



Workshop Manual

Audi A4 1995 ➤

4-cylinder engine (2-valve), mechanics

Engine ID	AHL	ANA	ARM						
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Edition 08.2003

List of Workshop Manual Repair Groups

Repair Group

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

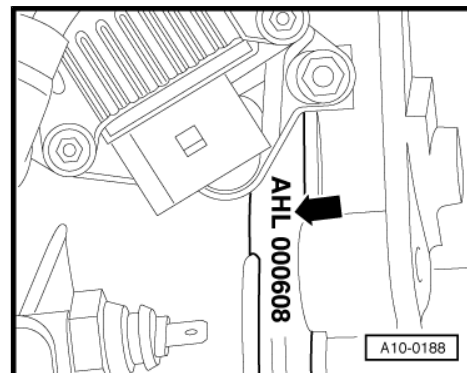
1 Technical data

1.1 Engine number

The engine number ("engine code" and "serial number") can be found at the joint between engine and gearbox (left-side).

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

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



1.2 Engine data

Code letters		AHL	ANA	ARM
Capacity	ltr.	1.6	1.6	1.6
Power output	kW at rpm	74/5600	74/5600	74/5600
Torque	Nm at rpm	145/3800	145/3800	145/3800
Bore	Ø in mm	81.0	81.0	81.0
Stroke	mm	77.4	77.4	77.4
Compression		10.2	10.2	10.2
RON	at least	95 ¹⁾	95 ¹⁾	95 ¹⁾
Injection/ignition system		Simos 2	Simos 3.4	Simos 2.1
Firing order		1-3-4-2	1-3-4-2	1-3-4-2
Knock control		yes	yes	yes
Secondary air system		no	yes	no
Exhaust gas recirculation		no	yes	no
Intake manifold change-over		yes	yes	yes

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

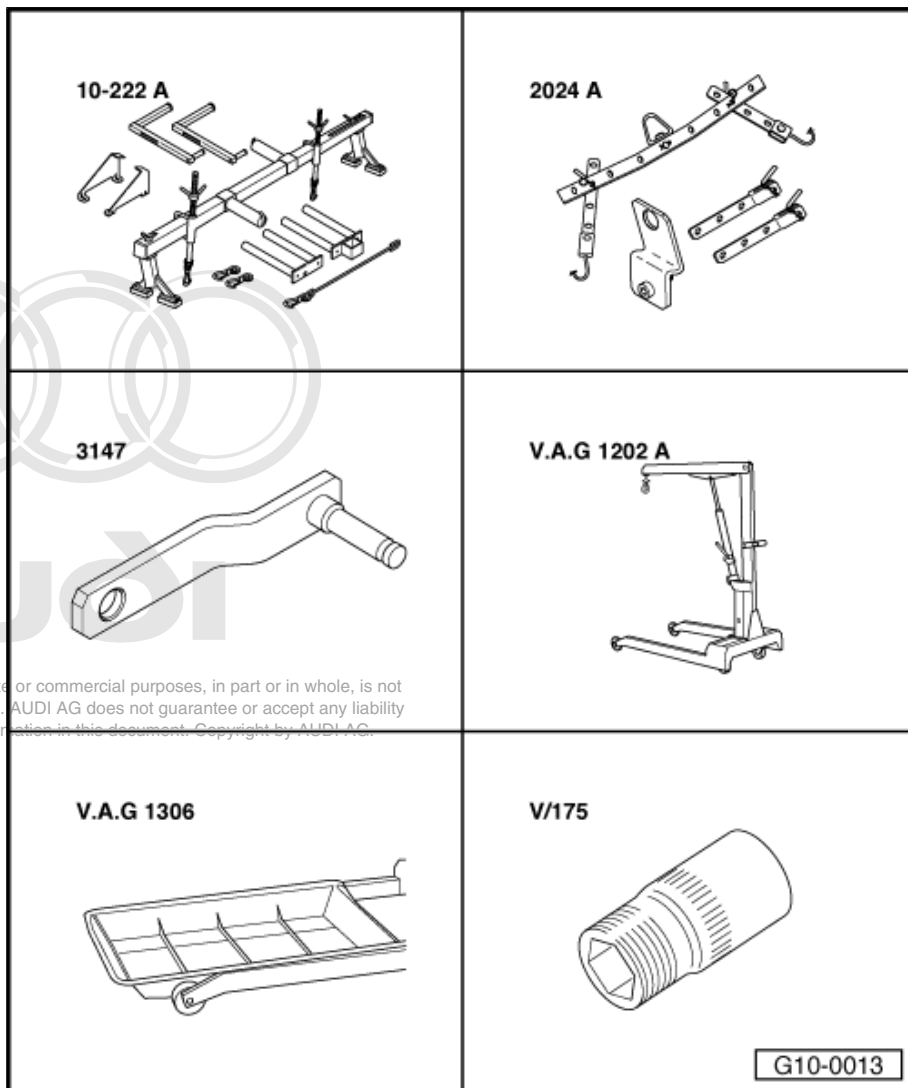
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10 – Removing and installing engine

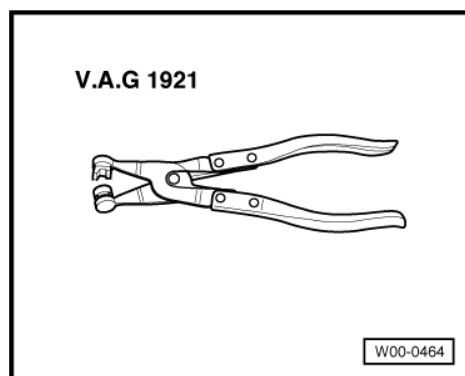
1 Removing and installing engine

Special tools and workshop equipment required

- ◆ Support bracket -10-222 A-
- ◆ Lifting tackle -2024 A-
- ◆ Gearbox support -3147-
- ◆ Workshop crane - V.A.G 1202 A- or workshop crane -VAS 6100-
- ◆ Drip tray -V.A.G 1306-
- ◆ Socket (15 mm) -V/175-



- ◆ Spring type clip pliers -V.A.G 1921-
- ◆ Drip tray



1.1 Removing - vehicles with engine code letters AHL, ARM



Note!

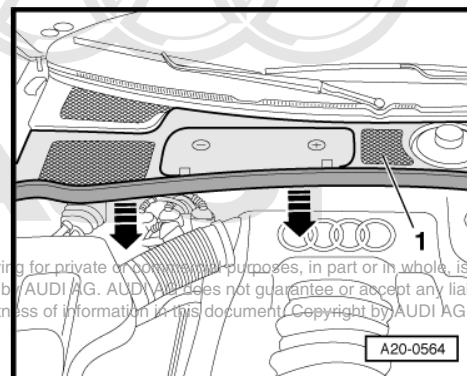
- ◆ *Renew all cable ties which are opened or cut open when removing the engine. Refit in the same position when installing the engine.*
- ◆ *The engine is removed from the front without the gearbox.*
- ◆ *Collect drained coolant in a clean container for re-use or disposal.*

Vehicles with automatic gearbox:

- Move selector lever into position "N".

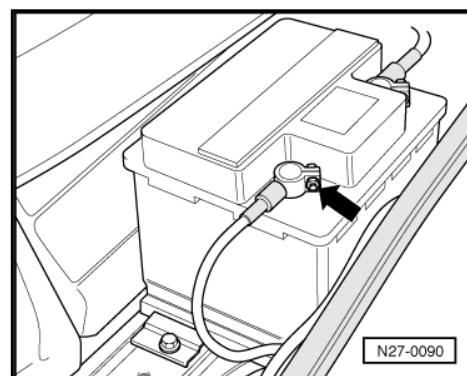
All models:

- Note radio code for vehicles with encoded radio (request if necessary).
- Move windscreen wipers to the vertical position.
- Detach rubber seal from plenum chamber cover in direction of -arrow-.
- Detach plenum chamber cover -1- to front.



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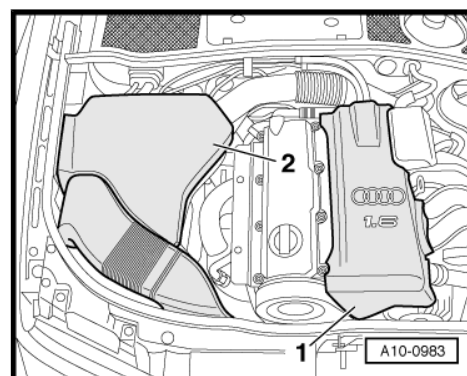
- With ignition switched off, disconnect earth wire -arrow- at battery.



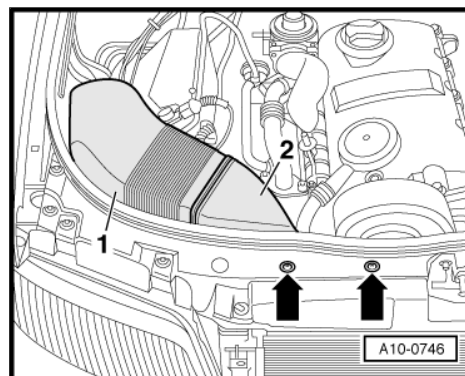
Caution

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 engine cover panel -1-.
- Remove air cleaner cover -2-.

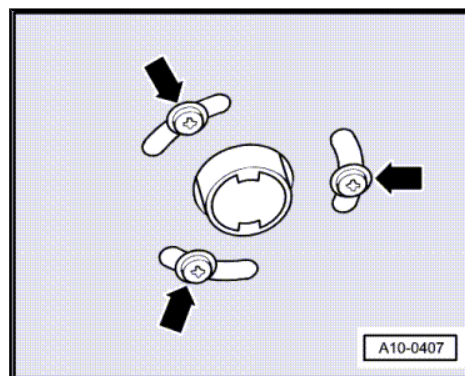


- Unscrew bolts -arrows-.
- Remove air ducts -1- and -2-.
- Remove front bumper ⇒ General body repairs, exterior; Rep. Gr. 63 .



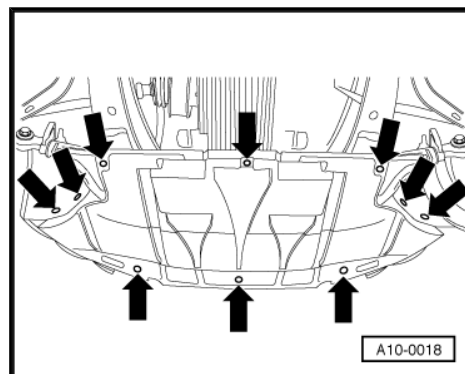
Vehicles with auxiliary heater:

- Remove bolts -arrows- securing exhaust pipe for auxiliary/additional heater to noise insulation.

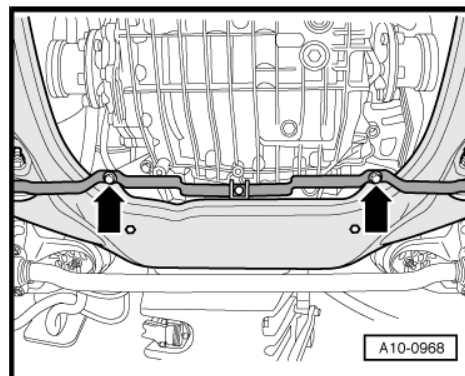


All models:

- Remove noise insulation -arrows-.

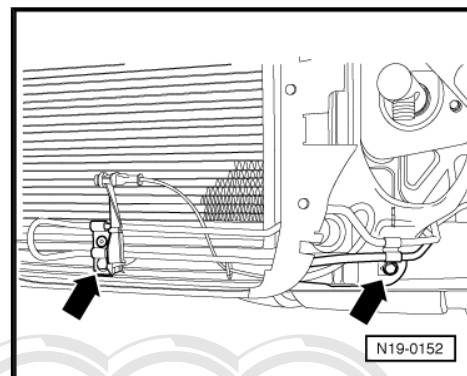


- Unbolt bracket for noise insulation -arrows-.

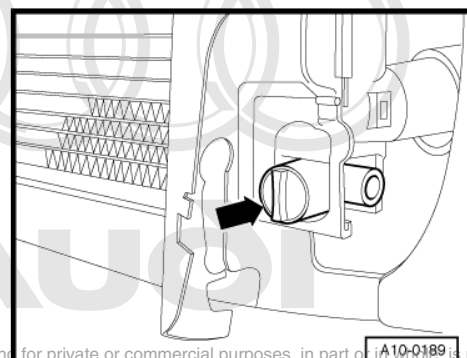


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- Unscrew coolant pipe for power steering hydraulic fluid -arrows- and move clear to side; do not open hydraulic fluid circuit.
- Tighten bracket for outside temperature sensor back on finger-tight.



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

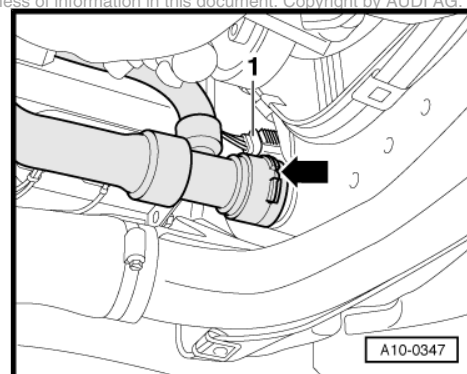


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- Detach coolant hose (bottom) from radiator by releasing retaining clip -arrow-.

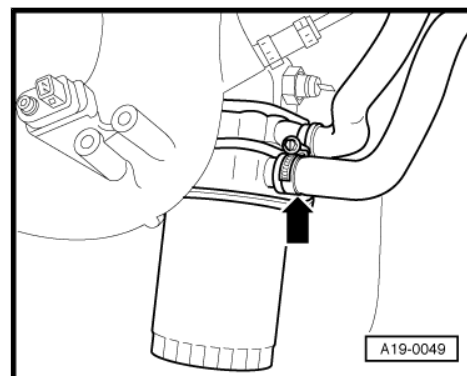
Vehicles with electric radiator fan:

- Unplug electrical connector -1- at radiator fan thermal switch -F18/F54- at radiator (bottom left) and move wiring clear.



All models:

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



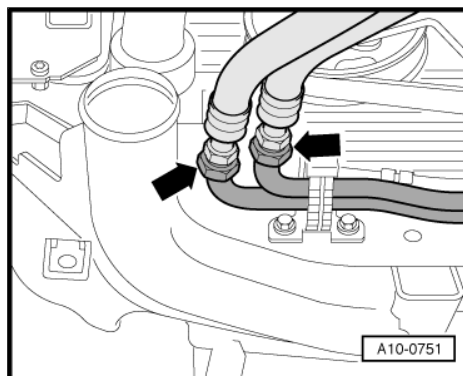
Vehicles with automatic gearbox:



Note!

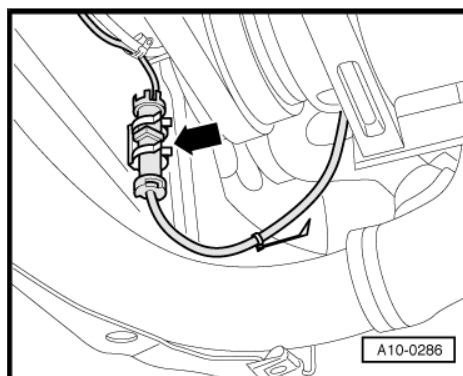
Note the rules for cleanliness when working on the automatic gearbox ⇒ Automatic gearbox 01N; Rep. Gr. 37.

- Place the drip tray underneath.
- Disconnect ATF pipes -arrows-.
- Unbolt bracket for ATF pipes (left-side) at engine.



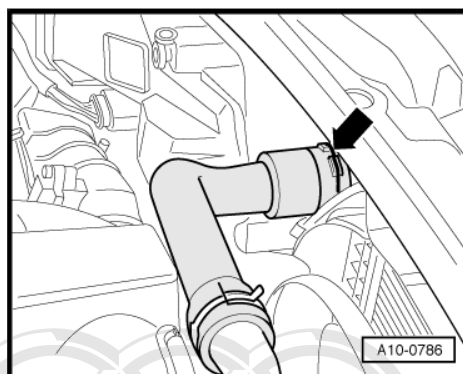
Vehicles with air conditioning:

- Unclip and disconnect green electrical connector -arrow- for magnetic clutch of air conditioner compressor at lock carrier (bottom right) and move wiring clear.

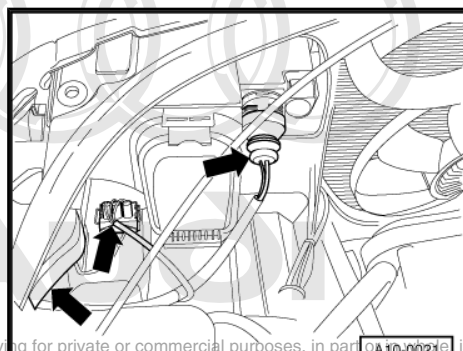


All models:

- Detach coolant hose (top) from radiator by releasing retaining clip -arrow-.

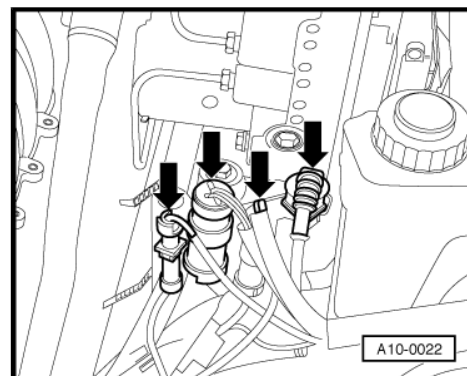


- Unplug electrical connectors -arrows- for headlights and headlight adjustment on both sides of vehicle.
- Turn bulb holders for turn signals anti-clockwise and remove from turn signal housing -left arrow- (both sides of vehicle).

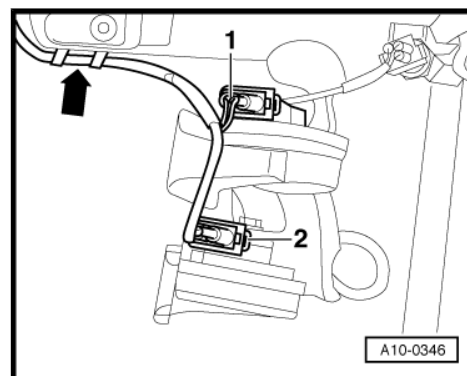


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- Remove cover for power steering reservoir and unplug electrical connectors -arrows-.
- Move wiring harness clear.
- Unplug electrical connector for anti-theft alarm on lock carrier (top left) and move wiring clear.



- Unplug electrical connectors on both horns -1- and -2-, detach wiring at bracket -arrow- and move wiring clear.



Vehicles with air conditioning:



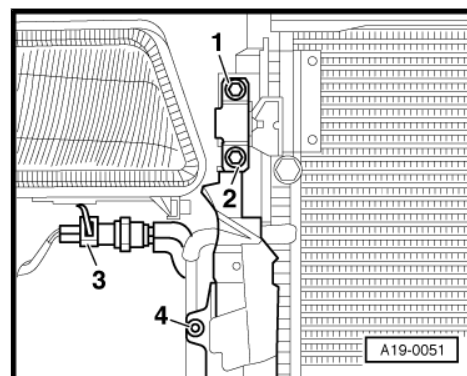
Caution

Refrigerant circuit of air conditioner 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 bolts -4- for air ducts (left and right) at radiator and detach air ducts.
- Unscrew securing bolts -1- and -2- for condenser.
- Unplug the electrical connector -3- at low-pressure switch for air conditioner -F73-.
- Pull condenser up out of its bracket, pivot to side and secure to right-side front wheel with wire.

All models:

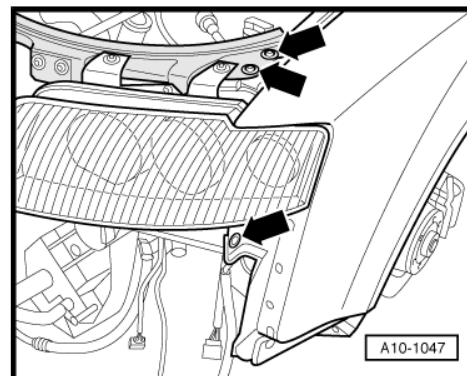
- Pull bonnet seals away from lock carrier and wing panels.



Note!

Protect wing panels from damage.

- Remove bolts (left and right) -arrows-.
- Disconnect bonnet lock cable at bonnet lock and move cable clear.



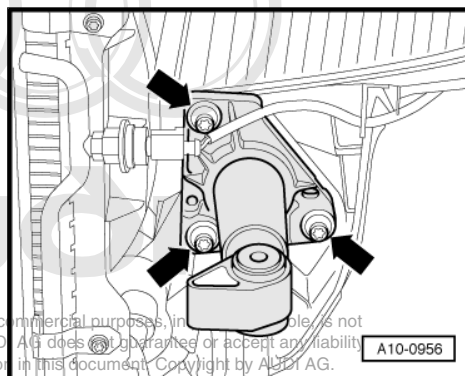
- Unscrew bolts from impact absorbers -arrows- (left and right).



Note!

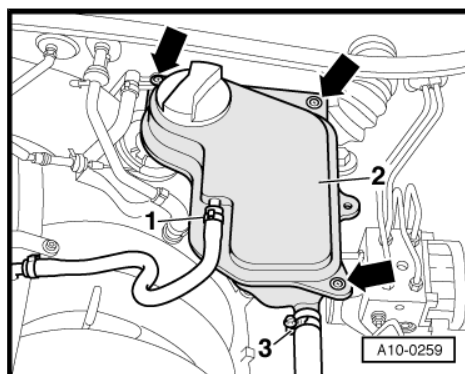
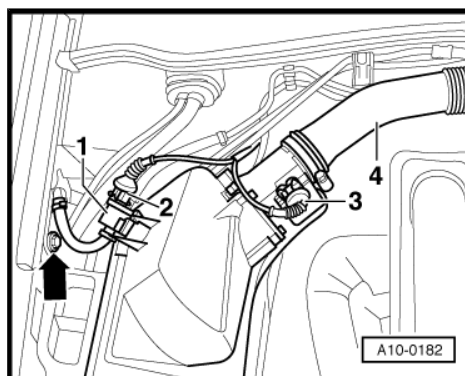
A second mechanic is required for removing the lock carrier.

- Remove lock carrier and place down in a secure position.



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- Unplug electrical connectors -2- and -3- for solenoid valve 1 for activated charcoal filter system -N80- and air mass meter -G70- .
- Disconnect the solenoid valve 1 for activated charcoal filter system -N80- -Item 1- at air cleaner housing.
- Remove air duct -4- between air cleaner and throttle valve module -J338- .
- Remove air cleaner housing -arrow-.
- Unscrew securing nuts for exhaust manifold/front exhaust pipe (accessible from above).
- Detach coolant hoses -1- and -3-.
- Unbolt coolant expansion tank -2- -arrows-.
- Disconnect electrical wiring for coolant shortage indicator switch -F66- at coolant expansion tank (bottom).

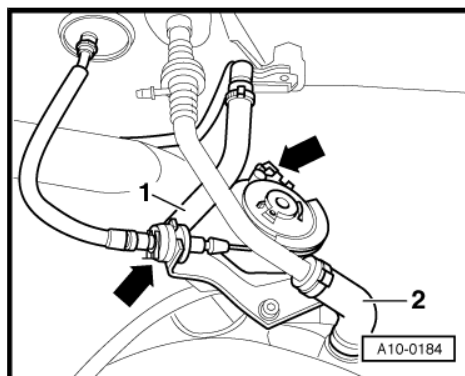


Vehicles with cruise control system:

- Disengage operating rod at throttle valve module -J338- .
- Detach vacuum hose at vacuum unit.

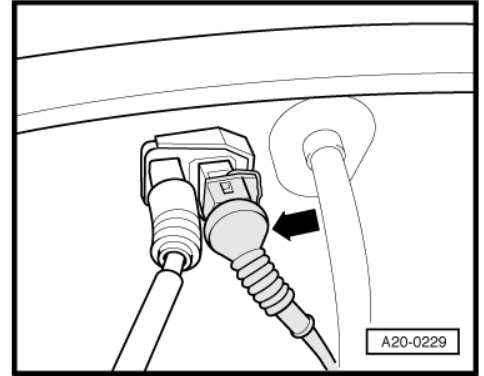
All models:

- Detach throttle cable from throttle valve module -J338- and from support bracket -arrows- (do not remove retainer). Move throttle cable clear to the side.
- Detach vacuum hose -1- leading to solenoid valve 1 for activated charcoal filter system -N80- .
- Detach vacuum hose -2- going to brake servo at intake manifold.



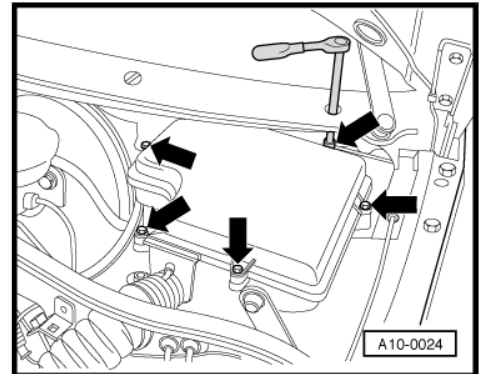
Vehicles with automatic gearbox:

- Unplug electrical connector at kickdown switch -arrow-.

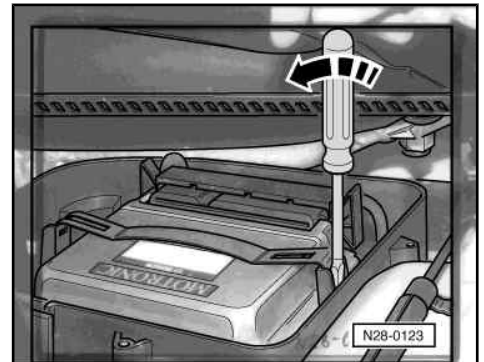


All models:

- Remove cover for electronics box in plenum chamber -arrows-.

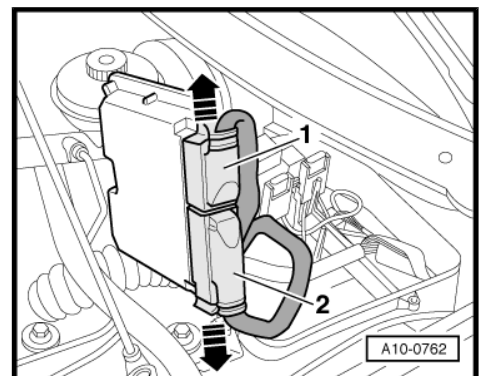


- Carefully lever off the retaining strap with a screwdriver -arrow-.



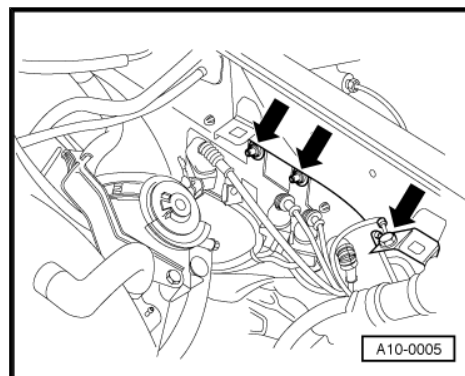
- Release retainer tabs -arrows- and unplug connectors 1 and 2- from engine control unit.

- Detach rear connectors on connector console.



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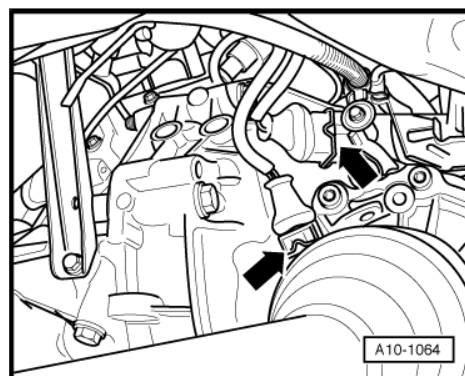
- Unscrew earth connection and bracket for connectors at plenum chamber -arrows-.
- Move wiring harness clear and lay on top of engine.



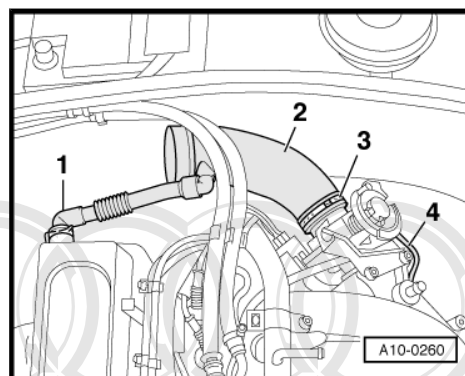
- Unplug the two electrical connectors -arrows- at gearbox.


Note!

Illustration shows vehicle with manual gearbox.

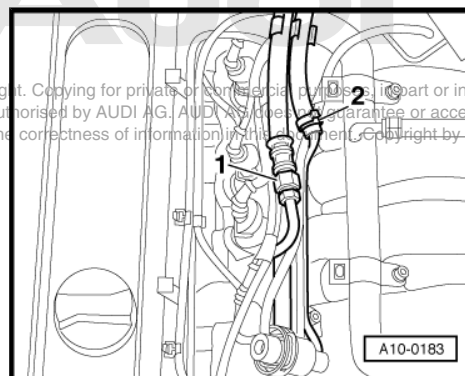


- Release hose clip -3- at the connection for air pipe/throttle valve housing.
- Release clip for connecting pipe -1- at cylinder head cover going to air pipe.
- Watch out for O-ring when removing.
- Disconnect hose -4-.
- Detach air pipe -2- from throttle valve housing.


Caution

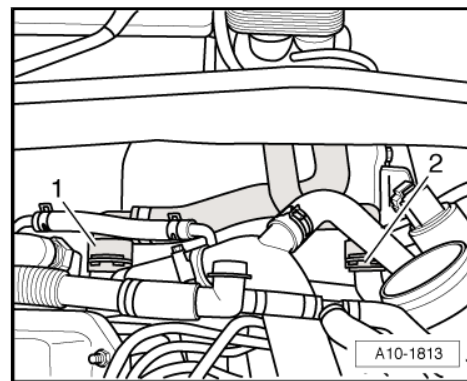
The fuel system is pressurised. Before opening the system place a cloth around the connection. Then dissipate pressure by carefully unfastening the connection.

- Disconnect fuel return pipe -2- and fuel supply pipe -1- at fuel rail.



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- Release retaining clips and detach coolant hoses -1- and -2- going to heat exchanger.

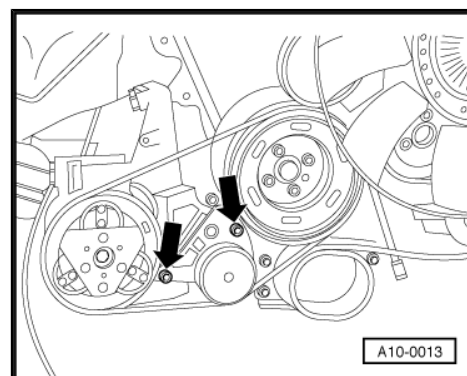


Note!

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.

Vehicles with air conditioning:

- Loosen securing bolts on tensioning roller for poly V-belt for A/C compressor -arrows-, slacken belt and remove.



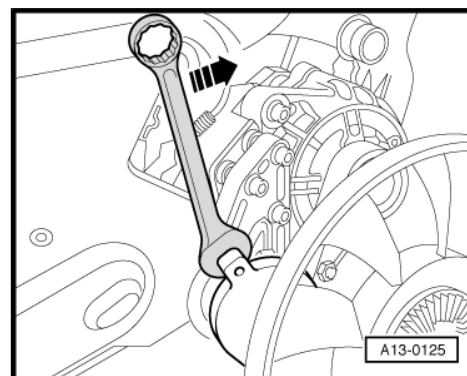
Caution

Refrigerant circuit of air conditioner must not be opened.

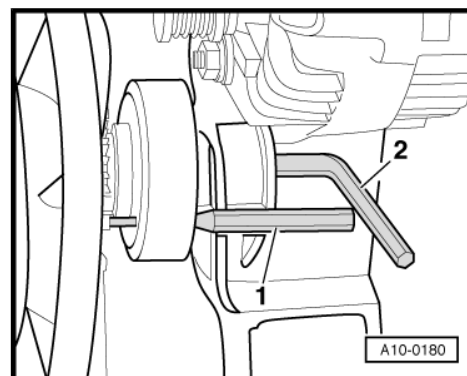
- Detach air conditioner compressor from bracket and secure to body with wire.

All models:

- Turn the tensioner in the direction of the -arrow- to slacken the poly V-belt.
- Remove poly V-belt from the alternator pulley.

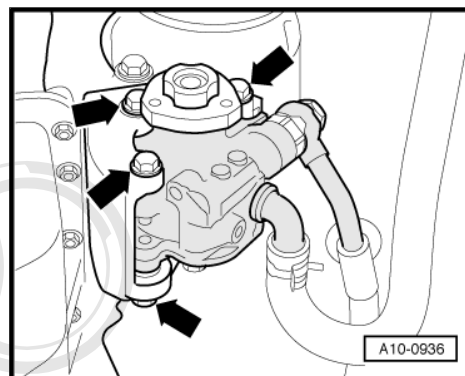


- Lock pulley for viscous fan with roll-pin drift -1- and unscrew using hexagon key -2-.
- Remove viscous fan from bearing.

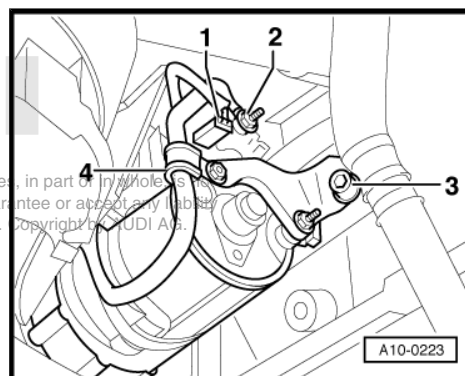


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- Unscrew pulley for power steering pump; counterhold with drift.
- Unscrew power steering pump -arrows- and tie up to one side. Leave pipes connected.



- Detach electrical wires -1- and -2- at starter; remove insulator from positive connection on starter.
- Unscrew clamp -4-.
- Unscrew bolt -3- for the starter bracket at cylinder block.
- Unbolt starter at gearbox and remove.



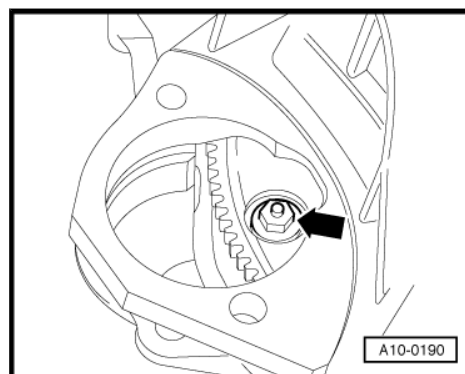
Vehicles with automatic gearbox:

- Unscrew 3 nuts -arrow- for torque converter through opening of removed starter using 15 mm socket insert -V/175- (turn crankshaft $\frac{1}{3}$ turn each time).



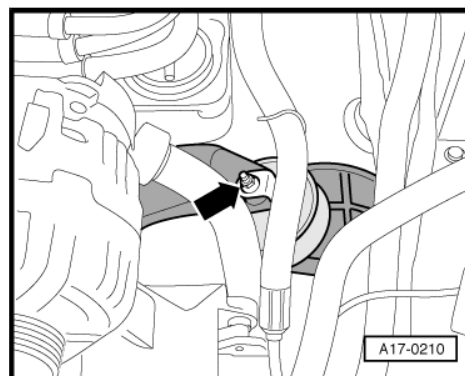
Note!

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



All models:

- Unbolt earth cable from engine support (right-side).
- Loosen top nuts -arrow- at engine mounts (left and right) several turns.

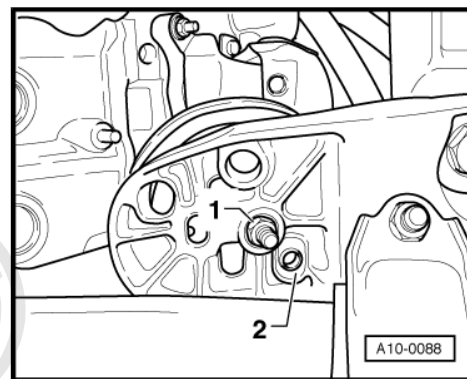


- Mark positions of bolt connections -1- and locating sleeves -2- on bottom of engine mounts (left and right).

 Note!

Different mounting holes are provided for the different engine versions.

- Remove bottom nuts -1- at engine mounting (left and right).
- Unscrew securing nuts for exhaust manifold/front exhaust pipe (accessible from below).
- Detach front exhaust pipe with catalytic converter from exhaust manifold.



 Note!

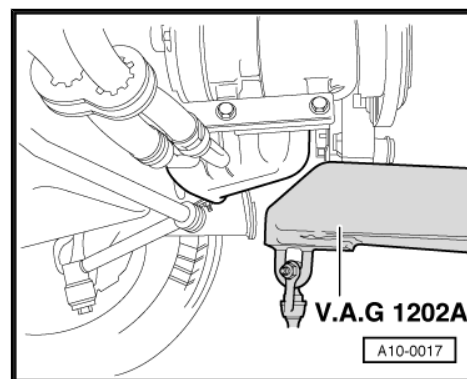
The flexible joint in front exhaust pipe must not be bent more than 10° to avoid any damage.

- Lay the front exhaust pipe with catalytic converter down onto heat shield for drive shaft.
- Raise engine and gearbox using workshop crane - V.A.G 1202 A- .



Caution

To avoid injury, ensure adequate support.



 Note!

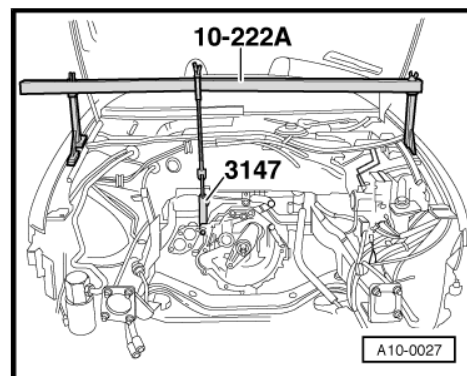
Make sure no wires/pipes are damaged at the top on the bulk-head.

- Unscrew engine/gearbox securing bolts (accessible from below).
- Lower engine again.
- Set up support bracket -10-222 A- behind gas-filled strut on wing panel flanges. The spindle must be at the front.
- Insert the gearbox support -3147- into the bolt holes for gearbox bell housing.
- Connect the gearbox support -3147- and support bracket -10-222 A- .

 Note!

Illustration shows engine removed.

- Unscrew top engine/gearbox securing bolts. Leave one bolt in place (finger-tight).



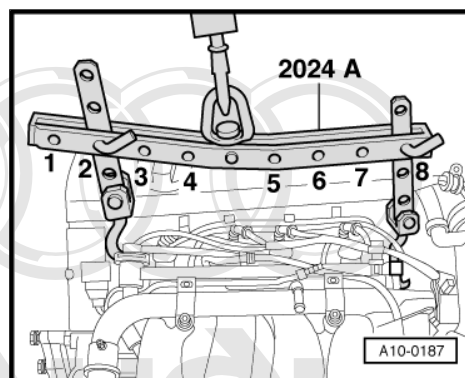
- Engage lifting tackle -2024 A- on engine and workshop crane
-VAS 6100- or -V.A.G 1202 A- .


Note!

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


Caution

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



- Unscrew last engine/gearbox securing bolt.

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Note!

Check that all hoses and other connections between engine and body have been detached.

- Lift engine over studs of engine mountings.
- Tighten spindle of support bracket -10-222 A- further.

Vehicles with automatic gearbox:

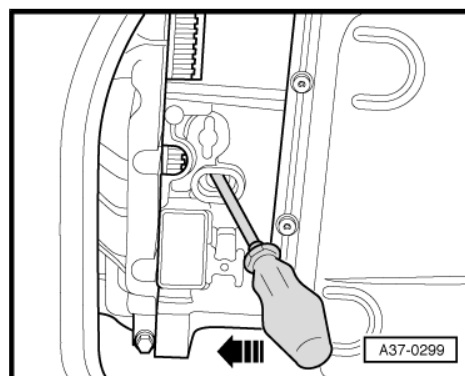
- Separate gearbox from engine and simultaneously detach torque converter from drive plate -arrow-.

All models:

- Detach engine from gearbox and lift engine forwards out of engine compartment.

Vehicles with automatic gearbox:

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



1.2 Removing - vehicles with engine code letters ANA


Note!

- ◆ Renew all cable ties which are opened or cut open when removing the engine. Refit in the same position when installing the engine.
- ◆ The engine is removed from the front without the gearbox.
- ◆ Collect drained coolant in a clean container for re-use or disposal.

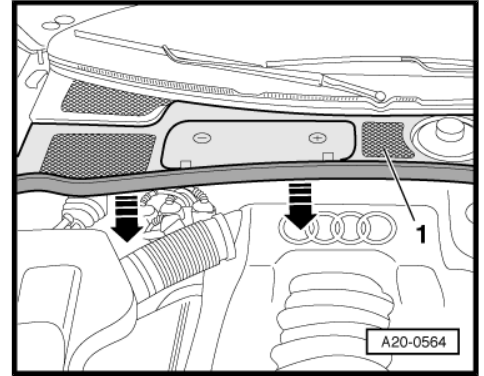
Vehicles with automatic gearbox:

- Move selector lever into position “N”.

All models:

- Obtain code on vehicles with coded radio / radio and navigation system (RNS).

- Detach rubber seal from plenum chamber cover in direction of -arrow-.
- Detach plenum chamber cover -1- to front.

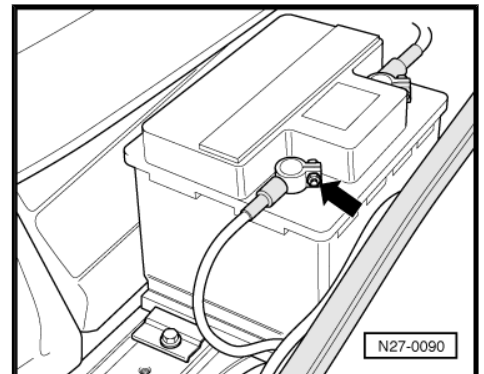


- With ignition switched off, disconnect earth wire -arrow- at battery.

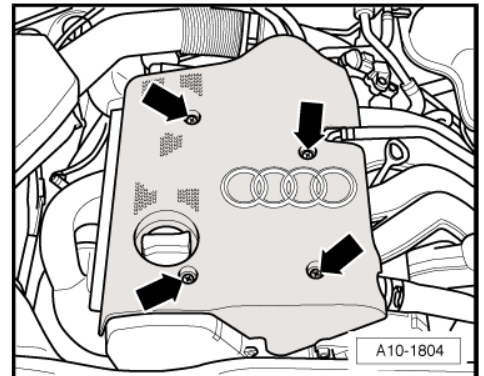


Caution

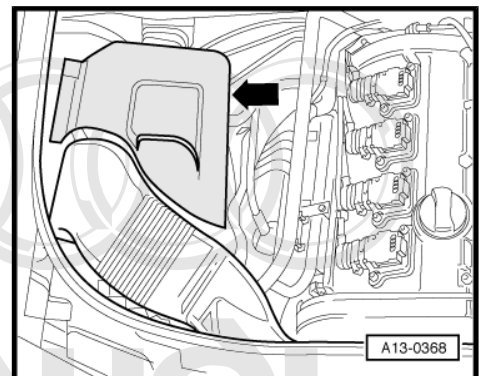
Hot steam/hot coolant may escape when opening expansion tank; cover filler cap with cloth and open carefully.



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

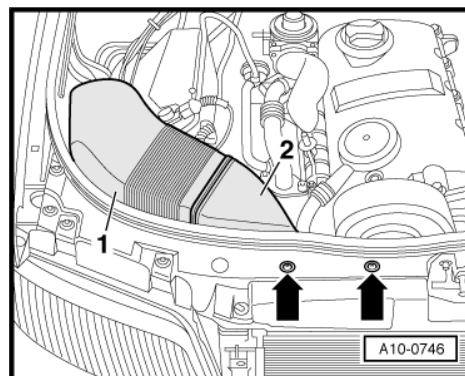


- Detach air cleaner cover -arrow-.



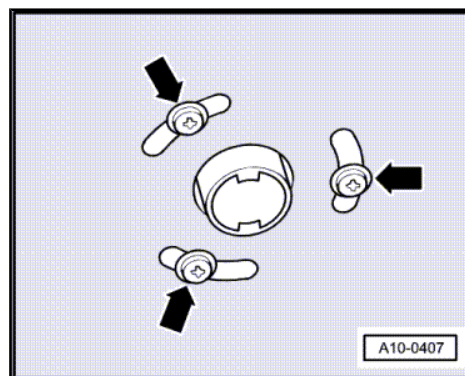
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- Unscrew bolts -arrows-.
- Remove air ducts -1- and -2-.
- Remove front bumper ⇒ General body repairs, exterior; Rep. Gr. 63 .



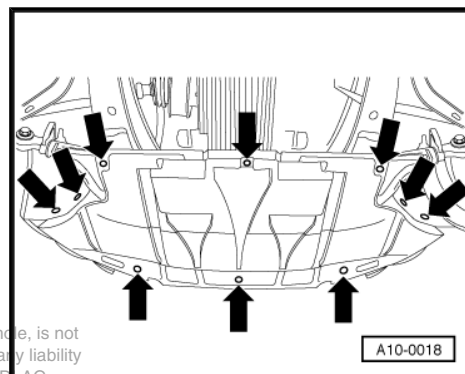
Vehicles with auxiliary heater:

- Remove bolts -arrows- securing exhaust pipe for auxiliary/additional heater to noise insulation.

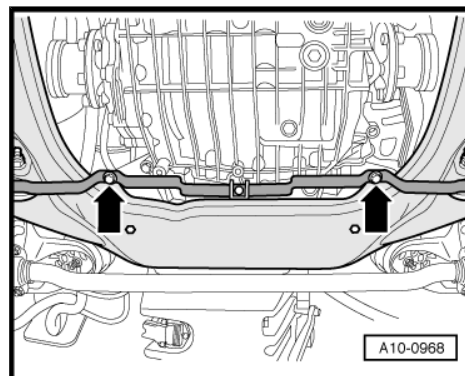


All models:

- Remove noise insulation -arrows-.



- Unbolt bracket for noise insulation -arrows-.



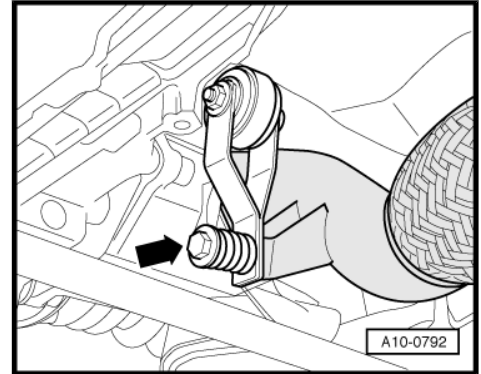
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- Detach exhaust system at gearbox bracket -arrow-.

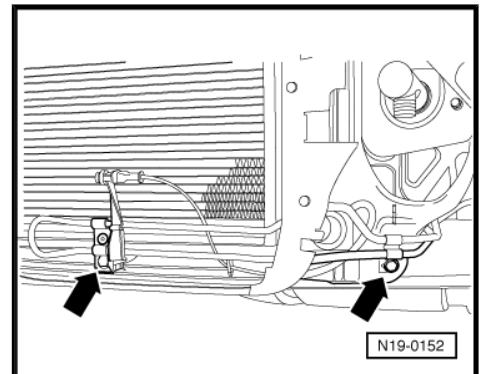


Note!

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



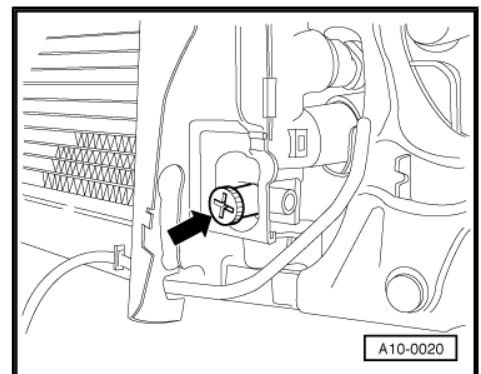
- Unscrew coolant pipe for power steering hydraulic fluid -arrows- and move clear to side; do not open hydraulic fluid circuit.



- Tighten bracket for outside temperature sensor back on finger-tight.

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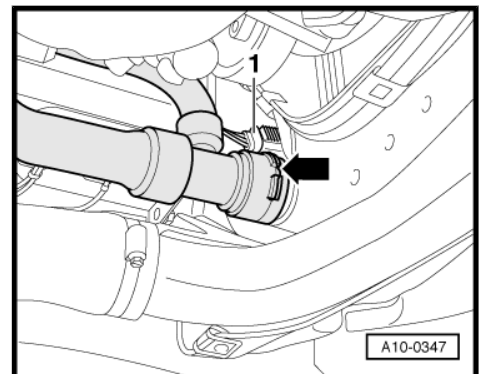
- Place drip tray -V.A.G 1306- under engine.
- Turn drain plug -arrow- on radiator anti-clockwise, if necessary fit drain hose to connection.



- Detach coolant hose (bottom) from radiator by releasing retaining clip -arrow-.

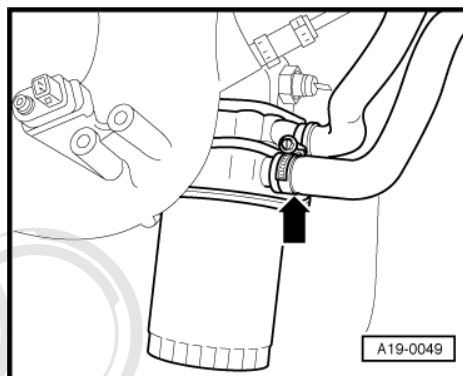
Vehicles with electric radiator fan:

- Unplug electrical connector -1- at radiator fan thermal switch -F18/F54- at radiator (bottom left) and move wiring clear.



All models:

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



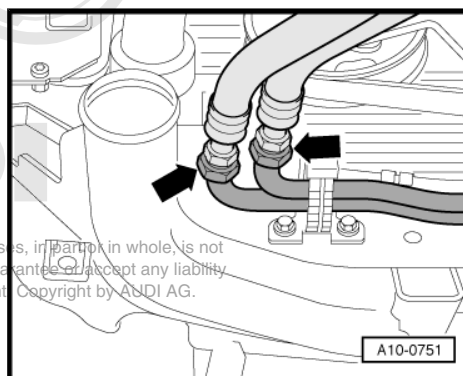
Vehicles with automatic gearbox:



Note!

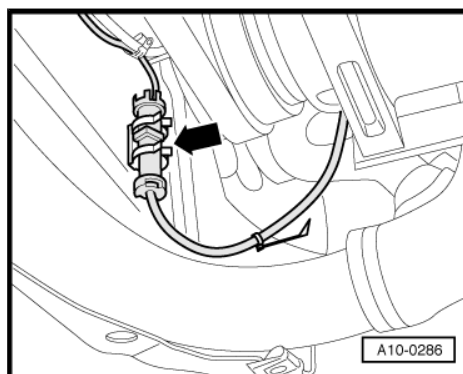
Note the rules for cleanliness when working on the automatic gearbox → Automatic gearbox 01N; Rep. Gr. 37.

- Place the drip tray underneath.
- Disconnect ATF pipes -arrows-.
- Unbolt bracket for ATF pipes (left-side) at engine.



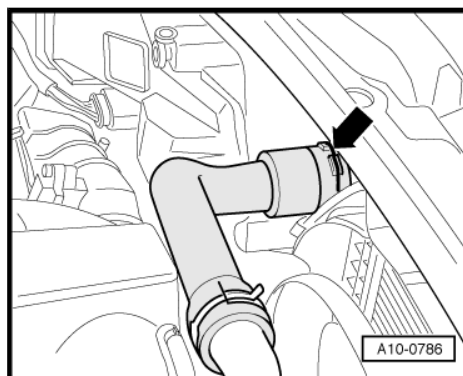
Vehicles with air conditioning:

- Unclip and disconnect green electrical connector -arrow- for magnetic clutch of air conditioner compressor at lock carrier (bottom right) and move wiring clear.

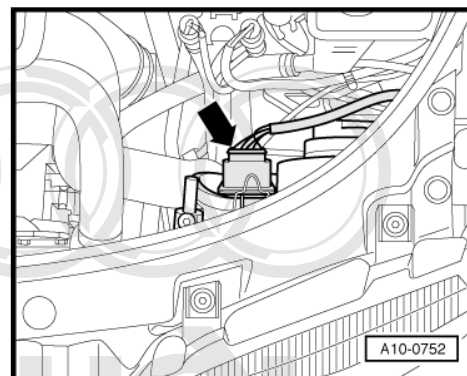


All models:

- Detach coolant hose (top) from radiator by releasing retaining clip -arrow-.

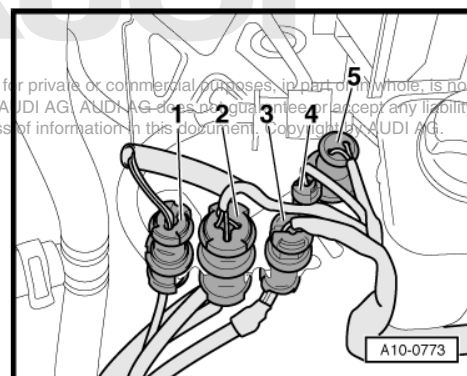


- Unplug electrical connector -arrow- for headlights on both sides.

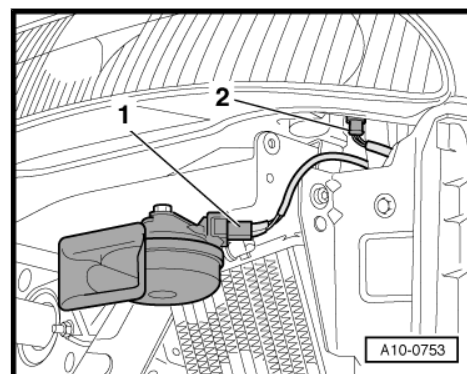


- Remove cover for power steering reservoir and unplug electrical connectors -1 ... 5-.
- Move wiring harness clear.

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- Unplug electrical connector -2- for indicator lights on both sides.
- Unplug electrical connector -1- at both horns and move wiring clear.



Vehicles with air conditioning:



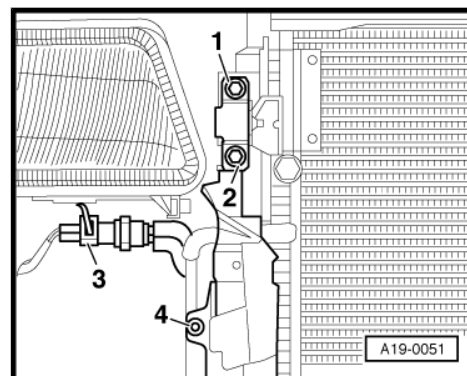
Caution

Refrigerant circuit of air conditioner 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 bolts -4- for air ducts (left and right) at radiator and detach air ducts.
- Unscrew securing bolts -1- and -2- for condenser.
- Unplug the electrical connector -3- at low-pressure switch for air conditioner -F73- .
- Pull condenser up out of its bracket, pivot to side and secure to right-side front wheel with wire.

All models:

- Pull bonnet seals away from lock carrier and wing panels.



Note!

Protect wing panels from damage.

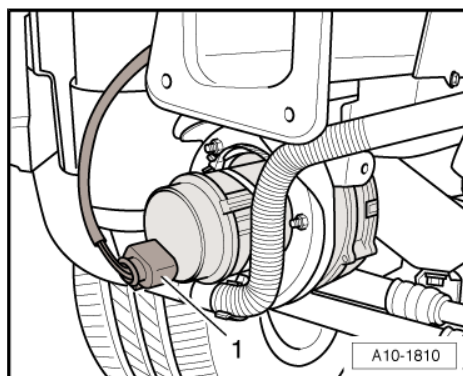
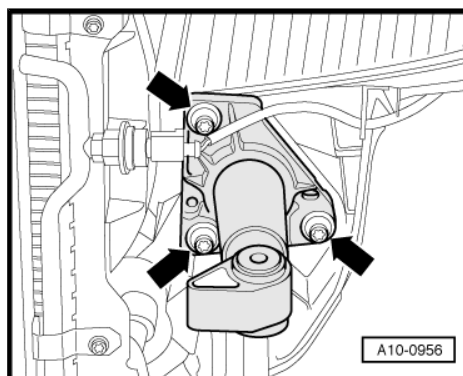
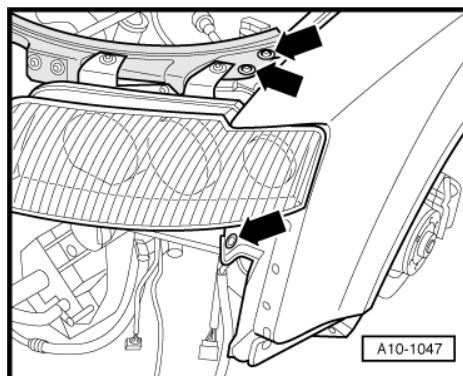
- Remove bolts (left and right) -arrows-.
- Disconnect bonnet lock cable at bonnet lock.
- Unscrew bolts from impact absorbers -arrows- (left and right).



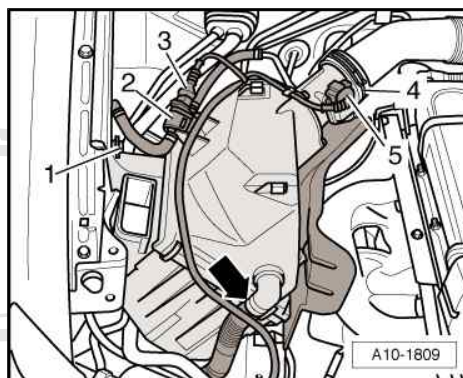
Note!

A second mechanic is required for removing the lock carrier.

- Remove lock carrier and place down in a secure position.
- Unplug electrical connector -1- at secondary air pump motor -V101-.



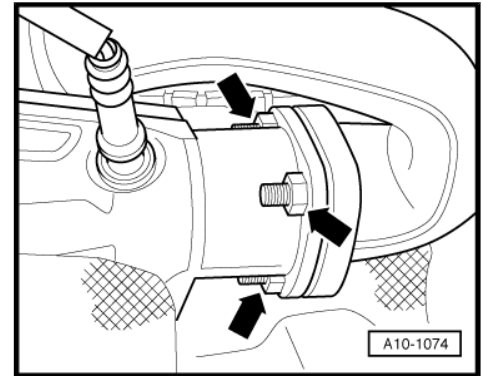
- Unplug electrical connectors -3- and -5- for solenoid valve 1 for activated charcoal filter system -N80- and air mass meter -G70-.
- Disconnect the solenoid valve 1 for activated charcoal filter system -N80- -Item 2- at air cleaner housing.
- Detach hose connection going to secondary air pump motor -V101- -arrow-.
- Release hose clip -4- for air pipe at air mass meter.
- Unscrew bolt -1- and remove air cleaner housing.



Audi

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- Unbolt catalytic converter from exhaust manifold -arrows-.
- Detach exhaust system from flange for exhaust manifold.

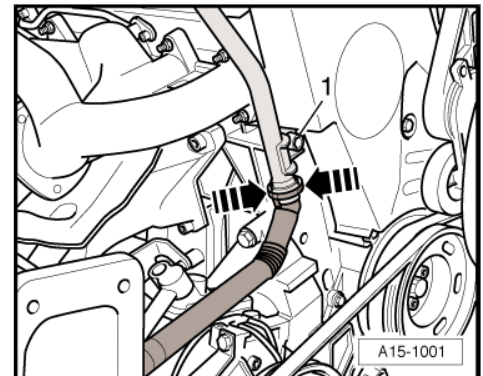


- Press the release tabs -arrows- and detach the hose at pipe going to combination valve for secondary air system.

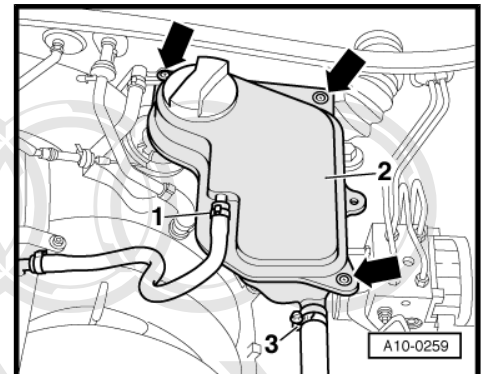


Note!

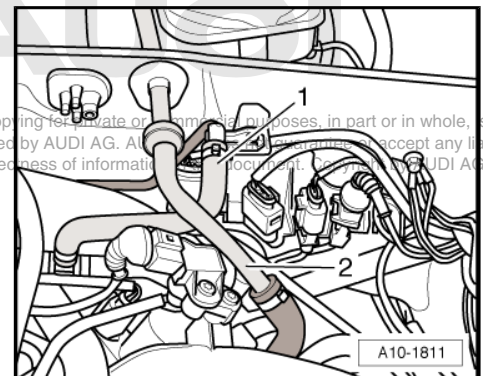
Ignore item marked -1-.



- Detach coolant hoses -1- and -3-.
- Unbolt coolant expansion tank -2- -arrows-.
- Disconnect electrical wiring for coolant shortage indicator switch -F66- at coolant expansion tank (bottom).

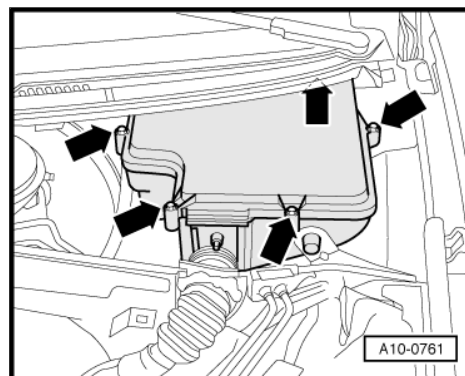


- Detach vacuum hose -1- leading to solenoid valve 1 for activated charcoal filter system -N80- .
- Detach vacuum hose -2- going to brake servo at intake manifold.

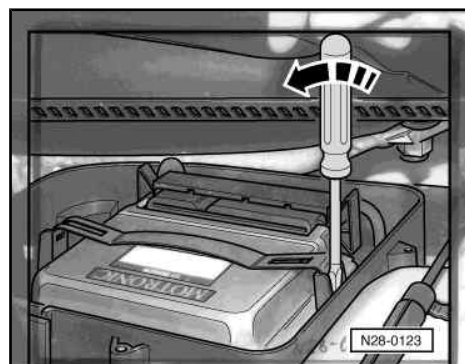


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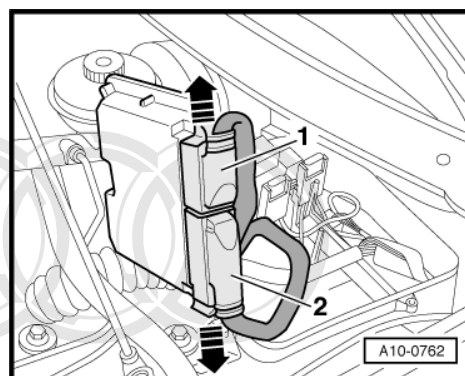
- Remove cover for electronics box in plenum chamber
-arrows-.



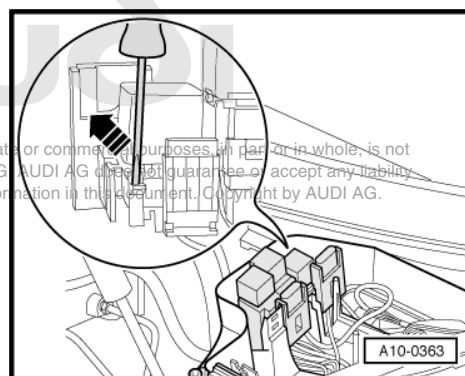
- Carefully lever off the retaining strap with a screwdriver
-arrow-.



- Release retainer tabs -arrows- and unplug connectors -1- and -2- from engine control unit.

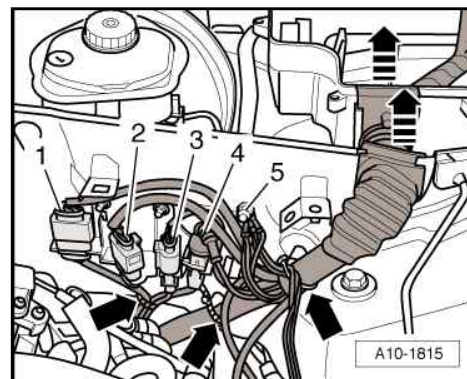


- Release retainer -arrow- and pull auxiliary relay carrier in electronics box upwards to remove.
- Detach rear connectors on connector console.



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- Unscrew earth connection -5-.
- Detach connectors -1 ... 4- from retainer.
- Detach electrical connectors -1- and -2- for Lambda probes.
- Move wiring clear -arrows- and lay on top of engine.



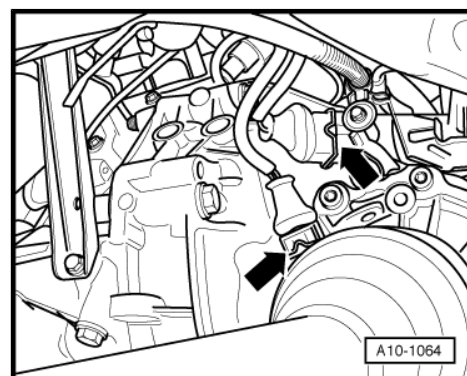
- Unplug the two electrical connectors -arrows- at gearbox.

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Note!

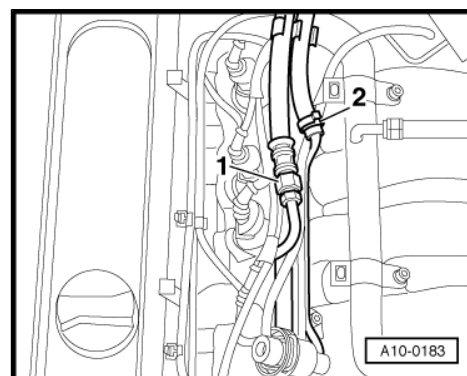
Illustration shows vehicle with manual gearbox.



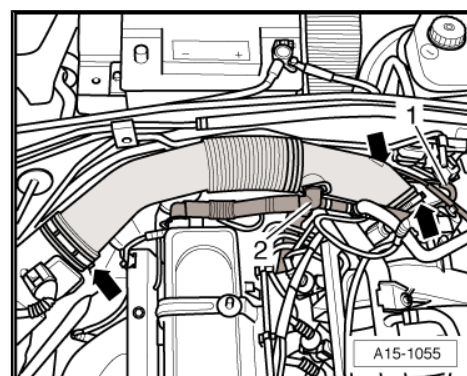
Caution

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

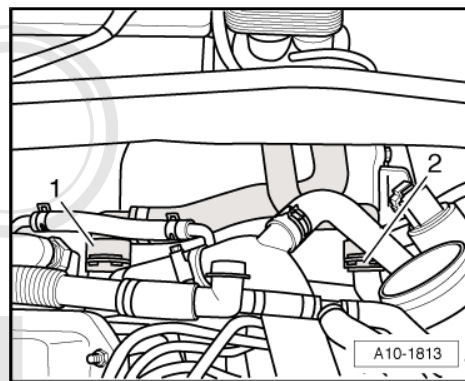
- Disconnect fuel return pipe -2- and fuel supply pipe -1- at fuel rail.



- Detach hose -2- for crankcase breather system at air pipe.
- Watch out for O-ring when removing.
- Detach vacuum hose -1-.
- Remove air pipe -arrows-.



- Release retaining clips and detach coolant hoses -1- and -2- going to heat exchanger.



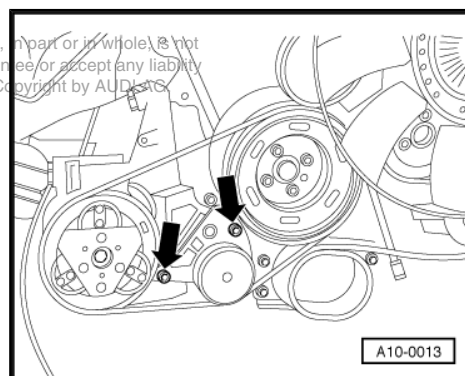
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Before removing, mark direction of rotation of poly V-belt with chalk or felt-tipped pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.

Vehicles with air conditioning:

- Loosen securing bolts on tensioning roller for poly V-belt for A/C compressor -arrows-, slacken belt and remove.



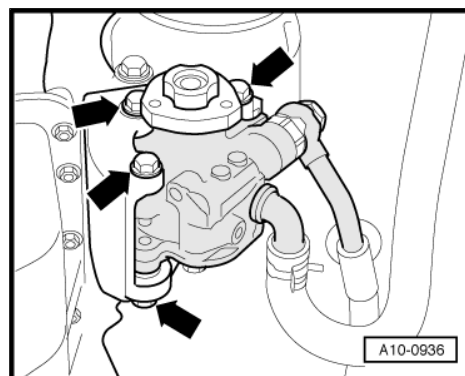
Caution

Refrigerant circuit of air conditioner must not be opened.

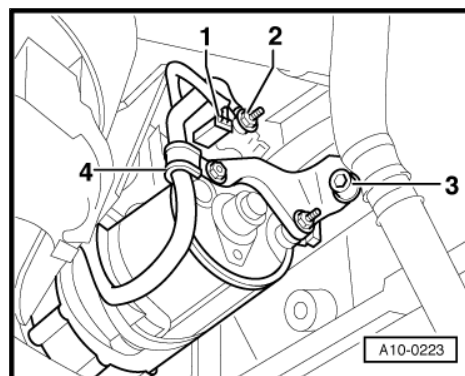
- Detach air conditioner compressor from bracket and secure to body with wire.

All models:

- Unscrew power steering pump -arrows- and tie up to one side. Leave pipes connected.



- Detach electrical wires -1- and -2- at starter; remove insulator from positive connection on starter.
- Unscrew clamp -4-.
- Unscrew bolt -3- for the starter bracket at cylinder block.
- Unbolt starter at gearbox and remove.



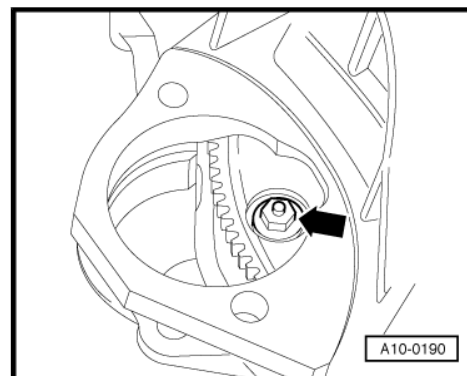
Vehicles with automatic gearbox:

- Unscrew 3 nuts -arrow- for torque converter through opening of removed starter using 15 mm socket insert -V/175- (turn crankshaft $\frac{1}{3}$ turn each time).



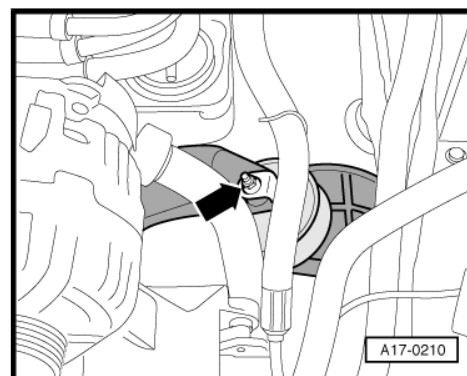
Note!

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



All models:

- Unbolt earth cable from engine support (right-side).
- Loosen top nuts -arrow- at engine mounts (left and right) several turns.



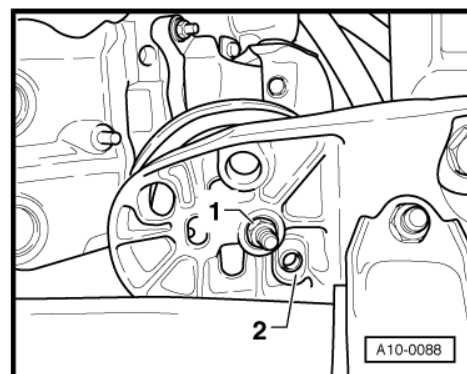
- Mark positions of bolt connections -1- and locating sleeves -2- on bottom of engine mounts (left and right).



Note!

Different mounting holes are provided for the different engine versions.

- Remove bottom nuts -1- at engine mounting (left and right).

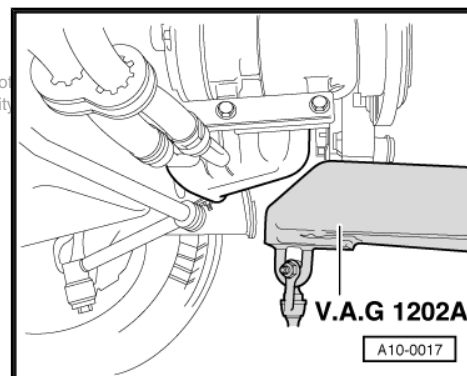


- Raise engine and gearbox using workshop crane - V.A.G 1202 A- .



Caution

To avoid injury, ensure adequate support.



Note!

Make sure no wires/pipes are damaged at the top on the bulk-head.

- Unscrew engine/gearbox securing bolts (accessible from below).
- Lower engine again.

- Set up support bracket -10-222 A- behind gas-filled strut on wing panel flanges. The spindle must be at the front.
- Insert the gearbox support -3147- into the bolt holes for gearbox bell housing.
- Connect the gearbox support -3147- and support bracket -10-222 A- using hooks -10-222 A/2- .



Note!

Illustration shows engine removed.

- Unscrew top engine/gearbox securing bolts. Leave one bolt in place (finger-tight).
- Engage lifting tackle -2024 A- on engine and workshop crane -VAS 6100- or -V.A.G 1202 A- .



Note!

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



Caution

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

- Unscrew last engine/gearbox securing bolt.



Note!

Check that all hoses and other connections between engine and body have been detached.

- Lift engine over studs of engine mountings.
- Tighten spindle of support bracket -10-222 A- further.

Vehicles with automatic gearbox:

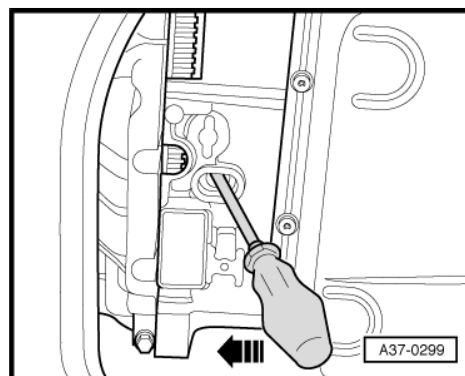
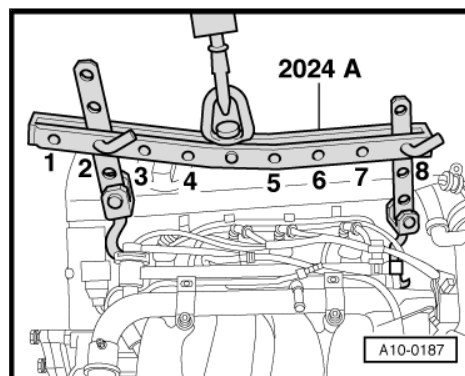
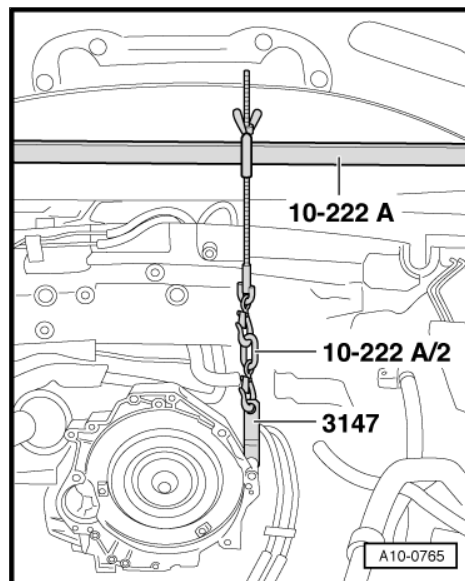
- Separate gearbox from engine and simultaneously detach torque converter from drive plate -arrow-.

All models:

- Detach engine from gearbox and lift engine forwards out of engine compartment.

Vehicles with automatic gearbox:

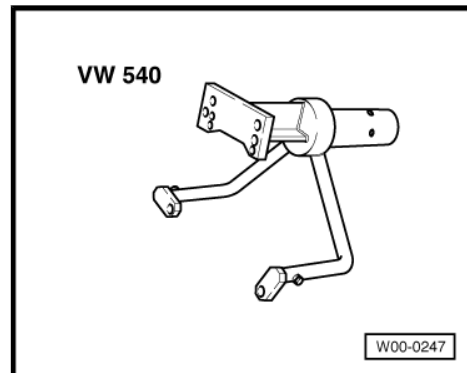
- If necessary, secure torque converter in gearbox with wire to prevent it falling.



1.3 Securing engine to engine stand

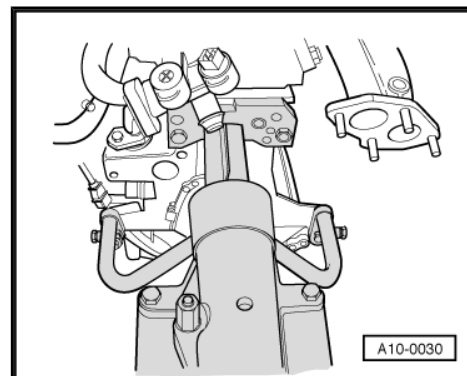
Special tools and workshop equipment required

- ◆ Engine and gearbox support -VW 540-



1.3.1 Procedure

Secure engine to repair stand using engine and gearbox support -VW 540- when dismantling/assembling engine.



1.4 Installing engine

Special tools and workshop equipment required

- ◆ Depth gauge (vehicles with automatic gearbox)

1.4.1 Procedure

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



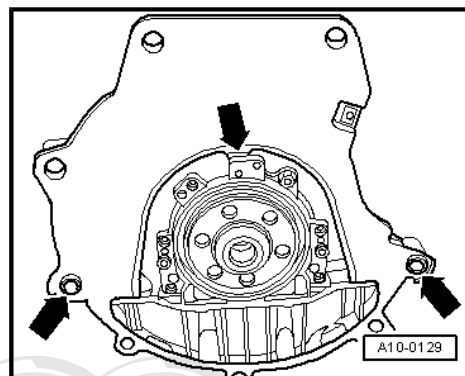
Note!

- ◆ *Reinstall all cable ties in the same locations when assembling.*
 - ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
 - ◆ *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.*
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- Check whether dowel sleeves for centring the engine/gearbox assembly are fitted in the cylinder block; install dowel sleeves if necessary.

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

Vehicles with manual gearbox:

- Check clutch release bearing for wear; renew if necessary.
- Lubricate splines of gearbox input shaft lightly with grease -G 000 100- . The guide sleeve for release bearing should not be lubricated.
- Make sure that clutch plate is properly centred.
- A needle bearing must be fitted in the crankshaft on vehicles with manual gearbox; insert needle bearing if not yet fitted
⇒ [page 71](#) .

**Vehicles with automatic gearbox:**

- In vehicles with automatic gearbox, the needle bearing must NOT be fitted in the crankshaft; remove needle bearing if fitted
⇒ [page 71](#) .
- To secure the torque converter to drive plate, use only the correct nuts (same as original equipment) ⇒ Parts catalogue .
- Tighten nuts for torque converter using 15 mm socket insert - V/175- .

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Checking installation position of torque converter:

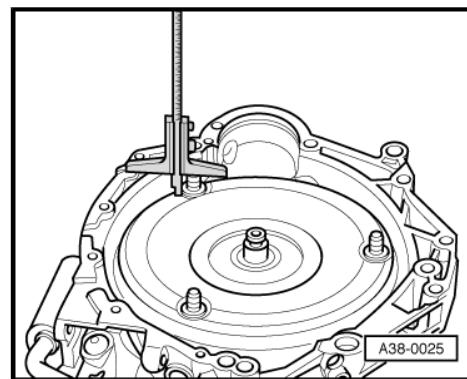
If the torque converter has been correctly installed, the distance between the contact surfaces at the bottom of the studs on the torque converter and the joint surface on the torque converter bell housing (with automatic gearbox 01N) is approx. 24.5 mm.

If the torque converter has not been completely inserted, this distance will be approx. 13 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.



All models:

- Install engine mountings free of stress. To do so, shake engine before tightening engine mountings.
- Install A/C compressor and power steering pump.
- Install poly V-belt ➔ [page 38](#) .
- Install lock carrier ➔ [page 34](#) .

Vehicles with automatic gearbox:

- Secure the ATF pipes ➔ Automatic gearbox 01N; Rep. Gr. 37 .

All models:

- Install exhaust system and align it free of stress ➔ [page 183](#) .

Vehicles with throttle cable:

- Adjust throttle cable ➔ Fuel supply system - petrol engines; Rep. Gr. 20 .

All models:

- Electrical connections and routing ➔ Current flow diagrams, Electrical fault finding and Fitting locations



Note!

- ◆ *When the battery is reconnected, please ensure that the vehicle equipment (e.g. radio, radio/navigation system, clock, electric window lifters) is activated as described in the operating instructions.*
- ◆ *Further procedures after reconnecting the voltage supply ➔ Simos injection and ignition system (4-cyl.); Rep. Gr. 24 .*
- Check oil level ➔ [page 138](#) .
- Fill cooling system ➔ [page 143](#) .



Note!

- ◆ *Drained-off coolant may only be used again if the original cylinder head and cylinder block are re-installed.*
- ◆ *Contaminated or dirty coolant must not be used again.*



Caution

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

Vehicles with automatic gearbox:

- Check ATF level ⇒ Automatic gearbox 01N; Rep. Gr. 37 .

All models:

- Check headlight adjustment ⇒ Electrical system; Rep. Gr. 94 .

1.5 Tightening torques



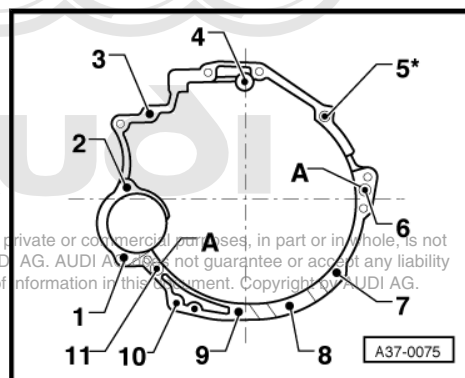
Note!

- ♦ *Tightening torques only apply to lightly greased, oiled, phosphated or blackened 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 is +/-15%.*

Securing engine/gearbox (manual gearbox)

Item	Bolt	Nm
1	M12×75	65
2	M12×90	65
3, 4	M12×75	65
5 ²⁾ , 6	M12×110	65
7 ... 10	M10×45	45
11	M10×135	45
A	Dowel sleeves for centralising	

2) The wiring harness bracket is also secured together with this bolt



Securing engine/gearbox (automatic gearbox)

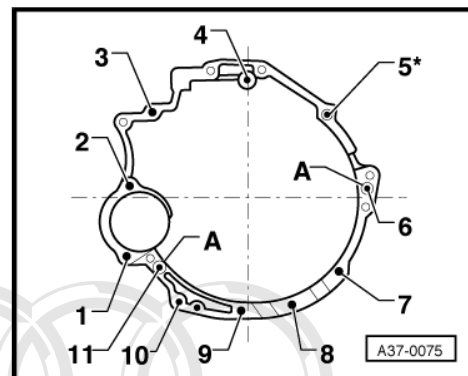
Item	Bolt	Nm
1, 2	M12×67	65
3, 4	M12×75	65
5 ³⁾ , 6	M12×90	65
7 ... 10	M10×45	45
11	M12×90	65
A	Dowel sleeves for centralising	

3) The wiring harness bracket is also secured together with this bolt

Component	Nm	
Bolts/nuts	M6	10
	M8	20
	M10	45
	M12	65
Except for the following:		
Engine mounting to bracket for engine mounting		23
Engine support to engine mounting		23
Drive plate to torque converter M10×1		85 ⁴⁾
Catalytic converter to exhaust manifold		30 ^{4) 5)}
Exhaust system to bracket on gearbox		25
Bracket for ATF pipes to sump		10
Power steering pump to bracket		23
Pulley to power steering pump		23
Viscous fan to bearing		45
A/C compressor to bracket		25
Condenser to radiator		4
Stop for torque reaction support to sump		28
Clips for air hoses		3,5
Cooling pipes for power steering hydraulic fluid to lock carrier		9
Fuel supply line to fuel rail		22
Battery cable clamp to battery terminal		6

4) Renew self-locking nuts.

5) Coat exhaust manifold studs with high-temperature lubricant; for high-temperature lubricant refer to ⇒ Parts catalogue .



13 – Crankshaft group

1 Dismantling and assembling engine

1.1 Lock carrier in service position - exploded view of components

1 - 45 Nm

2 - Front-end service sleeves
-3369-

3 - 10 Nm

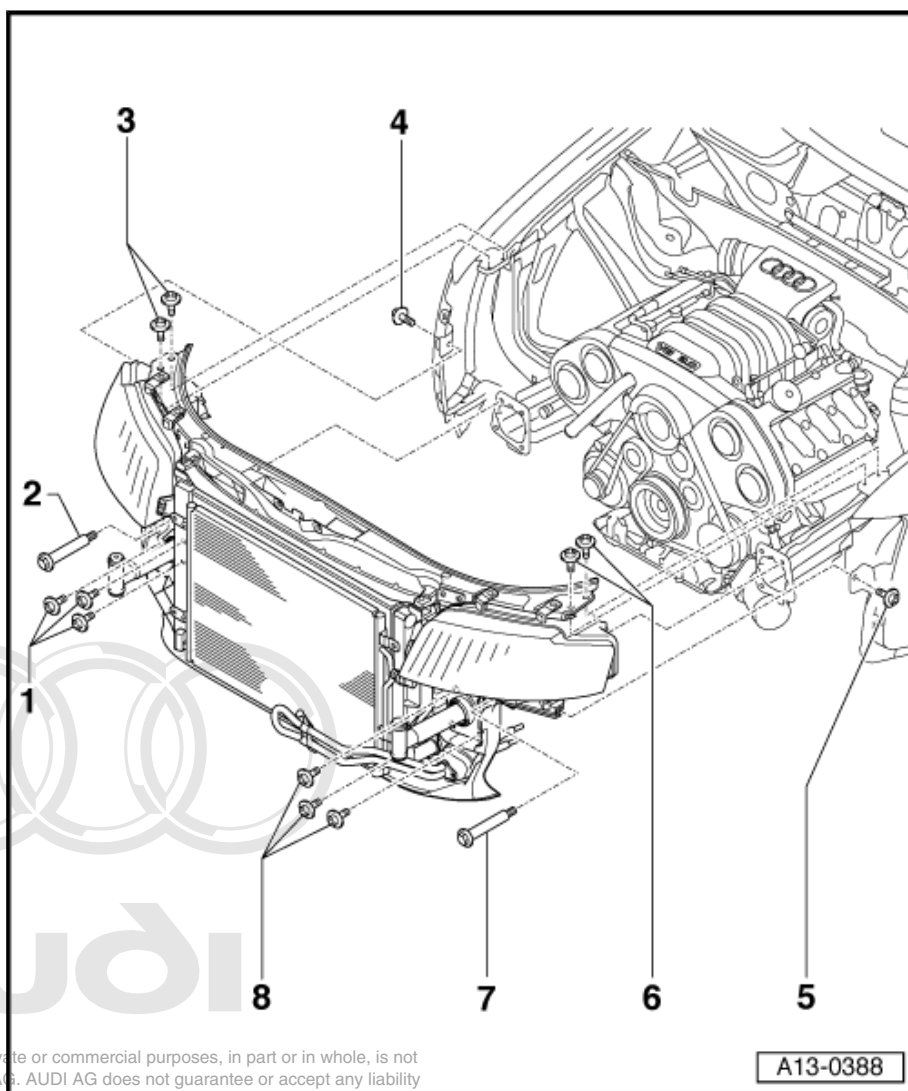
4 - 10 Nm

5 - 10 Nm

6 - 10 Nm

7 - Front-end service sleeves
-3369-

8 - 45 Nm



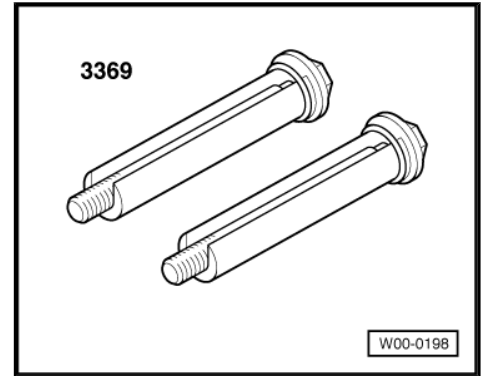
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A13-0388

1.2 Moving lock carrier into service position

Special tools and workshop equipment required

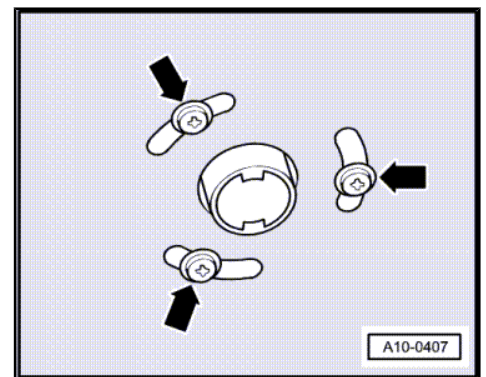
- ◆ Front-end service sleeves -3369-



1.2.1 Removing

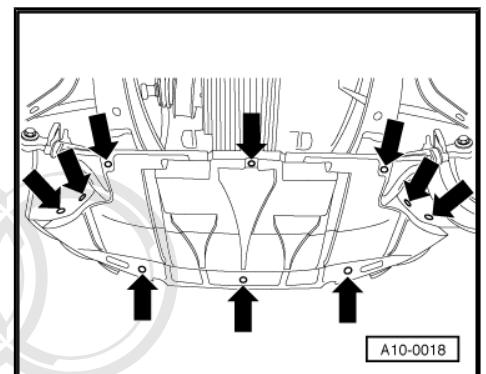
Vehicles with auxiliary heater:

- Remove bolts -arrows- securing exhaust pipe for auxiliary/additional heater to noise insulation.

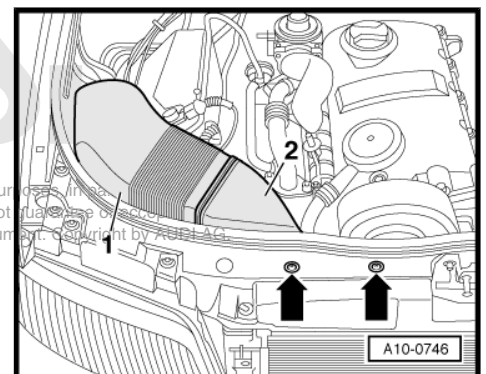


All models:

- Remove noise insulation -arrows-.

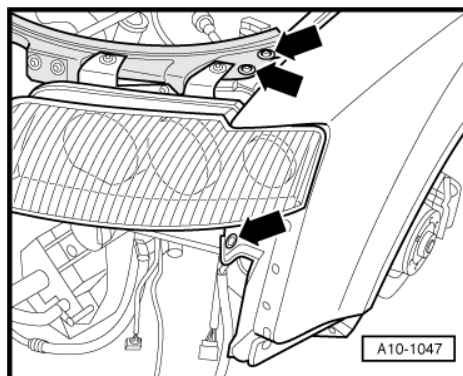


- Unscrew bolts -arrows-.
- Remove air ducts -1- and -2-.
- Pull bonnet seals away from lock carrier and wing panels.

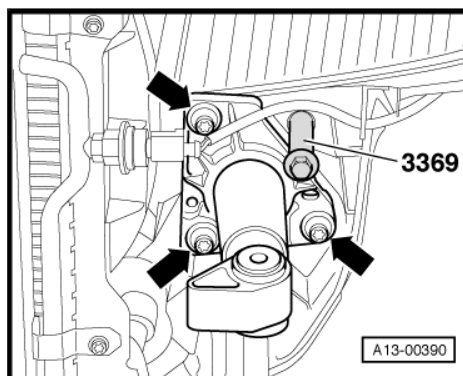


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- Remove front bumper ⇒ General body repairs, exterior; Rep. Gr. 63 .
- Remove bolts (left and right) -arrows-.



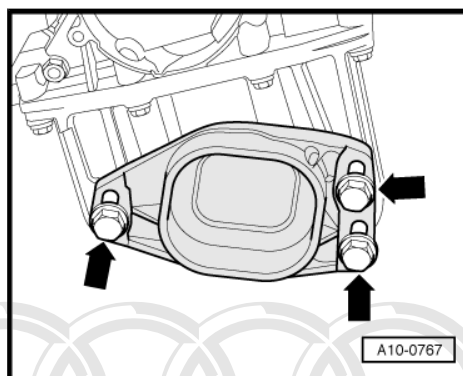
- Screw in front-end service sleeves -3369- (left and right) in the holes.
- Remove bolts (left and right) -arrows-.
- Carefully pull the lock carrier forward.



1.2.2 Installing

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

- Tighten lock carrier to longitudinal member with 45 Nm and to wing panels with 10 Nm.
- Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight, and tighten bolts -arrows-.
- Install front bumper ⇒ General body repairs, exterior; Rep. Gr. 63 .
- Check headlight adjustment ⇒ Electrical system; Rep. Gr. 94 .



1.2.3 Tightening torques

Component		Nm
Lock carrier to	Longitudinal member	45
	Wing panel	10
Stop for torque reaction support to sump		28

1.3 Poly V-belt drive for power steering pump, alternator and viscous fan - exploded view of components

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1 - 11 Nm

- ☐ Install using locking fluid; locking fluid ⇒ Parts catalogue

2 - Fan wheel for viscous fan

- ☐ Removing and installing ⇒ [page 160](#)

3 - 10 Nm

4 - Poly V-belt

- ☐ Before removing, mark direction of rotation with chalk or felt-tipped pen
- ☐ Check for wear
- ☐ Do not kink
- ☐ Removing and installing ⇒ [page 38](#)
- ☐ Position of poly V-belt on vehicles without air conditioner ⇒ Fig. ⇒ [page 36](#)

5 - Bolt (special type) ⇒ Parts catalogue

- ☐ If bolt strength is 8.8, renew and tighten to 10 Nm + 90° further
- ☐ If bolt strength is 10.9, tighten to 40 Nm

6 - Pulley for poly V-belt

- ☐ Can only be installed in one position ⇒ [page 37](#)

7 - Pulley for viscous fan

- ☐ Removing and installing ⇒ [page 160](#)

8 - Retaining ring for viscous fan bearing

- ☐ Removing and installing ⇒ [page 161](#)

9 - 23 Nm

10 - Tensioning element for poly V-belt

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

11 - Bearing for viscous fan

- ☐ Removing and installing ⇒ [page 161](#)

12 - 46 Nm

13 - Washer

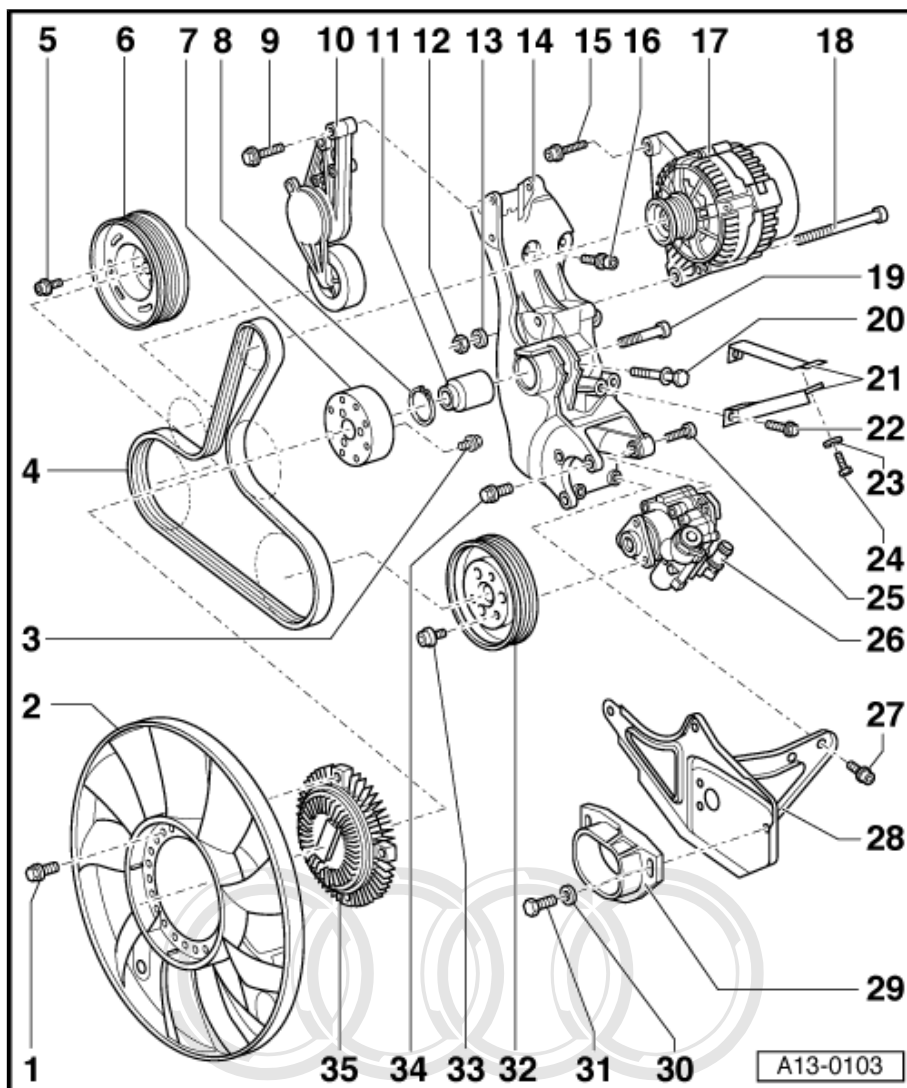
14 - Bracket for ancillary units

- ☐ Removing and installing ⇒ [page 41](#)

15 - 23 Nm

16 - 45 Nm

- ☐ Install using locking fluid; locking fluid ⇒ Parts catalogue
- ☐ Different bolt lengths. Allocation and tightening sequence ⇒ [page 44](#)



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17 - Alternator

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

18 - 46 Nm**19 - 45 Nm****20 - 45 Nm**

- ☐ Install using locking fluid; locking fluid ⇒ Parts catalogue
- ☐ Different bolt lengths. Allocation and tightening sequence ⇒ [page 44](#)

21 - Support for intake manifold**22 - 20 Nm****23 - Washer****24 - 20 Nm****25 - 23 Nm****26 - Power steering pump**

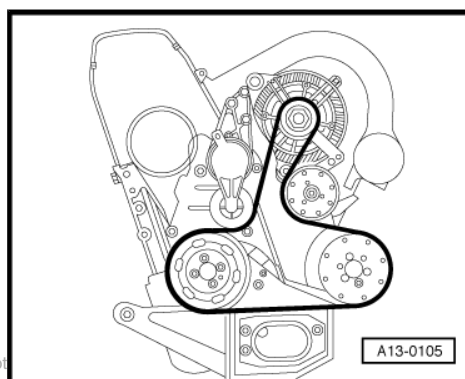
- ☐ Removing and installing ⇒ Running gear, front-wheel drive and four-wheel drive; Rep. Gr. 48
- ☐ To facilitate positioning of power steering pump, drive back threaded bush for securing bolt at bracket slightly

27 - 40 Nm**28 - Bracket**

- ☐ For stop for torque reaction support
- ☐ For vehicles up to 04 / 1999

29 - Stop for torque reaction support**30 - Washer****31 - 28 Nm****32 - Pulley for power steering pump****33 - 23 Nm****34 - 23 Nm****35 - Viscous coupling**

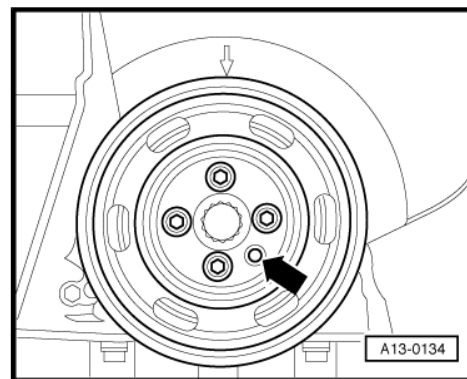
- ☐ Removing and installing ⇒ [page 160](#)

Poly V-belt on vehicles without air conditioner

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Installing vibration damper

- The vibration damper can only be installed in one position. The hole -arrow- in the vibration damper must be located over the projection on the toothed belt sprocket.



1.4 Poly V-belt drive for air conditioner - exploded view of components



Caution

Refrigerant circuit of air conditioner must not be opened.

1 - Bracket

2 - Air conditioner compressor

- After removing compressor from mountings, secure it to longitudinal member with wire or similar. Do not leave it suspended from refrigerant pipes.
- Do not unscrew or disconnect refrigerant hoses or pipes.

3 - Dowel sleeve

- Check for correct seating in bracket

4 - 33 Nm

5 - Bracket for air conditioner compressor

6 - Tensioning roller for poly V-belt

7 - Washer

8 - 23 Nm

9 - Poly V-belt

- Before removing, mark direction of rotation with chalk or felt-tipped pen
- Check for wear

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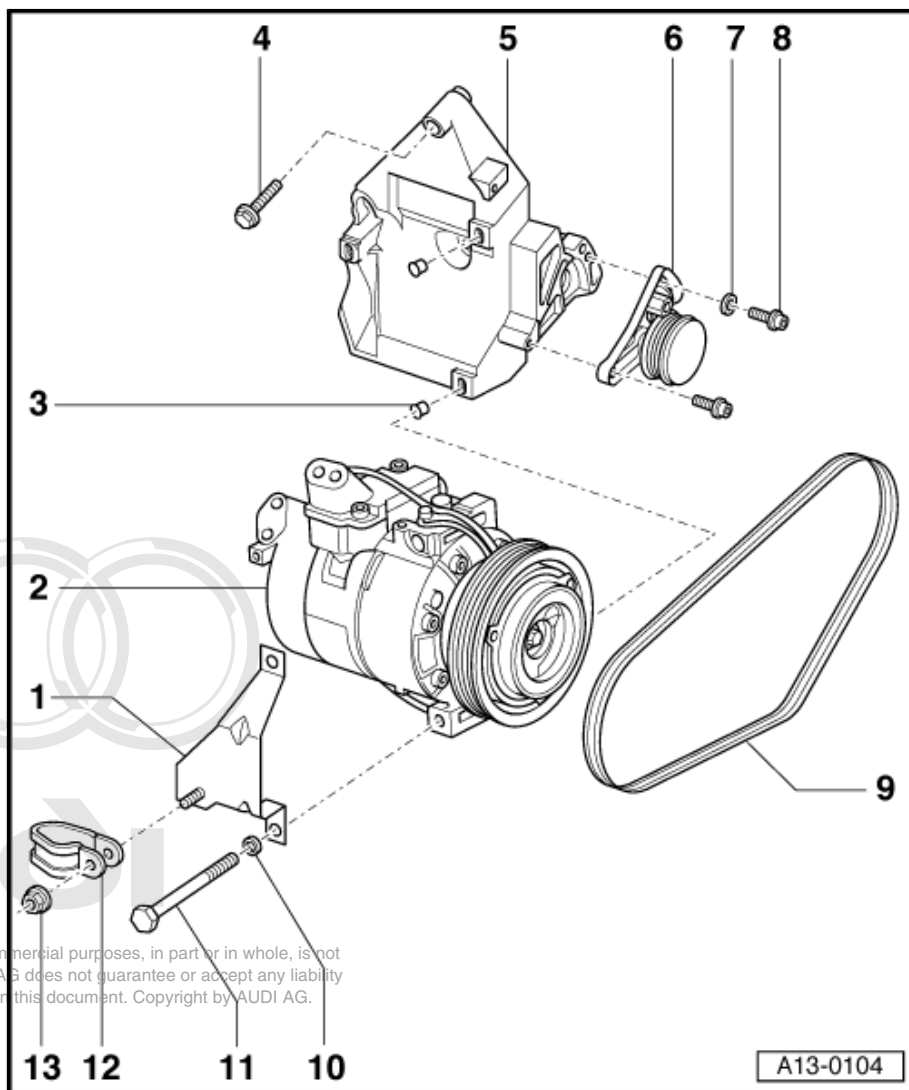
Do not kink

Removing and installing

⇒ page 38

Poly V-belt routing

⇒ page 38



10 - Washer

11 - 25 Nm

12 - Retaining clamp

13 - 6 Nm

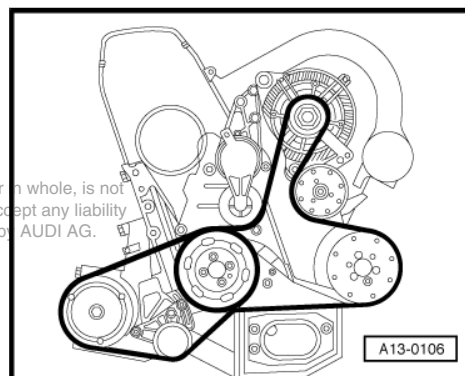
14 -



Poly V-belt routing

- Additional poly V-belt for AC compressor

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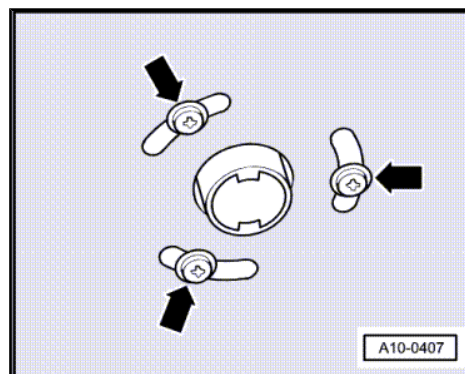


1.5 Removing and installing poly V-belt

1.5.1 Removing

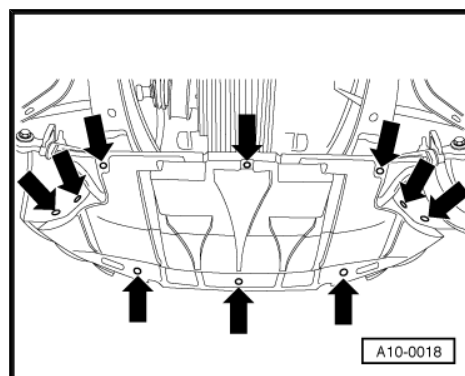
Vehicles with auxiliary heater:

- Remove bolts -arrows- securing exhaust pipe for auxiliary/additional heater to noise insulation.



All models:

- Remove noise insulation -arrows-.

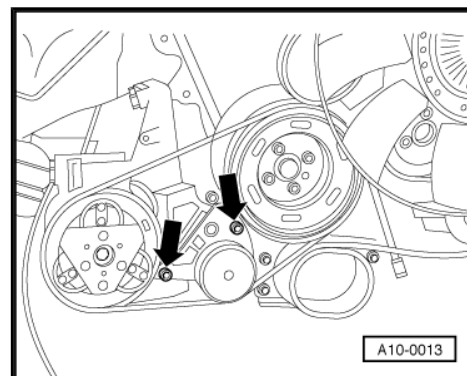


Vehicles with air conditioning:

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.

- Loosen securing bolts on tensioning roller for poly V-belt for A/C compressor -arrows-, slacken belt and remove.

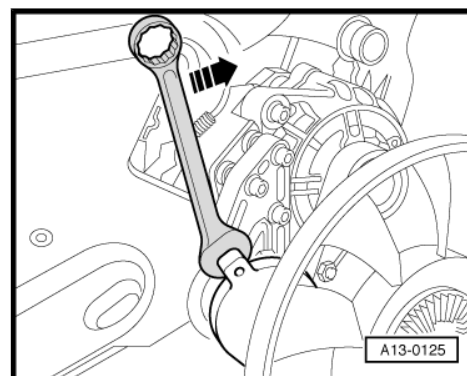


All models:

Note!

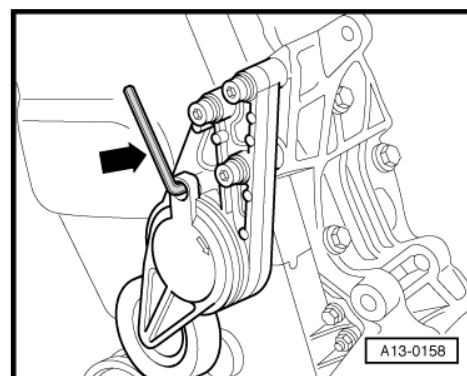
Before removing, mark direction of rotation of poly V-belt with chalk or felt-tipped pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.

- Turn the tensioner in the direction of the -arrow- to slacken the poly V-belt.
- Remove poly V-belt from alternator and release tensioner.



Note!

Poly V-belt tensioner can be locked by inserting an appropriate angled hexagon key -arrow- in locating holes.



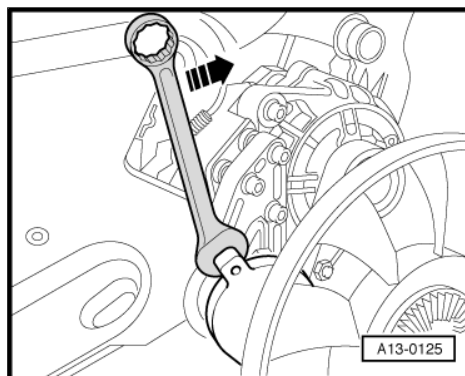
1.5.2 Installing

Note!

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

- Position poly V-belt on pulleys of crankshaft and power steering pump; pull upwards with suitable tool if necessary.

- Turn the tensioner in the direction of the -arrow- to install the poly V-belt.
- Then position poly V-belt on alternator pulley and slacken off tensioner.
- Check for proper position of poly V-belt and make sure it is correctly seated on pulleys.
- Poly V-belt routing ⇒ [page 36](#)

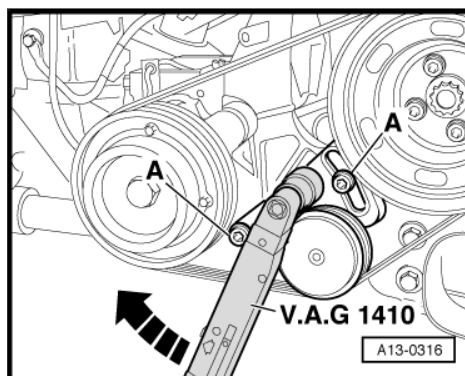


Vehicles with air conditioning:

- Install poly V-belt for AC compressor.
- Poly V-belt routing ⇒ [page 38](#)
- Apply torque wrench to hexagon flats on tensioning roller in “seven o’ clock” position as shown and tension with a torque of 30 Nm in direction of -arrow-.
- Simultaneously tighten bolts -A- to 23 Nm.

All models:

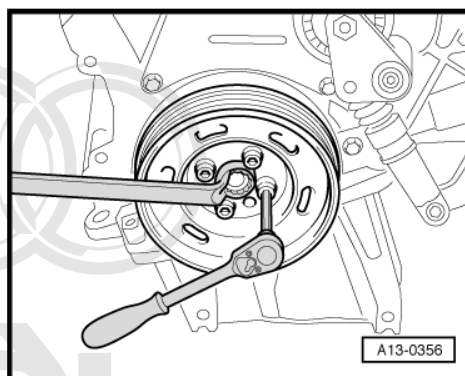
- Start engine and check that belt runs properly.



1.6 Removing and installing crankshaft pulley

1.6.1 Removing

- Lock carrier in service position ⇒ [page 32](#) .
- Poly V-belt must be removed ⇒ [page 38](#) .
- Unbolt crankshaft pulley; counterhold on centre bolt with ring spanner.



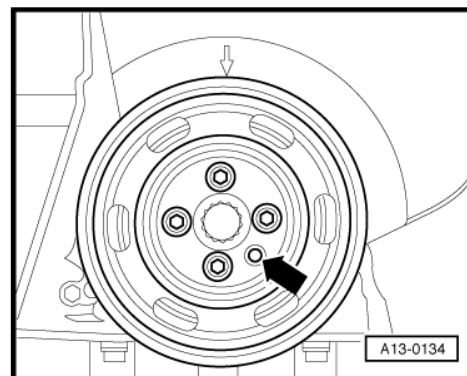
1.6.2 Installing

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

- Use new bolts for securing.
- Install the crankshaft pulley with genuine bolts only: ⇒ Parts catalogue .

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- Assembly is only possible in one position; the hole -arrow- in the crankshaft pulley must fit over the projection on the toothed belt sprocket.
- Tighten the bolts for the crankshaft pulley as follows:
 - If bolt strength is 8.8, renew and tighten to 10 Nm + 90° further
 - If bolt strength is 10.9, tighten to 40 Nm

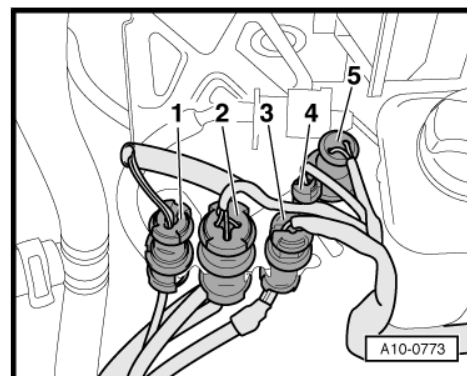


1.7 Removing and installing bracket for ancillary units

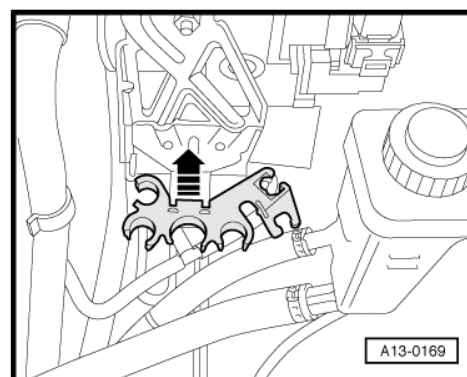
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1.7.1 Removing

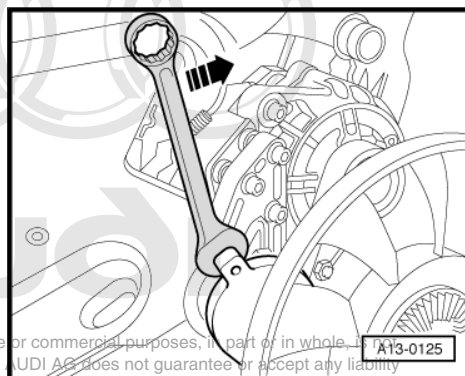
- Obtain code on vehicles with coded radio / radio and navigation system (RNS).
- Disconnect earth wire at battery with ignition switched off.
- Remove cover for power steering reservoir.
- Detach electrical connectors -1 ... 5- from bracket.



- Unclip bracket for connectors from console for ABS unit and pull upwards -arrow-.

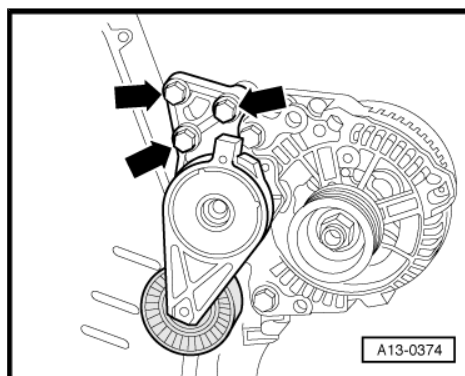


- Turn the tensioner in the direction of the -arrow- to slacken the poly V-belt.
- Remove poly V-belt from the alternator pulley.



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- Remove tensioner for poly V-belt -arrows-.

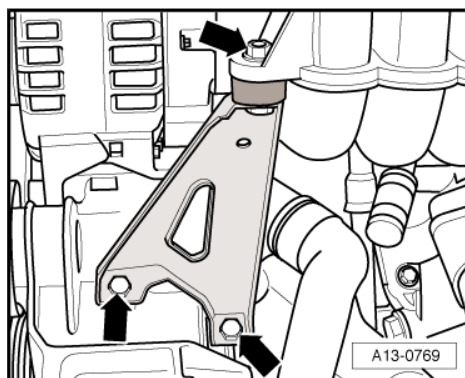


- Remove support for top section of intake manifold -arrows-.

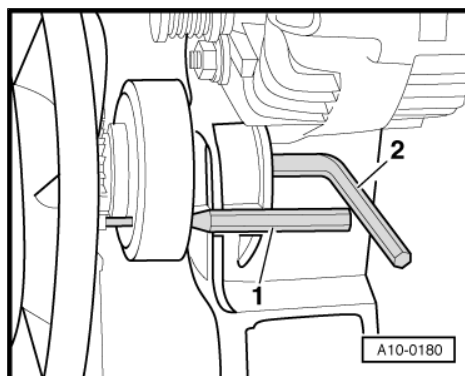


Note!

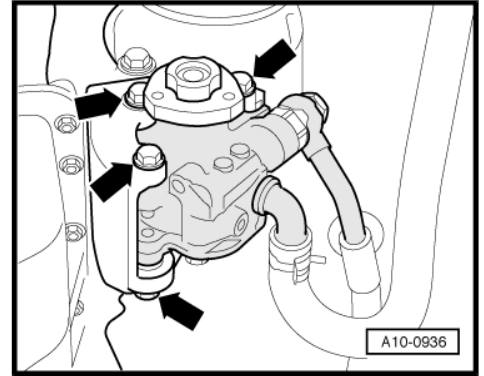
Illustration shows vehicle with engine code letters ANA.



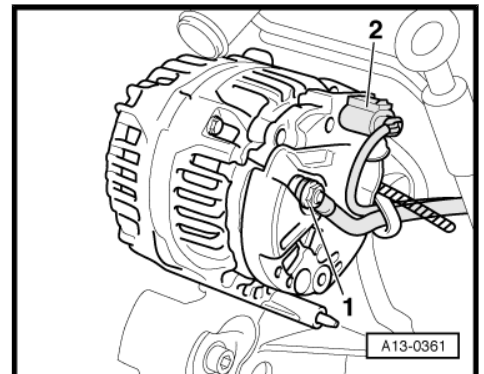
- Lock pulley for viscous fan with roll-pin drift -1- and unscrew using hexagon key -2-.
- Detach viscous fan from bearing and lay it forwards in radiator cowl.



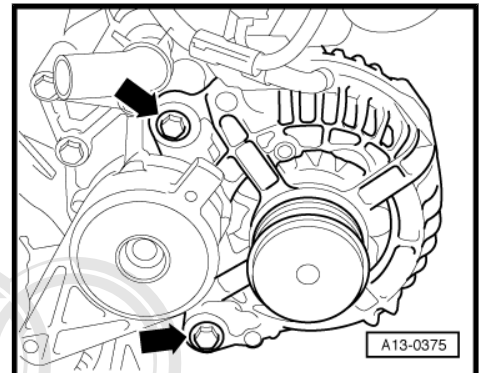
- Unscrew pulley for power steering pump; counterhold with drift.
- Unbolt power steering pump -arrows-. Leave pipes connected.



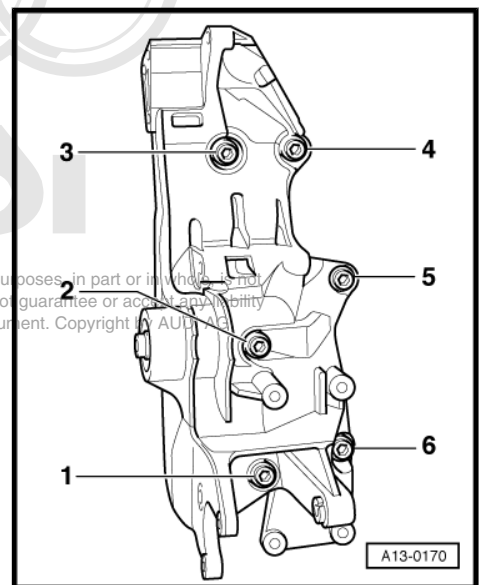
- Detach electrical connector -2-.
- Unscrew wire -1- at alternator.
- Unscrew wire clamp on alternator.



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



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



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1.7.2 Installing

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

- Insert bolts with locking fluid; Locking fluid ⇒ Parts catalogue .
- Note bolt lengths: -1, 2- M10×85, -3 ... 6- M10x45
- Tighten bolts in diagonal sequence.
- To facilitate positioning of alternator, drive back bush for bottom securing bolt slightly.
- Install viscous fan ⇒ [page 160](#) .
- Install poly V-belt ⇒ [page 38](#) .



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- ◆ *When the battery is reconnected, please ensure that the vehicle equipment (e.g. radio, radio/navigation system, clock, electric window lifters) is activated as described in the operating instructions.*
- ◆ *Further procedures after reconnecting the voltage supply ⇒ Simos injection and ignition system (4-cyl.); Rep. Gr. 24 .*

1.7.3 Tightening torques

Component		Nm
Bracket for ancillary units to cylinder block		45 ⁶⁾
Power steering pump to bracket		23
Pulley to power steering pump		23
Tensioner for poly V-belt to bracket for ancillaries		23
Viscous fan to bearing		45
Alternator to bracket	M8	23
	M10	46
Support for top section	Top section of intake manifold	20
of intake manifold to	Bracket	20

6) Install using locking fluid; locking fluid ⇒ Parts catalogue

1.8 Toothed belt drive - Overview of components



Note!

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

1 - Toothed belt guard - bottom

- ☐ Unbolt crankshaft pulley to remove

2 - 10 Nm

- ☐ Install using locking fluid; locking fluid ⇒ Parts catalogue

3 - Toothed belt guard - centre

4 - Toothed belt guard - top

- ☐ Engage carefully in centre toothed belt guard when installing

5 - Toothed belt

- ☐ Before removing, mark direction of rotation with chalk or felt-tipped pen
- ☐ Check for wear
- ☐ Do not kink
- ☐ Removing ⇒ [page 46](#)
- ☐ Installing (adjusting valve timing) ⇒ [page 49](#)

6 - 15 Nm

7 - Corrugated washer

8 - 100 Nm

- ☐ Use counterhold -3415- to loosen and tighten ⇒ [page 46](#)

9 - Camshaft sprocket

- ☐ With sender wheel for Hall sender -G40-
- ☐ For removal and installation, remove toothed belt from camshaft sprocket ⇒ [page 51](#)
- ☐ Installation position fixed by Woodruff key ⇒ [Item 12 \(page 45\)](#)

10 - Toothed belt guard

11 - 10 Nm

12 - Woodruff key

- ☐ Check for firm attachment

13 - Hall sender -G40-

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

14 - 10 Nm

15 - Toothed belt guard - rear

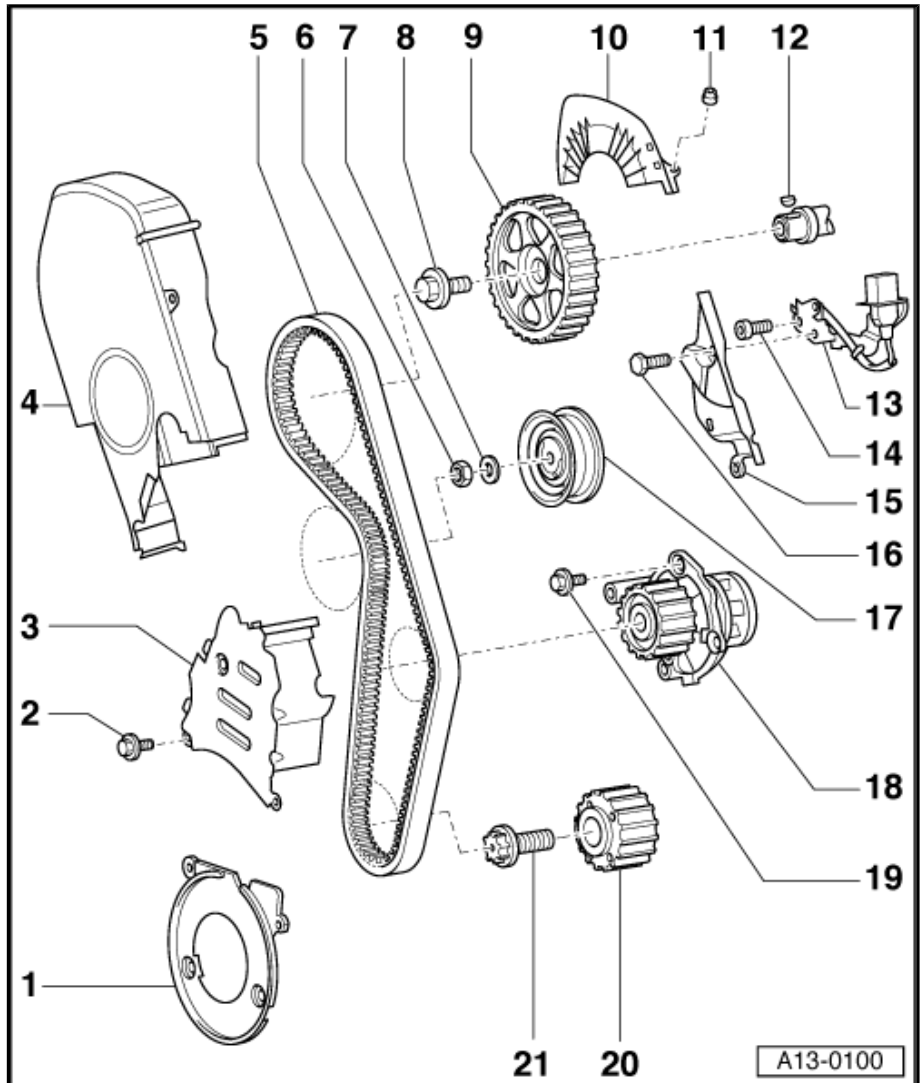
16 - 20 Nm

17 - Semi-automatic tensioning roller

- ☐ Checking ⇒ [page 55](#)
- ☐ Installation position ⇒ [page 46](#)

18 - Coolant pump

- ☐ Removing and installing ⇒ [page 148](#)



19 - 15 Nm

20 - Crankshaft sprocket

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

21 - 90 Nm + 90° (1/4 turn) further

- ☐ Renew
- ☐ Do not lubricate with oil
- ☐ Use counterhold -3415- to loosen and tighten
- ☐ Fit counterhold tool -3415- ⇒ [page 46](#)

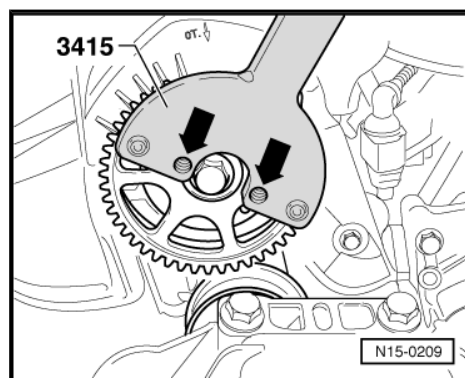
Loosening camshaft sprocket

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



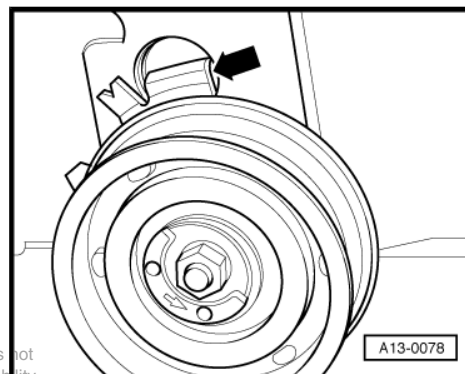
Note!

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



Installation position for semi-automatic tensioning roller

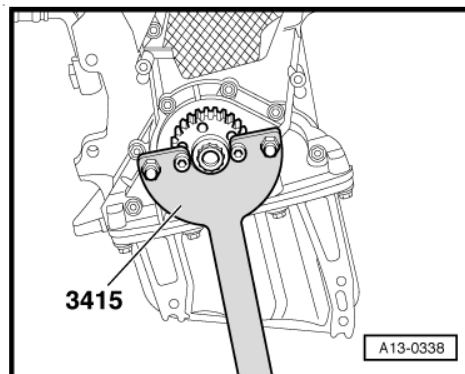
- Retaining lug -arrow- must engage in slot on cylinder head.



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Removing and installing crankshaft sprocket

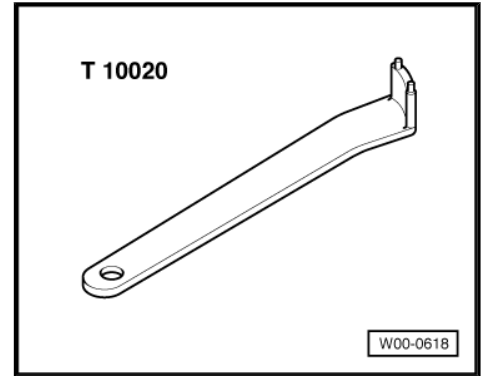
- Use counterhold -3415- when loosening and tightening central bolt.



1.9 Removing and installing toothed belt

Special tools and workshop equipment required

- ◆ 2-hole pin wrench -T10020-



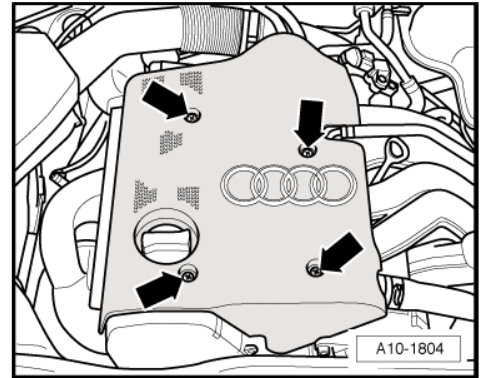
1.9.1 Removing

- Engine in vehicle.
- Lock carrier in service position ➔ [page 32](#) .
- Take off engine cover panel -arrows-.



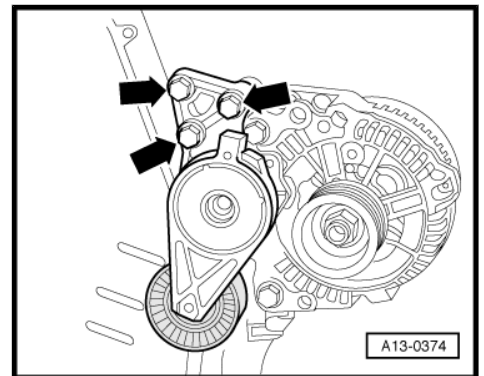
Note!

Illustration shows vehicle with engine code letters ANA.



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- Remove poly V-belt ➔ [page 38](#) .
- Remove tensioner for poly V-belt -arrows-.

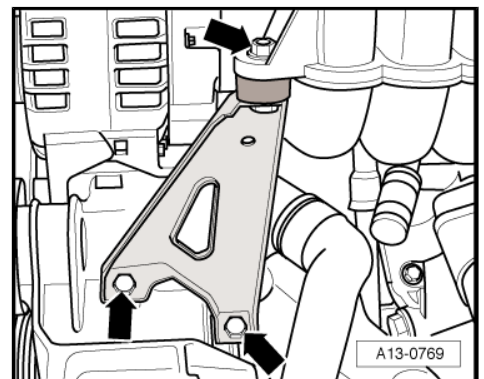


- Remove support for top section of intake manifold -arrows-.

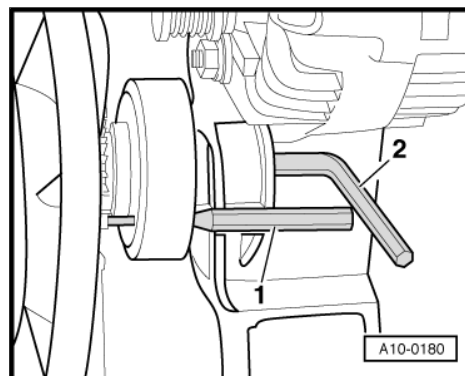


Note!

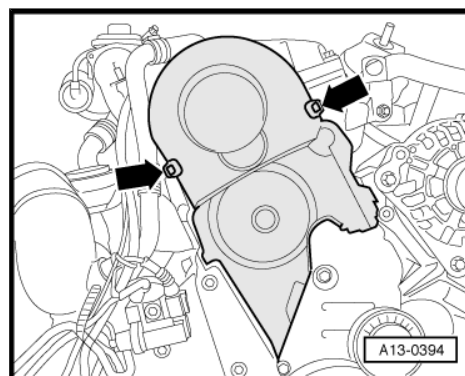
Illustration shows vehicle with engine code letters ANA.



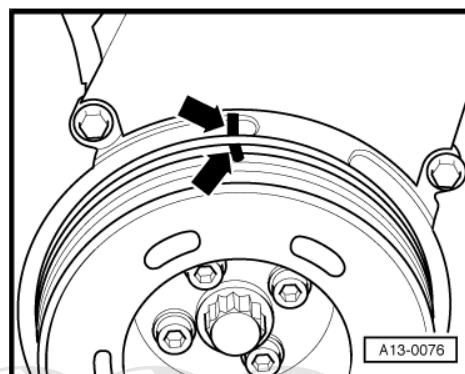
- Lock pulley for viscous fan with roll-pin drift -1- and unscrew using hexagon key -2-.
- Remove viscous fan from bearing.



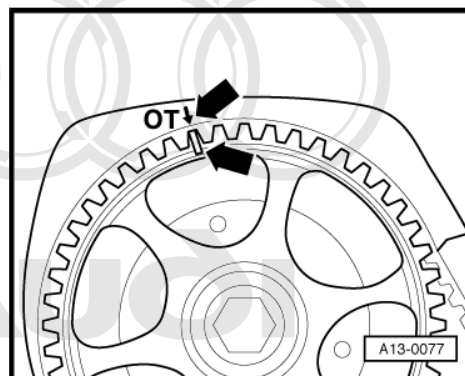
- Remove toothed belt guard (top) -arrows-.



- Set crankshaft to markings for TDC of No. 1 cylinder -arrows- by turning central bolt on crankshaft sprocket in direction of rotation.



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



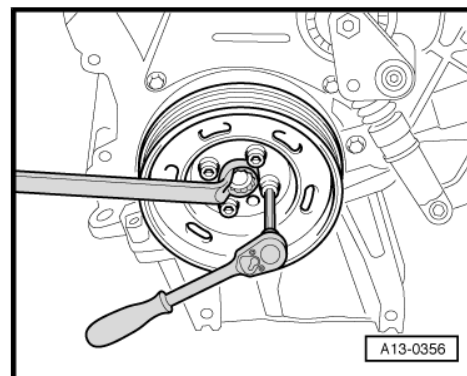
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- Remove the crankshaft pulley.

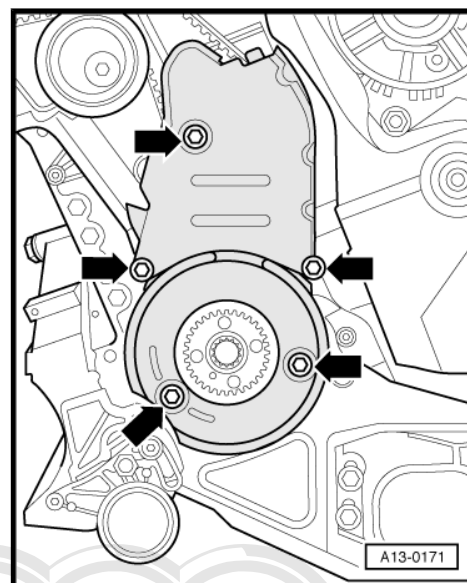


Note!

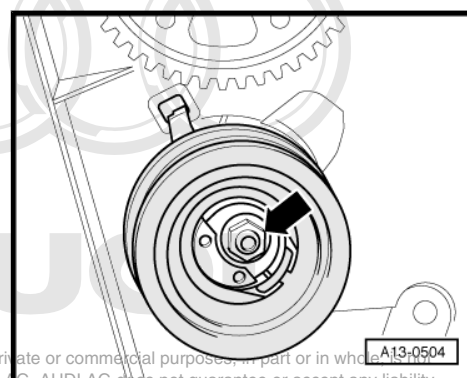
To loosen and tighten the crankshaft pulley, counterhold central bolt with a ring spanner.



- Unscrew lower and centre toothed belt guards -arrows-.



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



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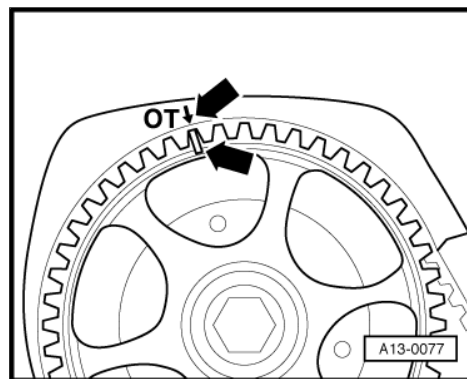
1.9.2 Installing (adjusting valve timing)



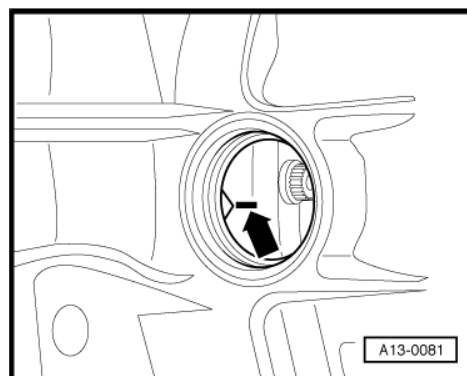
Note!

- ◆ *Toothed belt adjustment is only to be performed when engine is cold.*
- ◆ *Toothed belt adjustment is also to be performed as follows when carrying out repair work which only requires toothed belt to be removed from camshaft sprocket.*
- ◆ *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 the mark on toothed belt guard -arrows-.



- Check again to see whether crankshaft is at TDC for No. 1 cylinder:
- Vehicles with manual gearbox

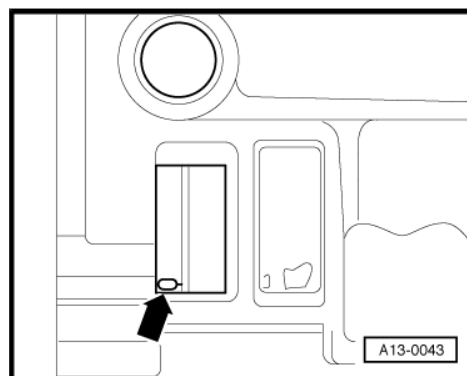


- Vehicles with automatic gearbox

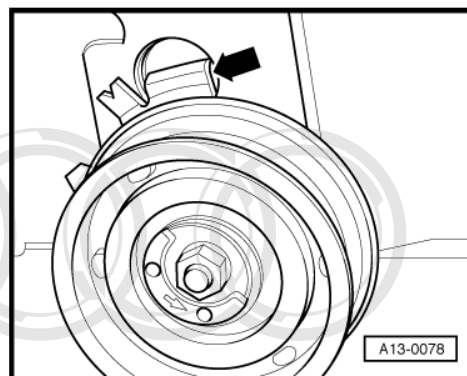


Note!

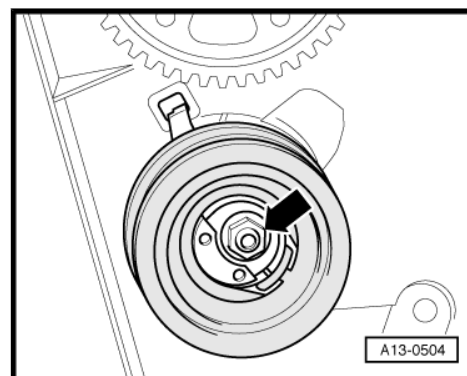
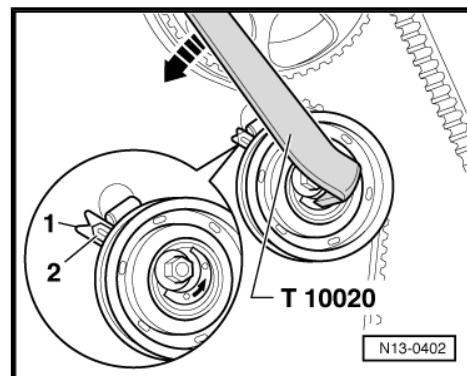
Positioning crankshaft at TDC for cylinder 1 with engine removed
⇒ [page 54](#).



- Fit toothed belt on crankshaft sprocket (note rotation direction).
- Fit toothed belt in the sequence: coolant pump, tensioning roller, camshaft sprocket.
- Note installation position for semi-automatic tensioning roller:
- Retaining lug -arrow- must engage in slot on cylinder head.



- Before tensioning the toothed belt, use 2-hole pin wrench - T10020- to turn the tensioning roller at the eccentric adjuster five times to the stop in both directions.
- Tension toothed belt. To do so, turn 2-hole pin wrench - T10020- at the eccentric adjuster to the stop in direction of -arrow-.
- Then release tension on toothed belt until the notch -1- and the pointer -2- are aligned (use a mirror).
- Tighten securing nut to 15 Nm -arrow-.
- Turn crankshaft at central bolt on toothed belt sprocket two revolutions in direction of engine rotation and check whether camshaft and crankshaft markings align with their respective reference points.
- Install toothed belt guard.
- Install crankshaft pulley [⇒ page 40](#) .
- Install poly V-belt and tensioner for poly V-belt [⇒ page 38](#) .



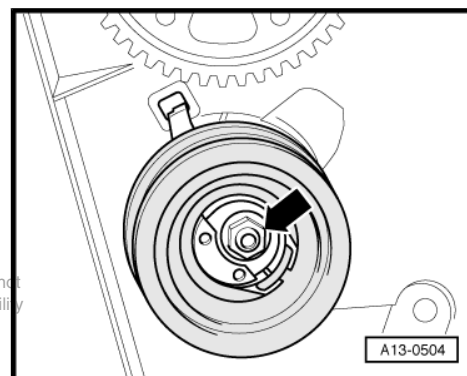
1.9.3 Tightening torques

Component	Nm
Tensioning roller to cylinder head	15
Bottom section of toothed belt guard to cylinder block	10 ⁷⁾
Toothed belt guard (centre) to cylinder block	10 ⁷⁾
Viscous fan to bearing	45
Tensioner for poly V-belt to bracket for ancillaries	23

7) Install using locking fluid; locking fluid $\Rightarrow$ Parts catalogue .

1.10 Removing toothed belt from camshaft sprocket

- Position crankshaft at TDC for cylinder 1 with engine installed [⇒ page 53](#) .
- Positioning crankshaft at TDC for cylinder 1 with engine removed [⇒ page 54](#) .
- Loosen tensioning roller nut -arrow- several turns.
- Remove toothed belt from camshaft sprocket.



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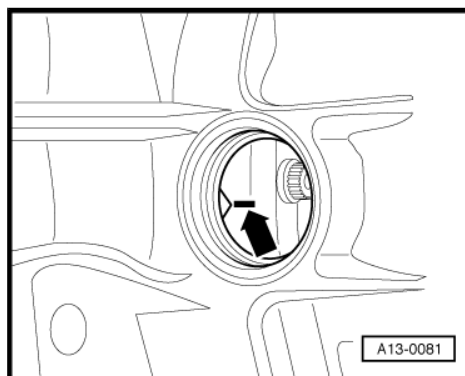
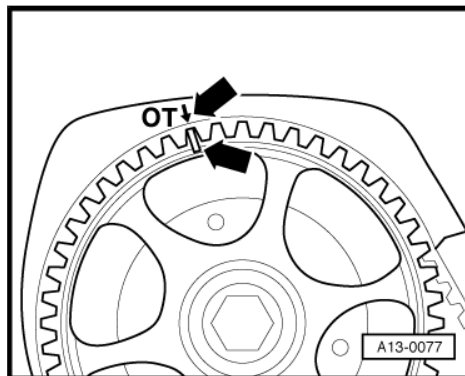
1.10.1 Installing (adjusting valve timing)



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 the mark on toothed belt guard -arrows-.
- Check again to see whether crankshaft is at TDC for No. 1 cylinder:



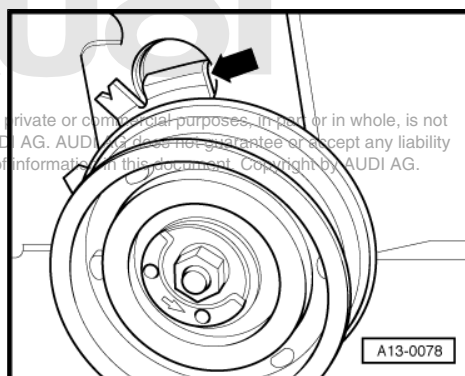
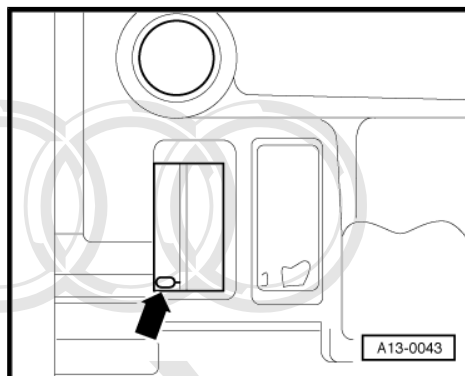
- ◆ Vehicles with manual gearbox
- ◆ Vehicles with automatic gearbox



Note!

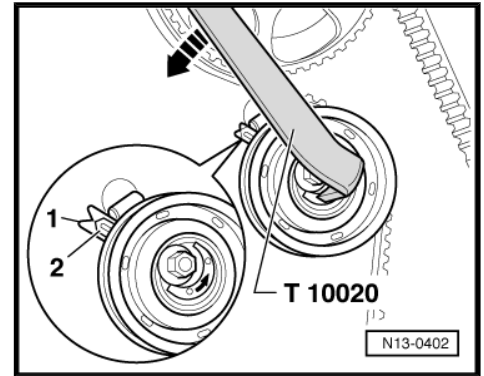
*Positioning crankshaft at TDC for cylinder 1 with engine removed
⇒ [page 54](#).*

- Fit toothed belt onto camshaft sprocket.
- Note installation position for semi-automatic tensioning roller:
 - Retaining lug -arrow- must engage in slot on cylinder head.
- Before tensioning the toothed belt, use 2-hole pin wrench T10020- to turn the tensioning roller at the eccentric adjuster five times to the stop in both directions.



- Tension toothed belt. To do so, turn 2-hole pin wrench - T10020- at the eccentric adjuster to the stop in direction of -arrow-.
- Then release tension on toothed belt until the notch -1- and the pointer -2- are aligned (use a mirror).
- Tighten securing nut to 15 Nm.

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



1.10.2 Tightening torque

Component	Nm
Tensioning roller to cylinder head	15

1.11 Positioning crankshaft at TDC for cylinder 1 with engine installed

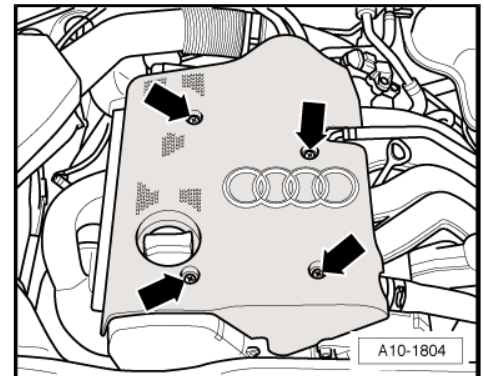
1.11.1 Procedure

- Take off engine cover panel -arrows-.

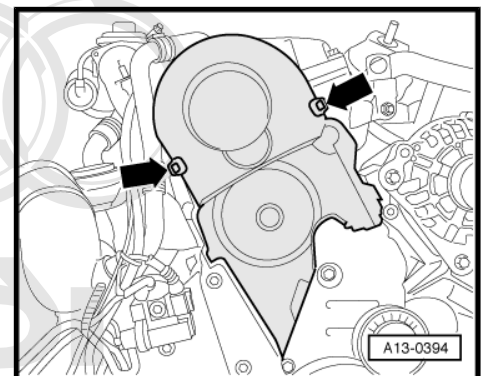


Note!

Illustration shows vehicle with engine code letters ANA.

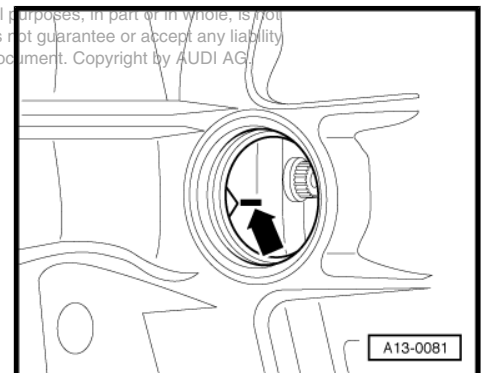


- Remove toothed belt guard (top) -arrows-.

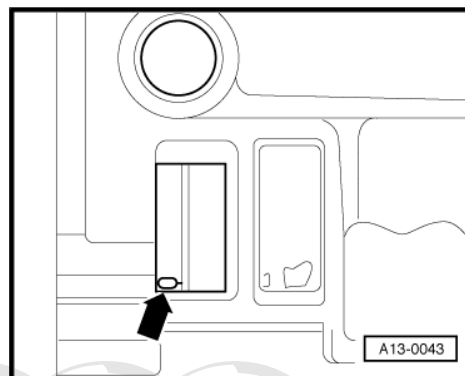


- Turn crankshaft to TDC marking of No. 1 cylinder at central bolt of crankshaft toothed belt sprocket (in direction of engine rotation).

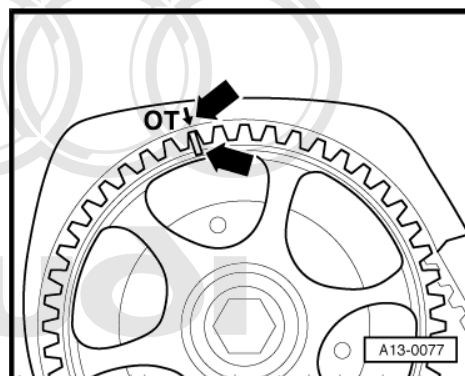
- Vehicles with manual gearbox



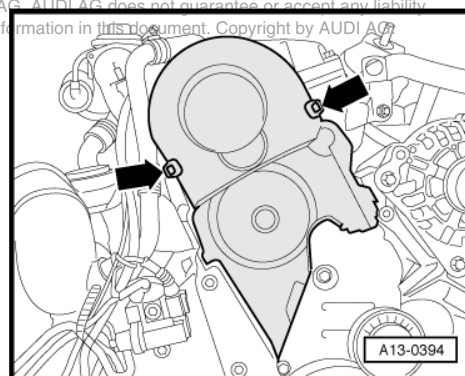
- Vehicles with automatic gearbox



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

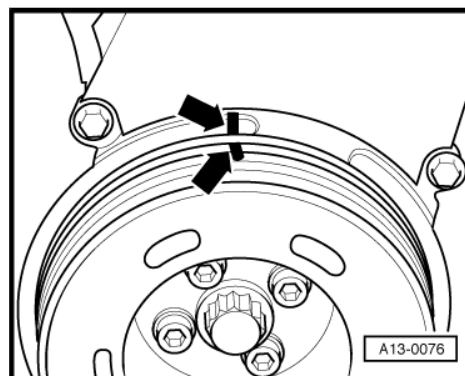


1.12 Positioning crankshaft to TDC for cylinder 1 with engine removed

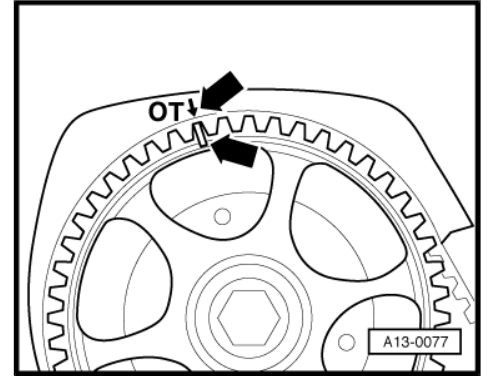


1.12.1 Procedure

- Remove toothed belt guard (top) -arrows-.
- Set crankshaft to markings for TDC of No. 1 cylinder -arrows- by turning central bolt on crankshaft sprocket in direction of rotation.



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



1.13 Checking semi-automatic tensioning roller for toothed belt

Note!

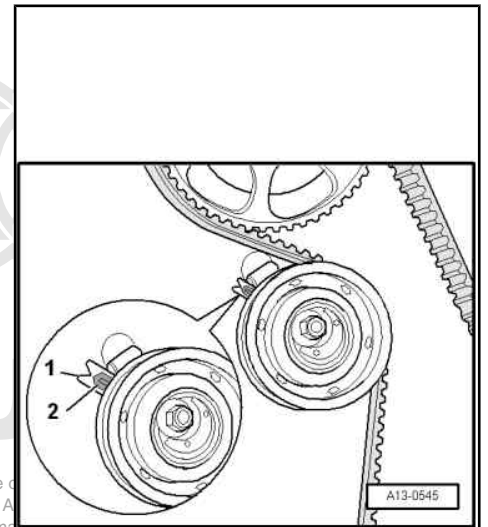
- ◆ Lock carrier in service position ⇒ [page 32](#).
- ◆ Toothed belt guard (top) removed.
- ◆ Toothed belt fitted and tensioned.

1.13.1 Test sequence

- Tension toothed belt by exerting force with thumb. The pointer -2- should move to side.
- Release tension on toothed belt. Tensioner should return to initial position. (Notch -1- should align again with pointer -2-).

Note!

Use a mirror to check.



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2 Removing and installing sealing flanges and flywheel/drive plate



Note!

Servicing clutch ⇒ 5-speed manual gearbox 012; Rep. Gr. 30.

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

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1 - 15 Nm

2 - Oil seal

- ☐ Renew ⇒ [page 57](#)
- ☐ Do not lubricate sealing lip of oil seal

3 - Sealing flange (front)

- ☐ Must be positioned on dowel sleeves
- ☐ Removing and installing ⇒ [page 60](#)
- ☐ Install using sealant; sealant ⇒ Parts catalogue

4 - Cylinder block

- ☐ Removing and installing crankshaft ⇒ [page 69](#)
- ☐ Dismantling and assembling pistons and con-rods ⇒ [page 75](#)

5 - Special bolt

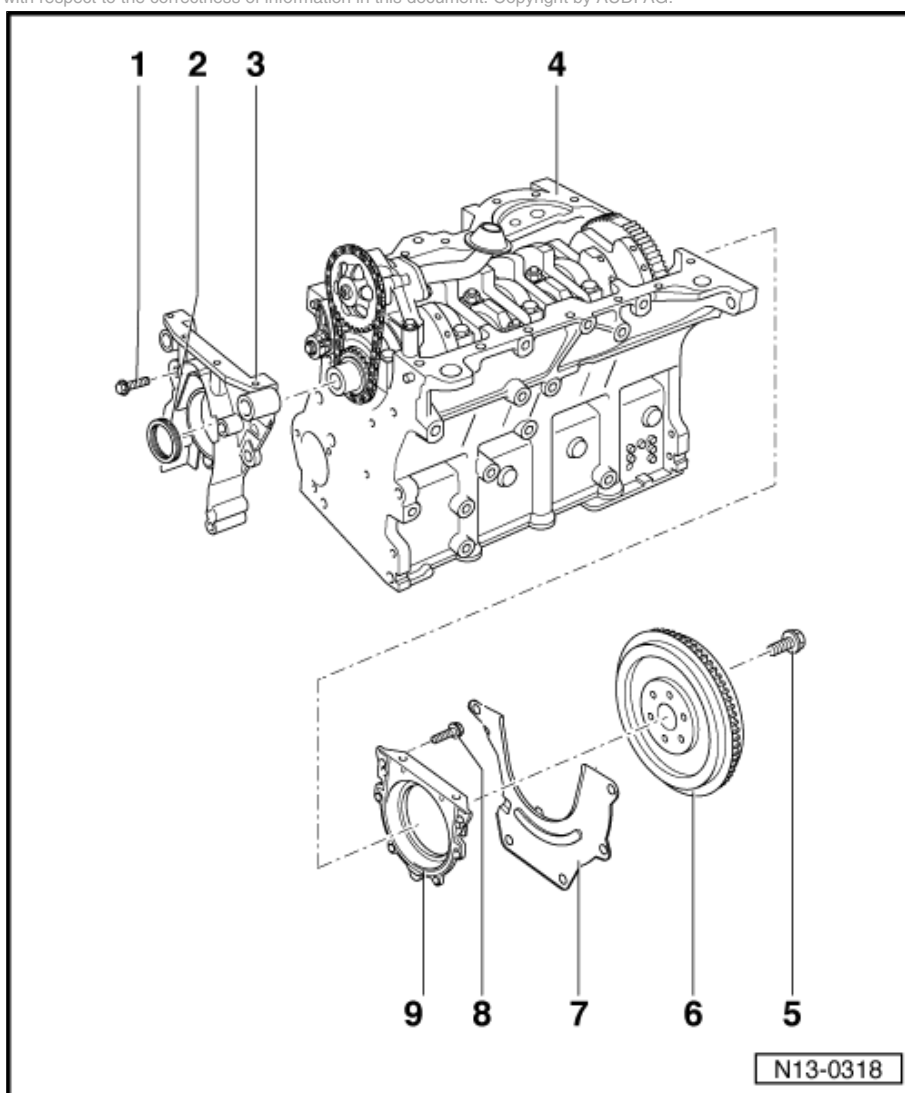
- ☐ Renew
- ☐ Use only genuine bolts ⇒ Parts catalogue
- ☐ Tightening torque: fly-wheel to crankshaft ⇒ [page 66](#)
- ☐ Tightening torque: drive plate to crankshaft ⇒ [page 68](#)

6 - Flywheel/drive plate

- ☐ Removing and installing flywheel ⇒ [page 65](#)
- ☐ Removing and installing drive plate ⇒ [page 66](#)
- ☐ Can only be installed in one position (holes are off-set)

7 - Intermediate plate

- ☐ Must be positioned on dowel sleeves
- ☐ Do not damage/bend when assembling
- ☐ Is fitted on sealing flange ⇒ [page 57](#)



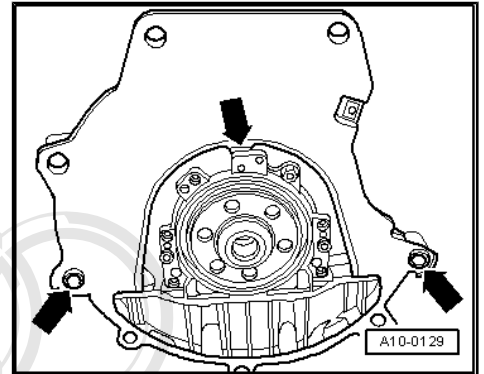
8 - 15 Nm

9 - Rear sealing flange

- ☐ With seal
- ☐ Removing and installing ⇒ [page 63](#)
- ☐ Install using sealant; sealant ⇒ Parts catalogue

Installing intermediate plate

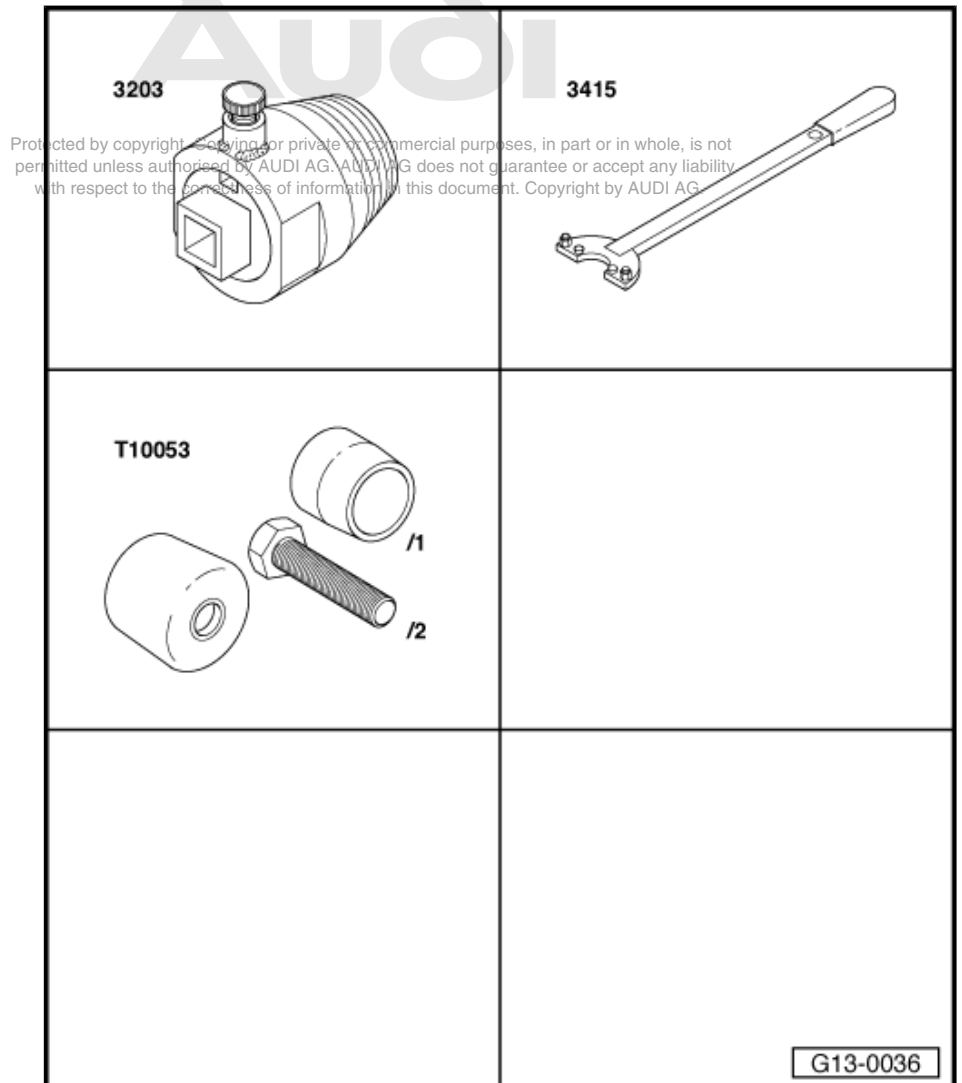
- Fit intermediate plate to sealing flange and push onto dowel sleeves -arrows-.



2.2 Renewing crankshaft oil seal (pulley end)

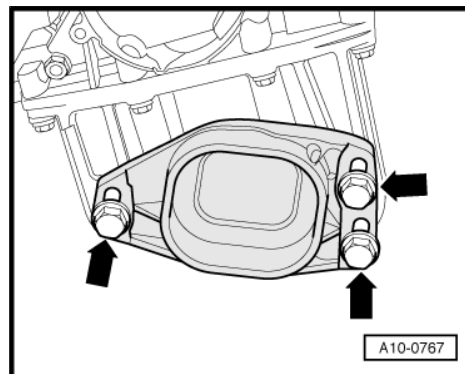
Special tools and workshop equipment required

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

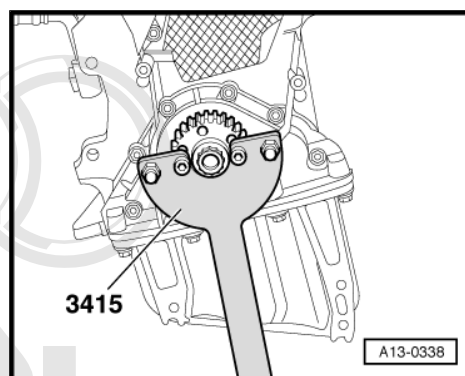


2.2.1 Removing

- Engine in vehicle.
- Lock carrier in service position ⇒ [page 32](#) .
- Remove toothed belt completely ⇒ [page 46](#) .
- Unbolt stop for torque reaction support -arrows-.

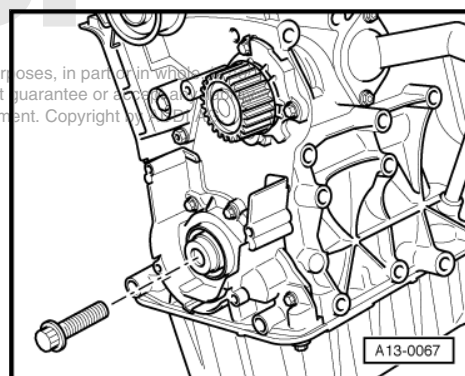


- Remove crankshaft sprocket; use counterhold -3415- to lock sprocket in place.

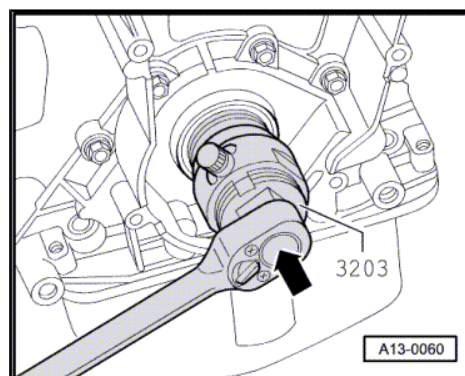


- Before fitting oil seal extractor, fully screw in centre bolt for sprocket into crankshaft.

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

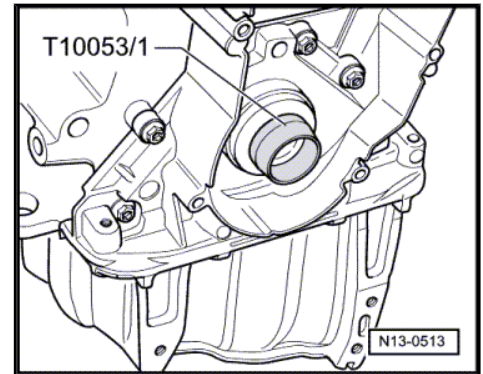


2.2.2 Installing

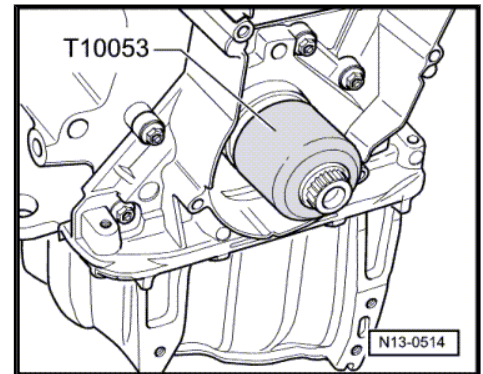
Note!

Do not lubricate sealing lip and external edge 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 press sleeve -T10053- and bolt -T10053/2-.
- Renew centre bolt for toothed belt sprocket.

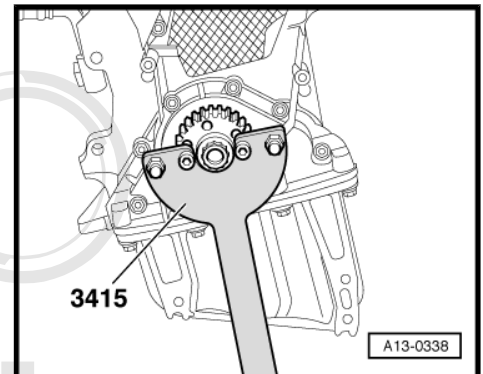


- Secure crankshaft sprocket; to do so, counterhold sprocket with counterhold tool -3415-.

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 49](#).
- Install poly V-belt ⇒ [page 38](#).
- Install lock carrier ⇒ [page 34](#).



2.2.3 Tightening torque

Component	Nm
Toothed belt sprocket to crankshaft	90 + 90° ⁸⁾ ⁹⁾

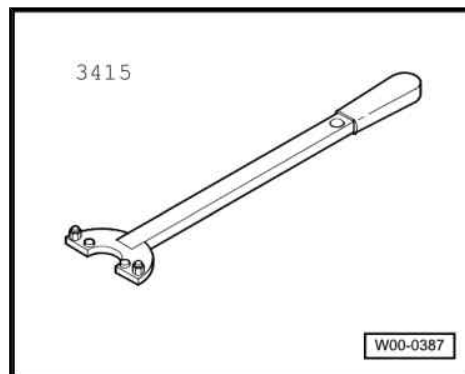
8) Renew bolt.

9) 90° equals a quarter turn.

2.3 Removing and installing front sealing flange

Special tools and workshop equipment required

- ◆ Counterhold -3415-



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

2.3.1 Removing

- Engine in vehicle.
- Lock carrier in service position ⇒ [page 32](#) .
- Remove toothed belt completely ⇒ [page 46](#) .

Vehicles with air conditioning:



Caution

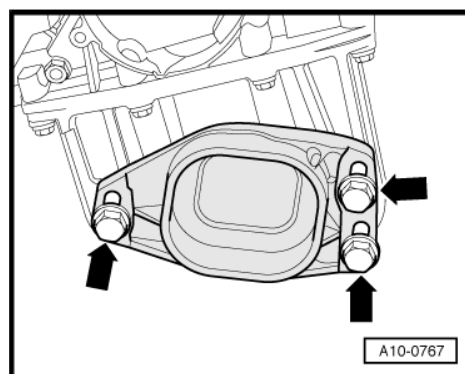
Refrigerant circuit of air conditioner must not be opened.

- Detach air conditioner compressor from bracket and secure to body with wire.
- Unbolt bracket for air conditioner compressor ⇒ [Item 5 \(page 37\)](#) .

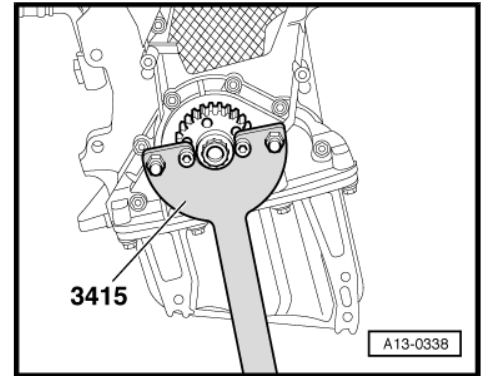
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All models:

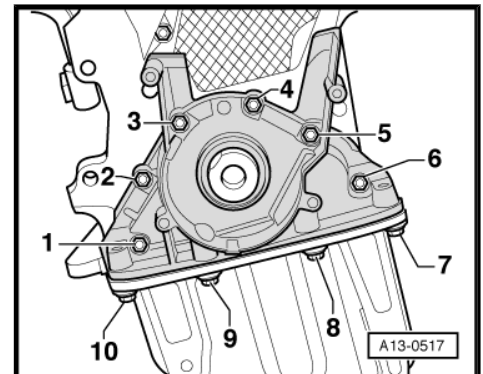
- Unbolt stop for torque reaction support -arrows-.



- Remove crankshaft sprocket; use counterhold -3415- to lock sprocket in place.



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



2.3.2 Installing



Note!

Place a cloth over the exposed section of the sump.

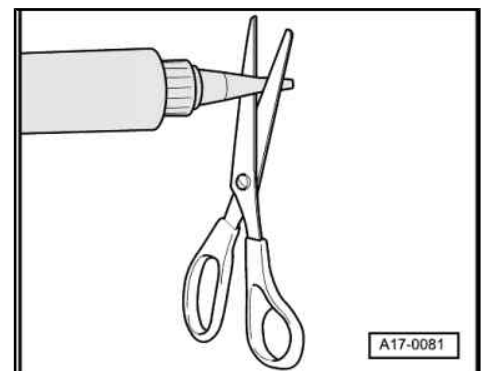
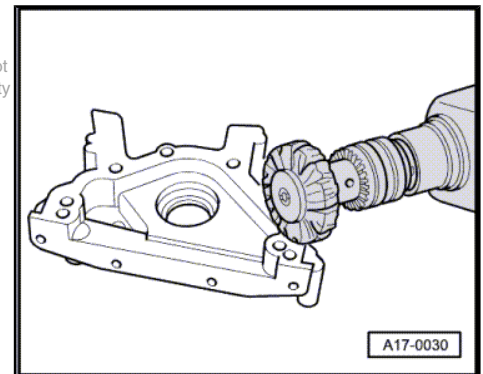
- Carefully remove sealant residue on cylinder block and on sump.
- Remove sealant residue on sealing flange using rotating plastic brush or similar.



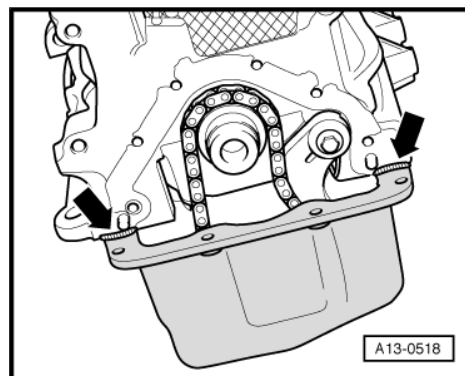
Caution

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-.

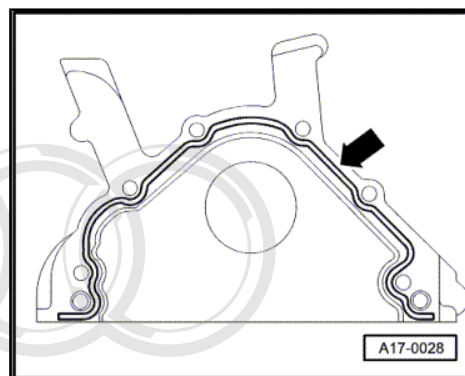


- Apply the bead of sealant onto the clean sealing surface of the sealing flange as illustrated -arrow-.
- Thickness of sealant bead: 2 ... 3 mm



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 silicone sealant.



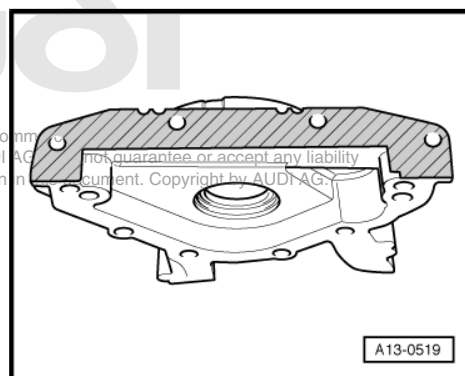
- Coat the lower sealing surface on the sealing flange lightly with sealant -hatched area-.
- Carefully push the sealing flange onto the dowel pins on the engine block.

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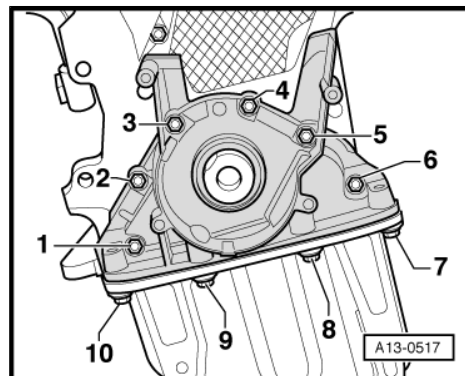


Note!

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



- Tighten bolts in the specified sequence:
- First tighten bolts -1 ... 6-.
- Then tighten bolts -7 ... 10-.
- Install crankshaft oil seal (pulley end) ⇒ [page 59](#) .
- Fit toothed belt (adjust valve timing) ⇒ [page 49](#) .
- Install bracket for air conditioner compressor ⇒ [Item 5 \(page 37\)](#) .
- Install lock carrier ⇒ [page 34](#) .



2.3.3 Tightening torques

Component	Nm
Sealing flange to cylinder block	15
Bracket for air conditioner compressor to cylinder block	33
A/C compressor to bracket	25

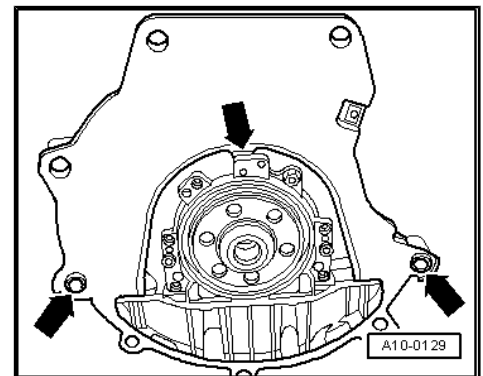
2.4 Removing and installing sealing flange (rear)

Special tools and workshop equipment required

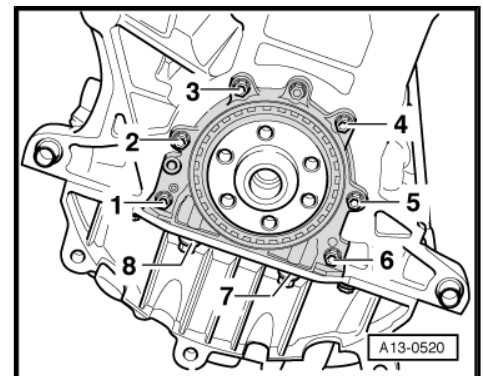
- ◆ Electric drill with plastic brush attachment
- ◆ Safety goggles
- ◆ Silicone sealant ⇒ Parts catalogue

2.4.1 Removing

- Gearbox removed
- Remove flywheel/drive plate ⇒ [page 65](#) and ⇒ [page 66](#) .
- Detach intermediate plate at sealing flange and dowel sleeves -arrows-.



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



2.4.2 Installing

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



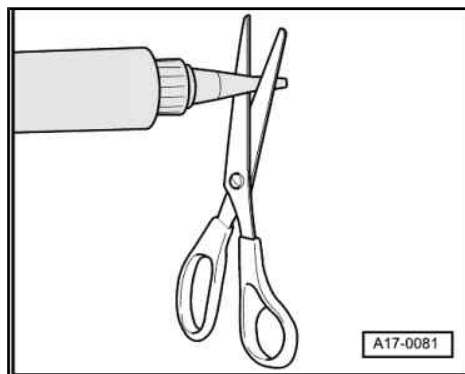
Note!

Place a cloth over the exposed section of the sump.

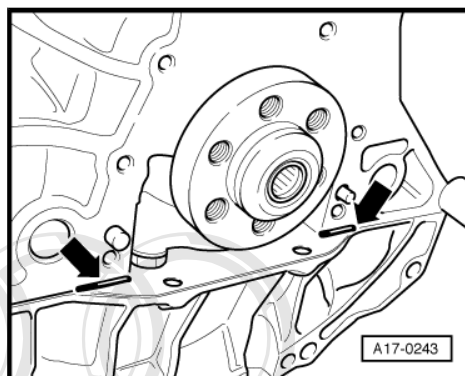
- Carefully remove sealant residues from sump and bottom of sealing flange.
- Clean sealing surfaces; they must be free of oil and grease.

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- 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-.



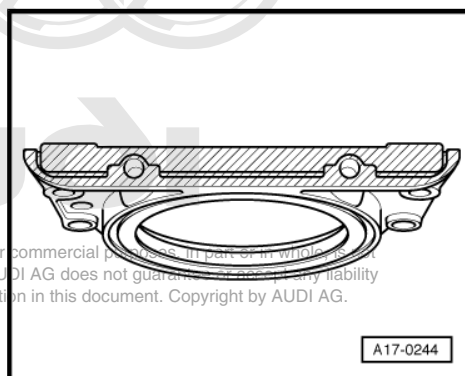
- Coat the lower sealing surface on the sealing flange lightly with sealant -hatched area-.



Note!

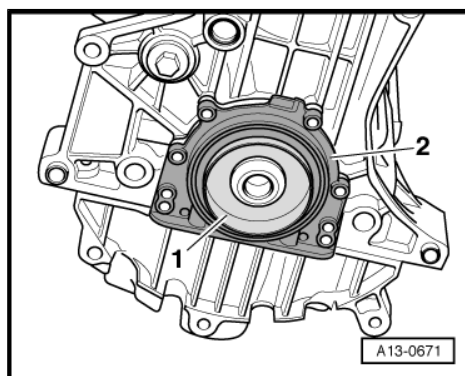
The sealing flange must be installed within 5 minutes after applying silicone sealant.

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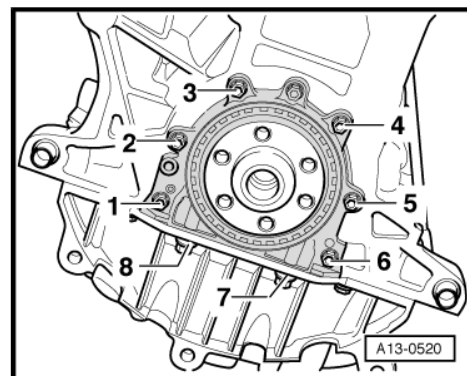


Carefully push sealing flange -2- together with guide sleeve -1- (fitted on replacement part) onto crankshaft when installing.

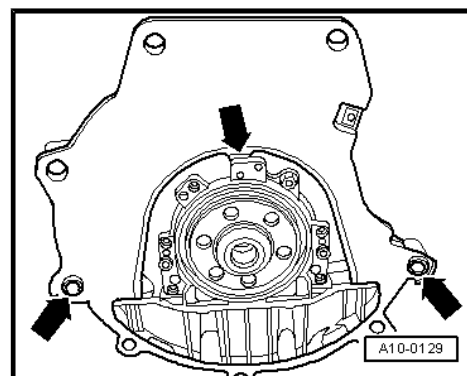
- Carefully push sealing flange onto dowel pins on engine block.



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



- Fit intermediate plate to sealing flange and push onto dowel sleeves -arrows-.
- Install flywheel/drive plate ⇒ [page 66](#) and ⇒ [page 66](#) .



2.4.3 Tightening torque

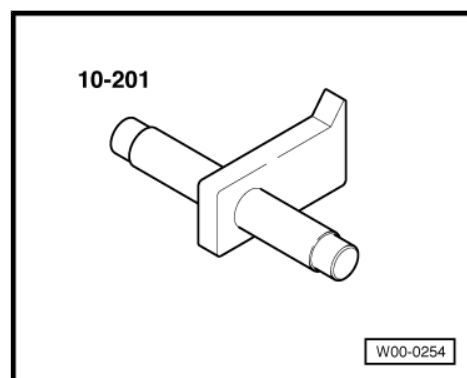
Component	Nm
Sealing flange to cylinder block	15

2.5 Removing and installing flywheel

Special tools and workshop equipment required

- ◆ Counterhold -10-201-

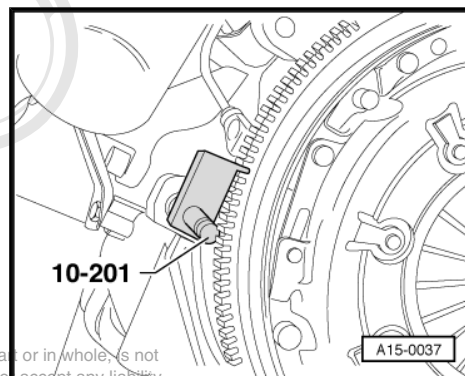
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2.5.1 Removing

- Gearbox removed
- Mark installation position of flywheel on engine.

- Insert counterhold -10-201- to unscrew bolts.
- Unbolt flywheel.



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2.5.2 Installing

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

- Use new bolts for securing.
- Fit counterhold -10-201- the other way round to tighten bolts.

2.5.3 Tightening torque

Component		Nm
Flywheel	22.5 mm ^{10) 11)}	60 + 90° ¹²⁾
to crankshaft	43 mm ^{10) 11)}	60 + 180° ¹³⁾

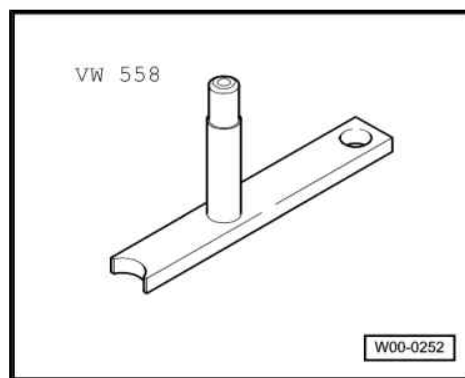
10) Bolt length

11) Renew bolts.

12) 90° equals a quarter turn.

13) 180° equals half of a turn.

2.6 Removing and installing drive plate



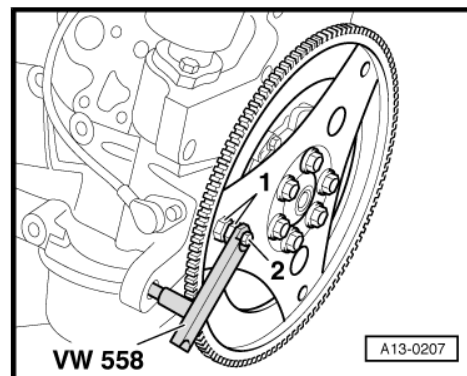
Special tools and workshop equipment required

- ◆ Counterhold -VW 558-
- ◆ M8×45 hexagon bolt and two M10 hexagon nuts
- ◆ Depth gauge

2.6.1 Removing

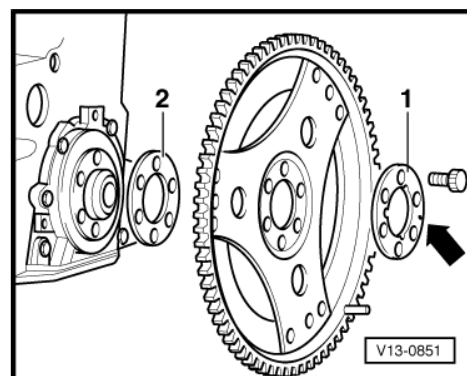
- Mark installation position of drive plate on engine.

- Secure counterhold -VW 558- to drive plate using hexagon bolt M8x45 -Item 2-. Fit two M10 hexagon nuts -1- between counterhold tool and drive plate.
- Unbolt drive plate.

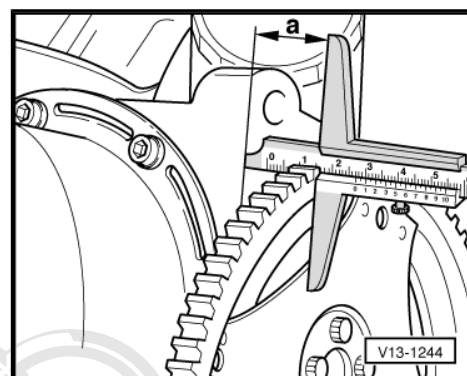


2.6.2 Installing

- Fit drive plate with shim -2- and washer -1-. Lug -arrow- must face torque converter.
- Insert at least 3 old securing bolts and tighten to 30 Nm.



- Check installation position of drive plate by measuring at three points and calculate average.
- Specification for automatic gearbox 01N: dimension -a- = 26 ... 28 mm

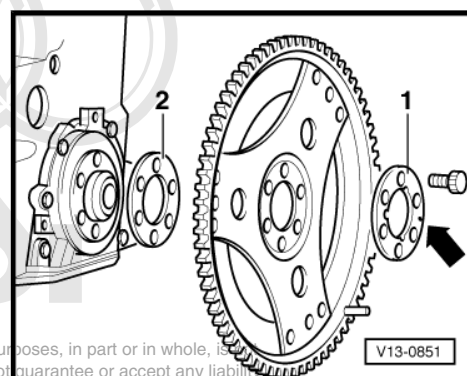


If specification is exceeded:

- Remove drive plate again and fit without shim -2-. Tighten bolts to 30 Nm again.
- Repeat measurement procedure.

If reading matches specification:

- Renew bolts and tighten.



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2.6.3 Tightening torque

Component	Nm
Drive plate to crankshaft	60 + 90° ¹⁴⁾ ¹⁵⁾

14) Renew bolts.

15) 90° equals a quarter turn.



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3 Removing and installing crankshaft



Note!

- ◆ *Bearing shells of the correct thickness are assigned to the cylinder block at the factory. Coloured dots are used to identify bearing shell thickness.*
- ◆ *When carrying out repairs, secure engine to assembly stand with engine and gearbox support - VW 540- [→ page 27](#).*

3.1 Crankshaft - Exploded view of components

1 - Bearing shell

- ☐ For cylinder block with oil groove
- ☐ Do not interchange used bearing shells (mark)
- ☐ Install new bearing shells for the cylinder block with the correct coloured markings [→ page 71](#)
- ☐ Note location

2 - Chain sprocket for oil pump chain

- ☐ Renew [→ page 72](#)

3 - Bearing shell

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

4 - Thrust washer

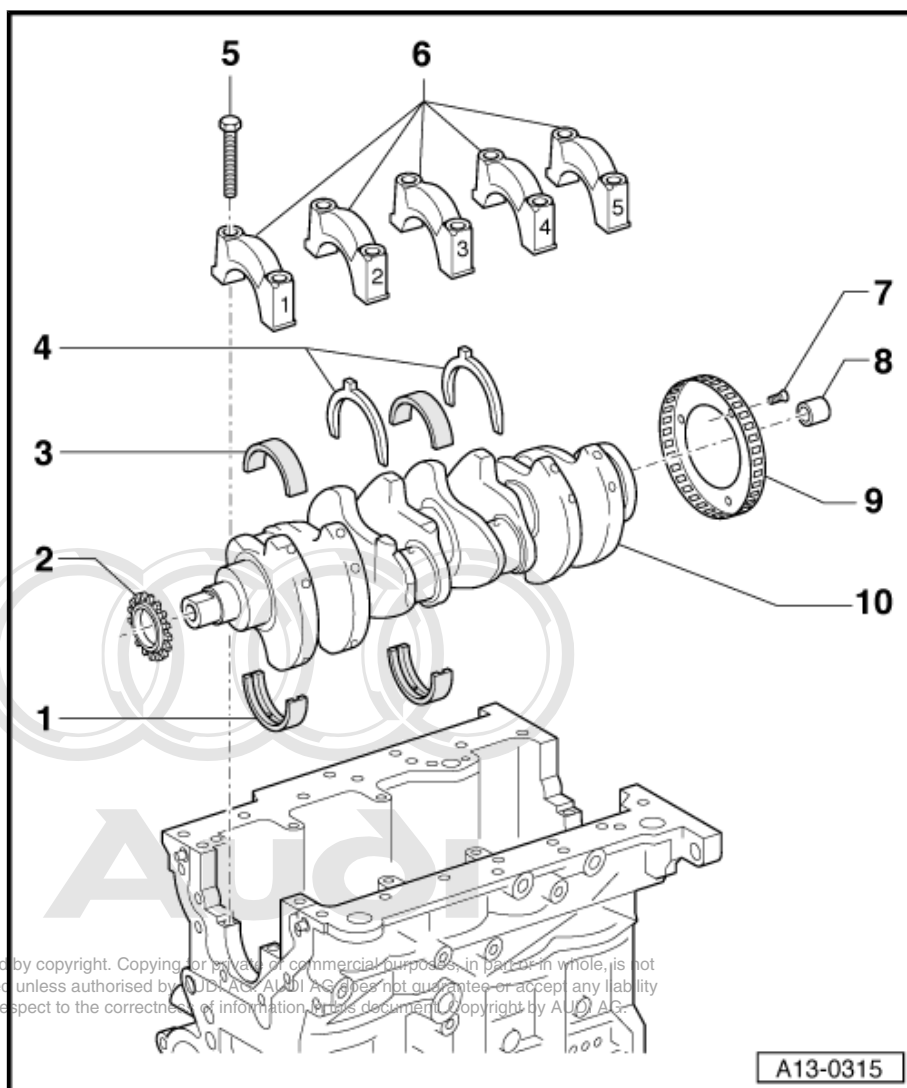
- ☐ For bearing No. 3
- ☐ Note location
- ☐ Oil grooves face outwards

5 - 40 Nm + 90° (1/4 turn) further

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

6 - Bearing cap

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



7 - 10 Nm + 90° (1/4 turn) further

- ☐ Renew
- ☐ Sender wheel must be renewed if bolts are loosened ⇒ [page 70](#)

8 - Needle bearing

- ☐ For vehicles with manual gearbox
- ☐ Extracting and driving in ⇒ [page 71](#)

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 70](#)

10 - Crankshaft

- ☐ Axial clearance (new): 0.07 ... 0.21 mm
- ☐ Wear limit (axial clearance): 0.30 mm
- ☐ Check radial clearance with Plastigage
- ☐ Radial clearance (new): 0.01 ... 0.04 mm
- ☐ Wear limit (radial clearance): 0.15 mm
- ☐ Do not rotate the crankshaft when checking the radial clearance
- ☐ Crankshaft dimensions ⇒ [page 72](#)

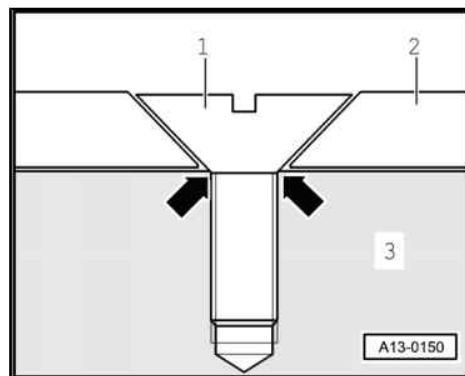
Removing and installing sender wheel

- 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 fitted in one position as holes are offset.



Tightening torque

Component	Nm
Sender wheel to crankshaft	10 + 90° ¹⁶⁾ ¹⁷⁾

16) Renew bolts.

17) 90° equals a quarter turn.



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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.

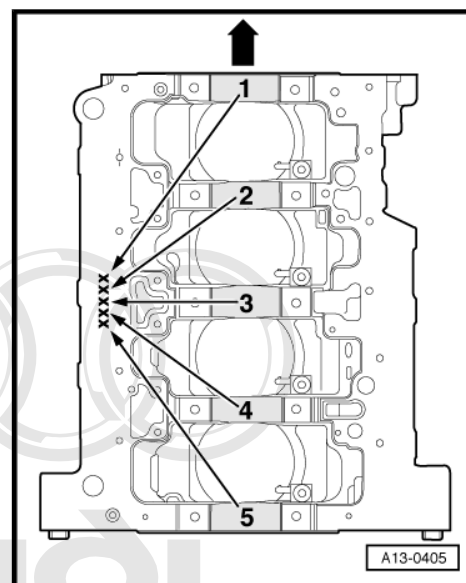


Note!

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

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

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



Note!

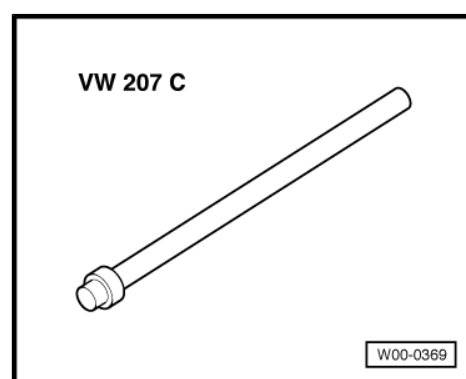
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- ◆ If no marking is visible on the cylinder block, the bearing shells with a "yellow" marking must be used.
- ◆ The crankshaft bearing shells in the bearing caps are only supplied as spare parts with "yellow" coloured markings.

3.2 Extracting and driving in needle bearing for crankshaft

Special tools and workshop equipment required

- ◆ Drift -VW 207 C- or centring drift -3176-

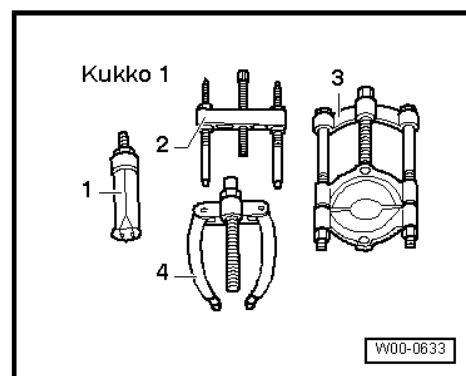


- ◆ 1 - Internal puller -Kukko 21/1-
- ◆ 4 - Counterhold -Kukko 22/1-
- ◆ Depth gauge



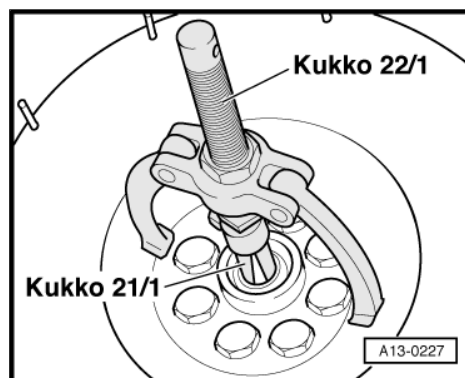
Note!

- ◆ A needle bearing must be fitted in the crankshaft on vehicles with manual gearbox; insert needle bearing if not yet fitted.
- ◆ In vehicles with automatic gearbox, the needle bearing must NOT be fitted in the crankshaft; remove needle bearing if fitted.



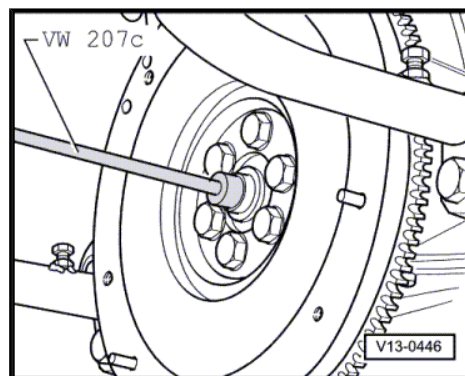
3.2.1 Removing

- Remove needle bearing using the internal puller -Kukko 21/1- and counterhold -Kukko 22/1- .



3.2.2 Installing

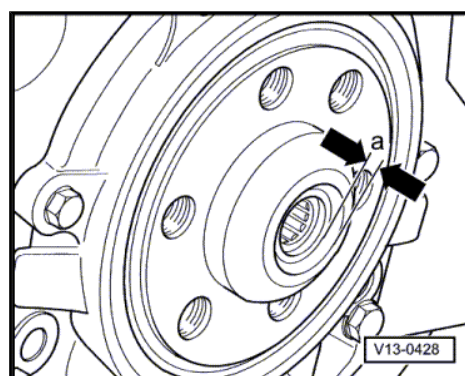
- Drive in needle bearing using drift -VW 207 C- or centring drift -3176- .
- The inscription on needle bearing must be visible when installed.



Installation depth of needle bearing

- Dimension -a- = 1.5 mm.

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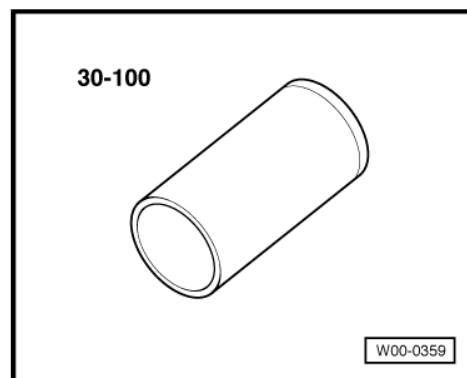
3.3 Crankshaft dimensions

Honing dimension (in mm)	Crankshaft main bearing journal Ø	Crankshaft conrod journal Ø
Basic dimension	54.00 -0.022 -0.042	47.80 -0.022 -0.042
1st undersize	53.75 -0.022 -0.042	47.55 -0.022 -0.042
2nd undersize	53.50 -0.022 -0.042	47.30 -0.022 -0.042
3rd undersize	53.25 -0.022 -0.042	47.05 -0.022 -0.042

3.4 Removing and installing chain sprocket

Special tools and workshop equipment required

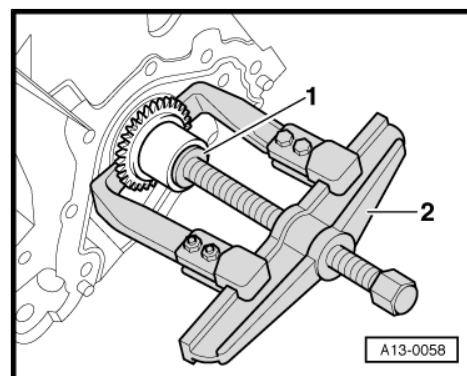
- ◆ Fitting sleeve -30-100-



- ◆ Commercially available two-arm puller
- ◆ Protective gloves

3.4.1 Removing

- Remove sealing flange (front) ⇒ [page 60](#) .
- Remove sump ⇒ [page 126](#) .
- Remove oil pump sprocket, chain tensioner and chain
⇒ [Item 23 \(page 124\)](#) .
- Detach chain sprocket for crankshaft with puller -2-; use a
suitable washer -1- to protect crankshaft journal.



3.4.2 Installing

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



Caution

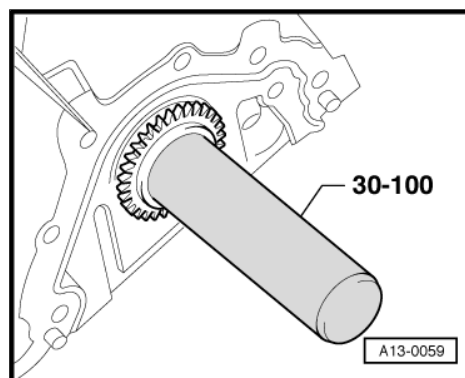
Wear protective gloves!

- Heat chain sprocket in oven for approx. 15 minutes to 220°C.
- Using pliers, locate sprocket on end of crankshaft.
- Installation position: wider collar on sprocket faces engine

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- 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

4.1 Different conrods and conrod bolts

Depending on version, cracked conrods may be used instead of sawn conrods.

Distinguishing features of sawn and cracked conrods:

A - Sawn conrods = smooth joint surface

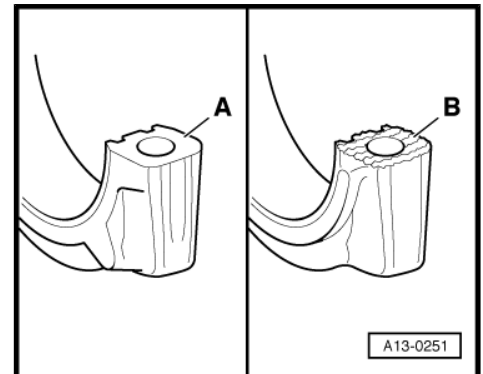
B - Cracked conrods¹⁸⁾ = rough joint surface

18) Broken into two sections by cracking.



Note!

Oil spray jet and pressure relief valve ⇒ [page 79](#)



4.2 Piston with sawn conrod - exploded view of components

1 - Piston rings

- ☐ Offset gaps by 120°
- ☐ Remove and install using piston ring clamp
- ☐ Inscription "TOP" faces towards piston crown
- ☐ Checking ring gap ⇒ [page 78](#)
- ☐ Checking ring to groove clearance ⇒ [page 78](#)

2 - Piston

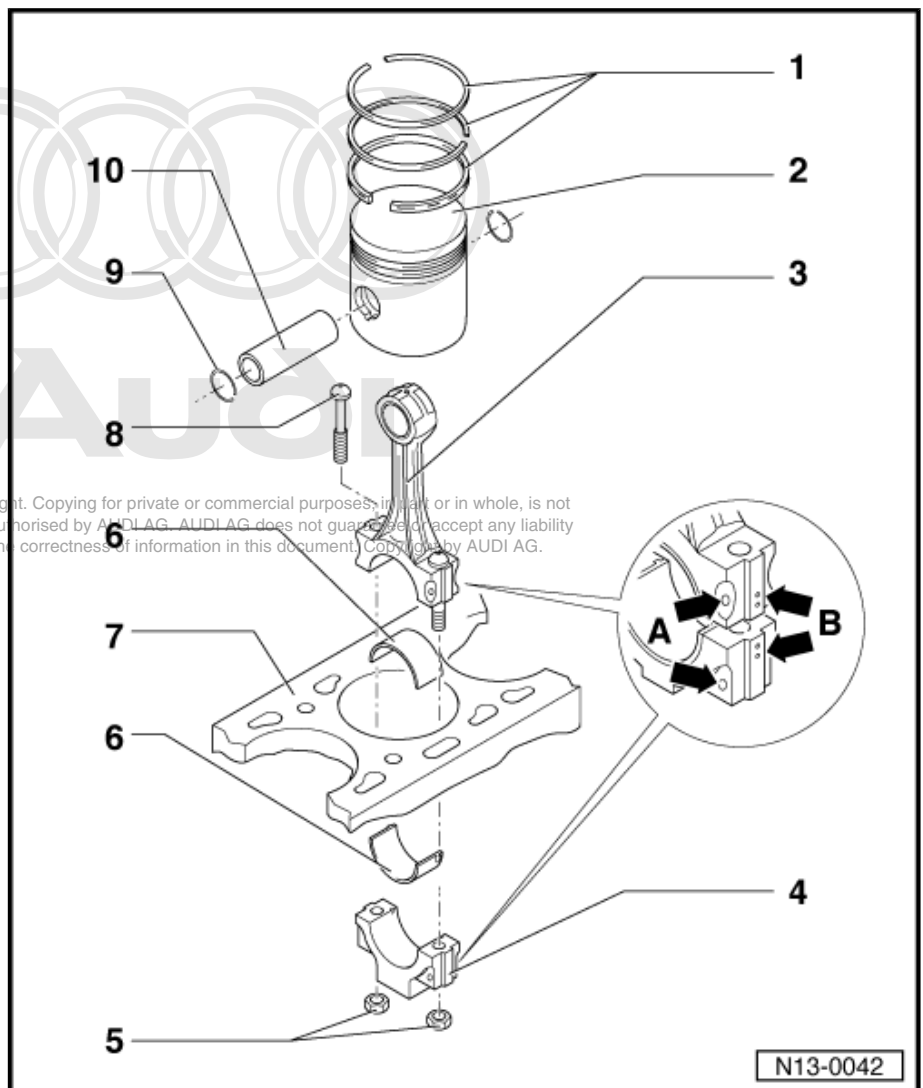
- ☐ Checking ⇒ [page 78](#)
- ☐ Mark installation position and cylinder allocation
- ☐ Arrow on piston crown points to pulley end
- ☐ Install using piston ring clamp
- ☐ Piston and cylinder dimensions ⇒ [page 79](#)

3 - Conrod

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

4 - Conrod bearing cap

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





5 - 30 Nm + 1/4 turn (90°) further

- ☐ Renew conrod bolt ⇒ [Item 8 \(page 76\)](#)
- ☐ Lubricate threads and contact surface
- ☐ To measure radial clearance, tighten to 30 Nm but not further

6 - Bearing shell

- ☐ Note installation position
- ☐ Do not interchange used bearing shells (mark)
- ☐ Ensure tight fit in retaining lugs
- ☐ Upper bearing shell with oil hole for piston pin lubrication
- ☐ Axial clearance (new): 0.10 ... 0.35 mm
- ☐ Wear limit (axial clearance): 0.40 mm
- ☐ Check radial clearance with Plastigage; do not rotate crankshaft when checking radial clearance
- ☐ Radial clearance (new): 0.01 ... 0.05 mm
- ☐ Wear limit (radial clearance): 0.12 mm

7 - Cylinder block

- ☐ Checking cylinder bore ⇒ [page 79](#)
- ☐ Piston and cylinder dimensions ⇒ [page 79](#)

8 - Conrod bolt

- ☐ Renew

9 - Circlip

10 - Piston pin

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



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4.3 Piston with cracked conrods - exploded view of components

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

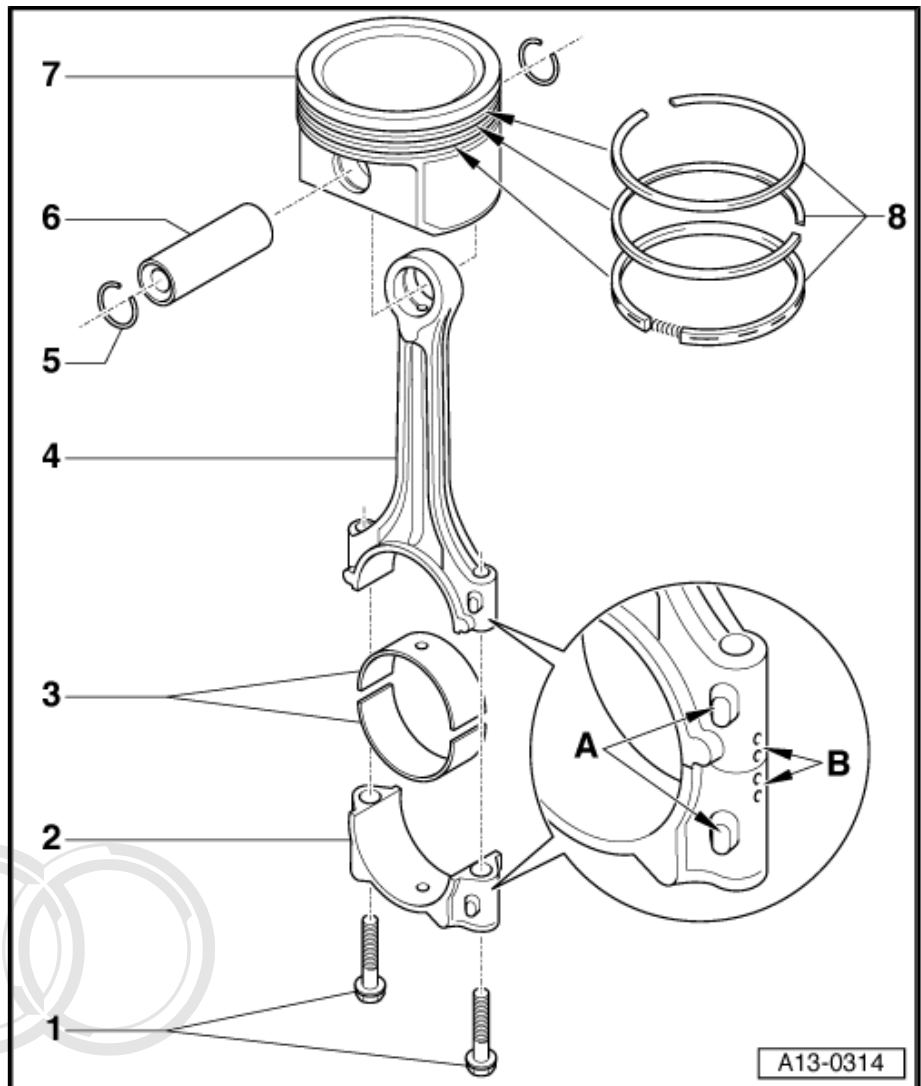
- ☐ Renew
- ☐ Lubricate threads and contact surface
- ☐ Use old bolt for measuring radial clearance
- ☐ To measure radial clearance, tighten to 30 Nm but not further

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 79](#)
- ☐ Do not interchange used bearing shells (mark)
- ☐ Axial clearance (new): 0.05...0.31 mm; wear limit: 0.37 mm
- ☐ Check radial clearance with Plastigage: new: 0.01 ... 0.06 mm; wear limit: 0.12 mm. Do not turn crankshaft when measuring radial clearance



4 - Conrod

- ☐ Only renew as a 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

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

7 - Piston

- ☐ Checking [⇒ page 78](#)
- ☐ Mark installation position and cylinder allocation
- ☐ Arrow on piston crown points to pulley end
- ☐ Install using piston ring clamp
- ☐ Piston and cylinder dimensions [⇒ page 79](#)
- ☐ Checking cylinder bore [⇒ page 79](#)

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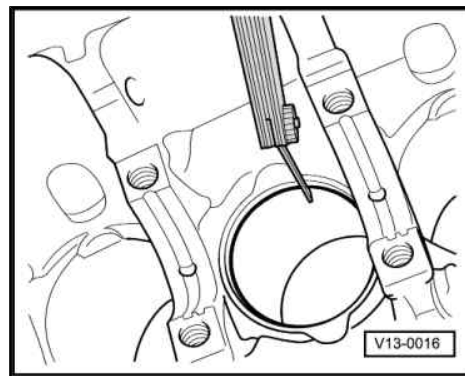
8 - Piston rings

- ❑ Offset gaps by 120°
- ❑ Remove and install using piston ring clamp
- ❑ "TOP" must face towards piston crown
- ❑ Checking ring gap ⇒ [page 78](#)
- ❑ Checking ring to groove clearance ⇒ [page 78](#)

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.

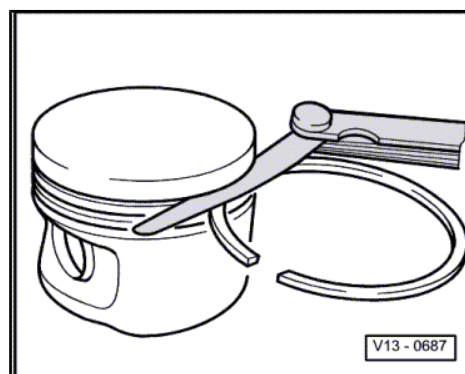
Piston ring (in mm)	New	Wear limit
1st compression ring	0.20 ... 0.40	0.8
2nd compression ring	0.20 ... 0.40	0.8
Oil scraper ring	0.25 ... 0.50	0.8



Checking ring-to-groove clearance

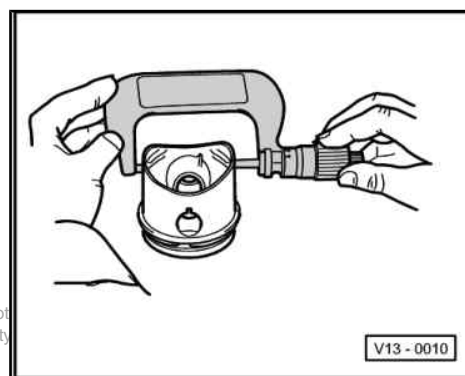
- Clean groove in piston before checking clearance.

Piston ring (in mm)	New	Wear limit
1st compression ring	0.06 ... 0.09	0.20
2nd compression ring	0.05 ... 0.08	0.20
Oil scraper ring	0.03 ... 0.06	0.15



Checking piston

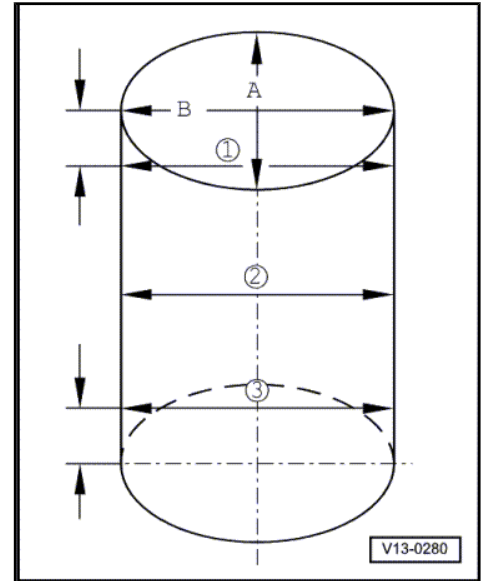
- Measure approx. 10 mm from the bottom edge, perpendicular to the piston pin axis.
- Max. deviation from nominal dimension: 0.04 mm.



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Checking cylinder bore

- Use 50 ... 0.100 mm internal dial gauge to take measurements at 3 points in transverse direction -A- and longitudinal direction -B-.
- Max. deviation from nominal dimension: 0.08 mm.

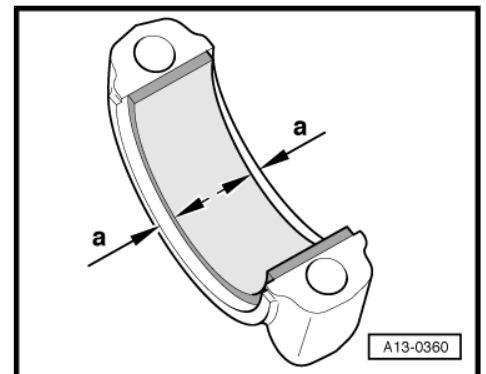


Installation position of bearing shell with cracked conrods

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

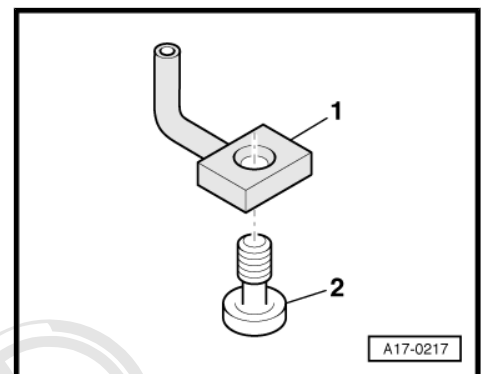


The bearing shell with the oil bore must be inserted in the conrod.



Oil spray jet and pressure relief valve

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



4.4 Piston and cylinder dimensions

Honing dimension	Piston Ø	Cylinder bore Ø
Basic dimension mm	80.965 ¹⁹⁾	81.01

19) Dimensions do not include graphite coating (thickness 0.02 mm) The graphite coating will wear down in service.

15 – Cylinder head, valve gear

1 Removing and installing cylinder head

1.1 Cylinder head - exploded view of components

1 - 15 Nm

2 - 20 Nm

3 - Toothed belt guard - rear

4 - Cylinder head

- ☐ Removing ⇒ [page 84](#) and ⇒ [page 87](#)
- ☐ Checking for distortion ⇒ [page 82](#)
- ☐ Machining dimension ⇒ [page 82](#)
- ☐ Installing ⇒ [page 91](#)
- ☐ If renewed, fill with fresh coolant

5 - O-ring

- ☐ Renew
- ☐ Only for vehicles with engine code ANA

6 - 10 Nm

- ☐ Only for vehicles with engine code ANA

7 - 20 Nm

- ☐ Only for vehicles with engine code ANA

8 - Heat shield

- ☐ Only for vehicles with engine code ANA

9 - Air pipe

- ☐ For secondary air system
- ☐ Only for vehicles with engine code ANA

10 - 20 Nm

- ☐ Only for vehicles with engine code ANA

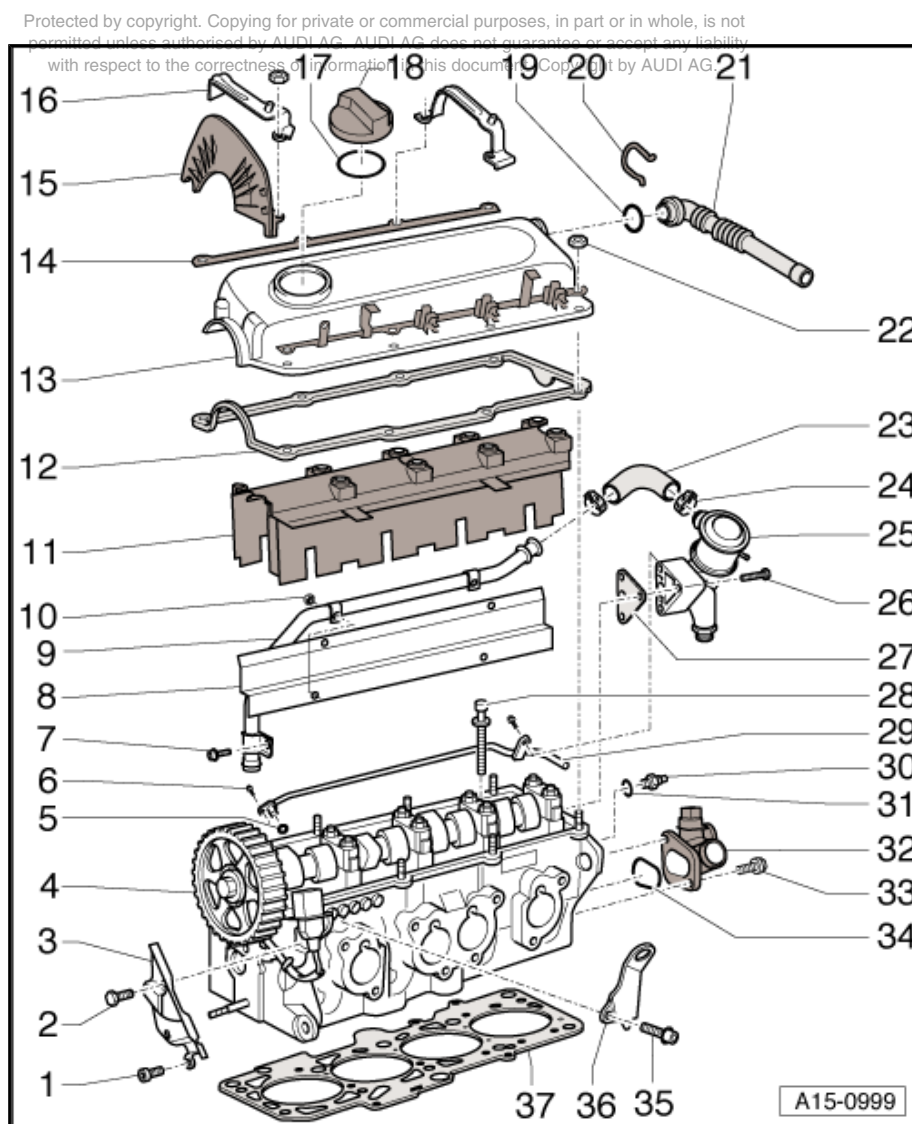
11 - Oil deflector

12 - Gasket for cylinder head cover

- ☐ Renew if damaged or leaking
- ☐ Before fitting, apply sealant at transitions ⇒ [page 82](#) and ⇒ [page 82](#)
- ☐ Sealant ⇒ Parts catalogue

13 - Cylinder head cover

- ☐ Removing and installing ⇒ [page 82](#)



14 - Reinforcing strip

15 - Toothed belt guard

16 - Bracket for engine cover panel

17 - Seal

- ☐ Renew if damaged or leaking

18 - Filler cap

19 - O-ring

- ☐ Renew if damaged or leaking

20 - Securing clip

21 - Crankcase breather hose

22 - 10 Nm

- ☐ Tighten in stages and in diagonal sequence

23 - Connecting hose for secondary air system

- ☐ Only for vehicles with engine code ANA

24 - Clip

25 - Combination valve for secondary air system

- ☐ With support for exhaust gas recirculation pipe
- ☐ Only for vehicles with engine code ANA

26 - 10 Nm

27 - Gasket

- ☐ Renew
- ☐ Only for vehicles with engine code ANA

28 - Cylinder head bolt

- ☐ Renew
- ☐ Note sequence when loosening ⇒ [page 90](#)
- ☐ Note sequence when tightening ⇒ [page 94](#)

29 - Coolant pipe

- ☐ Only for vehicles with engine code ANA

30 - Oil temperature sender -G8- or screw plug, 15 Nm

31 - Seal

- ☐ Renew

32 - Coolant distribution housing and hose connection

- ☐ With coolant temperature sender

33 - 10 Nm

34 - Seal

- ☐ Renew

35 - 20 Nm

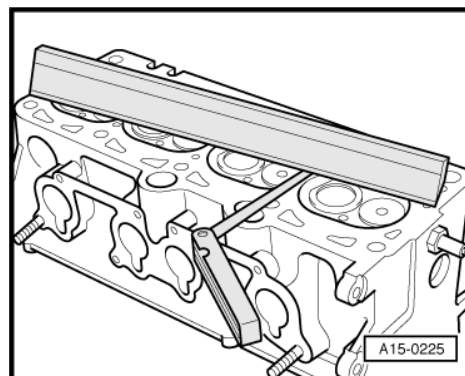
36 - Lifting eye

37 - Cylinder head gasket

- ☐ Renewing; see "Removing cylinder head" ⇒ [page 84](#) and ⇒ [page 87](#)
- ☐ Installation position: Part number points towards cylinder head, and must be legible from the inlet side
- ☐ If renewed, fill with fresh coolant

Checking cylinder head for distortion

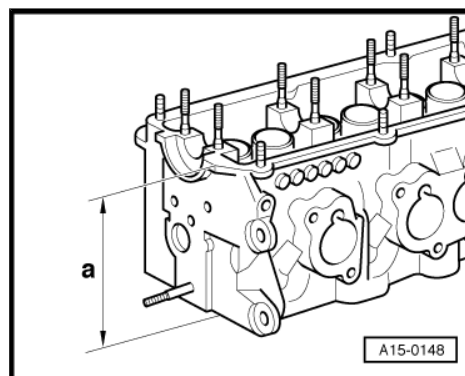
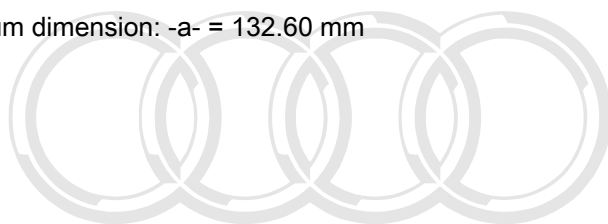
- Use straight edge and feeler gauge to measure for distortion at several points.
- Maximum permissible distortion: 0.1 mm.



Cylinder head machining limit

Reworking of the cylinder head (surface grinding) is only permissible down to the minimum height -a-.

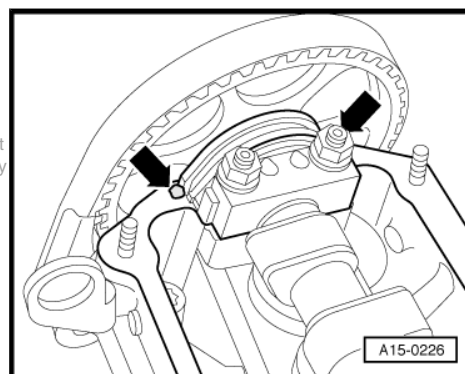
- Minimum dimension: -a- = 132.60 mm



Sealing points between bearing cap and cylinder head

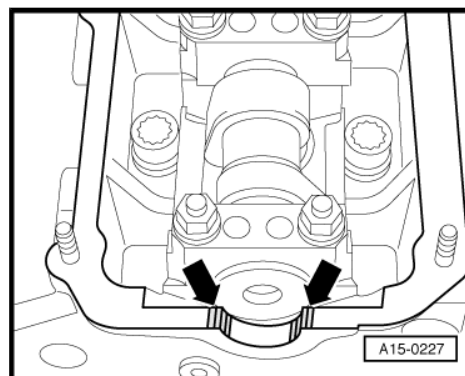
- Apply small quantity of sealant to transitions -arrows- at top sealing surface of cylinder head; sealant ⇒ Parts catalogue .

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Sealing transitions

- Apply small quantity of sealant to transitions for semi-circular seal -arrows- at top sealing surface of cylinder head; sealant ⇒ Parts catalogue .



1.2 Removing and installing cylinder head cover

Special tools and workshop equipment required

- ◆ Sealant ⇒ Parts catalogue

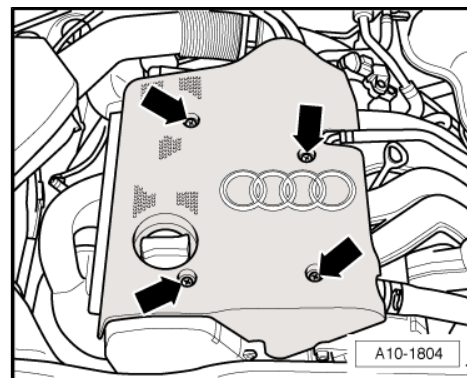
1.2.1 Removing

- Take off engine cover panel -arrows-.

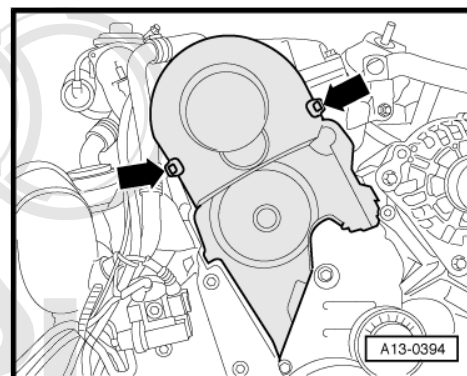


Note!

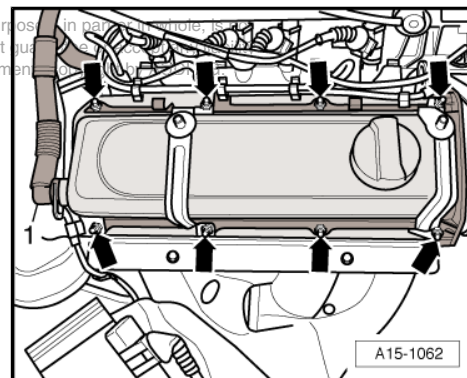
Illustration shows vehicle with engine code letters ANA.



- Remove toothed belt guard (top) -arrows-.



- Detach hose -1- for crankcase breather system at cylinder head cover.
- Watch out for O-ring when removing.
- Unscrew nuts for cylinder head cover -arrows-.
- Remove reinforcing strips and cylinder head cover.



1.2.2 Installing

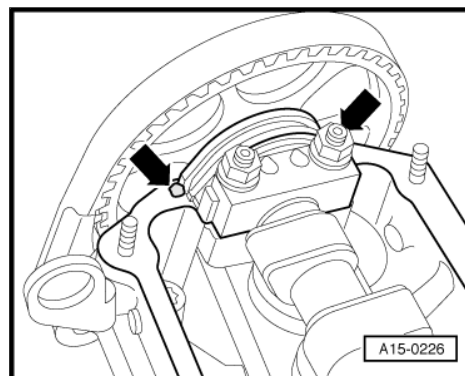
Installation is carried out in the reverse order; note the following:



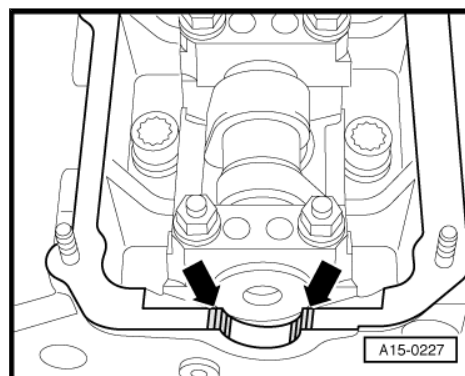
Note!

Renew cylinder head cover gaskets if damaged.

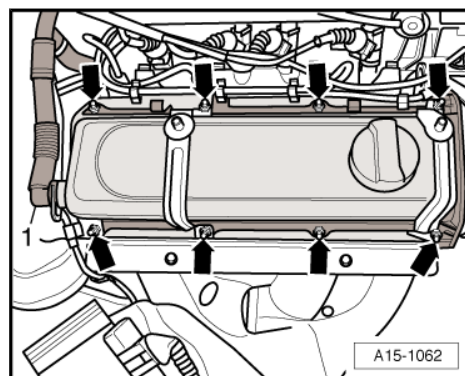
- Apply small quantity of sealant to transitions -arrows- at upper sealing surface of cylinder head.
- Sealant ⇒ Parts catalogue



- Apply small quantity of sealant to transitions for semi-circular seal -arrows- at top sealing surface of cylinder head; sealant ⇒ Parts catalogue .



- Fit cylinder head cover, reinforcing strips, toothed belt guard and bracket for engine cover panel.
- Tighten nuts for cylinder head cover -arrows- in diagonal sequence.
- Make sure toothed belt guard (top) is correctly fitted.



1.2.3 Tightening torque

Component	Nm
Cylinder head cover to cylinder head	10

1.3 Removing cylinder head - vehicles with engine code letters AHL, ARM

- Engine in vehicle.
- Lock carrier in service position ⇒ [page 32](#) .



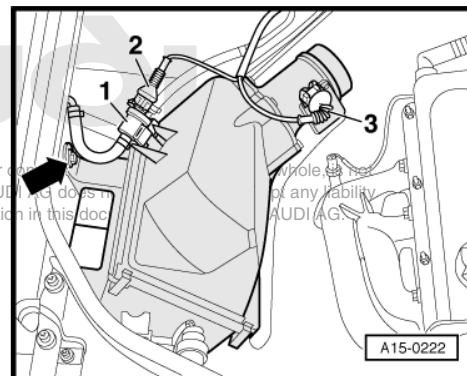
Note!

- ♦ 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 45 .

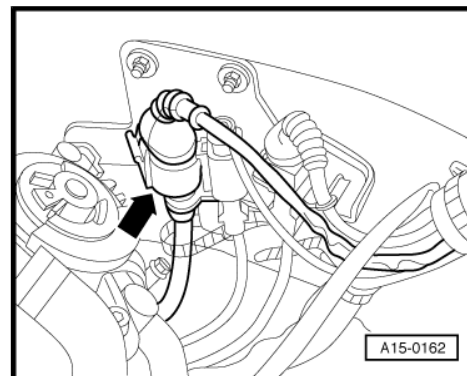
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1.3.1 Procedure

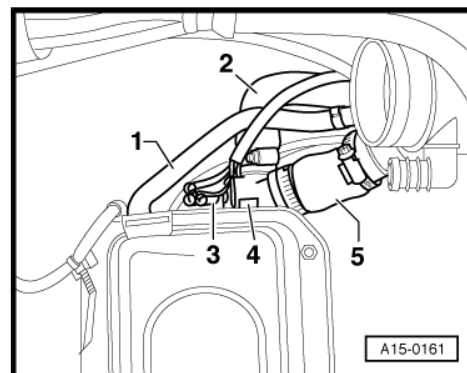
- Obtain code on vehicles with coded radio / radio and navigation system (RNS).
- Disconnect earth wire at battery with ignition switched off.
- Drain off coolant ➔ [page 143](#) .
- Remove intake manifold ➔ [page 96](#) .
- Unplug electrical connectors -2- and -3- for solenoid valve 1 for activated charcoal filter system -N80- and air mass meter -G70- .
- Disconnect the solenoid valve 1 for activated charcoal filter system -N80- -Item 1- at air cleaner housing.
- Remove air cleaner housing -arrow- Protected by copyright. Copying for private or other purposes is prohibited unless authorised by AUDI AG. AUDI AG does not accept any liability with respect to the correctness of information in this document. AUDI AG
- Unscrew securing nuts for exhaust manifold/front exhaust pipe (accessible from above).
- Press exhaust system to rear until studs at exhaust manifold are clear.



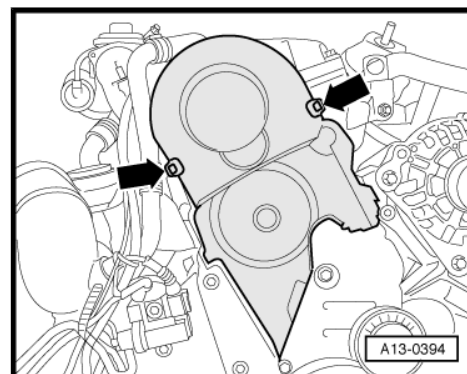
- Detach electrical connector -arrow- for Lambda probe from bracket, unplug and move wiring clear.



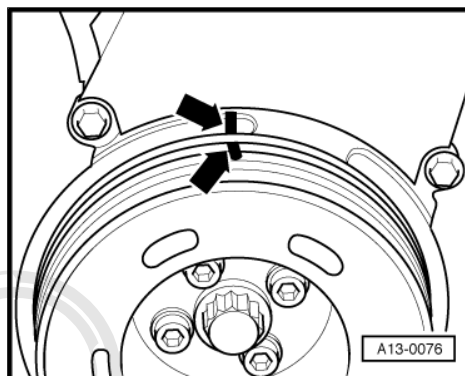
- Detach coolant hose -2- going to heat exchanger at cylinder head.
- Unplug electrical connector -3- at coolant temperature sender -G62- .
- Unplug electrical connector -4- at oil temperature sender -G8- .



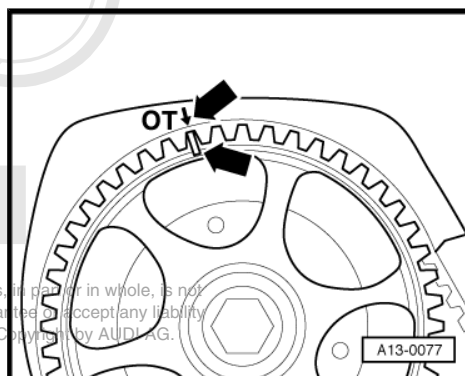
- Remove toothed belt guard (top) -arrows-.



- Set crankshaft to markings for TDC of No. 1 cylinder -arrows- by turning central bolt on crankshaft sprocket in direction of rotation.

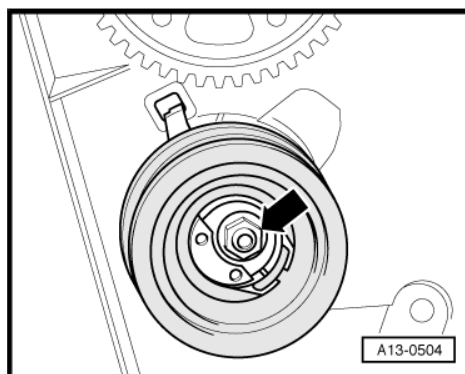


- At the same time the marking at camshaft sprocket must align with the marking on toothed belt guard -arrows-. If necessary, turn crankshaft 1 turn further.

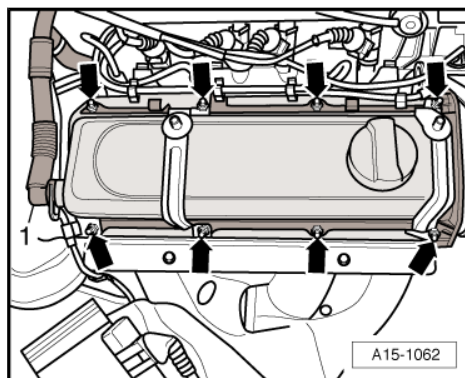


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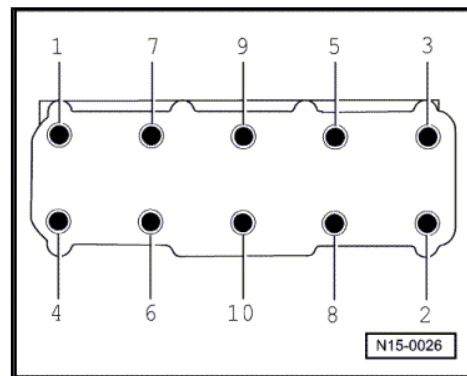
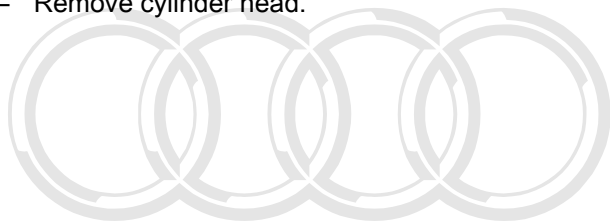
- Loosen tensioning roller nut -arrow- several turns.
- Remove toothed belt from camshaft sprocket.
- Unscrew M8 bolt for toothed belt guard (rear).
- Detach spark plug connectors and move clear to side.



- Detach hose -1- for crankcase breather system at cylinder head cover.
- Watch out for O-ring when removing.
- Unscrew nuts for cylinder head cover -arrows-.
- Remove reinforcing strips and cylinder head cover.



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



1.4 Removing cylinder head - vehicles with engine code letters ANA

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Engine in vehicle

- Lock carrier in service position ➔ [page 32](#) .



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 45 .

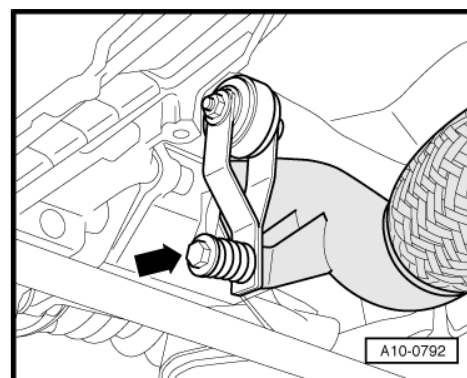
1.4.1 Procedure

- Obtain code on vehicles with coded radio / radio and navigation system (RNS).
- Disconnect earth wire at battery with ignition switched off.
- Drain off coolant ➔ [page 143](#) .
- Remove top section of intake manifold ➔ [page 99](#) .
- Detach exhaust system at gearbox bracket -arrow-.

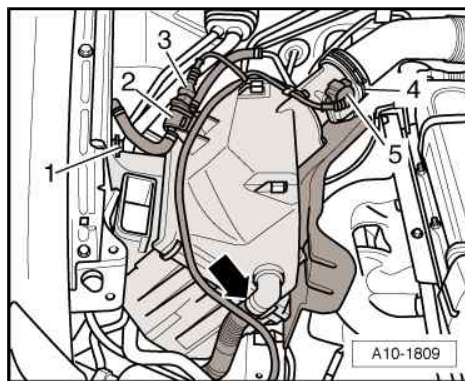


Note!

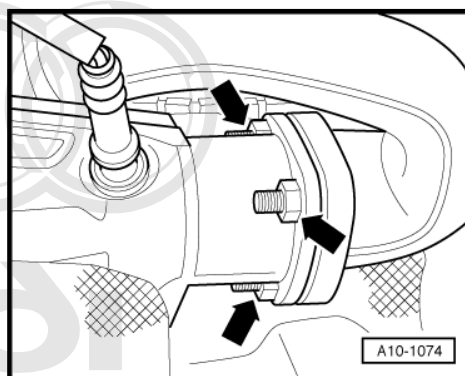
The flexible joint in front exhaust pipe must not be bent more than 10° to avoid any damage.



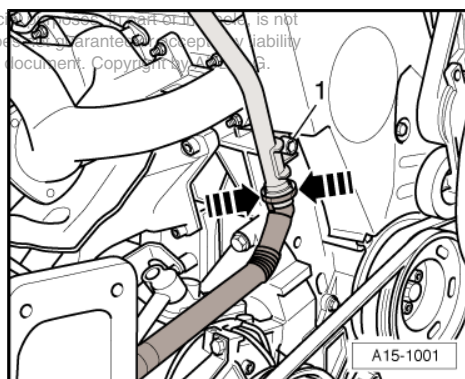
- Unplug electrical connectors -3- and -5- for solenoid valve 1 for activated charcoal filter system -N80- and air mass meter -G70- .
- Disconnect the solenoid valve 1 for activated charcoal filter system -N80- -Item 2- at air cleaner housing.
- Detach hose connection going to secondary air pump -V101- -arrow-.
- Release hose clip -4- for air duct at air mass meter.
- Unscrew bolt -1- and remove air cleaner housing.



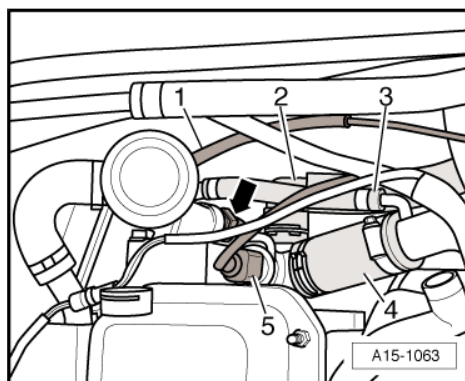
- Unbolt catalytic converter from exhaust manifold -arrows-.
- Detach exhaust system from flange for exhaust manifold.



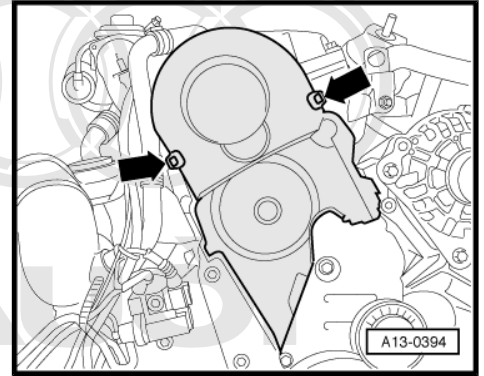
- Press the release tabs -arrows- and detach the hose at pipe going to combination valve for secondary air system.
- Unscrew bolt -1-.



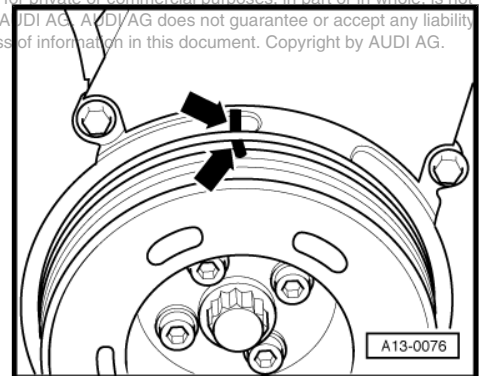
- Detach coolant hoses -2- and -4- at rear on support of cylinder head.
- Detach coolant hose -3- at coolant pipe.
- Detach vacuum hose -1- at combination valve.
- Unplug electrical connector -5- at coolant temperature sender -G62- .
- Unbolt connecting pipe for exhaust gas recirculation (bottom) at support -arrow-.



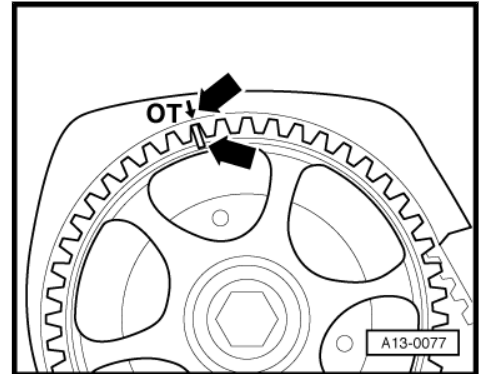
- Remove toothed belt guard (top) -arrows-.



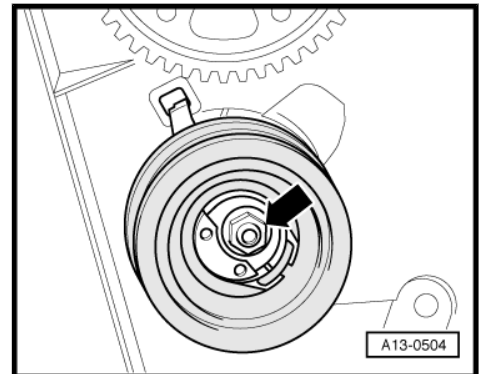
- Set crankshaft to markings for TDC of No. 1 cylinder -arrows- by turning central bolt on crankshaft sprocket in direction of rotation.



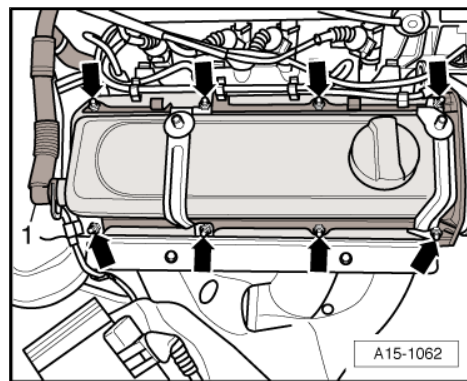
- At the same time the marking at camshaft sprocket must align with the marking on toothed belt guard -arrows-. If necessary, turn crankshaft 1 turn further.



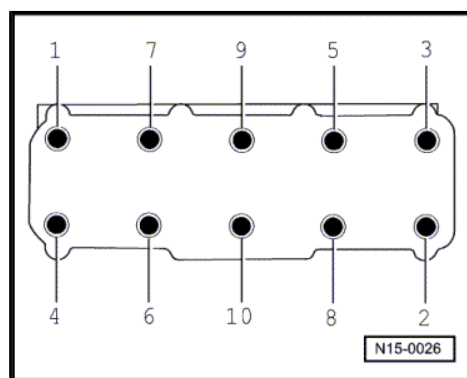
- Loosen tensioning roller nut -arrow- several turns.
- Remove toothed belt from camshaft sprocket.
- Unscrew M8 bolt for toothed belt guard (rear).
- Detach spark plug connectors and move clear to side.



- Detach hose -1- for crankcase breather system at cylinder head cover.
- Watch out for O-ring when removing.
- Unscrew nuts for cylinder head cover -arrows-.
- Remove reinforcing strips and cylinder head cover.



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



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1.5 Installing cylinder head

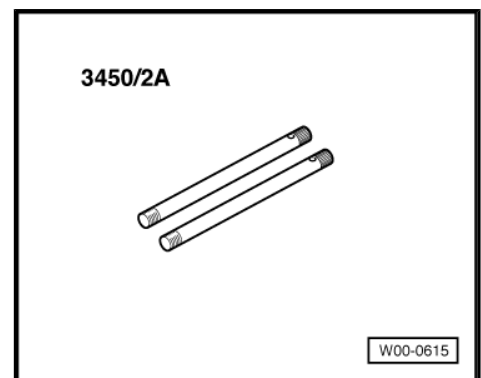


Note!

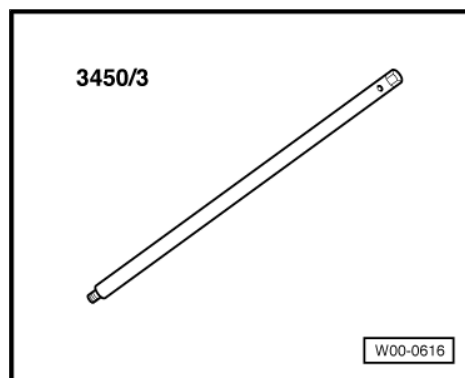
- ◆ *Renew the cylinder head bolts.*
- ◆ *On assembly, renew oil seals and gaskets as well as self-locking nuts and bolts that are tightened by turning through to a specified angle.*
- ◆ *If repairing, carefully remove any remaining gasket material from the cylinder head and cylinder block. Ensure that 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 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.*
- ◆ *No oil or coolant must be allowed to remain in the blind holes for the cylinder head bolts in the cylinder block.*
- ◆ *When installing an exchange cylinder head with fitted camshaft, the contact surfaces between bucket tappets and cams must be oiled after installing the head.*
- ◆ *The plastic protectors fitted to protect the open valves must only be removed immediately before fitting the cylinder head.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) → Parts catalogue.*
- ◆ *When fitting a new cylinder head or cylinder head gasket, drain off all the old coolant and refill with new coolant.*

Special tools and workshop equipment required

- ◆ Guide pin -3450/2A-

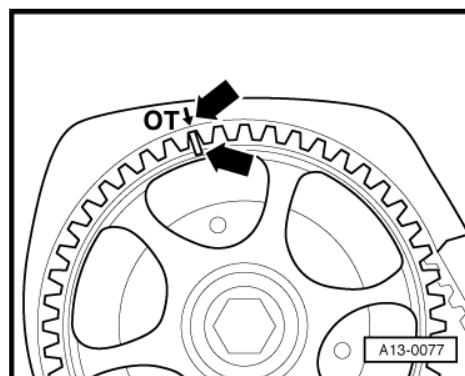


- ◆ Fitting tool -3450/3-



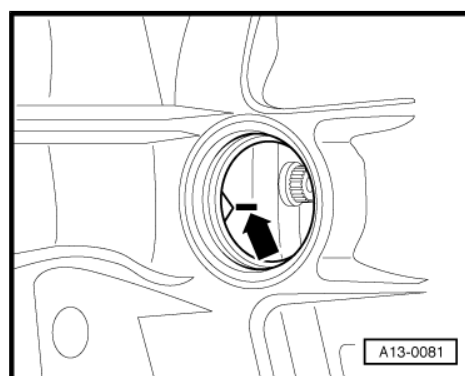
1.5.1 Installing

- Set camshaft to TDC for No. 1 cylinder before fitting cylinder head -arrows-.
- The cams for cylinder 1 must point upwards evenly on camshaft.

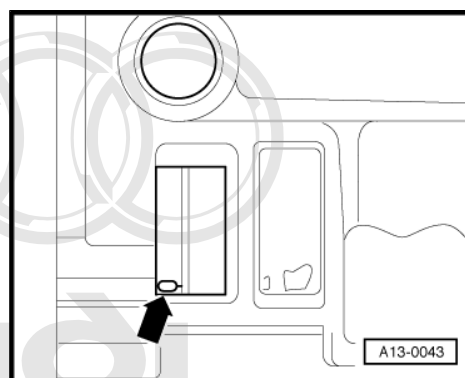


- Check again to see whether crankshaft is at TDC for No. 1 cylinder:

- Vehicles with manual gearbox



- Vehicles with automatic gearbox



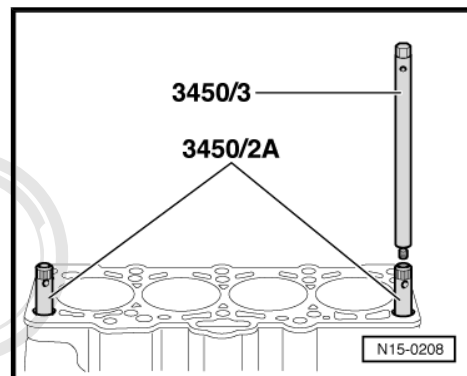
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- To centralise, screw guide pins -3450/2A- into outer holes on inlet side using fitting tool -3450/3- .



Note!

- ◆ *The maximum permissible diameter for the centralising holes in the cylinder head was restricted in the upper section.*
- ◆ *Therefore, before fitting the cylinder head check to be sure that the guide pins can be removed upwards. If necessary, grind down the knurled surface of the guide pins slightly.*



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

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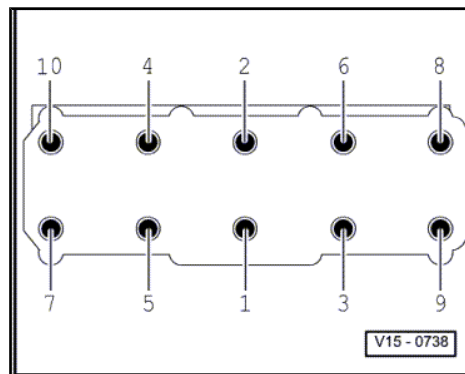
- Tighten cylinder head in 3 stages in the sequence shown:

Stage	Tightening
1	– Tighten with torque wrench to 40 Nm.
2	– Turn 90° (1/4 turn) further using a rigid wrench.
3	– Turn 90° (1/4 turn) further using a rigid wrench.



Note!

Re-tightening of cylinder head bolts is not necessary on completion of repair work.



- Install cylinder head cover ⇒ [page 82](#) .
- Fit toothed belt (adjust valve timing) ⇒ [page 52](#) .
- Install intake manifold ⇒ [page 96](#) / top section of intake manifold ⇒ [page 99](#) .

Vehicles with throttle cable:

- Adjust throttle cable ⇒ Fuel supply system - petrol engines; Rep. Gr. 20 .

All models:

- Check oil level ⇒ [page 138](#) .



Note!

If engine oil is contaminated, perform oil change ⇒ Maintenance ; Booklet 45 .

- Align exhaust system free of stress ⇒ [page 183](#) .
- Fill cooling system ⇒ [page 143](#) .



Note!

- ◆ When the battery is reconnected, please ensure that the vehicle equipment (e.g. radio, radio/navigation system, clock, electric window lifters) is activated as described in the operating instructions.
- ◆ Further procedures after reconnecting the voltage supply ⇒ Simos injection and ignition system (4-cyl.); Rep. Gr. 24 .

1.5.2 Tightening torques

Component	Nm
Catalytic converter to exhaust manifold	30 ^{20) 21)}
Front exhaust pipe to exhaust manifold	30 ^{20) 21)}
Gearbox bracket for exhaust system to front exhaust pipe	25
Connecting pipe for secondary air system to cylinder block	20
Connecting pipe for exhaust gas recirculation to connection flange	25
Lifting eye to cylinder head	20

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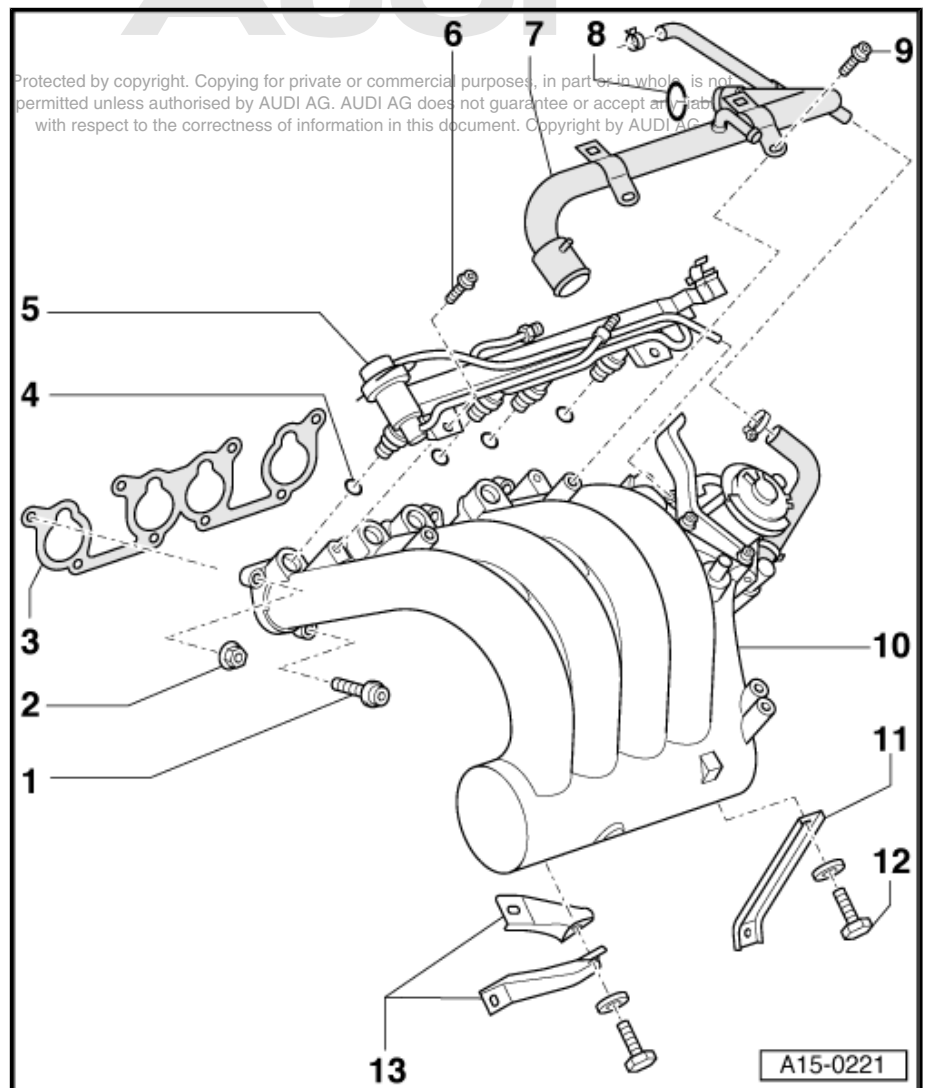
Component	Nm
Earth cable to cylinder head	10

20) Renew self-locking nuts.

21) Coat exhaust manifold studs with high-temperature lubricant; for high-temperature lubricant refer to ⇒ Parts catalogue .

1.6 Intake manifold (engine code letters AHL, ARM) - exploded view of components

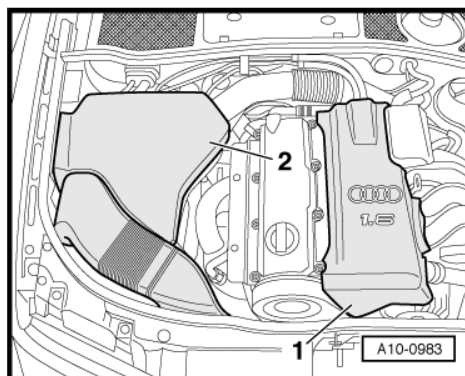
- 1 - 20 Nm
- 2 - 20 Nm
- 3 - Gasket
 - ☐ Renew
- 4 - O-ring
 - ☐ For injector
 - ☐ Renew
- 5 - Fuel rail
 - ☐ With injectors
- 6 - 10 Nm
- 7 - Coolant pipe (top)
- 8 - O-ring
 - ☐ For coolant pipe (top)
 - ☐ Renew
- 9 - 10 Nm
- 10 - Intake manifold
 - ☐ Removing and installing
⇒ [page 96](#)
- 11 - Bracket
 - ☐ For intake manifold
- 12 - 20 Nm
- 13 - Bracket
 - ☐ For intake manifold



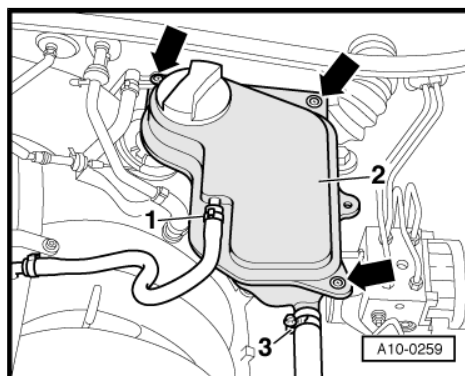
1.7 Removing and installing intake manifold - vehicles with engine code letters AHL, ARM

1.7.1 Removing

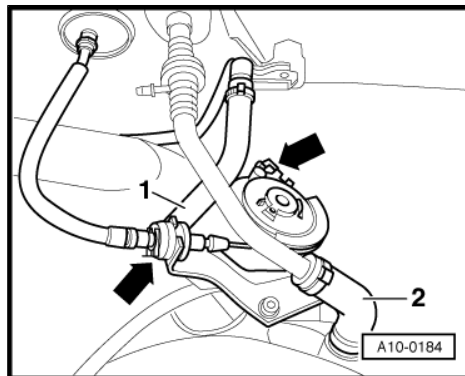
- Remove engine cover panel -1-.
- Remove air cleaner cover -2-.



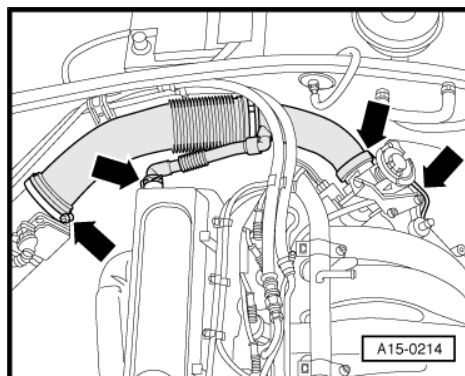
- Drain off coolant ⇒ [page 143](#).
- Detach coolant hoses -1- and -3-.
- Unbolt coolant expansion tank -2- -arrows-.
- Disconnect electrical wiring for coolant shortage indicator switch -F66- at coolant expansion tank (bottom).



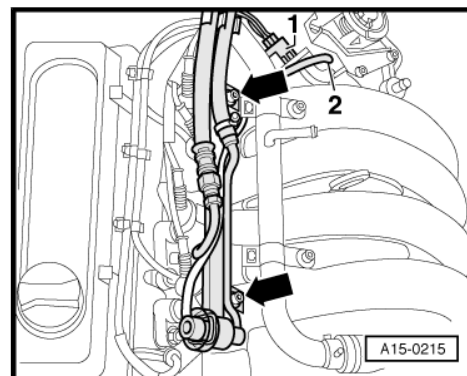
- Detach throttle cable from throttle valve module -J338- and from support bracket -arrows- (do not remove retainer).
- Detach hose -1- leading to solenoid valve 1 for activated charcoal filter system -N80-.
- Detach vacuum hose -2- going to brake servo at intake manifold.



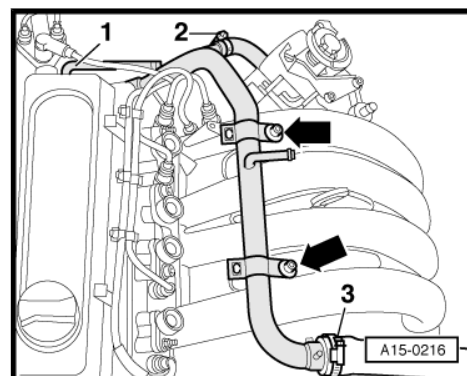
- Detach air intake hose and crankcase breather hose -arrows-.
- Detach coolant hoses at throttle valve module -J338-.
- Unplug electrical connector at intake air temperature sender -G42-.



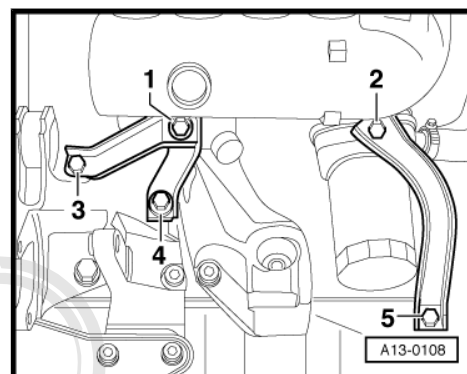
- Unplug electrical connector -1- at throttle valve module - J338- .
- Detach vacuum pipe -2- going to fuel pressure regulator.
- Unplug electrical connector for Hall sender -G40- .
- Unscrew securing bolts for fuel rail -arrows-.
- Pull fuel rail off intake manifold together with injectors and set it down on a clean cloth at rear of engine compartment.



- Disconnect coolant hoses -1 ... 3-.
- Unscrew coolant pipe (top) -arrows-.



- Loosen bracket for intake manifold (front and rear) at bottom bolt connections -3-, -4- and -5-.
- Unscrew bolts -1- and -2- for bracket for intake manifold.
- Pull out oil dipstick.
- Unscrew bolts and nuts for intake manifold/cylinder head and remove intake manifold.



Note!

Seal intake ports in cylinder head with clean cloths.

1.7.2 Installing

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



Note!

Renew seals and gaskets.

- Adjust throttle cable => Fuel supply system - petrol engines; Rep. Gr. 20 .

- Fill cooling system => [page 143](#) .

1.7.3 Tightening torques

Component	Nm
Intake manifold support to intake manifold	20
Support for intake manifold to engine	20
Fuel rail to intake manifold	10
Coolant pipe (top) to intake manifold	10

1.8 Intake manifold (engine code letters ANA) - exploded view of components

1 - Top section of intake manifold

- ☐ Removing and installing
⇒ [page 99](#)

2 - Connecting hose

- ☐ Renew if damaged

3 - 20 Nm

4 - 20 Nm

5 - Seal

- ☐ Renew

6 - Bottom section of intake manifold

- ☐ Removing and installing
⇒ [page 101](#)

7 - Fuel rail

- ☐ With injectors

8 - 10 Nm

9 - O-ring

- ☐ Renew

10 - 10 Nm

11 - Coolant pipe (top)

12 - Throttle valve connection

13 - 10 Nm

14 - Seal

- ☐ Renew if damaged

15 - 20 Nm

16 - Bonded rubber bush

17 - Support for top section of intake manifold

18 - 20 Nm

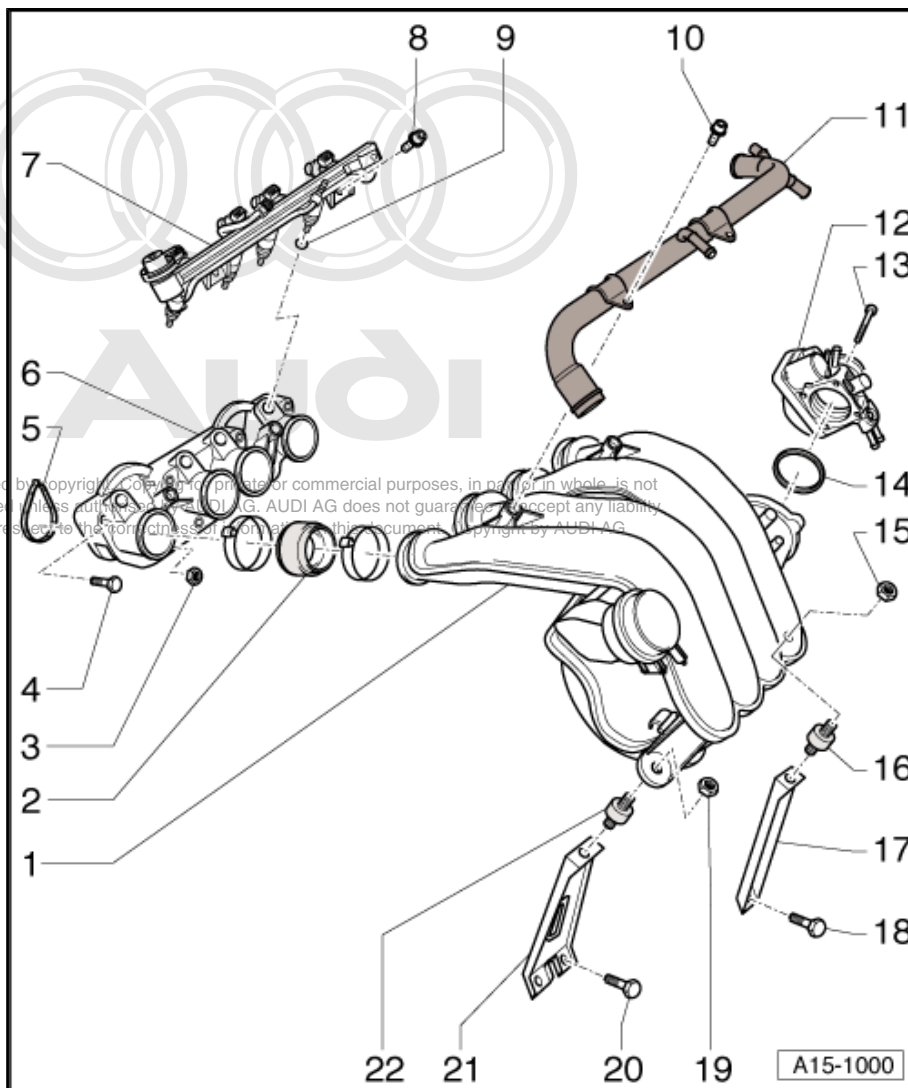
19 - 20 Nm

20 - 20 Nm

21 - Support

- ☐ For top section of intake manifold

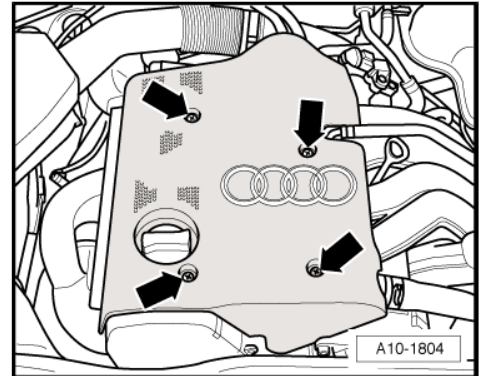
22 - Bonded rubber bush



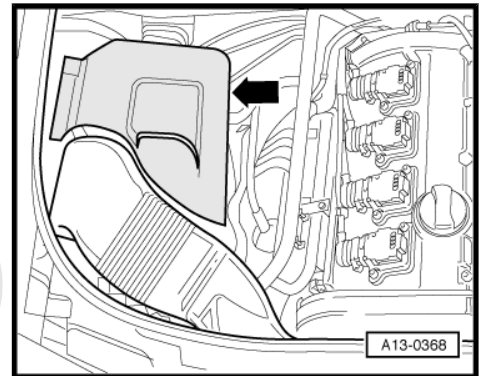
1.9 Removing and installing intake manifold (top section) - vehicles with engine code letters ANA

1.9.1 Removing

- Take off engine cover panel -arrows-.

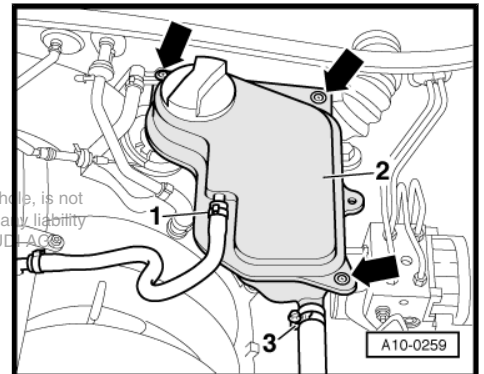


- Detach air cleaner cover -arrow-.

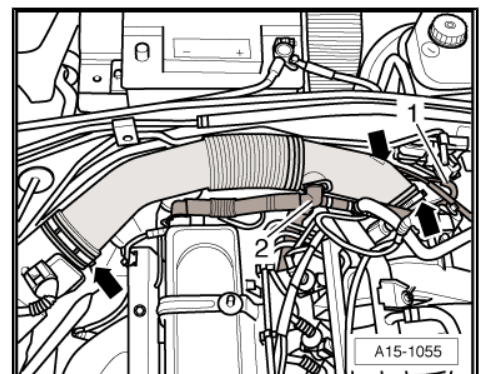


- Drain off coolant ⇒ [page 143](#).
- Detach coolant hoses -1- and -3-.
- Unbolt coolant expansion tank -2- -arrows-.
- Disconnect electrical wiring for coolant shortage indicator switch -F66- at coolant expansion tank (bottom).

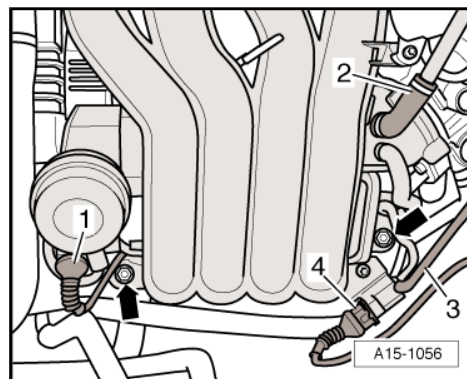
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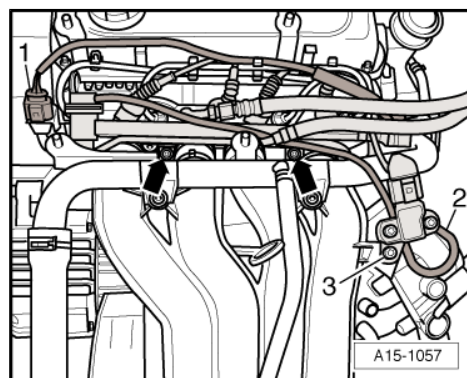
- Detach hose -2- for crankcase breather system at air pipe.
- Watch out for O-ring when removing.
- Detach vacuum hose -1-.
- Remove air pipe -arrows-.



- Detach vacuum hose -2- going to brake servo at intake manifold.
- Detach vacuum hose -3-.
- Unplug electrical connectors -1- and -4-.
- Unscrew nuts -arrows-.



- Unplug electrical connector -1- at Hall sender -G40-.
- Detach vacuum hose -2-.
- Unscrew bolt -3-.
- Unscrew securing bolts for fuel rail -arrows-.
- Pull fuel rail off intake manifold together with injectors and set it down on a clean cloth at rear of engine compartment.

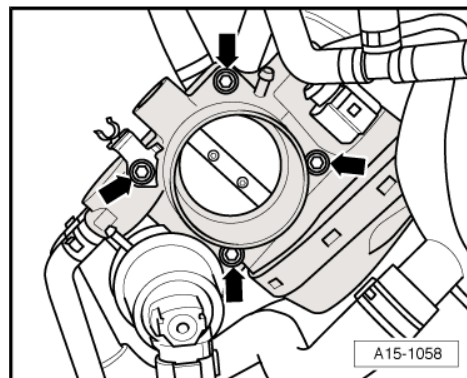


- Unbolt throttle valve housing at intake manifold -arrows-.

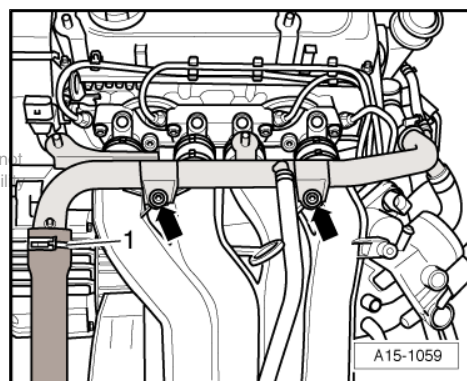


Note!

Illustration shows engine removed.



- Detach coolant hose -1- from coolant pipe.
- Unscrew coolant pipe (top) -arrows-.

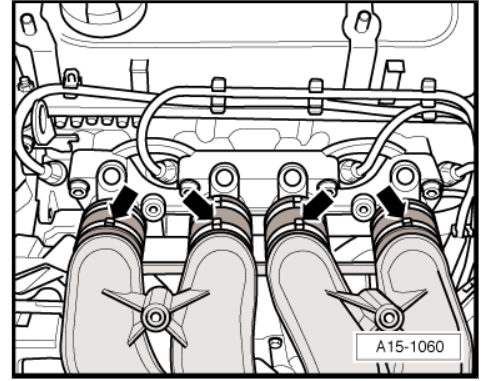


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- Loosen the clips at the connection -arrows-.
- Pull out oil dipstick.
- Remove top section of intake manifold.

i Note!

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



1.9.2 Installing

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

i Note!

Renew seals and gaskets.

- Insert top section of intake manifold into connecting hoses and secure with hose clips -arrows-.
- Fill cooling system ➔ [page 143](#) .

1.9.3 Tightening torques

Component	Nm
Intake manifold (top section) to support	20
Support for intake manifold (top section) to engine	20
Fuel rail to intake manifold (top section)	10
Coolant pipe to intake manifold (top section)	10
Throttle valve housing to intake manifold (top section)	10

1.10 Removing and installing intake manifold (bottom section) - vehicles with engine code letters ANA

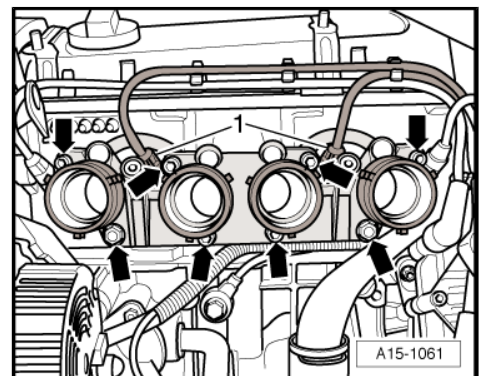
1.10.1 Removing

- Remove top section of intake manifold ➔ [page 99](#) .
- Unplug spark plug connectors -1- for cylinders 2 and 3.
- Unscrew bolts and nuts -arrows- and remove bottom section of intake manifold.

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i Note!

Seal intake ports in cylinder head with clean cloths.



1.10.2 Installing

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



Note!

Renew seals and gaskets.

- Install top section of intake manifold ⇒ [page 99](#) .

1.10.3 Tightening torque

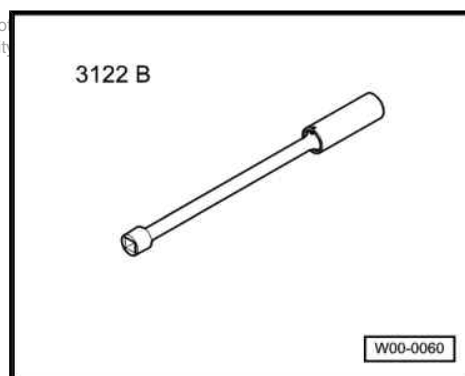
Component	Nm
Bottom section of intake manifold to cylinder head	20

1.11 Checking compression

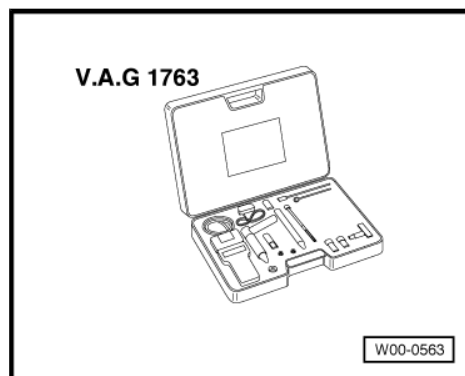
Special tools and workshop equipment required

- ◆ Spark plug socket and extension -3122 B-

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- ◆ Compression tester -V.A.G 1763-



1.11.1 Test requirements

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

1.11.2 Test sequence

- Switch off ignition.
- Open lid of fuse box at left side of instrument panel.

- Pull out fuse No. S228 in fuse carrier (position -28-; left row, 5th large fuse from the top).

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- Take off engine cover panel -arrows-.



Note!

Illustration shows vehicle with engine code letters ANA.

All models:

- Detach spark plug connectors.
- Remove spark plugs with spark plug socket -3122 B- .
- Open throttle valve fully.
- Check compression pressure with compression tester -V.A.G 1763- .



Note!

Using the compression tester ⇒ operating instructions .

- Operate starter until pressure reading on tester no longer rises.

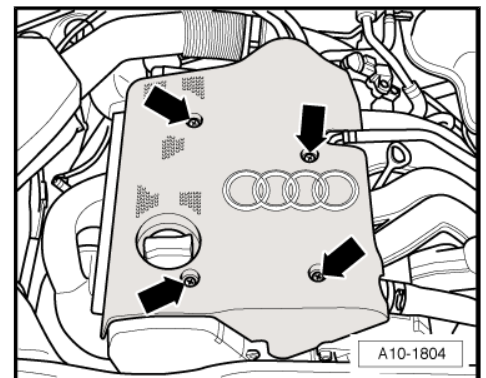
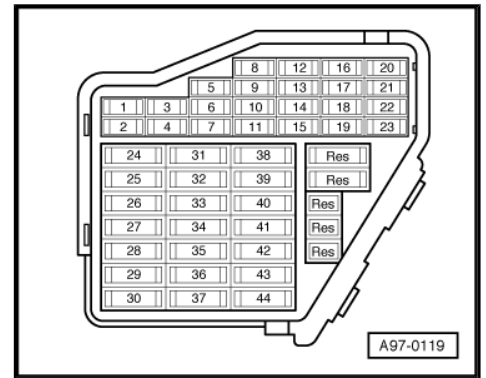
Compression pressure:

New pressure in bar	Wear limit bar	Permissible difference between cylinders bar
10.0 ... 13.0	7.0	3.0 (maximum)

- Install spark plugs.
- Finally, interrogate and erase the engine control unit fault memory, as faults are stored when the fuses are removed ⇒ Simos injection and ignition system (4-cyl.); Rep. Gr. 01 .

1.11.3 Tightening torque

Component	Nm
Spark plugs in cylinder head	30



2 Servicing valve gear



Note!

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

2.1 Exploded view of components

1 - 100 Nm

- ☐ Use counterhold -3415- to loosen and tighten
⇒ [page 46](#)

2 - Camshaft sprocket

- ☐ With sender wheel for Hall sender -G40-
- ☐ For removal and installation, remove toothed belt from camshaft sprocket ⇒ [page 51](#)
- ☐ Installation position fixed by Woodruff key
⇒ [Item 4 \(page 104\)](#)

3 - Oil seal

- ☐ Renew ⇒ [page 106](#)

4 - Woodruff key

- ☐ Check for firm attachment

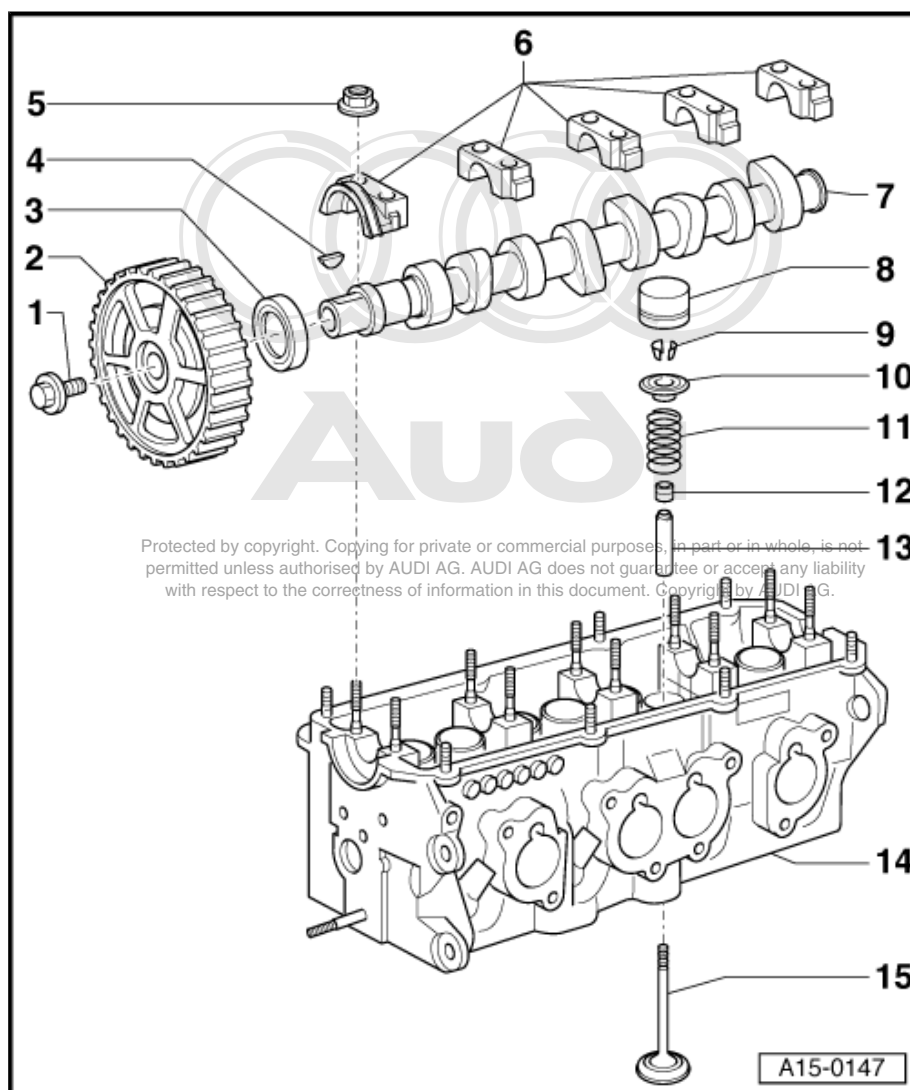
5 - 20 Nm

6 - Bearing cap

- ☐ Installation position
⇒ [page 106](#)
- ☐ Installation sequence ⇒
Installing camshaft,
Page ⇒ [page 111](#)

7 - Camshaft

- ☐ Check radial clearance with Plastigage (bucket tappet removed)
- ☐ Wear limit (radial clearance): 0.1 mm
- ☐ Runout: max. 0.01 mm
- ☐ Checking axial clearance ⇒ [page 106](#)



- ☐ Removing and installing ⇒ [page 110](#)

8 - Hydraulic bucket tappets

- ☐ Checking ⇒ [page 112](#)
- ☐ Removing and installing with cylinder head installed ⇒ [page 113](#)
- ☐ Removing and installing with cylinder head removed using 2037
- ☐ Do not interchange
- ☐ Place down with contact surface facing downwards
- ☐ Check axial clearance of camshaft before installing ⇒ [page 106](#)
- ☐ Lubricate contact surface

9 - Valve cotters

10 - Valve spring plate

11 - Valve springs

- ☐ Removing and installing with cylinder head installed ⇒ [page 113](#)
- ☐ Remove and install with cylinder head removed using valve spring compressor -2037-

12 - Valve stem oil seal

- ☐ Renew ⇒ [page 113](#)

13 - Valve guide

- ☐ Checking ⇒ [page 116](#)
- ☐ Renew ⇒ [page 117](#)
- ☐ Valve guide with collar (repair version)

14 - Cylinder head

- ☐ See note ⇒ [page 104](#)
- ☐ Checking valve guides ⇒ [page 116](#)
- ☐ Machining valve seats ⇒ [page 119](#)

15 - Valve

- ☐ Do not machine, only grinding-in is permitted
- ☐ Removing and installing with cylinder head removed using 2037
- ☐ Valve dimensions ⇒ [page 105](#)
- ☐ Checking valve guides ⇒ [page 116](#)
- ☐ Machining valve seats ⇒ [page 119](#)

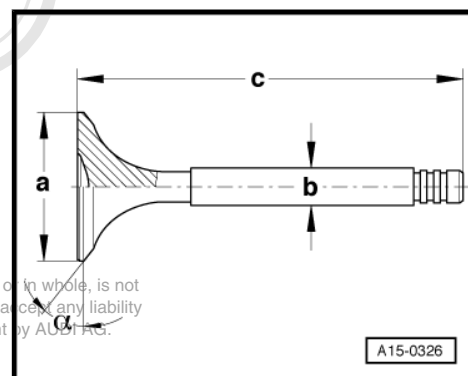
Valve dimensions



Note!

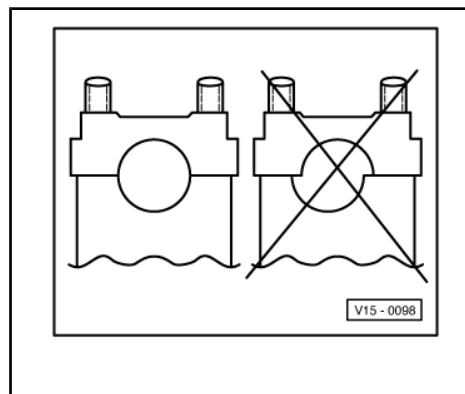
Inlet and exhaust valves must not be machined. Only grinding-in is permitted.

Dimension		Inlet valve	Exhaust valve
Ø a	mm	39.5 ± 0.15	32.9 ± 0.15
Ø b	mm	6.92 ± 0.02	6.92 ± 0.02
c	mm	91.85	91.15
α	°	45	45



Installation position of camshaft bearing caps

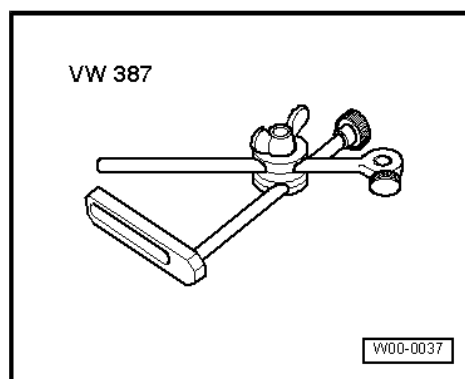
Ensure correct positioning. Before installing camshaft, fit bearing caps and determine correct position for installation.



2.2 Checking axial clearance of camshaft

Special tools and workshop equipment required

- ◆ Universal dial gauge bracket -VW 387-

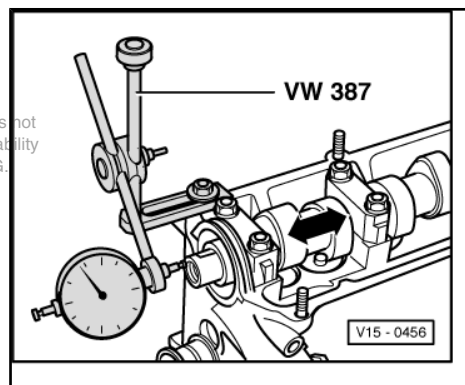


- ◆ Dial gauge

2.2.1 Test sequence

- Measure with bucket tappets removed and with first and last bearing caps fitted.
- Secure universal dial gauge bracket -VW 387- with dial gauge to cylinder head.
- Determine axial clearance.
- Wear limit (axial clearance): 0.15 mm

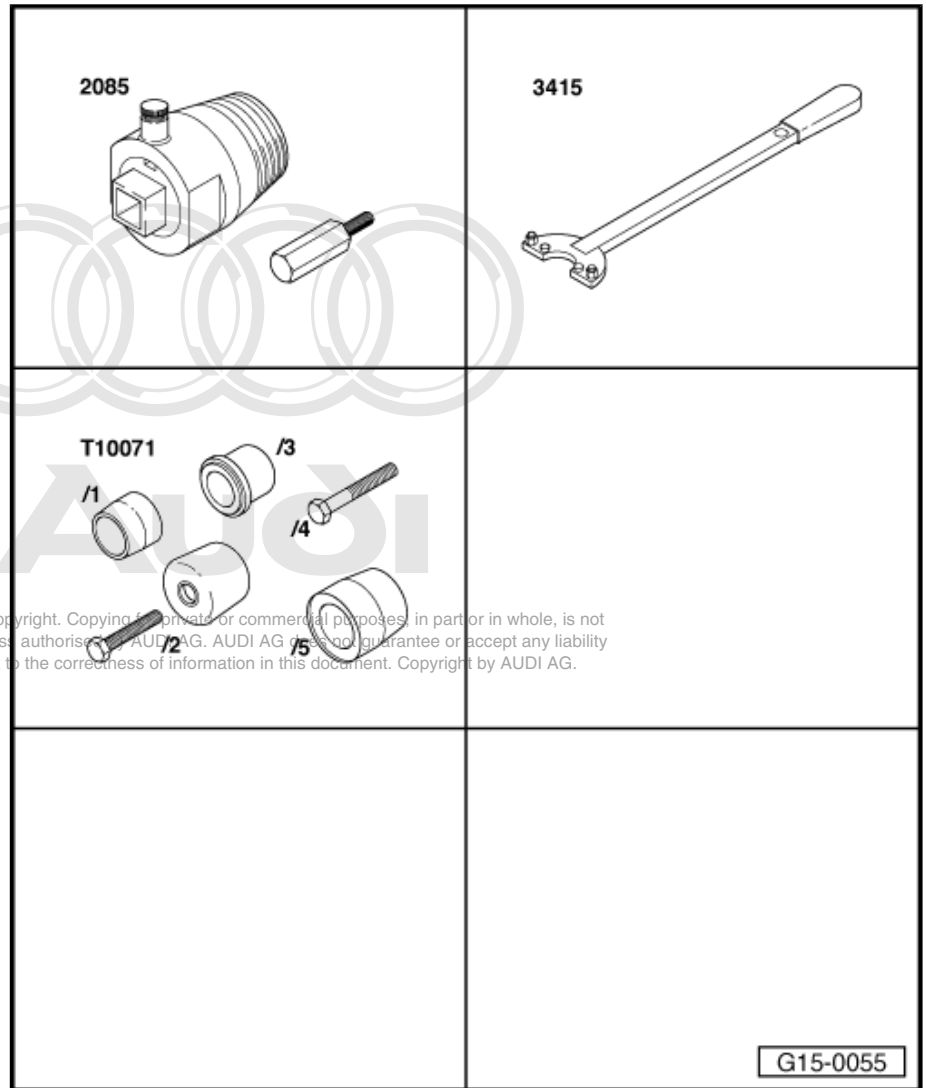
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2.3 Renewing camshaft oil seal

Special tools and workshop equipment required

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



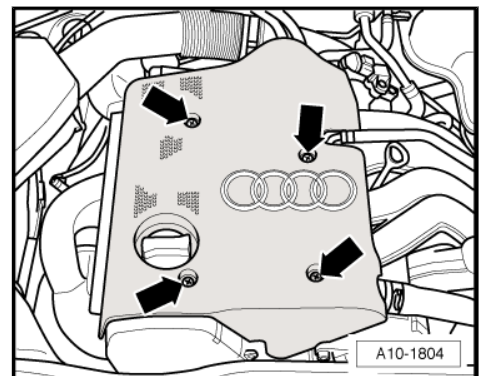
2.3.1 Removing

- Cylinder head installed
- Take off engine cover panel -arrows-.

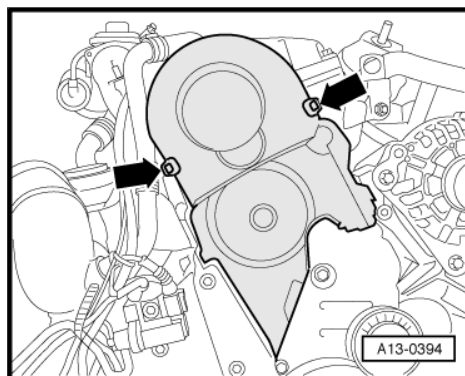


Note!

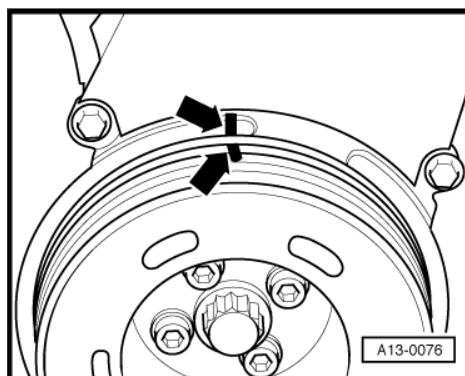
Illustration shows vehicle with engine code letters ANA.



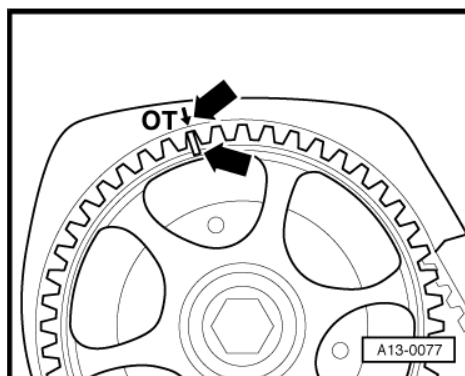
- Remove toothed belt guard (top) -arrows-.



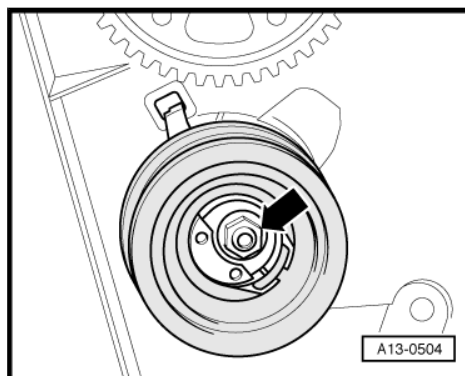
- Set crankshaft to markings for TDC of No. 1 cylinder -arrows- by turning central bolt on crankshaft sprocket in direction of rotation.



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



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

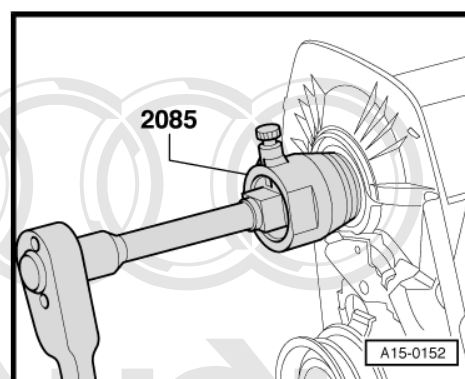
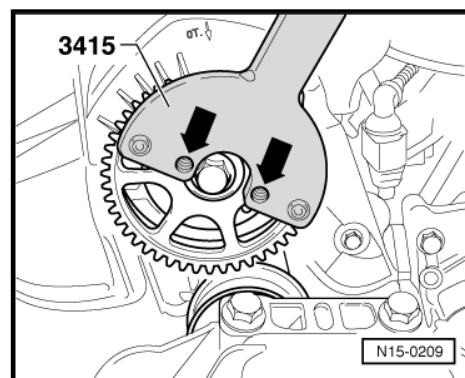


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 Note!

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

- Loosen camshaft sprocket using counterhold -3415-.
- Detach camshaft sprocket.
- Remove parallel key from camshaft.
- To guide oil seal extractor, screw securing bolt for camshaft sprocket into camshaft as far as the stop by hand.
- Adjust 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, while exerting firm pressure, screw it into oil seal as far as possible.
- 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.



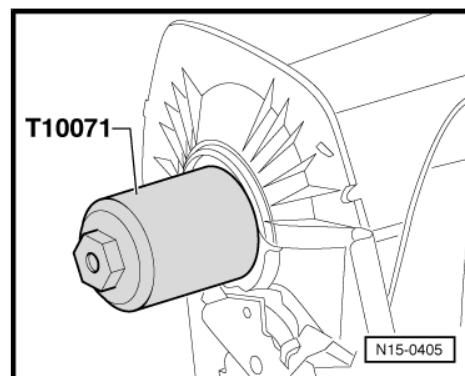
2.3.2 Installing

 Note!

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Do not lubricate sealing lip of oil seal.

- Position oil seal with guide sleeve -T10071/1- and press in as far as the stop using press sleeve -T10071- and bolt -T10071/2-.
- Remove guide sleeve.
- Insert parallel key into camshaft.

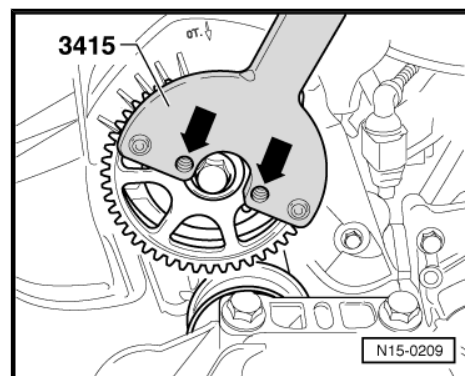


- Tighten camshaft sprocket using counterhold -3415-.

 Note!

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

- Fit toothed belt (adjust valve timing) ⇒ [page 52](#).



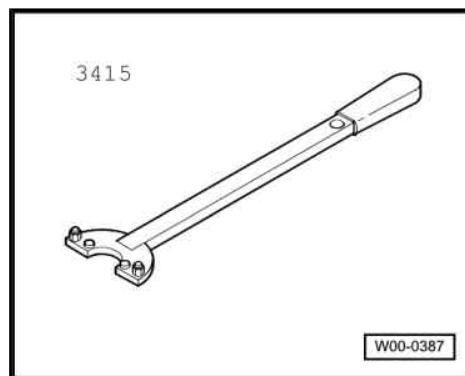
2.3.3 Tightening torque

Component	Nm
Camshaft sprocket to camshaft	100

2.4 Removing and installing camshaft

Special tools and workshop equipment required

- ◆ Counterhold -3415-



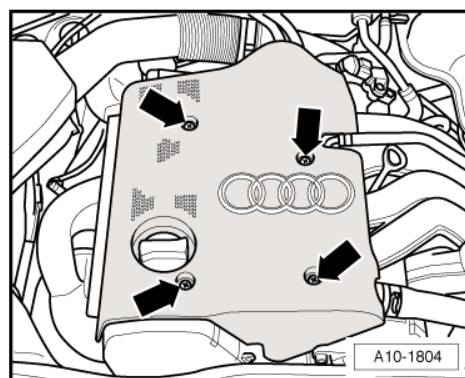
2.4.1 Removing

- Cylinder head installed
- Take off engine cover panel -arrows-.

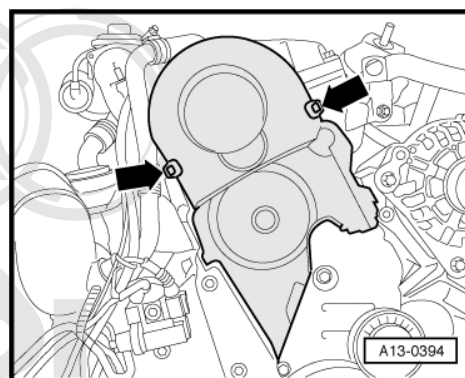


Note!

Illustration shows vehicle with engine code letters ANA.



- Remove toothed belt guard (top) -arrows-.



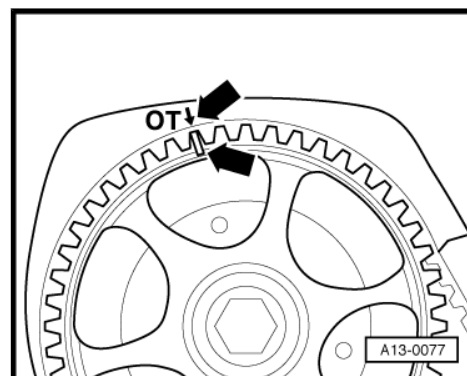
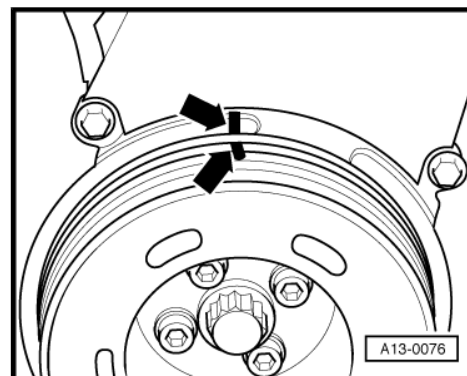
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- Set crankshaft to markings for TDC of No. 1 cylinder -arrows- by turning central bolt on crankshaft sprocket in direction of rotation.

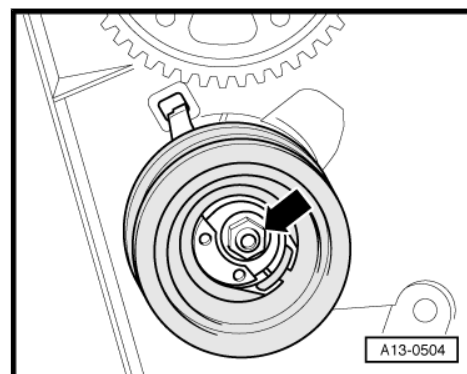


- At the same time the marking on front of camshaft sprocket must align with the marking on the rear toothed belt guard -arrows-. If necessary, turn crankshaft 1 turn further.

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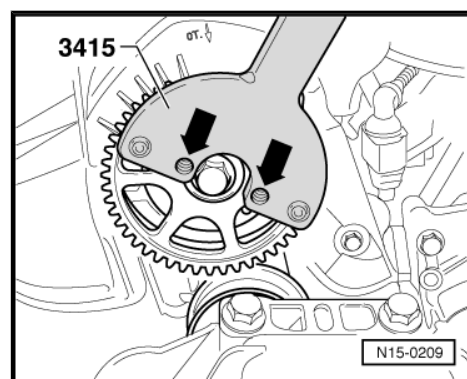
- Loosen tensioning roller nut -arrow- several turns.
- Remove toothed belt from camshaft sprocket.



Note!

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

- Loosen camshaft sprocket using counterhold -3415-.
- Detach camshaft sprocket.
- Remove parallel key from camshaft.
- Remove cylinder head cover ⇒ [page 82](#).
- Remove oil deflector.
- Unscrew nuts from bearing caps 1, 3 and 5. Then slacken bearing caps 2 and 4 alternately in diagonal sequence.
- Remove camshaft.



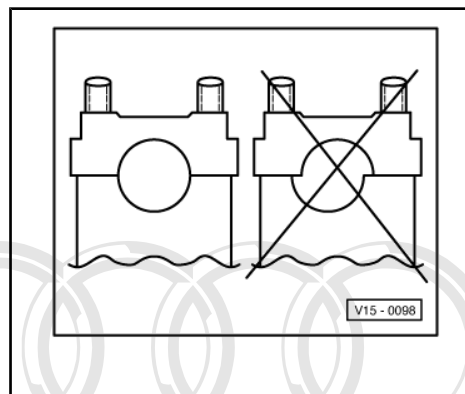
2.4.2 Installing

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



Note!

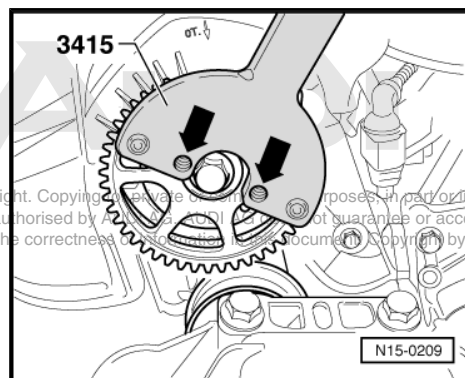
- ◆ *Renew camshaft oil seal.*
- ◆ *Before installing, fit bearing caps and determine correct position for installation; make sure they are not offset.*
- Lubricate running surfaces of the camshaft.
- Tighten bearing caps 2 and 4 alternately in diagonal sequence to 20 Nm.
- Fit bearing caps 5, 1 and 3 and tighten to 20 Nm.
- Insert parallel key into camshaft.
- Tighten camshaft sprocket using counterhold -3415- .
- Install cylinder head cover ⇒ [page 82](#) .



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 52](#) .



Note!

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

2.4.3 Tightening torques

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

2.5 Checking hydraulic bucket tappets

Special tools and workshop equipment required

- ◆ Feeler gauge
- ◆ Wood or plastic wedge



Note!

- ◆ *Hydraulic bucket tappets cannot be serviced.*
- ◆ *Irregular valve noise during starting is normal.*

2.5.1 Test sequence

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

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

 Note!

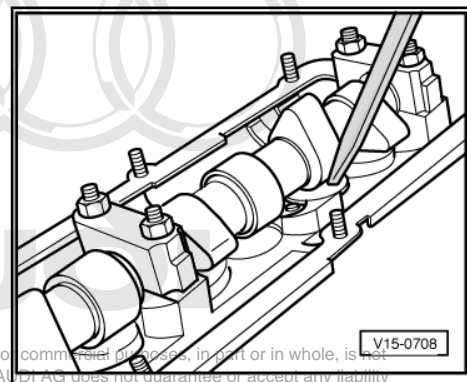
If the irregular valve noises stop but recur repeatedly on short trips, a new oil retention valve must be fitted. The oil retention valve is located in the oil filter bracket ➔ [Item 6 \(page 125\)](#).

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

- Remove cylinder head cover ➔ [page 82](#).
- Turn crankshaft until cams of bucket tappets to be tested are at top:
- Vehicles with manual gearbox: push vehicle forwards with 4th gear engaged and ignition switched off.
- Vehicles with automatic gearbox: remove noise insulation.
- Turn crankshaft clockwise at central bolt for crankshaft toothed belt sprocket.
- Measure clearance between cam and bucket tappet.
- Use a wooden or plastic wedge to push down bucket tappet. If a 0.20 mm feeler gauge can be inserted between camshaft and tappet, renew tappet.
- To renew bucket tappet, see “Removing and installing camshaft” ➔ [page 110](#).

 Note!

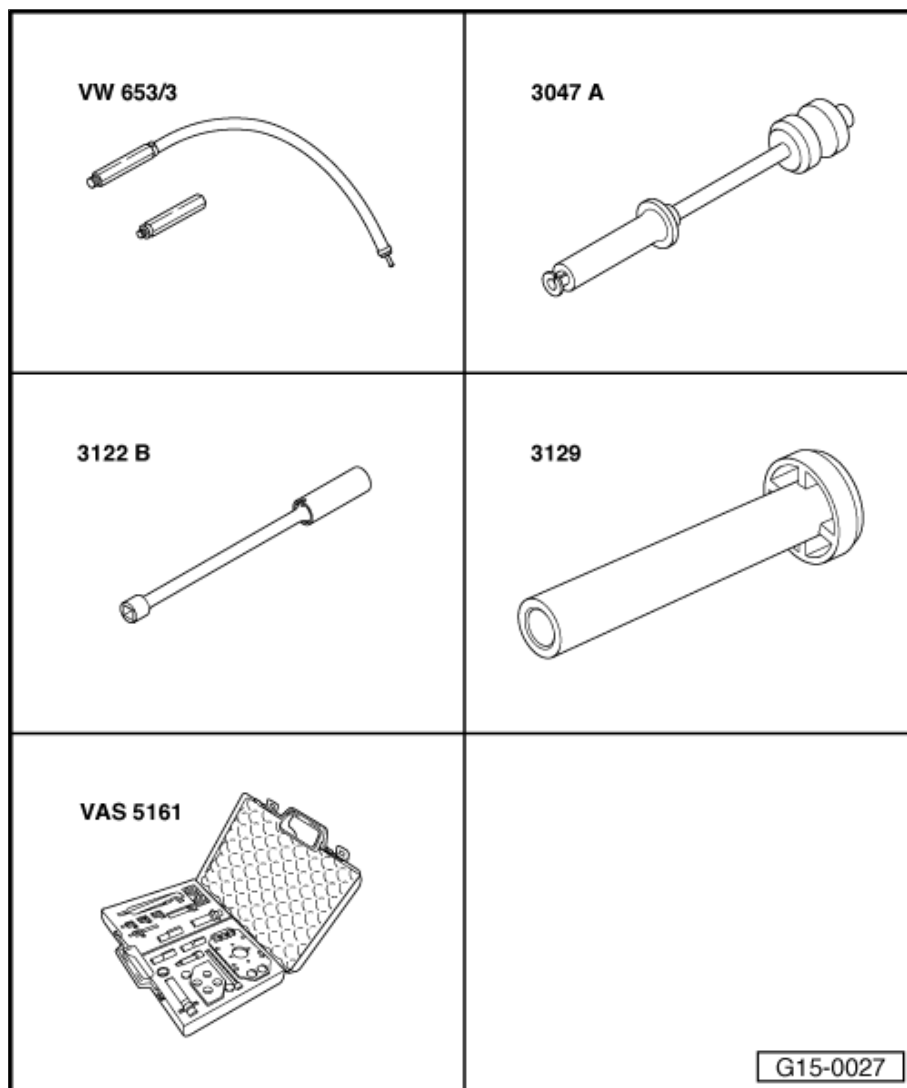
- ◆ *After installing the camshaft, wait for about 30 minutes before starting the engine. Hydraulic valve compensation elements have to settle (otherwise valves will strike pistons).*
- ◆ *After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves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



2.6 Renewing valve stem oil seals

Special tools and workshop equipment required

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



2.6.1 Removing

- Cylinder head installed.



Note!

If cylinder head is removed, the valve stem oil seals can be renewed using valve spring compressor -2037-.

- Remove the camshaft ⇒ [page 110](#) .



Note!

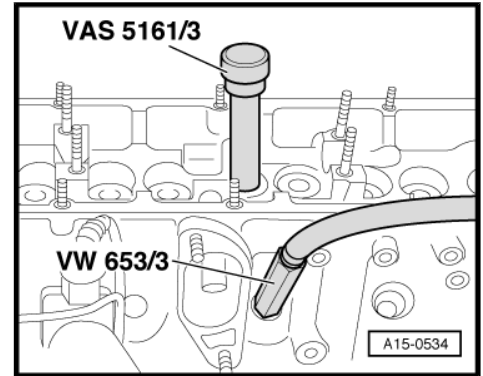
- ◆ *Take care not to interchange bucket tappets.*
- ◆ *Use waterproof felt-tip pen to mark assignment of bucket tappets on back.*

- Take bucket tappets out of guides and set them down with running surface facing downwards.
- Remove spark plugs with spark plug socket -3122 B- .
- Set piston of the respective cylinder to “bottom dead centre”.

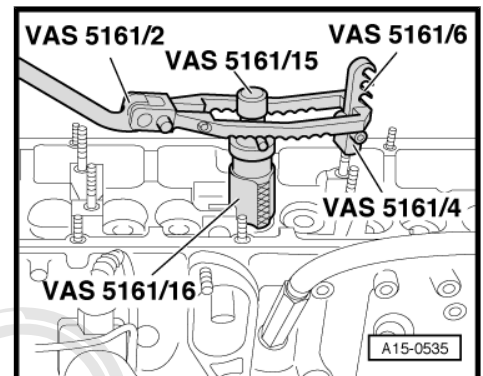


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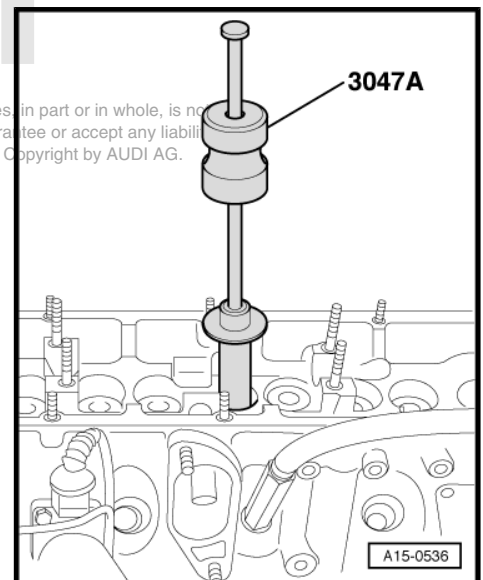
- Screw pressure hose -VW 653/3- into spark plug hole and apply steady pressure: at least 6 bar.
- Knock loose sticking valve cotters on all valves using punch -VAS 5161/3- and a plastic hammer.



- Screw snap-in device -VAS 5161/6- with interlocking fork -VAS 5161/4- onto stud on cylinder head.
- Push guide bush -VAS 5161/16- into bucket tappet guide of the valve to be removed until stop.
- Installation position of guide bush: hatched area faces direction of travel.
- Insert assembly cartridge -VAS 5161/15- into guide bush.
- Attach pressure fork -VAS 5161/2- to snap-in device -VAS 5161/6- and push assembly cartridge down.
- At the same time, turn knurled screw of assembly cartridge clockwise until ends engage in valve cotters.
- Move knurled screw back and forth slightly; the valve cotters are thus forced apart and enter into cartridge.
- Release the pressure fork.
- Remove assembly cartridge, guide bush, valve head and valve springs.
- Detach valve stem oil seals using puller -3047 A- .



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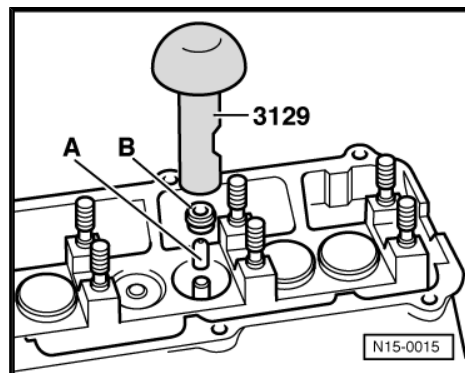
2.6.2 Installing



Note!

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

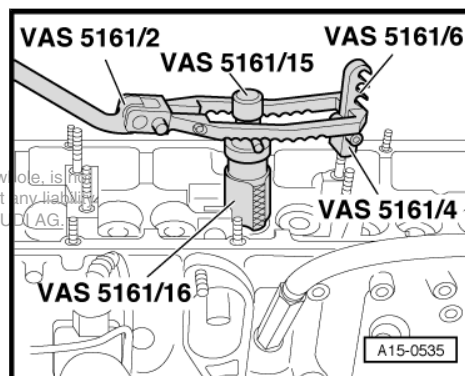
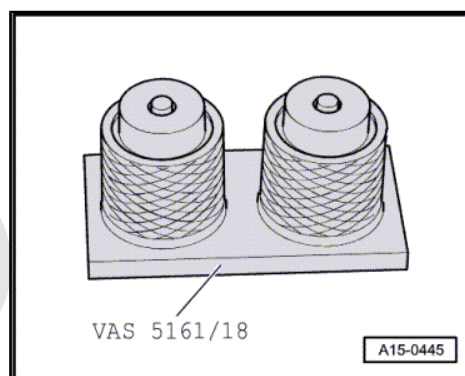
- To prevent damage to the new valve stem seals -B-, attach plastic sleeve -A- to valve stem.
- Lightly oil sealing lip of valve stem seal.
- Slip valve stem oil seal over plastic sleeve.
- Carefully press the valve stem oil seal onto valve guide using fitting tool -3129- .
- Remove plastic sleeve.
- If valve cotter pins have been removed from assembly cartridge, they need to be put into insertion device -VAS 5161/18- first.



Note!

The large diameter of the valve cotter pins points upwards.

- Press assembly cartridge -VAS 5161/15- onto insertion device from above and take up valve cotter pins.
- Reinstall the assembly cartridge -VAS 5161/15- into guide bush -VAS 5161/16- .
- Push pressure fork down and pull knurled screw upwards while turning to left and right - this will insert the valve cotter pins.
- Release the pressure fork with knurled screw still in pulled position.
- Insert bucket tappet.
- Install the camshaft ⇒ [page 111](#) .



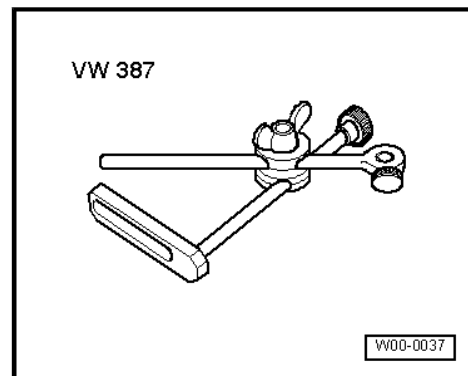
Note!

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

2.7 Checking valve guides

Special tools and workshop equipment required

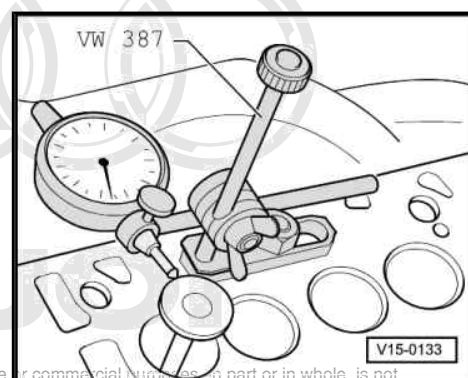
- ◆ Universal dial gauge bracket -VW 387-



- ◆ Dial gauge

2.7.1 Test sequence

- Insert valve into valve guide. End of valve stem must be flush with guide.
- Determine amount of sideways play.



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2.7.2 Wear limit

Intel valve guide	Exhaust valve guide
1.0 mm	1.3 mm



Note!

- ◆ *If the wear limit is exceeded, repeat the measurement with new valves. Renew valve guide if wear limit is still exceeded.*
- ◆ *If the valve has to be renewed as part of a repair, use a new valve for the measurement.*

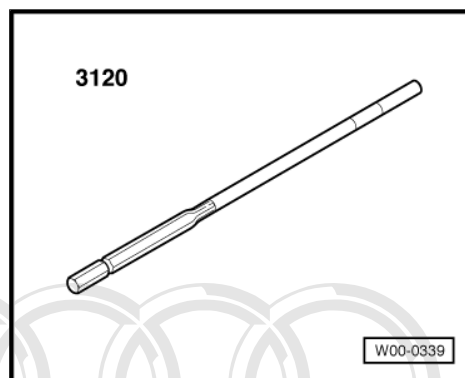
2.8 Checking valves

- Visually inspect for scoring on valve stems and valve seat surfaces. Renew valves if severe scoring is visible.

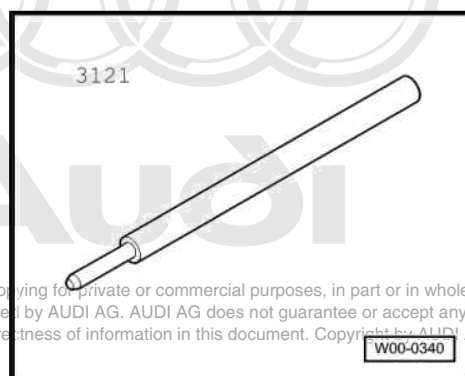
2.9 Renewing valve guides

Special tools and workshop equipment required

◆ Reamer -3120-



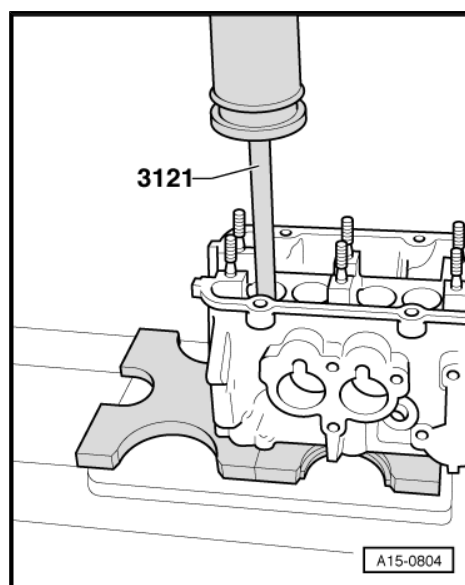
◆ Drift -3121-



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2.9.1 Removing

- Clean and check cylinder head. Cylinder heads with valve seats that can no longer be machined, or cylinder heads which have already been machined to the minimum dimension, are not suitable for renewing the valve guides.
- Use drift -3121- to press out worn valve guides as follows:
 - Valve guides without collar: from the camshaft side
 - Valve guides with collar (repair version): from the combustion chamber side



2.9.2 Installing

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

 Note!

Once valve guide is resting on collar, the pressing-in force must not exceed 10 kN (approx. 1.0 t), as otherwise collar could break off.

- Ream guides with reamer -3120- . Use plenty of cutting fluid.
- Machining valve seats [⇒ page 119](#) .
- Renewing valve stem seals [⇒ page 113](#) .

2.10 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!

- ◆ *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 116](#) .*
- ◆ *Valve seats should only be machined to the extent required to give a proper seating pattern.*
- ◆ *The maximum permissible machining dimension must be calculated before starting work.*
- ◆ *If the maximum machining dimension is exceeded, the hydraulic tappets will not function properly and the cylinder head will have to be renewed.*

2.10.1 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 valve stem end (upper edge) and upper cylinder head surface with a depth gauge.
- Calculate maximum permissible machining dimension based on measured distance and minimum dimension.

Minimum dimension	
Inlet valve	Exhaust valve
33.8 mm	34.1 mm

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

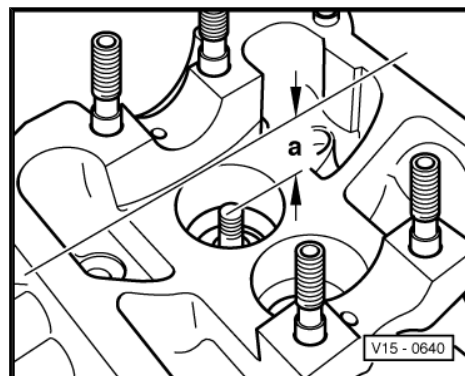
Example for inlet valve (outer):

Measured gap -a-	35.1 mm
- Minimum dimension	-34.1 mm
= Max. permissible machining dimension	= 1.0 mm



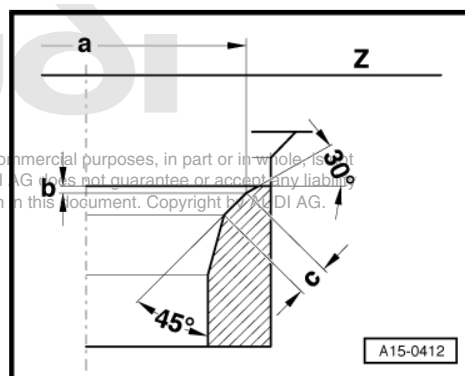
Note!

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.



2.10.2 Machining inlet valve seat

Inlet valve seat	
a	= $\varnothing$ 39.2 mm
b	= Max. permissible machining dimension
c	= approx. 2.0 mm
Z	= Bottom surface of cylinder head
45°	= Valve seat angle
30°	= Upper correction angle

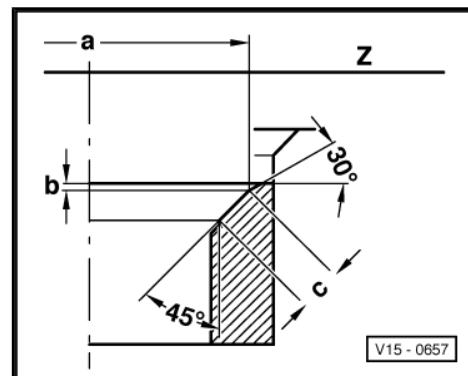


Note!

Calculating maximum permissible machining dimension
⇒ [page 119](#).

2.10.3 Machining exhaust valve seat

Exhaust valve seat	
a	= $\varnothing$ 32.4 mm
b	= Max. permissible machining dimension
c	= approx. 2.4 mm
Z	= Bottom surface of cylinder head
45°	= Valve seat angle
30°	= Upper correction angle



Note!

- ◆ Calculating maximum permissible machining dimension
⇒ [page 119](#).
- ◆ Exhaust valve seat inserts also have an additional constriction. When machining, it is essential to ensure that the radius of the constriction is not damaged.



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17 – Lubrication

1 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 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 124](#)*
- ◆ *Vehicles produced after 05 / 1999 with oil level/oil temperature sender -G266- → [page 124](#) .*

Viscosity grades and oil specifications ⇒ Maintenance ; Booklet 45 .

Oil capacities ⇒ Data sheets for exhaust emission test.

1.1 Lubrication system - exploded view of components

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1.1.1 Exploded view of components - Section 1



Note!

Illustration shows vehicle manufactured before 04 / 1999.

1 - Stop for torque reaction support

- ☐ For vehicles up to 04 / 1999
- ☐ Unbolt to remove oil pump

2 - 40 Nm

- ☐ For vehicles up to 04 / 1999

3 - 25 Nm

4 - Drive chain for oil pump

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

5 - Sealing flange (front)

- ☐ Apply silicone sealant when installing
⇒ [page 60](#)
- ☐ Sealant ⇒ Parts catalogue
- ☐ Renew crankshaft oil seal on pulley end
⇒ [page 59](#)

6 - 15 Nm

7 - Chain tensioner

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

8 - Chain sprocket for oil pump

- ☐ Removing and installing ⇒ [page 72](#)

9 - Dowel sleeves

- ☐ 2 x

10 - 15 Nm

11 - Intake pipe

- ☐ Clean strainer if dirty

12 - O-ring

- ☐ Renew

13 - Baffle plate

14 - 15 Nm

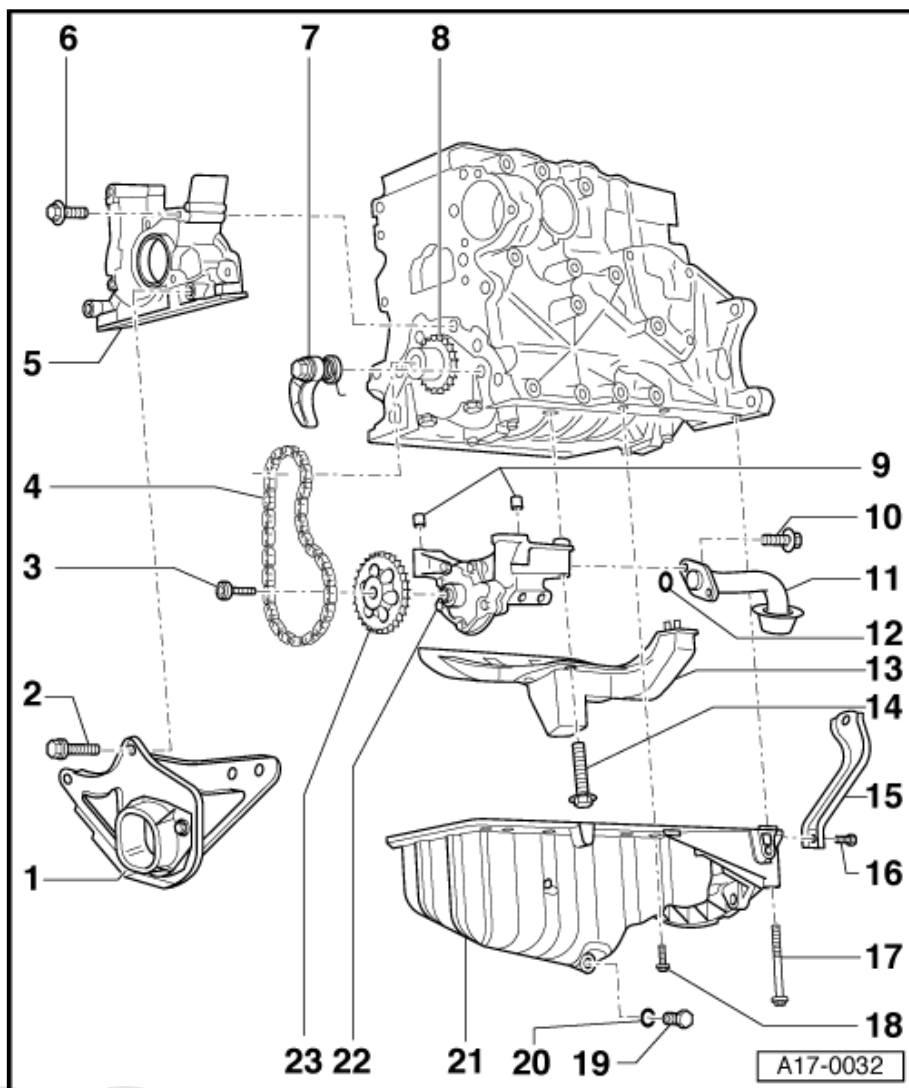
15 - Support for intake manifold

16 - 20 Nm

17 - 45 Nm

18 - 15 Nm

- ☐ Tighten in stages and in diagonal sequence
- ☐ Observe the tightening sequence ⇒ [page 134](#)



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19 - Oil drain plug -30 Nm-

20 - Seal

- ☐ Renew

21 - Sump

- ☐ Removing ⇒ [page 126](#)
- ☐ Installing ⇒ [page 132](#)
- ☐ Install using sealant; sealant ⇒ Parts catalogue
- ☐ On vehicles manufactured after 05 / 1999: with oil level/oil temperature sender -G266- ⇒ [page 124](#)

22 - Oil pump

- ☐ With pressure relief valve (12 bar)
- ☐ Removing and installing ⇒ [page 135](#)
- ☐ Before installing, check that the two dowel sleeves ⇒ [Item 9 \(page 123\)](#) for centring 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

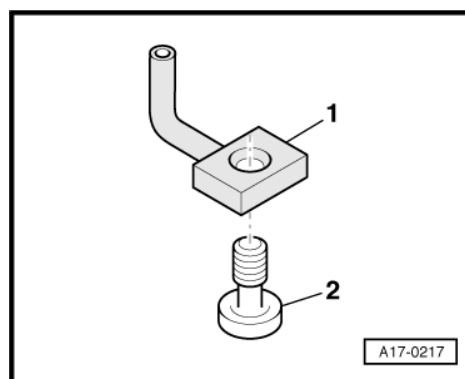
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23 - Chain sprocket for oil pump

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

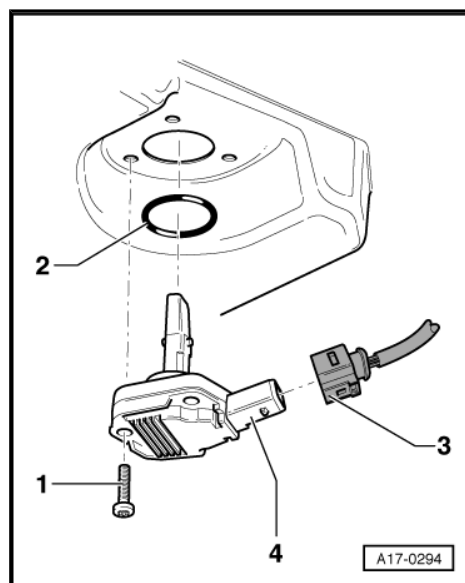
Oil spray jet and pressure relief valve

- 1 - Oil spray jet (for cooling of pistons)
 - 2 - Bolt with pressure relief valve -27 Nm-
- Opening pressure: 1.3 ... 1.6 bar



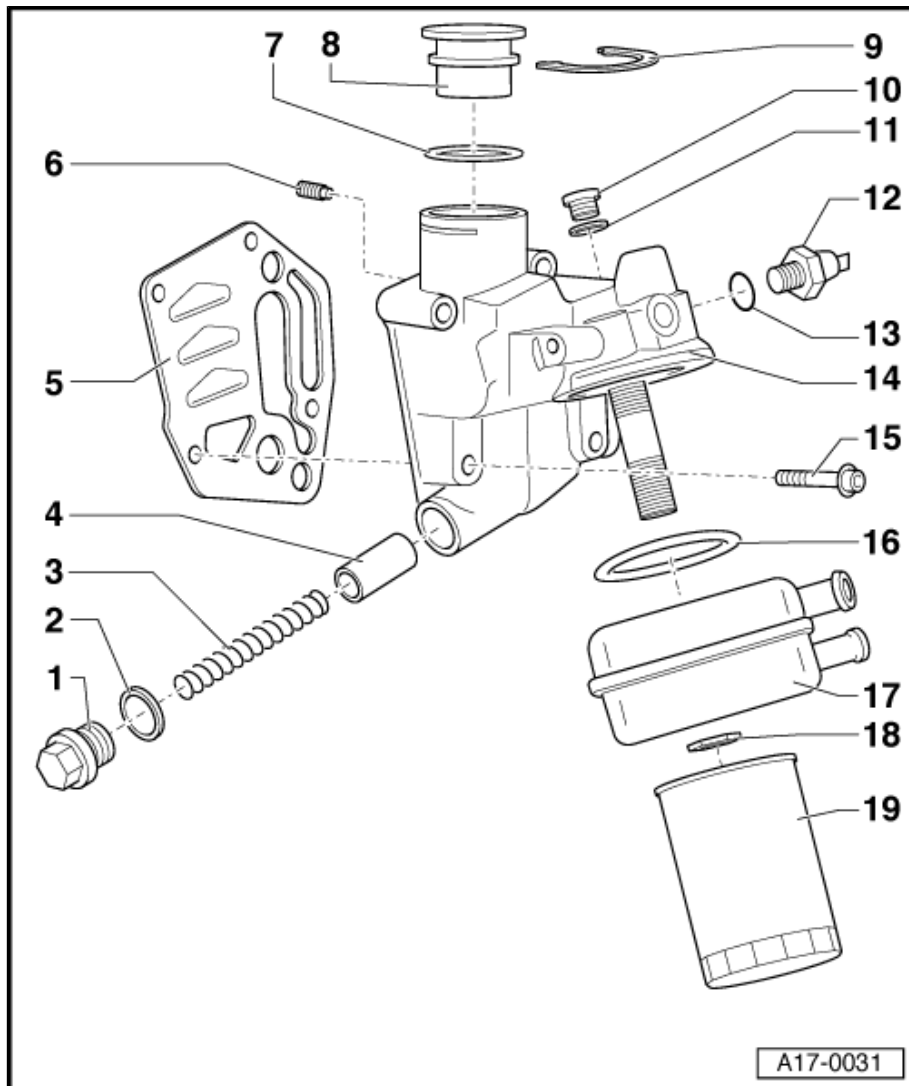
Removing and installing oil level/temperature sender -G266- (vehicles manufactured after 05 / 1999)

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



1.1.2 Lubrication system - Overview of components, part 2

- 1 - Screw plug -40 Nm-
- 2 - Seal
 - ☐ Renew
- 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
 - ☐ Tighten to 8 Nm
 - ☐ Integrated into oil filter bracket
- 7 - O-ring
 - ☐ Renew
 - ☐ Slip on as far as collar of cap
⇒ [Item 8 \(page 125\)](#)
- 8 - Filler cap / breather pipe for crankcase
- 9 - Retaining clip
- 10 - Screw plug -15 Nm-
- 11 - Seal
 - ☐ If seal is leaking, cut open and renew
- 12 - Oil pressure switch - F1-, 1.4 bar -25 Nm-
 - ☐ Black insulation
 - ☐ Checking ⇒ [page 135](#)
- 13 - Seal
 - ☐ If seal is leaking, cut open and renew
- 14 - Oil filter bracket
 - ☐ With pressure relief valve, approx. 4 bar
- 15 - 15 Nm + 90° (1/4 turn) further
 - ☐ Renew
- 16 - Seal
 - ☐ Renew
 - ☐ Engage in lugs on oil cooler
- 17 -
- Oil cooler



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- ☐ See note ⇒ [page 122](#)
 - ☐ Ensure clearance from surrounding components

18 - 25 Nm

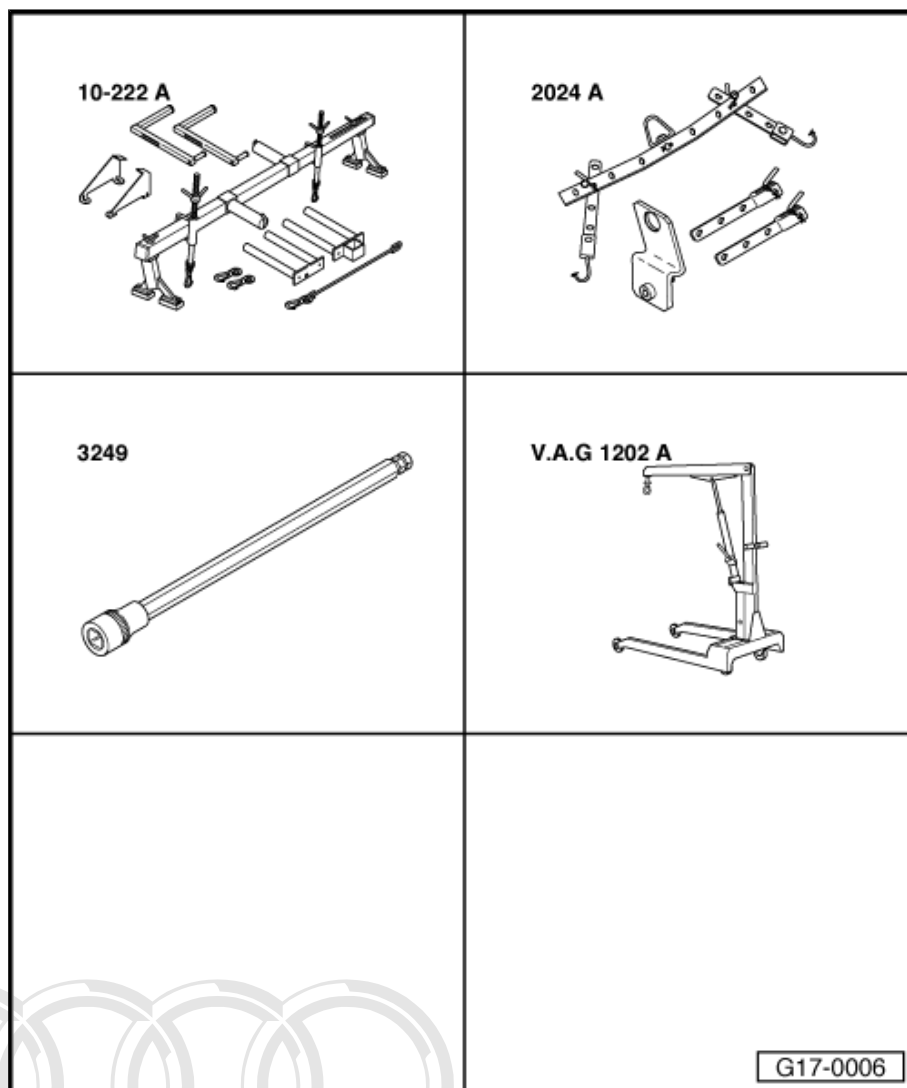
19 - Oil filter

- ☐ Observe change intervals ⇒ Maintenance ; Booklet 45
- ☐ Observe installation instructions on oil filter
- ☐ Tighten to 20 Nm

1.2 Removing and installing sump

Special tools and workshop equipment required

- ◆ Support bracket -10-222 A-
- ◆ Lifting tackle -2024 A-
- ◆ Hexagon key -3249-
- ◆ Workshop crane -V.A.G 1202 A-
- ◆ Electric drill with plastic brush attachment
- ◆ Safety goggles



1.2.1 Removing

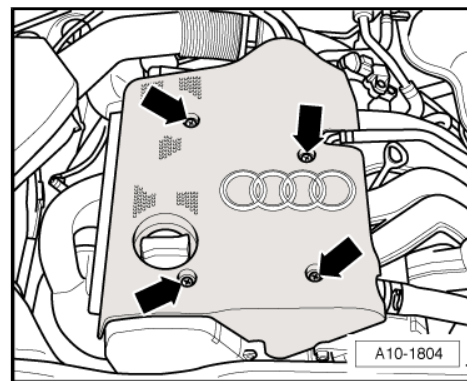
- Engine in vehicle.
- Lock carrier in service position ⇒ [page 32](#) .

- Take off engine cover panel -arrows-.

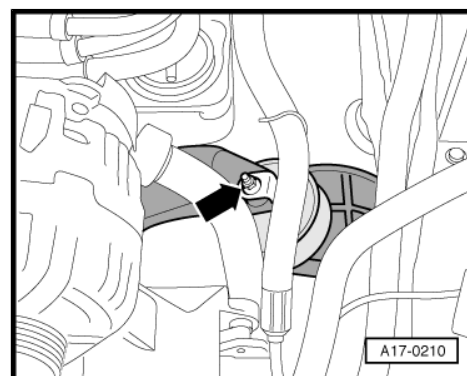


Note!

Illustration shows vehicle with engine code letters ANA.



- Unscrew nut -arrow- at top of engine mounting (left-side).

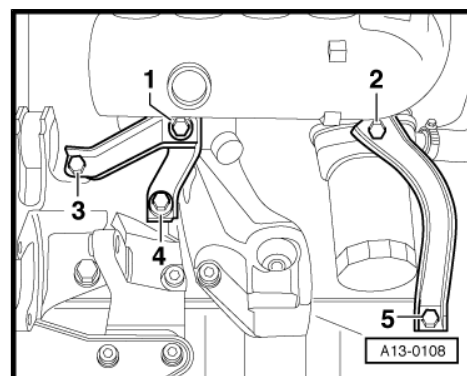


- Unscrew bolts -2- and -5- and remove support (rear) for intake manifold.



Note!

- ◆ *Illustration shows vehicle with engine code letters AHL.*
- ◆ *Ignore -Items 1, 3 and 4-.*



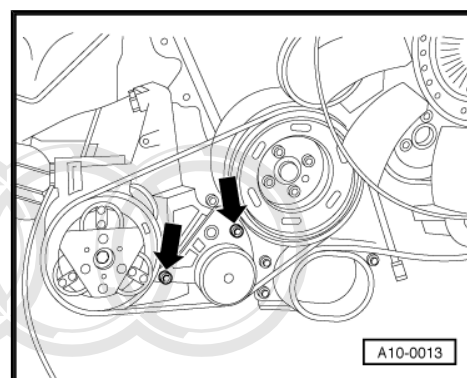
Vehicles manufactured before 04 / 1999:



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.

- Loosen securing bolts on tensioning roller for poly V-belt for A/C compressor -arrows-, slacken belt and remove.

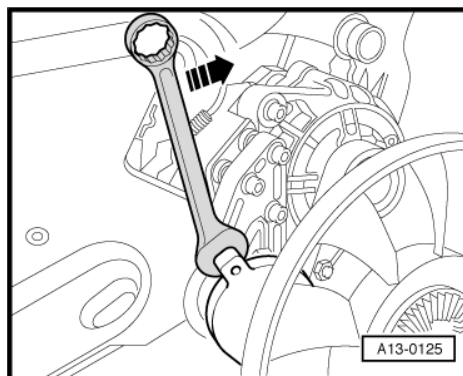




Note!

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.

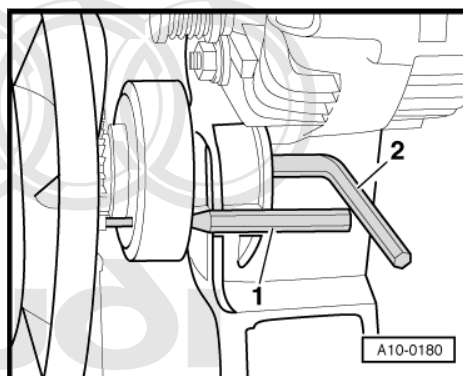
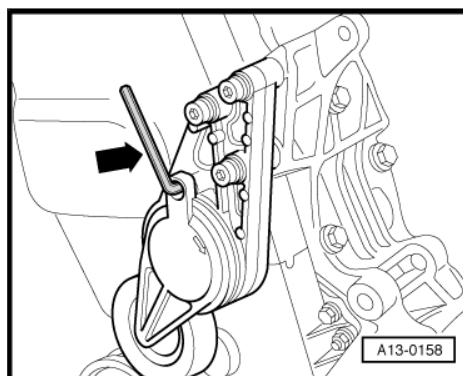
- Turn the tensioner in the direction of the -arrow- to slacken the poly V-belt.
- Remove poly V-belt from alternator and release tensioner.



Note!

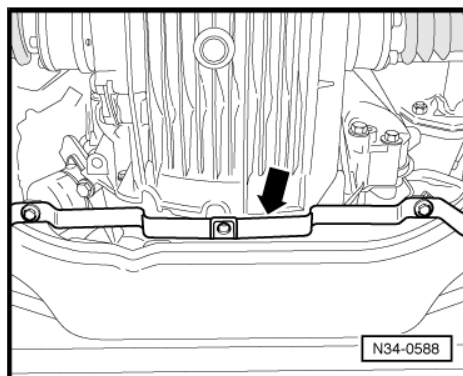
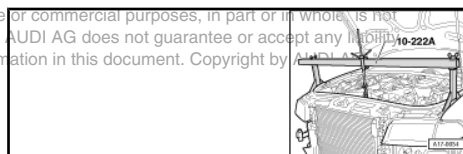
Poly V-belt tensioner can be locked by inserting an appropriate angled hexagon key -arrow- in locating holes.

- Lock pulley for viscous fan with roll-pin drift -1- and unscrew using hexagon key -2-.
- Detach viscous fan from bearing and lay it forwards in radiator cowl.



All models:

- Set up support bracket -10-222 A- on wing panel flanges.
- Support engine with support bracket at front engine lifting eye.
- Take up weight of engine with the spindle of support bracket, but do not lift.
- Drain off engine oil.
- Unbolt bracket for noise insulation -arrow-.



Vehicles with automatic gearbox:



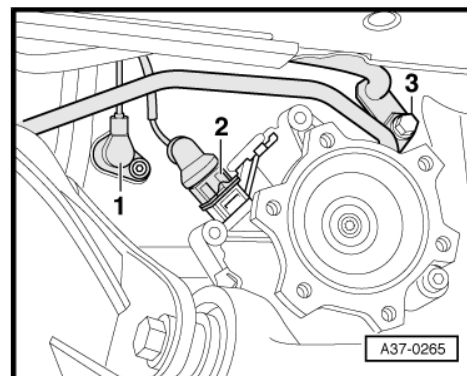
Note the rules for cleanliness when working on the automatic gearbox ⇒ Automatic gearbox 01N; Rep. Gr. 37.

- Unscrew bolt -3- and detach ATF pipes from gearbox.



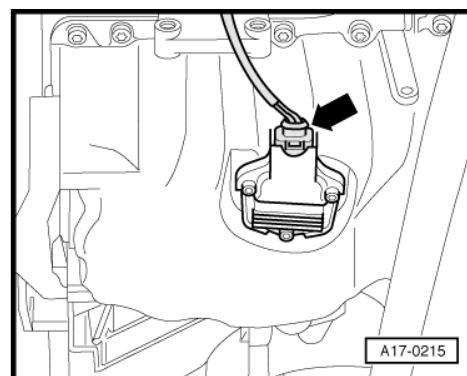
Disregard items marked -1- and -2-.

- Unbolt bracket for ATF pipe at engine.
- Move ATF pipes clear to side.



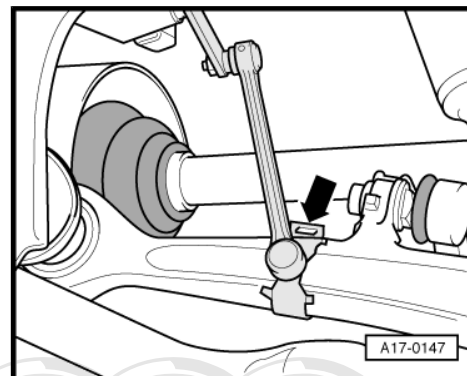
Vehicles manufactured after 05 / 1999:

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

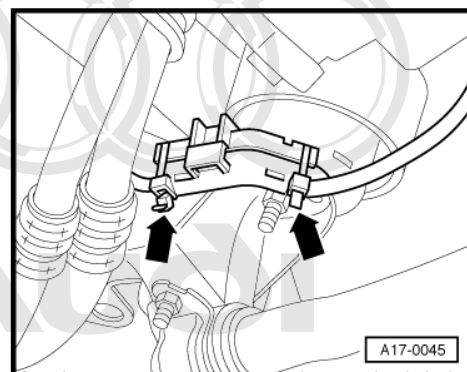


All models:

- If fitted, unclip actuator rod for self-levelling suspension sender at bottom transverse link -arrow-.



- Cut open the cable ties -arrows-, open bracket for starter wire and take out the electrical wire.



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- Mark positions of bolt connections -1- and locating sleeves -2- on bottom of engine mounts (left and right).

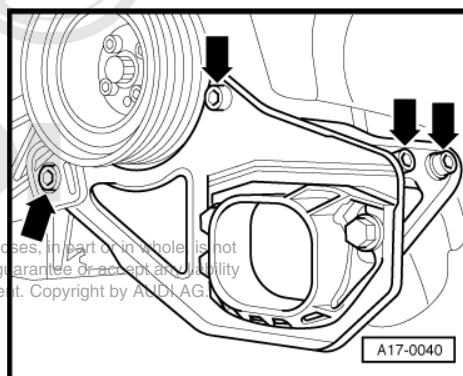
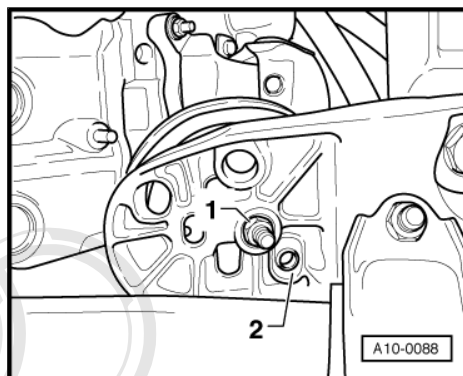

Note!

Different mounting holes are provided for the different engine versions.

- Unscrew nut -1- at bottom of engine mounting (right-side).
- Remove engine mounting (left-side).

Vehicles manufactured before 04 / 1999:

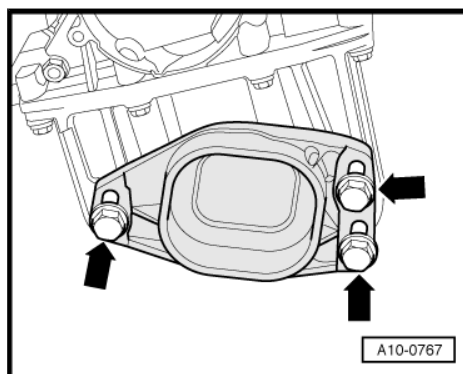
- Unbolt stop plate for torque reaction support -arrows-.



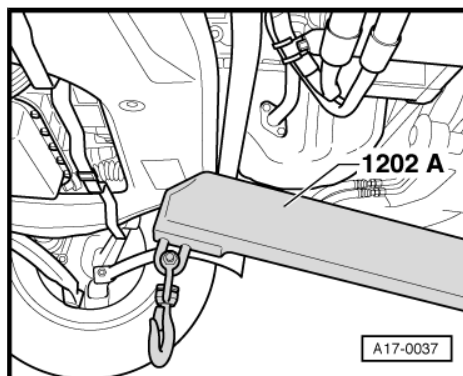
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Vehicles manufactured after 05 / 1999:

- Unbolt stop for torque reaction support -arrows-.


All models:

- Support subframe with workshop crane -V.A.G 1202 A- .

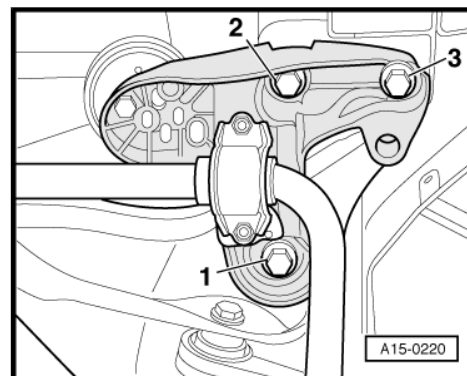


- First remove front subframe bolts -2- and -3- (left and right). Then unscrew bolts -1-.



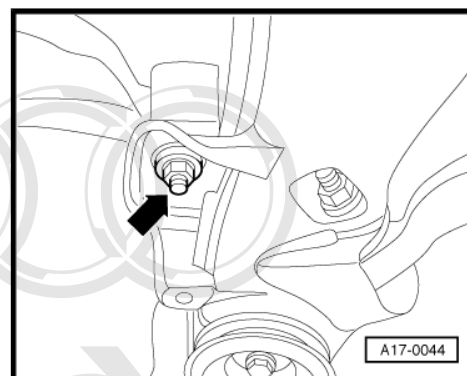
Note!

To avoid having to check and adjust wheel alignment, only loosen the front subframe mountings and lower the subframe at the front.



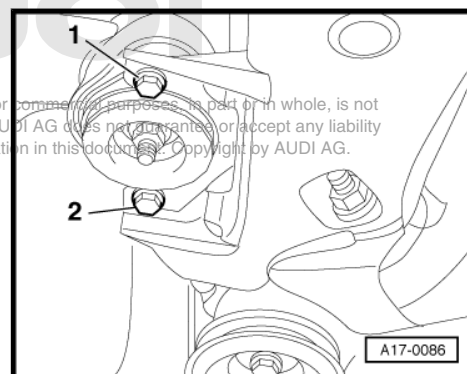
Vehicles with manual gearbox:

- Loosen nut -arrow- for gearbox mounting (left-side) until it aligns with the lower edge of the bolt (turned approx. 4 threads).



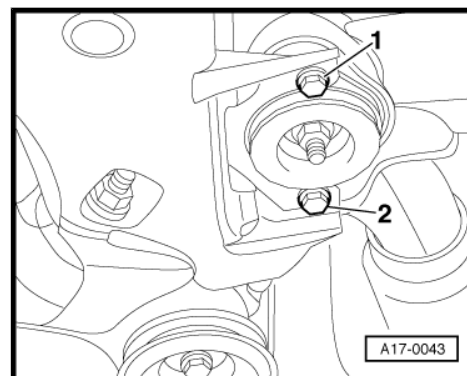
Vehicles with automatic gearbox:

- Loosen rear bolt -2- for gearbox mounting (left-side) a few turns, then unscrew front bolt -1- for gearbox mounting (left-side).

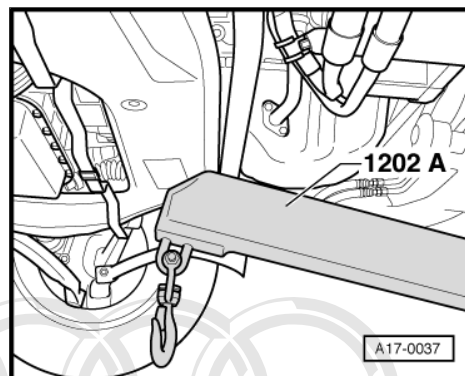


All models:

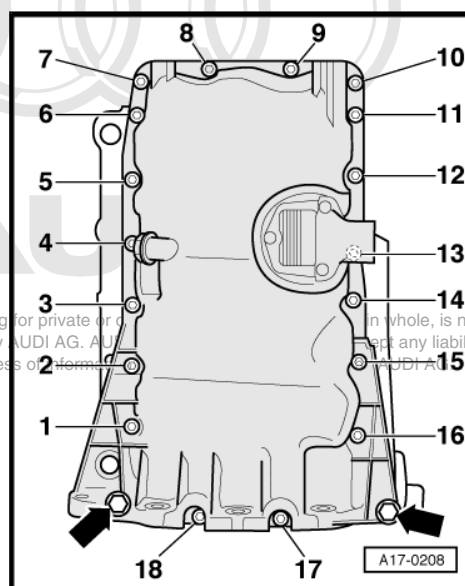
- Loosen rear bolt -2- for gearbox mounting (right-side) a few turns, then unscrew front bolt -1- for gearbox mounting (right-side).



- Lower subframe slowly using workshop crane -V.A.G 1202 A- .
- Remove workshop crane -V.A.G 1202 A- .



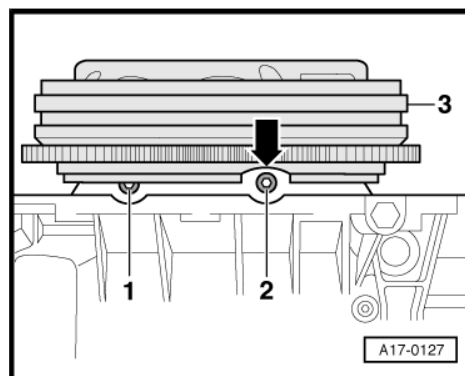
- Remove bolts securing sump to gearbox.
- Unscrew M10 bolts -arrows-.
- Slacken bolts -1 ... 18- in diagonal sequence.



Note!

Use hexagon key extension -3249- to unscrew the two rear sump bolts -1- and -2-. To do so on vehicles with manual gearbox turn the flywheel -3- until the recess -arrow- is aligned with the bolt.

- Take off sump; if necessary loosen it by striking lightly with a rubber hammer.
- Carefully remove sealant residues from cylinder block. For this purpose, remove baffle plate.



1.2.2 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.



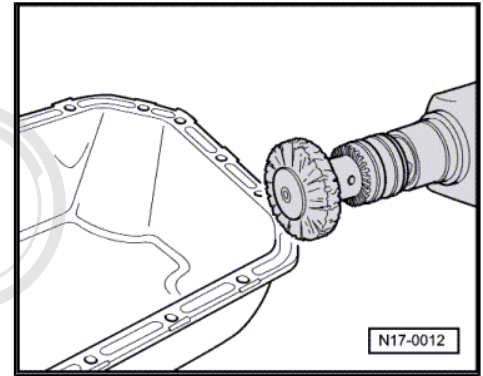
Caution

Wear safety goggles.

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

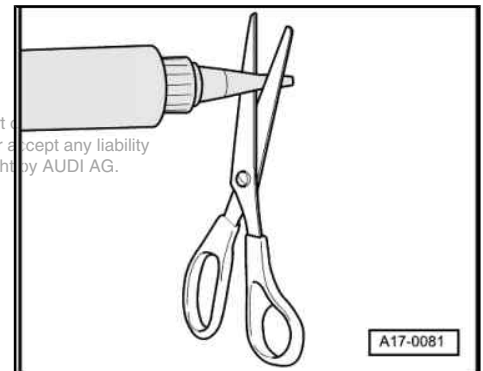
 Note!

The sump must be installed within 5 minutes after applying the silicone sealant.



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

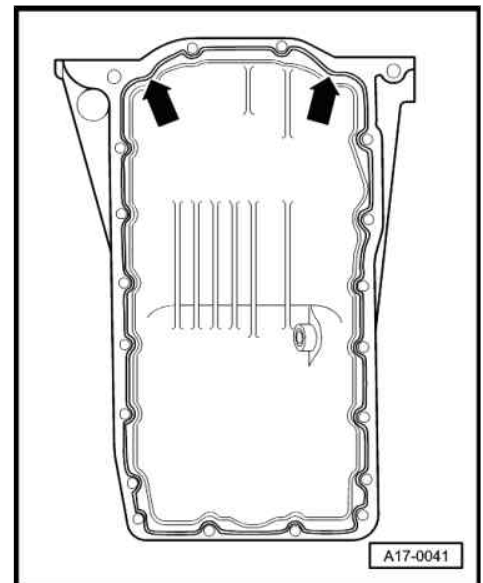
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- Apply bead of silicone sealant onto the clean sealing surface of the sump as shown in the illustration.
- Thickness of sealant bead: 2 ... 3 mm

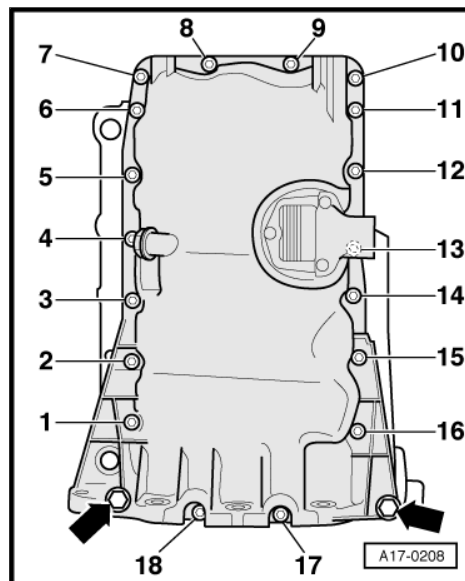
 Note!

- ◆ *The sump must be installed within 5 minutes after applying the silicone sealant.*
- ◆ *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.*



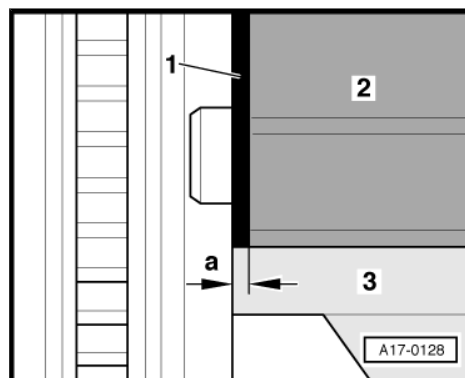
- Immediately install sump and tighten bolts in the sequence mentioned:

Se- quence	Tightening
1	– Tighten bolts -1 ... 18- in diagonal sequence initially to 5 Nm.
2	– Tighten bolts securing sump to gearbox to 45 Nm.
3	– Tighten bolts M10 -arrows- to 40 Nm.
4	– Tighten bolts -1 ... 18- in diagonal sequence to 15 Nm.



Note!

- ◆ *Renew seals and gaskets.*
- ◆ *When installing the sump -3- with the engine removed from the vehicle, make sure that it is positioned flush with the intermediate plate -1- at the flywheel end. In other words, the sump should protrude by 0.8 mm (distance -a-) from cylinder block -2-.*
- ◆ *After fitting sump assembly, the sealant must dry for approx. 30 minutes. Only then may the engine oil be filled.*



- Lift subframe with workshop crane -V.A.G 1202 A- .
- Install subframe ⇒ Running gear, front-wheel drive and four-wheel drive; Rep. Gr. 40 .

Vehicles with automatic gearbox:

- Secure the ATF pipes ⇒ Automatic gearbox 01N; Rep. Gr. 37 .

All models:

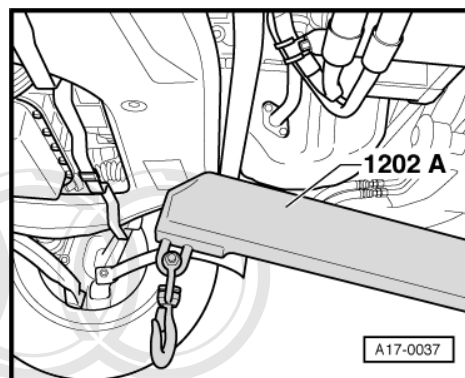
- Install lock carrier ⇒ [page 34](#) .
- Fill up with engine oil and check oil level.

Vehicles with automatic gearbox:

- Check ATF level ⇒ Automatic gearbox 01N; Rep. Gr. 37 .

Vehicles manufactured before 04 / 1999:

- Install poly V-belt ⇒ [page 38](#) .



1.2.3 Tightening torques

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Component		Nm
Sump	M7	15
to cylinder block	M10	40
Sump to gearbox		45
Stop plate for torque reaction support to engine		40

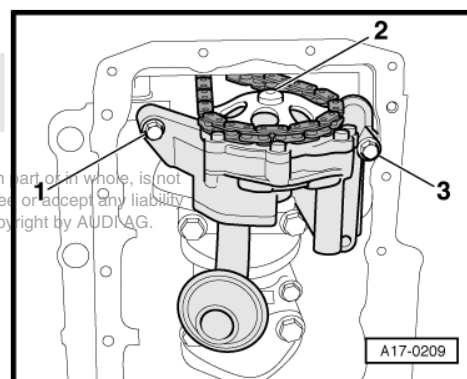
Component	Nm
Stop for torque reaction support to sump	28
Engine mounting to bracket for engine mounting	23
Engine mounting to engine support	23
Gearbox support to gearbox mounting	40
Gearbox mounting to subframe	23
Oil drain plug	30
Support for intake manifold (top section) to sump	20

1.3 Removing and installing oil pump

1.3.1 Removing

- Remove sump and baffle plate ⇒ [page 126](#) .
- Unscrew bolt -2-.
- Pull chain sprocket off oil pump shaft.
- Unscrew bolts -1- and -3- and remove oil pump.

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1.3.2 Installing

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

- Insert dowel sleeves ⇒ [Item 9 \(page 123\)](#) at top of oil pump.
- Installation position: Chain sprocket can only be fitted in one position on oil pump shaft.
- Install sump ⇒ [page 132](#) .

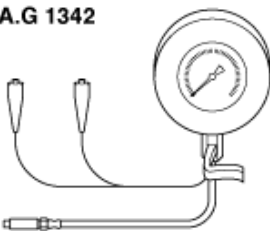
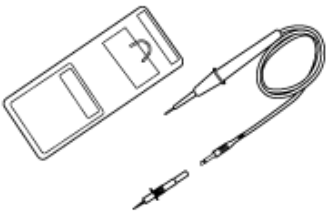
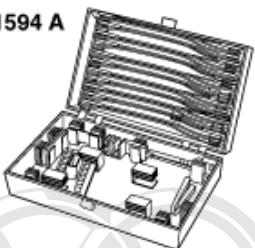
1.3.3 Tightening torques

Component	Nm
Chain sprocket to oil pump shaft	25
Oil pump to cylinder block	15

1.4 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-
- ◆ Adapter set -V.A.G 1594 A-

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

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G17-0001

1.4.1 Test requirements

- 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.

1.4.2 Function of dynamic oil pressure warning system

Testing warning lamp

The oil pressure warning lamp starts to flash when the ignition is switched on ("Terminal 15 on") with the engine not running (this does not apply to vehicles with auto-check system).

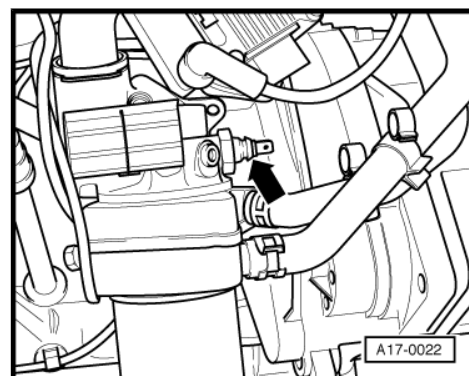
Conditions for activating the warning

- Engine not running; oil pressure switch closed.
- Coolant temperature above 60°C, engine speed above 1,500 rpm and oil pressure switch open.

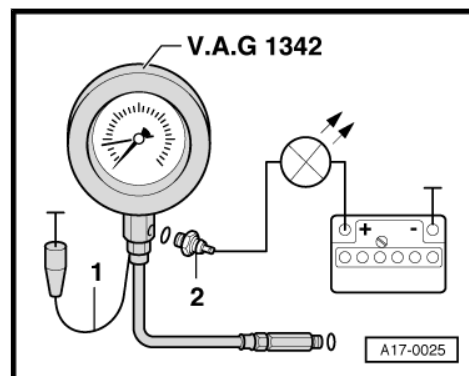
- Coolant temperature below 60°C, engine rpm above 300 rpm and oil pressure switch open.
- When engine speed is above 5,000 rpm an active oil pressure warning is not cancelled, irrespective of the condition of the oil pressure switch.
- If the power supply to the control unit is OK (terminal 15) and the oil pressure switch is open for longer than 0.5 seconds at engine speeds above 1,500 rpm, this condition is stored in the memory. If this condition occurs three times with "terminal 15 on" the warning will also become active or remain active at engine speeds below 1,300 rpm.

1.4.3 Preparation for test

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



- 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- .



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1.4.4 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 adapter set -V.A.G 1594 A- to oil pressure switch and battery positive (+).

- LED should not light up.

If the LED lights up:

- Renew oil pressure switch.
- Start the engine.



Note!

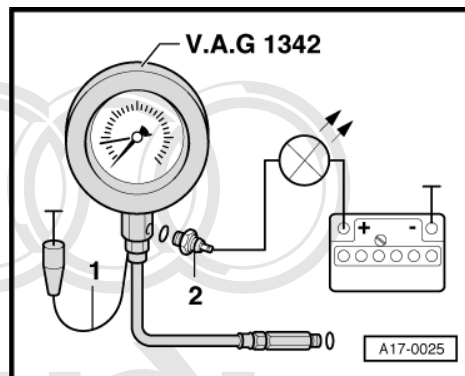
Observe tester and LED while starting, as switching point of oil pressure switch may already be exceeded when starting.

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- Test lamp should light up at 1.2 ... 1.6 bar.

If the LED does not light up:

- Renew oil pressure switch.



1.4.5 Checking oil pressure

- Start the engine.
- 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 135](#).

1.5 Engine oil

1.5.1 Viscosity grades and oil specifications

Viscosity grades and oil specifications: ⇒ Maintenance ; Booklet 45

1.6 Checking oil level

1.6.1 Test requirements

- Engine oil temperature at least 60°C.
- Vehicle must be level (horizontal)
- Wait a few minutes after switching off the engine to allow the oil to flow back into the sump.

1.6.2 Test sequence

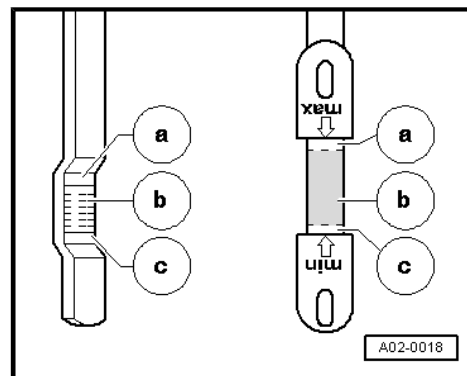
- Pull out the dipstick, wipe off with a clean cloth and insert it again as far as it will go.
- Pull out the dipstick again and read off the oil level.

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 marking -a- on the dipstick.



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19 – Cooling

1 Removing and installing parts of cooling system



Caution

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



Note!

- ◆ *When the engine is warm the cooling system is under pressure. If necessary release pressure before commencing repair work.*
- ◆ *Secure all hose connections with the correct 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.*
- ◆ *Always fit new seals and gaskets.*
- ◆ *The arrow markings on coolant pipes and on ends of hoses must align.*

1.1 Parts of cooling system - engine code letters AHL, ARM



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1 - Radiator

- ☐ Removing and installing
⇒ [page 157](#)
- ☐ If renewed, fill with fresh coolant

2 - Coolant pipe (top)

3 - Coolant pump, thermostat

- ☐ Removing and installing
coolant pump
⇒ [page 148](#)
- ☐ Removing and installing
thermostat ⇒ [page 152](#)
- ☐ Checking thermostat
⇒ [page 155](#)

4 - Cylinder head/cylinder block

- ☐ If renewed, fill with fresh coolant

5 - Heat exchanger

- ☐ If renewed, fill with fresh coolant

6 - Coolant pipe (bottom)

- ☐ Removing and installing
⇒ [page 155](#)

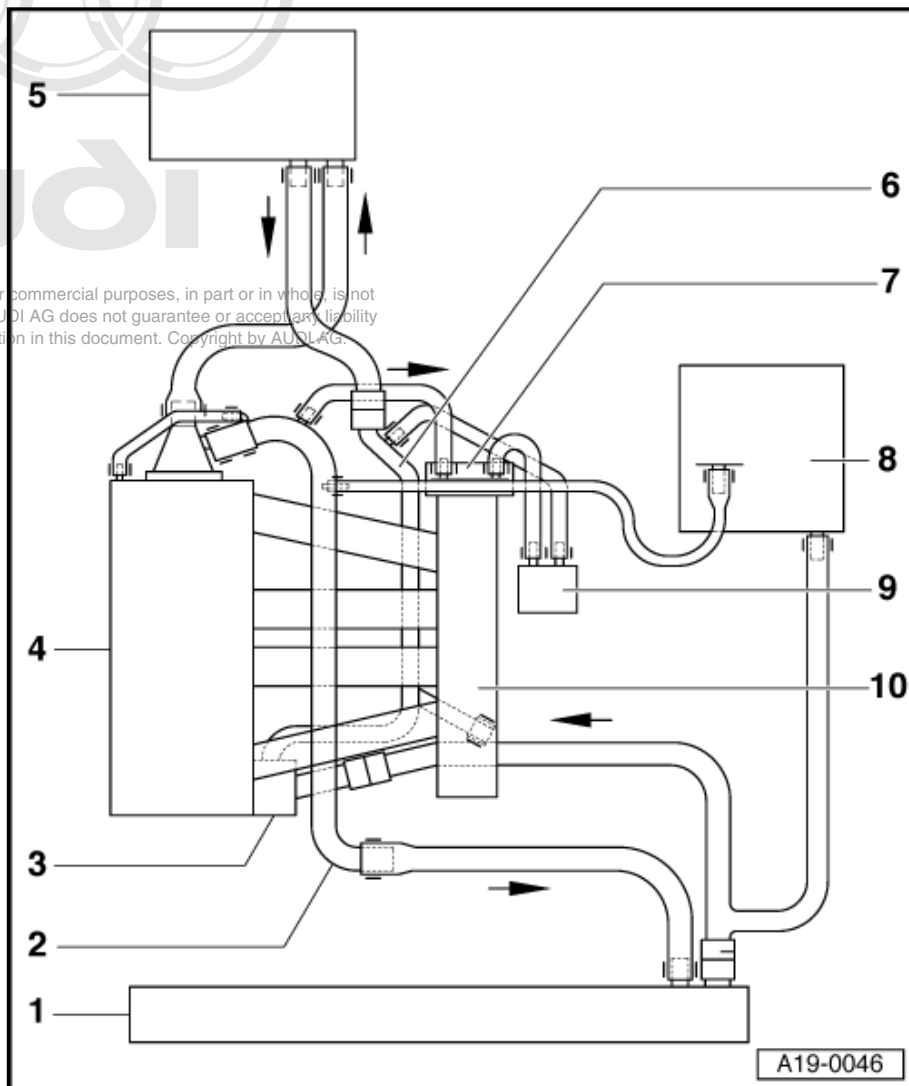
7 - Heating for throttle valve housing

8 - Expansion tank

- ☐ With filler cap
- ☐ Checking pressure relief valve in filler cap
⇒ [page 166](#)

9 - Oil cooler

10 - Intake manifold



1.2 Parts of cooling system - engine code letters ANA

1 - Heat exchanger

- ☐ If renewed, fill with fresh coolant

2 - Coolant pipe (bottom)

- ☐ Removing and installing
⇒ [page 155](#)

3 - Heating for throttle valve housing

4 - Expansion tank

- ☐ With filler cap
- ☐ Checking pressure relief valve in filler cap
⇒ [page 166](#)

5 - Oil cooler

6 - Intake manifold

7 - Coolant hose (bottom)

8 - Coolant hose (top)

9 - Radiator

- ☐ Removing and installing
⇒ [page 157](#)
- ☐ If renewed, fill with fresh coolant

10 - Coolant pipe (top)

11 - Coolant pump, thermostat

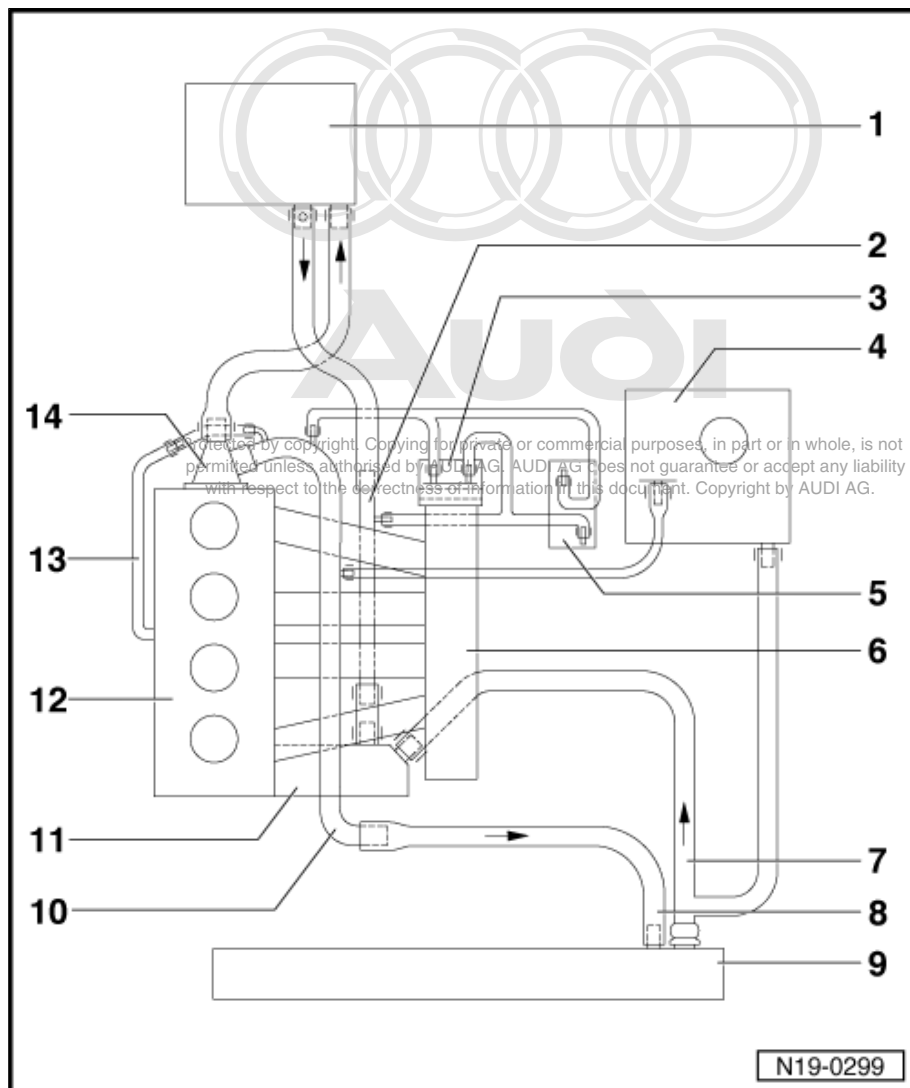
- ☐ Removing and installing coolant pump
⇒ [page 148](#)
- ☐ Removing and installing thermostat ⇒ [page 152](#)
- ☐ Checking thermostat
⇒ [page 155](#)

12 - Cylinder head/cylinder block

- ☐ If renewed, fill with fresh coolant

13 - Coolant pipe

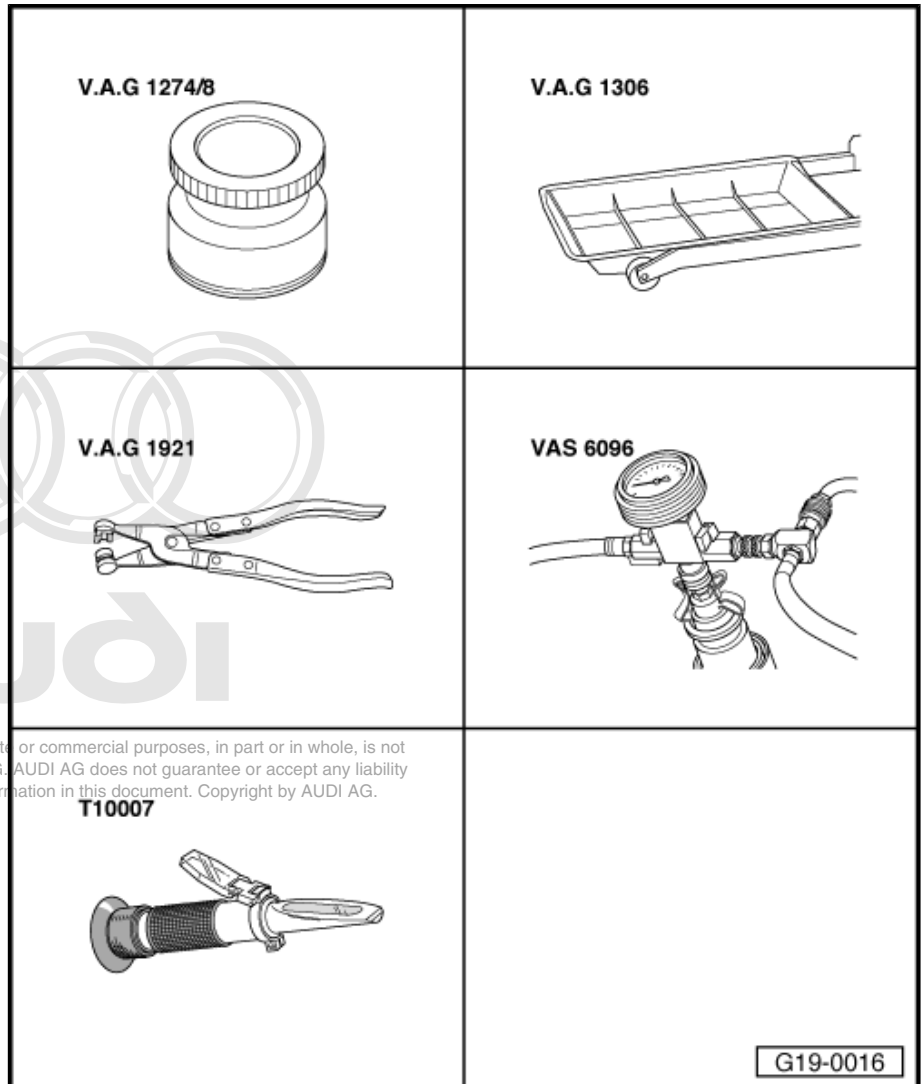
14 - Hose connection



1.3 Draining and filling cooling system

Special tools and workshop equipment required

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



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1.3.1 Draining



Note!

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



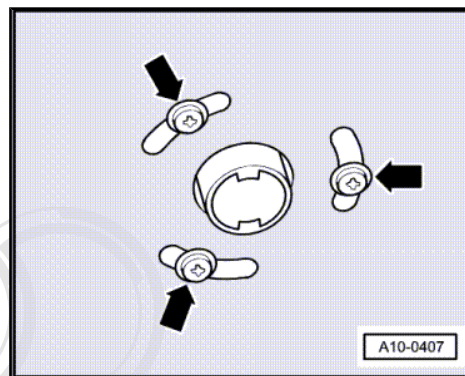
Caution

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.

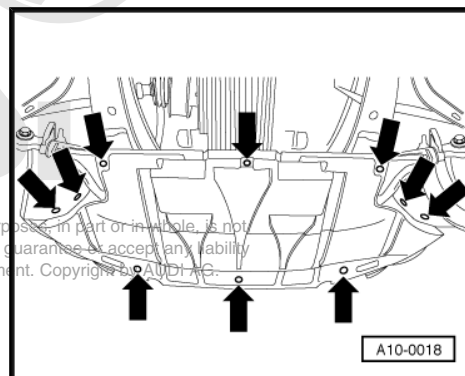
Vehicles with auxiliary heater:

- Remove bolts -arrows- securing exhaust pipe for auxiliary/additional heater to noise insulation.

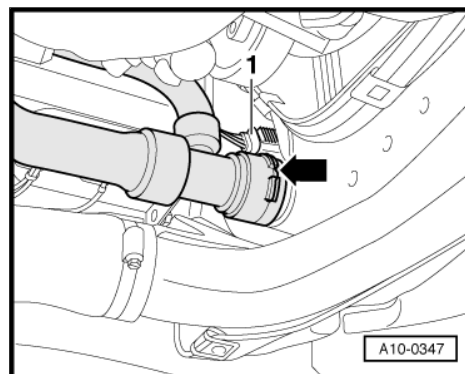


All models:

- Remove noise insulation -arrows-.

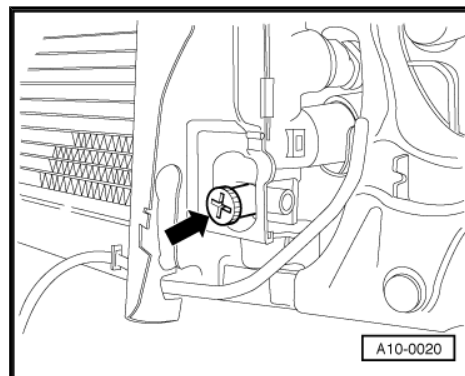


- Place drip tray -V.A.G 1306- under engine.
- Pull off retaining clip for coolant hose (bottom) -arrow- and remove coolant hose from radiator.

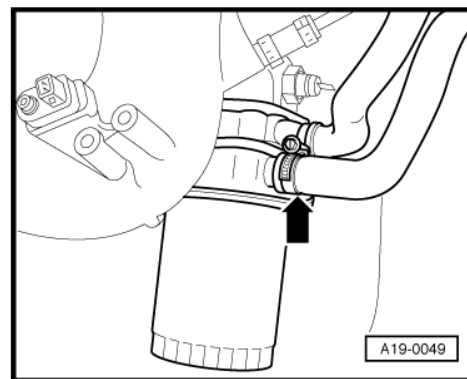


Note!

When the bumper is removed the coolant can also be drained from the radiator via the drain plug -arrow-.



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

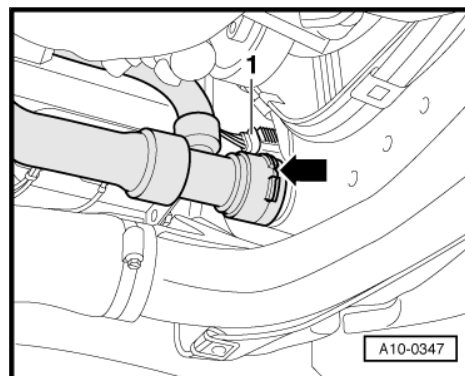


1.3.2 Filling

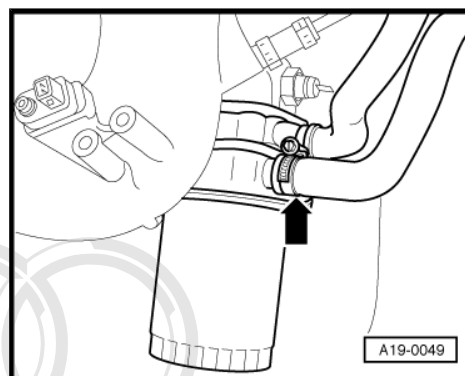
Note!

- ◆ The cooling system is filled all year round with a mixture of water and antifreeze/corrosion protection 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 "Meets 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 amount of "G 12+" can be increased, but only up to 60 % (this gives frost protection to about -40°C). If the antifreeze percentage exceeds 60%, frost protection decreases again and cooling efficiency is also impaired.
- ◆ Only use clean drinking 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-.

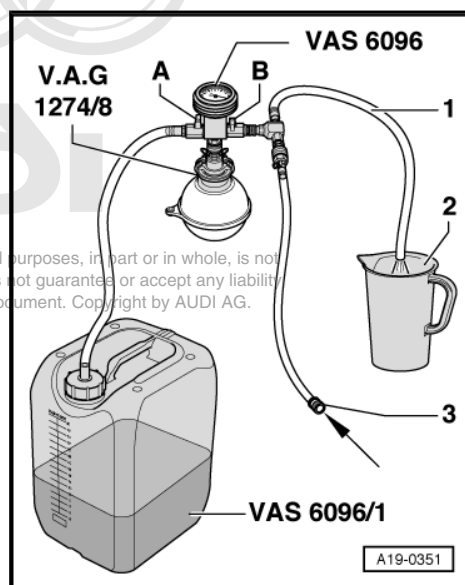
- Connect coolant hose to lower part of radiator -arrow-.



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



- Fill reservoir -VAS 6096/1- with at least 6 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-.
- Feed 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.



- Open valve -B- (turn lever in direction of flow).

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

- The needle on the gauge must move into the green zone.
- Also briefly open valve -A- (turn lever in direction of flow) so that hose on charge unit -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 must remain in the green zone.
- Close valve -B-.
- The needle on the gauge must 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 area, repeat the process.

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

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

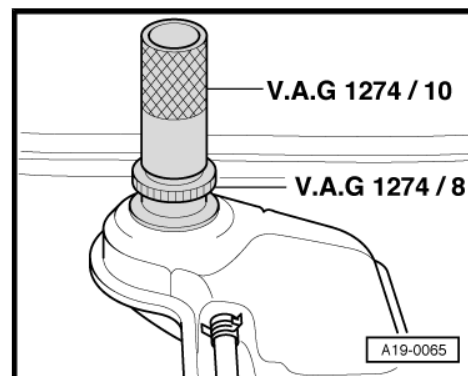
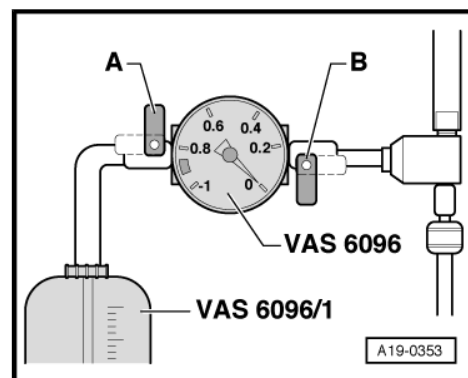
The vacuum in the cooling system causes the coolant to be drawn out of the cooling system charge unit -VAS 6096/1- ; the cooling system is then filled.

- Detach cooling system charge unit -VAS 6096- and fit special tool -V.A.G 1274/10- onto adapter -V.A.G 1274/8- .

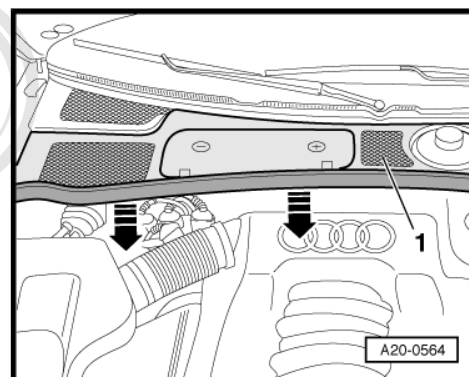


Note!

To fill expansion tank without using special tools detach expansion tank and raise it about 100 mm.

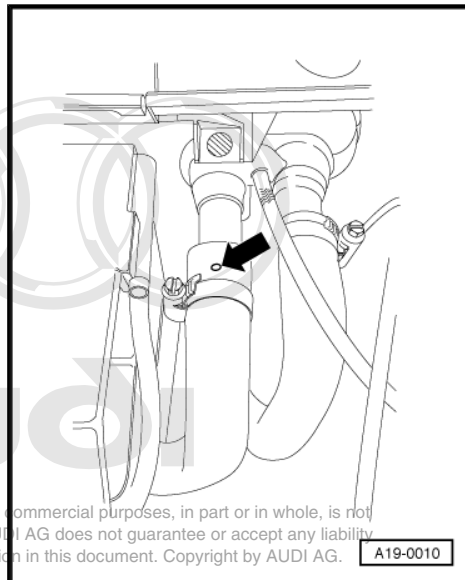


- Detach rubber seal from plenum chamber cover in direction of -arrow-.
- Detach plenum chamber cover -1- to front.



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- Push back protective cover for coolant hose on connection for heat exchanger.
- Release coolant hose going to heat exchanger and pull back hose until bleeder hole in hose -arrow- is no longer blocked by the connection.
- Fill up with coolant until it flows out at bleeder hole in coolant hose.
- Push coolant hose onto connection and tighten.

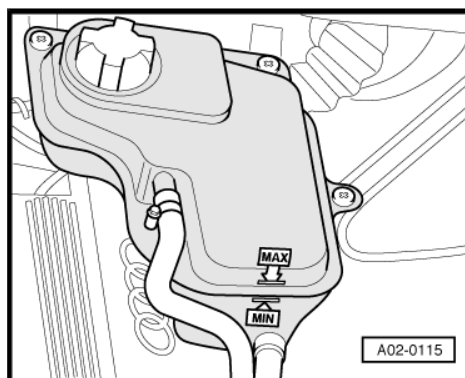


- Check the coolant level and top up coolant as far as the max mark.
- Start engine, run for max. 2 minutes at approx. 1500 rpm and fill in coolant up to overflow hole on expansion tank.
- Close expansion tank.
- Run engine until radiator fan cuts in.



Caution

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



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

1.4 Removing and installing coolant pump

1.4.1 Removing

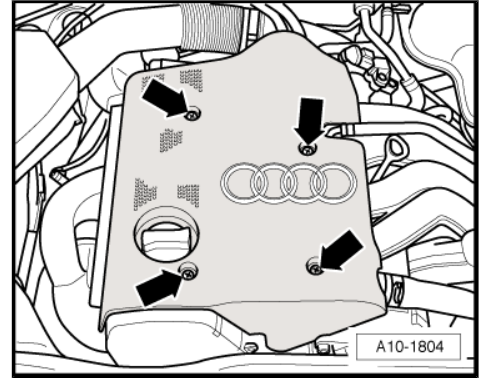
- Engine in vehicle.
- Lock carrier in service position ⇒ [page 32](#) .
- Drain off coolant ⇒ [page 143](#) .

- Take off engine cover panel -arrows-.



Note!

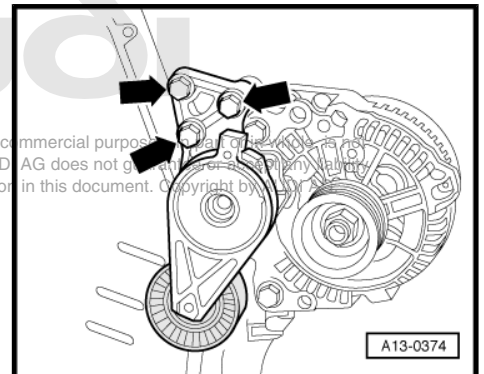
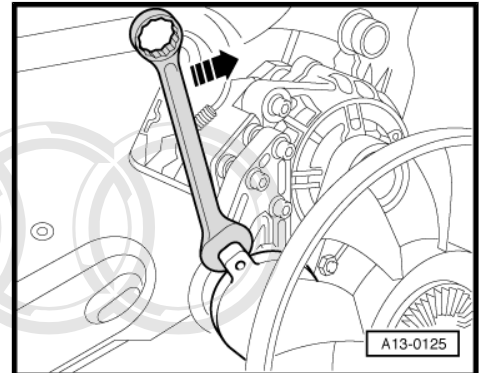
Illustration shows vehicle with engine code letters ANA.



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.
- Remove poly V-belt.
- Remove tensioner for poly V-belt -arrows-.

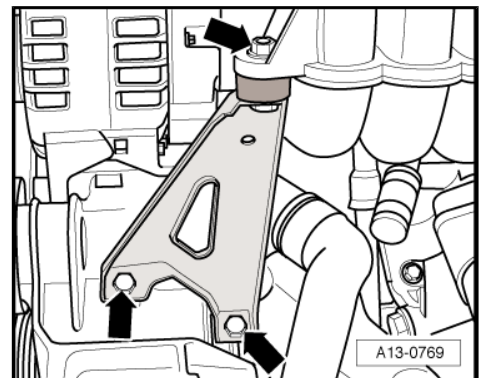


- Remove support for top section of intake manifold -arrows-.

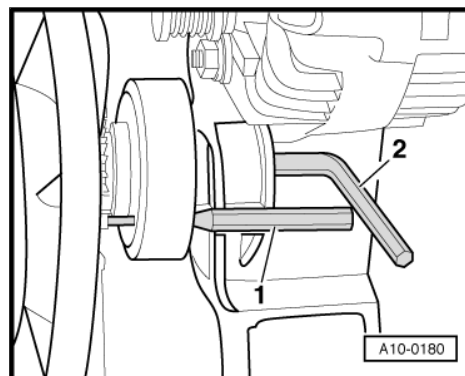


Note!

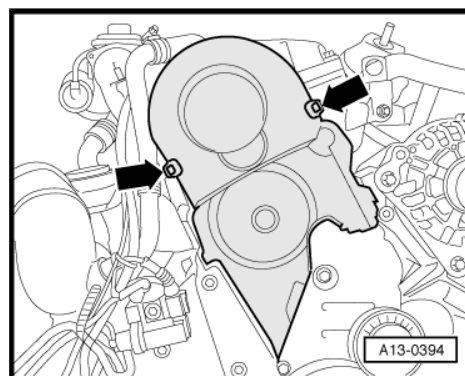
Illustration shows vehicle with engine code letters ANA.



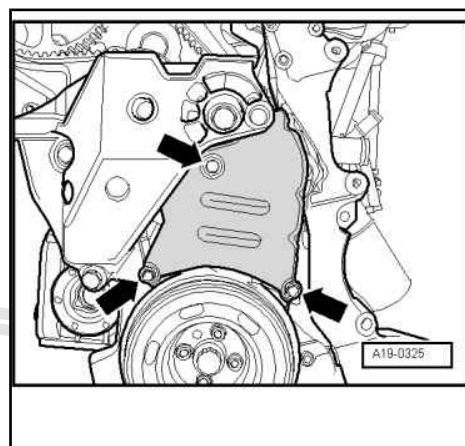
- Lock pulley for viscous fan with roll-pin drift -1- and unscrew using hexagon key -2-.
- Remove viscous fan from bearing.



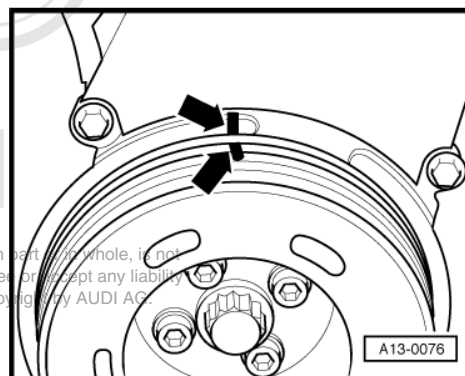
- Remove toothed belt guard (top) -arrows-.



- Remove toothed belt guard (centre) -arrows-.

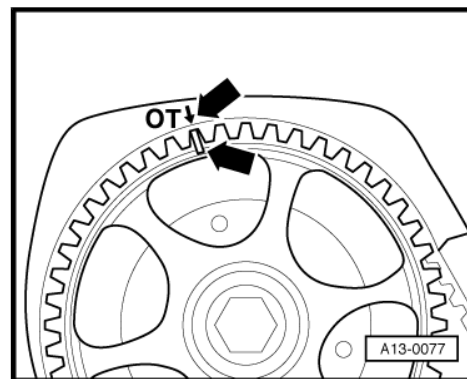


- Set crankshaft to markings for TDC of No. 1 cylinder -arrows- by turning central bolt on crankshaft sprocket in direction of rotation.



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

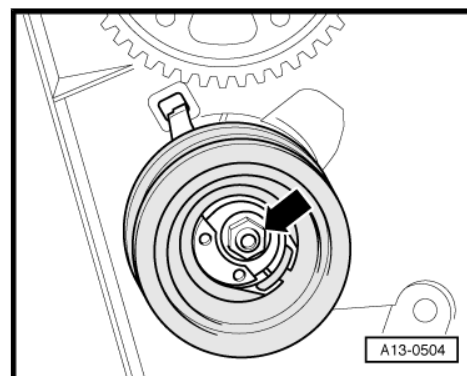


- Loosen tensioning roller nut -arrow- several turns.
- Detach toothed belt from camshaft sprocket and coolant pump.

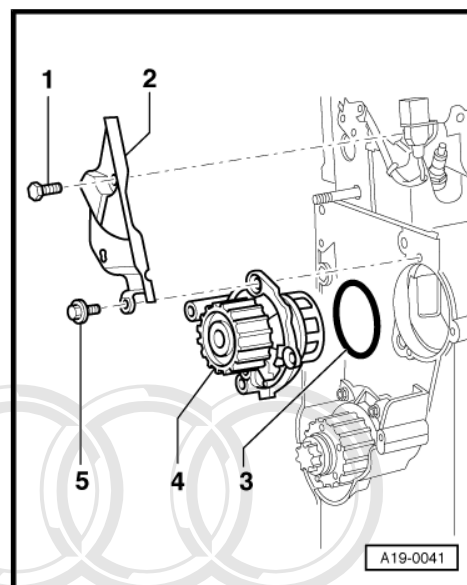


Note!

- ◆ *Vibration damper and toothed belt guard (bottom) can remain installed.*
- ◆ *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.*



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



1.4.2 Installing

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



Note!

- ◆ *Renew self-locking nuts and bolts when performing assembly work.*
- ◆ *Renew O-ring.*
- Clean and smoothen sealing surface for O-ring as required.

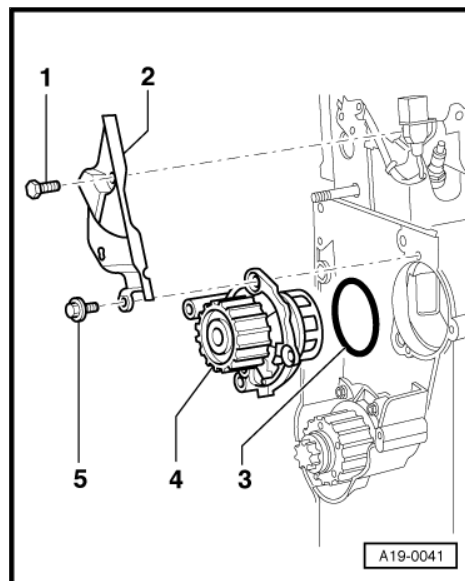
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- Lubricate new O-ring -3- with coolant additive "G12+".
- Fit coolant pump -4-.
- Installation position: Sealing plug in housing faces downwards.
- Install toothed belt guard (rear) -2- and tighten bolt -1- to 20 Nm.
- Tighten bolts -5- for coolant pump to 15 Nm.
- Fit toothed belt (adjust valve timing) ⇒ [page 49](#) .

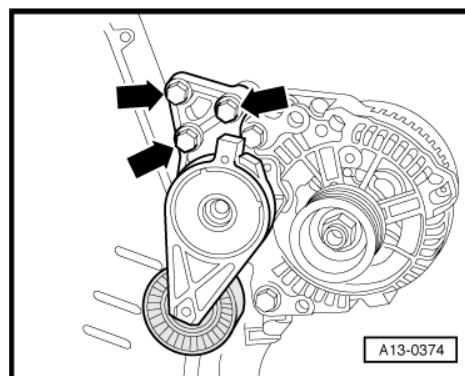


Note!

Follow all instructions for removing and installing toothed belt
⇒ [page 46](#) .



- Install tensioner for poly V-belt -arrows-.
- Install viscous fan ⇒ [page 160](#) .
- Install poly V-belt ⇒ [page 38](#) .
- Install lock carrier ⇒ [page 34](#) .
- Fill cooling system ⇒ [page 143](#) .



1.4.3 Tightening torques

Component	Nm	
Coolant pump to cylinder block	15	
Rear toothed belt guard to cylinder head	20	
Toothed belt guard (centre) to cylinder block	10 ²²⁾	
Tensioner for poly V-belt to bracket for ancillaries	23	
Support for top section	Top section of in- take manifold	20
of intake manifold to	Bracket	20

22) Install using locking fluid; locking fluid ⇒ Parts catalogue .

1.5 Removing and installing thermostat

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1.5.1 Removing

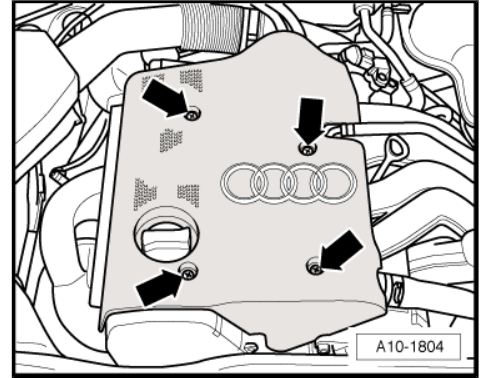
- Obtain code on vehicles with coded radio / radio and navigation system (RNS).
- Disconnect earth wire at battery with ignition switched off.
- Drain off coolant ⇒ [page 143](#) .

- Take off engine cover panel -arrows-.

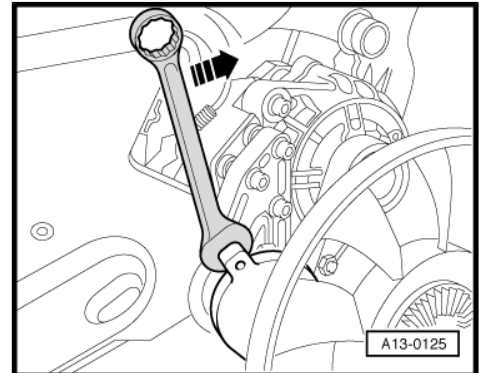


Note!

Illustration shows vehicle with engine code letters ANA.



- Turn the tensioner in the direction of the -arrow- to slacken the poly V-belt.
- Remove poly V-belt from the alternator pulley.

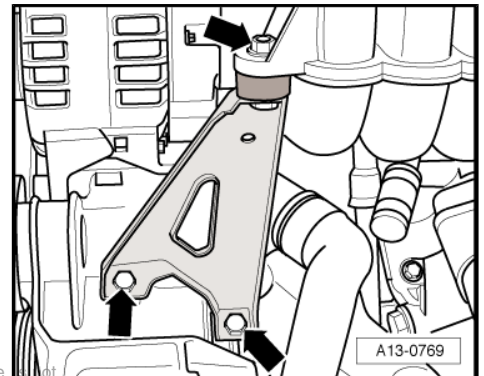


- Remove support for top section of intake manifold -arrows-.

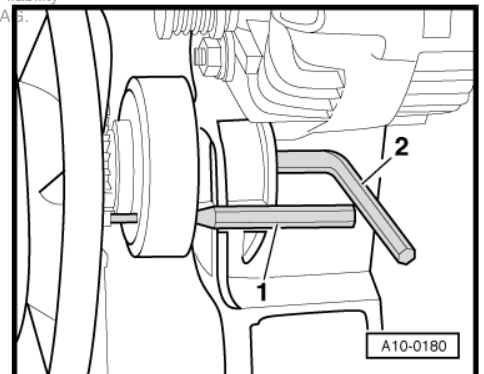


Note!

Illustration shows vehicle with engine code letters ANA.

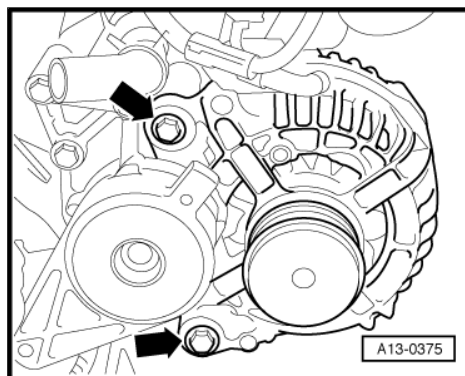
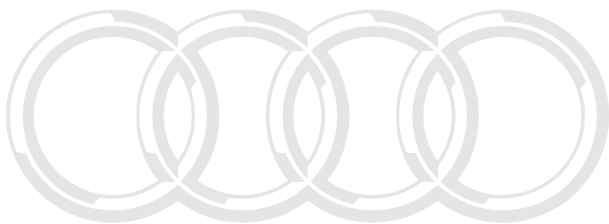


- Lock pulley for viscous fan with roll-pin drift -1- and unscrew using hexagon key -2-.
- Detach viscous fan from bearing and lay it forwards in radiator cowl.



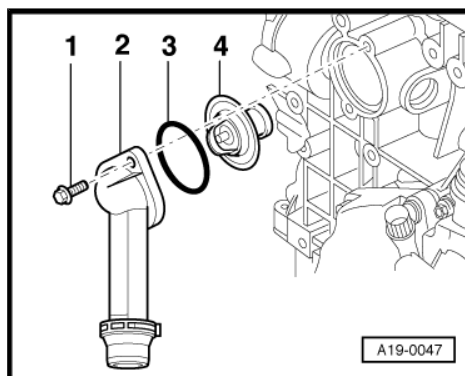
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- Unscrew securing bolts for alternator -arrows- and move alternator towards front. Leave wires connected.



- Release retaining clip and detach coolant hose from connection -2-.
- Remove bolts -1-, and detach hose connection -2-, O-ring -3- and coolant thermostat -4-.

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1.5.2 Installing

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



Note!

Always renew seals and gaskets.

- Clean and smoothen sealing surface for O-ring as required.
- Insert thermostat.
- Installation position: Cross-piece on thermostat should be vertical.
- Moisten new O-ring with coolant additive “G12+”.
- Install viscous fan ⇒ [page 160](#) .
- Install poly V-belt ⇒ [page 38](#) .
- Fill cooling system ⇒ [page 143](#) .



Note!

- ◆ *When the battery is reconnected, please ensure that the vehicle equipment (e.g. radio, radio/navigation system, clock, electric window lifters) is activated as described in the operating instructions.*
- ◆ *Further procedures after reconnecting the voltage supply ⇒ Simos injection and ignition system (4-cyl.); Rep. Gr. 24 .*

1.5.3 Tightening torques

Component	Nm
Hose connection to cylinder block	15

Component		Nm
Alternator to bracket	M8	23
	M10	46
Support for top section of intake manifold to	Top section of intake manifold	20
	Bracket	20

1.5.4 Checking thermostat

- Heat thermostat in water bath.

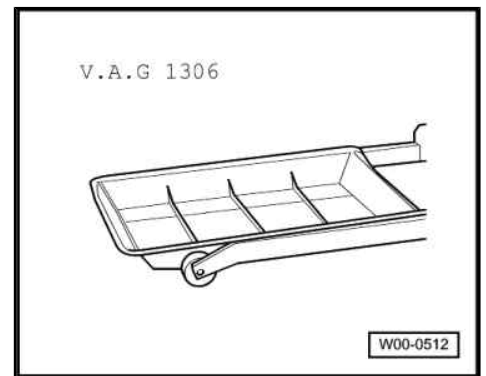
Starts to open	Fully open	Opening travel
approx. 87°C	approx. 102°C ²³⁾	at least 8 mm

23) Cannot be tested.

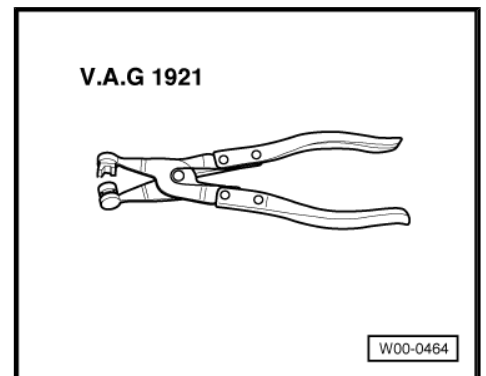
1.6 Removing and installing coolant pipe (bottom)

Special tools and workshop equipment required

- ◆ Drip tray -V.A.G 1306-



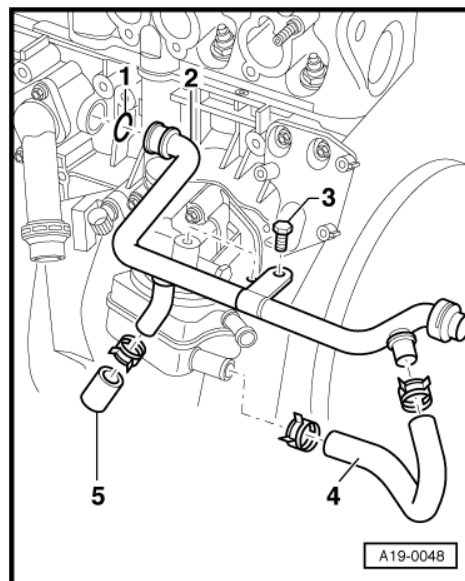
- ◆ Hose clip pliers -V.A.G 1921-



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1.6.1 Removing

- Drain off coolant ⇒ [page 143](#) .
- Remove intake manifold ⇒ [page 96](#) or top section of intake manifold ⇒ [page 99](#) .
- Detach coolant hose going to heat exchanger at rear of coolant pipe -2-. To do so, release retaining clip at connecting flange.
- Disconnect coolant hose -4- going to oil cooler at coolant pipe.
- Unscrew bolt -3-.
- Move wiring clear at coolant pipe (bottom).
- Push coolant pipe to rear and detach.
- If fitted, remove plug -5-.



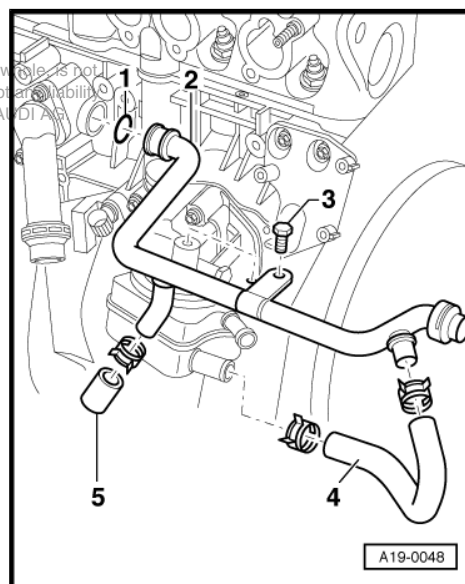
1.6.2 Installing

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.
- Lubricate new O-ring -1- with "G 12+" and push onto coolant pipe -2-.
- Push coolant pipe into bore on cylinder block.
- Install upper section of intake manifold ⇒ [page 96](#) or ⇒ [page 99](#) .
- Fill cooling system ⇒ [page 143](#) .



1.6.3 Tightening torques

Component	Nm
Coolant pipe to oil filter bracket	20
Hose clips for coolant hoses	2

1.7 Radiator and radiator fan - exploded view of components

1 - Radiator

- ☐ Removing and installing
⇒ [page 157](#)
- ☐ After replacing, renew
coolant completely

2 - Clip

3 - Bracket for radiator

- ☐ Note installation position

4 - Coolant hose (top)

5 - Rubber washer

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6 - Radiator fan -V7-

- ☐ Depending on equipment

7 - Fan ring

8 - 10 Nm

9 - 10 Nm

10 - Electrical connector for radiator fan

11 - Coolant hose (bottom)

- ☐ Going to hose connection for thermostat and expansion chamber

12 - O-ring

- ☐ Renew

13 - Electrical connector

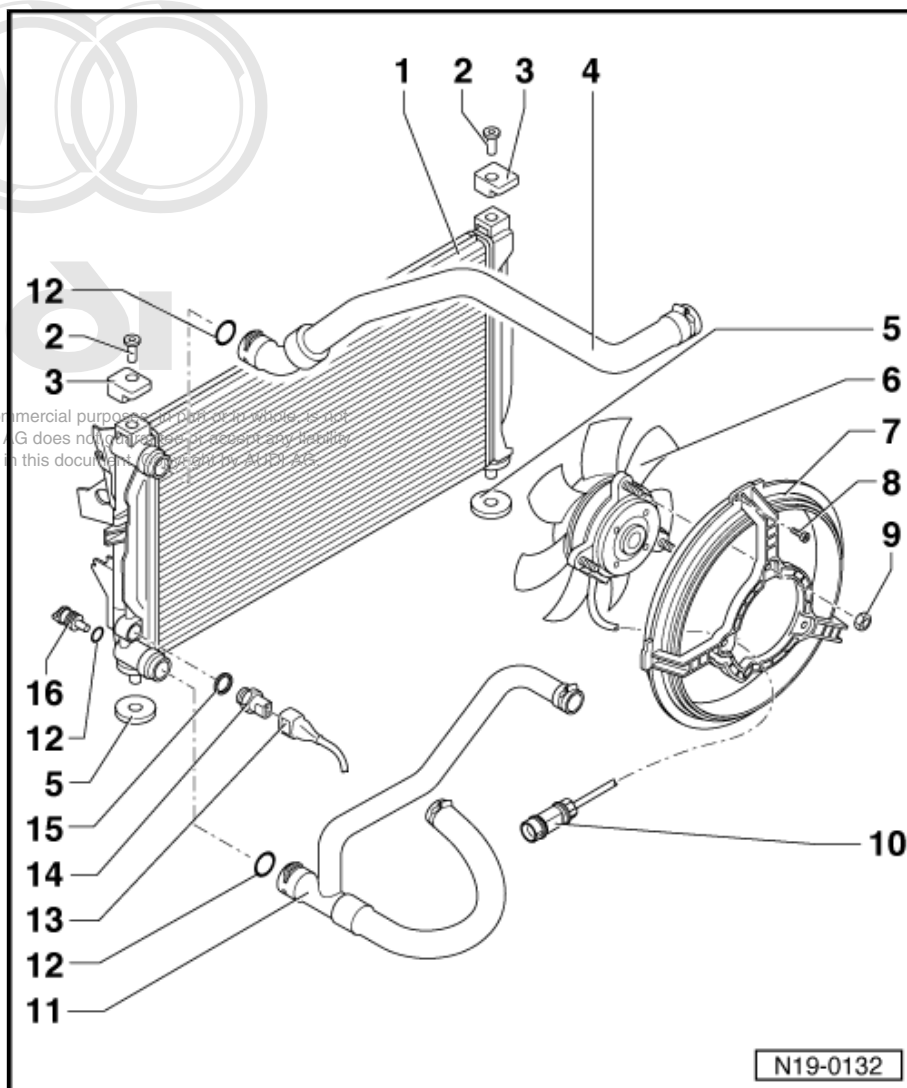
14 - Radiator fan thermal switch -F18/F54- - 35 Nm

- ☐ Switching temperatures: Stage 1 on: 92 ... 97 °C/ off: 84 ... 91°C
- ☐ Switching temperatures: Stage 2 on: 99 ... 105°C/ off: 91 ... 98°C

15 - Seal

- ☐ Renew

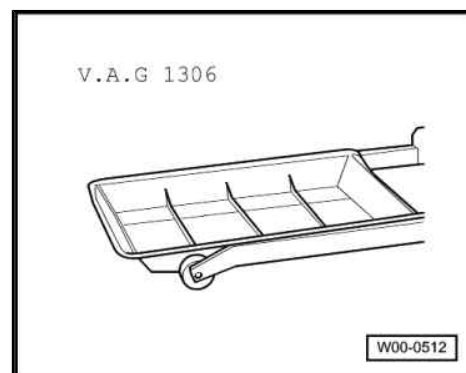
16 - Drain plug, 10 Nm



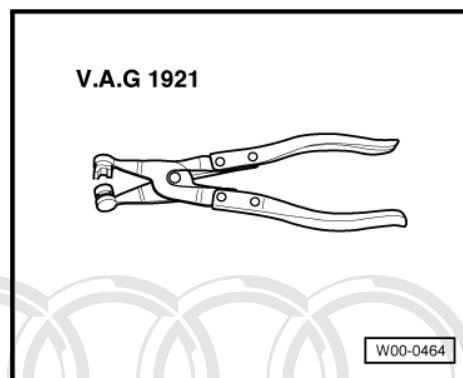
1.8 Removing and installing radiator

Special tools and workshop equipment required

- ◆ Drip tray -V.A.G 1306-



- ◆ Hose clip pliers -V.A.G 1921-



1.8.1 Removing

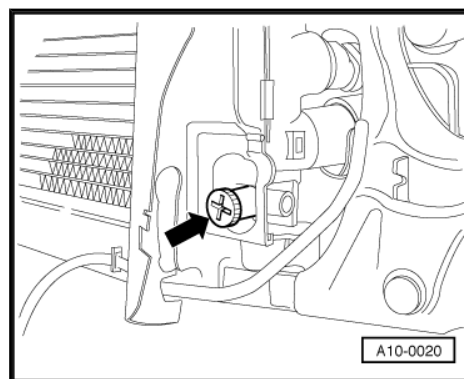
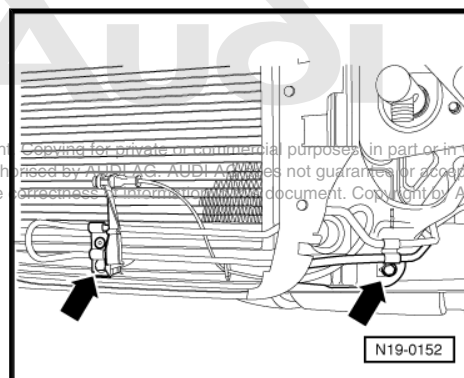
- Remove front bumper ⇒ General body repairs, exterior; Rep. Gr. 63 .
- Unbolt cooling pipe for hydraulic fluid for power steering -arrows-.



Caution

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

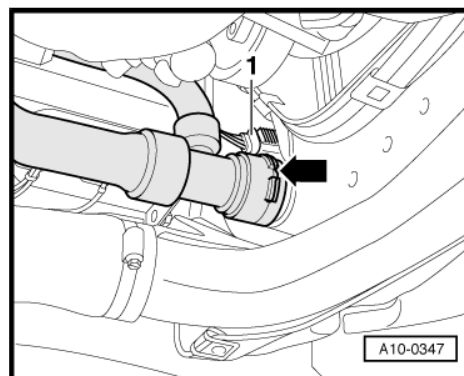
- Open filler cap on coolant expansion tank.
- Place drip tray -V.A.G 1306- under engine.
- Turn drain plug -arrow- on radiator anti-clockwise, if necessary fit drain hose to connection.



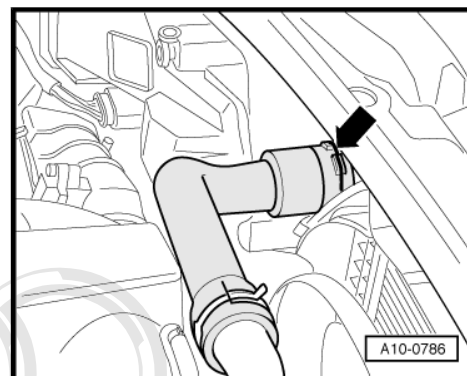
- Pull off retaining clip for coolant hose (bottom) -arrow- and remove coolant from radiator.

Vehicles with electric radiator fan:

- Unplug electrical connector -1- at radiator fan thermo-switch - F18/F54- at radiator (bottom left).



- Pull off retaining clip -arrow- for coolant hose (top) and remove coolant hose from radiator.



Vehicles with automatic gearbox:

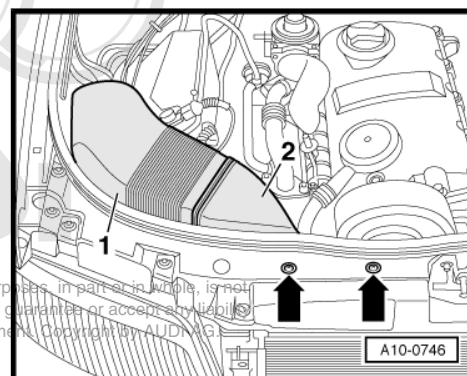
- Unscrew bolts -arrows-.
- Remove air ducts -1- and -2-.



Note!

Note the rules for cleanliness when working on the automatic gearbox ⇒ Automatic gearbox 01N; Rep. Gr. 37

- Place the drip tray underneath.
- Remove ATF pipes from radiator ⇒ Automatic gearbox 01N; Rep. Gr. 37 .
- Tie ATF lines up onto longitudinal member to prevent fluid leaking out.



Vehicles with air conditioning:



Caution

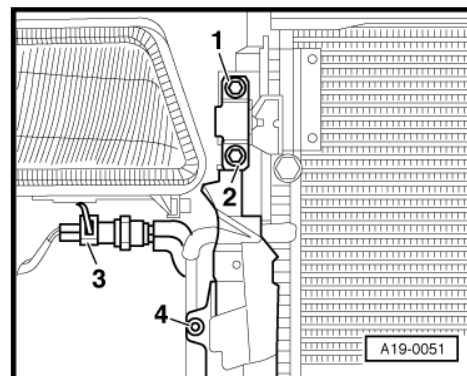
Refrigerant circuit of air conditioner must not be opened.



Note!

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

- Unscrew bolt -4- for air ducts (left and right) at radiator.
- Unscrew securing bolts -1- and -2- for condenser.
- Unplug electrical connector -3- at air conditioner pressure switch -F129- .
- Pull condenser up out of its bracket, pivot to side and secure to right-side front wheel with wire.



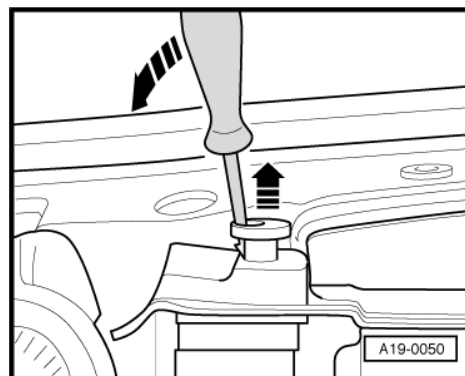
All models:



Note!

Protect wing panels from damage.

- Release two retaining pins for radiator and pull out upwards -arrows-.
- Swivel radiator forwards and lift off.



1.8.2 Installing

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

- Install lock carrier (front) ⇒ General body repairs, exterior; Rep. Gr. 63 .
- Fill cooling system ⇒ [page 143](#) .

Vehicles with automatic gearbox:

- Secure the ATF pipes ⇒ Automatic gearbox 01N; Rep. Gr. 37 .
- Check ATF level ⇒ Automatic gearbox 01N; Rep. Gr. 37 .

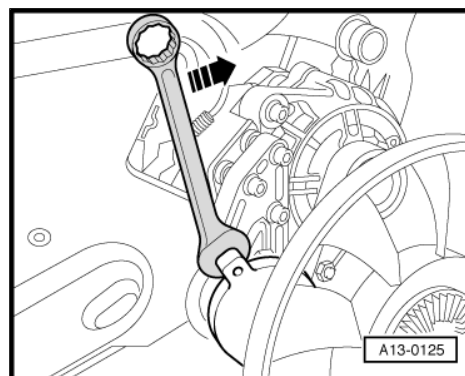
1.8.3 Tightening torques

Component	Nm
Condenser to radiator	4
Cooling pipe to radiator	9
Hose clips for coolant hoses	2

1.9 Removing and installing viscous fan

1.9.1 Removing

- Lock carrier in service position ⇒ [page 32](#) .
- Turn the tensioner in the direction of the -arrow- to slacken the poly V-belt.
- Remove poly V-belt from the alternator pulley.



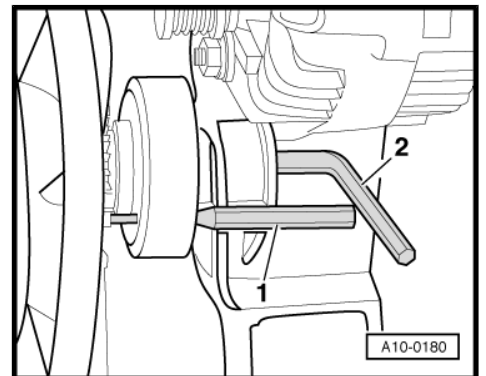
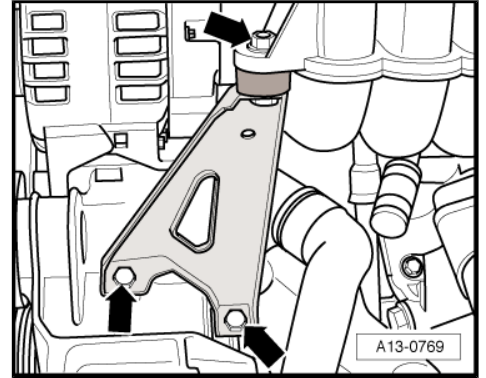
- Remove support for top section of intake manifold -arrows-.



Illustration shows vehicle with engine code letters ANA.

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- Lock pulley for viscous fan with roll-pin drift -1- and unscrew using hexagon key -2-.
- Take out viscous fan.



1.9.2 Installing

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

- Install poly V-belt → [page 38](#) .
- Install lock carrier → [page 34](#) .

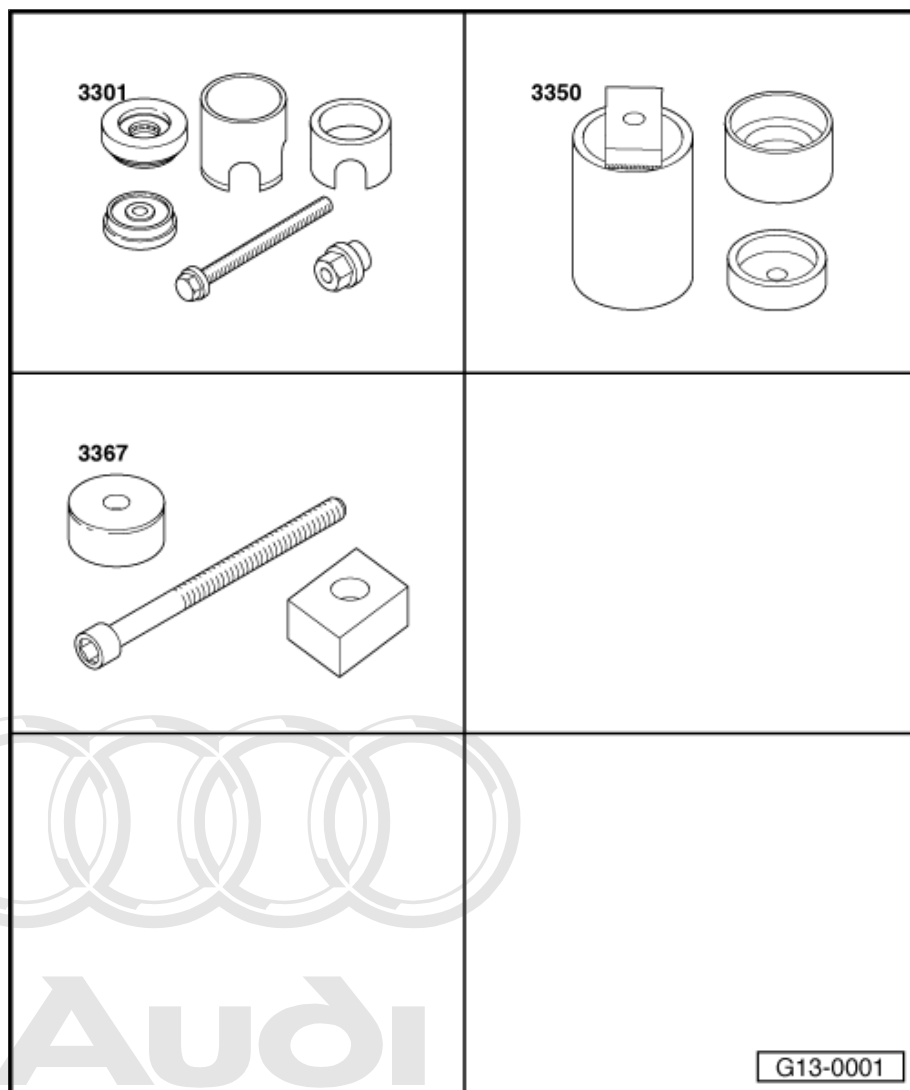
1.9.3 Tightening torques

Component		Nm
Viscous fan to bearing		45
Support for top section	Top section of intake manifold	20
of intake manifold to	Bracket	20

1.10 Removing and installing bearing for viscous fan in bracket

Special tools and workshop equipment required

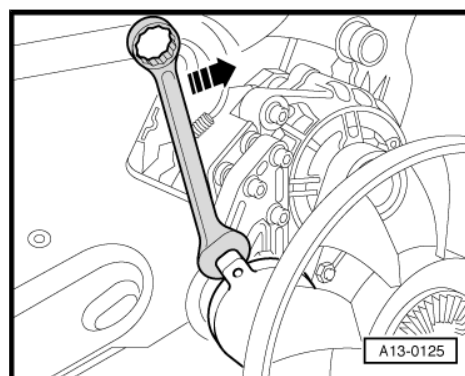
- ◆ Assembly tool -3301-
- ◆ Assembly tool -3350-
- ◆ Viscous fan fitting tool -3367-



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1.10.1 Removing

- Lock carrier in service position ⇒ [page 32](#) .
- Turn the tensioner in the direction of the -arrow- to slacken the poly V-belt.
- Remove poly V-belt from the alternator pulley.



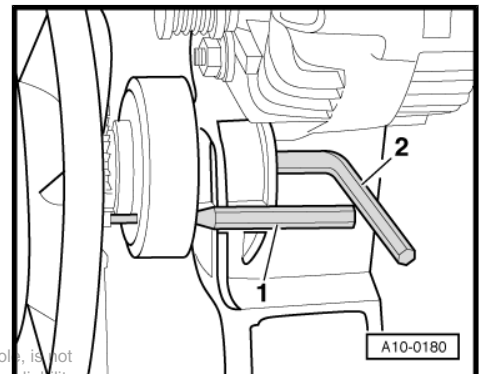
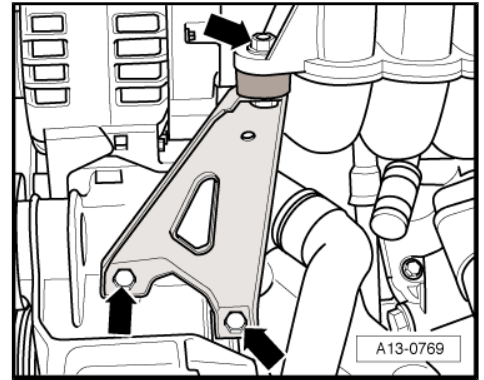
- Remove support for top section of intake manifold -arrows-.



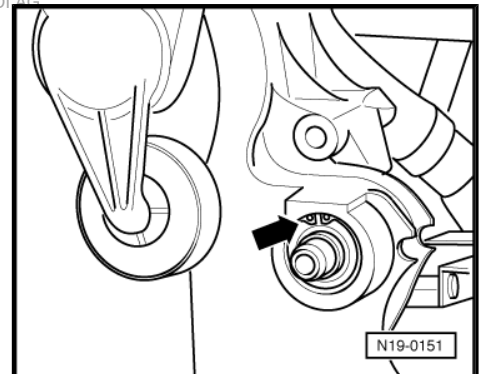
Note!

Illustration shows vehicle with engine code letters ANA.

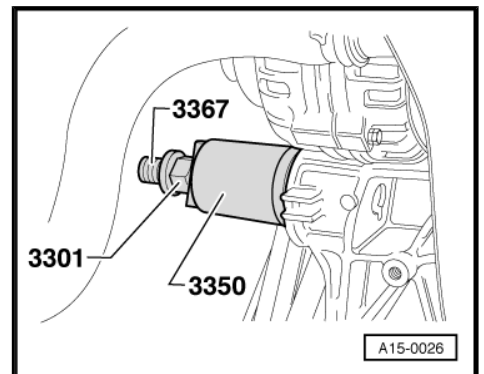
- Lock pulley for viscous fan with roll-pin drift -1- and unscrew using hexagon key -2-.
- Remove viscous fan from bearing.



- Use angled circlip pliers to remove circlip -arrow- from bearing bush.



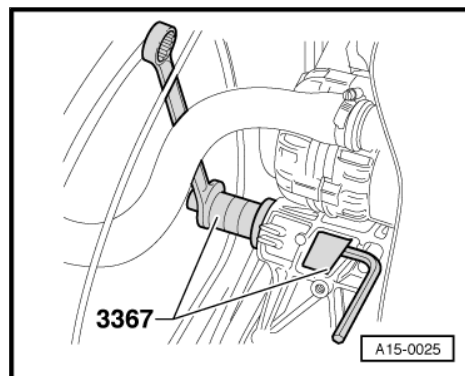
- Pull bearing out of bush using nut from assembly tool -3301-, bolt from viscous fan fitting tool -3367/3- and assembly tool -3350-.



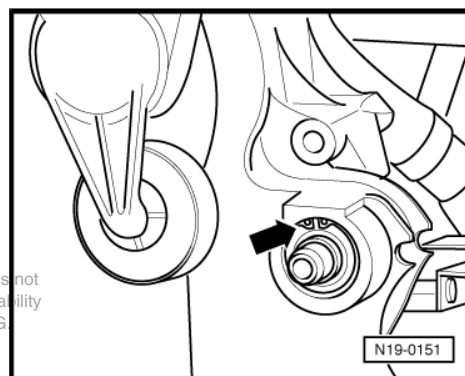
1.10.2 Installing

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

- Press bearing in, using viscous fan fitting tool -3367- and nut from assembly tool -3301- .



- Use angled circlip pliers to install circlip -arrow- in bracket for viscous fan.
- Install viscous fan ⇒ [page 160](#) .
- Install lock carrier ⇒ [page 34](#) .

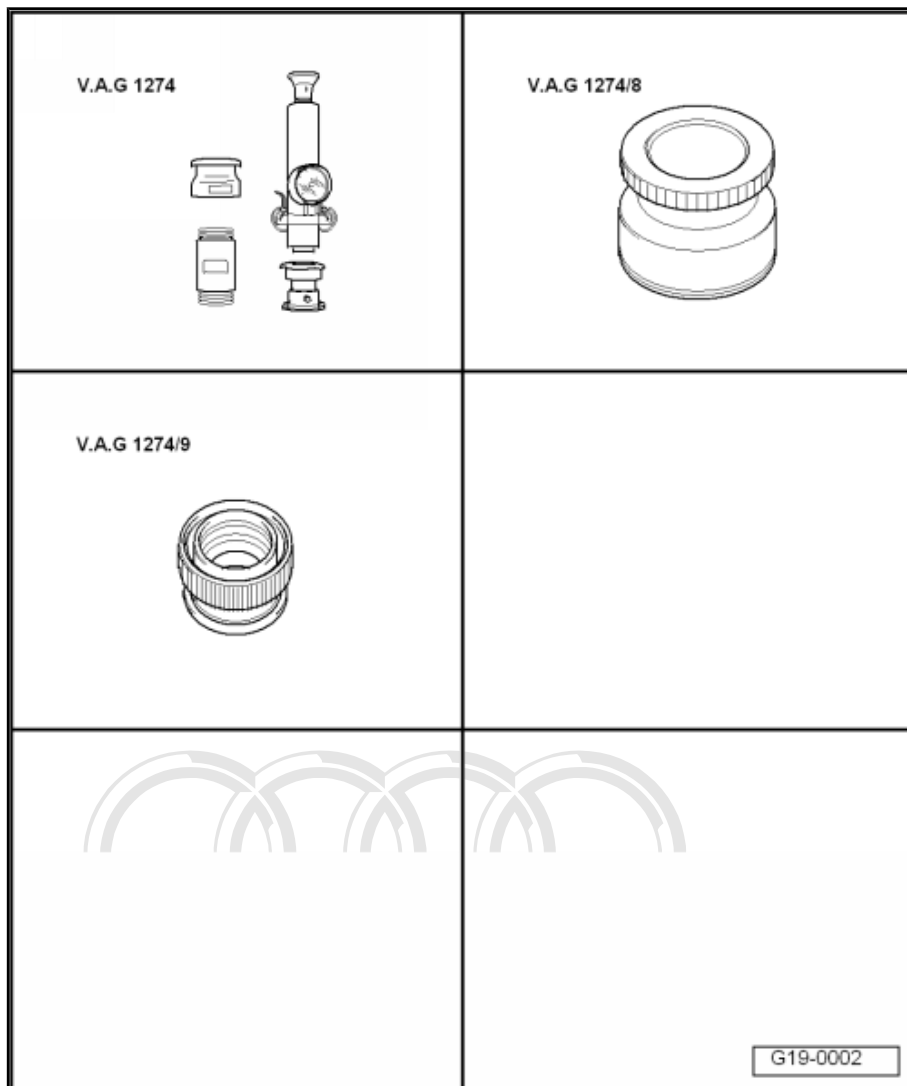


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1.11 Checking cooling system for leaks

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-



1.11.1 Test requirement

- Engine must be warm.

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1.11.2 Test sequence



Caution

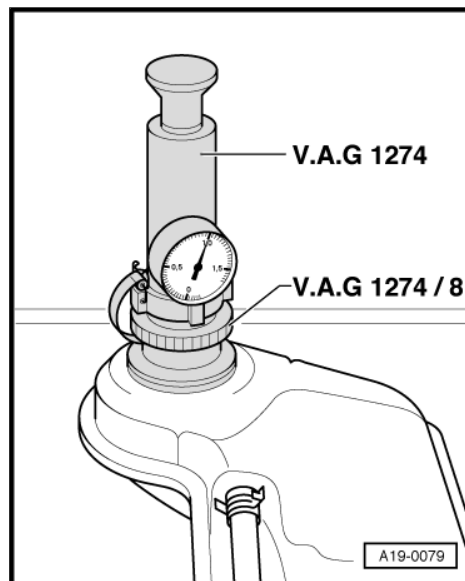
Hot steam/hot coolant may escape when opening expansion tank; cover filler cap with cloth and open carefully.

- Open filler cap on coolant expansion tank.

- 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.



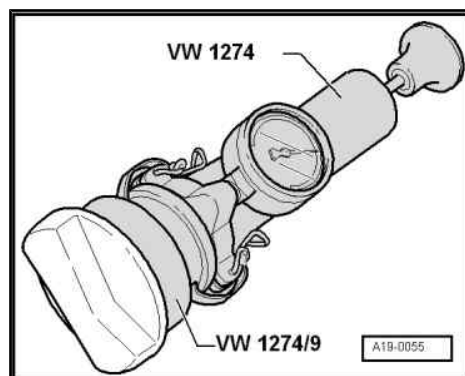
1.11.3 Checking pressure relief valve in filler cap

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

If the relief valve does not open as described:

- Renew the filler cap.



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.
- ◆ Use screwdriver to unfasten and tighten lock washers for heat shields. Tightening torque: 2 Nm

1.1 Exhaust system (engine code letters AHL, ARM) - exploded view of components

1 - 30 Nm

- ☐ Renew

2 - Gasket

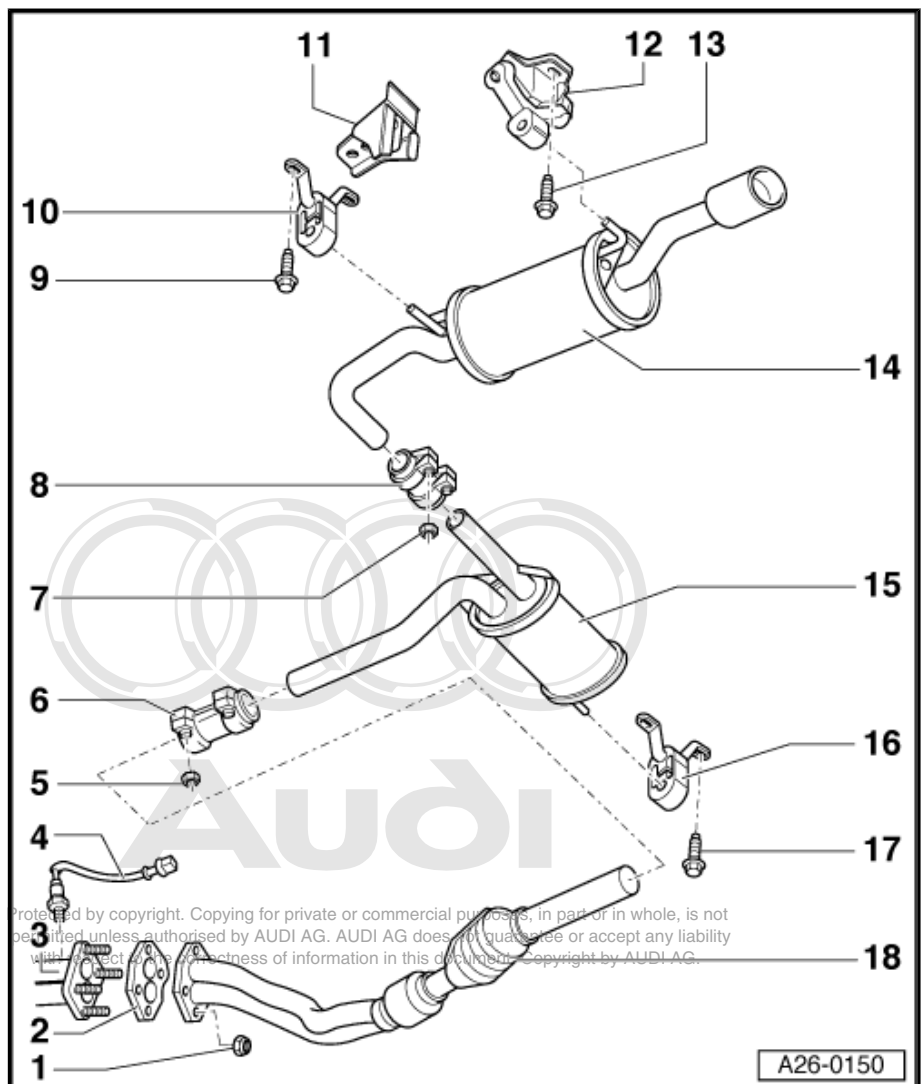
- ☐ Renew

3 - Exhaust manifold

- ☐ Removing and installing
⇒ [page 172](#)

4 - Lambda probe -G39-

- ☐ checking ⇒ Simos injection and ignition system (4-cylinder); Rep. Gr. 24
- ☐ 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
- ☐ Remove and install using ring spanner for Lambda probe -3337-
- ☐ Tighten to 55 Nm
- ☐ Connector for Lambda probe ⇒ [page 173](#)





5 - 40 Nm

6 - Clamp (front)

- ☐ Align exhaust system so it is free of stress before tightening clamp ⇒ [page 183](#)
- ☐ Installation position ⇒ [page 170](#)
- ☐ Tighten assembly evenly

7 - 40 Nm

8 - Clamp (rear)

- ☐ For separate replacement of centre and rear silencers
- ☐ Align exhaust system so it is free of stress before tightening clamp ⇒ [page 183](#)
- ☐ Installation position ⇒ [page 170](#)
- ☐ Tighten assembly evenly

9 - 25 Nm

10 - Mounting

11 - Stop plate

12 - Mounting

13 - 25 Nm

14 - Rear silencer

- ☐ Combined in one unit with centre silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting location ⇒ [page 172](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 183](#)

15 - Centre silencer

- ☐ Combined in one unit with rear silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting location ⇒ [page 172](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 183](#)

16 - Mounting

17 - 25 Nm

18 - Front exhaust pipe with catalytic converter

- ☐ With flexible joint
- ☐ Protect from damage by knocks and impacts
- ☐ De-coupling element may only be bent slightly - not more than 10°
- ☐ To remove, unbolt underbody cross member (20 Nm)
- ☐ Align exhaust system so it is free of stress ⇒ [page 183](#)

1.2 Exhaust system (engine code letters ANA) - exploded view of components

1 - 40 Nm

2 - Clamp (rear)

- ☐ For separate replacement of centre and rear silencers
- ☐ Align exhaust system so it is free of stress before tightening clamp
⇒ [page 183](#)
- ☐ Installation position
⇒ [page 170](#)
- ☐ Tighten assembly evenly

3 - 25 Nm

4 - Mounting

5 - Stop plate

6 - 25 Nm

7 - 25 Nm

- ☐ Renew

8 - 30 Nm

- ☐ Renew

9 - Gasket

- ☐ Renew

10 - Exhaust manifold

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

11 - Catalytic converter

- ☐ Protect from damage by knocks and impacts
- ☐ Removing and installing
⇒ [page 177](#)

12 - Lambda probe -G39-

- ☐ checking ⇒ Simos injection and ignition system (4-cylinder); Rep. Gr. 24
- ☐ 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
- ☐ Remove and install using ring spanner for Lambda probe -3337-
- ☐ Tighten to 55 Nm
- ☐ Connector for Lambda probe ⇒ [page 173](#)

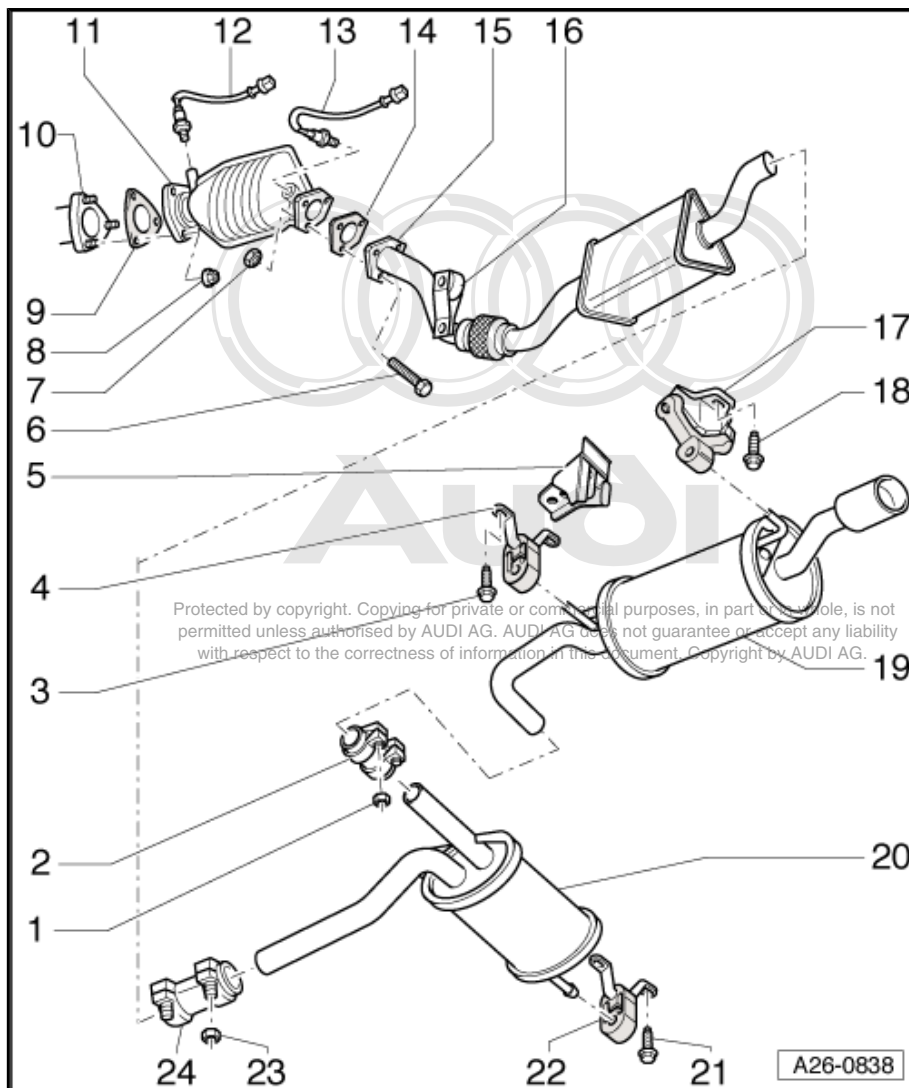
13 - Lambda probe after catalytic converter -G130-

14 - Gasket

- ☐ Renew

15 - Front exhaust pipe with front silencer

- ☐ With flexible joint
- ☐ Do not bend flexible joint more than 10° - otherwise it can be damaged
- ☐ Removing and installing ⇒ [page 182](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 183](#)



16 - Mounting

- ☐ Mounting components ⇒ [page 171](#)

17 - Mounting

18 - 25 Nm

19 - Rear silencer

- ☐ Combined in one unit with centre silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting location ⇒ [page 172](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 183](#)

20 - Centre silencer

- ☐ Combined in one unit with rear silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting location ⇒ [page 172](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 183](#)

21 - 25 Nm

22 - Mounting

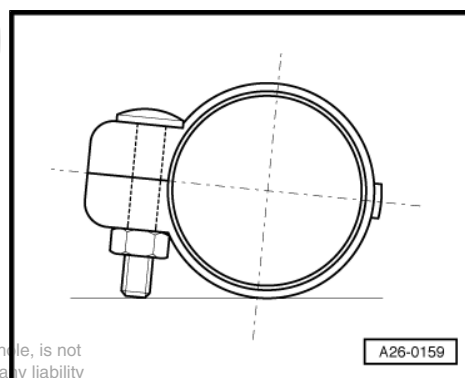
23 - 40 Nm

24 - Clamp (front)

- ☐ Align exhaust system so it is free of stress before tightening clamp ⇒ [page 183](#)
- ☐ Installation position ⇒ [page 170](#)
- ☐ Tighten assembly evenly

Installation position of front clamp

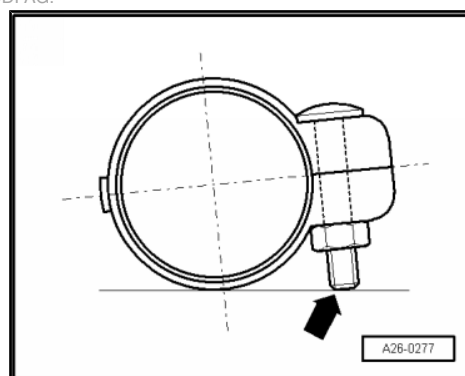
- Install clamp so that the bolt ends do not protrude beyond bottom of clamp.
- Bolt connection faces to left.



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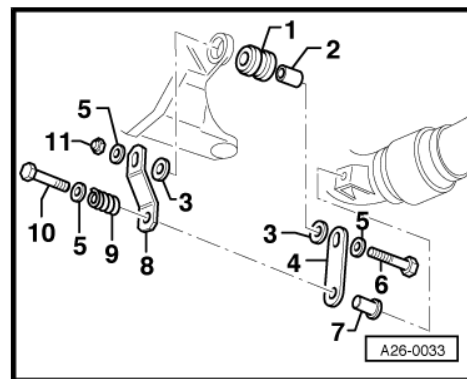
Installation position of rear clamp

- When fitting clamp, make sure the end of the bolt does not project below the bottom of the clamp -arrow-.
- Bolt connection faces to rear



Components of exhaust pipe mountings for vehicles with manual gearbox

- 1 - Buffer
- 2 - Spacer
- 3 - Washer
- 4 - Bracket (right-side)
- 5 - Washer
- 6 - Bolt -25 Nm-
- 7 - Spacer sleeve
- 8 - Bracket (left-side)
- 9 - Compression spring
- 10 - Bolt -25 Nm-
- 11 - Nut, self-locking -25 Nm-

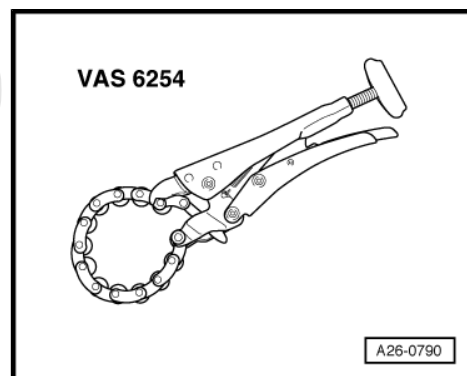


1.3 Separating centre and rear silencers

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

Special tools and workshop equipment required

- ◆ Chain tube cutter -VAS 6254-



- ◆ Safety goggles

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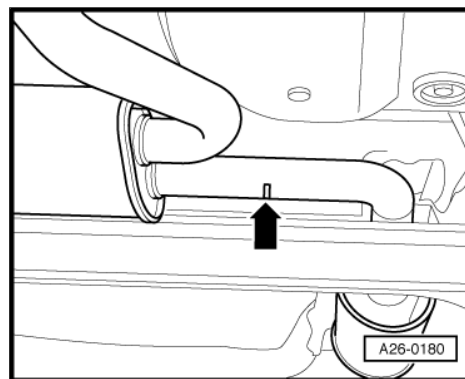
1.3.1 Procedure



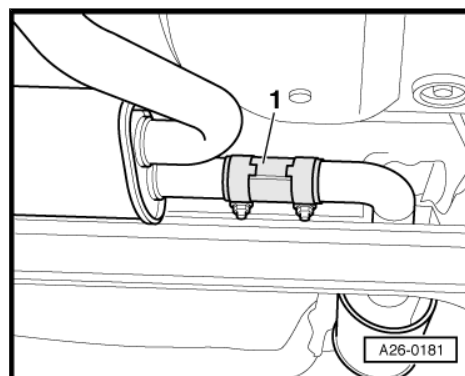
Caution

Wear safety goggles.

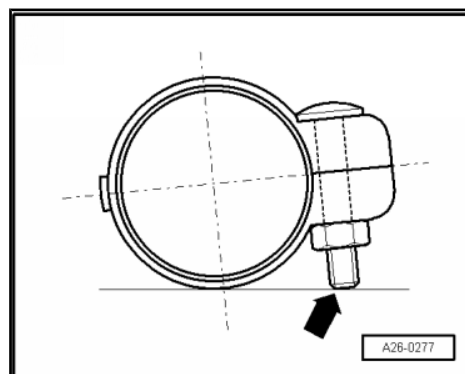
- Cut through exhaust pipe at a right angle at cutting point -arrow- using pipe cutter -VAS 6254- .



- When reassembling, position the clamp -1- so that the middle is over the cutting point.



- When fitting clamp, make sure the end of the bolt does not project below the bottom of the clamp -arrow-.
- Bolt connection faces to rear
- Align exhaust system free of stress ⇒ [page 183](#) .



1.4 Removing and installing exhaust manifold - vehicles with engine code letters AHL, ARM



Note!

- ◆ *Renew gaskets and self-locking nuts.*
- ◆ *The flexible pipe connection (de-coupling element) on the front exhaust pipe must not be bent more than 10° - otherwise it can be damaged.*

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1.4.1 Removing

- Unbolt coolant expansion tank -2- -arrows-.
- Disconnect wire for coolant shortage indicator switch -F66- and move coolant expansion tank to one side.



Note!

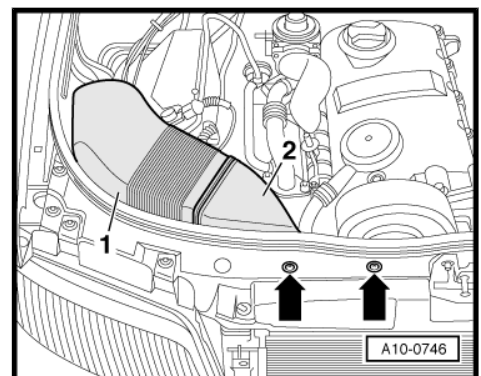
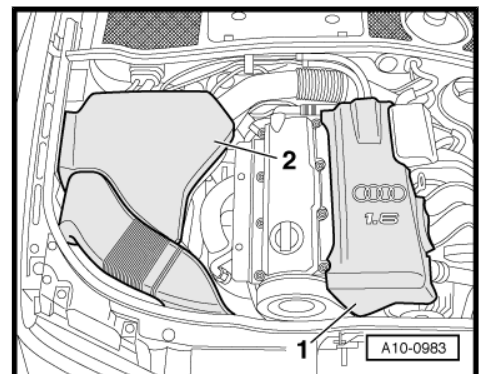
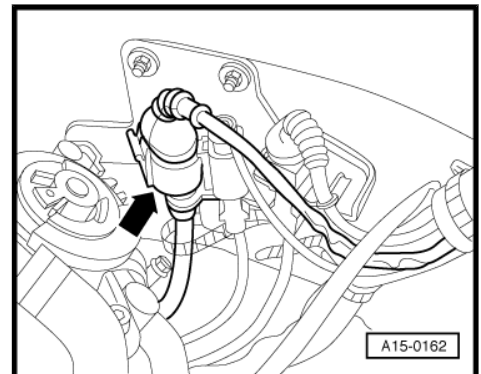
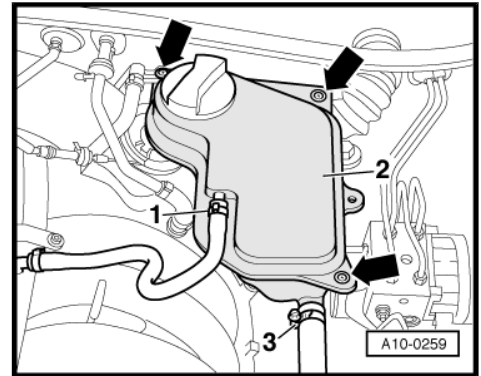
Coolant hoses -1- and -3- remain connected.

- Unplug electrical connector -arrow- for Lambda probe -G39- and move wiring clear.

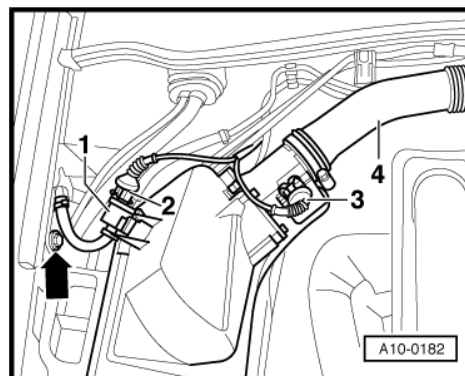
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- Remove air cleaner cover -2-.

- Unscrew bolts -arrows-.
- Remove air ducts -1- and -2-.

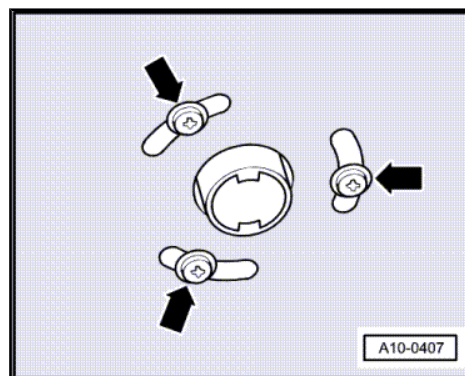


- Unplug electrical connectors -2- and -3- for solenoid valve 1 for activated charcoal filter system -N80- and air mass meter -G70- .
- Disconnect the solenoid valve 1 for activated charcoal filter system -N80- -Item 1- at air cleaner housing.
- Loosen bolt -arrow- and remove air cleaner housing from air duct -4-.



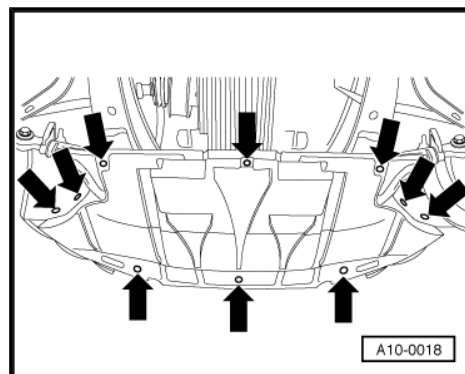
Vehicles with auxiliary heater:

- Remove bolts -arrows- securing exhaust pipe for auxiliary/additional heater to noise insulation.



All models:

- Remove noise insulation -arrows-.

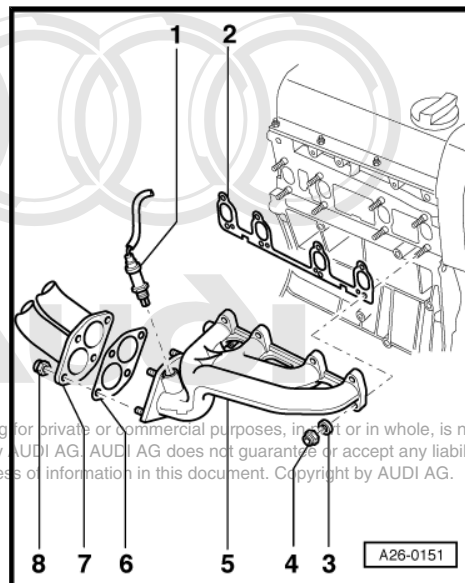


- Unscrew securing nuts for exhaust manifold/front exhaust pipe (accessible from below).
- Unbolt front exhaust pipe -7- from exhaust manifold -5- and push slightly towards rear.
- Unbolt exhaust manifold -5- from cylinder head.
- Remove exhaust manifold with Lambda probe -1-.



Note!

The flexible joint in front exhaust pipe must not be bent more than 10° to avoid any damage.



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1.4.2 Installing

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

- Renew gaskets -2- and -6- for exhaust manifold.
- Renew self-locking nuts -4- and -8-.
- Fit washers -3- underneath nuts -4-.
- Align exhaust system free of stress ⇒ [page 183](#) .
- Interrogate fault memory ⇒ Simos injection and ignition system (4-cylinder); Rep. Gr. 01 .

1.4.3 Tightening torques

Component	Nm
Exhaust manifold to cylinder head	25 ²⁴⁾ ²⁵⁾
Front exhaust pipe to exhaust manifold	30 ²⁴⁾ ²⁵⁾

24) Coat exhaust manifold studs with high-temperature lubricant; for high-temperature lubricant refer to ⇒ Parts catalogue .

25) Renew self-locking nuts.

1.5 Removing and installing exhaust manifold - vehicles with engine code letters ANA



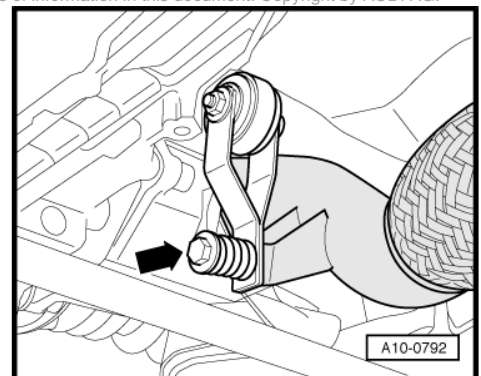
Note!

- ◆ *Renew gaskets and self-locking nuts.*
- ◆ *The flexible joint in front exhaust pipe must not be bent more than 10 ° to avoid any damage.*

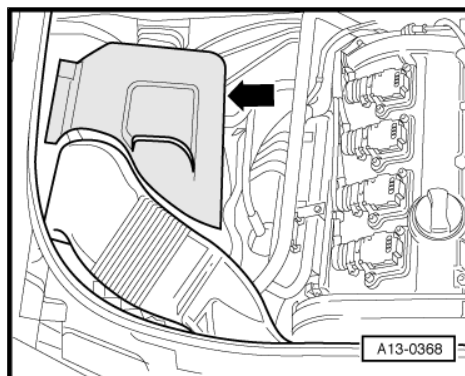
1.5.1 Removing

- Detach exhaust system at gearbox bracket -arrow-.

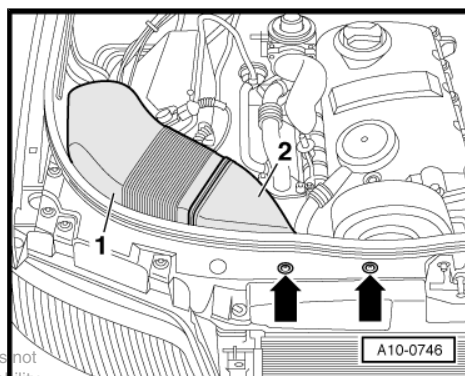
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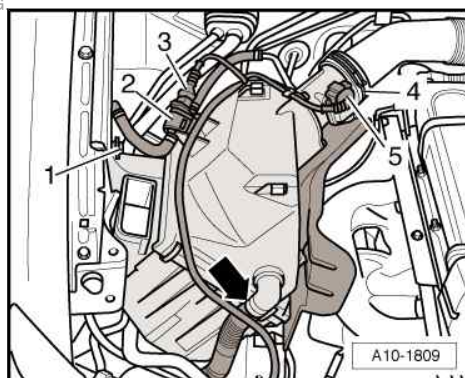
- Detach air cleaner cover -arrow-.



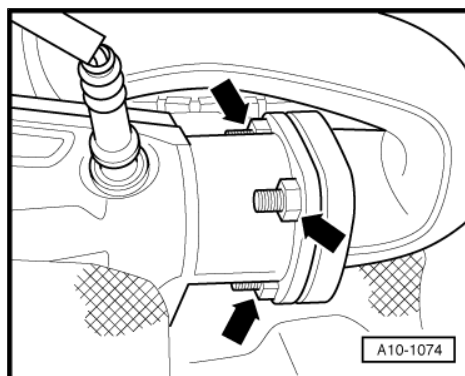
- Unscrew bolts -arrows-.
- Remove air ducts -1- and -2-.



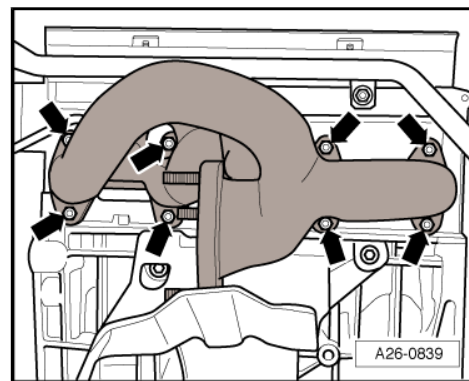
- Unplug electrical connectors -3- and -5- for solenoid valve 1 for activated charcoal filter system -N80- and air mass meter -G70- .
- Disconnect the solenoid valve 1 for activated charcoal filter system -N80- -Item 2- at air cleaner housing.
- Detach hose connection going to secondary air pump -V101- -arrow-.
- Release hose clip -4- for air duct at air mass meter -G70- .
- Unscrew bolt -1- and remove air cleaner housing.



- Unbolt catalytic converter from exhaust manifold -arrows-.
- Detach exhaust system from flange for exhaust manifold.



- Unscrew all nuts -arrows- on exhaust manifold.
- Remove washers and exhaust manifold.



1.5.2 Installing

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



Note!

Renew gaskets and self-locking nuts.

1.5.3 Tightening torques

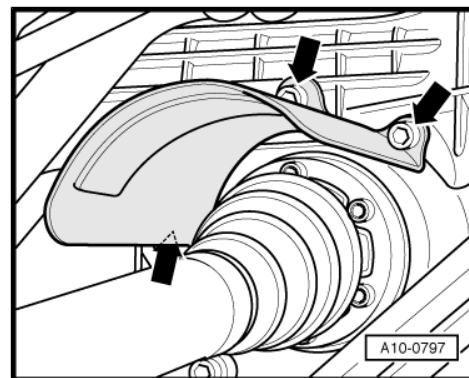
Component	Nm
Exhaust manifold to cylinder head	25 ²⁶⁾ ²⁷⁾
Catalytic converter to exhaust manifold	30 ²⁶⁾ ²⁷⁾
Gearbox bracket for exhaust system to front exhaust pipe	25

26) Coat exhaust manifold studs with high-temperature lubricant; for high-temperature lubricant refer to ⇒ Parts catalogue .

27) Renew self-locking nuts.

1.6 Removing and installing catalytic converter - vehicles with engine code letters ANA

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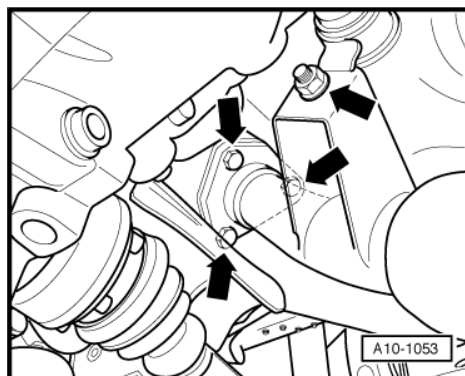
1.6.1 Removing

- Detach heat shield -arrows- above drive shaft (right-side).

- Remove bolts -arrows- securing catalytic converter to front exhaust pipe.
- Detach exhaust system at gearbox bracket -arrow-.


Note!

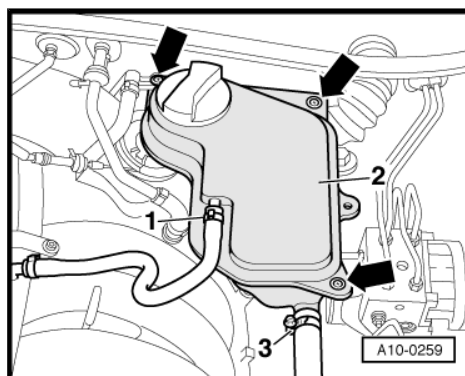
The flexible pipe connection (de-coupling element) on the front exhaust pipe must not be bent more than 10° - otherwise it can be damaged.



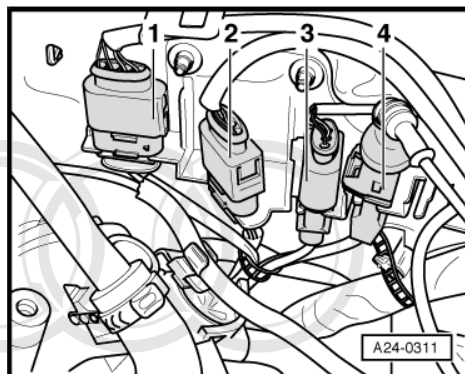
- Unbolt coolant expansion tank -2- -arrows-.
- Disconnect wire for coolant shortage indicator switch -F66- and move coolant expansion tank to one side.


Note!

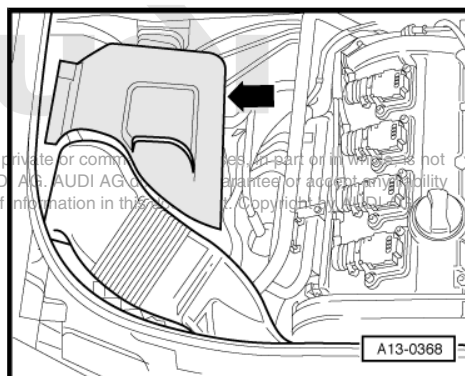
Coolant hoses -1- and -3- remain connected.



- Unplug electrical connectors -1- and -2- for Lambda probe -G39- (before catalytic converter) and Lambda probe -G130- (after catalytic converter).
- 1 - Brown, going to Lambda probe -G130- (after catalytic converter)
 - 2 - Black, going to Lambda probe -G39- (before catalytic converter)

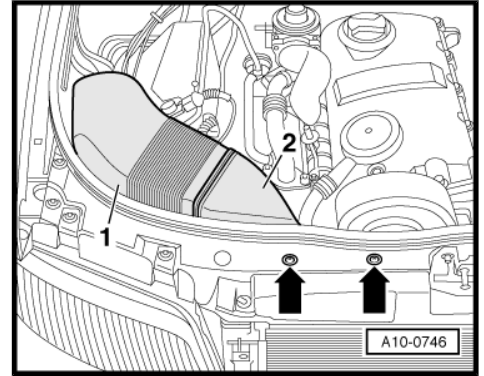


- Detach air cleaner cover -arrow-.

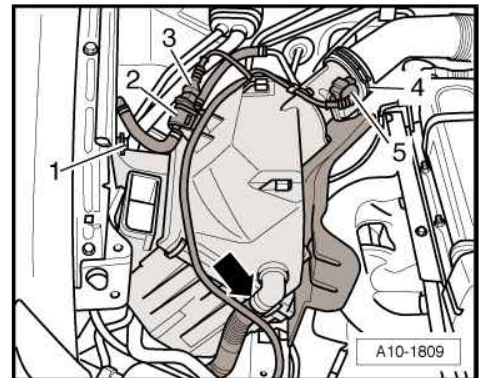


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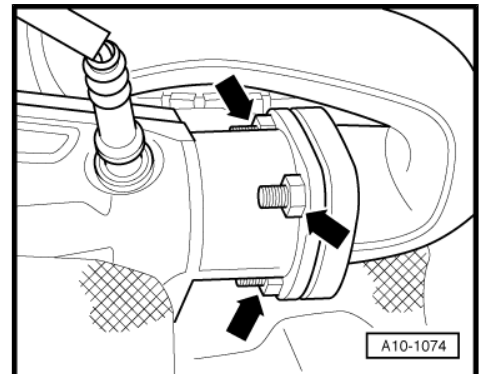
- Unscrew bolts -arrows-.
- Remove air ducts -1- and -2-.



- Unplug electrical connectors -3- and -5- for solenoid valve 1 for activated charcoal filter system -N80- and air mass meter -G70- .
- Disconnect the solenoid valve 1 for activated charcoal filter system -N80- -Item 2- at air cleaner housing.
- Detach hose connection going to secondary air pump -V101- -arrow-.
- Release hose clip -4- for air duct at air mass meter.
- Unscrew bolt -1- and remove air cleaner housing.



- Unbolt catalytic converter from exhaust manifold -arrows-.
- Carefully lift out catalytic converter with Lambda probes.



1.6.2 Installing

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



Note!

Renew gaskets and self-locking nuts.

- Align exhaust system free of stress ⇒ [page 183](#) .

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1.6.3 Tightening torques

Components	Nm
Catalytic converter to exhaust manifold	30 ²⁸⁾ ²⁹⁾
Front exhaust pipe to catalytic converter	25 ²⁹⁾
Front exhaust pipe to gearbox bracket	25
Heat shield to gearbox	23

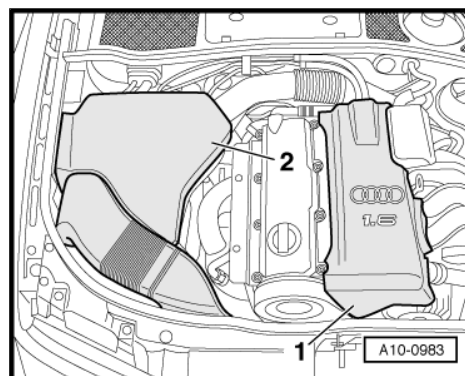
28) Coat exhaust manifold studs with high-temperature lubricant; for high-temperature lubricant refer to ⇒ Parts catalogue .

29) Renew self-locking nuts.

1.7 Removing and installing front exhaust pipe - vehicles with engine code letters AHL, ARM

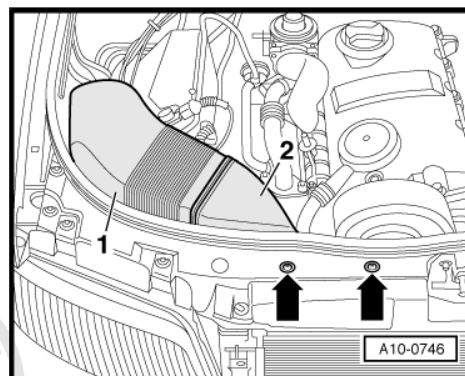
1.7.1 Removing

- Remove air cleaner cover -2-.

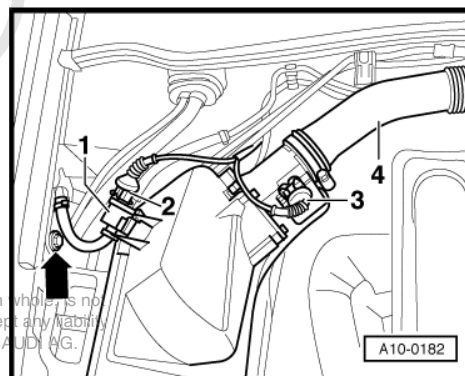


- Unscrew bolts -arrows-.

- Remove air ducts -1- and -2-.



- Unplug electrical connectors -2- and -3- for solenoid valve 1 for activated charcoal filter system -N80- and air mass meter -G70- .
- Disconnect the solenoid valve 1 for activated charcoal filter system -N80- -Item 1- at air cleaner housing.
- Loosen bolt -arrow- and remove air cleaner housing from air duct -4-.
- Unscrew securing nuts for exhaust manifold/front exhaust pipe (accessible from above).



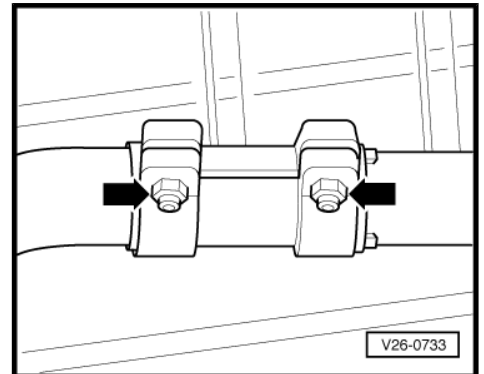
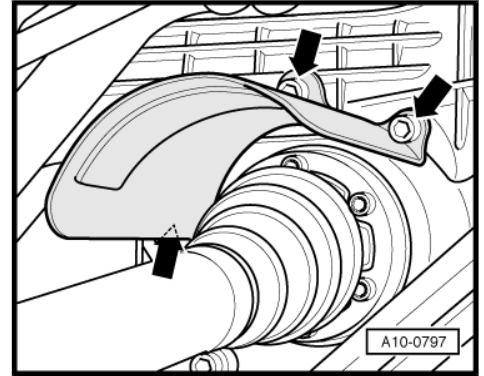
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- Detach heat shield -arrows- above drive shaft (right-side).
- Unscrew securing nuts for exhaust manifold/front exhaust pipe (accessible from below).

 Note!

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

- Remove underbody cross member.
- Separate exhaust system at clamp -arrows-.
- Remove front exhaust pipe.



1.7.2 Installing

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

 Note!

Renew gaskets and self-locking nuts.

- Align exhaust system free of stress ⇒ [page 183](#).

1.7.3 Tightening torques

Components	Nm
Front exhaust pipe to exhaust manifold	30 ³⁰⁾ ³¹⁾
Underbody cross member to body	20
Heat shield to gearbox	23

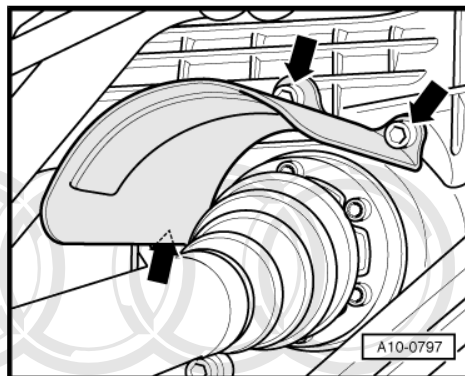
30) Coat exhaust manifold studs with high-temperature lubricant; for high-temperature lubricant refer to ⇒ Parts catalogue

31) Renew self-locking nuts

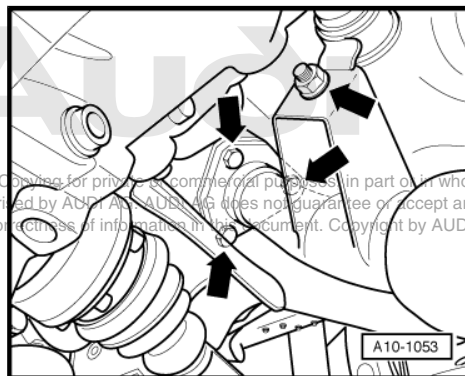
1.8 Removing and installing front exhaust pipe - vehicles with engine code letters ANA

1.8.1 Removing

- Detach heat shield -arrows- above drive shaft (right-side).



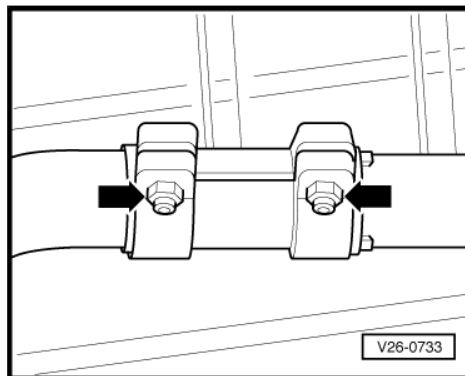
- Remove bolts -arrows- securing catalytic converter to front exhaust pipe.
- Detach exhaust system at gearbox bracket -arrow-.



Note!

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

- Remove underbody cross member.
- Separate exhaust system at clamp -arrows-.
- Remove front exhaust pipe.



1.8.2 Installing

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



Note!

Renew gaskets and self-locking nuts.

- Align exhaust system free of stress ⇒ [page 183](#) .

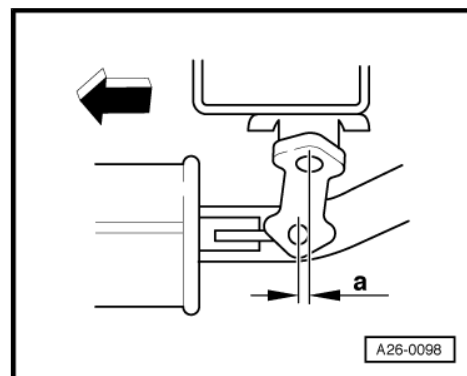
1.8.3 Tightening torques

Components	Nm
Front exhaust pipe to catalytic converter	25 ³²⁾
Underbody cross member to body	20
Heat shield to gearbox	23

32) Renew self-locking nuts

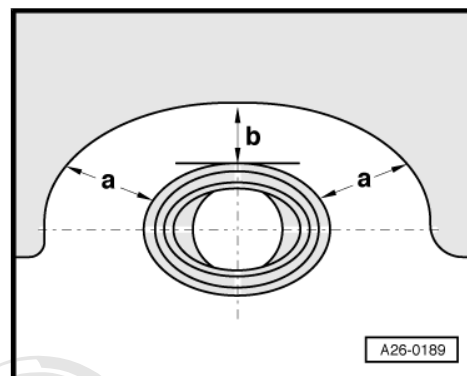
1.9 Stress-free alignment of exhaust system

- The exhaust system must be aligned when it is cool.
- Loosen bolts on clamp (front) ⇒ [Item 6 \(page 168\)](#) or ⇒ [Item 24 \(page 170\)](#) .
- Push exhaust system towards front of vehicle -arrow-, so that rear mounting for rear silencer is preloaded by -a- = 7 ... 9 mm.
- Tighten bolts on clamp evenly to 40 Nm.



Tailpipe alignment

- Align rear silencer so that there is an equal distance -a- and -b- between the cut-out in the bumper and the tailpipe.
- Distance -a- and -b- = 33 ... 39 mm



1.10 Checking exhaust system for leaks

- Start the engine and run at idling speed.
- Plug tailpipe with cloths or stoppers until check is completed.
- Listen for noise at connection points (cylinder head/exhaust manifold, exhaust manifold/catalytic converter, etc.) to locate any leaks.
- Rectify any leaks that are found.

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2 Exhaust gas recirculation system - vehicles with engine code letters ANA



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 system is activated by the engine control unit via the exhaust gas recirculation valve -N18-.*
- ◆ *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.*

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2.1 Exhaust gas recirculation system - exploded view of components

1 - Union nut -25 Nm-

2 - Sealing bush

3 - 10 Nm

4 - Connecting flange

- ☐ On cylinder head (rear right)

5 - 10 Nm

6 - Gasket

- ☐ Renew

7 - Connecting hose

- ☐ Leading to secondary air pump motor -V101-

8 - Combination valve for secondary air

- ☐ Fitting location
⇒ [page 196](#)
- ☐ Checking ⇒ [page 208](#)
- ☐ Removing and installing
⇒ [page 210](#)

9 - Gasket

- ☐ Renew

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

- ☐ After renewing, adapt to engine control unit ⇒ Simos injection and ignition system (4-cyl.); Rep. Gr. 24
- ☐ Checking adaption of zero position
⇒ [page 186](#)
- ☐ Checking (electrical test) ⇒ [page 187](#)

11 - Vent pipe

- ☐ Leading to air intake hose

12 - Throttle valve module -J338-

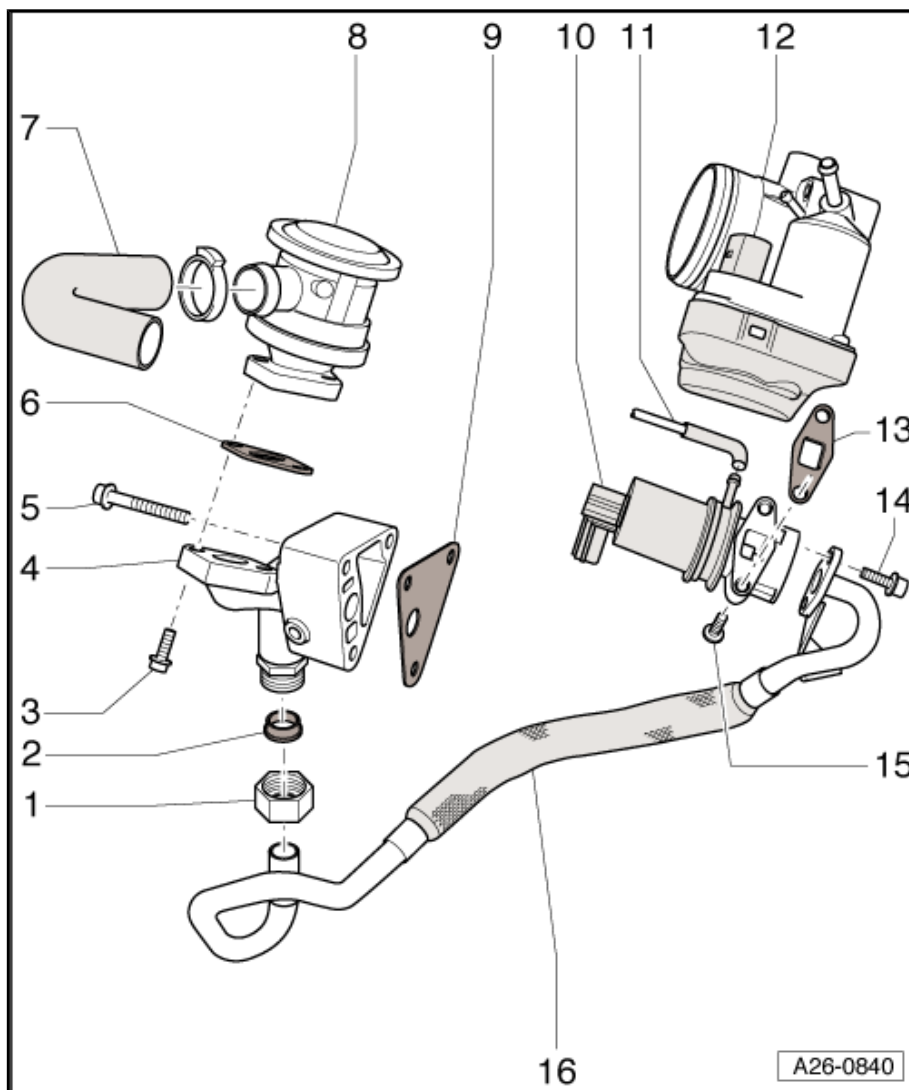
13 - Gasket

- ☐ Renew

14 - 10 Nm

15 - 10 Nm

16 - Connecting pipe for exhaust gas recirculation



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

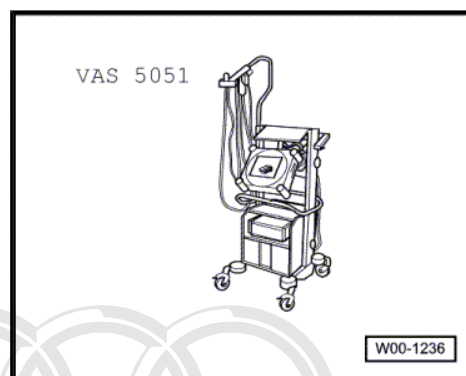


Note!

- ◆ 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. ⇒ Simos injection and ignition system (4-cyl.); 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-



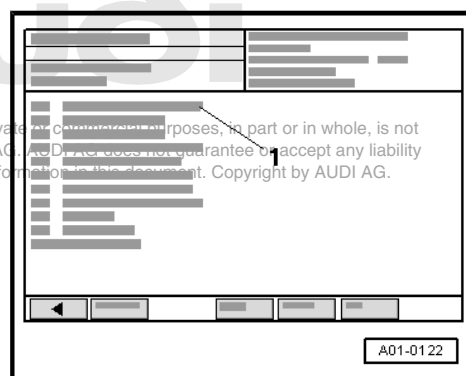
2.2.1 Test sequence

- Connect vehicle diagnostic, testing and information system -VAS 5051- and select vehicle system "01 - Engine electronics" from list. Engine must be idling ⇒ Simos injection and ignition system (4-cyl.); Rep. Gr. 01 .

Display on -VAS 5051- :

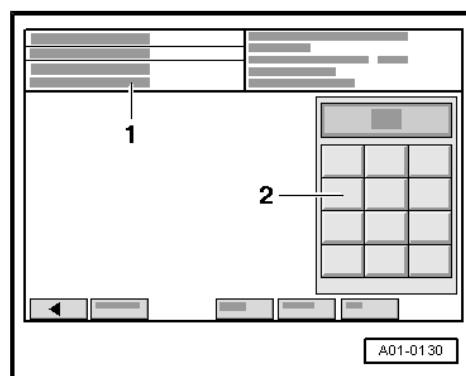
- Under -1- select diagnostic function "04 - Basic setting".

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Display on -VAS 5051- :

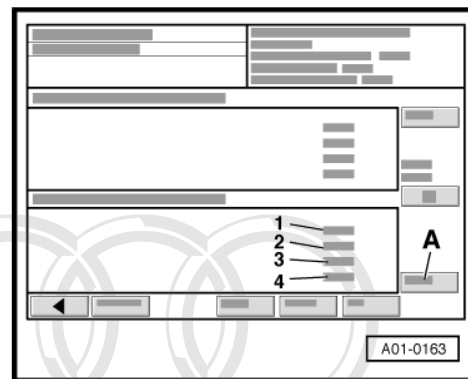
- 1 - Enter display group
- Use keypad -2- to enter "074" for "display group number 074" and confirm the entry by pressing the **Q** key.



Display on -VAS 5051- :

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

Display zone	Readout	Specification
1	Zero position: x.x V	0.3 ... 1.2 V ³³⁾
4	Adaption status: ADP. runs ADP. O.K. ERROR	ADP. O.K. ³⁴⁾



33) If the specification is not attained, check the exhaust gas recirculation valve for dirt and foreign objects; renew valve if necessary.

34) If specification is not attained: Perform electrical test of exhaust gas recirculation valve.



Note!

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

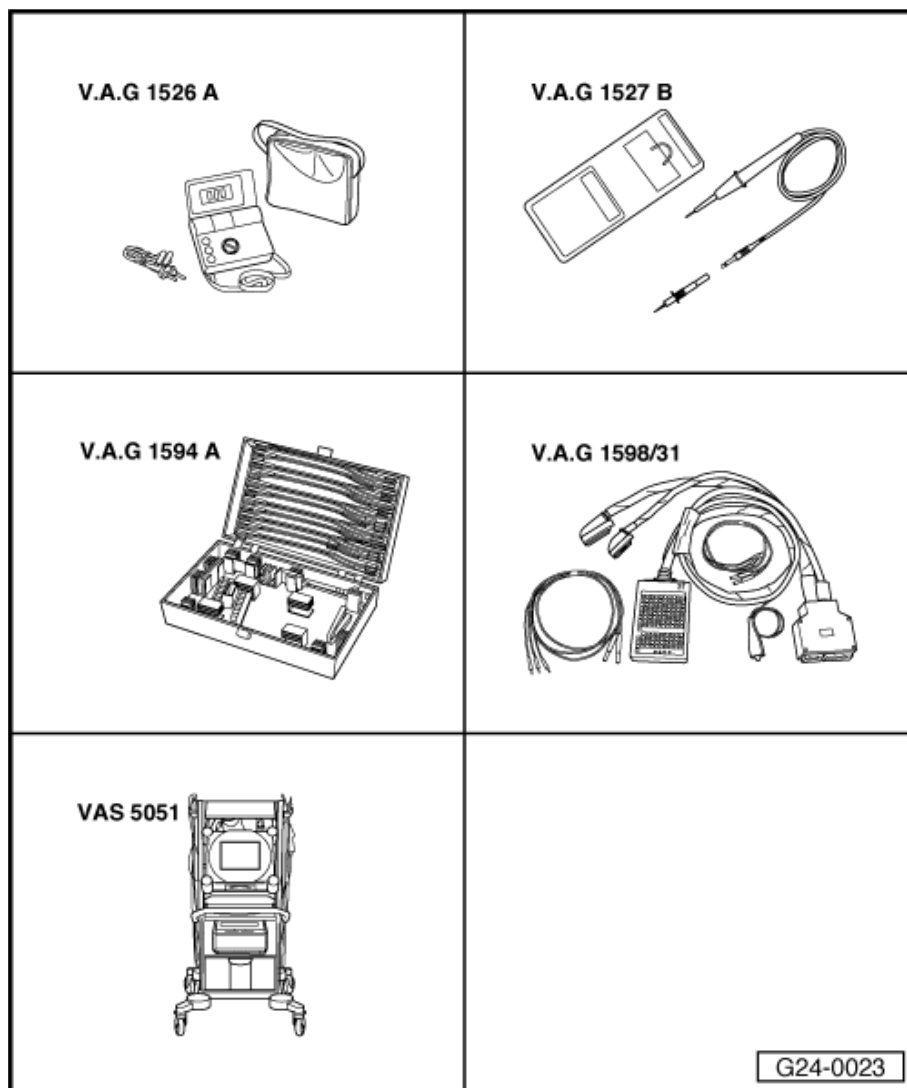
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- Terminate function "04 - Basic setting" by pressing the  key.
- Press "06 - End output".
- Switch off ignition.

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 A-
- ◆ Voltage tester -V.A.G 1527 B-
- ◆ Adapter set -V.A.G 1594 A-
- ◆ Test box -V.A.G 1598/31-
- ◆ Vehicle diagnosis, testing and information system - VAS 5051-



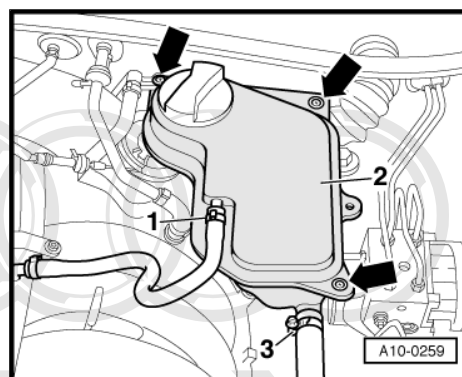
2.3.1 Checking internal resistance

- Unbolt coolant expansion tank -2- -arrows-.
- Disconnect wire for coolant shortage indicator switch -F66- and move coolant expansion tank to one side.



Note!

Coolant hoses -1- and -3- remain connected.

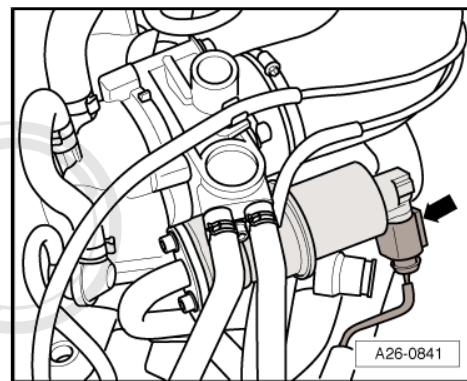


- Unplug electrical connector -arrow-.



Note!

Illustration shows engine removed.



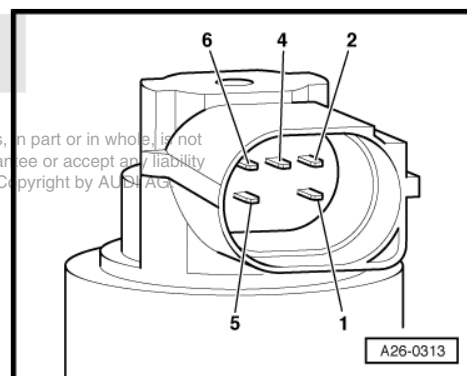
- :Connect up multimeter for resistance measurement as follows.

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

If the specifications are not obtained:

- Renew the exhaust gas recirculation valve -N18- with exhaust gas recirculation potentiometer -G212- → [page 193](#) .

If the specifications are obtained, check power supply for exhaust gas recirculation valve -N18- .



2.3.2 Checking power supply for exhaust gas recirculation valve -N18-

Test condition:

- Check that current supply relay for Simos control unit -J363- is OK. ⇒ Simos injection and ignition system (4-cyl.); Rep. Gr. 28



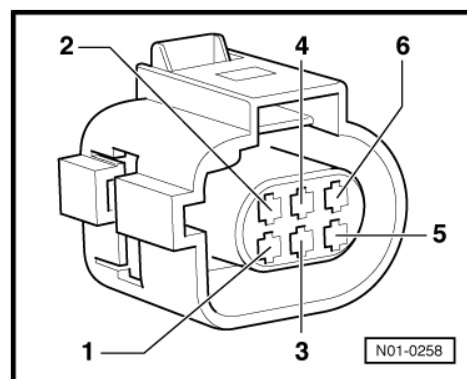
Note!

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

- Connect voltage tester -V.A.G 1527 B- as follows:

Connector Contact	Measure against
-1-	Engine earth

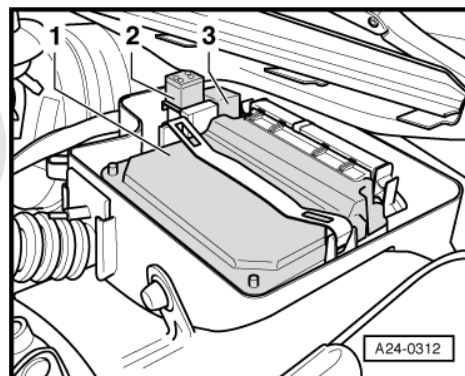
- Switch on ignition.
- The LED should light up.
- Switch off ignition.



If the LED does not light up:

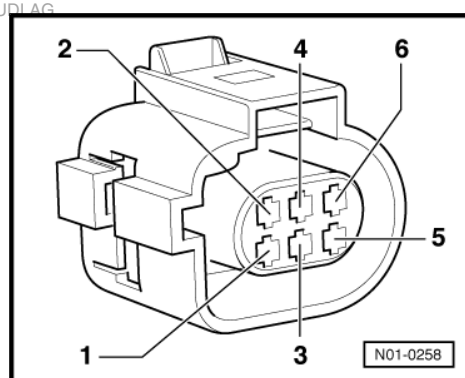
- Refer to current flow diagram to check for open circuit in wiring leading from contact 1 of connector to current supply relay for Simos control unit -J363- -item 3- (in 3-position relay carrier in electronics box, plenum chamber, left-side).
- Eliminate open circuit in wiring (refer to current flow diagram).

If the LED lights up, check voltage supply for exhaust gas recirculation potentiometer -G212- .



2.3.3 Checking voltage supply for exhaust gas recirculation potentiometer -G212-

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



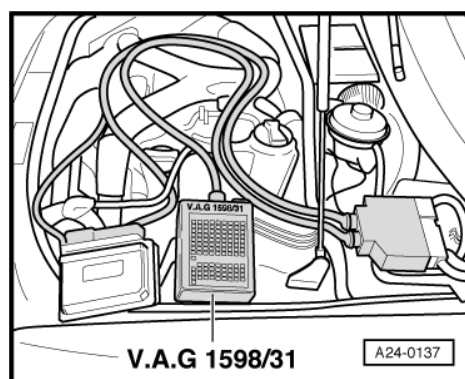
If specification is not reached:

- Connect test box -V.A.G 1598/31- to connectors of wiring harness; do not connect engine control unit. Connect earth clamp of test box to earth (not shown in illustration) ⇒ Simos injection and ignition system (4-cyl.); Rep. Gr. 24 .



Caution

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



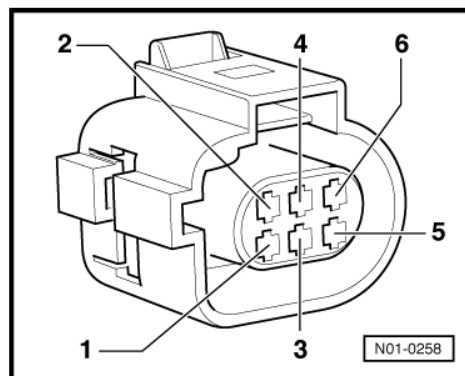
- Check for open circuit and short to positive or earth in the following wiring:

Connector Contact	Test box -V.A.G 1598/31- Socket
-2-	96
-4-	84

- Eliminate open circuit in wiring (refer to current flow diagram).

If the wiring is OK:

- Renew engine control unit.



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

- Connect test box -V.A.G 1598/31- to connectors of wiring harness; do not connect engine control unit. Connect earth clamp of test box to earth (not shown in illustration) ⇒ Simos injection and ignition system (4-cyl.); Rep. Gr. 24 .



Caution

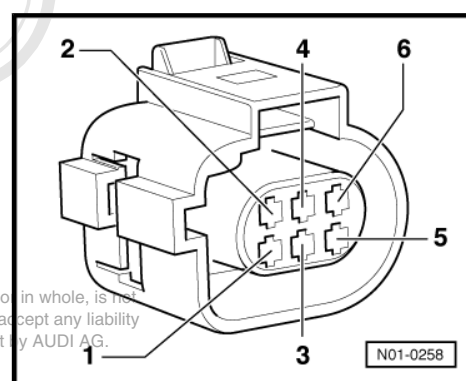
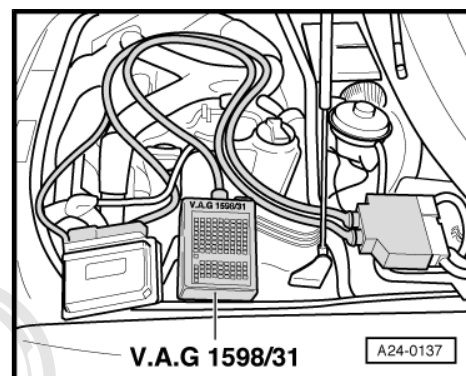
To prevent damage to the electronic components, select appropriate measuring range before connecting the measuring cables and observe the test requirements.

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

Connector Contact	Test box -V.A.G 1598/31- Socket
-6-	108

- Eliminate open circuit in wiring (refer to current flow diagram).

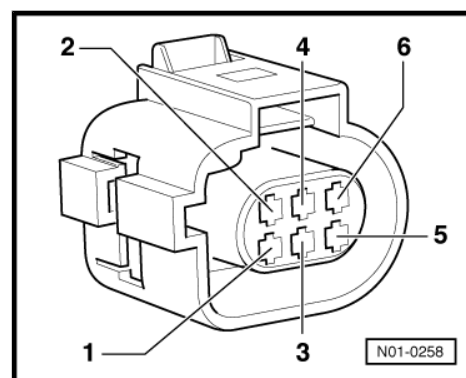
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2.3.5 Checking activation of exhaust gas recirculation valve -N18-

Test condition:

- Voltage supply OK.
- Connect voltage tester -V.A.G 1527 B- to contacts -1- and -5- of the connector.
- Connect vehicle diagnostic, testing and information system - VAS 5051- and select vehicle system "01 - Engine electronics" from list. Ignition must be switched on ⇒ Simos injection and ignition system (4-cyl.); Rep. Gr. 01 .



Display on -VAS 5051- :

- Under selection menu -1- select the diagnostic function “03 - Final control diagnosis”.
- Press the button until the valve for exhaust gas recirculation -N18- is actuated.
- 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 test box -V.A.G 1598/31- to connectors of wiring harness; do not connect engine control unit. Connect earth clamp of test box to earth (not shown in illustration) ⇒ Simos injection and ignition system (4-cyl.); Rep. Gr. 24 .



Caution

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

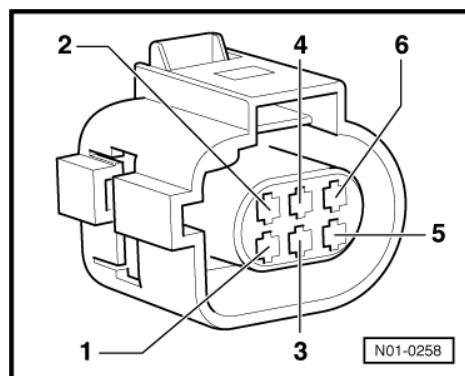
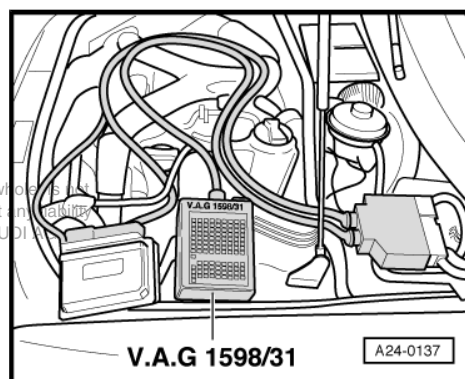
- Check for open circuit and short to positive or earth in the following wiring:

Connector Contact	Test box -V.A.G 1598/31- Socket
-5-	115

- Eliminate open circuit in wiring (refer to current flow diagram).

If the wiring is OK:

- Renew engine control unit.



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

2.4.1 Removing

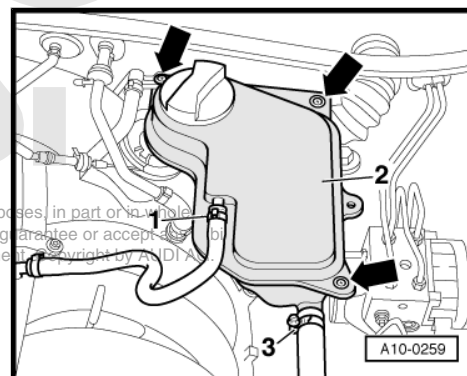
- Unbolt coolant expansion tank -2- -arrows-.
- Disconnect wire for coolant shortage indicator switch -F66- and move coolant expansion tank to one side.



Note!

Coolant hoses -1- and -3- remain connected.

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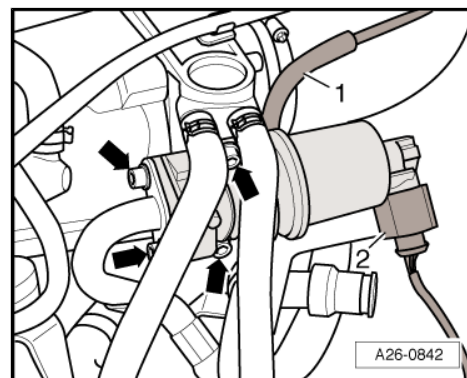


- Detach vacuum hose -1-.
- Detach electrical connector -2- from the exhaust gas recirculation valve.
- Unscrew bolts -arrows-.
- Remove exhaust gas recirculation valve.



Note!

Illustration shows engine removed.



2.4.2 Installing

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



Note!

Renew seals and gaskets.

2.4.3 Tightening torques

Component	Nm
Exhaust gas recirculation valve to throttle valve housing	10
Connecting pipe for exhaust gas recirculation to exhaust gas recirculation valve	10

3 Secondary air system - vehicles with engine code letters ANA

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

3.1.1 Principle

The over-enrichment of the mixture in the cold start phase produces a higher proportion of unburnt hydrocarbons in the exhaust gas. The injection of secondary air improves the post-oxidation in the catalytic converter and thus reduces pollutant emissions. The heat produced by the post-oxidation considerably shortens the start-up time of the catalytic converter and significantly enhances the emission quality in the cold-running phase.

3.1.2 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 injection and permits air to flow into the exhaust system upstream of the catalytic converter.

3.1.3 Secondary air system - exploded view of components

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1 - Secondary air pump motor -V101-

- ☐ Fitting location
⇒ [page 196](#)

2 - Air cleaner

3 - Combination valve for secondary air

- ☐ Fitting location
⇒ [page 196](#)
- ☐ Removing and installing
⇒ [page 210](#)

4 - Throttle valve module - J338-

5 - Secondary air pump relay - J299-

- ☐ Fitting location
⇒ [page 196](#)

6 - Simos control unit -J361-

- ☐ Fitting location
⇒ [page 196](#)

7 - Non-return valve

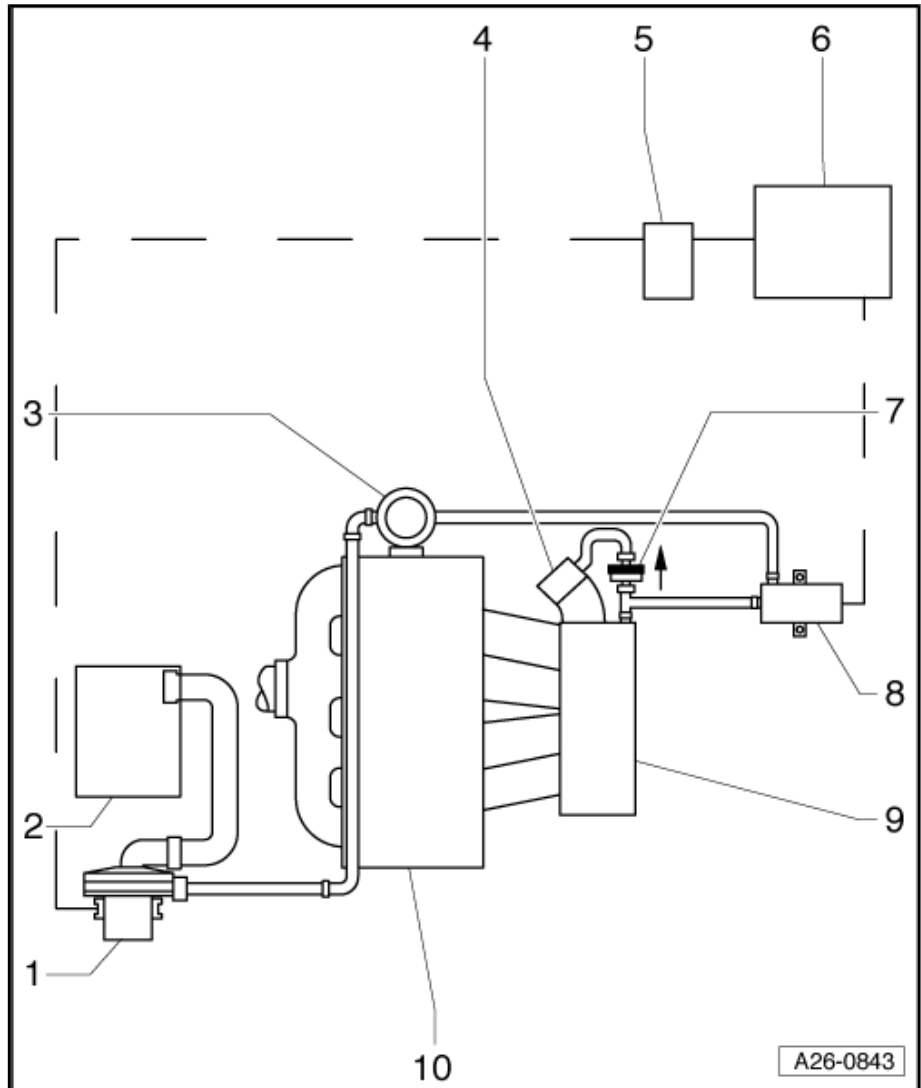
- ☐ Installation position: as shown in illustration, the arrow points in direction of flow

8 - Secondary air inlet valve - N112-

- ☐ Fitting location
⇒ [page 195](#)

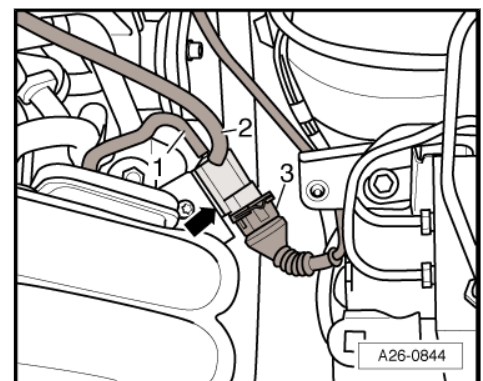
9 - Intake manifold

10 - Cylinder head



Fitting location of secondary air inlet valve -N112-

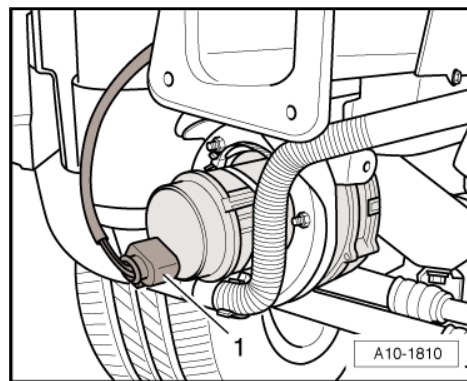
- ◆ Fitting location: At rear left of intake manifold, below coolant expansion tank -arrow-.



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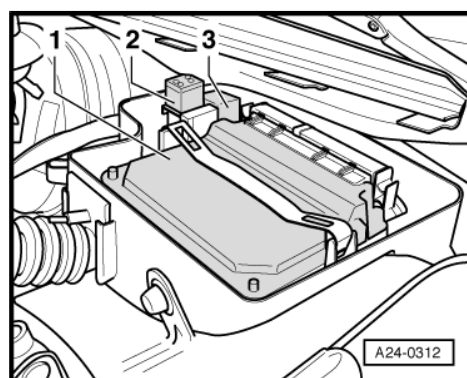
Fitting location of secondary air pump motor -V101-

- ◆ At front right of engine compartment, below longitudinal member.



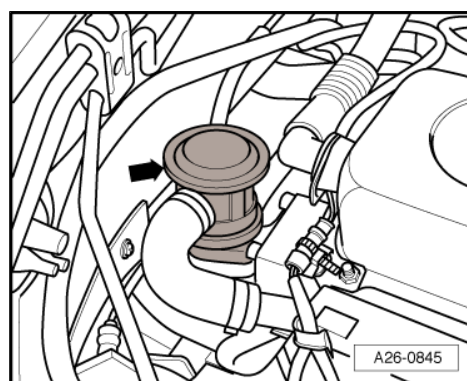
Fitting location of secondary air pump relay -J299-

- ◆ In electronics box (plenum chamber).
- 1 - Simos control unit -J361-
- 2 - Secondary air pump relay -J299-
- 3 - Current supply relay for Simos control unit -J363-



Fitting location of combination valve for secondary air

- ◆ At rear right of cylinder head, below intake hose -arrow-.



3.2 Carrying out diagnosis of secondary air system



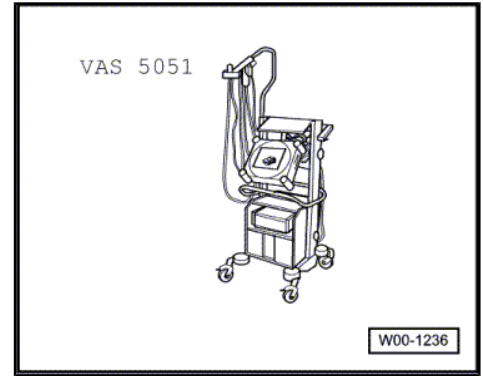
Note!

- ◆ The secondary air system is monitored by Simos control unit -J361- ⇒ Simos injection and ignition system (4-cyl.); Rep. Gr. 01.
- ◆ Diagnosis of the secondary air system can also be initiated via the basic setting function, display group 077.

Special tools and workshop equipment required

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◆ Vehicle diagnosis, testing and information system -VAS 5051-

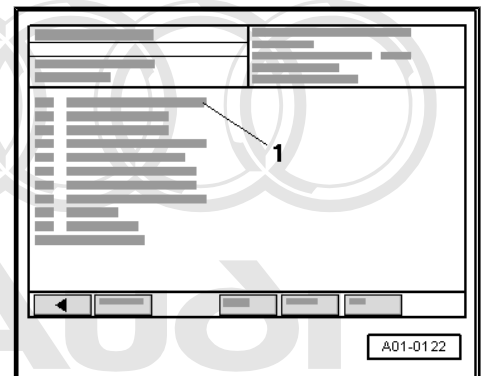


3.2.1 Test sequence

- Connect vehicle diagnostic, testing and information system - VAS 5051- and select vehicle system "01 - Engine electronics" from list. Engine must be idling ⇒ Simos injection and ignition system (4-cyl.); Rep. Gr. 01 .

Display on -VAS 5051- :

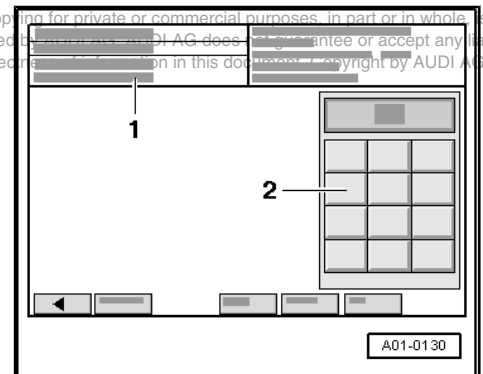
- Under -1- select diagnostic function "04 - Basic setting".



Display on -VAS 5051- :

1 - Enter display group

- Use keypad -2- to enter "077" for "display group number 077" and confirm the entry by pressing the  key.



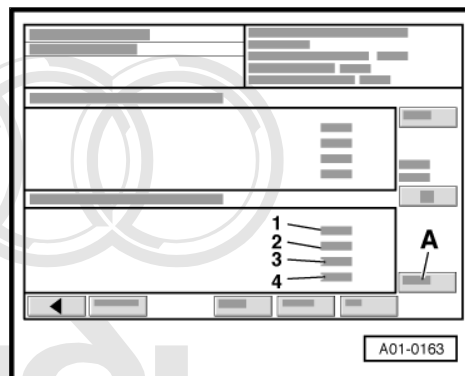
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Display on -VAS 5051- :

- Activate basic setting by touching key .
- Simultaneously press accelerator and brake pedal; engine speed must be approx. 1,400 rpm.

Test condition:

- Accelerator and brake pedal pressed simultaneously, engine running at approx. 1,400 rpm.
- Check display in zones -1- and -4-.



Display zone	Readout	Specification
1	Engine speed: xxxx rpm	approx. 1400 rpm
4	Status of diagnosis: ³⁵⁾ Test OFF Test ON Syst. OK Syst. n. OK.	Syst. OK

35) 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.

- Terminate function "04 - Basic setting" by pressing the  key.

If specified value "Syst. OK" is attained:

- Press "06 - End output".
- Switch off ignition.

If specification is not reached:

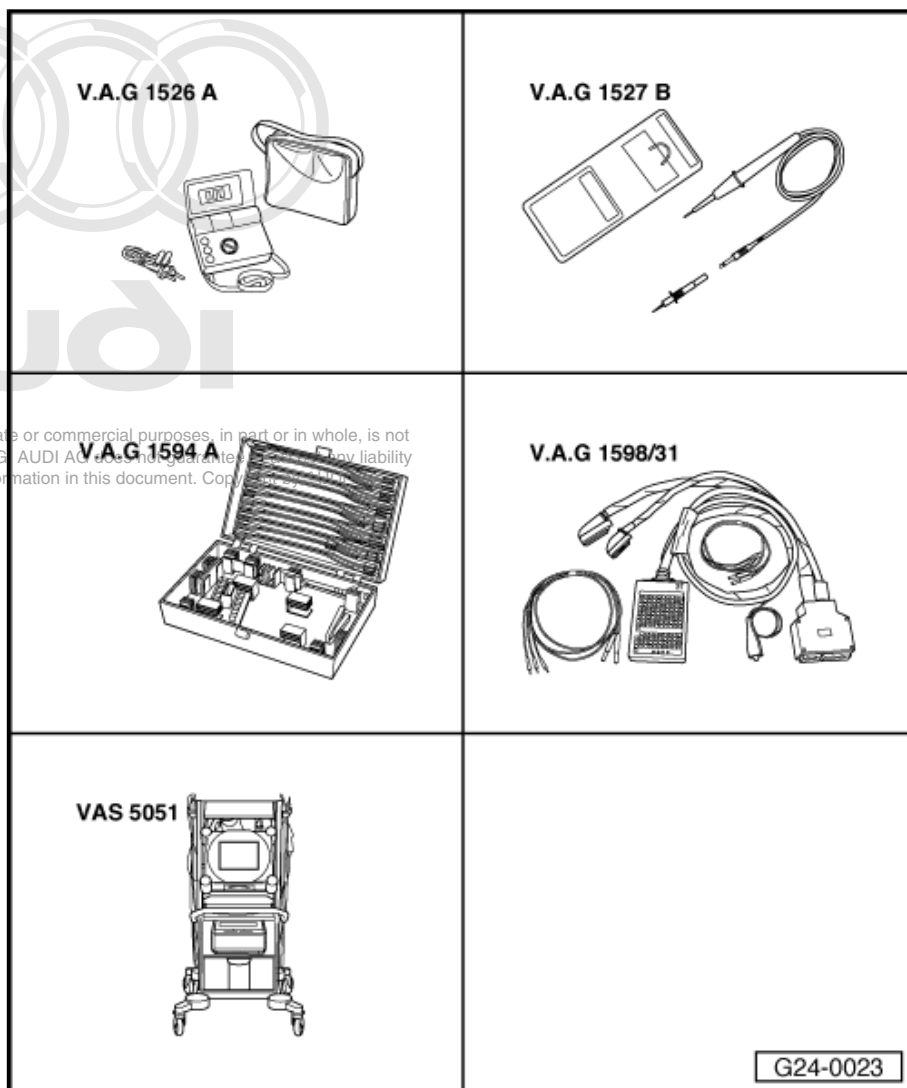
- Interrogate fault memory, rectify faults if necessary and then erase fault memory: ⇒ Simos injection and ignition system (4-cyl.); Rep. Gr. 01 .
- ♦ Checking secondary air inlet valve -N112- ⇒ [page 198](#) .
- ♦ Checking secondary air pump relay -J299- ⇒ [page 203](#) .

3.3 Checking secondary air inlet valve -N112-

Special tools and workshop equipment required

- ◆ Hand-held multimeter - V.A.G 1526 A-
- ◆ Voltage tester -V.A.G 1527 B-
- ◆ Adapter set -V.A.G 1594 A-
- ◆ Test box -V.A.G 1598/31-
- ◆ Vehicle diagnosis, testing and information system - VAS 5051-

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3.3.1 Test sequence



Note!

The secondary air inlet valve -N112- and the wiring connections are monitored by the engine control unit.

- Connect vehicle diagnostic, testing and information system - VAS 5051- and select vehicle system "01 - Engine electronics" from list. Ignition must be switched on ⇒ Simos injection and ignition system (4-cyl.); Rep. Gr. 01 .
- Read fault memory of engine control unit ⇒ Simos injection and ignition system (4-cyl.); Rep. Gr. 01 .

If a fault relating to secondary air inlet valve -N112- is displayed:

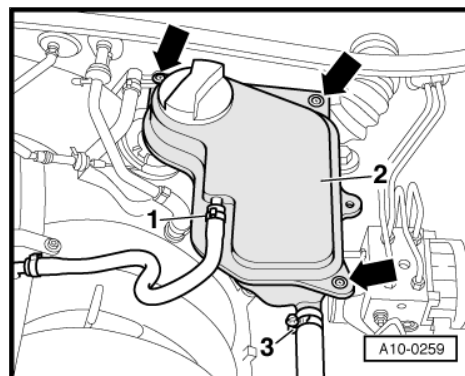


- Unbolt coolant expansion tank -2- -arrows-.
- Disconnect wire for coolant shortage indicator switch -F66- and move coolant expansion tank to one side.

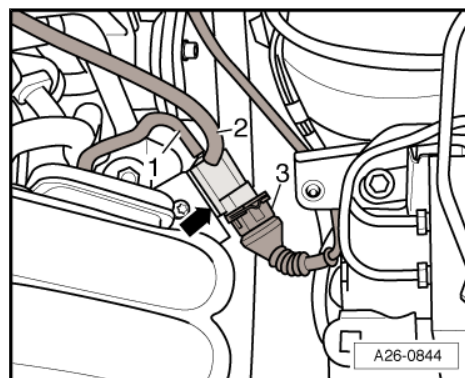


Note!

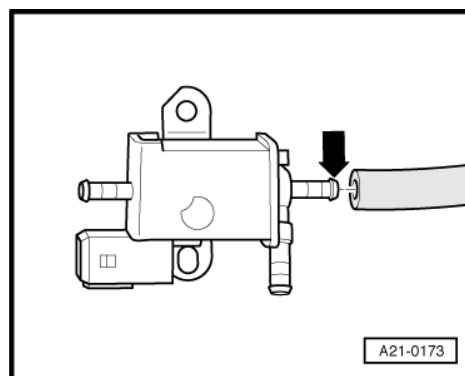
Coolant hoses -1- and -3- remain connected.



- Disconnect hoses -1- and -2- from secondary air inlet valve; leave electrical connector -3- attached.



- Connect test hose to the valve connector marked with an -arrow-.



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- Vehicle diagnostic, testing and information system -VAS 5051- 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- :

- Under selection menu -1- select the diagnostic function "03 - Final control diagnosis".
- Press the button  until the secondary air inlet valve -N112- is actuated.
- The valve should click and open and close (check by blowing into the test hose).
- Exit function "03 - Final control diagnosis" by pressing the  key.
- Switch off ignition.



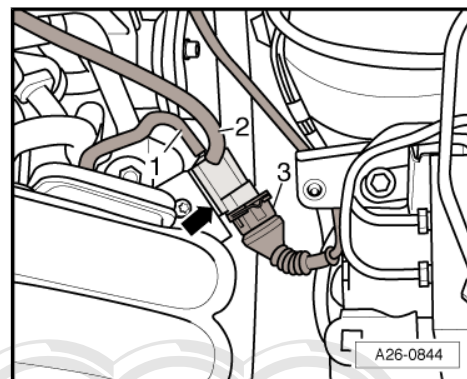
If valve does not open or close correctly:

- Renew secondary air inlet valve -N112- ⇒ [page 210](#) .

If valve does not click during final control diagnosis, check internal resistance for secondary air inlet valve -N112- .

3.3.2 Checking internal resistance

- Unplug electrical connector -3- at secondary air inlet valve -N112- .

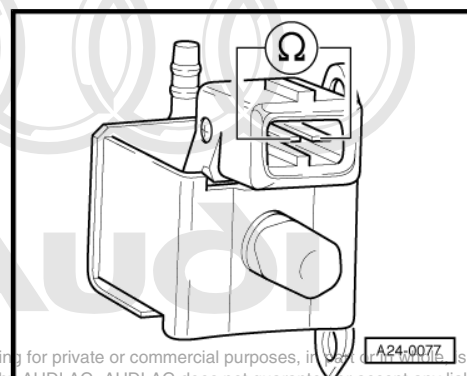


- Connect multimeter to measure resistance between contacts 1 and 2 on valve.
- Specification: 27 ... 30 Ω at room temperature

If specification is not reached:

- Renew secondary air inlet valve -N112- ⇒ [page 210](#) .

If the reading matches the specification, test voltage supply for secondary air inlet valve -N112- .



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3.3.3 Checking voltage supply

- Fuse for secondary air inlet valve OK. ⇒ Current flow diagrams, Electrical fault finding and Fitting locations
- Fuel pump relay OK.



Note!

The secondary air inlet valve -N112- is supplied with power via the fuel pump relay.

- Unplug connector from secondary air inlet valve -N112- .
- Connect voltage tester -V.A.G 1527 B- as follows:

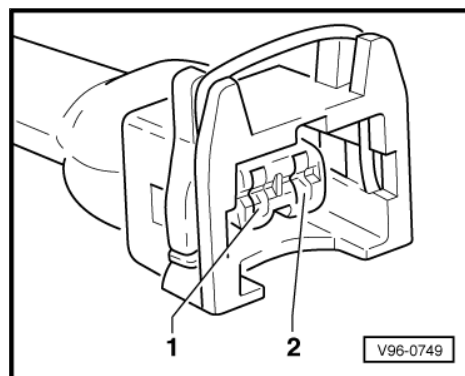
Connector Contact	Measure against
-1-	Engine earth

- Operate the starter briefly.
- The LED should light up.
- Switch off ignition.

If the LED does not light up:

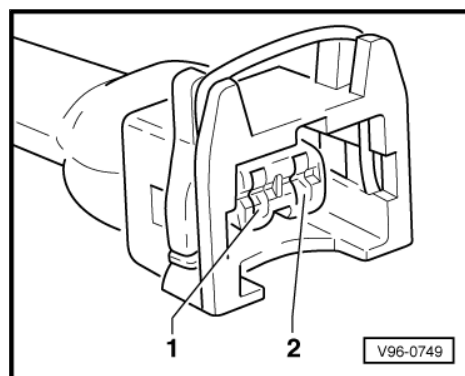
- Refer to current flow diagram to check for open circuit in wiring from contact 1 of connector via fuse to fuel pump relay.
- Eliminate open circuit in wiring (refer to current flow diagram).

If LED lights up, check activation of secondary air inlet valve -N112- .



3.3.4 Checking activation

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- Vehicle diagnostic, testing and information system -VAS 5051- is connected; vehicle self-diagnosis and vehicle system "01 - Engine electronics" is selected. When doing this the ignition must be switched on.
- Connect voltage tester -V.A.G 1527 B- to contacts -1- (plus) and -2- of the connector.



Display on -VAS 5051- :

- Under selection menu -1- select the diagnostic function "03 - Final control diagnosis".
- Press the button until the secondary air inlet valve -N112- is actuated.
- LED should flash slowly.
- Exit function "03 - Final control diagnosis" by pressing the key.
- Press "06 - End output".
- Switch off ignition.



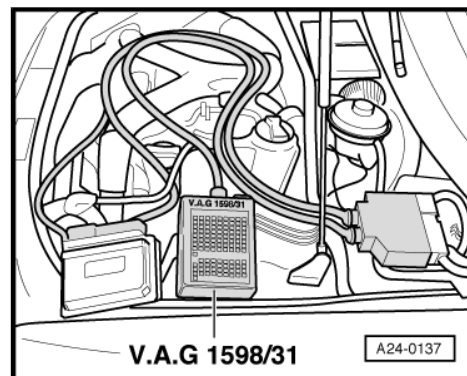
If the LED lamp does not flash or lights up continuously:

- Connect test box -V.A.G 1598/31- to connectors of wiring harness; do not connect engine control unit. Connect earth clamp of test box to earth (not shown in illustration) ⇒ Simos injection and ignition system (4-cyl.); Rep. Gr. 24 .



Caution

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



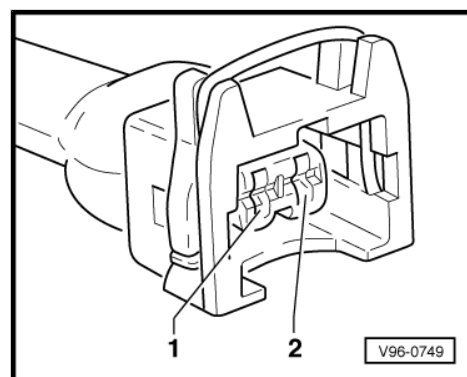
- Check for open circuit and short to positive or earth in the following wiring:

Connector Contact	Test box -V.A.G 1598/31- Socket
-2-	71

- Eliminate open circuit in wiring (refer to current flow diagram).

If the wiring is OK:

- Renew engine control unit.

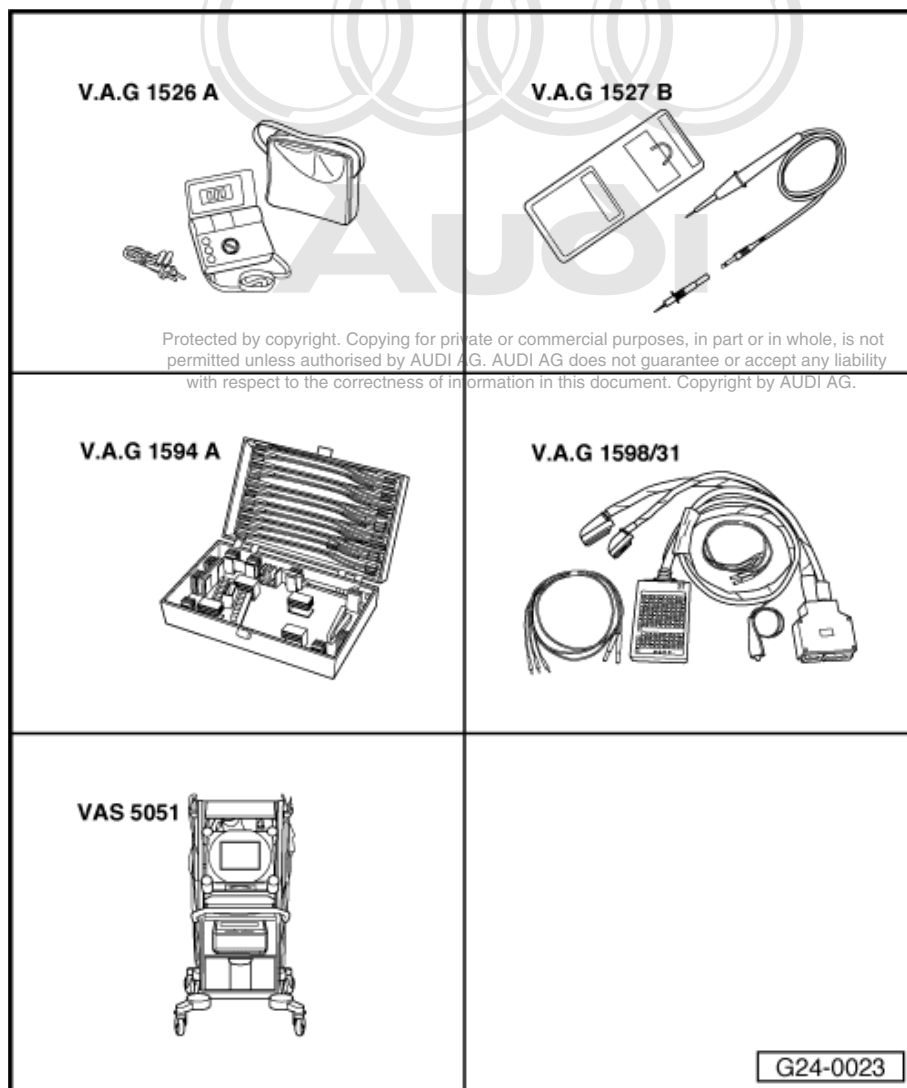


3.4 Checking secondary air pump relay -J299- and activation

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Special tools and workshop equipment required

- ◆ Hand-held multimeter - V.A.G 1526 A-
- ◆ Voltage tester -V.A.G 1527 B-
- ◆ Adapter set -V.A.G 1594 A-
- ◆ Test box -V.A.G 1598/31-
- ◆ Vehicle diagnosis, testing and information system - VAS 5051-

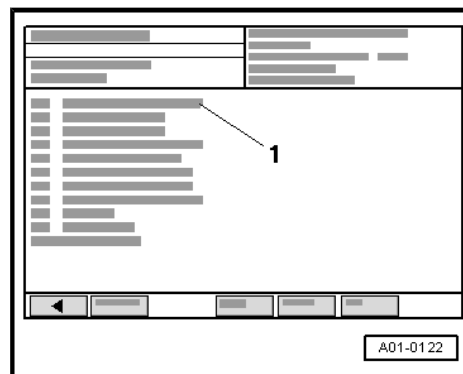


3.4.1 Test sequence

- Connect vehicle diagnostic, testing and information system - VAS 5051- and select vehicle system "01 - Engine electronics" from list. Ignition must be switched on ⇒ Simos injection and ignition system (4-cyl.); Rep. Gr. 01 .

Display on -VAS 5051- :

- Under selection menu -1- select the diagnostic function "03 - Final control diagnosis".
- Press the button  until the secondary air pump relay -J299- is activated.



- The secondary air pump relay -J299- -item 2- (located on the 3-position relay carrier in electronics box in plenum chamber, left-side) should pick up 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:

- Checking voltage supply of secondary air pump relay -J299-
⇒ [page 205](#)

- Check activation of secondary air pump relay -J299-
⇒ [page 206](#).

B - If the relay picks up but the secondary air pump motor -V101- does not run:

- Check voltage supply of secondary air pump motor -V101-
⇒ [page 207](#).

3.4.2 Checking voltage supply of secondary air pump relay -J299- .

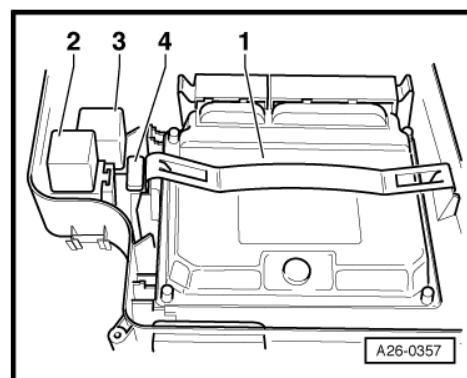
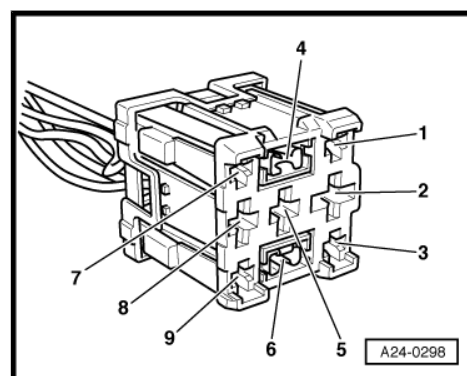
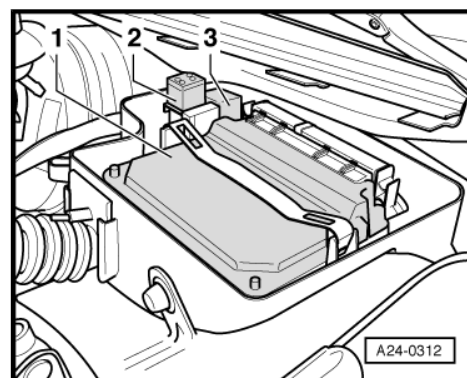
- Disconnect secondary air pump relay -J299- .
- Connect up multimeter as follows to measure voltage.

3-position relay carrier in electronics box in plenum chamber, position 2 Contact	Measure against
-8-	Engine earth

- Specification: approx. battery voltage

If specification is not reached:

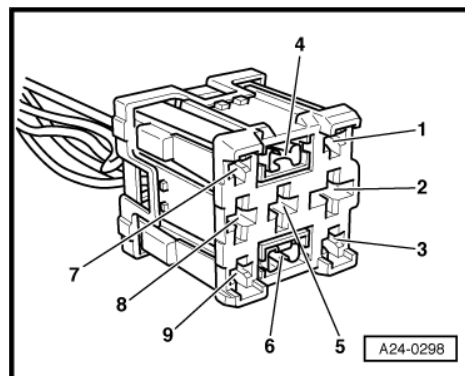
- Perform the following checks marked with a dot.
- Check fuse S130 (50 A) in electronics box in plenum chamber -item 4-.
- Check for open circuit in wiring from battery + (terminal 30) via fuse S131 to secondary air pump relay -J299- -item 2- (on 3-position relay carrier in electronics box in plenum chamber, position 2).
- Eliminate open circuit in wiring (refer to current flow diagram).



- Connect up multimeter as follows to measure voltage.

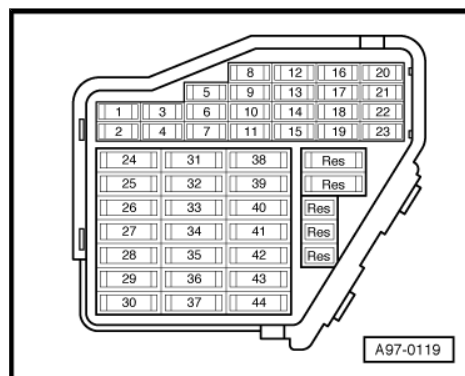
3-position relay carrier in electronics box in plenum chamber, position 2 Contact	Measure against
-4-	Engine earth

- Operate the starter briefly.
- Specification: approx. battery voltage



If specification is not reached:

- Perform the following checks marked with a dot.
- ◆ Check fuse S229 (position 29 in fuse carrier).
- ◆ Check for open circuit in wiring from secondary air pump relay -J299- (on 3-position relay carrier in electronics box in plenum chamber) via fuse S229 (position 29 in fuse carrier) to fuel pump relay.
- Eliminate open circuit in wiring (refer to current flow diagram).



3.4.3 Checking activation of secondary air pump relay

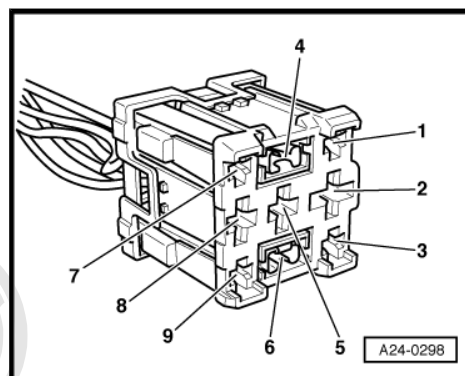
- Switch off ignition.
- Disconnect secondary air pump relay.
- Connect voltage tester -V.A.G 1527 B- as follows:

3-position relay carrier in electronics box in plenum chamber, position 2 Contact	Measure against
-6-	Battery positive

- Vehicle diagnostic, testing and information system -VAS 5051- 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- :

- Under selection menu -1- select the diagnostic function "03 - Final control diagnosis".
- Press the button  until the secondary air pump relay -J299- is activated.
- The LED should flash.
- Exit function "03 - Final control diagnosis" by pressing the  key.
- Switch off ignition.



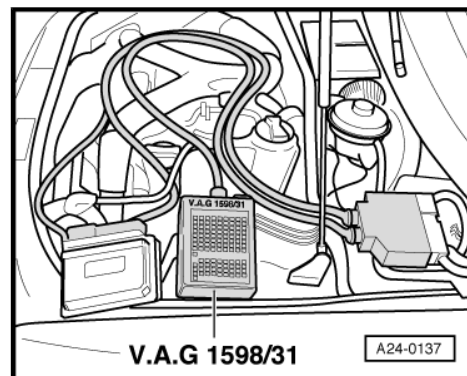
If the LED does not flash:

- Connect test box -V.A.G 1598/31- to connectors of wiring harness; do not connect engine control unit. Connect earth clamp of test box to earth (not shown in illustration) ⇒ Simos injection and ignition system (4-cyl.); Rep. Gr. 24 .



Caution

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



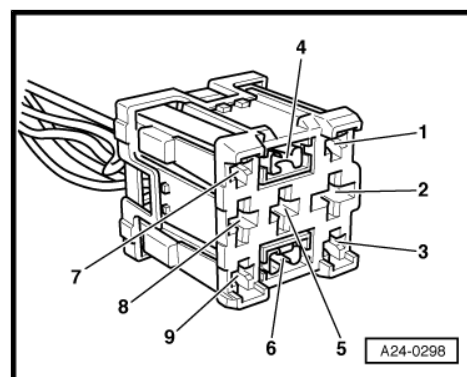
- Check for open circuit and short to positive or earth in the following wiring:

3-position relay carrier in electronics box in plenum chamber, position 2 Contact	Test box -V.A.G 1598/31- Socket
-6-	72

- Eliminate open circuit in wiring (refer to current flow diagram).

If no fault is found:

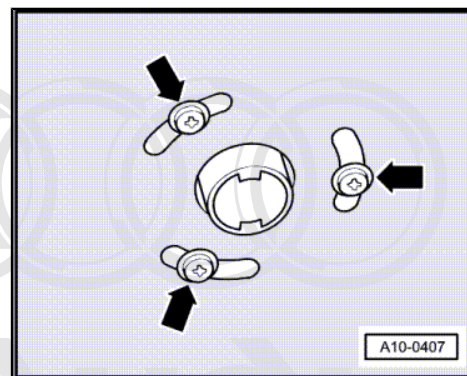
- Renew secondary air pump relay -J299- .



3.4.4 Checking voltage supply of secondary air pump motor -V101-

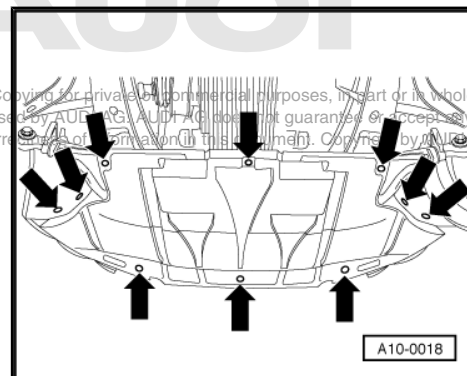
Vehicles with auxiliary heater:

- Remove bolts -arrows- securing exhaust pipe for auxiliary/additional heater to noise insulation.



All models:

- Remove noise insulation -arrows-.



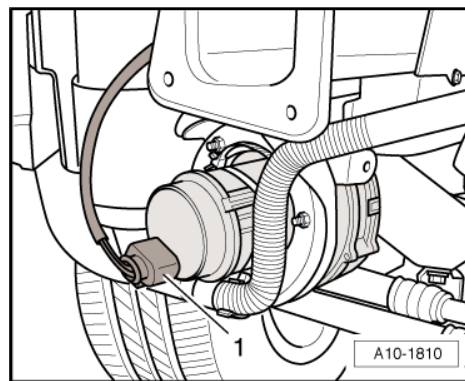
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- Unplug electrical connector -1- at secondary air pump motor -V101- .

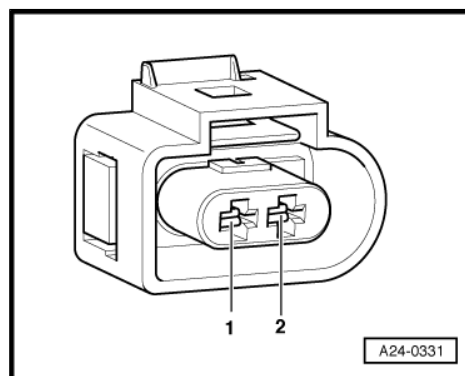


Note!

Shown in illustration with bumper removed.



- Connect voltage tester -V.A.G 1527 B- between contacts -1- and -2-.
- Vehicle diagnostic, testing and information system -VAS 5051- 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- :

- Under selection menu -1- select the diagnostic function "03 - Final control diagnosis".
- Press the button  until the secondary air pump relay -J299- is activated.
- The LED should flash.
- Exit function "03 - Final control diagnosis" by pressing the  key.
- Switch off ignition.

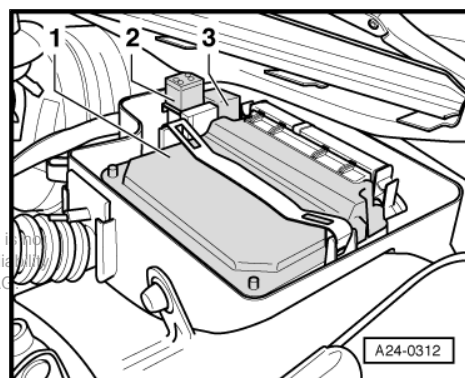


If the LED does not flash:

- Perform the following checks marked with a dot.
- Check for open circuit in wiring from connector on secondary air pump motor -V101- to secondary air pump relay -J299- -item 2- (on 3-position relay carrier in electronics box in plenum chamber, position 2).
- Check for open circuit in wiring from contact 1 of connector to earth (refer to current flow diagram).
- Eliminate open circuit in wiring (refer to current flow diagram).

If no fault is found:

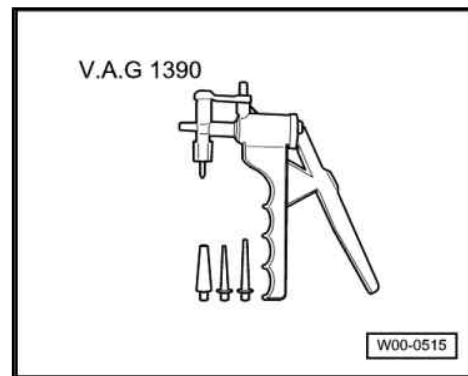
- Renew the secondary air pump ⇒ [page 211](#) .



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

Special tools and workshop equipment required

- ◆ Hand-operated vacuum pump -V.A.G 1390-



 Note!

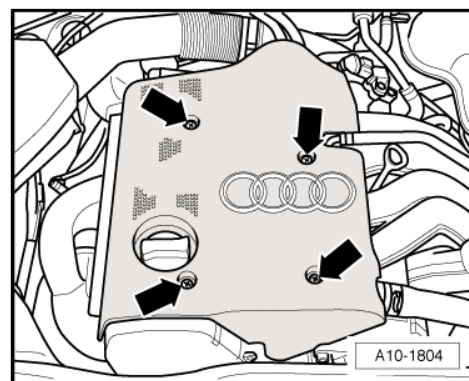
- ◆ Vacuum hoses and hose connections do not leak.
- ◆ Vacuum hoses are not clogged.

3.5.1 Test sequence

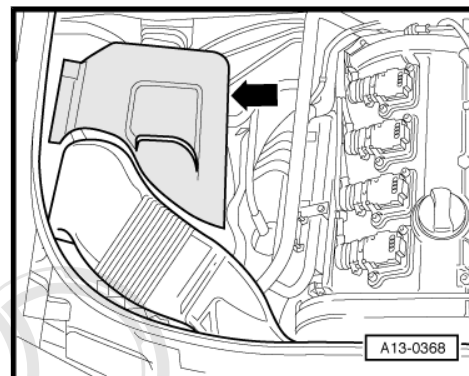
- Take off engine cover panel -arrows-.

 Note!

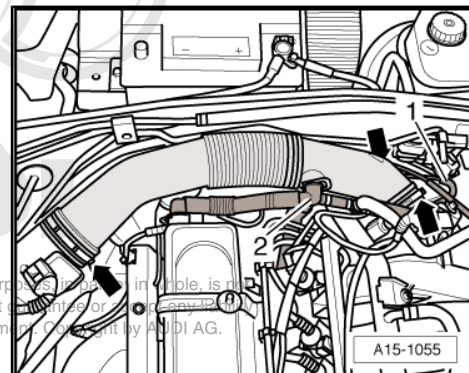
Illustration shows vehicle with engine code letters ANA.



- Detach air cleaner cover -arrow-.

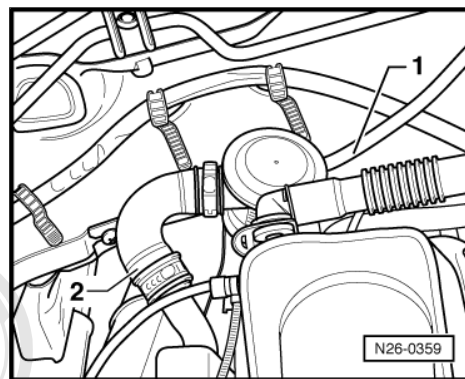


- Detach hose -2- for crankcase breather system at air pipe.
- Watch out for O-ring when removing.
- Detach vacuum hose -1-.
- Remove air pipe -arrows-.



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- Detach vacuum hose -1- at combination valve.
- Connect the hand vacuum pump -V.A.G 1390- to vacuum connection of combination valve.
- Remove heat insulation mat.
- Disconnect hose -2- at pipe leading to combination valve for secondary air.
- Blow gently into pipe (do not use compressed air).
 - The combination valve must be closed; blowing through must not be possible.
- Operate the hand vacuum pump.
 - The combination valve should open; it should now be possible to blow through the hose.



If the combination valve does not open:

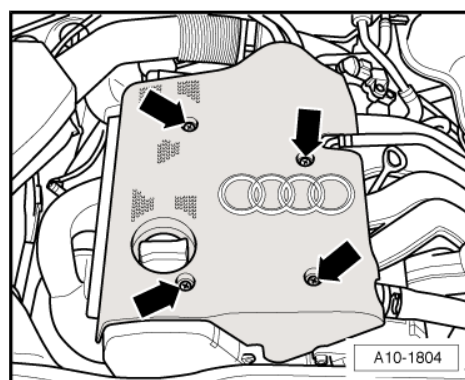
- Renew combination valve ⇒ [page 210](#) .

3.6 Removing and installing combination valve for secondary air system

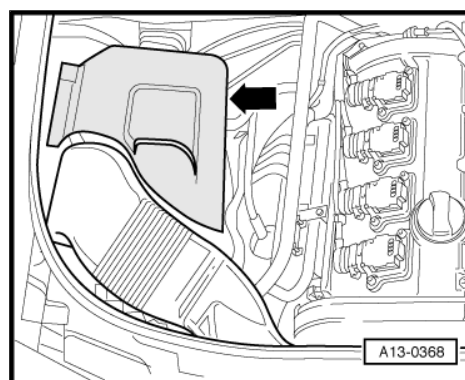
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3.6.1 Removing

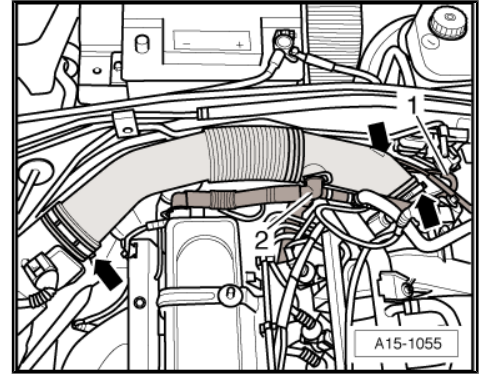
- Take off engine cover panel -arrows-.



- Detach air cleaner cover -arrow-.



- Detach hose -2- for crankcase breather system at air pipe.
- Watch out for O-ring when removing.
- Detach vacuum hose -1-.
- Remove air pipe -arrows-.



- Detach vacuum hose -1-.
- Remove heat insulation mat.
- Disconnect hose -2- at pipe leading to combination valve for secondary air system.
- Unbolt combination valve for secondary air system -arrows-.

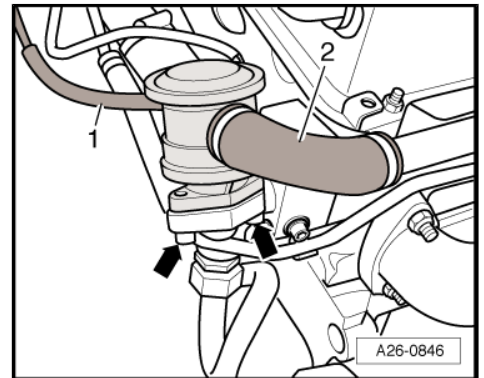


Illustration shows engine removed.

3.6.2 Installing

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



Renew seals and gaskets.

3.6.3 Tightening torque

Component	Nm
Combination valve to connecting flange	25

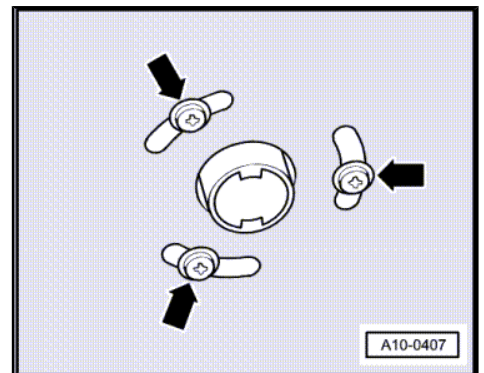
3.7 Removing and installing secondary air pump

3.7.1 Removing

Vehicles with auxiliary heater:

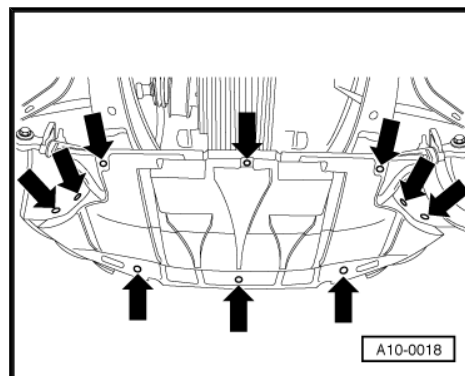
- Remove bolts -arrows- securing exhaust pipe for auxiliary/additional heater to noise insulation.

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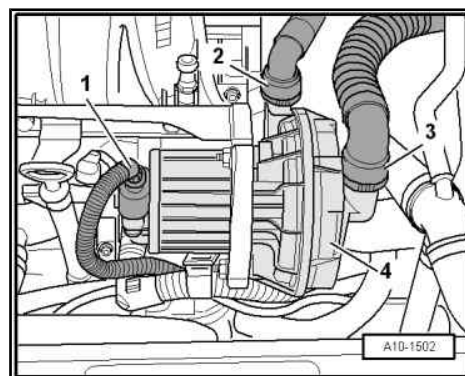


All models:

- Remove noise insulation -arrows-.



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



3.7.2 Installing

Install in reverse order.

3.7.3 Tightening torque

Component	Nm
Secondary air pump to bracket	10



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