

Audi A3 1997 ➤

4-cylinder Engine (2-valve), Mechanical Components

Engine ID	AEH	AKL	APF						
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Edition 07.2002



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List of Workshop Manual Repair GroupsList of Workshop Manual Repair Groups Audi A3 1997 ➤

4-cylinder Engine (2-valve), Mechanical Components

Repair Group

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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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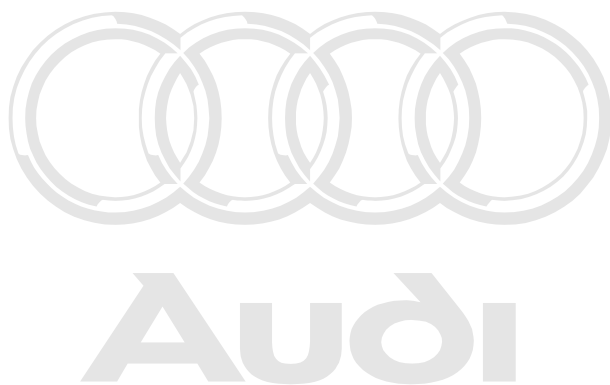
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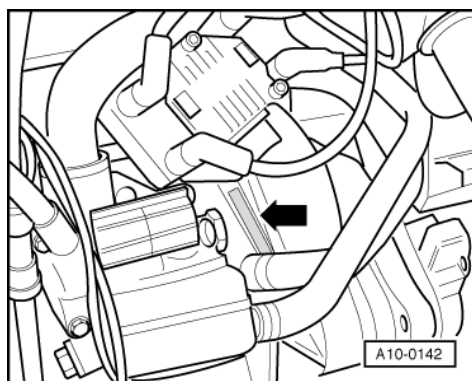
00 - Technical data

1 - Technical data

1.1 - Technical data

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1.2 - Engine number



-> The engine number ("Engine code" and "Serial number") can be found at the front joint between engine and gearbox.

Additionally there is a sticker on the toothed belt guard showing the engine code and serial number.

The engine code is also indicated on the vehicle data stickers.

1.3 - Engine data

Code		AEH	AKL	APF
Capacity	l	1.6	1.6	1.6
Output	kW at rpm	74/5600	74/5600	74/5600
Torque	Nm at rpm	145/3800	145/3800	145/3800
Bore	ø in mm	81.0	81.0	81.0
Stroke	mm	77.4	77.4	77.4
Compression		10.2	10.2	10.2
RON	at least	95 1)	95 1)	95 1)
Injection-/Ignition system		Simos 2	Simos 2	Simos 3.3
Firing order		1-4-3-2	1-4-3-2	1-4-3-2
Knock control		yes	yes	yes
Secondary air system		no	no	yes
Exhaust gas recirculation system		no	no	yes
Intake manifold changeover		yes	yes	yes

1) Regular unleaded petrol RON 91 can be used but will cause a slight loss of power.



Code	AEH	AKL	APF
Valve timing 2)			
Inlet opens after TDC	5°	5°	5°
Inlet closes after BDC	41°	41°	41°
Exhaust opens before BDC	37°	37°	37°
Exhaust closes before TDC	1°	1°	1°

2) With 1 mm valve lift and 0 mm valve play

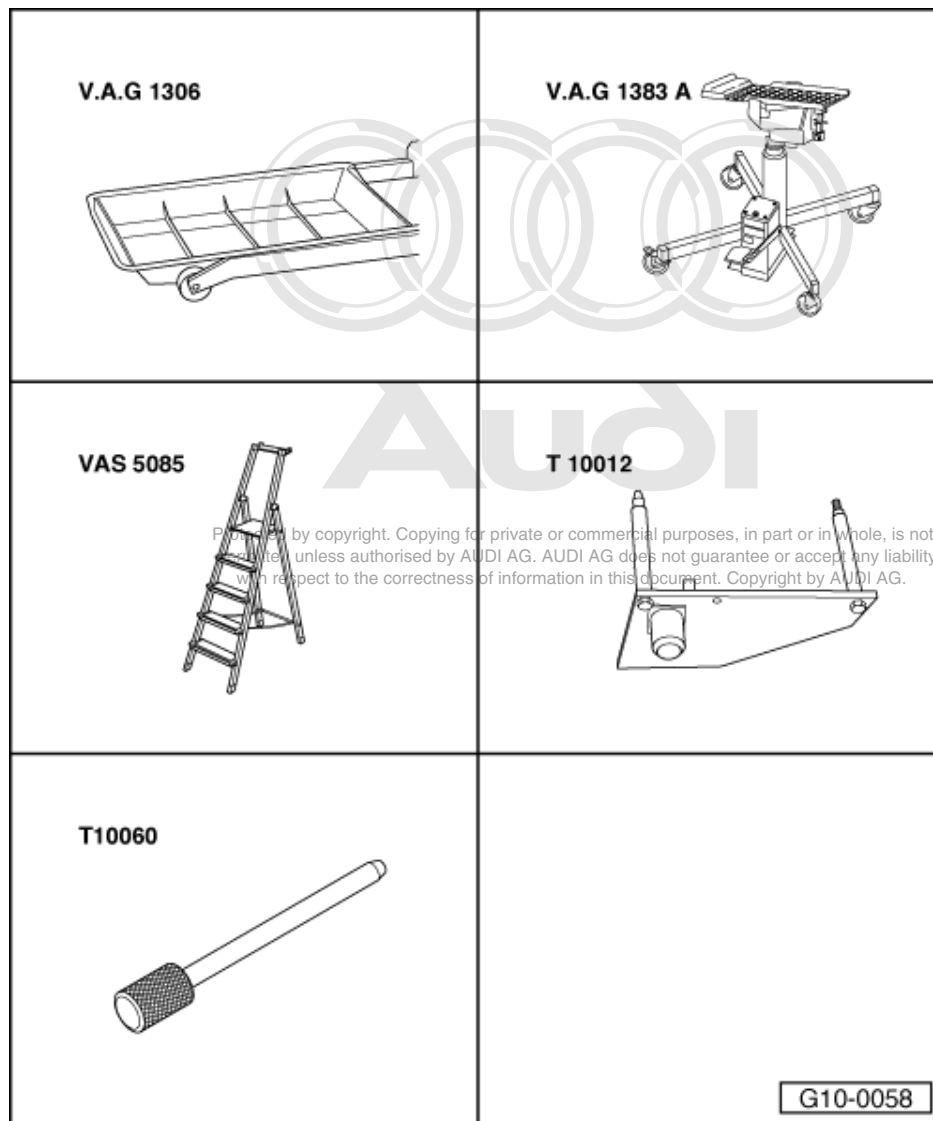


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10 - Removing and installing engine

1 - Removing and installing engine

1.1 - Removing and installing engine



Special tools and workshop equipment required

- ◆ Drip tray V.A.G 1306
- ◆ Engine/gearbox lifter V.A.G 1383 A
- ◆ Stepladder VAS 5085
- ◆ Engine mounting T10012
- ◆ Mandrel T10060



1.2 - Removing - vehicles with engine codes AEH, AKL

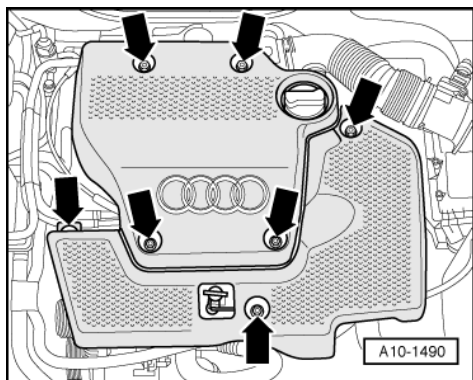
Notes:

- ♦ The engine is removed from underneath together with the gearbox.
- ♦ Replace all cut and defective cable ties. Refit cable ties in the same position when installing the engine.
- ♦ Collect drained coolant in a clean container for re use or disposal.

Important

On vehicles with telematics, activate service mode of telematics control unit before disconnecting battery. => Radio, Telephone and Navigation System; Repair group 91

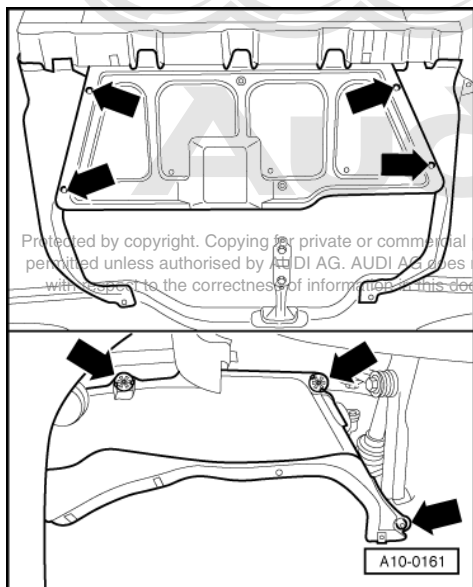
- Refer to coding on vehicles with encoded radio/radio navigation system (RNS); if necessary, interrogate.
- Disconnect earth strap at battery with ignition switched off.



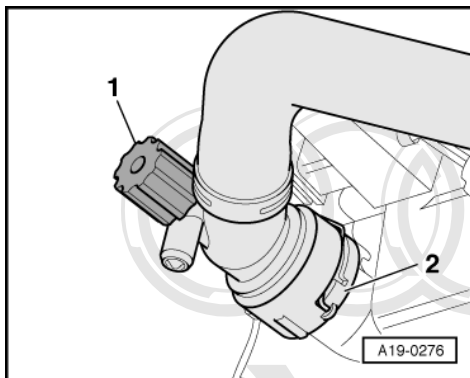
Important

Hot steam or hot coolant can escape when opening expansion tank. Cover cap with a cloth and open carefully.

- Open the cover of the coolant expansion tank
- -> Remove engine covers -arrows-.



- -> Remove noise insulation from centre, left and right sides -arrows-



- Place drip tray V.A.G 1306 below engine.

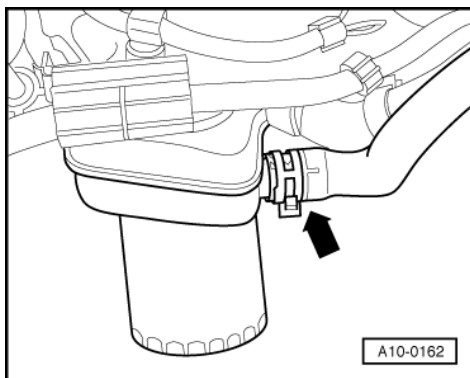
Vehicles with drain plug:

- -> Turn drain plug -1- on radiator anti-clockwise, fit auxiliary hose to connection if necessary.

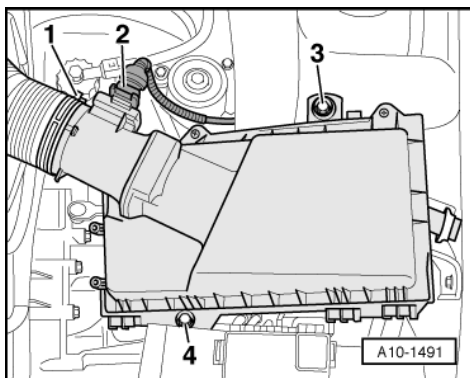
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All models:

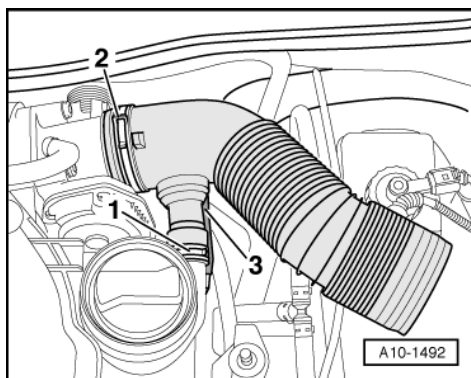
- Pull off retaining clip -2- for bottom coolant hose and detach coolant hose from radiator.



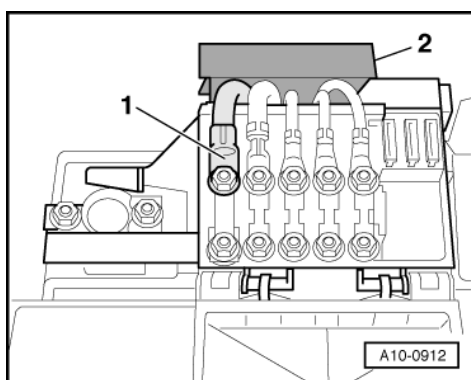
- -> Also disconnect lower coolant hose on oil cooler -arrow-, and drain off remaining coolant.



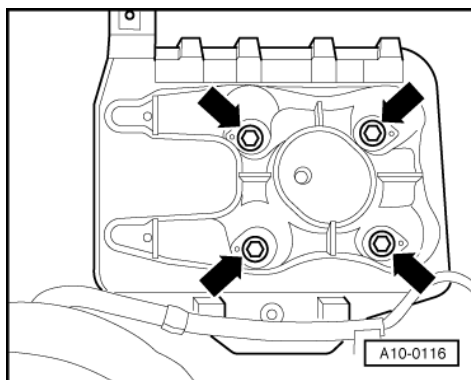
- -> Detach the air duct hose -1- from the air mass meter.
- Unplug connector -2- at air mass meter.
- Unscrew bolts -3- and -4-.
- Remove air cleaner housing.



- -> Disconnect hoses -1- and -3-.
- Remove the air duct, release spring clamp -2- for this purpose.



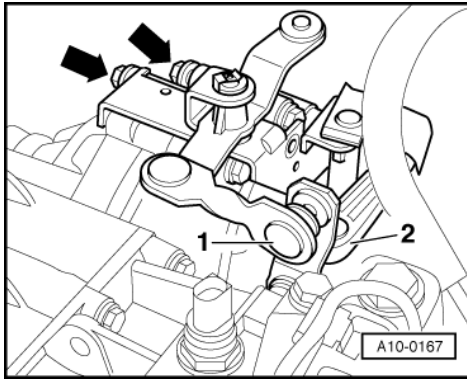
- Open cover of main fuse box towards front.
- -> Unclip protective cover -2- for electrical cables.
- Unscrew black electric cable -1- from fuse bar.
- Remove the battery.



- -> Remove battery carrier -arrows-.

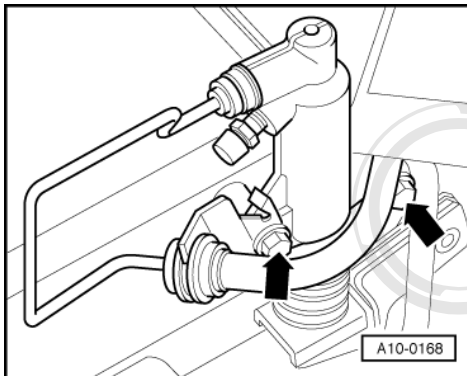


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Vehicles with manual gearbox:

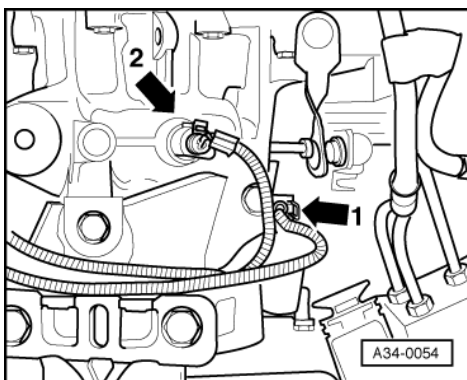
- -> Press off selector rods -1- and -2- with a screwdriver.
- Unscrew shift mechanism from gearbox -arrows- and suspend.



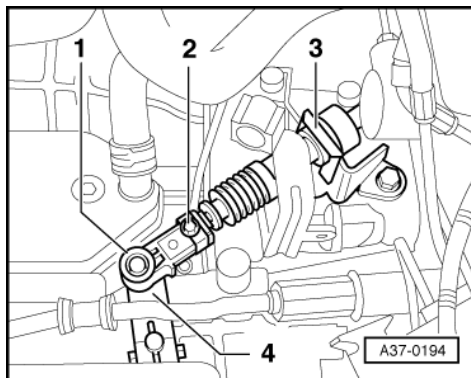
- -> Detach slave cylinder -arrows- and move clear to one side. Secure slave cylinder in position with wire; do not open hydraulic connections.

Important
Do not depress clutch pedal after removing slave cylinder.

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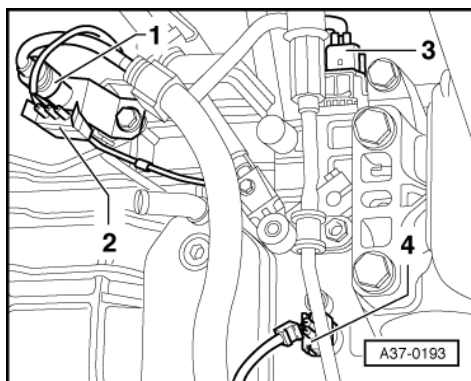


- -> Unplug the connector -arrow 1- at speedometer sender -G22.
- Unplug the connector -arrow 2- for the reversing light switch.
- Lay wiring aside.



Vehicles with automatic gearbox:

- -> Press off selector lever cable -1- with screwdriver at gearbox selector lever -4- detach securing clip -3- from support bracket.
- Detach selector cable and move to one side.

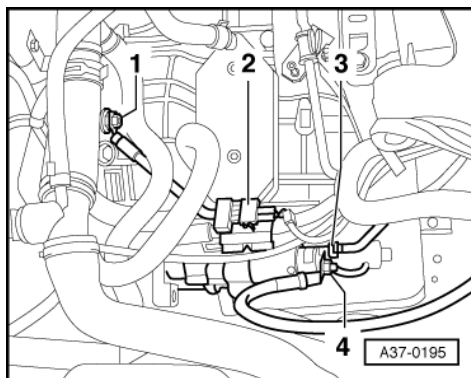


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- -> Unplug connectors:
 - 1 - To solenoid valves (10-pin connector)
 - 2 - To road speed sender -G68
 - 3 - At multi-function switch -F125
 - 4 - At gearbox speed sender -G38
- Lay wiring harness aside.

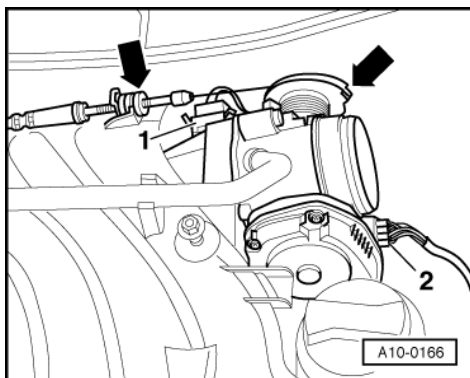
All models:

- Unbolt bracket for power steering pressure line from rear of gearbox support.

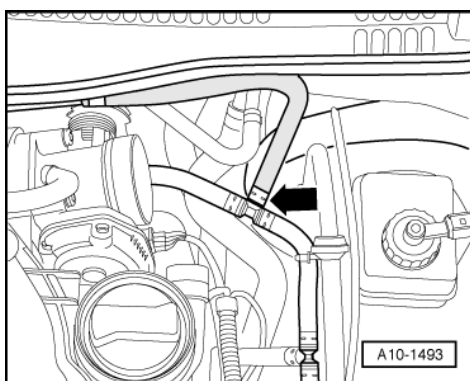


- -> Unscrew earth wiring -1- from flange engine/gearbox.
- Disconnect leads -3- and -4- to the starter.
- Unplug connector -2- and pull out of bracket.

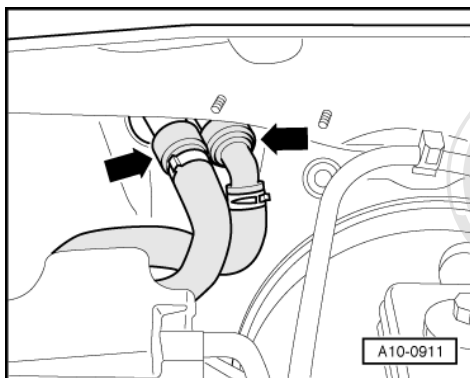
- Disengage wires from bracket on starter, move wires to one side and detach bracket.



- -> Unplug electrical connectors:
 - 1 - Intake air temperature sender -G42
 - 2 - Throttle valve control part -J338
- Lay wiring aside.
- Detach throttle cable -arrows- and unclip at intake manifold.

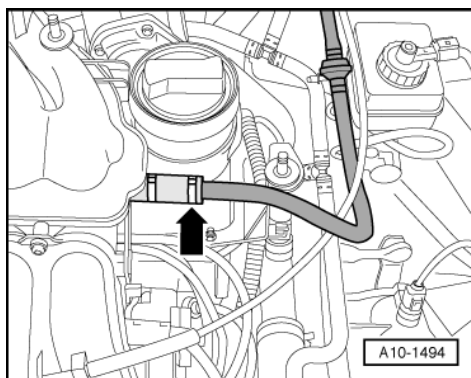


- -> Detach the coolant hose -arrow- to the coolant compensation tank at the T-union.

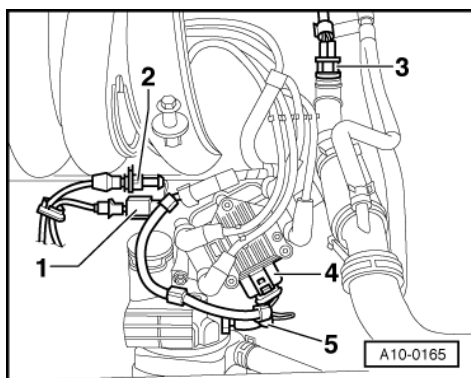


- -> Detach refrigerant hoses to radiator heat exchanger on bulkhead -arrows-.

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- -> Disconnect the vacuum hose -arrow- to the brake servo at the intake manifold.

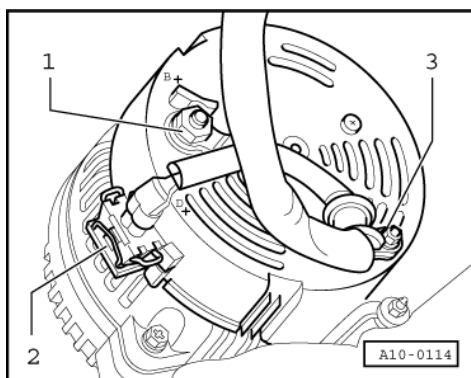


- -> Disconnect electrical connectors:

- 1 - Engine speed sender -G28
- 2 - Knock sensor -G61
- 3 - Coolant temperature sensor -G62
- 4 - Ignition coils -N and -N128 with output stage -N122
- 5 - Oil pressure switch -F1 (on oil filter bracket)
- Oil temperature sender -G8 (on oil filter bracket)

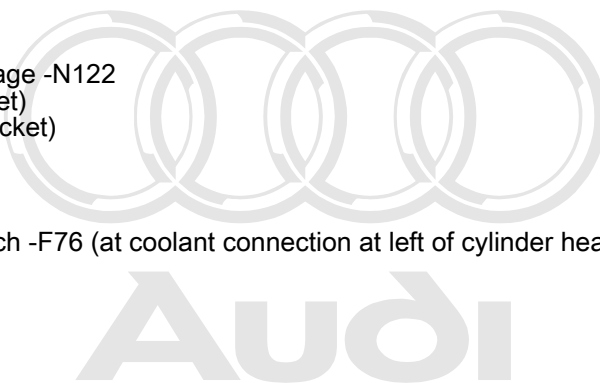
Vehicles with air conditioner:

- Unplug the connector of the electronic thermost switch -F76 (at coolant connection at left of cylinder head).



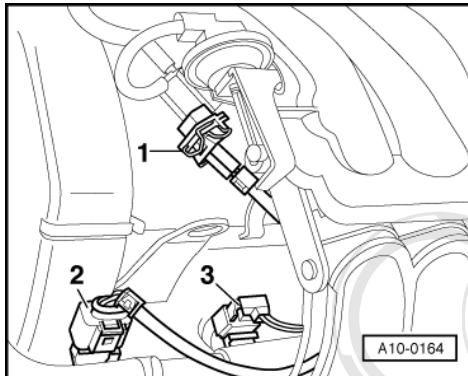
All models:

- -> Detach connector -2-.
- Unscrew wire -1- from alternator.



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- Unscrew the cable clamp -3- and lay wiring aside.

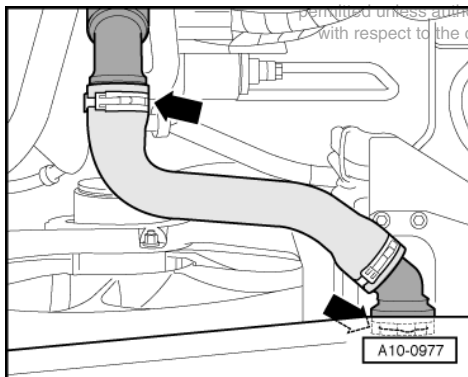


- -> Disconnect electrical connectors:

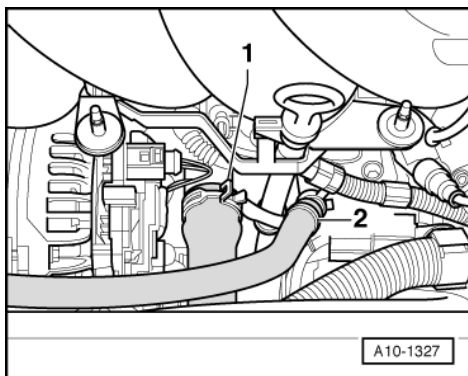
- 1 - Intake manifold change-over valve -N156
- 2 - Hall sender -G40
- 3 - Injectors -N30, -N31, -N32, -N33

- Lay wiring aside.

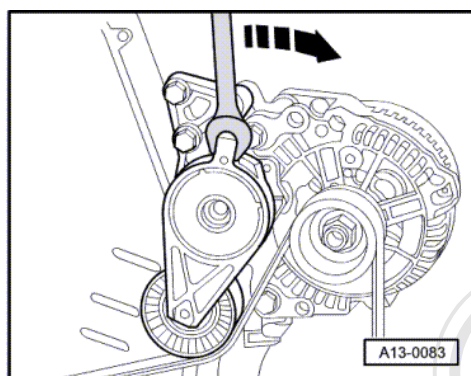
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- -> Detach coolant hose between engine and radiator -arrows-.



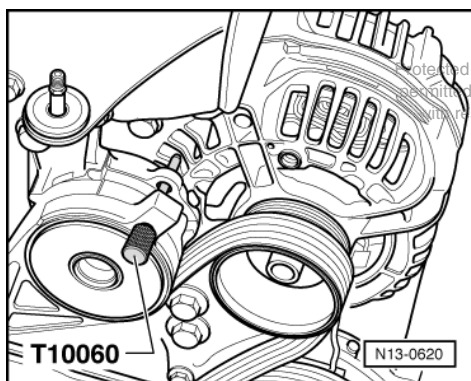
- -> Detach coolant hoses -1- and -2-.



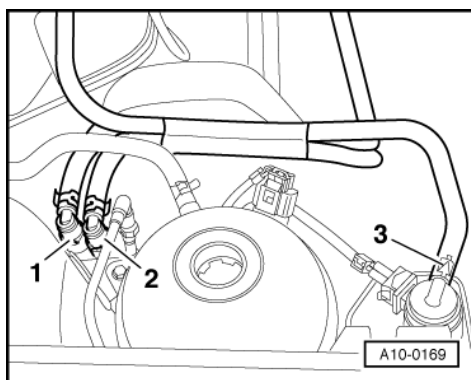
Note:

Mark the running direction with chalk or a felt-tipped pen before removing the ribbed belt. If the belt runs in the opposite direction when it is refitted, this can cause breakage.

- -> To loosen ribbed belt, turn tensioner in direction of arrow.



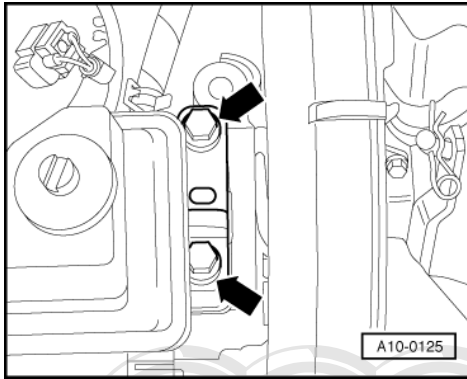
- -> Lock the ribbed belt tensioner with mandrel T10060 or with an angled Allen key.
- Remove ribbed belt.



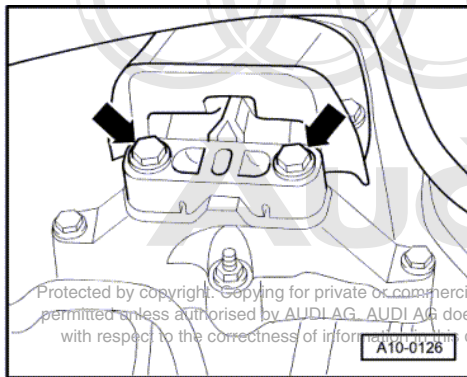
Important

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

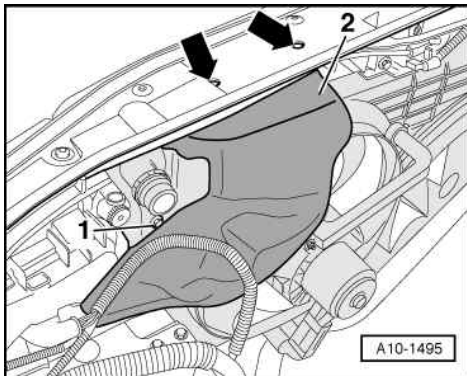
- -> Mark fuel feed pipe -1- and fuel return pipe -2- and detach (press release tab).
- Disconnect hose -3- from ACF container.



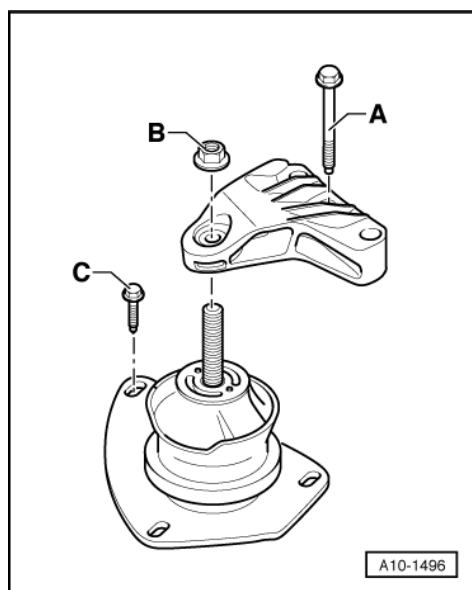
- -> Loosen bolts -arrows- of assembly mounting on engine...



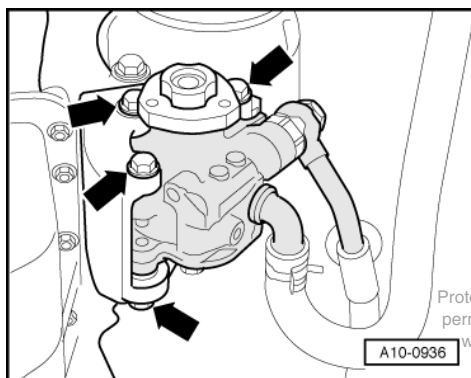
- -> ...and on gearbox approx. 2 turns.



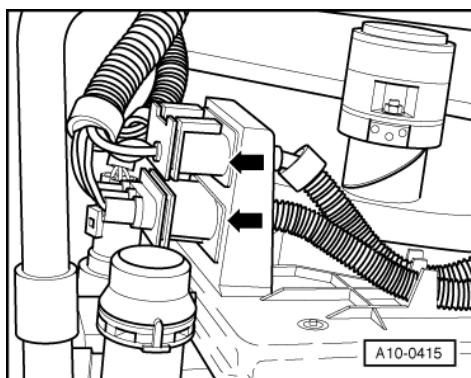
- -> Unscrew bolts -arrows- where installed.
- Remove the air duct -2-.
- Unscrew fastening bolts -1- (accessible from above) for radiator cowl.



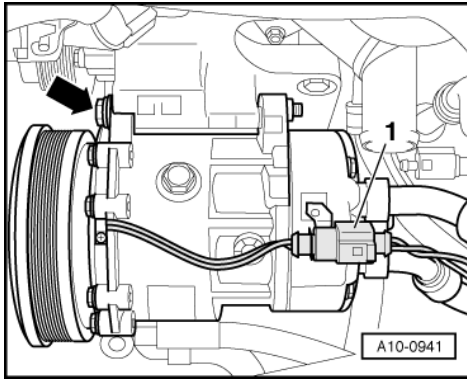
- -> Disconnect power steering line from gearbox -arrow-.



- Detach pulley of vane pump for power steering; counterhold with drift.
- -> Detach vane pump for power steering -arrows-. Do not detach hydraulic connections.



- -> Detach both connectors for left radiator fan on bottom of radiator cowl.
- Unscrew bolts accessible from below on radiator cowl.
- Remove the radiator cowl with both vents from below.
- Suspend vane pump for power steering together with line from lock carrier.

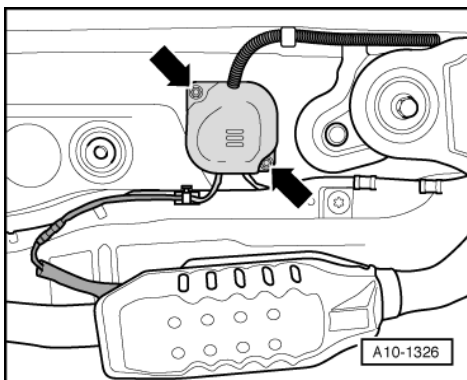


Vehicles with air conditioner:

- -> Detach connector -1- for solenoid clutch on air conditioner compressor.

Important
The air conditioner refrigerant circuit must not be opened.

- Unbolt AC compressor -arrow- and suspend together with connected refrigerant hoses from bonnet lock.



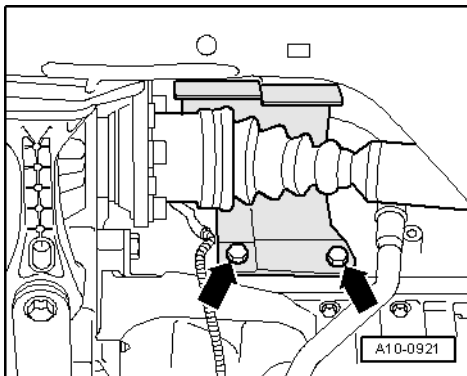
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All models:

- -> Unscrew protective cover -arrows- on vehicle floor.
- Unplug connector for lambda probes and lay lambda probe wiring aside.

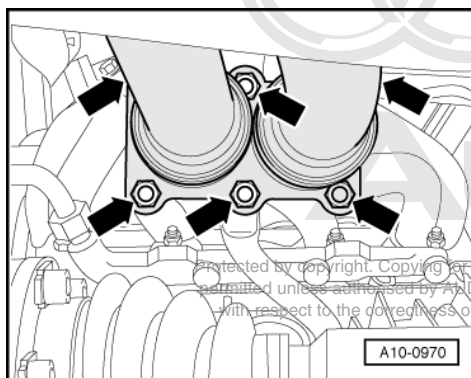
Note:

Vehicles with engine code AEH are equipped with only one lambda probe.





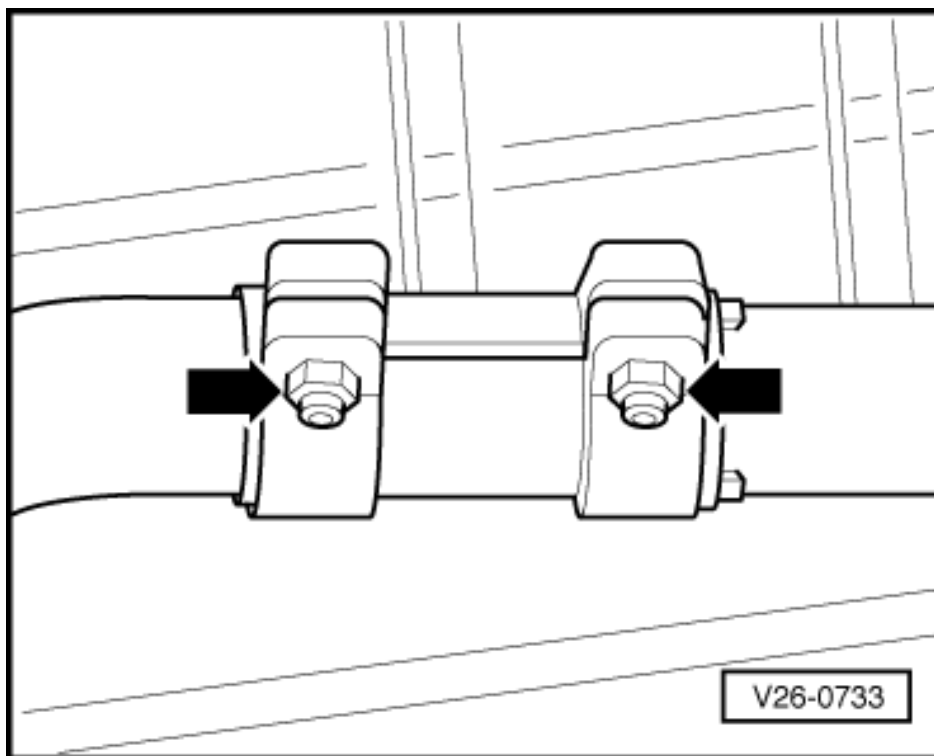
- -> Unbolt heat shield for right drive shaft -arrows-.



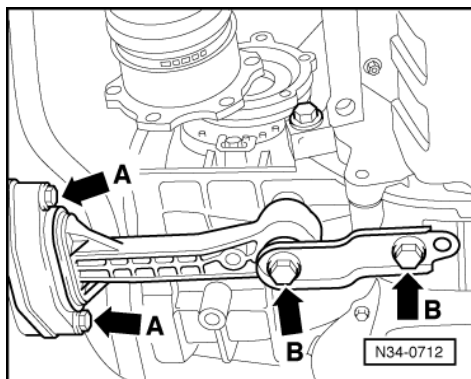
Note:

The isolating element in front exhaust pipe must not be deflected more than 10° to avoid damage.

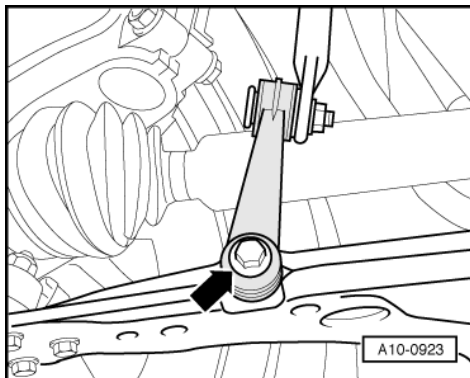
- -> Unscrew securing bolts -arrows- of front exhaust pipe/exhaust manifold.



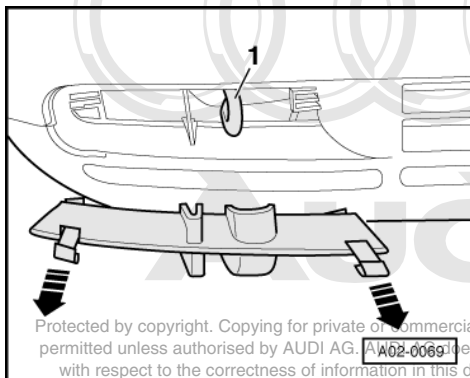
- -> Detach the exhaust system at the clamping sleeve -arrows-.
- Detach the front exhaust pipe, swivel the front exhaust pipe 180° for this purpose.



- -> First remove bolts -A- and then bolts -B- from pendulum support.
- Detach pendulum support.



- -> Unbolt right connecting link from wishbone -arrows-.
- Unscrew drive shaft on left and right from gearbox flange.
- Turn front wheels to the right.
- Push engine forward and at the same time swivel right drive shaft towards front.

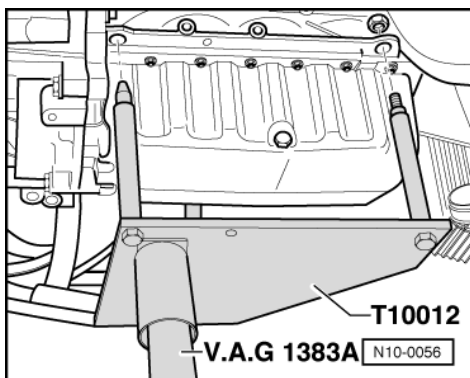


- -> Pull release tabs -arrows- and remove air intake grille.
- Suspend right drive shaft at towing eye -1- using a wire loop.

Note:

Protect bumper from scratches by using an adhesive tape.

- Move left drive shaft towards rear and attach to anti-roll bar using a wire loop.

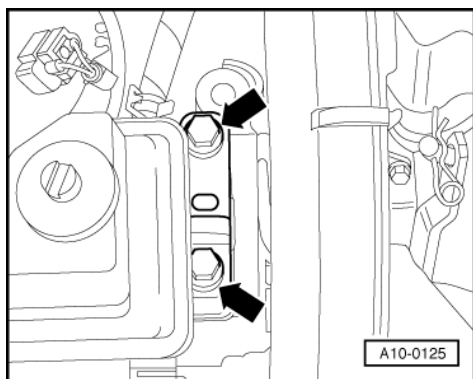


- -> Attach engine mounting T10012 with securing nut and bolt with approx. 20 Nm to cylinder block.
- Insert engine/gearbox lifter V.A.G 1383 A in engine mounting T10012 and raise slightly.

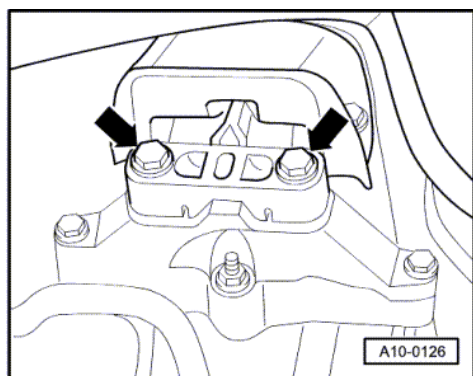


Note:

To unscrew bolts for assembly mounting use stepladder VAS 5085.



- -> Loosen bolts -arrows- of assembly mounting on engine...



- -> ...and from gearbox.

Notes:

- ♦ Check that all hoses 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.

1.3 - Removing - vehicles with engine code APF

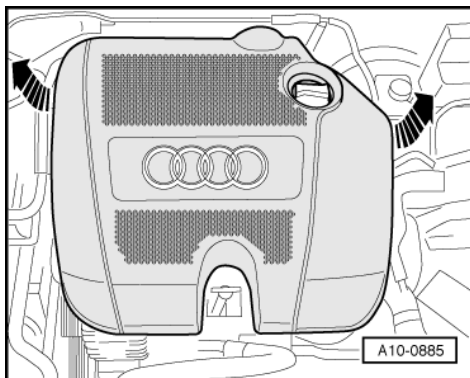
Notes:

- ♦ The engine is removed from underneath together with the gearbox.
- ♦ Replace all cut and defective cable ties. Refit cable ties in the same position when installing the engine.
- ♦ Collect drained coolant in a clean container for reuse or disposal.

Important

On vehicles with telematics, activate service mode of telematics control unit before disconnecting battery.=>Radio, Telephone and Navigation System; Repair group 91

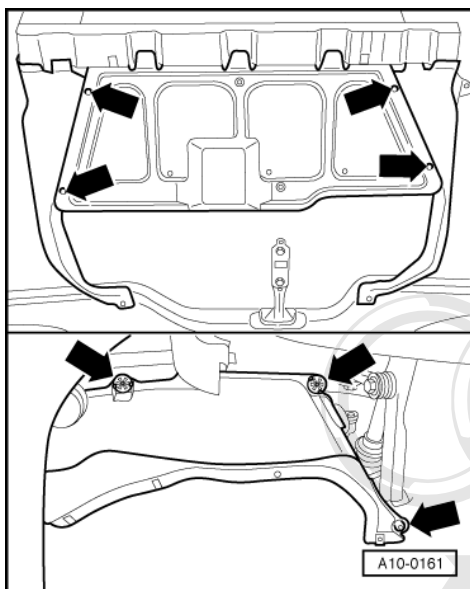
- Refer to coding on vehicles with encoded radio/radio navigation system (RNS); if necessary, interrogate.
- Disconnect earth strap at battery with ignition switched off.



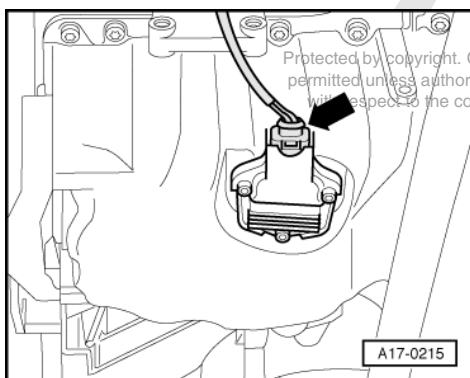
Important

Hot steam or hot coolant can escape when opening expansion tank. Cover cap with a cloth and open carefully.

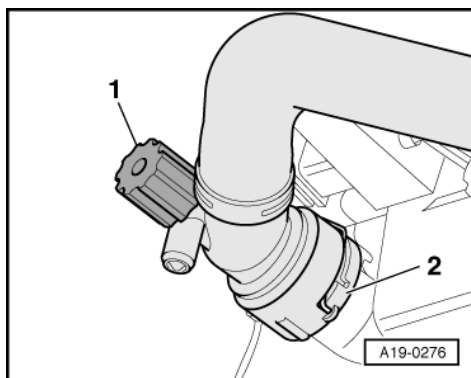
- Open the cover of the coolant expansion tank
- -> Remove engine cover -arrows-.



- -> Remove noise insulation from centre, left and right sides -arrows-



- -> Detach connector from oil level sender -arrow-.
- Move wiring to the top.



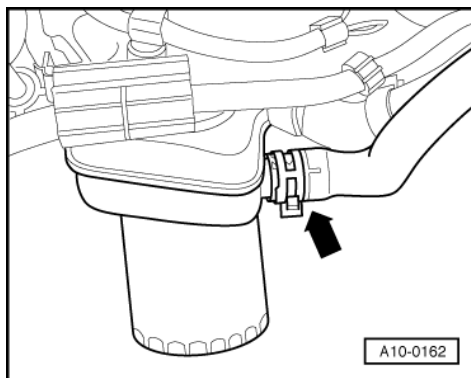
- Place drip tray V.A.G 1306 below engine.

Vehicles with drain plug:

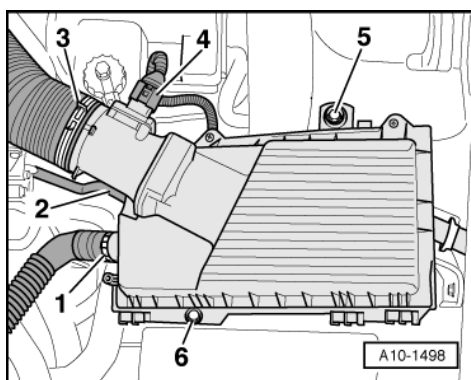
- -> Turn drain plug -1- on radiator anti-clockwise, fit auxiliary hose to connection if necessary.

All models:

- Pull off retaining clip -2- for bottom coolant hose and detach coolant hose from radiator.

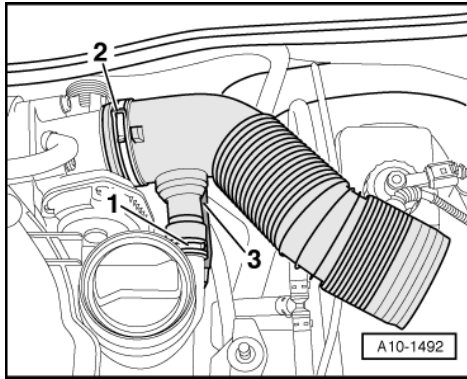


- -> Also disconnect lower coolant hose on oil cooler -arrow-, and drain off remaining coolant.

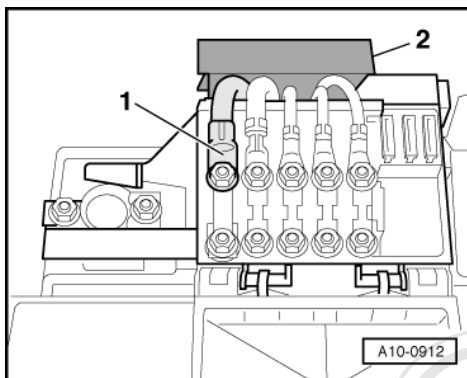


- -> Disconnect the air duct hose -3- from the air mass meter.
- Unplug connector -4- at air mass meter.
- Disconnect hoses -1- and -2- from the air cleaner housing.
- Unscrew bolts -5- and -6-.
- Remove air cleaner housing.

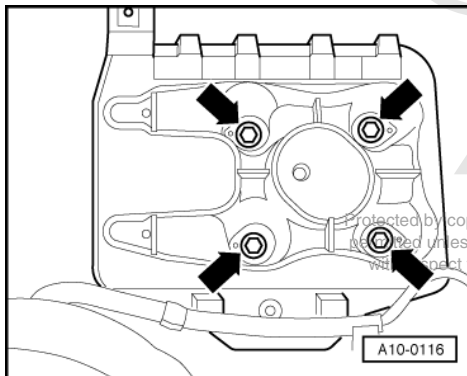
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- -> Disconnect hoses -1- and -3-.
- Remove air duct, release spring clamp -2- for this purpose.

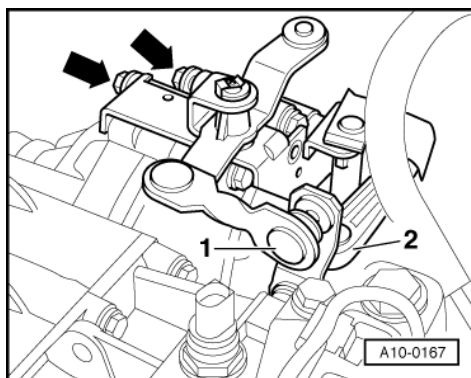


- Open cover of main fuse box towards front.
- -> Unclip protective cover -2- for electrical cables.
- Unscrew black electric cable -1- from fuse bar.
- Remove the battery.



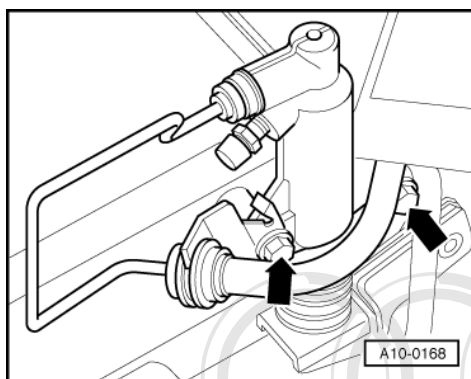
- -> Remove battery carrier -arrows-.

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Vehicles with manual gearbox:

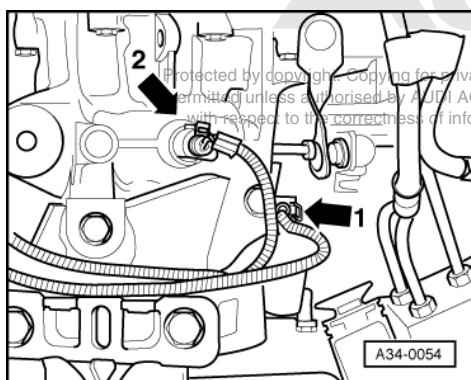
- -> Press off selector rods -1- and -2- with a screwdriver.
- Detach shift mechanism from gearbox -arrows- and suspend.



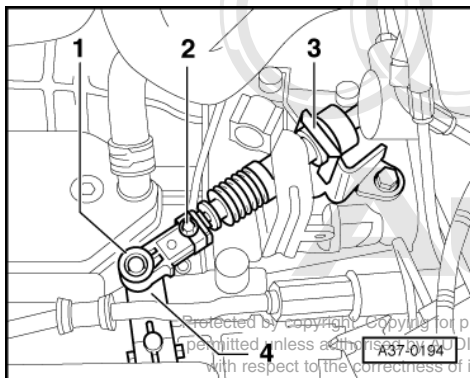
- -> Detach slave cylinder -arrows - and move clear to one side. Secure slave cylinder in position with wire; do not open hydraulic connections.

Important

Do not depress clutch pedal after removing slave cylinder.

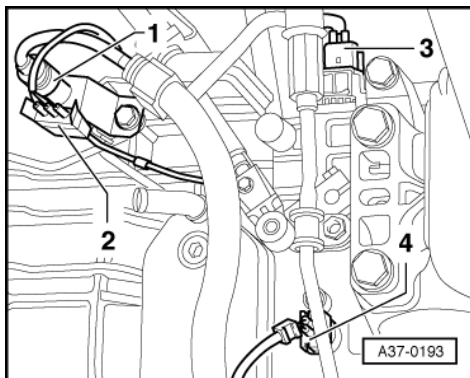


- -> Unplug the connector -arrow 1- at speedometer sender -G22.
- Unplug the connector -arrow 2- for the reversing light switch.
- Lay wiring aside.



Vehicles with automatic gearbox:

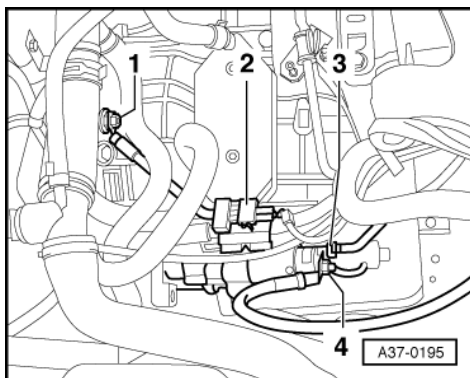
- -> Press off selector lever cable -1- with screwdriver at gearbox selector lever -4- detach securing clip -3- from support bracket.
- Detach selector cable and move to one side.



- -> Disconnect electrical connectors:
 - 1 - To solenoid valves (10-pin connector)
 - 2 - To road speed sender -G68
 - 3 - At multi-function switch -F125
 - 4 - At gearbox speed sender -G38
- Lay wiring harness aside.

All models:

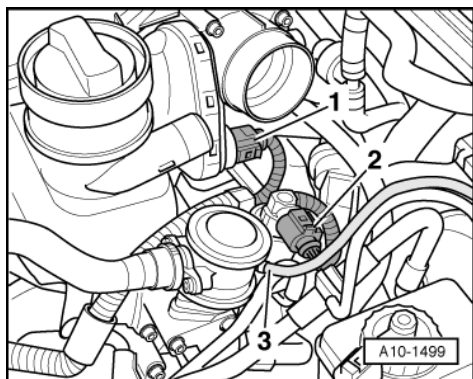
- Unbolt bracket for power steering pressure line from rear of gearbox support.



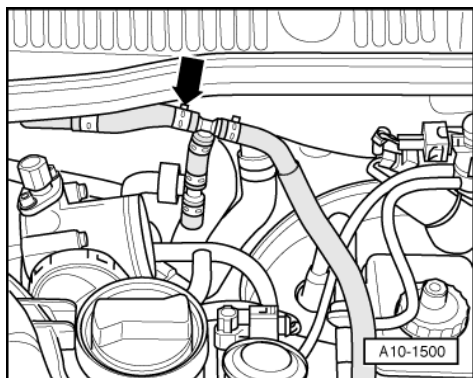
- -> Unscrew earth wiring -1- from flange engine/gearbox.
- Disconnect leads -3- and -4- to the starter.
- Unplug connector -2- and pull out of bracket.



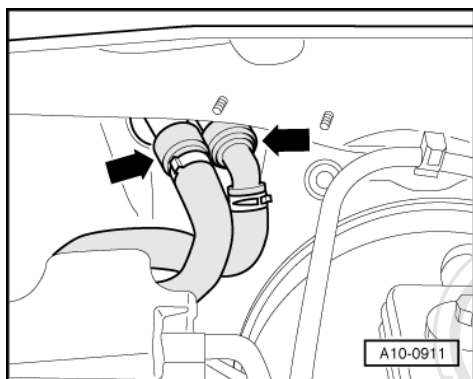
- Disengage wires from bracket on starter, move wires to one side and detach bracket.



- -> Unplug the connectors at the throttle valve body -1- and at the exhaust gas recirculation valve -2-.
- Lay wiring aside.
- Detach hose -3- from combination valve for secondary air inlet.



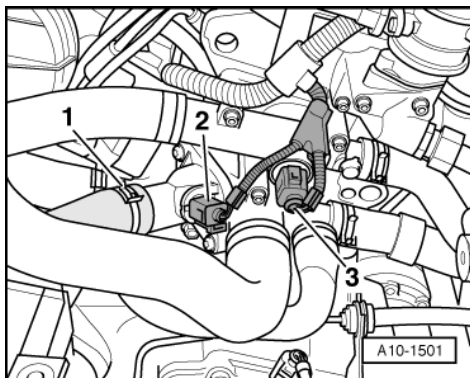
- -> Disconnect the coolant hose -arrow- to the coolant compensation tank at the T-union.



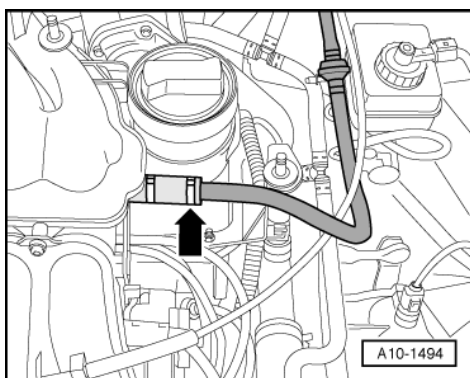
- -> Detach refrigerant hoses to radiator heat exchanger on bulkhead -arrows-.



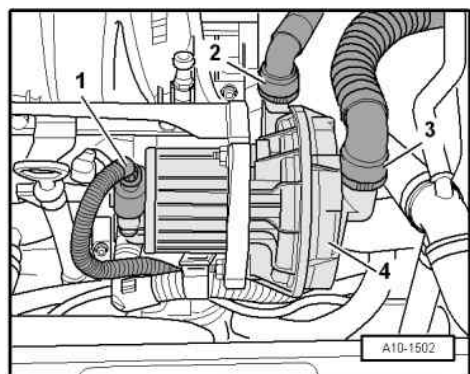
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- -> Disconnect the coolant hose -1- from the coolant distributor housing.
- Unplug the connectors at the coolant temperature sender -G62 -Item 2- and at the thermostat for map-controlled engine cooling -3-.

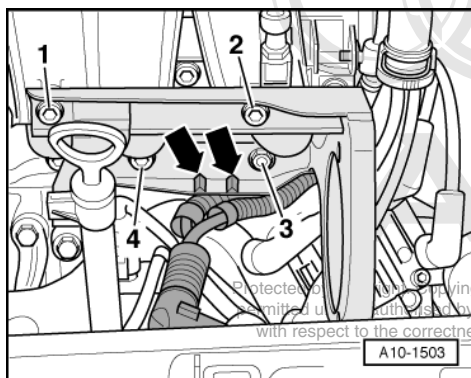


- -> Disconnect the vacuum hose -arrow- to the brake servo at the intake manifold.

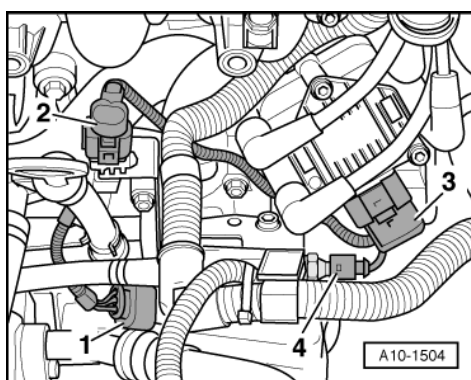


- -> Detach connector -1-.
- Disconnect hoses -2- and -3- at the secondary air pump.
- Detach the secondary air pump -4- from the bracket.

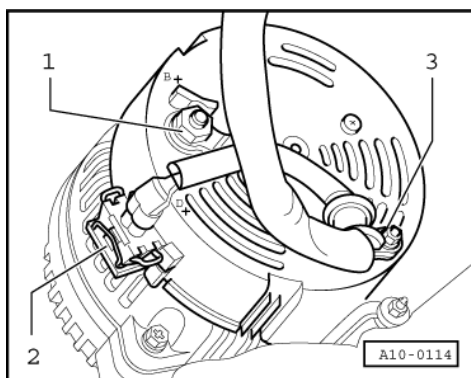
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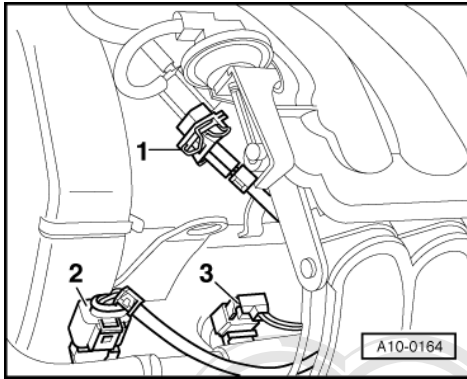
- -> Unscrew bolts -1...4- of the secondary air pump bracket.
- Lay the wiring aside -arrow- and remove the secondary air pump bracket.



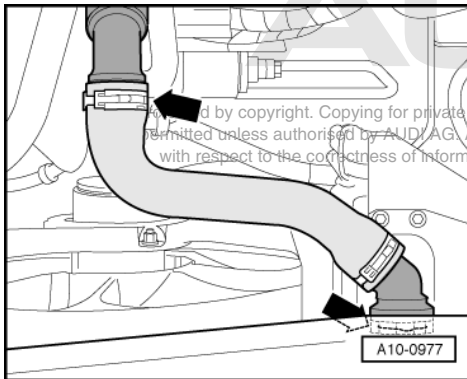
- -> Disconnect electrical connectors:
 - 1 - Knock sensor -G61
 - 2 - Engine speed sender -G28
 - 3 - Ignition coils -N and -N128 with output stage -N122
 - 4 - Oil pressure switch -F1 (on oil filter bracket)
 - Oil temperature sender -G8 (on oil filter bracket)
- Lay wiring aside.



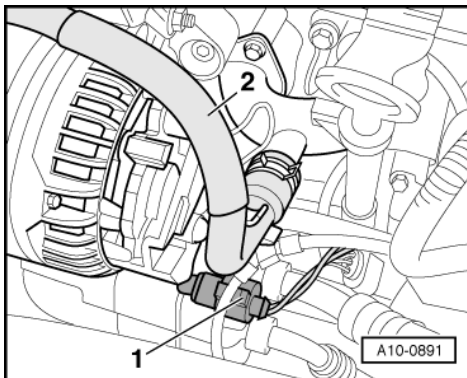
- -> Detach connector -2-.
- Unscrew wire -1- from alternator.
- Unscrew the cable clamp -3- and lay wiring aside.



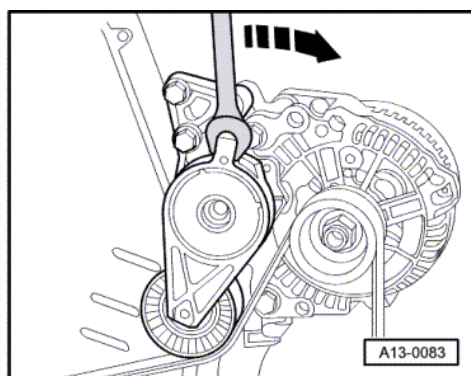
- -> Disconnect electrical connectors:
 - 1 - Intake manifold change-over valve -N156
 - 2 - Hall sender -G40
 - 3 - Injectors -N30, -N31, -N32, -N33
- Lay wiring aside.



- -> Detach coolant hose between engine and radiator -arrows-.



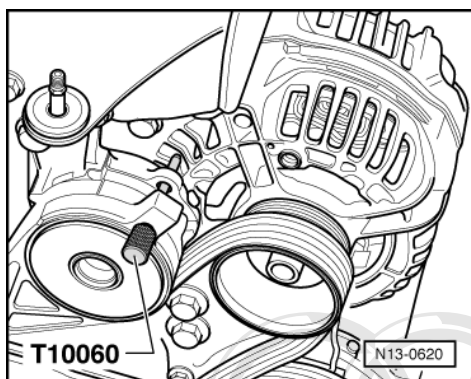
- -> Remove coolant hose -2- and set aside.
- Unplug connector -1- for solenoid clutch on air conditioner compressor.
- Move wiring harness aside.



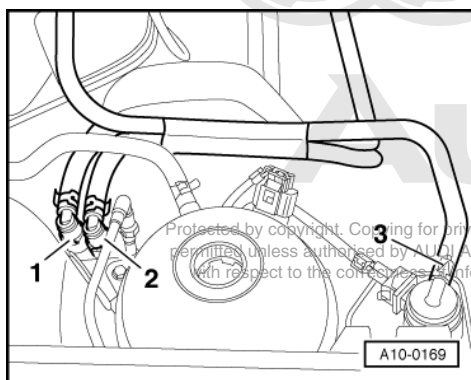
Note:

Mark the running direction with chalk or a felt-tipped pen before removing the ribbed belt. If the belt runs in the opposite direction when it is refitted, this can cause breakage.

- -> To loosen ribbed belt, turn tensioner in direction of arrow.



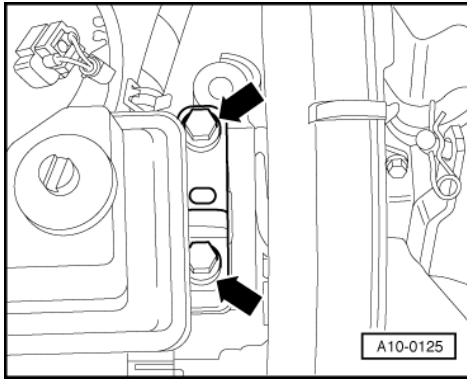
- -> Lock the ribbed belt tensioner with mandrel T10060 or with an angled Allen key.
- Remove ribbed belt.



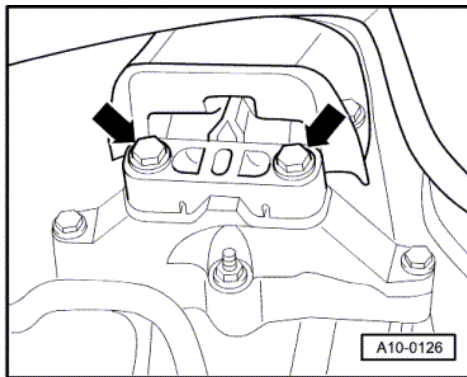
Important

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

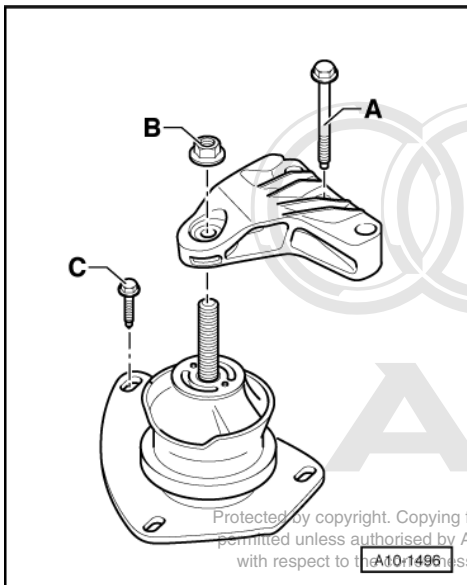
- -> Mark fuel feed pipe -1- and fuel return pipe -2- and disconnect (press release tab).
- Disconnect hose -3- from ACF container.



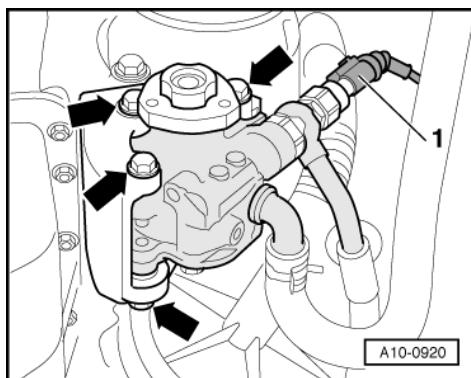
- -> Loosen bolts -arrows- of assembly mounting on engine...



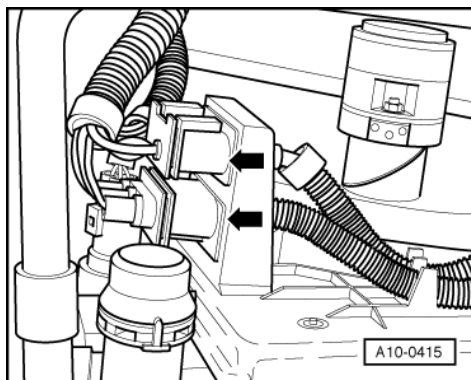
- -> ...and on gearbox approx. 2 turns.
- Unscrew bolts accessible from above securing bolts for radiator cowl.



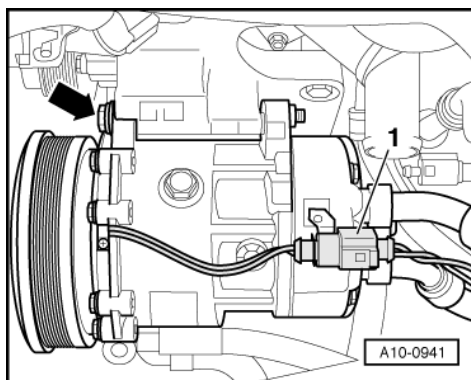
- -> Disconnect power steering line from gearbox -arrow-.



- -> Detach electrical connection from -1- pressure switch/power steering -F88.
- Lay wiring aside.
- Detach pulley of power steering vane pump; counterhold with drift.
- Detach vane pump for power steering -arrows-. Do not detach hydraulic connections.



- -> Detach both connectors for left radiator fan on bottom of radiator cowl.
- Unscrew bolts accessible from below on radiator cowl.
- Remove the radiator cowl with both vents from below.
- Suspend vane pump for power steering together with line from lock carrier.

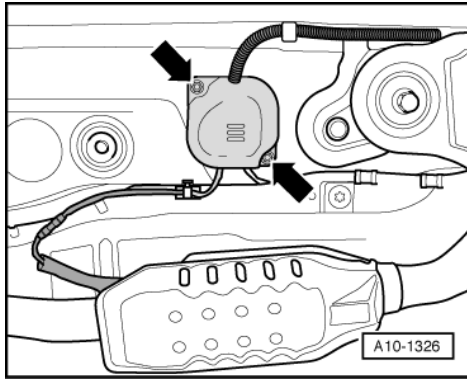


Vehicles with air conditioner:

Important

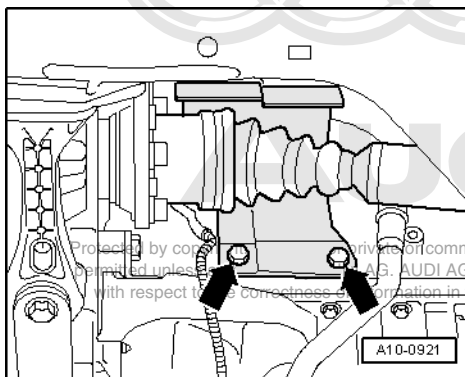
The air conditioner refrigerant circuit must not be opened.

- -> Remove bolts -arrow- for air conditioner compressor.
- Suspend the air conditioner compressor together with the connected refrigerant hoses from the bonnet lock.

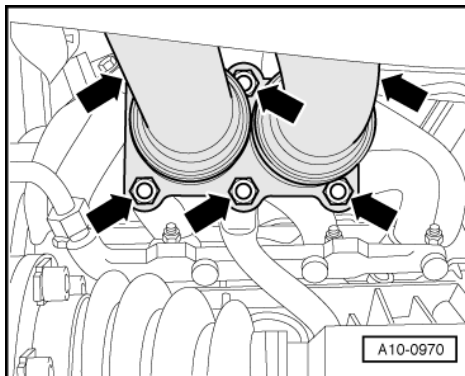


All models:

- -> Unscrew protective cover -arrows- on vehicle floor.
- Unplug connector for lambda probes and lay wiring aside.



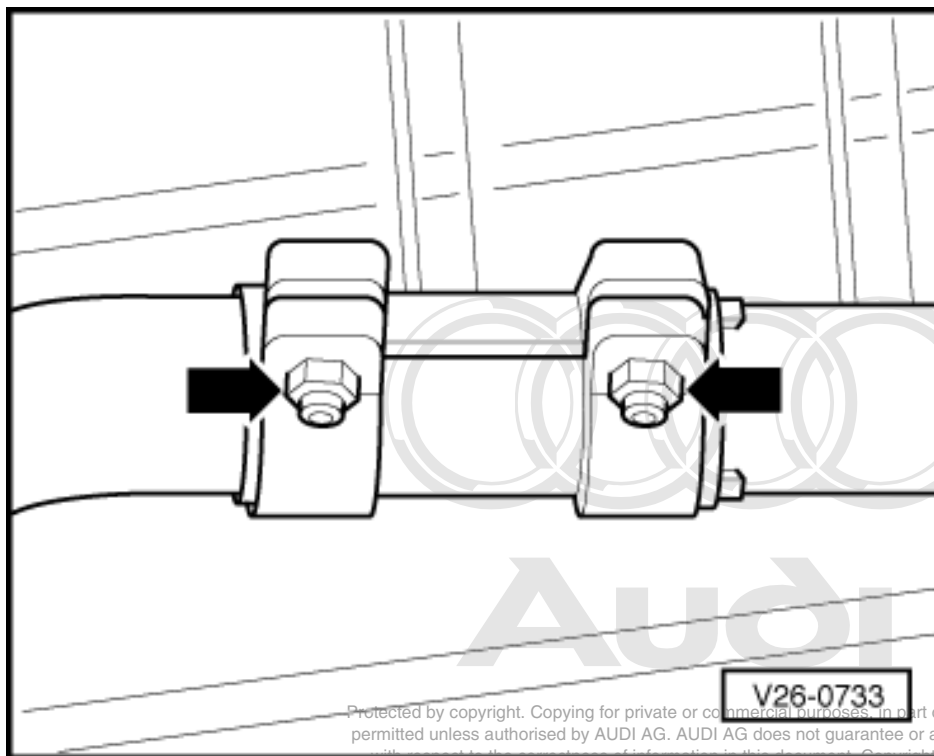
- -> Unbolt heat shield for right drive shaft -arrows-.



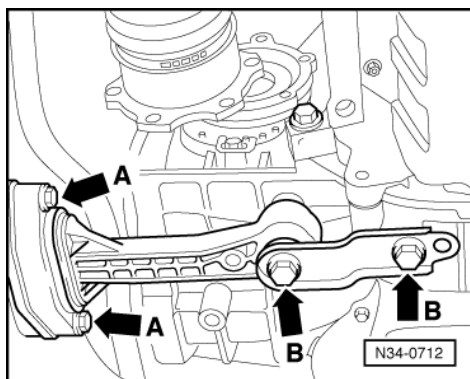
Note:

The isolating element in front exhaust pipe must not be deflected more than 10° to avoid damage.

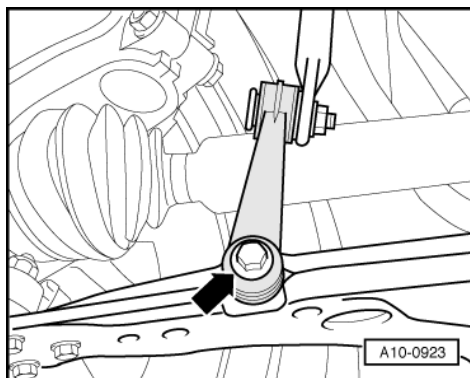
- -> Remove securing bolts -arrows- of front exhaust pipe/exhaust manifold.



- -> Detach the exhaust system at the clamping sleeve -arrows-.
- Detach the front exhaust pipe, swivel the front exhaust pipe 180° for this purpose.

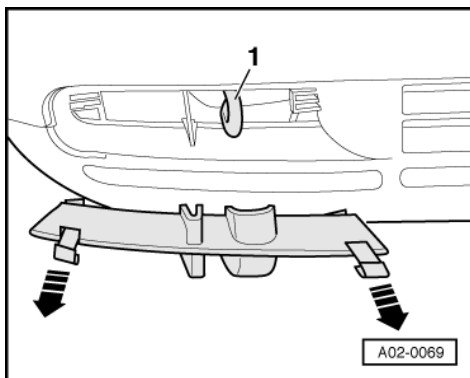


- -> First remove bolts -A- and then bolts -B- from pendulum support.
- Detach pendulum support.



- -> Unbolt right connecting link from wishbone -arrows-.
- Unscrew drive shaft on left and right from gearbox flange.
- Turn front wheels to the right.

- Push engine forward and at the same time swivel right drive shaft towards front.

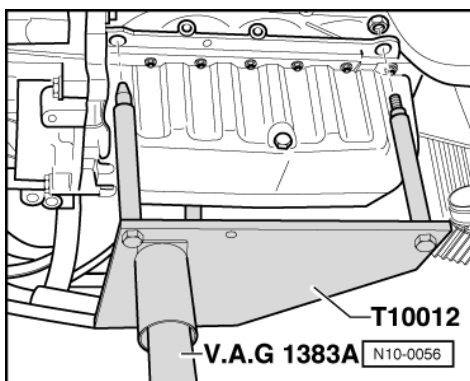


- -> Pull release tabs -arrows- and remove air intake grille.
- Suspend right drive shaft at towing eye -1- using a wire loop.

Note:

Protect bumper from scratches by using an adhesive tape.

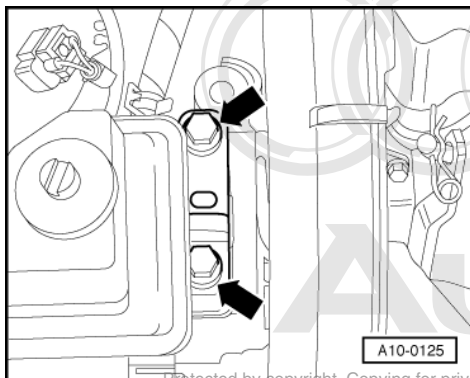
- Move left drive shaft towards rear and attach to anti-roll bar using a wire loop.



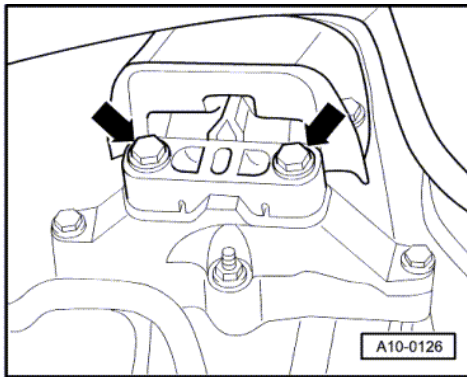
- -> Attach engine mounting T10012 with securing nut and bolt with approx. 20 Nm to cylinder block.
- Insert engine/gearbox lifter V.A.G 1383 A in engine mounting T10012 and raise slightly.

Note:

To unscrew bolts for assembly mounting use stepladder VAS 5085.



- -> Loosen bolts -arrows- of assembly mounting on engine...



- -> ...and from gearbox.

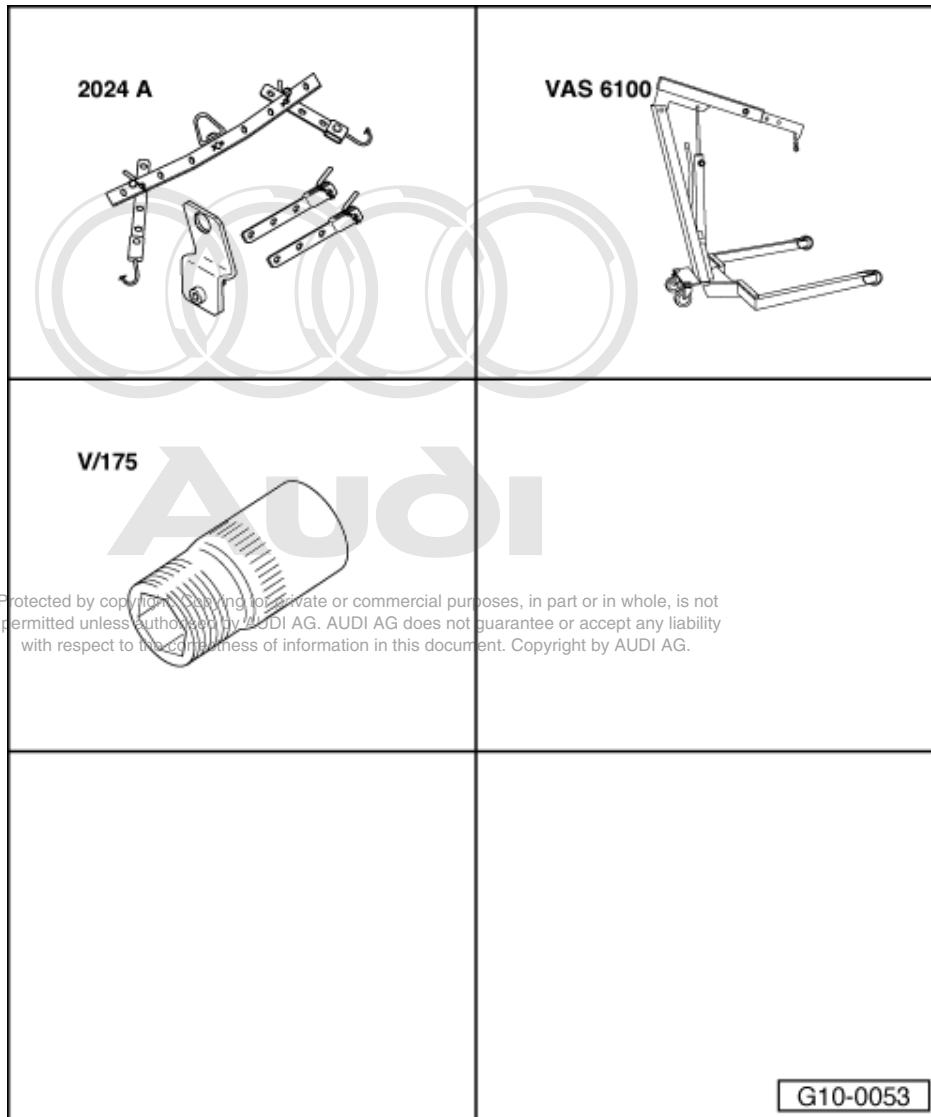
Notes:

- ♦ Check that all hoses 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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1.4 - Detaching engine from gearbox



Special tools and workshop equipment required

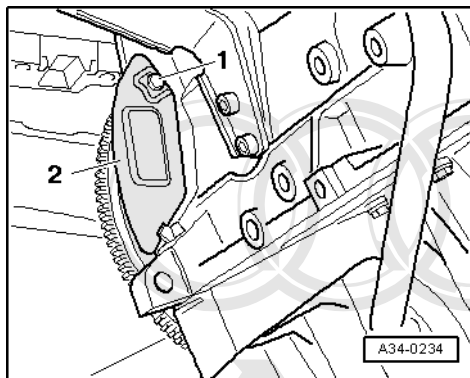
- ◆ Lifting tackle 2024 A
- ◆ VAS 6100

or

- ◆ Workshop crane V.A.G 1202 A
- ◆ 15 mm socket insert Matra V/175 (on vehicles with automatic gearbox)

Procedure

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

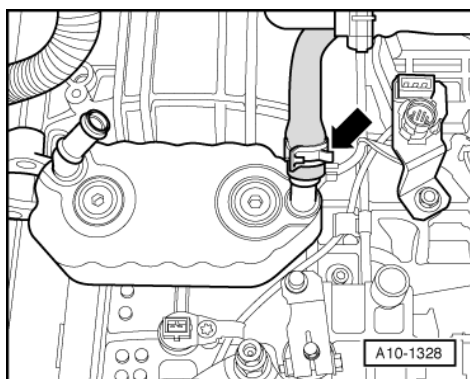


Vehicles with manual gearbox:

- -> Unscrew bolt -1- with gearbox installed.
- Pull up splash plate -2-.

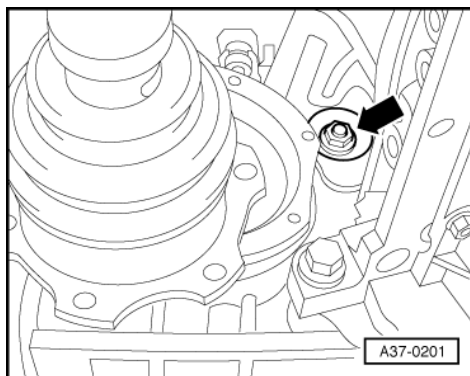
Note:

Shown in illustration with gearbox removed.



Vehicles with automatic gearbox:

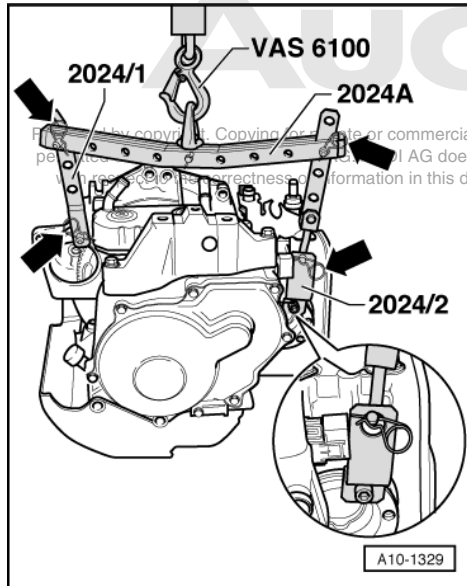
- -> Disconnect coolant hoses from ATF cooler -arrow-.



- Remove plug from hole in torque converter cover plate.
- -> Screw out 3 nuts of torque converter -arrow- with socket attachment SW 15 Matra V/175 (turn crankshaft 1/3 of a turn each time).

Note:

To prevent engine from turning when loosening torque converter nuts, counterhold central bolt on vibration damper.



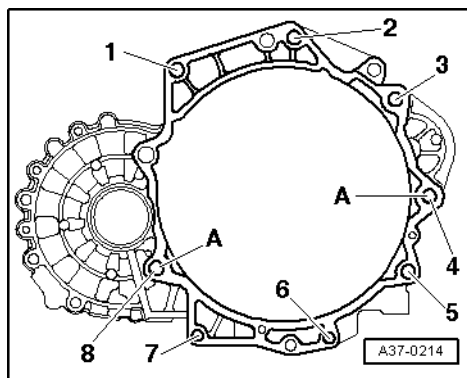
- Remove starter.
- -> Attach lifting tackle 2024 A to automatic gearbox and workshop lifter VAS 6100 or V.A.G 1202 A.

Note:

To balance the centre of gravity of the engine, position the hook attachments as shown in the illustration.

Important

The hooks and locating pins of the lifting tackle must be secured with locking pins -arrows in illustration-.



All models:

- -> Unscrew bolts -1...8- at engine/gearbox flange.
- Take off starter.

Note:

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

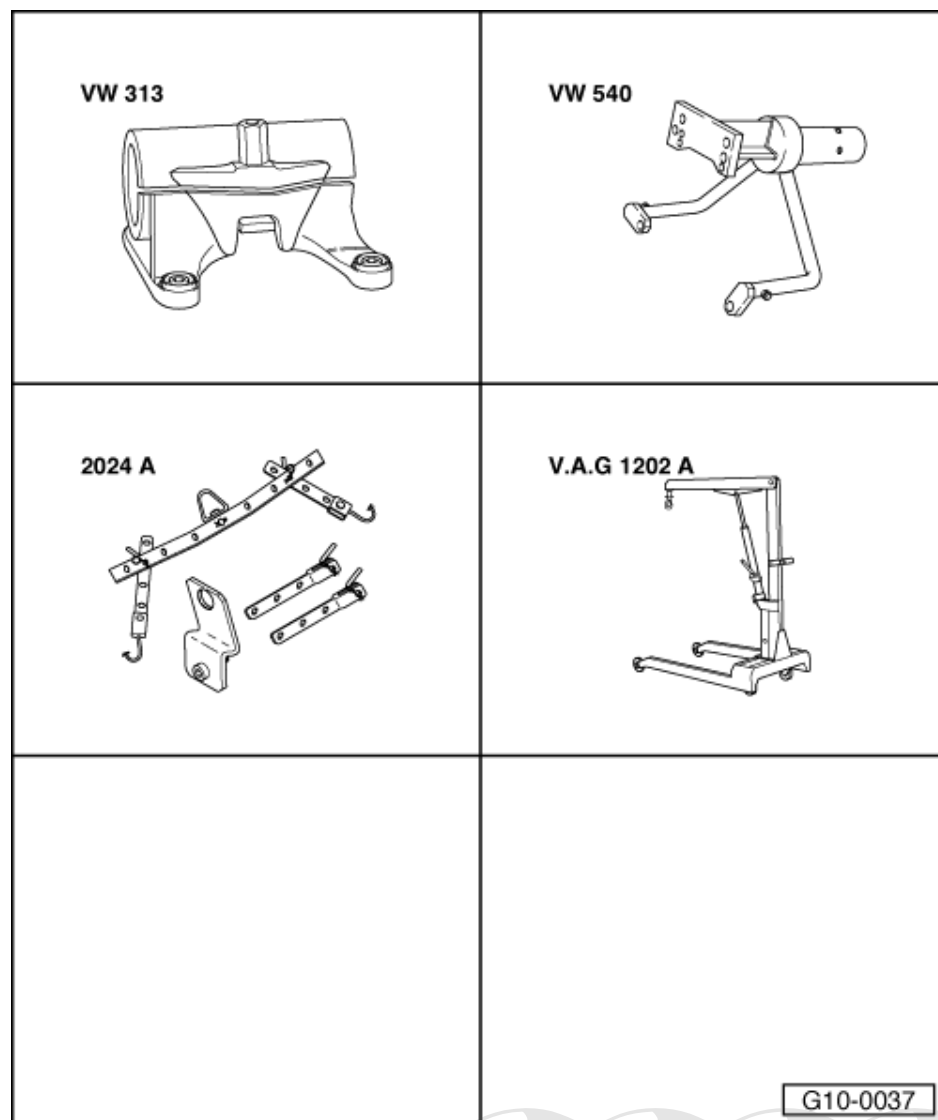
- Remove gearbox from engine.



Vehicles with automatic gearbox:

- If necessary, secure torque converter in gearbox with wire to prevent it falling out.

1.5 - Attaching engine to repair stand



Special tools and workshop equipment required

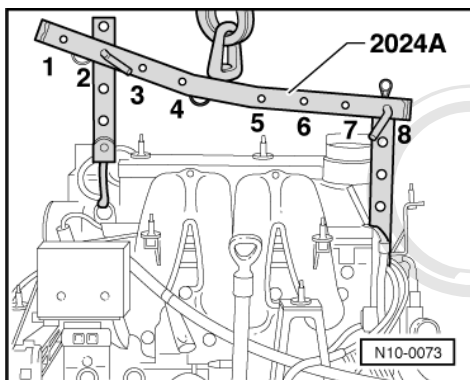
- ♦ Support clamp VW 313
- ♦ Engine and gearbox support VW 540
- ♦ Lifting tackle 2024 A
- ♦ Workshop crane V.A.G 1202 A

or

- ♦ VAS 6100



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Procedure

- Gearbox separated from engine.
- -> Attach lifting tackle 2024 A to engine and workshop crane VAS 6100 or V.A.G 1202 A.

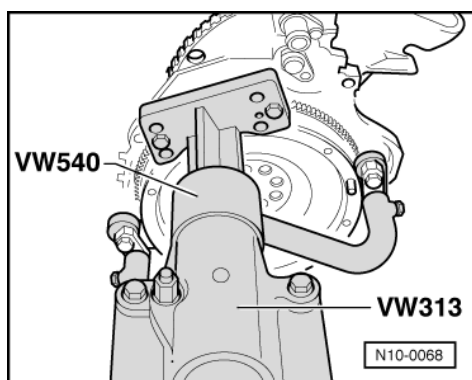
Note:

To balance the centre of gravity of the engine, position the hook attachments as shown in the illustration.

Important

The hook attachments and locating pins on the lifting tackle must be secured with locking pins.

- Lift engine off engine bracket T10012 using workshop crane VAS 6100 or V.A.G 1202 A.



-> When working on the engine, it should be secured to the repair stand VW 313 using the engine mounting VW 540.

1.6 - Installing

Special tools and workshop equipment required

- ♦ Depth gauge (for vehicles with automatic gearbox)

Procedure

- Engine installed on engine bracket T10012.

Installation is carried out in the reverse order to removal, noting the following:

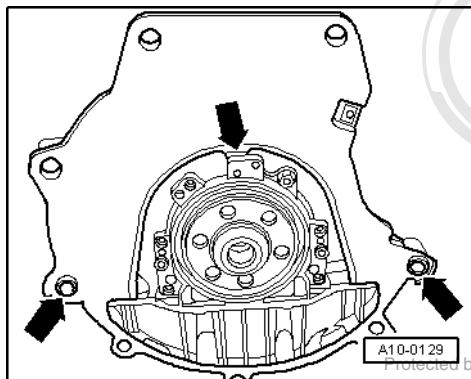


Notes:

- ♦ When installing the engine all cable ties must be fitted in the same position.
- ♦ Secure all hose connections with the correct hose clamps (same as original equipment):

=> Parts List

- ♦ When performing installation procedures always replace self-locking nuts and bolts.
- ♦ Replace seals, gaskets, and bolts which have a specified tightening angle.
- Check whether the dowel sleeves for centralising engine/gearbox are in the cylinder block, install if necessary.



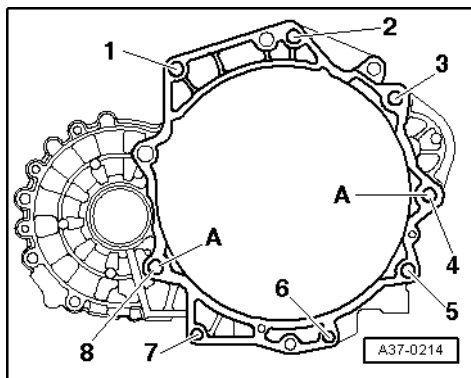
- -> Engage intermediate plate on sealing flange and push onto dowel sleeves - arrows

Vehicles with manual gearbox:

- If necessary, check that clutch plate is properly centred.
- Check clutch release bearing for wear, replace if necessary.
- Lightly lubricate clutch release bearing, release bearing guide sleeve and splines on input shaft with G 000 100.
- Attach gearbox to engine.

Notes:

- ♦ The tightening torques listed on this page apply only to lightly greased, oiled, phosphated, or black finished nuts and bolts.
- ♦ Additional lubricant such as engine or gearbox oil may be used, but do not use graphite lubricant.
- ♦ Do not use degreased parts.
- ♦ Tightening torque tolerance $\pm 15\%$.



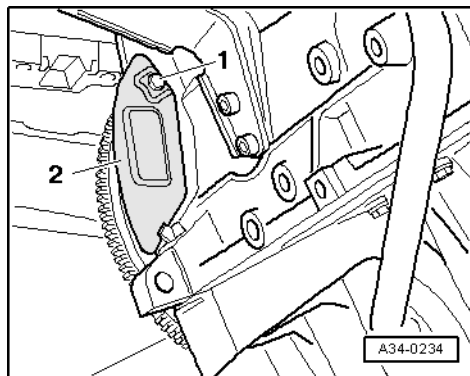
-> Engine/gearbox mountings (manual gearbox)

Item	Bolt	Nm
1, 2 1)	M12 x 65	80
3 1), 4 1)	M12 x 180	80

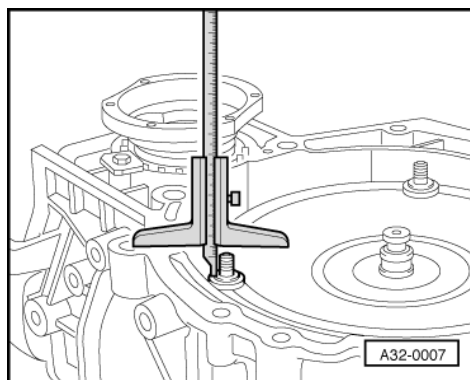
Item	Bolt	Nm
5...7	M10 x 50	45
8	M12 x 80	80

1) Bolt with threaded pin M8

A: Centring sleeves



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



Vehicles with automatic gearbox:

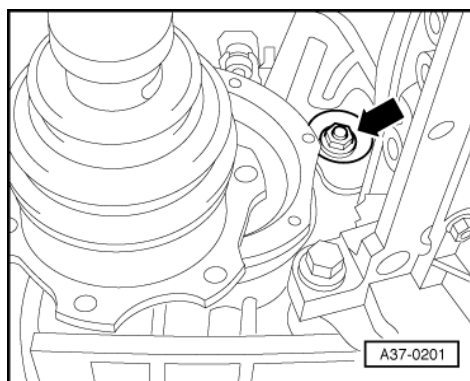
- To secure the torque converter on the drive plate only use the correct nuts as specified in the parts catalogue.

=> Parts List

-> If the torque converter is correctly installed, the depth between the contact surfaces at the bottom of the studs on the torque converter and the contact surface of the torque converter bell housing is about 22 mm. If the torque converter has not been completely inserted, this distance will be approx. 10 mm.

Important

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

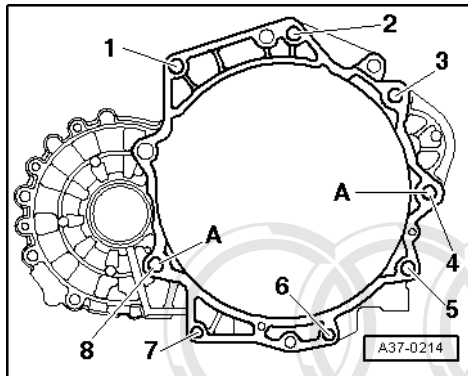




- -> Before installing engine, rotate torque converter and drive plate so that one hole/one stud are level with the aperture of the torque converter cover plate -arrow-.
- Attach gearbox to engine.
- Secure nuts of torque converter with special tool Matra V/175.

Notes:

- ♦ The tightening torques listed on this page apply only to lightly greased, oiled, phosphated, or black finished nuts and bolts.
- ♦ Additional lubricant such as engine or gearbox oil may be used, but do not use graphite lubricant.
- ♦ Do not use degreased parts.
- ♦ Tightening torque tolerance $\pm 15\%$.



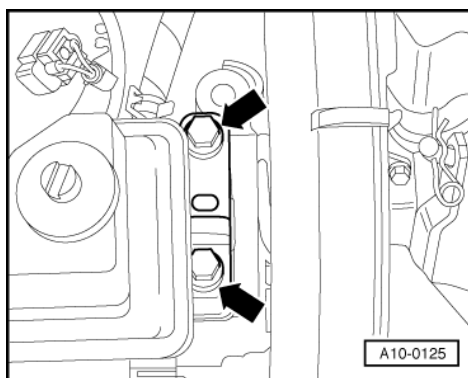
-> Fastening engine to gearbox in vehicles with automatic gearbox

Item	Bolt	Nm
1, 2 1)	M12 x 65	80
3 1), 4 1)	M12 x 180	80
5...7	M10 x 50	45
8	M12 x 80	80

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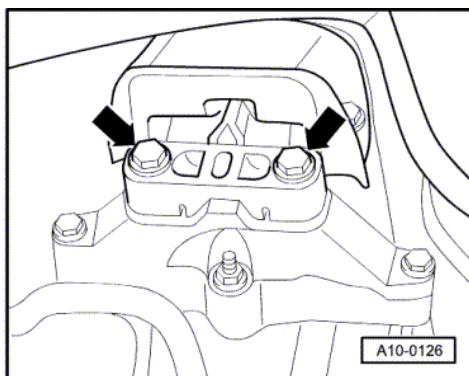
1) Bolt with threaded pin M8

A: Centring sleeves



All models:

- Guide engine/gearbox assembly into the chassis.
- -> Unscrew bolts -arrows- engine mounting from engine console...



- -> ...and gearbox mounting on gearbox console hand tight.
- Only use new bolts to secure.

Note:

The bolts are tightened to final torque only after adjusting the engine mounting => Page 45.

- Remove engine mounting T10012 from engine.
- Install drive shafts.

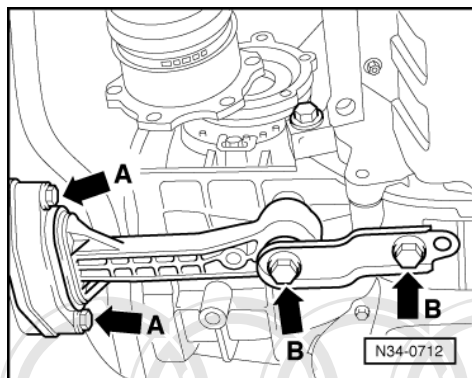
=> Running Gear, FWD and 4WD; Repair group 40

Note:

Before further assembly carry out the installation of the drive shafts.

- Install the connecting rod.

=> Running Gear, FWD and 4WD; Repair group 40



- -> First attach pendulum support to gearbox -arrows B- and then to subframe -arrows A-.
- Only use new bolts to secure.
- Install exhaust system and align it stress-free => Page 238.
- Drive bushes for the securing bolts back slightly to facilitate positioning of the vane pump and air conditioner compressor.
- Install the vane pump and the air conditioner compressor => Page 51.

Vehicles with manual gearbox:

- Install hydraulic clutch slave cylinder:

=> 5-speed Manual Gearbox 02K; Repair group 30; Servicing clutch release mechanism Servicing clutch release mechanism

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- Attach shift mechanism to gearbox and adjust:

=> 5-speed Manual Gearbox 02K; Repair group 34; Servicing shift mechanism Servicing shift mechanism

All models:

- Install ribbed belt=> Page 56 .
- Adjust engine mounting => Page 45 .

Vehicles with throttle cable:

- Adjust throttle cable:

=> Fuel Supply System - Petrol Engines; Repair group 20; Servicing throttle mechanism - Vehicles with mechanical throttle mechanism Servicing throttle mechanism - Vehicles with mechanical throttle mechanism

All models:

- Electrical connections and routing:

=> Current Flow Diagrams, Electrical Fault-finding and Fitting Locations

Notes:

- ♦ If the battery is reconnected, please ensure that the vehicle equipment (radio, radio/navigation system, clock, electric window lifters) is activated as described in the operating instructions.
- ♦ Deactivate the service mode of the telematics control unit.

=> Radio, Telephone and Navigation System; Repair group 91

- ♦ Further measures after reconnection of voltage supply:

=> Simos Fuel Injection and Ignition System; Repair group 24

- Check oil level => Page 183 .
- Top up coolant => Page 217 .

Notes:

- ♦ Drained coolant may only be used again if the original cylinder head and cylinder block are re installed.
- ♦ Coolant must not be used again if it is dirty.

Important

Do not use charging unit for boost starting. There is danger of damaging the vehicle control units.

Tightening torques

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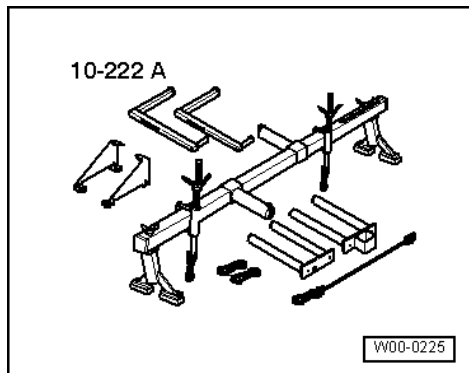
Component		Nm
Bolts/nuts	M6	10
	M8	20
	M10	45
	M12	65
Except for the following:		
Drive plate to torque M10 x1 converter		85
Pendulum support to gearbox		40 + 90° 1)2)
Pendulum support to subframe		20 + 90°1)2)
Air conditioner compressor to bracket for auxiliary mechanical units		45

Component	Nm
Battery cable clamp to battery terminal	6

- 1) 90° corresponds to a quarter of a turn
- 2) Replace nuts and bolts

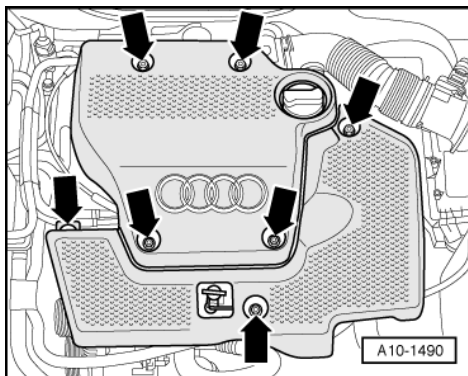
2 - Adjusting engine mounting

2.1 - Adjusting engine mounting



Special tools and workshop equipment required

- ♦ Support bar 10-222A

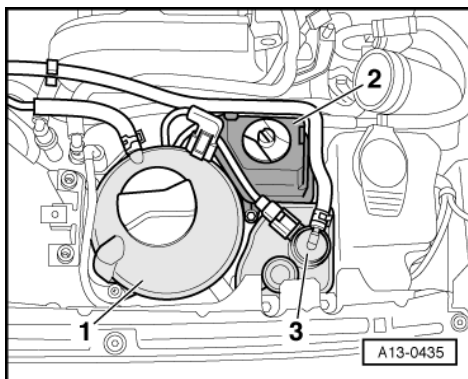


Checking adjustment

- -> Remove engine covers -arrows-.

Note:

Fig. shows bolted engine cover.



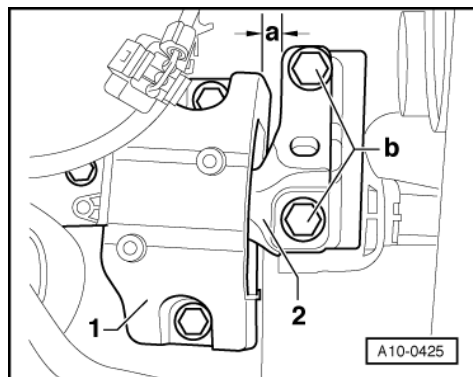
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- -> Detach the coolant expansion tank -1- and refill reservoir -2- for power steering. Do not detach hoses.

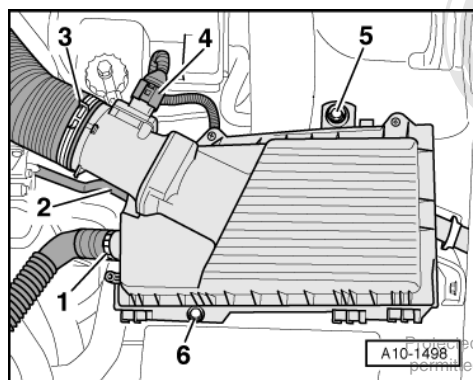
Note:

The ACF -3- remains installed.



- -> Both bolt heads -b- must be flush with the edge of the support arm -2-.
- Between engine console -1- and support arm -2- of the right engine mounting must be a distance $a = 13$ mm.

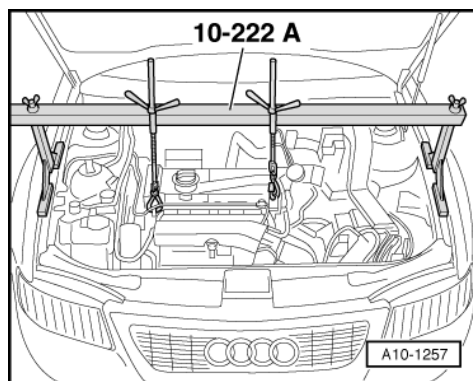
Use a 12 mm flat bar (if necessary, use special tool 2011) to check distance -a-. It must be easy to insert the flat bar.



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

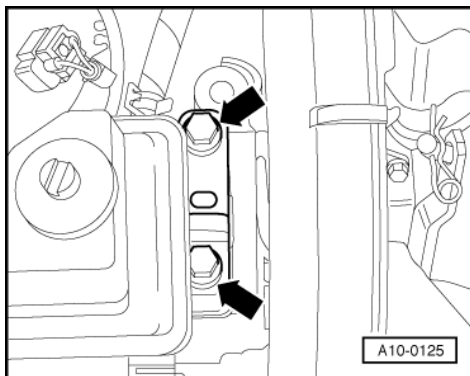
- -> Disconnect the air duct hose -3- from the air mass meter.
- Unplug connector -4- at air mass meter.
- Where fitted, disconnect vacuum hoses -1- and -2- at air cleaner housing.
- Unscrew bolts -5- and -6-.
- Remove air cleaner housing.



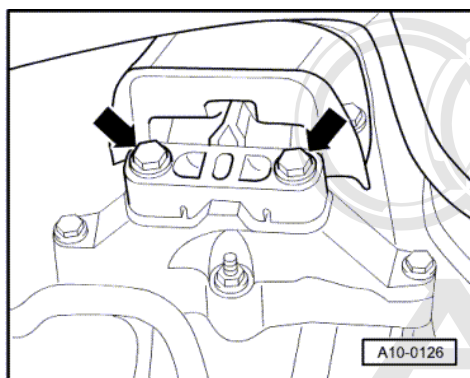
Note:

Push a plastic or wooden support between the wing mounting flange and side panel in order to prevent deformation of the wing.

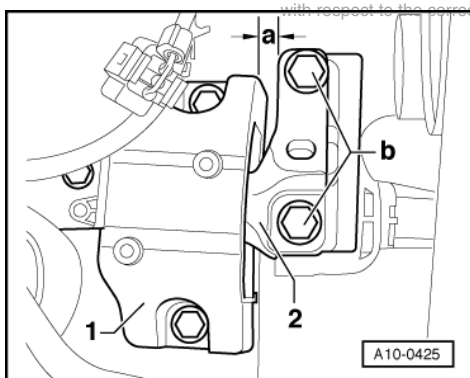
- -> Set up support bar 10-222 A in front of gas pressure spring onto wing bolt edge. Spindles are at the front.
- Attach the snap hooks of the spindles to the lifting eye or bracket T10013.
- Lift engine with both spindles evenly and slightly.



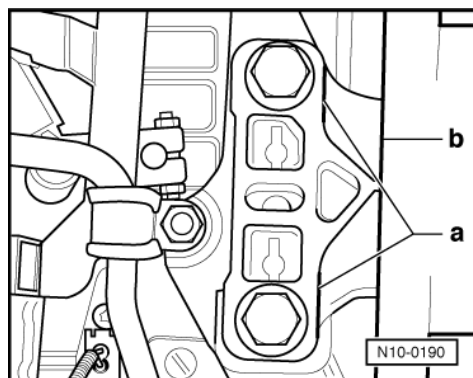
- -> Loosen bolts -arrows- of assembly mounting on engine...



- -> ...and from gearbox. Replace all 4 bolts one by one (if not already replaced when engine was installed) and hand-tighten them.



- -> Loosen bolts -b- of support arms on left and right approx. two turns.
- Using an assembly iron displace engine between engine console -1- and support arm -2- until the distance on engine side is $a = 13 \text{ mm}$.
 - It must be easy to insert a 12 mm flat bar (or special tool 2011).
 - Both bolt heads -b- must be flush with the edge of the support arm.
- Tighten bolts -b- for mechanical unit bracket on engine side $60 \text{ Nm} + 90^\circ$.



- -> Ensure that the edges on the load arm on the gearbox side -a- and gearbox console -b- are parallel.
- Tighten bolts -b- for mechanical unit bracket on gearbox side to 60 Nm + 90°.

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



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13 - Crankshaft group

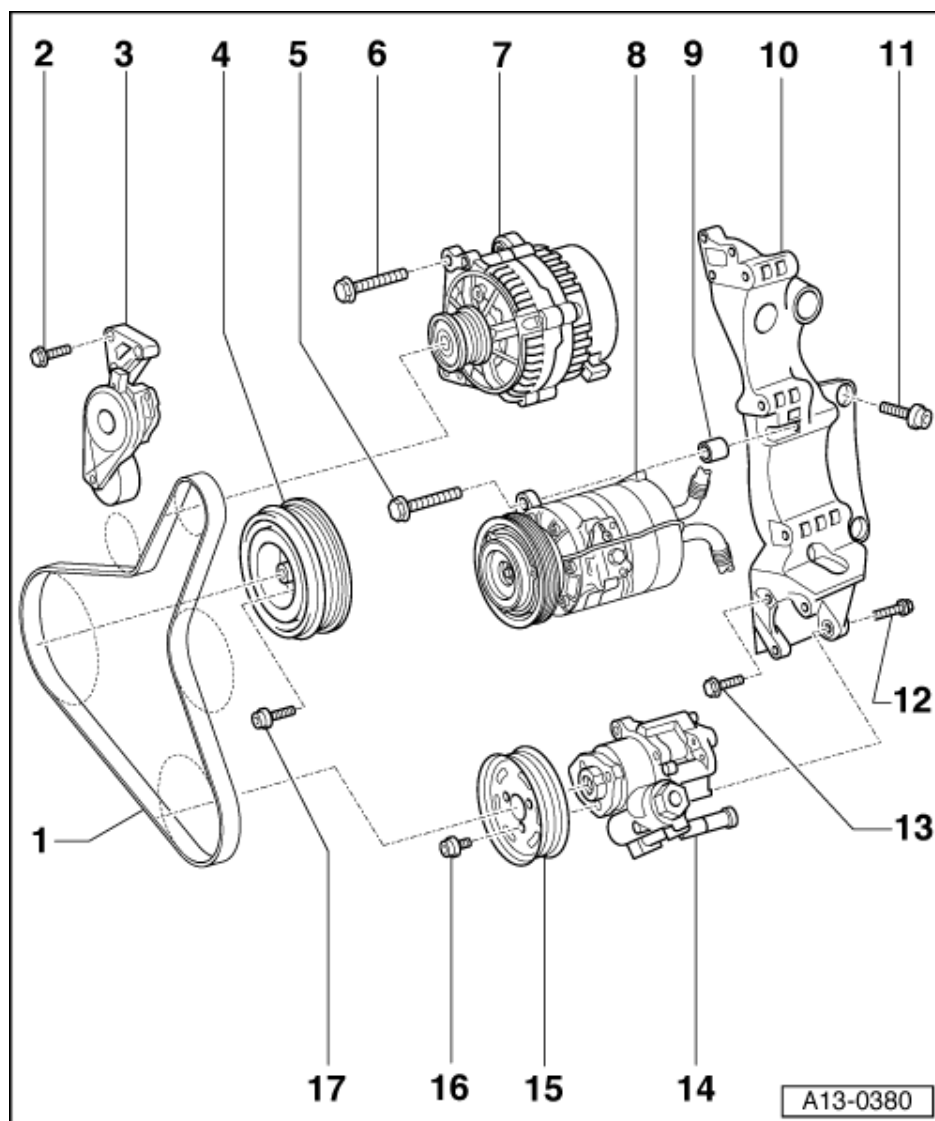
1 - Dismantling and assembling engine

1.1 - Dismantling and assembling engine

1.2 - Removing and installing ribbed belt

Notes:

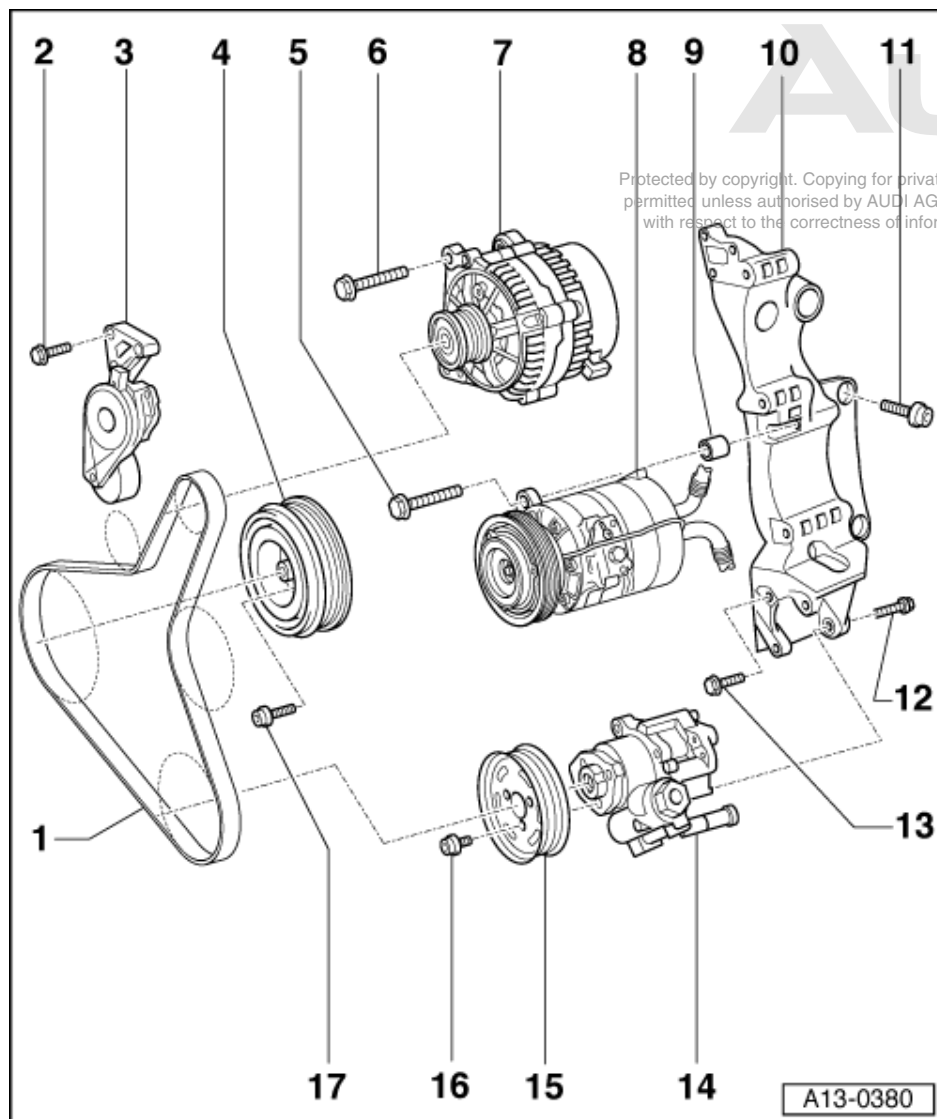
- ♦ Mark the running direction with chalk or felt pen before removing the ribbed belt. If the belt runs in the opposite direction when it is refitted, this can cause breakage. Ensure that the belt is properly seated in the pulleys when installing.
- ♦ The following illustration shows the belt drive on vehicles with air conditioner.



1 Ribbed belt

- ♦ Ribbed belt on vehicles without air conditioner=>Fig. 53
- ♦ Ribbed belt on vehicles with air conditioner=>Fig. 53
- ♦ A double ribbed belt is fitted on engines with AC compressor
- ♦ Check for wear
- ♦ Do not kink
- ♦ Removing and installing
=>Page 55.

2 23 Nm



3 Tensioner for ribbed belt

- ♦ Swivel with open-ended spanner to slacken ribbed belt.
- ♦ Lock tensioner with mandrel T10060 or with an angled Allen key.

4 Belt pulley

- ♦ For ribbed belt
- ♦ Removing and installing
=>Page 54.

5 45 Nm

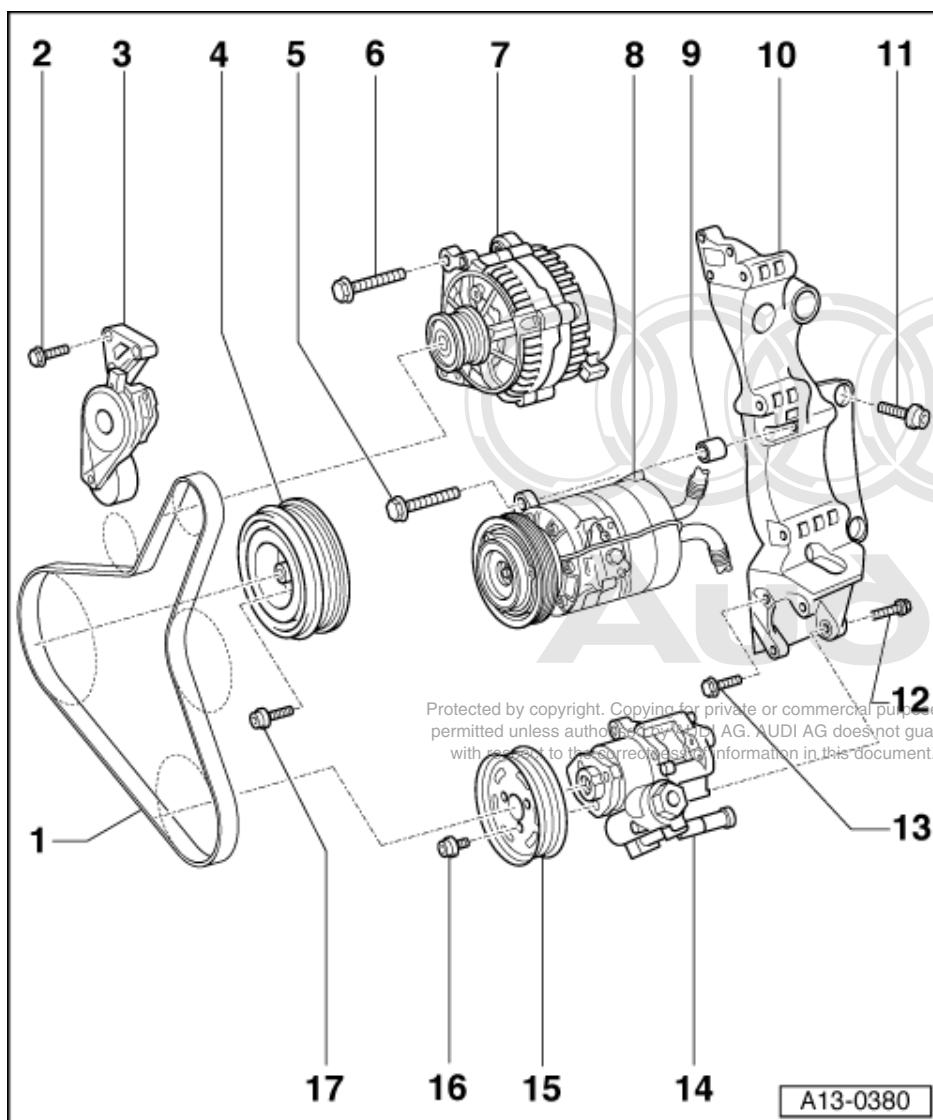
6 23 Nm

7 Alternator

- ♦ Removing and installing:

=> Electrical System; Repair group 27

- ♦ To facilitate attachment of the alternator, slightly drive back threaded bushes for the alternator securing bolts



8 Air conditioner compressor

- ♦ After removing compressor secure to lock carrier with wire. Do not leave compressor suspended on refrigerant hoses.
- ♦ Do not unscrew or disconnect refrigerant hoses or pipes.
- ♦ To facilitate positioning of the air conditioner compressor, drive back threaded bushes for retaining bolts slightly at the compressor.

9 Spacer bush

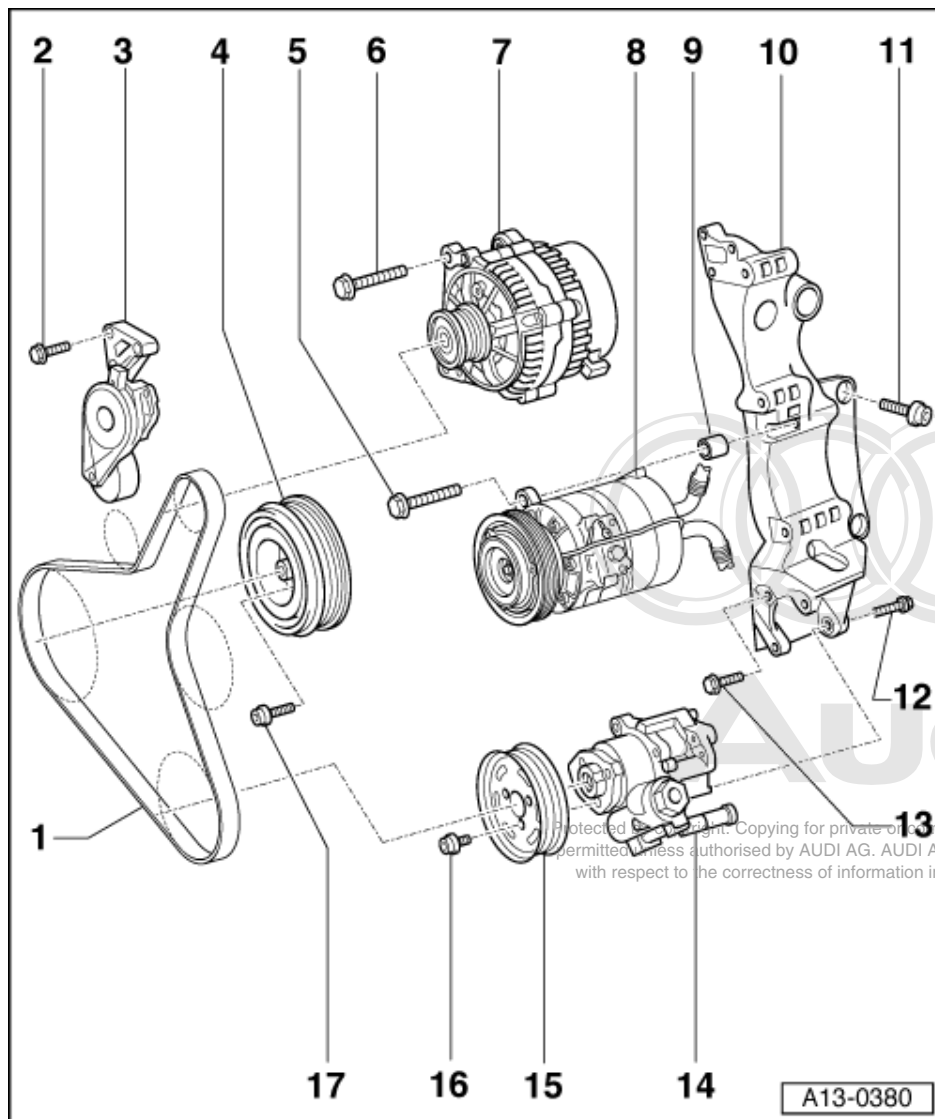
- ♦ Not fitted on all versions

10 Bracket for auxiliary assembly

11 45 Nm

- ♦ Observe the tightening sequence =>Page 57

12 23 Nm



13 23 Nm

14 Vane pump

- ♦ For power steering
- ♦ Removing and installing:

=> Running Gear, FWD and 4WD; Repair group 48

- ♦ To facilitate attachment of the vane pump slightly drive back thread bush for securing bolt at bracket

15 Belt pulley

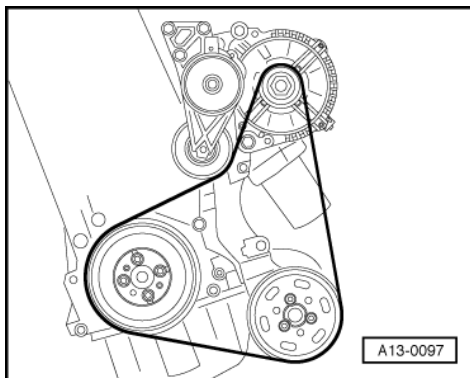
- ♦ For vane pump

16 23 Nm

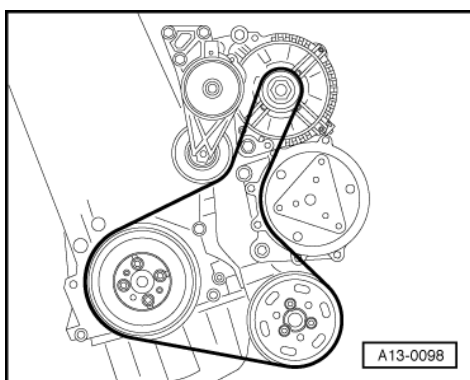
17 Bolt (special type)

=> Parts List

- ♦ Replace bolt with bolt strength rating 8.8 and tighten to 10 Nm + 90°
- ♦ Bolt with strength rating 10.9: tighten to 40 Nm.



-> Fig.1 Ribbed belt routing on vehicles without air conditioner

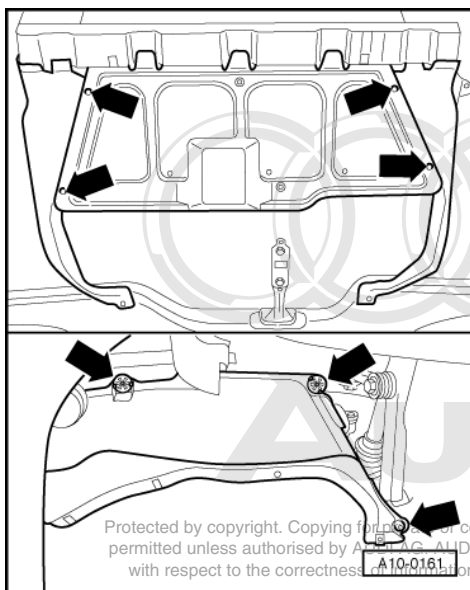


-> Fig.2 Ribbed belt routing on vehicles with air conditioner

Note:

Engines with an air conditioner compressor are fitted with a double ribbed belt.

1.3 - Removing and installing crankshaft pulley

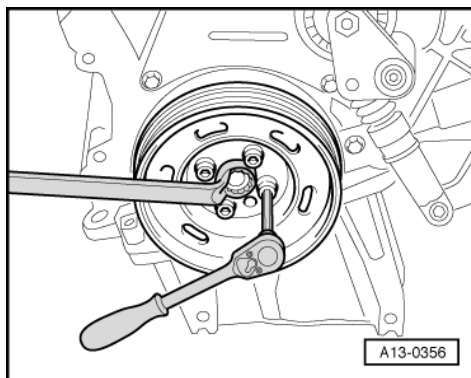


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Removing

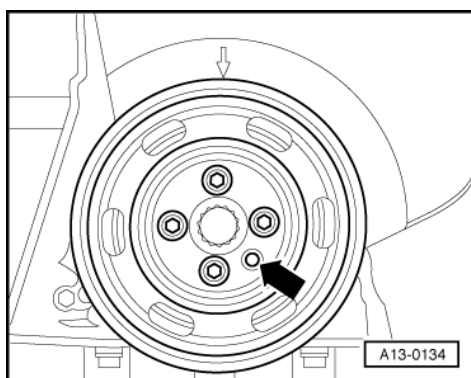
- Ribbed belt must be removed =>Page 55 .
- -> Remove noise insulation in centre and on right -arrows-.



- -> Remove the crankshaft pulley.

Note:

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



Installing

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

- Only use new bolts to secure.
- -> Install the crankshaft pulley with genuine bolts only:

=> Parts List

- Can only be installed in one position. The hole -arrow- in the crankshaft pulley must fit over the projection on the toothed belt sprocket.

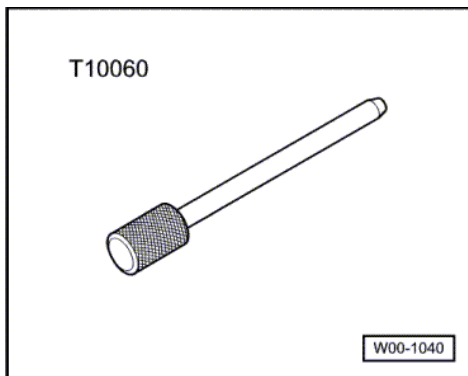
Tighten the bolts of the crankshaft pulley as follows.

- Replace bolts with bolt strength rating 8.8 and tighten to 10 Nm + 90°
- Tighten bolts to 40 Nm for bolt strength rating 10.9



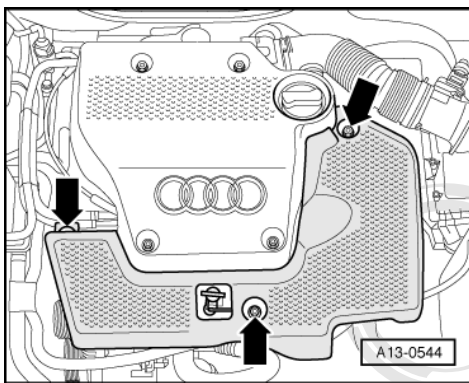
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1.4 - Removing and installing ribbed belt



Special tools and workshop equipment required

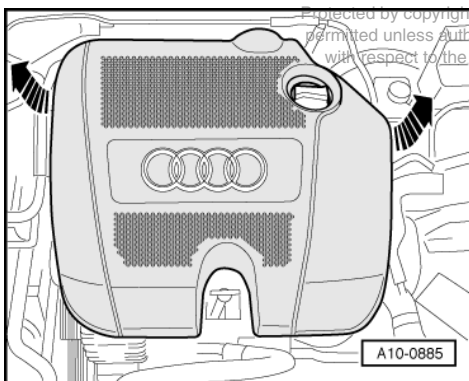
- ◆ Mandrel T10060



Removing

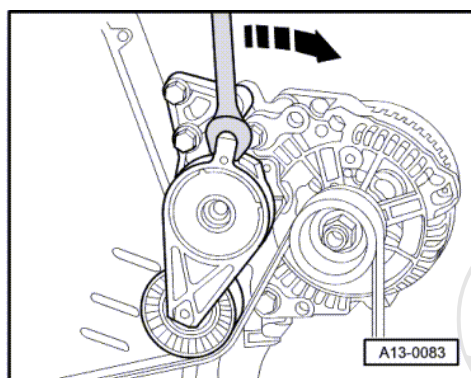
Vehicles with bolted engine cover:

- -> Remove the front engine cover -arrows-.



Vehicles with clip-on engine cover:

- -> Remove engine cover -arrows-.

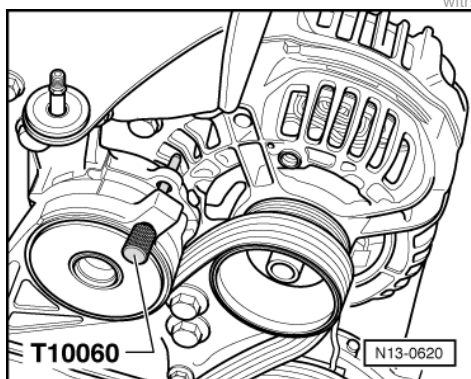


All models:

Note:

Mark the running direction with chalk or a felt-tipped pen before removing the ribbed belt. If the belt runs in the opposite direction when it is refitted, this can cause breakage.

- -> To slacken ribbed belt, turn tensioning element in direction of arrow.



- -> Lock the ribbed belt tensioner with mandrel T10060 or with an angled Allen key.
- Remove ribbed belt.

Installing

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

Note:

Before fitting the ribbed belt ensure that all mechanical units (alternator, air conditioner compressor, vane pump) are tight.

- Fit ribbed belt over crankshaft pulley and vane pump pulley. If necessary, pull the belt upwards using an auxiliary tool.
- Fit ribbed belt over alternator pulley last. Release tensioner.
- Check that ribbed belt is properly seated.
 - Ribbed belt routing => Fig. 53
- Start engine and check belt running.

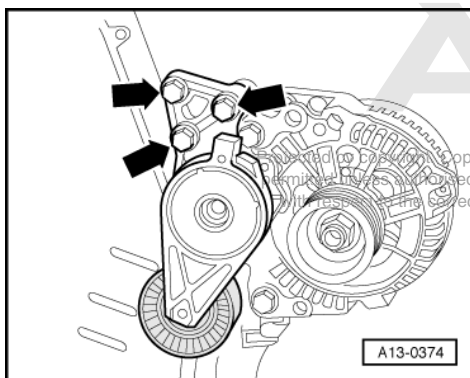
1.5 - Removing and installing bracket for auxiliary assemblies

Removing

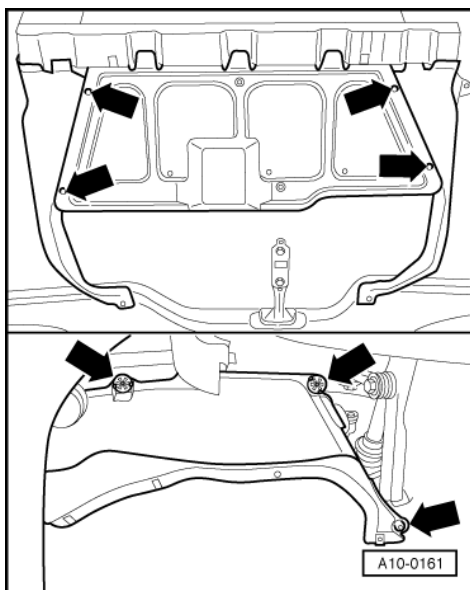
Important

On vehicles with telematics, activate service mode of telematics control unit before disconnecting battery. => Radio, Telephone and Navigation System; Repair group 91

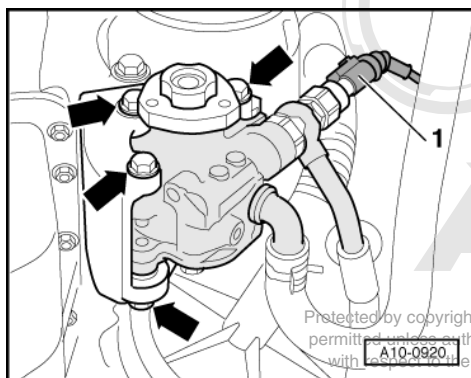
- Refer to coding on vehicles with encoded radio/radio navigation system (RNS); if necessary, interrogate.
- Disconnect earth strap at battery with ignition switched off.
- Remove ribbed belt => Page 55.



- -> Remove tensioner for ribbed belt cover -arrows-.

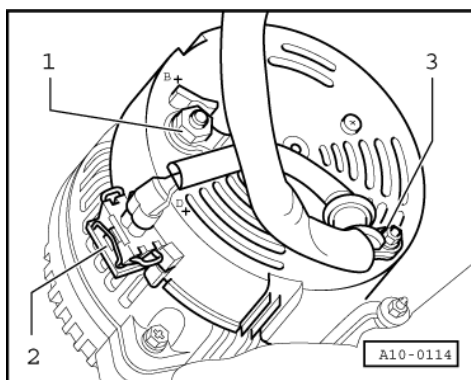


- -> Remove noise insulation in centre and on right -arrows-.

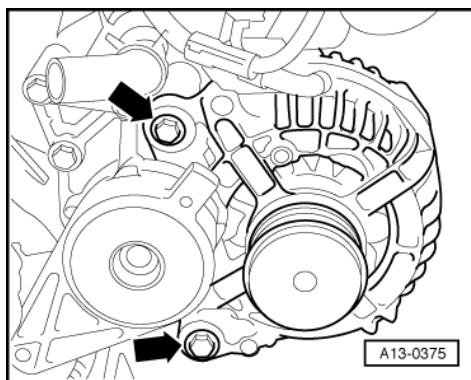


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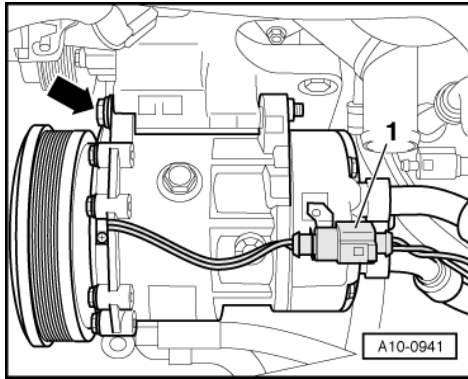
- -> Where fitted, unplug connector -1- at power steering pressure switch -F88.
- Detach pulley of power steering vane pump; counterhold with a drift.
- Detach vane pump for power steering -arrows-. Do not detach hydraulic connections.



- -> Detach connector -2-.
- Unscrew wire -1- from alternator.
- Unscrew the cable clamp -3- and lay wiring aside.



- -> Unscrew bolts -arrows-.
- Detach alternator and guide upwards out of engine compartment.



Vehicles with air conditioner:

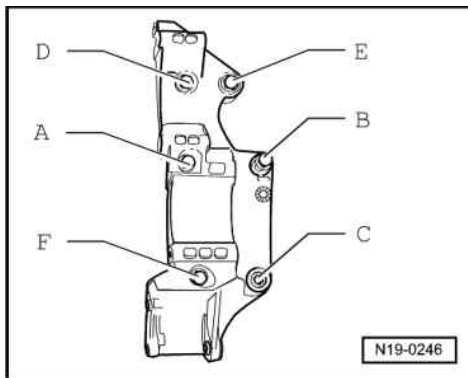
- -> Detach connector -1- for solenoid clutch on air conditioner compressor.

Important

The air conditioner refrigerant circuit must not be opened

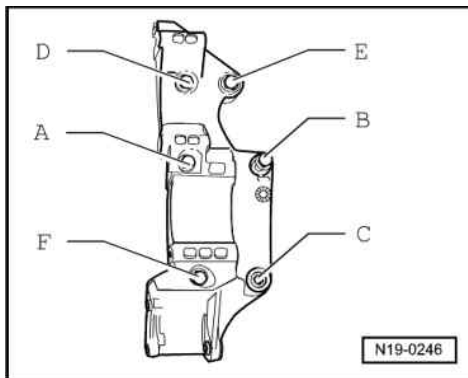
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- Screw out bolts -arrow- for air conditioner compressor.
- Lower air conditioner and suspend from lock carrier with wire.



All models:

- -> Unbolt bracket for auxiliary assemblies -bolts A...F-.





Installing

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

- -> Tighten bolts in sequence -A...F- to 45 Nm.
- Drive bush for bottom securing bolt back slightly to facilitate positioning of alternator, vane pump and air conditioner compressor.
- Install ribbed belt=> Page 56 .

Notes:

- ♦ If the battery is reconnected, please ensure that the vehicle equipment (radio, radio/navigation system, clock, electric window lifters) is activated as described in the operating instructions.
- ♦ Deactivate the service mode of the telematics control unit.

=> Radio, Telephone and Navigation System; Repair group 91

- ♦ Further measures after reconnection of voltage supply:

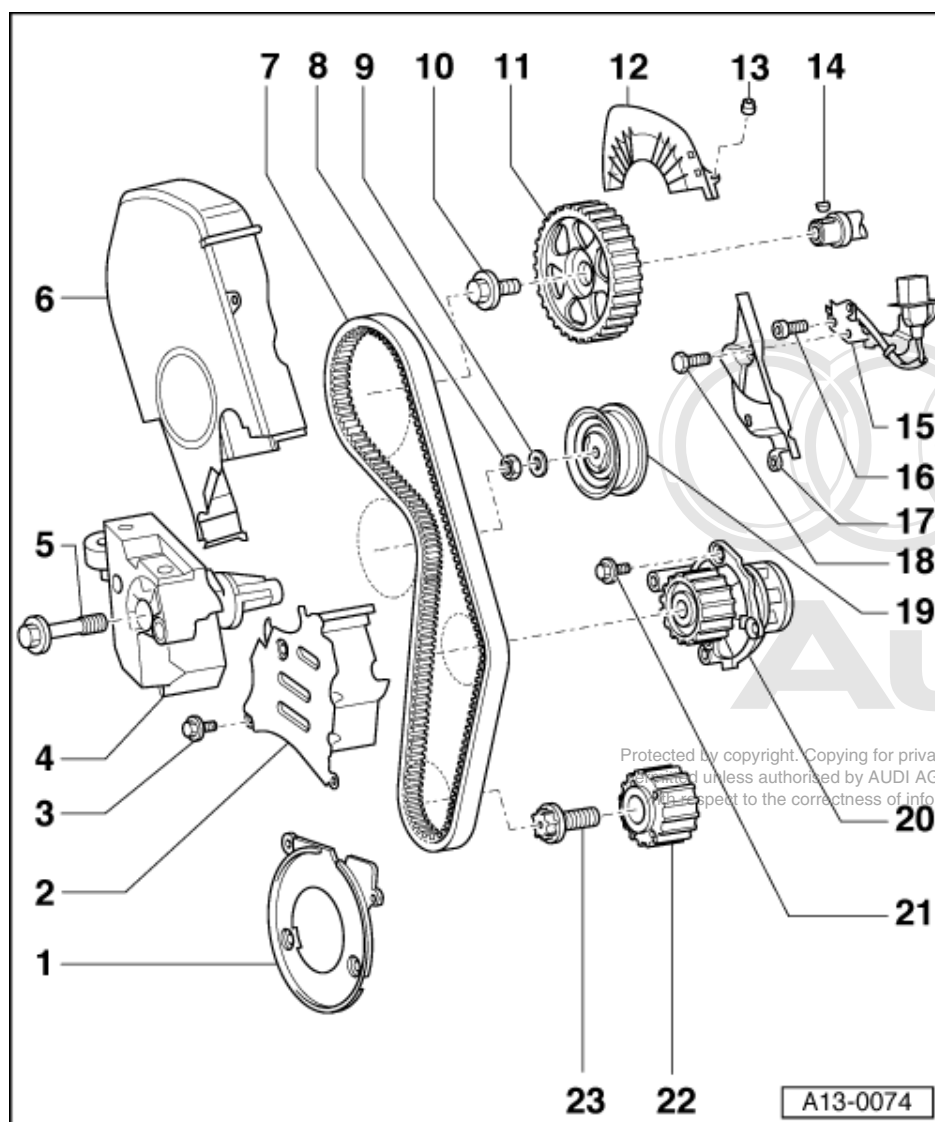
=> Simos Fuel Injection and Ignition System; Repair group 24

Tightening torques

Component	Nm
Bracket for auxiliary mechanical units to cylinder block	45
Air conditioner compressor to bracket for auxiliary mechanical units	45
Alternator to bracket for auxiliary mechanical units	23
Vane pump to bracket for auxiliary mechanical units	23
Belt pulley to vane pump	23
Tensioner for ribbed belt tensioner to bracket for auxiliary mechanical units	23

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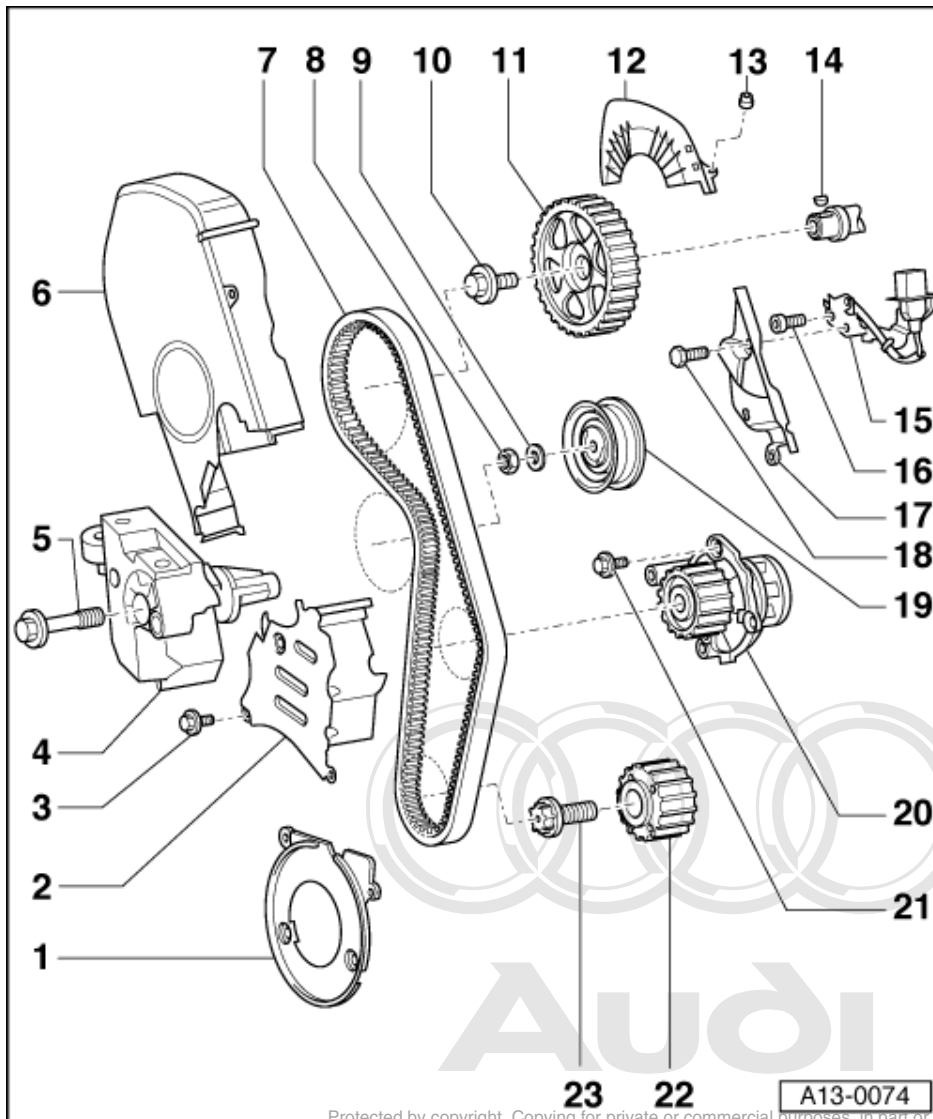
1.6 - Removing and installing toothed belt

**Note:**

Mark the running direction with chalk or felt pen before removing the toothed belt. If the belt runs in the opposite direction when it is refitted, this can cause breakage.

- 1 Toothed belt guard - lower**
 - ♦ Detach to remove crankshaft pulley
- 2 Toothed belt guard - centre**
- 3 10 Nm**
 - ♦ Install using locking compound
 - ♦ Locking compound

=> Parts List



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4 Removing

- ♦ Engine support => Removing and installing toothed belt, Page 67

5 45 Nm

- ♦ Observe the tightening sequence =>Page 73

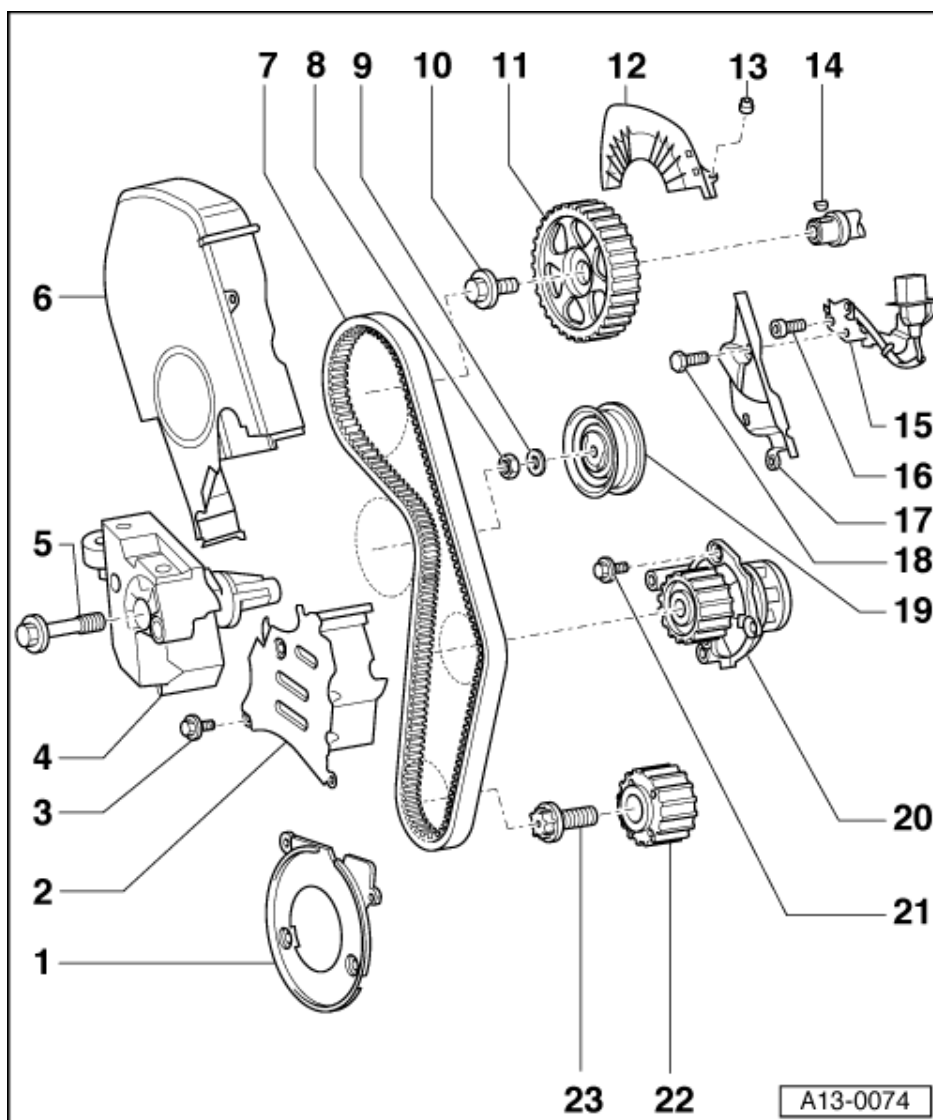
6 Toothed belt guard - upper

- ♦ When installing, engage carefully in centre toothed belt guard.

7 Toothed belts

- ♦ Mark running direction with chalk or felt pen before removing
- ♦ Check for wear
- ♦ Removing => Page 67
- ♦ Install (adjust valve timing) => Page 71 .

8 20 Nm



9 Corrugated washer

10 100 Nm

- ♦ To loosen and tighten, use counterhold 3415 =>Fig. 1

11 Camshaft sprocket

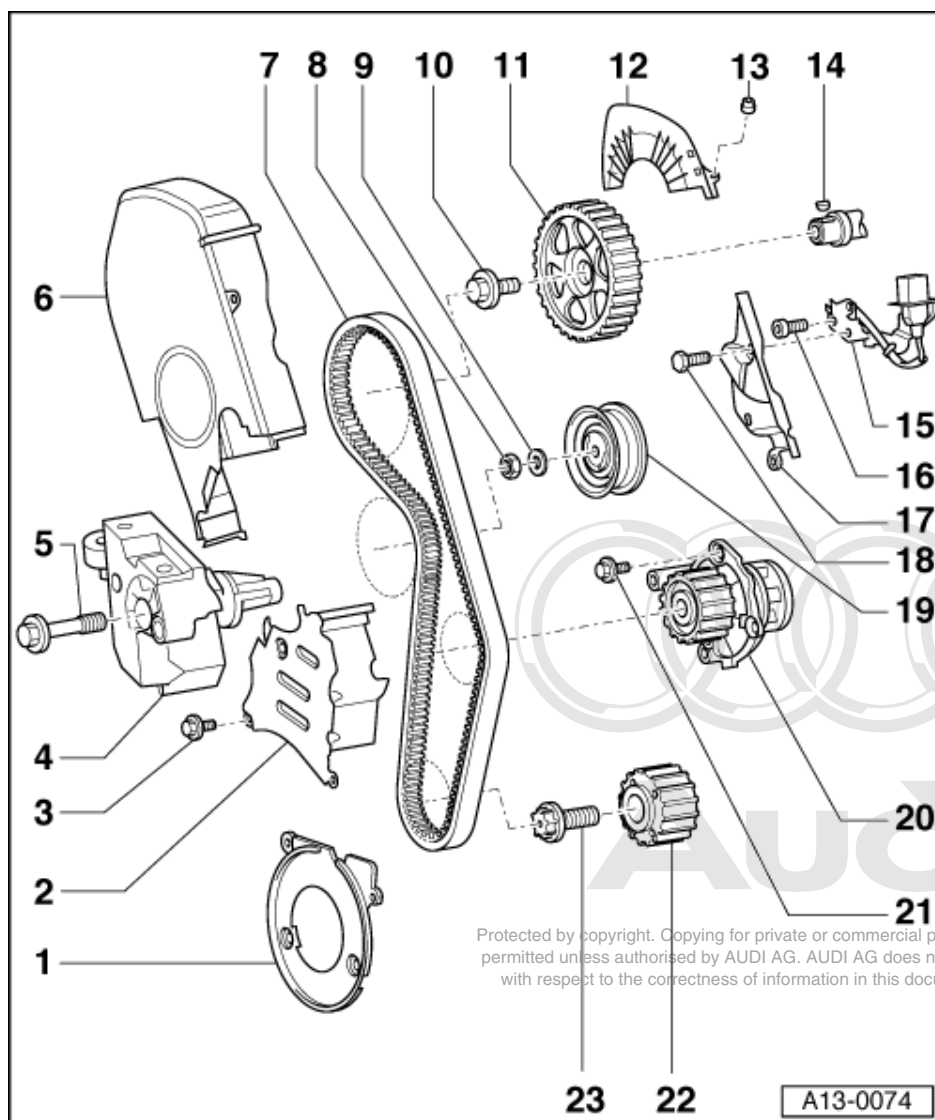
- ♦ With sender wheel for Hall sender -G40
- ♦ For removal and installation remove toothed belt => Page 67
- ♦ Installation position is fixed by Woodruff key -Item 14 -

12 Toothed belt guard - upper

- ♦ When installing, engage carefully in centre toothed belt guard.

13 10 Nm

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14 Woodruff key

- ♦ Ensure tight fit

15 Hall sender -G40

- ♦ Make sure base plate is properly centred when installing

16 10 Nm

17 Toothed belt guard - rear

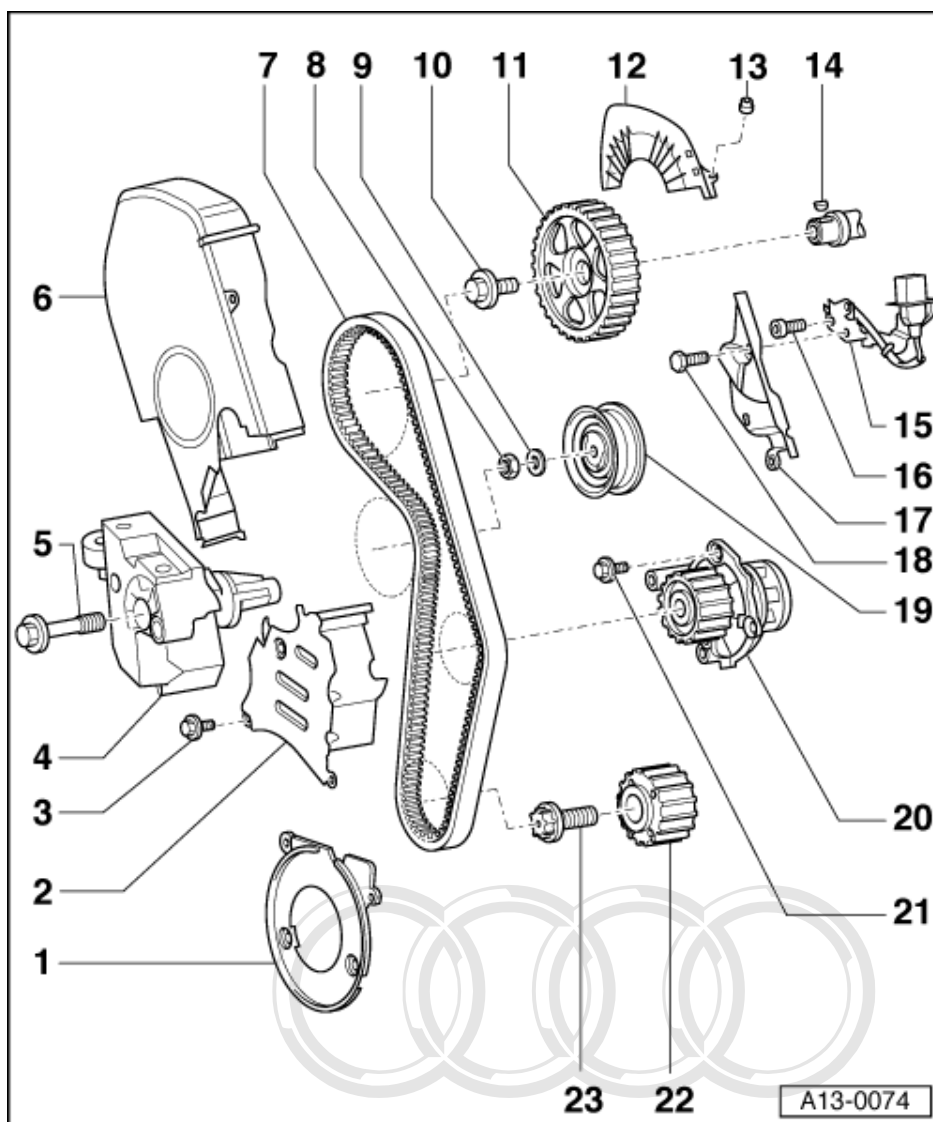
18 20 Nm

19 Tensioning roller (semi-automatic)

- ♦ Checking => Page 79
- ♦ Installation position => Fig. 2 .

20 Coolant pump

- ♦ Removing and installing
=>Page 187 .



21 15 Nm

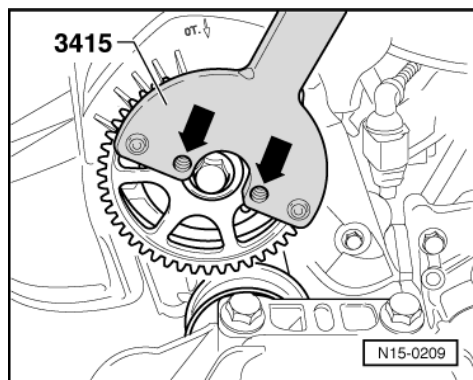
22 Crankshaft sprocket

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

23 90 Nm + 90° (1/4 turn) further

- ♦ Replace
- ♦ Do not use oil
- ♦ Counter hold with 3415 to loosen and tighten
- ♦ Bolt on counterhold 3415 => Fig. 66

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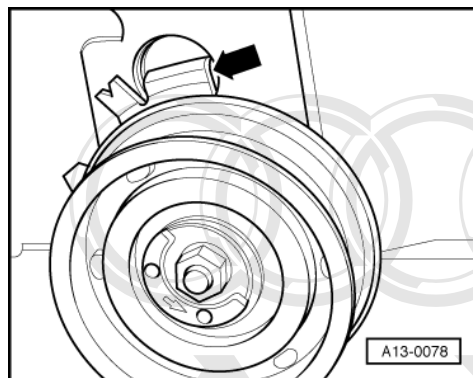


-> Fig.1 Detaching camshaft sprocket

- Use counterhold tool 3415 to loosen and tighten the central bolt.

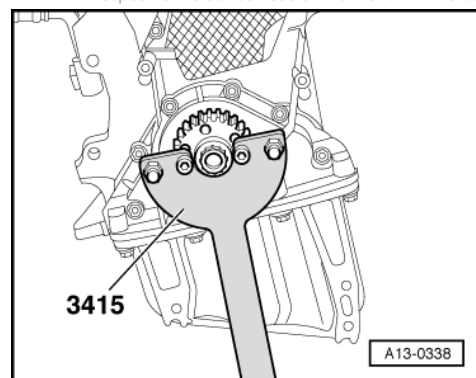
Note:

Remove the bolts from the threaded bores -arrows- before applying counterhold 3415.



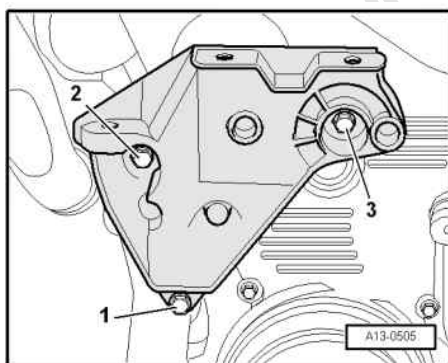
-> Fig.2 Installation position of semi-automatic tensioning roller

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-> Fig.3 Removing and installing crankshaft sprocket

- Use counterhold 3415 to loosen and tighten the central bolt.

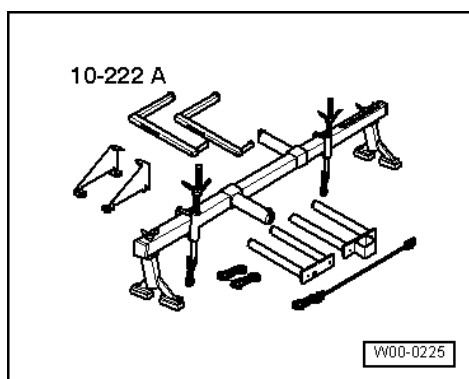


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-> Fig.4 Installing engine support

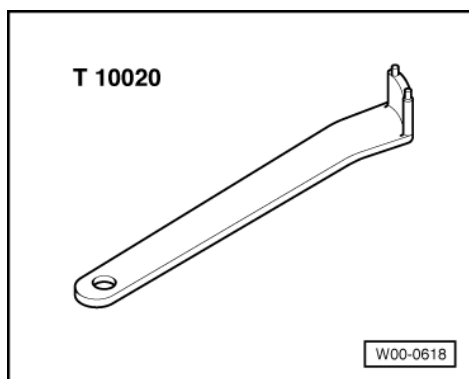
- Remove bolts -1...3-.
- Then tighten the bolts -1...3- to 45 Nm.

1.7 - Removing and installing complete toothed belt

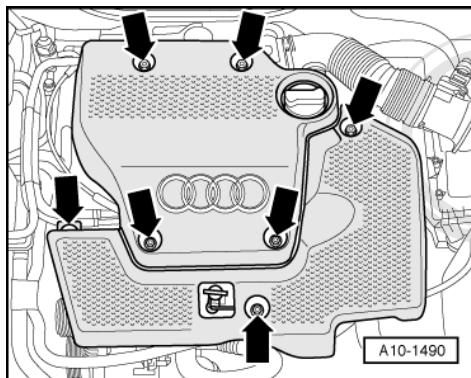


Special tools and workshop equipment required

- ♦ Support bar 10-222A



- ♦ Pin wrench T10020



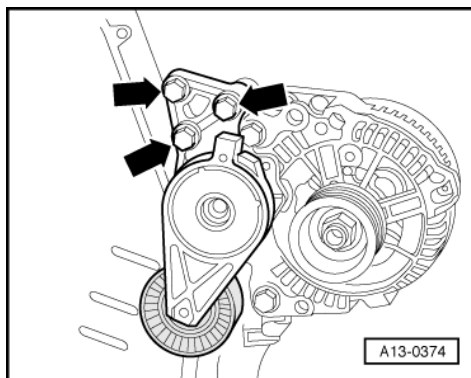
Removing

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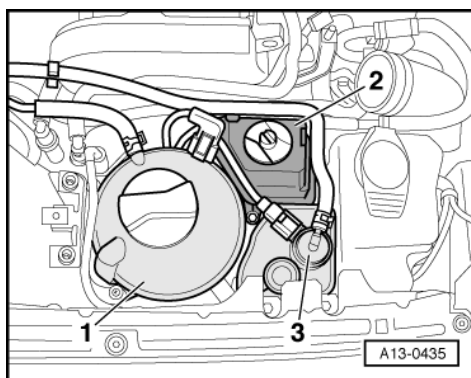
- -> Remove engine covers -arrows-

Note:

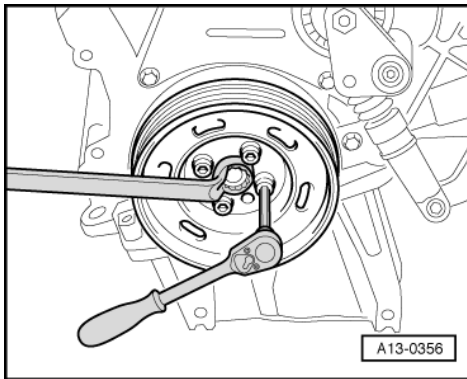
Illustration shows bolted engine cover.



- Remove ribbed belt => Page 55 .
- -> Remove tensioner for ribbed belt cover -arrows-.



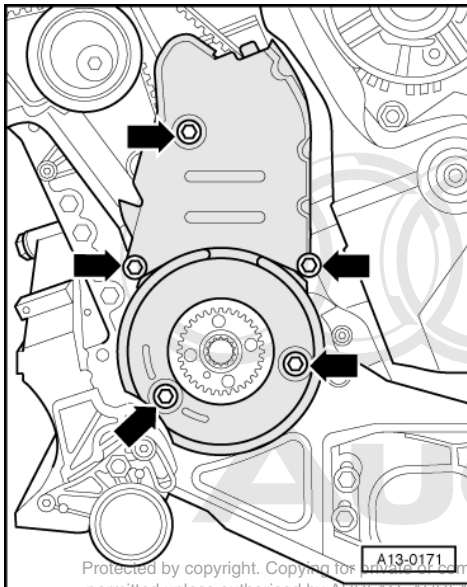
- -> Detach the coolant expansion tank -1-, refill reservoir -2- for power steering and ACF -3-. Do not detach hoses.



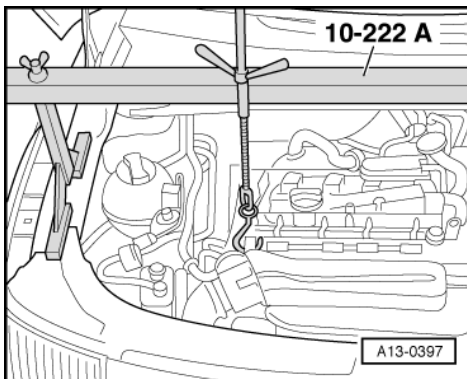
- Position crankshaft to TDC for cylinder 1 with engine installed => Page 76 .
- Position crankshaft to TDC for cylinder 1 with engine removed => Page 78 .
- -> Remove the crankshaft pulley.

Note:

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



- -> Unbolt lower and centre toothed belt guards -arrows-.

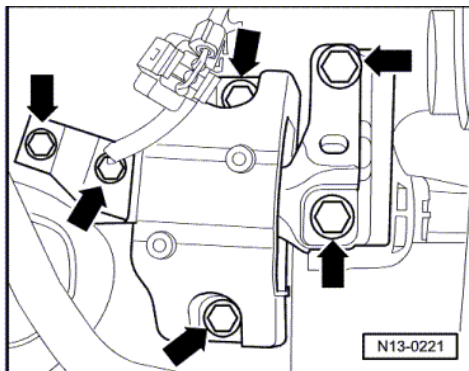




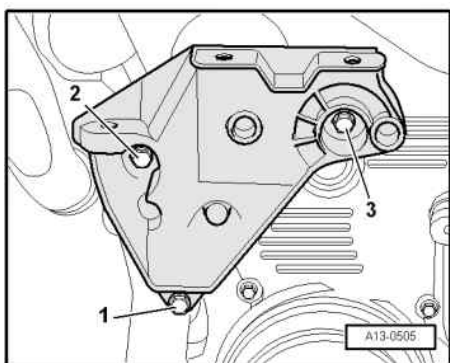
Note:

Push a plastic or wooden support between the wing mounting flange and side panel in order to prevent deformation of the wing.

- -> Set up support bar 10-222 A on wing panel flanges. Spindle is at front.
- Attach the snap hook of the spindle to the right lifting eye.
- Lift engine slightly with spindle of engine support bracket 10 222 A.



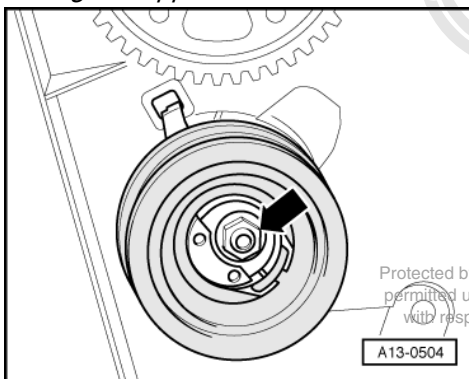
- -> Unbolt brace between engine console and chassis -arrows-.
- Unbolt engine console from engine support and from chassis -arrows-.
- Take out engine console.



- -> Remove bolts for engine support -1...3- and swivel engine support slightly to the rear.

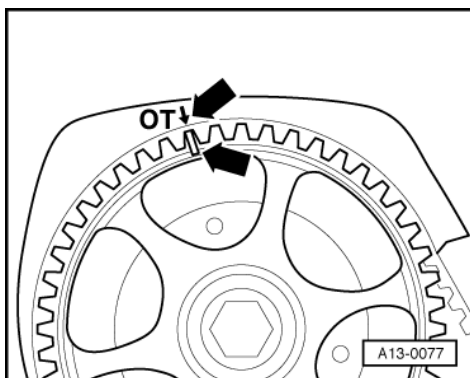
Note:

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



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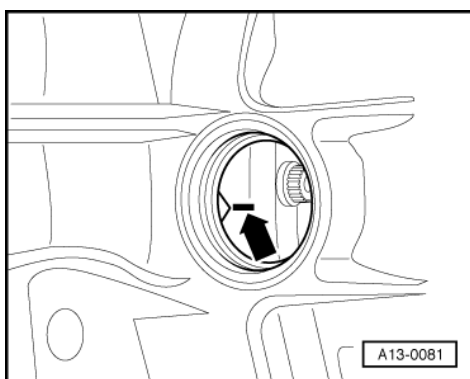
- Mark running direction of belt with chalk or felt pen.
- -> Loosen the tensioning roller nut -arrow- by several turns.
- Remove toothed belt.



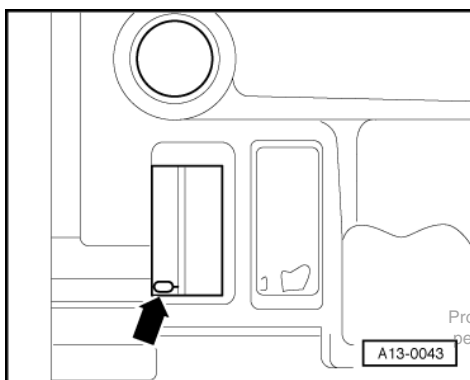
Installing (adjusting valve timing)

Notes:

- ◆ Adjustments to the toothed belt may only be performed when engine is cold.
 - ◆ When turning the camshaft, the crankshaft must not be at TDC for any piston. Danger of damage to valves/ piston crown.
- -> Bring mark on camshaft sprocket in line with the mark on toothed belt guard -arrows-.



- Check again whether the crankshaft is positioned to TDC for cylinder 1:
 - -> Vehicles with manual gearbox



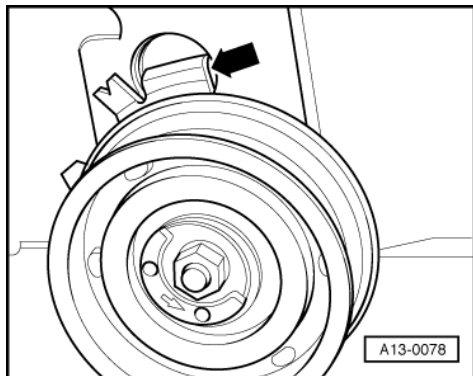
- -> Vehicles with automatic gearbox

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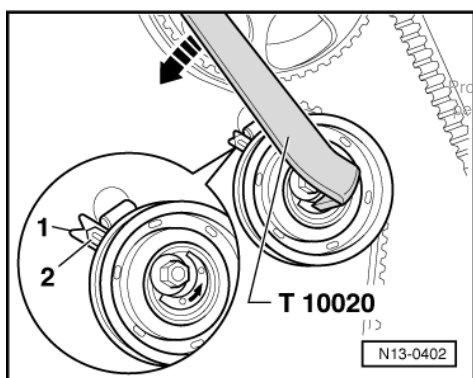
Note:

Position crankshaft to TDC for cylinder 1 with engine removed=> Page **78**.

- Place toothed belt on crankshaft sprocket (observe DOR).
- Fit toothed belt onto coolant pump, then tensioning roller, and finally camshaft sprocket.

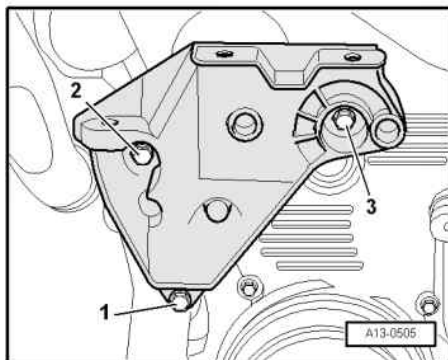


- -> Note installation position of semi-automatic tensioning roller:
- Retaining lug -arrow- must engage in slot on cylinder head.



- Before tensioning the toothed belt, turn the tensioning roller at the eccentric cam using pin wrench T10020 five times to the stop in both directions.
- -> Tension the toothed belt. Turn pin wrench T 10020 to the stop in direction of arrow at the eccentric cam for this purpose.
- Then relieve the toothed belt tension until the notch -1- and the pointer -2- are aligned (use a mirror).
- Tighten securing nut to 20 Nm.
- Crank crankshaft at central bolt of the toothed belt crankshaft in direction of engine rotation twice and check whether the camshaft and crankshaft markings align with their respective reference points.
- Install toothed belt guard.

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The remaining installation steps are performed in the reverse sequence - note the following points:

-> Secure the engine support as follows:

- Remove bolts -1...3-.
- Then tighten the bolts -1...3- to 45 Nm.
- Install engine console.
- Install the crankshaft pulley => Page 54.
- Adjust engine mounting => Page 45.
- Install ribbed belt => Page 56.
- Install coolant compensation tank, refill reservoir for power steering and ACF.

Tightening torques

Component	Nm
Tensioning roller to cylinder head	20
Lower toothed belt guard to cylinder block	10 1)
Centre toothed belt guard to cylinder block	10 1)
Engine support to cylinder block	45
Engine console to chassis	40 + 90°2)3)
Brace to body/engine console	25
Tensioner for ribbed belt tensioner to bracket for auxiliary mechanical units	23

- 1) Install using locking compound;
locking compound

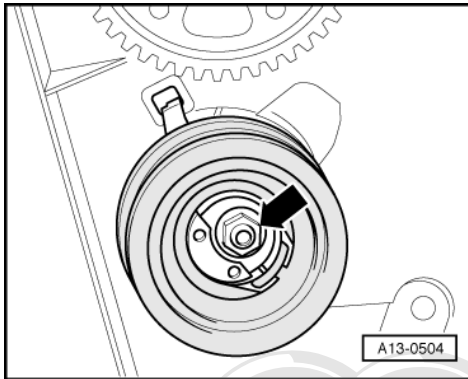
=> Parts List

- 2) Replace bolts
- 3) 90° corresponds to a quarter of a turn

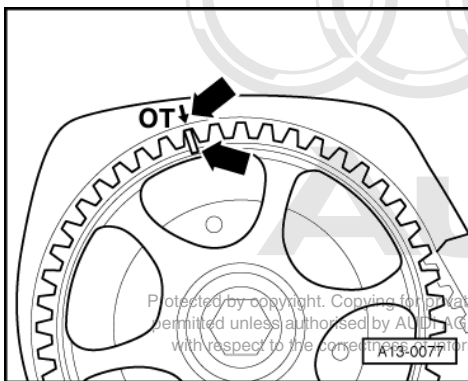
1.8 - Removing toothed belt from camshaft sprocket

- Position crankshaft to TDC for cylinder 1 with engine installed => Page 76.

- Position crankshaft to TDC for cylinder 1 with engine removed => Page **78** .



- -> Loosen the tensioning roller nut -arrow- by several turns.
- Take toothed belt off camshaft sprocket.



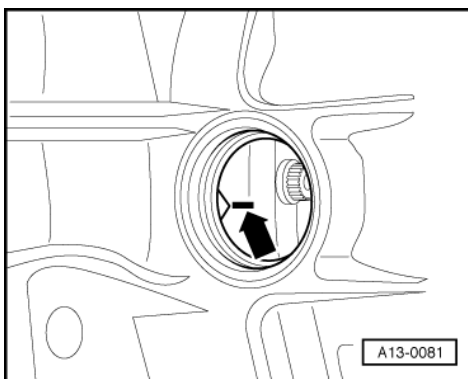
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Installing (adjusting valve timing)

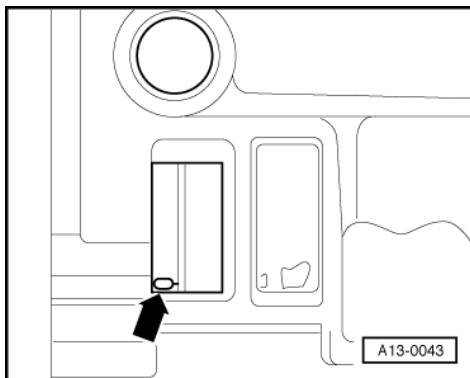
Note:

When turning the camshaft the crankshaft must not be at TDC. Danger of damage to valves/piston crown.

- -> Bring mark on camshaft sprocket in line with the mark on toothed belt guard -arrows-.



- Check again whether the crankshaft is positioned to TDC for cylinder 1:
 - -> Vehicles with manual gearbox

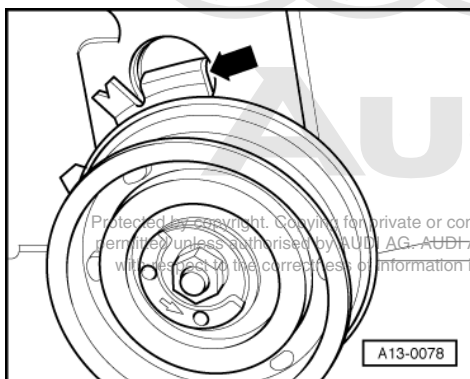


- -> Vehicles with automatic gearbox

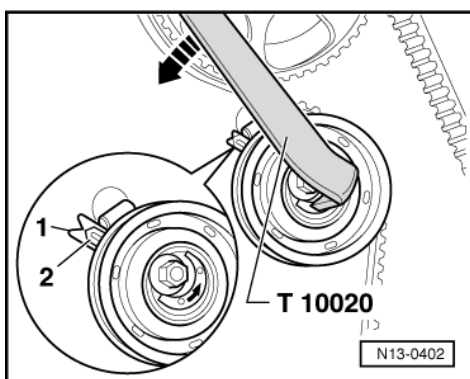
Note:

Position crankshaft to TDC for cylinder 1 with engine removed=> Page 78.

- Attach toothed belt to camshaft sprocket.



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



- Before tensioning the toothed belt, turn the tensioning roller at the eccentric cam using pin wrench T10020 five times to the stop in both directions.
- -> Tension the toothed belt. Turn pin wrench T10020 to the stop in direction of arrow at the eccentric cam for this purpose.
- Then relieve the toothed belt tension until the notch -1- and the pointer -2- are aligned (use a mirror).
- Tighten securing nut to 20 Nm.

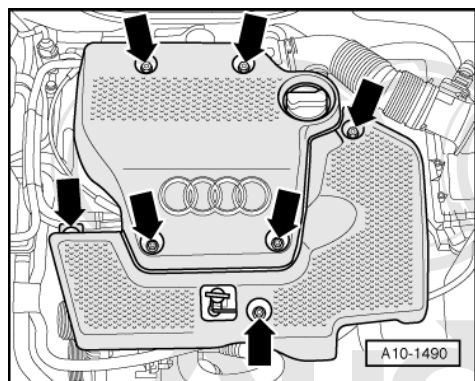
The remaining installation steps are carried out in the reverse sequence:



Tightening torque

Component	Nm
Tensioning roller to cylinder head	20

1.9 - Positioning crankshaft to TDC for cylinder 1 with engine installed

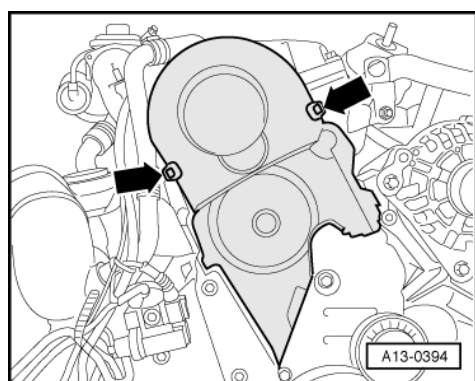


Procedure

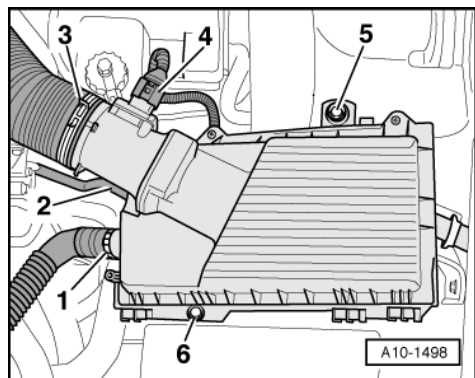
➤ Remove engine covers -arrows-.
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Note.

Illustration shows bolted engine cover.

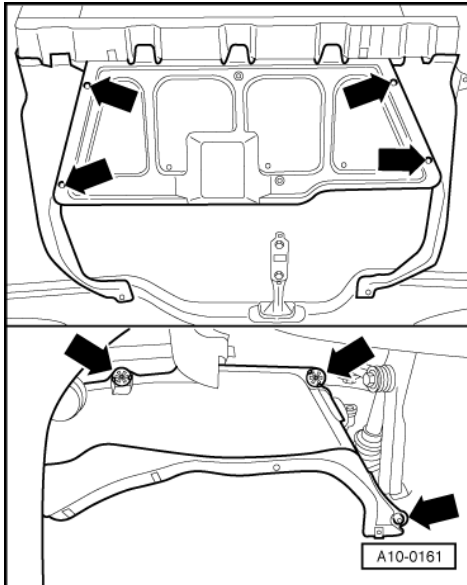


- -> Remove the upper toothed belt guard -arrows-.

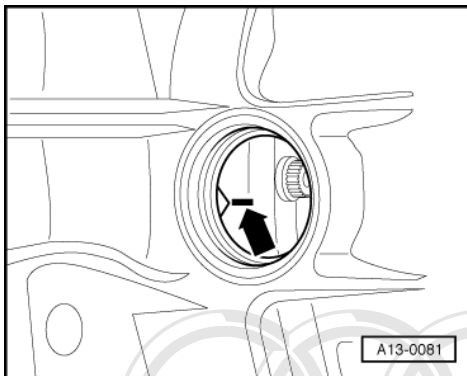


- -> Disconnect the air duct hose -3- from the air mass meter.
- Unplug connector -4- at air mass meter.
- Where fitted, disconnect vacuum hoses -1- and -2- at air cleaner housing.

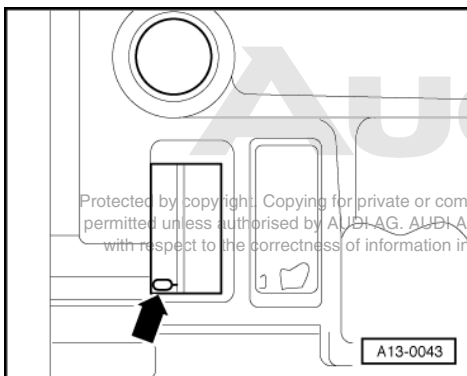
- Unscrew bolts -5- and -6-.
- Remove air cleaner housing.



- -> Remove noise insulation in centre and on right -arrows-.



- Set crankshaft to TDC marking of No. 1 cylinder at central bolt of crankshaft toothed belt sprocket in direction of engine rotation ...
- -> Vehicles with manual gearbox

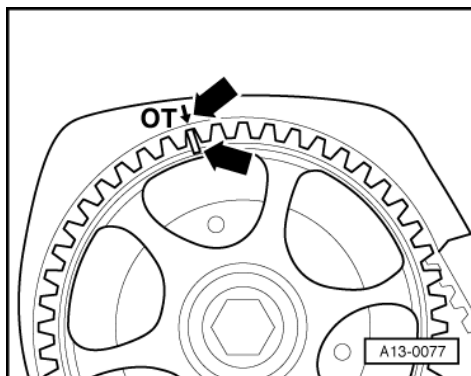


- -> Vehicles with automatic gearbox

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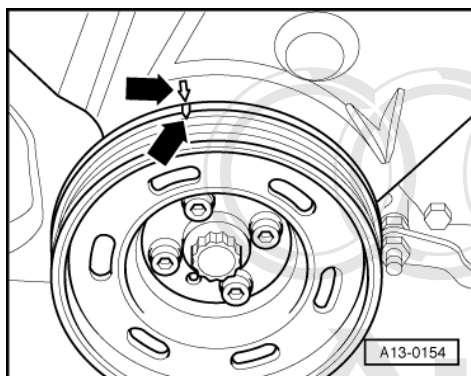
Note:

Position crankshaft to TDC for cylinder 1 with engine removed=> Page 78 .



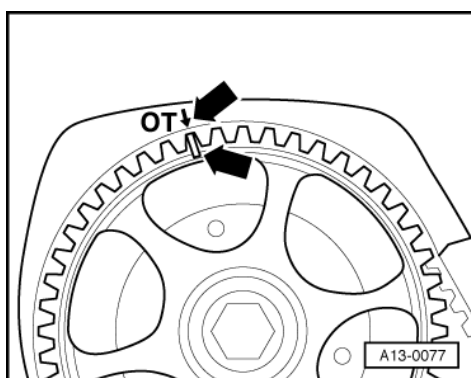
- -> ...at the same time the marking on front of camshaft sprocket must align with the marking at the rear toothed belt guard -arrows-. If necessary, turn crankshaft 1 turn further.

1.10 - Positioning crankshaft to TDC for cylinder 1 with engine removed



- Upper toothed belt guard removed
- -> Set crankshaft to TDC mark for cylinder No. 1 -arrows- by turning central bolt on crankshaft toothed belt sprocket in direction of engine rotation

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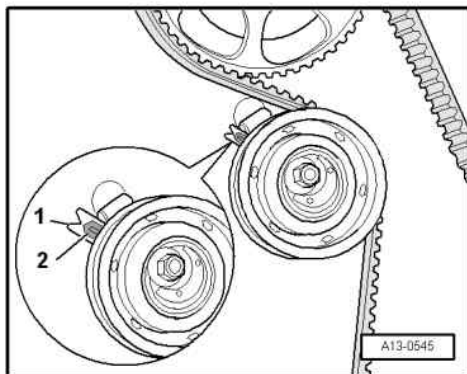


- -> ...at the same time the marking on front of camshaft sprocket must align with the marking at the rear toothed belt guard -arrows-. If necessary, turn crankshaft 1 turn further.

1.11 - Checking semi-automatic toothed belt tensioning roller

Test requirements:

- Remove upper toothed belt guard.
- Toothed belt in position and tensioned.



Test sequence

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

Note:

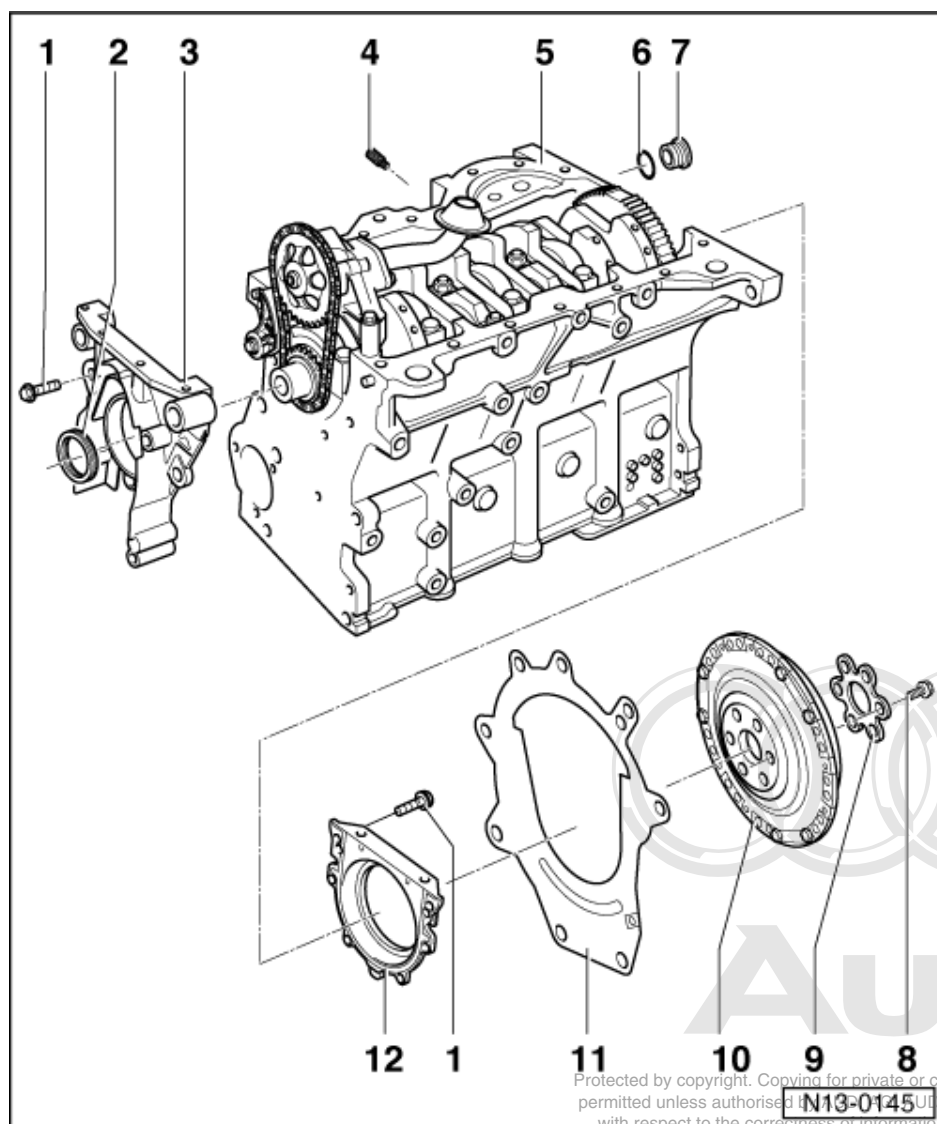
Use a mirror to check.



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2 - Removing and installing sealing flanges and flywheel/drive plate

2.1 - Removing and installing sealing flanges and flywheel/drive plate



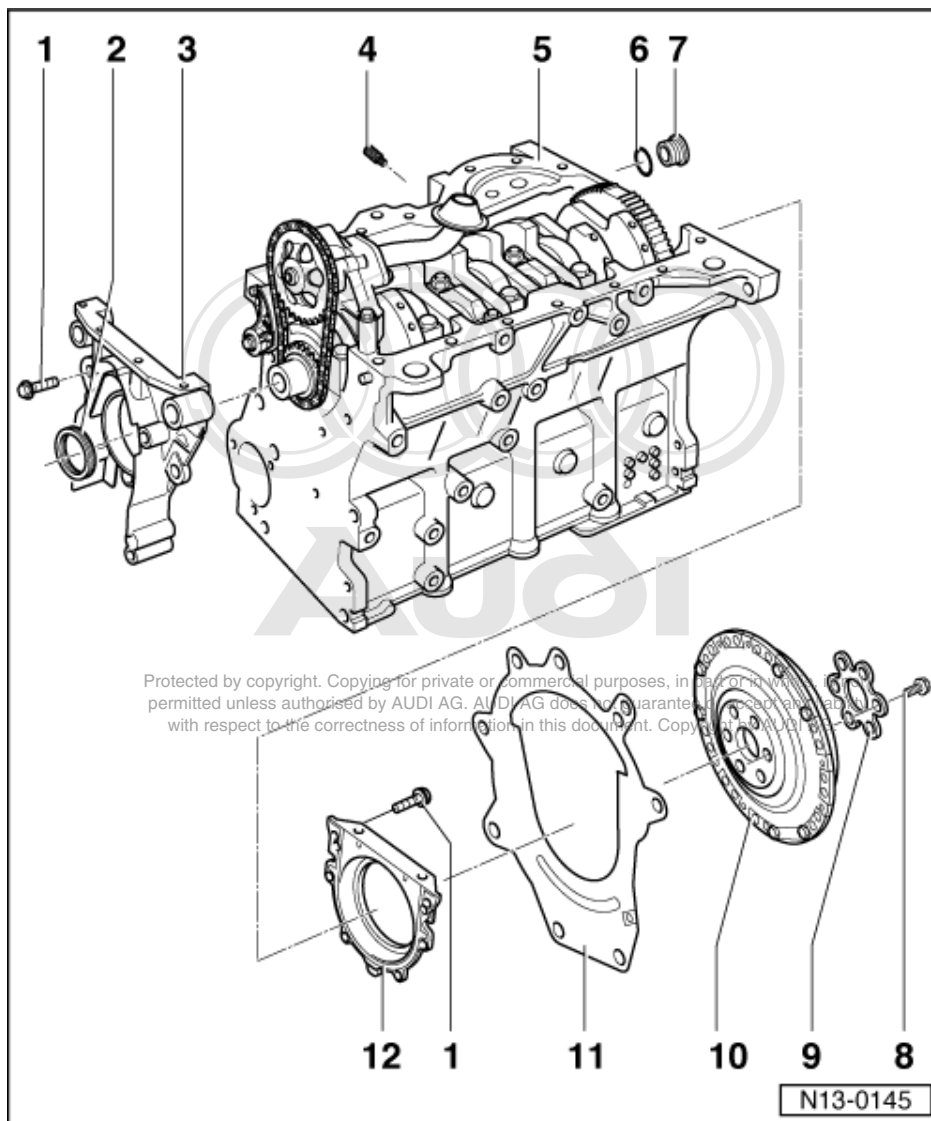
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Note:

For repairs to the clutch:

=> 5-speed Manual Gearbox 02K; Repair group 30; Servicing clutch Servicing clutch

- 1 15 Nm
- 2 Sealing ring
 - ♦ Replacing => Page 83 .
 - ♦ Do not use oil
- 3 Sealing flange - front
 - ♦ Must be located on dowel sleeves
 - ♦ Removing and installing
=>Page 86 .
- 4 Not installed



5 Cylinder block

- ♦ Removing and installing crankshaft=> Page 95
- ♦ Dismantling and assembling pistons and conrods => Page 102

6 Sealing ring

- ♦ Replace

7 Screw plug - 100 Nm

8 90 Nm + 90° (1/4 turn) further

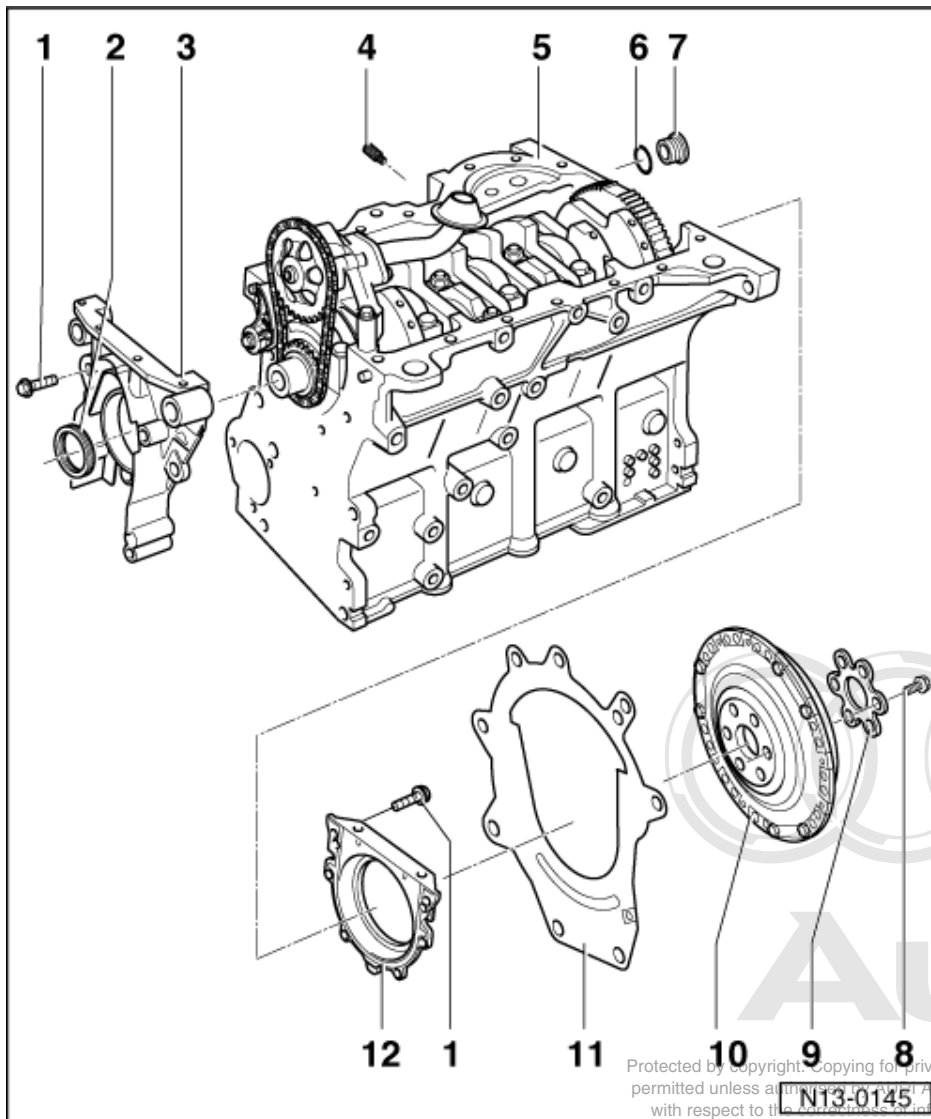
- ♦ Replace

9 Washer

- ♦ Note installation position

10 Pressure plate/drive plate

- ♦ Removing and installing pressure plate => Page 92
- ♦ Removing and installing drive plate => Page 93
- ♦ Can only be installed in one position. Holes are off set

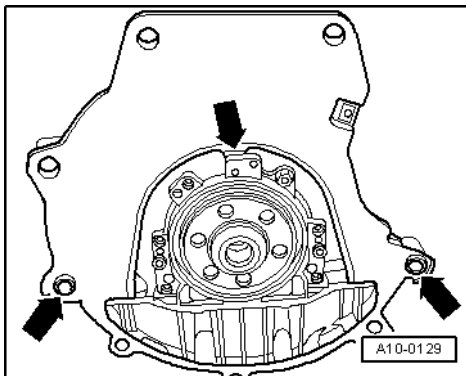


11 Intermediate plate

- ◆ Must be located on dowel sleeves
- ◆ Do not damage/bend when assembling.
- ◆ attached to sealing flange => Fig. 83

12 Rear sealing flange

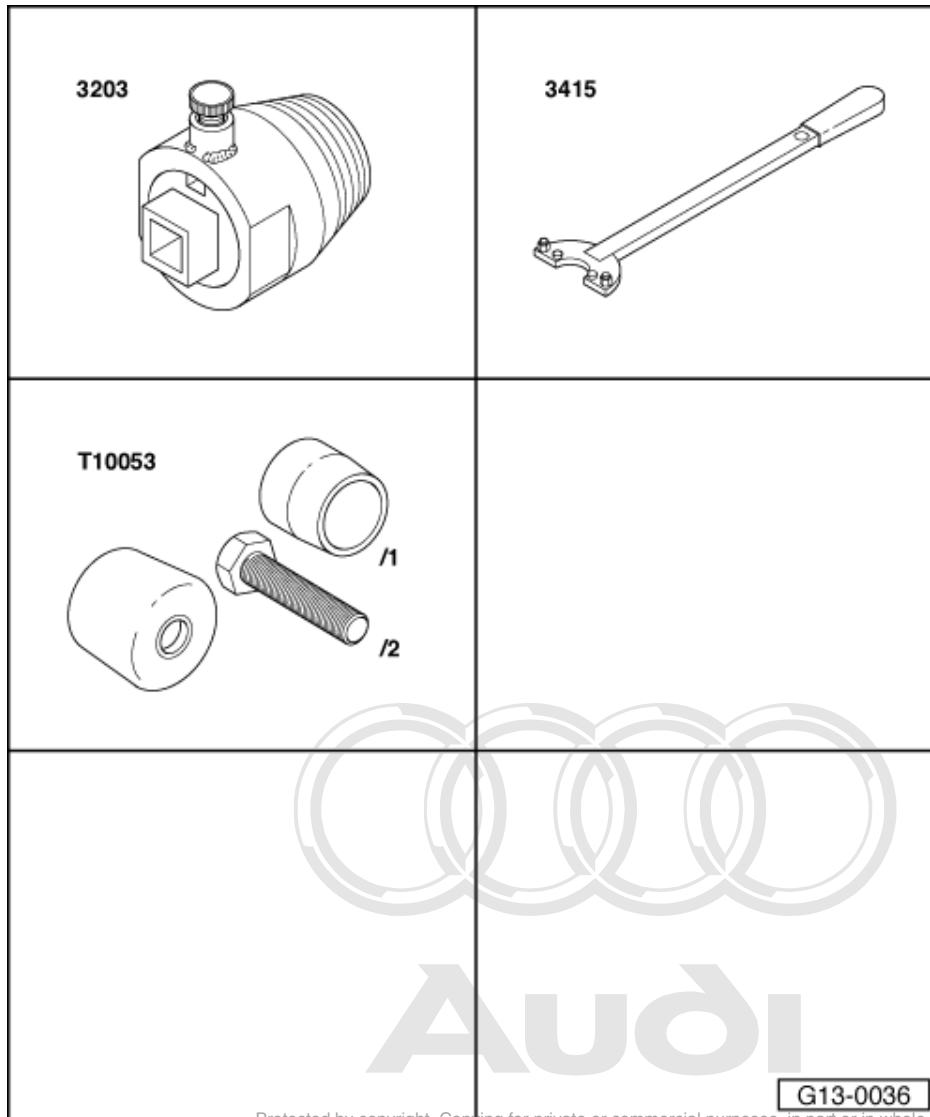
- ◆ With sealing ring
- ◆ Removing and installing
=>Page 89.



-> Fig.1 Installing intermediate plate

- Attach intermediate plate on sealing flange and press onto dowel sleeves -arrows-.

2.2 - Replacing crankshaft oil seal on pulley end

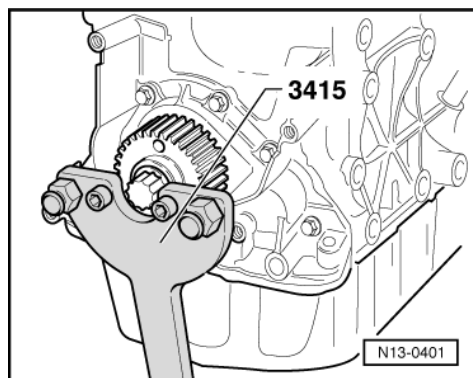


G13-0036

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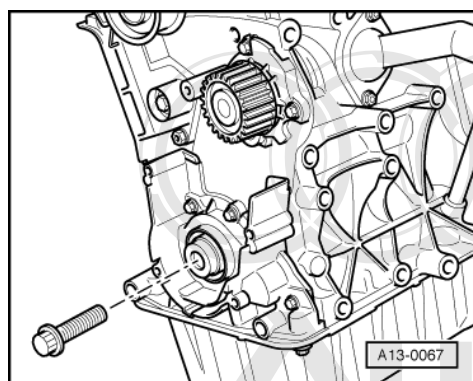
Special tools and workshop equipment required

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



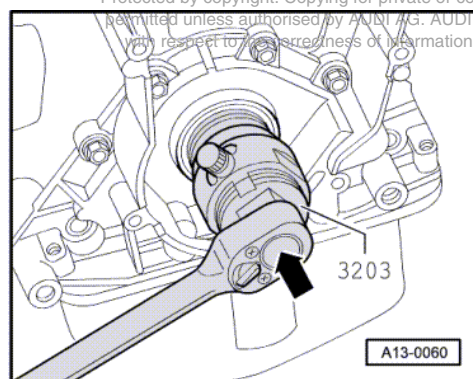
Removing

- Engine in vehicle
- Remove toothed belt => Page 67 .
- -> Remove crankshaft toothed belt sprocket. Counter hold sprocket with 3415.

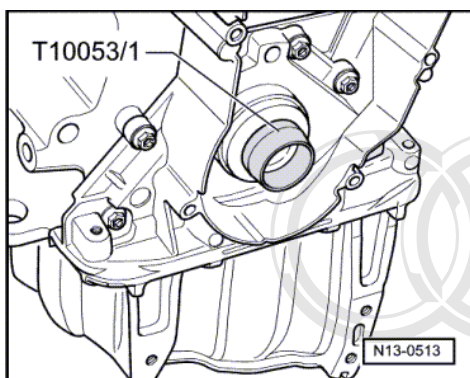


- -> Before applying oil seal extractor, screw central bolt for toothed belt sprocket into crankshaft up to limit stop.

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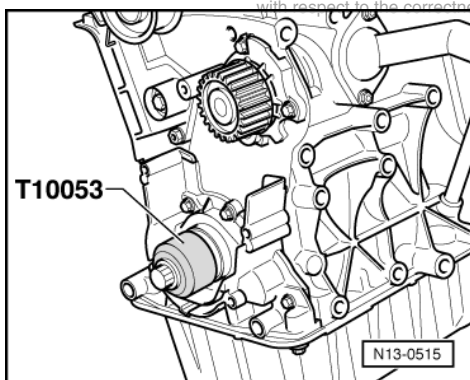


- Unscrew inner section of oil seal extractor 3203 nine turns out of outer section and lock with knurled screw.
- -> Lubricate threaded head of oil seal extractor, place it in position and exerting firm pressure, screw it into oil seal as far as possible.
- Loosen knurled screw and turn inner part against crankshaft until the oil seal is pulled out.
- Clamp flats of oil seal extractor in vice. Remove oil seal with pliers.
- Clean contact surface and sealing surface.

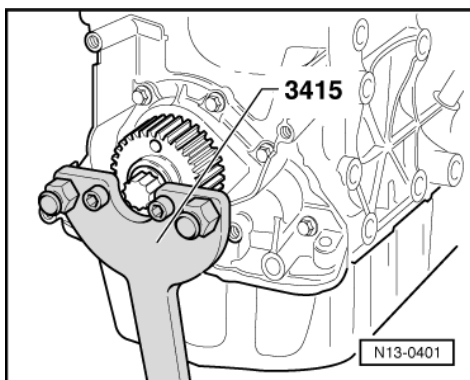


Installing

- Do not lubricate sealing lip or outer circumference of seal before pressing in.
 - -> Place guide sleeve T10053/1 onto crankshaft journal.
 - Push oil seal over guide sleeve.
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- -> Press in oil seal until flush using press sleeve T10053 and bolt T10053/2.



- Replace bolt for crankshaft sprocket.
- -> Install toothed belt crankshaft sprocket. Counter hold toothed belt sprocket with counterhold 3415.

Notes:

- ◆ Contact surface between sprocket and crankshaft must be free of oil.
- ◆ Do not oil bolt for crankshaft sprocket.
- Install toothed belt (adjust valve timing) => Page 71 .
- Install ribbed belt=> Page 56 .



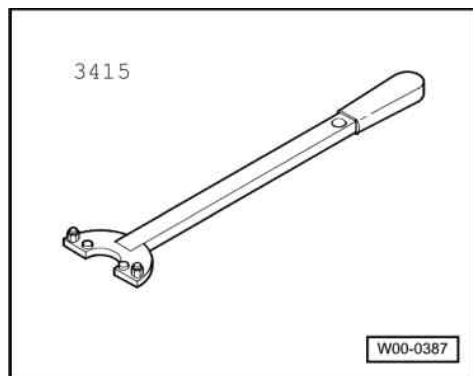
Tightening torque

Component	Nm
Toothed belt sprocket to crankshaft	90 + 90°1)2)

- 1) Replace bolt
- 2) 90° corresponds to a quarter of a turn

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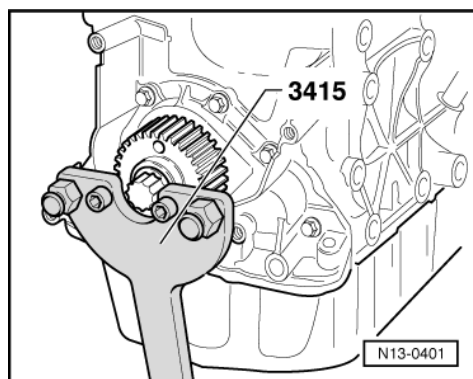
2.3 Removing and installing front sealing flange



Special tools, workshop equipment, and other items required

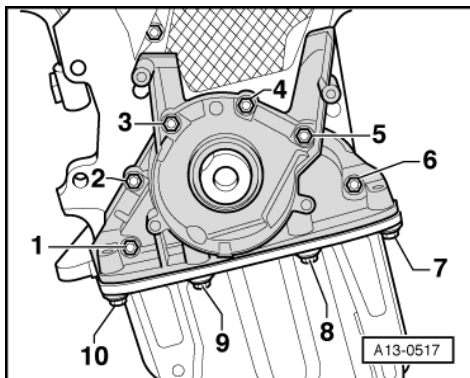
- ♦ Counterhold 3415
- ♦ Electric drill with plastic brush attachment
- ♦ Protective goggles
- ♦ Silicone sealant

=> Parts List

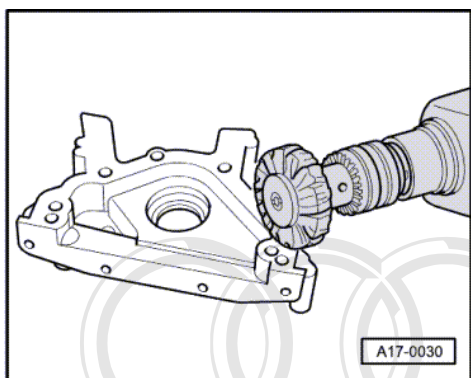


Removing

- Engine in vehicle
- Remove toothed belt => Page 67.
- -> Remove crankshaft toothed belt sprocket. Counter hold sprocket with 3415.



- -> Unscrew bolts -1...10-
- Lever off sealing flange and remove.
- Drive out oil seal with flange removed.



Installing

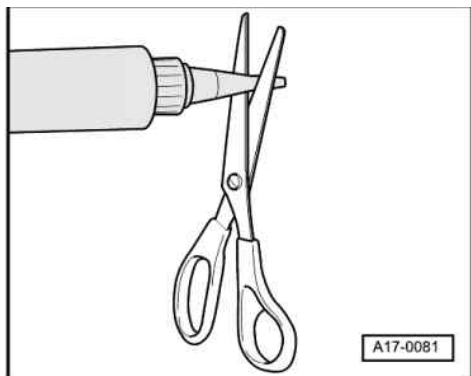
Note:

Place a cloth over the open part of the oil pan.

- Carefully remove any residual sealant from cylinder block and oil pan.
- **-> Remove sealant residues from sealing flange, e.g. with rotating plastic brush or similar.**

Important
 Wear protective goggles.

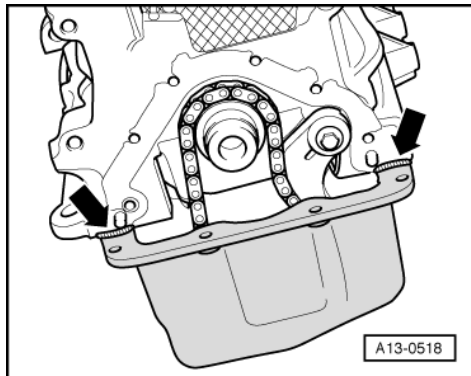
- Clean sealing surfaces: they must be free of oil and grease.



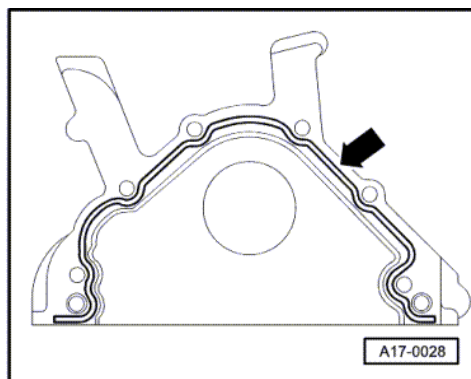
Note:

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

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



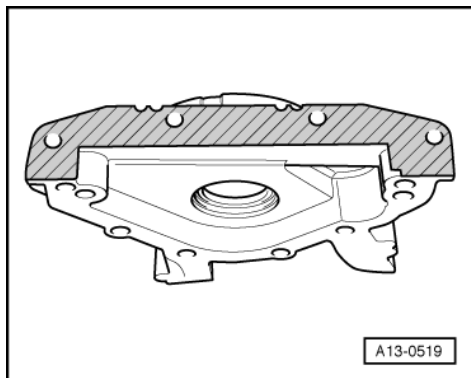
- -> Apply a thin bead of silicone sealant at the edge between the cylinder block and the oil pan -arrows-.



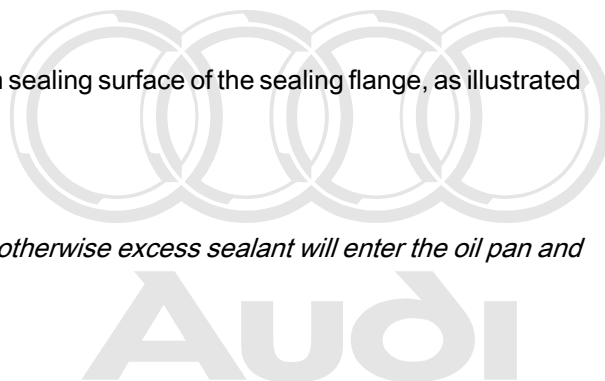
- -> Apply the bead of silicone sealant -arrow- onto the clean sealing surface of the sealing flange, as illustrated (arrow).
- Thickness of sealant bead: 2...3 mm

Note:

The bead of sealant must not be thicker than prescribed, as otherwise excess sealant will enter the oil pan and obstruct the strainer in the oil intake manifold.



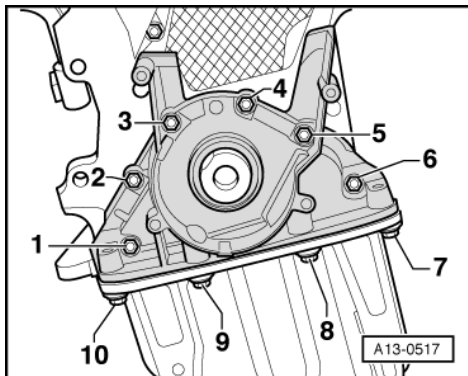
- -> Coat the lower sealing surface at the sealing flange lightly with silicone sealant -hatched area-.
- Carefully push the sealing flange onto the dowel pins at the engine block.



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Note:

To fit sealing flange with the oil seal already installed, use guide sleeve T10053/1.



- Tighten bolts in the specified sequence:
 - -> Tighten bolts -1...6-.
 - Tighten bolts -7...10-.
- Install crankshaft oil seal => Page 85 .
- Install toothed belt (adjust valve timing) => Page 71 .

Tightening torque

Component	Nm
Sealing flange to cylinder block	15

2.4 - Removing and installing rear sealing flange

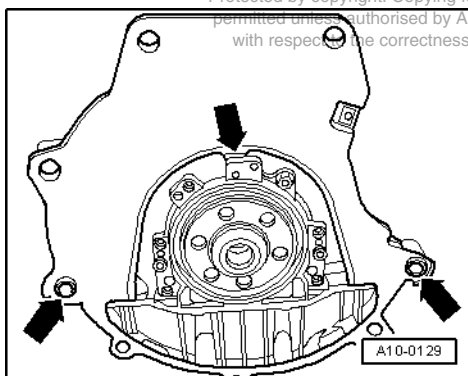
Auxiliary equipment required

- ◆ Electric drill with plastic brush attachment
- ◆ Protective goggles
- ◆ Silicone sealant

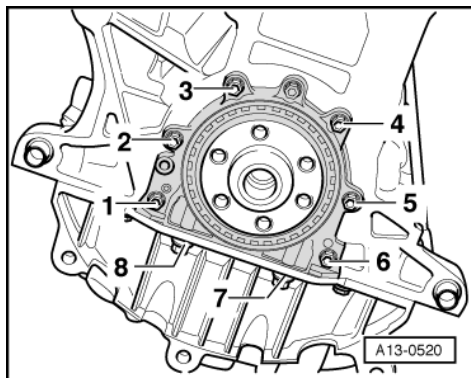
=> Parts List

Removing

- Gearbox removed
- Remove pressure plate/drive plate => Pages 93 .



- -> Detach intermediate plate at sealing flange and dowel sleeves -arrows-.



- -> Unscrew bolts -1...8-.
- Lever off rear sealing flange and remove.

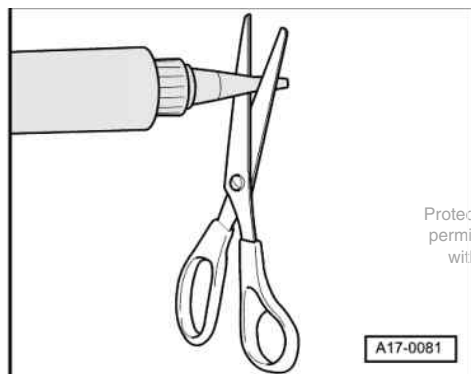
Installing

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

Note:

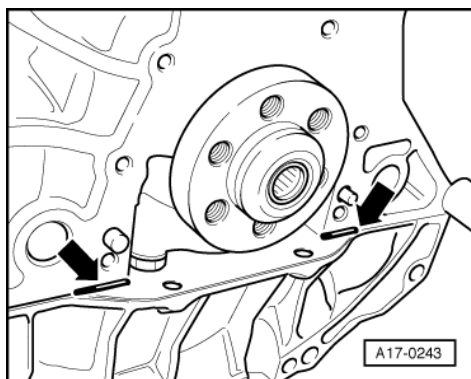
Place a cloth over the open part of the oil pan.

- Carefully remove residual sealant at the oil pan and bottom of sealing flange.
- Clean sealing surfaces: they must be free of oil and grease.

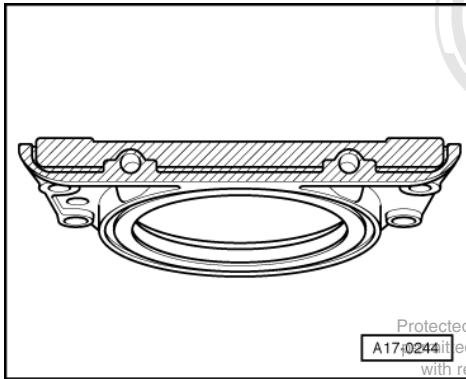


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- -> Cut off nozzle of tube at front marking ($\varnothing$ of nozzle approx. 3 mm).



- -> Apply a thin bead of silicone sealant at the edge between the cylinder block and the oil pan -arrows-.



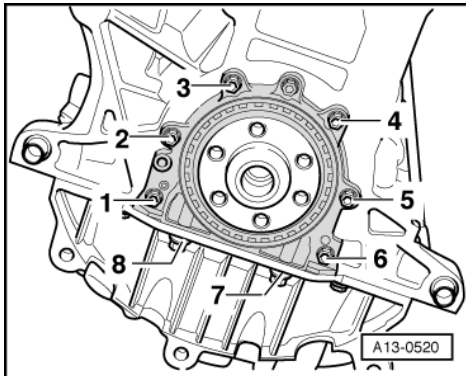
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- -> Coat the lower sealing surface at the sealing flange lightly with silicone sealant -hatched area-.

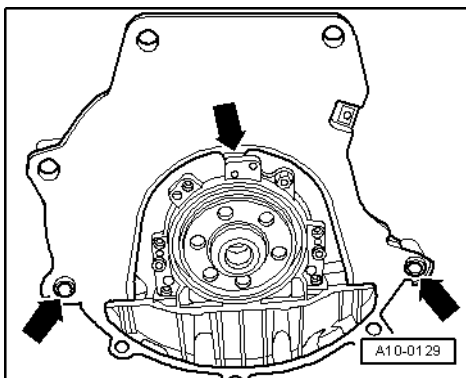
Note:

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

- When installing, push guide sleeve from installation kit onto crankshaft.
- Carefully push the sealing flange onto the dowel pins at the engine block.



- Tighten bolts in the specified sequence:
 - -> Tighten bolts -1...6-.
 - Tighten bolts -7- and -8-.



- -> Engage intermediate plate on sealing flange and push onto dowel sleeves -arrows-.
- Install pressure plate/drive plate => Pages 93.

Tightening torque

Component	Nm
Sealing flange to cylinder block	15

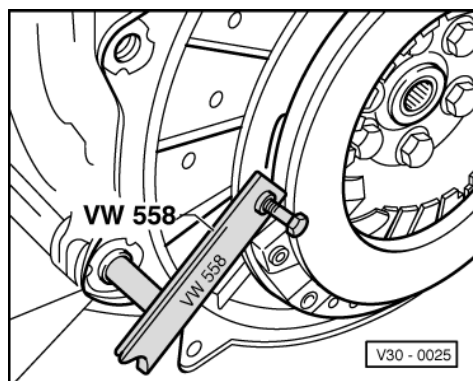


2.5 - Removing and installing pressure plate



Special tools and workshop equipment required

- ♦ Counterhold VW 558



Removing

- Flywheel removed.
- -> Insert counterhold VW 558 into hole in cylinder block and bolt onto pressure plate.
- Mark pressure plate with respect to engine.
- Remove the pressure plate.

Installing

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

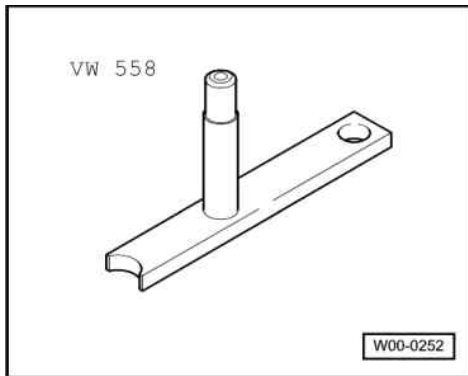
- Only use new bolts to secure.

Tightening torque

Component	Nm
Pressure plate to crankshaft	60 + 90°1)

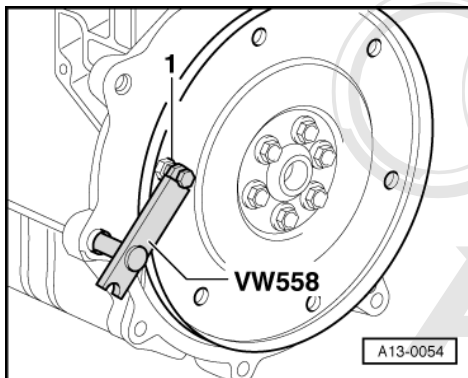
- 1) 90° corresponds to a quarter of a turn

2.6 - Removing and installing drive plate



Special tools and workshop equipment required

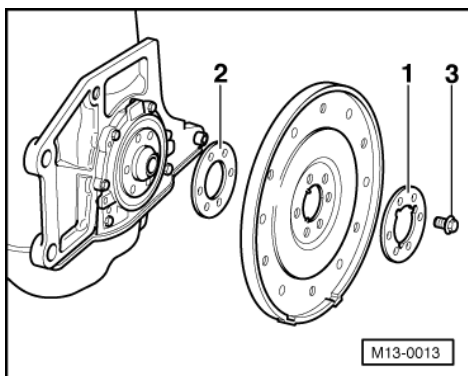
- ◆ Counterhold VW 558
- ◆ Hexagon bolt M8 x 45 and two M10 hexagon nuts
- ◆ Caliper gauge or depth gauge



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Removing

- -> Secure counterhold VW 558 to the drive plate with a hexagon bolt M8x45. Place two M10 hexagon nuts -1- between counterhold and drive plate.
- Mark position of drive plate relative to engine.
- Unbolt drive plate.

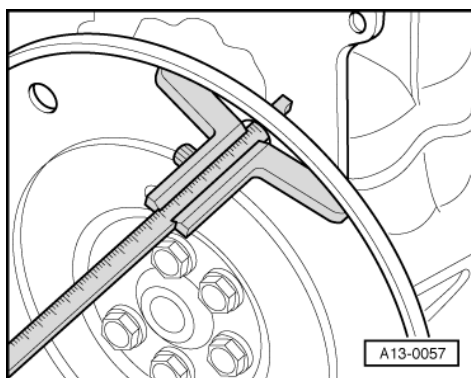


Installing

- -> Place drive plate with shim -2- and washer -1- in position.



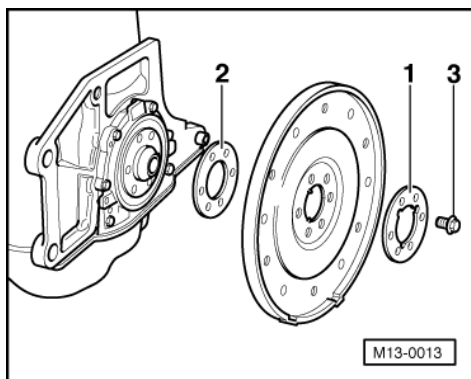
- Insert at least 3 of the old securing bolts -3- and tighten to 30 Nm.



- -> Check fitting location of drive plate by measuring at three points and calculate average.
- Specification: 19.5...21.1 mm

Note:

Measurement is taken through the hole in the drive plate to the machined surface of the cylinder block.



If specification is exceeded:

- -> Remove drive plate again and fit without shim -2-. Retighten bolts to 30 Nm.
- Measure distance again.

If specification is attained:

- Fit new bolts and tighten.

Tightening torque

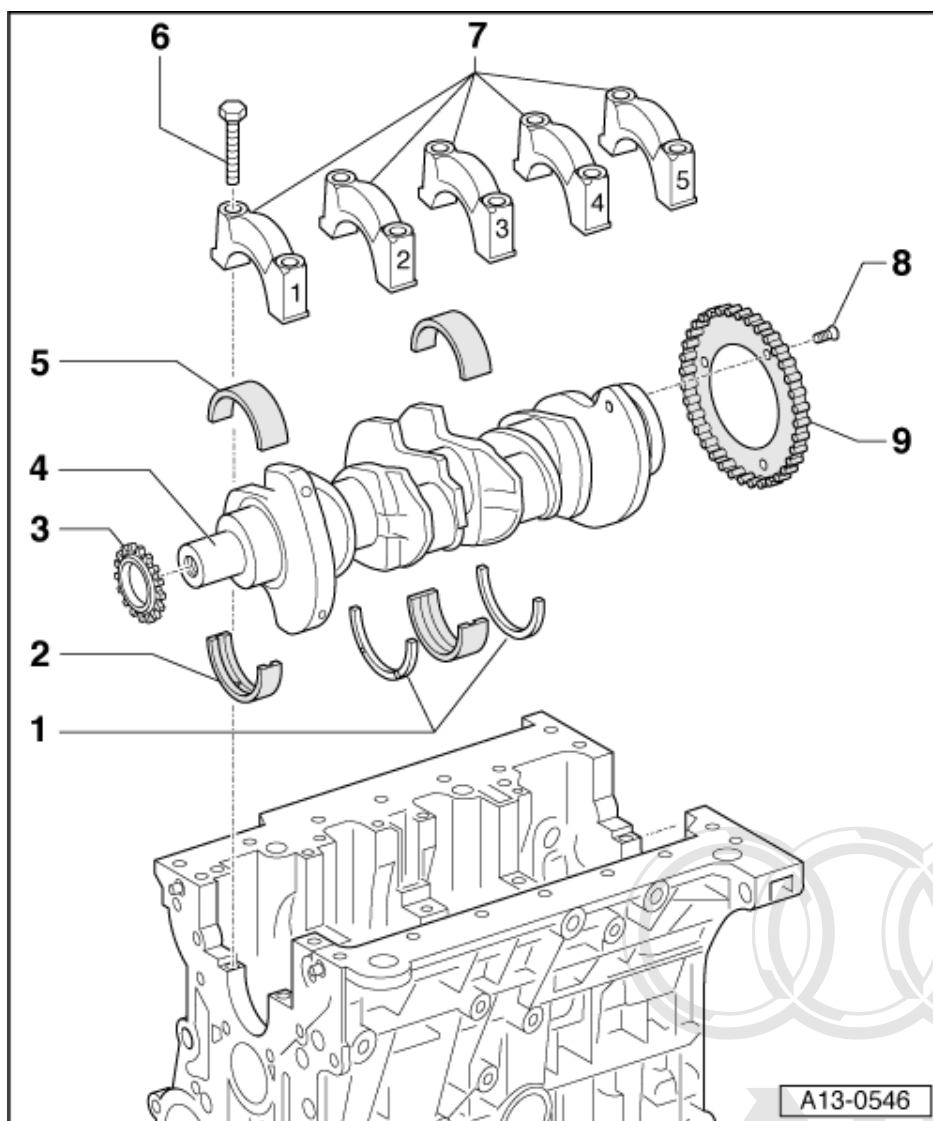
Component	Nm
Drive plate to crankshaft	60 + 90°1)

- 1) 90° corresponds to a quarter of a turn

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3 - Removing and installing crankshaft

3.1 - Removing and installing crankshaft

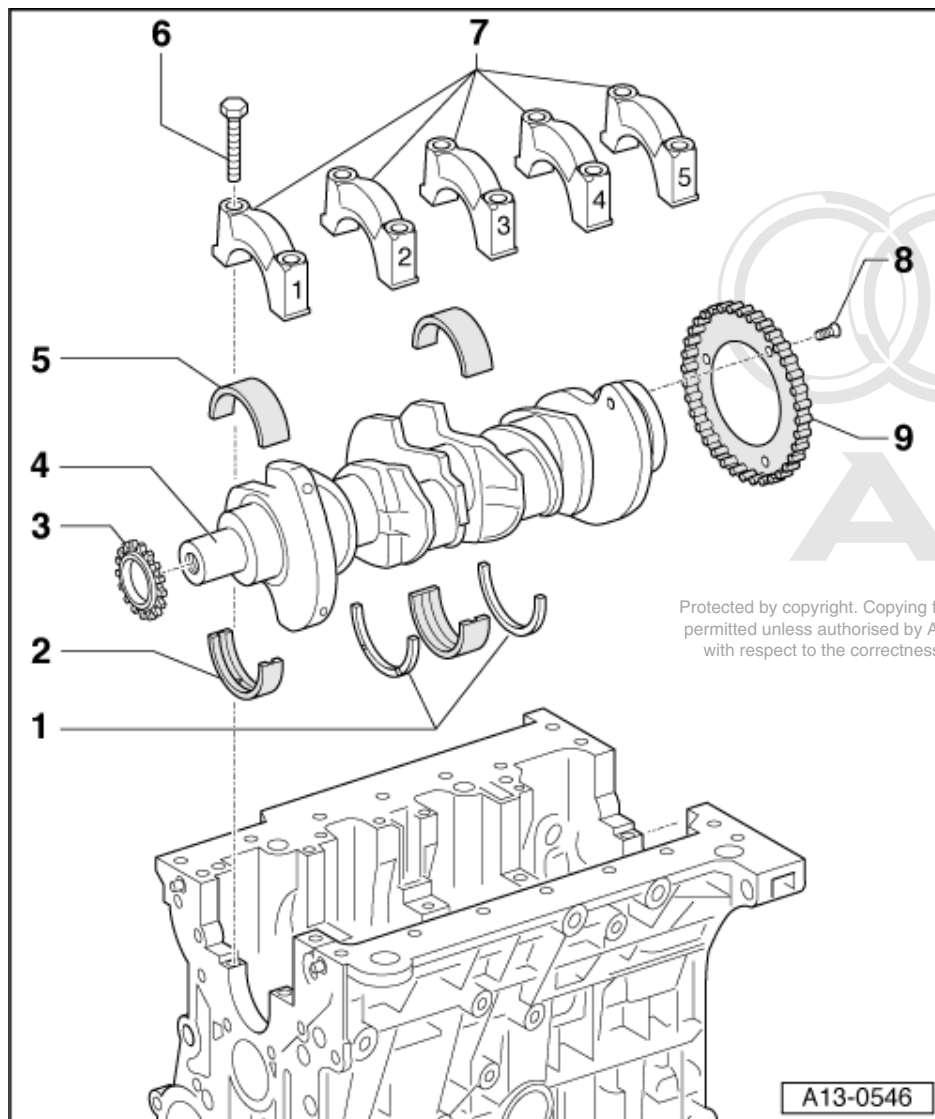


Notes:

- ◆ Bearing shells of the correct thickness are allocated to the cylinder block at the factory. Coloured dots are used to mark the thickness of the bearing shells.
- ◆ When working on the engine, it should be secured to the engine stand using the engine bracket VW 540 => Page 38.

1 Thrust washers

- ◆ For bearing No. 3
- ◆ Installation position: Bolted connection facing to the rear



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2 Bearing shell

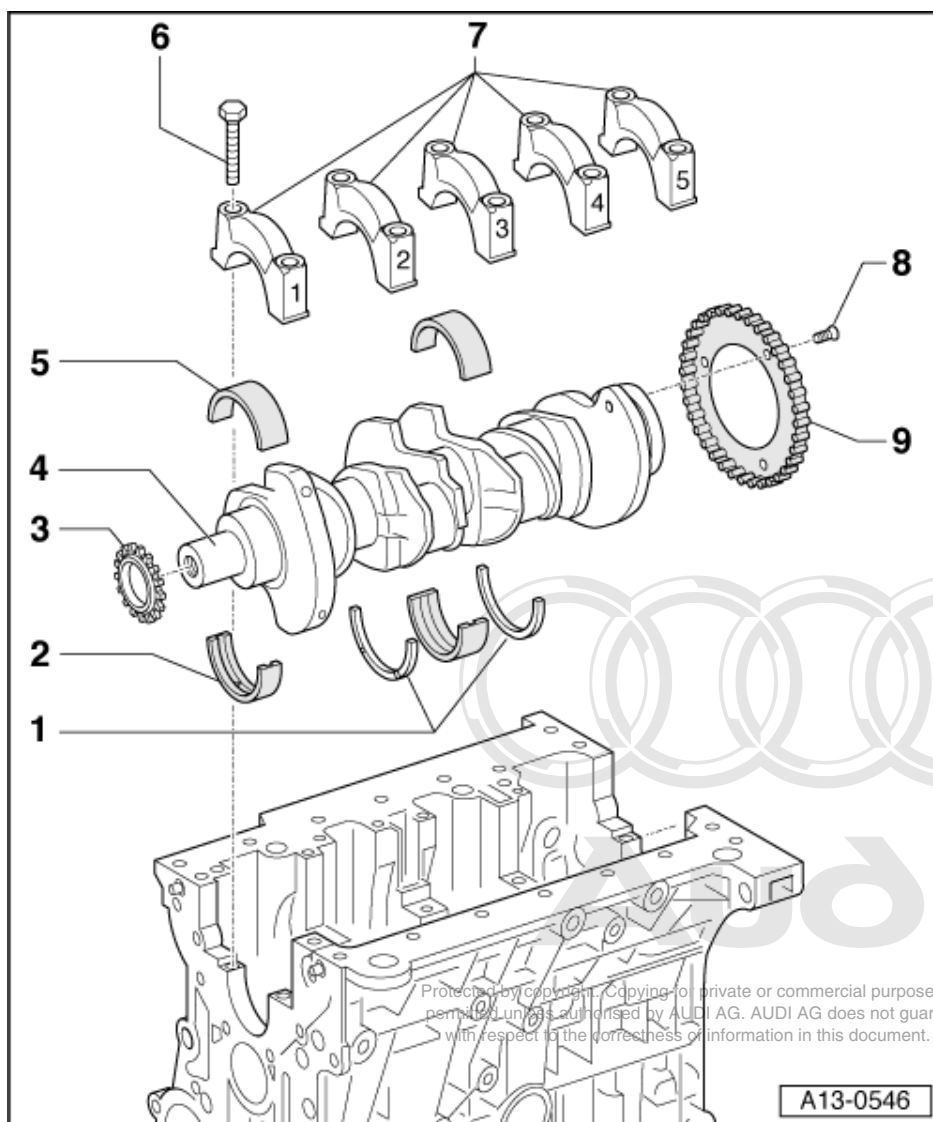
- ◆ For cylinder block with oil groove
- ◆ Do not interchange used bearing shells (mark).
- ◆ Install new bearing shells for the cylinder block with the correct coloured markings => Fig. 100
- ◆ Note fixing arrangement

3 Chain sprocket

- ◆ For oil pump drive chain
- ◆ Replacing => Page 101 .

4 Crankshaft

- ◆ Axial play new: 0.07...0.23 mm
Wear limit: 0.30 mm
- ◆ Check radial play with Plastigage
New: 0.01...0.04 mm
Wear limit: 0.15 mm
- ◆ Do not rotate the crankshaft when checking the radial play.
- ◆ Crankshaft dimensions
=>Page 101 .

**5 Bearing shell**

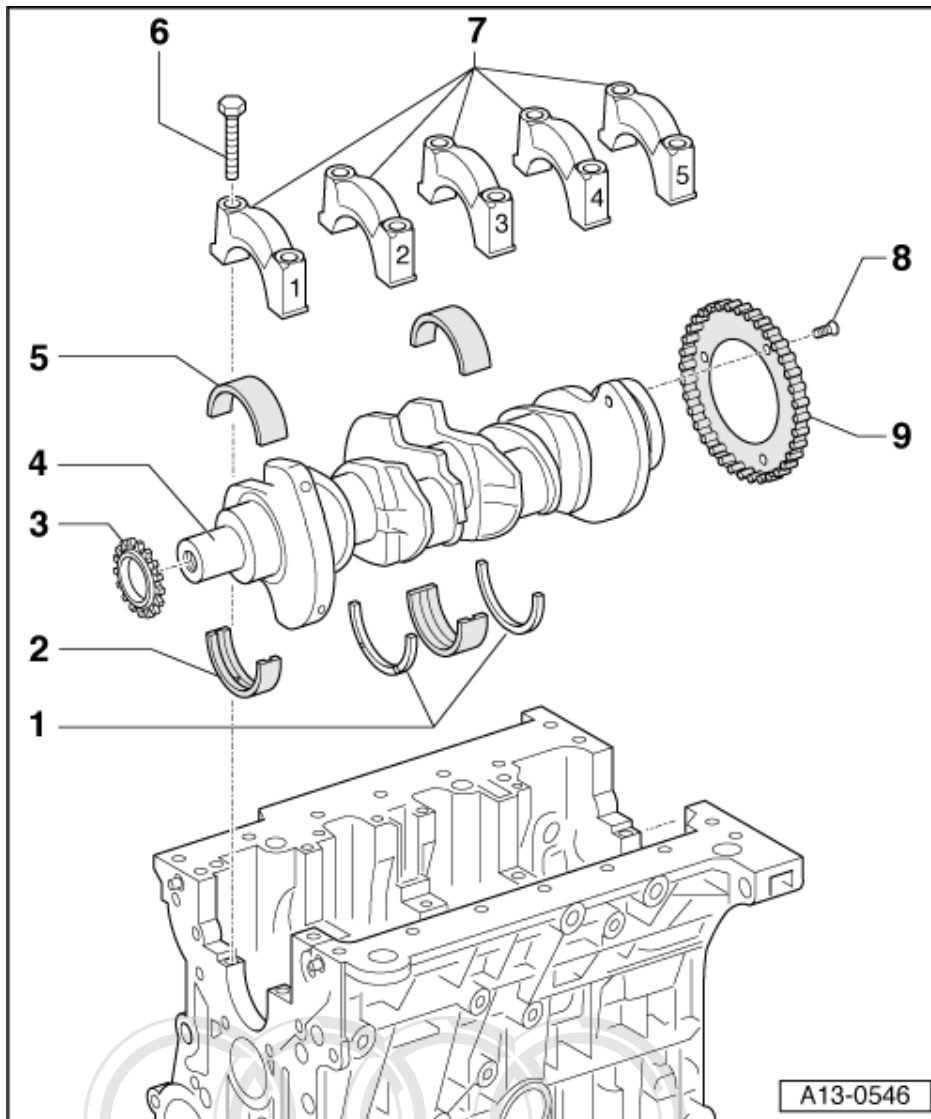
- ◆ For bearing cap without oil groove
- ◆ Do not interchange used bearing shells (mark).
- ◆ The crankshaft bearing shells in the bearing caps are only supplied as spare parts with "yellow" coloured markings.
- ◆ Note fixing arrangement

6 40 Nm + 90° (1/4 turn) further

- ◆ Replace
- ◆ When measuring radial play of crankshaft, tighten to 40 Nm but do not turn 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.



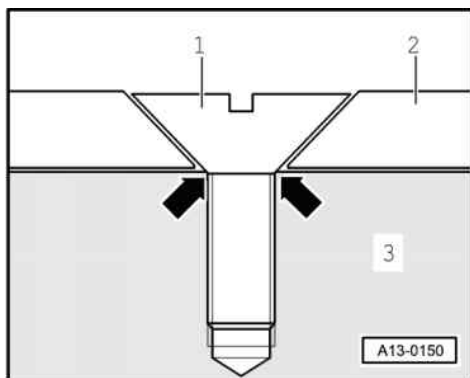
8 10 Nm + 90° (1/4 turn) further

- ◆ Replace
- ◆ After each loosening of bolts replace sender wheel
=> Fig. 99

9 Sender wheel

- ◆ For engine speed sender -G28
- ◆ Can only be installed in one position. Holes are off set
- ◆ Always replace sender wheel if securing bolts have been unscrewed.
- ◆ Removing and installing
=> Fig. 99

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➔ Fig.1 Removing and installing sender wheel

- Always replace sender wheel -2- if securing bolts -1- have been unscrewed.

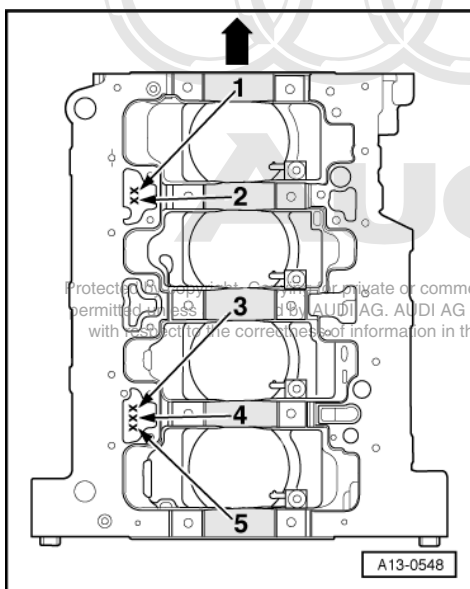
Notes:

- ♦ If the securing bolts are tightened a second time, the seats for the countersunk bolt heads in the sender wheel will be distorted to such an extent that the bolt heads will come into direct contact with the crankshaft -3- (-arrows-) and the sender wheel will only fit loosely under the bolts.
- ♦ The mounting holes are asymmetrically spaced, so it is only possible to install the sender wheel in one position.

Tightening torque

Component	Nm
Sender wheel to crankshaft	10 + 90° 1)2)

- 1) Replace bolts
- 2) 90° corresponds to a quarter of a turn



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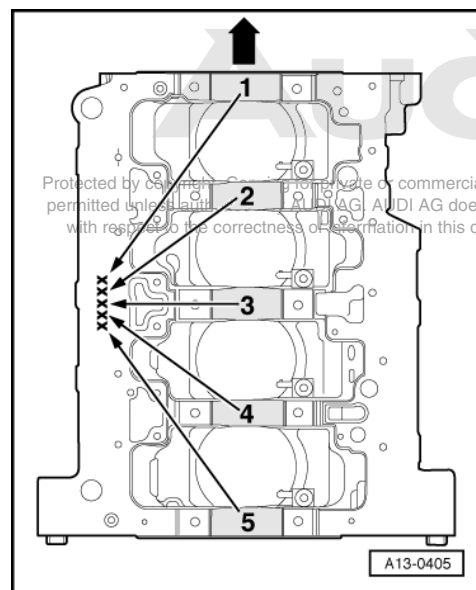
Fig.2 Allocation of crankshaft bearing shells for cylinder block - design-dependent

Bearing shells of the correct thickness are allocated to the cylinder block at the factory. Coloured dots on the bearing shell serve as markings to indicate bearing shell thickness.

-> Marking version I:

Notes:

- ♦ The arrow points to pulley side.
- ♦ The markings are visible after removal of the oil pan.



-> Marking version II:

Notes:

- ♦ The arrow points to pulley side.
- ♦ The markings are visible without removal of the oil pan.

The position of each bearing shell is marked with letters on the lower sealing area of the cylinder block.

Letter on cylinder block		Colour of bearing
R	=	red
G	=	yellow
B	=	blue

Notes:

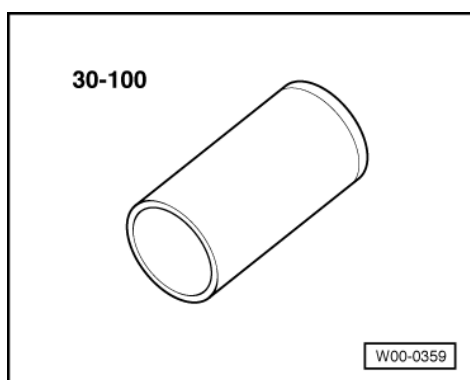
- ♦ If no marking is visible on the cylinder block, the bearing shells with a "yellow" marking must be used in the cylinder block.
- ♦ The crankshaft bearing shells in the bearing caps are only supplied as spare parts with "yellow" coloured markings.

3.2 - Crankshaft dimensions

(in mm)

Honing dimension	Crankshaft bearing main journal $\varnothing$	Conrod bearing main journal $\varnothing$
Basic dimension	-0.022 54.00 -0.042	-0.022 47.80 -0.042
1st undersize	-0.022 53.75 -0.042	-0.022 47.55 -0.042
2nd undersize	-0.022 53.50 -0.042	-0.022 47.30 -0.042
3rd undersize	-0.022 53.25 -0.042	-0.022 47.05 -0.042

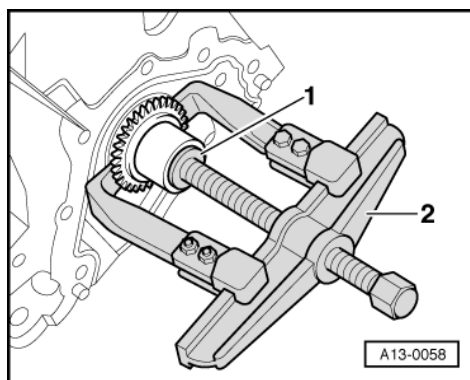
3.3 - Removing and installing chain sprocket



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Special tools and workshop equipment required

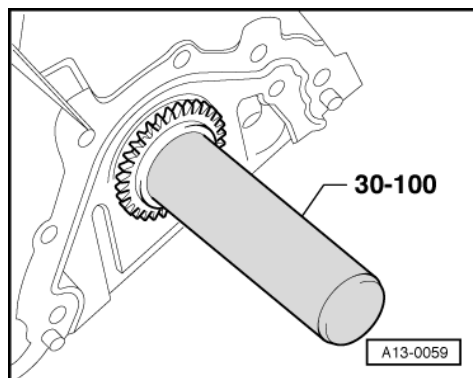
- ◆ Sleeve 30-100
- ◆ Two-arm puller, commercially available.
- ◆ Protective gloves





Removing

- Removing front sealing flange => Page 86 .
- Remove oil pan => Page 176 .
- Remove chain wheel of oil pump, chain tensioner and chain =>-Item 169 .
- -> Detach chain sprocket from crankshaft with puller -2- : use a suitable washer -1- to protect end of crankshaft.



Installing

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

Important
Wear protective gloves.

- Heat chain sprocket in oven for approx. 15 minutes to 220 °C.

Note:

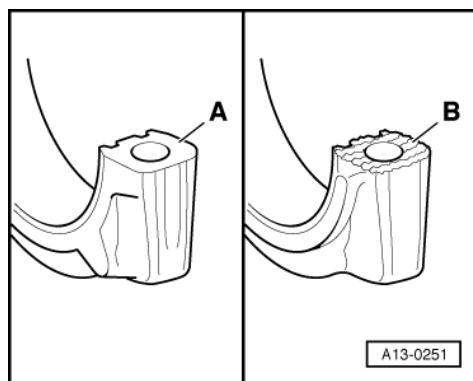
Installation position: wide collar on sprocket facing towards engine,

- -> Fit chain sprocket on end of crankshaft using pliers and push onto seat on crankshaft with drift sleeve 30-100.

4 - Dismantling and assembling pistons and conrods

4.1 - Dismantling and assembling pistons and conrods

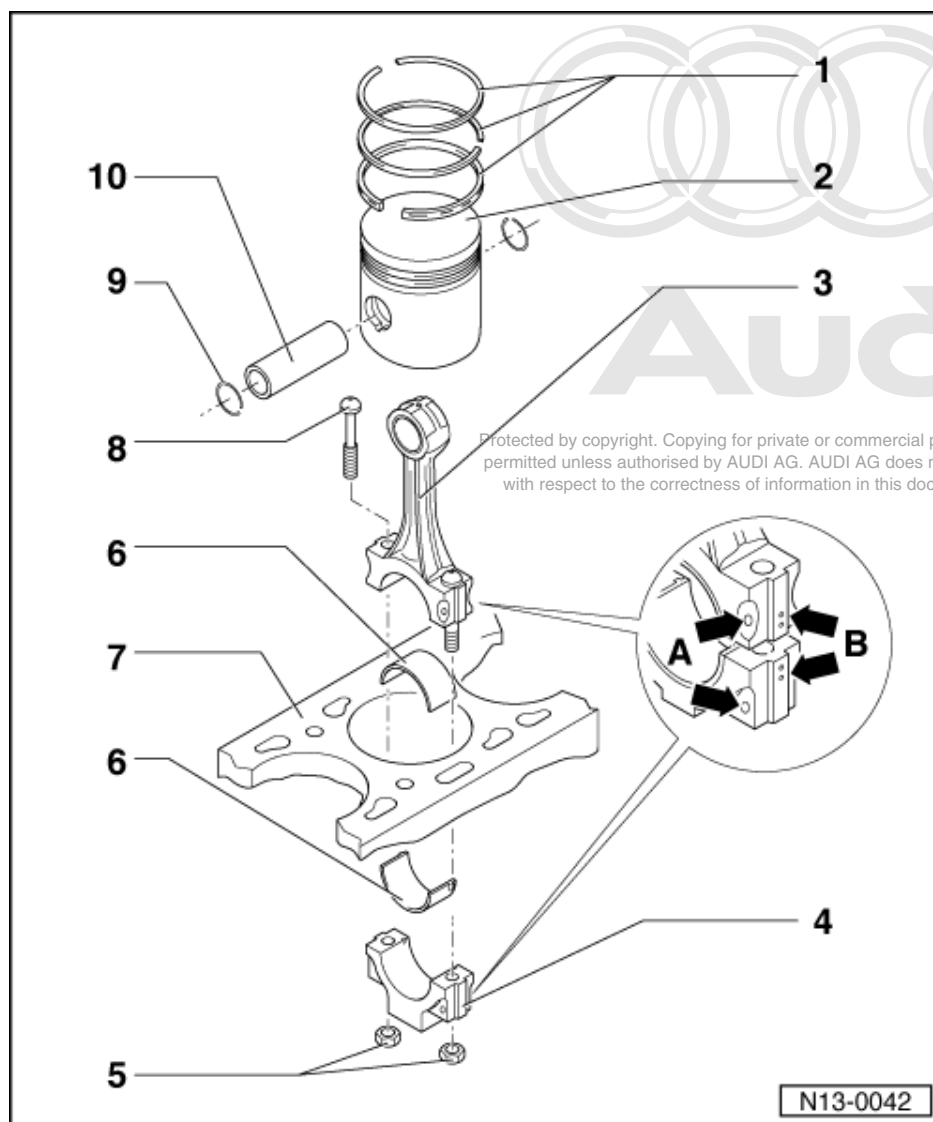
4.2 - Different conrods and conrod bolts



- ◆ Depending on the design, cracked rather than sawn conrods are installed
- ◆ Characteristics of sawn and cracked conrods

A - -> Sawn conrod = smooth separation surface
 B - Cracked conrod = rough separation surface

4.3 - Sawn conrods



Note:

Oil spray jet and pressure relief valve

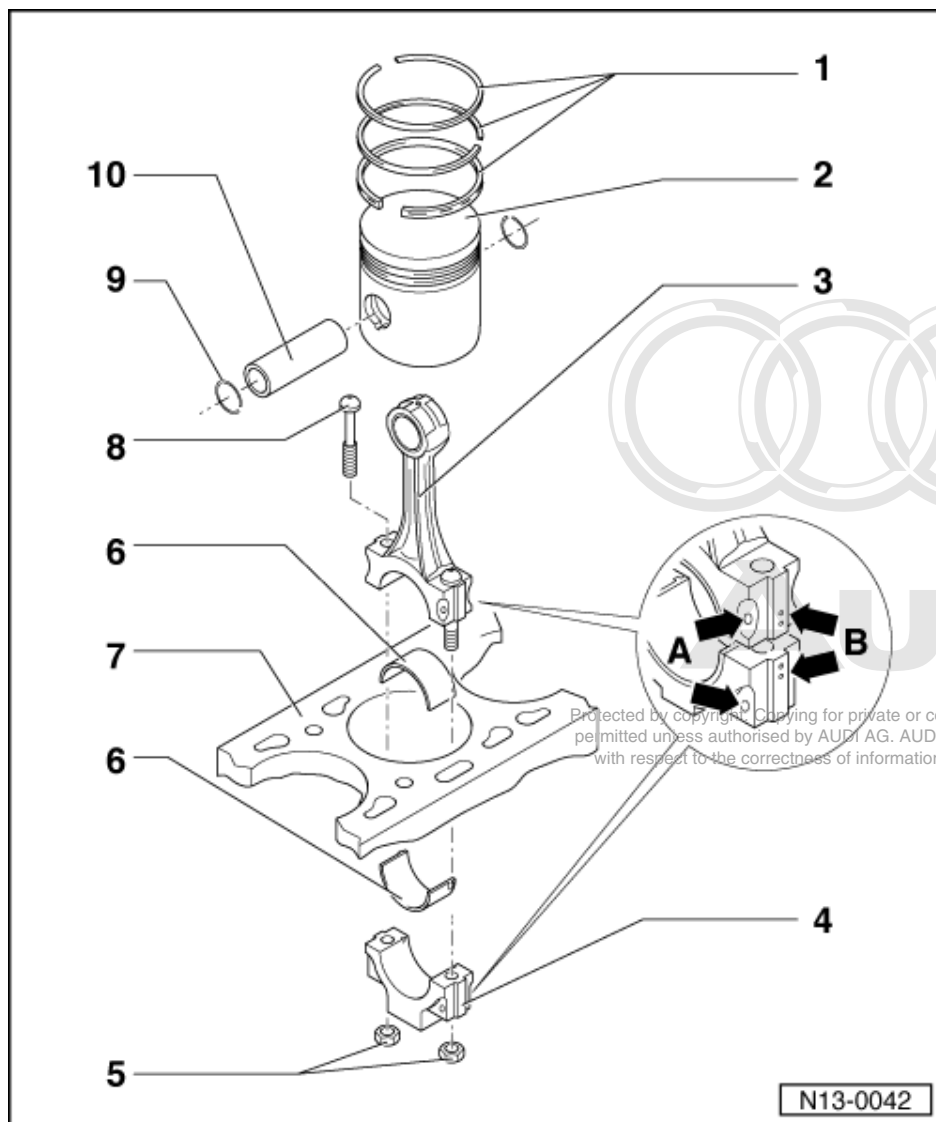
=> Fig. 112

1 Piston rings

- ◆ Offset gaps by 120°
- ◆ Remove and install with piston ring pliers.
- ◆ "TOP" faces towards piston crown
- ◆ Checking ring gap
=> Fig. 110
- ◆ Checking ring to groove play
=> Fig. 110

2 Piston

- ◆ Checking => Fig. 111
- ◆ Mark installation position and cylinder number.
- ◆ Arrow on piston crown points to pulley end.
- ◆ Install using piston ring clamp.
- ◆ Piston and cylinder dimensions
=>Page 112.



3 Conrod

- ◆ Only replace as a set
- ◆ Mark cylinder number B
- ◆ Installation position:
Markings A face towards pulley side
- ◆ With oil bore for piston pin lubrication

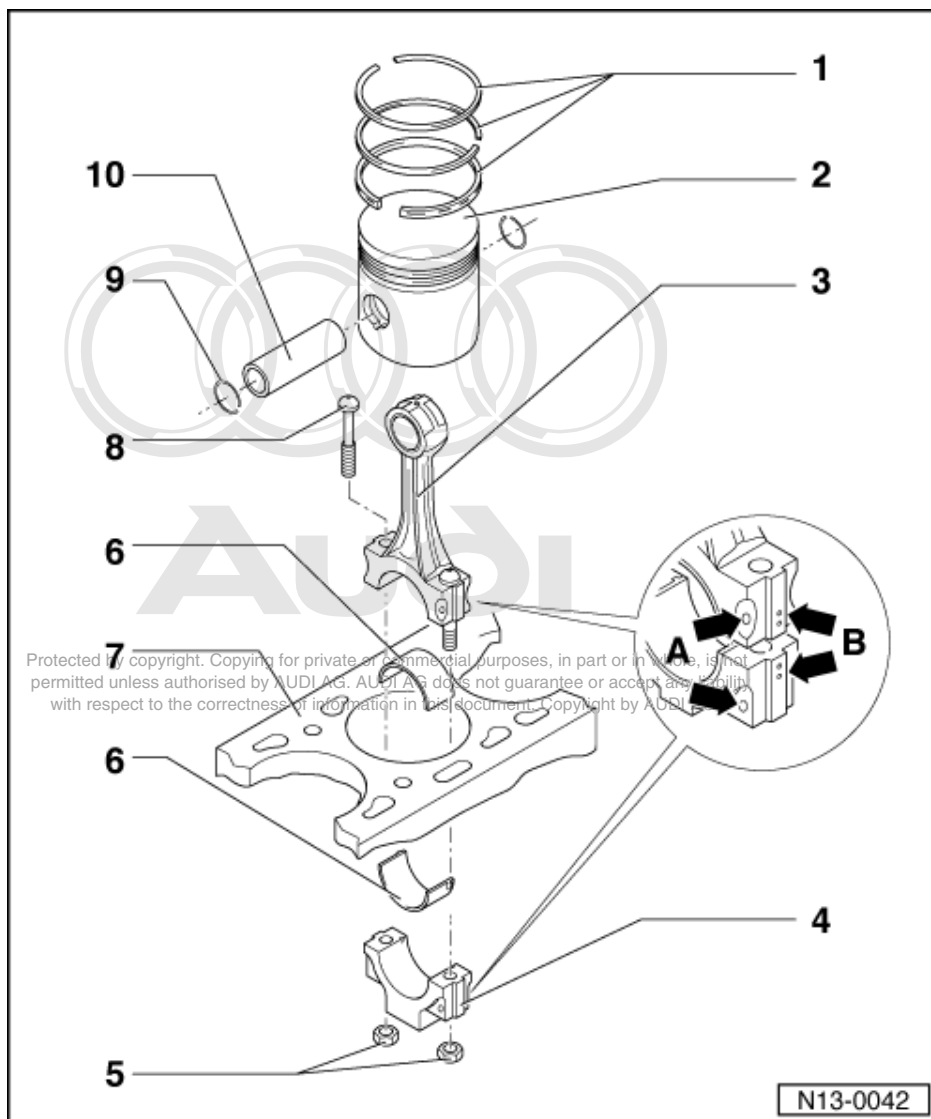
4 Conrod bearing cap

- ◆ Mark cylinder number B
- ◆ Installation position:
Markings A face towards pulley side

5 30 Nm + 90° (1/4 turn) further

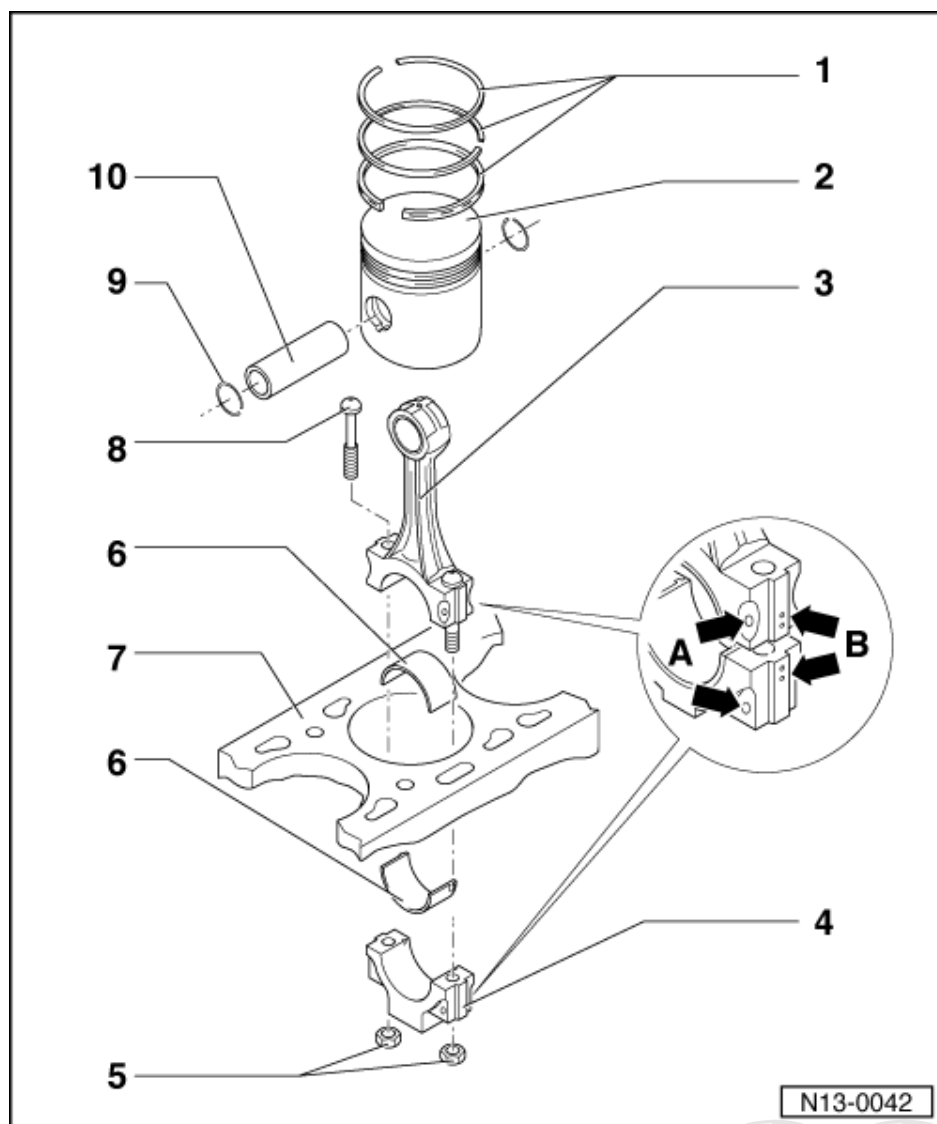
- ◆ Replace conrod bolt -Item 8 -
- ◆ Oil threads and contact surface

- ♦ To measure radial play tighten to 30 Nm but no further



6 Bearing shell

- ♦ Upper bearing shell with oil bore for piston bolt lubrication
- ♦ Note installation position
- ♦ Do not interchange used bearing shells (mark).
- ♦ Ensure retaining lugs fit tightly in recesses.
- ♦ Axial play
 New: 0.05...0.31 mm
 Wear limit: 0.37 mm
- ♦ Check radial play with Plastigage:
 New: 0.01...0.06 mm
 Wear limit: 0.12 mm.
 Do not rotate crankshaft when checking radial play



7 Cylinder block

- ♦ Checking cylinder bore
=> Fig. 111
- ♦ Piston and cylinder dimensions
=>Page 112.

8 Conrod bolt

- ♦ Replace

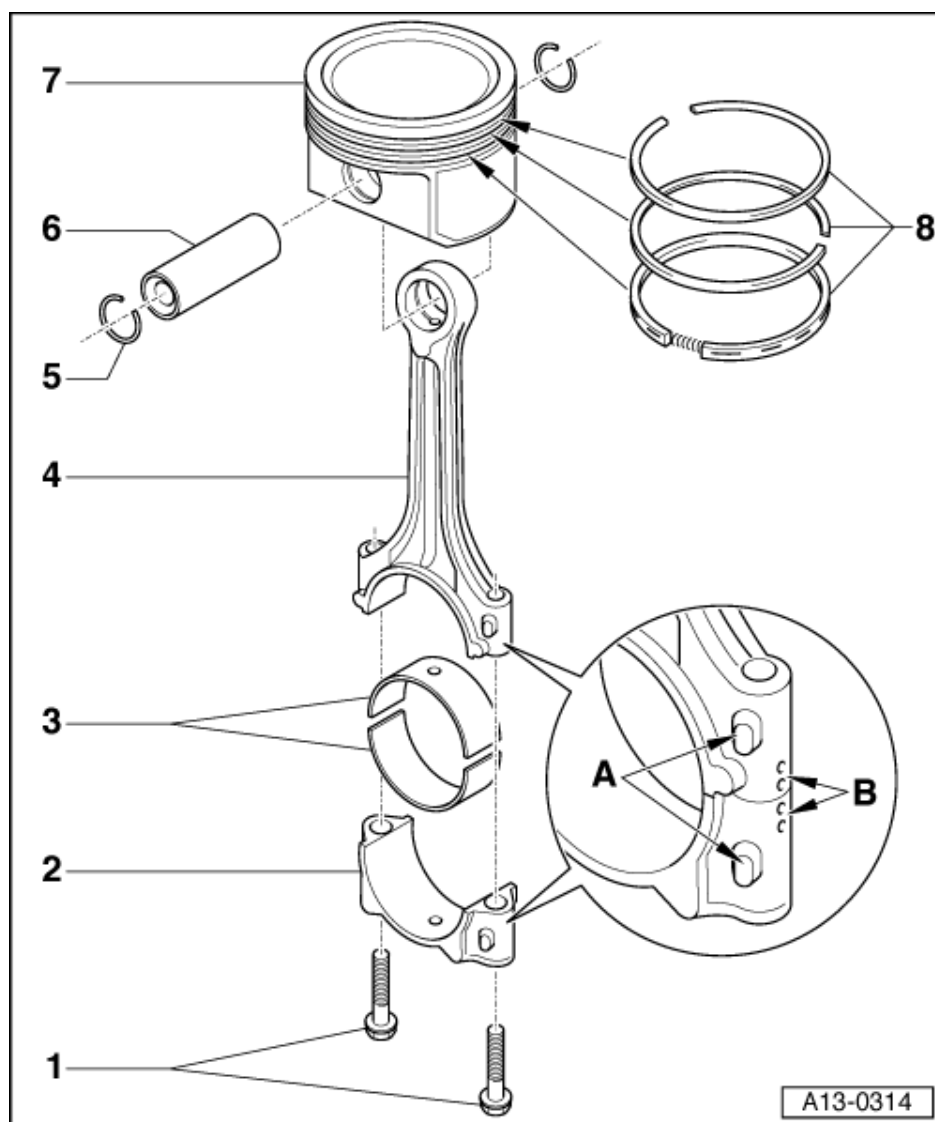
9 Circlip

10 Piston pin

- ♦ If difficult to remove, heat piston to approx. 60 °C.
- ♦ Remove and install with VW 222a

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4.4 - Cracked conrods

**Note:**

Oil spray jet and pressure relief valve

=> Fig. 112

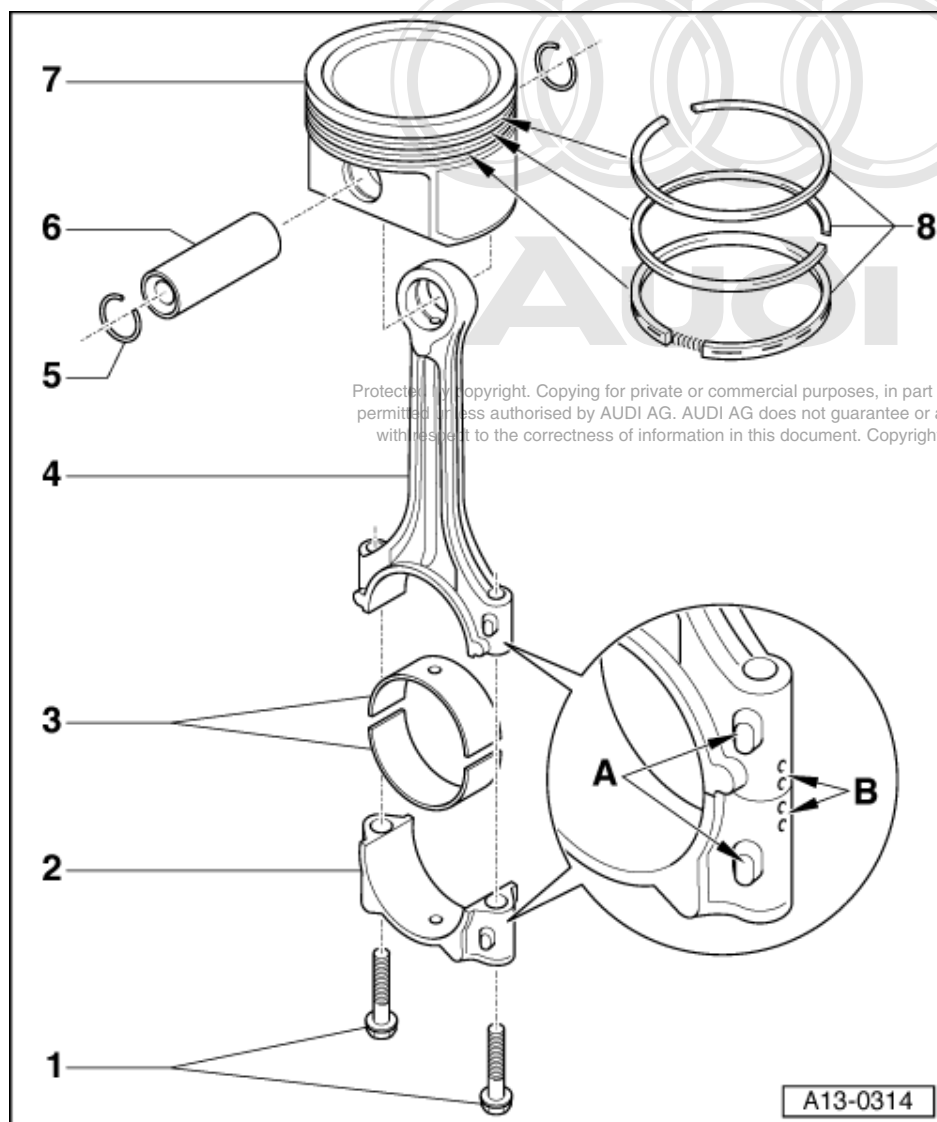
1 Conrod bolt - 30 Nm + 90° (1/4 turn) further

- ◆ Replace
- ◆ Oil threads and contact surface
- ◆ To measure radial play use old bolt
- ◆ To measure radial play tighten to 30 Nm but no further

2 Conrod bearing cap

- ◆ Mark cylinder number B
- ◆ Installation position:
Markings A face towards pulley side

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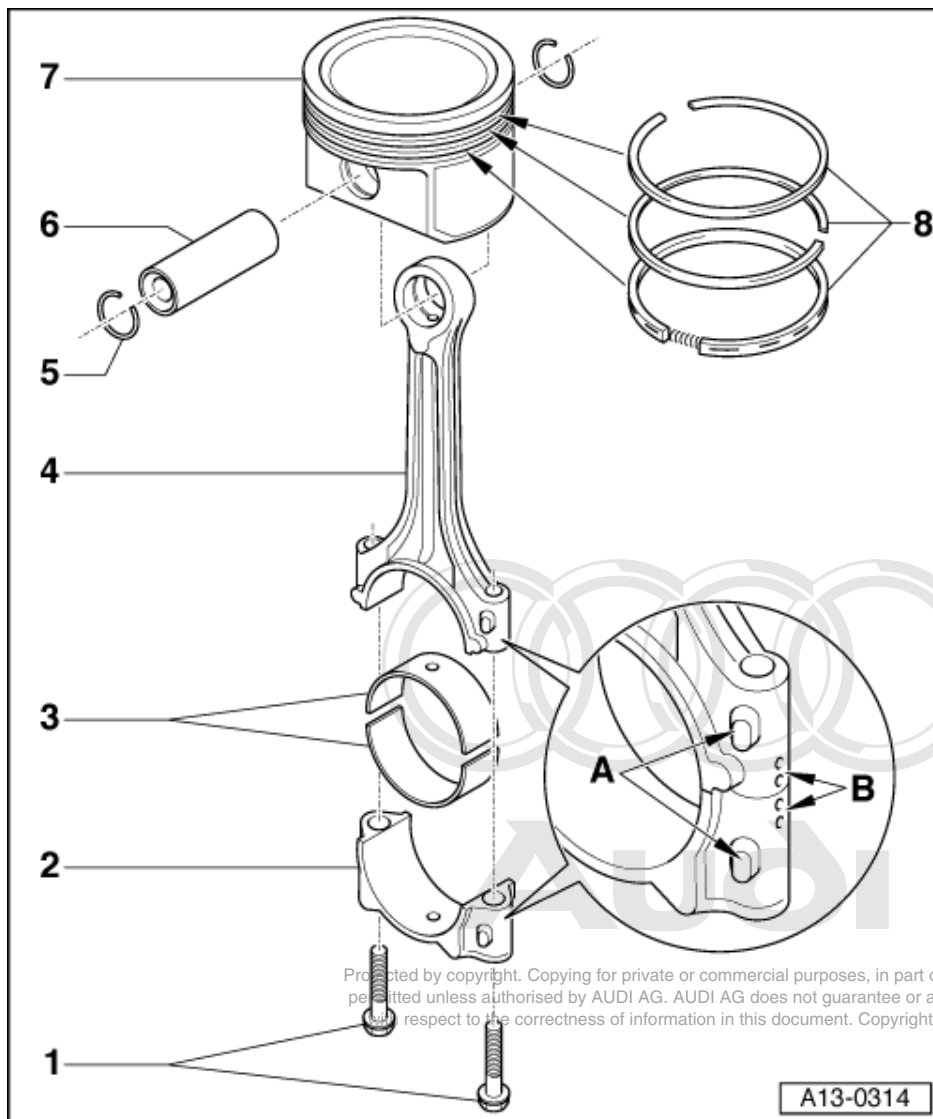


3 Bearing shells

- ◆ Upper bearing shell with oil bore for piston bolt lubrication
- ◆ Installation position
=> Fig. 112
- ◆ Do not interchange used bearing shells (mark).
- ◆ Axial play
New: 0.05...0.31 mm
Wear limit: 0.37 mm
- ◆ Check radial play with Plastigage:
New: 0.01...0.06 mm
Wear limit: 0.12 mm.
Do not rotate crankshaft when checking radial play

4 Conrod

- ◆ Only replace as a set
- ◆ Mark cylinder number B
- ◆ Installation position:
Markings A face towards pulley side
- ◆ With oil bore for piston pin lubrication

**5 Circlip****6 Piston pin**

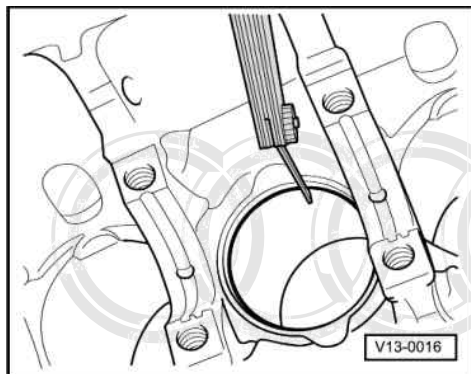
- ◆ If difficult to remove, heat piston to approx. 60 °C.
- ◆ Remove and install with VW 222a

7 Piston

- ◆ Checking => Fig. 111
- ◆ Mark installation position and cylinder number.
- ◆ Arrow on piston crown points to pulley end.
- ◆ Install using piston ring clamp.
- ◆ Piston and cylinder dimensions
=>Page 112 .

8 Piston rings

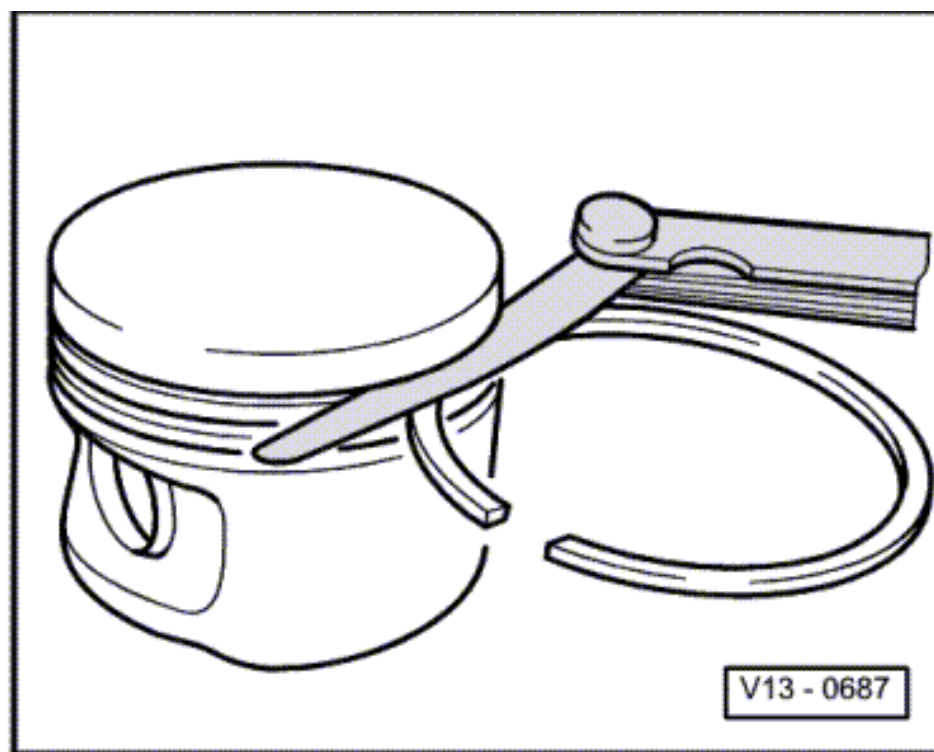
- ◆ Offset gaps by 120°
- ◆ Remove and install with piston ring pliers.
- ◆ "TOP" must face piston crown.
- ◆ Checking ring gap
=> Fig. 110
- ◆ Checking ring to groove play
=> Fig. 110



-> Fig. 1 Checking piston ring gap

- Push ring into cylinder seated squarely on cylinder wall from top down up to approx. 15 mm before bottom edge of cylinder. Use a piston without rings.

Piston ring Dimensions in mm	New	Wear limit
1st compression ring	0.20...0.40	0.8
2nd compression ring	0.20...0.40	0.8
Oil scraper ring	0.25...0.50	0.8

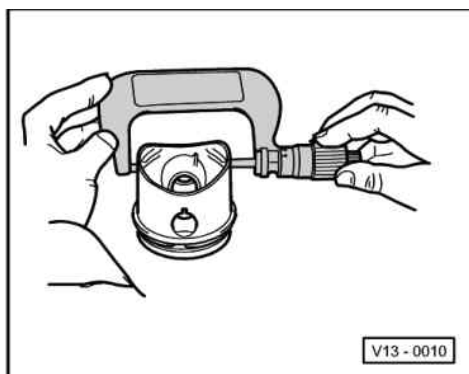


-> Fig. 2 Checking ring to groove play

- Clean groove before checking play.

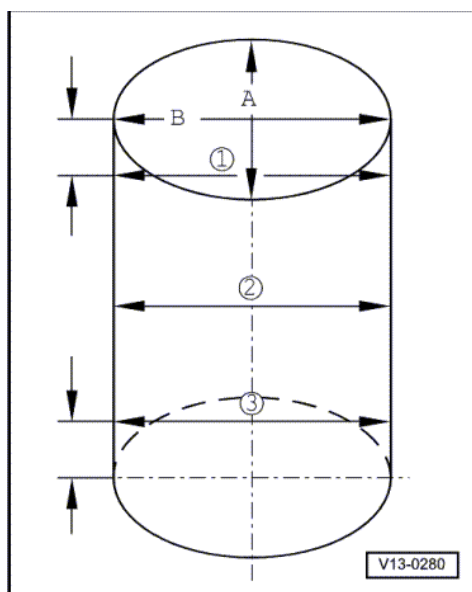
Piston ring Dimensions in mm	New	Wear limit
1st compression ring	0.06...0.09	0.20
2nd compression ring	0.05...0.08	0.20

Piston ring Dimensions in mm	New	Wear limit
Oil scraper ring	0.03...0.06	0.15



-> Fig. 3 Checking piston

- Measure approx. 10 mm from the lower edge, offset by 90° to the piston pin axis.
 - Permissible deviation from nominal dimension:
no more than 0.04 mm.

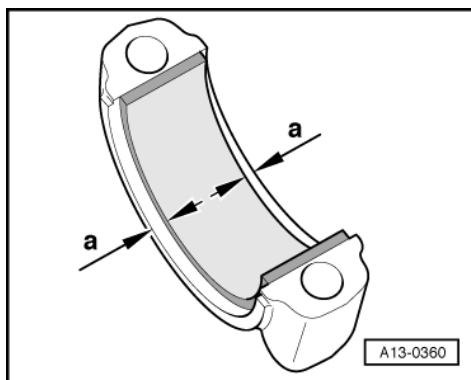


-> Fig. 4 Checking cylinder bores

- Measure at three positions diagonally in transverse direction -A- and in longitudinal direction -B- using a 50...100 mm internal dial gauge.
 - Permissible deviation from nominal dimension:
no more than 0.08 mm.



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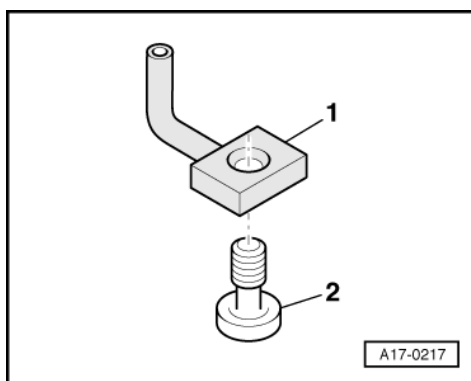


-> Fig.5 Installation position of bearing shell with cracked conrods

- Install bearing shells centrally into conrod or into conrod bearing cap.
- Dimension a = 3.0 mm

Note:

The bearing shell with the oil bore must be inserted in the conrod.



-> Fig.6 Oil spray jet and pressure relief valve

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

4.5 - Piston and cylinder dimensions

Honing dimension	Piston-ø	Cylinder bore-ø
Basic dimension mm	80.965 1)	81.01

- 1) Dimension without graphite coating (thickness 0.02 mm)
The graphite coating wears away.

15 - Cylinder head, Valve gear

1 - Removing and installing cylinder head

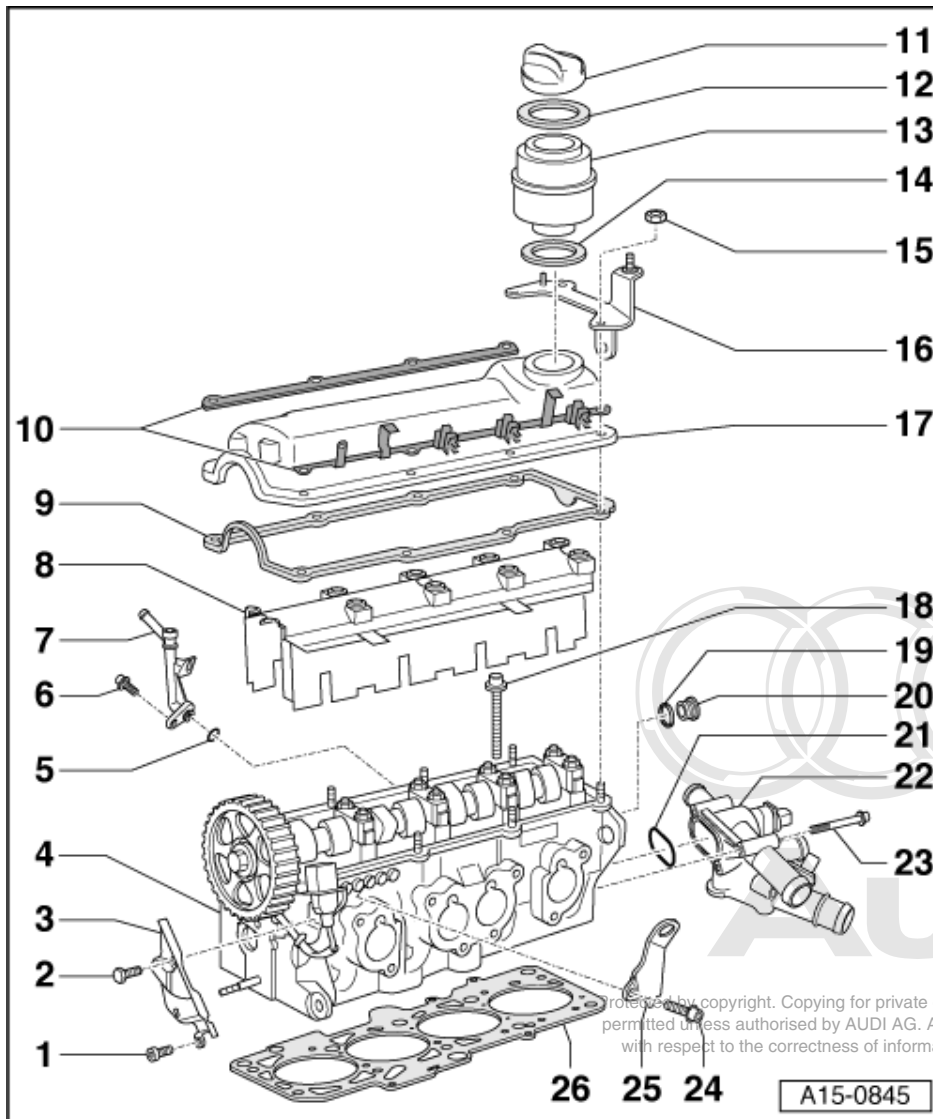
1.1 - Removing and installing cylinder head

Notes:

- ◆ Replace the cylinder head bolts.
- ◆ When performing repairs, replace seals, gaskets, self-locking nuts and bolts which have a specified tightening angle.
- ◆ When installing an exchange cylinder head with fitted camshaft, the contact surfaces between tappets and cams must be oiled after installing the head.
- ◆ The plastic protectors fitted to protect the open valves must only be removed immediately before fitting the cylinder head.
- ◆ When fitting a new cylinder head or cylinder head gasket, drain off all the old coolant and re-fill with new coolant.
- ◆ Cylinder heads which have cracks between the valve seats or between valve seat inserts and the spark plug thread can be used further without reducing service life, provided the cracks do not exceed a maximum of 0.3 mm in width, or when no more than the first 4 turns of the spark plug threads are cracked.



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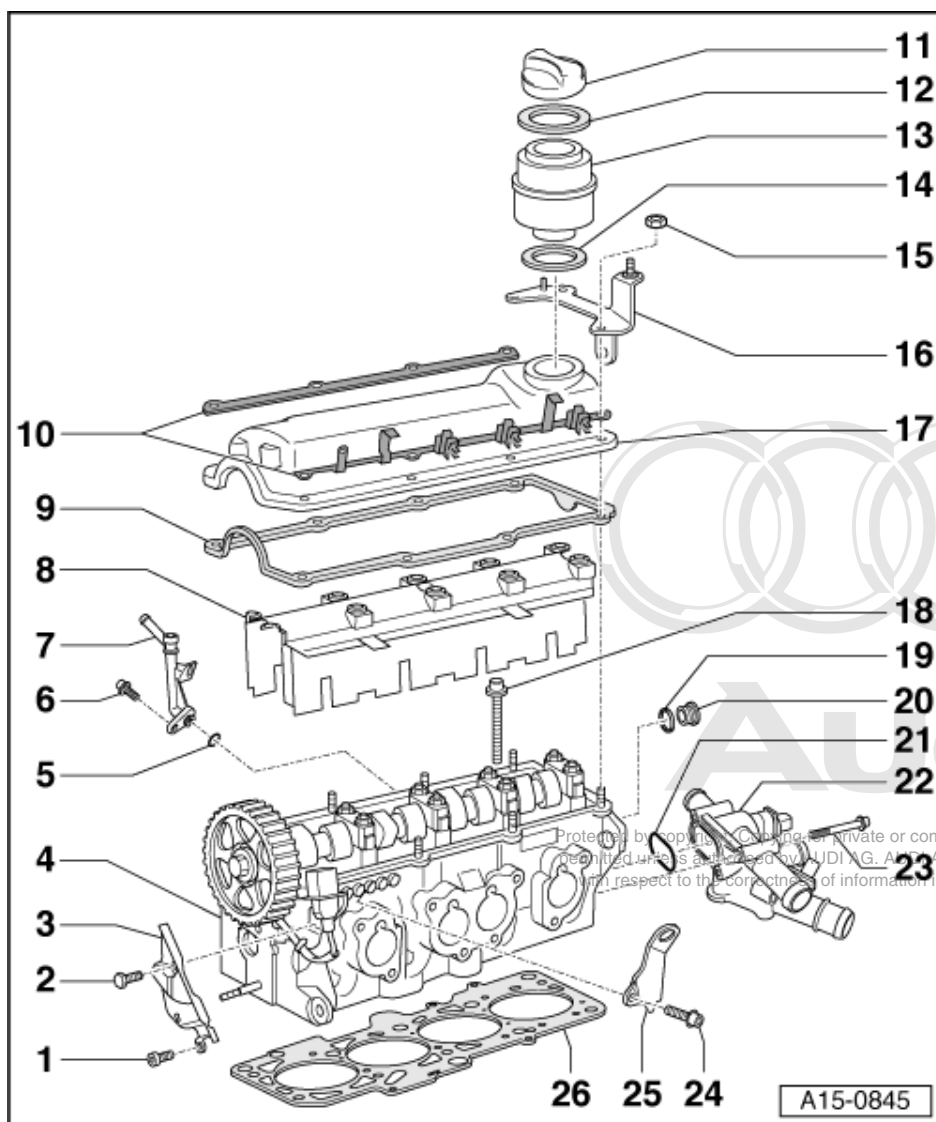


Part 1

Note:

The cylinder head for vehicles with engine code APF is illustrated in the Fig.

- 1 15 Nm
- 2 20 Nm
- 3 Toothed belt guard - rear
- 4 Cylinder head
 - ♦ Cylinder head => Pages 138
 - ♦ Checking for distortion
=> Fig. 121
 - ♦ Reworking dimension
=> Fig. 121
 - ♦ Installing => Page 142
 - ♦ After replacing, fill with fresh coolant
- 5 O-ring
 - ♦ Replace



6 10 Nm

7 **Breather connection**

- ◆ To coolant compensation tank
- ◆ Only for vehicles with engine code APF

8 **Oil deflector**

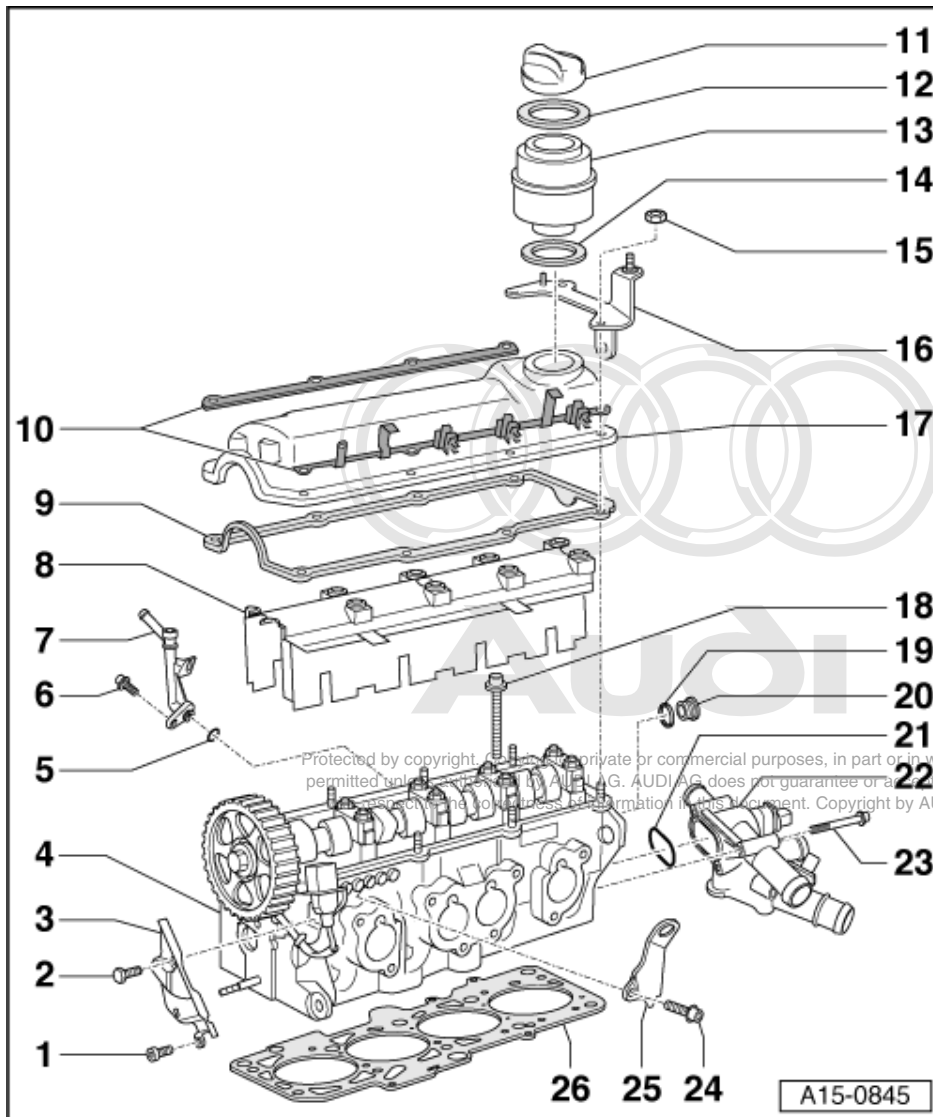
9 **Cylinder head cover gasket**

- ◆ Replace if damaged or leaking
- ◆ Before fitting gasket, apply sealant at sealing points => Fig. 121
- ◆ Sealants

=> Parts List

10 **Reinforcement strips**

11 **Cap**



12 Seal

- ◆ Replace if damaged or leaking

13 Breather housing

- ◆ Turn clockwise to remove

14 Seal

- ◆ Replace if damaged or leaking

15 10 Nm

- ◆ Tighten in stages and in diagonal sequence

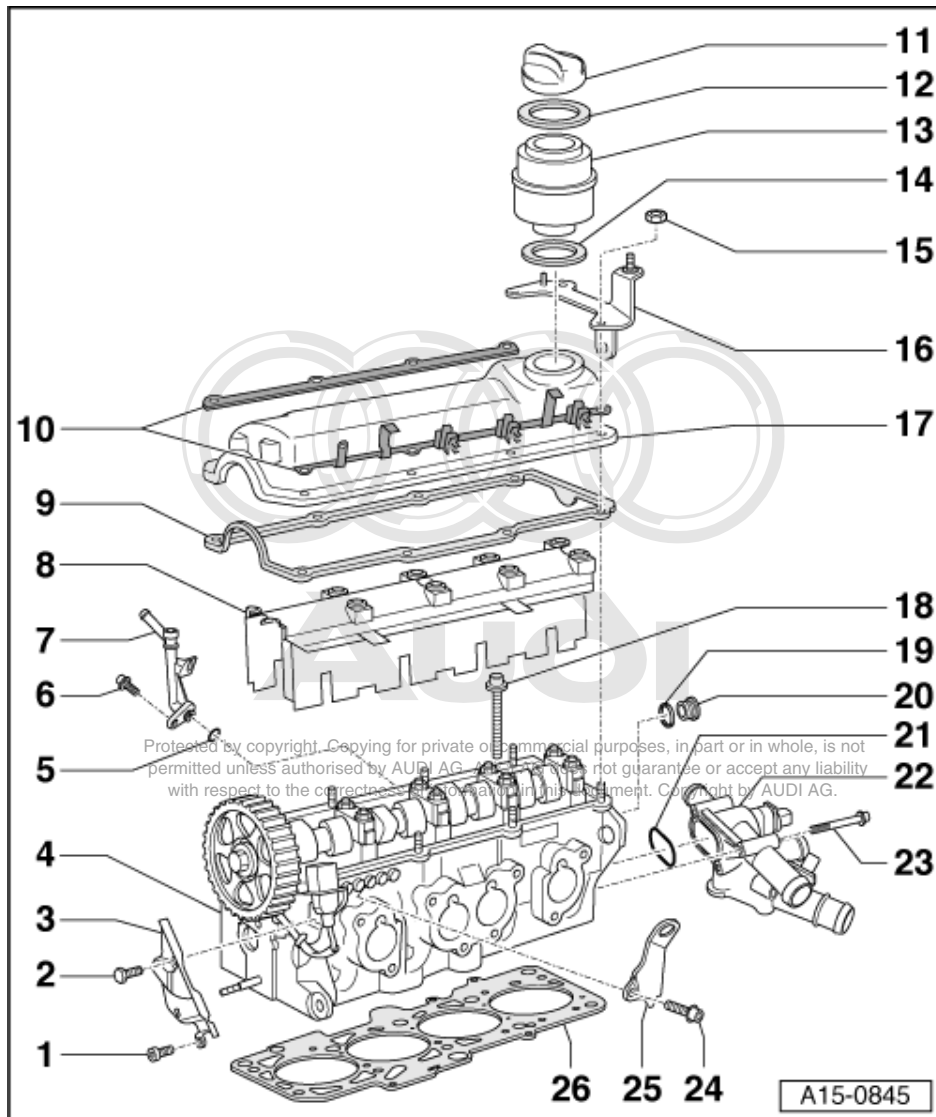
16 Bracket

17 Cylinder head cover

- ◆ Removing and installing
=>Page 133 .

18 Cylinder head bolt

- ◆ Replace
- ◆ Note sequence when loosening => Page 138
- ◆ Note sequence when tightening => Page 144

**19 Sealing ring**

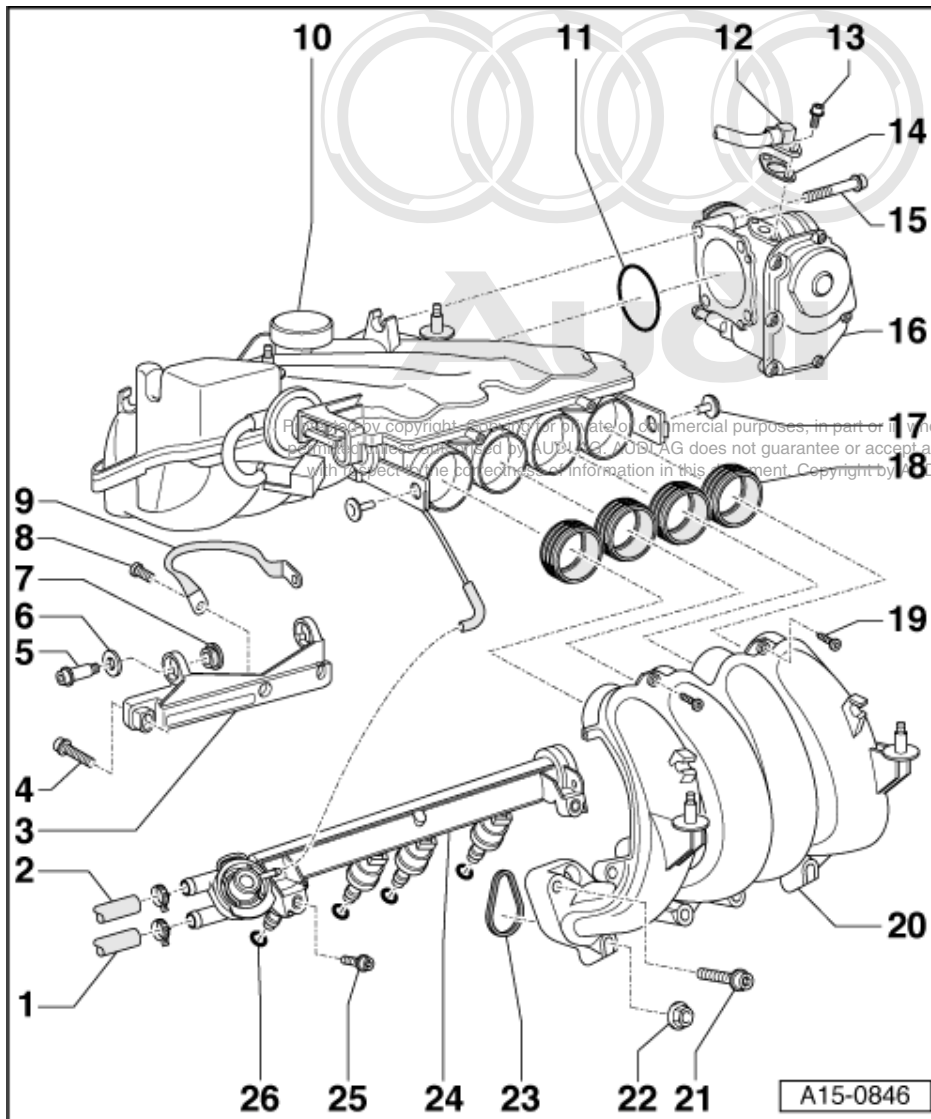
- ♦ Replace

20 Screw plug - 15 Nm**21 Sealing ring**

- ♦ Replace

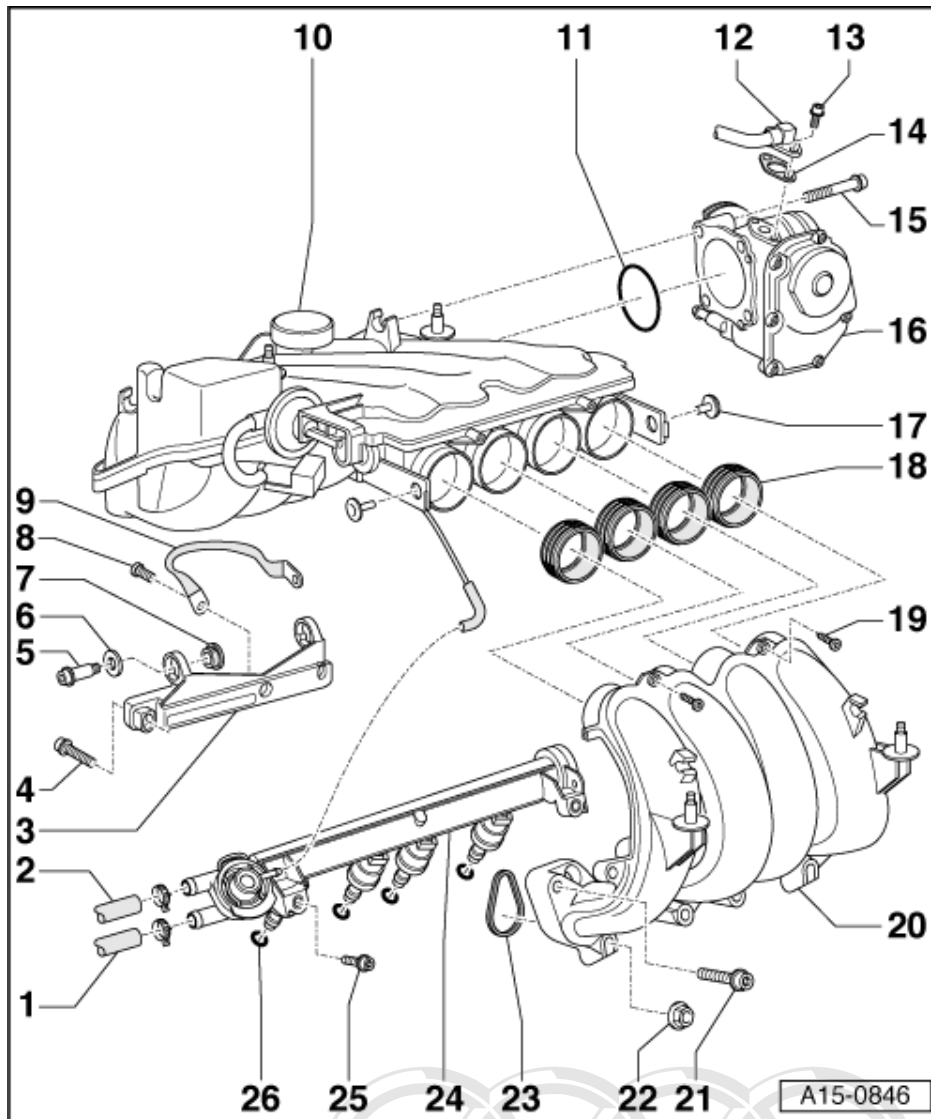
22 Coolant distributor housing/connection**23 10 Nm****24 20 Nm****25 Lifting eye****26 Cylinder head gasket**

- ♦ Replace => Removing cylinder head, Page [135](#).
- ♦ Installation position: Part number points towards cylinder head, and must be legible from the inlet side
- ♦ After replacing, fill with fresh coolant



Part 2

- 1 Fuel return pipe
 - ♦ Mark before removing
- 2 Fuel feed pipe
 - ♦ Mark before removing
- 3 Support
 - ♦ For upper section of intake manifold
- 4 22 Nm
- 5 10 Nm
- 6 Washer
- 7 Rubber bush
- 8 10 Nm
 - ♦ Not fitted on all versions
- 9 Earth wire
 - ♦ Not fitted on all versions

**10 Upper section of intake manifold**

- ♦ Removing and installing for vehicles with engine codes AEH, AKL => Page 122
- ♦ Removing and installing for vehicles with engine code APF => Page 126

11 Sealing ring

- ♦ Replace

12 Pipe for exhaust gas recirculation

- ♦ Only for vehicles with engine code APF

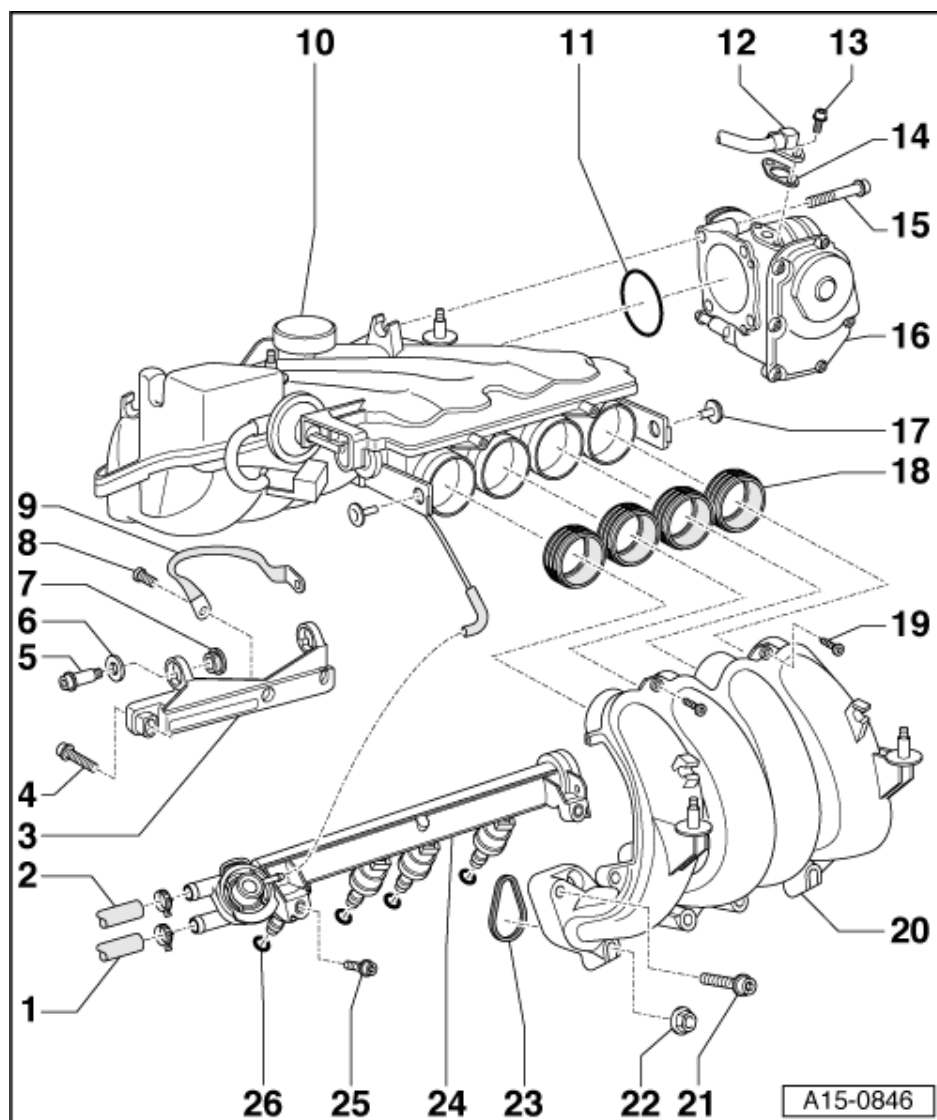
13 10 Nm**14 Seal**

- ♦ Replace

15 10 Nm**16 Throttle valve connection****17 Clip**

- ♦ Not fitted on all versions

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18 Sealing ring

- ◆ Replace
- ◆ Install with adhesive sealant
- ◆ Adhesive sealant

=> Parts List

19 3 Nm

20 Lower section of intake manifold

- ◆ Removing and installing=>Page 130

21 20 Nm

22 20 Nm

23 Sealing ring

- ◆ Replace

24 Fuel rail

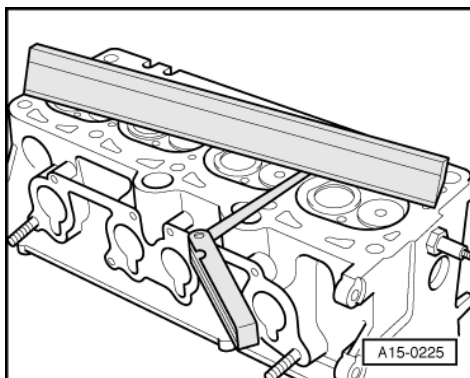
- ◆ With injectors

25 10 Nm

26 O-ring

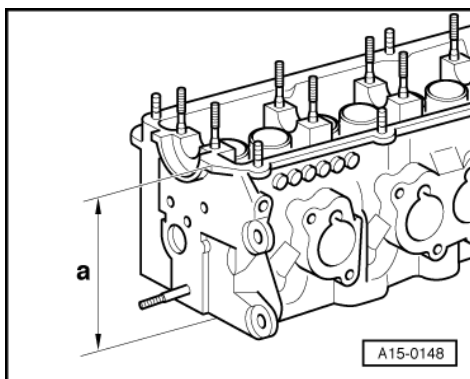
- ◆ For injectors
- ◆ Replace

- ♦ Coat with clean engine oil.



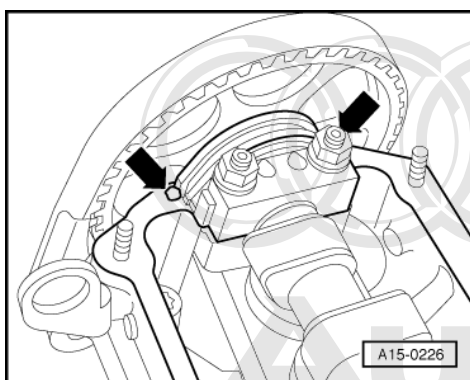
-> Fig.1 Checking cylinder head for distortion

- Use straightedge and feeler gauge to measure at several points.
 - Max. permissible distortion: 0.1 mm



-> Fig.2 Reworking dimension for cylinder head

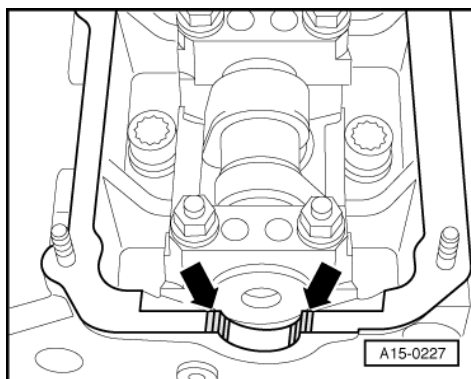
- Reworking the cylinder head (grinding) is only permitted down to minimum dimension a.
 - Minimum dimension a = 132.60 mm



-> Fig. 3 Sealing points for bearing caps/cylinder head

- Apply a small quantity of sealant to joints - arrows - on upper sealing surface of cylinder head.
 - Sealants

=> Parts List



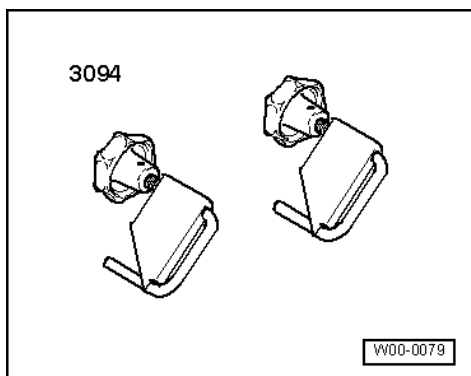
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-> Fig. 4 Sealing connections between camshaft adjuster and cylinder head

- Apply a small quantity of sealant to joints -arrows- on upper sealing surface of cylinder head.
- Sealants

=> Parts List

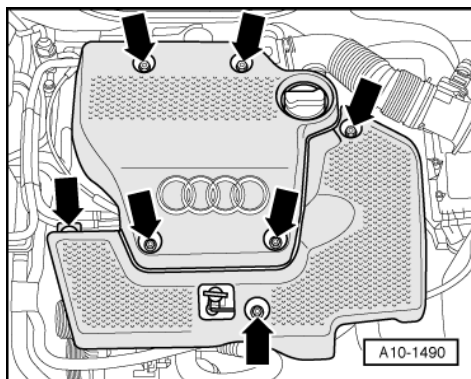
1.2 - Removing and installing upper section of intake manifold - vehicles with engine codes AEH, AKL



Special tools, workshop equipment, and other items required

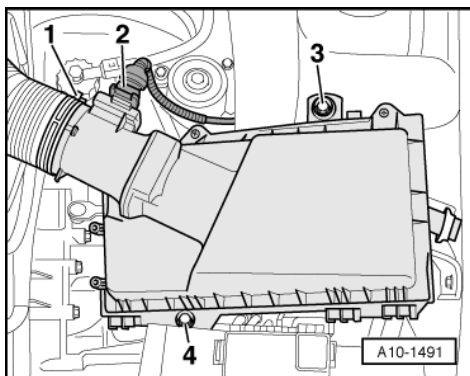
- ♦ Hose clamps 3094
- ♦ Adhesive sealant

=> Parts List

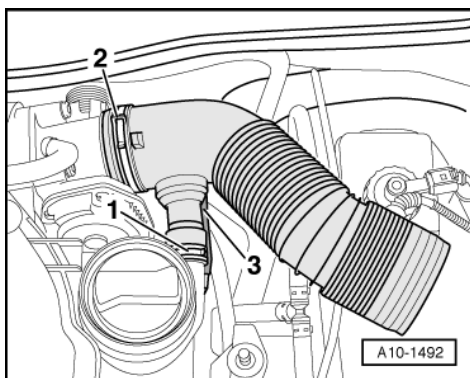


Removing

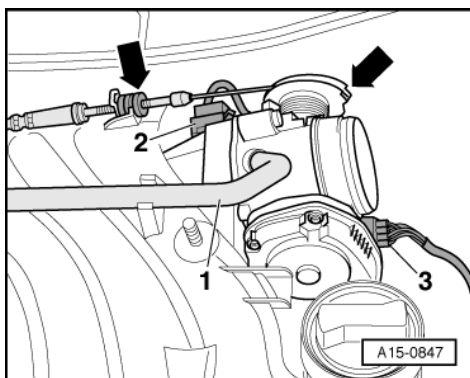
- -> Remove the front engine cover -arrows-.



- -> Disconnect the air duct hose -1- from the air mass meter.
- Unplug connector -2- at air mass meter.
- Unscrew bolts -3- and -4-.
- Remove air cleaner housing.

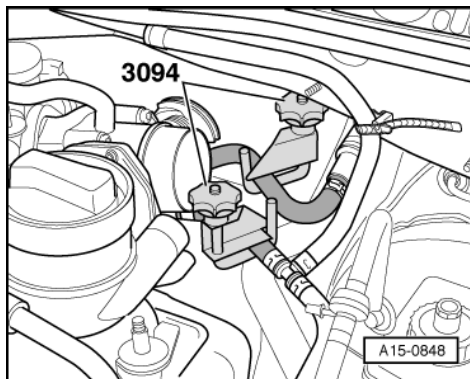


- -> Disconnect hoses -1- and -3-.
- Remove the air duct, release spring clamp -2- for this purpose.

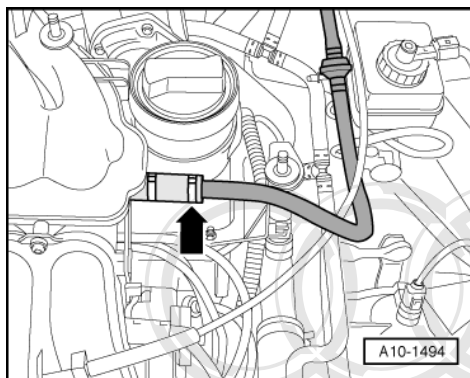


- -> Detach the throttle cable -arrows-.
- Disconnect hose -1- to ACF.
- Unplug connectors:
 - 2 - Intake air temperature sender -G42
 - 3 - Throttle valve control part -J338
- Lay wiring aside.

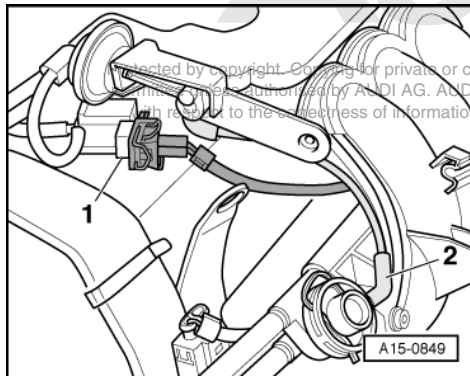
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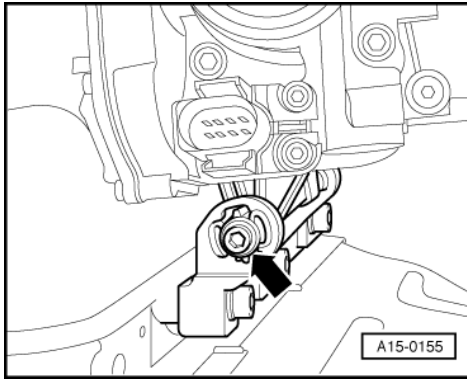
- -> Clamp off coolant hoses with hose clamps 3094.
- Disconnect the coolant hoses at the throttle valve connection.



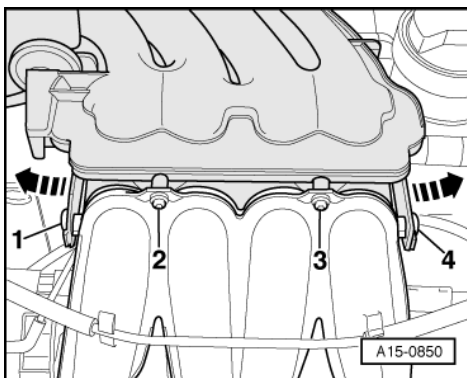
- -> Detach the vacuum hose -arrow- to the brake servo at the intake manifold.
- Turn the breather housing clockwise and detach from the cylinder head.
- Close off the openings in the cylinder head cover with a clean cloth.



- -> Unplug connector -1- at intake manifold changeover valve -N156.
- Disconnect vacuum hose -2-.



- Detach earth strap at bracket for upper section of intake manifold.
- -> Remove the two bolts arrow on the rear intake manifold mounting (one on the left, one on the right) - arrow-.



- -> Remove bolts -1- and -2-.
- Where fitted, lever off the clips -1- and -4-.
- Pull the retaining lugs slightly to the side to release -arrows-.
- Press off the upper section of the intake manifold from the lower section rearwards.

Note:

Plug the intake ports of the intake manifold (lower section) with clean cloths.

Installing

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

Note:

Replace seals and gaskets.

- Bond the sealing rings onto the lower section of the intake manifold, between the upper and lower sections of the manifold, with adhesive sealant.
 - Adhesive sealant

=> Parts List

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Push the upper section onto the bottom section of the intake manifold and bolt into place.

- Allow the retaining lugs on the left and right to engage and secure each with a clip.
- Coat the collar of the bolts for the rear intake manifold mounting with silicone-free lubricant and tighten.
 - Lubricant

=> Parts List

- Adjust throttle cable:



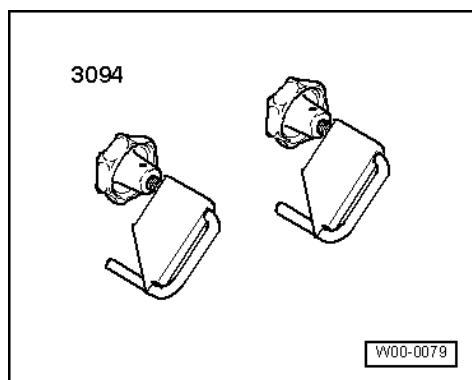
=> Fuel Supply System - Petrol Engines; Repair group 20; Servicing throttle mechanism - Vehicles with mechanical throttle mechanism Servicing throttle mechanism - Vehicles with mechanical throttle mechanism

- Top up coolant => Page **217** .

Tightening torques

Component	Nm
Upper section of intake manifold to lower section	3
Upper section of intake manifold to support	10
Earth wire to support for upper section of intake manifold	10

1.3 - Removing and installing upper section of intake manifold - vehicles with engine code APF

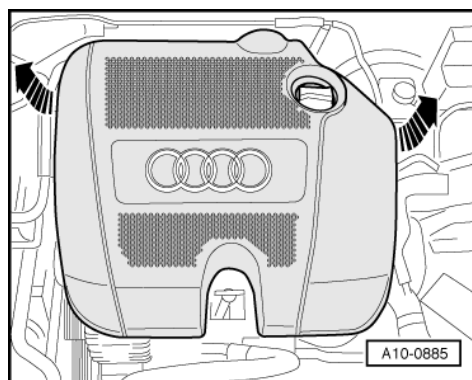


Special tools, workshop equipment, and other items required

- ♦ Hose clamps 3094
- ♦ Adhesive sealant

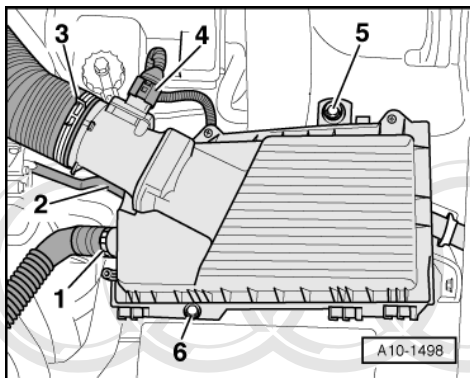
=> Parts List

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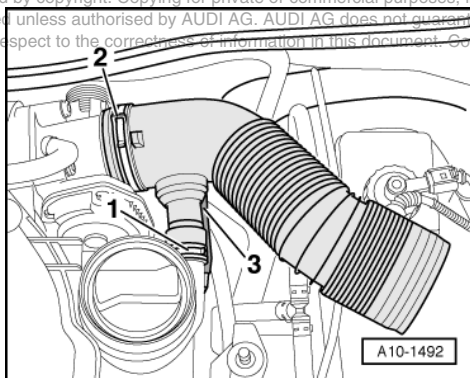
Removing

- -> Remove engine cover -arrows-.

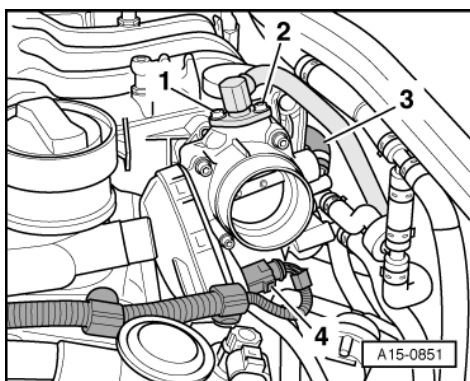


- -> Disconnect the air duct hose -3- from the air mass meter.
- Unplug connector -4- at air mass meter.
- Disconnect hoses -1- and -2- from the air cleaner housing.
- Unscrew bolts -5- and -6-.
- Remove air cleaner housing.

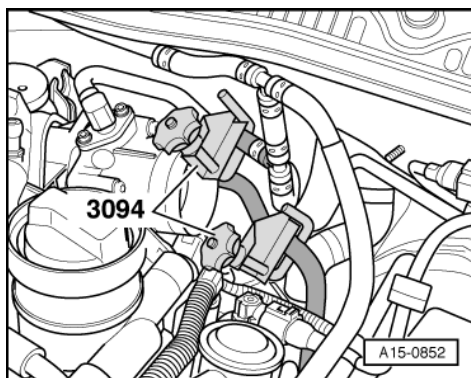
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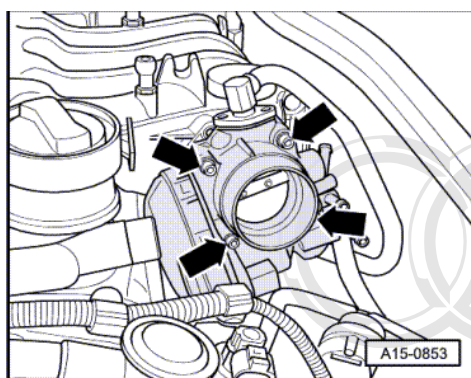
- -> Disconnect hoses -1- and -3-.
- Remove the air duct, release spring clamp -2- for this purpose.



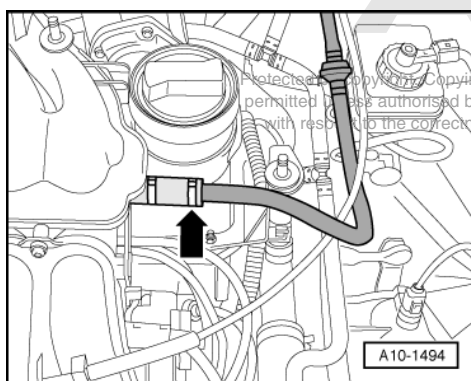
- -> Remove bolts -1- and -2-.
- Disconnect hose -3- to ACF.
- Detach connector -4- at throttle valve control part -J338.



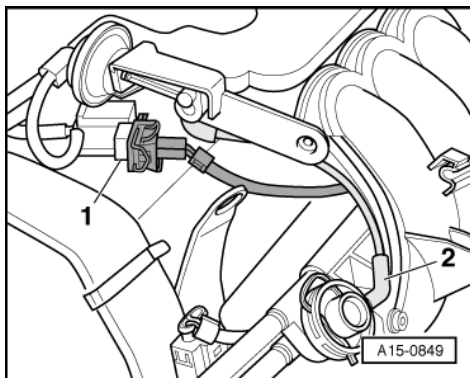
- -> Clamp off coolant hoses with hose clamps 3094.
- Disconnect the coolant hoses at the throttle valve connection.



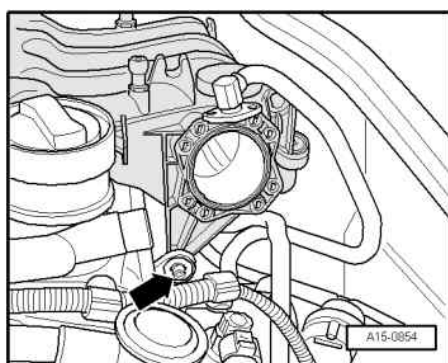
- -> Remove throttle valve connection -arrows-.



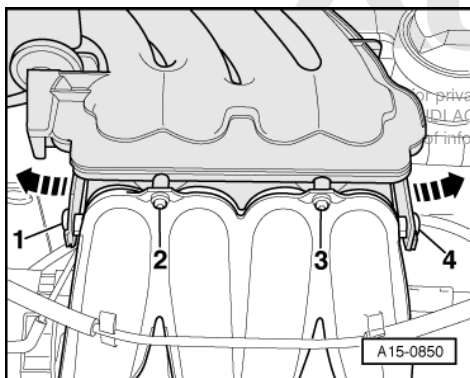
- -> Detach the vacuum hose -arrow- to the brake servo at the intake manifold.
- Turn the breather housing clockwise and remove from the cylinder head.
- Close off the openings in the cylinder head cover with a clean cloth.



- -> Unplug connector -1- at intake manifold changeover valve -N156.
- Disconnect vacuum hose -2-.



- -> Remove the two bolts arrow on the rear intake manifold mounting (one on the left, one on the right) - arrow-.



- -> Remove bolts -1- and -2-.
- Where fitted, lever off the clips -1- and -4-.
- Pull the retaining lugs slightly to the side to release -arrows-.
- Press off the upper section of the intake manifold from the lower section rearwards.

Note:

Close off the intake ports of the intake manifold (lower section) with clean cloths.

Installing

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



Note:

Replace seals and gaskets.

- Bond the sealing rings onto the lower section of the intake manifold, between the upper and lower sections of the manifold, with adhesive sealant.
 - Adhesive sealant

=> Parts List

- Push the upper section onto the bottom section of the intake manifold and bolt into place.
- Allow the retaining lugs on the left and right to engage and secure each with a clip.
- Coat the collar of the bolts for the rear intake manifold mounting with silicone-free lubricant and tighten.
 - Lubricant

=> Parts List

- Top up coolant => Page 217 .

Tightening torques

Component	Nm
Upper section of intake manifold to lower section	3
Upper section of intake manifold to support	10
Throttle valve connection to intake manifold	10
Exhaust gas recirculation pipe to intake manifold	10

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1.4 - Removing and installing lower section of intake manifold

Auxiliary equipment required

- ♦ Adhesive sealant

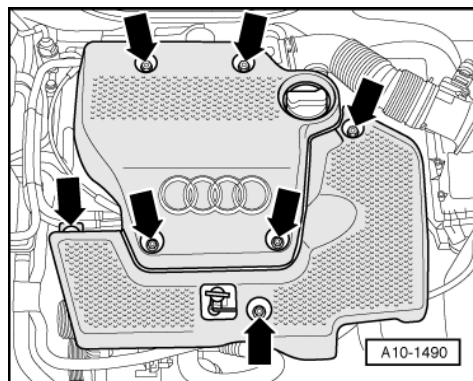
=> Parts List

Removing

Important

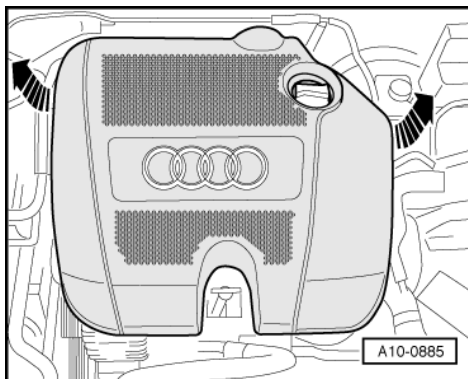
On vehicles with telematics, activate service mode of telematics control unit before disconnecting battery. => Radio, Telephone and Navigation System; Repair group 91

- Refer to coding on vehicles with encoded radio/radio navigation system (RNS); if necessary, interrogate.
- Disconnect earth strap at battery with ignition switched off.



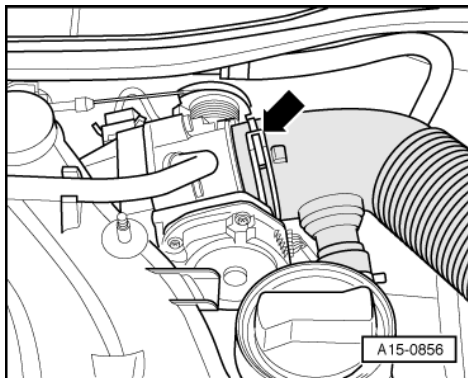
Vehicles with bolted engine cover:

- -> Remove the front engine cover -arrows-.



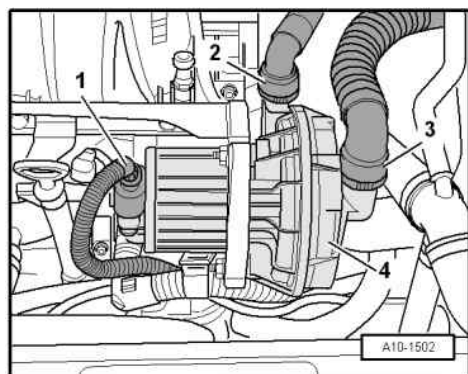
Vehicles with clip-on engine cover:

- -> Remove engine cover -arrows-.



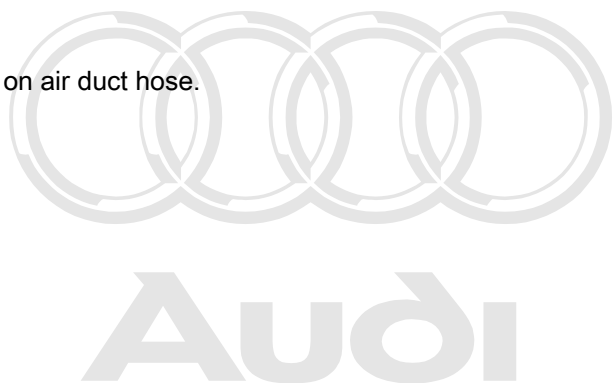
All models:

- -> Release spring clamp -arrow- and push back on air duct hose.



Vehicles with engine code APF:

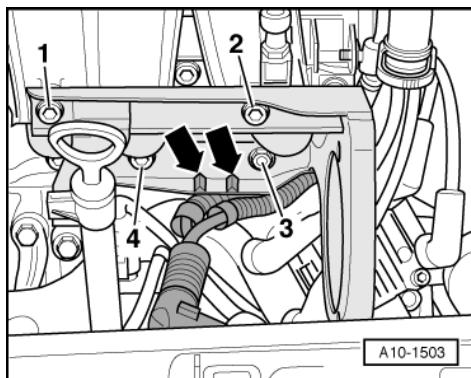
- -> Detach connector -1-.
- Disconnect hoses -2- and -3- at the secondary air pump.



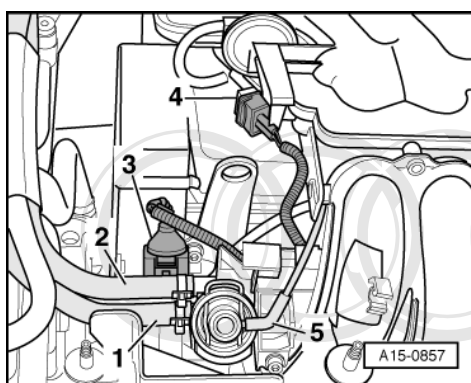
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- Detach the secondary air pump -4- from the bracket.



- -> Unscrew bolts -1...4- of the secondary air pump bracket.
- Lay the wiring aside -arrow- and remove the secondary air pump bracket.



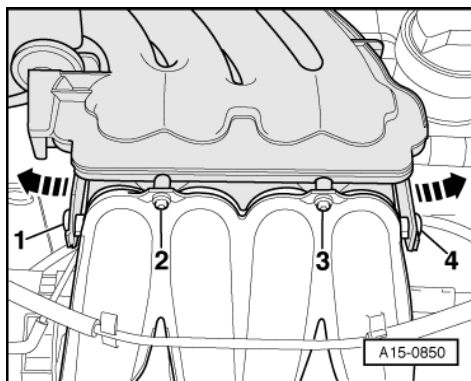
All models:

Important

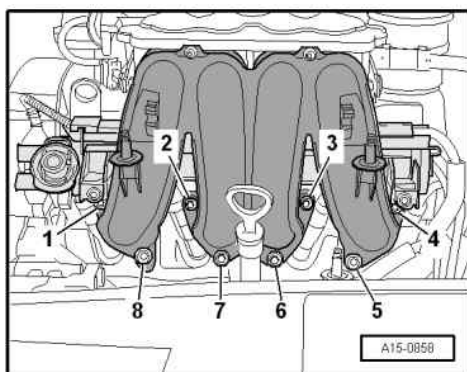
The fuel system is pressurised. Before opening the system place a cloth around the connection point. Then release pressure by carefully loosening the connection.

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- **Unbolt bracket for engine cover.**
- -> Mark fuel feed pipe -2- and fuel return pipe -1- and detach at the fuel rail.
- Disconnect vacuum hose -5 - from fuel pressure regulator.
- Unplug connectors:
 - 3 - Hall sender -G40
 - 4 - Intake manifold change-over valve -N156
- Where fitted, unclip the throttle cable at the lower section of the intake manifold.



- -> Remove bolts -1- and -2-.
- Lever off the clips -1- and -4-.
- Pull the retaining lugs slightly to the side to release -arrows-.



- -> Remove bolts -1...8- and detach the lower section of the intake manifold.
- Unclip the wiring duct at the lower section of the lower section of the intake manifold and detach the connectors for the injectors.

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Plug intake ports on cylinder head with clean cloths.

Installing

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

Note:

Replace seals and gaskets.

- Bond the sealing rings onto the lower section of the intake manifold, between the upper and lower sections of the manifold, with adhesive sealant.
- Adhesive sealant

=> Parts List

Tightening torques

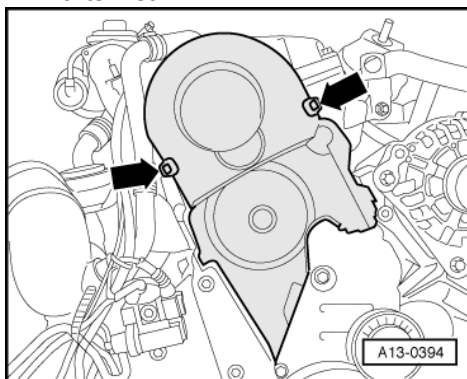
Component	Nm
Upper section of intake manifold to lower section	3
Lower section of intake manifold to cylinder head	20
Engine cover bracket to lower section of intake manifold	20

1.5 - Removing and installing cylinder head cover

Auxiliary equipment required

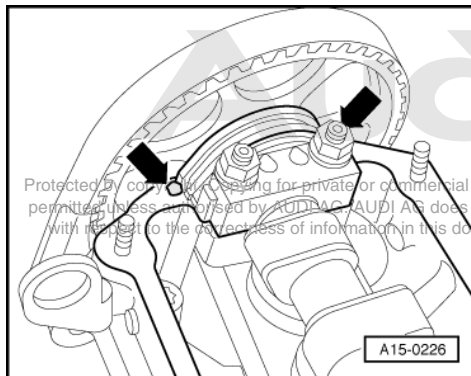
- ♦ Sealants

=> Parts List



Removing

- Remove upper section of intake manifold => Page 122 .
- -> Remove the upper toothed belt guard -arrows-.
- Loosen nuts on cylinder head cover.
- Remove reinforcement strips, bracket, toothed belt guard and cylinder head cover. => from Page 116 .



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Installing

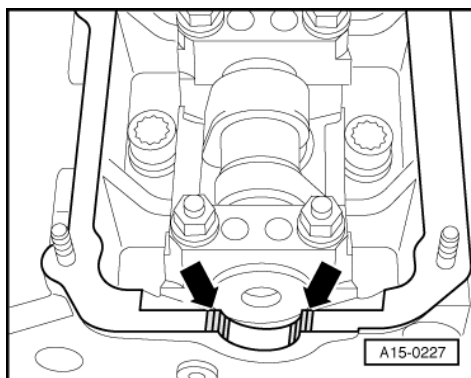
Installation is carried out in the reverse order; note the following:

Note:

Replace cylinder head cover gaskets if damaged.

- -> Apply a small quantity of sealant to joints -arrows- on upper sealing surface of cylinder head.
- Sealants

=> Parts List



- -> Apply a small quantity of sealant to joints -arrows- on upper sealing surface of cylinder head.
- Sealants

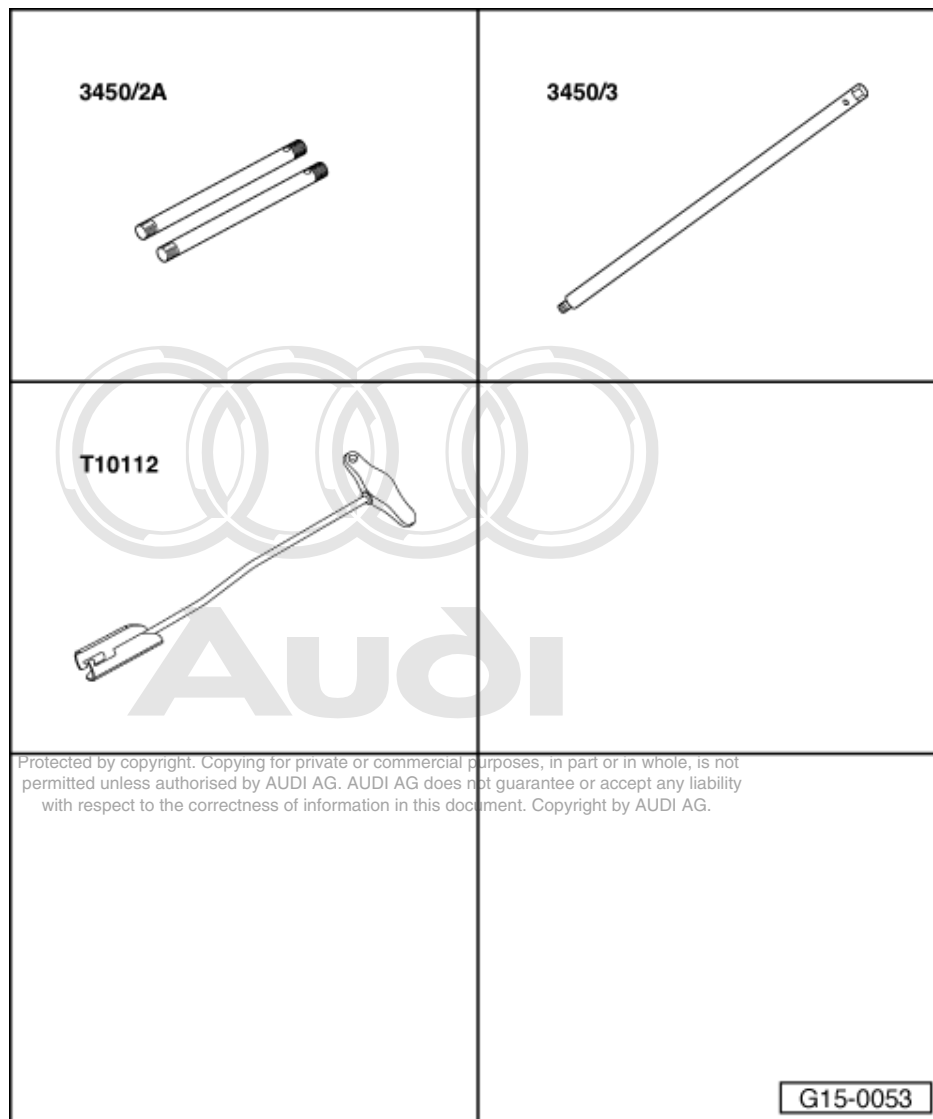
=> Parts List

- Position cylinder head cover, reinforcement strips, toothed belt guard and bracket.
- Tighten nuts for cylinder head cover in diagonal sequence.
- Note correct seating of upper toothed belt protection.
- Install upper section of intake manifold => Page 122 .

Tightening torque

Component	Nm
Cylinder head cover to cylinder head	10

1.6 - Removing cylinder head - vehicles with engine codes AEH, AKL



Special tools and workshop equipment required

- ◆ Guide pin 3450/2A
- ◆ Removal/installation tool 3450/3
- ◆ Puller T10112

- Engine in vehicle

Notes:

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



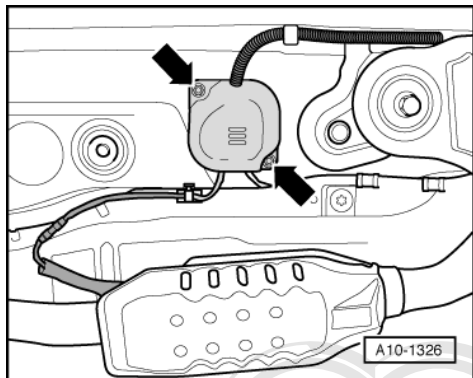
- ♦ If engine oil is contaminated perform oil change:

=> Maintenance Manual

Important

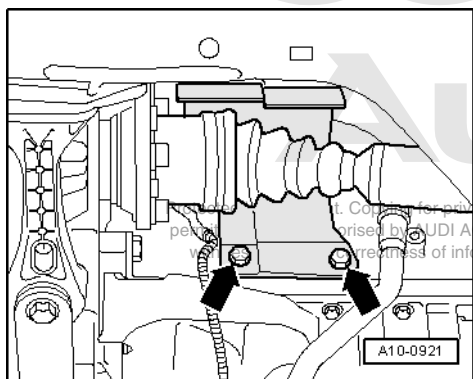
On vehicles with telematics, activate service mode of telematics control unit before disconnecting battery. => Radio, Telephone and Navigation System; Repair group 91

- Refer to coding on vehicles with encoded radio/radio navigation system (RNS); if necessary, interrogate.
- Disconnect earth strap at battery with ignition switched off.
- Drain coolant => Page 215 .



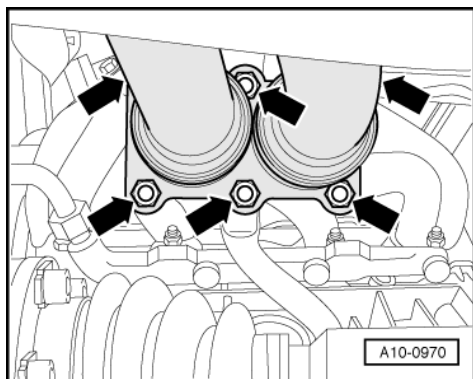
Vehicles with engine code AKL:

- -> Unscrew protective cover -arrows- on vehicle floor.
- Unplug connector for lambda probe upstream of catalytic converter and lay wiring aside.



All models:

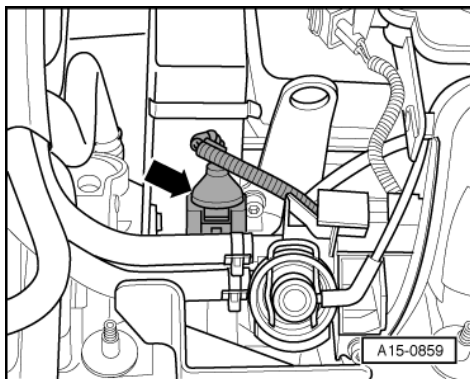
- -> Unbolt heat shield for right drive shaft -arrows-.



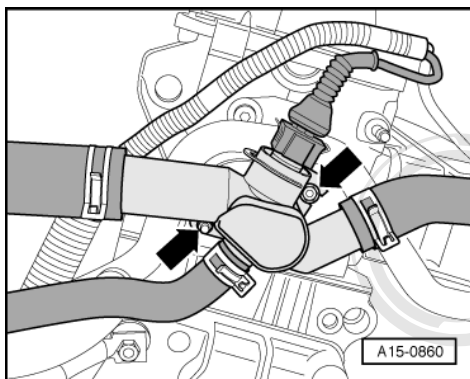
Note:

The isolating element in front exhaust pipe must not be deflected more than 10° to avoid damage.

- -> Remove securing bolts -arrows- of front exhaust pipe/exhaust manifold.
- Remove front exhaust pipe from exhaust manifold.
- Remove upper section of intake manifold => Page 122 .



- -> Unplug connector -arrow- at Hall sender -G40.
- Unclip the wiring duct at the intake manifold and detach the connectors for the injectors.
- Move wiring harness aside.
- Detach the spark plug connectors using puller T10112.
- Unbolt bracket for engine cover.
- Position crankshaft to TDC for cylinder 1 with engine installed => Page 76 .
- Position crankshaft to TDC for cylinder 1 with engine removed => Page 78 .
- Removing toothed belt from camshaft sprocket
=>Page 73 .
- Disconnect coolant hose from cylinder head (left side).



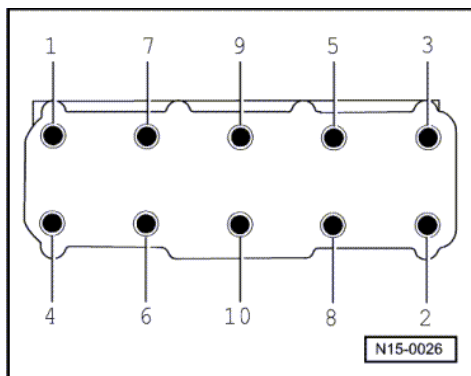
- -> Detach the left connection from the cylinder head -arrows- and lay aside.

Note:

The coolant hoses remain attached at the connection.

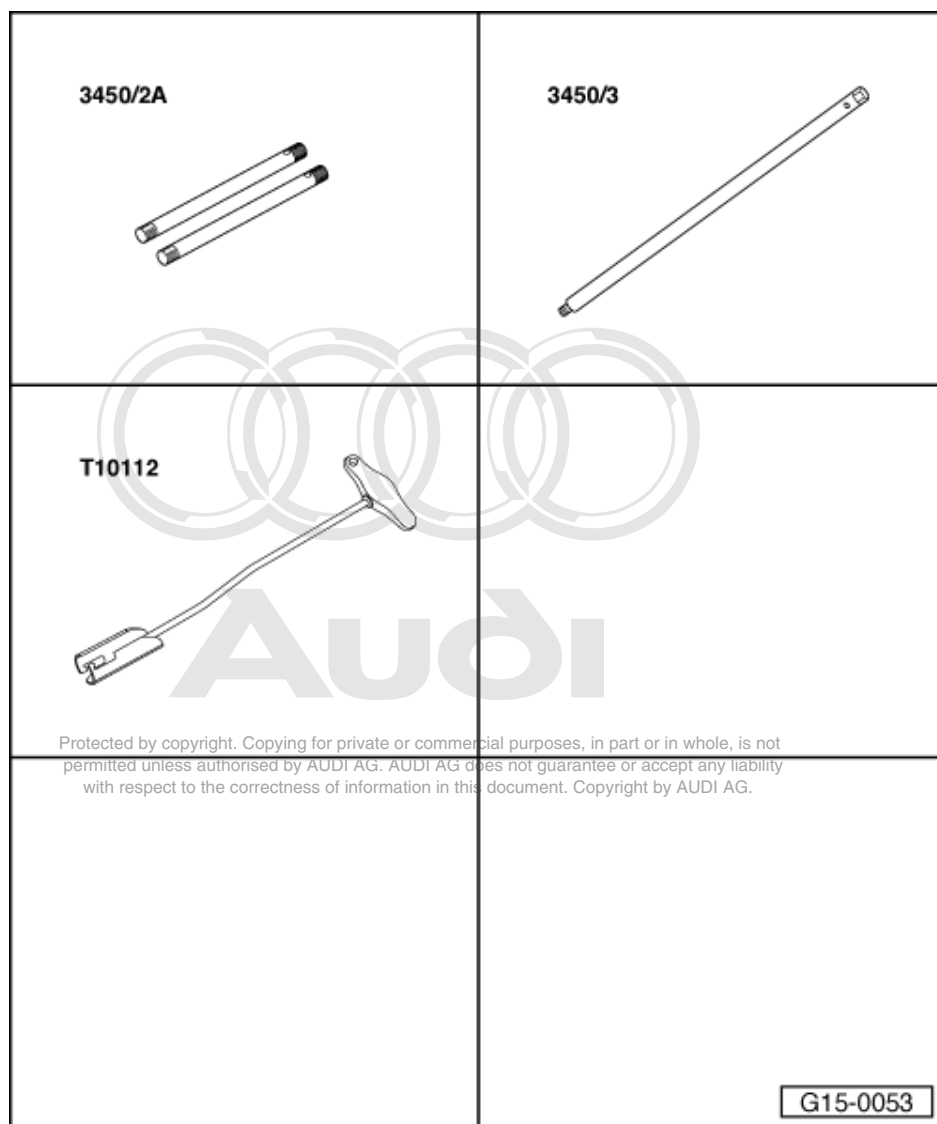
- Removing cylinder head cover => page 133

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- -> Loosen cylinder head bolts in the sequence 1...10.
- Remove cylinder head.

1.7 - Removing cylinder head - vehicles with engine code APF



Special tools and workshop equipment required

- ◆ Guide pin 3450/2A
- ◆ Removal/installation tool 3450/3
- ◆ Puller T10112

- Engine in vehicle

Notes:

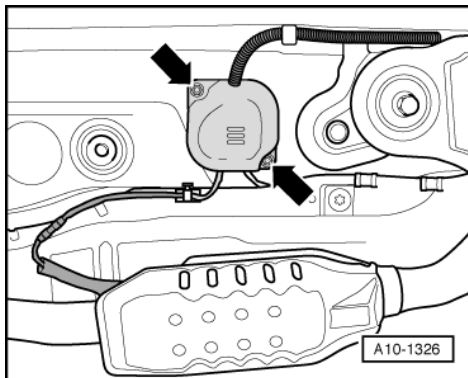
- ◆ All cable ties which are released or cut open when removing must be fitted in the same position when installing.
- ◆ If engine oil is contaminated perform oil change:

=> Maintenance Manual

Important

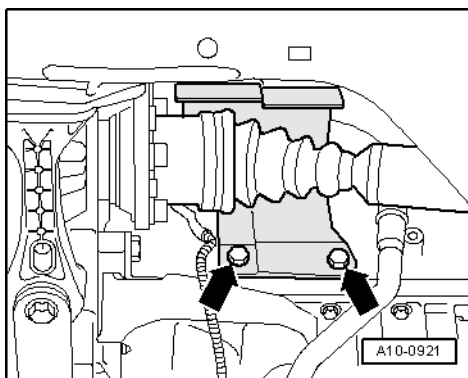
On vehicles with telematics, activate service mode of telematics control unit before disconnecting battery. => Radio, Telephone and Navigation System; Repair group 91

- Refer to coding on vehicles with encoded radio/radio navigation system (RNS); if necessary, interrogate.
- Disconnect earth strap at battery with ignition switched off.
- Drain coolant => Page 215 .

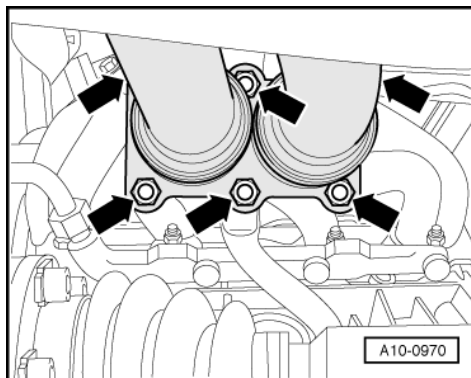


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- -> Unscrew protective cover -arrows- on vehicle floor.
- Unplug connector for lambda probe upstream of catalytic converter and lay wiring aside.



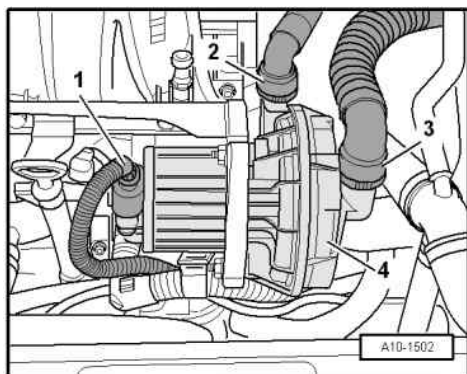
- -> Unbolt heat shield for right drive shaft -arrows-.



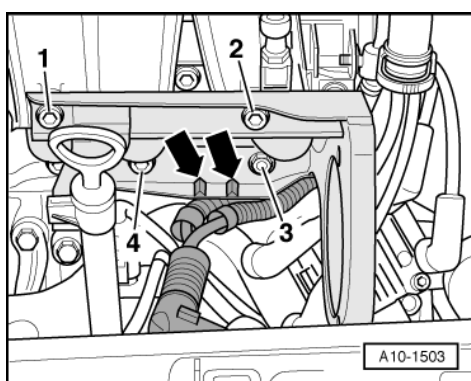
Note:

The isolating element in front exhaust pipe must not be deflected more than 10° to avoid damage.

- -> Remove securing bolts -arrows- of front exhaust pipe/exhaust manifold.
- Remove front exhaust pipe from exhaust manifold.
- Remove upper section of intake manifold => Page 126 .
- Disconnect the thin coolant hose at the breather connection -Item 115 at rear of cylinder head.



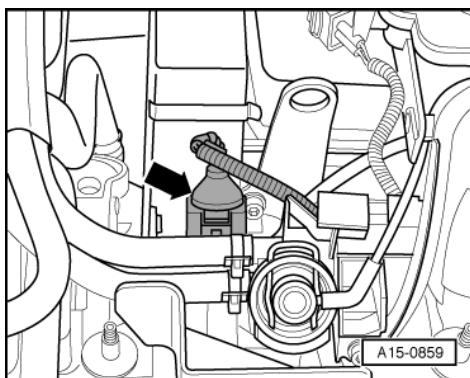
- -> Detach connector -1-.
- Disconnect hoses -2- and -3- at the secondary air pump.
- Detach the secondary air pump -4- from the bracket.



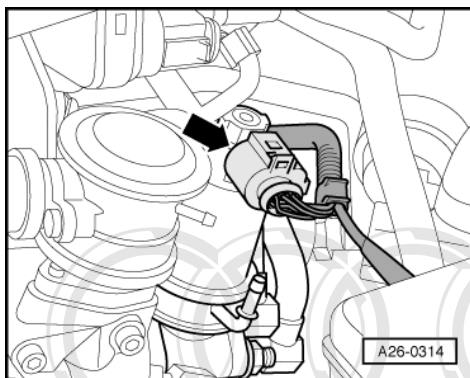
- -> Unscrew bolts -1...4- of the secondary air pump bracket.
- Lay the wiring aside -arrow- and remove the secondary air pump bracket.



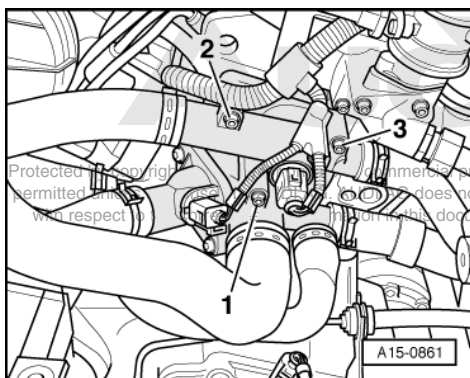
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- -> Unplug connector -arrow- at Hall sender -G40.
- Unclip the wiring duct at the intake manifold and detach the connectors for the injectors.
- Lay the wiring duct aside.
- Detach the spark plug connectors using puller T10112.
- Position crankshaft to TDC for cylinder 1 with engine installed => Page 76 .
- Position crankshaft to TDC for cylinder 1 with engine removed => Page 78 .
- Removing toothed belt from camshaft sprocket
=>Page 73 .



- -> Unplug connector -arrow-.

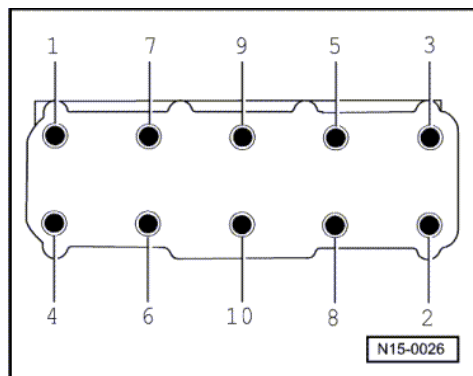


- -> Unscrew bolts -1...3- of the coolant distributor housing on the left of the cylinder head and lay the housing aside.

Note:

The coolant hoses remain connected.

- Removing cylinder head cover => page 133



- -> Loosen cylinder head bolts in the sequence 1...10.
- Remove cylinder head.

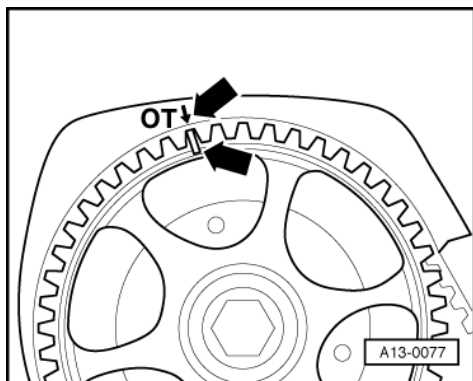
1.8 - Installing cylinder head

Notes:

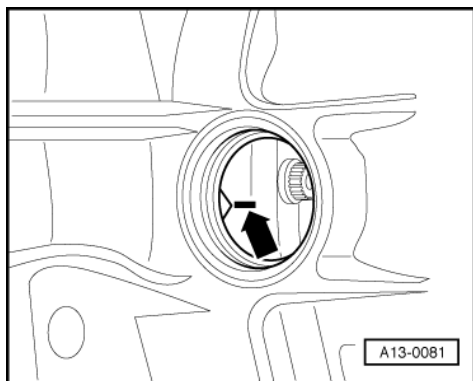
- ♦ Replace the cylinder head bolts.
- ♦ When performing installation procedures always replace self-locking nuts and bolts.
- ♦ Replace seals, gaskets, and bolts which have a specified tightening angle.
- ♦ Secure all hose connections with the correct hose clamps (same as original equipment):

=> Parts List

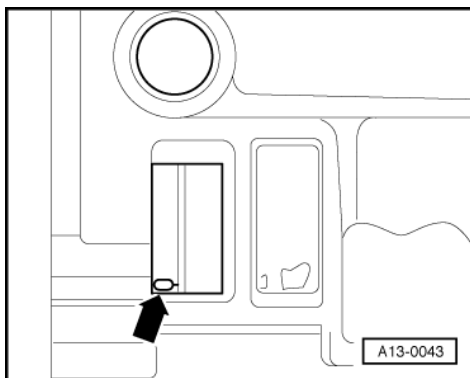
- ♦ If repairing, carefully remove any remains of gasket material from the cylinder head and cylinder block. Make sure that no long scores or scratches are made on the surfaces.
- ♦ Carefully remove any remaining emery and abrasive material.
- ♦ Remove new cylinder head gasket from packaging, just before installation.
- ♦ Handle gasket extremely carefully. Damaging the silicone layer or the indented area will lead to leaks.
- ♦ No oil or coolant must be allowed to remain in the blind holes for the cylinder head bolts in the cylinder head.



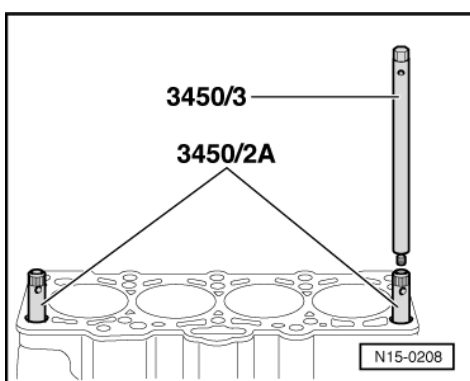
- -> Bring mark on camshaft sprocket in line with the mark on toothed belt guard -arrows-.



- Check again whether the crankshaft is positioned to TDC for cylinder 1:
 - -> Vehicles with manual gearbox



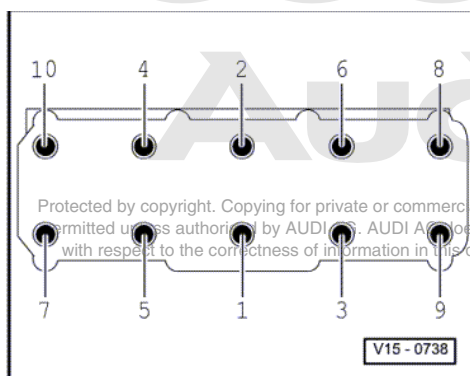
- -> Vehicles with automatic gearbox



- -> Place cylinder head gasket in position.
 - Check installation position of cylinder head gasket. Part number points towards cylinder head, and must be legible from the inlet side
- To centralise, screw guide pins 3450/2A with removal/installation tool 3450/3 into the outer holes on the intake side.

Notes:

- ♦ The tolerance of the centring holes in the cylinder head has been reduced in the upper area.
- ♦ For this reason, check whether the guide pins can be removed upwards prior to fitting the cylinder head. If necessary, grind down the knurl of the guide pin slightly.
- Position cylinder head.
- Fit 8 cylinder head bolts and tighten by hand.
- Unscrew guide pins through bolt holes using removal/installation tool 3450/3 and install remaining cylinder head bolts.
- Insert cylinder head bolts and tighten by hand.



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- ➔ Tighten cylinder head in three stages in sequence shown, as follows:
- Tighten using torque wrench:
 - 1st Stage: 40 Nm
- Tighten with rigid wrench:
 - 2nd Stage: 90°(1/4 turn) further
 - 3rd Stage: 90°(1/4 turn) further

Note:

It is not necessary to retighten cylinder head bolts after repairs have been performed.

- Install cylinder head cover => Page 134 .
- Install toothed belt (adjust valve timing) => Page 74 .
- Install upper section of intake manifold => Page 126 .

Vehicles with throttle cable:

- Adjust throttle cable:

=> Fuel Supply System - Petrol Engines; Repair group 20; Servicing throttle mechanism - Vehicles with mechanical throttle mechanism Servicing throttle mechanism - Vehicles with mechanical throttle mechanism

All models:

- Check oil level => Page 183 .

Note:

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When engine oil is contaminated perform oil change:

=> Maintenance Manual

- Install front exhaust pipe => Page 238 .
- Stress-free alignment of exhaust system => Page 238
- Top up coolant => Page 217 .

Notes:

- ♦ If the battery is reconnected, please ensure that the vehicle equipment (radio, radio/navigation system, clock, electric window lifters) is activated as described in the operating instructions.
- ♦ Deactivate the service mode of the telematics control unit.

=> Radio, Telephone and Navigation System; Repair group 91

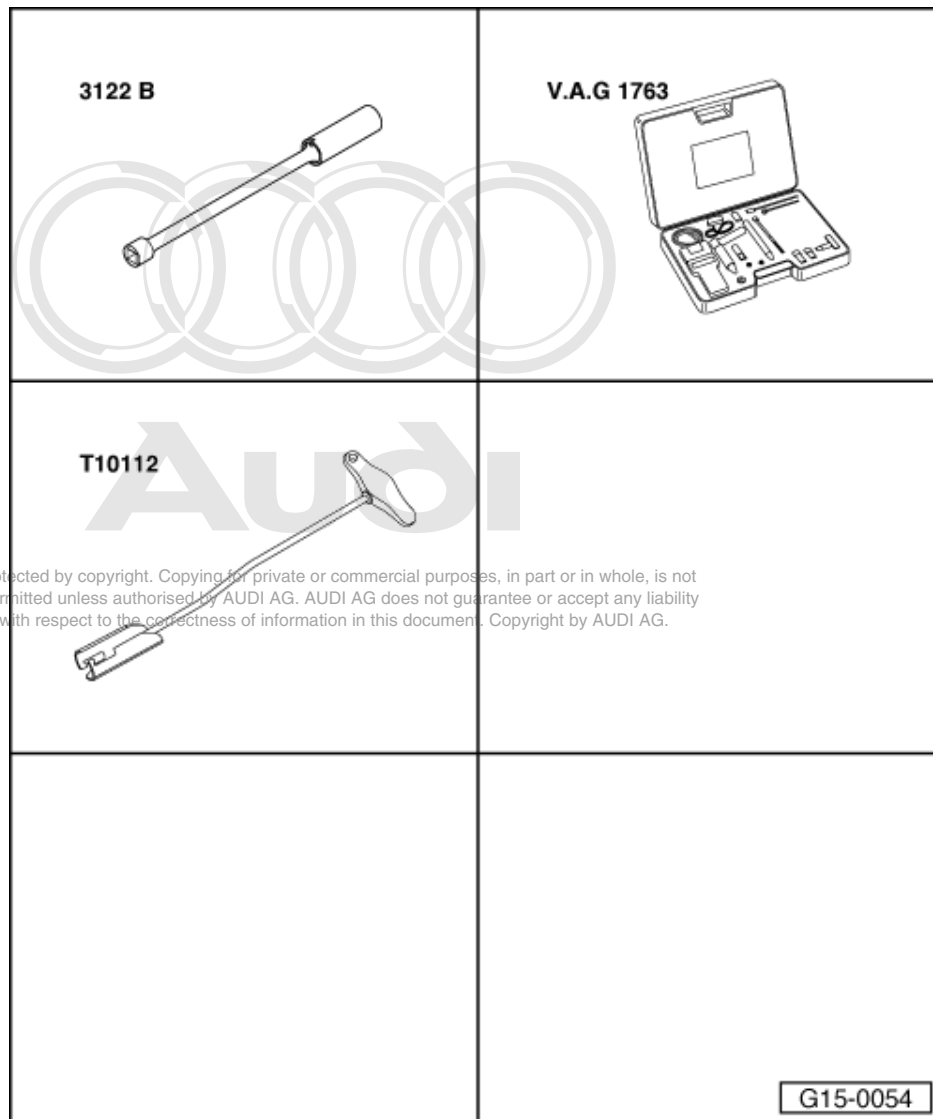
- ♦ Further measures after reconnection of voltage supply:

=> Simos Fuel Injection and Ignition System; Repair group 24

Tightening torques

Component	Nm
Connection to cylinder head	10
Coolant distributor housing to cylinder head	10
Bracket for secondary air pump to cylinder head	20

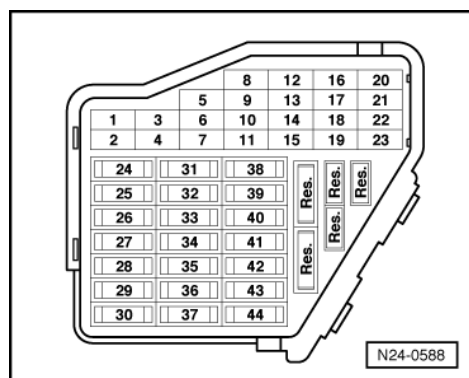
1.9 - Checking compression



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Special tools and workshop equipment required

- ◆ Spark plug socket 3122 B
- ◆ Compression test unit V.A.G 1763
- ◆ Puller T10112



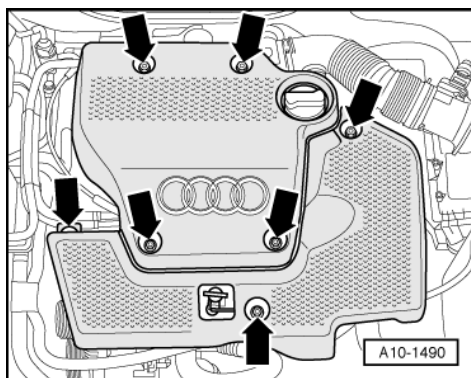


Test requirements:

- Engine oil temperature at least 30 °C
- Battery voltage at least 12.7 V

Test sequence

- Switch ignition off.
- -> Remove the fuses from sockets "32" and "29" for ignition coils and injectors.



- -> Remove engine covers -arrows-.

Note:

Illustration shows bolted engine cover.

- Detach the connectors at the outer injectors.
- Detach the spark plug connectors using puller T10112.
- Remove spark plugs with spark plug socket 3122B.
- Fully open throttle valve.
- Check compression with compression test unit V.A.G 1763.

Note:

Using the compression tester

=> Operating Instructions

- Operate starter until tester shows no further pressure increase.

Compression values:

New pressure in bar	Wear limit pressure in bar	Permissible difference between cylinders pressure in bar
10.0...13.0	7.0	max. 3.0

- Install spark plugs.
- Finally, interrogate and erase the engine control unit fault memory as faults are stored when the fuses are removed.

=> Simos Fuel Injection and Ignition System; Repair group 01

Tightening torque

Component	Nm
-----------	----



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Spark plugs in cylinder head

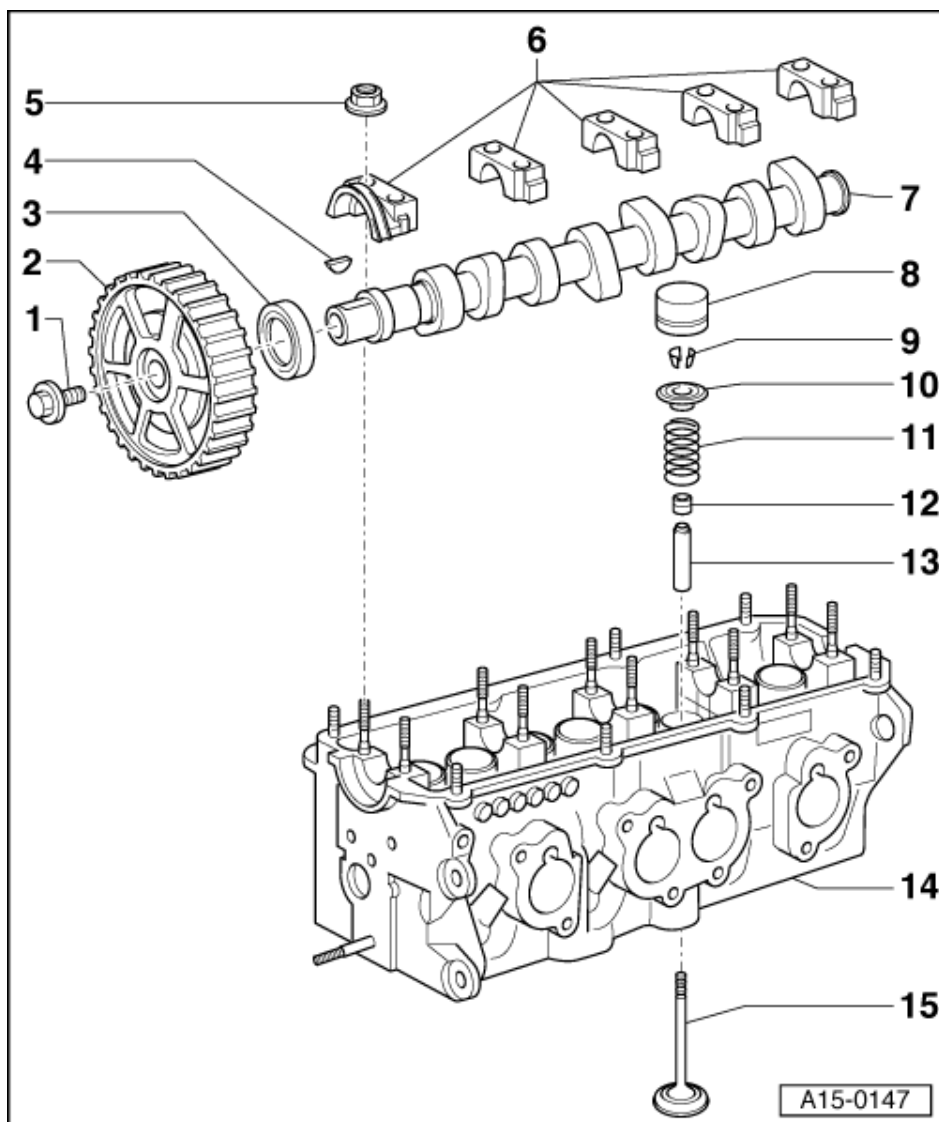
30

2 - Servicing valve gear

2.1 - Servicing valve gear

Notes:

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



1 100 Nm

- ♦ For loosening and tightening use counterhold 3036 =>Fig. 66

2 Camshaft sprocket

- ♦ With sender wheel for Hall sender -G40

- ♦ For removal and installation remove toothed belt => Page 67
- ♦ Installation position is fixed by Woodruff key -Item 4 -

3 Sealing ring

- ♦ Replacing => Page 153 .

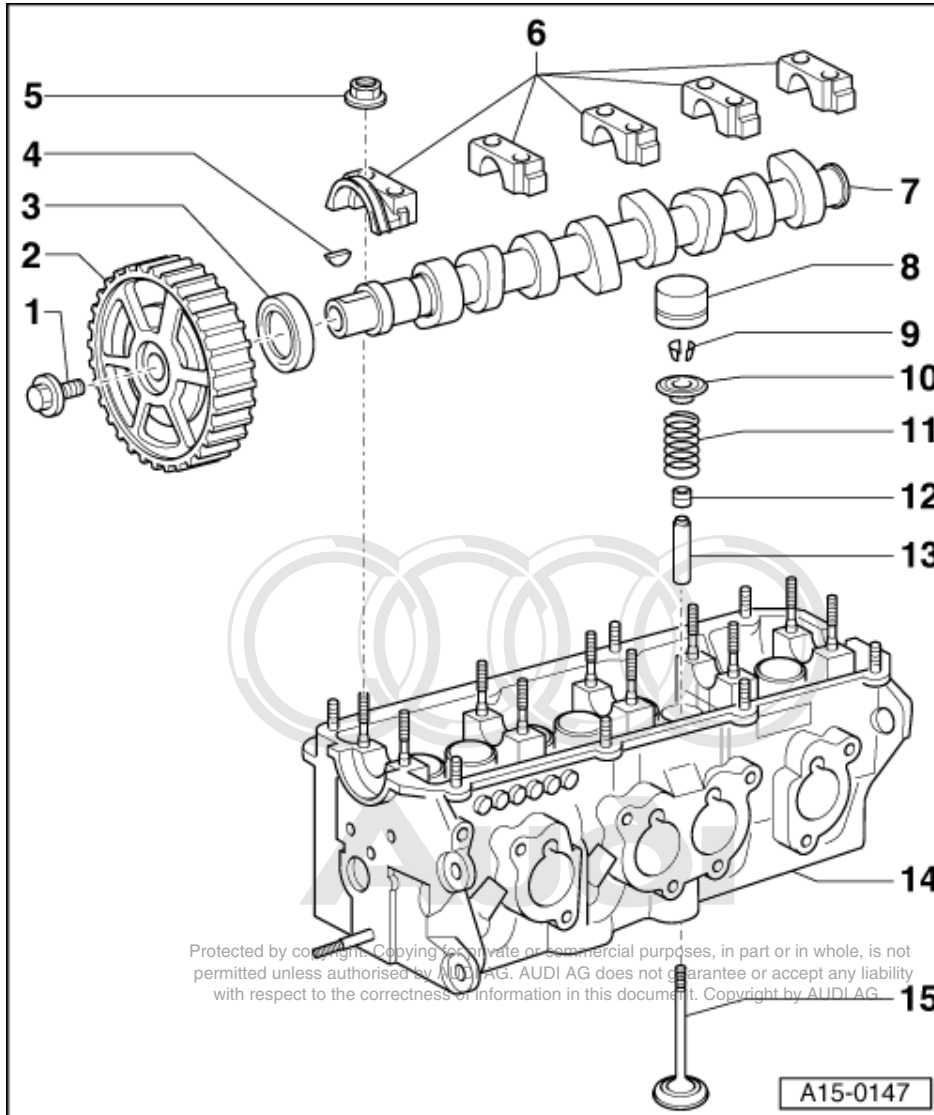
4 Woodruff key

- ♦ Ensure tight fit

5 20 Nm

6 Bearing cap

- ♦ Installation position => Fig. 2 .
- ♦ Installation sequence => Installing camshaft, Page 156



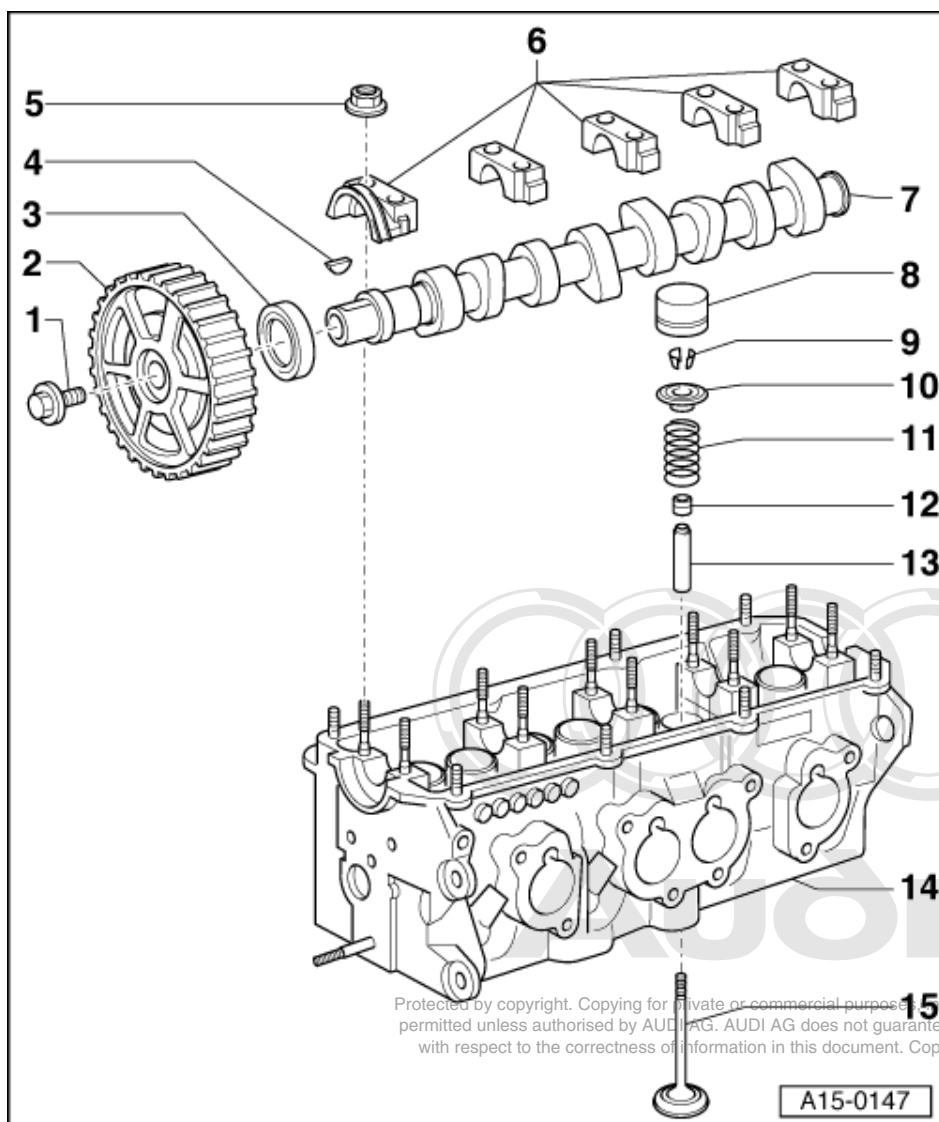
7 Camshaft

- ♦ Check radial play with plastigage (bucket tappets not installed).
Wear limit: 0.1 mm
- ♦ Run-out: no more than 0.01 mm
- ♦ Checking axial play
=>Page 152 .
- ♦ Removing and installing
=>Page 155 .

8 Hydraulic bucket tappet

- ♦ Checking => Page 157
- ♦ Removing and installing with cylinder head installed
=>Page 159 .
- ♦ Removing and installing with cylinder head removed with 2037

- ♦ Do not interchange
- ♦ Store with cam contact surface downwards
- ♦ Before installing check camshaft axial play=>Page 152 .
- ♦ Oil contact surface



9 Valve cotteners

10 Valve spring plate

11 Valve springs

- ♦ Removing and installing with cylinder head installed
=>Page 159 .
- ♦ Removing and installing with cylinder head removed with 2037

12 Valve stem seal

- ♦ Replacing => Page 159 .

13 Valve guide

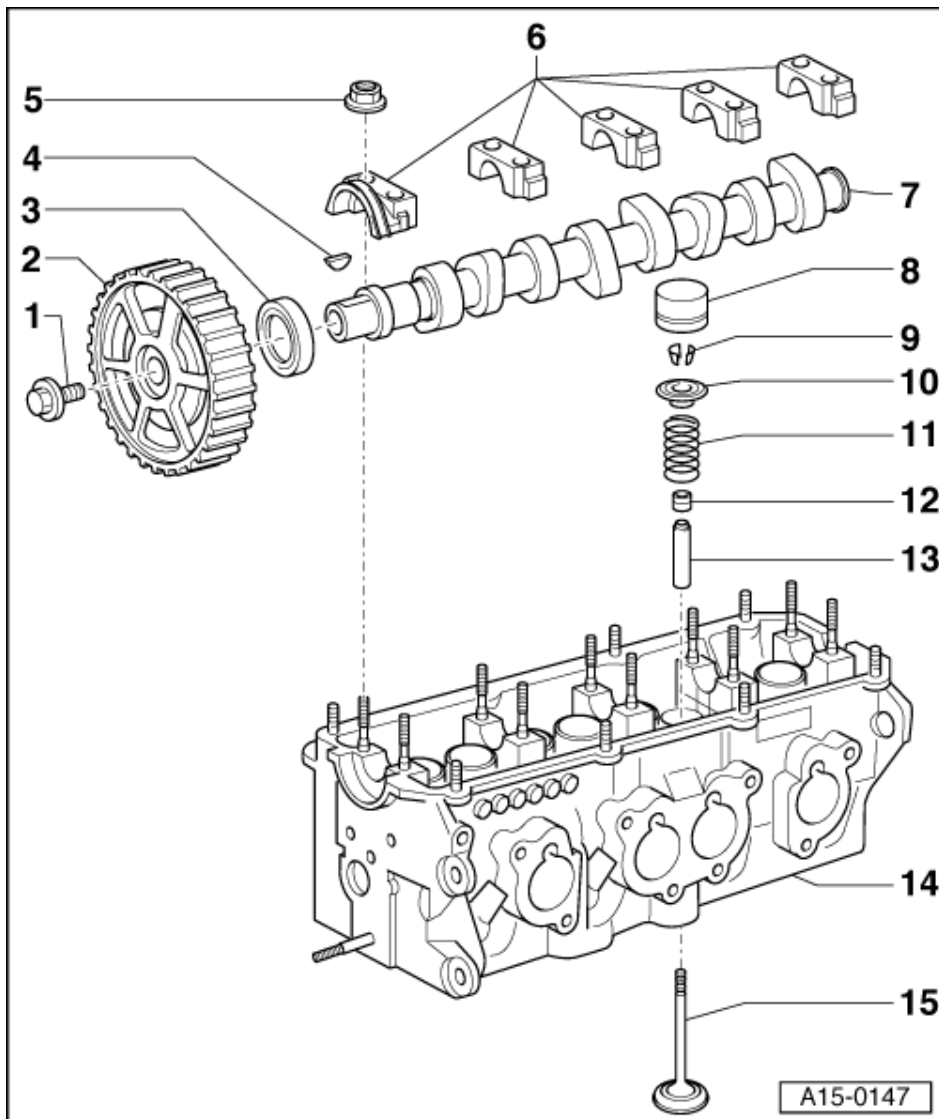
- ♦ Checking => Page 162

14 Cylinder head

- ♦ See note
=>Page 147 .
- ♦ Checking valve guides
=>Page 162 .
- ♦ Reworking valve seats



=>Page 165 .

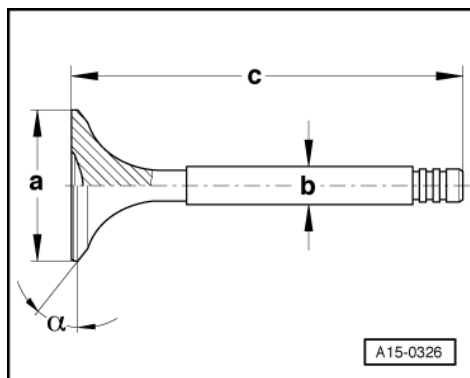


15 Valve

- ◆ Do not rework, only grinding in is permitted
- ◆ Removing and installing with cylinder head removed with 2037
- ◆ Valve dimensions
=> Fig. 151
- ◆ Checking valve guides
=>Page 162 .
- ◆ Reworking valve seats
=>Page 165 .



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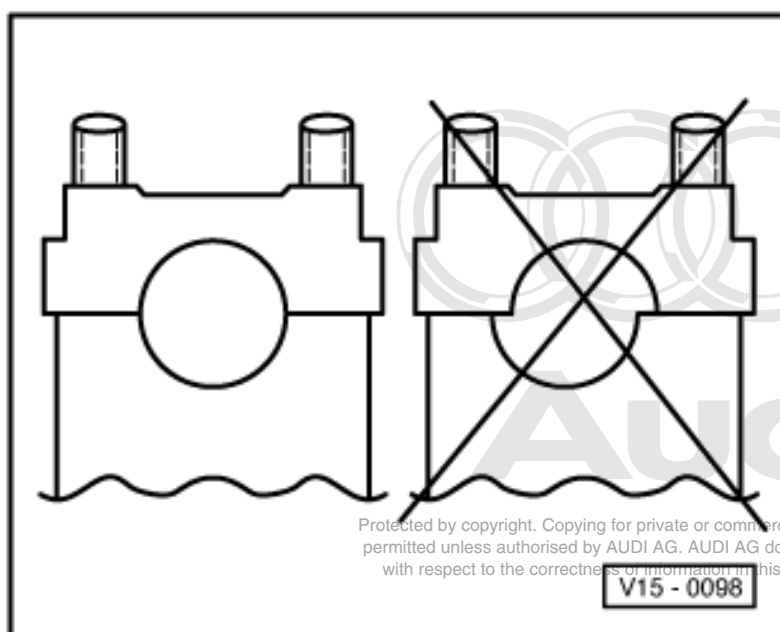


-> Fig. 1 Valve dimensions

Note:

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

Dim.	Inlet valve	Exhaust valve
øa mm	39.5 ±0.15	32.9 ±0.15
øa mm	6.92 ±0.02	6.92 ±0.02
c mm	91.85	91.15
α <°	45	45



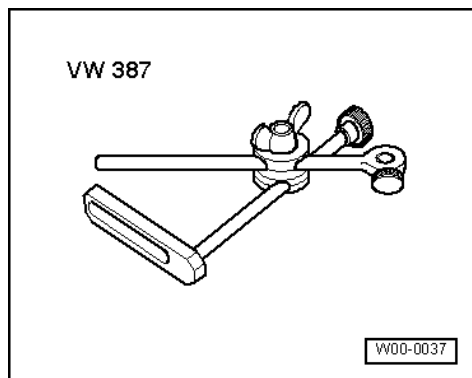
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-> Fig. 2 Installation position of camshaft bearing caps

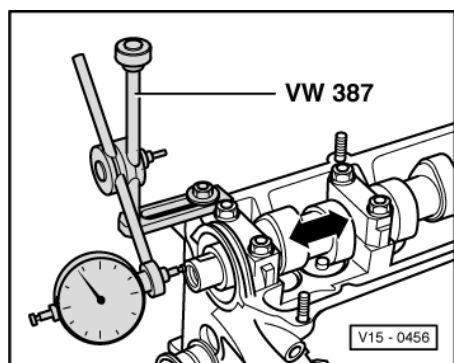
Note offset. Before installing camshaft fit bearing caps and determine installation position.

2.2 - Checking camshaft axial play



Special tools and workshop equipment required

- ♦ Universal dial gauge bracket VW 387
- ♦ Dial gauge



Test sequence

Measure with tappets removed and with first and last bearing caps fitted.

- -> Attach universal dial gauge bracket VW 387 with dial gauge to cylinder head.

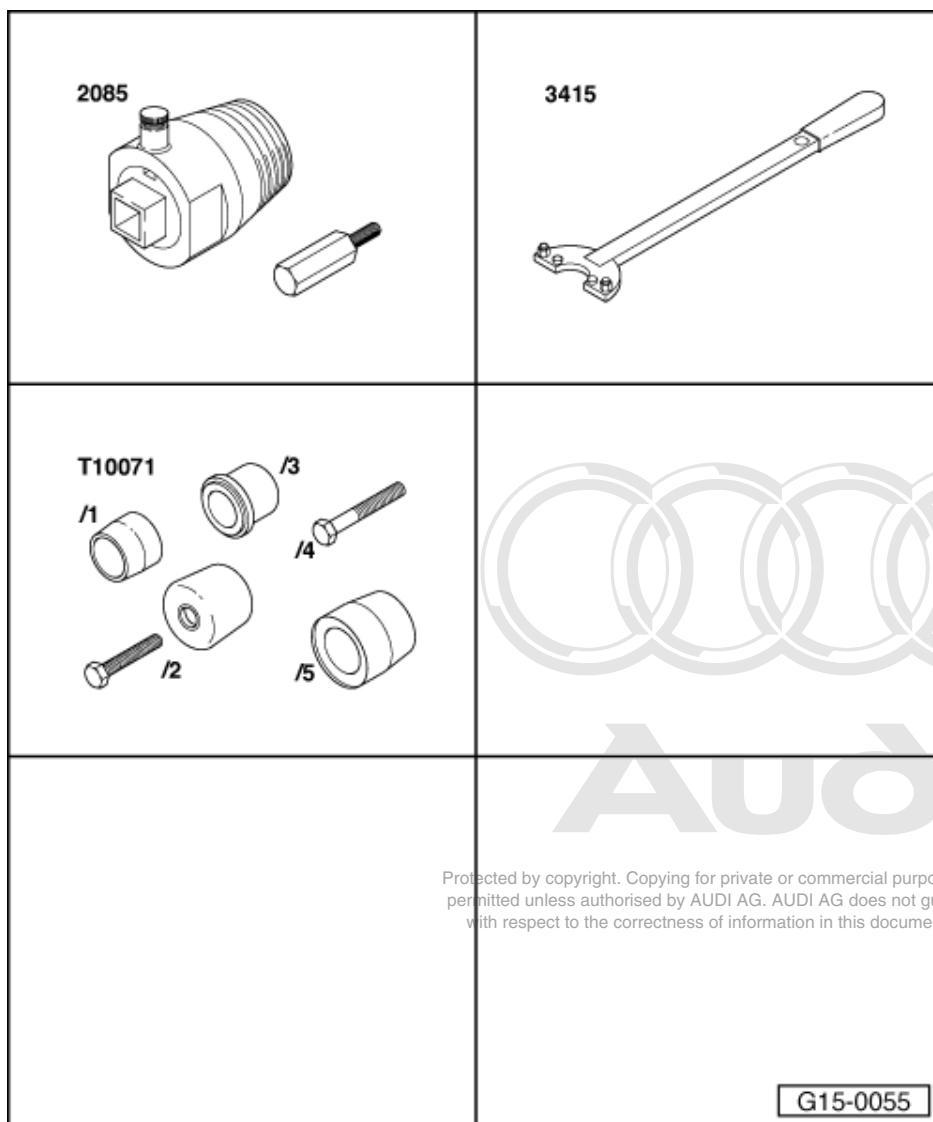
Wear limit for camshaft.

- ♦ Axial play: no more than 0.15 mm



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2.3 - Replacing camshaft oil seal

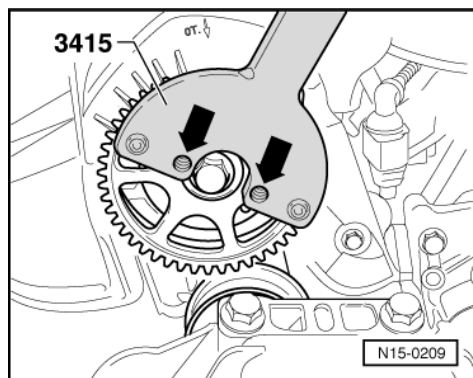


Special tools and workshop equipment required

- ◆ Oil seal extractor 2085
- ◆ Counterhold 3415
- ◆ Assembly tool T10071

Removing

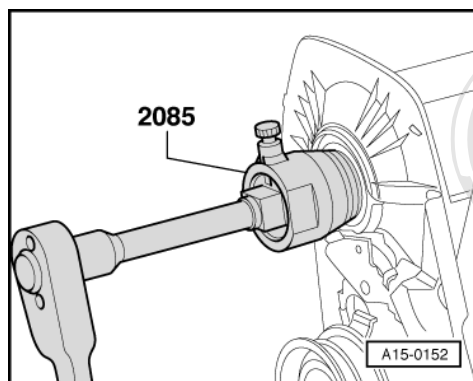
- Cylinder head installed
- Position crankshaft to TDC for cylinder 1 with engine installed => Page 76 .
- Position crankshaft to TDC for cylinder 1 with engine removed => Page 78 .
- Removing toothed belt from camshaft sprocket
=>Page 73 .



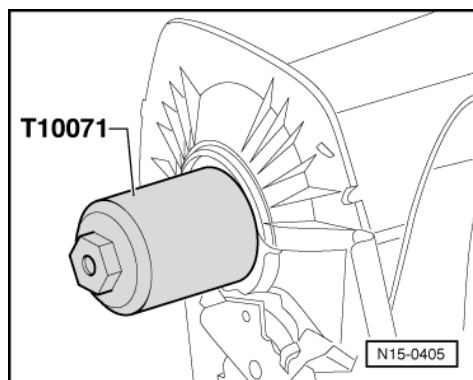
Note:

Remove the bolts from the threaded bores -arrows- before applying counterhold 3415.

- -> Detach camshaft sprocket (use counterhold 3415).
- Remove camshaft sprocket.
- Remove Woodruff key from camshaft.



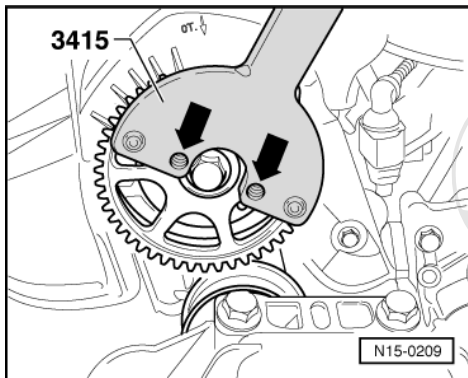
- Fully insert securing bolt for camshaft sprocket into camshaft by hand in order to guide the oil seal extractor.
- Adjust inner part of oil seal extractor 2085 until it is flush with the outer part and lock in position with knurled screw.
- -> Lubricate threaded head of oil seal extractor 2085, place it in position and, exerting firm pressure, screw it into oil seal as far as possible.
- Loosen knurled screw and turn inner part of extractor against camshaft until oil seal has been extracted.
- Clamp flats of oil seal extractor in vice. Remove oil seal with pliers.



Installing

- Do not lubricate sealing lip of oil seal.
- -> Position oil seal with guide sleeve T10071/1 and press in up to stop with press sleeve T10071/2.
- Remove guide sleeve.

- Insert Woodruff key in camshaft.



- -> Fit and tighten the camshaft sprocket (use counterhold 3415)

Note:

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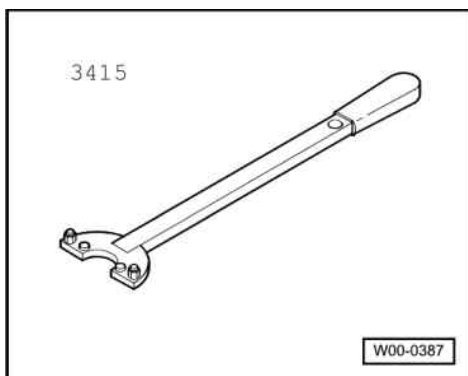
If a piston is at TDC the valves could strike the piston when turning the camshaft. To avoid damage to valves and pistons the pistons must not be at TDC. Danger of damaging valves/pistons.

- Install toothed belt (adjust valve timing) => Page 74 .

Tightening torque

Component	Nm
Camshaft sprocket to camshaft	100

2.4 - Removing and installing camshaft

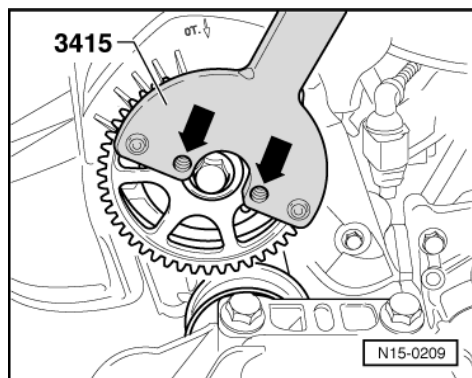


Special tools and workshop equipment required

- ♦ Counterhold 3415

Removing

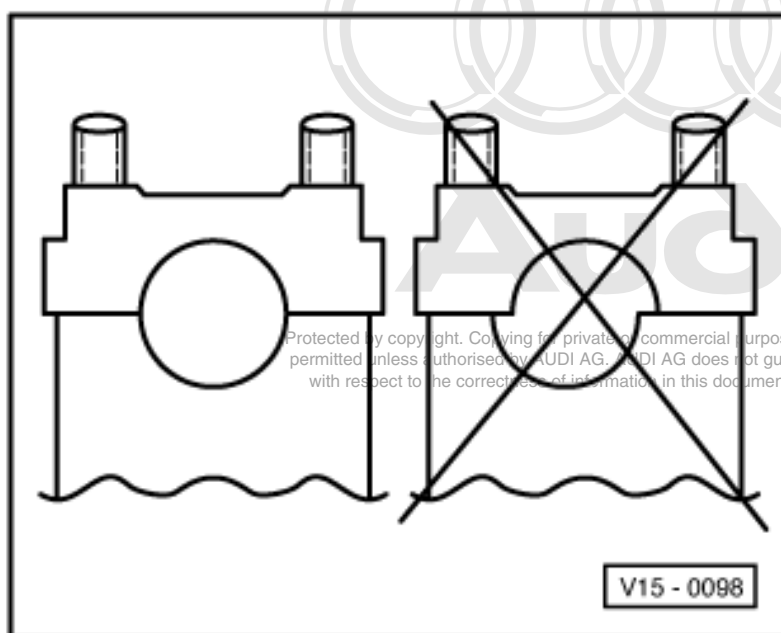
- Cylinder head installed
- Position crankshaft to TDC for cylinder 1 with engine installed => Page 76 .
- Position crankshaft to TDC for cylinder 1 with engine removed => Page 78 .
- Removing toothed belt from camshaft sprocket
=>Page 73 .



Note:

Remove the bolts from the threaded bores -arrows- before applying counterhold 3415.

- -> Detach camshaft sprocket (use counterhold 3415).
- Remove camshaft sprocket.
- Remove Woodruff key from camshaft.
- Remove cylinder head cover => Page 133 .
- Remove oil deflector.
- Only remove bearing caps 1, 3 and 5. Loosen bearing caps 2 and 4 alternately and diagonally.
- Remove camshaft.



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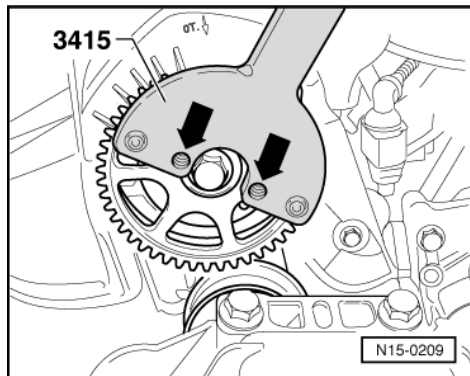
Installing

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

Notes:

- ♦ Renew camshaft oil seal.

- ♦ -> Before installing bearing caps, note bore offset and determine installation position.
- Oil camshaft running surfaces.
- Tighten bearing caps 2 and 4 alternately and diagonally to 20 Nm.
- Install bearing caps 5, 1 and 3 and also tighten to 20 Nm.
- Insert Woodruff key in camshaft.



- -> Fit and tighten the camshaft sprocket (use counterhold 3415).
- Install cylinder head cover => Page 134 .

Note:

If a piston is at TDC the valves could strike the piston when turning the camshaft. To avoid damage to valves and pistons the pistons must not be at TDC. Danger of damaging valves/pistons.

- Install toothed belt (adjust valve timing) => Page 74 .

Notes:

- ♦ Wait about 30 minutes after installing the camshafts before starting the engine. Hydraulic valve compensation elements have to settle (otherwise valves will strike pistons).
- ♦ After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.

Tightening torques

Component	Nm
Bearing cap to cylinder head	20
Camshaft sprocket to camshaft	100

2.5 - Checking hydraulic bucket tappets

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Auxiliary equipment required

- ♦ Feeler gauge
- ♦ Wood or plastic wedge

Notes:

- ♦ Hydraulic tappets cannot be adjusted or repaired.
- ♦ Irregular valve noise during starting is normal.

Test sequence

- Start engine and run until the radiator fan has switched on once.



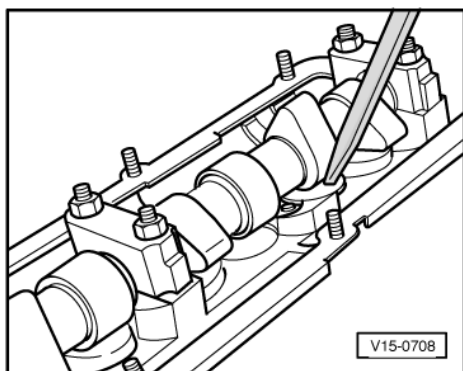
- Increase engine speed to about 2500 rpm for 2 minutes (perform road test if necessary).

Note:

If the irregular valve noises stop but recur repeatedly during short journeys, a new oil retention valve must be fitted. Oil retention valve fitting location: In oil filter bracket => -Item 174 .

If the hydraulic tappets are still noisy, locate defective tappets as follows:

- Remove cylinder head cover => Page 133 .
- Rotate crankshaft until the cams of the bucket tappets to be checked are pointing upwards:
 - Vehicles with manual gearbox: push vehicle forwards with 4th gear engaged and ignition switched off.
 - Vehicles with automatic gearbox: Remove centre and right noise insulation.
 - Turn crankshaft clockwise at crankshaft toothed belt sprocket central bolt.



- Determine play between cam and tappet.
- -> Use a wooden or plastic wedge to push down bucket tappet. If an 0.20 mm feeler gauge can be inserted between camshaft and tappet, replace tappet.
- Replacing bucket tappet => Removing camshaft, Page 155 .

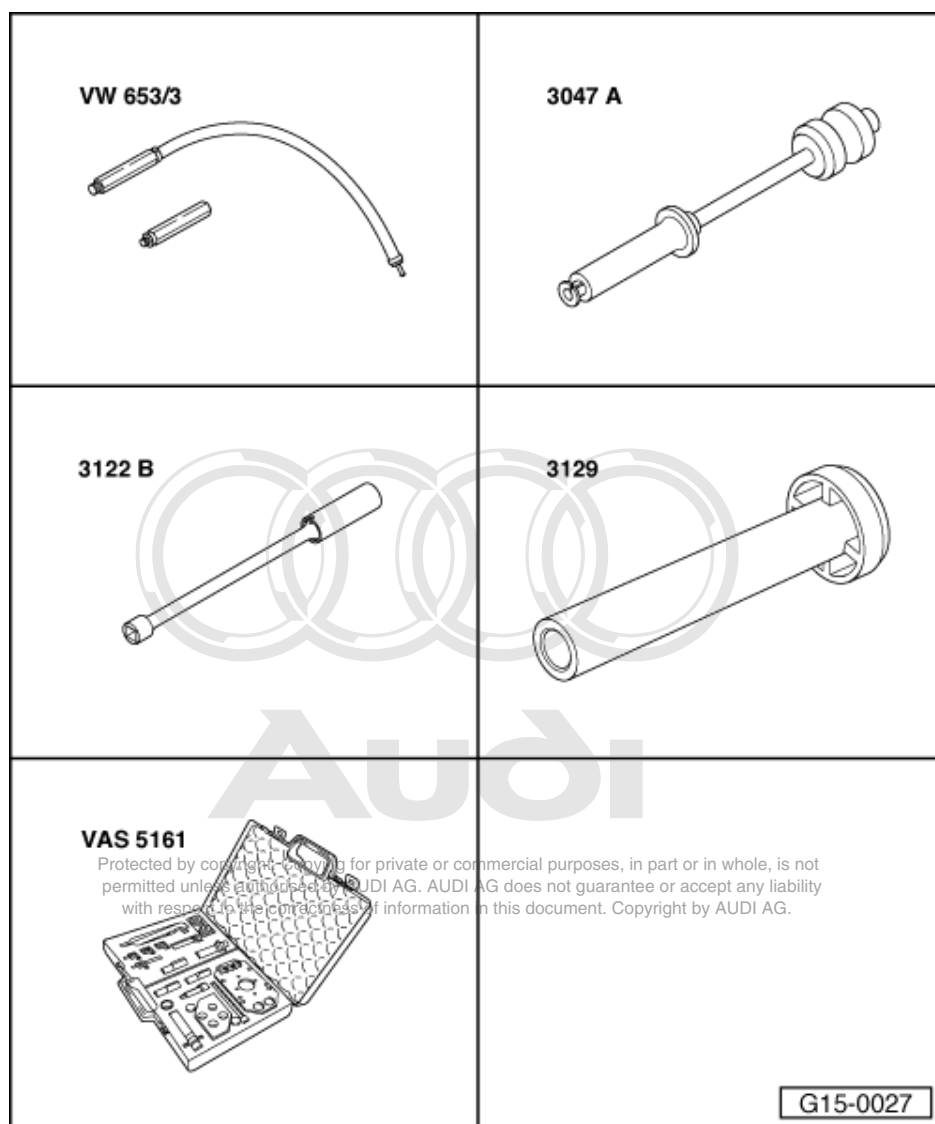
Notes:

- ♦ After installing the camshaft, wait for about 30 minutes before starting the engine. Hydraulic valve compensation elements have to settle (otherwise valves will strike pistons).
- ♦ After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.



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2.6 - Replacing valve stem seals



Special tools and workshop equipment required

- ◆ Pressure hose VW 653/3
- ◆ Puller 3047 A
- ◆ Spark plug socket 3122 B
- ◆ Fitting tool 3129
- ◆ Disassembly and assembly tool VAS 5161

Removing

- Cylinder head installed

Note:

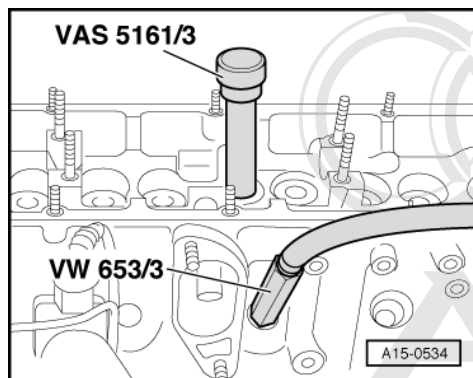
When cylinder head was removed the valve stem seals can be replaced when using special tool 2037.

- Removing camshaft => Page 155 .

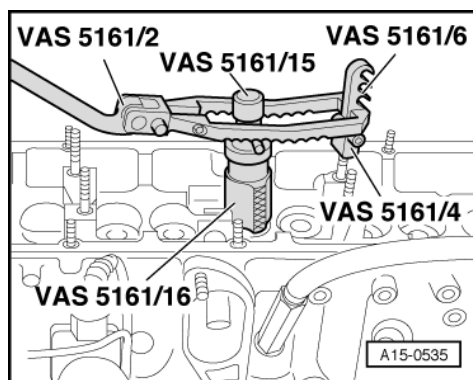
Notes:

- ◆ Make sure that the bucket tappets are not interchanged.

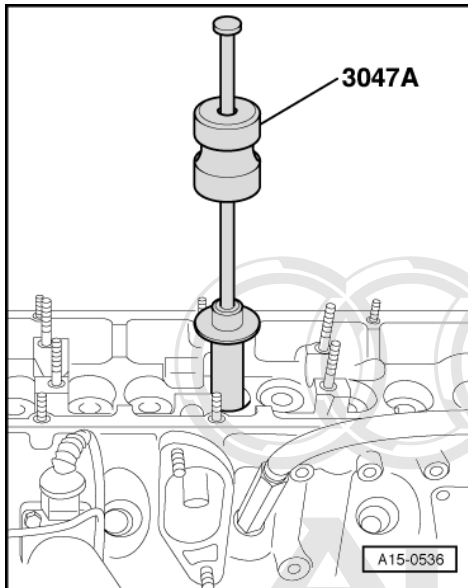
- ♦ Mark allocation of bucket tappets on rear with a waterproof felt-tip pen.
- Remove the bucket tappets from guides and put them down with the contact surface downwards.
- Remove spark plugs with spark plug socket 3122B.



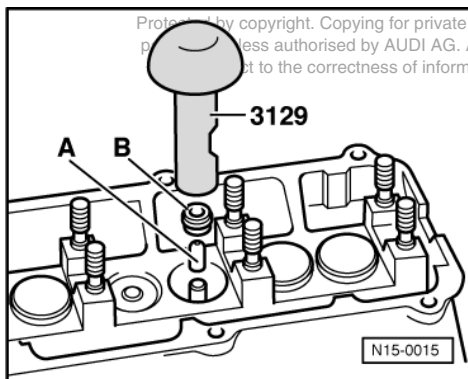
- Set piston of appropriate cylinder to "bottom dead centre".
- -> Screw in the pressure hose VW 653/3 into spark plug thread and put under constant pressure; at least 6 bar pressure.
- Loosen the valve wedges at all valves using mandrel VAS 5161/3 and a plastic hammer.



- -> Screw the catch part VAS 5161/6 with insertion fork VAS 5161/4 onto a stud on the cylinder head.
- Push guide bush VAS 5161/16 into bucket tappet guide of the valve to be removed until limit stop.
- Installation position of guide bush: Corrugated area points in direction of travel
- Push assembly cartridge VAS 5161/15 into guide bush.
- Attach pressure fork VAS 5161/2 to catch part VAS 5161/6 and push assembly cartridge down.
- At the same time turn knurled screw of assembly cartridge towards the right until the tips of the valve wedges engage.
- Slightly move the knurled screw back and forth. This causes the valve wedges to be pressed apart and taken into the cartridge.
- Release the pressure fork.
- Remove assembly cartridge, guide bush, valve plate and valve springs.



- -> Use 3047 A to remove valve stem seals.

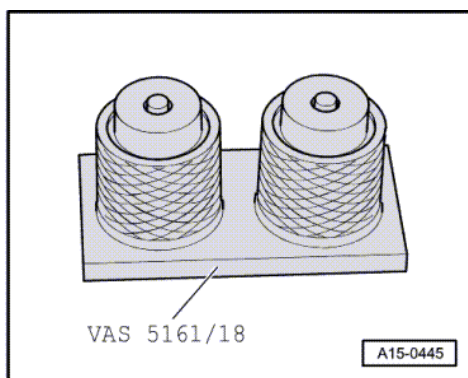


Installing

Note:

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

- -> To prevent damage to the new valve stem seals -B-, place plastic sleeve -A- on valve stem.
- Lightly lubricate sealing lip of valve stem seal.
- Push valve stem seal onto plastic sleeve.
- Carefully press the valve stem seal onto valve guide using press tool 3129.
- Remove plastic sleeve again.



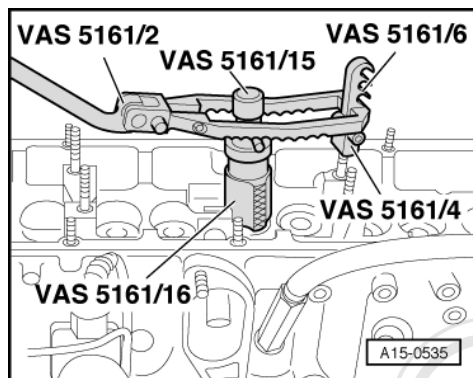


- -> If the valve wedges were taken out of the assembly cartridge they must first be inserted into the installing tool VAS 5161/18.

Note:

The large diameter of the valve wedges points upwards.

- Push assembly cartridge VAS 5161/15 from the top onto installing tool and take up the valve wedges.



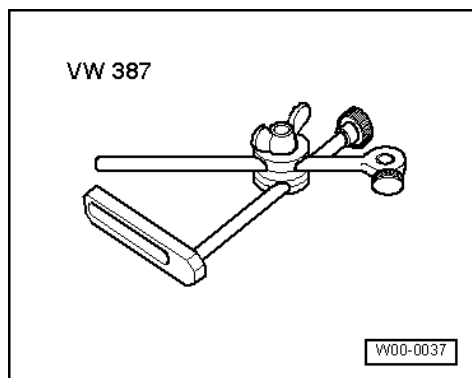
- -> Reinstall the assembly cartridge VAS 5161/15 into guide bush VAS 5161/16.
- Push pressure fork down and pull knurled screw upwards by turning to left and right - thus the valve wedges are installed.
- Take load of the pressure fork when knurled screw is still tight.
- Insert bucket tappet.
- Installing camshaft =>Page 156 .

Notes:

- ♦ After installing the camshaft, wait for about 30 minutes before starting the engine. Hydraulic valve compensation elements have to settle (otherwise valves will strike pistons).
- ♦ After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.

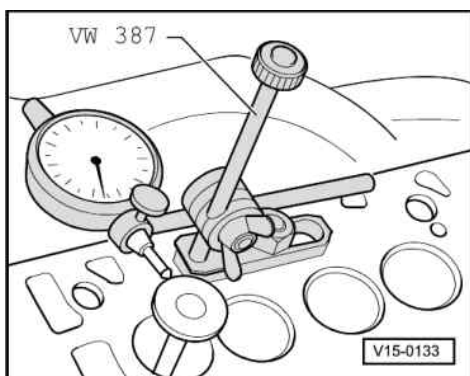
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2.7 - Checking valve guides



Special tools and workshop equipment required

- ♦ Universal dial gauge bracket VW 387
- ♦ Dial gauge



Test sequence

- -> Set valve in guide. The end of the valve stem is flush with guide.
- Determine rock.

Wear limit

Inlet valve guide	Exhaust valve guide
1.0 mm	1.3 mm

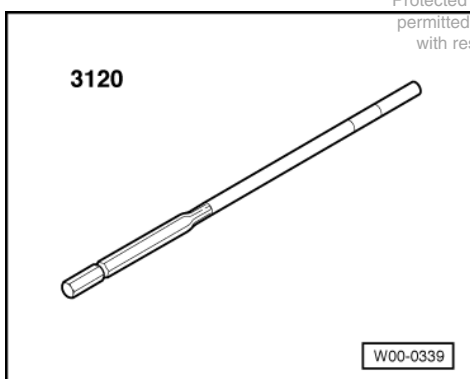
Notes:

- ♦ If the wear limit is exceeded, repeat the measurement with new valves. If the wear limit is again exceeded, replace the cylinder head. The valve guides cannot be replaced.
- ♦ If the valve must be replaced as part of a repair, use a new valve for the calculation.

2.8 - Checking valves

- Visually inspect stem and seat for scoring. Replace valves in the case of severe scoring.

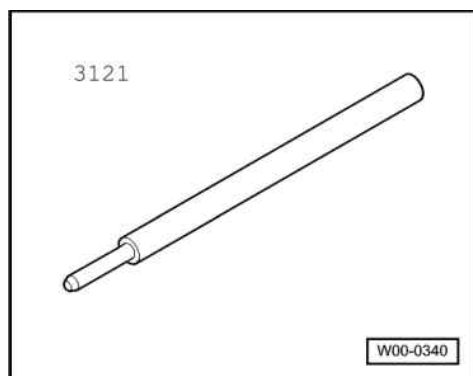
2.9 - Replacing valve guides



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Special tools and workshop equipment required

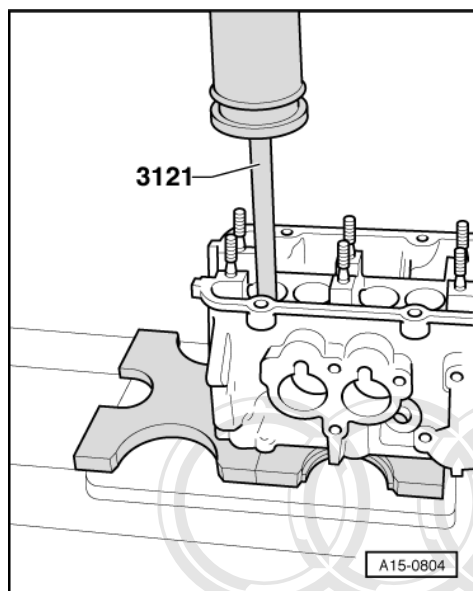
- ♦ Hand reamer 3120 and cutting fluid



- ♦ Drift 3121

Removing

- Clean and check cylinder head. Cylinder heads in which the valve seats can no longer be reworked, or cylinder heads which have already been machined to the minimum dimension, should not have the valve guides replaced.



- Press out worn valve guides with 3121 as follows:
 - -> Valve guides without collar: from the camshaft side
 - Valve guides with collar (repair version): from the combustion chamber side

Installing

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- Lubricate new valve guides with oil and press in with 3121 from the camshaft side (cylinder head cold) until collar makes contact.

Note:

When the collar on the valve guide makes contact, the pressure must not exceed 10 kN (approx. 1.0 t) otherwise the collar can break off.

- Ream guides out with hand reamer 3120. Use plenty of cutting fluid.
- Reworking valve seats => Page 165 .
- Renewing valve stem seals => Page 159 .

2.10 - Reworking valve seats

Note:

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

Special tools and workshop equipment required

- ◆ Depth gauge
- ◆ Valve seat machining tool

Notes:

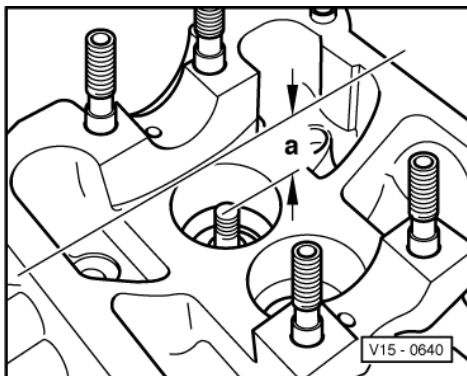
- ◆ When repairing engines with leaking valves, it is not sufficient to reface the valve seats and replace the valves. The valve guides must also be checked for wear. This is particularly important on high mileage engines => Page 162 .
- ◆ Only rework the valve seats as far as is necessary to ensure a good seating pattern.
- ◆ Before starting to rework the valve seats, calculate the maximum permissible reworking dimension.
- ◆ If the maximum reworking dimension is exceeded, the hydraulic tappets will not work properly and the cylinder head will have to be replaced.

Calculating maximum permissible reworking dimension

- Insert valve and press firmly against valve seat.

Note:

If the valve must be replaced as part of a repair, use a new valve for the calculation.



- -> Measure distance -a- between valve shaft end (upper edge) and upper cylinder head area with a depth gauge.
- Calculate max. permissible reworking dimension from measured distance and minimum dimension.

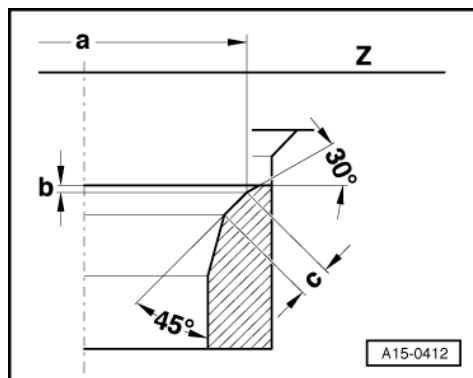
Minimum dimensions	
Inlet valve	Exhaust valve
33.8 mm	34.1 mm

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

Example (for outer inlet valve):	
Measured distance a	35.1 mm
- Minimum dimension	-34.1 mm
= Max. permissible reworking dim.	= 1.0 mm

Note:

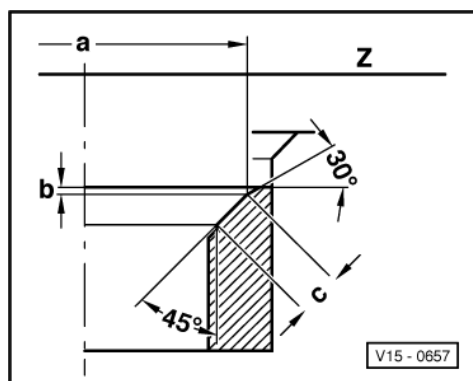
If the maximum permissible reworking dimension is 0 mm or less than 0 mm, repeat the measurement with a new valve. If the measured result is again 0 mm or less than 0 mm, replace the cylinder head.



-> Reworking inlet valve seat

Inlet valve seat	
a	= $\varnothing 39.2$ mm
b	= max. permissible reworking dimension 1)
c	= approx. 2.0 mm
Z	= Lower surface of cylinder head
45°	= Valve seat angle
30°	= Upper correction angle

- 1) Calculating maximum permissible reworking dimension => Page 165 .



-> Reworking exhaust valve seat

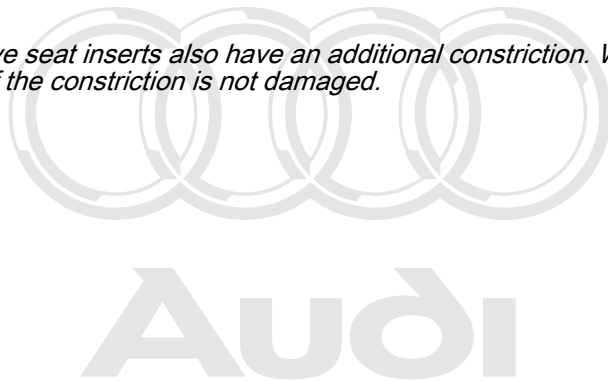
Exhaust valve seat	
a	= $\varnothing 32.4$ mm
b	= max. permissible reworking dimension 1)
c	= approx. 2.4 mm
Z	= Lower surface of cylinder head
45°	= Valve seat angle
30°	= Upper correction angle

- 1) Calculating maximum permissible reworking dimension => Page 165 .

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Note:

Exhaust valve seat inserts also have an additional constriction. When reworking it is essential to ensure that the radius of the constriction is not damaged.



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17 - Lubrication

1 - Removing and installing parts of the lubrication system

1.1 - Removing and installing parts of the lubrication system

Notes:

- ♦ 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 replaced 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.
- ♦ Oil spray jet and pressure relief valve
=> Fig. 173

Viscosity grades and oil specifications:

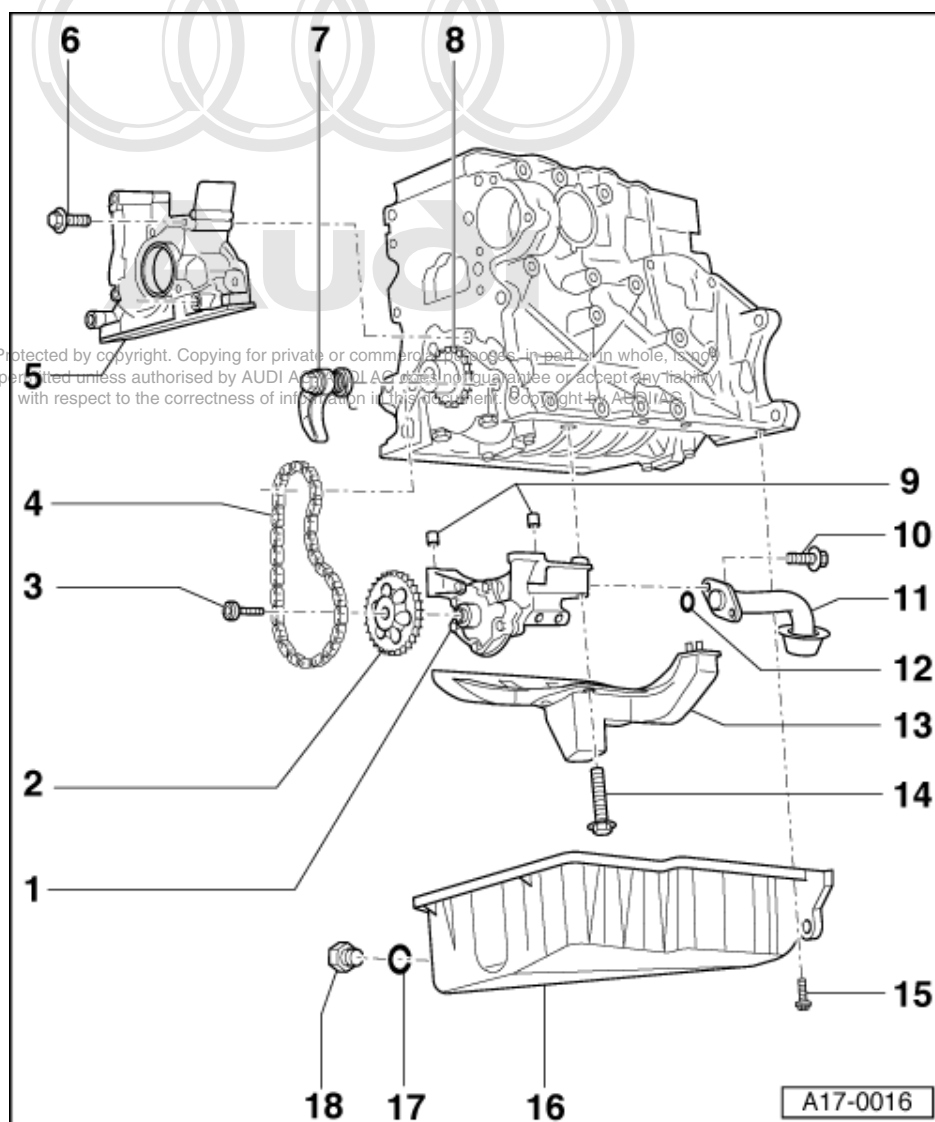
=> Maintenance Manual

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Oil system capacity:

=> Exhaust emissions test

1.2 - Overview of components



Part 1

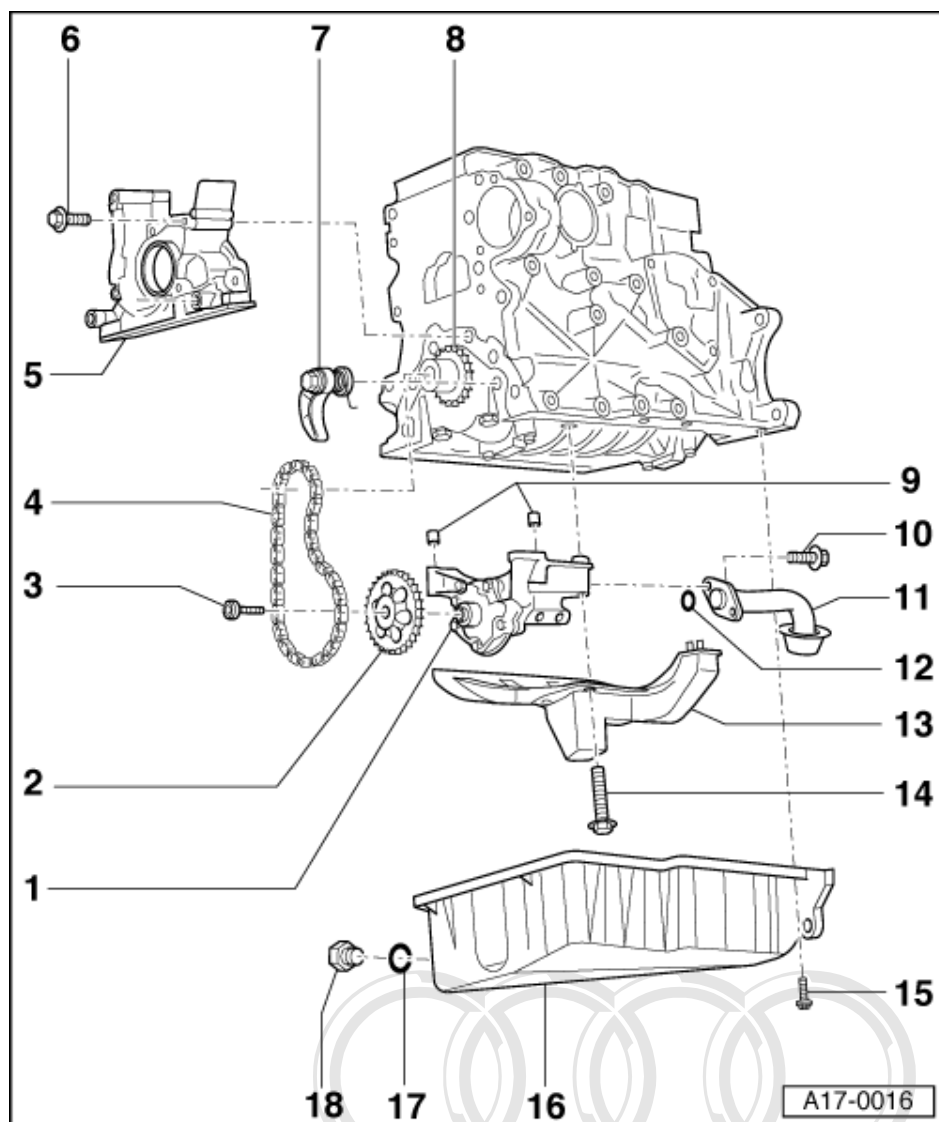
1 Oil pump

- ◆ With pressure relief valve (12 bar)
- ◆ Removing and installing
=>Page 179.
- ◆ Prior to installation check that both dowel sleeves -Item 9 - used for centring the oil pump/cylinder block are still present.
- ◆ Renew pump if there is scoring on moving surfaces and gears.
- ◆ 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 22 Nm

**4 Drive chain for oil pump**

- ◆ Mark D.O.R. before removing
- ◆ Check for wear

5 Sealing flange - front

- ◆ Apply silicone sealant when installing => Page 86
- ◆ Sealants

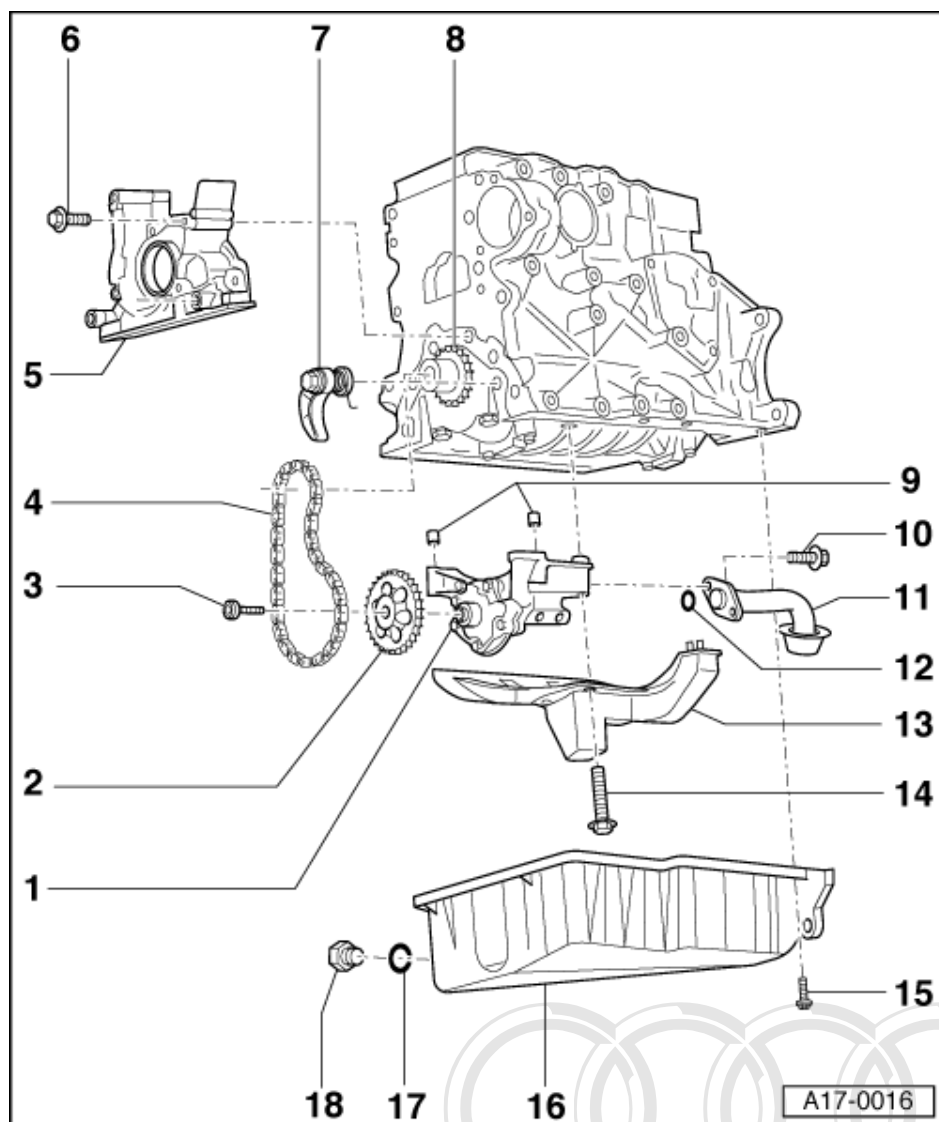
=> Parts List

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- ◆ Renewing crankshaft oil seal on pulley end => Page 83

6 15 Nm**7 Chain tensioner**

- ◆ Tighten to 16 Nm
- ◆ Do not dismantle
- ◆ Note installation position
- ◆ Pre-tension spring and engage before installing



16 Oil pan

- ◆ Removing and installing
=>Page **176**.
- ◆ apply silicone sealant when installing
- ◆ Sealants

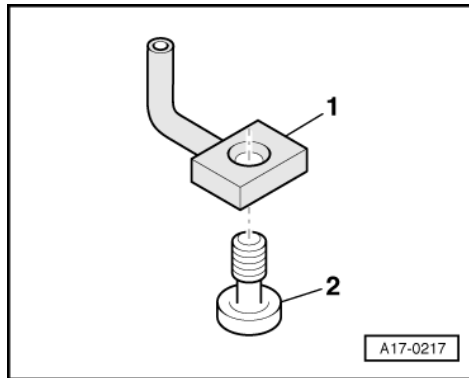
=> Parts List

17 Sealing ring

- ◆ Replace

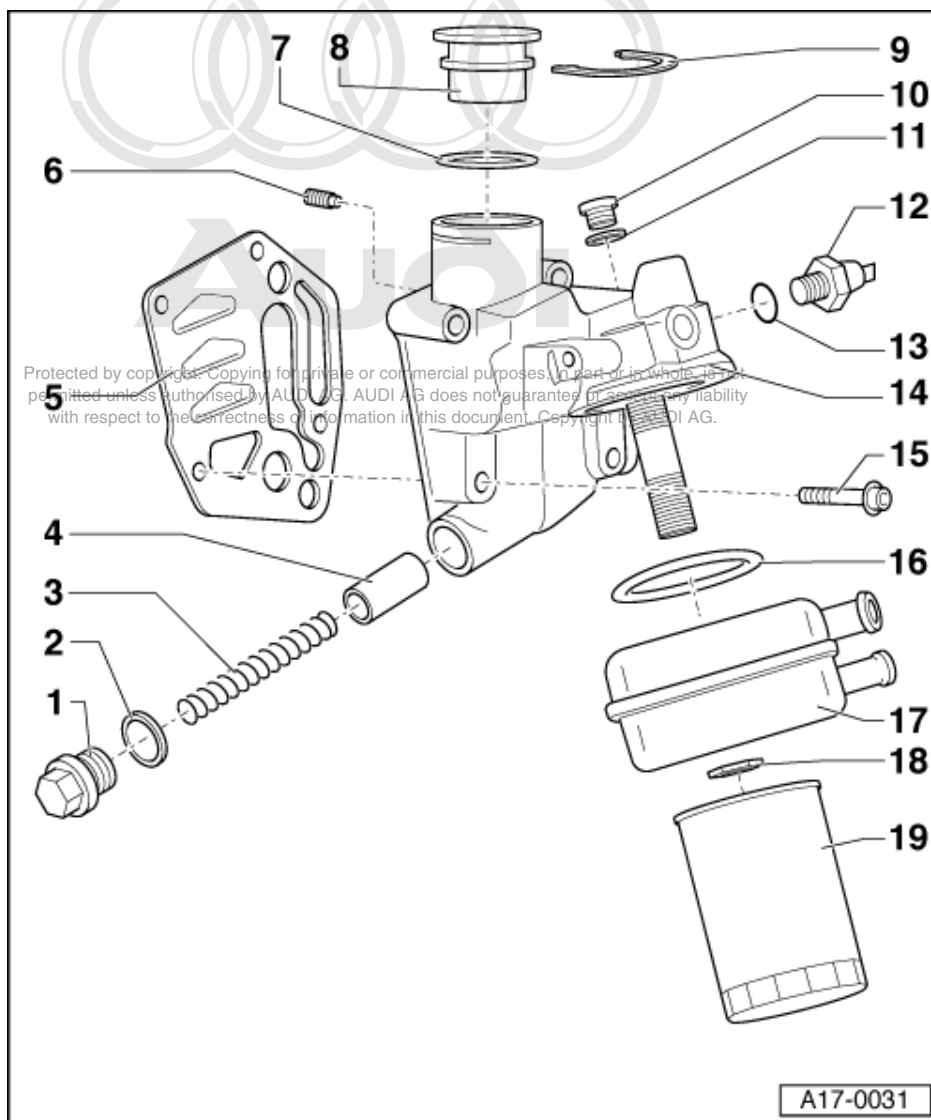
18 Oil drain plug, 30 Nm

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-> Fig.1 Oil spray jet and pressure relief valve

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

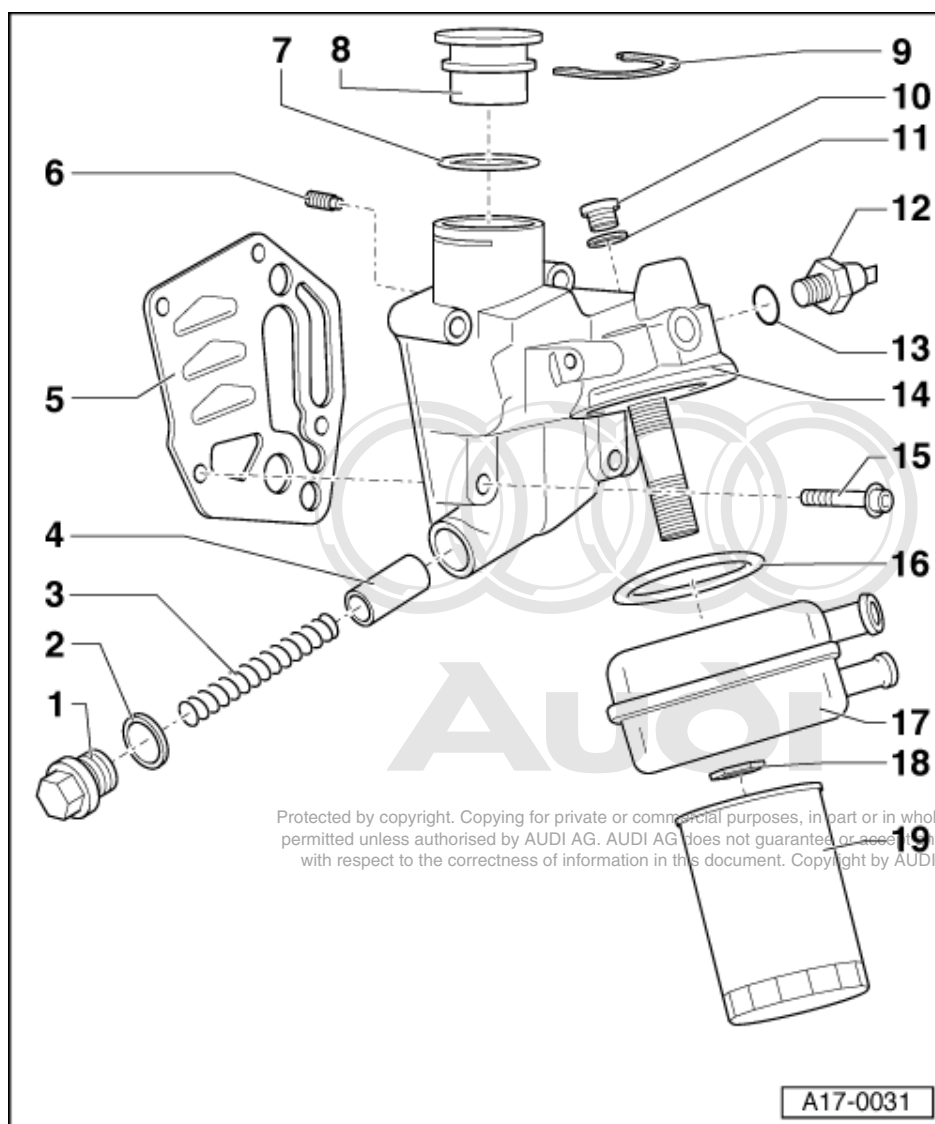


Part 2

- 1 Screw plug - 40 Nm
- 2 Sealing ring

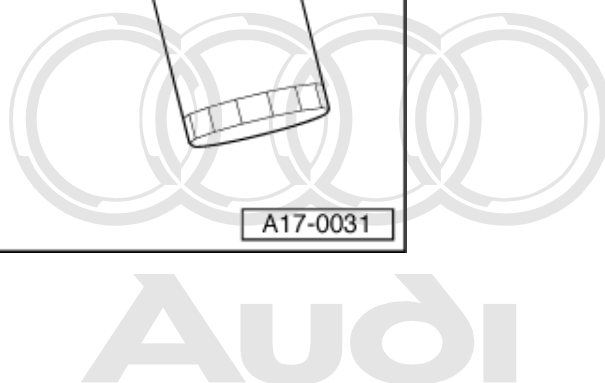


- ♦ Replace
- 3 Spring**
 - ♦ For pressure relief valve approx. 4 bar
- 4 Piston**
 - ♦ For pressure relief valve approx. 4 bar
- 5 Seal**
 - ♦ Replace
- 6 Oil retention valve**
 - ♦ Tighten to 8 Nm
 - ♦ Built into oil filter bracket
- 7 O-ring**
 - ♦ Replace
 - ♦ Slide on until flush with collar on cap -Item 8 -



- 8 Cap**
- 9 Locking clip**
- 10 Screw plug - 15 Nm**
- 11 Sealing ring**
 - ♦ If seal is leaking, cut open and replace.
- 12 Oil pressure switch -F1, 1.4 bar**
 - 25 Nm
 - ♦ Black insulation

- ### 13 Sealing ring



- 17 Oil cooler

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=> Maintenance Manual

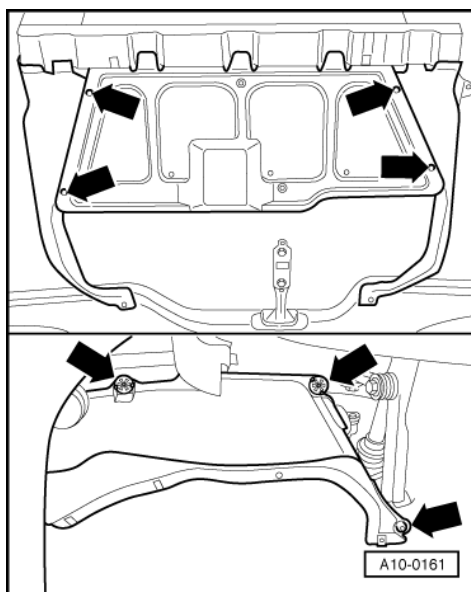
- ♦ Observe installation instructions on oil filter
- ♦ Tighten to 20 Nm

1.3 - Removing and installing oil pan

Auxiliary equipment required

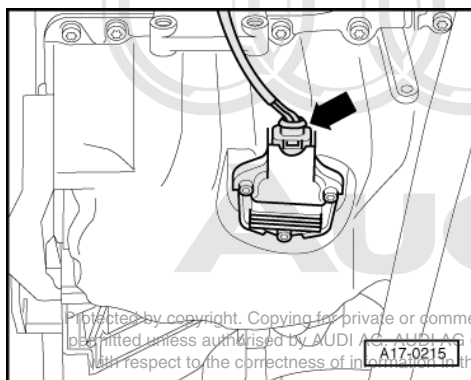
- ♦ Electric drill with plastic brush attachment
- ♦ Protective goggles
- ♦ Sealants

=> Parts List

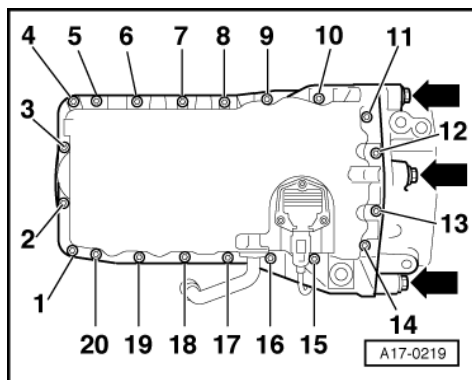


Removing

- -> Remove noise insulation in centre and on right -arrows-.
- Drain engine oil.



- -> Where fitted, detach connector -arrow- at oil level sender.

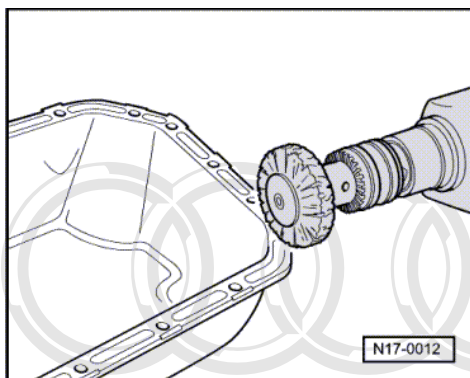


- -> Unscrew bolts of oil pan/gearbox -arrows-.
- Slacken bolts -1...20- diagonally.

Note:

Loosen and tighten oil pan bolts with jointed wrench 3185. Unscrew using socket attachment 3249.

- Take off oil pan: if necessary loosen it by striking lightly with a rubber hammer.



Installing

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

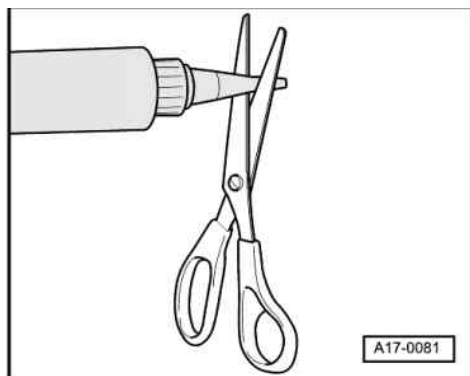
- Carefully remove sealant residues from cylinder block. For this purpose, remove baffle plate.

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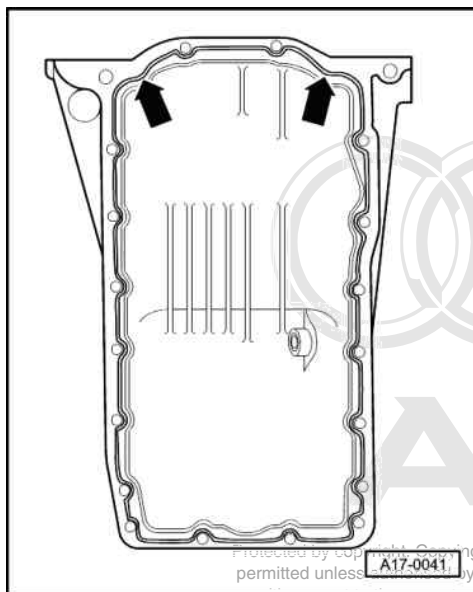
Important

Wear protective goggles.

- -> Remove sealant residues from oil pan, e.g. with rotating plastic brush or similar.
- Clean sealing surfaces: they must be free of oil and grease.



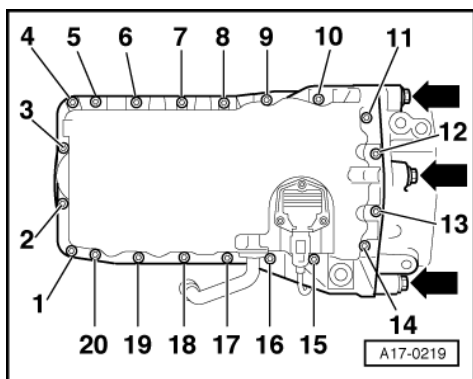
- -> Cut off nozzle of tube at front marking ($\varnothing$ of nozzle approx. 3 mm).



- -> Apply the bead of silicone sealant onto the clean sealing surface of the oil pan, as illustrated.
- Thickness of sealant bead: 2...3 mm

Notes:

- ♦ The oil pan must be installed within 5 minutes after applying the silicone sealant.
- ♦ The bead of sealant must not be thicker than prescribed, as otherwise excess sealant will enter the oil pan and obstruct the strainer in the oil intake manifold.
- ♦ Be particularly careful when applying the bead of sealant around the rear sealing flange (arrows in illustration).



- Immediately install oil pan and tighten bolts in the sequence mentioned:
 - -> Pre-tighten bolts -1...20- diagonally to 5 Nm.
 - Tighten bolts of oil pan/gearbox -arrows- to 45 Nm.
 - Tighten bolts -1...20- diagonally to 15 Nm.

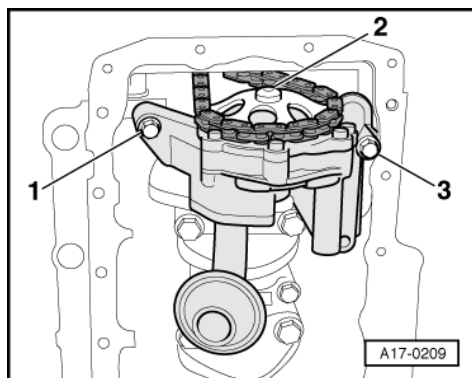
Notes:

- ♦ When installing the oil pan with the engine out of the vehicle, ensure that the oil pan is flush with the cylinder block at the flywheel end.
- ♦ After fitting oil pan assembly, the sealant must dry for approx. 30 minutes. Only then may the engine oil be filled.
- Fill up with engine oil and check oil level.

Tightening torques

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

1.4 - Removing and installing oil pump



Removing

- Remove oil pan and baffle plate
=>Page 176 .
- -> Unscrew bolt -2-.
- Remove chain sprocket from oil pump shaft.
- Screw out bolts -1- and -3- and detach oil pump.

Installing

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

- Insert dowel sleeves -Item 171 on top of oil pump.
- Oil pump shaft/sprocket wheel installation position: Can only be fitted in one position.
- Installing oil pan => Page 177

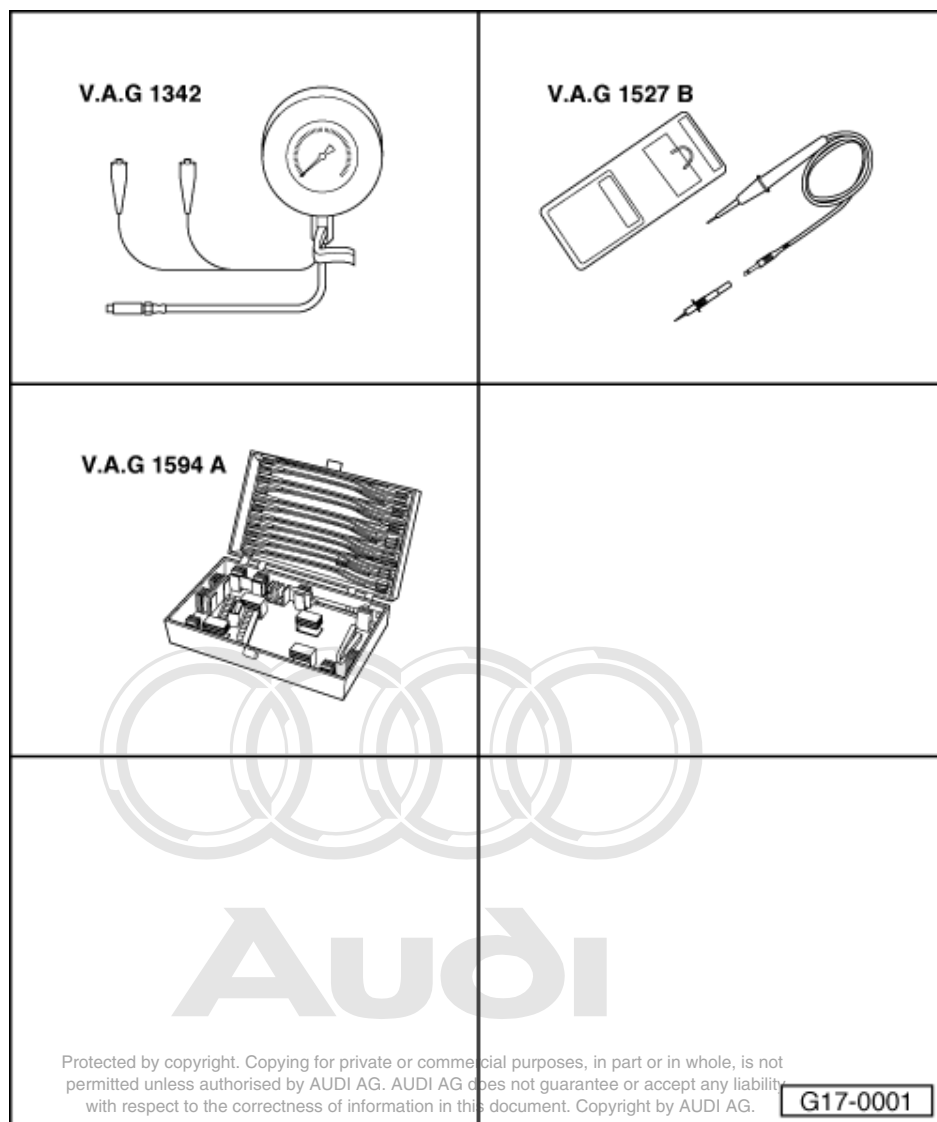
Tightening torques

Component	Nm
Chain sprocket to oil pump shaft	22
Oil pump to cylinder block	16

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1.5 - Checking oil pressure and oil pressure switch

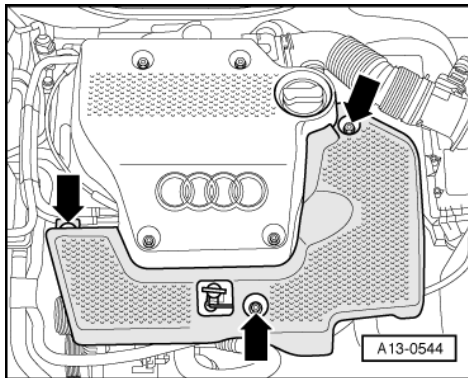


Special tools and workshop equipment required

- ♦ V.A.G 1342
- ♦ V.A.G 1527 B
- ♦ V.A.G 1594 A

Test requirements:

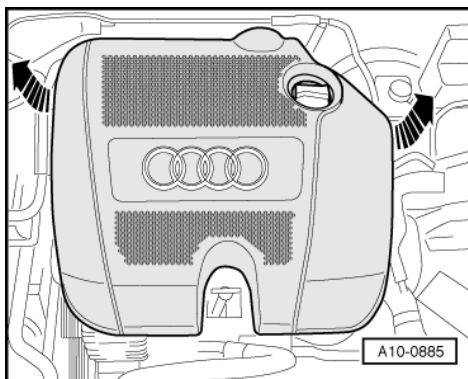
- Oil level OK.
- Engine oil temperature approx. 80 °C.
- Oil pressure warning lamp -K3 must illuminate when ignition is switched on.
- In vehicles with driver information system (DIS) the display "OK" must light up.



Test sequence

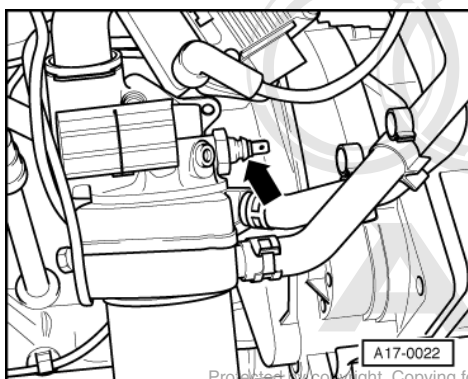
Vehicles with bolted engine cover:

- -> Remove the front engine cover -arrows-.



Vehicles with clip-on engine cover:

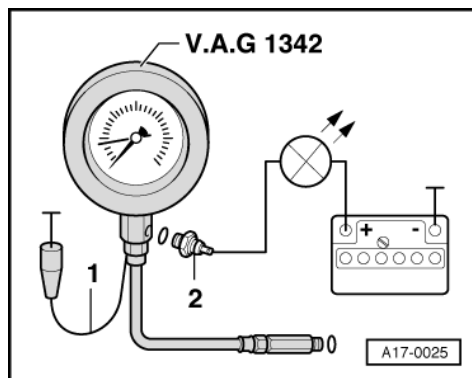
- -> Remove engine cover -arrows-.



Checking oil pressure switch

- -> Unplug connector at oil pressure switch -arrow-.

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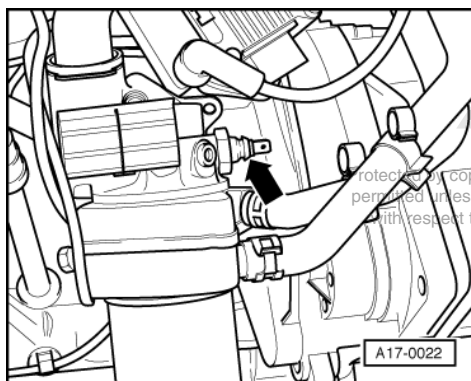
- -> Unscrew oil pressure switch and screw in oil pressure tester V.A.G 1342.
- Screw oil pressure switch -2- into V.A.G 1342.
- Connect brown wire -1- of tester to earth (-).
- Connect voltage tester V.A.G 1527 B to oil pressure switch and positive side of battery (+) using test leads from V.A.G 1594 A.
 - LED should not illuminate.
- If the LED illuminates, fit a new oil pressure switch.
- Start the engine.

Note:

The switching point of the oil pressure switch can be reached when the engine is cranked on the starter motor, so watch the tester and the LED while starting the engine.

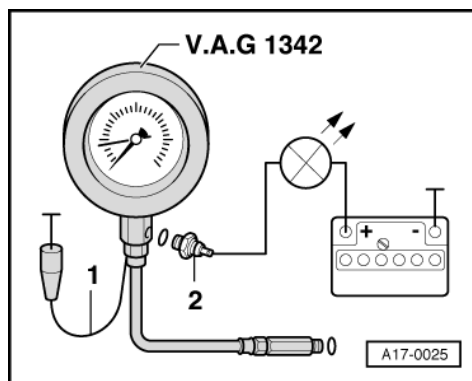
Black oil pressure switch:

- At 1.2...1.6 bar.
If the LED does not illuminate, fit a new oil pressure switch.



Checking oil pressure

- -> Unplug connector at oil pressure switch -arrow-



- -> Unscrew oil pressure switch and screw in oil pressure tester V.A.G 1342.
- Screw oil pressure switch -2- into V.A.G 1342.
- Start engine (engine oil temperature approx. 80 °C).
 - Oil pressure at idling speed: at least 1.2 bar
 - Oil pressure at 2000 rpm: at least 3.5 bar

If the specifications are not obtained:

- Pressure relief valve or oil pump defective, replace oil pump => Page 179 .

1.6 - Engine oil

Viscosity grades and oil specifications

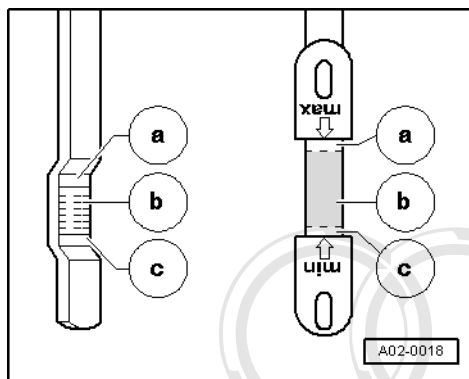
Viscosity grades and oil specifications:

=> Maintenance Manual

1.7 - Checking oil level

Test requirements:

- Engine oil temperature at least 60 °C
- Vehicle must be level (horizontal)
- Wait a few minutes after switching off the engine to allow the oil to flow back into the oil pan.
- Pull out the dipstick, wipe with a clean cloth and insert again to stop.
- Pull out the dipstick again and read off the oil level.



-> Markings on oil dipstick:

- a - Oil must not be topped up.
- b - Oil may be topped up. The oil level may rise as far as area -a- after topping up.
- c - Oil must be topped up. The oil level is sufficient if somewhere in area -b- (grooved area) after topping up.

Note:

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The oil level must not be above marking -a- on the dipstick. Copyright by AUDI AG.



19 - Cooling system

1 - Removing and installing cooling system components - vehicles with engine codes AEH, AKL

1.1 - Removing and installing cooling system components - vehicles with engine codes AEH, AKL

Important

Hot steam or hot coolant can escape when opening expansion tank. Cover cap with a cloth and open carefully.

Notes:

- ♦ When the engine is warm the cooling system is under pressure. If necessary release pressure before commencing repair work.
- ♦ Secure all hose connections with the correct hose clamps (same as original equipment):

=> Parts List

- ♦ Hose clamp pliers V.A.G 1921 or spring clamp pliers VAS 5024 A are recommended for use in installing spring clamps.
- ♦ Replace seals and gaskets.
- ♦ The arrow markings on the coolant pipes and on the ends of the hoses must align.



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1.2 - Parts of cooling system

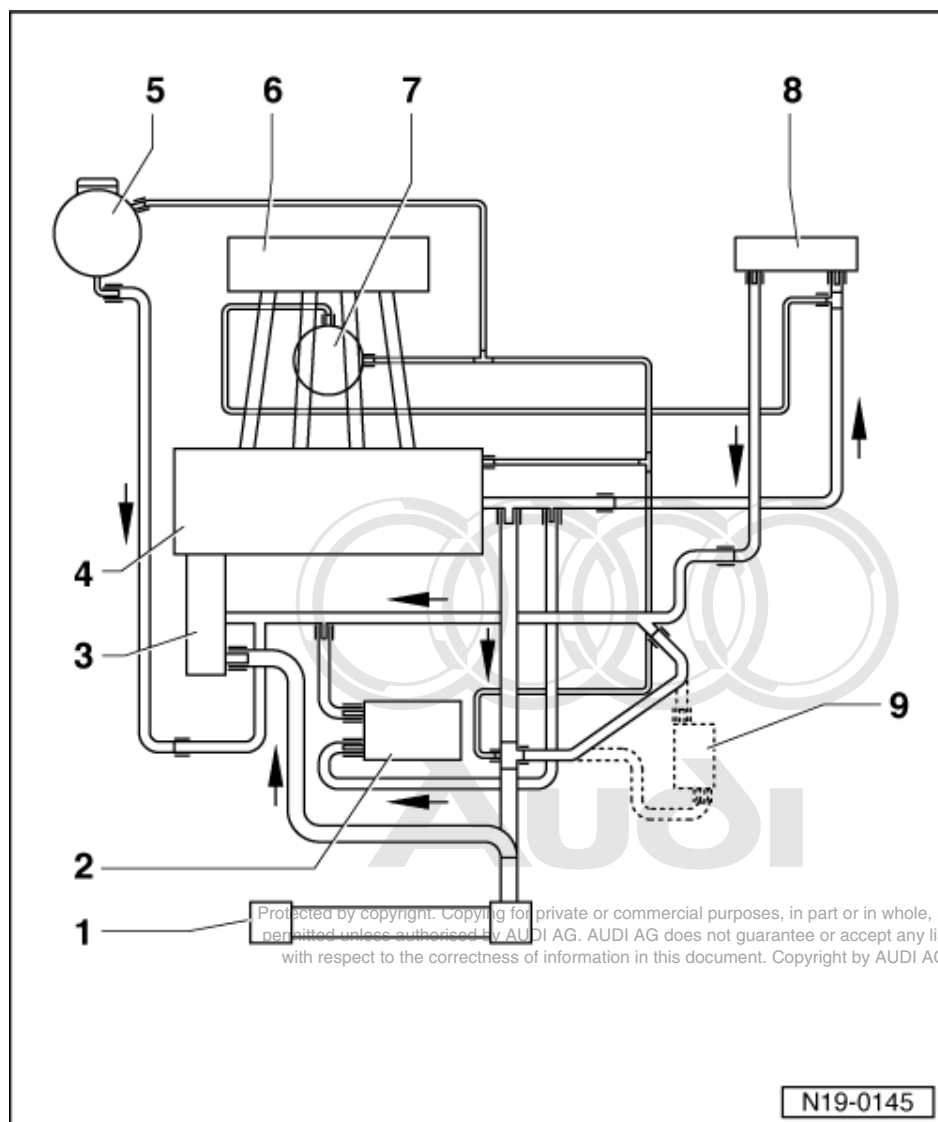


Diagram of coolant hose connections

1 Radiator

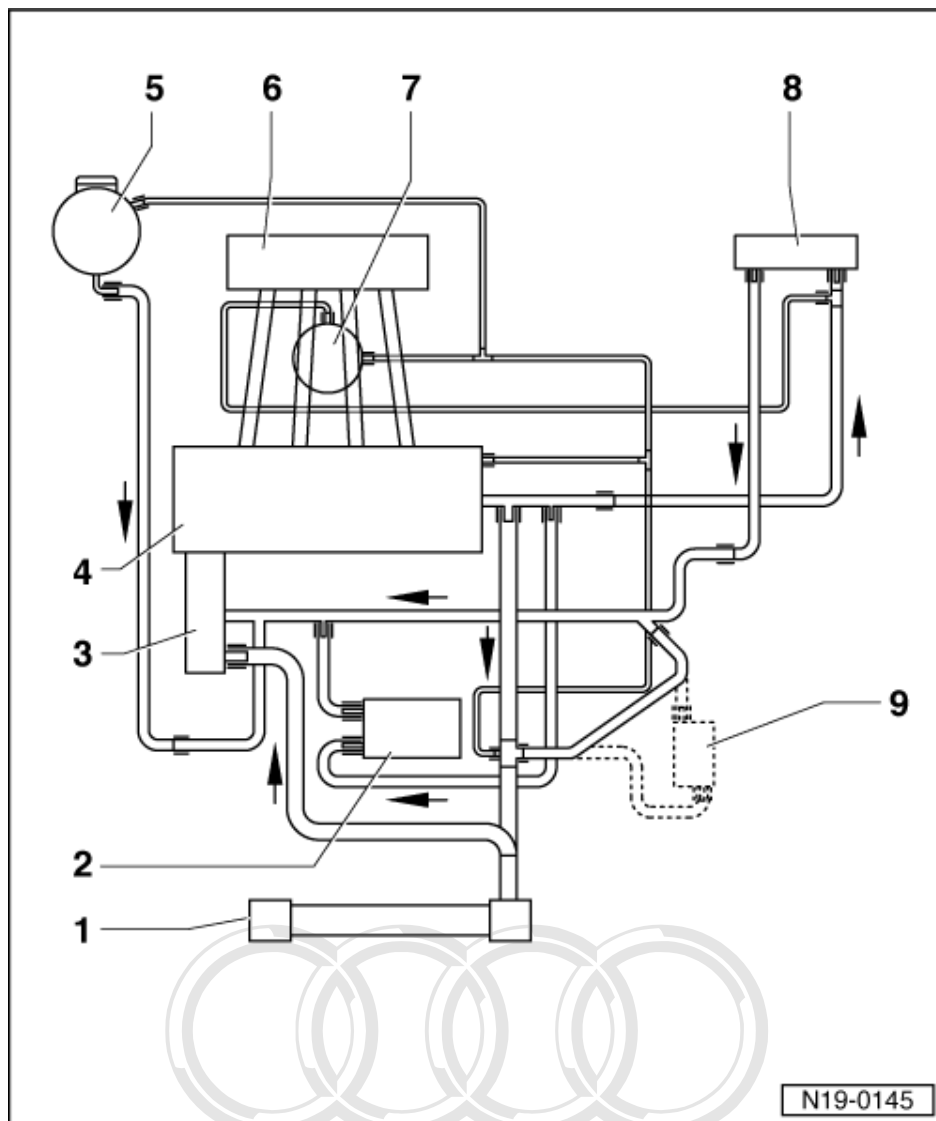
- ♦ Removing and installing
=>Page **221** .
- ♦ After replacing, fill with fresh coolant

2 Oil cooler

- ♦ Removing and installing => Item **175**

3 Coolant pump, coolant thermostat

- ♦ Removing and installing coolant pump => Page **187**
- ♦ Removing and installing thermostat => Page **189**
- ♦ Checking thermostat => Page **190**


4 Cylinder head/cylinder block

- ◆ After replacing, fill with fresh coolant

5 Expansion tank

- ◆ With filler cap
- ◆ Check pressure relief valve in sealing cap => Page [226](#)

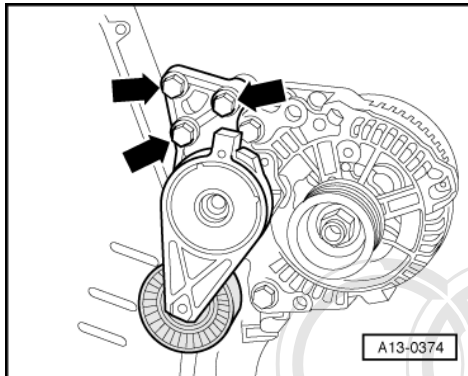
6 Intake manifold
7 Throttle valve connection heating
8 Heating system heat exchanger

- ◆ After replacing, fill with fresh coolant

9 Gearbox oil cooler

- ◆ For ATF
- ◆ For vehicles with automatic gearbox

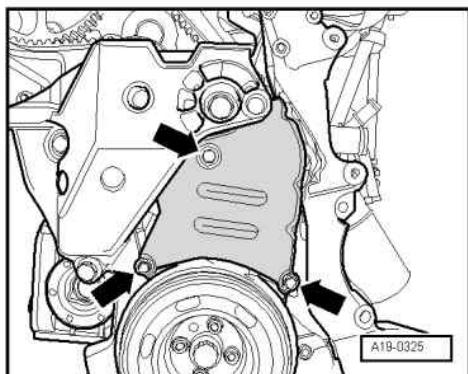
1.3 - Removing and installing coolant pump



Removing

- Remove ribbed belt => Page 55 .
- Remove bracket for engine cover.
- -> Remove tensioner for ribbed belt cover -arrows-.
- Drain coolant => Page 215 .
- Position crankshaft to TDC for cylinder 1 with engine installed => Page 76 .
- Position crankshaft to TDC for cylinder 1 with engine removed => Page 78 .
- Removing toothed belt from camshaft sprocket
=>Page 73 .

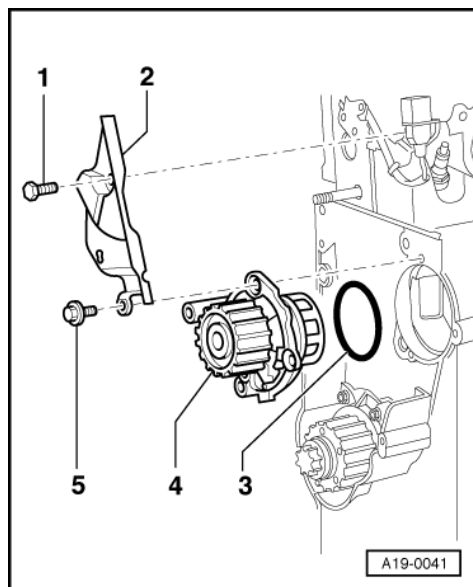
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- -> Remove centre toothed belt guard -arrows-.

Notes:

- ◆ The vibration damper and lower toothed belt guard do not have to be removed.
- ◆ The toothed belt should be left in position on the crankshaft sprocket.
- ◆ Before removing the coolant pump, cover toothed belt with a cloth to protect from coolant.



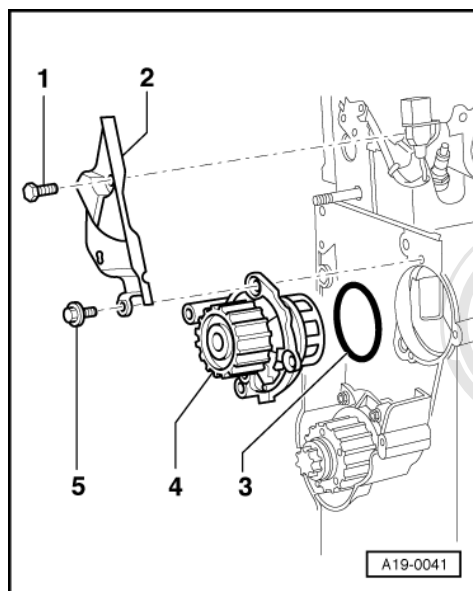
- -> Remove bolts -1- and -5-.
- Remove the rear toothed belt guard -2-, the coolant pump -4- and the O-ring -3-.

Installing

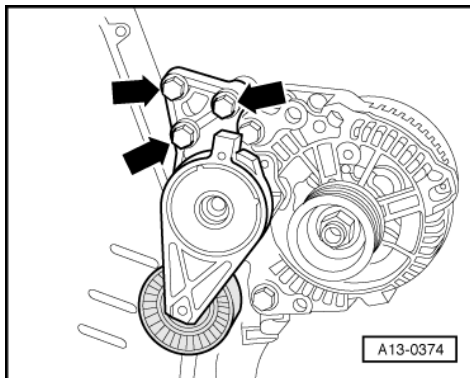
Installation is carried out in the reverse order; note the following:

Notes:

- ♦ When performing installation procedures always replace self-locking nuts and bolts.
- ♦ Replace O-ring.



- Clean and smooth down sealing surface for O-ring as required.
- -> Lightly smear new O-ring -3- with coolant G 012 A8 D.
- Fit coolant pump -4-.
- Installation position: Sealing plug in housing faces downwards.
- Fit rear toothed belt guard and tighten bolt -1- to 20 Nm.
- Tighten bolts -5- for coolant pump to 15 Nm.
- Install toothed belt (adjust valve timing) => Page 74 .



- -> Remove tensioner for ribbed belt -arrows-.
- Install ribbed belt=> Page 56 .
- Top up coolant => Page 217 .

Tightening torques

Component	Nm
Coolant pump to cylinder block	15
Rear toothed belt guard to cylinder head	20
Centre section of toothed belt guard to cylinder block	10 1)
Tensioner for ribbed belt tensioner to bracket for auxiliary mechanical units	23

- 1) Install using locking compound;
locking compound

=> Parts List

1.4 - Removing and installing coolant thermostat

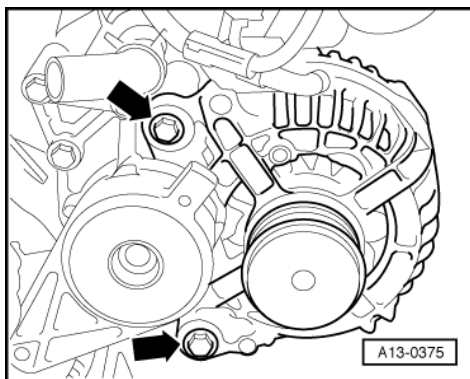
Removing

Important

On vehicles with telematics, activate service mode of telematics control unit before disconnecting battery.=>Radio, Telephone and Navigation System; Repair group 91

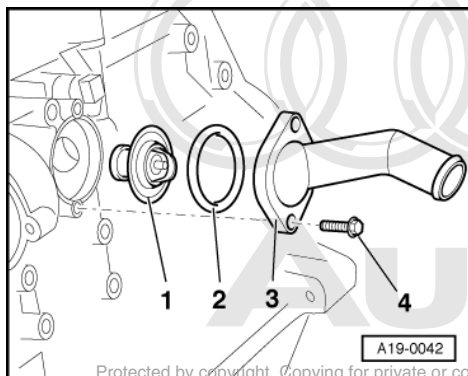
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- Refer to coding on vehicles with encoded radio/radio navigation system (non-OEM only); inquire as necessary.
- Disconnect earth strap at battery with ignition switched off.
- Drain coolant => Page 215 .
- Remove ribbed belt => Page 55 .





- -> Detach the alternator bolted connections -arrows- and move the alternator towards the front. Do not detach hydraulic connections.



- -> Remove coolant hose from connector -3-.
- Remove bolt -4-, and detach connector, O-ring -2- and coolant thermostat -1-.

Installing

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

Note:

Replace O-ring.

- Clean and smooth down sealing surface for O-ring as required.
- Insert coolant thermostat.
 - Installation position: Cross-piece on thermostat should be vertical.
- Coat new O-ring with coolant G 012 A8 D.
- Install ribbed belt=> Page 56 .
- Top up coolant => Page 217 .

Notes:

- ♦ If the battery is reconnected, please ensure that the vehicle equipment (radio, radio/navigation system, clock, electric window lifters) is activated as described in the operating instructions.
- ♦ Deactivate the service mode of the telematics control unit.

=> Radio, Telephone and Navigation System; Repair group 91

- ♦ Further measures after reconnection of voltage supply:

=> Simos Fuel Injection and Ignition System; Repair group 24

Tightening torques

Component	Nm
Connection to cylinder block	15
Alternator to bracket for auxiliary mechanical units	23

Checking coolant thermostat

- Heat thermostat in water bath.

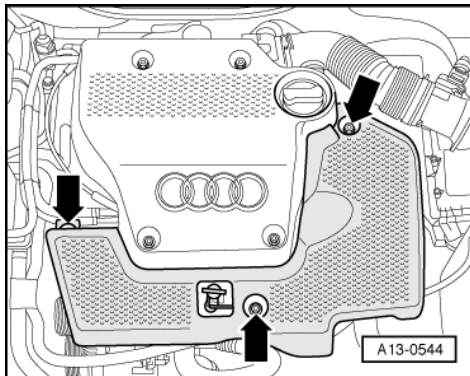
Starts to open	Fully open	Opening travel
approx. 87 °C	approx. 102 °C1)	at least 7 mm

- 1) Cannot be tested

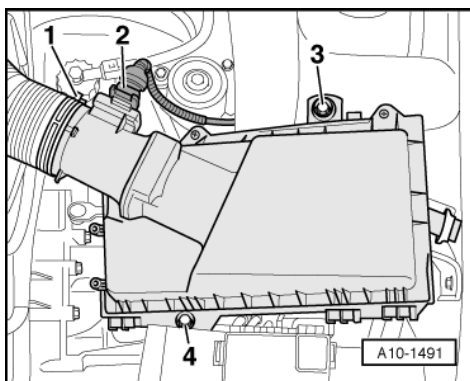
1.5 - Removing and installing coolant pipe

Removing

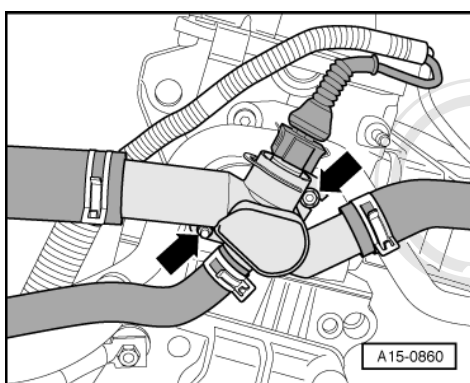
- Drain coolant => Page 215 .



- -> Remove the front engine cover -arrows-.



- -> Disconnect the air duct hose -1- from the air mass meter.
- Unplug connector-2- at air mass meter.
- Unscrew bolts -3- and -4-.
- Remove air cleaner housing.



- -> Detach the left connection from the cylinder head -arrows- and lay aside.

Note:

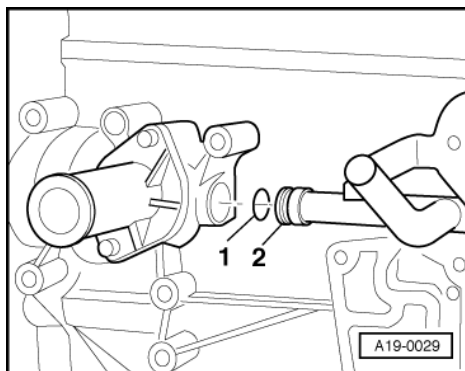
The coolant hoses remain attached at the connection.

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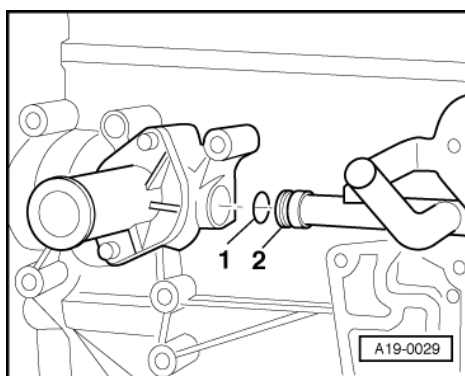
- Remove the ignition coil.
- Unplug the knock sensor connector and the engine-speed sender connector from the bracket at the coolant pipe.



- Disconnect the coolant hoses at the coolant pipe.



- -> Take coolant pipe -2- from connection.



Installing

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

Note:

Replace seals and gaskets.

- Before installing, clean and smooth down sealing surface for O- ring.
- -> Coat new O-ring -1- with G 012 A8 D and push onto coolant pipe -2-.
- Push coolant pipe into opening in cylinder block.
- Install the ignition coil.

=> Simos Fuel Injection and Ignition System; Repair group 28

- Top up coolant => Page 217 .

Tightening torque

Component	Nm
Connection to cylinder head	10

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2 - Removing and installing cooling system components - vehicles with engine code APF

2.1 - Removing and installing cooling system components - vehicles with engine code APF

Important
Hot steam or hot coolant can escape when opening expansion tank. Cover cap with a cloth and open carefully.

Notes:

- ♦ When the engine is warm the cooling system is under pressure. If necessary release pressure before commencing repair work.
- ♦ Secure all hose connections with the correct hose clamps (same as original equipment):

=> Parts List

- ♦ Hose clamp pliers V.A.G 1921 or spring clamp pliers VAS 5024 A are recommended for use in installing spring clamps.
- ♦ Replace seals and gaskets.
- ♦ The arrow markings on the coolant pipes and on the ends of the hoses must align.



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2.2 - Parts of cooling system

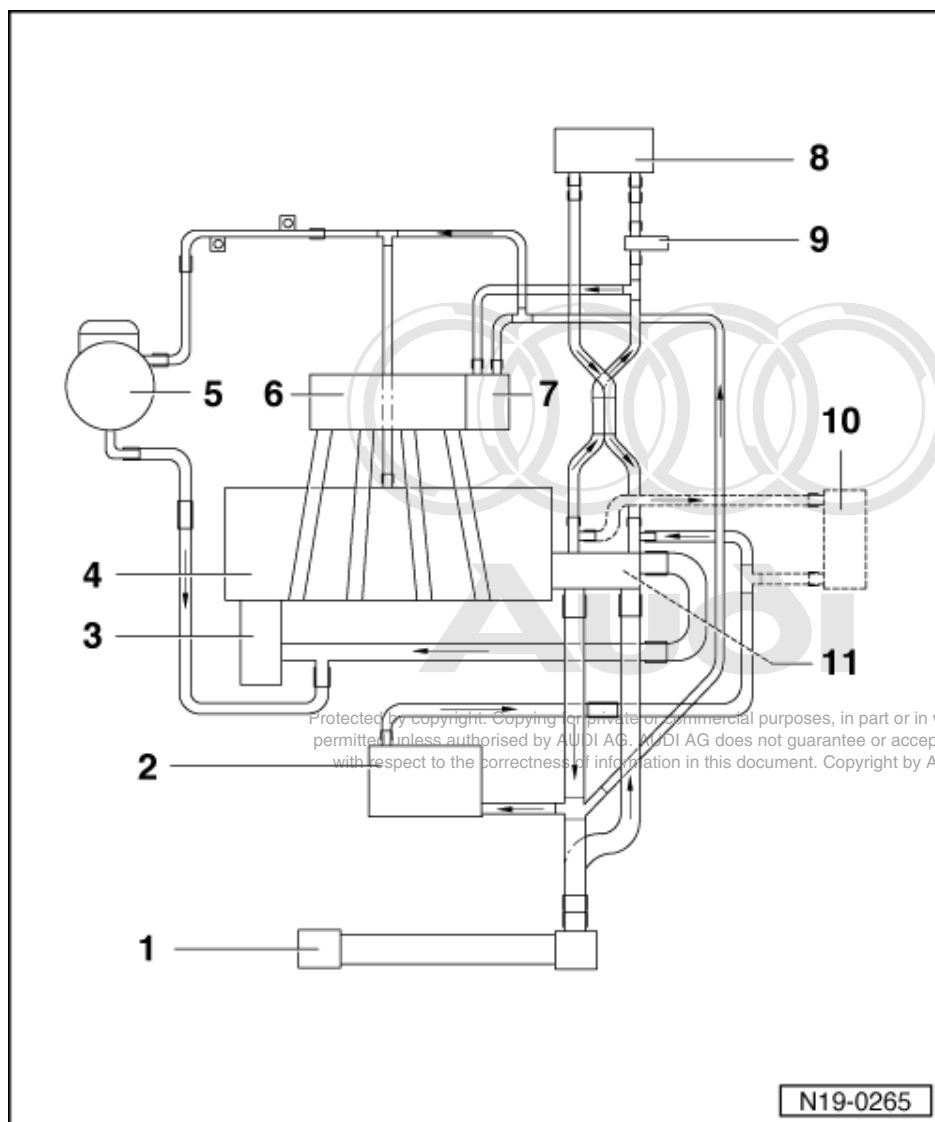


Diagram of coolant hose connections

1 Radiator

- ♦ Removing and installing
=>Page 221 .
- ♦ After replacing, fill with fresh coolant

2 Oil cooler

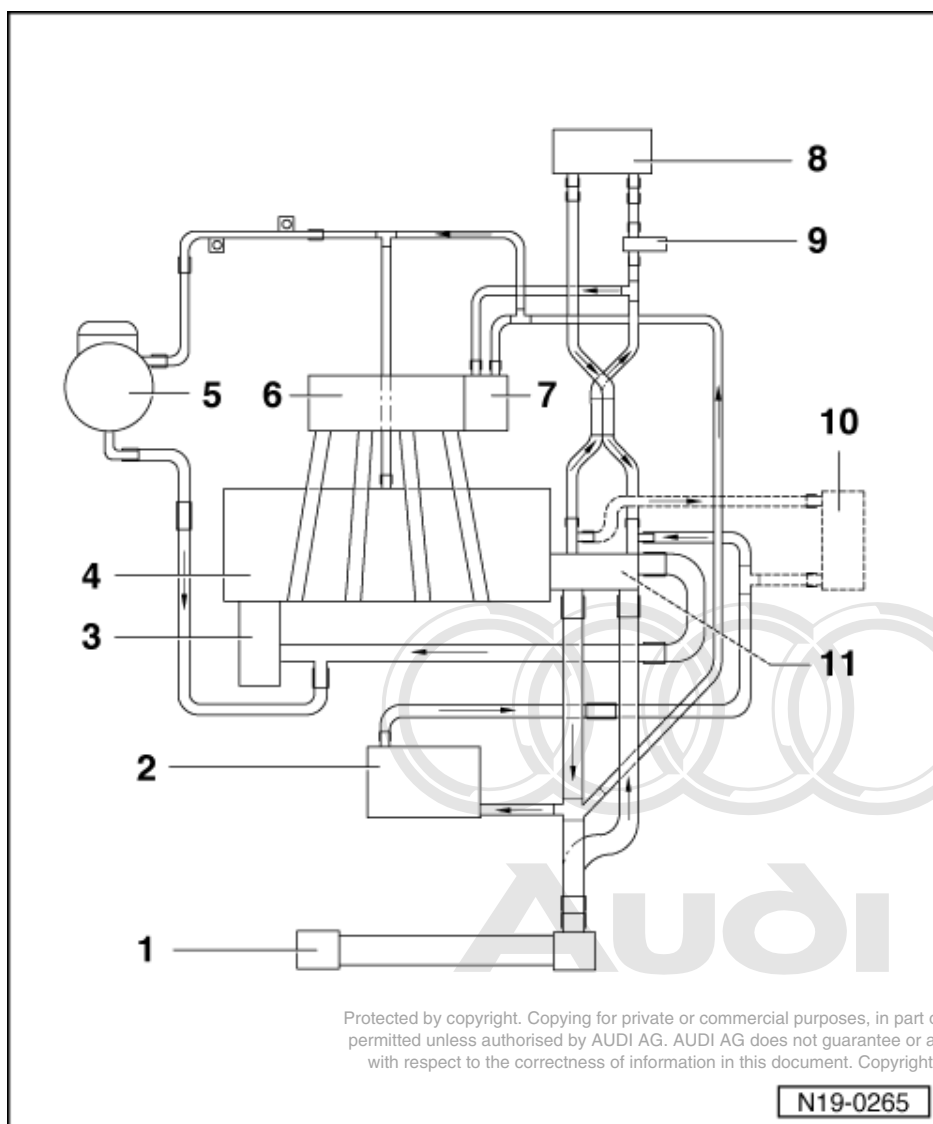
- ♦ Removing and installing => Item 175

3 Coolant pump

- ♦ Removing and installing => Page 196

4 Cylinder head/cylinder block

- ♦ After replacing, fill with fresh coolant

**5 Expansion tank**

- ♦ With filler cap
- ♦ Check pressure relief valve in sealing cap => Page 226

6 Intake manifold**7 Throttle valve connection heating****8 Heating system heat exchanger**

- ♦ After replacing, fill with fresh coolant

9 Heating valve**10 Gearbox oil cooler**

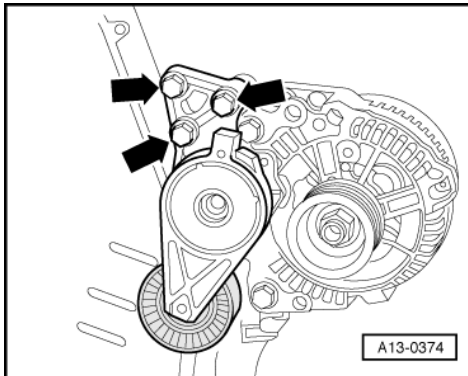
- ♦ For ATF
- ♦ For vehicles with automatic gearbox

11 Thermostat for map-controlled engine cooling system -F265

- ♦ In coolant distributor housing
- ♦ Removing and installing=>Page 211

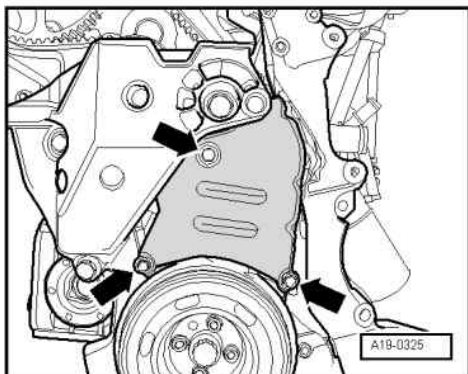


2.3 - Removing and installing coolant pump



Removing

- Remove ribbed belt => Page 55 .
- -> Remove tensioner for ribbed belt cover -arrows-.
- Drain coolant => Page 215 .
- Position crankshaft to TDC for cylinder 1 with engine installed => Page 76 .
- Position crankshaft to TDC for cylinder 1 with engine removed => Page 78 .
- Removing toothed belt from camshaft sprocket
=>Page 73 .

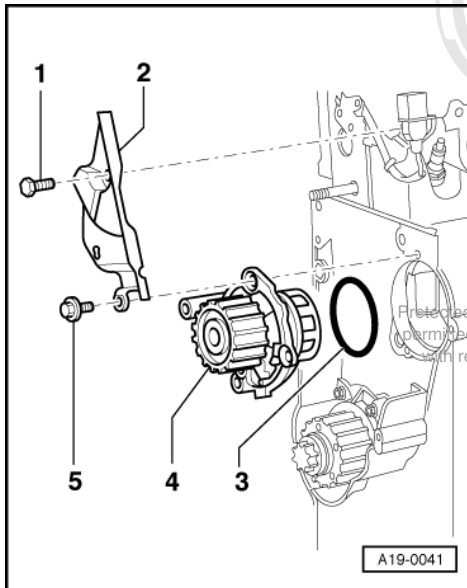


- -> Remove centre toothed belt guard -arrows-.

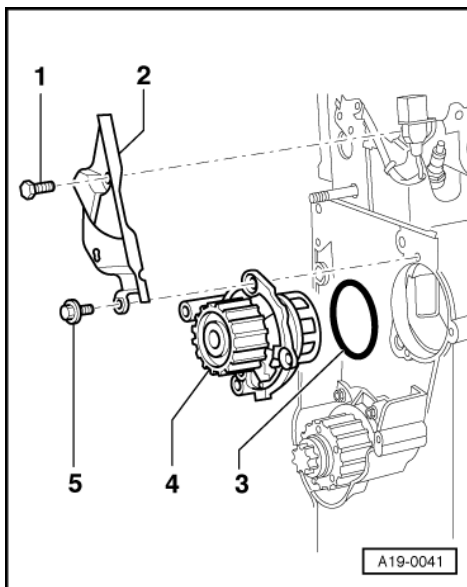
Notes:

- ♦ The vibration damper and lower toothed belt guard do not have to be removed.
- ♦ The toothed belt should be left in position on the crankshaft sprocket.
- ♦ Before removing the coolant pump, cover toothed belt with a cloth to protect from coolant.

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- -> Remove bolts -1- and -5-.
- Remove the rear toothed belt guard -2-, the coolant pump -4- and the O-ring -3-.

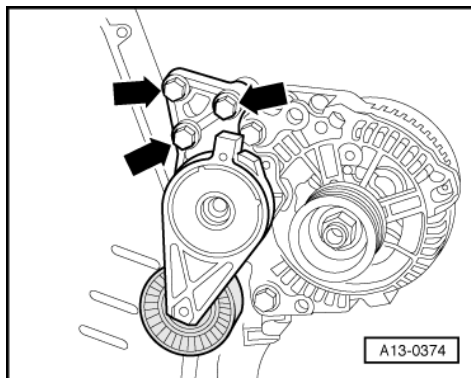


Installing

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

Notes:

- ◆ When performing installation procedures always replace self-locking nuts and bolts.
- ◆ Replace O-ring.
- Clean and smooth down sealing surface for O-ring as required.
- -> Lightly smear new O-ring -3- with coolant G 012 A8 D.
- Fit coolant pump -4-.
 - Installation position: Sealing plug in housing faces downwards.
- Fit rear toothed belt guard and tighten bolt 1 to 20 Nm.
- Tighten bolts -5- for coolant pump to 15 Nm.
- Install toothed belt (adjust valve timing) => Page 74 .



- -> Remove tensioner for ribbed belt -arrows-.
- Install ribbed belt=> Page 56 .
- Top up coolant => Page 217 .

Tightening torques

Component	Nm
Coolant pump to cylinder block	15
Rear toothed belt guard to cylinder head	20
Centre toothed belt guard to cylinder block	10 1)
Tensioner for ribbed belt tensioner to bracket for auxiliary mechanical units	23

- 1) Install using locking compound;
locking compound

=> Parts List

2.4 - Electronically controlled cooling system

Function

The cooling system of this engine is regulated by maps in the engine control unit, specifying the nominal temperature, thermostatic control of the coolant temperature and direct actuation of the fan speeds, all according to engine load.

The higher engine temperature in the part load ranges has the following advantages:

- ♦ Consumption reduction in part load ranges
- ♦ Reduction of the CO and HC untreated emissions

Further information:

=> Self-study Program No. 222

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=> "Electronically controlled cooling system"

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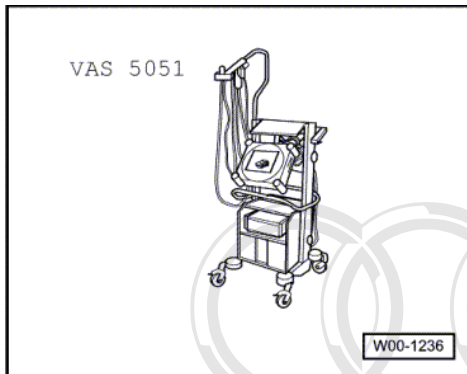
2.5 - Performing diagnosis of the map-controlled engine cooling system

Notes:

- ♦ The map-controlled engine cooling system is monitored by the engine control unit:

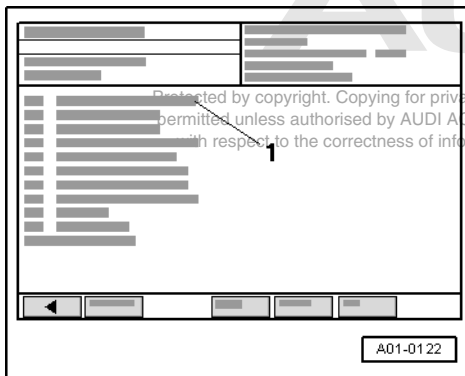
=> Simos Fuel Injection and Ignition System; Repair group 01

- ♦ The result of a continuous plausibility check can also be read off in the "Read measured value block" function, display group 130.



Special tools and workshop equipment required

- ♦ VAS 5051 with VAS 5051/1



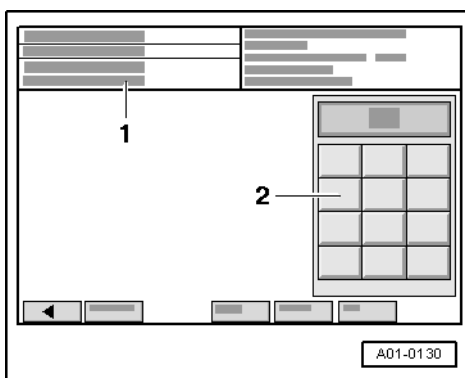
Test sequence

- Connect vehicle diagnostic, testing and information system VAS 5051 and select vehicle system "01 - Engine electronics". For this purpose, the engine must be running at idling speed.

=> Simos Fuel Injection and Ignition System; Repair group 01

-> Display on VAS 5051:

- Under -1- select diagnostic function "08 - Read measured value block".

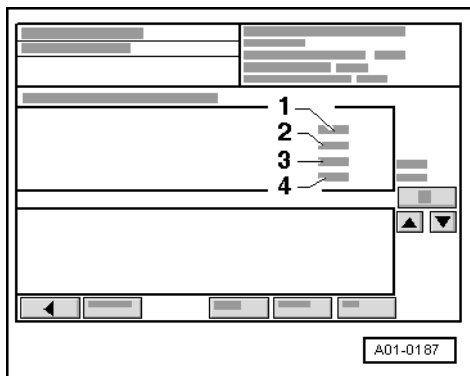




-> Display on VAS 5051:

1 - Enter display group

- Enter "130" for "display group number 130" in zone -2- and confirm the entry by pressing the Q key.



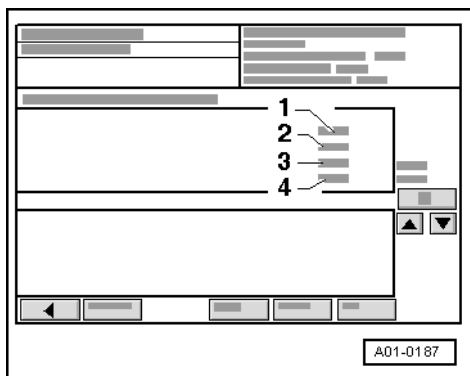
-> Display on VAS 5051:

- Check readout in display zones -1-, -2- and -4-.

	Display zones			
	1	2	3	4
Display group 130: Diagnosis of map-controlled engine cooling system				
Display	xxx.x °C	xxx.x °C	xxx %	---
Display	Coolant temperature Engine outlet	Coolant temperature Radiator outlet	Duty cycle Thermostat	Diagnosis status
Range				Test OFF Test ON Syst. OK Syst. NOK
Specified value	80...115 °C	max. 100 °C	0...100 %	Syst. OK
Note:	The coolant temperature at the engine outlet must always be higher than at the radiator outlet.			Only the plausibility of the system is checked. Therefore, "Syst. OK" may be displayed even though an electrical fault has been detected.

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- Select the s key in order to change to display group 131.



-> Display on VAS 5051:

- Check display in display zone -4-.

	Display zones			
	1	2	3	4
Display group 131: Diagnosis of map-controlled engine cooling system				
Display	xxx.x °C	xxx.x °C	xxx %	xxxxxxxx
Display	Coolant temperature Engine outlet	Coolant temperature Radiator outlet	Duty cycle Thermostat	Status of map-controlled engine cooling system
Specified value	80...115 °C	max. 100 °C	0...100 %	0xxxxxxxx
Note:	The coolant temperature at the engine outlet must always be higher than at the radiator outlet.			Significance of 8-figure display =>Page 201 .

- Exit function "08 - Read measured value block" by pressing the *key.
- Press "06 - End output".
- Switch ignition off.

Significance of 8-figure display for display group 131

1	2	3	4	5	6	7	8	Display zone 4
							1	Fan speed 1 active 1)2)
							1	Fan speed 2 active 1)2)
					x			Vacant
				x				Vacant
			1					Regulator deviation positive = 0/ negative = 1
		1						Fan actuation active
	1							Thermostat actuation active
1								Faults relating to the map-controlled engine cooling system stored 3)

1) If the coolant temperature senders -G62 or -G83, the wiring connections, or the fan output speeds are faulty, the fan speeds are actuated continuously by the engine control unit.

2) The fan speeds can also be actuated by the air conditioner.

3) Interrogate the fault memory of the engine control unit:

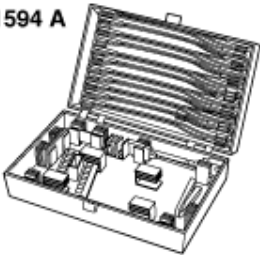
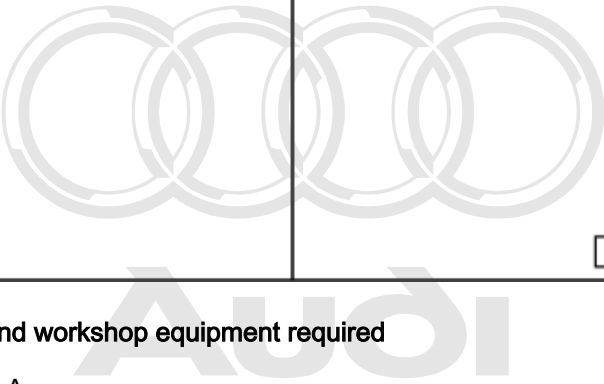
=> Simos Fuel Injection and Ignition System; Repair group 01



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2.6 - Performing electrical check of map-controlled engine cooling system

V.A.G 1526 A 	V.A.G 1594 A 
V.A.G 1598/31 	
	 G24-0020

Special tools and workshop equipment required

- ♦ V.A.G 1526 A
- ♦ V.A.G 1594 A
- ♦ V.A.G 1598/31

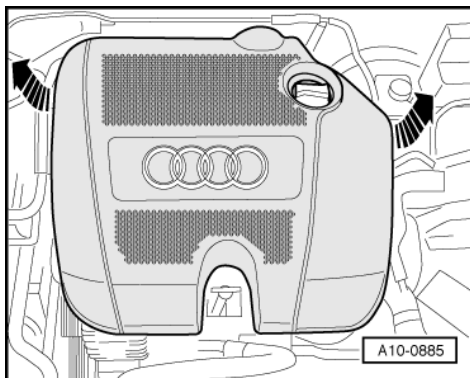
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Important

The motors for the radiator fan may start up.

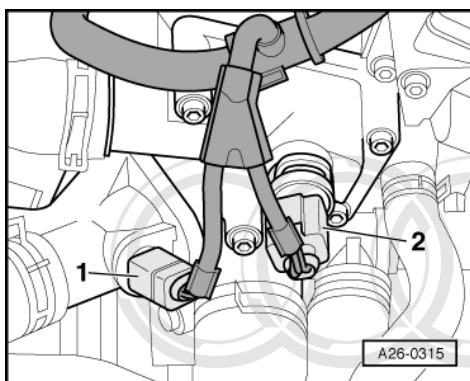
Test requirements:

- Diagnosis of map-controlled engine cooling system performed => Page **198** .



Test sequence

- -> Remove engine cover -arrows-.
- Start engine and run at idling speed.

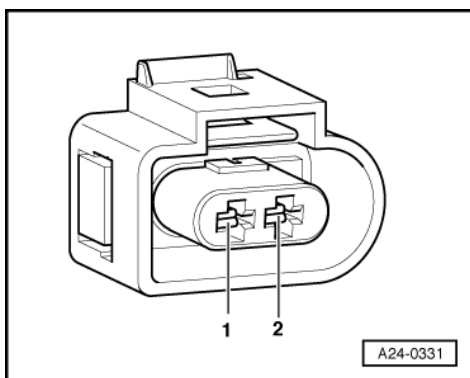


- -> Unplug 4-pin connector -1- at coolant temperature sender -G62.

Note:

Unplugging the connector from the coolant temperature sender causes the engine control unit to detect a fault in the map-controlled engine cooling system. It then constantly actuates the thermostat using full battery voltage.

- Unplug the 2-pin connector -2- from thermostat for map-controlled engine cooling system -F265.



- -> Connect multimeter between contacts 1 and 2 to measure voltage.
- Specification: Approx. battery voltage (after a short waiting period)

If specification is not attained:

- Connect multimeter as follows to measure voltage:



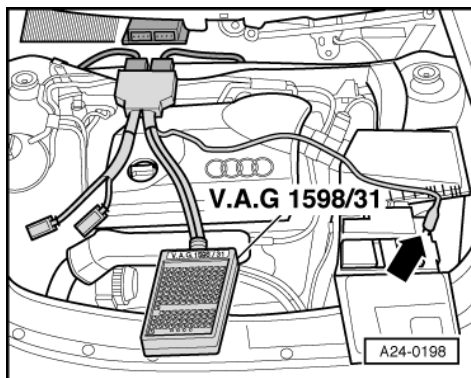
Connector Contact	Measure to
1	Engine earth

- Specification: approx. battery voltage
Switch ignition off.

If specification is not attained:

- Check the wiring from contact 1 of the connector to the power supply relay for Simos control unit -J363 (below cover on left of bulkhead) for open circuit using the current flow diagram.
- Eliminate open circuit or using the current flow diagram.

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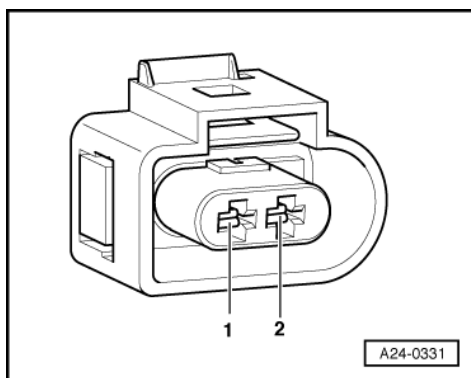
If specification is attained:

- -> Connect the V.A.G 1598/31 test box to wiring harness connectors; the engine control unit should not be connected. Attach the earth clip of test box to earth -arrow-.

=> Simos Fuel Injection and Ignition System; Repair group 24

Important

To prevent damage to the electronic components, select appropriate measuring range before connecting the measuring cables and observe the test requirements.



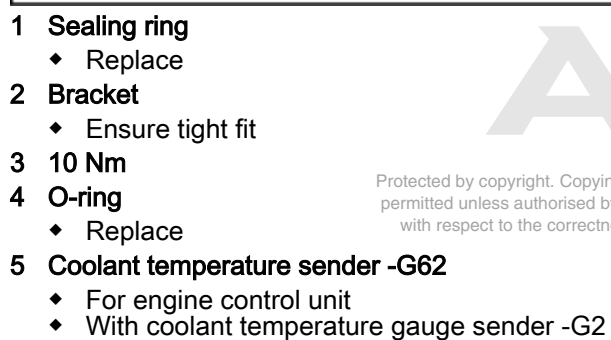
- -> Check for open circuit in the following wiring connections:

Connector Contact	Test box V.A.G 1598/31 Socket
2	116

- Eliminate open circuit using the current flow diagram.

- Check function of thermostat => Page 207 .
- Plug in the connectors.
- Finally, interrogate and erase the engine control unit fault memory as faults are stored when the connectors are unplugged.

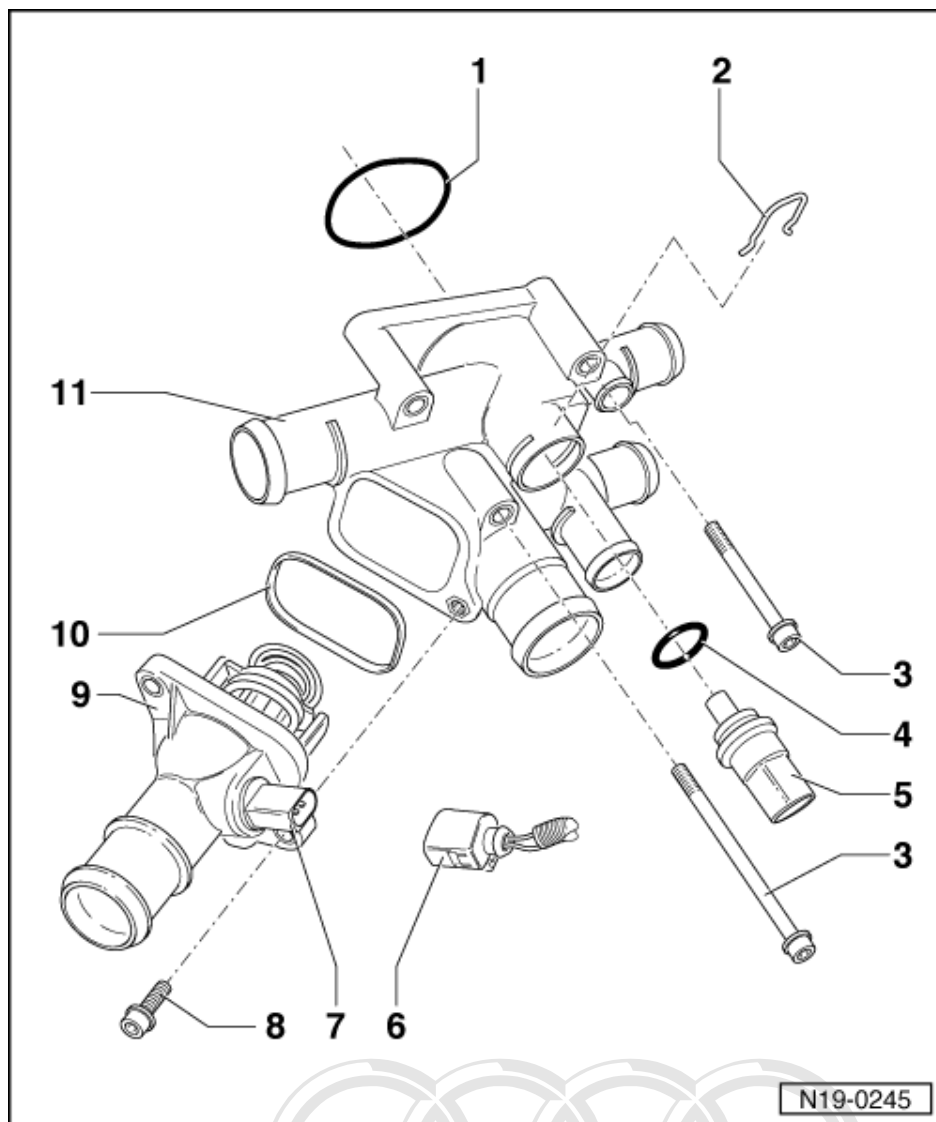
2.7 - Disassembling and assembling coolant distributor housing



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♦ Checking:

=> Simos Fuel Injection and Ignition System; Repair group 01



6 Connector

7 Heating resistor connection

8 10 Nm

9 Thermostat for map-controlled engine cooling system -F265

- ♦ With connection
- ♦ With electrical heating element for controlled opening
- ♦ Checking: =>Page 207
- ♦ Start of opening approx. 105 °C
- ♦ Opening travel at least 7 mm
- ♦ Performing electrical check => Page 202
- ♦ Removing and installing=>Page 211

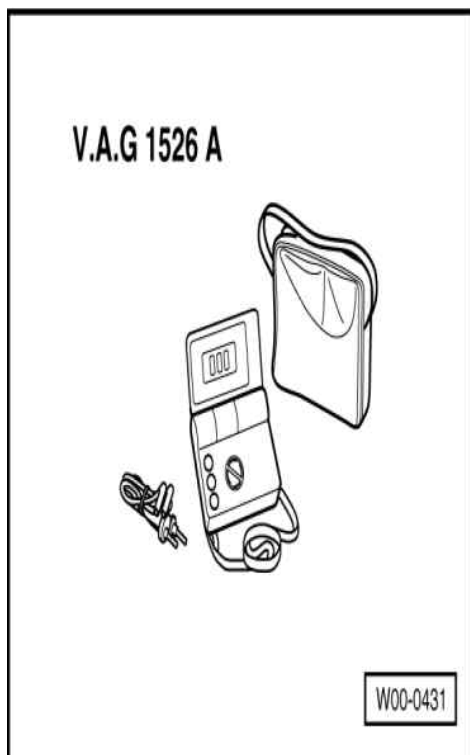
10 Sealing ring

- ♦ Replace

11 Coolant distributor housing

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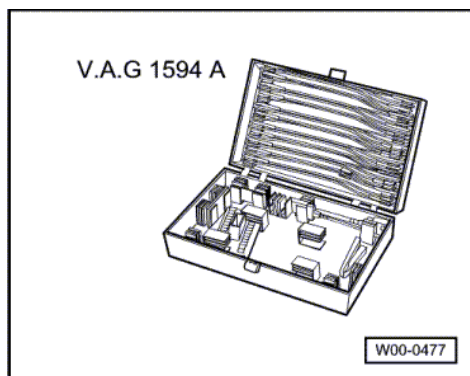
2.8 - Checking thermostat for map-controlled engine cooling system



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Special tools and workshop equipment required

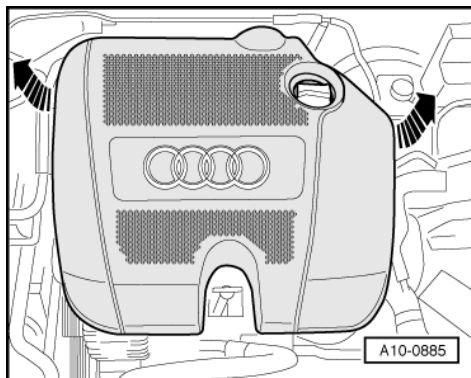
- ♦ Hand-held multimeter V.A.G 1526 A



- ♦ Measuring tool set V.A.G 1594 A

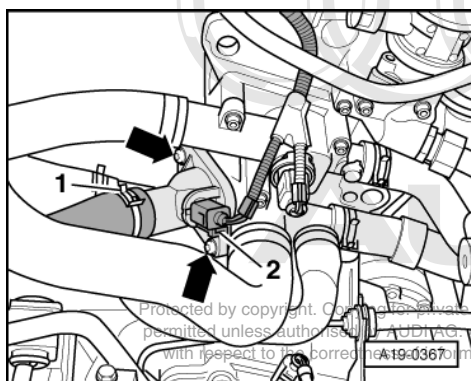
Test requirements:

- Engine cold



Testing internal resistance of heating element

- -> Remove engine cover -arrows-.

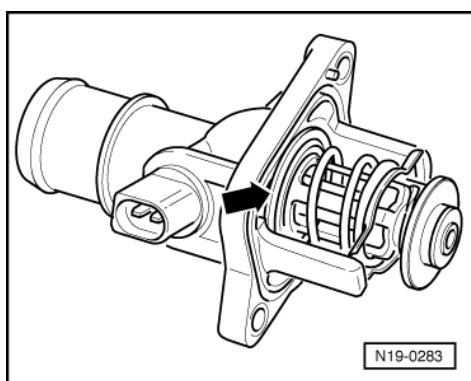


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- -> Unplug connector -2- at thermostat for map-controlled engine cooling system -F265.
- Connect multimeter to thermostat to measure resistance.
- Specification: 14...16 wat 25 °C

If specification is not attained:

- Replace thermostat for map-controlled engine cooling system -F265=>Page 211 .

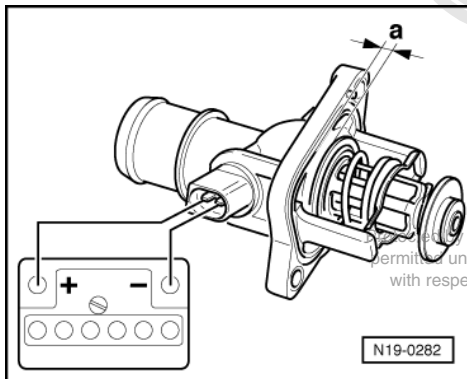


Function test of thermostats

- Remove the thermostat for the map-controlled engine cooling system -F265=>Page 211 .
- -> Check the thermostat when cold.
- The large valve disc -arrow- must seal off the connection flange all the way round.

If not:

- Replace thermostat for map-controlled engine cooling system -F265=>Page 211 .



- -> Connect the contacts of the thermostat for map-controlled engine cooling system -F265 using auxiliary cables from V.A.G 1594 A.

Important
Wear protective gloves.

- Using pliers, carefully place the thermostat vertically into a pot of boiling water up to the flange.

The resistance heating now additionally heats the wax in the thermostat.

Note:

This check must not be performed in air as the expansion element may be damaged.

- Check that the minimum travel of a = 7 mm is attained after 10 minutes.

If 7 mm travel is attained:

- Disconnect voltage supply to battery.

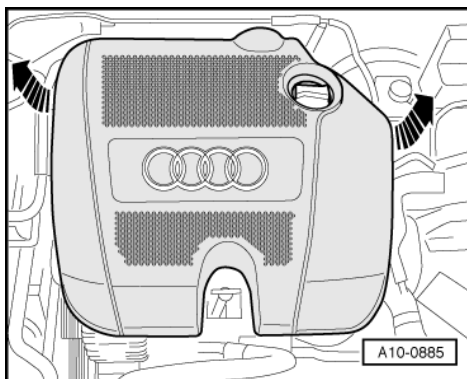
If the minimum travel is not reached:

- Replace the thermostat for the map-controlled engine cooling system -F265.
- Finally, interrogate the engine control unit fault memory and erase any faults that may have been stored when the connectors were unplugged.

=> Simos Fuel Injection and Ignition System; Repair group 01

2.9 - Checking coolant temperature sender -G83 (radiator outlet)

Fitting location: Bottom left of radiator.





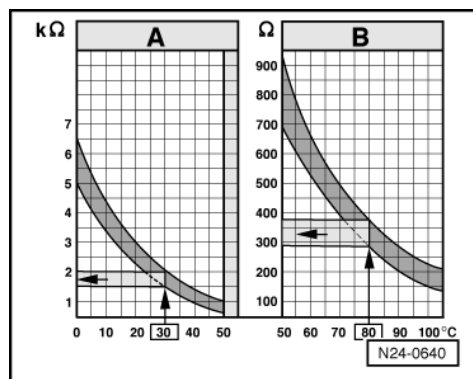
- -> Remove engine cover -arrows-.

Note:

Checking coolant temperature sender -G62:

=> Simos Fuel Injection and Ignition System; Repair group 28

- Unplug 2-pin connector at coolant temperature sender -G83.
- Connect multimeter to sender to measure resistance.



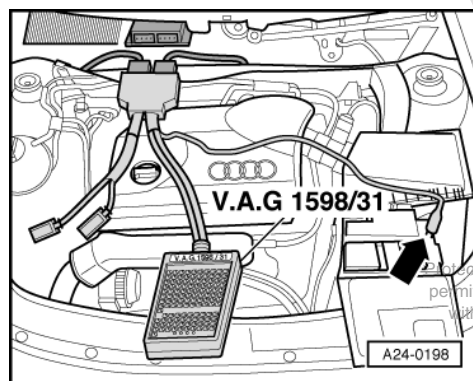
-> Sample readings:

Range A shows resistance values for temperature range 0...50 °C and range B shows the values for temperature range 50...100 °C.

- ♦ 30 °C is measured in range A and corresponds to a resistance of 1.5...2.0 kΩ
- ♦ 80 °C is measured in range B and corresponds to a resistance of 275...375 Ω

If specification is not attained:

- Replace coolant temperature sender -G83.



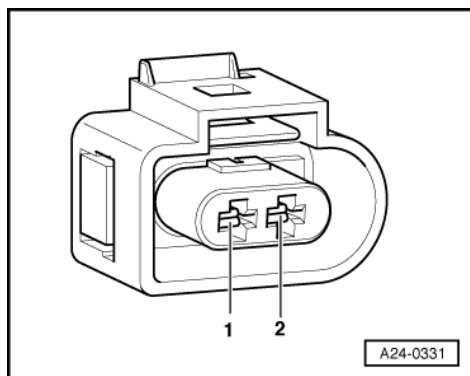
If specification is attained:

- Switch ignition off.
- -> Connect the V.A.G 1598/31 test box to wiring harness connectors; the engine control unit should not be connected. Attach the earth clip of test box to earth -arrow-.

=> Simos Fuel Injection and Ignition System; Repair group 24

Important

To prevent damage to the electronic components, select appropriate measuring range before connecting the measuring cables and observe the test requirements.

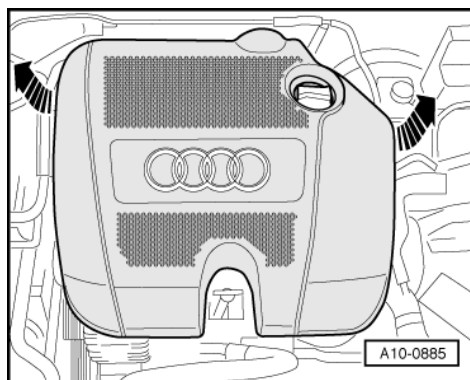


- -> Check for open circuit and short to positive or earth in the following wiring connections:

Connector Contact	Test box V.A.G 1598/31 Socket
1	25
2	47

- Additionally check wires for short to one another.
- Use current flow diagram to eliminate open circuit in wiring/short circuit.

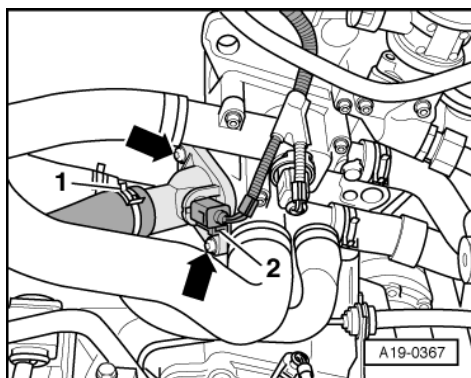
2.10 - Removing and installing thermostat for map-controlled engine cooling system



Removing

- Drain coolant => Page 215 .
- -> Remove engine cover -arrows-.

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- -> Unplug connector -2- at thermostat for map-controlled engine cooling system -F265.
- Detach retaining clip for bottom coolant hose and detach coolant hose from radiator.
- Disconnect coolant hose -1- at thermostat.
- Unscrew the bolts -arrows- and remove the thermostat.

Installing

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

Note:

Replace sealing ring.

- Top up coolant => Page 217 .

Tightening torque

Component	Nm
Thermostat to coolant distributor housing	10

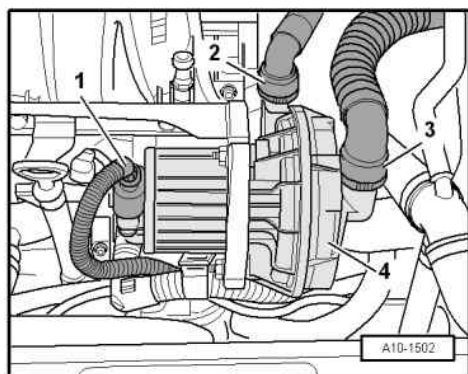
2.11 - Removing and installing coolant pipe

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Removing

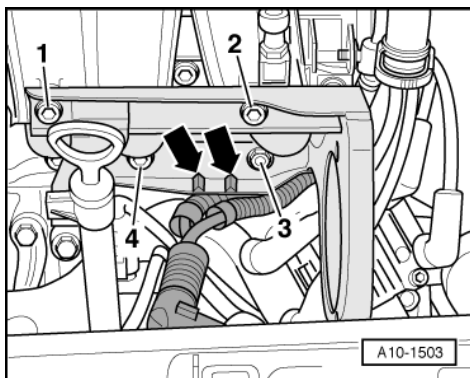
- Drain coolant => Page 215 .
- Remove alternator.

=> Electrical System; Repair group 27

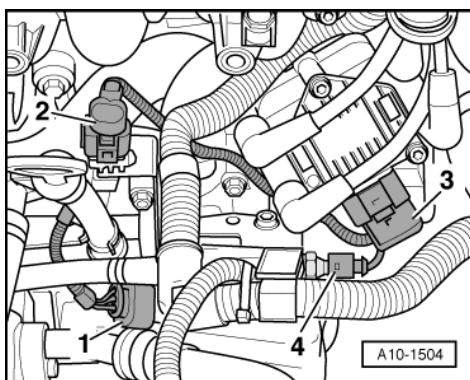


- -> Detach connector -1-.
- Disconnect hoses -2- and -3- at the secondary air pump.

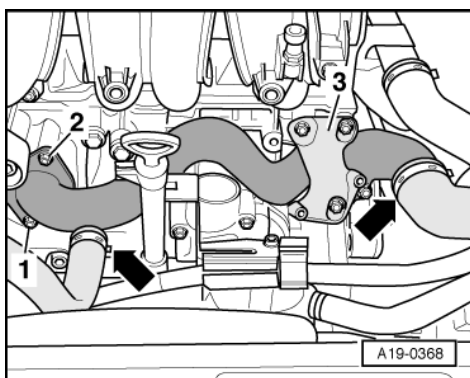
- Detach the secondary air pump -4- from the bracket.



- -> Unscrew bolts -1...4- of the secondary air pump bracket.
- Lay the wiring aside -arrow- and remove the secondary air pump bracket.



- -> Disconnect electrical connectors:
- 1 - Knock sensor -G61
- 2 - Engine speed sender -G28
- 3 - Ignition coils -N and -N128 with output stage -N122
- 4 - Oil pressure switch -F1 (on oil filter bracket)
- Oil temperature sender -G8 (on oil filter bracket)
- Lay wiring aside.



- Detach ignition coil from bracket.
- -> Remove bracket -3- for ignition coil.
- Disconnect the coolant hoses -arrows- at the coolant pipe.
- Remove bolts -1- and -2- and detach coolant pipe.



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Installing

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

Note:

Replace seals and gaskets.

- Install alternator.

=> Electrical System; Repair group 27

- Top up coolant => Page **217** .

Tightening torques

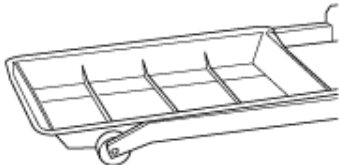
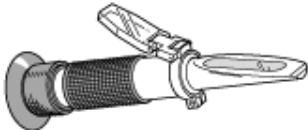
Component	Nm
Coolant pipe to cylinder block	15
Coolant pipe to bracket for ignition coil	10
Bracket for ignition coil to cylinder block	15
Ignition coil to bracket	10



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3 - Cooling system - all engine codes

3.1 - Cooling system - all engine codes

V.A.G 1306 	V.A.G 1921 
T10007 	
	G19-0008

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3.2 - Draining and filling cooling system

Special tools and workshop equipment required

- ♦ Drip tray V.A.G 1306
- ♦ Hose clamp pliers V.A.G 1921
- ♦ Refractometer T10007

Draining

Note:

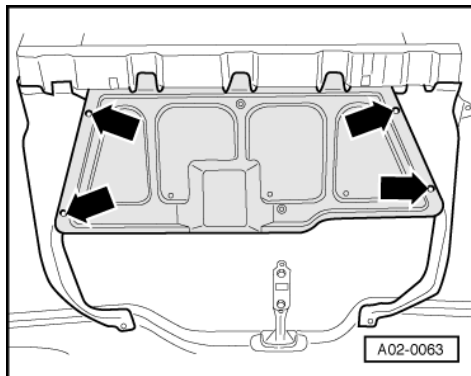
Collect drained coolant in a clean container for re use or disposal.



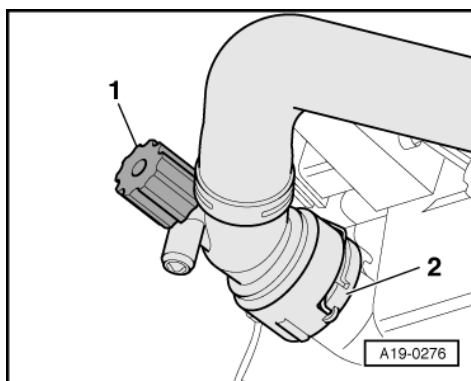
Important

Hot steam or hot coolant can escape when opening expansion tank. Cover cap with a cloth and open carefully.

- Open the cover of the coolant expansion tank



- -> Remove centre noise insulation -arrows-.



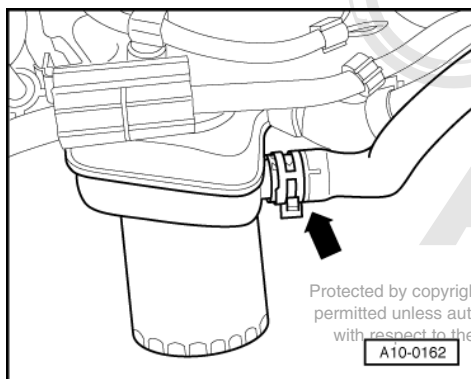
- Place drip tray V.A.G 1306 below engine.

Vehicles with drain plug:

- -> Turn drain plug -1- on radiator anti-clockwise, fit auxiliary hose to connection if necessary.

Vehicles without drain plug:

- Pull off retaining clip -2- for bottom coolant hose and detach coolant hose from radiator.



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All models:

- -> Also disconnect lower coolant hose on oil cooler -arrow-, and drain off remaining coolant.

Filling

Notes:

- ◆ The cooling system is filled all year round with a mixture of water and antifreeze/corrosion protection agent.
- ◆ Only use coolant additive G 012 A8 D - meeting specification TL VW 774 D.
Identification: red colour

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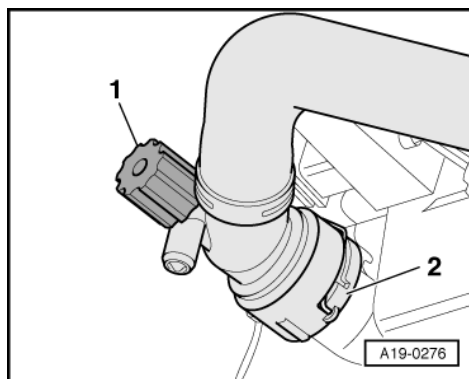
**Important
G**

- ◆ If the fluid in the expansion tank is brown, this means G 012 A8 D has been mixed with another type of coolant. In this case, flush out the cooling system and fill with fresh coolant. To flush the system, fill it with clean water and run the engine for about 2 minutes. This should remove as much of the old coolant as possible.
- ◆ G 012 A8 D and coolant additives marked "meeting specification TL VW 774 D" prevent frost and corrosion damage and stop scaling, and at the same time raise the boiling point of the coolant. For these reasons the cooling system must be filled all year round with the correct anti freeze and anti corrosion additive.
- ◆ Because of its high boiling point, the coolant improves engine reliability under heavy loads, particularly in countries with tropical climates.
- ◆ Protection against frost must be assured to approx. -25°C (in countries with an arctic climate to approx. -35° C).
- ◆ The coolant concentration must not be reduced by adding water even in warmer seasons and in warmer countries. The anti-freeze ratio must be at least 40 %.
- ◆ If greater frost protection is required in very cold climates, the amount of G 012 A8 D can be increased, but only up to 60 % (this gives frost protection to about -40 °C), as otherwise frost protection is reduced again and cooling effectiveness is also reduced.
- ◆ Only use clean drinking water to mix the coolant.
- ◆ If radiator, heat exchanger, cylinder head or cylinder head gasket is replaced, do not reuse old coolant.
- ◆ Use special tool T10007 to check frost protection of coolant additive G012 A8 D in cooling system.

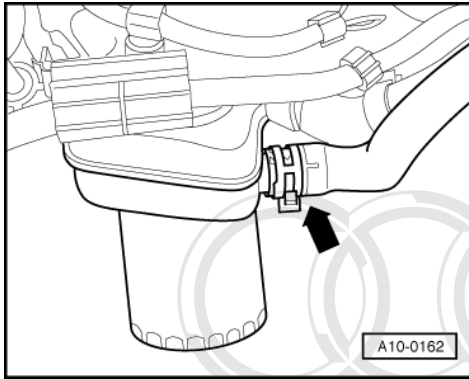
Recommended mixture ratios:

Frost protec- tion to	Anti freeze concentration	G 012A8 D 1)	Water1)
-25 °C	40 %	2.0 l	3.0 l
-35 °C	50 %	2.5 l	2.5 l

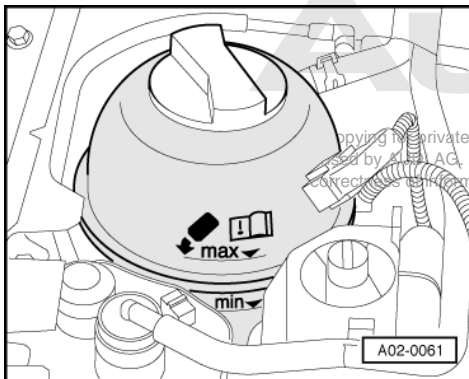
- 1) Coolant quantity: 5.0 litres (may vary depending upon the vehicle equipment)



- -> Turn drain plug -1- at radiator clockwise, or fit hose -2- at radiator.



- -> Connect the coolant hose to the oil cooler -arrow-.



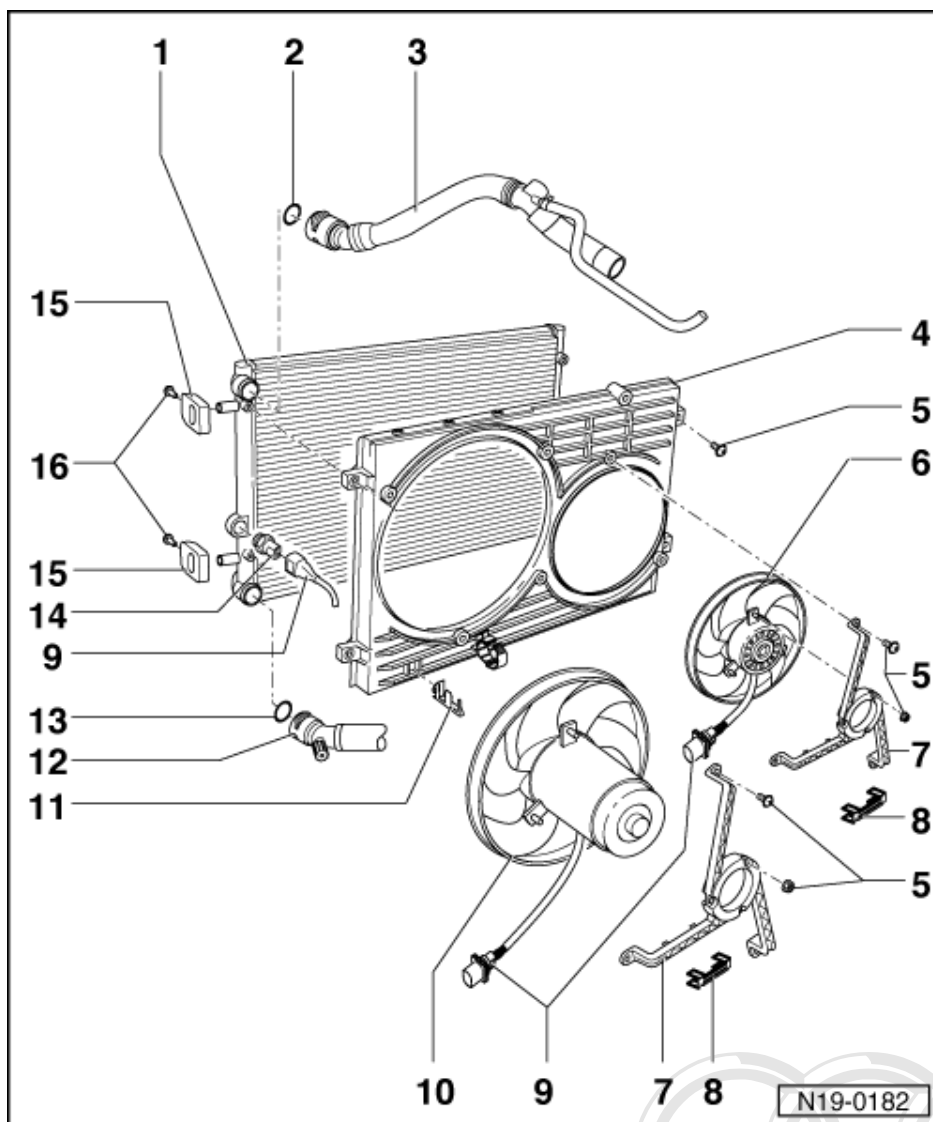
- -> Top up coolant to max. mark on expansion tank.
- Start engine, allow to run at approx. 1500 rpm for max. 2 minutes, and at the same time fill with coolant up to overflow hole on the expansion tank.
- Fit expansion tank cap.
- Run engine until radiator fan cuts in.

Important

Hot steam or hot coolant can escape when opening expansion tank. Cover cap with a cloth and open carefully.

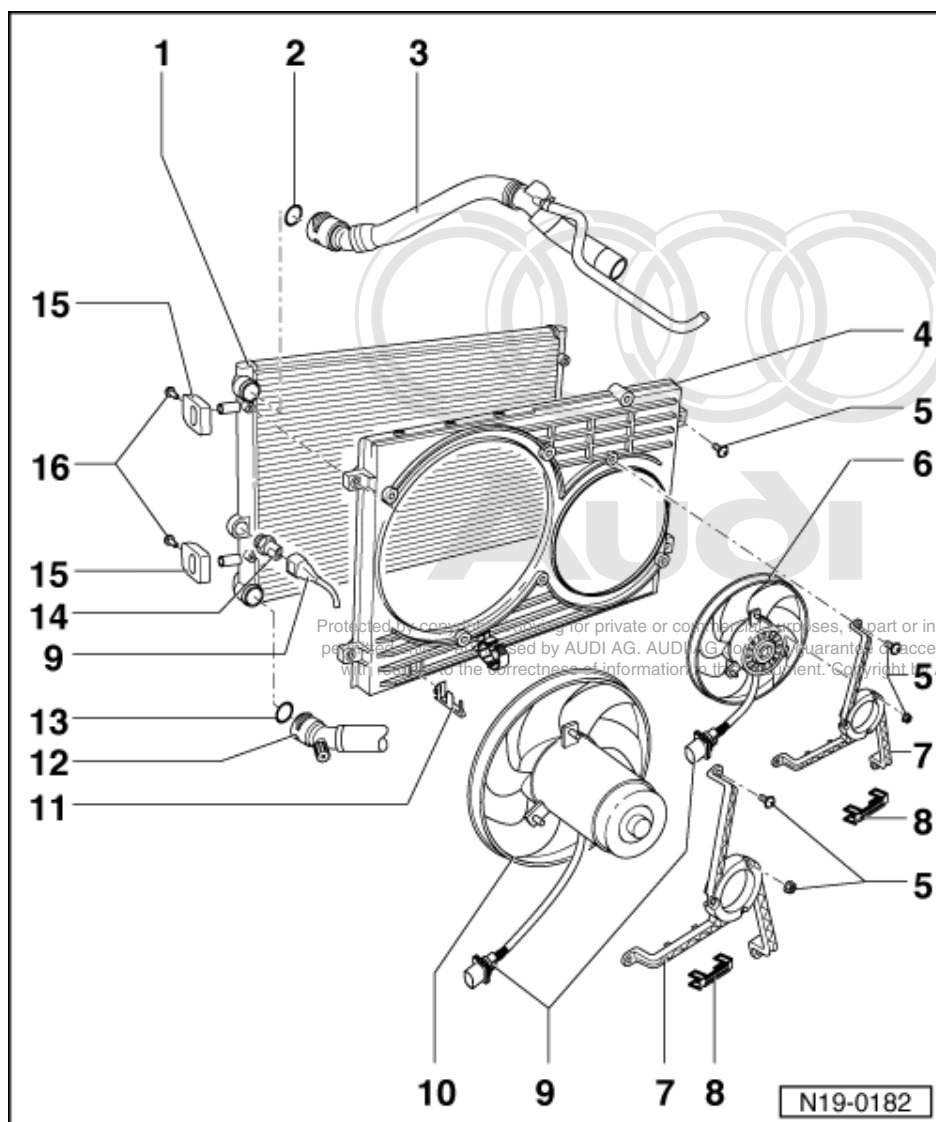
- Check coolant level and top up if necessary. If the engine is warm, coolant level must be at max. mark; if cold, between min. and max. marks.
- Stop engine.

3.3 - Radiator and radiator fan - Assembly overview



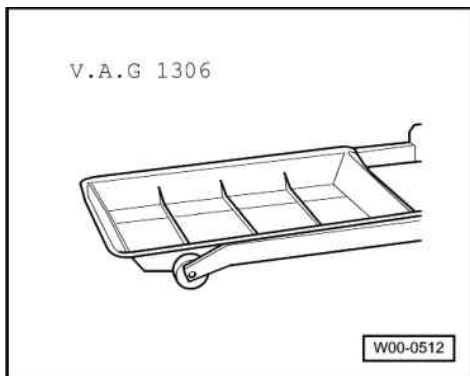
- 1 Radiator
 - ♦ Removing and installing
=>Page 221 .
 - ♦ If replaced renew the complete coolant
- 2 O-ring
 - ♦ Replace
- 3 Upper coolant hose
- 4 Radiator cowl
- 5 10 Nm
- 6 Additional fan
 - ♦ Dependent on equipment level
- 7 Fan ring
- 8 Bracket
- 9 Connector

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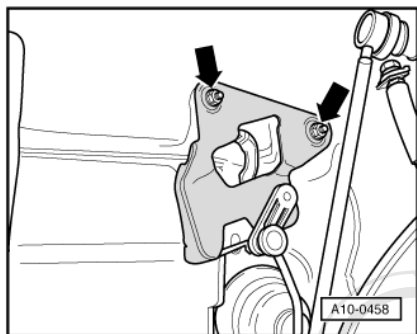
- 10 Radiator fan -V7**
- 11 Bracket**
 - ◆ For connector plug
- 12 Lower coolant hose**
 - ◆ To connection for thermostat
- 13 O-ring**
 - ◆ Replace
- 14 Thermoswitch for radiator fan -F18/-F54 - 35 Nm**
 - ◆ Switching temperatures:
 - 1st stage
 - on: 92...97 °C
 - off: 84...91 °C
 - 2nd stage
 - on: 99...105 °C
 - off: 91...98 °C
- 15 Bracket**
 - ◆ For radiator
 - ◆ Note installation position
- 16 15 Nm**

3.4 - Removing and installing radiator



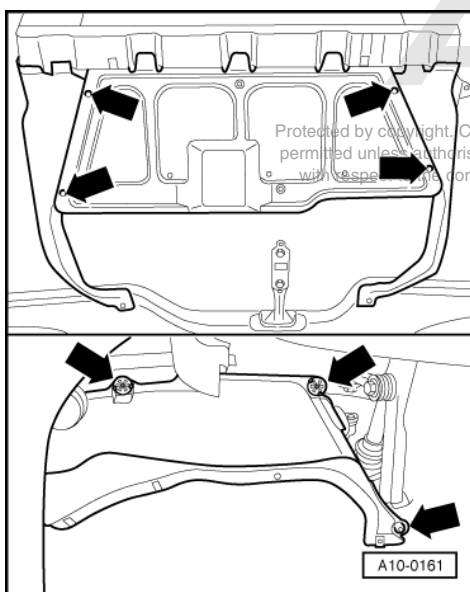
Special tools and workshop equipment required

- ♦ Drip tray V.A.G 1306



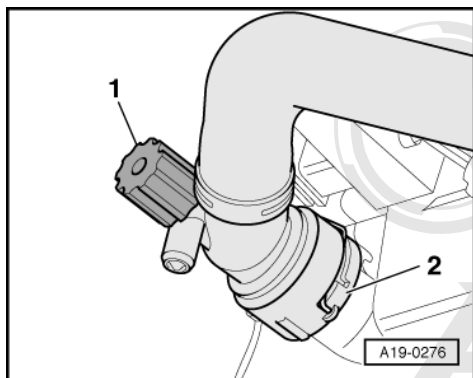
Removing

- -> Remove the headlight range control bracket in top left of wheel housing -arrows- in vehicles with automatic headlight range control.





- -> Remove noise insulation from centre, left and right sides -arrows-



- Place drip tray V.A.G 1306 below engine.

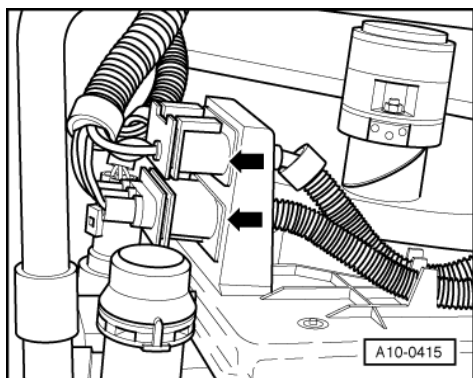
Vehicles with drain plug:

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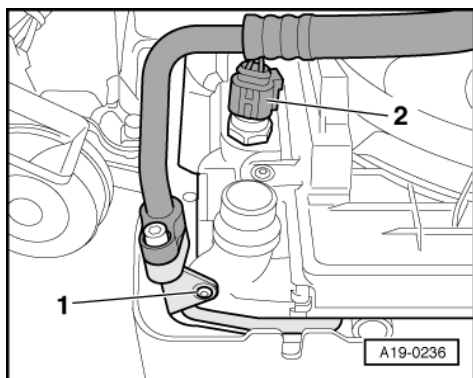
- -> Turn drain plug -1- on radiator anti-clockwise, fit auxiliary hose to connection if necessary, and drain coolant at radiator.

All models:

- Pull off retaining clip -2- for bottom coolant hose and detach coolant hose from radiator.



- -> Detach both connectors -arrows- for radiator fan on bottom left of radiator cowl.



- -> Detach connector -2- at thermoswitch -F18.

Vehicles with air conditioner:

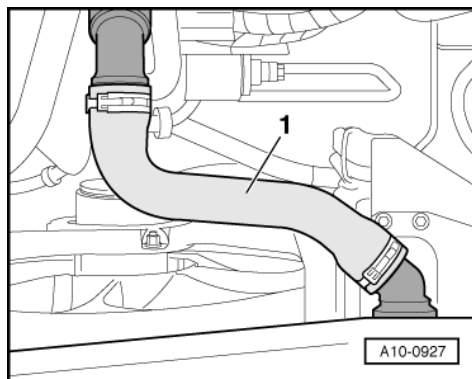
Important

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.

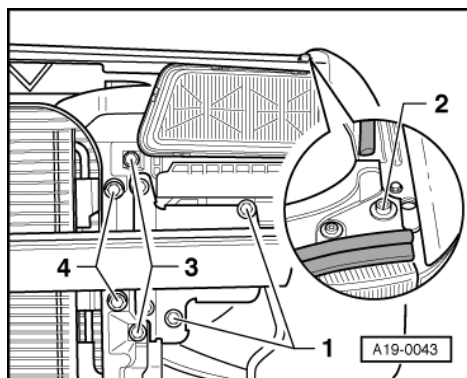
- Detach coolant pipe -1- from radiator.



All models:

- -> Remove coolant hose -1- from top of radiator.
- Remove the front bumper cover:

=> General Body Assembly, Exterior; Repair group 63; Front bumper; Removing and installing front bumper
Front bumper Removing and installing front bumper



Vehicles with air conditioner:

Important

The air conditioner refrigerant circuit must not be opened.

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Note:

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

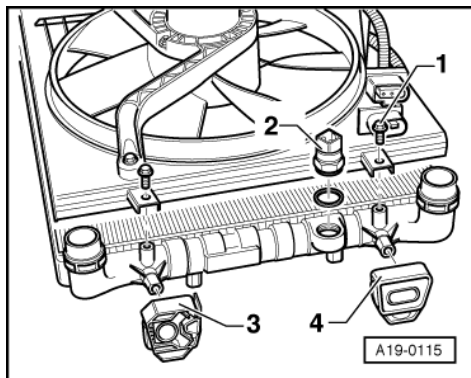
- -> Unscrew securing bolts -4- of condenser.



- Tie up condenser to lock carrier using wire loop.

All models:

- Unscrew bolts -3- of radiator.
- Unscrew bolts -1- for lock carrier.
- Slacken bolts -2- two turns.
- Pull lock carrier carefully forward as far as possible (the help of a 2nd mechanic is required) and lower radiator and fan out of vehicle.



Installing

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

- -> Fit mountings -3- and -4- on radiator as illustrated.
- Fit radiator securing bolts (the help of a 2nd mechanic is required).
- Installing lock carrier with attachments:

=> General Body Assembly, Exterior; Repair group 50; Front chassis; Removing and installing lock carrier with attachments Front chassis Removing and installing lock carrier with attachments

- Install the front bumper cover:

=> General Body Assembly, Exterior; Repair group 63; Front bumper; Removing and installing front bumper Front bumper Removing and installing front bumper

- Top up coolant => Page 217 .
- Adjust headlights.

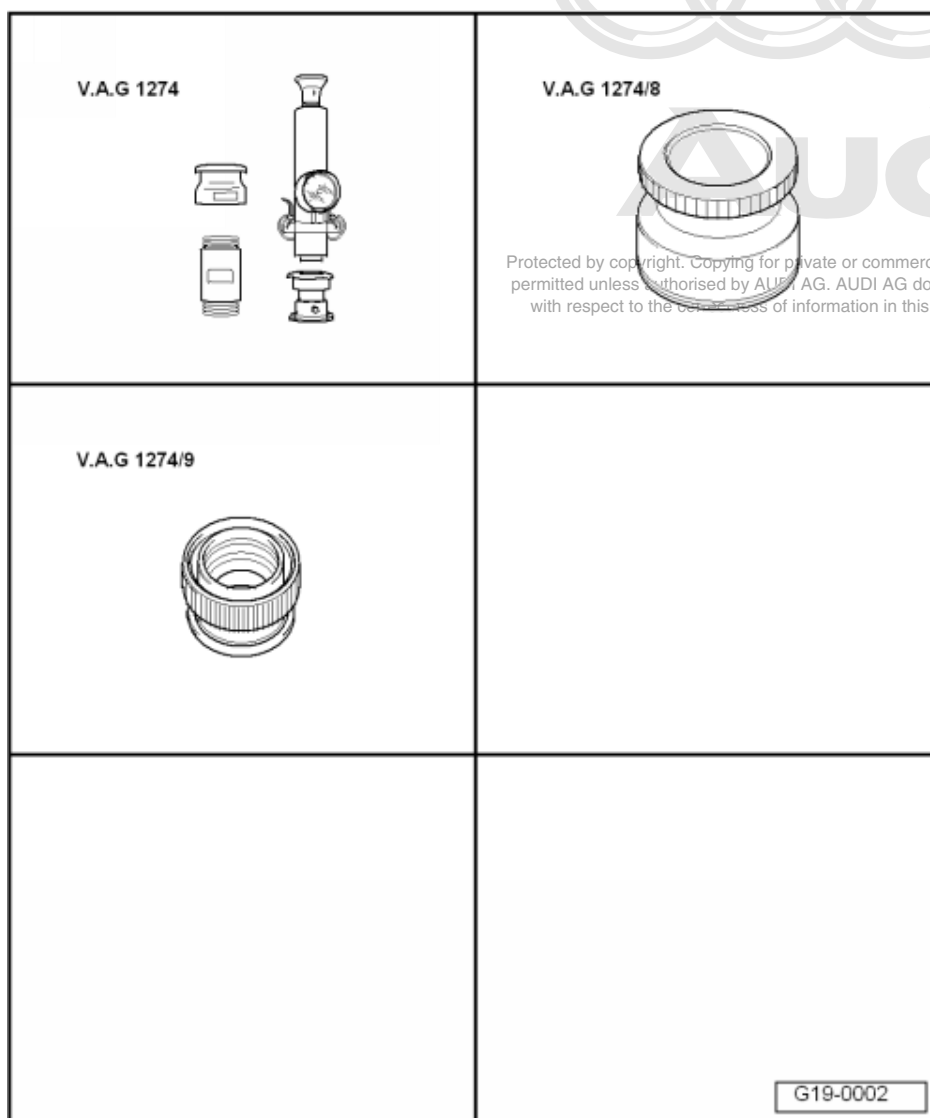
=> Electrical System; Repair group 94; Servicing headlights Servicing headlights

Tightening torques

Component	Nm
Radiator cowl to radiator	10
Thermostat in radiator	35
Coolant pipe to radiator	10
Condenser to radiator	10
Radiator to lock carrier	15

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3.5 - Checking cooling system for leaks



Special tools and workshop equipment required

- ◆ V.A.G 1274
- ◆ V.A.G 1274/8
- ◆ V.A.G 1274/9

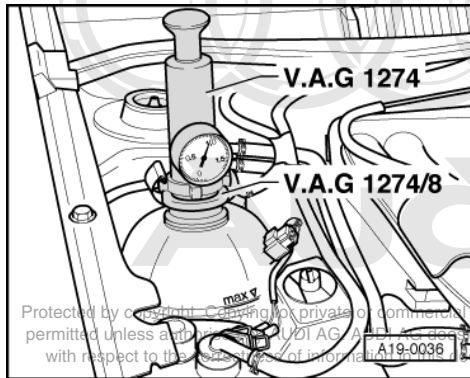
Test requirements:

- Engine at operating temperature.

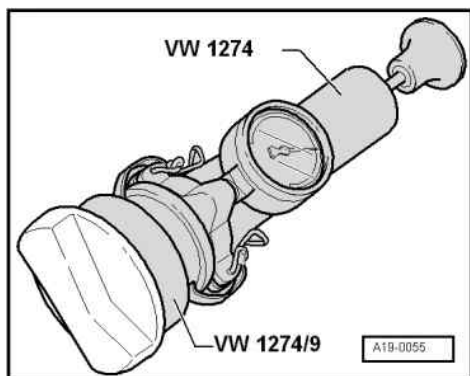
Test sequence

Important
Hot steam or hot coolant can escape when opening expansion tank. Cover cap with a cloth and open carefully.

- Open the cover of the coolant expansion tank



- -> Fit tester V.A.G 1274 with adapter V.A.G 1274/8 onto expansion tank.
- Using hand pump on tester, build up a pressure of approx. 1.0 bar.
- If this pressure is not maintained, locate and rectify leaks.



Checking pressure relief valve in filler cap.

- -> Fit tester V.A.G 1274 with adapter V.A.G 1274/9 onto sealing cap.
- Operate hand pump.
 - The pressure relief valve should open at a pressure of 1.4...1.6 bar.

26 - Exhaust system

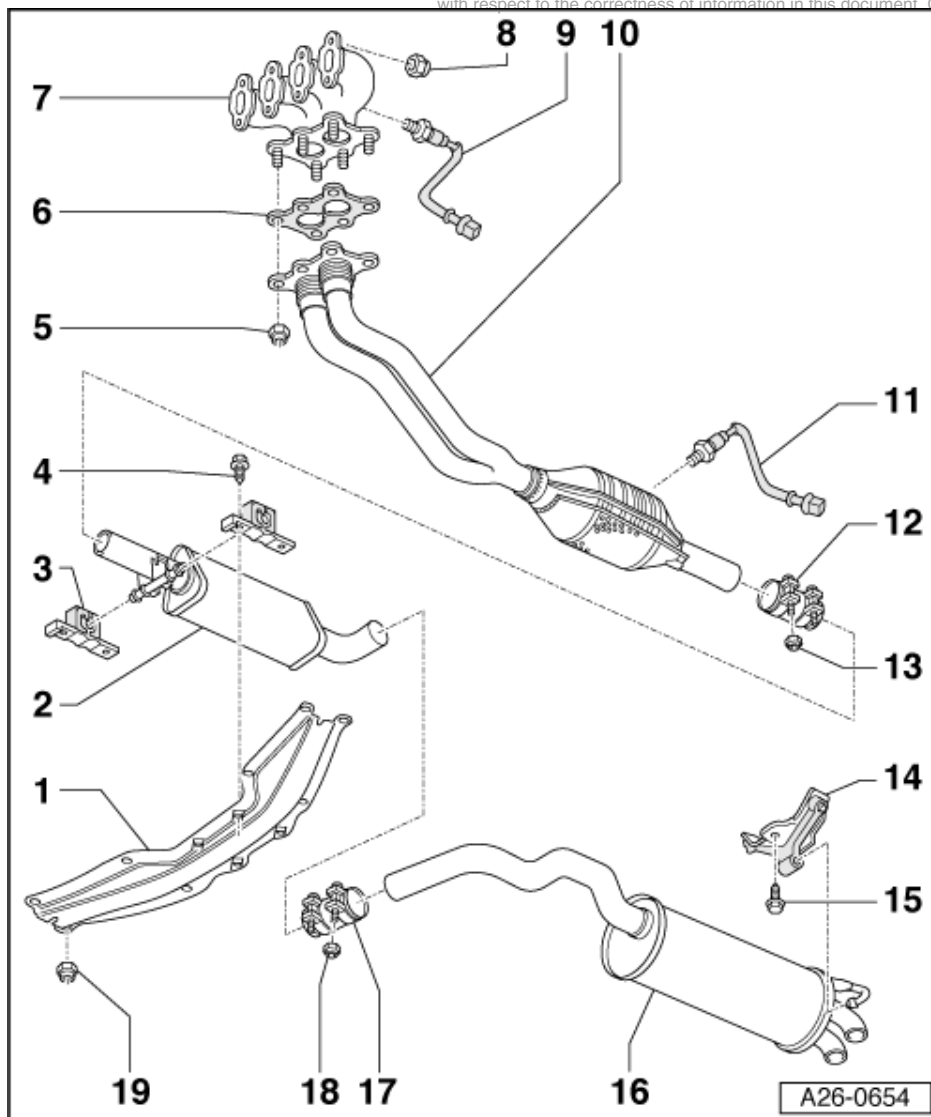
1 - Removing and installing parts of exhaust system

1.1 - Removing and installing parts of exhaust system

Notes:

- ♦ Always replace seals, 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 clamping sleeve and align silencers and exhaust pipe so that sufficient clearance is maintained to the body at all points and the mountings are evenly loaded.
- ♦ Slacken and tighten clamping plates for heat shields with a screwdriver.
Tightening torque: 2 Nm

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1 Tunnel cross piece

- ♦ With bore for aligning exhaust system => Page 238

2 Centre silencer

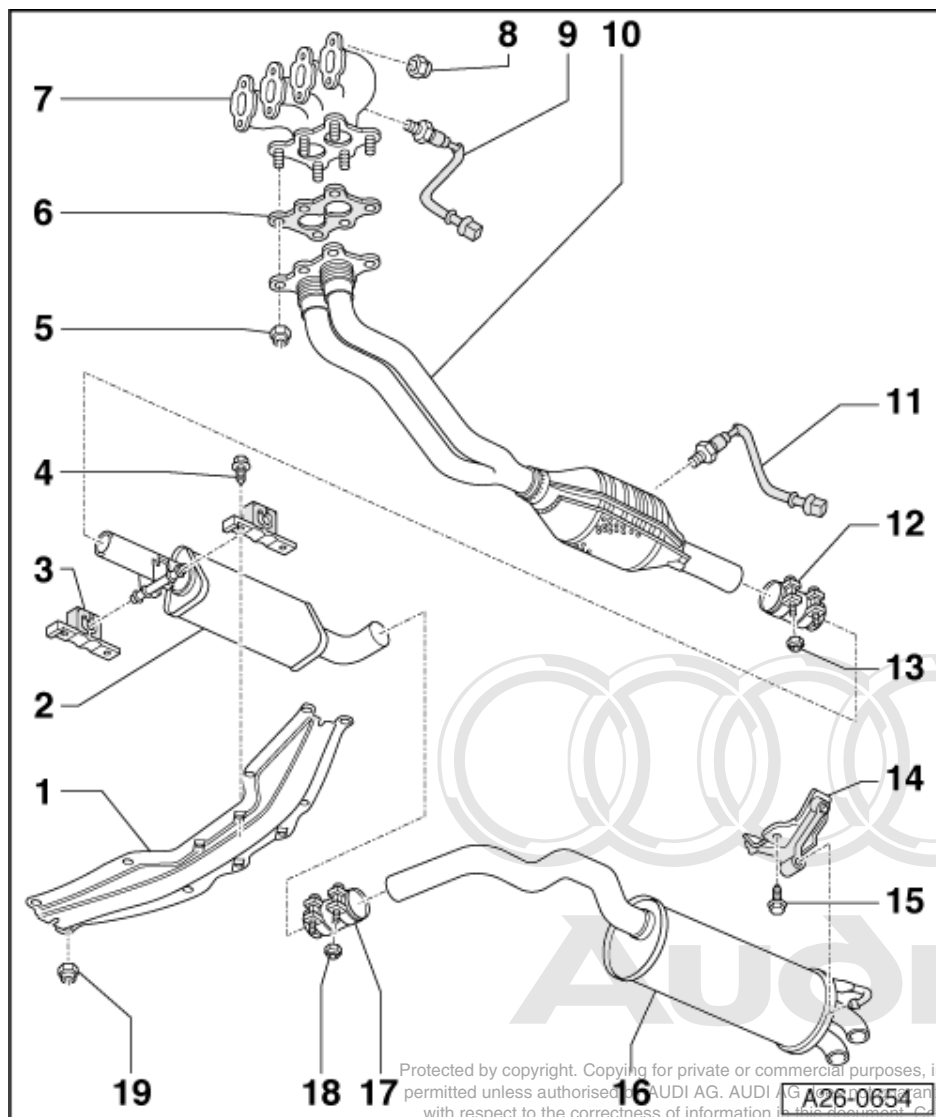
- ♦ Centre and rear silencers are one unit as original equipment. In cases of repair, replace individually
- ♦ Cutting point => Page 234

- ♦ Align exhaust system so it is free of stress before tightening clamp => Page 238

3 Mounting

- ♦ Installation position
=> Fig. 233
- ♦ Replace if damaged

4 23 Nm



5 40 Nm

- ♦ Replace
- ♦ Coat stud bolts of exhaust manifold with high-temperature lubricant
- ♦ High-temperature lubricant

=> Parts List

- ♦ Observe the tightening sequence =>Page 238

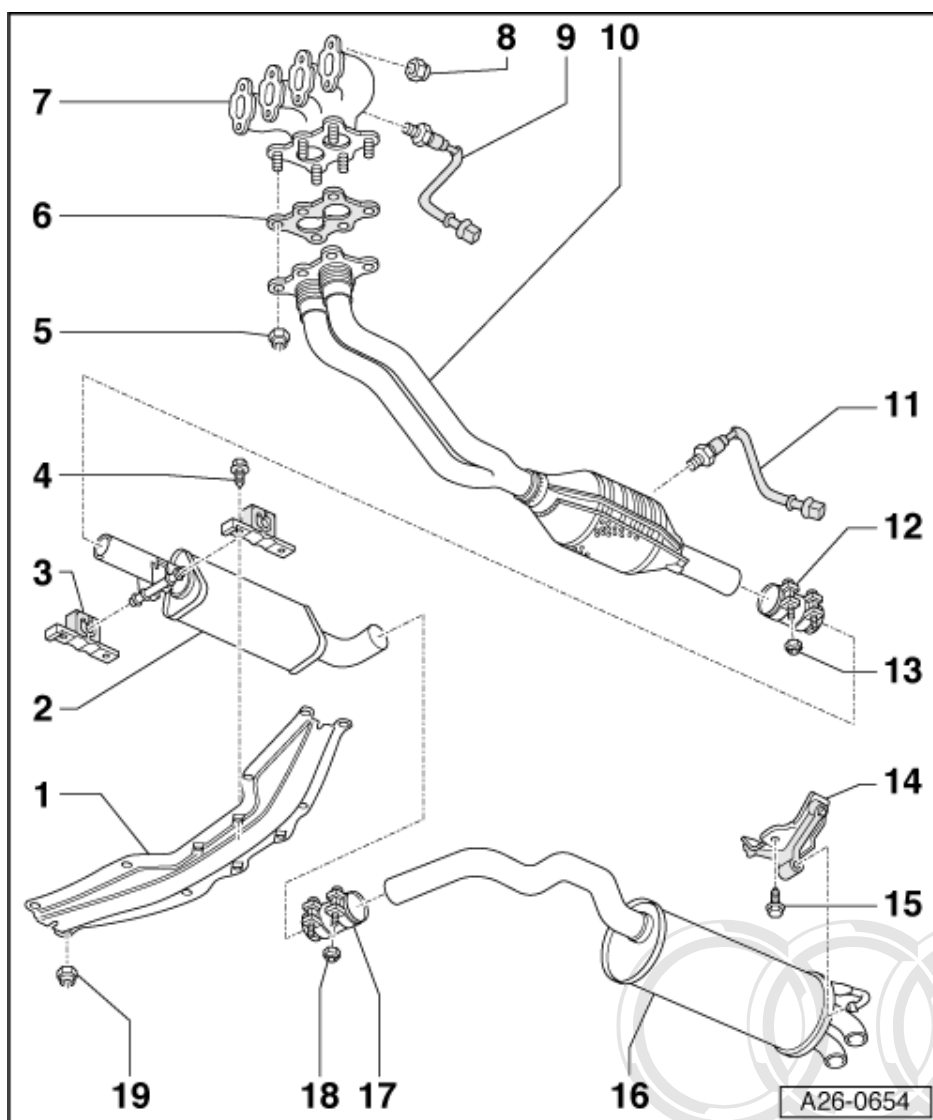
6 Gasket

- ♦ Replace
- ♦ Installation position for vehicles with engine codes AKL, APF:
Recess in rib of gasket points rearwards (towards lambda probe)

7 Exhaust manifold

- ♦ Removing and installing for vehicles with engine codes AEH, AKL => Page 234

- ♦ Removing and installing for vehicles with engine code APF => Page 235



8 25 Nm

- ♦ Replace

9 Lambda probe - 55 Nm

- ♦ Upstream of catalytic converter
- ♦ Grease only the threads with high-temperature lubricant. The lubricant must not penetrate into the slots on the probe body.
- ♦ High-temperature lubricant

=> Parts List

- ♦ Checking:

=> Simos Fuel Injection and Ignition System; Repair group 24

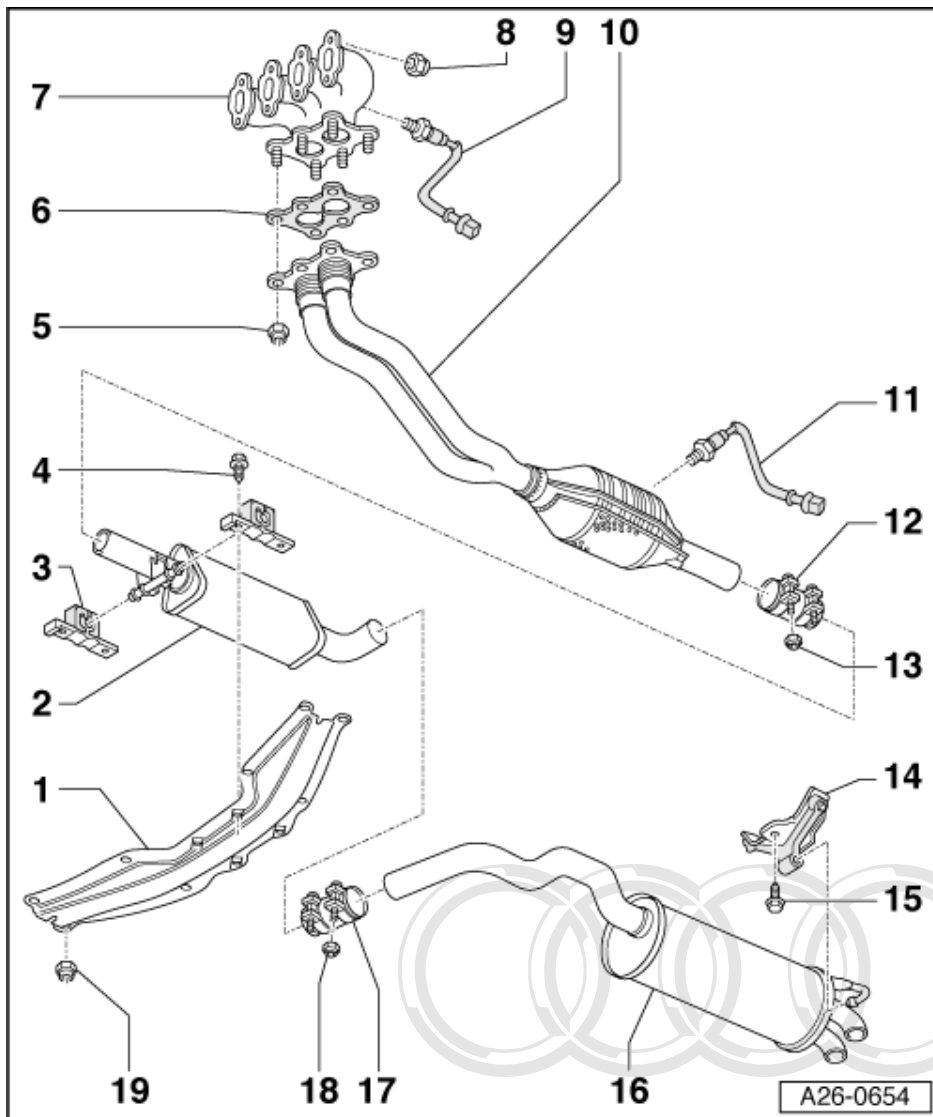
- ♦ Connector for lambda probe under protective cover => Page 236

10 Front exhaust pipe

- ♦ With catalytic converter
- ♦ Protect from damage by knocks and impact
- ♦ Removing and installing
=>Page 236 .

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- ♦ Align exhaust system so it is free of stress before tightening clamp => Page 238



11 Lambda probe - 55 Nm

- ♦ Downstream of catalytic converter
- ♦ Grease only the threads with high-temperature lubricant. The lubricant must not penetrate into the slots on the probe body.
- ♦ High-temperature lubricant

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=> Parts List

- ♦ Checking:

=> Simos Fuel Injection and Ignition System; Repair group 24

- ♦ Connector for lambda probe under protective cover => Page 236

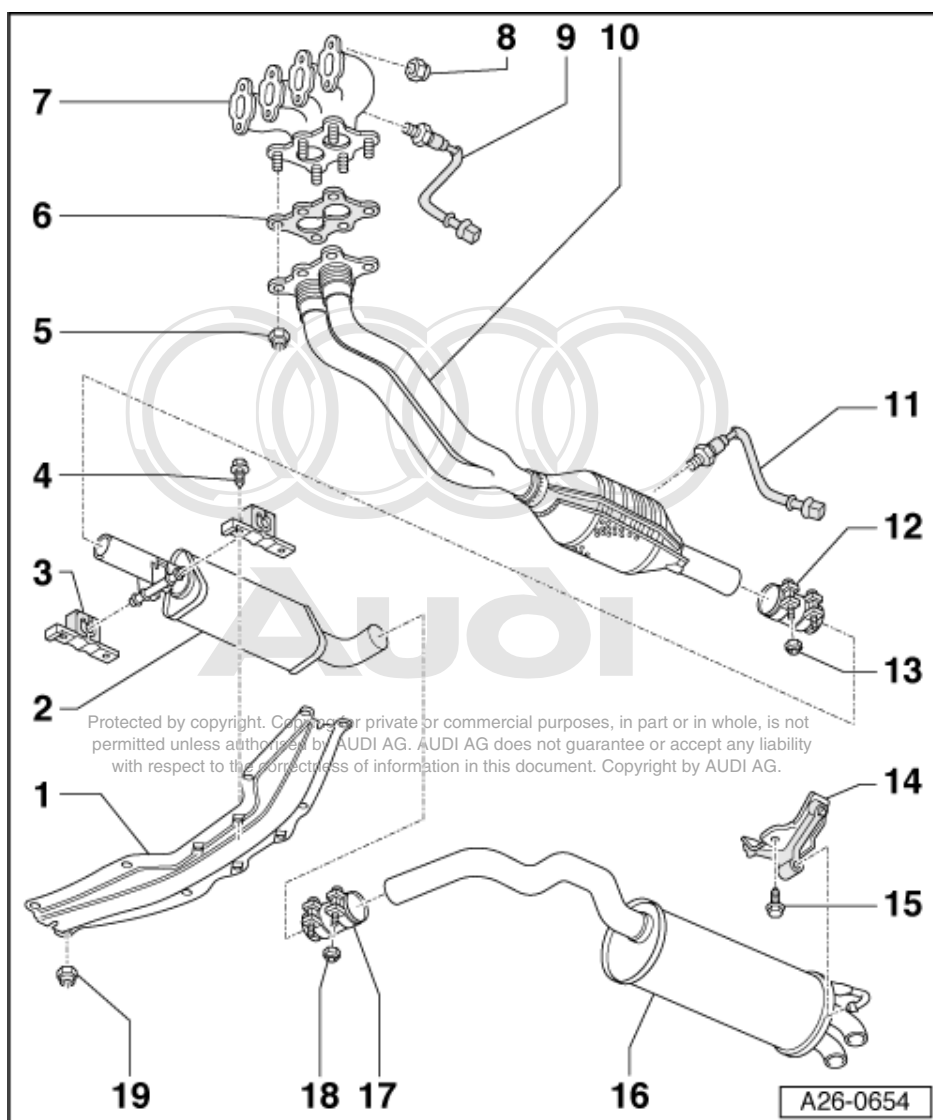
12 Front clamping sleeve

- ♦ Align exhaust system so it is free of stress before tightening clamp => Page 238
- ♦ Installation position
=>Fig. 232
- ♦ Tighten bolted connections evenly.

13 40 Nm

14 Mounting

- ♦ Replace if damaged



15 23 Nm

16 Rear silencer

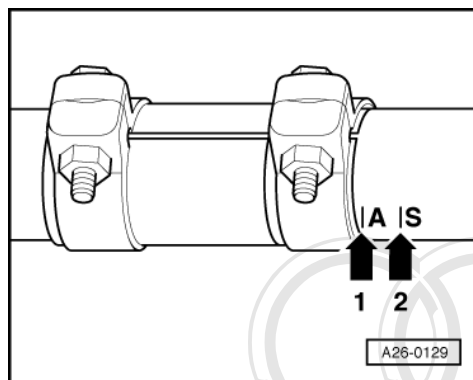
- ♦ Rear and centre silencer are one unit as original equipment. In cases of repair, replace individually
- ♦ Cutting point => Page 234
- ♦ Align exhaust system so it is free of stress before tightening clamp => Page 238

17 Rear clamping sleeve

- ♦ For separate replacement of centre and rear silencers
- ♦ Installation position
=> Fig. 232
- ♦ Tighten bolted connections evenly.

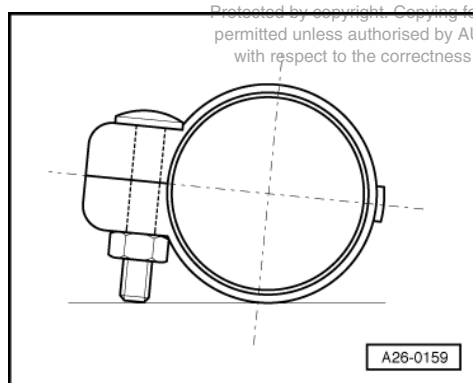
18 40 Nm

19 23 Nm

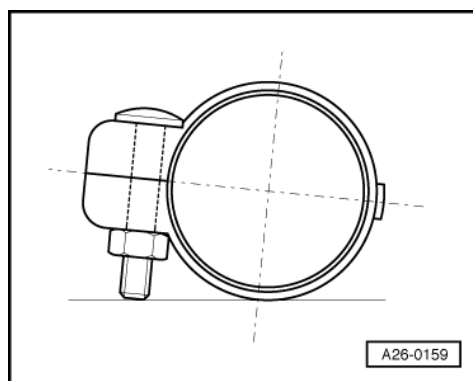


-> Fig.1 Installation position of front clamp

- Position clamp about 5 mm away from the relevant marking line.
- ♦ Arrow 1 - vehicles with automatic gearbox
- ♦ Arrow 2 - vehicles with manual gearbox

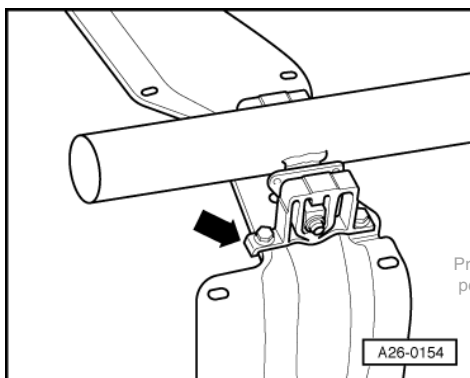


- -> Install the clamps so that the ends of the bolts do not protrude over the lower edge of the clamping sleeve.
- Bolted connection facing to the left



-> Fig.2 Installation position of rear clamp

- Install the clamping sleeve so that the ends of the bolts do not protrude over the lower edge of the clamping sleeve.
- Bolted connection facing to the front



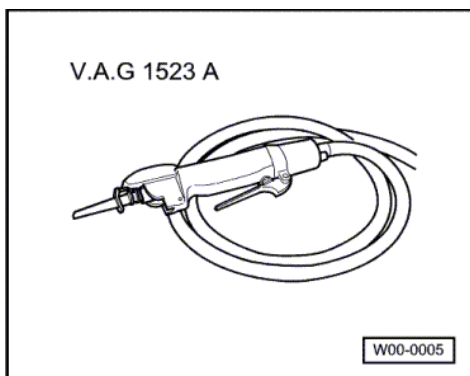
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-> Fig. 3 Installation position of mounting

Angled end at base of mounting -arrow- faces in direction of travel.

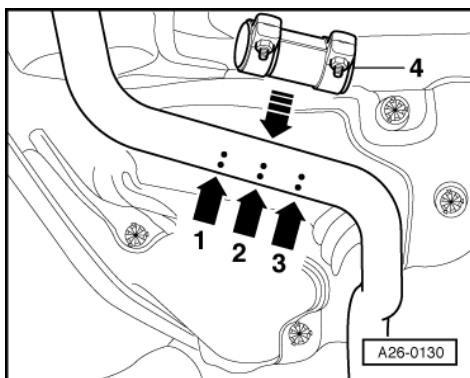
1.2 - Separating centre and rear silencers

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



Special tools and workshop equipment required

- ♦ Body saw V.A.G 1523 A
- ♦ Protective goggles

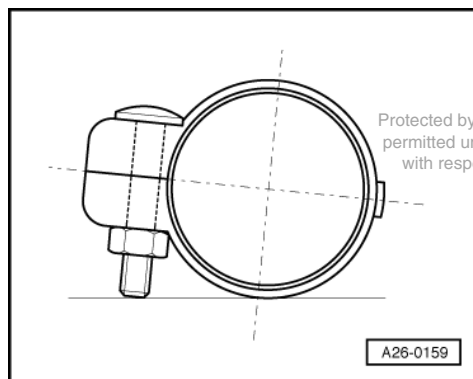




Procedure

Important
Wear protective goggles.

- -> Cut through exhaust pipe at right angles with body saw, e.g. V.A.G 1523 A at cutting point -arrow 2-.
- Position clamp 4 between side markings- arrows 1 and 3- when installing.



- -> Install clamps so that the bolt-ends do not protrude over the lower edge of the clamping sleeve.
- Bolted connection facing to the front
- Stress-free alignment of exhaust system => Page 238

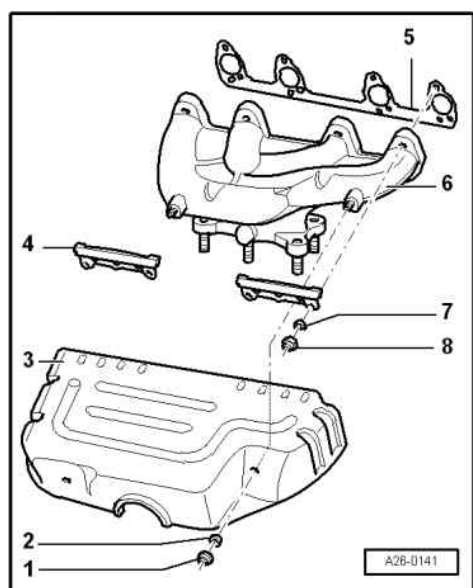
1.3 - Removing and installing exhaust manifold - vehicles with engine codes AEH, AKL

Removing

- Remove upper section of intake manifold => Page 122 .
- Remove front exhaust pipe together with catalytic converter=> Page 236 .

Vehicles with engine code AKL:

- Detach connector for lambda probe upstream of catalytic converter.



All models:

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

Installing

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

Note:

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- Install front exhaust pipe => Page 238 .
- Install upper section of intake manifold => Page 122 .
- Stress-free alignment of exhaust system => Page 238

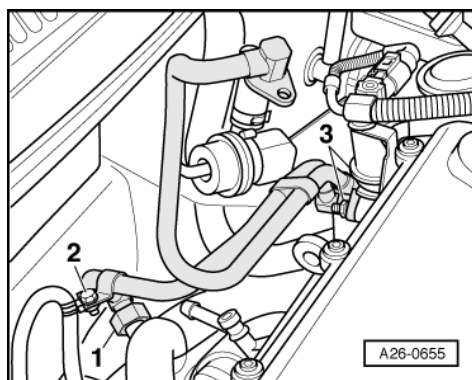
Tightening torques

Component		Nm
Exhaust manifold to cylinder head		25
Heat shield to bracket	M6	10
	M8	23

1.4 - Removing and installing exhaust manifold - vehicles with engine code APF

Removing

- Remove upper section of intake manifold => Page 126 .
- Remove front exhaust pipe together with catalytic converter=> Page 236 .
- Remove support for exhaust manifold.
- Detach connector for lambda probe upstream of catalytic converter.
- Detach heat shield from exhaust manifold.



- -> Unbolt cable clamp -2-.
- Loosen union nut -1-.
- Remove nuts -3- and remove connecting pipe for exhaust gas recirculation.
- Unscrew nuts on exhaust manifold and remove washers.
- Remove exhaust manifold and exhaust manifold gasket.



Installing

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

Note:

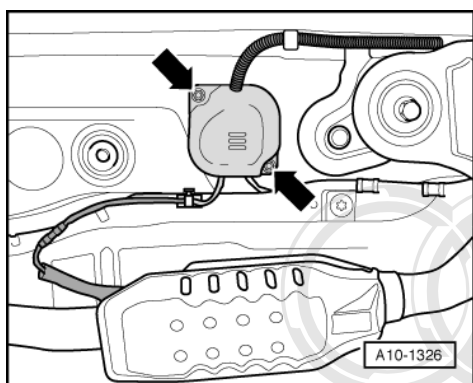
Always replace seals, gaskets and self-locking nuts.

- Install front exhaust pipe => Page 238 .
- Install upper section of intake manifold => Page 126 .
- Stress-free alignment of exhaust system => Page 238

Tightening torques

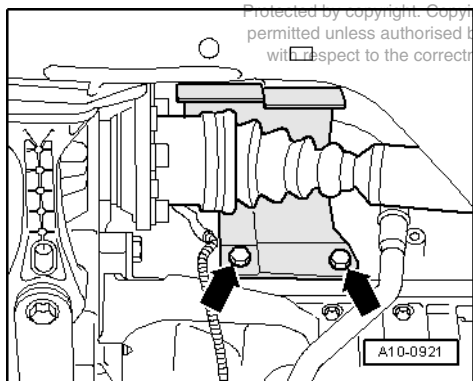
Component	Nm
Exhaust manifold to cylinder head	25
Exhaust manifold support to exhaust manifold	40
Exhaust manifold support to cylinder block	40
Connecting pipe for exhaust gas recirculation to valve for exhaust gas recirculation	25
Connecting pipe for secondary air inlet to exhaust manifold	60

1.5 - Removing and installing front exhaust pipe with catalytic converter



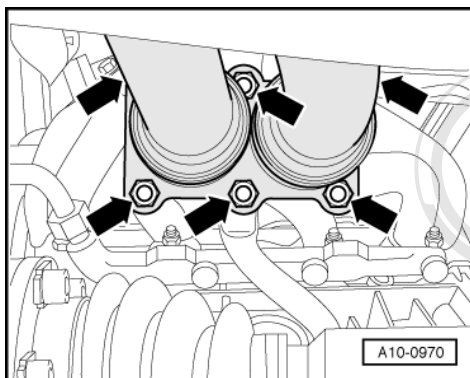
Removing

- -> Unscrew protective cover -arrows- on vehicle floor.
- Unplug connector for lambda probe in catalytic converter and lay wiring aside.



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- -> Unbolt heat shield for right drive shaft -arrows-.

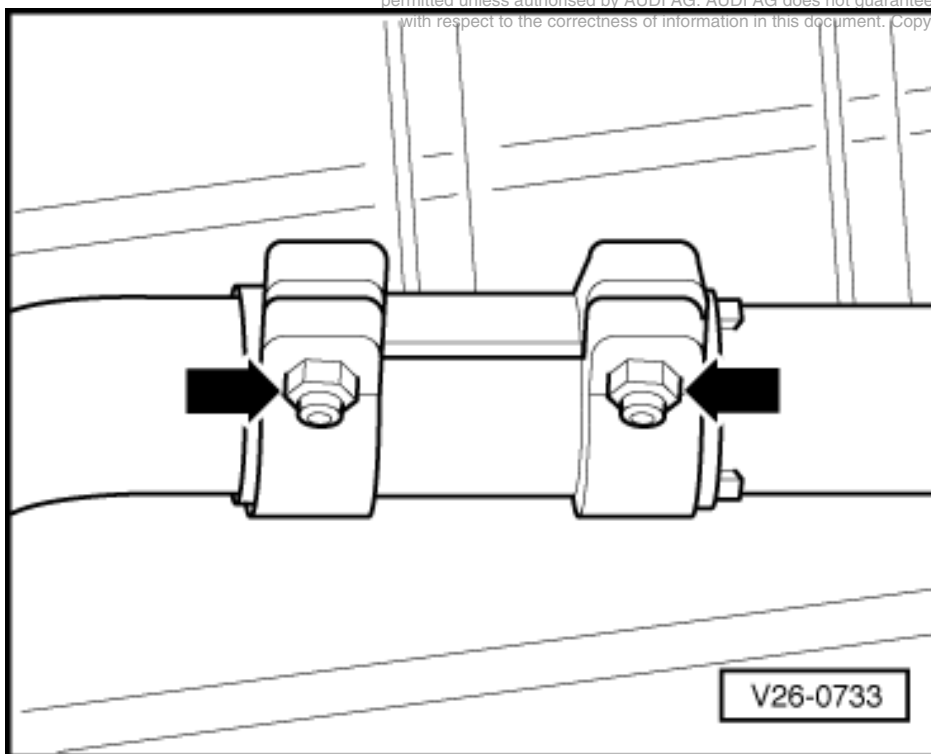


Note:

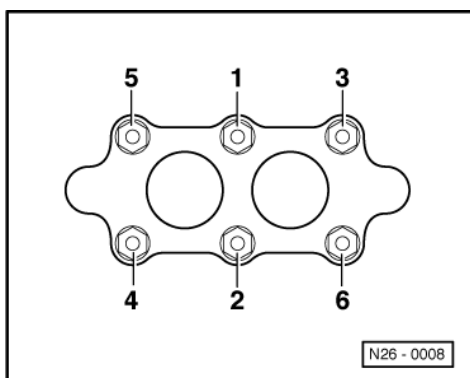
The isolating element in front exhaust pipe must not be deflected more than 10° to avoid damage.

- -> Remove securing bolts -arrows- of front exhaust pipe/exhaust manifold.

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- -> Detach the exhaust system at the clamping sleeve -arrows-.
- Detach the front exhaust pipe, swivel the front exhaust pipe 180° for this purpose.





Installing

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

Notes:

- ♦ Always replace seals, gaskets and self-locking nuts.
- ♦ For vehicles with engine codes AKL and APF, note the installation position of the gasket between the exhaust manifold and front exhaust pipe: Recess in rib of gasket points rearwards (towards lambda probe)
- -> Fasten the front exhaust pipe to the exhaust manifold using the tightening sequence shown.
- Stress-free alignment of exhaust system => Page 238

Tightening torques

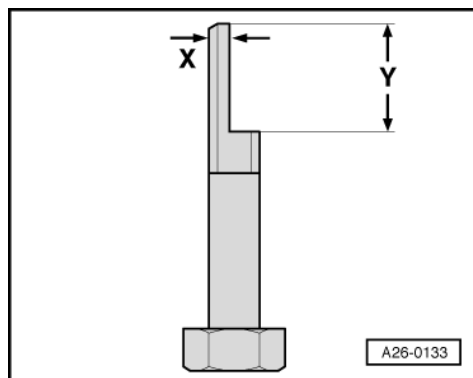
Component	Nm
Front exhaust pipe to exhaust manifold	40 1)
Drive shaft heat shield to cylinder block	35

- 1) Coat the exhaust manifold stud bolts with high-temperature lubricant;
High-temperature lubricant

=> Parts List

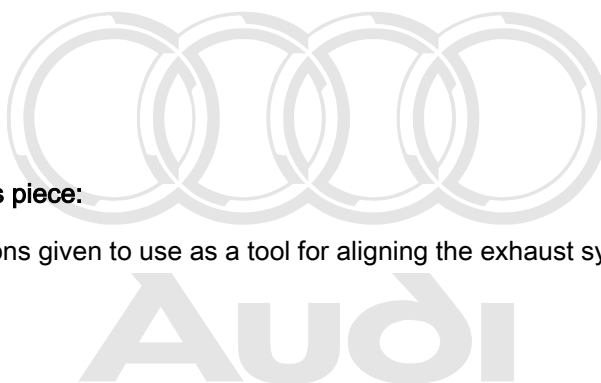
1.6 - Stress free alignment of exhaust system

- Depending on vehicle version, a make-shift tool must be fashioned from an M10 or M14 bolt, in order to adjust the exhaust system position.
- The exhaust system must be aligned when cold.

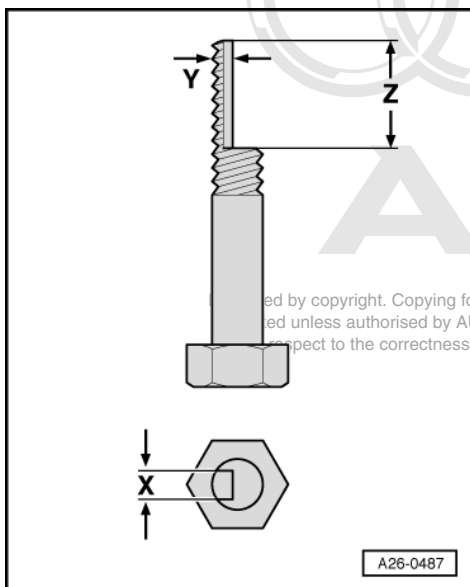


Vehicles with $\varnothing 10.5$ mm bore in rear of tunnel cross piece:

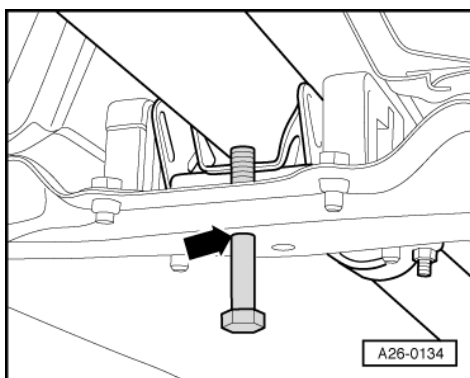
- -> Modify an M10 bolt according to the dimensions given to use as a tool for aligning the exhaust system.
- Dimension X = 4 mm
- Dimension Y = 25 mm



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Vehicles with $\varnothing 14.5$ mm bore in rear of tunnel cross piece:

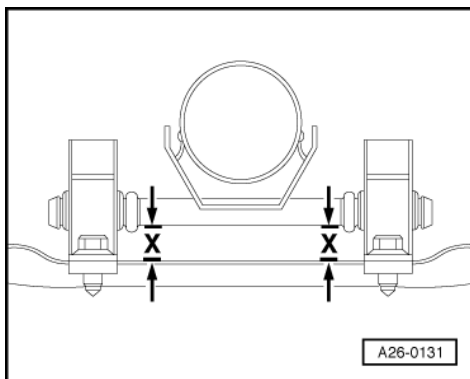
- -> Modify an M14 bolt according to the dimensions given to use as a tool for aligning the exhaust system.
- Dimension X = 10 mm
- Dimension Y = 6 mm
- Dimension Z = 25 mm


All models:

- Slacken bolted connections on front clamping sleeve -Item 230 .
- -> Insert modified bolt (aligning tool) through rear bore -arrow- in tunnel cross piece, with flat part of bolt facing towards mounting pin on exhaust system.

Note:

With bolt inserted, exhaust system is pre tensioned in the direction of travel.





- Align centre and rear silencer horizontally:
 - -> The attachment bolt on exhaust pipe must be parallel to tunnel cross piece (dimension x on left and right is the same).
- Position the front clamp.
 - Installation position of clamp =>Fig. 1
- Tighten bolted connections on clamp evenly to 40 Nm.

1.7 - Checking exhaust system for leaks

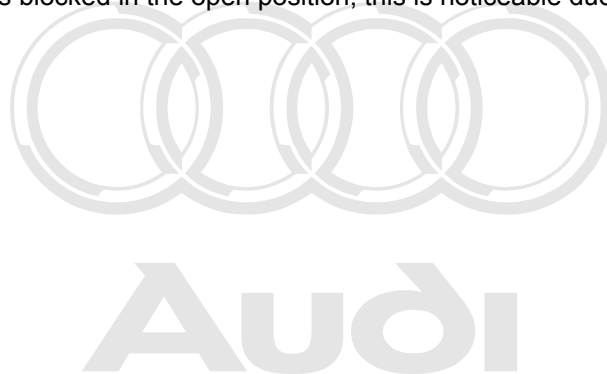
- Start engine and run at idling speed.
- Plug tailpipes with cloths or stoppers until check is completed.
- Listen for noise at the connection points (cylinder head/manifold; manifold/front exhaust pipe; front exhaust pipe etc.) to locate any leaks.
- Rectify any leaks that are found.

2 - Exhaust gas recirculation system - vehicles with engine code APF

2.1 - Exhaust gas recirculation system - vehicles with engine code APF

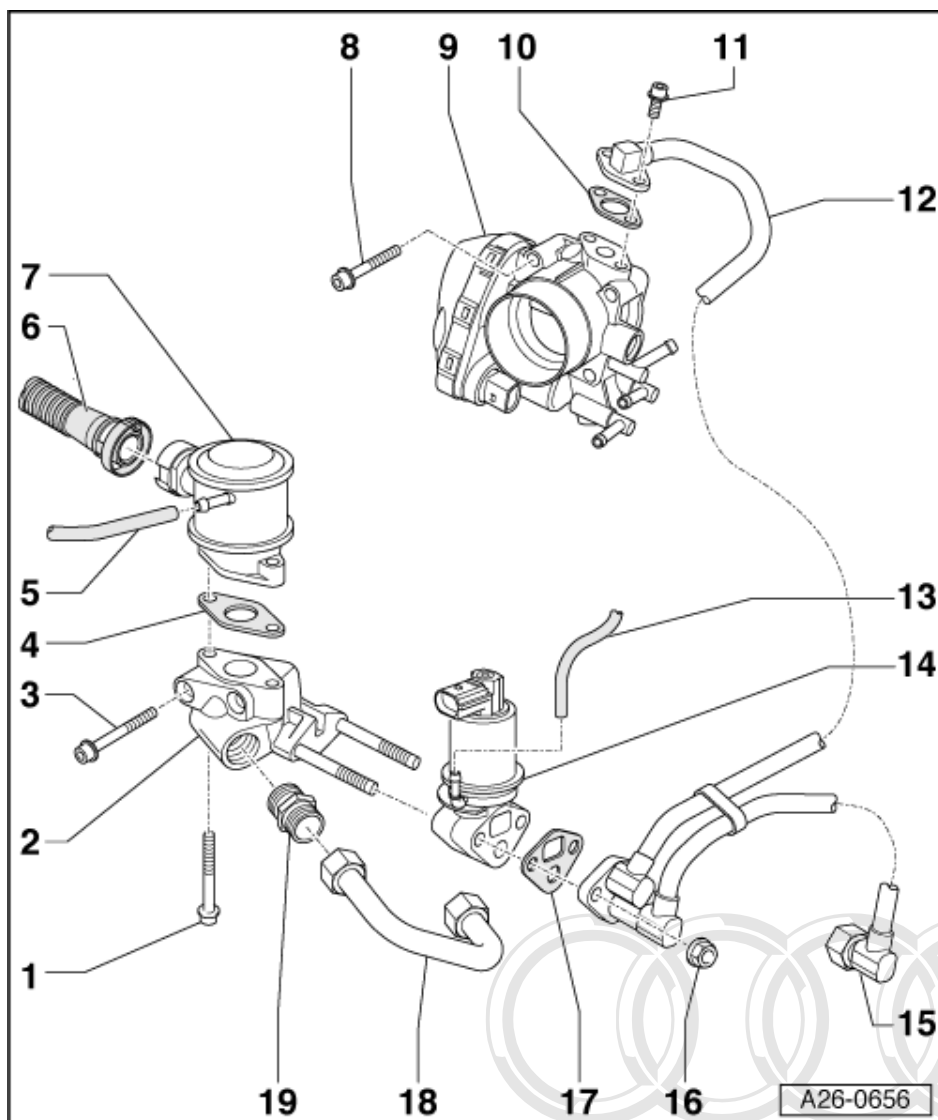
Notes:

- ♦ In some operating statuses, the intake air is fed via the exhaust gas recirculation valve -N18. By means of this admixture, a lowering of the combustion temperature and consequently an improvement of the exhaust gas composition is achieved.
- ♦ Actuation of the exhaust gas recirculation system is performed by the engine control unit via the exhaust gas recirculation valve -N18.
- ♦ Every conceivable valve position is possible through pulsed actuation.
- ♦ The exhaust gas recirculation potentiometer -G212 signals the current position of the exhaust gas recirculation valve -N18 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.



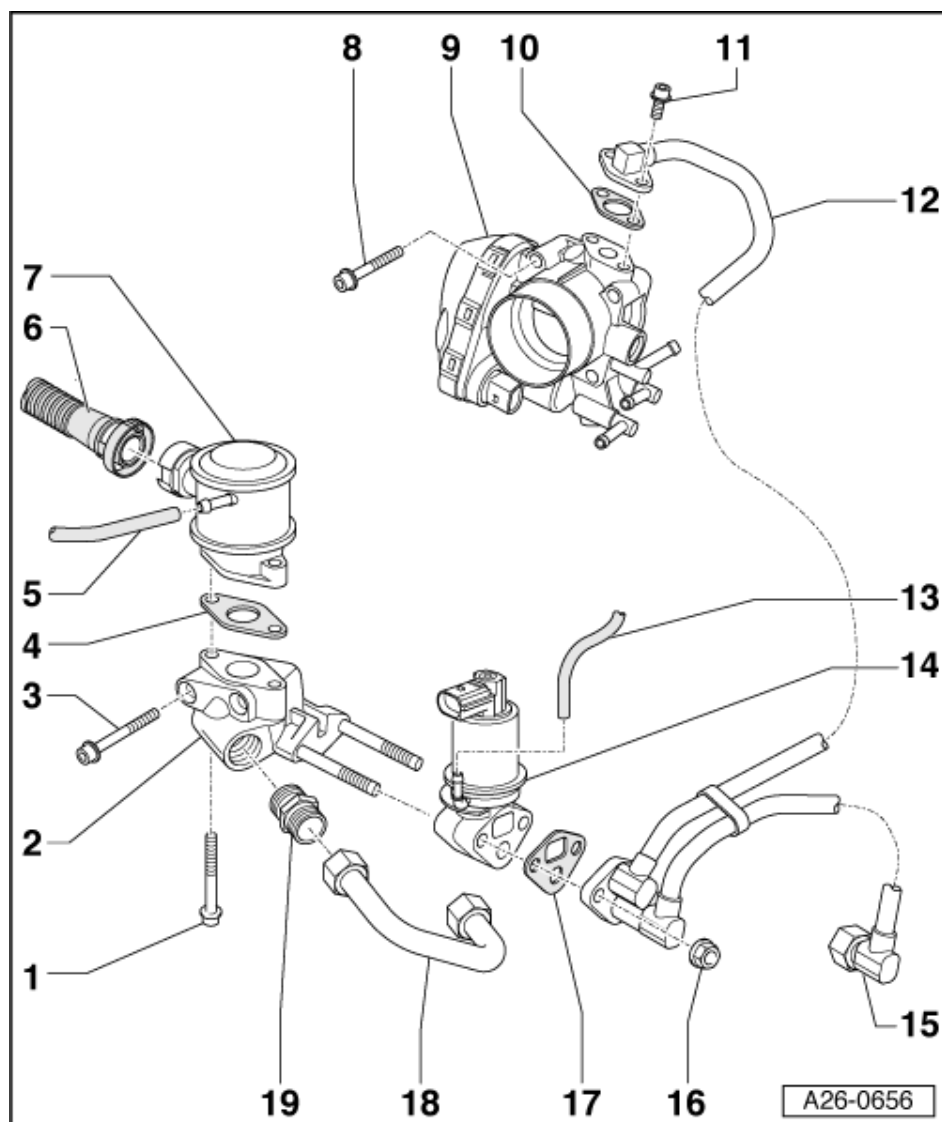
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2.2 - Removing and installing exhaust gas recirculation components



- 1 10 Nm
- 2 Connecting flange
- 3 10 Nm
- 4 Gasket
 - ♦ Replace
- 5 Vacuum line
 - ♦ From secondary air inlet valve -N112
- 6 Air hose
 - ♦ From secondary air pump
- 7 Combination valve for secondary air inlet
 - ♦ Fitting location
=> Fig. 259
 - ♦ Checking => Page 273
 - ♦ removing and installing
=>Page 274 .

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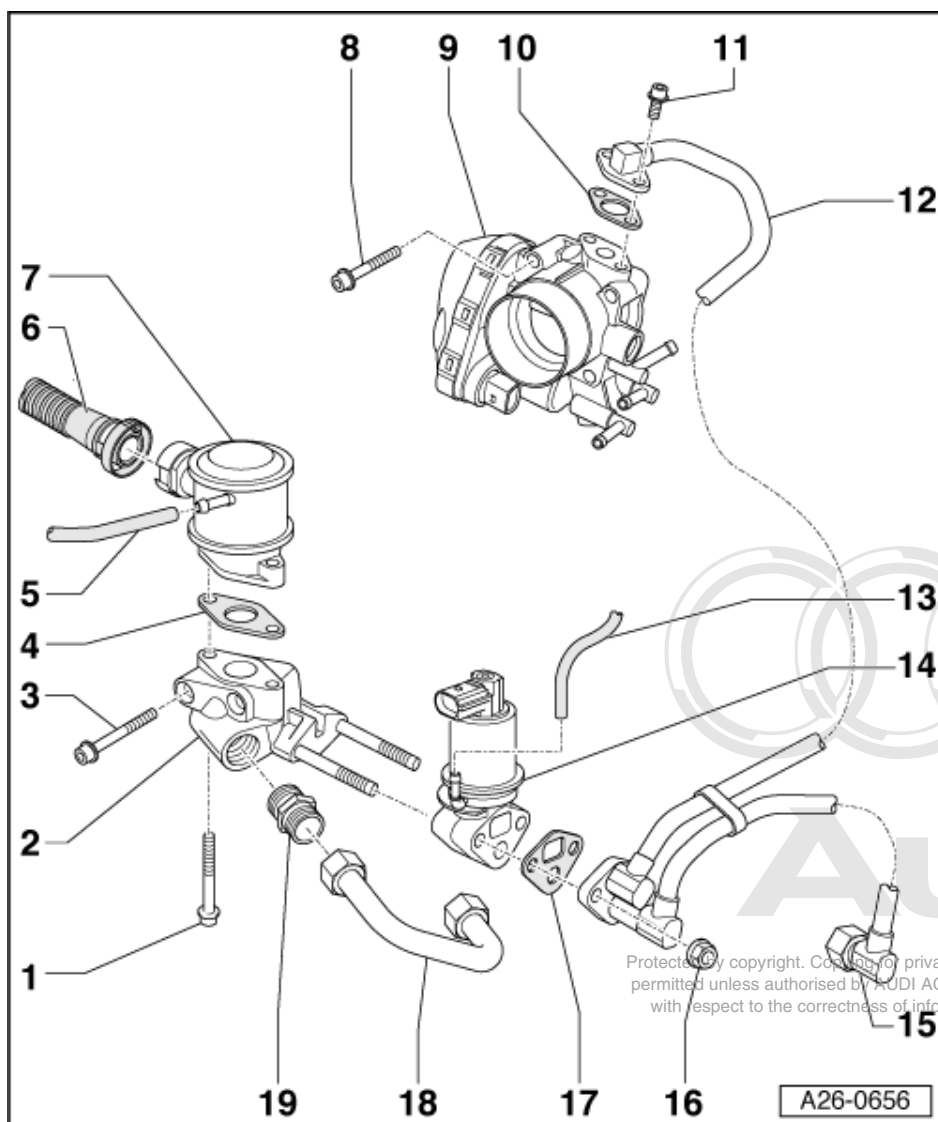


- 8 10 Nm
- 9 Throttle valve control part -J338
- 10 Seal
 - ♦ Replace
- 11 10 Nm
- 12 Connecting pipe
 - ♦ For exhaust gas recirculation
- 13 Vent pipe
 - ♦ To air cleaner housing
- 14 Exhaust gas recirculation valve -N18 with exhaust gas recirculation potentiometer -G 212
 - ♦ Adapt to engine control unit after replacement:

=> Simos Fuel Injection and Ignition System; Repair group 24

- ◆ Checking adaption of zero position => Page 243
- ◆ Performing electrical check => Page 246

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**15 Union nut, 60 Nm**

- ♦ At connecting pipe for exhaust gas recirculation

16 25 Nm

- ♦ Replace

17 Seal

- ♦ Replace

18 Connecting pipe

- ♦ For secondary air inlet
- ♦ Tighten union nut to 25 Nm.

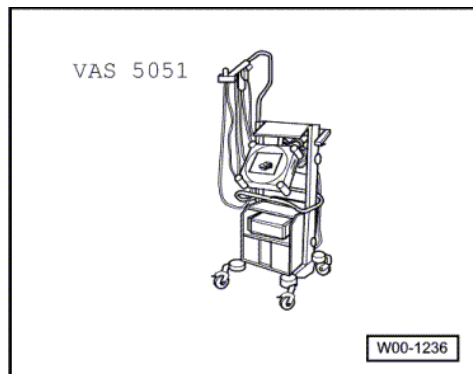
19 Connection - 35 Nm**2.3 - Checking adaption of zero position for exhaust gas recirculation valve -N18****Notes:**

- ♦ After replacing the engine control unit or the exhaust gas recirculation valve -N18, the engine control unit and exhaust gas recirculation valve must be adapted to one another.



=> Simos Fuel Injection and Ignition System; Repair group 24

- ♦ Check the adaption status and the zero position before performing repair measures.



Special tools and workshop equipment required

- ♦ VAS 5051 with VAS 5051/1



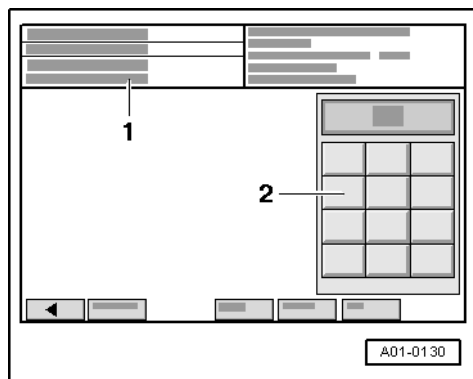
Test sequence

- Connect vehicle diagnostic, testing and information system VAS 5051 and select vehicle system "01 - Engine electronics". For this purpose, the engine must be running at idling speed.

=> Simos Fuel Injection and Ignition System; Repair group 01

-> Display on VAS 5051:

- Under -1- select diagnostic function "08 - Read measured value block".

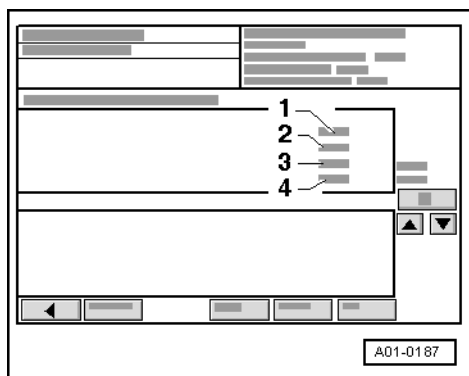


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-> Display on VAS 5051:

1 - Enter display group

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



-> Display on VAS 5051:

- Check readout in display zones -1- and -4-.

	Display zones			
	1	2	3	4
Display group 074: Adaptation of exhaust gas recirculation valve				
Display	x.x V	x.x V	xxx %	---
Display	Zero position	Max. stop	Duty cycle	Adaption status
Range				ADP process running ADP OK ERROR
Specified value	0.3...1.2 V	3.0...4.8 V	0...100 %	ADP OK
Note:	If the specification is not attained, check the exhaust gas recirculation valve for dirt and foreign objects. Replace valve if necessary.			If specification is not attained: Perform electrical test of exhaust gas recirculation valve =>Page 246 .

Note on display zone 4:

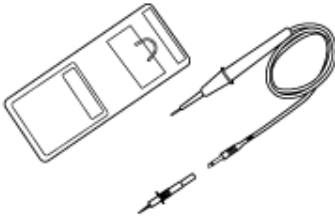
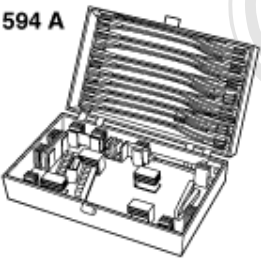
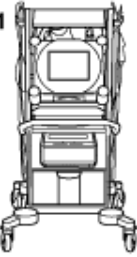
"ADP" in display zone 4 stands for "Adaption".

- Exit function "08 - Read measured value block" by pressing the ◀ key.
- Press "06 - End output".
- Switch ignition off.

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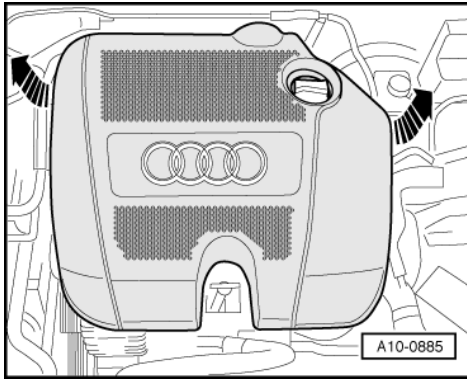
2.4 - Performing electrical check of exhaust gas recirculation valve -N18 and exhaust gas recirculation potentiometer -G212

V.A.G 1526 A 	V.A.G 1527 B 
V.A.G 1594 A 	V.A.G 1598/31 
VAS 5051 	G24-0023

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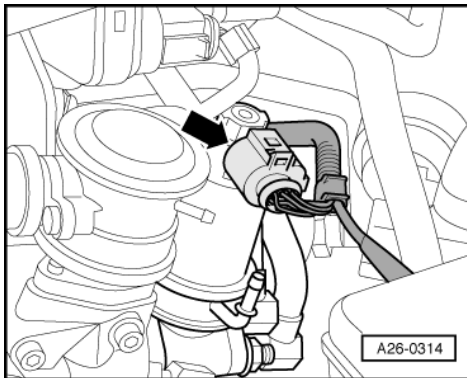
Special tools and workshop equipment required

- ♦ V.A.G 1526 A
- ♦ V.A.G 1527 B
- ♦ V.A.G 1594 A
- ♦ V.A.G 1598/31
- ♦ VAS 5051 with VAS 5051/1

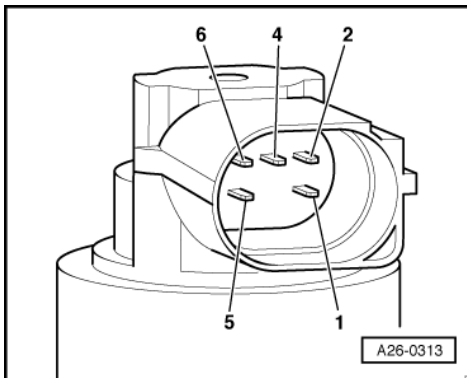


Checking internal resistance

- -> Remove engine cover -arrows-.



- -> Unplug connector -arrow-.



- -> Connect multimeter as follows to **measure resistance**:

Component	Connector Contact	Specified value at room temperature
Exhaust gas recirculation valve -N18	1 + 5	7.5...8.5 ω
Exhaust gas recirculation potentiometer -G212	2 + 4	2.6...4.8 ω
	2 + 6	0.5...6.3 ω

If the specifications are not obtained:

- Replace the exhaust gas recirculation valve -N18 with exhaust gas recirculation potentiometer -G212 => Page **252**.



If specifications are attained:

Checking voltage supply for exhaust gas recirculation valve -N18

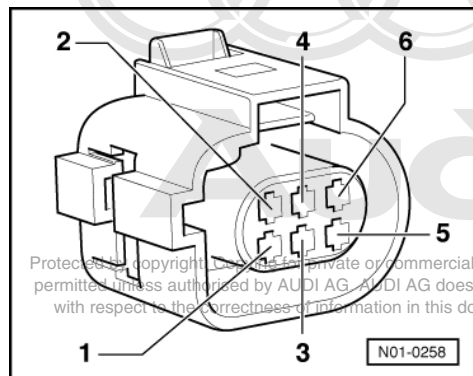
Test requirements:

- Check that power supply relay for Simos control unit -J363 is OK.

=> Simos Fuel Injection and Ignition System; Repair group 28

Note:

The power supply to the exhaust gas recirculation valve is provided by the power supply relay for the Simos control unit -J363.



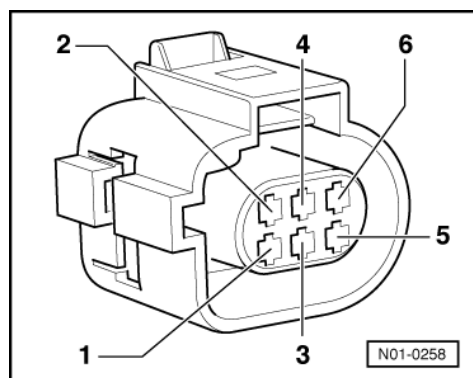
- -> Connect voltage tester V.A.G 1527 B as follows:

Connector Contact	Measure to
1	Engine earth

- Switch the ignition on.
 - The LED should illuminate.
- Switch ignition off.

If the LED does not illuminate:

- Check the wiring from contact 1 of the connector to the power supply relay for Simos control unit -J363 (below cover on left of bulkhead) for open circuit using the current flow diagram.
- Eliminate open circuit using the current flow diagram.

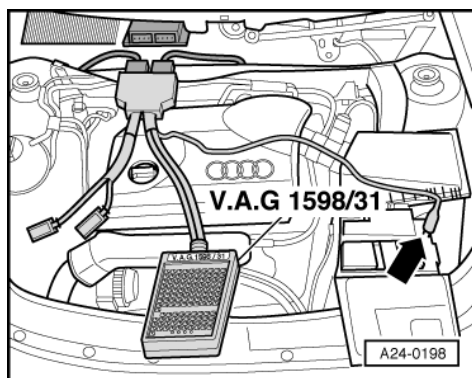


If the LED illuminates:

Checking voltage supply for exhaust gas recirculation potentiometer -G212

- -> Connect multimeter between contacts 2 and 4 to measure voltage.
- Switch the ignition on.

- Specification: 4.5...5.5 V
- Switch ignition off.



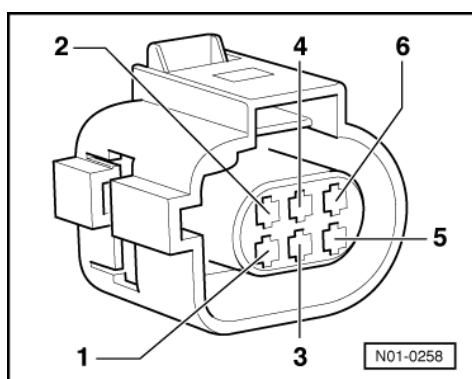
If specification is not attained:

- -> Connect the V.A.G 1598/31 test box to wiring harness connectors; the engine control unit should not be connected. Attach the earth clip of test box to earth -arrow-.

=> Simos Fuel Injection and Ignition System; Repair group 24

Important

To prevent damage to the electronic components, select appropriate measuring range before connecting the measuring cables and observe the test requirements.



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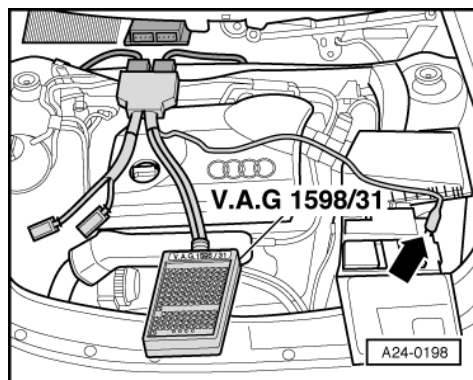
- -> Check for open circuit and short to positive or earth in the following wiring connections:

Connector Contact	Test box V.A.G 1598/31 Socket
2	96
4	84

- Use current flow diagram to eliminate open circuit in wiring/short circuit.

If the wiring is OK:

- Replace engine control unit.



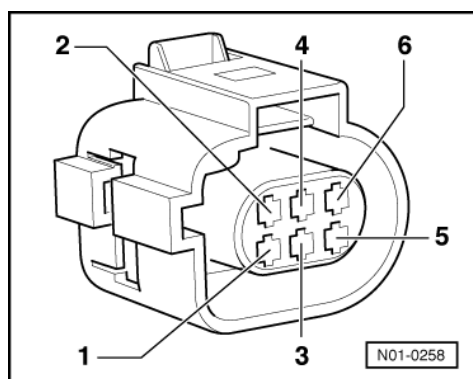
Checking signal wire between exhaust gas recirculation potentiometer -G212 and engine control unit

- -> Connect the V.A.G 1598/31 test box to wiring harness connectors; the engine control unit should not be connected. Attach the earth clip of test box to earth -arrow-.

=> Simos Fuel Injection and Ignition System; Repair group 24

Important

To prevent damage to the electronic components, select appropriate measuring range before connecting the measuring cables and observe the test requirements.

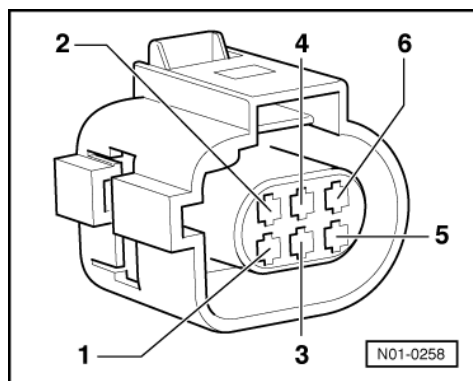


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- -> Check for open circuit and short to positive or earth in the following wiring connection:

Connector Contact	Test box V.A.G 1598/31 Socket
6	108

- Use current flow diagram to eliminate open circuit in wiring/short circuit.



Checking actuation of exhaust gas recirculation valve -N18**Test requirements:**

- Power supply OK.
- -> Connect voltage tester V.A.G 1527 B to contacts 1 and 5 of the connector.
- Connect vehicle diagnostic, testing and information system VAS 5051 and select vehicle system "01 - Engine electronics". For this purpose, the ignition must be switched on.

=> Simos Fuel Injection and Ignition System; Repair group 01



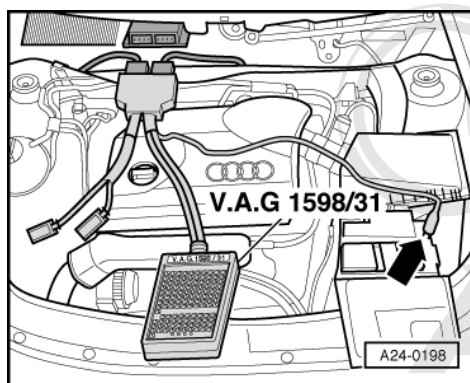
-> Display on VAS 5051:

- Under -1- select the diagnostic function "03 - Final control diagnosis".
- Actuate the exhaust gas recirculation valve -N18.
 - The LED must flash slowly.

Note:

Voltage testers with a low current consumption continue to glow faintly between actuation from the engine control unit (rather than extinguishing completely) and become much brighter when actuated.

- Exit function "03 - Final control diagnosis" by pressing the ◀ key.
- Press "06 - End output".
- Switch ignition off.



If LED does not flash:

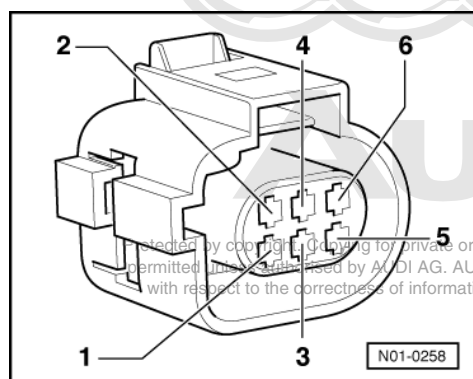
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- -> Connect the V.A.G 1598/31 test box to wiring harness connectors; the engine control unit should not be connected. Attach the earth clip of test box to earth -arrow-.

=> Simos Fuel Injection and Ignition System; Repair group 24

Important

To prevent damage to the electronic components, select appropriate measuring range before connecting the measuring cables and observe the test requirements.



- -> Check for open circuit and short to positive or earth in the following wiring connection:

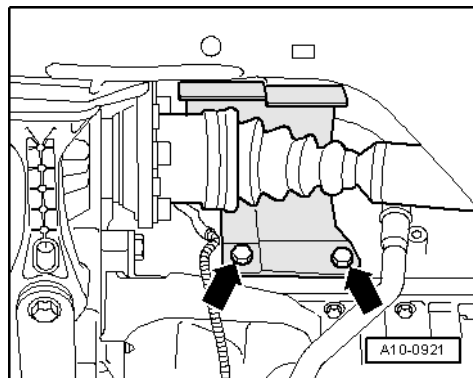
Connector Contact	Test box V.A.G 1598/31 Socket
5	115

- Use current flow diagram to eliminate open circuit in wiring/short circuit.

If the wiring is OK:

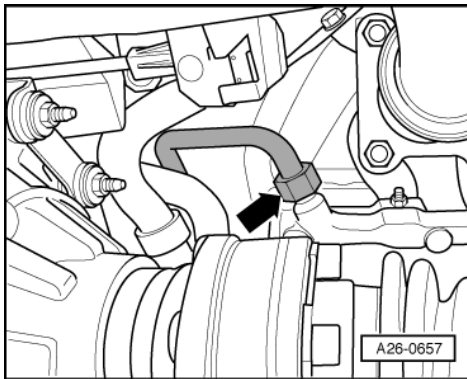
- Replace engine control unit.

2.5 - Removing and installing exhaust gas recirculation valve -N18 with exhaust gas recirculation potentiometer -G 212

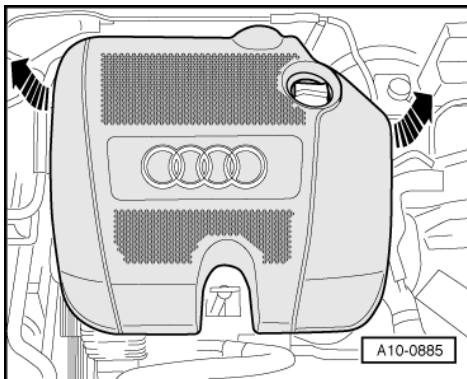


Removing

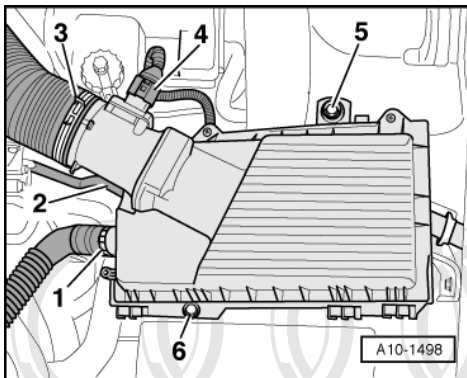
- -> Unbolt heat shield for right drive shaft -arrows-.



- -> Loosen the lower union nut -arrow- of the connecting pipe for secondary air inlet.

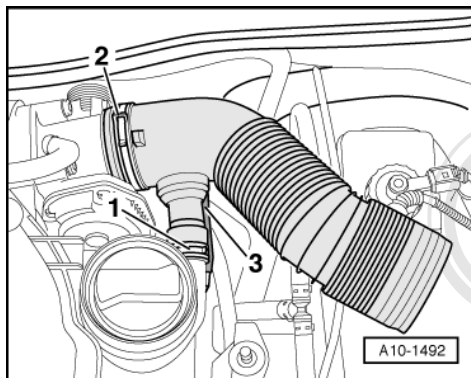


- -> Remove engine cover -arrows-.

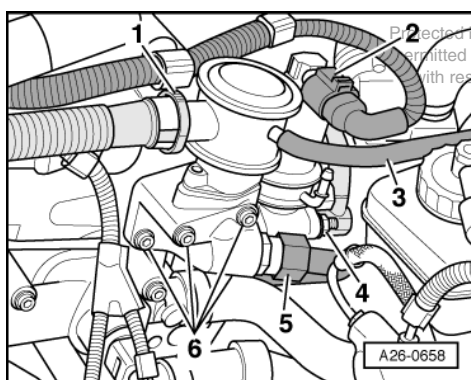


- -> Disconnect the air duct hose -3- from the air mass meter.
- Unplug connector-4- at air mass meter.
- Disconnect hoses -1- and -2- from the air cleaner housing.
- Unscrew bolts -5- and -6-.
- Remove air cleaner housing.

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- -> Disconnect hoses -1- and -3-.
- Remove the air duct, release spring clamp -2- for this purpose.



- -> Loosen the upper union nut -5- of the connecting pipe for secondary air inlet.
- Disconnect hoses -1- and -3-.
- Detach connector -2- from the exhaust gas recirculation valve.
- Unscrew nuts -4- and bolt -6-.
- Remove the combination valve and the exhaust gas recirculation valve.

Installing

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

Note:

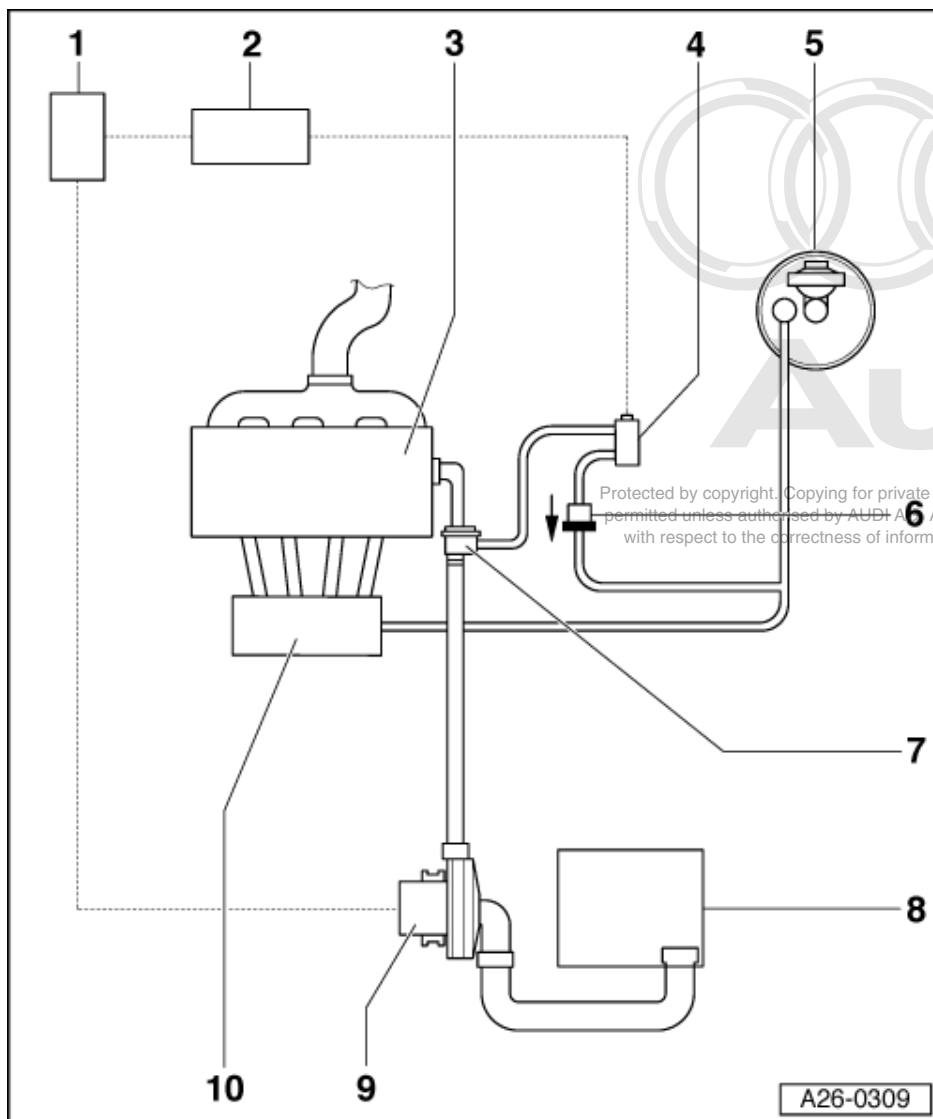
Replace gaskets and seals.

Tightening torques

Component	Nm
Connecting flange to cylinder head	10
Exhaust gas recirculation valve to connecting flange	25
Connecting pipe for secondary air inlet to exhaust manifold	60
Drive shaft heat shield to cylinder block	35

3 - Secondary air system - vehicles with engine code APF

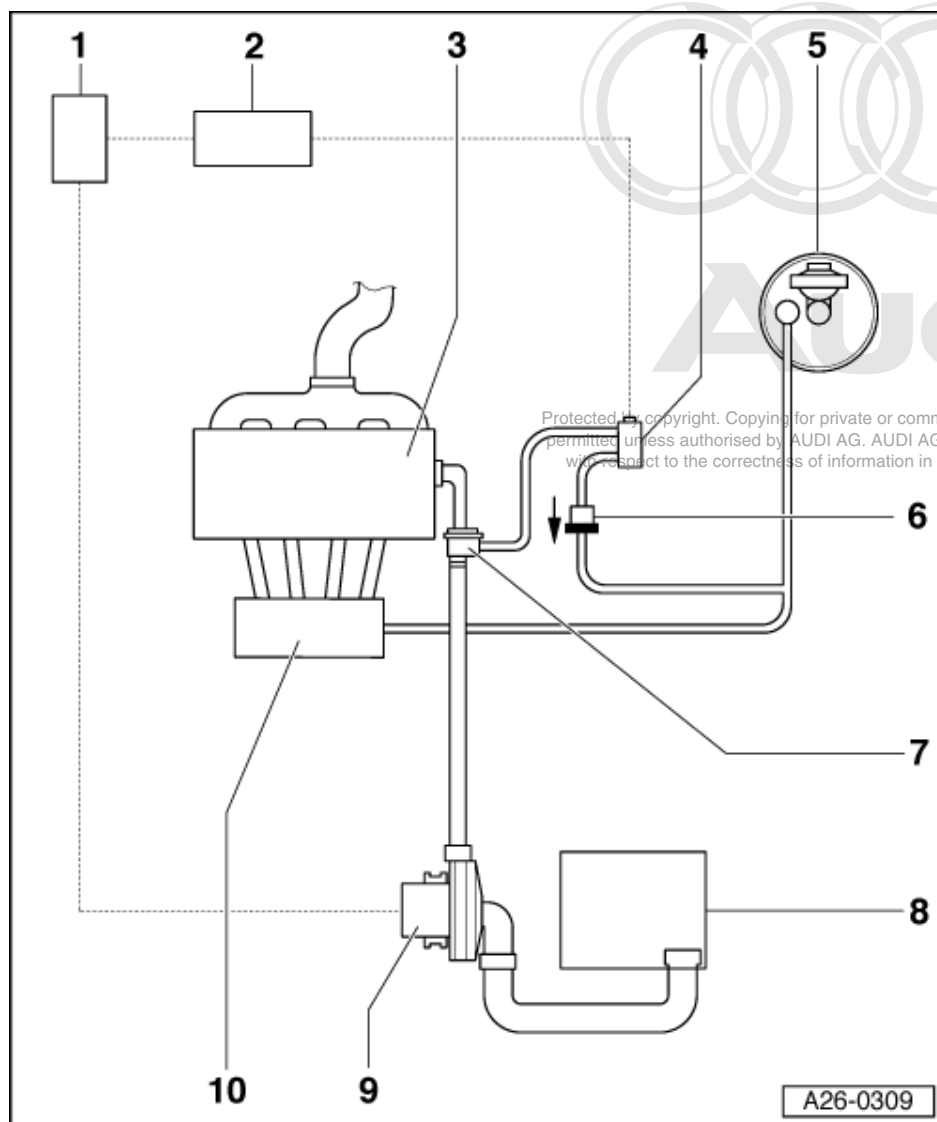
3.1 - Secondary air system - vehicles with engine code APF



The secondary air system permits faster warm-up and thus makes the catalytic converter ready for operation sooner after cold starting.

Principle

On account of the over enrichment of the mixture in the cold start phase the percentage of unburned hydrocarbons in the exhaust gas is higher. The injection of secondary air improves the post-oxidation in the catalytic converter and thus reduces pollutant emissions. The heat liberated by the post-oxidation considerably shortens the start-up time of the catalytic converter and significantly enhances the emission quality in the cold-running phase.



1 Secondary air pump relay -J299

- ♦ Fitting location
=> Fig. 258

2 Engine control unit -J361

3 Cylinder head

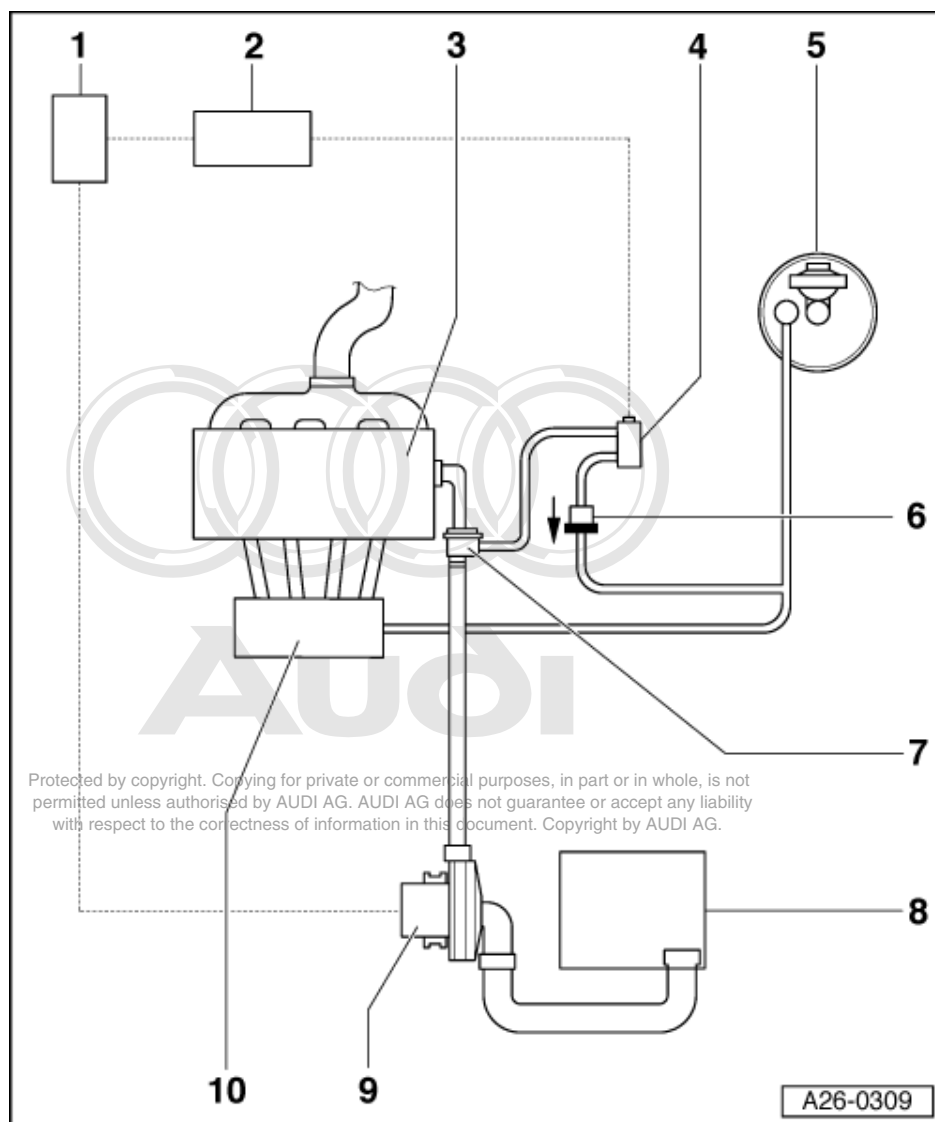
4 Secondary air inlet valve -N112

- ◆ Fitting location
=> Fig. 258

5 Brake servo

6 Non-return valve

- ◆ Installation position: as shown in Fig, arrow faces in direction of flow



7 Combination valve for secondary air inlet

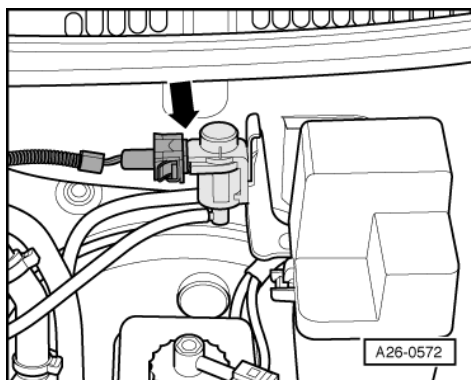
- ♦ Fitting location
=> Fig. 259
- ♦ Removing and installing
=>Page 274 .

8 Air cleaner

9 Secondary air pump motor -V101

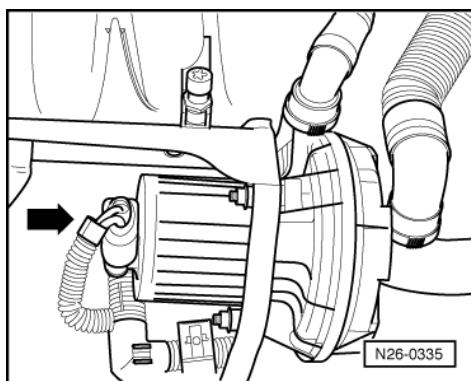
- ♦ Fitting location
=> Fig. 258

10 Intake manifold



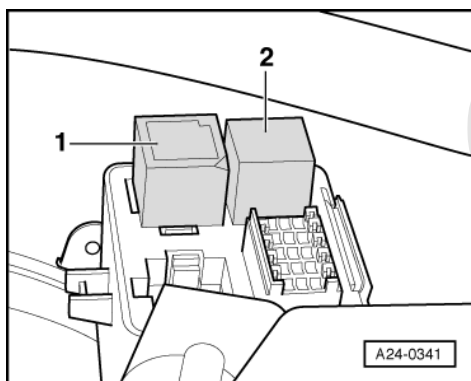
-> Fig.1 Fitting location of secondary air inlet valve -N112

- ♦ Fitting location: On left behind bulkhead -arrow-.



-> Fig.2 Fitting location of motor for secondary air pump -V101

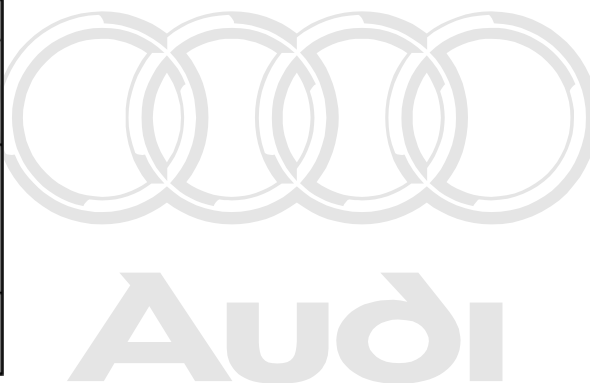
- ♦ Fitting location: At front of engine

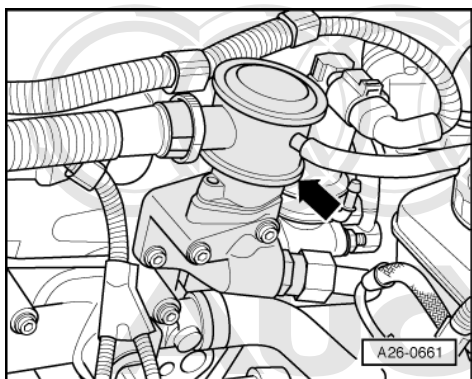


-> Fig.3 Fitting location of relay for secondary air pump -J299

- ♦ Fitting location: Under left-hand cover at the splash wall

- 1 - Secondary air pump relay -J299
- 2 - Power supply relay for Simos control unit -J363



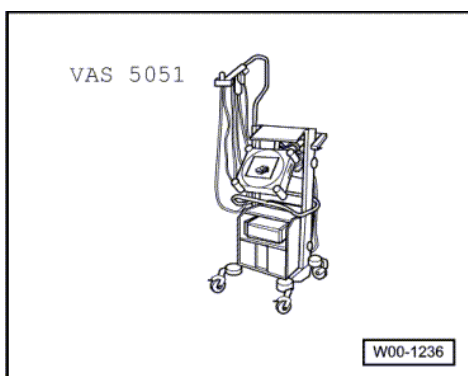


> **Fig.4 Fitting location of combination valve for secondary air inlet**
♦ Fitting location: At left of cylinder head

3.2 - Performing diagnosis of secondary air system

Note:

- ♦ The secondary air system is monitored by the engine control unit -J361:
- => Simos Fuel Injection and Ignition System; Repair group 01
- ♦ Diagnosis of the secondary air system can also be initiated in the basic setting function, display group 077.



Special tools and workshop equipment required

- ♦ VAS 5051 with VAS 5051/1





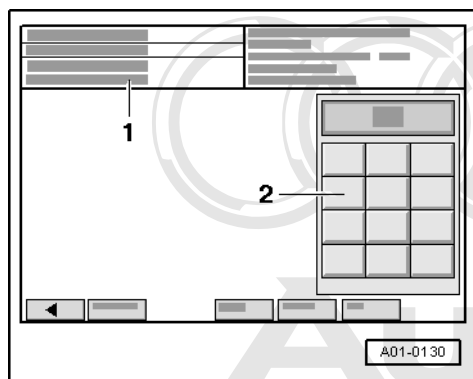
Test sequence

- Connect vehicle diagnostic, testing and information system VAS 5051 and select vehicle system "01 - Engine electronics". For this purpose, the engine must be running at idling speed.

=> Simos Fuel Injection and Ignition System; Repair group 01

-> Display on VAS 5051:

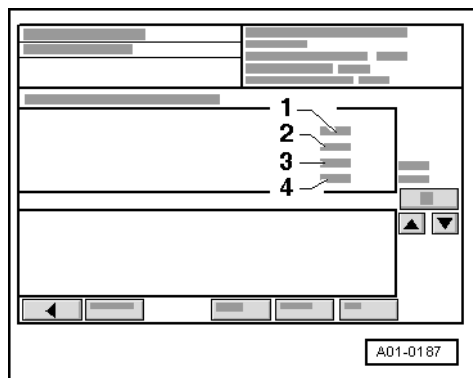
- Under -1- select diagnostic function "04 - Basic setting".



-> Display on VAS 5051: 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.

1 - Enter display group

- Enter "077" for "display group number 077" in zone -2- and confirm the entry by pressing the Q key.



-> Display on VAS 5051:

- Check display in display zone -4-.
- Depress the brake pedal, the engine speed increases to approx. 1400 rpm.

Test conditions:

- Brake pedal depressed, engine speed approx. 1400 rpm.

Note:

This test can only be performed once per engine start.

- Hold down the brake pedal until the result of the diagnosis is displayed in display zone 4.

	Display zones			
	1	2	3	4
Display group 077: Diagnosis of secondary air system				
Display	xxxx rpm	xxx °C		---
Display	Engine speed	Coolant temperature		Diagnosis status
Range				Test OFF Test ON Syst. OK Syst. NOK
Specified value	approx. 1400 rpm			Syst. OK

Note:

The test takes approx. 30 seconds. If the test cannot be performed, switch off the engine and start it again. The secondary air pump must run during the test.

- End function "04 - Basic setting" by pressing the ◀ key.

If specified value "Syst. OK" is attained:

- Press "06 - End output".
- Switch ignition off.

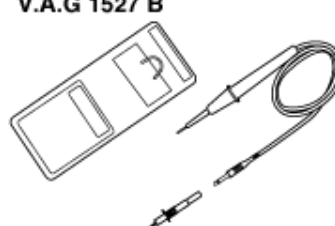
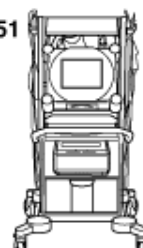
If specification is not attained:

- Interrogate fault memory, rectify faults if necessary and then erase fault memory.

=> Simos Fuel Injection and Ignition System; Repair group 01

- ♦ Check secondary air inlet valve -N112 => Page 262 .
- ♦ Check secondary air pump relay -J299 => Page 267 .

3.3 - Checking secondary air inlet valve -N112

V.A.G 1526 A 	V.A.G 1527 B 
V.A.G 1594 A 	V.A.G 1598/31 
VAS 5051 	G24-0023

Special tools and workshop equipment required

- ♦ V.A.G 1526 A
- ♦ V.A.G 1527 B
- ♦ V.A.G 1594 A
- ♦ V.A.G 1598/31
- ♦ VAS 5051 with VAS 5051/1

Test sequence

Note:

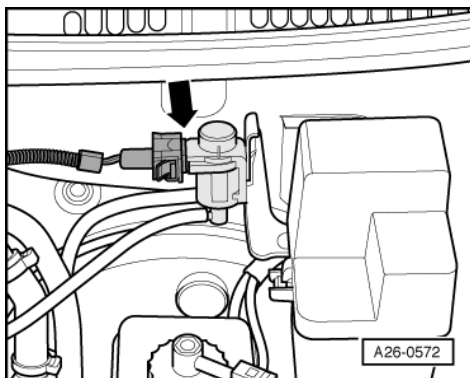
Protected by copyright. Copying for private or commercial purposes, in part or in whole, is not permitted without the written permission of Audi AG.
The secondary air inlet valve -N112 and the wiring connections are monitored by the engine control unit.
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- Connect vehicle diagnostic, testing and information system VAS 5051 and select vehicle system "01 - Engine electronics". For this purpose, the ignition must be switched on.

=> Simos Fuel Injection and Ignition System; Repair group 01

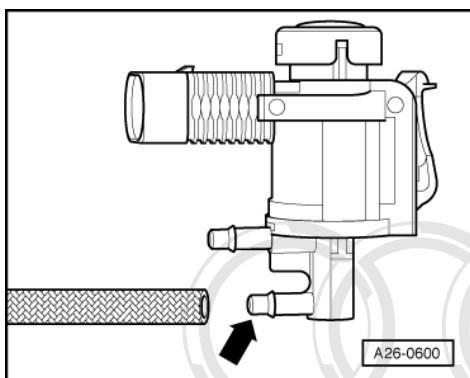
- Read out the fault memory of the engine control unit.

=> Simos Fuel Injection and Ignition System; Repair group 01

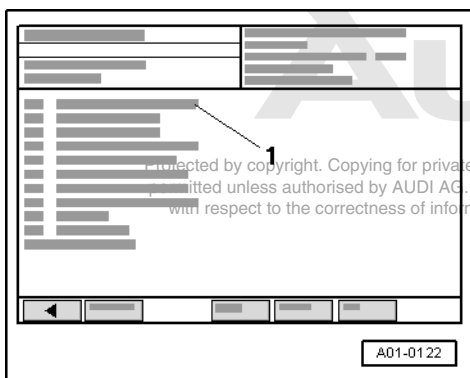


If a fault relating to secondary air inlet valve -N112 is displayed:

- -> Unclip secondary air inlet valve -N112 -arrow- from bracket.
- Detach hoses from secondary air inlet valve; leave the electrical connector attached.



- -> Connect auxiliary hose to the valve connector marked with an arrow.



- Vehicle diagnostic, testing and information system VAS 5051 connected, vehicle self-diagnosis and vehicle system "01 - Engine electronics" selected. For this purpose, the ignition must be switched on.

-> Display on VAS 5051:

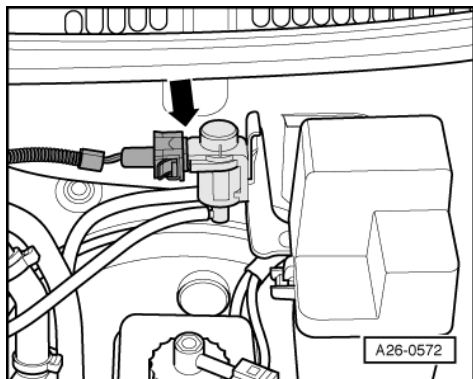
- Under -1- select the diagnostic function "03 - Final control diagnosis".
- Actuate the secondary air inlet valve -N112:
- ♦ The valve should click...



- ♦ ...and should open and close (check by blowing into the auxiliary hose).
- Exit function "03 - Final control diagnosis" by pressing the ◀ key.
- Switch ignition off.

If valve does not open or close properly:

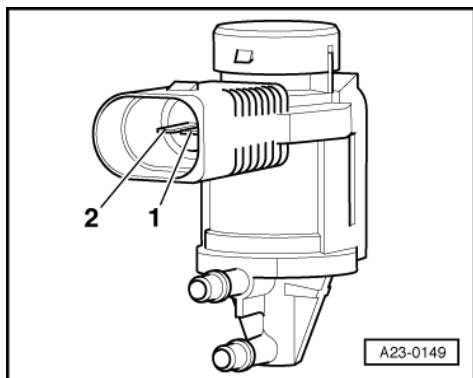
- Replace secondary air inlet valve -N112 => Page 26-76.



If the valve does not click during final control diagnosis:

Checking internal resistance

- -> Unplug the connector at the secondary air inlet valve -N112 -arrow-.



- -> Connect multimeter between contacts 1 and 2 on valve to measure resistance.
- Specification: 52.5...62.5 wat room temperature

If specified value is not attained:

- Replace secondary air inlet valve -N112 => Page 26-76.

If specification is attained:

Checking power supply

Test requirements:

- Fuse for secondary air inlet valve OK.

=> Current Flow Diagrams, Electrical Fault-finding and Fitting Locations

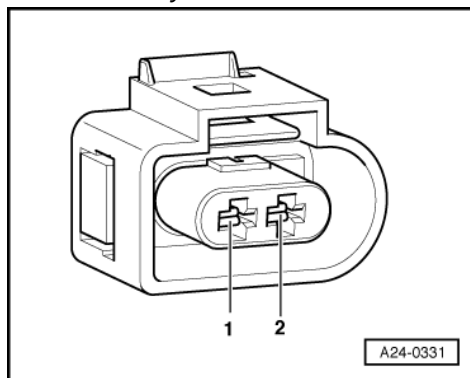
- Fuel pump relay OK.



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Note:

The secondary air inlet valve -N112 receives its power supply via the fuel pump relay.



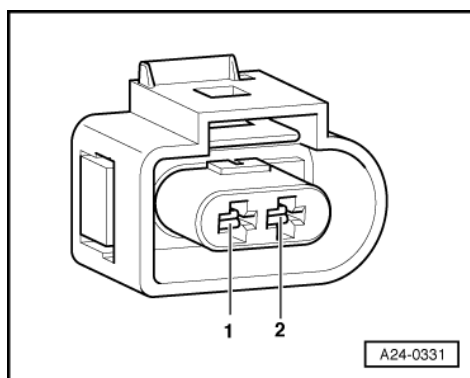
- -> Connect voltage tester V.A.G 1527 B as follows:

Connector Contact	Measure to
1	Engine earth

- Operate starter briefly.
 - The LED should illuminate.
- Switch ignition off.

If the LED does not illuminate:

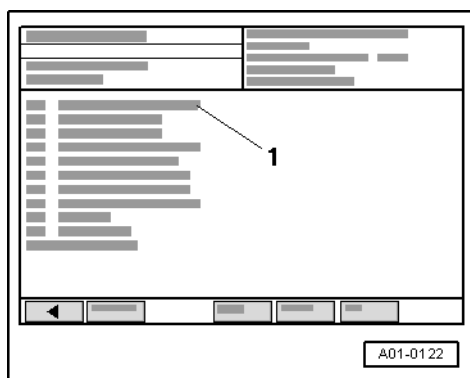
- Check the wiring from contact 1 on the connector via the fuse to the fuel pump relay for an open circuit using the current flow diagram.
- Eliminate open circuit using the current flow diagram.



If the LED illuminates:

Checking actuation

- -> Connect voltage tester V.A.G 1527 B to contacts 1 (positive) and 2 of the connector.

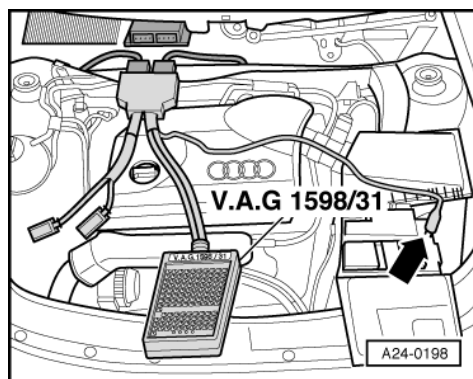


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-> Display on VAS 5051:

- Vehicle diagnostic, testing and information system VAS 5051 connected, vehicle self-diagnosis and vehicle system "01 - Engine electronics" selected. For this purpose, the ignition must be switched on.
- Under -1- select the diagnostic function "03 - Final control diagnosis".
- Actuate the secondary air inlet valve -N112:
 - The LED must flash slowly.



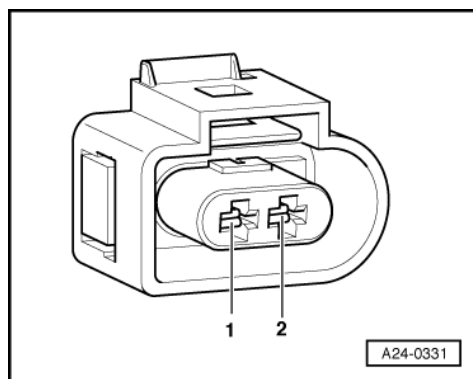
If the LED lamp does not flash or if it illuminates continuously:

- -> Connect the V.A.G 1598/31 test box to wiring harness connectors; the engine control unit should not be connected. Attach the earth clip of test box to earth -arrow-.

=> Simos Fuel Injection and Ignition System; Repair group 24

Important

To prevent damage to the electronic components, select appropriate measuring range before connecting the measuring cables and observe the test requirements.



- -> Check for open circuit and short to positive or earth in the following wiring connection:

Connector Contact	Test box V.A.G 1598/31 Socket
2	71

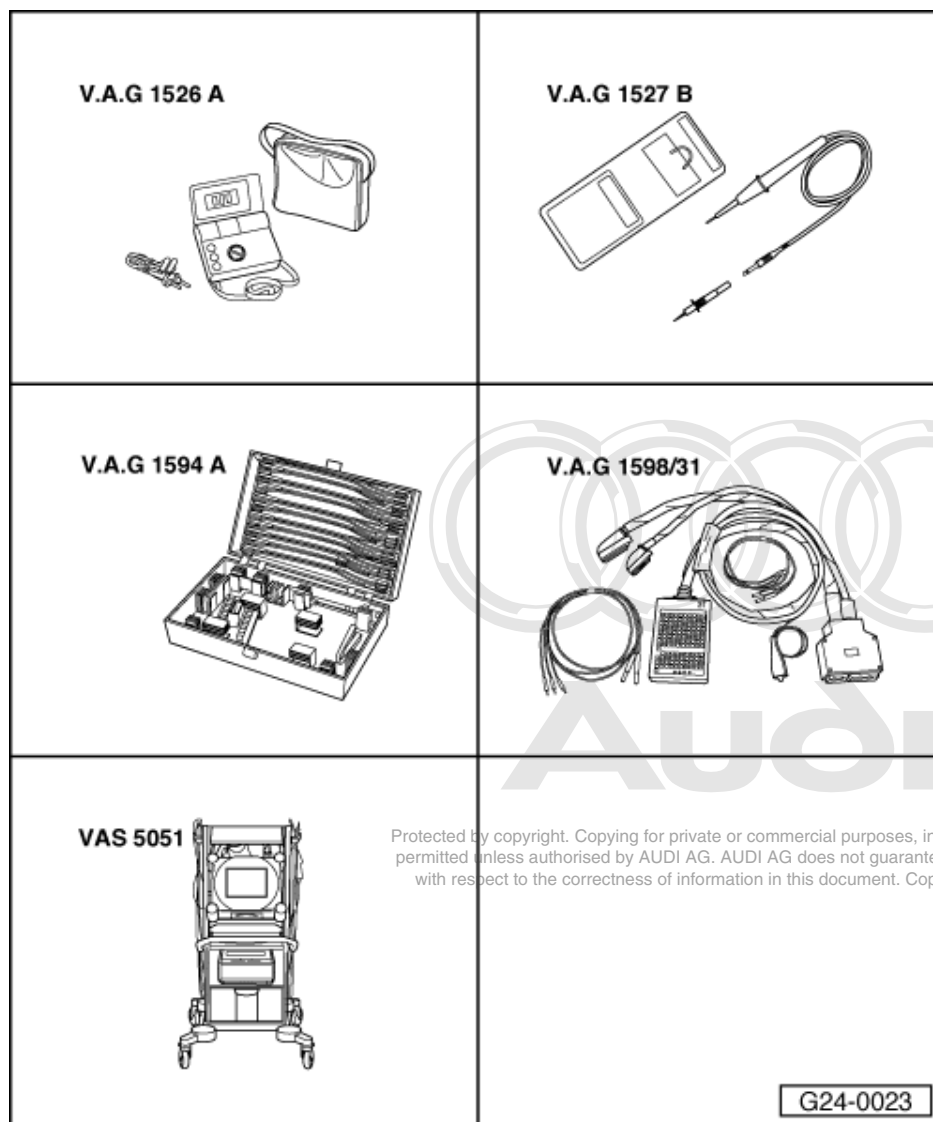
- Use current flow diagram to eliminate open circuit in wiring/short circuit.

If the wiring is OK:

- Replace engine control unit.

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3.4 - Checking secondary air pump relay -J299 and actuation



Special tools and workshop equipment required

- ◆ V.A.G 1526 A
- ◆ V.A.G 1527 B
- ◆ V.A.G 1594 A
- ◆ V.A.G 1598/31
- ◆ VAS 5051 with VAS 5051/1



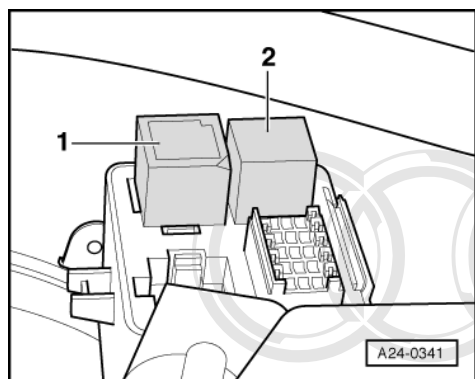
Test sequence

- Connect vehicle diagnostic, testing and information system VAS 5051 and select vehicle system "01 - Engine electronics". For this purpose, the ignition must be switched on.

=> Simos Fuel Injection and Ignition System; Repair group 01

-> Display on VAS 5051:

- Under -1- select the diagnostic function "03 - Final control diagnosis".



- Actuate the secondary air pump relay -J299.
- -> The relay for secondary air pump -1- (under cover on left on the bulkhead) must tighten and the engine for the secondary air pump -V101 must start in intervals.
- Exit function "03 - Final control diagnosis" by pressing the ◀ key.
- Press "06 - End output".
- Switch ignition off.

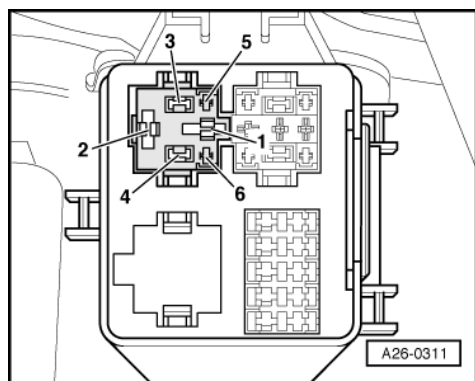
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A - If relay does not respond:

- Check voltage supply of secondary air pump relay => Page 268 .
- Check activation of secondary air pump relay => Page 270 .

B - If relay responds but secondary air pump motor does not run:

- Check voltage supply of secondary air pump relay => Page 272 .

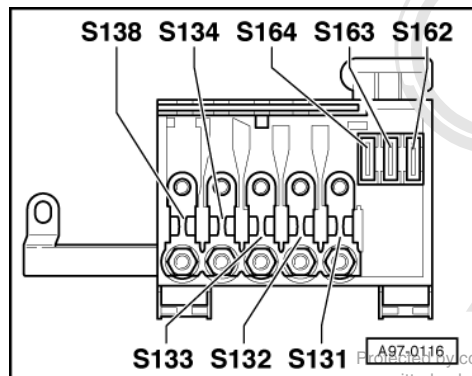


Checking voltage supply of secondary air pump relay

- Detach secondary air pump relay.
- -> Connect multimeter as follows to measure voltage.

Relay carrier under left cover at the bulk-head Contact	Measure to
1	Engine earth

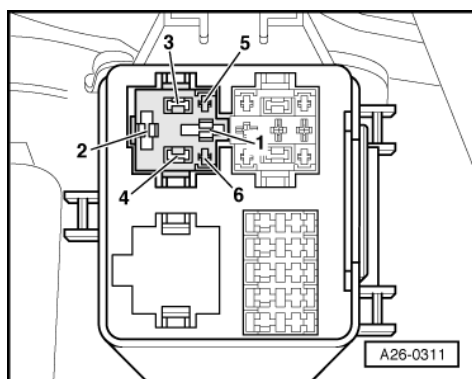
- Specification: approx. battery voltage



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If specification is not attained:

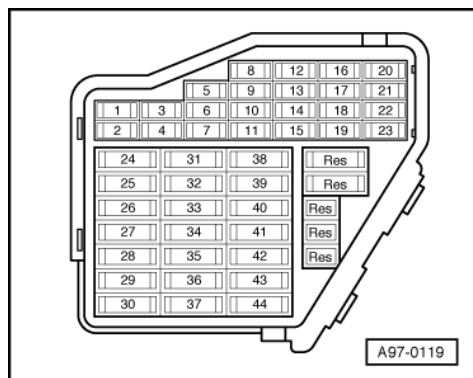
- Carry out the following tests (marked with dots):
 - -> Check fuse S131 (50 A) in main fuse box/battery.
 - Check wiring from battery + (terminal 30) to fuse S131 for secondary air pump relay -J299 (under the left cover at the bulkhead) for open circuit using the current flow diagram.
- Eliminate open circuit using the current flow diagram.



- -> Connect multimeter as follows to measure voltage.

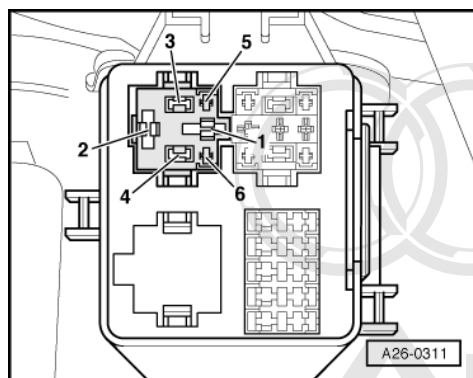
Relay carrier under left cover at the bulk-head Contact	Measure to
3	Engine earth

- Operate starter briefly.
 - Specification: approx. battery voltage
- Switch ignition off.



If specification is not attained:

- Carry out the following tests (marked with dots):
- -> Check fuse S243 (in fuse box, terminal 43).
- Check for open circuit in wiring from secondary air pump relay -J299 (under left cover at bulkhead) via fuse S243 (in fuse box, position 43) to fuel pump relay using the current flow diagram.
- Eliminate open circuit using the current flow diagram.



Checking actuation of secondary air pump relay

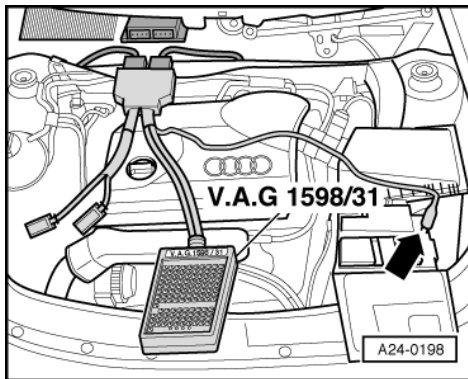
- Detach secondary air pump relay.
- -> Connect voltage tester V.A.G 1527 B as follows:

Relay carrier under left cover at the bulkhead Contact	Measure to
4	Battery positive



-> Display on VAS 5051:

- Vehicle diagnostic, testing and information system VAS 5051 connected, vehicle self-diagnosis and vehicle system "01 - Engine electronics" selected. For this purpose, the ignition must be switched on.
- Under -1- select the diagnostic function "03 - Final control diagnosis".
- Actuate the secondary air pump relay -J299.
 - The LED should flash.
- Exit function "03 - Final control diagnosis" by pressing the ◀ key.
- Switch ignition off.



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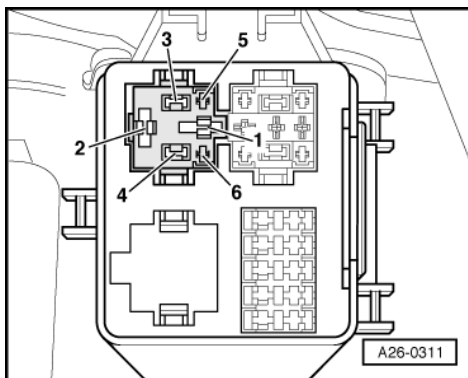
If LED does not flash:

- -> Connect the V.A.G 1598/31 test box to wiring harness connectors; the engine control unit should not be connected. Attach the earth clip of test box to earth -arrow-.

=> Simos Fuel Injection and Ignition System; Repair group 24

Important

To prevent damage to the electronic components, select appropriate measuring range before connecting the measuring cables and observe the test requirements.



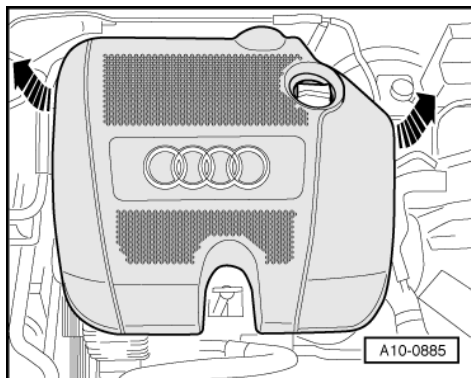
- -> Check for open circuit and short to positive or earth in the following wiring connection:

Relay carrier under left cover at the bulkhead Contact	Test box V.A.G 1598/31 Socket
4	72

- Use current flow diagram to eliminate open circuit in wiring/short circuit.

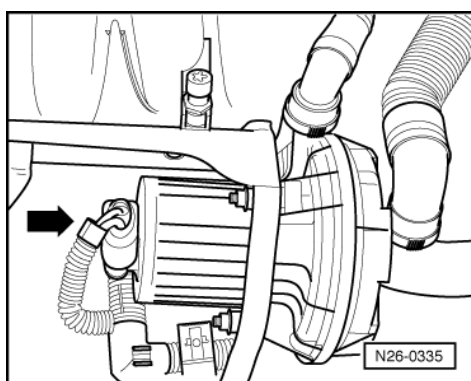
If no fault is found:

- Replace secondary air pump relay -J299.

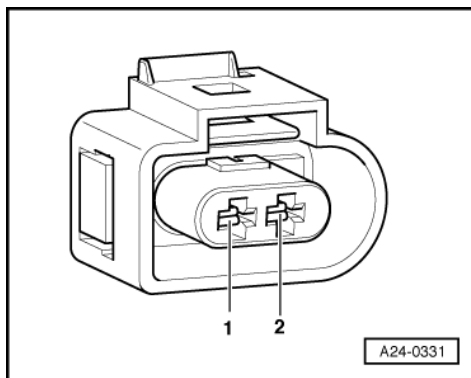


Checking voltage supply for secondary air pump motor

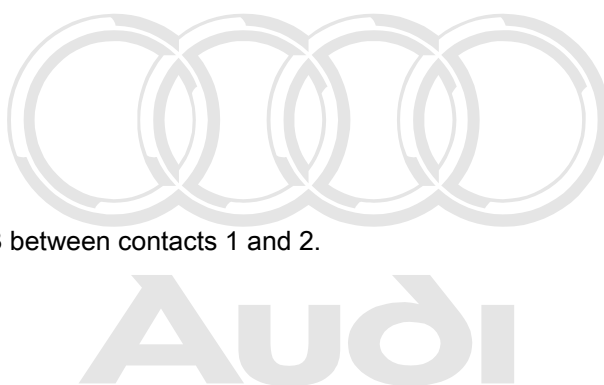
- -> Remove engine cover -arrows-.



- -> Unplug connector -arrow- at secondary air pump motor -V101.



- -> Connect voltage tester V.A.G 1527 B between contacts 1 and 2.



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- Vehicle diagnostic, testing and information system VAS 5051 connected, vehicle self-diagnosis and vehicle system "01 - Engine electronics" selected. For this purpose, the ignition must be switched on.

-> Display on VAS 5051:

- Under -1- select the diagnostic function "03 - Final control diagnosis".
- Actuate the secondary air pump relay -J299.
 - The LED should flash.

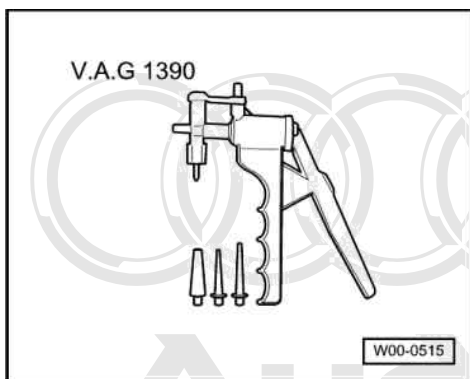
If LED does not flash:

- Carry out the following tests (marked with dots):
- Check for open circuit in wiring from contact 1 of connector to secondary air pump relay -J299 (in relay carrier under left cover at bulkhead) using the current flow diagram.
- Check for open circuit in wiring between contact 1 of the connector to earth using the current flow diagram.
- Eliminate open circuit using the current flow diagram.

If no fault is found:

- Replace the secondary air pump => page **277** .

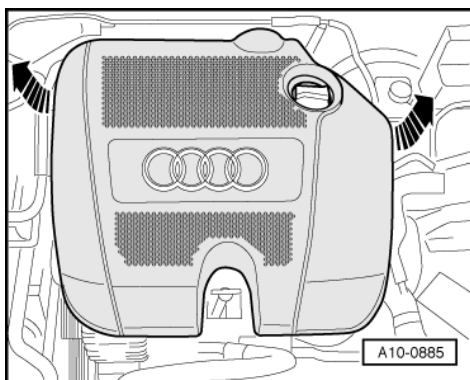
3.5 - Checking combination valve for secondary air inlet for function and leaks



Special tools and workshop equipment required

♦ Vacuum hand pump V.A.G 1390

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Test requirements:

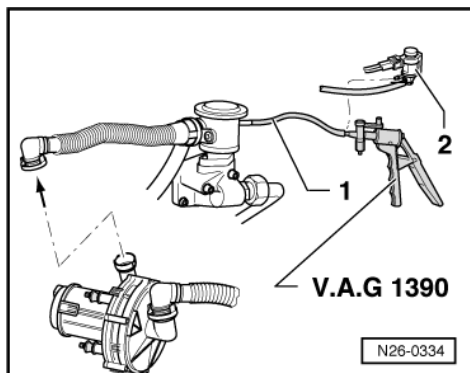
- Vacuum pipes and hose connections do not leak.



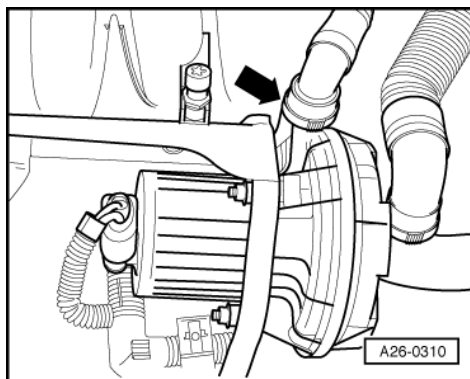
- Vacuum pipes not clogged.

Test sequence

- -> Remove engine cover -arrows-.



- -> Detach vacuum hose -1- from combination valve.
- Connect hand vacuum pump V.A.G 1390 to vacuum unit of combination valve.

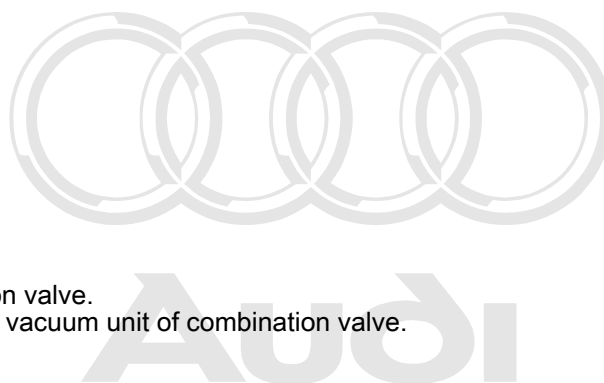
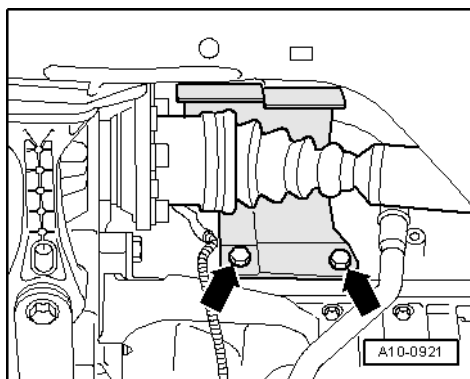


- -> Detach pressure hose -arrow- at secondary air pump.
- Blow into pipe with slight pressure (do not use compressed air).
 - The combination valve must be closed; blowing through must not be possible.
- Actuate hand vacuum pump.
 - The combination valve must open; blowing through must be possible

If the combination valve does not open:

- Replace combination valve => Page 26-76.

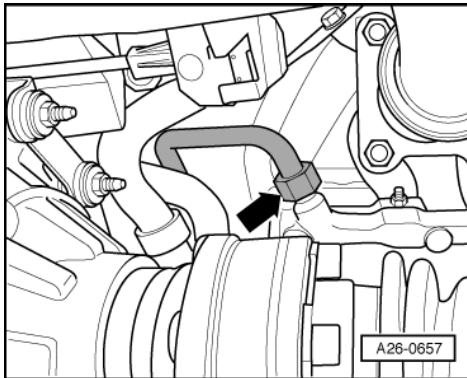
3.6 - Removing and installing combination valve for secondary air inlet



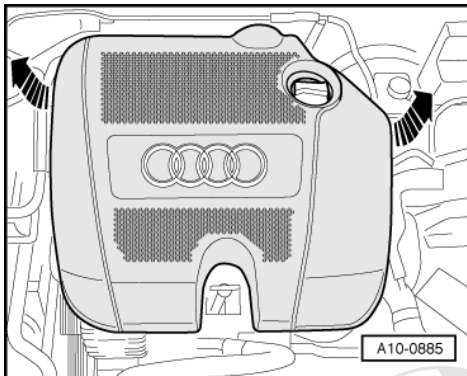
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Removing

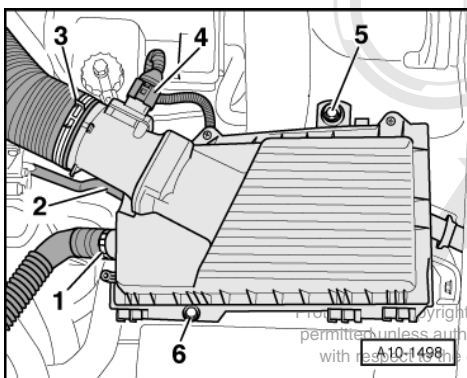
- -> Unbolt heat shield for right drive shaft -arrows-.



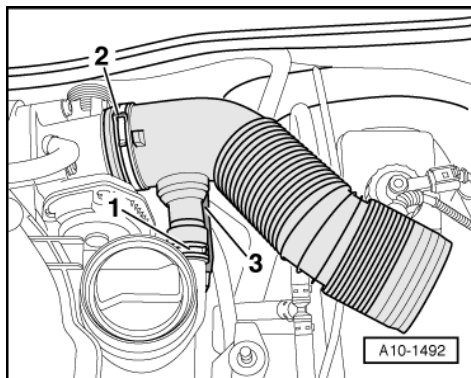
- -> Loosen the lower union nut -arrow- of the connecting pipe for secondary air inlet.



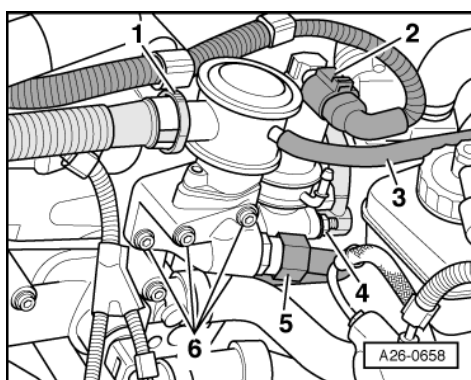
- -> Remove engine cover -arrows-.



- -> Disconnect the air duct hose -3- from the air mass meter.
- Unplug connector-4- at air mass meter.
- Disconnect hoses -1- and -2- from the air cleaner housing.
- Unscrew bolts -5- and -6-.
- Remove air cleaner housing.



- -> Disconnect hoses -1- and -3-.
- Remove the air duct, release spring clamp -2- for this purpose.



- -> Loosen the upper union nut -5- of the connecting pipe for secondary air inlet.
- Disconnect hoses -1- and -3-.
- Detach connector -2- from the exhaust gas recirculation valve.
- Remove nuts -4- and bolts -6-.
- Remove the combination valve and the exhaust gas recirculation valve.

Installing

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

Note:

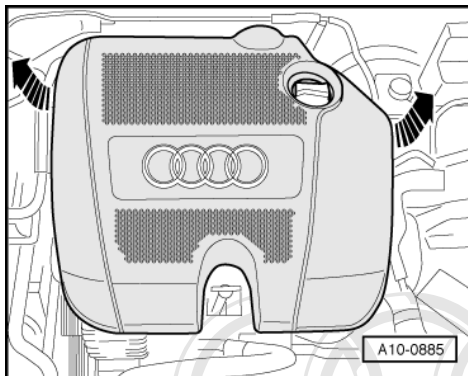
Replace seals and gaskets.

Tightening torques

Component	Nm
Connecting flange to cylinder head	10
Exhaust gas recirculation valve to connecting flange	25
Connecting pipe for secondary air inlet to exhaust manifold	60
Drive shaft heat shield to cylinder block	35

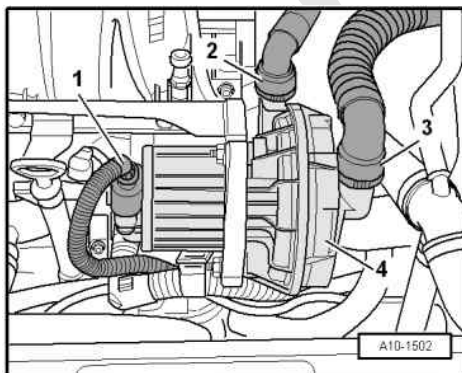
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3.7 - Removing and installing secondary air pump



Removing

- -> Remove engine cover -arrows-.



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

Installing

Installation is in reverse order.

Tightening torque

Component	Nm
Secondary air pump to bracket	10