

Workshop Manual Audi A3 2004 ➤

4-cylinder injection engine (1.6 ltr. 2-valve), mechanics

Engine ID	BGU	BSE	BSF	CCS A	CMX A				
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Edition 08.2010



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List of Workshop Manual Repair Groups

Repair Group

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



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

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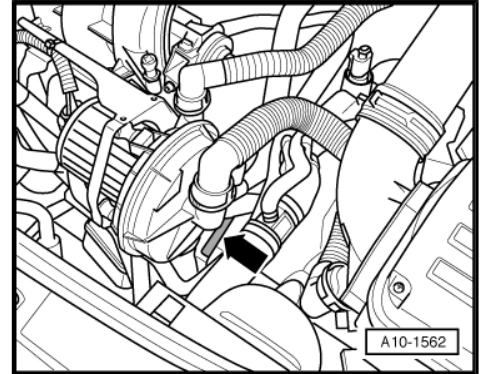
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00 – Technical data

1 Engine number

- ◆ The engine number („Engine code“ and „Serial number“) can be found at the joint between engine and gearbox -arrow-.
- ◆ Additionally there is a sticker on the toothed belt cover showing the „engine code“ and „serial number“.
- ◆ Starting with the letter „C“, the engine codes consist of 4 letters.
- ◆ The first 3 characters of the engine code stand for the engine capacity and the mechanical construction and design. They are stamped on the cylinder block, together with the serial number.
- ◆ The 4th character indicates the power output and torque of the engine, and is determined by the engine control unit.



Note

- ◆ *The 4-character engine code can be found on the type plate (in versions for some countries only) and on the vehicle data sticker and the engine control unit.*
- ◆ *Fitting locations of the type plate (certain countries only) and the vehicle data sticker ⇒ Maintenance ; Booklet 808 .*



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2 Engine data

Code letters		BGU	BSE	BSF
Capacity	ltr.	1.595	1.595	1.595
Power output	kW at rpm	75/5600	75/5600	75/5600
Torque	Nm at rpm	148/3800	148/3800	148/3800
Bore	Ø mm	81.0	81.0	81.0
Stroke	mm	77.4	77.4	77.4
Compression ratio		10.3	10.3	10.3
RON	at least	95 ¹⁾	95 ¹⁾	95 ¹⁾
Injection/ignition system		Simos	Simos	Simos
Firing order		1-3-4-2	1-3-4-2	1-3-4-2
Emission standards		EU 4	EU 4	EU 2
Exhaust gas recirculation		yes	no	no
Turbocharging/supercharging		no	no	no
Knock control		1 sensor	1 sensor	1 sensor
Lambda control		2 probes	2 probes	2 probes
Variable valve timing		no	no	no
Intake manifold change-over		yes	yes	yes
Secondary air system		yes	yes	no
Valves per cylinder		2	2	2

• ¹⁾ Unleaded regular grade petrol (RON 91) can also be used, but this will result in a loss of power

Code letters		CCSA	CMXA
Capacity	ltr.	1.595	1.595
Power output	kW at rpm	75/5600	75/5600
Torque	Nm at rpm	148/3800	148/3800
Bore	Ø mm	81.0	81.0
Stroke	mm	77.4	77.4
Compression ratio		10.3	10.3
RON	at least	95 ¹⁾ , E85 ²⁾	95 ¹⁾ , E85 ²⁾
Injection/ignition system		Simos	Simos
Firing order		1-3-4-2	1-3-4-2
Emission standards		EU 4	EU 5
Exhaust gas recirculation		no	no
Turbocharging/supercharging		no	no
Knock control		1 sensor	1 sensor
Lambda control		2 probes	2 probes
Variable valve timing		no	no
Intake manifold change-over		yes	yes
Secondary air system		yes	yes
Valves per cylinder		2	2

• ¹⁾ Unleaded regular grade petrol (RON 91) can also be used, but this will result in a loss of power

• ²⁾ Fuel with max. 85% bioethanol can be used

3 Safety precautions

When working on the fuel system note the following warnings:



WARNING

Risk of injury - fuel system operates under high pressure.

- ◆ *Wrap a clean cloth around the connection and carefully loosen the connection to release the fuel pressure.*

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To avoid any risk of injuries to persons and/or damage to the fuel injection and ignition system, always observe the following safety precautions.

- ◆ Always switch off the ignition before connecting or disconnecting electrical wiring for the injection or ignition system or tester cables.
- ◆ Always switch off ignition before washing engine.
- ◆ Faults are stored in engine control unit if electrical connectors were unplugged and engine was started: „Generate readiness code“ in „Guided Functions“ ⇒ Vehicle diagnostic, testing and information system VAS 5051.



Caution

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

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

– Disconnect battery ⇒ Rep. gr. 27 .

When working on the cooling system note the following warnings:



WARNING

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

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

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

**WARNING**

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

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

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

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4 General repair instructions

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

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

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

4.2 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.

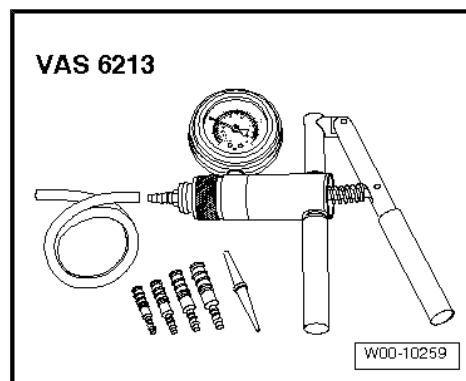
4.3 Installing radiators and condensers

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.

4.4 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 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 hand vacuum pump -VAS 6213- or if the pressure drops again immediately, check hand vacuum pump and connecting hoses for leaks.

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.



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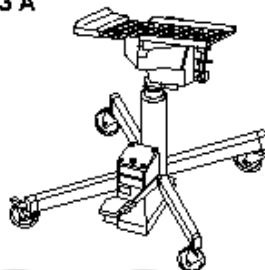
10 – Removing and installing engine

1 Removing engine

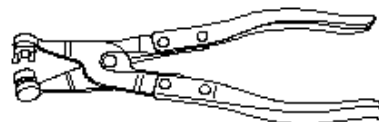
Special tools and workshop equipment required

- ◆ Engine and gearbox jack - V.A.G 1383 A-
- ◆ Hose clip pliers -V.A.G 1921-
- ◆ Stepladder -VAS 5085-
- ◆ Drip tray for workshop hoist -VAS 6208-
- ◆ Engine bracket -T10012-

V.A.G 1383 A



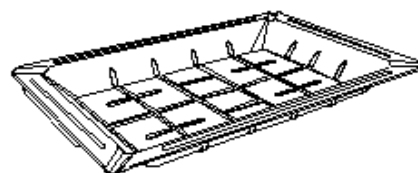
V.A.G 1921



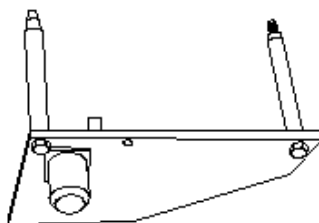
VAS 5085



VAS 6208



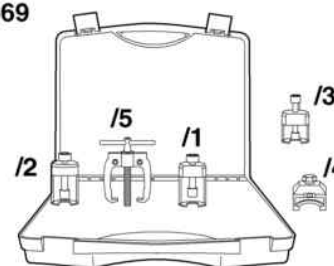
T 10012



G10-10004

- ◆ Tool set for wiper arms -T10369-

T10369



W00-10632

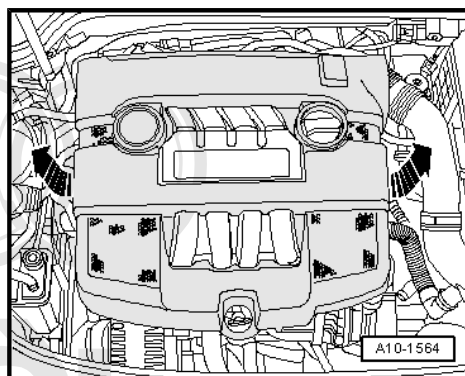
Procedure



Note

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

- Remove engine cover panel -arrows-.



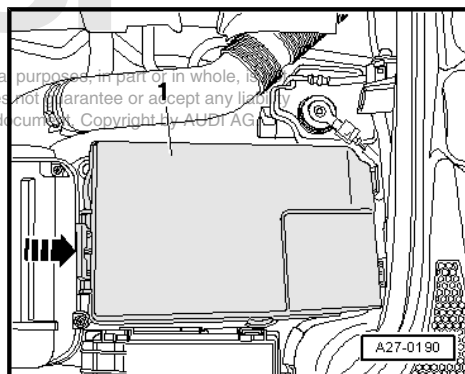
- Remove cover -1- over battery. To do so, press release tab -arrow-.



Caution

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

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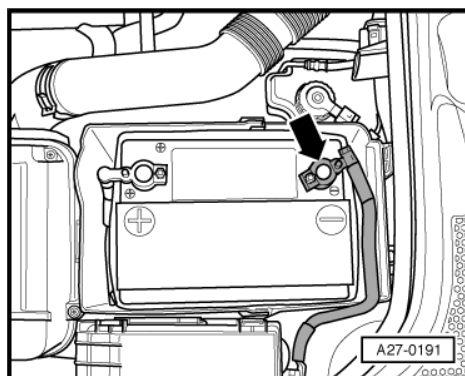


- With ignition switched off, disconnect battery earth cable -arrow-.



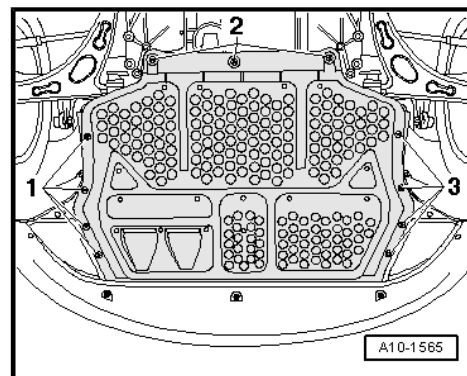
WARNING

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

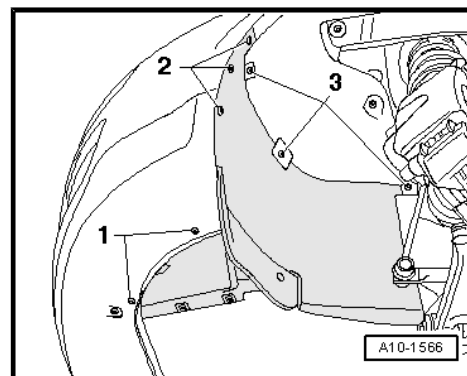


- Open filler cap on coolant expansion tank.

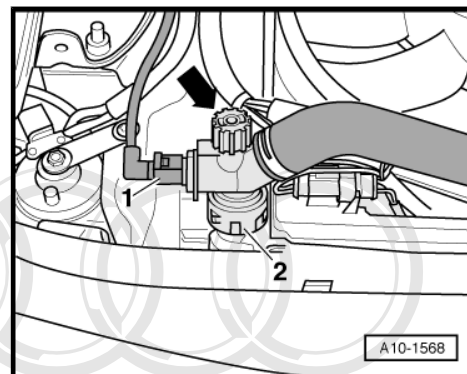
- Remove both front wheels.
- Remove centre noise insulation -fasteners 1 ... 3-.



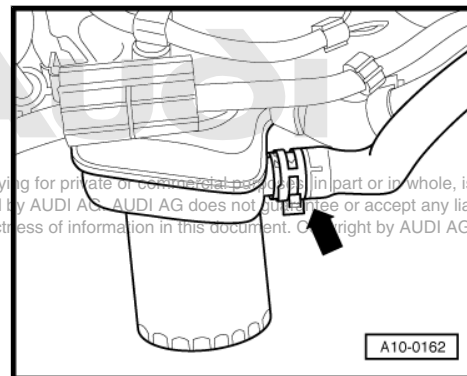
- Remove noise insulation (left and right) -fasteners 1 ... 3-.



- Unplug electrical connector -1- at radiator outlet coolant temperature sender -G83- .
- Place drip tray for workshop hoist -VAS 6208- under engine.
- Turn drain plug -arrow- on radiator anti-clockwise, if necessary fit drain hose to connection.
- Disconnect coolant hose -2- (bottom) from radiator (pull out retaining clip).

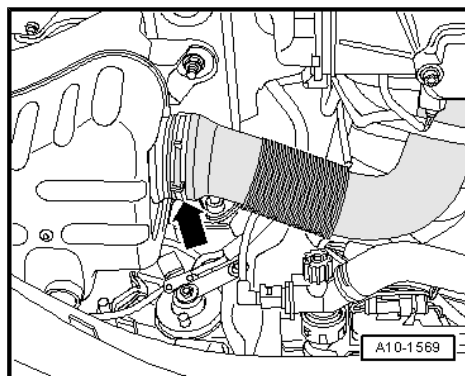


- Also disconnect coolant hose at bottom of oil cooler -arrow-, and drain off remaining coolant.

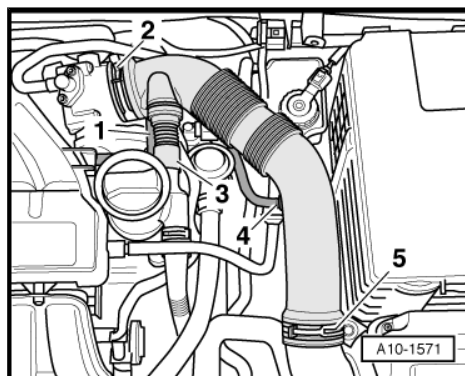


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- Disconnect air hose -arrow- at bottom of resonator.

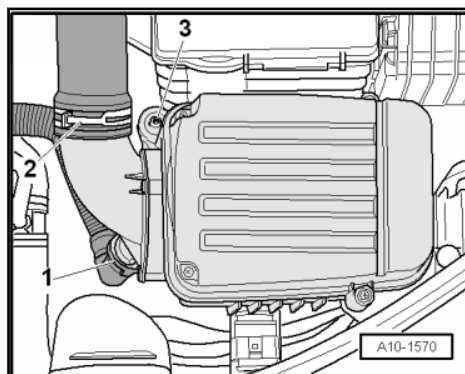


- Detach hoses -1-, -3- and -4-.
- Release spring-type hose clips -2- and -5- and remove air hose.

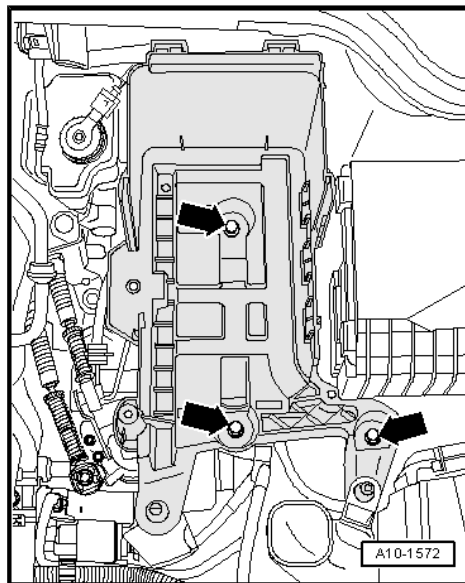


- Disconnect hoses -1- and -2- from air cleaner housing.
- Remove bolt -3-.
- Take out air cleaner housing.
- Disconnect air intake hose between resonator and lock carrier and take out.

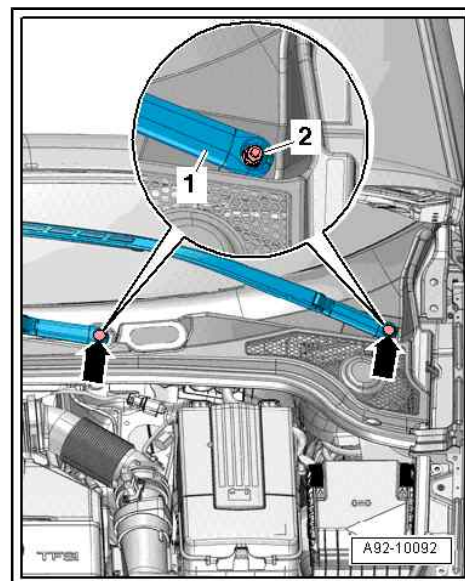
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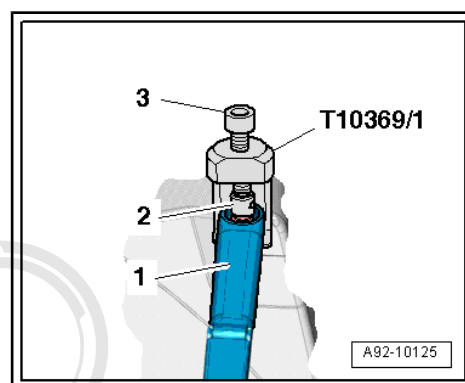
- Remove battery ⇒ Rep. gr. 27 .
- Unclip front section of trim for battery.
- Remove battery tray -arrows-.
- Detach battery tray from front of air duct.



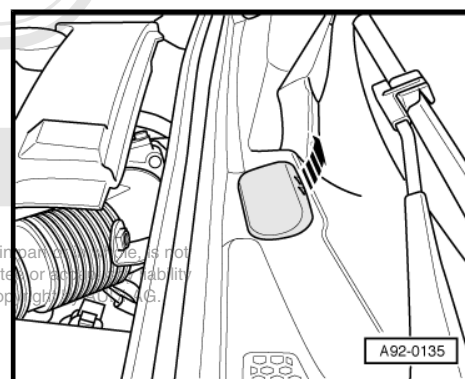
- Lever off caps -arrows- on wiper arms -1- with a screwdriver.
- Slacken nuts -2- one turn.



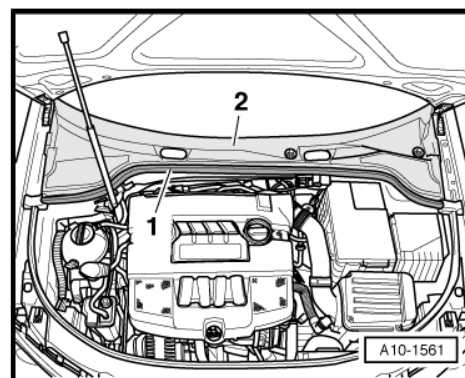
- Apply puller -T10369/1- to wiper arm -1-, as shown in illustration.
- Apply thrust piece -2- onto wiper shaft.
- Turn bolt -3- in clockwise direction until wiper arm is pulled off wiper shaft.
- Remove nuts and detach windscreen wiper arms.



- Unclip washer jets -arrow-.
- Push washer jets through assembly opening back into plenum chamber, leaving hoses connected.

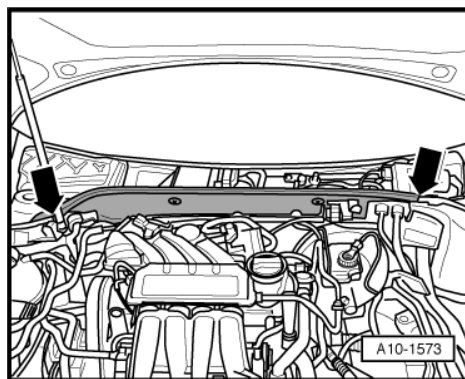


- Pull off rubber seal -1- on plenum chamber cover.
- Detach plenum chamber cover -2-.



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- Detach engine wiring harness at rear plenum chamber panel.
- Remove plenum chamber intermediate plate -arrows-.

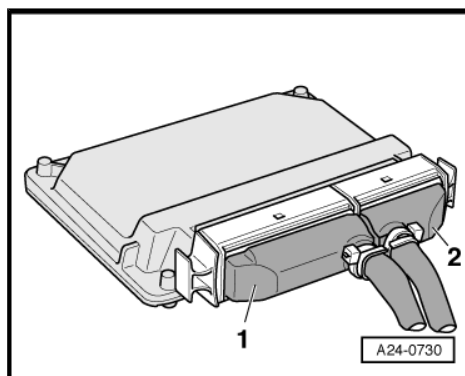


- Remove engine control unit ⇒ Rep. gr. 24 .
- Unplug engine wiring harness connector -2-.

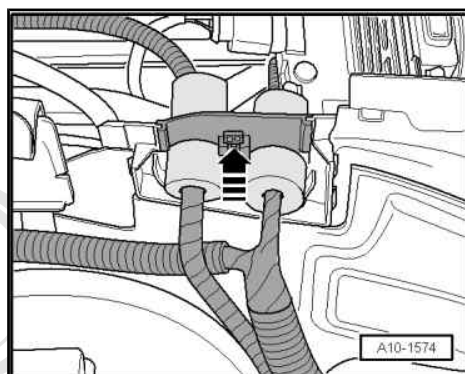


Note

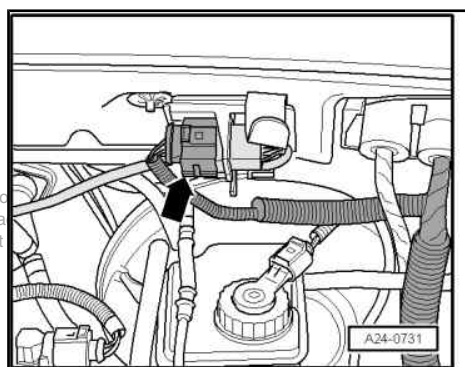
The electrical connector -1- remains connected.



- Release wiring protector for engine wiring harness -arrow- and lift off.

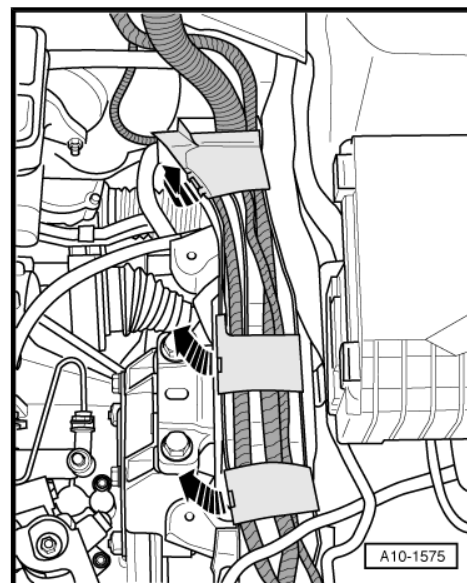


- Remove electrical connector -arrow- for Lambda probe -G39- (before catalytic converter) from bracket and unplug connector.

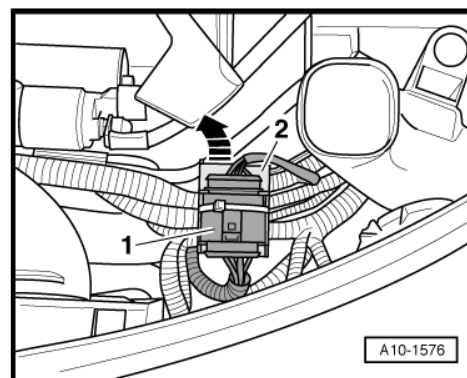


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- Open wiring duct brackets -arrows-.

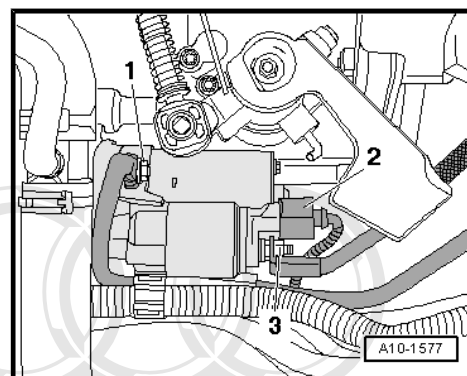


- Move electrical connector -1- clear and disconnect.
- Open wiring duct bracket located below -2-.
- Remove engine control unit wiring harness from wiring duct.

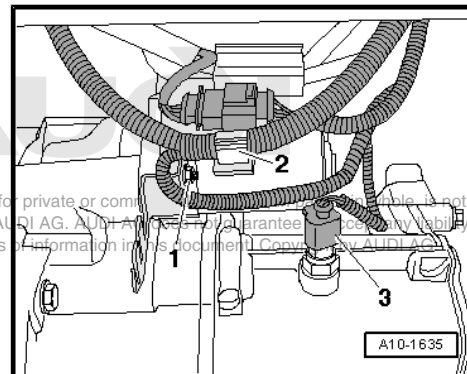


Vehicles with manual gearbox:

- Disconnect earth cable -1-.
- Disconnect wires -2- and -3- from starter.
- Move wiring clear.



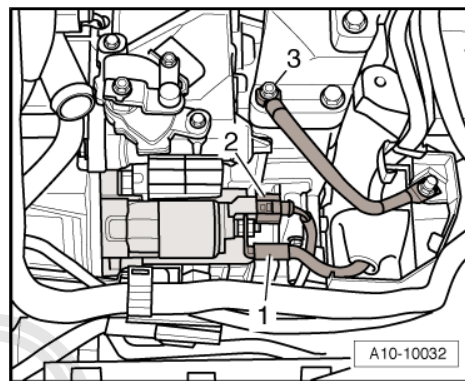
- Unplug electrical connector -3- for reversing light switch.
- Move engine wiring harness at bracket -2- clear.
- Unscrew nut -1- and remove bracket with wiring from stud.



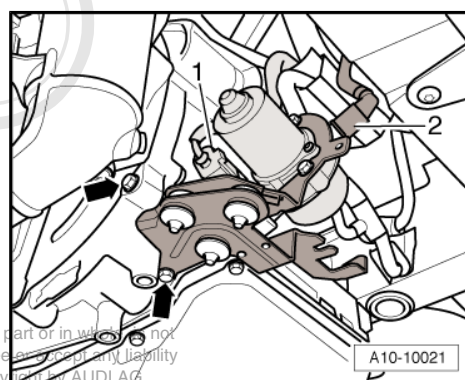
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Vehicles with automatic gearbox:

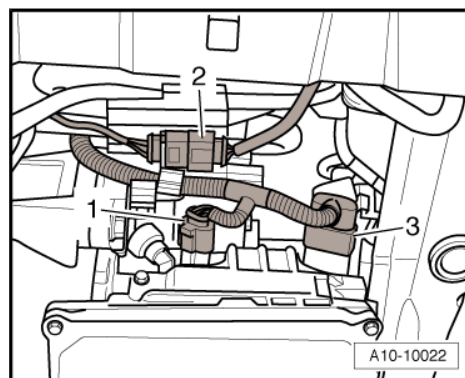
- Disconnect earth cable -3-.
- Disconnect wires -1- and -2- at starter and move wires clear.



- Unplug electrical connector -1-.
- Detach vacuum hose -2-.
- Unscrew bolts -arrows- and remove vacuum pump for brake servo.

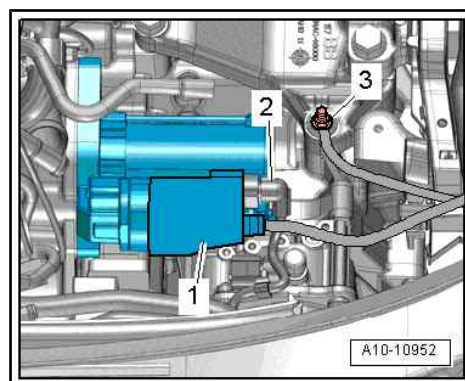


- Unplug electrical connectors -1- and -3- at automatic gearbox.
- Unplug electrical connector -2- and move electrical wire clear.



Vehicles with dual clutch gearbox:

- Unplug electrical connector -2-.
- Push back protective cover -1- and unscrew „B+“ cable at starter solenoid switch.
- Remove nut -3- for earth wire.

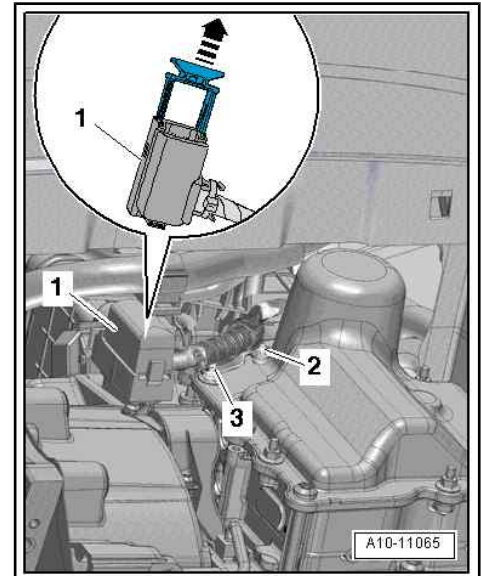


**Caution**

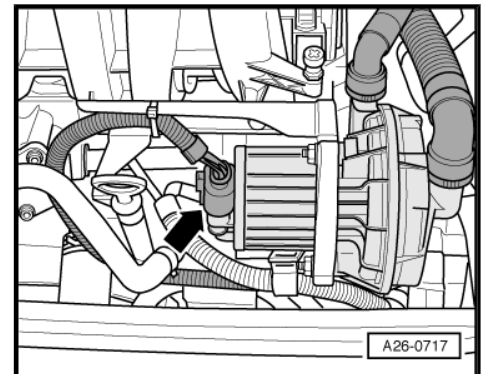
Risk of serious damage to gearbox components.

Do NOT touch connector contacts in gearbox connector with your hands as static discharge might damage the control unit and the mechatronic unit irreparably.

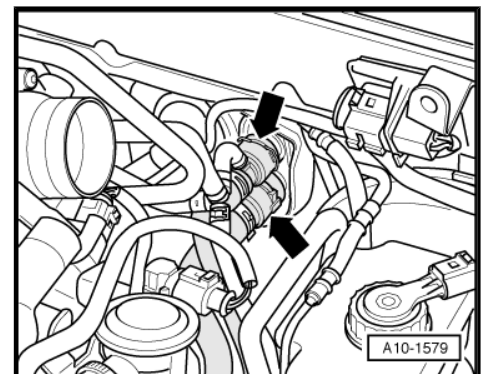
- Touch vehicle earth with bare hands to discharge any static charge.
- Pull locking device upwards -arrow- and unplug electrical connector -1- for mechatronic unit for dual clutch gearbox -J743-.
- Remove nuts -2- and -3- and detach bracket for electrical wiring from gearbox.

**All vehicles (continued):**

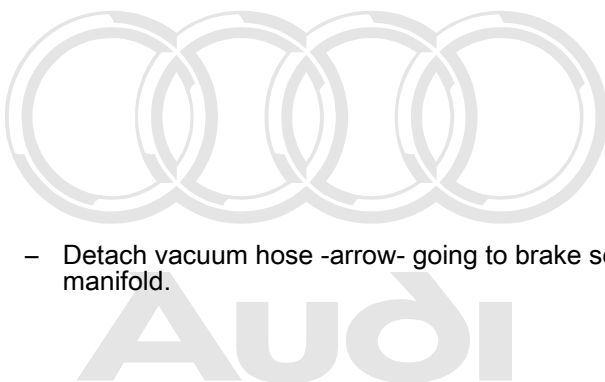
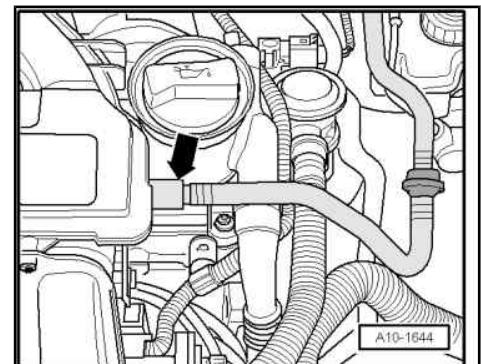
- If fitted, unplug electrical connector -arrow- at secondary air pump motor -V101-.
- Move wire clear.



- Detach coolant hoses going to heat exchanger at bulkhead -arrows-.



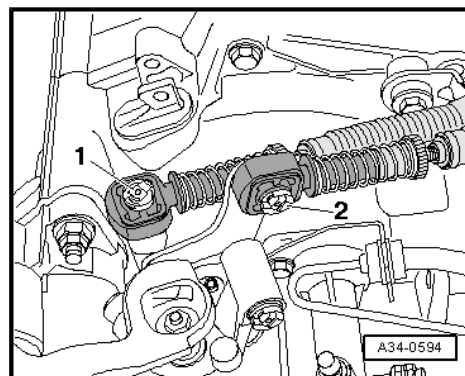
- Detach vacuum hose -arrow- going to brake servo at intake manifold.



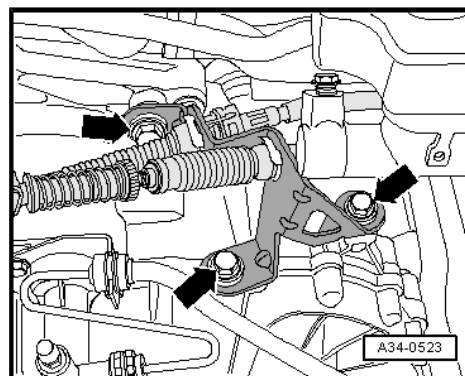
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Vehicles with manual gearbox:

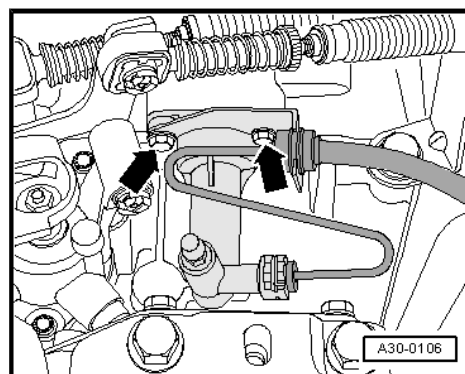
- Unclip securing clips -1- and -2- on both selector cables.
- Pull selector cable end-pieces with selector cables off selector shaft lever and relay lever.



- Detach cable support bracket from gearbox -arrows- and place to one side.



- Detach slave cylinder -arrows- and place to one side. Do not open pipes.

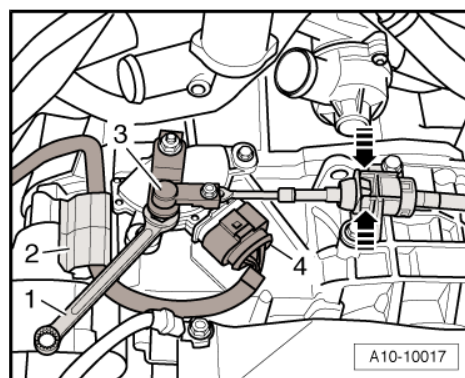


Caution

Do not press clutch pedal after removing slave cylinder.

Vehicles with automatic gearbox:

- Pry off selector lever cable -3- from lever for selector shaft using a 10 mm open-end spanner -item 1-, or similar.
- Compress retaining tabs on support bracket for selector lever cable -arrows- and pull selector lever cable out of support bracket on gearbox.
- Unplug electrical connector -4- and release electrical wiring at bracket -2-.



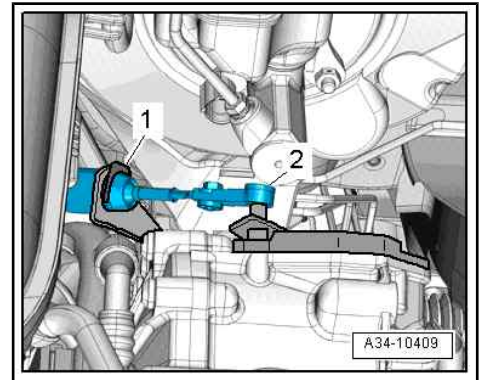
Vehicles with dual clutch gearbox:

- Use removal lever -80 - 200- to lever off selector lever cable -2- from selector shaft lever.
- Detach circlip -1- for selector lever cable.

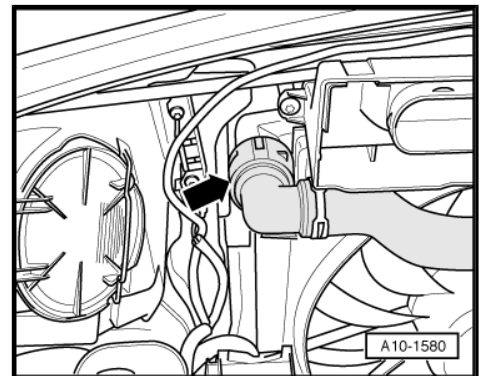
**Caution**

Avoid damage to the selector lever cable.

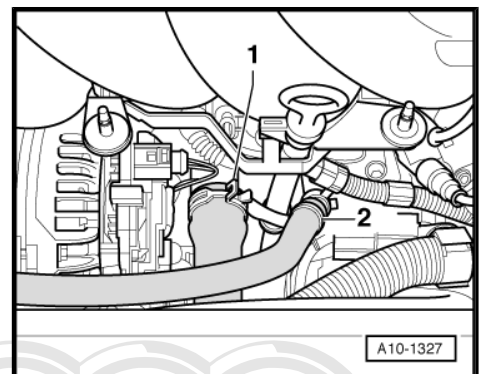
- ◆ **Carefully guide selector lever cable out of cable support bracket.**
- ◆ **Take care not to bend or kink selector lever cable.**

**All vehicles (continued):**

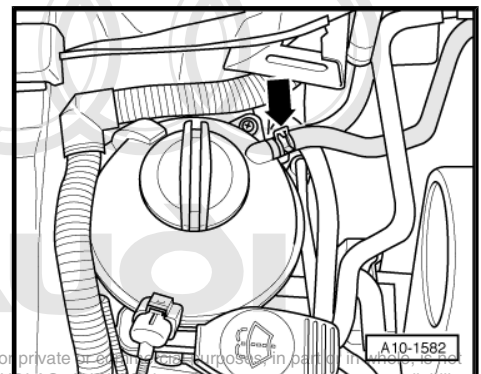
- Lift retaining clip and disconnect coolant hose -arrow- (top) from radiator.



- Detach coolant hoses -1- and -2-.



- Detach coolant hose -arrow- at expansion tank.



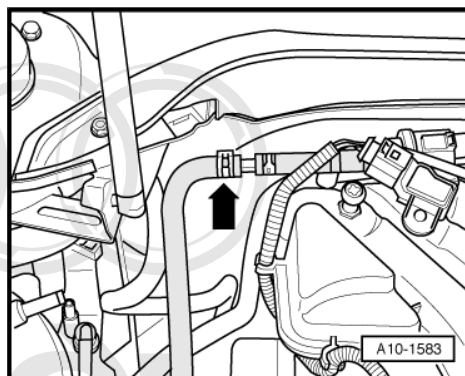
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- Disconnect vacuum hose going to activated charcoal filter at the position marked with an -arrow-.

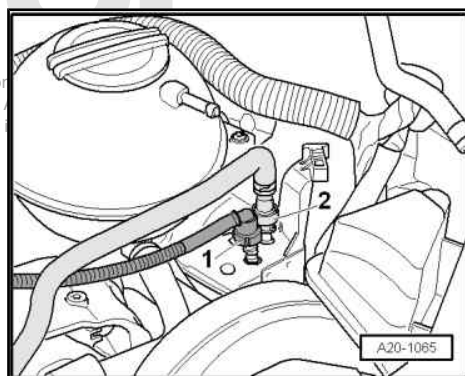


WARNING

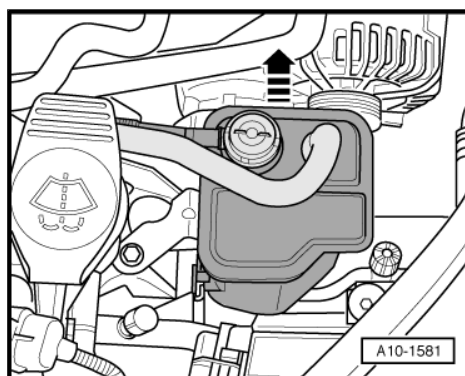
The fuel system is pressurised. Wrap a cloth around the connection before opening the system. Then release pressure by carefully loosening the connection.



- Disconnect fuel supply pipe -2- by pulling release tab.
- Disconnect vacuum line -1- going to activated charcoal filter (press release tab).



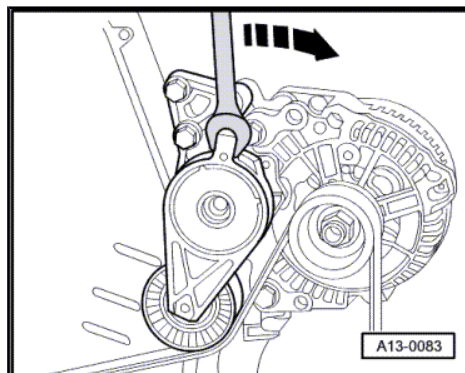
- Lift out activated charcoal filter from retainer with pipes connected -arrow-.



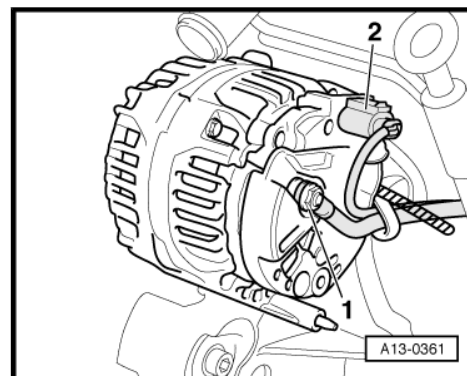
Note

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

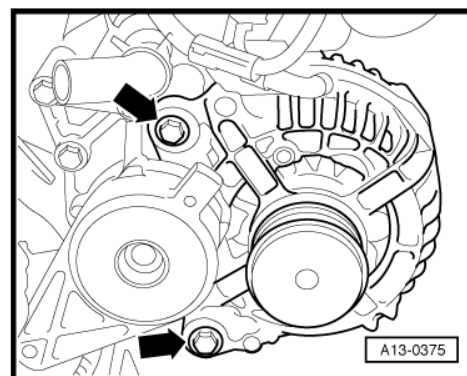
- To slacken the poly V-belt, turn the tensioner in the direction of the -arrow-.
- Lock the belt tensioner with an angled Allen key.
- Remove poly V-belt.



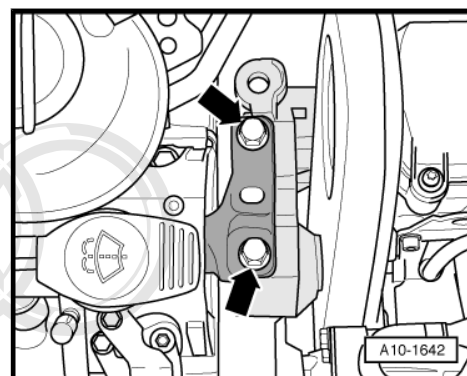
- Unplug electrical connector -2-.
- Unscrew wire -1- at alternator.
- Unbolt wiring clamp at alternator and move wiring clear.



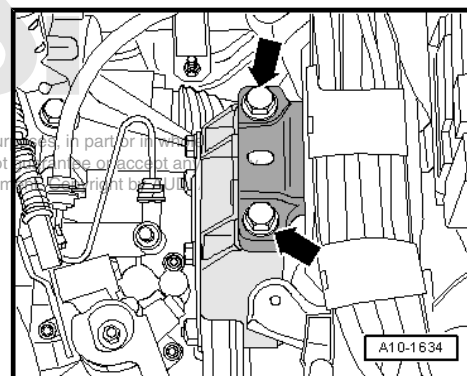
- Unscrew bolts -arrows- and remove alternator.



- Loosen bolts -arrows- of assembly mounting for engine approx. 2 turns.



- Loosen bolts -arrows- of assembly mounting for gearbox approx. 2 turns.



WARNING

The air conditioner refrigerant circuit must not be opened.

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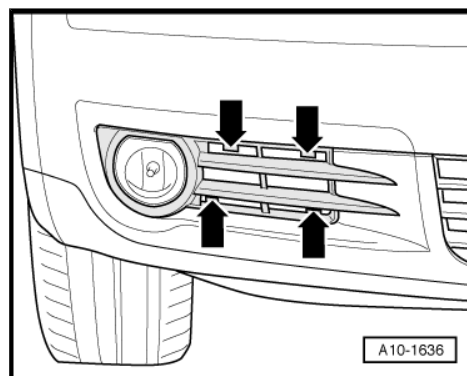
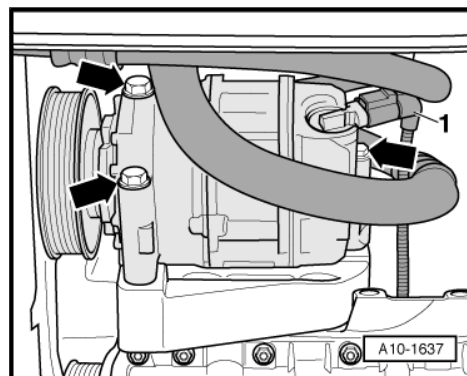
- Unplug electrical connector -1- for magnetic clutch of air conditioner compressor.
- Remove bolts -arrows- for air conditioner compressor.



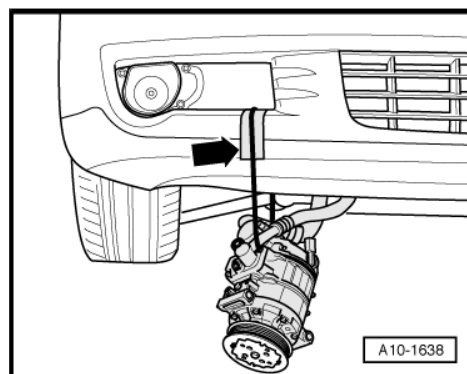
Note

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

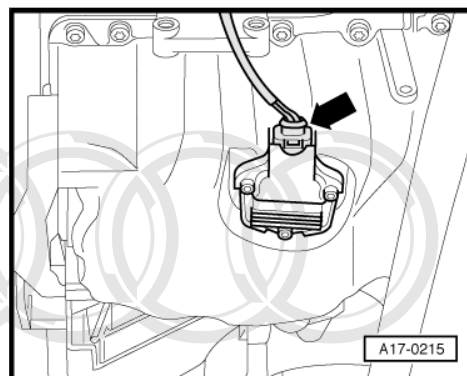
- Release retaining hooks -arrows- using a screwdriver and remove air intake grille from bottom of bumper.



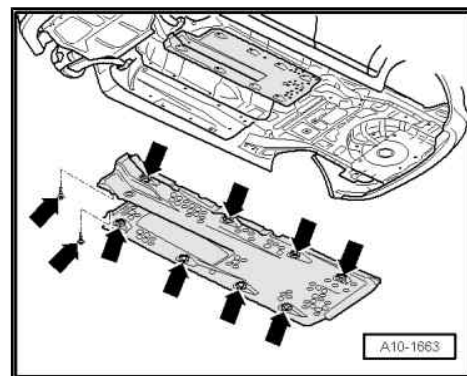
- Protect bumper from scratches using adhesive tape -arrow-.
- Tie up air conditioner compressor together with refrigerant hoses on bumper (refrigerant hoses remain connected).



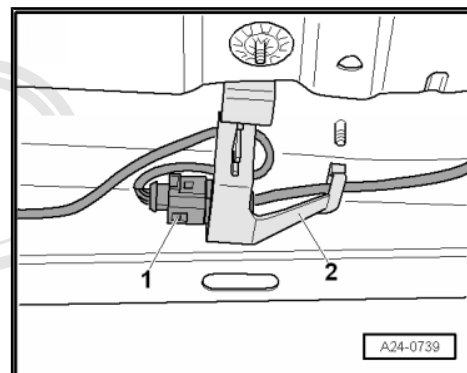
- Unplug electrical connector at oil level and oil temperature sender -G266- -arrow-.



- Remove underbody cover (right-side) -arrows-.



- Unplug electrical connector -1- for Lambda probe after catalytic converter -G130- .
- Remove the plug connector from the bracket -2- and move the Lambda probe wiring clear.



- Remove front cross-piece for underbody -arrows-.

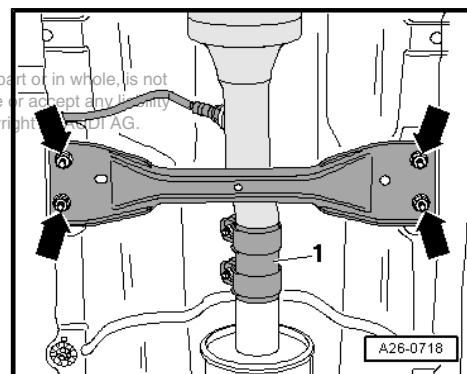


Note

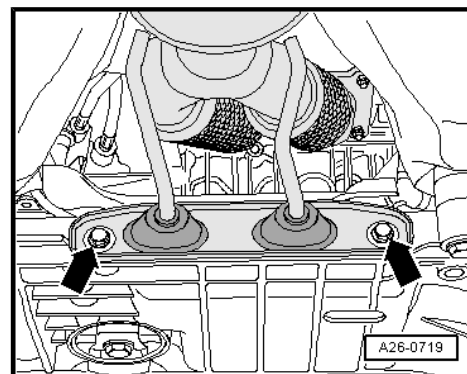
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To avoid damage, the flexible joints in the front exhaust pipe must not be bent more than 10°.

- Disconnect exhaust system at clamp -1-.

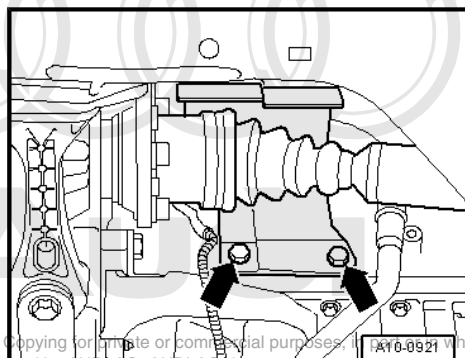


- Unbolt bracket for exhaust system -arrows-.



- Unbolt heat shield for drive shaft (right-side) -arrows-.

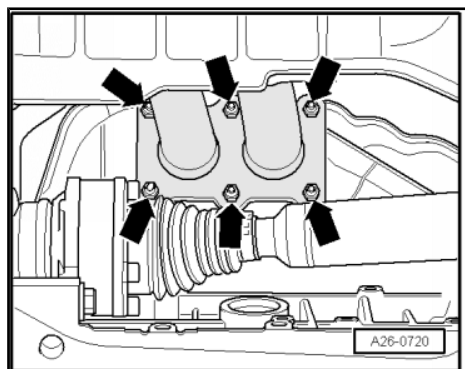
Vehicles with engine codes BGU, BSE, BSF, CCSA



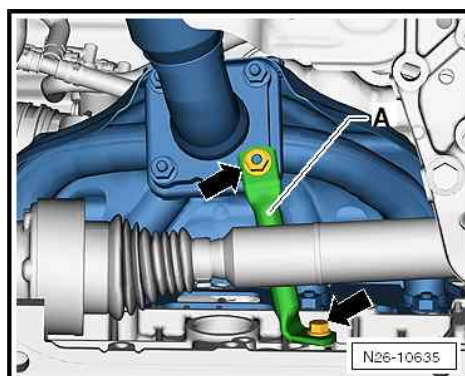
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- Remove securing nuts -arrows- on front exhaust pipe/exhaust manifold.

Vehicles with engine code CMXA



- Remove support -A-.



- Remove securing nuts -arrows- on front exhaust pipe/exhaust manifold.

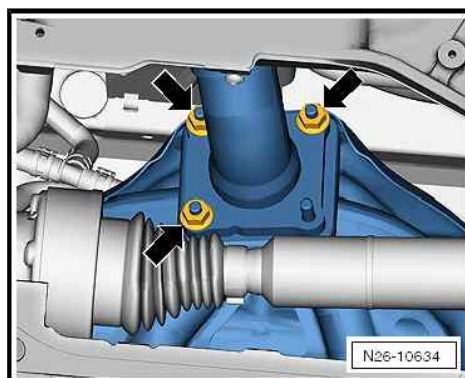
All models:

- Detach front exhaust pipe with catalytic converter.
- Unbolt drive shafts (left and right) from gearbox flanges.
- Tie up the left drive shaft.

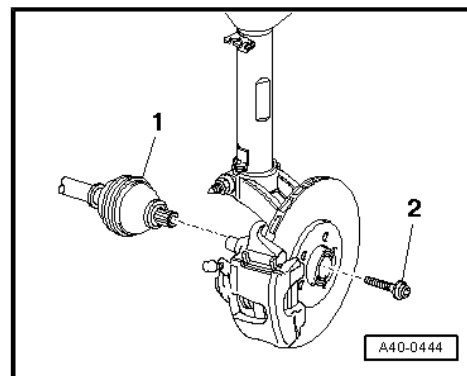


Caution

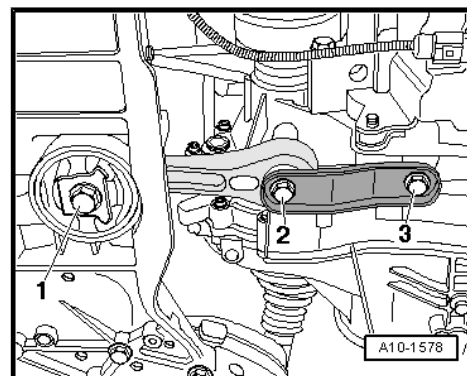
When slackening the flange bolt securing the drive shaft, the wheel bearing must not be under load (vehicle must not be standing on its wheels).



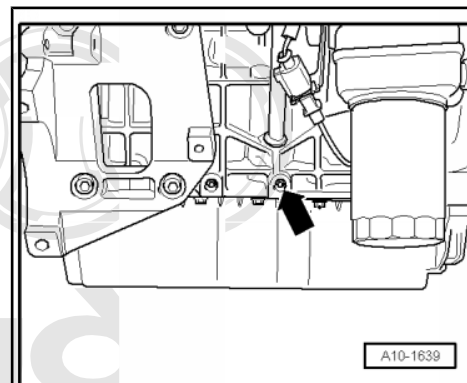
- Have a second mechanic press the brake pedal.
- Unscrew flange bolt -2- from drive shaft (right-side).
- Remove drive shaft (right-side).



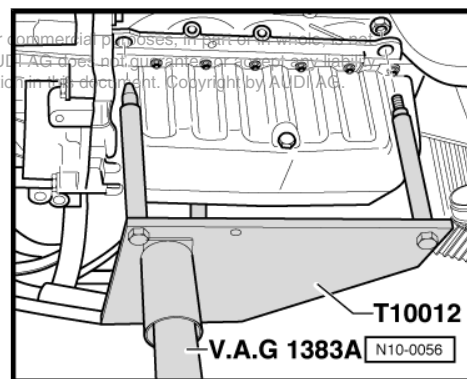
- Unscrew bolts -1 ... 3- and remove pendulum support.



- Unscrew sealing bolt -arrow- at front of cylinder block.



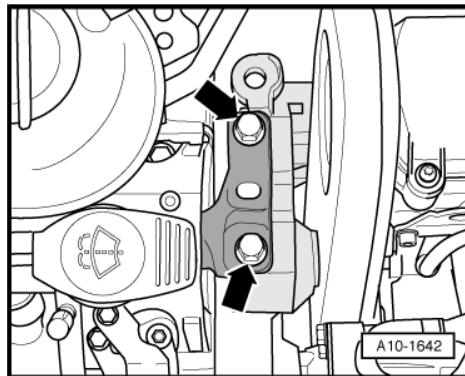
- Attach engine bracket -T10012- with securing nut and bolt to cylinder block: approx. 20 Nm.
- Insert engine and gearbox jack -V.A.G 1383 A- in engine bracket -T10012- and raise engine slightly.



**Note**

To unscrew bolts for assembly mounting use stepladder - VAS 5085-.

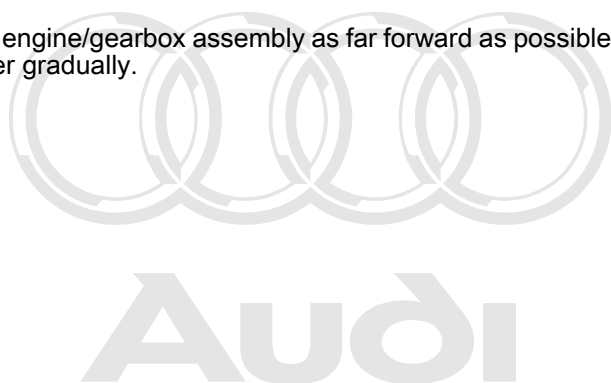
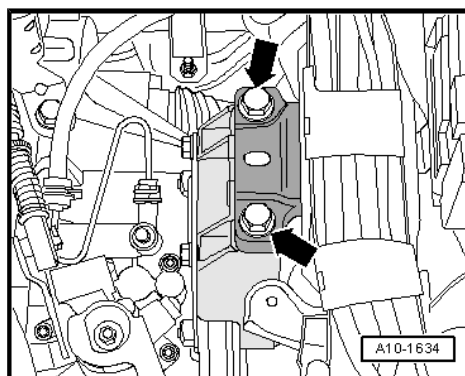
- Remove bolts -arrows- of assembly mounting on engine.



- Remove bolts -arrows- of assembly mounting for gearbox.

**Note**

- ◆ *Check that all hoses, pipes and wiring connections between engine, gearbox and body have been detached.*
- ◆ *Carefully guide engine/gearbox assembly when lowering to avoid damage.*
- Pull engine/gearbox assembly as far forward as possible, and lower gradually.

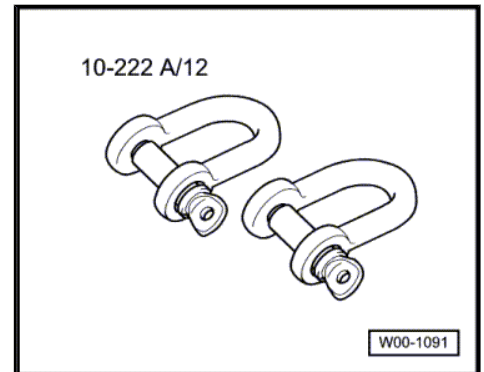


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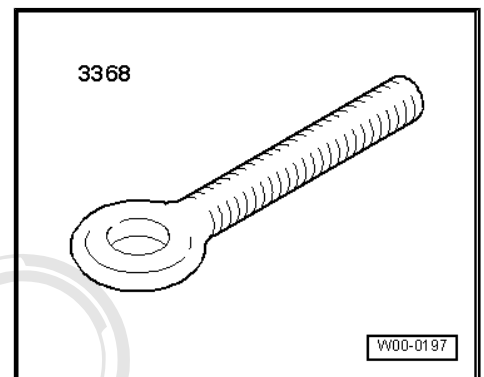
2 Separating engine and gearbox

Special tools and workshop equipment required

- ◆ Shackle -10 - 222 A /12- for vehicles with automatic gearbox and vehicles with dual clutch gearbox



- ◆ Eye-head bolt -3368- for vehicles with dual clutch gearbox



- ◆ Workshop hoist -VAS 6100- for vehicles with automatic gearbox and vehicles with dual clutch gearbox



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Procedure

- Engine/gearbox assembly removed and attached to engine bracket -T10012- .

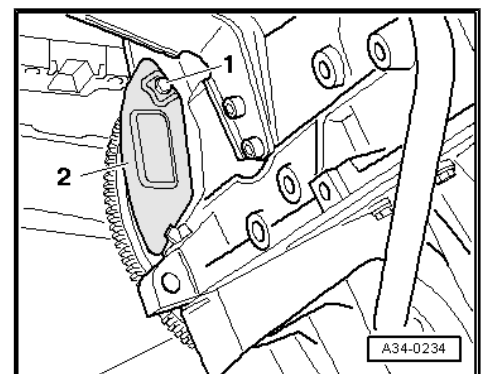
Vehicles with manual gearbox:

- Unscrew bolt -1- with gearbox installed.
- Pull up cover plate -2- and remove.



Note

Shown in illustration with gearbox removed.



- Remove bolts -1 ... 8- on engine/gearbox flange.
- Detach starter.



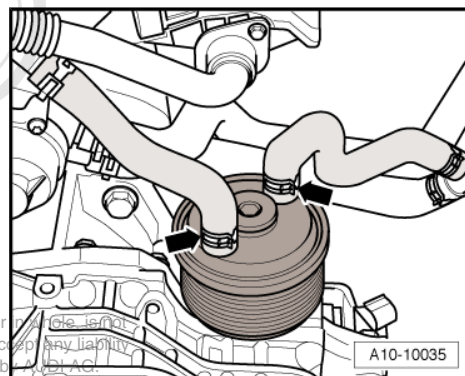
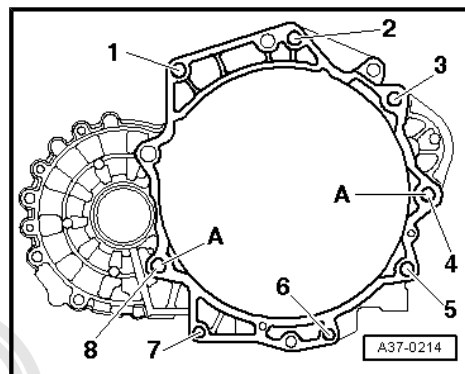
Note

The manual gearbox can be detached from the engine without a workshop hoist; a 2nd mechanic is required for this purpose.

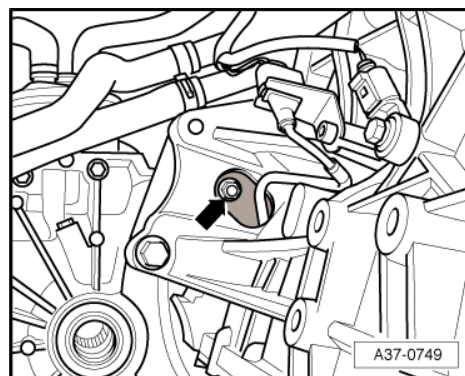
- Separate gearbox from engine.

Vehicles with automatic gearbox:

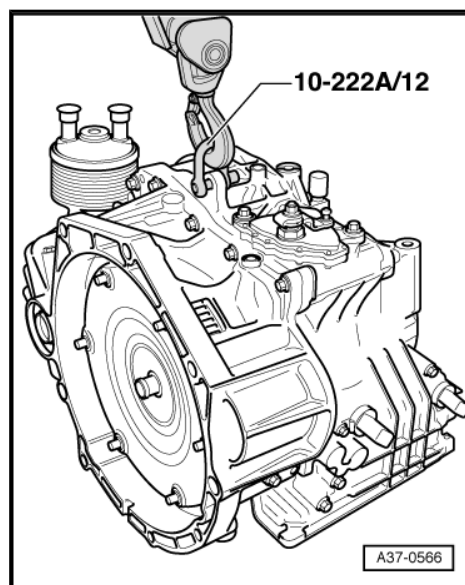
- Disconnect coolant hoses -arrows- at ATF cooler.



- Remove cover cap for torque converter nuts from cylinder block.
- Unscrew 6 nuts -arrow- for torque converter through opening in gearbox (turn crankshaft $\frac{1}{6}$ turn each time).



- Secure gearbox to workshop hoist -10 - 222 A /12- using shackle -VAS 6100- .



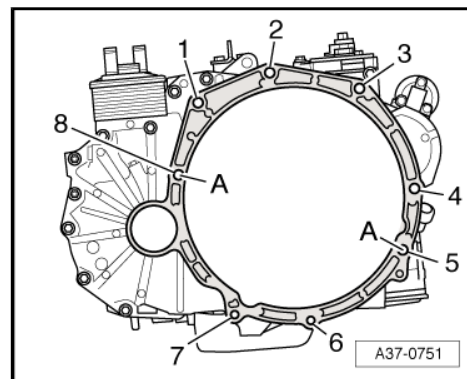
- Remove bolts -1 ... 8- on engine/gearbox flange.



Note

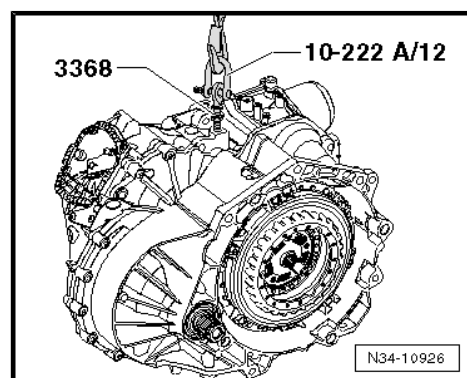
The starter remains installed.

- Separate gearbox from engine.

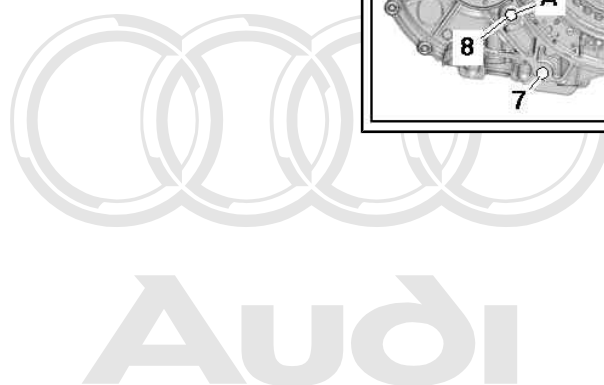
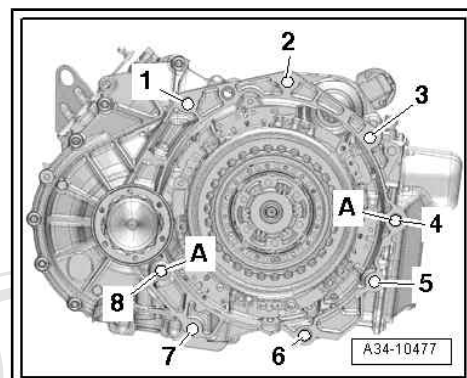


Vehicles with dual clutch gearbox:

- Screw eye-head bolt -3368- into threaded hole on top of gearbox housing as far as stop.
- Secure gearbox to workshop hoist -10 - 222 A /12- using shackle -VAS 6100- .



- Remove bolts -1 ... 8- on engine/gearbox flange.
- Separate gearbox from engine.

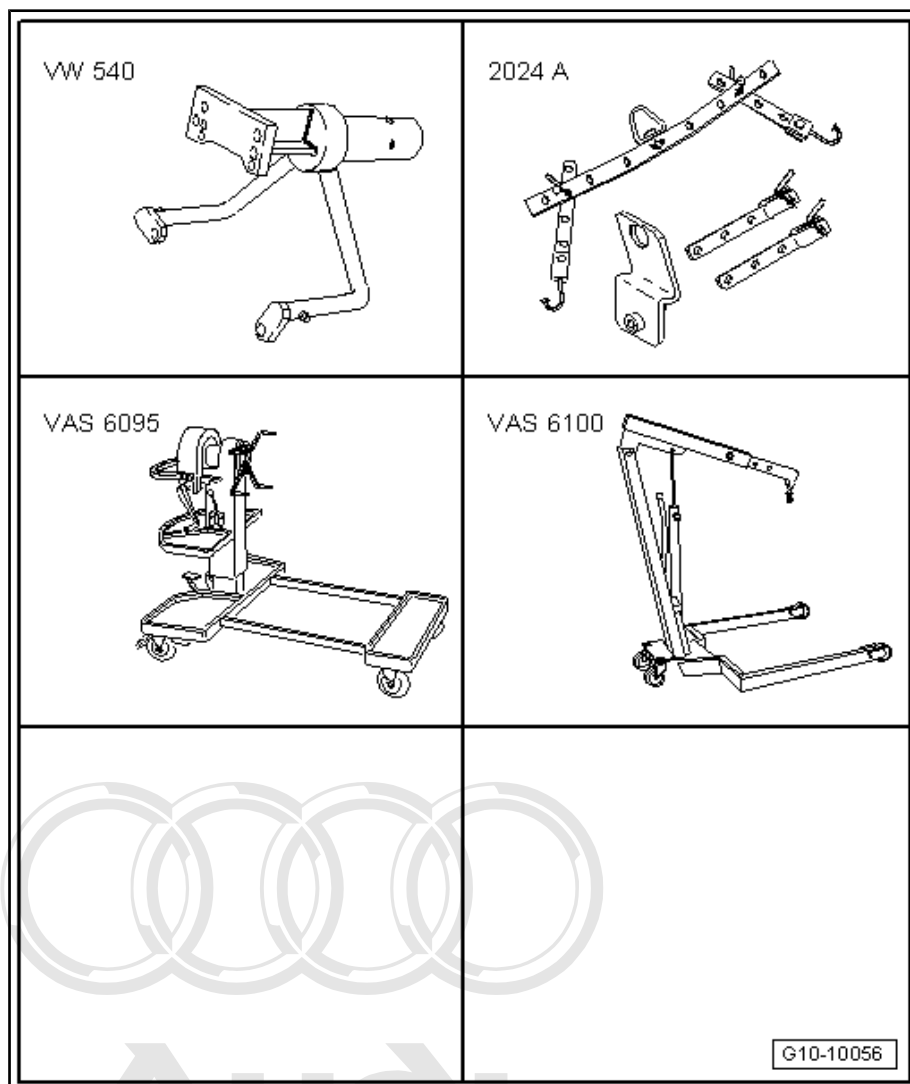


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3 Securing engine to engine and gearbox support

Special tools and workshop equipment required

- ◆ Engine and gearbox support -VW 540-
- ◆ Lifting tackle -2024 A-
- ◆ Engine and gearbox support -VAS 6095-
- ◆ Workshop hoist - VAS 6100-



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Procedure

- Gearbox detached from engine.
- Detach crankcase breather hose from oil filler neck.
- Engage lifting tackle -2024 A- on engine and workshop hoist -VAS 6100- .



Note

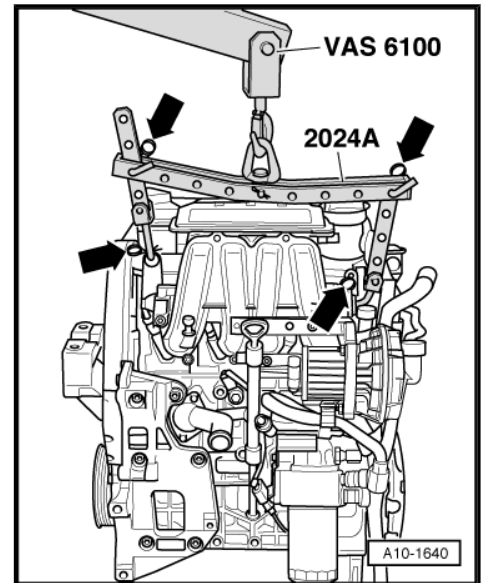
To adjust to the centre of gravity of the assembly, the perforated rails of the support hooks must be positioned as shown.



WARNING

Accident risk from loose components of support bracket.

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



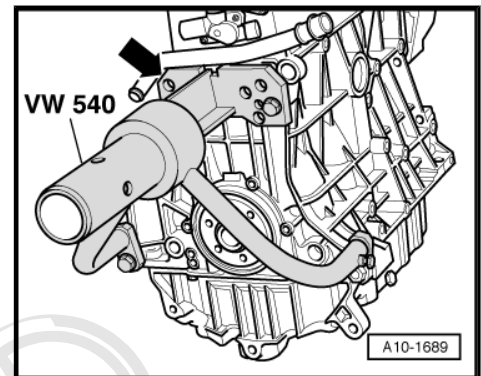
- Lift engine off engine bracket -VAS 6100- using workshop hoist -T10012- .
- Secure engine and gearbox support -VW 540- to engine, as shown in illustration.



Note

When fitting the engine and gearbox support -VW 540- with the coolant pipe installed, bevel the left corner of the mounting plate -arrow- in the same way as the right corner, as shown in the illustration.

- Secure engine to engine and gearbox support -VW 540- using engine and gearbox support -VAS 6095- .



4 Installing engine

Procedure

- Engine attached to engine bracket -T10012-

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



Note

- ◆ *Renew self-locking nuts and bolts when performing assembly work.*
- ◆ *Renew bolts which are tightened to a specified angle as well as oil seals and gaskets.*
- ◆ *Reinstall all cable ties in the same locations when assembling.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- ◆ *Clean input shaft splines and (in the case of used clutch plates) the hub splines. Remove corrosion and apply only a very thin coating of grease for clutch plate splines -G 000 100- to the splines. Then move clutch plate back and forth on input shaft until the hub moves smoothly on the shaft. Remove any excess grease.*
- ◆ *Tightening torques apply only to lightly greased, oiled, phosphated or black-finished nuts and bolts.*
- ◆ *Additional lubricant such as engine oil or gearbox oil may be used, but do not use lubricant containing graphite.*
- ◆ *Do not use degreased parts.*
- ◆ *Tolerance for tightening torques: $\pm 15\%$.*

- Check whether dowel sleeves for centring the engine/gearbox assembly are fitted in the cylinder block; install if necessary.

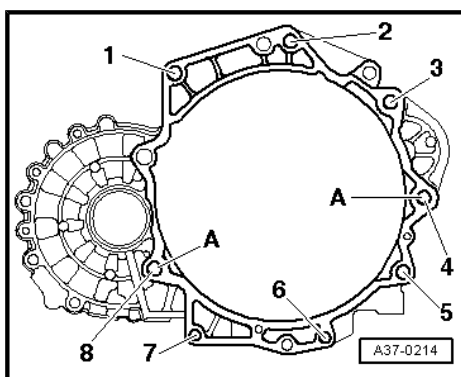
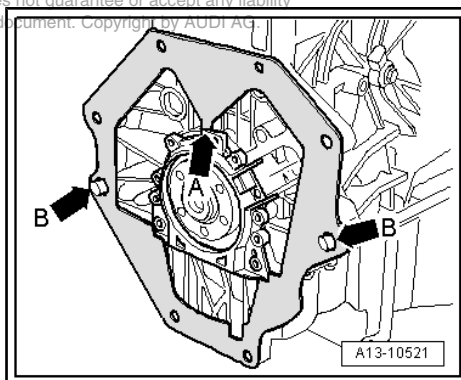
- Make sure that intermediate plate is engaged on sealing flange -arrow A- and pushed onto dowel sleeves -arrows B-.

Vehicles with manual gearbox:

- Check that clutch plate is correctly centred ⇒ Rep. gr. 30 .
- Check clutch release bearing for wear; renew if necessary.
- Bolt gearbox to engine.

Securing engine to manual gearbox

Item	Bolt	Nm
1, 2	M12x65	80
3 ¹⁾ , 4 ¹⁾	M12x135	80
5 ... 7	M10x60	40
8	M12x90	65
A	Dowel sleeves for centralising	
• ¹⁾ Bolt with M8 threaded pin		

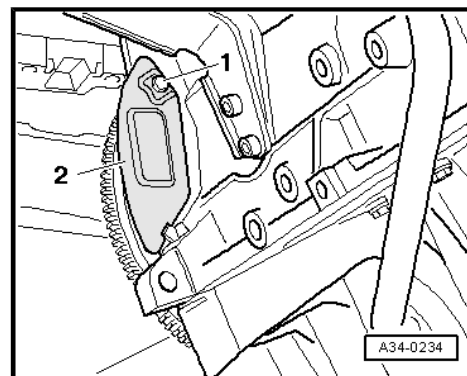


- Push in deflector plate -2- in such a way that the lower lug engages into the cylinder block and secure on top with bolt -1-.



Note

Shown in illustration with gearbox removed.



Vehicles with automatic gearbox:

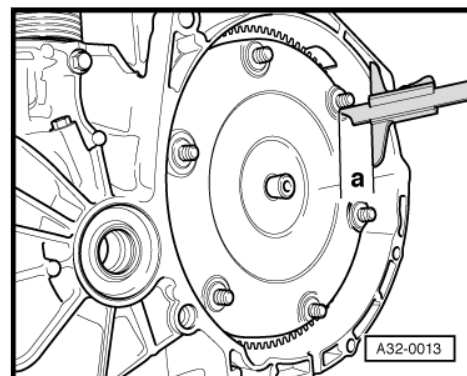
Checking installation depth of torque converter:

If the torque converter has been correctly installed, the distance between the contact surfaces at the bottom of the studs on the torque converter and the joint surface on the torque converter bell housing (with automatic gearbox) -a- is at least 19.5 mm.



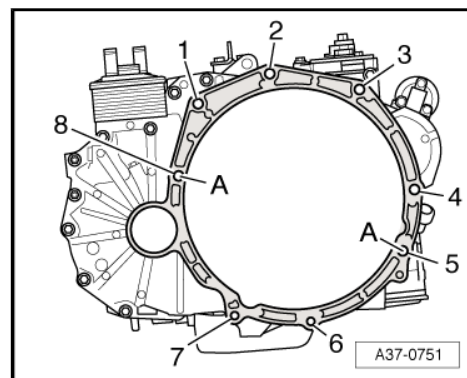
Caution

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



Securing engine to automatic gearbox

Item	Bolt	Nm
1, 2	M12x55	80
3 1)2), 4 1)2)	M12x165	80
5	M10x65	40
6, 7	M10x55	40
8	M12x100	65
A	Dowel sleeves for centralising	
• 1) Bolt with M8 threaded pin • 2) Bolt also secures starter to gearbox		

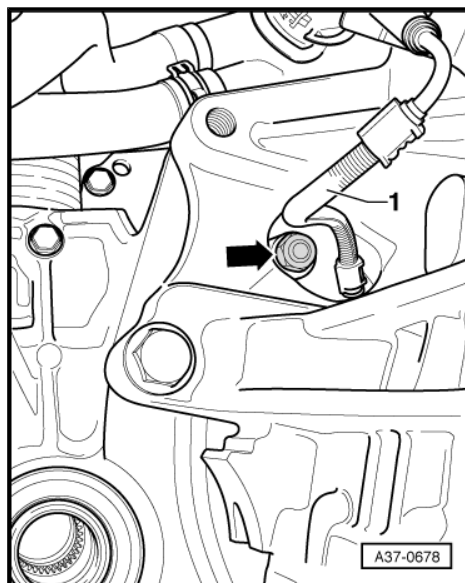


- To secure torque converter on drive plate, use only new nuts -arrow- of the correct type (same as original equipment), as specified in ⇒ Electronic parts catalogue .



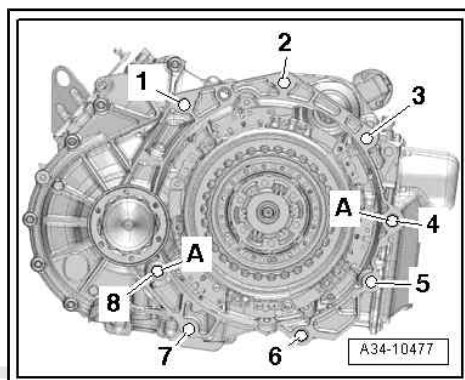
Note

Disregard -item 1-.



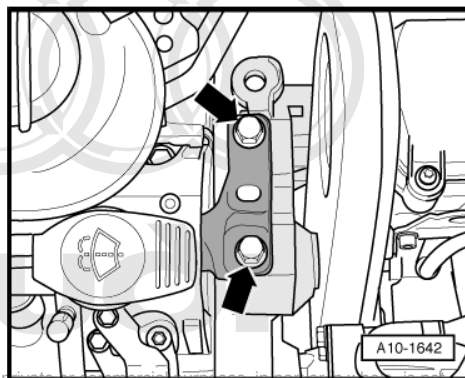
Securing engine to dual clutch gearbox

Item	Bolt	Nm
1, 3	M12x55	80
2	M12x170	80
4	M12x80	80
5, 6, 7	M10x50	40
8	M12x90	65
A	Dowel sleeves for centralising	



All vehicles (continued):

- Guide engine/gearbox assembly into the body.
- Tighten bolts -arrows- of assembly mounting for engine initially hand-tight.



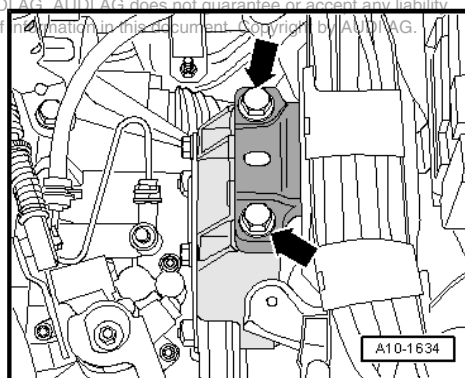
- Tighten bolts of assembly mounting for gearbox -arrows- initially hand-tight.
- Use new securing bolts.



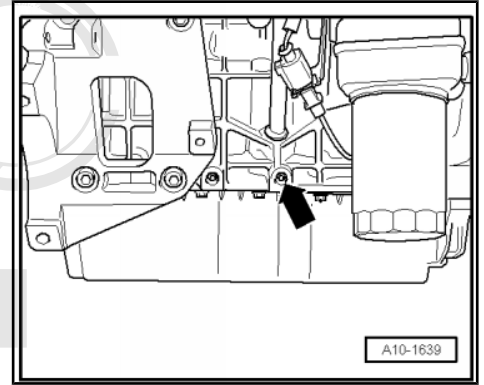
Note

The bolts are tightened to final torque only after adjusting the assembly mountings ⇒ [page 36](#) .

- Remove engine bracket -T10012- from engine.

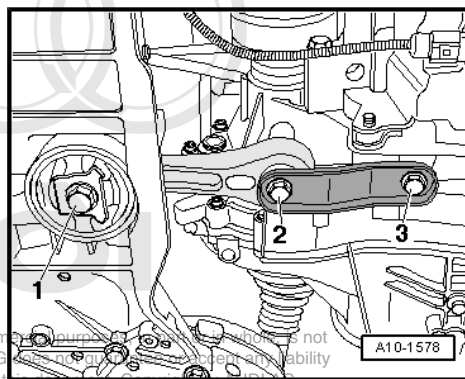


- Apply locking fluid to sealing plug -arrow- and insert plug.
- ◆ Locking fluid ⇒ Electronic parts catalogue



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- Secure pendulum support with bolts -1 ... 3- to gearbox and subframe.
- Install drive shafts ⇒ Rep. gr. 40 .
- Install front exhaust pipe with catalytic converter: vehicles with engine codes BGU, BSE, BSF, CCSA ⇒ [page 151](#) .
- Install front exhaust pipe with catalytic converter: vehicles with engine code CMXA ⇒ [page 159](#) .
- Align the exhaust system so it is free of stress ⇒ [page 154](#) .
- Install air conditioner compressor ⇒ Rep. gr. 87 .
- Install slave cylinder for hydraulic clutch mechanism ⇒ Rep. gr. 30 .
- Attach and adjust selector mechanism at manual gearbox ⇒ Rep. gr. 34 .
- Attach and adjust selector lever cable ⇒ Rep. gr. 34 or ⇒ Rep. gr. 37 .
- To facilitate positioning of alternator, drive back bushes for securing bolts slightly.
- Install alternator ⇒ Rep. gr. 27 .
- Install poly V-belt ⇒ [page 43](#) .
- Adjust engine mountings ⇒ [page 36](#) .
- Electrical connections and routing ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- Install battery ⇒ Rep. gr. 27 .
- Install wiper arms ⇒ Rep. gr. 92 .
- Bleed fuel system ⇒ Rep. gr. 24 .
- Check engine oil level ⇒ Maintenance ; Booklet 808 .
- Connect coolant hose with plug-in connector to radiator ⇒ [page 141](#) .
- Fill cooling system ⇒ [page 131](#) .



Note

- ◆ *Drained coolant may not be used again if the cylinder head or cylinder block have been renewed.*
- ◆ *Contaminated or dirty coolant must not be used again.*



Caution

Never use battery charging equipment for boost starting. There is danger of damaging the vehicle's control units.

- Check ATF level of automatic gearbox ⇒ Rep. gr. 37 .

Tightening torques

Component		Nm
Bolts/nuts	M6	10
	M7	15
	M8	20
	M10	40
	M12	65
Except for the following:		
Torque converter to drive plate		57 ¹⁾
Sealing plug in cylinder block		10 ²⁾
Pendulum support to:	Gearbox	40 + 90° ¹⁾³⁾
	Subframe	100 + 90° ¹⁾³⁾
Air-conditioner compressor to bracket for ancillaries		25
Terminal B+ to starter		16
Earth wire to gearbox		23
¹⁾ Renew nuts/bolts. ²⁾ Apply locking fluid when installing; refer to ⇒ Electronic parts catalogue for locking fluid. ³⁾ 90° = one quarter turn.		

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5 Assembly mountings

5.1 Assembly mountings - exploded view

1 - Gearbox support

- ☐ Illustration shows version for dual clutch gearbox

2 - Bolt

- ☐ Gearbox support to gearbox
- ☐ Tightening torque ⇒ Rep. gr. 34

3 - Bolt

- ☐ Gearbox support to gearbox
- ☐ Tightening torque ⇒ Rep. gr. 34

4 - Engine mounting

5 - Bolt

- ☐ Engine mounting to body
- ☐ Renew
- ☐ 40 Nm + turn 90° further

6 - Bracket for activated charcoal filter

7 - Bolt

- ☐ 9 Nm

8 - Nut

- ☐ 9 Nm

9 - Bolt

- ☐ Connecting bracket to body
- ☐ Renew
- ☐ 20 Nm + turn 90° further

10 - Bolt

- ☐ Connecting bracket to engine mounting
- ☐ Renew
- ☐ 20 Nm + turn 90° further

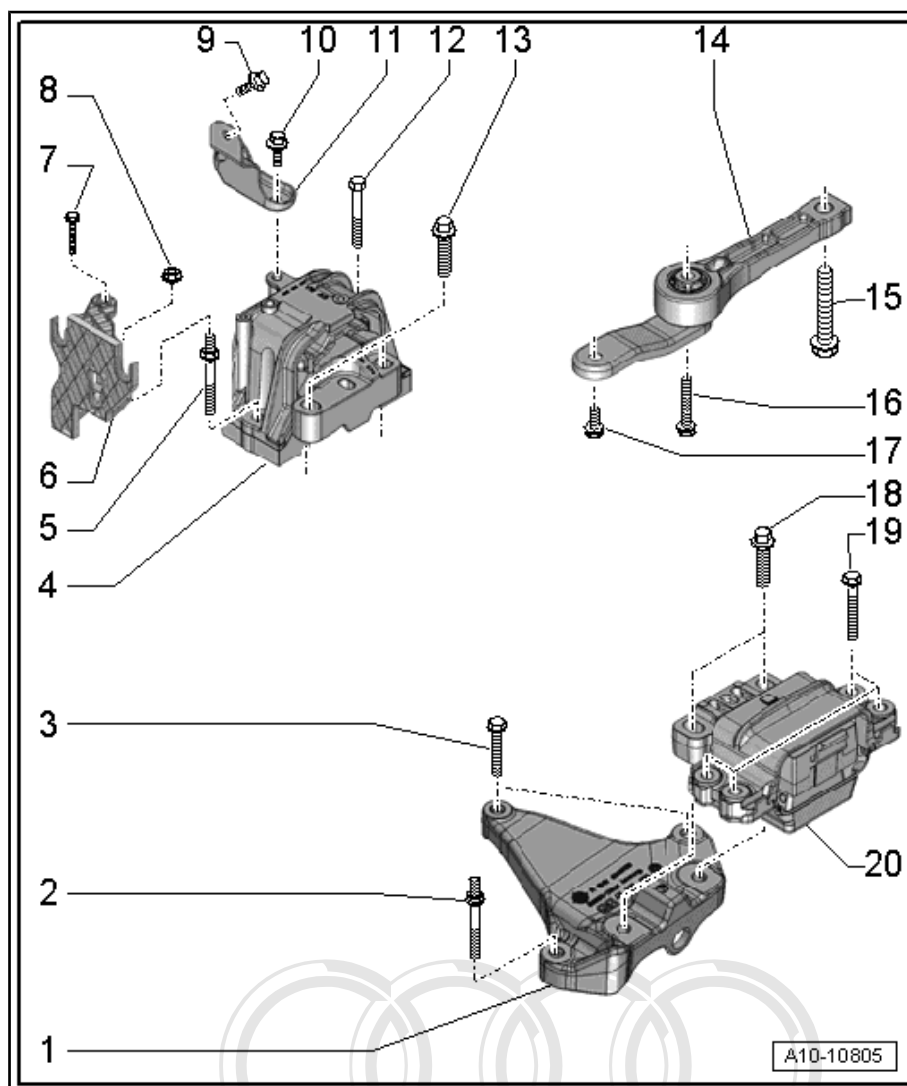
11 - Connecting bracket

12 - Bolt

- ☐ Engine mounting to body
- ☐ Renew
- ☐ 40 Nm + turn 90° further

13 - Bolt

- ☐ Engine mounting to timing chain cover
- ☐ Renew
- ☐ 60 Nm + turn 90° further



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14 - Pendulum support

15 - Bolt

- ☐ Pendulum support to subframe
- ☐ Renew
- ☐ 100 Nm + turn 90° further

16 - Bolt

- ☐ Pendulum support to gearbox
- ☐ Renew
- ☐ 40 Nm + turn 90° further

17 - Bolt

- ☐ Pendulum support to gearbox
- ☐ Renew
- ☐ 40 Nm + turn 90° further

18 - Bolt

- ☐ Gearbox mounting to gearbox support
- ☐ Tightening torque ⇒ Rep. gr. 34

19 - Bolt

- ☐ Gearbox mounting to body
- ☐ Tightening torque ⇒ Rep. gr. 34

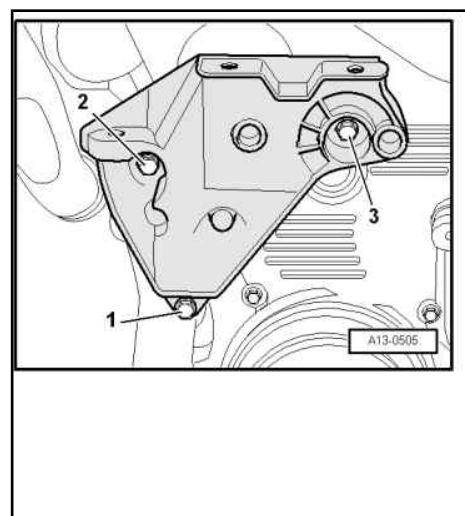
20 - Gearbox mounting

- ☐ Illustration shows version for dual clutch gearbox

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Installing engine support

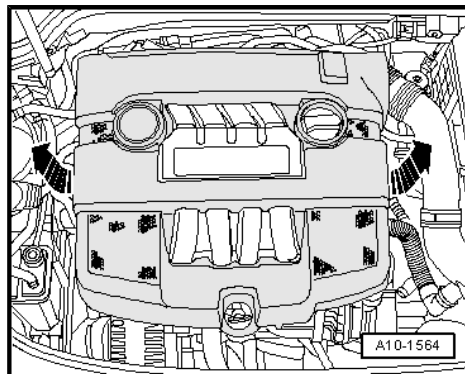
- Initially screw in bolts -1 ... 3- hand-tight.
- Then tighten bolts -1 ... 3- to 45 Nm.



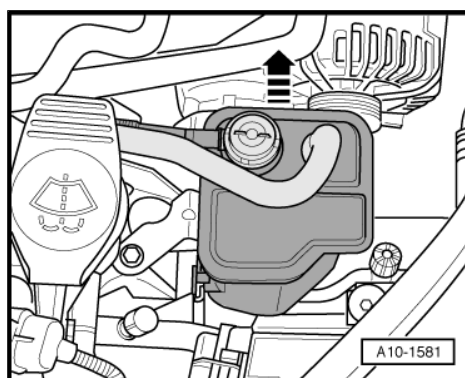
5.2 Checking adjustment of assembly mountings (engine/gearbox mountings)

Procedure

- Remove engine cover panel -arrows-.



- Lift out activated charcoal filter from retainer -arrow- with pipes connected and lay aside.



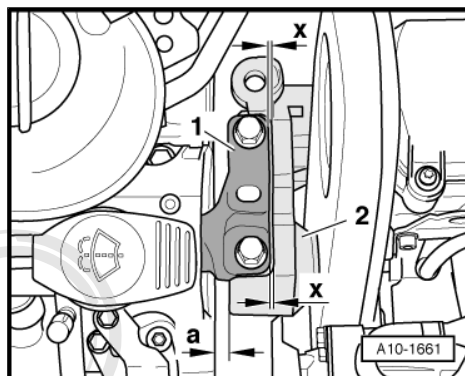
The following specifications must be obtained:

- There must be a distance of -a- = 16 mm between engine support and longitudinal member (right-side).
- The side of the engine support casting -2- must be aligned parallel to the support arm -1- (distance -x- = distance -x-).



Note

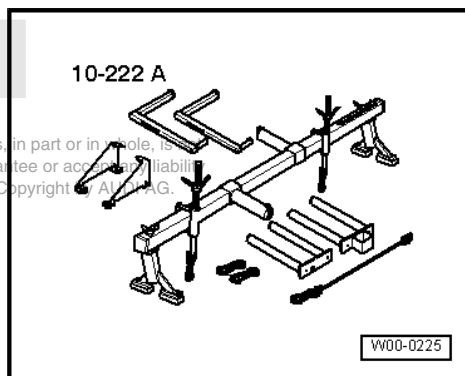
Distance -a- = 16 mm can also be checked with a metal rod of suitable size, or similar.



5.3 Adjusting assembly mountings

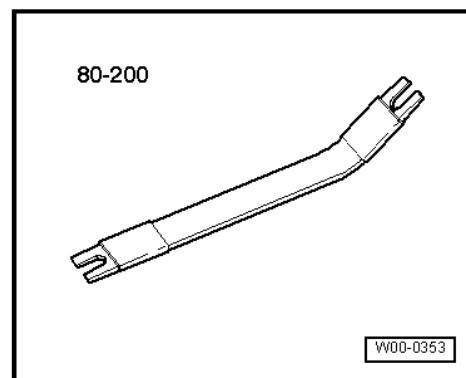
Special tools and workshop equipment required

- ♦ Support bracket -10 - 222 A-



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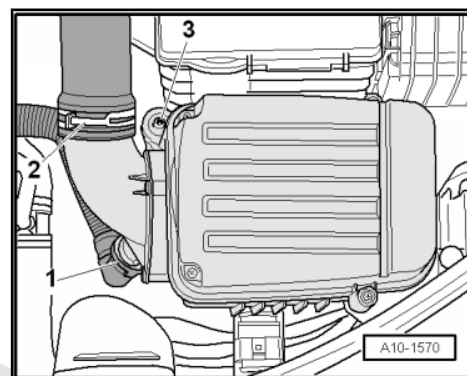
- ◆ Removal lever -80 - 200- for vehicles from 06.2008 onwards



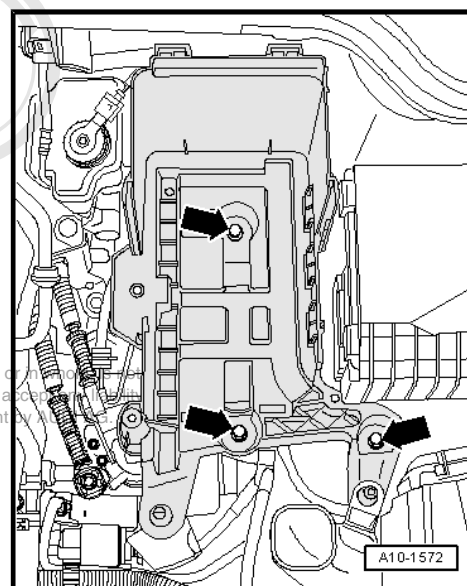
Adjusting

If the distance measured is too large or small, proceed as follows:

- Disconnect hoses -1- and -2- from air cleaner housing.
- Remove bolt -3-.
- Take out air cleaner housing.

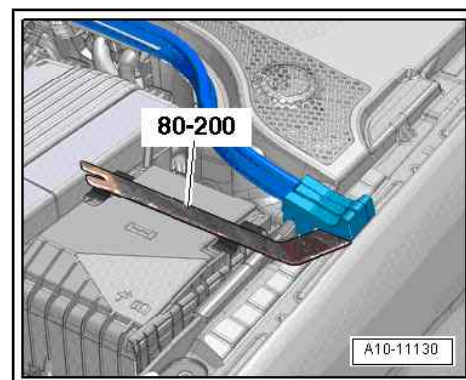


- Remove battery ⇒ Rep. gr. 27 .
- Unclip front section of trim for battery.
- Remove battery tray -arrows-.
- Detach battery tray from front of air duct.



Vehicles from 06.2008 onwards:

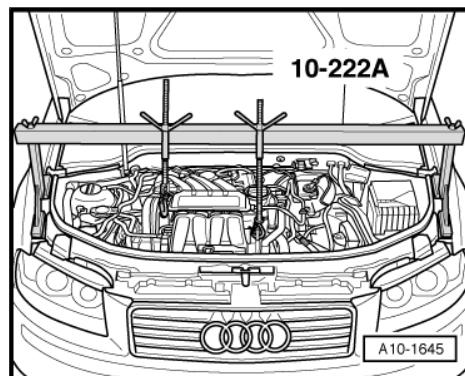
- Lever off clip of sealing element with removal lever -80 - 200- and fold open sealing element.



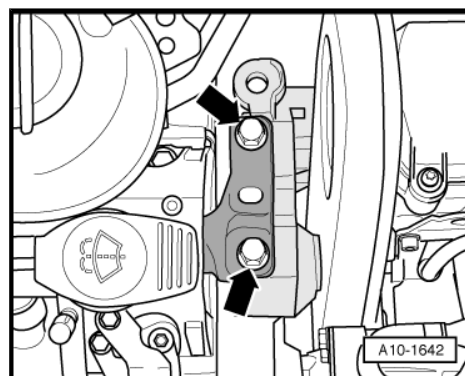
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All vehicles (continued):

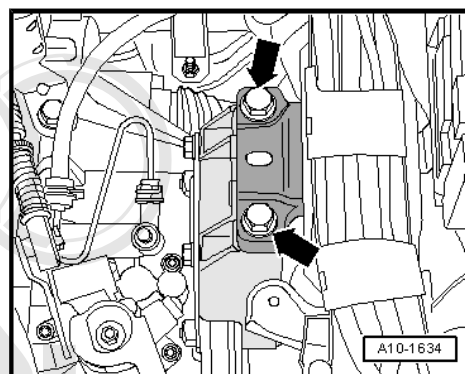
- Position support bracket -10-222 A- on bolted flanges of wing panels (vehicles up to 05.2008) or body flanges (vehicles from 06.2008 onwards).
- The spindles face forwards.
- Detach crankcase breather hose from oil filler neck.
- Attach hooks of spindles to lifting eyes.
- Take up weight of engine evenly with both spindles (but do not raise engine).



- Remove bolts of assembly mounting for engine -arrows-.

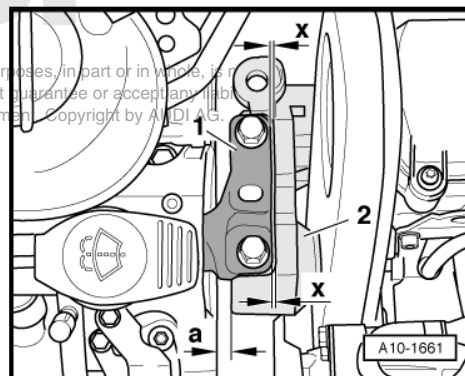


- Unscrew bolts of assembly mounting at gearbox -arrows-.
- Renew all 4 bolts one by one (if not already renewed when engine was installed) and hand-tighten them.



- By applying a suitable lever between support arm -1- of engine mounting and engine support -2-, adjust position of engine until the following specifications are obtained:

- There must be a distance of $a = 16 \text{ mm}$ between engine support and longitudinal member (right-side).
- The side of the engine support casting -2- must be aligned parallel to the support arm -1- (distance $-x = \text{distance } -x-$).



Note

Distance $-a-$ = 16 mm can also be checked with a metal rod of suitable size, or similar.

- Tighten the bolts for engine assembly mounting.

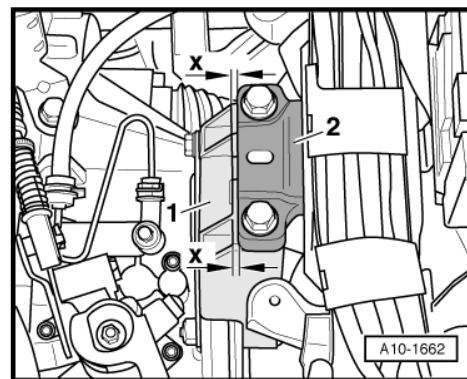
- On the gearbox side, check that the edges of the support arm -2- and gearbox support -1- are parallel (distance -x- = distance -x-).
- Tighten the bolts for gearbox assembly mounting.

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

- Install battery ⇒ Rep. gr. 27 .

Tightening torques

Component		Nm
Support arm to:	Engine support	60 + 90° 1)2)
	Gearbox support	60 + 90° 1)2)
• 1) Renew bolts.		
• 2) 90° = one quarter turn.		



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13 – Crankshaft group

1 Dismantling and assembling engine

1.1 Poly V-belt drive - exploded view

1 - Pulley

- ☐ For poly V-belt
- ☐ Removing and installing
⇒ [page 44](#)

2 - Special bolt, 10 Nm + 90° (1/4 turn) further

- ☐ Renew ⇒ Electronic parts catalogue

3 - 23 Nm

4 - Tensioner for poly V-belt

- ☐ Pivot with open-end spanner to slacken poly V-belt
- ☐ Lock tensioner with locking pin - T10060 A-

5 - Bracket for ancillaries

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

6 - 23 Nm

7 - Deflector plate

8 - 23 Nm

9 - Alternator

- ☐ Removing and installing
⇒ Rep. gr. 27
- ☐ To facilitate attachment of alternator, knock back threaded bushes for alternator securing bolts slightly

10 - 45 Nm

- ☐ Apply locking fluid when installing; refer to ⇒ Electronic parts catalogue
- ☐ Observe correct tightening sequence ⇒ [page 45](#)

11 - Bush

- ☐ 2x

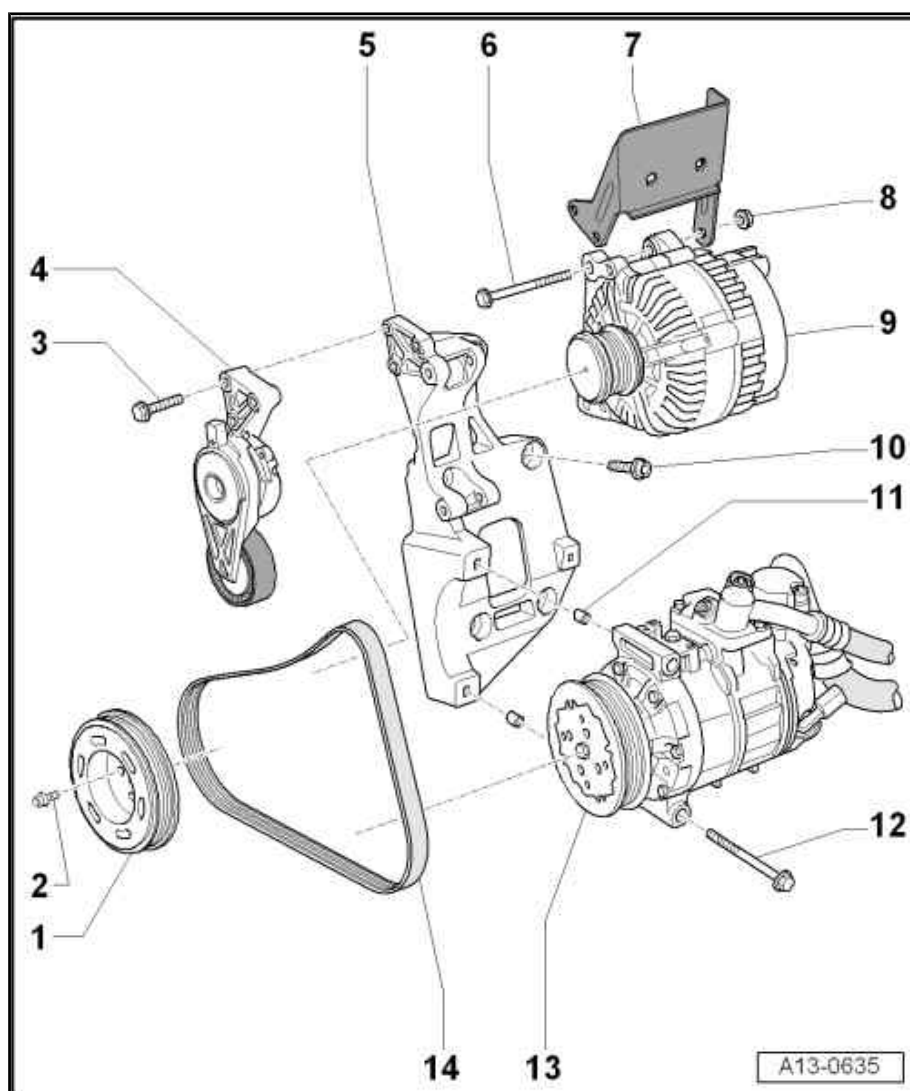
12 - 25 Nm

13 - Air conditioner compressor

- ☐ Removing and installing ⇒ Rep. gr. 87

14 - Poly V-belt

- ☐ Before removing, mark direction of rotation with chalk or felt-tipped pen
- ☐ Check for wear
- ☐ Do not kink



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

1.2 Removing and installing poly V-belt

Special tools and workshop equipment required

- ◆ Locking pin -T10060 A-



Removing

- Remove engine cover panel -arrows-.

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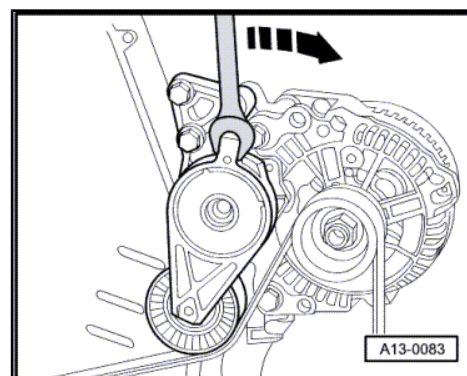
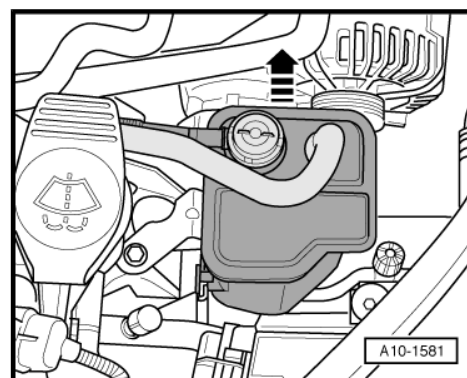
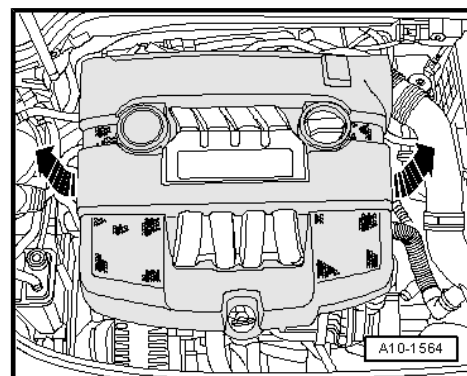
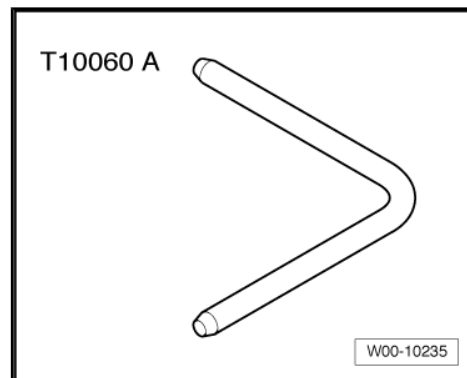
- Lift out activated charcoal filter from retainer -arrow- with pipes connected and lay aside.



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.

- Turn the tensioner in the direction of the -arrow- to slacken the poly V-belt.



- Lock poly V-belt tensioner using locking pin -T10060 A- .
- Remove poly V-belt.

Installing

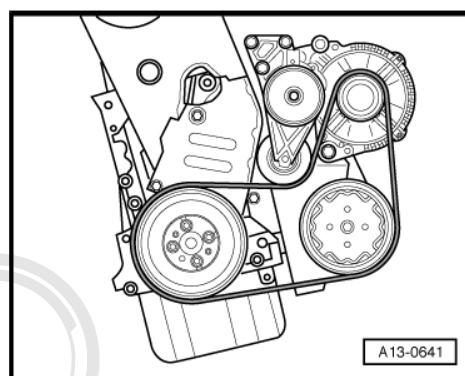
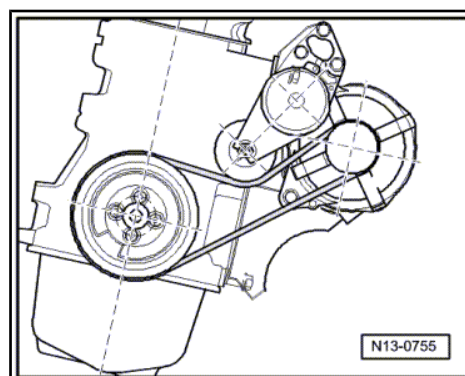
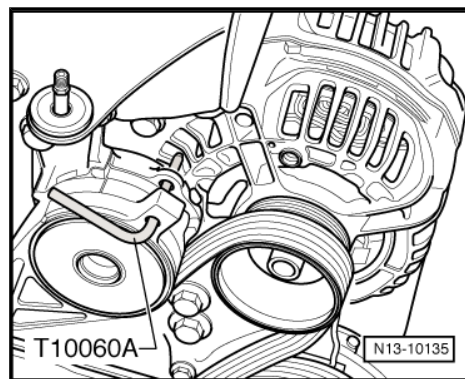
Installation is carried out in the reverse order; note the following:



Note

Before fitting poly V-belt, make sure all mechanical units (e.g. alternator and air conditioner compressor) are firmly in position.

- Vehicles without air conditioner: Fit poly V-belt on pulleys of crankshaft and alternator and release tensioner.
- Vehicles with air conditioner: Fit poly V-belt on pulleys of crankshaft, air conditioner compressor and finally alternator and release tensioner.
- Check poly V-belt for proper seating.
- Start engine and check that belts run properly.

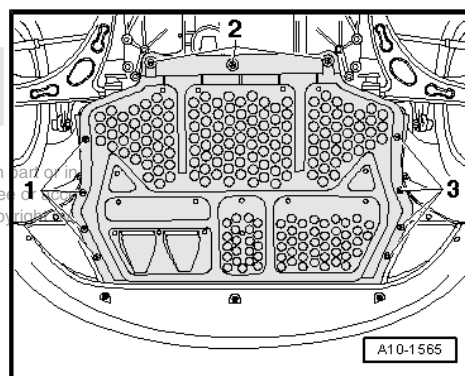


1.3 Removing and installing crankshaft pulley

Removing

- Remove poly V-belt ⇒ [page 43](#) .
- Remove centre noise insulation -fasteners 1 ... 3-.

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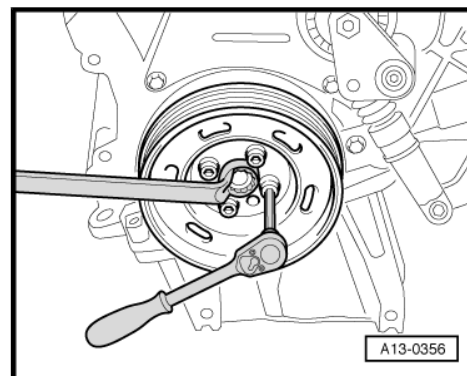


- Unbolt crankshaft pulley.



Note

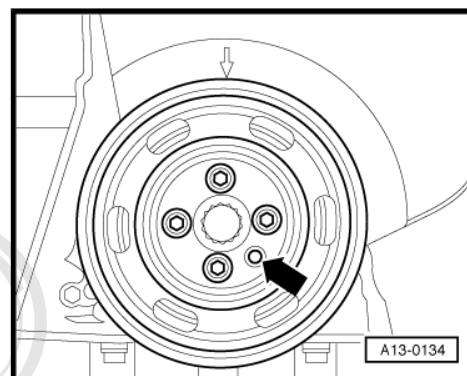
To loosen and tighten the crankshaft pulley, counterhold central bolt with a ring spanner.



Installing

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

- Install crankshaft pulley with genuine bolts only ⇒ Electronic parts catalogue .
- Assembly is only possible in one position: The hole -arrow- in the crankshaft pulley must fit over the projection on the toothed belt sprocket.
- Install poly V-belt ⇒ [page 43](#) .



Tightening torque

Component	Nm
Pulley to crankshaft	10 + 90° ¹⁾²⁾
• ¹⁾ Renew bolts. • ²⁾ 90° = one quarter turn.	

1.4 Removing and installing bracket for ancillaries

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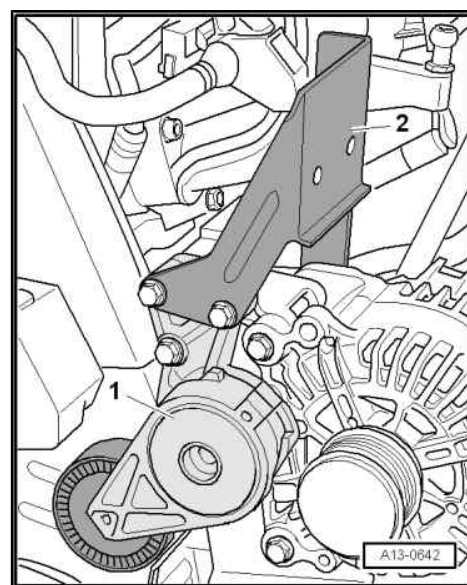
Removing



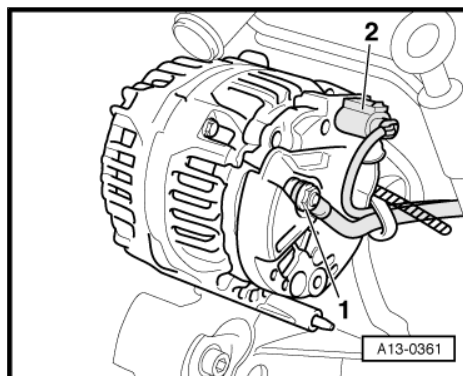
Caution

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

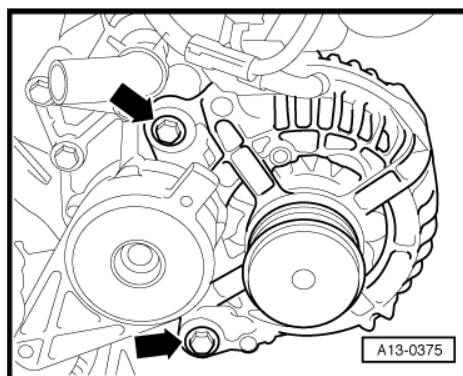
- Disconnect earth wire at battery with ignition switched off.
- Remove poly V-belt ⇒ [page 43](#) .
- Remove deflector plate -2- and tensioning element -1- for poly V-belt.



- Unplug electrical connector -2-.
- Unscrew wire -1- at alternator.
- Unscrew wire clamp on alternator.

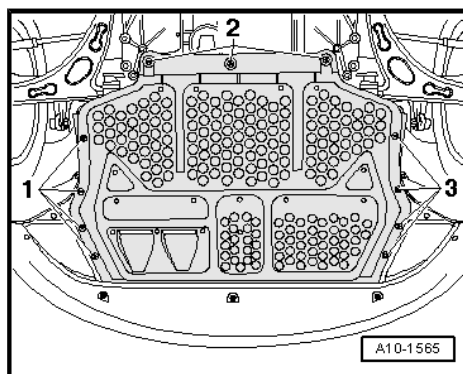


- Unscrew bolts -arrows- and remove alternator.



- Remove centre noise insulation -fasteners 1 ... 3-.

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



WARNING

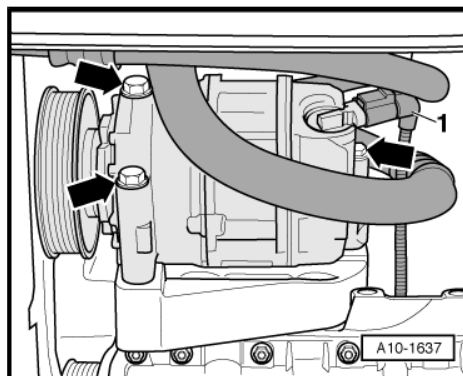
The air conditioner refrigerant circuit must not be opened.

- Remove bolts -arrows- for air conditioner compressor.

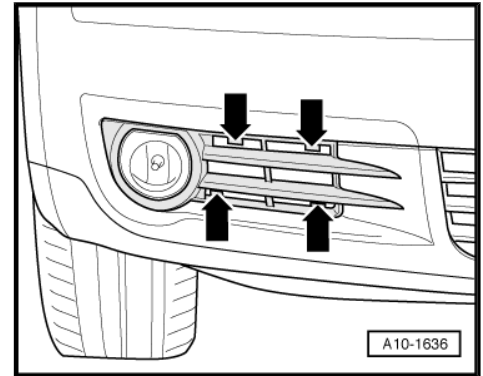


Note

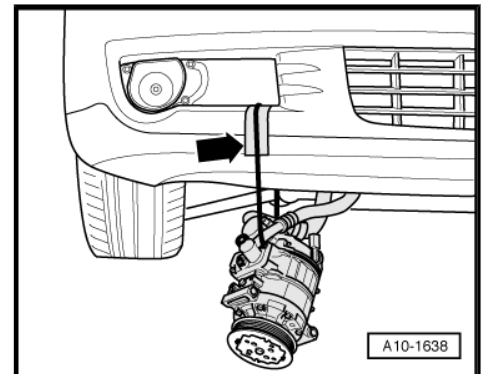
To prevent damage to the air conditioner compressor and refrigerant pipes/hoses, ensure that the pipes and hoses are not stretched, kinked or bent.



- Release retaining hooks -arrows- using a screwdriver and remove air intake grille from bottom of bumper.



- Protect bumper from scratches using adhesive tape -arrow-.
- Tie up air conditioner compressor together with refrigerant hoses on bumper (refrigerant hoses remain connected).



- Remove bracket for ancillaries -bolts 1 ... 6-.

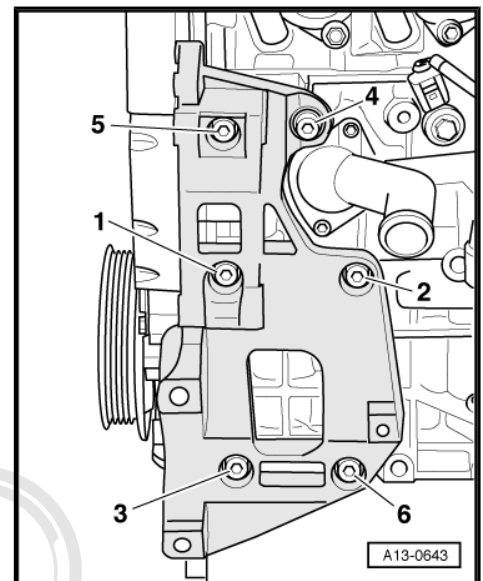
Installing

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

- Tighten bolts in the sequence -1 ... 6-.
- Install alternator ⇒ Rep. gr. 27 .
- Install air conditioner compressor ⇒ Rep. gr. 87 .
- Install poly V-belt ⇒ [page 43](#) .
- Connect battery. Procedures required ⇒ Rep. gr. 27 .

Tightening torques

Component	Nm
Bracket for ancillaries to cylinder block	45 ¹⁾
Tensioner for poly V-belt to bracket for ancillaries	23
Deflector plate to bracket for ancillaries	23
• ¹⁾ Apply locking fluid when installing; refer to ⇒ Electronic parts catalogue for locking fluid.	



1.5 Toothed belt drive - exploded view

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1 - 10 Nm

- ☐ Apply locking fluid when installing; refer to ⇒ Electronic parts catalogue

2 - Toothed belt cover (centre)

3 - Engine support

- ☐ Removing ⇒ „1.6 Removing and installing toothed belt“, page 50
- ☐ Installing ⇒ page 37

4 - 45 Nm

- ☐ Observe correct tightening sequence ⇒ page 57

5 - Toothed belt cover (top)

- ☐ Removing and installing ⇒ page 49

6 - 23 Nm

7 - Washer

8 - Semi-automatic tensioning roller

- ☐ Checking ⇒ page 61
- ☐ Installation position ⇒ page 50

9 - 100 Nm

- ☐ Use counterhold tool -3415- when loosening and tightening ⇒ page 49

10 - Camshaft sprocket

- ☐ Remove toothed belt prior to removing and installing ⇒ page 50
- ☐ Located in position by Woodruff key -item 14-

11 - 10 Nm

- ☐ Apply locking fluid when installing; refer to ⇒ Electronic parts catalogue

12 - 23 Nm

- ☐ Apply locking fluid when installing; refer to ⇒ Electronic parts catalogue

13 - Toothed belt cover (rear)

14 - Woodruff key

- ☐ Check for firm attachment

15 - O-ring

- ☐ Renew

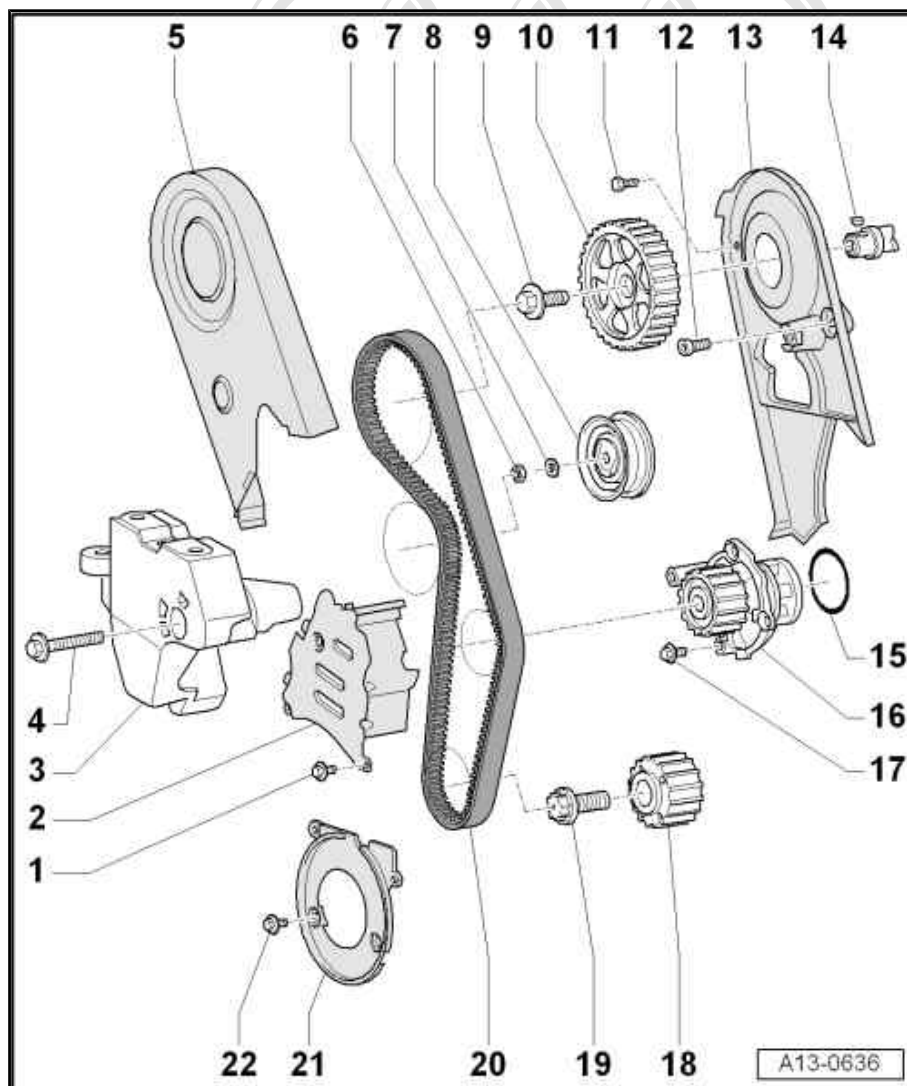
16 - Coolant pump

- ☐ Removing and installing ⇒ page 134

17 - 15 Nm

18 - Crankshaft sprocket

- ☐ Contact surface between sprocket and crankshaft must be free of oil
- ☐ Can only be installed in one position



19 - 90 Nm + 90° (1/4 turn) further

- ☐ Renew
- ☐ Do not lubricate with oil
- ☐ Use counterhold tool -3415- to loosen and tighten
- ☐ Fit counterhold tool -3415- [⇒ page 50](#)

20 - Toothed belt

- ☐ Before removing, mark direction of rotation with chalk or felt-tipped pen
- ☐ Check for wear
- ☐ Removing [⇒ page 50](#)
- ☐ Installing (adjusting valve timing) [⇒ page 55](#)
- ☐ Detaching from camshaft sprocket [⇒ page 57](#)

21 - Toothed belt cover (bottom)

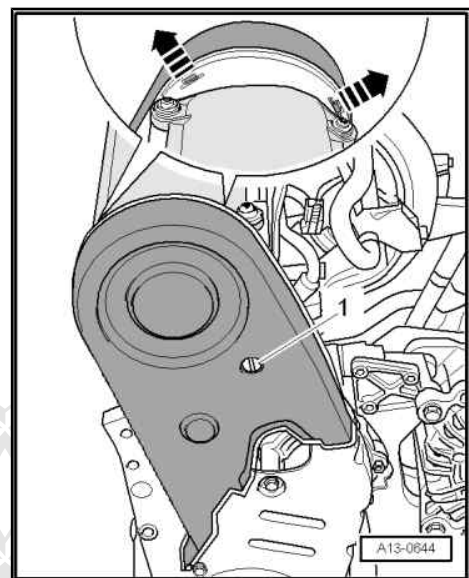
- ☐ Unbolt crankshaft pulley to remove

22 - 10 Nm

- ☐ Apply locking fluid when installing; refer to ⇒ Electronic parts catalogue

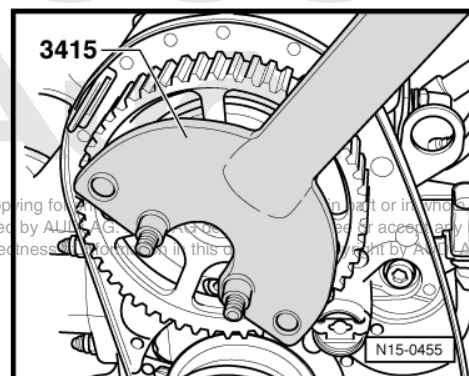
Removing and installing toothed belt cover (top)

- Turn quick-release fastener -item 1- 90° anti-clockwise.
- Raise retaining tabs -arrows- and detach top toothed belt cover.
- Carefully attach top toothed belt cover to centre toothed belt cover when installing.



Loosening camshaft sprocket

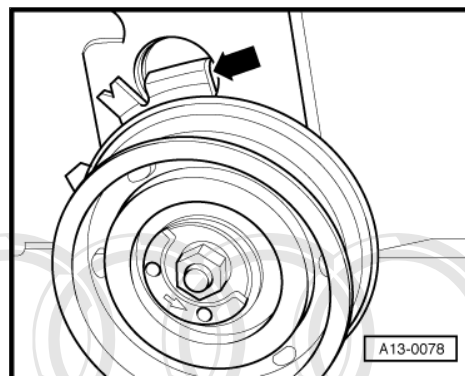
- Use counterhold -3415- when loosening and tightening central bolt.



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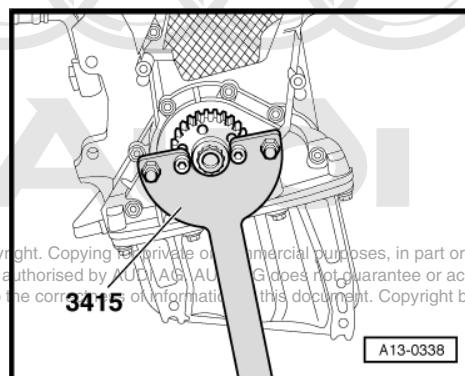
Installation position of semi-automatic tensioning roller

- Retaining lug -arrow- must engage in slot on cylinder head.



Removing and installing crankshaft sprocket

- Use counterhold -3415- when loosening and tightening central bolt.

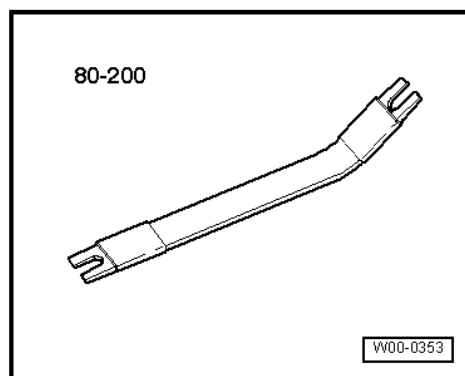
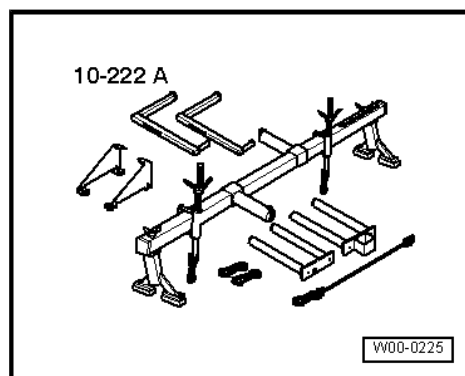


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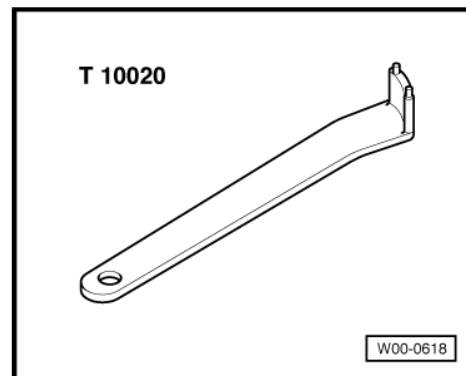
1.6 Removing and installing toothed belt

Special tools and workshop equipment required

- ◆ Support bracket -10 - 222 A-
- ◆ Removal lever -80 - 200- for vehicles from 06.2008 onwards

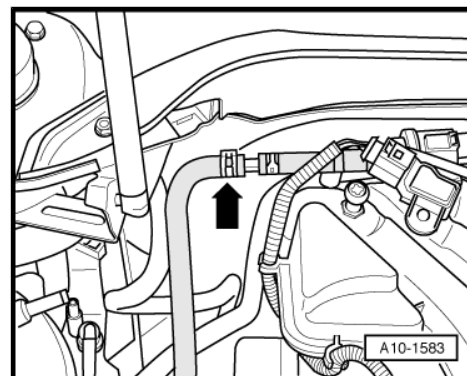


- ◆ Pin wrench -T10020-



Removing

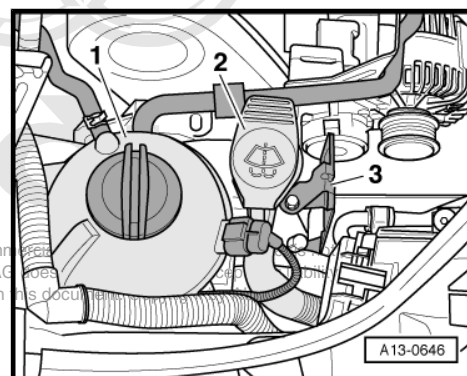
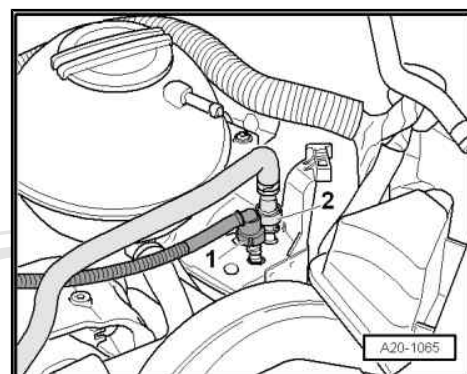
- Disconnect vacuum hose going to activated charcoal filter at the position marked with an -arrow-.
- Remove poly V-belt ⇒ [page 43](#) .



WARNING

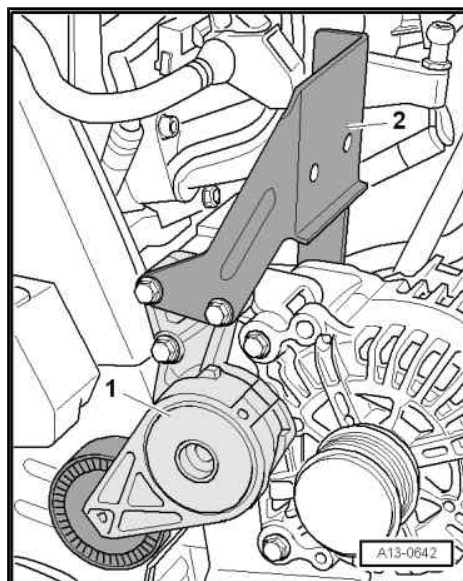
The fuel system is pressurised. Wrap a cloth around the connection before opening the system. Then release pressure by carefully loosening the connection.

- Disconnect fuel supply pipe -2- by pulling release tab.
- Disconnect vacuum line -1- going to activated charcoal filter (press release tab).
- Unscrew bracket -3- for activated charcoal filter.
- Unfasten bolt at filler neck of washer fluid reservoir -2-.
- Disconnect electrical wire for coolant shortage indicator switch -F66- at coolant expansion tank -1-.
- Unbolt coolant expansion tank and lay it aside with pipes connected.

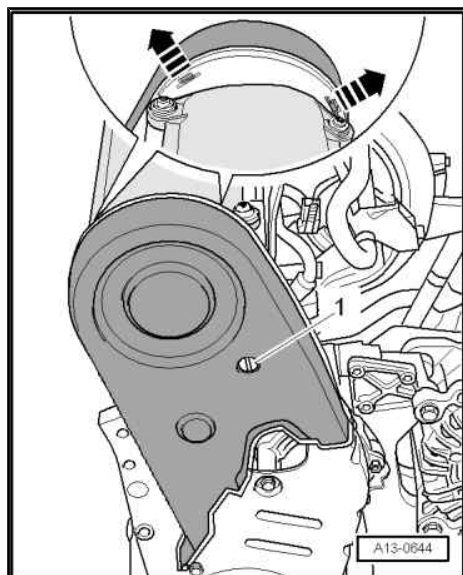


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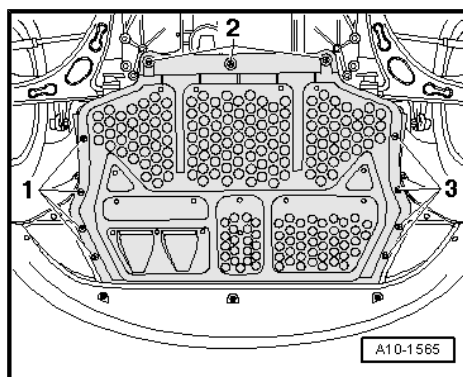
- Remove deflector plate -2- and tensioning element -1- for poly V-belt.



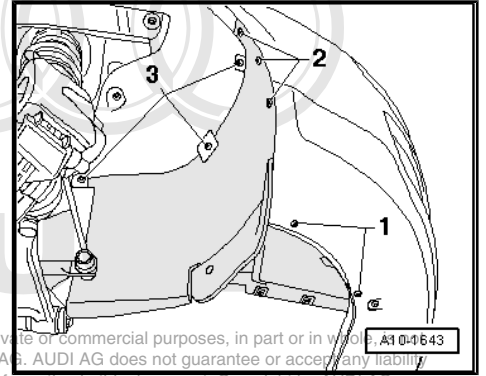
- Turn quick-release fastener -item 1- 90° anti-clockwise.
- Raise retaining tabs -arrows- and detach top toothed belt cover.



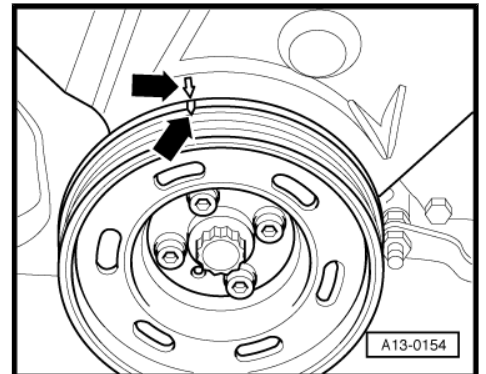
- Remove centre noise insulation -fasteners 1 ... 3-.



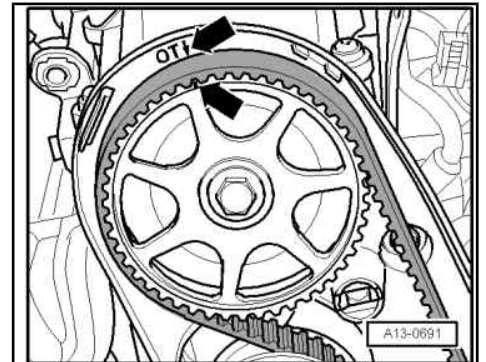
- Remove noise insulation (right-side) -fasteners 1 ... 3-.



- Turn crankshaft at central bolt on crankshaft sprocket in direction of engine rotation to TDC mark for No. 1 cylinder -arrows-.



- At the same time the marking on front of the camshaft sprocket must align with the marking on the rear toothed belt cover -arrows-.
- Rotate crankshaft one turn further if necessary.

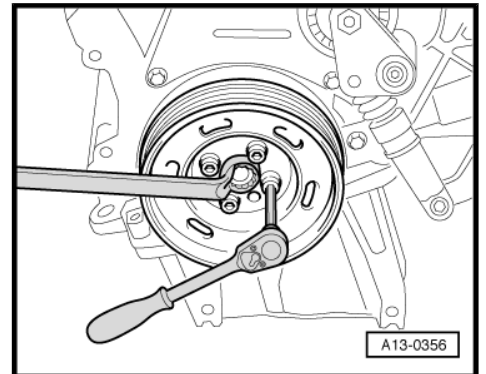


- Unbolt crankshaft pulley.

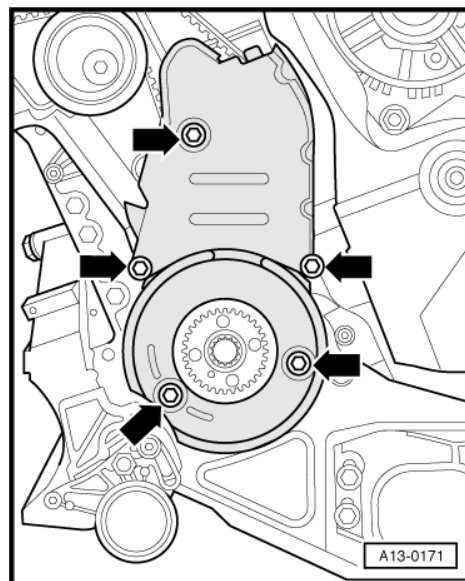


Note

To loosen and tighten the crankshaft pulley, counterhold central bolt with a ring spanner.

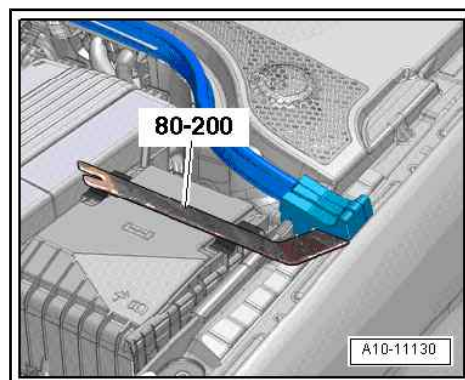


- Unbolt toothed belt covers (bottom and centre) -arrows-.



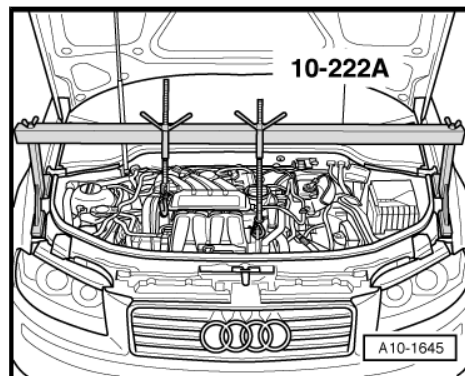
Vehicles from 06.2008 onwards:

- Lever off clip of sealing element with removal lever -80 - 200- and fold open sealing element.

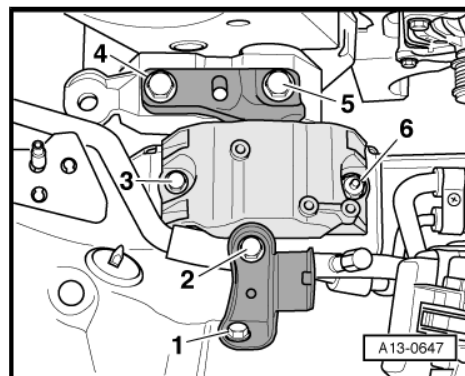


All vehicles (continued):

- Position support bracket -10 - 222 A- on bolted flanges of wing panels (vehicles up to 05.2008) or body flanges (vehicles from 06.2008 onwards).
- The spindles face forwards.
- Detach crankcase breather hose from oil filler neck.
- Attach hooks of spindles to lifting eyes.
- Take up weight of engine evenly with both spindles (but do not raise engine).



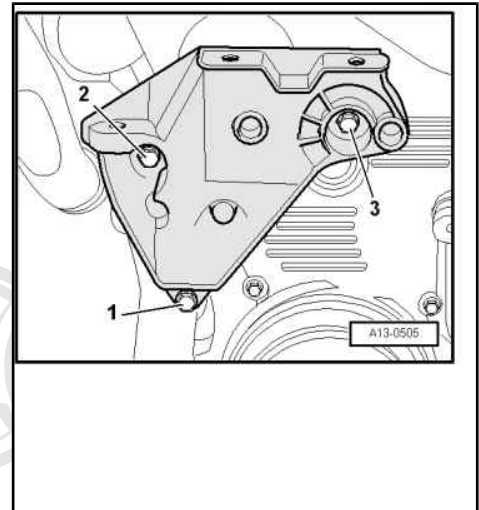
- Remove bolts -1- and -2- and detach connecting bracket.
- Remove bolts -3- -6- and remove engine mounting.



- Remove bolts -1 ... 3- and detach engine support.

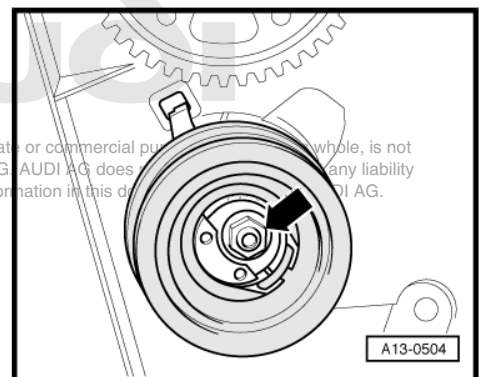
**Note**

To slacken the bolts for the engine support, raise or lower the engine slightly as necessary via the spindles on engine support bracket -10 - 222 A- .



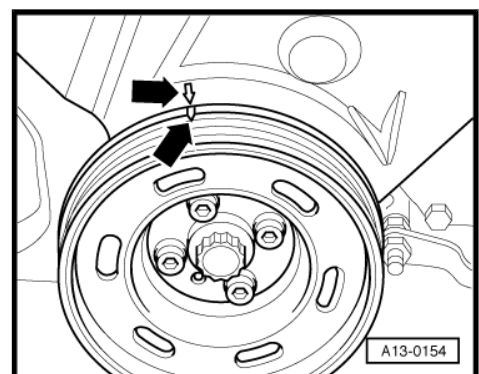
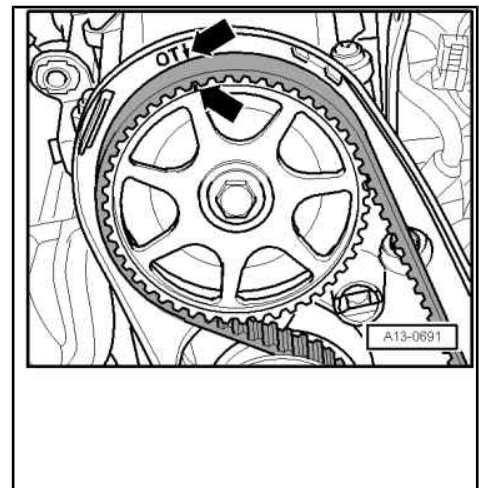
- Mark direction of rotation of toothed belt with chalk or felt pen.
- Loosen nut on tensioning roller -arrow- several turns.
- Remove toothed belt.

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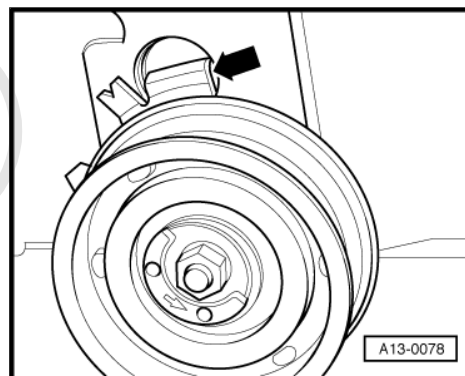
**Installing (adjusting valve timing)****Note**

When turning the camshaft, the crankshaft must not be at TDC. Otherwise, there is a risk of damage to valves and piston crowns.

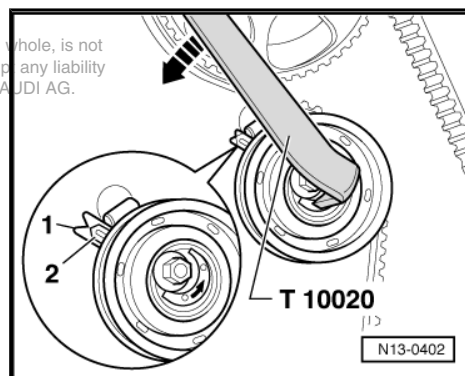
- Align mark on camshaft sprocket with mark on toothed belt cover -arrows-.
- Fit toothed belt onto crankshaft sprocket, noting direction of rotation.
- Install bottom toothed belt cover.
- Secure pulley with bolt, noting fixing arrangement.
- Check again that crankshaft is at TDC of No. 1 cylinder -arrow-.
- Fit toothed belt onto coolant pump, then tensioning roller, and finally camshaft sprocket.



- Note correct position of semi-automatic tensioning roller:
- Retaining lug -arrow- must engage in slot on cylinder head.



- Turn tensioning roller at eccentric adjuster in anti-clockwise direction -arrow- using pin wrench -T 10020- until pointer -2- is above notch -1- (toothed belt over-tensioned).



- Repeat this work step („over-tensioning“ toothed belt) 5 times so that toothed belt stretches slightly.
- Now release tensioning roller until pointer -2- and notch -1- are aligned.
- Tighten securing nut
- Turn crankshaft at central bolt on toothed belt sprocket two revolutions in direction of engine rotation without stopping during final 45°.
- Check whether camshaft and crankshaft markings align at TDC with their respective reference points.
- Check again whether toothed belt is tensioned properly, repeat adjustment procedure if necessary.
- Install toothed belt cover.

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

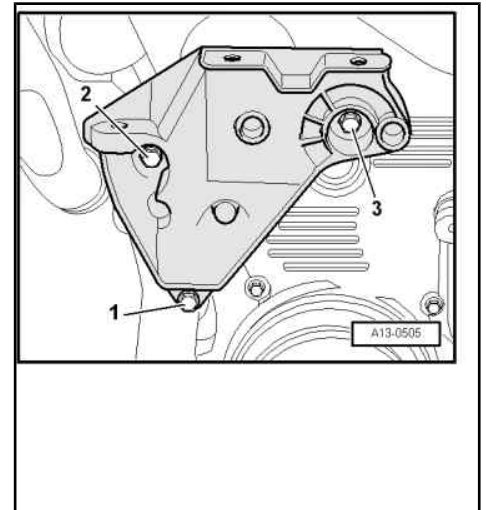
Secure the engine support as follows:

- Initially screw in bolts -1 ... 3- hand-tight.
- Then tighten bolts -1 ... 3- to 45 Nm.
- Install engine mounting.
- Install crankshaft pulley ⇒ [page 44](#) .
- Adjust engine mountings ⇒ [page 36](#) .
- Install poly V-belt ⇒ [page 43](#) .
- Bleed fuel system ⇒ Rep. gr. 24 .

Tightening torques

Component	Nm
Toothed belt tensioning roller to cylinder head	23
Toothed belt cover (bottom) to cylinder block	10 ¹⁾
Toothed belt cover (centre) to cylinder block	10 ¹⁾
Engine support to cylinder block	45
Engine mounting to body	40 + 90° ²⁾³⁾
Connecting bracket to body/engine mounting	20 + 90° ²⁾³⁾
Tensioner for poly V-belt to bracket for ancillaries	23
Deflector plate to bracket for ancillaries	23
• ¹⁾ Apply locking fluid when installing; refer to ⇒ Electronic parts catalogue for locking fluid. • ²⁾ Renew bolts. • ³⁾ 90° = one quarter turn	

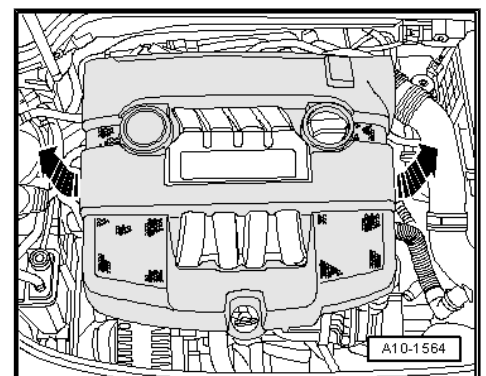
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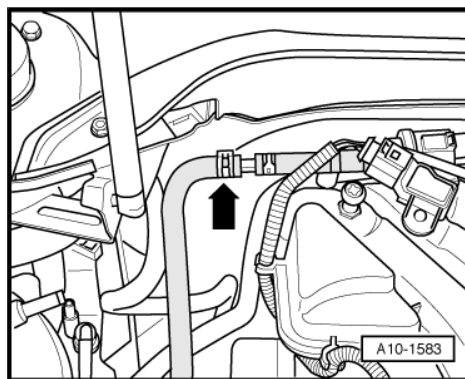
1.7 Detaching toothed belt from camshaft sprocket

Procedure

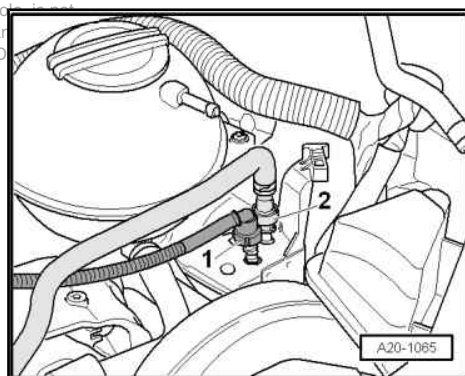
- Remove engine cover panel -arrows-.



- Disconnect vacuum hose going to activated charcoal filter at the position marked with an -arrow-.



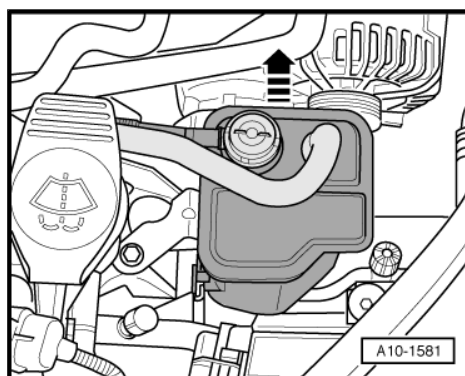
- Disconnect vacuum pipe 1- (press release tab) and move wire to activated charcoal filter clear.



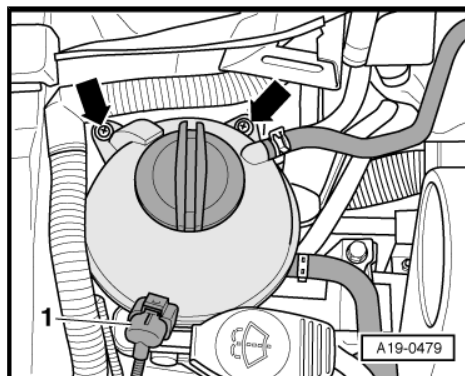
Note

Disregard -item 2-.

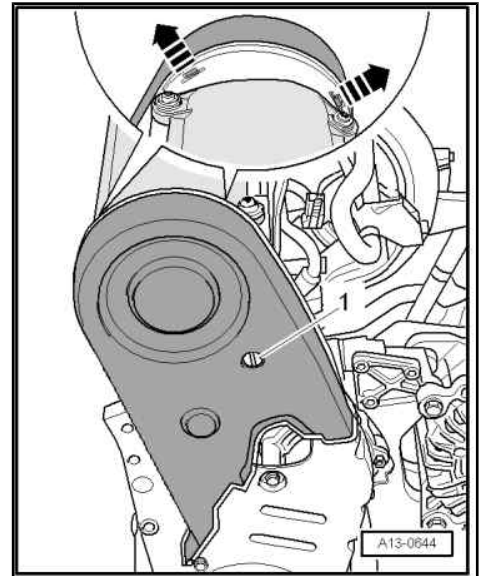
- Lift out activated charcoal filter from retainer with pipes connected -arrow-.



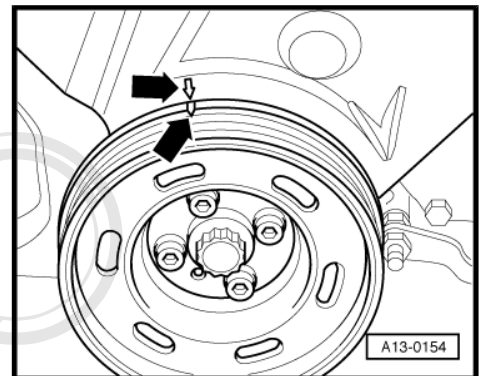
- Unplug electrical connector for coolant shortage indicator switch -F66- at coolant expansion tank.
- Unbolt coolant expansion tank -arrows- and lay it aside with hoses connected.



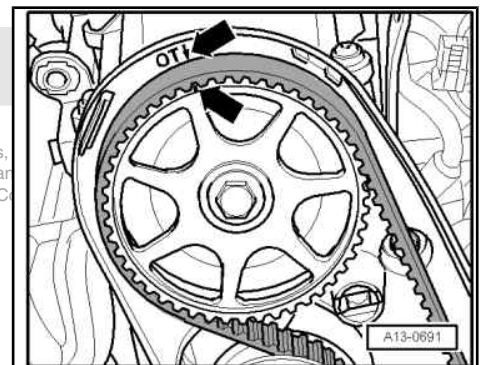
- Turn quick-release fastener -item 1- 90° anti-clockwise.
- Raise retaining tabs -arrows- and detach top toothed belt cover.



- Turn crankshaft at central bolt on crankshaft sprocket in direction of engine rotation to TDC mark for No. 1 cylinder -arrows-.

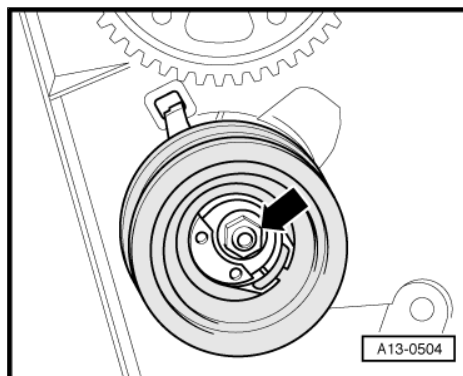


- At the same time the marking on front of the camshaft sprocket must align with the marking on the rear toothed belt cover -arrows-.
- Rotate crankshaft one turn further if necessary.



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- Loosen nut on tensioning roller -arrow- several turns.
- Remove toothed belt from camshaft sprocket.



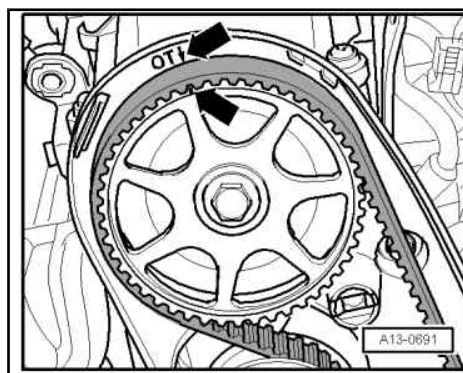
Installing (adjusting valve timing)



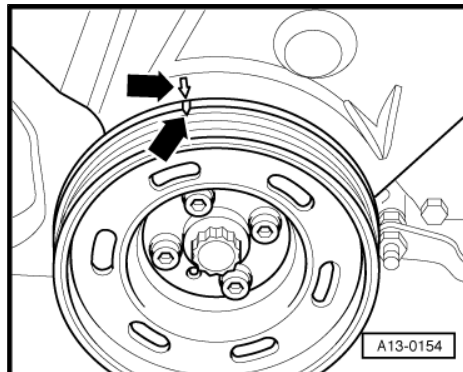
Note

When turning the camshaft, the crankshaft must not be at TDC. Otherwise, there is a risk of damage to valves and piston crowns.

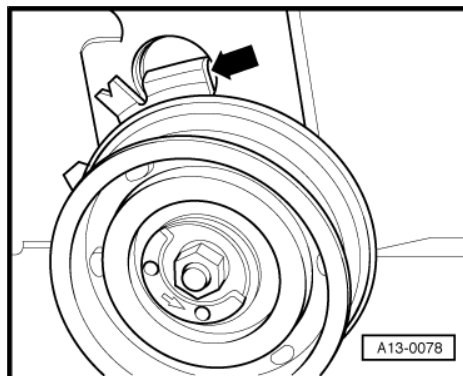
- Align mark on camshaft sprocket with mark on toothed belt cover -arrows-.



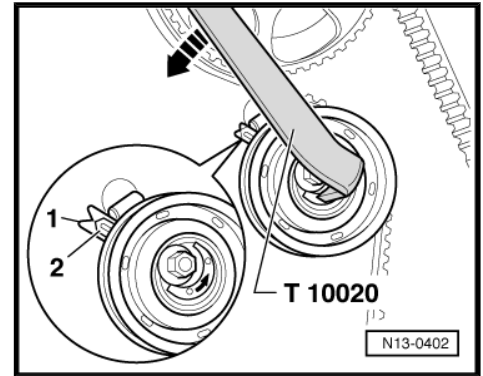
- Check again that crankshaft is at TDC of No. 1 cylinder -arrow-.
- Fit toothed belt onto coolant pump, tensioning roller and camshaft sprocket.



- Note correct position of semi-automatic tensioning roller:
 - Retaining lug -arrow- must engage in slot on cylinder head.



- Turn tensioning roller at eccentric adjuster in anti-clockwise direction -arrow- using pin wrench -T10020- until pointer -2- is above notch -1- (toothed belt over-tensioned).
- Repeat this work step („over-tensioning“ toothed belt) 5 times so that toothed belt stretches slightly.
- Now release tensioning roller until pointer -2- and notch -1- are aligned.
- Tighten securing nut
- Turn crankshaft at central bolt on toothed belt sprocket two revolutions in direction of engine rotation without stopping during final 45°.
- Check whether camshaft and crankshaft markings align at TDC with their respective reference points.
- Check again whether toothed belt is tensioned properly, repeat adjustment procedure if necessary.
- Fit toothed belt cover (top section).



The remaining installation steps are carried out in the reverse sequence.

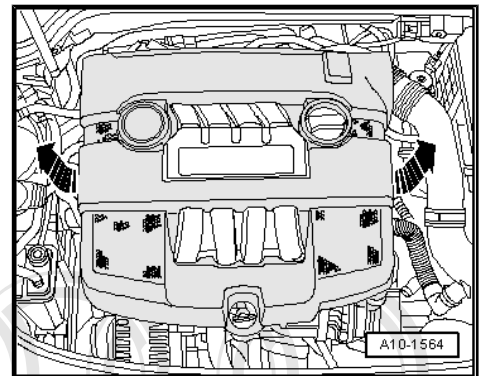
Tightening torque

Component	Nm
Toothed belt tensioning roller to cylinder head	23

1.8 Checking semi-automatic tensioning roller for toothed belt

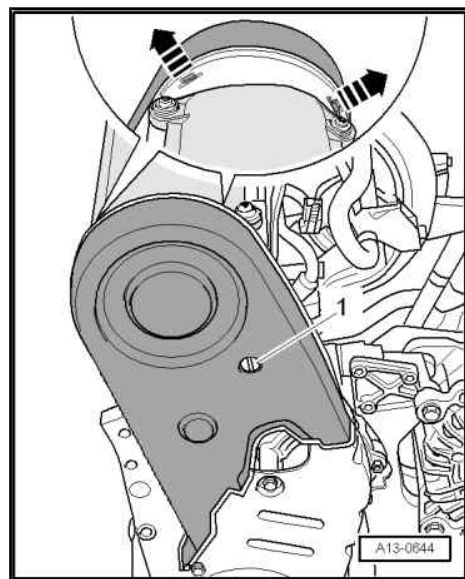
Test sequence

- Toothed belt in position and tensioned.
- Remove engine cover panel -arrows-.

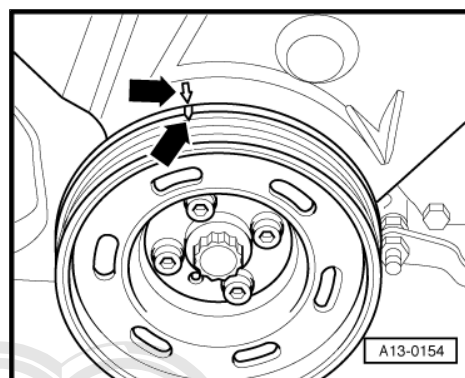


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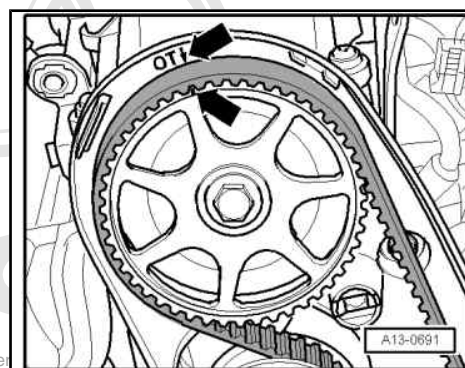
- Turn quick-release fastener -item 1- 90° anti-clockwise.
- Raise retaining tabs -arrows- and detach top toothed belt cover.



- Turn crankshaft at central bolt on crankshaft sprocket in direction of engine rotation to TDC mark for No. 1 cylinder -arrows-.



- At the same time the marking on front of the camshaft sprocket must align with the marking on the rear toothed belt cover -arrows-.
- Rotate crankshaft one turn further if necessary.



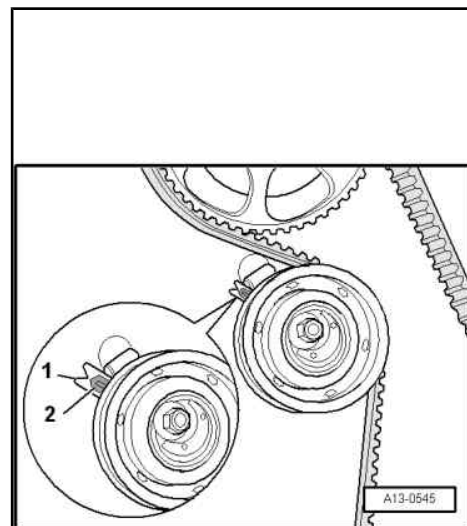
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- Push in toothed belt with firm thumb pressure.
- The pointer -2- should move sideways.
- Release thumb pressure on toothed belt.
- Tensioner should return to initial position. (Pointer back in line with notch -1-).



Note

Use a mirror to check.



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2 Removing and installing sealing flanges and flywheel/drive plate



Note

Servicing clutch ⇒ Rep. gr. 30

2.1 Sealing flanges and flywheel/drive plate - exploded view

1 - 15 Nm

2 - Seal

- ☐ Renewing ⇒ [page 65](#)
- ☐ Do not lubricate with oil

3 - Sealing flange (pulley end)

- ☐ Should be positioned on dowel pins
- ☐ Removing and installing ⇒ [page 67](#)

4 - Threaded pin, 10 Nm

- ☐ Apply locking fluid when installing; refer to ⇒ Electronic parts catalogue

5 - Cylinder block

6 - Seal

- ☐ Renew

7 - Screw plug, 100 Nm

8 - Securing bolt for flywheel/drive plate

- ☐ Renew
- ☐ Removing and installing flywheel ⇒ [page 72](#)
- ☐ Removing and installing drive plate ⇒ [page 73](#)

9 - Flywheel/drive plate

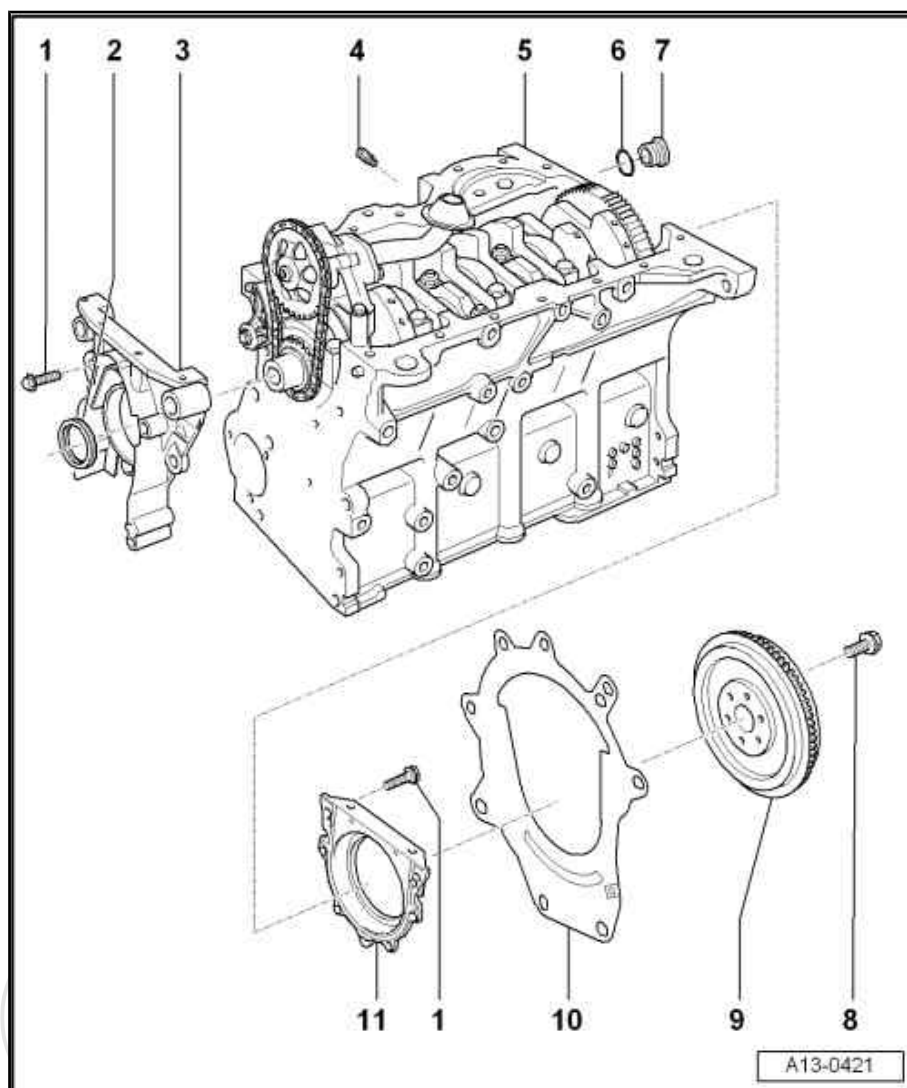
- ☐ Removing and installing flywheel ⇒ [page 72](#)
- ☐ Removing and installing drive plate ⇒ [page 73](#)
- ☐ Can only be installed in one position (holes are off-set)

10 - Intermediate plate

- ☐ Must be positioned on dowel sleeves
- ☐ Do not damage/bend when assembling
- ☐ Is fitted onto sealing flange ⇒ [page 65](#)

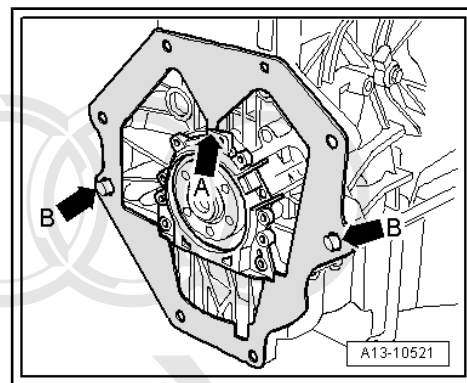
11 - Sealing flange (gearbox end)

- ☐ With oil seal
- ☐ Removing and installing ⇒ [page 69](#)
- ☐ Do not lubricate with oil



Installing intermediate plate

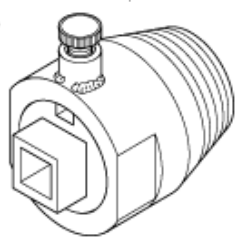
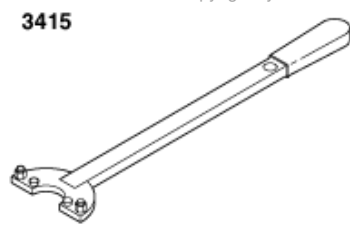
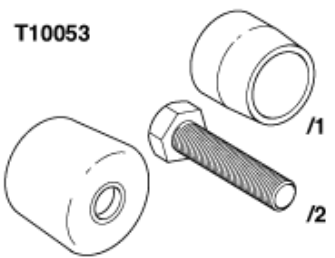
- Engage intermediate plate on sealing flange -arrow A- and push onto dowel sleeves -arrows B-.



2.2 Renewing crankshaft oil seal (pulley end)

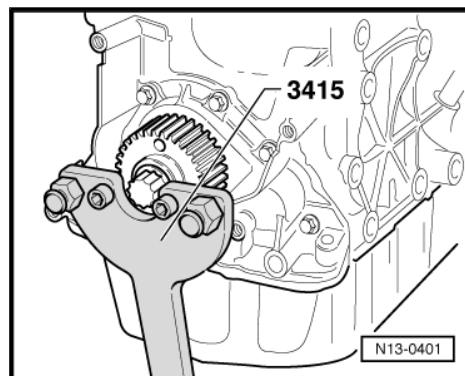
Special tools and workshop equipment required

- ◆ Oil seal extractor -3203-
- ◆ Counterhold tool -3415-
- ◆ Assembly tool -T10053-

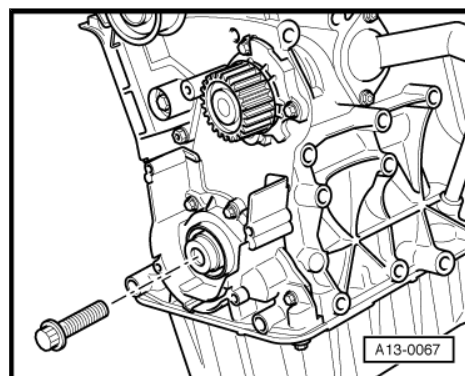
Protected by copyright. Copying for private or commercial purposes, in part or in whole, is not permitted unless authorised by AUDI AG. AUDI AG does not guarantee or accept any liability with respect to the correctness of information in this document. Copyright by AUDI AG. 3203 	3415 
T10053 	
	G13-0036

Procedure

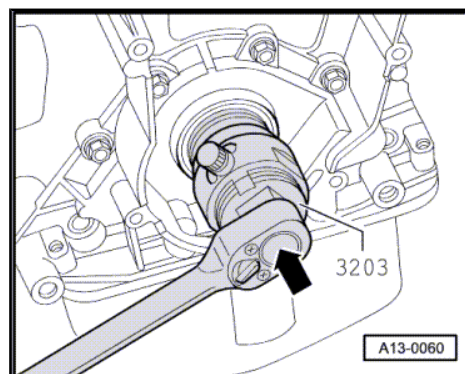
- Engine in vehicle.
- Remove toothed belt ⇒ [page 50](#) .
- Remove crankshaft sprocket; use counterhold tool -3415- to lock sprocket in place.



- Before fitting oil seal extractor, fully screw in centre bolt for sprocket into crankshaft.



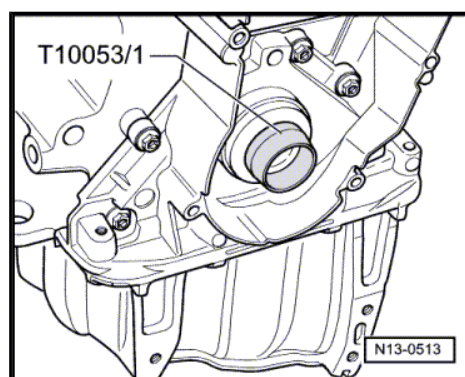
- Unscrew inner section of oil seal extractor -3203- nine turns out of outer section and lock inner section with knurled screw.
- Lubricate threaded head of oil seal extractor, place it in position and screw it into oil seal as far as possible (applying firm pressure).
- Loosen knurled screw and turn 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.



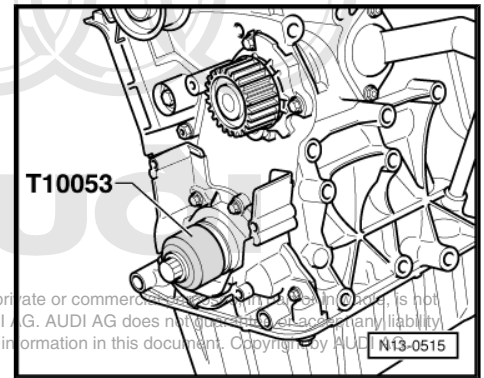
Note

Do not lubricate sealing lip and outer rim of oil seal before pressing in.

- Place guide sleeve -T10053/1- onto crankshaft journal.
- Slide oil seal over guide sleeve.



- Press in oil seal as far as stop using press sleeve and bolt from -T10053- .

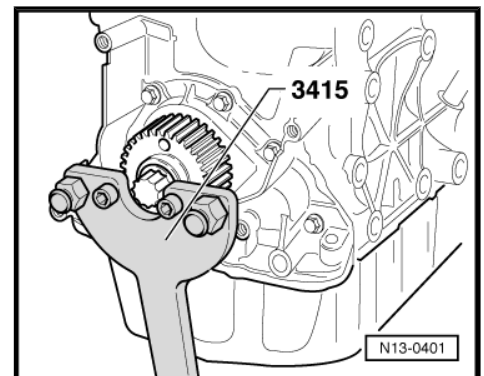


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- Renew centre bolt for toothed belt sprocket.
- Secure crankshaft sprocket; to do so, counterhold sprocket with counterhold tool -3415- .

Note

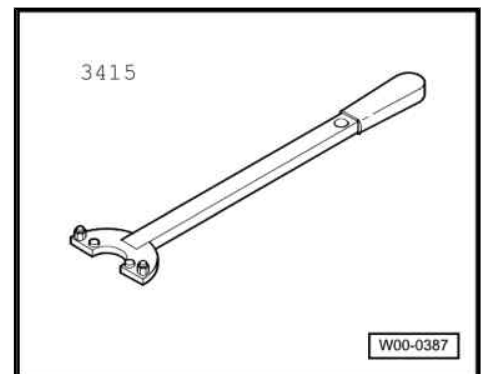
- ◆ *Contact surface between toothed belt sprocket and crankshaft must be free of oil.*
- ◆ *Do not lubricate bolt for crankshaft sprocket.*
- Install toothed belt (adjust valve timing) ⇒ [page 55](#) .
- Install poly V-belt ⇒ [page 43](#) .



Tightening torque

Component	Nm
Toothed belt sprocket to crankshaft	90 + 90° ¹⁾²⁾
• ¹⁾ Renew bolts. • ²⁾ 90° = one quarter turn	

2.3 Removing and installing sealing flange (pulley end)

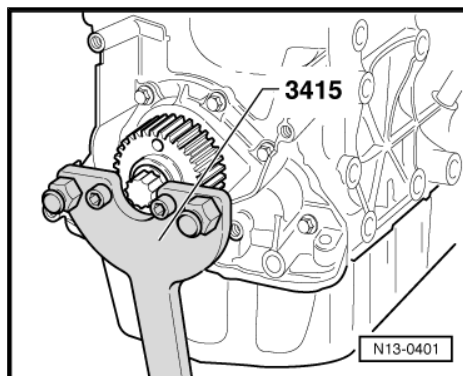


Special tools and workshop equipment required

- ◆ Counterhold tool -3415-
- ◆ Electric drill with plastic brush attachment
- ◆ Safety goggles
- ◆ Sealant ⇒ Electronic parts catalogue

Removing

- Engine in vehicle.
- Remove toothed belt ⇒ [page 50](#) .
- Remove crankshaft sprocket; use counterhold tool -3415- to lock sprocket in place.



- Remove bolts -1 ... 10-.
- Pry off sealing flange (pulley end) and remove.
- Drive out oil seal with flange removed.

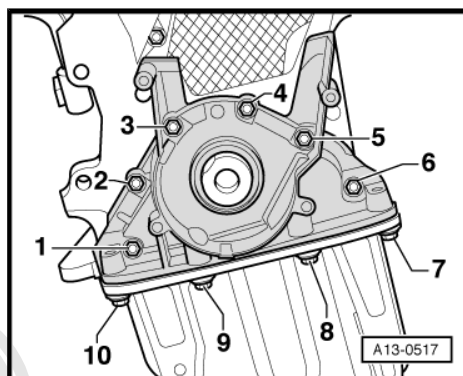
Installing



Note

Place a cloth over the exposed section of the sump.

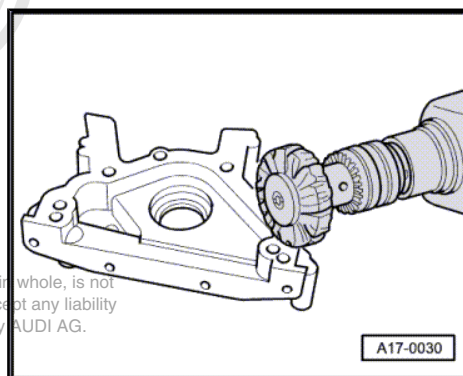
- Carefully remove sealant residue on cylinder block and on sump.



WARNING

Wear safety goggles.

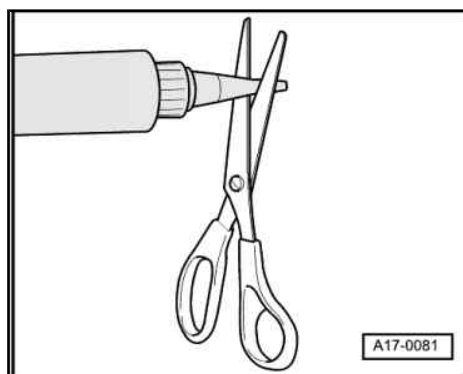
- Remove sealant residue on sealing flange using rotating plastic brush or similar.
- Clean sealing surfaces; they must be free of oil and grease.



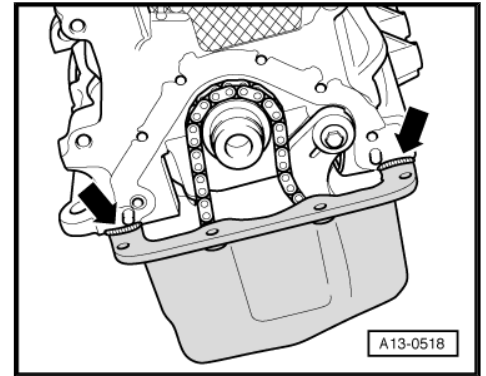
Note

Note the use-by date of the sealant.

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



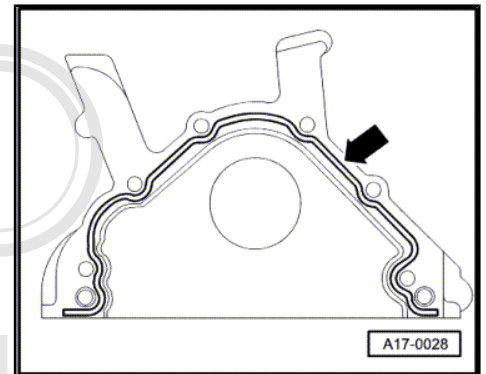
- Apply a thin bead of sealant at the edge of the joint between the cylinder block and the sump -arrows-.



- Apply the bead of sealant onto the clean sealing surface of the sealing flange as illustrated -arrow-.
- Thickness of sealant bead: 2 ... 3 mm

i Note

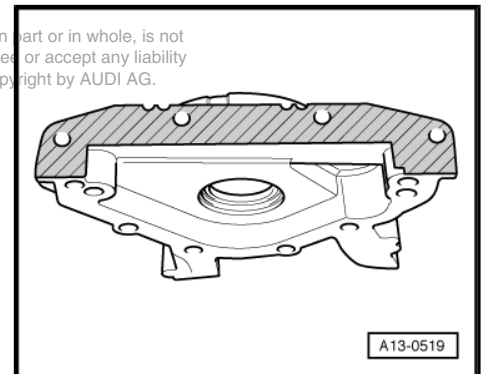
- ◆ The bead of sealant must not be thicker than specified, otherwise excess sealant can enter the sump and obstruct the strainer in the oil intake pipe.
- ◆ The sealing flange must be installed within 5 minutes after applying sealant.



- Coat the lower sealing surface on the sealing flange lightly with sealant -hatched area-.
- Carefully push the sealing flange onto the dowel pins on the engine block.

i Note

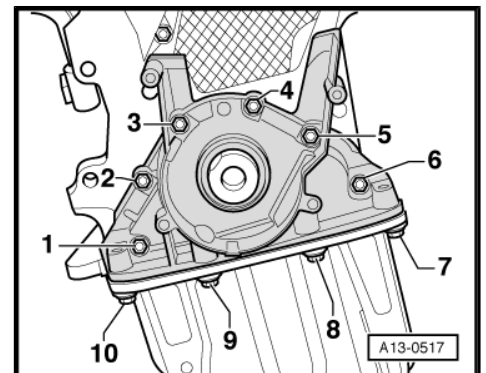
Use guide sleeve -T10053/1- to attach sealing flange with oil seal fitted.



- Tighten bolts in the specified sequence:
- First tighten bolts -1 ... 6-.
- Then tighten bolts -7 ... 10-.
- Install crankshaft oil seal (pulley end) ⇒ [page 65](#) .
- Install toothed belt (adjust valve timing) ⇒ [page 55](#) .

Tightening torque

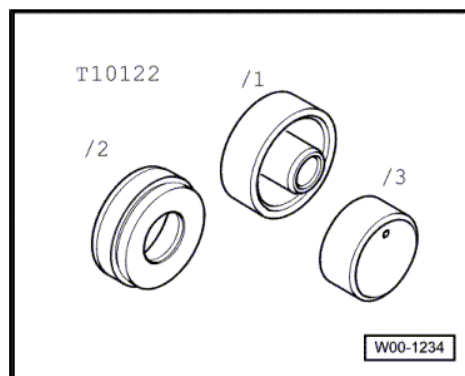
Component	Nm
Sealing flange (pulley end) to cylinder block	15



2.4 Removing and installing sealing flange (gearbox end)

Special tools and workshop equipment required

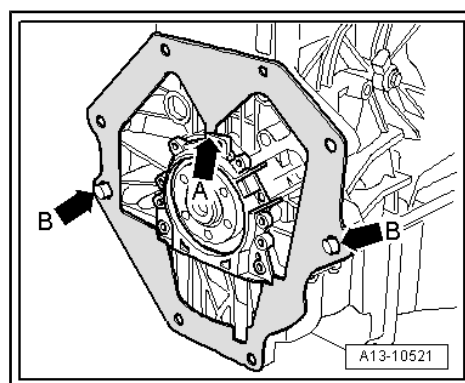
◆ Fitting tool -T10122-



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

Removing

- Gearbox removed.
- Remove flywheel ⇒ [page 72](#) .
- Disengage intermediate plate on sealing flange -arrow A- and pull intermediate plate off dowel sleeves -arrows B-.



- Remove bolts -1 ... 8-.
- Lever off sealing flange (gearbox end) and remove.

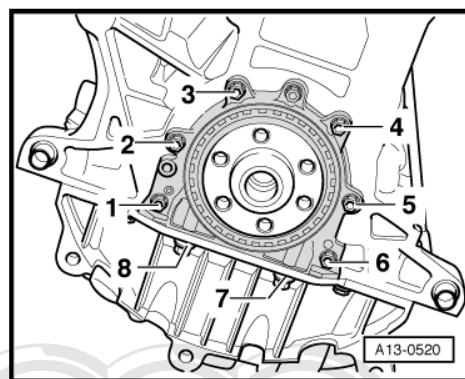
Installing

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

***i** Note*

Place a cloth over the exposed section of the sump.

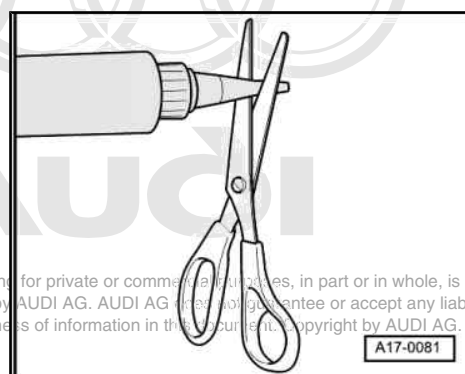
- Carefully remove sealant residues from sump and bottom of sealing flange.
- Clean sealing surfaces; they must be free of oil and grease.



***i** Note*

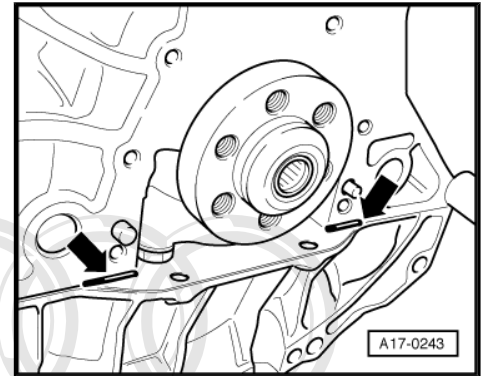
Note the use-by date of the sealant.

- Cut off tube nozzle at front marking (diameter of nozzle approx. 3 mm).



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

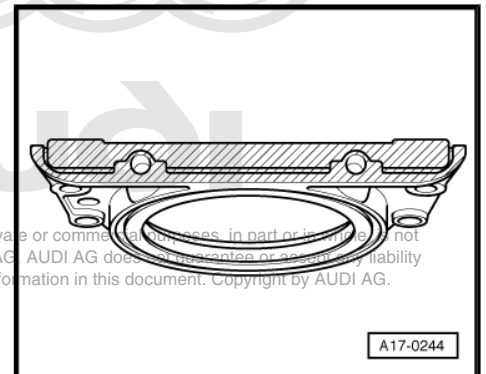


- Coat the lower sealing surface on the sealing flange lightly with sealant -hatched area-.

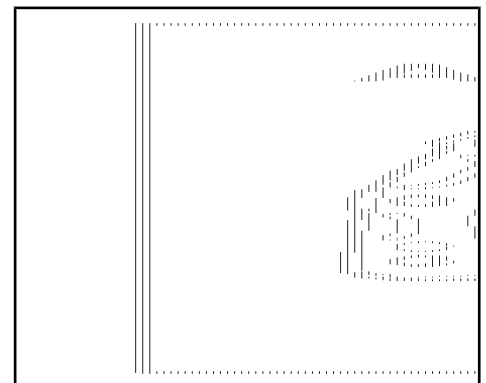
**Note**

The sealing flange must be installed within 5 minutes after applying sealant.

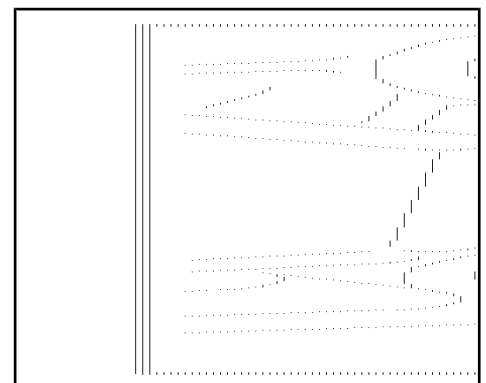
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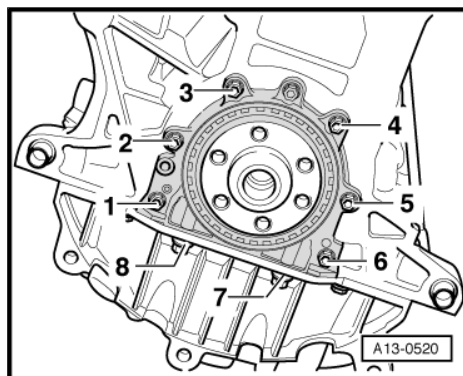
- Attach fitting sleeve -T10122/1- to guide sleeve -T10122/2- .
- Slide sealing flange -A- over fitting sleeve and onto guide sleeve.



- Detach fitting sleeve -T10122/1- , position guide sleeve -T10122/2- on crankshaft journal and push sealing flange onto cylinder block.



- Tighten bolts in the specified sequence:
- First tighten bolts -1 ... 6-.
- Then tighten bolts -7- and -8-.

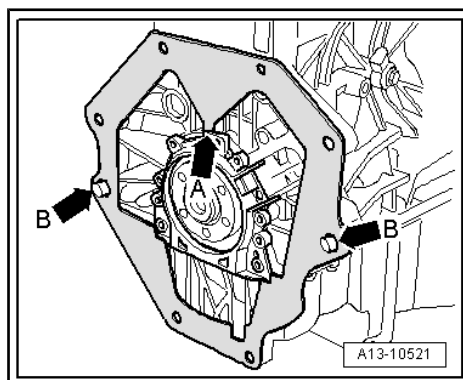


- Engage intermediate plate on sealing flange -arrow A- and push onto dowel sleeves -arrows B-.
- Install flywheel ⇒ [page 72](#) .

Tightening torque

Component	Nm
Sealing flange (gearbox end) to cylinder block	15

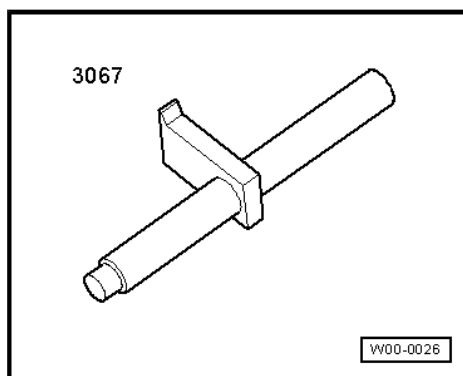
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2.5 Removing and installing flywheel

Special tools and workshop equipment required

- ◆ Counterhold tool -3067-



Removing

- Gearbox removed.
- Remove clutch pressure plate ⇒ Rep. gr. 30 .
- Mark installation position of flywheel on engine.
- Insert counterhold tool -3067- to slacken bolts.
- Unbolt flywheel.

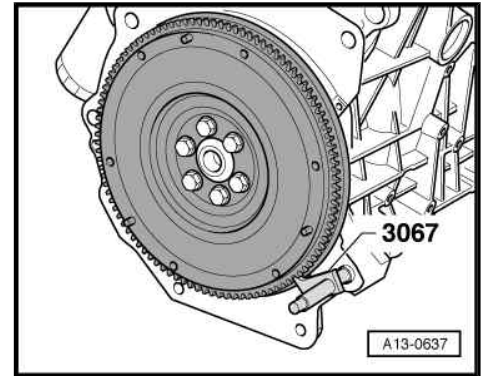
Installing

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

- Use new securing bolts.
- Fit counterhold tool -3067- the other way round to tighten bolts.
- Install clutch pressure plate ⇒ Rep. gr. 30 .

Tightening torque

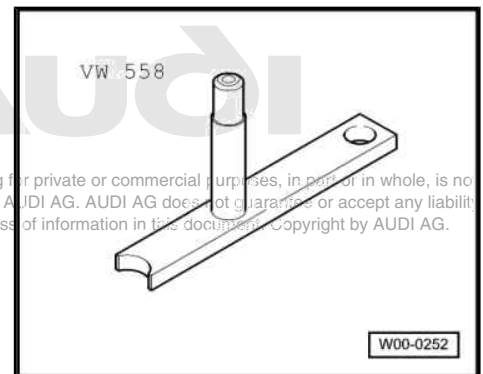
Component	Nm
Flywheel to crankshaft	
Bolt length 19.5 mm	60 + 90° 1)2)
• 1) Renew bolt. • 2) 90° = one quarter turn.	



2.6 Removing and installing drive plate

Special tools and workshop equipment required

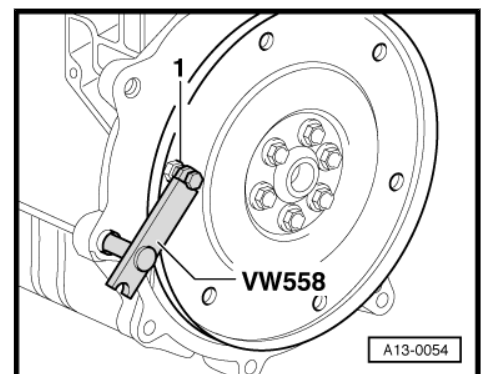
- ◆ Clutch counterhold tool -VW 558-



- ◆ Hexagon bolt M8x45 and hexagon nut M10 (2x)
- ◆ Depth gauge

Removing

- Gearbox removed.
- Secure counterhold tool for clutch -VW 558- to drive plate using hexagon bolt M8x45. Insert two M10 hexagon nuts -1- between counterhold tool and drive plate.
- Mark installation position of drive plate on crankshaft.
- Unbolt drive plate.

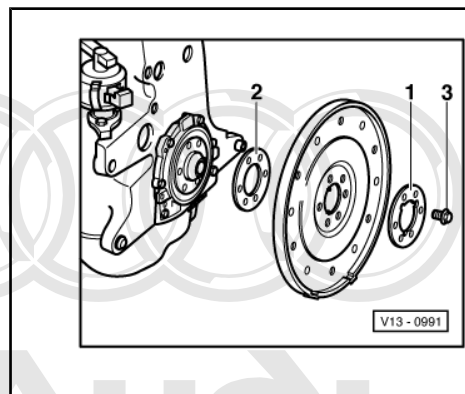


Installing

- Fit drive plate with shim -2- (thickness 1.2 mm) and washer -1- (thickness 0.5 mm).
- Secure drive plate with new bolts.

Tightening torque

Component	Nm
Drive plate to crankshaft	60 + 90° 1)2)
• 1) Renew bolts. • 2) 90° = one quarter turn.	



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3 Crankshaft



Note

- ◆ *Bearing shells of the correct thickness are assigned to the cylinder block at the factory. Coloured dots are used to identify the thickness of the bearing shells.*
- ◆ *When carrying out repairs, secure engine with engine and gearbox support -VW 540- to engine and gearbox support -VAS 6095- ⇒ [page 28](#).*

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3.1 Crankshaft - exploded view

1 - Thrust washers

- ☐ For bearing No. 3
- ☐ Installation position: oil grooves face toward crank webs

2 - Bearing shell

- ☐ For cylinder block (with oil groove)
- ☐ Do not interchange used bearing shells (mark positions)
- ☐ Install new bearing shells for the cylinder block with the correct coloured markings ⇒ [page 77](#)
- ☐ Note location
- ☐ Check radial clearance with Plastigage

3 - Chain sprocket

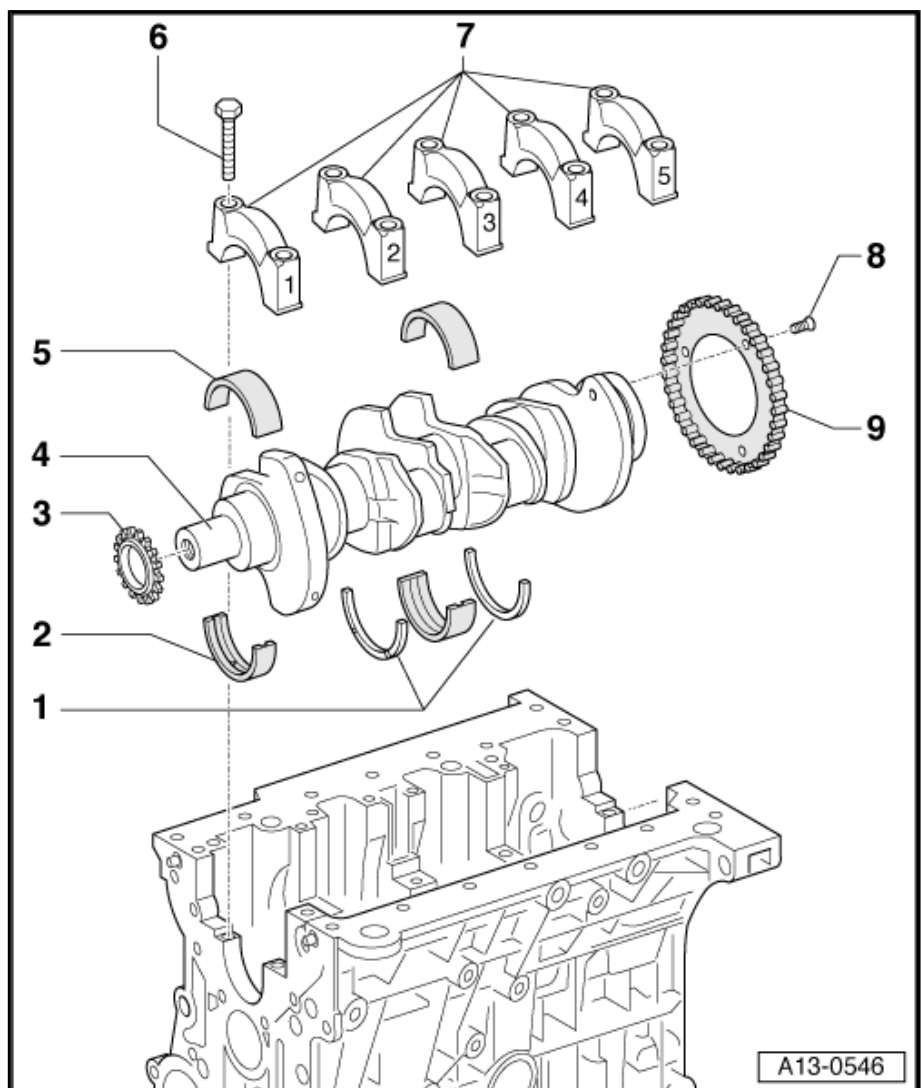
- ☐ For oil pump chain
- ☐ Renewing ⇒ [page 77](#)

4 - Crankshaft

- ☐ Axial clearance when new: 0.07 ... 0.23 mm; wear limit: 0.30 mm
- ☐ Check radial clearance with Plastigage
- ☐ Do not rotate the crankshaft when checking the radial clearance
- ☐ Radial clearance when new: 0.017 ... 0.037 mm; wear limit 0.07 mm
- ☐ Crankshaft dimensions ⇒ [page 77](#)

5 - Bearing shell

- ☐ For bearing cap (without oil groove)
- ☐ Do not interchange used bearing shells (mark positions)
- ☐ The crankshaft bearing shells in the bearing caps are only supplied as spare parts with „yellow“ colour-coding.



- ☐ Note location
- ☐ Check radial clearance with Plastigage

6 - 40 Nm + 90° (1/4 turn) further

- ☐ Renew
- ☐ For measuring radial clearance of crankshaft, tighten to 40 Nm but not further

7 - Bearing cap

- ☐ Bearing cap 1: Pulley end
- ☐ Installation position: Bearing shell retaining lugs (cylinder block/bearing cap) must be on the same side.

8 - 10 Nm + 90° (1/4 turn) further

- ☐ Renew
- ☐ Sender wheel must be renewed if bolts are loosened ⇒ [page 76](#)

9 - Sender wheel

- ☐ For engine speed sender -G28-
- ☐ Can only be installed in one position (holes are off-set)
- ☐ Sender wheel must be renewed if bolts are loosened
- ☐ Removing and installing ⇒ [page 76](#)

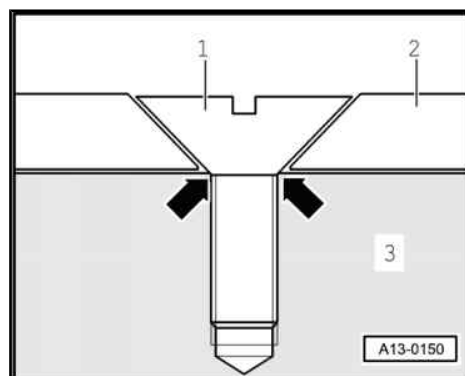
Removing and installing sender wheel

- Sender wheel -2- must always be renewed after slackening off bolts -1-.



Note

- ◆ If the countersunk bolts are tightened a second time, the seats for the bolt heads in the sender wheel will be deformed to such an extent that the bolt heads make contact with the crankshaft -3- -arrows- and the sender wheel beneath the bolts will be loose.
- ◆ Sender wheel can only be installed in one position. Holes are off-set.



Tightening torque

Component	Nm
Sender wheel to crankshaft	10 + 90° 1)2)
• 1) Renew bolts. • 2) 90° = one quarter turn	

Allocation of crankshaft bearing shells for cylinder block

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

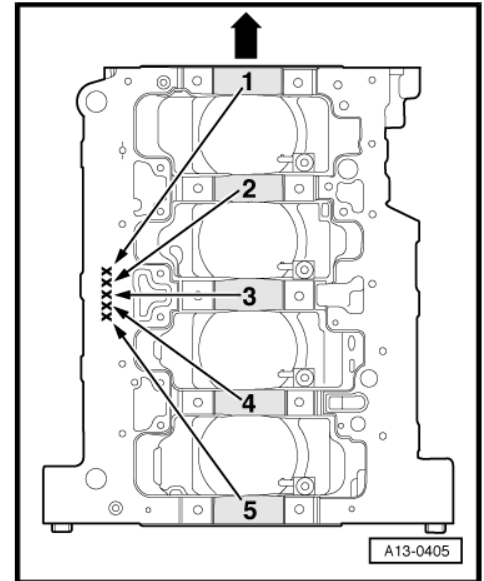


Note

- ◆ Arrow points towards pulley side.
- ◆ The markings are visible without removal of the sump.

Letter codes on lower sealing surface of cylinder block indicate which bearing shell is to be fitted at each location.

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



Note

- ◆ Use blue bearing shells for the top crankshaft bearings if the identification is no longer visible.
- ◆ The bottom crankshaft bearing shells are only supplied as replacement parts with „yellow“ marking.
- ◆ The crankshaft bearing shells in the bearing caps are only supplied as spare parts with „yellow“ coloured markings.

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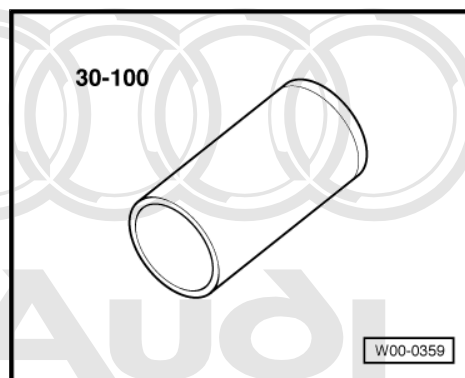
3.2 Crankshaft dimensions

Honing dimension (in mm)	Crankshaft main bearing journal Ø	Conrod bearing journal Ø
Basic dimension	48.00 -0.017 -0.037	42.00 -0.022 -0.042
Repair undersize I	47.75 -0.017 -0.037	41.75 -0.022 -0.042
Repair undersize II	47.50 -0.017 -0.037	41.50 -0.022 -0.042
Repair undersize III	47.25 -0.017 -0.037	41.25 -0.022 -0.042

3.3 Removing and installing chain sprocket

Special tools and workshop equipment required

◆ Drift sleeve -30 - 100-

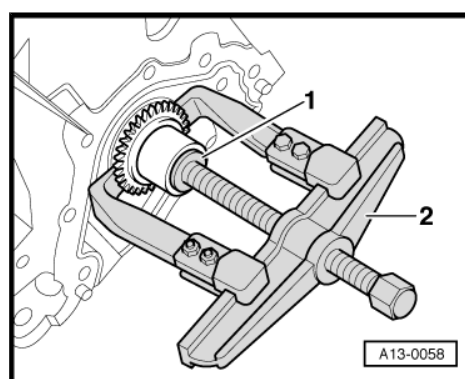


◆ Two-arm puller, commercially available

◆ Protective gloves

Removing

- Remove sealing flange (pulley end) ⇒ [page 67](#) .
- Remove sump ⇒ [page 119](#) .
- Remove oil pump sprocket, chain tensioner and chain ⇒ [Item 2 \(page 118\)](#) .
- Detach chain sprocket from crankshaft with puller -2-; use a suitable washer -1- to protect end of crankshaft.



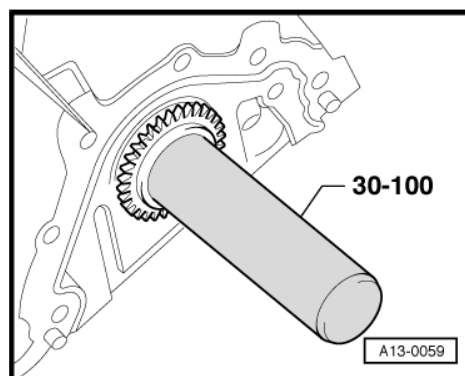
Installing



WARNING

Wear protective gloves.

- Heat chain sprocket in oven for approx. 15 minutes to 220°C.
- Using pliers, locate sprocket on end of crankshaft.
- Installation position: wider collar on sprocket faces engine.
- Push sprocket onto crankshaft as far as the stop using drift sleeve -30 - 100- .



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

- Install oil pump sprocket, chain tensioner and chain ⇒ [Item 2 \(page 118\)](#) .
- Install sump ⇒ [page 119](#) .
- Install sealing flange (pulley end) ⇒ [page 67](#) .

4 Pistons and conrods



Note

Oil spray jet and pressure relief valve ⇒ [page 82](#)

4.1 Pistons and conrods - exploded view

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

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

2 - Conrod bearing cap

- ☐ Mark cylinder number -B-
- ☐ Installation position: Markings -A- face towards pulley end

3 - Bearing shells

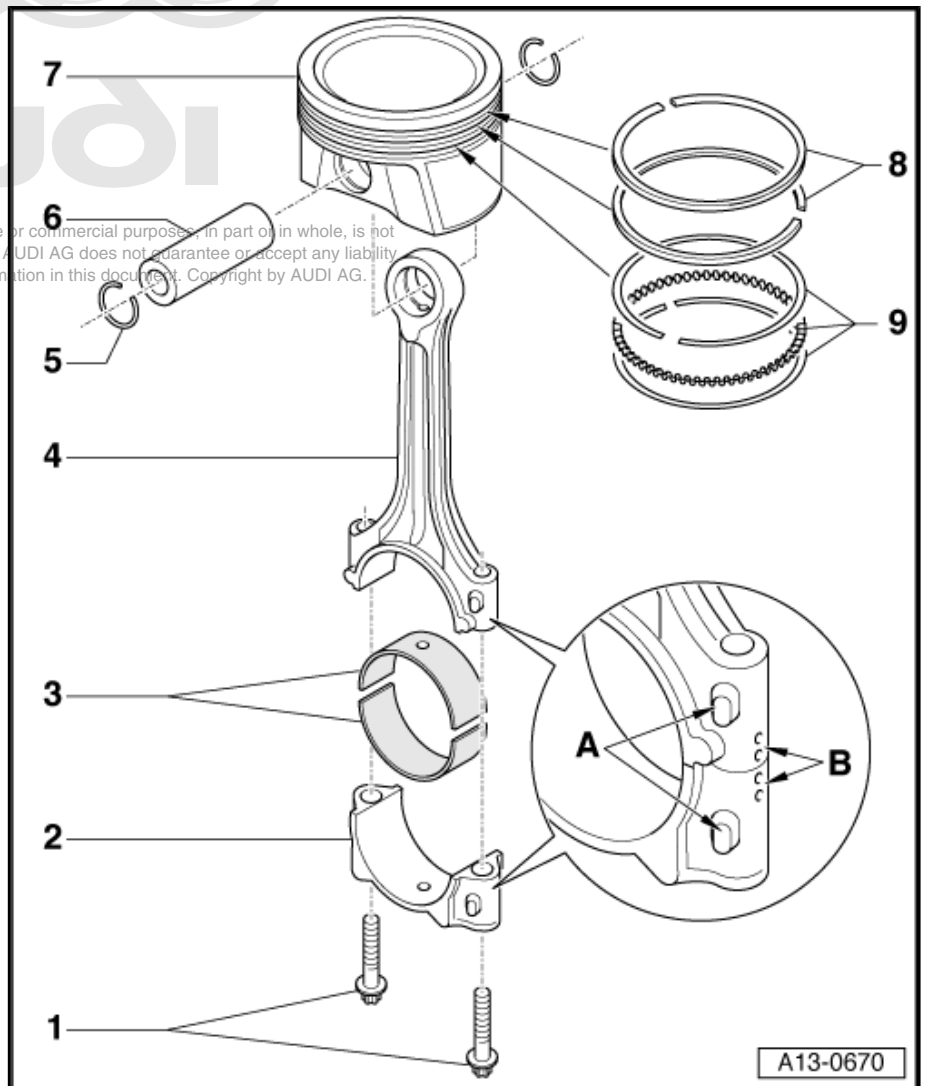
- ☐ Engine code BGU: Upper bearing shell has oil drilling for piston pin lubrication
- ☐ Engine codes BSE, BSF, CCSA, CMXA: Upper bearing shell does not have oil drilling
- ☐ Installation position ⇒ [page 81](#)
- ☐ Do not interchange used bearing shells (mark positions)
- ☐ Axial clearance when new: 0.09 ... 0.35 mm; wear limit: 0.4 mm
- ☐ Check radial clearance with Plastigage
- ☐ Do not rotate crankshaft when checking radial clearance
- ☐ Radial clearance when new: 0.020 ... 0.061 mm; wear limit 0.091 mm

4 - Conrod

- ☐ Only renew as a complete set
- ☐ With industrially cracked conrod bearing cap
- ☐ Separating parts of new conrod ⇒ [page 81](#)
- ☐ Mark cylinder number -B-
- ☐ Installation position: Markings -A- face towards pulley end

5 - Circlip

- ☐ Renew



6 - Piston pin

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

7 - Piston

- ☐ Checking ⇒ [page 81](#)
- ☐ Mark installation position and cylinder number
- ☐ Arrow on piston crown points to pulley end
- ☐ Install using piston ring clamp
- ☐ Checking cylinder bore ⇒ [page 81](#)
- ☐ Piston and cylinder dimensions ⇒ [page 82](#)

8 - Piston rings

- ☐ Compression rings
- ☐ Offset gaps by 120°
- ☐ Use piston ring pliers to remove and install
- ☐ „TOP“ must face towards piston crown
- ☐ Checking ring gap ⇒ [page 80](#)
- ☐ Checking ring-to-groove clearance ⇒ [page 80](#)

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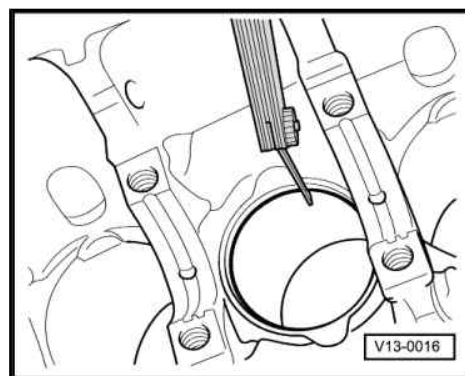
9 - Piston ring

- ☐ Oil scraper ring
- ☐ 3 parts
- ☐ Offset gap of top steel element of piston ring by 120° to next compression ring
- ☐ Offset gaps of individual parts of oil scraper ring

Checking piston ring gap

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

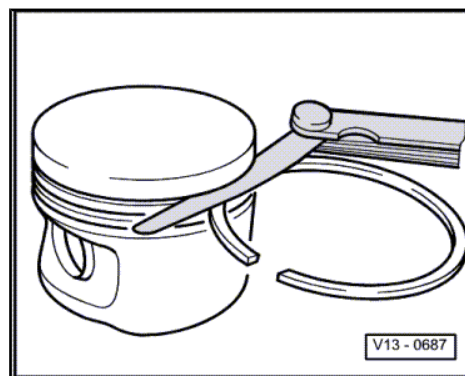
Piston ring Dimensions in mm	New	Wear limit
Compression rings	0.75 ... 1.00	1.40
Steel elements of oil scraper ring	0.20 ... 0.60	0.90



Checking ring-to-groove clearance

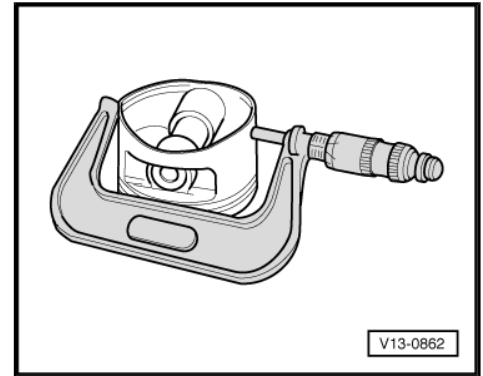
- Clean groove in piston before checking clearance.

Piston ring Dimensions in mm	New	Wear limit
Compression rings	0.06 ... 0.09	0.20
Oil scraper rings	0.04 ... 0.12	0.20



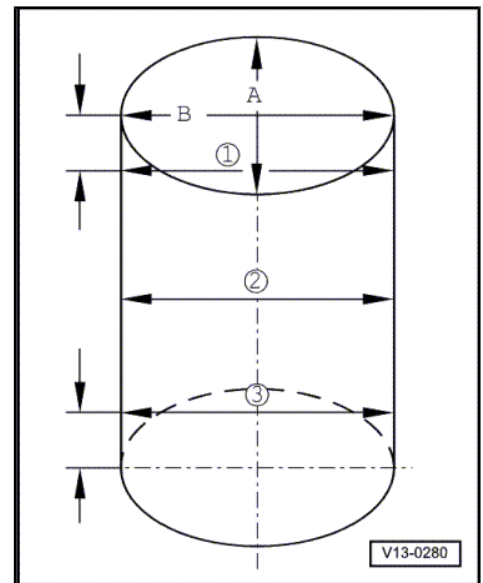
Checking piston

- Measure approx. 10 mm from the bottom edge, perpendicular to the piston pin axis.
- Maximum deviation from nominal dimension: 0.04 mm.



Checking cylinder bore

- Use an internal dial 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.



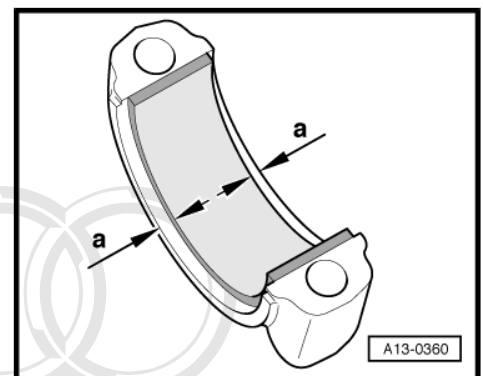
Installation position of bearing shells in conrods

- Insert bearing shells centrally in conrod/conrod bearing cap.
- Distance -a- = 3.0 mm.



Note

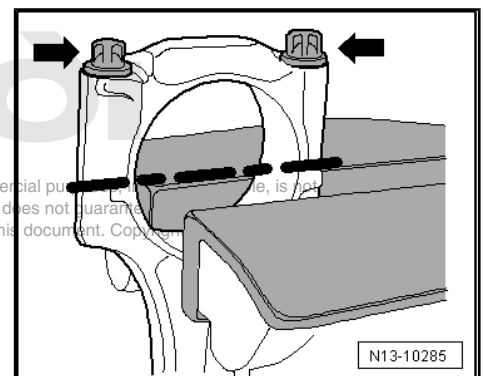
- ♦ Engine code BGU: The bearing shell with the oil drilling must be fitted in the conrod.
- ♦ Engine codes BSE, BSF, CCSA, CMXA: Bearing shells do not have oil drillings.



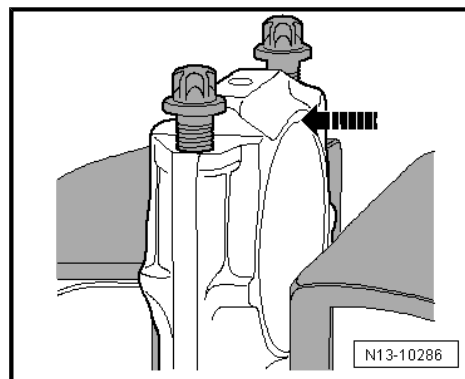
Separating parts of new conrod

It is possible that the two parts of a new conrod are not completely separated as intended. If it is not possible to take off the conrod bearing cap by hand, proceed as follows:

- To avoid any risk of damage, the conrod should only be clamped lightly in a vice using jaw covers as shown in illustration.
- The conrod is clamped in position below the dotted line.
- Unscrew bolts -arrows- approx. 5 turns.



- Using a plastic hammer, carefully knock conrod bearing cap loose -arrow-.



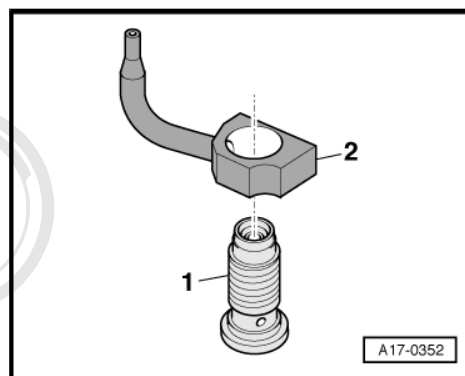
Oil spray jet and pressure relief valve

- 1 - Bolt with pressure relief valve, 27 Nm
- 2 - Oil spray jet (for cooling of pistons)



Note

- ◆ Take care not to bend oil spray jets.
- ◆ Always renew bent oil spray jets.



4.2 Piston and cylinder dimensions

Honing dimension (in mm)	Piston Ø	Cylinder bore Ø
Basic dimension	80.965 ¹⁾	81.010
Repair oversize	81.465 ¹⁾	81.510
¹⁾Dimensions not including graphite coating (thickness 0.02 mm). The graphite coating will wear down in service.		

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15 – Cylinder head, valve gear

1 Cylinder head

1.1 Cylinder head - exploded view

1 - 23 Nm

- ☐ Apply locking fluid when fitting
- ☐ Locking fluid ⇒ Electronic parts catalogue

2 - Camshaft sprocket

3 - 100 Nm

- ☐ Use counterhold tool -3415- to loosen and tighten

4 - 10 Nm

- ☐ Apply locking fluid when installing; refer to ⇒ Electronic parts catalogue

5 - Toothed belt cover (rear)

6 - Parallel key

7 - Seal

- ☐ Renew

8 - 10 Nm

9 - Breather connection

- ☐ To coolant expansion tank

10 - Special bolt, 9 Nm

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

11 - Seal

- ☐ Renew if damaged or leaking

12 - Filler cap

13 - Cylinder head cover

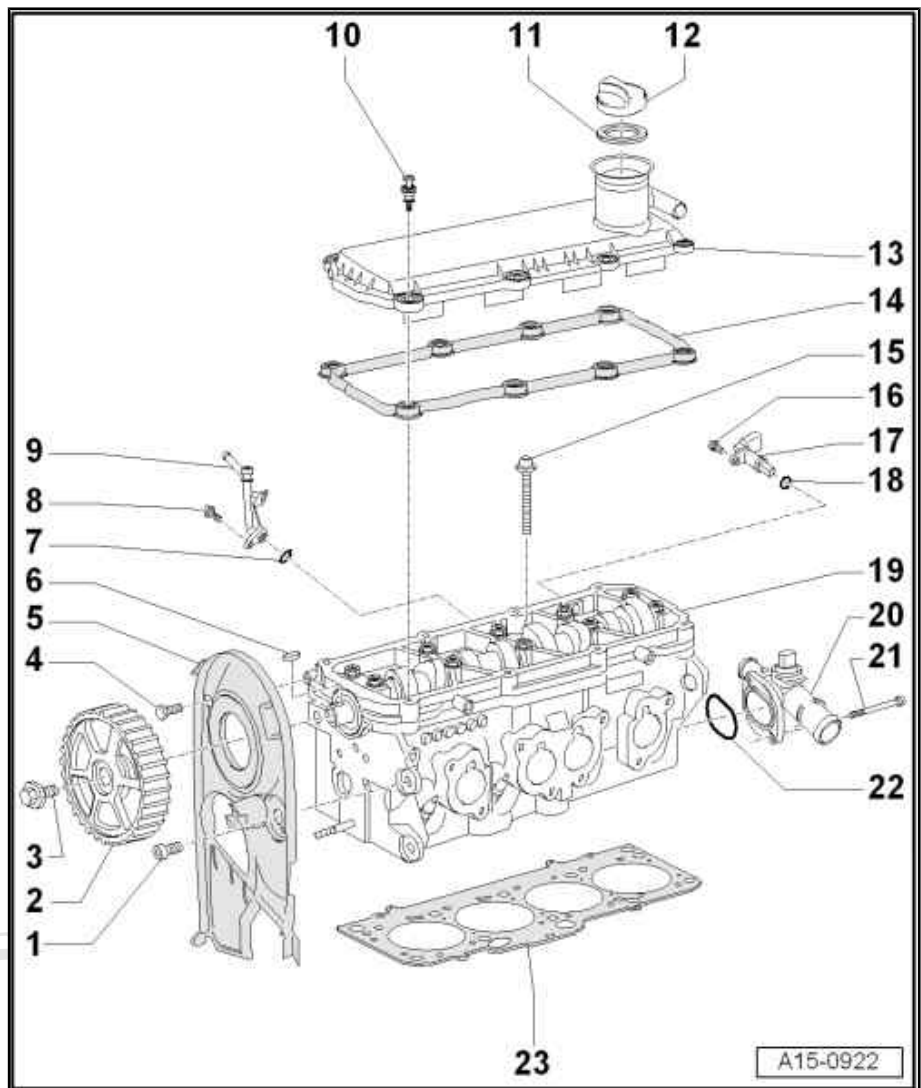
- ☐ Removing and installing ⇒ [page 85](#)

14 - Gasket for cylinder head cover

- ☐ Renew if damaged or leaking
- ☐ Engage in spacer sleeves of ⇒ [Item 10 \(page 83\)](#)

15 - Cylinder head bolt

- ☐ Renew
- ☐ Note correct sequence when loosening ⇒ [page 93](#)
- ☐ Note correct sequence when tightening ⇒ [page 95](#)



16 - 10 Nm

17 - Hall sender -G40-

18 - O-ring

- ☐ Renew

19 - Cylinder head

- ☐ Removing and installing ⇒ [page 85](#)
- ☐ Checking for distortion ⇒ [page 84](#)
- ☐ Machining limit ⇒ [page 84](#)
- ☐ If renewed, change coolant and engine oil

20 - Connection

21 - 10 Nm

22 - O-ring

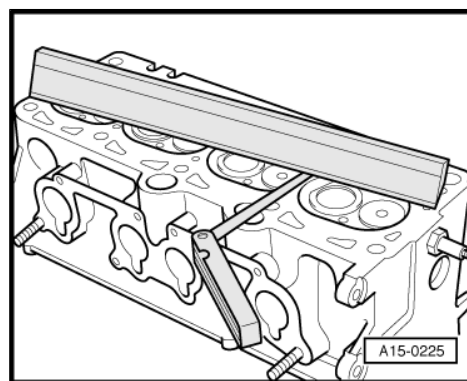
- ☐ Renew

23 - Cylinder head gasket

- ☐ Renewing ⇒ „1.3 Removing and installing cylinder head“, [page 85](#)
- ☐ Installation position: Part number points towards cylinder head, and must be legible from the inlet side
- ☐ If renewed, change coolant and engine oil

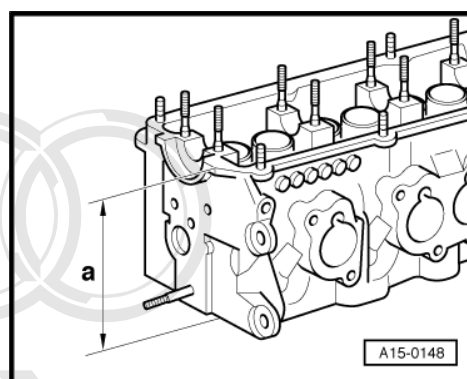
Checking cylinder head for distortion

- 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 = 132.8 mm



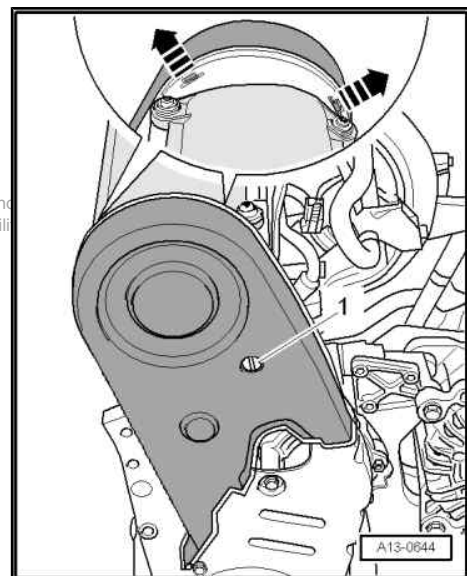
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1.2 Removing and installing cylinder head cover

Removing

- Remove intake manifold ⇒ Rep. gr. 24 .
- Turn quick-release fastener -item 1- 90° anti-clockwise.
- Raise retaining tabs -arrows- and detach top toothed belt cover.

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- Remove crankcase breather hose from cylinder head cover.
- Remove cylinder head cover bolts in the sequence -8 ... 1-.
- Remove cylinder head cover.

Installing

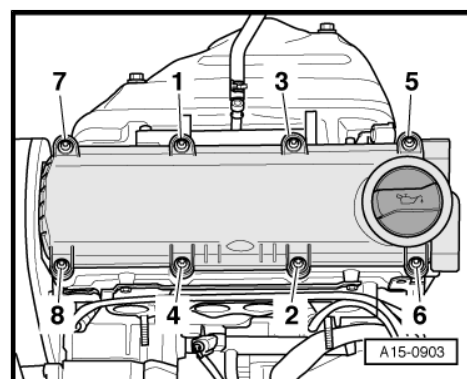
Installation is carried out in the reverse order; note the following:



Note

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

- Tighten bolts for cylinder head cover in the sequence -1 ... 8-.
- Install intake manifold ⇒ Rep. gr. 24 .



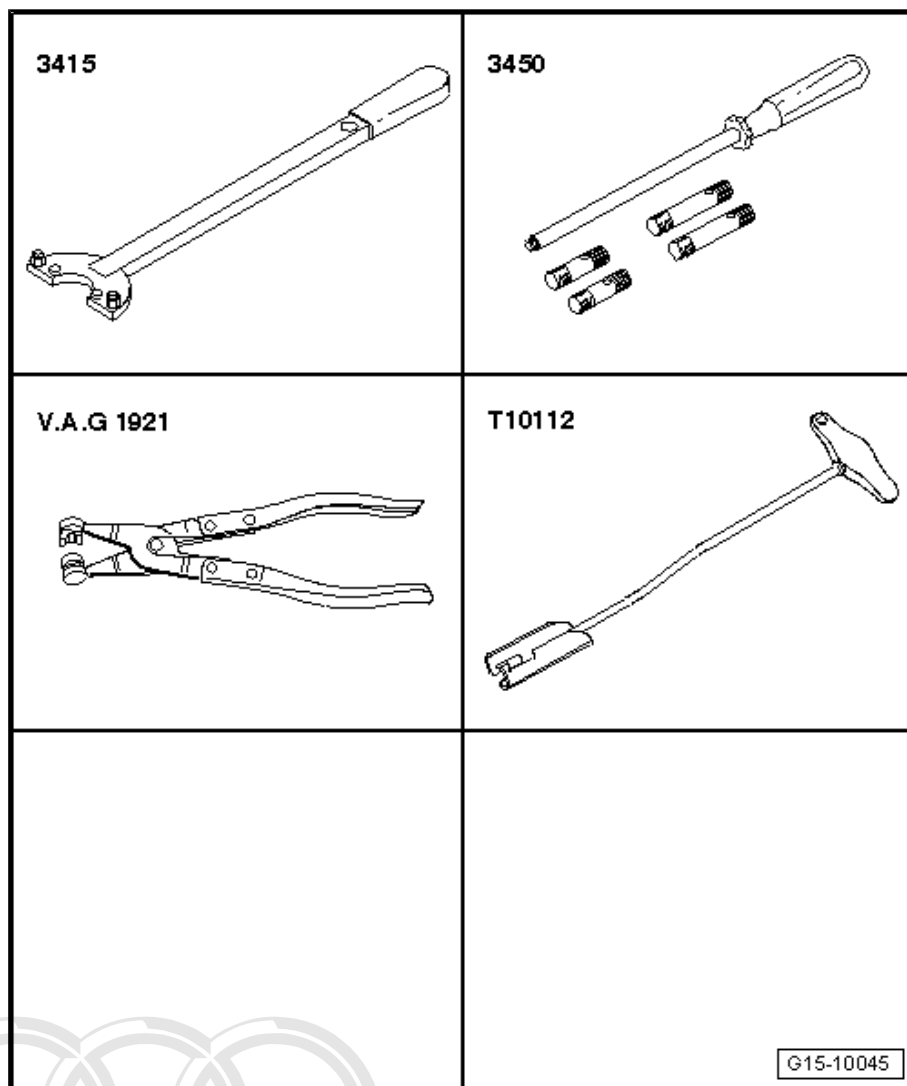
Tightening torque

Component	Nm
Cylinder head cover to cylinder head	9

1.3 Removing and installing cylinder head

Special tools and workshop equipment required

- ◆ Counterhold tool -3415-
- ◆ Guide pin -3450-
- ◆ Hose clip pliers -V.A.G 1921-
- ◆ Puller -T10112-



Removing



Note

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



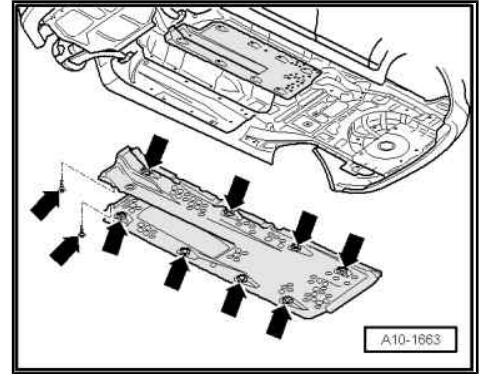
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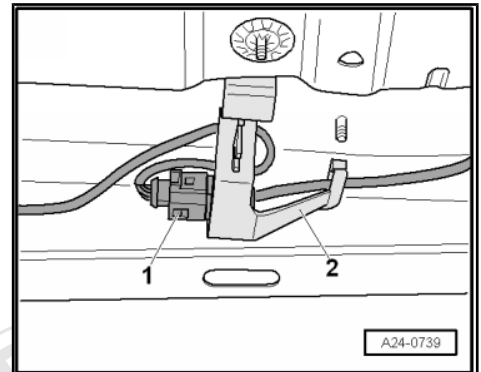
Observe notes on procedure for disconnecting the battery ⇒ Rep. gr. 27.

- Disconnect earth wire at battery with ignition switched off.
- Drain off coolant ⇒ [page 129](#).

- Remove underbody cover (right-side) -arrows-.



- Unplug electrical connector -1-.
- Detach plug connector from bracket -2- and expose wire leading to Lambda probe after catalytic converter -G130-.



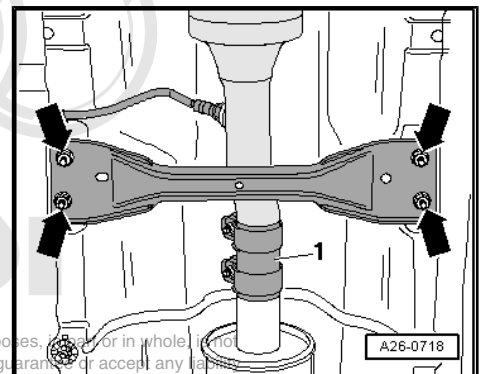
- Remove front cross-piece for underbody -arrows-.



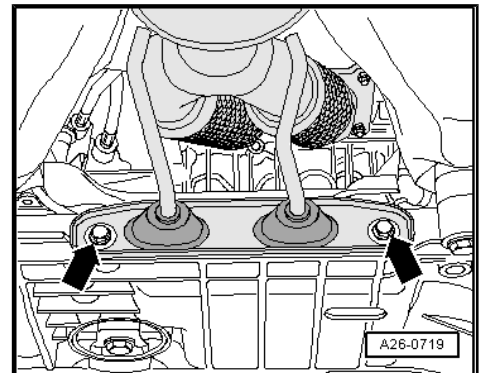
Note

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

- Disconnect exhaust system at clamp -1-.



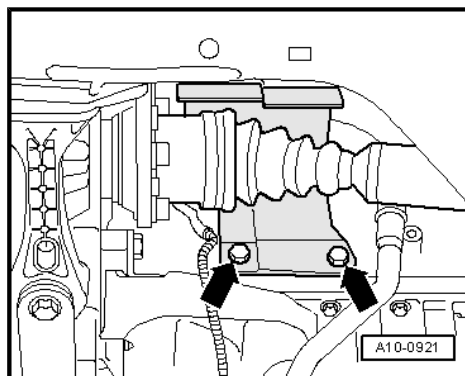
- Unbolt bracket for exhaust system -arrows-.



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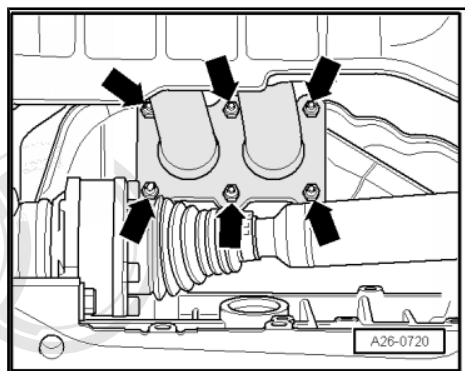
- Unbolt heat shield for drive shaft (right-side) -arrows-.

Vehicles with engine codes BGU, BSE, BSF, CCSA

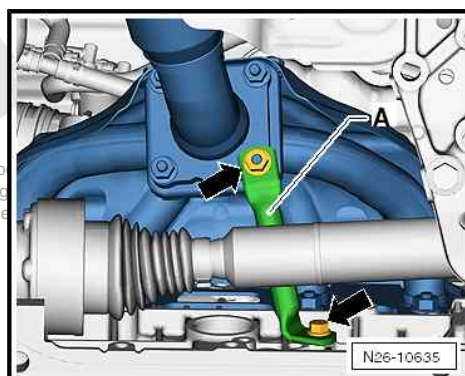


- Remove securing nuts -arrows- on front exhaust pipe/exhaust manifold.

Vehicles with engine code CMXA



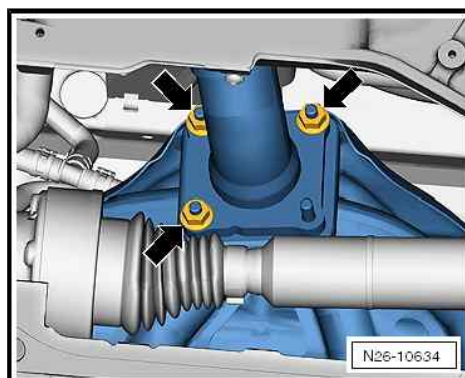
- Remove support -A-.



- Remove securing nuts -arrows- on front exhaust pipe/exhaust manifold.

All models:

- Detach front exhaust pipe with catalytic converter.

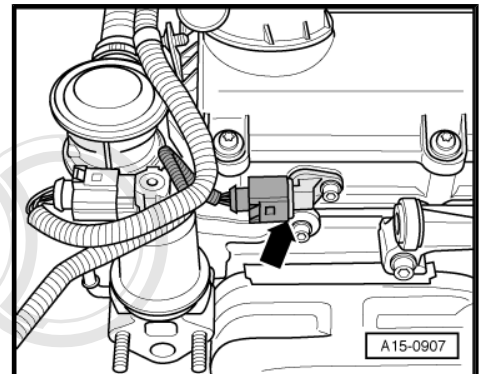
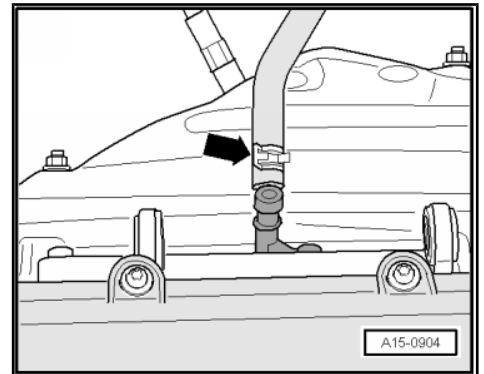
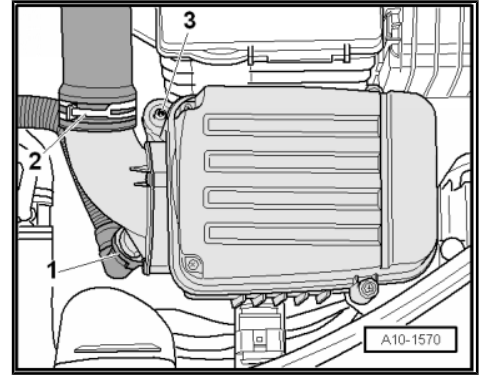


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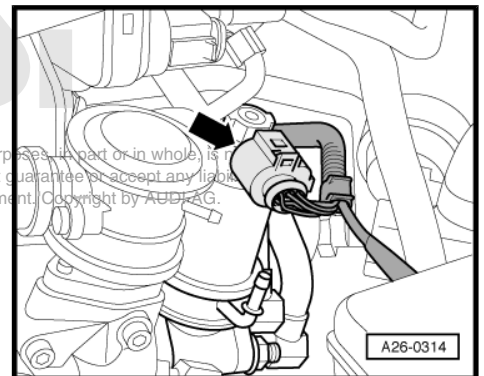
- Disconnect hoses -1- and -2- from air cleaner housing.
 - Remove bolt -3-.
 - Take out air cleaner housing.
 - Remove intake manifold ⇒ Rep. gr. 24 .
 - Detach spark plug connectors using puller -T10112- .
-
- Disconnect coolant hose -arrow- at breather connection on rear of cylinder head.
-
- Unplug electrical connector -arrow- at Hall sender -G40- .

**Note**

Illustration shows engine removed.

**Vehicles with engine code BGU:**

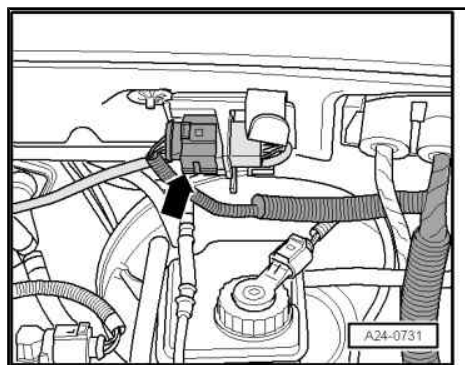
- Unplug electrical connector -arrow- at exhaust gas recirculation valve -N18- .
- Move wiring harness clear.



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All vehicles (continued):

- Remove electrical connector -arrow- for Lambda probe -G39- (before catalytic converter) from bracket and unplug connector.

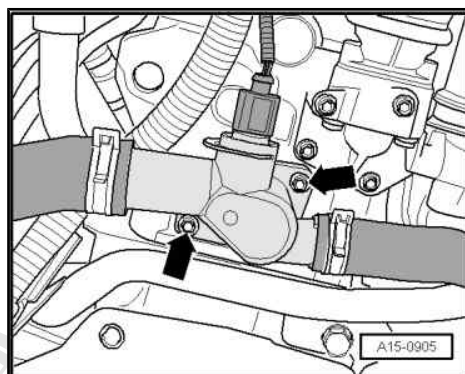


- Detach connection (left-side) from cylinder head -arrows- and lay aside.



Note

Leave coolant hoses connected.

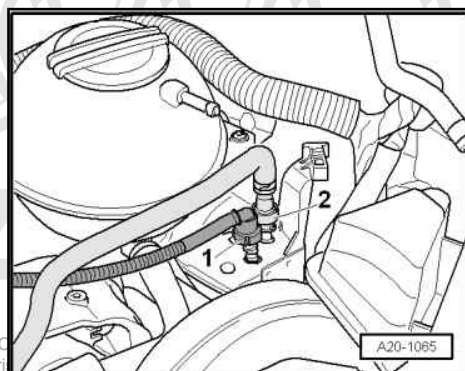


- Disconnect vacuum line -1- going to activated charcoal filter (press release tab).

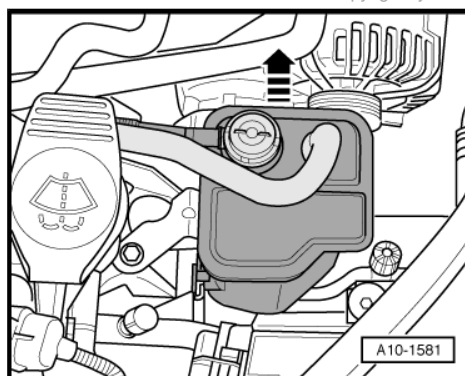


Note

Disregard -item 2-.

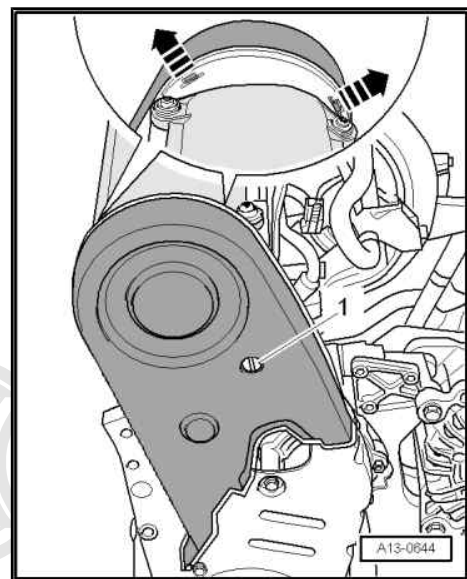


- Lift out activated charcoal filter from retainer with pipes connected -arrow-.

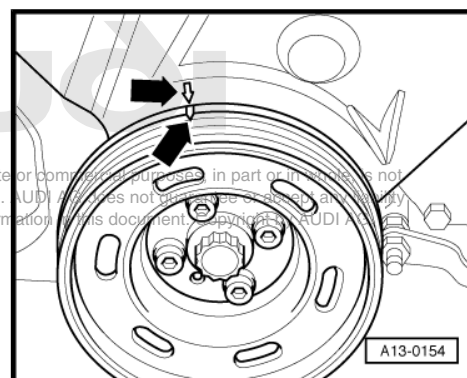


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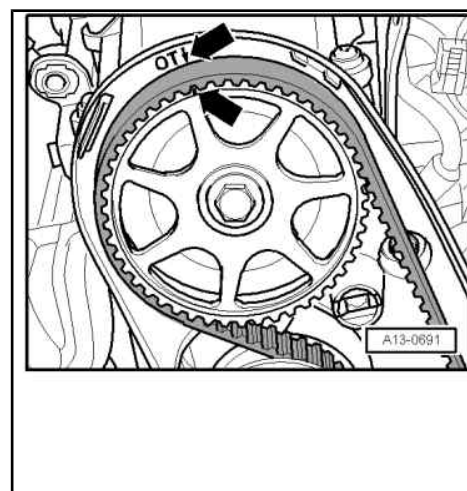
- Turn quick-release fastener -item 1- 90° anti-clockwise.
- Raise retaining tabs -arrows- and detach top toothed belt cover.



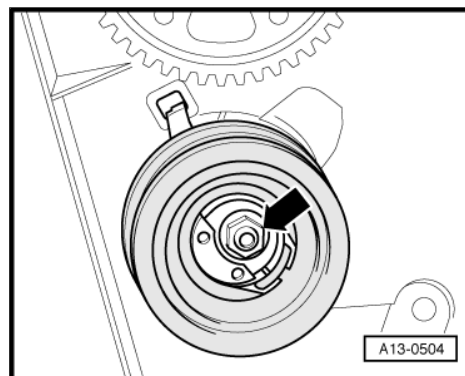
- Turn crankshaft at central bolt on crankshaft sprocket in direction of engine rotation to TDC mark for No. 1 cylinder -arrows-.



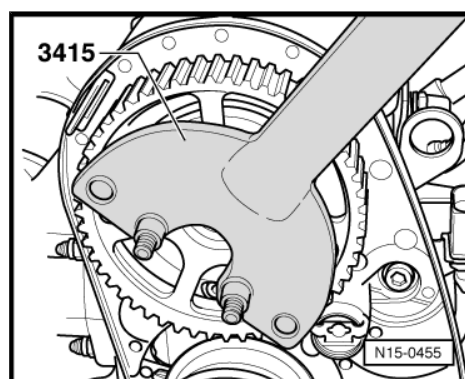
- At the same time the marking on front of the camshaft sprocket must align with the marking on the rear toothed belt cover -arrows-.
- Rotate crankshaft one turn further if necessary.



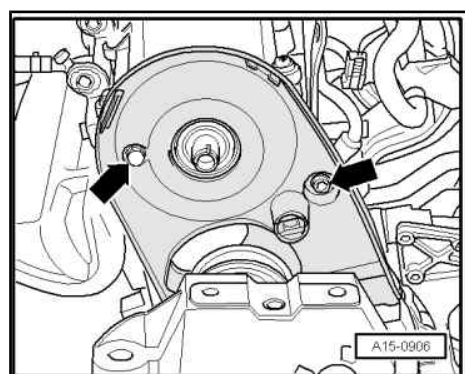
- Loosen nut on tensioning roller -arrow- several turns.
- Remove washer.
- Remove toothed belt from camshaft sprocket.



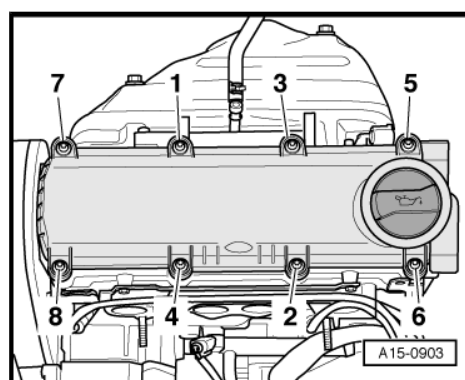
- Loosen camshaft sprocket using counterhold -3415- .
- Detach camshaft sprocket.
- Remove Woodruff key from camshaft.



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



- Remove crankcase breather hose from cylinder head cover.
- Remove cylinder head cover bolts in the sequence -8 ... 1-.
- Remove cylinder head cover.



- Slacken cylinder head bolts in the sequence -1 ... 10-.



Note

Two mechanics are needed to remove the cylinder head.

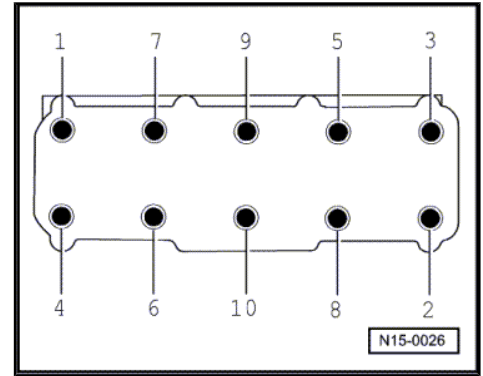
- Swivel cylinder head to left and out of rear toothed belt cover and detach tensioning roller at the same time.

Installing



Note

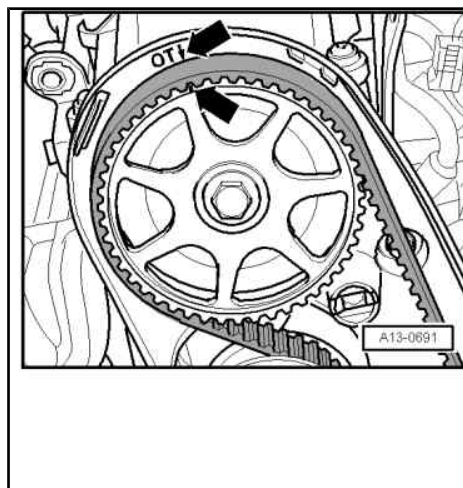
- ◆ *Renew the cylinder head bolts.*
- ◆ *Renew self-locking nuts and bolts when performing assembly work.*
- ◆ *Renew bolts which are tightened to a specified angle as well as oil seals and gaskets.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- ◆ *If repairing, carefully remove any remaining gasket material from the cylinder head and cylinder block. Ensure that no long scores or scratches are made on the surfaces.*
- ◆ *Carefully remove any remaining emery and abrasive material.*
- ◆ *Cylinder heads which have cracks between the valve seats or between a valve seat insert and the spark plug thread can be re-installed without reducing service life, provided the cracks are only slight and do not exceed a maximum of 0.3 mm in width, and no more than the first 4 turns of the spark plug threads are cracked.*
- ◆ *Do not remove new cylinder head gasket from packaging until it is ready to be fitted.*
- ◆ *Handle gasket very carefully. Damage to the silicone coating or the indented area will lead to leaks.*
- ◆ *The plastic protectors fitted to protect the open valves should not be removed until the cylinder head is ready to be fitted.*
- ◆ *When installing an exchange cylinder head with fitted cam-shaft, the contact surfaces between roller rocker fingers and cams must be oiled after installing the head.*
- ◆ *No oil or coolant must be allowed to remain in the blind holes for the cylinder head bolts in the cylinder block.*
- ◆ *After fitting a new cylinder head or cylinder head gasket, change the coolant and the engine oil.*



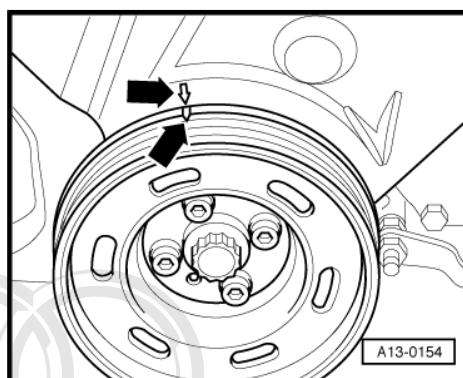
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- Align mark on camshaft sprocket with mark on toothed belt cover -arrows-.



- Check again that crankshaft is at TDC of No. 1 cylinder -arrow-.

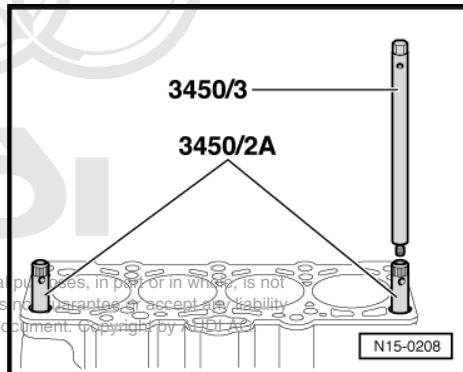


- To centralize cylinder head gasket and cylinder head, screw guide pins -3450/2A- into the outer holes on the intake side using fitting tool -3450/3- .



Note

- ♦ *The maximum permissible diameter for the centering bores (outer holes on the intake side) in the cylinder head was restricted in the upper section.*
- ♦ *Check before tightening whether the guide pins can be pushed through the bores in the cylinder head. If necessary, grind down the knurled surface of the guide pins slightly.*



- Fit new cylinder head gasket.
- Check installation position of cylinder head gasket. Part number points towards cylinder head, and must be legible from the inlet side.



Note

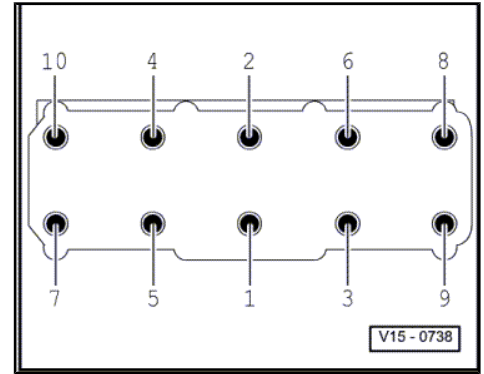
Two mechanics are needed to install the cylinder head.

- Fit cylinder head onto rear toothed belt cover from the side and at the same time push tensioning roller onto threaded pin.
- Fit cylinder head onto cylinder block.
- Insert 8 cylinder head bolts and tighten finger-tight.
- Unscrew guide pins through bolt holes in cylinder head using fitting tool -3450/3- and install remaining cylinder head bolts.

- Tighten cylinder head bolts in 3 stages in the sequence shown:
- 1. Tighten with torque wrench to 40 Nm.
- 2. Turn 90° (1/4 turn) further using a rigid wrench.
- 3. Turn 90° (1/4 turn) further using a rigid wrench.

 Note

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



- Install cylinder head cover ⇒ [page 85](#) .
- Install toothed belt (adjust valve timing) ⇒ [page 60](#) .
- Install poly V-belt ⇒ [page 43](#) .
- Install intake manifold ⇒ Rep. gr. 24
- Install front exhaust pipe with catalytic converter: vehicles with engine codes BGU, BSE, BSF, CCSA ⇒ [page 151](#) .
- Install front exhaust pipe with catalytic converter: vehicles with engine code CMXA ⇒ [page 159](#) .
- Align the exhaust system so it is free of stress ⇒ [page 154](#) .
- Change engine oil ⇒ Maintenance ; Booklet 808 .
- Connect battery. Procedures required ⇒ Rep. gr. 27 .
- Fill cooling system with fresh coolant ⇒ [page 129](#) .

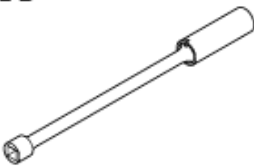
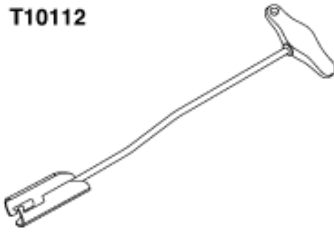
Tightening torques

Component		Nm
Rear toothed belt cover to cylinder head	M6	10 ¹⁾
	M8	23 ¹⁾
Camshaft sprocket to camshaft		100
Coolant hose connection to cylinder head		10
• ¹⁾ Apply locking fluid when installing; refer to ⇒ Electronic parts catalogue for locking fluid.		

1.4 Checking compression

Special tools and workshop equipment required

- ◆ Spark plug socket and extension -3122 B-
- ◆ Compression tester -V.A.G 1763-
- ◆ Puller -T10112-

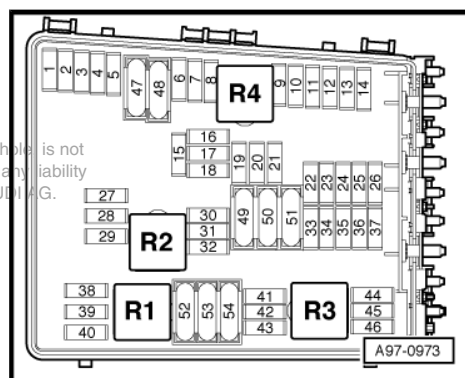
3122 B 	V.A.G 1763 
T10112 	
	G15-0054

Test conditions

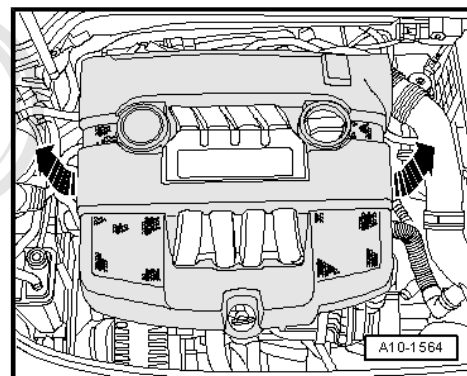
- Engine oil temperature at least 30 °C.
- Battery voltage at least 12.5 V.

Test sequence

- Switch off ignition.
- Open cover of electronics box in engine compartment and remove fuses F6 and F32 for ignition coils and injectors.



- Remove engine cover panel -arrows-.
- Detach electrical connectors at outer injectors.



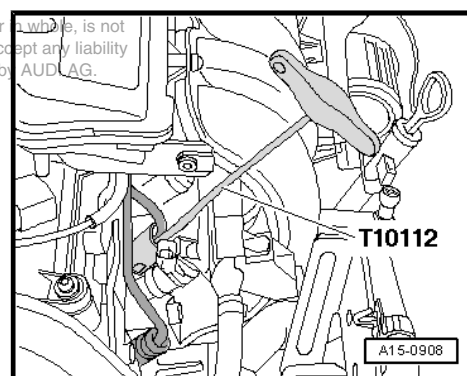
- Detach spark plug connectors using puller T10112.
- Remove spark plugs with spark plug socket 3122 B.
- Test the compression pressure with the compression tester - V.A.G 1763- .



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.



Compression pressure	bar
When new	10.0 ... 13.0
Wear limit	7.0
Difference between cylinders	3.0 (maximum)

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

- Install spark plugs ⇒ Maintenance ; Booklet 808 .
- Faults are stored in engine control unit because electrical connectors were unplugged and engine was started: „Generate readiness code“ in „Guided Functions“ ⇒ Vehicle diagnostic, testing and information system VAS 5051.

2 Valve gear



Note

- ◆ *Cylinder heads which have cracks between the valve seats or between a valve seat insert and the spark plug thread can be re-installed without reducing service life, provided the cracks are only slight and do not exceed a maximum of 0.3 mm in width, and no more than the first 4 turns of the spark plug threads are cracked.*
- ◆ *After installing the camshaft, the engine must NOT be started for about 30 minutes. Hydraulic valve compensation elements have to settle (otherwise valves will strike pistons).*
- ◆ *After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.*
- ◆ *Renew gaskets and seals.*

2.1 Valve gear - exploded view

1 - 100 Nm

- ☐ Use counterhold tool -3415- when loosening and tightening
⇒ [page 49](#)

2 - Camshaft sprocket

- ☐ Remove toothed belt prior to removing and installing ⇒ [page 50](#)
- ☐ Located in position by parallel key -item 4-

3 - Seal

- ☐ Renewing ⇒ [page 101](#)

4 - Parallel key

- ☐ Check for firm attachment

5 - 23 Nm

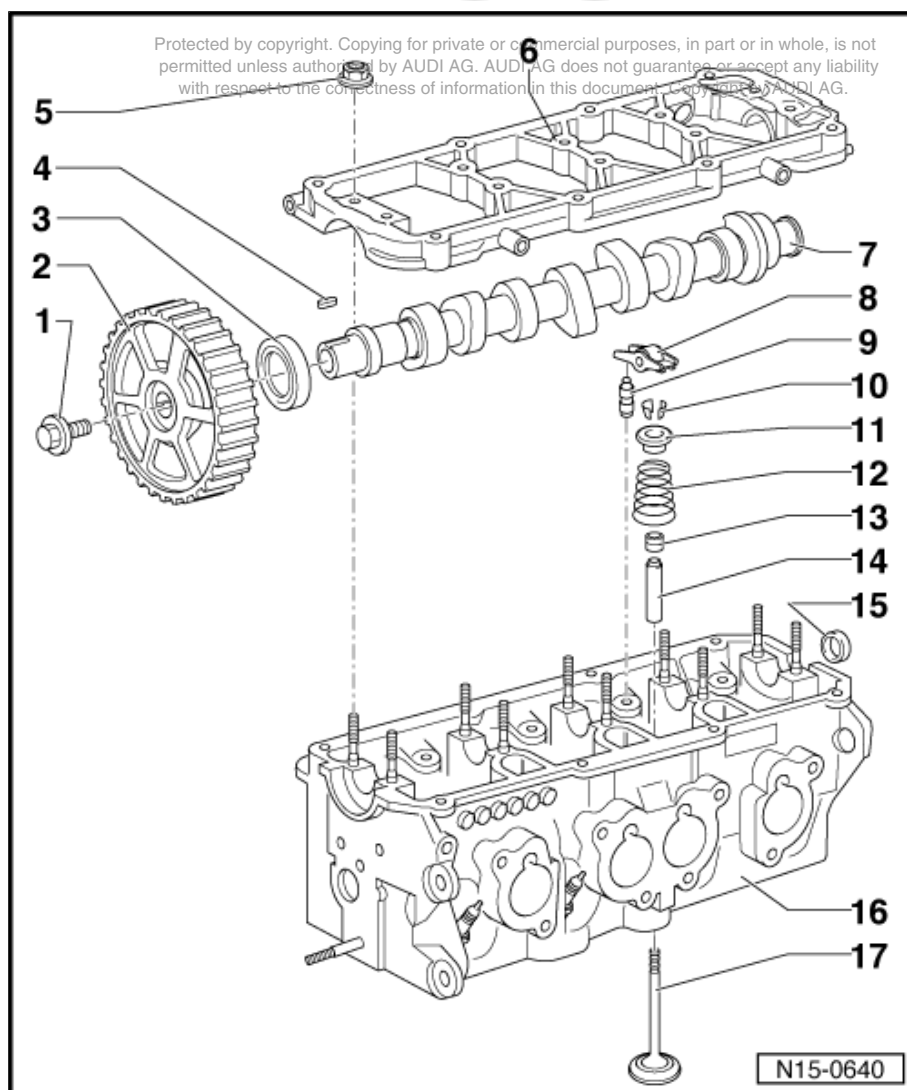
- ☐ Observe correct tightening sequence
⇒ [page 105](#)

6 - Retaining frame

- ☐ With integrated camshaft bearings
- ☐ Bearing 1 at pulley end
- ☐ Removing and installing
⇒ ["2.5 Removing and installing camshaft", page 102](#)
- ☐ Sealing surface must not be machined

7 - Camshaft

- ☐ Runout: max. 0.04 mm
- ☐ Measuring axial clearance ⇒ [page 99](#)



- ☐ Measuring radial clearance ⇒ [page 100](#)
- ☐ Removing and installing ⇒ [page 102](#)

8 - Roller rocker finger

- ☐ Do not interchange
- ☐ Check roller bearing
- ☐ Lubricate contact surface
- ☐ Use retaining clip to clip onto supporting element when installing

9 - Supporting element

- ☐ With hydraulic valve clearance compensation
- ☐ Checking hydraulic valve clearance compensation ⇒ [page 112](#)
- ☐ Do not interchange
- ☐ Lubricate contact surface

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10 - Valve cotters

11 - Valve spring plate

12 - Valve spring

- ☐ Remove and install with cylinder head removed using valve spring compressor -2037-

13 - Valve stem oil seal

- ☐ Renewing: with cylinder head installed ⇒ [page 105](#) , with cylinder head removed ⇒ [page 108](#)

14 - Valve guide

- ☐ Checking ⇒ [page 113](#)

15 - Filler cap

- ☐ Insert flush
- ☐ Punch hole in centre using a screwdriver and lever off for removal

16 - Cylinder head

- ☐ See note ⇒ [page 98](#)
- ☐ Checking valve guides ⇒ [page 113](#)
- ☐ Machining valve seats ⇒ [page 114](#)
- ☐ Sealing surface on camshaft side must not be machined.

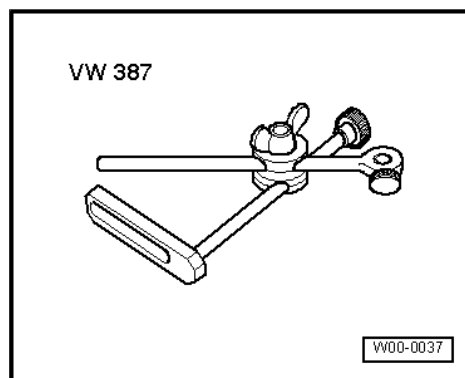
17 - Valve

- ☐ Remove and install with cylinder head removed using valve spring compressor -2037-
- ☐ Must not be machined; only grinding-in is permissible
- ☐ Valve dimensions ⇒ [page 113](#)
- ☐ Checking valve guides ⇒ [page 113](#)
- ☐ Machining valve seats ⇒ [page 114](#)

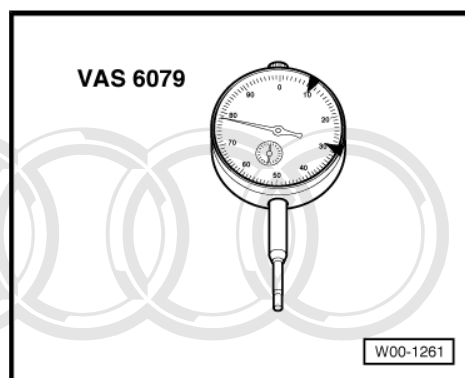
2.2 Measuring axial clearance of camshaft

Special tools and workshop equipment required

- ◆ Universal dial gauge bracket -VW 387-

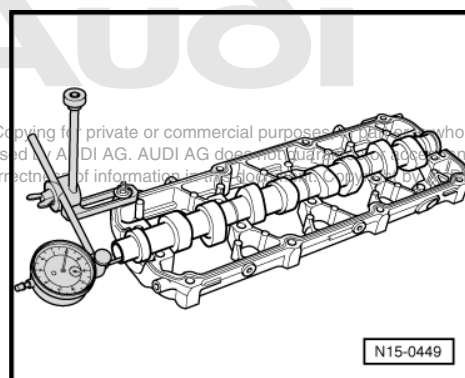


- ◆ Dial gauge -VAS 6079-



Test sequence

- Perform measurement with retaining frame removed.
- Secure universal dial gauge bracket -VW 387- with dial gauge -VAS 6079- to retaining frame.
- Determine axial clearance.
- Wear limit: 0.17 mm.



2.3 Measuring radial clearance of camshaft

Special tools and workshop equipment required

- ◆ Plastigage

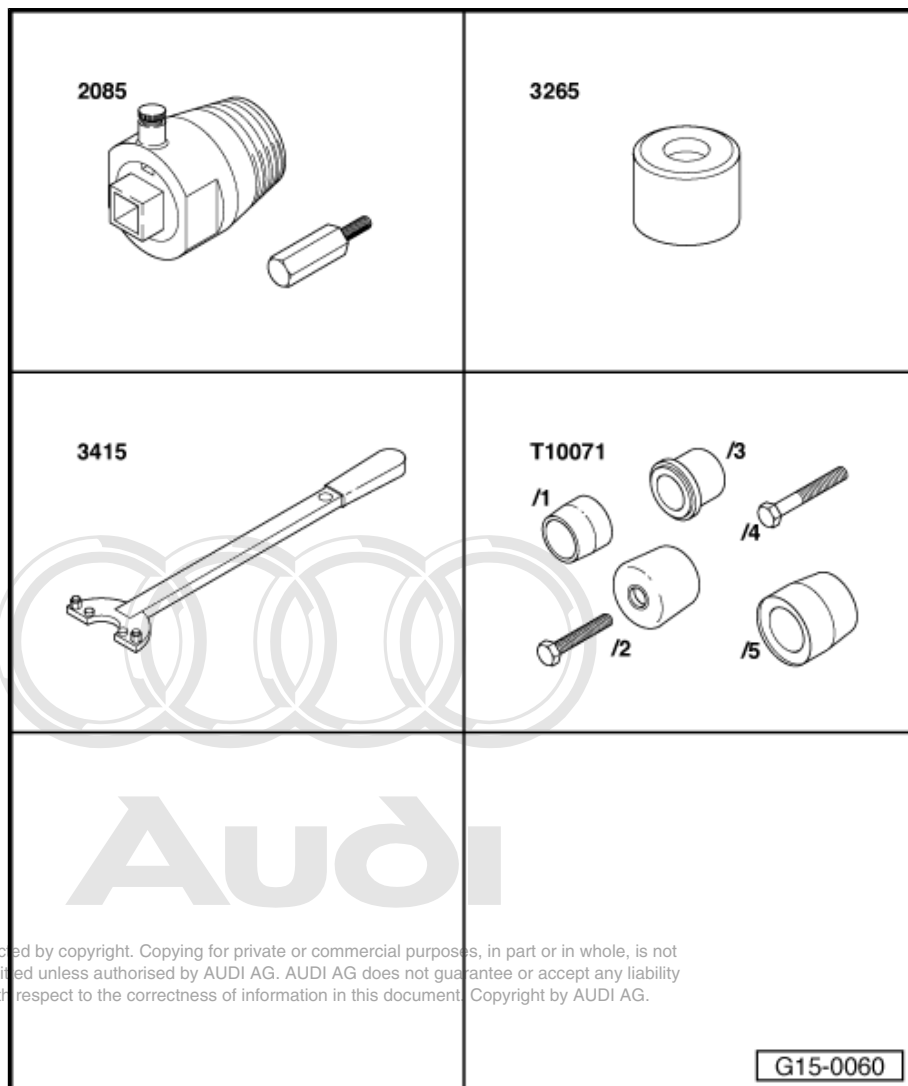
Procedure

- Remove roller rocker fingers
⇒ „2.5 Removing and installing camshaft“, page 102 .
- Clean bearings and bearing journals.
- Place a length of Plastigage corresponding to the width of the bearing on the bearing journal or bearing shell to be measured.
- The Plastigage must be positioned in the centre of the bearing.
- Fit retaining frame and tighten to 23 Nm without rotating camshaft.
- Remove retaining frame again.
- Compare width of Plastigage with measurement scale.
- Wear limit: 0.1 mm.

2.4 Renewing camshaft oil seal

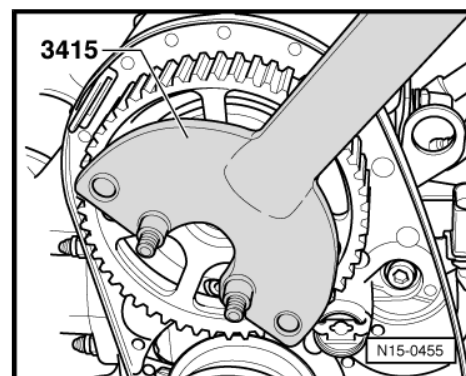
Special tools and workshop equipment required

- ◆ Oil seal extractor -2085-
- ◆ Fitting sleeve -3265-
- ◆ Counterhold tool -3415-
- ◆ Assembly tool -T10071-

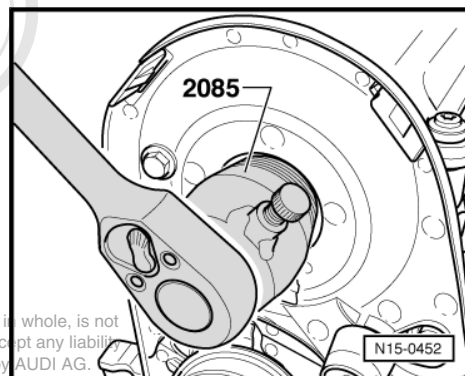


Procedure

- Cylinder head installed
- Remove toothed belt from camshaft sprocket ⇒ [page 57](#) .
- Loosen camshaft sprocket using counterhold -3415- .
- Detach camshaft sprocket.
- Remove parallel key from camshaft.



- To guide oil seal extractor, screw securing bolt for camshaft sprocket into camshaft as far as the stop by hand.
- Adjust the inner part of oil seal extractor -2085- so it is flush with the outer part and lock in position with knurled screw.
- Lubricate threaded head of oil seal extractor -2085- , place it in position and screw it into oil seal as far as possible (applying firm pressure).
- Loosen knurled screw and turn inner section against camshaft until oil seal is pulled out.
- Clamp flats of oil seal extractor in vice. Remove oil seal with pliers.



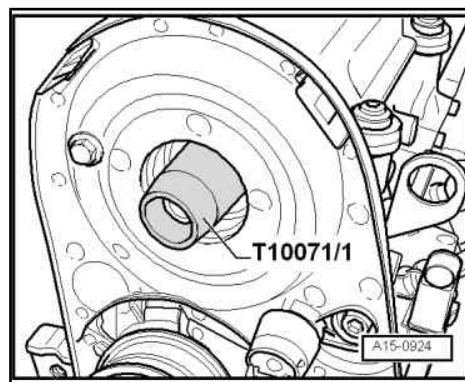
Installing



Note

Do not lubricate sealing lip of oil seal.

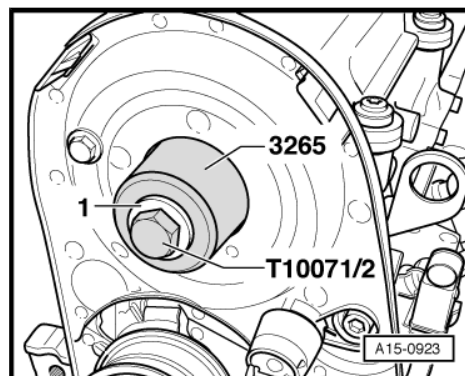
- Slide oil seal over guide sleeve -T10071/1- .
- Detach guide sleeve.
- Press in oil seal all the way using fitting sleeve -3265- and bolt -T10071/2- .



Note

Place a large, commercially available M12 washer -item 1- below bolt to prevent wear on the press sleeve.

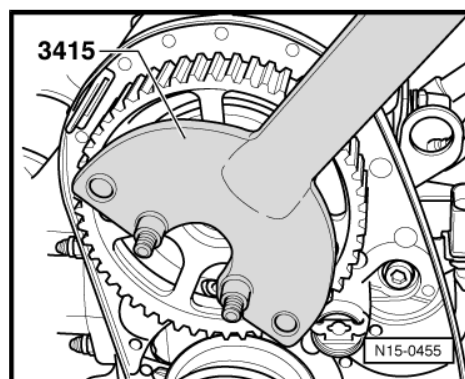
- Insert parallel key into camshaft.
- Tighten camshaft sprocket using counterhold -3415- .



Note

If a piston is at TDC the valves could strike the piston when turning the camshaft. Pistons must therefore not be at TDC. This could otherwise result in damage to valves and pistons.

- Install toothed belt (adjust valve timing) ⇒ [page 60](#) .



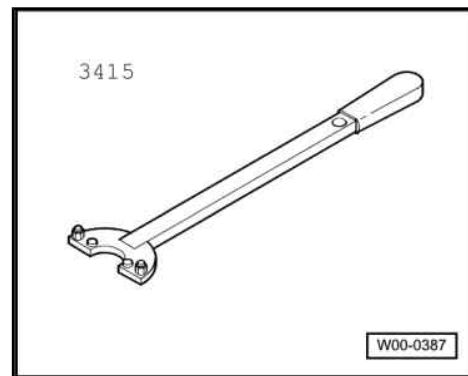
Tightening torque

Component	Nm
Camshaft sprocket to camshaft	100

2.5 Removing and installing camshaft

Special tools and workshop equipment required

- ◆ Counterhold tool -3415-



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

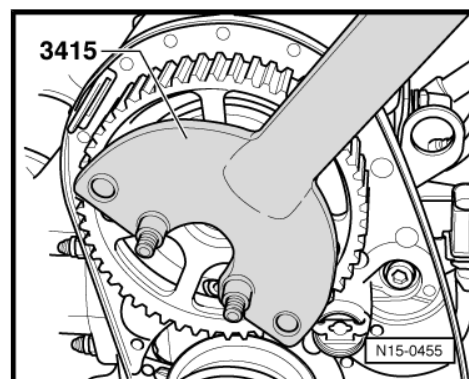
Removing

- Cylinder head installed.

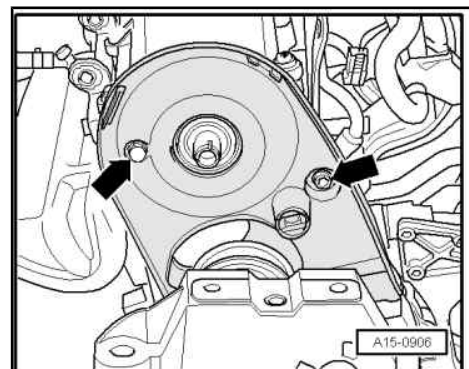


Note

- ◆ *Sealing surfaces at retaining frame and cylinder head may be cleaned but not machined.*
- ◆ *Camshaft bearings are integrated into cylinder head/retaining frame. **Toothed belt must be detached before removing retaining frame.***
- ◆ *Renew camshaft oil seal and sealing cap at rear if retaining frame has been unfastened.*
- Remove intake manifold ⇒ Rep. gr. 24 .
- Remove toothed belt from camshaft sprocket ⇒ [page 57](#) .
- Loosen camshaft sprocket using counterhold -3415- .
- Detach camshaft sprocket.
- Remove parallel key from camshaft.
- Remove cylinder head cover ⇒ [page 85](#) .



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



- Unscrew nuts -1, 2, 7, 8, 9, 10-.
- Unscrew nuts -3, 4, 5, 6- in several stages and in diagonal sequence.
- Remove retaining frame.
- Remove camshaft.
- Ensure that the rocker fingers and the supporting elements are not interchanged.

Installing



Note

Renew gaskets and seals.

- Pistons must not be at TDC.
- Make sure dirt and remnants of sealant do not drop into cylinder head.
- Remove old sealant from groove in retaining frame -arrow- and from sealing surfaces.
- Remove sealant residues from cylinder head, e.g. with rotating plastic brush or similar.



WARNING

Wear safety goggles.

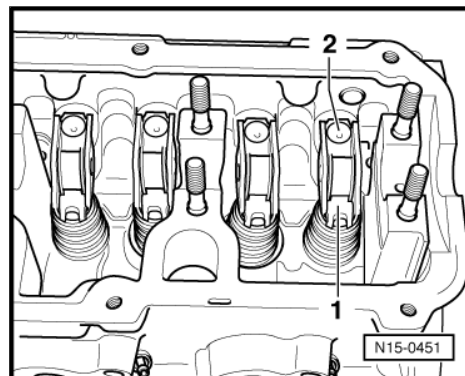
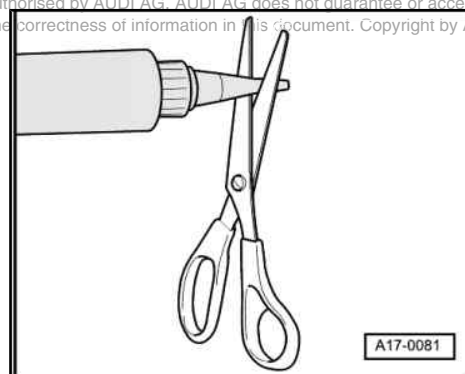
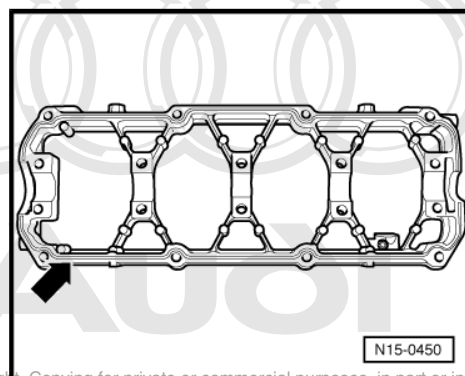
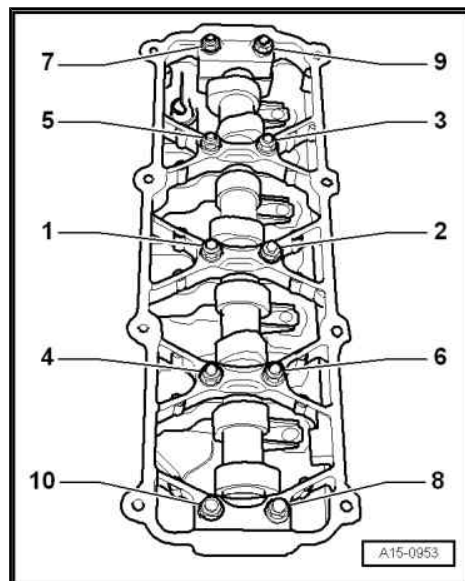
- Clean sealing surfaces; they must be free of oil and grease.



Note

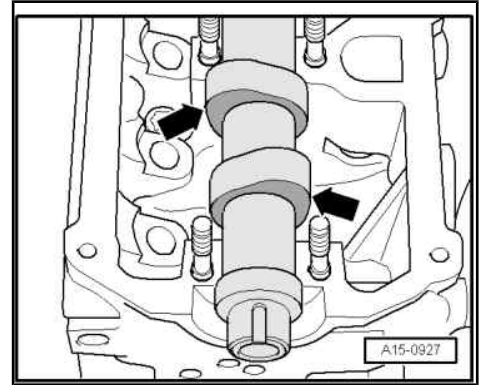
Note the use-by date of the sealant.

- Cut off tube nozzle at front marking (diameter of nozzle approx. 1 mm).
- Ensure all roller rocker fingers contact the valve ends -1- correctly and are clipped into their respective support elements -2-.

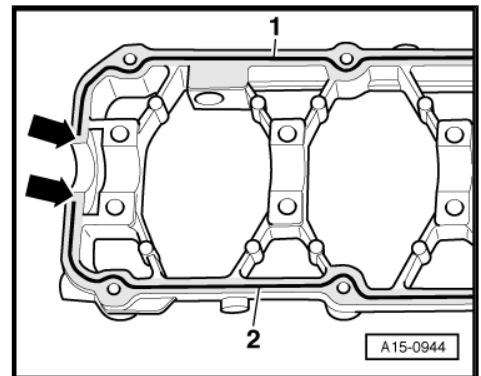


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- Lubricate running surfaces of the camshaft.
- Install camshaft in TDC position for cylinder 1:
- The cams for cylinder 1 must point upwards evenly on camshaft -arrows-.



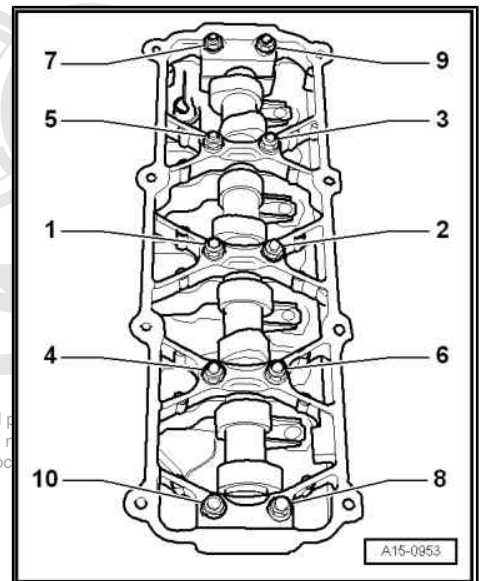
- Apply an even bead of sealant -1- and -2- onto the clean groove of the retaining frame (slightly projecting from the groove).
- Apply a thin coat of sealant onto the sealing surface in front of the ends of the beads of sealant -arrows-.



Note

- ◆ Do not apply the sealant thicker than prescribed. If necessary remove excess sealant with a lint-free cloth.
- ◆ No time should be allowed to elapse when fitting and securing retaining frame, as sealant starts to harden immediately.

- Insert rear sealing cap ⇒ [Item 15 \(page 99\)](#) so that it is flush.
- Fit retaining frame and lightly tighten nuts -3, 4, 5, 6- diagonally in several stages.
- Then tighten nuts -1, 2, 7, 8, 9, 10- lightly.
- Finally tighten nuts to specified torque in the sequence -1 ... 10-.
- Install cylinder head cover ⇒ [page 85](#) .
- Renew camshaft oil seal ⇒ [page 101](#) .
- Install toothed belt (adjust valve timing) ⇒ [page 60](#) .



Note

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

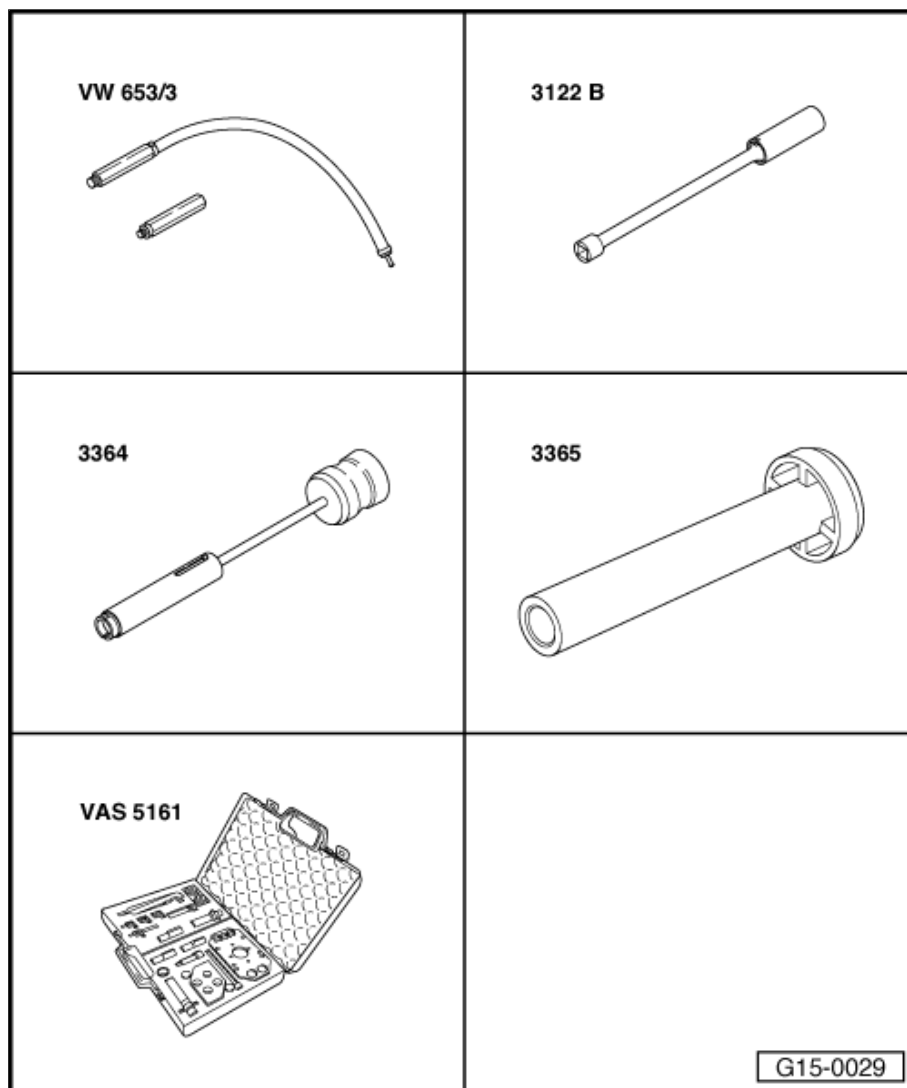
Tightening torque

Component	Nm
Retaining frame to cylinder head	23

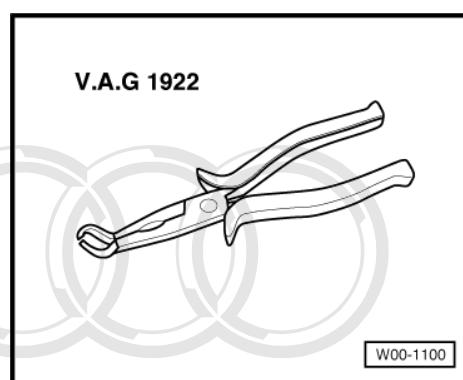
2.6 Renewing valve stem oil seals with cylinder head installed

Special tools and workshop equipment required

- ◆ Pressure hose -VW 653/3-
- ◆ 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- with guide plate for 1.6 ltr. 2-valve engine -VAS 5161/20- and knurled spacer ring (height: 8.4 mm) -VAS 5161/21-5-



- ◆ Spark plug connector pliers -V.A.G 1922-

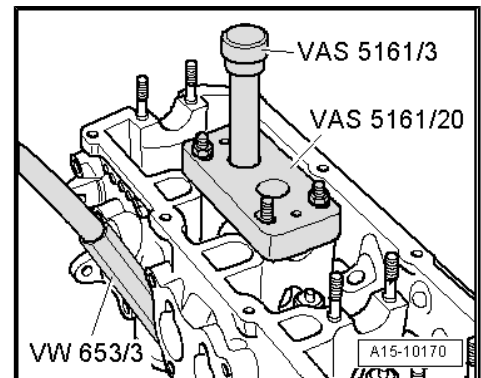


Procedure

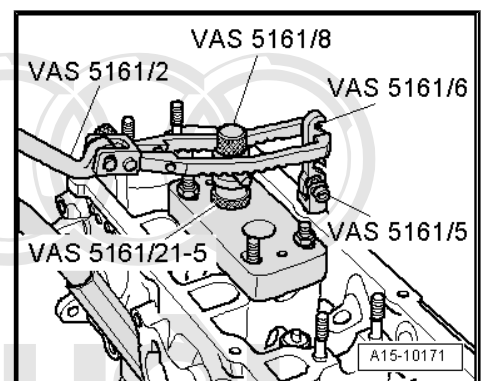
- Remove the camshaft ⇒ [page 102](#) .
- Mark original positions of roller rocker fingers and hydraulic compensation elements for reinstallation.
- Remove roller rocker fingers together with hydraulic compensation elements and put down on a clean surface.
- Detach spark plug connectors using spark plug connector pliers -V.A.G 1922- .

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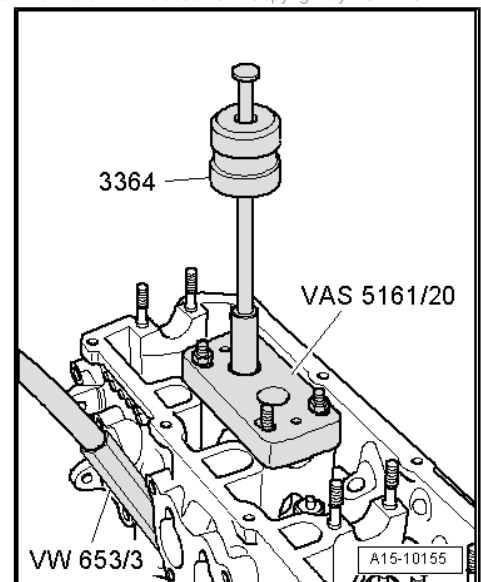
- Remove spark plugs with spark plug socket -3122 B- .
- Set piston of the respective cylinder to „bottom dead centre“.
- Fit guide plate for 1.6 ltr. 2-valve engine -VAS 5161/20- onto cylinder head.
- The marking „OBEN“ (TOP) faces upwards.
- Secure guide plate with two nuts.
- Screw pressure hose -VW 653/3- into spark plug hole and connect to compressed air supply.
- Minimum pressure: 6 bar
- Insert punch -VAS 5161/3- into guide plate and knock sticking valve cotters loose using a plastic hammer.



- Screw snap-in device -VAS 5161/6- with engaging fork -VAS 5161/5- into guide plate.
- Slide knurled spacer ring (height 8.4 mm) -VAS 5161/21-5- onto assembly cartridge -VAS 5161/8- .
- Hook pressure fork -VAS 5161/2- into snap-in device and press assembly cartridge downwards.
- At the same time, turn knurled screw of assembly cartridge clockwise until tips engage in valve cotters.
- Move knurled screw back and forth slightly; the valve cotters are thus forced apart and taken up by the cartridge.
- Release pressure fork.
- Take off assembly cartridge with knurled spacer ring.
- Remove valve spring plate and valve spring.
- Remove valve stem oil seals using the valve stem seal puller -3364- .



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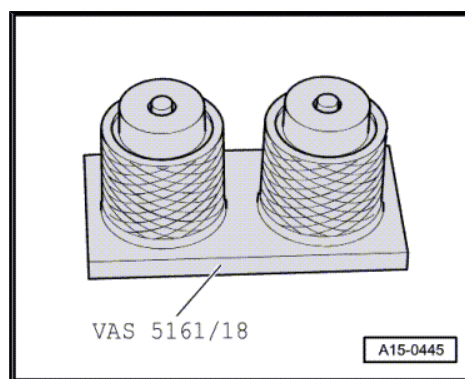
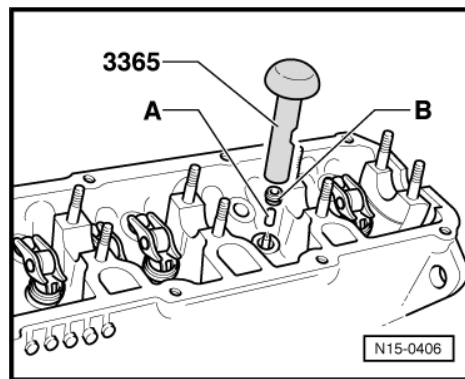




Note

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

- Fit plastic sleeve -A- onto the valve stem to prevent damage to the new valve stem oil seal -B-.
- Lightly lubricate sealing lip of valve stem oil seal.
- Slip valve stem oil seal over plastic sleeve.
- Carefully press valve stem oil seal onto valve guide using valve stem seal fitting tool -3365-.
- Remove plastic sleeve.
- If valve cotter pins had been removed from assembly cartridge they must first be inserted in insertion device -VAS 5161/18-.
- Larger diameter of valve cotter pins faces upwards.
- Press assembly cartridge onto insertion device from above and take up valve cotter pins.
- Insert valve spring and valve spring plate.



- Re-insert assembly cartridge with knurled spacer ring (height: 8.4 mm) into guide plate.
- Push pressure fork down and pull knurled screw upwards while turning to left and right - this will insert the valve cotter pins.
- Release pressure fork with knurled screw still in pulled position.
- Repeat procedure for each valve.

Assembling

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

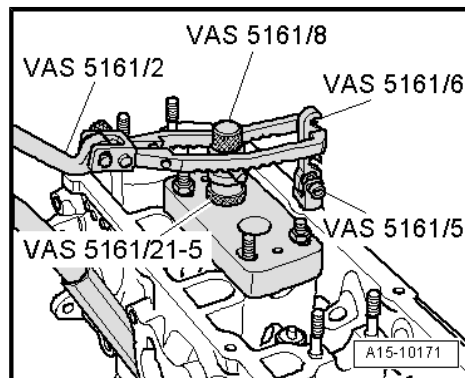
- Ensure that all roller rocker fingers make contact with the ends of the valve stems correctly and are clipped onto their respective hydraulic compensation elements.
- Install camshaft ⇒ [page 102](#).
- Install spark plugs ⇒ [Maintenance : Booklet 808](#).

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Note

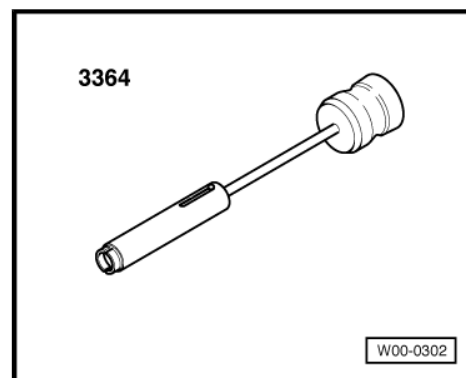
- ◆ After installing the camshaft, the engine must NOT be started for about 30 minutes. Hydraulic valve compensation elements have to settle (otherwise valves will strike pistons).
- ◆ After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make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



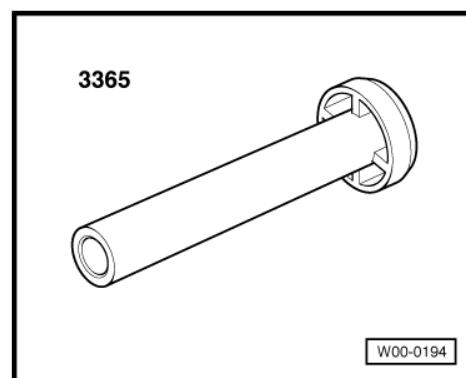
2.7 Renewing valve stem oil seals with cylinder head removed

Special tools and workshop equipment required

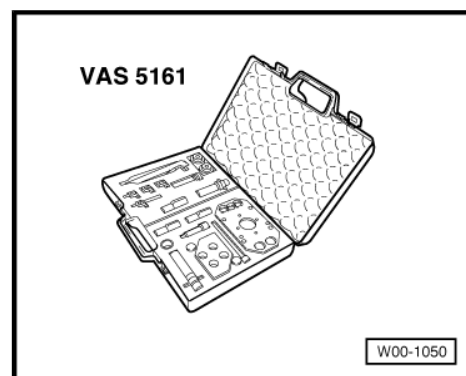
◆ Valve stem seal puller -3364-



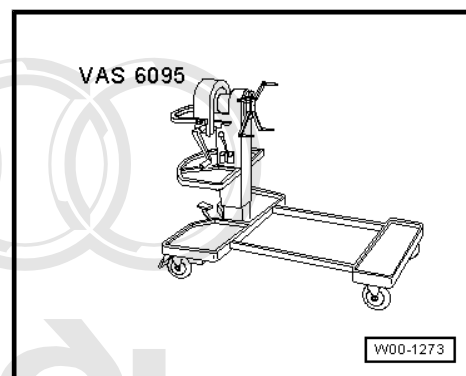
◆ Valve stem seal fitting tool -3365-



◆ Removal and installation device for valve cotters -VAS 5161-



◆ Engine and gearbox support -VAS 6095-



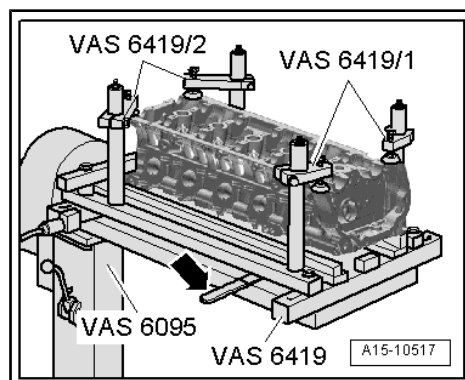
◆ Cylinder head tensioning device -VAS 6419-

Procedure

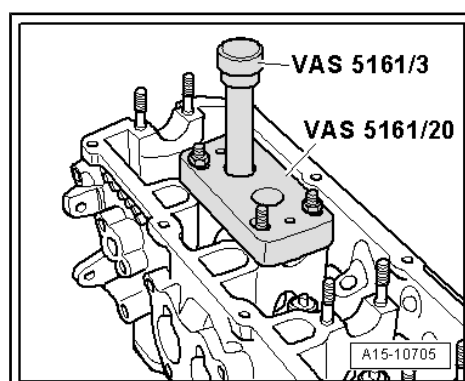
- Remove the camshaft ⇒ [page 102](#).
- Mark original positions of roller rocker fingers and hydraulic compensation elements for reinstallation.

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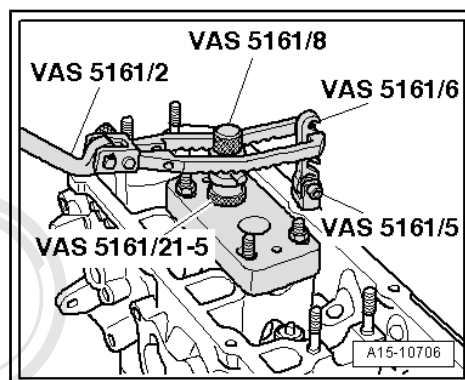
- Remove roller rocker fingers together with hydraulic compensation elements and put down on a clean surface.
- Insert cylinder head tensoning device -VAS 6419- into engine and gearbox support -VAS 6095- .
- Secure cylinder head in cylinder head tensoning device, as illustrated.
- Connect cylinder head tensoning 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.



- Fit guide plate for 1.6 ltr. 2-valve engine -VAS 5161/20- onto cylinder head.
- The marking „OBEN“ (TOP) faces upwards.
- Secure guide plate with two nuts.
- Screw pressure hose -VW 653/3- into spark plug hole and connect to compressed air supply.
- Minimum pressure: 6 bar
- Insert punch -VAS 5161/3- into guide plate and knock sticking valve cotters loose using a plastic hammer.

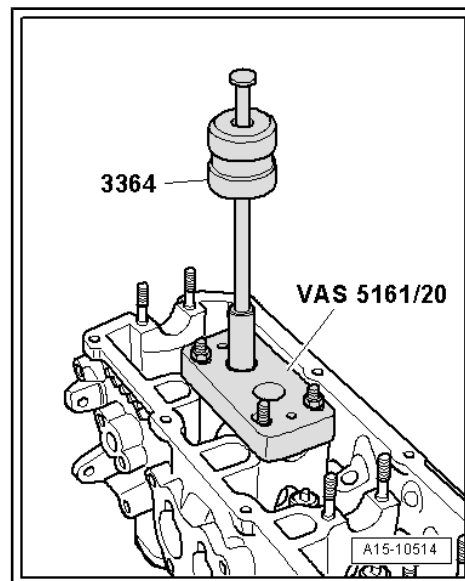


- Screw snap-in device -VAS 5161/6- with engaging fork -VAS 5161/5- into guide plate.
- Slide knurled spacer ring (height 8.4 mm) -VAS 5161/21-5- onto assembly cartridge -VAS 5161/8- .
- Hook pressure fork -VAS 5161/2- into snap-in device and press assembly cartridge downwards.
- At the same time, turn knurled screw of assembly cartridge clockwise until tips engage in valve cotters.
- Move knurled screw back and forth slightly; the valve cotters are thus forced apart and taken up by the assembly cartridge.
- Release pressure fork.
- Remove assembly cartridge.
- Remove valve spring with valve spring plate.



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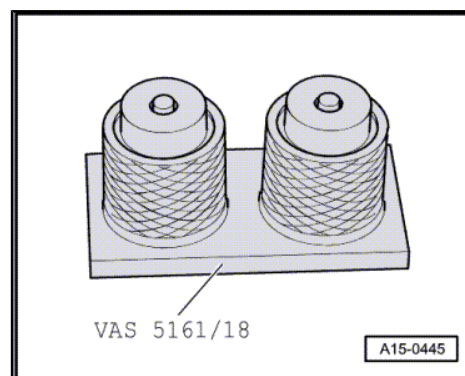
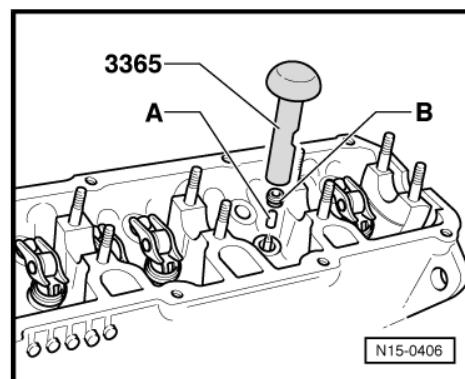
- Remove valve stem oil seals using the valve stem seal puller -3364- .



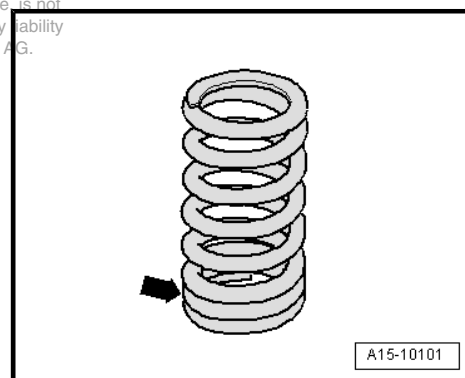
Note

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 valve stem oil seal onto valve guide using valve stem seal fitting tool -3365- .
- Remove plastic sleeve.
- If valve cotters had been removed from assembly cartridge they must first be inserted in insertion device -VAS 5161/18- .
 - Larger diameter of valve cotters faces upwards.
- Press assembly cartridge onto insertion device from above and take up valve cotters.



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

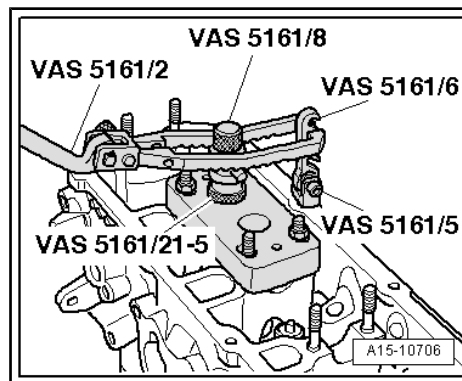


- Re-insert assembly cartridge with knurled spacer ring (height: 8.4 mm) into guide plate.
- Push pressure fork down and pull knurled screw upwards, while turning screw in both directions – this will insert the valve cotteners.
- Release pressure fork with knurled screw still in pulled position.
- Repeat 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 camshaft ⇒ [page 102](#) .



2.8 Checking supporting elements with hydraulic clearance compensation

Special tools and workshop equipment required

- ◆ Feeler gauge

Test sequence



Note

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

- 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 noises stop but recur repeatedly during short trips, renew the oil retention valve. The oil retention valve is located in the oil filter bracket ⇒ [Item 20 \(page 124\)](#) .

If the supporting elements with hydraulic clearance compensation are still noisy, proceed as follows to determine defective supporting element:

- Remove cylinder head cover ⇒ [page 85](#) .
- Turn crankshaft until cam of the supporting element to be checked is at the top (push vehicle in direction of travel with fourth gear engaged and ignition switched off).

- Determine clearance between cam and roller rocker finger.
- Press roller rocker finger down using a screwdriver -arrow-.

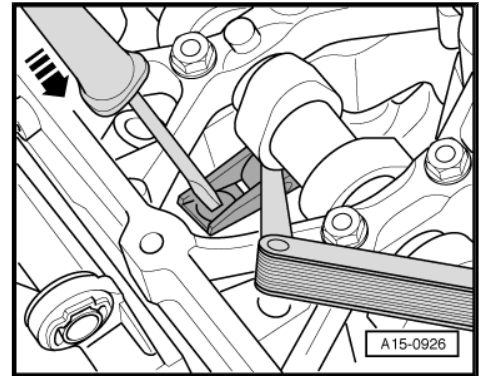
If it is possible to insert a feeler gauge of 0.20 mm between camshaft and roller rocker finger:

- Renew supporting element
⇒ „2.5 Removing and installing camshaft“, page 102 .



Note

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



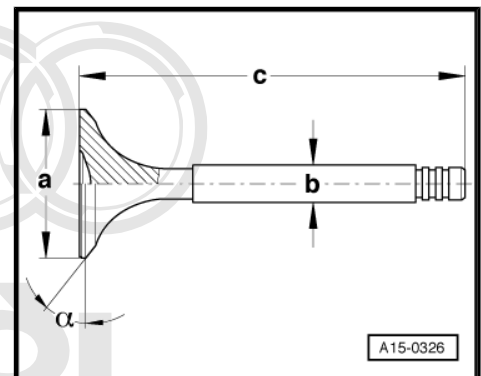
2.9 Valve dimensions



Note

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

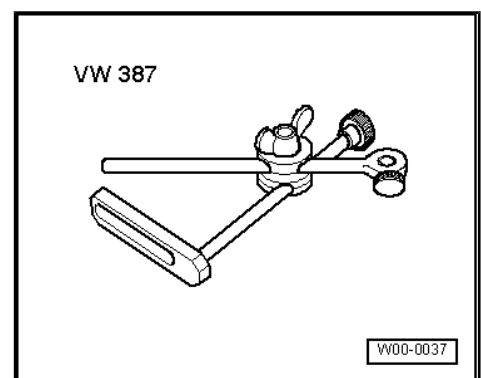
Dimension		Inlet valve	Exhaust valve
Ø a	mm	39.5 ± 0.15	32.9 ± 0.15
Ø b	mm	5.980 ± 0.007	5.965 ± 0.007
c	mm	93.85	93.85
α	°	45	45



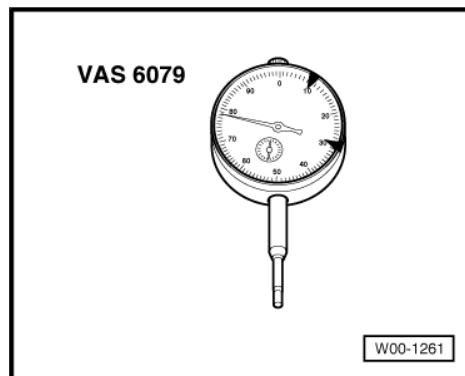
2.10 Checking valve guides

Special tools and workshop equipment required

- ◆ Universal dial gauge bracket -VW 387-



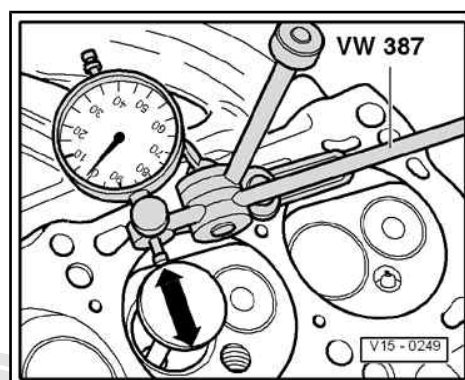
◆ Dial gauge -VAS 6079-



Test sequence

Note

- ◆ If the valve has to be renewed as part of a repair, use a new valve for the measurement.
- ◆ Only insert inlet valve into inlet guide and exhaust valve into exhaust guide, as the stem diameters are different.
- Insert valve into valve guide.
- End of valve stem must be flush with guide.
- Secure dial gauge -VAS 6079- to cylinder head with universal dial gauge bracket -VW 387- as shown in illustration.
- Measure sideways play -arrows-.
- Wear limit: 1.0 mm.
- If the wear limit is exceeded, repeat the measurement with new valves.
- Renew cylinder head if wear limit is still exceeded.



Note

Valve guides cannot be renewed.

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2.11 Checking valves

- Visually inspect for scoring on valve stem and on seating surface.
- Renew valves with significant score marks.

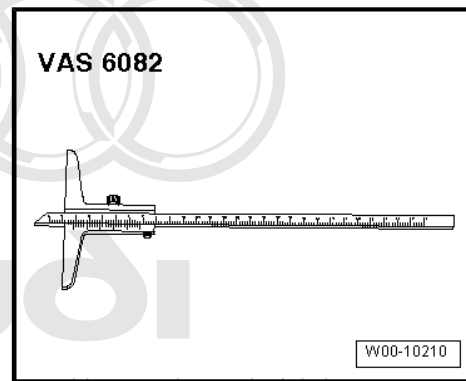
2.12 Machining valve seats

Note

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

Special tools and workshop equipment required

- ◆ Depth gauge -VAS 6082-



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- ◆ Valve seat machining tool



Note

- ◆ *When servicing engines with leaking valves, it is not sufficient to machine (reface) the valve seats and renew the valves. The valve guides must also be checked for wear. This is particularly important on high-mileage engines ⇒ [page 113](#).*
- ◆ *Valve seats should only be machined to the extent required to give a proper seating pattern.*
- ◆ *Calculate the maximum permissible machining dimension before machining.*
- ◆ *If the machining dimension is exceeded, the function of the hydraulic valve clearance compensation can no longer be ensured and the cylinder head must be renewed.*

Calculating maximum permissible machining dimension

- Insert valve and press firmly against valve seat.



Note

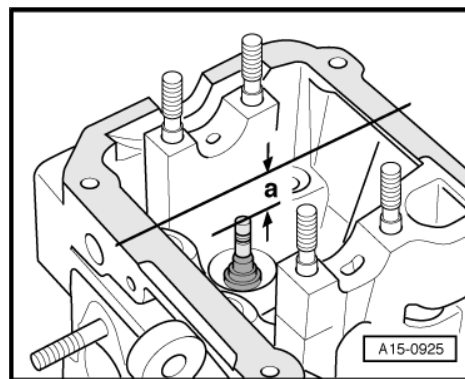
If the valve has to be renewed as part of a repair, use a new valve for the measurement.

- Use depth gauge -VAS 6082- to measure distance -a- between end of valve stem (upper edge) and top surface of cylinder head.
- Calculate max. permissible machining dimension from measured distance and minimum dimension.
- Minimum dimension for inlet valve and exhaust valve: 31.2 mm.

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

Example for inlet valve:

Measured gap -a-	31.5 mm
– Minimum dimension	– 31.2 mm
= Max. permissible machining dimension	= 0.3 mm



Note

If the maximum permissible machining dimension is 0 mm or less than 0 mm, repeat the measurement with a new valve. If the result is again 0 mm or less than 0 mm, renew the cylinder head.

Machining inlet valve seat

a - Ø 39.2 mm

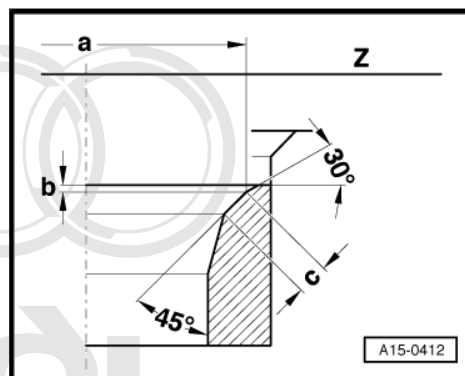
b - Maximum permissible machining dimension

c - 1.8 ... 2.2 mm

Z - Bottom surface of cylinder head

45° - Valve seat angle

30° - Correction angle (top)



Note

Calculating maximum permissible machining dimension

⇒ [page 116](#).

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Machining exhaust valve seat

a - $\varnothing$ 32.4 mm

b - Maximum permissible machining dimension

c - 2.2 ... 2.6 mm

Z - Bottom surface of cylinder head

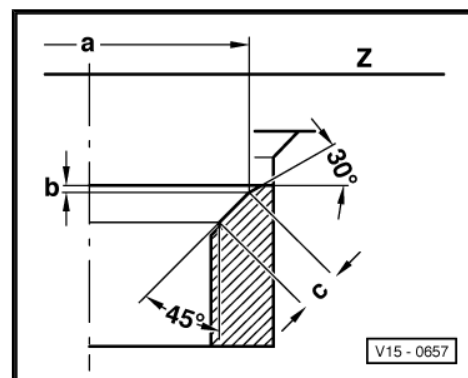
45° - Valve seat angle

30° - Correction angle (top)



Note

- ◆ *Calculating maximum permissible machining dimension
⇒ [page 116](#).*
- ◆ *Exhaust valve seat inserts also have an additional constriction. When machining, it is essential to ensure that the radius of the constriction is not damaged.*



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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 must be cleaned carefully, and the oil cooler must be renewed in order to prevent further damage occurring later.
- ◆ The oil level must not be above max. mark on dipstick – danger of damage to catalytic converter.
- ◆ Refer to ⇒ Maintenance tables for engine oil capacity, oil specifications and viscosity grades.
- ◆ Oil spray jet and pressure relief valve ⇒ [page 82](#)

1.1 Sump, oil pump - exploded view

1 - Oil pump

- ☐ With pressure relief valve (12 bar)
- ☐ Removing and installing ⇒ [page 122](#)
- ☐ Before installing, check that the two dowel sleeves ⇒ [Item 9 \(page 119\)](#) for centralising oil pump/cylinder block are fitted
- ☐ Renew if running surfaces and gears are scored
- ☐ Tightening torque for oil pump cover to oil pump housing: 10 Nm

2 - Chain sprocket for oil pump

- ☐ Sprocket can only be fitted on oil pump shaft in one position.

3 - 20 Nm + 90° (1/4 turn) further

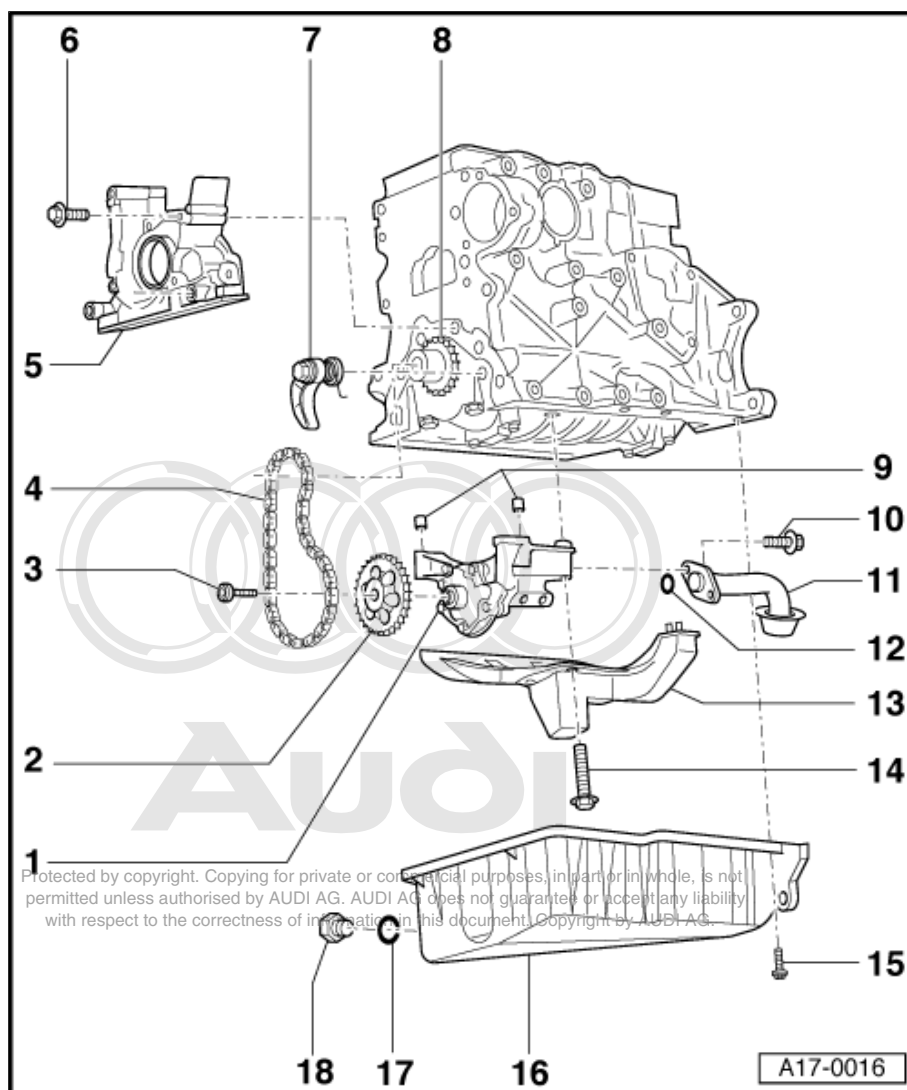
- ☐ Renew

4 - Drive chain for oil pump

- ☐ Mark direction of rotation before removing
- ☐ Check for wear

5 - Sealing flange (pulley end)

- ☐ Apply sealant prior to installing ⇒ [page 67](#)
- ☐ Renewing crankshaft oil seal - pulley end ⇒ [page 65](#)



6 - 15 Nm

7 - Chain tensioner

- ☐ Do not dismantle
- ☐ Note installation position
- ☐ When installing, pre-tension spring and engage
- ☐ Tighten to 16 Nm

8 - Chain sprocket for oil pump

- ☐ Removing and installing ⇒ [page 77](#)

9 - Dowel sleeves

- ☐ 2x

10 - 15 Nm

11 - Suction pipe

- ☐ Clean strainer if dirty

12 - O-ring

- ☐ Renew

13 - Baffle plate

14 - 16 Nm

15 - 15 Nm

16 - Sump

- ☐ Removing and installing ⇒ [page 119](#)
- ☐ With oil level and oil temperature sender -G266-
- ☐ Removing and installing oil level and oil temperature sender -G266- ⇒ [page 119](#)

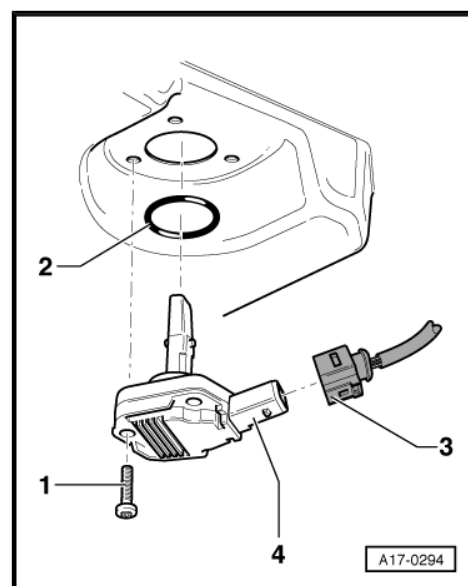
17 - Seal

- ☐ Renew

18 - Oil drain plug, 30 Nm

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

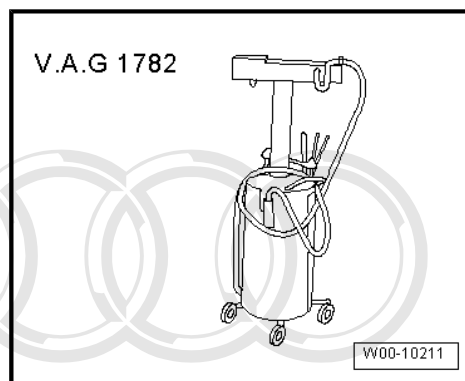
- 1 - Bolt, 10 Nm (self-locking); renew
- 2 - Seal; renew
- 3 - Electrical connector
- 4 - Oil level and oil temperature sender -G266-



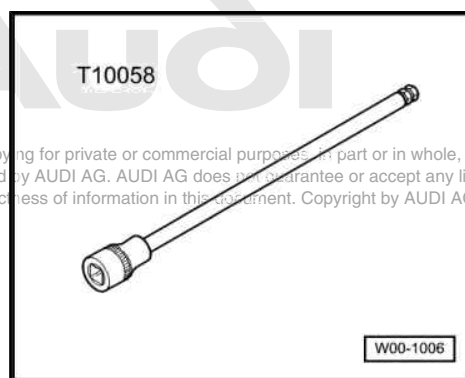
1.2 Removing and installing sump

Special tools and workshop equipment required

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



- ◆ Allen key, long reach -T10058-

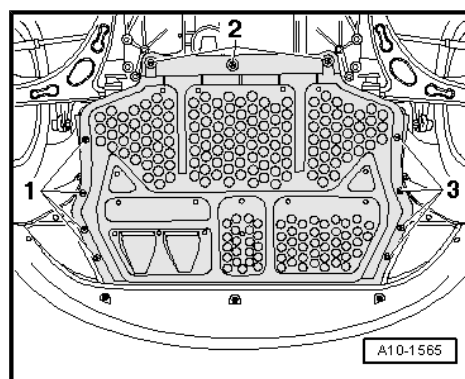


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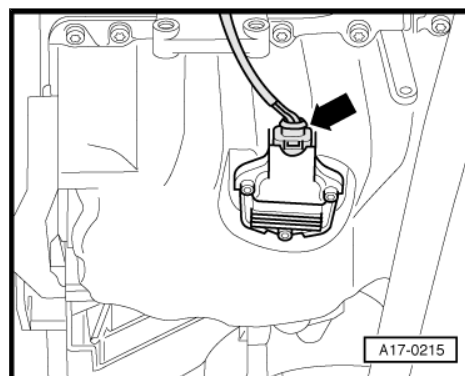
- ◆ Electric drill with plastic brush attachment
- ◆ Safety goggles
- ◆ Sealant ⇒ Electronic parts catalogue

Removing

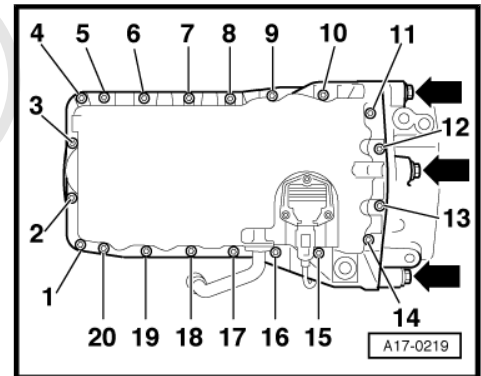
- Remove centre noise insulation -fasteners 1 ... 3-.
- Then place used oil collection and extraction unit -V.A.G 1782- under engine and drain engine oil.



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



- Unscrew sump/gearbox bolts -arrows-.
- Slacken bolts -1 ... 20- in diagonal sequence and remove.
- Take off sump: if necessary loosen it by striking lightly with a rubber hammer.



Installing

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

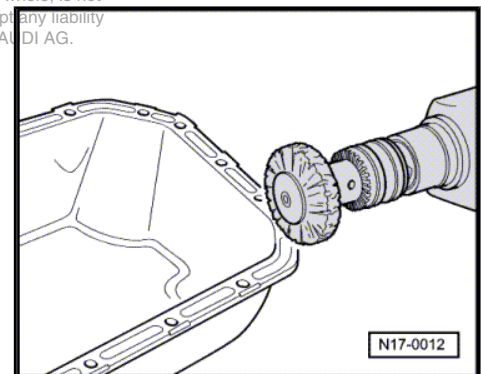
- Carefully remove sealant residues from cylinder block. For this purpose, remove baffle plate.



WARNING

Wear safety goggles.

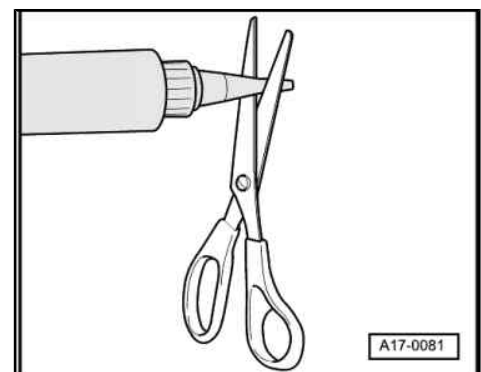
- Remove sealant residue from sump, e.g. with rotating plastic brush or similar.
- Clean sealing surfaces; they must be free of oil and grease.



Note

Note the use-by date of the sealant.

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

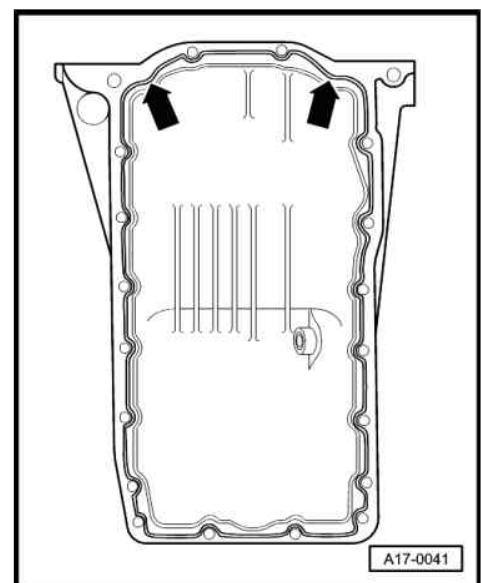


- Apply bead of sealant onto clean sealing surface of sump as shown in illustration.
- Thickness of sealant bead: 2 ... 3 mm



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.*
- ◆ *Take particular care when applying sealant bead in area of rear sealing flange -arrows- as shown in this figure.*
- ◆ *The sump must be installed within 5 minutes after applying sealant.*



- Immediately install sump and tighten bolts in the following sequence:

1. Pre-tighten bolts -1 ... 20- to 5 Nm in diagonal sequence.
2. Tighten sump/gearbox bolts -arrows- to 45 Nm.
3. Tighten bolts -1 ... 20- in diagonal sequence to 15 Nm.



Note

- ◆ When installing sump with engine removed from vehicle, ensure that sump is positioned flush with cylinder block at fly-wheel end.
- ◆ After fitting sump assembly, the sealant must dry for approx. 30 minutes. Then (and only then) fill the engine with engine oil.

- Fill up with engine oil ⇒ Maintenance ; Booklet 808 .

Tightening torques

Component	Nm
Sump to cylinder block	15
Sump to gearbox	45
Oil drain plug	30

1.3 Removing and installing oil pump

Removing

- Remove sump and baffle plate ⇒ [page 119](#) .
- Remove bolt -2-.
- Pull chain sprocket off oil pump shaft.
- Unscrew bolts -1- and -3- and remove oil pump.

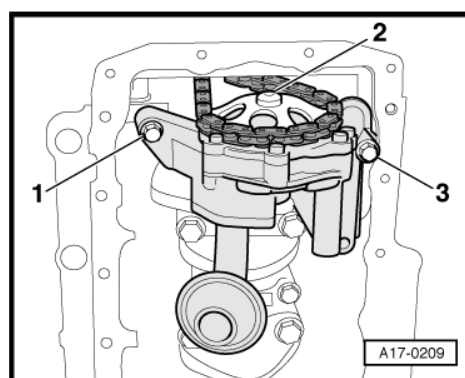
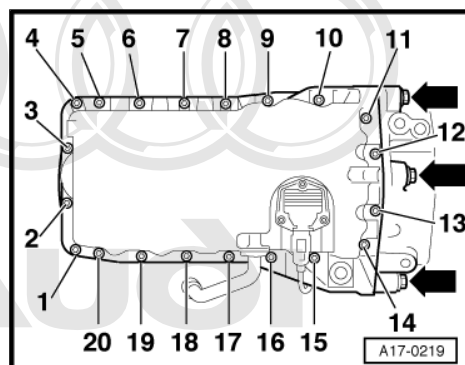
Installing

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

- Insert dowel sleeves ⇒ [Item 9 \(page 119\)](#) at top of oil pump.
- Installation position: Chain sprocket can only be fitted in one position on oil pump shaft.
- Install sump ⇒ [page 119](#) .

Tightening torques

Component	Nm
Chain sprocket to oil pump shaft	20 + 90° ¹⁾²⁾
Oil pump to cylinder block	16
• ¹⁾ Renew bolts. • ²⁾ 90° = one quarter turn	



1.4 Oil filter, oil filter bracket - exploded view

-
- This diagram illustrates the exploded view of the Audi A17-0351 engine component assembly. The components are numbered 1 through 20, showing their relative positions and assembly sequence. The central component is the main engine block (19). Other parts include a timing cover (5), a timing belt (2), a timing belt tensioner (18), a timing belt guide (17), a timing belt pulley (16), a timing belt cover (15), a timing belt cover gasket (14), a timing belt cover bolt (13), a timing belt cover nut (12), a timing belt cover washer (11), a timing belt cover cap (10), a timing belt cover cap gasket (9), a timing belt cover cap bolt (8), a timing belt cover cap nut (7), a timing belt cover cap washer (6), a timing belt cover cap gasket (5), a timing belt cover cap bolt (4), a timing belt cover cap nut (3), a timing belt cover cap washer (2), a timing belt cover cap gasket (1), a timing belt cover cap bolt (20), a timing belt cover cap nut (19), a timing belt cover cap washer (18), a timing belt cover cap gasket (17), a timing belt cover cap bolt (16), a timing belt cover cap nut (15), a timing belt cover cap washer (14), a timing belt cover cap gasket (13), a timing belt cover cap bolt (12), a timing belt cover cap nut (11), a timing belt cover cap washer (10), a timing belt cover cap gasket (9).
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- A17-0351

19 - Oil cooler

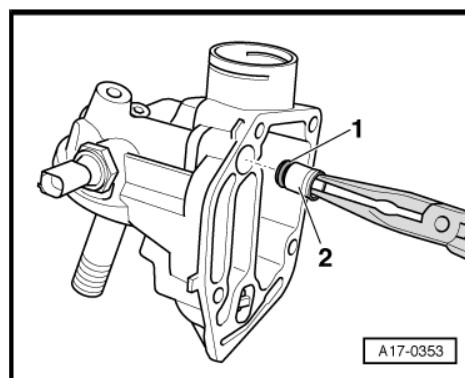
- ☐ Only for engine code BGU
- ☐ See note ⇒ [page 118](#)
- ☐ Ensure clearance from surrounding components
- ☐ Diagram of coolant hose connections ⇒ [page 127](#)

20 - Oil filter bracket

- ☐ With pressure relief valve, approx. 4 bar

Removing and installing oil retention valve

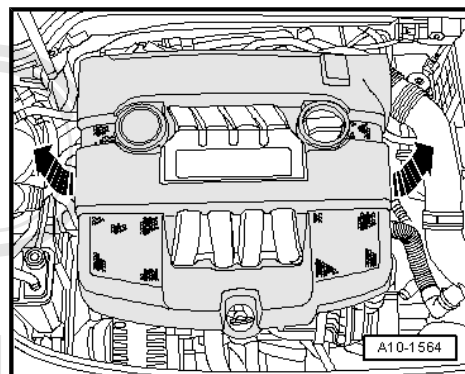
- Oil filter bracket must be removed.
- Pull out oil retention valve -2- using long-nose pliers (turn backwards and forwards when removing).
- Renew seal -1-.
- Press in new oil retention valve onto stop.



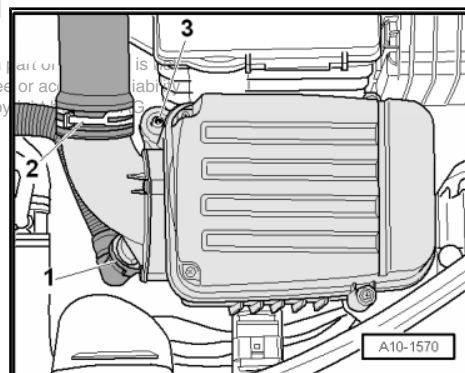
1.5 Removing and installing oil pressure switch -F1-

Removing

- Remove engine cover panel -arrows-.



- Disconnect hoses -1- and -2- from air cleaner housing.
- Remove bolt -3-.
- Take out air cleaner housing.



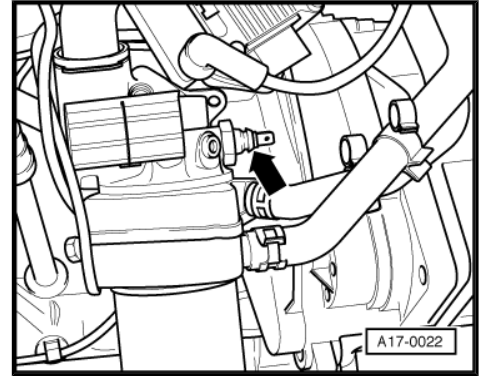
- Unplug electrical connector at oil pressure switch -F1-
-arrow-.
- Unscrew oil pressure switch.

Installing

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



If leakage occurs, cut open and renew seal for oil pressure switch.



Tightening torque

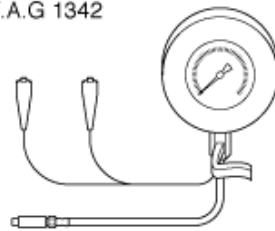
Component	Nm
Oil pressure switch -F1- to oil filter bracket	25

1.6 Checking oil pressure and oil pressure switch

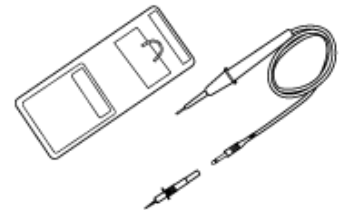
Special tools and workshop equipment required

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

V.A.G 1342



V.A.G 1527 B



V.A.G 1594 C



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G17-0023

Test conditions

- Oil level OK

- Engine oil temperature approx. 80 °C

Procedure

- Remove oil pressure switch ⇒ [page 124](#) .
- Connect oil pressure tester -V.A.G 1342- to threaded hole for oil pressure switch.
- Screw oil pressure switch -2- into oil pressure tester -V.A.G 1342- .

Checking oil pressure switch

- Connect brown wire -1- of oil pressure tester to earth (-).
- Connect voltage tester -V.A.G 1527B- with test leads from auxiliary measuring set -V.A.G 1594C- to oil pressure switch and battery positive (+).
- LED should not light up.

If the LED lights up:

- Renew oil pressure switch.
- Start engine.



Note

Observe tester and LED while starting, as switching point of oil pressure switch may already be exceeded when starting.

- LED should light up at 1.2 ... 1.6 bar.

If LED does not light up:

- Renew oil pressure switch.

Checking oil pressure

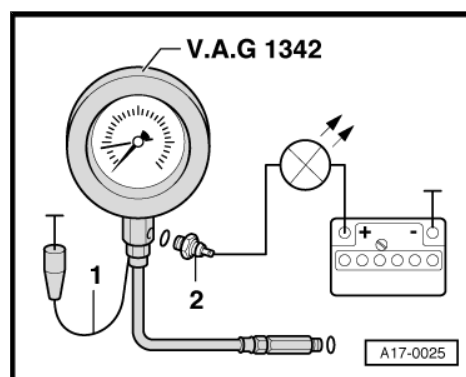
- Start engine (engine oil temperature approx. 80 °C).
- Minimum oil pressure at idling speed: 1.2 bar
- Minimum oil pressure at 2000 rpm: 3.5 bar.
- Install oil pressure switch ⇒ [page 124](#) after completing test.

1.7 Engine oil

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

1.8 Checking engine oil level

Check engine oil level ⇒ Maintenance ; Booklet 808 .



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.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) → Electronic parts catalogue .*
- ◆ *Renew gaskets and seals.*
- ◆ *The arrow markings on coolant pipes and on ends of hoses must align.*

1.1 Diagram of coolant hose connections



Note

The illustration shows the connections for a vehicle with engine code BGU and manual gearbox.



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1 - Radiator

- ☐ Removing and installing
⇒ [page 141](#)
- ☐ If renewed, refill system
with fresh coolant

2 - Thermostat

- ☐ Removing and installing
⇒ [page 135](#)
- ☐ Checking ⇒ [page 136](#)

3 - Coolant pump

- ☐ Removing and installing
⇒ [page 134](#)

4 - Cylinder head/cylinder block

- ☐ If renewed, refill system
with fresh coolant

5 - Expansion tank

- ☐ With filler cap
- ☐ Checking pressure relief valve in filler cap
⇒ [page 147](#)

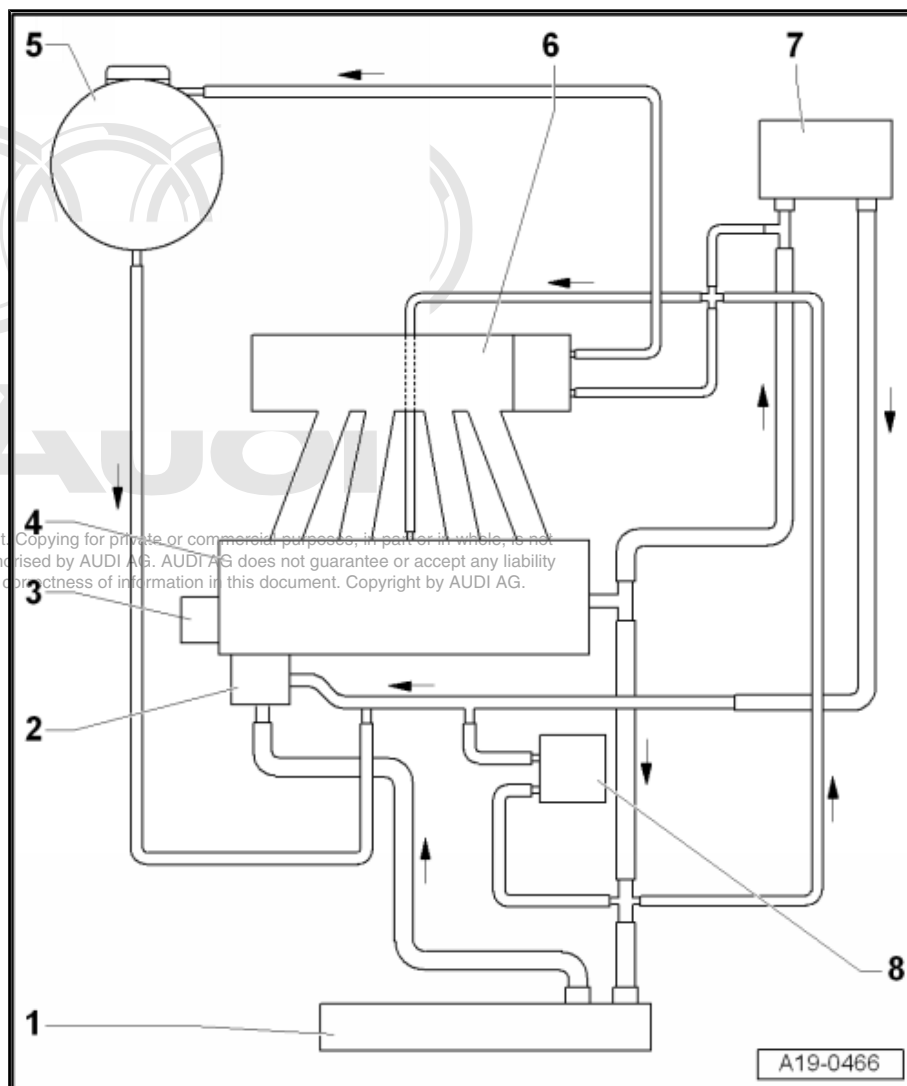
6 - Intake manifold with heating for throttle valve housing

7 - Heat exchanger (for heating system)

- ☐ If renewed, refill system
with fresh coolant

8 - Oil cooler

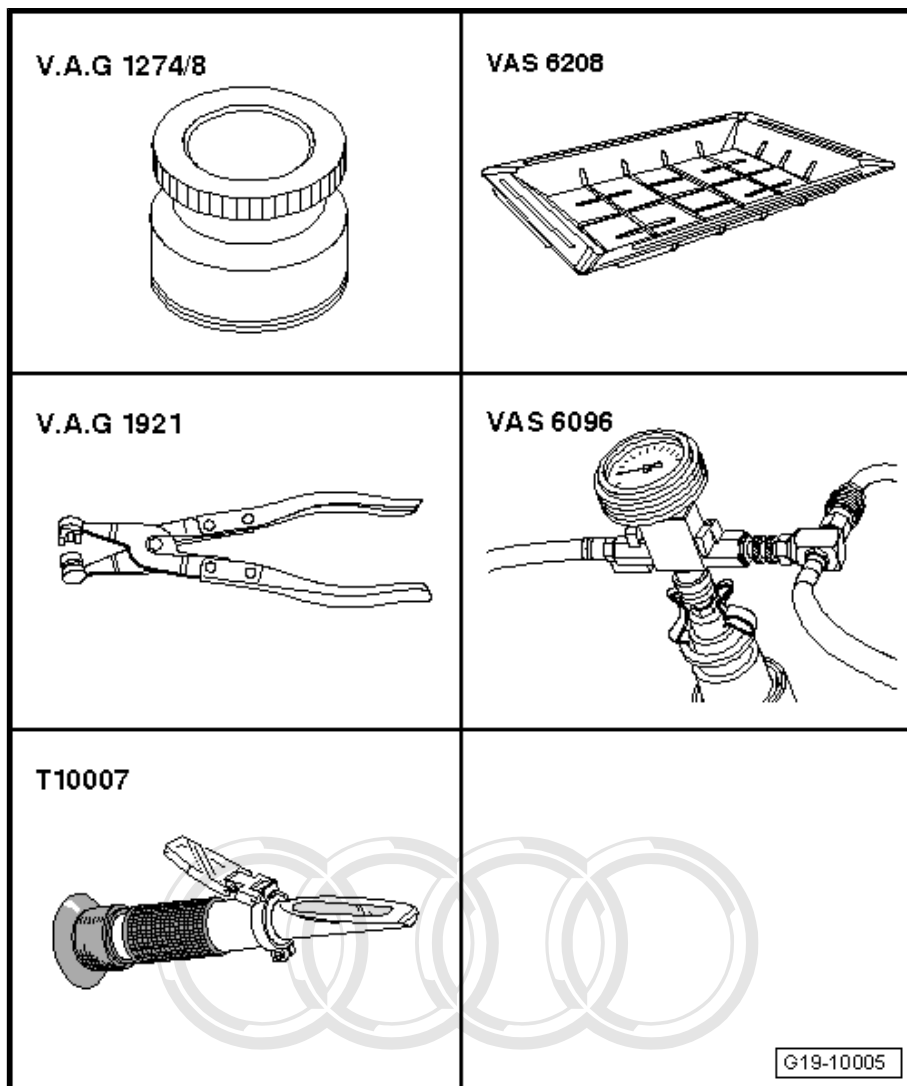
- ☐ Removing and installing
⇒ [Item 19 \(page 124\)](#)



1.2 Draining and filling cooling system

Special tools and workshop equipment required

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



Draining



Note

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

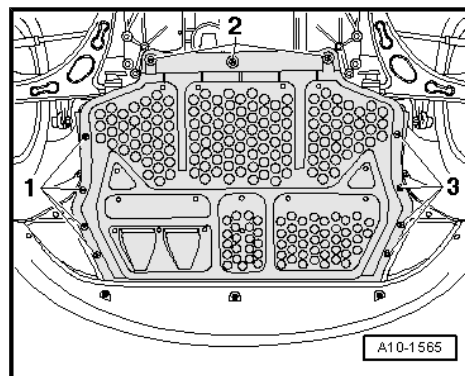


WARNING

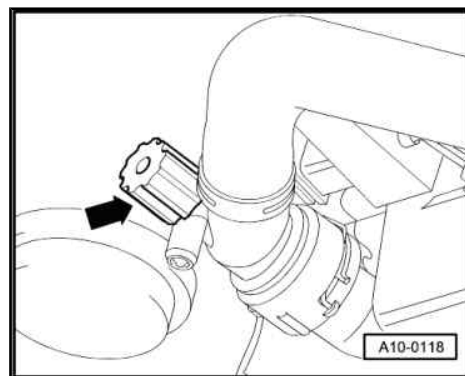
Hot steam or hot coolant can escape when expansion tank is opened; cover filler cap with cloth and open carefully.

- Open filler cap on coolant expansion tank.

- Remove centre noise insulation -fasteners 1 ... 3-.



- Place drip tray for workshop hoist -VAS 6208- under engine.
- Turn drain plug -arrow- on radiator anti-clockwise, if necessary fit drain hose to connection.



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- If fitted, also disconnect coolant hose at bottom of oil cooler -arrow- and drain off remaining coolant.

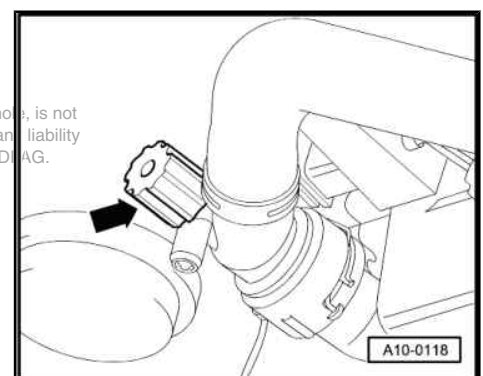
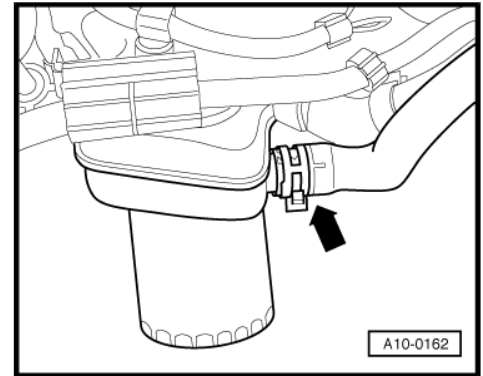
Filling



Note

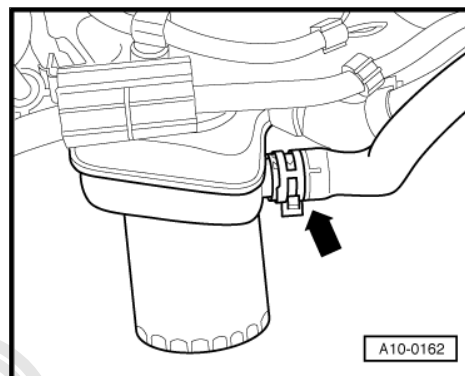
- ◆ *The cooling system is filled all year round with a mixture of water and radiator antifreeze/anti-corrosion agent.*
- ◆ *Use only the radiator antifreeze/anti-corrosion agent approved for this engine ⇒ Electronic parts catalogue . Other coolant additives could seriously impair in particular the anti-corrosion properties. The resulting damage could lead to loss of coolant and consequently to serious engine damage.*
- ◆ *The specified 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:*
 - ◆ *radiator, heat exchanger for heater, cylinder head and 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- .*

- Close drain plug -arrow-.

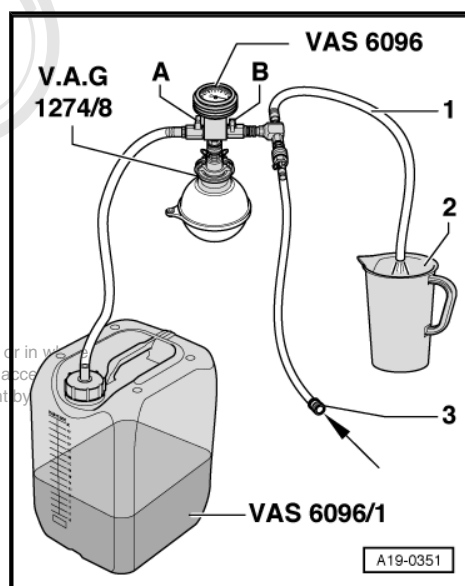


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- If fitted, connect coolant hose to oil cooler -arrow-.



- Fill reservoir of cooling system charge unit -VAS 6096- with at least 8 litres of premixed coolant (according to 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 for cooling system tester -V.A.G 1274/8- onto coolant expansion tank.
- Attach cooling system charge unit -VAS 6096- to adapter - V.A.G 1274/8- .
- Run vent hose -1- into a small container -2-. (The vented air draws along a small amount of coolant, which should be collected.)
- Close the two valves -A- and -B- by setting lever at right angle to direction of flow.
- Connect hose -3- to compressed air.
- Pressure: 6 ... 10 bar.



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

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

- The needle on the gauge should move into the green zone.
- Also briefly open valve -A- (turn lever in direction of flow) so that hose on charge unit -VAS 6096- can fill with coolant.
- Close valve -A- again.
- Leave valve -B- open for another 2 minutes.
- The suction jet pump will continue generating a vacuum in the cooling system.
- The needle on the gauge should remain in the green zone.
- Close valve -B-.
- The needle on the gauge should stop in the green zone. The vacuum level in the cooling system is then sufficient for subsequent filling.

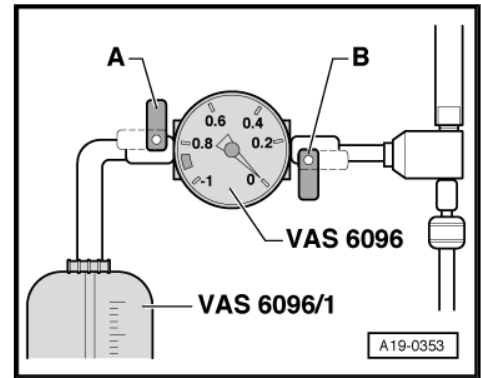
If the needle does not reach the green zone, repeat the process.

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

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

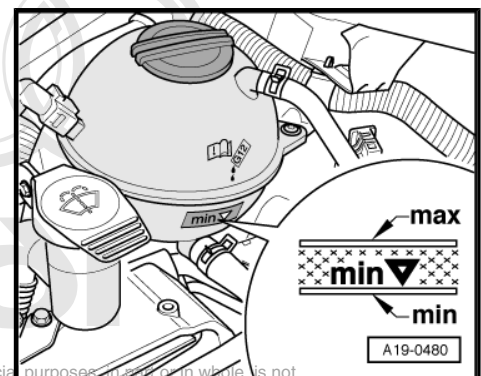
The vacuum in the cooling system causes the coolant to be drawn out of the reservoir for cooling system charge unit -VAS 6096- ; the cooling system is then filled.

- Check the coolant level and top up coolant as far as the max mark.
- Start engine, run for 2 minutes (maximum) at approx. 1500 rpm and top up coolant to overflow hole on expansion tank with engine running.
- Close filler cap on coolant expansion tank.
- Run engine until radiator fan cuts in.



WARNING

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

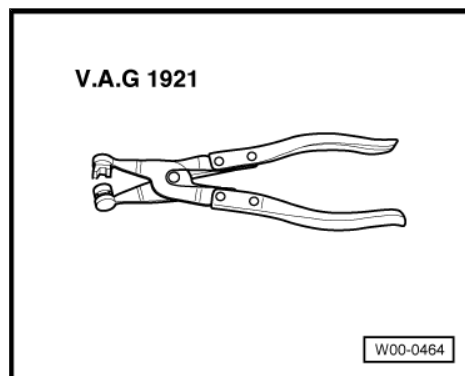


- Check coolant level and top up if necessary.
- When the engine is at normal operating temperature, coolant level must be at MAX mark, when engine is cold it must be between MIN and MAX marks.
- Switch engine off.

1.3 Removing and installing coolant pump

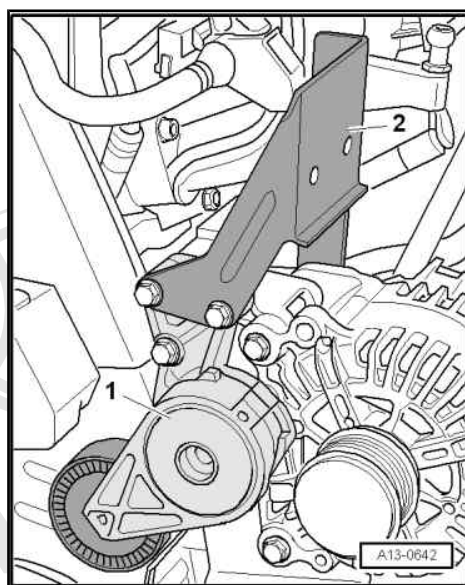
Special tools and workshop equipment required

- ◆ Hose clip pliers -V.A.G 1921-



Removing

- Drain off coolant ⇒ [page 129](#) .
- Remove poly V-belt ⇒ [page 43](#) .
- Detach deflector plate -2-.
- Remove tensioner -1- for poly V-belt.

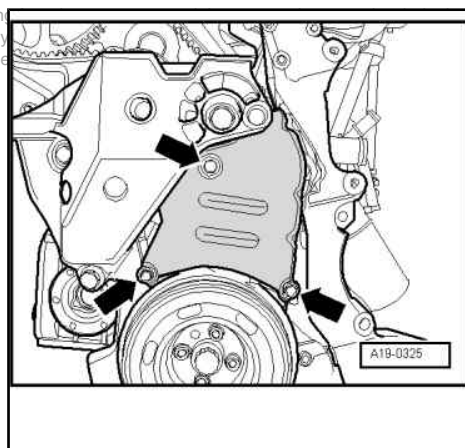


- Remove toothed belt from camshaft sprocket ⇒ [page 57](#) .
- Remove the centre toothed belt cover -arrows-.



Note

- ◆ The belt pulley and toothed belt cover (bottom) do not have to be removed.
- ◆ The toothed belt should be left in position on the crankshaft sprocket.
- ◆ Before removing coolant pump, cover toothed belt with a cloth to protect against coolant.



- Unscrew bolts -1- for coolant pump and remove coolant pump -2-.
- Remove O-ring -3-.

Installing

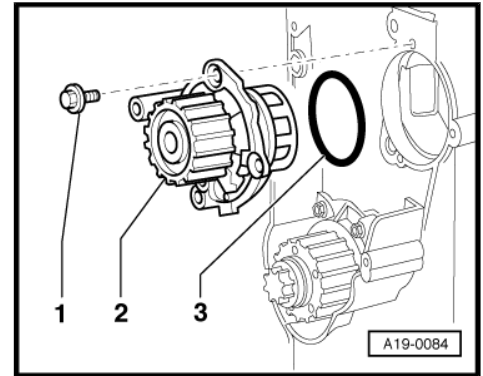
Installation is carried out in the reverse order; note the following:



Note

Renew O-ring.

- Clean and smoothen sealing surface for O-ring as required.
- Moisten new O-ring -3- with coolant.
- Fit coolant pump -2-.
- Installation position: Sealing plug in housing faces downwards.
- Tighten bolts -1- for coolant pump.
- Install toothed belt (adjust valve timing) ⇒ [page 60](#) .
- Install poly V-belt ⇒ [page 43](#) .
- Fill cooling system ⇒ [page 131](#) .



Tightening torques

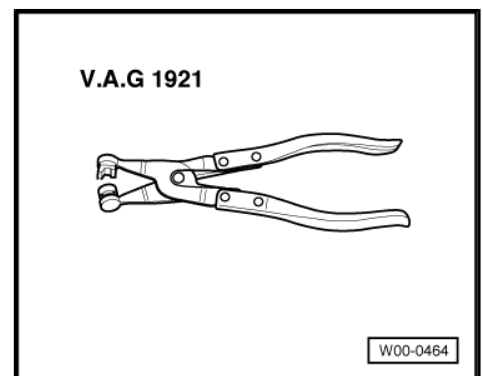
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Component	Nm
Coolant pump to cylinder block	15
Toothed belt cover (centre) to cylinder block	10 ¹⁾
Tensioner for poly V-belt to bracket for ancillaries	23
Deflector plate to bracket for ancillaries	23
• ¹⁾ Apply locking fluid when installing; refer to ⇒ Electronic parts catalogue for locking fluid.	

1.4 Removing, installing and checking thermostat

Special tools and workshop equipment required

- ◆ Hose clip pliers -V.A.G 1921-



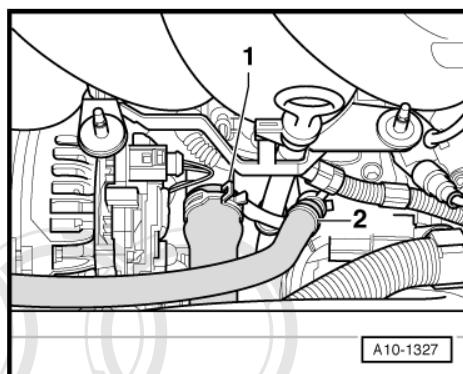
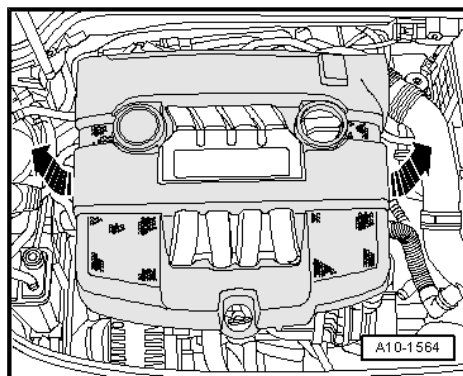
Removing



Caution

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

- Disconnect earth wire at battery with ignition switched off.
- Remove engine cover panel -arrows-.
- Drain off coolant ⇒ [page 129](#) .
- Detach coolant hoses -1- and -2-.



- Remove bolts -4- and detach connection -3-, O-ring -2- and thermostat -1-.

Installing

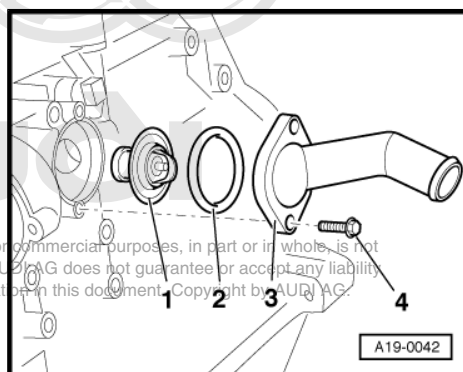
Installation is carried out in the reverse order; note the following:



Note

Renew O-ring.

- Clean and smoothen sealing surface for O-ring as required.
- Insert thermostat.
- Installation position: Cross-piece on thermostat should be vertical.
- Coat new O-ring with coolant.
- Connect battery. Procedures required ⇒ Rep. gr. 27 .
- Fill cooling system ⇒ [page 131](#) .



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Tightening torque

Component	Nm
Connection to cylinder block	15

Checking thermostat

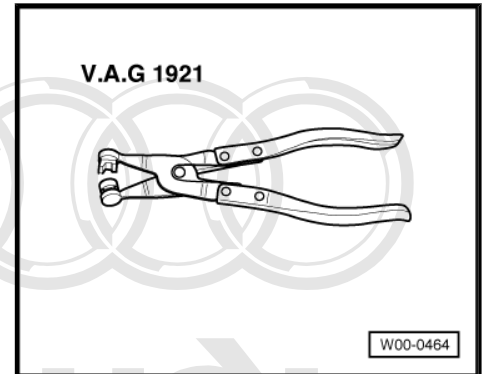
- Heat up the removed thermostat in hot water.

Starts to open	Fully open	Opening travel
approx. 87 °C	approx. 102 °C ¹⁾	at least 7 mm
• ¹⁾ Cannot be tested.		

1.5 Removing and installing coolant pipe

Special tools and workshop equipment required

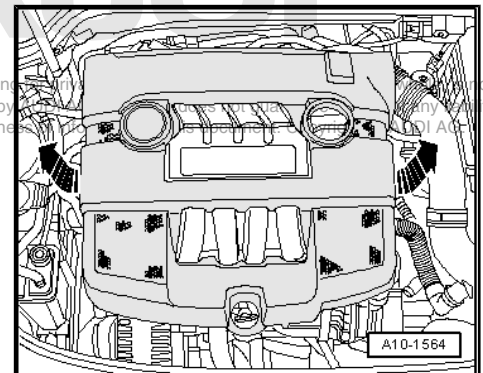
- ◆ Hose clip pliers -V.A.G 1921-



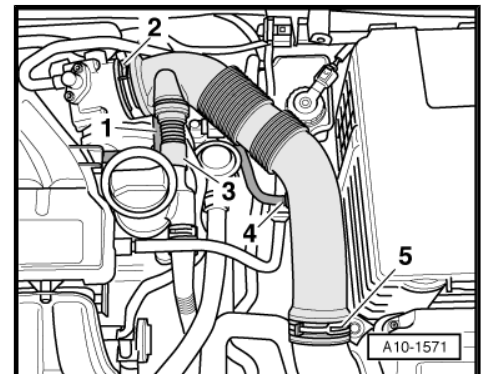
Removing

- Drain off coolant ⇒ [page 129](#) .
- Remove engine cover panel -arrows-.

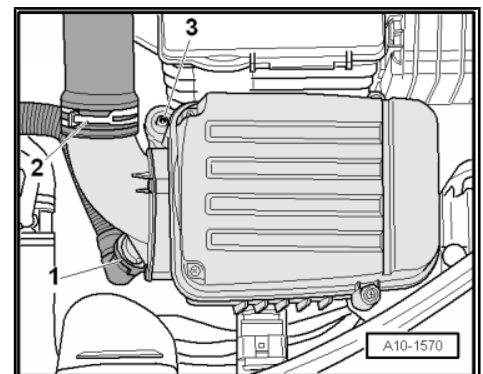
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- Detach hoses -1-, -3- and -4-.
- Release spring-type hose clips -2- and -5- and remove air hose.

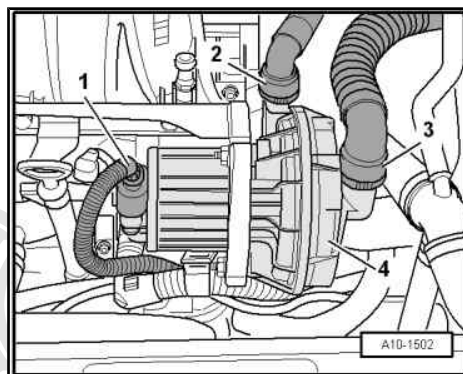


- Disconnect hoses -1- and -2- from air cleaner housing.
- Remove bolt -3-.
- Take out air cleaner housing.

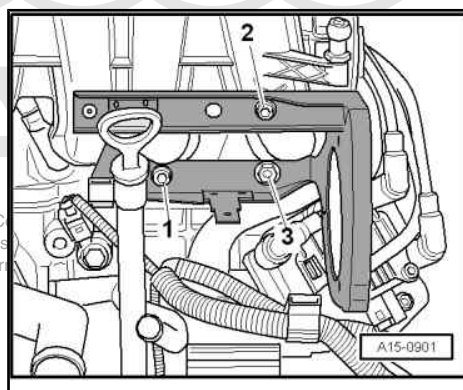


Vehicles with engine code BGU:

- Unplug electrical connector -1-.
- Disconnect hoses -2- and -3- at secondary air pump.
- Detach secondary air pump -4- from bracket.



- Unscrew bolts -1- and -2- and nut -3- on secondary air pump bracket.
- Detach bracket.

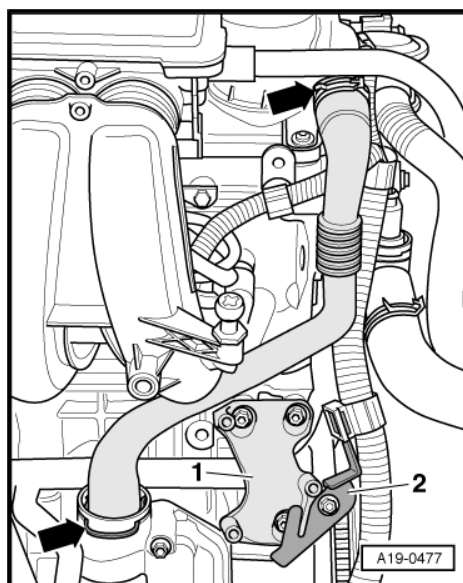
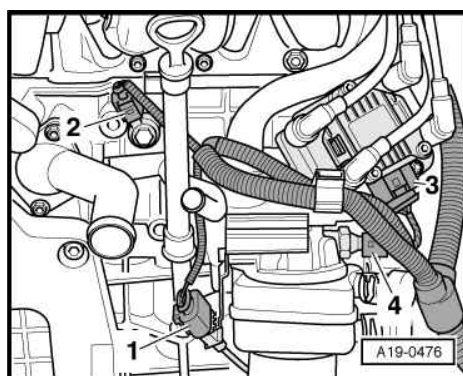


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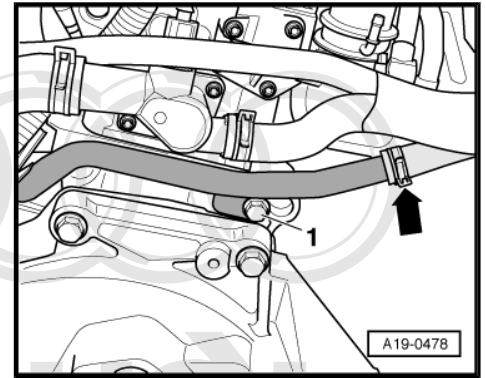
is not liability AG.

All vehicles (continued):

- Unplug electrical connectors:
 - 1 - Engine speed sender -G28-
 - 2 - Knock sensor 1 -G61-
 - 3 - Ignition coil 1 -N- and ignition coil 2 -N128- with output stage -N122-
 - 4 - Oil pressure switch -F1- (on oil filter bracket)
- Move wiring clear.
- Remove ignition coil assembly.
- Remove wiring harness bracket -2- and ignition coils bracket -1-.
- Remove crankcase breather pipe -arrows-.



- Disconnect coolant hose -arrow- from coolant pipe (hose leads to heat exchanger for heater).
- Unscrew securing bolt -1- on coolant pipe.



- Disconnect front coolant hoses at coolant pipe.
- Detach coolant pipe -2- from connection.
- Remove O-ring -1-.

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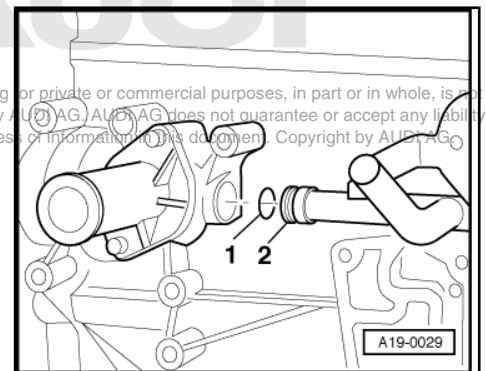
Installing

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



Note

- ◆ *Renew gaskets, seals and O-rings.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- Clean and smoothen sealing surface for O-ring as required.
- Lubricate new O-ring -1- with coolant and push O-ring onto coolant pipe -2-.
- Push coolant pipe into bore on cylinder block.
- Install ignition coil assembly ⇒ Rep. gr. 28 .
- Fill cooling system ⇒ [page 131](#) .



Tightening torques

Component	Nm
Coolant pipe to cylinder block	40
Bracket for ignition coil to cylinder block	15
Bracket for wiring harness to cylinder block	10
Ignition coil to bracket	10
Bracket for secondary air pump to intake manifold	23
Secondary air pump to bracket	10

1.6 Radiator and radiator fans - exploded view

1 - Radiator fan -V7-

- ☐ Removing and installing ⇒ [page 143](#)
- ☐ With radiator fan control unit -J293-
- ☐ Note routing of wiring ⇒ [page 144](#)

2 - 10 Nm

3 - Coolant hose (bottom)

- ☐ To connection for thermostat
- ☐ Lift retaining clip to detach
- ☐ Connecting to radiator ⇒ [page 141](#)

4 - Retaining clip

5 - Radiator fan thermal switch -F18-

6 - O-ring

- ☐ Renew

7 - O-ring

- ☐ Renew

8 - Coolant hose (top)

- ☐ To connection at cylinder head
- ☐ Lift retaining clip to detach
- ☐ Connecting to radiator ⇒ [page 141](#)

9 - O-ring

- ☐ Renew

10 - Radiator

- ☐ Removing and installing ⇒ [page 141](#)
- ☐ If renewed, change coolant in entire system

11 - Bracket

- ☐ For radiator

12 - 5 Nm

13 - Retainer

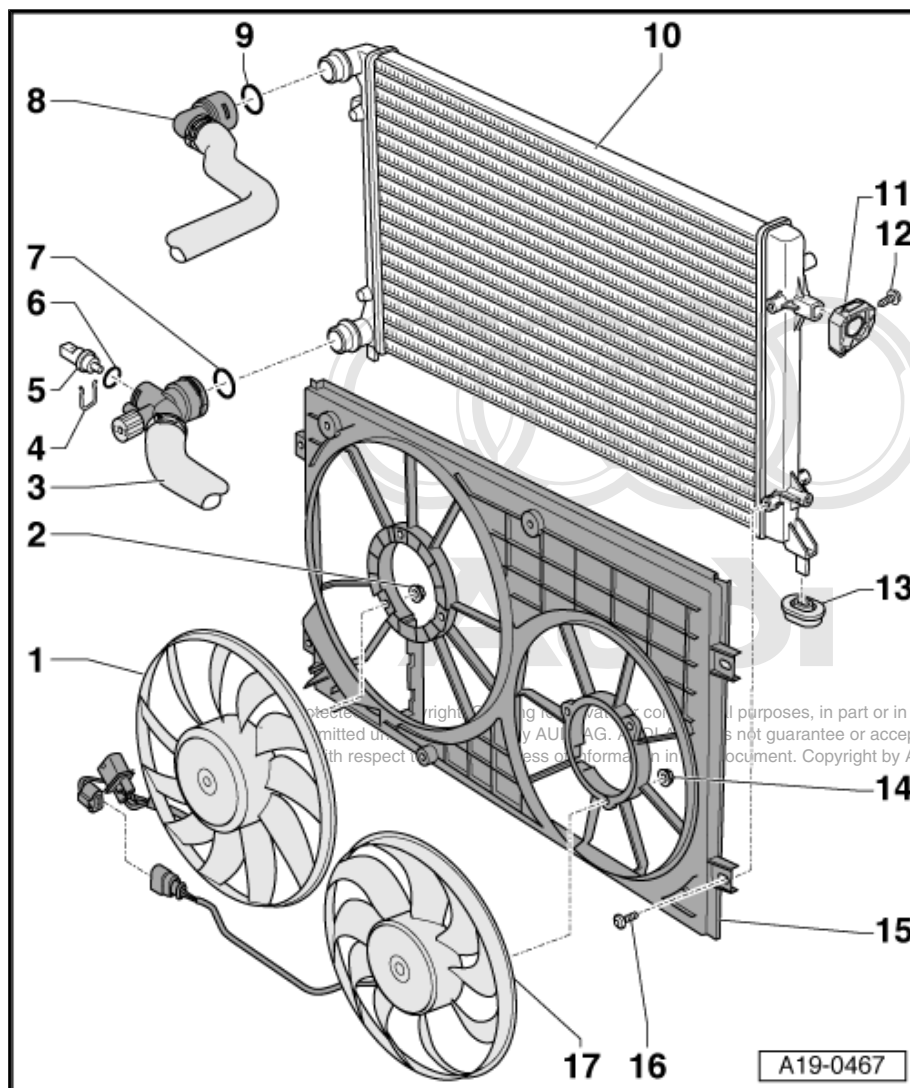
14 - 10 Nm

15 - Radiator cowl

16 - 5 Nm

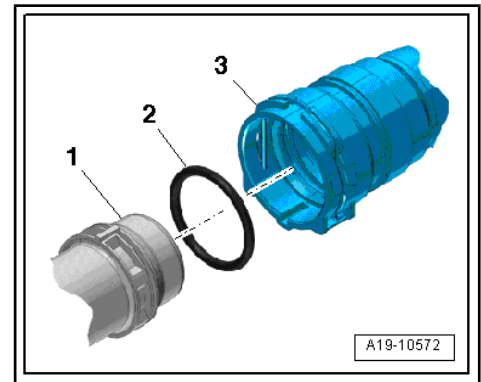
17 - Radiator fan 2 -V177-

- ☐ Removing and installing ⇒ [page 143](#)
- ☐ Note routing of wiring ⇒ [page 144](#)



Connecting coolant hose with plug-in connector

- Remove old O-ring -2- from coolant hose -3-.
- Lubricate new O-ring with coolant additive and fit O-ring in coolant hose.
- Press coolant hose onto 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.



1.7 Removing and installing radiator

Special tools and workshop equipment required

- ◆ Hose clip pliers -V.A.G 1921-



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V.A.G 1921



W00-0464

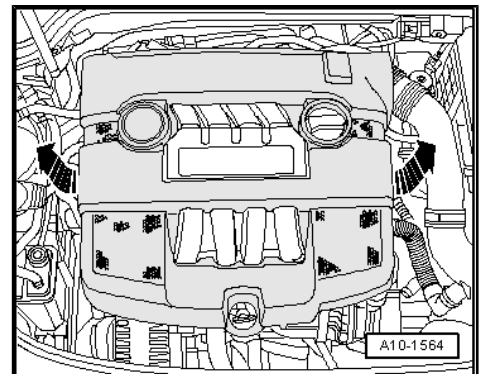
Removing



Note

If there are slight impressions on the fins, refer to [⇒ page 5](#).

- Remove engine cover panel -arrows-.
- Drain off coolant [⇒ page 129](#).

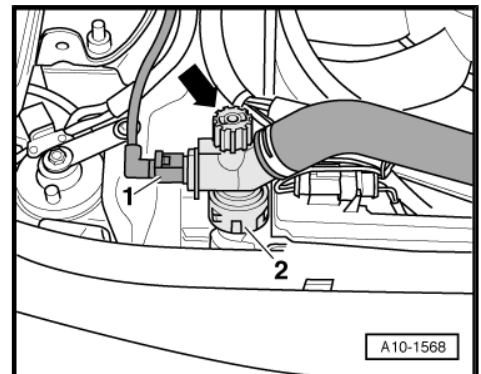


- Unplug electrical connector -1- at radiator outlet coolant temperature sender -G83-.
- Disconnect coolant hose -2- (bottom) from radiator (pull out retaining clip).

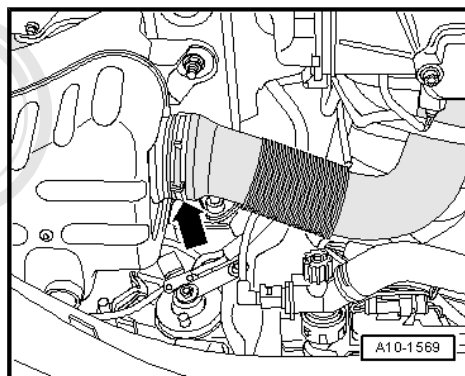


Note

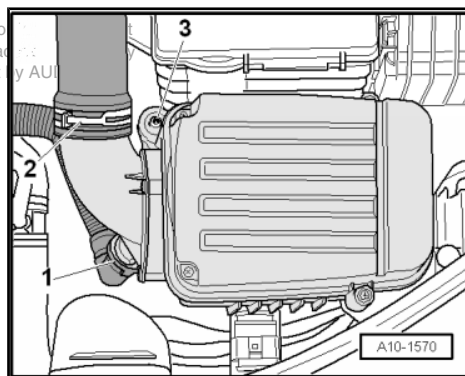
Disregard -arrow-.



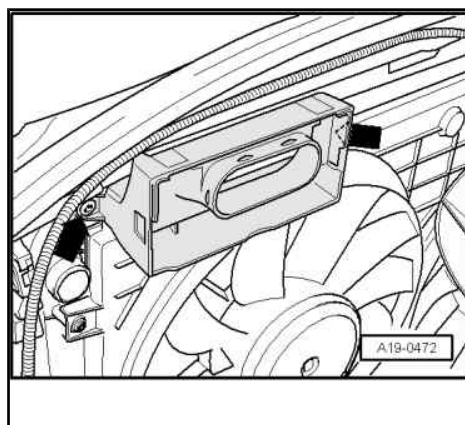
- Disconnect air hose -arrow- at bottom of resonator.
- Remove front bumper ⇒ Rep. gr. 63 .



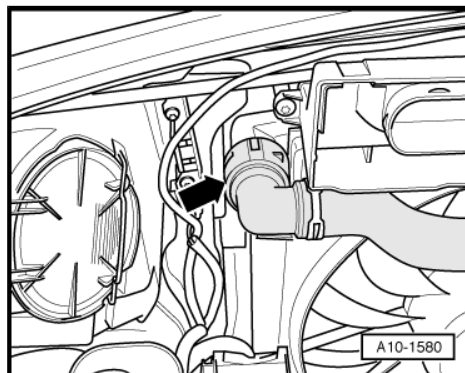
- Disconnect hoses 1 and 2 from air cleaner housing
- Remove bolt -3-.
- Take out air cleaner housing.



- Detach air hose (going to resonator) at lock carrier.
- Unscrew air duct at lock carrier -arrows-.



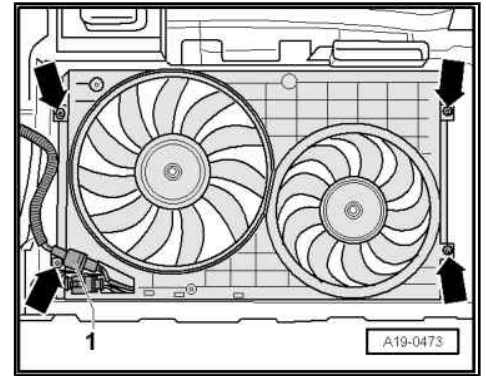
- Lift retaining clip and disconnect coolant hose -arrow- (top) from radiator.



- Unplug electrical connector -1-.
- Unscrew bolts -arrows- and remove radiator cowl.
- Remove the left and right-hand air ducts from the radiator.

**WARNING**

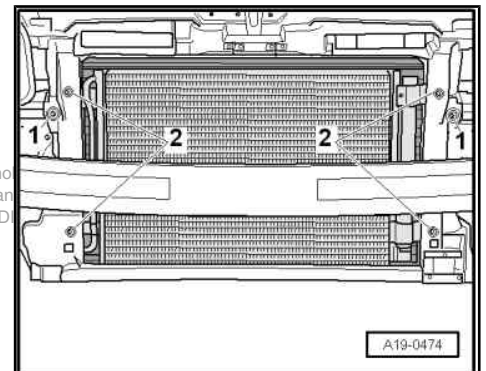
The air conditioner refrigerant circuit must not be opened.

**Note**

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

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- Unscrew securing bolts -2- for the condenser.
- Remove bolts -1- at radiator.
- Swivel radiator slightly towards rear.
- Detach radiator upwards and take it out from below.

**Installing**

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

- Connect coolant hose with plug-in connector to radiator
⇒ [page 141](#).
- Install front bumper ⇒ Rep. gr. 63.
- Fill cooling system ⇒ [page 131](#).

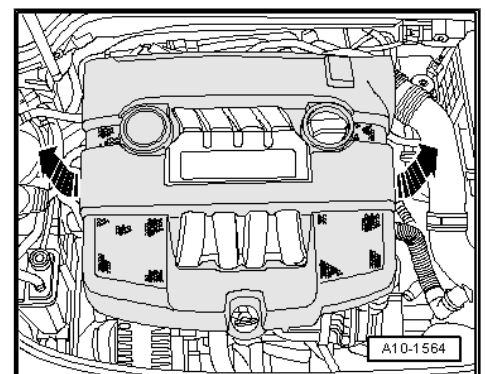
Tightening torques

Component	Nm
Radiator to bracket	5
Condenser to radiator	5
Radiator cowl to radiator	5

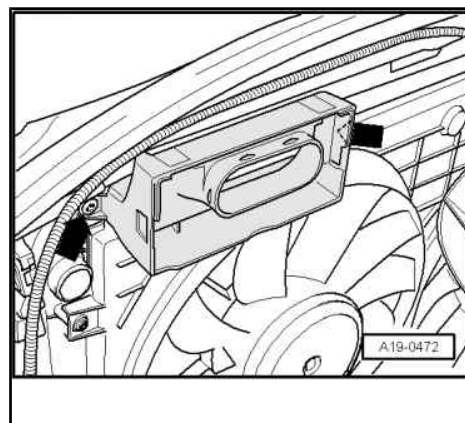
1.8 Removing and installing radiator fan - V7- and radiator fan 2 -V177-

Removing

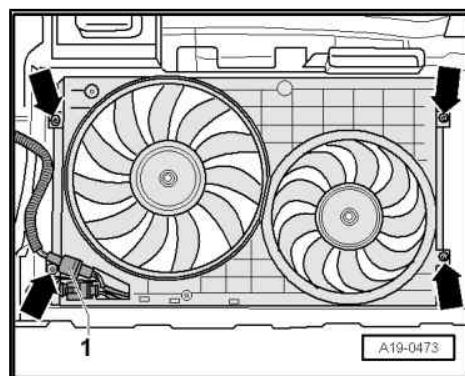
- Remove engine cover panel -arrows-.



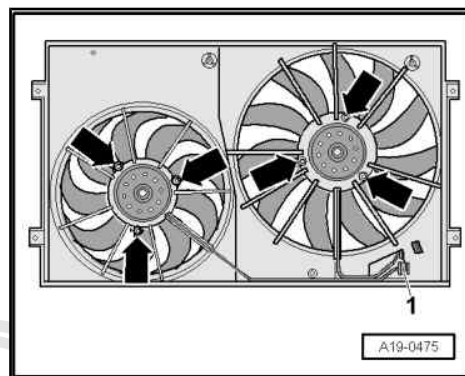
- Detach air hose (going to resonator) at lock carrier.
- Unscrew air duct at lock carrier -arrows-.



- Unplug electrical connector -1-.
- Unscrew bolts -arrows- and remove radiator cowl.



- Unplug electrical connector -1-.
- Move wiring clear.
- Unscrew nuts -arrows- and remove fans.



Installing

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

- Check that retaining clips -1- for radiator fan wiring are positioned correctly.
- The retaining clips must be fitted as illustrated.
- The retaining clips must be inserted into the slots provided on the ribs of the radiator cowl.



Caution

The radiator can be damaged if the retaining clips are not fitted in the correct positions.

Tightening torques

Component	Nm
Radiator fan to radiator cowl	10
Radiator cowl to radiator	10

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1.9 Engine pre-heating system for vehicles with engine codes CCSA, CMXA - exploded view

1 - Pre-heating element

- ☐ Installation position
⇒ [page 145](#)

2 - Bracket**3 - Nut**

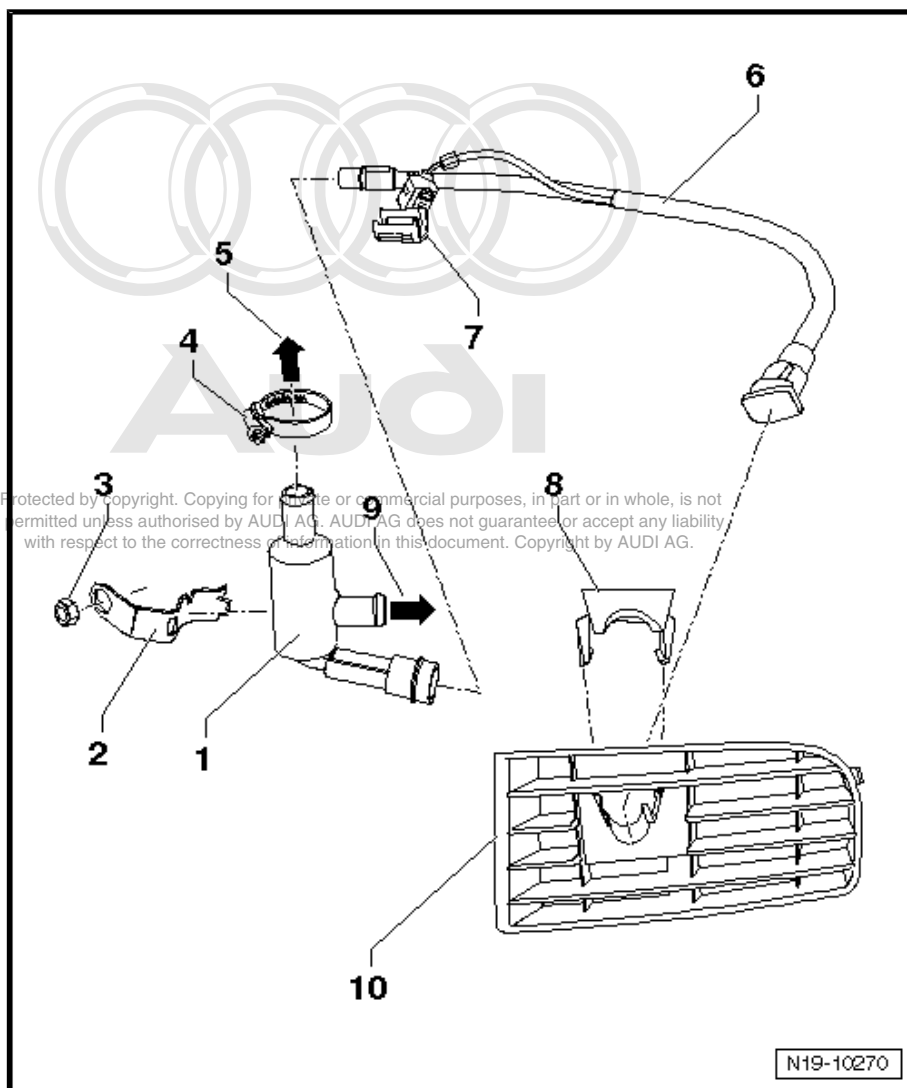
- ☐ 40 Nm

4 - Hose clip**5 - To coolant pipe****6 - Connecting wire for 220 V****7 - Locking device****8 - Bracket**

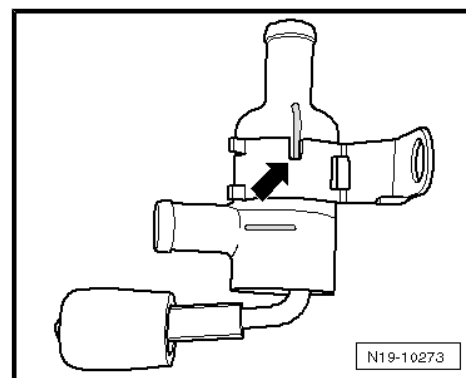
- ☐ Version fitted in vehicle may differ from illustration

9 - To branched connection of coolant hose (going to top of radiator)**10 - Air intake grille**

- ☐ Version fitted in vehicle may differ from illustration

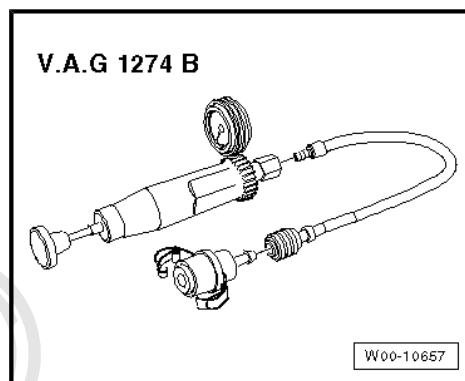
**Installation position of pre-heating element**

- Lug -arrow- must engage in recess in bracket.

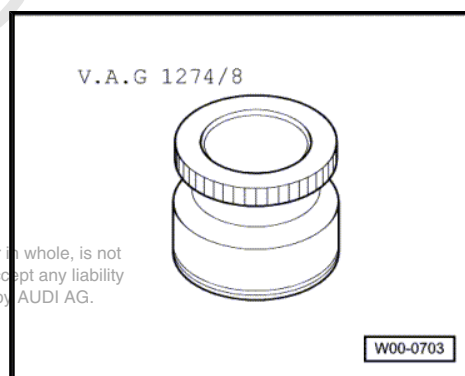
**1.10 Checking cooling system for leaks**

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.



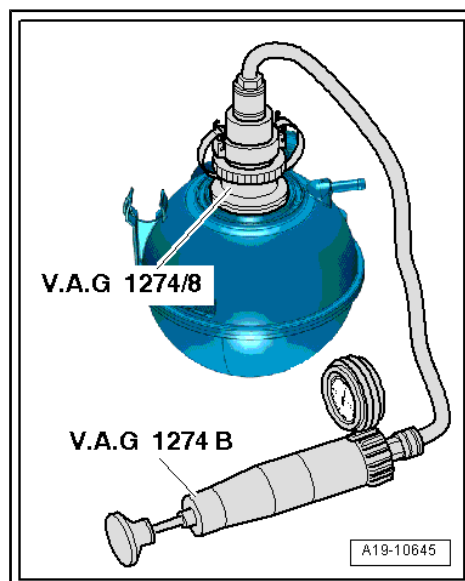
WARNING

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 tester to create a pressure of approx. 1.0 bar.

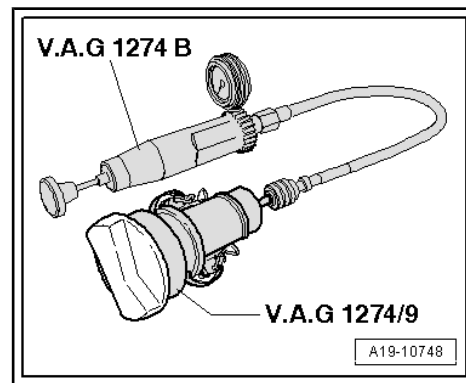
If the pressure drops:

- Trace leak and repair.



Checking pressure relief valve in filler cap

- Attach cooling system tester -V.A.G 1274 B- with adapter - V.A.G 1274/9- to filler cap.
- Operate hand pump.
- The pressure relief valve should open at a pressure of 1.4 ... 1.6 bar.



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26 – Exhaust system

1 Silencers and exhaust manifold - vehicles with engine codes BGU, BSE, BSF, CCSA



Note

- ◆ Renew gaskets and self-locking nuts.
- ◆ After working on the exhaust system, ensure that the system is not under stress and that it has sufficient clearance from the body. If necessary, loosen clamp and align silencers and exhaust pipe so that sufficient clearance is maintained to the body at all points and the mountings are evenly loaded.

1.1 Silencers and exhaust manifold on vehicles with engine codes BGU, BSE, BSF, CCSA - exploded view

1 - Rear tunnel cross-piece

2 - Centre silencer

- ☐ Combined in one unit with rear silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Separating centre and rear silencers
⇒ [page 150](#)
- ☐ Align exhaust system so it is free of stress
⇒ [page 154](#)

3 - Mounting

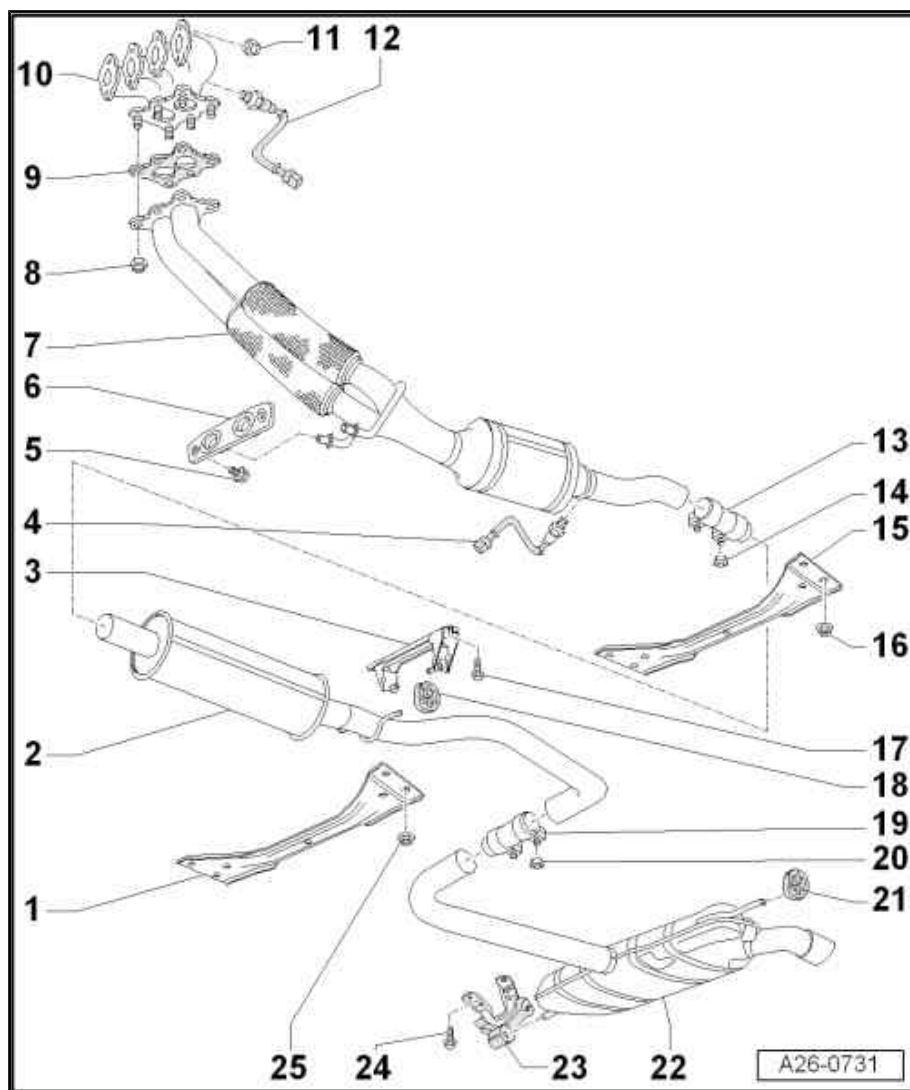
4 - Lambda probe after catalytic converter -G130-, 55 Nm

- ☐ The threads on the new Lambda probes are coated with a special assembly paste.
- ☐ If re-installing old Lambda probe, coat thread with high-temperature paste: Refer to ⇒ Electronic parts catalogue for high-temperature paste
- ☐ The assembly paste/high-temperature paste must not get into the slots on the probe body.
- ☐ Removing and installing
⇒ Rep. gr. 24

5 - 23 Nm

6 - Mounting

- ☐ Renew if damaged


not
bility

7 - Front exhaust pipe with catalytic converter

- ☐ Protect against knocks and impact
- ☐ With flexible joint
- ☐ Do not bend flexible joint more than 10° – otherwise it can be damaged
- ☐ Removing and installing ⇒ [page 151](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 154](#)

8 - 25 Nm

- ☐ Renew
- ☐ Lubricate exhaust manifold studs with high-temperature paste. For high-temperature paste refer to ⇒ Electronic parts catalogue
- ☐ Observe correct tightening sequence ⇒ [page 153](#)

9 - Gasket

- ☐ Renew

10 - Exhaust manifold

- ☐ Removing and installing ⇒ [page 153](#)

11 - 25 Nm

- ☐ Renew

12 - Lambda probe -G39- (before catalytic converter), 55 Nm

- ☐ The threads on the new Lambda probes are coated with a special assembly paste.
- ☐ If re-installing old Lambda probe, coat thread with high-temperature paste: Refer to ⇒ Electronic parts catalogue for high-temperature paste
- ☐ The assembly paste/high-temperature paste must not get into the slots on the probe body.
- ☐ Removing and installing ⇒ Rep. gr. 24.

13 - Clamp (front)

- ☐ Align exhaust system so it is free of stress before tightening clamp ⇒ [page 154](#)
- ☐ Installation position ⇒ [page 150](#)
- ☐ Tighten bolt connections evenly.

14 - 25 Nm

15 - Front tunnel cross-piece

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16 - 23 Nm

17 - 23 Nm

18 - Rubber mounting

- ☐ Renew if damaged

19 - Clamp (rear)

- ☐ For separate replacement of centre and rear silencers
- ☐ Installation position ⇒ [page 150](#)
- ☐ Tighten bolt connections evenly.

20 - 25 Nm

21 - Rubber mounting

- ☐ Renew if damaged

22 - Rear silencer

- ☐ Combined in one unit with centre silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Separating centre and rear silencers ⇒ [page 150](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 154](#)

23 - Mounting

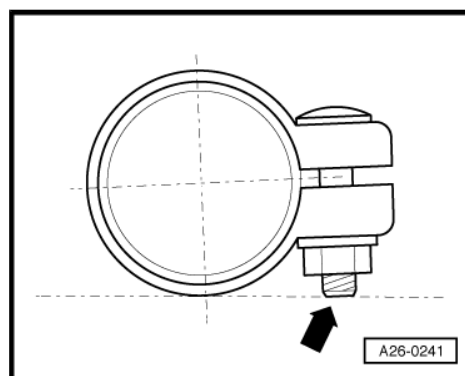
- ☐ Renew if damaged

24 - 23 Nm

25 - 23 Nm

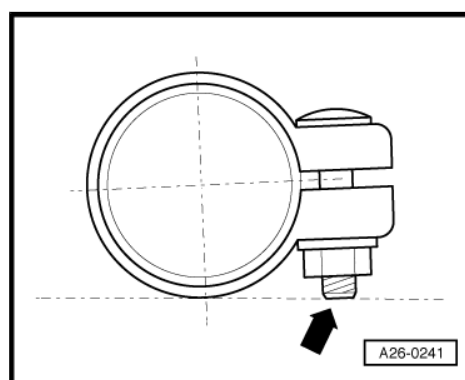
Installation position of front clamp

- When fitting clamp, make sure ends of bolts do not project below bottom of clamp -arrow-.
- Bolt connection faces to right.



Installation position of rear clamp

- When fitting clamp, make sure ends of bolts do not project below bottom of clamp -arrow-.
- Bolt connection faces to rear

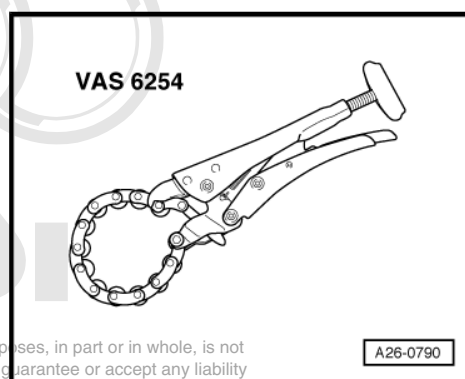


1.2 Separating centre and rear silencers

- ◆ The connecting pipe can be cut through at the cutting point provided in order to renew the centre and rear silencers separately.
- ◆ The cutting point is marked by an indentation on the outside of the exhaust pipe.

Special tools and workshop equipment required

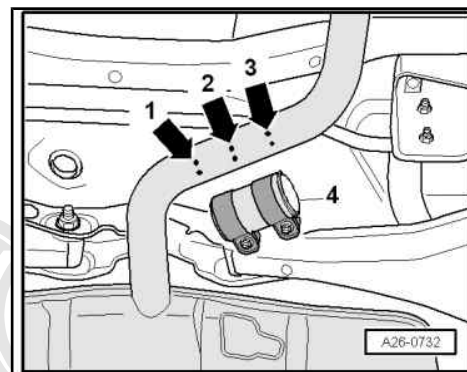
- ◆ Chain pipe cutter -VAS 6254-



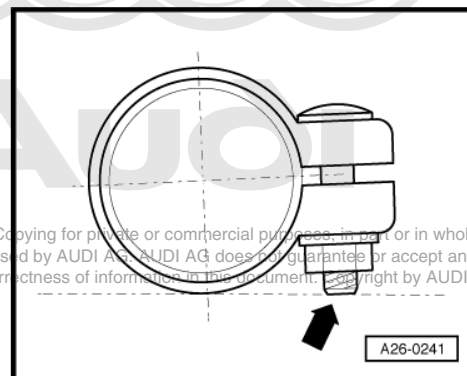
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Procedure

- Cut through exhaust pipe at a right angle at cutting point -arrow 2- using chain pipe cutter -VAS 6254- .
- When installing, position clamp -4- at marks -arrow 1- and -arrow 3- on side of exhaust pipe.



- When fitting clamp, make sure ends of bolts do not project below bottom of clamp -arrow-.
- Bolt connection faces to rear
- Align exhaust system so it is free of stress ⇒ [page 154](#) .

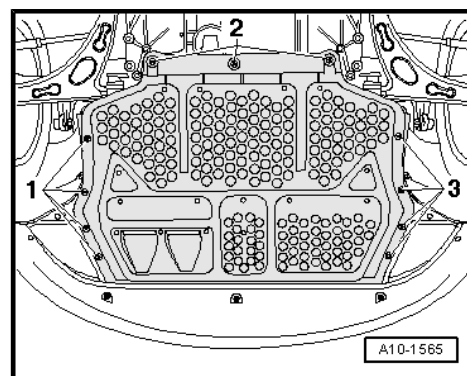


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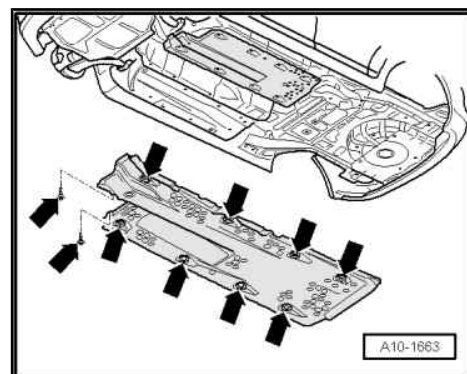
1.3 Removing and installing front exhaust pipe with catalytic converter

Removing

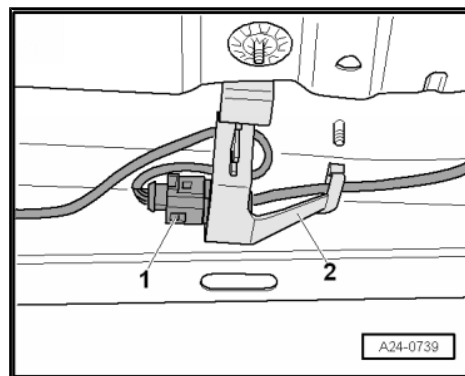
- Remove centre noise insulation -fasteners 1 ... 3-.



- Remove underbody cover (right-side) -arrows-.



- Unplug electrical connector -1- for Lambda probe after catalytic converter -G130- .
- Remove the plug connector from the bracket -2- and move the Lambda probe wiring clear.



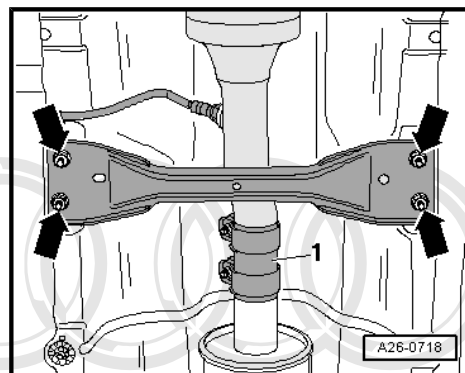
- Remove front cross-piece for underbody -arrows-.



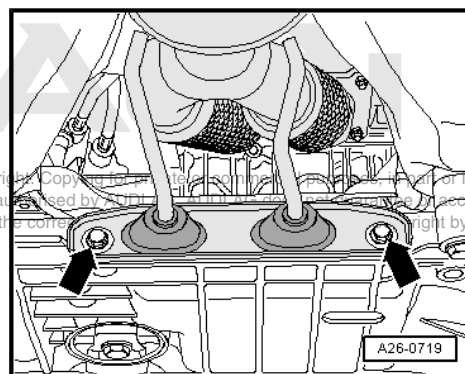
Note

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

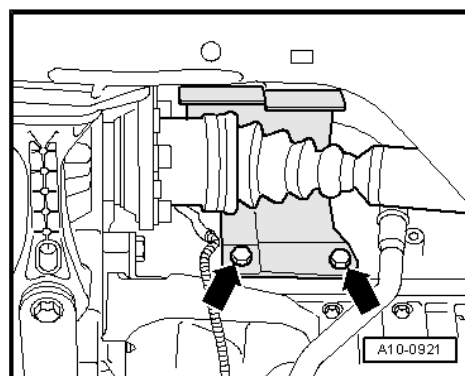
- Disconnect exhaust system at clamp -1-.



- Unbolt bracket for exhaust system -arrows-.

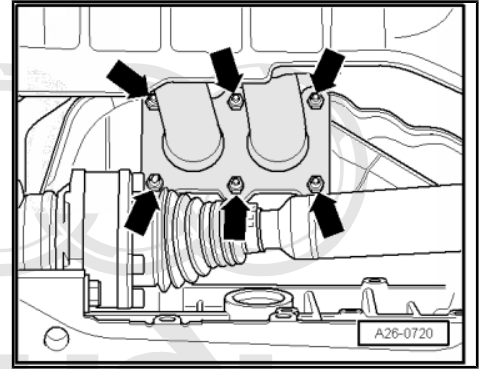


- Unbolt heat shield for drive shaft (right-side) -arrows-.



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- Remove securing nuts -arrows- on front exhaust pipe/exhaust manifold.
- Detach front exhaust pipe with catalytic converter.



Installing

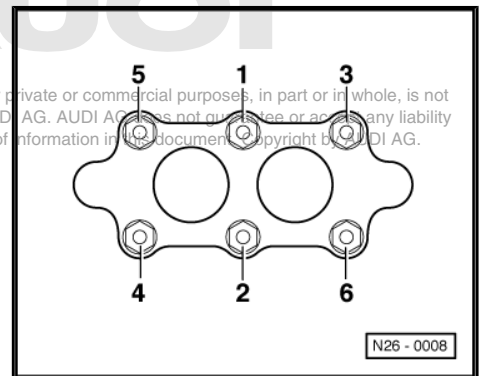
Installation is carried out in the reverse order; note the following:



Note

Renew gaskets and self-locking nuts.

- Fasten the front exhaust pipe to the exhaust manifold using the tightening sequence shown.
- Align exhaust system so it is free of stress ⇒ [page 154](#).



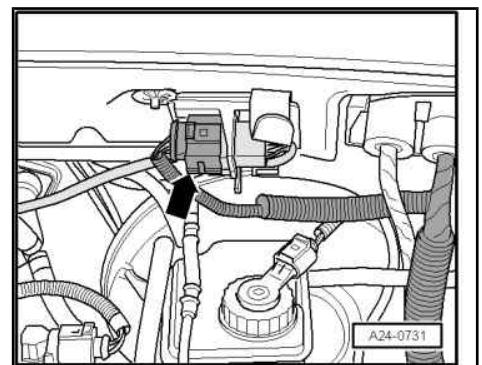
Tightening torques

Component	Nm
Front exhaust pipe to exhaust manifold	25 ¹⁾²⁾
Drive shaft heat shield to cylinder block	35
Bracket for exhaust system to subframe	23
Front tunnel cross-piece to body	23
• ¹⁾ Lubricate exhaust manifold studs with high-temperature paste. For high-temperature paste refer to ⇒ Electronic parts catalogue. • ²⁾ Renew self-locking nuts.	

1.4 Removing and installing exhaust manifold

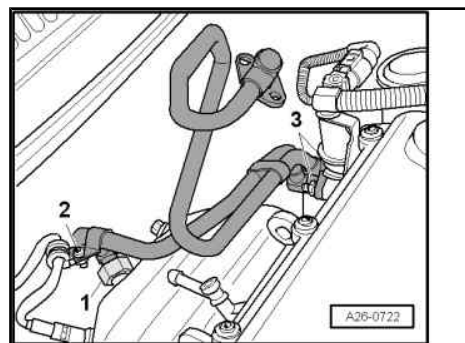
Removing

- Remove front exhaust pipe together with catalytic converter ⇒ [page 151](#).
- Remove intake manifold ⇒ Rep. gr. 24.
- Remove electrical connector -arrow- for Lambda probe -G39- (before catalytic converter) from bracket and unplug connector.



Vehicles with engine code BGU:

- Unscrew clamp -2-.
- Loosen union nut -1-.
- Remove nuts -3- and remove connecting pipe for exhaust gas recirculation.



All vehicles (continued):

- Remove nuts -1- for heat shield -3-, and detach washers -2-.
- Remove nuts -8- on both brackets -4-, and detach washers -7-.
- Unscrew the remaining nuts on exhaust manifold -6- and remove washers.
- Detach exhaust manifold and gasket -5-.

Installing

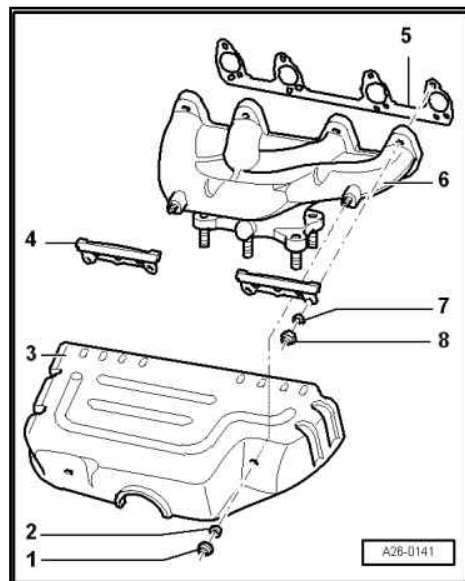
Installation is carried out in the reverse order; note the following:



Note

Renew gaskets and self-locking nuts.

- Install intake manifold ⇒ Rep. gr. 24 .
- Install front exhaust pipe together with catalytic converter ⇒ [page 151](#) .
- Align exhaust system so it is free of stress ⇒ [page 154](#) .



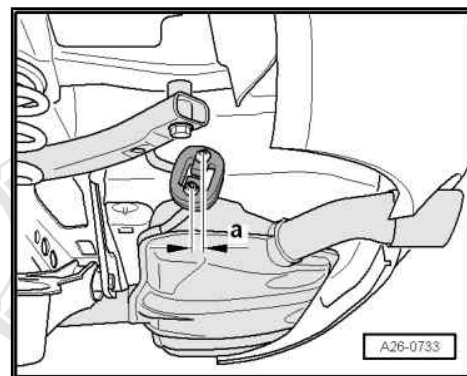
Component	Nm
Exhaust manifold to cylinder head	25 ¹⁾²⁾
Heat shield to exhaust manifold	23
EGR connecting pipe to EGR valve	23
EGR connecting pipe to exhaust manifold	60
• ¹⁾ Lubricate exhaust manifold studs with high-temperature paste. For high-temperature paste refer to ⇒ Electronic parts catalogue . • ²⁾ Renew self-locking nuts.	

1.5 Stress-free alignment of exhaust system

- The exhaust system must be aligned when it is cool.
- Loosen bolt connections of front clamp ⇒ [Item 13 \(page 149\)](#) .

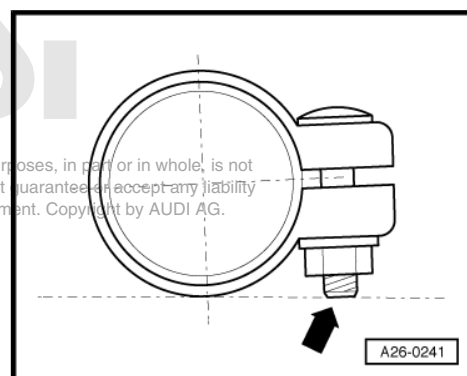
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- Push exhaust system towards front of vehicle -arrow- so that mounting for rear silencer is preloaded by -a- = 15 ... 17 mm.



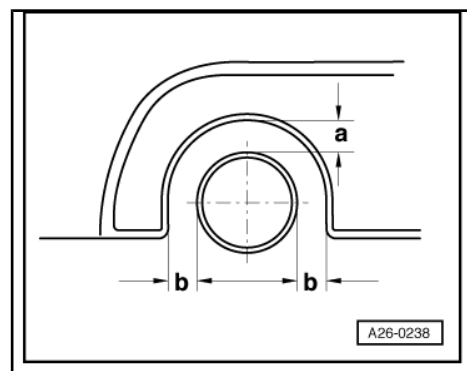
- When fitting clamp, make sure ends of bolts do not project below bottom of clamp -arrow-.
- Bolt connection faces to right.
- Tighten bolt connections on clamp evenly to 25 Nm.

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Tailpipe alignment

- Align rear silencer so that distances -a- and -b- between bumper cut-out and tailpipe are equal.
- Loosen the mounting of the rear silencer to align the tailpipe if necessary.



1.6 Checking exhaust system for leaks

- Start engine and run at idling speed.
- Plug the tailpipe (e. g. with rags or stopper) and leave plugged until the check is complete.
- Listen for noise at connection points (cylinder head/exhaust manifold, exhaust manifold/front exhaust pipe, etc.) to locate any leaks.
- Rectify any leaks that are found.

2 Silencers and exhaust manifold - vehicles with engine code CMXA



Note

- ◆ Renew gaskets and self-locking nuts.
- ◆ After working on the exhaust system, ensure that the system is not under stress and that it has sufficient clearance from the body. If necessary, loosen clamp and align silencers and exhaust pipe so that sufficient clearance is maintained to the body at all points and the mountings are evenly loaded.

2.1 Silencers and exhaust manifold - exploded view

1 - Gasket

- ☐ Renew

2 - Exhaust manifold

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

3 - Bracket

4 - Nut

- ☐ 23 Nm
- ☐ Renew
- ☐ Lubricate exhaust manifold studs with high-temperature paste. For high-temperature paste refer to ⇒ Electronic parts catalogue

5 - Heat shield

6 - Nut

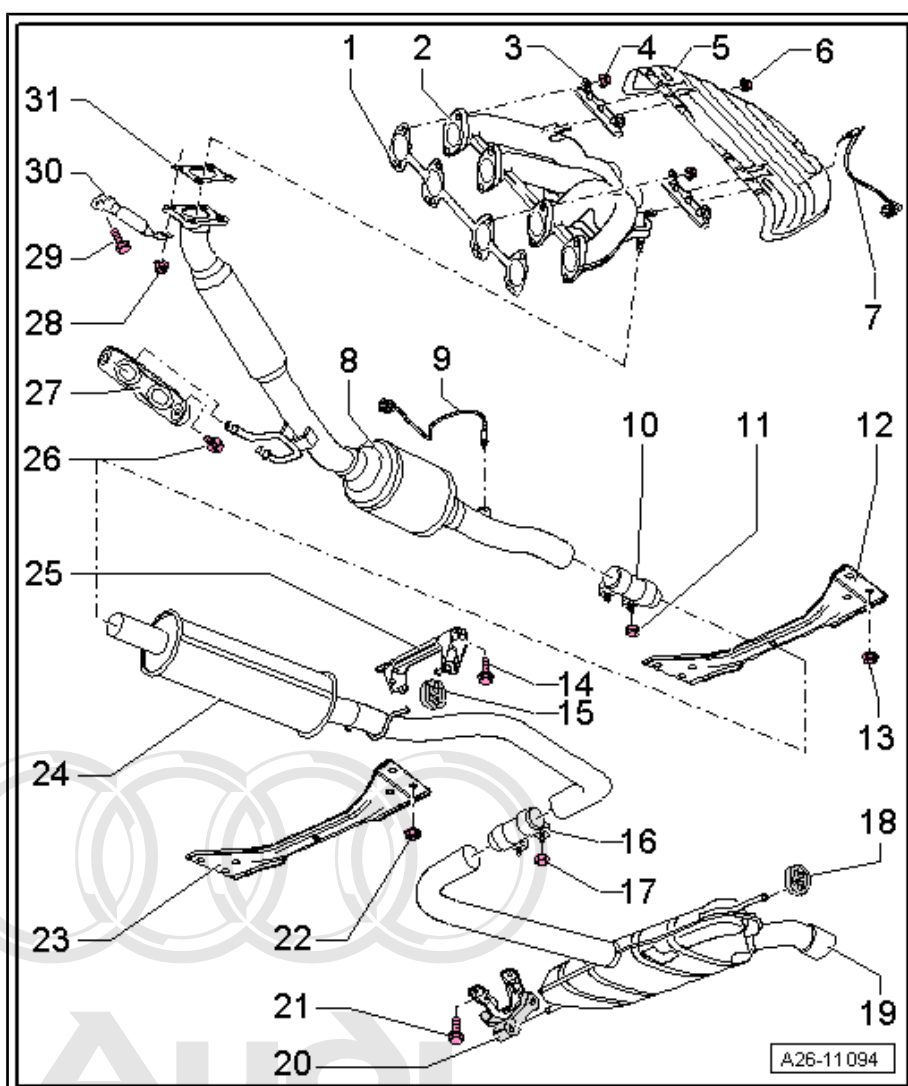
- ☐ 23 Nm

7 - Lambda probe -G39- (before catalytic converter), 55 Nm

- ☐ After renewing, erase learnt values and in ⇒ engine control unit, „Guided Functions“.
- ☐ When re-using the old Lambda probe, grease thread with high-temperature paste -G 052 112 A3- ; the paste must not get into the slots of the probe body.

8 - Front exhaust pipe with catalytic converter

- ☐ Protect against knocks and impact
- ☐ With flexible joint
- ☐ Do not bend flexible joint more than 10° – otherwise it can be damaged
- ☐ Removing and installing ⇒ [page 159](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 163](#)



9 - Lambda probe after catalytic converter -G130- , 55 Nm

- ☐ The threads on the new Lambda probes are coated with a special assembly paste.
- ☐ If re-installing old Lambda probe, coat thread with high-temperature paste: Refer to ⇒ Electronic parts catalogue for high-temperature paste
- ☐ The assembly paste/high-temperature paste must not get into the slots on the probe body.
- ☐ Removing and installing ⇒ Rep. gr. 24

10 - Clamp (front)

- ☐ Align exhaust system so it is free of stress before tightening clamp ⇒ [page 163](#)
- ☐ Installation position ⇒ [page 158](#)
- ☐ Tighten bolt connections evenly.

11 - Nut

- ☐ 23 Nm

12 - Rear tunnel cross-piece

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13 - Nut

- ☐ 23 Nm

14 - Bolt

- ☐ 23 Nm

15 - Rubber mounting

- ☐ Renew if damaged

16 - Clamp (rear)

- ☐ For separate replacement of centre and rear silencers
- ☐ Installation position ⇒ [page 163](#)
- ☐ Tighten bolt connections evenly.

17 - Nut

- ☐ 23 Nm

18 - Rubber mounting

- ☐ Renew if damaged

19 - Rear silencer

- ☐ Combined in one unit with centre silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Separating centre and rear silencers ⇒ [page 158](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 163](#)

20 - Mounting

- ☐ Renew if damaged

21 - Bolt

- ☐ 23 Nm

22 - Nut

- ☐ 23 Nm

23 - Front tunnel cross-piece

24 - Centre silencer

- ☐ Combined in one unit with rear silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Separating centre and rear silencers ⇒ [page 158](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 163](#)

25 - Mounting

- ☐ Renew if damaged

26 - Bolt

- ☐ 23 Nm

27 - Mounting

- ☐ Renew if damaged

28 - Nut

- ☐ 25 Nm
- ☐ Renew
- ☐ Lubricate exhaust manifold studs with high-temperature paste. For high-temperature paste refer to ⇒ Electronic parts catalogue

29 - Bolt

- ☐ 23 Nm

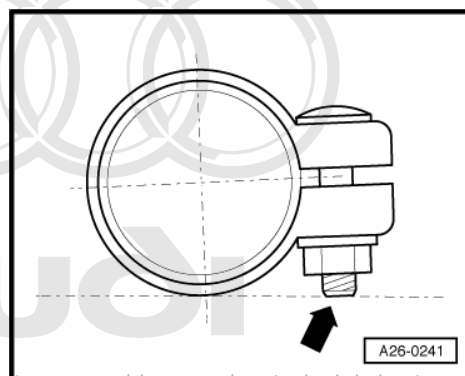
30 - Support for exhaust manifold

31 - Gasket

- ☐ Renew

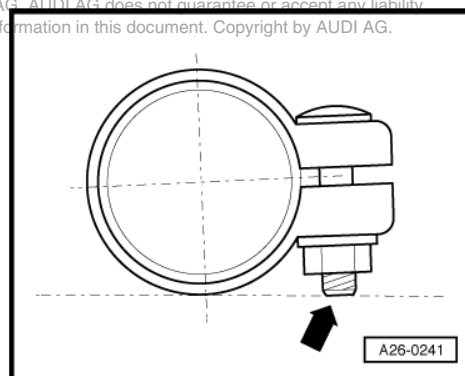
Installation position of front clamp

- When fitting clamp, make sure ends of bolts do not project below bottom of clamp -arrow-.
- Bolt connection faces to right.



Installation position of rear clamp

- When fitting clamp, make sure ends of bolts do not project below bottom of clamp -arrow-.
- Bolt connection faces to rear

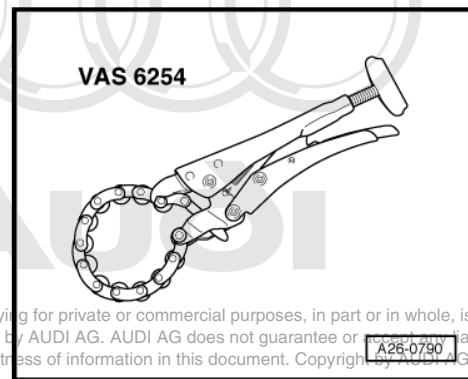


2.2 Separating centre and rear silencers

- ◆ The connecting pipe can be cut through at the cutting point provided in order to renew the centre and rear silencers separately.
- ◆ The cutting point is marked by an indentation on the outside of the exhaust pipe.

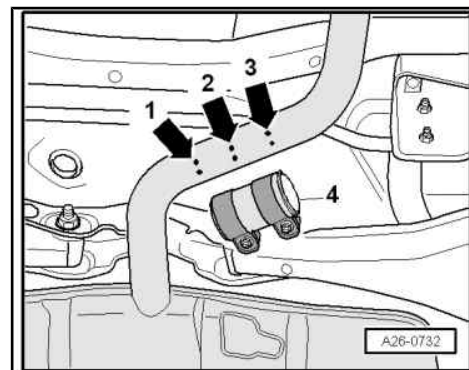
Special tools and workshop equipment required

◆ Chain pipe cutter -VAS 6254-

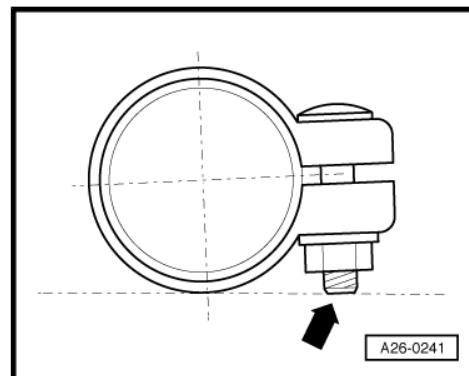


Procedure

- Cut through exhaust pipe at a right angle at cutting point -arrow 2- using chain pipe cutter -VAS 6254- .
- When installing, position clamp -4- at marks -arrow 1- and -arrow 3- on side of exhaust pipe.



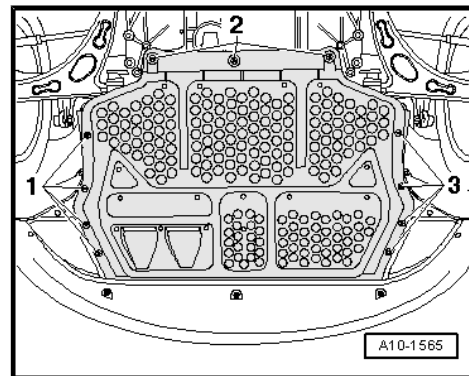
- When fitting clamp, make sure ends of bolts do not project below bottom of clamp -arrow-.
- Bolt connection faces to rear
- Align exhaust system so it is free of stress ⇒ [page 163](#) .



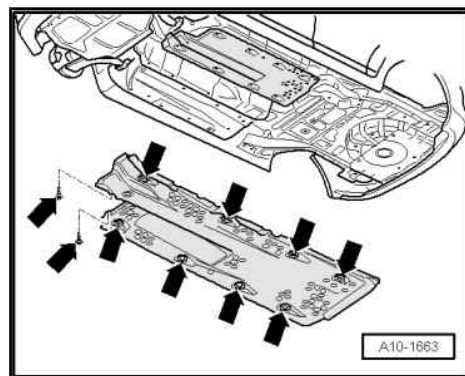
2.3 Removing and installing front exhaust pipe with catalytic converter

Removing

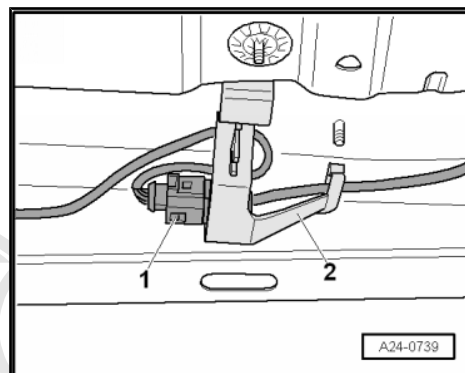
- Remove centre noise insulation -fasteners 1 ... 3-.



- Remove underbody cover (right-side) -arrows-.



- Unplug electrical connector -1- for Lambda probe after catalytic converter -G130- .
- Remove the plug connector from the bracket -2- and move the Lambda probe wiring clear.



- Remove front cross-piece for underbody -arrows-.

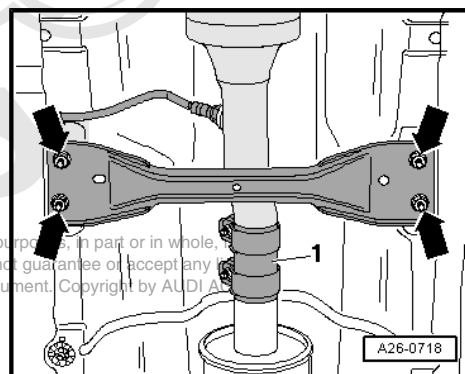


Note

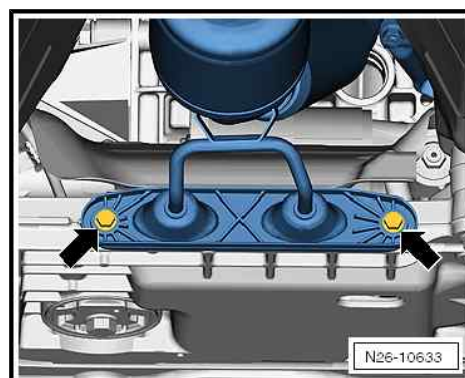
The flexible joint (de-coupling element) in the front exhaust pipe must not be bent more than 10° – otherwise it can be damaged.

- Disconnect exhaust system at clamp -1-.

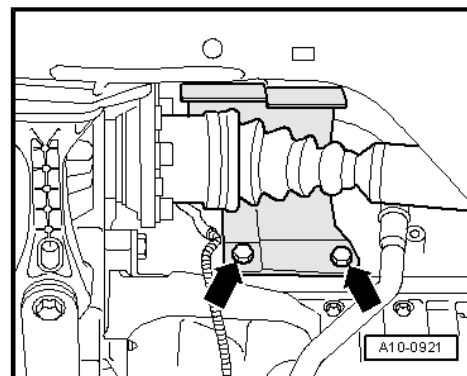
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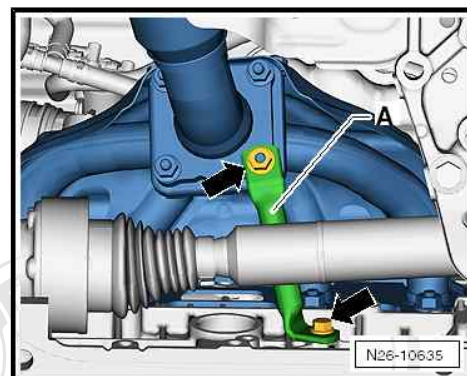
- Unbolt bracket for exhaust system -arrows-.



- Remove heat shield for drive shaft (right-side) -arrows-.



- Remove support -A-.

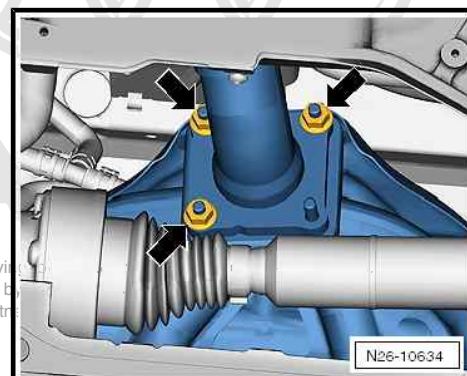


- Remove securing nuts -arrows- on front exhaust pipe/exhaust manifold.
- Detach front exhaust pipe with catalytic converter.

Installing:

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

- Renew gaskets and self-locking nuts.

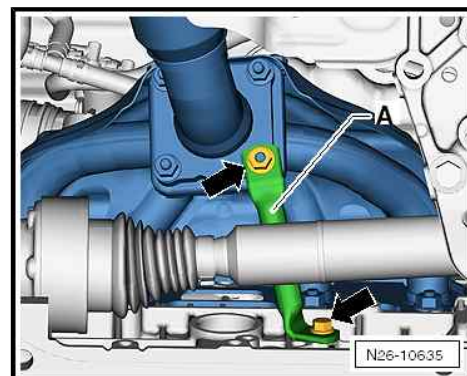


- Install support -A- so it is free of stress.
- Align the exhaust system so it is free of stress ⇒ [page 163](#).

Tightening torques:

Component	Nm
Front exhaust pipe to exhaust manifold	25 ¹⁾
Drive shaft heat shield to cylinder block	35
Bracket for exhaust system to subframe	23
Front tunnel cross-piece to body	23

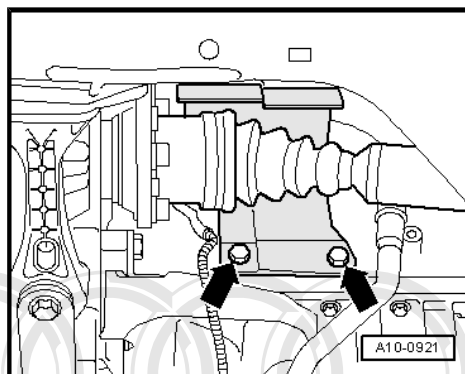
1) Renew self-locking nuts.



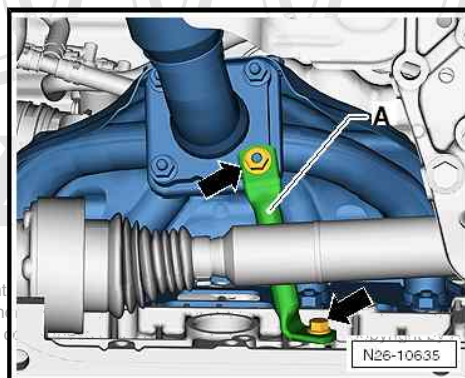
2.4 Removing and installing exhaust manifold

Removing

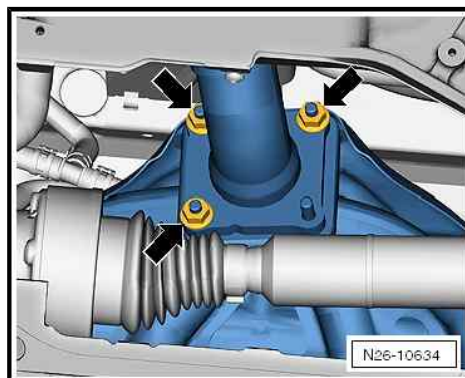
- Remove heat shield for drive shaft (right-side) -arrows-.



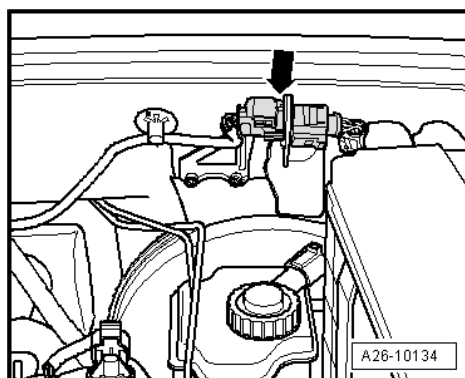
- Remove support -A-.



- Remove securing nuts -arrows- on front exhaust pipe/exhaust manifold.
- Detach front exhaust pipe from exhaust manifold.
- Remove intake manifold ⇒ Rep. gr. 24 .



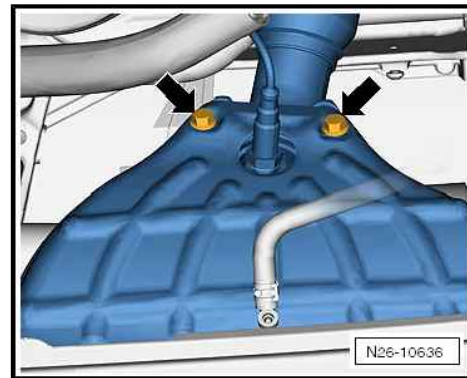
- Remove electrical connector -arrow- for Lambda probe -G39- from bracket and unplug connector. Move Lambda probe cable clear.



Note

Lambda probe -G39- need not be removed.

- Remove bolts -arrows- securing heat shield and detach heat shield.

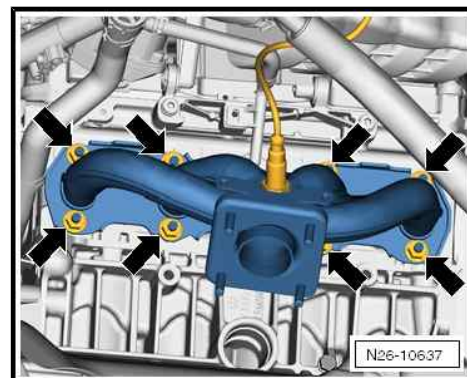


- Remove nuts -arrows- at exhaust manifold and detach exhaust manifold.

Installing

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

- Renew gaskets and self-locking nuts.
- Install intake manifold ⇒ Rep. gr. 24 .
- Install front exhaust pipe with catalytic converter ⇒ [page 159](#) .
- Align the exhaust system so it is free of stress ⇒ [page 163](#) .



Tightening torques:

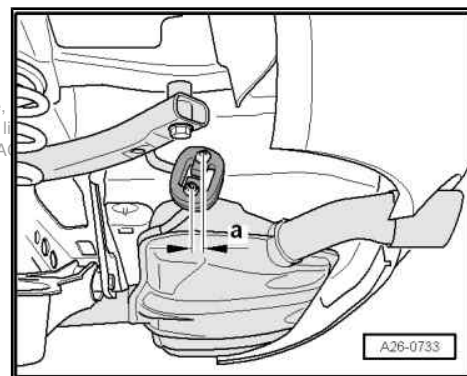
Component	Nm
Exhaust manifold to cylinder head	25 ²⁾
Heat shield to exhaust manifold	10

2) Renew self-locking nuts.

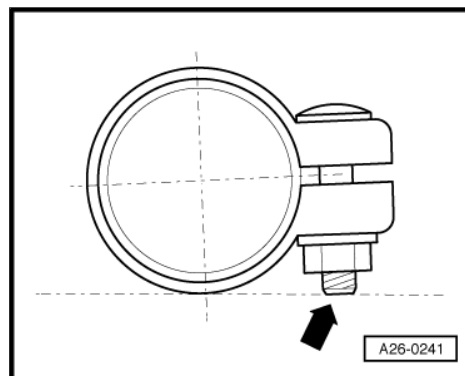
2.5 Stress-free alignment of exhaust system

- The exhaust system must be aligned when it is cool.
- Loosen bolt connections of front clamp ⇒ [Item 10 \(page 157\)](#) .
- Push exhaust system towards front of vehicle -arrow- so that mounting for rear silencer is preloaded by -a- = 15 ... 17 mm.

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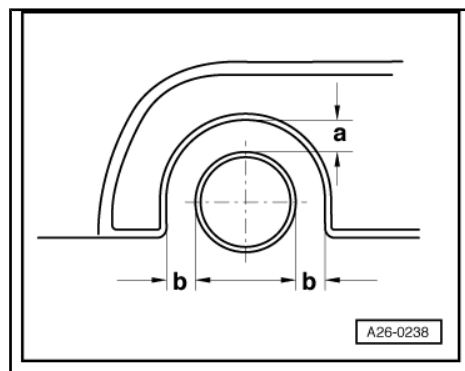


- When fitting clamp, make sure ends of bolts do not project below bottom of clamp -arrow-.
- Bolt connection faces to right.
- Tighten bolt connections on clamp evenly to 25 Nm.



Tailpipe alignment

- Align rear silencer so that distances -a- and -b- between bumper cut-out and tailpipe are equal.
- Loosen the mounting of the rear silencer to align the tailpipe if necessary.



2.6 Checking exhaust system for leaks

- Start engine and run at idling speed.
- Plug the tailpipe (e. g. with rags or stopper) and leave plugged until the check is complete.
- Listen for noise at connection points (cylinder head/exhaust manifold, exhaust manifold/front exhaust pipe, etc.) to locate any leaks.
- Rectify any leaks that are found.



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3 Exhaust gas recirculation system - vehicles with engine code BGU



Note

- ◆ *Under certain operating conditions, exhaust gas is fed into the intake air via the exhaust gas recirculation valve -N18-. By means of this mixture, a lowering of the combustion temperature and consequently an improvement of the exhaust gas composition is achieved.*
- ◆ *The exhaust gas recirculation valve -N18- is activated by the engine control unit.*
- ◆ *Pulsed actuation makes it possible to obtain any required valve position.*
- ◆ *The exhaust gas recirculation potentiometer -N18- signals the current position of the exhaust gas recirculation valve -G212- to the engine control unit. The valve and the potentiometer are integrated in a single component.*
- ◆ *If the exhaust gas recirculation valve -N18- is blocked in the open position, this is noticeable due to poor idling characteristics.*

3.1 Exhaust gas recirculation system - exploded view

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1 - 10 Nm

2 - Connecting flange

3 - 10 Nm

4 - Gasket

☐ Renew

5 - Gasket

☐ Renew

6 - Air hose

☐ From secondary air pump

7 - Combination valve for secondary air system

☐ Checking ⇒ [page 174](#)

☐ Removing and installing ⇒ [page 174](#)

8 - 10 Nm

9 - Throttle valve module - J338-

10 - Gasket

☐ Renew

11 - 10 Nm

12 - Connecting pipe

☐ For exhaust gas recirculation

13 - Breather pipe

☐ To intake air hose

14 - Union nut, 60 Nm

☐ On connecting pipe for exhaust gas recirculation

15 - 23 Nm

16 - Gasket

☐ Renew

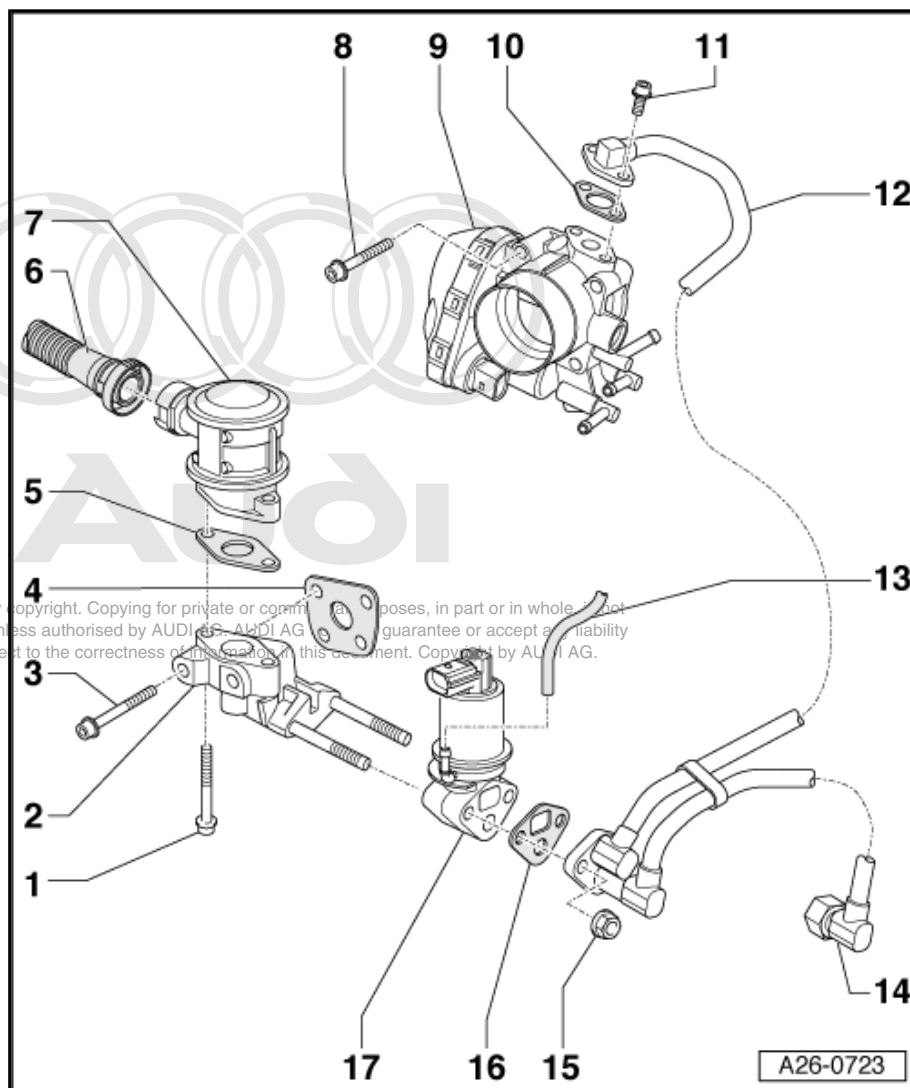
17 - Exhaust gas recirculation valve -N18- with exhaust gas recirculation potentiometer -G212-

☐ Checking adaption of zero position ⇒ [page 167](#)

☐ Electrical test via „Guided Fault Finding“ function ⇒ Vehicle diagnostic, testing and information system VAS 5051

☐ Removing and installing ⇒ [page 168](#)

☐ Adapt to engine control unit after renewing ⇒ Rep. gr. 24



3.2 Checking adaption of zero position for exhaust gas recirculation valve -N18-

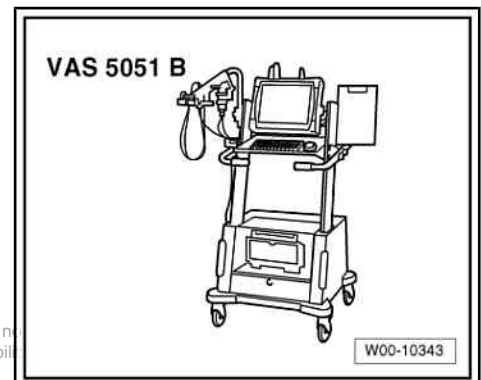


Note

- ◆ After renewing the engine control unit or the exhaust gas recirculation valve -N18-, the control unit and the valve must be adapted to one another ⇒ Rep. gr. 24 .
- ◆ Check the adaption status and the zero position before performing repair measures.
- ◆ On vehicles complying with emissions standard EU2 (PR No. „0GV“) it is not possible to adapt the exhaust gas recirculation valve -N18- since this function is not active in the control unit software. The PR No. „0GV“ is listed on the vehicle data sticker.

Special tools and workshop equipment required

- ◆ Vehicle diagnostic, testing and information system -VAS 5051B- with diagnosis lead -VAS 5051/5A-



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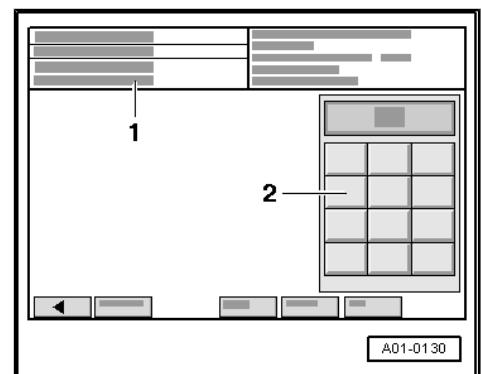
Test sequence

- Connect up vehicle diagnostic, testing and information system -VAS 5051B- with diagnosis lead -VAS 5051/5A- and select vehicle system „01 - Engine electronics“ from list. Engine must be idling.
- From list -1- select diagnostic function „04 - Basic setting“.

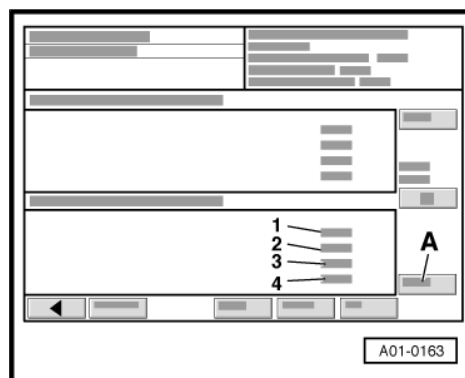


- Enter „074“ for „display group number 074“ in zone -2- and confirm the entry by pressing the  key.

1 - Enter display group



- Activate basic setting by touching key **A**.
- Check display in display zones -1- and -4-.



Display group 002		
Display zones		Explanatory notes
1	... V	Zero position of exhaust gas recirculation valve -N18- • Specification: 0.3 ... 1.2 V If specification is not obtained: – Check exhaust gas recirculation valve for dirt and foreign particles. If necessary, renew exhaust gas recirculation valve.
4	...	Adaption status of exhaust gas recirculation valve -N18- • ADP runs • ADP. O.K. • ERROR If specified value „ADP. O.K.“ is not obtained: – Perform electrical test of exhaust gas recirculation valve -N18- in „Guided Fault Finding“ → Vehicle diagnostic, testing and information system VAS 5051.



Note

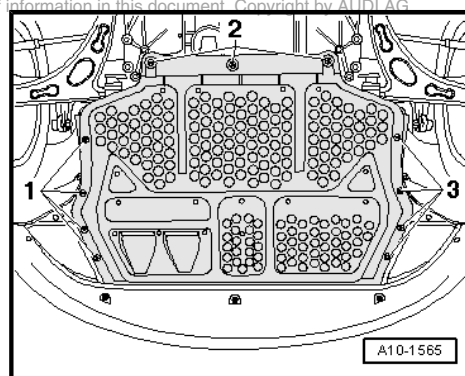
The abbreviation „ADP“ in display zone 4 stands for „Adaption“.

- Exit function „04 - Basic setting“ by pressing the **0** key.
- Press „06 - End output“.
- Switch off ignition.

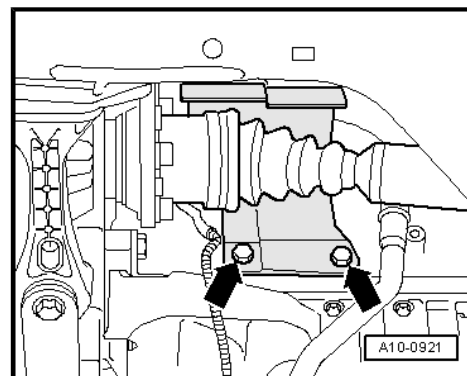
3.3 Removing and installing exhaust gas recirculation valve -N18- with exhaust gas recirculation potentiometer -G212-

Removing

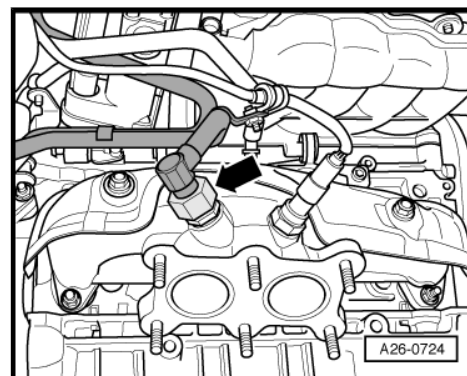
- Remove centre noise insulation -fasteners 1 ... 3-.



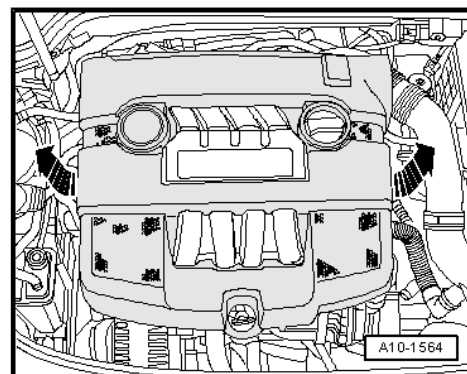
- Unbolt heat shield for drive shaft (right-side) -arrows-.



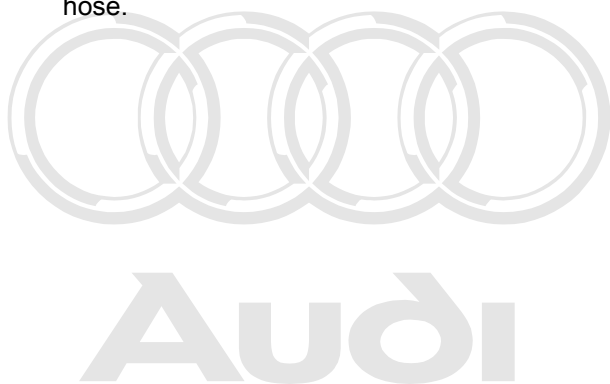
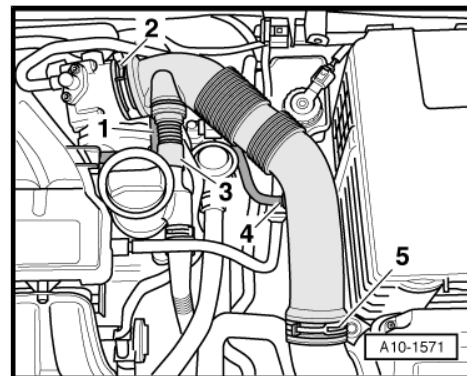
- Loosen the union nut -arrow- of the connecting pipe for exhaust gas recirculation.



- Remove engine cover panel -arrows-.

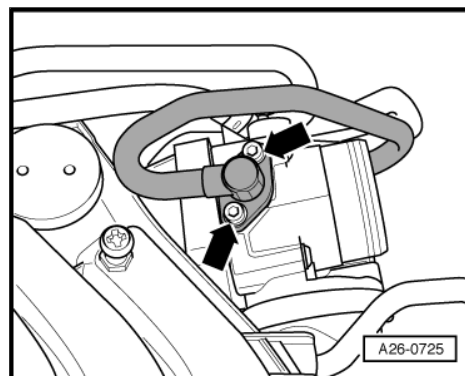


- Detach hoses -1-, -3- and -4-.
- Release spring-type hose clips -2- and -5- and remove air hose.



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- Detach connecting pipe for exhaust gas recirculation from throttle valve connection -arrows-.



- Unplug electrical connector -1-.
- Unscrew nuts -2- and -3- and detach EGR connecting pipe from exhaust gas recirculation valve.
- Detach exhaust gas recirculation valve -N18- together with exhaust gas recirculation potentiometer -G212- .

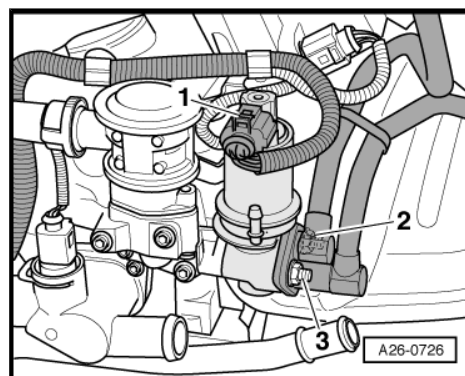
Installing

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



Note

Renew seals and gaskets.



Tightening torques

Component	Nm
Connecting pipe to EGR valve	23
Connecting pipe to throttle valve connection	10
Connecting pipe to exhaust manifold	60
Drive shaft heat shield to cylinder block	35



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4 Secondary air system - vehicles with engine codes BGU, BSE, CCSA, CMXA

The secondary air system is designed to enable the catalytic converter to heat up and reach its operating temperature more quickly after a cold start.

4.1 Principle and function

Principle

The over-enrichment of the mixture in the cold start phase produces a higher proportion of unburnt hydrocarbons in the exhaust gas. The secondary air system improves the afterburning (oxidation) process in the catalytic converter, and thus reduces toxic emissions. The heat generated by oxidation accelerates the „light off“ of the catalytic converter and significantly improves exhaust gas quality during warm-up.

Function

The engine control unit activates the secondary air pump motor - J299- via the secondary air pump relay -V101- . The stream of air from the secondary air pump opens the combination valve for secondary air and permits air to flow into the exhaust system upstream of the catalytic converter.

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4.2 Secondary air system for vehicles with engine code BGU - exploded view

1 - Combination valve for secondary air system

- ❑ Checking ⇒ page 174
- ❑ Removing and installing ⇒ page 174

2 - 23 Nm

3 - Exhaust gas recirculation valve -N18- with exhaust gas recirculation potentiometer - G212-

4 - 10 Nm

5 - O-ring

- ☐
- Renew if damaged

6 - Air hose

- ❑ Check that it is securely seated
- ❑ Press release tab to disconnect

7 - Air hose

- ❑ Check that it is securely seated
- ❑ Press release tab to disconnect

8 - To air cleaner

**9 - Secondary air pump motor
-V101-**

- ❑ Removing and installing
⇒ page 175

10 - Electrical connector

11 - 10 Nm

12 - 20 Nm

13 - 8 Nm

14 - Bracket

- ☐ For secondary air pump motor -V101-
- ☐ Secured to intake manifold

15 - Bottom section of intake manifold

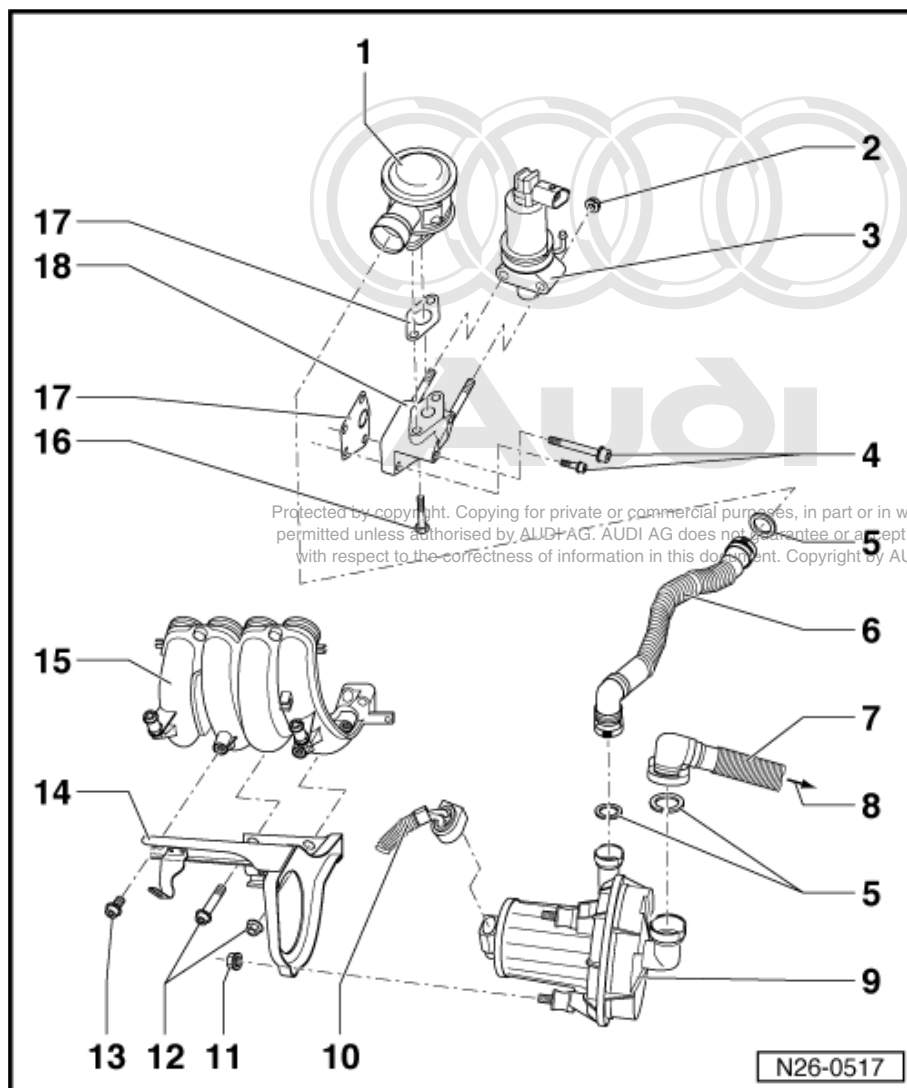
16 - 10 Nm

17 - Gasket

- ☐ Note installation position
- ☐ Renew

18 - Connection/bracket

- ☐ For combination valve for secondary air and exhaust gas recirculation valve -N18-



4.3 Secondary air system for vehicles with engine codes BSE, CCSA, CMXA - exploded view

1 - Combination valve for secondary air system

- ☐ Checking ⇒ [page 174](#)
- ☐ Removing and installing ⇒ [page 174](#)

2 - 10 Nm

3 - O-ring

- ☐ Renew if damaged

4 - Air hose

- ☐ Check that it is securely seated
- ☐ Press release tab to disconnect

5 - Air hose

- ☐ Check that it is securely seated
- ☐ Press release tab to disconnect

6 - To air cleaner

7 - Secondary air pump motor -V101-

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

8 - Electrical connector

9 - 10 Nm

10 - 20 Nm

11 - 8 Nm

12 - Bracket

- ☐ For secondary air pump

13 - Bottom section of intake manifold

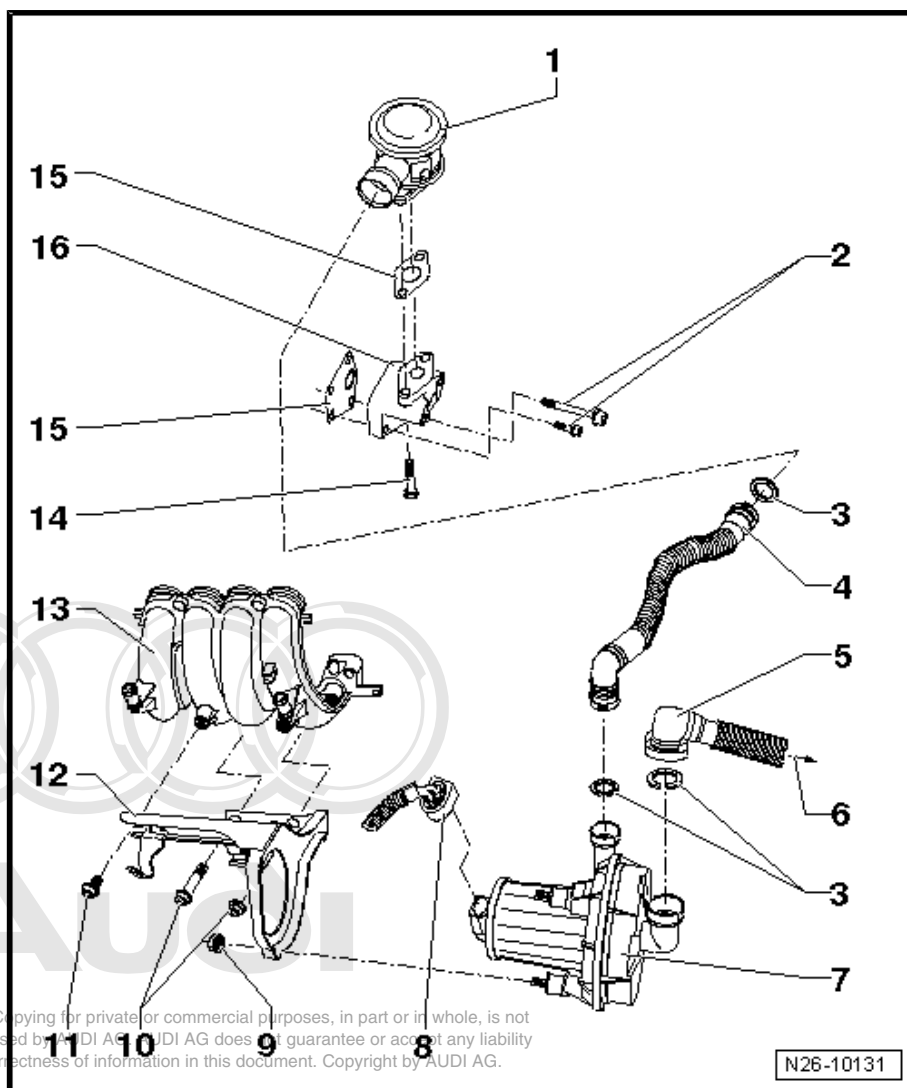
14 - 10 Nm

15 - Gasket

- ☐ Note installation position
- ☐ Renew

16 - Connection

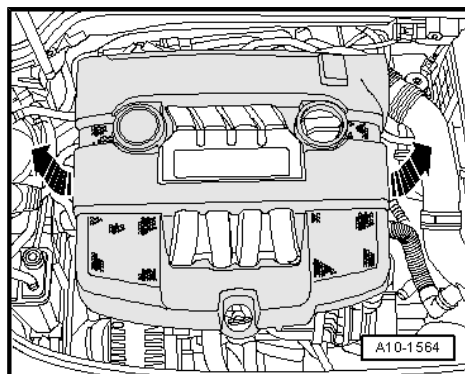
- ☐ For combination valve for secondary air system



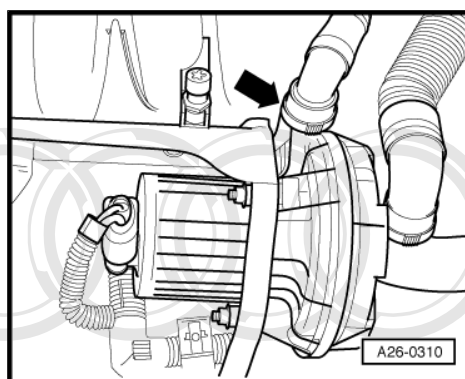
4.4 Checking combination valve for secondary air system for proper operation and leakage

Test sequence

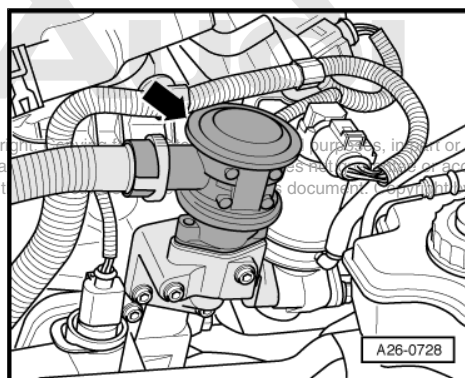
- Remove engine cover panel -arrows-.



- Detach pressure hose -arrow- at secondary air pump.



- Blow lightly into pipe with your mouth (do not use compressed air).
- The combination valve -arrow- should be closed; it should not be possible to blow through the valve.
- Blow into pipe with your mouth using more pressure (do not use compressed air).
- The combination valve should open; it should now be possible to blow through the hose.



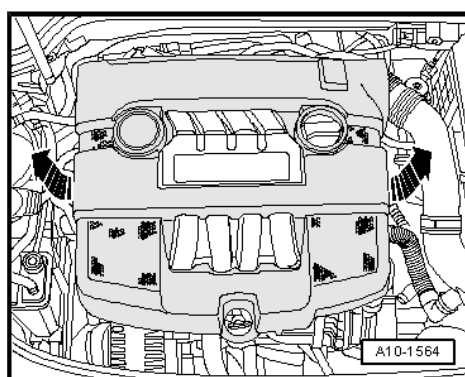
If the combination valve does not open:

- Renew combination valve ⇒ [page 174](#) .

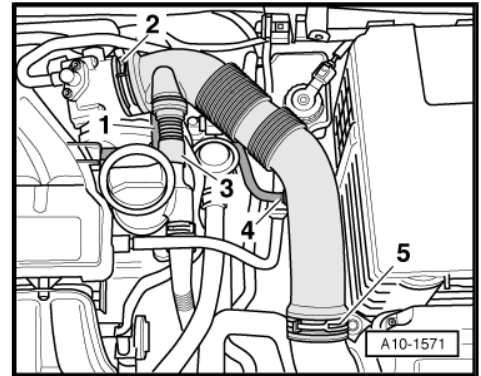
4.5 Removing and installing combination valve for secondary air system

Removing

- Remove engine cover panel -arrows-.



- Detach hoses -1-, -3- and -4-.
- Release spring-type hose clips -2- and -5- and remove air hose.



- Detach hose -1- from combination valve.
- Remove bolts -arrows-.
- Detach combination valve.

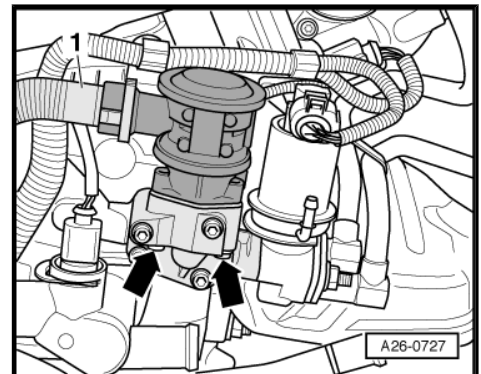
Installing

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



Note

Renew seals and gaskets.



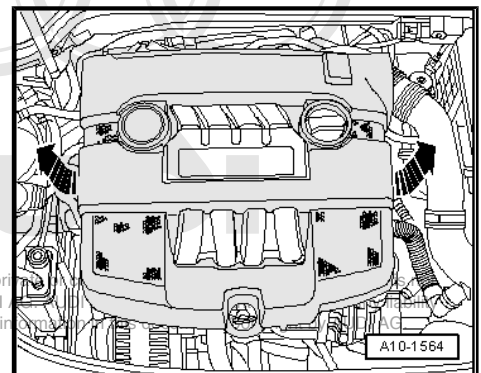
Tightening torque

Component	Nm
Combination valve to connecting flange	10

4.6 Removing and installing secondary air pump

Removing

- Remove engine cover panel -arrows-.



- Unplug electrical connector -1-.
- Disconnect hoses -2- and -3- at secondary air pump.
- Detach secondary air pump -4- from bracket.

Installing

Install in reverse order.

Tightening torque

Component	Nm
Secondary air pump to bracket	10

