

Workshop Manual Audi A3 1997 ➤

4-cylinder engine (2-valve), mechanics							
Engine ID	AVU	BFQ					

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List of Workshop Manual Repair Groups

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

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00 – Technical data

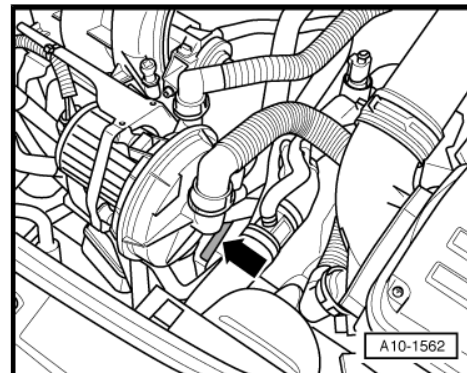
1 Technical data

1.1 Engine number

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

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

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



1.2 Engine data

Code letters		AVU	BFQ
Capacity	ltr.	1.595	1.595
Power output	kW at rpm	75/5600	75/5600
Torque	Nm at rpm	148/3800	148/3800
Bore	Ø in mm	81.0	81.0
Stroke	mm	77.4	77.4
Compression ratio		10.5	10.5
RON		95 ¹⁾	95 ¹⁾
Injection/ignition system		Simos	Simos
Firing order		1-3-4-2	1-3-4-2
Exhaust gas recirculation system		yes	yes
Turbocharging/supercharging		no	no
Knock control		yes	yes
Variable valve timing		no	no
Intake manifold change-over		yes	yes
Secondary air system		yes	yes

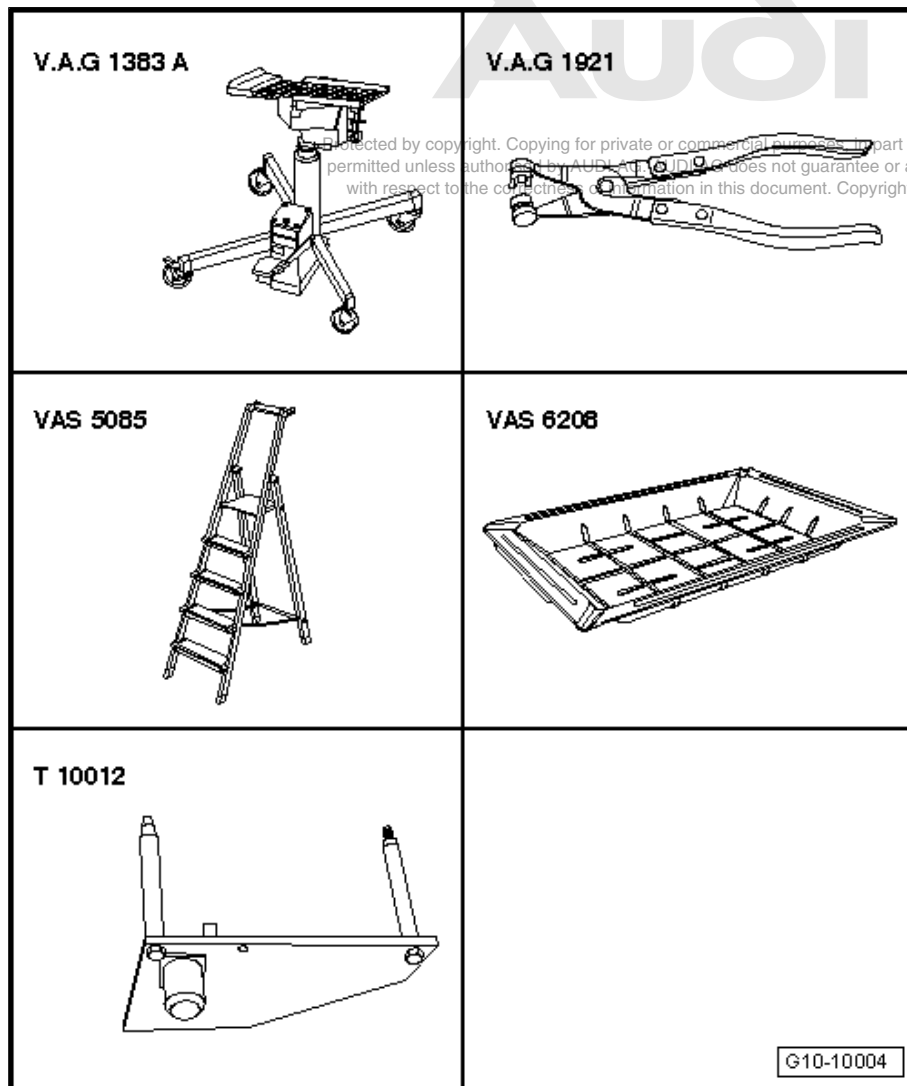
• ¹⁾ Unleaded petrol RON 91 can also be used, but results in reduced power

10 – Removing and installing engine

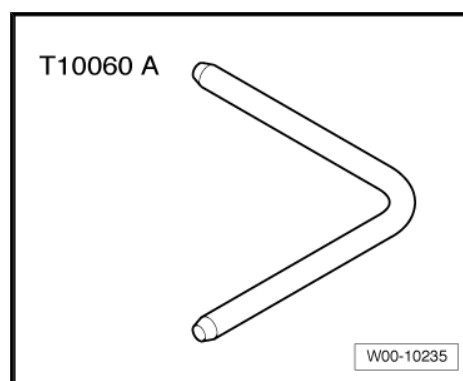
1 Removing and installing engine

Special tools and workshop equipment required

- ◆ Engine and gearbox jack - V.A.G 1383 A-
- ◆ Hose clip pliers -V.A.G 1921-
- ◆ Stepladder -VAS 5085-
- ◆ Drip tray for workshop hoist -VAS 6208- or -V.A.G 1306-
- ◆ Engine bracket -T10012-



- ◆ Locking pin -T10060 A-



1.1 Removing engine



Note

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

- Switch off ignition.
- Press release tabs -arrow- and remove cover -1- over battery.

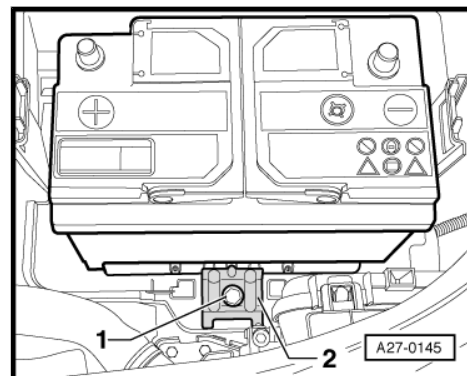
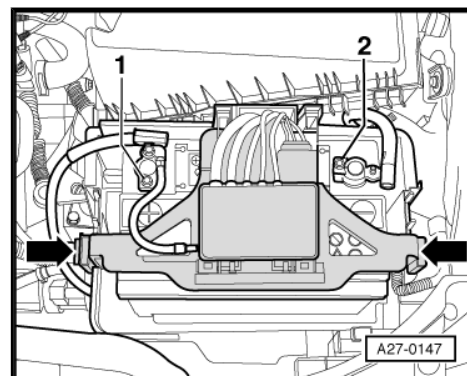
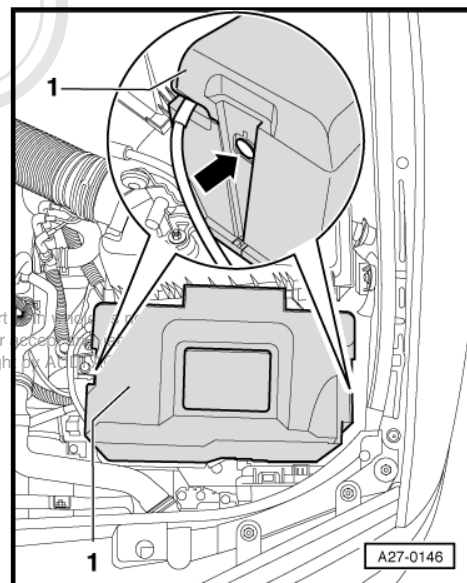


Caution

Observe notes on procedure for disconnecting the battery → Rep. Gr. 27.

- Loosen nut -2- several turns and disconnect earth clamp from battery terminal.
- Loosen nut -1- several turns and disconnect cable clamp from positive battery terminal.
- Press release tabs -arrows- and fold back main fuse box.

- Remove hexagon bolt -1- at battery retainer -2-.
- Pull battery out of fastening strip of battery tray.
- Lift battery out of engine compartment.

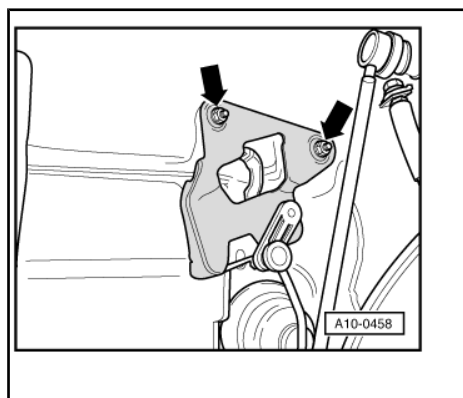
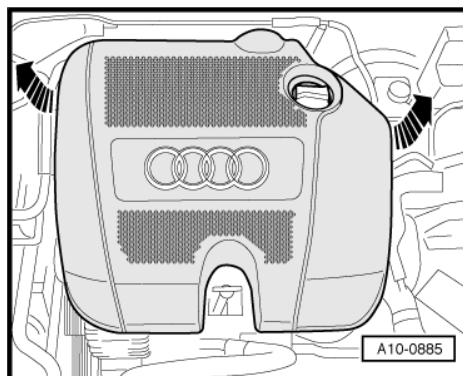


- Take off engine cover panel -arrows-.

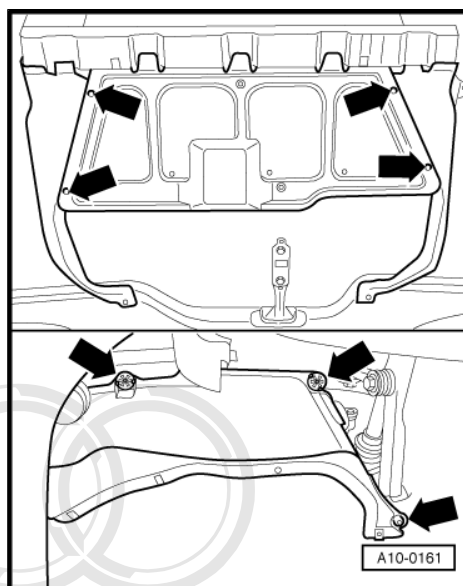

WARNING

Hot steam/hot coolant may escape when opening expansion tank; cover filler cap with cloth and open carefully.

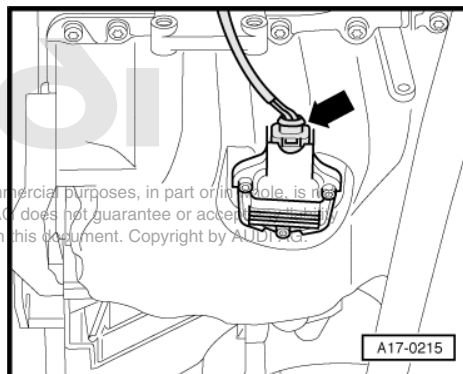
- Open filler cap on coolant expansion tank.
- On vehicles with automatic headlight range control detach bracket for headlight range control sender at top of wheel housing (left-side) -arrows-.



- Remove noise insulation panels (centre, left and right) -arrows-.

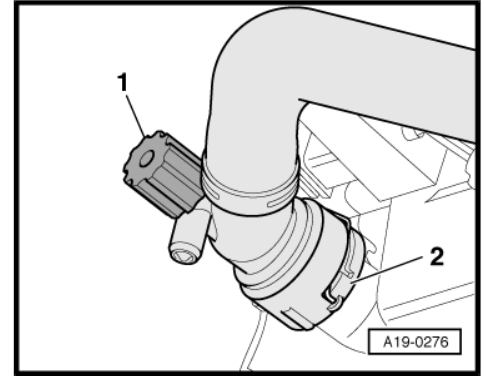


- Unplug electrical connector -arrow- at oil level/temperature sender -G266- and move wiring to the top.



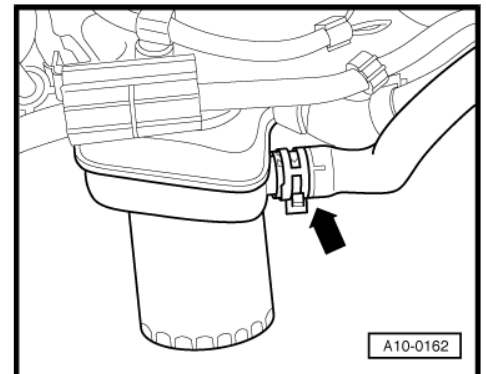
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- Place drip tray for workshop hoist -VAS 6208- or -V.A.G 1306- under engine.
- Turn drain plug -1- on radiator anti-clockwise, fit auxiliary hose to connection if necessary.
- Pull off retaining clip for bottom coolant hose and detach coolant hose -2- from radiator.

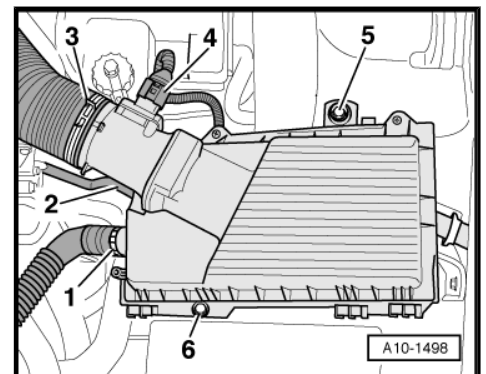


- Also disconnect coolant hose at bottom of oil cooler -arrow-, and drain off remaining coolant.

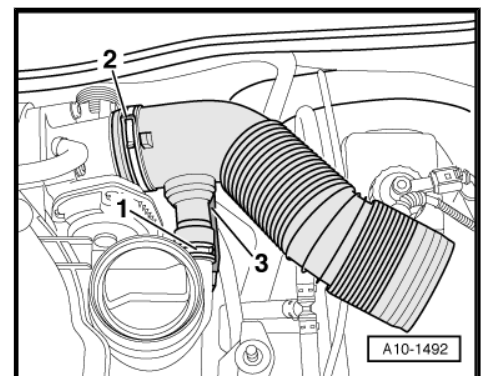
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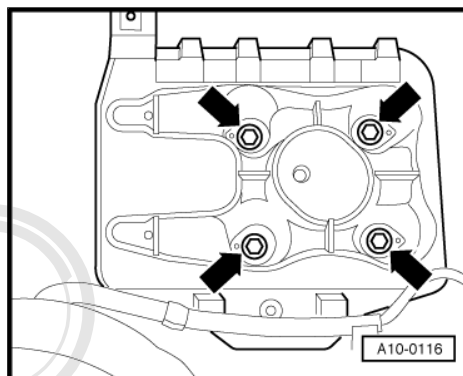
- Disconnect hoses -1- and -2- from air cleaner housing.
- Release spring-type hose clip -3- and detach air intake hose at air mass meter -G70- .
- Unplug electrical connector -4- at air mass meter -G70- .
- Remove bolts -5- and -6-.
- Take out air cleaner housing.



- Disconnect hose -3-.
- Release spring-type hose clips -1- and -2- and remove air hose.



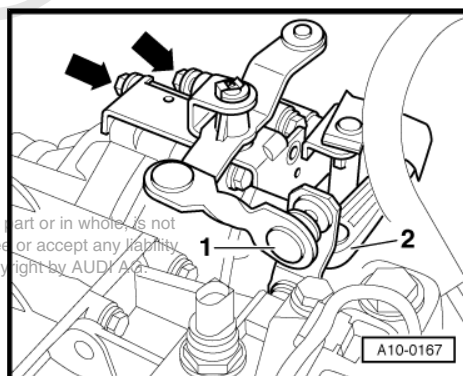
- Remove battery tray -arrows-.



Vehicles with manual gearbox:

- Pry off selector rods -1- and -2- using a screwdriver.
- Detach selector mechanism from gearbox -arrows- and tie up.

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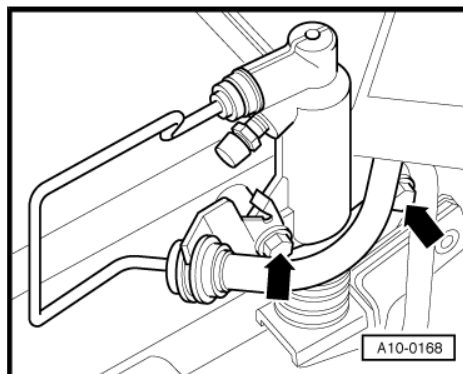


- Remove clutch slave cylinder -arrows-.
- Detach hydraulic line from gearbox and place clutch slave cylinder to side (do not open system).

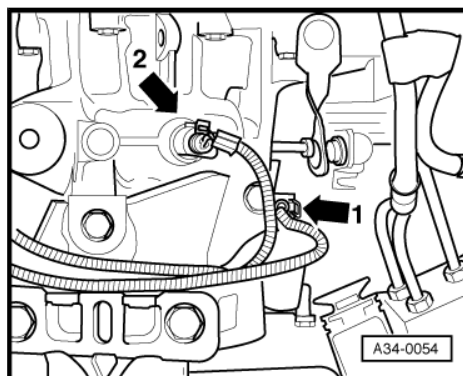


Caution

Do not operate clutch pedal with slave cylinder removed.



- Unplug electrical connectors -arrow 1- at speedometer sender -G22- and -arrow 2- for reversing light switch -F4- and move wiring clear.



Vehicles with automatic gearbox:

- Pry selector lever cable -1- off gearbox selector lever -4- using a screwdriver and detach retaining clip -3- from support bracket.
- Detach selector lever cable and move to one side.



Note

Disregard -item 2-.

- Unplug the electrical connectors and move wiring harness clear.

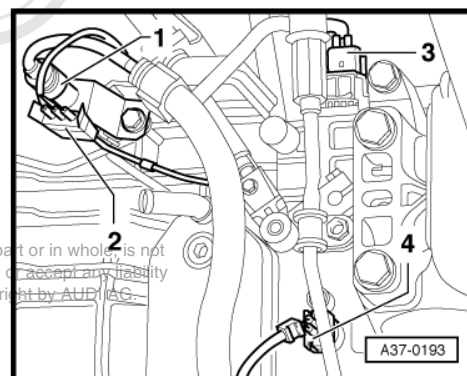
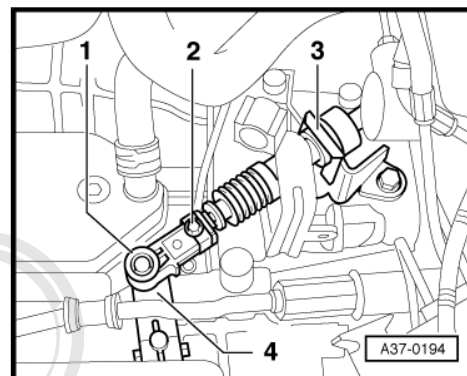
1 - To solenoid valves (10-pin connector)

2 - To vehicle speed sender -G68-

3 - At multi-function switch -F125-

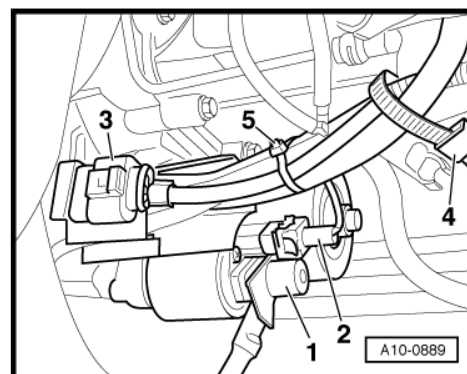
4 - At gearbox speed sender -G38-

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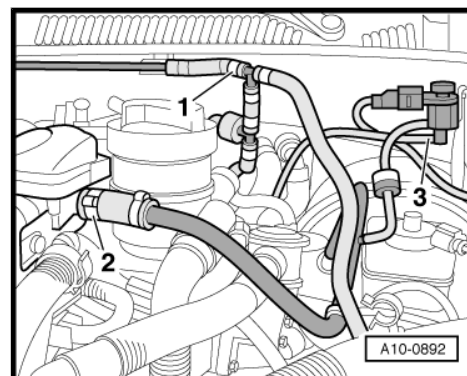


All models:

- Detach electrical wires -1- and -2- at starter.
- Detach electrical connector -3-.
- Unscrew earth wire at engine/gearbox flange.
- Cut open cable tie -5- and open cable tie -4-.
- Disengage wires from bracket on starter, move wires to one side and detach bracket.



- Detach vacuum hose -2- going to brake servo at intake manifold.
- Detach the coolant hose -1- going to the coolant expansion tank at the T-connection.
- Disconnect vacuum hose -3- leading to secondary air inlet valve -N112-.

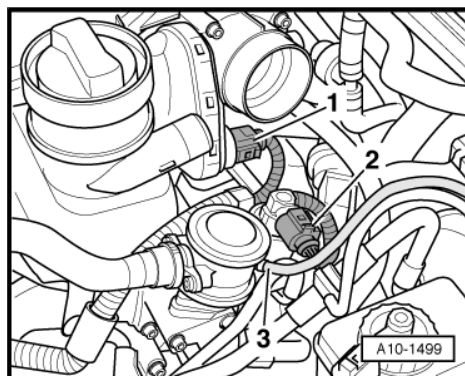


- Unplug electrical connectors at throttle valve module -J338- -item 1- and at exhaust gas recirculation valve -N18- -item 2- and move electrical wires clear.

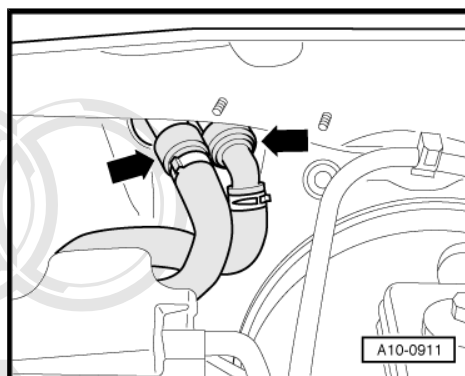


Note

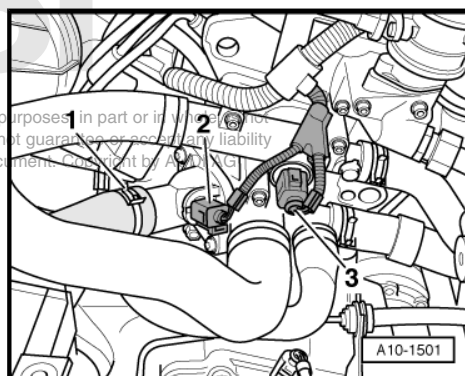
Disregard -item 3-.



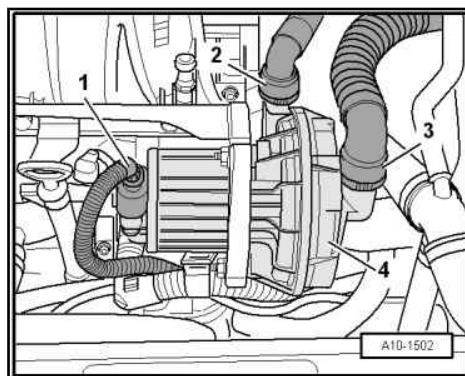
- Detach coolant hoses going to to heat exchanger at bulkhead -arrows-.



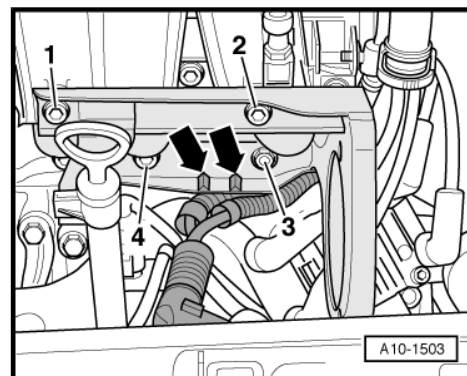
- Detach coolant hose from coolant distributor housing; to do so, loosen spring clamp -1-.
- Unplug the connectors at the coolant temperature sender -G62- -item 2- and at the thermostat for map-controlled engine cooling -F265- -item 3-.



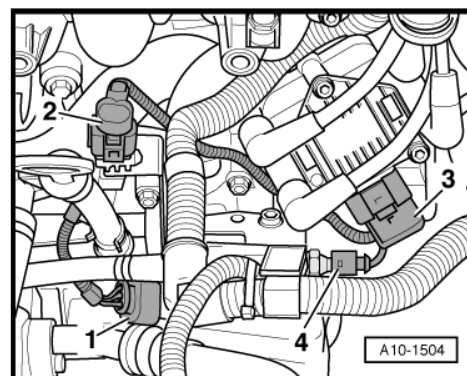
- Unplug electrical connector -1- at secondary air pump motor -V101- .
- Disconnect hoses -2- and -3- at secondary air pump.
- Remove the secondary air pump -4- from bracket and move wiring clear.



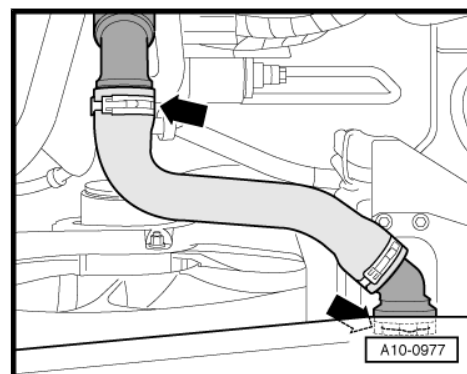
- Unscrew bolts -1-, -2- and -4- and nut -3- on secondary air pump bracket.
- Move wiring clear -arrows- and remove the secondary air pump bracket.



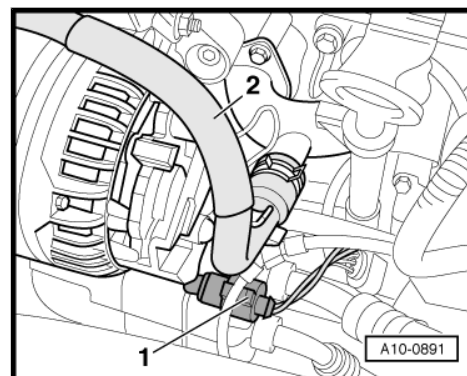
- Unplug electrical connectors and move wiring clear:
 - 1 - Knock sensor 1 -G61-
 - 2 - Engine speed sender -G28-
 - 3 - Ignition coil 1 -N- , ignition coil 2 -N128- and output stage -N122-
 - 4 - Oil pressure switch -F1- (on oil filter bracket)



- Remove top coolant hose between engine and radiator -arrows-.

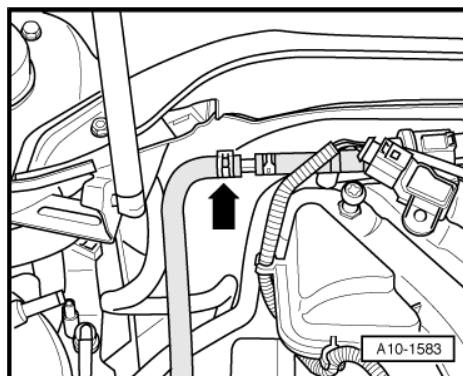


- Detach coolant hose -2- and move clear.
- Unplug electrical connector -1- for magnetic clutch of AC compressor and move wiring clear.



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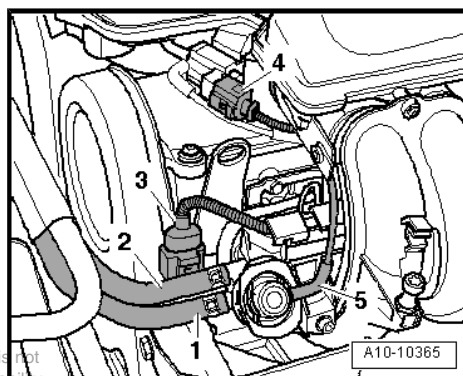
- Disconnect vacuum hose going to activated charcoal filter at the position marked with an -arrow-.



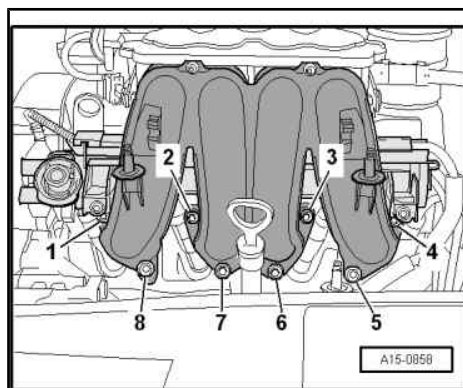
- Unplug electrical connectors -3- and -4-.
- Disconnect vacuum hose -5- from fuel pressure regulator.


WARNING

The fuel system is pressurised. Before opening the system place a cloth around the connection. Then dissipate pressure by carefully unfastening the connection.



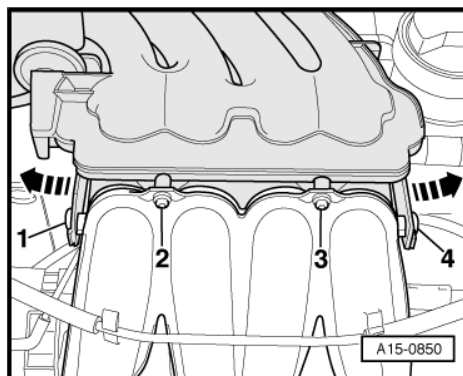
- Mark fuel supply pipe -2- and fuel return pipe -1- and detach from fuel rail.
- Unscrew bolts -1 ... 4- and -7- and nut -8-.



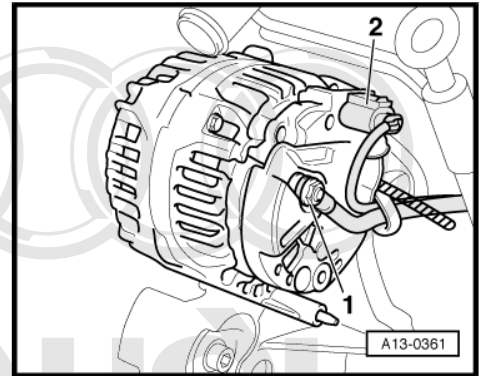
- Remove bolts -2- and -3-.
- Lever off the clips -1- and -4-.
- Press retainers slightly aside to release -arrows- and detach lower section of intake manifold from upper section.
- Unclip wiring harness from lower section of intake manifold.
- Unplug electrical connectors going to injectors and move wiring clear.


Note

Block off intake ports in cylinder head with clean rags.



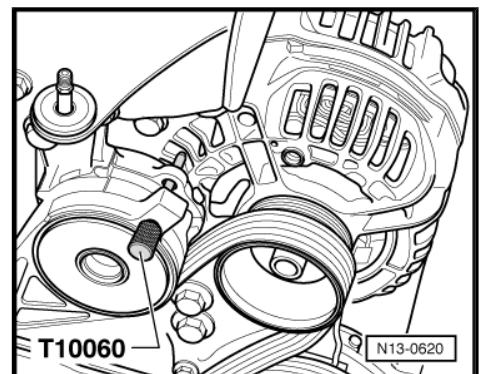
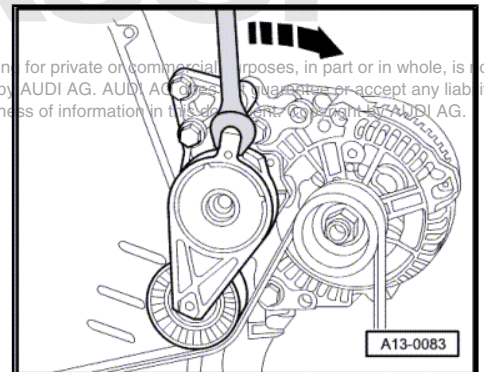
- Detach electrical connector -2-.
- Unscrew wire -1- at alternator.
- Unbolt wiring clamp at alternator and move wiring clear.
- Move engine wiring harness clear.



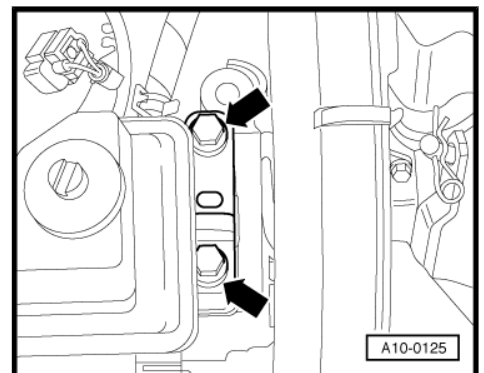
Note

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

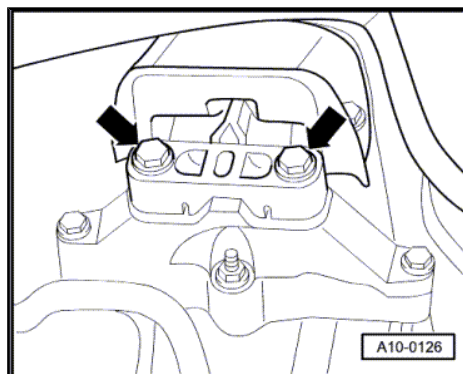
- Turn the tensioner in the direction of the -arrow- to slacken the poly V-belt.
- Lock poly V-belt tensioner using locking pin -T10060 A- .
- Remove poly V-belt.



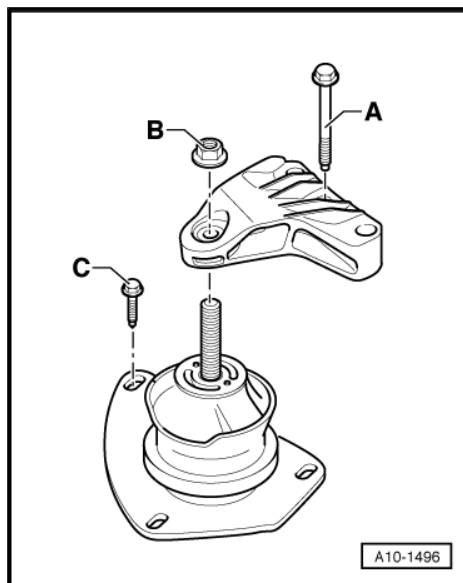
- Loosen bolts -arrows- of assembly mounting at engine approx. 2 turns.



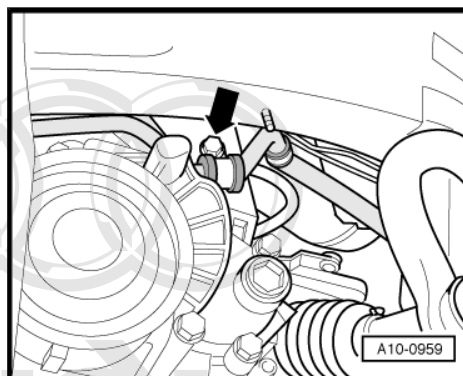
- Loosen bolts -arrows- of assembly mounting at gearbox approx. 2 turns.
- Unscrew securing bolts for radiator cowl which are accessible from above.



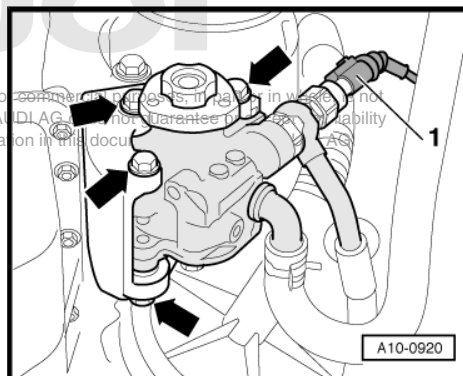
- Detach power steering pressure line from gearbox -arrow-.



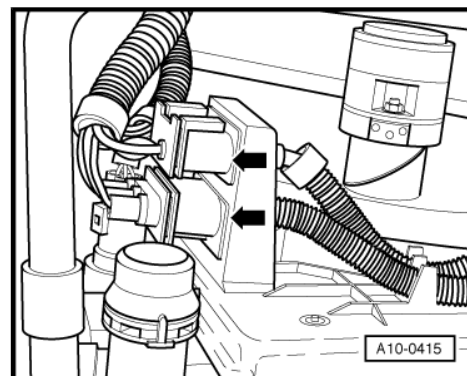
- Unbolt bracket for power steering pressure line from rear of gearbox support -arrow-.



- Unplug electrical connector -1- at power assisted steering pressure switch -F88- and move wiring clear.
- Counterhold power steering pump pulley using a drift and detach pulley.
- Unbolt power steering pump -arrows-. Leave pipes connected.



- Detach both connectors -arrows- for radiator fan at bottom left of radiator cowl.
- Unscrew radiator cowl bolts accessible from below.
- Remove the radiator cowl with both fans from below.
- Tie up power steering pump together with line to lock carrier.



- Remove bolts -A- for air conditioner compressor.



WARNING

The air conditioner refrigerant circuit must not be opened.

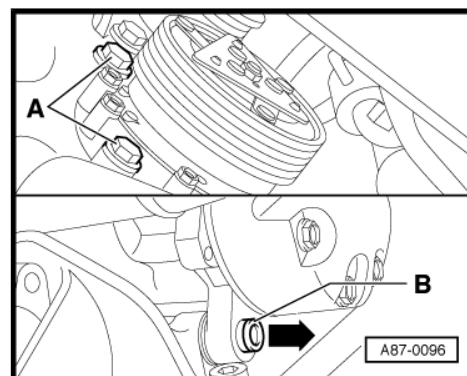
- Tie up air conditioner compressor together with refrigerant hoses to bonnet lock (refrigerant hoses remain connected).

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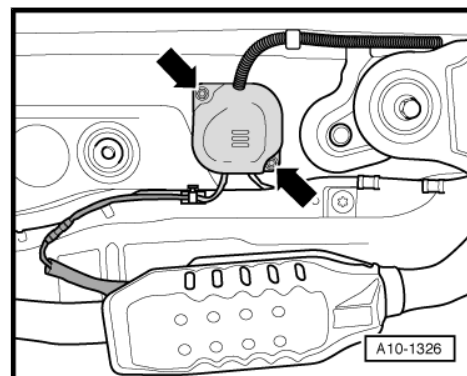


Note

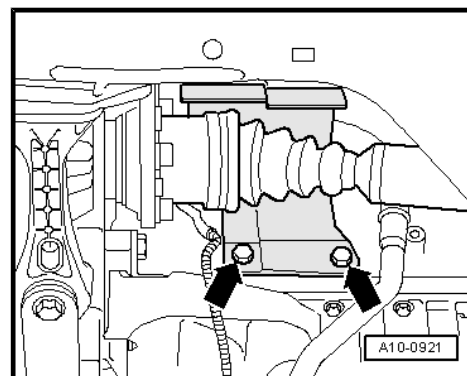
To prevent damage to the air conditioner compressor and refrigerant pipes/hoses, ensure that the pipes and hoses are not stretched, kinked or bent.



- Unscrew protective cover -arrows- on vehicle underbody.
- Unplug connectors and move wiring for lambda probes clear.



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

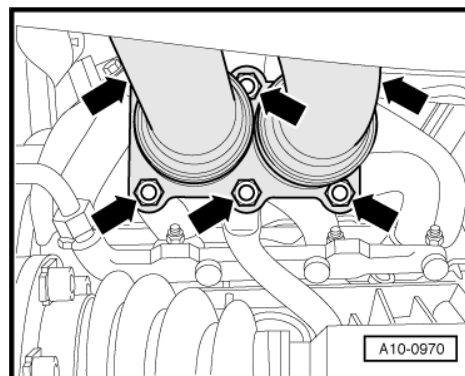


- Remove securing nuts on front exhaust pipe/exhaust manifold -arrows-.

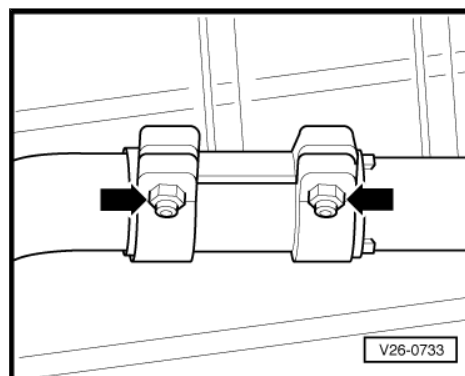


Note

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



- Separate exhaust system at clamp -arrows-.
- Remove front exhaust pipe (pivot front exhaust pipe through 180°).



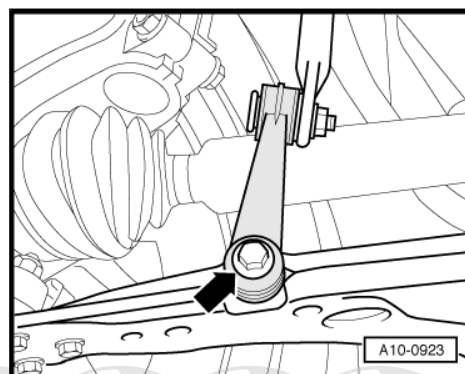
- Unbolt drive shafts (left and right) from gearbox flanges.
- Move left drive shaft towards rear and attach to anti-roll bar using a wire loop.



Note

Take care not to damage the surface coating of the drive shaft.

- Unbolt right coupling rod from wishbone -arrow-.



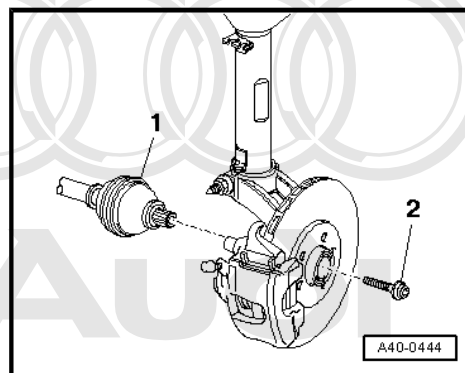
- Operate brake pedal (2nd mechanic required).



Caution

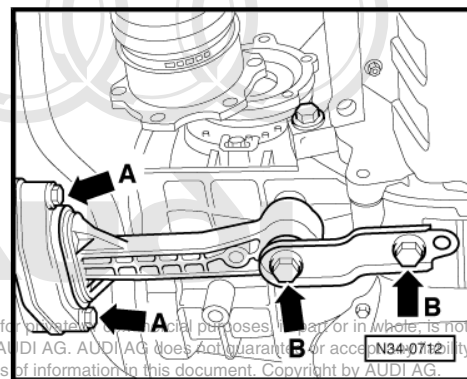
When slackening the flange bolt securing the drive shaft, the wheel bearing must not be under load (vehicle must not be standing on its wheels).

- Unscrew flange bolt -2- from drive shaft (right-side).



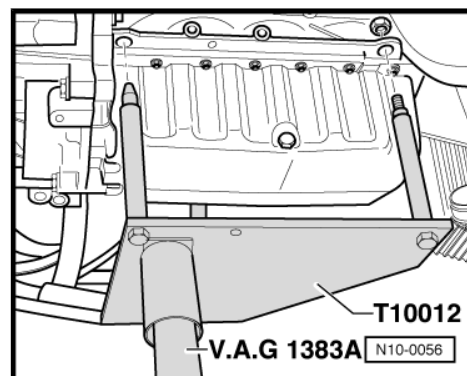
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- First remove bolts -A- and then bolts -B- from pendulum support.
- Remove pendulum support.
- Turn front wheels to the right.
- Push engine forward and at the same time take out right drive shaft towards front.



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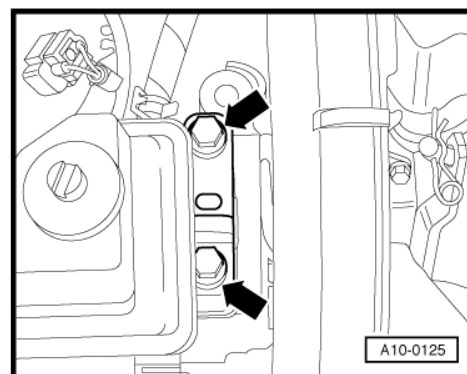
- Attach engine bracket -T10012- with securing nut and bolt to cylinder block: approx. 20 Nm.
- Insert engine and gearbox jack -V.A.G 1383 A- in engine bracket -T10012- and raise engine slightly.



Note

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

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

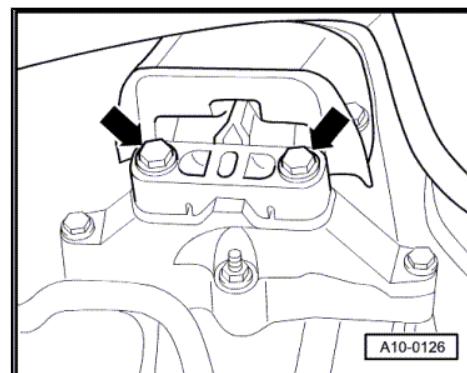


- Loosen bolts -arrows- of assembly mounting on gearbox.



Note

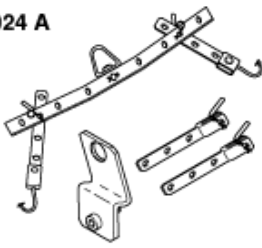
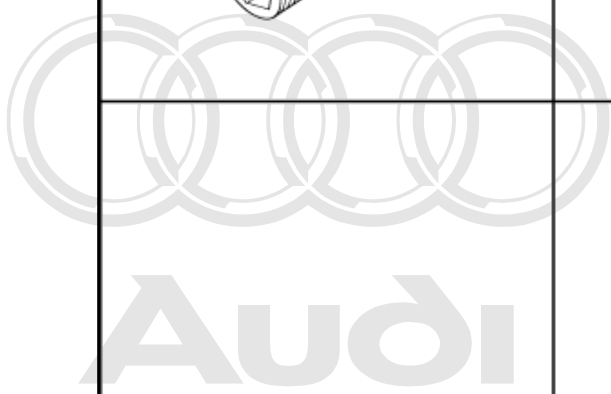
- ♦ *Check that all hoses, pipes and wiring connections between engine, gearbox and body have been detached.*
- ♦ *Carefully guide engine/gearbox assembly when lowering to avoid damage.*
- Pull engine/gearbox assembly as far forward as possible, and lower gradually.



1.2 Separating engine and gearbox

Special tools and workshop equipment required

- ◆ Lifting tackle -2024 A-
- ◆ Workshop hoist -VAS 6100- or -V.A.G 1202 A-
- ◆ 15 mm socket insert -Matra V/175- (for vehicles with automatic gearbox)

2024 A 	VAS 6100 
V/175 	
	G10-0053

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Procedure

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

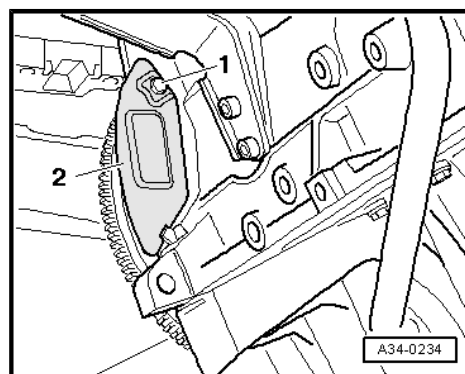
Vehicles with manual gearbox:

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



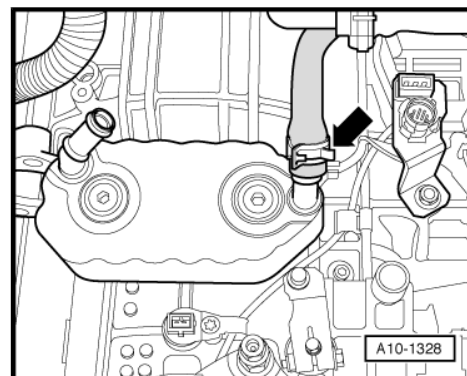
Note

Shown in illustration with gearbox removed.

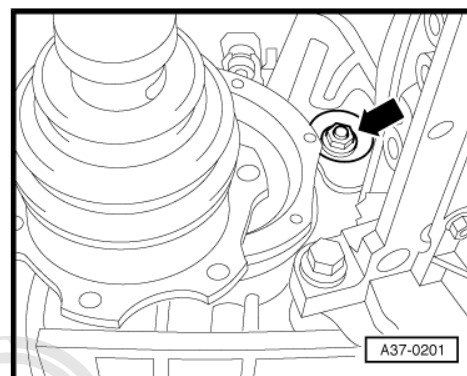


Vehicles with automatic gearbox:

- Disconnect coolant hoses from ATF cooler -arrow-.



- Remove plug in drilling on torque converter cover plate.
- Unscrew 3 nuts for torque converter -arrow- using 15 mm socket insert -Matra V/175- (turn crankshaft $\frac{1}{3}$ turn each time).



Note

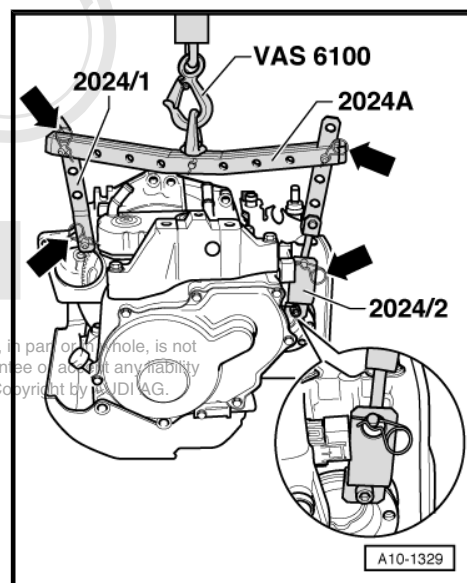
Counterhold at central bolt of vibration damper when unscrewing nuts for torque converter.

- Remove starter.
- Hook lifting tackle -2024 A- onto automatic gearbox and workshop hoist -VAS 6100- or -V.A.G 1202 A-.



Note

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



WARNING

Support hooks and locking pins on lifting tackle must be secured with locking clips -arrows in illustration-.

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All models:

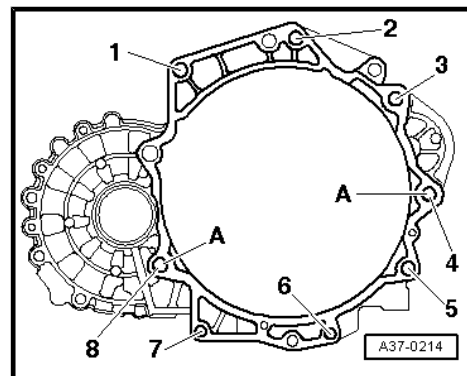
- Remove bolts -1 ... 8- on engine/gearbox flange.
- Remove starter.



Note

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

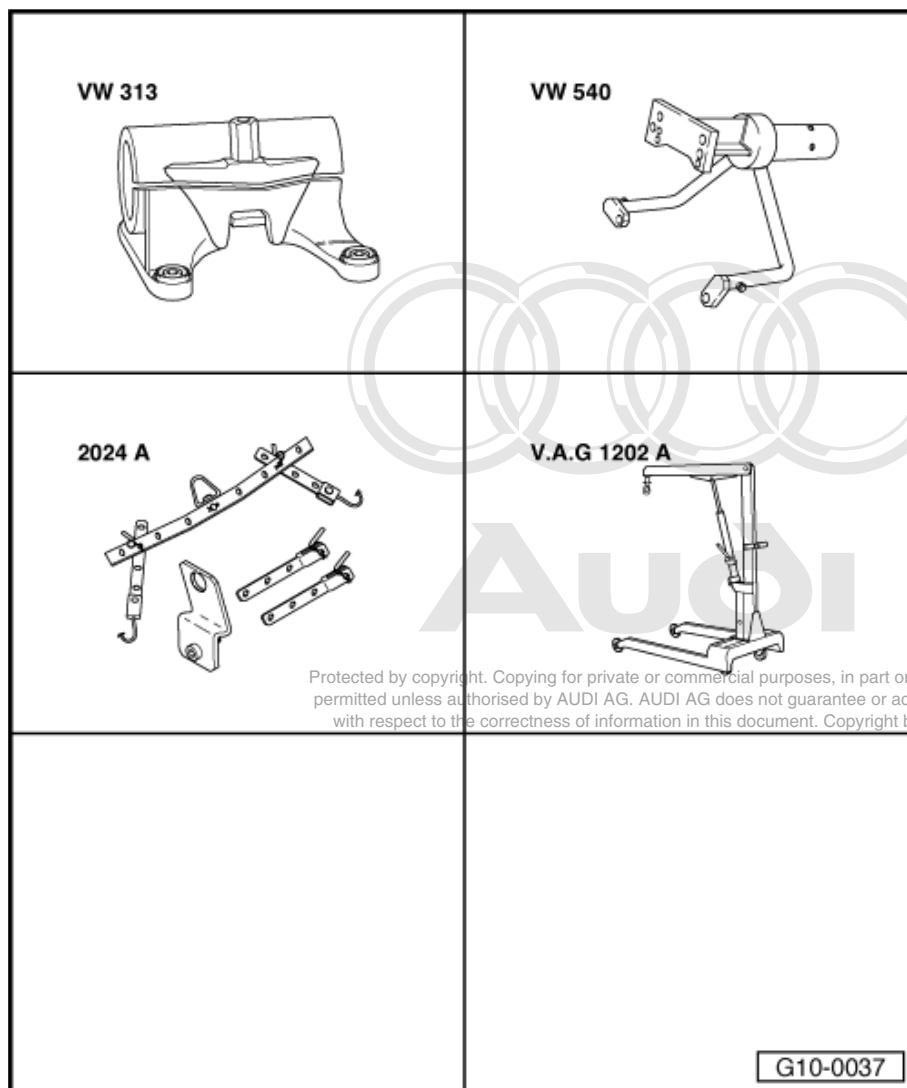
- Remove gearbox from engine.



1.3 Securing engine to assembly stand

Special tools and workshop equipment required

- ◆ Support clamp -VW 313-
- ◆ Engine and gearbox support -VW 540-
- ◆ Lifting tackle -2024 A-
- ◆ Workshop hoist - VAS 6100- or - V.A.G 1202 A-



Procedure

- Gearbox detached from engine.
- Detach crankcase breather hose from oil filler neck.
- Hook lifting tackle -2024 A- onto engine and workshop hoist - VAS 6100- or -V.A.G 1202 A- .



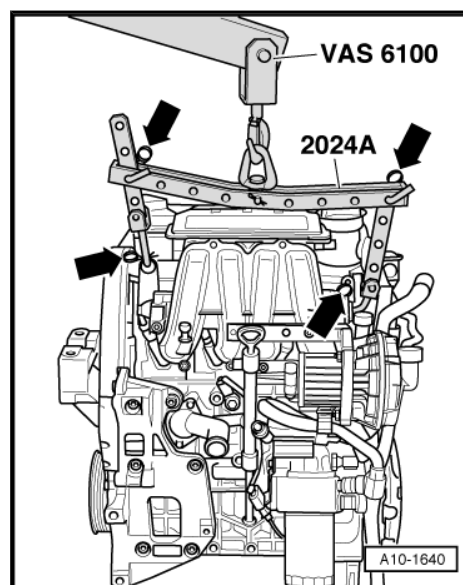
Note

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



WARNING

Support hooks and locking pins on lifting tackle must be secured with locking clips -arrows in illustration-.

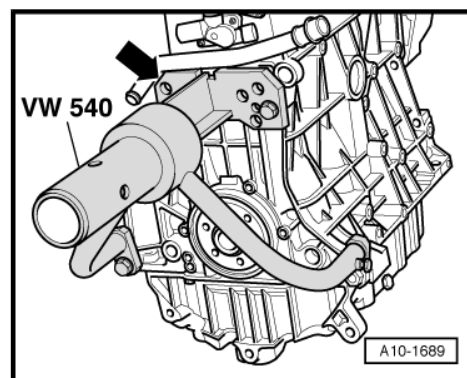


- Lift engine off engine bracket -T10012- using workshop hoist -VAS 6100- or -V.A.G 1202 A- .

- When carrying out repairs, secure engine to support clamp - VW 313- using engine and gearbox support -VW 540- .

 Note

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



1.4 Installing engine

- Engine installed on engine bracket -T10012- .

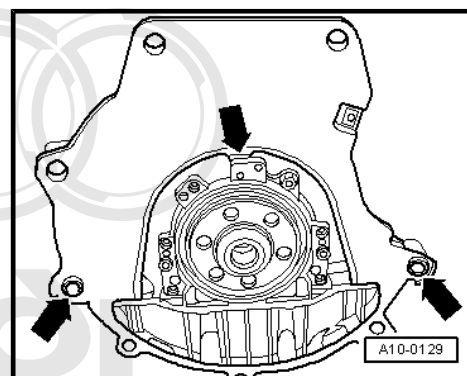
Installation is carried out in the reverse order; note the following:

 Note

- ◆ *Renew self-locking nuts and bolts when performing assembly work.*
- ◆ *Renew bolts which are tightened to a specified angle as well as oil seals and gaskets.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- ◆ *Fit all cable ties in the original positions when installing.*
- Check whether dowel sleeves for centring the engine/gearbox assembly are fitted in the cylinder block; install if necessary.
- Ensure that the intermediate plate is engaged on the sealing flange and pushed onto the dowel sleeves -arrows-.

Vehicles with manual gearbox:

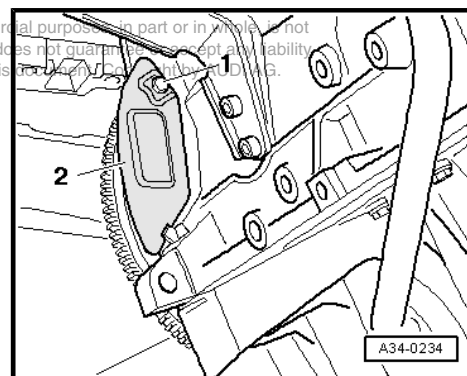
- Check that clutch plate is correctly centred ⇒ Rep. Gr. 30 .
- Clean input shaft splines and (in the case of used clutch plates) the hub splines. Remove corrosion and apply only a very thin coating of grease for clutch plate splines -G 000 100- to the splines. Then move clutch plate back and forth on input shaft until the hub moves smoothly on the shaft. Remove any excess grease.



- Bolt gearbox to engine.
- 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-.

 Note

Shown in illustration with gearbox removed.



Vehicles with automatic gearbox:

- To secure the torque converter to drive plate, use only the correct nuts (same as original equipment) ⇒ Parts catalogue .

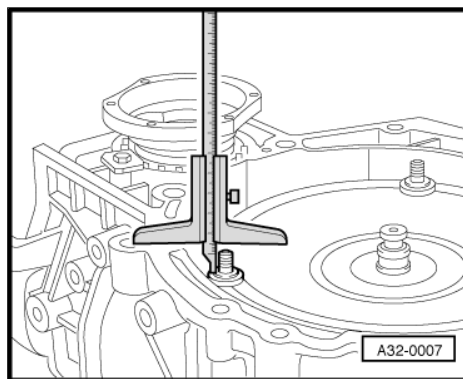
If the torque converter is correctly installed, the depth between the contact surfaces at the bottom of the studs on the torque converter and the contact surface of the torque converter bell housing is about 22 mm.

If the torque converter has not been completely inserted, this distance will be approx. 10 mm.



Caution

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



- Before installing engine, rotate torque converter and drive plate so that one hole/one stud are level with the drilling on torque converter cover plate -arrow-.
- Bolt gearbox to engine.
- Tighten nuts for torque converter using 15 mm socket insert -Matra V/175-.

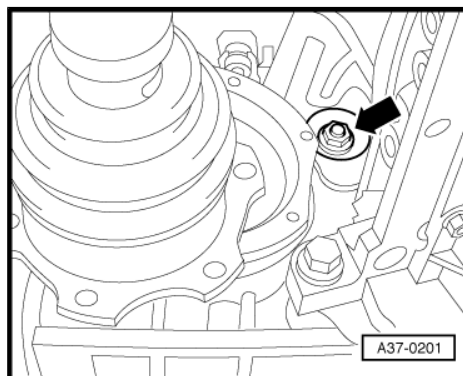
All models:

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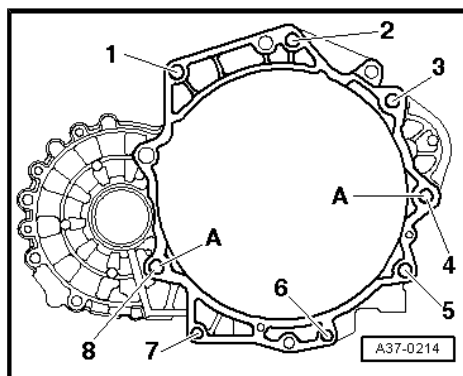
Note

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

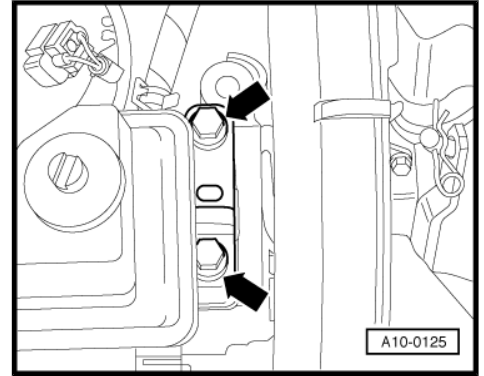


Securing engine to gearbox

Item	Bolt	Nm
1, 2 ¹⁾	M12x65	80
3 ¹⁾ , 4 ¹⁾	M12x180	80
5 ... 7	M10x50	45
8	M12x80	80
A	Dowel sleeves for centralising	
• ¹⁾ Bolt with M8 stud		



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

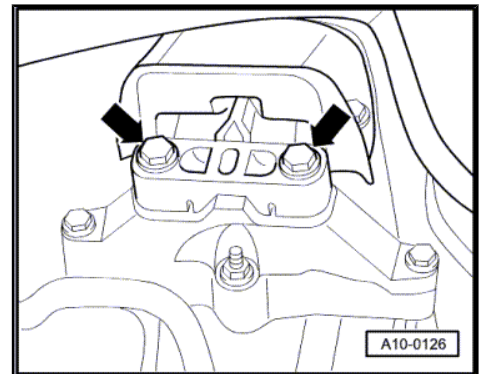


- Tighten bolts of assembly mounting on gearbox -arrows- initially finger-tight.
- Use new bolts for securing.

i Note

The bolts are tightened to final torque only after adjusting the engine mountings ⇒ [page 24](#) .

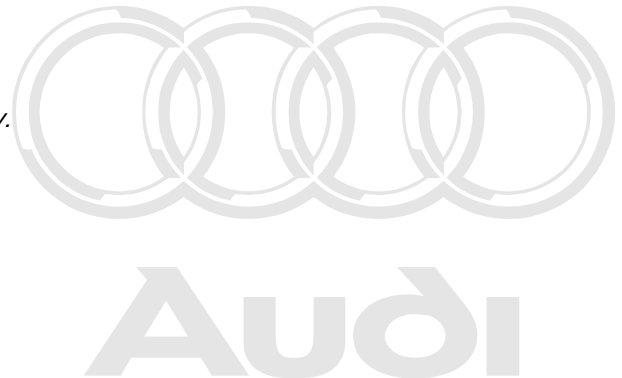
- Remove engine bracket -T10012- from engine.
- Install drive shafts ⇒ Rep. Gr. 40 .



i Note

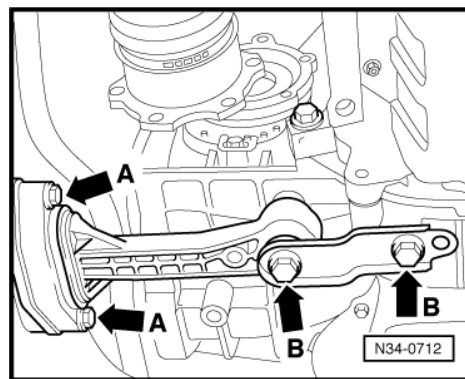
Drive shafts must be installed prior to further assembly.

- Install the coupling rod ⇒ Rep. Gr. 40 .



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- First attach pendulum support to gearbox -arrows B- and then to subframe -arrows A-.
- Use new bolts for securing.
- Install exhaust system and align it free of stress
⇒ [page 157](#) .
- Drive back the respective bushes for securing bolts slightly to facilitate installation of power steering pump and air conditioner compressor.
- Install air conditioner compressor ⇒ Rep. Gr. 87 .
- Install power steering pump ⇒ Rep. Gr. 48 .
- Install alternator ⇒ Rep. Gr. 27 .
- Install poly V-belt ⇒ [page 29](#) .
- Install bottom section of intake manifold ⇒ [page 88](#) .
- Install secondary air pump ⇒ [page 181](#) .



Vehicles with manual gearbox:

- Install clutch slave cylinder ⇒ Rep. Gr. 30 .
- Attach and adjust selector mechanism at gearbox ⇒ Rep. Gr. 34 .

Vehicles with automatic gearbox:

- Installing and adjusting selector lever cable ⇒ Rep. Gr. 37

All models:

- Adjust engine mountings ⇒ [page 24](#) .
- Install air cleaner housing ⇒ Rep. Gr. 24 .
- Electrical connections and routing ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- Install battery ⇒ Rep. Gr. 27 .
- Check oil level ⇒ [page 119](#) .



Caution

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

- Fill cooling system ⇒ [page 125](#) .



Note

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

Tightening torques

Component	Nm
Bolts/nuts	M6 10
	M8 20
	M10 45
	M12 65
Except for the following:	
Drive plate to torque converter	85
Pendulum support to gearbox	40 + 90° ¹⁾²⁾
Pendulum support to subframe	20 + 90° ¹⁾²⁾
Heat shield to cylinder block	35
Bracket for headlight range control sender to body	6
Earth wire to gearbox	23
• ¹⁾ Renew nuts/bolts. • ²⁾ 90° = one quarter turn.	

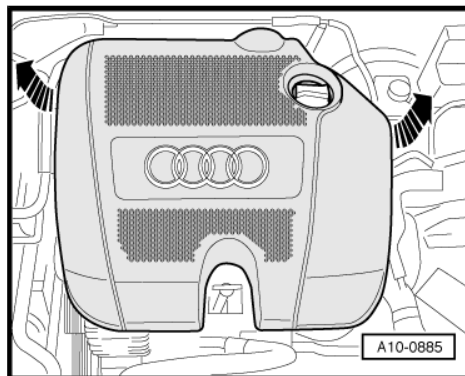


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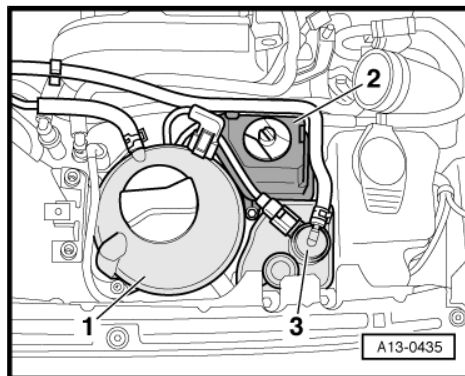
2 Adjusting assembly mountings

2.1 Checking

- Take off engine cover panel -arrows-.



- Detach coolant expansion tank -1- and power steering reservoir -2-. Hoses remain connected.



Note

Activated charcoal filter -3- remains installed.

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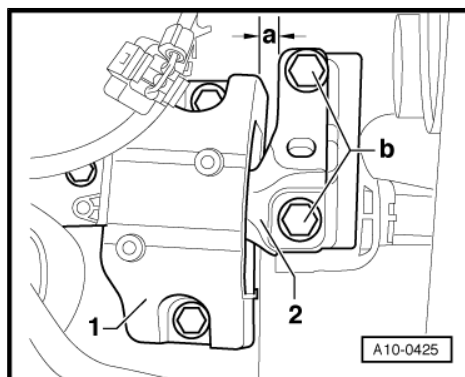
The following specifications must be obtained:

- Both bolt heads -b- must be flush with the edge of the support arm -2-.
- The distance -a- between engine mounting -1- and support arm -2- of the right engine mounting must be 13 mm.



Note

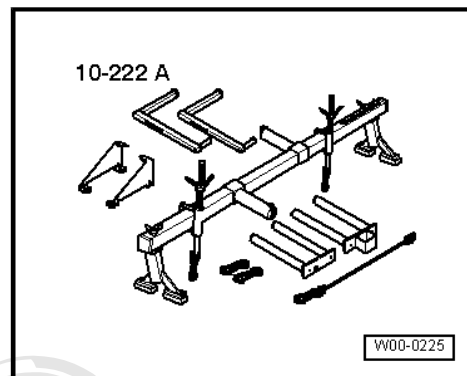
Distance -a- = 13 mm can also be checked with a metal rod of suitable size, or similar.



2.2 Adjusting assembly mountings

Special tools and workshop equipment required

◆ Support bracket -10-222 A-



◆ Mud wing compensation plate -T40045-

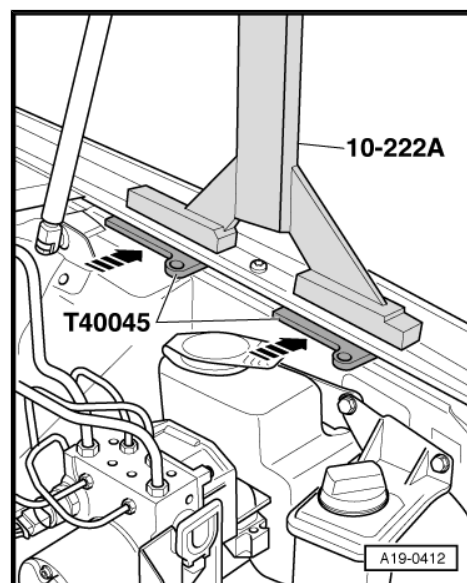
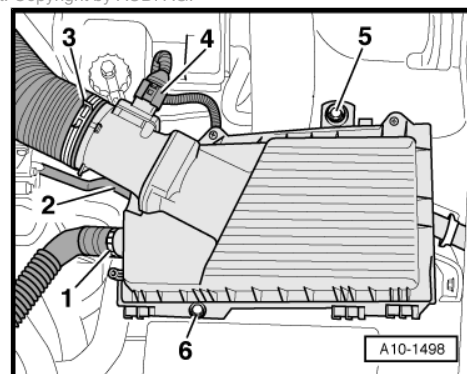


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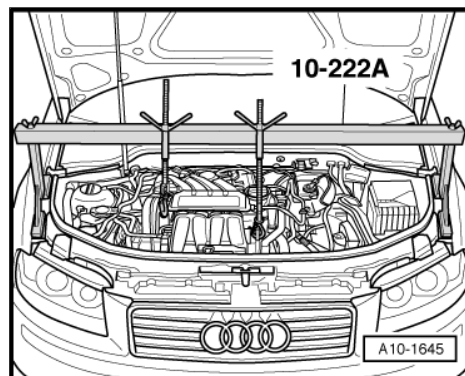
Adjusting

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

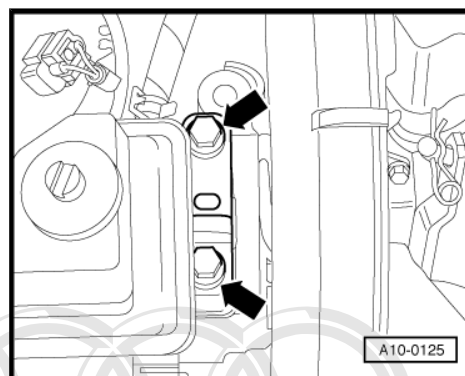
- Disconnect hoses -1- and -2- from air cleaner housing.
- Release spring-type hose clip -3- and detach air intake hose at air mass meter -G70- .
- Unplug electrical connector -4- at air mass meter -G70- .
- Remove bolts -5- and -6-.
- Take out air cleaner housing.
- Remove the rubber sealing strip from the edges of the wing mounting flanges.
- Place compensation plates -T40045- between the wing mounting flange and the body panel underneath, so that the support bracket -10-222 A- does not damage the wing mounting flanges.



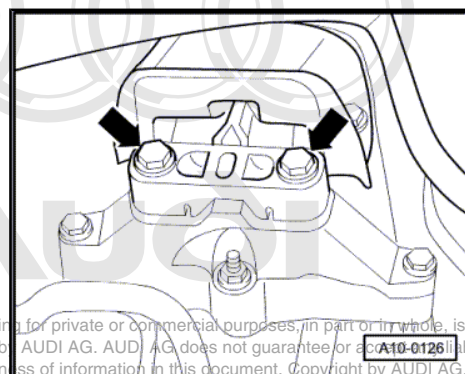
- Set up support bracket -10-222 A- on wing panel flanges.
- The spindles face forwards.
- Detach crankcase breather hose from oil filler neck.
- Attach hooks of spindles to lifting eyes.
- Take up weight of engine evenly with both spindles (but do not raise engine).



- Unscrew bolts of assembly mounting at engine -arrows-.



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



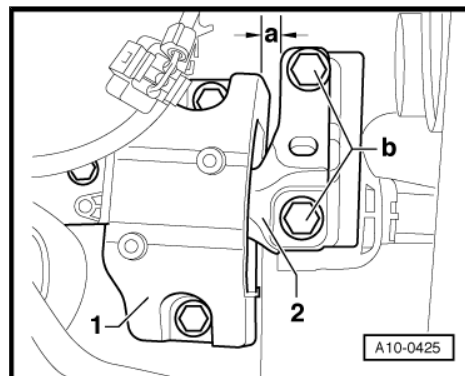
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- Using a tyre iron, adjust engine between engine mounting -1- and support arm -2- until the specifications listed below are obtained:
- The distance -a- between engine mounting and support arm of the right engine mounting must be 13 mm.
- Both bolt heads -b- must be flush with the edge of the support arm.



Note

Distance -a- = 13 mm can also be checked with a metal rod of suitable size, or similar.



- Tighten the bolts -b- for engine assembly mounting.

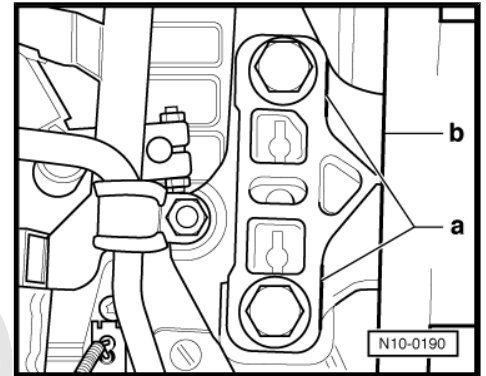
- Ensure that the edges of the support arm (on the gearbox assembly mounting) -a- and gearbox mounting -b- are parallel.
- Tighten the bolts for gearbox assembly mounting.

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

- Install air cleaner housing ⇒ Rep. Gr. 24 .

Tightening torques

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



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13 – Crankshaft group

1 Dismantling and assembling engine

1.1 Poly V-belt drive - exploded view of components

1 - Poly V-belt

- ☐ Before removing, mark direction of rotation with chalk or felt-tipped pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.
- ☐ Engines with an air conditioner compressor are fitted with a double-sided poly V-belt.
- ☐ Check for wear
- ☐ Do not kink
- ☐ Removing and installing ⇒ [page 29](#)
- ☐ Position of poly V-belt on vehicles without air conditioner ⇒ Fig. ⇒ [page 29](#)
- ☐ Position of poly V-belt on vehicles with air conditioner ⇒ Fig. ⇒ [page 29](#)

2 - Pulley for poly V-belt

- ☐ Removing and installing ⇒ [page 31](#)

3 - 23 Nm

4 - Tensioner for poly V-belt

- ☐ Pivot with open-end spanner to slacken poly V-belt
- ☐ Lock tensioner with locking pin -T10060 A- or with an angled Allen key

5 - 23 Nm

6 - Splash plate

7 - 23 Nm

8 - Bracket for ancillaries

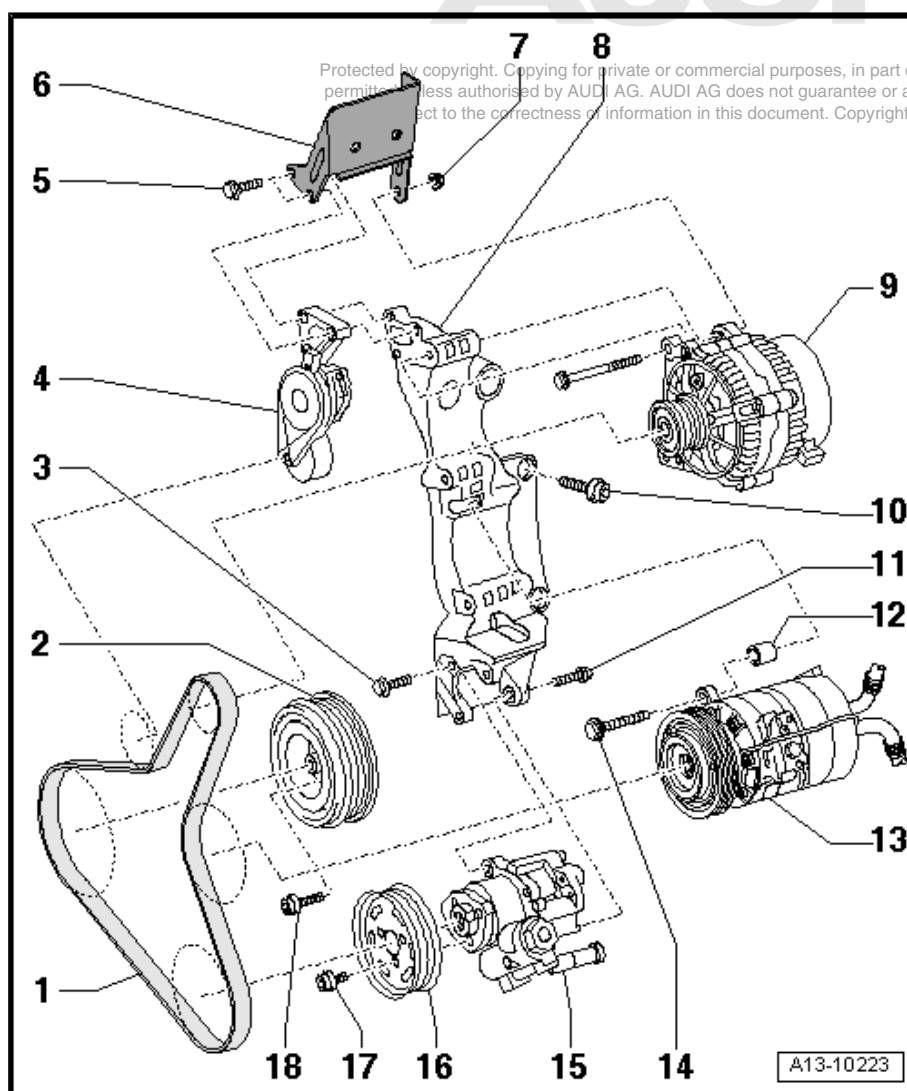
- ☐ Removing and installing ⇒ [page 32](#)

9 - Alternator

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

10 - 45 Nm

- ☐ Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue



- ❑ Observe the tightening sequence ⇒ [page 32](#)

11 - 23 Nm

12 - Spacer bush

13 - Air conditioner compressor

- ❑ Removing and installing ⇒ Rep. Gr. 87

14 - 45 Nm

15 - Power steering pump

- ❑ Removing and installing ⇒ Rep. Gr. 48

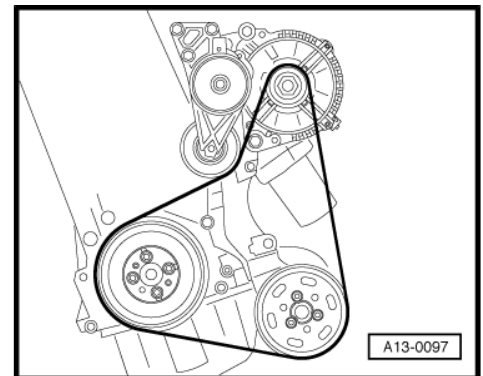
16 - Pulley for power steering pump

17 - 23 Nm

18 - Special bolt

- ❑ Bolt strength 8.8: Renew bolt and tighten to 10 Nm + 90° (1/4 turn) further
- ❑ If bolt strength is 10.9, tighten to 40 Nm

Poly V-belt on vehicles without air conditioner

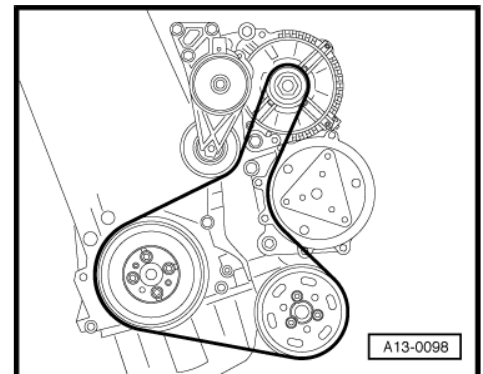


Poly V-belt on vehicles with air conditioner



Note

Engines with an air conditioner compressor are fitted with a double-sided poly V-belt.

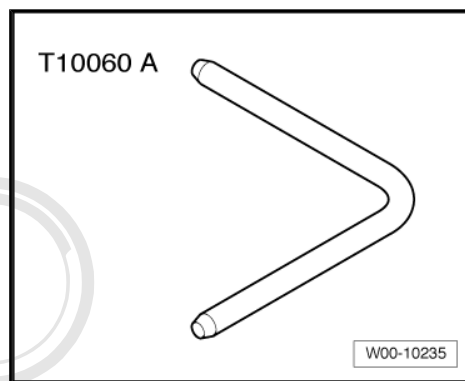


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1.2 Removing and installing poly V-belt

Special tools and workshop equipment required

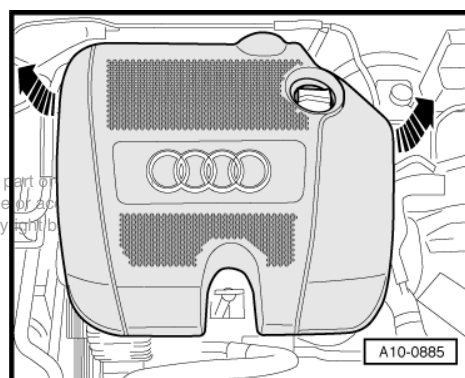
◆ Locking pin -T10060 A-



Removing

- Take off engine cover panel -arrows-.

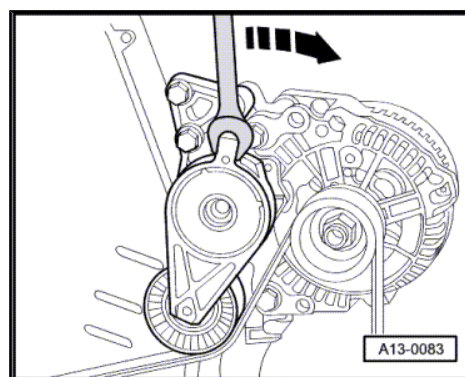
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Note

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

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



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

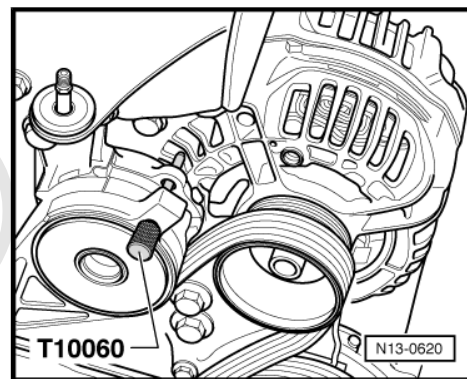
Installing

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



Note

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



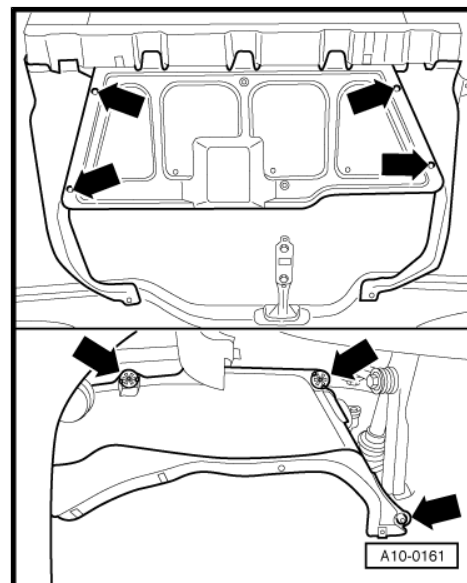
- Fit poly V-belt onto crankshaft pulley, power steering pump pulley and air conditioner compressor pulley.
- Then position poly V-belt on alternator pulley and release tensioner.
- Check poly V-belt for proper seating.
- Routing of poly V-belt: on vehicles without air conditioning system ⇒ [page 29](#) ; on vehicles with air conditioning system ⇒ [page 29](#) .
- Start engine and check that belt runs properly.

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1.3 Removing and installing crankshaft pulley

Removing

- Poly V-belt must be removed ⇒ [page 29](#) .
- Remove noise insulation panels (centre and right) -arrows-.

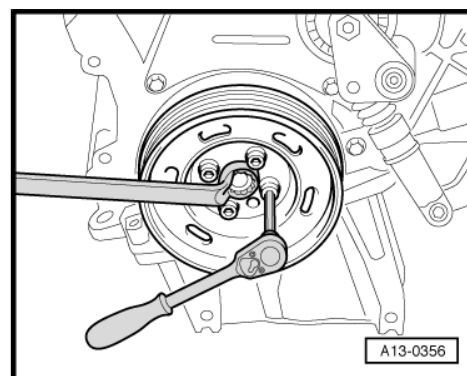


- Unbolt crankshaft pulley.



Note

Use a ring spanner to counterhold at central bolt of crankshaft when removing and installing pulley.



Installing

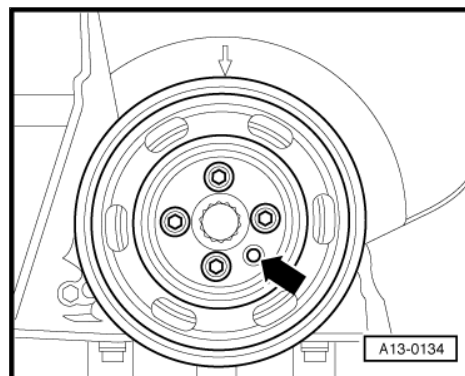
Installation is carried out in the reverse order; note the following:

- Install the crankshaft pulley with genuine bolts only: ⇒ Parts catalogue .
- Assembly is only possible in one position: The hole -arrow- in the crankshaft pulley must fit over the projection on the toothed belt sprocket.

Tightening torque

Component	Nm
Pulley to crankshaft sprocket	
Bolt strength 8.8	10 + 90° 1)2)
Bolt strength 10.9	40

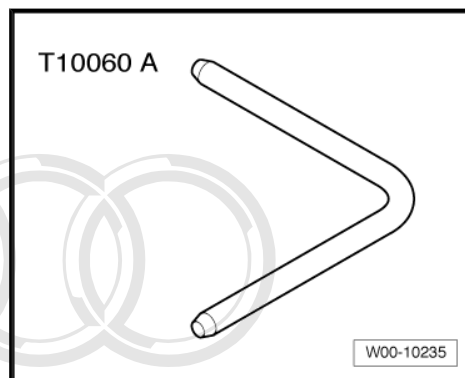
- 1) Renew bolts.
- 2) 90° = one quarter turn.



1.4 Removing and installing bracket for ancillaries

Special tools and workshop equipment required

- ◆ Locking pin -T10060 A-



Removing

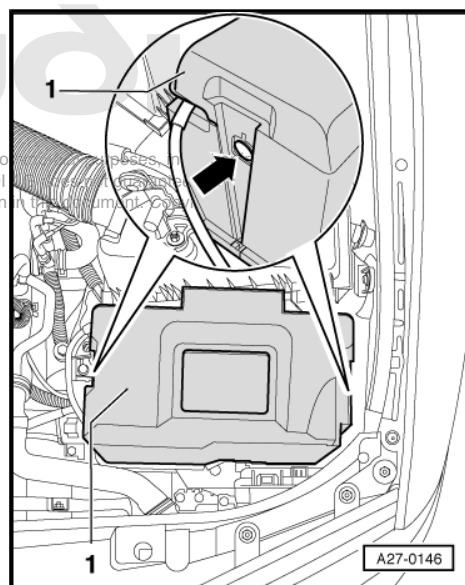
- Switch off ignition.
- Press release tabs -arrow- and remove cover -1- over battery.



Caution

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

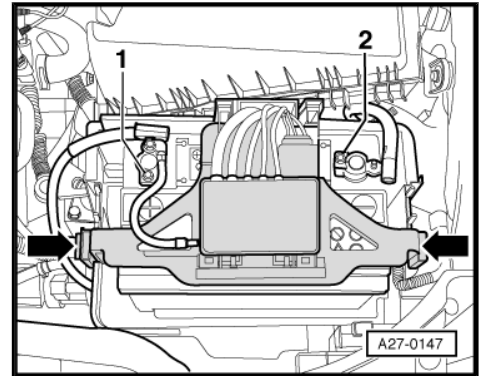
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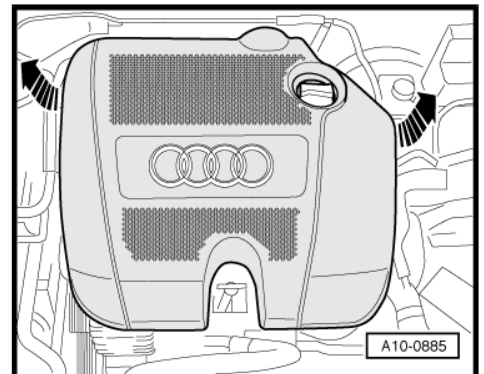
- Loosen nut -2- several turns and disconnect earth clamp from battery terminal.

 Note

Disregard -item 1-.



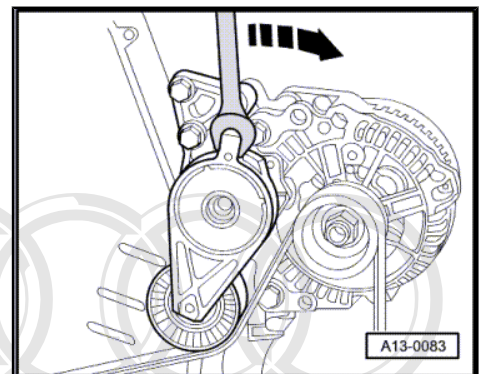
- Take off engine cover panel -arrows-.



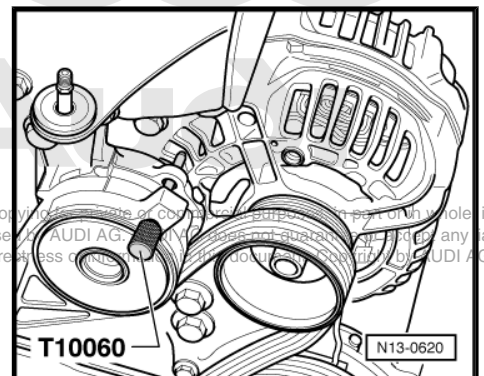
 Note

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

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

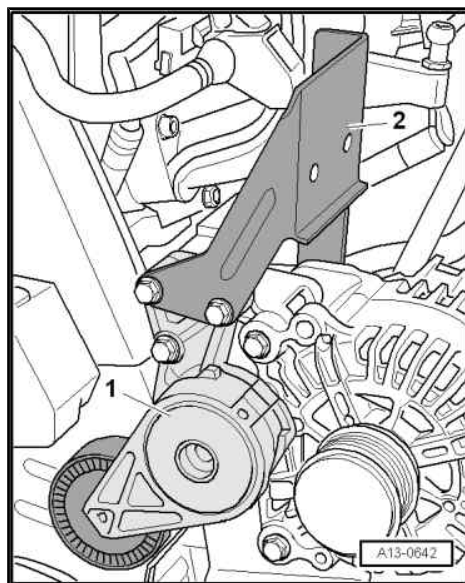


- Lock poly V-belt tensioner using locking pin -T10060 A- .
- Remove poly V-belt.

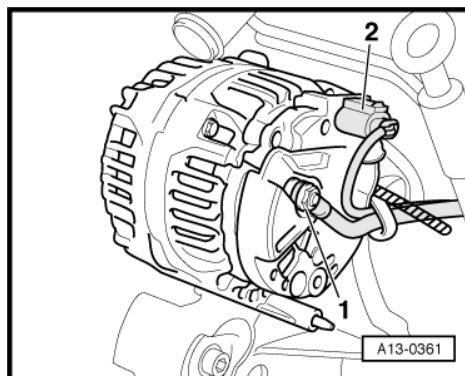


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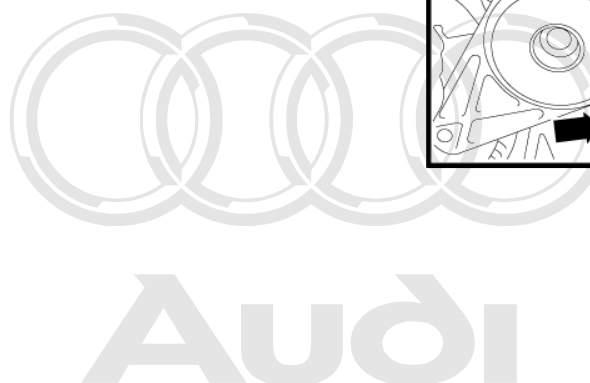
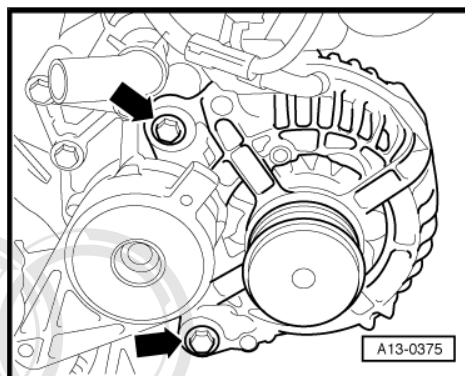
- Remove splash plate -2- and tensioning element -1- for poly V-belt.



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

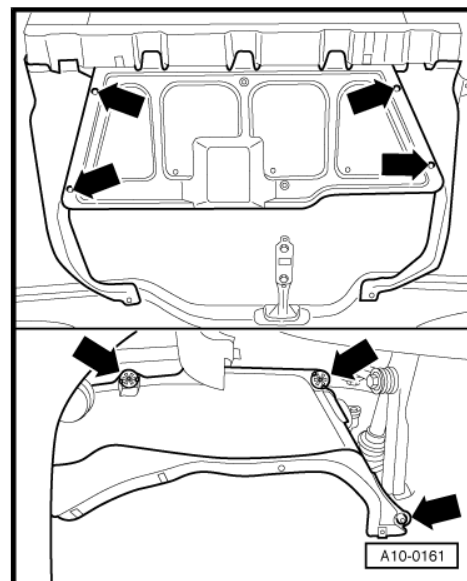


- Unscrew bolts -arrows- and remove alternator.

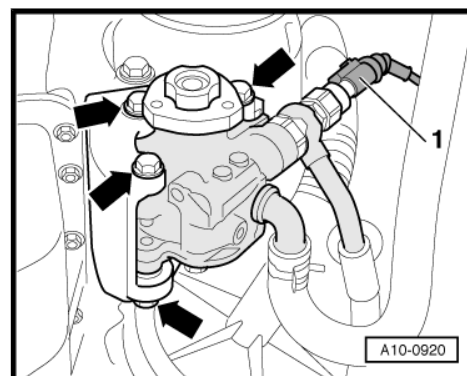


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- Remove noise insulation panels (centre and right) -arrows-.



- Unplug electrical connector -1- at power assisted steering pressure switch -F88- .
- Counterhold power steering pump pulley using a drift and detach pulley.
- Unbolt power steering pump -arrows-. Leave pipes connected.



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



WARNING

The air conditioner refrigerant circuit must not be opened.

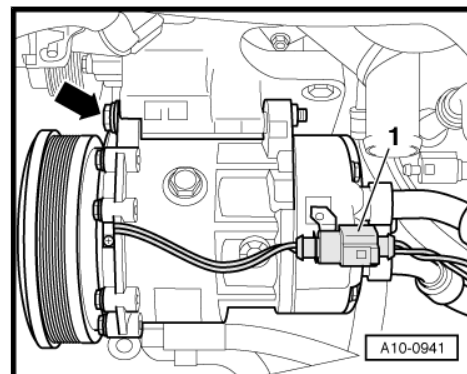
- Unscrew bolts -arrow- for air conditioner compressor.



Note

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

- Tie up air conditioner compressor together with refrigerant hoses to lock carrier (refrigerant hoses remain connected).



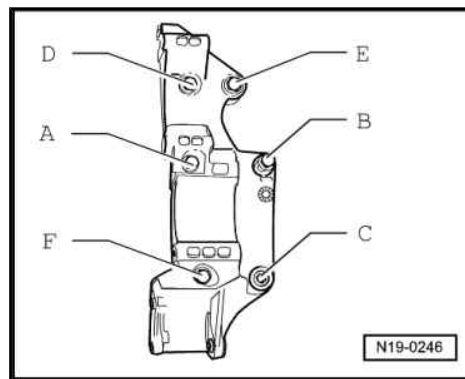
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- Remove bracket for ancillaries -bolts A ... F-.

Installing

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

- Tighten bolts in the sequence -A ... F-.
- Install air conditioner compressor ⇒ Rep. Gr. 87 .
- Install power steering pump ⇒ Rep. Gr. 48 .
- Install alternator ⇒ Rep. Gr. 27 .
- Install poly V-belt ⇒ [page 29](#) .
- Connect battery. Procedures required ⇒ Rep. Gr. 27 .



Tightening torques

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Component	Nm
Bracket for ancillaries to cylinder block	45 ¹⁾
Tensioner for poly V-belt to bracket for ancillaries	23
Splash plate to bracket for ancillaries	23
• ¹⁾ Install using locking fluid; locking fluid ⇒ Parts catalogue .	

1.5 Toothed belt drive - exploded view of components

1 - 10 Nm

- ☐ Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue

2 - Toothed belt cover (centre)

3 - Engine support

- ☐ Removing and installing ⇒ ["1.6 Removing and installing toothed belt", page 39](#)

4 - 45 Nm

- ☐ Observe the tightening sequence ⇒ [page 46](#)

5 - Toothed belt cover (top)

6 - 23 Nm

7 - Washer

8 - Semi-automatic tensioning roller

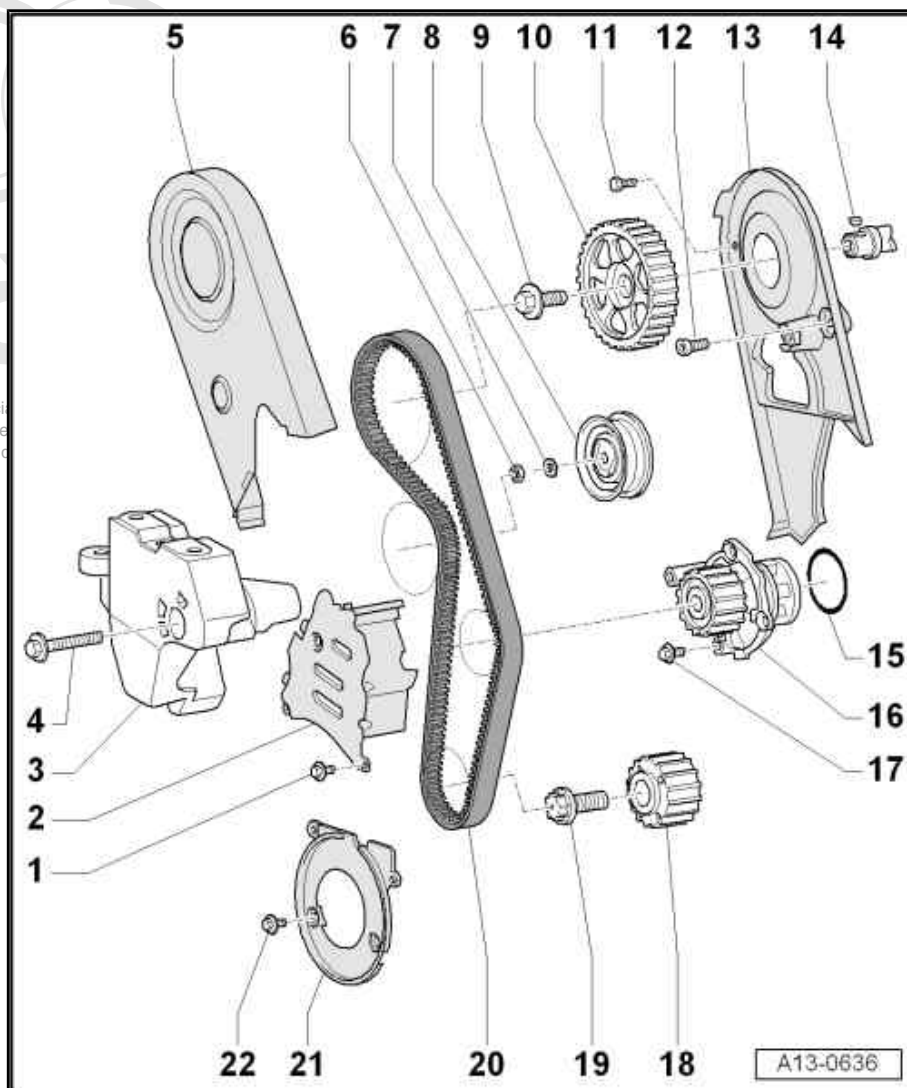
- ☐ Checking ⇒ [page 49](#)

9 - 100 Nm

- ☐ Use counterhold tool -3415- to loosen and tighten ⇒ [page 38](#)

10 - Camshaft sprocket

- ☐ With sender wheel for Hall sender -G40-
- ☐ Removing and installing ⇒ ["1.7 Removing toothed belt from camshaft sprocket", page 46](#)
- ☐ Installation position fixed by Woodruff key ⇒ [Item 14 \(page 37\)](#)



11 - 10 Nm

- ☐ Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue

12 - 23 Nm

- ☐ Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue

13 - Toothed belt cover (rear)

14 - Woodruff key

- ☐ Check for firm attachment

15 - O-ring

- ☐ Renew

16 - Coolant pump

- ☐ Removing and installing ⇒ [page 128](#)

17 - 15 Nm

18 - Crankshaft toothed belt sprocket

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

19 - 90 Nm + 90° (1/4 turn) further

- ☐ Renew

- ☐ Do not lubricate with oil
- ☐ Use counterhold tool -3415- when loosening and tightening
- ☐ Fit counterhold tool -3415- ⇒ [page 38](#)

20 - Toothed belt

- ☐ Before removing, mark direction of rotation with chalk or felt-tipped pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.
- ☐ Check for wear
- ☐ Removing ⇒ [page 39](#)
- ☐ Installing (adjusting valve timing) ⇒ [page 44](#)
- ☐ Detaching from camshaft sprocket ⇒ [page 46](#)

21 - Toothed belt cover (bottom)

- ☐ Unbolt crankshaft pulley to remove

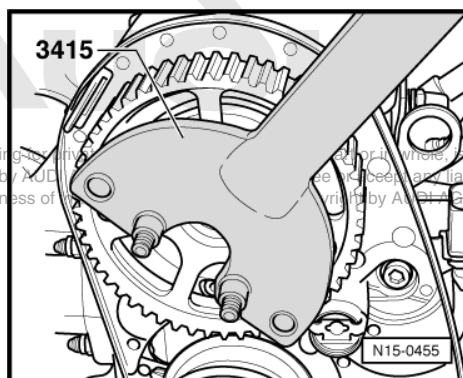
22 - 10 Nm

- ☐ Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue

Loosening camshaft sprocket

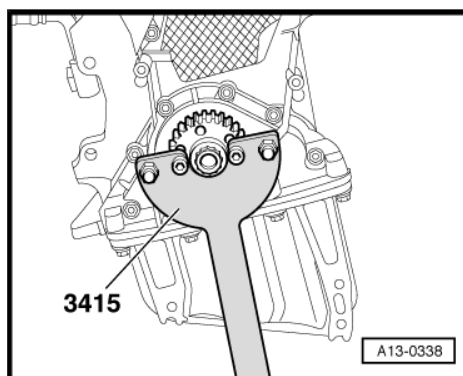
- Use counterhold tool -3415- when loosening and tightening central bolt.

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Removing and installing crankshaft sprocket

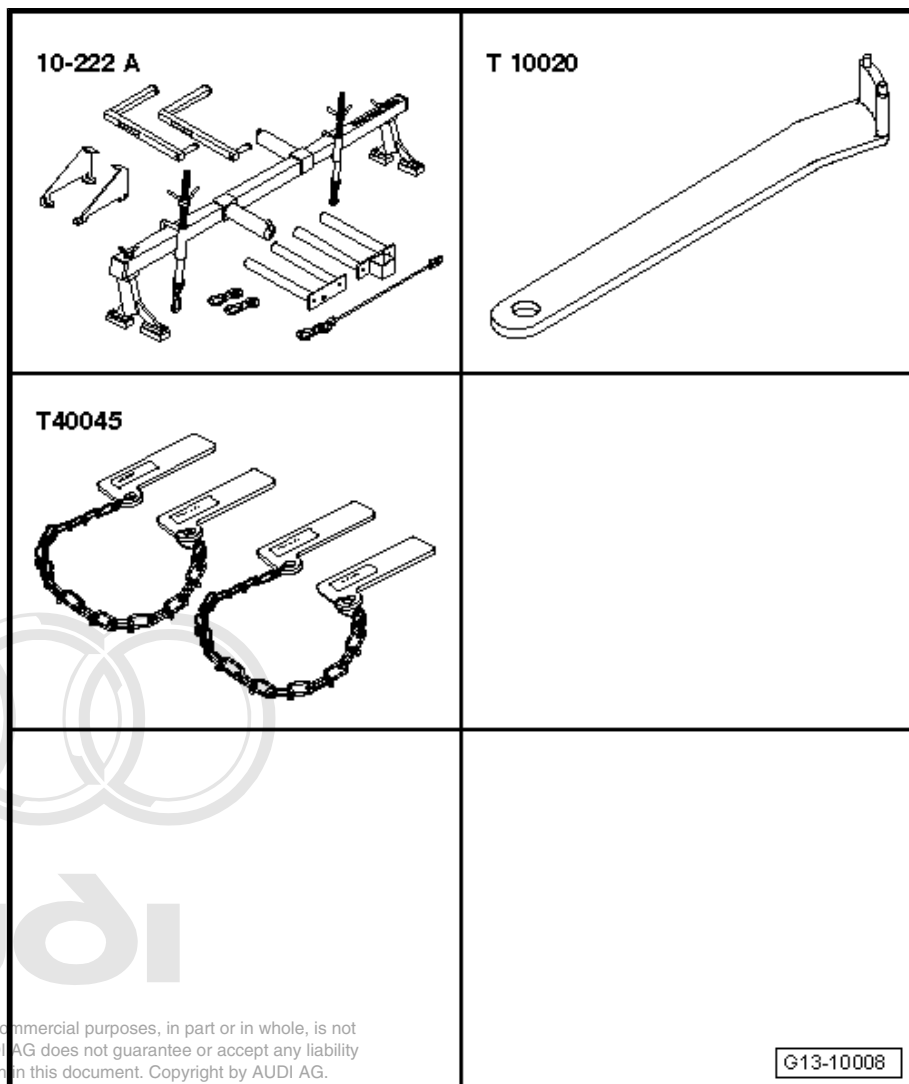
- Use counterhold tool -3415- when loosening and tightening central bolt.



1.6 Removing and installing toothed belt

Special tools and workshop equipment required

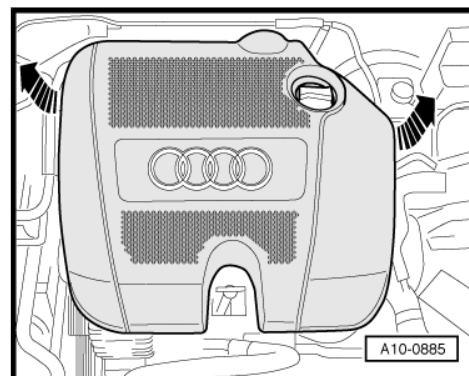
- ◆ Support bracket -10-222 A-
- ◆ 2-hole pin wrench -T10020-
- ◆ Mud wing compensation plate -T40045-



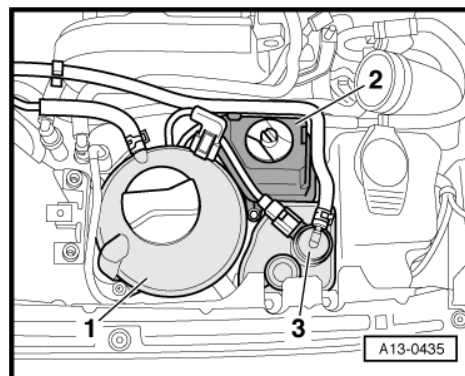
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Removing

- Take off engine cover panel -arrows-.



- Detach coolant expansion tank -1-, power steering reservoir -2- and activated charcoal filter -3-. Hoses remain connected.

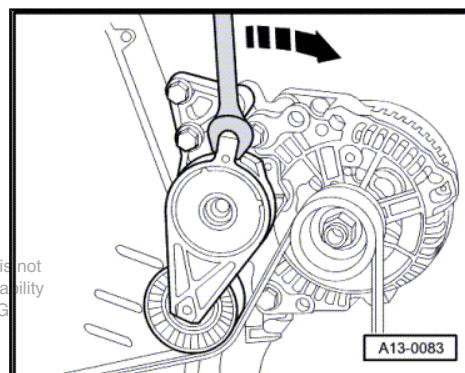


Note

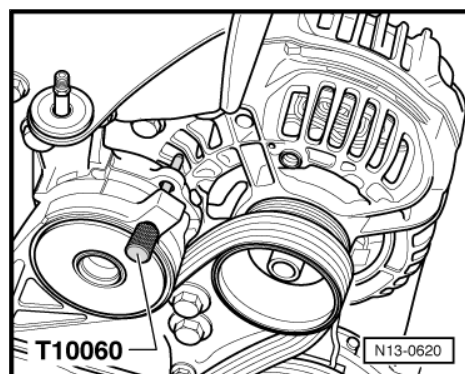
Before removing, mark direction of rotation of poly V-belt with chalk or felt-tipped pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.

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

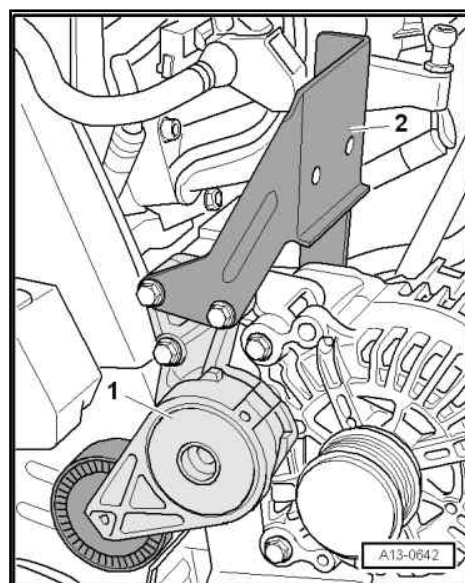
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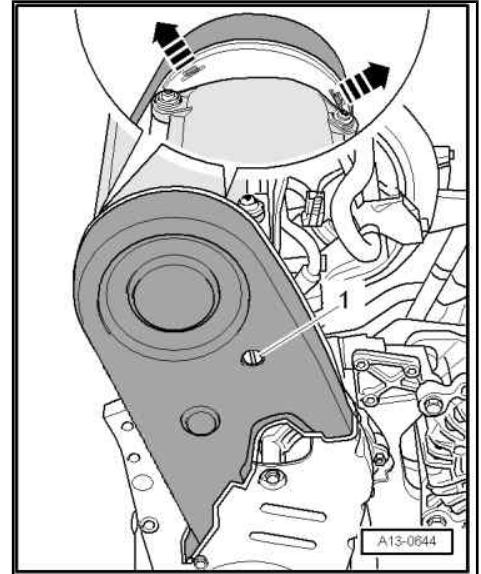
- Lock poly V-belt tensioner using locking pin -T10060 A-.
- Remove poly V-belt.



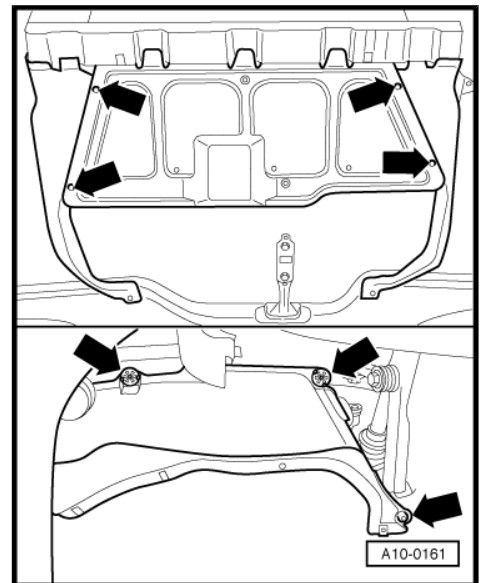
- Remove splash plate -2- and tensioning element -1- for poly V-belt.



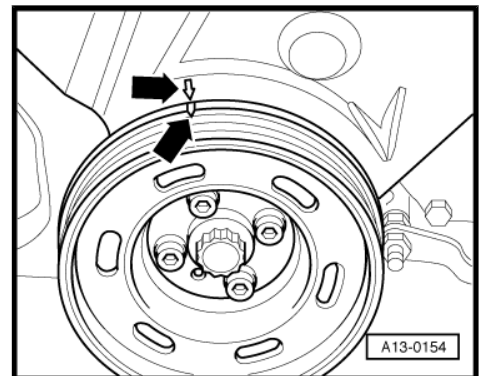
- Turn quick-release fastener -item 1- 90° anti-clockwise.
- Raise retaining tabs -arrows- and detach upper toothed belt cover.



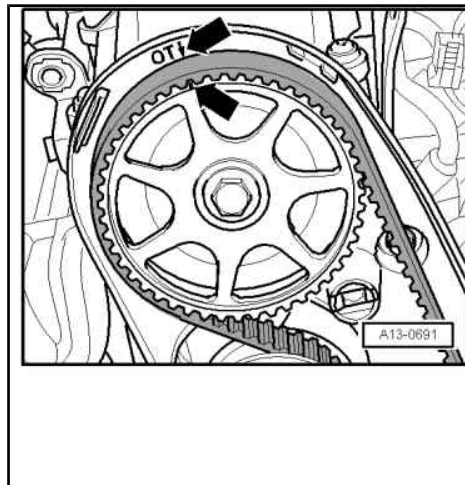
- Remove noise insulation panels (centre and right) -arrows-.



- Turn crankshaft at central bolt on crankshaft sprocket in direction of engine rotation to TDC mark -arrows-.



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

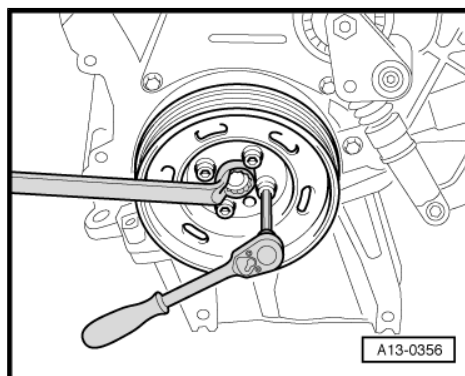


- Unbolt crankshaft pulley.

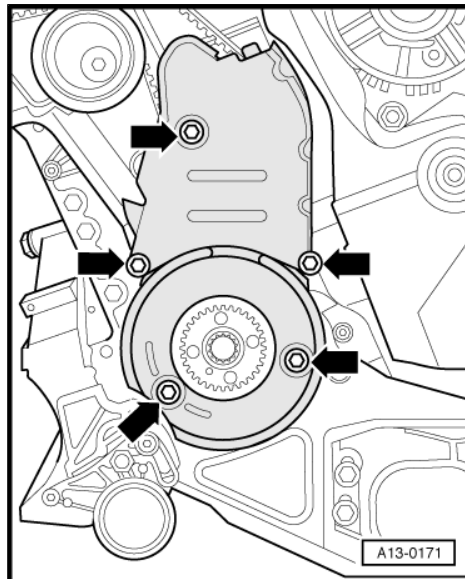


Note

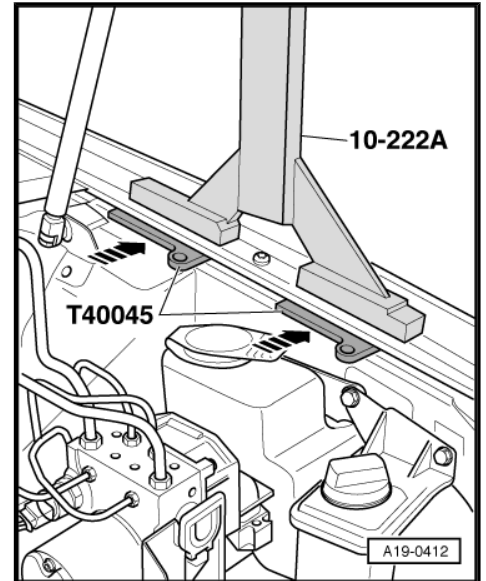
To loosen and tighten the crankshaft pulley, counterhold central bolt with a ring spanner.



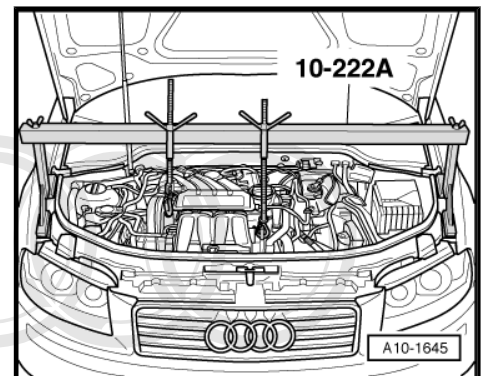
- Unbolt lower and centre toothed belt covers -arrows-.



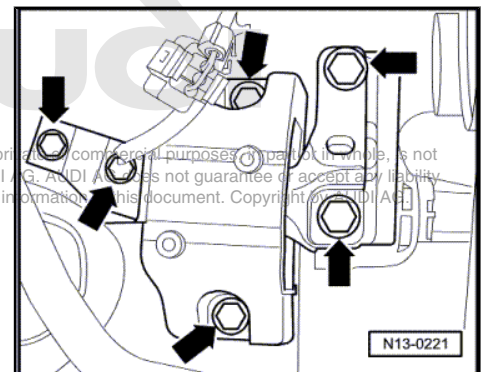
- Remove the rubber sealing strip from the edges of the wing mounting flanges.
- Place compensation plates -T40045- between the wing mounting flange and the body panel underneath, so that the support bracket -10-222 A- does not damage the wing mounting flanges.



- Set up support bracket -10-222 A- on wing panel flanges.
 - The spindles face forwards.
- Detach crankcase breather hose from oil filler neck.
- Attach hooks of spindles to lifting eyes.
- Take up weight of engine evenly with both spindles (but do not raise engine).



- Remove bolts -arrows- and detach connecting bracket, engine support and engine mounting.



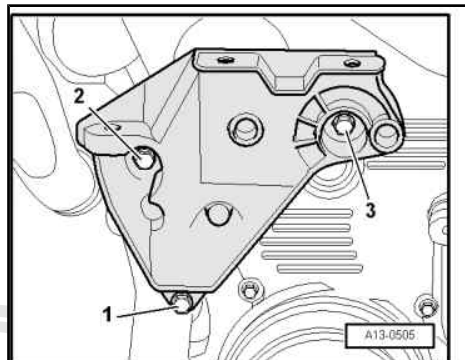
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- Remove bolts -1 ... 3- and detach engine support.



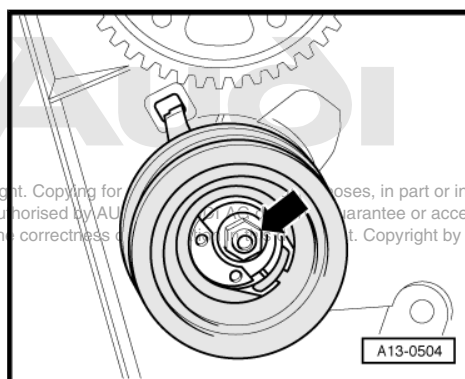
Note

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



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

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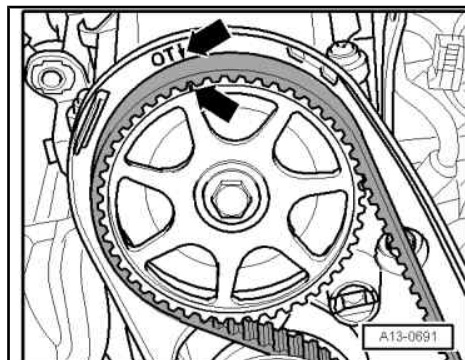
Installing (adjusting valve timing)



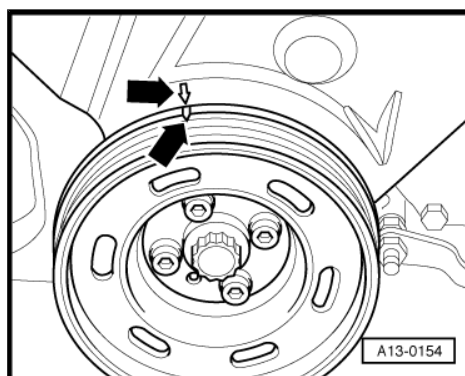
Note

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

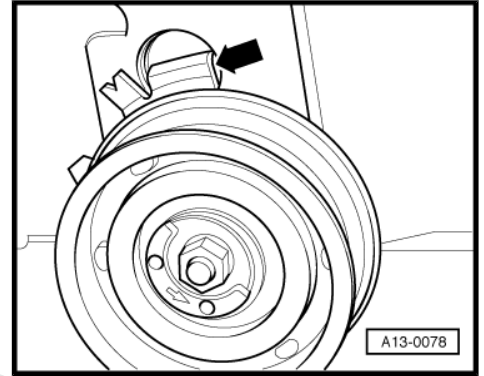
- Align mark on camshaft sprocket with mark on toothed belt cover -arrows-.
- Fit toothed belt onto crankshaft sprocket, noting direction of rotation.
- Install bottom toothed belt cover.



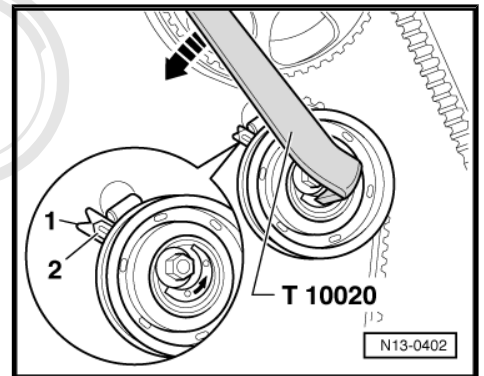
- Secure pulley with bolt, noting fixing arrangement.
- Check again whether the crankshaft is positioned at TDC -arrows-.
- Fit toothed belt in the sequence: coolant pump, tensioning roller, camshaft sprocket.



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



- Turn tensioning roller at eccentric adjuster to stop in -direction of arrow- using 2-hole pin wrench -T10020- .
- Slacken tensioning roller until pointer -2- is approx. 10 mm below the notch -1-.
- Again, turn tensioning roller at eccentric adjuster to stop in -direction of arrow-.
- Slacken tensioning roller again until pointer -2- is approx. 10 mm below the notch -1-.
- Then tension tensioning roller until pointer -2- and notch -1- are back in line.
- Tighten securing nut.



- Turn crankshaft at central bolt on crankshaft sprocket two revolutions in direction of engine rotation and check whether camshaft and crankshaft markings align at TDC with their respective reference points.
- Check again whether toothed belt is tensioned properly, repeat adjustment procedure if necessary.
- Install toothed belt cover.

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

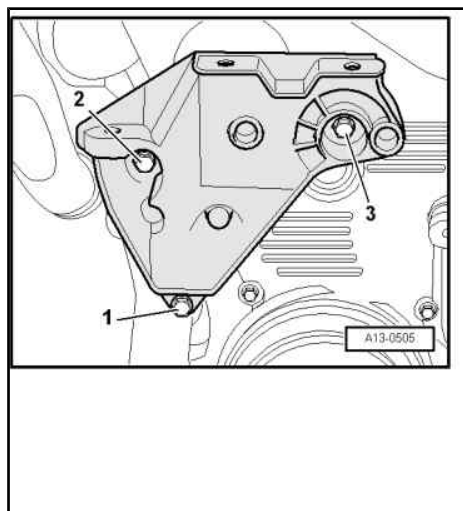
Secure the engine support as follows:

- Initially screw bolts -1 ... 3- in finger-tight.
- Then tighten bolts -1 ... 3-.
- Install engine mounting.
- Install crankshaft pulley ⇒ [page 32](#) .
- Adjust engine mountings ⇒ [page 24](#) .
- Install poly V-belt ⇒ [page 29](#) .
- Secure coolant expansion tank, power steering reservoir and activated charcoal filter.

Tightening torques

Component	Nm
Toothed belt tensioning roller to cylinder head	23
Toothed belt cover (bottom) to cylinder block	10 ¹⁾
Toothed belt cover (centre) to cylinder block	10 ¹⁾
Engine support to cylinder block	45
Engine mounting to body	40 + 90° ^{2) 3)}
Connecting bracket to body/engine mounting	25
Tensioner for poly V-belt to bracket for ancillaries	23
Splash plate to bracket for ancillaries	23
• 1) Install using locking fluid; locking fluid ⇒ Parts catalogue . • 2) Renew bolts. • 3) 90° = one quarter turn.	

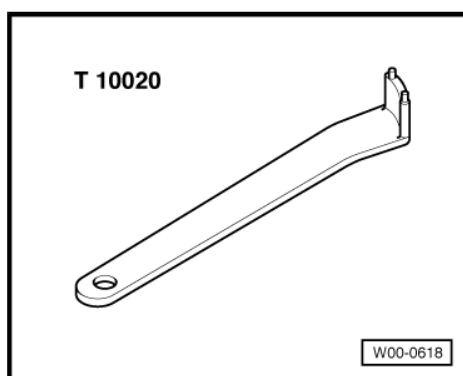
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1.7 Removing toothed belt from camshaft sprocket

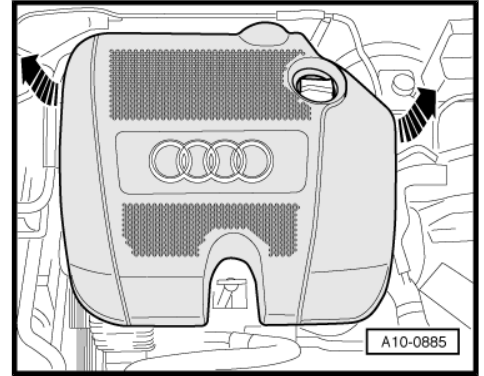
Special tools and workshop equipment required

- ◆ 2-hole pin wrench -T10020-

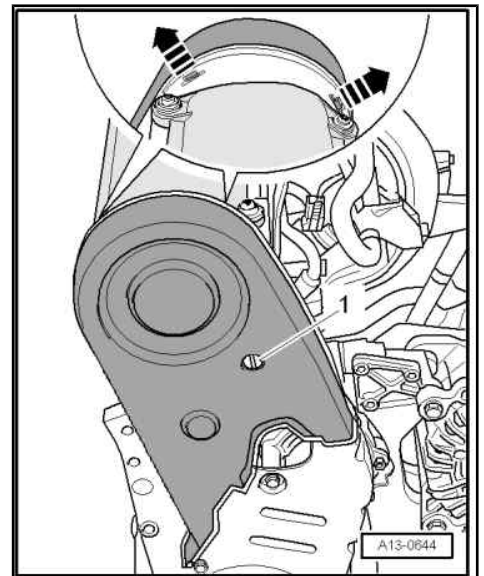


Procedure

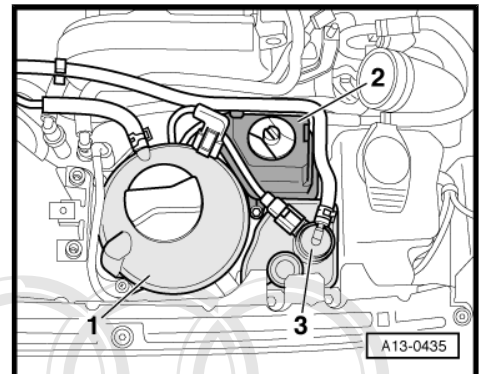
- Take off engine cover panel -arrows-.



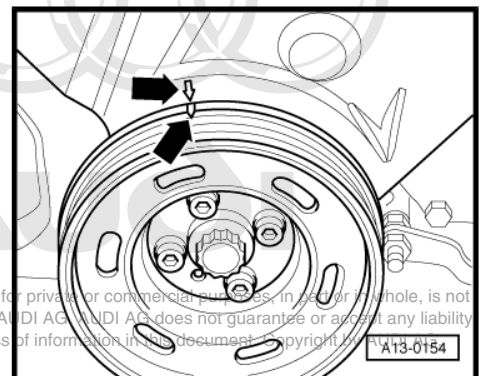
- Turn quick-release fastener -item 1- 90° anti-clockwise.
- Raise retaining tabs -arrows- and detach upper toothed belt cover.



- Detach coolant expansion tank -1-, power steering reservoir -2- and activated charcoal filter -3-. Hoses remain connected.

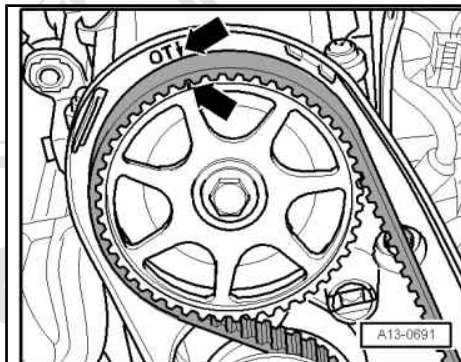


- Turn crankshaft at central bolt on crankshaft sprocket in direction of engine rotation to TDC mark -arrows-.



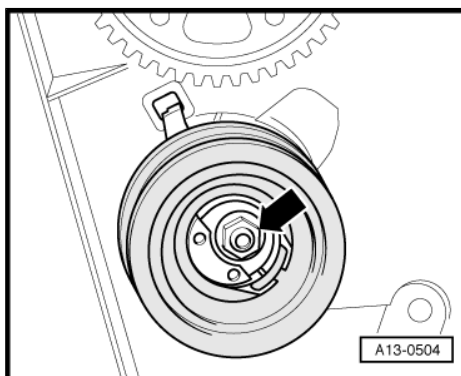
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- At the same time the marking on front of the camshaft sprocket must align with the marking on the rear toothed belt cover -arrows-.
- Rotate crankshaft one turn further if necessary.



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



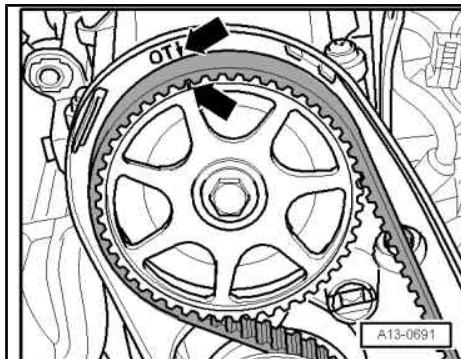
Installing (adjusting valve timing)



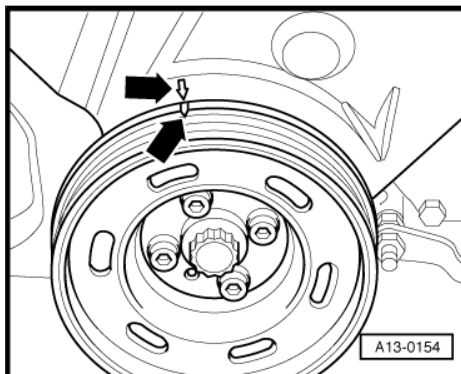
Note

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

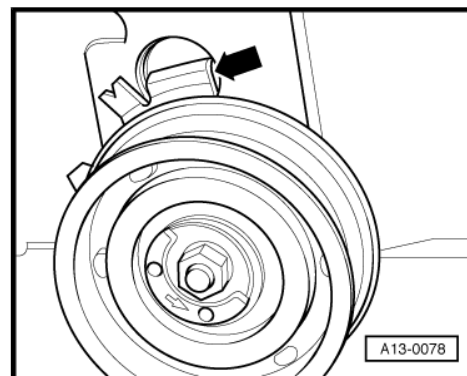
- Align mark on camshaft sprocket with mark on toothed belt cover -arrows-.



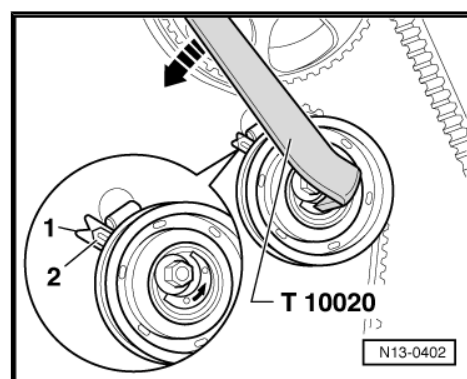
- Check again whether the crankshaft is positioned at TDC -arrows-.
- Fit toothed belt onto coolant pump, tensioning roller and camshaft sprocket.



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



- Turn tensioning roller at eccentric adjuster to stop in -direction of arrow- using 2-hole pin wrench -T10020- .
- Slacken tensioning roller until pointer -2- is approx. 10 mm below the notch -1-.
- Again, turn tensioning roller at eccentric adjuster to stop in -direction of arrow-.
- Slacken tensioning roller again until pointer -2- is approx. 10 mm below the notch -1-.
- Then tension tensioning roller until pointer -2- and notch -1- are back in line.
- Tighten securing nut
- Turn crankshaft at central bolt on crankshaft sprocket two revolutions in direction of engine rotation and check whether camshaft and crankshaft markings align at TDC with their respective reference points.
- Check again whether toothed belt is tensioned properly, repeat adjustment procedure if necessary.
- Fit toothed belt cover (top section).



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

Tightening torque

Component	Nm
Toothed belt tensioning roller to cylinder head	23

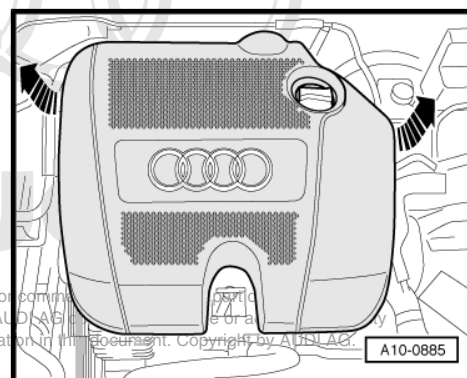
1.8 Checking semi-automatic tensioning roller for toothed belt

Test requirement

- Toothed belt fitted and tensioned.

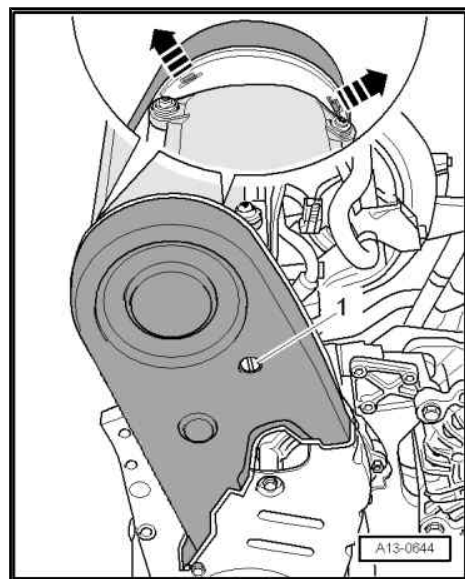
Test sequence

- Take off engine cover panel -arrows-.

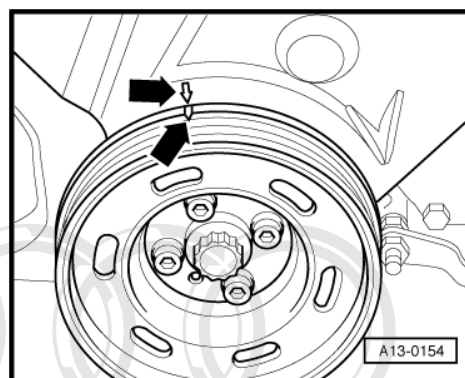


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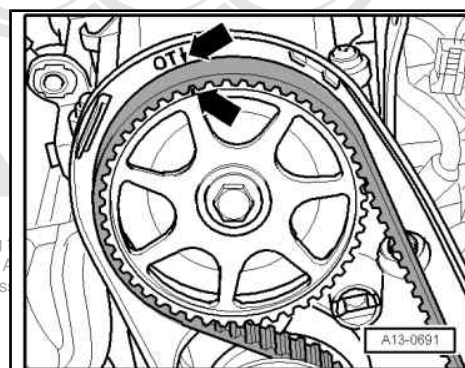
- Turn quick-release fastener -item 1- 90° anti-clockwise.
- Raise retaining tabs -arrows- and detach upper toothed belt cover.



- Turn crankshaft at central bolt on crankshaft sprocket in direction of engine rotation to TDC mark -arrows-.



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



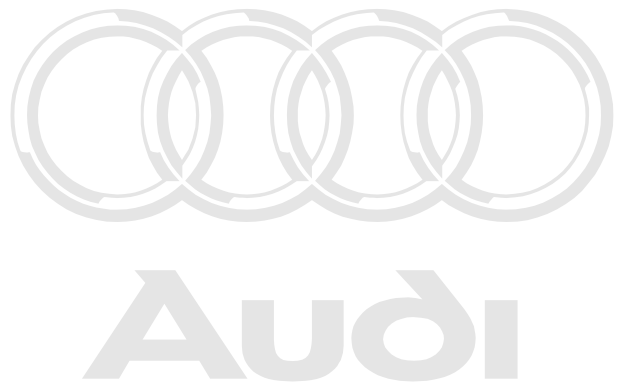
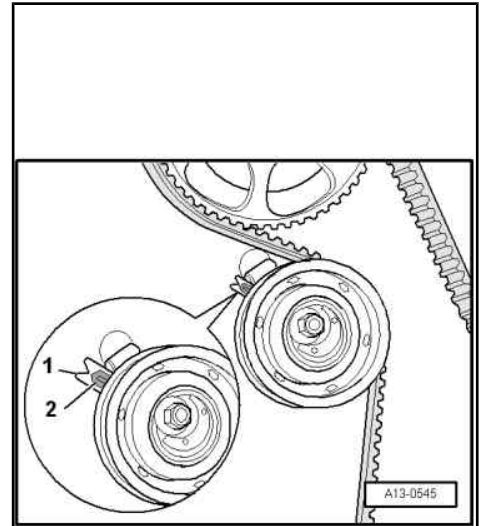
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- Push in toothed belt with firm thumb pressure.
- The pointer -2- should move to side.
- Release thumb pressure on toothed belt.
- Tensioner should return to initial position. (Pointer back in line with notch -1-).



Note

Use a mirror to check.



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2 Removing and installing sealing flanges and pressure plate/drive plate

2.1 Sealing flanges and pressure plate/drive plate - exploded view of components



Note

Servicing clutch ⇒ Rep. Gr. 30

1 - 15 Nm

2 - Oil seal

- ☐ Renewing ⇒ [page 54](#)
- ☐ Do not lubricate with oil

3 - Sealing flange (front)

- ☐ Should be positioned on dowel pins
- ☐ Removing and installing ⇒ [page 56](#)

4 - Stud, 10 Nm

- ☐ Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue

5 - Cylinder block

6 - Seal

- ☐ Renew

7 - Screw plug, 100 Nm

8 - Securing bolt for pressure plate/drive plate

- ☐ Renew
- ☐ Tightening torque: vehicles with manual gearbox ⇒ [page 61](#) ; vehicles with automatic gearbox ⇒ [page 62](#)

9 - Intermediate piece

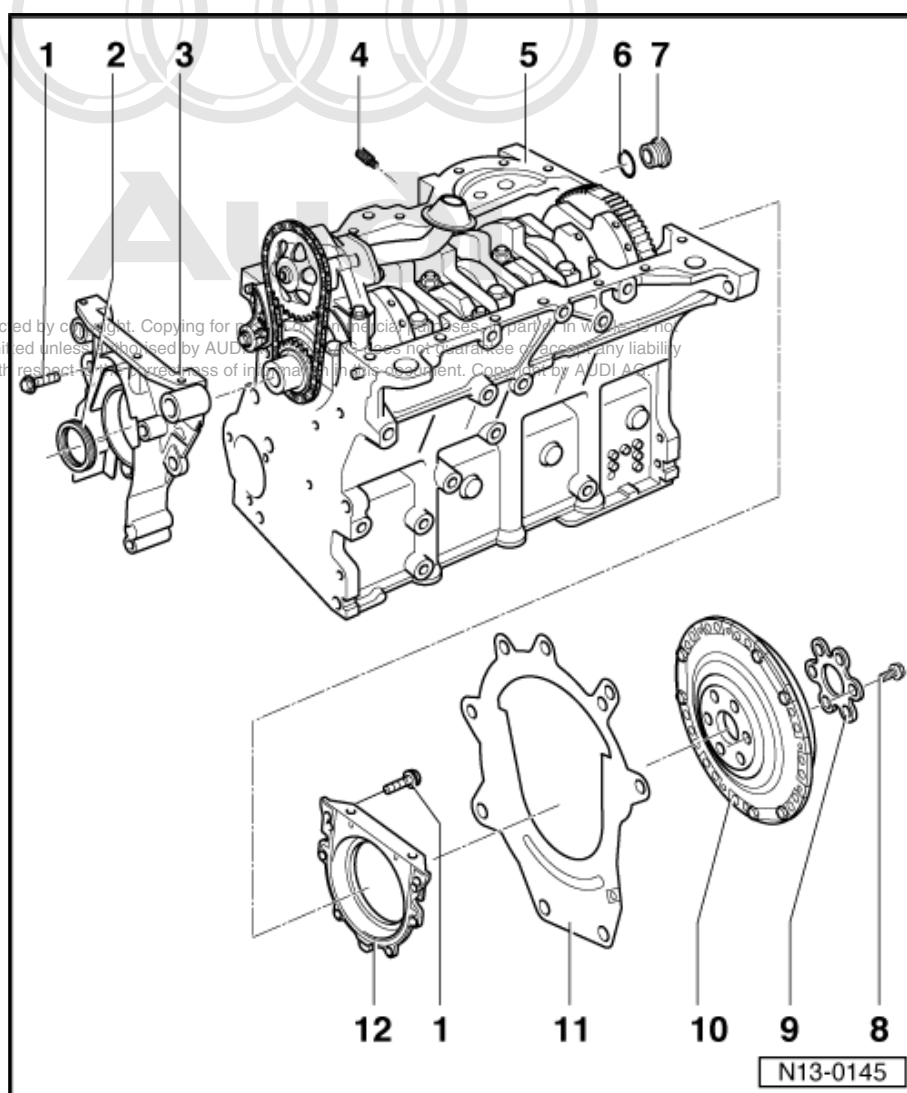
- ☐ Installation position ⇒ [page 53](#)

10 - Pressure plate/drive plate

- ☐ Removing and installing pressure plate ⇒ [page 60](#)
- ☐ Removing and installing drive plate ⇒ [page 61](#)
- ☐ Can only be installed in one position (holes are off-set)

11 - Intermediate plate

- ☐ Must be positioned on dowel sleeves
- ☐ Do not damage/bend when assembling
- ☐ Is fitted on sealing flange ⇒ [page 53](#)

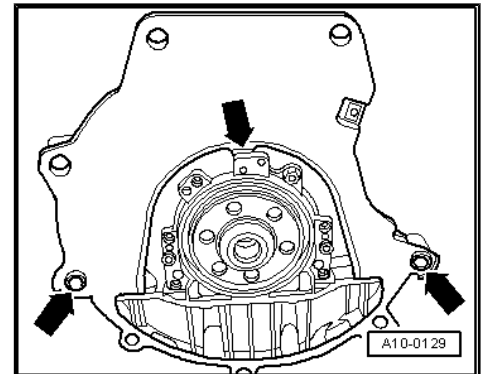


12 - Rear sealing flange

- ☐ With oil seal
- ☐ Removing and installing ⇒ [page 58](#)
- ☐ Do not lubricate with oil

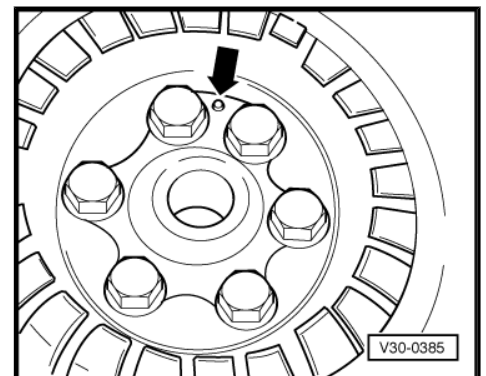
Installing intermediate plate

- Fit intermediate plate to sealing flange and push onto dowel sleeves -arrows-.



Installation position of intermediate piece

- The lug -arrow- points away from pressure plate.

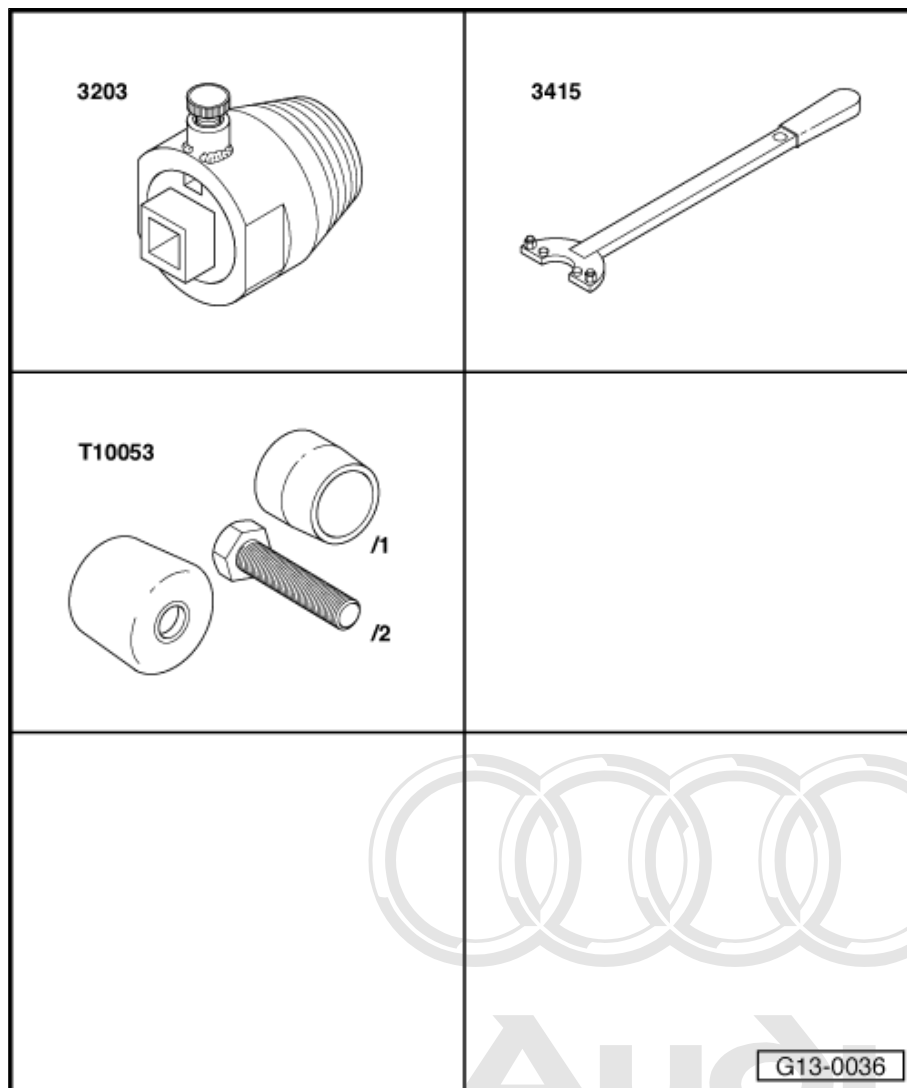


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2.2 Renewing crankshaft oil seal (pulley end)

Special tools and workshop equipment required

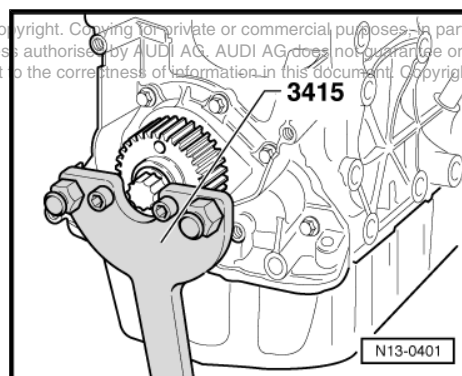
- ◆ Oil seal extractor -3203-
- ◆ Counterhold tool -3415-
- ◆ Assembly tool -T10053-



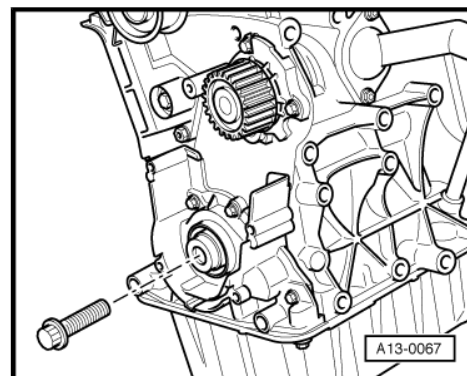
Procedure

- Engine in vehicle.
- Remove toothed belt ➔ [page 39](#) .
- Remove crankshaft sprocket; use counterhold tool -3415- to lock sprocket in place.

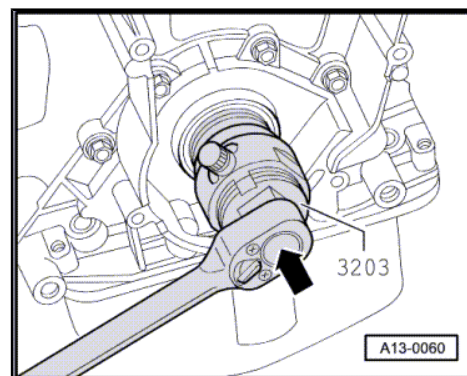
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- Before fitting oil seal extractor, fully screw in centre bolt for sprocket into crankshaft.



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



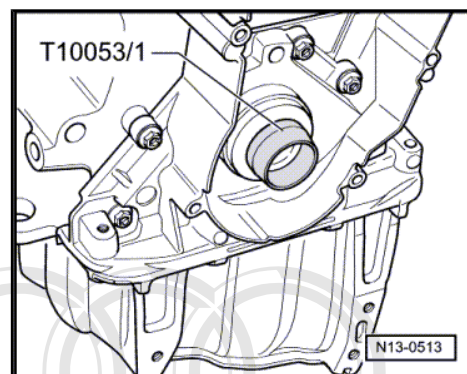
- Clean running surface and sealing surface.



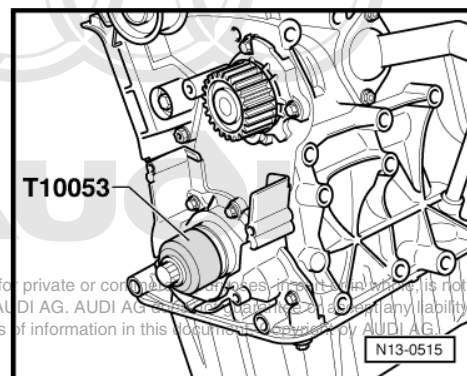
Note

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

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



- Press oil seal on as far as the stop using assembly tool -T10053- and bolt -T10053/2-.



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

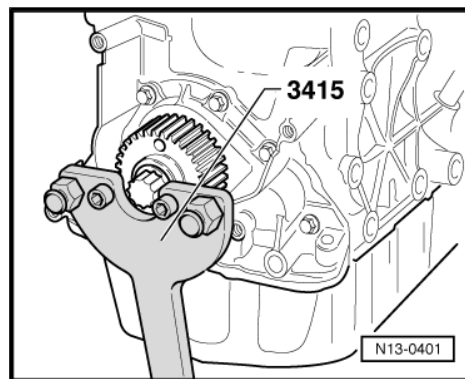


Note

- ◆ *Contact surface between toothed belt sprocket and crankshaft must be free of oil.*
- ◆ *Do not lubricate bolt for crankshaft sprocket.*
- Fit toothed belt (adjust valve timing) ⇒ [page 44](#) .
- Install poly V-belt ⇒ [page 29](#) .

Tightening torque

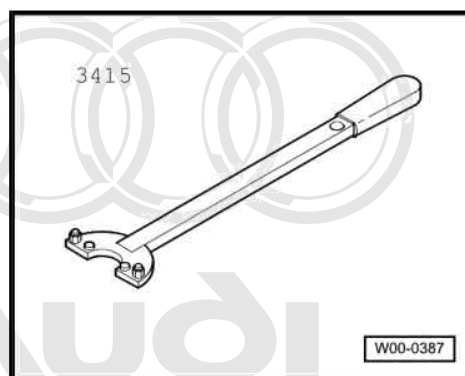
Component	Nm
Toothed belt sprocket to crankshaft	90 + 90° 1) 2)
• 1) Renew bolt. • 2) 90° = one quarter turn.	



2.3 Removing and installing sealing flange (front)

Special tools and workshop equipment required

- ◆ Counterhold tool -3415-

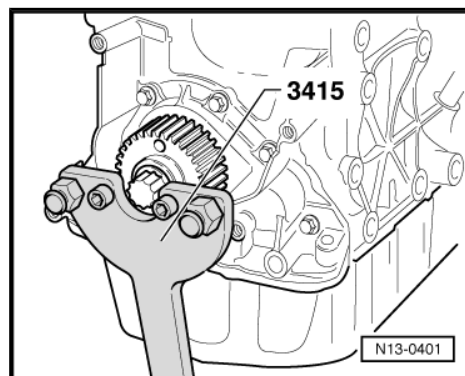


- ◆ Electric drill with plastic brush attachment
- ◆ Safety goggles
- ◆ Sealant ⇒ Parts catalogue

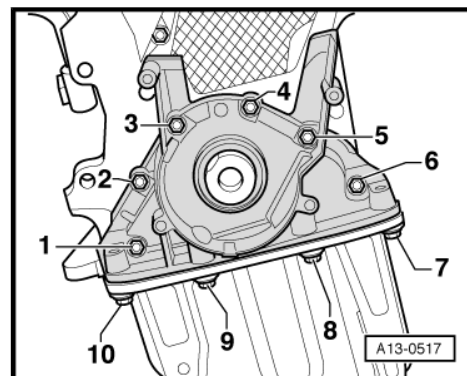
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Removing

- Engine in vehicle.
- Remove toothed belt ⇒ [page 39](#) .
- Remove crankshaft sprocket; use counterhold tool -3415- to lock sprocket in place.



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



Installing



Note

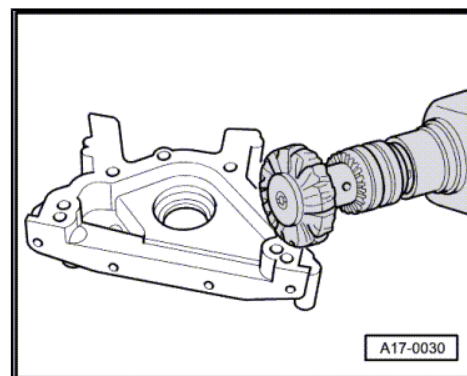
Place a cloth over the exposed section of the sump.

- Carefully remove sealant residue on cylinder block and sump.
- Remove sealant residue from sealing flange with rotating plastic brush or similar.

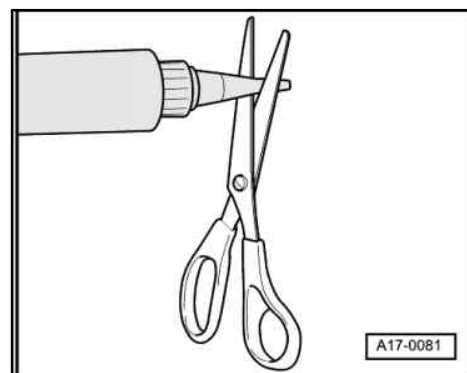


WARNING

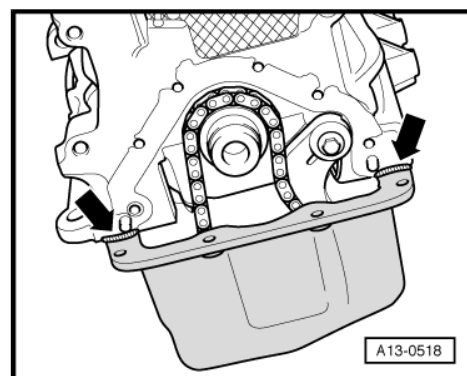
Wear safety goggles.



- Clean sealing surfaces; they must be free of oil and grease.
- Cut off tube nozzle at front marking (nozzle approx. 3 mm Ø).



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



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- Apply the bead of sealant 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 specified, otherwise excess sealant can enter the sump and obstruct the strainer in the oil intake pipe.
- ◆ The sealing flange must be installed within 5 minutes after applying sealant.

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



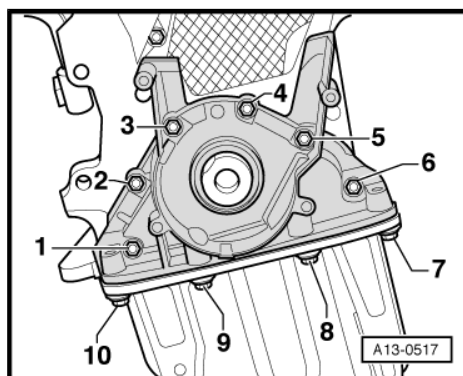
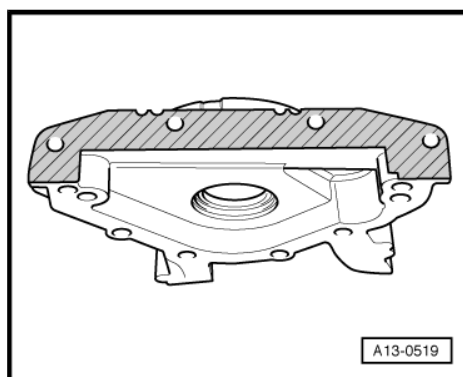
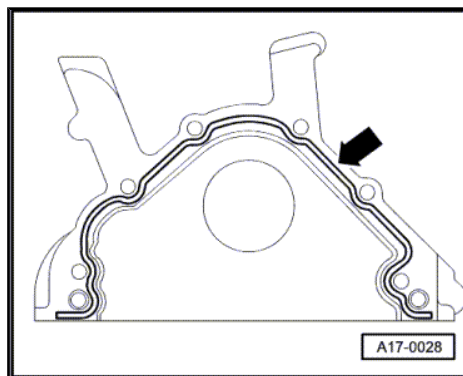
Note

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

- First tighten bolts in the sequence -1 ... 6- as shown on illustration.
- Then tighten bolts in the sequence -7 ... 10- as shown on illustration.
- Install crankshaft oil seal (pulley end) ➔ [page 54](#) .
- Fit toothed belt (adjust valve timing) ➔ [page 44](#) .

Tightening torque

Component	Nm
Sealing flange to cylinder block	15



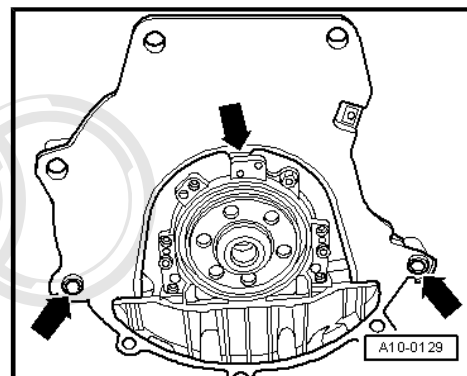
2.4 Removing and installing sealing flange (rear)

Special tools and workshop equipment required

- ◆ Electric drill with plastic brush attachment
- ◆ Safety goggles
- ◆ Sealant ➔ Parts catalogue

Removing

- Gearbox removed.
- Remove pressure plate on vehicles with manual gearbox
⇒ [page 60](#) ; remove drive plate on vehicles with automatic
gearbox ⇒ [page 61](#) .
- Detach intermediate plate at sealing flange and dowel sleeves
-arrows-.



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

Installing

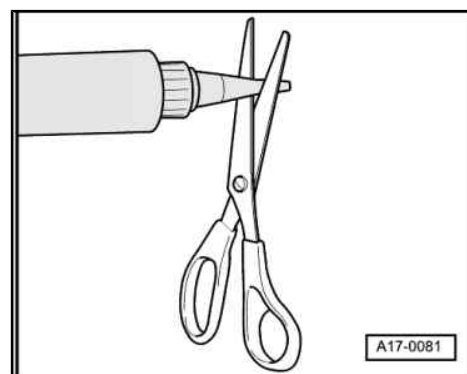
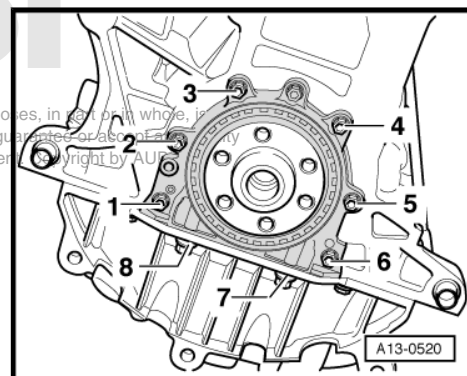
Installation is carried out in the reverse order, note the following:



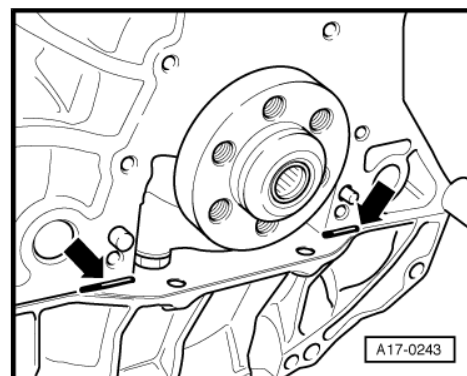
Note

Place a cloth over the exposed section of the sump.

- Carefully remove sealant residue from sump and bottom of sealing flange.
- Clean sealing surfaces; they must be free of oil and grease.
- Cut off tube nozzle at front marking (nozzle approx. 3 mm Ø).



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



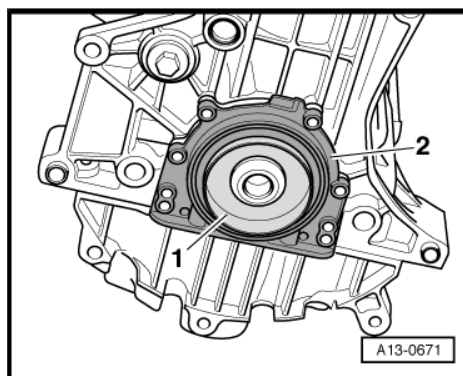
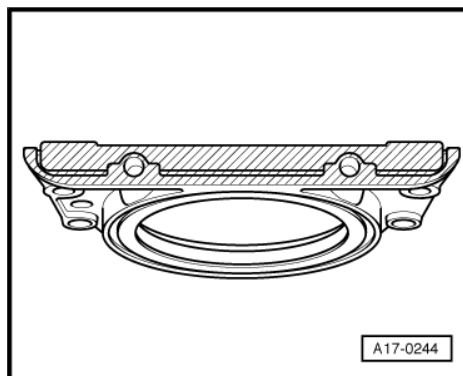
- Coat the lower sealing surface on the sealing flange lightly with sealant -hatched area-.



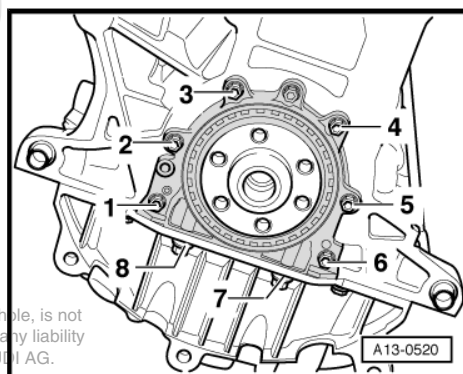
Note

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

- Carefully push sealing flange -2- together with guide sleeve -1- (fitted on replacement part) onto crankshaft when installing.
- Carefully push sealing flange onto dowel pins on engine block.



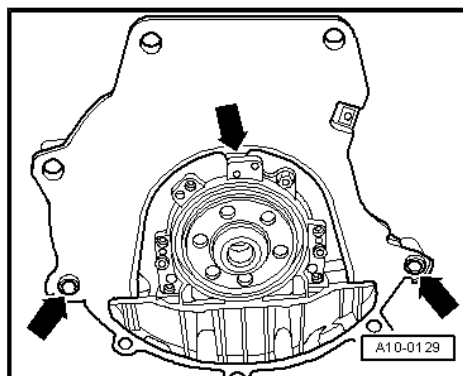
- First tighten bolts in the sequence -1 ... 6- as shown on illustration.
- Then tighten bolts -7- and -8-.
-



- Fit intermediate plate to sealing flange and push onto dowel sleeves -arrows-.
- Install pressure plate on vehicles with manual gearbox ⇒ [page 60](#) ; install drive plate on vehicles with automatic gearbox ⇒ [page 61](#) .

Tightening torque

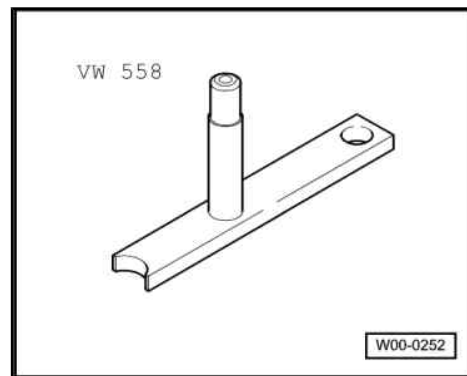
Component	Nm
Sealing flange to cylinder block	15



2.5 Removing and installing pressure plate

Special tools and workshop equipment required

◆ Counterhold for clutch -VW 558-



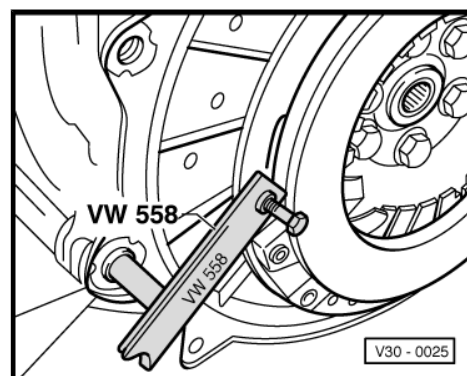
Removing

- Gearbox removed.
- Remove flywheel ⇒ Rep. Gr. 30 .
- Fit counterhold tool for clutch -VW 558- to pressure plate when slackening bolts.
- Remove pressure plate.

Installing

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

- Use new bolts for securing.
- The pressure plate can only be installed in one position. Holes are off-set.
- Fit counterhold tool for clutch -VW 558- to pressure plate when tightening bolts.
- Install flywheel ⇒ Rep. Gr. 30 .



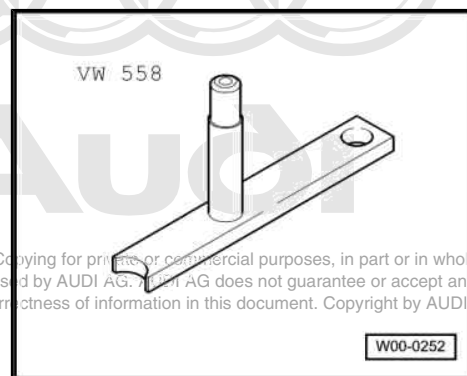
Tightening torque

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

2.6 Removing and installing drive plate

Special tools and workshop equipment required

◆ Counterhold for clutch -VW 558-



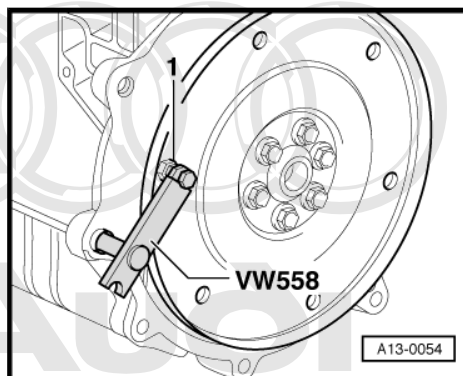
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◆ M8×45 hexagon bolt and two M10 hexagon nuts

◆ Caliper gauge or depth gauge

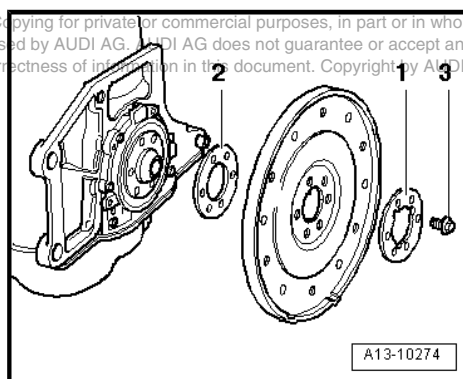
Removing

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



Installing

- Install drive plate with shim -2- and washer -1-.
- The pressure plate can only be installed in one position. Holes are off-set.
- Fit at least 3 old securing bolts and tighten to 30 Nm.

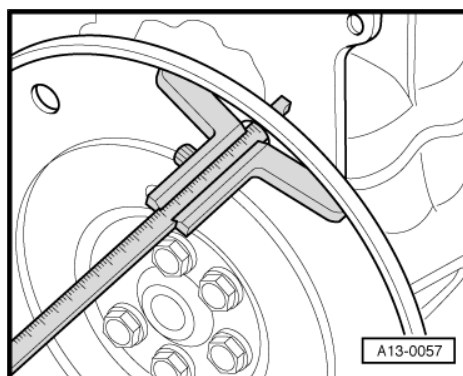


- Measure depth at three points and calculate average value.
- Specification: 19.5 ... 21.1 mm.



Note

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



If specification is exceeded:

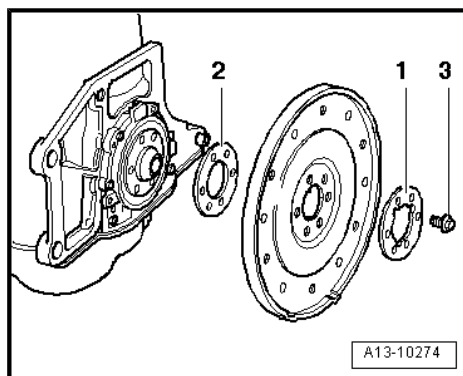
- Remove drive plate for a second time.
- Install drive plate without shim -2-. Re-tighten bolts in diagonal sequence to 30 Nm.
- Repeat measurement.

If reading matches specification:

- Use new bolts for securing.

Tightening torque

Component	Nm
Drive plate to crankshaft	
Bolt length 17 mm	60 + 90° 1) 2)
• 1) Renew bolts. • 2) 90° = one quarter turn.	



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A13-0546

- ☐ Check radial clearance with Plastigage

6 - 40 Nm + 90° (1/4 turn) further

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

7 - Bearing cap

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

8 - 10 Nm + 90° (1/4 turn) further

- ☐ Renew
- ☐ Sender wheel must be renewed if bolts are loosened ⇒ [page 64](#)

9 - Sender wheel

- ☐ For engine speed sender -G28-
- ☐ Can only be installed in one position (holes are off-set)
- ☐ Sender wheel must be renewed if bolts are loosened
- ☐ Removing and installing ⇒ [page 64](#)

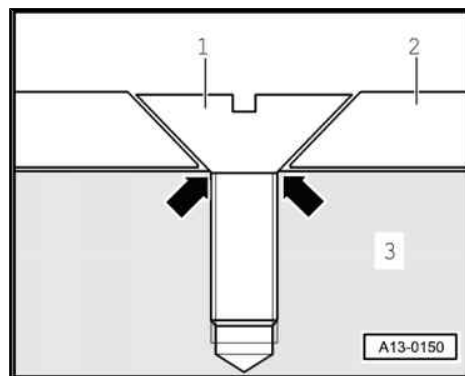
Removing and installing sender wheel

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



Note

- ◆ After fastening for a second time, attachment point of countersunk-head bolts in sender wheel is deformed to such an extent that bolt heads make contact with crankshaft -3- -arrows- and sender wheel beneath bolts is loose.
- ◆ Sender wheel can only be installed in one position. Holes are off-set.



Tightening torque

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

Allocation of crankshaft bearing shells for cylinder block

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

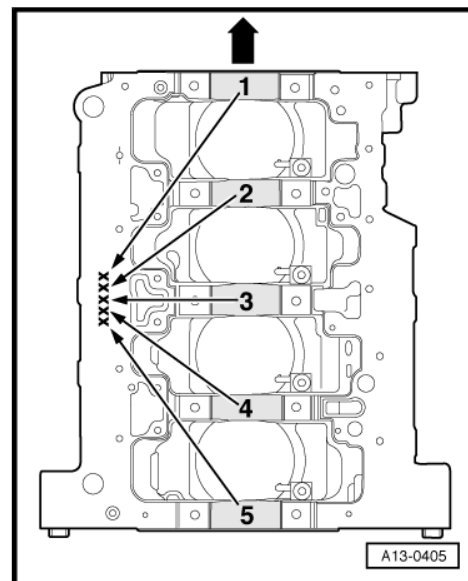


Note

- ◆ The -arrow- points to pulley end.
- ◆ The markings are visible without removal of the sump.

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

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



Note

The crankshaft bearing shells in the bearing caps are only supplied as spare parts with "yellow" coloured markings.

3.2 Crankshaft dimensions

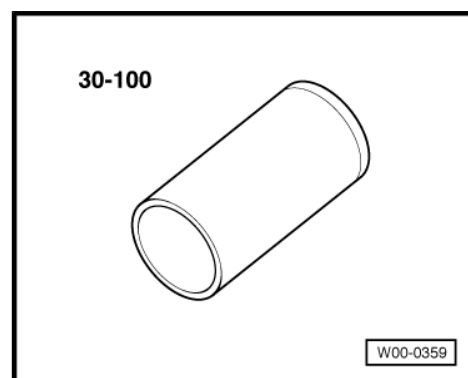
Honing dimension (in mm)	Crankshaft main bearing journal Ø	Conrod bearing journal Ø
Basic dimension	48.00 -0.017 -0.037	42.00 -0.022 -0.042
1st undersize	47.75 -0.017 -0.037	41.75 -0.022 -0.042
2nd undersize	47.50 -0.017 -0.037	41.50 -0.022 -0.042
3rd undersize	47.25 -0.017 -0.037	41.25 -0.022 -0.042

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3.3 Removing and installing chain sprocket

Special tools and workshop equipment required

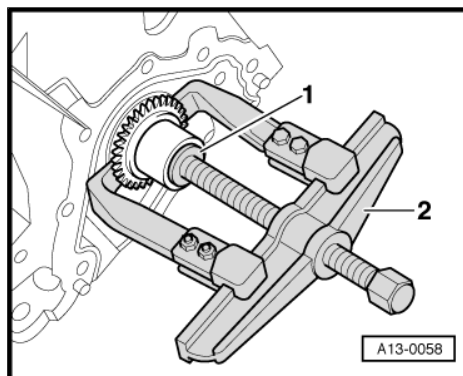
- ◆ Fitting sleeve -30-100-



- ◆ Two-arm puller, commercially available
- ◆ Protective gloves

Removing

- Remove sealing flange (front) ⇒ [page 56](#) .
- Remove sump ⇒ [page 112](#) .
- Remove oil pump sprocket, chain tensioner and chain
⇒ [Item 2 \(page 110\)](#) .
- Detach chain sprocket for crankshaft with puller -2-; use a suitable washer -1- to protect crankshaft journal.



Installing

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

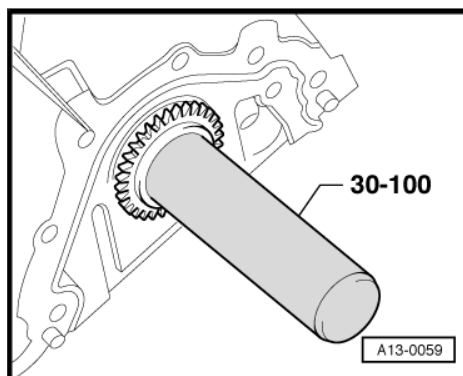
- Heat chain sprocket in oven for approx. 15 minutes to 220°C.



WARNING

Wear protective gloves.

- Using pliers, locate sprocket on end of crankshaft.
- Installation position: wider collar on sprocket faces engine.
- Push sprocket onto crankshaft as far as the stop using fitting sleeve -30-100- .



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4 Dismantling and assembling pistons and conrods



Note

Oil spray jet and pressure relief valve ⇒ [page 69](#).

4.1 Pistons and conrods - exploded view of components

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

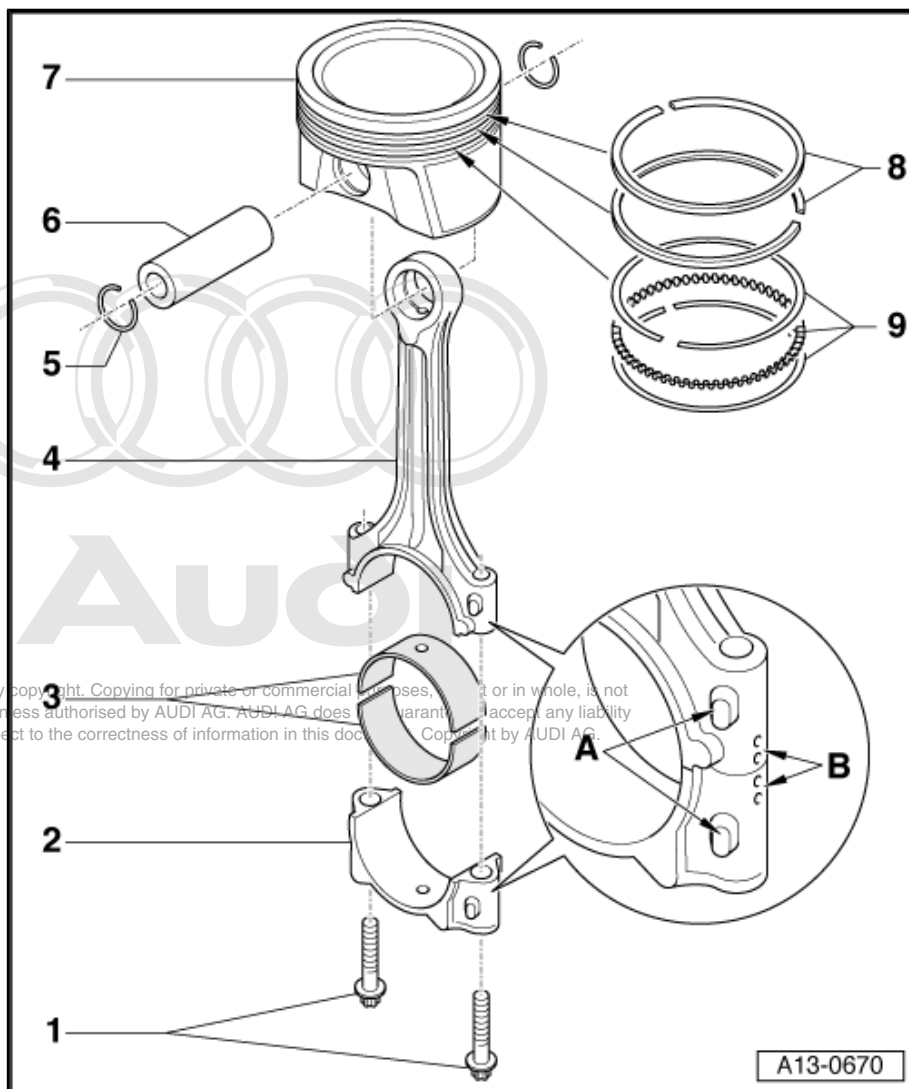
- ☐ Renew
- ☐ Lubricate threads and contact surface
- ☐ Use old bolt for measuring radial clearance
- ☐ To measure radial clearance, tighten to 30 Nm but not further

2 - Conrod bearing cap

- ☐ Mark cylinder allocation -B-
- ☐ Installation position: Markings -A- face towards pulley side

3 - Bearing shells

- ☐ Upper bearing shell with oil hole for piston pin lubrication
- ☐ Installation position ⇒ [page 69](#)
- ☐ Do not interchange used bearing shells (mark positions)
- ☐ Axial clearance when new: 0.09 ... 0.35 mm; Wear limit: 0.4 mm
- ☐ Check radial clearance with Plastigage
- ☐ Do not rotate crankshaft when checking radial clearance
- ☐ Radial clearance when new: 0.020 ... 0.061 mm; Wear limit 0.091 mm



4 - Conrod

- ☐ Only renew as a complete set
- ☐ Mark cylinder allocation -B-
- ☐ Installation position: Markings -A- face towards pulley side
- ☐ With oil passage for piston pin lubrication

5 - Circlip

6 - Piston pin

- ☐ Not available as separate replacement part
- ☐ If difficult to move, heat piston to approx. 60 °C

- ☐ Remove and install using drift -VW 222 A-

7 - Piston

- ☐ Checking ⇒ [page 69](#)
- ☐ Mark installation position and cylinder allocation
- ☐ Arrow on piston crown points to pulley end
- ☐ Install using piston ring clamp
- ☐ Checking cylinder bore ⇒ [page 69](#)
- ☐ Piston and cylinder dimensions ⇒ [page 70](#)

8 - Piston rings

- ☐ Compression rings
- ☐ Offset gaps by 120°
- ☐ Remove and install using piston ring clamp
- ☐ "TOP" must face towards piston crown
- ☐ Checking ring gap ⇒ [page 68](#)
- ☐ Checking ring-to-groove clearance ⇒ [page 68](#)

9 - Piston ring

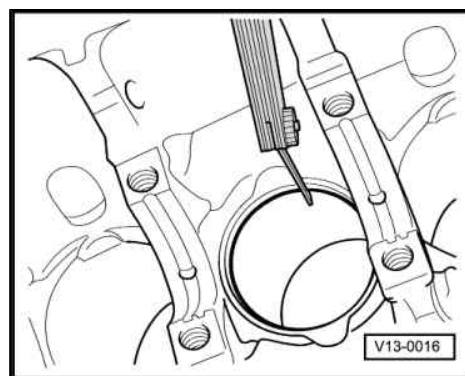
- ☐ Oil scraper ring
- ☐ 3 pieces
- ☐ Offset gap of top steel element of piston ring by 120° to next compression ring
- ☐ Offset gaps of individual parts of oil scraper ring

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Checking piston ring gap

- Insert ring at right angle to cylinder wall from above and push down into lower cylinder opening approx. 15 mm from bottom of cylinder. To do so, use a piston without rings.

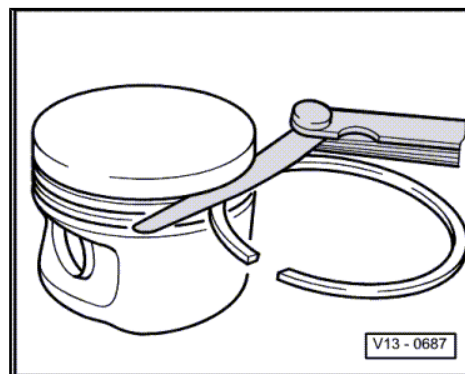
Piston ring Dimensions in mm	New	Wear limit
Compression rings	0.20 ... 0.40	0.80
Steel elements of oil scraper ring	0.20 ... 0.60	0.90



Checking ring-to-groove clearance

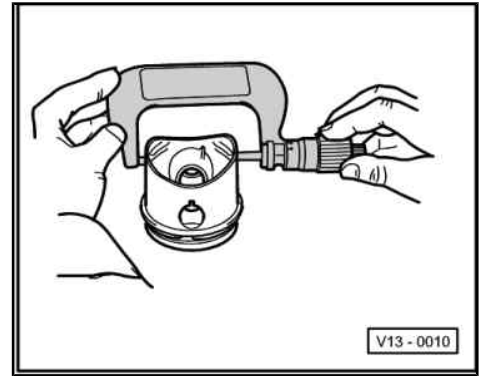
- Clean groove in piston before checking clearance.

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



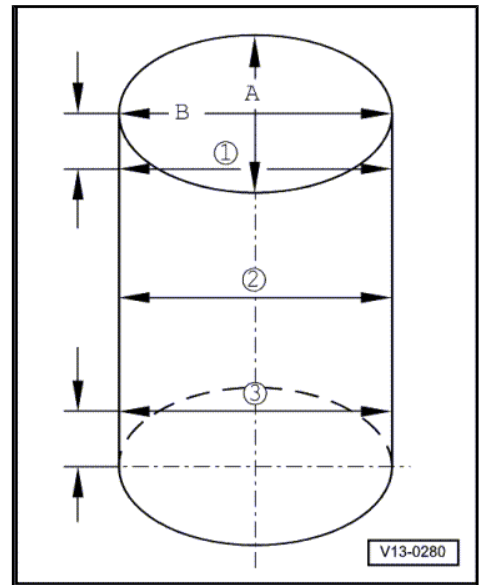
Checking piston

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



Checking cylinder bore

- Use 50 ... 100 mm internal dial gauge to take measurements at 3 points in transverse direction -A- and longitudinal direction -B-.
- Maximum deviation from nominal dimension: 0.08 mm.



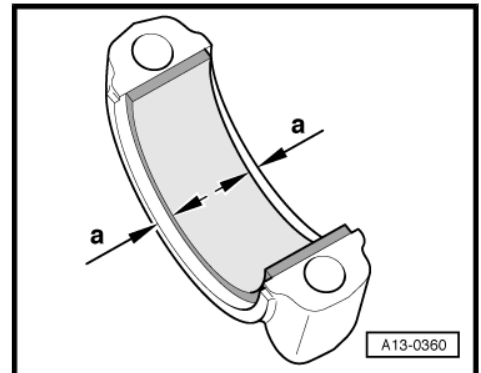
Installation position of bearing shells in conrods

- Insert bearing shells in centre of conrod/conrod bearing cap.
- Dimension -a- = 3.0 mm.



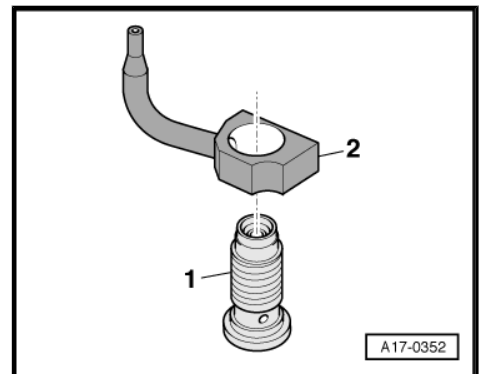
Note

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



Oil spray jet and pressure relief valve

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





4.2 Piston and cylinder dimensions

Honing dimension (in mm)	Piston Ø	Cylinder bore Ø
Basic dimension	80.965 ¹⁾	81.010
1st oversize	81.465 ¹⁾	81.510
¹⁾ Dimension not including graphite coating (thickness 0.02 mm). The graphite coating wears down in service.		



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15 – Cylinder head, valve gear

1 Removing and installing cylinder head

1.1 Cylinder head - exploded view of components

1 - Filler cap

2 - Seal

- ☐ Renew if damaged or leaking

3 - Breather housing

- ☐ Turn clockwise to remove

4 - Oil deflector

5 - Bracket

6 - 10 Nm

7 - Coolant distributor housing with thermostat

- ☐ Exploded view of components ⇒ [page 136](#)

8 - O-ring

- ☐ Renew

9 - 20 Nm

10 - Cylinder head gasket

- ☐ Renewing
⇒ ["1.3 Removing and installing cylinder head", page 73](#)
- ☐ Installation position: Part number points towards cylinder head, and must be legible from the inlet side
- ☐ If renewed, refill system with fresh coolant

11 - Hall sender -G40-

- ☐ When tightening, make sure that base plate is centralised

12 - 10 Nm

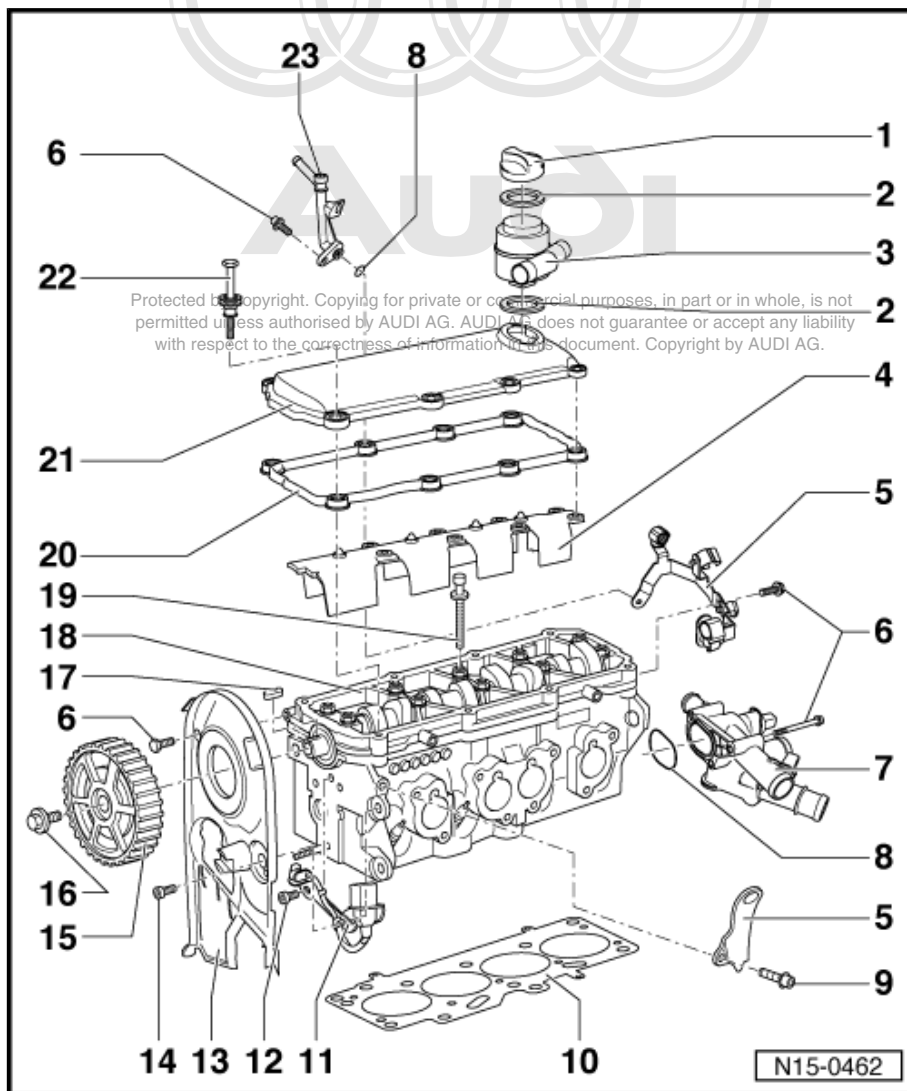
13 - Toothed belt cover (rear)

14 - 23 Nm

- ☐ Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue

15 - Camshaft sprocket

- ☐ With sender wheel for Hall sender -G40-
- ☐ Removing and installing ⇒ ["1.7 Removing toothed belt from camshaft sprocket", page 46](#)
- ☐ Installation position fixed by Woodruff key ⇒ [Item 17 \(page 72\)](#)



16 - 100 Nm

- ☐ Use counterhold tool -3415- when loosening and tightening

17 - Woodruff key

18 - Cylinder head

- ☐ Removing and installing ⇒ [page 73](#)
- ☐ Checking for distortion ⇒ [page 72](#)
- ☐ Machining limit ⇒ [page 72](#)
- ☐ If renewed, refill system with fresh coolant

19 - Cylinder head bolt

- ☐ Renew
- ☐ Note correct sequence when loosening ⇒ [page 80](#)
- ☐ Note correct sequence when tightening ⇒ [page 82](#)

20 - Gasket for cylinder head cover

- ☐ Renew if damaged or leaking
- ☐ Engage in spacer sleeves of ⇒ [Item 22 \(page 72\)](#)

21 - Cylinder head cover

- ☐ Removing and installing ⇒ [page 73](#)

22 - Special bolt, 9 Nm

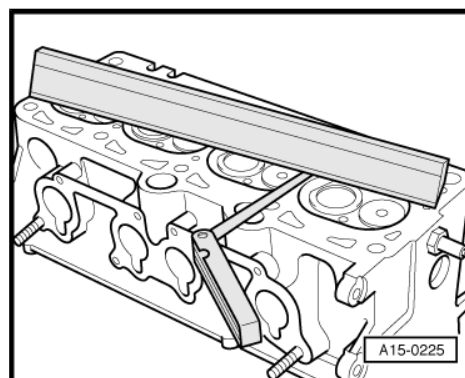
- ☐ Renew if damaged or leaking
- ☐ Note correct sequence when tightening ⇒ [page 73](#)

23 - Breather connection

- ☐ To coolant expansion tank

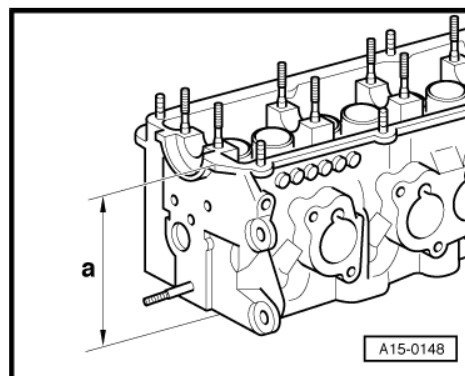
Checking cylinder head for distortion

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



Cylinder head machining limit

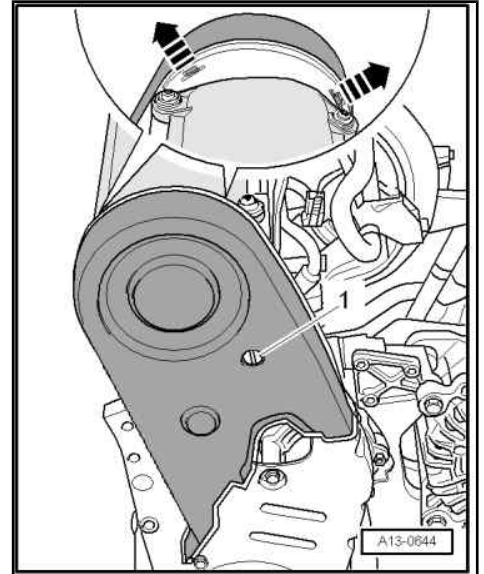
- Machining of the cylinder head (surface grinding) is only permissible down to the minimum dimension -a-.
- Minimum dimension: -a- = 132.8 mm



1.2 Removing and installing cylinder head cover

Removing

- Remove intake manifold ⇒ [page 84](#) .
- Turn quick-release fastener -item 1- 90° anti-clockwise.
- Raise retaining tabs -arrows- and detach top toothed belt cover.



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

Installing

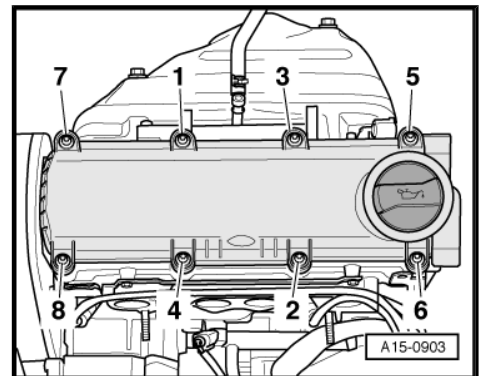
Installation is carried out in the reverse order; note the following:



Note

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

- Tighten bolts for cylinder head cover in the sequence -1 ... 8-.
- Install intake manifold ⇒ [page 84](#) .



Tightening torque

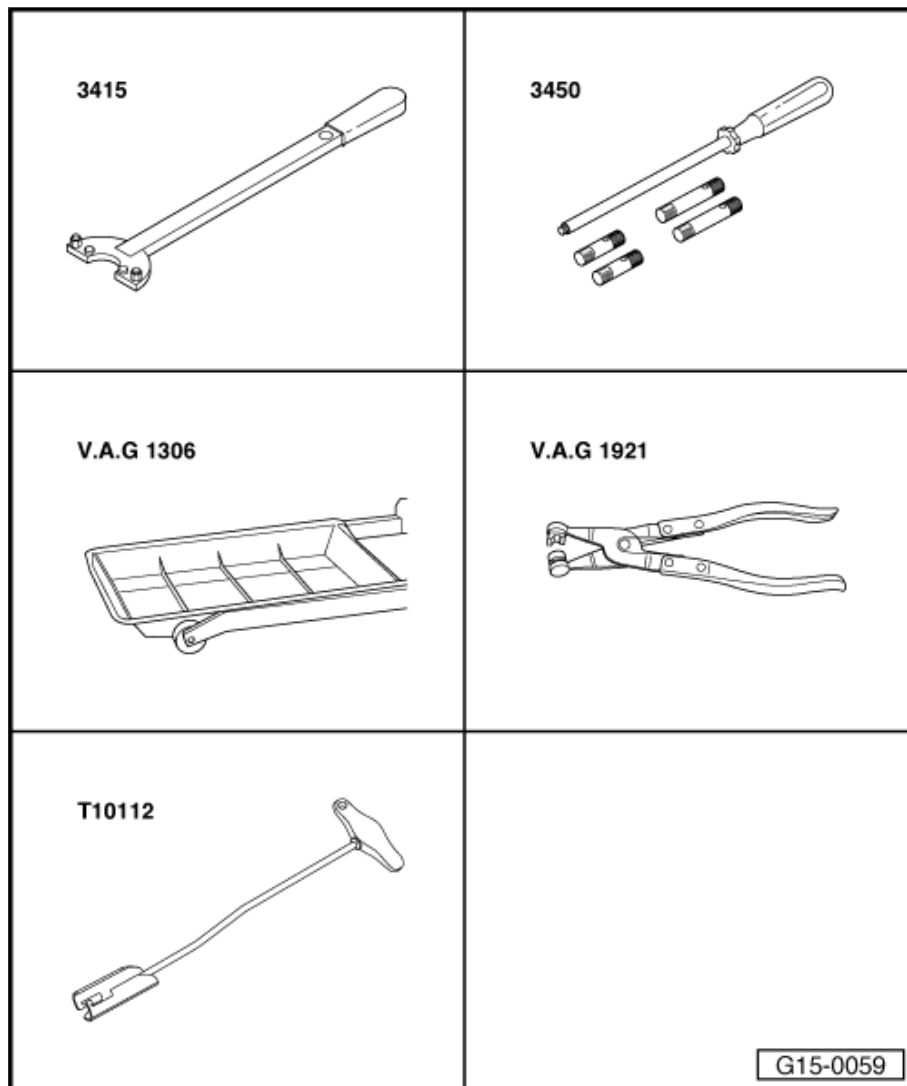
Component	Nm
Cylinder head cover to cylinder head	9

1.3 Removing and installing cylinder head

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Special tools and workshop equipment required

- ◆ Counterhold tool -3415-
- ◆ Guide pin -3450-
- ◆ Drip tray for workshop hoist -VAS 6208- or -V.A.G 1306-
- ◆ Hose clip pliers -V.A.G 1921-
- ◆ Puller -T10112-



Removing



Note

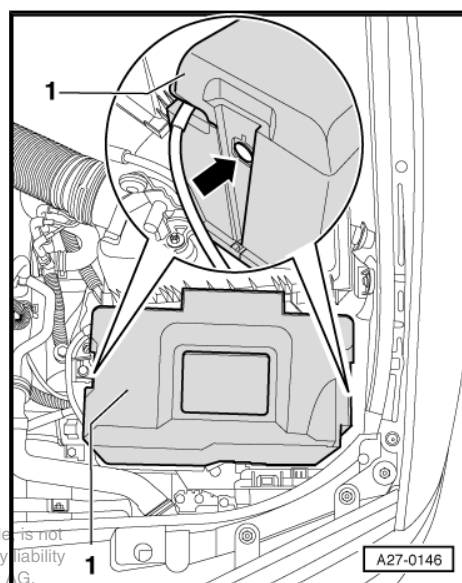
- ◆ All cable ties which are released or cut open when removing must be fitted in the same position when installing.
- ◆ If engine oil is contaminated, perform oil change ⇒ Maintenance ; Booklet 806 .
- Switch off ignition.
- Press release tabs -arrow- and remove cover -1- over battery.



Caution

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

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- Loosen nut -2- several turns and disconnect earth clamp from battery terminal.

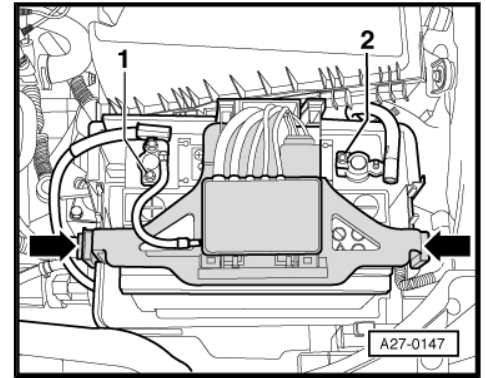


Disregard -item 1-.

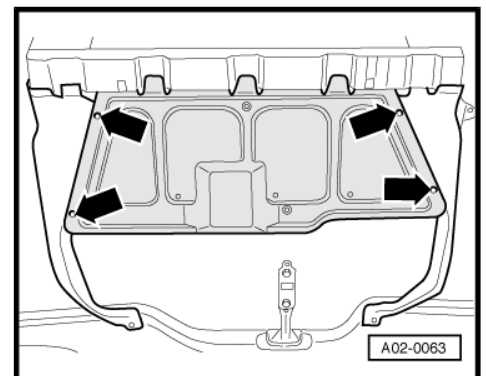


WARNING

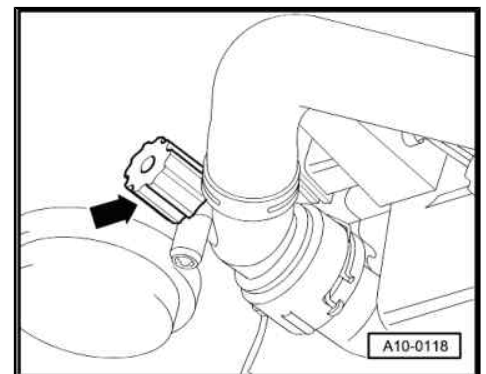
Hot steam/hot coolant may escape when opening expansion tank; cover filler cap with cloth and open carefully.



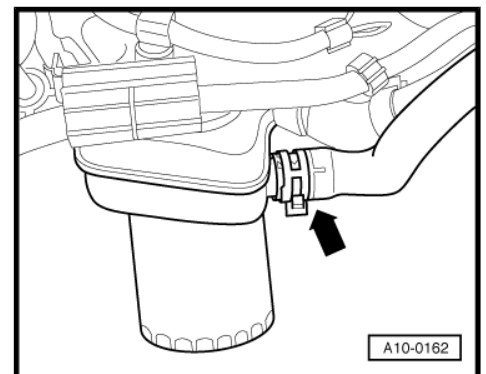
- Open filler cap on coolant expansion tank.
- Remove centre noise insulation -arrows-.



- Place drip tray for workshop hoist -VAS 6208- or -V.A.G 1306- under engine.
- Turn drain plug -arrow- on radiator anti-clockwise, if necessary fit drain hose to connection.

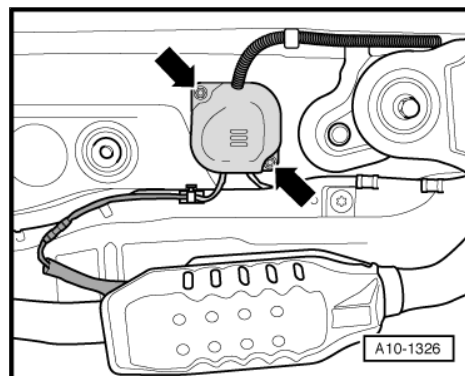


- Also disconnect coolant hose at bottom of oil cooler -arrow-, and drain off remaining coolant.

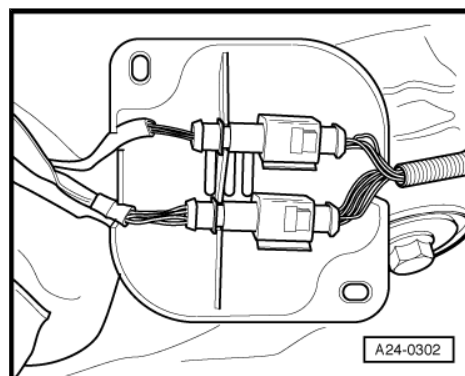


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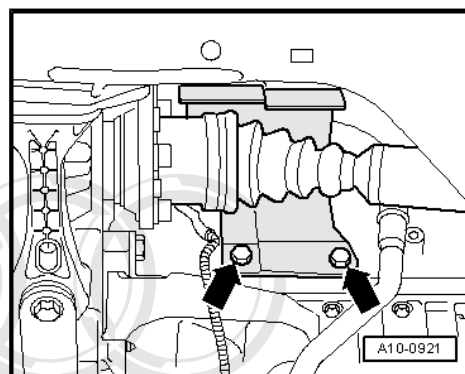
- Unscrew protective cover -arrows- on vehicle underbody.



- Unplug connector (black) for lambda probe before catalytic converter.
- Move wiring to the top.



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



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

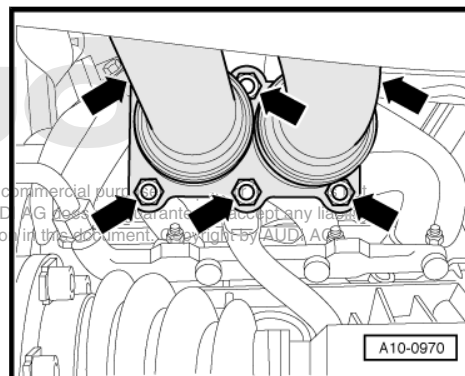


Note

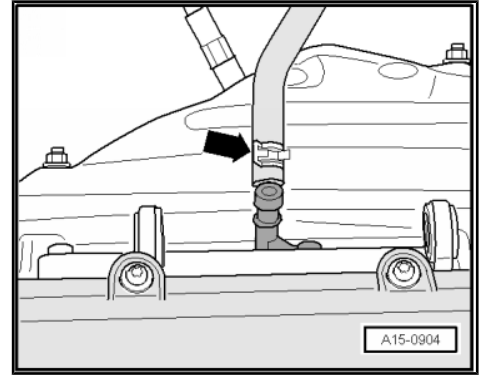
To avoid damage, the flexible joints in the front exhaust pipe must not be bent more than 10°.

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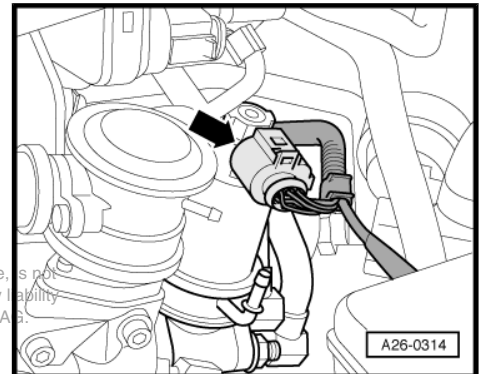
- Detach front exhaust pipe from exhaust manifold.



- Remove intake manifold ➔ [page 84](#) .
- Disconnect coolant hose -arrow- at breather connection on rear of cylinder head.
- Detach spark plug connectors using puller -T10112- .



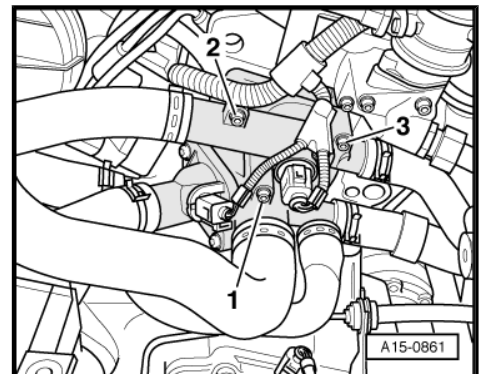
- Unplug electrical connector -arrow- at exhaust gas recirculation valve -N18- .
- Move wiring harness clear.



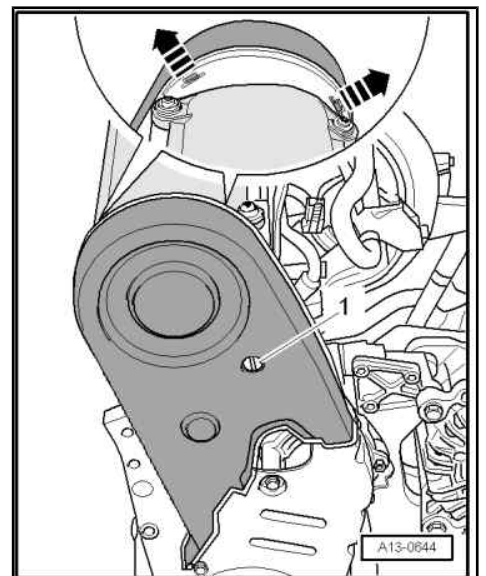
- Unscrew bolts -1 ... 3- on coolant distributor housing on left side of cylinder head and place housing aside.

 Note

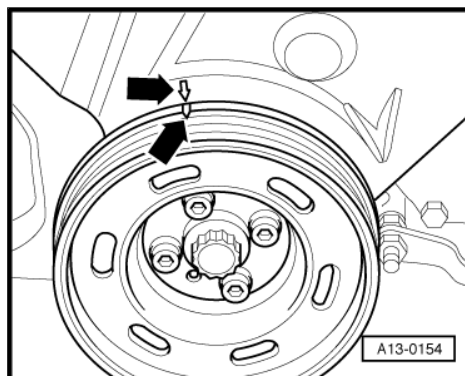
Leave coolant hoses connected.



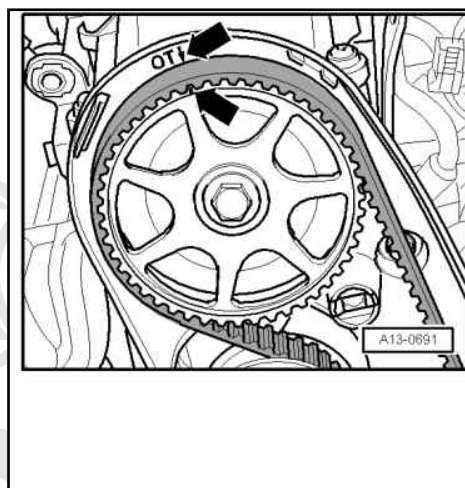
- Turn quick-release fastener -item 1- 90° anti-clockwise.
- Raise retaining tabs -arrows- and detach top toothed belt cover.



- Turn crankshaft at central bolt on crankshaft sprocket in direction of engine rotation to TDC mark -arrows-.

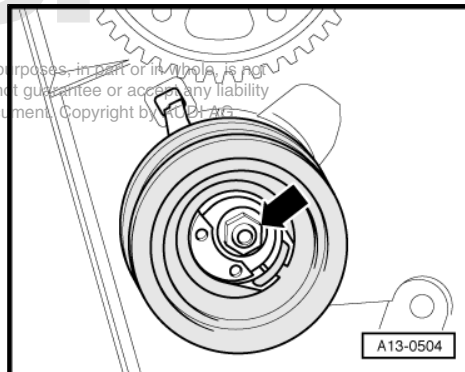


- At the same time the marking on front of the camshaft sprocket must align with the marking on the rear toothed belt cover -arrows-.
- Rotate crankshaft one turn further if necessary.

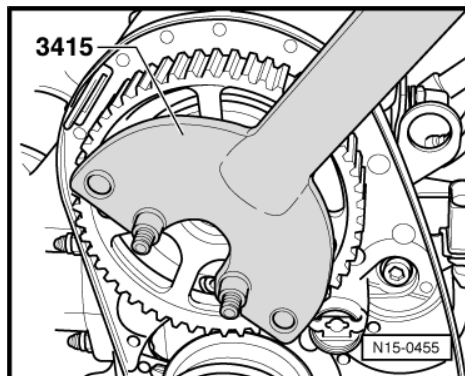


- Unscrew nut -arrow- for tensioning roller.
- Remove washer.
- Remove toothed belt from camshaft sprocket.

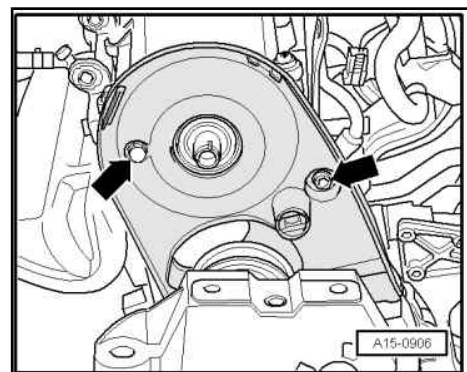
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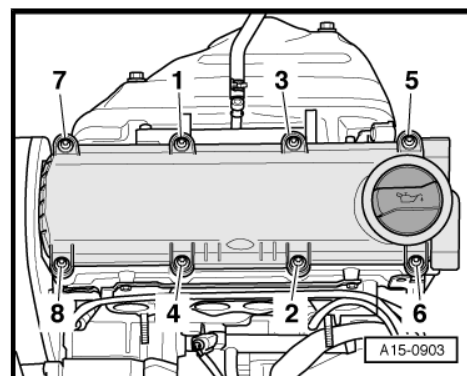
- Loosen camshaft sprocket using counterhold -3415- .
- Detach camshaft sprocket.
- Remove Woodruff key from camshaft.



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



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



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- Loosen cylinder head bolts in the sequence: -1 ... 10-.



Note

Two mechanics are needed to remove the cylinder head.

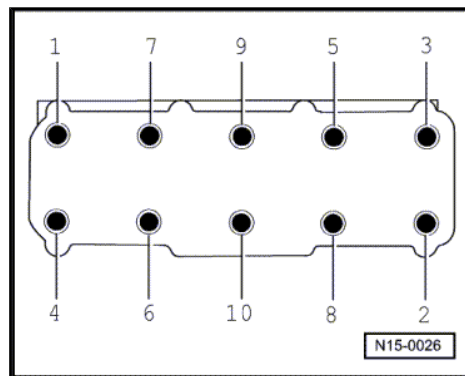
- Swivel cylinder head to left and out of rear toothed belt cover and detach tensioning roller at the same time.

Installing



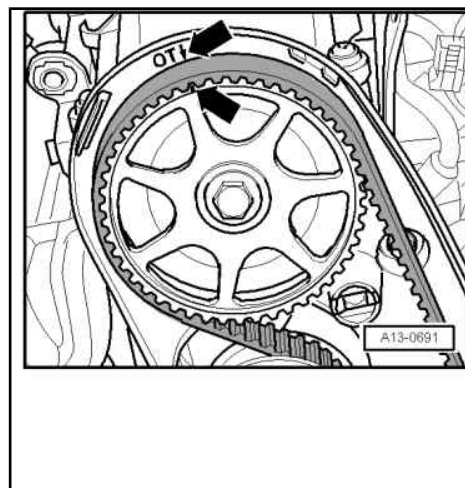
Note

- ◆ *Renew the cylinder head bolts.*
- ◆ *Renew self-locking nuts and bolts when performing assembly work.*
- ◆ *Renew bolts which are tightened to a specified angle as well as oil seals and gaskets.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- ◆ *If repairing, carefully remove any remaining gasket material from the cylinder head and cylinder block. Ensure that no long scores or scratches are made on the surfaces.*
- ◆ *Carefully remove any remaining emery and abrasive material.*
- ◆ *Cylinder heads which have cracks between the valve seats or between the 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.*
- ◆ *Do not remove new cylinder head gasket from packaging until it is ready to be fitted.*
- ◆ *Handle gasket very carefully. Damage to the silicone coating or the indented area will lead to leaks.*
- ◆ *The plastic protectors fitted to protect the open valves should not be removed until the cylinder head is ready to be fitted.*
- ◆ *When installing an exchange cylinder head with fitted camshaft, the contact surfaces between roller rocker fingers and cams must be oiled after installing the head.*
- ◆ *No oil or coolant must be allowed to remain in the blind holes for the cylinder head bolts in the cylinder block.*
- ◆ *When fitting a new cylinder head or cylinder head gasket, drain off all the old coolant and refill with new coolant.*
- ◆ *Fit all cable ties in the original positions when installing.*

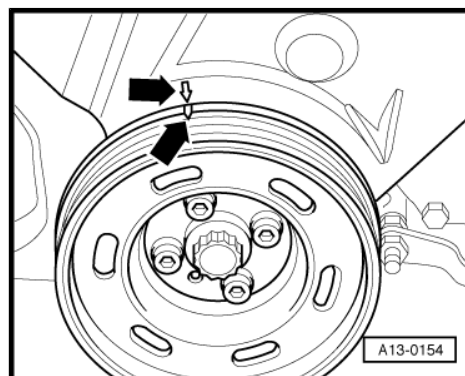


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- Align mark on camshaft sprocket with mark on toothed belt cover -arrows-.



- Check again whether the crankshaft is positioned at TDC -arrows-.

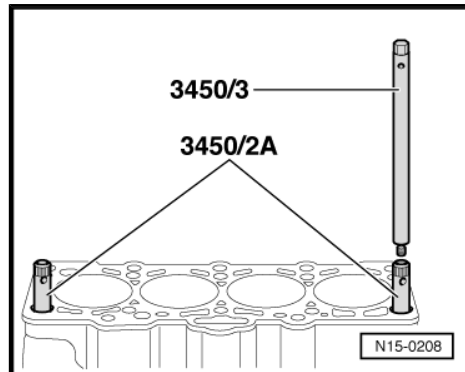


- To centralize cylinder head gasket and cylinder head, screw guide pins -3450/2A- into the outer bores on the intake side using fitting tool -3450/3-.



Note

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



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



Note

Two mechanics are needed to install the cylinder head.

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

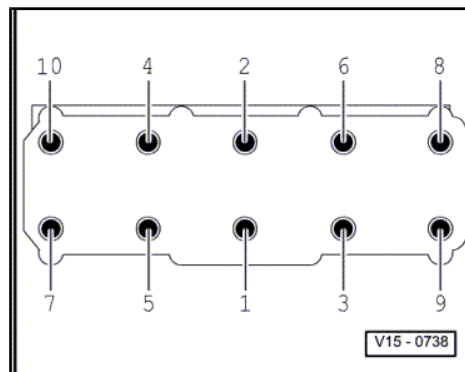
- Tighten cylinder head bolts in three stages in the sequence shown:

1. Tighten with torque wrench to 40 Nm.
2. Turn 90° ($\frac{1}{4}$ turn) further using a rigid wrench.
3. Turn 90° ($\frac{1}{4}$ turn) further using a rigid wrench.



Note

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



- Install cylinder head cover ⇒ [page 73](#) .
- Fit toothed belt (adjust valve timing) ⇒ [page 48](#) .
- Install intake manifold ⇒ [page 84](#) .
- Install front exhaust pipe ⇒ [page 154](#) .
- Align exhaust system free of stress ⇒ [page 157](#) .
- Connect battery. Procedures required ⇒ Rep. Gr. 27 .
- Check oil level ⇒ [page 119](#) .



Note

If engine oil is contaminated, perform oil change ⇒ Maintenance ; Booklet 806 .

- Fill cooling system with fresh coolant ⇒ [page 125](#) .
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Tightening torques

Component		Nm
Toothed belt cover (rear)	M6	10 ¹⁾
to cylinder head	M8	23 ¹⁾
Camshaft sprocket to camshaft		100
Coolant distributor connection to cylinder head		10
Heat shield to cylinder block		35
• ¹⁾ Install using locking fluid; locking fluid ⇒ Parts catalogue .		

2 Removing and installing intake manifold

2.1 Intake manifold - exploded view of components

1 - Fuel return pipe

- ☐ Mark before removing

2 - Fuel supply pipe

- ☐ Mark before removing

3 - Support for intake manifold

4 - 23 Nm

5 - 10 Nm

6 - Rubber bush

7 - Intake manifold (top section)

- ☐ Removing and installing
⇒ [page 84](#)

8 - O-ring

- ☐ Renew

9 - Pipe for exhaust gas recirculation

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10 - 10 Nm

11 - Gasket

- ☐ Renew

12 - 10 Nm

13 - Throttle valve connection

14 - Spreader clip

15 - Seal

- ☐ Renew if damaged

16 - 3 Nm

17 - Bottom section of intake manifold

- ☐ Removing and installing ⇒ [page 88](#)

18 - 20 Nm

19 - 20 Nm

20 - Seal

- ☐ Renew

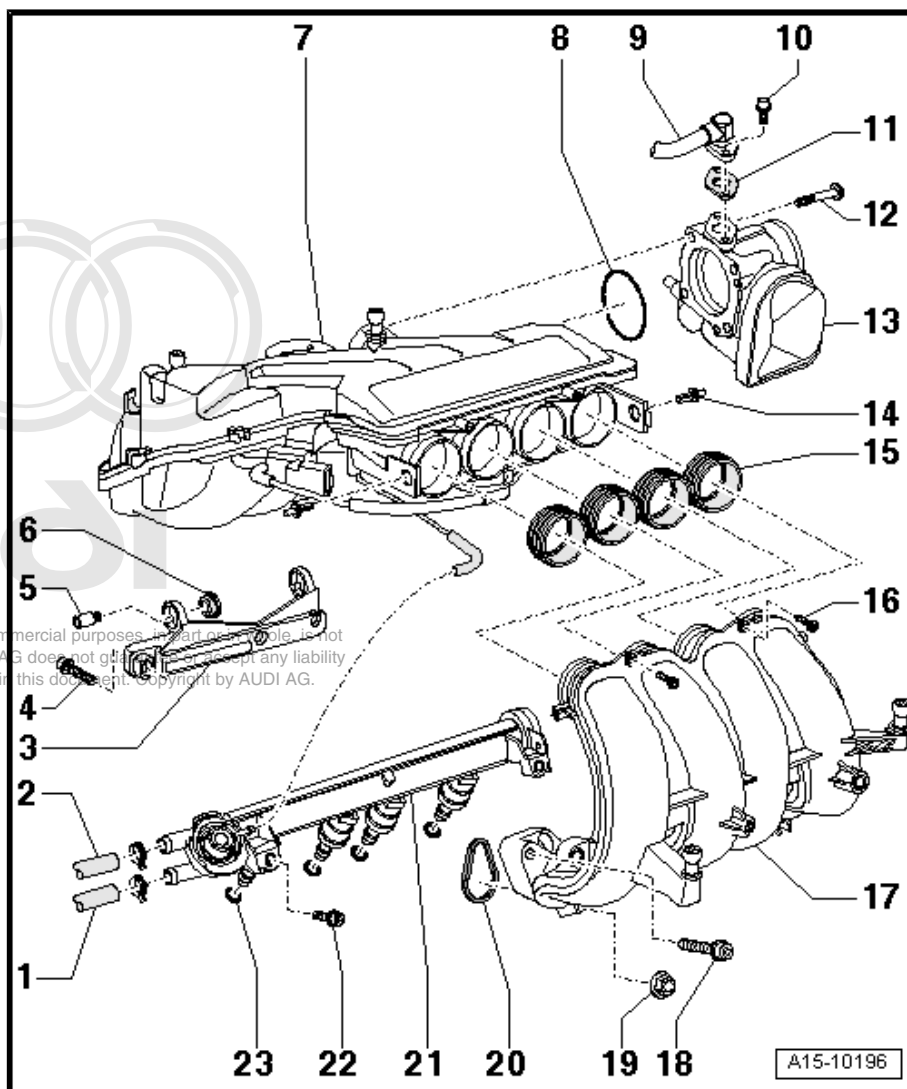
21 - Fuel rail

- ☐ With injectors

22 - 10 Nm

23 - O-ring

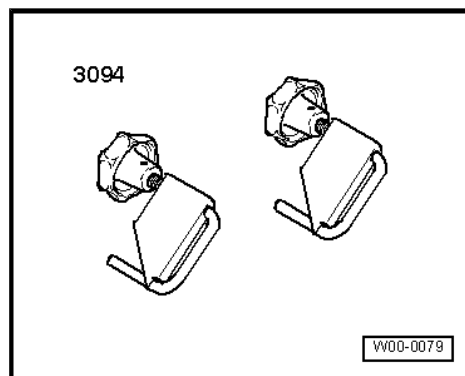
- ☐ For injectors
- ☐ Renew
- ☐ Lubricate with clean engine oil



2.2 Removing and installing intake manifold

Special tools and workshop equipment required

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



Removing



Note

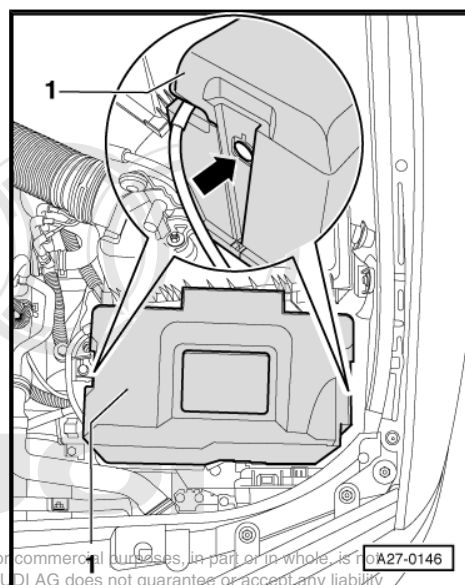
The top and bottom sections of the intake manifold are removed and installed together as one unit.

- Switch off ignition.
- Press release tabs -arrow- and remove cover -1- over battery.



Caution

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

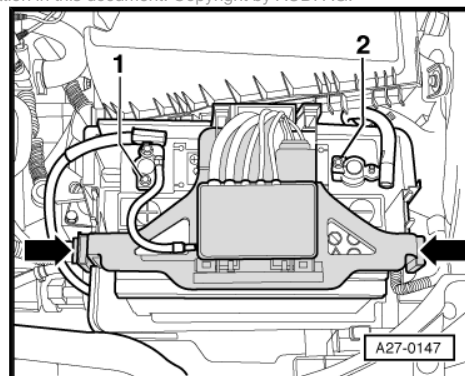


- Loosen nut -2- several turns and disconnect earth clamp from battery terminal.

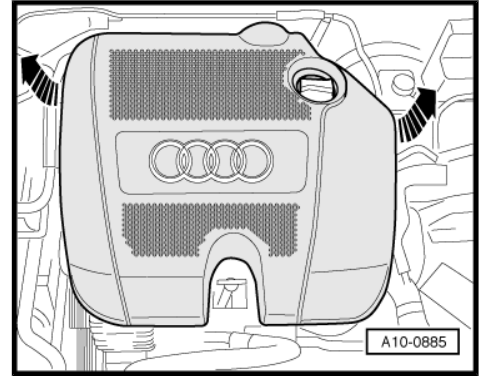


Note

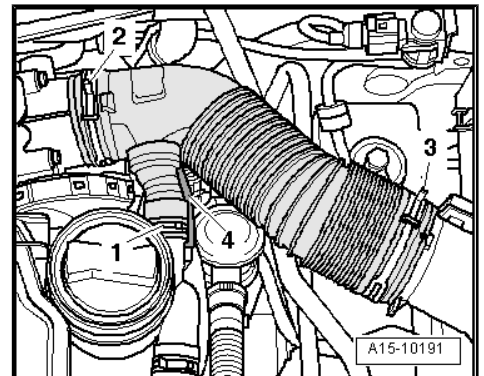
Disregard -item 1-.



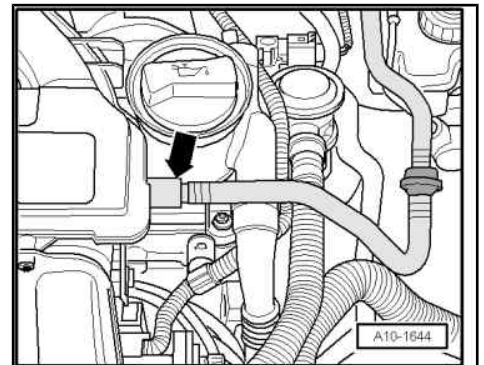
- Take off engine cover panel -arrows-.



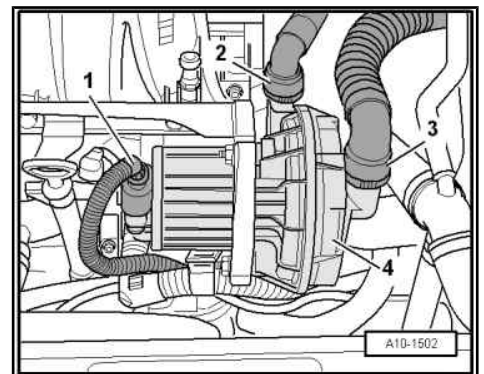
- Disconnect hose -4-.
- Release spring-type hose clips -1-, -2- and -3- to remove air intake hose.



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

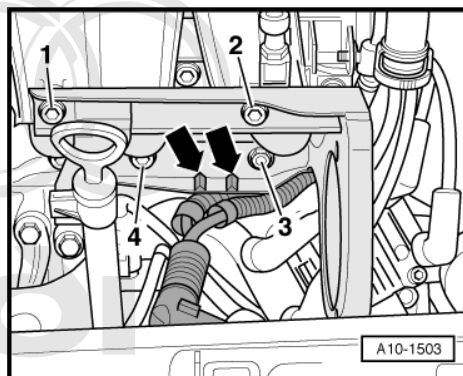


- Detach electrical connector -1-.
- Disconnect hoses -2- and -3- at secondary air pump.
- Detach secondary air pump -4- from bracket.



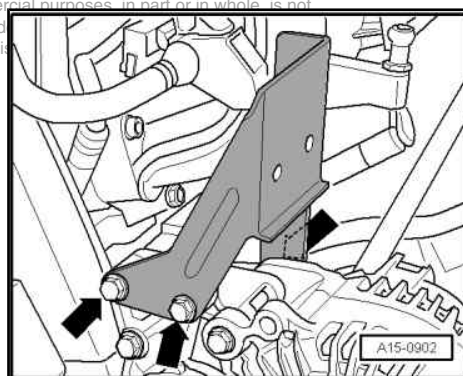
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- Unscrew bolts -1-, -2- and -4- and nut -3- on secondary air pump bracket.
- Move wiring clear -arrows- and remove the secondary air pump bracket.



- Remove splash plate -arrows-.

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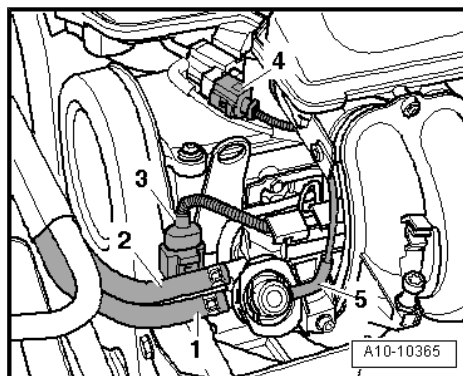
- Unplug electrical connectors -3- and -4-.



WARNING

The fuel system is pressurised. Before opening the system place a cloth around the connection. Then dissipate pressure by carefully unfastening the connection.

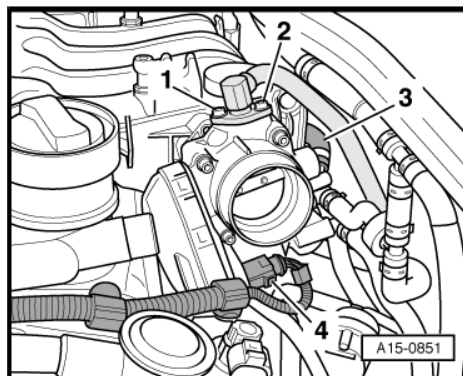
- Mark fuel supply pipe -2- and fuel return pipe -1- and detach from fuel rail.



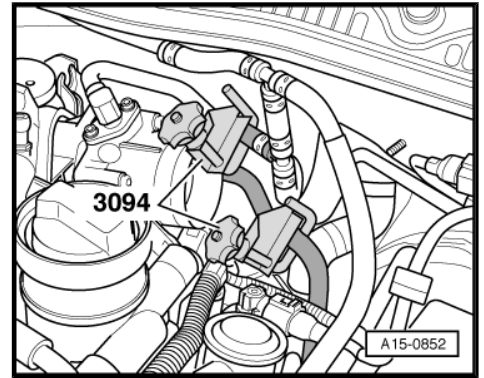
Note

Disregard -item 5-.

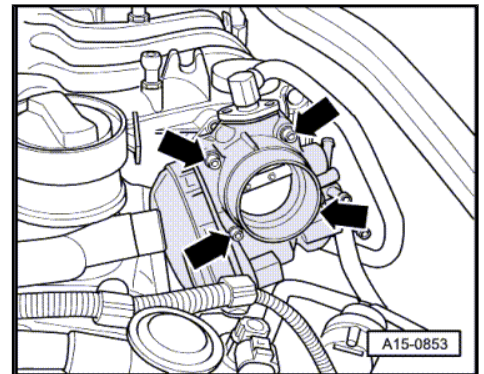
- Remove bolts -1- and -2-.
- Detach vacuum hose -3- leading to activated charcoal filter and move hose clear at intake manifold.
- Detach electrical connector -4- at throttle valve module - J338- .



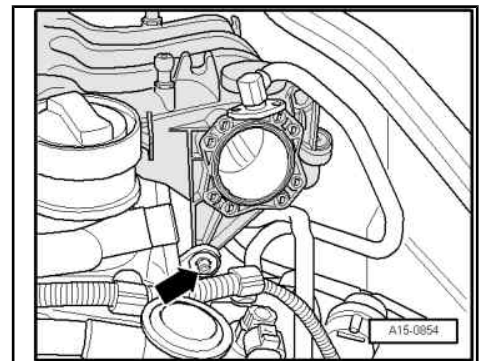
- Clamp off coolant hoses with hose clamps -3094- .
- Disconnect coolant hoses at throttle valve housing.



- Remove throttle valve housing -arrows-.



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



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- Unscrew bolts -1 ... 4-, -7- and nut -8- and detach intake manifold.



Note

Block off intake ports in cylinder head with clean cloths.

Installing

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



Note

- ◆ *Renew gaskets and seals.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*

- Connect battery. Procedures required ⇒ Rep. Gr. 27 .
- Fill cooling system ⇒ [page 125](#) .

Tightening torques

Component	Nm
Intake manifold to cylinder head	20
Intake manifold to bracket	10
Bracket for secondary air pump to intake manifold	20
Splash plate to bracket for ancillaries	23
Throttle valve connection to intake manifold	10
Exhaust gas recirculation pipe to throttle valve housing	10

2.3 Removing and installing intake manifold (bottom section)

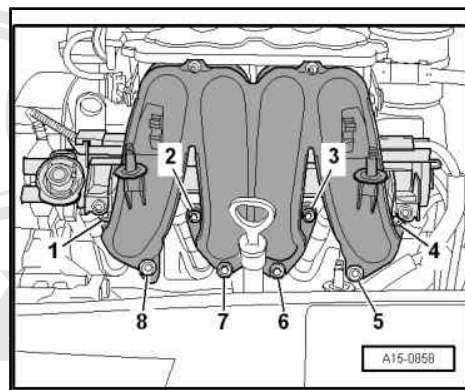
Removing

- Switch off ignition.
- Press release tabs -arrow- and remove cover -1- over battery.

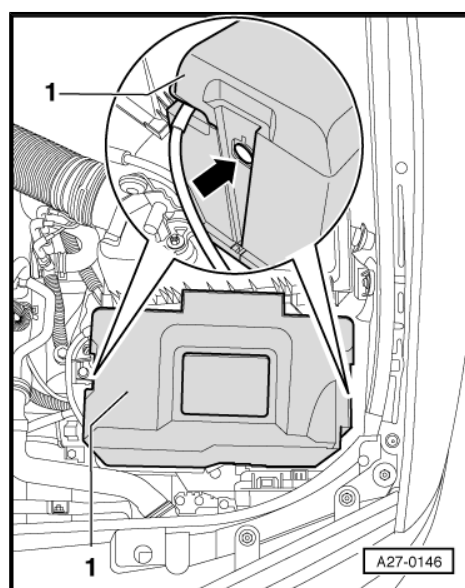


Caution

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



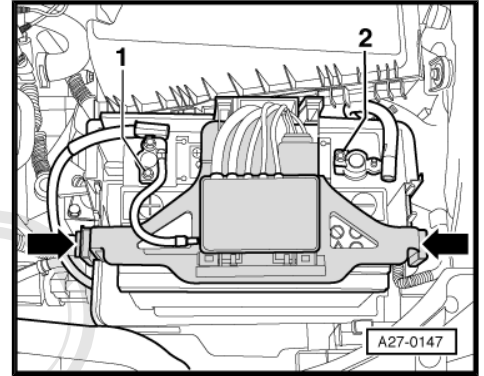
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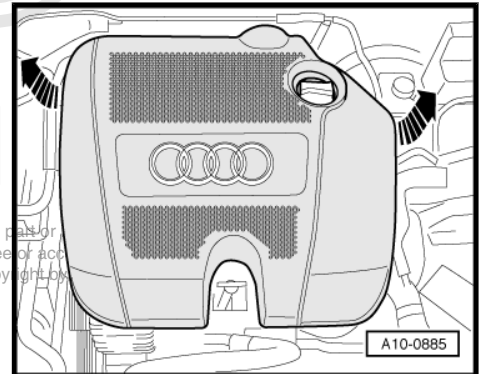
- Loosen nut -2- several turns and disconnect earth clamp from battery terminal.

i Note

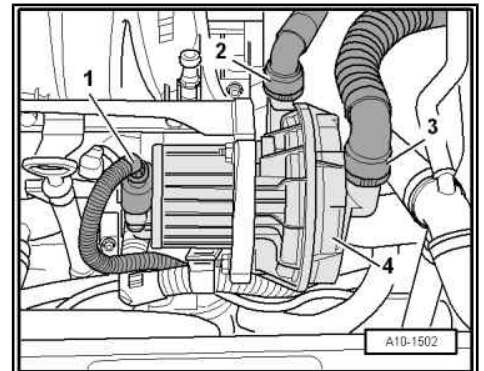
Disregard -item 1-.



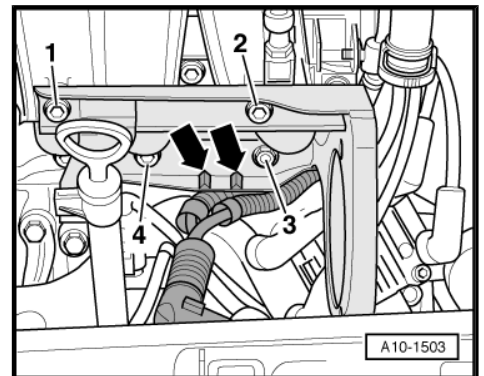
- Take off engine cover panel -arrows-.



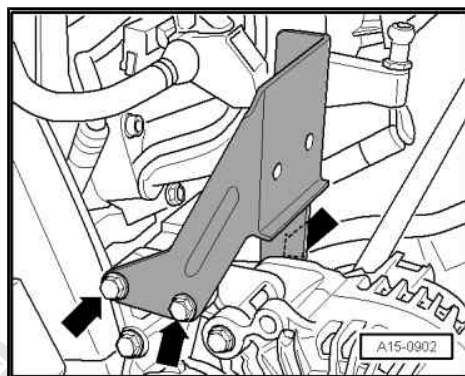
- Detach electrical connector -1-.
- Disconnect hoses -2- and -3- at secondary air pump.
- Detach secondary air pump -4- from bracket.



- Unscrew bolts -1-, -2- and -4- and nut -3- on secondary air pump bracket.
- Move wiring clear -arrows- and remove the secondary air pump bracket.



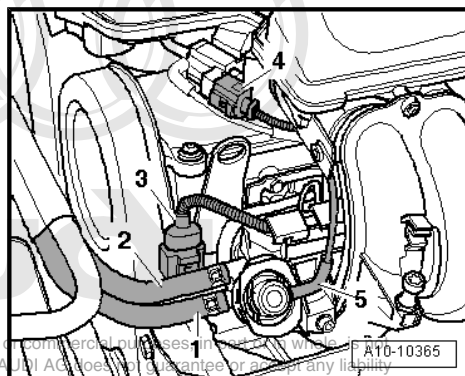
- Remove splash plate -arrows-.



- Unplug electrical connectors -3- and -4-.
- Disconnect vacuum hose -5- from fuel pressure regulator.

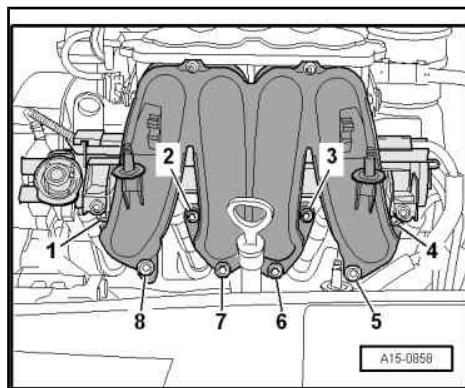

WARNING

The fuel system is pressurised. Before opening the system place a cloth around the connection. Then dissipate pressure by carefully unfastening the connection.



- Mark fuel supply pipe -2- and fuel return pipe -1- and detach from fuel rail.

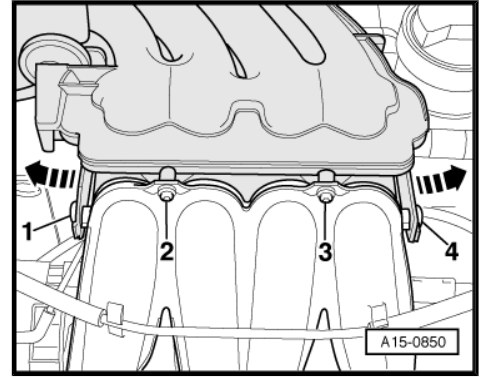
- Unscrew bolts -1 ... 4- and -7- and nut -8-.



- Remove bolts -2- and -3-.
- Lever off the clips -1- and -4-.
- Press retainers slightly aside to release -arrows- and detach bottom section of intake manifold from top section.
- Unclip wiring duct at bottom section of intake manifold and detach electrical connectors for injectors.

 Note

Block off intake ports in cylinder head with clean cloths.



Installing

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

 Note

Renew gaskets and seals.

- Install secondary air pump ⇒ [page 181](#) .
- Connect battery. Procedures required ⇒ Rep. Gr. 27 .

Tightening torques

Component	Nm
Top section of intake manifold to bottom section	3
Intake manifold (bottom section) to cylinder head	20
Bracket for secondary air pump to bottom section of intake manifold	20
Splash plate to bracket for ancillaries	23

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2.4 Checking compression

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



T10112

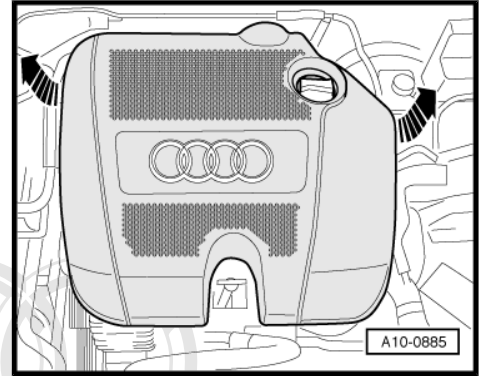
G15-0054

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

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



- Take off engine cover panel -arrows-.



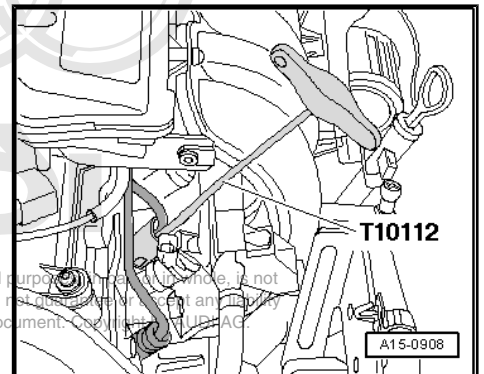
- Detach electrical connectors at outer injectors.
- Detach spark plug connectors using puller -T10112- .
- Remove spark plugs with spark plug socket -3122 B- .
- Test the compression pressure with the compression tester - V.A.G 1763- .



Note

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Using the compression tester ⇒ *operating instructions* .



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

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

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

- Install spark plugs ⇒ Rep. Gr. 28 .
- When finished, interrogate and erase the engine control unit fault memory, as faults are stored when fuses are removed and connectors are detached ⇒ Vehicle diagnosis, testing and information system VAS 5051.

3 Servicing valve gear



Note

- ◆ *Cylinder heads which have cracks between the valve seats or between the 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, the engine must NOT be started for about 30 minutes. Hydraulic valve compensation elements have to settle (otherwise valves will strike pistons).*
- ◆ *After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.*
- ◆ *Renew gaskets and seals.*

3.1 Valve gear - exploded view of components

1 - 100 Nm

- ☐ Use counterhold tool -3415- to loosen and tighten ⇒ [page 38](#)

2 - Camshaft sprocket

- ☐ With sender wheel for Hall sender -G40-
- ☐ Removing and installing ⇒ ["1.7 Removing toothed belt from camshaft sprocket", page 46](#)
- ☐ Installation position fixed by Woodruff key ⇒ [Item 4 \(page 94\)](#)

3 - Oil seal

- ☐ Renewing ⇒ [page 96](#)

4 - Woodruff key

- ☐ Check for firm attachment

5 - 23 Nm

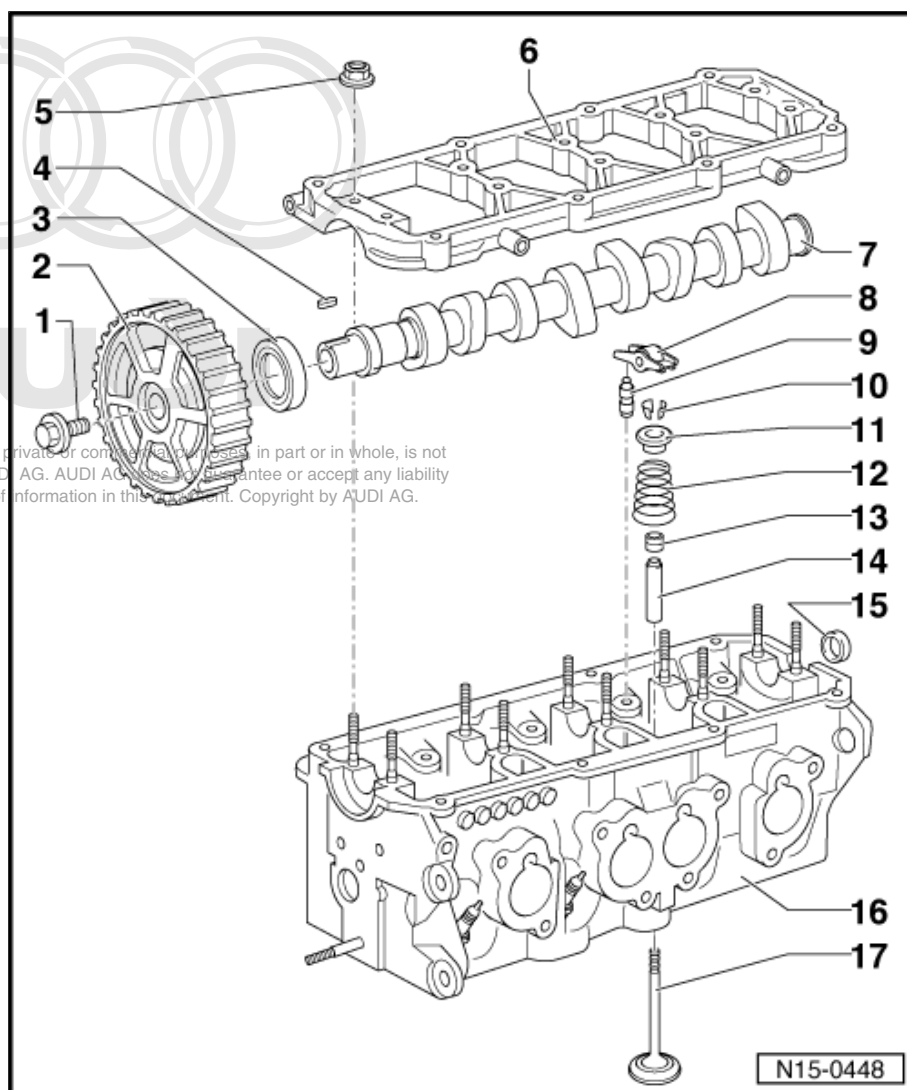
- ☐ Observe the tightening sequence ⇒ [page 101](#)

6 - Retaining frame

- ☐ With integrated camshaft bearings
- ☐ Bearing 1 at pulley end
- ☐ Removing and installing ⇒ ["3.4 Removing and installing camshaft", page 98](#)
- ☐ Sealing surface must not be machined

7 - Camshaft

- ☐ Check radial clearance using Plastigage (with roller rocker fingers removed)



- ☐ Radial clearance: wear limit: 0.1 mm
- ☐ Runout: max. 0.04 mm
- ☐ Checking axial clearance ⇒ [page 95](#)
- ☐ Removing and installing ⇒ [page 98](#)

8 - Roller rocker finger

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

9 - Supporting element

- ☐ With hydraulic valve clearance compensation
- ☐ Checking hydraulic valve play compensation ⇒ [page 104](#)
- ☐ Do not interchange
- ☐ Lubricate contact surface

10 - Valve cotters

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11 - Valve spring plate

12 - Valve spring

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

13 - Valve stem oil seal

- ☐ Renewing ⇒ [page 101](#)

14 - Valve guide

- ☐ Checking ⇒ [page 106](#)

15 - Sealing cap

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

16 - Cylinder head

- ☐ See note ⇒ [page 94](#)
- ☐ Checking valve guides ⇒ [page 106](#)
- ☐ Machining valve seats ⇒ [page 107](#)
- ☐ Sealing surface on camshaft side must not be machined.

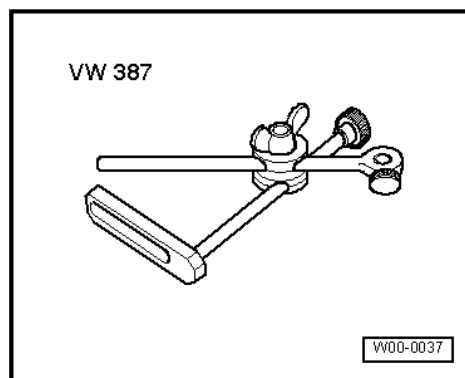
17 - Valve

- ☐ Remove and install with cylinder head removed using valve spring compressor -2037-
- ☐ Must not be machined; only grinding-in is permissible
- ☐ Valve dimensions ⇒ [page 106](#)
- ☐ Checking valve guides ⇒ [page 106](#)
- ☐ Machining valve seats ⇒ [page 107](#)

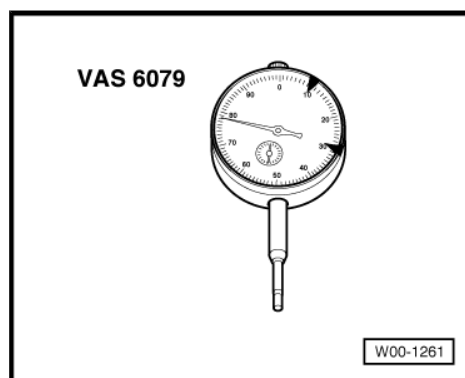
3.2 Checking axial clearance of camshaft

Special tools and workshop equipment required

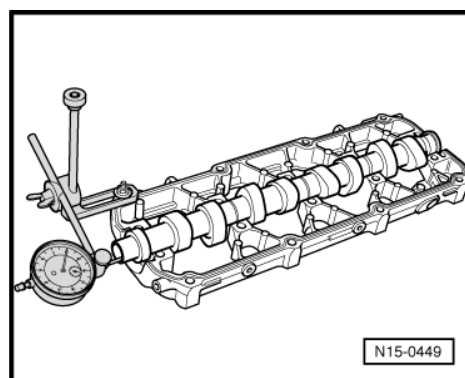
◆ Universal dial gauge bracket -VW 387-



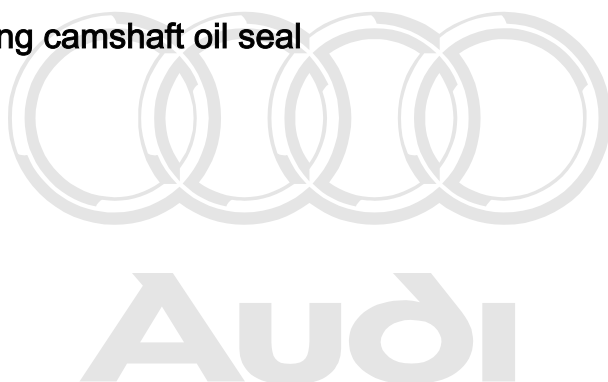
◆ Dial gauge -VAS 6079-

**Test sequence**

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



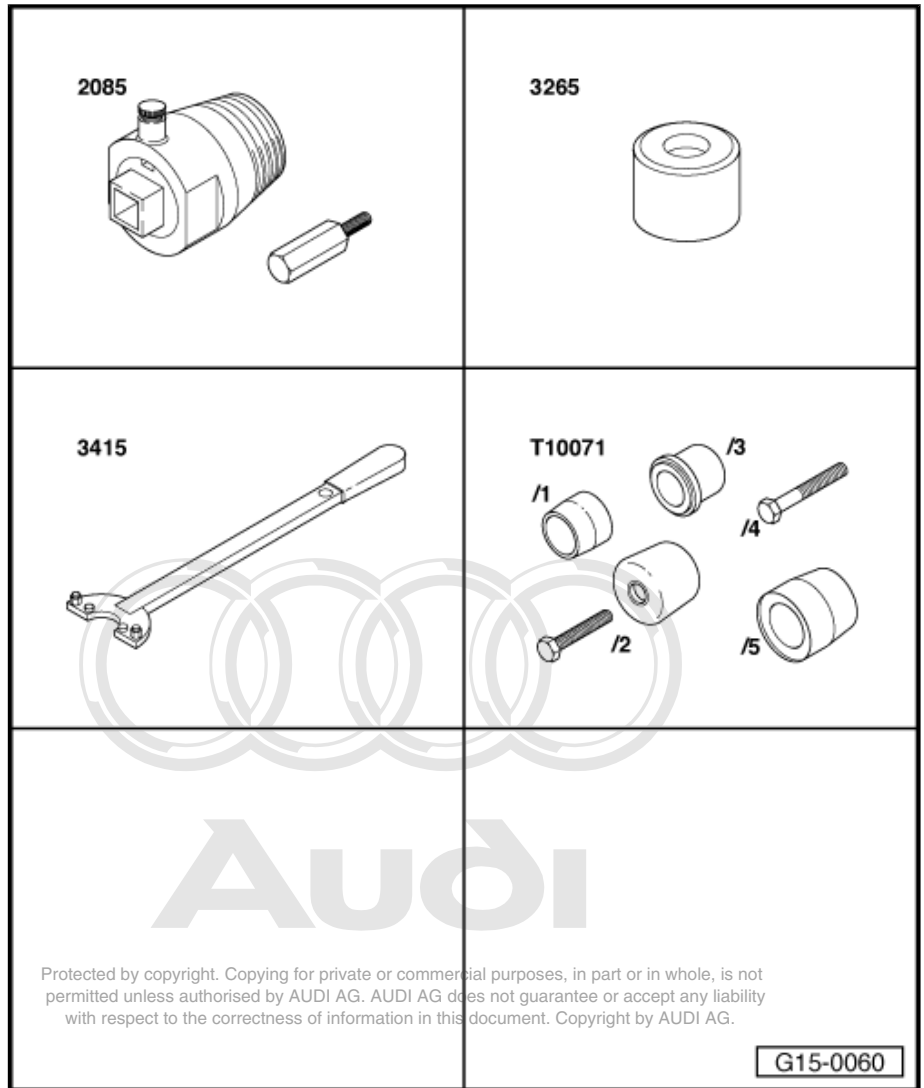
3.3 Renewing camshaft oil seal



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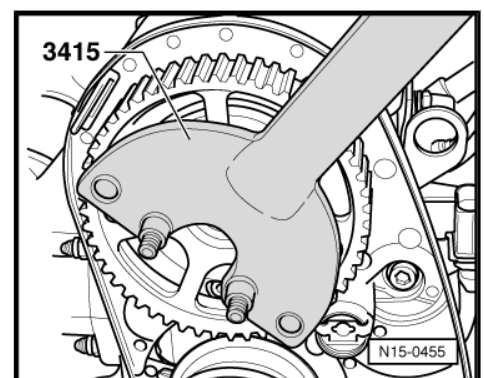
Special tools and workshop equipment required

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

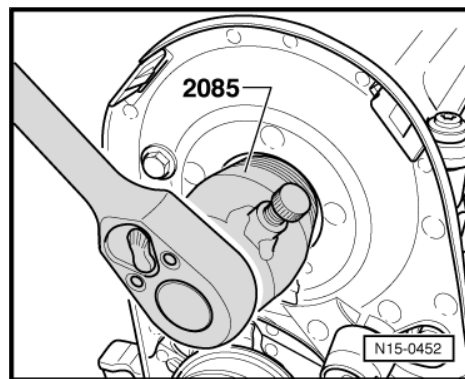


Procedure

- Cylinder head installed.
- Remove toothed belt from camshaft sprocket ⇒ [page 46](#) .
- Loosen camshaft sprocket using counterhold -3415- .
- Detach camshaft sprocket.
- Remove Woodruff key from camshaft.



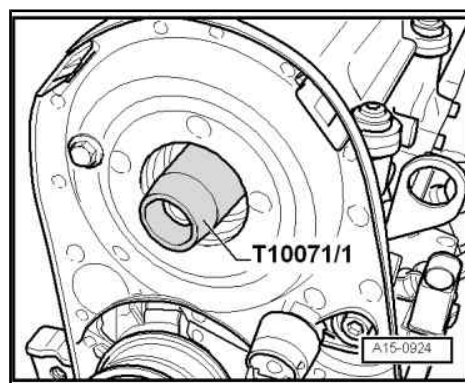
- To guide oil seal extractor, screw securing bolt for camshaft sprocket into camshaft as far as the stop by hand.
- Adjust inner part of oil seal extractor -2085- so that it is level with the outer part and lock in position with knurled screw.
- Lubricate threaded head of oil seal extractor -2085- ,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



 Note

Do not lubricate sealing lip of oil seal.

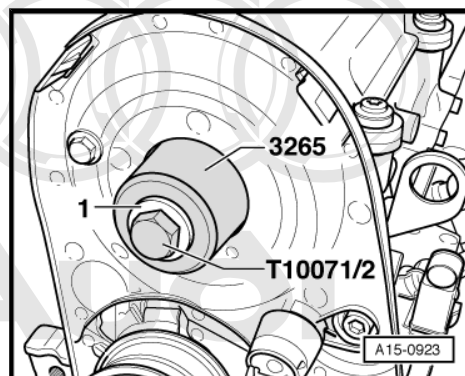
- Slide oil seal over guide sleeve -T10071/1- .
- Detach guide sleeve.



- Press in oil seal all the way using fitting sleeve -3265- and bolt -T10071/2- .

 Note

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

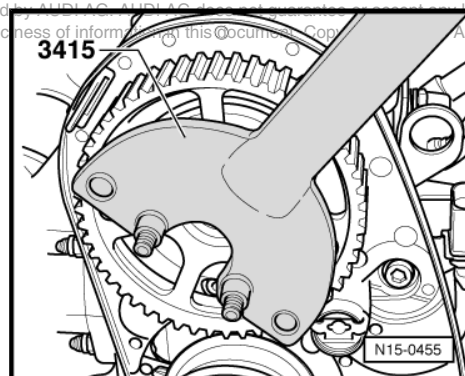


- Insert Woodruff key into camshaft.
- Tighten camshaft sprocket using counterhold -3415- .

 Note

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

- Fit toothed belt (adjust valve timing) ⇒ [page 48](#) .



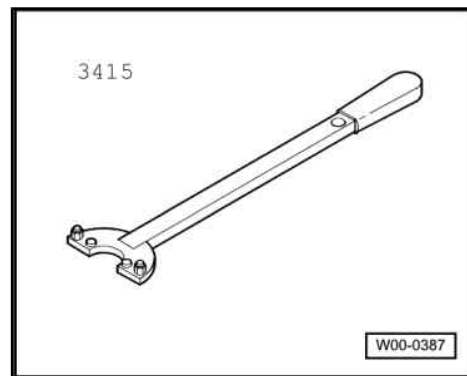
Tightening torque

Component	Nm
Camshaft sprocket to camshaft	100

3.4 Removing and installing camshaft

Special tools and workshop equipment required

- ◆ Counterhold tool -3415-



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

Removing

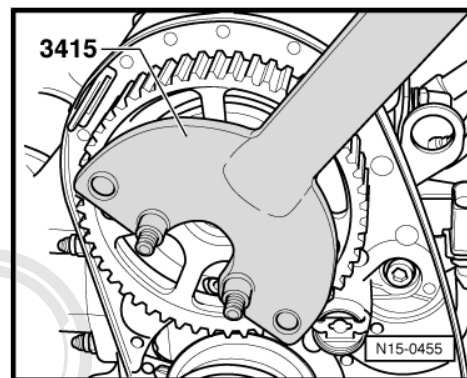
- Cylinder head installed.



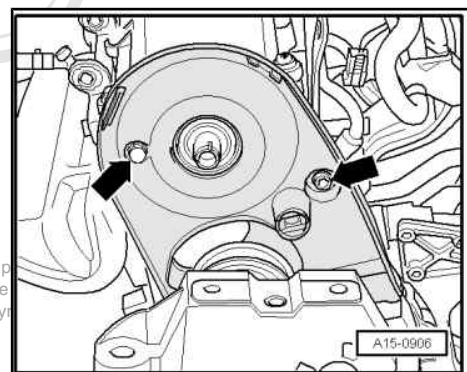
Note

- ◆ *Sealing surfaces at retaining frame and cylinder head may be cleaned but not machined.*
- ◆ *Camshaft bearings are integrated into cylinder head/retaining frame. Toothed belt must be detached before removing retaining frame.*
- ◆ *Renew camshaft oil seal and sealing cap at rear if retaining frame has been unfastened.*

- Remove intake manifold ⇒ [page 84](#) .
- Remove toothed belt from camshaft sprocket ⇒ [page 46](#) .
- Loosen camshaft sprocket using counterhold -3415- .
- Detach camshaft sprocket.
- Remove Woodruff key from camshaft.



- Remove cylinder head cover ⇒ [page 73](#) .
- Unbolt toothed belt cover (rear) from cylinder head -arrows-.



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

Installing



Note

Renew gaskets and seals.

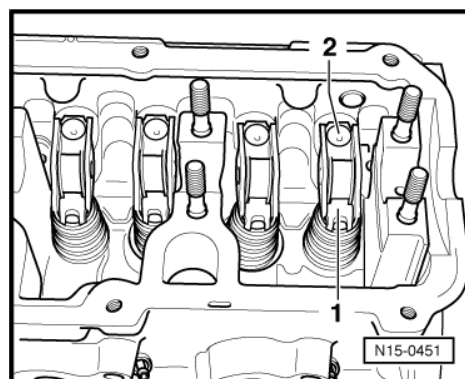
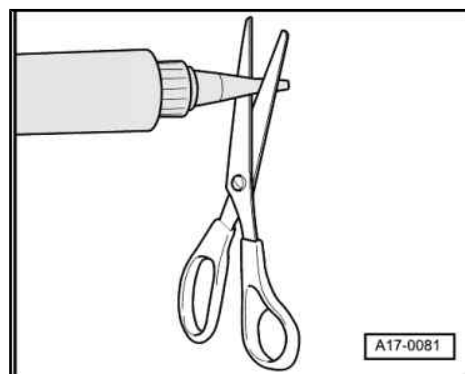
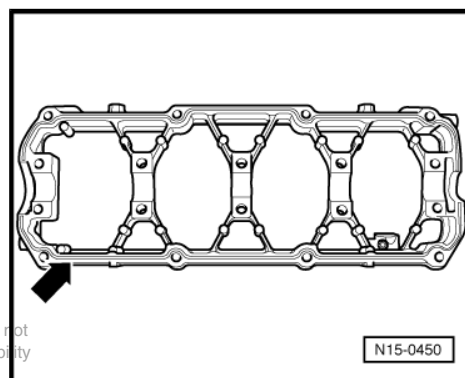
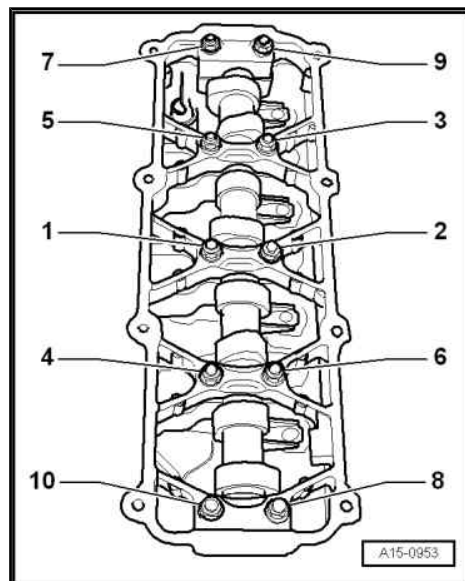
- Pistons must not be at TDC.
- Make sure dirt and remnants of sealant do not drop into cylinder head.
- Remove old sealant from groove in retaining frame -arrow- and from sealing surfaces.
- Remove sealant residues from cylinder head, e.g. with rotating plastic brush or similar.



WARNING

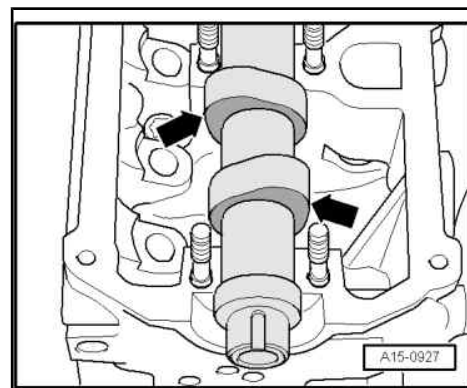
Wear safety goggles.

- Clean sealing surfaces; they must be free of oil and grease.
- Cut off tube nozzle at front marking (nozzle approx. 1 mm Ø).

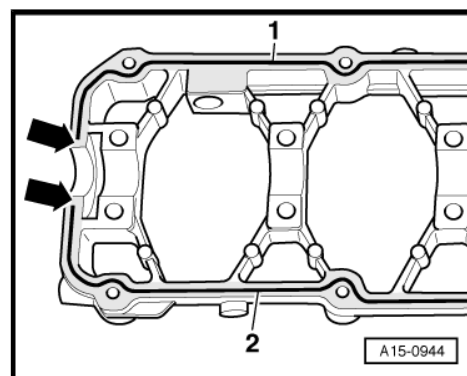


- Ensure all roller rocker fingers contact the valve ends -1- correctly and are clipped into their respective support elements -2-.

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



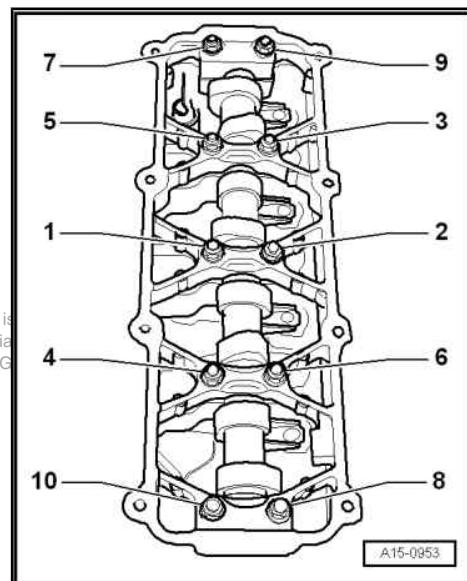
- Apply an even bead of sealant -1- and -2- onto the clean groove of the retaining frame (slightly projecting from the groove).
- Apply a thin coat of sealant onto the sealing surface in front of the ends of the beads of sealant -arrows-.



Note

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

- Insert rear sealing cap ⇒ [Item 15 \(page 95\)](#) so that it is flush.
- Fit retaining frame and lightly tighten nuts -3-, -4-, -5- and -6- diagonally in several stages.
- Then tighten nuts -1-, -2-, -7-, -8-, -9- and -10- slightly.
- Then tighten nuts in the sequence -1 ... 10- to the specified torque.
- Install cylinder head cover ⇒ [page 73](#).
- Renew camshaft oil seal ⇒ [page 96](#).
- Fit toothed belt (adjust valve timing) ⇒ [page 48](#).



Note

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

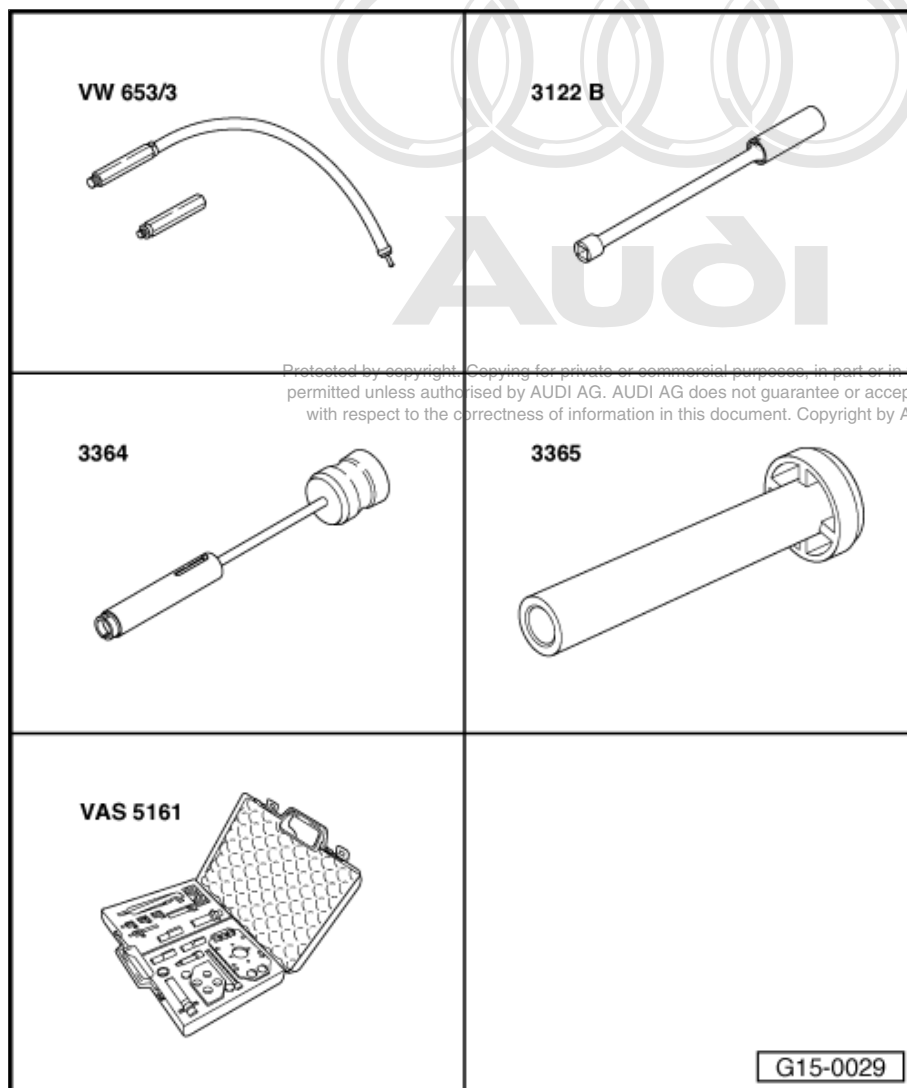
Tightening torque

Component	Nm
Retaining frame to cylinder head	23

3.5 Renewing valve stem oil seals

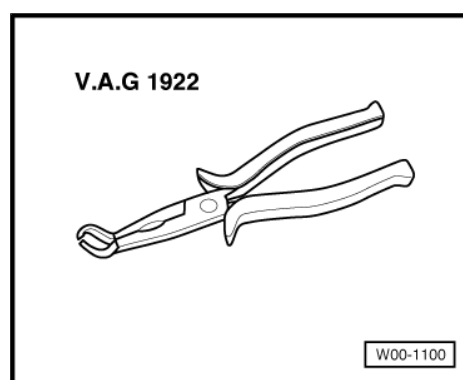
Special tools and workshop equipment required

- ◆ Pressure hose -VW 653/3-
- ◆ Spark plug socket and extension -3122 B-
- ◆ Valve stem seal puller -3364-
- ◆ Valve stem seal fitting tool -3365-
- ◆ Assembly and removal device for valve cotters -VAS 5161- with guide plate for 1.6 ltr. 2-valve engine -VAS 5161/20- and knurled spacer ring (height: 8.4 mm) -VAS 5161/21-5-



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



Procedure

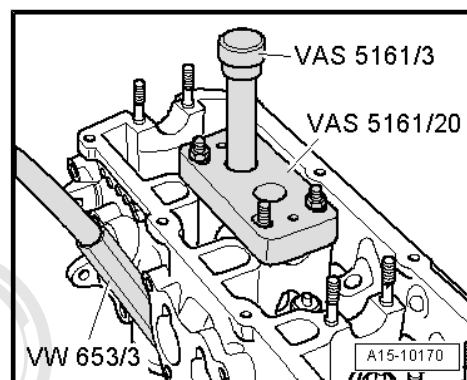
- Remove the camshaft ⇒ [page 98](#) .



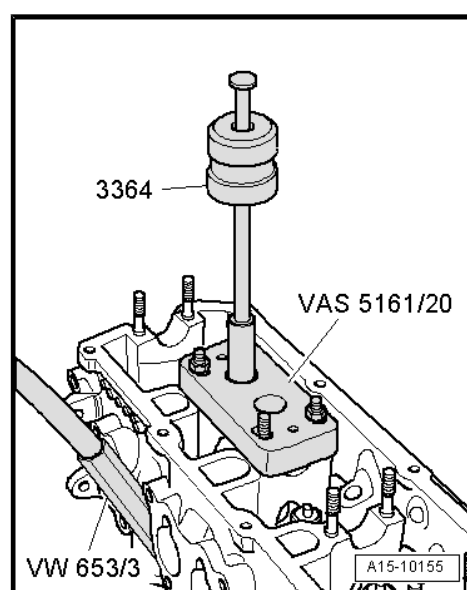
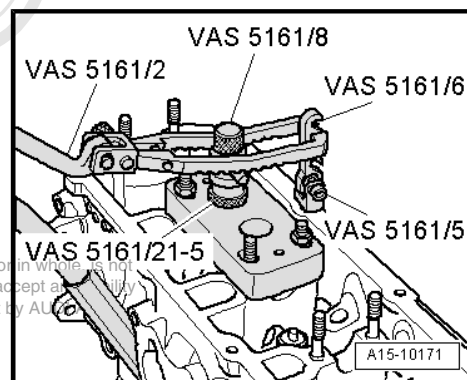
Note

Use waterproof felt-tip pen to mark the assignment of the roller rocker fingers.

- Remove roller rocker fingers and place onto a clean surface. When doing so, make sure that roller rocker fingers are not interchanged.
- Detach spark plug connectors using spark plug connector pliers -V.A.G 1922- .
- Remove spark plugs with spark plug socket -3122 B- .
- Set piston of the respective cylinder to "bottom dead centre".
- Fit guide plate -VAS 5161/20- onto cylinder head.
 - The marking "OBEN" (TOP) faces upwards.
- Secure guide plate with two nuts.
- Screw pressure hose -VW 653/3- into spark plug hole and connect to compressed air supply.
 - Air pressure: at least 6 bar
- Insert drift -VAS 5161/3- into guide plate and knock valve cot-
ters loose using a plastic hammer.



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





Note

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

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

- Remove the plastic sleeve.

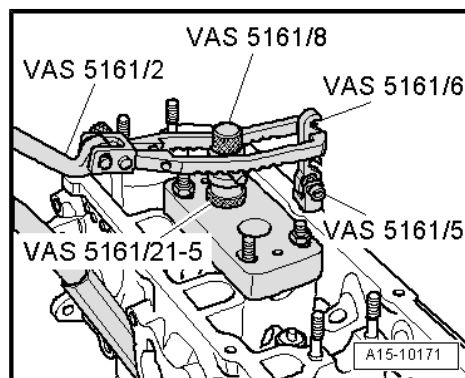
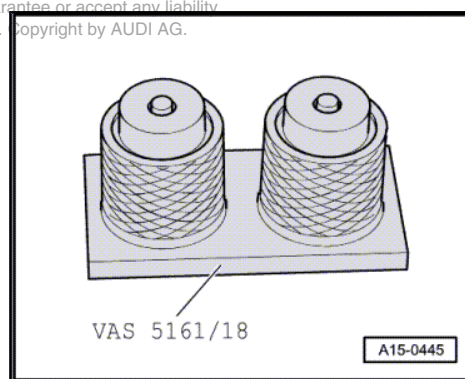
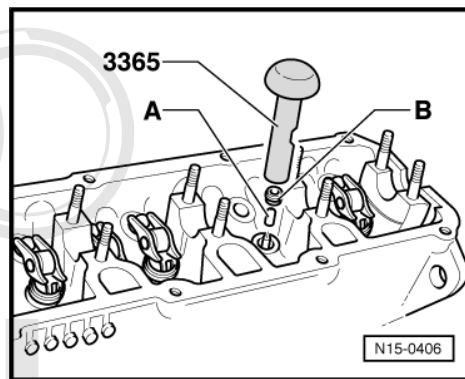
- If valve cotters have been removed from assembly cartridge, they need to be put into insertion device -VAS 5161/18- first.

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

- Re-insert assembly cartridge with knurled spacer ring (height: 8.4 mm) into guide plate.
- Push pressure fork down and pull knurled screw upwards while turning to left and right - this will insert the valve cotters.
- Release the pressure fork with knurled screw still in pulled position.
- Install roller rocker fingers.

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

- Install spark plugs ⇒ Rep. Gr. 28 .
- Install camshaft ⇒ [page 98](#) .



Note

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

3.6 Checking supporting elements with hydraulic clearance compensation

Special tools and workshop equipment required

- ◆ Feeler gauge

Test sequence



Note

- ◆ *It is not possible to service the supporting elements with hydraulic clearance compensation.*
- ◆ *Irregular valve noises when starting engine are normal.*
- Start engine and let it run until the radiator fan has switched on once.
- Increase engine speed to approx. 2500 rpm for 2 minutes (perform test drive if necessary).



Note

If the irregular valve noises stop but recur repeatedly during short journeys, then the oil retention valve is defective. The oil retention valve is located in the oil filter bracket ⇒ [Item 20 \(page 117\)](#).

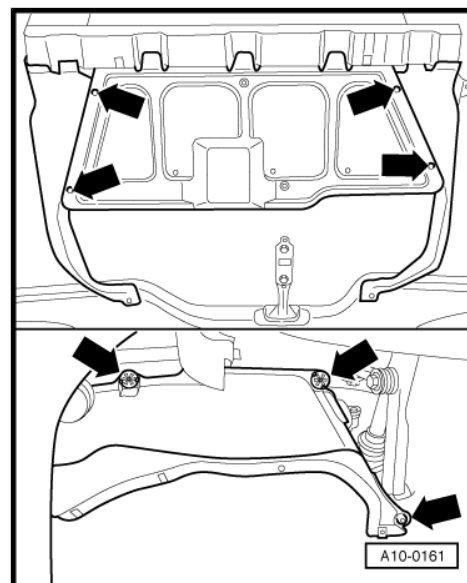
If the supporting elements with hydraulic clearance compensation are still noisy, proceed as follows to determine defective supporting element:

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- Remove cylinder head cover ⇒ [page 73](#).
- Turn crankshaft until cam of the supporting element to be checked is at the top (push vehicle in direction of travel with fourth gear engaged and ignition switched off).

Vehicles with automatic gearbox:

- Remove noise insulation panels (centre and right) -arrows-.
- Rotate crankshaft clockwise at centre bolt for toothed belt sprocket until cams of supporting element to be checked are pointing upwards.



All models:

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

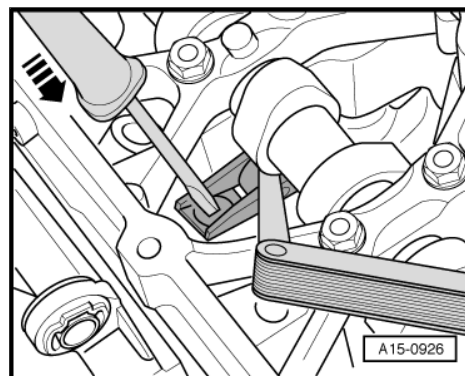
If it is possible to insert a feeler gauge of 0.20 mm between camshaft and roller rocker finger:

- Renew supporting element
⇒ ["3.4 Removing and installing camshaft", page 98](#) .



Note

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



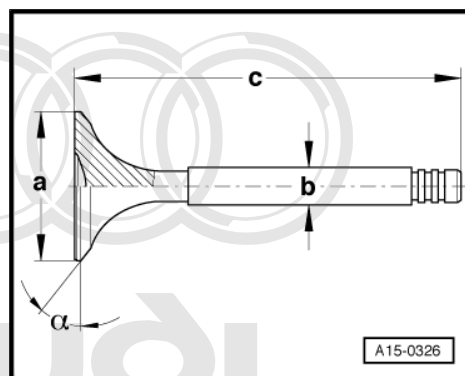
3.7 Valve dimensions



Note

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

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

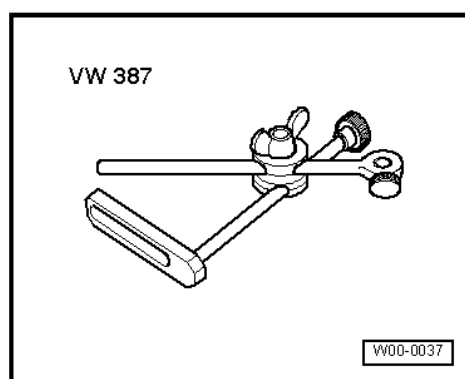


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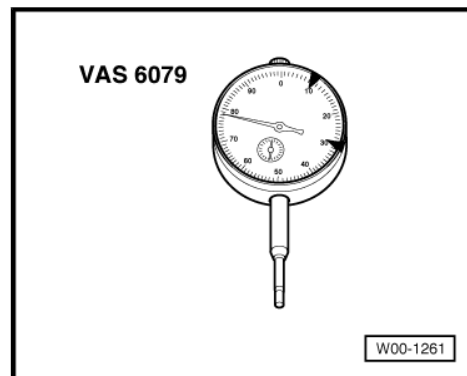
3.8 Checking valve guides

Special tools and workshop equipment required

- ◆ Universal dial gauge bracket -VW 387-



- ◆ Dial gauge -VAS 6079-



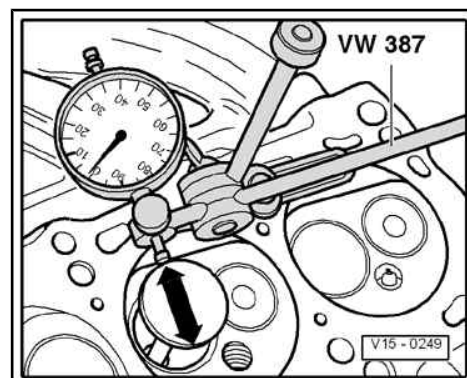
Test sequence

- Insert valve into valve guide.
- End of valve stem must be flush with guide.
- Determine amount of sideways play.
- Wear limit (sideways play): 0.6 mm.



Note

- ◆ *If the wear limit is exceeded, repeat the measurement with new valves. Renew cylinder head if wear limit is still exceeded. Valve guides cannot be renewed.*
- ◆ *If the valve has to be renewed as part of a repair, use a new valve for the measurement.*



3.9 Machining valve seats



Note

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

Special tools and workshop equipment required

- ◆ Depth gauge
- ◆ Valve seat machining tool



Note

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- ◆ *When servicing engines with leaking valves, it is not sufficient to machine (reface) the valve seats and renew the valves. The valve guides must also be checked for wear. This is particularly important on high-mileage engines ⇒ [page 106](#).*
- ◆ *Valve seats should only be machined to the extent required to give a proper seating pattern.*
- ◆ *Calculate the maximum permissible machining dimension before machining.*
- ◆ *If the machining dimension is exceeded, the function of the hydraulic valve play compensation can no longer be guaranteed and the cylinder head must be renewed.*

Calculating maximum permissible machining dimension

- Insert valve and press firmly against valve seat.



Note

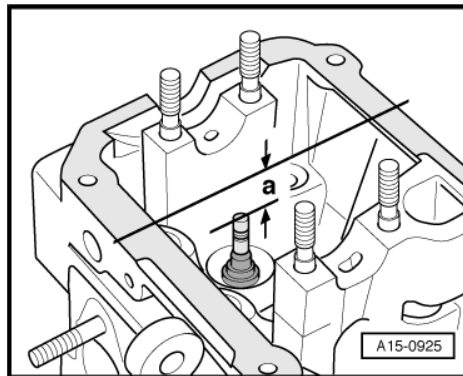
If the valve has to be renewed as part of a repair, use a new valve for the measurement.

- Measure distance -a- between top end of valve stem and upper surface of cylinder head with a depth gauge.
- Calculate max. permissible machining dimension from measured distance and minimum dimension.
- Minimum dimension for inlet valve and exhaust valve: 31.2 mm.

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

Example:

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



Note

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

Machining inlet valve seat

a - Ø 39.2 mm

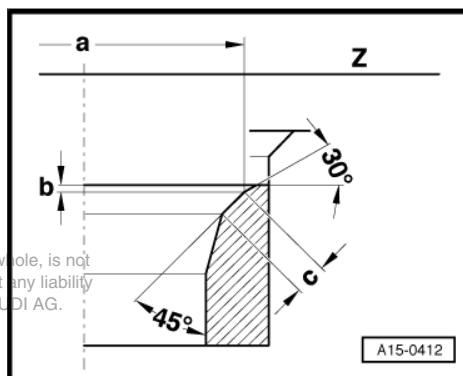
b - Maximum permissible machining dimension

c - 1.8 ... 2.2 mm

Z - Bottom surface of cylinder head

45° - Valve seat angle

30° - Correction angle (top)



Note

Calculating maximum permissible machining dimension
⇒ [page 108](#).

Machining exhaust valve seat

a - $\varnothing$ 32.4 mm

b - Maximum permissible machining dimension

c - 2.2 ... 2.6 mm

Z - Bottom surface of cylinder head

45° - Valve seat angle

30° - Correction angle (top)

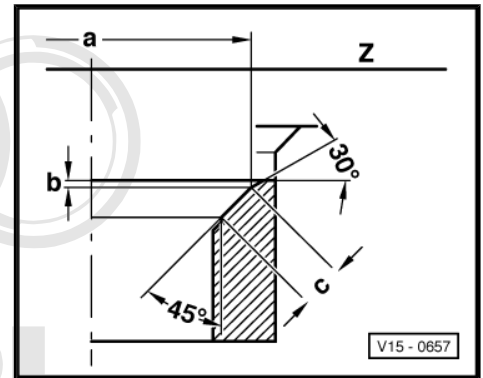


Note

- ◆ *Calculating maximum permissible machining dimension*

⇒ [page 108](#).

- ◆ *Exhaust valve seat inserts also have an additional constriction. When machining, it is essential to ensure that the radius of the constriction is not damaged.*



3.10 Checking valves

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

17 – Lubrication

1 Removing and installing parts of lubrication system



Note

- ◆ If large quantities of metal shavings or particles are found in the engine oil when repairing the engine, the oil passages must be cleaned carefully, and the oil cooler must be renewed in order to prevent further damage occurring later.
- ◆ The oil level must not be above max. mark on dipstick – danger of damage to catalytic converter.
- ◆ Oil spray jet and pressure relief valve ⇒ [page 111](#)

Viscosity grades and oil specifications ⇒ Maintenance ; Booklet 806 .

Oil capacities ⇒ Maintenance tables .

1.1 Sump, oil pump - exploded view of components

1 - Oil pump

- ☐ With pressure relief valve (12 bar)
- ☐ Removing and installing ⇒ [page 115](#)
- ☐ Before installing, check that the two dowel sleeves ⇒ [Item 9 \(page 111\)](#) for centralising oil pump/cylinder block are fitted
- ☐ Renew if running surfaces and gears are scored
- ☐ Tightening torque for oil pump cover to oil pump housing: 10 Nm

2 - Chain sprocket for oil pump

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

3 - 20 Nm + 90° (1/4 turn) further

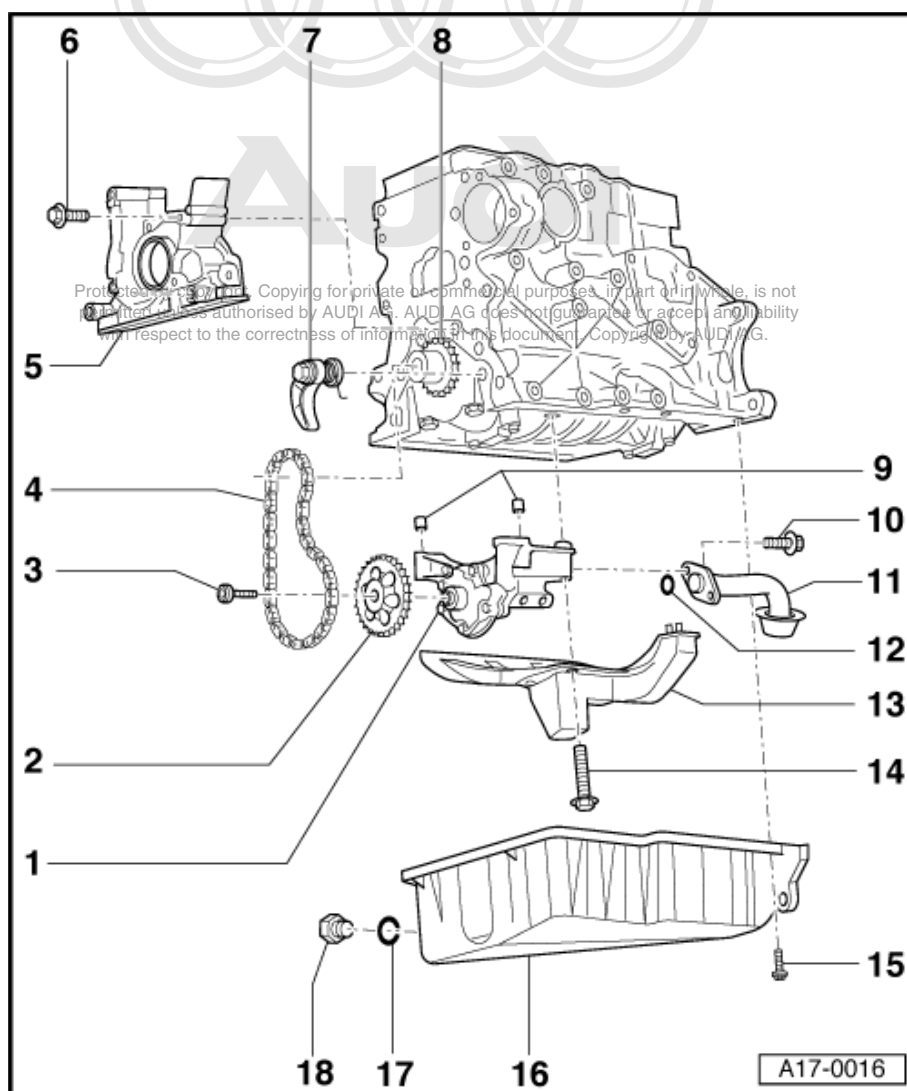
- ☐ Renew

4 - Drive chain for oil pump

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

5 - Sealing flange (front)

- ☐ Apply sealant prior to installing ⇒ [page 56](#)
- ☐ Renew crankshaft oil seal on pulley end



[⇒ page 54](#)

6 - 15 Nm

7 - Chain tensioner

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

8 - Chain sprocket for oil pump

- ☐ Removing and installing [⇒ page 65](#)

9 - Dowel sleeves

- ☐ 2 x

10 - 15 Nm

11 - Intake pipe

- ☐ Clean strainer if dirty

12 - O-ring

- ☐ Renew

13 - Baffle plate

14 - 16 Nm

15 - 15 Nm

16 - Sump

- ☐ Removing and installing [⇒ page 112](#)
- ☐ With oil level/oil temperature sender -G266-
- ☐ Removing and installing the oil level/temperature sender -G266- [⇒ page 112](#)

17 - Seal

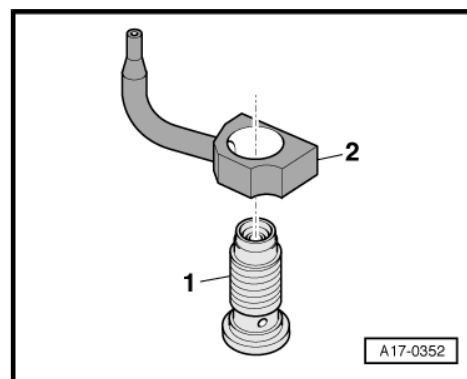
- ☐ Renew

18 - Oil drain plug, 30 Nm

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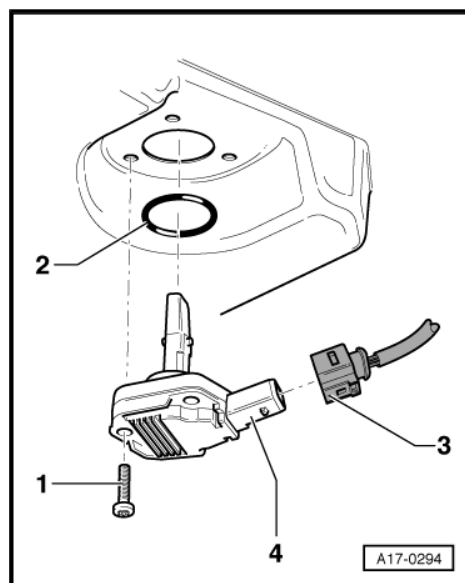
Oil spray jet and pressure relief valve

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



Removing and installing oil level/temperature sender -G266-

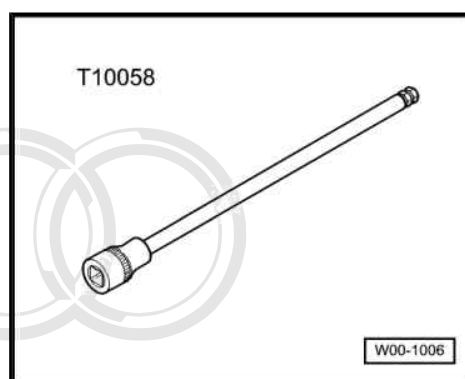
- 1 - Bolt -10 Nm-; self-locking, renew
- 2 - O-ring; renew
- 3 - Electrical connector
- 4 - With oil level/oil temperature sender -G266-



1.2 Removing and installing sump

Special tools and workshop equipment required

- ◆ Allen key (long reach) -T10058-

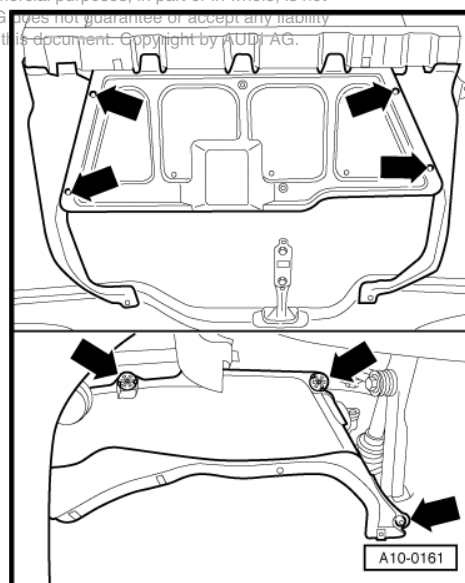


- ◆ Electric drill with plastic brush attachment
- ◆ Safety goggles
- ◆ Sealant ⇒ Parts catalogue

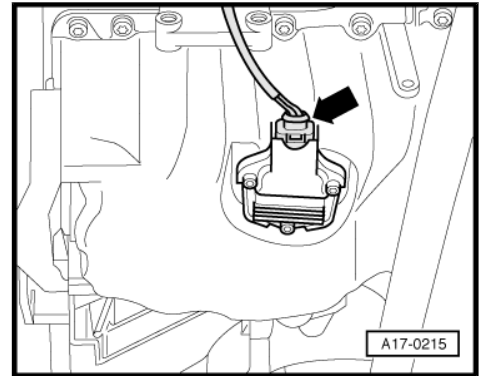
Removing

- Remove noise insulation panels (centre and right) -arrows-.
- Drain engine oil ⇒ Maintenance ; Booklet 806 .

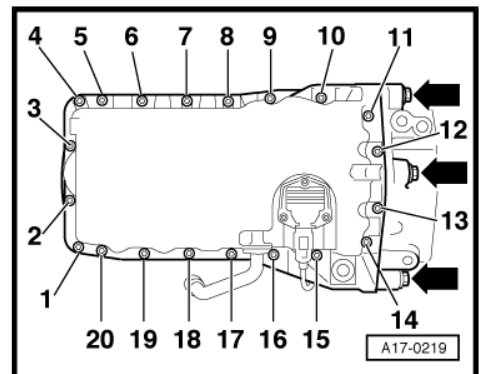
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- Unplug electrical connector -arrow- at oil level/oil temperature sender -G266- .



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



Installing

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

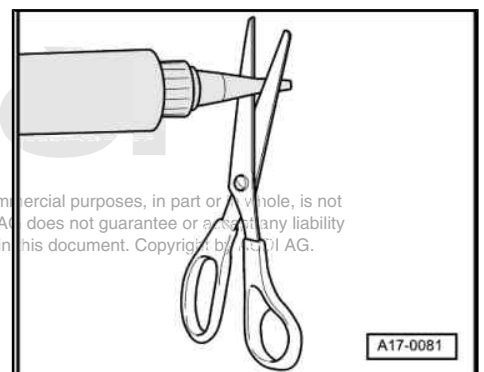
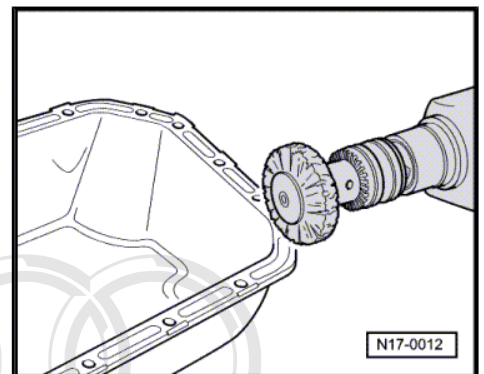
- Carefully remove sealant residues from cylinder block. For this purpose, remove baffle plate.



WARNING

Wear safety goggles.

- Remove sealant residue from sump, e.g. with rotating plastic brush or similar.
- Clean sealing surfaces; they must be free of oil and grease.
- Cut off tube nozzle at front marking (nozzle approx. 3 mm Ø).



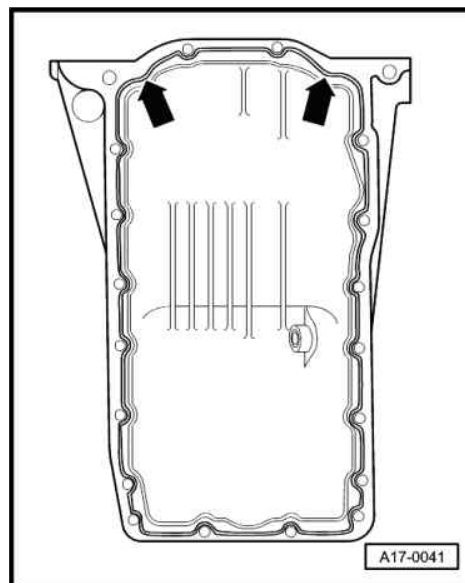
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- Apply bead of sealant onto the clean sealing surface of the sump as shown in the illustration.
- Thickness of sealant bead: 2 ... 3 mm



Note

- ◆ *The bead of sealant must not be thicker than specified, otherwise excess sealant can enter the sump and obstruct the strainer in the oil intake pipe.*
- ◆ *Take particular care when applying sealant bead in area of rear sealing flange -arrows- as shown in this figure.*
- ◆ *The sump must be installed within 5 minutes after applying sealant.*



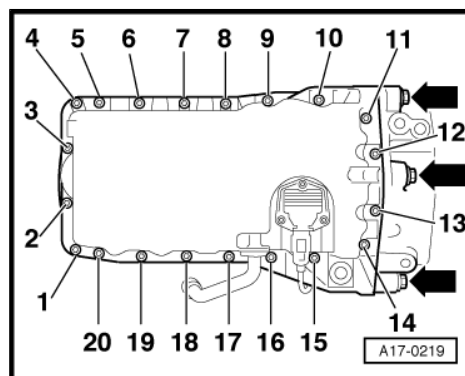
- Immediately install sump and tighten bolts in the following sequence:

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



Note

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



- Fill up with engine oil and check oil level.

Tightening torques

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

1.3 Removing and installing oil pump

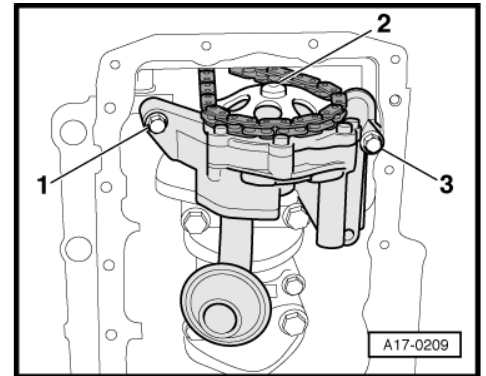
Removing

- Remove sump and baffle plate ⇒ [page 112](#) .
- Remove bolt -2-.
- Pull chain sprocket off oil pump shaft.
- Unscrew bolts -1- and -3- and remove oil pump.

Installing

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

- Insert dowel sleeves ⇒ [Item 9 \(page 111\)](#) at top of oil pump.
- Installation position: Chain sprocket can only be fitted in one position on oil pump shaft.
- Install sump ⇒ [page 112](#) .



Tightening torques

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

1.4 Oil filter, oil filter bracket - exploded view of components

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1 - Screw plug, 40 Nm
2 - Seal

- ☐ Not available as separate replacement part

3 - Spring

- ☐ For pressure relief valve, approx. 4 bar

4 - Piston

- ☐ For pressure relief valve, approx. 4 bar

5 - Gasket

- ☐ Renew

6 - Oil retention valve

- ☐ Removing and installing
⇒ [page 117](#)

7 - O-ring

- ☐ Renew
- ☐ Fit onto oil retention valve
⇒ [Item 6 \(page 116\)](#)

8 - O-ring

- ☐ Renew
- ☐ Slip on as far as collar of pipe
⇒ [Item 9 \(page 116\)](#)

9 - Crankcase breather pipe
10 - Retaining clip
11 - Screw plug, 15 Nm
12 - Seal

- ☐ If seal is leaking, cut open and renew

13 - Oil pressure switch -F1-, 1.4 bar, 25 Nm

- ☐ Black insulation
- ☐ Checking ⇒ [page 117](#)

14 - Seal

- ☐ If seal is leaking, cut open and renew

15 - 15 Nm + 90° (1/4 turn) further

- ☐ Renew

16 - Gasket

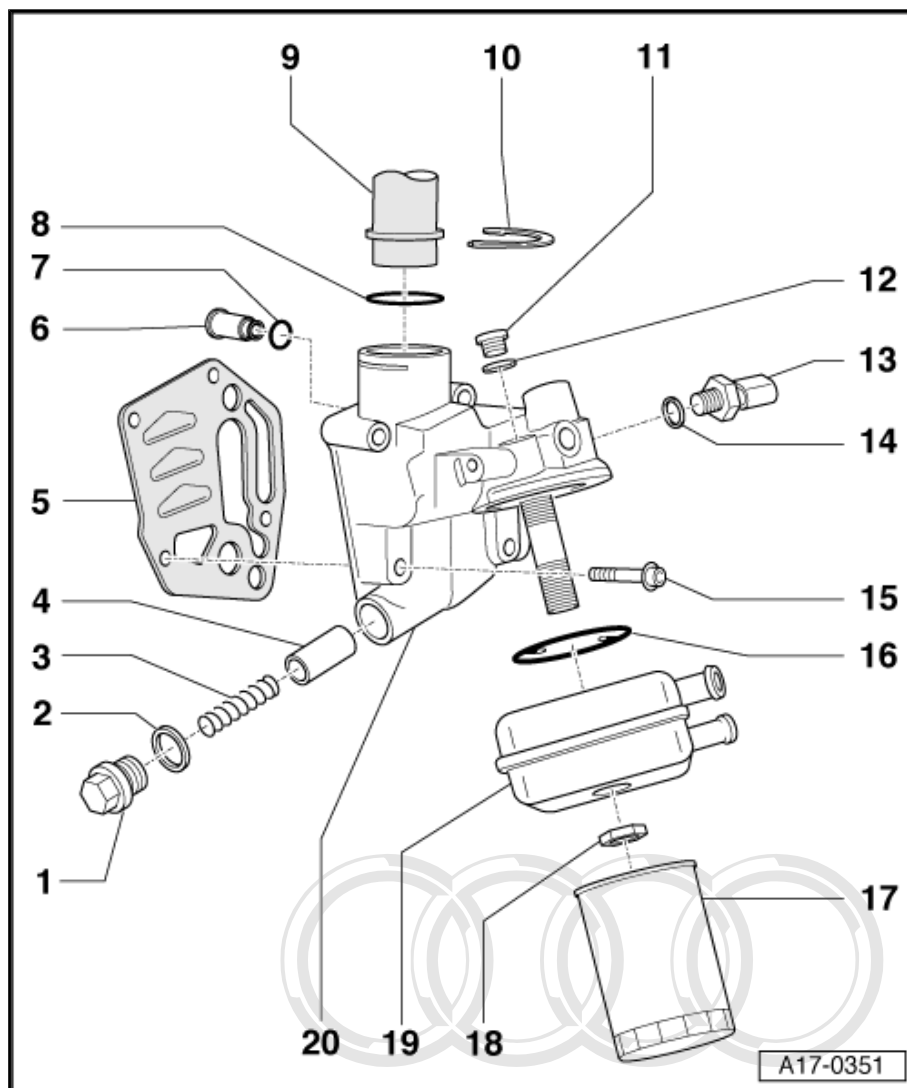
- ☐ Renew
- ☐ Engage in lugs on oil cooler

17 - Oil filter

- ☐ Observe change intervals ⇒ Maintenance ; Booklet 806
- ☐ Observe installation instructions on oil filter
- ☐ Tighten to 20 Nm

18 - 25 Nm
19 - Oil cooler

- ☐ See note ⇒ [page 110](#)



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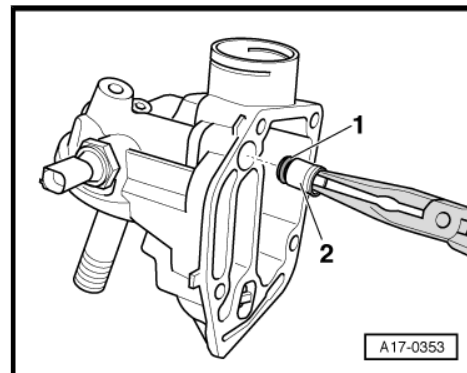
- ☐ Ensure clearance from surrounding components
- ☐ Diagram of coolant hose connections ⇒ [page 121](#)

20 - Oil filter bracket

- ☐ With pressure relief valve, approx. 4 bar

Removing and installing oil retention valve

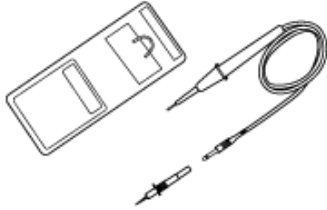
- Oil filter bracket must be removed.
- Pull out oil retention valve -2- using long-nose pliers (turn backwards and forwards when removing).
- Renew seal -1-.
- Press in new oil retention valve onto stop.



1.5 Checking oil pressure and oil pressure switch

Special tools and workshop equipment required

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

V.A.G 1342 	V.A.G 1527 B 
V.A.G 1594 C 	
	G17-0023

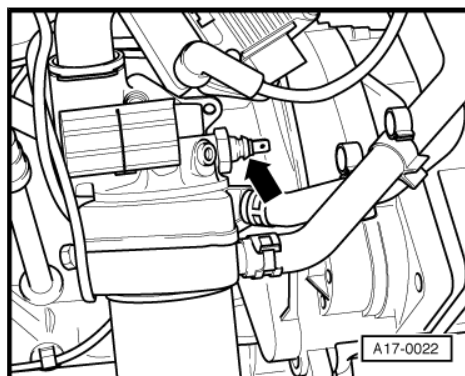
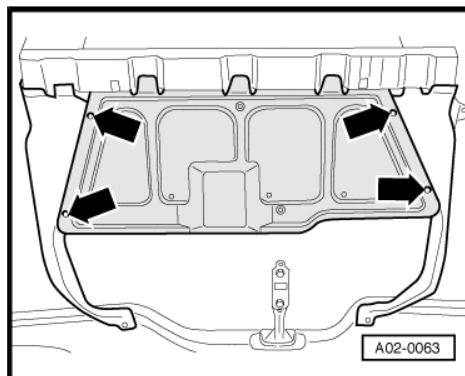


Test conditions

- Oil level OK
- Engine oil temperature approx. 80 °C
- Oil pressure warning lamp -K3- should come on when ignition is switched on.
- On vehicles with driver information system (DIS), the message "OK" should light up in the display.

Preparation for test

- Remove centre noise insulation -arrows-.
- Unplug electrical connector at oil pressure switch -F1- -arrow-.
- Unscrew oil pressure switch.



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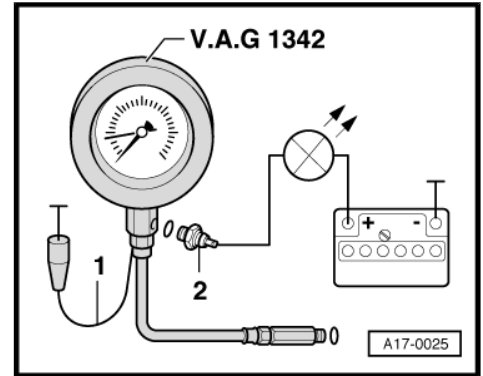
- Connect oil pressure tester -V.A.G 1342- to threaded hole for oil pressure switch.
- Screw oil pressure switch -2- into oil pressure tester -V.A.G 1342- .

Checking oil pressure switch

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

If the LED lights up:

- Renew oil pressure switch.
- Start engine.



Note

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

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

If the LED does not light up:

- Renew oil pressure switch.

Checking oil pressure

- Start engine (engine oil temperature approx. 80 °C).
- Minimum oil pressure at idling speed: 1.2 bar.
- Minimum oil pressure at 2000 rpm: 3.5 bar.

The pressure relief valve or oil pump is defective if the specifications are not attained.

- Renew the oil pump ⇒ [page 115](#) .

1.6 Engine oil

Viscosity grades and oil specifications ⇒ Maintenance ; Booklet 806 .

1.7 Checking oil level

Test conditions

- 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 sump.

Test sequence

- Pull out the dipstick, wipe off with a clean cloth and insert it again as far as it will go.
- Pull out the dipstick again and read off the oil level.



Markings on oil dipstick:

a - Do not top up oil.

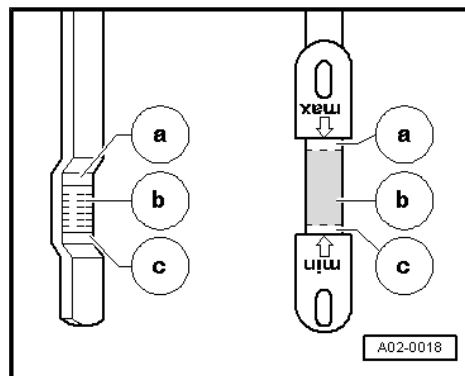
b - Oil may be topped up. The oil level may rise as far as area -a- after topping up.

c - Oil must be topped up. It is sufficient if the oil level is somewhere in area -b- (grooved area on dipstick) after topping up.



Note

The oil level must not be above the "max" marking and not below the "min" marking.



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19 – Cooling

1 Removing and installing parts of cooling system



WARNING

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



Note

- ◆ *The cooling system is under pressure when the engine is hot. If necessary, relieve pressure before commencing repair work.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- ◆ *Hose clip pliers -V.A.G 1921- or spring-type clip pliers -VAS 5024 A- are recommended for installing spring-type clips.*
- ◆ *Renew gaskets and seals.*
- ◆ *The arrow markings on coolant pipes and on ends of hoses must align.*

1.1 Diagram of coolant hose connections



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1 - Radiator

- ☐ Removing and installing
⇒ [page 145](#)
- ☐ If renewed, refill system
with fresh coolant

2 - Oil cooler

- ☐ Removing and installing
⇒ [Item 19 \(page 116\)](#)

3 - Coolant pump

- ☐ Removing and installing
⇒ [page 128](#)

4 - Cylinder head/cylinder block

- ☐ If renewed, refill system
with fresh coolant

5 - Expansion tank

- ☐ With filler cap
- ☐ Checking pressure relief valve in filler cap
⇒ [page 150](#)

6 - Intake manifold

7 - Heating for throttle valve housing

8 - Heat exchanger

- ☐ If renewed, refill system
with fresh coolant

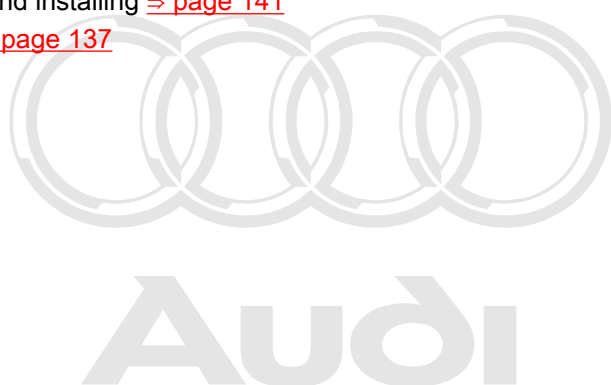
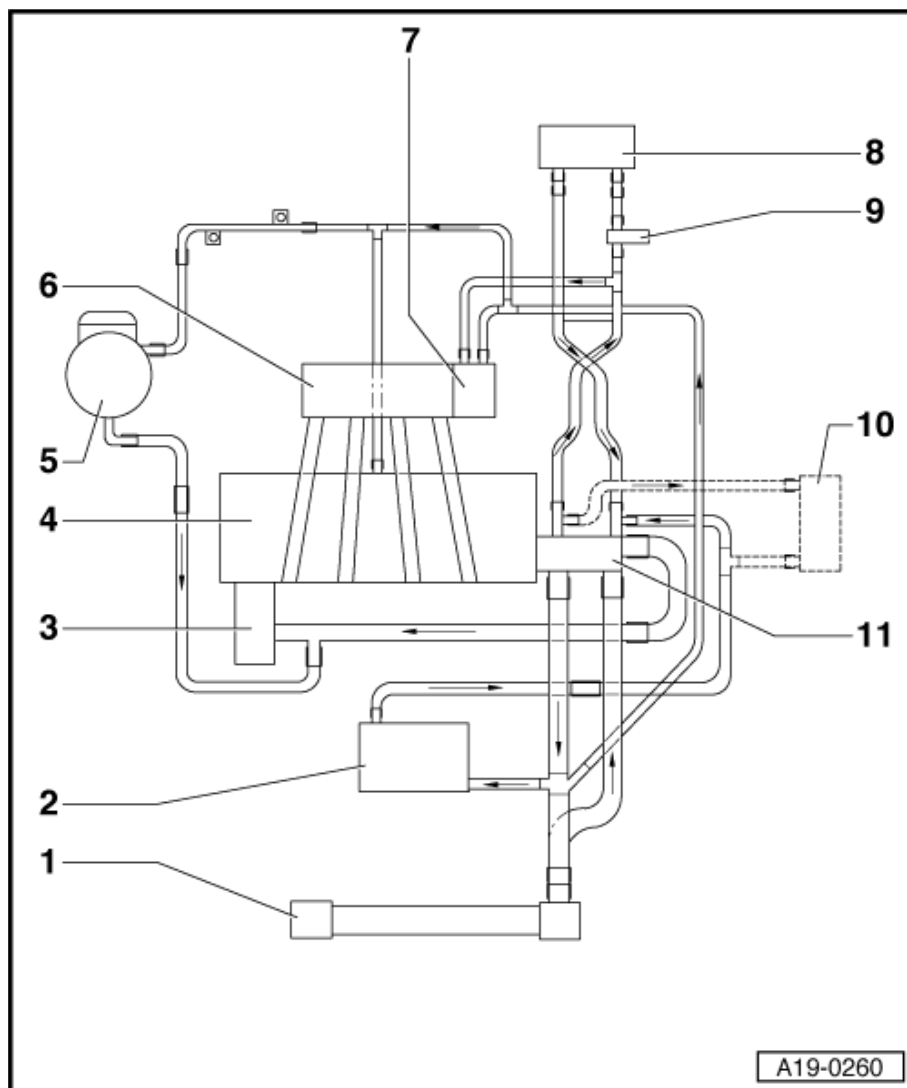
9 - Heating valve

10 - ATF cooler

- ☐ Vehicles with automatic
gearbox only

11 - Thermostat for map-controlled engine cooling system

- ☐ Removing and installing ⇒ [page 141](#)
- ☐ Checking ⇒ [page 137](#)

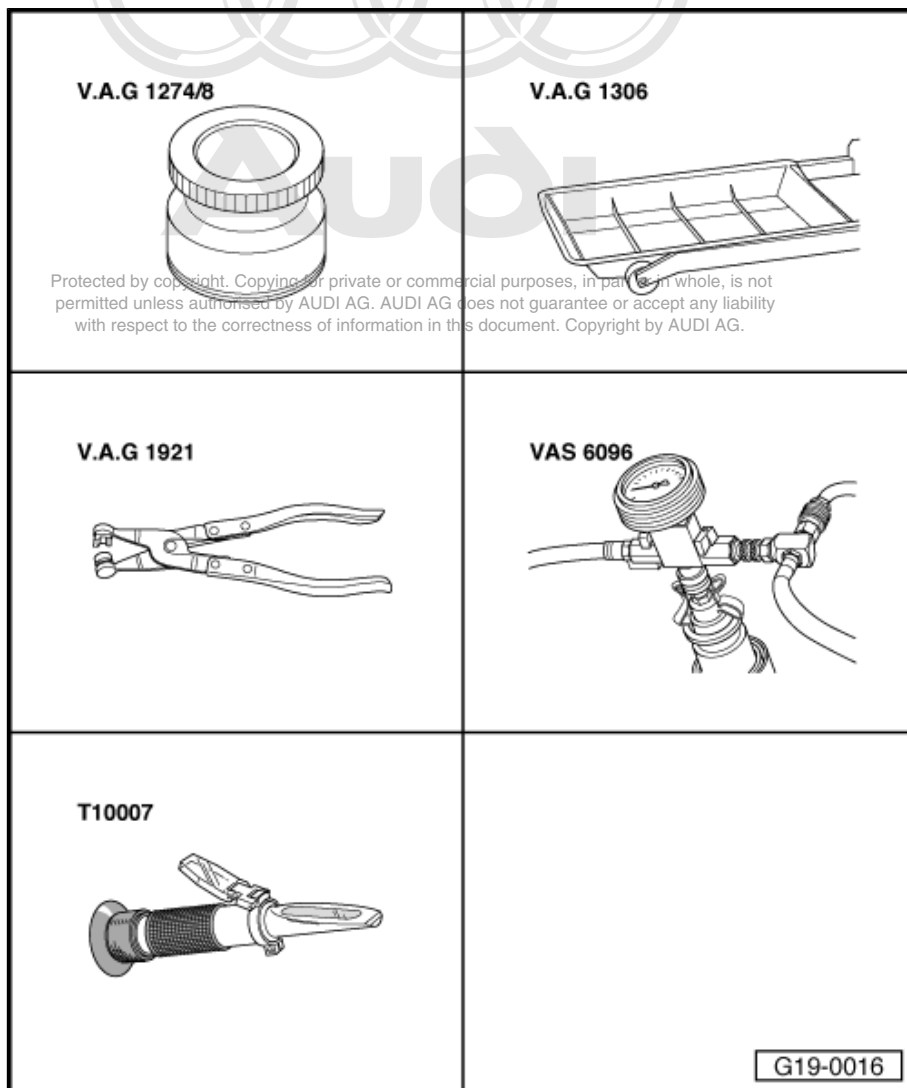


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1.2 Draining and filling cooling system

Special tools and workshop equipment required

- ◆ Adapter for cooling system tester -V.A.G 1274/8-
- ◆ Drip tray for workshop hoist -VAS 6208- or -V.A.G 1306-
- ◆ Hose clip pliers -V.A.G 1921-
- ◆ Cooling system charge unit -VAS 6096- with -VAS 6096/1-
- ◆ Refractometer -T10007-



Draining



Note

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

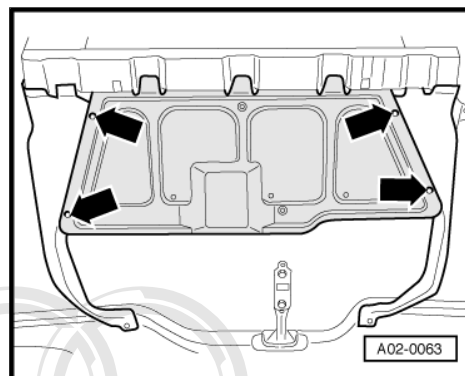


WARNING

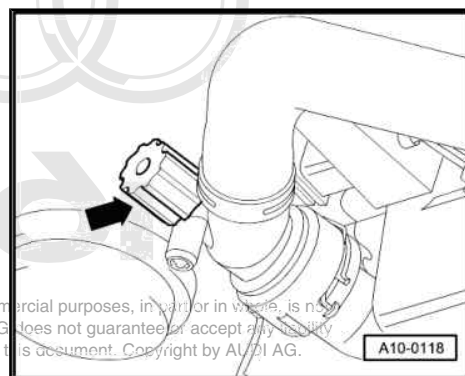
Hot steam or hot coolant can escape when expansion tank is opened; cover filler cap with cloth and open carefully.

- Open filler cap on coolant expansion tank.

- Remove centre noise insulation -arrows-.



- Place drip tray for workshop hoist -VAS 6208- or -V.A.G 1306- under engine.
- Turn drain plug -arrow- on radiator anti-clockwise, if necessary fit drain hose to connection.



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

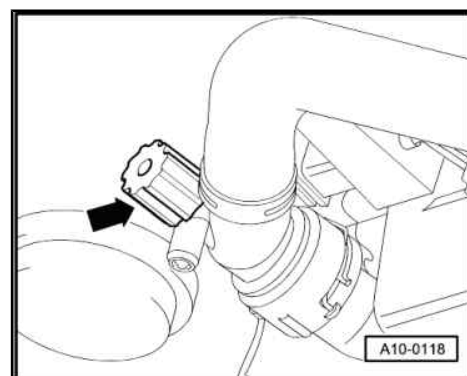
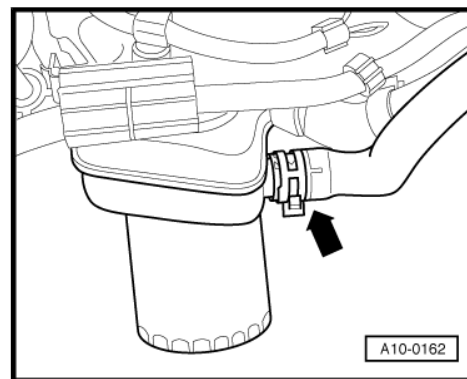
Filling



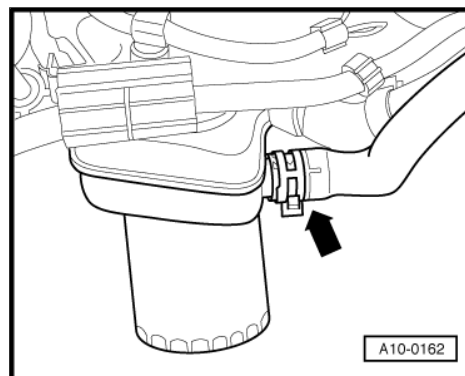
Note

- ◆ The cooling system is filled all year round with a mixture of water and radiator antifreeze/anti-corrosion agent.
- ◆ It is important to use only coolant additive Plus -G 012 A8F A1- (also designated as "G12+") "meeting specification TL VW 774 F". Other coolant additives could seriously impair in particular the anticorrosion properties. The resulting damage could lead to loss of coolant and consequently to serious engine damage.
- ◆ Coolant additive "G12+" may be mixed with additives "G11" and "G12".
- ◆ "G12+" and coolant additives marked "Conforming with specification TL VW 774 F" prevent frost and corrosion damage and stop scale from forming. Such additives also raise the boiling point of the coolant. For these reasons the cooling system must be filled all year round with the correct antifreeze and anticorrosion additive.
- ◆ Because of its high boiling point, the coolant improves engine reliability under heavy loads, particularly in countries with tropical climates.
- ◆ Frost protection is required down to about -25°C (in countries with arctic climate: down to about -35°C).
- ◆ The coolant concentration must not be reduced by adding water even in warmer seasons and in warmer countries. The antifreeze percentage must be at least 40 %.
- ◆ If greater frost protection is required in very cold climates, the proportion of "G12+" can be increased, however only up to 60 % (giving frost protection to about -40°C). If antifreeze concentration exceeds 60%, frost protection is reduced again and cooling efficiency is also impaired.
- ◆ Use only clean tap water for mixing coolant.
- ◆ If radiator, heat exchanger, cylinder head, cylinder head gasket or cylinder block have been renewed, do not re-use old coolant.
- ◆ Contaminated or dirty coolant must not be used again.
- ◆ To check frost protection level of coolant additive "G12+" you must use a refractometer -T10007-.

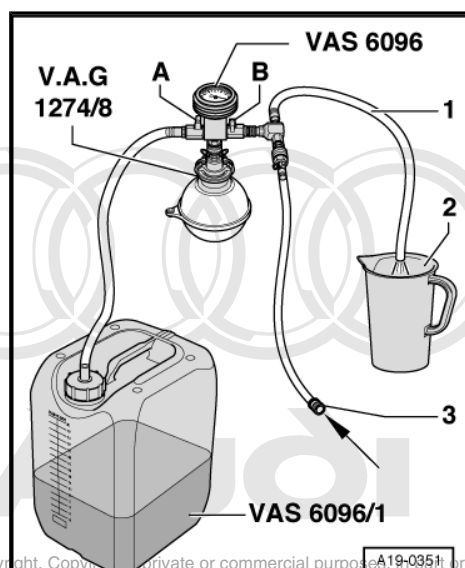
- Close drain plug -arrow-.



- Connect coolant hose to oil cooler -arrow-.



- Fill reservoir -VAS 6096/1- with at least 8 litres of premixed coolant (based on recommended ratio):
 - “G12+” (40 %) and water (60 %) for frost protection to –25°C
 - “G12+” (50 %) and water (50 %) for frost protection to –35°C
 - “G12+” (60 %) and water (40 %) for frost protection to –40°C
- Screw adapter for cooling system tester -V.A.G 1274/8- onto coolant expansion tank.
- Fit cooling system charge unit -VAS 6096- onto adapter - V.A.G 1274/8- .
- Run vent hose -1- into a small container -2-. (The vented air draws along a small amount of coolant, which should be collected.)
- Close both valves -A- and -B- (turn lever perpendicular to direction of flow).
- Connect hose -3- to compressed air.
- Pressure: 6 ... 10 bar.



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

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

- The needle on the gauge should move into the green zone.
- Also briefly open valve -A- (turn lever in direction of flow) so that hose on reservoir -VAS 6096/1- can fill with coolant.
- Close valve -A- again.
- Leave valve -B- open for another 2 minutes.
- The suction jet pump will continue generating a vacuum in the cooling system.
- The needle on the gauge should remain in the green zone.
- Close valve -B-.
- The needle on the gauge should stop in the green zone. The vacuum level in the cooling system is then sufficient for subsequent filling.

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

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

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

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

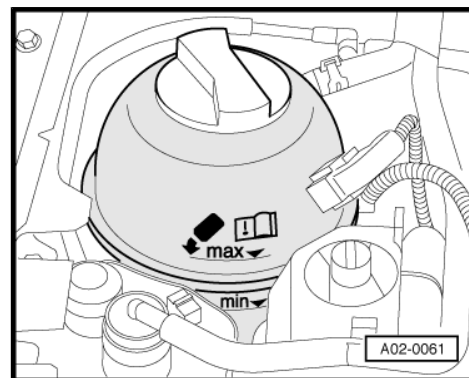
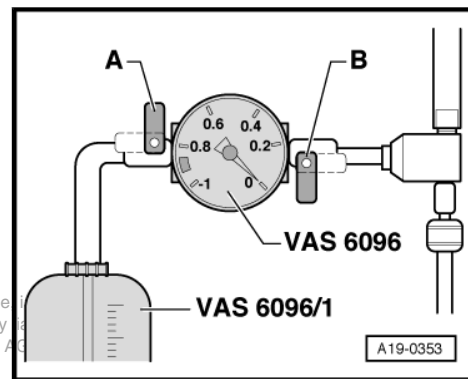
- On vehicles with auxiliary heater, switch heater on (for about 30 seconds) and then off again.
- Check the coolant level and top up coolant as far as the max mark.
- Start engine, run for max. 2 minutes at approx. 1500 rpm and top up coolant to overflow hole on expansion tank with engine running.
- Close filler cap on expansion tank.
- Run engine until radiator fan cuts in.
- Switch engine off.



WARNING

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

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



1.3 Removing and installing coolant pump

Special tools and workshop equipment required

- ◆ Drip tray for workshop hoist -VAS 6208- or -V.A.G 1306-
- ◆ Hose clip pliers -V.A.G 1921-

Removing

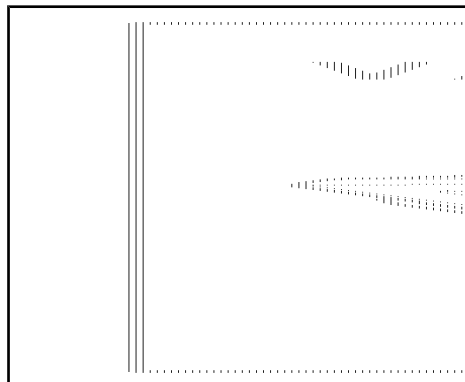


WARNING

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

- Open filler cap on coolant expansion tank.
- Take off engine cover panel -arrows-.

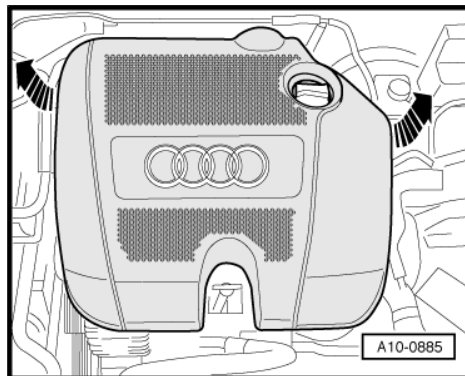
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V.A.G 1921

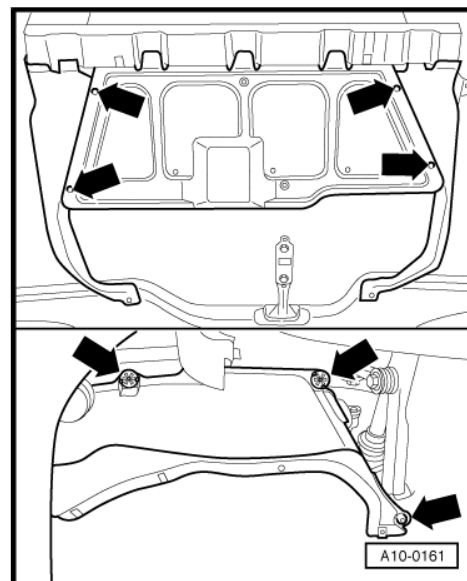


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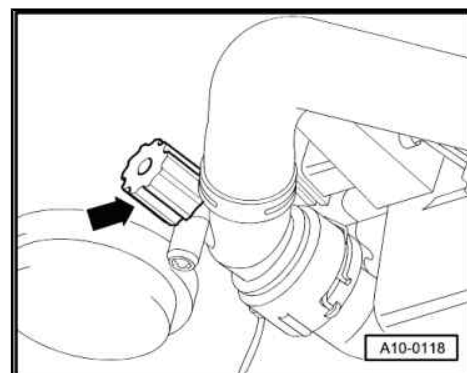


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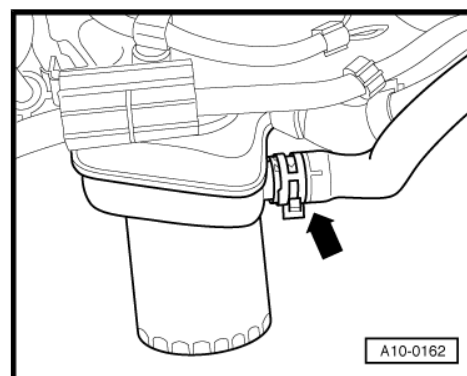
- Remove noise insulation panels (centre and right) -arrows-.



- Place drip tray for workshop hoist -VAS 6208- or -V.A.G 1306- under engine.
- Turn drain plug -arrow- on radiator anti-clockwise, if necessary fit drain hose to connection.



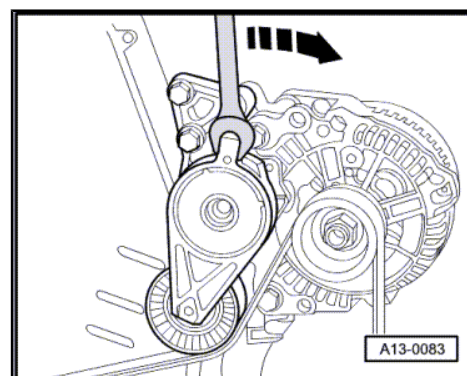
- Also disconnect coolant hose at bottom of oil cooler -arrow-, and drain off remaining coolant.



Note

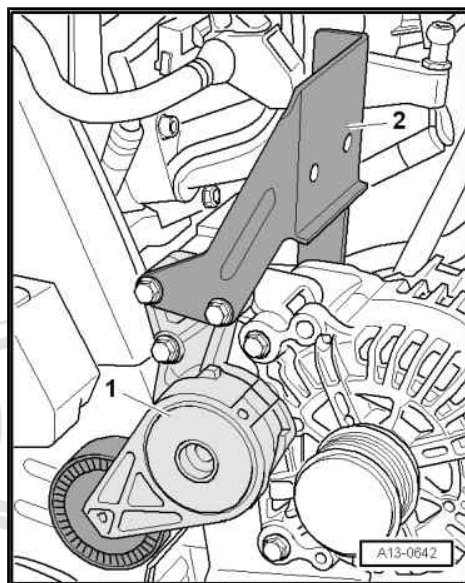
Before removing, mark direction of rotation of poly V-belt with chalk or felt-tipped pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.

- Turn the tensioner in the direction of the -arrow- to slacken the poly V-belt.
- Lock poly V-belt tensioner using locking pin -T10060 A- .
- Remove poly V-belt.



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- Detach splash plate -2-.
- Remove tensioner -1- for poly V-belt.



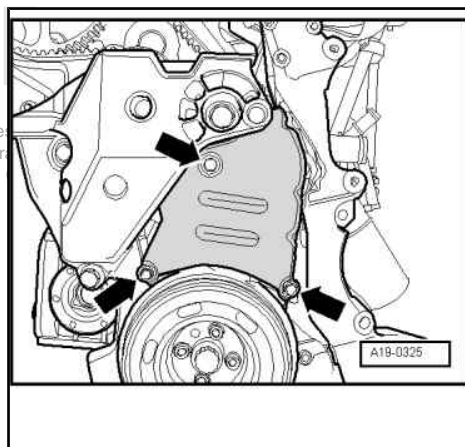
- Remove toothed belt from camshaft sprocket ⇒ [page 46](#) .
- Remove toothed belt cover (centre) -arrows-.



Note

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



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

Installing

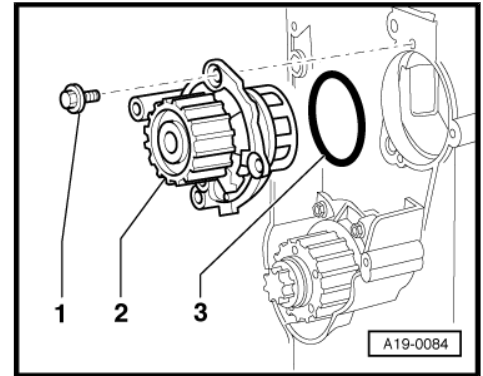
Installation is carried out in the reverse order; note the following:



Note

Renew O-ring.

- Clean and smoothen sealing surface for O-ring as required.
- Lubricate new O-ring -3- with coolant additive "G12+".
- Fit coolant pump -2-.
- Installation position: Sealing plug in housing faces downwards.
- Tighten bolts -1- for coolant pump.
- Fit toothed belt (adjust valve timing) [⇒ page 48](#) .
- Install poly V-belt [⇒ page 29](#) .
- Fill cooling system [⇒ page 125](#) .



Tightening torques

Component	Nm
Coolant pump to cylinder block	15
Toothed belt cover (centre) to cylinder block	10 ¹⁾
Tensioner for poly V-belt to bracket for ancillaries	23
Splash plate to bracket for ancillaries	23
• ¹⁾ Install using locking fluid; locking fluid ⇒ Parts catalogue .	

1.4 Map-controlled engine cooling system

Function

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

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

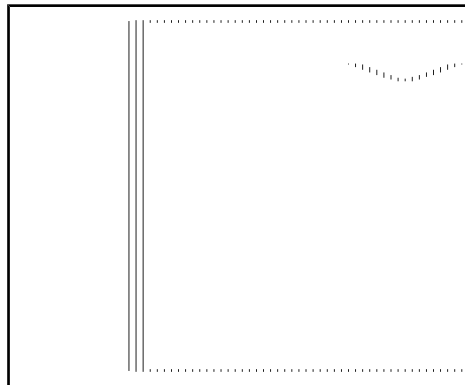
Further information: [⇒ Self-study programme No 222 ; "Electrically controlled cooling system"](#)

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1.5 Performing diagnosis of map-controlled engine cooling system

Special tools and workshop equipment required

- ◆ Vehicle diagnosis, testing and information system - VAS 5051 A- with diagnosis lead -VAS 5051/1-



Note

- ◆ The map-controlled engine cooling system is monitored by the engine control unit ⇒ Rep. Gr. 01 .
- ◆ In addition, the result of a continuous plausibility test can be read off in the function "Read measured value block", "Display group 130".

Test condition

- Vehicle diagnostic, testing and information system - VAS 5051 A- with diagnosis lead -VAS 5051/1- is connected; vehicle self-diagnosis and vehicle system "01 - Engine electronics" is selected. Engine must be idling.
- Coolant temperature at least 80 °C.

Test sequence

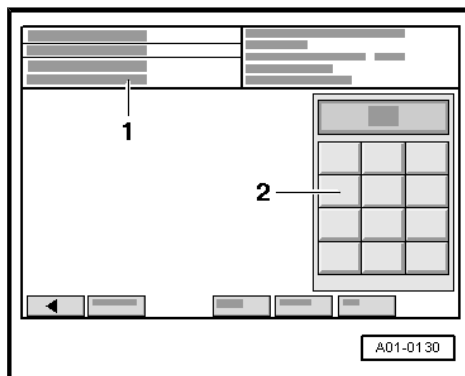
Display on -VAS 5051 A-

- From the list -1- select diagnostic function "08 - Read measured value block".



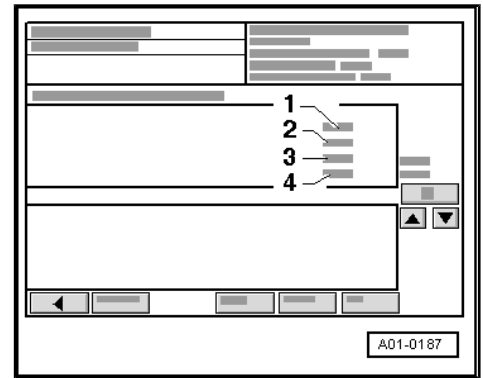
Display on -VAS 5051 A-

- 1 - Enter display group (highest possible entry = 255)
- Use keypad -2- to enter "130" for "Display group number 130" and confirm by touching the  key.



Display on -VAS 5051-

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



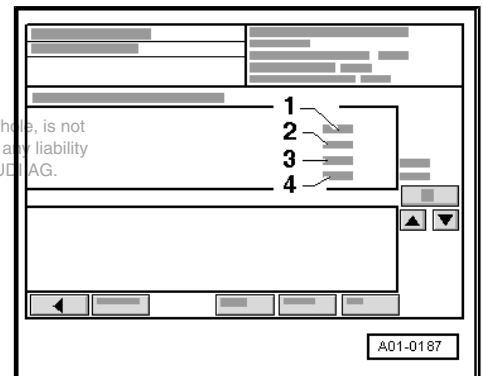
Display group 130: Map-controlled engine cooling system				
Display zone	Indicated on display	Display shows	Operating range	Specification
1	XXX.X °C	Coolant temperature at engine outlet		80 ... 115 °C ¹⁾
2	XXX.X °C	Coolant temperature at radiator outlet		max. 100 °C ¹⁾
4	XXXXXXXX	Diagnosis status	Test OFF Test ON Syst. OK Syst. n. OK	Syst. OK ²⁾
• ¹⁾ The coolant temperature at the engine outlet must always be above the temperature at the radiator outlet. • ²⁾ Only the plausibility of the system is checked. Therefore, "Syst. OK" may be displayed even though an electrical fault has been detected.				

- Switch to "display group 131" by touching the  key.

Display on -VAS 5051 A-

- Check display in zone -4-.

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Display group 131: Map-controlled engine cooling system				
Display zone	Indicated on display	Display shows	Specification	Note
4	XXXXXXXX	Status	0XXXXXXXX	If the display shows 1XXXXXXXX, the system has stored a fault relating to the map-controlled engine cooling system ¹⁾
• ¹⁾ Interrogate fault memory of engine control unit ⇒ Vehicle diagnosis, testing and information system VAS 5051.				

- Press the  button to exit from the function “08 - Read measured value block”.
- Press “06 - End output”.
- Switch off ignition.

1.6 Electrical test of map-controlled engine cooling system

Special tools and workshop equipment required

- ◆ Hand-held multimeter -
V.A.G 1526 A- or -
V.A.G 1526 B-
- ◆ Auxiliary measuring set -
V.A.G 1594 A- or -
V.A.G 1594 C-
- ◆ Adapter cable, 121-pin -
V.A.G 1598/31- (test box)

V.A.G 1526 A



V.A.G 1594 A



V.A.G 1598/31



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G24-0020

Test sequence



WARNING

The radiator fan motors may start up.



Note

Diagnosis of map-controlled engine cooling system has been performed => [page 131](#).

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Take off engine cover panel -arrows-

- Start engine and run at idling speed.
- Unplug electrical connector -1- at coolant temperature sender -G62-.



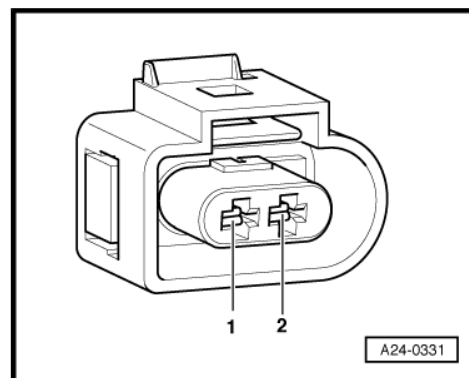
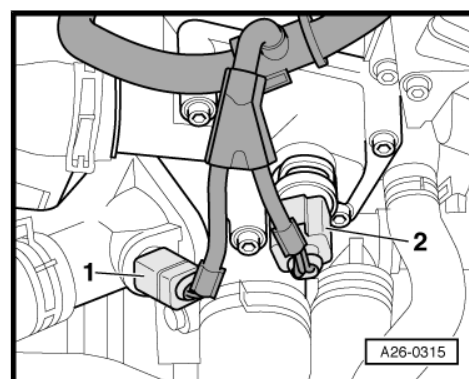
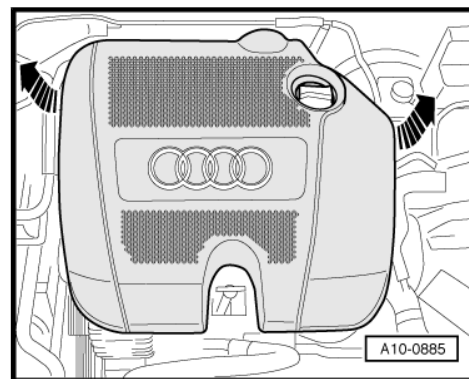
Note

Unplugging the connector from the coolant temperature sender -G62- 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 connector -2- at map-controlled engine cooling thermostat -F265-.
- Connect multimeter (voltage test range) between contacts -1- and -2-.
- Specification: Approx. battery voltage (after a short delay)

If specification is not obtained:

- Connect multimeter to measure voltage between contact -1- and earth.
- Specification: approx. battery voltage
- Switch off ignition.



If specification is not obtained:

- Check the wiring from contact 1 of the connector to the power supply relay for Simos control unit -J363- -item 2- (below cover on left of bulkhead) for open circuit using the current flow diagram.
- Repair wiring connection if necessary.

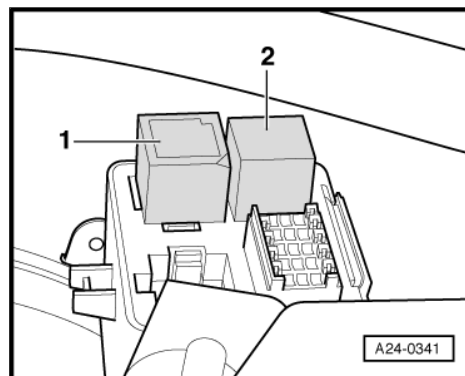
If no fault is found:

- Connect adapter cable, 121-pin -V.A.G 1598/31- (test box) to connectors of wiring harness; do not connect engine control unit. Connect earth clip of test box to earth ⇒ Rep. Gr. 24 .



Caution

To avoid damage to the electronic components, select the required measuring range and observe test conditions before connecting the test leads.



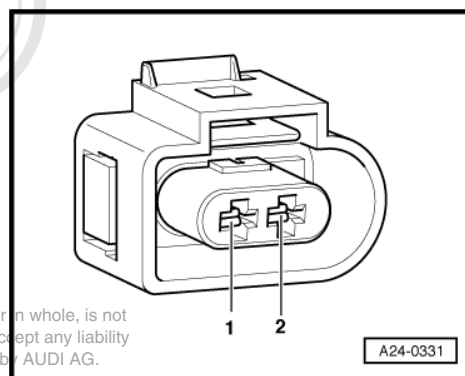
- Check for open circuit in the following wiring connection:

Connector Contact	Adapter cable, 121-pin -V.A.G 1598/31- (test box) Socket
-2-	116

- Repair wiring connection if necessary.

If no fault is found:

- Check function of the thermostat ⇒ [page 137](#)
- Plug in electrical connectors.
- Interrogate and erase the fault memory for engine control unit, as faults are stored when the connectors are unplugged ⇒ Vehicle diagnosis, testing and information system VAS 5051.



1.7 Coolant distributor housing - exploded view of components

1 - O-ring

- ☐ Renew

2 - Retaining clip

- ☐ Check for firm attachment

3 - 10 Nm

4 - O-ring

- ☐ Renew

5 - Coolant temperature sender -G62-

- ☐ For engine control unit
- ☐ With coolant temperature sender -G2-
- ☐ Checking ⇒ Rep. Gr. 01.

6 - Electrical connector

7 - Heating element connection

8 - 10 Nm

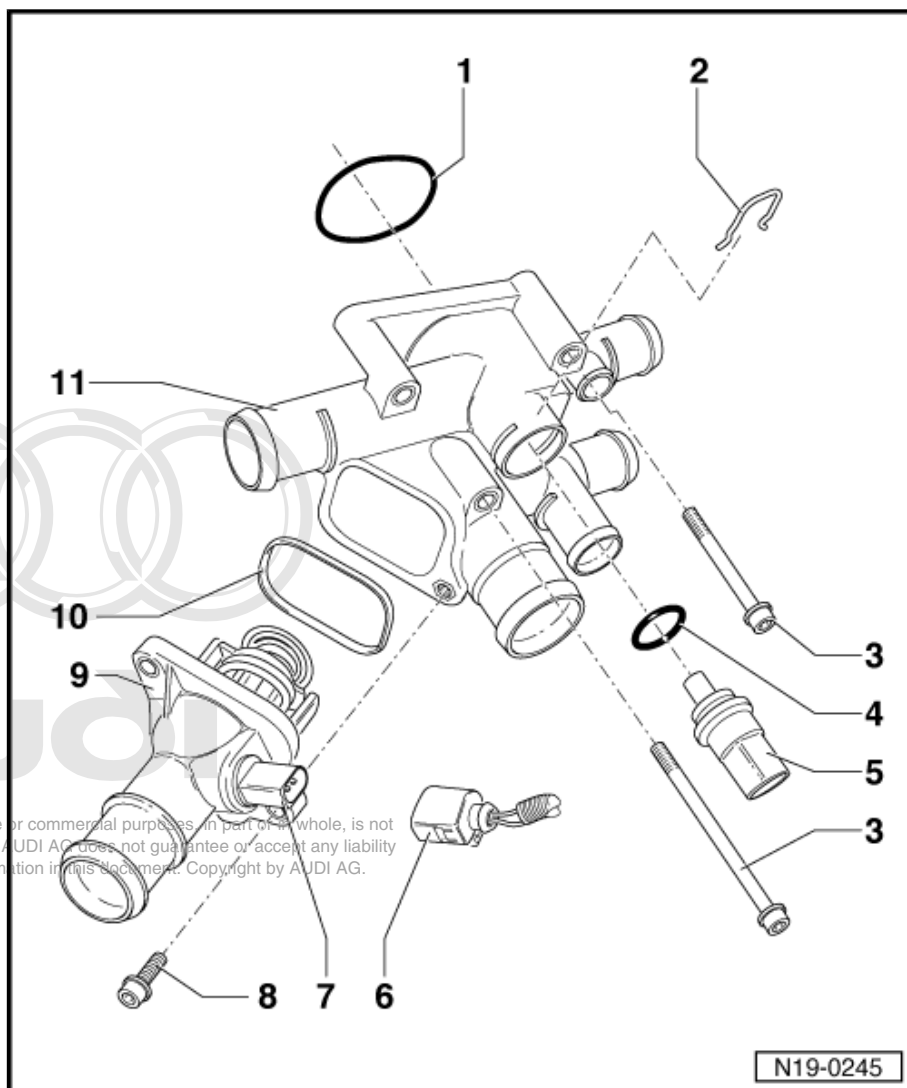
9 - Thermostat for map-controlled engine cooling system - F265-

- ☐ With hose connection
- ☐ With electrical heating element for controlled opening
- ☐ Checking ⇒ [page 137](#)
- ☐ Starts to open at approx. 105 °C
- ☐ Opening travel at least 7 mm
- ☐ Checking (electrical test) ⇒ [page 134](#)
- ☐ Removing and installing ⇒ [page 141](#)

10 - Seal

- ☐ Renew

11 - Coolant distributor housing



1.8 Checking thermostat for map-controlled engine cooling system

Special tools and workshop equipment required

◆ Hand-held multimeter -V.A.G 1526 B-

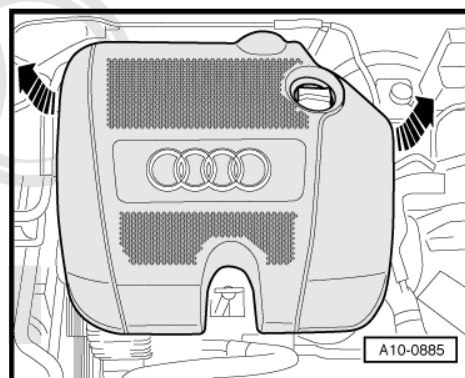


◆ Auxiliary measuring set -V.A.G 1594 C-



Testing internal resistance of heating element

- Engine cold.
- Take off engine cover panel -arrows-.



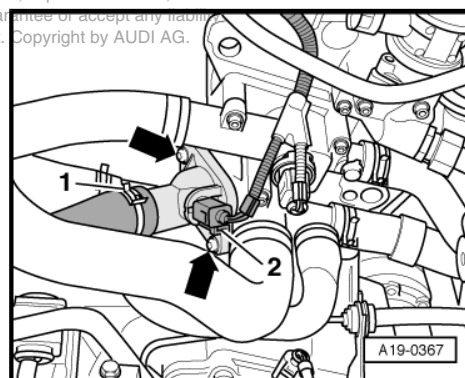
- Unplug connector -2- at map-controlled engine cooling thermostat -F265- .

- Connect multimeter to thermostat to measure resistance.

- Specification: 14 ... 16 Ω at 25°C.

If specification is not obtained:

- Renew map-controlled engine cooling thermostat -F265-
⇒ [page 141](#) .



Function test of thermostat

- Thermostat cold.
- Remove map-controlled engine cooling thermostat -F265- [⇒ page 141](#) .
- The large valve head -arrow- must seal off the connection flange all the way round.

If not:

- Renew map-controlled engine cooling thermostat -F265- .
- Connect the contacts of the map-controlled engine cooling thermostat -F265- to a battery using test leads from auxiliary measuring set -V.A.G 1594 C- .



WARNING

Wear protective gloves.

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

The electric heating element now additionally heats the wax in the thermostat.



Note

Do not expose the thermostat to air during this test, otherwise the expansion element can become damaged.

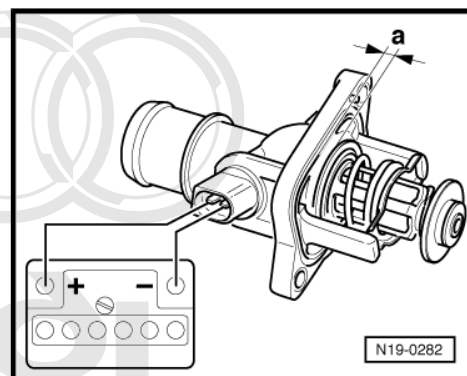
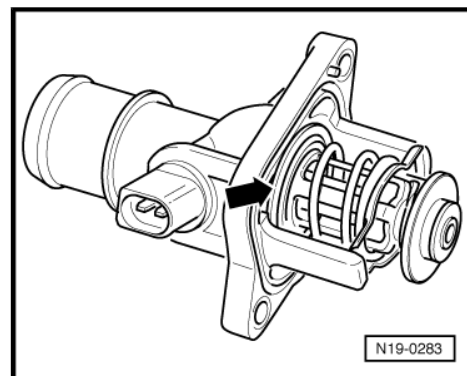
- Check whether the minimum travel of -a- = 7 mm is attained after 10 minutes,

If the specification is obtained:

- Disconnect voltage supply from battery.

If specification is not obtained:

- Renew map-controlled engine cooling thermostat -F265- .
- Interrogate and erase the fault memory for engine control unit, as faults are stored when the connector is unplugged ⇒ Vehicle diagnosis, testing and information system VAS 5051.



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1.9 Checking coolant temperature sender - radiator outlet -G83-

Special tools and workshop equipment required

◆ Hand-held multimeter -V.A.G 1526 B-



◆ Auxiliary measuring set -V.A.G 1594 C-

**Test sequence**

Fitting location: Bottom left of radiator.

**Note**

Checking coolant temperature sender -G62- ⇒ Rep. Gr. 28.

- Unplug electrical connector at coolant temperature sender - radiator outlet -G83- .
- Connect multimeter (resistance measurement range) to sender.

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Examples:

Area -A- shows the resistance values for the temperature range 0 ... 50 °C, area -B- the values for the temperature range 50 ... 100 °C.

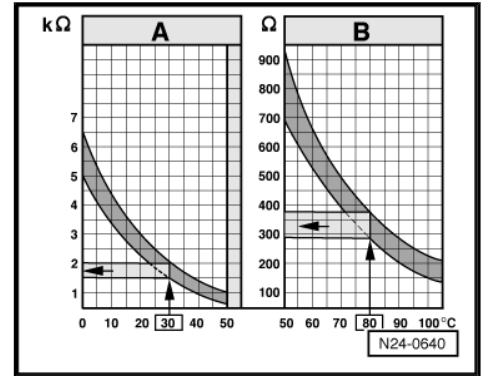
- ◆ 30 °C is measured in range -A- and corresponds to a resistance of 1.5 .. 2.0 kΩ.
- ◆ 80 °C is measured in range -B- and corresponds to a resistance of 275 .. 375 Ω.

If specification is not obtained:

- Renew coolant temperature sender - radiator outlet -G83- .

If reading matches specification:

- Switch off ignition.
- Connect adapter cable, 121-pin -V.A.G 1598/31- (test box) to connectors of wiring harness; do not connect engine control unit. Connect earth clip of test box to earth ⇒ Rep. Gr. 24 .



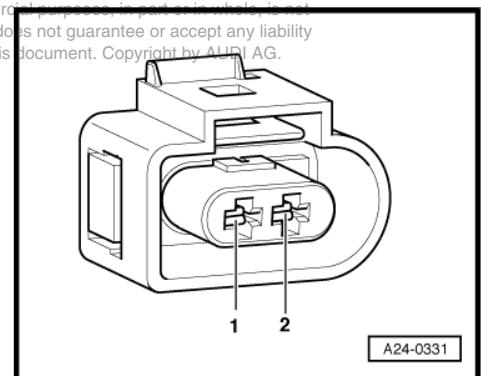
Caution

To avoid damage to the electronic components, select the required measuring range and observe test conditions before connecting the test leads.

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

Connector Contact	Adapter cable, 121-pin -V.A.G 1598/31- (test box) Socket
-1-	25
-2-	47

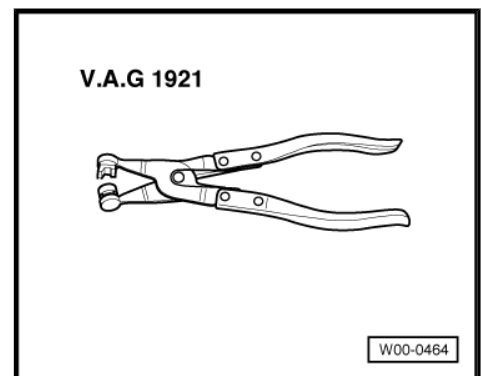
- Repair wiring connection if necessary.



1.10 Removing and installing map-controlled engine cooling thermostat

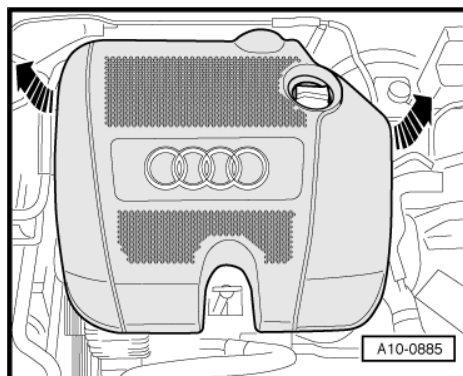
Special tools and workshop equipment required

- ◆ Hose clip pliers -V.A.G 1921-

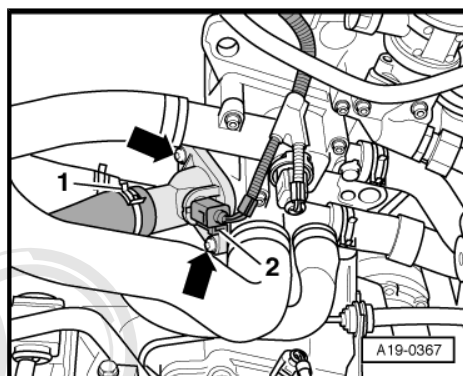


Removing

- Take off engine cover panel -arrows-.
- Drain off coolant ⇒ [page 123](#) .



- Unplug connector -2- at map-controlled engine cooling thermostat -F265- .
- Release spring-type hose clip -1- and disconnect coolant hose from thermostat.
- Unscrew bolts -arrows- and remove thermostat.



Installing

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



Note

Renew O-ring.

- Clean and smoothen sealing surface for O-ring as required.
- Moisten new O-ring with coolant additive “G12+”.
- Insert thermostat.
- Fill cooling system ⇒ [page 125](#) .

Tightening torque

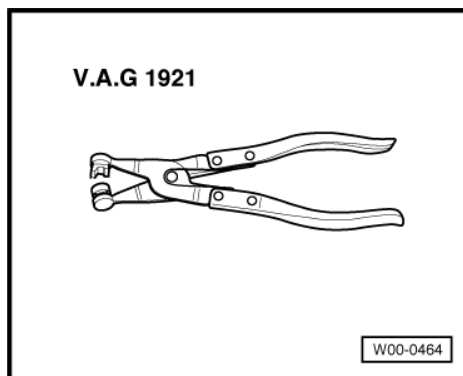
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Component	Nm
Mapped-controlled engine cooling thermostat - F265- to coolant distributor housing	10

1.11 Removing and installing coolant pipe

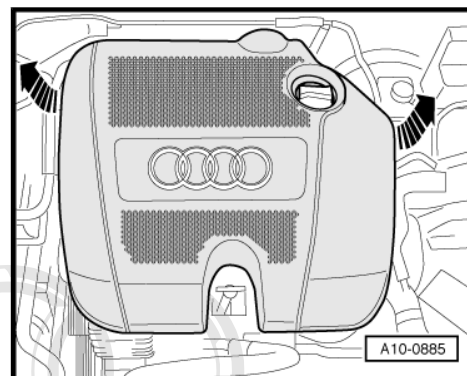
Special tools and workshop equipment required

- ◆ Hose clip pliers -V.A.G 1921-

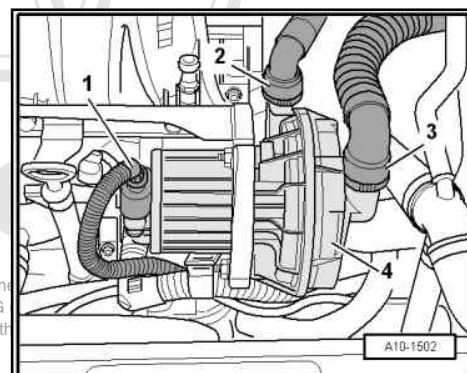


Removing

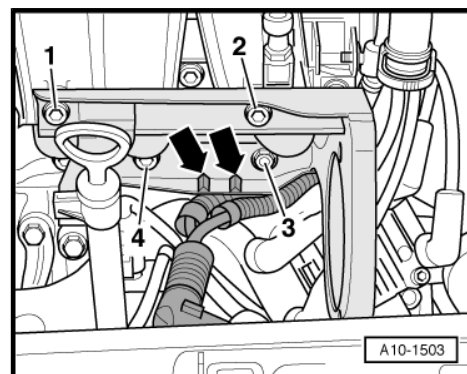
- Take off engine cover panel -arrows-.
- Drain off coolant ⇒ [page 123](#) .
- Remove alternator ⇒ Rep. Gr. 27 .



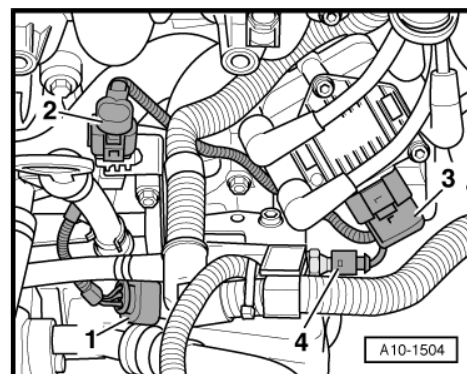
- Detach electrical connector -1-.
- Disconnect hoses -2- and -3- at secondary air pump.
- Detach secondary air pump -4- from bracket.



- Unscrew bolts -1-, -2- and -4- and nut -3- on secondary air pump bracket.
- Move wiring clear -arrows- and remove the secondary air pump bracket.



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



- Unscrew bracket -3- for ignition coil.
- Remove crankcase breather pipe.
- Disconnect coolant hoses -arrows- at coolant pipe.
- Remove bolts -1- and -2- and detach coolant pipe.

Installing

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

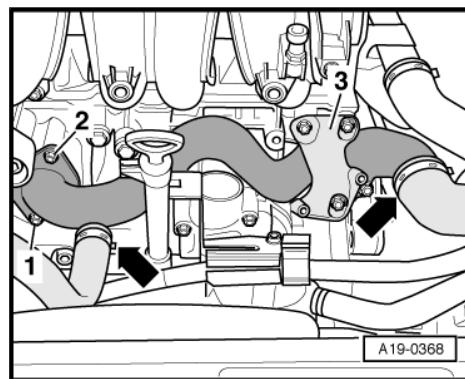


Note

- ◆ *Renew gaskets, seals and O-rings.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- Clean and smoothen sealing surface for O-ring as required.
- Install alternator ⇒ Rep. Gr. 27 .
- Install secondary air pump ⇒ [page 181](#) .
- Fill cooling system ⇒ [page 125](#) .

Tightening torques

Component	Nm
Coolant pipe to cylinder block	15
Bracket for ignition coil to cylinder block	15
Bracket for secondary air pump to intake manifold	23



1.12 Radiator and radiator fan - exploded view of components



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1 - Radiator

- ☐ Removing and installing
⇒ [page 145](#)
- ☐ If renewed, change
coolant in entire system

2 - O-ring

- ☐ Renew

3 - Coolant hose (top)

4 - Radiator cowl

5 - 10 Nm

6 - Additional fan

- ☐ Depending on equip-
ment

7 - Fan ring

8 - Retaining clip

9 - Electrical connector

10 - Radiator fan -V7-

11 - Retainer for connector

12 - Bottom coolant hose

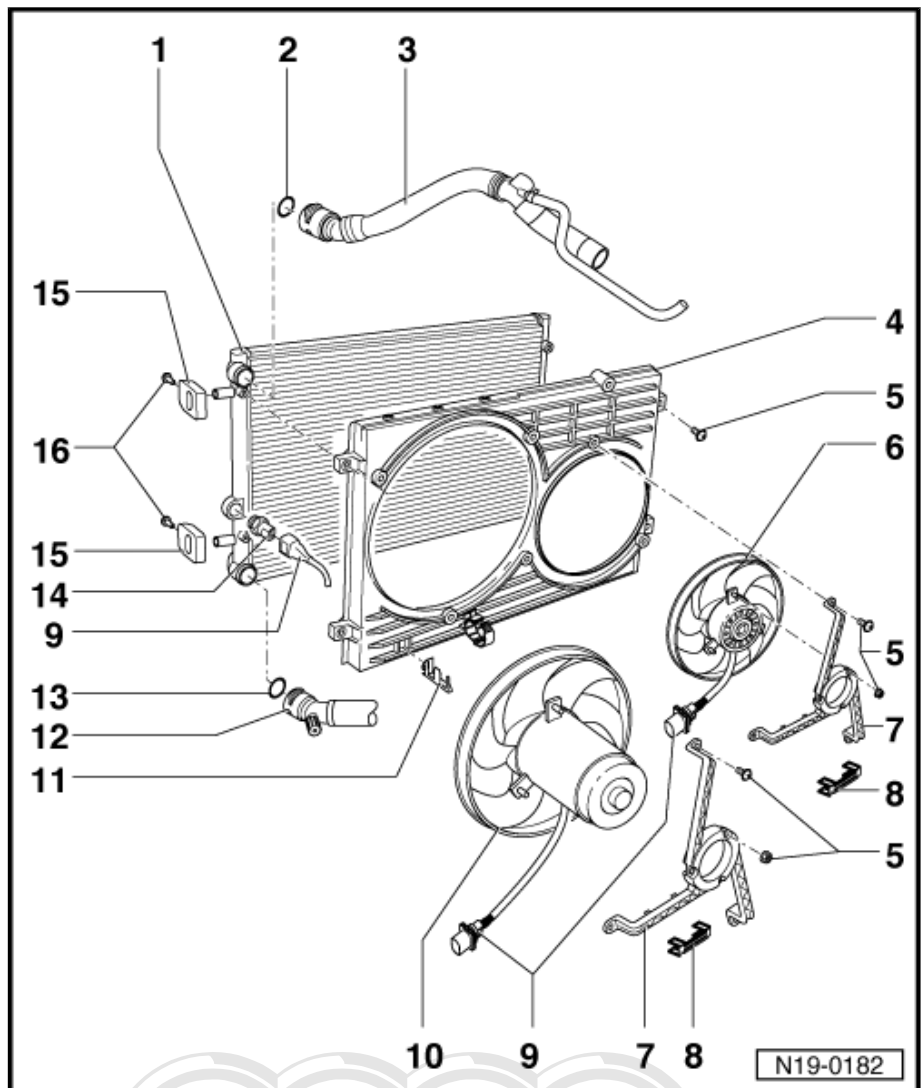
13 - O-ring

- ☐ Renew if damaged

14 - Coolant temperature sender - radiator outlet -G83-

15 - Mounting for radiator

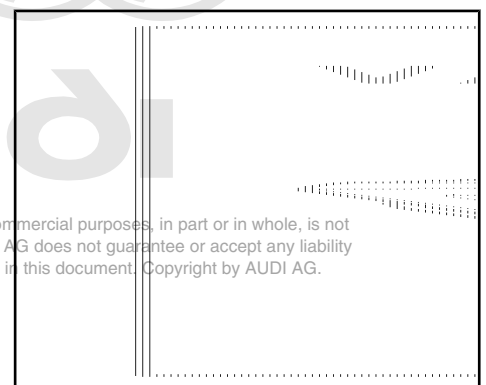
16 - 5 Nm



1.13 Removing and installing radiator

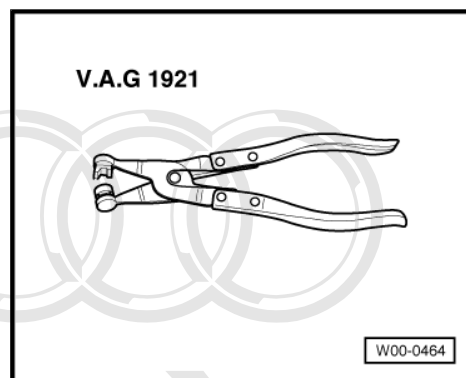
Special tools and workshop equipment required

- ◆ Drip tray for workshop hoist -VAS 6208- or -V.A.G 1306-



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◆ Hose clip pliers -V.A.G 1921-



Removing

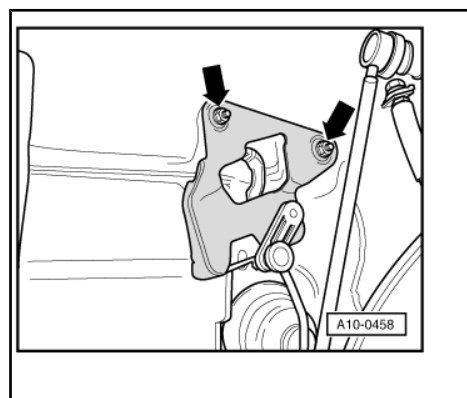


WARNING

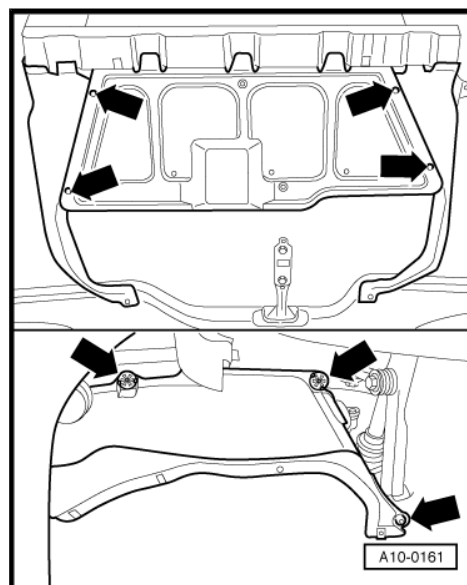
Hot steam or hot coolant can escape when expansion tank is opened; cover filler cap with cloth and open carefully.

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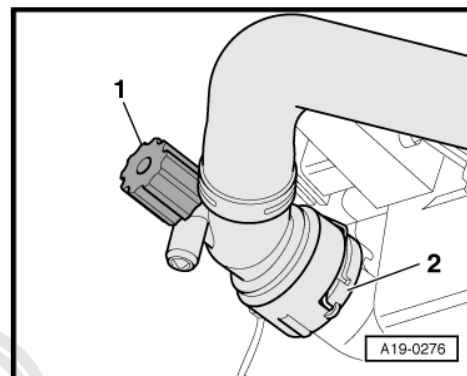
- Open filler cap on coolant expansion tank.
- Unscrew securing bolts for radiator cowl which are accessible from above.
- On vehicles with automatic headlight range control detach bracket for headlight range control sender at top of wheel housing (left-side) -arrows-.



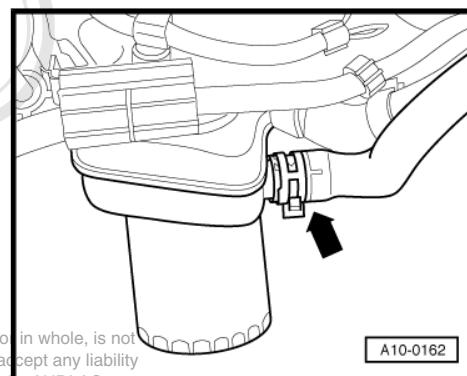
- Remove noise insulation panels (centre, left and right) -arrows-.



- Place drip tray for workshop hoist -VAS 6208- or -V.A.G 1306- under engine.
- Turn drain plug -arrow- on radiator anti-clockwise, if necessary fit drain hose to connection.
- Pull off retaining clip for bottom coolant hose and detach coolant hose -2- from radiator.

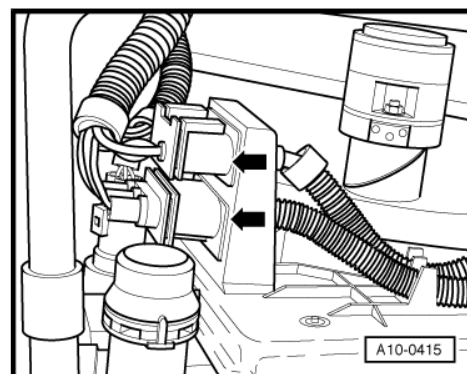


- Also disconnect coolant hose at bottom of oil cooler -arrow-, and drain off remaining coolant.



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- Detach both connectors -arrows- for radiator fan at bottom left of radiator cowl.
- Unscrew radiator cowl bolts accessible from below.
- Remove the radiator cowl with both fans from below.



- Unplug electrical connector -2- from coolant temperature sender - radiator outlet -G83- .



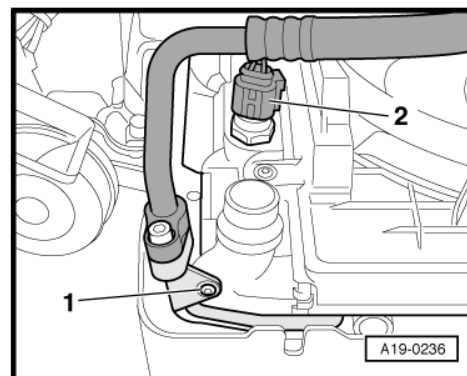
WARNING

The air conditioner refrigerant circuit must not be opened.



Note

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



- Detach refrigerant line -1- at radiator.

- Remove upper coolant hose -1- at radiator.
- Remove front bumper ⇒ Rep. Gr. 63 .
- Remove the left and right-hand air ducts from the radiator.



WARNING

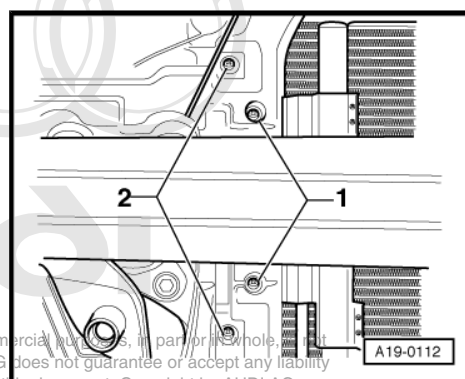
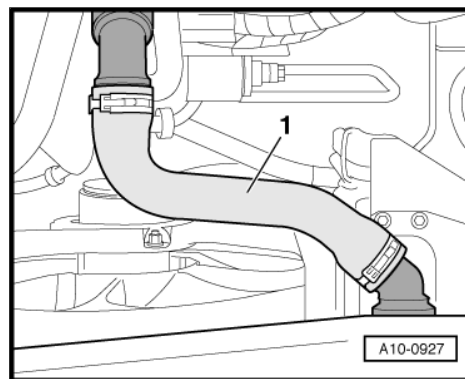
The air conditioner refrigerant circuit must not be opened.



Note

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

- Unscrew securing bolts -1- for the condenser.
- Remove bolts -2- at radiator.
- Tie up condenser to lock carrier with wire.
- Swivel radiator slightly to the rear and take it out from below.



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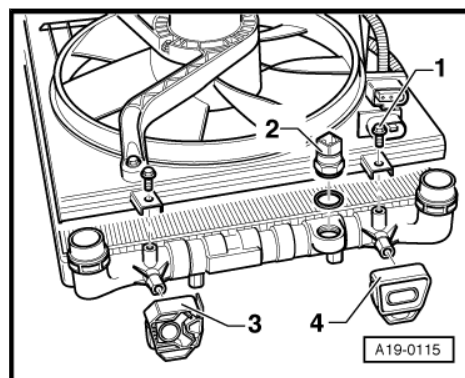
Installing

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

- Fit mountings -3- and -4- on radiator as illustrated.
- Have second mechanic fit radiator bolts.
- Install front bumper ⇒ Rep. Gr. 63 .
- Fill cooling system ⇒ [page 125](#) .

Tightening torques

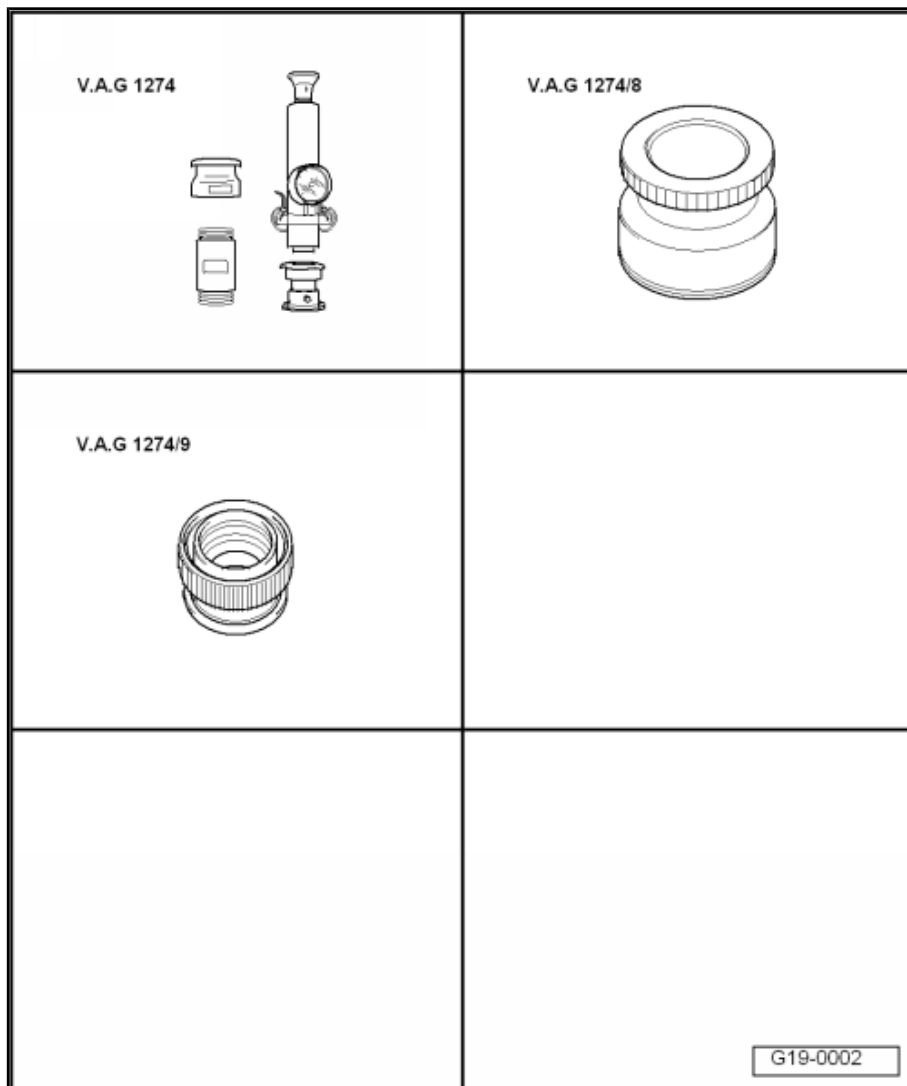
Component	Nm
Radiator to mounting	5
Condenser to radiator	5
Refrigerant line to radiator	5
Bracket for headlight range control sender to body	6
Radiator cowl to radiator	5



1.14 Checking cooling system for leaks

Special tools and workshop equipment required

- ◆ Cooling system tester - V.A.G 1274-
- ◆ Adapter for cooling system tester -V.A.G 1274/8-
- ◆ Adapter for cooling system tester -V.A.G 1274/9-



Test condition

- Engine must be warm.

Test sequence



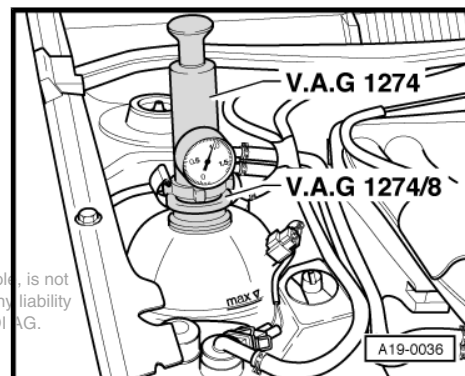
WARNING

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

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

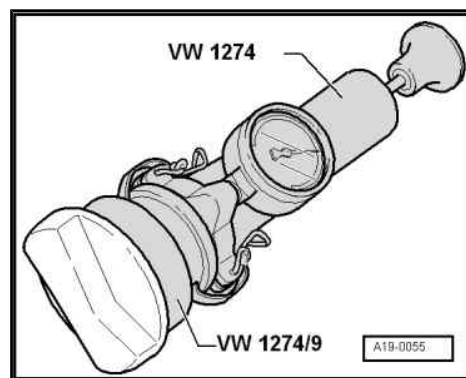
If the pressure drops:

- Trace leak and repair.



Checking pressure relief valve in filler cap

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



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26 – Exhaust system

1 Removing and installing parts of exhaust system



Note

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

1.1 Exhaust system - exploded view of components

1 - Tunnel cross-piece

- ☐ With bore for aligning exhaust system
⇒ [page 157](#)

2 - Centre silencer

- ☐ Combined in one unit with rear silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting point
⇒ [page 154](#)
- ☐ Align exhaust system so it is free of stress
⇒ [page 157](#)

3 - Mounting

- ☐ Installation position
⇒ [page 153](#)
- ☐ Renew if damaged

4 - 23 Nm

5 - 40 Nm

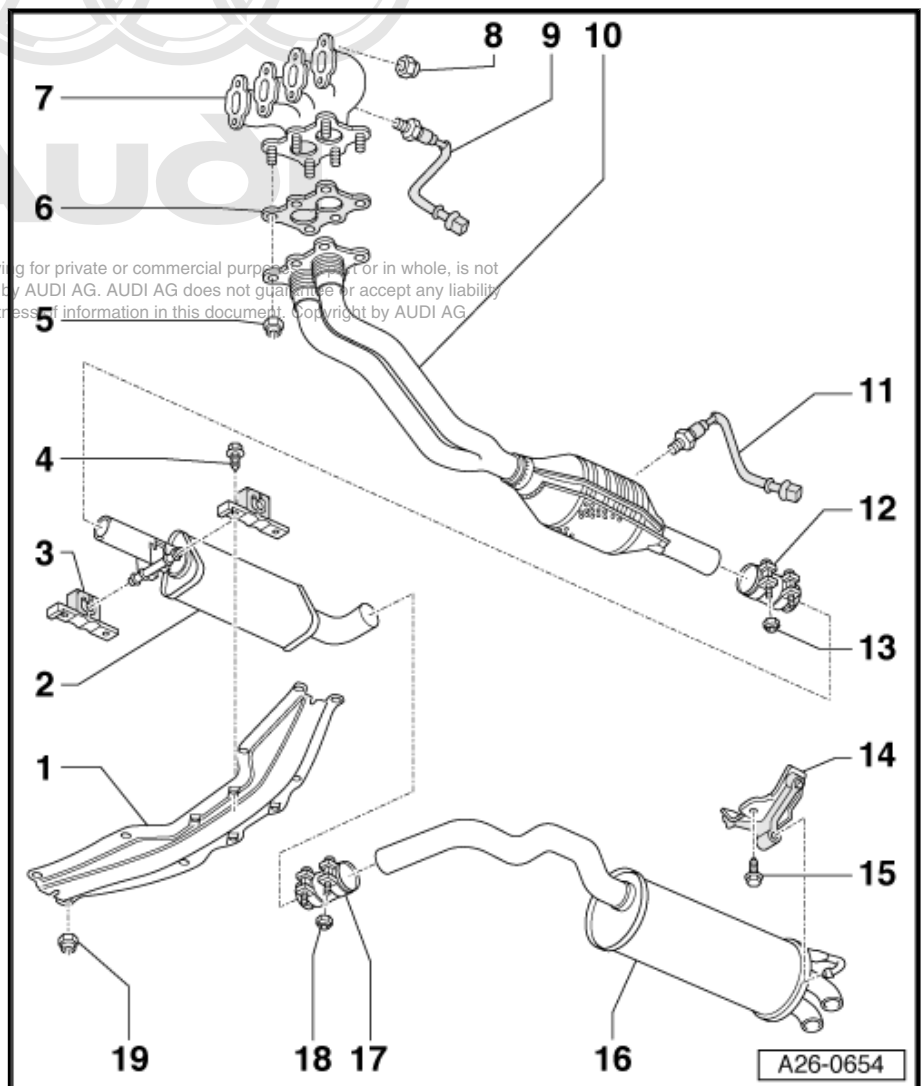
- ☐ Renew
- ☐ Lubricate exhaust manifold studs with high-temperature paste. For high-temperature paste refer to ⇒ Parts catalogue
- ☐ Observe correct tightening sequence
⇒ [page 156](#)

6 - Gasket

- ☐ Renew

7 - Exhaust manifold

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





8 - 25 Nm

- ☐ Renew

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

- ☐ Threads of new Lambda probes are already greased with assembly paste; the paste must not get into the slots on the probe body
- ☐ When re-using the old Lambda probe, grease thread with high-temperature lubricant; the paste must not get into the slots of the probe body; High-temperature lubricant ⇒ Parts catalogue
- ☐ Removing and installing ⇒ Rep. Gr. 24.
- ☐ Tighten to 55 Nm

10 - Front exhaust pipe with catalytic converter

- ☐ Protect against knocks and impact
- ☐ With flexible joint
- ☐ Do not bend flexible joint more than 10° - otherwise it can be damaged
- ☐ Removing and installing ⇒ [page 154](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 157](#)

11 - Lambda probe after catalytic converter -G130-

- ☐ Threads of new Lambda probes are already greased with assembly paste; the paste must not get into the slots on the probe body
- ☐ When re-using the old Lambda probe, grease thread with high-temperature lubricant; the paste must not get into the slots of the probe body; High-temperature lubricant ⇒ Parts catalogue
- ☐ Removing and installing ⇒ Rep. Gr. 24
- ☐ Tighten to 55 Nm

12 - Clamp (front)

- ☐ Before tightening, align exhaust system so it is free of stress ⇒ [page 157](#)
- ☐ Installation position ⇒ [page 153](#)
- ☐ Tighten bolt connections evenly

13 - 40 Nm

14 - Mounting

- ☐ Renew if damaged

15 - 23 Nm

16 - Rear silencer

- ☐ Combined in one unit with centre silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting point ⇒ [page 154](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 157](#)

17 - Clamp (rear)

- ☐ For separate replacement of centre and rear silencers
- ☐ Installation position ⇒ [page 153](#)
- ☐ Tighten bolt connections evenly

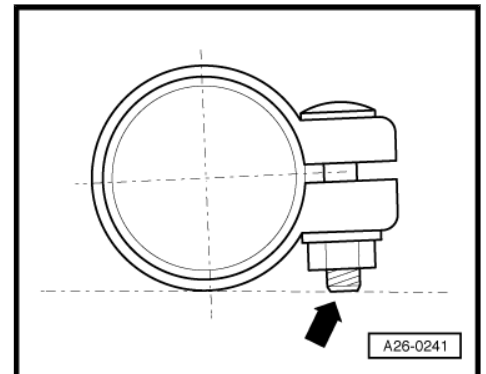
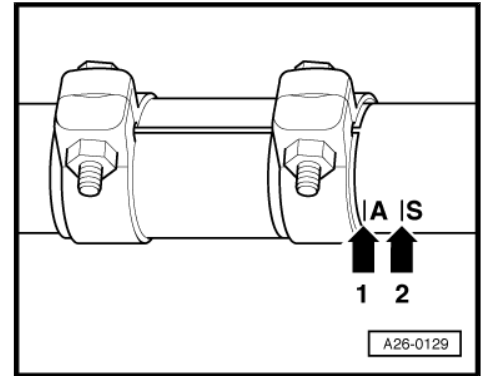
18 - 40 Nm

19 - 25 Nm

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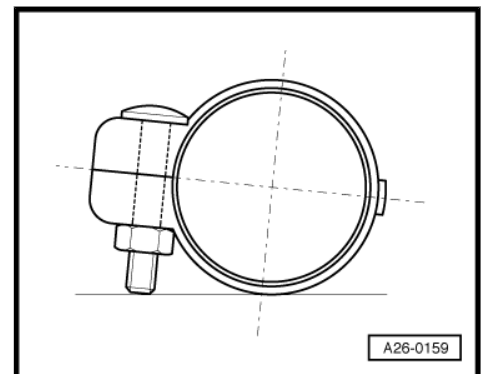
Installation position of front clamp

- Position clamp at a distance of approx. 5 mm from applicable marking.
 - -Arrow 1- Vehicles with automatic gearbox.
 - -Arrow 2- Vehicles with manual gearbox.
-
- Fit clamp so that ends of bolts -arrow- do not protrude beyond bottom of clamp.
 - Bolt connection faces to right.



Installation position of rear clamp

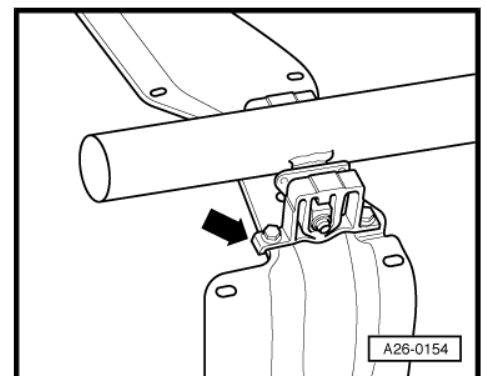
- Fit clamp so that ends of bolts do not protrude beyond bottom of clamp.
- Bolt connection faces front.



Installation position of mounting

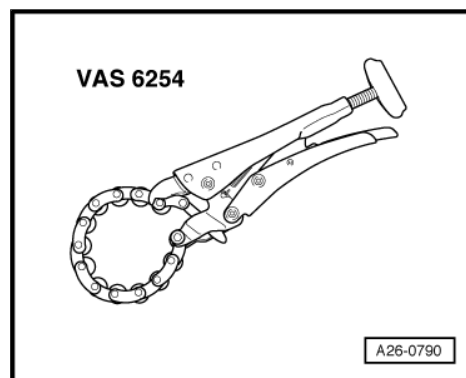
- Flanged end on base of mounting -arrow- faces in direction of travel.

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1.2 Separating centre and rear silencers

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

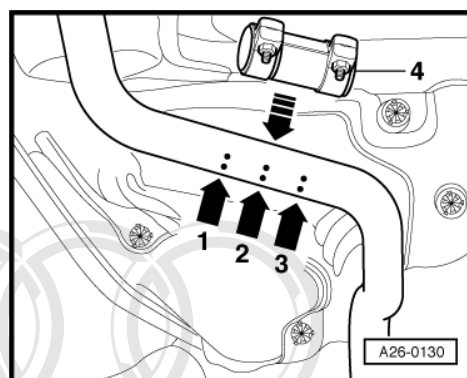


Special tools and workshop equipment required

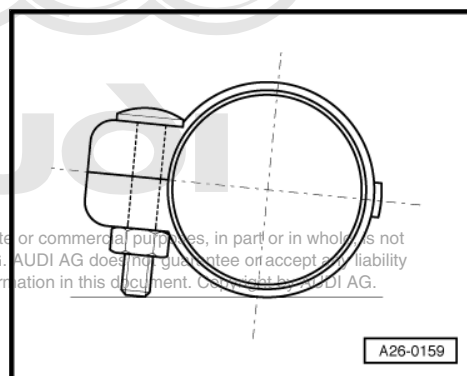
- ◆ Chain-type pipe cutter -VAS 6254-

Procedure

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



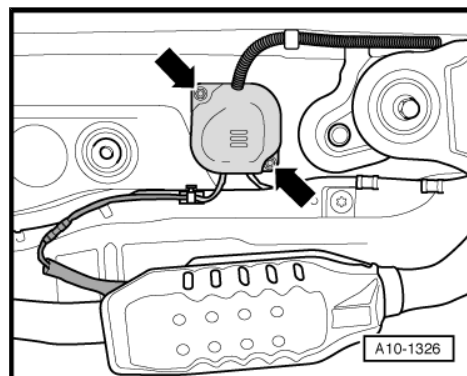
- Fit clamp so that ends of bolts do not protrude beyond bottom of clamp.
- Bolt connection faces front.
- Align exhaust system free of stress ⇒ [page 157](#) .



1.3 Removing and installing front exhaust pipe with catalytic converter

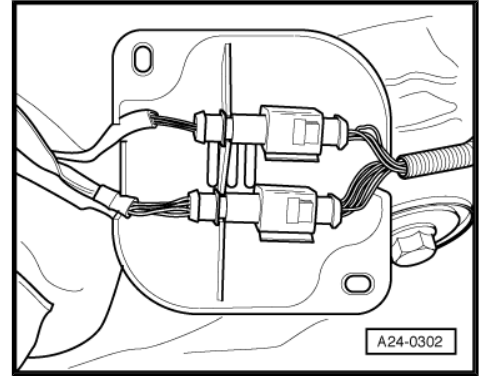
Removing

- Unscrew protective cover -arrows- on vehicle underbody.

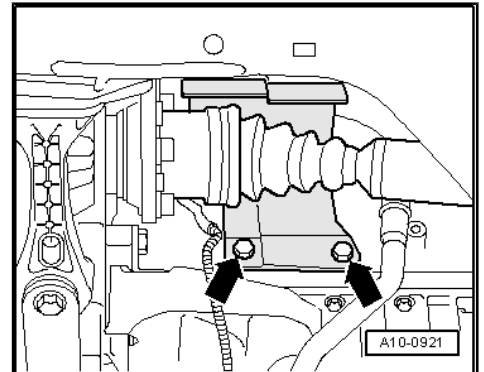


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- Unplug electrical connector (brown) for Lambda probe after catalytic converter -G130- and move wiring clear.



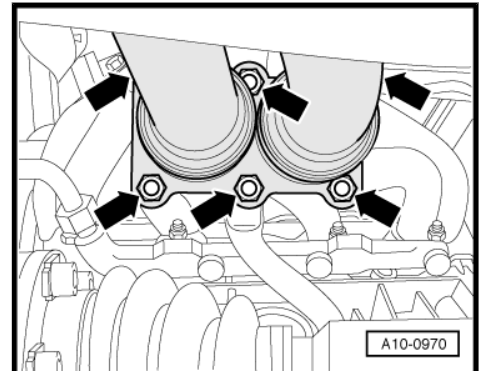
- Unbolt heat shield for drive shaft (right-side) -arrows-.



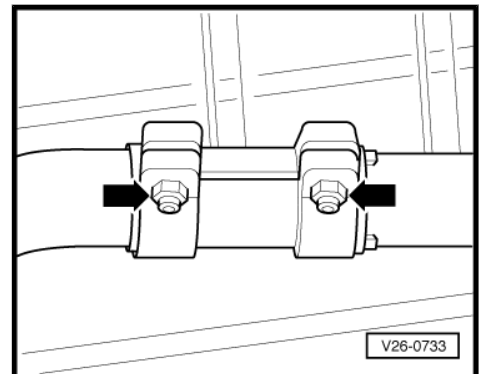
- Remove securing nuts on front exhaust pipe/exhaust manifold -arrows-.

i Note

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



- Separate exhaust system at clamp -arrows-.
- Remove front exhaust pipe (pivot front exhaust pipe through 180°).



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Installing

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



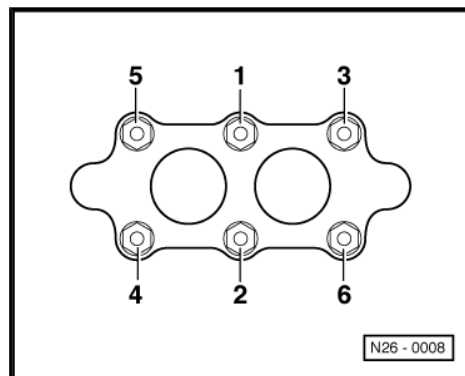
Note

Renew gaskets and self-locking nuts.

- Tighten bolt connections on front exhaust pipe/exhaust manifold in the sequence -1 ... 6-.
- Align exhaust system free of stress ⇒ [page 157](#) .

Tightening torques

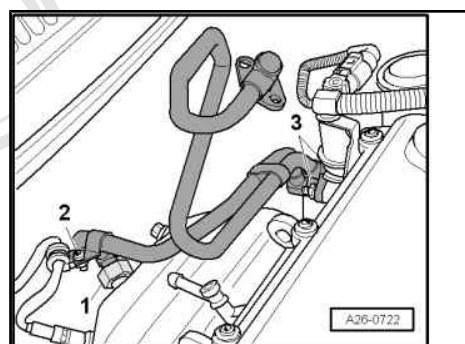
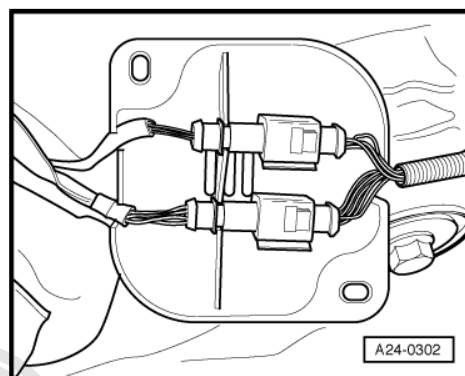
Component	Nm
Front exhaust pipe to exhaust manifold	40 ¹⁾²⁾
Drive shaft heat shield to cylinder block	35
• ¹⁾ Lubricate exhaust manifold studs with high-temperature paste. For high-temperature paste refer to ⇒ Parts catalogue . • ²⁾ Renew self-locking nuts.	



1.4 Removing and installing exhaust manifold

Removing

- Remove front exhaust pipe together with catalytic converter ⇒ [page 154](#) .
- Unplug connector (black) for lambda probe before catalytic converter.
- Move wiring to the top.
- Remove exhaust manifold support.
- Remove intake manifold ⇒ [page 84](#) .
- Unscrew clamp -2-.
- Loosen union nut -1-.
- Remove nuts -3- and remove connecting pipe for exhaust gas recirculation.



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

Installing

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



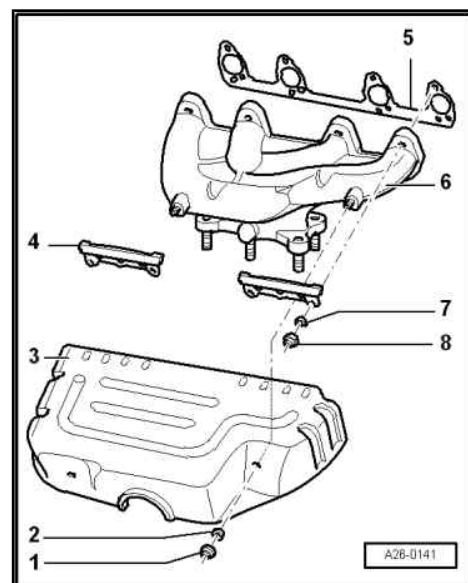
Note

Renew gaskets and self-locking nuts.

- Install intake manifold ⇒ [page 84](#) .
- Install front exhaust pipe together with catalytic converter ⇒ [page 154](#) .
- Align exhaust system free of stress ⇒ [page 157](#) .

Tightening torques

Component	Nm
Exhaust manifold to cylinder head	25 ¹⁾²⁾
Heat shield to exhaust manifold	23
EGR connecting pipe to exhaust gas recirculation valve	25
EGR connecting pipe to exhaust manifold	60
Support for exhaust manifold to exhaust manifold	40
Support for exhaust manifold to cylinder block	40
• ¹⁾ Lubricate exhaust manifold studs with high-temperature paste. For high-temperature paste refer to ⇒ Parts catalogue . • ²⁾ Renew self-locking nuts.	



1.5 Stress-free alignment of exhaust system

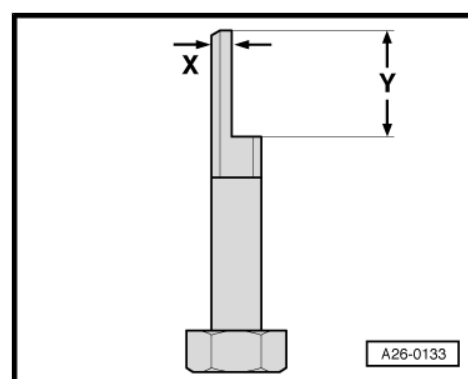
Special tools and workshop equipment required

- ◆ Depending on version, an improvised tool has to be made up from an M10 or M14 bolt for alignment of the exhaust system.

Vehicles with Ø 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.

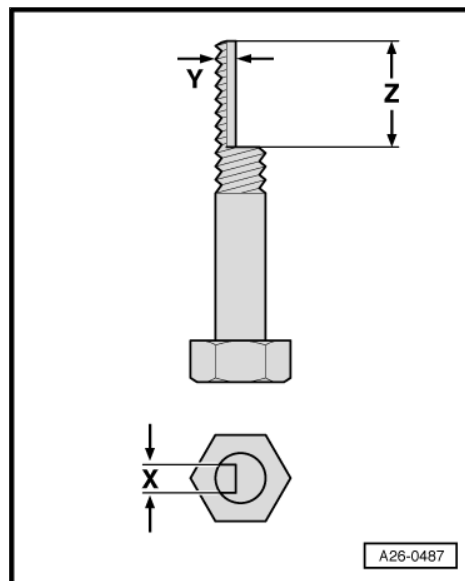
- Dimension -X- = 4 mm.
- Dimension -Y- = 25 mm.



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.



Procedure

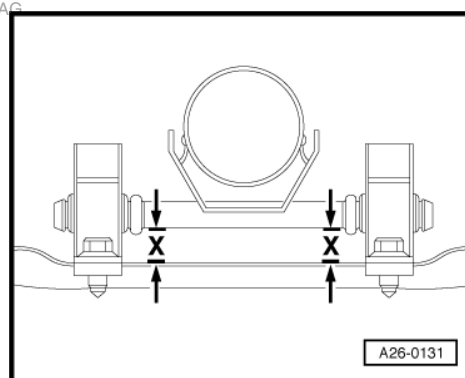
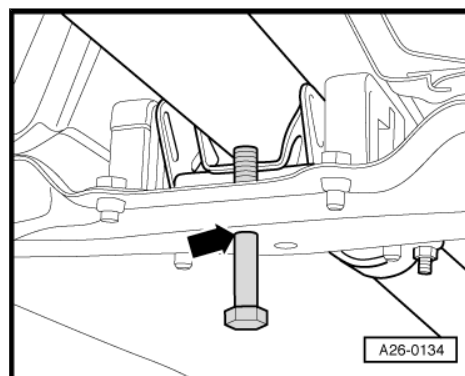
- The exhaust system must be aligned when it is cool.
- Loosen bolt connections of front clamp
⇒ [Item 12 \(page 152\)](#) .
- Insert modified bolt (aligning tool) through rear bore -arrow- in tunnel cross piece, with flat part of bolt facing towards mounting pin on exhaust system.

Note

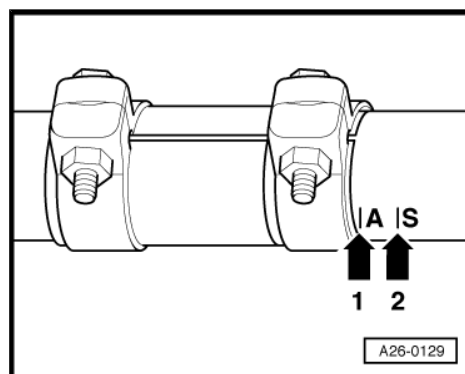
Exhaust system is pre-tensioned in direction of travel with improvised tool inserted.

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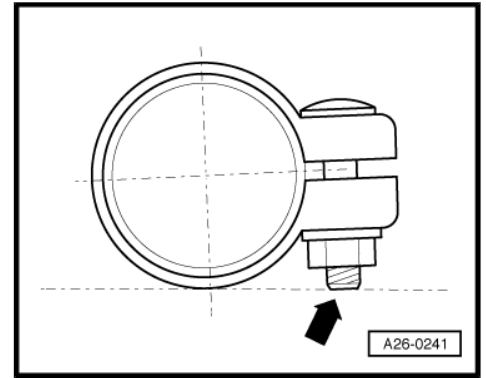
- Align centre and rear silencers horizontally.
- The mounting pin on the exhaust pipe must be positioned parallel with the tunnel cross-piece.
- Dimension -x- (left-side) = dimension -x- (right-side)



- Position front clamp at a distance of approx. 5 mm from applicable marking.
- -Arrow 1- Vehicles with automatic gearbox.
- -Arrow 2- Vehicles with manual gearbox.



- Fit clamp so that ends of bolts -arrow- do not protrude beyond bottom of clamp.
- Bolt connection faces to right.
- Tighten bolts on clamp evenly to 40 Nm.



1.6 Checking exhaust system for leaks

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



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2 Exhaust gas recirculation system



Note

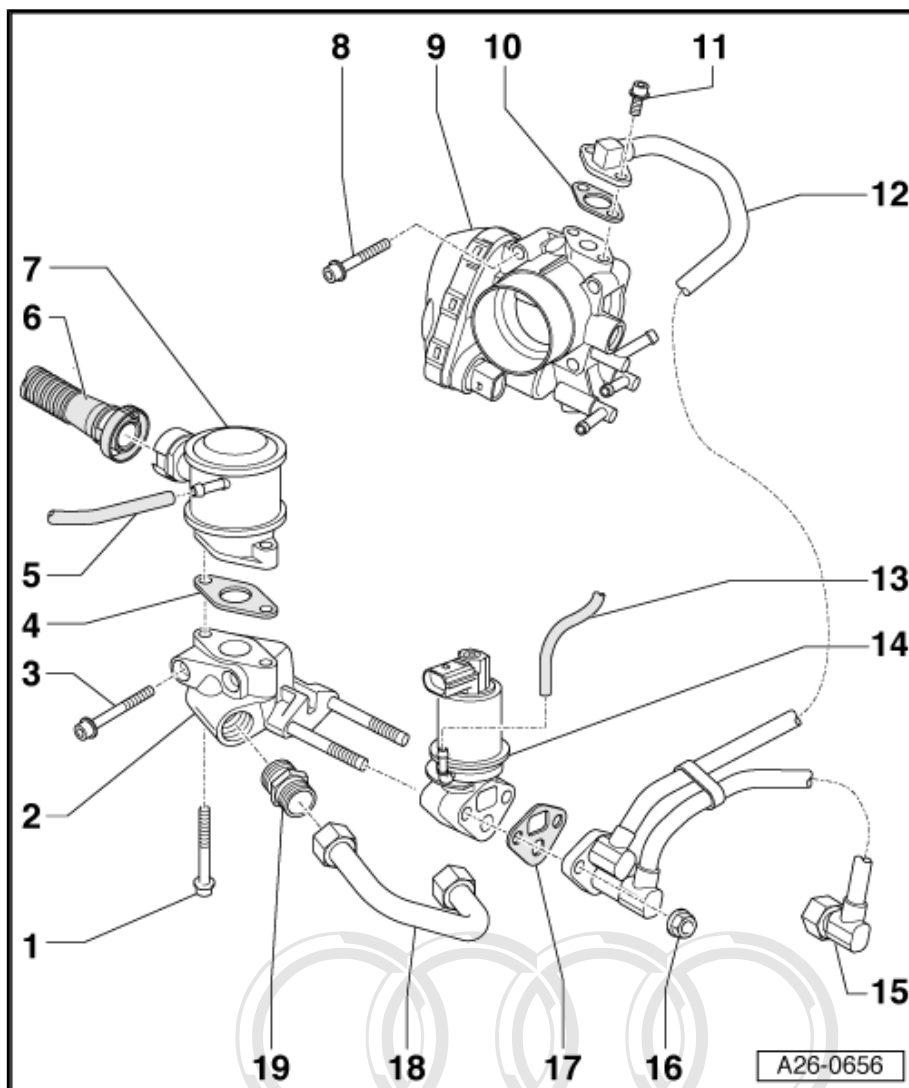
- ◆ *Under certain operating conditions, exhaust gas is fed into the intake air via the exhaust gas recirculation valve -N18-. By means of this mixture, a lowering of the combustion temperature and consequently an improvement of the exhaust gas composition is achieved.*
- ◆ *The exhaust gas recirculation valve -N18- is activated by the engine control unit.*
- ◆ *Pulsed actuation makes it possible to obtain any required valve position.*
- ◆ *The exhaust gas recirculation potentiometer -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.*

2.1 Exhaust gas recirculation system - exploded view of components



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- 1 - 10 Nm
- 2 - Connecting flange
- 3 - 10 Nm
- 4 - Gasket
 - ☐ Renew
- 5 - Not fitted
- 6 - Air hose
 - ☐ From secondary air pump
- 7 - Combination valve for secondary air
 - ☐ Checking ⇒ [page 179](#)
 - ☐ Removing and installing ⇒ [page 180](#)
- 8 - 10 Nm
- 9 - Throttle valve module - J338-
- 10 - Gasket
 - ☐ Renew
- 11 - 10 Nm
- 12 - Connecting pipe for exhaust gas recirculation
- 13 - Breather pipe
 - ☐ To air cleaner housing
- 14 - Exhaust gas recirculation valve -N18- with exhaust gas recirculation potentiometer - G212-
 - ☐ Adapt to engine control unit after renewing ⇒ Rep. Gr. 24
 - ☐ Checking adaption of zero position ⇒ [page 162](#)
 - ☐ Checking (electrical test) ⇒ [page 163](#)
- 15 - Union nut, 60 Nm
 - ☐ On connecting pipe for exhaust gas recirculation
- 16 - 23 Nm
- 17 - Gasket
 - ☐ Renew
- 18 - Connecting pipe
 - ☐ For secondary air
 - ☐ Tighten union nut to 25 Nm
- 19 - Connection, 35 Nm



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

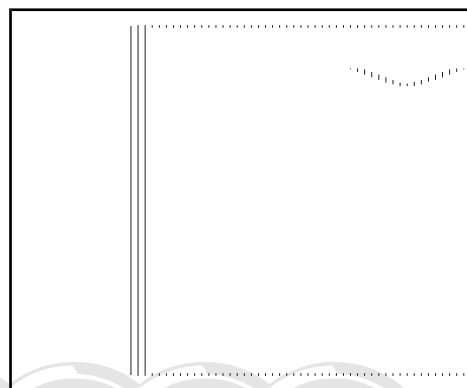


Note

- ◆ 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 ⇒ Rep. Gr. 24 .
- ◆ Check the adaption status and the zero position before performing repair measures.

Special tools and workshop equipment required

- ◆ Vehicle diagnosis, testing and information system -VAS 5051 A- with diagnosis lead -VAS 5051/1-



Test sequence

- Connect up vehicle diagnostic, testing and information system -VAS 5051 A- with diagnosis lead -VAS 5051/1- and select vehicle system "01 - Engine electronics" from list. Engine must be idling.

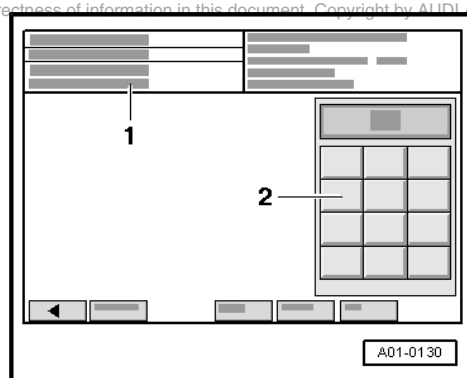
Display on -VAS 5051 A-

- From the selection menu -1- select diagnostic function "04 - Basic setting".



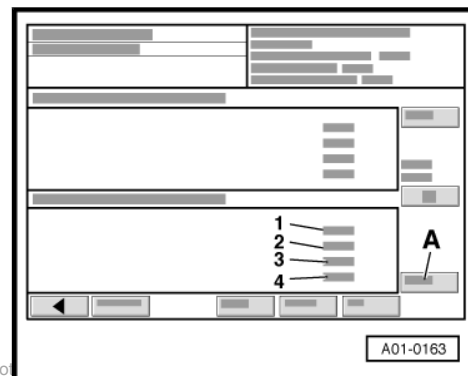
Display on -VAS 5051 A-

- 1 - Enter display group
- Enter "74" on keypad -2- for "display group 074" and confirm your entry by pressing the  key.



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- Activate basic setting by touching **Activate** key -A-.
- Display on -VAS 5051 A-
- Check display in zones -1- and -4-.



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Display group 074: Adaption of zero position for exhaust gas recirculation valve -N18-				
Display zone	Indicated on display	Display shows		Specification
1	X.X V	Zero position		0.3 ... 1.2 V ¹⁾
4	XXXXXXXX	Adaption status	ADP. runs ADP OK ERROR	ADP OK ²⁾
• ¹⁾ If the specification is not attained, check the exhaust gas recirculation valve for dirt and foreign objects; renew valve if necessary. • ²⁾ If specification is not attained: Perform electrical test of exhaust gas recirculation valve.				



Note

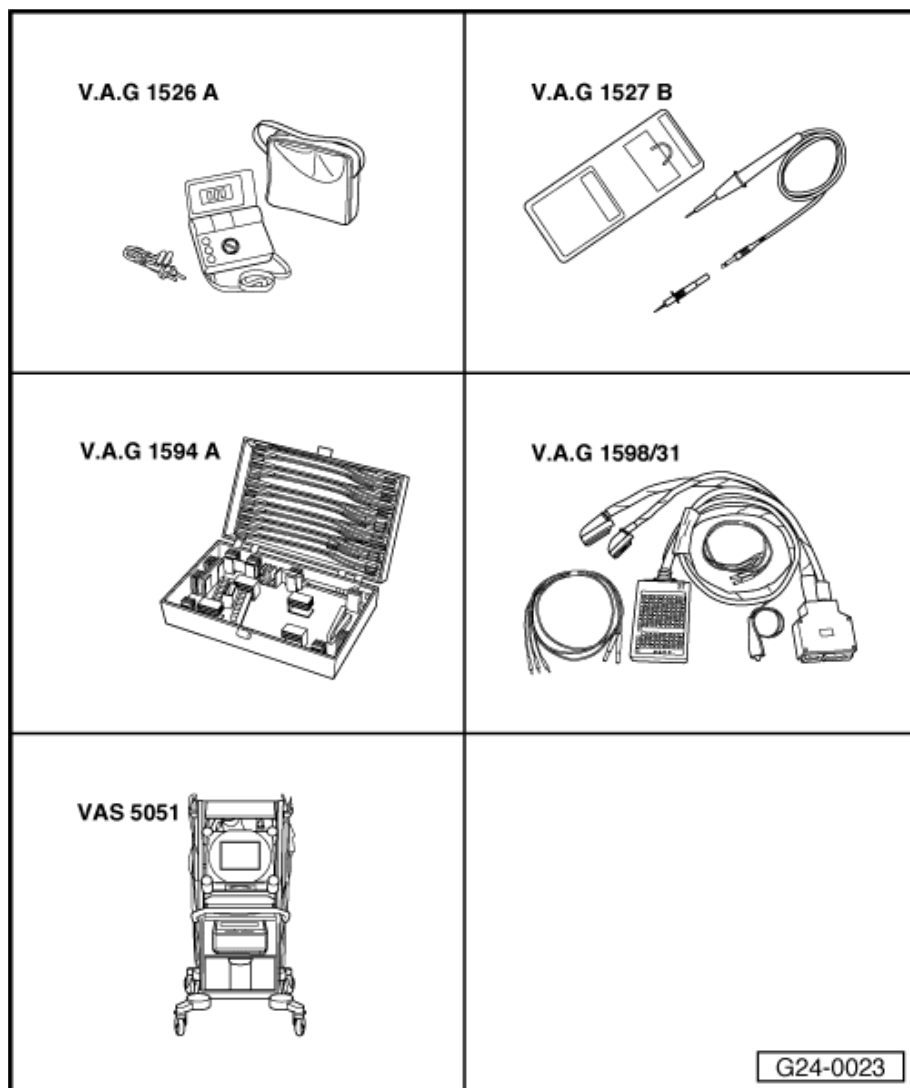
The abbreviation "ADP" in display zone 4 stands for "Adaption".

- Exit function "04 - Basic setting" by pressing the  key.
- Press "06 - End output".
- Switch off ignition.

2.3 Electrical test of exhaust gas recirculation valve -N18- and exhaust gas recirculation potentiometer -G212-

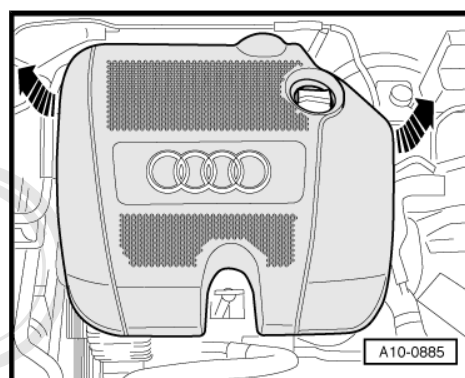
Special tools and workshop equipment required

- ◆ Hand-held multimeter - V.A.G 1526 B- or -V.A.G 1526 A-
- ◆ Voltage tester -V.A.G 1527 B-
- ◆ Auxiliary measuring set - V.A.G 1594 C- or -V.A.G 1594 B-
- ◆ Adapter cable, 121-pin - V.A.G 1598/31- (test box)
- ◆ Vehicle diagnosis, testing and information system - VAS 5051 A- with diagnosis lead -VAS 5051/1-



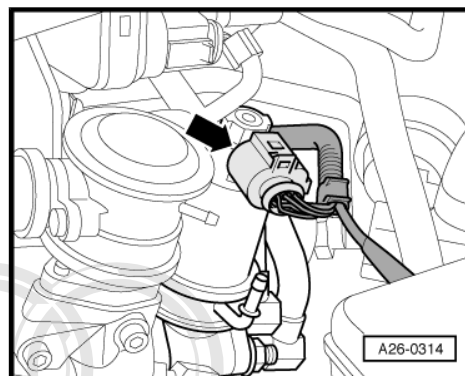
Checking internal resistance

- Take off engine cover panel -arrows-.



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- Unplug electrical connector -arrow-.



- Connect up multimeter for resistance measurement as follows.

Component	Connector Contact	Specification at room temperature
Exhaust gas recirculation valve -N18-	-1- + -5-	7.5 ... 8.5 Ω
Potentiometer for exhaust gas recirculation -G212-	-2- + -4- -2- + -6-	2.6 ... 4.8 Ω 0.5 ... 6.3 Ω

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If the specifications are not obtained:

- Renew the exhaust gas recirculation valve -N18- with exhaust gas recirculation potentiometer -G212- → [page 169](#).

If the specifications are obtained:

- Check voltage supply of exhaust gas recirculation valve -N18-.

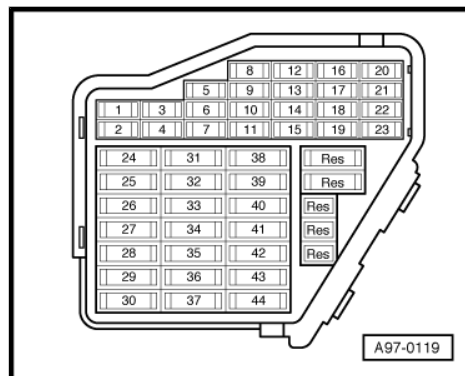
Checking voltage supply for exhaust gas recirculation valve -N18-

- Check that power supply relay for Simos control unit -J363- is OK.
- Fuse in fuse holder -S237- (position 37) OK.

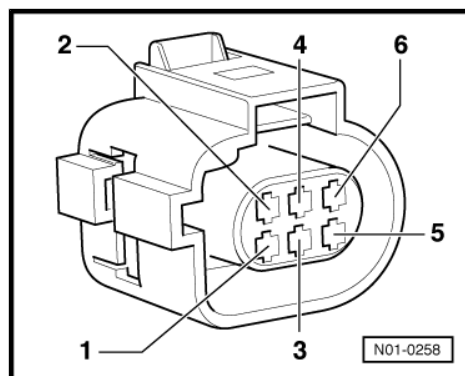


Note

The power supply to the exhaust gas recirculation valve is provided by the current supply relay for Simos control unit -J363- via fuse in fuse holder -S237-.



- Connect voltage tester -V.A.G 1527 B- between contact -1- and earth.
- Switch on ignition.
- The LED should light up.
- Switch off ignition.

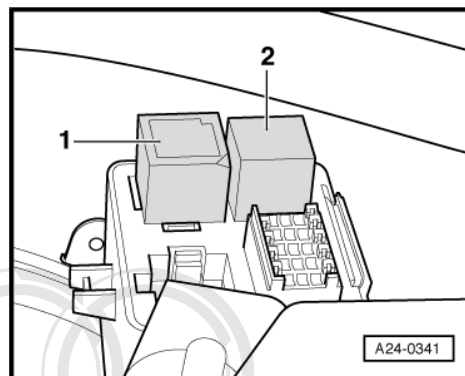


If the LED does not light up:

- Check the wiring from contact “1” of the connector to the power supply relay for Simos control unit -J363- -item 2- (below cover on left side of bulkhead) for open circuit using the current flow diagram.
- Repair wiring connection if necessary.

If the LED lights up:

- Check voltage supply of exhaust gas recirculation potentiometer -G212- .

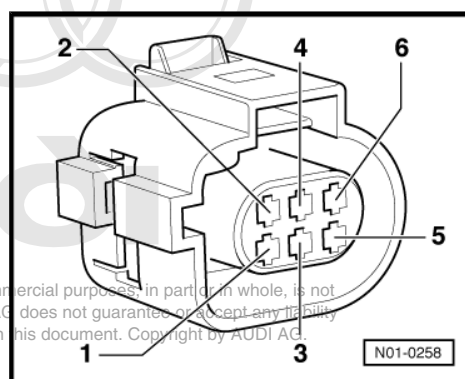


Checking voltage supply for exhaust gas recirculation potentiometer -G212-

- Connect multimeter between contacts -2- and -4- of connector to measure voltage.
- Switch on ignition.
- Specification: 4.5 ... 5.5 V
- Switch off ignition.

If specification is not obtained:

- Connect adapter cable, 121-pin -V.A.G 1598/31- (test box) to connectors of wiring harness; do not connect engine control unit. Connect earth clip of test box to earth ⇒ Rep. Gr. 24 .



Caution

To avoid damage to the electronic components, select the required measuring range and observe test conditions before connecting the test leads.

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

Connector Contact	Adapter cable, 121-pin -V.A.G 1598/31- (test box) Socket
-2-	96
-4-	84

- Repair wiring connection if necessary.

If wiring is OK:

- Renew engine control unit.

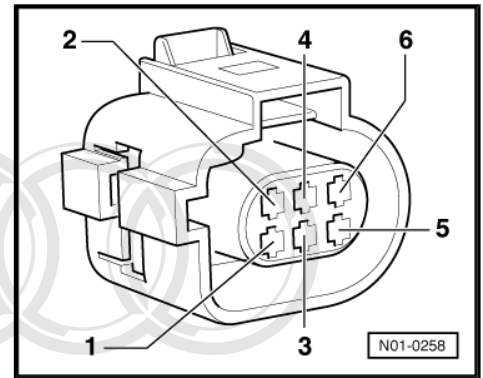
Checking signal wire between exhaust gas recirculation potentiometer -G212- and engine control unit

- Connect adapter cable, 121-pin -V.A.G 1598/31- (test box) to connectors of wiring harness; do not connect engine control unit. Connect earth clip of test box to earth => Rep. Gr. 24.



Caution

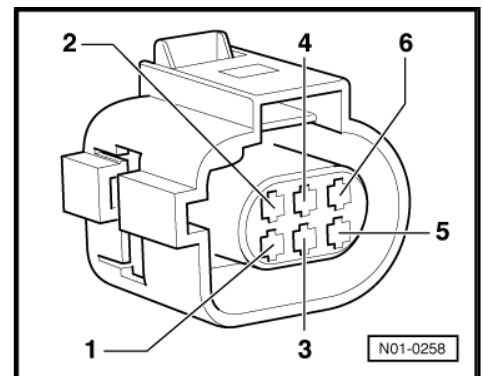
To avoid damage to the electronic components, select the required measuring range and observe test conditions before connecting the test leads.



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

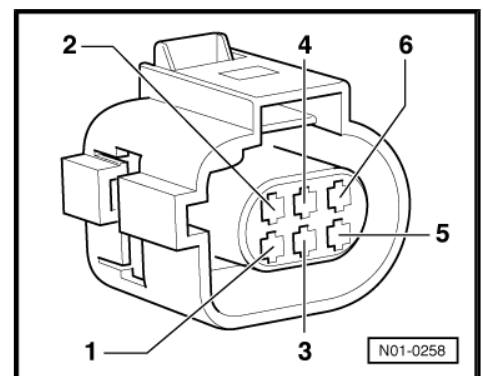
Connector Contact	Adapter cable, 121-pin -V.A.G 1598/31- (test box) Socket
6	108

- Repair wiring connection if necessary.



Checking activation of exhaust gas recirculation valve -N18-

- Voltage supply OK.
- Connect voltage tester -V.A.G 1527 B- to contacts -1- and -5- of the connector.
- Connect up vehicle diagnostic, testing and information system -VAS 5051 A- with diagnosis lead -VAS 5051/1- and select vehicle system "01 - Engine electronics" from list. When doing this, the ignition must be switched on.



Display on -VAS 5051 A-

- From the menu -1- select the diagnostic function “03 - Final control diagnosis”.



Display on -VAS 5051 A-

- Keep touching the key until the following display appears:

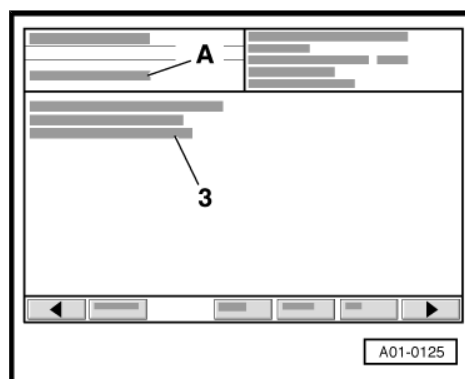
A - 3rd control element in test

3 - Exhaust gas recirculation valve -N18-

- Press the key again.

A - Actuator is running; continued switching is allowed

- LED should flash slowly.



Note

Voltage testers with a low current draw do not go out completely between activation signals from engine control unit, but continue to glow slightly and become distinctly brighter on activation.

- Exit function “03 - Final control diagnosis” by pressing the key.
- Press “06 - End output”.
- Switch off ignition.

If the LED does not flash:

- Connect adapter cable, 121-pin -V.A.G 1598/31- (test box) to connectors of wiring harness; do not connect engine control unit. Connect earth clip of test box to earth ⇒ Rep. Gr. 24 .



Caution

To avoid damage to the electronic components, select the required measuring range and observe test conditions before connecting the test leads.

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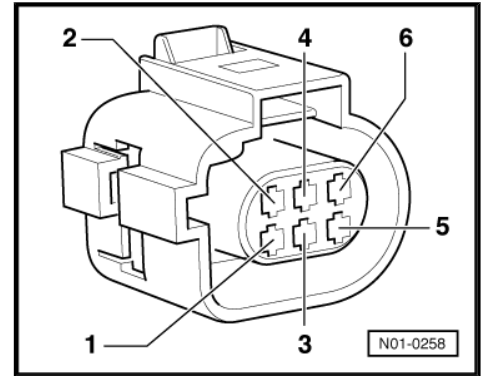
- Check for open circuit and short to positive or earth in the following wiring:

Connector Contact	Adapter cable, 121-pin -V.A.G 1598/31- (test box) Socket
5	115

- Repair wiring connection if necessary.

If wiring is OK:

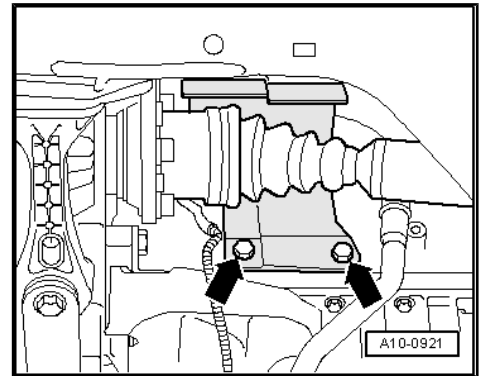
- Renew engine control unit.



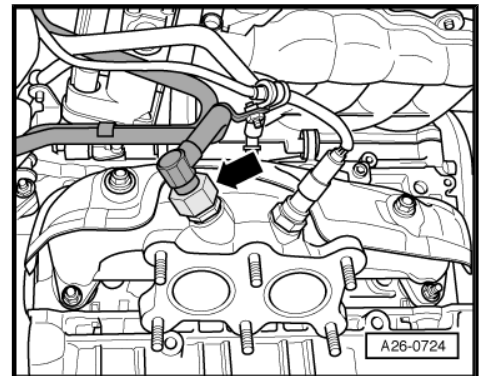
2.4 Removing and installing exhaust gas recirculation valve -N18- with exhaust gas recirculation potentiometer -G212-

Removing

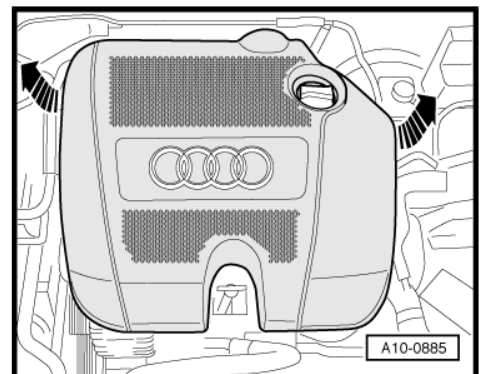
- Unbolt heat shield for drive shaft (right-side) -arrows-.



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

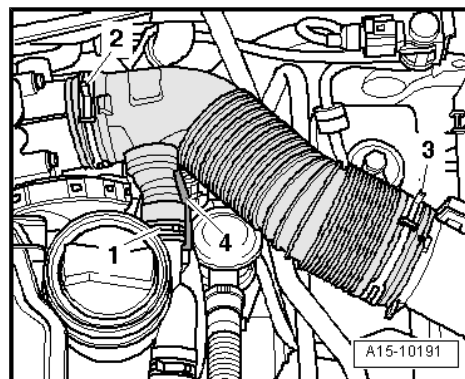


Take off engine cover panel -arrows-.

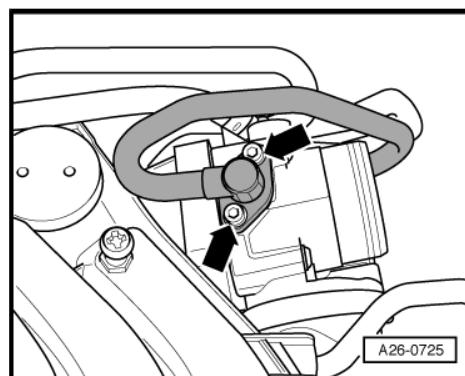


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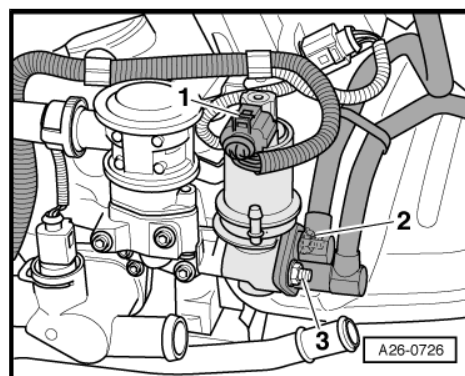
- Disconnect hose -4-.
- Release spring-type hose clips -1-, -2- and -3- to remove air intake hose.



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



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



Installing

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

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Note

Renew gaskets.

Tightening torques

Component	Nm
EGR connecting pipe to exhaust gas recirculation valve	23
EGR connecting pipe to throttle valve housing	10
EGR connecting pipe to exhaust manifold	60
Drive shaft heat shield to cylinder block	35

3 Secondary air system

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

3.1 Principle and function

Principle

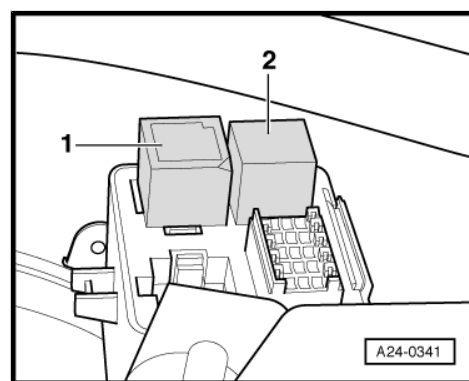
The over-enrichment of the mixture in the cold start phase produces a higher proportion of unburnt hydrocarbons in the exhaust gas. The secondary air system improves the afterburning (oxidation) process in the catalytic converter, and thus reduces toxic emissions. The heat generated by oxidation accelerates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

Function

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

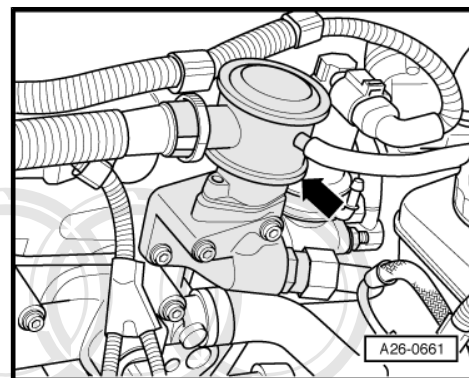
Fitting location of secondary air pump relay -J299-

- Fitting location: Under cover on bulkhead (left-side).
- 1 - Secondary air pump relay -J299-
 - 2 - Current supply relay for Simos control unit -J363-



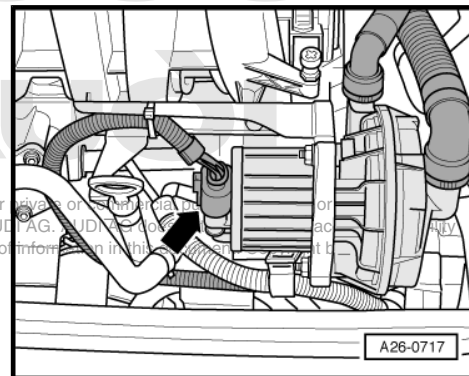
Fitting location of combination valve for secondary air

- Fitting location: At left of cylinder head.



Fitting location of secondary air pump motor -V101-

- Fitting location: At front of engine.



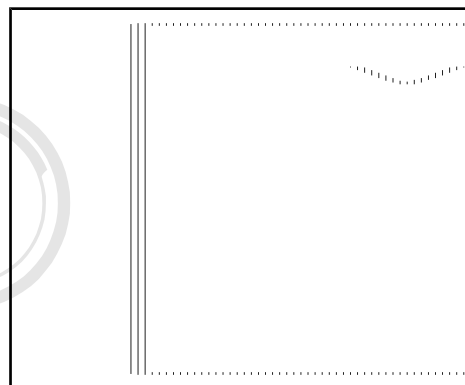
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3.2 Carrying out diagnosis of secondary air system



Note

- ♦ The secondary air system is monitored by the Simos control unit -J361-.
- ♦ Diagnosis of the secondary air system can also be initiated via the basic setting function, "display group 077".



Special tools and workshop equipment required

- ♦ Vehicle diagnosis, testing and information system -VAS 5051 A- with diagnosis lead -VAS 5051/1-

Test sequence

- Connect up vehicle diagnostic, testing and information system -VAS 5051 A- with diagnosis lead -VAS 5051/1- and select vehicle system "01 - Engine electronics" from list. Engine must be idling.

Display on -VAS 5051 A-

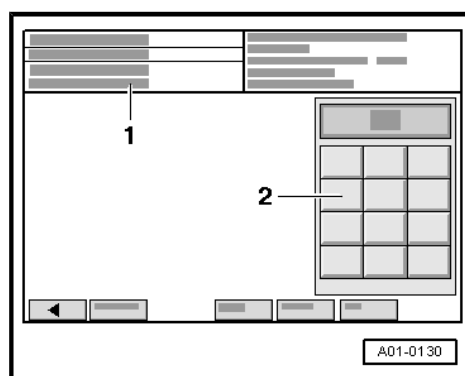
- From the selection menu -1- select diagnostic function "04 - Basic setting".



Display on -VAS 5051 A-

1 - Enter display group

- Enter "77" on keypad -2- for "display group 077" and confirm your entry by pressing the **Q** key.



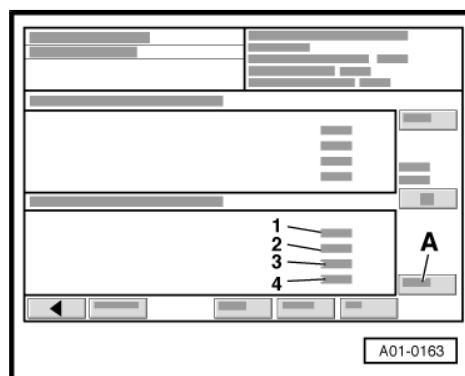
- Activate basic setting by touching **Activate** key -A-.

Display on -VAS 5051 A-

- Simultaneously press accelerator and brake pedal; engine speed must be approx. 1500 rpm.

Test condition:

- Accelerator and brake pedal pressed simultaneously, engine running at approx. 1500 rpm.
- Check display in zones -1- and -4-.



Display group 077: Diagnosis of secondary air system				
Display zone	Indicated on display	Display shows		Specification
1	XXXX rpm	Engine speed		approx. 1500 rpm
4	XXXXXXXX	Diagnosis status	Test OFF Test ON Syst. OK Syst. n. OK	Syst. OK ¹⁾
¹⁾ The test takes approx. 30 seconds. If test cannot be completed, switch off engine and restart. The secondary air pump must run during the test.				

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- Exit function “04 - Basic setting” by pressing the  key.

If reading matches specification:

- Press “06 - End output”.
- Switch off ignition.

If specification is not obtained:

- Interrogate fault memory. Rectify fault if necessary and erase fault memory.
- Check secondary air pump relay -J299- ➔ [page 173](#) .

3.3 Checking secondary air pump relay -J299- and activation

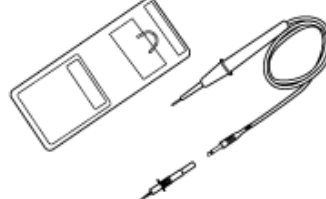
Special tools and workshop equipment required

- ◆ Hand-held multimeter - V.A.G 1526 A- or -V.A.G 1526 B-
- ◆ Voltage tester - V.A.G 1527 B-
- ◆ Auxiliary measuring set - V.A.G 1594 A- or -V.A.G 1594 C-
- ◆ Adapter cable, 121-pin - V.A.G 1598/31- (test box)
- ◆ Vehicle diagnosis, testing and information system - VAS 5051 A- with diagnosis lead -VAS 5051/1-

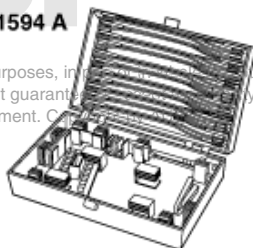
V.A.G 1526 A



V.A.G 1527 B



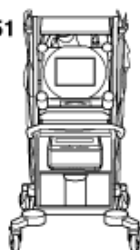
V.A.G 1594 A



V.A.G 1598/31



VAS 5051



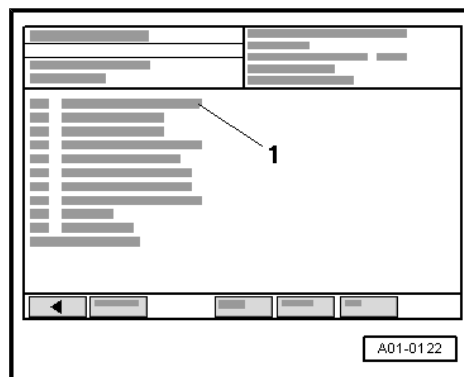
G24-0023

Test sequence

- Connect up vehicle diagnostic, testing and information system -VAS 5051 A- with diagnosis lead -VAS 5051/1- and select vehicle system “01 - Engine electronics” from list. When doing this, the ignition must be switched on.

Display on -VAS 5051 A-

- From the menu -1- select the diagnostic function “03 - Final control diagnosis”.



Display on -VAS 5051 A-

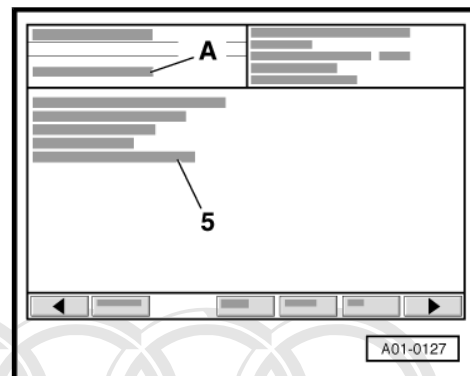
- Keep touching the  key until the following display appears:

A - 5th control element in test

5 - Secondary air pump relay -J299-

- Press the  key again.

A - Actuator is running; continued switching is allowed



- The secondary air pump relay -J299- -item 1- (below cover on left side of bulkhead) should pick up intermittently (with an audible click) and the secondary air pump motor -V101- should start up intermittently.

- Exit function “03 - Final control diagnosis” by pressing the  key.
- Press “06 - End output”.
- Switch off ignition.

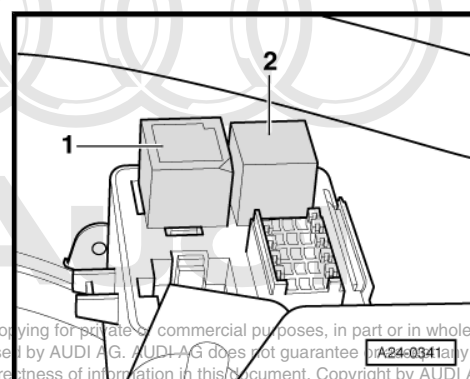
A - If the relay does not pick up:

- Check voltage supply of secondary air pump relay [⇒ page 175](#).
- Check activation of secondary air pump relay [⇒ page 176](#).

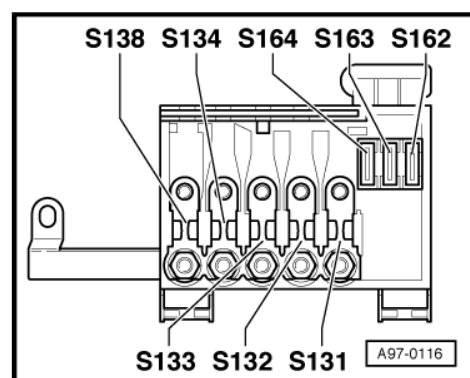
B - If the relay picks up but the secondary air pump motor does not run:

- Check voltage supply of secondary air pump motor [⇒ page 177](#).

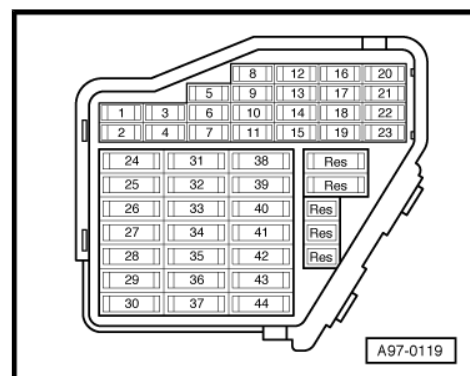
Checking voltage supply of secondary air pump relay



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- Fuse 1 -S131- (50 A) in main fuse box/battery OK
- Fuse in fuse holder -S243- (position 43) OK.



- Disconnect secondary air pump relay.
- Connect multimeter to measure voltage between contact -1- and earth.

- Specification: approx. battery voltage

If specification is not obtained:

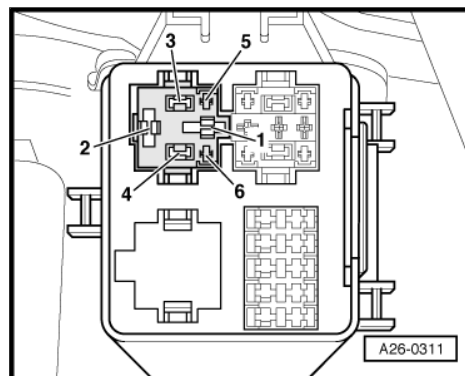
- Check wiring between battery + (terminal 30) and fuse 1 - S131- for secondary air pump relay -J299- (below cover on left side of bulkhead) for open circuit using the current flow diagram.
- Repair wiring connection if necessary.
- Connect multimeter to measure voltage between contact -3- and earth.
- Operate the starter briefly.

- Specification: approx. battery voltage

- Switch off ignition.

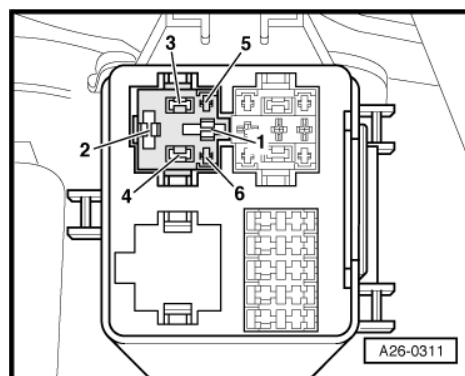
If specification is not obtained:

- Check wiring between secondary air pump relay -J299- (below cover on left side of bulkhead) and fuel pump relay -J17- via fuse for open circuit using the current flow diagram.
- Repair wiring connection if necessary.



Checking activation of secondary air pump relay

- Disconnect secondary air pump relay.
- Connect up voltage tester -V.A.G 1527 B- between contact -4- and battery positive.



- Vehicle diagnostic, testing and information system -VAS 5051 A- with diagnosis lead -VAS 5051/1- is connected; vehicle self-diagnosis and vehicle system "01 - Engine electronics" is selected. When doing this, the ignition must be switched on.

Display on -VAS 5051 A-

- From the menu -1- select the diagnostic function "03 - Final control diagnosis".



Display on -VAS 5051 A-

- Keep touching the  key until the following display appears:

A - 5th control element in test

5 - Secondary air pump relay -J299-

- Press the  key again.

A - Actuator is running; continued switching is allowed

- The LED should flash.

- Exit function "03 - Final control diagnosis" by pressing the  key.

- Switch off ignition.

If the LED does not flash:

- Connect adapter cable, 121-pin -V.A.G 1598/31- (test box) to connectors of wiring harness; do not connect engine control unit. Connect earth clip of test box to earth ⇒ Rep. Gr. 24 .



Caution

To avoid damage to the electronic components, select the required measuring range and observe test conditions before connecting the test leads.

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

Relay carrier on bulkhead (left-side) Contact	Adapter cable, 121-pin -V.A.G 1598/31- (test box) Socket
-4-	72

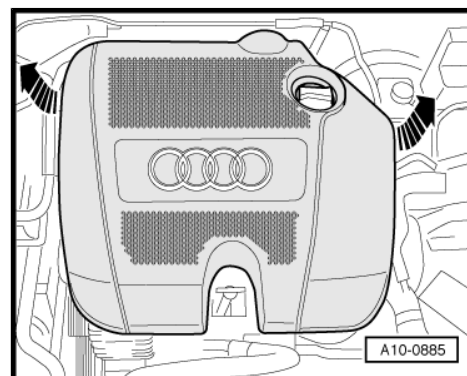
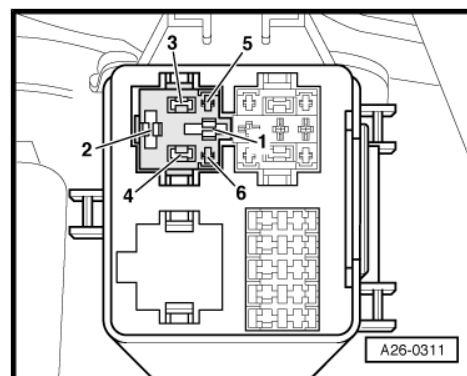
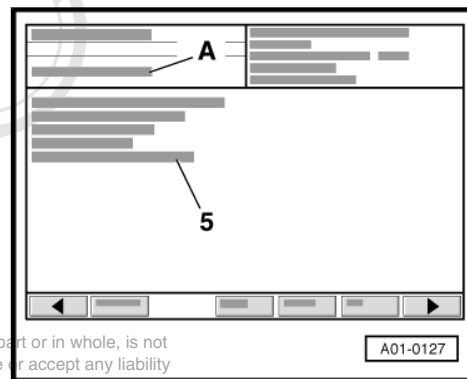
- Repair wiring connection if necessary.

If no fault is found:

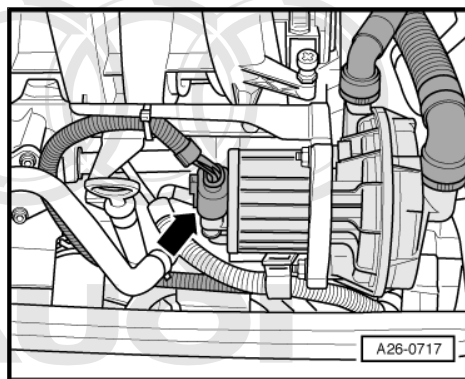
- Renew secondary air pump relay -J299- .

Checking voltage supply for secondary air pump motor

- Take off engine cover panel -arrows-.

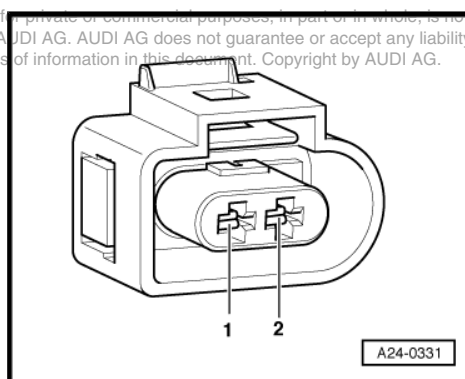


- Unplug electrical connector -arrow- at secondary air pump motor -V101- .



- 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 A- with diagnosis lead -VAS 5051/1- is connected; vehicle self-diagnosis and vehicle system "01 - Engine electronics" is selected. When doing this, the ignition must be switched on.

Display on -VAS 5051 A-

- From the menu -1- select the diagnostic function "03 - Final control diagnosis".



Display on -VAS 5051 A-

- Keep touching the  key until the following display appears:

A - 5th control element in test

5 - Secondary air pump relay -J299-

- Press the  key again.

A - Actuator is running; continued switching is allowed

- The LED should flash.

- Exit function "03 - Final control diagnosis" by pressing the  key.

- Switch off ignition.

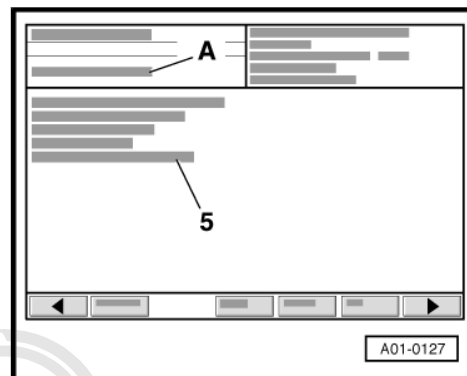
If the LED does not flash:

- Check for open circuit in wiring from contact 2 of connector to secondary air pump relay -J299- (in relay carrier below cover on left side of bulkhead) using the current flow diagram.
- Use current flow diagram to check for open circuit in wiring leading from contact 1 of connector to earth.
- Repair wiring connection if necessary.

If no fault is found:

- Renew the secondary air pump ⇒ [page 181](#)

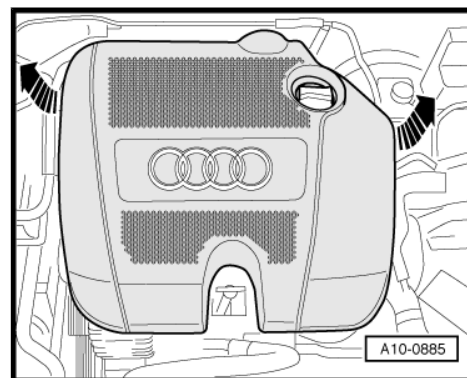
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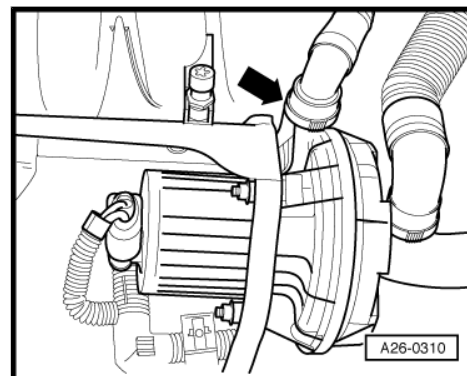
3.4 Checking combination valve for secondary air system for proper operation and leakage

Test sequence

- Take off engine cover panel -arrows-.



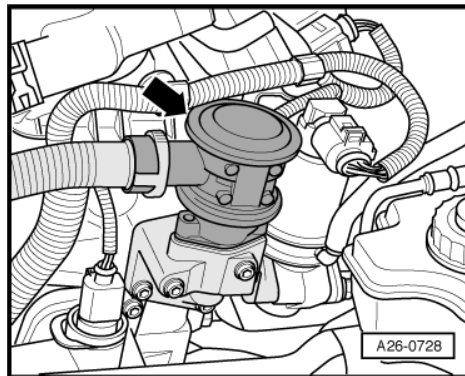
- Detach pressure hose -arrow- at secondary air pump.



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

If combination valve for secondary air does not open:

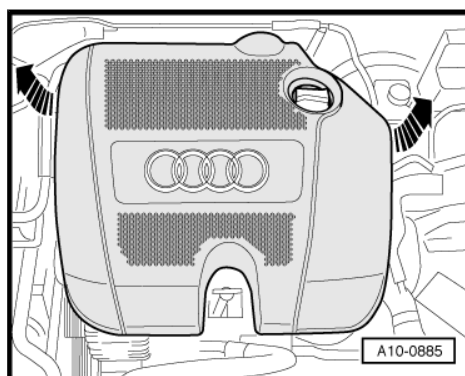
- Renew secondary air combination valve ⇒ [page 180](#) .



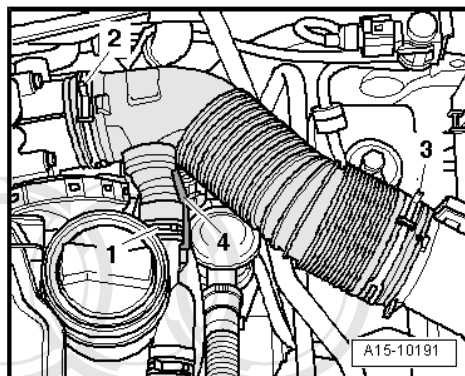
3.5 Removing and installing combination valve for secondary air system

Removing

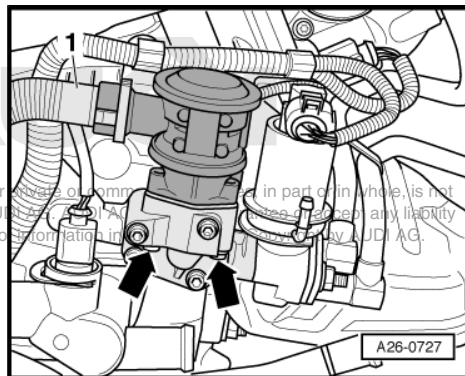
- Take off engine cover panel -arrows-.



- Disconnect hose -4-.
- Release spring-type hose clips -1-, -2- and -3- to remove air intake hose.



- Disconnect hose -1- at combination valve for secondary air.
- Unscrew bolts -arrows-.
- Detach combination valve for secondary air.



Installing

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



Renew gaskets.

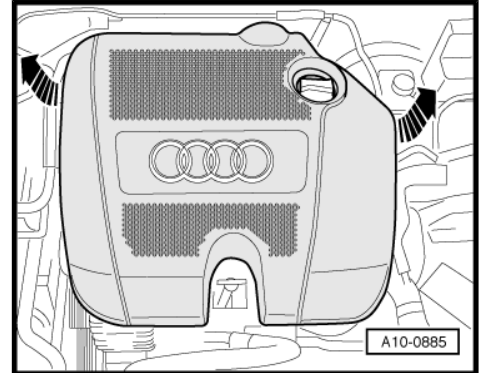
Tightening torque

Component	Nm
Combination valve for secondary air to flange	10

3.6 Removing and installing secondary air pump

Removing

- Take off engine cover panel -arrows-.



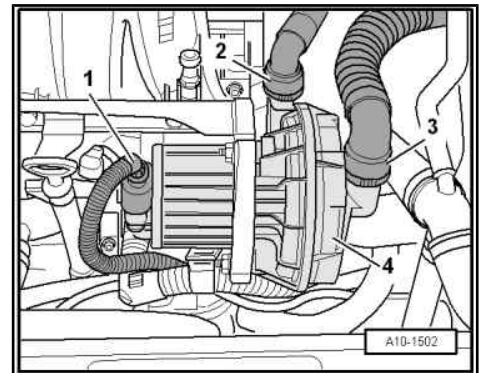
- Detach electrical connector -1-.
- Disconnect hoses -2- and -3- at secondary air pump.
- Detach secondary air pump -4- from bracket.

Installing

Install in reverse order.

Tightening torque

Component	Nm
Secondary air pump to bracket	10



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