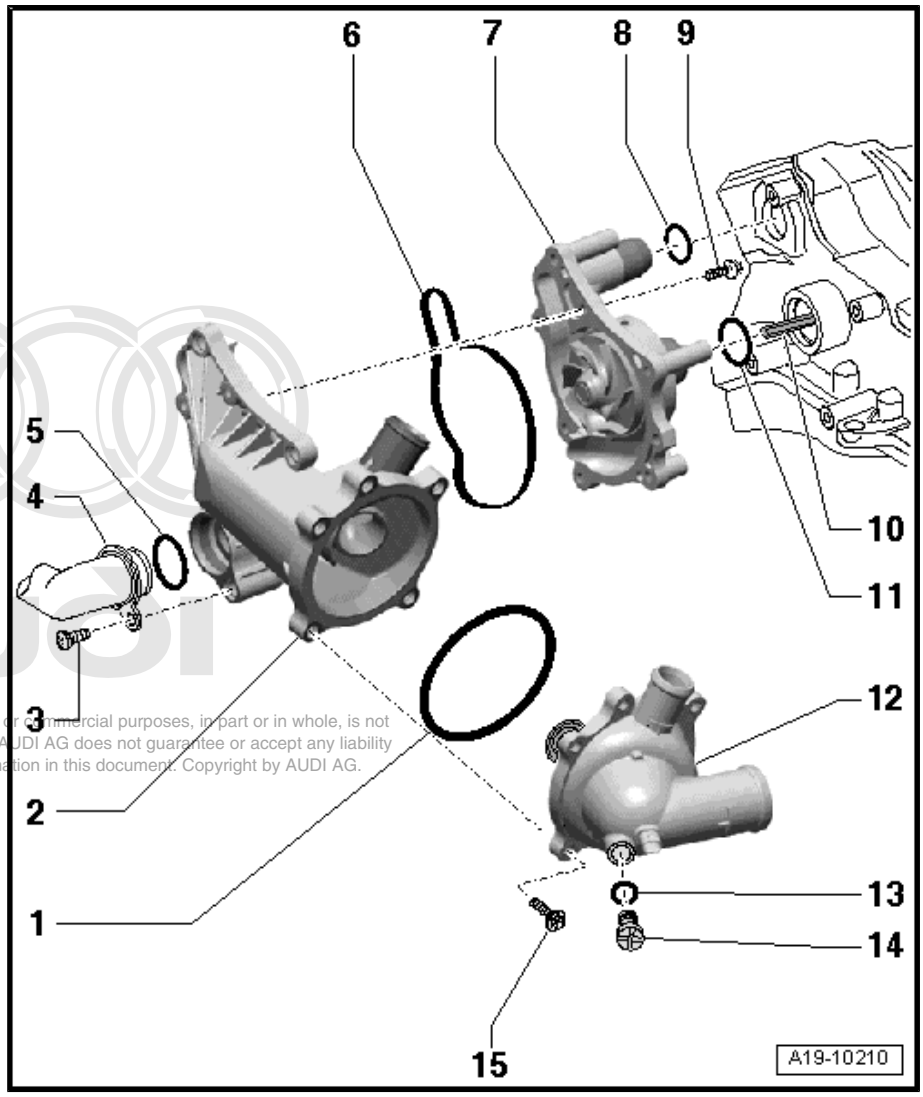
- The coolant level must be at the MAX marking when the engine is cold.
- The coolant level can be above the MAX marking when the engine is warm.



Tightening torques

Component	Nm
Drain plug to thermostat housing	4
Drain plug to front coolant pipe	10

1.4 Coolant pump and thermostat - exploded view



1 - Seal
- ❑ Renew

2 - Housing for coolant pump
- ❑ Removing and installing ⇒ page 177

3 - 8 Nm + 90° further
- ❑ Renew

4 - Coolant pipe (front)
- ❑ Removing and installing ⇒ page 186

5 - O-ring
- ❑ Renew

6 - Seal
- ❑ Renew

7 - Coolant pump
- ❑ Removing and installing ⇒ page 177

8 - O-ring
- ❑ Renew

9 - 9 Nm

10 - Drive shaft for coolant pump

11 - O-ring
- ❑ Renew

12 - Thermostat housing
- ❑ Removing and installing ⇒ page 179
- ❑ Thermostat opening values ⇒ page 179

13 - O-ring
- ❑ Renew

14 - Drain plug, 4 Nm

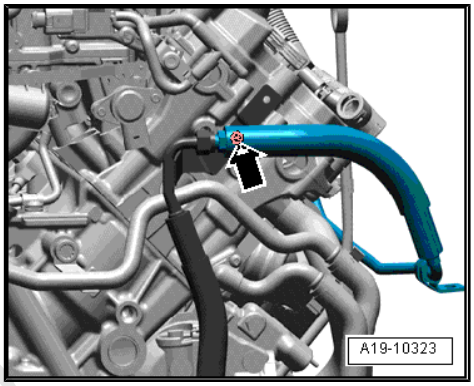
15 - 9 Nm

1.5 Removing and installing coolant pump

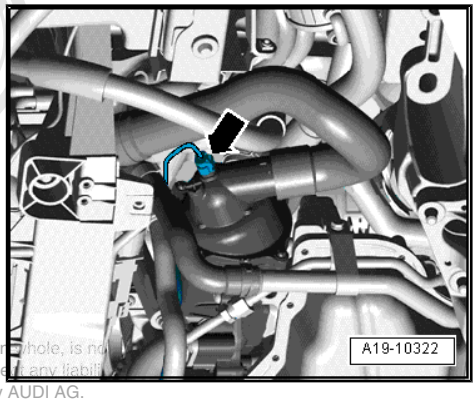
Removing

– Remove coolant pipe (front) ⇒ page 186 .

– Unbolt bracket for power steering pressure pipe on front of cylinder head -arrow-.



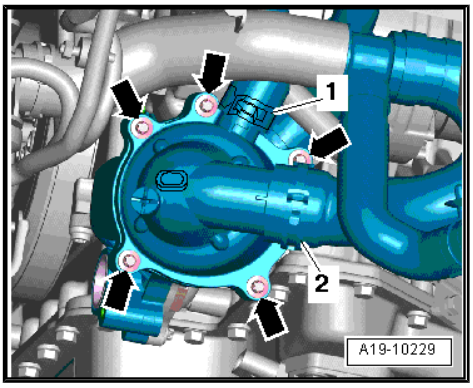
– Unplug electrical connector -arrow- at radiator outlet coolant temperature sender -G83- .



– Detach coolant hose -2- (bottom) from thermostat housing.

– Remove bolts -arrows-.

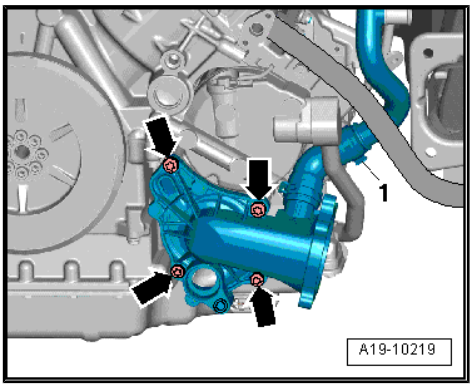
– Remove thermostat housing and detach coolant hose -1- (top) from thermostat housing.



– Slacken hose clip -1- on coolant hose.

– Remove bolts -arrows-.

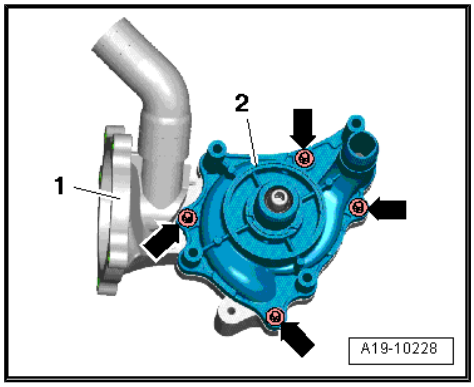
– Pull off coolant pump housing forwards (note the drive shaft for coolant pump).



Note

The coolant hose can only be disconnected when the coolant pump is removed.

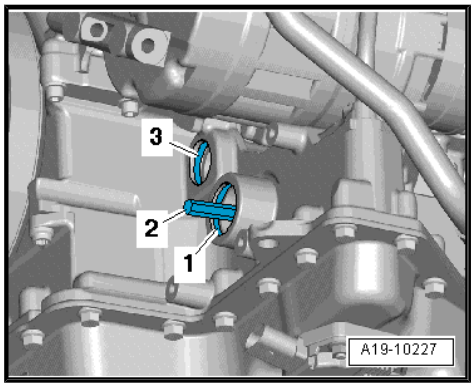
– Remove bolts -arrows-.
– Remove coolant pump -2- from housing -1-.



Installing

Note

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



– Fit new O-rings -1- and -3-.
– Insert drive shaft -2- for coolant pump in the mounting for the oil pump on engine 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:

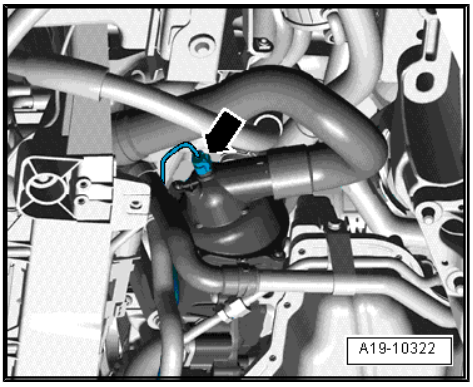
– Install thermostat housing ⇒ page 179 .
– Install coolant pipe (front) ⇒ page 186 .
– Fill cooling system ⇒ page 172 .

Tightening torques

Component	Nm
Coolant pump to housing	9
Coolant pump housing to sump (top section)	9
Bracket for power steering pressure pipe to cylinder head	9

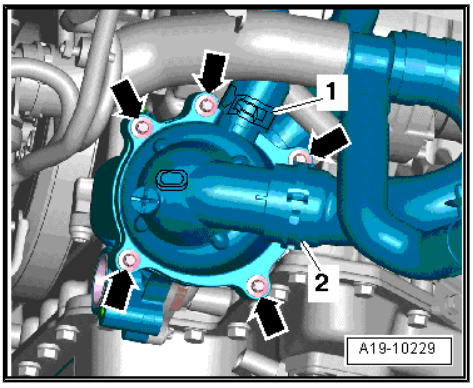
1.6 Removing and installing thermostat housing

Removing



– Drain off coolant ⇒ page 170 .

– 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 172 .

Tightening torque

Component	Nm
Thermostat housing to coolant pump housing	9

1.7 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.

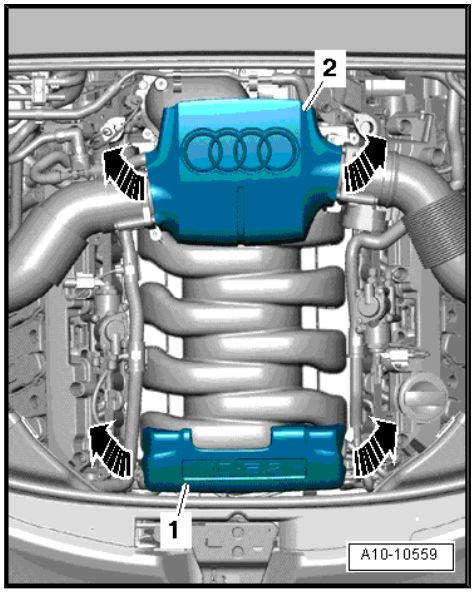
1.8 Removing and installing coolant temperature sender -G62-

Removing

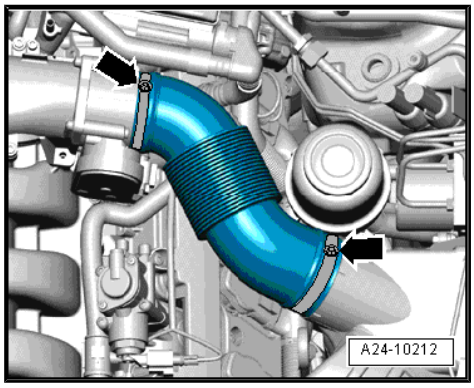
- Engine cold.

– Open filler cap on coolant expansion tank briefly and allow residual pressure in cooling system to escape.

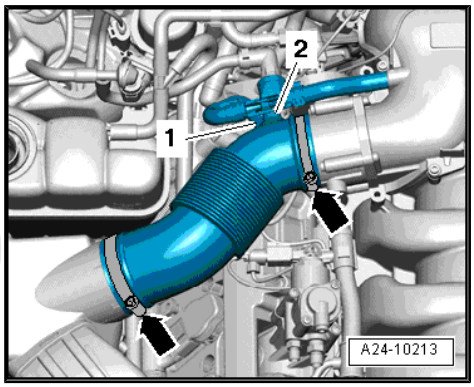
– Pull off engine cover panel (rear) -2- -arrows-.



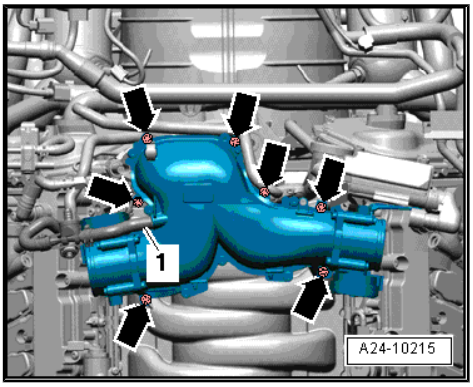
– Remove air hose (left-side) -arrows-.



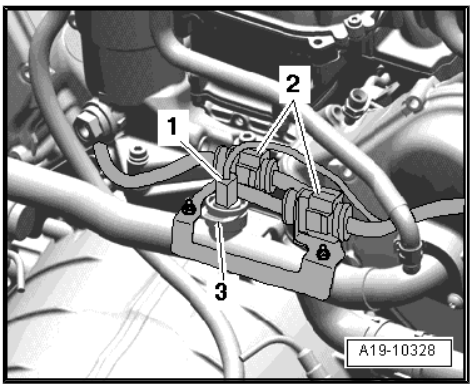
– Remove air hose (right-side) -arrows-.



– 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- .
– 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 .*

– Fill cooling system ⇒ page 172 .

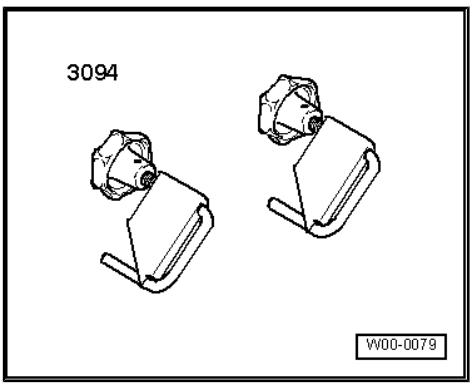
Tightening torques

Component	Nm
Air duct to intake manifold	9

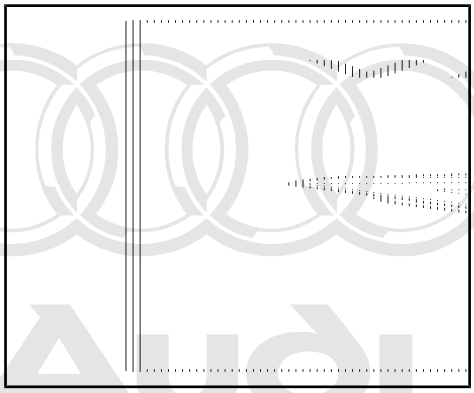
1.9 Removing and installing continued coolant circulation pump -V51-

Special tools and workshop equipment required

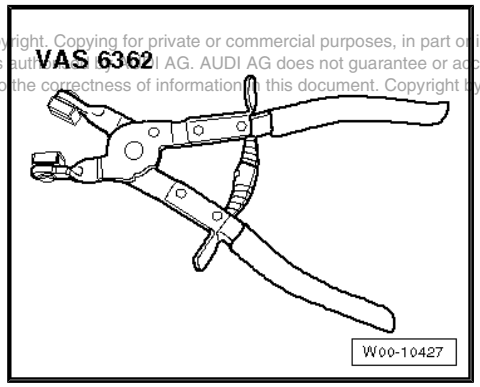
- Hose clamps for hoses up to 25 mm -3094-



♦ Drip tray for workshop hoist -VAS 6208-



♦ Hose clip pliers -VAS 6362-

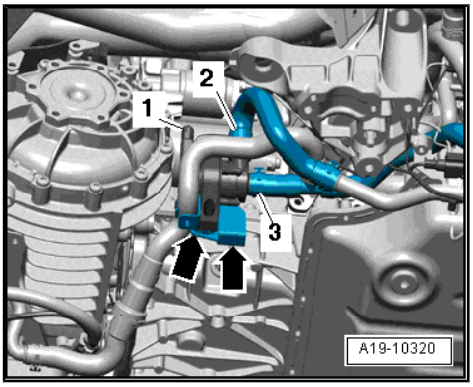


Removing

WARNING

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

– Open filler cap on coolant expansion tank.
– Remove anti-roll bar ⇒ Rep. Gr. 40 .



– Clamp off coolant hoses -2- and -3- using hose clamps -3094- .
– Unplug electrical connector -1-.
– Remove bolts -arrows-.
– Place drip tray for workshop hoist -VAS 6208- under continued coolant circulation pump -V51- .
– Disconnect coolant hoses from continued coolant circulation pump -V51- .

Installing

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

Note

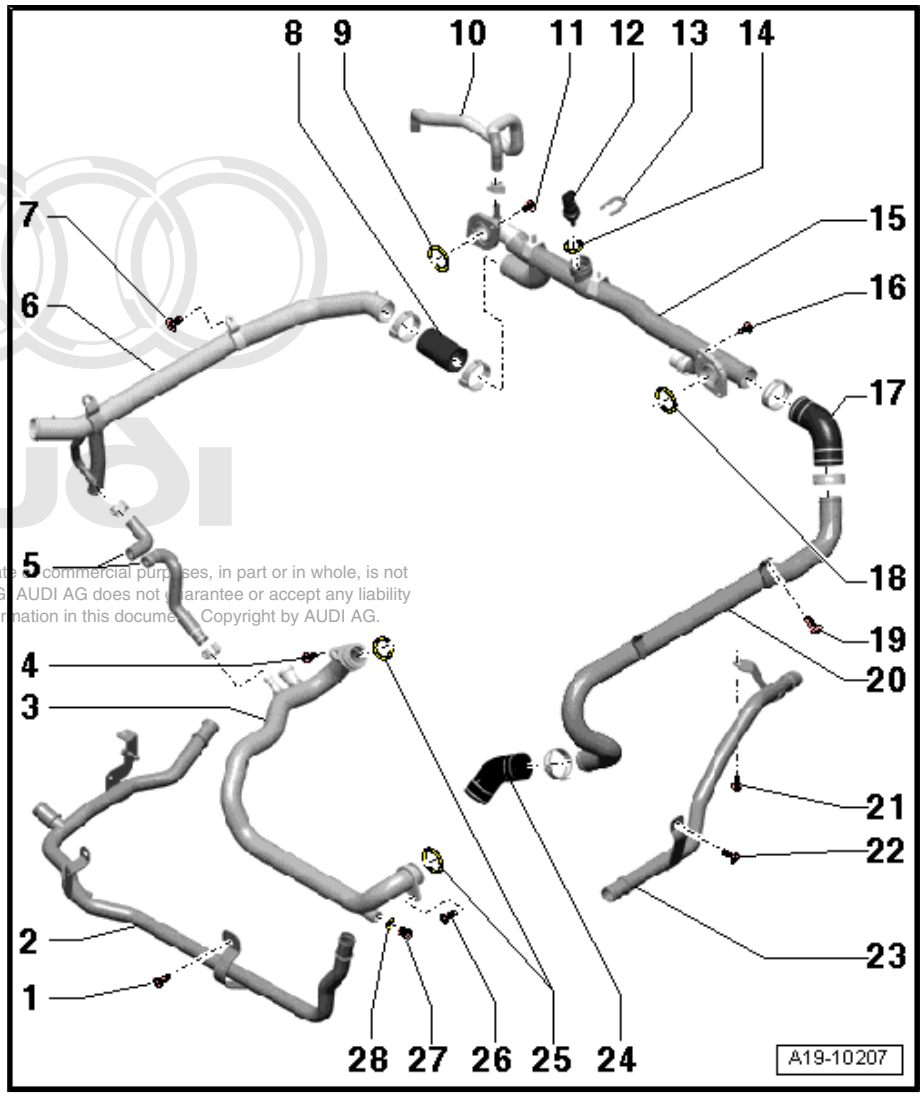
Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .

– Install anti-roll bar ⇒ Rep. Gr. 40 .
– Fill cooling system ⇒ page 172 .

Tightening torques

Component	Nm
Retaining clip for continued coolant circulation pump	5
Bracket for continued coolant circulation pump -V51- to body	9

1.10 Coolant pipes - exploded view



1 - 9 Nm

2 - Coolant pipe (bottom front)

- ❑ Removing and installing ⇒ page 185

3 - Coolant pipe (front)

- ❑ Removing and installing ⇒ page 186

4 - 8 Nm + 90° further

- ❑ Renew

5 - Coolant hoses

- ❑ To alternator

6 - Coolant pipe (right-side)

- ❑ Removing and installing ⇒ page 190

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 180

13 - Retaining clip

14 - O-ring

- ❑ Renew

15 - Coolant pipe (rear)

- ❑ Removing and installing ⇒ page 187

16 - 9 Nm

17 - Coolant hose

18 - O-ring

- ❑ Renew

19 - 9 Nm

20 - Coolant pipe (left-side)

- ❑ Removing and installing ⇒ page 189

21 - 9 Nm

22 - 9 Nm

23 - Coolant pipe (bottom left)

- ❑ Removing and installing ⇒ page 189

24 - Coolant hose

- ❑ To coolant pump housing

25 - O-rings

❑ Renew

26 - 8 Nm + 90° further

❑ Renew

27 - Drain plug, 10 Nm

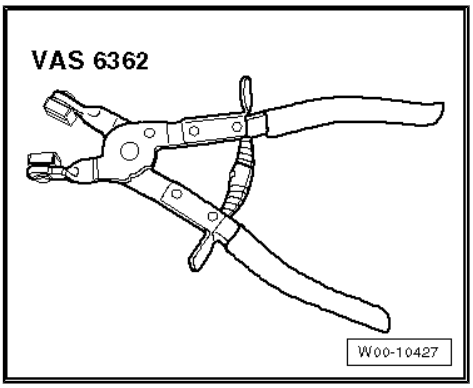
28 - Seal

❑ Renew

1.11 Removing and installing coolant pipe (bottom front)

Special tools and workshop equipment required

♦ Hose clip pliers -VAS 6362-



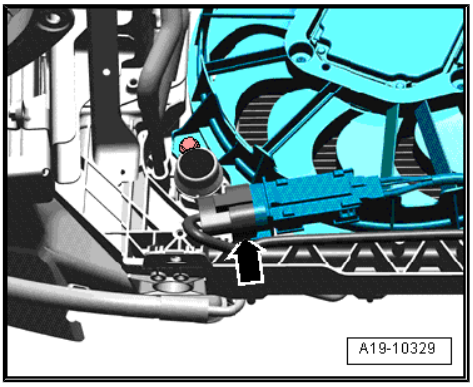
Removing

Note

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

– Drain off coolant ⇒ page 170

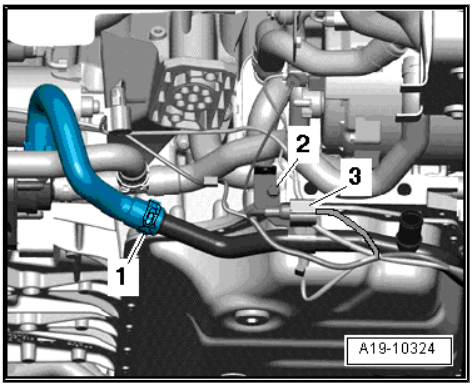
– Disengage electrical connector -arrow- from retainer on left side of lock carrier; do not unplug connector.



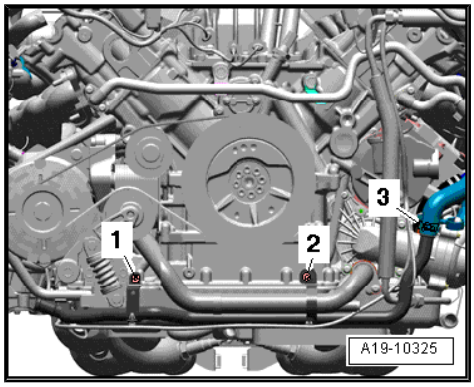
– Disengage electrical connector -3- from retainer and move wiring clear.

– Detach coolant hose -1- from coolant pipe (bottom front).

– Remove bolt -2-.



– Unscrew bolts -1- and -2- and detach coolant pipe (bottom front) 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 .*
- *Fit all cable ties in the original positions when installing.*

– Fill cooling system ⇒ page 172 .

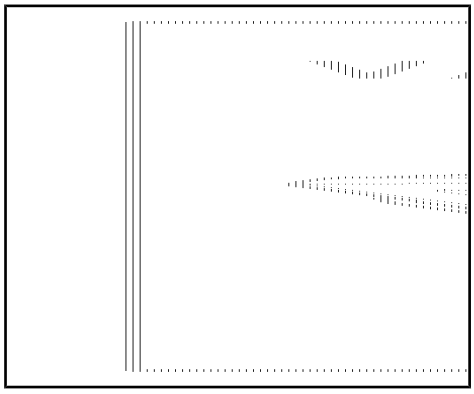
Tightening torque

Component	Nm
Coolant pipe (bottom front) to sump (top section)	9

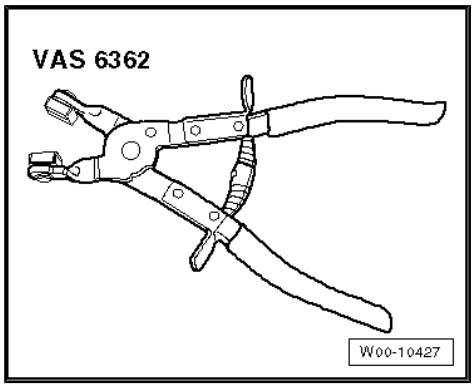
1.12 Removing and installing coolant pipe (front)

Special tools and workshop equipment required

- Drip tray for workshop hoist -VAS 6208-

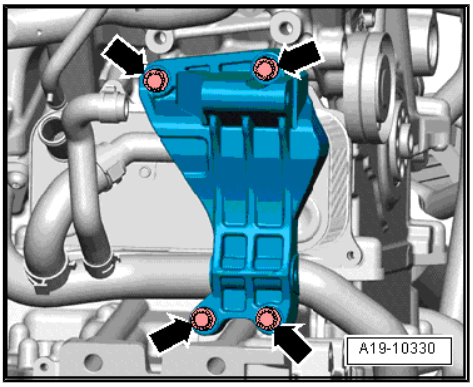


- Hose clip pliers -VAS 6362-



Removing

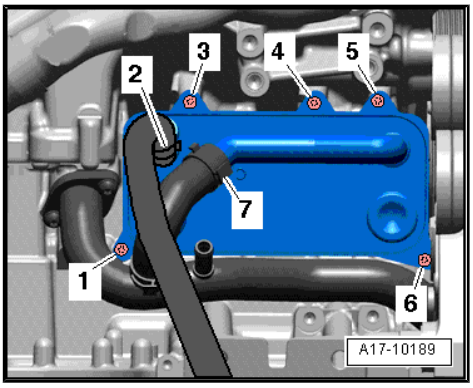
– Drain off coolant ⇒ page 170 .
– Remove alternator ⇒ Rep. Gr. 27 .
– Remove bolts -arrows- and detach bracket for alternator.
– Remove coolant pipe (bottom front) ⇒ page 185 .



Note

Lay a cloth under the connection to catch escaping oil.

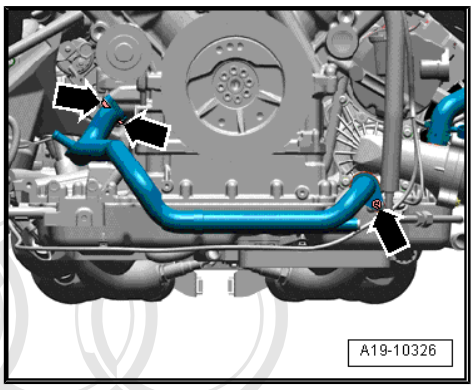
– Detach coolant hoses -2- and -7-.
– Remove bolts -1, 3, 4, 5, 6- and detach engine oil cooler.



– 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 163 .
– Install coolant pipe (bottom front) ⇒ page 185 .
– Install alternator ⇒ Rep. Gr. 27 .
– Fill cooling system ⇒ page 172 .

Tightening torques

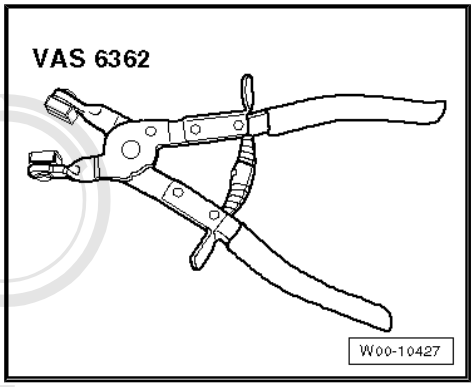
Component		Nm
Front coolant pipe to:	Coolant pump	8 +90° 1)
	Sump (top section)	8 +90° 1)
Bracket for alternator to engine	M8	22
	M10	46

• 1) Renew bolts.

1.13 Removing and installing coolant pipe (rear)

Special tools and workshop equipment required

♦ Hose clip pliers -VAS 6362-



Removing

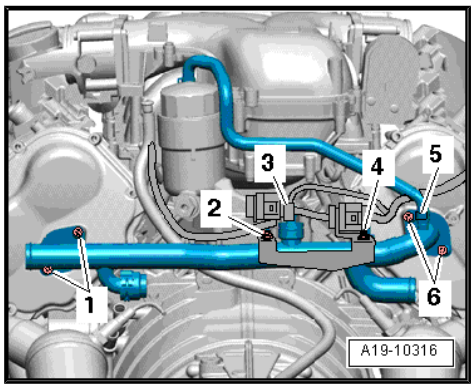
Note

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

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

– Remove coolant pipe (left-side) ⇒ page 189 .

– Remove coolant pipe (right-side) ⇒ page 190 .



– 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 189 .

– Install coolant pipe (right-side) ⇒ page 190 .

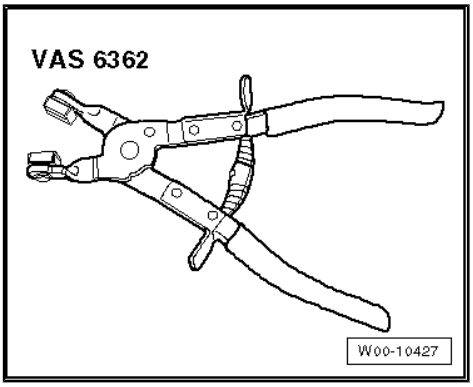
Tightening torques

Component	Nm
Coolant pipe (rear) to cylinder head	9
Bracket for electrical connectors to coolant pipe (rear)	9

1.14 Removing and installing coolant pipe (left-side)

Special tools and workshop equipment required

- Hose clip pliers -VAS 6362-

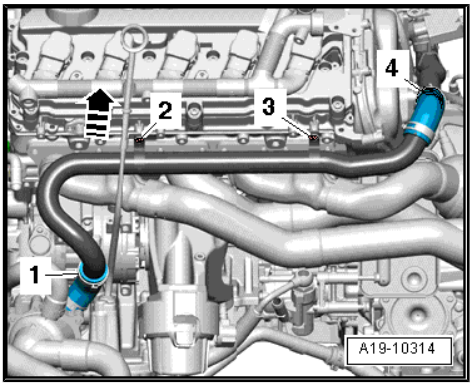


Removing

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

– Remove bolts -2- and -3- and lift out guide tube for oil dipstick -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.

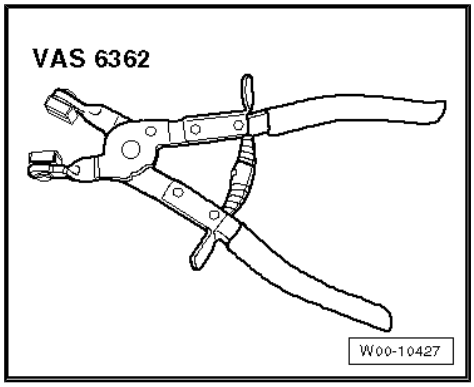
Tightening torque

Component	Nm
Coolant pipe (left-side) to cylinder head	9

1.15 Removing and installing coolant pipe (bottom left)

Special tools and workshop equipment required

♦ Hose clip pliers -VAS 6362-

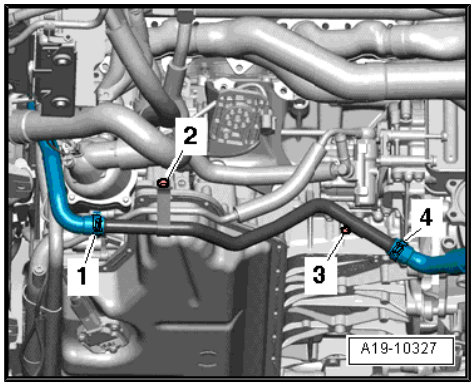


Removing

– Drain off coolant ⇒ page 170 .
– Remove nut -2- and bolt -3-.
– Disconnect coolant pipe (left-side) 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 .

– Fill cooling system ⇒ page 172 .

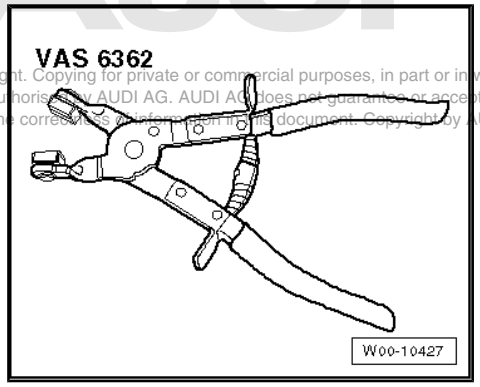
Tightening torque

Component	Nm
Coolant pipe (bottom left) to sump (top section)	9

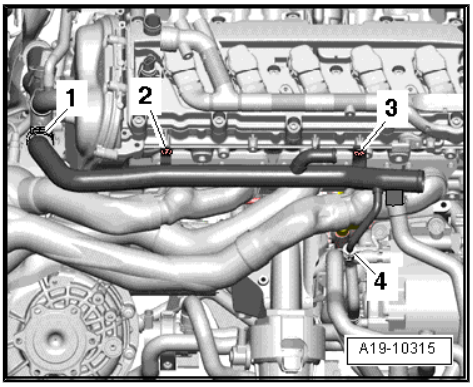
1.16 Removing and installing coolant pipe (right-side)

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- and -4- 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 torque

Component	Nm
Coolant pipe (right-side) to cylinder head	9

1.17 Removing and installing radiator

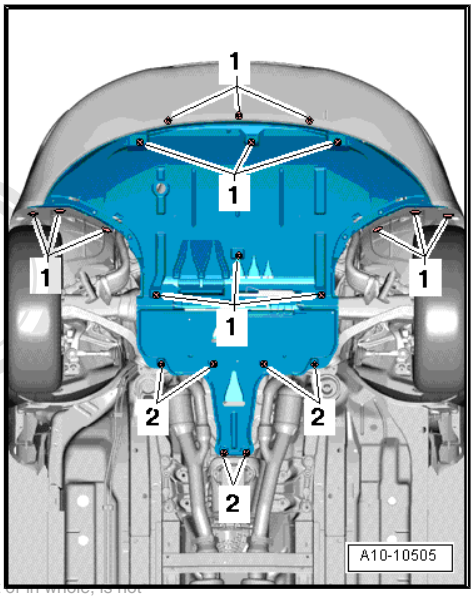
Removing

Note

If there are slight impressions on the fins, refer to ⇒ page 6 .

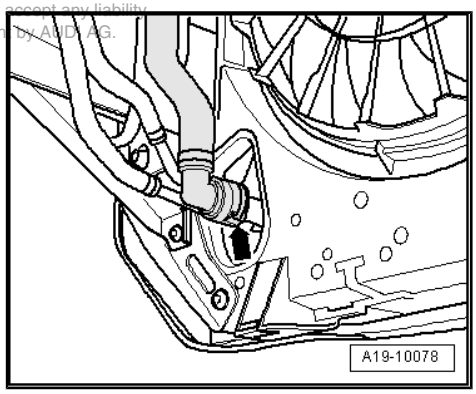
– Open quick-release fasteners -1- and remove noise insulation (front).

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

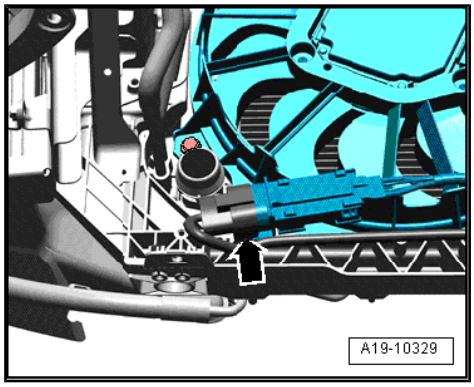


– Drain off coolant ⇒ page 170.

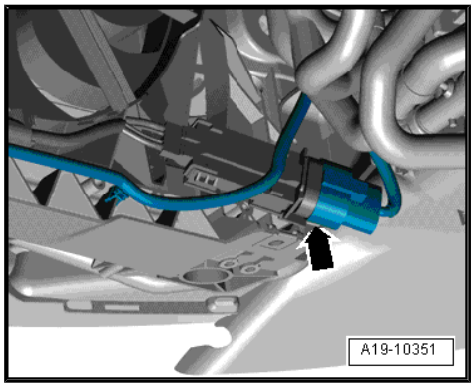
– Detach coolant hose -arrow- from bottom left of radiator.



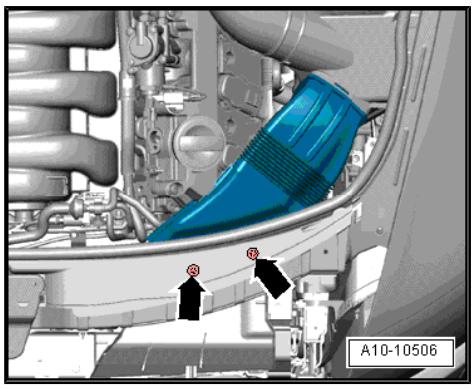
– Unplug electrical connector -arrow- and disengage connector from retainer on left side of lock carrier.



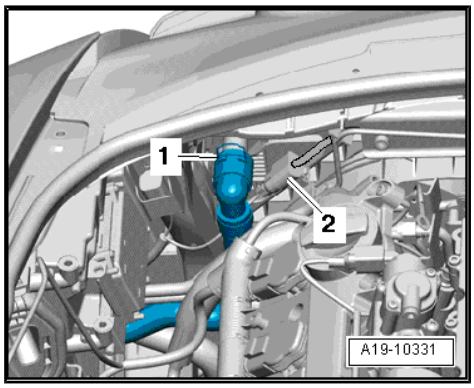
– Unplug electrical connector -arrow- and disengage connector from retainer on right side of lock carrier.



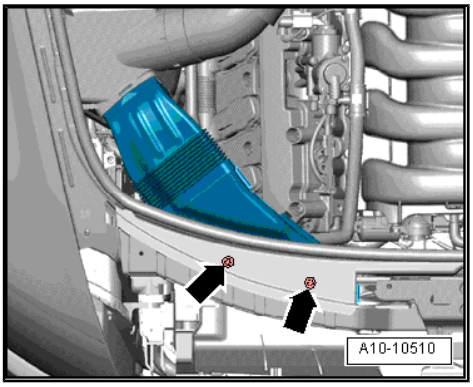
– Remove bolts -arrows- and remove air duct (left-side).



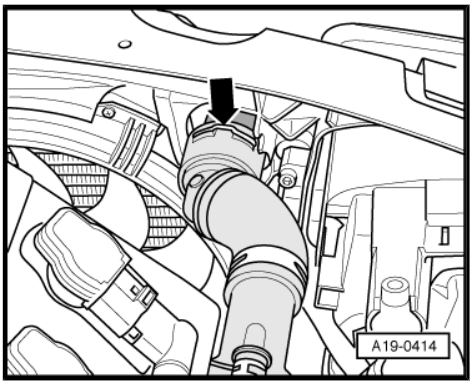
– Remove coolant hose -1- (top left) from radiator.
– Remove electrical connector for bonnet lock -2- from retainer.



– Remove bolts -arrows- and remove air duct (right-side).



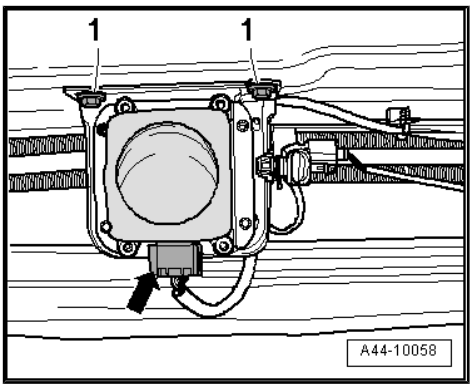
– Detach coolant hose (top right) -arrow- from radiator.



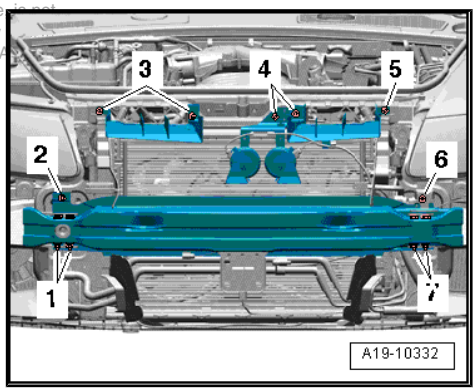
– Detach electrical connector -arrow- from adaptive cruise control unit -J428- (if fitted).

Note

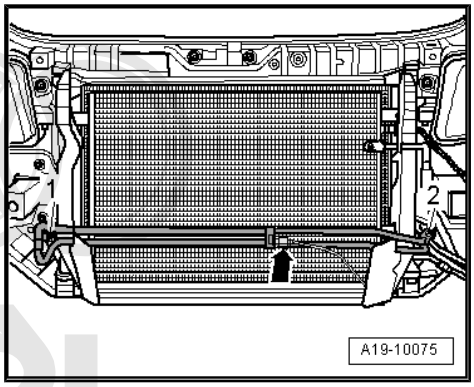
Disregard -item 1-.



– Unscrew bolts -3- and -5- and remove air ducts.
– Unscrew bolts -4- and remove bracket for horns; electrical wiring remains attached.
– Unscrew brackets -2- and -6- for headlights.
– Unscrew nuts -1- and -7- and remove bumper.



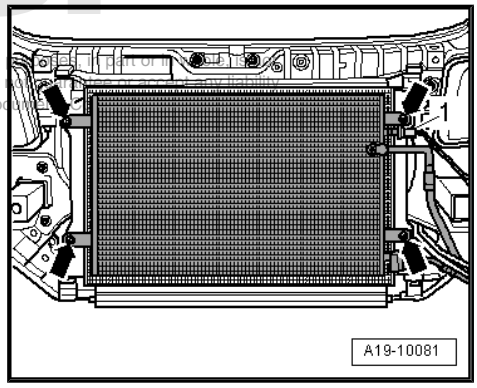
– Unclip ambient temperature sensor -G17- -arrow- from bracket.
– Unscrew bolts -1- and -2- for power steering cooling pipe; the hydraulic hoses remain attached.
– Detach air ducts (left and right) from radiator.



WARNING

The air conditioner refrigerant circuit must not be opened.

– Unplug electrical connector -1-.
– Remove bolts -arrows-.

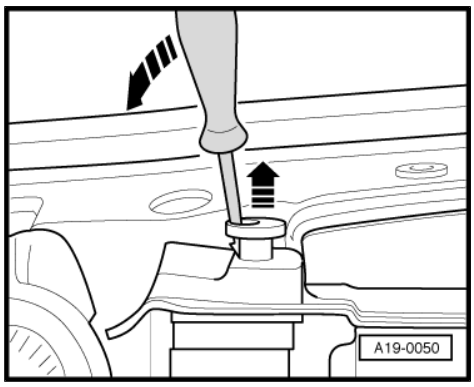


Note

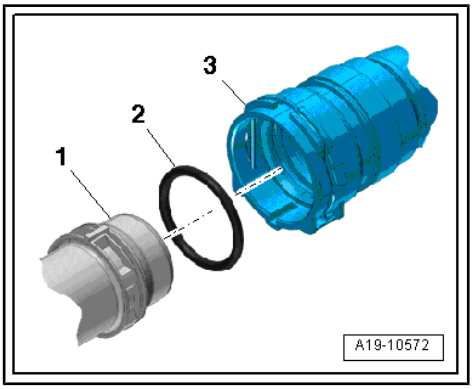
To prevent damage to the refrigerant lines, ensure that the pipes and hoses are not stretched, kinked or bent.

– Pivot condenser downwards with pipes/hoses attached.

– Release two retaining pins for radiator and pull out upwards -arrows-.
– Swivel radiator slightly to the front and lift it out.



Installing



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

– Remove old O-ring -2- from coolant hose -3-.
– Lightly lubricate new O-ring with coolant and fit O-ring in coolant hose.
– Press coolant hose onto radiator -1- until it engages with a click.
– Press coolant hose in again and then pull to check that plug-in connector is correctly engaged.
– Install bumper and bumper cover (front) ⇒ Rep. Gr. 63 .
– Fill cooling system ⇒ page 172 .

Note

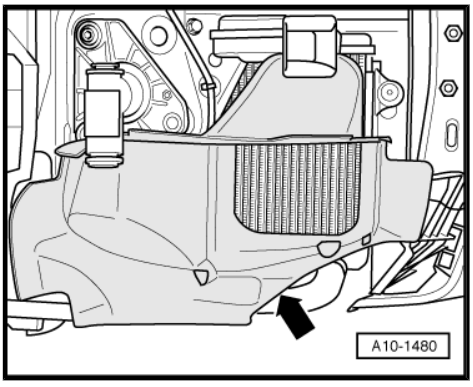
The coolant in the entire system must be changed if the radiator is renewed

Tightening torques

Component	Nm
Condenser to lock carrier	6
Power steering cooling pipe to lock carrier	9
Bracket for horns to lock carrier	8

1.18 Removing and installing auxiliary radiator (left-side)

Removing

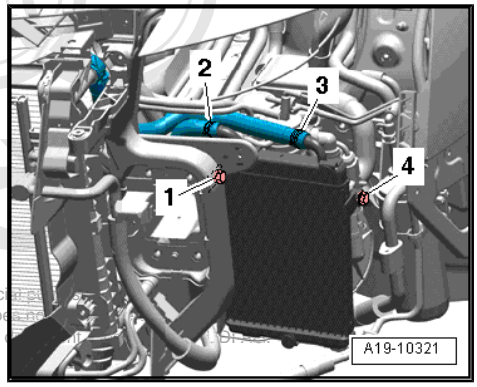


Note

If there are slight impressions on the fins, refer to ⇒ page 6 .

– Drain off coolant ⇒ page 170 .
– Remove bumper cover (front) ⇒ Rep. Gr. 63 .
– Remove air duct (left-side) -arrow- in front of auxiliary radiator.

– Unscrew bolts -1- and -4- and detach auxiliary radiator at bottom from bracket.
– Detach coolant hoses -2- and -3- and remove auxiliary radiator (left-side).



Note

Shown in illustration with headlight removed.

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 172 .

Note

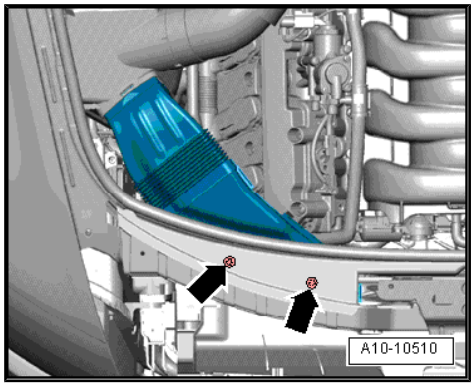
The coolant in the entire system must be changed if the radiator is renewed

Tightening torque

Component	Nm
Auxiliary radiator (left-side) to bracket	9

1.19 Removing and installing auxiliary radiator (right-side)

Removing

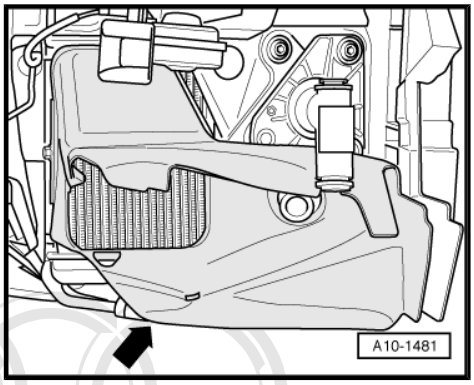


Note

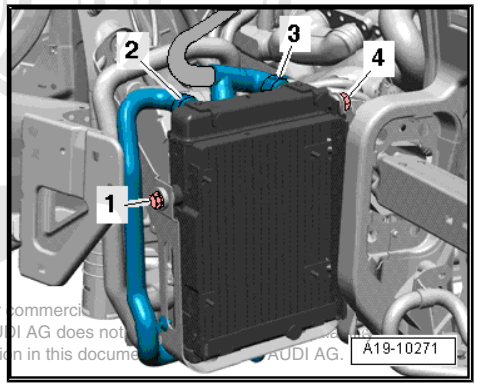
If there are slight impressions on the fins, refer to ⇒ page 6 .

– Remove bolts -arrows- and remove air duct (right-side).

– Remove bumper cover (front) ⇒ Rep. Gr. 63 .
– Remove air duct -arrow- in front of auxiliary radiator (right-side).



– Unscrew bolts -1- and -4- and detach auxiliary radiator at bottom from bracket.
– Detach coolant hoses -2- and -3- and remove auxiliary radiator (right-side).



Note

Shown in illustration with headlight removed.

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 172 .

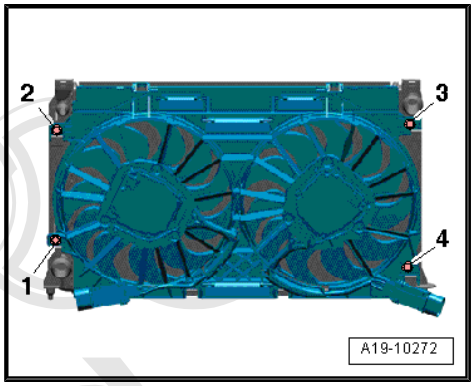
Note

The coolant in the entire system must be changed if the radiator is renewed

Tightening torque

Component	Nm
Auxiliary radiator (right-side) to bracket	9

1.20 Removing and installing radiator cowl



Removing

– Drain off coolant ⇒ page 170 .
– Remove radiator ⇒ page 191 .
– Unscrew bolts -1 … 4- and remove radiator cowl.

Installing

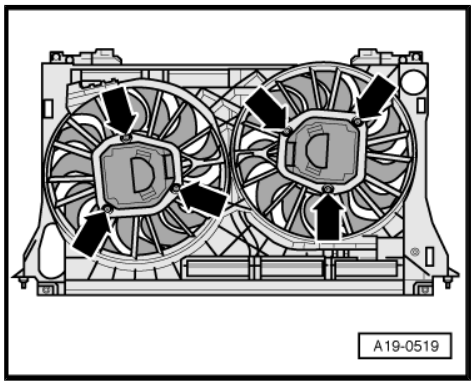
Installation is carried out in the reverse order; note the following:

– Install radiator ⇒ page 191 .
– Fill cooling system ⇒ page 172 .

Tightening torque

Component	Nm
Radiator cowl to radiator	9

1.21 Removing and installing radiator fans



Removing

– Remove radiator ⇒ page 191 .
– Remove radiator cowl ⇒ page 198 .
– 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 198 .
– Install radiator ⇒ page 191 .
– Fill cooling system ⇒ page 172 .

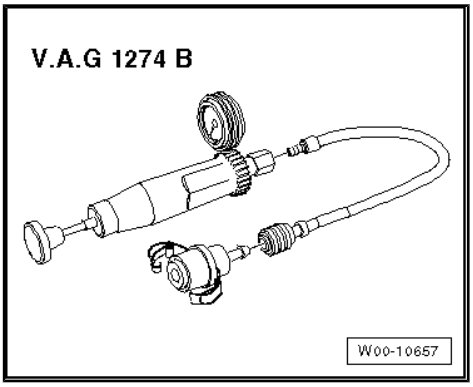
Tightening torque

Component	Nm
Radiator fan to radiator cowl	10 1)
• 1) Renew bolts.	

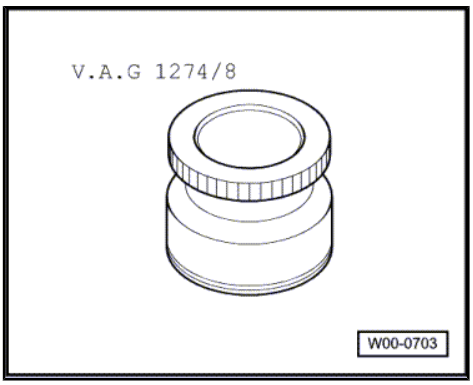
1.22 Checking cooling system for leaks

Special tools and workshop equipment required

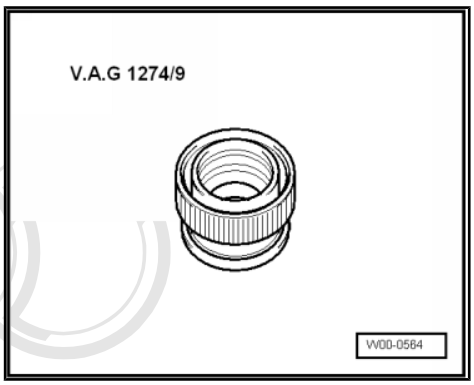
♦ Cooling system tester -V.A.G 1274 B-



♦ 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.

WARNING

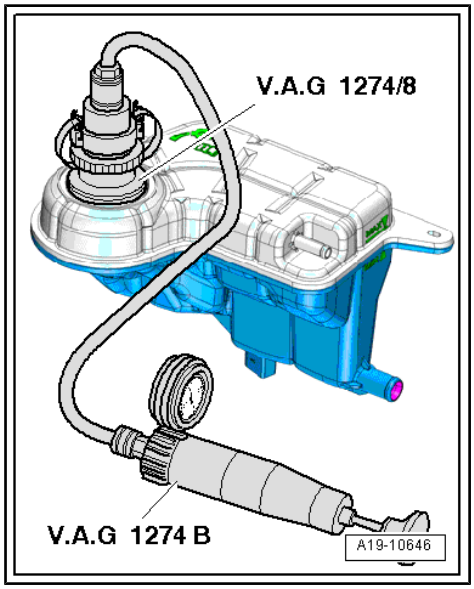
Hot steam or hot coolant can escape when expansion tank is opened; cover filler cap with cloth and open carefully.

– Open filler cap on coolant expansion tank.

– Attach cooling system tester -V.A.G 1274 B- with adapter -V.A.G 1274/8- to expansion tank.
– Use hand pump on cooling system tester to create a pressure of approx. 1.0 bar.

If the pressure drops:

– Locate leak and eliminate fault.

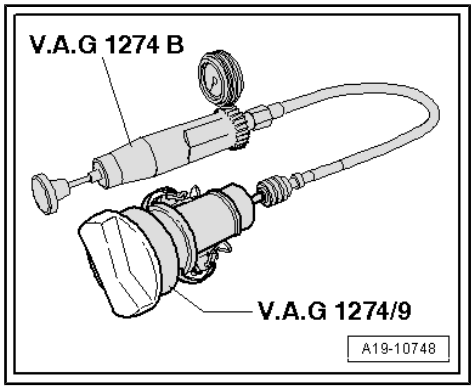


Checking pressure relief valve in filler cap

– 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 - 25 Nm
- ❑ Renew
- ❑ Tightening torque and tightening sequence: (left-side) ⇒ page 209 , (right-side) ⇒ page 212

2 - Gasket
- ❑ Renew

3 - 23 Nm
- ❑ Renew

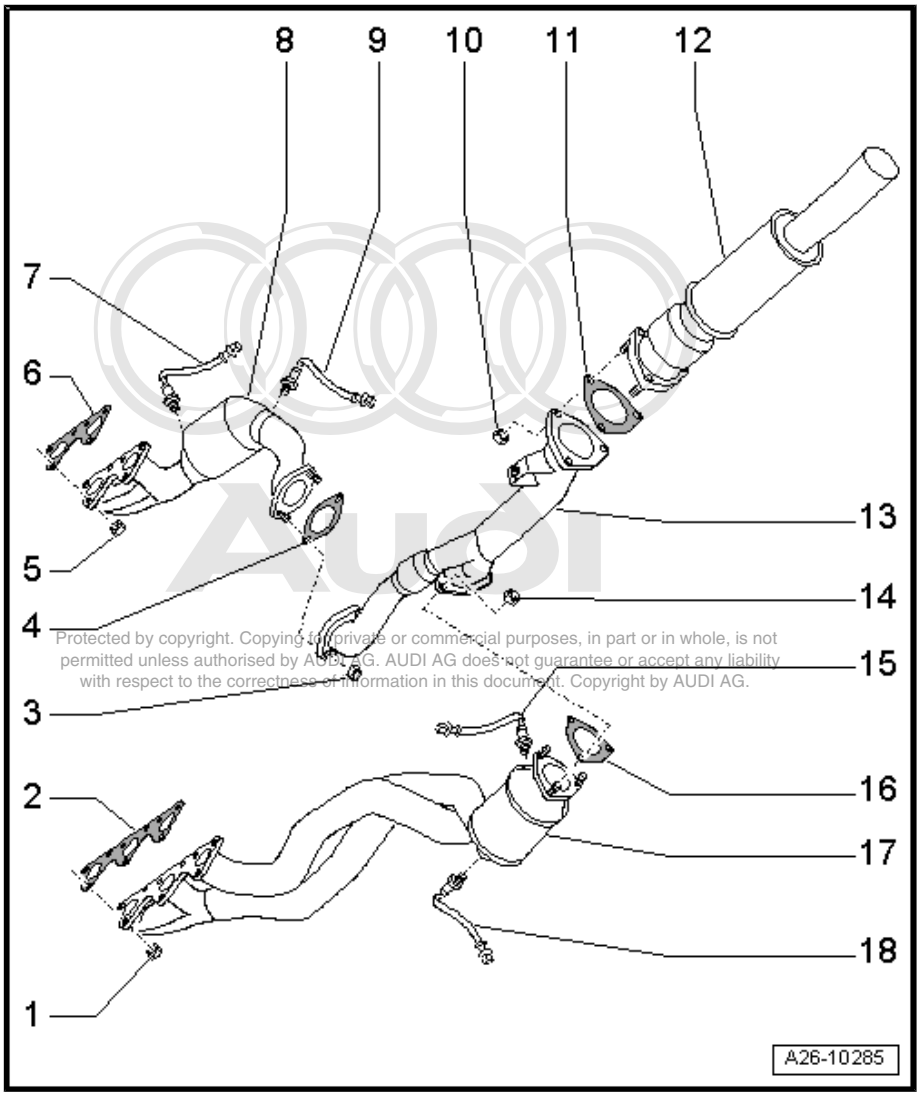
4 - Gasket
- ❑ Renew

5 - 25 Nm
- ❑ Renew
- ❑ Tightening torque and tightening sequence: (left-side) ⇒ page 209 , (right-side) ⇒ page 212

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 206 , right-side ⇒ page 209

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 215 , right-side ⇒ page 216
- ❑ Align exhaust system so it is free of stress ⇒ page 216

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 212 , right-side ⇒ page 213
- ❑ Align exhaust system so it is free of stress ⇒ page 216

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

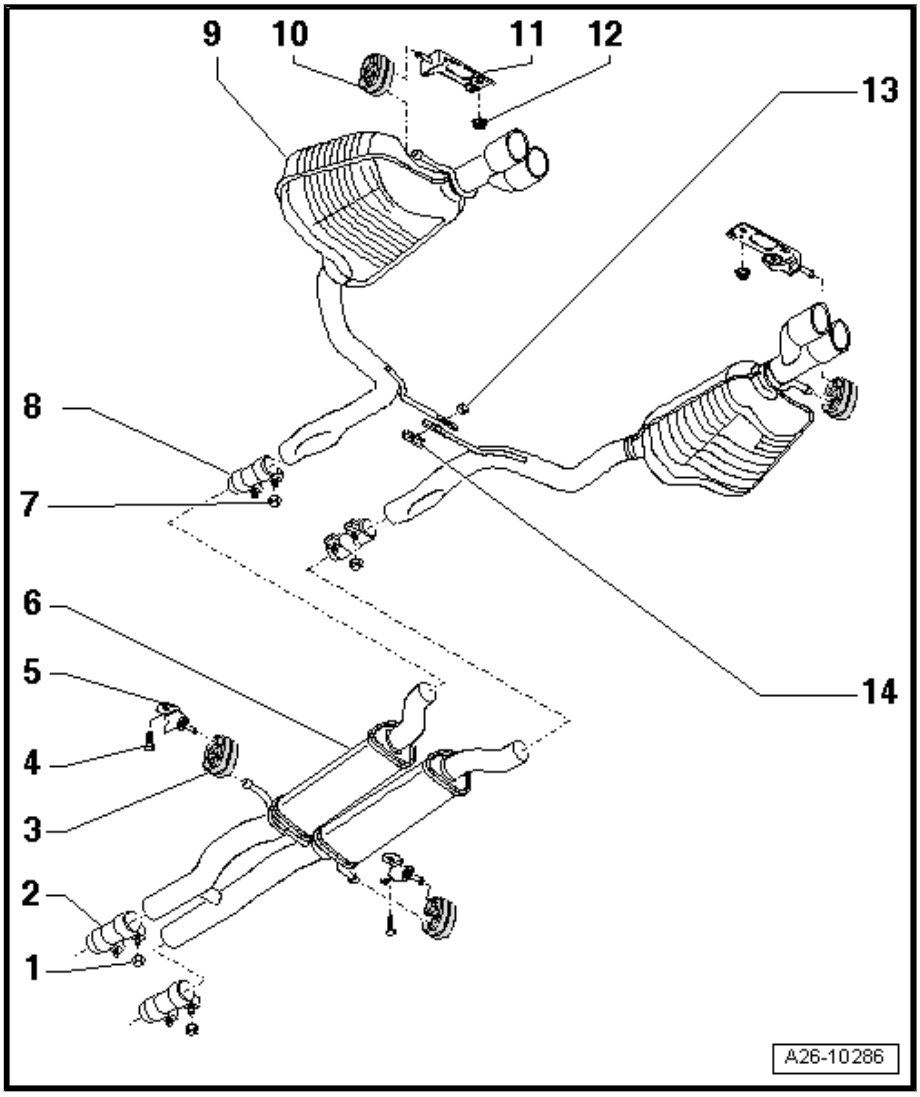
17 - Exhaust manifold (front) with catalytic converter

- ❑ For exhaust bank I (cylinders 1, 2, 3)
- ❑ Protect against knocks and impact
- ❑ Removing and installing: left-side ⇒ page 206 , right-side ⇒ page 209

18 - Lambda probe -G39- (before catalytic converter)

- ❑ For exhaust bank I (cylinders 1, 2, 3)
- ❑ Removing and installing ⇒ Rep. Gr. 24

Exhaust system (rear)



1 - 23 Nm

2 - Clamp (front)

- ❑ Installation position ⇒ page 204
- ❑ Before tightening, align exhaust system so it is free of stress ⇒ page 216
- ❑ Tighten bolt connections evenly

3 - Rubber mounting

- ❑ Renew if damaged

4 - 23 Nm

5 - Mounting

- ❑ Renew if damaged

6 - Centre silencer

- ❑ Combined in one unit with rear silencer as original equipment. Can be renewed individually for repair purposes
- ❑ Cutting point ⇒ page 205
- ❑ Align exhaust system so it is free of stress ⇒ page 216

7 - 23 Nm

8 - Clamp (rear)

- ❑ For separate replacement of centre and rear silencers
- ❑ Installation position ⇒ page 205
- ❑ Before tightening, align exhaust system so it is free of stress ⇒ page 216
- ❑ Tighten bolt connections evenly

9 - Rear silencer

- ❑ For left side of vehicle
- ❑ Combined in one unit with centre silencer as original equipment. Can be renewed individually for repair purposes
- ❑ Cutting point ⇒ page 205
- ❑ Align exhaust system so it is free of stress ⇒ page 216

10 - Rubber mounting

- ❑ Renew if damaged

11 - Mounting

- ❑ Renew if damaged

12 - 23 Nm

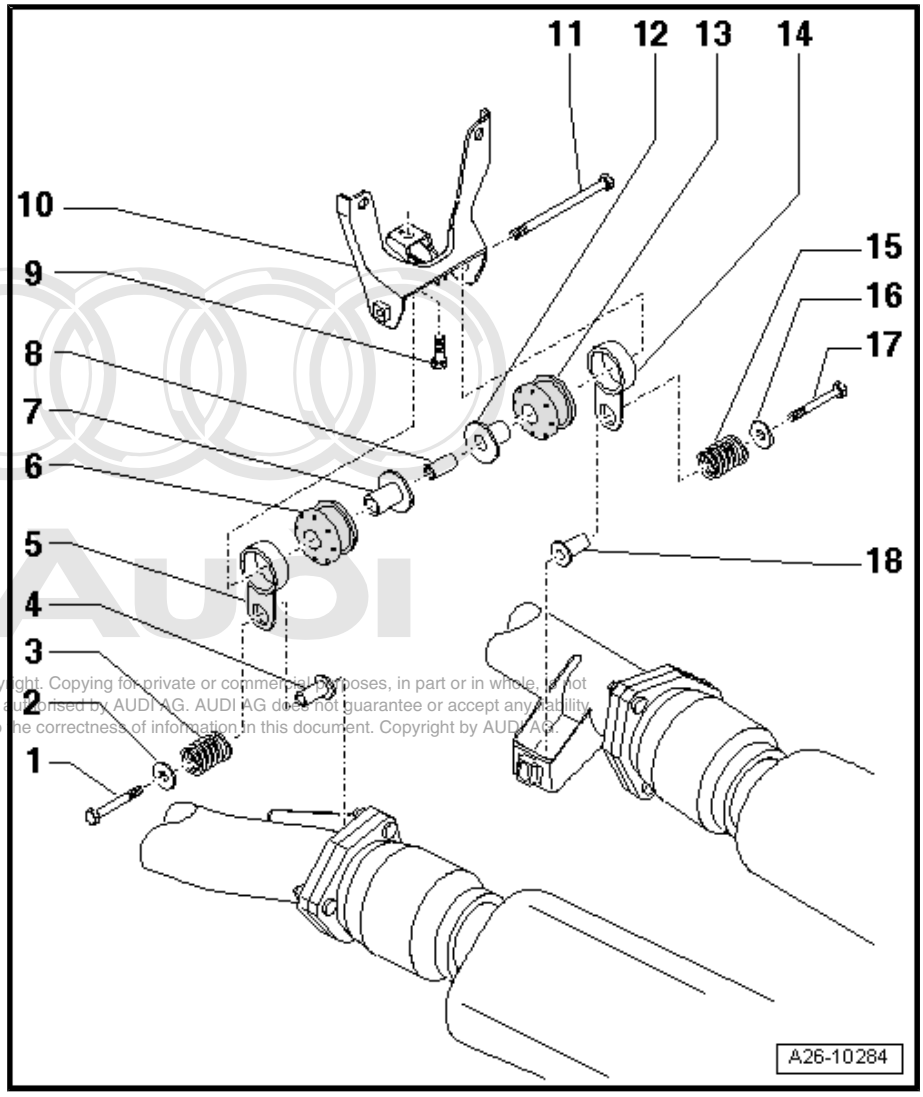
13 - 23 Nm

- ❑ Renew

14 - Connecting bracket

Mounting components

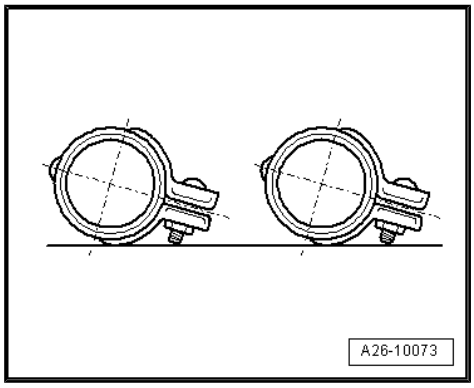
1 - 23 Nm
2 - Washer
3 - Compression spring
4 - Spacer sleeve
5 - Bracket
6 - Buffer
7 - Spacer sleeve
8 - Sleeve
9 - 23 Nm
10 - Mounting bracket
11 - 23 Nm
12 - Spacer sleeve
13 - Buffer
14 - Bracket
15 - Compression spring
16 - Washer
17 - 23 Nm
18 - Spacer sleeve



Installation position of front clamps

– Fit clamps so that ends of bolts do not protrude beyond bottom of clamp.

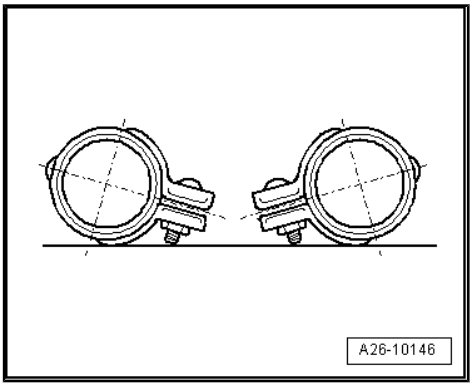
• Bolt connections face to right.



Installation position of rear clamps

– Fit clamps so that ends of bolts do not protrude beyond bottom of clamp.

• Bolt connections face one another.



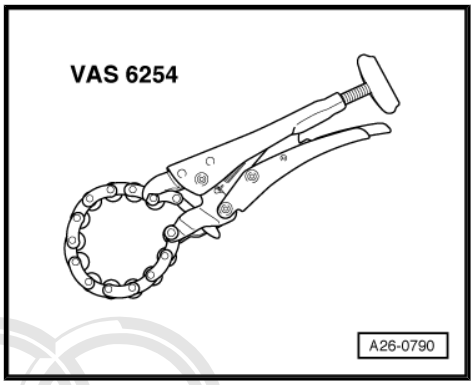
1.2 Separating centre and rear silencers

♦ 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.

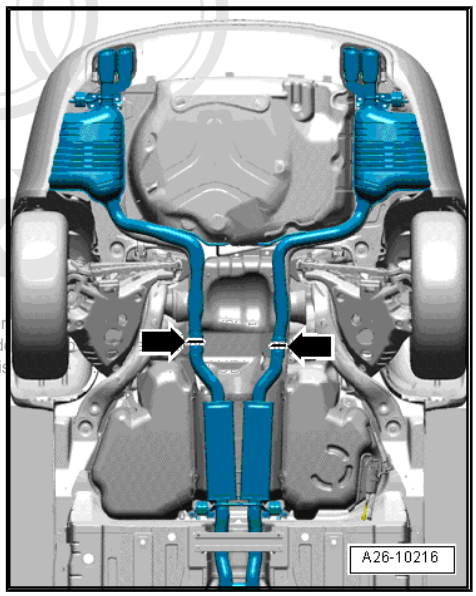
Special tools and workshop equipment required

♦ Chain-type pipe cutter -VAS 6254-

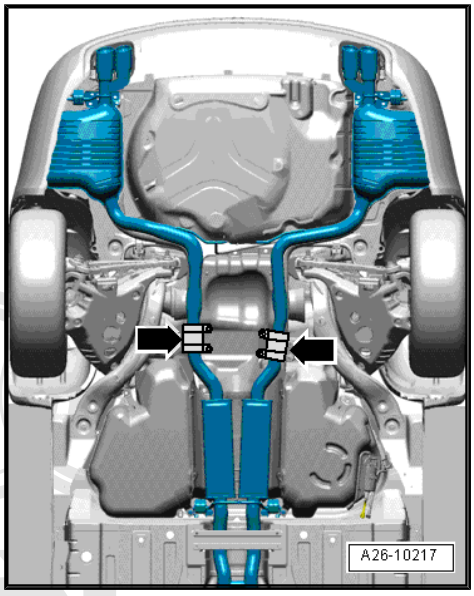


Procedure

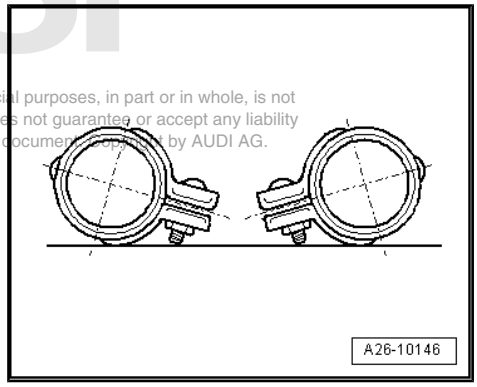
– Cut through exhaust pipes at a right angle at cutting points -arrows- using chain-type pipe cutter -VAS 6254- .



– 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 216.



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.

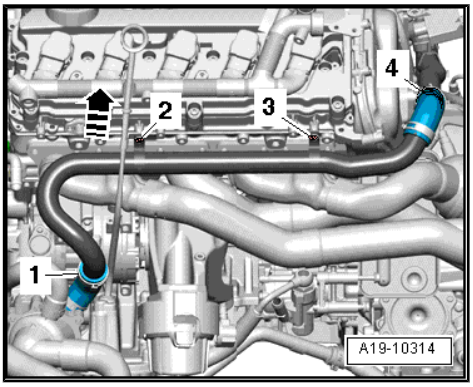
Note

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

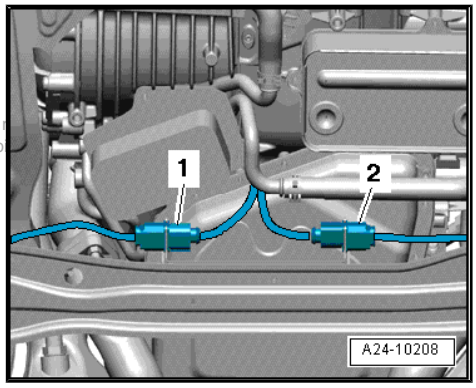
♦ *All cable ties which are released or cut open when removing must be fitted in the same position when installing.*

– Remove bolts -2- and -3- and lift out guide tube for oil dipstick -arrow-.

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



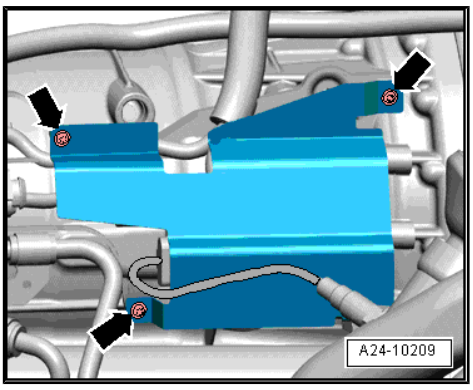
– Take electrical connector -2- for Lambda probe 3 -G285- (before catalytic converter) out of bracket and unplug it.



Note

Disregard -item 1-.

– Unbolt heat shield for electrical connectors for Lambda probes (right-side) from gearbox -arrows-.

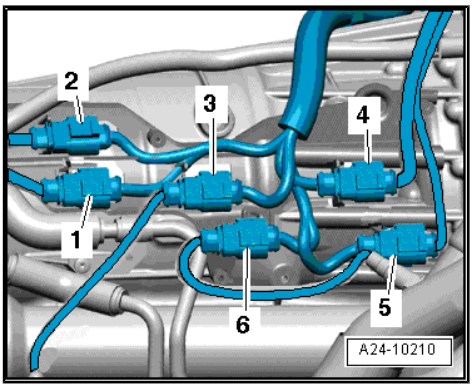


– Take the following electrical connectors for Lambda probes out of bracket at gearbox and unplug connectors.

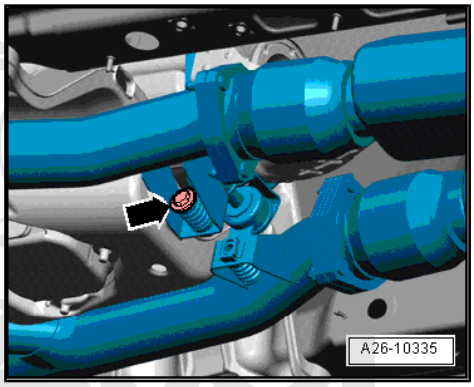
1 - For Lambda probe 3 -G287- (after catalytic converter)

2 - For Lambda probe 4 -G288- (after catalytic converter)

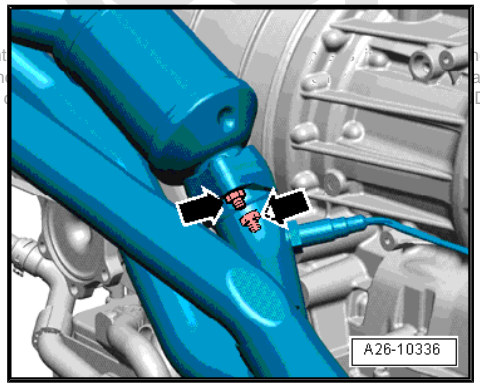
4 - Connector for Lambda probe 4 -G286- (before catalytic converter)



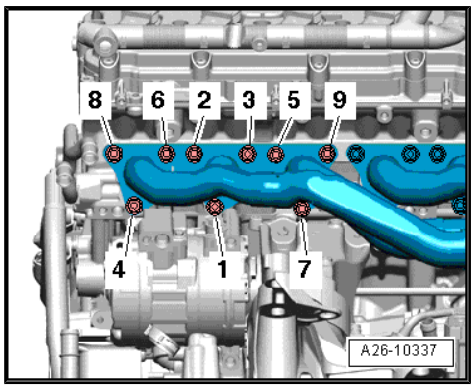
– Unscrew bolt -arrow- at bracket for exhaust pipes (left-side).



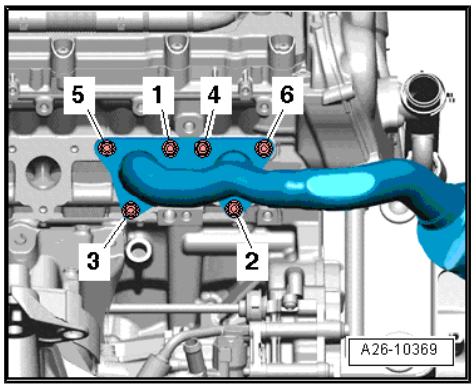
– Unscrew nuts -arrows-.



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



– 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:

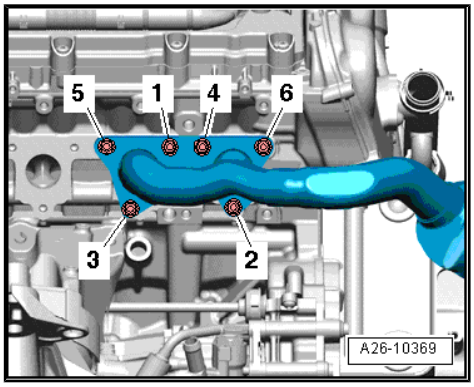
Note

- *Renew 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.*

– Attach exhaust manifold (rear left) together with catalytic converter to cylinder head.

– Tighten nuts for exhaust manifold (rear left) in 3 stages in the sequence shown:

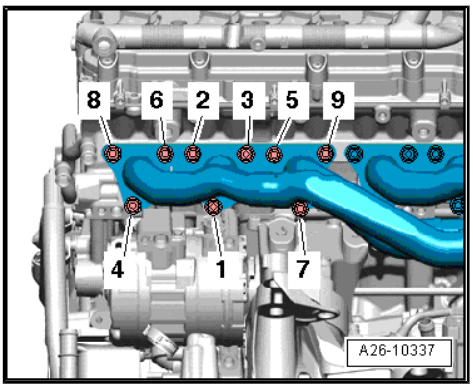
Stage	Nuts	Tightening torque
1.	-1 … 6-	Screw in by hand until nuts make contact with exhaust manifold
2.	-1 … 6-	10 Nm
3.	-1 … 6-	25 Nm



– Attach exhaust manifold (front left) together with catalytic converter to cylinder head.

– Tighten nuts for exhaust manifold (front left) 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



– Align exhaust system free of stress after installing engine ⇒ page 216 .

Tightening torques

Component		Nm
Exhaust manifold (front) with catalytic converter to cylinder head		25 1)2)3)
Exhaust manifold (rear) with catalytic converter to:	Cylinder head	25 1)2)3)
	Y-pipe	23
Y-pipe to bracket		23
Coolant pipe to cylinder head		9

- 1) Renew nuts.
- 2) Grease with high-temperature paste; refer to ⇒ Electronic parts catalogue for high-temperature paste
- 3) Tighten in three stages.

1.4 Removing and installing exhaust pipes (right-side)

Removing

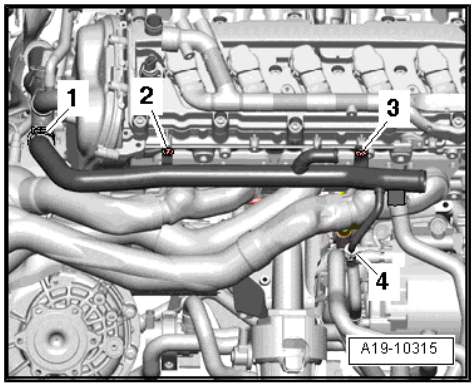
- Engine removed and in position on scissor-type assembly platform -VAS 6131 A- with gearbox attached.

Note

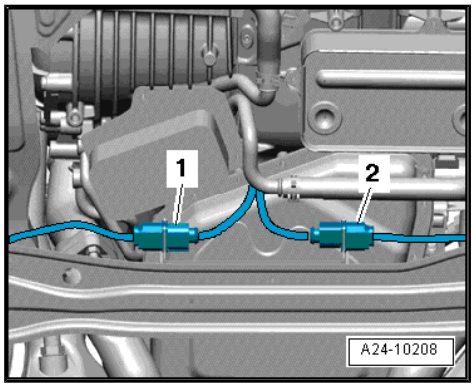
- *Fit all heat shields and heat insulation sleeves in the original positions when installing.*
- *All cable ties which are released or cut open when removing must be fitted in the same position when installing.*

– Remove bolts -2- and -3-.

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



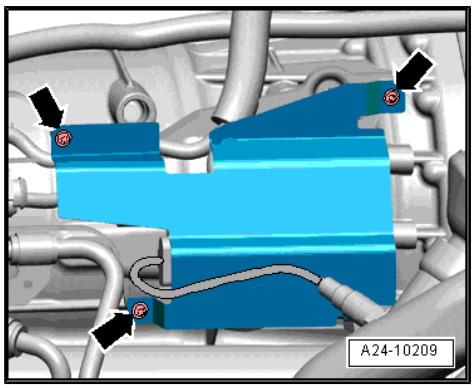
– Take electrical connector -1- for Lambda probe -G39- (before catalytic converter) out of bracket and unplug it.



Note

Disregard -item 2-.

– Unbolt heat shield for electrical connectors for Lambda probes (right-side) from gearbox -arrows-.

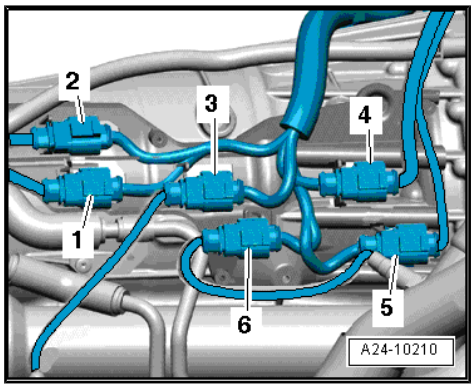


– Take the following electrical connectors for Lambda probes out of bracket at gearbox and unplug connectors.

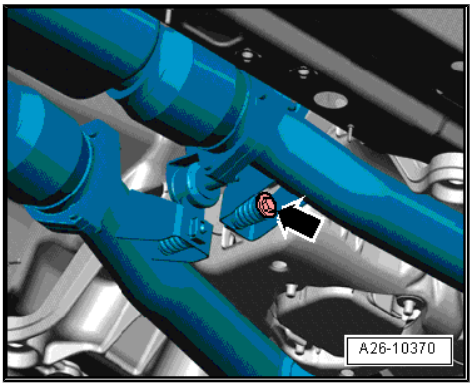
3 - For Lambda probe after catalytic converter -G130-

5 - For Lambda probe 2 -G108- (before catalytic converter)

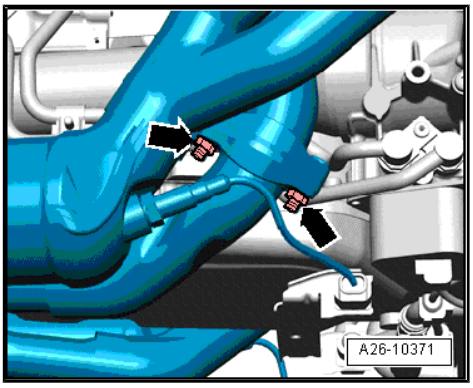
6 - For Lambda probe 2 -G131- (after catalytic converter)



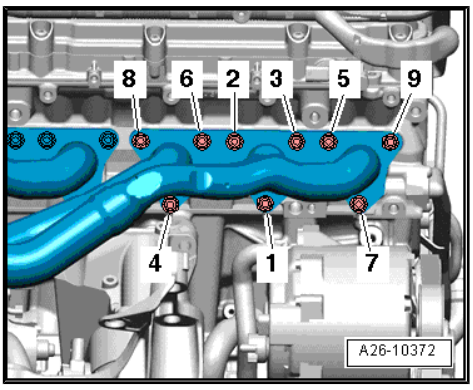
– Unscrew bolt -arrow- at bracket for exhaust pipes (right-side).



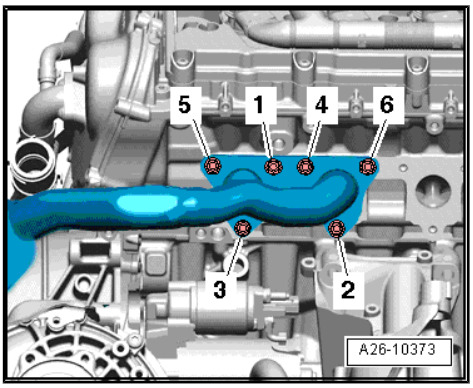
– Unscrew nuts -arrows-.



– 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.



Installing

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

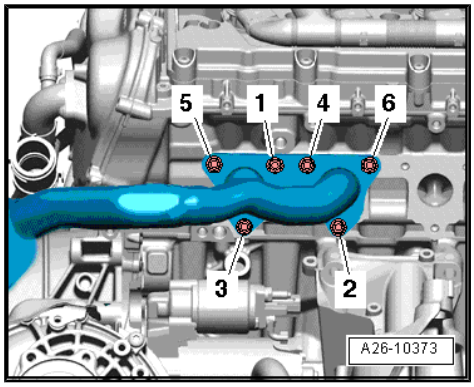
Note

- *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.*

– Attach exhaust manifold (rear right) together with catalytic converter to cylinder head.

– Tighten nuts for exhaust manifold (rear right) in 3 stages in the sequence shown:

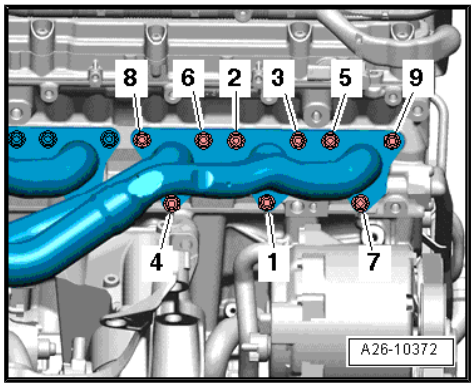
Stage	Nuts	Tightening torque
1.	-1 … 6-	Screw in by hand until nuts make contact with exhaust manifold
2.	-1 … 6-	10 Nm
3.	-1 … 6-	25 Nm



– Attach exhaust manifold (front right) together with catalytic converter to cylinder head.

– Tighten nuts for exhaust manifold (front right) 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



– Align exhaust system free of stress after installing engine ⇒ page 216 .

Tightening torques

Component		Nm
Exhaust manifold (front) with catalytic converter to cylinder head		25 1)2)3)
Exhaust manifold (rear) with catalytic converter to:	Cylinder head	25 1)2)3)
	Y-pipe	23
Y-pipe to bracket		23
Coolant pipe to cylinder head		9

- 1) Renew nuts.
- 2) Grease with high-temperature paste; refer to ⇒ Electronic parts catalogue for high-temperature paste
- 3) Tighten in three stages.

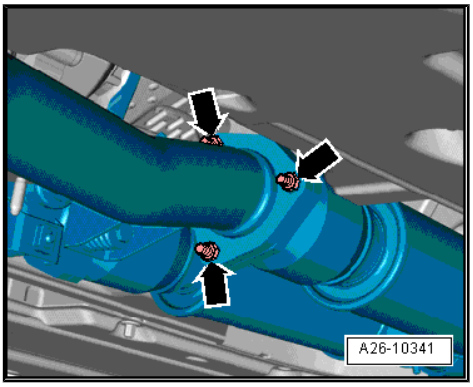
1.5 Removing and installing Y-pipe (left-side)

Removing

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

– Remove exhaust pipes (left-side) ⇒ page 206 .

– 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 exhaust pipes (left-side) ⇒ page 206 .

– Align exhaust system free of stress after installing engine ⇒ page 216 .

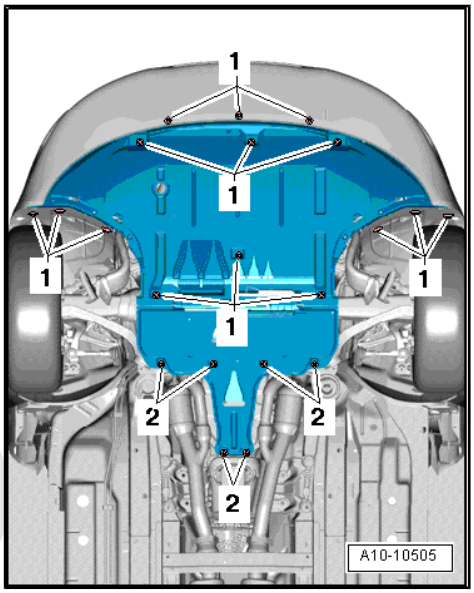
Tightening torque

Component	Nm
Y-pipe to front silencer	23 1)
• 1) Renew nuts.	

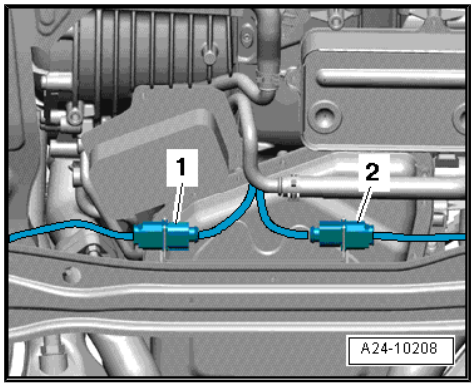
1.6 Removing and installing Y-pipe (right-side)

Removing

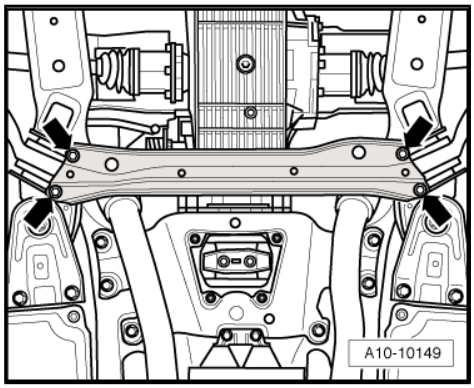
– Open quick-release fasteners -2- and remove rear noise insulation.



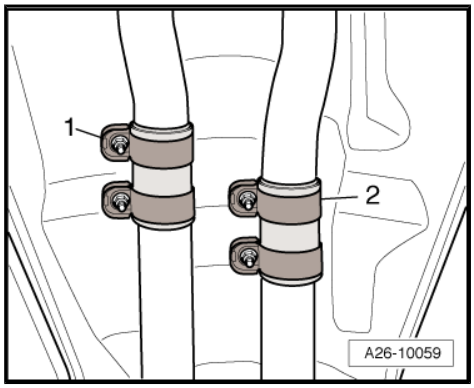
– Remove electrical connectors -1- and -2- for Lambda probes from bracket.
– Unplug electrical connector -1-.



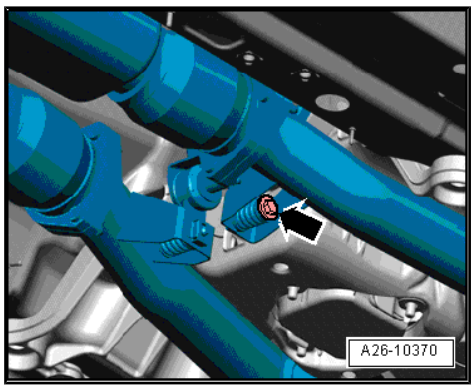
– Unbolt cross piece from subframe -arrows-.



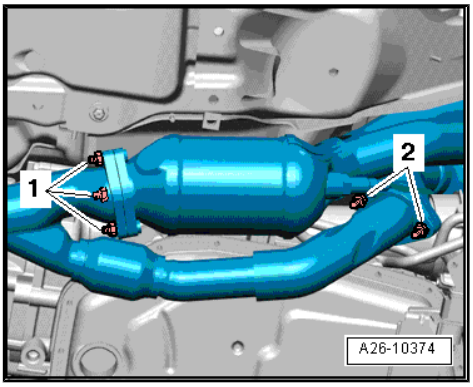
– Loosen clamp (right-side) -1- and move to rear.



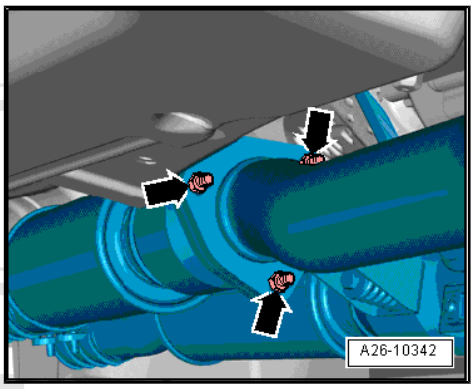
– Unscrew bolt -arrow- at bracket for exhaust pipes (right-side).



– Remove nuts -1- and -2- and detach Y-pipe together with front silencer.



– 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 cross piece for subframe ⇒ Rep. Gr. 40 .
– Align exhaust system so it is free of stress ⇒ page 216 .

Tightening torque

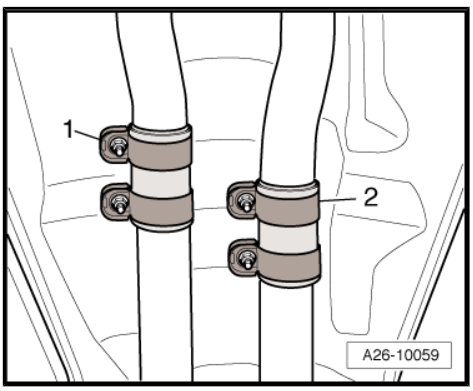
Component		Nm
Y-pipe to:	Front silencer	23 1)
	Catalytic converter	23 1)

• 1) Renew nuts.

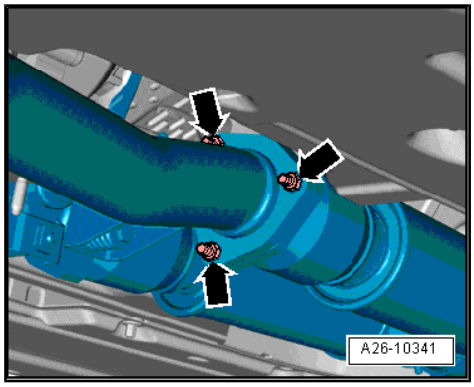
1.7 Removing and installing front silencer (left-side)

Removing

– Loosen clamp (left-side) -2- and move to rear.



– 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 216 .

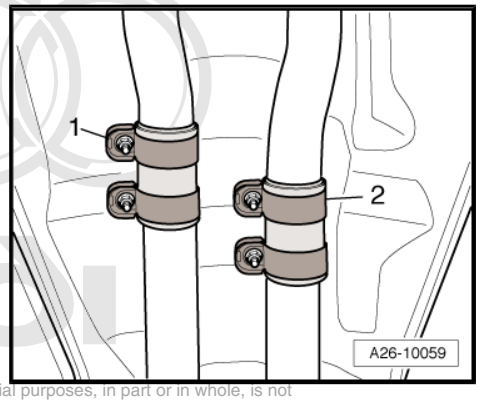
Tightening torque

Component	Nm
Front silencer to Y-pipe	23 1)
• 1) Renew nuts.	

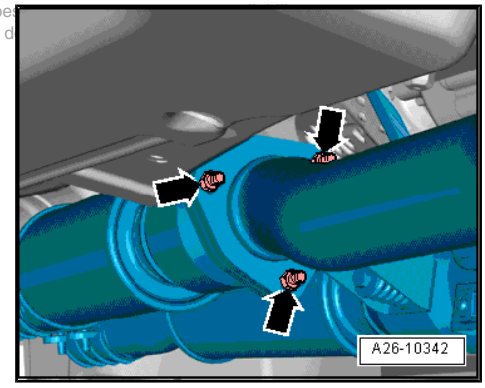
1.8 Removing and installing front silencer (right-side)

Removing

– Loosen clamp (right-side) -1- and move to rear.



– 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 216 .

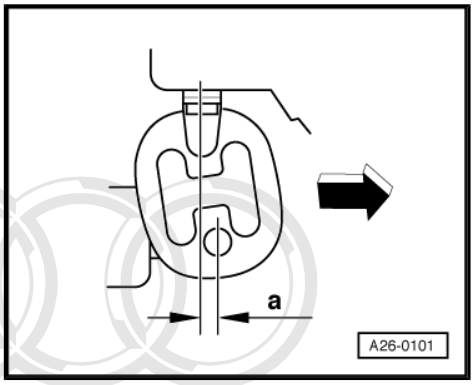
Tightening torque

Component	Nm
Front silencer to Y-pipe	23 1)
• 1) Renew nuts.	

1.9 Stress-free alignment of exhaust system

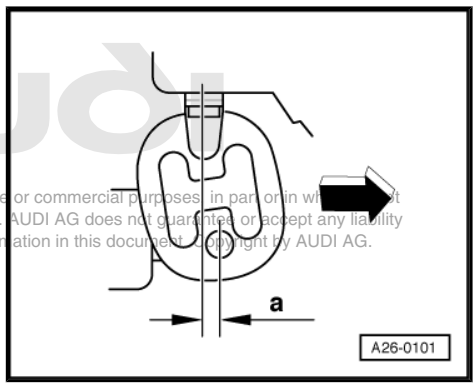
• The exhaust system must be aligned when it is cool.

Vehicles without clamps between centre silencer and rear silencer



- Loosen bolts for clamps ⇒ Item 2 (page 203) .
- Push exhaust system towards front of vehicle -arrow-, so that rubber mountings for rear silencers are preloaded by dimension -a- = 13 ... 17 mm.
- Tighten bolts on clamps evenly to 23 Nm.
- Align tailpipes ⇒ page 217 .

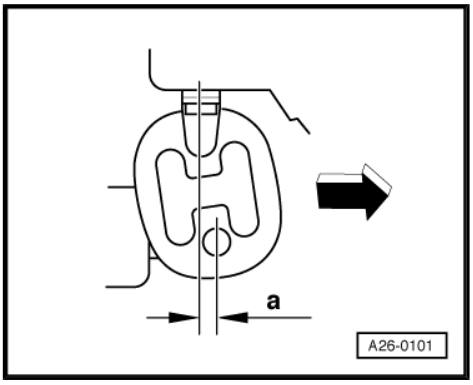
Vehicles with clamps between centre silencer and rear silencer



Note

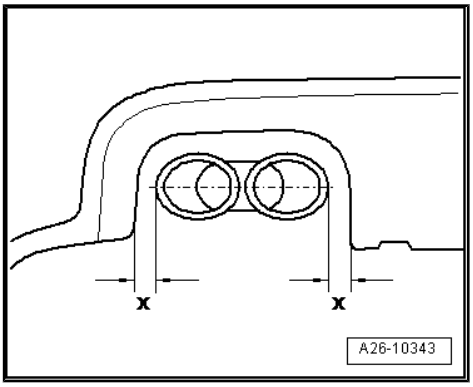
On vehicles with clamps fitted between centre silencer and rear silencer, it is also necessary to align the centre silencer.

- Loosen bolts on clamps ⇒ Item 2 (page 203) and ⇒ Item 8 (page 203) .
- Push front section of exhaust system towards front of vehicle -arrow- so that rubber mountings for centre silencer are preloaded by dimension -a- = 9 ... 13 mm.
- Tighten bolts on front clamps evenly to 23 Nm.



- Push rear section of exhaust system towards front of vehicle -arrow- until rear mountings for rear silencer are preloaded by dimension -a- = 13 ... 17 mm.
- Align rear silencers horizontally.
- Tighten bolts on rear clamps evenly to 23 Nm.
- Align tailpipes ⇒ page 217 .

Aligning tailpipes

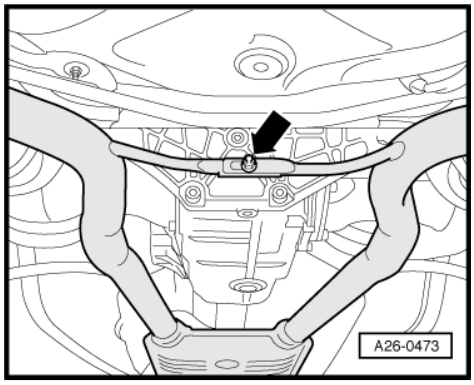


- Check clearance between tailpipes (left and right) and bumper cover:

• Dimension -x- (left-side) = dimension -x- (right-side)

If necessary, correct dimension “x” as follows:

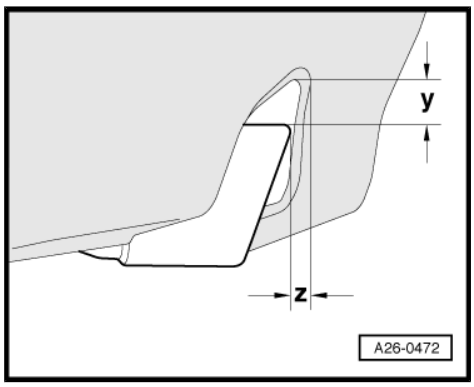
– Slacken bolt connection -arrow- on brace between exhaust pipes.
– Adjust the distance between the rear silencers.
– Tighten bolt connection to 23 Nm.



– Check distances -y- and -z- between tailpipes and bumper cover:

• Dimension -y- = 18.5 ... 23.0 mm.
• Dimension -z- Saloon = 5.5 ... 10.5 mm.
• Dimension -z- Avant = 11.5 ... 16.5 mm.

– If necessary, check whether the exhaust system is aligned free of stress ⇒ page 216 .



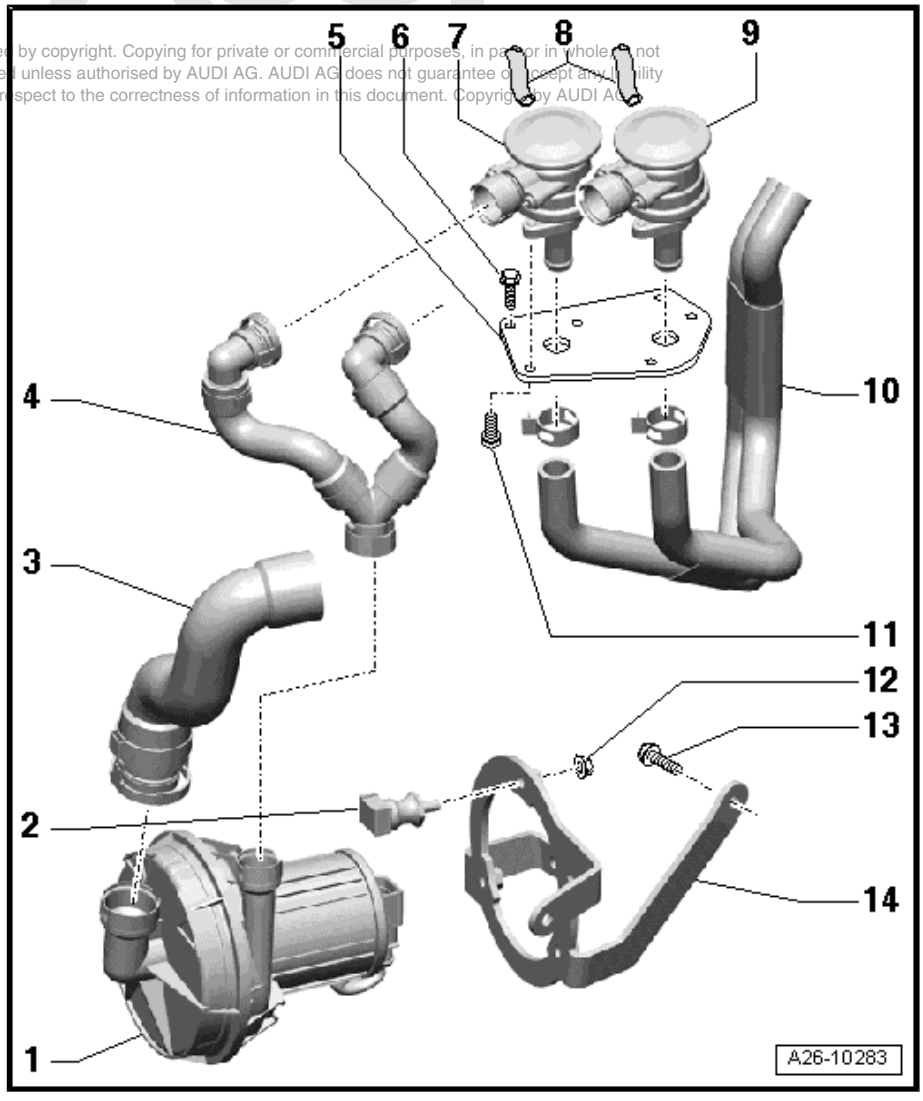
2 Secondary air system

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 - Secondary air pump motor -V101-

- ❑ Fitting location: At front right in engine compartment below longitudinal member
- ❑ Removing and installing ⇒ page 220
- ❑ Checking in “Guided Fault Finding” ⇒ Vehicle diagnosis, testing and information system VAS 5051

2 - Bonded rubber mounting

3 - Air hose

- ❑ From air cleaner

4 - Air hose

- ❑ Between secondary air pump motor -V101- and combination valves for secondary air system

5 - Mounting bracket

6 - 9 Nm

7 - Combination valve for secondary air system

- ❑ Fitting location: front left of engine compartment
- ❑ Checking ⇒ page 221
- ❑ Removing and installing ⇒ page 222

8 - Vacuum hoses

9 - Combination valve for sec-

ondary air system

- ❑ Fitting location: front left of engine compartment
- ❑ Checking ⇒ page 221
- ❑ Removing and installing ⇒ page 222

10 - Air hose

- ❑ To engine

11 - 9 Nm

12 - 9 Nm

13 - 9 Nm

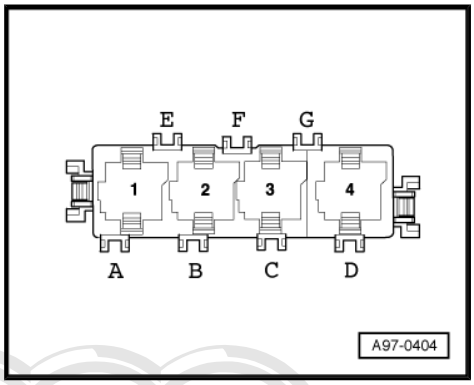
14 - Mounting bracket

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)



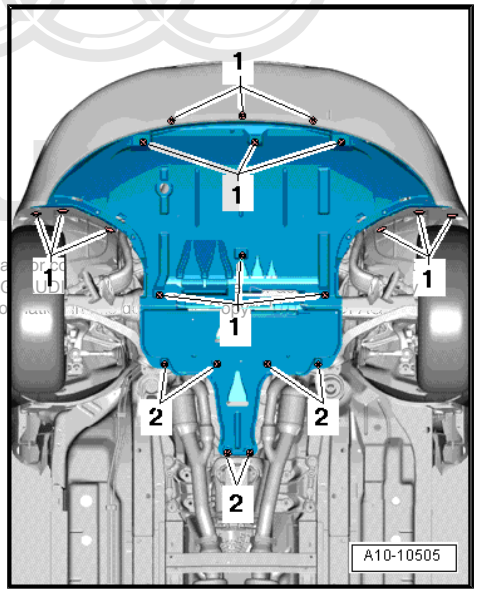
2.3 Removing and installing secondary air pump

Removing

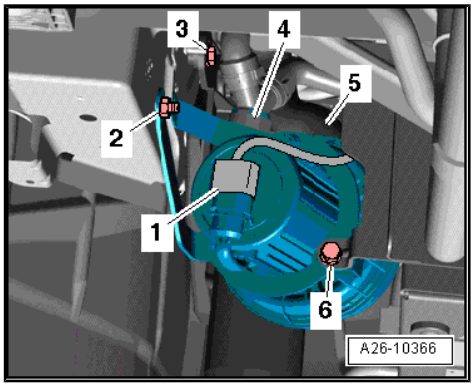
Note

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

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



– Unplug electrical connector -1-.
– Detach air hoses -4- and -5- at secondary air pump by pressing release tabs.
– Remove nut and bolts -2, 3, 6- and take out secondary air pump.



Installing

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

Note

Fit all cable ties in the original positions when installing.

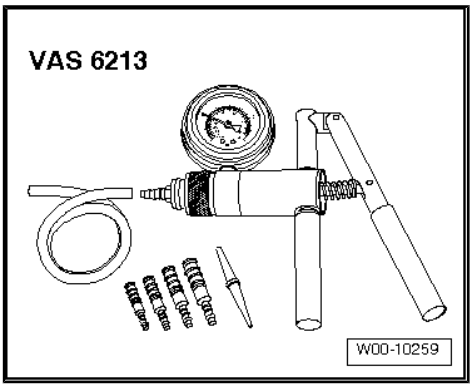
Tightening torques

Component	Nm
Secondary air pump to bracket	9
Secondary air pump bracket to body	9

2.4 Checking combination valves for secondary air system for correct operation and leakage

Special tools and workshop equipment required

♦ Hand-operated vacuum pump -VAS 6213-



Procedure

- No leaks in hose connections.

– Remove relevant combination valve for secondary air ⇒ page 222 .

– Connect the hand-operated vacuum pump -VAS 6213- to vacuum connection -1- of combination valve for secondary air.

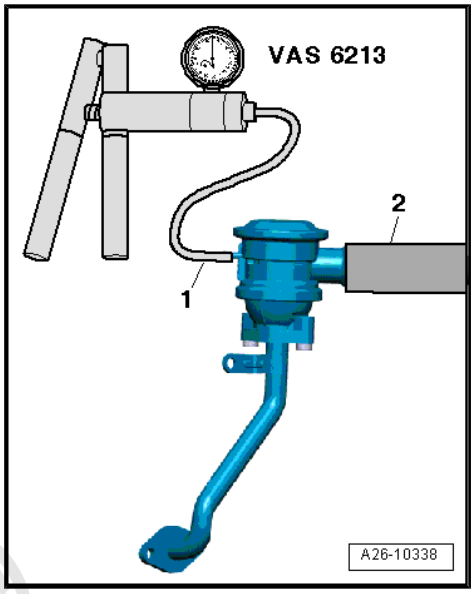
– Connect suitable test hose -2- to combination valve for secondary air.

– 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 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:

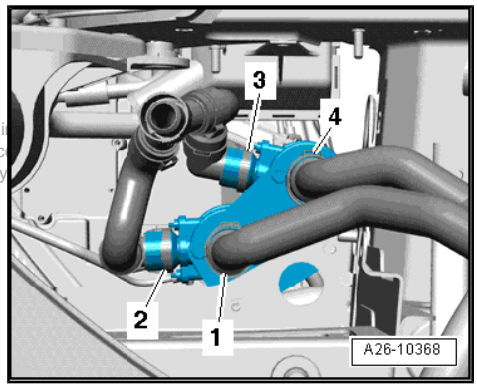
– Renew relevant secondary air combination valve ⇒ page 222 .

2.5 Removing and installing combination valves for secondary air system

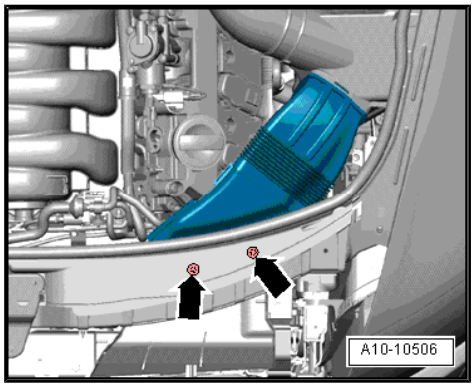
Removing

– Remove secondary air pump ⇒ page 220 .

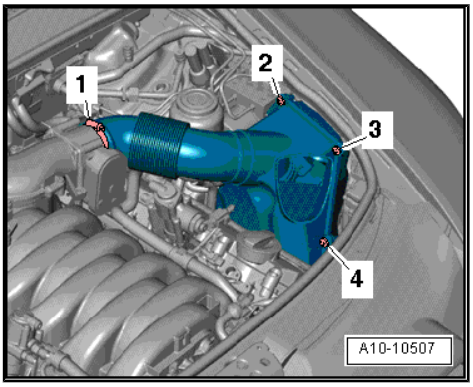
– Detach air hoses -1 ... 4- from combination valves for secondary air system.



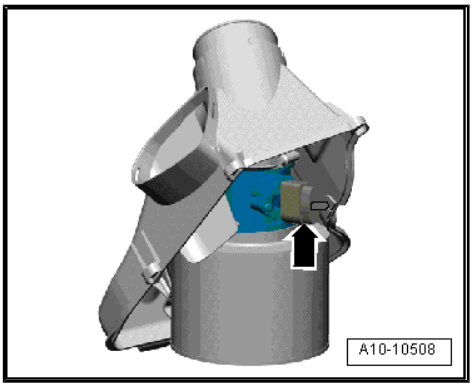
– Remove bolts -arrows- and remove air duct (left-side).



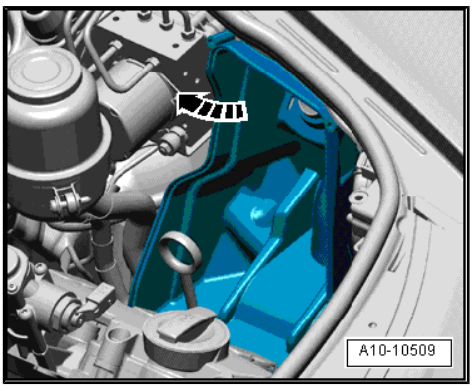
– Loosen hose clip -1- and remove bolts -2, 3, 4-.
– Remove top section of air cleaner (left-side).



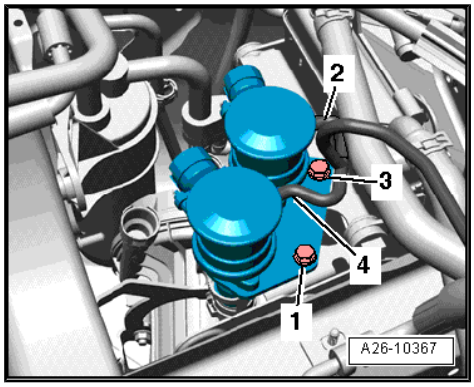
– Unplug electrical connector -arrow- at air mass meter 2 - G246- .



– Pull bottom section of air cleaner away from connection on side.
– Pivot bottom section of air cleaner upwards -arrow- and remove.



– Detach vacuum hoses -2- and -4- from combination valves for secondary air system.
– Unscrew bolts -1- and -3- and detach bracket with combination valves for secondary air system.
– Unscrew relevant combination valve for secondary air system from bracket.



Installing

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

Note

Renew seals and gaskets.

– Install secondary air pump ⇒ page 220 .
– Install air cleaner housing (left-side) ⇒ Rep. Gr. 24 .

Tightening torques

Component	Nm
Combination valve for secondary air to bracket	9
Bracket for combination valves for secondary air system to auxiliary radiator	9