

Audi

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Workshop Manual

Audi A3 2004 ➤

Audi A3 Sportback 2005 ➤

6-cylinder injection engine (3.2 ltr. 4-valve), mechanics

Engine ID	BDB	BMJ	BUB	CBR A					
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Edition 05.2013

List of Workshop Manual Repair Groups

Repair Group

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



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 Engine number

(ARL003364; Edition 05.2013)

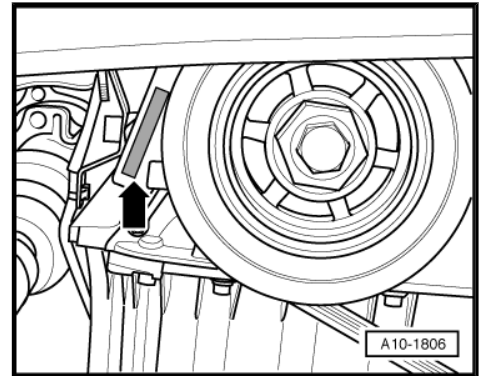
The engine number ("engine code" and "serial number") can be found at the front next to the poly V-belt pulley on the crankshaft -arrow-.

There is also a sticker on the cylinder head cover showing the "engine code" and "serial number".

Starting with the letter "C", the engine codes consist of 4 letters.

The first 3 characters of the engine code stand for the engine capacity and the mechanical construction and design. They are stamped on the cylinder block, together with the serial number.

The 4th character indicates the power output and torque of the engine, and is determined by the engine control unit.



Note

- ◆ *The engine code is additionally marked at the engine lifting eye (right-side).*
- ◆ *The 3-character engine code also appears on the vehicle data sticker.*
- ◆ *The 4-character engine code can be found on the type plate (in versions for some countries only) and on the vehicle data sticker and the engine control unit.*
- ◆ *Fitting locations of the type plate (certain countries only) and the vehicle data sticker ⇒ Maintenance ; Booklet 808 .*



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2 Engine data

Code letters		BDB	BMJ
Capacity	ltr.	3.189	3.189
Power output	kW at rpm	184/6300	184/6300
Torque	Nm at rpm	320/2500 ... 3000	320/2500 ... 3000
Bore	Ø in mm	84	84
Stroke	mm	95.9	95.9
Compression ratio		10.85	10.85
RON	at least	98 ¹⁾	98 ¹⁾
Injection/ignition system		Motronic	Motronic
Firing order		1-5-3-6-2-4	1-5-3-6-2-4
Emission standards		EU4	LEV2
Exhaust gas recirculation		no	no
Turbocharging/supercharging		no	no
Lambda control		4 Lambda probes	4 Lambda probes
Variable valve timing		yes	yes
Intake manifold change-over		yes	yes
Secondary air system		yes	yes
Valves per cylinder		4	4

• ¹⁾ Unleaded premium RON 95 can also be used, but results in reduced power

Code letters		BUB	CBRA
Capacity	ltr.	3.189	3.189
Power output	kW at rpm	184/6300	184/6300
Torque	Nm at rpm	320/2500 ... 3000	320/2500 ... 3000
Bore	Ø in mm	84	84
Stroke	mm	95.9	95.9
Compression ratio		10.85	10.85
RON	at least	98 ¹⁾	98 ¹⁾
Injection/ignition system		Motronic	Motronic
Firing order		1-5-3-6-2-4	1-5-3-6-2-4
Emission standards		EU4	LEV2
Exhaust gas recirculation		no	no
Turbocharging/supercharging		no	no
Lambda control		4 Lambda probes	4 Lambda probes
Variable valve timing		yes	yes
Intake manifold change-over		yes	yes
Secondary air system		yes	yes
Valves per cylinder		4	4

• ¹⁾ Unleaded premium RON 95 can also be used, but results in reduced power

3 Safety precautions

When working on the fuel system note the following warnings:



WARNING

The fuel system operates at extremely high pressure. This can cause injury.

- ◆ *The fuel pressure in the high-pressure section of the injection system must be reduced to a residual pressure prior to opening the system.*
- ◆ *Wrap a clean cloth around the connection and carefully loosen the connection to allow the residual pressure to dissipate.*

- Procedure before opening high-pressure section of injection system ⇒ [page 4](#) .



WARNING

Escaping fuel can cause a fire risk.

- ◆ *The power supply for the fuel pump control unit - G6- must be disconnected before opening the fuel system, as the fuel system pressurisation pump - J538- will be activated briefly when the driver's door is opened with the battery still connected.*

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Caution

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

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

- Disconnect battery ⇒ Rep. gr. 27 .

⇒ [“3.1 Observe the following to prevent injuries to persons and damage to the injection and ignition system:”, page 3](#)

⇒ [“3.2 Using testers and measuring instruments during a road test”, page 4](#)

⇒ [“3.3 Working on the cooling system”, page 4](#)

⇒ [“3.4 Procedure before opening high-pressure section of injection system”, page 4](#)

3.1 Observe the following to prevent injuries to persons and damage to the injection and ignition system:

Observe the following to prevent injuries to persons and damage to the injection and ignition system:

- ◆ Do not touch or disconnect ignition coils with output stages when the engine is running or being turned at cranking speed.

- ◆ Always switch off the ignition before connecting or disconnecting electrical wiring for the injection or ignition system or tester cables.
- ◆ If you want to turn the engine at cranking speed without actually starting it (e.g. compression test), first unplug the connectors from the ignition coils and the injectors. After completing the work, interrogate and erase the event memory.
- ◆ Always switch off ignition before washing engine.
- ◆ Faults are stored in engine control unit if electrical connectors have been unplugged:
 - Connect vehicle diagnostic, testing and information system - VAS 5051B- .
 - Start “Guided Functions” mode.
 - Generate readiness code in engine control unit.

3.2 Using testers and measuring instruments during a road test

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



WARNING

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

Persons sitting in the front passenger's seat could be injured if the airbag is triggered in an accident.

- *The use of test equipment while driving causes distraction.*
- *There is an increased risk of injury if test equipment is not secured.*

Test equipment must always be secured on the rear seat with a strap and operated from the rear seat by a second person.

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3.3 Working on the cooling system

When working on the cooling system note the following:



WARNING

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

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

3.4 Procedure before opening high-pressure section of injection system

- ◆ The injection system consists of a high-pressure section (maximum approx. 120 bar) and a low-pressure section (approx. 6 bar).
- ◆ Before removing a component in the high-pressure section of the injection system, the fuel pressure in the high-pressure

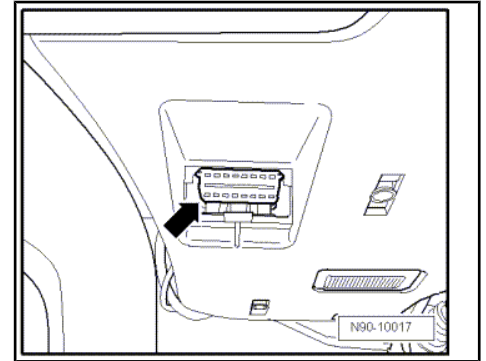
section must be reduced to a residual pressure of approx. 6 bar; follow the procedure outlined below.

Special tools and workshop equipment required

- ◆ Vehicle diagnostic, testing and information system - VAS 5051B-

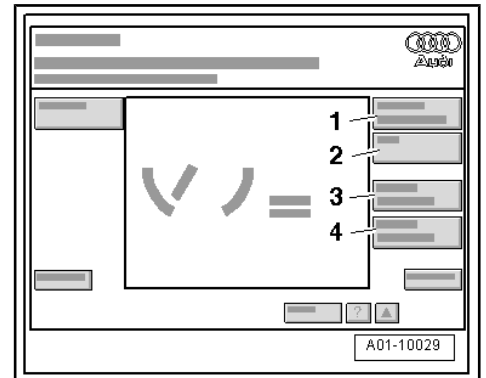
Procedure

- With ignition switched off, connect vehicle diagnostic, testing and information system - VAS 5051B- with diagnosis lead to diagnosis connection.
- Start the engine and run at idling speed.



Display on -VAS 5051B- :

- Select Vehicle self-diagnosis from the list -item 1-.



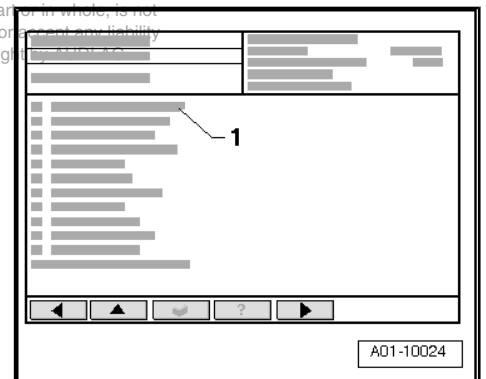
Display on -VAS 5051B- :

- From menu -1-, select vehicle system "Engine electronics" and press  key to continue.



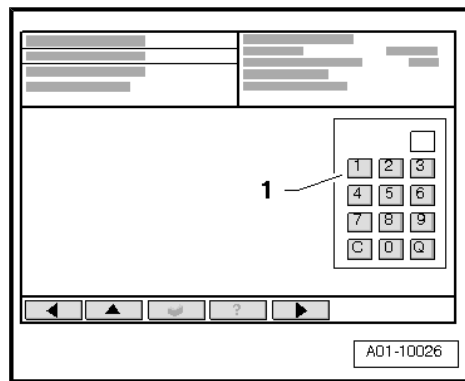
Display on -VAS 5051B- :

- From menu -1-, select function "Measured values" and press  key to continue.



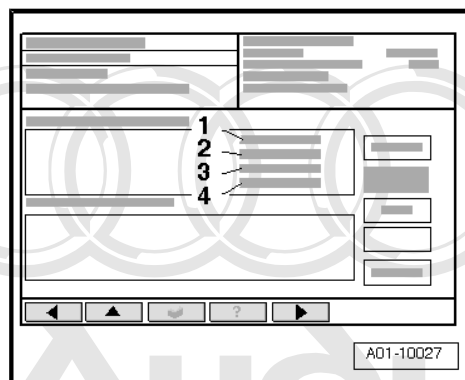
Display on -VAS 5051B- :

- Press keys **1** **4** **0** on keypad -1- to select “Display group 140” and confirm entry by pressing **Q** key.

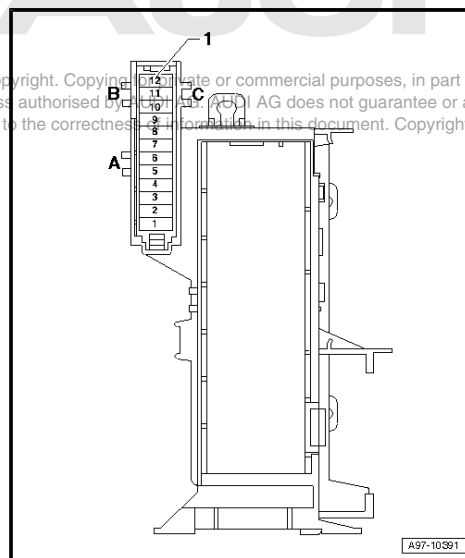


Display on -VAS 5051B- :

- Check display indicating fuel pressure in fuel rail in display zone -3-.
- With engine idling the figure displayed will be 35 ... 45 bar. The display shows the actual pressure in the fuel rail which is being generated by the high-pressure pump.
- Remove luggage compartment side trim (right-side) ⇒ Rep. gr. 70 .



- Remove fuse 6 in fuse holder F - SF6- for fuel pump control unit - J538- in fuse holder in luggage compartment (right-side).



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Display on -VAS 5051B- :

- With engine still running, check display zone -3- for fuel pressure in fuel system:
- The fuel pressure will decrease very quickly because the mechanical high-pressure pump is no longer being supplied with fuel from the fuel tank by the electric fuel pump.
- Switch off ignition as soon as fuel pressure has dropped to just below 8 bar.



Note

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Fuel pressure must not fall below 6 bar, otherwise the engine will stall (this could damage the catalytic converter).

The fuel rail is still filled with fuel, however it is no longer under high pressure.



WARNING

There is a risk of injury: avoid skin contact with fuel.

- ◆ *Wear safety goggles and protective clothing when opening the fuel system.*
- ◆ *Before opening the high-pressure section of the fuel system, place a clean cloth around the connection to catch escaping fuel.*

- Disconnect a fuel line connection without delay.

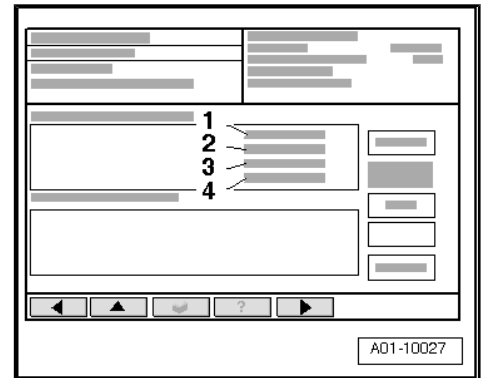


Note

The pressure will increase again due to the effect of residual heat if the high-pressure system is not opened immediately.

Additional steps required

- Re-fit fuse 6 in fuse holder F - SF6- .
- With ignition switched off, connect vehicle diagnostic, testing and information system - VAS 5051B- .
- Start “Guided Functions” mode.
- Generate readiness code in engine control unit ⇒ Vehicle diagnostic tester.



4 General repair instructions

⇒ ["4.1 Rules for cleanliness when working on fuel supply system, injection system and turbocharger", page 8](#)

⇒ ["4.2 Checking fuel system for leaks", page 8](#)

⇒ ["4.3 Foreign particles in engine", page 8](#)

⇒ ["4.4 Contact corrosion!", page 9](#)

⇒ ["4.5 Routing and attachment of pipes, hoses and wiring", page 9](#)

⇒ ["4.6 Checking vacuum system", page 9](#)

⇒ ["4.7 Installing radiators, condensers and charge air coolers", page 10](#)

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

Even small amounts of dirt can cause malfunctions. For this reason, please observe the following rules when working on the fuel supply system, injection system and turbocharger:

- ◆ Carefully clean connection points and the surrounding area with engine cleaner or brake cleaner and dry thoroughly before opening.
- ◆ Seal off open pipes/lines and connections immediately with clean plugs, e.g. from engine bung set - VAS 6122- .
- ◆ Place parts that have been removed on a clean surface and cover them over. Use only lint-free cloths.
- ◆ Carefully cover or seal open components if repairs cannot be carried out immediately.
- ◆ Only install clean components; replacement parts should only be unpacked immediately prior to installation. Do not use parts that have not been stored in their packing (e.g. in tool boxes etc.).
- ◆ When the system is open, do not work with compressed air and do not move the vehicle.
- ◆ Protect unplugged electrical connectors against dirt and moisture and make sure connections are dry when attaching.

4.2 Checking fuel system for leaks

- Allow engine to run for several minutes at moderate rpm.
- Switch off ignition.
- Check complete fuel system for leaks.
- If leaks are found although the connections have been tightened to the correct torque, the relevant component must be renewed.
- Road-test vehicle and accelerate with full throttle at least once.
- Then inspect high-pressure section of fuel system again for leaks.

4.3 Foreign particles in engine

- ◆ When working on the engine, all open inlet and exhaust ports must be sealed with suitable plugs (e.g. from engine bung set

- VAS 6122-) to prevent foreign particles from entering the engine.

- ◆ In the event of mechanical damage to one of the cylinder banks, the intake and exhaust systems and combustion chambers of the opposite cylinder bank must always be examined to prevent further damage occurring later.

4.4 Contact corrosion!

Contact corrosion can occur if unsuitable fasteners are used (e.g. bolts, nuts, washers, etc.).

For this reason, only fasteners with a special surface coating are used.

Additionally, all rubber and plastic parts and all adhesives are made of non-conductive materials.

Always install new parts if you are not sure whether used parts can be re-fitted ⇒ Electronic parts catalogue .

Note the following:

- ◆ We recommend using only genuine replacement parts; these have been tested and are compatible with aluminium.
- ◆ We recommend the use of Audi accessories.
- ◆ Damage caused by contact corrosion is not covered under warranty.

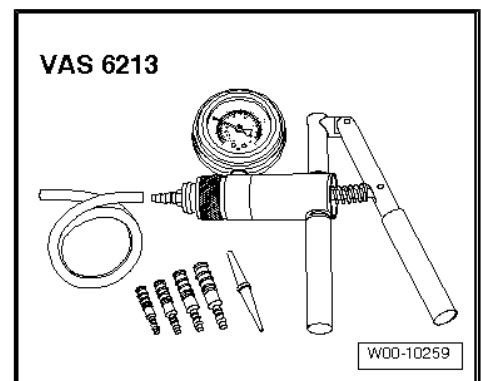
4.5 Routing and attachment of pipes, hoses and wiring

- ◆ Mark fuel lines, hydraulic lines, vacuum lines, lines for activated charcoal filter and electrical wiring etc. before removal so they can be re-installed in the original positions and correctly connected. Make sketches or take photographs if necessary.
- ◆ To prevent damaging pipes, hoses and wiring, ensure sufficient clearance from all moving or hot components in engine compartment (little space in engine compartment).

4.6 Checking vacuum system

Special tools and workshop equipment required

- ◆ Hand vacuum pump - VAS 6213-



Procedure

- Check all vacuum lines in the complete vacuum system for:
 - ◆ Cracks
 - ◆ Traces of animal bites
 - ◆ Kinked or crushed lines



- ◆ Lines porous or leaking
- Check vacuum line to solenoid valve and from solenoid valve to corresponding component.
- If a fault is stored in the event memory, check the vacuum lines leading to the corresponding component and also check the remaining vacuum lines in the system.
- If it is not possible to build up pressure with the hand vacuum pump - VAS 6213- or if the pressure drops again immediately, check the hand vacuum pump and connecting hoses for leaks.

4.7 Installing radiators, condensers and charge air coolers

Even when the radiator, condenser and charge air cooler are correctly installed, slight impressions may be visible on the fins of these components. This does not mean that the components are damaged. If the fins are only very slightly distorted, this does not justify renewal of the radiator, condenser or charge air cooler.

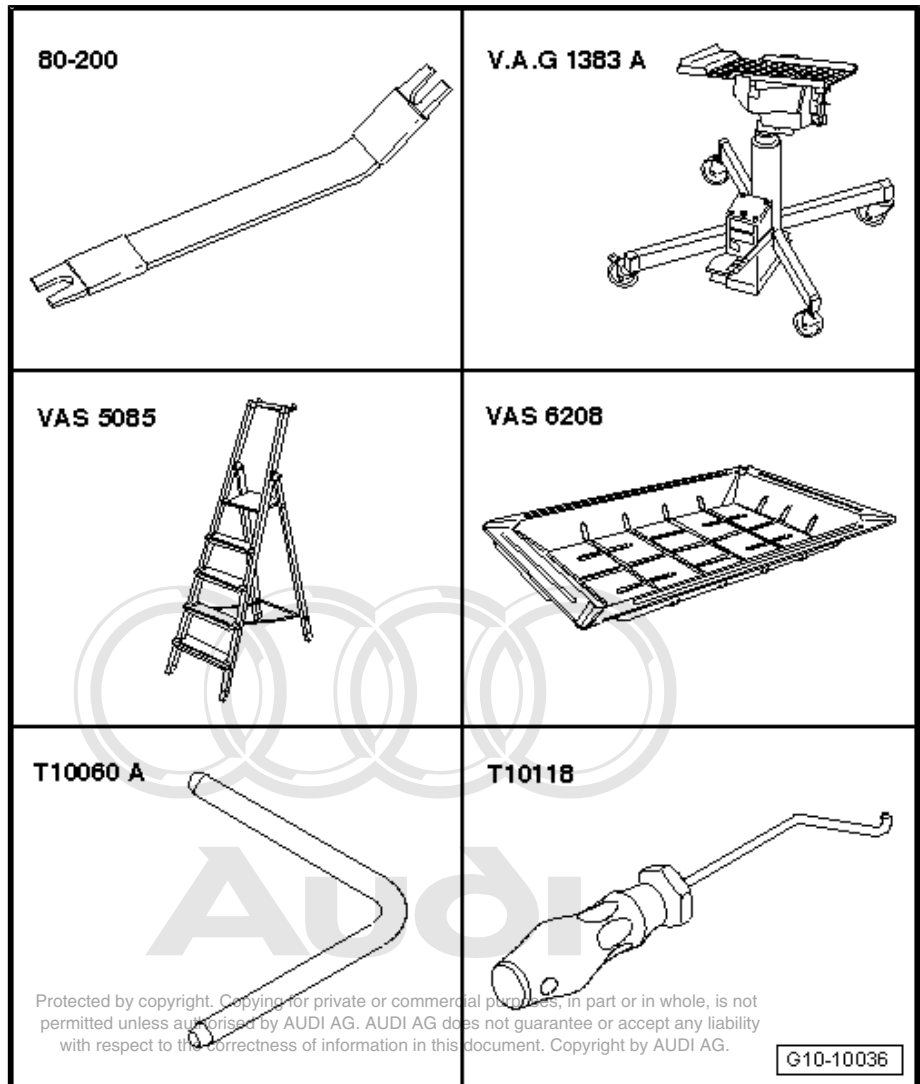
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10 – Removing and installing engine

1 Removing and installing engine

Special tools and workshop equipment required

- ◆ Removal lever - 80 - 200-
- ◆ Engine and gearbox jack - V.A.G 1383 A-
- ◆ Stepladder - VAS 5085-
- ◆ Drip tray for workshop hoist - VAS 6208-
- ◆ Locking pin - T10060 A-
- ◆ Assembly tool - T10118-



- ◆ Engine support - T40074-

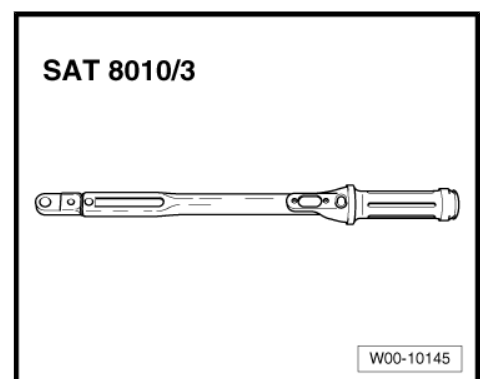
⇒ ["1.1 Removing engine", page 12](#)

⇒ ["1.2 Separating engine from manual gearbox", page 29](#)

⇒ ["1.3 Separating engine from direct shift gearbox", page 31](#)

⇒ ["1.4 Securing engine to engine and gearbox support", page 33](#)

⇒ ["1.5 Installing engine", page 34](#)



1.1 Removing engine



Note

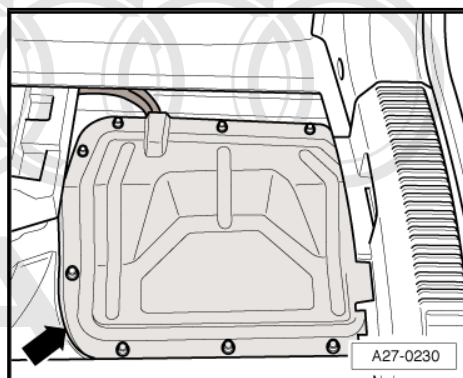
- ◆ *The engine is removed from underneath together with the gearbox.*
- ◆ *Renew all cable ties which are released or cut open when removing the engine. Refit in the same position when installing the engine.*
- ◆ *Heat insulation sleeves removed when taking out the engine are to be reinstalled in the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



Caution

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

- Remove the moulded insert for tools from beneath the luggage compartment floor cover.
- Unscrew the lid -arrow- of the battery compartment.
- Remove moulded insert from top of battery.



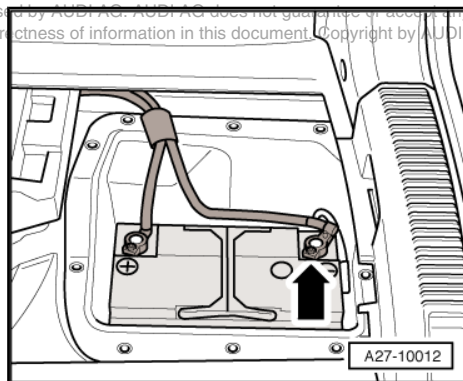
- With ignition switched off, disconnect earth wire -arrow- at battery.



WARNING

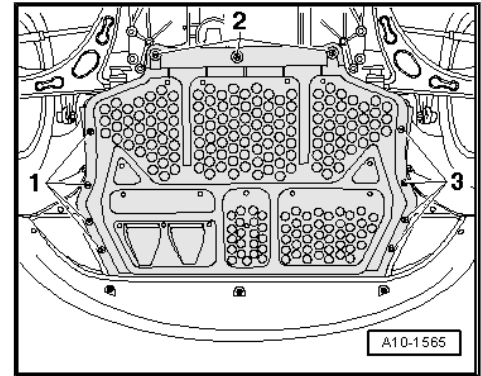
Hot steam/hot coolant can escape - risk of scalding.

- ◆ *The cooling system is under pressure when the engine is hot.*
- ◆ *Cover filler cap on coolant expansion tank with a cloth and open carefully to dissipate pressure.*

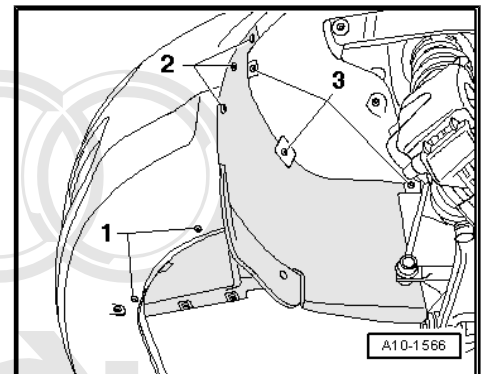


- Open filler cap on coolant expansion tank.
- Remove both front wheels.

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



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



- Unplug electrical connector -1- at radiator outlet coolant temperature sender - G83- .

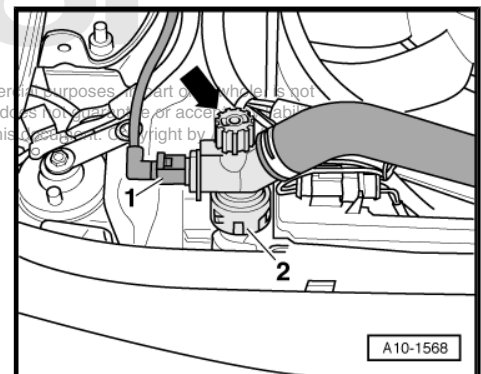
- Place drip tray for workshop hoist VAS 6208 -under engine

Vehicles with drain plug:

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

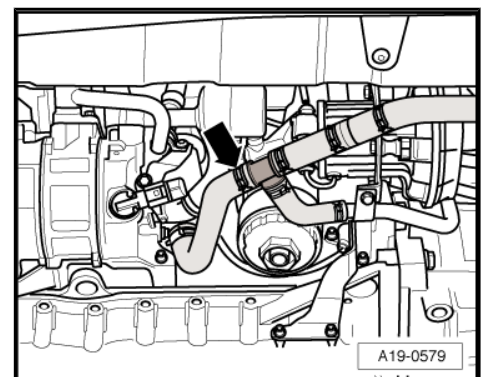
All vehicles (continued):

- Remove bottom coolant hose -2- from radiator by pulling off retaining clip.
- Drain cooling system.
- In addition, remove lower coolant hose to continued circulation coolant pump - V51- -arrow- and drain off remaining coolant.

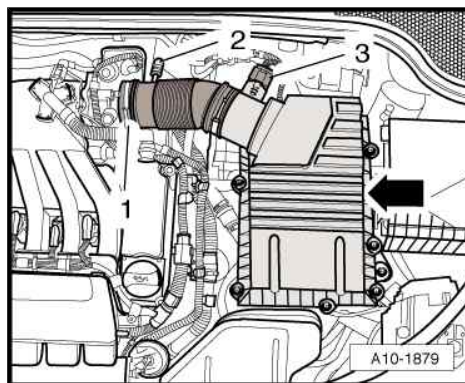


Note

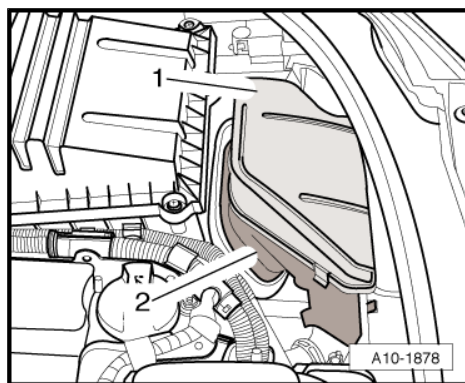
Illustration shows vehicle with dual clutch gearbox.



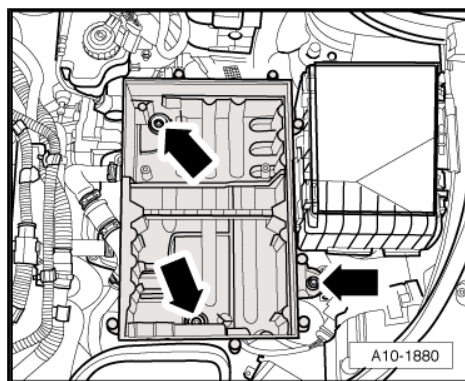
- Detach vacuum hose -2- from air intake hose (if fitted).
- Detach air hose -1- at the throttle valve module - J338- .
- Unplug electrical connector for air mass meter - G70- -item 3-.
- Unscrew air cleaner housing (upper section) -arrow-.
- Take out filter element.



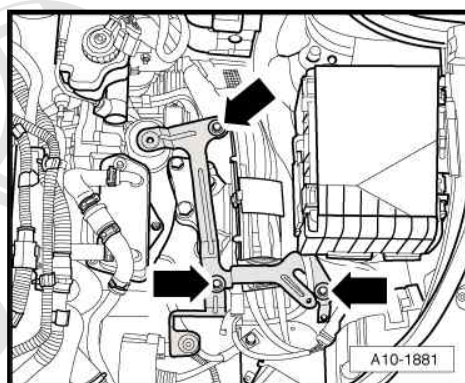
- Pull cover -1- off air duct (release clips on sides).
- Unclip air duct -2-.



- Unscrew air cleaner housing (lower section) -arrows-.

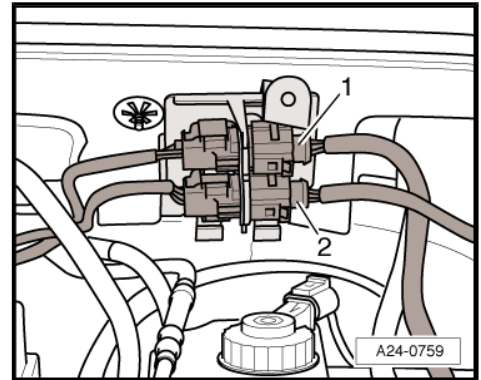


- Unscrew bracket for air cleaner housing -arrows-.

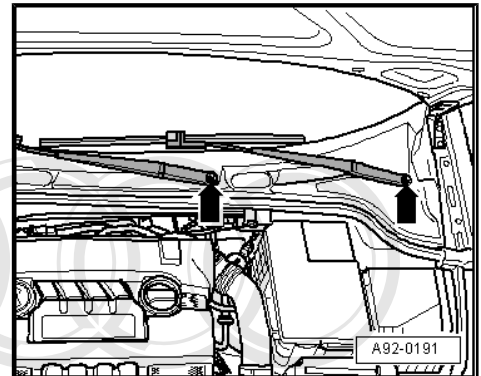


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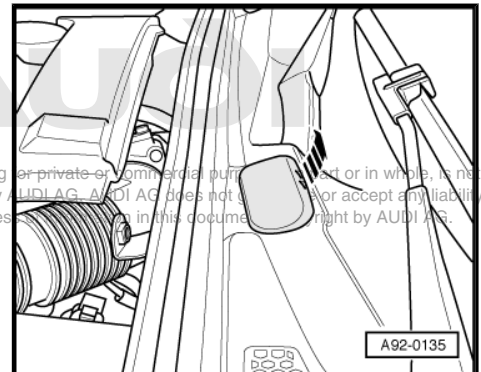
- Unplug electrical connector -1- for Lambda probe 2 - G108- and connector -2- for Lambda probe - G39- .
- Move electrical wiring to Lambda probes clear.



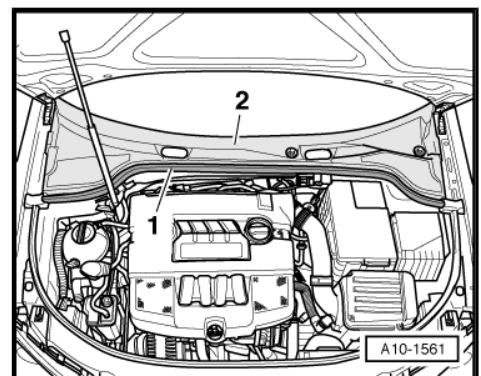
- Lever off caps on windscreen wiper arms with a screwdriver.
- Loosen hexagon nuts -arrows- several turns.
- Loosen wiper arms from wiper shafts by tilting slightly, remove hexagon nuts and take off wiper arms.



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

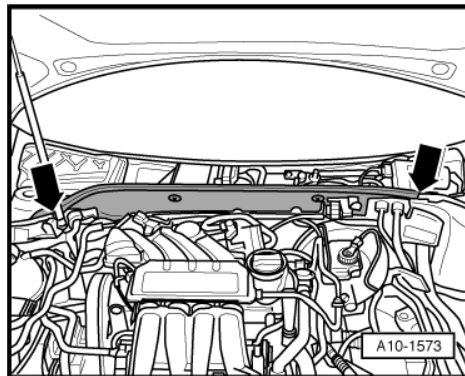


- Pull off rubber seal -1- on plenum chamber cover.
- Detach plenum chamber cover -2-.



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- Move engine wiring harness clear at rear on plenum chamber partition panel.
- Remove plenum chamber partition panel -arrows-.

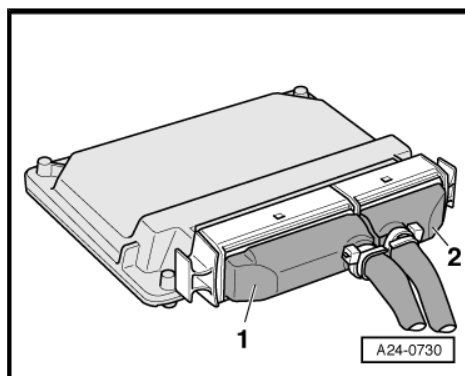


- Remove engine control unit ⇒ Rep. gr. 24 .
- Unplug engine wiring harness connector -2-.



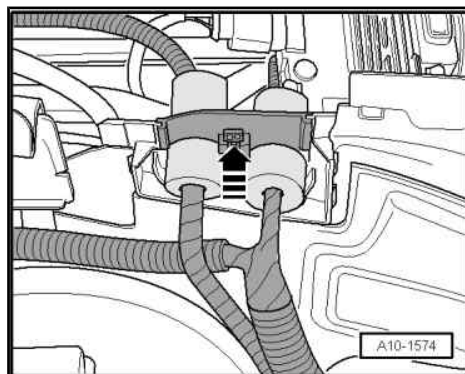
Note

The electrical connector -1- remains connected.



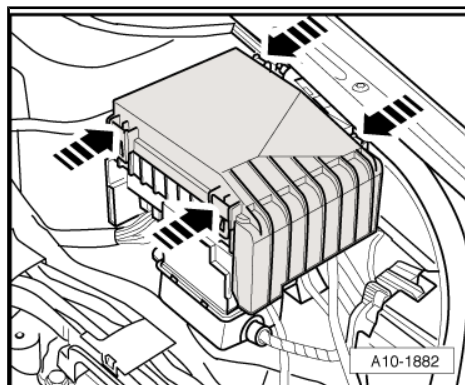
- Release wiring protector for engine wiring harness -arrow- and lift off.

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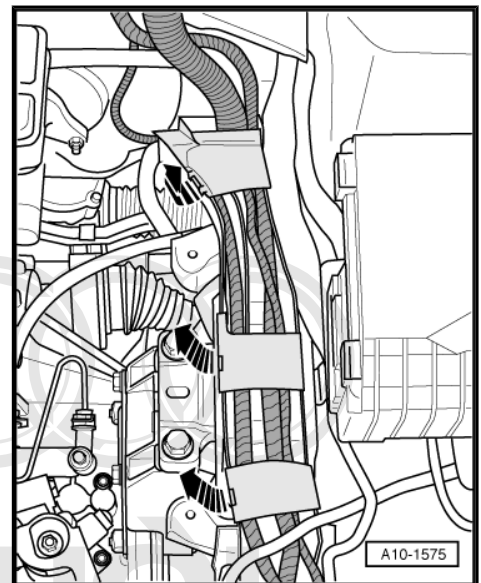
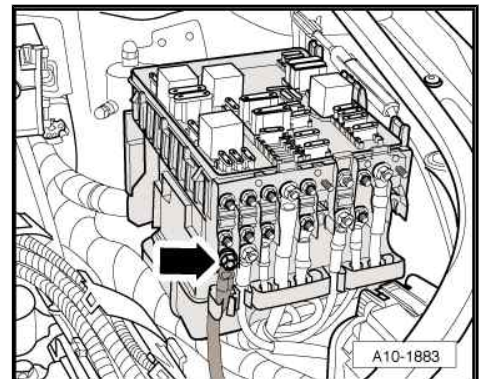
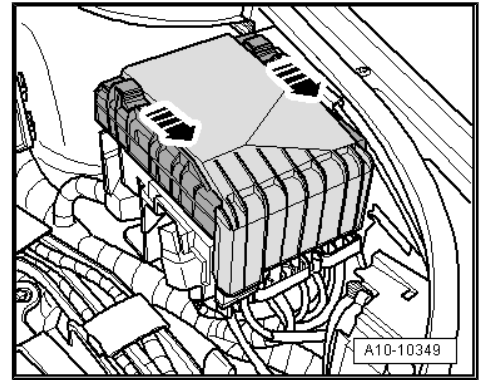
Vehicles with electronics box (previous version):

- Press retaining clips in direction of the -arrows- and remove cover from electronics box in engine compartment.

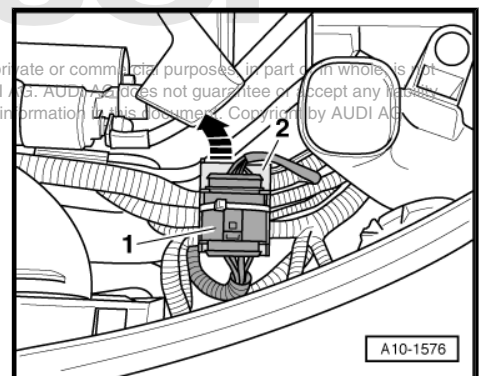


Vehicles with electronics box (current version):

- Press the two clips in direction of the -arrows- and remove cover from electronics box in engine compartment.
- Unscrew terminal 30 wire -arrow- from electronics box in engine compartment and move it clear.
- Open wiring duct brackets -arrows-.



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

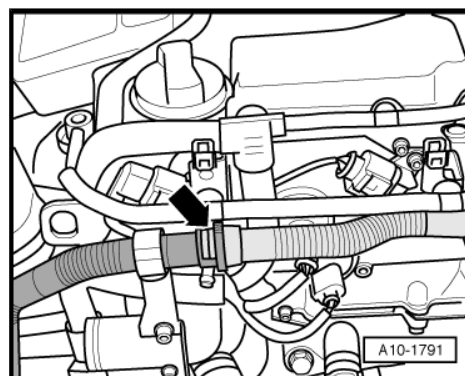
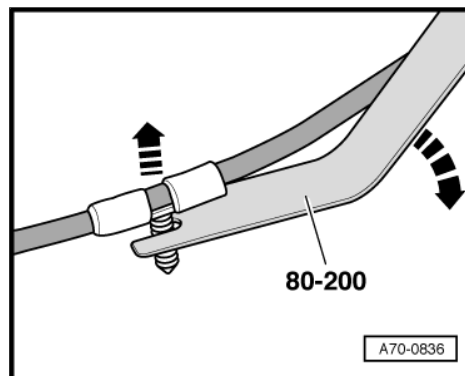




Note

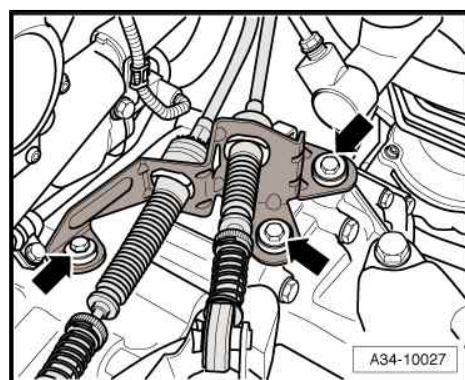
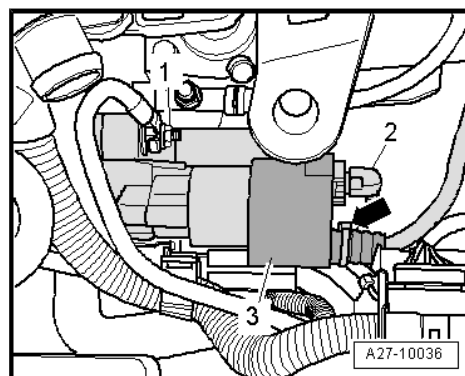
Use removal lever - 80-200- to lever out the wiring clips.

- Disconnect secondary air hose at the position marked with an -arrow-.
- Move air hose to secondary air pump clear.



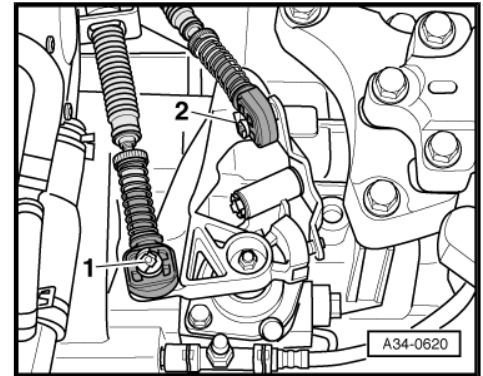
Vehicles with manual gearbox:

- Remove cable tie -arrow- for protective cover -3-.
 - Unplug electrical connector -2-.
 - Push back protective cover and unscrew B+ cable at solenoid switch.
 - Disconnect earth cable -1-.
 - Unscrew top starter securing bolt.
-
- Unbolt cable support bracket from gearbox -arrows-.



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- Unclip retaining clip -1- from gear selector cable and retaining clip -2- from gate selector cable.
- Pull selector cable end-pieces with selector cables off selector shaft lever and relay lever.
- Tie selector cables with cable support bracket to one side.

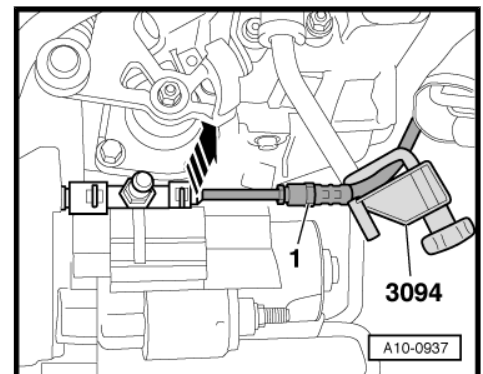


- Clamp off pressure hose to clutch slave cylinder using a hose clamp - 3094- .
- Pull out retainer towards the top -arrow- and disconnect pressure hose -1- from hose connector.



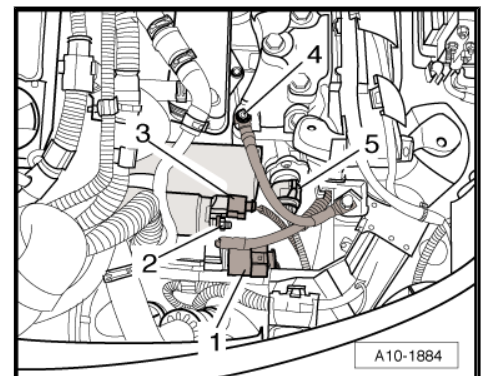
Caution

The clutch pedal must not be depressed after disconnecting the pressure hose going to the clutch slave cylinder.



Vehicles with dual clutch gearbox:

- Unplug electrical connectors -1-, -3- and -5-.
- Detach protective cover and unscrew wire -2- at starter solenoid switch.
- Disconnect earth cable -4-.

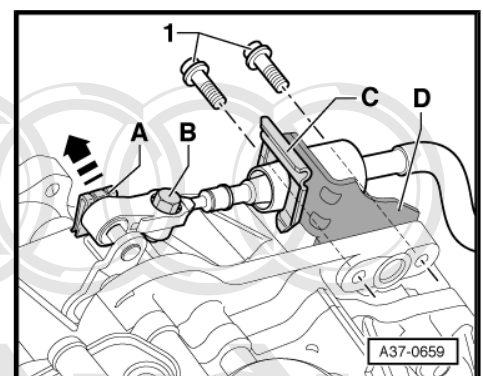


- Unscrew bolts -1- for cable support bracket -D-.
- Pull off the retaining clip -A- upwards -arrow- and detach selector lever cable from gearbox.



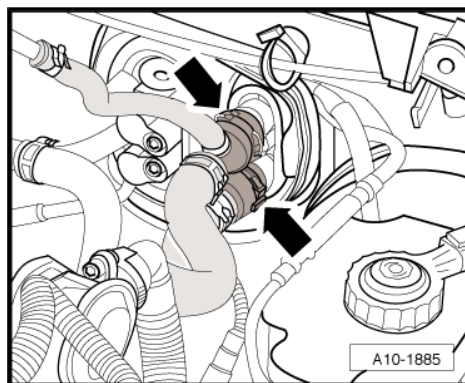
Note

Ignore items marked -B- and -C-.

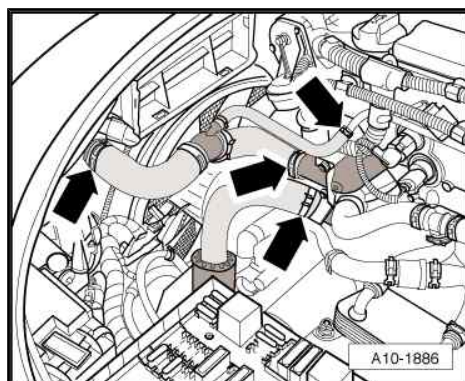


All vehicles (continued):

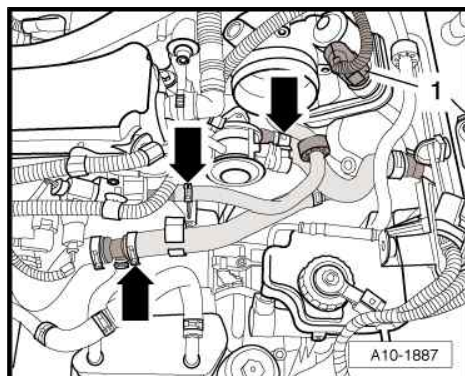
- Detach coolant hoses going to to heat exchanger at bulkhead -arrows-.



- Detach coolant hoses at the connections indicated -arrows-.



- Unplug electrical connector -1- at throttle valve module - J338- .
- Detach coolant hoses at the connections indicated -arrows-.

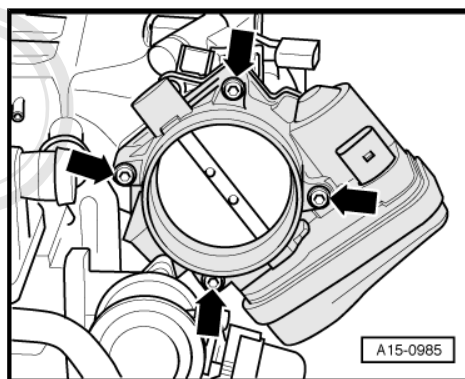


- Unbolt the throttle valve module - J338- from the intake manifold -arrows-.



WARNING

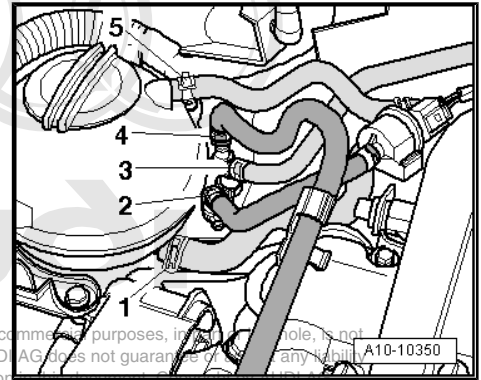
The fuel system is pressurised. Wrap a cloth around the connection before opening the system. Then release pressure by carefully loosening the connection.



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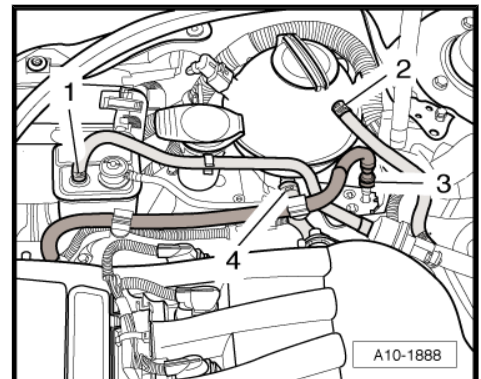
USA vehicles:

- Disconnect following hose connections:
- 1 - Coolant hose to expansion tank
- 2 - Vacuum hose to activated charcoal filter
- 3 - Vacuum hose to tank leak diagnostic pump
- 4 - Fuel supply line
- 5 - Coolant hose to expansion tank



Rest-of-world vehicles:

- Disconnect vacuum line -1- from activated charcoal filter and move line clear.
- Pull off fuel supply hose -3-.
- Detach coolant hoses -2- and -4-.

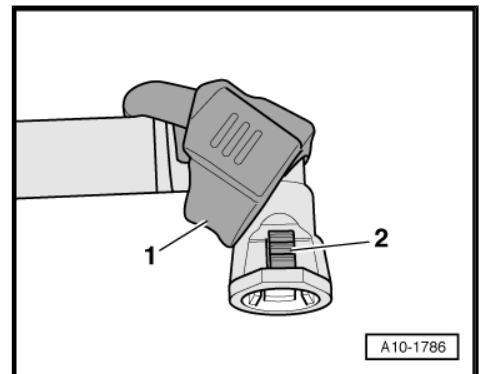


All vehicles (continued):



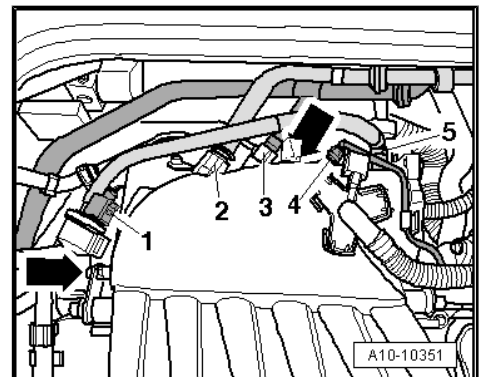
Note

Some versions have plug-in vacuum connections on the intake manifold as illustrated. To disconnect, push back rubber cap -1- and slide back retaining tab -2-.



- Disconnect hoses and electrical connectors at indicated locations:

- 1 - Electrical connector at activated charcoal filter system solenoid valve 1 - N80-
- 2 - Vacuum hose to brake servo
- 3 - Vacuum hose to exhaust flap; fitted in addition to the tank leak diagnostic pump on USA vehicles
- 5 - Vacuum hose to activated charcoal filter solenoid valve 1 - N80-

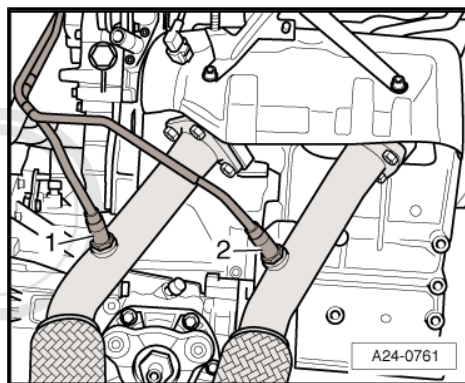


Note

Disregard -item 4-.

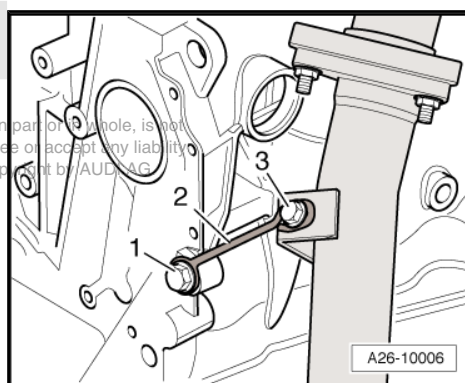
- Unbolt hose bracket -arrows-.
- Remove hose bracket with coolant hoses and vacuum hoses.

- Unscrew Lambda probe 2 - G108- -item 1- and Lambda probe - G39- -item 2-.

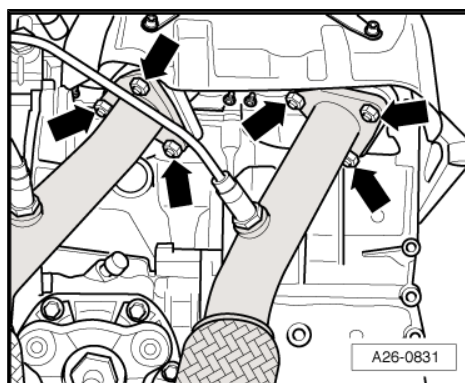


- Unscrew bolts -1- and -3- and remove support -2- for front exhaust pipe.

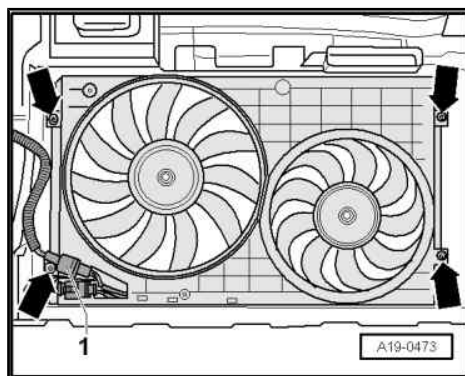
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- Unscrew nuts of front exhaust pipe at exhaust manifolds -arrows-.



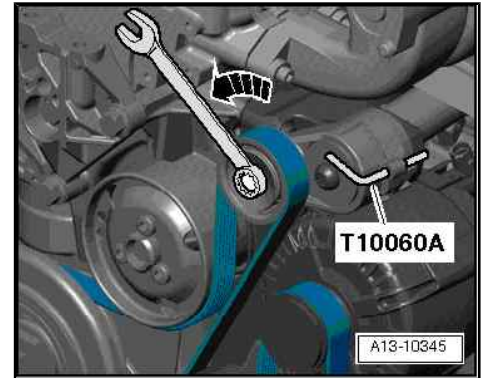
- Unscrew upper securing bolts -upper arrows- for radiator cowl.



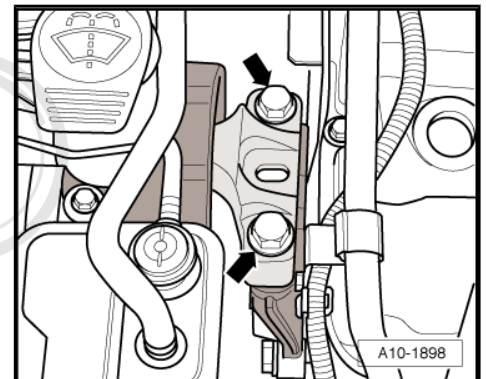
 Note

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

- Turn tensioner in direction of -arrow- to slacken poly V-belt and lock in position with locking pin - T10060 A- .
- Remove poly V-belt.

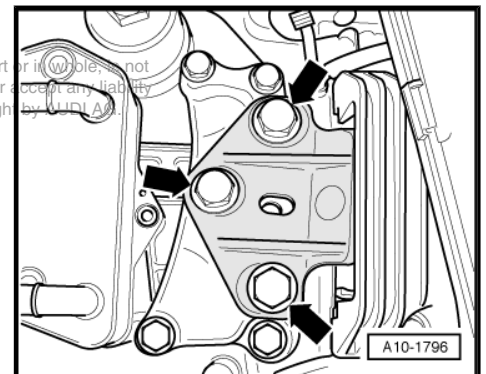


- Loosen bolts of assembly mounting at engine -arrows- approx. 2 turns.

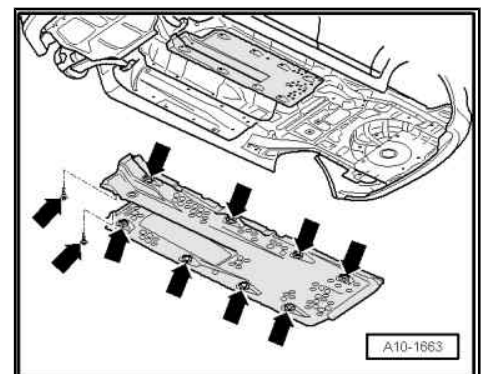


- Loosen bolts of assembly mounting at gearbox -arrows- approx. 2 turns.

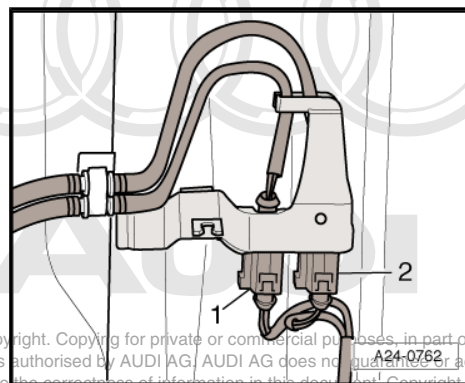
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- Remove underbody cover (right-side) -arrows-.



- Unplug electrical connector -1- for Lambda probe after catalytic converter - G130- and connector -2- for Lambda probe 2 after catalytic converter - G131- .
- Remove plug connector from bracket and move wiring to Lambda probes clear.



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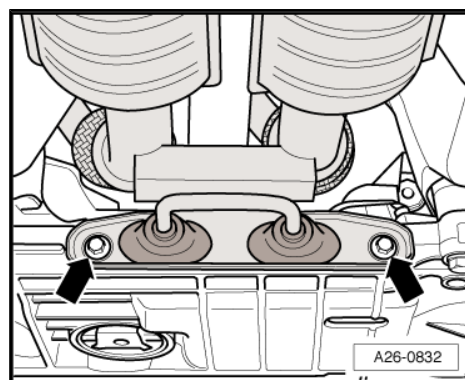
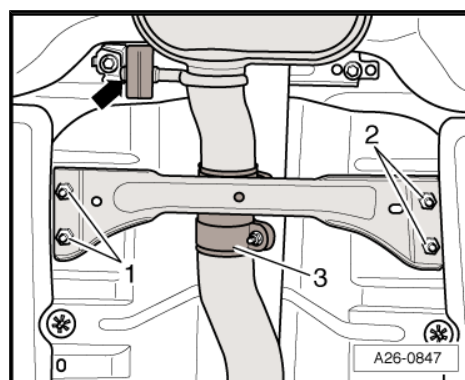
- Remove front cross member for underbody; to do so, unscrew nuts -1- and -2-.



Note

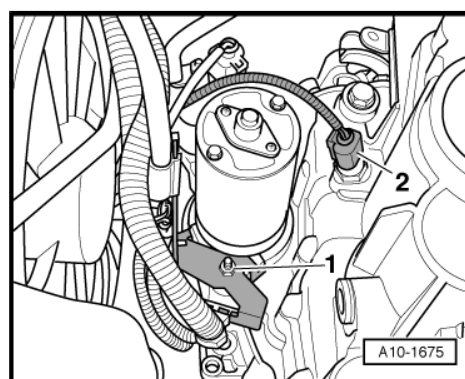
To avoid damage, the flexible joints in the front exhaust pipe must not be bent more than 30°.

- Disconnect exhaust system at clamp -3-.
- Unscrew bracket for exhaust system -arrows- and remove exhaust system.

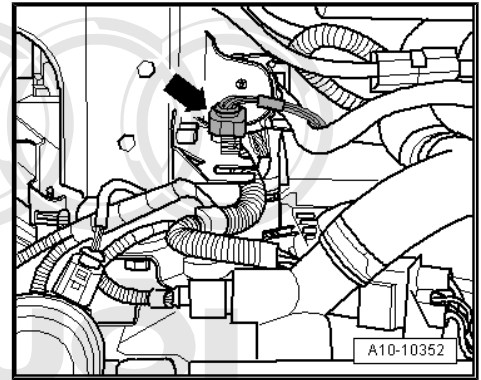


Vehicles with manual gearbox:

- Unplug electrical connector -2- at reversing light switch - F4- .
- Unscrew nut -1- and remove bracket with wiring from bottom starter securing bolt.

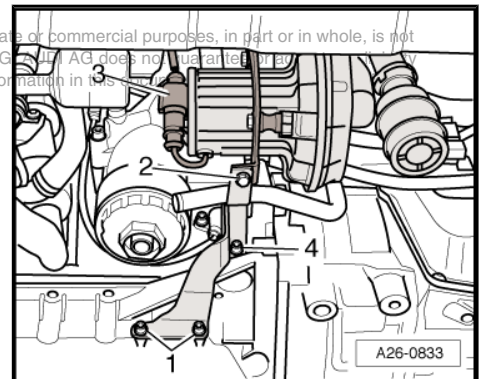


- Unplug electrical connector -arrow- at longitudinal member (bottom left).

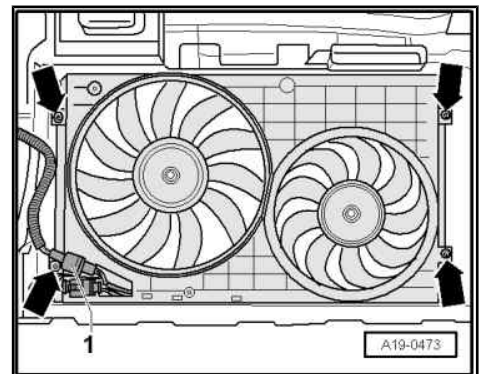


All vehicles (continued):

- Move coolant hose at bottom of radiator cowl clear.
- Detach electrical connector -3- at secondary air pump motor - V101- and move wire clear.
- Unscrew bracket -2- for coolant pipe going to gear oil cooler on vehicles with direct shift gearbox.
- Remove bolts -1-.
- Loosen bolt -4- and remove secondary air pump with bracket.



- Detach electrical connectors -1- for radiator fans at bottom of radiator cowl.
- Unscrew lower securing bolts -lower arrows- for radiator cowl.
- Remove the radiator cowl with both fans from below.



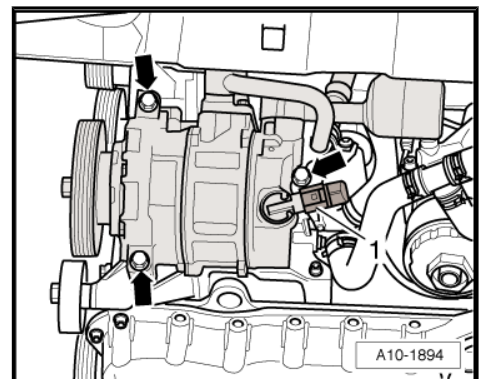
- Unplug electrical connector -1- for magnetic clutch at air conditioner compressor and move electrical wiring clear.



WARNING

The air conditioner refrigerant circuit must not be opened.

- Unscrew bolts -arrow- for air conditioner compressor.
- Tie up air conditioner compressor together with refrigerant hoses at front of longitudinal member (refrigerant hoses remain connected).

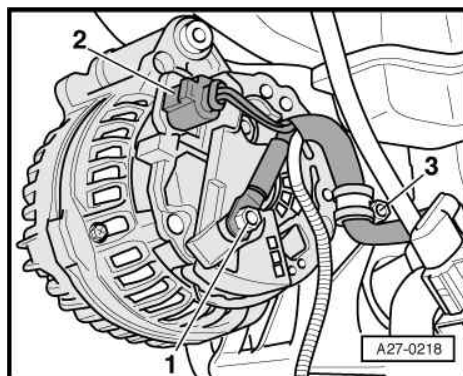


- Unscrew wire -1- at alternator.
- Unplug electrical connector -2-.



Note

Disregard -item 3-.



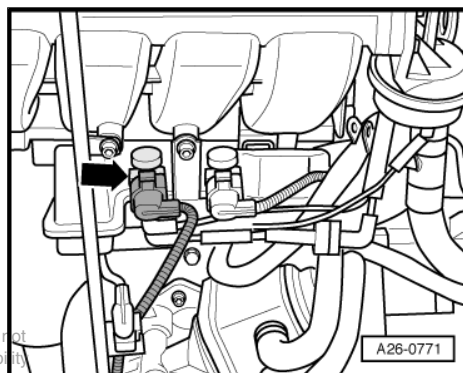
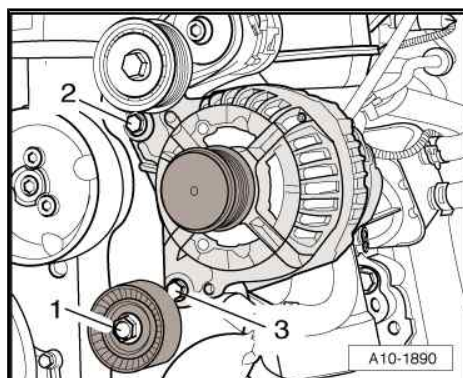
- Remove the upper idler roller -1-.
- Unscrew securing bolts -2- and -3- for alternator.



Note

The alternator can only be removed from bracket with upper securing bolt still inserted.

- Detach alternator from bracket for ancillaries.
- Take out alternator to the bottom left.
- Unplug electrical connector -arrow- at secondary air inlet valve - N112- .

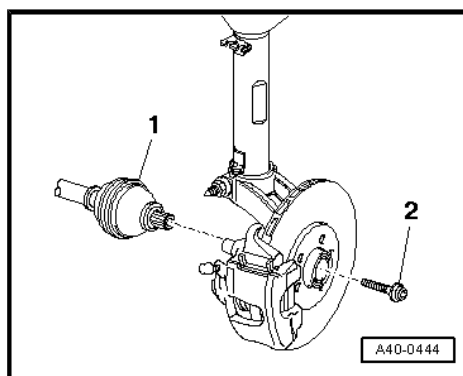


Caution

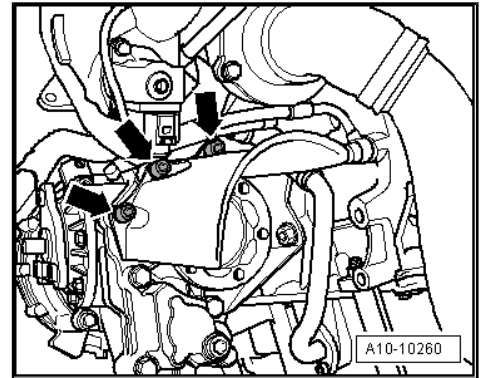
When slackening the flange bolt securing the drive shaft, the wheel bearing must not be under load (vehicle must not be standing on its wheels).

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- Have a 2nd mechanic press the brake pedal.
- Unscrew flange bolt -2- from drive shaft (right-side) -1-.



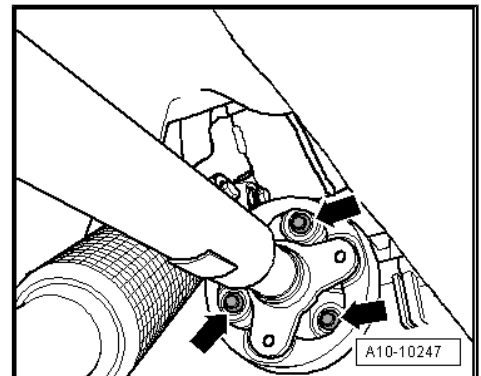
- Unscrew heat shield for drive shaft (right-side) from bevel box -arrows-.
- Remove drive shaft (right-side) ⇒ Rep. gr. 40 .
- Detach drive shaft (left-side) from flange shaft of gearbox.



- Mark position of flexible coupling and flange for bevel box in relation to each other.
- Unbolt flexible coupling for propshaft at bevel box -arrows-.

 Note

When loosening bolts, counterhold at propshaft flange/final drive with a suitable lever.



- Push propshaft horizontally as far back as possible.

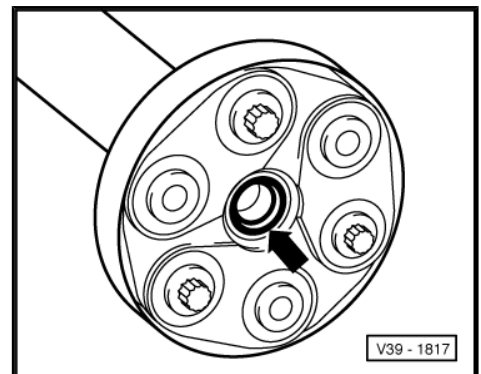


Caution

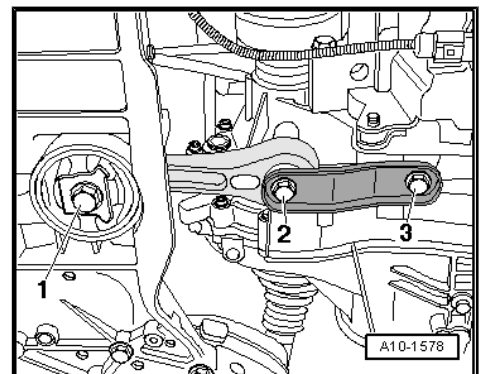
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♦ **The oil seal -arrow- in the flange of propshaft must not be damaged when removing and installing the engine/gearbox assembly. The propshaft must be renewed if oil seal is damaged.**

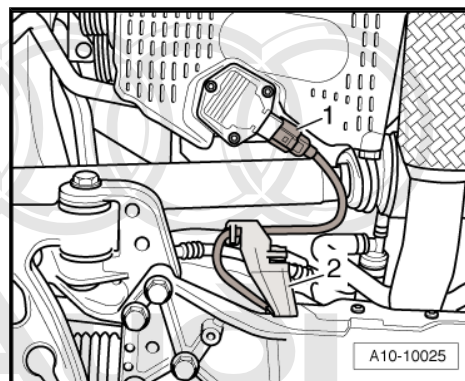
♦ **When unscrewing the bolts for the pendulum support/sub-frame, the engine/gearbox assembly swings slightly forward.**



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



- Unplug electrical connector -1- at oil level and oil temperature sender - G266- .
- Unclip bracket -2- for wire to oil level and oil temperature sender - G266- at subframe.



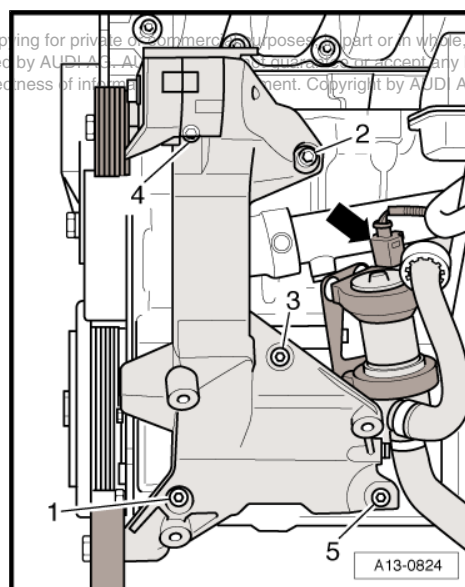
- Unplug electrical connector -arrow- at continued coolant circulation pump - V51- .
- Pull the continued circulation coolant pump - V51- downwards out of the rubber retainers on bracket (with coolant hoses attached). If necessary, spray rubber retainers with silicone-free lubricant.



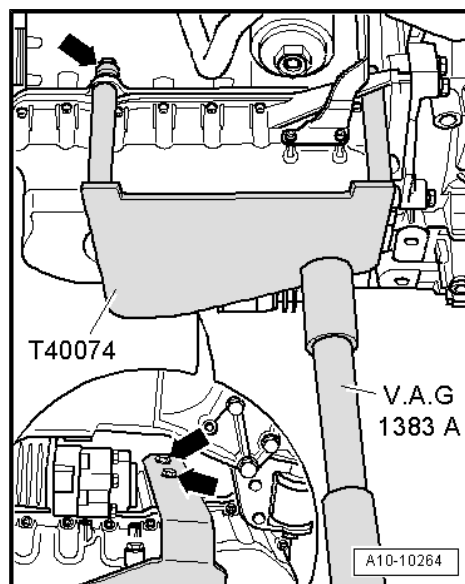
Note

The coolant pump with attached coolant hoses can be left in place on the engine.

- Remove bolts -1 ... 5- and detach bracket for ancillaries.



- Secure engine support - T40074- to cylinder block and tighten to approx. 20 Nm -arrows-.
- Insert engine and gearbox jack - V.A.G 1383 A- in engine support - T40074- and raise engine/gearbox assembly slightly.





Note

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

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

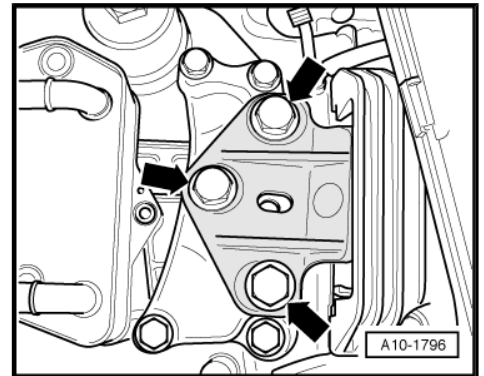
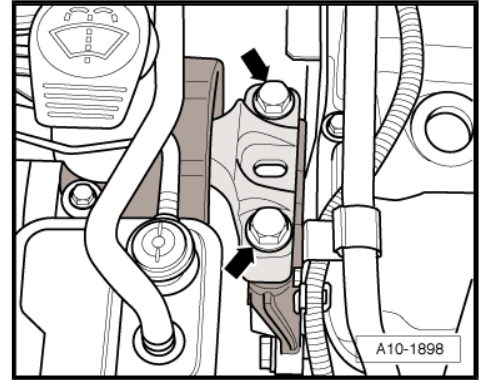
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- Unscrew bolts of assembly mounting at gearbox -arrows-.



Note

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



1.2 Separating engine from manual gearbox

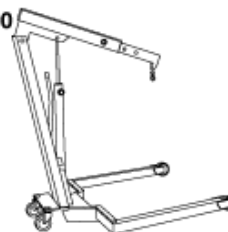
Special tools and workshop equipment required

- ◆ Hooks - 10-222 A/2-
- ◆ Workshop hoist - VAS 6100-
- ◆ Lifting tackle - T40013-

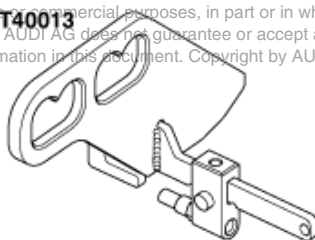
10-222 A/2



VAS 6100



T40013

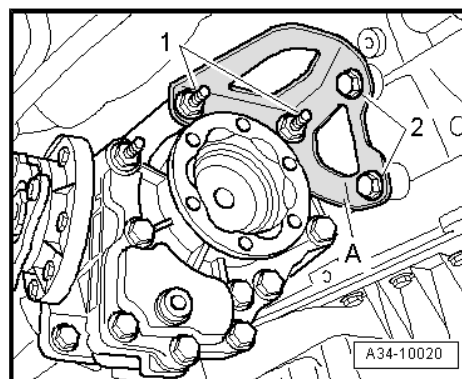


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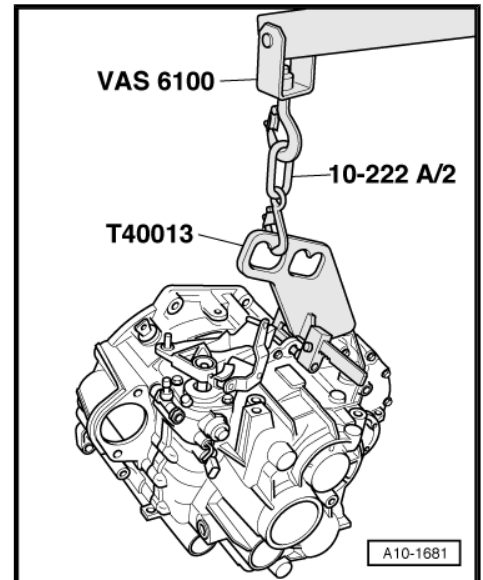
G34-0029

Procedure

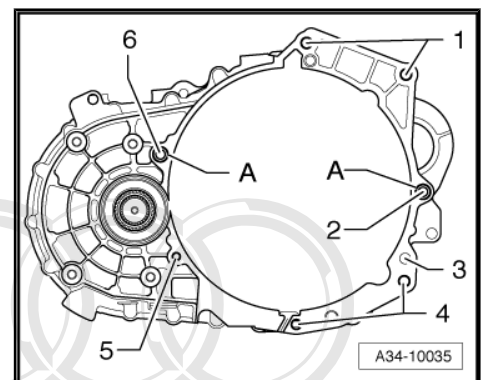
- Engine/gearbox assembly removed and attached to engine support.
- Unscrew bolts -1- and -2- at bracket -A- for bevel box and remove bracket.



- Attach lifting tackle - T40013- to gearbox and close lock.
- Attach workshop hoist - VAS 6100- with hooks - 10-222 A/2- to the lifting tackle.



- Remove bolts -1 ... 6- on engine/gearbox flange.
- Separate gearbox from engine.

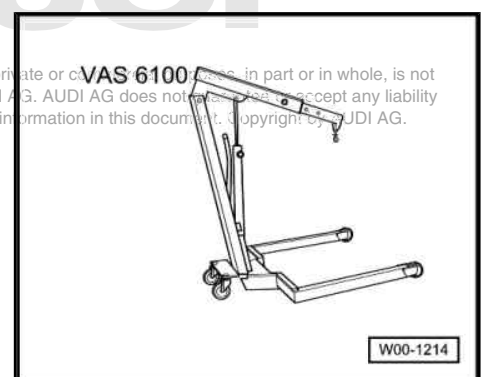


1.3 Separating engine from direct shift gearbox

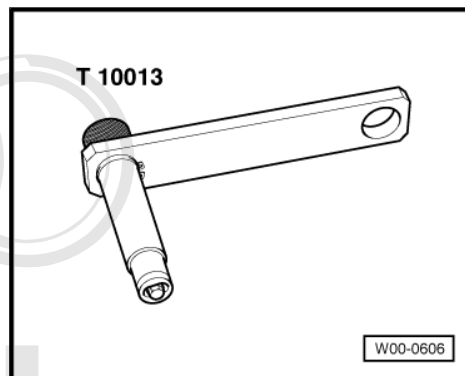
Special tools and workshop equipment required

- ◆ Workshop hoist - VAS 6100-

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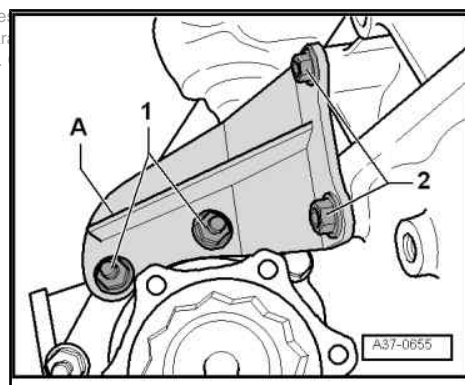
◆ Retainer - T10013-



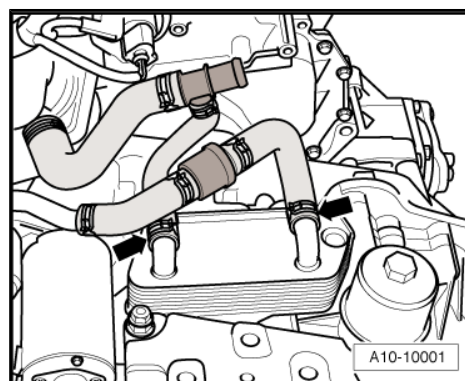
◆ Bolt M8x40 with nut and washer with Ø 30 mm

Procedure

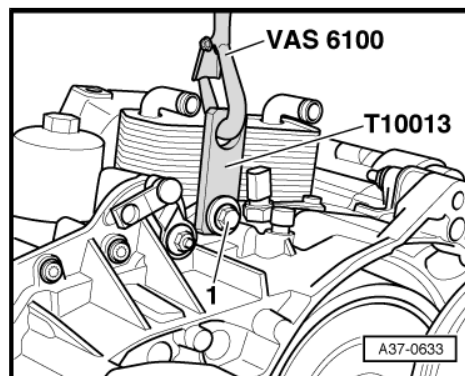
- Engine/gearbox assembly removed and attached to engine support.
- Unscrew bolts -1- and -2- at bracket -A- for bevel box and remove bracket.



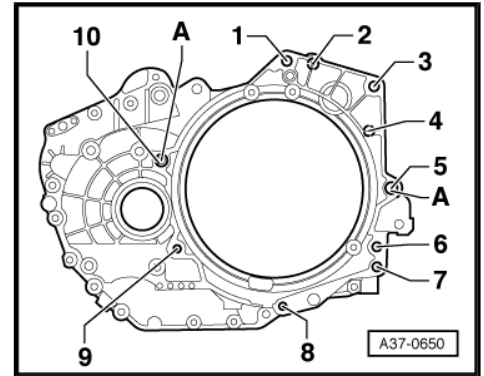
- Disconnect coolant hoses -arrows- at gear oil cooler.



- Remove the pin from retainer - T10013- ; to do so, remove circlip.
- Secure retainer - T10013- with a bolt M8x40 and washer Ø 30 mm to the gearbox lifting eye.
- Attach workshop hoist - VAS 6100- to retainer - T10013- .



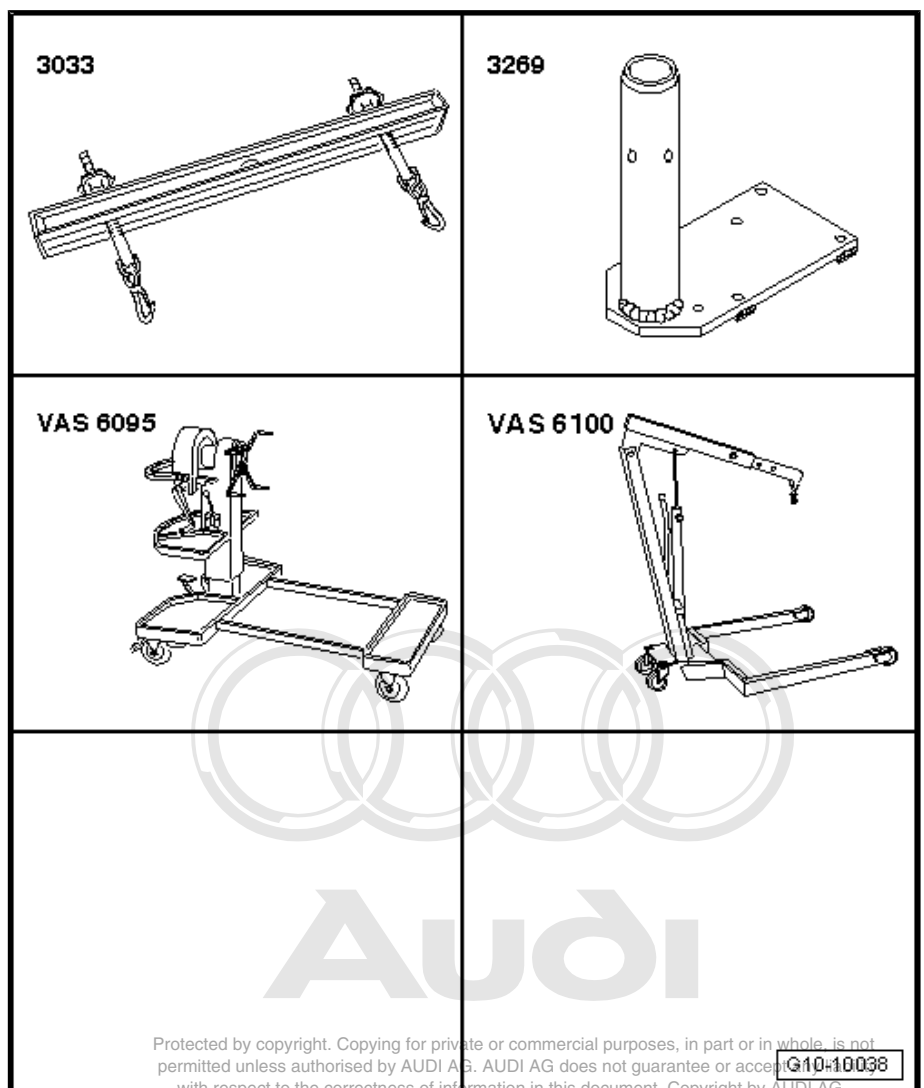
- Remove bolts -1-, -2- and -5 ... 10- on engine/gearbox flange.
- Separate gearbox from engine.



1.4 Securing engine to engine and gearbox support

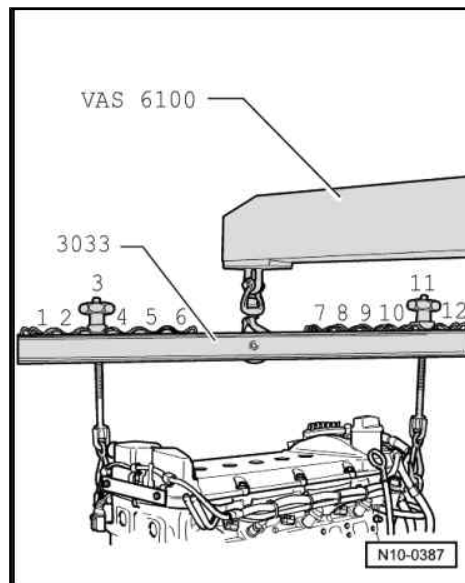
Special tools and workshop equipment required

- ◆ Lifting tackle - 3033-
- ◆ Engine bracket - 3269-
- ◆ Engine and gearbox support - VAS 6095-
- ◆ Workshop hoist - VAS 6100-



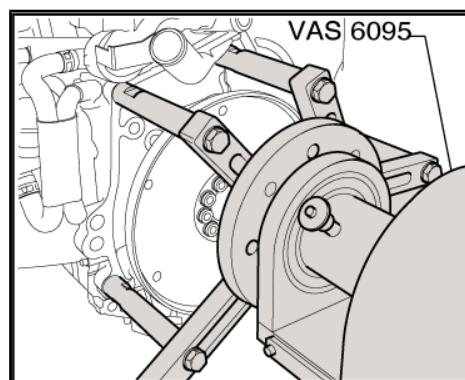
Procedure

- Attach lifting tackle - 3033- to engine and workshop hoist - VAS 6100- as shown in the illustration.
- Lift engine off engine support using workshop hoist - VAS 6100- .



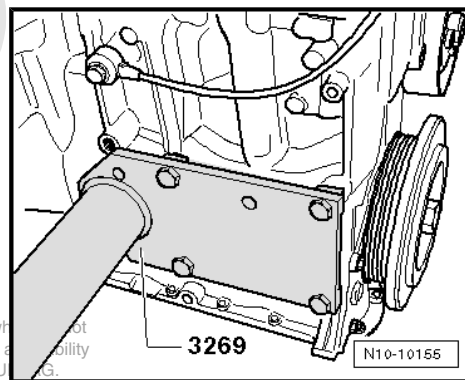
Securing engine at gearbox end

- Secure engine and gearbox support - VAS 6095- to gearbox end of cylinder block as shown in illustration.



Securing engine at side

- Secure engine bracket - 3269- to side of cylinder block as shown in illustration.
- Secure engine to engine and gearbox support - 3269- using engine bracket - VAS 6095- .



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1.5 Installing engine

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



Note

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

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

Vehicles with manual gearbox:

- There should be no needle bearing fitted in the crankshaft on vehicles with manual gearbox; remove needle bearing if fitted
⇒ [page 68](#) .
- Check clutch release bearing for wear; renew if necessary.
- Lubricate splines of gearbox input shaft lightly with grease for clutch plate splines - G 000 100- .
- Check that the clutch plate is properly centralised (only necessary if you have carried out other work on the clutch).

Vehicles with direct shift gearbox:

- A needle bearing must be fitted in the crankshaft on vehicles with direct shift gearbox; install needle bearing if not yet fitted
⇒ [page 68](#) .

All vehicles (continued):

- Bolt gearbox to engine.
- Use new securing bolts.



Note

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

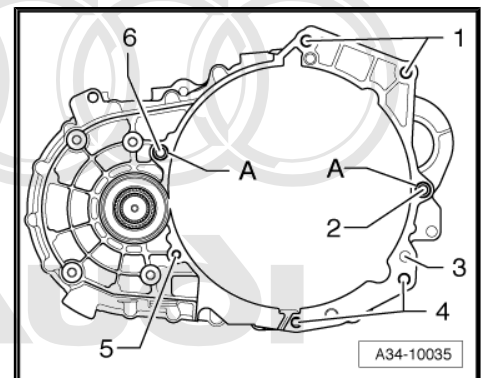
Securing engine to manual gearbox

Item	Bolt	Nm
1 ¹⁾ , 3	M12x55	80
2 ²⁾	M12x65	80
4, 5 ²⁾ ³⁾	M10x50	40
6 ²⁾	M12x80	80
A	Dowel sleeves for centralising	

1) Bolt with M8 threaded pin

2) Screwed into gearbox from engine side.

3) Retaining clip for bolt must be fitted in sump.



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Securing engine to direct shift gearbox

Item	Bolt	Nm
1	M12x55	80
2 ⁴⁾ ⁵⁾	M10x40	40
3 ⁴⁾ , 6	M12x55	80
4 ⁵⁾ , 9	M10x45	40
5	M12x65	80
7, 8	M10x50	40
10	M12x70	80
A	Dowel sleeves for centralising	

4) Bolt with M8 threaded pin

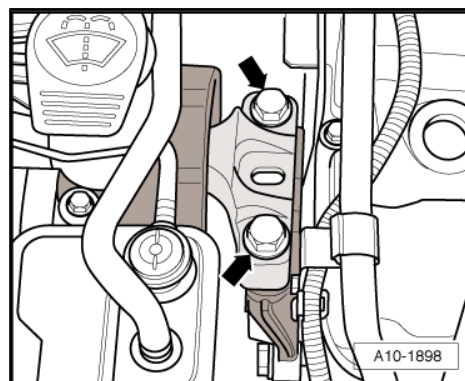
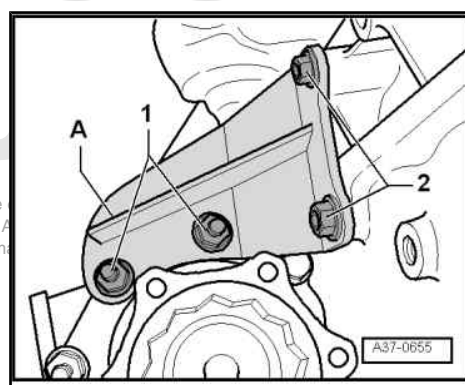
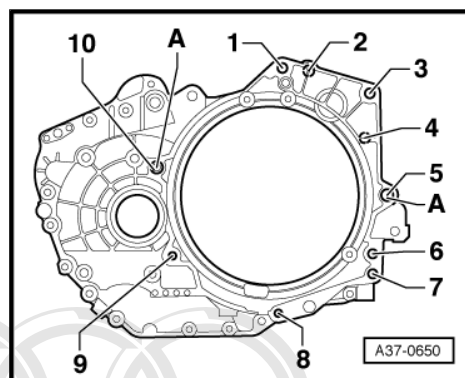
5) Bolt is only used to secure starter to gearbox.

– Install the bracket -A- for bevel box; note the following procedure:

- Initially tighten bolts -1- to 3 Nm.
- Tighten bolts -2- to 35 Nm.
- Then tighten bolts -1- to 45 Nm.

– Guide engine/gearbox assembly into the body.

– Tighten bolts securing engine support to engine mounting -arrows- initially hand-tight.



- Tighten bolts securing gearbox mounting to gearbox support -arrows- initially hand-tight.
- Use new securing bolts.

 Note

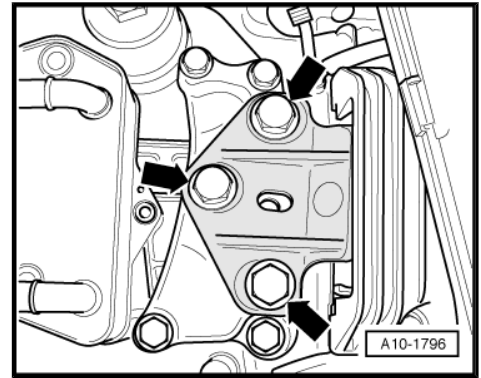
The bolts are tightened to final torque only after adjusting the engine mountings ⇒ [page 40](#) .

- Remove engine support from engine.
- Install drive shafts ⇒ Rep. gr. 40 .

 Note

Drive shafts must be installed prior to further assembly.

- Secure pendulum support to gearbox with new bolts -Item 2- and -Item 3-.

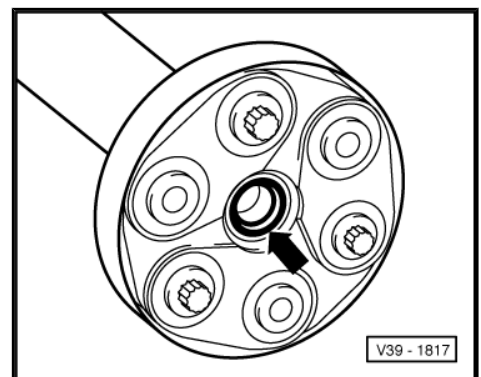
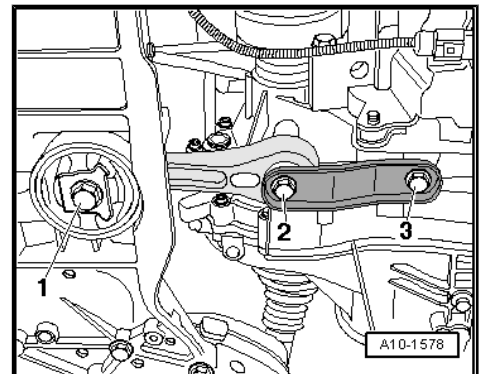


- Push engine/gearbox assembly towards bulkhead; the journal of the bevel box must be simultaneously inserted horizontally and carefully into the flange of the propshaft.

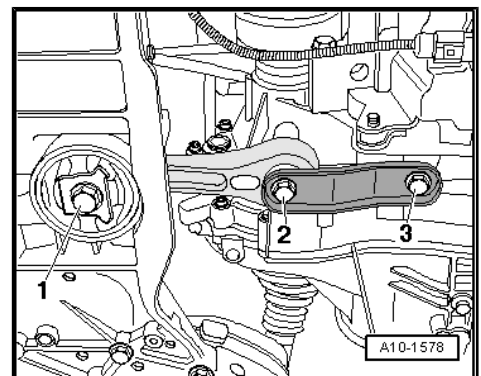


Caution

The oil seal -arrow- in the flange of propshaft must not be damaged when installing the engine/gearbox assembly. The propshaft must be renewed if oil seal is damaged.



- Secure pendulum support to subframe using new bolt -item 1-.



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- Secure propshaft with flexible coupling to the flange of the bevel box -arrows-.

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

- Install exhaust system and align free of stress ⇒ [page 202](#) .

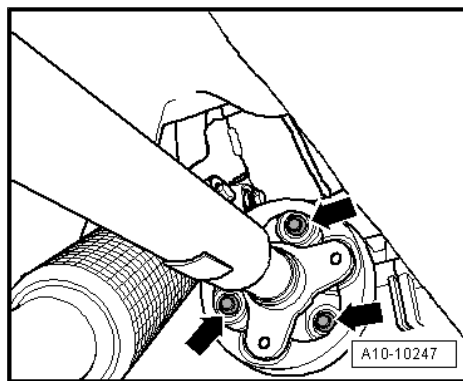
Vehicles with manual gearbox:

- Installing and adjusting selector mechanism ⇒ Rep. gr. 34 .
- Connect pipe/hose to bleeder connection on clutch slave cylinder and bleed clutch system ⇒ Rep. gr. 30 .



Caution

The clutch pedal must not be depressed prior to bleeding the clutch system.



Vehicles with direct shift gearbox:

- Install selector lever cable ⇒ Rep. gr. 37 .

All vehicles (continued):

- Install bracket for ancillary units ⇒ [page 49](#)
- To facilitate positioning of alternator, drive back bushes for securing bolts slightly.
- Install alternator ⇒ Rep. gr. 27 .
- Install air conditioner compressor.
- Install radiator cowl
⇒ ["1.13 Removing and installing radiator fan V7 and radiator fan 2 V177"](#), [page 192](#) .
- Install secondary air pump ⇒ [page 219](#) .
- Install poly V-belt ⇒ [page 46](#) .
- Adjust engine mountings ⇒ [page 40](#) .
- Install windscreen wiper arms ⇒ Rep. gr. 92 .
- Electrical connections and routing ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- Connect earth strap to battery ⇒ Rep. gr. 27 .
- Check oil level ⇒ [page 166](#)

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Caution

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

- Fill cooling system ⇒ [page 165](#) .



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.*

Tightening torques

Component	Nm
Bolts/nuts	M6 10
	M7 15
	M8 20
	M10 40
	M12 65
Except for the following:	
Pendulum support to gearbox	40 + 90° ^{6) 7)}
Pendulum support to subframe	100 + 90° ^{6) 7)}
Flexible coupling to flange	60
Front exhaust pipe to exhaust manifold	40 ⁶⁾
Drive shaft heat shield to bevel box	23
Terminal B+ to starter	16
Earth wire to gearbox	22

6) Renew nuts and bolts.

7) 90° = a quarter of a turn.

2 Assembly mountings

⇒ [“2.1 Assembly mountings - exploded view”, page 40](#)

⇒ [“2.2 Checking adjustment of assembly mountings \(engine/gearbox mountings\)”, page 41](#)

⇒ [“2.3 Adjusting assembly mountings”, page 41](#)

2.1 Assembly mountings - exploded view

1 - Bolt

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

2 - 50 Nm + 90° (1/4 turn further)

- ☐ Pendulum support to gearbox
- ☐ Renew

3 - Engine support

4 - 45 Nm

- ☐ Engine support to engine

5 - Engine mounting

6 - 40 Nm + 90° (1/4 turn further)

- ☐ Engine mounting to body
- ☐ Renew

7 - Connecting bracket

8 - 20 Nm + 90° (1/4 turn further)

- ☐ Connecting bracket to engine mounting
- ☐ Renew

9 - 20 Nm + 90° (1/4 turn further)

- ☐ Connecting bracket to body
- ☐ Renew

10 - 40 Nm + 90° (1/4 turn further)

- ☐ Engine mounting to body
- ☐ Renew

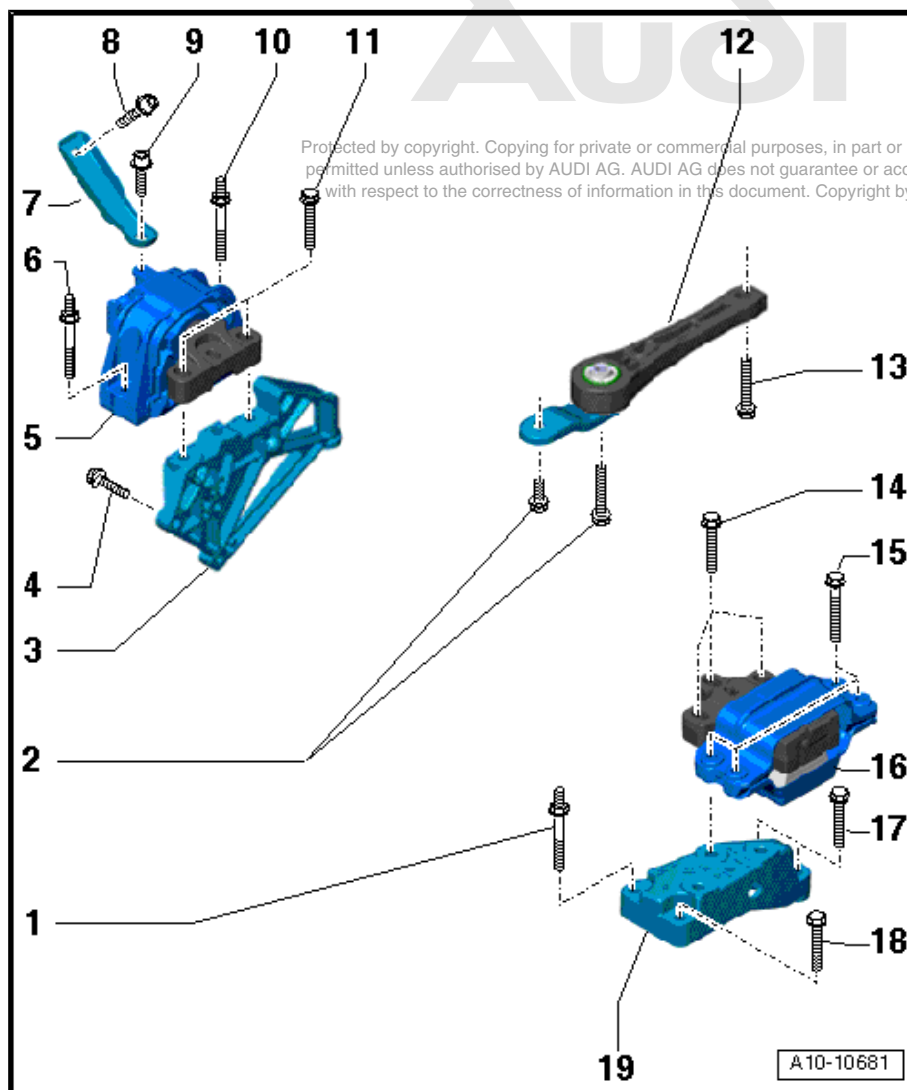
11 - 60 Nm + 90° (1/4 turn further)

- ☐ Engine mounting to engine support
- ☐ Renew

12 - Pendulum support

13 - Bolt

- ☐ Pendulum support to subframe



- ☐ Renew

14 - Bolt

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

15 - 100 Nm + 90° (1/4 turn further)

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

16 - Gearbox mounting

- ☐ Illustration shows version for direct shift gearbox

17 - Bolt

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

18 - Bolt

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

19 - Gearbox support

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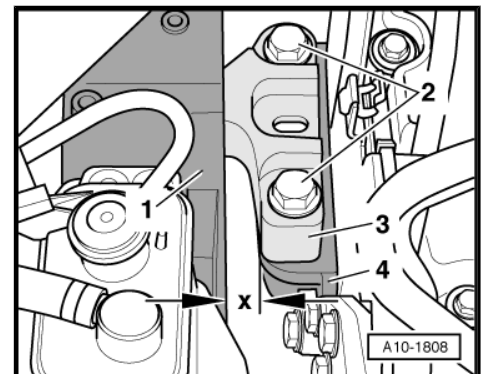
2.2 Checking adjustment of assembly mountings (engine/gearbox mountings)

- Check the following dimensions at engine/gearbox assembly mounting (right-side):
 - The two bolt heads -2- must be parallel with the edge of the support arm -3-.
 - There must be a distance of -x- = 16 mm between engine mounting -1- and engine support -4-.



Note

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

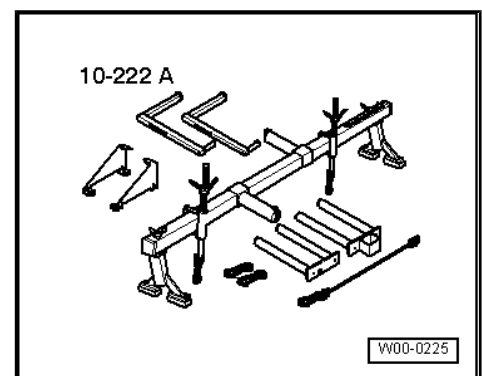


If the distance measured is too large or small, the engine mountings must be adjusted ⇒ [page 41](#).

2.3 Adjusting assembly mountings

Special tools and workshop equipment required

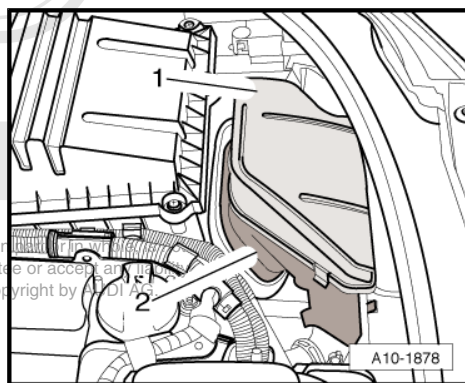
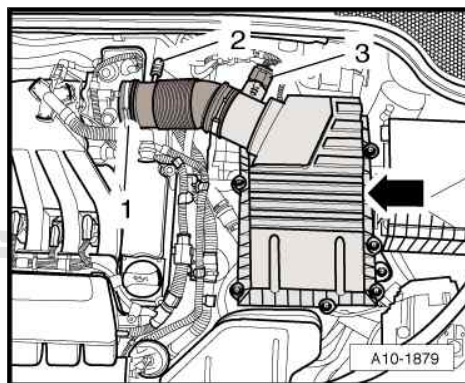
- ◆ Support bracket - 10-222 A-



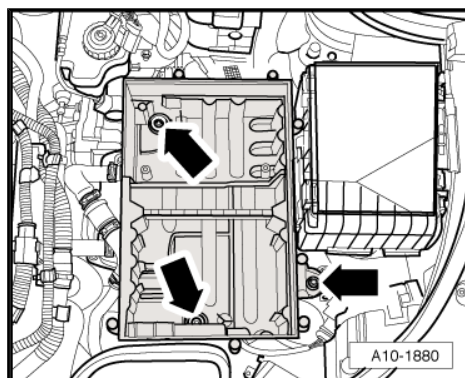
Adjusting

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

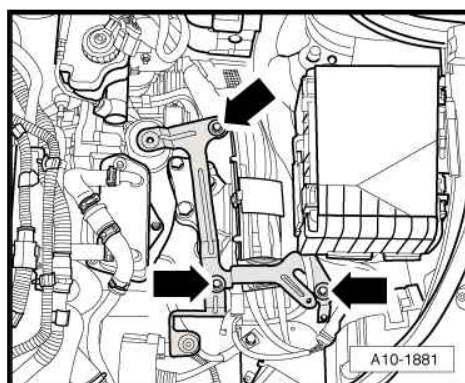
- Detach vacuum hose -2- from air intake hose (if fitted).
- Detach air hose -1- at the throttle valve module - J338- .
- Unplug electrical connector for air mass meter - G70-
-item 3-.
- Unscrew air cleaner housing (upper section) -arrow-.
- Take out filter element.
- Pull cover -1- off air duct (release clips on sides).
- Unclip air duct -2-.



- Unscrew air cleaner housing (lower section) -arrows-.

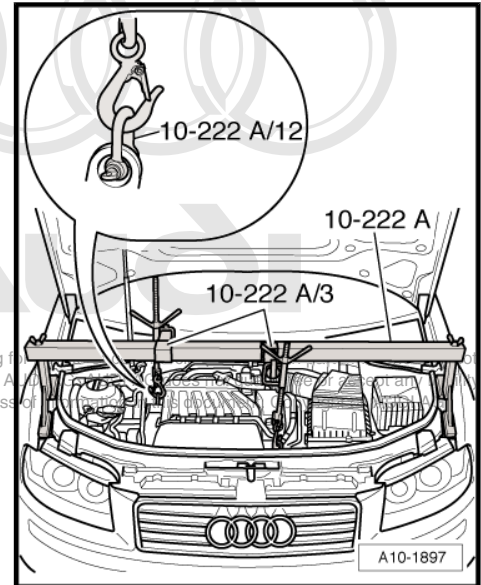


- Unscrew bracket for air cleaner housing -arrows-.

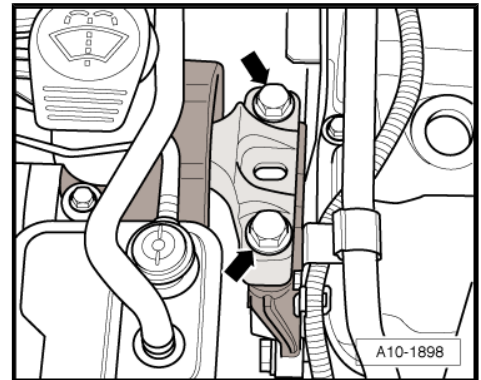


- Attach a shackle - 10-222 A/12- to the engine lifting eye (rear right).
- Set up support bracket - 10-222 A- with adapters - 10-222 A/3- on wing panel flanges.
- Attach the spindles to lifting eye and to shackle.
- Lift the engine evenly a short distance with both spindles.

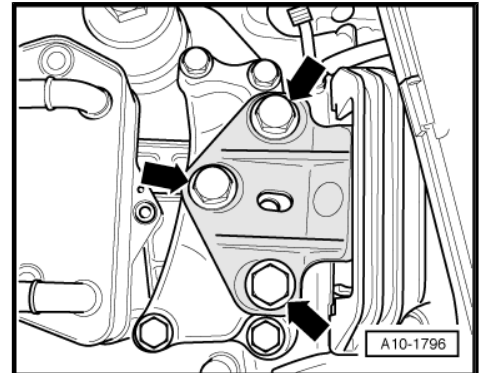
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- Remove bolts of assembly mounting for engine -arrows-.



- Unscrew bolts of assembly mounting at gearbox -arrows-.
- Renew each of the 5 bolts in turn (if not already done when installing engine) and hand-tighten.
- Loosen the bolts for support arms on right and left approx. 2 turns.

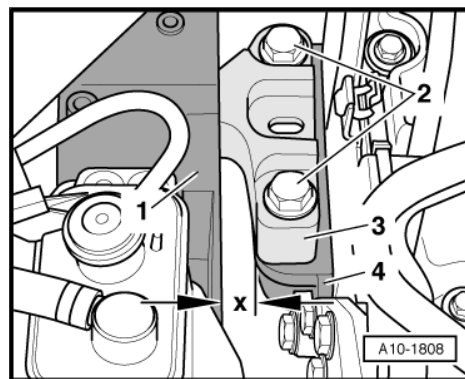


- Using a suitable lever, adjust engine between engine mounting -1- and engine support -4- until the specifications listed below are obtained:
- The two bolt heads -2- must be parallel with the edge of the support arm -3-.
- There must be a distance of -x- = 16 mm between engine mounting -1- and engine support -4-.



Note

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



- Tighten the bolts for engine assembly mounting.
- Ensure that edges of support arm (on gearbox assembly mounting) -1- and gearbox mounting -2- are parallel.
- Dimension -x- must be identical on both sides of mounting.
- Tighten the bolts for gearbox assembly mounting.

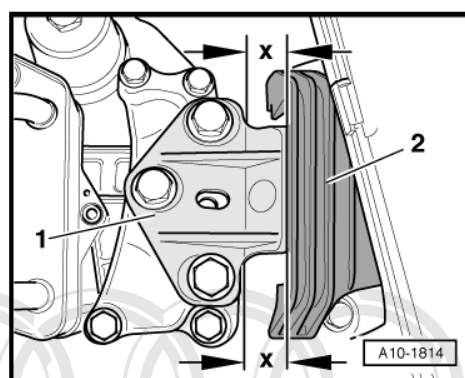
The remaining installation steps are carried out in the reverse sequence.

Tightening torques

Component	Nm
Support arm to engine support	60 + 90° 8) 9)
Support arm to gearbox support	60 + 90° 8) 9)

8) Renew bolts.

9) 90° equals a 1/4 turn.



13 – Crankshaft group

1 Cylinder block (pulley end)

⇒ [“1.1 Poly V-belt drive - exploded view”, page 45](#)

⇒ [“1.2 Removing and installing poly V-belt”, page 46](#)

⇒ [“1.3 Removing and installing tensioner for poly V-belt”, page 48](#)

⇒ [“1.4 Removing and installing bracket for ancillaries”, page 49](#)

⇒ [“1.5 Removing and installing vibration damper”, page 53](#)

⇒ [“1.6 Renewing crankshaft oil seal \(pulley end\) - vehicles up to 11.2004”, page 54](#)

⇒ [“1.7 Removing and installing sealing flange, pulley end”, page 57](#)

1.1 Poly V-belt drive - exploded view

1 - Poly V-belt

- ☐ Check for wear
- ☐ Do not kink
- ☐ Before removing, mark direction of rotation with chalk or felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.

- ☐ Removing and installing
⇒ [page 46](#)

- ☐ When installing, make sure it is properly seated on pulleys.

2 - Vibration damper

- ☐ With poly V-belt pulley
- ☐ Removing and installing
⇒ [page 53](#)

3 - Bolt

- ☐ Renew
- ☐ 100 Nm + turn 180° further
- ☐ Use counterhold tool - T10069- when loosening and tightening

4 - Bolt

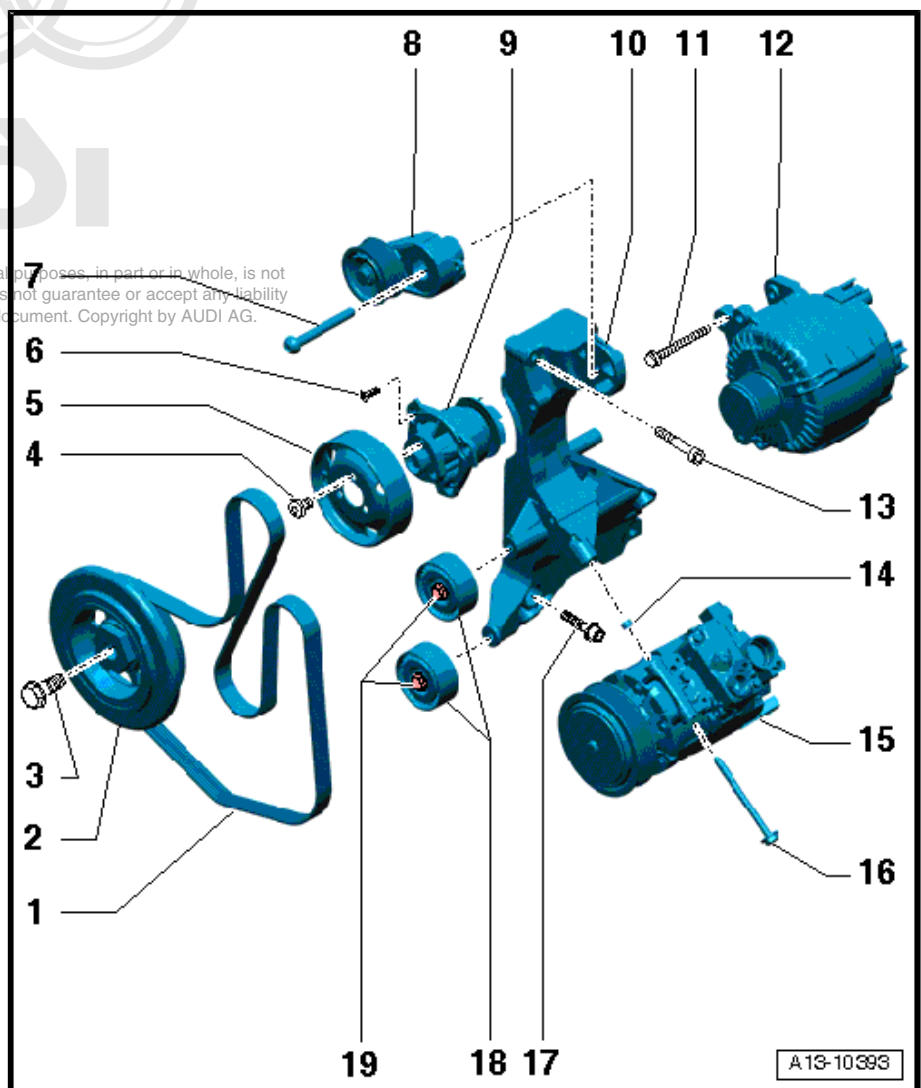
- ☐ 20 Nm

5 - Poly V-belt pulley for coolant pump

6 - 8 Nm

7 - Bolt

- ☐ 50 Nm



8 - Tensioner for poly V-belt

- ☐ Pivot with open-end spanner to slacken poly V-belt
- ☐ Lock in position with locking pin - T10060 A- .
- ☐ Removing and installing ⇒ [page 48](#)

9 - Coolant pump

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

10 - Bracket for ancillaries

- ☐ Removing and installing ⇒ [page 49](#)

11 - Bolt

- ☐ 23 Nm

12 - Alternator

- ☐ Removing and installing ⇒ Rep. gr. 27

13 - Bolt

- ☐ 3x
- ☐ Tightening torque and tightening sequence ⇒ [page 46](#)

14 - Dowel sleeve for air conditioner compressor

15 - Air conditioner compressor

- ☐ Do not unscrew or disconnect refrigerant hoses or pipes
- ☐ Removing and installing ⇒ Rep. gr. 87

16 - 25 Nm

17 - Fitted bolt

- ☐ 2x
- ☐ Tightening torque and tightening sequence ⇒ [page 46](#)

18 - Idler rollers

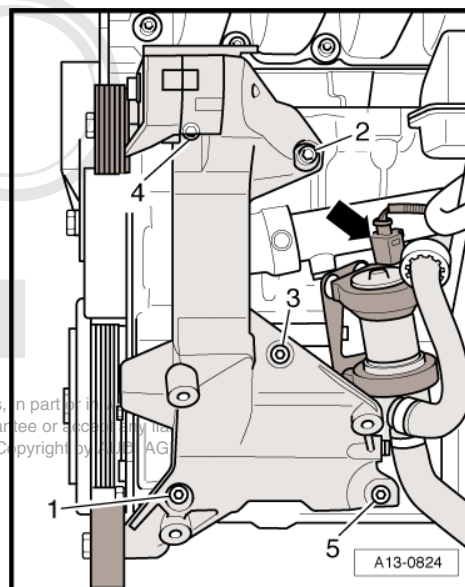
19 - Bolt

- ☐ 40 Nm

Tightening sequence on bracket for ancillaries

- Tighten bolts in the sequence -1 ... 5- in 2 stages as follows:

1. Tighten bolts hand tight.
2. Tighten bolts to 23 Nm.

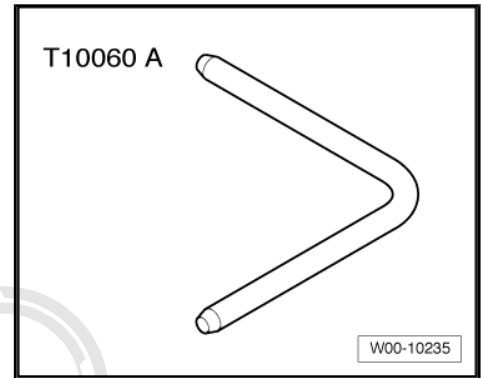


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1.2 Removing and installing poly V-belt

Special tools and workshop equipment required

◆ Locking pin - T10060 A-



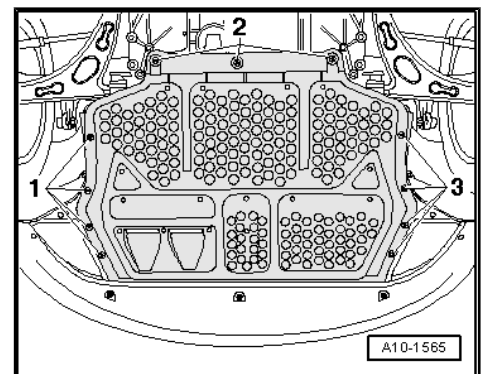
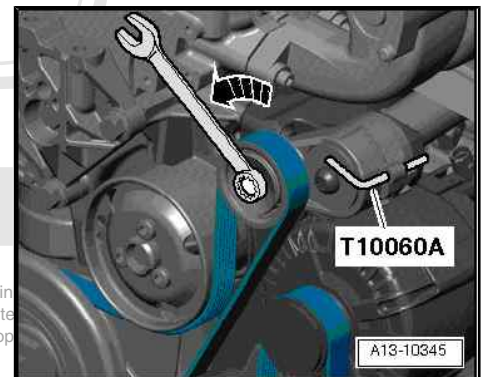
Removing



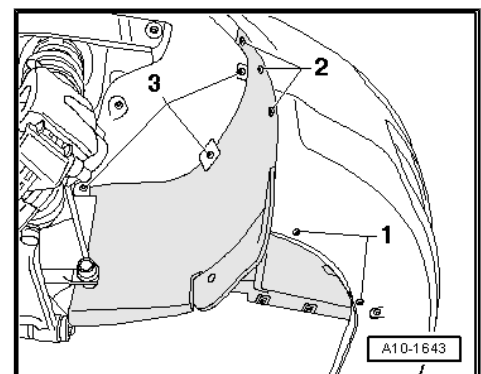
Note

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

- Turn tensioner in direction of -arrow- to slacken poly V-belt and lock in position with locking pin - T10060 A-
- Remove poly V-belt from alternator pulley.
- Remove centre noise insulation -fasteners 1 ... 3-



- Remove noise insulation (right-side) -fasteners 1 ... 3-
- Remove poly V-belt from remaining pulleys.



Installing

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



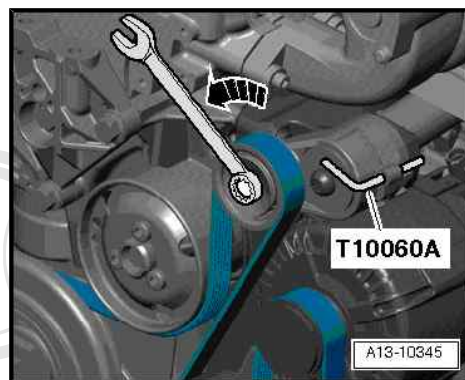
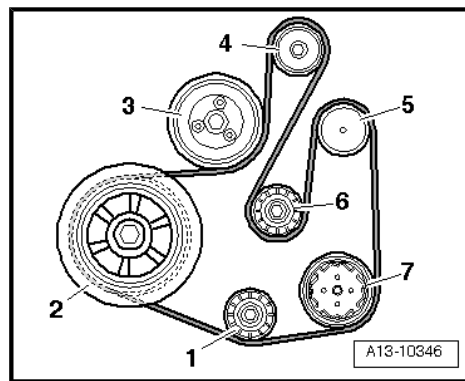
Note

Before fitting the poly V-belt ensure that all mechanical units (alternator, air conditioner compressor) are tightened.

– Fit poly V-belt as follows:

- 1 - Idler roller
- 2 - Vibration damper
- 3 - Coolant pump
- 4 - Tensioning roller
- 5 - Alternator
- 6 - Idler roller
- 7 - Air conditioner compressor

- Hold tensioner with ring spanner, remove locking pin - T10060 A- or Allen key and release tensioner.
- Check poly V-belt for proper seating.
- Start engine and check that belt runs properly.



1.3 Removing and installing tensioner for poly V-belt

Removing



Note

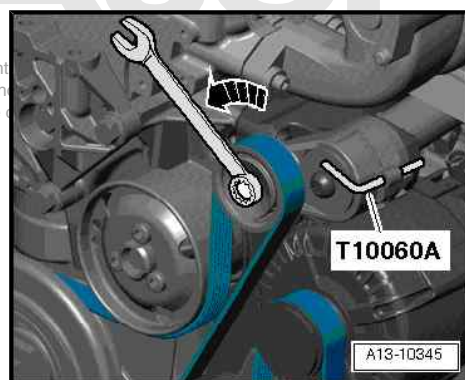
Before removing, mark direction of rotation of poly V-belt with chalk or felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.

- Turn tensioner in direction of -arrow- to slacken poly V-belt and lock in position with locking pin - T10060 A- .



Note

Do not lock tensioner.



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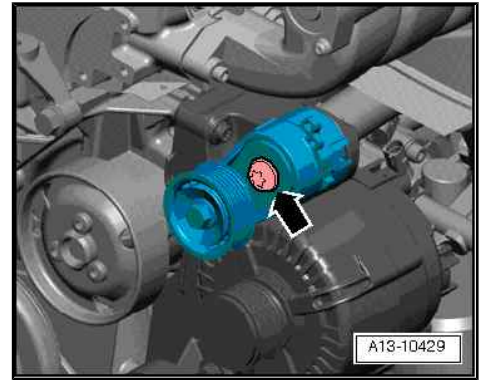
- Remove bolt -arrow- and take off tensioner for poly-V-belt.

Installing

- Tightening torque ➔ [page 45](#)

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

- Install poly V-belt ➔ [page 46](#) .

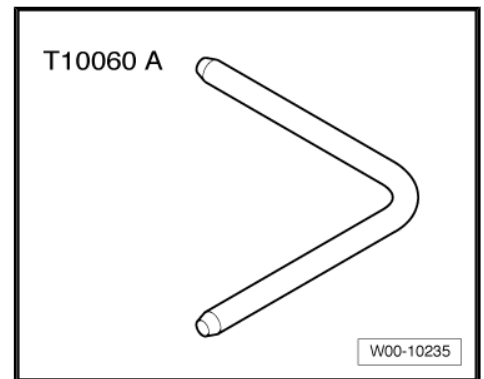


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1.4 Removing and installing bracket for ancillaries

Special tools and workshop equipment required

- ◆ Locking pin - T10060 A-



Removing



Note

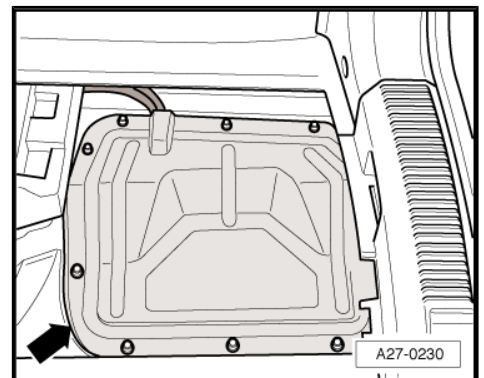
All cable ties which are released or cut open when removing must be refitted in the same position when installing.



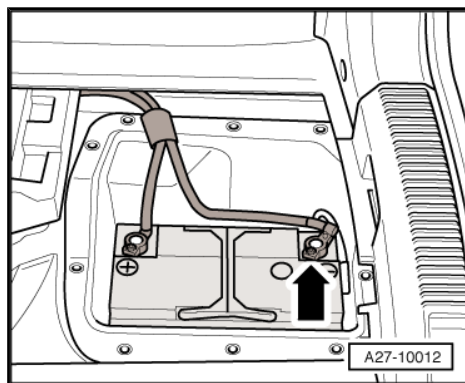
Caution

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

- Remove the moulded insert for tools from beneath the luggage compartment floor cover.
- Unscrew the lid -arrow- of the battery compartment.
- Remove moulded insert from top of battery.

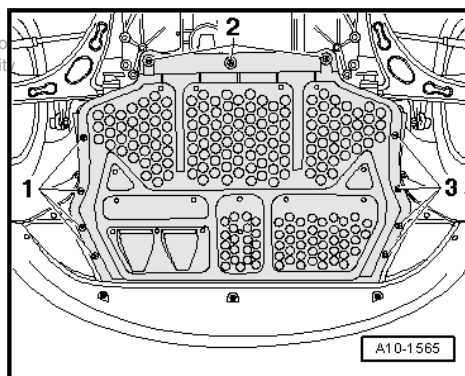


- With ignition switched off, disconnect earth wire -arrow- at battery.

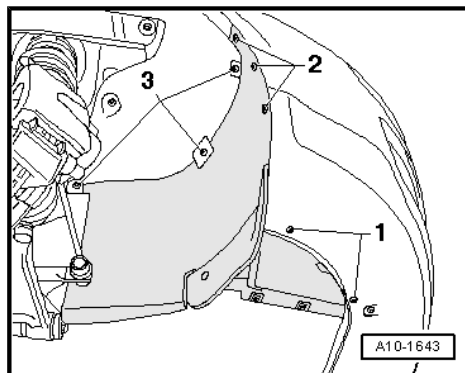


- Remove centre noise insulation -fasteners 1 ... 3-.

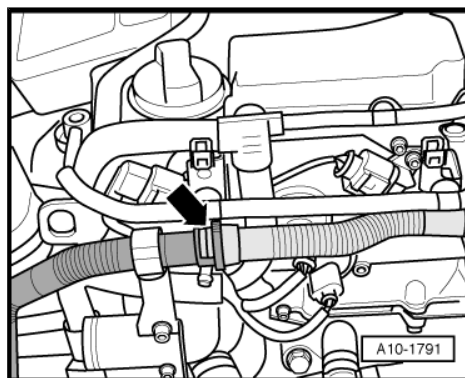
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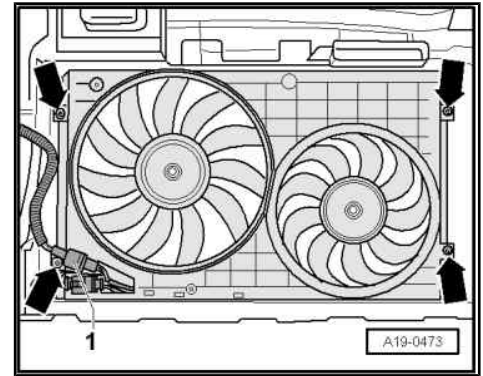
- Remove noise insulation (right-side) -fasteners 1 ... 3-.



- Disconnect secondary air hose at the position marked with an -arrow-.
- Move air hose to secondary air pump clear.



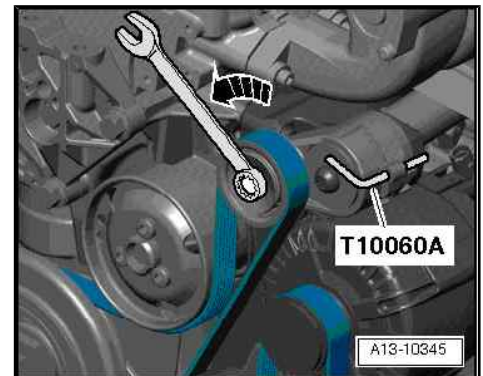
- Unscrew upper securing bolts -upper arrows- for radiator cowl.



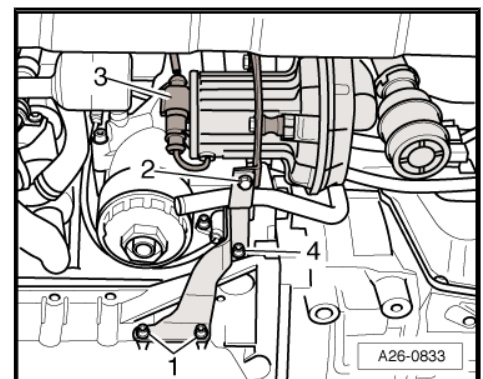
Note

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

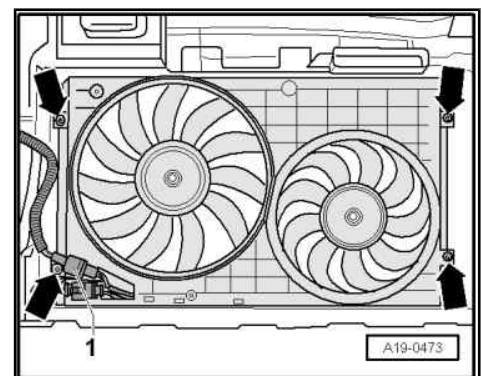
- Turn tensioner in direction of -arrow- to slacken poly V-belt and lock in position with locking pin - T10060 A- .
- Remove poly V-belt.



- Move coolant hose at bottom of radiator cowl clear.
- Detach electrical connector -3- at secondary air pump motor - V101- and move wire clear.
- Unscrew bracket -2- for coolant pipe going to gear oil cooler on vehicles with direct shift gearbox.
- Remove bolts -1-.
- Loosen bolt -4- and remove secondary air pump with bracket.



- Detach electrical connectors -1- for radiator fans at bottom of radiator cowl.
- Unscrew lower securing bolts -lower arrows- for radiator cowl.
- Remove the radiator cowl with both fans from below.



- Unplug electrical connector -1- for magnetic clutch at air conditioner compressor and move electrical wiring clear.



WARNING

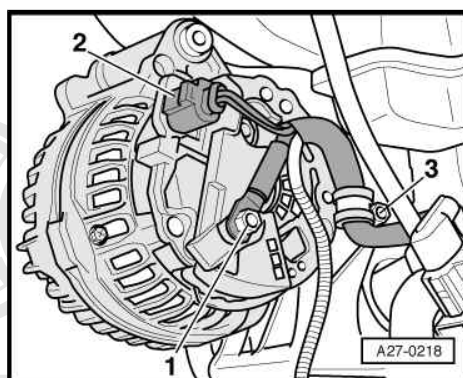
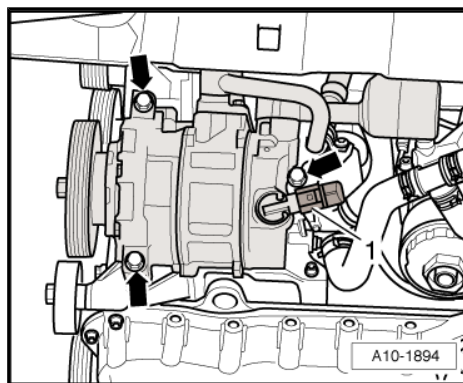
The air conditioner refrigerant circuit must not be opened.

- Unscrew bolts -arrow- for air conditioner compressor.
- Tie up air conditioner compressor together with refrigerant hoses at front of longitudinal member (refrigerant hoses remain connected).
- Unscrew wire -1- at alternator.
- Unplug electrical connector -2-.



Note

Disregard -item 3-.



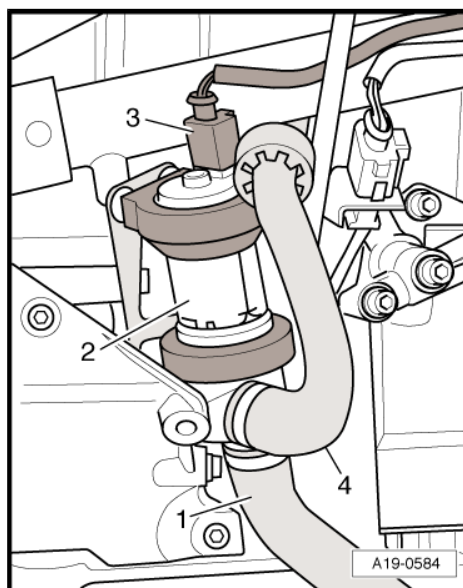
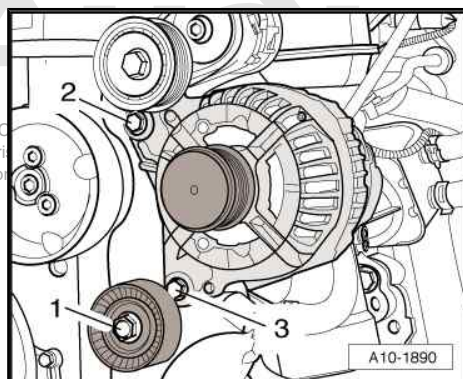
- Remove the upper idler roller -1-.
- Unscrew securing bolts -2- and -3- for alternator.



Note

The alternator can only be removed from bracket with upper securing bolt still inserted.

- Detach alternator from bracket for ancillaries.
- Take out alternator to the bottom left.
- Unplug electrical connector -3- at continued circulation coolant pump - V51- -Item 2- and pull pump downwards out of rubber retainers on bracket with coolant hoses -1- and -4- attached. If necessary, spray rubber retainers with silicone-free lubricant.



- Remove bolts -1 ... 5- and detach bracket for ancillaries.



Disregard -arrow-.

Installing

- Tightening torque
⇒ ["1.1 Poly V-belt drive - exploded view", page 45](#)

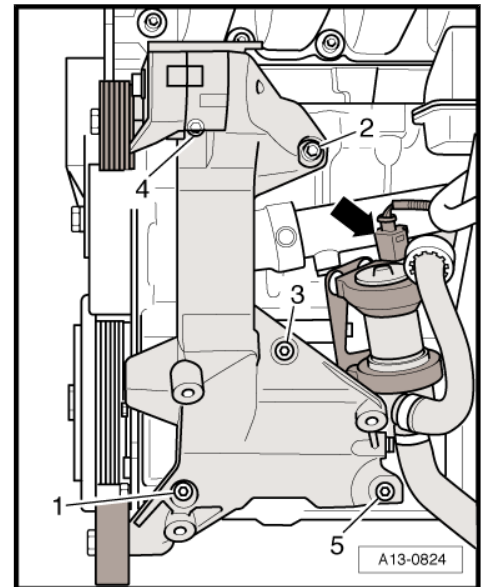
Installation is carried out in the reverse order; note the following:



Bolts -1- and -2- are fitted bolts.

- Tighten bolts in the sequence -1 ... 5- initially only hand-tight.
Then tighten bolts in the sequence -1 ... 5- to the specified torque.

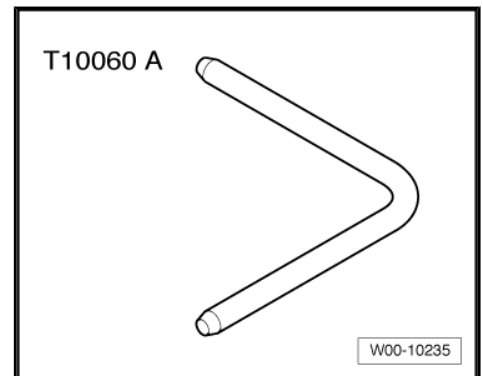
- To facilitate positioning of alternator, drive back bushes for securing bolts slightly.
- Install alternator ⇒ Rep. gr. 27 .
- Install air conditioner compressor ⇒ Rep. gr. 87 .
- Install poly V-belt ⇒ [page 46](#) .



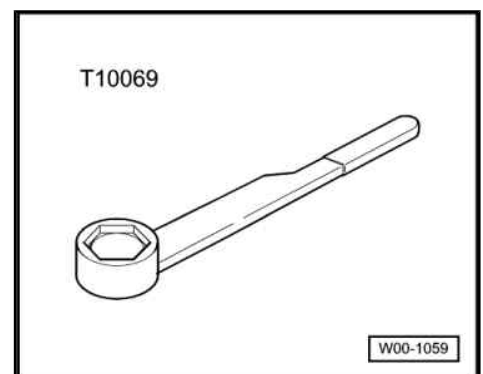
1.5 Removing and installing vibration damper

Special tools and workshop equipment required

- ◆ Locking pin - T10060 A-



- ◆ Counterhold tool - T10069-



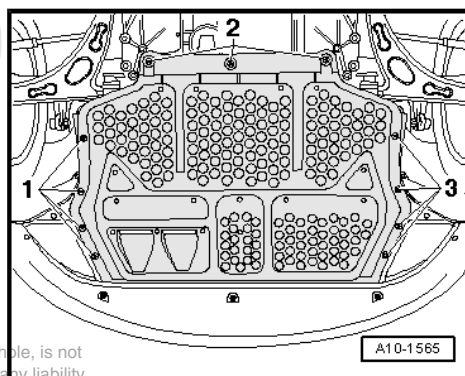
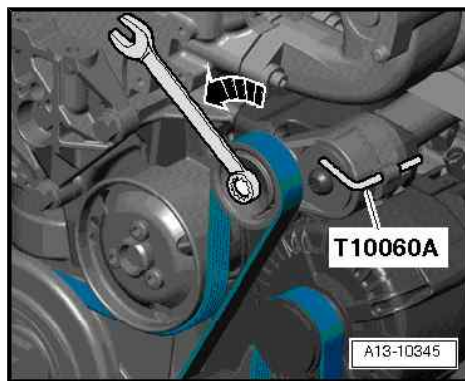
Removing



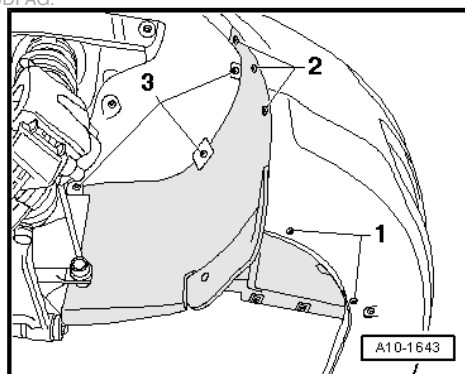
Note

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

- Turn tensioner in direction of -arrow- to slacken poly V-belt and lock in position with locking pin - T10060 A- .
- Remove centre noise insulation -fasteners 1 ... 3-.



- Remove noise insulation (right-side) -fasteners 1 ... 3-.
- Remove poly V-belt from pulley for vibration damper.



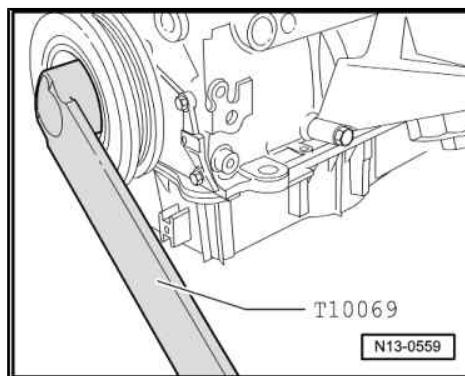
- Unscrew bolt for vibration damper (use counterhold - T10069-).

Installing

- Tightening torque ➤ [page 45](#)

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

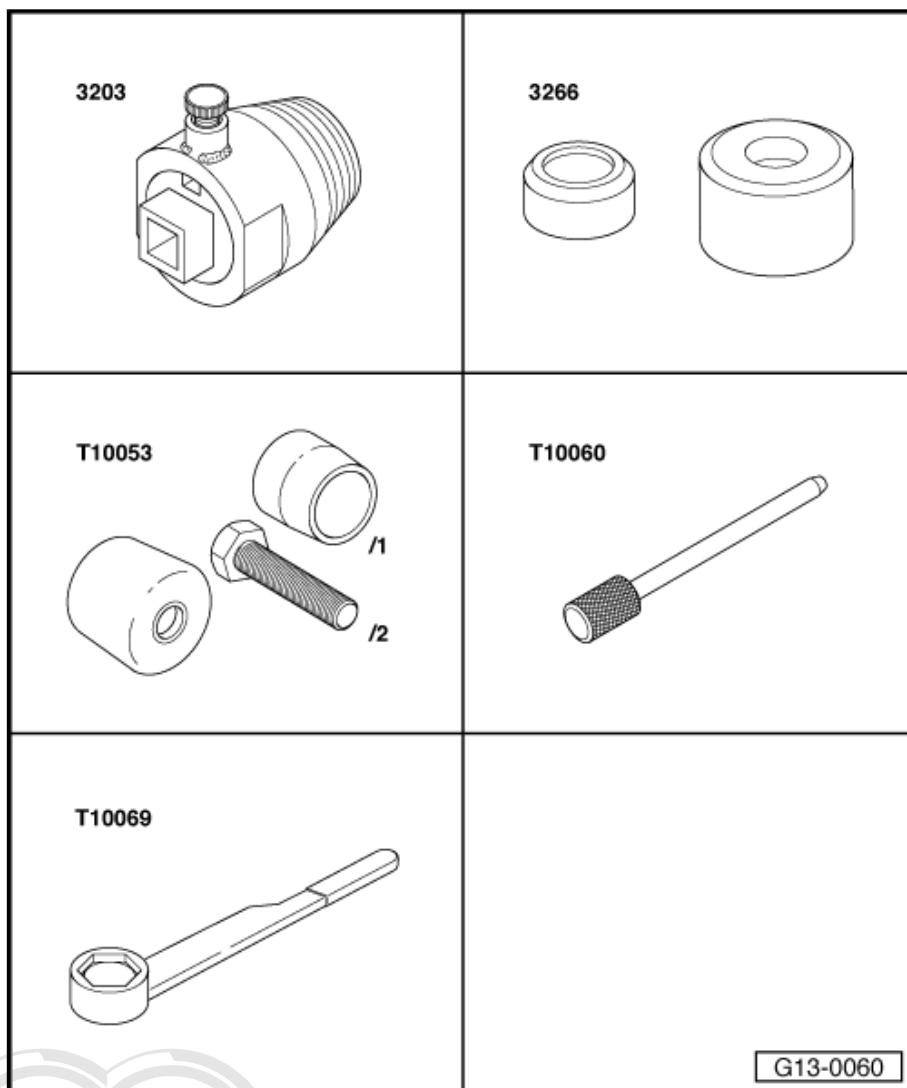
- Use a new bolt for securing.
- Use counterhold - T10069- when tightening bolt for vibration damper.
- Install poly V-belt ➤ [page 46](#) .



1.6 Renewing crankshaft oil seal (pulley end) - vehicles up to 11.2004

Special tools and workshop equipment required

- ◆ Oil seal extractor - 3203-
- ◆ Fitting sleeves - 3266-
- ◆ Assembly tool - T10053-
- ◆ Locking pin - T10060 A-
- ◆ Counterhold tool - T10069-



Procedure

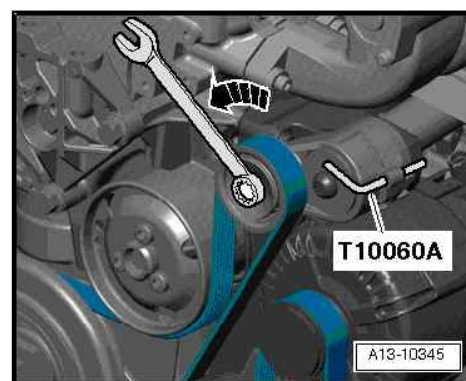


Note

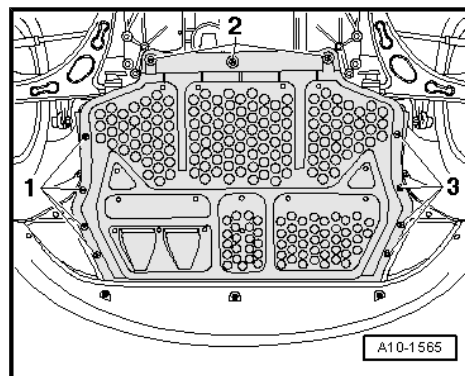
Before removing, mark direction of rotation of poly V-belt with chalk or felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.

- Turn tensioner in direction of -arrow- to slacken poly V-belt and lock in position with locking pin - T10060 A-

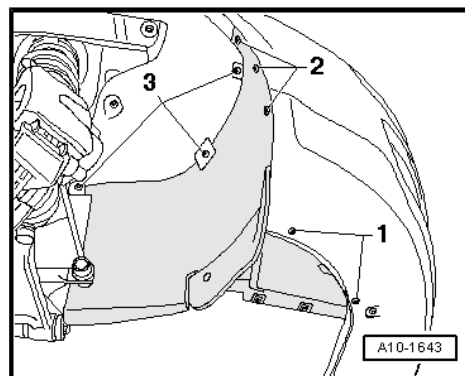
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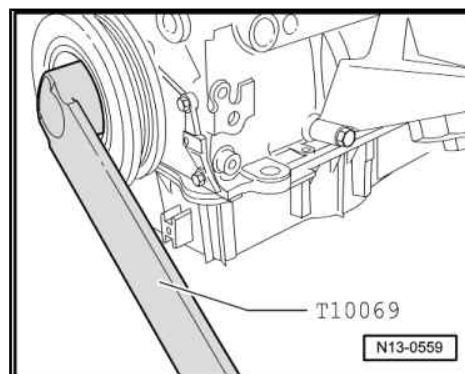
- Remove centre noise insulation -fasteners 1 ... 3-.



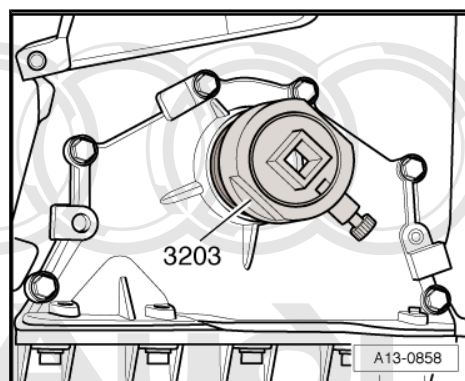
- Remove noise insulation (right-side) -fasteners 1 ... 3-.
- Remove poly V-belt from pulley for vibration damper.



- Unscrew bolt for vibration damper (use counterhold - T10069-).



- Unscrew inner section of oil seal extractor - 3203- 3 turns (approx. 4 mm) out of outer section and lock with knurled screw.
- Lubricate threaded head of oil seal extractor, place it in position and screw it into oil seal as far as possible (applying firm pressure).
- Loosen knurled screw and turn inner part against crankshaft until the oil seal is pulled out.
- Clamp flats of oil seal extractor in vice. Remove oil seal with pliers.
- Clean running surface and sealing surface.

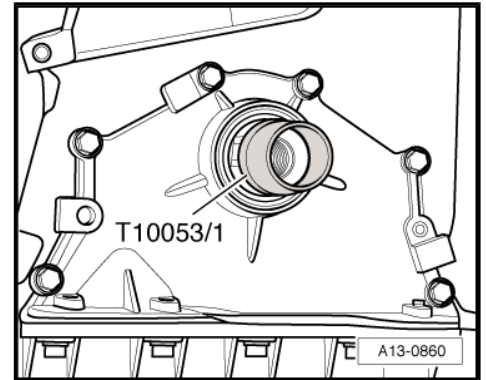


Note

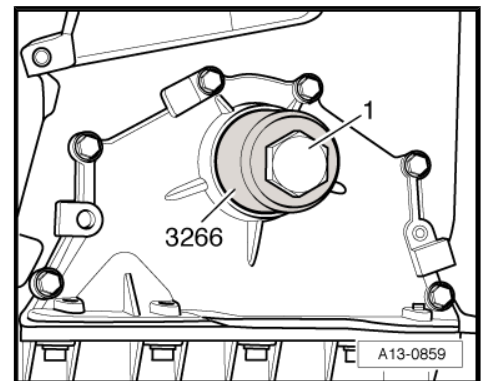
Do not lubricate the oil seal before installing.

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- Place guide sleeve - T10053/1- onto crankshaft journal.
- Push oil seal carefully over the guide sleeve onto the crankshaft journal as far as possible.
- Detach guide sleeve.



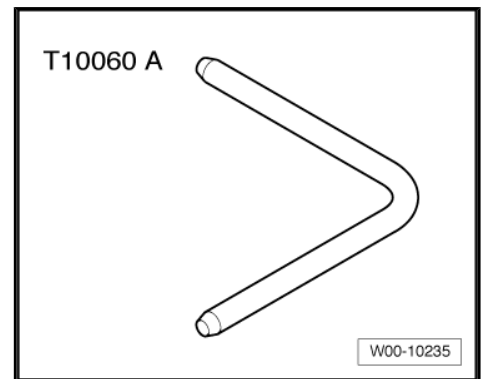
- Press the oil seal in as far as the stop using the old securing bolt -1- for vibration damper and the fitting sleeve from -3266-.
- Install vibration damper with new securing bolt ➔ [page 53](#) .
- Install poly V-belt ➔ [page 46](#) .



1.7 Removing and installing sealing flange, pulley end

Special tools and workshop equipment required

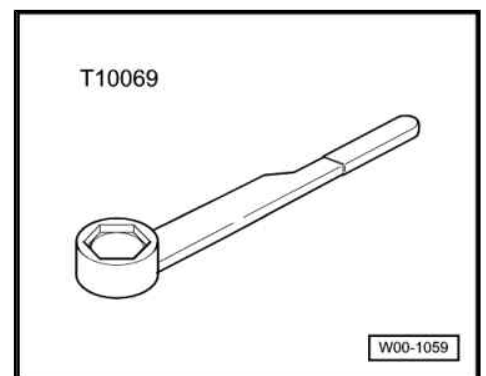
- ◆ Locking pin - T10060 A-



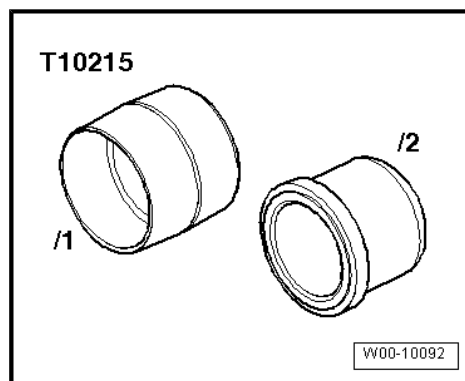
- ◆ Counterhold tool - T10069-



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- ◆ Assembly tool - T10215- for vehicles from 11.2005 onwards



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

Removing

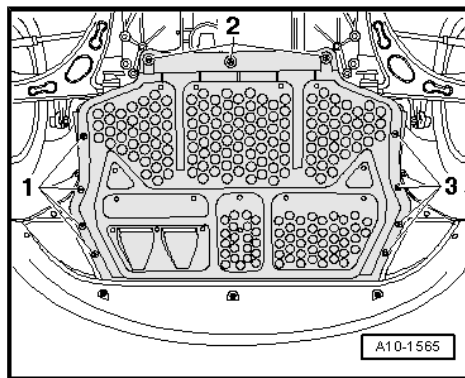
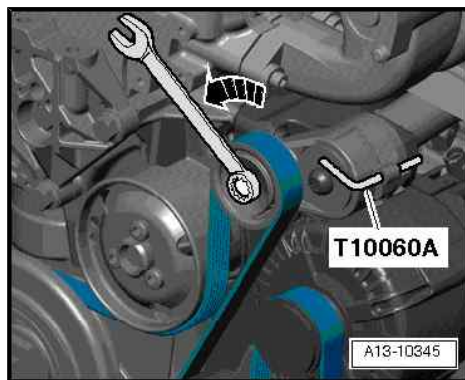
- Engine in vehicle.



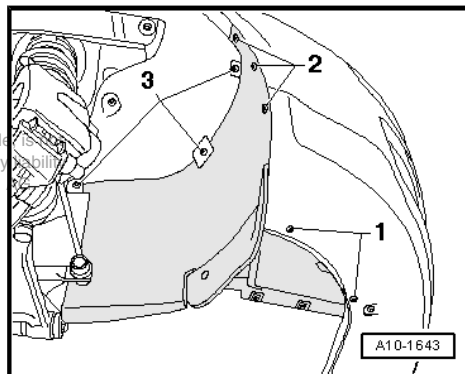
Note

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

- Turn tensioner in direction of -arrow- to slacken poly V-belt and lock in position with locking pin - T10060 A- .
- Remove centre noise insulation -fasteners 1 ... 3-.

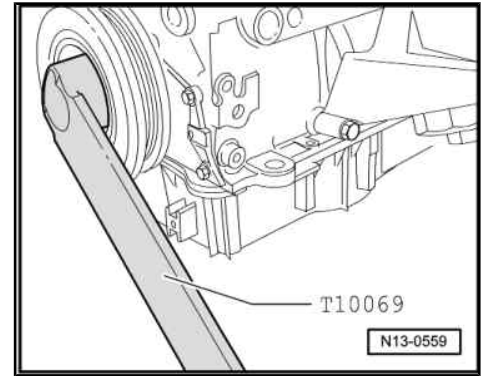


- Remove noise insulation (right-side) -fasteners 1 ... 3-.
- Remove poly V-belt from pulley for vibration damper.



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- Unscrew bolt for vibration damper (use counterhold - T10069-).



- Remove bolts 1...11.
- Lever off front sealing flange and remove.
- Drive out oil seal with flange removed.

Installing

- Tightening torque ➔ [page 45](#)

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



Note

Place a cloth over the exposed section of the sump.

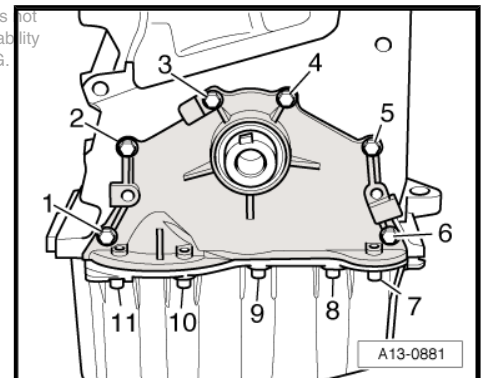
- Carefully remove any sealant residue on the cylinder block and sump.



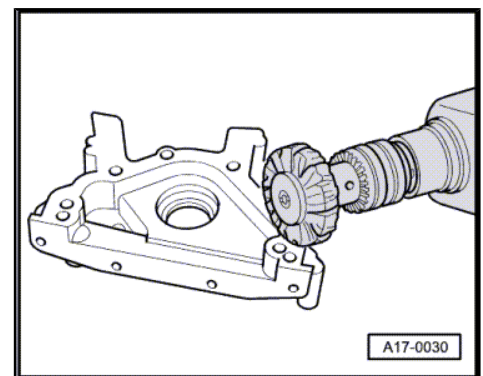
WARNING

Risk of eye injury.

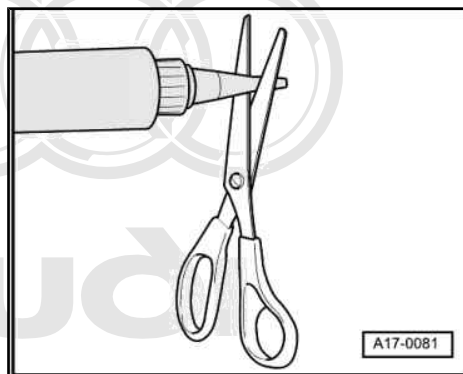
◆ *Wear safety goggles.*



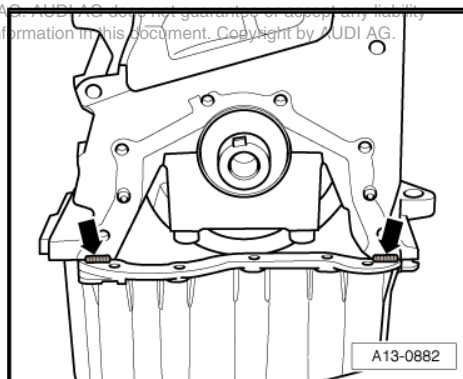
- Remove sealant residue from sealing flange with rotating plastic brush or similar.
- Clean sealing surfaces; they must be free of oil and grease.



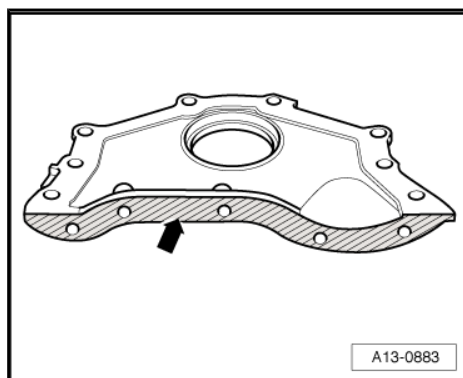
- Cut off tube nozzle at front marking (diameter of nozzle approx. 3 mm).



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



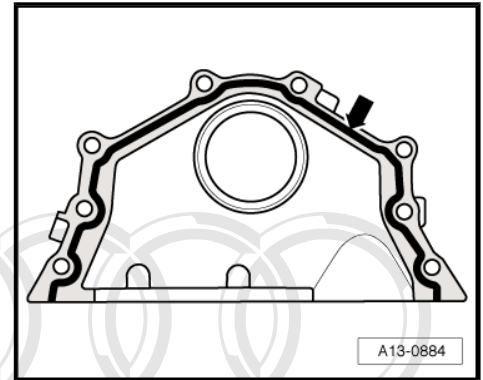
- Coat the lower sealing surface on the sealing flange lightly with sealant -hatched area-.



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

 Note

- ♦ Sealant bead must not be wider than 3 mm, otherwise excess sealant could ingress into sump and clog strainer in oil intake pipe.
- ♦ The sealing flange must be installed within 5 minutes after applying sealant.



Vehicles up to 11.2004:

- Push the sealing flange carefully onto the dowel pins on the cylinder block.

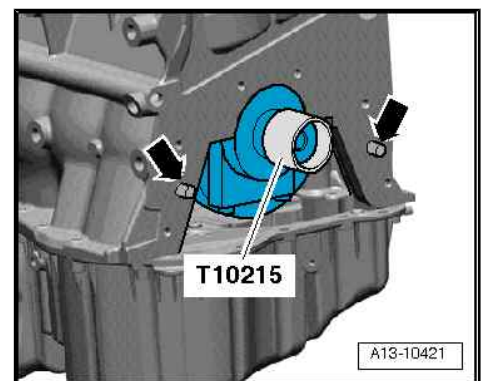
 Note

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

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Vehicles from 11.2004 onwards:

- Carefully push sealing flange over assembly tool - T10215- onto dowel pins -arrows- on cylinder block.



All vehicles (continued):

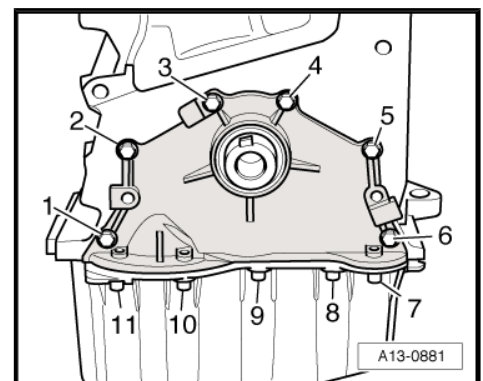
- Tighten bolts in 3 stages as follows:
 1. Screw in bolts -1 ... 11- hand-tight.
 2. Tighten bolts -1 ... 6- in diagonal sequence and in stages to 10 Nm.
 3. Tighten bolts -7 ... 11- to 10 Nm.

Vehicles up to 11.2004:

- Install crankshaft oil seal (pulley end) ➔ [page 54](#) .

All vehicles (continued):

- Install vibration damper with new securing bolt ➔ [page 53](#) .
- Install poly V-belt ➔ [page 46](#) .



2 Cylinder block (gearbox end)



Note

When carrying out repairs, secure engine to engine and gearbox support ➔ [page 33](#) .

➔ ["2.1 Dual-mass flywheel - exploded view of components", page 62](#)

➔ ["2.2 Removing and installing dual-mass flywheel", page 63](#)

➔ ["2.3 Renewing crankshaft oil seal", page 63](#)

2.1 Dual-mass flywheel - exploded view of components



Note

-Items 4 ... 23- ➔ [page 99](#) .

1 - 60 Nm + turn 90° further

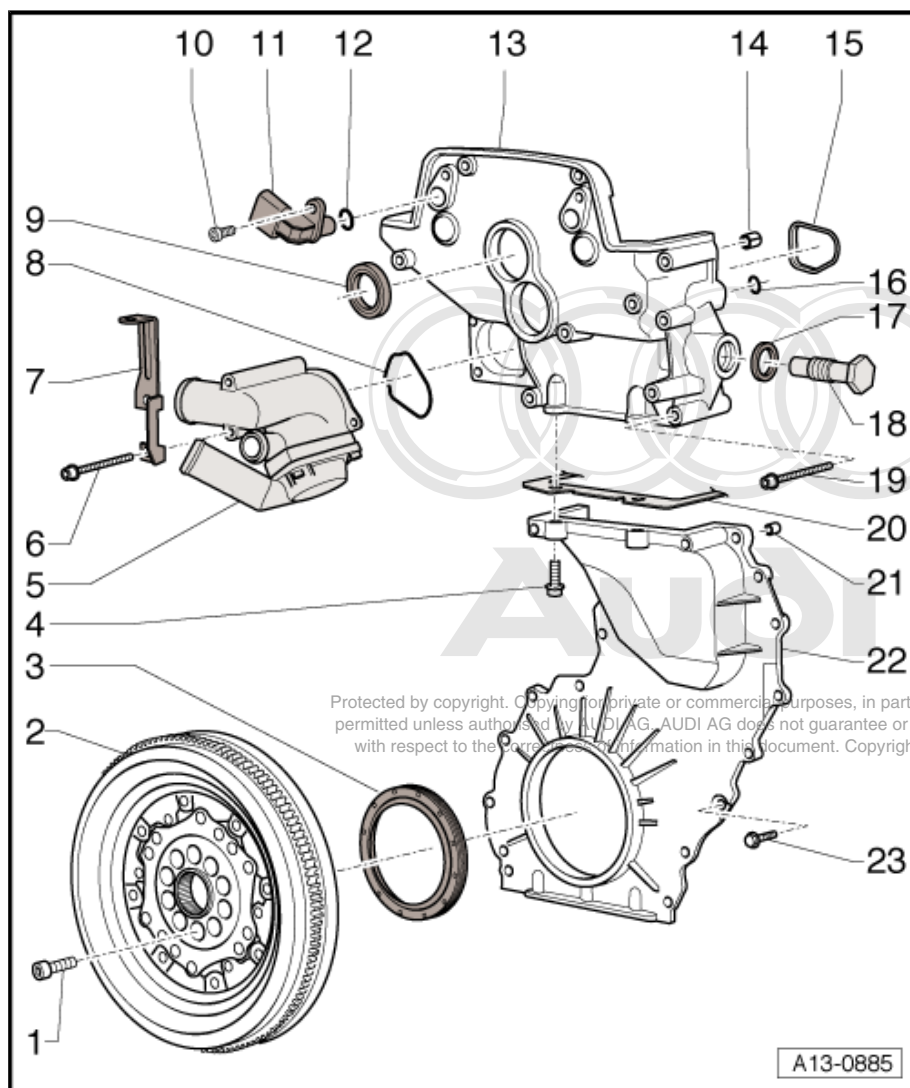
☐ Renew

2 - Dual-mass flywheel

☐ Removing and installing
➔ [page 63](#)

3 - Oil seal

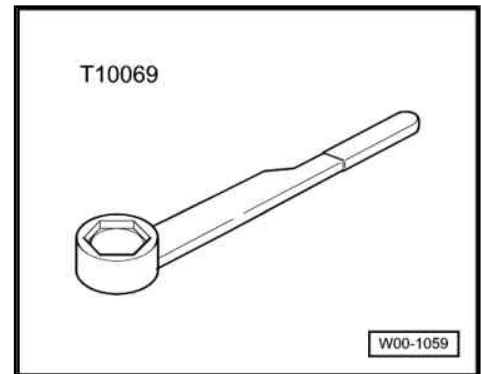
☐ Renewing ➔ [page 63](#)



2.2 Removing and installing dual-mass fly-wheel

Special tools and workshop equipment required

- ◆ Counterhold tool - T10069-

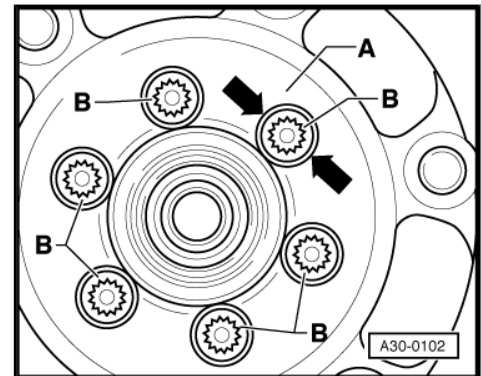


Removing

- Gearbox removed.
- Mark position of dual-mass flywheel on engine.



To prevent damage to the dual-mass flywheel when removing, the bolts -B- must not be removed with an impact wrench or similar. The bolts may only be removed by hand using conventional tools.



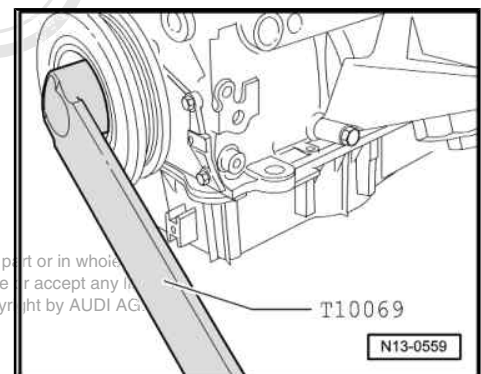
- Rotate the dual-mass flywheel -A- so that the bolts align with the holes -arrows-.
- When unscrewing the bolts, make sure that the bolt heads do not come into contact with the dual-mass flywheel; the flywheel will otherwise be damaged as the bolts are screwed out.
- Unbolt dual-mass flywheel (counterhold on vibration damper with tool - T10069-).

Installing

- Tightening torque ➔ [page 62](#)

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

- Use new securing bolts.

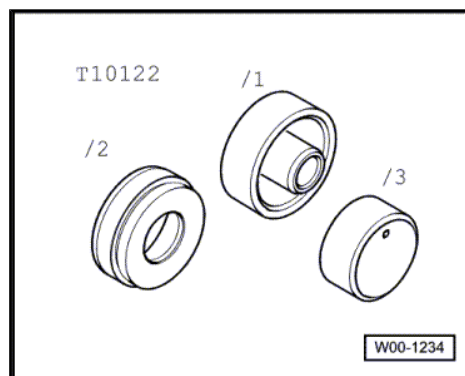


2.3 Renewing crankshaft oil seal

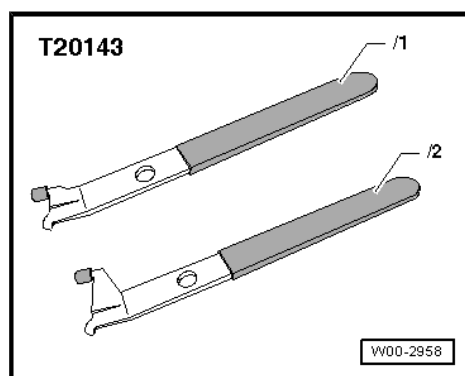
Special tools and workshop equipment required

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♦ Fitting tool - T10122-

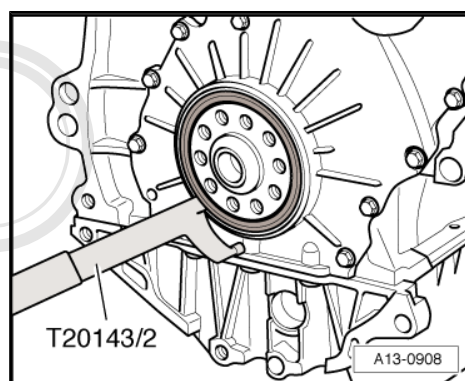


♦ Oil seal extractor lever - T20143/2-



Procedure

- Gearbox removed.
- Remove dual-mass flywheel ➤ [page 63](#) .
- Pry out the oil seal using the oil seal extractor lever - T20143/2- .
- Clean running surface and sealing surface.

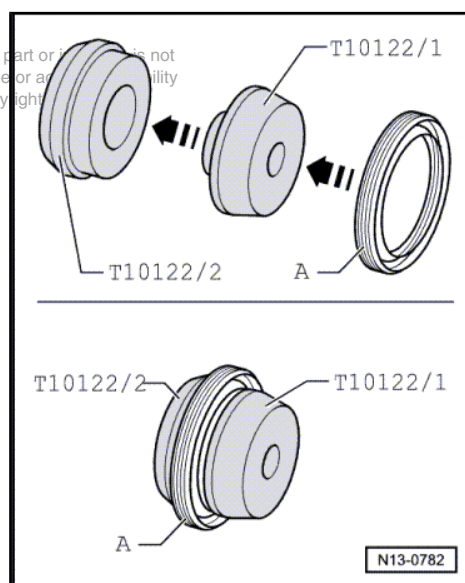


Note

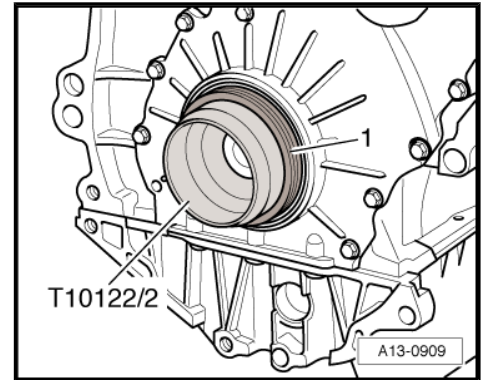
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Do not lubricate the oil seal before installing.

- Press the new oil seal -A- over the fitting sleeve - T10122/1- onto the guide sleeve - T10122/2- .
- Fitting position: closed side faces fitting sleeve.
- Separate both sleeves.



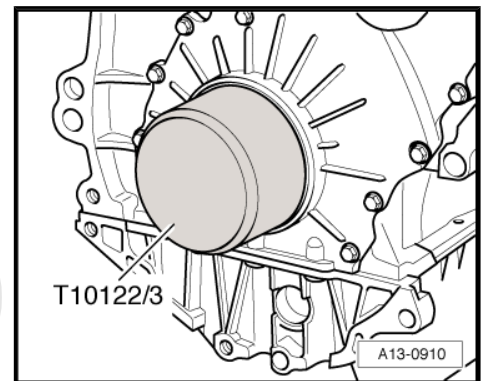
- Insert the guide sleeve - T10122/2- with oil seal onto crankshaft.



- Press in the oil seal with press tool - T10122/3- evenly so that it is flush.

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

- Install dual-mass flywheel ➔ [page 63](#) .



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3 Crankshaft

⇒ ["3.1 Exploded view - crankshaft", page 66](#)

⇒ ["3.2 Extracting and driving in needle bearing for crankshaft", page 68](#)

⇒ ["3.3 Crankshaft dimensions", page 70](#)

⇒ ["3.4 Measuring axial clearance of crankshaft", page 70](#)

⇒ ["3.5 Measuring radial clearance of crankshaft", page 71](#)

⇒ ["3.6 Allocation of main bearing shells", page 71](#)

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3.1 Exploded view - crankshaft



Note

- ◆ *When carrying out repairs, secure engine to engine and gear-box support ⇒ [page 33](#).*
- ◆ *Before removing the crankshaft, ensure that a suitable surface is prepared so that the sender wheel ⇒ [Item 10 \(page 68\)](#) is not damaged and does not lie against any other item.*
- ◆ *If large quantities of metal shavings or abrasion are found when performing engine repairs, this may be an indication of damage to the crankshaft or conrod bearings. The following work must be performed in order to avoid further damage:*
 - ◆ *Clean oil galleries thoroughly.*
 - ◆ *Renew oil non-return valve.*
 - ◆ *Renew oil spray jets.*
 - ◆ *Renew engine oil cooler.*
 - ◆ *Renew oil filter.*

1 - Cylinder block

- ☐ Checking cylinder bore
⇒ [page 78](#)
- ☐ Piston and cylinder dimensions ⇒ [page 79](#)

2 - Oil spray jet (for cooling of pistons)

- ☐ For crankshaft bearings 2 ... 7
- ☐ Opening pressure: 2.0 bar
- ☐ Removing and installing
⇒ [page 149](#)

3 - Bearing shell

- ☐ For cylinder block, with oil supply drilling
- ☐ Do not interchange used bearing shells (mark positions)
- ☐ Allocation of crankshaft bearing shells
⇒ [page 71](#)

4 - Crankshaft

- ☐ If crankshaft is renewed, new crankshaft bearing shells must be assigned to bearing caps
⇒ [page 71](#)
- ☐ After removing, place it down so that the sender wheel
⇒ [Item 10 \(page 68\)](#) does not become damaged
- ☐ Axial clearance when new: 0.07 ... 0.23 mm; wear limit: 0.30 mm
- ☐ Check radial clearance with Plastigage ⇒ [page 71](#)
- ☐ Do not rotate the crankshaft when checking the radial clearance
- ☐ Radial clearance when new: 0.02 ... 0.06 mm; wear limit 0.10 mm
- ☐ Crankshaft dimensions ⇒ [page 70](#)
- ☐ Chain sprocket is an integral part of crankshaft

5 - Thrust washer

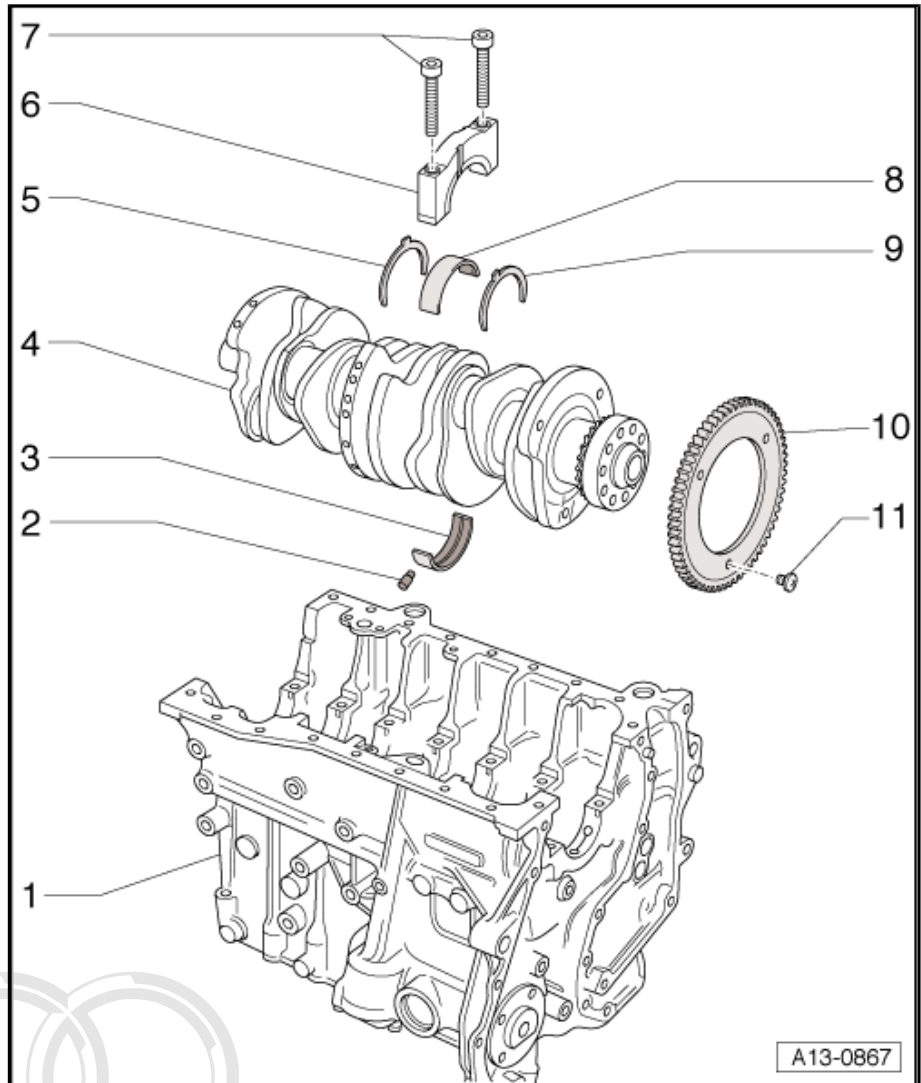
- ☐ For bearing No. 5
- ☐ Note location
- ☐ Oil groove points towards crankshaft

6 - Bearing cap

- ☐ Bearing cap 1: Pulley end
- ☐ Bearing cap 5 with recesses for thrust washers
- ☐ Bearing shell retaining lugs (cylinder block/bearing cap) must be on the same side

7 - Bolt

- ☐ 30 Nm + 180° (1/2 turn) further
- ☐ Renew
- ☐ Use old bolts when measuring radial clearance



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8 - Bearing shell

- ☐ For bearing cap, without drilling
- ☐ Do not interchange used bearing shells (mark positions)
- ☐ Allocation of crankshaft bearing shells ➔ [page 71](#)

9 - Thrust washer

- ☐ For bearing No. 5
- ☐ Note location
- ☐ Oil groove points towards crankshaft

10 - Sender wheel

- ☐ For engine speed sender - G28-
- ☐ Sender wheel must be renewed if bolts are loosened
- ☐ Installing ➔ [page 68](#)

11 - Bolt

- ☐ 10 Nm + 90° (1/4 turn) further
- ☐ Renew
- ☐ Sender wheel must be renewed if bolts are loosened ➔ [page 68](#)

Removing and installing sender wheel

- The sender wheel and securing bolts must be renewed if the bolts are loosened.
- Clean the contact surface of crankshaft/sender wheel; it must be free of oil and grease.
- Thinly coat the contact surface of crankshaft/sender wheel with locking fluid; for locking fluid refer to ➔ Electronic parts catalogue .

Installation position:

- The marking "VR6" -Item 2- must be positioned at the bore of the bolt which secures the crankshaft conrod journal -3- (dotted line shows outline of crankshaft -1-).
- The gap -arrow- in the starter gear ring is positioned opposite the "VR6" marking.
- Ignore the second "VR6" marking -item 4-.
- First tighten the new bolts only finger-tight.
- Then tighten bolt -3-.
- Tighten the two other bolts last.

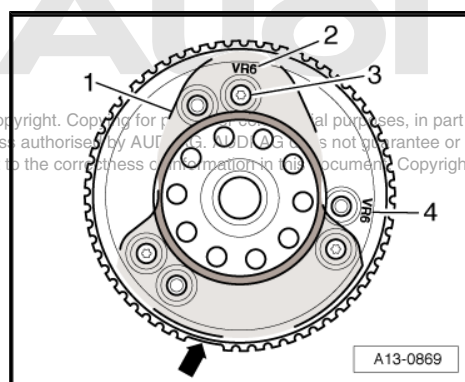
Tightening torque

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

10) 90° = a quarter of a turn.

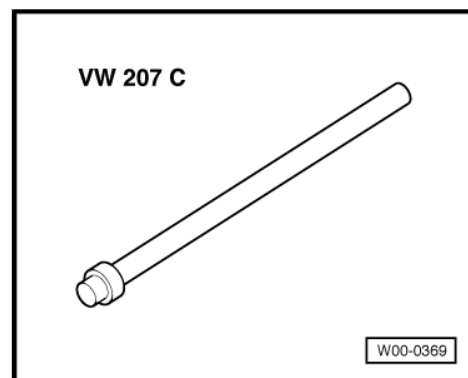
3.2 Extracting and driving in needle bearing for crankshaft

Special tools and workshop equipment required

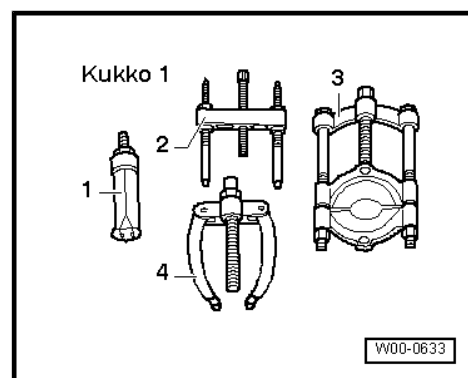


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- ◆ Drift - VW 207 C- or centring mandrel - 3176-



- ◆ 1 - Internal puller - Kukko 21/1-

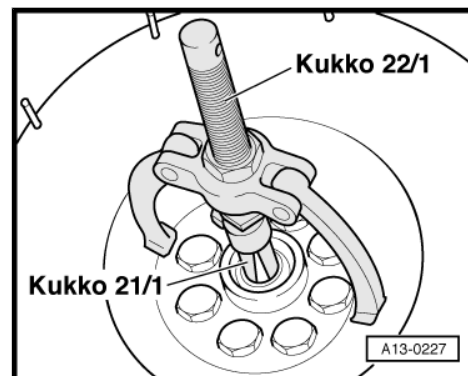


- ◆ 4 - Counter-support - Kukko 22/1-

- ◆ Depth gauge

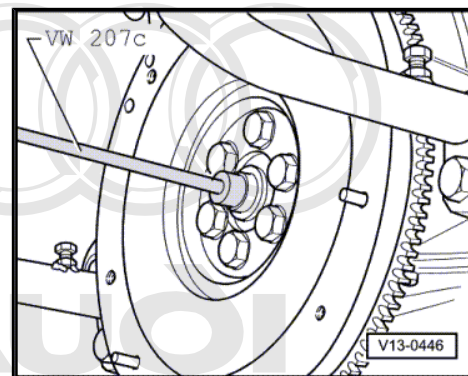
Removing

- Gearbox removed.
- Remove needle bearing using internal puller - Kukko 21/1- and counter-support - Kukko 22/1- .



Installing

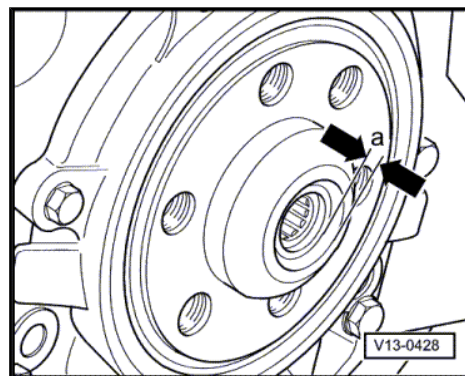
- Drive in needle bearing using drift - VW 207 C- or centring mandrel - 3176- .
- The inscription on needle bearing must be visible when installed.



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Installation position for needle bearing:

- Distance -a- = 2.0 mm



3.3 Crankshaft dimensions

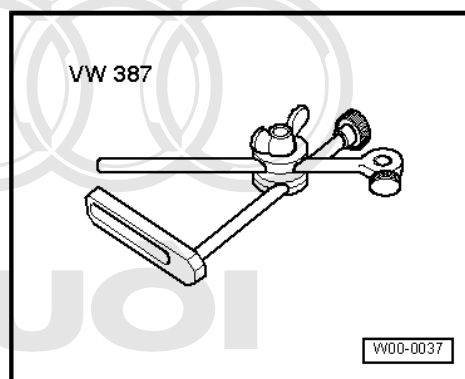
Honing dimension (in mm)	Crankshaft main bearing journal Ø	Conrod bearing journal Ø
Basic dimension 11)	59.958 ... 59.978	53.958 ... 53.978

11) Machining is not permitted.

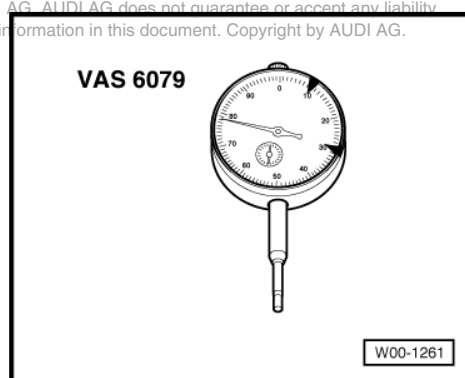
3.4 Measuring axial clearance of crankshaft

Special tools and workshop equipment required

- Universal dial gauge bracket - VW 387-



- Dial gauge - VAS 6079-



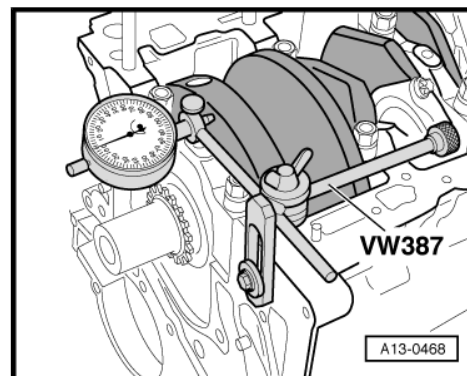
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Test sequence

- Bolt dial gauge - VAS 6079- with universal dial gauge bracket - VW 387- onto cylinder block and set it against crank web.
- Press crankshaft against dial gauge by hand and set gauge to "0".
- Push crankshaft away from dial gauge and read off value.

Axial clearance:

- New: 0.07 ... 0.23 mm
- Wear limit: 0.30 mm



3.5 Measuring radial clearance of crankshaft

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Special tools and workshop equipment required

- ◆ Plastigage

Important

- Do not turn crankshaft when measuring radial clearance.

Test sequence



Note

- ◆ *Do not interchange used bearings.*
- ◆ *Bearing shells worn down to nickel layer must be renewed.*
- Remove main bearing caps and clean bearing caps and journals.
- Place a length of Plastigage corresponding to the width of the bearing on the bearing journal or bearing shell.
- The strip of Plastigage must be positioned in the centre of the bearing shell.
- Fit main bearing cap and secure with old bolts
⇒ [Item 7 \(page 67\)](#) without rotating crankshaft.
- Remove main bearing cap again.
- Compare width of Plastigage with measurement scale.

Radial clearance:

- New: 0.02 ... 0.06 mm
- Wear limit: 0.10 mm
- Renew bolts for bolted connection to crankshaft.

3.6 Allocation of main bearing shells

Allocation of main bearing shells differs depending on production date of crankshaft.

Production date is stamped on outer crankshaft web of first cylinder.

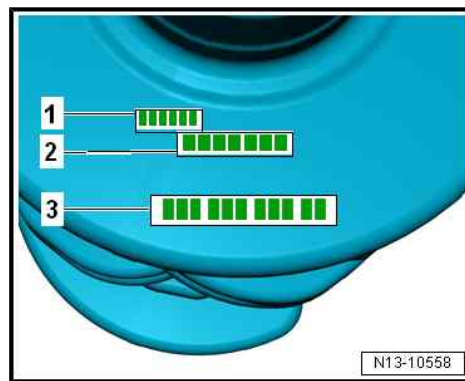
- 1 - Production date of crankshaft (DDMMYY)
 - 2 - Letters for allocation of bearing shells
 - 3 - Part number
- Use the production date to determine the allocation of the main bearing shells.

Allocation of main bearing shells for production date up to 230912

⇒ [“3.6.1 Allocation of main bearing shells for production date up to 23.09.12”, page 72](#)

Allocation of main bearing shells for production date from 240912 onwards

⇒ [“3.6.2 Allocation of main bearing shells for production date from 24.09.12 onwards”, page 74](#)



3.6.1 Allocation of main bearing shells for production date up to 23.09.12



Note

It is very important to note the production date (stamped on crankshaft web). Determining production date ⇒ [page 71](#)

Main bearing shells of the correct thickness are allocated to the cylinder block and crankshaft at the factory. Coloured dots are used to identify the thickness of the bearing shells.

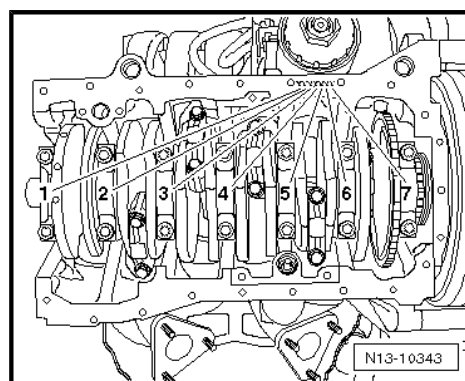
If cylinder block or crankshaft is renewed, new bearing shells must be assigned to bearing caps.

Determine the correct colour coding for the bearing shells based on the letters on the cylinder block and on the crankshaft.

The first letter stands for crankshaft bearing 1, the second letter for crankshaft bearing 2, etc.

Letters on cylinder block:

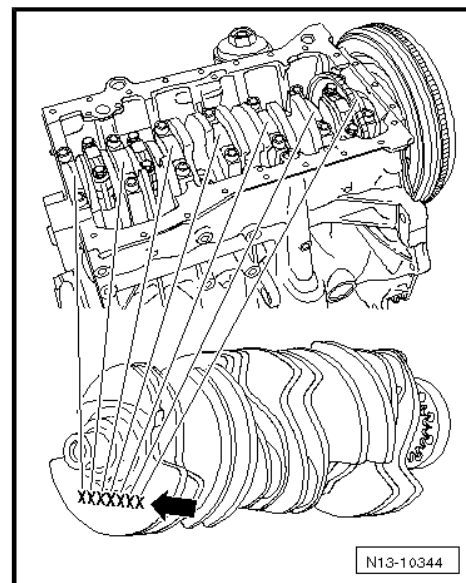
Letters for allocation of bearing shells are stamped on sealing surface of sump.



Letters on crankshaft:

Letters for allocation of bearing shells are stamped on outer crankshaft web of first cylinder.

- Note down letters and select colour coding to be fitted from the table.



Letter on cylinder block	Letter on crankshaft web	Colour coding of bearing shell for cylinder block (upper bearing shell)	Colour coding of bearing shell for bearing cap (lower bearing shell)
A, B, C	R	Red	Red
A, B, C	G	Yellow	Red
A, B, C	B	Yellow	Yellow
A, B, C	V	Blue	Yellow
D, E, G	R	Yellow	Red
D, E, G	G	Yellow	Yellow
D, E, G	B	Blue	Yellow
D, E, G	V	Blue	Blue
H, I, K	R	Yellow	Red
H, I, K	G	Yellow	Yellow
H, I, K	B	Blue	Yellow
H, I, K	V	Blue	Blue
L, M	R	Yellow	Yellow
L, M	G	Blue	Yellow
L, M	B	Blue	Yellow
L, M	V	Violet	Blue

Example:

Crankshaft bearing	1	2	3	4	5	6	7
Letters on cylinder block	G	H	K	H	G	E	G
Letters on crankshaft web	G	B	R	V	B	B	G
Colour coding of bearing shell for cylinder block (upper bearing shell)	Yellow	Blue	Yellow	Blue	Blue	Blue	Yellow
Colour coding of bearing shell for bearing cap (lower bearing shell)	Yellow	Yellow	Red	Blue	Yellow	Yellow	Yellow

3.6.2 Allocation of main bearing shells for production date from 24.09.12 onwards



Note

It is very important to note the production date (stamped on crankshaft web). Determining production date ➔ [page 71](#)

Main bearing shells of the correct thickness are allocated to the cylinder block and crankshaft at the factory. Coloured dots are used to identify the thickness of the bearing shells.

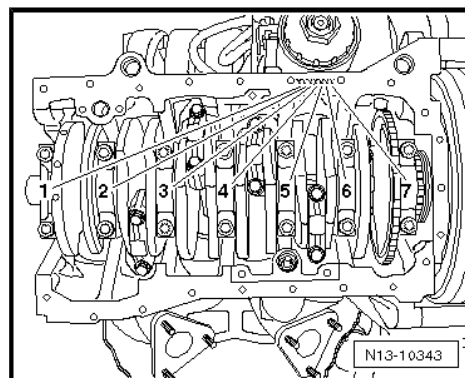
If cylinder block or crankshaft is renewed, new bearing shells must be assigned to bearing caps.

Determine the correct colour coding for the bearing shells based on the letters on the cylinder block and on the crankshaft.

The first letter stands for crankshaft bearing 1, the second letter for crankshaft bearing 2, etc.

Letters on cylinder block:

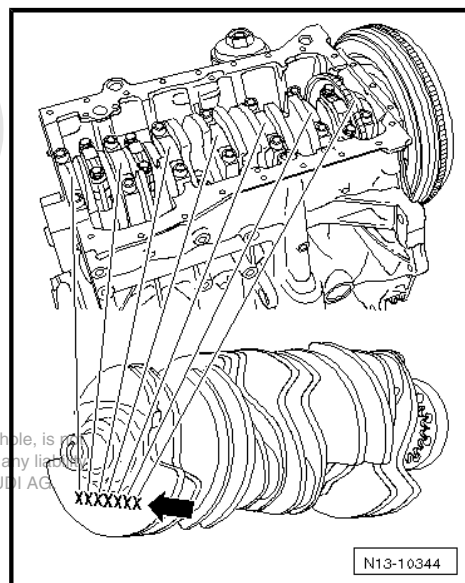
Letters for allocation of bearing shells are stamped on sealing surface of sump.



Letters on crankshaft:

Letters for allocation of bearing shells are stamped on outer crankshaft web of first cylinder.

- Note down letters and select colour coding to be fitted from the table.



Letter on cylinder block	Letter on crankshaft web	Colour coding of bearing shell for cylinder block (upper bearing shell)	Colour coding of bearing shell for bearing cap (lower bearing shell)
A, B, C	F	Red	Red
A, B, C	E	Yellow	Red
A, B, C	D	Yellow	Yellow
A, B, C	C	Blue	Yellow

Letter on cylinder block	Letter on crankshaft web	Colour coding of bearing shell for cylinder block (upper bearing shell)	Colour coding of bearing shell for bearing cap (lower bearing shell)
A, B, C	B	Blue	Blue
A, B, C	A	Violet	Blue
D, E, G	F	Yellow	Red
D, E, G	E	Yellow	Yellow
D, E, G	D	Blue	Yellow
D, E, G	C	Blue	Blue
D, E, G	B	Violet	Blue
D, E, G	A	Violet	Violet
H, I, K	F	Yellow	Red
H, I, K	E	Yellow	Yellow
H, I, K	D	Blue	Yellow
H, I, K	C	Blue	Blue
H, I, K	B	Violet	Blue
H, I, K	A	Violet	Violet
L, M	F	Yellow	Yellow
L, M	E	Blue	Yellow
L, M	D	Blue	Yellow
L, M	C	Violet	Blue
L, M	B	Violet	Violet
L, M	A	Violet	Violet

Example:

Crankshaft bearing	1	2	3	4	5	6	7
Letters on cylinder block	G	H	H	H	G	E	G
Letters on crankshaft web	A	B	A	C	C	A	B
Colour coding of bearing shell for cylinder block (upper bearing shell)	Violet	Violet	Violet	Blue	Blue	Violet	Violet
Colour coding of bearing shell for bearing cap (lower bearing shell)	Violet	Blue	Violet	Blue	Blue	Violet	Blue

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4 Dismantling and assembling pistons and conrods

⇒ [“4.1 Pistons and conrods - exploded view”, page 76](#)

⇒ [“4.2 Piston and cylinder dimensions”, page 79](#)

4.1 Pistons and conrods - exploded view

1 - Conrod bolt

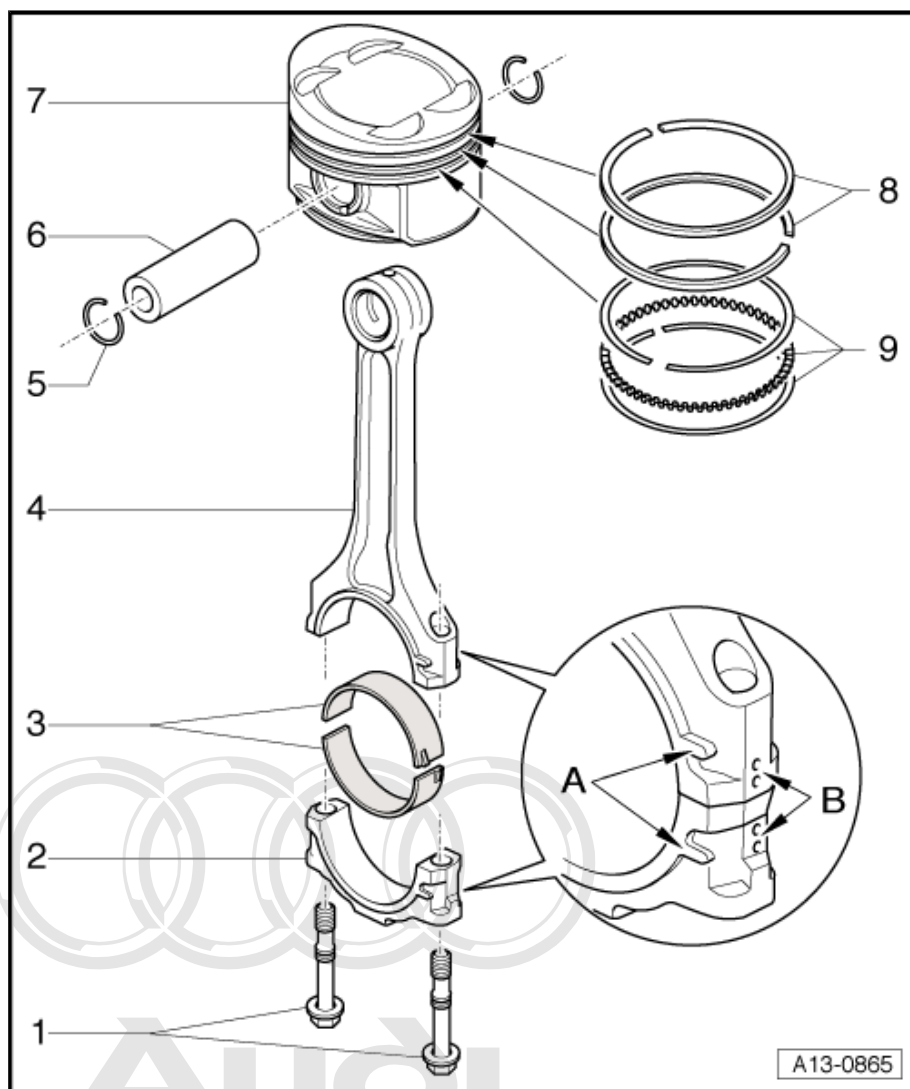
- ☐ Renew
- ☐ 30 Nm + turn 90° further
- ☐ Lubricate threads and contact surface
- ☐ Use old bolts when measuring radial clearance
- ☐ To measure radial clearance, tighten to 30 Nm then turn 90° further

2 - Conrod bearing cap

- ☐ Mark cylinder number -B-
- ☐ Installation position: Markings -A- must be on same side

3 - Bearing shells

- ☐ Do not interchange used bearing shells (mark positions)
- ☐ The lugs on the bearing shells must fit tightly in the recesses
- ☐ Installation position: lugs of both bearing shells must be on same side of conrod
- ☐ Axial clearance when new: 0.05 ... 0.31 mm; wear limit: 0.40 mm
- ☐ Check radial clearance with Plastigage
- ☐ Do not rotate the crankshaft when checking the radial clearance
- ☐ Radial clearance when new: 0.02 ... 0.07 mm; wear limit 0.10 mm
- ☐ As replacement parts, the upper bearing shell is supplied with colour-coding “yellow”, the lower bearing shell with colour-coding “red”.



4 - Conrod

- ☐ With oil drilling for piston pin lubrication
- ☐ Only renew as a complete set
- ☐ Mark cylinder number -B-
- ☐ Installation position: markings -A- must be on same side as lower side of piston (the lower side of piston crown points towards centre of cylinder block)

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 to conrod and cylinder allocation
- ☐ Lower side of piston crown points towards centre of cylinder block
- ☐ Piston and cylinder dimensions ⇒ [page 79](#)
- ☐ Install with funnel - T10147- ⇒ [page 78](#) .

8 - Piston rings

- ☐ Compression rings
- ☐ Offset gaps by 120°
- ☐ Use piston ring pliers to remove and install
- ☐ "TOP" must face towards piston crown
- ☐ Checking ring gap ⇒ [page 77](#)
- ☐ Checking ring-to-groove clearance ⇒ [page 77](#)

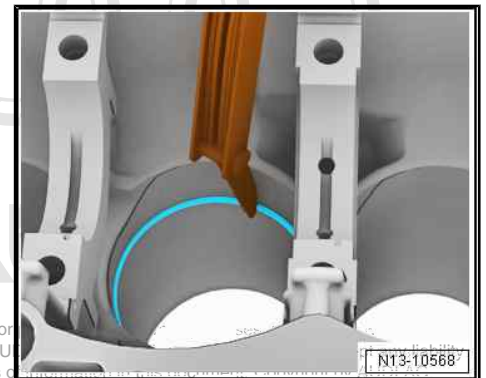
9 - Piston ring

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

Checking piston ring gap

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

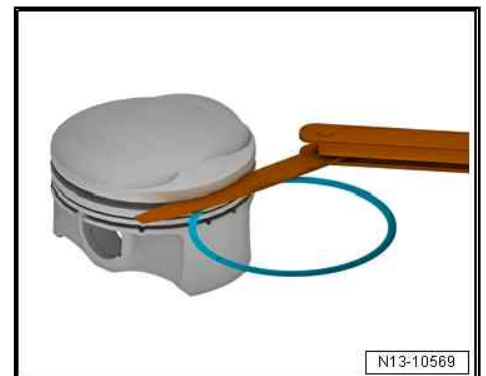
Piston ring (in mm)	New	Wear limit
Compression ring	0.20 ... 0.40	1.00
Tapered stepped ring	0.20 ... 0.40	1.00
Oil scraper ring	0.25 ... 0.50	1.00



Checking ring-to-groove clearance

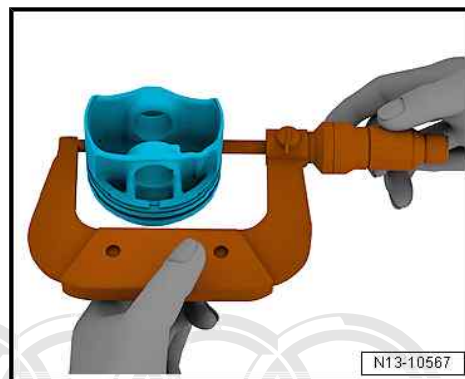
- Clean groove in piston before checking clearance.
- Use a feeler gauge to measure.

Piston ring (in mm)	New	Wear limit
Compression ring	0.04 ... 0.09	0.15
Tapered stepped ring	0.03 ... 0.06	0.15
Oil scraper ring	0.02 ... 0.06	0.15



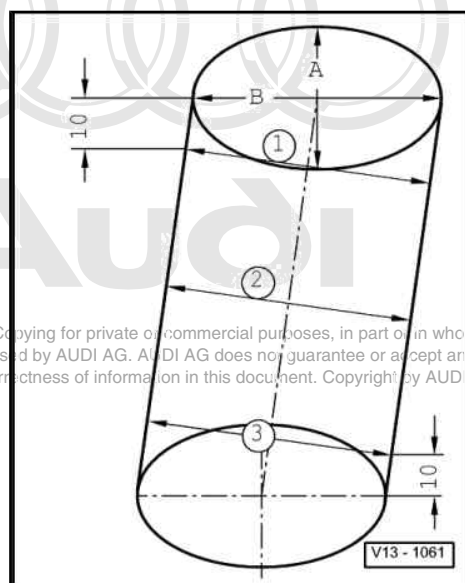
Checking piston

- Measure approx. 6 mm from the bottom edge, perpendicular to the piston pin axis.
- Use an external micrometer (75 ... 100 mm) to measure.
- Maximum deviation from nominal dimension: 0.04 mm.



Checking cylinder bore

- Make measurements at three positions diagonally in transverse direction -A- and in longitudinal direction -B-.
- Use a cylinder gauge (50 ... 100 mm) to measure.
- Maximum deviation from nominal dimension: 0.08 mm.



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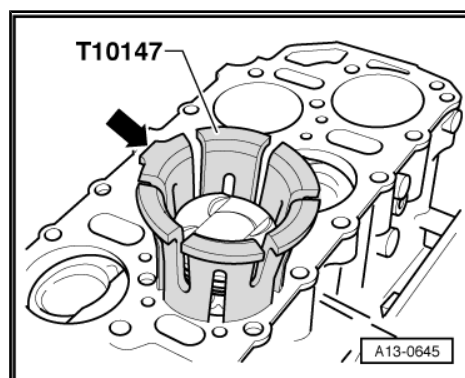
Install piston with funnel - T10147- .



Note

If a new fitting tool (funnel) is used to install the pistons, first pass piston (with oiled piston rings) twice through the tool and remove any resulting swarf. Only then install piston with piston rings.

- Lubricate tool and push piston in by hand.
- The flat side of the piston crown must face the projection on the fitting tool -arrow-.
- Hold upper part of tool (with piston inserted) and press piston in with both thumbs.
- Push piston in until it protrudes approx. 15 mm from the lower edge of the fitting tool.
- Place piston in appropriate cylinder bore.
- The projection on fitting tool -arrow- must face centre of cylinder block.
- Hold fitting tool firmly against cylinder block and push in the piston.



4.2 Piston and cylinder dimensions

Honing dimension (in mm)	Piston Ø	Cylinder bore Ø
Basic dimension	83.965	84.010



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15 – Cylinder head, valve gear

1 Removing and installing cylinder head

⇒ "1.1 Cylinder head - exploded view", page 80

⇒ "1.2 Removing and installing cylinder head cover", page 82

⇒ "1.3 Removing cylinder head", page 90

⇒ "1.4 Installing cylinder head", page 93

⇒ "1.5 Checking compression", page 96

1.1 Cylinder head - exploded view

1 - Cylinder head gasket

- ☐ Metal gasket
- ☐ Renew
- ☐ If renewed, change coolant and engine oil

2 - Cylinder head

- ☐ Removing ⇒ page 90
- ☐ Checking for distortion ⇒ page 82
- ☐ Installing ⇒ page 93
- ☐ If renewed, change coolant and engine oil

3 - Lifting eye

4 - 23 Nm

5 - Seals for cylinder head cover

- ☐ Renew if damaged

6 - Cylinder head cover

- ☐ Removing and installing ⇒ page 82

7 - Spacer sleeve

- ☐ With seal
- ☐ Renew seal if damaged

8 - 10 Nm

9 - Filler cap

10 - Seal for filler cap

- ☐ Renew if damaged

11 - Washer

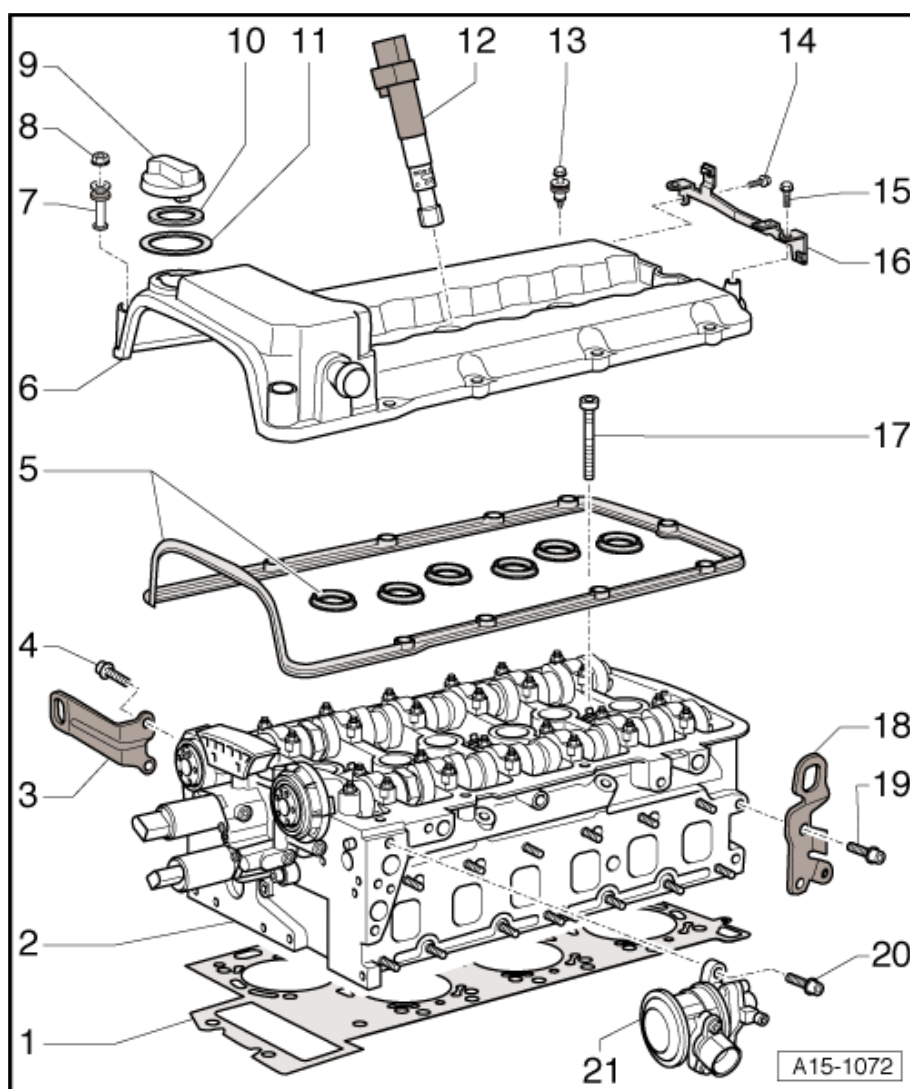
- ☐ Renew if damaged

12 - Ignition coil

- ☐ Remove with puller - T10095 A-

13 - 10 Nm

- ☐ Bolt with spacer sleeve and seal
- ☐ Renew seal if damaged



14 - 10 Nm

15 - 10 Nm

16 - Bracket for wiring harness

17 - Cylinder head bolt

- ☐ Renew
- ☐ Note correct sequence when loosening ⇒ [page 81](#)
- ☐ Note correct sequence when tightening ⇒ [page 82](#)

18 - Lifting eye

19 - 23 Nm

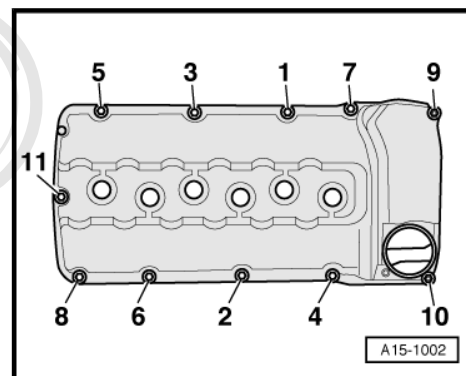
20 - Bolt

21 - Combination valve for secondary air system

- ☐ Version and fitting location ⇒ [page 206](#)

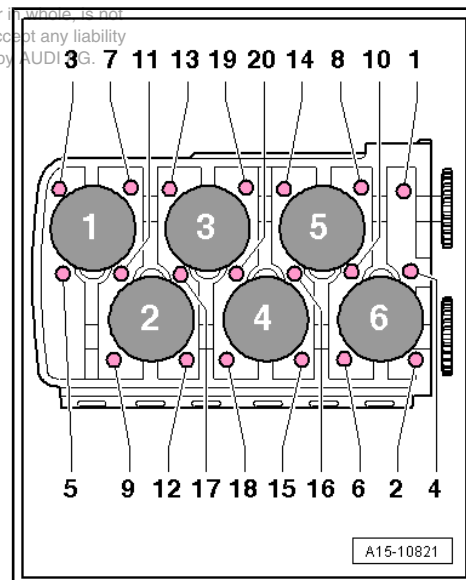
Cylinder head cover - tightening torque and tightening sequence

- Tighten bolts in the sequence -1 ... 11- to 10 Nm.



Slackening cylinder head bolts

- Loosen bolts in the sequence -1 ... 20-.



Cylinder head - tightening torque and tightening sequence

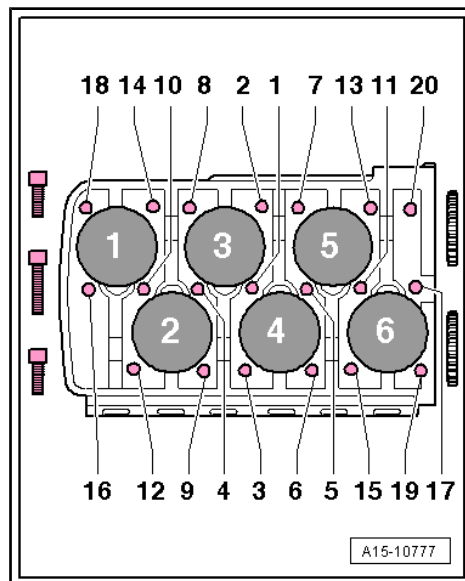
- Tighten bolts in the sequence -1 ... 20- in 4 stages as follows:



Note

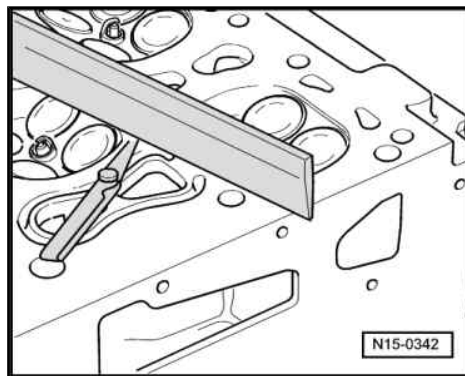
The long cylinder head bolts are inserted in the middle bores in cylinder head.

1. Tighten bolts hand tight.
2. Pre-tighten bolts to 30 Nm.
3. Tighten bolts to 50 Nm.
4. Turn bolts 180° ($\frac{1}{2}$ turn) further.



Checking cylinder head for distortion

- Use straight edge and feeler gauge to measure for distortion at several points.
- Max. permissible distortion: 0.05 mm

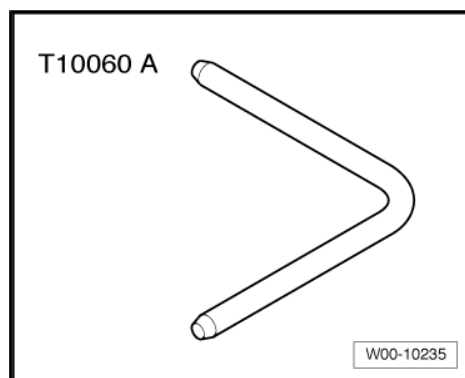


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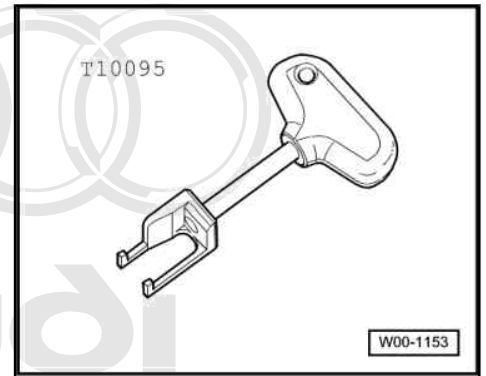
1.2 Removing and installing cylinder head cover

Special tools and workshop equipment required

- ◆ Locking pin - T10060 A-

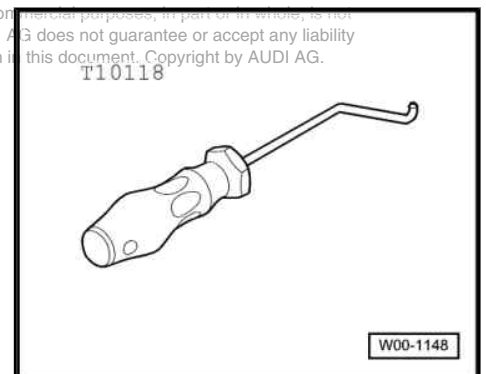


◆ Puller - T10095 A-



◆ Assembly tool - T10118-

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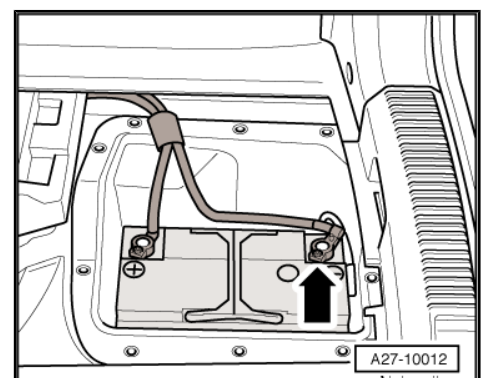
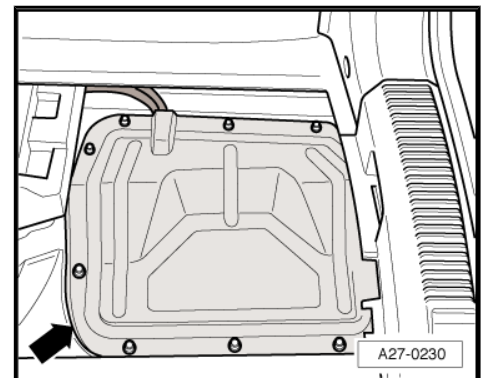
Removing



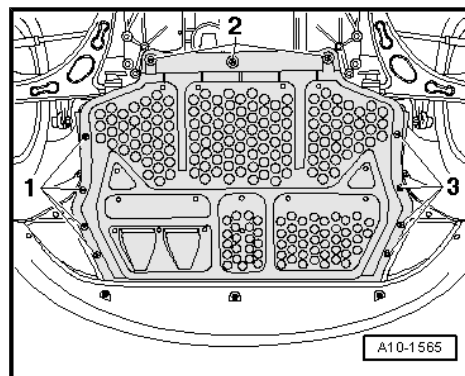
Caution

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

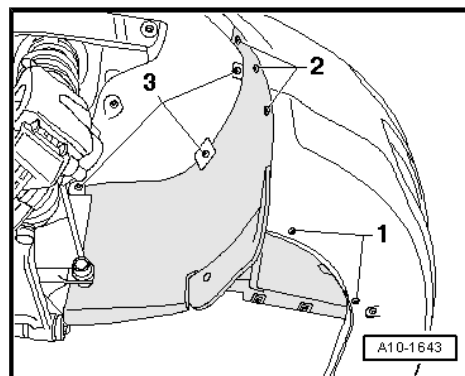
- Remove the moulded insert for tools from beneath the luggage compartment floor cover.
- Unscrew the lid -arrow- of the battery compartment.
- Remove moulded insert from top of battery.
- With ignition switched off, disconnect earth wire -arrow- at battery.



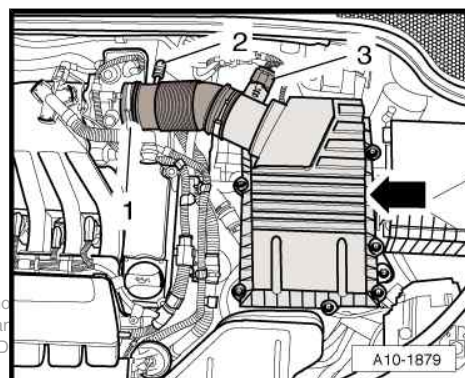
- Remove centre noise insulation -fasteners 1 ... 3-.



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

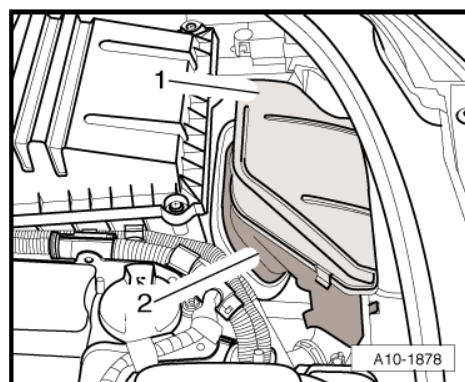


- Detach vacuum hose -2- from air intake hose (if fitted).
- Detach air hose -1- at the throttle valve module - J338-.
- Unplug electrical connector for air mass meter - G70- -item 3-.
- Unscrew air cleaner housing (upper section) -arrow-.
- Take out filter element.

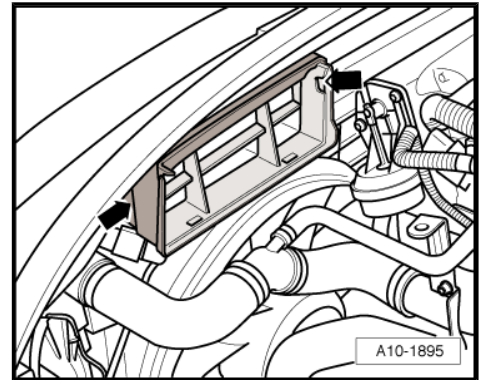


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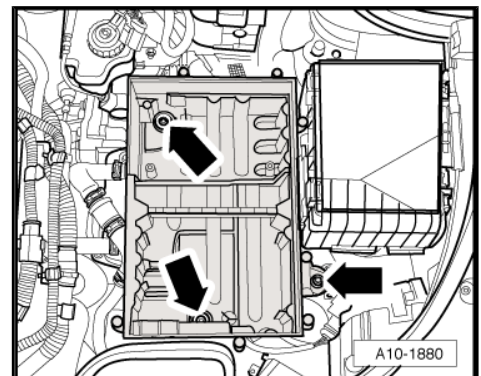
- Pull cover -1- off air duct (release clips on sides).
- Unclip air duct -2-.



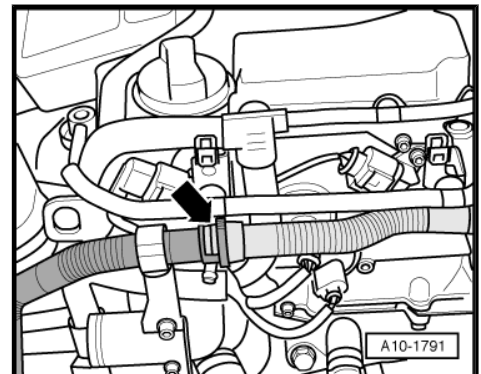
- Unscrew air duct (lower section) -arrows-.



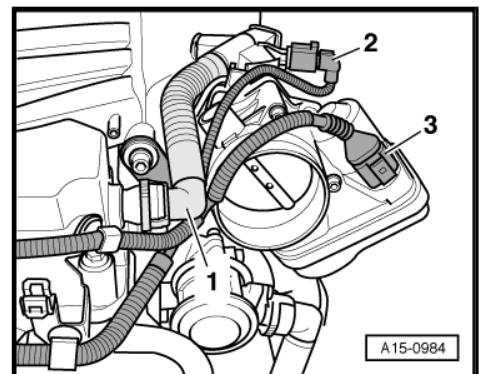
- Unscrew air cleaner housing (lower section) -arrows-.



- Disconnect secondary air hose at the position marked with an -arrow-.
- Move air hose to secondary air pump clear.

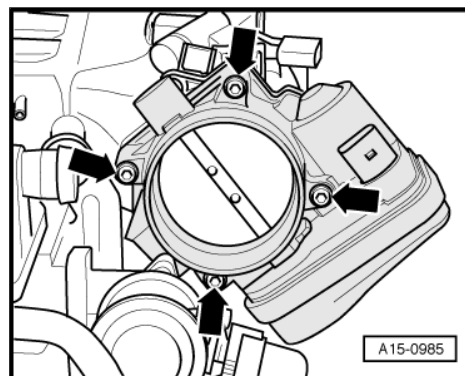


- Unplug electrical connectors -2- and -3-.
- Detach crankcase breather hose -1-.

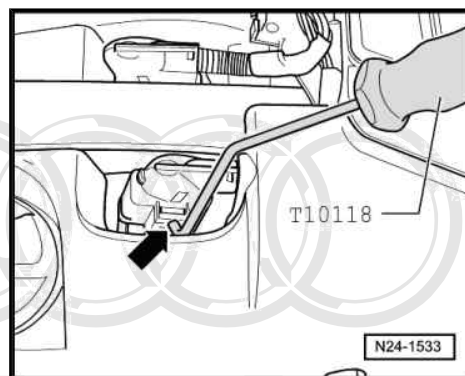


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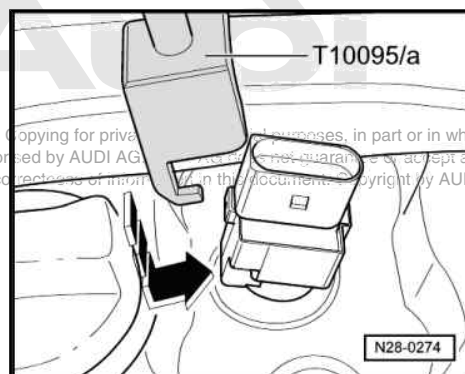
- Unbolt the throttle valve module - J338- from the intake manifold -arrows-.



- Detach electrical connectors at ignition coils by releasing tab -arrow- with assembly tool - T10118- and carefully pulling connector.



- Attach puller - T10095 A- to ignition coils as shown in illustration -arrow- and remove ignition coils one at a time.
- Detach wire guide from intake manifold and move clear.

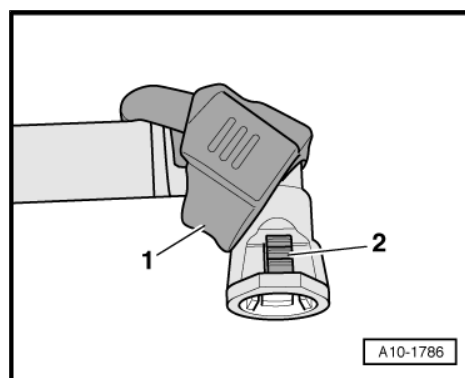


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Note

Some versions have plug-in vacuum connections on the intake manifold as illustrated. To disconnect, push back rubber cap -1- and slide back retaining tab -2-.



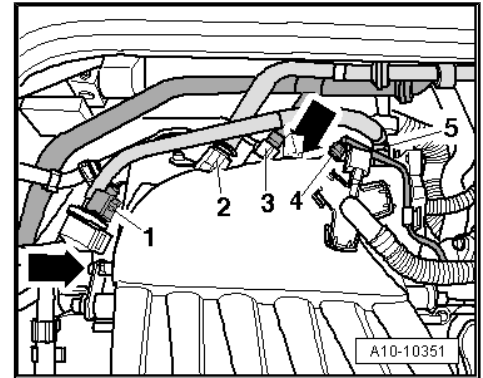
- Disconnect vacuum hoses -2 ... 5- at rear of intake manifold.



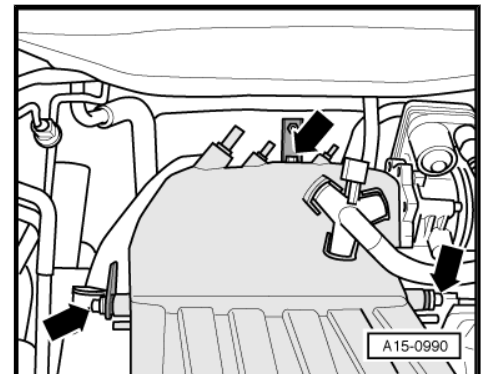
Note

Disregard -item 1-.

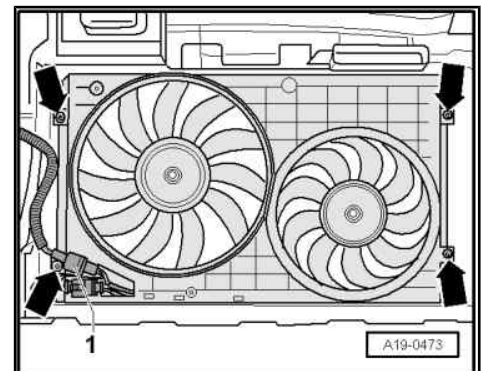
- Unbolt hose bracket from intake manifold -arrows- and move clear to rear, with hoses attached.



- Remove rear securing bolts -arrows- for intake manifold.



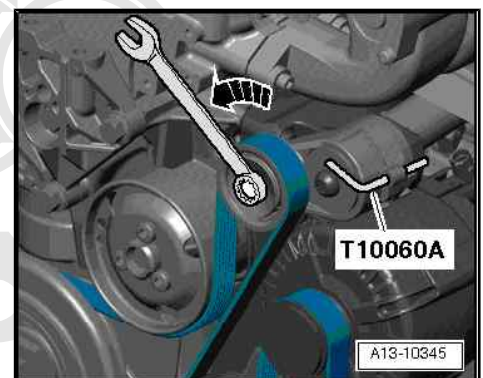
- Unscrew upper securing bolts -upper arrows- for radiator cowl.
- Pull out oil dipstick.



Note

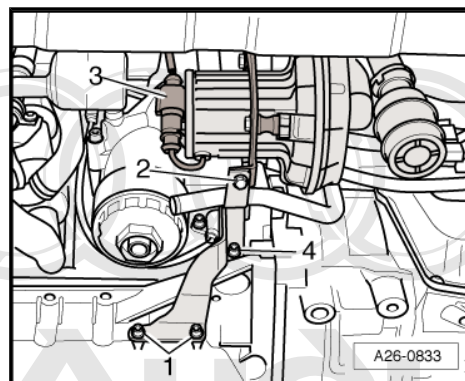
Before removing, mark direction of rotation of poly V-belt with chalk or felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.

- Turn tensioner in direction of -arrow- to slacken poly V-belt and lock in position with locking pin - T10060 A- .
- Remove poly V-belt.

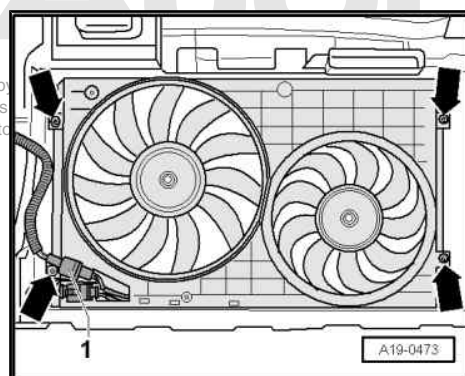


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- Move coolant hose at bottom of radiator cowl clear.
- Unplug electrical connector -3- at secondary air pump motor - V101- .
- Move wire clear.
- Unscrew bracket -2- for coolant pipe going to gear oil cooler on vehicles with direct shift gearbox.
- Remove bolts -1-.
- Loosen bolt -4- and remove secondary air pump with bracket.



- Detach electrical connectors -1- for radiator fans at bottom of radiator cowl.
- Unscrew lower securing bolts -lower arrows- for radiator cowl.
- Remove the radiator cowl with both fans from below.



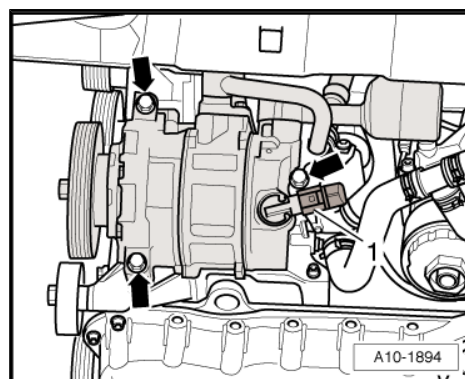
- Unplug electrical connector -1- for magnetic clutch at air conditioner compressor and move electrical wiring clear.



WARNING

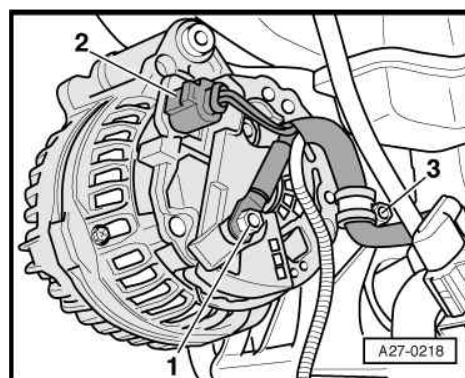
The air conditioner refrigerant circuit must not be opened.

- Unscrew bolts -arrow- for air conditioner compressor.
- Tie up air conditioner compressor together with refrigerant hoses at front of longitudinal member (refrigerant hoses remain connected).
- Unscrew wire -1- at alternator.
- Unplug electrical connector -2-.



Note

Disregard -item 3-.



- Remove the upper idler roller -1-.
- Unscrew securing bolts -2- and -3- for alternator.



Note

The alternator can only be removed from bracket with upper securing bolt still inserted.

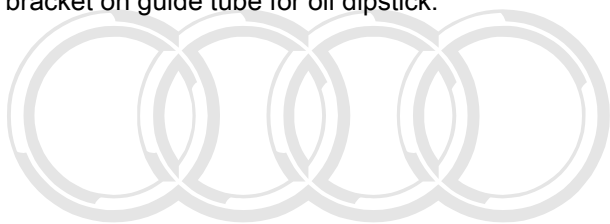
- Remove alternator from bracket for ancillary units (electrical wires remain connected).
- Take out alternator to the bottom left.
- Unplug electrical connector -arrow- at continued coolant circulation pump - V51- .
- Remove bolts -1 ... 5- and detach bracket for ancillaries.
- Pull the continued circulation coolant pump - V51- downwards out of the rubber retainers on bracket (with coolant hoses attached). If necessary, spray rubber retainers with silicone-free lubricant.



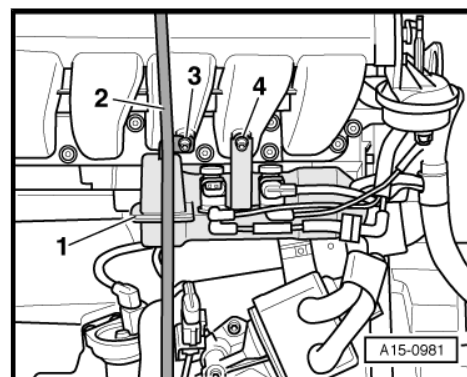
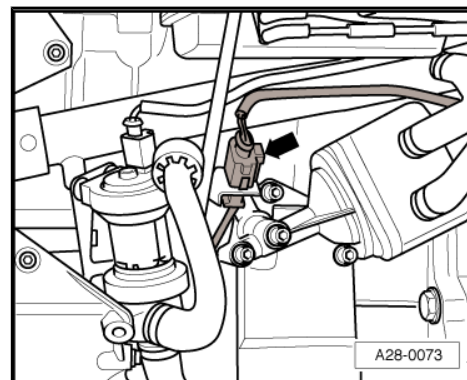
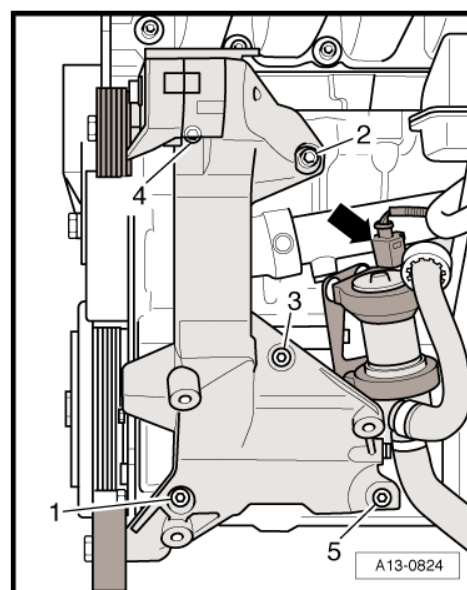
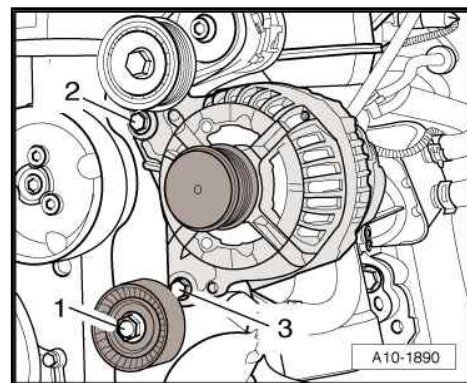
Note

The coolant pump with attached coolant hoses can be left in place on the engine.

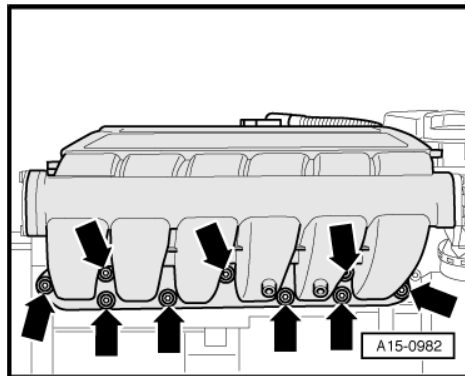
- Unhook connector -arrow- for engine speed sender - G28- from bracket on guide tube for oil dipstick.



- Unscrew bolt -3- and pull out guide tube for oil dipstick -2-.
- Unscrew bolt -4- and detach vacuum reservoir -1- from manifold.
- Move vacuum reservoir to side (hoses remain attached).



- Unscrew bolts -arrows- at front of intake manifold.

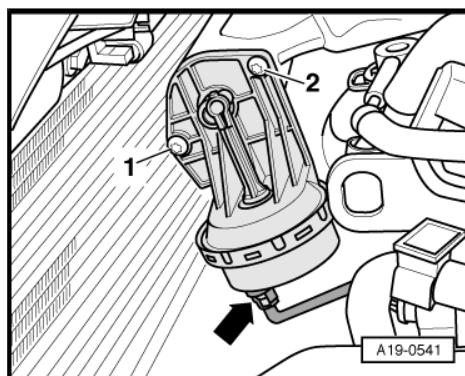


- Disconnect vacuum hose -arrow- at actuator for intake manifold change-over.



Note

Disregard items -1- and -2-.



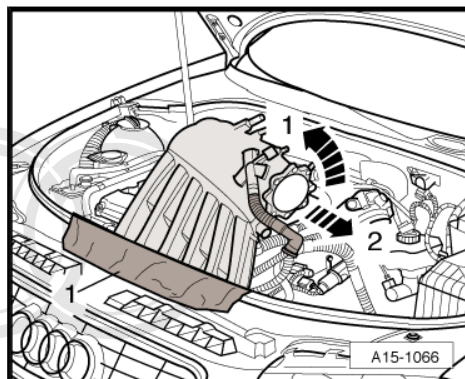
- Protect the intake manifold from damage with a clean cloth -1-.
- Pivot intake manifold forwards -arrow 1- and then pull slightly to the left -arrow 2-.



Note

Cover or plug the intake ports in the cylinder head with a clean cloth or foam plastic to prevent small items from dropping in.

- Unbolt bracket for fuel line (right-side) at cylinder head cover.
- Unbolt bracket for electrical connectors (left-side) from cover for timing chains.
- Unscrew cylinder head cover bolts in the sequence -11 ... 1-.



Installing

- Tightening torque

⇒ ["1.1 Cylinder head - exploded view", page 80](#)

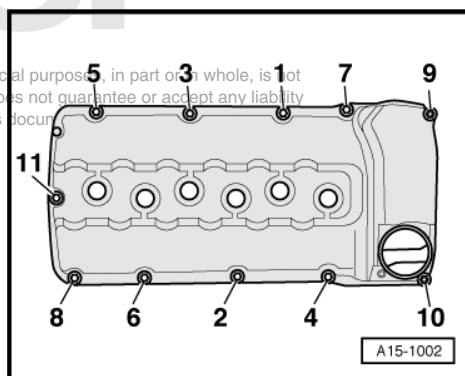
Installation is carried out in the reverse order; note the following:



Note

Renew gaskets for cylinder head cover and securing bolts if damaged.

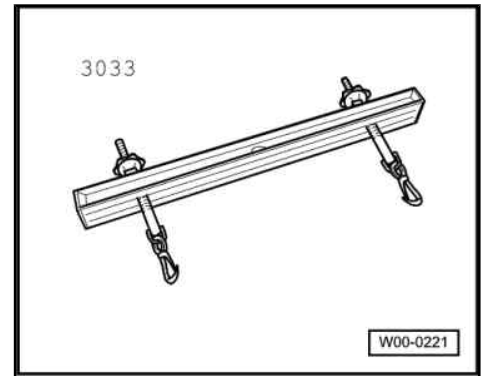
- Tighten cylinder head cover bolts in the sequence -1 ... 11-.
- Install intake manifold ⇒ Rep. gr. 24 .



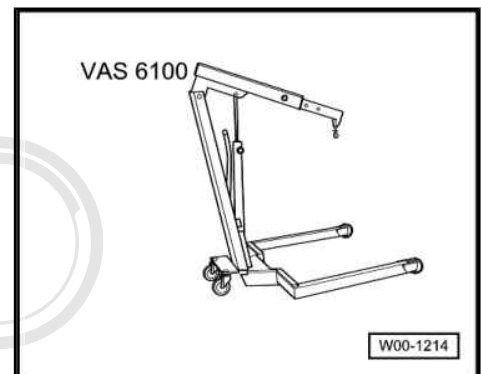
1.3 Removing cylinder head

Special tools and workshop equipment required

◆ Lifting tackle - 3033-



◆ Workshop hoist - VAS 6100-



Procedure

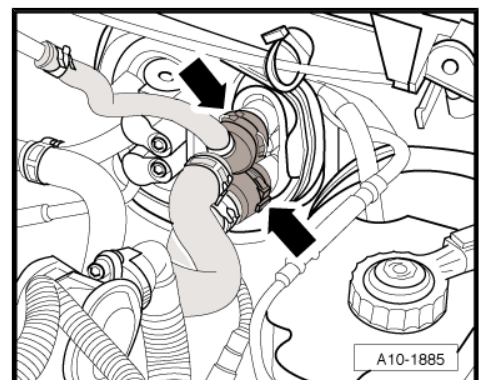
- Engine in vehicle.



Note

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- ◆ *All cable ties which are released or cut open when removing must be refitted in the same position when installing.*
- ◆ *Heat insulation sleeves that have been removed are to be re-installed in the original position.*
- ◆ *If engine oil is contaminated, perform oil change ⇒ Maintenance ; Booklet 808 .*
- Drain off coolant ⇒ [page 164](#) .
- Remove intake manifold ⇒ Rep. gr. 24 .
- Detach coolant hoses going to to heat exchanger at bulkhead -arrows-.



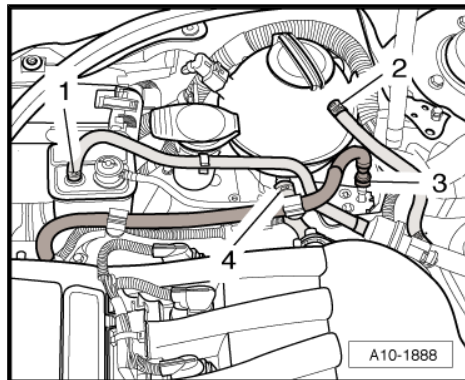
Rest-of-world vehicles:

- Disconnect vacuum line -1- from activated charcoal filter and move line clear.
- Detach coolant hoses -2- and -4-.



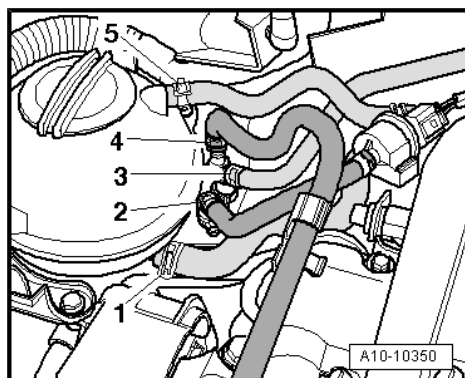
Note

Disregard -item 3-.



USA vehicles:

- Disconnect following hose connections:
- 1 - Coolant hose to expansion tank
- 2 - Vacuum hose to activated charcoal filter
- 3 - Vacuum hose to tank leak diagnostic pump
- 4 - Fuel supply line
- 5 - Coolant hose to expansion tank



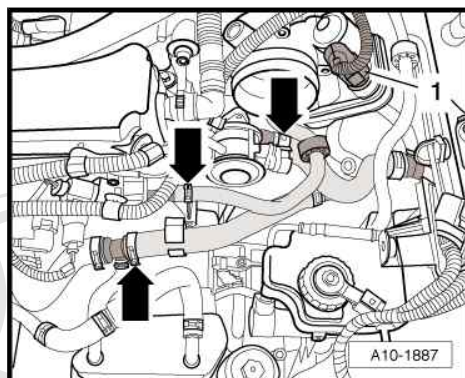
All vehicles (continued):

- Detach coolant hoses at the connections indicated -arrows-.



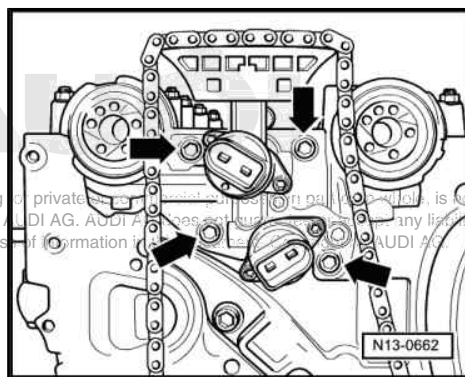
Note

- ◆ Disregard -item 1-.
- ◆ Illustration shows vehicle with direct shift gearbox.
- Remove hose bracket with coolant hoses and vacuum hoses.
- Remove timing chain from camshafts ➔ [page 104](#).
- Unbolt valve timing housing -arrows- and detach carefully from the rectangular section seals for the camshafts.
- Lay aside timing chain.



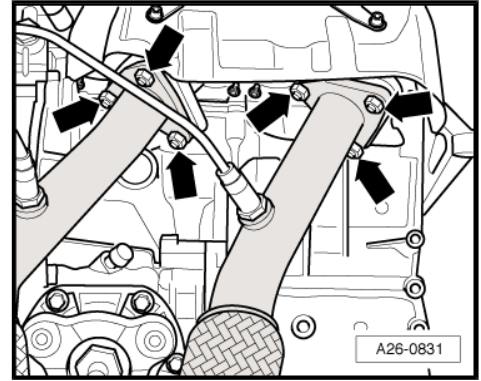
Note

To avoid damage, the flexible joints in the front exhaust pipe must not be bent more than 30°.

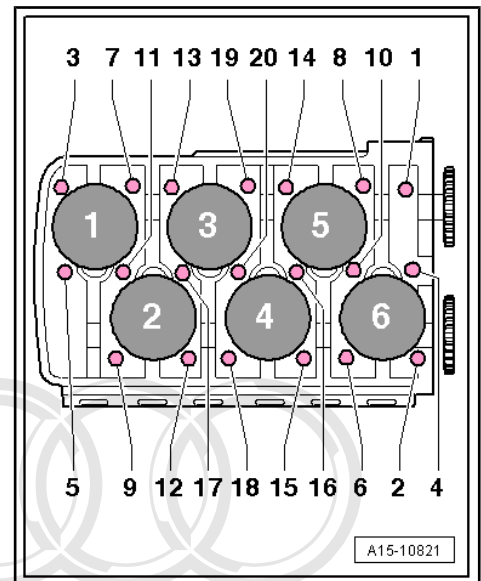


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- Unbolt front exhaust pipe from exhaust manifolds -arrows-.



- Loosen and remove the cylinder head bolts in the sequence indicated.



- Attach the lifting tackle - 3033- as follows:
 - Pulley end: position -3-.
 - Timing chain end: Item -10-.

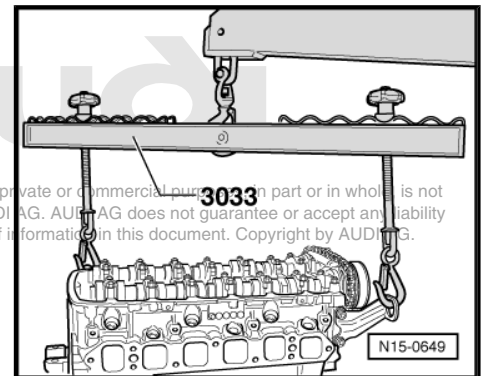


Note

The positions marked 1 ... 12 on the lifting tackle - 3033- face towards timing chain end.

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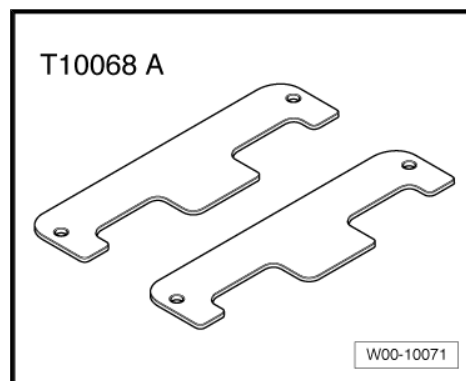
- Carefully lift off cylinder head.
- Place a clean cloth in the cylinders to prevent dirt from getting between the cylinder wall and piston.



1.4 Installing cylinder head

Special tools and workshop equipment required

◆ Camshaft bar - T10068 A-

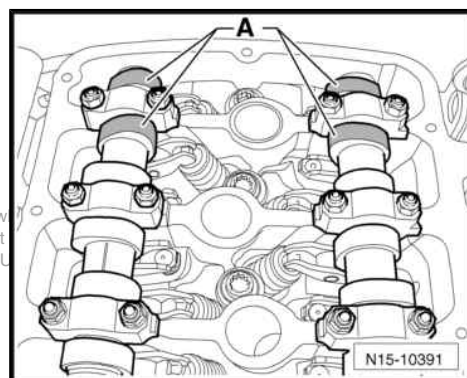


Procedure



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.*
 - ◆ *Do not remove new cylinder head gasket from packaging until it is ready to be fitted.*
 - ◆ *Handle gasket very carefully. Damage to the silicone coating or the indented area will lead to leaks.*
 - ◆ *The plastic protectors fitted to protect the open valves must only be removed immediately before fitting the cylinder head.*
 - ◆ *When installing an exchange cylinder head, the contact surfaces between the hydraulic compensation elements, roller rocker fingers and cams must be oiled before installing the head.*
 - ◆ *No oil or coolant must be allowed to remain in the blind holes for the cylinder head bolts in the cylinder block.*
 - ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
 - ◆ *After fitting a new cylinder head or cylinder head gasket, change the coolant and engine oil.*
- Set camshafts to TDC before fitting cylinder head.
 - Cams -A- of cylinder 1 must face each other.



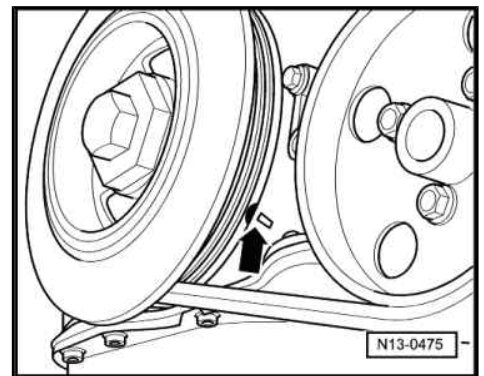
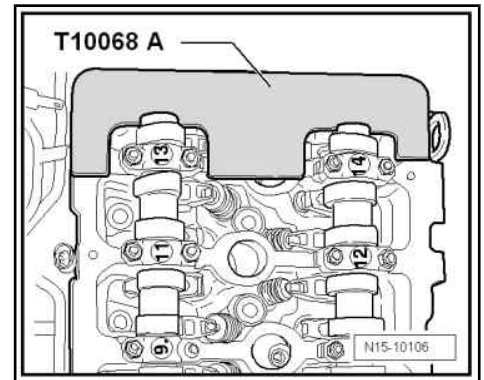
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- Check TDC position of camshafts:
- You should be able to insert the camshaft bar - T10068 A- in the slots in both camshafts.

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



- Fit cylinder head gasket.
- Note position of centring pins in cylinder block.
- Check installation position of cylinder head gasket; the Part No. should be legible from inlet side.
- Fit cylinder head.
- Insert and hand-tighten cylinder head bolts.



Note

The long cylinder head bolts are inserted in the middle bores in cylinder head.

- Tighten cylinder head bolts ⇒ [page 82](#) .



Note

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

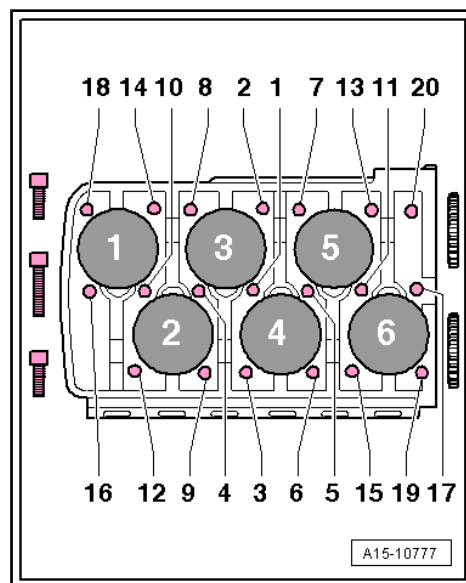
- Install camshaft timing chain ⇒ [page 109](#) and valve timing housing ⇒ [Item 1 \(page 102\)](#) .
- Install cylinder head cover ⇒ [page 82](#) .
- Install intake manifold ⇒ Rep. gr. 24 .
- Change engine oil ⇒ Maintenance ; Booklet 808 .
- Connect earth strap to battery ⇒ Rep. gr. 27 .
- Fill cooling system with fresh coolant ⇒ [page 164](#) .

Tightening torque

Component	Nm
Front exhaust pipe to exhaust manifold	25 ¹²⁾

12) Renew nuts

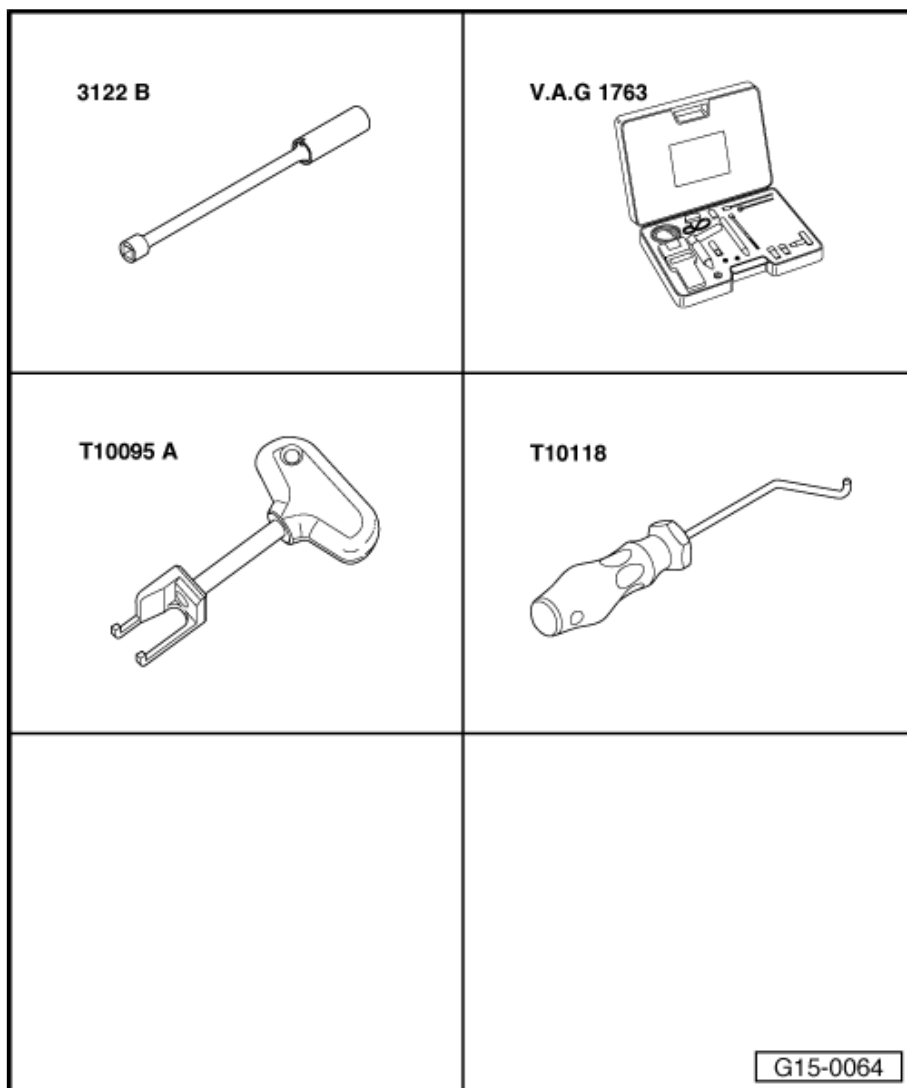
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1.5 Checking compression

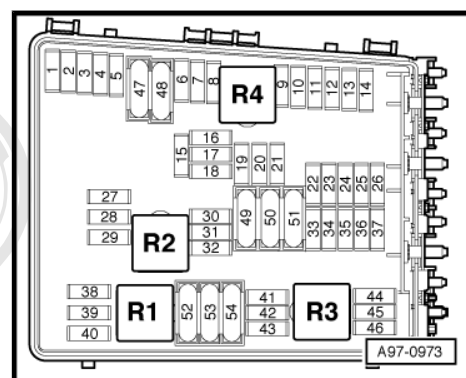
Special tools and workshop equipment required

- ◆ Spark plug socket and extension - 3122 B-
- ◆ Compression tester - V.A.G 1763-
- ◆ Puller - T10095 A-
- ◆ Assembly tool - T10118-



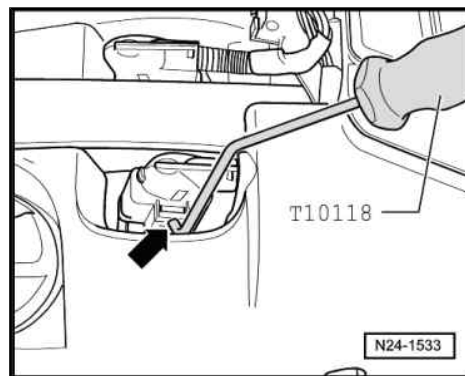
Procedure

- Engine oil temperature at least 30 °C.
- Battery voltage at least 12.5 V.
- Switch off ignition.
- Open lid of electronics box in engine compartment and remove injector fuse -29-.

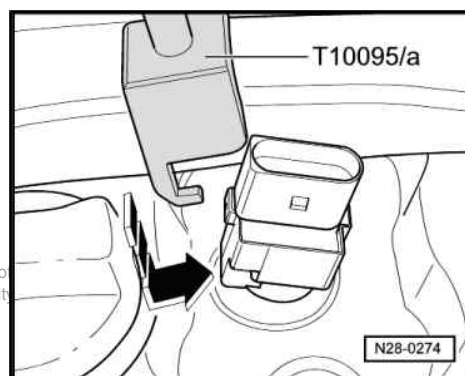


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- Detach electrical connectors at ignition coils by releasing tab -arrow- with assembly tool - T10118- and carefully pulling connector.



- Attach puller - T10095 A- to ignition coils as shown in illustration -arrow- and remove ignition coils one at a time.
- Remove spark plugs with spark plug socket - 3122 B- .
- Test the compression pressure with the compression tester - V.A.G 1763- .



Note

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Using the compression tester → Operating instructions

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

Compression pressure	bar
When new	10.0 ... 13.0
Wear limit	7.5
Maximum difference between cylinders	3.0

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

- Install spark plugs ⇒ Maintenance ; Booklet 808 .
- When finished, interrogate and erase the engine control unit fault memory, as faults are stored when fuses are removed and connectors are detached ⇒ Vehicle diagnostic tester.

2 Chain drive

⇒ [“2.1 Timing chain covers - exploded view”, page 99](#)

⇒ [“2.2 Renewing the oil seals in the upper cover for timing chains”, page 100](#)

⇒ [“2.3 Timing chain - exploded view of components”, page 101](#)

⇒ [“2.4 Detaching and re-fitting timing chain on camshafts”, page 104](#)

⇒ [“2.5 Removing and installing drive chain for valve gear and camshaft timing chain”, page 114](#)

2.1 Timing chain covers - exploded view



Note

-Items 1 ... 3- ⇒ [page 62](#) .

4 - Bolt

- ☐ Tightening torque
⇒ [page 100](#)

5 - Thermostat housing

- ☐ Removing and installing
⇒ [page 173](#)

6 - Bolt

- ☐ 10 Nm

7 - Bracket

- ☐ Version fitted in vehicle may differ from illustration

8 - Seal

- ☐ Renew

9 - Oil seal

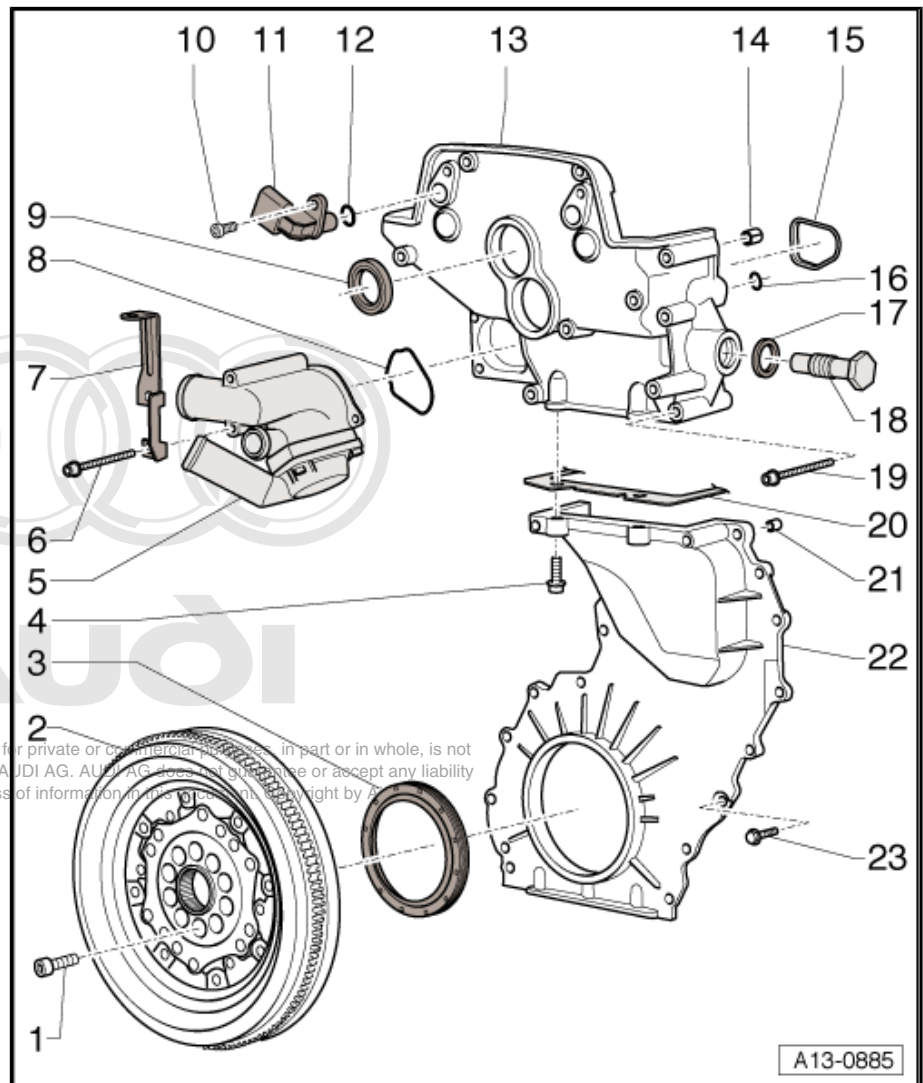
- ☐ 2x
- ☐ For inlet camshaft control valve 1 - N205- and exhaust camshaft control valve 1 - N318-
- ☐ Renew if damaged or leaking
- ☐ Renewing ⇒ [page 100](#)

10 - Bolt

- ☐ 10 Nm

11 - Hall sender

- ☐ 2x
- ☐ Mark electrical connec-



tor before disconnecting

12 - O-ring

- ☐ 2x
- ☐ Renew

13 - Timing chain cover (top)

- ☐ Coat sealing surfaces with sealant when installing ⇒ [page 113](#)

14 - Dowel sleeve

- ☐ 2x

15 - Seal

- ☐ Renew

16 - O-ring

- ☐ Renew

17 - Seal

- ☐ Renew if damaged or leaking

18 - Chain tensioner for camshaft timing chain

- ☐ Tightening torque ⇒ [page 101](#)

19 - Bolt

- ☐ Tightening torque and tightening sequence ⇒ [page 100](#)

20 - Cylinder head gasket

- ☐ Clean bores and fill with sealant ⇒ [page 113](#)

21 - Dowel pin**22 - Timing chain cover (bottom)**

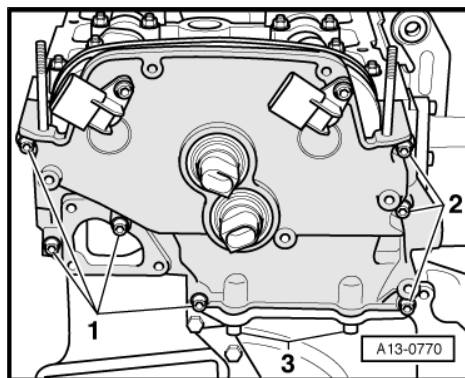
- ☐ Coat sealing surfaces with sealant when installing; for sealant refer to ⇒ Electronic parts catalogue

23 - Bolt

- ☐ 10 Nm
- ☐ Tighten in stages and in diagonal sequence

Timing chain cover (top) - tightening torque and tightening sequence

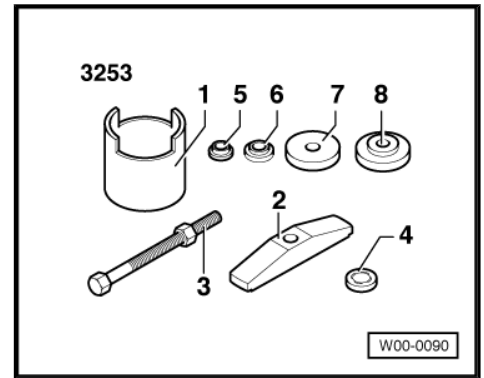
- 1 - Tighten bolts -1- and -2- initially to 5 Nm.
- 2 - Tighten bolts -3- to 23 Nm.
- 3 - Tighten bolts -1- and -2- to 10 Nm.



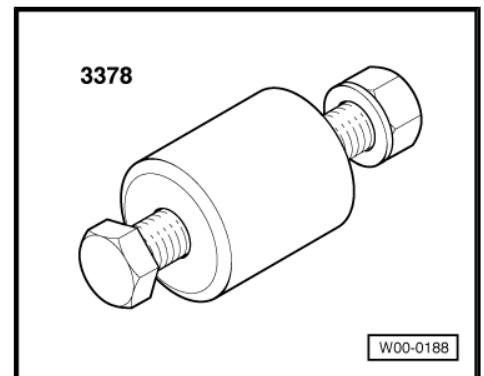
2.2 Renewing the oil seals in the upper cover for timing chains

Special tools and workshop equipment required

◆ Assembly tool - 3253-

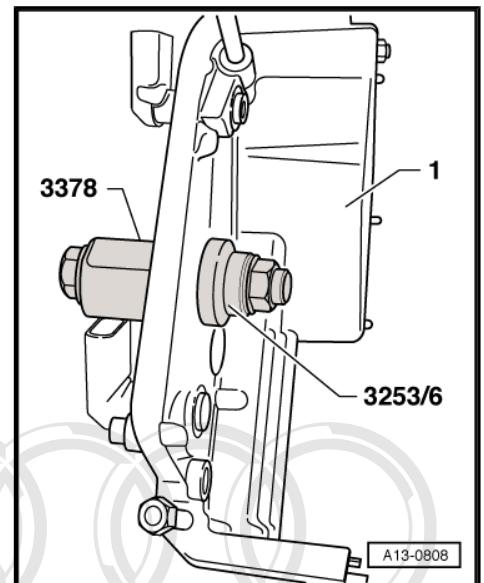


◆ Fitting sleeve - 3378-



Procedure

- Upper cover for timing chains removed.
- Use drift to drive out oil seals.
- Insert seal into upper cover for camshaft timing chain -1- with fitting sleeve - 3378- and then use assembly tool - 3253/6- to press it in flush.



2.3 Timing chain - exploded view of components

1 - Valve timing housing

- ☐ Removing and installing
⇒ ["3.4 Removing and installing camshafts"](#),
[page 129](#)
- ☐ Dismantling and assembling
⇒ [page 128](#)
- ☐ Check filter for dirt
⇒ [page 128](#)
- ☐ Lightly coat contact surfaces of oil seals before installing

2 - 8 Nm

- ☐ Renew

3 - Camshaft timing chain

- ☐ Before removing, mark running direction in colour
⇒ [page 103](#)
- ☐ Removing from camshafts
⇒ [page 104](#)
- ☐ Removing and installing
⇒ [page 114](#)

4 - Camshaft adjuster - exhaust

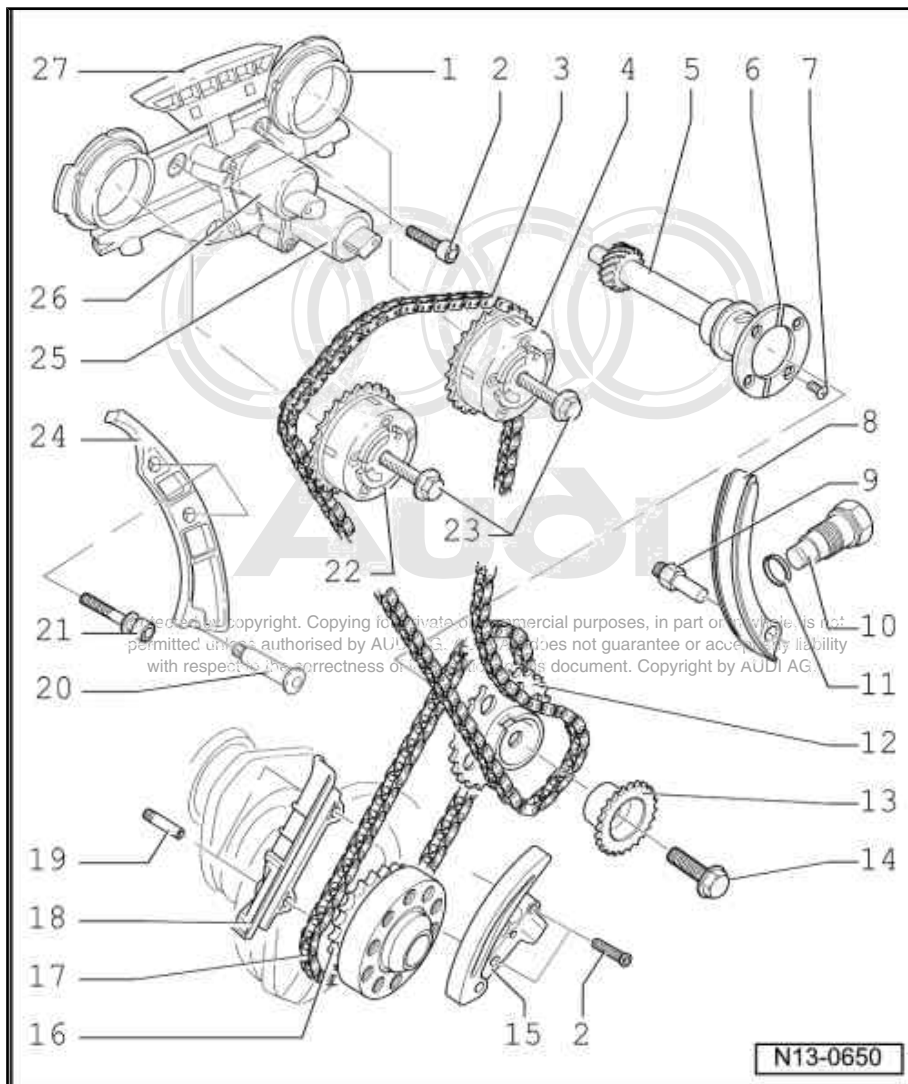
- ☐ Identification: "32A"
- ☐ Removing and installing
⇒ [page 104](#)

5 - Intermediate shaft

6 - Thrust washer

7 - 8 Nm

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



8 - Tensioning rail for timing chain

- ☐ To remove and install it is first necessary to remove both the upper and lower covers for the timing chains

9 - Mounting pin

10 - Chain tensioner for camshaft timing chain -40 Nm-

- ☐ Removing and installing ⇒ [page 104](#)

11 - Seal

- ☐ Renew if damaged or leaking

12 - Sprocket for drive chain for valve gear

- ☐ Removing and installing ⇒ [page 114](#)

13 - Sprocket for camshaft timing chain

- ☐ Removing and installing ⇒ [page 114](#)

14 - 60 Nm + turn 90° further

- ☐ Renew
- ☐ When loosening and tightening use tool - T10069- to counterhold on vibration damper.

15 - Chain tensioner with tensioning rail

- ☐ For drive chain
- ☐ Before installing, release locking spline in chain tensioner with a small screwdriver and press tensioning rail against chain tensioner

16 - Drive chain sprocket

- ☐ Integral part of crankshaft

17 - Drive chain for valve gear

- ☐ Mark rotation direction before removing ⇒ [page 103](#)
- ☐ Removing and installing ⇒ [page 114](#)

18 - Guide rail for drive chain for valve gear

- ☐ Removing and installing ⇒ [page 114](#)

19 - Pin, 10 Nm

- ☐ For guide rail

20 - 18 Nm

21 - 23 Nm

22 - Camshaft adjuster - inlet

- ☐ Identification: "24E"
- ☐ Removing and installing ⇒ [page 104](#)

23 - Bolt

- ☐ Renew
- ☐ Contact surface of sender wheel at bolt head must be dry when installing.
- ☐ To loosen and tighten, counterhold with open-end spanner on hexagon flats of camshaft ⇒ [page 104](#)
- ☐ 60 Nm + 90° (1/4 turn further)

24 - Guide rail for camshaft timing chain

- ☐ Removing and installing ⇒ [page 104](#)

25 - Exhaust camshaft control valve 1 - N318-

- ☐ For exhaust camshaft
- ☐ Mark electrical connector before disconnecting

26 - Camshaft control valve 1 - N205-

- ☐ For inlet camshaft
- ☐ Mark electrical connector before disconnecting

27 - Guide rail for camshaft timing chain

- ☐ Clipped onto valve timing housing

Marking rotation direction of timing chains

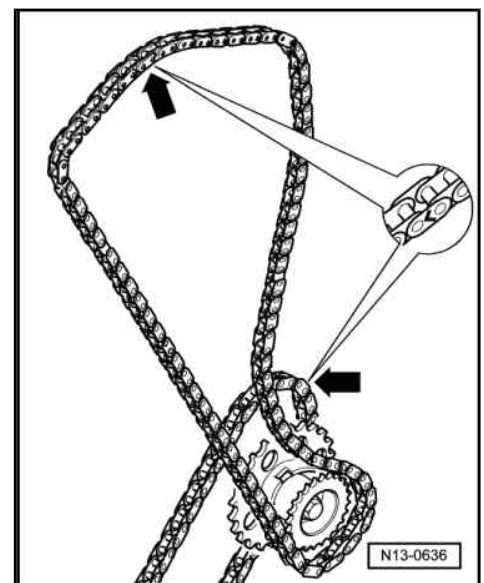
- Mark rotation direction of timing chains with coloured arrows before removing -arrows-.



Caution

Avoid damage to timing chains.

- ◆ *Do not mark chains by means of centre punch, notch or the like.*

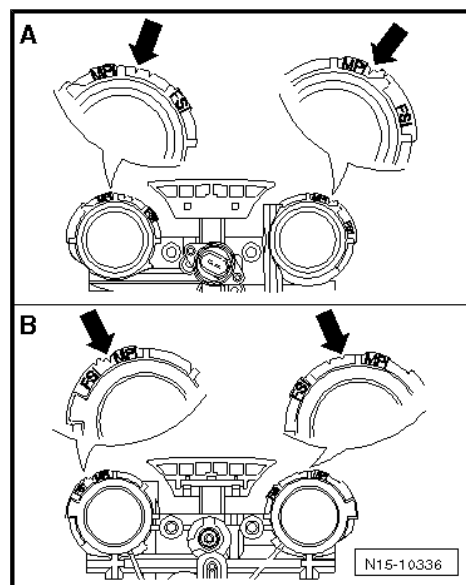


Markings on valve timing housing on MPI engines

-A- Illustration shows flywheel end

-B- Illustration shows vibration damper end

Notches -arrows- serve as reference points for markings on camshaft adjusters.

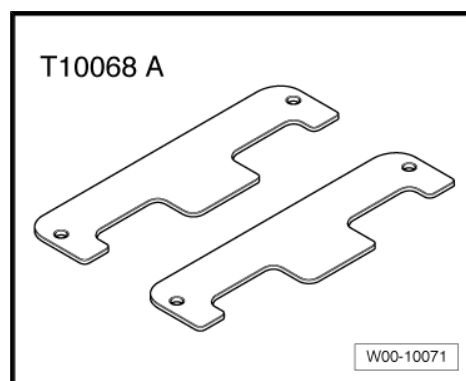


2.4 Detaching and re-fitting timing chain on camshafts

Special tools and workshop equipment required

- ◆ Camshaft bar - T10068 A-

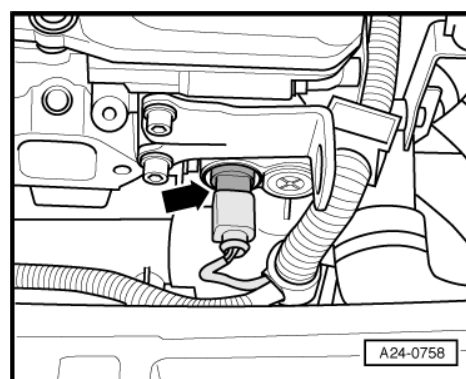
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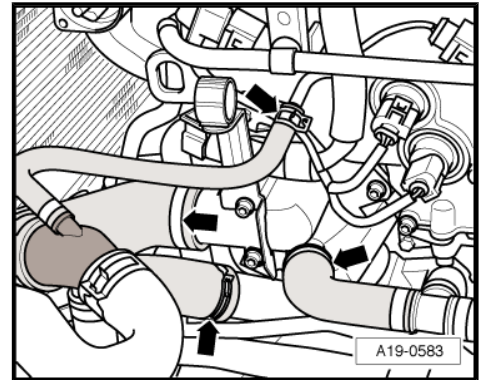
- ◆ Sealing compound (black) ⇒ Electronic parts catalogue
- ◆ Sealing paste ⇒ Electronic parts catalogue

Detaching camshaft timing chain

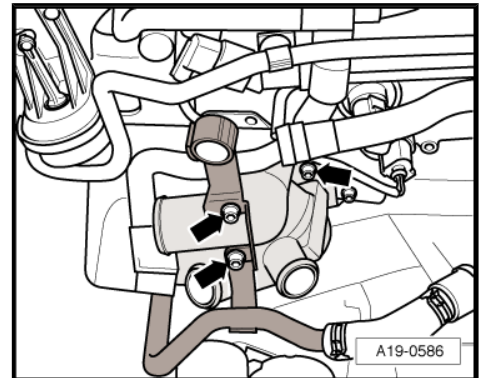
- Engine in vehicle.
- Drain off coolant ⇒ [page 164](#) .
- Remove intake manifold ⇒ Rep. gr. 24 .
- Unplug electrical connector at coolant temperature sender - G62- .



- Detach coolant hoses at the connections indicated -arrows-.



- Remove bolts -arrows-.
- Pull bracket for coolant pipe for gear oil cooler to the left.
- Swing the bracket for secondary air hose forwards.

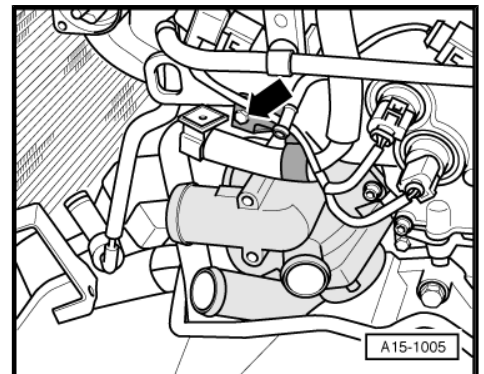


- Remove bolt -arrow- on bracket for wiring harness.

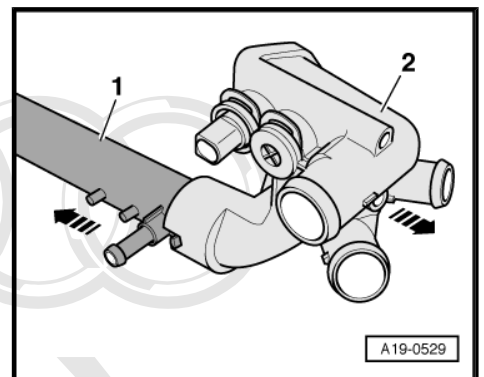


Caution

When removing the thermostat housing, push coolant pipe towards coolant pump with an assembly lever to prevent it from also being detached.

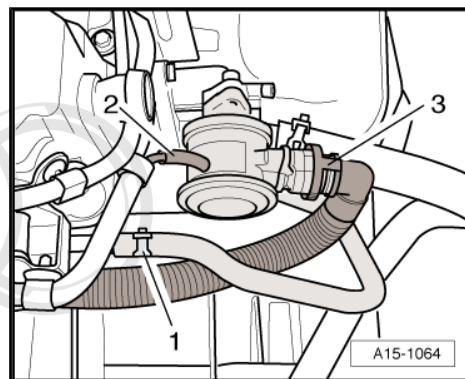


- Remove thermostat housing -2-; when doing so, press the coolant pipe -1- towards the coolant pump with an assembly lever.



Vehicles with engine code letters BDB, BMJ, BUB:

- Disconnect hose -3- and vacuum hose -2- from combination valve for secondary air system.
- Disconnect coolant hose -1-.



Vehicles with engine code letters CBRA:

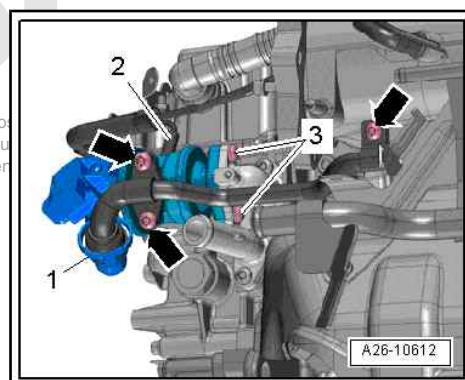
- Disconnect hose -1- and vacuum hose -2- from combination valve for secondary air system (left-side).

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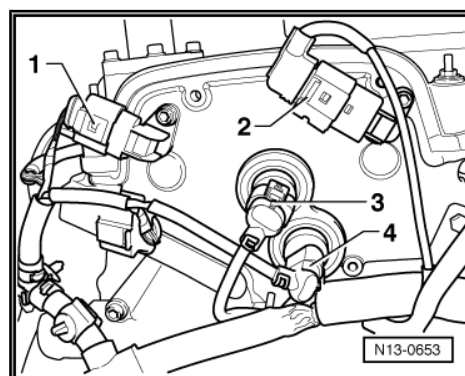
Note

Ignore items marked -3- and -arrows-.

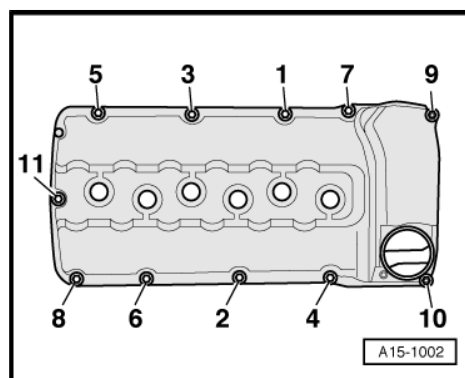


All vehicles (continued):

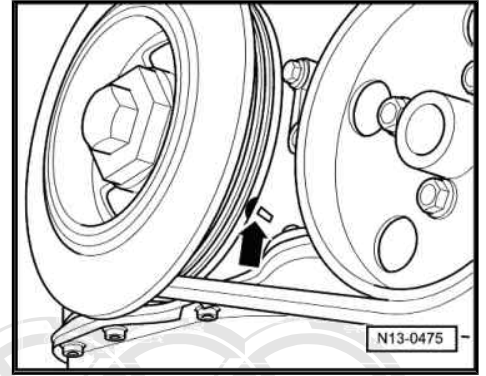
- Mark and unplug the electrical connectors:
 - 1 - Hall sender - G40-
 - 2 - Hall sender 2 - G163-
 - 3 - Camshaft control valve 1 - N205-
 - 4 - Exhaust camshaft control valve 1 - N318-
- Unscrew cable guide from cover for camshaft timing chain.



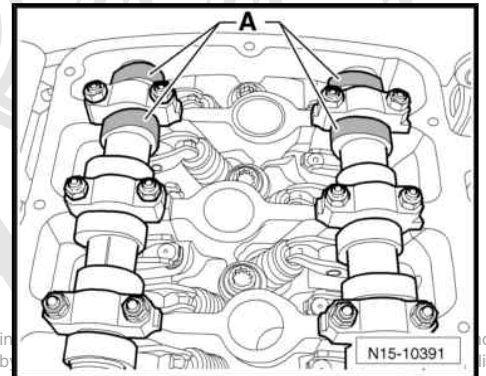
- Unscrew cylinder head cover bolts in the sequence -11 ... 1-.



- Turn the crankshaft to the TDC marking -arrow- in the normal direction of rotation via the securing bolt on the vibration damper.

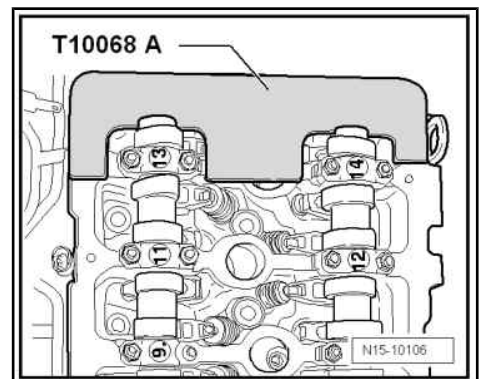


- Cams -A- of cylinder 1 must face each other.

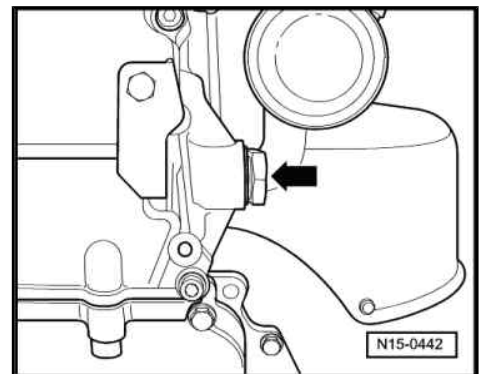


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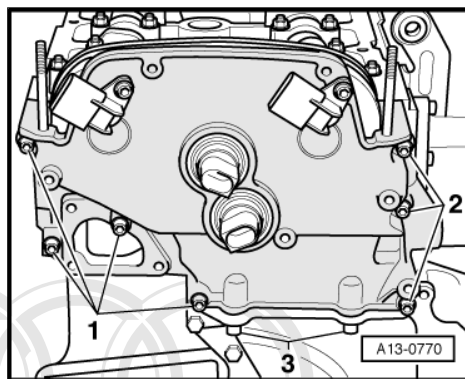
- At the same time insert camshaft bar - T10068 A- in the slots on both camshafts; if necessary, turn the crankshaft 1 rotation further.



- Unscrew chain tensioner for camshaft timing chain -arrow-.



- Unscrew bolts -1 ... 3- and remove timing chain cover (top) from cylinder head horizontally. Take care not to damage the cylinder head gasket when removing.



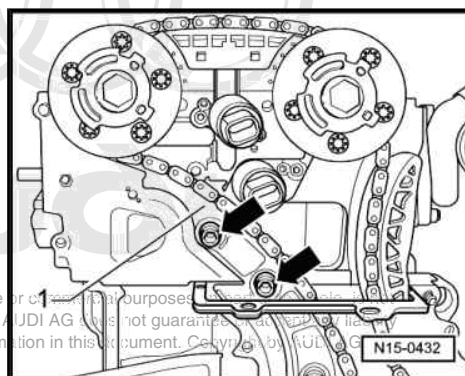
- Unscrew bolts -arrows- and remove guide rail -1-.
- Remove camshaft bar - T10068 A- .



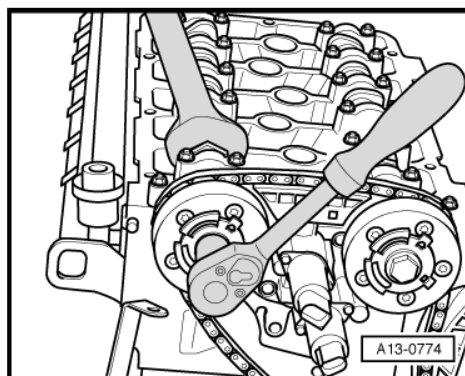
Note

The camshaft bar - T10068 A- must not be in place when loosening and tightening the securing bolts for the camshaft adjusters.

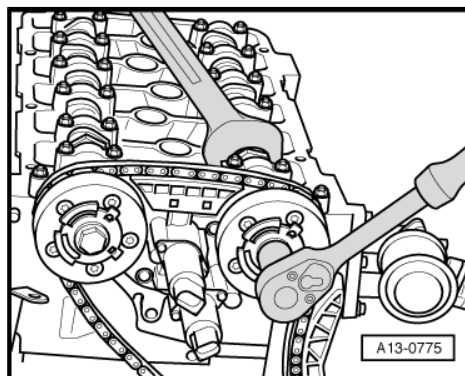
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- Unscrew the securing bolt at camshaft adjuster (inlet side); counterhold with open jaw spanner (32 mm) on hexagon flats of camshaft.
- Remove camshaft adjuster (inlet side).

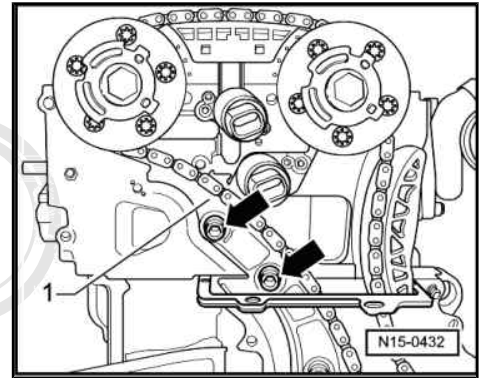


- Unscrew the securing bolt at camshaft adjuster (exhaust-side); counterhold with open jaw spanner (32 mm) on hexagon flats of camshaft.
- Remove camshaft adjuster (exhaust-side).
- Remove the camshaft timing chain over the camshaft control valves and set aside.

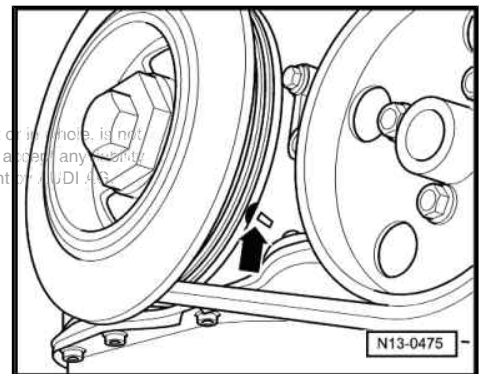


Fitting camshaft timing chain (adjusting valve timing)

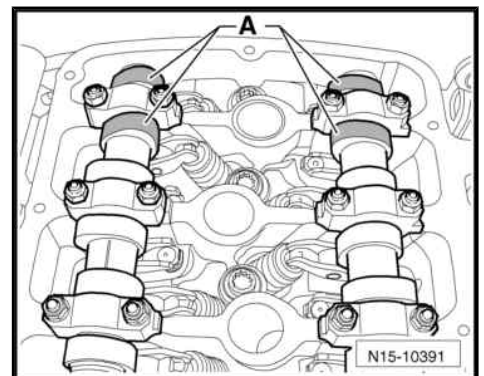
- Tightening torques ➔ [page 99](#) , ➔ [page 100](#) and ➔ [page 101](#) .
- Install guide rail -1- and tighten bolts -arrows-.



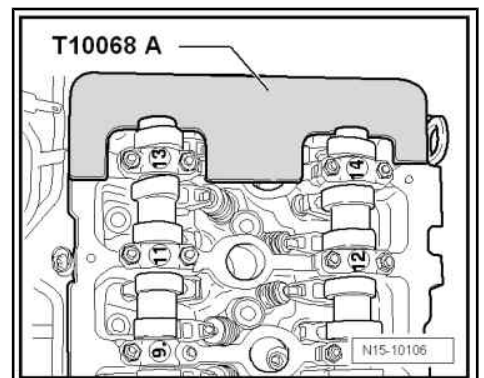
- Recheck TDC position of crankshaft -arrow-.



- Check TDC position of camshafts:
- Cams -A- of cylinder 1 must face each other.



- You should be able to insert the camshaft bar - T10068 A- in the slots in both camshafts.



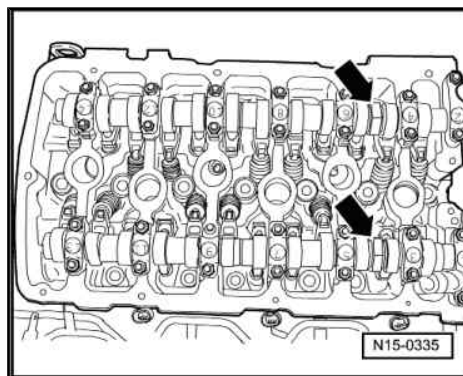
- If necessary, turn camshafts at hexagon flats -arrows- to correct position using a 32 mm open-end spanner.



Caution

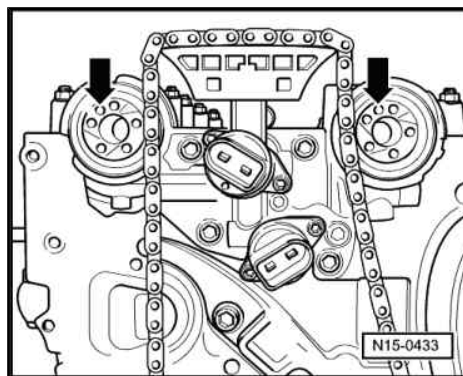
Avoid damage to valves and piston crowns.

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



Note

The two camshaft adjusters (marking 24E on inlet side and 32A on exhaust side) can only be secured to camshaft mounting in one position -arrows- (due to a dowel pin fitted).

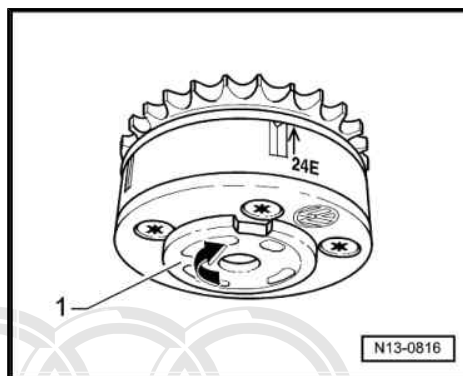


- First install the camshaft adjuster (inlet side):
- Turn sender wheel -1- clockwise -arrow- in camshaft adjuster as far as the stop.



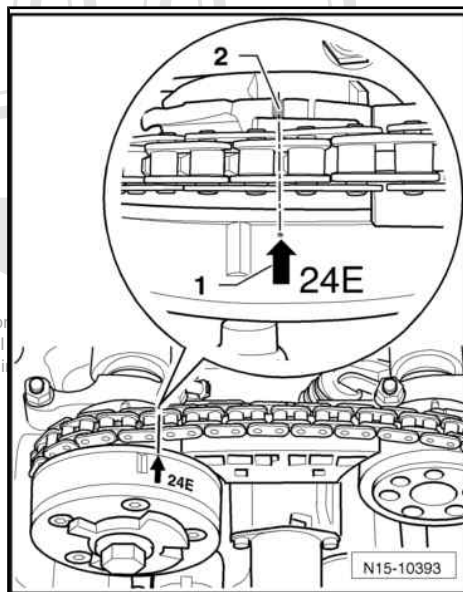
Note

The camshaft bar - T10068 A- must not be used as a counterhold tool.



- Tighten the camshaft adjuster (inlet side) in this position to the inlet camshaft finger-tight.
- Contact surface of sender wheel at bolt head must be dry when installing.
- The marking "24E" -item 1- and the tooth just behind it must align with the notch -2- in the valve timing housing. Markings on valve timing housing ➔ [page 104](#)
- Lay the camshaft timing chain in this position tautly onto the chain sprocket of camshaft adjuster (inlet side).

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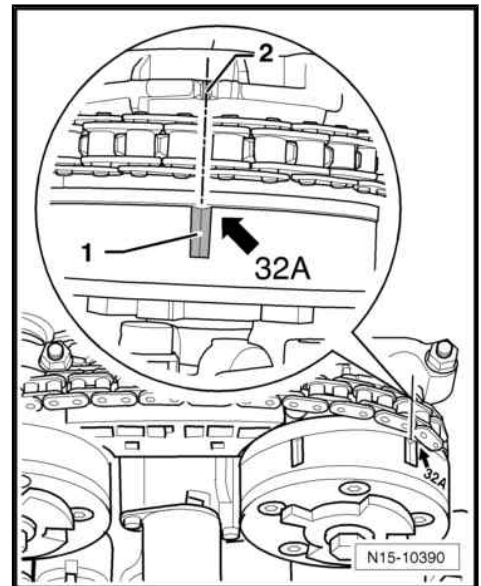
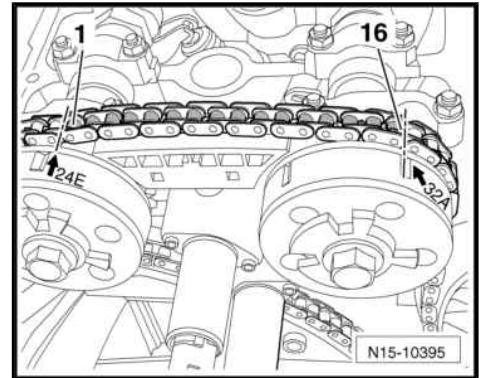


- Now count exactly 16 rollers on timing chain to the right starting at gear aligning with marking “24E”. Mark this roller with coloured pen.

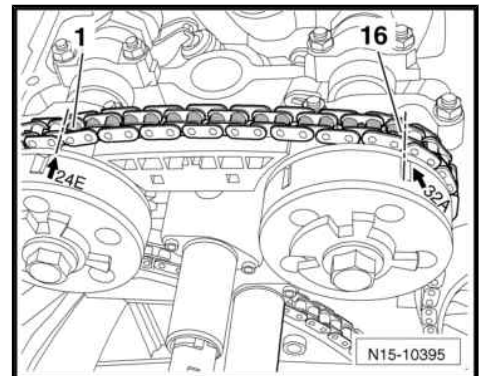
 Note

The camshaft adjuster (exhaust side) is locked when it is in the rest position, so the sender wheel cannot be turned out of position when adjusting the valve timing. If the camshaft adjuster is not locked in the rest position, turn adjuster by hand in both directions until it locks. If this is not possible, renew camshaft adjuster.

- Fit camshaft adjuster (exhaust side) “32A” into camshaft roller chain with gear tooth at marking -1-, so that there are exactly the 16 counted rollers between marking “24E” and “32A” and the markings -1- and -2- align.
- It must be easily possible to attach camshaft adjuster (exhaust side) to camshaft (exhaust side) and to tighten it hand-tight.

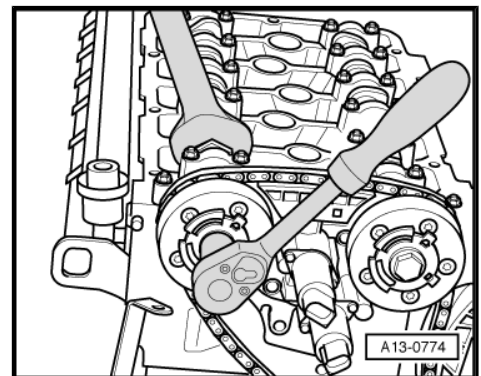


- Check again that both camshaft adjusters are positioned correctly.

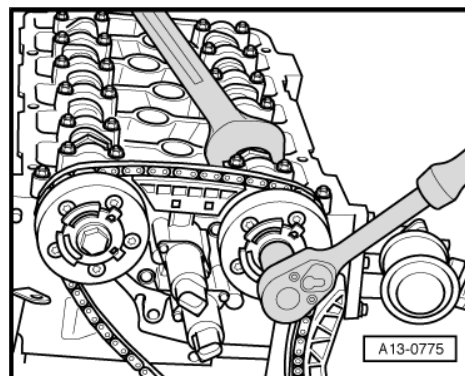


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- Remove camshaft bar - T10068 A- .
- Tighten bolt at camshaft adjuster (inlet side); counterhold with open-end spanner on hexagon flats of camshaft.



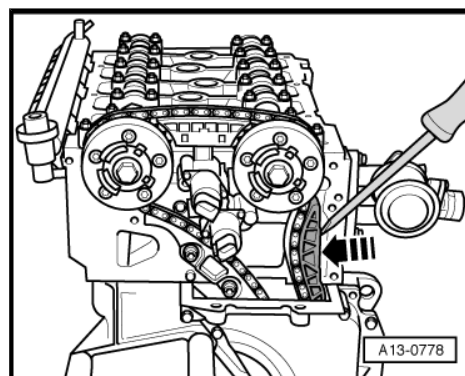
- Tighten bolt at camshaft adjuster (exhaust side); counterhold with open-end spanner on hexagon flats of camshaft.



Caution

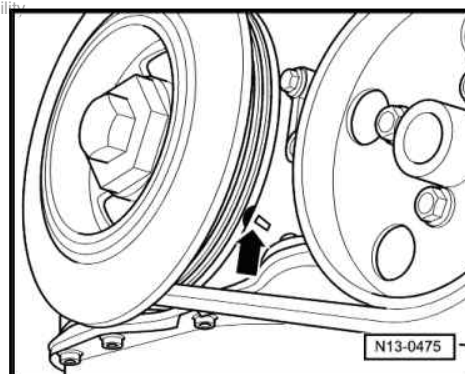
Prevent timing chain from slipping.

- ◆ **When turning the crankshaft, it is necessary to press the tensioning rail firmly against the camshaft timing chain manually (to replace function of chain tensioner) -arrow-.**

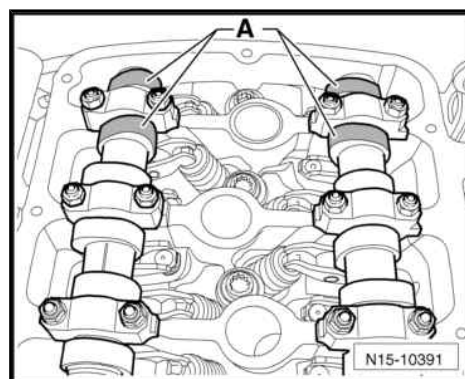


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- Turn crankshaft via the securing bolt for vibration damper 2 rotations in the normal direction of rotation until the marking is at TDC -arrow-.



- Cams -A- of cylinder 1 must face each other.

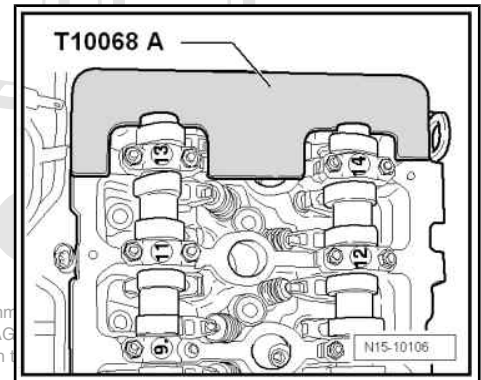


You should then be able to insert the camshaft bar - T10068 A- in the slots in both camshafts.

If the camshaft bar cannot be inserted:

- Repeat adjustment of valve timing.

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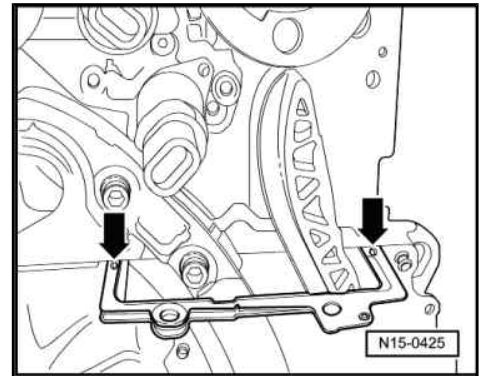
- Clean any old sealing compound from the 3 mm bores -arrows- in the cylinder head gasket.
- Fill the 3 mm bores in the cylinder head gasket with sealing compound (black) ⇒ Electronic parts catalogue .



Note

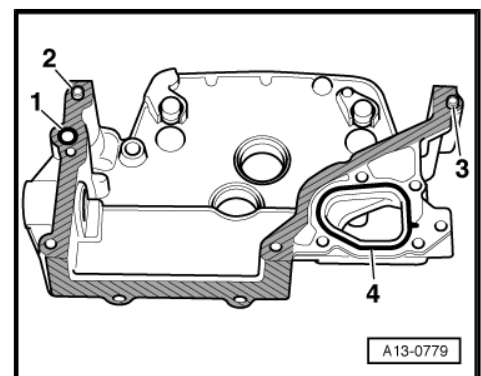
With the cylinder head installed the holes in the cylinder head gasket are only half visible.

- Renew the oil seals in the upper cover for timing chains
⇒ [page 100](#) .
- Clean sealing surfaces; they must be free of oil and grease.
- Check if the dowel sleeves -2- and -3- are inserted in the upper cover for timing chains.
- Insert a new oil seal -1- and a new seal -4-.
- Thinly coat clean surface of upper cover for timing chains -hatched surface in illustration- with sealing paste ⇒ Electronic parts catalogue .



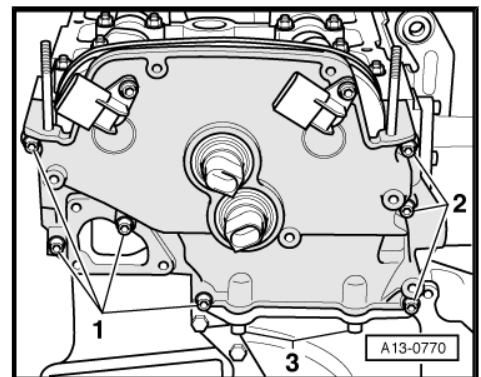
Note

- ◆ *Also apply a thin coat of sealing paste to the surface beneath the cylinder head gasket (do not kink gasket).*
- ◆ *The upper cover for the timing chains must be installed within 5 minutes after applying the sealing paste.*



- Install upper cover for timing chains and tighten bolts in the following sequence:

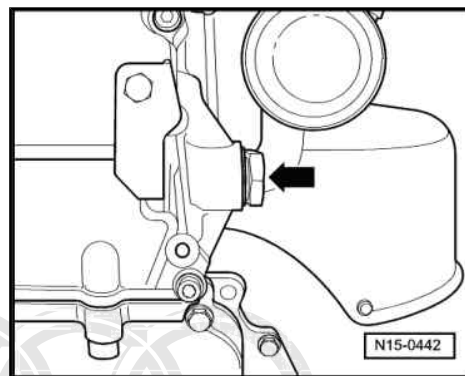
- 1 - Tighten bolts -1- and -2- to 5 Nm.
- 2 - Tighten bolts -3- to 23 Nm.
- 3 - Tighten bolts -1- and -2- to 10 Nm.



- Secure chain tensioner -arrow- for camshaft timing chain.
- Turn the crankshaft 2 rotations in the normal direction of rotation and recheck valve timing.
- Install cylinder head cover ➔ [page 82](#) .
- Install intake manifold ➔ Rep. gr. 24 .
- Install thermostat housing ➔ [page 173](#) .

13) Renew bolt.

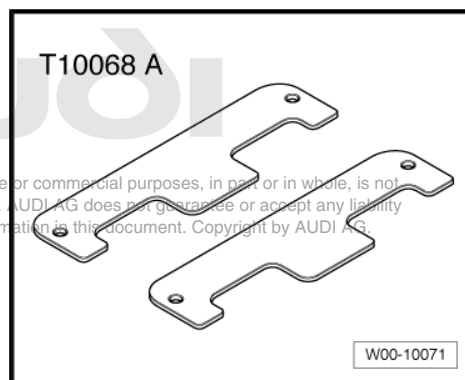
14) 90° = a quarter of a turn.



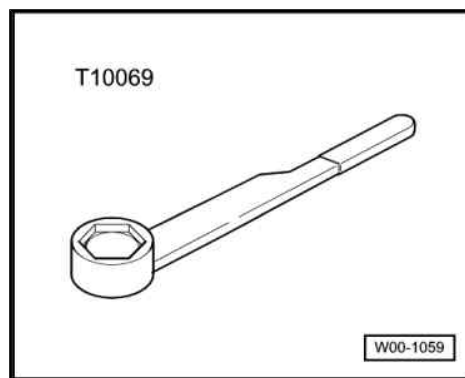
2.5 Removing and installing drive chain for valve gear and camshaft timing chain

Special tools and workshop equipment required

- ◆ Camshaft bar - T10068 A-



- ◆ Counterhold tool - T10069-

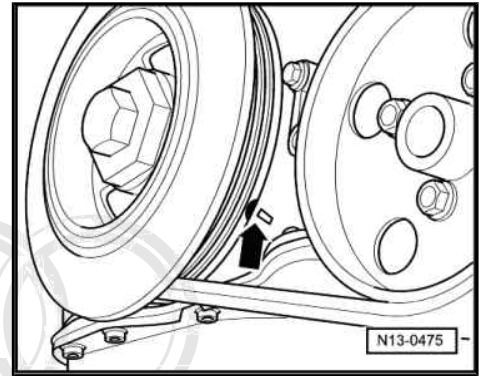


- ◆ Sealing compound (black) ➔ Electronic parts catalogue
- ◆ Sealing paste ➔ Electronic parts catalogue

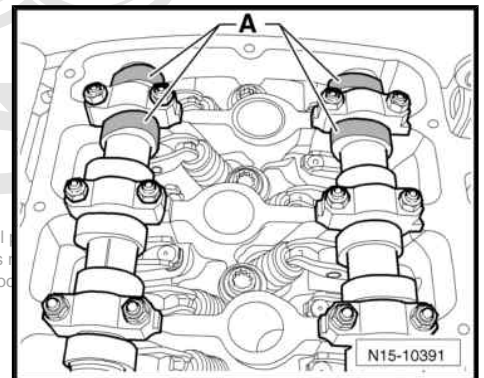
Removing

- Engine removed ➔ [page 12](#) .
- Engine separated from gearbox
➔ ["1.2 Separating engine from manual gearbox", page 29](#) and
➔ ["1.3 Separating engine from direct shift gearbox", page 31](#) .
- Dual-mass flywheel removed ➔ [page 63](#) .
- Intake manifold removed ➔ Rep. gr. 24 .
- Cylinder head cover removed ➔ [page 82](#) .
- Thermostat housing removed ➔ [page 173](#) .
- Sump removed ➔ [page 150](#) .

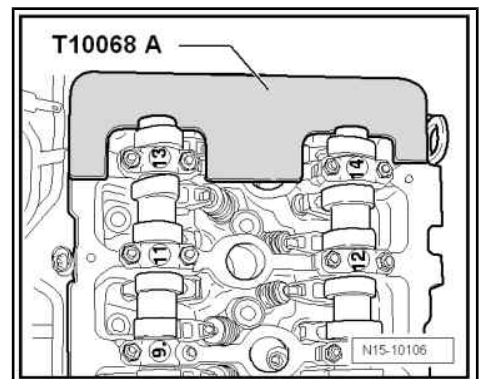
- Turn the crankshaft to the TDC marking -arrow- in the normal direction of rotation via the securing bolt on the vibration damper.



- Cams -A- of cylinder 1 must face each other.

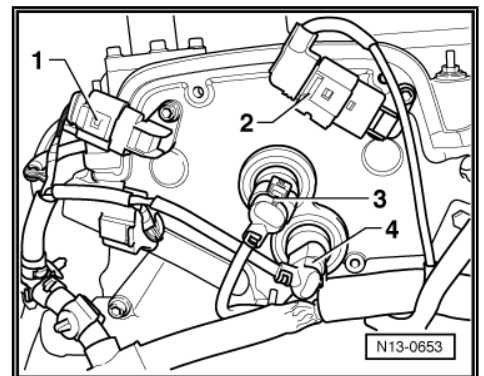


- At the same time insert camshaft bar - T10068 A- in the slots on both camshafts; if necessary, turn the crankshaft 1 rotation further.

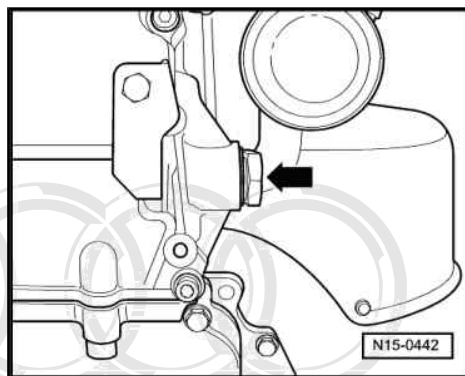


- Mark and unplug the electrical connectors:

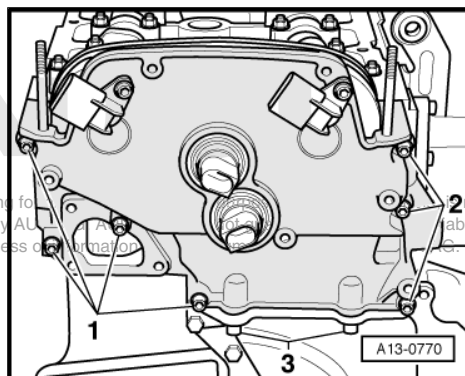
- 1 - Hall sender - G40-
- 2 - Hall sender 2 - G163-
- 3 - Camshaft control valve 1 - N205-
- 4 - Exhaust camshaft control valve 1 - N318-



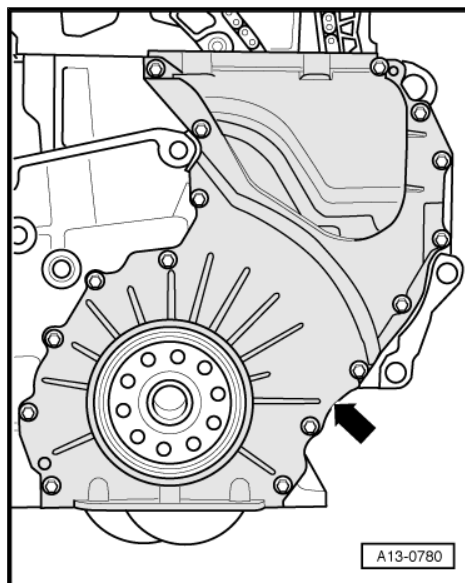
- Unscrew chain tensioner for camshaft timing chain -arrow-.



- Unscrew bolts -1 ... 3- and remove timing chain cover (top) from cylinder head horizontally. Take care not to damage the cylinder head gasket when removing.



- Unscrew bolts and remove lower cover -arrow- for timing chains horizontally from cylinder block. Take care not to damage the cylinder head gasket when removing.
- Press out crankshaft oil seal (timing chain end) from the timing chain cover.



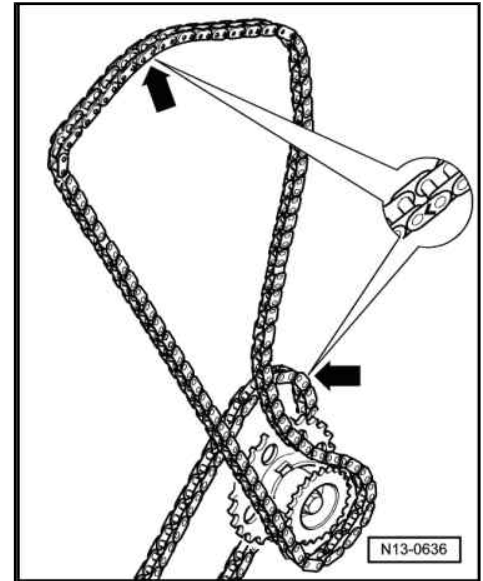
- Mark rotation direction of timing chains with coloured arrows before removing -arrows-.



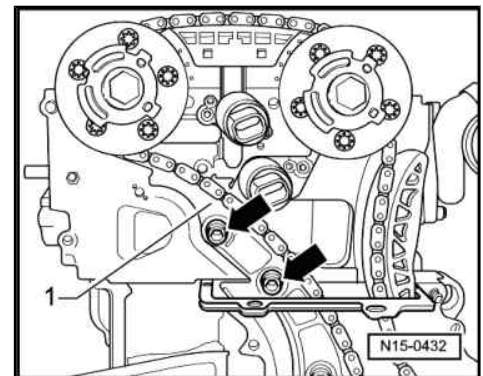
Caution

Avoid damage to timing chains.

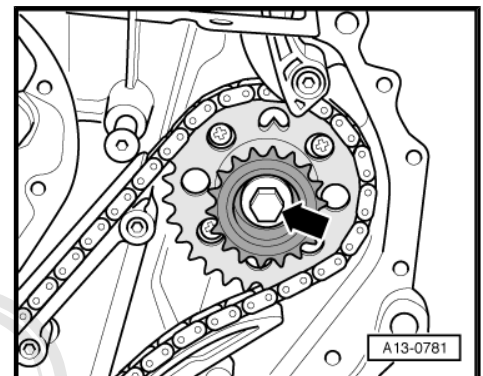
- ◆ *Do not mark chains by means of centre punch, notch or the like.*



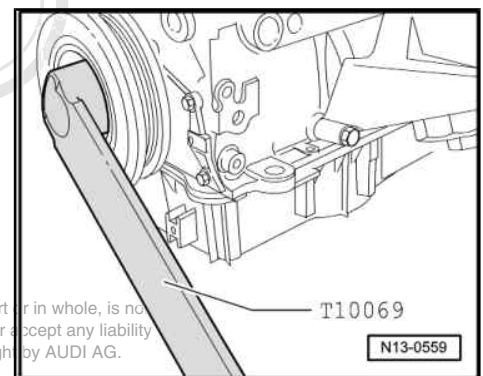
- Unscrew bolts -arrows- and remove guide rail -1-.
- Remove camshaft timing chain from sprocket for intermediate shaft.
- Remove camshaft timing chain carefully from behind the projection of the cylinder head gasket.



- Loosen bolt -arrow- for chain sprockets on intermediate shaft approx. 1 turn.

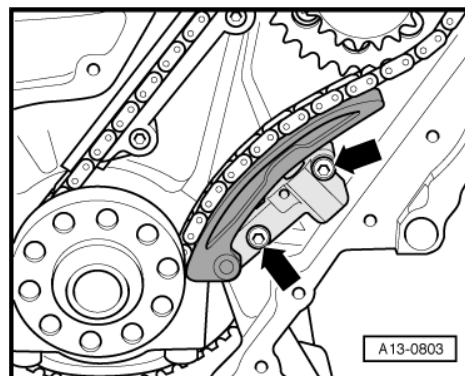


- To do so, apply counterhold tool - T10069- to vibration damper for support.

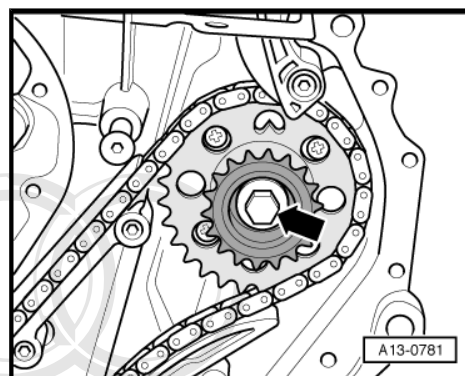


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- Unscrew chain tensioner for drive chain for valve gear -arrows-.

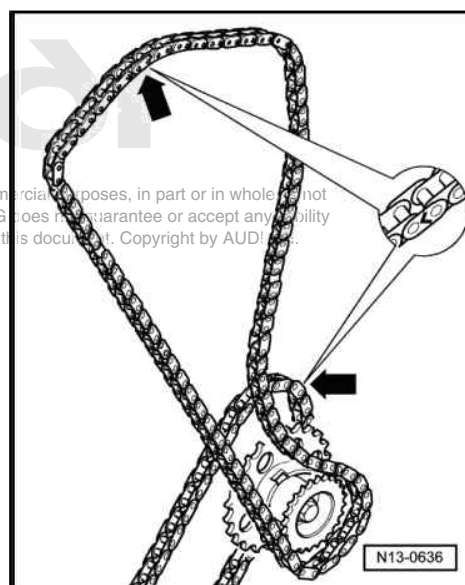


- Unscrew bolt -arrow- and remove drive chain together with chain sprockets from intermediate shaft.



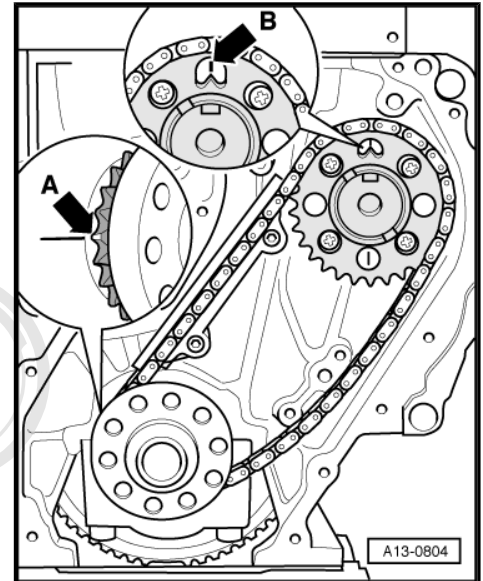
Installing

- Tightening torques ➔ [page 99](#) , ➔ [page 101](#) .
- Note the marking for rotation direction -lower arrow- when re-installing a used drive chain for valve gear.

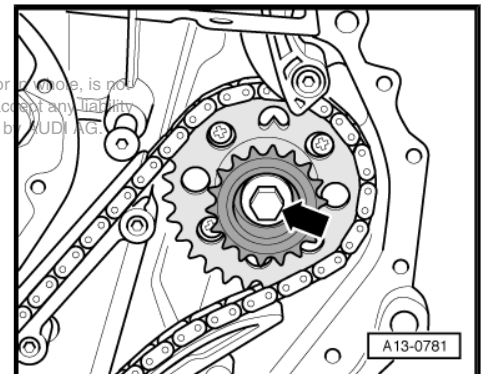


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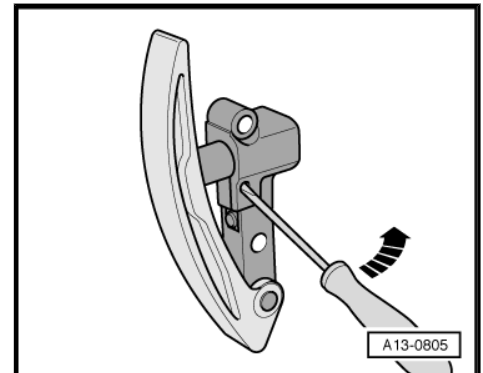
- Install drive chain together with large sprocket on intermediate shaft.
- Can only be installed in one position.
- Turn intermediate shaft slightly if large sprocket cannot be fitted.
- Check whether the crankshaft is still positioned at “TDC”:
 - The ground-down tooth of the drive chain sprocket must align with the main bearing joint -arrow A-.
 - The notch on the sprocket for intermediate shaft must align with the groove -arrow B- on the thrust washer for intermediate shaft.



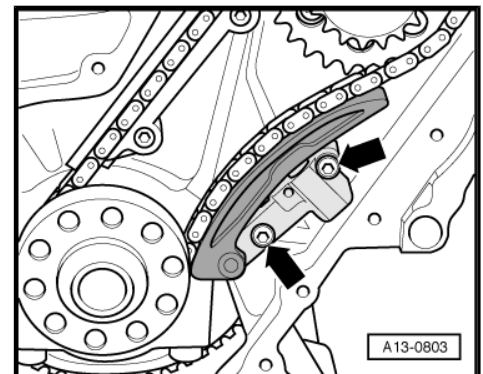
- Fit small sprocket to intermediate shaft.
- Can only be installed in one position.
- Renew bolt for chain sprockets of intermediate shaft.
- Hand-tighten bolt -arrow- for chain sprockets.



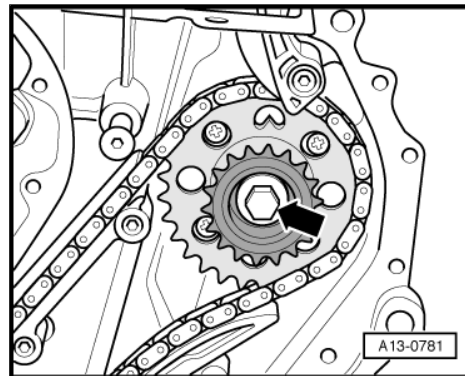
- Release locking spline in chain tensioner with a small screwdriver -arrow-.



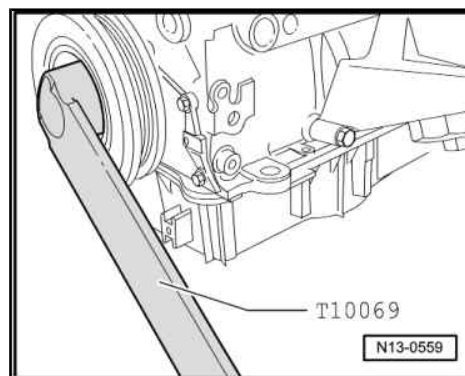
- Press tensioning rail against chain tensioner and secure chain tensioner in this position -arrows-.



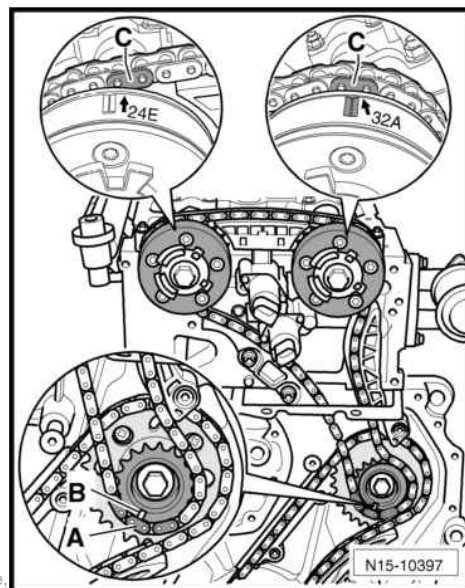
- Tighten bolt for chain sprockets -arrow-.



- Use counterhold tool - T10069- to counterhold bolt for vibration damper.

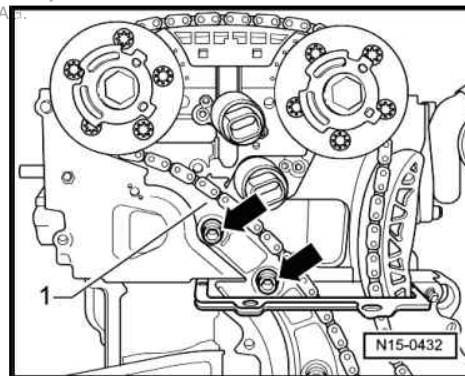


- Fit timing chain onto camshaft adjusters. Make sure that the two individual copper-coloured chain links -C- align with markings on camshaft adjuster. In some cases the camshaft adjuster (inlet side) must be turned slightly.
- Fit timing chain onto small chain sprocket. The marking -B- must align with the copper-coloured chain link in the middle -A-.



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- Install guide rail -1- and tighten bolts -arrows-.
- Remove camshaft bar - T10068 A- .

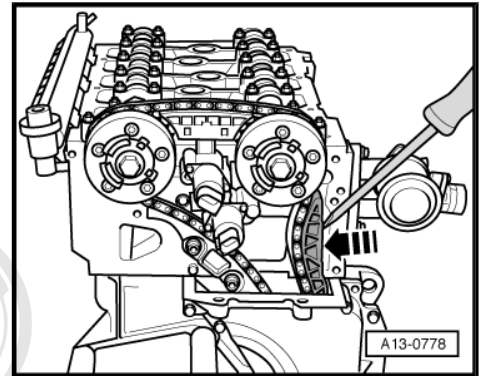




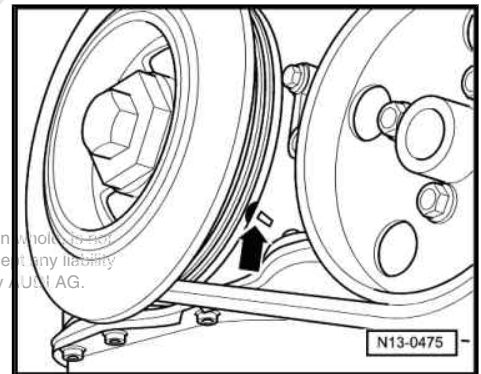
Caution

Prevent timing chain from slipping.

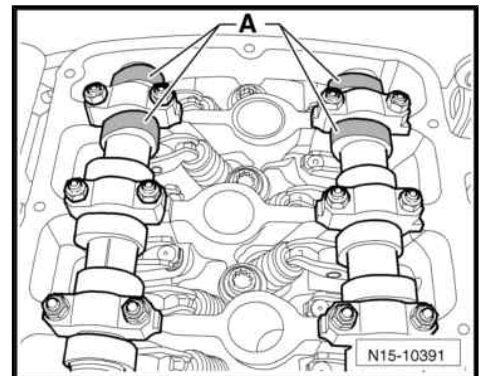
- ◆ **When turning the crankshaft, it is necessary to press the tensioning rail firmly against the camshaft timing chain manually (to replace function of chain tensioner) -arrow-.**



- Turn crankshaft via the securing bolt for vibration damper 2 rotations in the normal direction of rotation until the marking is at TDC -arrow-.



- Cams -A- of cylinder 1 must face each other.



- You should then be able to insert the camshaft bar - T10068 A- in the slots in both camshafts.

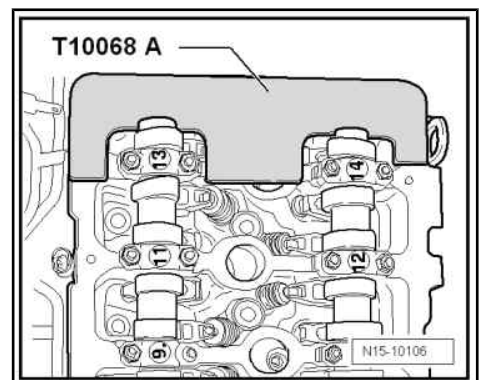


Note

The marked chain links will now be in an undefined position.

If the camshaft bar cannot be inserted:

- Repeat adjustment of valve timing.



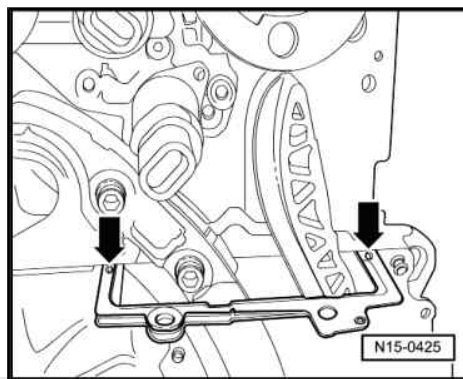
- Clean any old sealing compound from the 3 mm bores -arrows- in the cylinder head gasket.



Note

With the cylinder head installed the holes in the cylinder head gasket are only half visible.

- Clean the sealing surfaces on the engine and on both covers; they must be free of oil and grease.



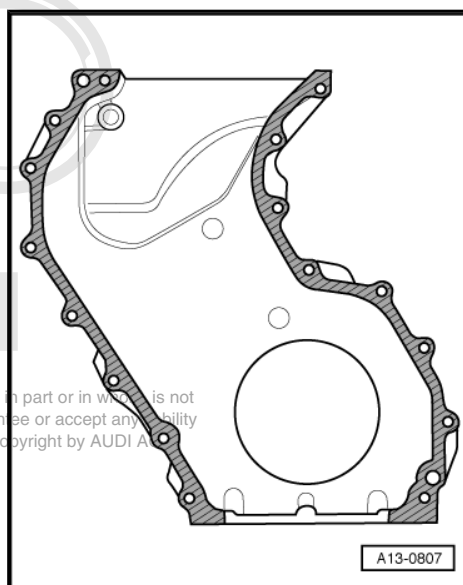
- Check whether the dowel pins for lower cover for timing chains are inserted in the cylinder block.
- Thinly coat clean surface of lower cover for timing chains -hatched surface in illustration- with sealing paste ➔ Electronic parts catalogue .



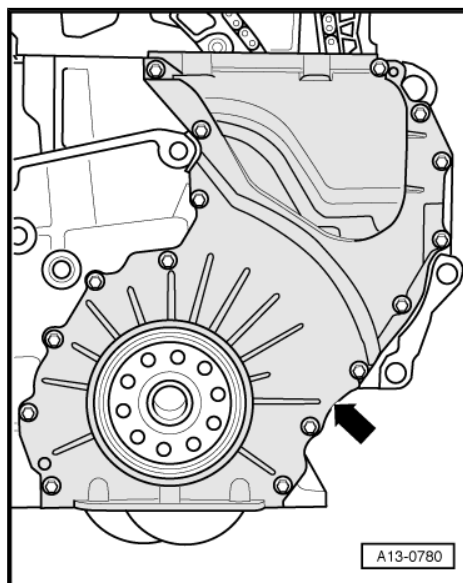
Note

The lower cover for the timing chains must be installed within 5 minutes after applying the sealing paste.

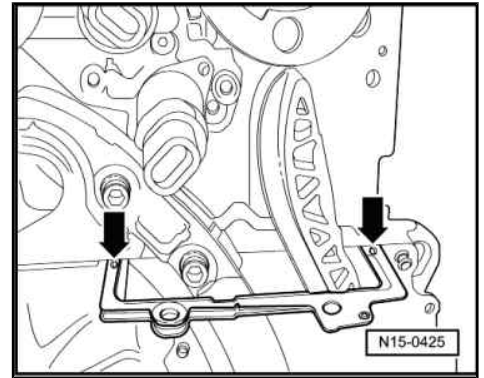
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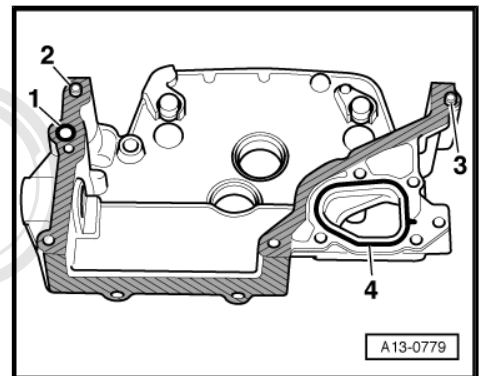
- Tighten the bolts securing lower cover -arrow- for timing chains in diagonal sequence in stages.



- Fill the 3 mm bores -arrows- in the cylinder head gasket with sealing compound (black) ⇒ Electronic parts catalogue .
- Renew the oil seals in the upper cover for timing chains
⇒ [page 100](#) .

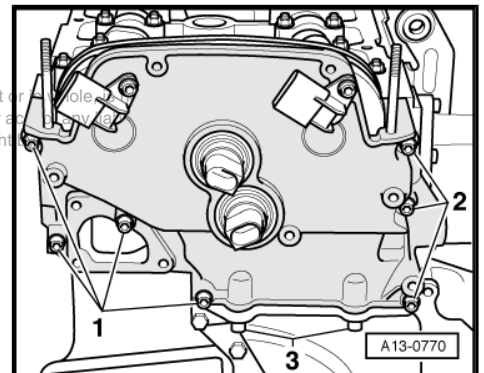


- Check if the dowel sleeves -2- and -3- are inserted in the upper cover for timing chains.
- Insert a new oil seal -1- and a new seal -4-.
- Thinly coat clean surface of upper cover for timing chains -hatched surface in illustration- with sealing paste ⇒ Electronic parts catalogue .

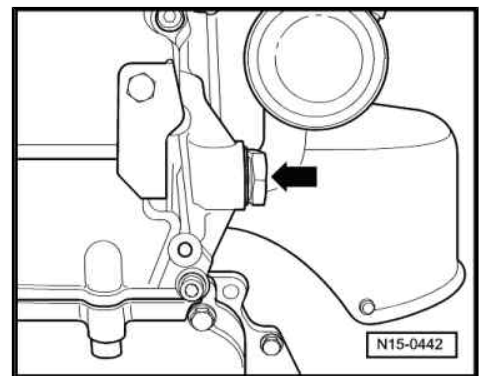


- Install upper cover for timing chains and tighten bolts in the following sequence:

- 1 - Tighten bolts -1- and -2- to 5 Nm.
- 2 - Tighten bolts -3- to 23 Nm.
- 3 - Tighten bolts -1- and -2- to 10 Nm.



- Secure chain tensioner -arrow- for camshaft timing chain.
- Turn the crankshaft 2 rotations in the normal direction of rotation and recheck valve timing.
- Install crankshaft oil seal (timing chain end) ⇒ [page 63](#) .
- Install cylinder head cover ⇒ [page 82](#) .
- Install intake manifold ⇒ Rep. gr. 24 .
- Install thermostat housing ⇒ [page 173](#) .
- Install sump ⇒ [page 151](#) .
- Install dual-mass flywheel ⇒ [page 63](#) .
- Install engine ⇒ [page 34](#) .
- Fill up with engine oil and check oil level ⇒ [page 160](#) .



3 Valve gear



Note

- ◆ *After installing camshafts, wait for approx. 30 minutes before starting 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.*

⇒ [“3.1 Valve gear - exploded view”, page 124](#)

⇒ [“3.2 Checking axial clearance of camshafts”, page 129](#)

⇒ [“3.3 Measuring radial clearance of camshafts”, page 129](#)

⇒ [“3.4 Removing and installing camshafts”, page 129](#)

⇒ [“3.5 Renewing valve stem oil seals with cylinder head installed”, page 134](#)

⇒ [“3.6 Renewing valve stem oil seals with cylinder head removed”, page 138](#)

⇒ [“3.7 Valve dimensions”, page 143](#)

⇒ [“3.8 Checking valve guides”, page 143](#)

⇒ [“3.9 Machining valve seats”, page 144](#)

3.1 Valve gear - exploded view



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1 - Camshaft adjuster - exhaust

- ☐ Identification: "32A"
- ☐ Removing and installing
⇒ ["2.4 Detaching and re-fitting timing chain on camshafts", page 104](#)

2 - Bolt

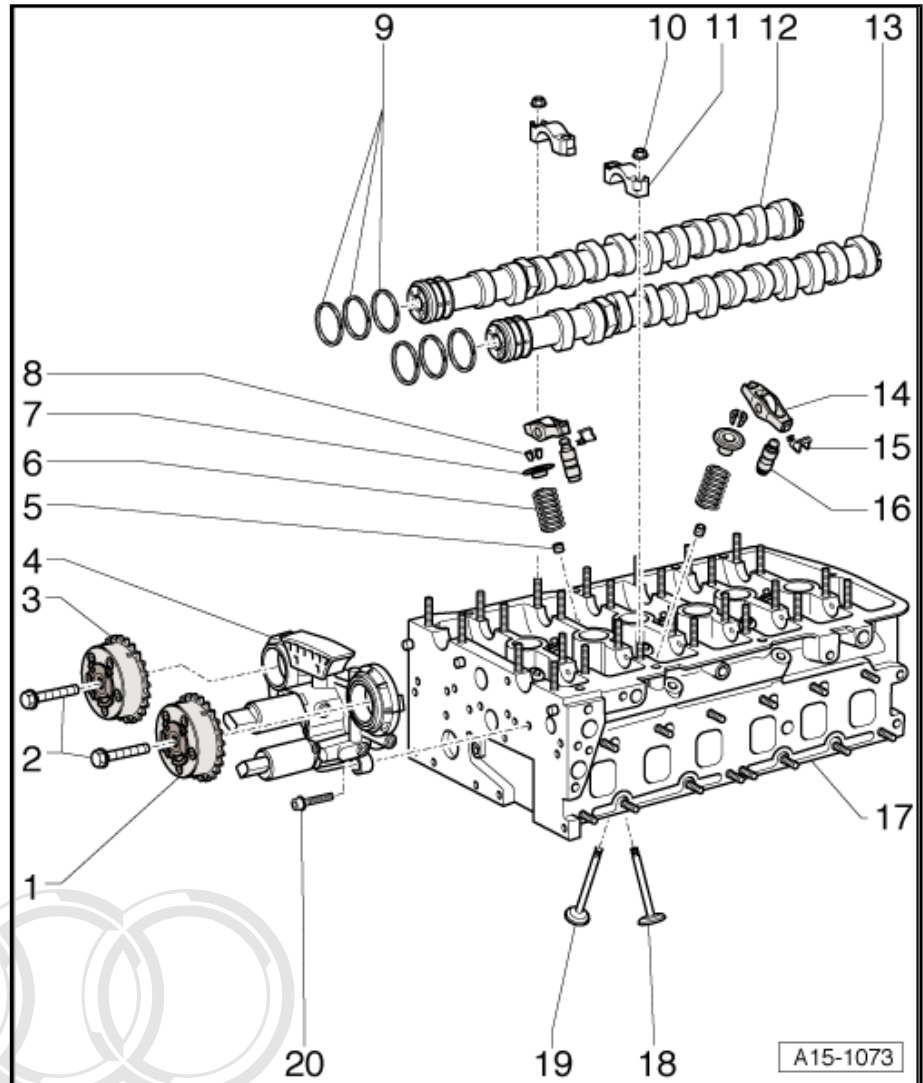
- ☐ Renew
- ☐ To remove and install, counterhold with 32 mm open-end spanner on camshaft ⇒ [page 104](#)
- ☐ Tightening torque
⇒ [Item 23 \(page 103\)](#)

3 - Camshaft adjuster - inlet

- ☐ Identification: "24E"
- ☐ Removing and installing
⇒ ["2.4 Detaching and re-fitting timing chain on camshafts", page 104](#)

4 - Valve timing housing

- ☐ Removing and installing
⇒ ["3.4 Removing and installing camshafts", page 129](#)
- ☐ Check filter of valve timing housing for dirt before installing
⇒ [page 128](#)
- ☐ When installing, lightly oil contact surfaces of oil seals
- ☐ Dismantling and assembling ⇒ [page 128](#)



5 - Valve stem oil seal

- ☐ Renewing with cylinder head installed ⇒ [page 134](#)
- ☐ Renewing with cylinder head removed ⇒ [page 138](#)

6 - Valve spring

- ☐ Installation position: large Ø points downwards

7 - Valve spring plate

8 - Valve cotters

9 - Piston rings

- ☐ 3x for each camshaft
- ☐ Renew all if leak detected
- ☐ Do not stretch piston rings too much when fitting
- ☐ Offset gaps by 120°
- ☐ When installing valve timing housing ⇒ [Item 4 \(page 125\)](#) , lightly oil contact surfaces of piston rings

10 - Nut

- ☐ Tightening torque and tightening sequence ⇒ [page 128](#)

11 - Bearing cap

- ☐ Installation position ⇒ [page 127](#)
- ☐ Installation sequence ⇒ [page 131](#)

12 - Inlet camshaft

- ☐ Check radial clearance with Plastigage ⇒ [page 129](#)
- ☐ Radial clearance: wear limit: 0.1 mm
- ☐ Runout: max. 0.01 mm
- ☐ Checking axial clearance ⇒ [page 129](#)
- ☐ Removing and installing ⇒ [page 129](#)
- ☐ Identification ⇒ [page 127](#)

13 - Exhaust camshaft

- ☐ Check radial clearance with Plastigage ⇒ [page 129](#)
- ☐ Radial clearance: wear limit: 0.1 mm
- ☐ Runout: max. 0.01 mm
- ☐ Checking axial clearance ⇒ [page 129](#)
- ☐ Removing and installing ⇒ [page 129](#)
- ☐ Identification ⇒ [page 127](#)

14 - Roller rocker finger

- ☐ Do not interchange
- ☐ Check roller bearing
- ☐ Before installing, check camshaft axial clearance ⇒ [page 129](#)
- ☐ Lubricate contact surface
- ☐ Attach to hydraulic compensation element using securing clip -item 15-

15 - Securing clip

- ☐ Check for firm attachment

16 - Hydraulic valve compensation element

- ☐ Do not interchange
- ☐ Before installing, check camshaft axial clearance ⇒ [page 129](#)
- ☐ Lubricate contact surface

17 - Cylinder head

- ☐ Checking valve guides ⇒ [page 143](#)
- ☐ Machining valve seats ⇒ [page 144](#)

18 - Inlet valve

- ☐ Must not be machined; only grinding-in is permissible
- ☐ Valve dimensions ⇒ [page 143](#)
- ☐ Checking valve guides ⇒ [page 143](#)
- ☐ Machining valve seats ⇒ [page 144](#)

19 - Exhaust valve

- ☐ Must not be machined; only grinding-in is permissible
- ☐ Valve dimensions ⇒ [page 143](#)
- ☐ Checking valve guides ⇒ [page 143](#)
- ☐ Machining valve seats ⇒ [page 144](#)

20 - Bolt

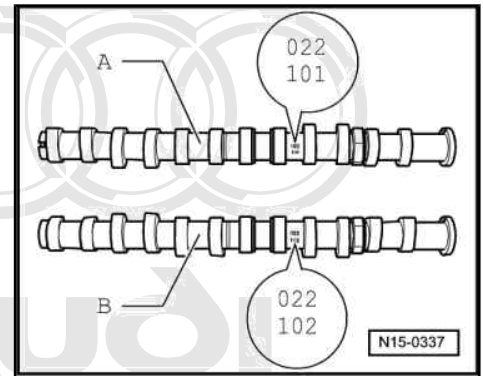
- ☐ 8 Nm

Camshaft identification

The camshaft identification is located between the cam pairs for cylinder No. 4 and 5.

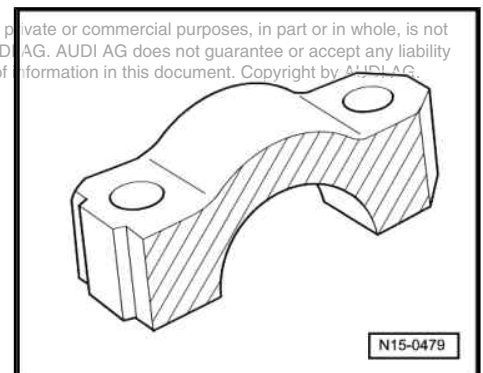
A - Exhaust camshaft; identification 022 - index 101

B - Inlet camshaft; identification 022 - index 102



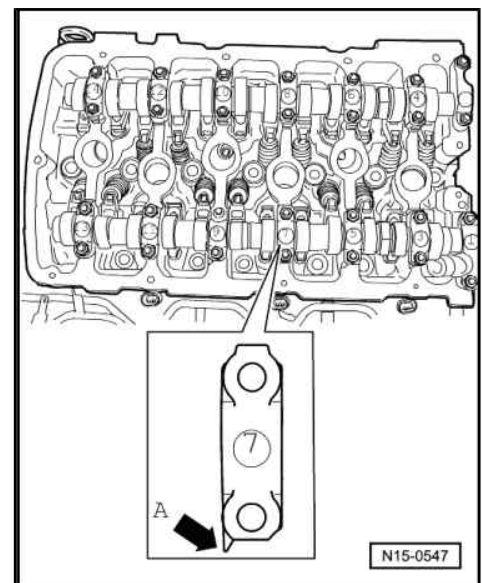
Coat contact surface of bearing caps 7 and 8 with lubricating paste

- Thinly coat contact surface -(hatched surface in illustration)- of bearing caps 7 and 8 with lubricating paste ⇒ Electronic parts catalogue .



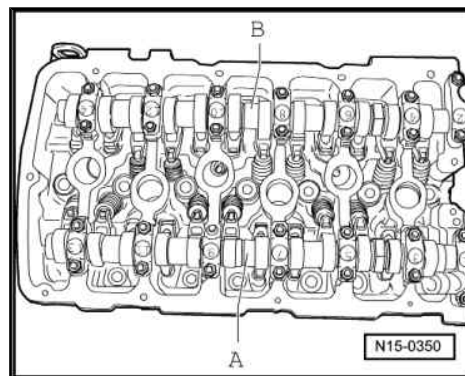
Installation position of bearing caps for camshafts

- The pointed section of the bearing caps -arrow A- for inlet and exhaust camshafts faces outwards.



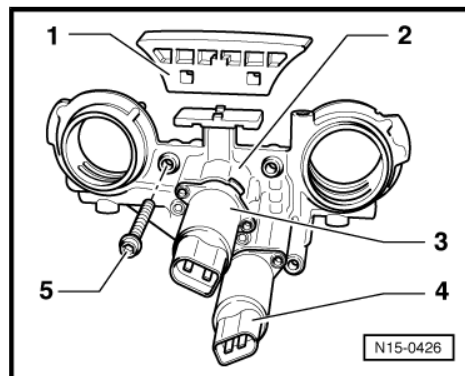
Camshafts - tightening torque and tightening sequence

- Tighten nuts on inlet camshaft -A- in five stages as follows:
 - 1 - Tighten nuts for bearing caps 5 and 9 alternately and diagonally until bearing caps make contact.
 - 2 - Tighten nuts for bearing caps 5 and 9 to 5 Nm and turn 45° (1/8 turn) further.
 - 3 - Tighten nuts for bearing caps 1 and 13 to 5 Nm and turn 45° (1/8 turn) further.
 - 4 - Tighten nuts for bearing cap 7 to 5 Nm and turn 45° (1/8 turn) further.
 - 5 - Tighten nuts for bearing caps 3 and 11 to 5 Nm and turn 45° (1/8 turn) further.
- Tighten nuts on exhaust camshaft -B- in five stages as follows:
 - 1 - Tighten nuts for bearing caps 6 and 10 alternately and diagonally until bearing caps make contact.
 - 2 - Tighten nuts for bearing caps 6 and 10 to 5 Nm and turn 45° (1/8 turn) further.
 - 3 - Tighten nuts for bearing caps 2 and 14 to 5 Nm and turn 45° (1/8 turn) further.
 - 4 - Tighten nuts for bearing cap 8 to 5 Nm and turn 45° (1/8 turn) further.
 - 5 - Tighten nuts for bearing caps 4 and 12 to 5 Nm and turn 45° (1/8 turn) further.



Dismantling and assembling valve timing housing

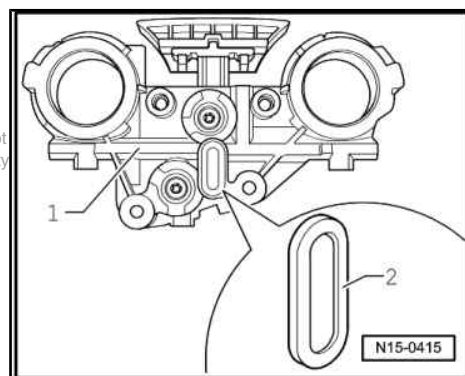
- 1 - Guide rail; clipped onto valve timing housing
- 2 - Valve timing housing
- 3 - Camshaft control valve 1 - N205-
- 4 - Exhaust camshaft control valve 1 - N318-
- 5 - Bolt



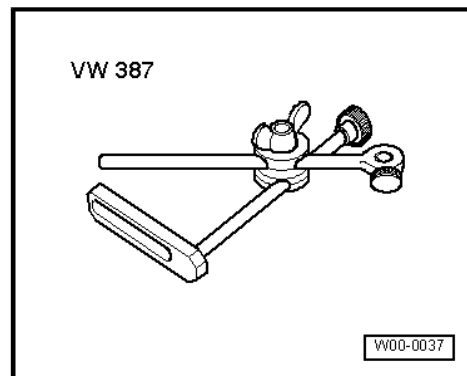
Check filter of valve timing housing for dirt

- Unclip the filter -2- on the back of valve timing housing -1- and clean away any dirt or grime.

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3.2 Checking axial clearance of camshafts



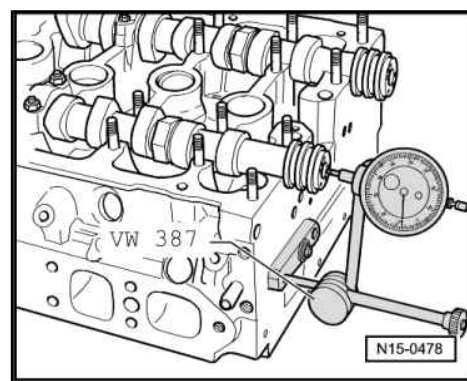
Special tools and workshop equipment required

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

Test sequence

- Perform measurement with roller rocker fingers and hydraulic compensation elements removed. Axial bearing cap for appropriate camshaft remains attached.
- Secure universal dial gauge bracket - VW 387- with dial gauge to cylinder head.

- Determine axial clearance.
- Axial clearance: wear limit: 0.10 mm



3.3 Measuring radial clearance of camshafts

Procedure

- Remove camshafts ⇒ [page 129](#) .
- Clean bearing cap and bearing journal.
- Remove roller rocker fingers
⇒ [“3.4 Removing and installing camshafts”, page 129](#) .
- Place a length of Plastigage corresponding to the width of the bearing on the bearing journal or bearing shell to be measured.
- The Plastigage must be positioned in the centre of the bearing.
- Fit bearing cap and secure with "old" nuts without rotating camshaft ⇒ [Item 10 \(page 125\)](#) .
- Remove bearing cap again.
- Compare width of Plastigage with measurement scale.

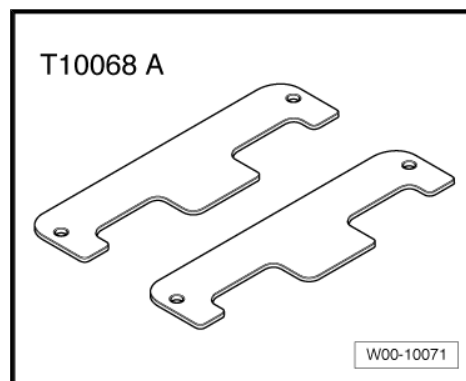
Radial clearance:

- Wear limit: 0.1 mm.

3.4 Removing and installing camshafts

Special tools and workshop equipment required

◆ Camshaft bar - T10068 A-



◆ Lubricating paste ⇒ Electronic parts catalogue

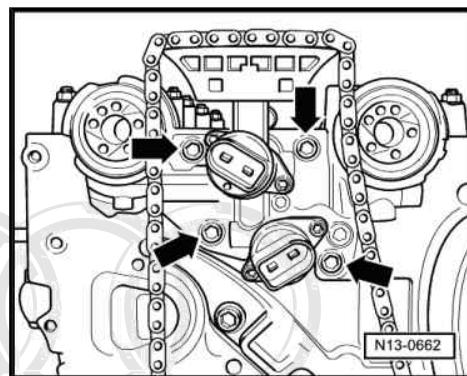
Removing

- Engine in vehicle.

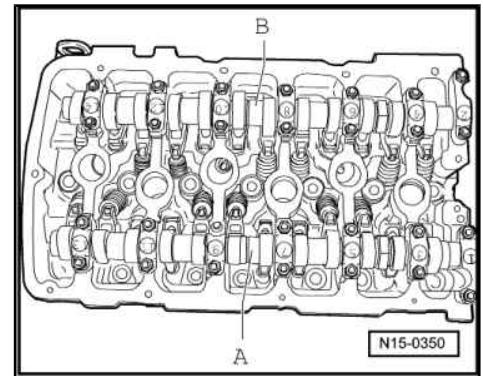


Note

- ◆ *All cable ties which are released or cut open when removing must be refitted in the same position when installing.*
- ◆ *Heat insulation sleeves that have been removed are to be re-installed in the original position.*
- Remove timing chain from camshafts ⇒ [page 104](#) .
- Unbolt the valve timing housing -arrows-.
- Carefully detach the valve timing housing from the oil seals for the camshafts.



- Remove the inlet camshaft -A- as follows:
 - 1 - Unbolt bearing caps 1 and 13.
 - 2 - Unbolt bearing caps 3 and 11.
 - 3 - Unbolt bearing cap 7.
 - 4 - Loosen bearing caps 5 and 9 alternately in a diagonal sequence and remove.
- Remove the exhaust camshaft -B- as follows:
 - 1 - Unbolt bearing caps 2 and 14.
 - 2 - Unbolt bearing caps 4 and 12.
 - 3 - Unbolt bearing cap 8.
 - 4 - Loosen bearing caps 6 and 10 alternately in a diagonal sequence and remove.
- Carefully remove the camshafts and place them down on a clean surface.



Installing

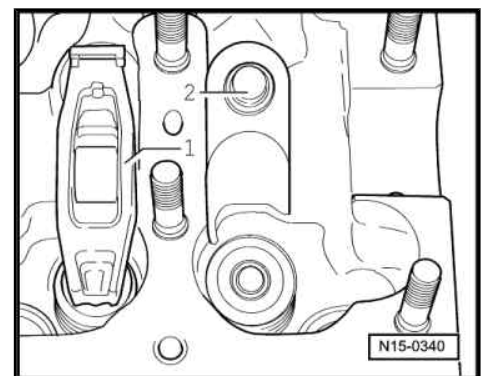
- Tightening torques ➔ [page 124](#) , ➔ [page 128](#) .



Note

- ◆ *The crankshaft must not be at TDC at any cylinder when the camshafts are installed. Otherwise, there is a risk of damage to valves and piston crowns.*
- ◆ *After installing camshafts, wait for approx. 30 minutes before starting 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.*

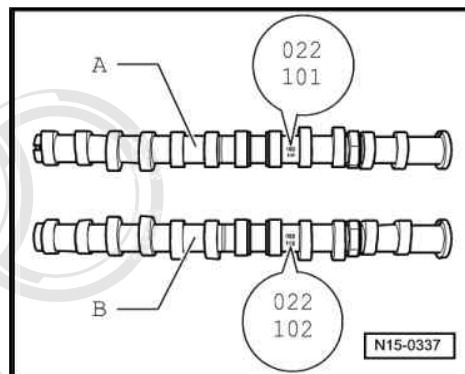
- Fit hydraulic compensation elements in cylinder head.
- Fit roller rocker fingers -1- onto ends of valve stems and clip onto hydraulic compensation elements -2-.
- Lubricate running surfaces of camshafts.



- Insert the respective camshaft in the camshaft bearings of cylinder head.
- Pay attention to the camshaft identification located between the cam pairs for cylinder No. 4 and 5:

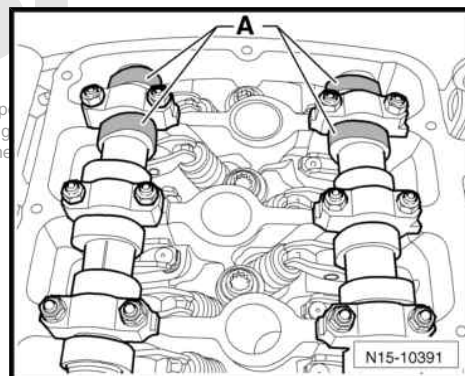
A - Exhaust camshaft; identification 022 - index 101

B - Inlet camshaft; identification 022 - index 102

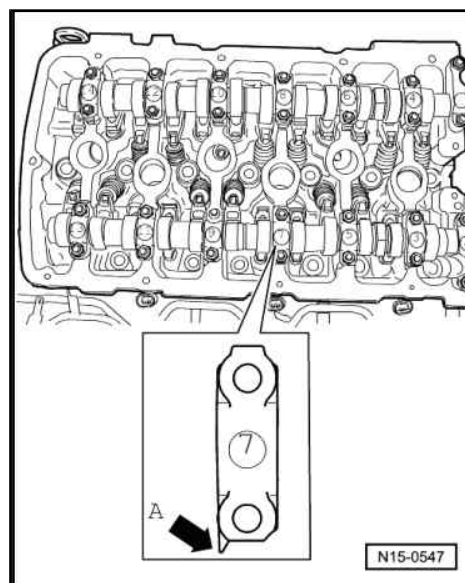


- Position camshafts in cylinder head so that cams -A- of cylinder 1 face each other.

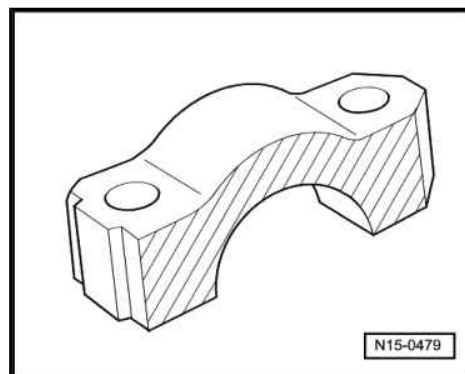
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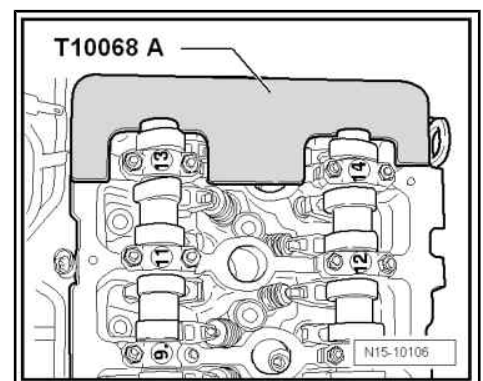
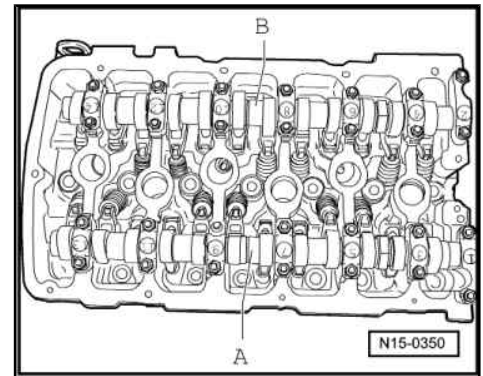
- Note the installation position of the bearing caps:
- The pointed section -arrow A- of the bearing caps for inlet and exhaust camshafts faces outwards.
- The identification markings for the bearing caps are legible from the inlet side.



- Thinly coat contact surface -(hatched surface in illustration)- of bearing caps 7 and 8 with lubricating paste ⇒ Electronic parts catalogue .



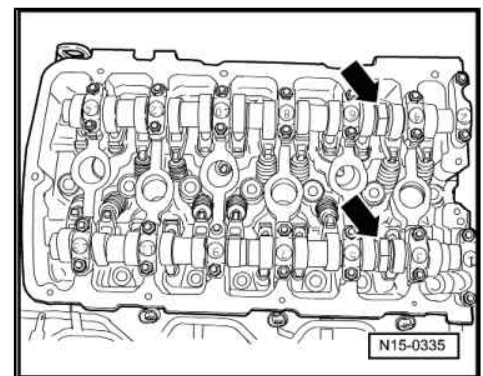
- Install the inlet camshaft -A- as follows:
 - 1 - Tighten bearing caps 5 and 9 alternately in diagonal sequence and then tighten to final torque.
 - 2 - Tighten bearing caps 1 and 13.
 - 3 - Tighten bearing cap 7.
 - 4 - Tighten bearing caps 3 and 11.
- Install the exhaust camshaft -B- as follows:
 - 1 - Tighten bearing caps 6 and 10 alternately in diagonal sequence and then tighten to final torque.
 - 2 - Tighten bearing caps 2 and 14.
 - 3 - Tighten bearing cap 8.
 - 4 - Tighten bearing caps 4 and 12.
- Position the camshafts in cylinder head to TDC.
- You should be able to insert the camshaft bar - T10068 A- in the slots in both camshafts.



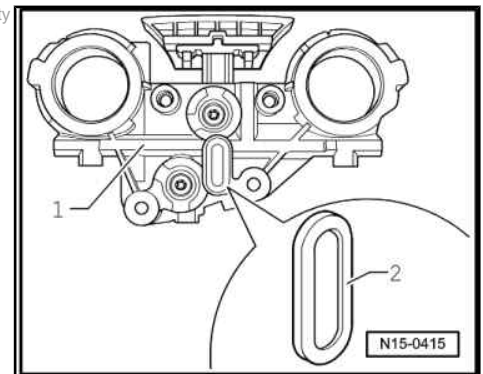
- If necessary, turn camshafts at hexagon flats -arrows- to correct position using a 32 mm open-end spanner.



The crankshaft must not be at TDC at any cylinder when the camshafts are turned. Otherwise, there is a risk of damage to valves and piston crowns.

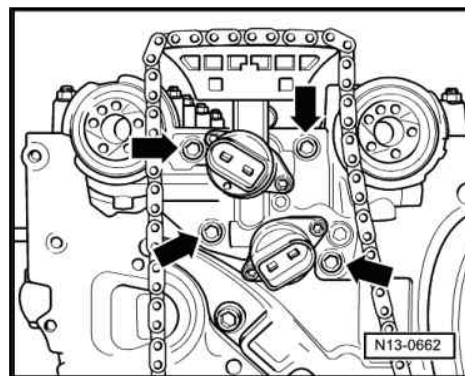


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- Unclip the filter -2- on the back of valve timing housing -1- and clean away any dirt or grime.
 - Lightly oil the contact surfaces for the camshaft oil seals in the valve timing housing.
 - Lightly oil contact surfaces of oil seals on the camshafts and carefully push the valve timing housing over the camshaft oil seals.



- Tighten the valve timing housing -arrows-.
- Install camshaft timing chain (adjust valve timing)
⇒ [page 109](#) .

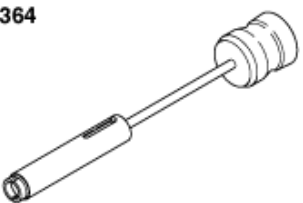
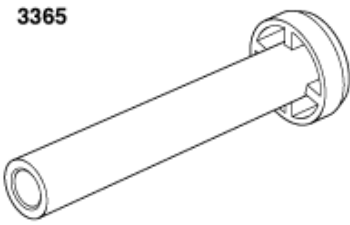
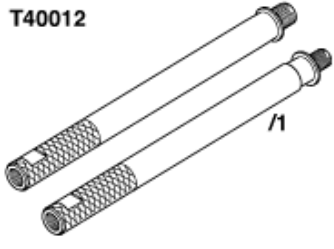
15) 45° equals 1/8 of a turn.



3.5 Renewing valve stem oil seals with cylinder head installed

Special tools and workshop equipment required

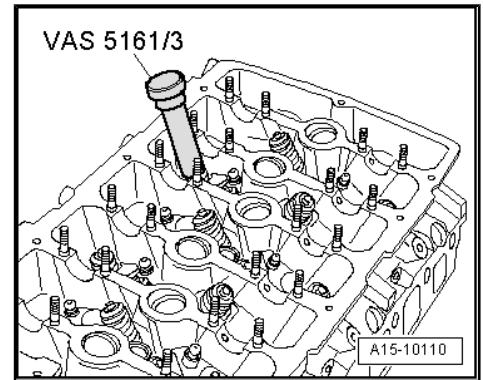
- ◆ Spark plug socket and extension - 3122 B-
- ◆ Valve stem seal puller - 3364-
- ◆ Valve stem seal fitting tool - 3365-
- ◆ Removal/installing device for valve cutters VAS 5161- with guide plate - VAS 5161/25-
- ◆ Adapters - T40012-

3122 B 	3364 
3365 	VAS 5161 
T40012 	G15-0058

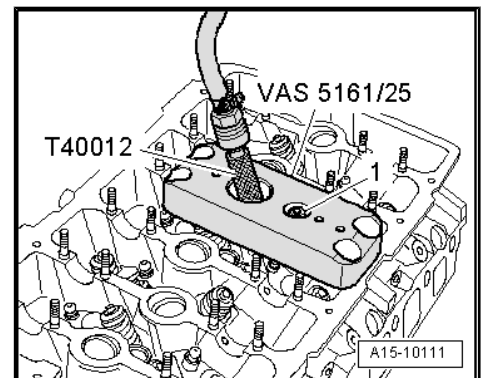
Procedure

- Engine removed
- Remove camshafts ⇒ [page 129](#) .
- Remove spark plugs with spark plug socket - 3122 B- .

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



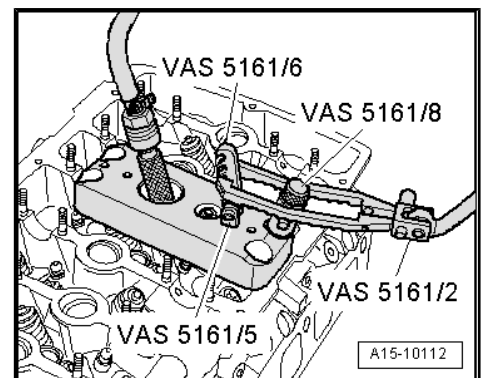
- Fit guide plate - VAS 5161/25- from removal and installation device for valve cotter - VAS 5161- on cylinder head.
- Secure guide plate with one nut -1-.
- Screw adapter - T40012- with seal hand-tight into the corresponding spark plug thread and apply a steady pressure.
- Minimum pressure: 6 bar



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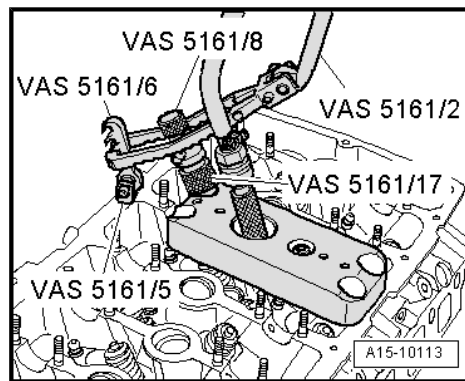
Procedure for rear row of valves:

- Screw snap-in device - VAS 5161/6- with engaging fork - VAS 5161/5- into guide plate.
- Insert assembly cartridge - VAS 5161/8- into guide plate.
- Attach pressure fork - VAS 5161/2- to snap-in device and push assembly cartridge down.
- At the same time, turn knurled screw of assembly cartridge clockwise until tips engage in valve cotter.
- Move knurled screw back and forth slightly; the valve cotter is thus forced apart and taken up by the assembly cartridge.
- Release pressure fork.
- Remove assembly cartridge.
- Detach guide plate and turn to one side.
- The compressed air hose remains connected.
- Remove valve spring with valve spring plate.



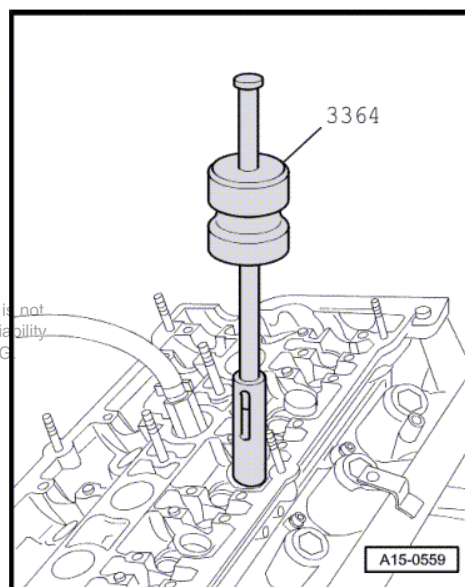
Procedure for front row of valves:

- Screw snap-in device - VAS 5161/6- with engaging fork - VAS 5161/5- onto cylinder head.
- Slide knurled spacer ring - VAS 5161/17- onto assembly cartridge - VAS 5161/8- .
- Insert assembly cartridge into guide plate.
- Attach pressure fork - VAS 5161/2- to snap-in device and push assembly cartridge down.
- At the same time, turn knurled screw of assembly cartridge clockwise until tips engage in valve cotters.
- Move knurled screw back and forth slightly; the valve cotters are thus forced apart and taken up by the assembly cartridge.
- Release pressure fork.
- Remove assembly cartridge.
- Detach guide plate and turn to one side.
- The compressed air hose remains connected.
- Remove valve spring with valve spring plate.



Continuation for both rows of valves:

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



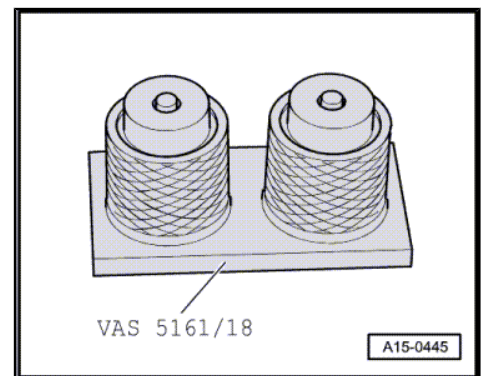
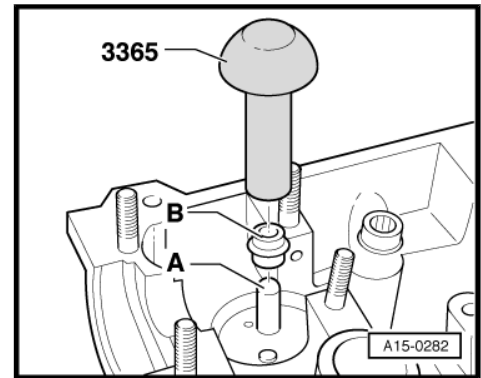
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 Note

- ◆ *To press on the green-coloured valve stem seals (as currently supplied), the valve stem oil seal fitting tool - 3365- must be drilled out to $\varnothing$ 10.5 mm.*
- ◆ *Mark the drilled-out fitting tool so it can be used again later.*
- ◆ *A plastic sleeve -A- is included with the new valve stem oil seals.*
- Fit plastic sleeve -A- onto the valve stem to prevent damage to the new valve stem oil seal -B-.
- Lightly lubricate sealing lip of valve stem oil seal.
- Slip valve stem oil seal over plastic sleeve.
- Carefully press the valve stem oil seal onto valve guide using fitting tool -3365- .
- Remove plastic sleeve.

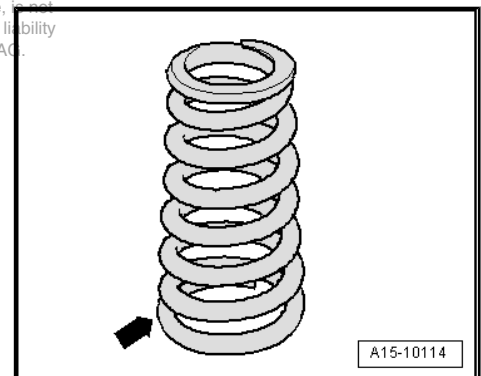
If valve cotters have been removed from assembly cartridge, they need to be put into insertion device - VAS 5161/18- first.

- Larger diameter of valve cotters faces upwards.



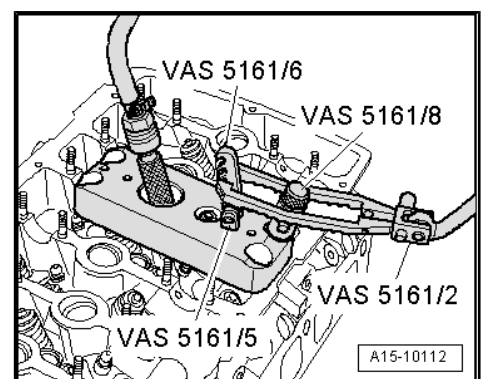
- Install valve spring and valve spring plate
- Position of valve spring:

- The larger diameter -arrow- faces the cylinder head.



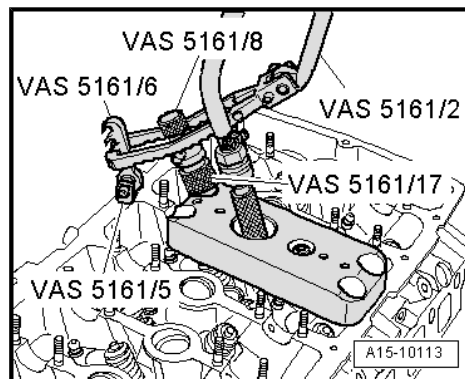
Procedure for rear row of valves:

- Bolt guide plate onto cylinder head again, as shown in the illustration.
- Insert assembly cartridge into guide plate.
- Push pressure fork down and pull knurled screw upwards, while turning screw in both directions – this will insert the valve cotters.
- Release pressure fork with knurled screw still in pulled position.



Procedure for front row of valves:

- Insert assembly cartridge with knurled spacer ring into guide plate.
- Push pressure fork down and pull knurled screw upwards, while turning screw in both directions – this will insert the valve cotter.
- Release pressure fork with knurled screw still in pulled position.
- Install camshafts ➔ [page 131](#) .
- Install spark plugs ➔ Maintenance ; Booklet 808 .

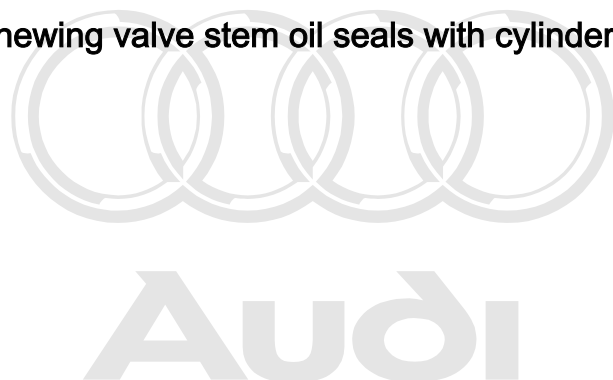


Caution

Avoid damage to valves and piston crowns after working on valve gear.

- ◆ *The hydraulic tappets have to settle; wait for approx. 30 minutes after installing camshafts before starting engine.*
- ◆ *Turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.*

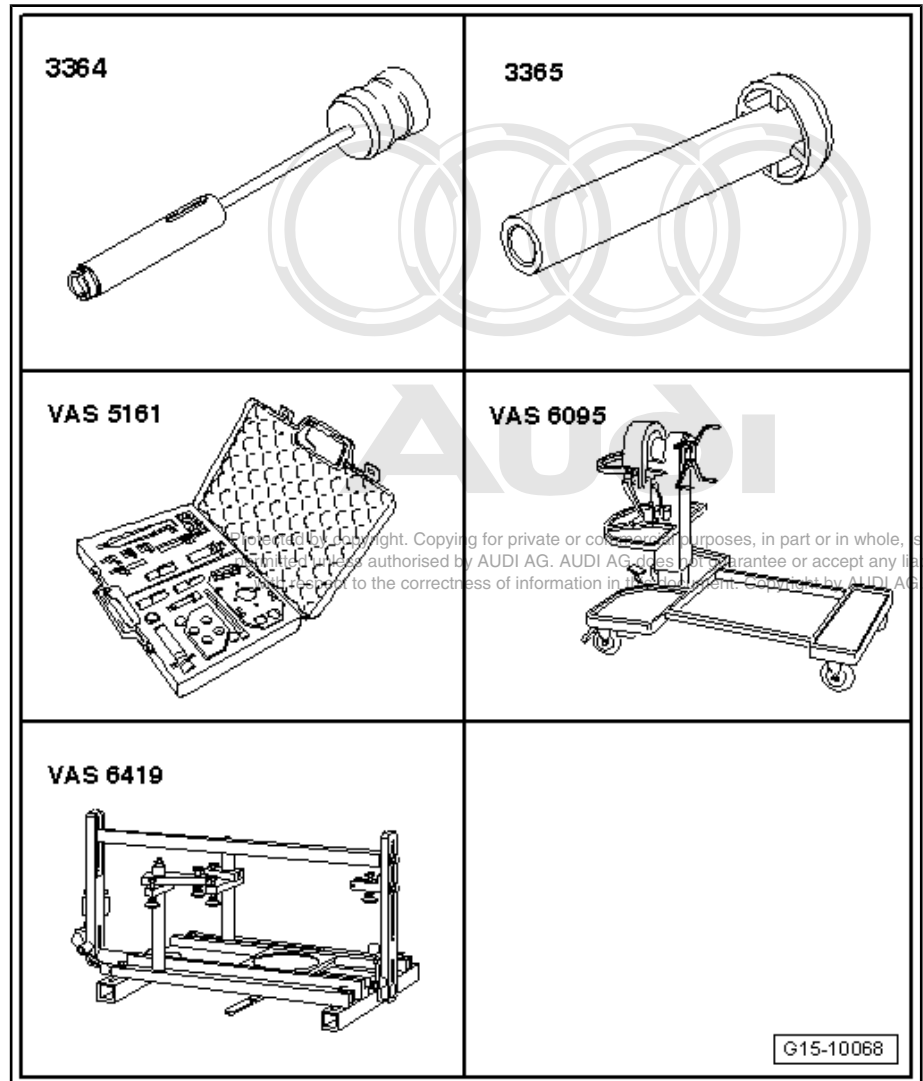
3.6 Renewing valve stem oil seals with cylinder head removed



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Special tools and workshop equipment required

- ◆ Valve stem seal puller - 3364-
- ◆ Valve stem seal fitting tool - 3365-
- ◆ Removal / installing device for valve cotters - VAS 5161- with guide plate - VAS 5161/25-
- ◆ Engine and gearbox support - VAS 6095-
- ◆ Cylinder head tensioning device - VAS 6419-

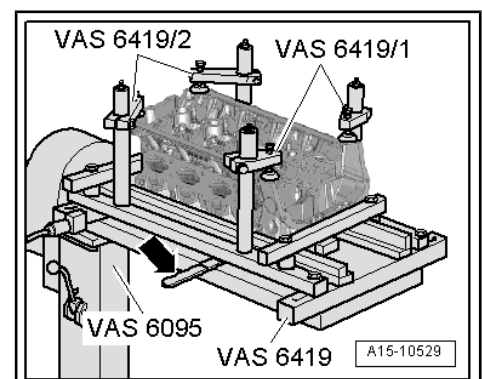


Special tools and workshop equipment required

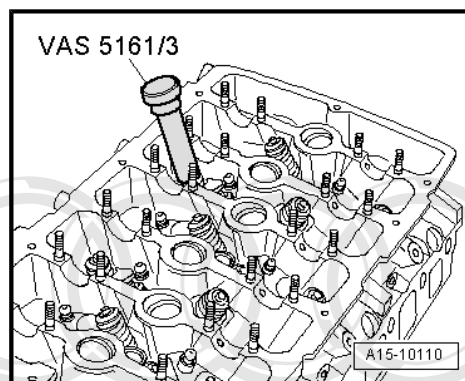


Procedure

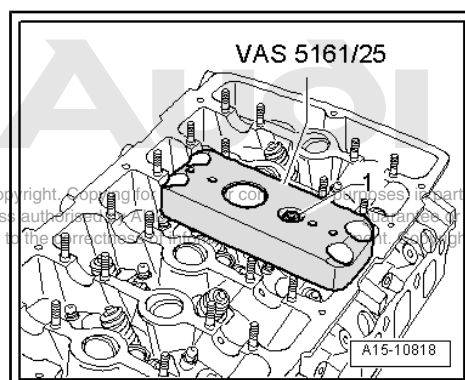
- Remove camshafts ⇒ [page 129](#) .
- Mark original positions of roller rocker fingers and hydraulic compensation elements for reinstallation.
- Remove roller rocker fingers together with hydraulic compensation elements and put down on a clean surface.
- Attach tensioning device -VAS 6419- to engine and gearbox support - VAS 6095- .
- Secure cylinder head in tensioning device -VAS 6419- as illustrated.
- Connect compressed air line to tensioning device -VAS 6419- .
- Using lever -arrow-, slide air pad under combustion chamber where valve stem oil seals are to be removed.
- Apply just enough compressed air to bring air pad into contact with valve heads.



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

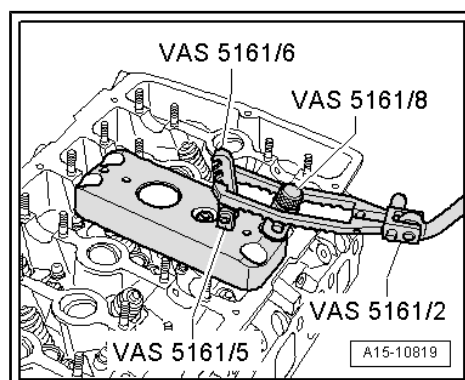


- Fit guide plate - VAS 5161/25- from removal and installation device for valve cotter - VAS 5161- on cylinder head.
- Secure guide plate with one nut -1-.



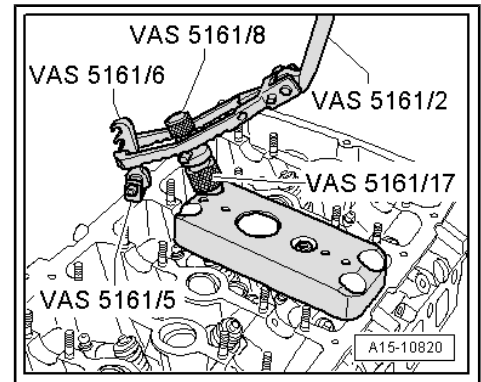
Procedure for rear row of valves:

- Screw snap-in device - VAS 5161/6- with engaging fork - VAS 5161/5- into guide plate.
- Insert assembly cartridge - VAS 5161/8- into guide plate.
- Attach pressure fork - VAS 5161/2- to snap-in device and push assembly cartridge down.
- At the same time, turn knurled screw of assembly cartridge clockwise until tips engage in valve cotter.
- Move knurled screw back and forth slightly; the valve cotter are thus forced apart and taken up by the assembly cartridge.
- Release pressure fork.
- Remove assembly cartridge.
- Detach guide plate and turn to one side.
- Remove valve spring with valve spring plate.



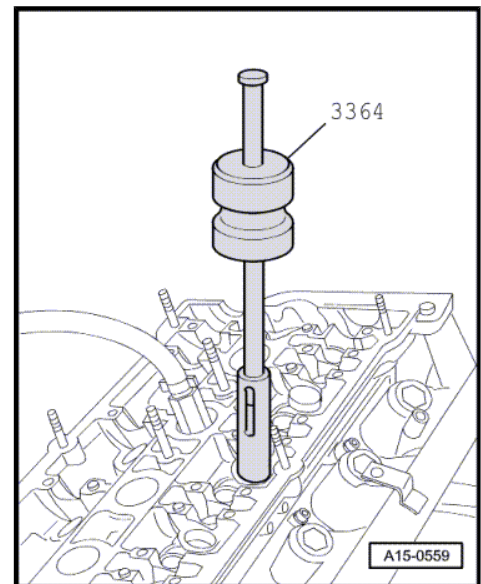
Procedure for front row of valves:

- Screw snap-in device - VAS 5161/6- with engaging fork - VAS 5161/5- onto cylinder head.
- Slide knurled spacer ring - VAS 5161/17- onto assembly cartridge - VAS 5161/8- .
- Insert assembly cartridge into guide plate.
- Attach pressure fork - VAS 5161/2- to snap-in device and push assembly cartridge down.
- At the same time, turn knurled screw of assembly cartridge clockwise until tips engage in valve cotters.
- Move knurled screw back and forth slightly; the valve cotters are thus forced apart and taken up by the assembly cartridge.
- Release pressure fork.
- Remove assembly cartridge.
- Detach guide plate and turn to one side.
- Remove valve spring with valve spring plate.



Continuation for both rows of valves:

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



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Note

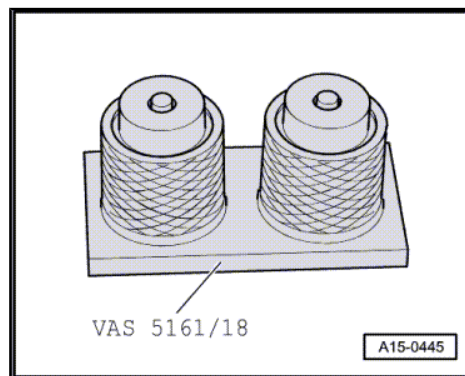
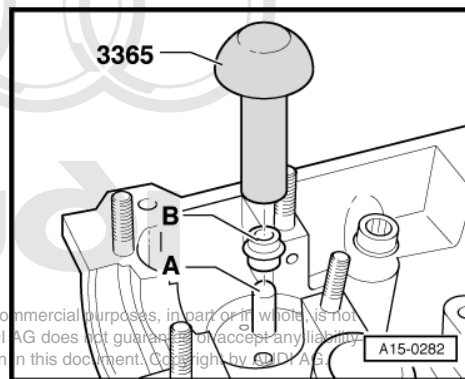
- ◆ To press on the green-coloured valve stem seals (as currently supplied), the valve stem oil seal fitting tool - 3365- must be drilled out to $\varnothing$ 10.5 mm.
- ◆ Mark the drilled-out fitting tool so it can be used again later.
- ◆ A plastic sleeve -A- is included with the new valve stem oil seals.

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

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

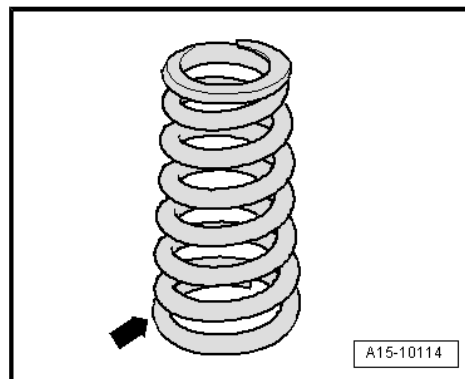
- Larger diameter of valve cotters faces upwards.



- Install valve spring and valve spring plate.

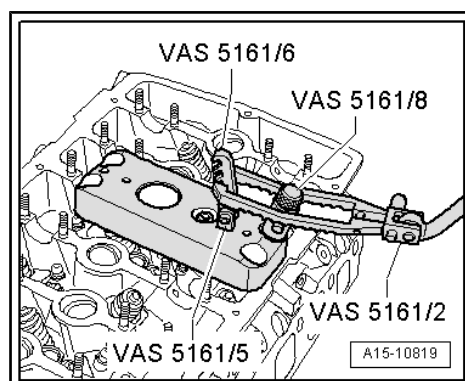
Position of valve spring:

- The larger diameter -arrow- faces the cylinder head.



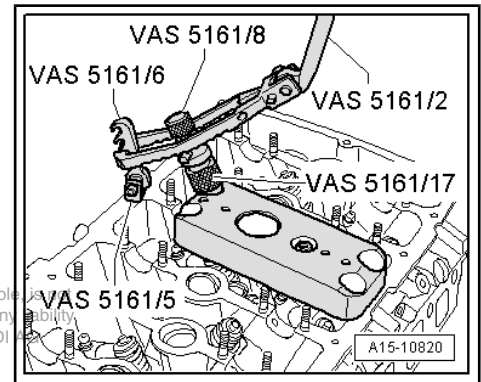
Procedure for rear row of valves:

- Bolt guide plate onto cylinder head again, as shown in the illustration.
- Insert assembly cartridge into guide plate.
- Push pressure fork down and pull knurled screw upwards, while turning screw in both directions – this will insert the valve cotters.
- Release pressure fork with knurled screw still in pulled position.



Procedure for front row of valves:

- Insert assembly cartridge with knurled spacer ring into guide plate.
- Push pressure fork down and pull knurled screw upwards, while turning screw in both directions – this will insert the valve cotter.
- Release pressure fork with knurled screw still in pulled position.
- Install camshafts ⇒ [page 131](#)
- Install spark plugs ⇒ Maintenance ; Booklet 808 .



Note

- ◆ After installing camshafts, wait for approx. 30 minutes before starting 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.

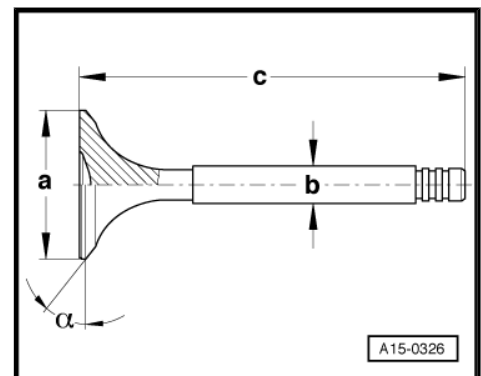
3.7 Valve dimensions



Note

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

Dimension		Short inlet valve	Long inlet valve	Short exhaust valve	Long exhaust valve
Ø a	mm	31.00	31.00	27.00	27.00
Ø b	mm	5.96	5.96	5.94	5.94
c	mm	102.20	136.10	102.50	136.40
α	°	45	45	45	45



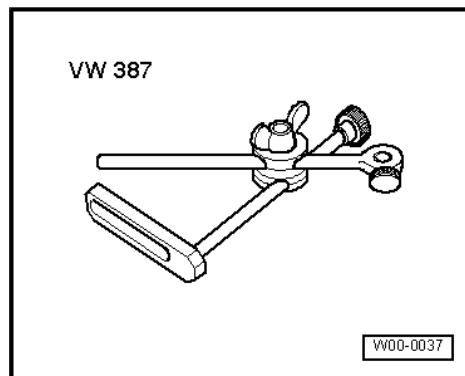
WARNING

- ◆ Care must be taken when disposing of old sodium-cooled exhaust valves.
- ◆ The valves must be sawn in two with a metal saw between the centre of the stem and valve head. When doing so, the valves must not come into contact with water. After preparing the valves, throw a maximum of ten into a bucket of water. Then step away immediately, since a chemical reaction will occur in which the sodium filling burns.
- ◆ After performing these steps the valves can be disposed of in the normal way.

3.8 Checking valve guides

Special tools and workshop equipment required

- ◆ Universal dial gauge bracket - VW 387-



- ◆ Dial gauge

Test sequence

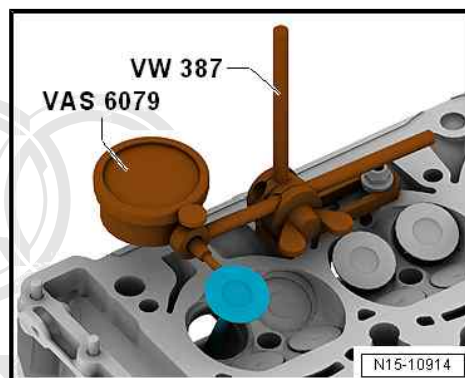
- Insert valve into valve guide. Only insert inlet valve into inlet guide and exhaust valve into exhaust guide, as the stem diameters are different.
- End of valve stem must be flush with valve guide.
- Determine amount of sideways play.
- Wear limit (sideways play): 0.8 mm.



Note

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

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3.9 Machining valve seats



Note

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

Special tools and workshop equipment required

- ◆ Depth gauge
- ◆ Valve seat machining tool

 Note

- ◆ *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 143](#).*
- ◆ *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 machining dimension is exceeded, the function of the hydraulic valve clearance compensation can no longer be ensured and the cylinder head must be renewed.*

Calculating maximum permissible machining dimension

- Insert valve and press firmly against valve seat.

 Note

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

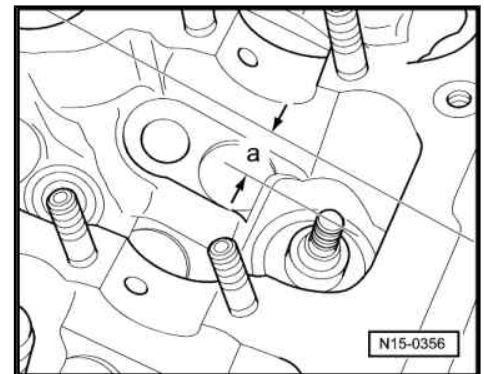
- Measure distance -a- between end of valve stem and upper cylinder head surface with a depth gauge.
- Calculate the maximum permissible machining dimension using the measured distance and the minimum dimension.

Minimum dimensions			
Short inlet valve	Long inlet valve	Short exhaust valve	Long exhaust valve
31.8 mm	10.2 mm	31.8 mm	10.2 mm

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

Example for long inlet valve:

Measured distance	10.6 mm
- Minimum dimension	- 10.2 mm
= Maximum permissible machining dimension	= 0.4 mm



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 Note

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

Machining inlet valve seat

a - $\varnothing$ 30.6 mm

b - Maximum permissible machining dimension

c - 0.9 ... 1.5 mm

d - Max. $\varnothing$ 35.0 mm

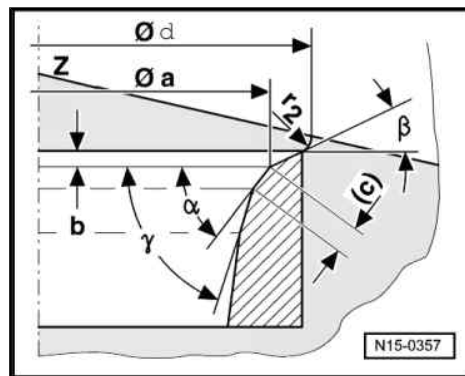
r2 - Radius 2.0 mm

Z - Bottom surface of cylinder head

α - 45° valve seat angle

β - 30° upper correction angle

γ - 60° lower correction angle



Note

Calculating maximum permissible machining dimension
⇒ [page 145](#).

Machining exhaust valve seat

a - $\varnothing$ 26.7 mm

b - Maximum permissible machining dimension

c - 1.2 ... 1.7 mm

d - Max. $\varnothing$ 29.0 mm

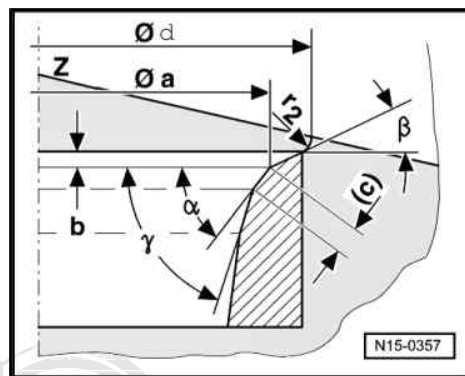
r2 - Radius 2.0 mm

Z - Bottom surface of cylinder head

α - 45° valve seat angle

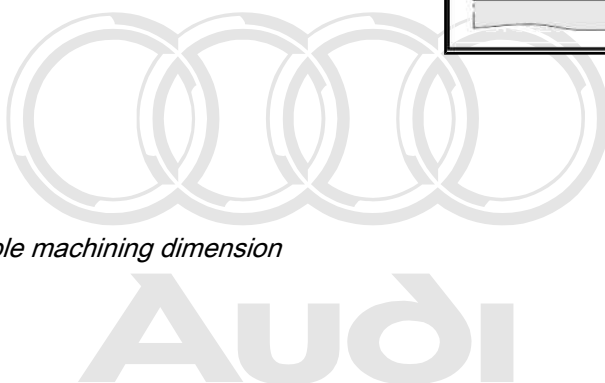
β - 30° upper correction angle

γ - 60° lower correction angle



Note

Calculating maximum permissible machining dimension
⇒ [page 145](#).



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17 – Lubrication

1 Oil pump and sump



Note

- ◆ *If large quantities of metal shavings or abrasion are found when performing engine repairs, this may be an indication of damage to the crankshaft or conrod bearings. To prevent further damage, the following procedures must be carried out after completion of repair work: the oil galleries must be carefully cleaned and renew the oil spray jets, oil cooler and oil filter.*
- ◆ *Refer to ⇒ Maintenance tables for engine oil capacity, oil specifications and viscosity grades.*



Caution

Risk of damage to catalytic converter.

- ◆ *The oil level must not be above the "max" mark on the dipstick.*

1.1 Oil pump and sump - exploded view

1 - 5 Nm

- ❑ Secured to intake manifold

2 - Oil dipstick

3 - Guide tube for oil dipstick

4 - Cylinder block

5 - Oil return valve

- ❑ Removing and installing
⇒ [page 149](#)
- ❑ Note installation position

6 - 8 Nm

7 - Cover for oil pump drive

8 - O-ring

- ☐ Renew
- ☐ Lubricate before installing

9 - Oil pump drive

10 - Intermediate shaft

11 - Thrust washer

12 - 10 Nm

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

13 - Oil spray jet (for cooling of pistons)

- ☐ For crankshaft bearings 2 ... 7
- ☐ Opening pressure: 2.0 bar
- ☐ Removing and installing ⇒ page 149

14 - Input shaft for oil pump drive

15 - Oil pump

- ❑ Dismantling and assembling ⇒ [page 153](#)
- ❑ Apply sealing paste to oil pressure pipe at cylinder block and at oil pump housing; for sealing paste refer to ⇒ Electronic parts catalogue

16 - 23 Nm

17 - Oil drain plug, 30 Nm

18 - Sump

- ❑ Removing and installing ⇒ [page 150](#)
- ❑ Tightening torque and tightening sequence ⇒ [page 149](#)

19 - Oil level and oil temperature sender - G266-

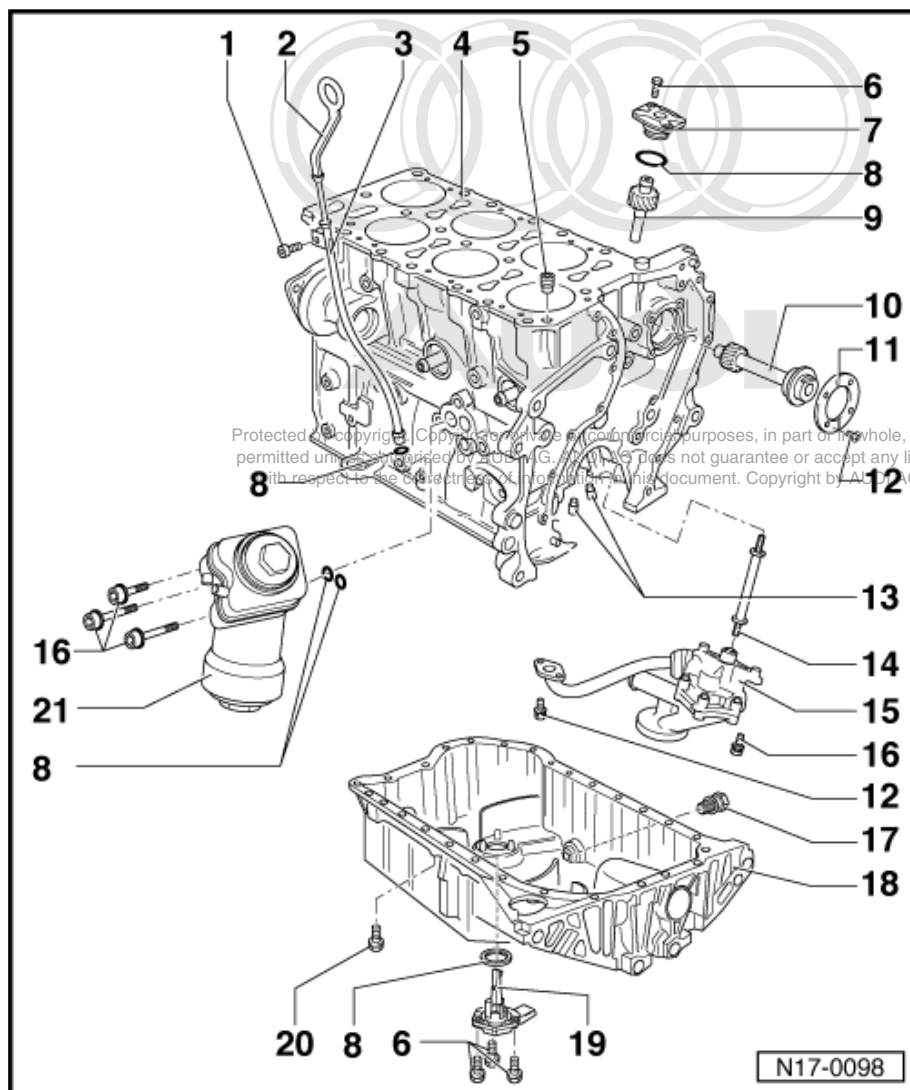
- ❏ Removing and installing ⇒ [page 150](#)

20 - Bolt

- ❏ Tightening torque and tightening sequence ⇒ [page 149](#)

21 - Oil filter housing

- ❏ Exploded view of components ⇒ **page 155**



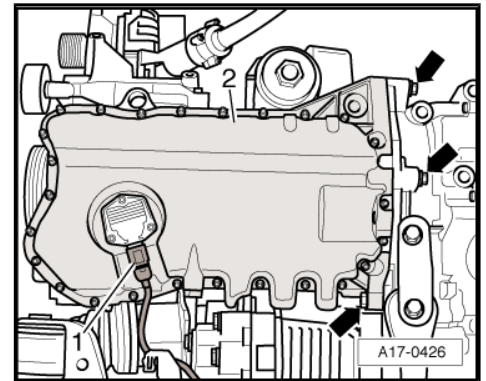
❑ Removing and installing ⇒ [page 156](#)

Sump - tightening torque and tightening sequence

- Tighten bolts in 3 stages as follows:
 1. Tighten bolts securing sump to cylinder block in diagonal sequence initially to 5 Nm.
 2. Tighten bolts securing sump to gearbox -arrows- ⇒ [page 35](#) .
 3. Tighten bolts securing sump to cylinder block in diagonal sequence to 12 Nm.

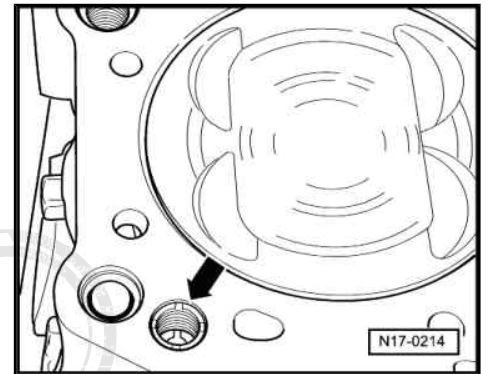
 **Note**

Disregard item -1-.



Removing and installing oil return valve

- To remove, screw in bolt M8x1.5 approx. 4 turns into valve -arrow- and pull out.
- To install, lubricate O-ring and press valve into oil passage by hand.

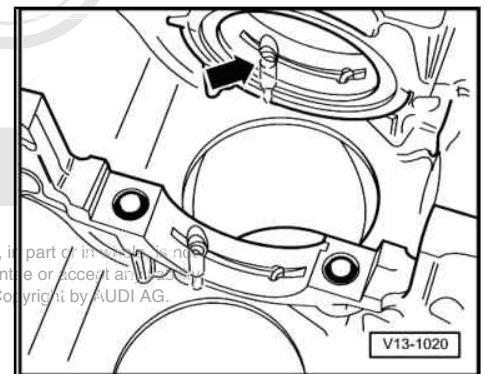


Removing and installing oil spray jet

 **Note**

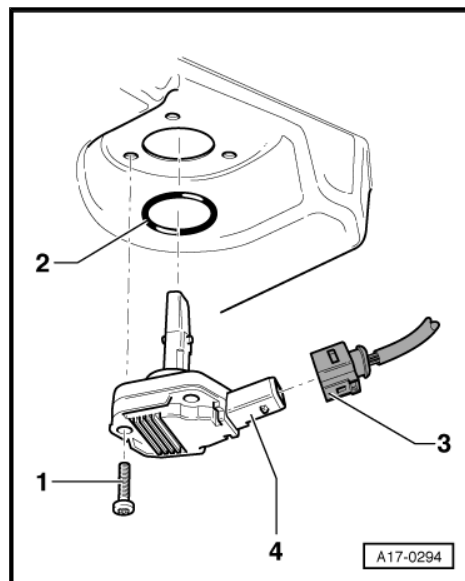
Oil spray jets are installed in crankshaft main bearings 2 ... 7.

- To remove, use drift with $\varnothing$ 4 mm to press out oil spray jet towards crankshaft bearing.
- To install, use drift with $\varnothing$ 6 mm to press in oil spray jet -arrow- by hand.



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

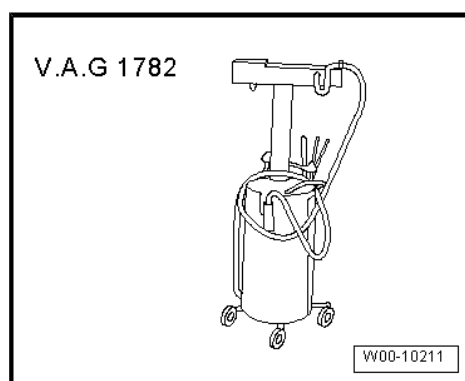
- 1 - Bolt, 10 Nm (self-locking); renew
- 2 - Seal; renew
- 3 - Electrical connector
- 4 - Oil level and oil temperature sender - G266-



1.2 Removing and installing sump

Special tools and workshop equipment required

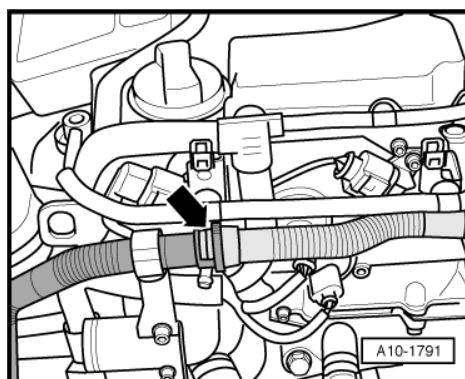
- ◆ Used oil collection and extraction unit - V.A.G 1782-



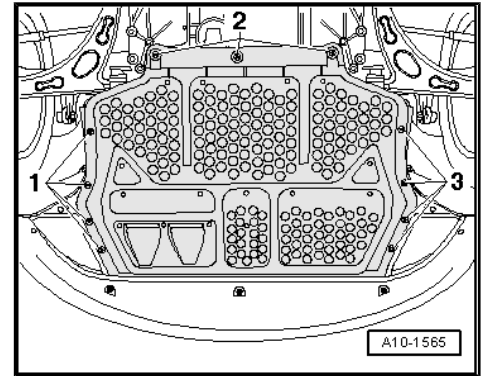
- ◆ Electric drill with plastic brush attachment
- ◆ Safety goggles
- ◆ Sealant ⇒ Electronic parts catalogue

Removing

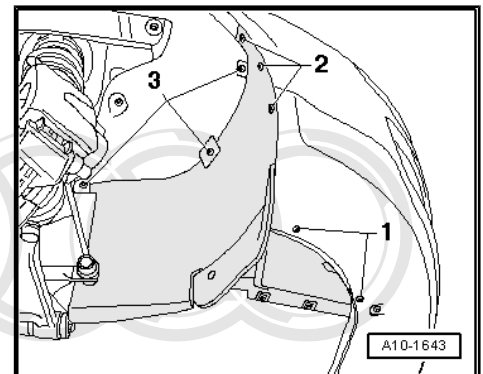
- Disconnect secondary air hose at the position marked with an -arrow-.



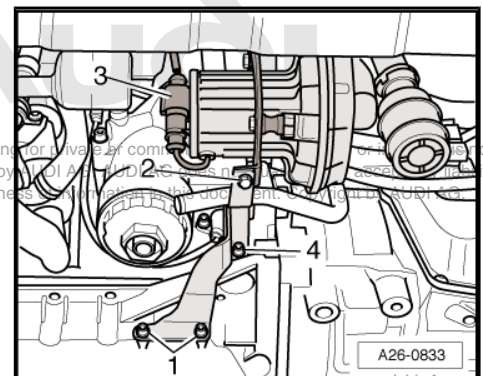
- Remove centre noise insulation -fasteners 1 ... 3-.



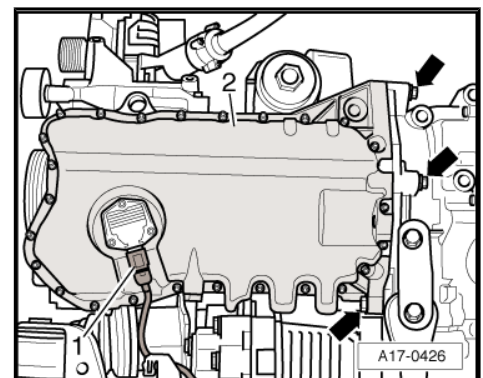
- Remove noise insulation (right-side) -fasteners 1 ... 3-.
- Drain off engine oil.



- Move coolant hose at bottom of radiator cowl clear.
- Detach electrical connector -3- at secondary air pump motor - V101- and move wire clear.
- Unscrew bracket -2- for coolant pipe going to gear oil cooler on vehicles with direct shift gearbox.
- Remove bolts -1-.
- Loosen bolt -4- and remove secondary air pump with bracket.



- Unplug electrical connector -1- at oil level and oil temperature sender - G266- .
- Unscrew sump/gearbox bolts -arrows-.
- Unscrew bolts for sump -2- in diagonal sequence and remove.
- Take off sump; if necessary loosen it by striking lightly with a rubber hammer.



Installing

- Tightening torques ➔ [page 147](#) , ➔ [page 149](#) .

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

- Carefully remove sealant residue from cylinder block.

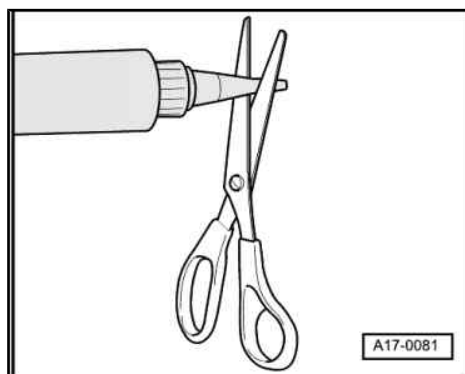
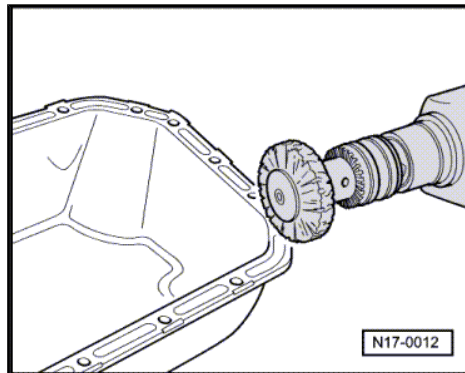


WARNING

Risk of eye injury.

- ◆ *Wear safety goggles.*

- Remove sealant residue from sump, e.g. with rotating plastic brush or similar.
- Clean sealing surfaces; they must be free of oil and grease.
- Cut off tube nozzle at front marking (diameter of nozzle approx. 2 mm).



- Apply the sealant onto the clean sealing surface of the sump as illustrated -arrow-.
- Width of sealant bead: 2 mm.



Caution

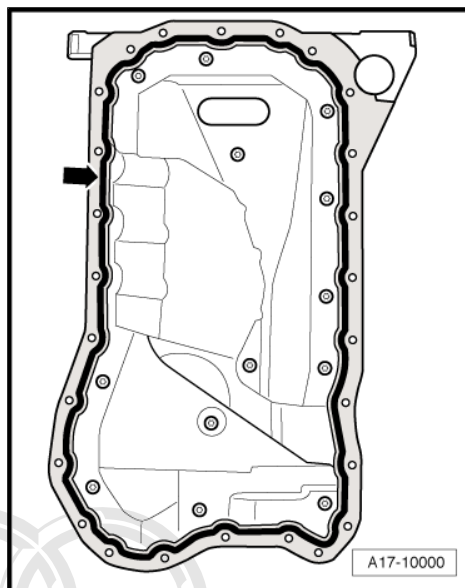
Make sure oil strainer is not clogged by excess sealant.

- ◆ *The bead of sealant must not be thicker than specified.*



Note

- ◆ *Take extra care when applying sealant bead in the area around the lower cover for timing chains.*
- ◆ *The sump must be installed within 5 minutes after applying sealant.*



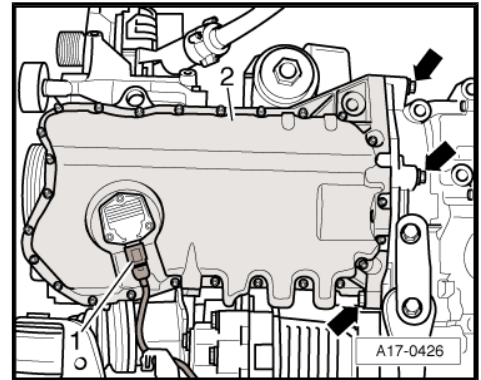
- Tighten bolts securing sump -2- ➔ [page 149](#) .
- 1 -
- Plug in electrical connector -1- for oil level and oil temperature sender - G266- .



Caution

Take care to avoid leakage at sump.

- ◆ *After fitting sump assembly, the sealant must dry for approx. 30 minutes. Then (and only then) fill the engine with engine oil.*



- Fill up with engine oil and check oil level ➔ [page 160](#) .

1.3 Oil pump - exploded view

1 - Input shaft for oil pump drive

2 - Oil pump housing

3 - 23 Nm

4 - Gears

- ☐ Checking backlash ➔ [page 154](#)
- ☐ Checking axial clearance ➔ [page 154](#)

5 - Oil pump cover

- ☐ With pressure relief valve
- ☐ Opening pressure of pressure relief valve: 5.3 ... 5.7 bar
- ☐ Clean strainer if dirty

6 - 8 Nm

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

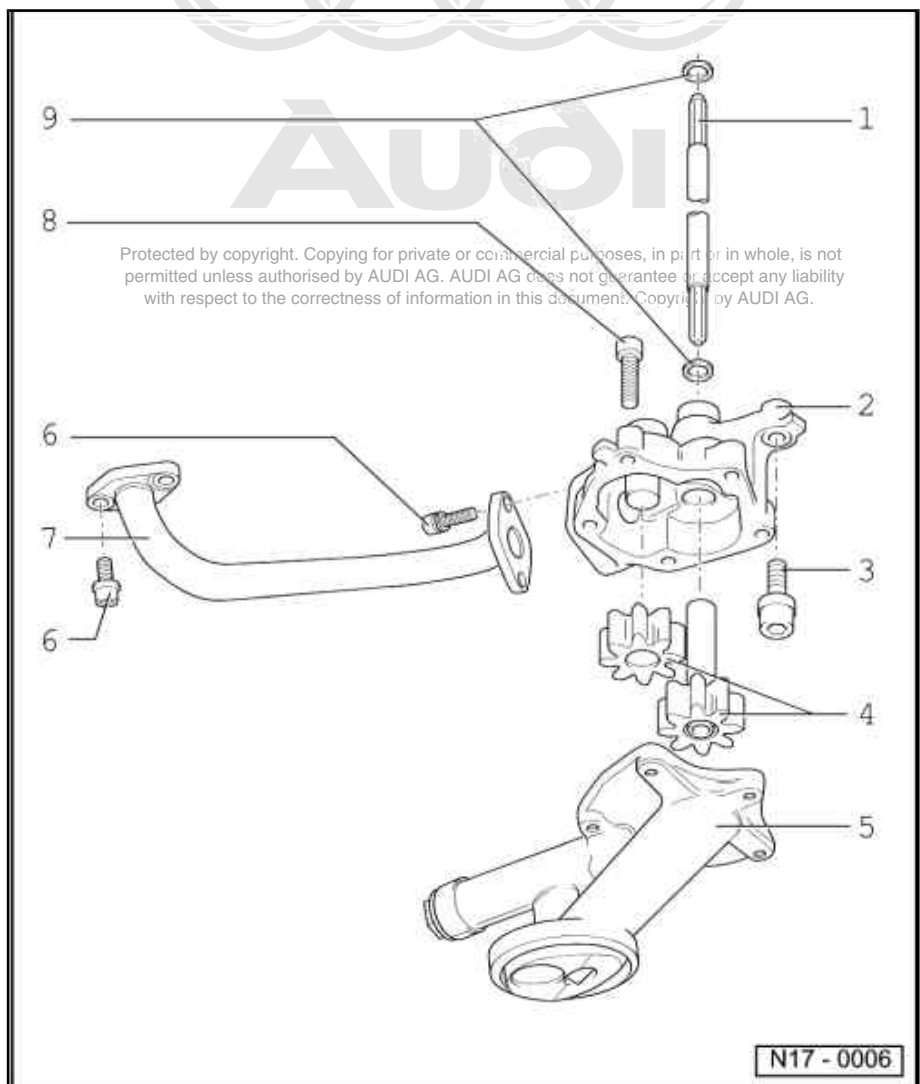
7 - Oil pressure pipe

- ☐ Apply sealing paste at cylinder block and at oil pump housing; for sealing paste refer to ➔ Electronic parts catalogue

8 - 10 Nm

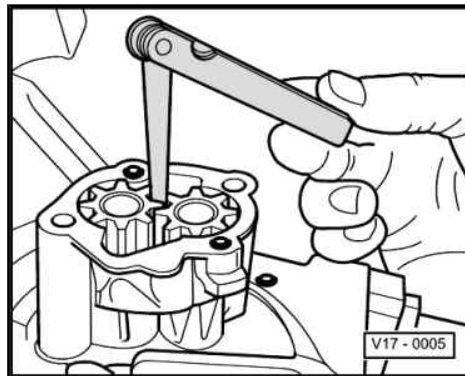
9 - Seal

- ☐ Renew if damaged

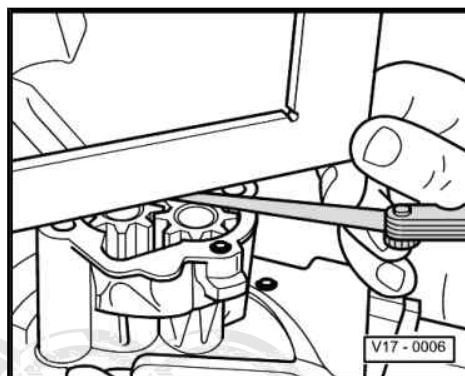


Checking backlash

- Use a feeler gauge to measure.
- Wear limit (backlash): 0.20 mm.

**Checking axial clearance**

- Use a feeler gauge and straight edge to measure.
- Axial clearance: wear limit: 0.10 mm



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2 Oil cooler and oil filter housing

2.1 Oil cooler, oil filter housing - exploded view

1 - Sealing cap

- ☐ Tighten to 25 Nm

2 - O-ring

- ☐ Renew

3 - Oil filter element

- ☐ Removing and installing
⇒ Maintenance ; Book-
let 808

4 - Oil filter housing

- ☐ With oil retention valve

5 - 23 Nm

6 - Screw plug, 15 Nm

7 - Seal

- ☐ If seal is leaking, cut
open and renew

8 - Seal

- ☐ If seal is leaking, cut
open and renew

9 - Oil pressure switch - F1

- ☐ Black insulation
- ☐ Opening/closing pres-
sure 1.4 bar
- ☐ Checking ⇒ [page 159](#)
- ☐ Removing and installing
⇒ [page 158](#)
- ☐ Tighten to 25 Nm

10 - Seals

- ☐ Renew

11 - Sealing cap

- ☐ Tighten to 25 Nm

12 - Seal

- ☐ Renew
- ☐ Lubricate before installing

13 - Oil cooler

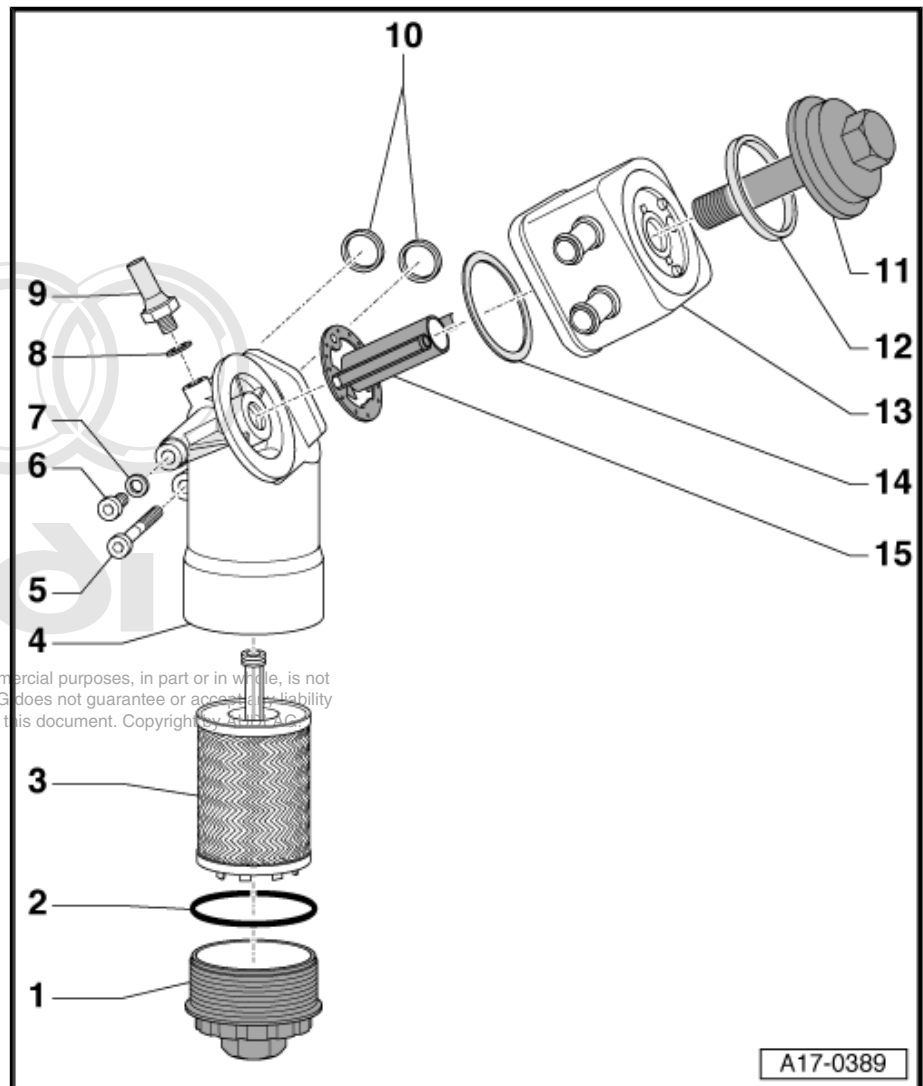
- ☐ Ensure clearance from adjacent components
- ☐ Diagram of coolant hose connections ⇒ [page 162](#)
- ☐ See note if making repairs on engine ⇒ [page 147](#)

14 - Seal

- ☐ Installation position ⇒ [page 156](#)
- ☐ Lubricate before installing
- ☐ Press onto oil cooler with plastic element ⇒ [Item 15 \(page 155\)](#)

15 - Plastic element

- ☐ Insert into oil cooler together with oil seal ⇒ [Item 14 \(page 155\)](#)

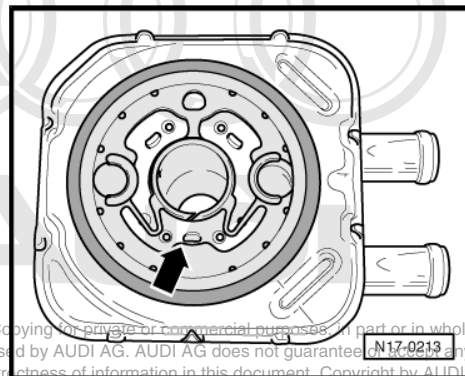


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❑ Installation position ➔ [page 156](#)

Installation position of seal and plastic element in oil cooler

- First insert oil seal (coat with oil) into oil cooler.
- Insert the plastic element into the oil cooler.
- The side of the plastic element without the support must align with the lug -arrow- of oil cooler.

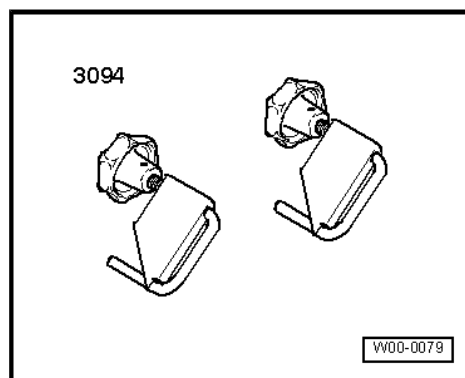


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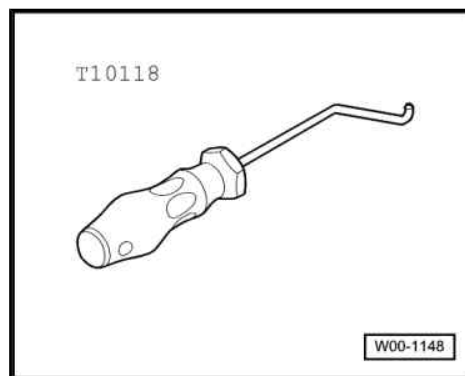
2.2 Removing and installing oil filter housing

Special tools and workshop equipment required

- ◆ Hose clamps up to Ø 25 mm - 3094-



- ◆ Assembly tool - T10118-



Removing



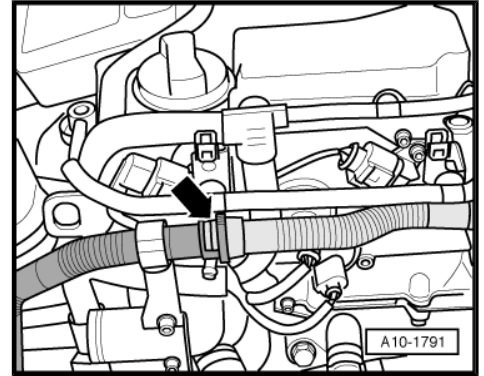
WARNING

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

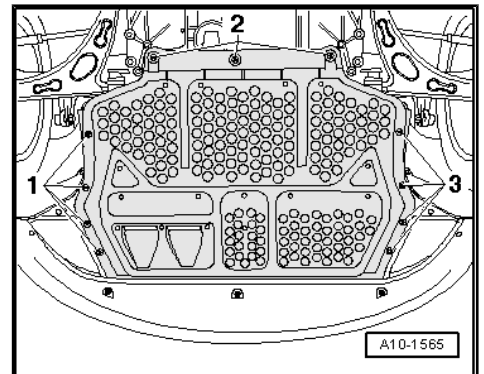
- ◆ *The cooling system is under pressure when the engine is hot.*
- ◆ *Cover filler cap on coolant expansion tank with a cloth and open carefully to dissipate pressure.*

- Open filler cap on coolant expansion tank.

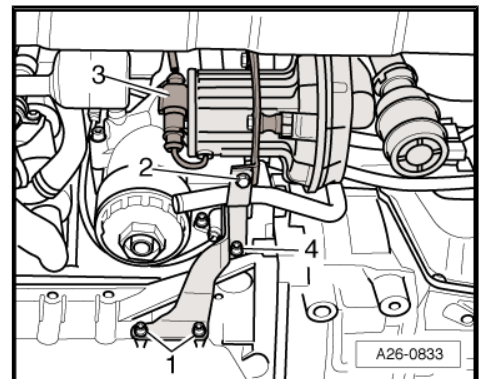
- Disconnect secondary air hose at the position marked with an -arrow-.



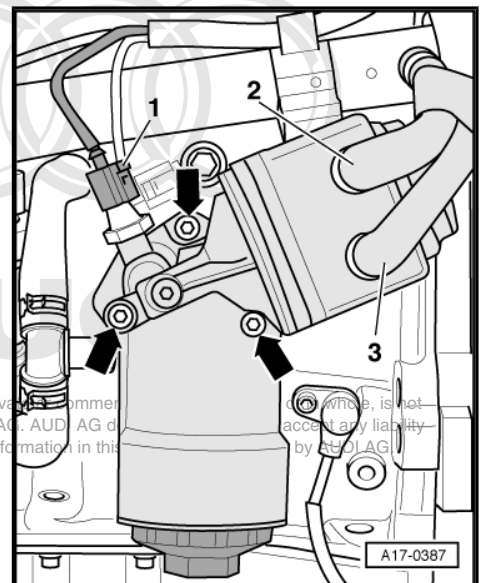
- Remove centre noise insulation -fasteners 1 ... 3-.



- Move coolant hose at bottom of radiator cowl clear.
- Detach electrical connector -3- at secondary air pump motor - V101- and move wire clear.
- Unscrew bracket -2- for coolant pipe going to gear oil cooler on vehicles with direct shift gearbox.
- Remove bolts -1-.
- Loosen bolt -4- and remove secondary air pump with bracket.



- Clamp off coolant hoses -2- and -3- using hose clamps - 3094- .
- Unplug electrical connector -1- at oil pressure switch using assembly tool - T10118- .
- Disconnect coolant hoses -2- and -3- at oil filter bracket.
- Unscrew bolts -arrows- and remove oil filter bracket.



Installing

- Tightening torque ⇒ [page 155](#)

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



Note

Renew seal.

- Fill cooling system ⇒ [page 165](#) .

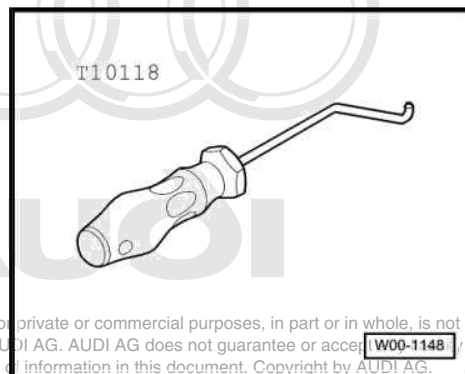
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2.3 Removing and installing oil pressure switch - F1-

Special tools and workshop equipment required

- ◆ Assembly tool - T10118-



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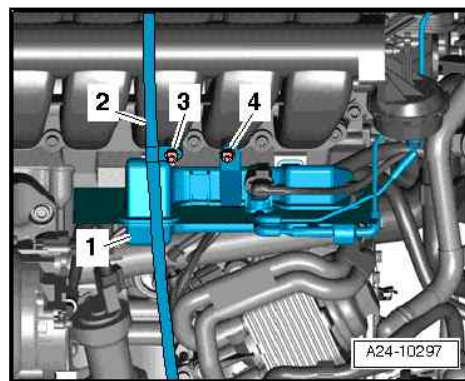
Removing

- Remove poly V-belt ➔ [page 46](#) .
- Pull out oil dipstick.
- Unscrew bolt -3- and pull out guide tube for oil dipstick -2- and move clear to one side.

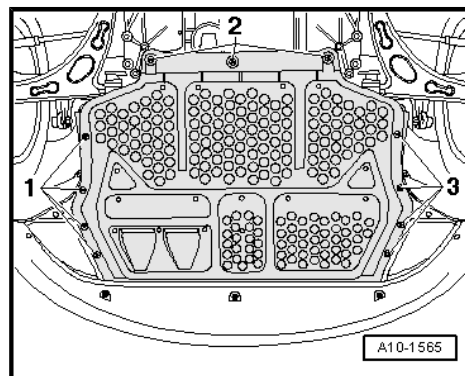


Note

Disregard -items 1 and 4-.



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



- Unplug electrical connector -1- for magnetic clutch at air conditioner compressor and move electrical wiring clear.

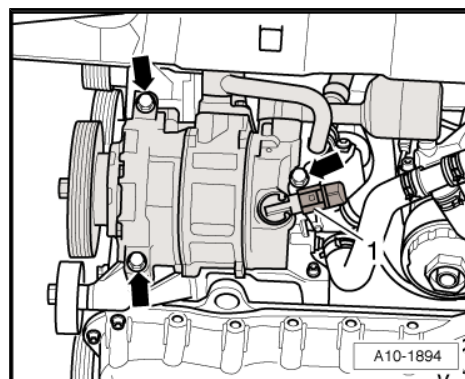


WARNING

Risk of injury caused by refrigerant.

- ◆ **The air conditioner refrigerant circuit must not be opened.**

- Remove bolts -arrows-.
- Tie up air conditioner compressor together with refrigerant hoses at front of noise insulation frame (refrigerant hoses remain connected).



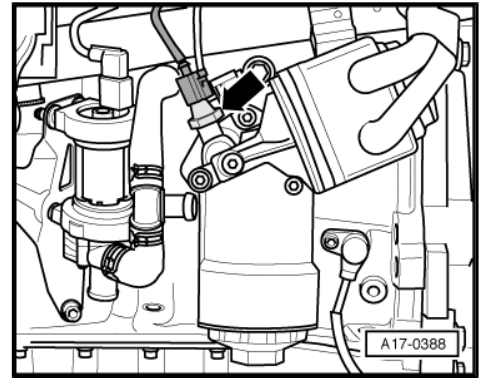
- Unplug electrical connector -arrow- at oil pressure switch - F1- using assembly tool - T10118- .
- Remove oil pressure switch - F1- .

Installing

- Tightening torque ➔ [page 155](#)

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

- Install air conditioner compressor ➔ Rep. gr. 87 .
- Install poly V-belt ➔ [page 46](#) .

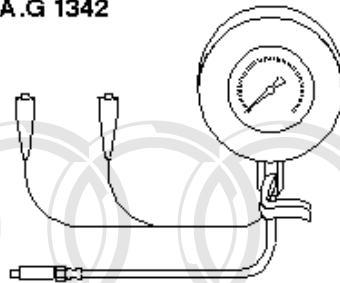


2.4 Checking oil pressure and oil pressure switch - F1-

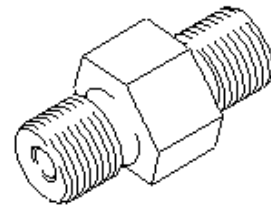
Special tools and workshop equipment required

- ◆ Oil pressure tester - V.A.G 1342-
- ◆ Adapter - V.A.G 1342/14-
- ◆ Voltage tester - V.A.G 1527B-
- ◆ Auxiliary measuring set - V.A.G 1594C-

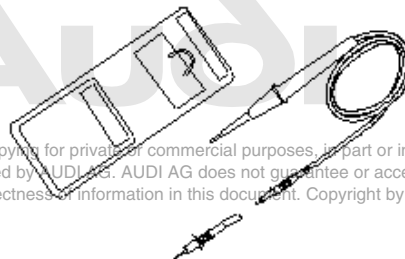
V.A.G 1342



V.A.G 1342/14



V.A.G 1527 B



V.A.G 1594 C



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G17-10005

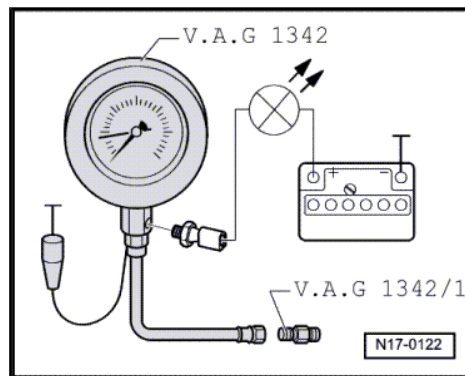
Procedure

- Oil level OK
- Engine oil temperature approx. 80 °C
- The message "OK" must light up in the driver information display.
- Remove oil pressure switch ➔ [page 158](#) .

- Connect oil pressure tester - V.A.G 1342- with adapter - V.A.G 1342/14- to bore for oil pressure switch.
- Screw oil pressure switch into oil pressure tester - V.A.G 1342- .
- Install guide tube for oil dipstick and insert oil dipstick.
- Install air conditioner compressor ⇒ Rep. gr. 87 .
- Install poly V-belt ⇒ [page 46](#) .

Checking oil pressure switch

- Connect brown wire of oil pressure tester to earth “-”.
- Connect voltage tester - V.A.G 1527B- with adapter leads from auxiliary measuring set - V.A.G 1594C- to oil pressure switch and battery positive (“+”).
- LED should not light up.
- Renew oil pressure switch if LED lights up when engine is not running.
- Start engine.



Note

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

- LED should light up at 1.2 ... 1.6 bar.
- Renew oil pressure switch if LED does not light up.

Checking oil pressure

- Start engine.
- Minimum oil pressure at 1500 rpm: 1.7 bar.
- Minimum oil pressure at 2000 rpm: 2.5 bar.

Assembling

- Install oil pressure switch ⇒ [page 158](#) .

2.5 Engine oil

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

2.6 Checking oil level

Procedure

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

Markings on oil dipstick:

a - Do not top up oil.

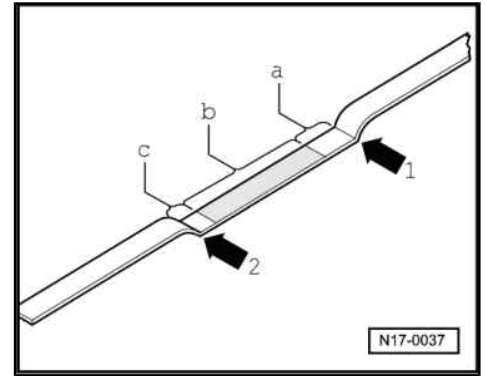
b - Oil may be topped up. The oil level may rise as far as area -a- after topping up.

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



Note

The oil level must not be above the MAX marking -arrow 1- and not below the MIN marking -arrow 2-.



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19 – Cooling

1 Removing and installing parts of cooling system



WARNING

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

- ◆ *The cooling system is under pressure when the engine is hot.*
- ◆ *Cover filler cap on coolant expansion tank with a cloth and open carefully to dissipate pressure.*



Note

- ◆ *The cooling system is under pressure when the engine is hot. If necessary, relieve pressure before commencing repair work.*
- ◆ *The arrow markings on coolant pipes and on ends of hoses must align.*

1.1 Diagram of coolant hose connections



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1 - Radiator

- ☐ Removing and installing
⇒ [page 186](#)
- ☐ If renewed, refill system
with fresh coolant

2 - Non-return valve

3 - Continued coolant circulation pump - V51-

- ☐ Removing and installing
⇒ [page 183](#)

4 - Oil cooler

- ☐ If renewed, refill system
with fresh coolant

5 - Coolant pump

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

6 - Cylinder head/cylinder block

- ☐ If renewed, refill system
with fresh coolant

7 - Expansion tank

8 - Filler cap for expansion tank

- ☐ With pressure relief
valve
- ☐ Checking pressure relief
valve ⇒ [page 192](#)

9 - Throttle valve module - J338-

10 - Heat exchanger

- ☐ If renewed, refill system
with fresh coolant

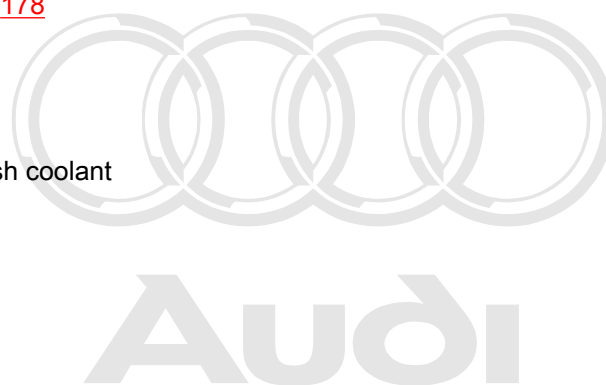
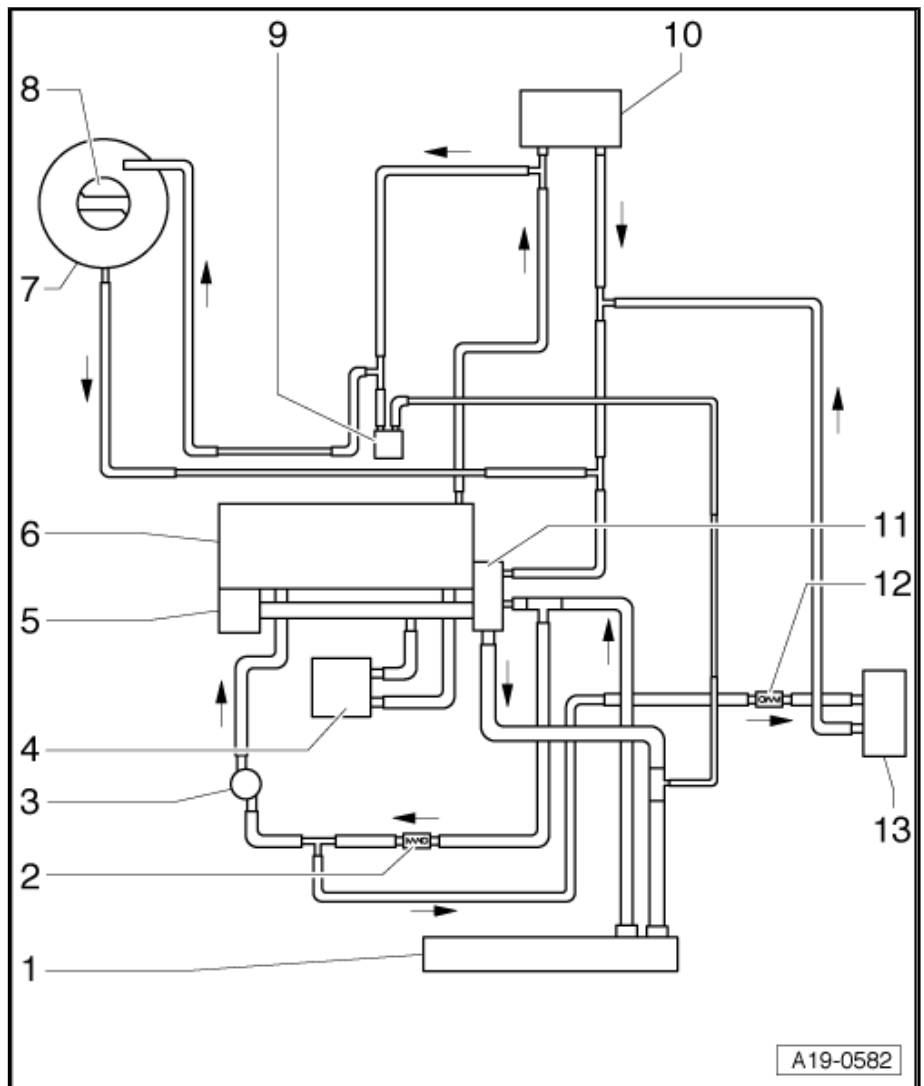
11 - Thermostat

- ☐ Removing and installing ⇒ [page 178](#)
- ☐ Checking ⇒ [page 179](#)

12 - Non-return valve

13 - Gear oil cooler

- ☐ If renewed, refill system
with fresh coolant

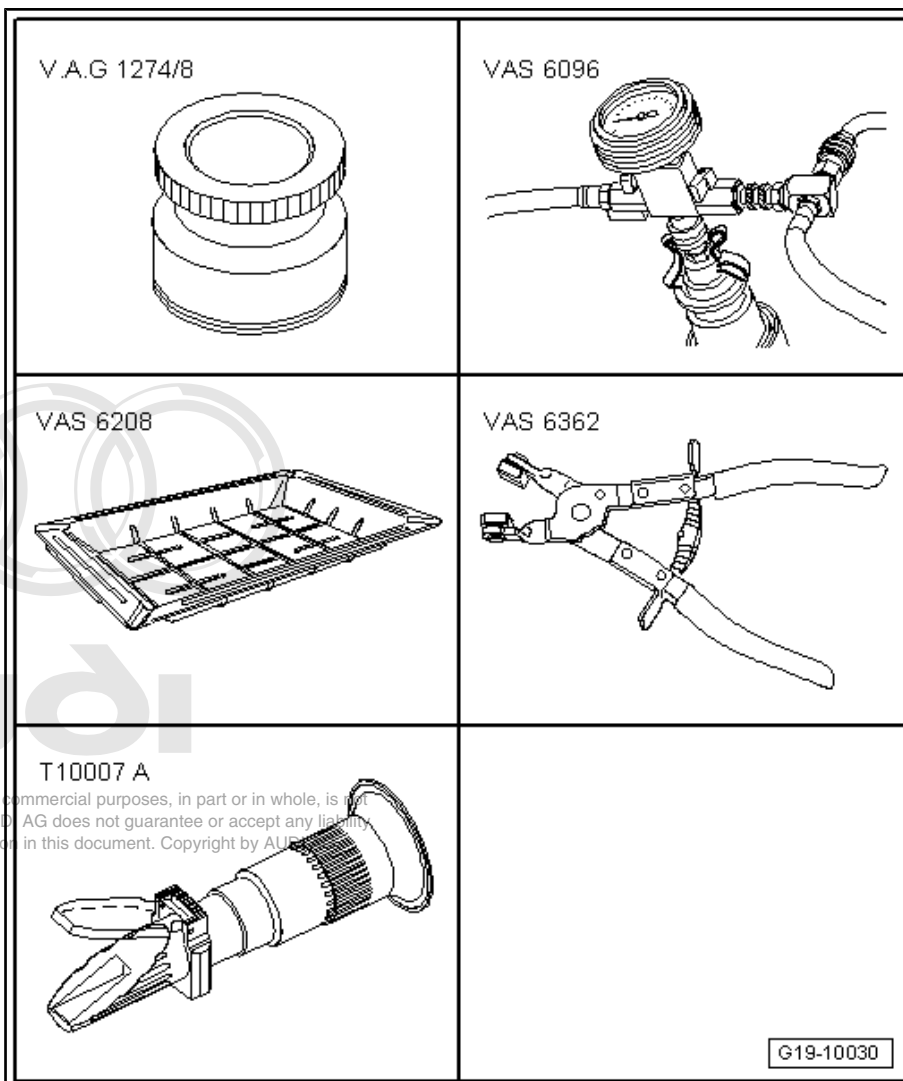


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1.2 Draining and filling cooling system

Special tools and workshop equipment required

- ◆ Adapter for cooling system tester - V.A.G 1274/8-
- ◆ Cooling system charge unit - VAS 6096- with - VAS 6096/1-
- ◆ Drip tray for workshop hoist - VAS 6208-
- ◆ Hose clip pliers - VAS 6362-
- ◆ Refractometer - T10007 A-



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Draining



Note

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



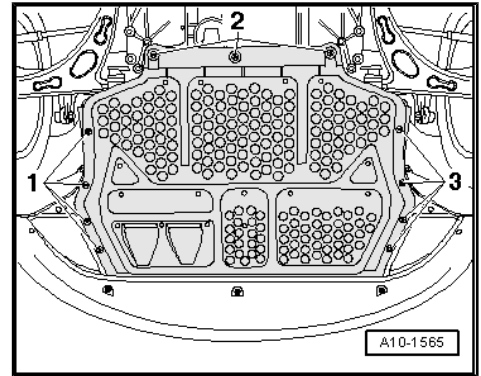
WARNING

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

- ◆ The cooling system is under pressure when the engine is hot.
- ◆ Cover filler cap on coolant expansion tank with a cloth and open carefully to dissipate pressure.

- Open filler cap on coolant expansion tank.

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



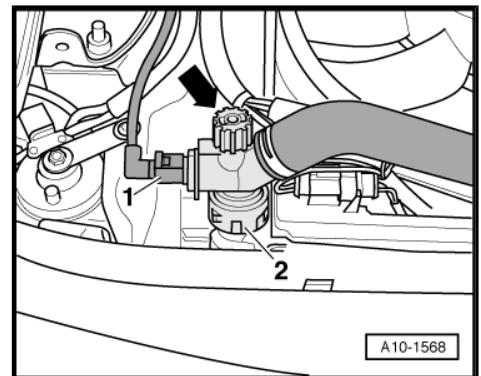
- Place drip tray for workshop hoist - VAS 6208- under engine.

Vehicles with drain plug:

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

Vehicles without drain plug:

- Remove bottom coolant hose -2- from radiator by pulling off retaining clip.

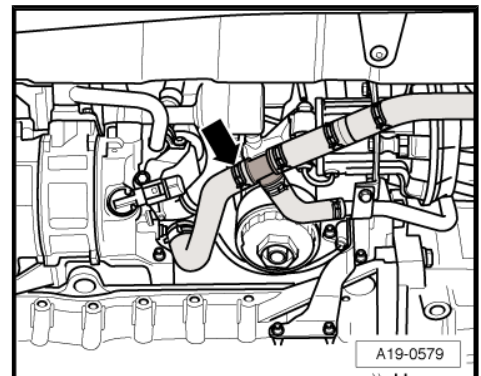


Disregard -item 1-.

All vehicles (continued):

- Drain cooling system.
- In addition, remove lower coolant hose to continued circulation coolant pump - V51- -arrow- and drain off remaining coolant.

Filling



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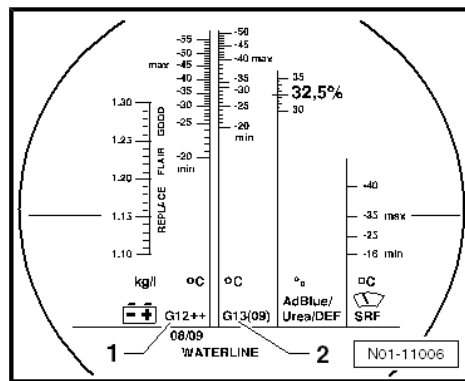


Note

- ◆ *The effectiveness of the coolant is greatly influenced by the quality of the water with which it is mixed. Because water may contain different substances depending on the country or even the region, Audi has decided to specify the water quality for cooling systems. Distilled water meets all the requirements. It is therefore recommended to use distilled water when topping up or filling up with coolant (also applies to all older models).*
- ◆ *Use only coolant additives listed in the ⇒ [Electronic parts catalogue](#) . Other coolant additives could seriously impair in particular the anti-corrosion properties. The resulting damage could lead to loss of coolant and consequently to serious engine damage.*
- ◆ *Coolant with the recommended mixture ratio ⇒ [page 166](#) prevents frost and corrosion damage and stops scaling. At the same time it raises the boiling point of the fluid in the system. For this reason the cooling system must be filled all year round with the correct coolant 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 -36 °C).*
- ◆ *The coolant concentration must not be reduced by adding water even in warmer seasons and in warmer countries. The antifreeze concentration must be at least 40 %.*
- ◆ *If greater frost protection is required in very cold climates, the amount of antifreeze can be increased, but only up to 60 %, as otherwise frost protection decreases again, and the cooling efficiency is also impaired.*
- ◆ *For checking anti-freeze protection in cooling system with coolant generation G13, refractometer - T10007 A- MUST be used.*
- ◆ *Read off the level of frost protection on the scale for the relevant coolant additive.*
- ◆ *Do not reuse coolant.*
- ◆ *Secure all hose connections with correct type of hose clips (as original equipment) ⇒ [Electronic parts catalogue](#) .*

Recommended mixture ratio for coolant

- Coolant (40 %) and water (60 %) for frost protection to -25 °C
- Coolant (50 %) and water (50 %) for frost protection to -36 °C
- Coolant ⇒ [Electronic parts catalogue](#)



Vehicles with drain plug:

- Close drain plug -arrow-.

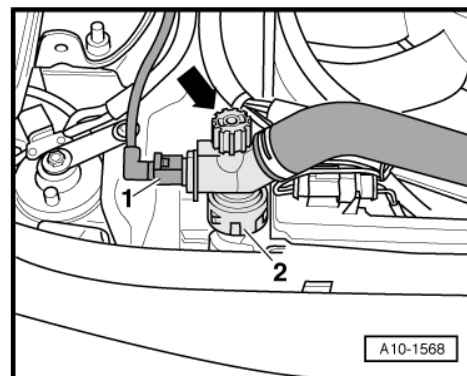
Vehicles without drain plug:

- Connect coolant hose to lower part of radiator -2-.



Note

Disregard -item 1-.



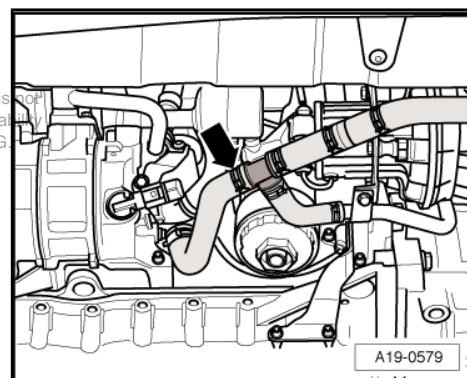
All vehicles (continued):

- Connect coolant hose to continued circulation coolant pump - V51- -arrow-.

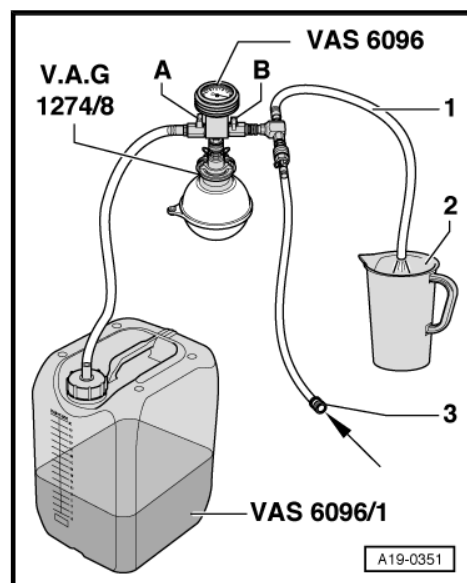


Note

Illustration shows vehicle with direct shift gearbox.



- Fill reservoir - VAS 6096/1- with at least 10 litres of premixed coolant (based on recommended ratio ➔ [page 166](#)).
- Screw adapter for cooling system tester - V.A.G 1274/8- onto coolant expansion tank.
- Attach cooling system charge unit - VAS 6096- onto adapter - V.A.G 1274/8- .
- Run vent hose -1- into a small container -2-. (The vented air draws along a small amount of coolant, which should be collected.)
- Close the two valves -A- and -B- by setting lever at right angle to direction of flow.
- Connect hose -3- to compressed air.
- Pressure: 6 ... 10 bar.



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

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

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

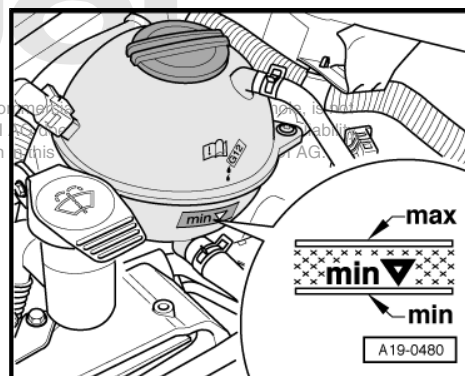
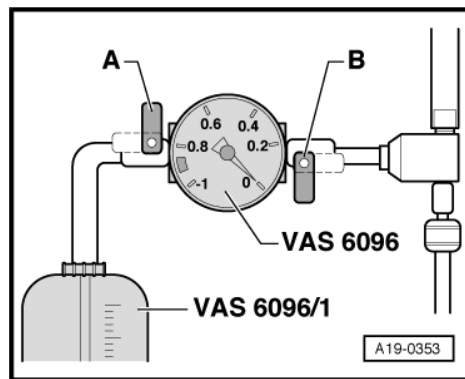
If the needle does not reach the green zone, repeat the process.

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

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

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

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



WARNING

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

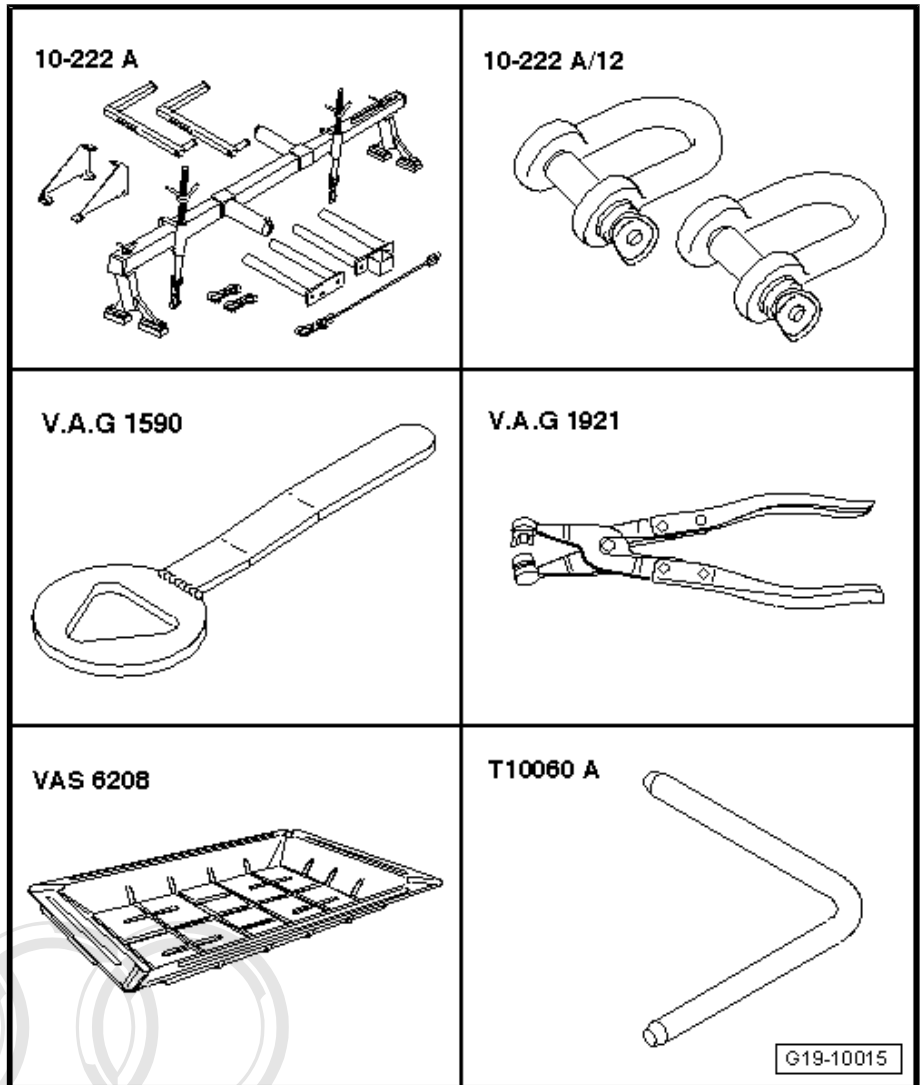
- ◆ **The cooling system is under pressure when the engine is hot.**
- ◆ **Cover filler cap on coolant expansion tank with a cloth and open carefully to dissipate pressure.**

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

1.3 Removing and installing coolant pump

Special tools and workshop equipment required

- ◆ Support bracket - 10-222 A-
- ◆ Shackle - 10-222 A/12-
- ◆ Water pump wrench - V.A.G 1590-
- ◆ Hose clip pliers - V.A.G 1921-
- ◆ Drip tray for workshop hoist - VAS 6208-
- ◆ Locking pin - T10060 A-
- ◆ Bolt M8x40



Removing



WARNING

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

◆ **The cooling system is under pressure when the engine is hot.**

◆ **Cover filler cap on coolant expansion tank with a cloth and open carefully to dissipate pressure.**

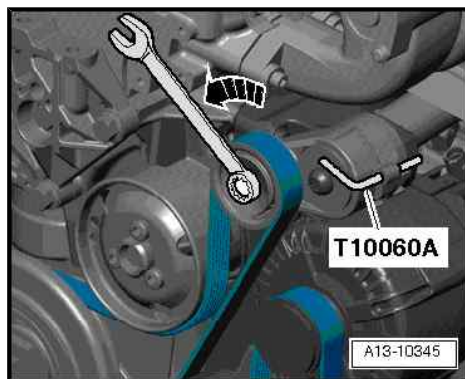
- Open filler cap on coolant expansion tank.



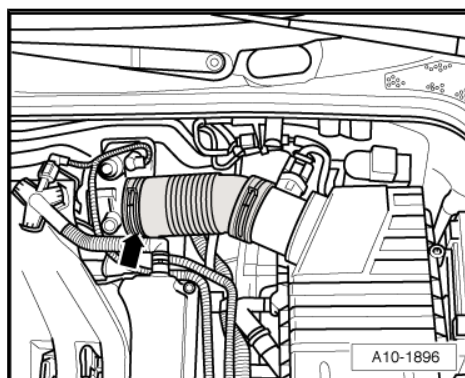
Note

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

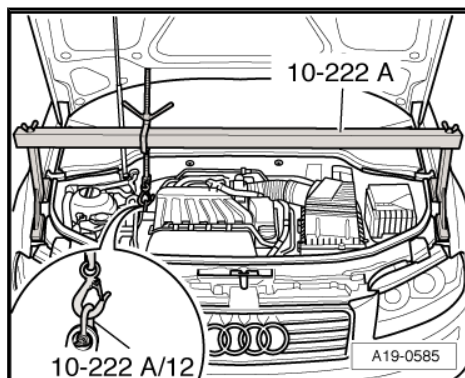
- Turn tensioner in direction of -arrow- to slacken poly V-belt and lock in position with locking pin - T10060 A- .
- Remove poly V-belt.



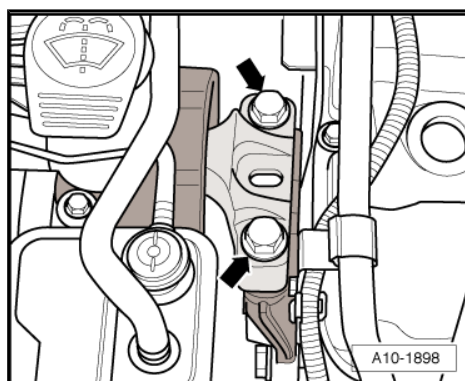
- **Detach air hose -arrow- at the throttle valve module J338-**



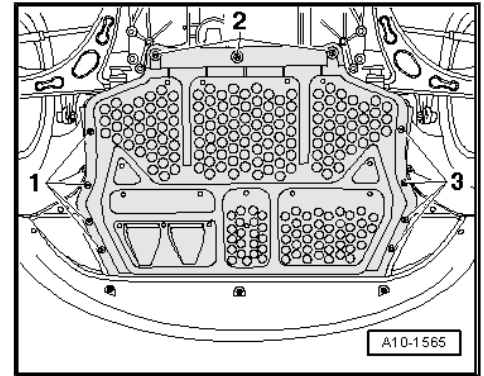
- Attach the shackle - 10-222 A/12- to the engine lifting eye (rear right).
- Set up support bracket - 10-222 A- on wing panel flanges.
 - The spindle is located at rear.
- Attach spindle hook to shackle.
- Pretension the spindle slightly.



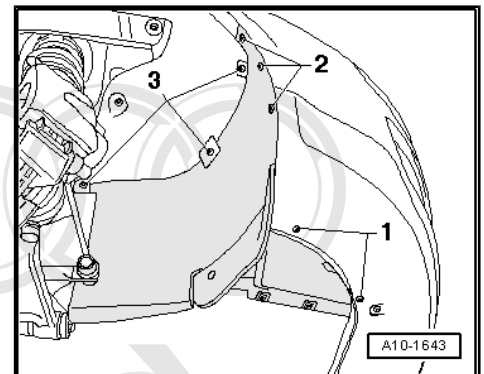
- Loosen bolts -arrows- of assembly mounting (left-side) at engine.



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



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



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

Vehicles with drain plug:

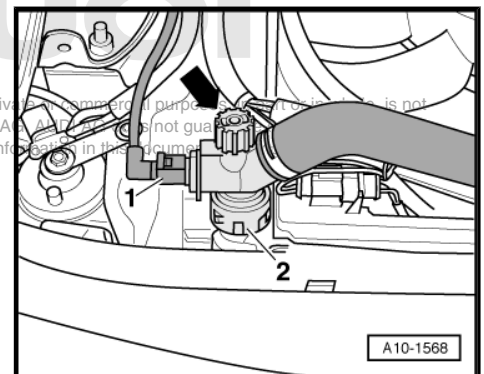
- Turn drain plug -arrow- on radiator anti-clockwise, if necessary fit drain hose to connection.

Vehicles without drain plug:

- Remove bottom coolant hose -2- from radiator by pulling off retaining clip.

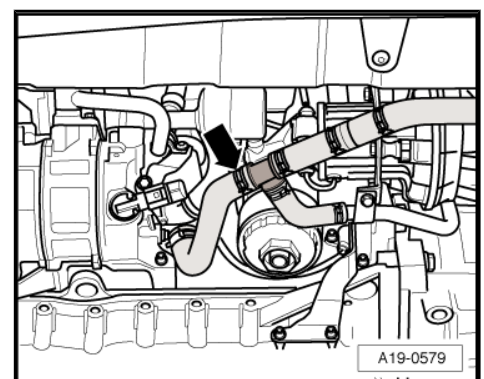
All vehicles (continued):

- Unplug electrical connector -1- at radiator outlet coolant temperature sender - G83- .
- In addition, remove lower coolant hose to continued circulation coolant pump - V51- -arrow- and drain off remaining coolant.

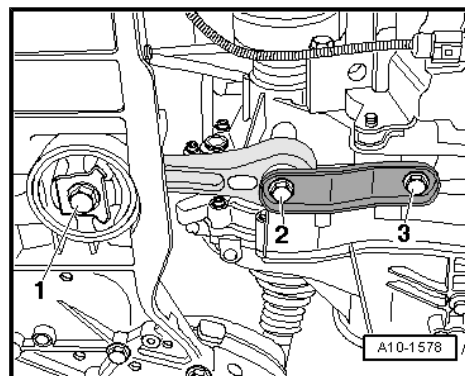


Note

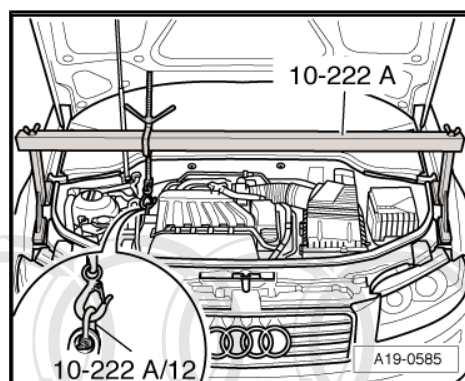
Illustration shows vehicle with direct shift gearbox.



- Remove -bolts 1 ... 3- and detach pendulum support.
- Unclip bracket for wire to oil level and oil temperature sender - G266- at subframe.



- Lower engine via spindle approx. 60 mm.



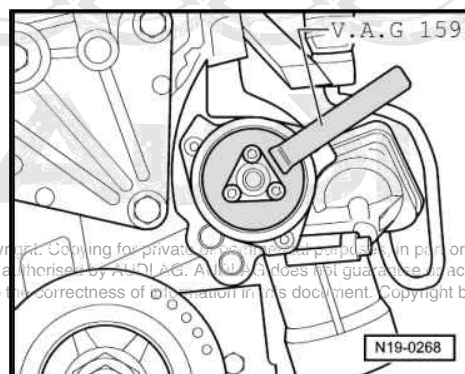
- Remove pulley; counterhold using water pump spanner - V.A.G 1590- .



Note

The pulley must not be removed if the engine has been taken out. In this case, the securing bolts for coolant pump are accessible through the bores of the pulley.

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- Unscrew bolts -1- for coolant pump -2-.
- Swing the coolant pump forwards and remove.

Installing

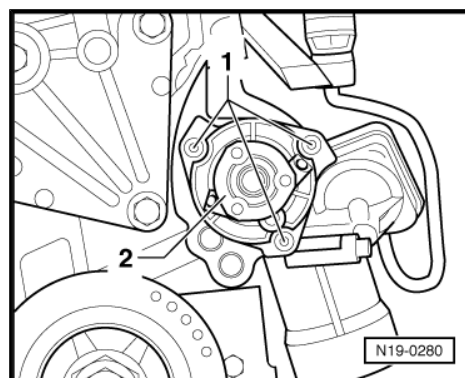
Installation is carried out in the reverse order; note the following:



Note

Renew O-ring.

- Clean and smoothen sealing surface for O-ring as required.
- Lubricate the new O-ring with coolant additive.

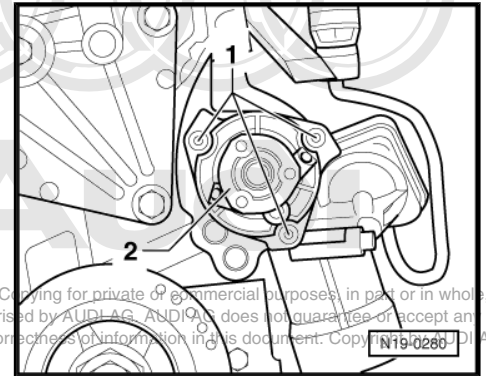


- Fit coolant pump -2-.
- Tighten bolts -1- for coolant pump.
- Install the pulley.
- Install poly V-belt ➔ [page 46](#) .
- Fill cooling system ➔ [page 165](#) .
- Adjust engine mountings ➔ [page 40](#) .

Tightening torques

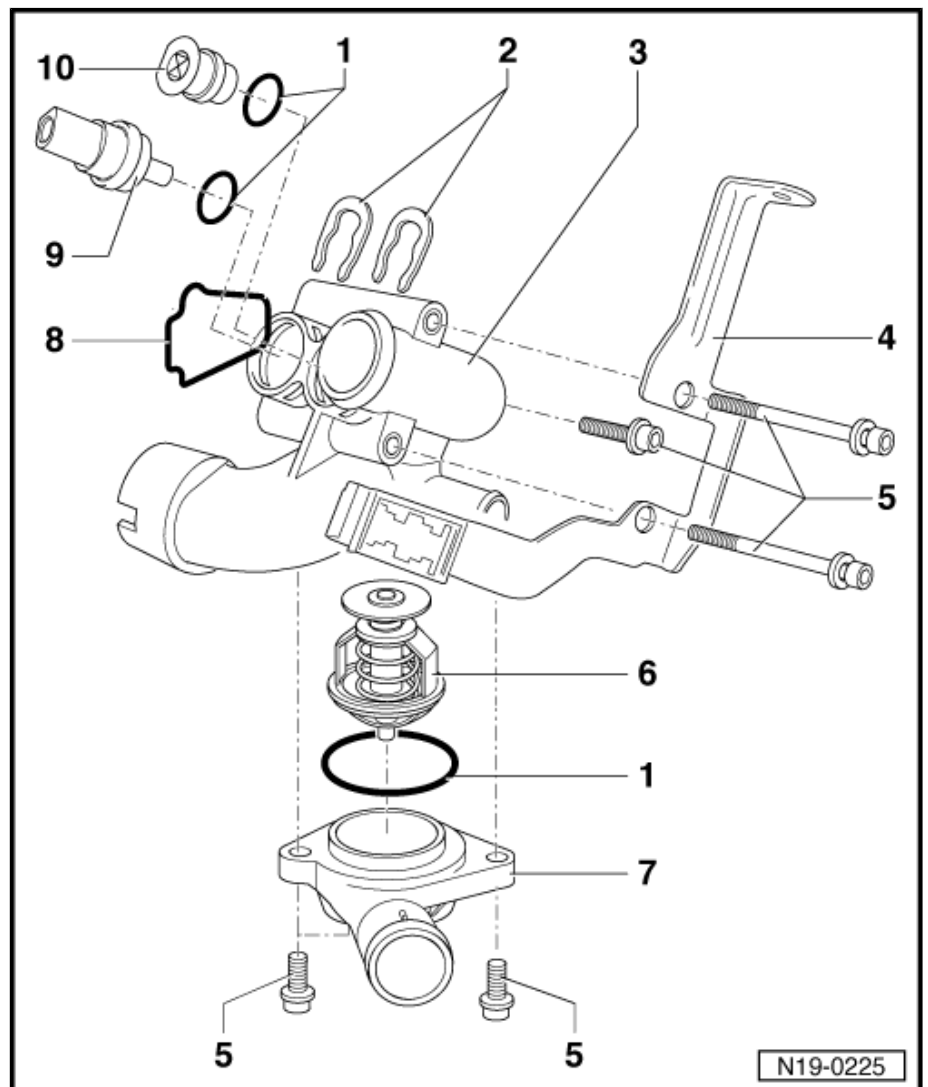
Component	Nm
Coolant pump to cylinder block	8
Pulley to coolant pump	20

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1.4 Thermostat housing - exploded view of components

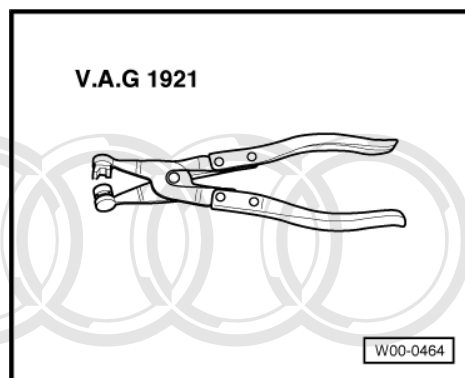
- 1 - O-ring
 - ☐ Renew
- 2 - Retaining clip
- 3 - Thermostat housing
 - ☐ Removing and installing ➔ [page 173](#)
- 4 - Bracket
- 5 - 10 Nm
- 6 - Thermostat
 - ☐ Removing and installing ➔ [page 178](#)
 - ☐ Checking ➔ [page 179](#)
- 7 - Connection
- 8 - Gasket
 - ☐ Renew
- 9 - Coolant temperature sender - G62-
 - ☐ With coolant temperature sender - G2-
 - ☐ Dissipate cooling system pressure before removal if necessary
- 10 - Sealing plug
 - ☐ Dissipate cooling system pressure before removal if necessary



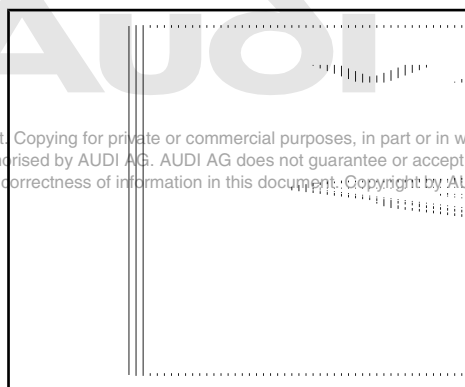
1.5 Removing and installing thermostat housing

Special tools and workshop equipment required

- ◆ Hose clip pliers - V.A.G 1921-



- ◆ Drip tray for workshop hoist - VAS 6208-



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Removing



Note

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

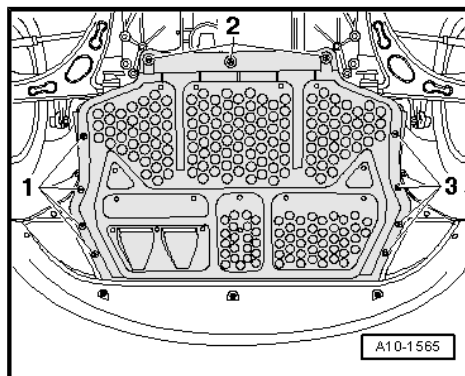


WARNING

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

- ◆ The cooling system is under pressure when the engine is hot.
- ◆ Cover filler cap on coolant expansion tank with a cloth and open carefully to dissipate pressure.

- Open filler cap on coolant expansion tank.
- Remove centre noise insulation -fasteners 1 ... 3-.



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

Vehicles with drain plug:

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

Vehicles without drain plug:

- Remove bottom coolant hose -2- from radiator by pulling off retaining clip.

All vehicles (continued):

- Unplug electrical connector -1- at radiator outlet coolant temperature sender - G83- .
- In addition, remove lower coolant hose to continued circulation coolant pump - V51- -arrow- and drain off remaining coolant.



Note

Illustration shows vehicle with direct shift gearbox.



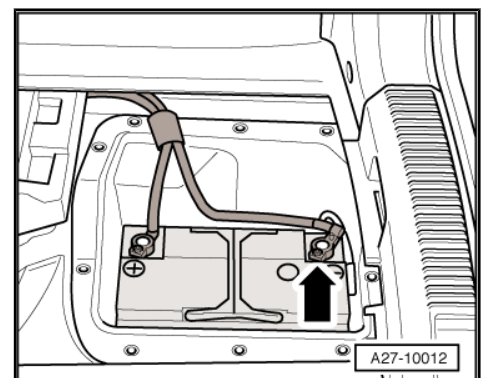
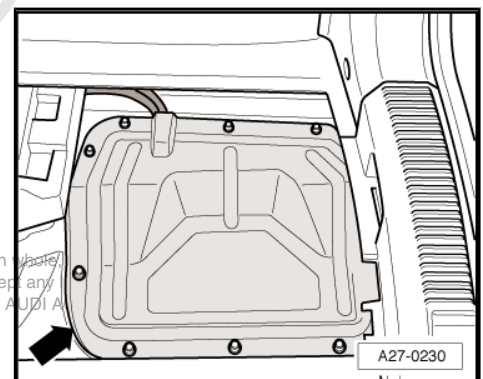
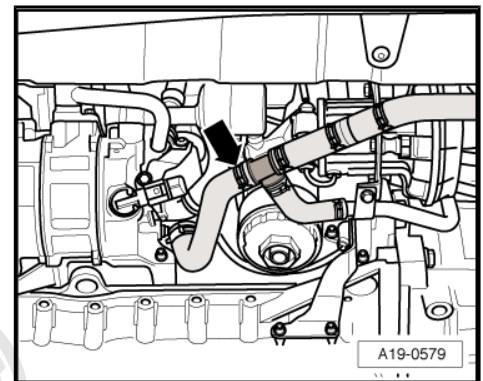
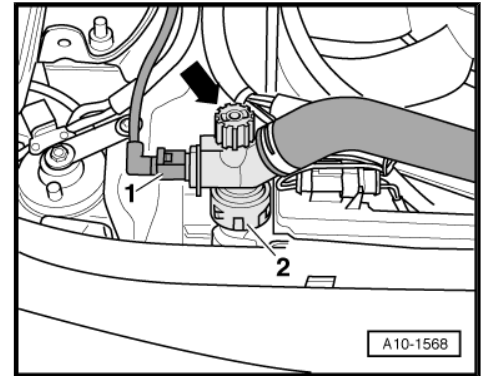
Caution

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

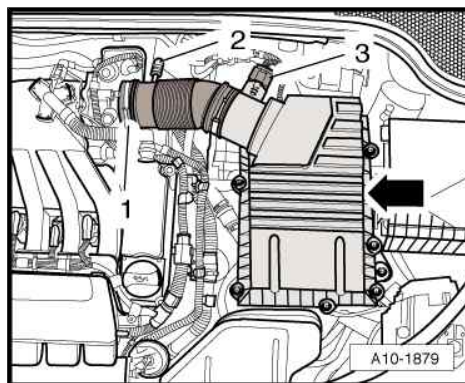
- Remove the moulded insert for tools from beneath the luggage compartment floor cover.
- Unscrew the lid -arrow- of the battery compartment.
- Remove moulded insert from top of battery.

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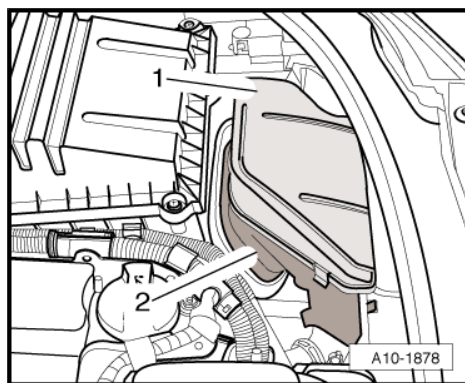
- With ignition switched off, disconnect earth wire -arrow- at battery.



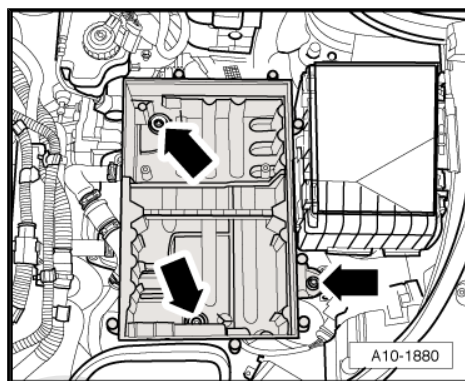
- Detach vacuum hose -2- from air intake hose (if fitted).
- Detach air hose -1- at the throttle valve module - J338- .
- Unplug electrical connector for air mass meter - G70- -item 3-.
- Unscrew air cleaner housing (upper section) -arrow-.
- Take out filter element.



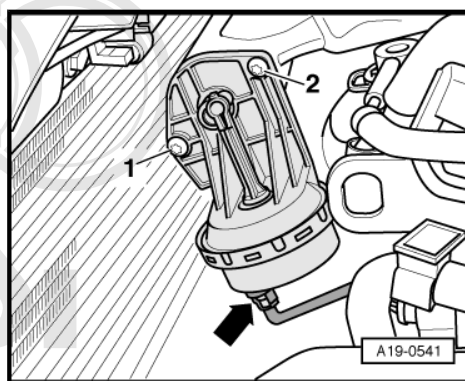
- Pull cover -1- off air duct (release clips on sides).
- Unclip air duct -2-.



- Unscrew air cleaner housing (lower section) -arrows-.

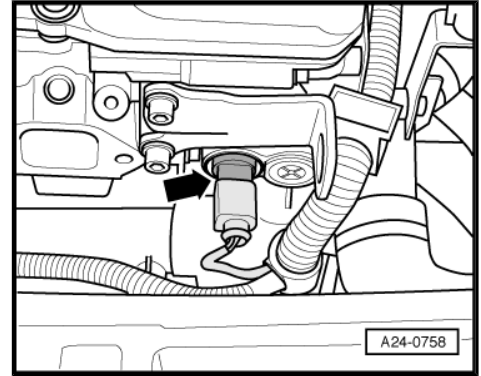


- Disconnect vacuum hose -arrow- at actuator for intake manifold change-over.
- Unscrew bolts -1- and -2- and detach actuator from intake manifold.

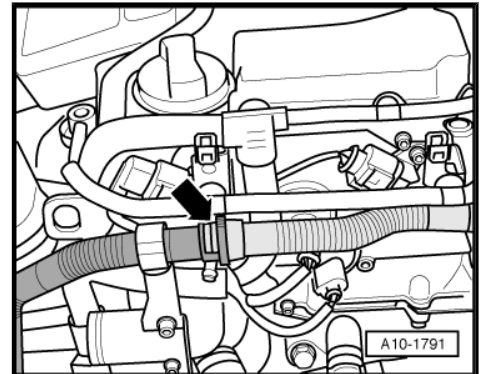


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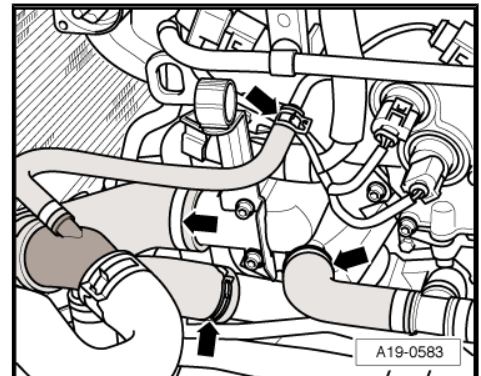
- Unplug electrical connector -arrow- at coolant temperature sender - G62- .



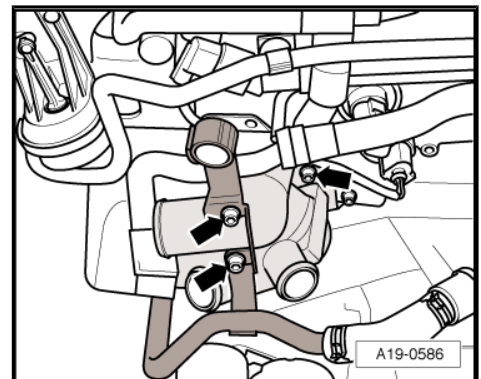
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- Disconnect secondary air hose at the position marked with an -arrow-.
 - Move air hose at bracket clear.



- Detach coolant hoses at the connections indicated -arrows-.



- Remove bolts -arrows-.
- Pull bracket for coolant pipe for gear oil cooler to the left.
- Swing the bracket for secondary air hose forwards.

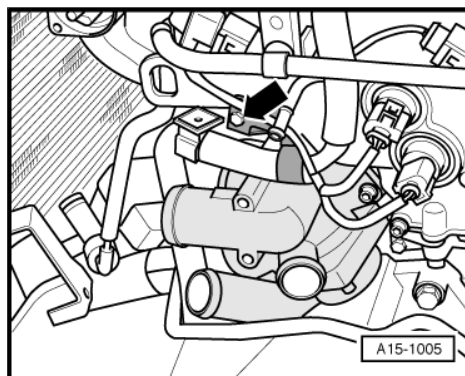


- Remove bolt -arrow- on bracket for wiring harness.



Caution

When removing the thermostat housing, push coolant pipe towards coolant pump with an assembly lever to prevent it from also being detached.



- Remove thermostat housing -2-; when doing so, press the coolant pipe -1- towards the coolant pump with an assembly lever.

Installing

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



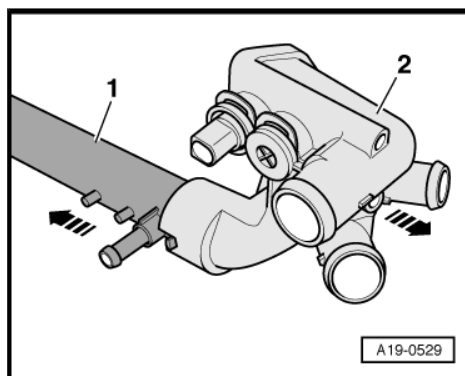
Note

Renew seals and gaskets.

- Fill cooling system ➔ [page 165](#) .
- Connect battery. Procedures required ➔ Rep. gr. 27 .

Tightening torques

Component	Nm
Thermostat housing to engine	10
Bracket for wiring harness to engine	10
Air cleaner housing to body	10



1.6 Removing and installing thermostat

Removing

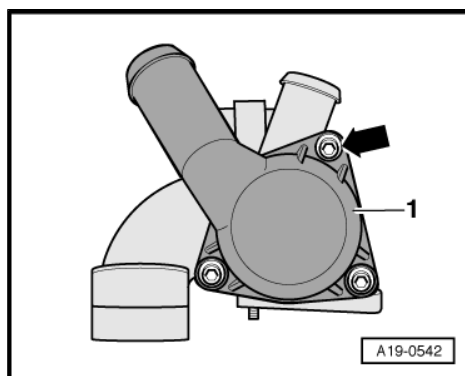
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Note

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

- Remove thermostat housing ➔ [page 173](#) .
- Unscrew bolts -arrows- and remove connection -1-.



- Remove the O-ring -3- with thermostat -2- from the thermostat housing -1-.

Installing

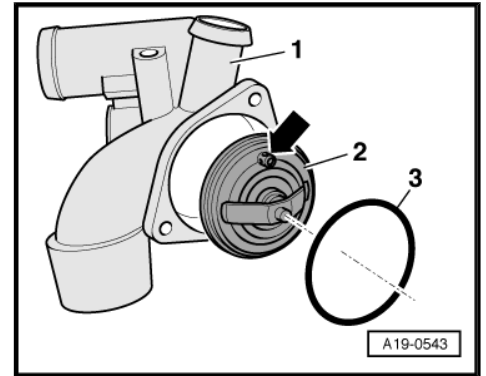
Installation is carried out in the reverse order; note the following:



Note

Renew gaskets and seals.

- Clean the sealing surface for O-ring.
- Insert thermostat.
- Installation position: position the vent valve -arrow- as shown in the illustration.
- Lubricate new O-ring -1- with coolant.
- Secure connection to thermostat housing.
- Install thermostat housing ➔ [page 173](#) .



Tightening torque

Component	Nm
Connection to thermostat housing	10

1.7 Checking thermostat

- Thermostat removed.
- Heat up the thermostat in a tub of water.

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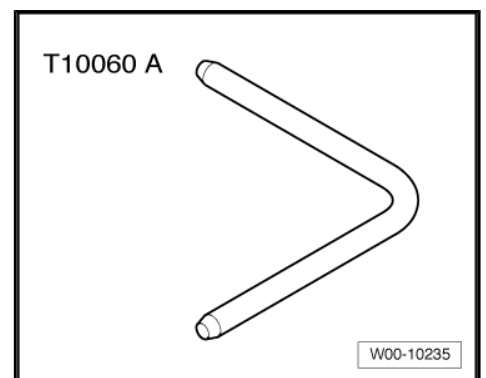
Starts to open	Fully open	Opening travel
approx. 80 °C	approx. 105 °C ¹⁶⁾	at least 7 mm

¹⁶⁾ Cannot be tested.

1.8 Removing and installing coolant pipe

Special tools and workshop equipment required

- ◆ Locking pin - T10060 A-



Removing



Note

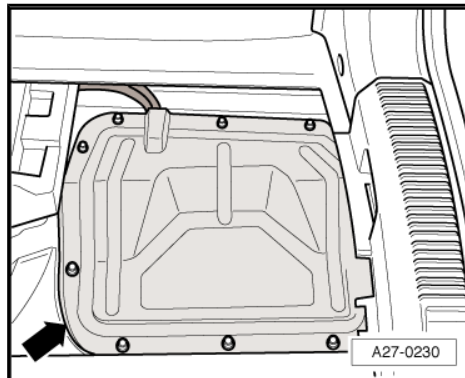
Collect drained coolant in a clean container for re-use or disposal.



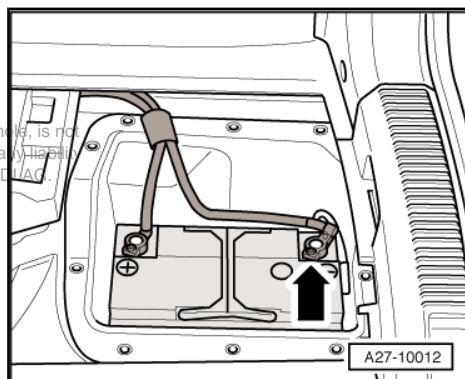
Caution

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

- Remove the moulded insert for tools from beneath the luggage compartment floor cover.
- Unscrew the lid -arrow- of the battery compartment.
- Remove moulded insert from top of battery.



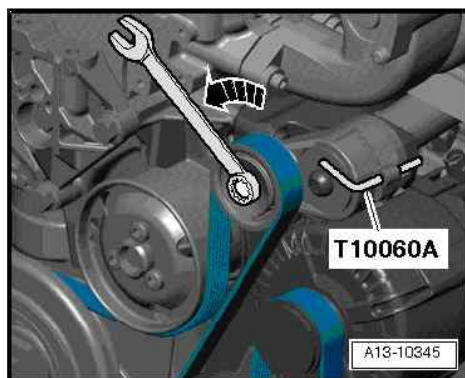
- With ignition switched off, disconnect earth wire -arrow- at battery.
- Remove thermostat housing ⇒ [page 173](#).
- Pull out oil dipstick.



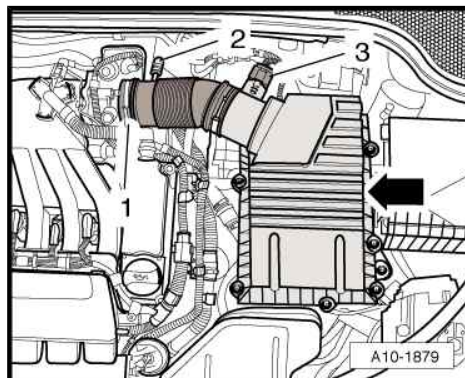
Note

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

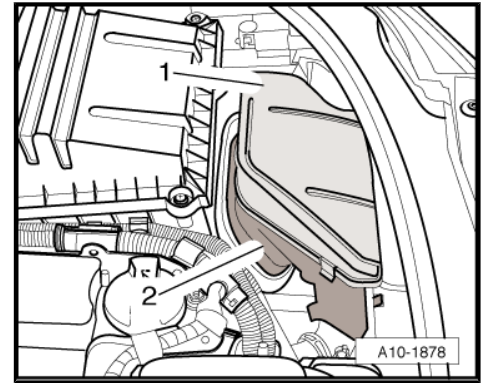
- Turn tensioner in direction of -arrow- to slacken poly V-belt and lock in position with locking pin - T10060 A-.



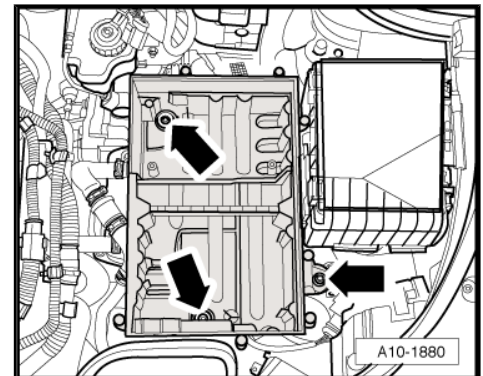
- Detach vacuum hose -2- from air intake hose (if fitted).
- Detach air hose -1- at the throttle valve module - J338-.
- Unplug electrical connector for air mass meter - G70- -item 3-.
- Unscrew air cleaner housing (upper section) -arrow-.
- Take out filter element.



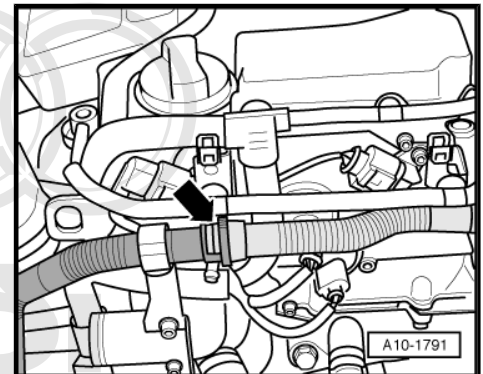
- Pull cover -1- off air duct (release clips on sides).
- Unclip air duct -2-.



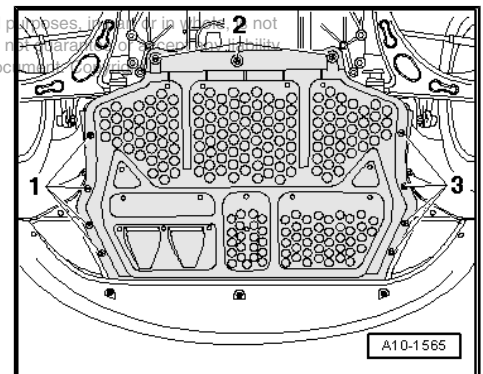
- Unscrew air cleaner housing (lower section) -arrows-.



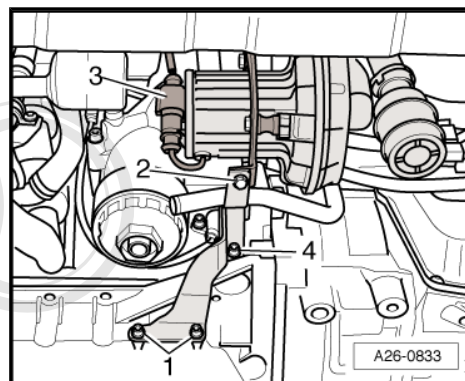
- Disconnect secondary air hose at the position marked with an -arrow-.
- Move air hose to secondary air pump clear.



- Remove centre noise insulation fasteners 1, 2, 3.



- Move coolant hose at bottom of radiator cowl clear.
- Detach electrical connector -3- at secondary air pump motor - V101- and move wire clear.
- Unscrew bracket -2- for coolant pipe going to gear oil cooler on vehicles with direct shift gearbox.
- Remove bolts -1-.
- Loosen bolt -4- and remove secondary air pump with bracket.



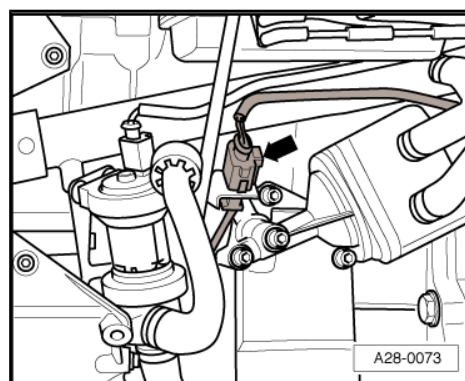
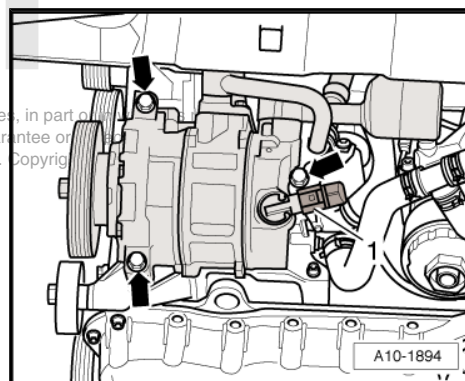
- Unplug electrical connector -1- for magnetic clutch at air conditioner compressor and move electrical wiring clear.


WARNING

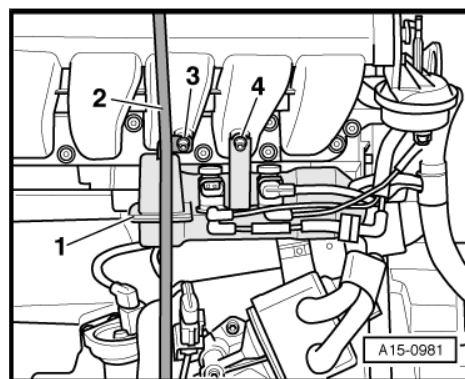
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The air conditioner refrigerant circuit must not be opened.

- Unscrew bolts -arrow- for air conditioner compressor.
- Tie up air conditioner compressor together with refrigerant hoses at front of longitudinal member (refrigerant hoses remain connected).
- Unhook connector -arrow- for engine speed sender - G28- from bracket on guide tube for oil dipstick.



- Unscrew bolt -3- and pull out guide tube for oil dipstick -2-.
- Unscrew bolt -4- and detach vacuum reservoir -1- from manifold.
- Move vacuum reservoir to side (hoses remain attached).



- Unplug electrical connector -3- at continued circulation coolant pump - V51- -Item 2-.
- Pull the pump downwards out of the rubber retainers on bracket. If necessary, spray rubber retainers with silicone-free lubricant.
- Unscrew bracket for continued circulation coolant pump - V51- .
- Unclip bracket for wiring harness (right-side) from coolant pipe.
- Disconnect wiring harness (left-side) from bracket at coolant pipe.
- Disconnect coolant hose to oil cooler at coolant pipe.
- Pull coolant pipe out of cylinder block.

Installing

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



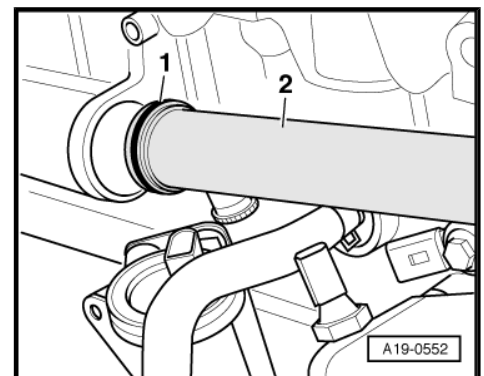
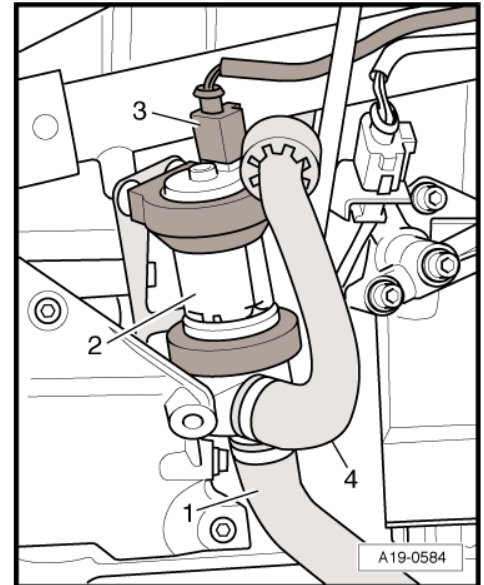
Note

Renew O-rings.

- Before installing, clean and smoothen sealing surface for O-ring in cylinder block.
- Lubricate new O-ring -1- with coolant additive and push O-ring onto coolant pipe -2-.
- Push coolant pipe into bore on cylinder block.
- Install thermostat housing ⇒ [page 173](#) .
- Install air conditioner compressor ⇒ Rep. gr. 87 .
- Install poly V-belt ⇒ [page 46](#) .
- Fill cooling system ⇒ [page 165](#) .

Tightening torque

Component	Nm
Bracket for coolant pump to bracket for ancillary units	10

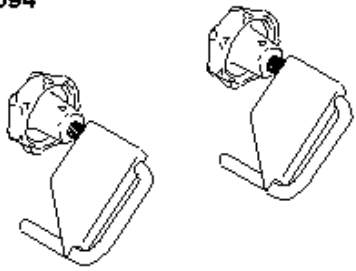
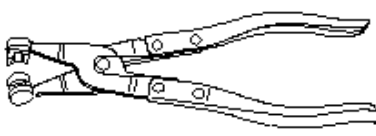
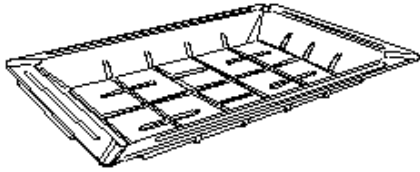


1.9 Removing and installing continued coolant circulation pump - V51-

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Special tools and workshop equipment required

- ◆ Hose clamps up to Ø 25 mm - 3094-
- ◆ Hose clip pliers - V.A.G 1921-
- ◆ Drip tray for workshop hoist - VAS 6208-

3094 	V.A.G 1921 
VAS 6208 	
	G19-10017

Removing



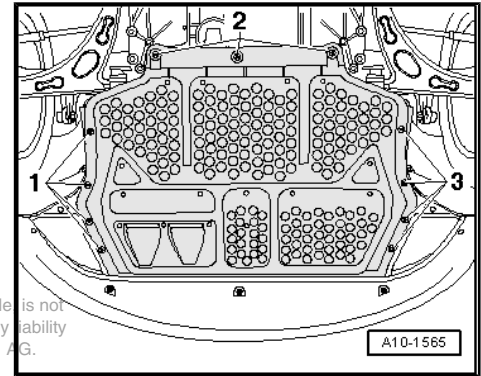
WARNING

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

- ◆ *The cooling system is under pressure when the engine is hot.*
- ◆ *Cover filler cap on coolant expansion tank with a cloth and open carefully to dissipate pressure.*

- Open filler cap on coolant expansion tank.

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



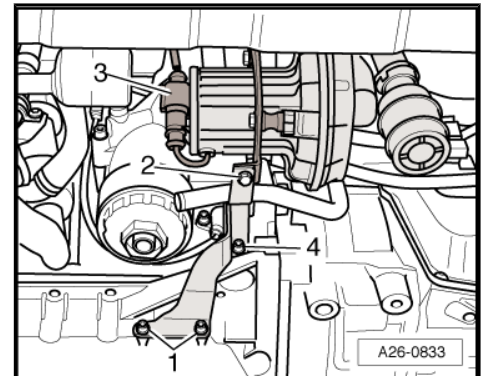
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- Move coolant hose at bottom of radiator cowl clear.
- Unscrew bracket -2- for coolant pipe going to gear oil cooler on vehicles with direct shift gearbox.



Note

Ignore items marked -1-, -3- and -4-.



- Unplug electrical connector -3- at continued circulation coolant pump - V51- -Item 2-.
- Pull the continued circulation coolant pump - V51- downwards out of the rubber retainers on bracket. If necessary, spray rubber retainers with silicone-free lubricant.
- Place drip tray for workshop hoist - VAS 6208- under engine.
- Clamp off coolant hoses -1- and -4- using hose clamps - 3094- and detach from continued circulation coolant pump - V51- .

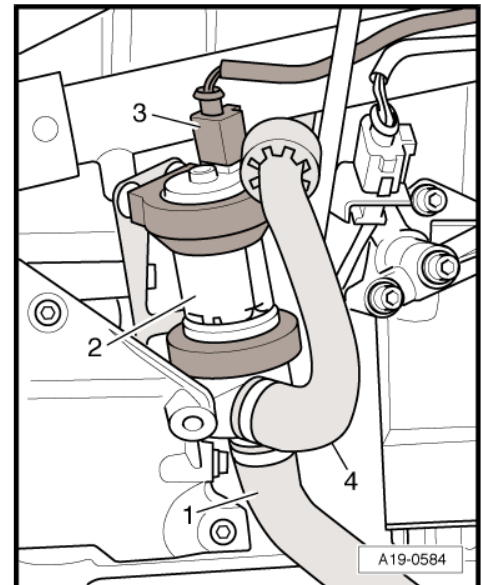
Installing

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

- Fill cooling system ➔ [page 165](#) .

Tightening torque

Component	Nm
Bracket for coolant hose to bracket for secondary air pump	10



1.10 Radiator and radiator fans - exploded view of components

1 - Radiator fan - V7-

- ☐ Removing and installing ➔ [page 192](#)
- ☐ Note routing of wiring ➔ [page 193](#)

2 - 5 Nm

3 - Coolant hose (bottom)

- ☐ To connection for thermostat

4 - Retaining clip

5 - Radiator fan thermal switch - F18-, - 35 Nm

6 - O-ring

- ☐ Renew

7 - O-ring

- ☐ Renew if damaged

8 - Coolant hose (top)

- ☐ To connection at cylinder head

9 - O-ring

- ☐ Renew if damaged

10 - Radiator

- ☐ Removing and installing ➔ [page 186](#)
- ☐ If renewed, change coolant in entire system

11 - Bracket

- ☐ For radiator

12 - 5 Nm

13 - Mounting

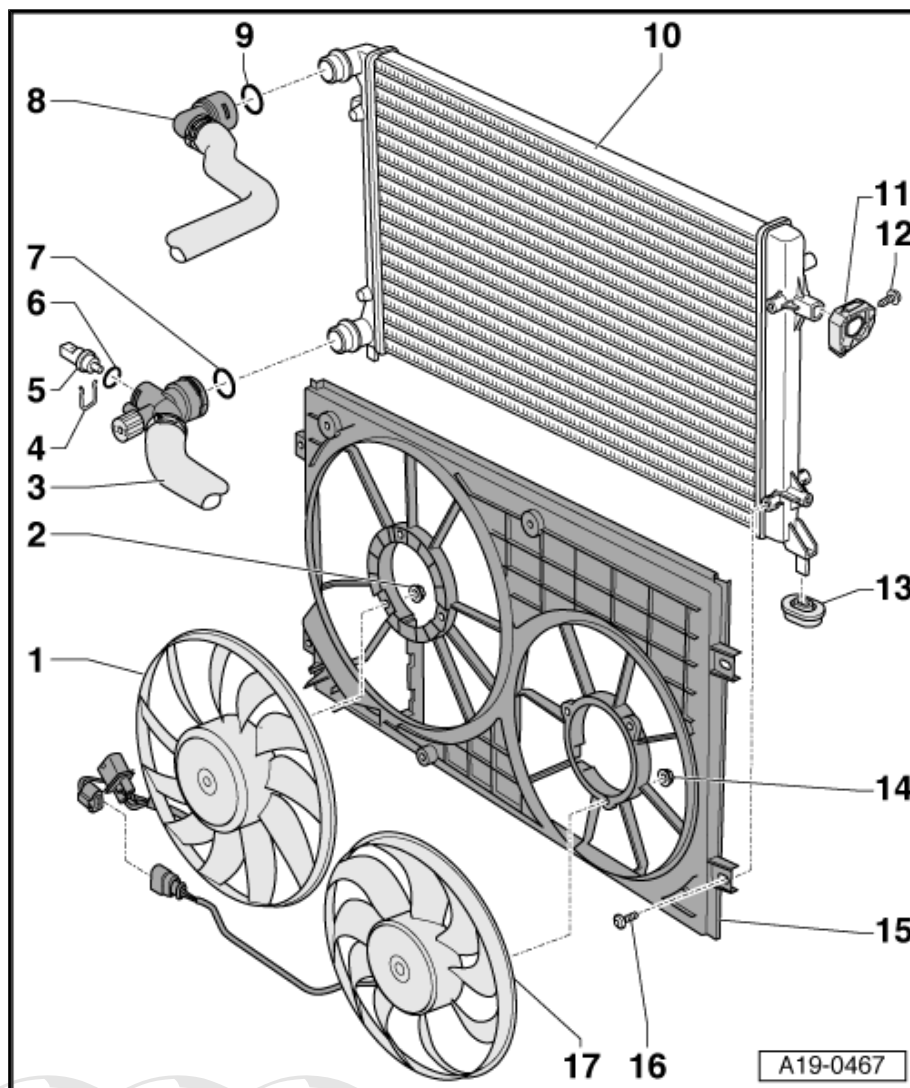
14 - 5 Nm

15 - Radiator cowl

16 - 5 Nm

17 - Radiator fan 2 - V177-

- ☐ Removing and installing ➔ [page 192](#)
- ☐ Note routing of wiring ➔ [page 193](#)

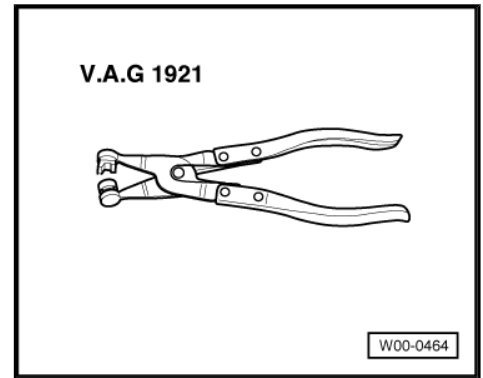


1.11 Removing and installing radiator

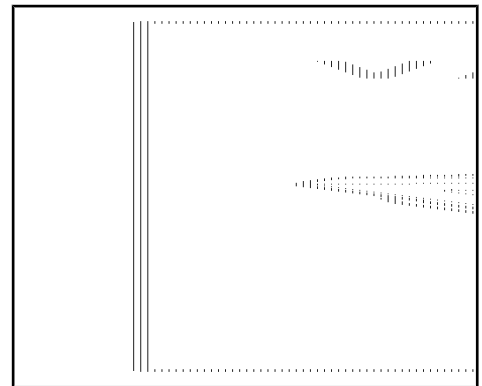
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Special tools and workshop equipment required

- ◆ Hose clip pliers - V.A.G 1921-



- ◆ Drip tray for workshop hoist - VAS 6208-



Removing



Note

Even when the radiator and condenser are correctly installed, slight impressions may be visible on the fins of these components. This does not mean that the components are damaged. If the fins are only very slightly distorted, this does not justify renewal of the radiator or the condenser.



WARNING

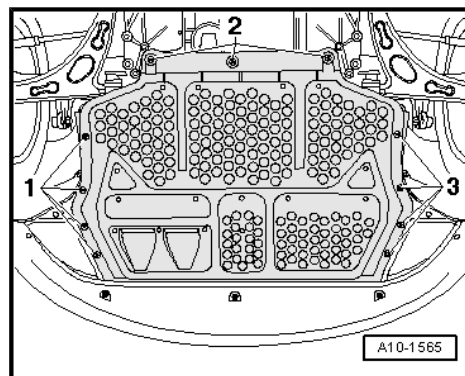
Hot steam/hot coolant can escape - risk of scalding.

- ◆ ***The cooling system is under pressure when the engine is hot.***

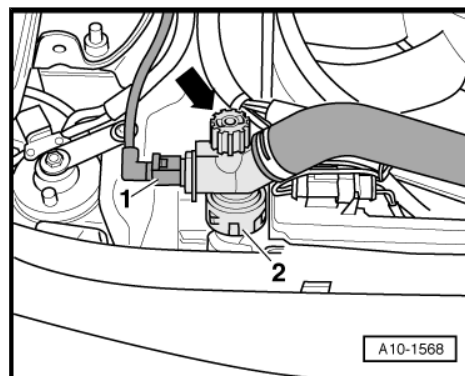
- ◆ ***Cover filler cap on coolant expansion tank with a cloth and open carefully to dissipate pressure.***

- Open filler cap on coolant expansion tank.

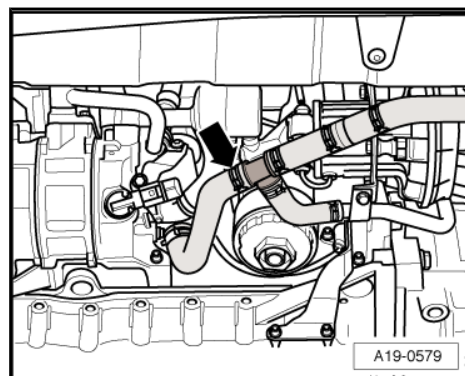
- Remove centre noise insulation -fasteners 1 ... 3-.



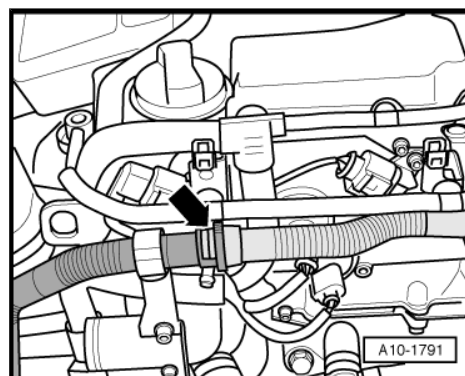
- Unplug electrical connector -1- at radiator outlet coolant temperature sender - G83- .
- Place drip tray for workshop hoist - VAS 6208- under engine.
- Turn drain plug -arrow- on radiator anti-clockwise, if necessary fit drain hose to connection.
- Remove bottom coolant hose -2- from radiator by pulling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



- In addition, remove lower coolant hose to continued circulation coolant pump - V51- -arrow- and drain off remaining coolant.
- Remove bumper cover (front) ⇒ Rep. gr. 63 .

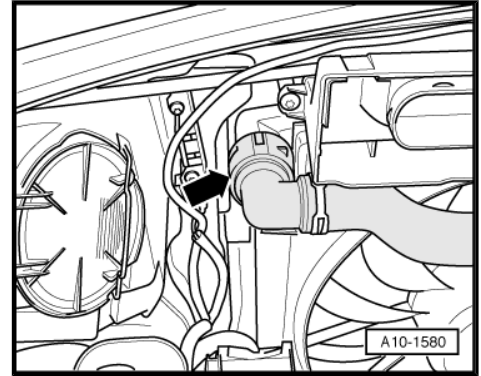


- Disconnect secondary air hose at the position marked with an -arrow-.
- Move air hose to secondary air pump clear.

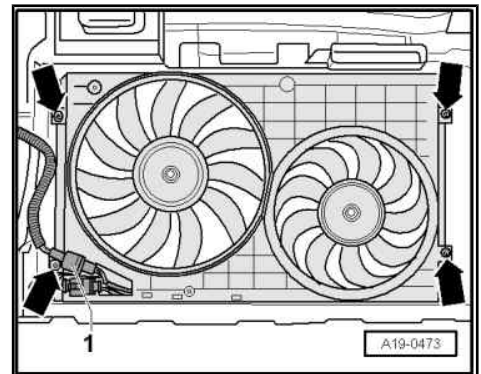


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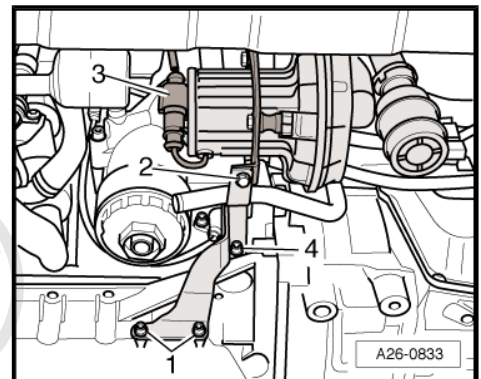
- Pull off retaining clip and remove top coolant hose -arrow- from radiator.



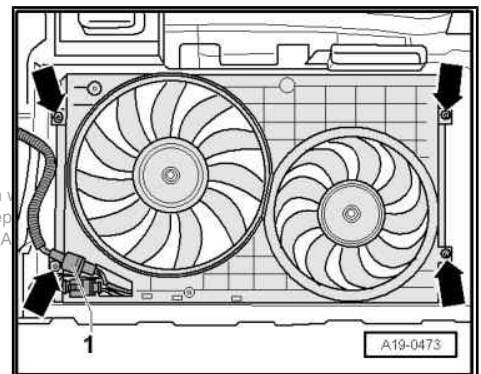
- Unscrew upper securing bolts -upper arrows- for radiator cowl.



- Move coolant hose at bottom of radiator cowl clear.
- Detach electrical connector -3- at secondary air pump motor - V101- and move wire clear.
- Unscrew bracket -2- for coolant pipe going to gear oil cooler on vehicles with direct shift gearbox.
- Remove bolts -1-.
- Loosen bolt -4- and remove secondary air pump with bracket.



- Detach electrical connectors -1- for radiator fans at bottom of radiator cowl.
- Unscrew lower securing bolts -lower arrows- for radiator cowl.
- Remove the radiator cowl with both fans from below.



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- Unbolt air ducts (left-side and right-side) at front of radiator.



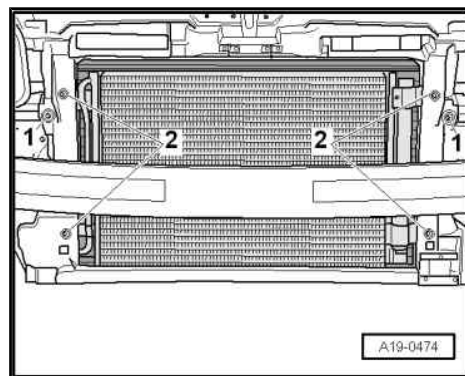
WARNING

The air conditioner refrigerant circuit must not be opened.



Note

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



- Unscrew securing bolts -2- for the condenser.
- Remove bolts -1- at radiator.
- Swivel radiator slightly towards rear.
- Disengage radiator upwards and remove from below.

Installing

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

- Install bumper cover (front) ⇒ Rep. gr. 63 .
- Install secondary air pump ⇒ [page 219](#) .
- Fill cooling system ⇒ [page 165](#) .

Tightening torques

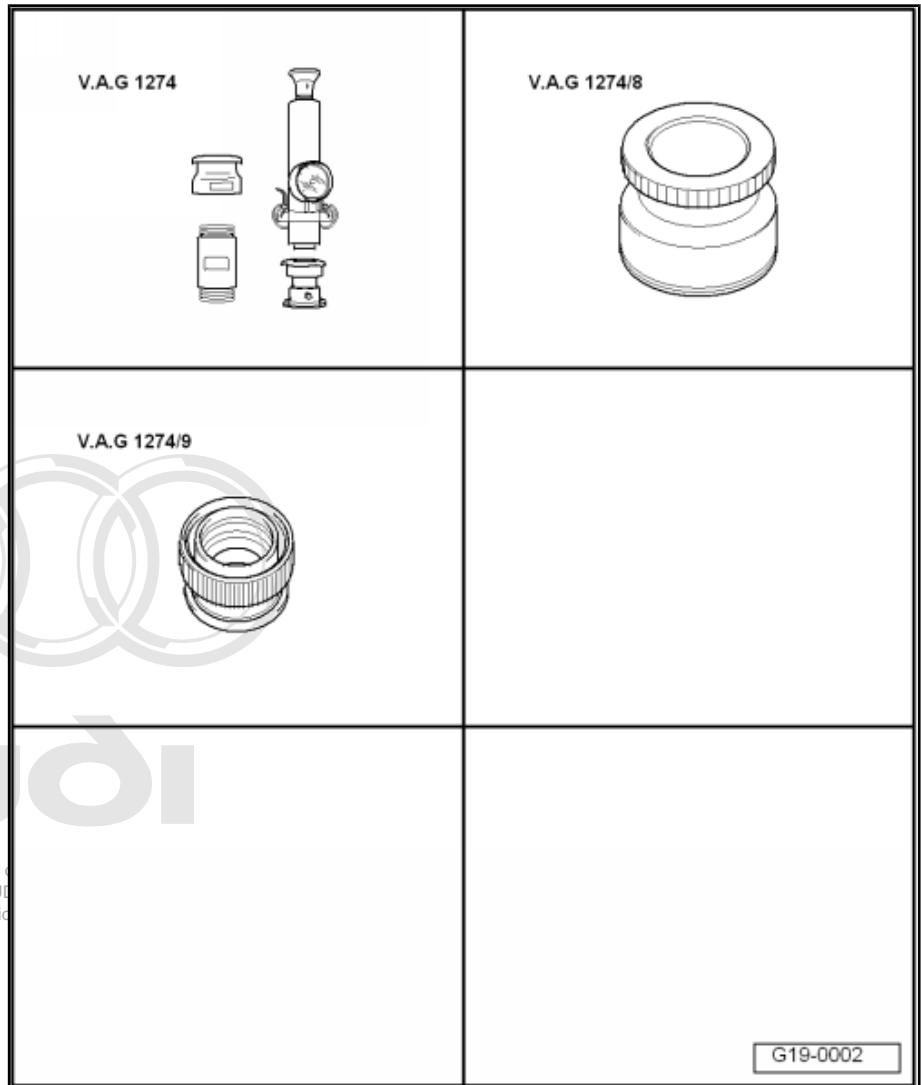
Component	Nm
Radiator to bracket	5
Condenser to radiator	5
Radiator cowl to radiator	5

1.12 Checking cooling system for leaks

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Special tools and workshop equipment required

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



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Procedure

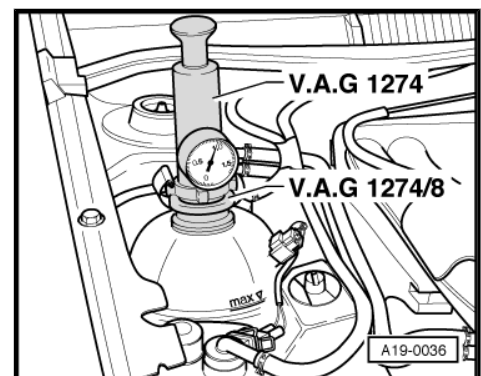
- Engine must be warm.



WARNING

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

- ◆ *The cooling system is under pressure when the engine is hot.*
- ◆ *Cover filler cap on coolant expansion tank with a cloth and open carefully to dissipate pressure.*



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

If the pressure drops:

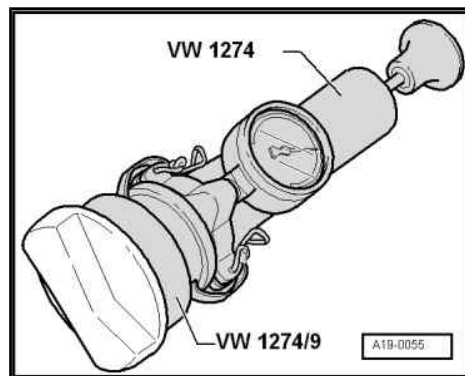
- Trace leak and repair.

Checking pressure relief valve in filler cap

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

If the pressure relief valve does not open as described:

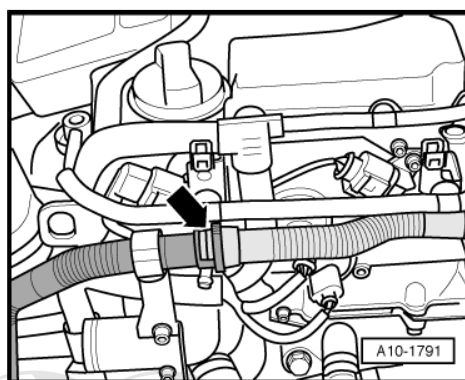
- Renew filler cap.



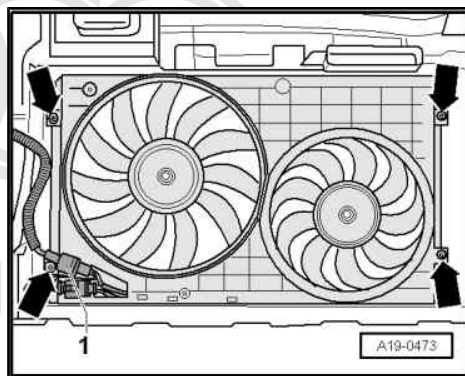
1.13 Removing and installing radiator fan - V7- and radiator fan 2 - V177-

Removing

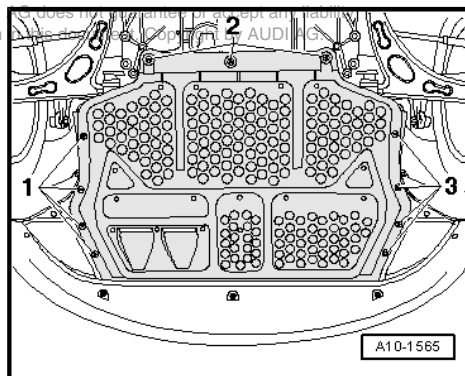
- Disconnect secondary air hose at the position marked with an -arrow-.
- Move air hose to secondary air pump clear.



- Unscrew upper securing bolts -upper arrows- for radiator cowl.

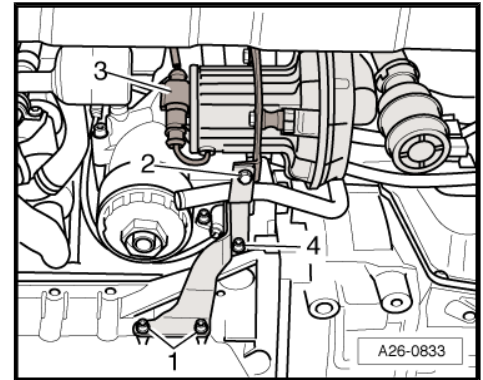


- Remove centre noise insulation -fasteners 1... 3-

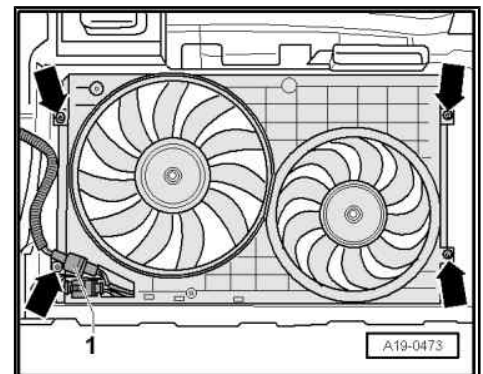


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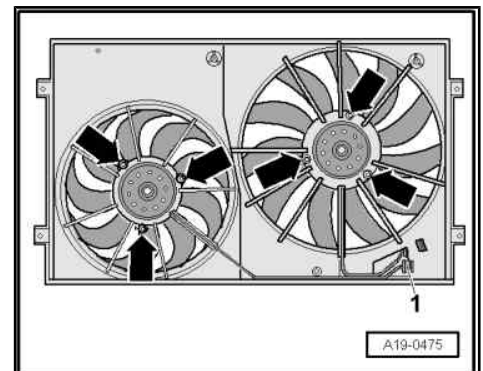
- Move coolant hose at bottom of radiator cowl clear.
- Detach electrical connector -3- at secondary air pump motor - V101- and move wire clear.
- Unscrew bracket -2- for coolant pipe going to gear oil cooler on vehicles with direct shift gearbox.
- Remove bolts -1-.
- Loosen bolt -4- and remove secondary air pump with bracket.



- Detach electrical connectors -1- for radiator fans at bottom of radiator cowl.
- Unscrew lower securing bolts -lower arrows- for radiator cowl.
- Remove the radiator cowl with both fans from below.



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



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Installing

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

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

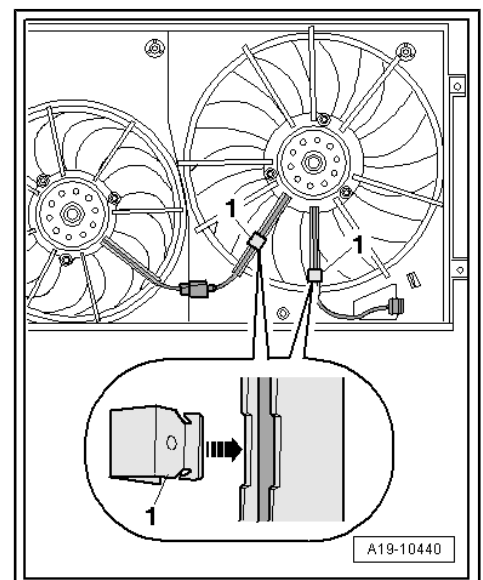


Caution

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

Tightening torques

Component	Nm
Radiator fan to radiator cowl	5
Radiator cowl to radiator	5



26 – Exhaust system

1 Removing and installing parts of exhaust system



Note

- ◆ After working on the exhaust system, ensure that the system is not under stress and that it has sufficient clearance from the body. If necessary, loosen 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 - exploded view

1 - Bracket

- ☐ For exhaust system

2 - Rubber mounting

- ☐ Renew if damaged

3 - 23 Nm

4 - Centre silencer

- ☐ Combined with rear silencer
- ☐ Align exhaust system so it is free of stress
⇒ [page 202](#)

5 - Rubber mounting

- ☐ Renew if damaged

6 - 23 Nm

7 - Bracket for exhaust system

8 - 25 Nm

9 - Mounting

- ☐ Renew if damaged

10 - 40 Nm

- ☐ Renew

11 - Gaskets

- ☐ Renew

12 - Support for front exhaust pipe

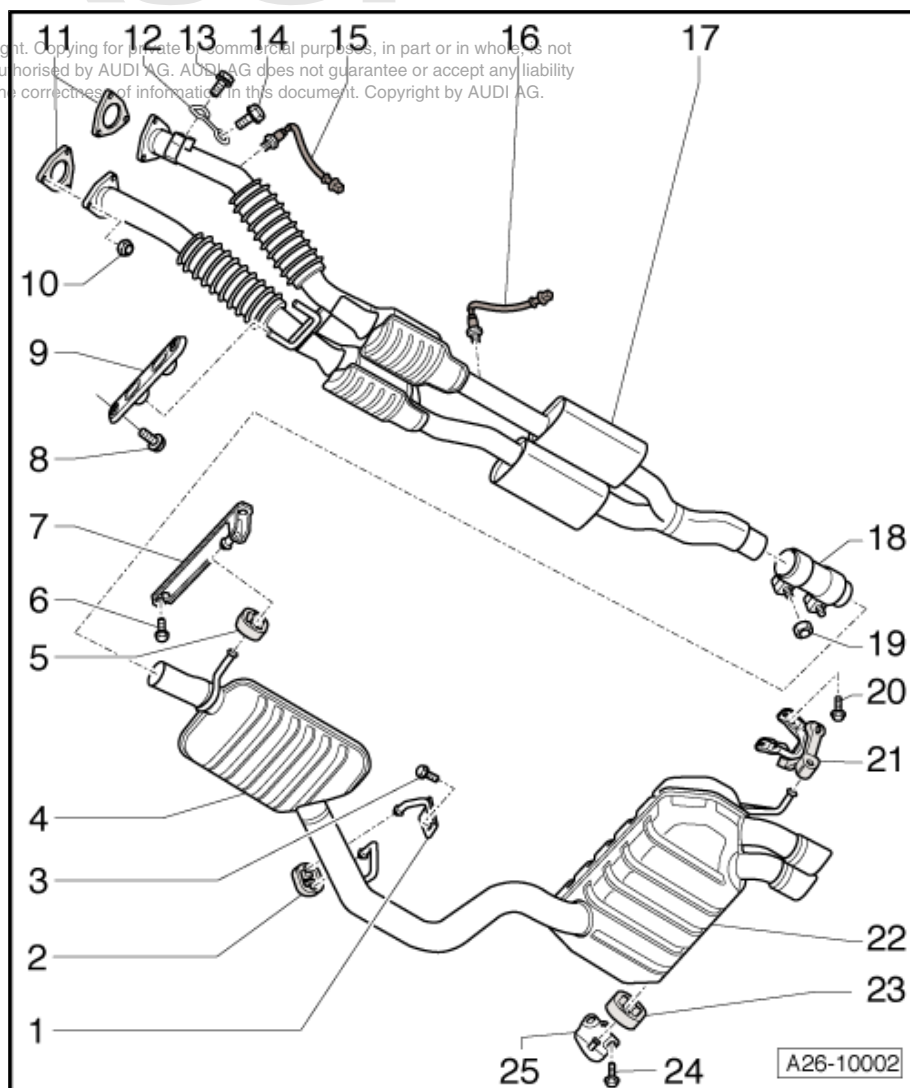
13 - 25 Nm

14 - 40 Nm

15 - Lambda probe before catalytic converter

- ☐ 2x

- ☐ Threads of new Lambda probes are already greased with assembly paste; the paste must not get into the slots on the probe body



- ☐ When re-using the old Lambda probe, grease thread with high-temperature lubricant; the paste must not get into the slots of the probe body; High-temperature lubricant ➔ Parts catalogue
- ☐ Removing and installing ➔ Rep. gr. 24

16 - Lambda probe after catalytic converter

- ☐ 2x
- ☐ Threads of new Lambda probes are already greased with assembly paste; the paste must not get into the slots on the probe body
- ☐ When re-using the old Lambda probe, grease thread with high-temperature lubricant; the paste must not get into the slots of the probe body; High-temperature lubricant ➔ Parts catalogue
- ☐ Removing and installing ➔ Rep. gr. 24

17 - Front exhaust pipe with catalytic converters and front silencer

- ☐ Do not bend flexible joint more than 30° – otherwise it can be damaged
- ☐ Install flexible joint so that it is not under tension.
- ☐ Take care not to damage wire mesh on flexible joint.
- ☐ Protect catalytic converter from damage by knocks and impact
- ☐ Removing and installing ➔ [page 196](#)
- ☐ Do not remove protective packaging from replacement part until you are ready to fit the flexible joint
- ☐ Align exhaust system so it is free of stress ➔ [page 202](#)

18 - Clamp

- ☐ Align exhaust system so it is free of stress before tightening clamp ➔ [page 202](#)
- ☐ Installation position ➔ [page 195](#)
- ☐ Tighten bolt connections evenly.

19 - 40 Nm

- ☐ Renew

20 - 23 Nm

21 - Mounting

- ☐ Renew if damaged

22 - Rear silencer

- ☐ Combined with centre silencer
- ☐ Align exhaust system so it is free of stress ➔ [page 202](#)

23 - Rubber mounting

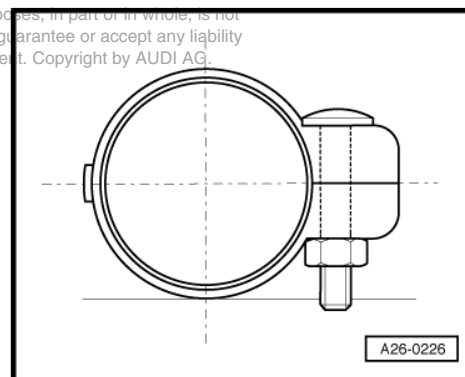
- ☐ Renew if damaged

24 - 23 Nm

25 - Bracket for exhaust system

Installation position of clamp

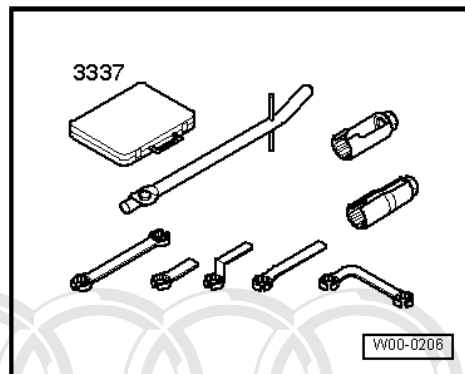
- Fit clamp in horizontal position.
- Bolt connection faces to right.



1.2 Removing and installing front exhaust pipe with catalytic converter and front silencer

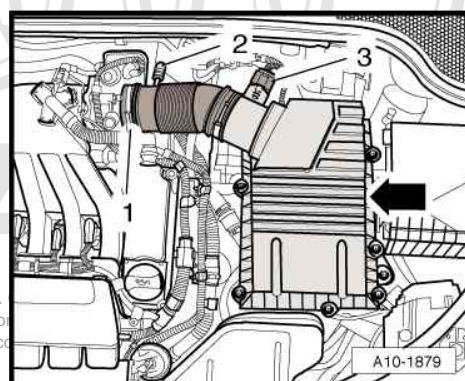
Special tools and workshop equipment required

- ♦ Lambda probe open ring spanner set - 3337-

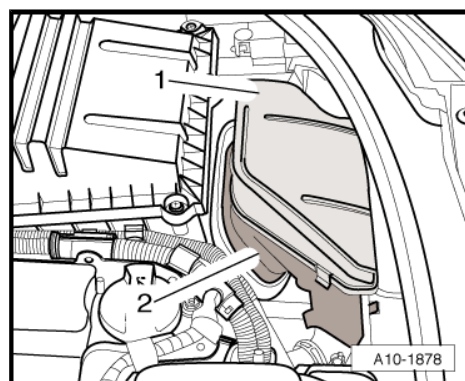


Removing

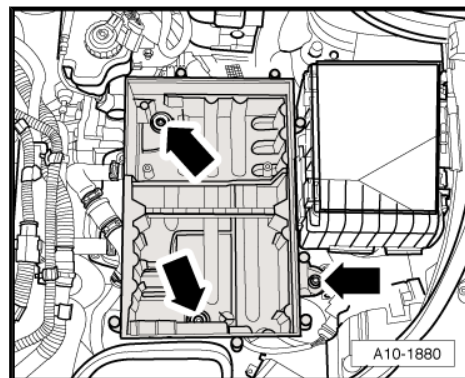
- Detach vacuum hose -2- from air intake hose (if fitted).
- Detach air hose -1- at the throttle valve module - J338- .
- Unplug electrical connector for air mass meter - G70- -item 3-.
- Unscrew air cleaner housing (upper section) -arrow-.
- Take out filter element.



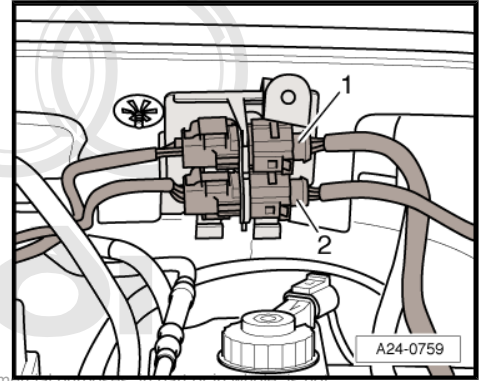
- Pull cover -1- off air duct (release clips on sides).
- Unclip air duct -2-.



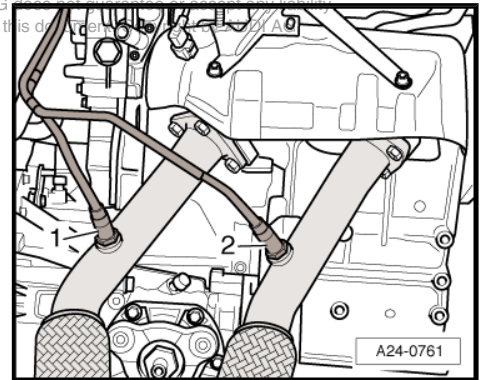
- Unscrew air cleaner housing (lower section) -arrows-.



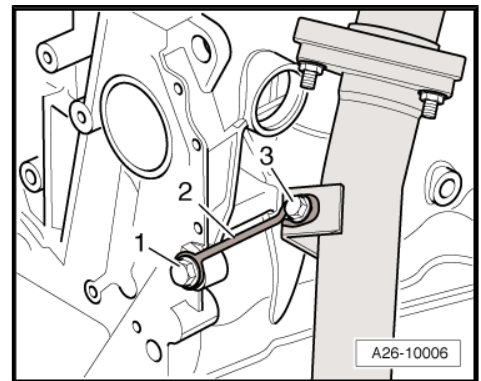
- Unplug electrical connectors -1- and -2- for Lambda probe - G39- (before catalytic converter) and Lambda probe 2 - G108- (before catalytic converter).
- Move electrical wiring to Lambda probes clear.



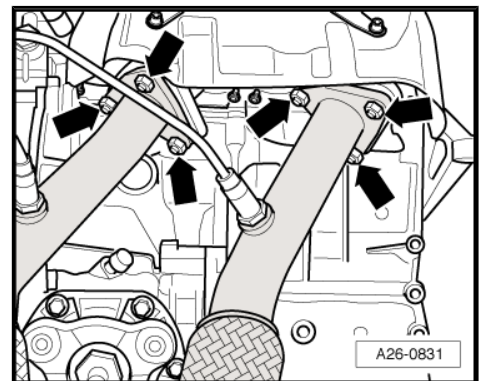
- Unscrew Lambda probe 2 - G108- -item 1- and Lambda probe - G39- -item 2-.



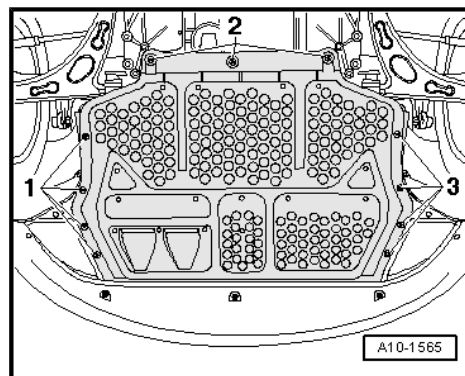
- Unscrew bolts -1- and -3- and remove support -2- for front exhaust pipe.



- Unscrew nuts of front exhaust pipe which are accessible from above from exhaust manifolds -arrows-.

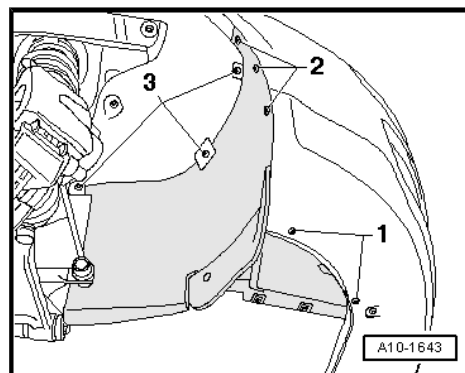


- Remove centre noise insulation -fasteners 1 ... 3-.

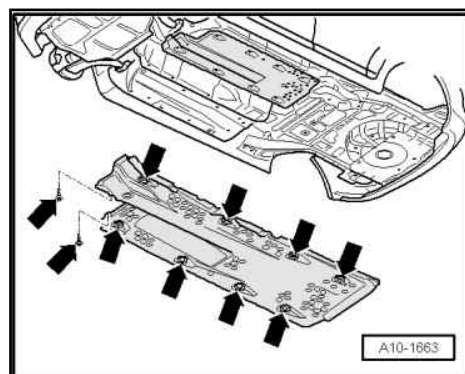


- Remove noise insulation (right-side) -fasteners 1 ... 3-.

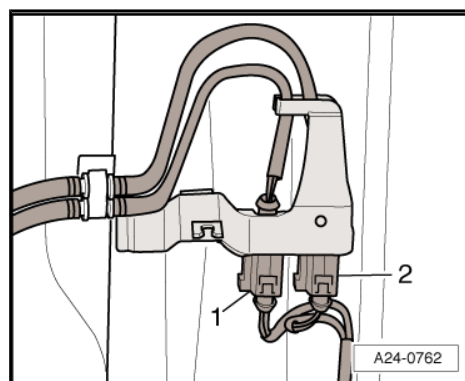
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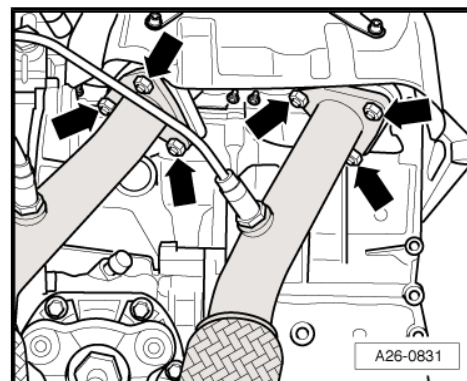
- Remove underbody cover (right-side) -arrows-.



- Unplug electrical connectors -1- and -2- on underbody (right-side).
- Detach plug connector from bracket and move wire to Lambda probe after catalytic converter - G130- and Lambda probe 2 after catalytic converter - G131- clear.



- Unscrew nuts of front exhaust pipe which are accessible from below from exhaust manifolds -arrows-.



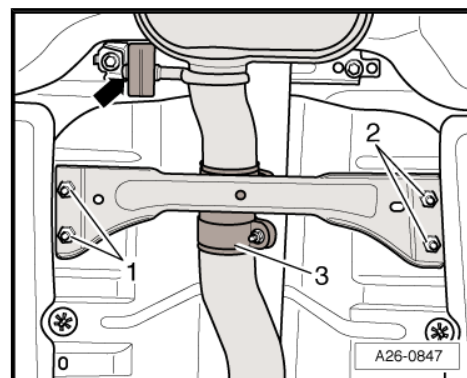
- Remove front cross member for underbody; to do so, unscrew nuts -1- and -2-.



Note

To avoid damage, the flexible joints in the front exhaust pipe must not be bent more than 30°.

- Disconnect exhaust system at clamp -3-.



- Unscrew bracket for exhaust system -arrows- and remove exhaust system.
- Remove front exhaust pipe with catalytic converter and front silencer.

Installing

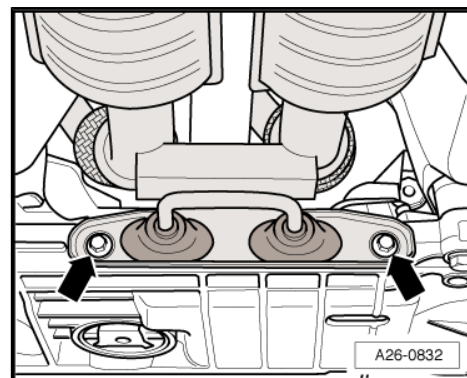
Installation is carried out in the reverse order; note the following:



Note

Renew gaskets and self-locking nuts.

- Align exhaust system so it is free of stress ⇒ [page 202](#) .



Tightening torques

Component	Nm
Front exhaust pipe to exhaust manifold	40 ¹⁷⁾
Catalytic converter to front exhaust pipe	23 ¹⁷⁾
Lambda probe in front exhaust pipe	55
Bracket for exhaust system to subframe	23

17) Renew nuts and bolts.

1.3 Exhaust manifold - exploded view

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1 - 23 Nm

- ☐ Renew

2 - Exhaust manifold

- ☐ Removing and installing
⇒ [page 200](#)

3 - Gasket

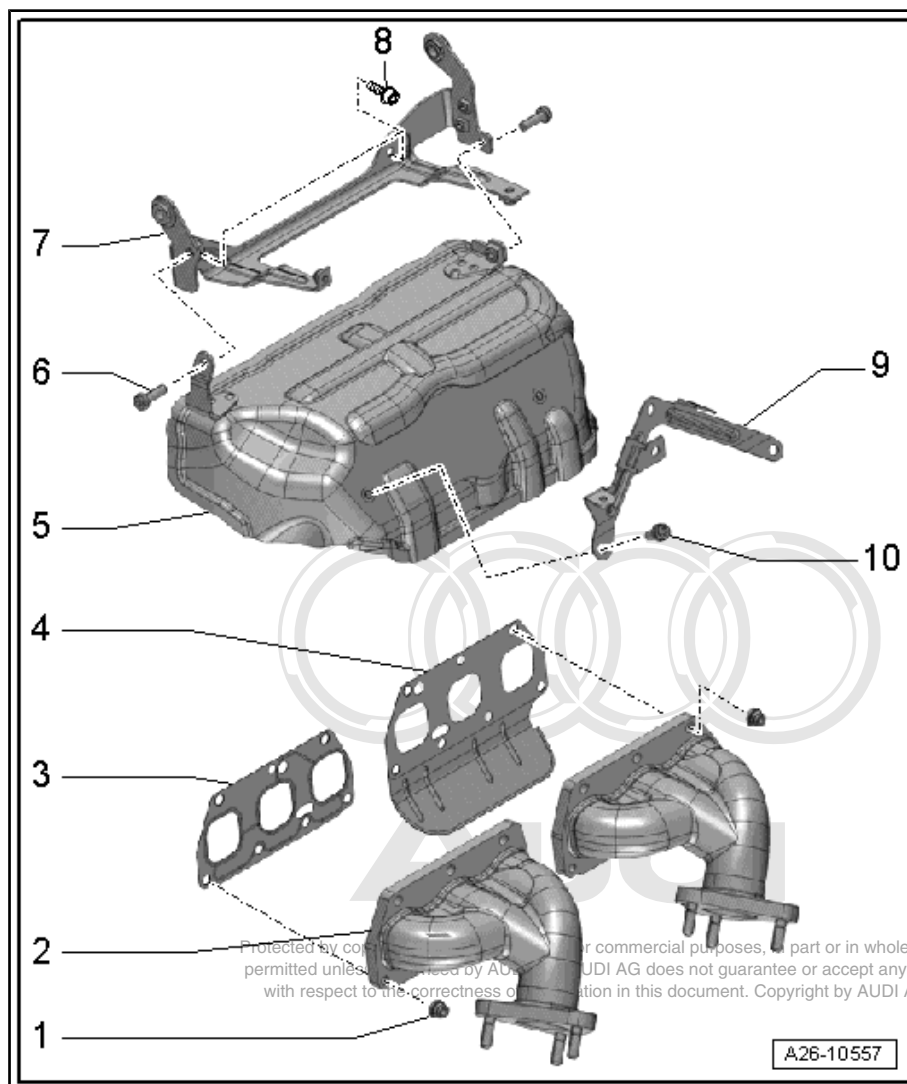
- ☐ Renew

4 - Gasket

- ☐ With heat shield
- ☐ Renew

5 - Heat shield
6 - 10 Nm
7 - Bracket

- ☐ Riveted to heat shield
(depending on version)

8 - 20 Nm
9 - Bracket
10 - 10 Nm


1.4 Removing and installing exhaust manifold

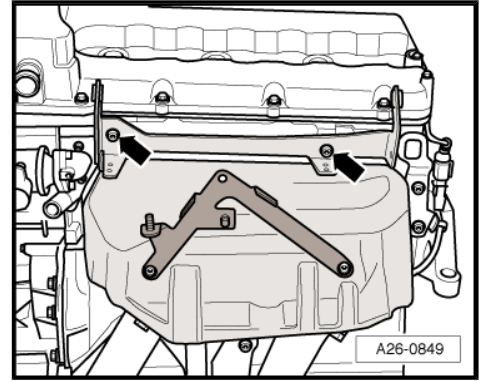
Removing


Note

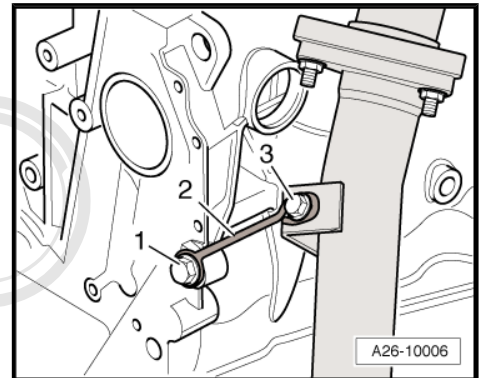
All cable ties which are released or cut open when removing must be refitted in the same position when installing.

- Remove intake manifold ⇒ Rep. gr. 24 .

- Remove heat shield above exhaust manifold -arrows-.



- Unscrew bolts -1- and -3- and remove support -2- for front exhaust pipe.



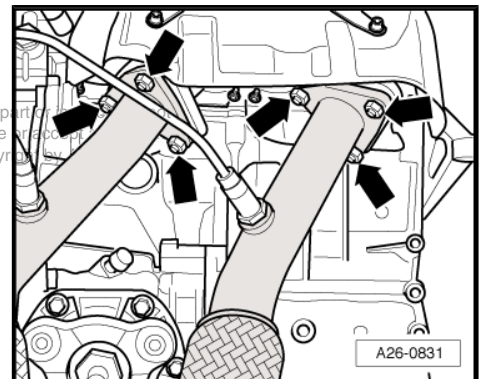
 Note

To avoid damage, the flexible joints in the front exhaust pipe must not be bent more than 30°.

- Unscrew front exhaust pipe from exhaust manifolds -arrows- and push back slightly.

 Note

Lambda probes remain installed.



- Unscrew the 7 nuts -arrows- on both exhaust manifolds and remove together with washers.
- Pull exhaust manifolds to rear and remove.

Installing

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



Note

Renew gaskets and self-locking nuts.

- Install intake manifold ⇒ Rep. gr. 24 .

Tightening torques

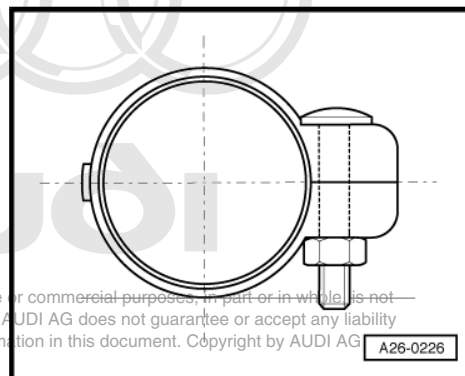
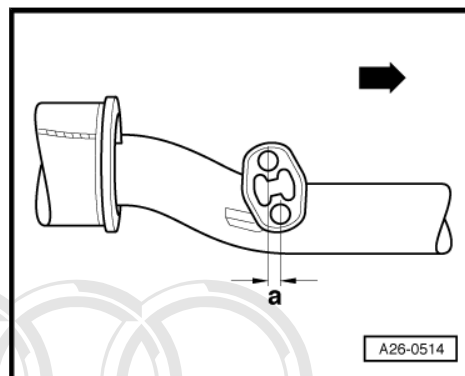
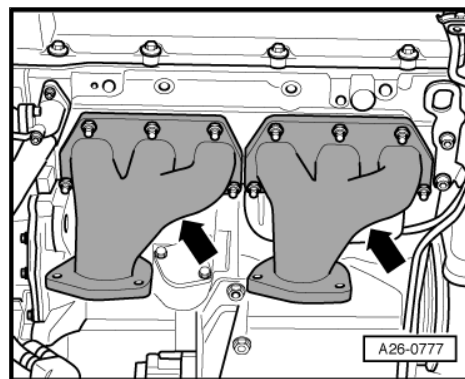
Component	Nm
Exhaust manifold to cylinder head	23 ¹⁸⁾
Front exhaust pipe to exhaust manifold	40 ¹⁸⁾
Heat shield for exhaust manifold to cylinder head	20

18) Renew nuts.

1.5 Stress-free alignment of exhaust system

- The exhaust system must be aligned when it is cool.
- Loosen bolts of clamp ⇒ [Item 18 \(page 195\)](#) .
- Push rear section of exhaust system towards front of vehicle -arrow- so that mounting ⇒ [Item 2 \(page 194\)](#) between centre and rear silencer is preloaded by -a- = 13 ... 17 mm.

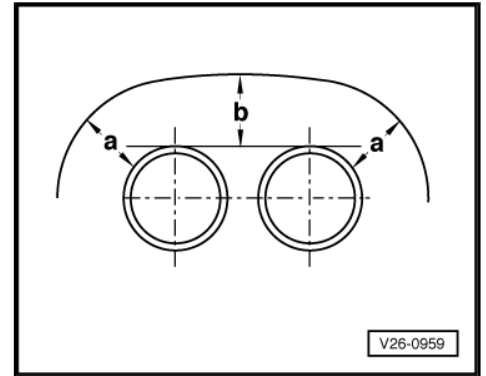
- Fit clamp in horizontal position.
- Bolt connection faces to right.
- Tighten clamp evenly to 40 Nm.



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Aligning tailpipes

- Align rear silencer so that there is an equal distance -a- and -b- between the cut-out in the bumper and the pipe ends.
- If necessary, loosen mountings for rear silencer to adjust the tailpipes.



1.6 Checking exhaust system for leaks

- Start the engine and run at idling speed.
- Plug tailpipes during leak test (e.g. with cloth or plug).
- Listen for noise at connection points (cylinder head/exhaust manifold, exhaust manifold/front exhaust pipe, etc.) to locate any leaks.
- Rectify any leaks that are found.



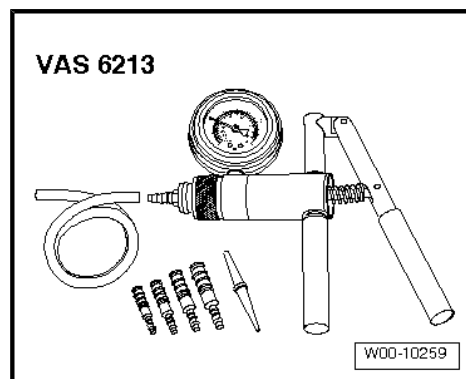
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2 Servicing exhaust flap

2.1 Checking vacuum unit for exhaust flap

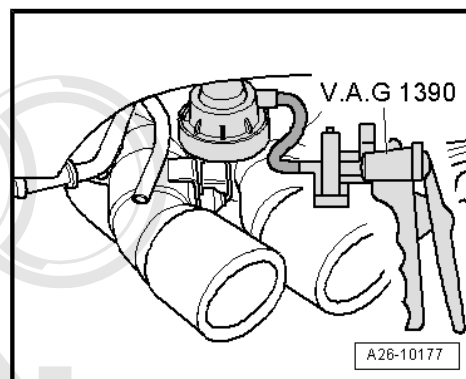
Special tools and workshop equipment required

- ◆ Hand vacuum pump - VAS 6213-



Test sequence

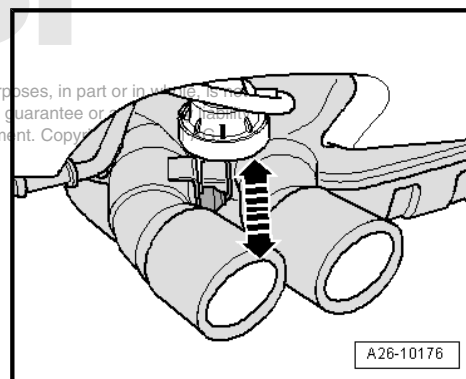
- Vacuum hoses and hose connections do not leak.
- Vacuum hoses are not clogged.
- Disconnect hose at vacuum unit for exhaust flap on relevant rear silencer.
- Connect hand vacuum pump to vacuum unit.



- Use hand vacuum pump to generate vacuum.
- The linkage should move upwards.
- Vent hand vacuum pump.
- Linkage should move downwards.

If the linkage does not move:

- Check the linkage for ease of movement and check the vacuum unit for leaks.



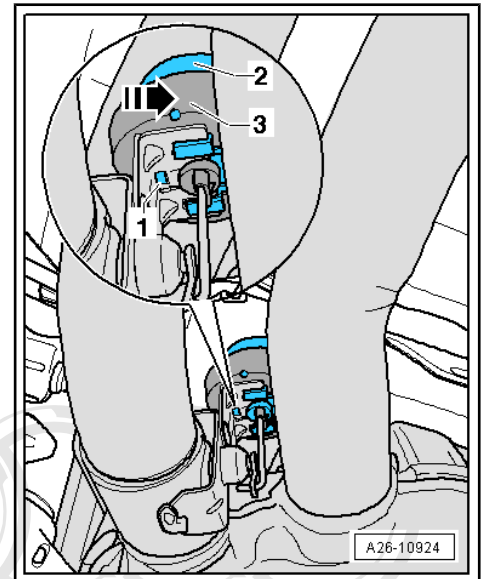
2.2 Removing and installing vacuum unit for exhaust flap

Removing

- Detach hose from vacuum unit for exhaust flap on relevant rear silencer.
- Press retaining tab -1- and unclip vacuum unit in direction of arrow.
- Detach vacuum unit from linkage for exhaust flap and remove with heat shield.

Installing

Install in reverse order.



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3 Servicing secondary air system

3.1 Principle and function

Principle

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

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How the system works

- ◆ During the cold start phase (coolant temperature at +15 ... +35 °C) the secondary air system blows air behind the exhaust valves for approx. 65 seconds. This produces an oxygen-rich exhaust gas, causes afterburning and reduces the heating-up phase of the catalytic converter.
- ◆ In addition, 20 seconds after each following engine start (until coolant temperature reaches 85 °C), the secondary air system switches on for 5 seconds when at idling speed and is checked by the self-diagnosis.
- ◆ The secondary air pump motor - V101- is actuated via the Motronic control unit - J220- and the secondary air pump relay - J299- .

3.2 Secondary air system - exploded view



Note

- ◆ *Fitting location for secondary air pump relay - J299-
⇒ [page 210](#)*
- ◆ *Fitting location for secondary air pump fuse ⇒ [page 211](#) .*

Vehicles with engine code letters BDB, BMJ

1 - Intake manifold

2 - Vacuum unit for intake manifold change-over

3 - To intake manifold

4 - Not fitted

5 - Combination valve for secondary air system

- ☐ Checking ⇒ [page 211](#)
- ☐ Removing and installing ⇒ [page 213](#)

6 - Gasket

- ☐ Renew

7 - Air channel

- ☐ In cylinder head

8 - 10 Nm

9 - Connection for combination valve

10 - 5 Nm

11 - Pressure hose

- ☐ Check for secure connection

12 - O-ring

- ☐ Renew if damaged

13 - Connection

14 - Bracket

- ☐ For secondary air pump motor - V101-
- ☐ With support for sump

15 - 20 Nm

16 - Electrical connector

17 - Rubber mounting

18 - Secondary air pump motor - V101-

- ☐ Removing and installing ⇒ [page 219](#)

19 - Air cleaner

- ☐ Clean if dirty

20 - Retaining clamp

21 - Intake hose

- ☐ Check for secure connection

22 - Non-return valve

- ☐ Installation position (light side/dark side): as shown in illustration; arrow indicates direction of flow

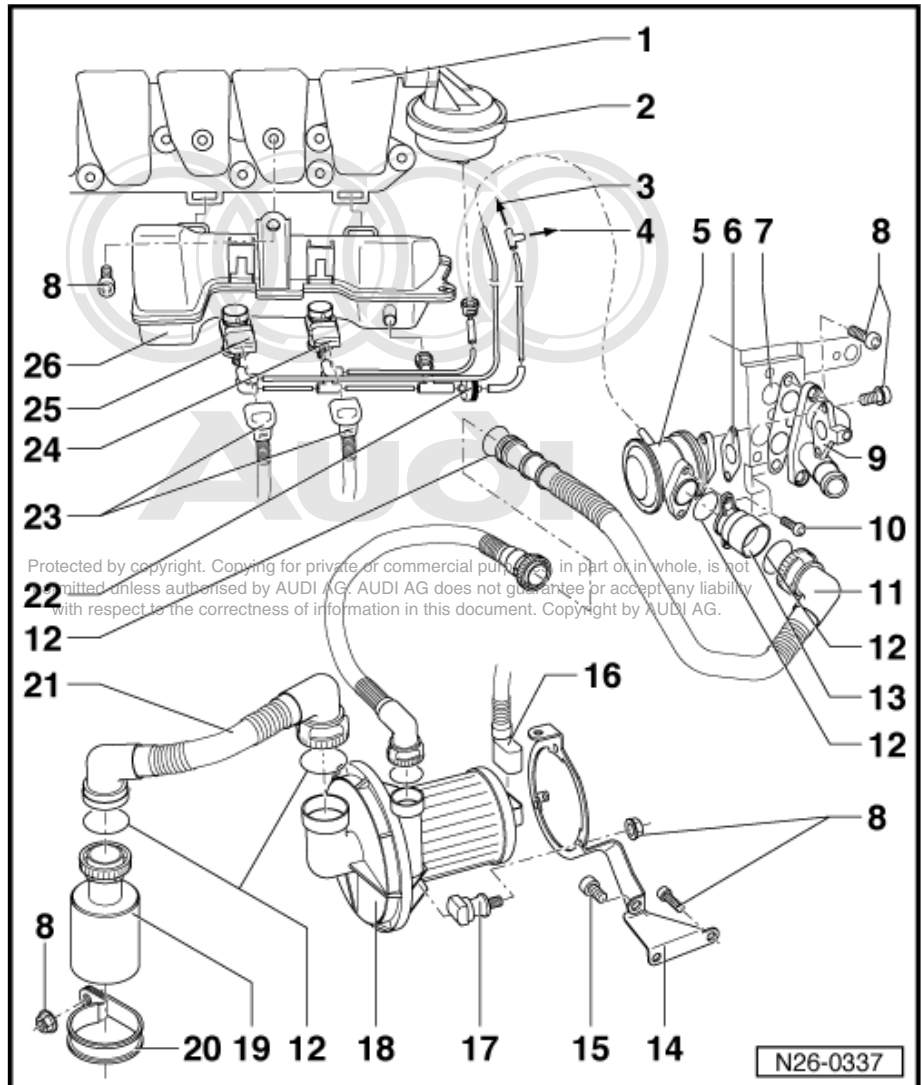
23 - Electrical connector

24 - Variable intake manifold change-over valve - N156-

25 - Secondary air inlet valve - N112-

- ☐ Fitting location ⇒ [page 211](#)

26 - Vacuum reservoir



Vehicles with engine code letters BUB

1 - Secondary air pump motor - V101-

- ☐ Removing and installing
⇒ [page 219](#)

2 - Rubber mounting

3 - 9 Nm

4 - Bracket

- ☐ For secondary air pump motor - V101-

5 - 9 Nm

6 - 9 Nm

7 - Secondary air hose

- ☐ Check for firm attachment

8 - Gasket

- ☐ Renew

9 - Connection

- ☐ For coolant and combination valve for secondary air system

10 - 9 Nm

11 - 9 Nm

12 - Gasket

- ☐ Renew

13 - Combination valve for secondary air system

- ☐ Checking ⇒ [page 212](#)
- ☐ Removing and installing
⇒ [page 213](#)

14 - O-ring

- ☐ Renew if damaged

15 - Secondary air hose

- ☐ Check for firm attachment

16 - O-ring

- ☐ Renew if damaged

17 - O-ring

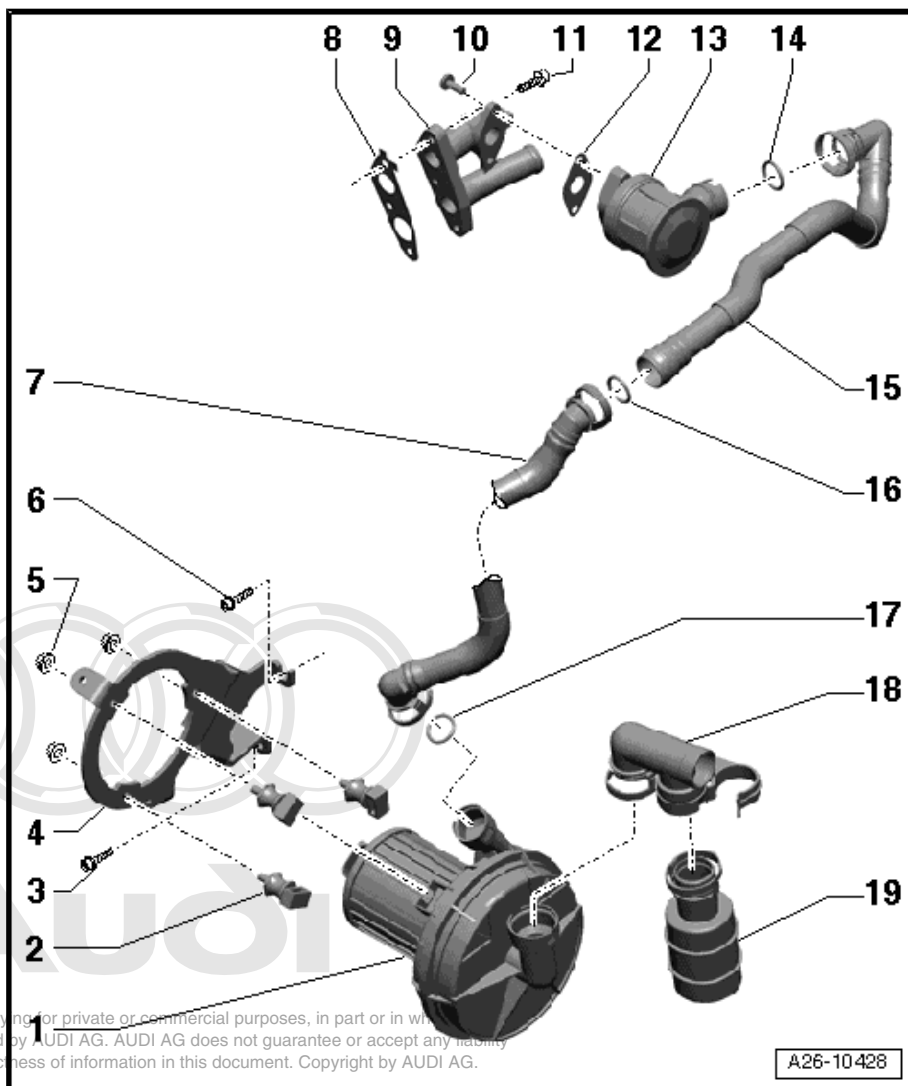
- ☐ Renew if damaged

18 - Connecting piece

- ☐ To air cleaner

19 - Air cleaner

- ☐ Clean if dirty



A26-10428

Vehicles with engine code letters CBRA

1 - Secondary air pump motor - V101-

- ☐ Removing and installing
⇒ [page 219](#)

2 - Rubber mounting

3 - 9 Nm

4 - Bracket

- ☐ For secondary air pump motor - V101-

5 - 9 Nm

6 - 9 Nm

7 - Hose

- ☐ Check for firm attachment

8 - Vacuum hoses

9 - Secondary air inlet valve 2 - N320-

- ☐ Fitting location
⇒ [page 211](#)

10 - Vacuum hoses

11 - Secondary air inlet valve - N112-

- ☐ Fitting location
⇒ [page 211](#)

12 - Gasket

- ☐ Renew

13 - Connection

- ☐ For coolant and combination valve for secondary air system (left-side)

14 - 9 Nm

15 - Gasket

- ☐ Renew

16 - Connection

- ☐ For combination valve for secondary air system (right-side)

17 - 9 Nm

18 - Hose

- ☐ Check for firm attachment

19 - 9 Nm

20 - Connection

- ☐ For combination valve for secondary air system (right-side)

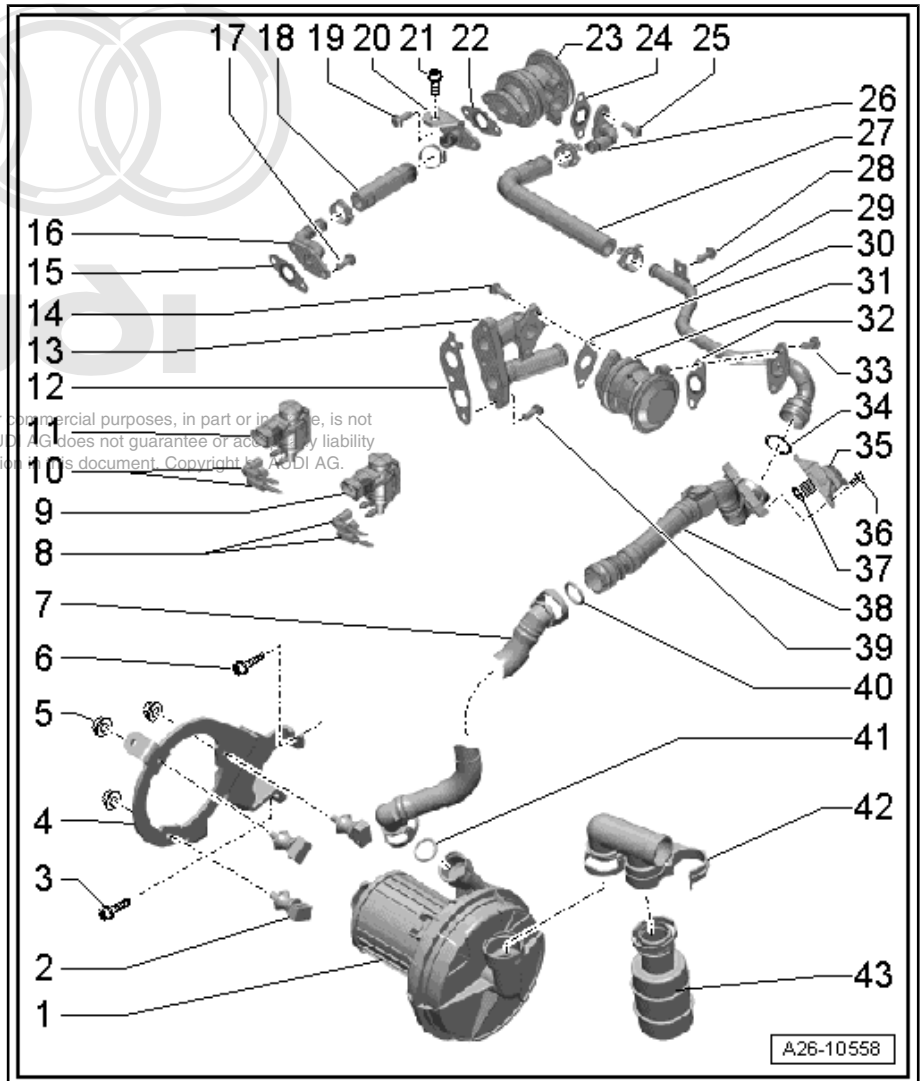
21 - 9 Nm

22 - Gasket

- ☐ Renew

23 - Combination valve for secondary air system (right-side)

- ☐ Checking ⇒ [page 213](#)
- ☐ Removing and installing ⇒ [page 217](#)





24 - Gasket

- ☐ Renew

25 - 9 Nm

26 - Elbow

- ☐ For combination valve for secondary air system (right-side)

27 - Hose

- ☐ Check for firm attachment

28 - 9 Nm

29 - Pipe

30 - Gasket

- ☐ Renew

31 - Combination valve for secondary air system (left-side)

- ☐ Checking ⇒ [page 213](#)
- ☐ Removing and installing ⇒ [page 217](#)

32 - Gasket

- ☐ Renew

33 - 9 Nm

34 - O-ring

- ☐ Renew if damaged

35 - Sender 1 for secondary air pressure - G609-

- ☐ Removing and installing ⇒ [page 219](#)

36 - 3.5 Nm

37 - O-ring

- ☐ Renew

38 - Pipe

39 - 9 Nm

40 - O-ring

- ☐ Renew if damaged

41 - O-ring

- ☐ Renew if damaged

42 - Connecting piece

- ☐ To air cleaner

43 - Air cleaner

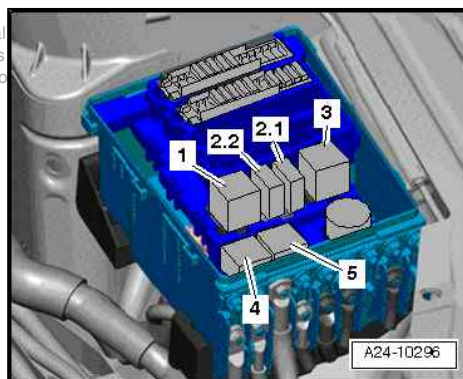
- ☐ Clean if dirty



Fitting location of secondary air pump relay - J299-

- ◆ In electronics box in engine compartment

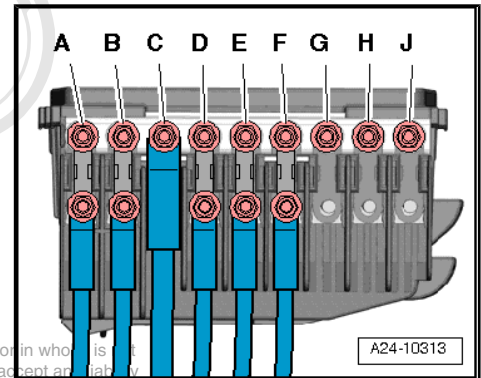
3 - Secondary air pump relay - J299-



Fitting location of fuse for secondary air pump motor - V101-

◆ In electronics box in engine compartment.

F - 40 A fuse for secondary air pump motor - V101-



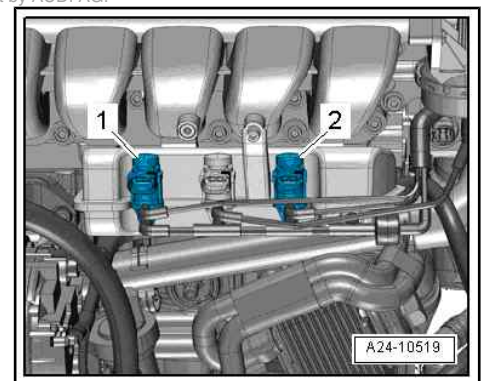
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Fitting location of secondary air inlet valve(s)

◆ At vacuum reservoir on front of intake manifold

1 - Secondary air inlet valve - N112-

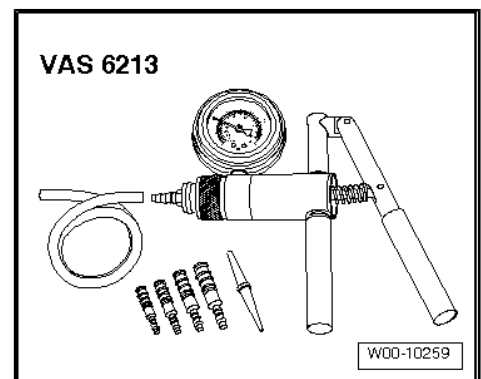
2 - Secondary air inlet valve 2 - N320- - only with engine code CBRA



3.3 Checking combination valve for secondary air system for proper operation and leakage - engine code BDB, BMJ

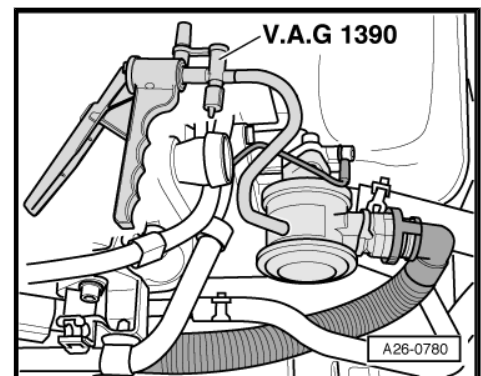
Special tools and workshop equipment required

◆ Hand vacuum pump - VAS 6213-

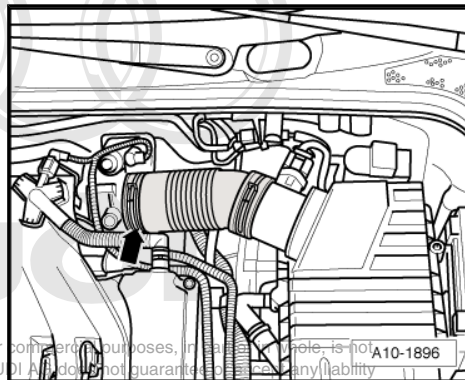


Procedure

- Vacuum hoses and hose connections do not leak.
- Vacuum hoses are not clogged.
- Disconnect vacuum hose at combination valve.
- Connect hand vacuum pump to vacuum connection on combination valve.



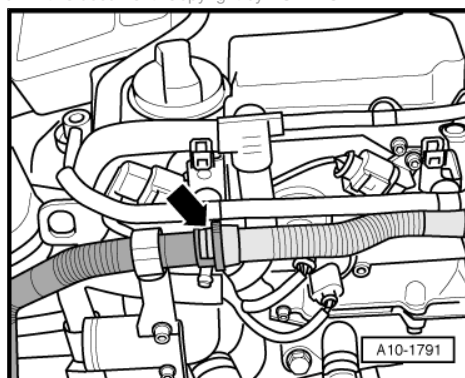
- Remove air intake hose -arrow- at throttle valve module - J338- and push slightly to the side.



- Disconnect secondary air hose at the position marked with an -arrow-.
- Blow gently into hose for combination valve (do not use compressed air).
- The combination valve should be closed; it should not be possible to blow through the valve.
- Operate 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:

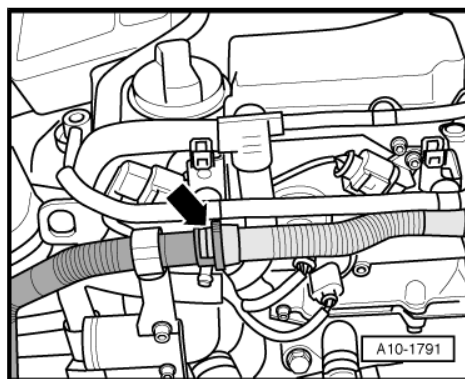
- Renew combination valve ⇒ [page 213](#) .



3.4 Checking combination valve for secondary air system for proper operation and leakage - engine code BUB

Procedure

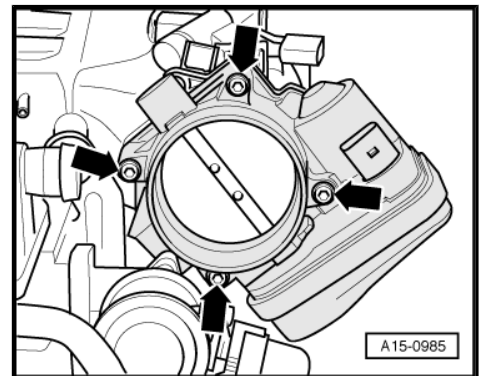
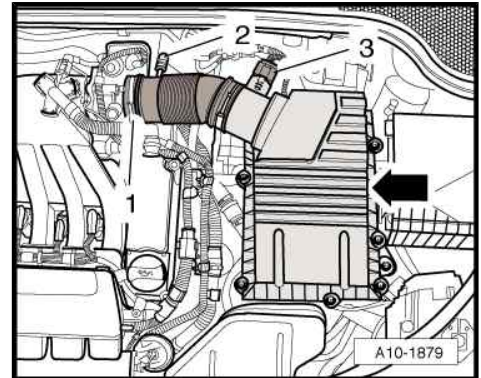
- Vacuum hoses and hose connections do not leak.
- Vacuum hoses are not clogged.
- Disconnect hose for secondary air system -arrow- and connect test hose to hose leading to combination valve for secondary air system.
- Blow lightly into test hose with your mouth (do not use compressed air).
- The combination valve for secondary air system should be closed; it should not be possible to blow through the hose.
- Blow into test hose with your mouth using more pressure (do not use compressed air).
- The combination valve for secondary air system should open; it should now be possible to blow through the hose.
- Renew combination valve for secondary air if you cannot determine the switching point ⇒ [page 213](#) .



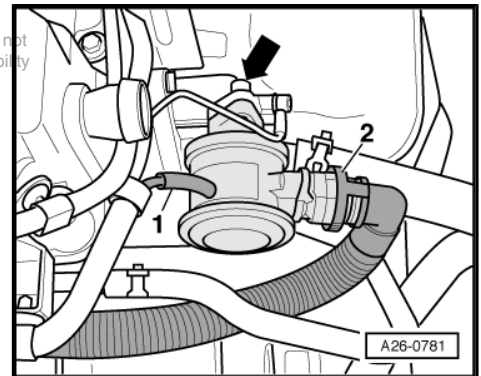
3.5 Removing and installing combination valve for secondary air system - engine code BDB, BMJ, BUB

Removing

- Detach vacuum hose -2- from air intake hose (if fitted).
- Detach air hose -1- at the throttle valve module - J338- .
- Unplug electrical connector for air mass meter - G70- -item 3-.
- Unscrew air cleaner housing (upper section) -arrow-.
- Unplug electrical connector at throttle valve module - J338- .
- Unbolt the throttle valve module - J338- from the intake manifold -arrows-.



- Disconnect air hose -2- and vacuum hose -1- (if fitted) at combination valve for secondary air system.
- Unscrew the 2 bolts -arrow- and detach combination valve.



Installing

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



Note

Renew seals and gaskets.

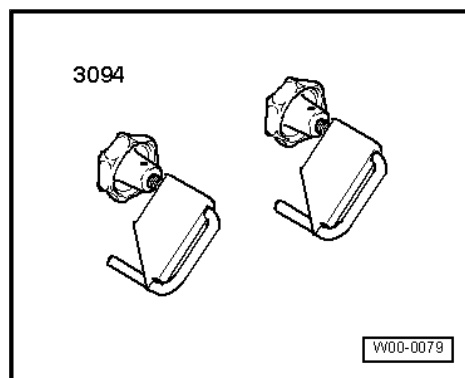
Tightening torques

Component	Nm
Combination valve for secondary air system to bracket or connection	9
Throttle valve module - J338- to intake manifold	10

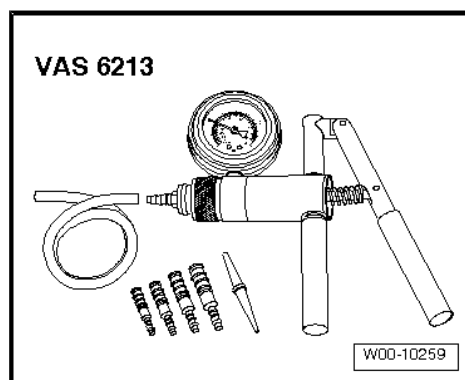
3.6 Checking combination valves for secondary air system for proper operation and leakage - engine code CBRA

Special tools and workshop equipment required

- ◆ Hose clamps, up to Ø 25 mm - 3094- for combination valve for secondary air system (left-side)



- ◆ Hand vacuum pump - VAS 6213-



Procedure

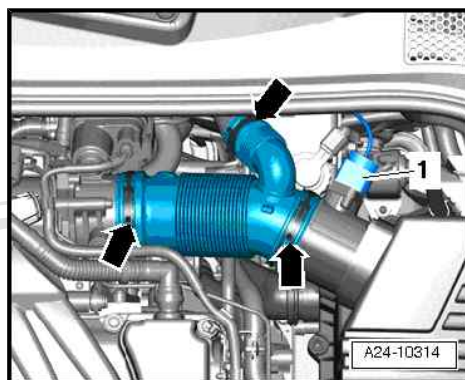
- Vacuum hoses and hose connections do not leak.
- Vacuum hoses are not clogged.

Combination valve for secondary air system (left-side):

- Disconnect air pipe -arrows-.



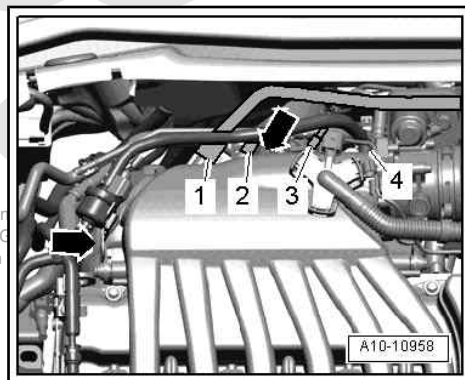
Disregard -item 1-.



- Disconnect vacuum hoses -1, 2, 4- at rear of intake manifold.
- Unbolt hose bracket from intake manifold -arrows- and move clear to rear, with hoses attached.

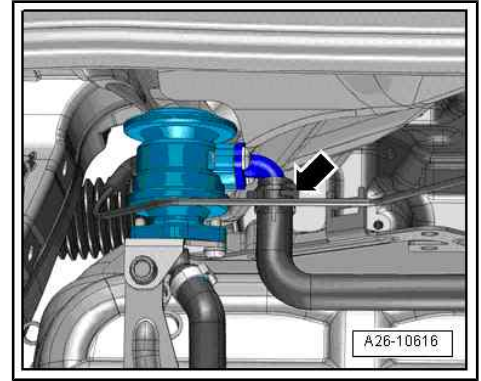


Disregard -item 3-.

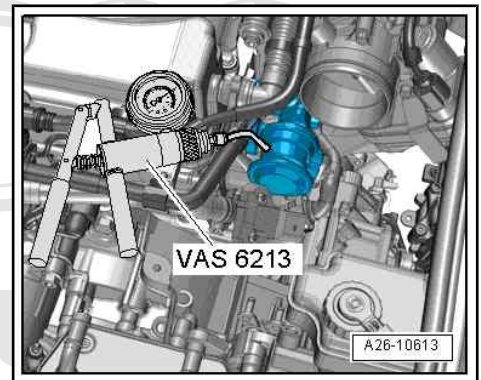


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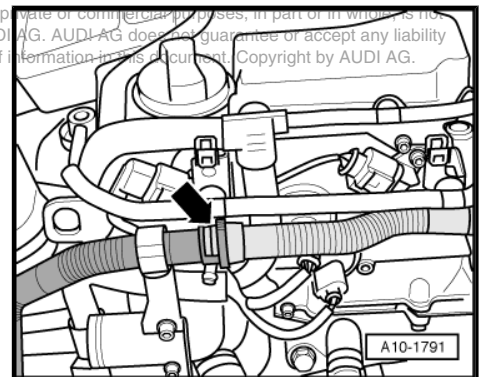
- Disconnect secondary air hose -arrow-, move hose clear towards the top and clamp off using hose clamp -3094- .



- Disconnect vacuum hose from combination valve for secondary air system (left-side).
- Connect hand vacuum pump - VAS 6213- to vacuum connection on combination valve for secondary air system.

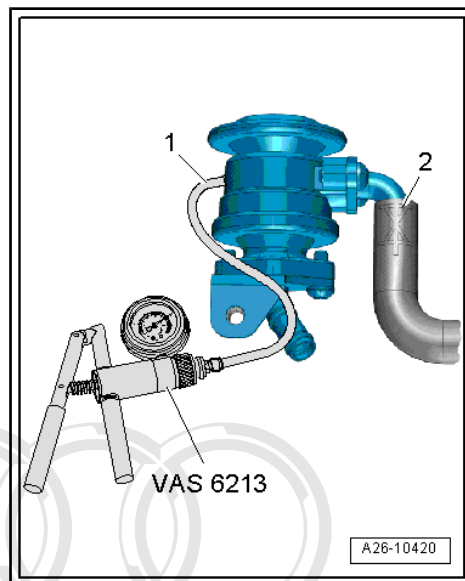


- Disconnect secondary air hose at the position marked with an -arrow-.
- Blow lightly into secondary air hose with your mouth (do not use compressed air).
 - The combination valve for secondary air system should be closed; it should not be possible to blow through the hose.
- Operate hand vacuum pump to produce a vacuum.
 - The combination valve for secondary air system should open; it should now be possible to blow through the hose.
- Renew combination valve for secondary air system (left-side) if valve does not react as described ⇒ [page 217](#) .



Combination valve for secondary air system (right-side):

- Remove combination valve for secondary air (right-side)
⇒ [page 217](#) .
- Connect hand vacuum pump - VAS 6213- to vacuum connection -1- on combination valve (right-side) for secondary air system.
- Connect a suitable test hose -2- onto combination valve for secondary air system.
- Blow lightly into test hose with your mouth (do not use compressed air).
- The combination valve for secondary air system should be closed; it should not be possible to blow through the hose.
- Operate hand vacuum pump to produce a vacuum.
- The combination valve for secondary air system should open; it should now be possible to blow through the hose.
- Renew combination valve for secondary air system (right-side) if valve does not react as described ⇒ [page 217](#) .

**Assembling**

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

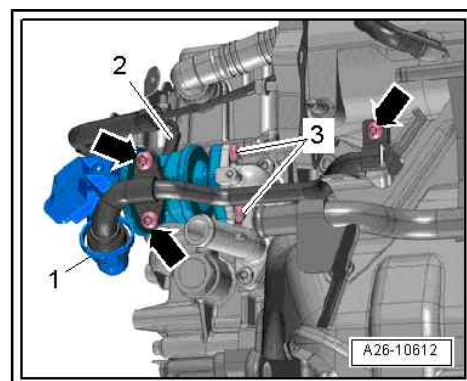
- Install combination valve for secondary air (right-side)
⇒ [page 217](#) .

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3.7 Removing and installing combination valve for secondary air system (left-side) - engine code CBRA

Removing

- Remove throttle valve module - J338- ➔ Rep. gr. 24 .
- Disconnect hose -1- from combination valve for secondary air system.
- Disconnect vacuum hose -2-.
- Remove bolts -arrows- and move secondary air pipe to one side.
- Remove bolts -3- and detach combination valve (left-side) for secondary air system.



Note

For illustration purposes, the installation position is shown from the rear and with the engine removed.

Installing

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

Note

Renew seals and/or gaskets.

- Install throttle valve module - J338- ➔ Rep. gr. 24 .

Tightening torque

Component	Nm
Combination valve for secondary air system to connection	9

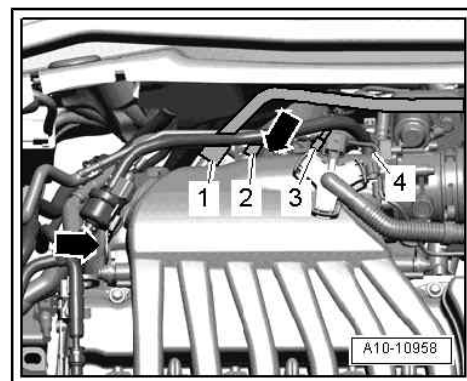
3.8 Removing and installing combination valve for secondary air system (right-side) - engine code CBRA

Removing

- Disconnect vacuum hoses -1, 2, 4- at rear of intake manifold and move hoses clear.
- Unbolt hose bracket from intake manifold -arrows- and move clear to rear, with hoses attached.

Note

Disregard -item 3-.

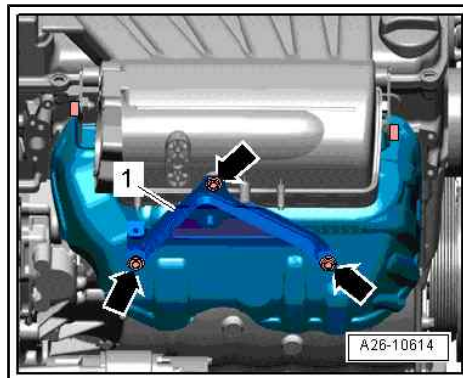


- Remove bolts -arrows- and detach bracket -1- for heat shield.



Note

For illustration purposes, the installation position is shown from the rear and with the engine removed.



- Disconnect vacuum hose -arrow-.
- Remove bolt -1- and detach combination valve for secondary air system (right-side) from secondary air hoses -2- and -3-.



Note

Disregard -item 4-.

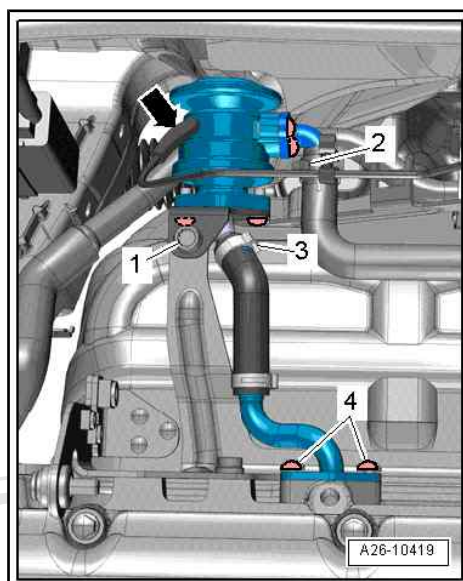
Installing

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



Note

- ♦ Renew seals and/or gaskets.
- ♦ Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .



- Install bracket for heat shield ⇒ [page 199](#) .

Tightening torque

Component	Nm
Combination valve for secondary air system to connection	9

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3.9 Removing and installing sender 1 for secondary air pressure - G609- - engine code CBRA

Removing

- Unplug electrical connector -1-.
- Remove bolts -arrows- and detach sender 1 for secondary air pressure - G609- .

Installing

- Tightening torque ➔ [page 206](#)

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

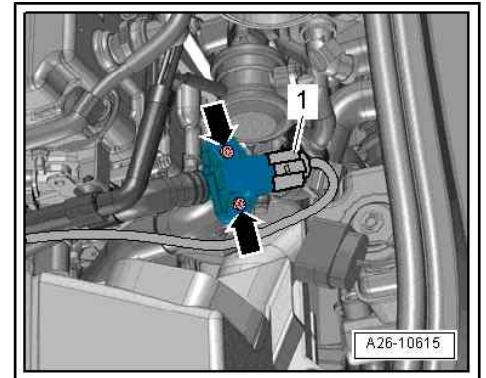


Note

Fit new O-ring.

Tightening torque

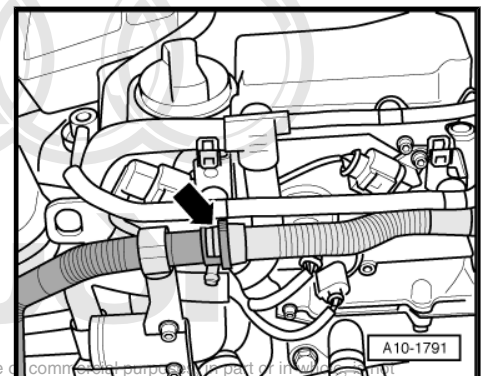
Component	Nm
Sender 1 for secondary air pressure - G609- to pipe	3.5



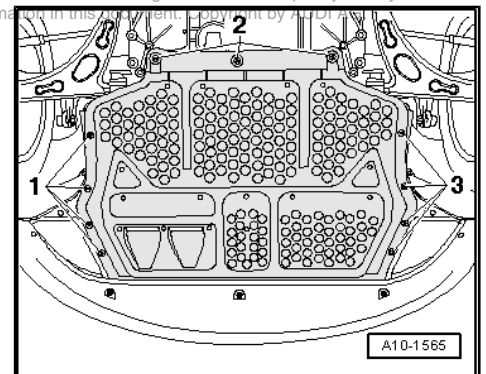
3.10 Removing and installing secondary air pump

Removing

- Disconnect secondary air hose at the position marked with an -arrow-.
- Move air hose to secondary air pump clear.



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



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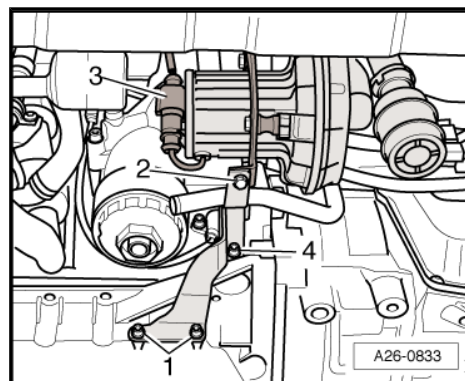
- Move coolant hose at bottom of radiator cowl clear.
- Detach electrical connector -3- at secondary air pump motor - V101- and move wire clear.
- Unscrew bracket -2- for coolant pipe going to gear oil cooler on vehicles with direct shift gearbox.
- Remove bolts -1-.
- Loosen bolt -4- and remove secondary air pump with bracket.

Installing

Install in reverse order.

Tightening torques

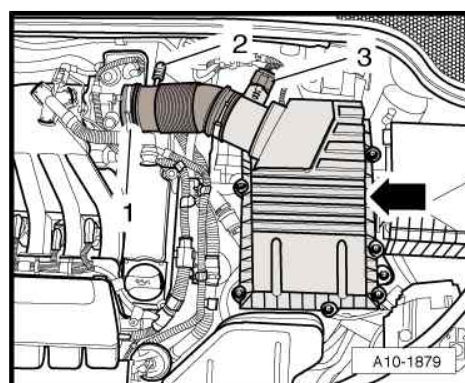
Component		Nm
Secondary air pump to bracket		10
Bracket for secondary air pump	M6	10
to cylinder block	M8	20



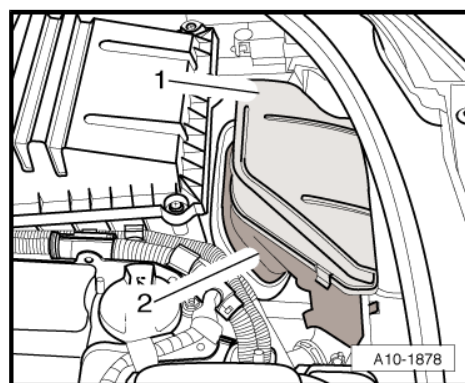
3.11 Removing and installing secondary air pump relay - J299-

Removing

- Detach vacuum hose -2- from air intake hose (if fitted).
- Detach air hose -1- at the throttle valve module - J338- .
- Unplug electrical connector for air mass meter - G70- -item 3-.
- Unscrew air cleaner housing (upper section) -arrow-.
- Take out filter element.



- Pull cover -1- off air duct (release clips on sides).
- Unclip air duct -2-.



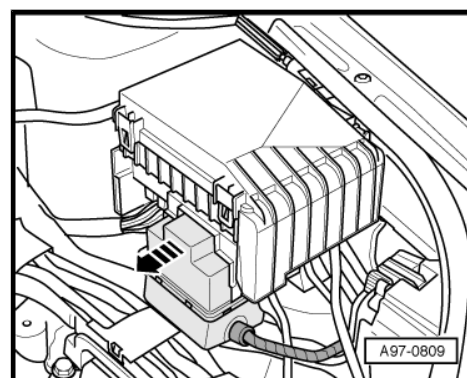
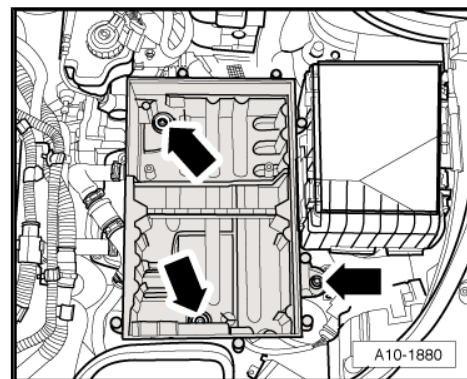
- Unscrew air cleaner housing (lower section) -arrows-.



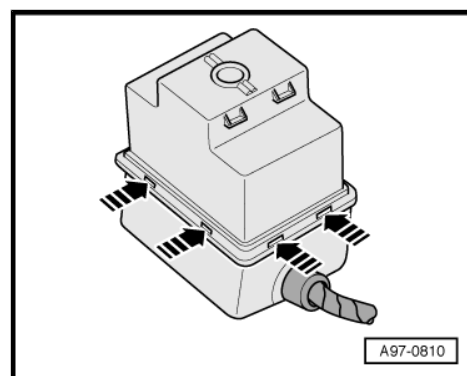
Vehicles with relay carrier (previous version):

- Pull out the 6-position relay carrier from under the electronics box in engine compartment -arrow-.

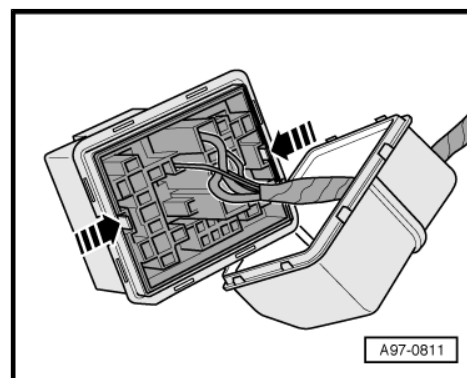
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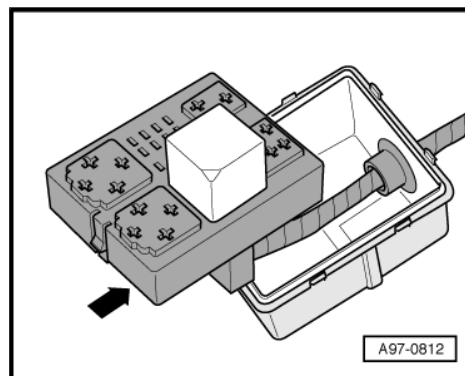
- Unclip cover of 6-position relay carrier -arrows-.



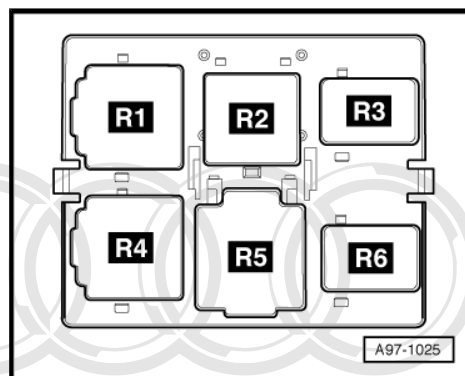
- Release retaining clips -arrows-.



- Remove 6-position relay carrier -arrow- from cover.



- Detach secondary air pump relay - J299- from position -R5- in 6-position relay carrier beneath electronics box in engine compartment.



Vehicles with relay carrier (new version):

- Pull out the relay carrier from under the electronics box in engine compartment -arrow-.
- Detach secondary air pump relay - J299- from position -1- in relay carrier under electronics box in engine compartment.

Installing

Install in reverse order.

