

Workshop Manual Audi A4 1995 ➤

**6-cylinder diesel direct injection engine (TDI),
mechanics**

Engine ID	AFB	AKN							
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Edition 09.2008



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List of Workshop Manual Repair Groups

Repair Group

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



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

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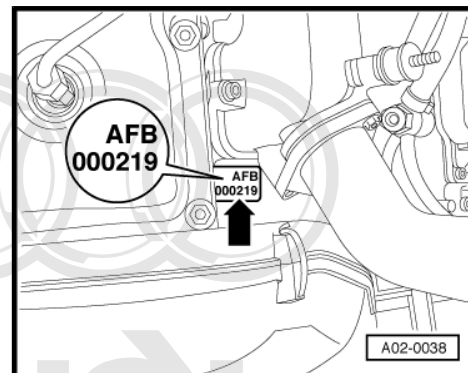


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00 – Technical data

1 Engine number

- ◆ The engine number (“engine code” and “serial number”) is stamped on the right inner side of the cylinder block between the cylinder head and the injection pump.
- ◆ Additionally there is a sticker on the toothed belt cover with “Engine code” and “Serial number”.
- ◆ The engine code is also to be found on the vehicle data sticker.



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2 Engine data

Code letters		AFB	AKN
Capacity	ltr.	2.5	2.5
Power output	kW at rpm	110/4000	110/4000
Torque	Nm at rpm	310/1500 ... 3200	310/1500 ... 3200
Bore	Ø in mm	78.3	78.3
Stroke	mm	86.4	86.4
Compression ratio		18.5	18.5
CN	not less than	45	45
Firing order		1-4-3-6-2-5	1-4-3-6-2-5
Exhaust gas recirculation		yes	yes
Turbocharging/super-charging		Turbocharger	Turbocharger
Self-diagnosis		yes	yes
Catalytic converter		yes	yes
Charge air cooling		yes	yes
Valves per cylinder		2	2

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3 Safety precautions

Observe the following points to prevent personal injuries and damage to the injection and glow plug system:

- ◆ Always switch off the ignition before connecting or disconnecting tester cables or electrical wiring for the injection or glow plug system.
- ◆ Always switch off ignition before washing engine.
- ◆ Faults are stored in engine control unit if electrical connectors were unplugged and the engine was started: "Interrogate fault memory" in "Vehicle self-diagnosis" ⇒ Vehicle diagnosis, testing and information system VAS 5051.



Caution

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

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

– Disconnect battery ⇒ Rep. Gr. 27 .

When working on the cooling system note the following warnings:



WARNING

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

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

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



WARNING

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

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.*

4 General repair instructions

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 lines and connections with clean plugs or sealing caps immediately.
- ◆ Place parts that have been removed on a clean surface and cover them over. Use only lint-free cloths.
- ◆ Carefully cover or seal open components if repairs cannot be carried out immediately.
- ◆ Only install clean components; replacement parts should only be unpacked immediately prior to installation. Do not use parts that have been previously unpacked and stored away loose (e.g. in toolboxes, etc.).
- ◆ When the system is open: Do not work with compressed air. Do not move the vehicle unless absolutely necessary.
- ◆ Protect unplugged electrical connectors against dirt and moisture and make sure connections are dry when attaching.

4.2 Checking for leaks in the fuel system

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- 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 check high-pressure part of fuel system again for leakage.

4.3 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.

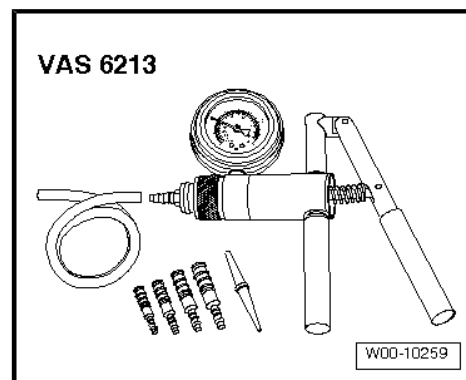
4.4 Installing radiators, condensers and charge air coolers

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, charge air cooler or condenser.

4.5 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 fault memory, check the vacuum lines leading to the corresponding component and also check the remaining vacuum lines in the system.
- If it is not possible to build up pressure with hand vacuum pump -VAS 6213- or if the pressure drops again immediately, check hand vacuum pump and connecting hoses for leaks.

4.6 Routing and attachment of pipes, hoses and wiring

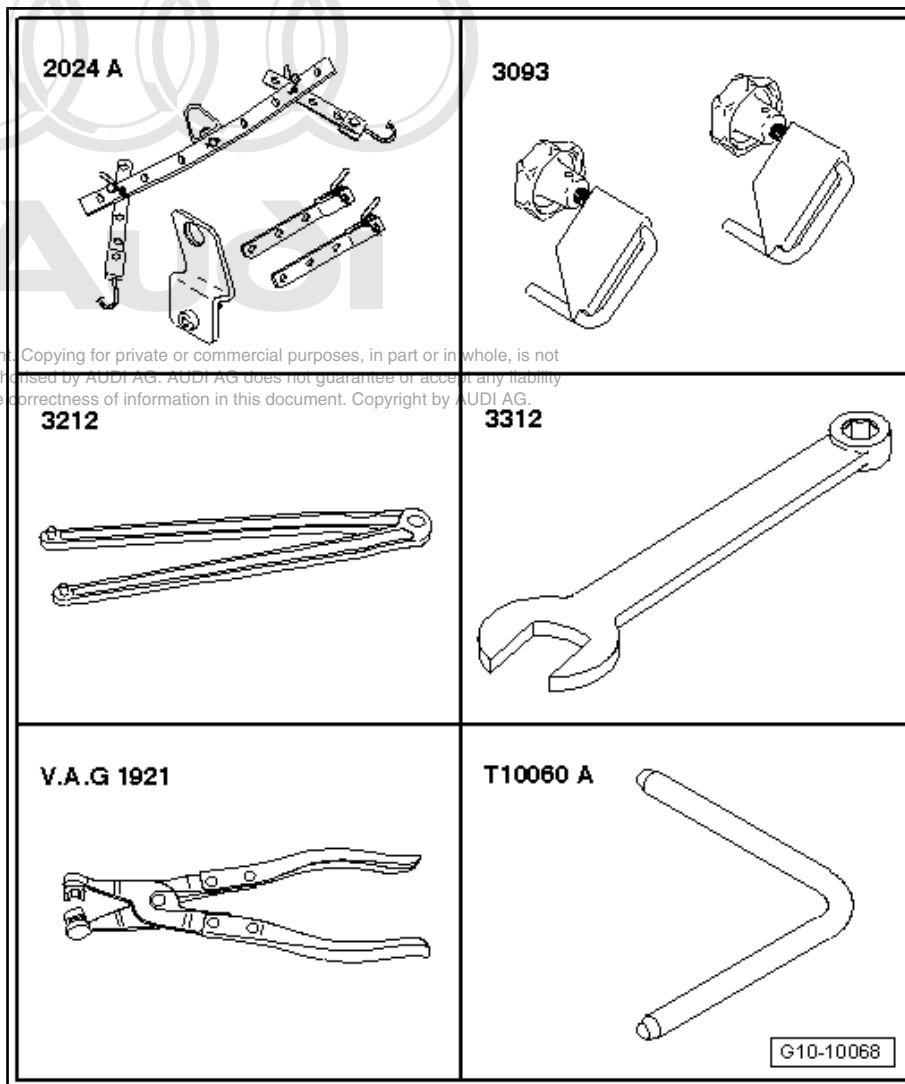
Mark hydraulic lines, vacuum lines and electrical wiring before removal so they can be re-installed in the original positions and correctly connected. Make sketches or take photographs if necessary.

10 – Removing and installing engine

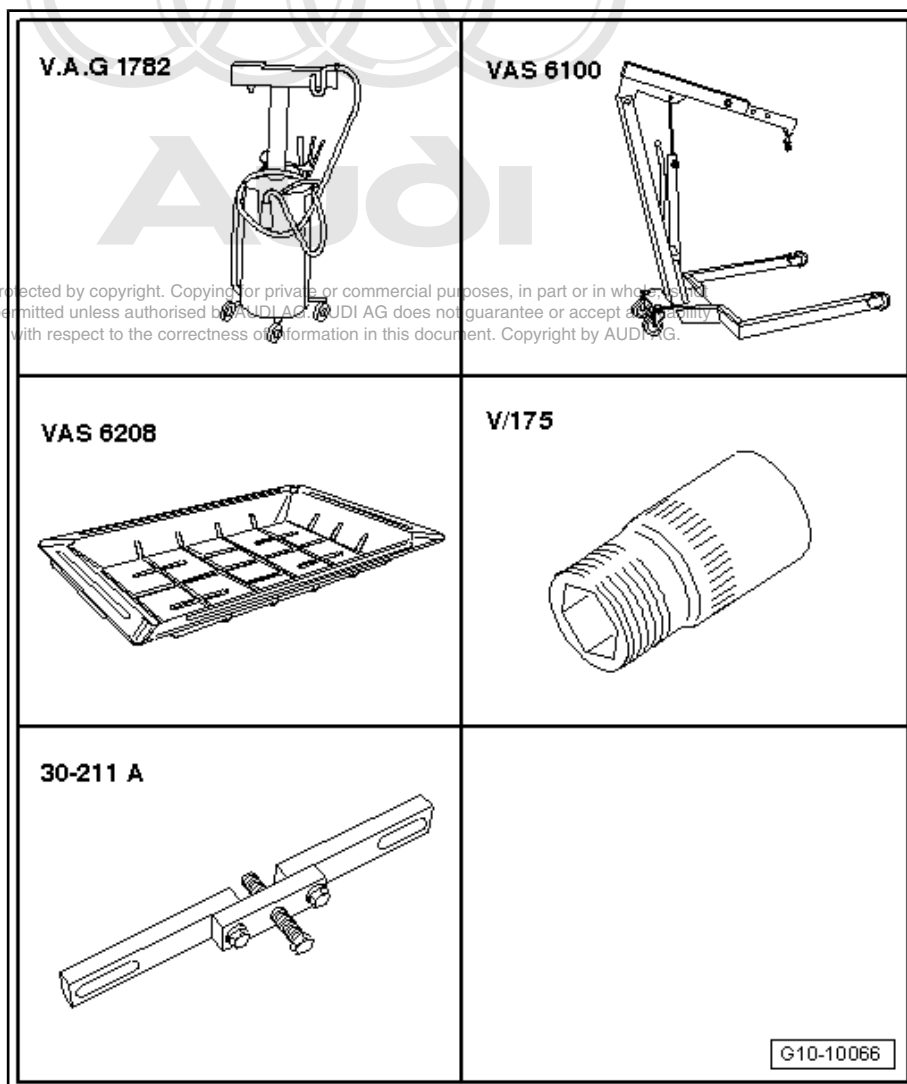
1 Removing engine

Special tools and workshop equipment required

- ◆ Lifting tackle -2024 A-
- ◆ Hose clamps for hoses up to 40 mm -3093-
- ◆ Pin wrench -3212-
- ◆ Open-end spanner -3312-
- ◆ Hose clip pliers -V.A.G 1921-
- ◆ Locking pin -T10060 A-



- ◆ Used oil collection and extraction unit -V.A.G 1782-
- ◆ Workshop hoist - VAS 6100-
- ◆ Drip tray for workshop hoist -VAS 6208-
- ◆ Special tool -V/175- for vehicles with automatic gearbox
- ◆ Support bridge -30 - 211 A- for vehicles with automatic gearbox



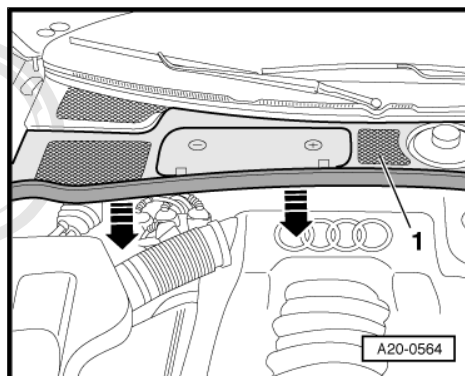
Procedure



Note

- ◆ *The engine is removed from the front without the gearbox.*
- ◆ *Collect drained coolant in a clean container for re-use or disposal.*
- ◆ *Fit all cable ties in the original positions when installing.*
- Move selector lever to position "N" on vehicles with automatic gearbox.

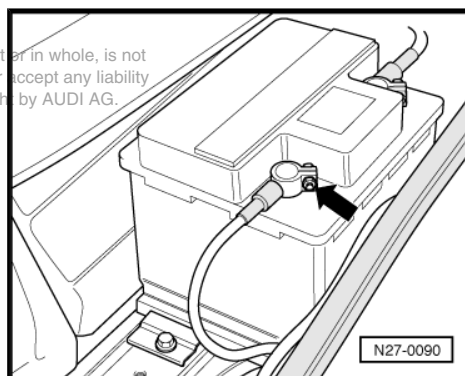
- If fitted, remove seal from plenum chamber cover -arrows-.
- Detach plenum chamber cover -1- towards the front.


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

- ◆ **Observe notes on procedure for disconnecting the battery.**



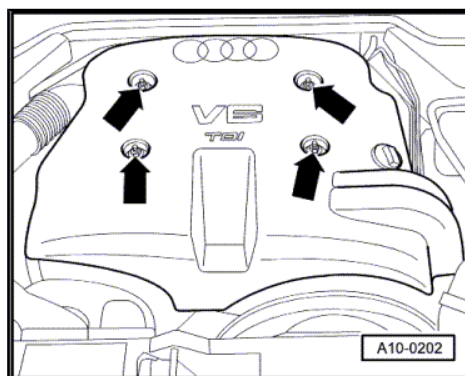
- Disconnect earth wire -arrow- from battery terminal ⇒ Rep. Gr. 27 .


WARNING

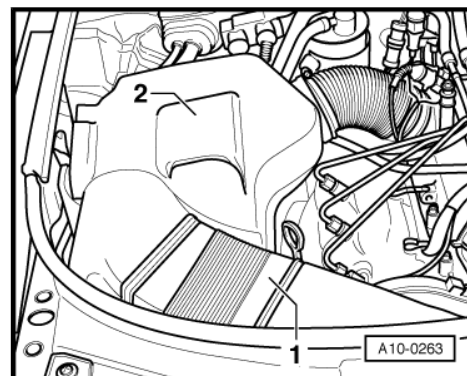
Hot steam/hot coolant can escape - risk of scalding.

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

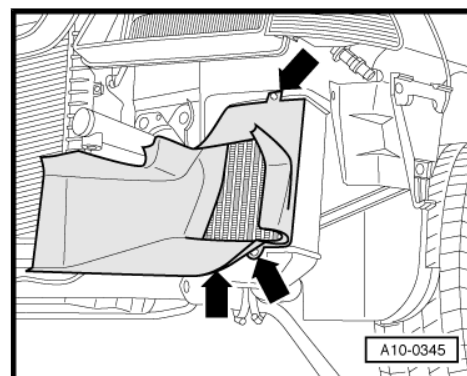
- Open filler cap on expansion tank.
- Detach caps on engine cover panel.
- Unbolt and remove engine cover panel -arrows-.



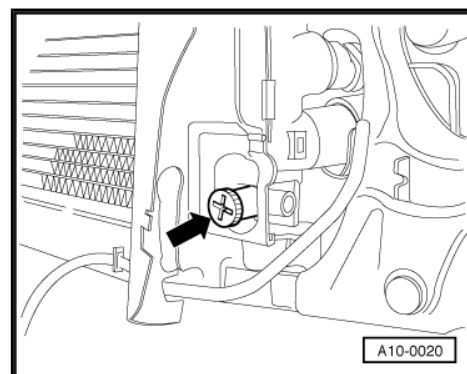
- Remove air duct -1- leading to air cleaner.
- Detach cover -2- from air cleaner.



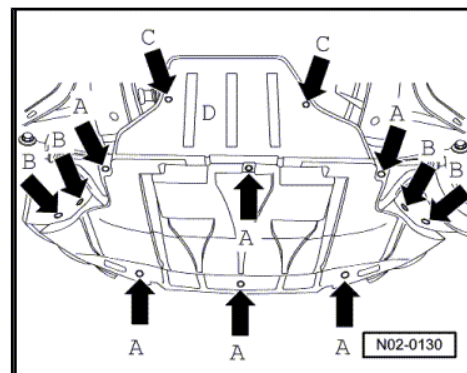
- Remove front bumper ⇒ Rep. Gr. 63 .
- Remove air duct in front of charge air cooler -arrows-.



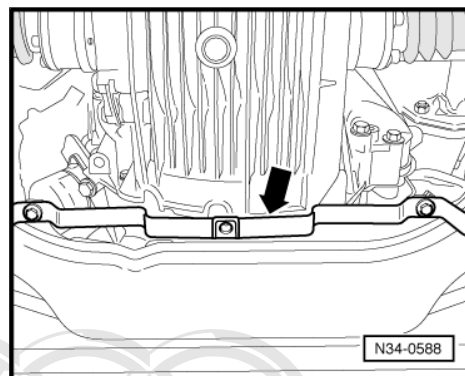
- Place drip tray for workshop hoist -VAS 6208- beneath engine.
- Turn drain plug -arrow- on radiator anti-clockwise, if necessary fit drain hose to connection.



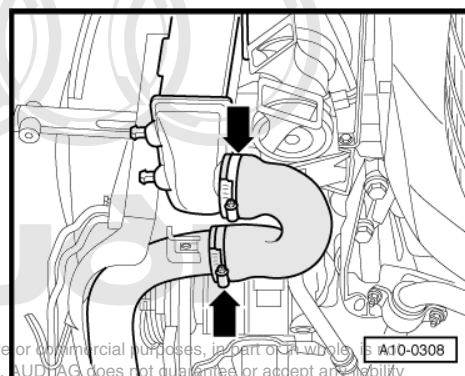
- Remove noise insulation (front and rear) -arrows A ... C-.



- Unbolt bracket for noise insulation -arrow-.

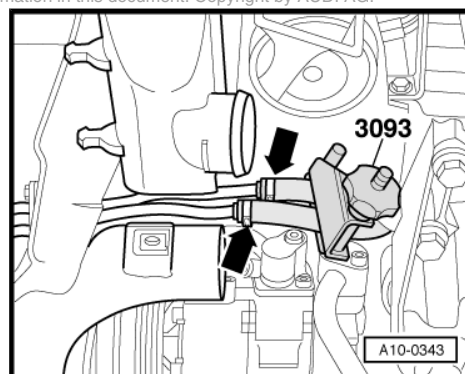


- Remove air hoses leading to charge air coolers on left and right side of vehicle -arrows-.

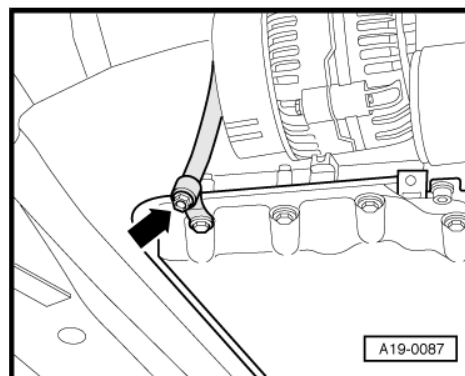


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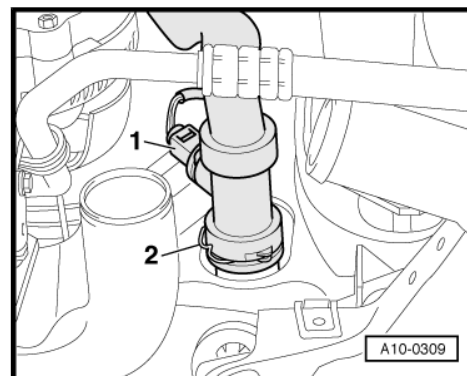
- Clamp off power-steering hoses at bottom left of engine compartment using hose clamps -3094- .
- Disconnect hoses -arrows- from cooling pipe and catch any escaping hydraulic fluid.



- Open drain plug -arrow- and drain off coolant.



- Disconnect connector -1- in bottom right coolant hose.
- Pull out retaining clip -2- and disconnect coolant hose from radiator.



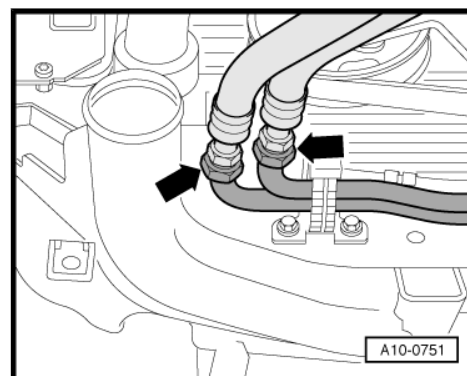
Vehicles with automatic gearbox:



Note

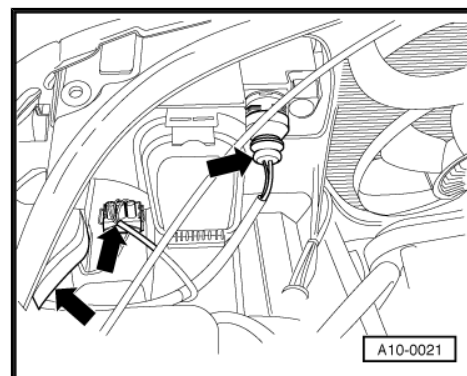
Observe rules for cleanliness when working on automatic gearbox ⇒ Rep. Gr. 37.

- Position used oil collection and extraction unit -V.A.G 1782- below connection point.
- Disconnect ATF pipes -arrows-.
- Unbolt bracket for ATF pipes (left-side) at engine.

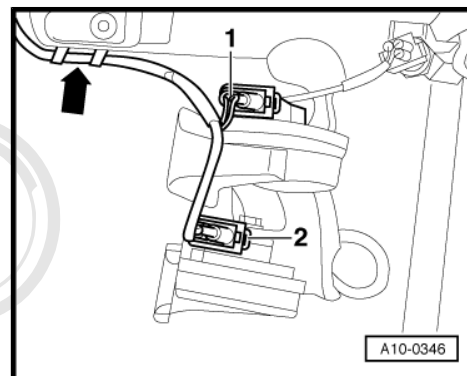


Vehicles up to approx. 11.1997:

- Unplug connectors for headlights and headlight adjustment -arrows-.
- Turn bulb holders for turn signals anti-clockwise and remove from turn signal housing -left arrow-.

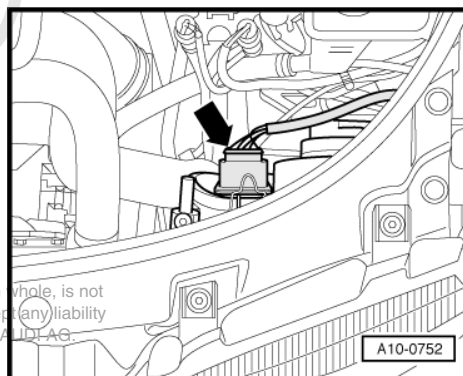


- Unplug connectors -1- and -2- on both horns, disengage electrical wiring at bracket -arrow- and move wiring clear.

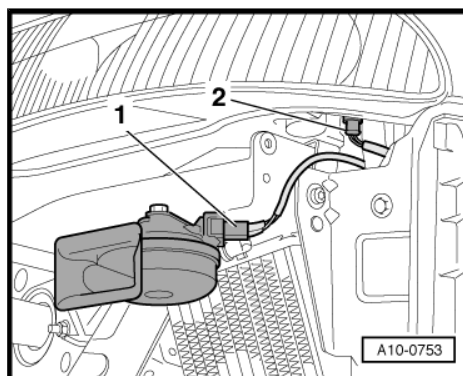


Vehicles from approx. 11.1997 onwards:

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

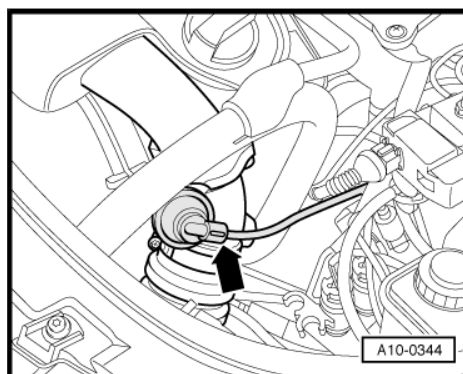


- Unplug electrical connector -2- for indicator lights on both sides.
- Unplug electrical connector -1- at both horns and move wiring clear.

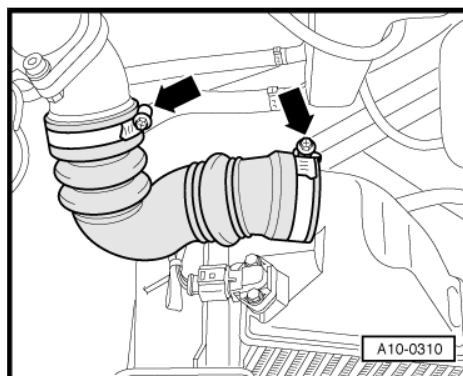


All vehicles (continued):

- Lift retaining clip and disconnect coolant hose (top left) from radiator.
- Detach cable for bonnet at lock carrier ⇒ Rep. Gr. 55 .

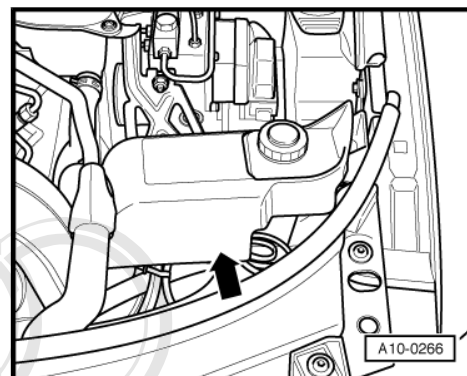


- Disconnect vacuum hose -arrow- at cut-off flap connection.

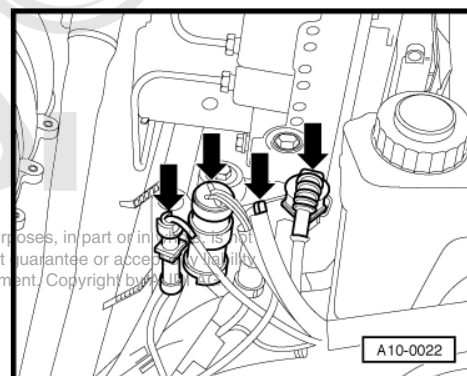


- Release hose clips -arrows- and remove air hose leading to charge air cooler (left-side).

- Remove cover -arrow- at power steering fluid reservoir.



- Unplug connectors located in front of ABS unit -arrows- and move wiring clear.
- Unplug connector for anti-theft alarm on lock carrier (top left) and move wiring clear.



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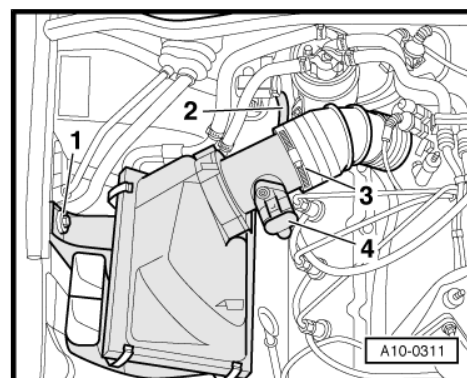
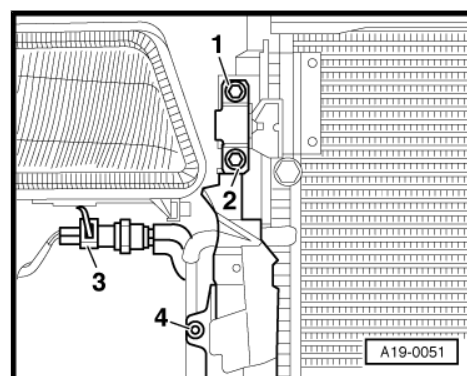
Caution

The air conditioner refrigerant circuit must not be opened.

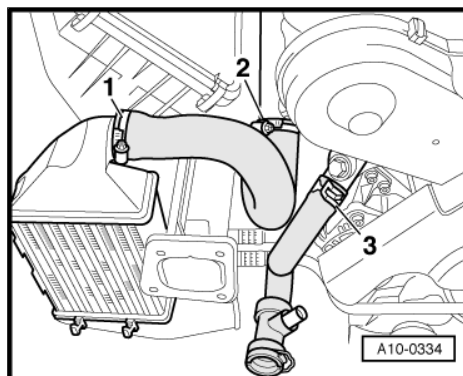
Danger of damage to refrigerant lines and hoses.

◆ *Do NOT stretch, kink or bend refrigerant lines and hoses.*

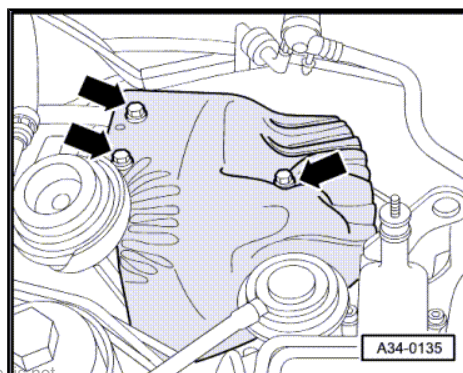
- Detach air ducts (left and right) from radiator -4-.
- Remove bolts -1- and -2- for condenser.
- Unplug connector -3- at air conditioning system pressure switch -F129-.
- Pull condenser up out of its bracket, pivot to side and secure to right-side front wheel with wire.
- Unbolt and remove lock carrier. Place clear of vehicle and ensure that it cannot tip over.
- Slacken hose clip -3-.
- Unplug connector -4-.
- Pull hose -2- off air cleaner housing.
- Unscrew bolt -1- and remove air cleaner housing.



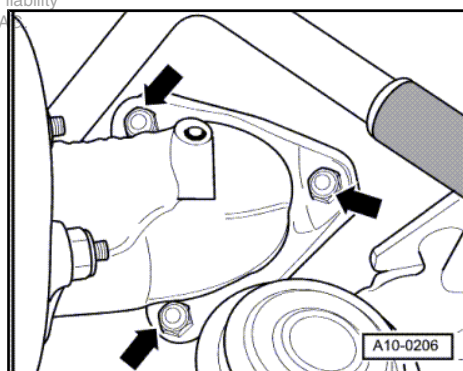
- Release hose clips -1- and -2- and remove air hose leading to charge air cooler (right-side).
- Disconnect coolant hose -3-.



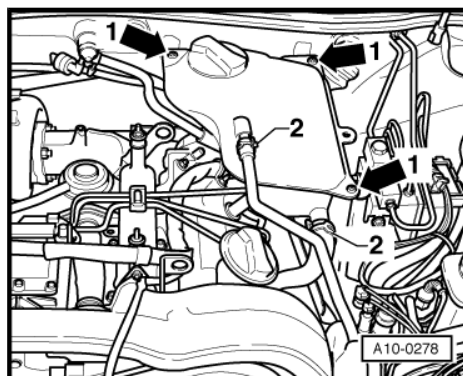
- Remove heat shield above turbocharger -arrows-.



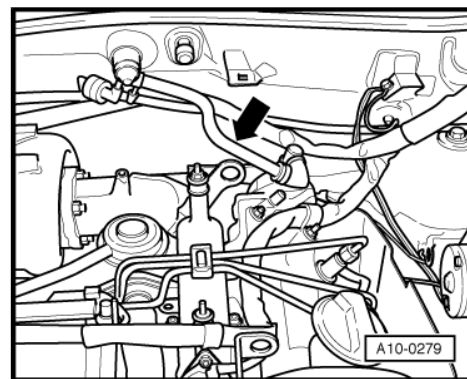
- Unbolt front exhaust pipe from connection for turbocharger -arrows-.



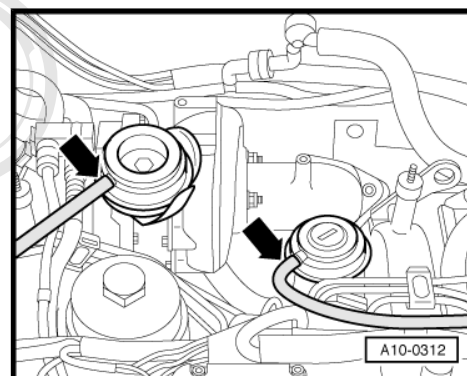
- Remove coolant hoses -2-.
- Unbolt coolant expansion tank -arrows 1-.
- Disconnect wiring to coolant shortage indicator switch -F66- and remove coolant expansion tank.



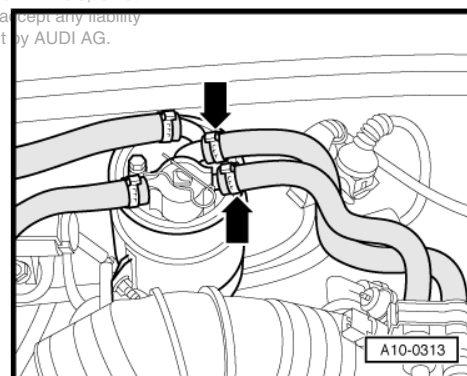
- Disconnect vacuum hose -arrow- from exhauster pump and move clear to one side.



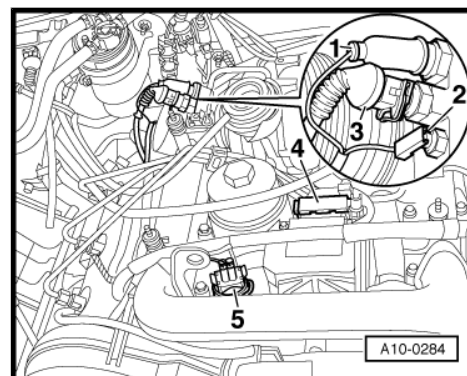
- Disconnect vacuum hoses -arrows- from turbocharger and mechanical exhaust gas recirculation valve.



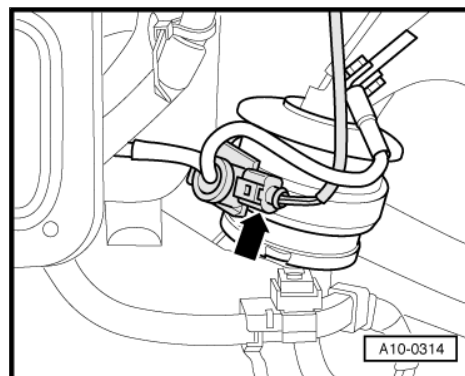
- Disconnect fuel hoses -arrows- from fuel filter.



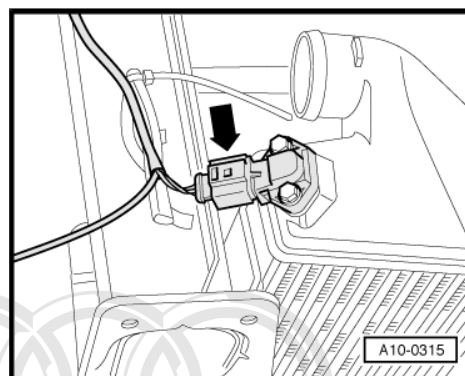
- Unplug connectors -1 ... 3-.
- Unplug connector -4- from injection pump.
- Unplug connector -5- from coolant temperature sender.
- Unplug connectors from glow plugs.



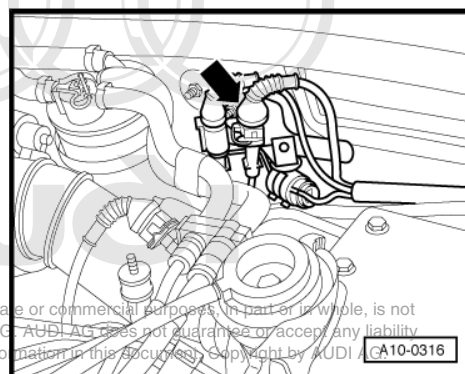
- Unplug connector -arrow- on engine mounting (right-side).



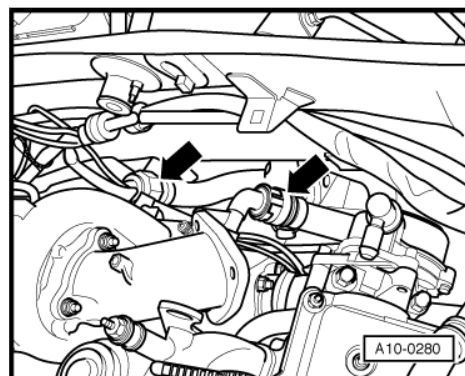
- Unplug connector -arrow- from intake manifold pressure sender -G71- .
- Remove cable clamp on cylinder head cover (left-side) and move wiring harness clear to the rear.



- Unplug connector -arrow- and move wiring for needle lift sender clear.

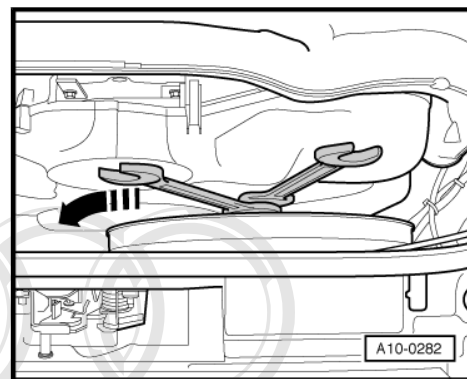


- Lift retaining clips -arrows- and detach coolant hoses leading to heat exchanger from coolant pipes.
- Move rear wiring harness at heat shield clear to one side.



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- Unscrew viscous fan (32 mm).

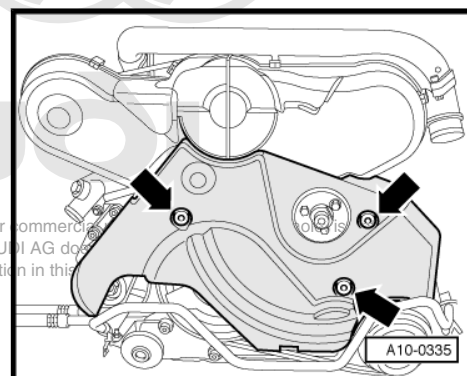


- Remove poly V-belt cover -arrows-.

**Note**

Watch position of spacer sleeves for poly V-belt cover.

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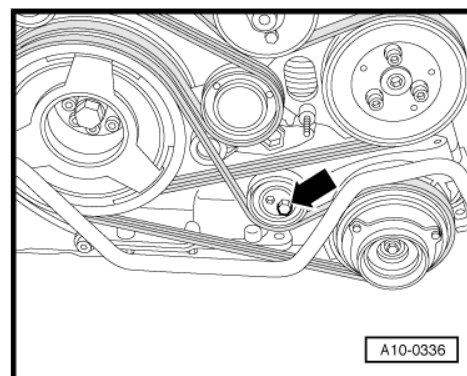


- Detach cover from tensioning roller of air conditioner compressor.

**Caution**

If a used belt runs in the opposite direction when it is refitted, this can cause breakage.

- ◆ *Before removing, mark direction of rotation of poly V-belt with chalk or felt-tipped pen for re-installation.*



- Slacken off bolt -arrow- of tensioning roller for air conditioner compressor and detach poly V-belt.
- On vehicles with automatic gearbox, unbolt bracket -2- for ATF lines (right-side) from sump.

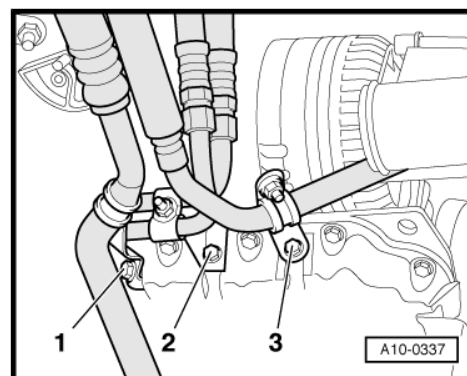
**Caution**

The air conditioner refrigerant circuit must not be opened.

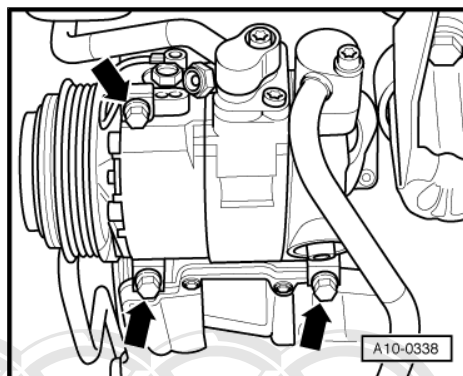
Danger of damage to refrigerant lines and hoses.

- ◆ *Do NOT stretch, kink or bend refrigerant lines and hoses.*

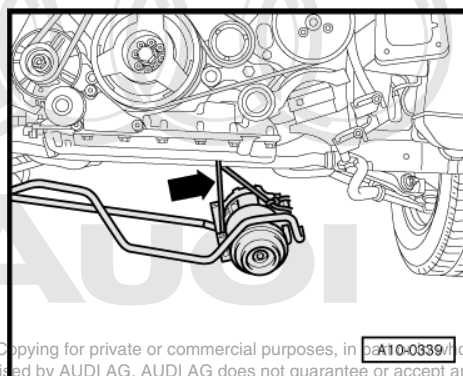
- Detach both brackets for refrigerant pipes -1- and -3- from sump.



- Unbolt air-conditioner compressor from bracket -arrows-.



- Tie up air conditioner compressor onto subframe, leaving refrigerant lines connected -arrow-.



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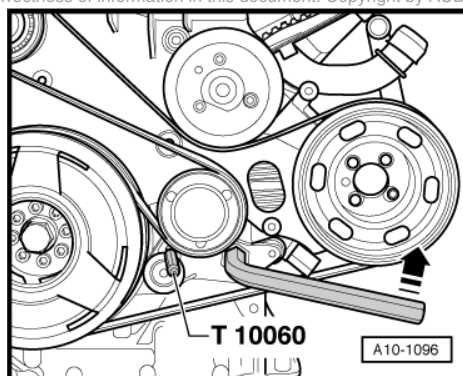


Caution

If a used belt runs in the opposite direction when it is refitted, this can cause breakage.

- ◆ *Before removing, mark direction of rotation of poly V-belt with chalk or felt-tipped pen for re-installation.*

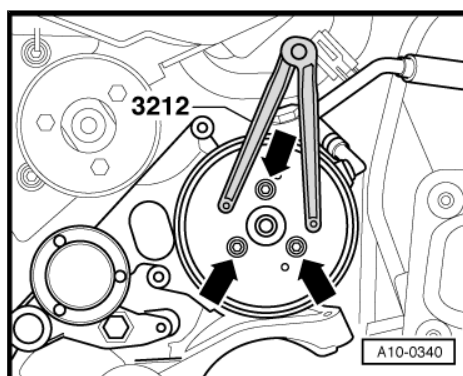
- To slacken poly V-belt, use an Allen key to turn tensioner in anti-clockwise direction -arrow- until the two bores align and locking pin -T10060- or -T10060 A- can be inserted.
- Take off poly V-belt.
- Unbolt poly V-belt pulley at power steering pump -arrows-, using pin wrench -3212- as a counterhold.
- Unbolt power steering pump from bracket and place it on longitudinal member.



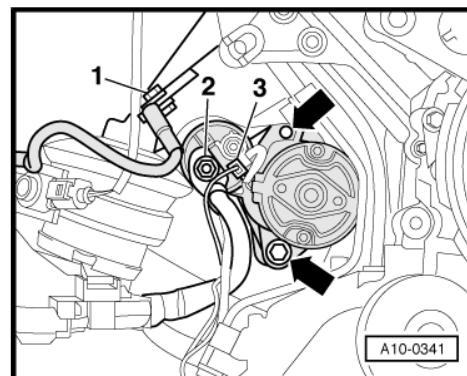
Note

Pipes of power steering pump remain connected.

- Remove bolts for alternator.
- Detach alternator to front.
- Unbolt wiring from removed alternator.



- Detach wires -2- and -3- at starter; remove insulator from positive connection on starter.
- Unbolt earth wire -1- from engine support (right-side).
- Unscrew bolts -arrows- securing starter working from gearbox side and remove starter.



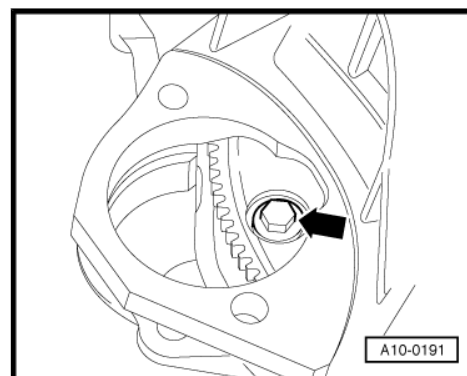
Vehicles with automatic gearbox:

- Use special tool -V/175- to unscrew 3 bolts for torque converter through opening for starter (turn crankshaft $\frac{1}{3}$ turn further each time).



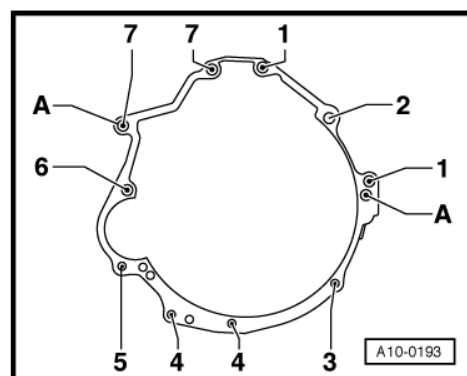
Note

When loosening torque converter bolts, counterhold crankshaft by applying spanner to central bolt on vibration damper.

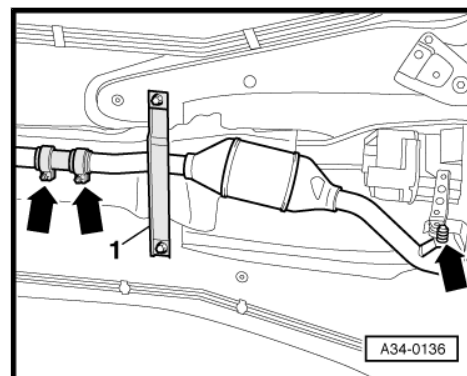


All vehicles (continued):

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



- Unbolt cross member -1-.
- Remove front exhaust pipe together with catalytic converter -arrows-.

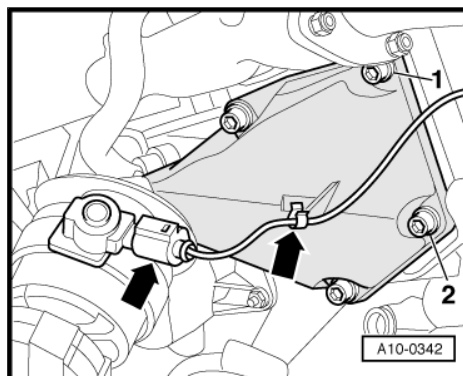


- Unplug connector on engine mounting (left-side) and unclip wiring -arrows-.
- Remove rear bolts -1- and -2- on engine supports (left and right).



Note

Do not remove the two front bolts on the engine supports.



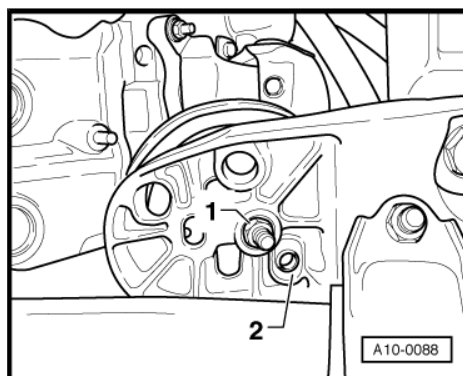
- Mark position of nuts -1- and locating sleeves -2- on bottom of engine mountings (right and left).



Note

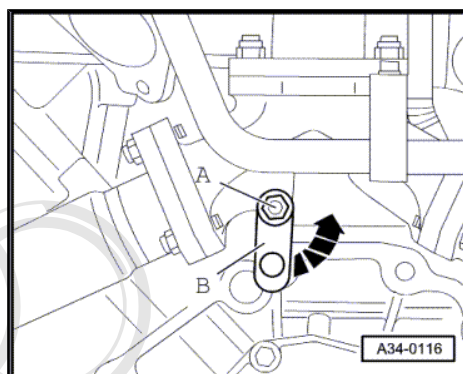
Different mounting holes are provided for the different engine versions.

- Remove bottom nut -1- at engine mountings (left and right).
- Unscrew engine/gearbox securing bolts (top); leave one bolt in place (hand-tight).
- Loosen bolt -A- (at rear of turbocharger) a few turns and turn brace -B- to side in direction of -arrow-. Then tighten bolt -A- again slightly.



Note

In the illustration the engine is shown from the rear with the gearbox removed.



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- Engage lifting tackle -2024 A- on engine and workshop hoist -VAS 6100- .

i Note

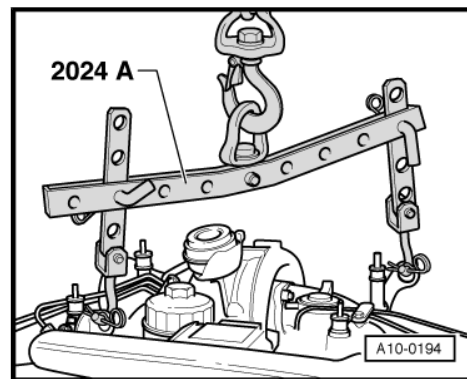
To adjust to the centre of gravity of the assembly, the perforated rails of the support hooks must be positioned as shown.



WARNING

Accident risk from loose components of support bracket.

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



- Unscrew final bolt.
- Raise engine and gearbox using workshop hoist -VAS 6100- .

i Note

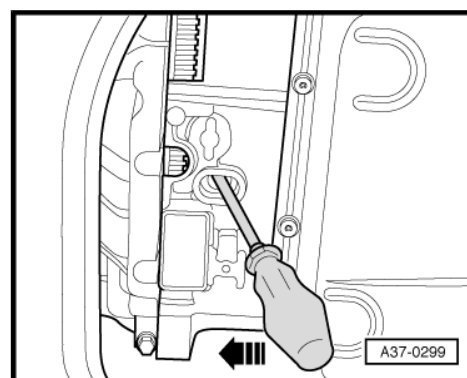
Make sure no wires/pipes are damaged at the top on the bulk-head.

- Remove front bolts on both engine supports and remove engine supports together with engine mountings.
- Lower engine again slightly.

i Note

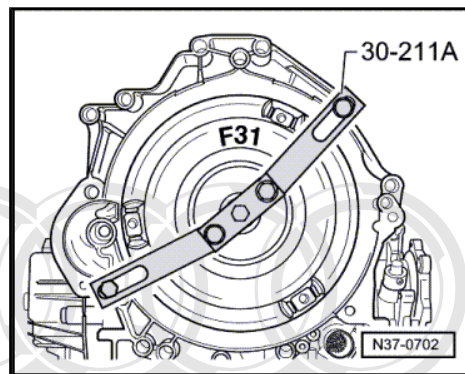
Check that all hoses and other connections between engine and body have been detached.

- Guide engine forwards out of engine compartment.
- On vehicles with automatic gearbox, separate gearbox from engine and at the same time detach torque converter from drive plate.
- Detach engine from gearbox and lift engine forwards out of engine compartment.





- On vehicles with automatic gearbox, secure torque converter in gearbox using support bridge -30 - 211 A- to prevent it falling out.



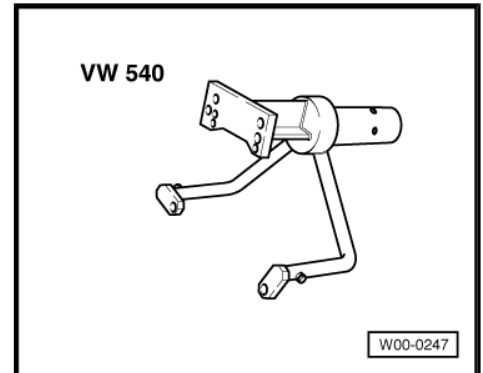
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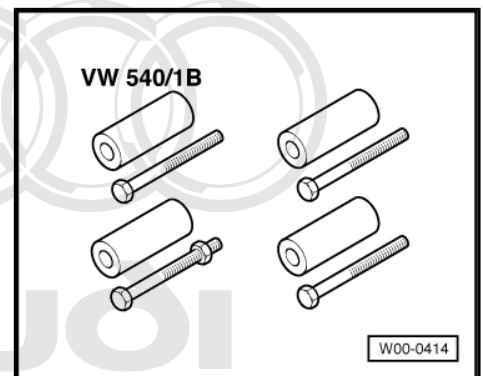
2 Securing engine to engine and gearbox support

Special tools and workshop equipment required

- ◆ Engine and gearbox support -VW 540-

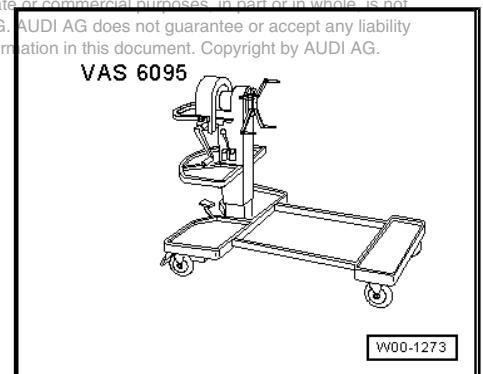


- ◆ Engine and gearbox support supplement -VW 540/1 B-



- ◆ Engine and gearbox support -VAS 6095-

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- ◆ Drill bit, $\varnothing$ 13 mm
- ◆ Electric drill
- ◆ Safety goggles

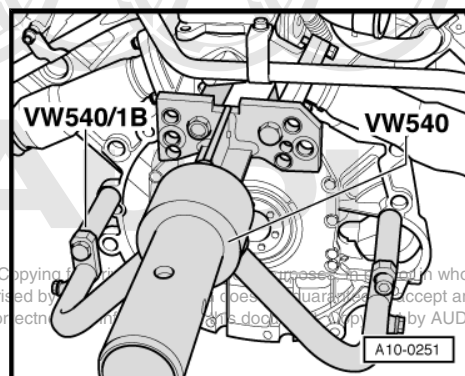
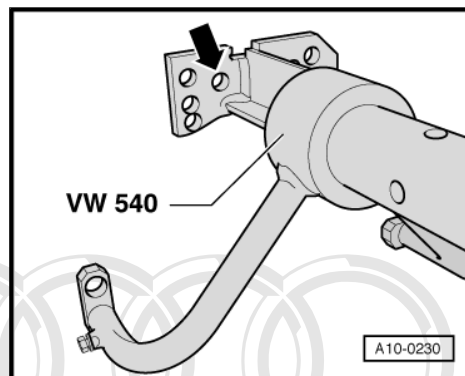
Procedure

**WARNING**

Protect eyes against injuries.

◆ *Wear safety goggles.*

- Drill out hole -arrow- in engine and gearbox support -VW 540- to 13 mm.
- Secure engine to engine and gearbox support -VAS 6095- using -VW 540- and -VW 540/1 B- prior to assembly work.



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3 Installing engine

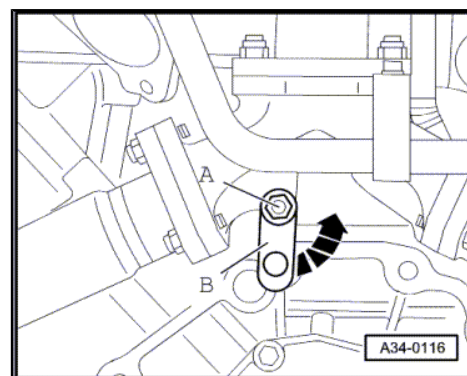
Procedure

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



Note

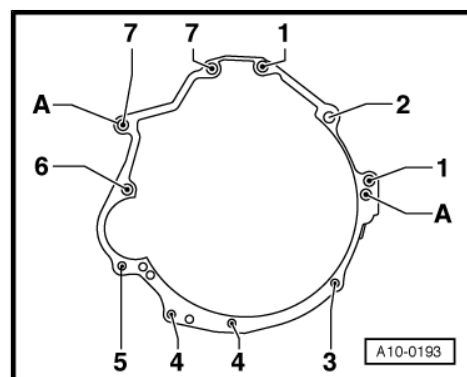
- ◆ *Renew the bolts tightened with specified tightening angle.*
- ◆ *Renew self-locking nuts and bolts as well as seals, gaskets and O-rings.*
- ◆ *Hose connections and hoses for charge air system must be free of oil and grease before assembly.*
- Before installing engine, check that brace -B- is still turned to one side in direction of -arrow- (brace is pivoted back down after installing engine).
- Before installing engine, tie electrical wiring to one side so that it cannot be trapped between engine and gearbox.



- Check whether dowel sleeves -A- for centring engine and gearbox are fitted in cylinder block; install missing dowel sleeves.

Vehicles with manual gearbox:

- Clean the input shaft splines and (in the case of used clutch plates) the hub splines. Remove corrosion and apply only a **very thin coating of grease G 000 100 to the splines**. Do not lubricate guide sleeve.
- Check clutch release bearing for wear; renew if necessary.
- Check that the clutch plate is properly centralised (only necessary if you have carried out other work on the clutch).
- A needle bearing must be fitted in the flywheel on vehicles with manual gearbox. Install needle bearing if necessary
⇒ [page 83](#) .



Vehicles with automatic gearbox:

- Short engines are supplied without centring sleeve in crankshaft. Drive centring sleeve in before installing drive plate
⇒ [page 88](#) .
- To secure torque converter on drive plate, use only new bolts (same as original equipment); refer to ⇒ Electronic parts catalogue .
- Tighten bolts for torque converter with special tool -V/175- .

Checking installation depth of torque converter:

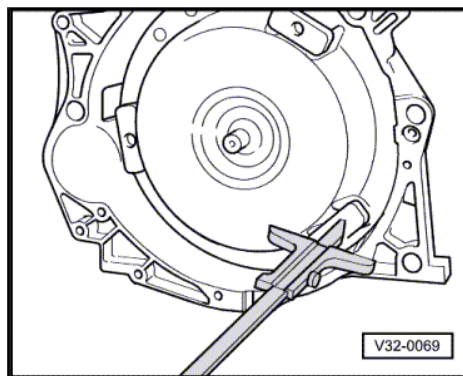
- If the torque converter has been correctly installed, the distance between the bottom contact surfaces at the threaded holes on the torque converter and the contact surface on the torque converter bell housing (with automatic gearbox) is approx. 23 mm.



Caution

Risk of damage to gearbox if torque converter is installed incorrectly.

- ◆ **If the torque converter has not been fully inserted, this distance will be approx. 11 mm.**



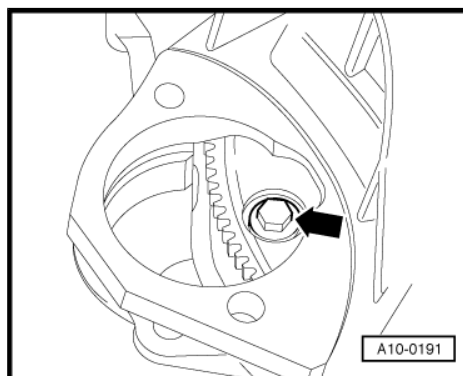
- Before bringing engine and gearbox together, turn torque converter and drive plate on engine so that the holes for one securing bolt are in line with the opening for the starter motor -arrow-.
- To secure torque converter on drive plate, use only new bolts (same as original equipment); refer to ⇒ Electronic parts catalogue .



Caution

Risk of damage to gearbox if torque converter is installed incorrectly.

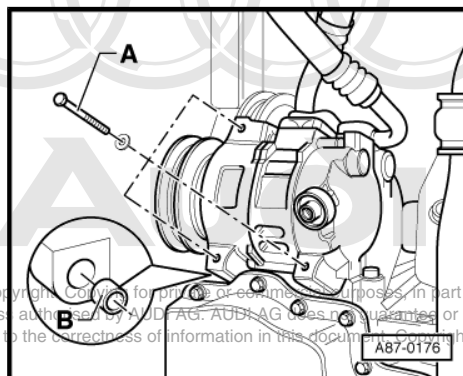
- ◆ **Before and during tightening of bolts securing engine to gearbox, continually check that the torque converter behind the drive plate can be turned.**
- ◆ **If the torque converter cannot be turned, the drive lugs of the ATF pump and consequently the gearbox will be damaged when the bolts are finally tightened.**



- Secure ATF lines to ATF cooler ⇒ Rep. Gr. 37 .

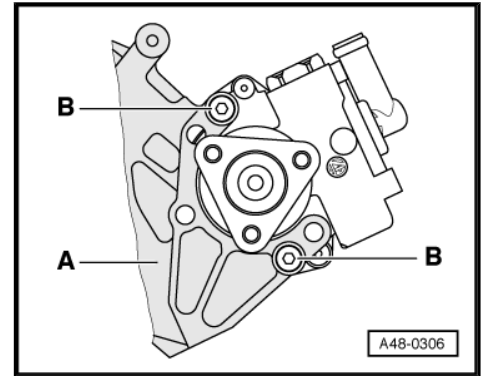
All vehicles (continued):

- Install engine mountings free of stress. To do so, shake engine before tightening engine mountings.
- Install air conditioner compressor and power steering pump.
- Check whether dowel sleeves -B- for centring air conditioner compressor have been fitted; insert missing dowel sleeves.

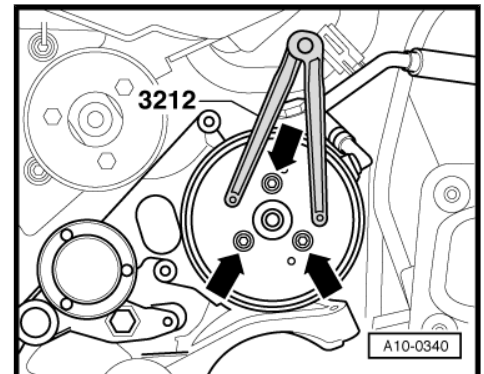


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- Bolt on power steering pump at holes -B- on bracket -A-.

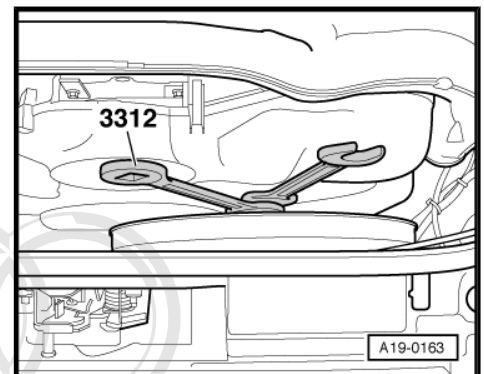


- Install poly V-belt pulley for power steering pump.



- Secure viscous fan.

Tightening torque for viscous fan	Nm
Torque wrench -V.A.G 1331- together with open-end spanner -3312-	37
Torque wrench -V.A.G 1331- without open-end spanner -3312-	70



- Install alternator ⇒ Rep. Gr. 27 .
- Install poly V-belt for power steering pump, alternator and viscous fan ⇒ [page 36](#) .
- Install lock carrier ⇒ [page 31](#) .

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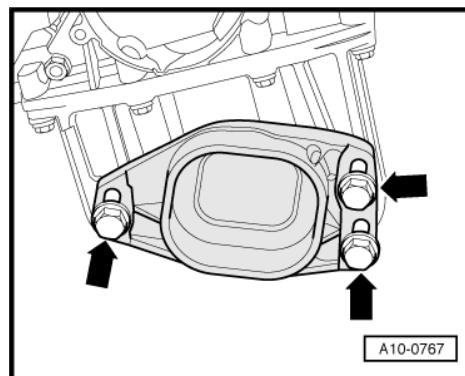
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- Allow stop for torque reaction support to rest on rubber buffer for torque reaction support and tighten bolts -arrows- to 28 Nm.
- Fill up with coolant ⇒ [page 184](#) .



Note

- ◆ *Do not use drained coolant again if:*
 - ◆ *the cylinder head or cylinder block have been renewed.*
 - ◆ *the coolant is contaminated or dirty.*
- Top up power steering fluid and bleed steering system ⇒ Rep. Gr. 48 .
- Align the exhaust system free of stress: vehicles with front-wheel drive ⇒ [page 238](#) , vehicles with four-wheel drive ⇒ [page 247](#) .
- Electrical connections and routing ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- Observe notes on procedure for connecting the battery ⇒ Rep. Gr. 27 .



Caution

Risk of damage to control units because of excessive voltage.

- ◆ ***Never use battery charging equipment for boost starting.***



Caution

Risk of irreparable damage to injection pump.

- ◆ ***Do not attempt to start the engine without first bleeding the fuel system!***

- Bleed fuel system ⇒ Rep. Gr. 20 .
- Check engine oil level ⇒ Maintenance ; Booklet 802 .
- Read out fault memory of engine control unit ⇒ Rep. Gr. 01 .



Note

Faults will have been stored in the memory because connectors have been unplugged. Therefore interrogate and erase fault memory after installing engine.

- Adjust headlights ⇒ Rep. Gr. 94 .
- On vehicles with automatic gearbox: check ATF level ⇒ Rep. Gr. 37 .

Tightening torque



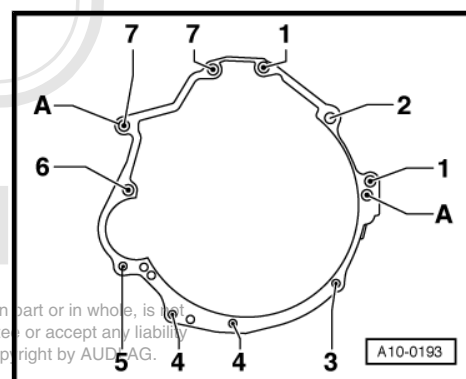
Note

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

Engine/gearbox connecting bolts (manual gearbox)

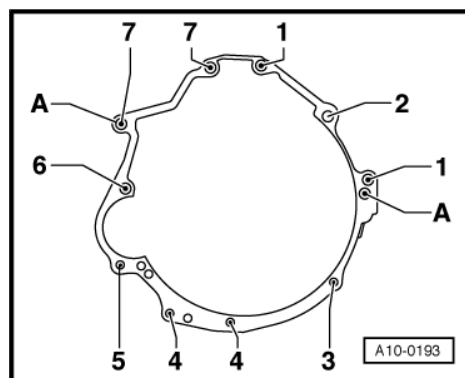
Item	Bolt	Nm
1	M12x80	65
2	M12x90	65
3	M10x50 ¹⁾	45
4	M10x45	45
5	M10x135	65
6	M12x110	65
7	M12x67	65
A	Dowel sleeves for centralising	

• ¹⁾ Special bolt.



Engine/gearbox connecting bolts (automatic gearbox)

Item	Bolt	Nm
1	M12x80	65
2	M12x90	65
3	M10x60	45
4	M10x45	45
5	M10x80	65
6	M12x110	65
7	M12x67	65
A	Dowel sleeves for centralising	



Component		Nm
Bolts/nuts	M6	10
	M8	20
	M10	45
	M12	65
Except for the following:		
Engine support to cylinder block		45
Air cleaner housing to body		10
Tensioning roller for poly V-belt for A/C compressor to bracket		22
Front exhaust pipe to connection for turbocharger		25
Heat shield to turbocharger		10
Support for intermediate flange to intermediate flange		22
Drain plug to coolant drain pipe		10
Stop for torque reaction support to lock carrier		25
Drive plate to torque converter M10x1		85
Air conditioner compressor to bracket		22
Power steering pump to bracket for power steering pump and oil cooler		22
Underbody cross member to body		20
Poly V-belt pulley to power steering pump		22
Engine mounting to subframe		25

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13 – Crankshaft group

1 Lock carrier service position

1.1 Lock carrier service position - exploded view

1 - Bolt

45 Nm

2 - Bolt

45 Nm

3 - Bolt

10 Nm

4 - Bolt

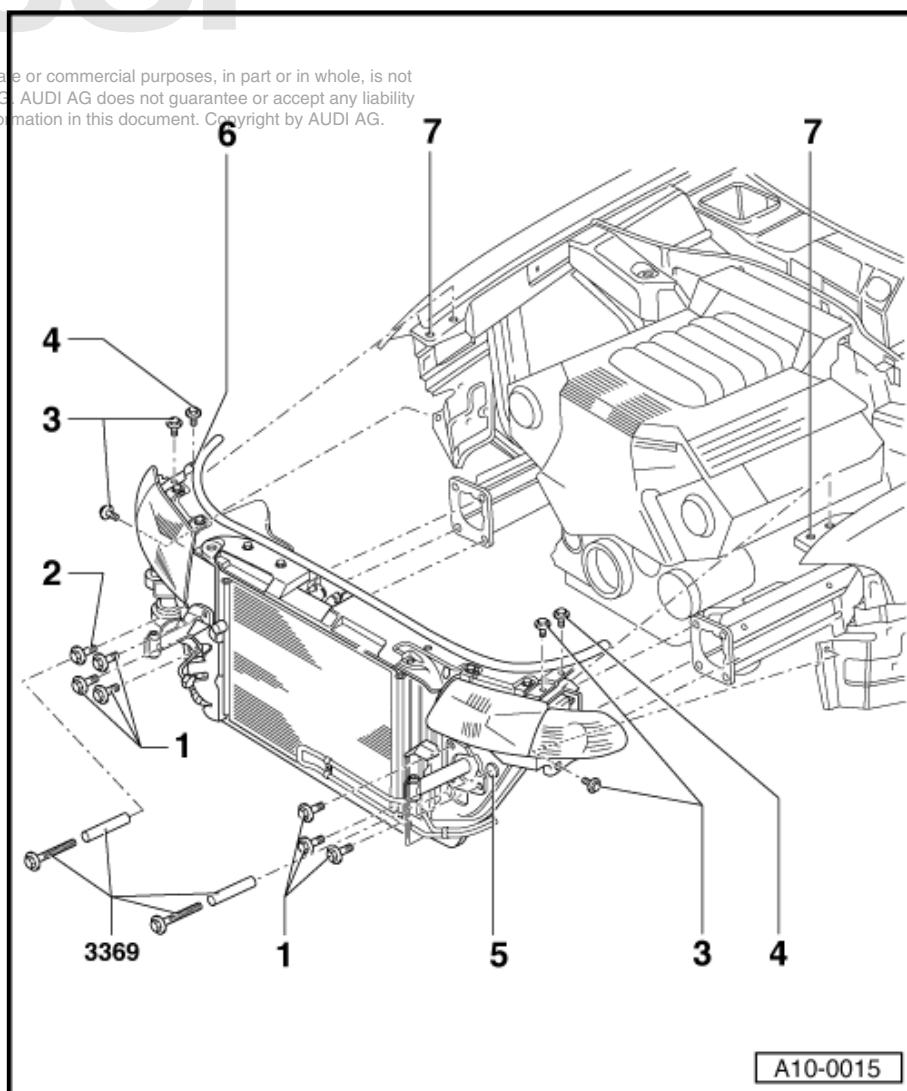
10 Nm

5 - Bore

- ☐ For front-end service sleeves -3369-

6 - Bore in lock carrier

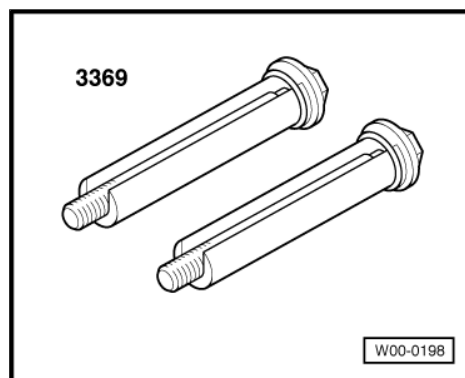
7 - Bore in wing panel



1.2 Moving lock carrier into service position

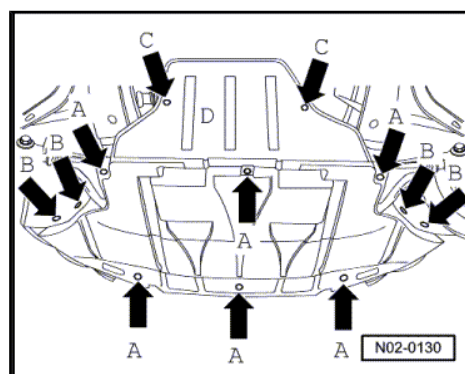
Special tools and workshop equipment required

◆ Front-end service sleeves -3369-

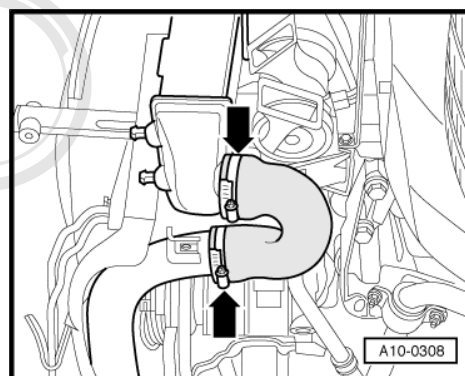


Procedure

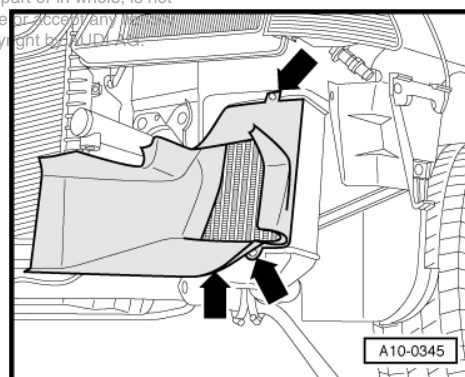
- Open quick-release fasteners -A- and -B- and detach noise insulation (front).
- Remove front bumper ⇒ Rep. Gr. 63 .



- Remove air hoses leading to charge air coolers on left and right side of vehicle -arrows-.



- Remove air duct in front of charge air cooler -arrows-.



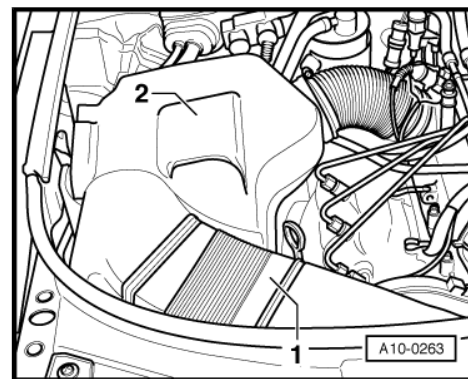
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- Remove air duct -1- leading to air cleaner.

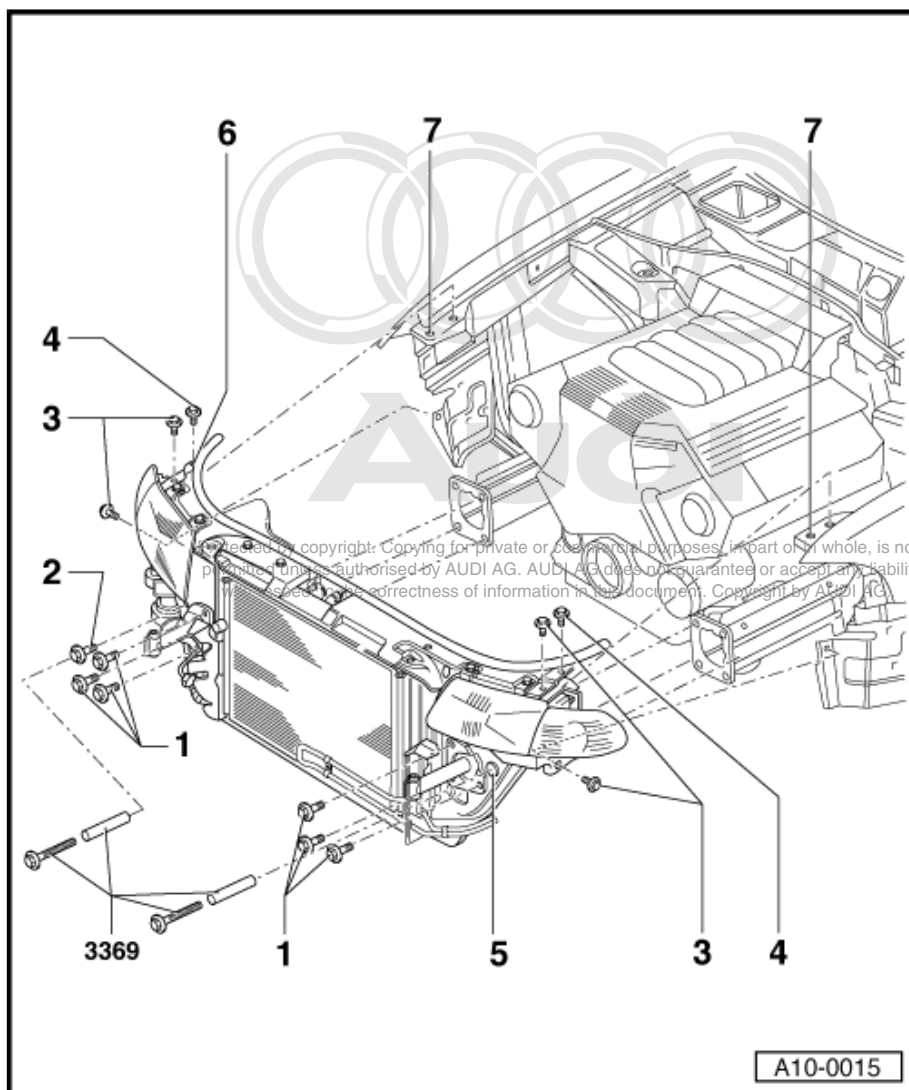
**Note**

Cover -2- does not have to be removed.

- If fitted, detach clips for wiring harness on left of radiator cowl.

**5 - Lock carrier**

- Remove bolt -2- for lock carrier and screw in front-end service sleeve -3369-.
- Screw front-end service sleeve -3369- into bore -5-.
- Remove bolts -1- and -3-.
- Remove bolts -4- and pull out lock carrier as far as stop.
- To secure lock carrier, screw suitable M6 bolts into rear bores in lock carrier -6- and bores in wing panel -7-.

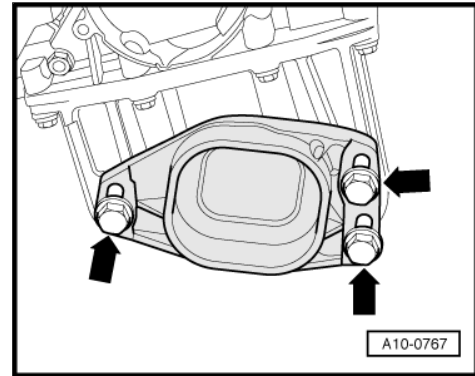
**Assembling**

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

- After installing lock carrier, check cable routing in area of radiator fan.



- Allow stop for torque reaction support to rest on rubber buffer for torque reaction support and tighten bolts -arrows- to 28 Nm.
- Install front bumper ⇒ Rep. Gr. 63 .



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2 Cylinder block (pulley end)

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

1 - Poly V-belt

- ☐ Check for wear
- ☐ Before removing, mark direction of rotation with chalk or felt-tipped pen
- ☐ Removing and installing
⇒ [page 36](#)
- ☐ Do not kink
- ☐ When installing, make sure it is properly seated on pulleys

2 - Spacer sleeve

3 - Bolt

Tightening torque ⇒ Rep. Gr. 27

4 - Alternator

- ☐ Removing and installing
⇒ Rep. Gr. 27

5 - Bolt

Tightening torque ⇒ Rep. Gr. 27

6 - Bolt

- ☐ 22 Nm

7 - Bracket

- ☐ For alternator

8 - Bolt

- ☐ 10 Nm

9 - Bolt

- ☐ 22 Nm

10 - Cover

- ☐ For idler roller

11 - Bolt

- ☐ 22 Nm

12 - Idler roller

- ☐ For poly V-belt

13 - Idler roller

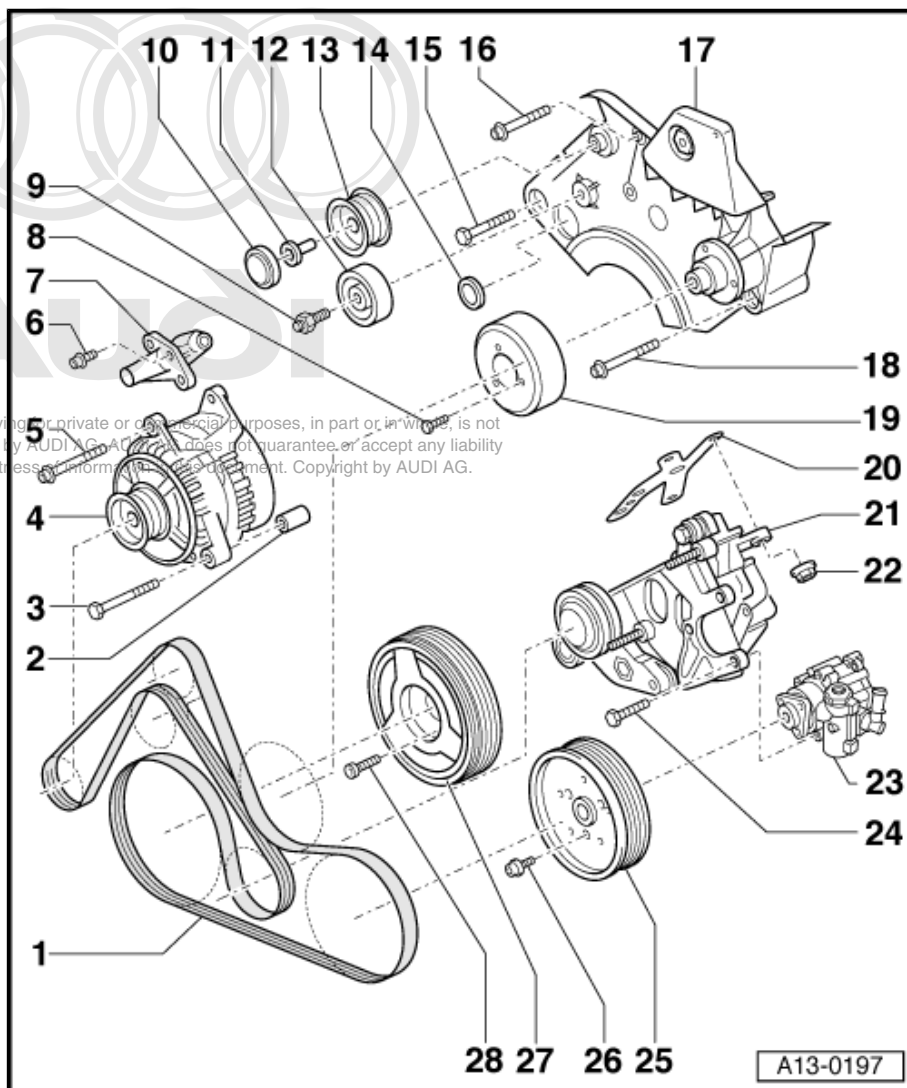
- ☐ For poly V-belt

14 - Cover cap

- ☐ For access to toothed belt tensioning roller

15 - Bolt

- ☐ 45 Nm



16 - Bolt

- ☐ 10 Nm

17 - Bracket

- ☐ For viscous fan
- ☐ Removing and installing ⇒ [page 71](#)
- ☐ Viscous fan bearings cannot be renewed separately
⇒ ["1.10 Removing and installing viscous fan", page 200](#)

18 - Bolt

- ☐ 22 Nm

19 - Poly V-belt pulley

- ☐ For viscous fan
- ☐ Removing and installing ⇒ [page 200](#)

20 - Gasket

- ☐ **Renew**
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21 - Bracket

- ☐ For power steering pump and oil cooler
- ☐ Removing and installing ⇒ [page 44](#)

22 - Nut

- ☐ 22 Nm

23 - Power steering pump

- ☐ Removing and installing ⇒ Rep. Gr. 48
- ☐ Note installation position ⇒ [page 44](#)

24 - Bolt

- ☐ 22 Nm

25 - Poly V-belt pulley

- ☐ For power steering pump
- ☐ Installation position: marking "vorne" (front) faces in direction of travel.
- ☐ Removing and installing ⇒ [page 44](#)

26 - Bolt

- ☐ 22 Nm

27 - Vibration damper

- ☐ With poly V-belt pulley
- ☐ Removing and installing ⇒ [page 42](#)

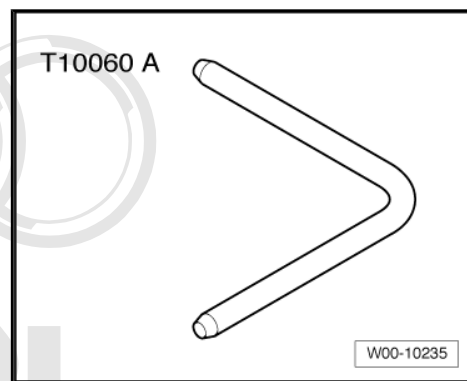
28 - Bolt

- ☐ 22 Nm

2.2 Removing and installing poly V-belt for power steering pump, alternator and viscous fan

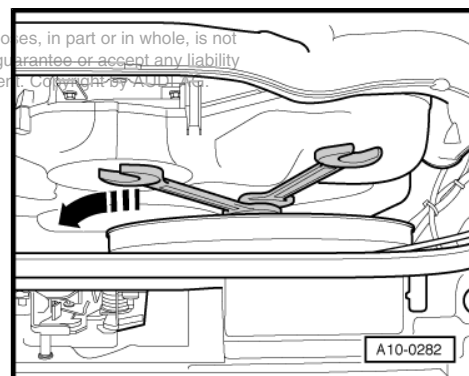
Special tools and workshop equipment required

◆ Locking pin -T10060 A-

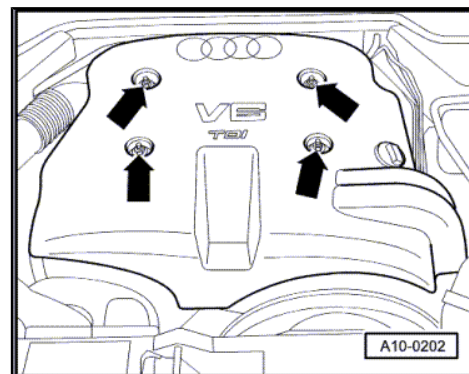


Removing

- Lock carrier must be in service position => [page 31](#).
- Unscrew viscous fan (32 mm).



- Detach caps on engine cover panel.
- Unbolt and remove engine cover panel -arrows-.
- Remove front toothed belt cover on left and right.

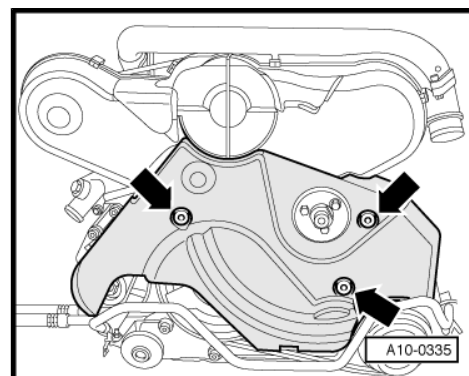


- Remove poly V-belt cover -arrows-.



Note

Watch position of spacer sleeves for poly V-belt cover.



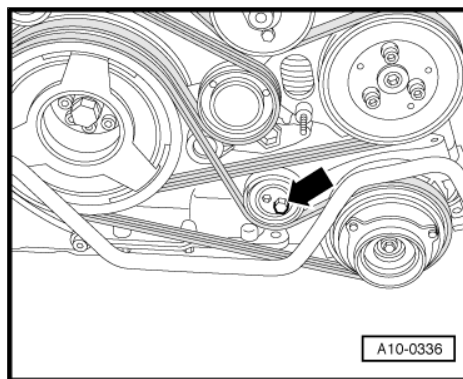
- Detach cover from tensioning roller of air conditioner compressor.



Caution

If a used belt runs in the opposite direction when it is refitted, this can cause breakage.

- ◆ *Before removing, mark direction of rotation of poly V-belt with chalk or felt-tipped pen for re-installation.*



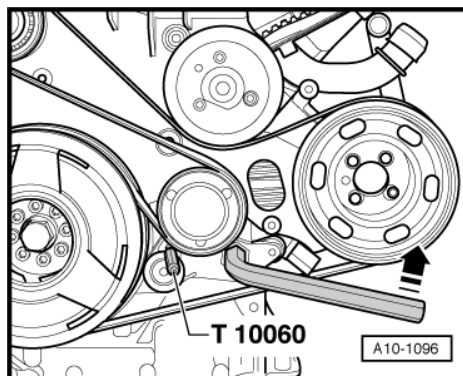
- Slacken off bolt -arrow- of tensioning roller for air conditioner compressor and detach poly V-belt for air conditioner compressor.



Caution

If a used belt runs in the opposite direction when it is refitted, this can cause breakage.

- ◆ *Before removing, mark direction of rotation of poly V-belt with chalk or felt-tipped pen for re-installation.*

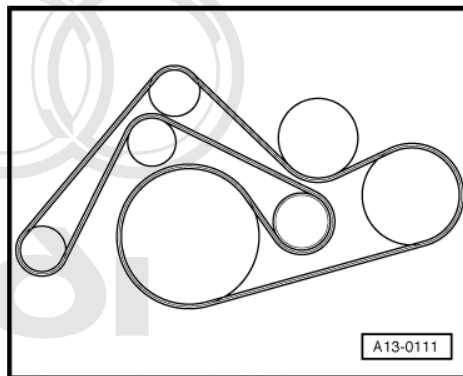


- To slacken poly V-belt, use an Allen key to turn tensioner in anti-clockwise direction -arrow- until the two bores align and locking pin -T10060- or -T10060 A- can be inserted.
- Detach poly V-belt for power steering pump, alternator and viscous fan.

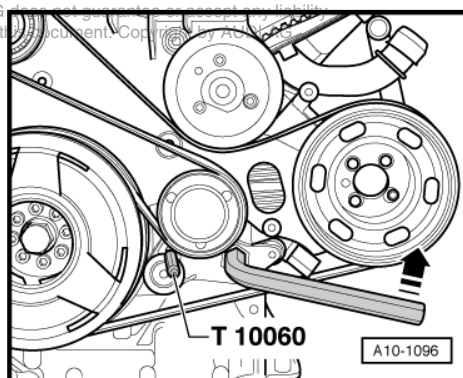
Installing

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

- Fit poly V-belt for power steering pump, alternator and viscous fan onto crankshaft pulley first, then on idler rollers and finally on tensioning roller.



- To remove locking pin -T10060- or -T10060 A- slacken tensioner with Allen key in anti-clockwise direction -arrow-.

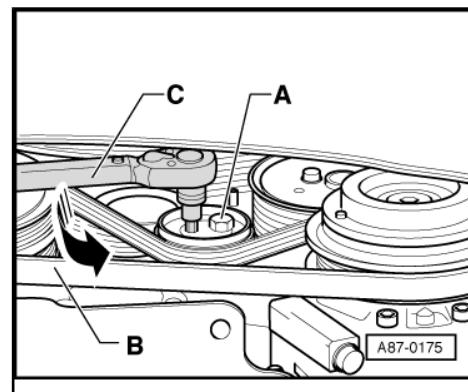


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- Fit poly V-belt for air conditioner compressor.
- Apply torque wrench -C- with 8 mm hexagon key (as shown) and pretension poly V-belt to 7 Nm by turning in direction of -arrow-.
- At the same time, use torque wrench to tighten bolt -A-.
- Press on cover for tensioning roller.
- Install viscous fan ⇒ [page 200](#) .
- Start engine and check that belt runs properly.

Tightening torques

Component	Nm
Tensioning roller for poly V-belt for A/C compressor to bracket	22
Poly V-belt cover to bracket	10

**2.3 Poly V-belt drive for air conditioner compressor - exploded view****1 - Poly V-belt**

- ☐ Before removing, mark direction of rotation with chalk or felt tipped pen

- ☐ Removing and installing ⇒ [page 40](#)
- ☐ Check for wear
- ☐ When installing, make sure it is properly seated on pulleys

2 - Cover

- ☐ For tensioning roller

3 - Bolt

- ☐ 22 Nm

4 - Tensioning roller

- ☐ For poly V-belt
- ☐ Removing and installing ⇒ ["2.4 Removing and installing poly V-belt for A/C compressor", page 40](#)

5 - Bracket

- ☐ For AC compressor

6 - Dowel sleeve

- ☐ 2x
- ☐ Check for correct seating in bracket

7 - Bolt

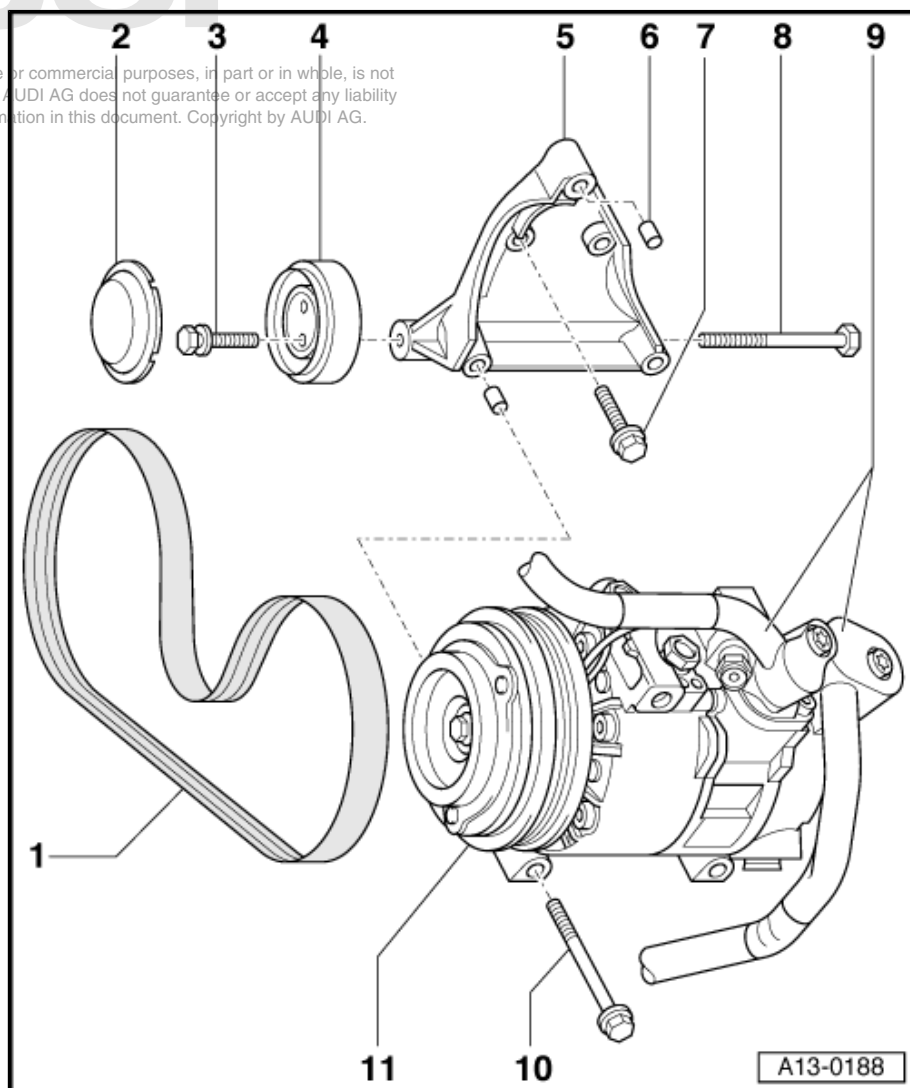
- ☐ 22 Nm

8 - Bolt

- ☐ 22 Nm

9 - Refrigerant lines

- ☐ Do not unbolt or disconnect



10 - Bolt

- 22 Nm

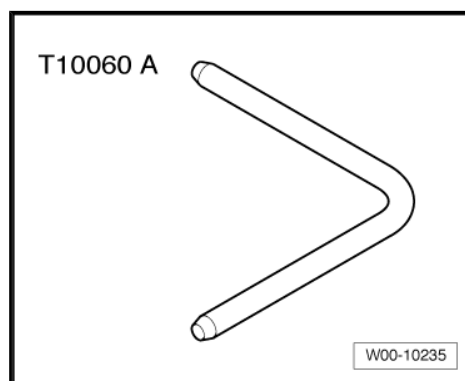
11 - Air conditioner compressor

- After detaching, secure compressor to subframe using wire or similar. Do not leave it suspended from refrigerant pipes.
- Do not unscrew or disconnect refrigerant hoses or pipes.
- When installing check dowel sleeves -item 6-

2.4 Removing and installing poly V-belt for A/C compressor

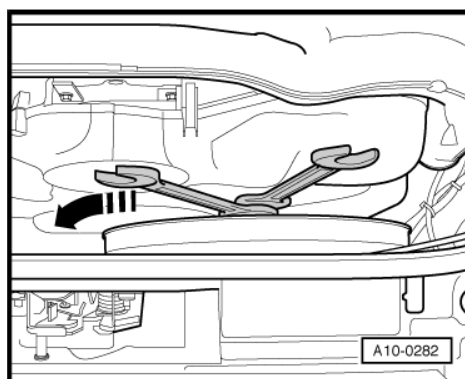
Special tools and workshop equipment required

- ◆ Locking pin -T10060 A-



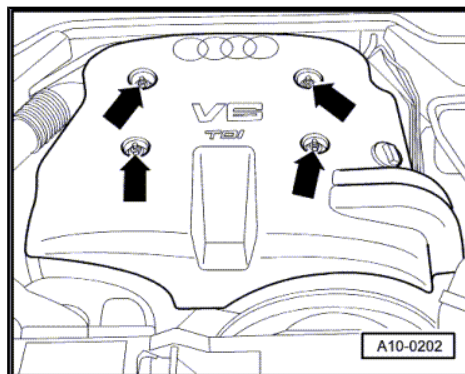
Removing

- Lock carrier must be in service position ⇒ [page 31](#).
- Unscrew viscous fan (32 mm).



- Detach caps on engine cover panel.
- Unbolt and remove engine cover panel -arrows-.
- Remove front toothed belt cover on left and right.

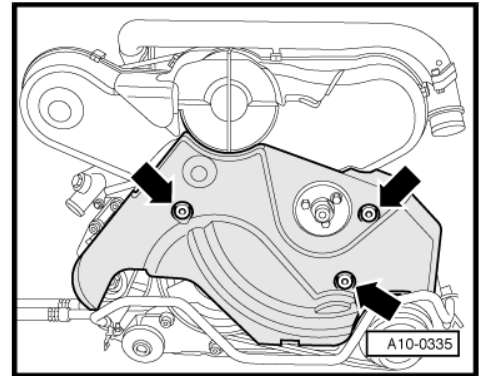
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- Remove poly V-belt cover -arrows-.

**Note**

Watch position of spacer sleeves for poly V-belt cover.

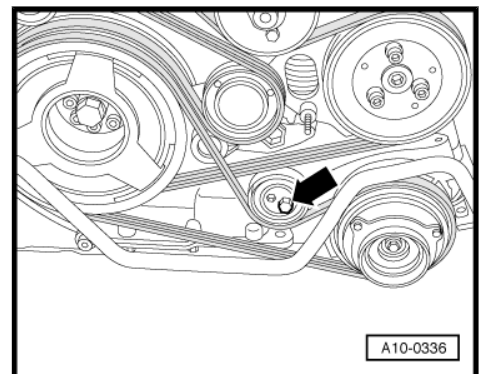


- Detach cover from tensioning roller of air conditioner compressor.

**Caution**

If a used belt runs in the opposite direction when it is refitted, this can cause breakage.

- ◆ *Before removing, mark direction of rotation of poly V-belt with chalk or felt-tipped pen for re-installation.*

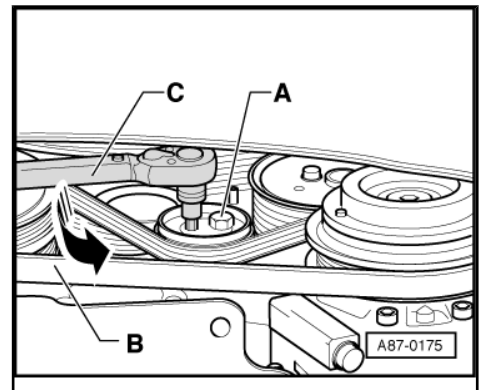


- Slacken off bolt -arrow- of tensioning roller for air conditioner compressor and detach poly V-belt for air conditioner compressor.

Installing

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

- Fit poly V-belt for air conditioner compressor.
- Apply torque wrench -C- with 8 mm hexagon key (as shown) and pretension poly V-belt to 7 Nm by turning in direction of -arrow-.
- At the same time, use torque wrench to tighten bolt -A-.
- Press on cover for tensioning roller.
- Install viscous fan ⇒ [page 200](#) .
- Start engine and check that belt runs properly.

**Tightening torques**

Component	Nm
Tensioning roller for poly V-belt for A/C compressor to bracket	22
Poly V-belt cover to bracket	10

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2.5 Removing and installing vibration damper

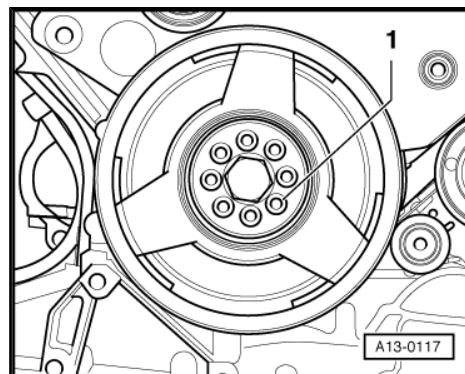
Removing

- Remove poly V-belt for power steering pump, alternator and viscous fan ⇒ [page 36](#) .
- Remove 8 bolts -1- and detach vibration damper.



Note

Central bolt does not have to be loosened when removing vibration damper.



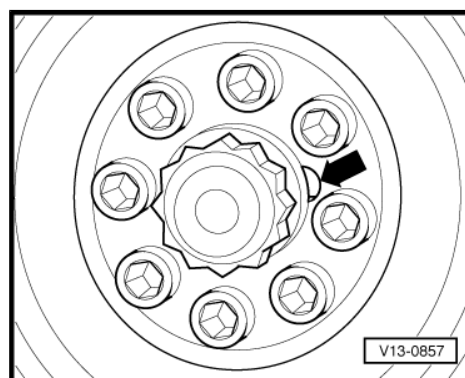
Installing

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

- On installation, make sure notch -arrow- in vibration damper is aligned with locating lug on toothed belt sprocket.
- Install poly V-belt for power steering pump, alternator and viscous fan ⇒ [page 36](#) .

Tightening torque

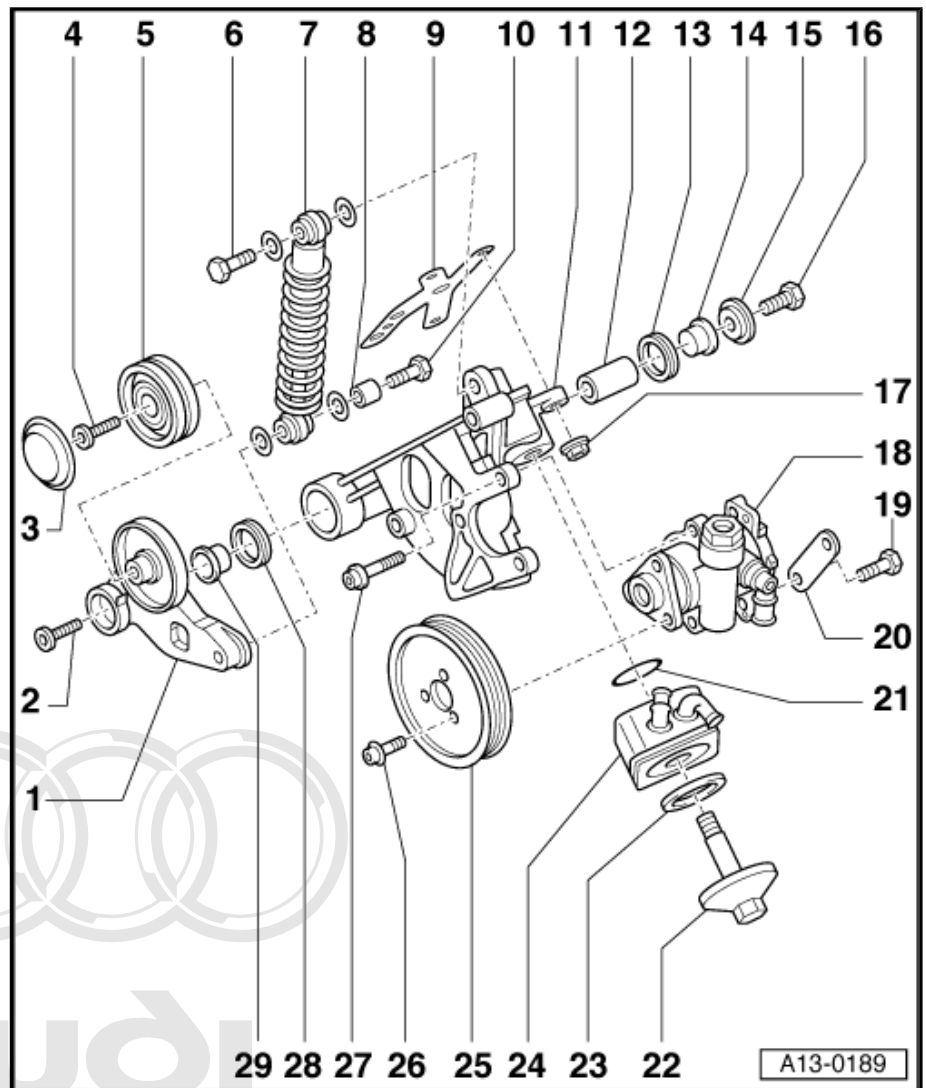
Component	Nm
Vibration damper to crankshaft	22



2.6 Bracket for power steering pump and oil cooler - exploded view

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- 1 - Lever**
 - ☐ For tensioner
- 2 - Fitted bolt**
 - ☐ 30 Nm
- 3 - Cover**
 - ☐ For tensioning roller
- 4 - Fitted bolt**
 - ☐ 22 Nm
- 5 - Tensioning roller**
 - ☐ For poly V-belt
- 6 - Bolt**
 - ☐ 22 Nm
- 7 - Spring/damper**
- 8 - Sleeve**
- 9 - Gasket**
 - ☐ Renew
- 10 - Bolt**
 - ☐ 22 Nm
- 11 - Bracket for power steering pump and oil cooler**
 - ☐ Removing and installing
⇒ [page 44](#)
- 12 - Pin**
- 13 - Seal**
 - ☐ Renew
- 14 - Mounting bush**
 - ☐ Removing and installing
⇒ [page 48](#)
- 15 - Washer**
 - ☐ Note installation position
- 16 - Bolt**
 - ☐ 30 Nm
- 17 - Nut**
 - ☐ 22 Nm
- 18 - Power steering pump**
 - ☐ Removing and installing ⇒ Rep. Gr. 48
 - ☐ Installation position ⇒ [page 44](#)
- 19 - Bolt**
 - ☐ 22 Nm
- 20 - Bracket**
- 21 - Seal**
 - ☐ Renew
 - ☐ Engage in lugs on oil cooler
- 22 - Bolt**
 - ☐ 25 Nm



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23 - Seal

- ☐ Renew

24 - Oil cooler

- ☐ See note ⇒ [page 145](#)
- ☐ Removing and installing ⇒ [page 176](#)

25 - Poly V-belt pulley

- ☐ Installation position: marking “vorne” (front) faces in direction of travel.
- ☐ Removing and installing ⇒ [page 44](#)

26 - Bolt

- ☐ 22 Nm

27 - Bolt

- ☐ 22 Nm

28 - Seal

- ☐ Renew

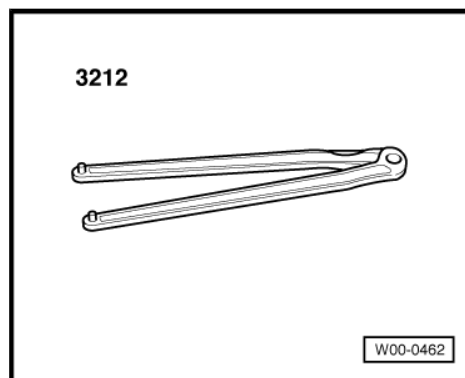
29 - Mounting bush

- ☐ Removing and installing ⇒ [page 48](#)

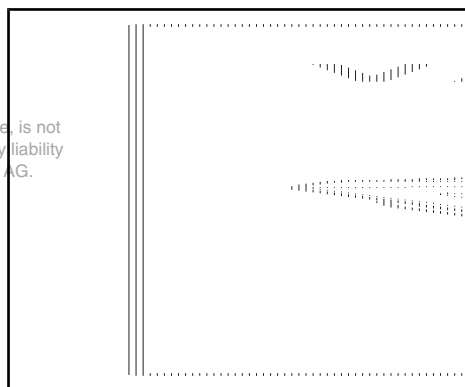
2.7 Removing and installing bracket for power steering pump and oil cooler

Special tools and workshop equipment required

- ◆ Pin wrench -3212-



- ◆ Drip tray for workshop hoist -VAS 6208-



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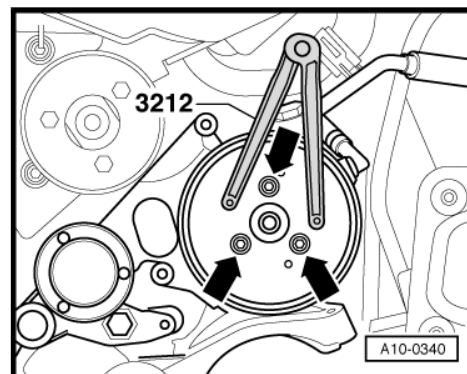
Removing

- Lock carrier must be in service position ⇒ [page 31](#) .
- Drain coolant ⇒ [page 181](#) .

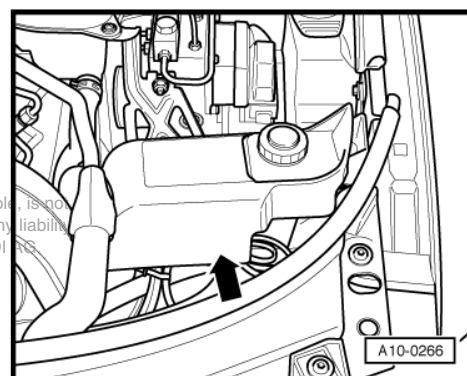
- Remove poly V-belt for power steering pump, alternator and viscous fan [⇒ page 36](#).
- Unbolt poly V-belt pulley for power steering pump -arrows- using pin wrench -3212- as a counterhold.
- Unbolt power steering pump from bracket and place it on longitudinal member.

**Note**

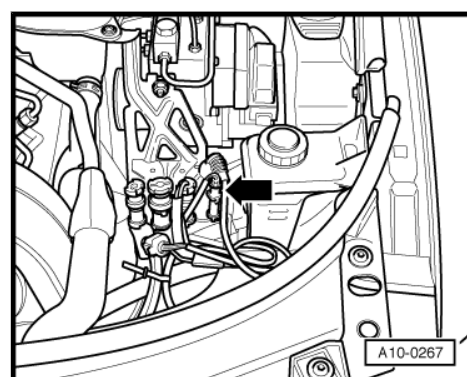
Pipes of power steering pump remain connected.



- Remove cover -arrow- at power steering fluid reservoir.



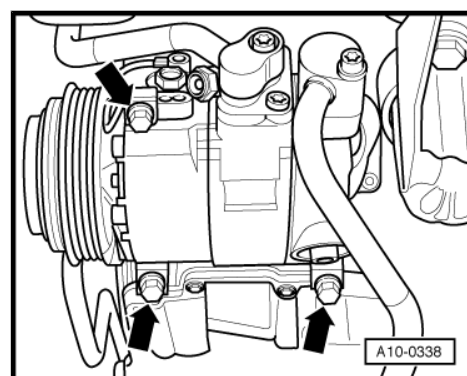
- Unplug connector -arrow- for magnetic clutch for air conditioner compressor and move wiring clear.

**WARNING**

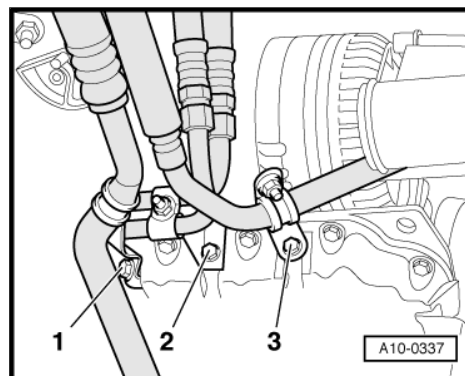
Risk of injury caused by refrigerant.

♦ *The air conditioner refrigerant circuit must not be opened.*

- Unbolt air-conditioner compressor from bracket -arrows-.



- Detach both brackets for refrigerant pipes -1- and -3- from sump.

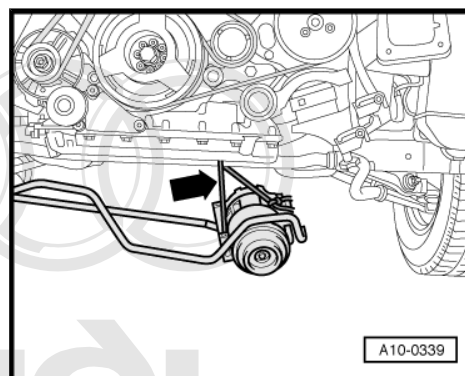


Caution

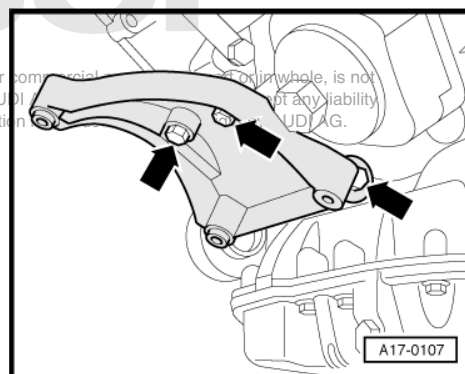
Danger of damage to refrigerant lines and hoses.

- ◆ ***Do NOT stretch, kink or bend refrigerant lines and hoses.***

- Tie up air conditioner compressor onto subframe, leaving refrigerant lines connected -arrow-.



- Unbolt bracket for A/C compressor -arrows-.



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- Slacken hose clips -arrows- and push clips back along hoses.
- Place drip tray for workshop hoist -VAS 6208- beneath engine.
- Detach rear hose from oil cooler.
- Unfasten bolted connections -1 ... 4- and detach bracket with oil cooler.

**Note**

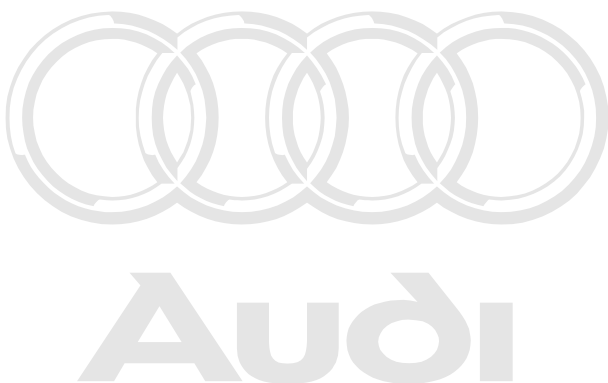
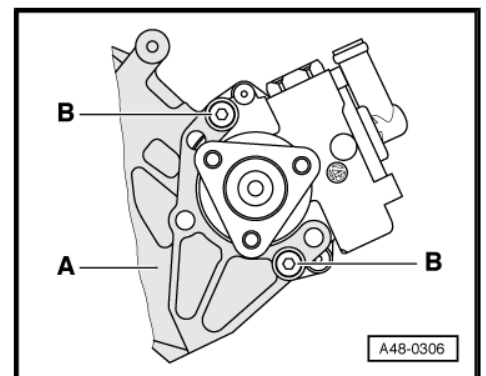
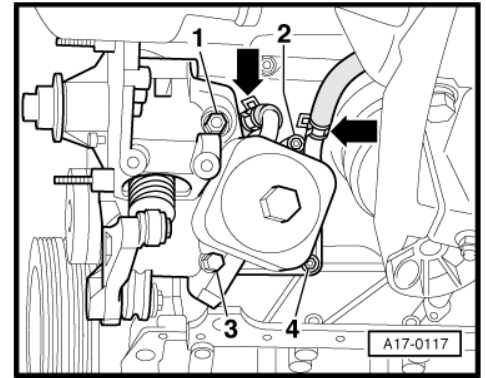
Caution: oil and coolant will come out.

Installing

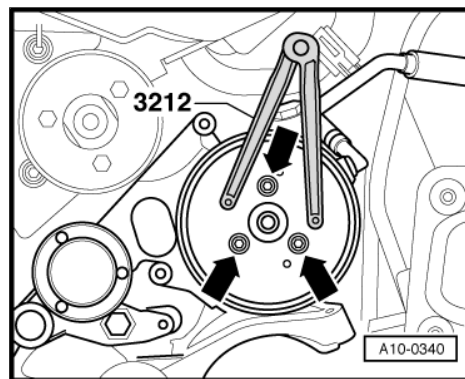
Installation is carried out in the reverse order; note the following:

**Note**

- ◆ *Renew gaskets and seals.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- Bolt on power steering pump at holes -B- on bracket -A-.



- Install poly V-belt pulley for power steering pump.
- Installation position: marking "vorne" (front) faces in direction of travel.
- Counterhold using pin wrench -3212- when tightening bolts -arrows-.
- Install air conditioner compressor ⇒ Rep. Gr. 87 .
- Install viscous fan ⇒ [page 200](#) .
- Install poly V-belt for power steering pump, alternator and viscous fan ⇒ [page 36](#) .
- Fill up with coolant ⇒ [page 184](#) .



Tightening torques

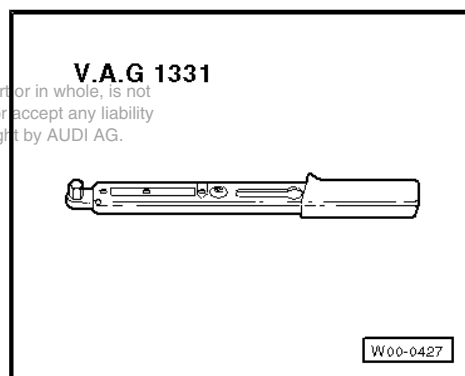
Component	Nm
Bracket for power steering pump and oil cooler to cylinder block	22
Bracket for air conditioner compressor to bracket for power steering pump and oil cooler	22
Air conditioner compressor to bracket	22
Power steering pump to bracket for power steering pump and oil cooler	22
Poly V-belt pulley to power steering pump	22

2.8 Removing and installing mounting bushes on bracket for power steering pump and oil cooler

Special tools and workshop equipment required

- ◆ Torque wrench -V.A.G 1331- with 13 mm attachment (commercially available)

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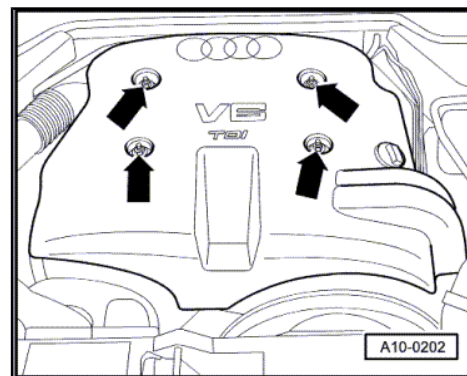


- ◆ Assembly tool -T40104-

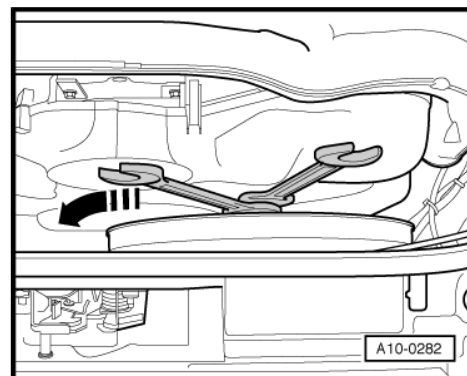
Removing

- Lock carrier must be in service position ⇒ [page 31](#) .

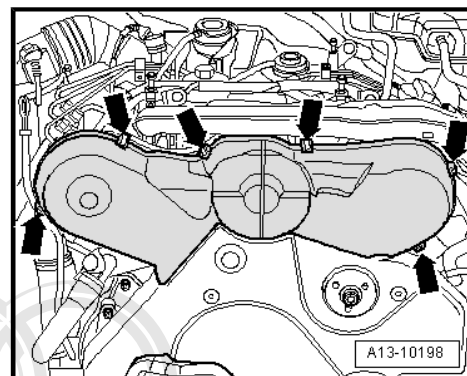
- Detach caps on engine cover panel.
- Unbolt and remove engine cover panel -arrows-.



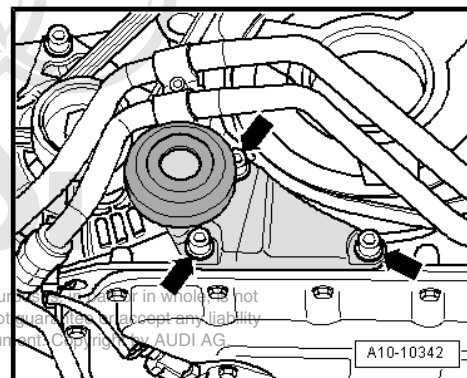
- Remove viscous fan (32 mm).



- Release fasteners -arrows- and remove toothed belt cover (left and right).



- Unscrew bolts -arrows- and remove torque reaction support.



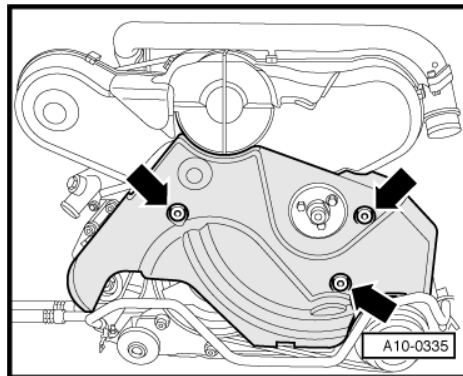
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- Remove poly V-belt cover -arrows-.



Note

Watch position of spacer sleeves for poly V-belt cover.



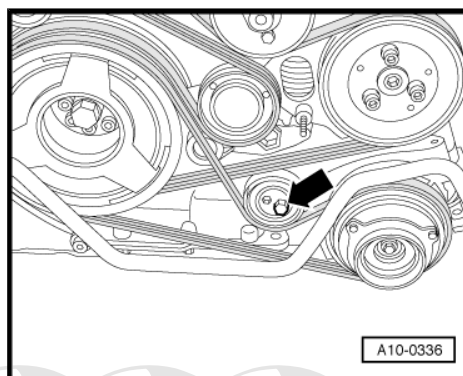
- Detach cover from tensioning roller of air conditioner compressor.



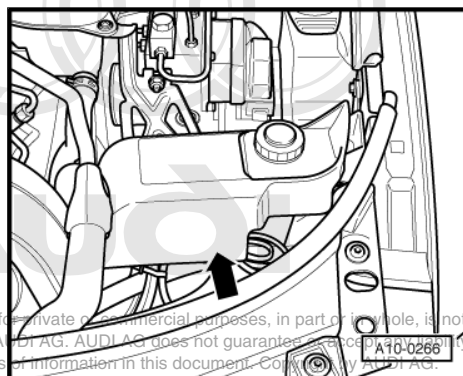
Caution

If a used belt runs in the opposite direction when it is refitted, this can cause breakage.

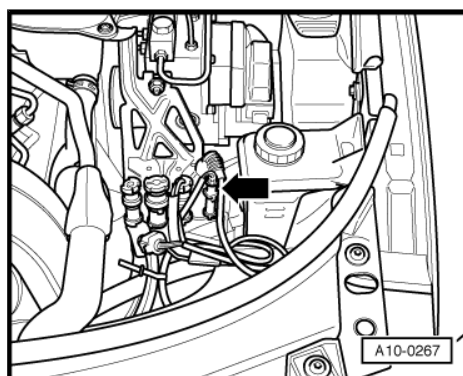
- ◆ *Before removing, mark direction of rotation of poly V-belt with chalk or felt-tipped pen for re-installation.*



- Slacken off bolt -arrow- of tensioning roller for air conditioner compressor and detach poly V-belt for air conditioner compressor.
- Remove cover -arrow- at power steering fluid reservoir.



- Unplug connector -arrow- for magnetic clutch for air conditioner compressor and move wiring clear.



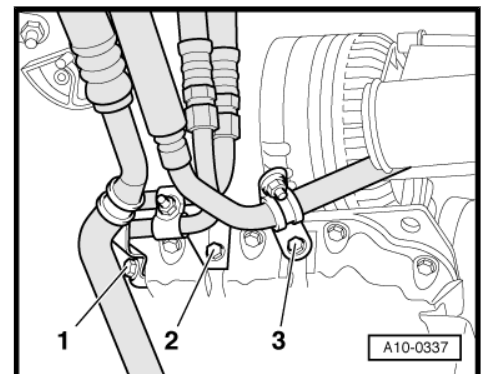
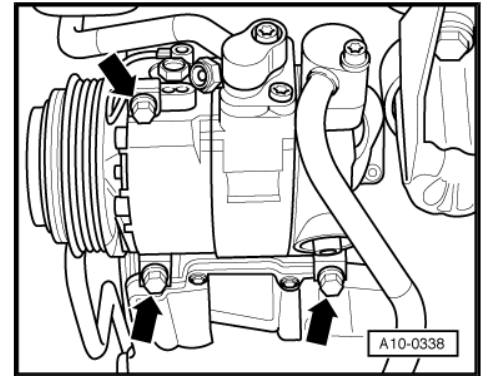
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**WARNING**

Risk of injury caused by refrigerant.

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

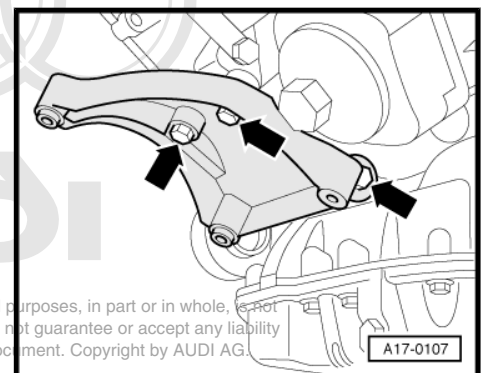
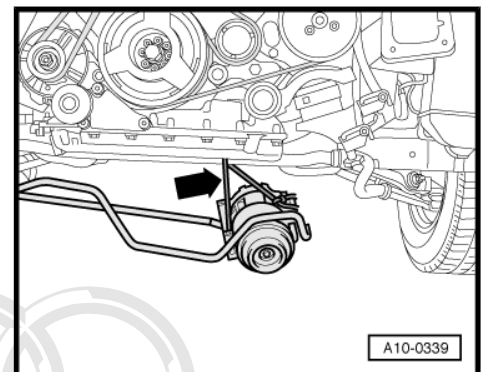
- Unbolt air-conditioner compressor from bracket -arrows-.
- Detach both brackets for refrigerant pipes -1- and -3- from sump.

**Caution**

Danger of damage to refrigerant lines and hoses.

◆ *Do NOT stretch, kink or bend refrigerant lines and hoses.*

- Tie up air conditioner compressor onto subframe, leaving refrigerant lines connected -arrow-.
- Unbolt bracket for A/C compressor -arrows-.



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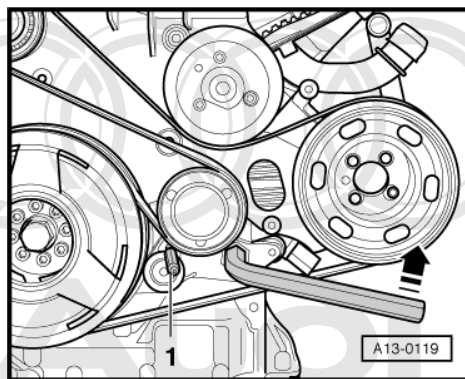


Caution

If a used belt runs in the opposite direction when it is refitted, this can cause breakage.

- ◆ *Before removing, mark direction of rotation of poly V-belt with chalk or felt-tipped pen for re-installation.*

- To slacken poly V-belt, turn tensioner in anti-clockwise direction -arrow- using Allen key and detach poly V-belt for power steering pump, alternator and viscous fan.

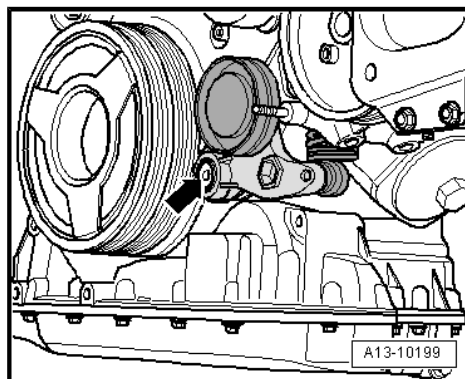


Note

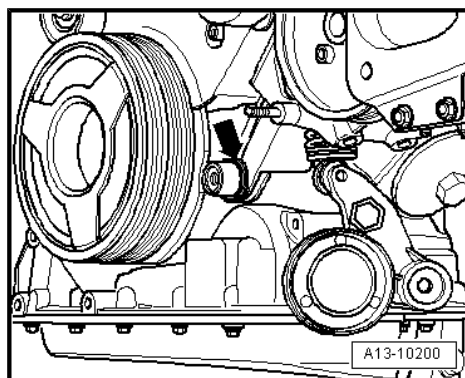
Disregard -item 1-.

- Remove dowel bolt -arrow-.
- Pivot lever for tensioner to one side.

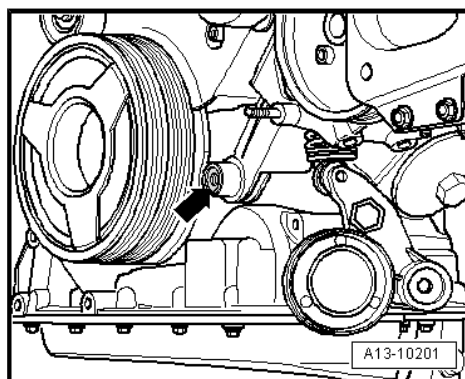
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- Pull seal -arrow- off bracket for power steering pump and oil cooler.



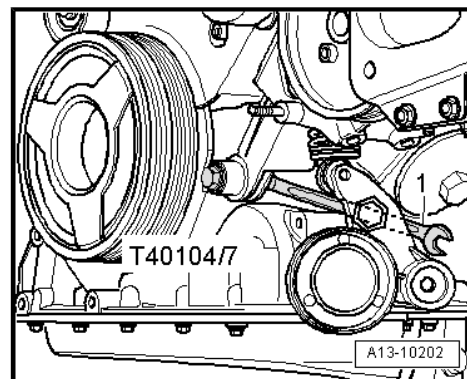
- Before continuing, check whether the mounting pin -arrow- can be turned or moved in the bracket for power steering pump and oil cooler.



Note

If the mounting pin is seized, it must be released by suitable means before proceeding further.

- Screw bolt -T40104/7- into mounting pin from the front.
- Tighten bolt -T40104/7- and at the same time counterhold rear bolt using a flat ring spanner -1-.
- Continue tightening bolt -T40104/7- until the head of the rear bolt shears off.
- Remove bolt head, washer and seal.
- Pull mounting pin out of bracket.
- Clamp mounting pin in vice and unscrew bolt -T40104/7- .



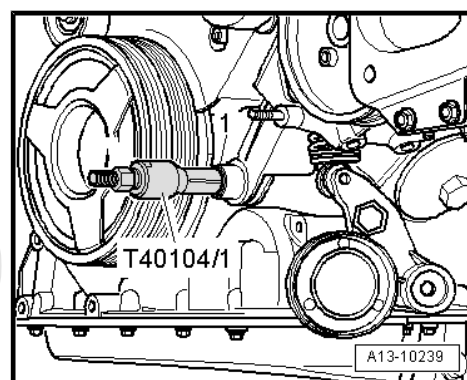
Pulling out front mounting bush:

- Insert internal puller -T40104/1- into drilling in bracket for power steering pump and oil cooler until puller engages behind mounting bush in drilling.
- Screw spreader pin of internal puller in just far enough by hand until the puller has a secure grip on the front mounting bush.



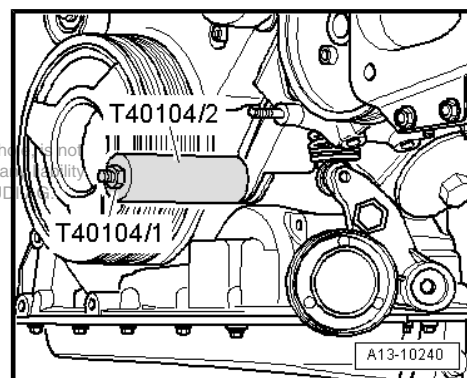
Note

If the jaws of the internal puller are spread too far, the puller will damage the drilling in the bracket when the bush is pulled out.



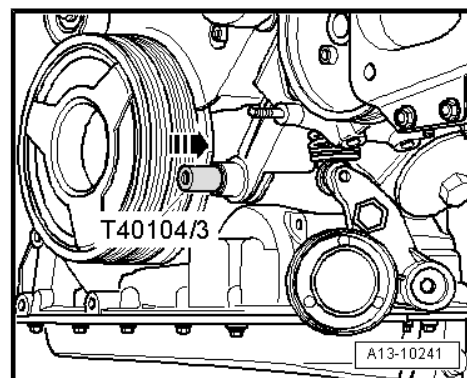
- Move internal puller to horizontal position and slide thrust sleeve -T40104/2- onto puller.
- Screw nut from -T40104/1- onto thread of spreader pin and pull front mounting bush out of bracket for power steering pump and oil cooler by screwing down nut.

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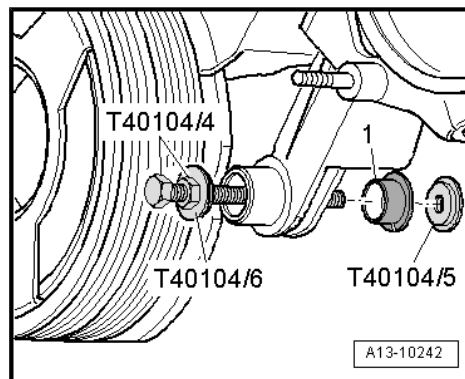
Driving out rear mounting bush:

- Insert pin -T40104/3- into drilling in bracket for power steering pump and oil cooler.
- The thread of the pin points in direction of travel.
- Drive out rear mounting bush towards rear using pin -T40104/3- .
- Pull out pin -T40104/3- again (screw M8 bolt into thread of pin).

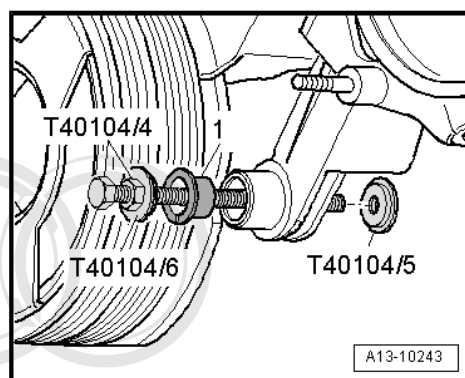


Installing

- Clean drilling and contact surfaces for seals on bracket for power steering pump and oil cooler.
- Pull rear mounting bush -item 1- into bracket for power steering pump and oil cooler, as shown in illustration.
- Slot in mounting bush faces downwards.

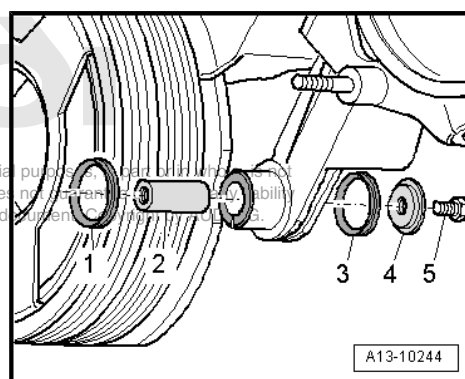


- Pull front mounting bush -item 1- into bracket for power steering pump and oil cooler, as shown in illustration.
- Slot in mounting bush faces downwards.



Install components of mounting as shown in illustration:

- 1 - Seal (front)
 - Sealing lip faces in direction of travel.
- 2- Mounting pin
 - Do not grease
 - Larger opening faces in direction of travel.
- 3 - Rear seal
 - Sealing lip faces in direction of travel.
- 4 - Washer
 - Shoulder faces in direction of travel.
 - Press seal onto washer.
- 5 - Rear bolt
 - Hand-tighten.



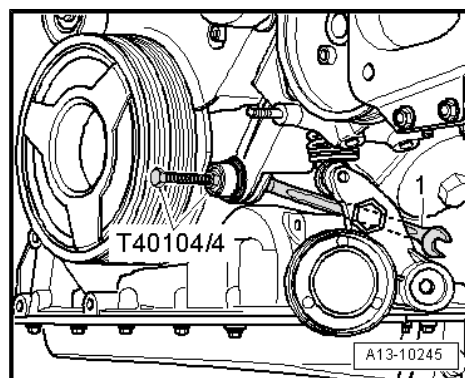
Tightening rear bolt to specified torque:



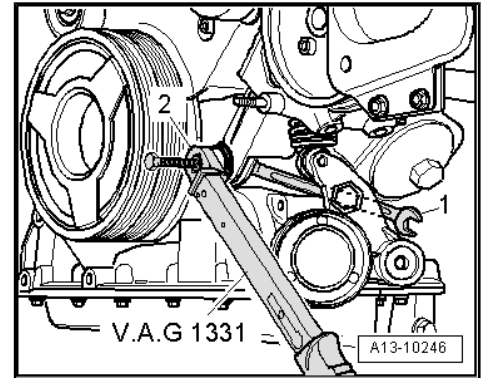
Note

The rear bolt on the mounting pin can only be reliably tightened to the specified torque using the method described below:

- Screw bolt with nut -T40104/4- approx. 10 turns into mounting pin.
- Lock nut -T40104/4- against mounting pin in this position (to do so, use ring spanner -1- to counterhold rear bolt).



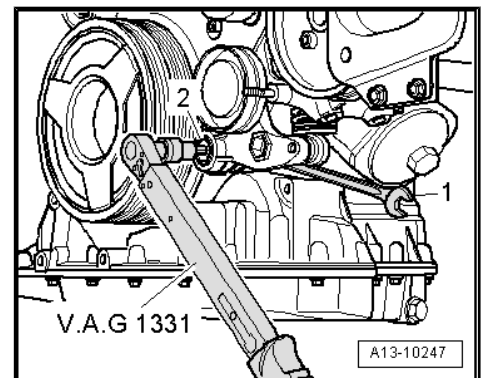
- Apply torque wrench -V.A.G 1331- with 13 mm attachment (commercially available) -item 2- to lock nut and tighten rear bolt to 30 Nm (counterhold rear bolt with ring spanner -1-).



- Fit lever for tensioner onto bracket for power steering pump and oil cooler.
- Tighten dowel bolt -2- to 30 Nm (to do so, counterhold rear bolt using ring spanner -1-).

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

- Install air conditioner compressor ⇒ Rep. Gr. 87 .
- Install viscous fan ⇒ [page 200](#) .
- Install poly V-belt for power steering pump, alternator and viscous fan ⇒ [page 36](#) .



Tightening torques

Component	Nm
Bracket for air conditioner compressor	22
Bracket for power steering pump and oil cooler to:	
Sump (top section)	22
Torque reaction support to top section of sump	45

2.9 Toothed belt drive for camshafts - exploded view

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1 - Crankshaft sprocket

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

2 - Tensioner for toothed belt

3 - Bolt

- ☐ 10 Nm

4 - Bolt

- ☐ 42 Nm

5 - Tensioning lever

- ☐ Fit washer -item 7- underneath

6 - Bolt

- ☐ 42 Nm

7 - Washer

- ☐ For tensioning lever

8 - Tensioning roller

- ☐ Fit washer -item 20- underneath

9 - Flange bolt

- ☐ Use counter-hold tool -3036- when loosening and tightening
- ☐ 75 Nm

10 - Camshaft sprocket

- ☐ For inlet camshaft
- ☐ To remove and install, first remove toothed belt from camshaft sprockets ⇒ [page 59](#)
- ☐ Remove using two-arm puller -T40001-

11 - Toothed belt

- ☐ Before removing, mark direction of rotation with chalk or felt-tipped pen
- ☐ Check for wear
- ☐ Removing ⇒ [page 66](#)
- ☐ Installing (adjusting valve timing) ⇒ [page 72](#)

12 - Bolt

- ☐ 10 Nm

13 - Coolant pump

- ☐ Removing and installing ⇒ [page 188](#)

14 - Bolt

- ☐ 10 Nm

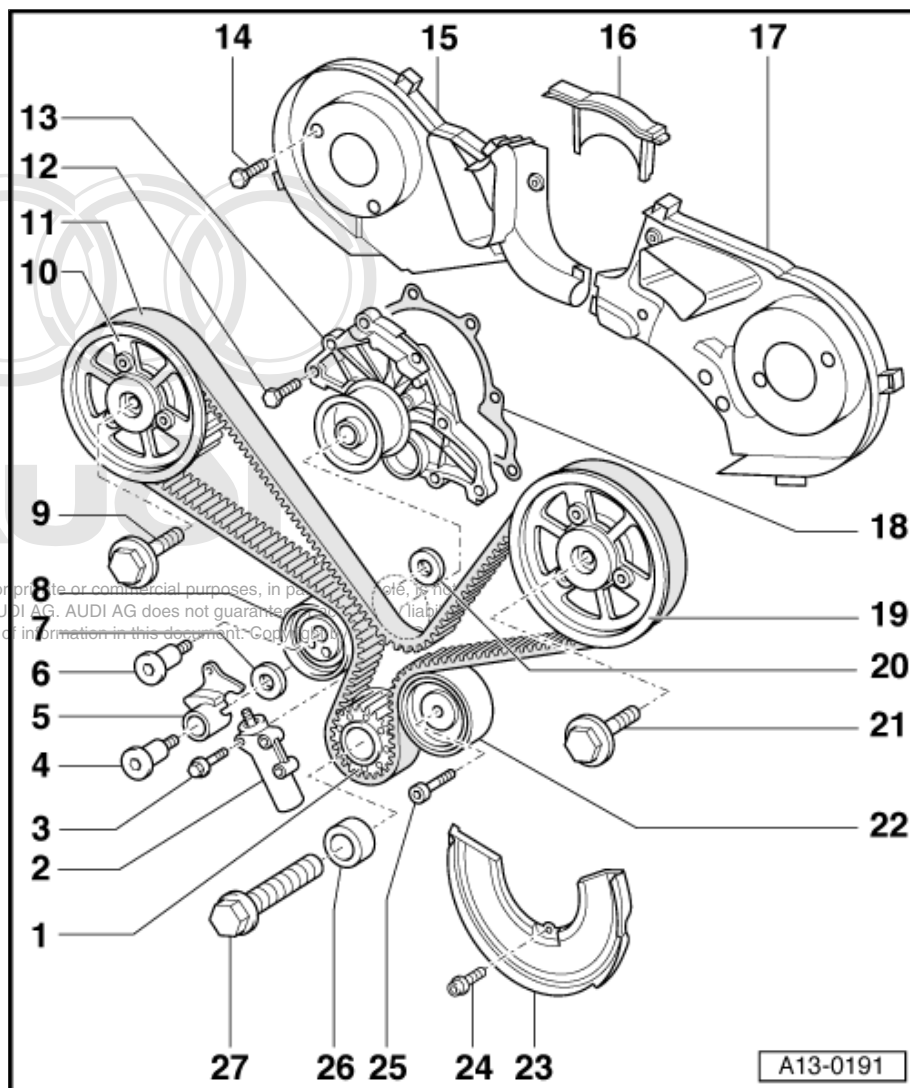
15 - Toothed belt cover (rear right)

16 - Toothed belt cover (rear centre)

17 - Toothed belt cover (rear left)

18 - Gasket

- ☐ Renew



19 - Camshaft sprocket

- ☐ For inlet camshaft
- ☐ To remove and install, first remove toothed belt from camshaft sprockets ⇒ [page 59](#)
- ☐ Remove using two-arm puller -T40001-

20 - Washer

- ☐ For tensioning roller

21 - Flange bolt

- ☐ 75 Nm
- ☐ Use counter-hold tool -3036- when loosening and tightening

22 - Idler roller

23 - Toothed belt cover (bottom)

- ☐ Unbolt vibration damper prior to removing

24 - Bolt

- ☐ 10 Nm

25 - Bolt

- ☐ 45 Nm

26 - Spacer sleeve

27 - Bolt

- ☐ Renew
- ☐ Do not lubricate with oil
- ☐ Use locking pin -3242- when loosening and tightening
- ☐ 200 Nm + turn 180° further



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2.10 Toothed belt drive for injection pump - exploded view

1 - Bracket

- ☐ For viscous fan
- ☐ Removing and installing
⇒ [page 71](#)

2 - Nut

- ☐ 36 Nm

3 - Bolt

- ☐ 22 Nm

4 - Vibration damper

- ☐ For injection pump sprocket

5 - Toothed belt

- ☐ For injection pump
- ☐ Before removing, mark direction of rotation with chalk or felt-tipped pen
- ☐ Check for wear
- ☐ Removing ⇒ [page 66](#)
- ☐ Fitting, tensioning
⇒ [page 72](#)

6 - Injection pump

- ☐ Removing and installing
⇒ Rep. Gr. 23
- ☐ Dynamically checking and adjusting commencement of injection
⇒ Rep. Gr. 23

7 - Injection pump sprocket

- ☐ With thrust collar on one or both sides depending on version
- ☐ Set to centre of elongated holes when installing

- ☐ Dynamically checking and adjusting commencement of injection after installation ⇒ Rep. Gr. 23

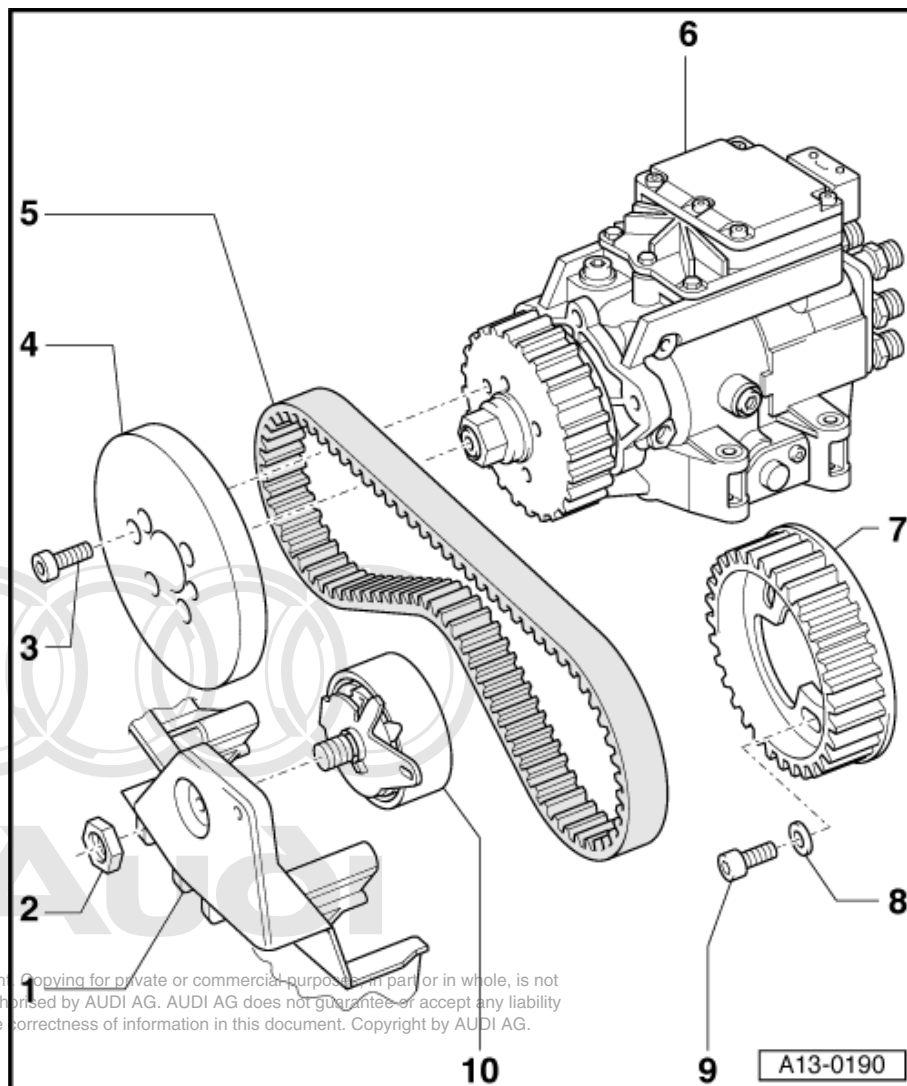
8 - Washer

9 - Bolt

- ☐ 22 Nm

10 - Tensioning roller

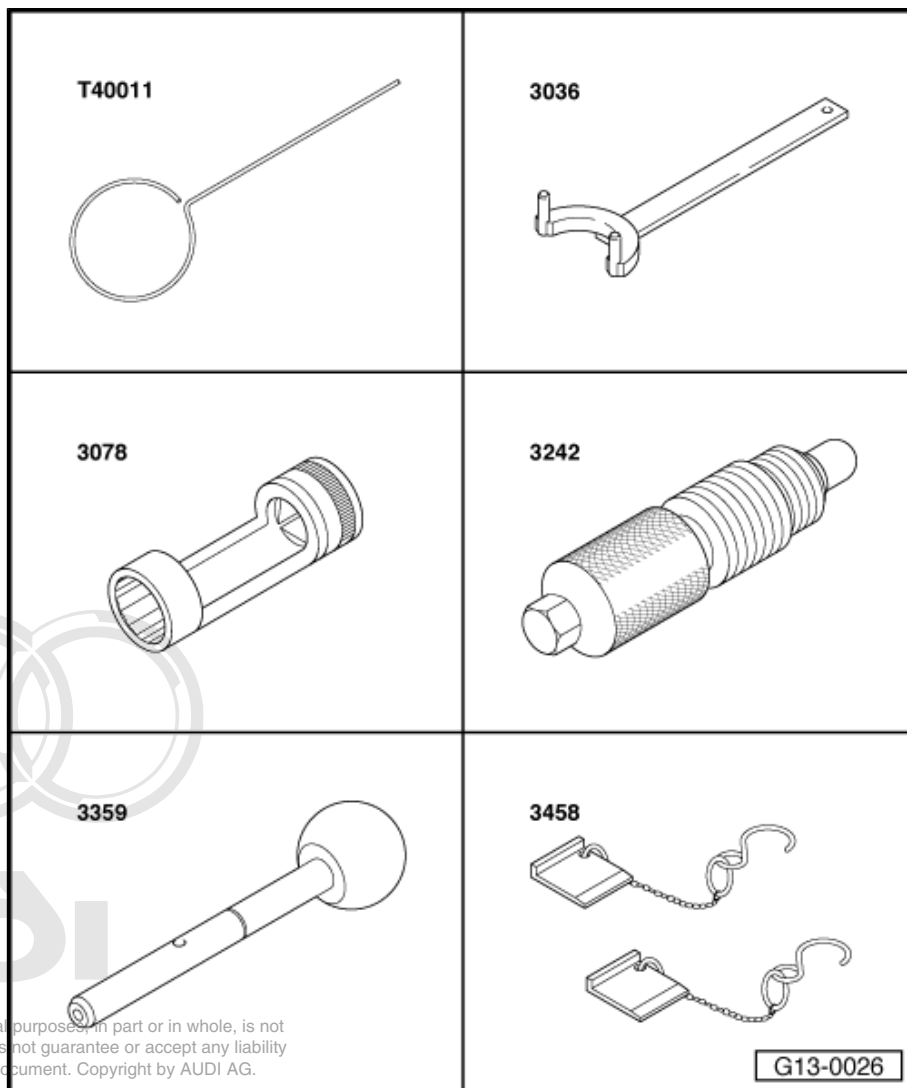
- ☐ For injection pump toothed belt



2.11 Removing toothed belt from camshaft sprockets

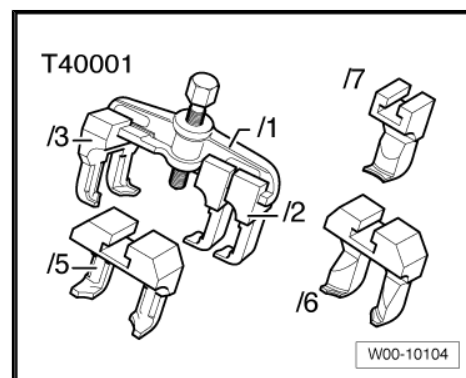
Special tools and workshop equipment required

- ◆ Locking pin -T40011-
- ◆ Counter-hold tool -3036-
- ◆ Socket (22 mm) -3078-
- ◆ Locking pin -3242-
- ◆ Diesel injection pump locking pin -3359-
- ◆ Camshaft holder -3458-



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- ◆ Two-arm puller -T40001-



Removing

- Engine in vehicle.
- Lock carrier must be in service position ⇒ [page 31](#) .
- Open oil filler cap.
- Turn engine until the marking “- OT -” (TDC) is visible on camshaft.



Note

Turn over the engine at the central bolt on the crankshaft.

- Unscrew plug for TDC marking from cylinder block.



Note

There is a TDC drilling in the crankshaft directly behind the plug (it is possible to feel the hole).

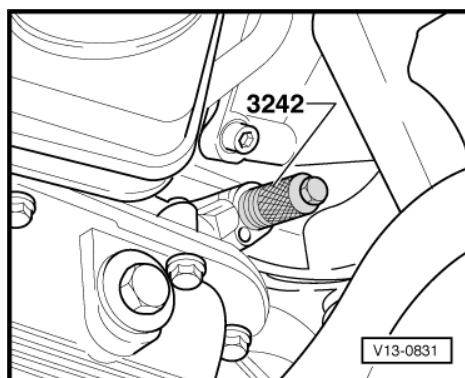
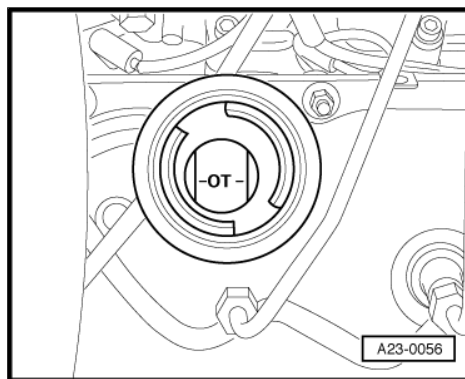


WARNING

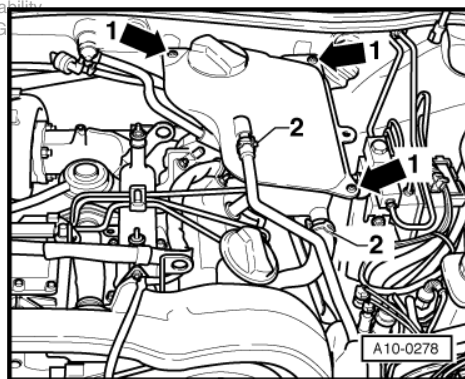
Injury risk.

- ◆ **Do not rotate the crankshaft while feeling for the TDC drilling with your finger.**

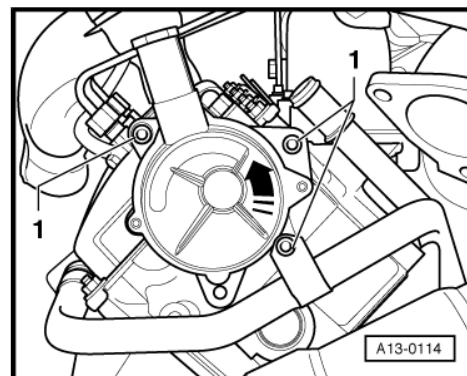
- Screw locking pin -3242- into threaded hole where plug has been removed, and tighten.



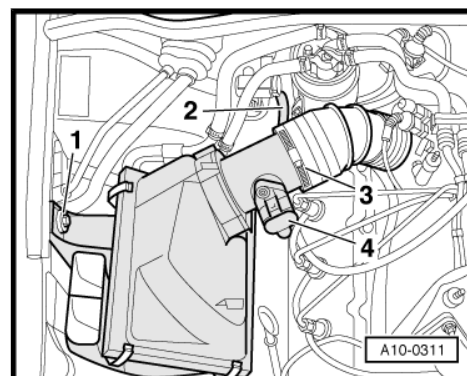
- **Unbolt coolant expansion tank -arrows 1-**
- Detach wire for coolant shortage indicator switch -F66- and move coolant expansion tank to one side with coolant hoses -2- attached.



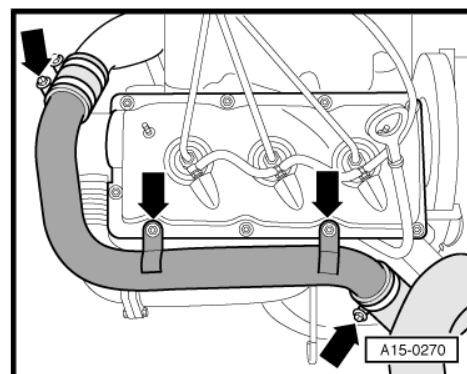
- Remove bolts -1- for exhauster pump with heat shield on cylinder head (left-side) and turn pump in anti-clockwise direction -arrow-.
- Move exhauster pump clear to the rear (leave hose attached).



- Slacken hose clip -3-.
- Unplug connector -4-.
- Pull hose -2- off air cleaner housing.
- Unscrew bolt -1- and remove air cleaner housing.
- Unfasten clamping nut for fuel filter and lift filter out of retainer.
- Disengage fuel lines at retainer and move fuel filter to side with lines connected.



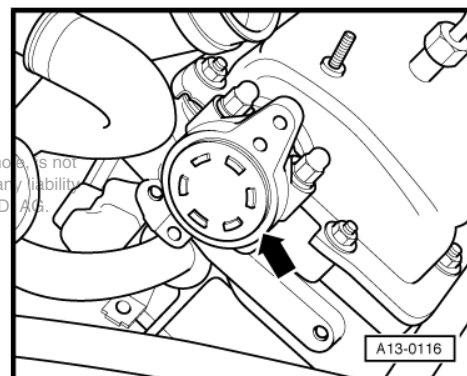
- Remove air intake pipe between turbocharger and charge air cooler (right-side) -arrows-.



- Using a screwdriver, lever off sealing cap -arrow- on cylinder head (right-side).

**Note**

- ◆ **Removal destroys sealing cap.**
- ◆ **Take care not to damage sealing surfaces.**

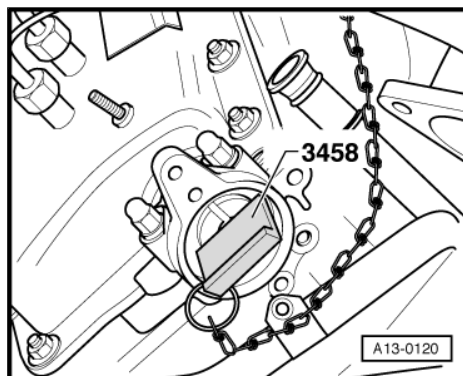


- Insert camshaft holder -3458- in both cylinder heads and secure them with chain to prevent them from falling.



Caution

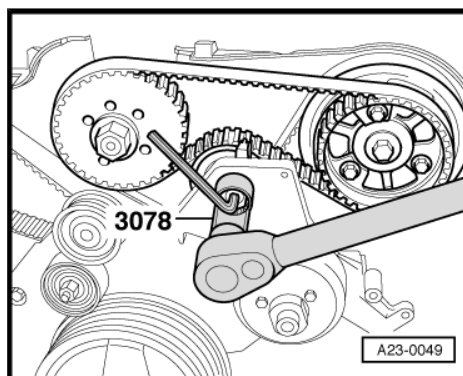
Do not use camshaft holders -3458- as counterhold tools.



Caution

If a used belt runs in the opposite direction when it is refitted, this can cause breakage.

- ◆ *Before removing, mark direction of rotation of toothed belt with chalk or felt-tipped pen for re-installation.*

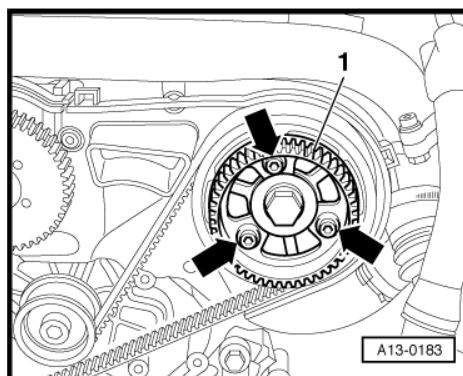


- Slacken toothed belt tensioner and take toothed belt off camshaft sprocket.
- Unbolt drive sprocket -1- for injection pump from camshaft sprocket -arrows-.



Caution

Do not use camshaft holder -3458- as a counterhold tool.



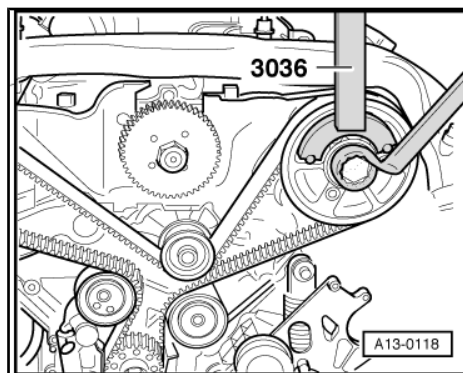
- Loosen bolts for camshaft sprockets using counter-hold tool -3036-.



Note

Leave bolts screwed in loosely.

- Detach cover cap at bottom right of bracket for viscous fan.

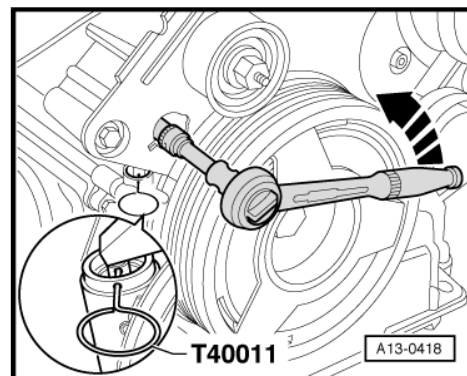


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- Turn toothed belt tensioning roller in anti-clockwise direction -arrow- using an 8 mm hexagon key until tensioning lever of tensioner is compressed far enough to allow locking pin - T40011- to be inserted into hole and plunger.

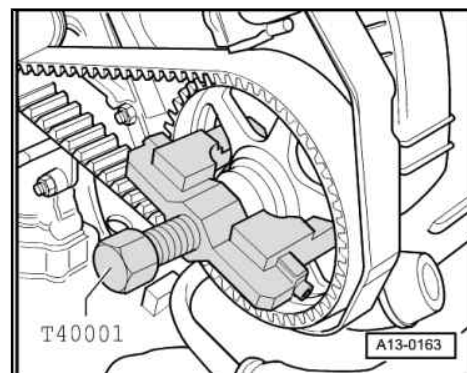
**Note**

The toothed belt tensioner is oil-damped and can therefore only be compressed slowly by applying constant pressure.

**Caution**

If a used belt runs in the opposite direction when it is refitted, this can cause breakage.

- ◆ *Before removing, mark direction of rotation of toothed belt with chalk or felt-tipped pen for re-installation.*



- Pull camshaft sprockets (left and right) off their tapers using two-arm puller -T40001- with claws -T40001/2- .
- Unbolt camshaft sprocket, left-side (cylinder bank 2).
- Detach toothed belt from camshaft sprockets.

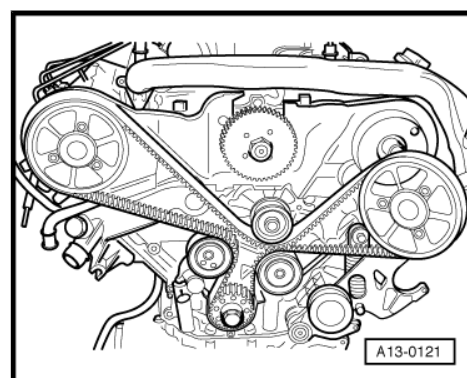
Installing (adjusting valve timing)

- Camshafts locked in position with camshaft holders -3458- .
- Crankshaft locked in position with locking pin -3242- .
- Camshaft sprockets free to turn.

The valve timing must be adjusted as described below, even when the toothed belt has only been removed from the camshaft sprocket:

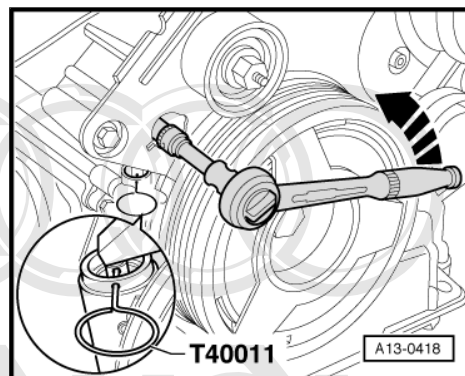
- The crankshaft must not be at "TDC" at any cylinder when the camshaft is turned. Otherwise, there is a risk of damage to valves and piston crowns.
- Do not use camshaft holders -3458- as counterhold tools.
- Adjustment can be performed with cold or warm engine.

- Fit the toothed belt onto one of the camshaft sprockets.
- Take second camshaft sprocket, fit toothed belt and install sprocket on camshaft.
- Tighten the two camshaft sprocket bolts until the sprockets can still just be turned without axial movement.

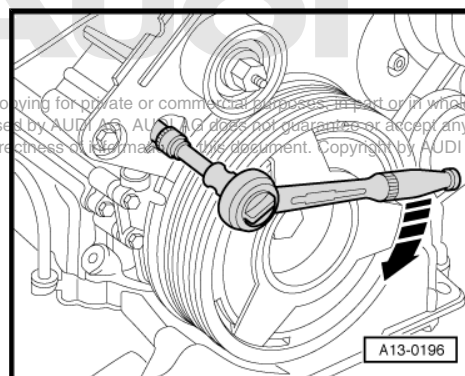


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- Use an 8 mm hexagon key to slacken toothed belt tensioning roller in anti-clockwise direction -arrow- and pull out locking pin -T40011- .



- Use torque wrench to pretension toothed belt to 15 Nm in clockwise direction -arrow-.



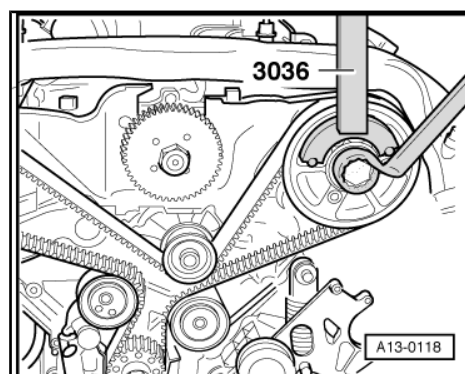
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- Tighten bolts for camshaft sprockets using counter-hold tool -3036- .

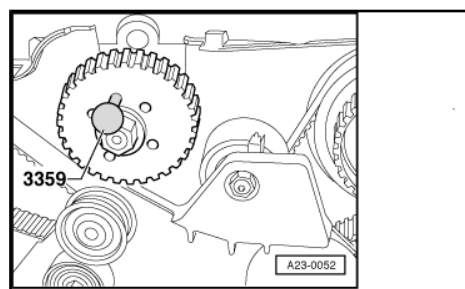


Caution

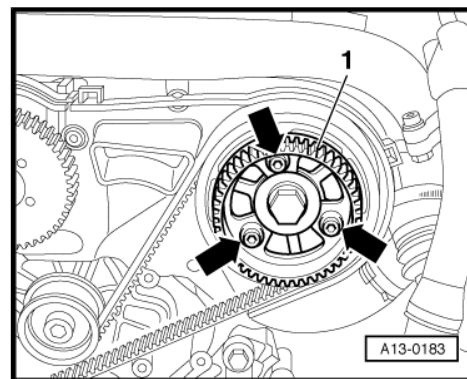
Do not use camshaft holders -3458- as counterhold tools.



- Lock injection pump sprocket with diesel injection pump locking pin -3359- .



- Install drive sprocket for injection pump -1- so that it is aligned centrally in elongated holes.
- Tighten drive sprocket -arrows- until it is still just possible to turn it on the camshaft sprocket.
- Position toothed belt for injection pump. Pay attention to the direction of rotation as marked upon removal.

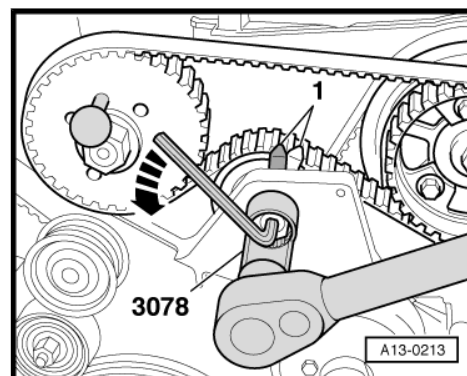


- Tension toothed belt by turning Allen key in anti-clockwise direction -arrow- until marks -1- coincide.
- Then tighten nut using socket (22 mm) -3078- .

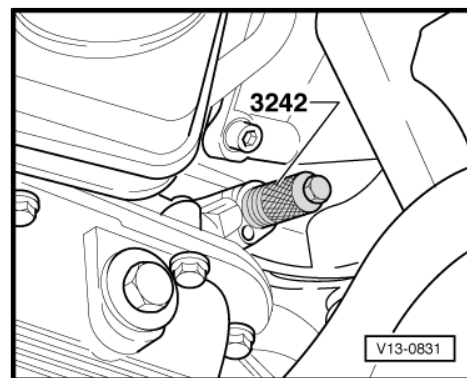
**Note**

Depending on version, pointer -1- may have no tip.

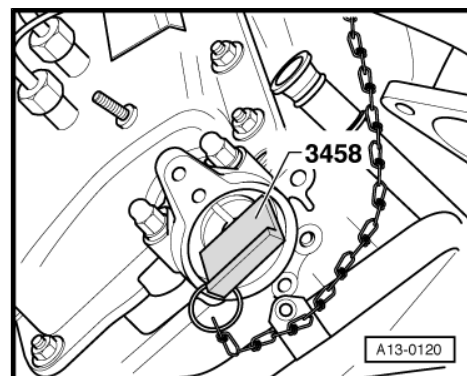
- Tighten bolts at camshaft sprocket.
- Remove diesel injection pump locking pin -3359- .
- Remove camshaft holders -3458- from both cylinder heads.
- Remove locking pin -3242- .
- Turn crankshaft two rotations in normal direction of rotation until the crankshaft is at "TDC" again.
- To check adjustment, screw locking pin -3242- into hole in cylinder block once again.



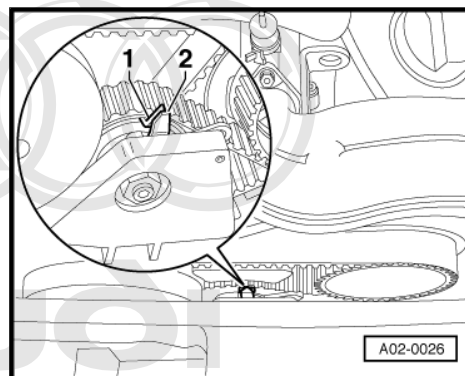
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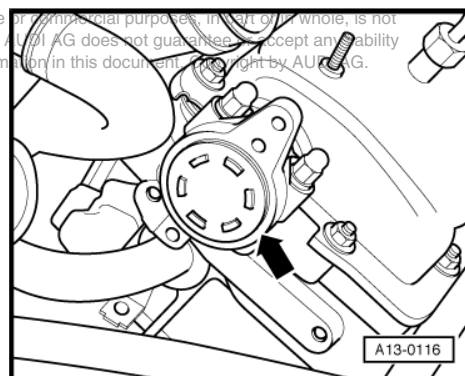
- Check positions of camshafts with camshaft holders -3458- . If it is not possible to insert camshaft holders, repeat adjustment.
- Remove camshaft holders -3458- from both cylinder heads.
- Remove locking pin -3242- .



- Check tension of toothed belt for injection pump.
- Marks -1- and -2- must be opposite one another.
- Screw plug for the TDC mark into cylinder block with a new seal.
- Install exhauster pump with new O-rings on cylinder head (left-side).



- Renew sealing cap (rear) on cylinder head (right-side).
- Using a suitable drift, knock in new sealing cap (core plug) -arrow- until flush.



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



Note

Renew seals and O-rings.

- Dynamically check and adjust commencement of injection ⇒ Rep. Gr. 23 .

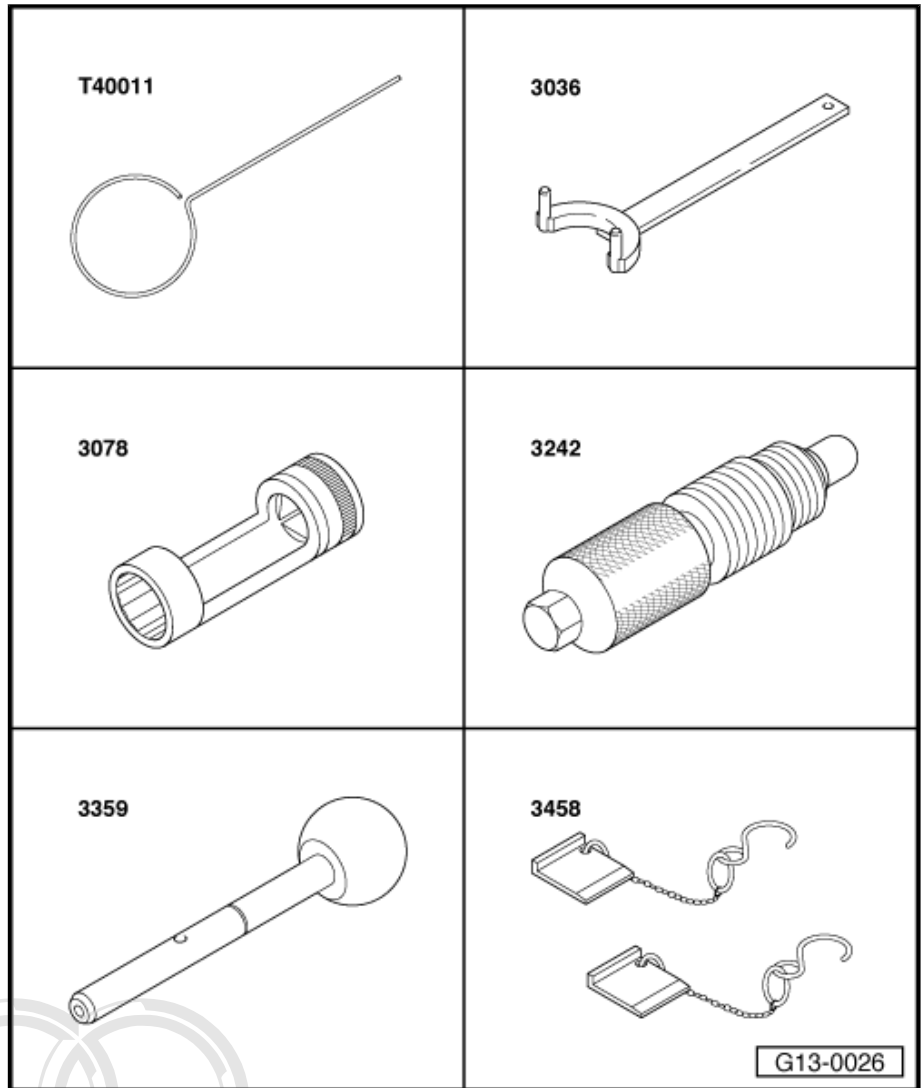
Tightening torques

Component	Nm
Camshaft sprocket to camshaft	75
Drive sprocket for injection pump to camshaft	22
Exhauster pump to cylinder head	10
Screw plug in cylinder block	10
Tensioning roller for injection-pump toothed belt to bracket for viscous fan	36

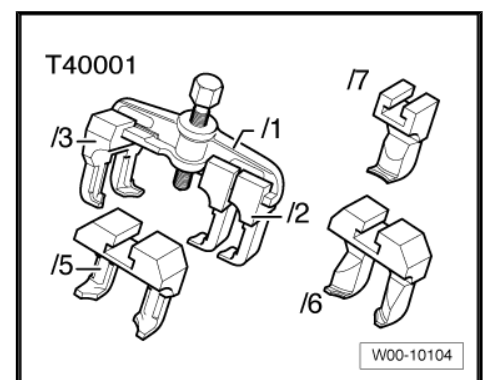
2.12 Removing and installing toothed belt

Special tools and workshop equipment required

- ◆ Locking pin -T40011-
- ◆ Counter-hold tool -3036-
- ◆ Socket (22 mm) -3078-
- ◆ Locking pin -3242-
- ◆ Diesel injection pump locking pin -3359-
- ◆ Camshaft holder -3458-



- ◆ Two-arm puller -T40001-



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Removing

- Engine in vehicle.
- Lock carrier must be in service position ⇒ [page 31](#) .
- Remove poly V-belt for power steering pump, alternator and viscous fan ⇒ [page 36](#) .
- Open oil filler cap.
- Turn engine until the marking “- OT -” (TDC) is visible on camshaft.



Note

Turn over the engine at the central bolt on the crankshaft.

- Unscrew plug for TDC marking from cylinder block.



Note

There is a TDC drilling in the crankshaft directly behind the plug (it is possible to feel the hole).

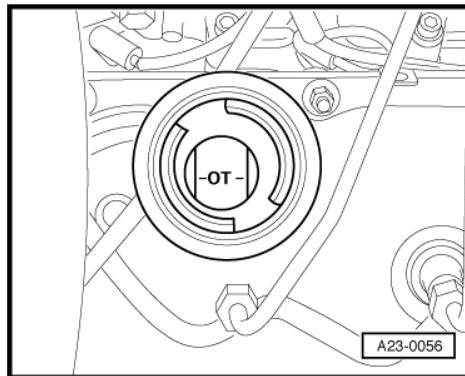


WARNING

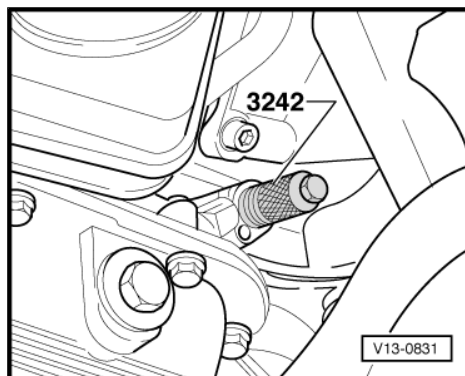
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Injury risk.

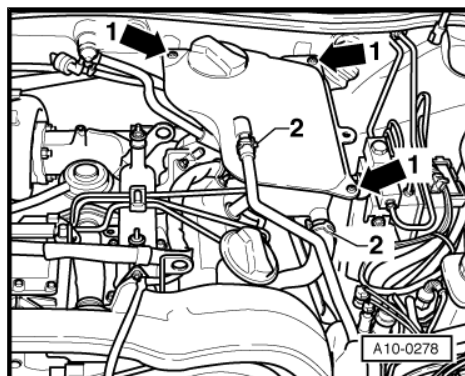
- ◆ Do not rotate the crankshaft while feeling for the TDC drilling with your finger.



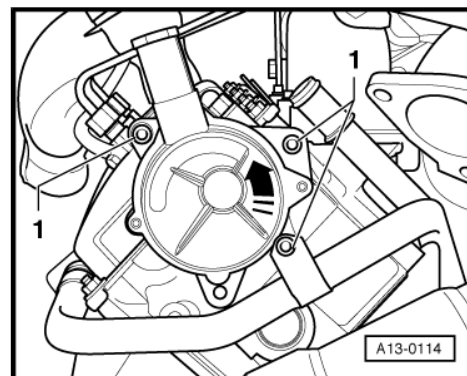
- Screw locking pin -3242- into threaded hole where plug has been removed and tighten.



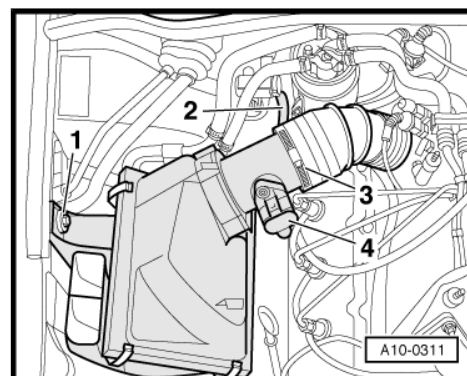
- Unbolt coolant expansion tank -arrows 1-.
- Detach wire for coolant shortage indicator switch -F66- and move coolant expansion tank to one side with coolant hoses -2- attached.



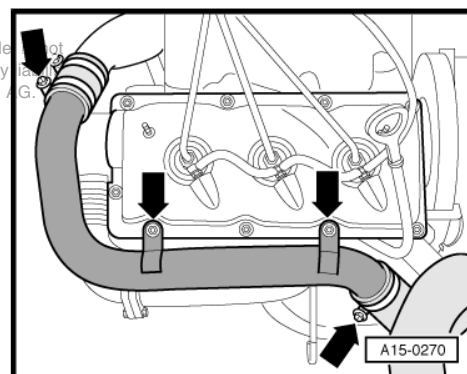
- Remove bolts -1- for exhaust pump with heat shield on cylinder head (left-side) and turn pump in anti-clockwise direction -arrow-.
- Move exhaust pump clear to the rear (leave hose attached).



- Slacken hose clip -3-.
- Unplug connector -4-.
- Pull hose -2- off air cleaner housing.
- Unscrew bolt -1- and remove air cleaner housing.
- Unfasten clamping nut for fuel filter and lift filter out of retainer.
- Disengage fuel lines at retainer and move fuel filter to side with lines connected.



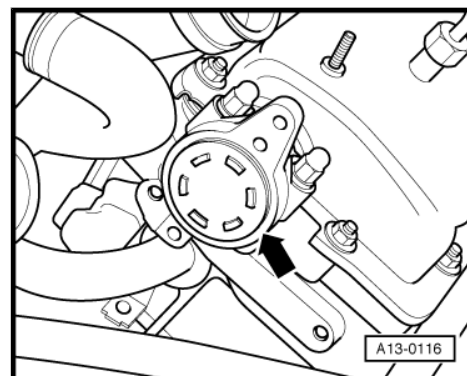
- Remove air intake pipe between turbocharger and charge air cooler (right-side) -arrows-.



- Using a screwdriver, lever off sealing cap -arrow- on cylinder head (right-side).

**Note**

- ◆ Removal destroys sealing cap.
- ◆ Take care not to damage sealing surfaces.

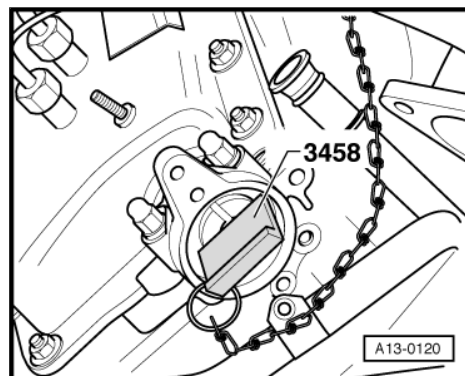


- Insert camshaft holder -3458- in both cylinder heads and secure them with chain to prevent them from falling.



Caution

Do not use camshaft holders -3458- as counterhold tools.

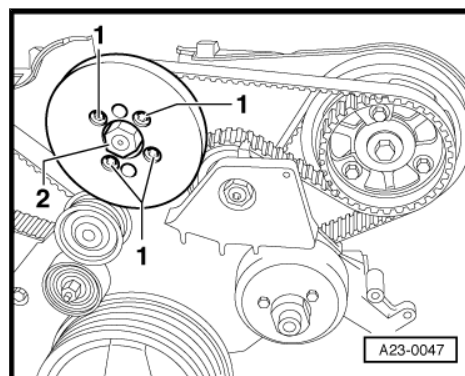


- Remove vibration damper on injection pump sprocket (unscrew bolts-1- prior to removing).



Caution

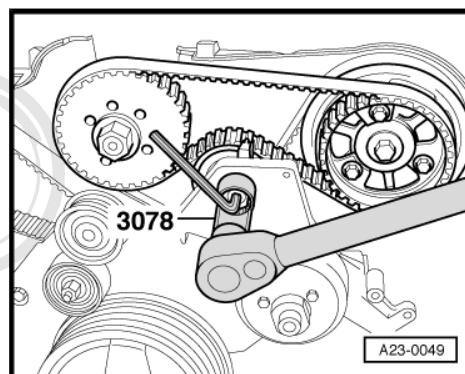
Do NOT loosen nut -2- for injection pump sprocket. Otherwise this would alter the basic setting of the injection pump. The setting cannot be re-adjusted with workshop equipment.



Caution

If a used belt runs in the opposite direction when it is refitted, this can cause breakage.

- ◆ *Before removing, mark direction of rotation of toothed belt with chalk or felt-tipped pen for re-installation.*



- Slacken toothed belt tensioner and take toothed belt off camshaft sprocket.

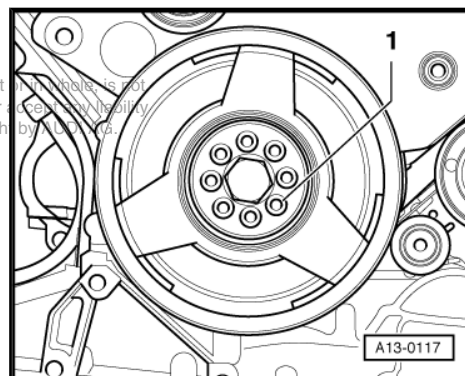
- Unscrew 8 bolts -1- and remove crankshaft vibration damper.



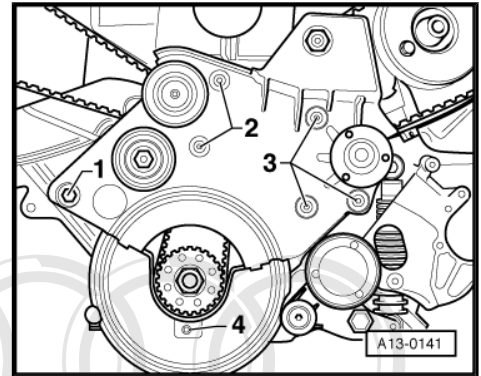
Note

Central bolt does not have to be loosened when removing vibration damper.

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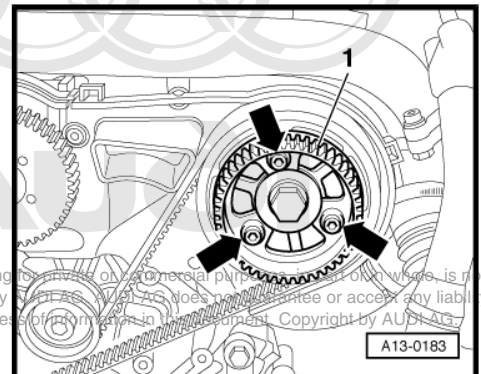
- Unbolt bottom section of toothed belt cover -4-.
- Unbolt viscous fan pulley.
- Remove bolts -1 ... 3- and detach bracket for viscous fan with idler rollers.



- Unbolt drive sprocket -1- for injection pump from camshaft sprocket -arrows-.

**Caution**

Do not use camshaft holder -3458- as a counterhold tool.

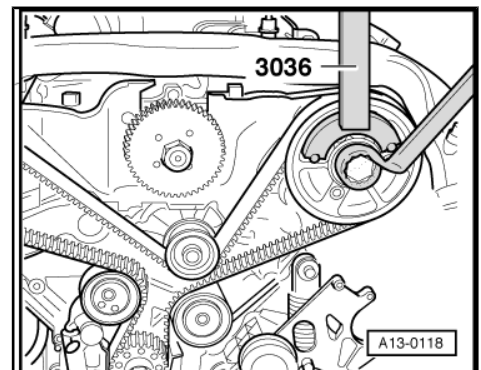


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- Loosen bolts for camshaft sprockets using counter-hold tool -3036-.

**Note**

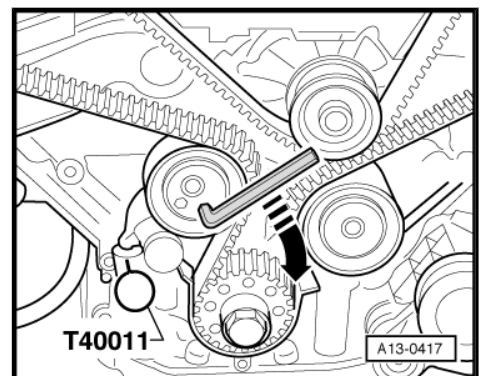
Leave bolts screwed in loosely.

**Caution**

If a used belt runs in the opposite direction when it is refitted, this can cause breakage.

- ◆ *Before removing, mark direction of rotation of toothed belt with chalk or felt-tipped pen for re-installation.*

- Turn toothed belt tensioning roller in clockwise direction -arrow- using an 8 mm hexagon key until tensioning lever of tensioner is compressed far enough to allow locking pin -T40011- to be inserted into hole and plunger.

**Note**

The toothed belt tensioner is oil-damped and can therefore only be compressed slowly by applying constant pressure.

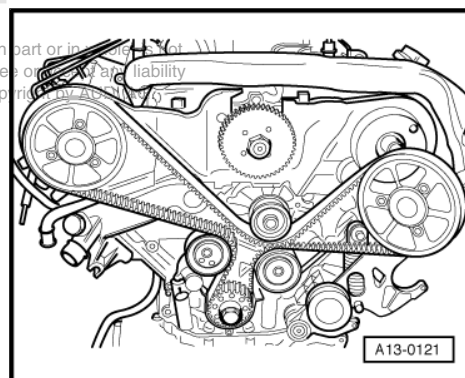
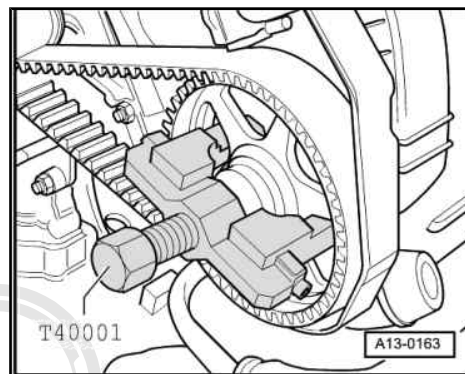
- Pull camshaft sprockets (left and right) off their tapers using two-arm puller -T40001- with claws -T40001/2- .
- Unbolt camshaft sprocket, left-side (cylinder bank 2).
- Remove toothed belt.

Installing (adjusting valve timing)

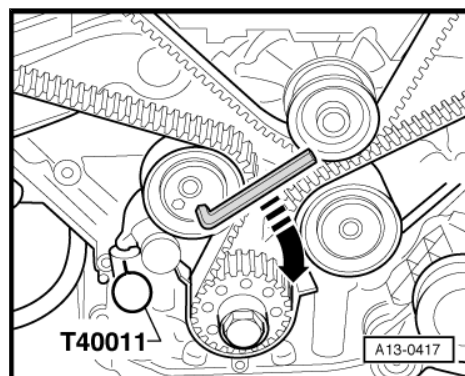
- Camshafts locked in position with camshaft holders -3458- .
- Crankshaft locked in position with locking pin -3242- .
- Camshaft sprockets free to turn.

The valve timing must be adjusted as described below, even when the toothed belt has only been removed from the camshaft sprocket.

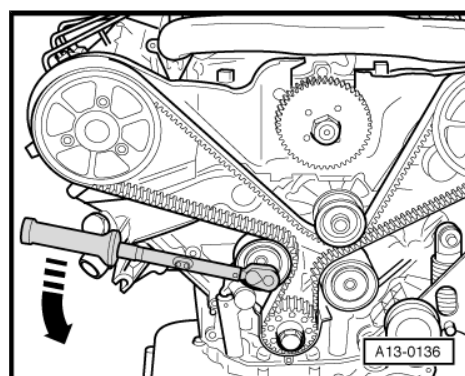
- The crankshaft must not be at “TDC” at any cylinder when the camshaft is turned. Otherwise, there is a risk of damage to valves and piston crowns.
- Do not use camshaft holders -3458- as counterhold tools.
- Adjustment can be performed with cold or warm engine.
- First fit the toothed belt onto the crankshaft sprocket, then onto the right camshaft, and then over the tensioning roller, the idler roller and the coolant pump.
- Finally, take toothed belt sprocket for left camshaft, fit toothed belt and install sprocket on camshaft.
- Tighten the two camshaft sprocket bolts until the sprockets can still just be turned without axial movement.



- Use an 8 mm hexagon key to slacken toothed belt tensioning roller in clockwise direction -arrow- and pull out locking pin -T40011- .



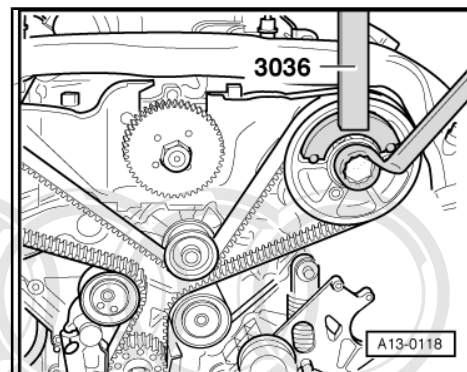
- Use torque wrench to pretension toothed belt to 15 Nm in anti-clockwise direction -arrow-.



- Tighten bolts for camshaft sprockets using counter-hold tool -3036- .

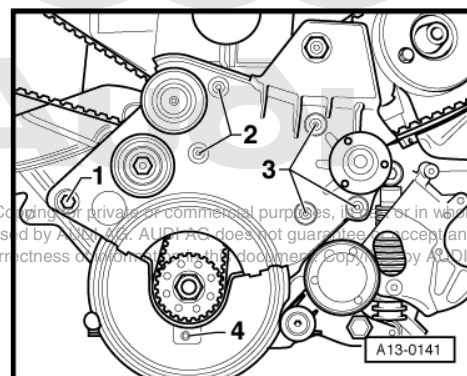
**Caution**

Do not use camshaft holders -3458- as counterhold tools.



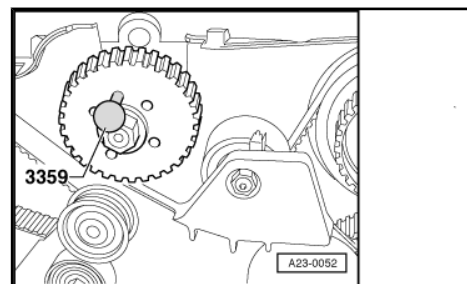
- Tighten bolts for bracket for viscous fan:

- 1 - 45 Nm
- 2 - 10 Nm
- 3 - 22 Nm
- 4 - 10 Nm

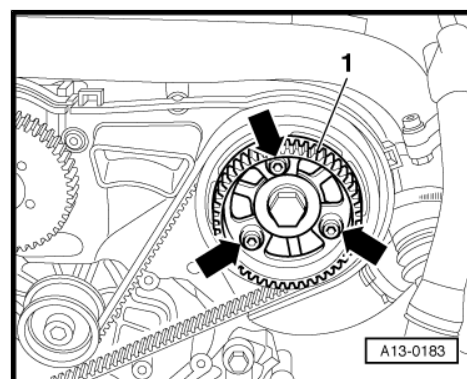


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- Lock injection pump sprocket with diesel injection pump locking pin -3359- .



- Install drive sprocket for injection pump -1- so that it is aligned centrally in elongated holes.
- Tighten drive sprocket -arrows- until it is still just possible to turn it on the camshaft sprocket.
- Position toothed belt for injection pump. Pay attention to the direction of rotation as marked upon removal.



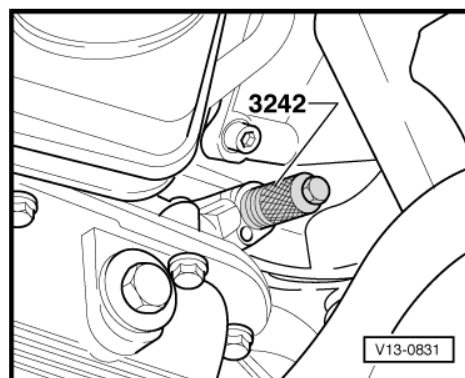
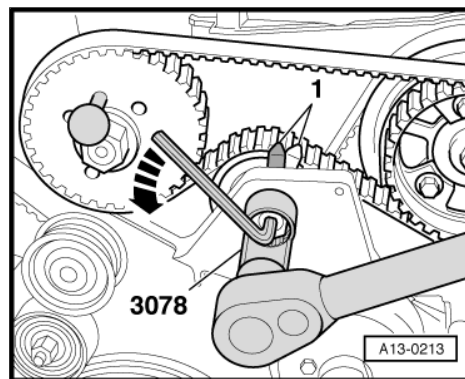
- Tension toothed belt by turning Allen key in anti-clockwise direction -arrow- until marks -1- coincide.
- Then tighten nut using socket (22 mm) -3078- .



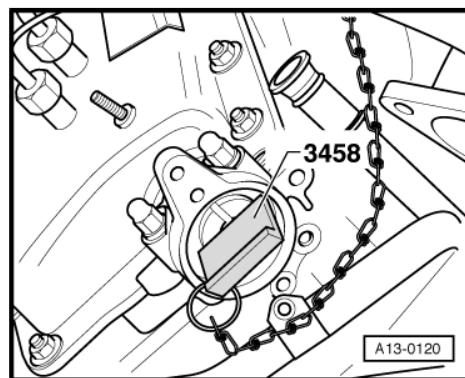
Note

Depending on version, pointer -1- may have no tip.

- Tighten bolts at camshaft sprocket.
- Remove diesel injection pump locking pin -3359- .
- Remove camshaft holders -3458- from both cylinder heads.
- Remove locking pin -3242- .
- Turn crankshaft two rotations in normal direction of rotation until the crankshaft is at "TDC" again.
- To check adjustment, screw locking pin -3242- into hole in cylinder block once again.

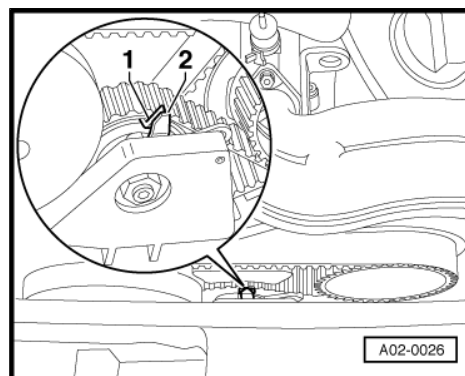


- Check positions of camshafts with camshaft holders -3458- .
- If it is not possible to insert camshaft holders, repeat adjustment.
- Remove camshaft holders -3458- from both cylinder heads.
 - Remove locking pin -3242- .

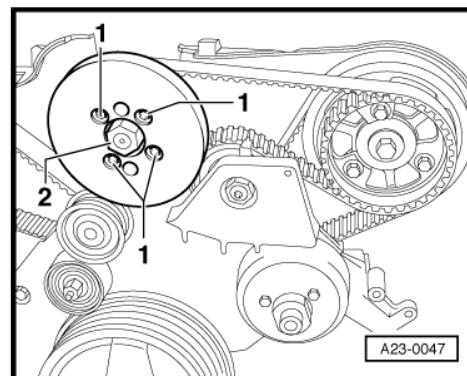


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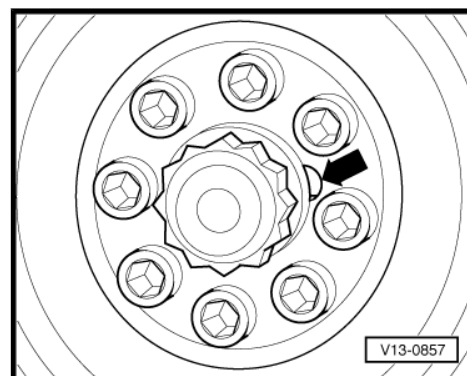
- Check tension of toothed belt for injection pump.
- Marks -1- and -2- must be opposite one another.



- Install vibration damper on injection pump sprocket (tighten bolts -1-).



- Install vibration damper. In doing so, pay attention to locking lug -arrow- on toothed belt sprocket.
- Screw plug for the TDC mark into cylinder block with a new seal.
- Install exhauster pump with new O-rings on cylinder head (left-side).



- Renew sealing cap (rear) on cylinder head (right-side).
- Using a suitable drift, knock in new sealing cap (core plug) -arrow- until flush.

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



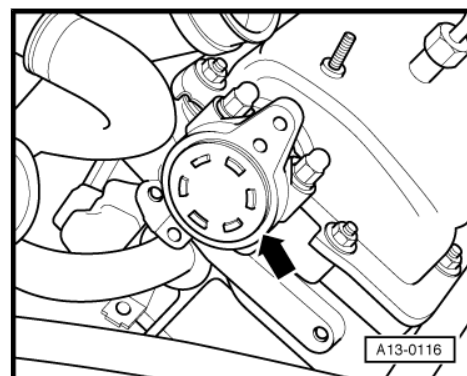
Note

◆ Renew seals and O-rings.

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◆ Renew sealing cap.

- Install poly V-belt for power steering pump, alternator and viscous fan ⇒ [page 36](#) .
- Install viscous fan ⇒ [page 200](#) .
- Dynamically check and adjust commencement of injection ⇒ Rep. Gr. 23 .



Tightening torques

Component	Nm
Camshaft sprocket to camshaft	75
Vibration damper to injection pump sprocket	22
Drive sprocket for injection pump to camshaft	22
Exhauster pump to cylinder head	10
Vibration damper to crankshaft sprocket	22
Screw plug in cylinder block	10
Tensioning roller for poly V-belt for A/C compressor to bracket	22
Tensioning roller for injection-pump toothed belt to bracket for viscous fan	36

3 Sealing flanges and dual-mass fly-wheel/drive plate

3.1 Sealing flanges and dual-mass flywheel/drive plate - exploded view



Note

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Servicing clutch ⇒ Rep. Gr. 30

1 - Bolt

- ☐ 10 Nm

2 - Bolt

- ☐ 30 Nm

3 - Oil seal for crankshaft (pulley end)

- ☐ Renewing ⇒ [page 78](#)

4 - O-ring

- ☐ For oil drilling
- ☐ Renew

5 - Timing chain tensioner

- ☐ Tighten to 35 Nm

6 - Bolt

- ☐ 10 Nm

7 - Guide tube for oil dipstick

8 - O-ring

- ☐ Renew

9 - Sump (top section)

- ☐ Different versions for engines with moulded gasket or liquid gasket; refer to ⇒ Electronic parts catalogue
- ☐ Removing and installing ⇒ [page 157](#)

10 - Bolt

- ☐ 45 Nm

11 - Balance shaft assembly

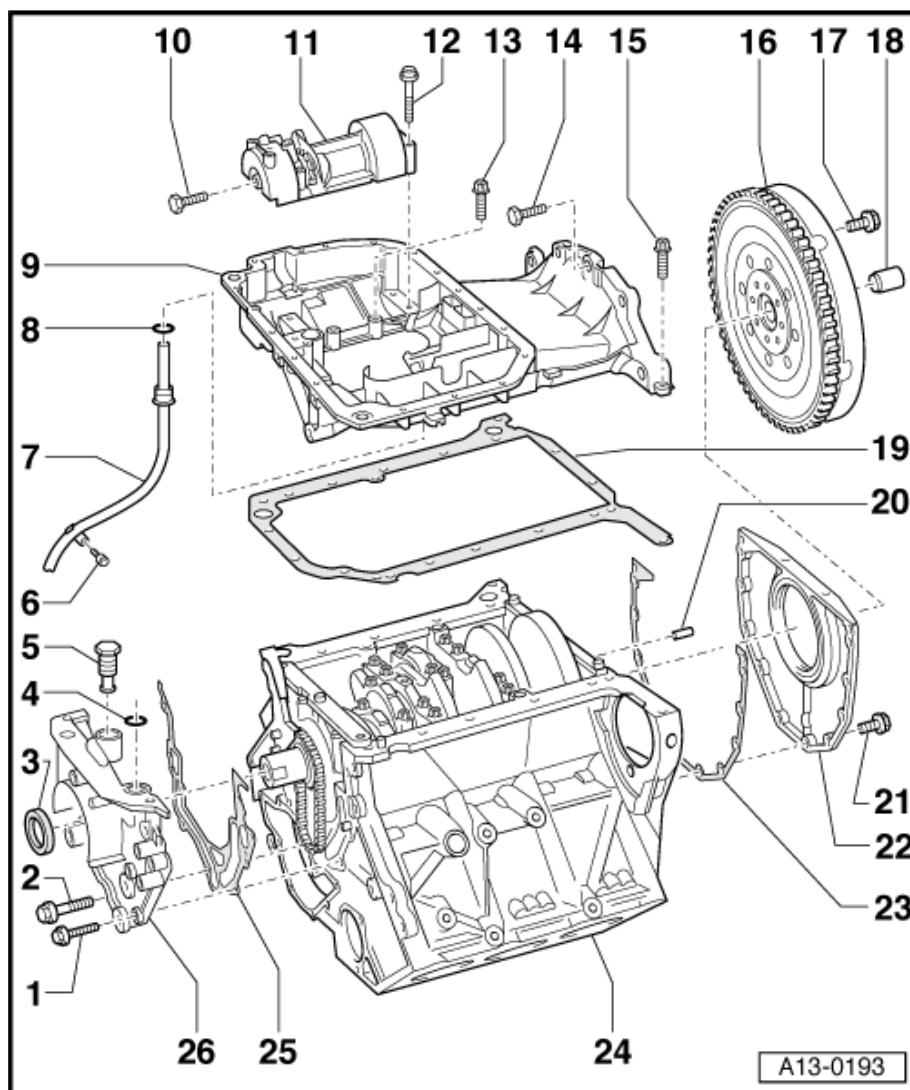
- ☐ With balance shaft
- ☐ Removing and installing ⇒ ["1.7 Removing sump \(top section\)", page 157](#)

12 - Bolt

- ☐ 22 Nm

13 - Bolts

- ☐ M6 to cylinder block = 13 Nm
- ☐ M6 to sealing flange = 10 Nm
- ☐ M7 = 16 Nm
- ☐ Allocation ⇒ Electronic parts catalogue



14 - Bolt

- ☐ 45 Nm

15 - Bolt

- ☐ M6 to cylinder block = 13 Nm
- ☐ M6 to sealing flange = 10 Nm
- ☐ M7 = 16 Nm
- ☐ Allocation ⇒ Electronic parts catalogue

16 - Dual-mass flywheel or drive plate

- ☐ Dual-mass flywheel on vehicles with manual gearbox, removing and installing ⇒ [page 82](#)
- ☐ Drive plate on vehicles with automatic gearbox, removing and installing ⇒ [page 84](#)

17 - Bolt

- ☐ Renew
- ☐ Tightening torque for dual-mass flywheel: 60 Nm + 180° turn further
- ☐ Tightening torque for drive plate (vehicles with automatic gearbox): 60 Nm + 90° turn further

18 - Needle bearing

- ☐ Extracting and driving in ⇒ [page 83](#)

19 - Gasket

Moulded gasket - vehicles up to approx. 05.1998

- ☐ Renewing ⇒ [page 165](#)

Liquid gasket - vehicles from approx. 06.1998 onwards

- ☐ Renewing ⇒ [page 166](#)

20 - Dowel pin

- ☐ Check that pin is firmly seated in crankshaft

21 - Bolt

- ☐ 10 Nm

22 - Sealing flange (gearbox end) with oil seal

- ☐ Remove upper section of sump in order to remove and install ⇒ [page 157](#)
- ☐ Lubricate sealing lip of oil seal lightly
- ☐ To install, push guide sleeve from installation kit onto crankshaft

23 - Gasket

- ☐ Renew

24 - Cylinder block

- ☐ Crankshaft - exploded view ⇒ [page 86](#)
- ☐ Pistons and conrods - exploded view ⇒ [page 91](#)

25 - Gasket

- ☐ Renew

26 - Sealing flange (pulley end)

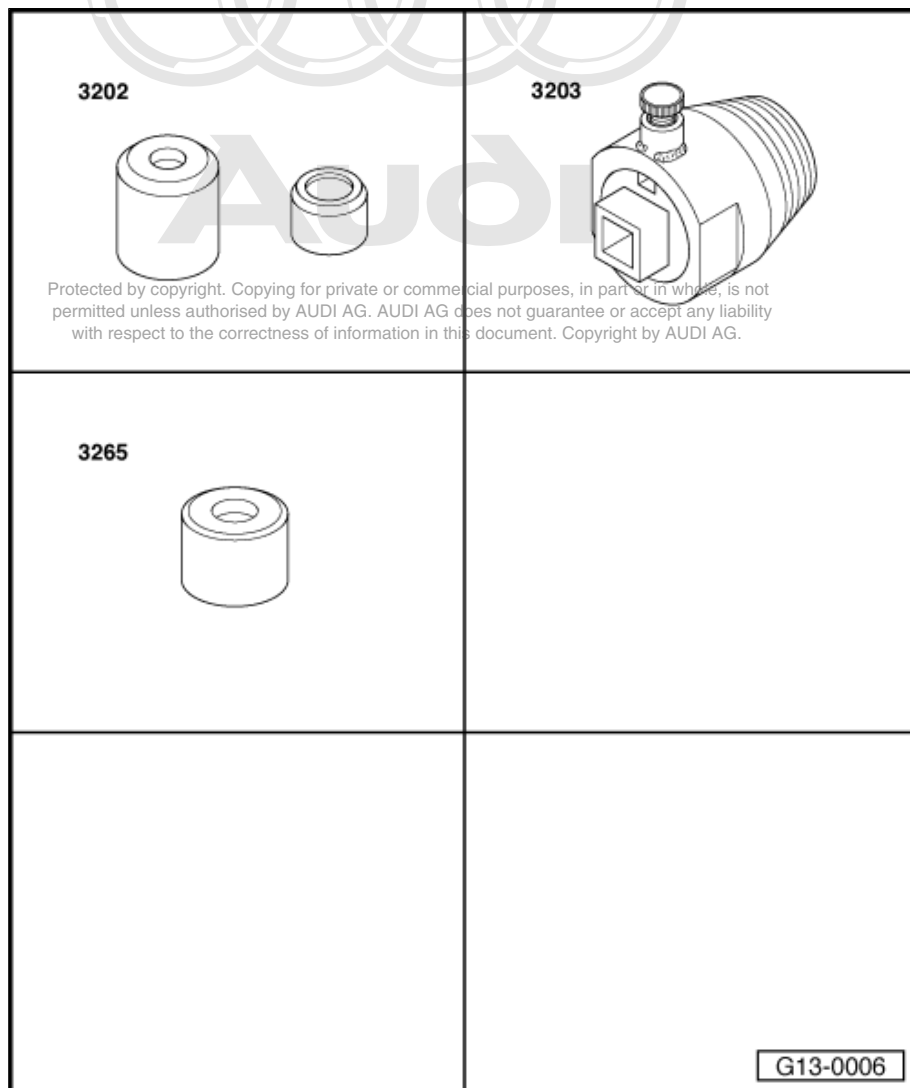
- ☐ Removing and installing ⇒ [page 79](#)

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3.2 Renewing crankshaft oil seal (pulley end)

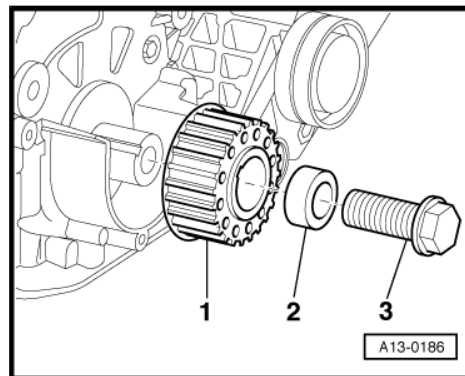
Special tools and workshop equipment required

- ◆ Fitting sleeves -3202-
- ◆ Oil seal extractor -3203-
- ◆ Fitting sleeve -3265-

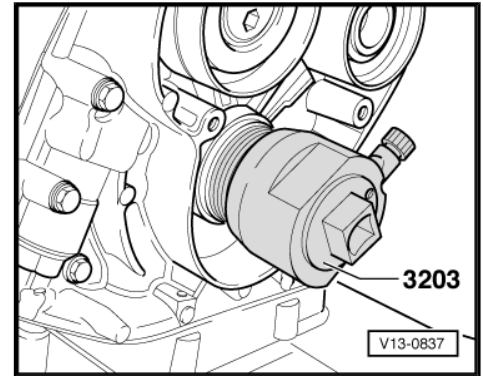


Procedure

- Engine in vehicle.
- Lock carrier must be in service position ⇒ [page 31](#) .
- Remove toothed belt ⇒ [page 66](#) .
- Unscrew central bolt -3- for toothed belt sprocket -1- on crankshaft.
- Detach spacer sleeve -2- and toothed belt sprocket.



- Screw inner section of oil seal extractor -3203- six turns out of outer section and lock with knurled screw.
- Lubricate threaded head of oil seal extractor, place it in position and screw it into oil seal as far as possible (applying firm pressure).
- Loosen knurled screw and turn inner part against crankshaft until the oil seal is pulled out.
- Clamp flats of oil seal extractor in vice and use pliers to remove oil seal.
- Clean contact surface and sealing surface.



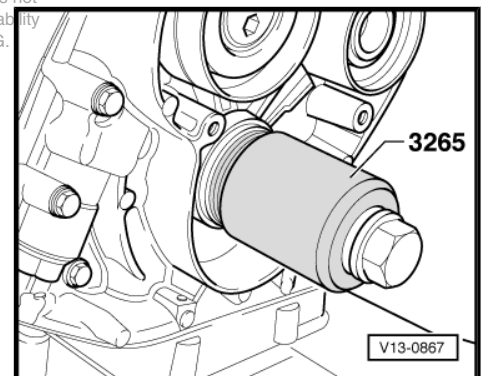
Note

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

- Install oil seal using fitting sleeve -3202/1-
- Press oil seal in so that it is flush using fitting sleeve -3265- and central bolt.

Note

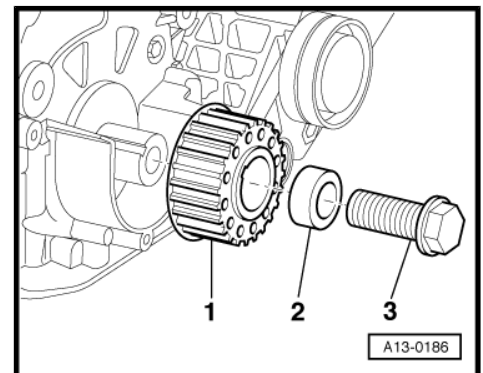
Fit spacer sleeve for crankshaft sprocket underneath central bolt.



- Install crankshaft sprocket -1- with spacer sleeve -2- and new central bolt -3-.

Note

- ♦ *Contact surface between toothed belt sprocket and crankshaft must be free of oil.*
- ♦ *Do not lubricate bolt for crankshaft sprocket.*
- Install toothed belt (adjust valve timing) ⇒ [page 72](#).



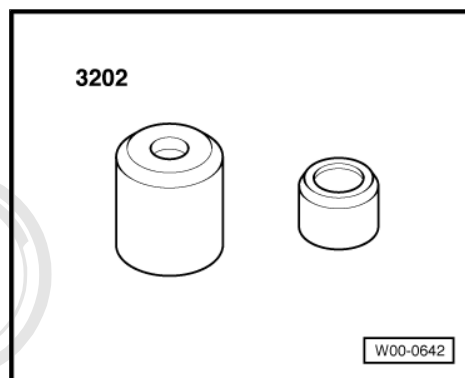
Tightening torque

Component	Nm
Toothed belt sprocket to crankshaft	200 + 180° 1)
• 1) Renew bolt.	

3.3 Removing and installing sealing flange (pulley end)

Special tools and workshop equipment required

◆ Fitting sleeves -3202-



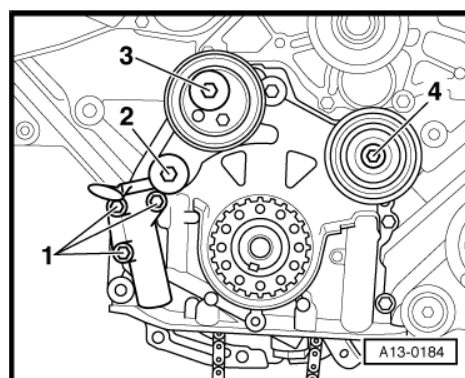
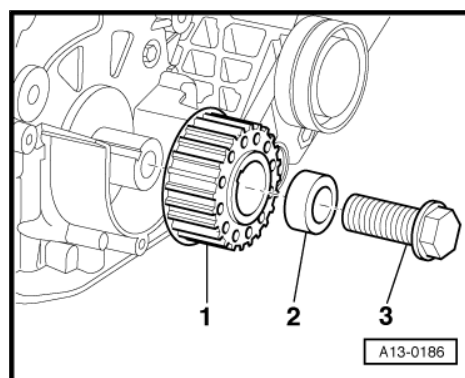
◆ Fitting sleeve -3265-



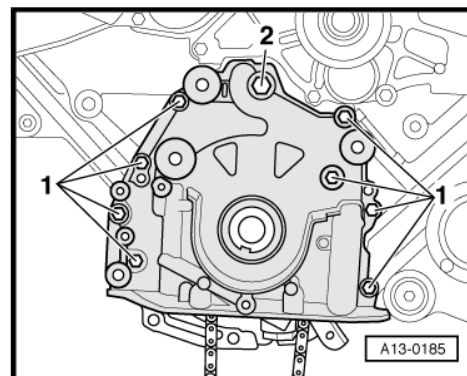
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Removing

- Engine in vehicle.
- Lock carrier must be in service position ⇒ [page 31](#) .
- Remove toothed belt ⇒ [page 66](#) .
- Unscrew central bolt -3- for toothed belt sprocket -1- on crankshaft.
- Detach spacer sleeve -2- and toothed belt sprocket.
- Remove top section of sump ⇒ [page 157](#) .
- Remove idler roller -4-, tensioning roller -3-, tensioning lever -2- and tensioner -1-.



- Remove bolts -1- and -2-.
- Remove sealing flange (pulley end).
- Drive out oil seal with flange removed.



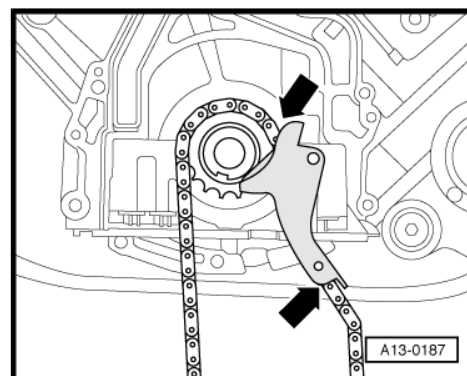
Installing

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



Note

- ◆ Before installing sealing flange, check position of drive chain for oil pump. Drive chain must make contact with guide rail of chain tensioner -arrows-.
- ◆ If sealing flange is installed with oil seal already fitted, place fitting sleeve -3202/1- on end of crankshaft before installing sealing flange.

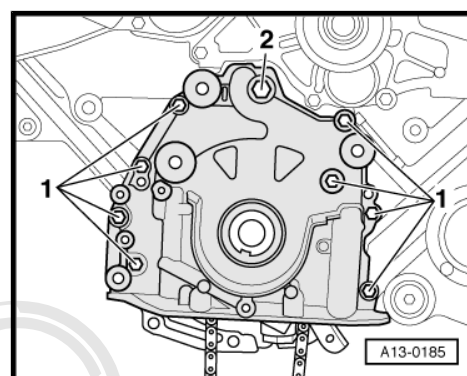


- Clean sealing surfaces.
- Apply locking fluid to bolt -2- and insert bolt.
- Tighten bolts -1- and -2-.



Note

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



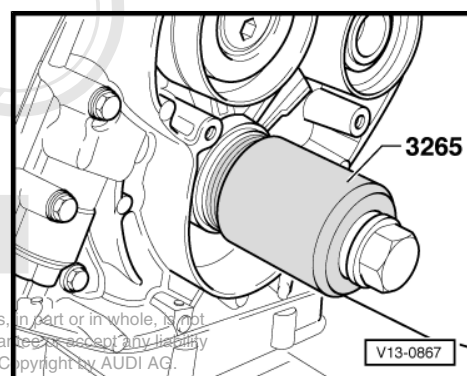
- Install oil seal using fitting sleeve -3202/1-.
- Press oil seal in so that it is flush using fitting sleeve -3265- and central bolt.



Note

Fit spacer sleeve for crankshaft sprocket underneath central bolt.

- Install idler roller.
- Installation position: recess in mounting hole (for bolt head) faces towards front.
- Pay attention to washers fitted behind tensioning roller and tensioning lever.



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- Install crankshaft sprocket -1- with spacer sleeve -2- and new central bolt -3-.



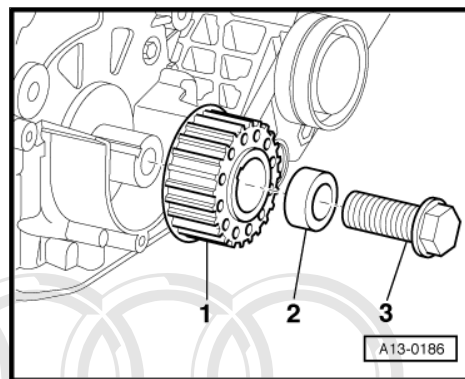
Note

- ◆ *Contact surface between toothed belt sprocket and crankshaft must be free of oil.*
- ◆ *Do not lubricate bolt for crankshaft sprocket.*

- Install toothed belt (adjust valve timing) ⇒ [page 72](#) .
- Install sump (top section): vehicles with moulded gasket ⇒ [page 165](#) , vehicles with liquid gasket ⇒ [page 166](#) .

Tightening torques

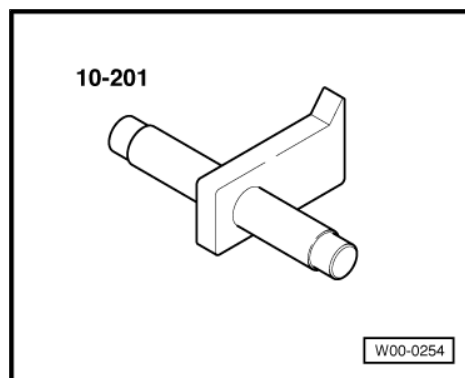
Component		Nm
Sealing flange (pulley end) to cylinder block	M6	10
	M8	30
Toothed belt sprocket to crankshaft		200 + 180° ¹⁾
Toothed belt tensioning roller to sealing flange (pulley end)		42
Tensioner to sealing flange (pulley end)		10
Tensioning lever to sealing flange (pulley end)		42
Idler roller to sealing flange (pulley end)		45
• ¹⁾ Renew bolt.		



3.4 Removing and installing dual-mass flywheel - vehicles with manual gearbox

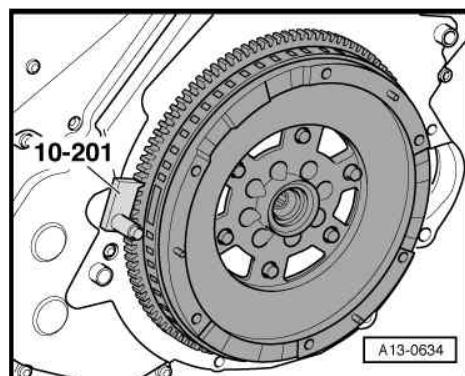
Special tools and workshop equipment required

- ◆ Counter-hold tool -10-201-



Removing

- Gearbox removed ⇒ Rep. Gr. 34 .
- Remove clutch pressure plate ⇒ Rep. Gr. 30 .
- Mark position of dual-mass flywheel on engine.
- Attach counter-hold tool -10-201- in order to loosen bolts.

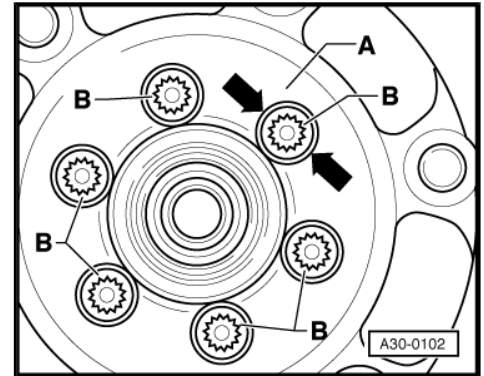




Note

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.



Installing

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



Note

The needle bearing is located in the dual-mass flywheel and must be driven in when renewing the dual-mass flywheel
⇒ [page 83](#).

- Use new securing bolts.
- Reverse position of counter-hold tool -10-201- in order to tighten bolts.
- Install clutch pressure plate ⇒ Rep. Gr. 30.

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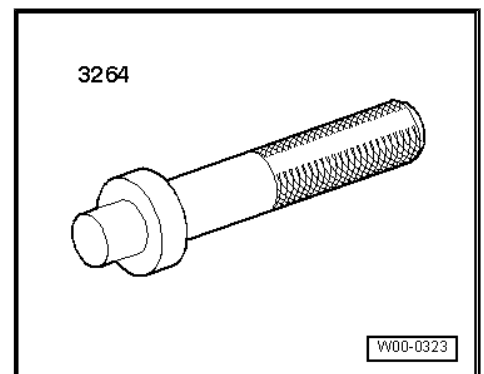
Tightening torque

Component	Nm
Dual-mass flywheel to crankshaft	60 + 180° 1)
• 1) Renew bolts.	

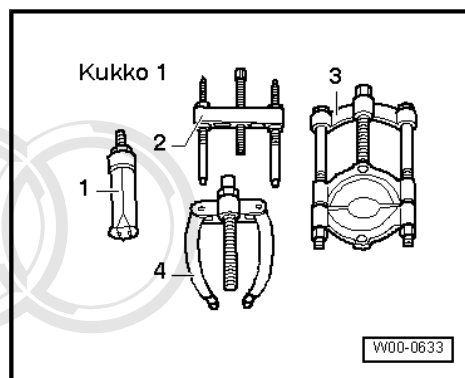
3.5 Extracting and driving in needle bearing for dual-mass flywheel

Special tools and workshop equipment required

- ◆ Punch -3264-



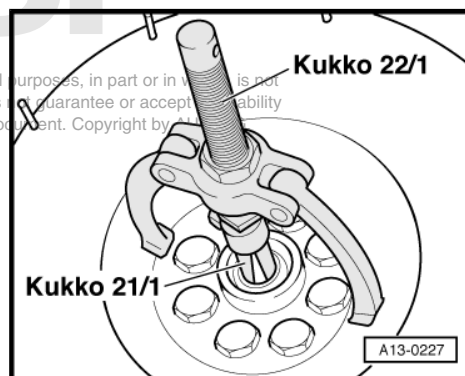
◆ -1- Internal puller -Kukko 21/2-



◆ -4- Counter-support -Kukko 22/1-

Procedure

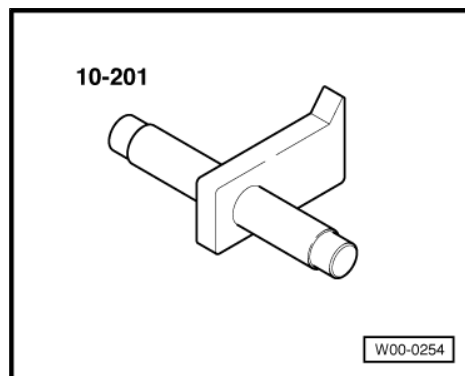
- Pull out needle bearing with internal puller -Kukko 21/2- and counter-support -Kukko 22/1-
- Drive needle bearing into dual-mass flywheel using punch -3264- .



3.6 Removing and installing drive plate - vehicles with automatic gearbox

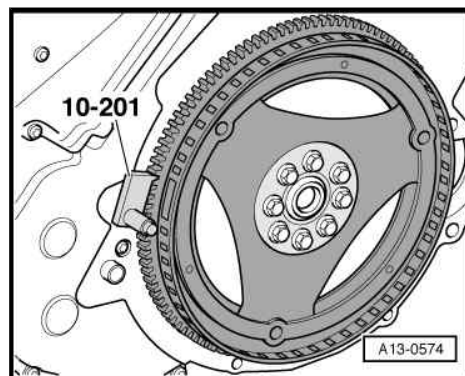
Special tools and workshop equipment required

◆ Counter-hold tool -10-201-



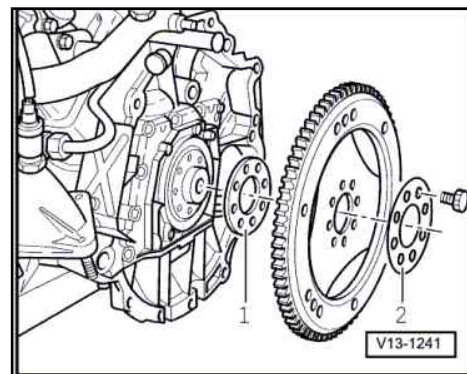
Removing

- Automatic gearbox removed ⇒ Rep. Gr. 37 .
- Attach counter-hold tool -10-201- in order to loosen bolts.
- Mark installation position of drive plate on engine.
- Unbolt drive plate.
- Take out shim located behind.

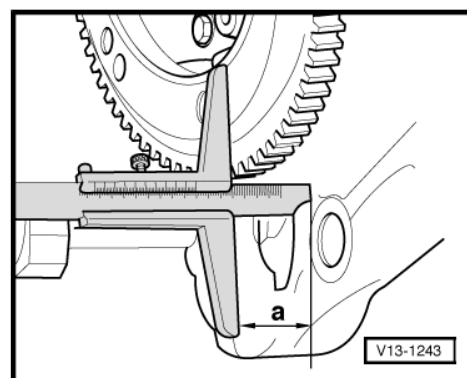


Installing

- Fit drive plate with packing plate -2- and 3.0 mm or 4.0 mm shim -1-.
- Insert at least 3 old bolts and tighten to 30 Nm.



- Measure distance -a- at three points and calculate average value.
- Specification: 18.1 ... 19.7 mm.

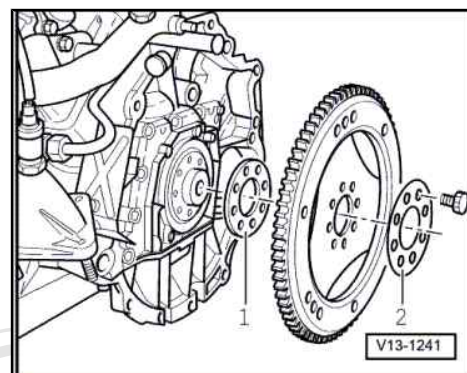


If specification is not obtained:

- Remove drive plate again and install with different shim -1-.
- Tighten bolts to 30 Nm again.
- Repeat measurement procedure.

If specification is obtained:

- Renew bolts and tighten to final setting.
- Reverse position of counter-hold tool -10-201- in order to tighten bolts.



Tightening torque

Component	Nm
Drive plate to crankshaft	60 + 90° 1)
• 1) Renew bolts.	

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4 Crankshaft

4.1 Crankshaft - exploded view



Note

- ◆ Secure engine to engine and gearbox support -VAS 6095- when performing assembly work ⇒ [page 23](#).
- ◆ Vehicles with automatic gearbox are provided with a centring sleeve for the torque converter in the crankshaft ⇒ [page 88](#).

1 - Dowel sleeve

- ☐ Insert in cylinder block

2 - Chain sprocket

- ☐ Removing and installing ⇒ [page 90](#)

3 - Crankshaft

- ☐ Measuring axial clearance ⇒ [page 88](#)
- ☐ Measuring radial clearance ⇒ [page 89](#)
- ☐ Crankshaft dimensions ⇒ [page 88](#)

4 - Dowel pin

5 - Support

- ☐ Note installation position ⇒ [page 88](#),
⇒ [page 88](#)

6 - Bolt

22 Nm

7 - Bolts

- ☐ For bearing cap
- ☐ Renew
- ☐ Tightening torque and sequence ⇒ [page 87](#)

8 - Bearing cap

- ☐ Note marking ⇒ [page 87](#)
- ☐ Installing ⇒ [page 87](#)

9 - Bolt

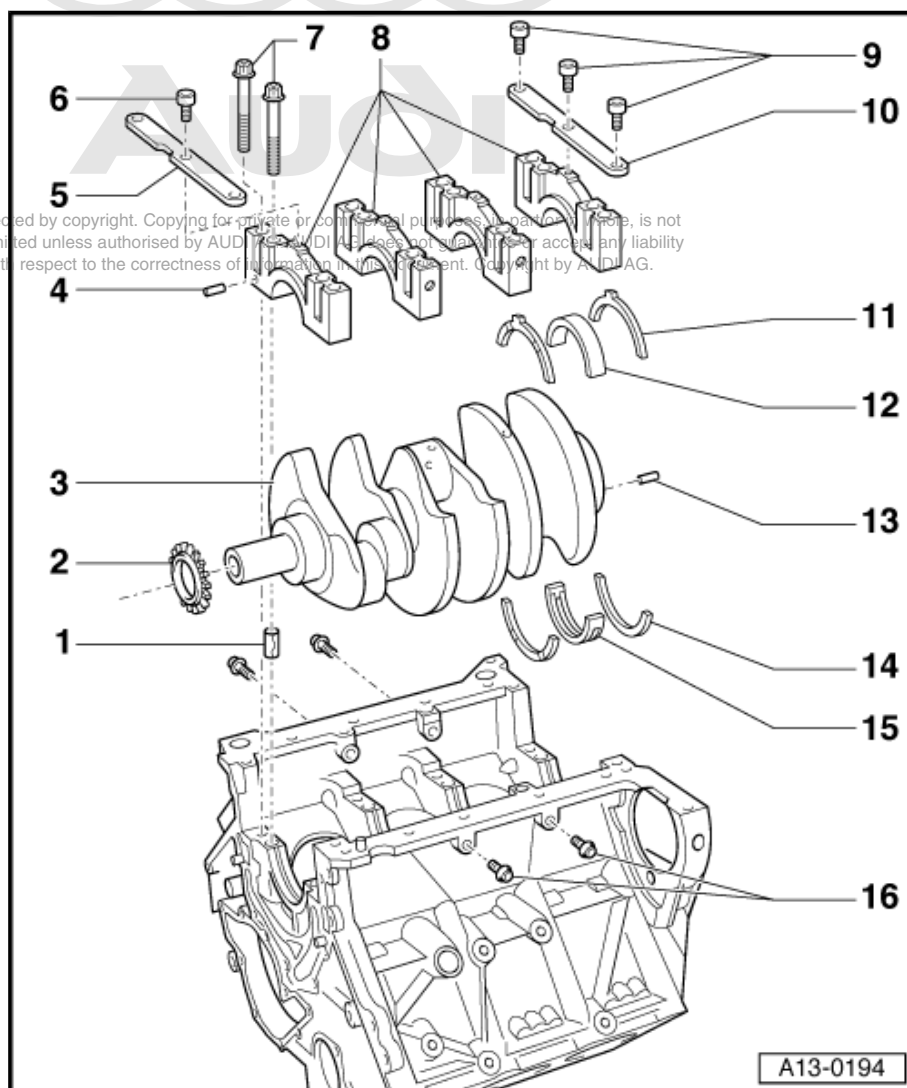
22 Nm

10 - Support

- ☐ Note installation position ⇒ [page 88](#)

11 - Thrust washer

- ☐ Only fitted on 4th crankshaft bearing
- ☐ Oil grooves face outwards
- ☐ Note location
- ☐ Measuring axial clearance of crankshaft ⇒ [page 88](#)



12 - Bearing shell

- ☐ For bearing cap (without oil groove)
- ☐ Mark used bearing shells for re-installation but not on bearing surface
- ☐ Bearing shells worn down to the base layer must be renewed

13 - Dowel pin

- ☐ Check that pin is firmly seated in crankshaft

14 - Thrust washer

- ☐ Only fitted on 4th crankshaft bearing
- ☐ Oil grooves face outwards
- ☐ Measuring axial clearance of crankshaft ⇒ [page 88](#)

15 - Bearing shell

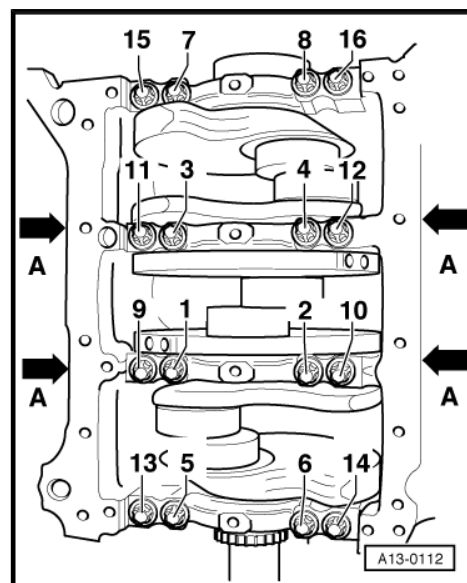
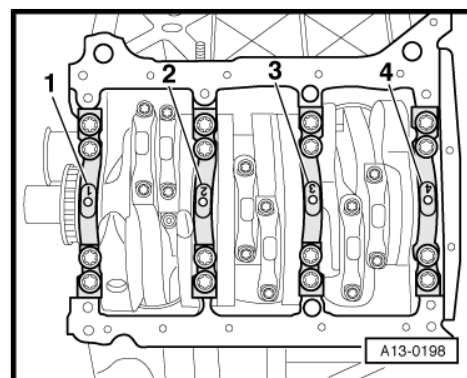
- ☐ For cylinder block (with oil groove)
- ☐ Mark used bearing shells for re-installation but not on bearing surface
- ☐ Bearing shells worn down to the base layer must be renewed

16 - Bolts

- ☐ For bearing cap
- ☐ Tightening torque and sequence ⇒ [page 87](#)

Markings on crankshaft bearing caps

- ◆ Bearing 1: pulley end
- ◆ Bearing 4: gearbox end



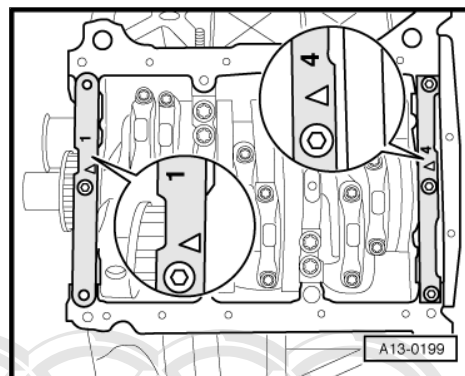
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Installing crankshaft bearing caps

- Renew bolts -1 ... 16- for main bearing cap.
- Insert dowel sleeves in bearing cap.
- Tighten bolts in 5 stages as follows:
 1. Tighten bolts -1 ... 8- to 60 Nm.
 2. Turn bolts -1 ... 8- 90° further.
 3. Tighten bolts -9 ... 16- to 60 Nm.
 4. Turn bolts -9 ... 16- 90° further.
 5. Tighten bolts -A- to 28 Nm.

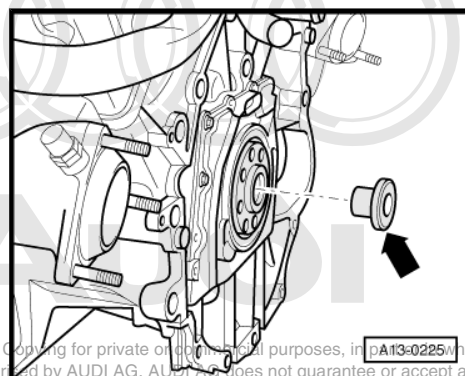
Fitting location of supports

- Arrow points in direction of travel.
- Support with mark -1- faces pulley end.
- Support with mark -4- faces gearbox end.



Centring sleeve for torque converter

- Short engines and reconditioned (exchange) engines as well as new and reconditioned crankshafts, are supplied without centring sleeve -arrow-.
- The centring sleeve must therefore be knocked in before fitting drive plate on vehicles with automatic gearbox.
- This centring sleeve must not be fitted on vehicles with manual gearbox.



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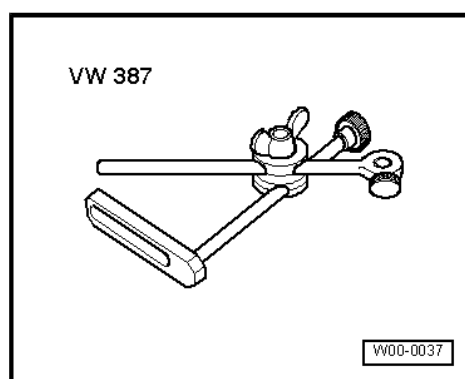
4.2 Crankshaft dimensions

Honing dimension	Crankshaft main bearing journal Ø mm	Conrod journal Ø mm
Basic dimension	65.00 -0.022 -0.042	58.00 -0.022 -0.042
Repair undersize	64.75 -0.022 -0.042	57.75 -0.022 -0.042

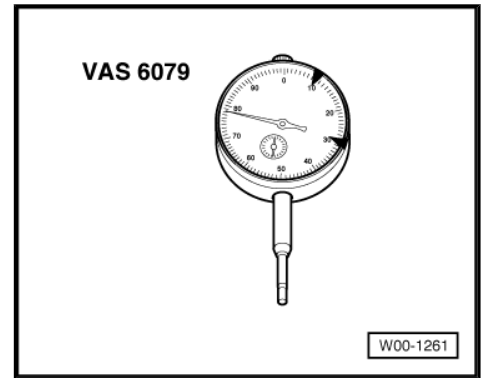
4.3 Measuring axial clearance of crankshaft

Special tools and workshop equipment required

- ◆ Universal dial gauge bracket -VW 387-



◆ Dial gauge -VAS 6079-

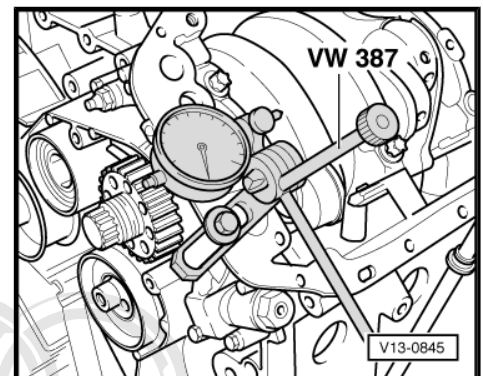


Procedure

- Secure dial gauge -VAS 6079- with universal dial gauge bracket -VW 387- to cylinder block as shown in illustration.
- Set dial gauge 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: 0.090 ... 0.251 mm.
- Wear limit: 0.280 mm.



4.4 Measuring radial clearance of crankshaft

Special tools and workshop equipment required

- ◆ Plastigage

Procedure



Note

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- ◆ *Mark used bearing shells for re-installation (but do not mark bearing surface).*
- ◆ *Bearing shells worn down to the base layer must be renewed.*
- Remove bearing cap and clean bearing cap and bearing journal.
- Place a length of Plastigage corresponding to the width of the bearing on the bearing journal or in the bearing shell.
- The Plastigage must be positioned in the centre of the bearing shell
- Fit bearing cap and tighten to 30 Nm without rotating crankshaft.
- Remove bearing cap again.
- Compare width of Plastigage with measurement scale.

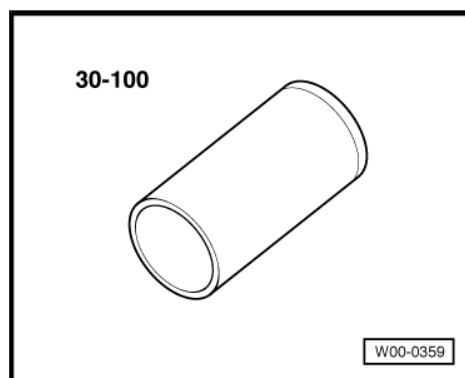
Radial clearance:

- New: 0.018 ... 0.045 mm.
- Wear limit: 0.100 mm.

4.5 Removing and installing chain sprocket

Special tools and workshop equipment required

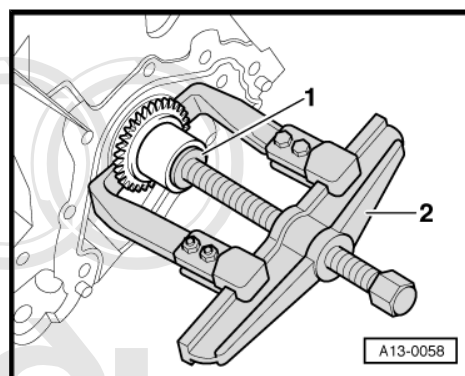
- ◆ Fitting sleeve -30 - 100-



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

Removing

- Remove upper section of sump ⇒ [page 157](#) .
- Remove sealing flange (pulley end) ⇒ [page 79](#) .
- Remove chain tensioner and chain.
- Detach chain sprocket from crankshaft with puller -2-; use a suitable washer -1- to protect end of crankshaft.



Installing



WARNING

Risk of burns.

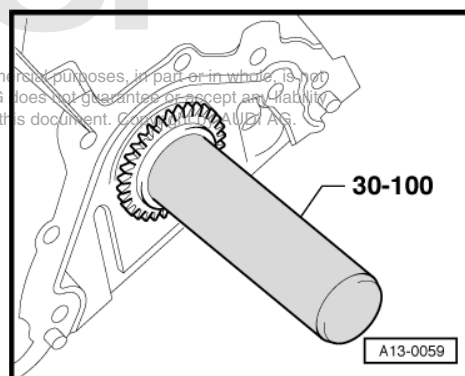
- ◆ **Wear protective gloves.**

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- Heat chain sprocket in oven for approx. 15 minutes to 220°C.
- Fit chain sprocket on end of crankshaft using pliers, and press onto crankshaft as far as the stop using drift sleeve -30 - 100- .

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

- Install sealing flange (pulley end) ⇒ [page 79](#) .
- Install sump (top section): vehicles with moulded gasket ⇒ [page 165](#) , vehicles with liquid gasket ⇒ [page 166](#) .



5 Pistons and conrods

5.1 Pistons and conrods - exploded view

1 - Bolt

- ☐ 30 Nm + turn 90° further
- ☐ Renew
- ☐ Lubricate threads and contact surface

2 - Conrod bearing cap

- ☐ Do not interchange
- ☐ Mark cylinder allocation in colour -B-
⇒ [page 93](#)
- ☐ Installation position:
Note position of lugs on casting -A- ⇒ [page 94](#)

3 - Bearing shells

- ☐ Note installation position
- ☐ Mark used bearing shells for re-installation but not on bearing surface
- ☐ Bearing shells worn down to the base layer must be renewed

4 - Conrod

- ☐ Only renew as a complete set
- ☐ Mark cylinder number -B-
- ☐ Installation position:
Note position of lugs on casting -A- ⇒ [page 94](#)
- ☐ Axial clearance for each conrod pair (when new):
0.20 ... 0.44 mm; wear limit: 0.60 mm
- ☐ Measuring radial clearance ⇒ [page 96](#)

5 - Circlip

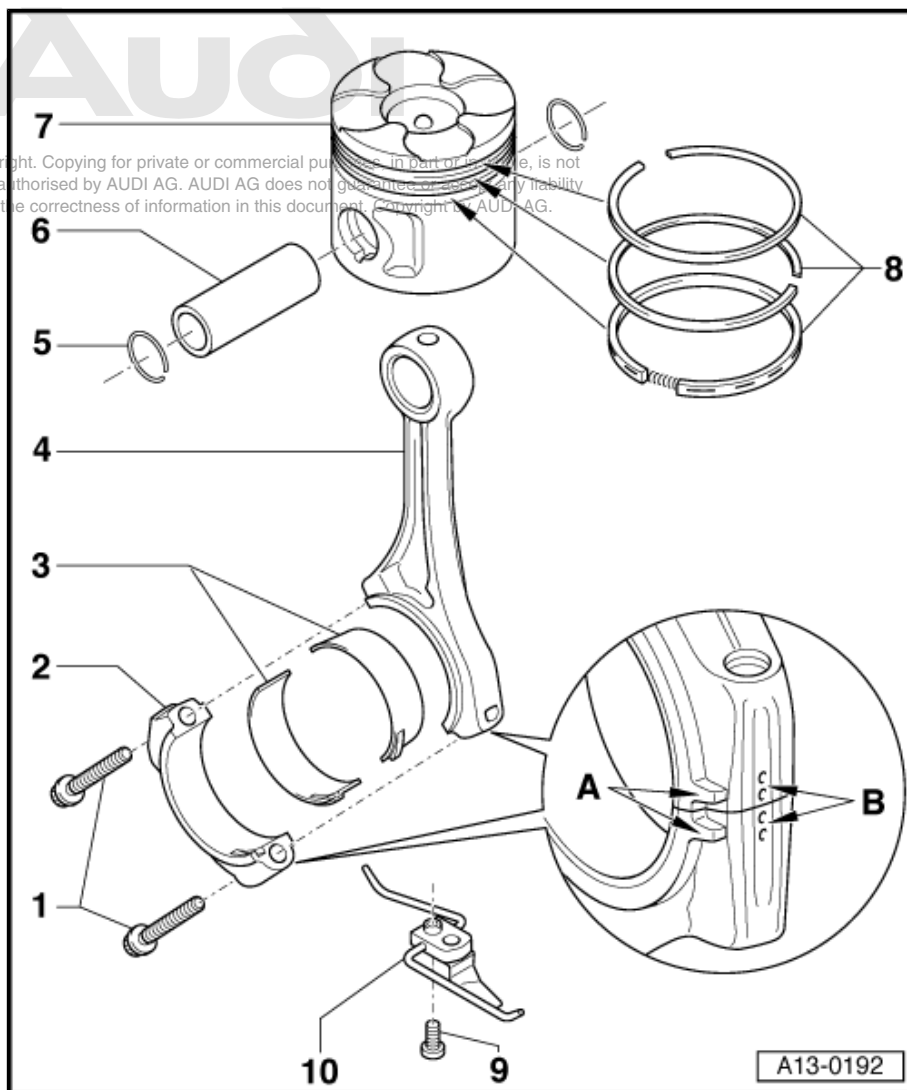
- ☐ Renew

6 - Piston pin

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

7 - Piston

- ☐ With combustion chamber
- ☐ Mark installation position and cylinder number ⇒ [page 93](#)
- ☐ Checking ⇒ [page 92](#)
- ☐ Arrow on piston crown faces centre of engine
- ☐ Install using piston ring clamp
- ☐ Renew piston if cracking is visible on piston crown or piston skirt



- ☐ Piston and cylinder dimensions ⇒ [page 96](#)
- ☐ Measuring cylinder bore ⇒ [page 93](#)
- ☐ Measuring piston projection at "TDC" ⇒ [page 94](#)

8 - Piston rings

- ☐ Offset gaps by 120°
- ☐ Use piston ring pliers to remove and install
- ☐ "TOP" must face towards piston crown
- ☐ Measuring ring gap ⇒ [page 92](#)
- ☐ Measuring ring-to-groove clearance ⇒ [page 92](#)

9 - Bolt

- ☐ 9 Nm

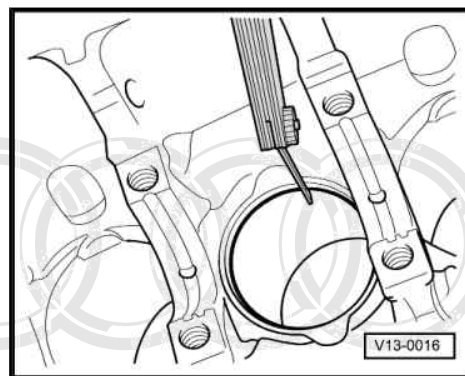
10 - Oil spray jet

- ☐ For piston cooling

Measuring 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.

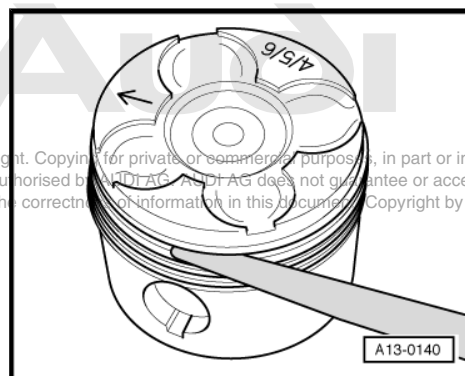
Piston ring	new mm	Wear limit mm
1st compression ring	0.20 ... 0.40	0.8
2nd compression ring	0.80 ... 1.00	1.4
Oil scraper ring	0.25 ... 0.50	0.8



Checking ring-to-groove clearance

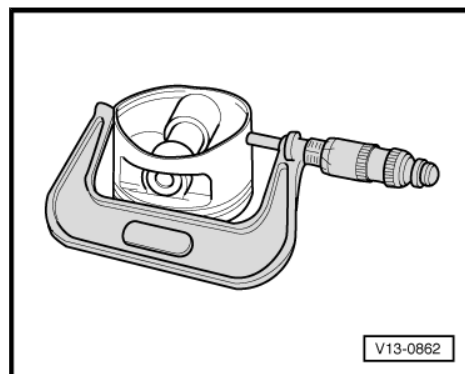
- Clean groove in piston before checking clearance.

Piston ring	new mm	Wear limit mm
1st compression ring	0.100 ... 0.135	0.150
2nd compression ring	0.045 ... 0.085	0.110
Oil scraper ring	0.025 ... 0.065	0.090



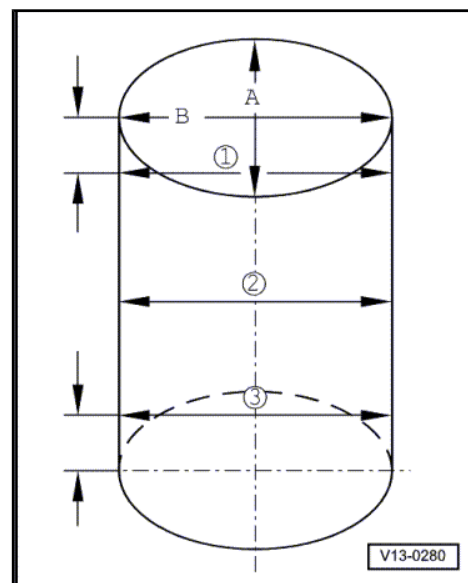
Checking piston

- Using a micrometer (75 ... 100 mm), measure approx. 10 mm from the lower edge, perpendicular to the piston pin axis.
- Maximum deviation from nominal dimension: 0.05 mm.



Checking cylinder bore

- Use a cylinder gauge -VAS 6078- to take measurements at 3 points in transverse direction -A- and in longitudinal direction -B-.
- Maximum deviation from nominal dimension: 0.08 mm.



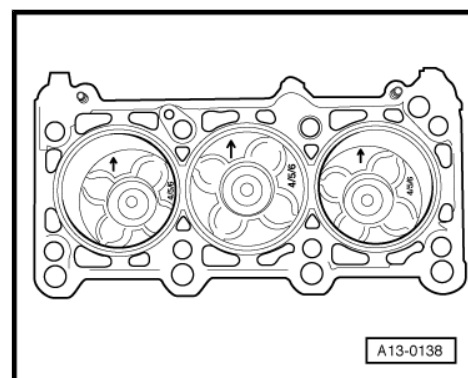
Piston installation position and piston/cylinder allocation



Note

Pistons in cylinders 1 ... 3 and 4 ... 6 are different.

- Installation position: arrows on piston crowns must point towards centre of engine
- Mark sequence with waterproof felt-tip pen on piston crown.



Caution

Do not damage the coating of the piston crown.

- ◆ ***Use a coloured pen to mark piston/cylinder allocation on piston crown for re-installation. Do not mark piston crown by means of centre punch, notch or the like.***

With new pistons, cylinder assignment is shown by a coloured or engraved marking on piston crown.

- ◆ Pistons for cylinders 1, 2 and 3 are marked "1/2/3"
- ◆ Pistons for cylinders 4, 5 and 6 are marked "4/5/6"
- ◆ Piston identification ⇒ [page 96](#)

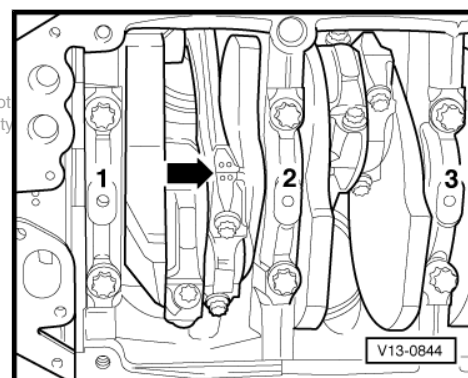
Marking conrods

- Use a coloured pen to mark matching conrods and conrod bearing caps with cylinder numbers -arrow- for re-installation.



Note

- ◆ *Only renew conrods as a complete set.*
- ◆ *Do not interchange conrod bearings.*



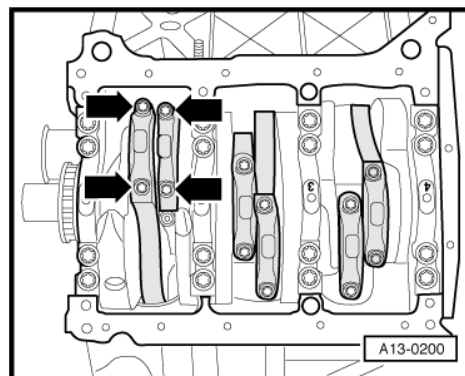
Installation position of conrods

- Lugs on castings -arrows- ⇒ [page 91](#) of conrods are located as shown in illustration.



Note

The illustration shows the first conrod pair.

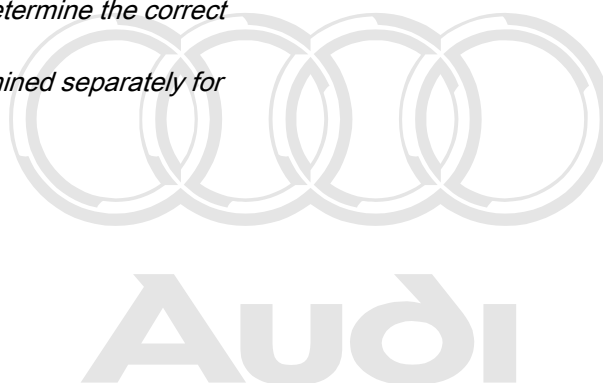


5.2 Measuring piston projection at "TDC"



Note

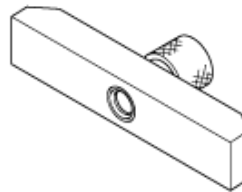
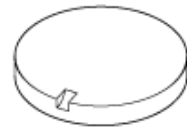
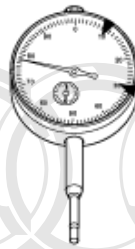
- ◆ *Piston projection at "TDC" must be measured when installing new pistons or a short engine. Depending upon piston projection, install the corresponding cylinder head gasket according to the table below:*
- ◆ *If the measured values for piston projection are not the same for all pistons, use the highest value to determine the correct size for the cylinder head gasket.*
- ◆ *The cylinder head gasket must be determined separately for each cylinder bank.*



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Special tools and workshop equipment required

- ◆ Measuring tool -VW 382/7-
- ◆ Measuring plate - VW 385/17-
- ◆ Dial gauge -VAS 6079-

VW 382/7**VW 385/17****VAS 6079**

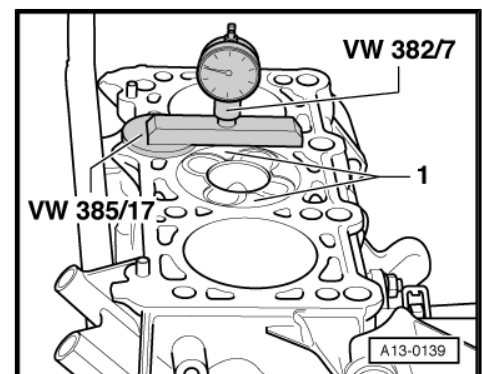
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G13-0064

Procedure

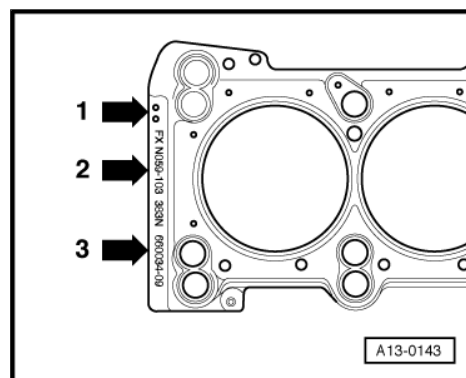
- Secure dial gauge -VAS 6079- with measuring bridge - VW 382/7- and measuring plate -VW 385/17- to cylinder block.
- Measure piston projection at two points -1- for each piston.

Piston projection above top surface of cylinder block in mm	Identification (No. of holes)
0.39 ... 0.49	1
0.49 ... 0.54	2
0.54 ... 0.65	3



Identification of cylinder head gasket

- 1 - Holes
- 2 - Part number
- 3 - Production code (can be disregarded)



5.3 Piston and cylinder dimensions

Piston identification		Piston Ø mm	Cylinder bore Ø mm
Basic dimension	I ¹⁾	78.253 ... 78.261 ²⁾	78.306 ... 78.310
	II ¹⁾	78.259 ... 78.267 ²⁾	78.310 ... 78.314
Intermediate size	I ¹⁾	78.293 ... 78.301 ²⁾	78.346 ... 78.350
	II ¹⁾	78.299 ... 78.307 ²⁾	78.350 ... 78.354
¹⁾ Piston identification is stamped on piston crown ⇒ page 96. ²⁾ Dimensions not including coating (thickness 0.02 mm). Coating on piston skirt will wear down in service.			

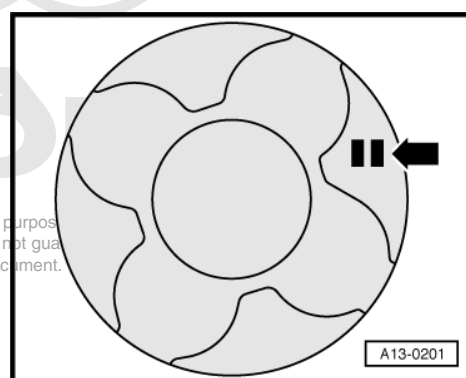
Piston identification on piston crown

Piston identification is stamped on piston crowns -arrow-.



Replacement pistons are only available with basic dimension.

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5.4 Measuring radial clearance of conrods

Special tools and workshop equipment required

- ◆ Plastigage

Procedure



- ◆ Mark used bearing shells for re-installation (but do not mark bearing surface).
- ◆ Bearing shells worn down to the base layer must be renewed.
- Remove conrod bearing cap. Clean bearing cap and bearing journal.
- Place a length of Plastigage corresponding to the width of the bearing on the bearing journal or in the bearing shell.

- Fit conrod bearing caps and tighten to 30 Nm without rotating crankshaft.
- Remove conrod bearing cap again.
- Compare width of Plastigage with measurement scale.

Radial clearance:

- New: 0.015 ... 0.062 mm.
- Wear limit: 0.12 mm.
- Renew conrod bolts.



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15 – Cylinder head, valve gear

1 Cylinder head

1.1 Cylinder head - exploded view



Note

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- ◆ **Never set down cylinder head on workbench, as this could damage injectors and glow plugs.**
- ◆ **A pressure limiting valve (for lubrication points in cylinder head) is screwed into each cylinder head. Tightening torque: 25 Nm.**

1 - Cylinder head

- ☐ Removing: left-side
⇒ [page 113](#); right-side
⇒ [page 116](#)
- ☐ Checking for distortion
⇒ [page 100](#)
- ☐ Cylinder heads must not be reworked on TDI engines
- ☐ Installing ⇒ [page 119](#)
- ☐ If renewed, change coolant and engine oil

2 - Gasket

- ☐ Renew if damaged or leaking
- ☐ Before fitting, seal transitions at outer bearing caps ⇒ [page 100](#)

3 - Bolt

- ☐ Renew
- ☐ Note correct sequence when slackening; cylinder head (left-side)
⇒ [page 116](#), cylinder head (right-side)
⇒ [page 119](#)
- ☐ Note correct sequence when tightening
⇒ [page 123](#)

4 - Cylinder head cover

- ☐ Removing and installing: left-side
⇒ [page 106](#), right-side
⇒ [page 109](#)

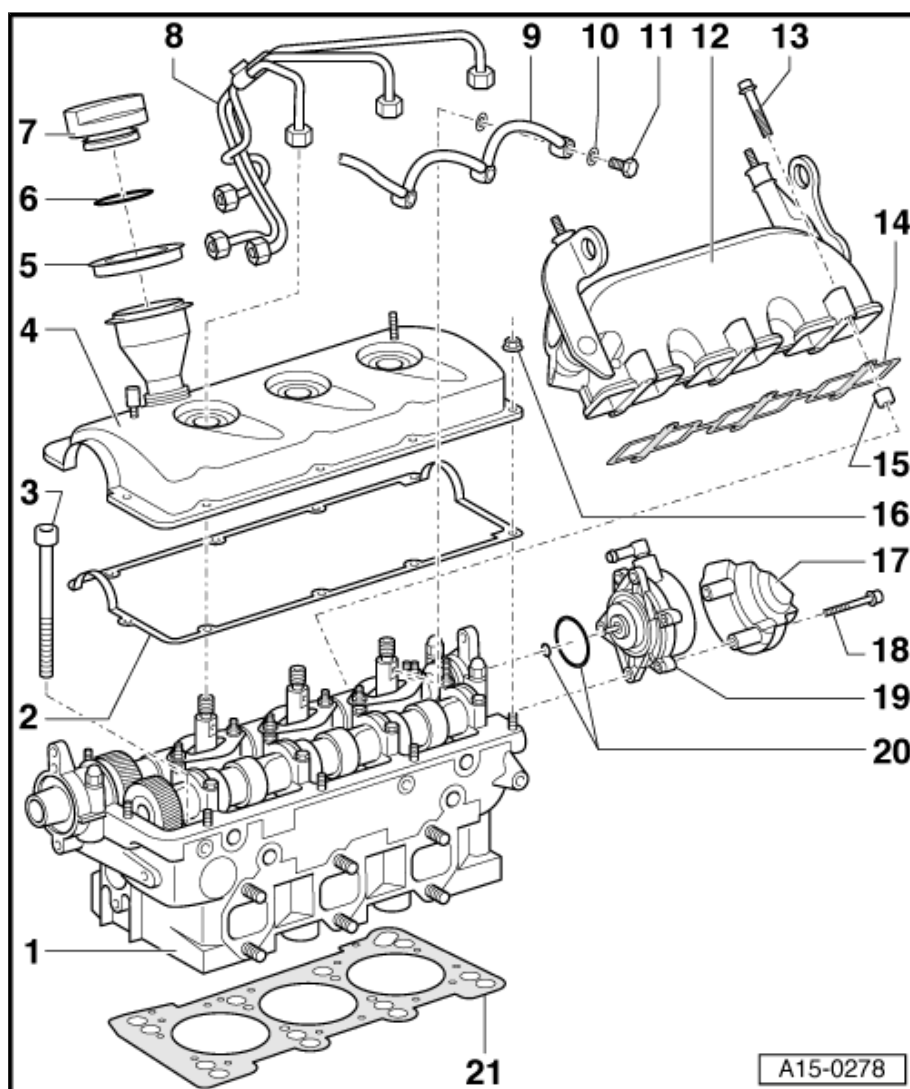
- ☐ Renew cylinder head cover if injector seals are damaged

5 - Deflector ring

- ☐ Renew if damaged

6 - Seal

- ☐ Renew if damaged or leaking



7 - Filler cap**8 - Injector pipes**

- ☐ Use ring spanner -3035- for removal
- ☐ Remove complete set of pipes
- ☐ Do not alter shape
- ☐ Tighten to 30 Nm

9 - Return pipe**10 - Seal**

- ☐ Renew

11 - Banjo bolt

- ☐ 5 Nm

12 - Intake manifold

- ☐ Removing and installing intake manifold (front section) ⇒ [page 101](#)
- ☐ Removing and installing intake manifold (left-side) ⇒ [page 102](#)
- ☐ Removing and installing intake manifold (right side) ⇒ [page 104](#)

13 - Bolt

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

14 - Gasket

- ☐ Renew

15 - Dowel sleeve

- ☐ 2x
- ☐ Take care to prevent dowel sleeves dropping into intake ports

16 - Nut

- ☐ 10 Nm
- ☐ Tighten in stages and in diagonal sequence
- ☐ Re-tighten to 10 Nm when engine is warm

17 - Heat shield

- ☐ For exhaust pump

18 - Bolt

- ☐ 10 Nm

19 - Exhaust pump

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

20 - O-rings

- ☐ For exhaust pump
- ☐ Renew

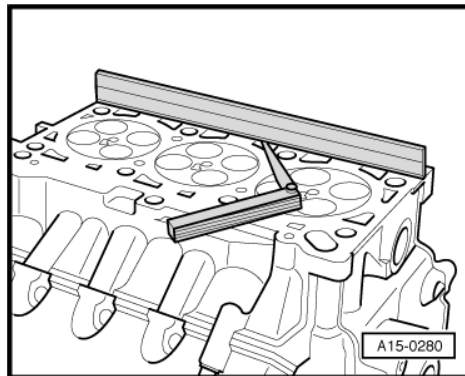
21 - Cylinder head gasket

- ☐ Different thicknesses
- ☐ Note marking ⇒ [page 100](#)
- ☐ Renewing: cylinder head (left-side) ⇒ [page 113](#) , cylinder head (right-side) ⇒ [page 116](#)
- ☐ Installation position: The word "oben" (top) or the part number should face towards the cylinder head
- ☐ If renewed, change coolant and engine oil

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Checking cylinder head for distortion

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



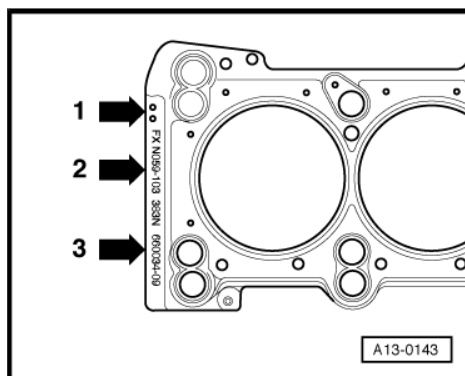
Identification of cylinder head gasket

- 1 - Holes
- 2 - Part number
- 3 - Production code (can be disregarded)



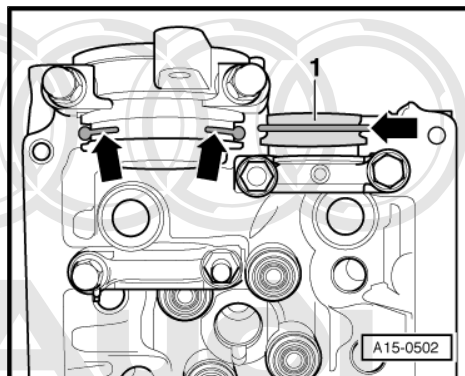
Note

- ◆ Cylinder head gaskets of different thicknesses are fitted depending on the amount of piston projection ⇒ [page 94](#).
- ◆ When renewing only the cylinder head gasket, the new gasket should have the same identification as the old one.

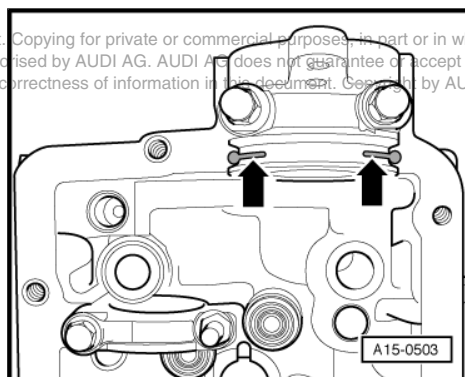


Sealing transitions at outer bearing caps in cylinder head

- Clean sealing surfaces; they must be free of oil and grease.
- Fit semi-circular seal -1-.
- Installation position: Parts number should be visible from outside; straight side of sealing surface should be flush with sealing surface of cylinder head.
- Draw a bead of sealant (Ø approx. 3 mm) over the semi-circular seal so that about 5 mm projects at both ends -right arrow-.



- Apply a drop of sealant (Ø approx. 5 mm) to all sealing points at joints between cylinder head and bearing caps ⇒ [Electronic parts catalogue](#).
- Apply sealant bead (Ø approx. 3 mm) up to approx. half the height of the bearing caps -arrows-.



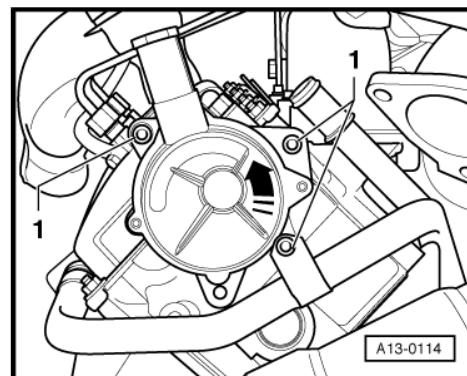
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Removing and installing exhauster pump

- Remove bolts -1- for exhauster pump with heat shield on cylinder head (left-side) and turn pump in anti-clockwise direction -arrow-.
- Fit new O-rings.

Tightening torque

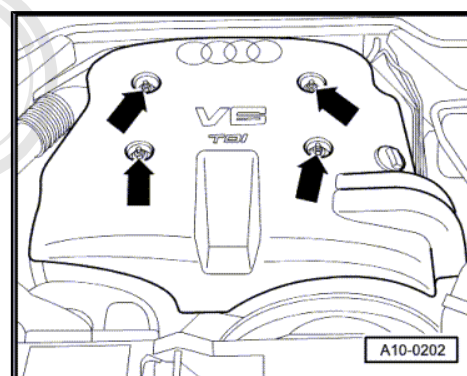
Component	Nm
Exhauster pump to cylinder head	10



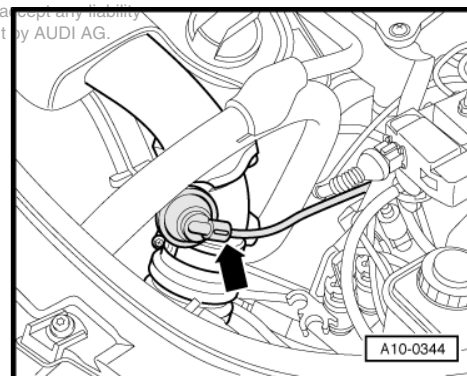
1.2 Removing and installing intake manifold (front section)

Removing

- Detach caps on engine cover panel.
- Unbolt and remove engine cover panel -arrows-.



- Disconnect vacuum hose at cut-off flap connection -arrow-.
- Detach air hose (left-side) from cut-off flap connection.



- Remove intake manifold (front section) -arrows-.

Installing

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

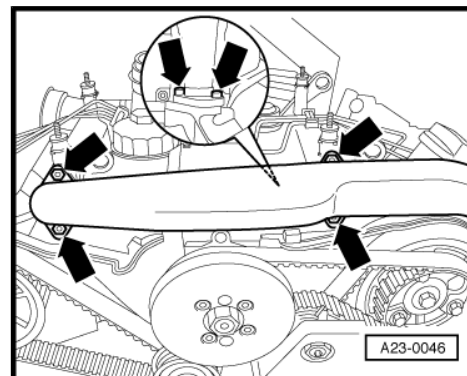


Note

Renew self-locking nuts, gaskets and seals.

Tightening torques

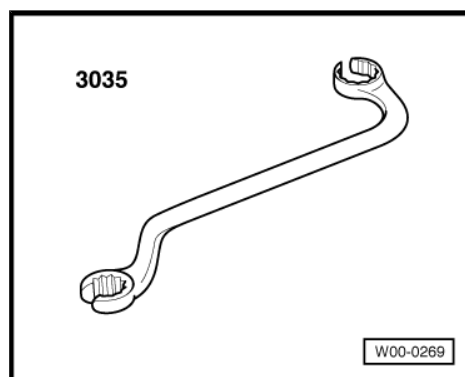
Component	Nm
Front section of intake manifold to left and right section of intake manifold	10
Exhaust gas recirculation pipe to front section of intake manifold	10



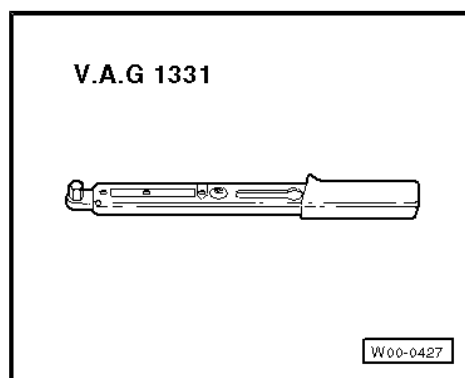
1.3 Removing and installing intake manifold (left-side)

Special tools and workshop equipment required

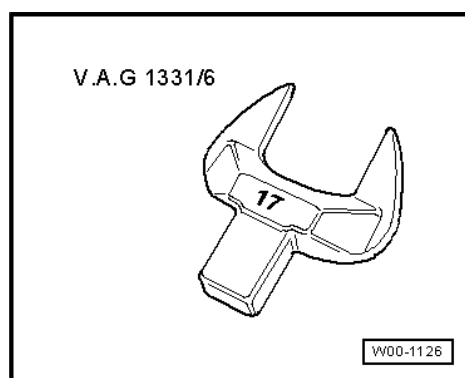
- ◆ Ring spanner -3035-



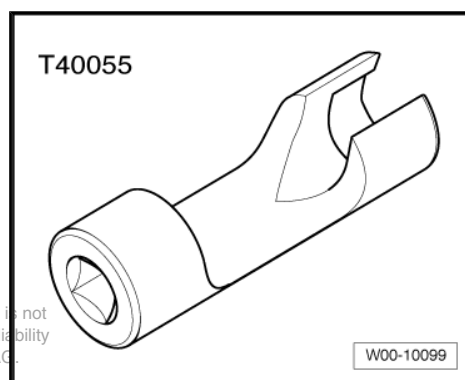
- ◆ Torque wrench -V.A.G 1331- with ratchet -V.A.G 1331/1-



- ◆ Tool insert AF 17 -V.A.G 1331/6-



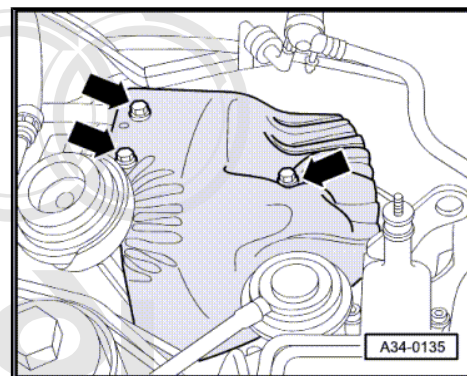
- ◆ Socket -T40055-



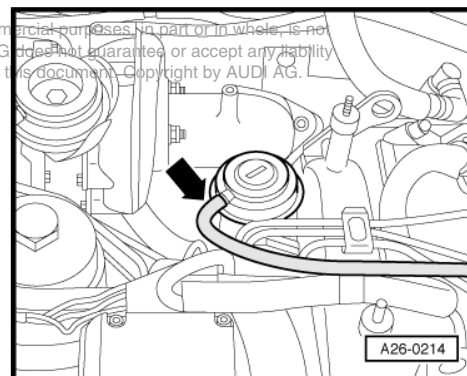
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Removing

- Remove intake manifold (front section) ⇒ [page 101](#) .
- Remove heat shield above turbocharger -arrows-.



- Disconnect vacuum hose at mechanical EGR valve.
- Mark injector pipes according to cylinder (e.g. with felt-tip pen).
- Disconnect injector pipes one by one with ring spanner -3035- .
- Move wiring harness near intake manifold (left-side) clear to the side.



- Remove intake manifold (left-side) -arrows-.



Note

- ♦ Watch the two dowel sleeves when removing intake manifold.
- ♦ Block off intake ports in cylinder head with clean rags.

Installing

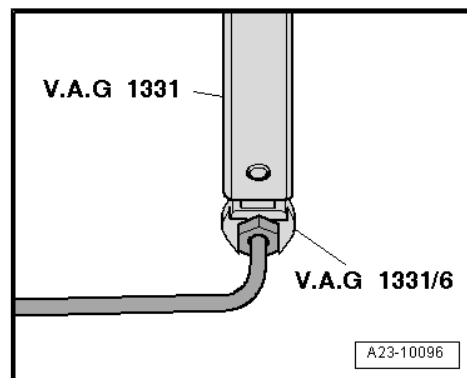
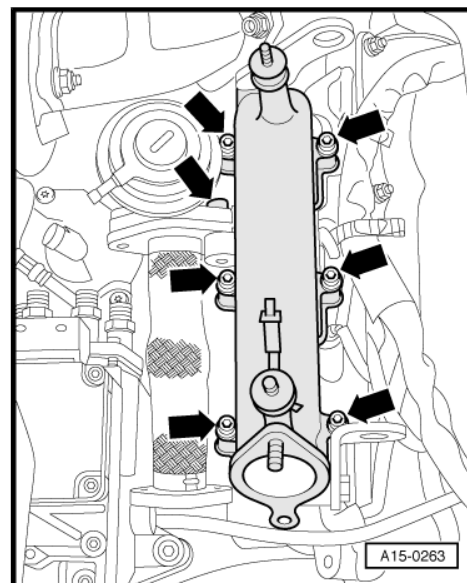
Installation is carried out in the reverse order; note the following:



Note

Renew self-locking nuts, gaskets and seals.

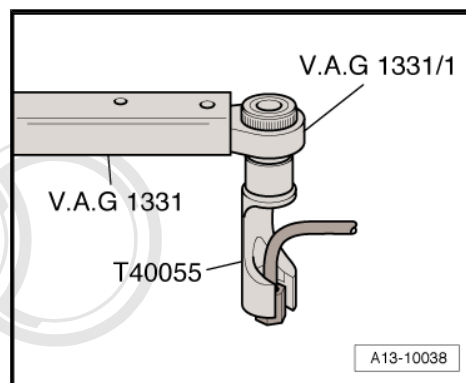
- Watch the two dowel sleeves when installing intake manifold.
- Install injector pipes one after the other (from bottom to top).
- Ensure stress-free installation of injector pipes.
- Tighten with torque wrench -V.A.G 1331- , and tool insert AF 17 -V.A.G 1331/6- .



- Tighten with torque wrench -V.A.G 1331- , ratchet -V.A.G 1331/1- and socket -T40055- .
- Install intake manifold (front section) ⇒ [page 101](#) .
- Check fuel system for leaks ⇒ [page 4](#) .

Tightening torques

Component		
Intake manifold (left-side) to cylinder head		10
Mechanical exhaust gas recirculation valve to intake manifold		22
Injector pipes to	Injectors	30
	Injection pump	30
Heat shield to turbocharger		10

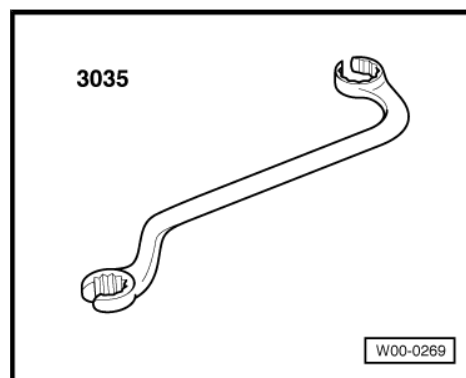


1.4 Removing and installing intake manifold (right-side)

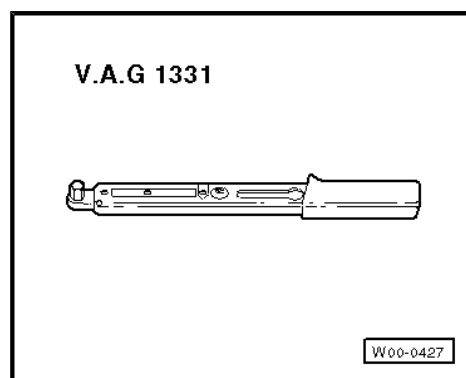
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Special tools and workshop equipment required

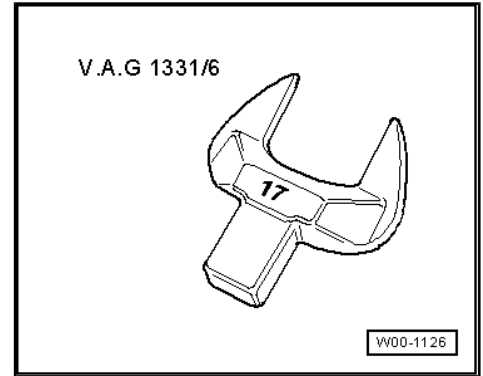
- ◆ Ring spanner -3035-



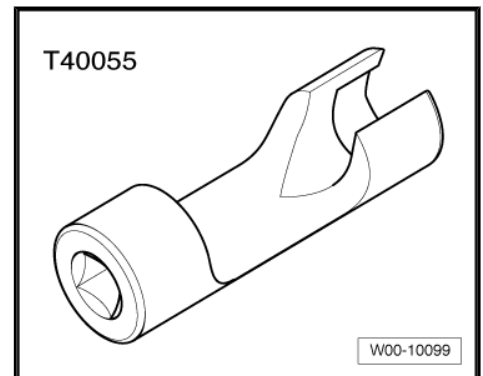
- ◆ Torque wrench -V.A.G 1331- with ratchet -V.A.G 1331/1-



- ◆ Tool insert AF 17 -V.A.G 1331/6-

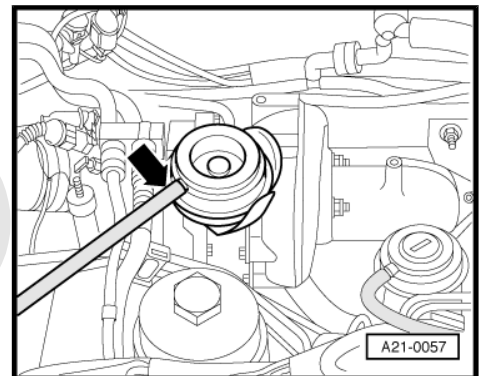


- ◆ Socket -T40055-



Removing

- Remove intake manifold (front section) ⇒ [page 101](#) .
- Disconnect hose -arrow- from turbocharger.
- Mark injector pipes according to cylinder (e.g. with felt-tip pen).
- Disconnect injector pipes one by one with ring spanner -3035- .
- Move wiring harness near intake manifold (right-side) clear to the side.
- Detach air hose from turbocharger and press to one side (do not remove completely).



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- Remove intake manifold (right-side) -arrows-.



Note

- ◆ Watch the two dowel sleeves when removing intake manifold.
- ◆ Block off intake ports in cylinder head with clean rags.

Installing

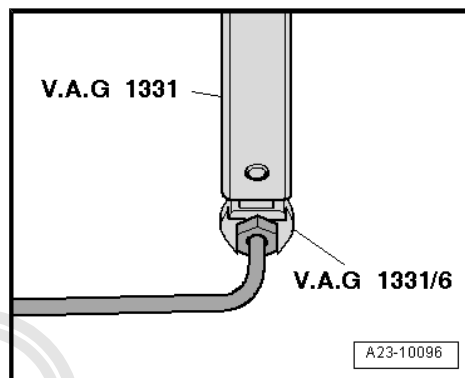
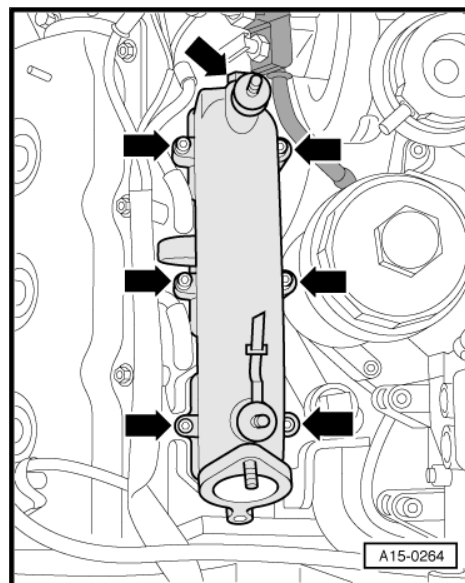
Installation is carried out in the reverse order; note the following:



Note

Renew self-locking nuts, gaskets and seals.

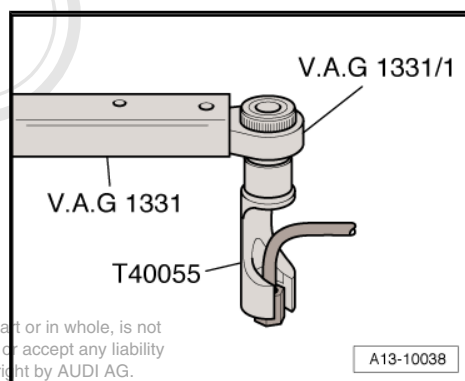
- Watch the two dowel sleeves when installing intake manifold.
- Install injector pipes one after the other (from bottom to top).
- Ensure stress-free installation of injector pipes.
- Tighten with torque wrench -V.A.G 1331- , and tool insert AF 17 -V.A.G 1331/6- .



- Tighten with torque wrench -V.A.G 1331- , ratchet -V.A.G 1331/1- and socket -T40055- .
- Install intake manifold (front section) ⇒ [page 101](#) .
- Check fuel system for leaks ⇒ [page 4](#) .

Tightening torques

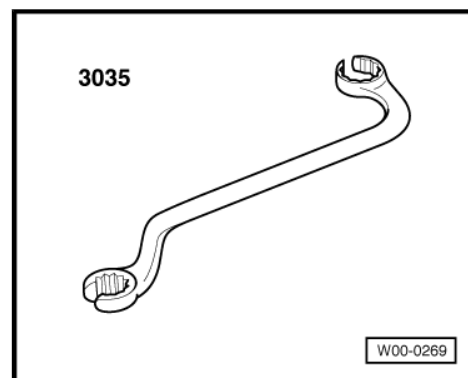
Component	Nm
Intake manifold (right-side) to cylinder head	10
Oil pipe to intake manifold	22
Injector pipes to	30
Injection pump	30



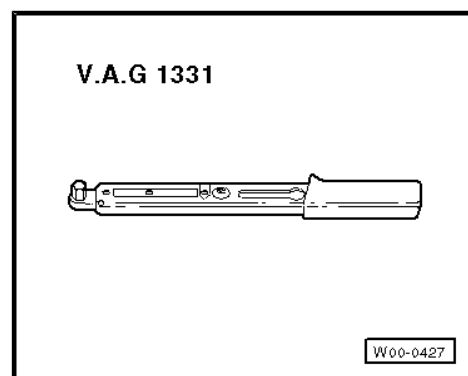
1.5 Removing and installing cylinder head cover (left-side)

Special tools and workshop equipment required

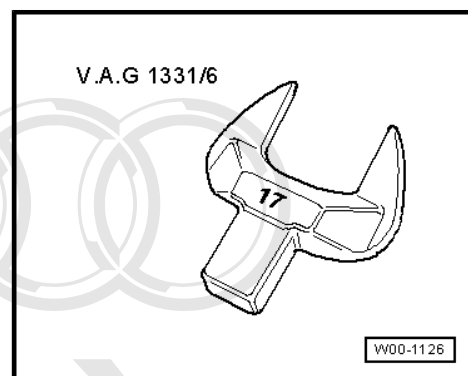
- ◆ Ring spanner -3035-



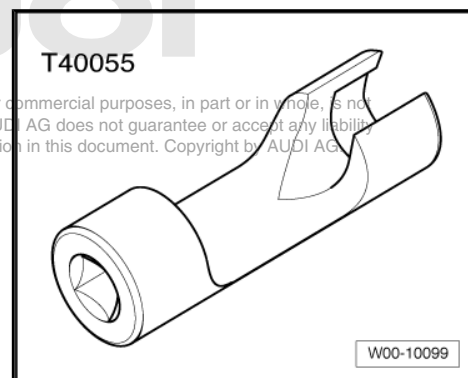
- ◆ Torque wrench -V.A.G 1331- with ratchet -V.A.G 1331/1-



- ◆ Tool insert AF 17 -V.A.G 1331/6-



- ◆ Socket -T40055-

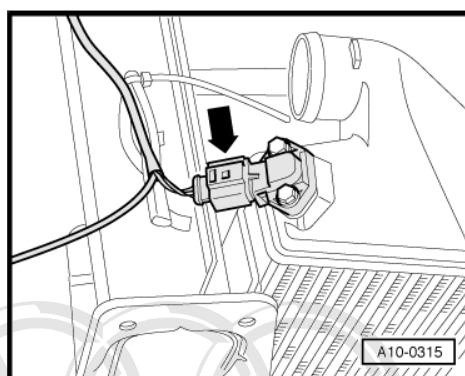
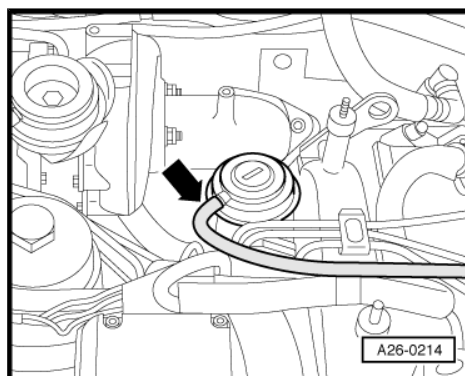
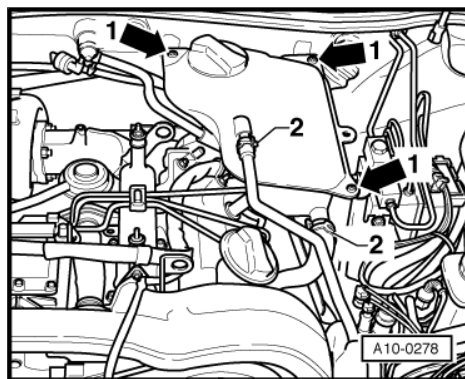


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- ◆ Sealant → Electronic parts catalogue

Removing

- Remove intake manifold (front section) ⇒ [page 101](#) .
- Unbolt coolant expansion tank -arrows 1-.
- Detach wire for coolant shortage indicator switch -F66- and move coolant expansion tank to one side with coolant hoses -2- attached.
- Disconnect vacuum hose -arrow- at mechanical exhaust gas recirculation valve.
- Mark injector pipes according to cylinder (e.g. with felt-tip pen).
- Disconnect injector pipes one by one with ring spanner -3035- .
- Unplug connector at intake manifold pressure sender -G71- -arrow-.
- Unfasten cable clamp at cylinder head cover (left-side) and move wiring harness clear to one side.



- Disconnect return pipe from injectors -1-.
- Remove nuts -arrows- and detach cylinder head cover.

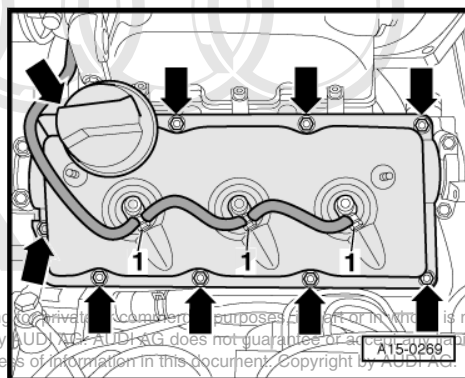
Installing

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



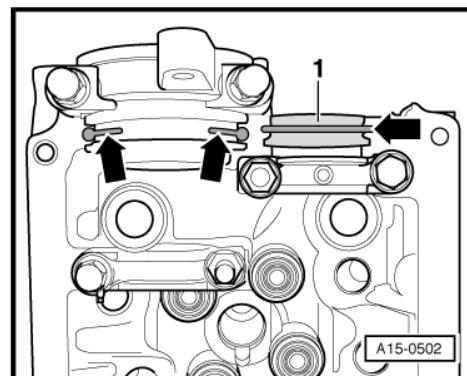
Note

- ◆ *Renew seals for return pipes.*
- ◆ *Renew cylinder head cover gaskets if damaged.*
- ◆ *Renew cylinder head cover if injector seals are damaged.*

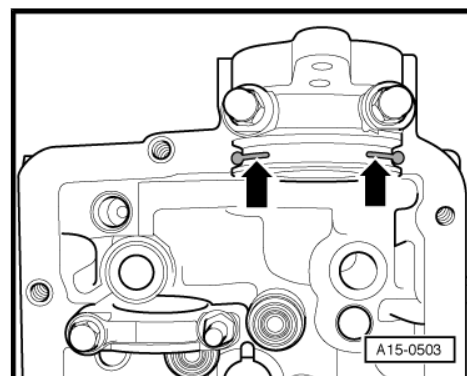


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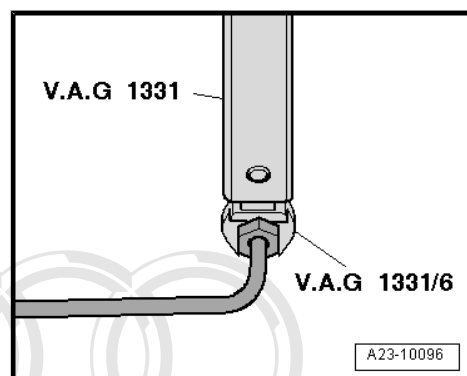
- Clean sealing surfaces; they must be free of oil and grease.
- Fit semi-circular seal -1-.
- Installation position: Parts number should be visible from outside; straight side of sealing surface should be flush with sealing surface of cylinder head.
- Draw a bead of sealant ($\varnothing$ approx. 3 mm) over the semi-circular seal so that about 5 mm projects at both ends -right arrow-.



- Apply a drop of sealant ($\varnothing$ approx. 5 mm) to all sealing points at joints between cylinder head and bearing caps.
- Apply sealant bead ($\varnothing$ approx. 3 mm) up to approx. half the height of the bearing caps -arrows-.
- Tighten nuts for cylinder head cover diagonally and in stages.
- Install injector pipes one after the other (from bottom to top).
- Ensure stress-free installation of injector pipes.



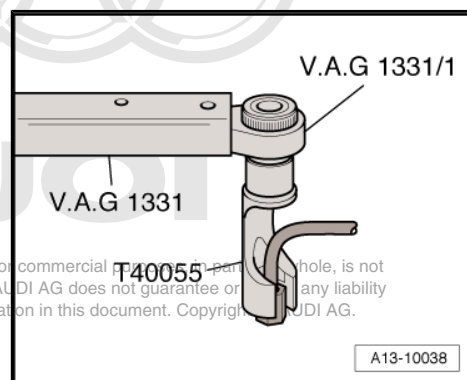
- Tighten with torque wrench -V.A.G 1331-, and tool insert AF 17 -V.A.G 1331/6-.



- Tighten with torque wrench -V.A.G 1331-, ratchet -V.A.G 1331/1- and socket -T40055-.
- Install intake manifold (front section) [⇒ page 101](#).
- Check fuel system for leaks [⇒ page 4](#).

Tightening torques

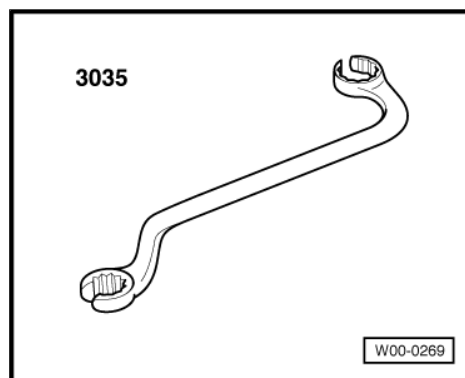
Component	Nm
Cylinder head cover to cylinder head	10 1)
Return pipes to injectors	5
Injector pipes to	
Injectors	30
Injection pump	30
• 1) Tighten to 10 Nm after engine is warm.	



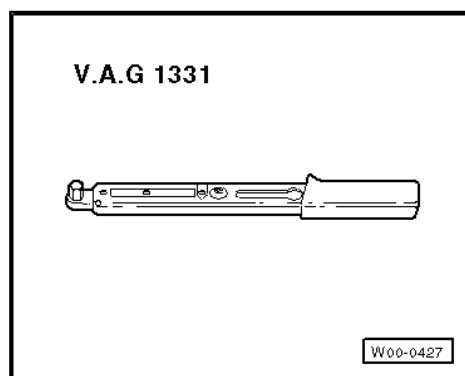
1.6 Removing and installing cylinder head cover (right-side)

Special tools and workshop equipment required

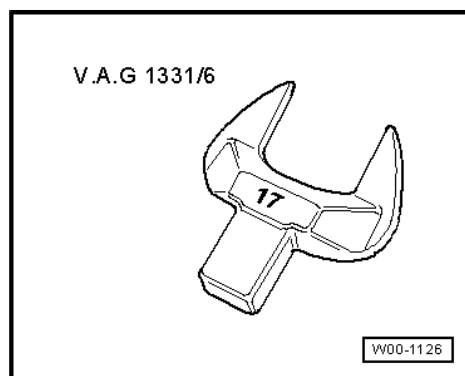
◆ Ring spanner -3035-



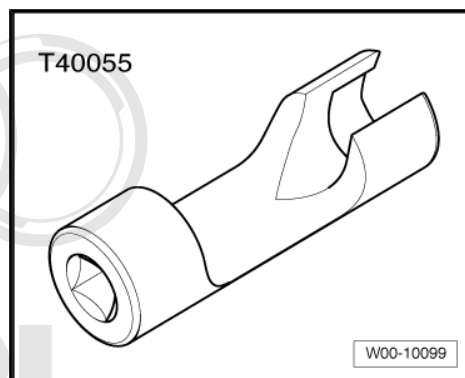
◆ Torque wrench -V.A.G 1331- with ratchet -V.A.G 1331/1-



◆ Tool insert AF 17 -V.A.G 1331/6-



◆ Socket -T40055-

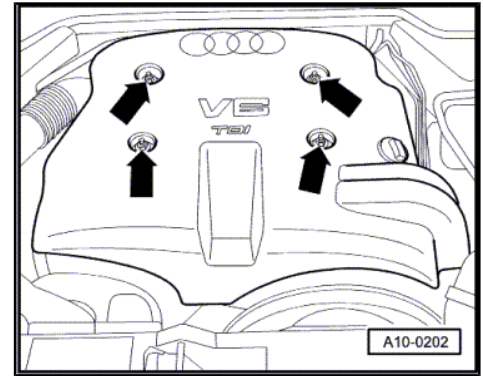


◆ Sealant ⇒ Electronic parts catalogue

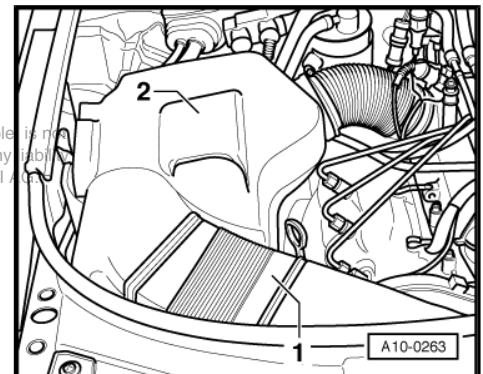
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Removing

- Detach caps on engine cover panel.
- Unbolt and remove engine cover panel -arrows-.

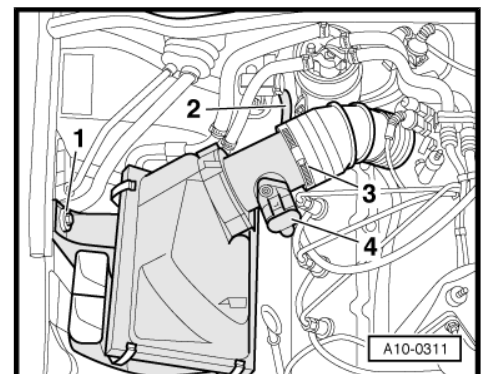


- Remove air duct -1- leading to air cleaner.
- Detach cover -2- from air cleaner.

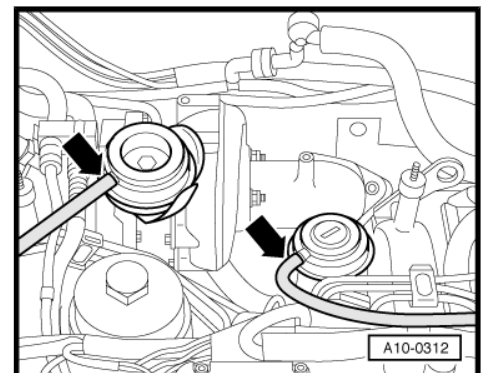


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- Slacken hose clip -3-.
- Unplug connector -4-.
- Pull hose -2- off air cleaner housing.
- Unscrew bolt -1- and remove air cleaner housing.
- Mark injector pipes according to cylinder (e.g. with felt-tip pen).
- Disconnect injector pipes one by one with ring spanner -3035-.



- Disconnect vacuum hoses -arrows- from turbocharger and mechanical exhaust gas recirculation valve.
- Move hoses clear.
- Unfasten cable clamp at cylinder head cover and move wiring harness clear to one side.

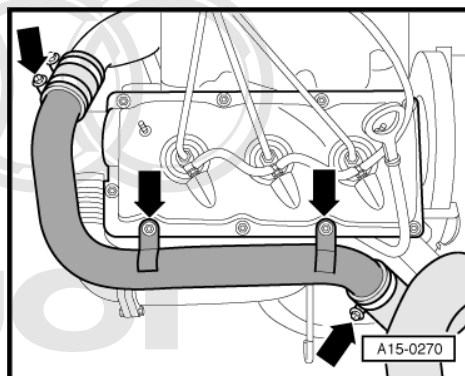


- Remove air intake pipe between turbocharger and charge air cooler (right-side) -arrows-.
- Unbolt guide tube for dipstick on cylinder head.

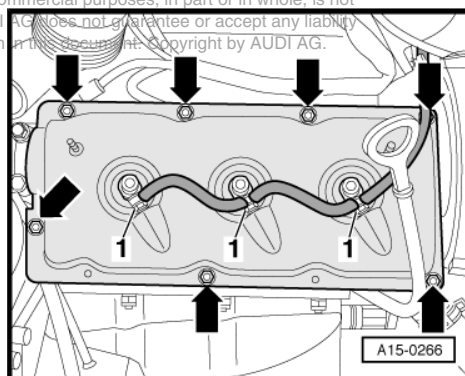


Note

The guide tube for the engine oil dipstick must not be lifted out completely, as otherwise the O-ring at the base of the guide tube will have to be renewed.



- Disconnect return pipe from injectors -1-.
- Remove nuts -arrows- and detach cylinder head cover.



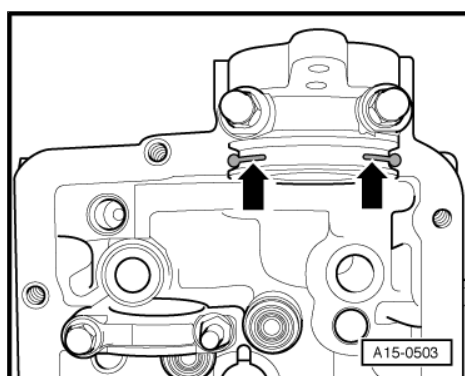
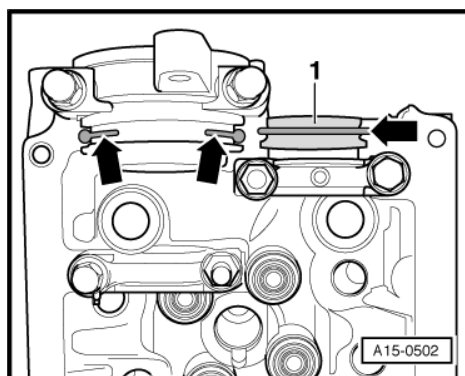
Installing

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

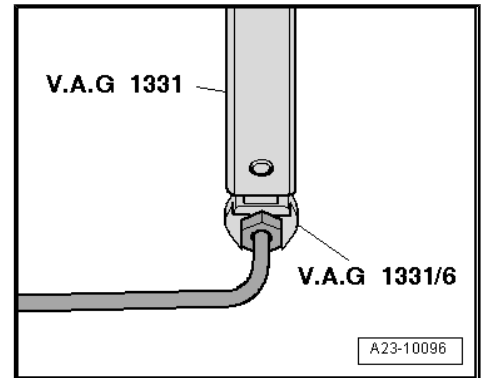


Note

- ◆ Renew seals for return pipes.
- ◆ Renew cylinder head cover gaskets if damaged.
- ◆ Renew cylinder head cover if injector seals are damaged.
- Clean sealing surfaces; they must be free of oil and grease.
- Fit semi-circular seal -1-.
- Installation position: Part number should be visible from outside; straight side of sealing surface should be flush with sealing surface of cylinder head.
- Draw a bead of sealant ($\varnothing$ approx. 3 mm) over the semi-circular seal so that about 5 mm projects at both ends -right arrow-.
- Apply a drop of sealant ($\varnothing$ approx. 5 mm) to all sealing points at joints between cylinder head and bearing caps.
- Apply sealant bead ($\varnothing$ approx. 3 mm) up to approx. half the height of the bearing caps -arrows-.
- Tighten nuts for cylinder head cover diagonally and in stages.
- Install injector pipes one after the other (from bottom to top).
- Ensure stress-free installation of injector pipes.



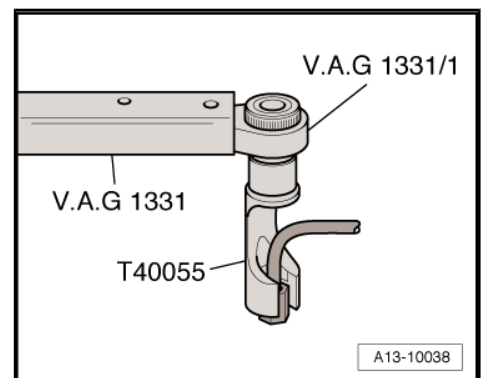
- Tighten with torque wrench -V.A.G 1331- , and tool insert AF 17 -V.A.G 1331/6- .



- Tighten with torque wrench -V.A.G 1331- , ratchet -V.A.G 1331/1- and socket -T40055- .
- Install intake manifold (front section) [⇒ page 101](#) .
- Check fuel system for leaks [⇒ page 4](#) .

Tightening torques

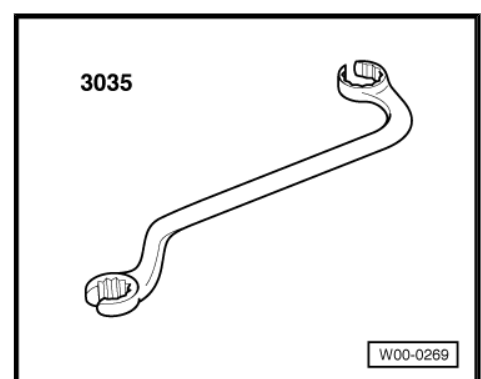
Component	Nm
Cylinder head cover to cylinder head	10 ¹⁾
Guide tube for dipstick to cylinder head	10
Return pipes to injectors	5
Injector pipes to	
Injectors	30
Injection pump	30
• ¹⁾ Tighten to 10 Nm after engine is warm.	



1.7 Removing cylinder head (left-side)

Special tools and workshop equipment required

- ◆ Ring spanner -3035-



Procedure

- Engine in vehicle.
- Lock carrier must be in service position [⇒ page 31](#) .



Note

Fit all cable ties in the original positions when installing.

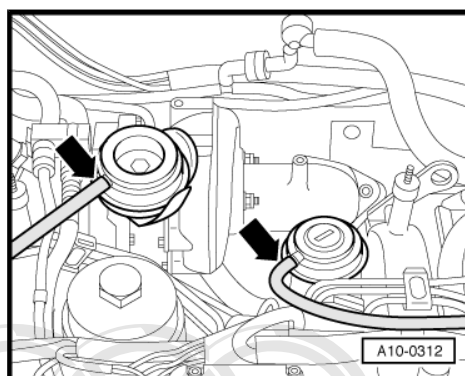


Caution

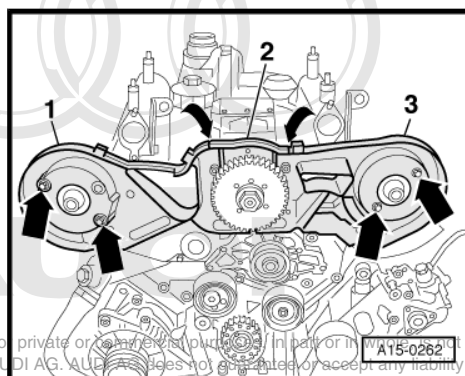
To prevent damage to the electronic components when disconnecting the battery:

◆ *Observe notes on procedure for disconnecting the battery.*

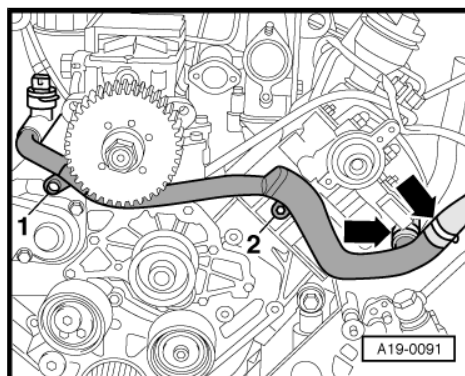
- Disconnect earth cable at battery ⇒ Rep. Gr. 27 .
- Drain coolant ⇒ [page 181](#) .
- Remove left exhaust manifold together with intermediate pipe ⇒ [page 251](#) .
- Take toothed belt off camshaft sprockets ⇒ [page 59](#) .
- Remove intake manifold (front section) ⇒ [page 101](#) .
- Disconnect vacuum hoses -arrows- from turbocharger and mechanical exhaust gas recirculation valve.
- Mark injector pipes according to cylinder (e.g. with felt-tip pen).
- Disconnect injector pipes one by one with ring spanner -3035- .



- Lift off centre section of rear toothed belt cover -2-.
- Unscrew bolts -arrows- and detach rear left toothed belt cover -3- and rear right toothed belt cover -1-.

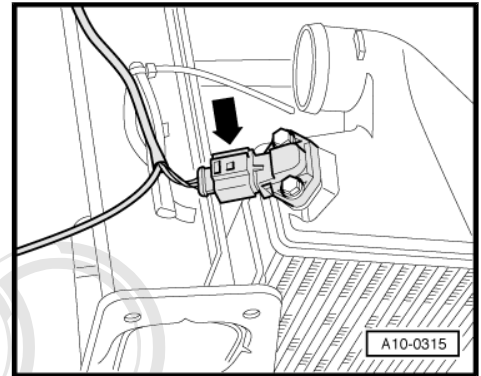


- Disconnect both coolant hoses -arrows-.
- Remove bolts -1- and -2-.
- Pull off coolant pipe towards the front.
- Unplug electrical connector at injection pump.
- Unplug electrical connectors on glow plugs.

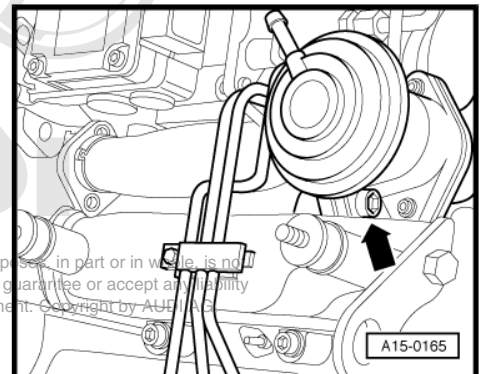


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- Unplug electrical connector -arrow- at intake manifold pressure sender -G71- .
- Unfasten cable clamp at cylinder head cover (left-side) and move wiring harness clear to one side.



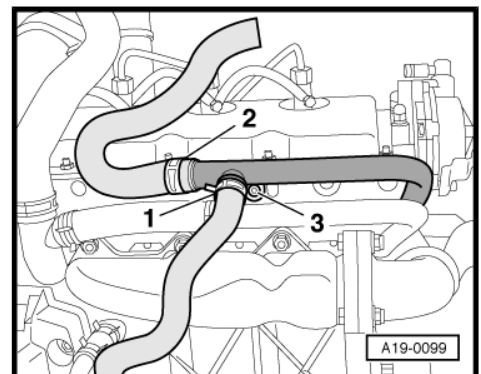
- Unbolt mechanical exhaust gas recirculation valve from left section of intake manifold -arrow-.



- Disconnect coolant hoses -1- and -2- at coolant pipe.
- Remove bolt -3-.

**Note**

Illustration shows coolant pipe with engine removed.

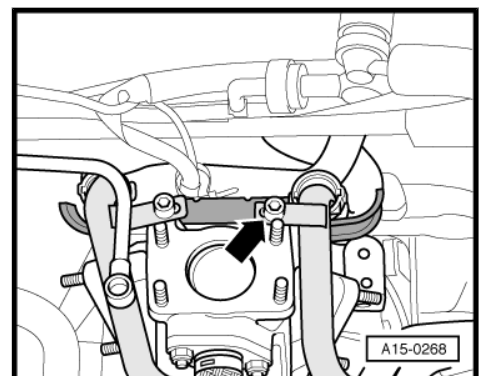


- Remove bolt -arrow- at coolant pipe (left-side).

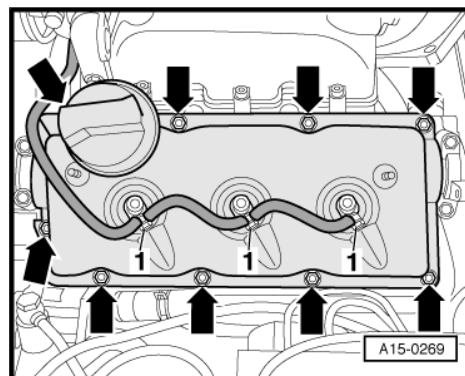
**Note**

Illustration shows coolant pipe with turbocharger removed.

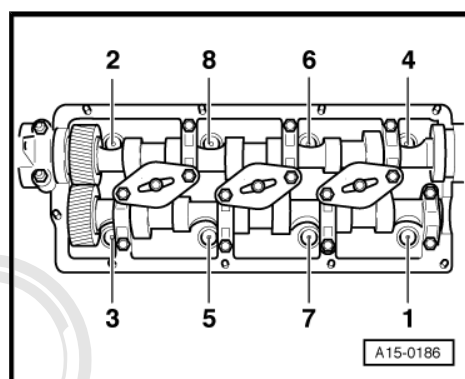
- Pull coolant pipe to rear out of cylinder block.



- Disconnect return pipe from injectors -1-.
- Unscrew nuts -arrows- for cylinder head cover and detach cylinder head cover.



- Slacken cylinder head bolts in the sequence indicated and remove bolts.
- Take off cylinder head and place it on a soft surface (such as foam plastic).



Caution

Risk of damage to injectors and glow plugs when putting down cylinder head.

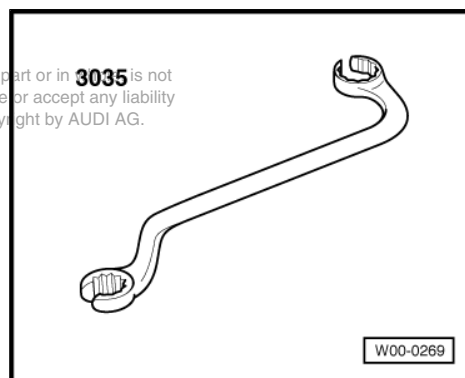
- ◆ After removal, the cylinder head must not be put down on the gasket side with the injectors and the glow plugs still installed, because the glow plugs project slightly beyond the gasket surface.

1.8 Removing cylinder head (right-side)

Special tools and workshop equipment required

- ◆ Ring spanner -3035-

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Removing

- Engine in vehicle.
- Lock carrier must be in service position ⇒ [page 31](#) .



Note

Fit all cable ties in the original positions when installing.

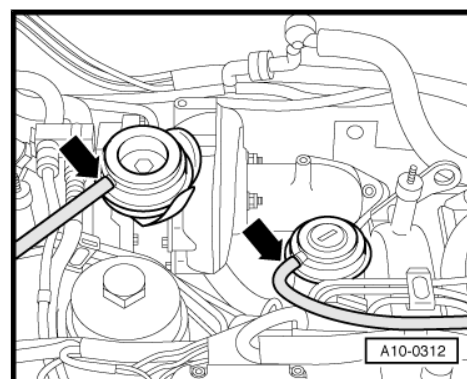
**Caution**

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

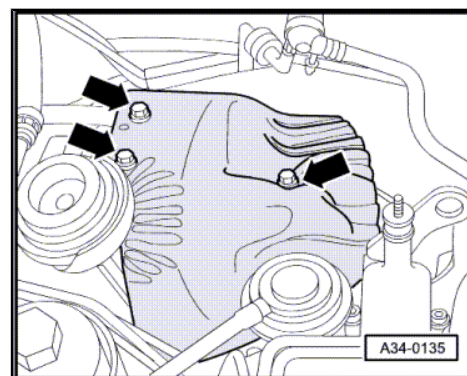
- ◆ *Observe notes on procedure for disconnecting the battery.*

- Disconnect earth cable at battery ⇒ Rep. Gr. 27 .
- Drain coolant ⇒ [page 181](#) .
- Remove right exhaust manifold together with intermediate pipe ⇒ [page 254](#) .
- Take toothed belt off camshaft sprockets ⇒ [page 59](#) .
- Remove intake manifold (front section) ⇒ [page 101](#) .
- Disconnect vacuum hoses -arrows- from turbocharger and mechanical exhaust gas recirculation valve.

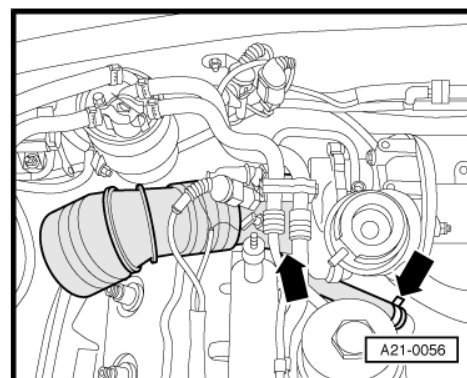
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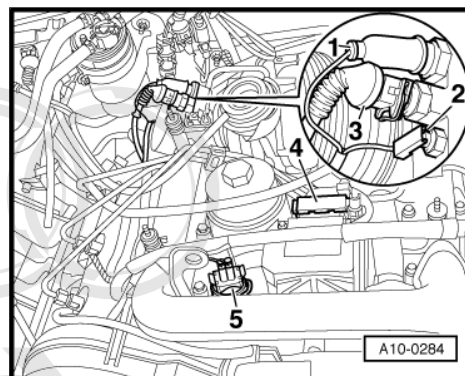
- Remove heat shield above turbocharger -arrows-.
- Mark injector pipes according to cylinder (e.g. with felt-tip pen).
- Disconnect injector pipes one by one with ring spanner -3035- .



- Remove air intake hose -arrows-.

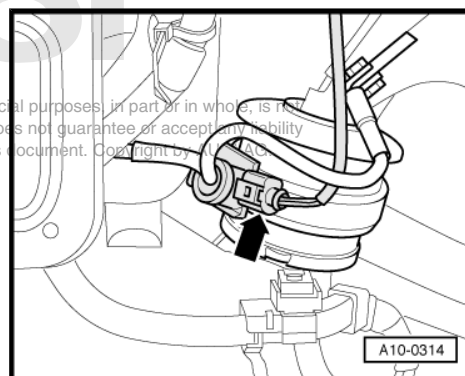


- Unplug electrical connectors -1 ... 3-.
- Unplug electrical connector -4- at injection pump.
- Unplug electrical connector -5- for coolant temperature sender.
- Unplug electrical connectors on glow plugs.
- Move wiring harness clear.

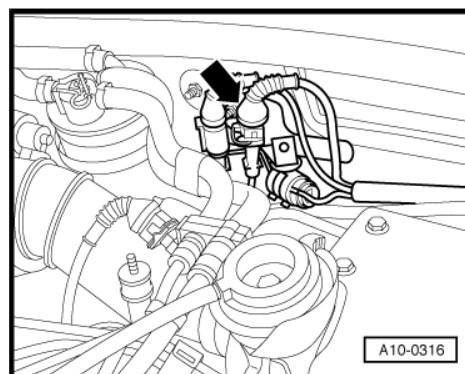


- Unplug electrical connector -arrow- at engine mounting (right-side).
- Move wiring harness clear.

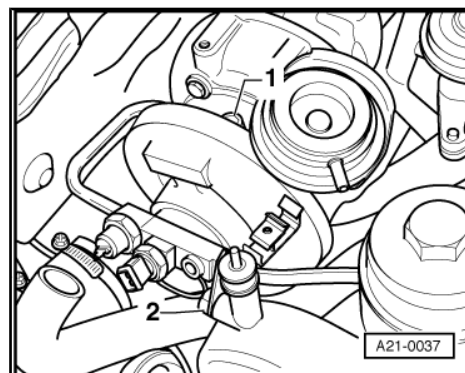
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- Unplug electrical connector -arrow- and move wiring for needle lift sender clear.



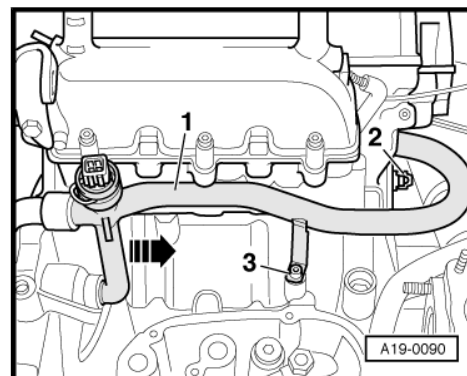
- Detach oil pipe -1- at turbocharger.
- Unscrew oil pipe at intake manifold -2-.



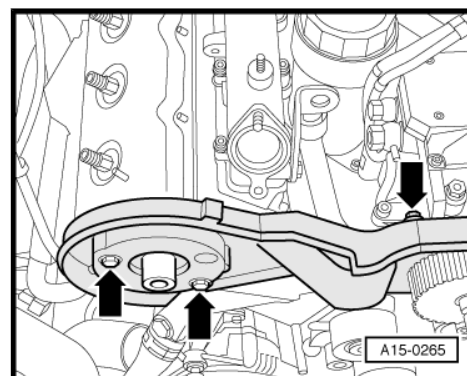
- Remove bolts -2- and -3-.
- Press coolant pipe -1- towards rear of vehicle and leave in position.

**Note**

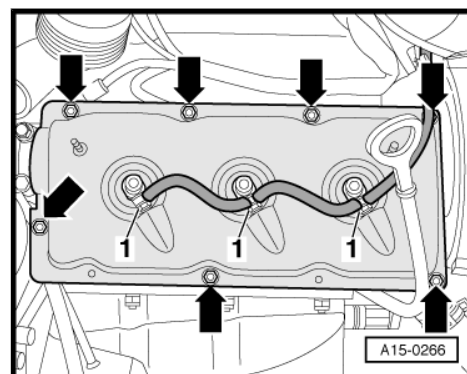
Illustration shows coolant pipe with oil filter bracket removed.



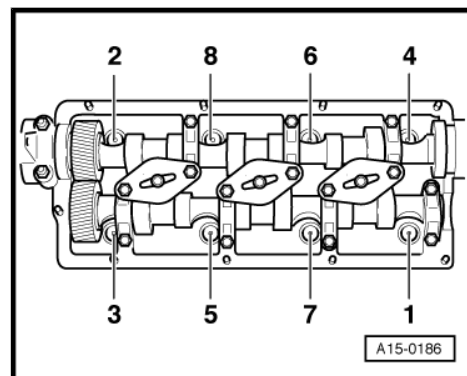
- Remove toothed belt cover (rear right) -arrows-.
- Unscrew guide tube for dipstick at cylinder head and lift off.



- Disconnect return pipe from injectors -1-.
- Unscrew nuts -arrows- for cylinder head cover and detach cylinder head cover.



- Slacken cylinder head bolts in the sequence indicated and remove bolts.
- Take off cylinder head and place it on a soft surface (such as foam plastic).

**Caution**

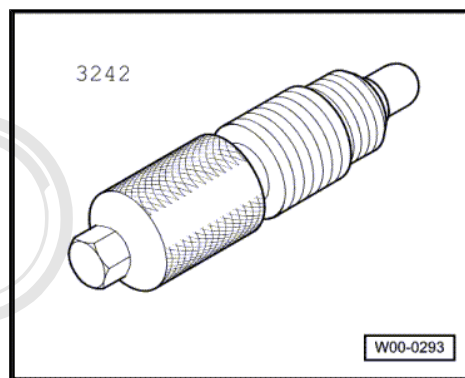
Risk of damage to injectors and glow plugs when putting down cylinder head.

- ◆ ***After removal, the cylinder head must not be put down on the gasket side with the injectors and the glow plugs still installed, because the glow plugs project slightly beyond the gasket surface.***

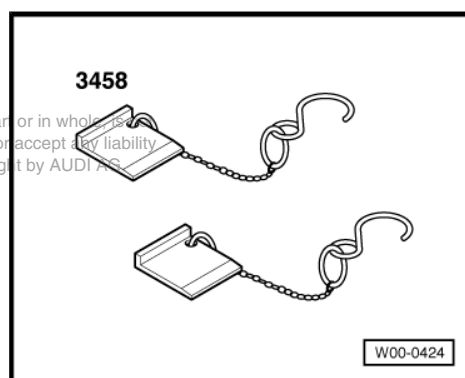
1.9 Installing cylinder head

Special tools and workshop equipment required

◆ Locking pin -3242-



◆ Camshaft holder -3458-



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Procedure

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

**Caution**

Avoid damage to sealing surfaces.

- ◆ *Carefully remove sealant residue from cylinder head and cylinder block.*
- ◆ *Ensure that no long scores or scratches are made on the surfaces.*

Avoid damage to cylinder block.

- ◆ *No oil or coolant must be allowed to remain in the blind holes for the cylinder head bolts in the cylinder block.*

Risk of leaks at cylinder head gasket.

- ◆ *Carefully remove any sealant residue from the cylinder head and cylinder block. Ensure that no long scores or scratches are made on the surfaces.*
- ◆ *Carefully remove any remaining emery and abrasive material.*
- ◆ *Do not remove new cylinder head gasket from packaging until it is ready to be fitted.*
- ◆ *Handle the cylinder head gasket very carefully to prevent damage to the silicone coating or the indented area of the gasket.*

Avoid damage to open valves.

- ◆ *When installing an exchange cylinder head, the plastic protectors fitted to protect the open valves should not be removed until the cylinder head is ready to be fitted.*

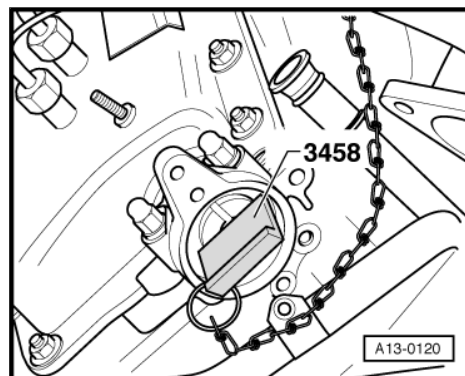
Avoid damage to valves and piston crowns after working on valve gear.

- ◆ *Turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.*

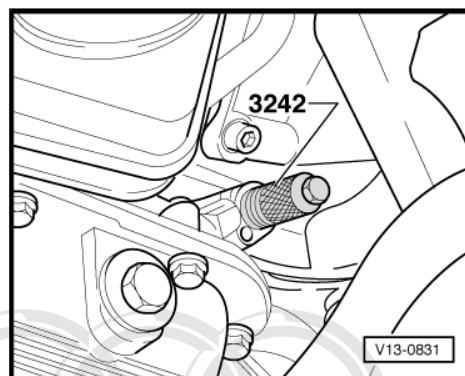
**Note**

- ◆ *Renew the bolts tightened with specified tightening angle.*
- ◆ *Renew self-locking nuts as well as seals, gaskets and O-rings.*
- ◆ *Cylinder heads must not be reworked on TDI engines.*
- ◆ *When installing an exchange cylinder head with camshafts fitted, the contact surfaces between the hydraulic compensation elements, roller rocker fingers and cams must be oiled.*
- ◆ *Hose connections and air pipes and hoses must be free of oil and grease before assembly.*
- ◆ *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 engine oil and coolant.*

- Before installing cylinder head, set crankshaft and camshafts to “TDC”:
- It should be possible to insert camshaft holder -3458- into camshaft.



- Locking pin -3242- must be screwed in with crankshaft at “TDC” position.



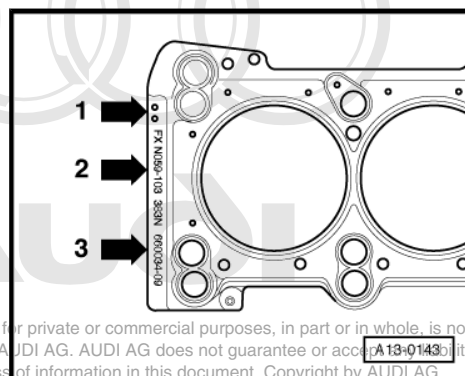
- Note identification markings on cylinder head gasket.

- 1 - Holes
- 2 - Part number
- 3 - Production code (can be disregarded)



Note

- ◆ If the cylinder head gasket or cylinder head have been replaced, select the new cylinder head gasket according to the number of holes on the old gasket.
- ◆ If parts of the crankshaft drive have been renewed, the new cylinder head gasket must be selected by measuring the piston projection at “TDC” ⇒ [page 94](#).



- Renew O-rings for coolant pipe before installing cylinder head.
- Place cylinder head gasket in position.
- Note position of centring pins in cylinder block.
- Note installation position of cylinder head gasket: the word “oben” (top) or the part number should face towards the cylinder head.

- Fit cylinder head.
- Tighten bolts in the sequence -1 ... 8- in 5 stages as follows:
 1. Screw in by hand until they make contact.
 2. Tighten to 35 Nm.
 3. Tighten to 60 Nm.
 4. Turn 90° further.
 5. Turn 90° further.

**Note**

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

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

- Install cylinder head cover: left-side ⇒ [page 106](#) ; right-side ⇒ [page 109](#) .
- When installing right cylinder head, renew O-ring at base of dipstick guide tube. To do this, take off poly V-belt, loosen alternator mounting bolts and pivot alternator to the side.
- Fit toothed belt onto camshaft sprockets (adjust valve timing) ⇒ [page 63](#) .

**Note**

Follow all instructions for removing and installing toothed belt ⇒ [page 66](#) .

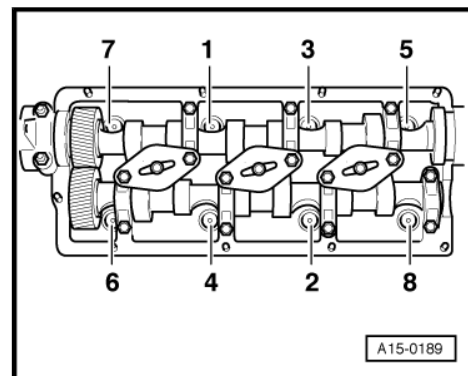
- Install exhaust manifold with intermediate pipe: left-side ⇒ [page 251](#) , right-side ⇒ [page 254](#) .
- Align the exhaust system free of stress: vehicles with front-wheel drive ⇒ [page 238](#) , vehicles with four-wheel drive ⇒ [page 247](#) .
- Change engine oil ⇒ Maintenance ; Booklet 802 .

**Caution**

Risk of irreparable damage to injection pump.

- ◆ ***Do not attempt to start the engine without first bleeding the fuel system!***

- Bleed fuel system ⇒ Rep. Gr. 20
- Observe notes on procedures required after connecting battery ⇒ Rep. Gr. 27 .
- Fill cooling system with fresh coolant ⇒ [page 184](#) .
- Check fuel system for leaks ⇒ [page 4](#) .



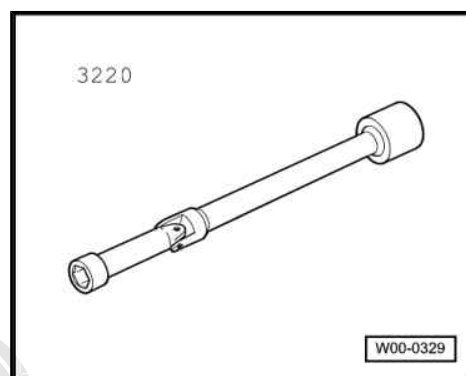
Tightening torques

Component	Nm
Guide tube for dipstick to cylinder head	10
Toothed belt cover to	
Cylinder head	10
Injection pump	10
Coolant pipe (front) to cylinder head/cyl- M6	10
inder block M8	22
Oil pipe to:	
Turbocharger	15
Intake manifold	22
Heat shield to turbocharger	10
Coolant pipe (left-side) to cylinder head	10
Coolant pipe to intermediate flange	22
Mechanical exhaust gas recirculation valve to intake manifold	22

1.10 Checking compression

Special tools and workshop equipment required

- ◆ U/J extension and socket, 10 mm -3220-



- ◆ Compression tester -V.A.G 1763- with adapter -V.A.G 1763/5-

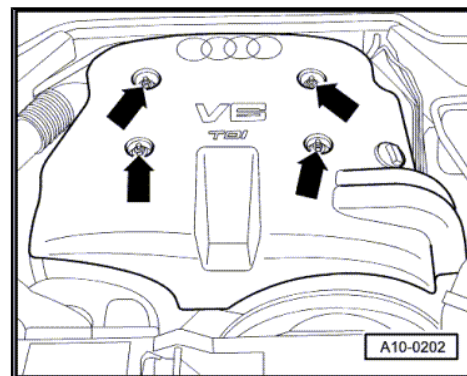


Test conditions

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

Procedure

- Detach caps on engine cover panel.
- Unbolt and remove engine cover panel -arrows-.
- Unplug electrical connector at injection pump.
- Remove all glow plugs ⇒ Rep. Gr. 28 .



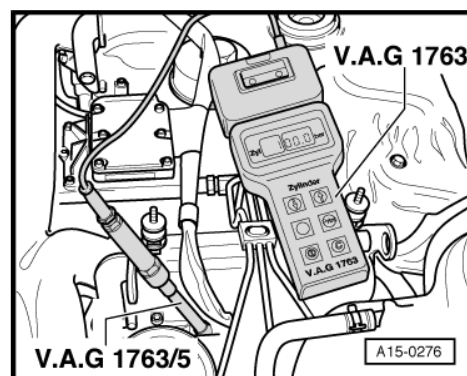
- Screw in adapter -V.A.G 1763/5- in place of the glow plug in each cylinder.



Note

Using the compression tester ⇒ operating instructions .

- Have a 2nd mechanic operate starter until tester shows no further pressure increase.
- Repeat procedure on each cylinder.



Compression pressure	bar
When new	27 ... 33
Wear limit	24
Maximum difference between cylinders	5

Assembling

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

- Install glow plugs ⇒ Rep. Gr. 28 .
- Faults are stored in engine control unit because electrical connectors were unplugged and the engine was started: "Interrogate fault memory" in "Vehicle self-diagnosis" ⇒ Vehicle diagnosis, testing and information system VAS 5051.

2 Valve gear



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.*

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2.1 Valve gear - exploded view



Note

The diagram shows the cylinder head on cylinder bank 2 (left-side).

1 - Bearing cap

- ☐ For inlet camshaft
- ☐ Before fitting, apply sealant to sealing surfaces of outer bearing caps ⇒ [page 134](#)
- ☐ Installation position and installation sequence ⇒ [page 130](#)

2 - Cap nut

- ☐ 15 Nm

3 - Bolt

- ☐ 10 Nm

4 - Cap nut

- ☐ 15 Nm

5 - Nut

- ☐ 10 Nm

6 - Bolt

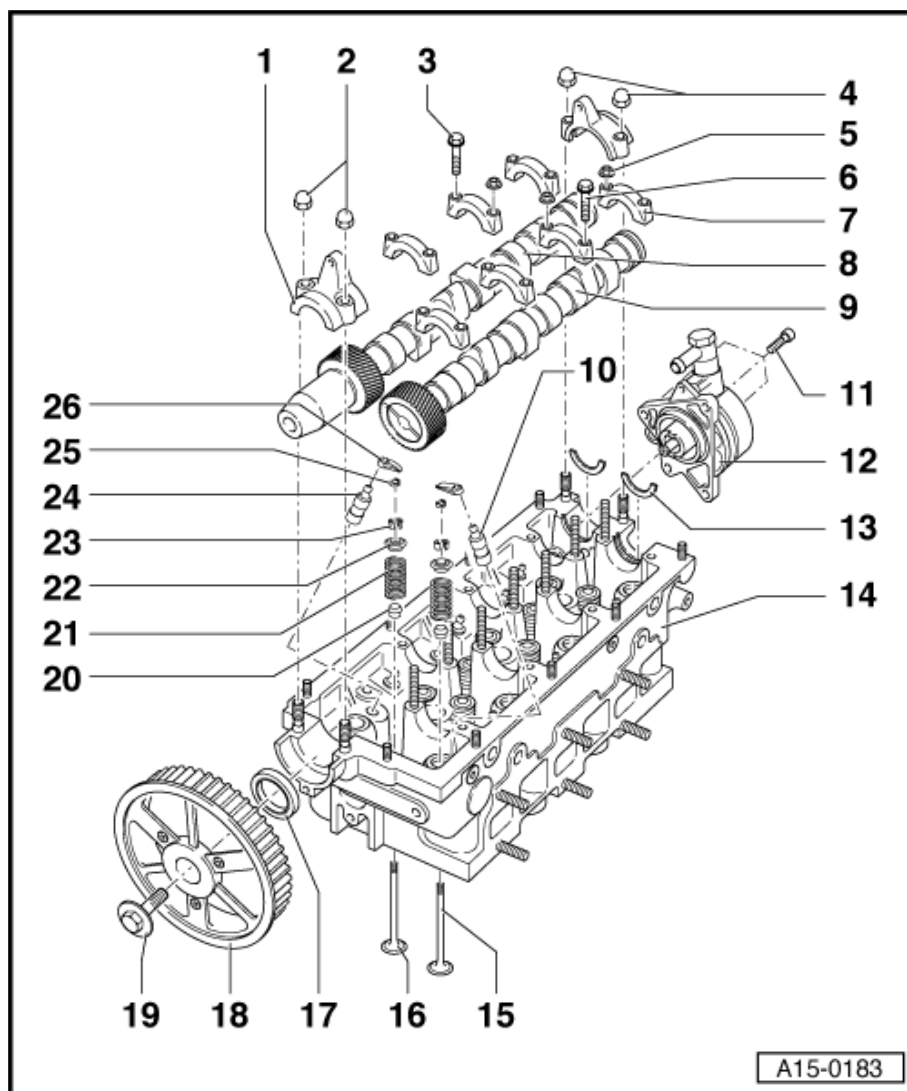
- ☐ 10 Nm

7 - Bearing cap

- ☐ For exhaust camshaft
- ☐ Installation position and installation sequence ⇒ [page 130](#)

8 - Inlet camshaft

- ☐ Removing and installing ⇒ [page 130](#)
- ☐ Measuring axial clearance ⇒ [page 128](#)
- ☐ Measuring radial clearance ⇒ [page 129](#)
- ☐ Runout: max. 0.04 mm



9 - Exhaust camshaft

- ☐ Removing and installing ⇒ [page 130](#)
- ☐ Measuring axial clearance ⇒ [page 128](#)
- ☐ Measuring radial clearance ⇒ [page 129](#)
- ☐ Runout: max. 0.04 mm

10 - Hydraulic valve compensation element

- ☐ Mark installation position with a coloured pen
- ☐ Checking ⇒ [page 136](#)
- ☐ Lubricate contact surface before fitting

11 - Bolt

- ☐ 10 Nm

12 - Exhauster pump

- ☐ For brake servo
- ☐ Removing and installing ⇒ [“2.11 Removing toothed belt from camshaft sprockets”, page 59](#)
- ☐ Renew O-rings

13 - Thrust washers

- ☐ 2x

14 - Cylinder head

- ☐ Removing: left-side ⇒ [page 113](#) ; right-side ⇒ [page 116](#)
- ☐ Installing ⇒ [page 119](#)
- ☐ Valve seats are not to be re-worked

15 - Exhaust valve

- ☐ Checking ⇒ [page 144](#)
- ☐ Valve dimensions ⇒ [page 143](#)
- ☐ Checking valve guides ⇒ [page 143](#)

16 - Inlet valve

- ☐ Checking ⇒ [page 144](#)
- ☐ Valve dimensions ⇒ [page 143](#)
- ☐ Checking valve guides ⇒ [page 143](#)

17 - Oil seal

- ☐ Renewing ⇒ [page 129](#)

18 - Camshaft sprocket

19 - Bolt

- ☐ Use counter-hold tool 3036 when loosening and tightening
- ☐ 75 Nm

20 - Valve stem oil seal

- ☐ Renewing: with cylinder head installed ⇒ [page 137](#) , with cylinder head removed ⇒ [page 140](#)

21 - Valve spring

22 - Valve spring plate

23 - Valve cotters

24 - Hydraulic valve compensation element

- ☐ Mark installation position with a coloured pen
- ☐ Checking ⇒ [page 136](#)
- ☐ Lubricate contact surface before fitting

25 - Guide for rocker finger

26 - Rocker finger

- ❑ Mark installation position with a coloured pen

2.2 Measuring axial clearance of camshafts

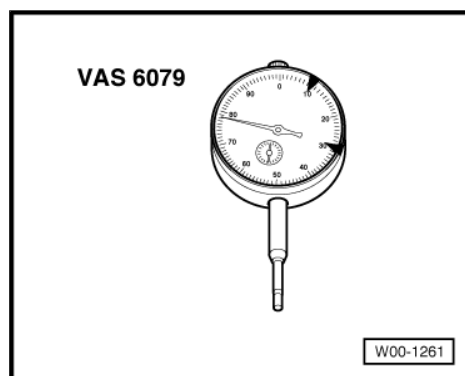
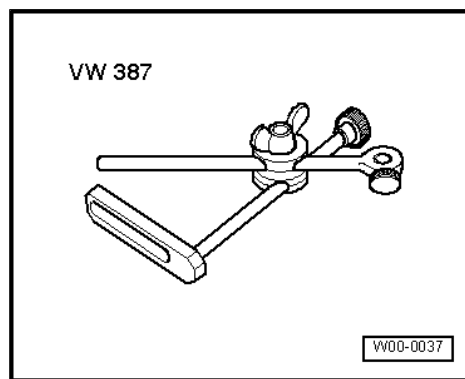
Special tools and workshop equipment required

- ◆ Universal dial gauge bracket -VW 387-



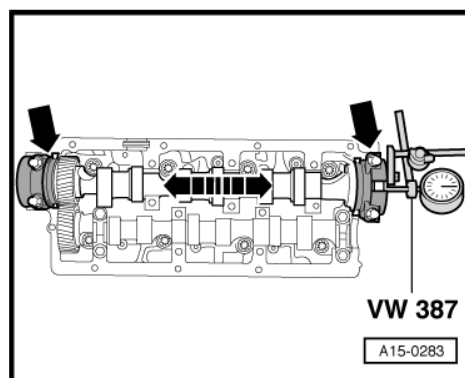
- ◆ Dial gauge -VAS 6079-

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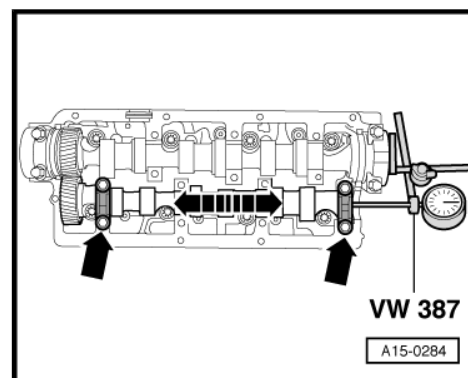


Procedure

- Perform measurement with rocker fingers removed and with front and rear bearing caps installed -vertical arrows-.
- Secure dial gauge -VAS 6079- to cylinder head with universal dial gauge bracket -VW 387- as shown in the following illustrations.
- Measure axial clearance of inlet camshaft -horizontal arrows-.
- Axial clearance: 0.06 ... 0.15 mm
- Wear limit: 0.30 mm



- Measure axial clearance of exhaust camshaft
– horizontal arrows-.
- Axial clearance: 0.06 ... 0.15 mm
- Wear limit: 0.30 mm



2.3 Measuring radial clearance of camshafts

Special tools and workshop equipment required

- ◆ Plastigage

Procedure

- Remove rocker fingers
⇒ [“2.5 Removing and installing camshafts”, page 130](#) .
- Clean bearing and bearing journal.
- 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.
- Re-insert camshafts, fit bearing caps and tighten
⇒ [“2.5 Removing and installing camshafts”, page 130](#) without rotating camshafts.
- Remove retaining frame and camshafts again.
- Compare width of Plastigage with measurement scale.

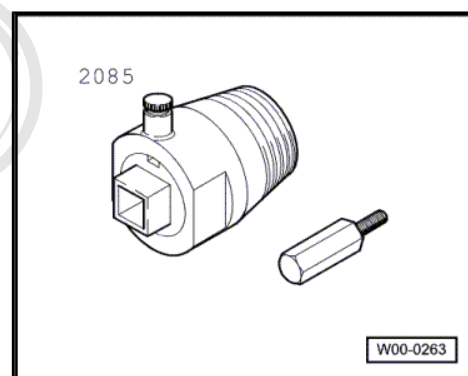
Radial clearance:

- New: 0.035 ... 0.085 mm.
- Wear limit: 0.100 mm.

2.4 Renewing oil seals for camshafts

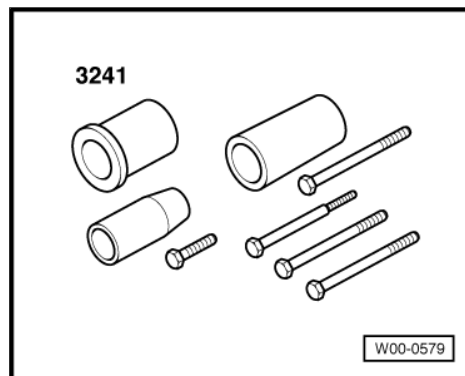
Special tools and workshop equipment required

- ◆ Oil seal extractor -2085-



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◆ Fitting sleeves -3241-



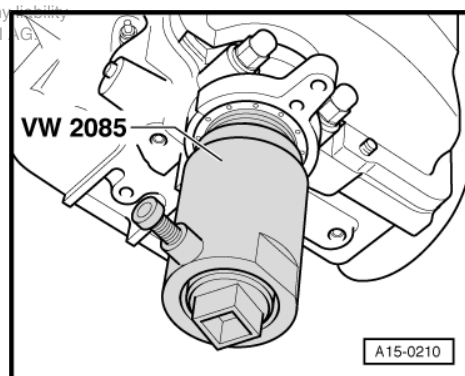
Procedure



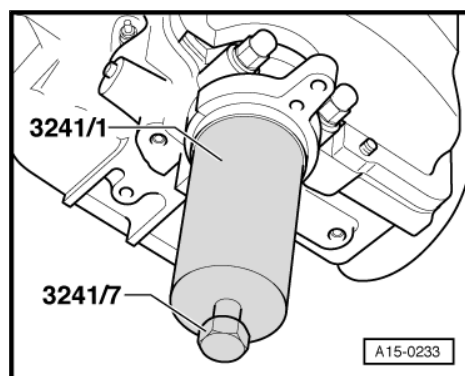
Note

If there are leaks at an oil seal, renew the oil seals on both cylinder heads.

- Take toothed belt off camshaft sprockets ⇒ [page 59](#).
- Adjust inner section of oil seal extractor -2085- so it is flush with the outer section and lock in position 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 section against camshaft until oil seal is pulled out.
- Clamp flats of oil seal extractor in vice and use pliers to remove oil seal.



- Clean contact surface and sealing surface.
- Do not lubricate sealing lip of oil seal.
- Slide oil seal over taper on camshaft.
- Insert 3 washers between bolt -3241/7- and fitting sleeve -3241/1- .
- Press in oil seal until flush using fitting sleeve and bolt.
- Fit toothed belt onto camshaft sprockets (adjust valve timing) ⇒ [page 63](#) .



2.5 Removing and installing camshafts

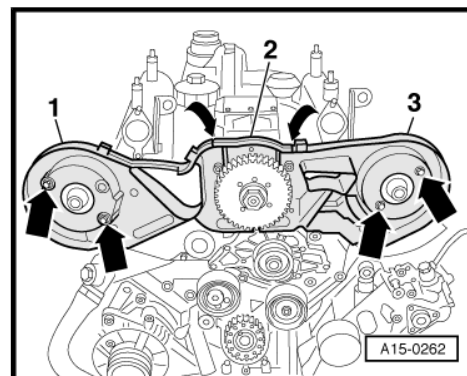
Special tools and workshop equipment required

- ◆ Sealant ⇒ Electronic parts catalogue

Removing

- Take toothed belt off camshaft sprockets ⇒ [page 59](#) .
- Remove cylinder head cover: left-side ⇒ [page 106](#) ; right-side ⇒ [page 109](#) .

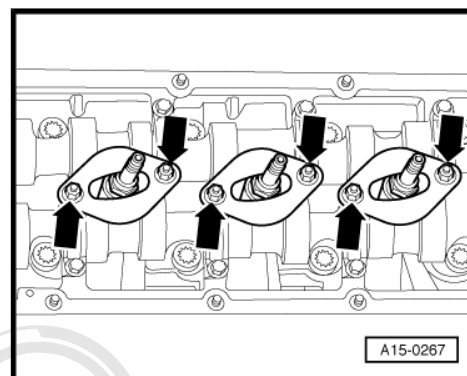
- Lift off centre section of rear toothed belt cover -2-.
- Unscrew bolts -arrows- and detach rear left toothed belt cover -3- / rear right toothed belt cover -1-.



- Remove retainers for relevant injectors -arrows- and lift out injectors.
- Use waterproof felt-tip pen to mark installation position of rocker fingers.
- Unscrew bearing caps for camshafts in stages and in diagonal sequence.
- Remove camshafts.

**Note**

Pay attention to rocker fingers and guides when detaching camshafts.

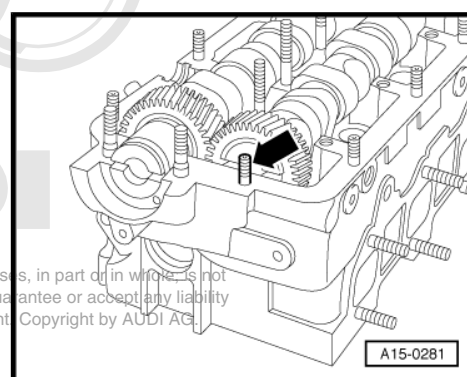
**Installing**

- Crankshaft locked in position with locking pin -3242- .
- Unscrew stud -arrow- in front of securing slot in exhaust camshaft.
- Insert thrust washers.
- Insert rocker finger guides and rocker fingers (note marking).

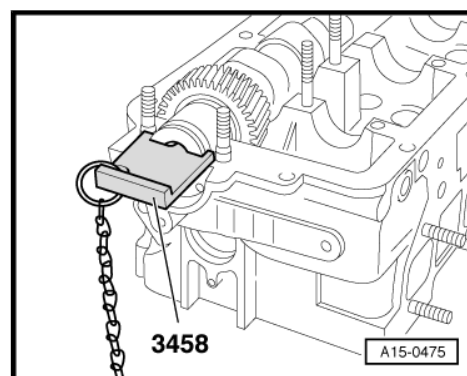
**Note**

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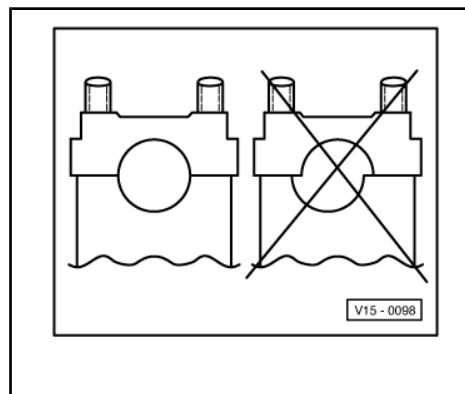
- ◆ *Pay attention to correct positioning of rocker finger guides.*
- ◆ *Apply a small quantity of grease to facilitate installation of rocker fingers and rocker finger guides (if necessary).*



- Install inlet camshaft so that the camshaft holder -3458- can be inserted.



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

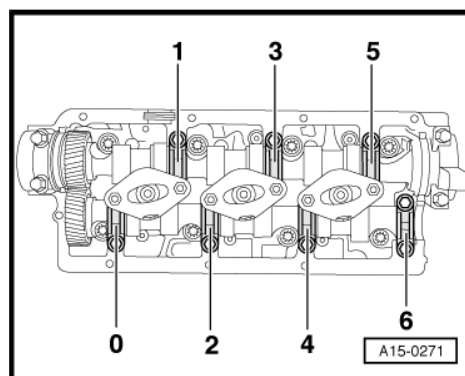


- Tighten bearing caps -1- and -5-.

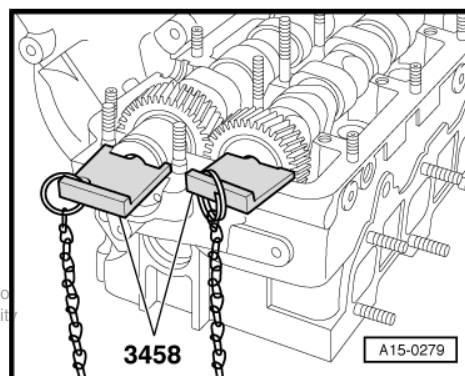


Note

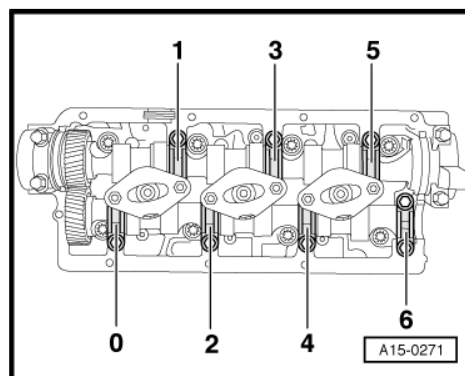
- ◆ Observe numbering on bearing caps.
- ◆ Shown on cylinder head (right-side) in illustration.



- Install exhaust camshaft so that the camshaft holder -3458- can be inserted.

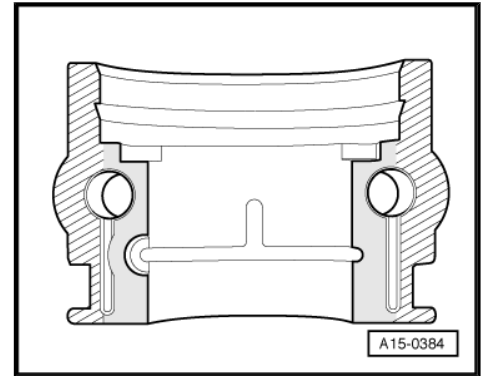


- Tighten bearing caps -0- and -4-.
- Re-check setting with camshaft holder -3458- .
- Check installation position of rocker fingers and guides.



- Remove old sealant completely from cylinder head and bearing cap.
- Clean contact surfaces between cylinder head and bearing cap; they must be free of oil and grease.
- Apply a small quantity of sealant to -hatched areas- of outer bearing cap at front left/rear right.

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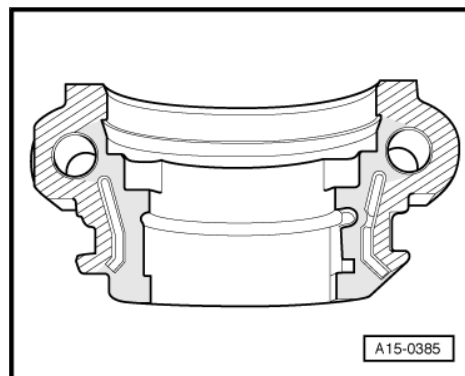
- Apply a small quantity of sealant to -hatched areas- of outer bearing cap at rear left/front right.



Note

Sealant must not be allowed to come into contact with -grey-shaded areas- shown in illustration.

- Fit outer bearing caps.
- Torque down remaining bearing caps.



Note

Renew copper seal and O-ring between cylinder head and injectors.

- Make sure injectors are properly positioned.
- Fit retainer.

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

- Fit toothed belt onto camshaft sprockets (adjust valve timing) ⇒ [page 63](#) .
- Install cylinder head cover: left-side ⇒ [page 106](#) ; right-side ⇒ [page 109](#) .



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.**

Tightening torques

Component		Nm
Bearing cap to cylinder head	Cap nut	15
	Nut	10
	Bolt	10
Stud in cylinder head		5
Injectors in cylinder head		10

2.6 Removing and installing outer camshaft bearing caps

Special tools and workshop equipment required

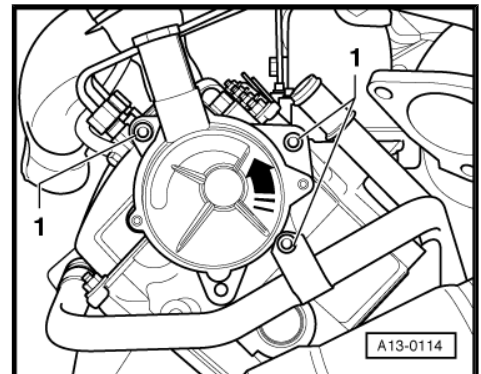
- ◆ Sealant ⇒ Electronic parts catalogue

**Note**

In the event of leakage in the area of the outer camshaft bearing caps, caps are to be removed and sealant applied.

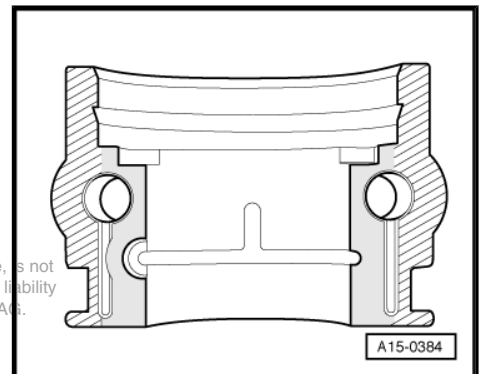
Removing

- Remove cylinder head cover: left-side ⇒ [page 106](#) ; right-side ⇒ [page 109](#) .
- Remove bolts -1- for exhauster pump with heat shield on cylinder head (left-side) and turn pump in anti-clockwise direction -arrow-.
- Move exhauster pump clear to the rear (leave hose attached).
- Unscrew outer bearing caps.

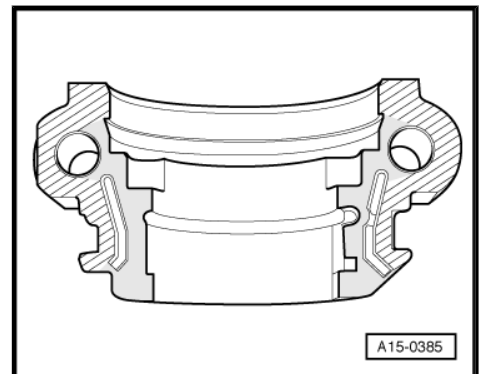
**Installing**

- Remove any traces of remaining sealant from cylinder head and camshaft bearing caps.
- Clean contact surfaces between cylinder head and bearing caps; surfaces must be free from oil and grease.
- Apply a small quantity of sealant to -hatched areas- of outer bearing cap at front left/rear right.

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- Apply a small quantity of sealant to -hatched areas- of outer bearing cap at rear left/front right.

**Note**

Sealant must not be allowed to come into contact with -grey-shaded areas- shown in illustration.

- Fit outer bearing caps.

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

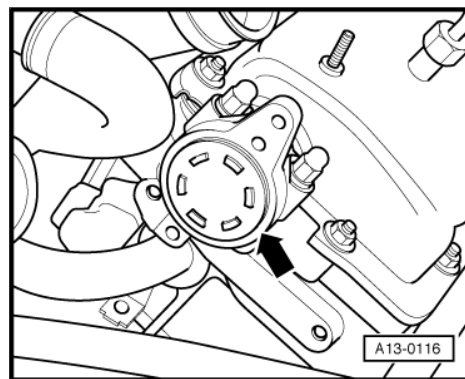
**Note**

Renew seals for cap nuts and O-rings for exhauster pump.

- Renew sealing cap (rear) on cylinder head (right-side).
- Using a suitable drift, knock in new sealing cap (core plug) -arrow- until flush.
- Install cylinder head cover: left-side ⇒ [page 106](#) ; right-side ⇒ [page 109](#) .

Tightening torques

Component		Nm
Bearing cap to cylinder head	Cap nut	15
	Nut	10
	Bolt	10
Exhauster pump to cylinder head		10



2.7 Checking hydraulic valve compensation elements

Special tools and workshop equipment required

- ◆ Feeler gauge



Note

- ◆ *Hydraulic valve compensation elements cannot be serviced.*
- ◆ *Irregular valve noises when starting engine are normal.*

Procedure

- Start engine and run until coolant temperature reaches approx. 80 °C.
- Increase engine speed to approx 2500 rpm for 2 minutes (perform road test if necessary).



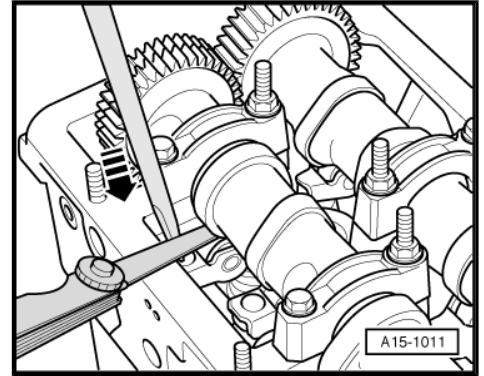
Note

- ◆ *If the irregular valve noises stop but recur repeatedly during short trips, renew the oil retention valve.*
- ◆ *The oil retention valve is located below the oil filter bracket ⇒ [page 175](#) .*

If the hydraulic valve compensation elements are still noisy, locate the defective element as follows:

- Remove cylinder head cover: left-side ⇒ [page 106](#) ; right-side ⇒ [page 109](#) .
- Rotate crankshaft until cam of hydraulic compensation element to be checked faces upwards. The procedure is:
- ◆ Vehicles with manual gearbox: push vehicle forwards with 4th gear engaged and ignition switched off.
- ◆ Vehicles with automatic gearbox: rotate crankshaft in clockwise direction via central bolt for vibration damper.

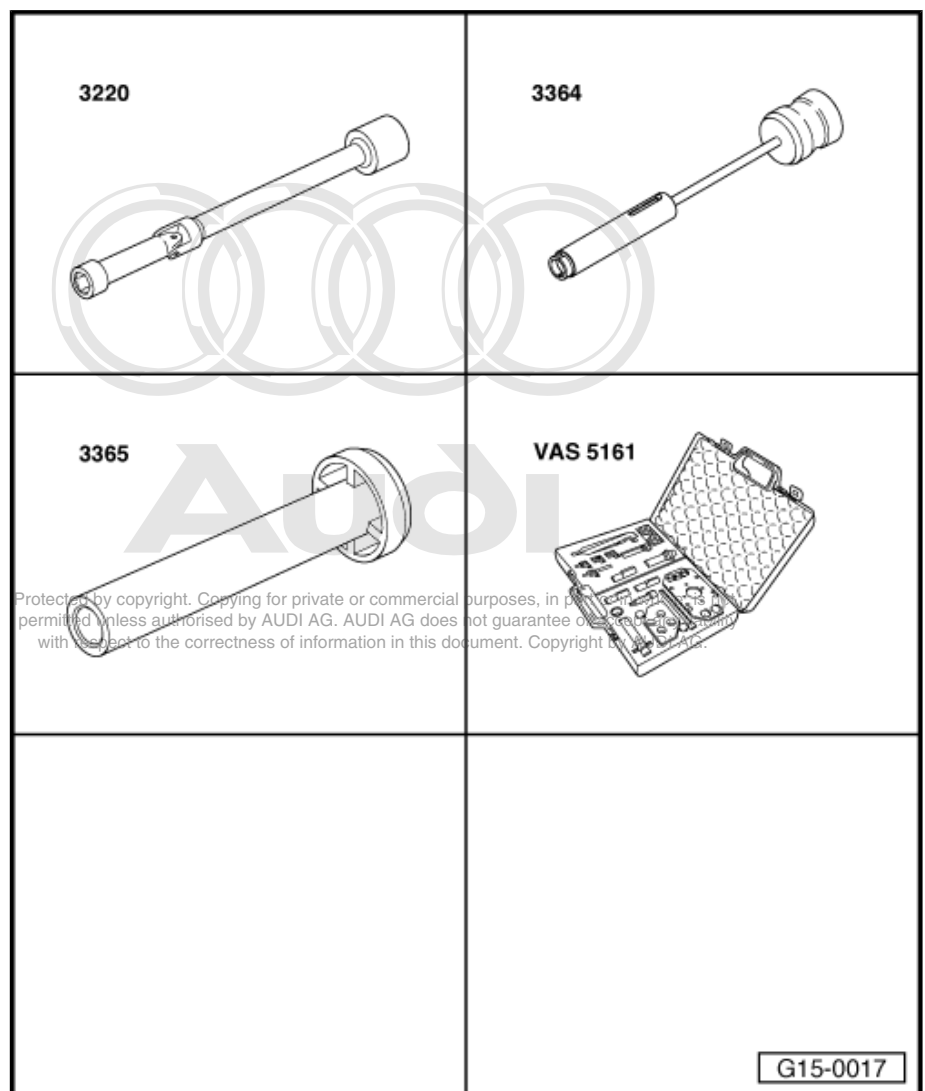
- Determine play between cam and rocker finger.
- Press rocker finger down -arrow- using a screwdriver.
- If it is possible to insert a feeler gauge of 0.20 mm between cam and roller rocker finger, renew compensation element
⇒ ["2.5 Removing and installing camshafts", page 130](#) .
- Install cylinder head cover: left-side ⇒ [page 106](#) ; right-side
⇒ [page 109](#) .



2.8 Renewing valve stem oil seals with cylinder head installed

Special tools and workshop equipment required

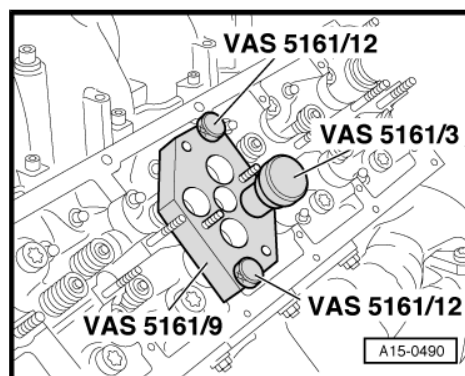
- ◆ U/J extension and socket, 10 mm -3220-
- ◆ Valve stem seal puller -3364-
- ◆ Valve stem seal fitting tool -3365-
- ◆ Removal and installation device for valve cotters - VAS 5161-



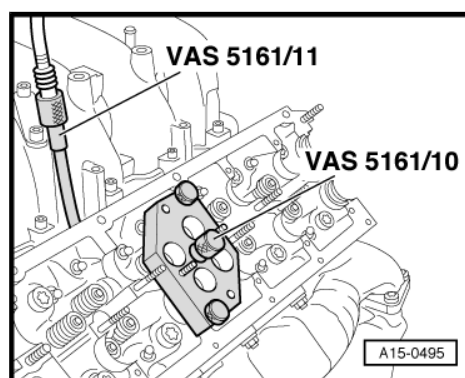
Procedure

- Remove camshafts ⇒ [page 130](#) .
- Remove all glow plugs ⇒ Rep. Gr. 28 .
- Mark original positions of rocker fingers and hydraulic compensation elements for reinstallation.

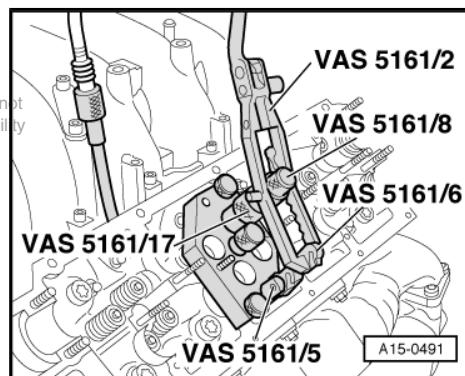
- Remove rocker fingers together with hydraulic compensation elements and put down on a clean surface.
- Set piston of appropriate cylinder to "bottom dead centre".
- Fit guide plate -VAS 5161/9- onto cylinder head.
- Secure guide plate with knurled screws -VAS 5161/12- .
- Apply drift -VAS 5161/3- to guide plate and use plastic-headed hammer to release sticking valve cotters.



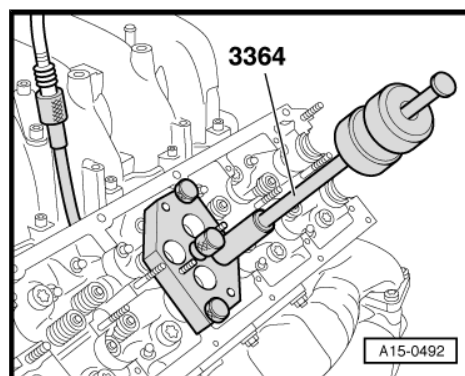
- Screw sealing pin -VAS 5161/10- into guide plate.
- Screw adapter -VAS 5161/11- hand-tight into corresponding glow plug thread.



- Screw snap-in device -VAS 5161/6- with engaging fork -VAS 5161/5- into guide plate.
- Slide knurled spacer ring -VAS 5161/17- onto assembly cartridge -VAS 5161/8-.
- Connect adapter to compressed air line using a commercially available connection piece, and apply constant air pressure.

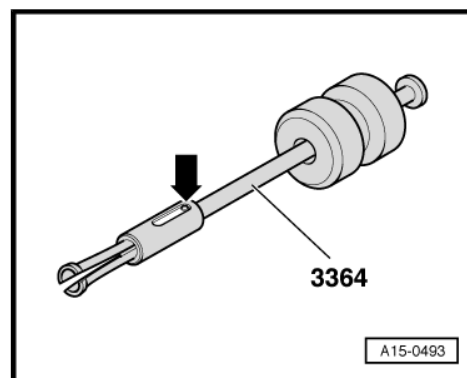


- Air pressure: at least 6 bar
- Attach pressure fork -VAS 5161/2- to snap-in device and push assembly cartridge down.
- At the same time, turn knurled screw of assembly cartridge clockwise until tips engage in valve cotters.
- Move knurled screw back and forth slightly; the valve cotters are thus forced apart and taken up by the assembly cartridge.
- Detach valve spring with valve spring plate.
- Pull off valve stem oil seal with valve stem seal puller -3364- .

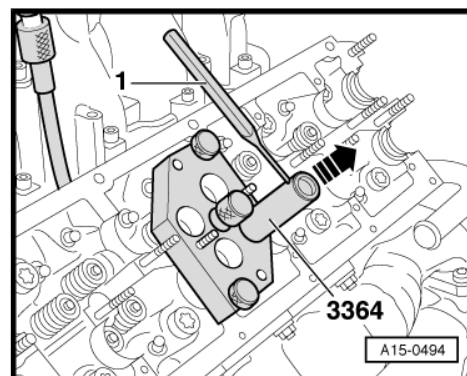


If the puller cannot be used on some of the valve stem oil seals due to the confined space, proceed as follows:

- Knock out pin -arrow- of puller using a drift and remove impact extractor attachment.



- Apply bottom section of puller -3364- to valve stem oil seal.
- Secure puller with a punch -1- or other suitable tool as shown in the illustration.
- Apply assembly lever to puller and pull out valve stem oil seal -arrow-.

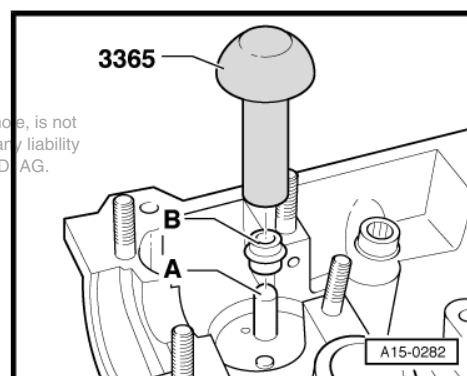


Caution

Make sure valve stem oil seals are not damaged when installing.

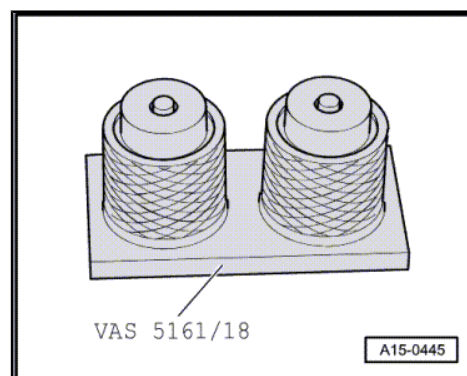
- ◆ **New valve stem oil seals -B- are supplied with plastic sleeve; fit plastic sleeve -A- onto valve stem.**

- Lightly oil sealing lip of valve stem oil seal.
- Slide valve stem oil seal onto plastic sleeve.
- Carefully press valve stem oil seal onto valve guide using valve stem seal fitting tool -3365-.
- Take off plastic sleeve.



If valve cotters had been removed from assembly cartridge they must first be inserted in insertion device -VAS 5161/18-.

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

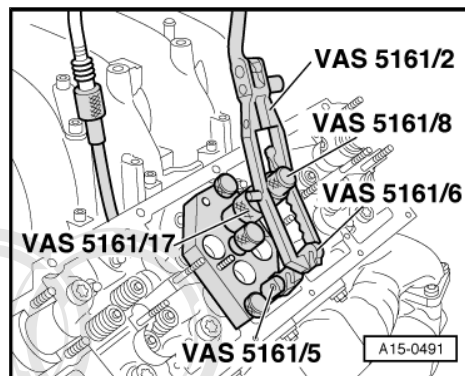


- Insert assembly cartridge in guide plate -VAS 5161/9- again.
- Press down pressure fork and pull knurled screw upwards while turning screw in both directions - this will insert the valve cotteners.
- Release the pressure fork with knurled screw still in pulled position.
- Repeat procedure for each valve.

Assembling

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

- Install camshafts ⇒ [page 130](#) .
- Install glow plugs ⇒ Rep. Gr. 28 .

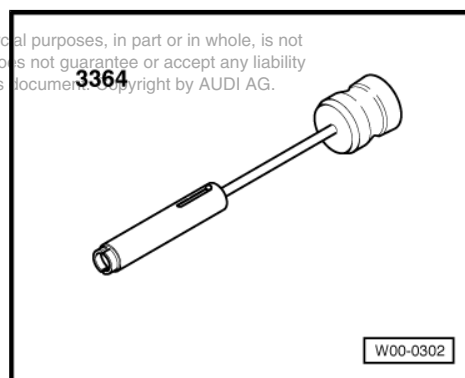


2.9 Renewing valve stem oil seals with cylinder head removed

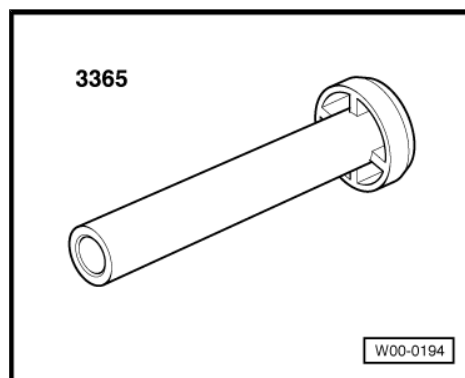
Special tools and workshop equipment required

- ◆ Valve stem seal puller -3364-

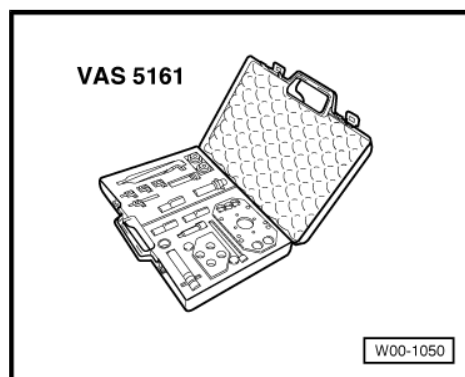
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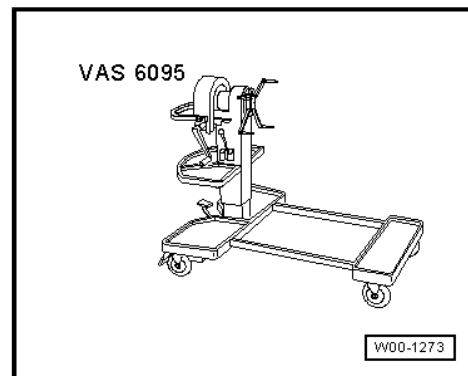
- ◆ Valve stem seal fitting tool -3365-



- ◆ Removal and installation device for valve cotteners -VAS 5161- with knurled spacer ring -VAS 5161/23-1- and guide plate -VAS 5161/23-



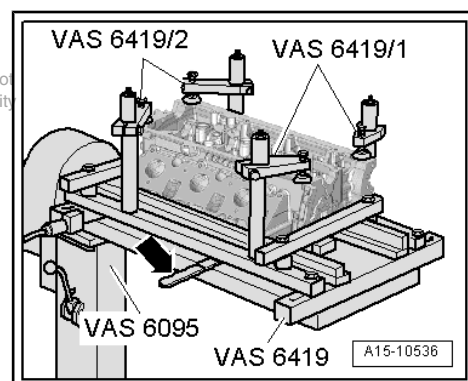
◆ Engine and gearbox support -VAS 6095-



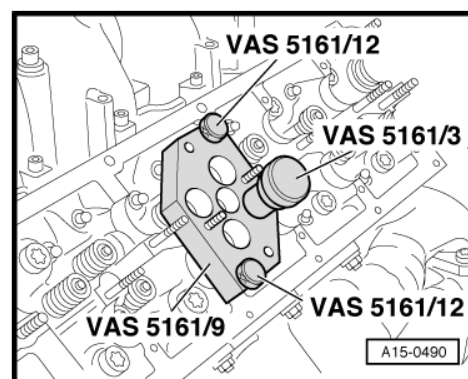
◆ Cylinder head clamping device -VAS 6419-

Procedure

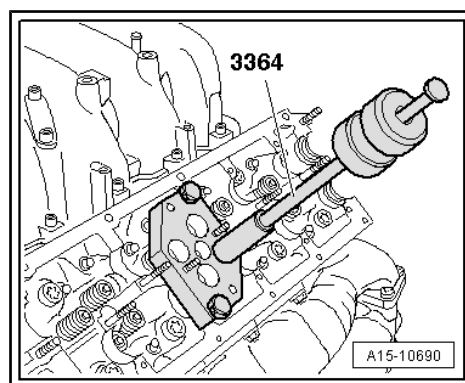
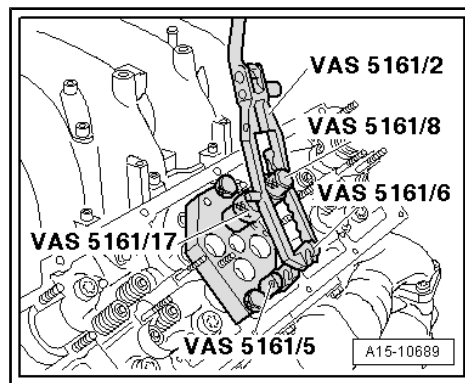
- Remove camshafts ⇒ [page 130](#) .
- Mark original positions of rocker fingers and hydraulic compensation elements for reinstallation.
- Remove rocker fingers together with hydraulic compensation elements and put down on a clean surface.
- Insert cylinder head clamping device -VAS 6419- into engine and gearbox support -VAS 6095- .
- Secure cylinder head in cylinder head clamping device as illustrated.
- **Connect cylinder head clamping device to compressed air**
- Using lever -arrow-, slide air pad under combustion chamber where valve stem oil seal is to be removed.
- Apply just enough compressed air to bring air pad into contact with valve heads.



- Fit guide plate -VAS 5161/9- onto cylinder head.
- Secure guide plate with knurled screws -VAS 5161/12- .
- Apply drift -VAS 5161/3- to guide plate and use plastic-headed hammer to release sticking valve cotters.



- Screw snap-in device -VAS 5161/6- with engaging fork - VAS 5161/5- into guide plate.
- Slide knurled spacer ring -VAS 5161/17- onto assembly cartridge -VAS 5161/8- .
- Attach pressure fork -VAS 5161/2- to snap-in device and push assembly cartridge down.
- At the same time, turn knurled screw of assembly cartridge clockwise until tips engage in valve 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.
- Take off assembly cartridge with knurled spacer ring.
- Detach valve spring with valve spring plate.
- Pull off valve stem oil seal with valve stem seal puller -3364- .

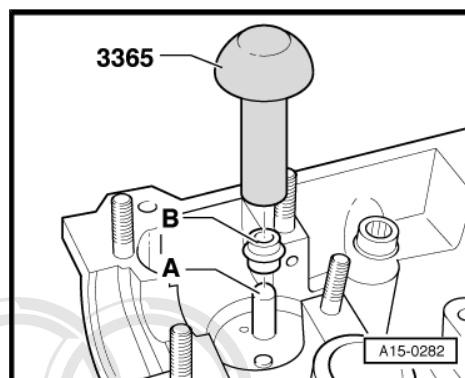


Caution

Make sure valve stem oil seals are not damaged when installing.

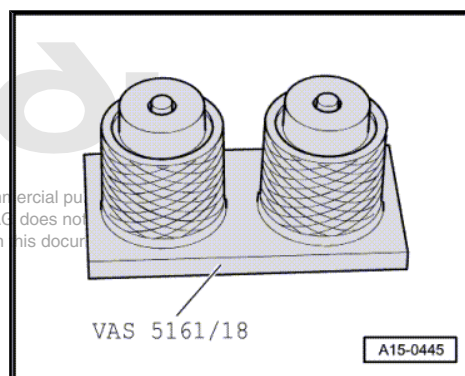
- ◆ **New valve stem oil seals -B- are supplied with plastic sleeve; fit plastic sleeve -A- onto valve stem.**

- Lightly oil sealing lip of valve stem oil seal.
- Slide valve stem oil seal onto plastic sleeve.
- Carefully press valve stem oil seal onto valve guide using valve stem seal fitting tool -3365- .
- Take off plastic sleeve.



If valve cotters had been removed from assembly cartridge they must first be inserted in insertion device -VAS 5161/18- .

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

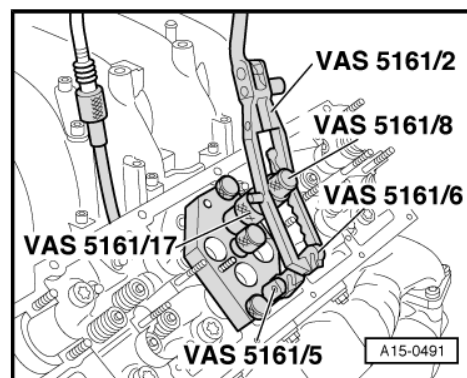


- Insert assembly cartridge in guide plate -VAS 5161/9- again.
- Press down pressure fork and pull knurled screw upwards while turning screw in both directions - this will insert the valve cotter.
- Release the pressure fork with knurled screw still in pulled position.
- Repeat procedure for each valve.

Assembling

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

- Install camshafts ⇒ [page 130](#) .



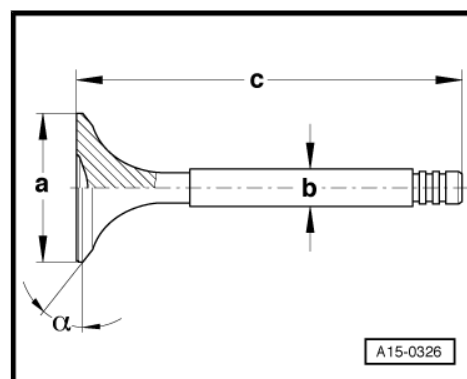
2.10 Valve dimensions



Note

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

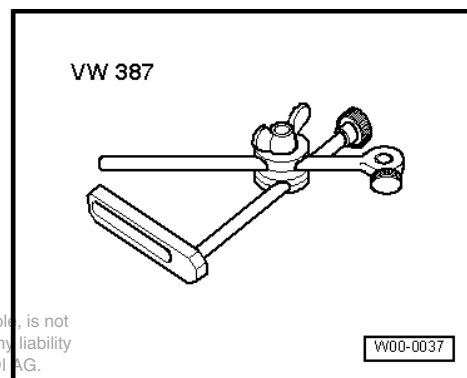
Dimension		Inlet valve	Exhaust valve
Ø a	mm	27.00 ... 27.20	24.00 ... 24.20
Ø b	mm	5.958 ... 5.972	5.958 ... 5.972
c	mm	100.35 ... 100.65	100.35 ... 100.65
α	°	45	45



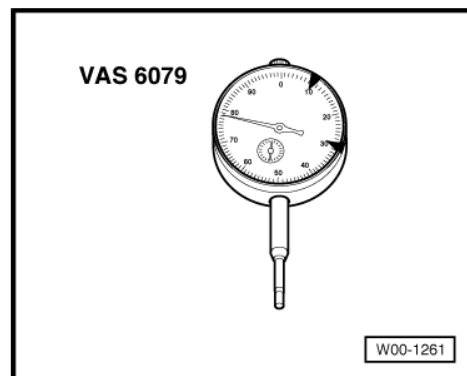
2.11 Checking valve guides

Special tools and workshop equipment required

- ♦ Universal dial gauge bracket -VW 387-



- ♦ Dial gauge -VAS 6079-



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Procedure



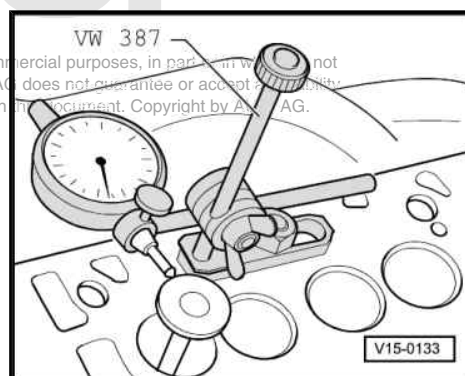
Note

- ◆ *If the valve has to be renewed as part of a repair, use a new valve for the measurement.*
- ◆ *Only insert inlet valve into inlet guide and exhaust valve into exhaust guide, as the stem diameters are different.*

- Insert valve into guide.
- End of valve stem must be flush with valve guide.
- Secure dial gauge -VAS 6079- to cylinder head with universal dial gauge bracket -VW 387- as shown in illustration.
- Measure the amount of sideways play.

Wear limit:

- Inlet valve guide: 1.0 mm
- Exhaust valve guide: 1.3 mm
- If the wear limit is exceeded, repeat the measurement with new valves.
- Renew cylinder head if wear limit is still exceeded.



Note

Valve guides cannot be renewed.

2.12 Checking valves

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

17 – Lubrication

1 Sump (bottom section), oil pump, sump (top section)



Caution

Risk of damage to catalytic converter.

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



Note

- ◆ *If large quantities of metal shavings or particles are found in the engine oil when repairing the engine, the oil passages must be cleaned carefully, and the oil cooler must be renewed in order to prevent further damage occurring later.*
- ◆ *Refer to ⇒ Maintenance tables for engine oil capacity, oil specifications and viscosity grades.*

1.1 Sump, oil pump - exploded view

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1 - Bolt

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

2 - Sump (bottom section)

- ☐ Different versions for engines with moulded gasket or engines with liquid gasket; refer to ⇒ Electronic parts catalogue
- ☐ Removing and installing ⇒ [page 148](#)
- ☐ With oil level and oil temperature sender - G266- (depending on equipment version)
- ☐ Removing and installing the oil level/temperature sender -G266- ⇒ [page 148](#)

3 - Chain guard

4 - Gasket

Moulded gasket for vehicles up to approx. 11.1998

- ☐ Renewing ⇒ [page 150](#)

Liquid gasket for vehicles from approx. 12.1998 onwards

- ☐ Renewing ⇒ [page 151](#)

5 - Bolt

- ☐ 10 Nm

6 - Bolt

- ☐ 22 Nm

7 - Oil pump

- ☐ With pressure control valve: 3.8 bar
- ☐ With pressure relief valve (11 bar)
- ☐ Removing and installing ⇒ [page 152](#)

8 - Drive chain for oil pump

- ☐ Removing and installing ⇒ ["3.3 Removing and installing sealing flange \(pulley end\)", page 79](#)

9 - Sprocket for oil pump

10 - Bolt

- ☐ 22 Nm

11 - O-ring

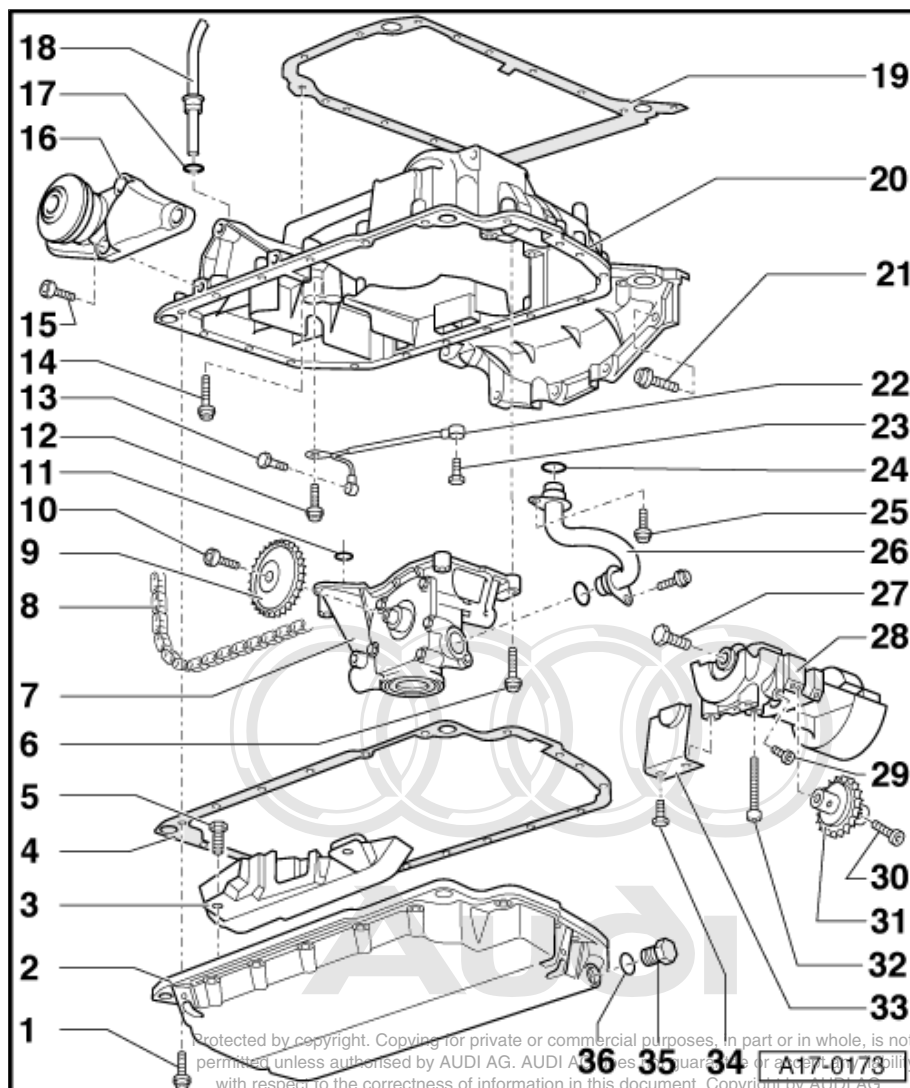
- ☐ Inserted in sealing flange (pulley end)
- ☐ Renew

12 - Bolt

- ☐ 10 Nm

13 - Banjo bolt

- ☐ 10 Nm



14 - Bolt

- ☐ M6 to cylinder block = 13 Nm
- ☐ M6 to sealing flange = 10 Nm
- ☐ M7 = 16 Nm
- ☐ Allocation ⇒ Electronic parts catalogue

15 - Bolt

- ☐ 45 Nm

16 - Torque reaction support

17 - O-ring

- ☐ Renew

18 - Guide tube for oil dipstick

- ☐ Tighten to 10 Nm

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19 - Gasket

Moulded gasket for vehicles up to approx. 05.1998

- ☐ Renewing ⇒ [page 165](#)

Liquid gasket for vehicles from approx. 06.1998 onwards

- ☐ Renewing ⇒ [page 166](#)

20 - Sump (top section)

- ☐ Different versions for engines with moulded gasket or engines with liquid gasket; refer to ⇒ Electronic parts catalogue
- ☐ Removing and installing ⇒ [page 157](#)

21 - Bolt

- ☐ 45 Nm

22 - Oil pipe

- ☐ From oil pump to balance shaft assembly

23 - Banjo bolt

- ☐ 10 Nm

24 - O-ring

- ☐ Renew

25 - Bolt

- ☐ 10 Nm

26 - Oil pressure pipe

27 - Bolt

- ☐ 45 Nm

28 - Balance shaft assembly

- ☐ With balance shaft
- ☐ Removing and installing ⇒ ["1.7 Removing sump \(top section\)", page 157](#)

29 - Bolt

- ☐ 10 Nm

30 - Bolt

- ☐ 10 Nm

31 - Idler sprocket

32 - Bolt

- ☐ 22 Nm

33 - Baffle plate

34 - 10 Nm

35 - Oil drain plug

- 25 Nm

36 - Seal

- Renew

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

Removing

- Drain off engine oil ⇒ Maintenance ; Booklet 802 .
- Unplug electrical connector -3-.
- Remove bolts -1- and detach oil level and oil temperature sender -G266- -item 4-.

Installing

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



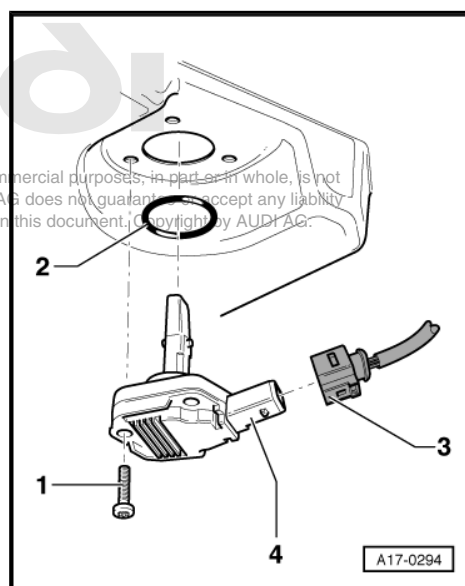
Note

Renew seal -2-.

- Fill up with engine oil and check engine oil level ⇒ Maintenance ; Booklet 802 .

Tightening torque

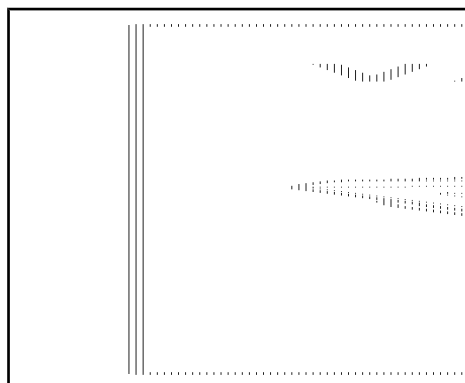
Component	Nm
Oil level and oil temperature sender -G266- to sump (bottom section)	10



1.3 Removing sump (bottom section)

Special tools and workshop equipment required

- ◆ Drip tray for workshop hoist -VAS 6208-



Removing

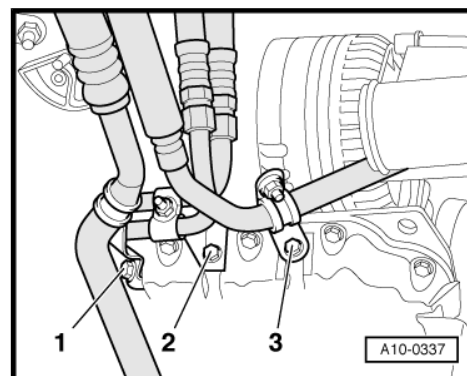


WARNING

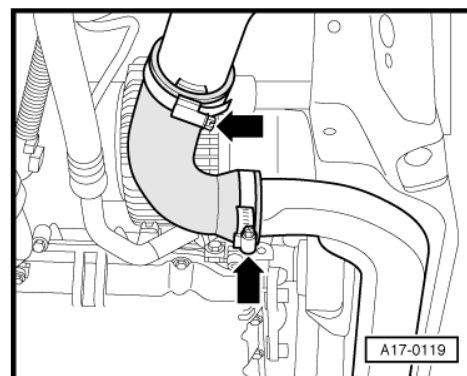
Hot steam/hot coolant can escape - risk of scalding.

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

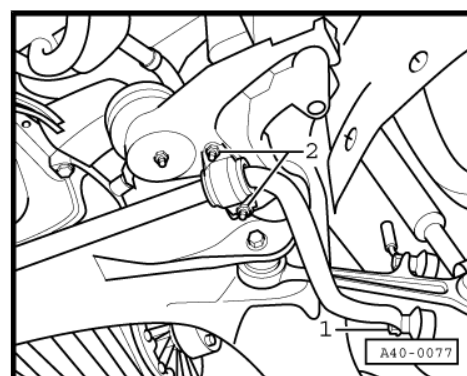
- Open filler cap on expansion tank.
- Drain off engine oil ⇒ Maintenance ; Booklet 802 .
- Detach the two refrigerant line brackets -1- and -3- from sump.
- On vehicles with automatic gearbox, unbolt bracket for ATF lines (right-side) from sump -2-.



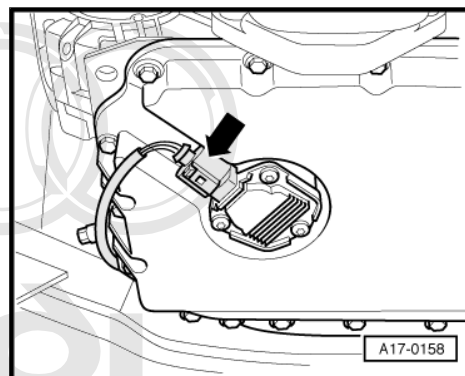
- Remove air hose (right-side) between charge air cooler and lock carrier -arrows-.



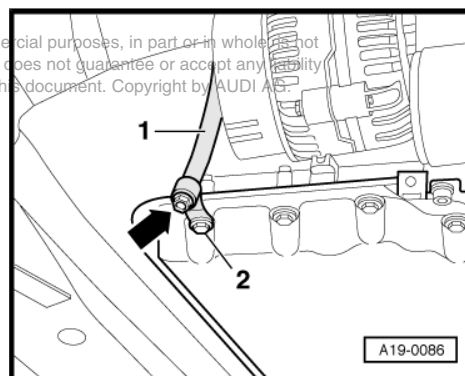
- Unbolt anti-roll bar from subframe -2- and swivel anti-roll bar down around mounting points -1-.



- If fitted, unplug electrical connector -arrow- at oil level and oil temperature sender -G266- .



- Place drip tray for workshop hoist -VAS 6208- beneath engine.
- Open drain plug -arrow- and drain off coolant.
- Remove bolt -2- and detach coolant drain pipe -1- from cylinder block.

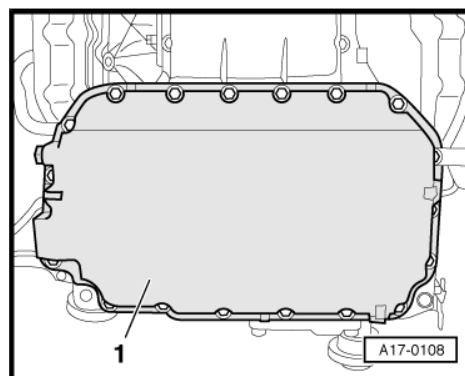


- Remove bolts and carefully detach sump (bottom section) -1- towards front.



Note

- ◆ *On vehicles with liquid gasket, carefully release sump (bottom section) from bonded joint.*
- ◆ *Pay attention to chain guard in sump when detaching sump (bottom section).*



1.4 Installing sump (bottom section) - engines with moulded gasket

Procedure

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



Caution

Risk of leaks.

- ◆ *It is essential to use a moulded gasket again if sump (bottom section) was previously fitted with such a gasket.*



Note

Renew gaskets, seals and O-rings.

- Clean sealing surfaces.

- Fit sump (bottom section) and tighten all bolts initially to 5 Nm in diagonal sequence.
- Tighten bolts on sump (bottom section) in diagonal sequence
- Fit new O-ring and locate coolant drain pipe carefully on cylinder block and press it as far as it will go into drilling using a lever.
- Fill up with coolant ⇒ [page 184](#) .
- Fill up with engine oil and check engine oil level ⇒ Maintenance ; Booklet 802 .

Tightening torques

Component	Nm
Sump (bottom section) to sump (top section)	10
Coolant drain pipe to sump	10
Oil drain plug	25
Drain plug to coolant drain pipe	10
Anti-roll bar to subframe	25 ¹⁾

- ¹⁾ Renew self-locking nuts.

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1.5 Installing sump (bottom section) - engines with liquid gasket

Special tools and workshop equipment required

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

Procedure

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



Caution

Risk of leaks.

- ◆ *It is essential to use a liquid gasket again if sump (bottom section) was previously fitted with such a gasket.*



Note

Renew gaskets, seals and O-rings.

- Remove remaining sealant on bottom and top sections of sump with a rotating plastic brush or similar.

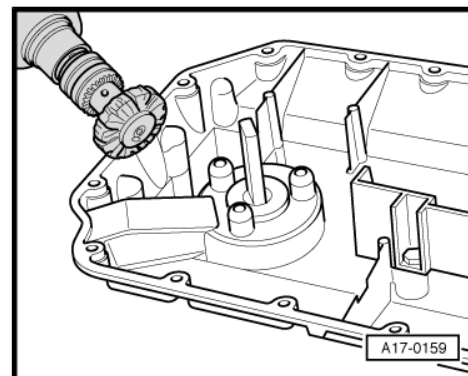


WARNING

Protect eyes against injuries.

- ◆ *Wear safety goggles.*

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

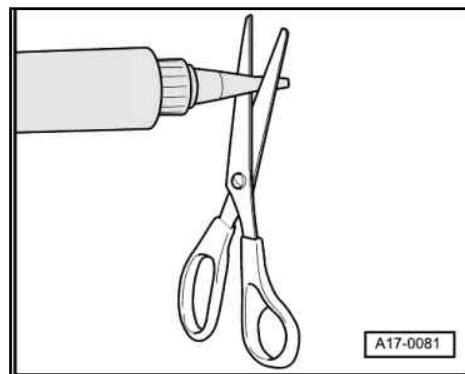




Note

Note the use-by date of the sealant.

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

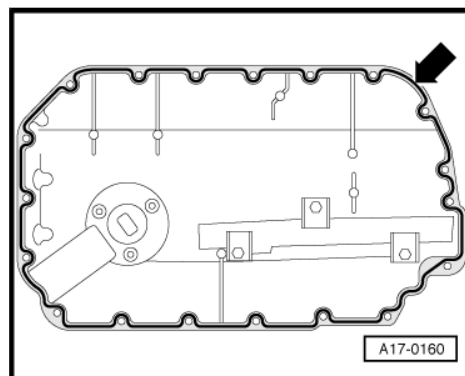


Caution

Make sure lubrication system is not clogged by excess sealant.

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

- Apply the bead of sealant onto the clean sealing surface of the sump (bottom section) as illustrated.
- Width of sealant bead -arrow-: 2 ... 3 mm.



Note

The sump (bottom section) must be installed within 5 minutes after applying the sealant.

- Fit sump (bottom section) and tighten all bolts initially to 5 Nm in diagonal sequence.
- Tighten bolts on sump (bottom section) in diagonal sequence
- Fit new O-ring and locate coolant drain pipe carefully on cylinder block and press it as far as it will go into drilling using a lever.
- Fill up with coolant ⇒ [page 184](#).
- Fill up with engine oil and check engine oil level ⇒ Maintenance ; [Booklet 802](#).

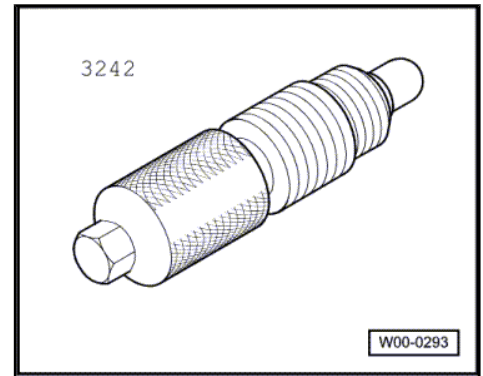
Tightening torques

Component	Nm
Sump (bottom section) to sump (top section)	10
Coolant drain pipe to sump	10
Oil drain plug	25
Drain plug to coolant drain pipe	10
Anti-roll bar to subframe	25 ¹⁾
• ¹⁾ Renew self-locking nuts.	

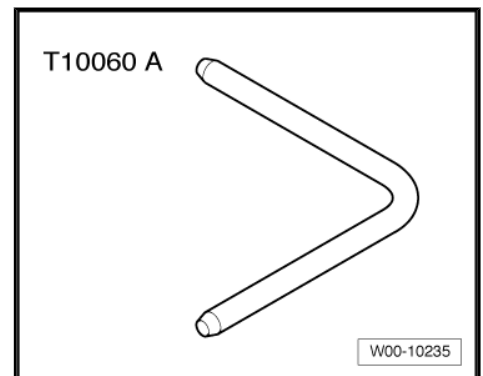
1.6 Removing and installing oil pump

Special tools and workshop equipment required

◆ Locking pin -3242-



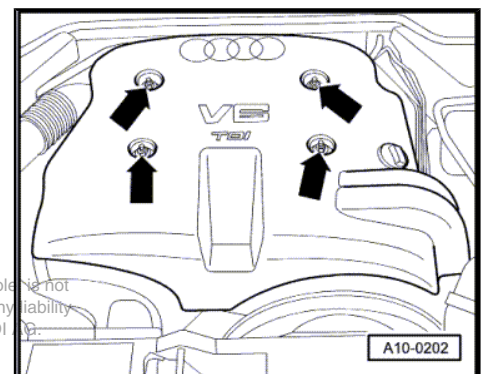
◆ Locking pin -T10060 A-



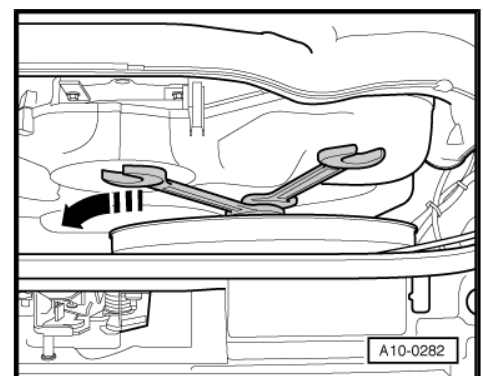
Removing

- Lock carrier must be in service position ⇒ [page 31](#).
- Detach caps on engine cover panel.
- Unbolt and remove engine cover panel -arrows-.

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- Unscrew viscous fan (32 mm).
- Remove front toothed belt cover on left and right.

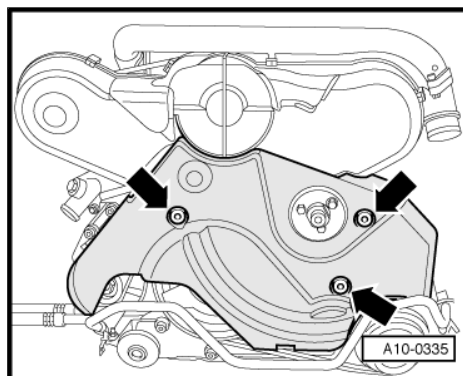


- Remove poly V-belt cover -arrows-.



Note

Watch position of spacer sleeves for poly V-belt cover.

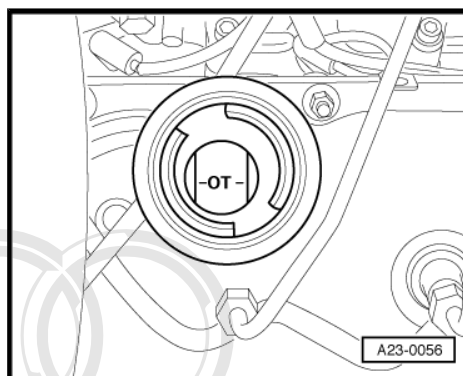


- Open oil filler cap.
- Turn engine until the marking “- OT -” (TDC) is visible on camshaft.



Note

Turn over the engine at the central bolt on the crankshaft.

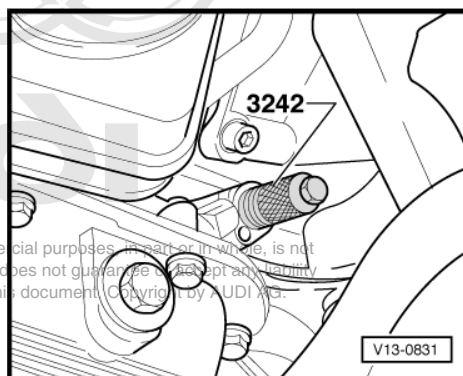


- Unscrew plug for TDC marking from cylinder block.



Note

There is a TDC drilling in the crankshaft directly behind the plug (it is possible to feel the hole).

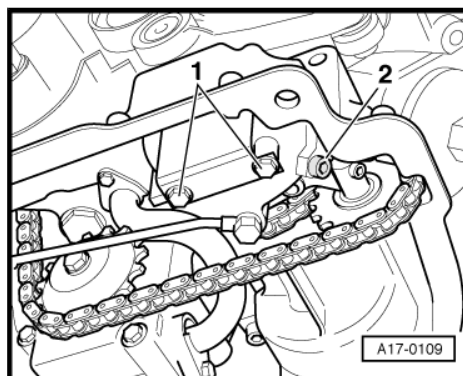


WARNING

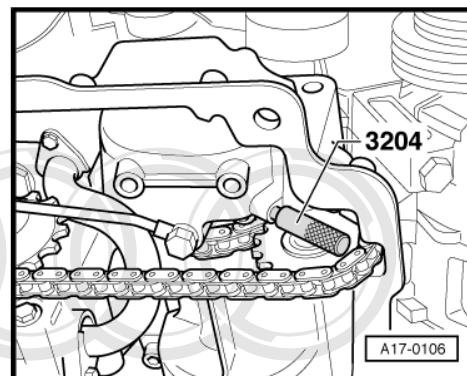
Injury risk.

- ◆ Do not rotate the crankshaft while feeling for the TDC drilling with your finger.

- Screw locking pin -3242- into bore; if necessary, turn crankshaft backwards and forwards slightly to fully centralise locking pin.
- Remove sump (bottom section) ⇒ [page 148](#) .
- Unscrew bolts -1- and remove baffle plate.
- Remove bolt -2-.

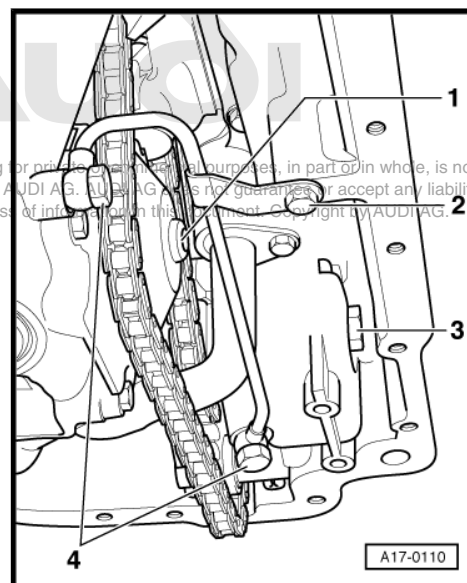


- Lock balance shaft with locking pin -T10060 A- or with locking pin -3204- .



- Slacken bolt -1- for chain sprocket at oil pump; do not remove bolt.
- Slacken bolt -3- for chain sprocket at balance shaft.
- Unscrew banjo bolts -4- and hexagon bolt -2- and detach oil pipe leading to balance shaft.

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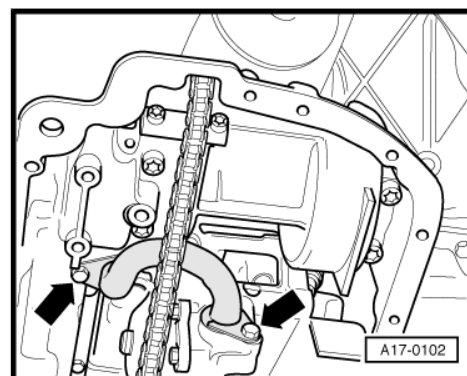


- Remove oil pressure pipe -arrows-.

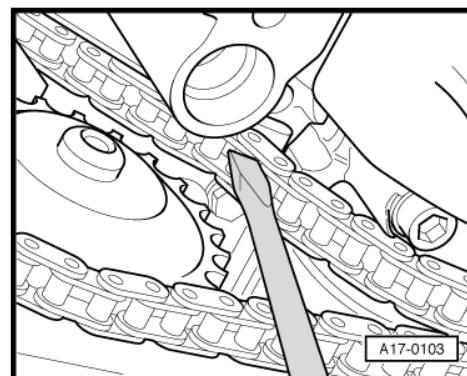


Note

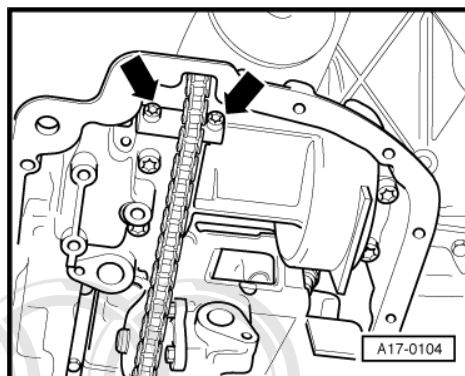
Caution: oil emerges at pump.



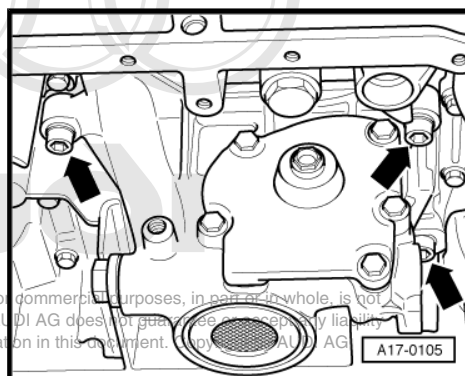
- Press drive chain upwards using a screwdriver.



- Slacken bolts -arrows- on idler sprocket for drive chain.
- Detach idler sprocket and chain sprocket of oil pump.



- Remove oil pump -arrows-.



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Installing

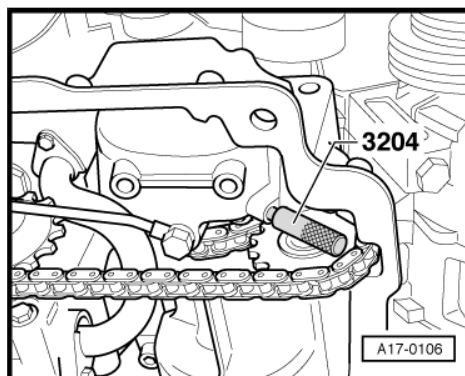
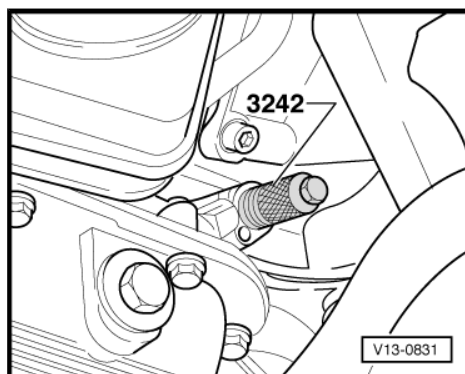
Installation is carried out in the reverse order; note the following:



Note

Renew gaskets, seals and O-rings.

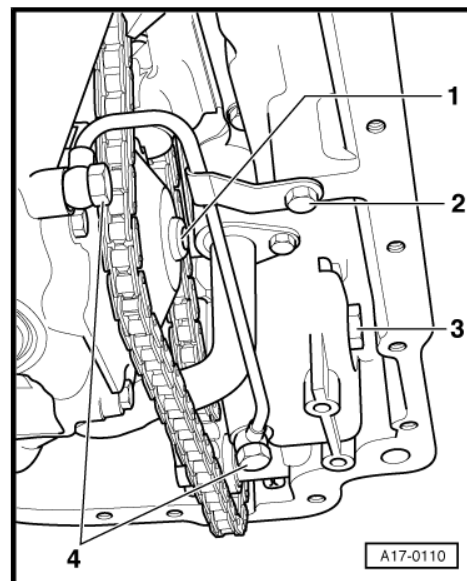
- Check that locking pin -3242- is screwed in.
- To lock balance shaft, insert locking pin -T10060 A- or locking pin -3204- .



- Now tighten bolt for chain sprocket -3-.
- Screw plug for the TDC mark into cylinder block with a new seal.
- Install sump (bottom section): vehicles with moulded gasket ⇒ [page 150](#) , vehicles with liquid gasket ⇒ [page 151](#) .
- Install viscous fan ⇒ [page 200](#) .

Tightening torques

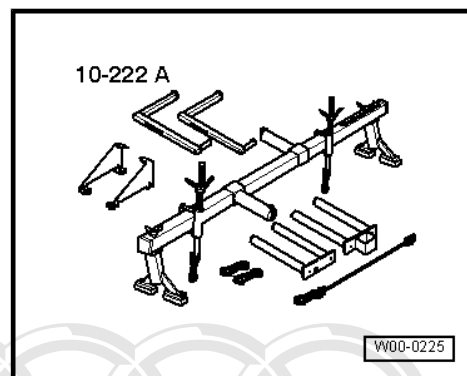
Component	Nm
Oil pump to cylinder block	22
Oil pressure pipe to Oil pump	10
Sump (top section)	10
Oil pipe going to balance shaft to oil pump	10
Oil pipe to mounting bracket for balance shaft	10
Idler sprocket for drive chain to sump (top section)	10
Baffle plate to mounting bracket for balance shaft	10
Chain sprocket for oil pump to oil pump	22
Chain sprocket for balance shaft to balance shaft	45
Sealing plug in cylinder block	10



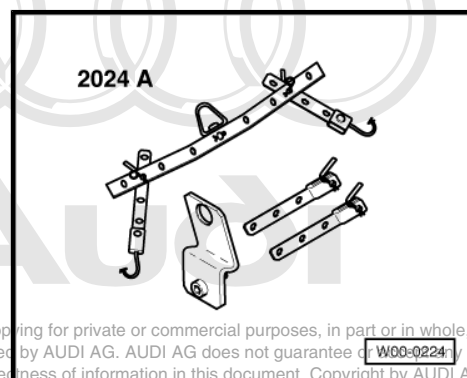
1.7 Removing sump (top section)

Special tools and workshop equipment required

- ◆ Support bracket -10 - 222 A-

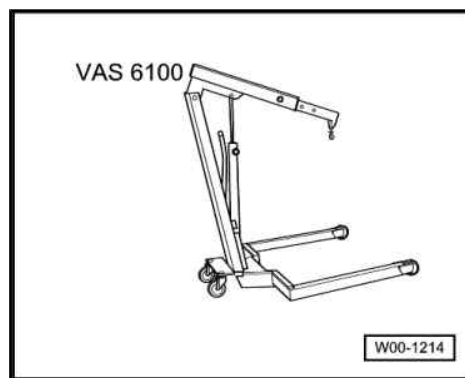


- ◆ Lifting tackle -2024 A-

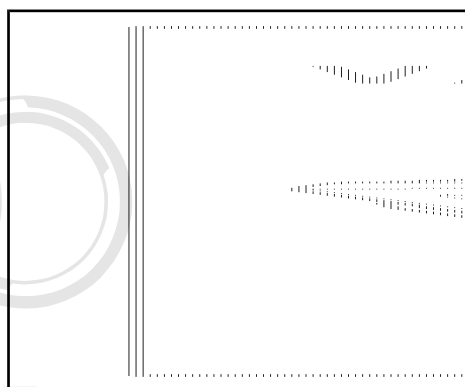


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- ◆ Workshop hoist -VAS 6100-



- ◆ Drip tray for workshop hoist -VAS 6208-



Removing

- Lock carrier must be in service position ⇒ [page 31](#) .

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Caution

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

- ◆ **Observe notes on procedure for disconnecting the battery.**

- Disconnect earth cable at battery ⇒ Rep. Gr. 27 .



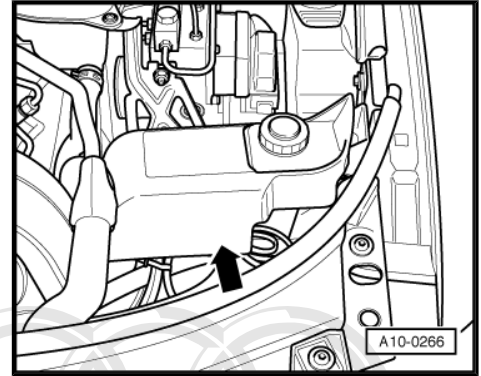
WARNING

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

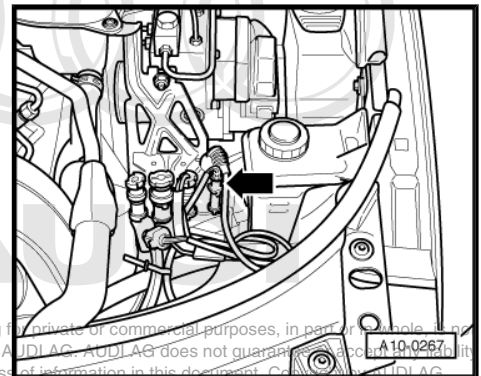
- ◆ **The cooling system is under pressure when the engine is hot.**
- ◆ **To allow pressure to dissipate, cover filler cap on expansion tank with cloth and open carefully.**

- Open filler cap on expansion tank.
- Remove poly V-belt for power steering pump, alternator and viscous fan ⇒ [page 36](#) .
- Pull out oil dipstick.
- Unbolt dipstick guide tube on cylinder head (right-side).

- Remove cover -arrow- at power steering fluid reservoir.

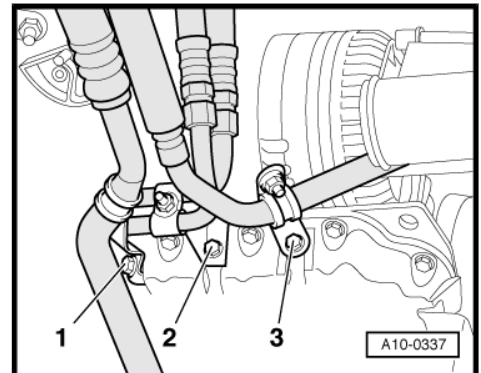


- Unplug connector -arrow- for magnetic clutch for air conditioner compressor and move wiring clear.



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- Detach the two refrigerant line brackets -1- and -3- from sump.
- On vehicles with automatic gearbox, unbolt bracket for ATF lines (right-side) from sump -2-.

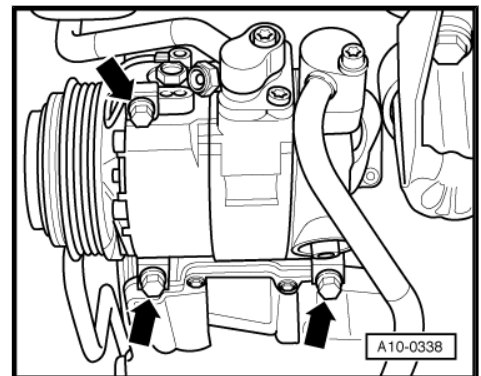


WARNING

Risk of injury caused by refrigerant.

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

- Unbolt air-conditioner compressor from bracket -arrows-.



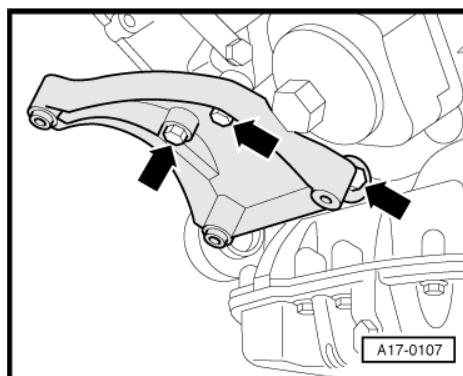
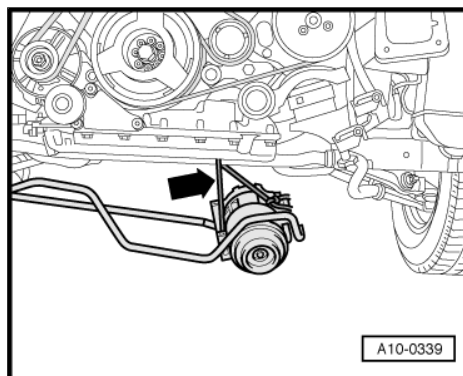


Caution

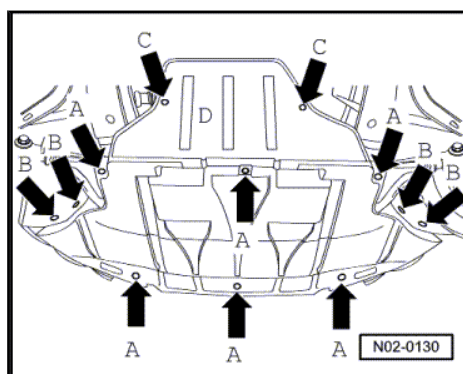
Danger of damage to refrigerant lines and hoses.

◆ **Do NOT stretch, kink or bend refrigerant lines and hoses.**

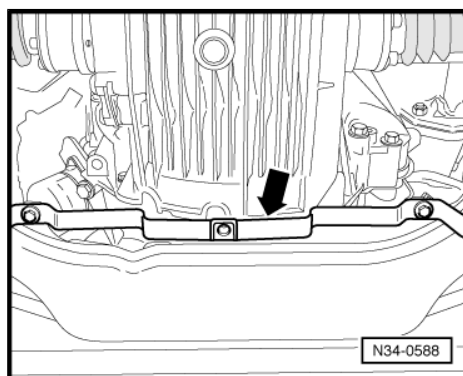
- Tie up air conditioner compressor onto subframe, leaving refrigerant lines connected -arrow-.
- Unbolt bracket for A/C compressor -arrows-.



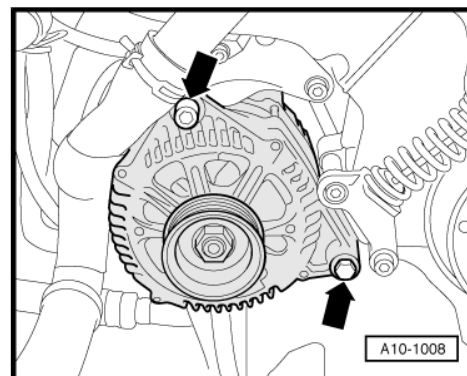
- Remove noise insulation (rear) -D- -arrows C-.



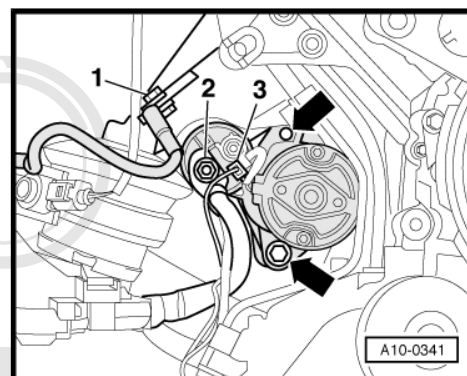
- Unbolt bracket for noise insulation -arrow-.



- Remove bolts -arrows-.
- Detach alternator to front.
- Unbolt wiring from removed alternator.

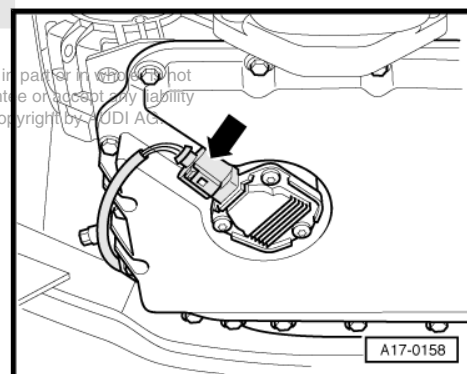


- Detach wires -2- and -3- at starter; remove insulator from positive connection on starter.
- Unscrew bolts -arrows- securing starter working from gearbox side and remove starter.

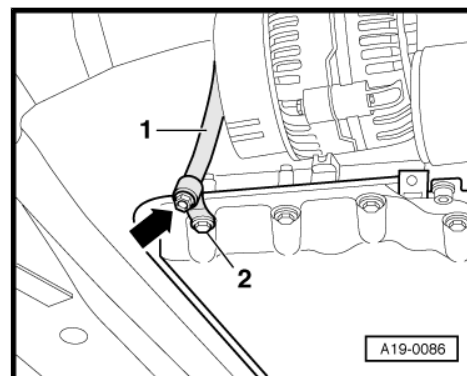


- If fitted, unplug electrical connector at oil level and oil temperature sender -G266- -arrow-.

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- Place drip tray for workshop hoist -VAS 6208- beneath engine.
- Open drain plug -arrow- and drain off coolant.
- Remove bolt -2- and detach coolant drain pipe -1- from cylinder block.
- Drain off engine oil ⇒ Maintenance ; Booklet 802 .

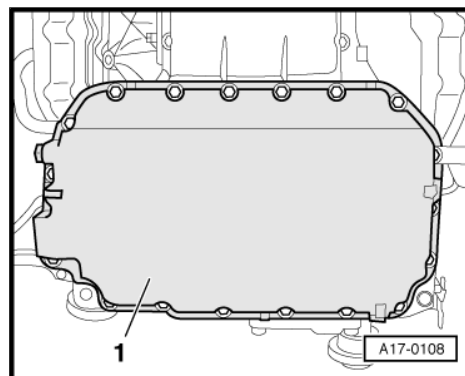


- Remove bolts and carefully detach sump (bottom section)
-1- towards front.



Note

Pay attention to chain guard in sump when detaching sump (bottom section).



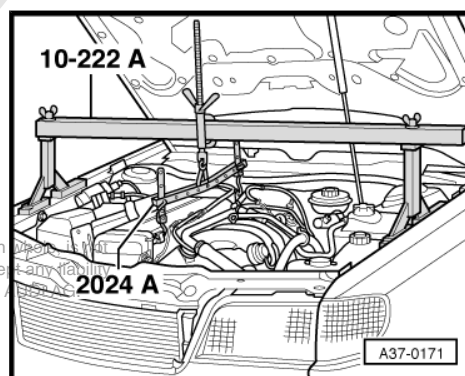
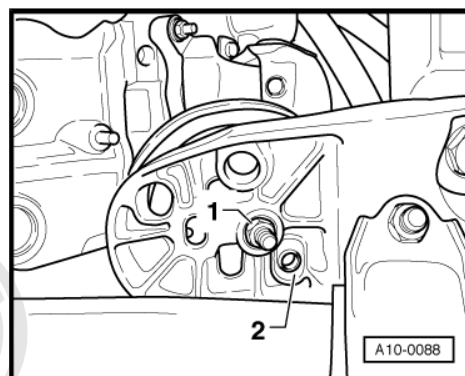
- Mark position of nuts -1- and locating sleeves -2- on bottom of engine mountings (right and left).



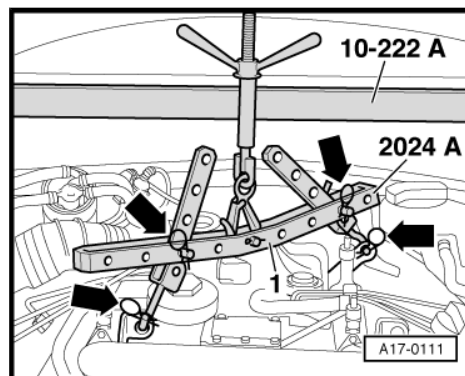
Note

Different mounting holes are provided for the different engine versions.

- Unscrew nut -1- at bottom of engine mounting (right-side).
- Position support bracket -10 - 222 A- on wing mounting flanges (spindle faces to front).



- Remove eyelet of lifting tackle -2024 A- .
- Re-insert pin -1- in centre hole of lifting tackle -2024 A- and secure with split pin.
- Hang the pin of lifting tackle -2024 A- onto the spindle of support bracket -10 - 222 A- .
- Engage lifting tackle -2024 A- in front and rear lifting eyes on engine.



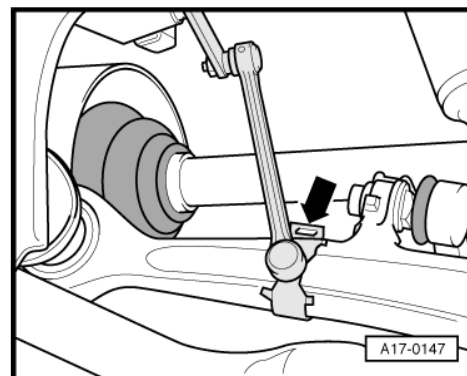
WARNING

Accident risk from loose components of lifting tackle.

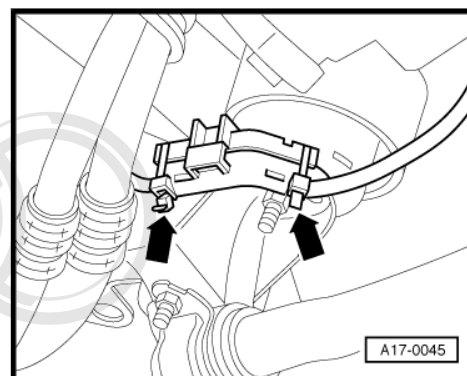
- ◆ The support hooks and retaining pins on the lifting tackle must be secured with locking pins -arrows-.

- Take up weight of engine with the spindle of support bracket -10 - 222 A- , but do not lift.

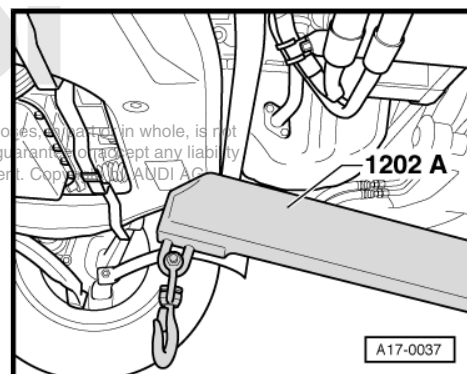
- If fitted, unclip actuator rod for vehicle level sender at bottom transverse link -arrow-.



- Cut through cable ties -arrows-. Open retainer for starter wiring and take out wiring.



- Support subframe with workshop hoist.

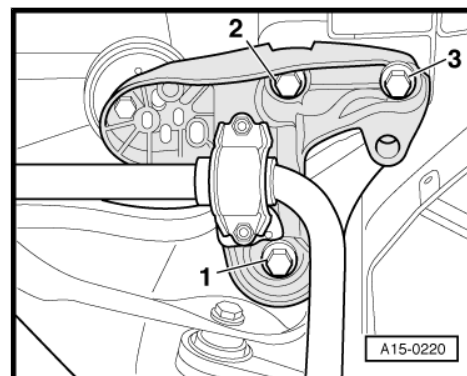


- First remove front subframe bolts -2- and -3- (left and right). Then remove bolts -1-.

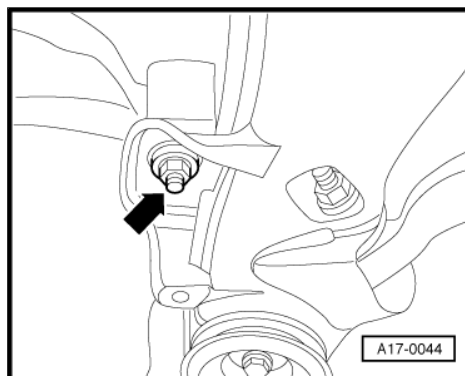


Note

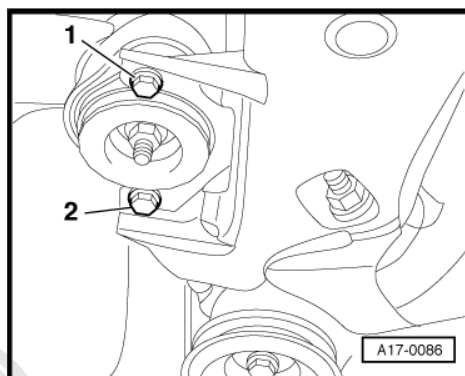
To avoid having to check and adjust wheel alignment, only loosen the front subframe mountings and lower the subframe at the front.



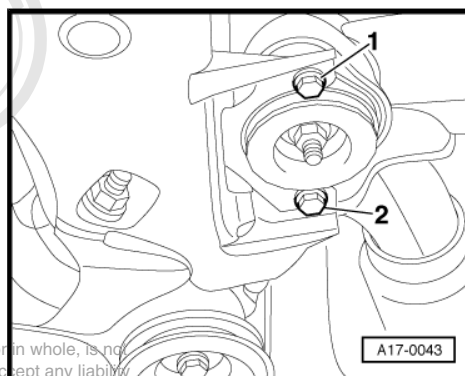
- On vehicles with manual gearbox, loosen nut -arrow- for gear-box mounting (left-side) until it is flush with lower end of bolt (turn approx. 4 threads).



- On vehicles with automatic gearbox, loosen rear bolt -2- for gearbox mounting (left-side) a few turns, then unscrew front bolt -1- for gearbox mounting (left-side).



- Loosen rear bolt -2- for gearbox mounting (right-side) several turns and remove front bolt -1- for gearbox mounting (right-side).



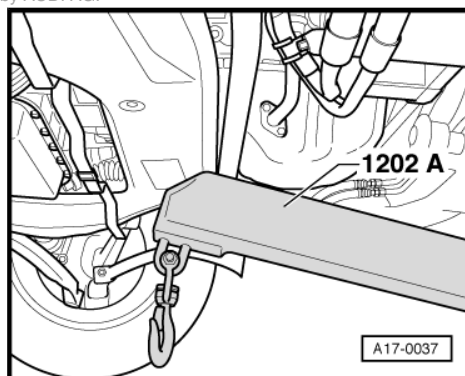
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- Lower subframe slowly using workshop hoist -VAS 6100- or -V.A.G 1202 A- .
- Remove workshop hoist.
- If necessary, raise engine slightly using spindle of engine support bracket.

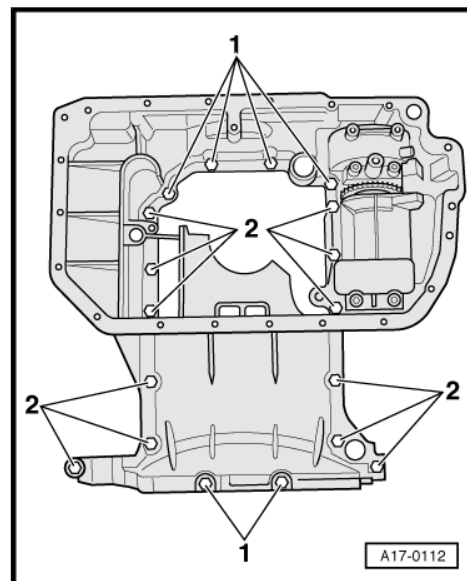


Note

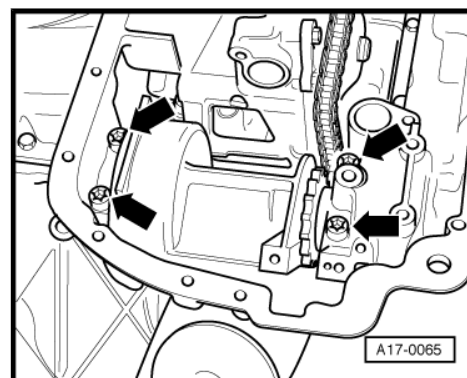
Do not lift engine to such an extent that pipes or coolant hoses are damaged or strained.



- Remove oil pump => [page 152](#) .
- Unscrew engine/gearbox connecting bolts in area of sump (top section).
- Press dipstick guide tube out of sump (top section).
- Unscrew bolts -1- and -2- for sump (top section).
- Press sump (top section) off spring pins on cylinder block.
- Push sump (top section) to left side of vehicle and take out.

**Note**

- ◆ *The balance shaft assembly can be unbolted from the sump (top section) -arrows-.*
- ◆ *Remove torque reaction support before renewing sump (top section).*



1.8 Installing sump (top section) - engines with moulded gasket

Procedure

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

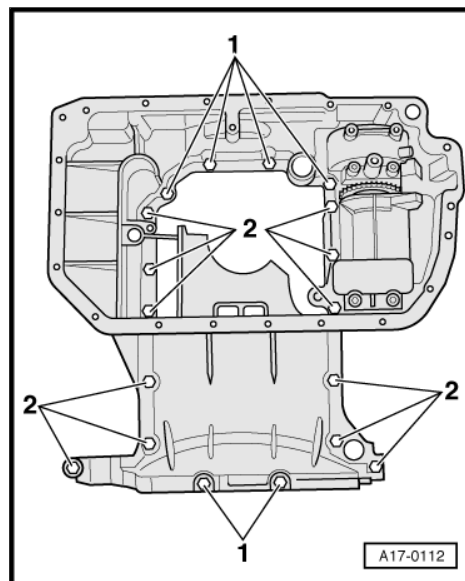
**Caution*****Risk of leaks.***

- ◆ *It is essential to use a moulded gasket again if sump (top section) was previously fitted with such a gasket.*

**Note*****Renew gaskets, seals and O-rings.***

- Clean sealing surfaces.
- Fit sump (top section) and tighten all bolts securing sump (top section) to cylinder block initially to 5 Nm in diagonal sequence.
- Tighten bolts securing sump (top section) to gearbox to 45 Nm.

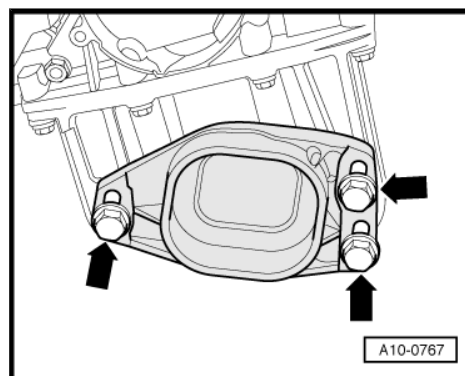
- Tighten bolts securing sump (top section) to cylinder block diagonally:
- Tighten bolts -1-.
- Tighten bolts -2-.
- Install oil pump ⇒ [page 152](#) .
- Install sump (bottom section) ⇒ [page 150](#) .
- Install alternator and starter ⇒ Rep. Gr. 27 .
- Install poly V-belt for power steering pump, alternator and viscous fan ⇒ [page 36](#) .



- Allow stop for torque reaction support to rest on rubber buffer for torque reaction support and tighten bolts -arrows- to 28 Nm.
- Fill up with engine oil and check engine oil level ⇒ Maintenance ; Booklet 802 .
- Fill up with coolant ⇒ [page 184](#) .
- Observe notes on procedures required after connecting battery ⇒ Rep. Gr. 27 .

Tightening torques

Component	Nm
Sump (top section) to Cylinder block	13
Sealing flanges (front and rear)	10
Gearbox	45
Balance shaft assembly to sump (top section)	22
Torque reaction support to top section of sump	45
Coolant drain pipe to sump	10
Stop for torque reaction support to lock carrier	25
Bracket for air conditioner compressor to: Sump (top section)	22
Bracket for power steering pump and oil cooler	22
Air conditioner compressor to bracket	22



1.9 Installing sump (top section) - engines with liquid gasket

Special tools and workshop equipment required

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

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Procedure

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



Caution

Risk of leaks.

- ◆ *It is essential to use a liquid gasket again if sump (bottom section) was previously fitted with such a gasket.*



Note

Renew gaskets, seals and O-rings.

- Remove remaining sealant on sump (top section) and cylinder block using rotating plastic brush or similar.



WARNING

Protect eyes against injuries.

- ◆ *Wear safety goggles.*

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



Note

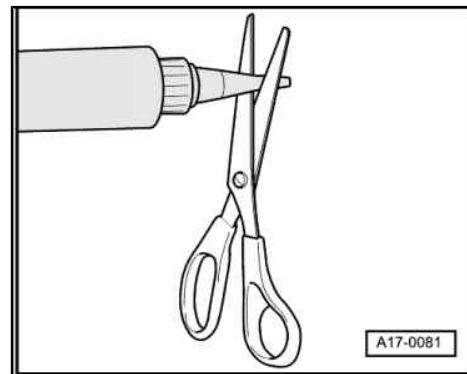
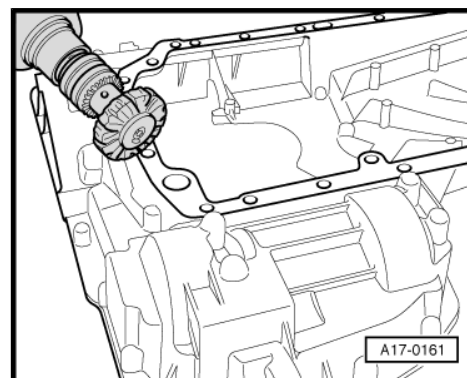
The sump (top section) must be installed within 5 minutes after applying sealant.



Note

Note the use-by date of the sealant.

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



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Caution

Make sure lubrication system is not clogged by excess sealant.

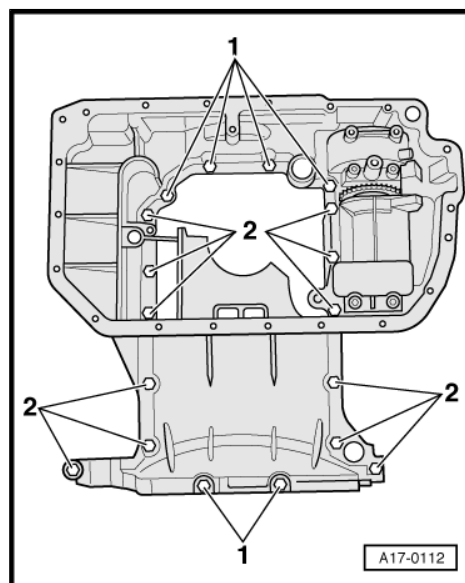
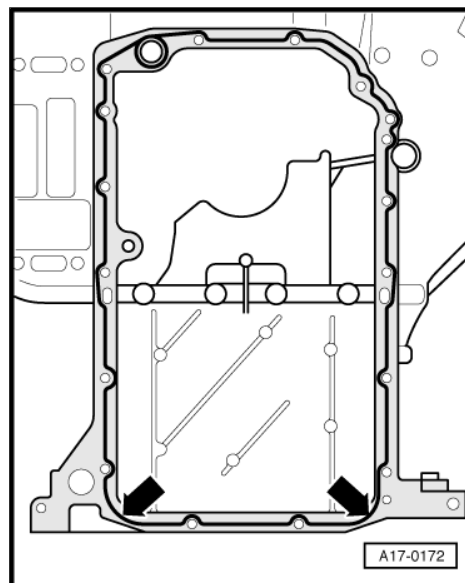
- ◆ **The bead of sealant must not be thicker than specified.**

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



Note

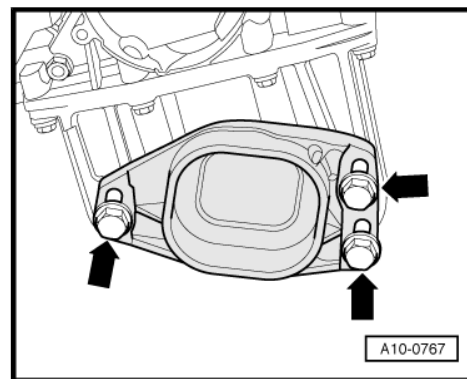
- ◆ *Take particular care when applying sealant bead in area of sealing flange (gearbox end).*
- ◆ *The sump (top section) must be installed within 5 minutes after applying the sealant.*
- When positioning sump (top section), insert dipstick guide tube in hole.
- Fit sump (top section) and tighten all bolts securing sump (top section) to cylinder block initially to 5 Nm in diagonal sequence.
- Tighten bolts securing sump (top section) to gearbox to 45 Nm.
- Tighten bolts -1- and -2- securing sump (top section) to cylinder block in diagonal sequence to 16 Nm.
- Install subframe ⇒ Rep. Gr. 40 .
- Install oil pump ⇒ [page 152](#) .
- Install sump (bottom section) ⇒ [page 151](#) .
- Install alternator and starter ⇒ Rep. Gr. 27 .
- Install poly V-belt for power steering pump, alternator and viscous fan ⇒ [page 36](#) .



- Allow stop for torque reaction support to rest on rubber buffer for torque reaction support and tighten bolts -arrows- to 28 Nm.
- Fill up with engine oil and check engine oil level ⇒ Maintenance ; Booklet 802 .
- Fill up with coolant ⇒ [page 184](#) .
- Observe notes on procedures required after connecting battery ⇒ Rep. Gr. 27 .

Tightening torques

Component	Nm
Sump (top section) Cylinder block, sealing to flanges	16
Gearbox	45
Balance shaft assembly to sump (top section)	22
Torque reaction support to top section of sump	45
Coolant drain pipe to sump	10
Stop for torque reaction support to lock carrier	25
Bracket for air conditioner compressor to: Sump (top section)	22
Bracket for power steering pump and oil cooler	22
Air conditioner compressor to bracket	22

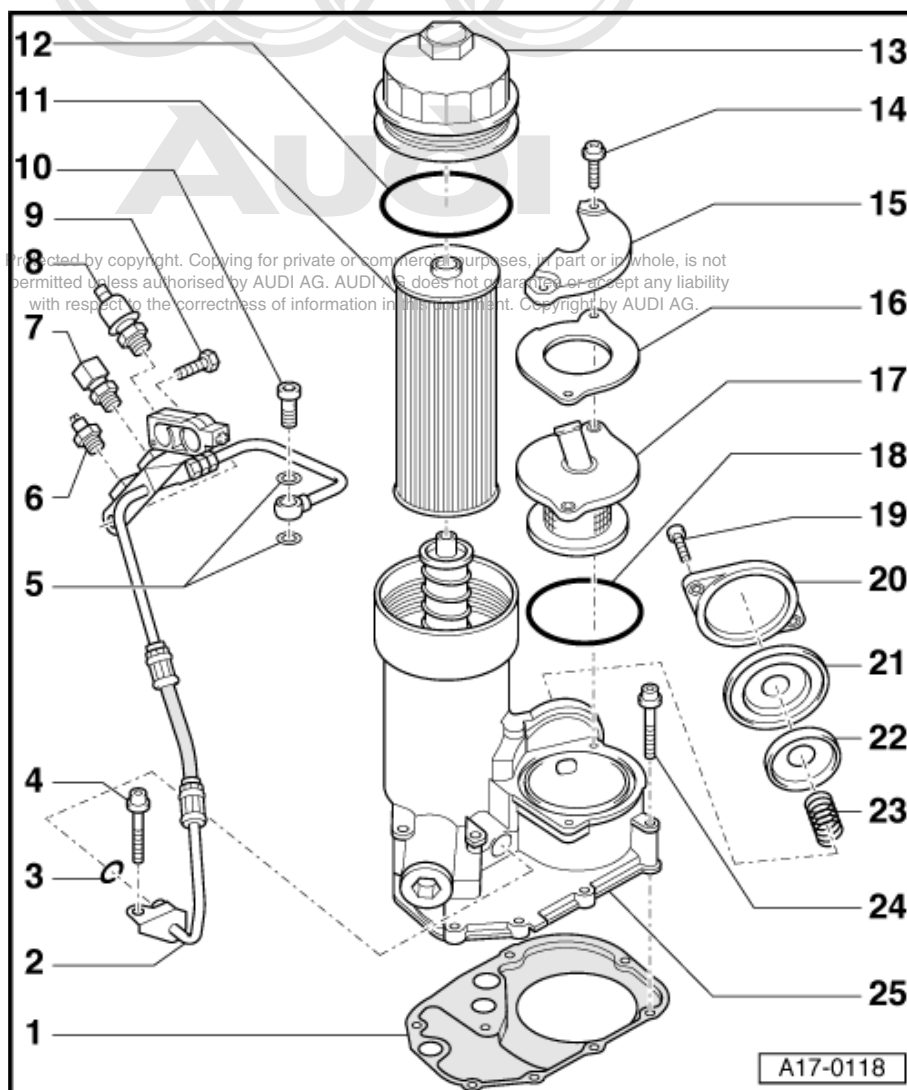


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2 Oil filter bracket, oil cooler

2.1 Oil filter bracket, oil filter - exploded view

- 1 - Gasket
 - ☐ Renew
- 2 - Oil supply pipe
 - ☐ To turbocharger
- 3 - O-ring
 - ☐ Renew
- 4 - Bolt
 - ☐ 10 Nm
- 5 - Seals
 - ☐ Renew
- 6 - Oil temperature sender - G8-
 - ☐ Renew seal
 - ☐ 15 Nm
- 7 - Gearbox oil temperature sender -G93-
 - ☐ 15 Nm
- 8 - Oil pressure switch -F1-
 - ☐ 1.9 bar, grey
 - ☐ Checking ⇒ [page 179](#)
 - ☐ Renew seal
 - ☐ Tighten to 25 Nm
- 9 - Bolt
 - ☐ 22 Nm
- 10 - Banjo bolt
 - ☐ 15 Nm
- 11 - Oil filter element
 - ☐ Removing and installing ⇒ Maintenance ; Booklet 802
- 12 - O-ring
 - ☐ Renew
- 13 - Sealing cap
 - ☐ Tighten to 25 Nm
- 14 - Bolt
 - ☐ 10 Nm
- 15 - Heat shield
- 16 - Retaining ring
- 17 - Connecting piece with oil separator
 - ☐ For crankcase breather
 - ☐ Clean strainer
 - ☐ Removing and installing ⇒ [page 171](#)



18 - Seal

- ☐ Renew

19 - Bolt

- ☐ 10 Nm

20 - Cover

- ☐ For pressure control valve

21 - Diaphragm

- ☐ For pressure control valve

22 - Pressure plate

- ☐ For pressure control valve

23 - Spring

- ☐ For pressure control valve

24 - Bolt

- ☐ Tighten in diagonal sequence
- ☐ 10 Nm

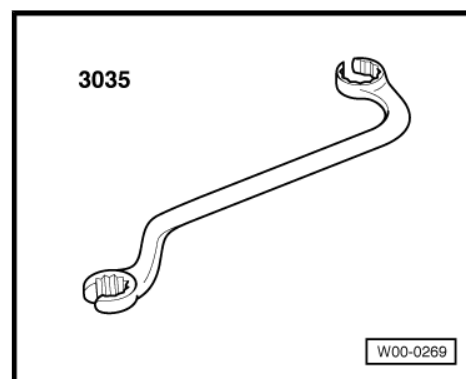
25 - Oil filter bracket

- ☐ With crankcase breather
- ☐ With pressure control valve for crankcase breather
- ☐ With filter bypass valve, 2.5 bar
- ☐ Check that guide tube for oil filter element is firmly seated
- ☐ Removing and installing ⇒ [page 174](#)

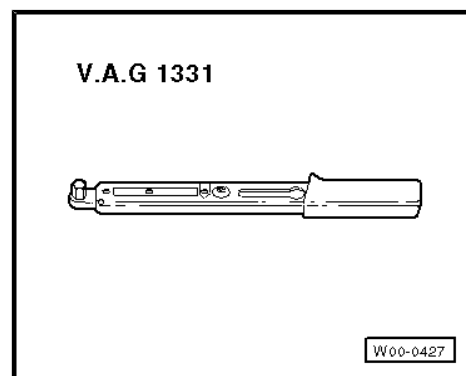
2.2 Removing and installing connecting piece with oil separator

Special tools and workshop equipment required

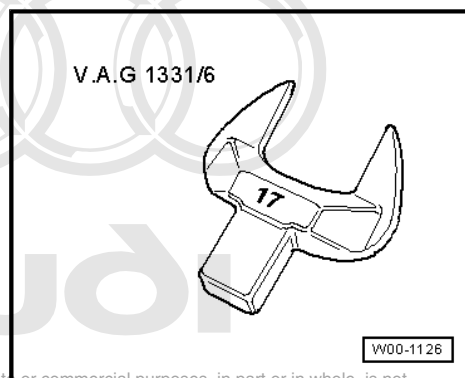
- ◆ Ring spanner -3035-



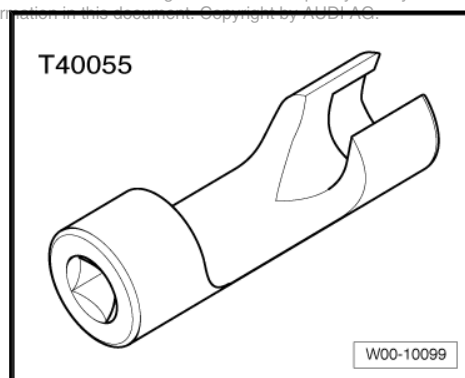
- ◆ Torque wrench -V.A.G 1331- with ratchet -V.A.G 1331/1-



- ◆ Tool insert AF 17 -V.A.G 1331/6-

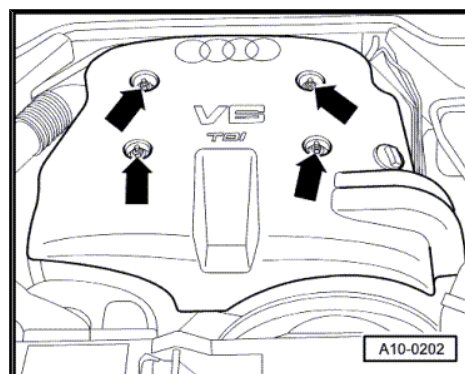


- ◆ Socket -T40055-

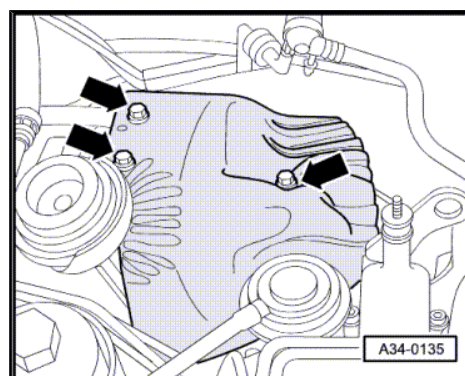


Removing

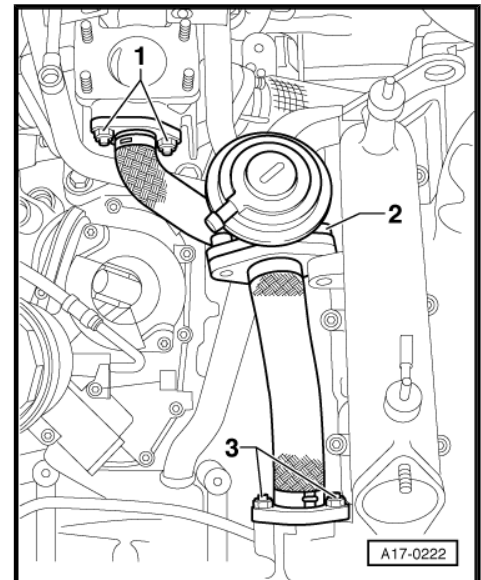
- Detach caps on engine cover panel.
- Unbolt and remove engine cover panel -arrows-.
- Mark injector pipes according to cylinder (e.g. with felt-tip pen).
- Disconnect injector pipes one by one with ring spanner -3035- .



- Remove heat shield above turbocharger -arrows-.



- Unscrew bolt (left-side) on mechanical exhaust gas recirculation valve -2-.
- Unscrew nuts -1- and -3-.
- Take out mechanical exhaust gas recirculation valve with exhaust gas recirculation pipes.



- Remove hose -1- from connecting piece with oil separator.
- Unscrew bolts -2- and remove connecting piece with oil separator.

Installing

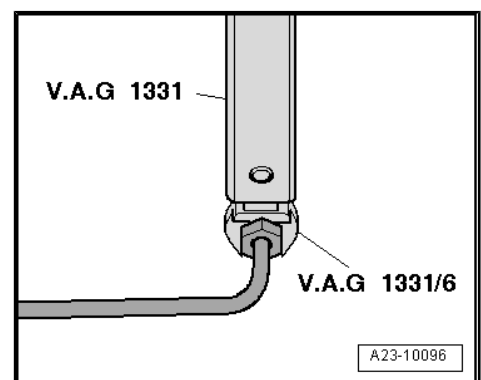
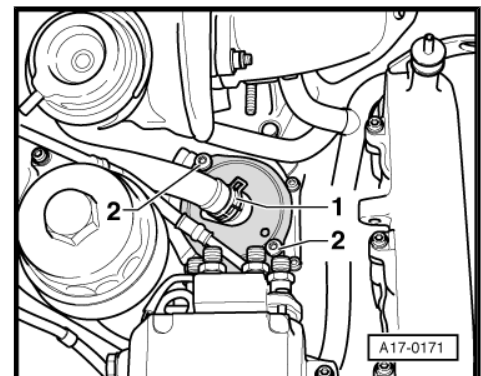
Installation is carried out in the reverse order; note the following:



Note

Renew gaskets, seals and O-rings.

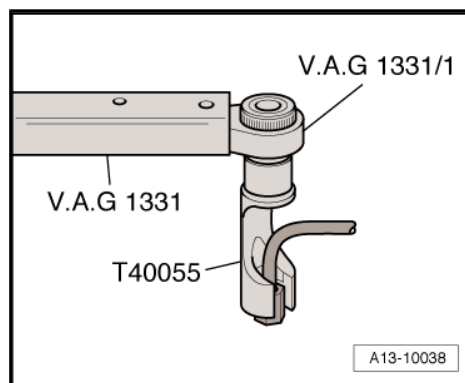
- Install injector pipes one after the other (from bottom to top).
- Ensure stress-free installation of injector pipes.
- Tighten with torque wrench -V.A.G 1331-, and tool insert AF 17 -V.A.G 1331/6-.



- Tighten with torque wrench -V.A.G 1331- , ratchet -V.A.G 1331/1- and socket -T40055- .
- Check fuel system for leaks ⇒ [page 4](#) .

Tightening torques

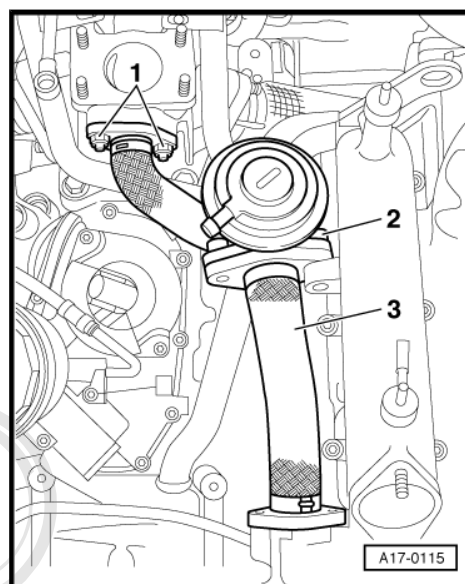
Component		Nm
Connection		10
Mechanical exhaust gas recirculation valve to intake manifold		22
Pipe for exhaust gas recirculation to	Intermediate flange	22
	Intake manifold (front)	10
Injector pipes to	Injectors	30
	Injection pump	30



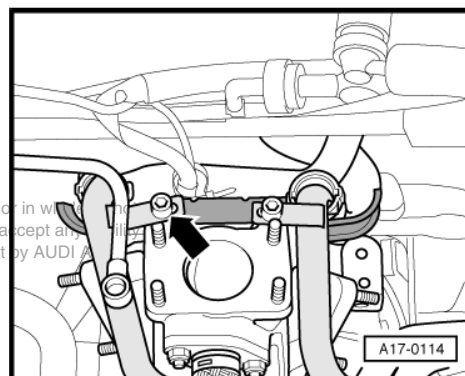
2.3 Removing and installing oil filter bracket

Removing

- Lock carrier must be in service position ⇒ [page 31](#) .
- Remove injection pump ⇒ Rep. Gr. 23 .
- Remove turbocharger ⇒ [page 226](#) .
- Unscrew bolt (left-side) on mechanical exhaust gas recirculation valve -2-.
- Remove nuts -1-.
- Remove exhaust gas recirculation pipe -3-.



- Loosen bolt -arrow- for coolant pipe.



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- Remove bolt -2-.
- Detach oil pipe -1-.
- Remove bolts -arrows-.
- Move coolant pipe to side and remove oil filter bracket.

Installing

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



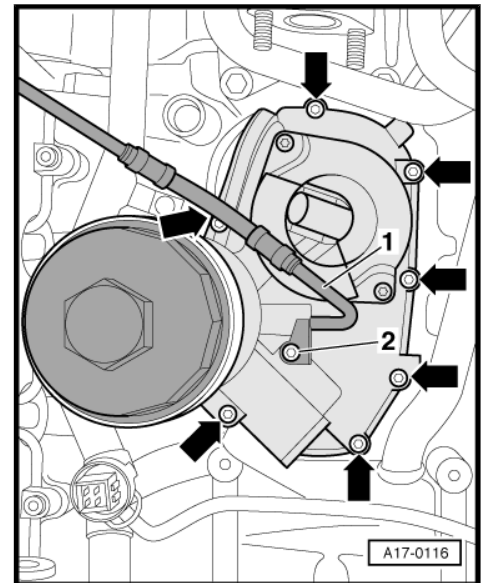
Note

Renew gaskets, seals and O-rings.

- Install turbocharger ⇒ [page 226](#) .
- Install injection pump ⇒ Rep. Gr. 23 .
- Dynamically check and adjust commencement of injection ⇒ Rep. Gr. 23 .

Tightening torques

Component	Nm
Oil filter bracket to cylinder block	10
Mechanical exhaust gas recirculation valve to intake manifold	22
Pipe for exhaust gas recirculation to intermediate flange	22
Intake manifold (front)	10
Oil supply pipe to oil filter bracket	10



2.4 Renewing oil retention valves

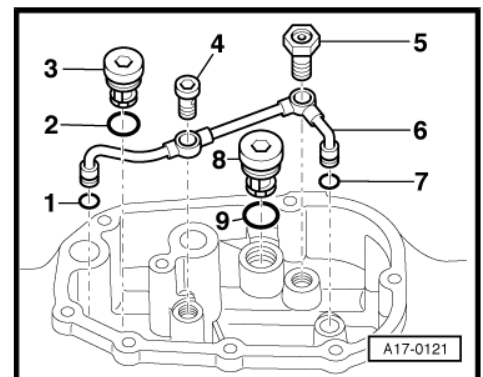
Procedure



Note

In the event of irregular valve noise which disappears after a lengthy drive but repeatedly re-occurs when travelling short distances, the oil retention valves must be renewed.

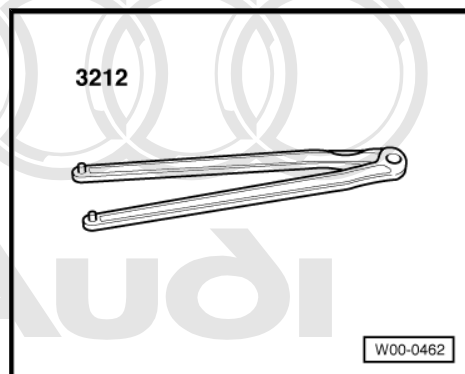
- Remove oil filter bracket ⇒ [page 174](#) .
- 1 - O-ring - renew
- 2 - O-ring - renew
- 3 - Oil retention valve for cylinder head (left-side), 20 Nm
- 4 - Banjo bolt, 15 Nm
- 5 - Spray nozzle valve for piston cooling spray nozzles, 20 Nm
- 6 - Oil pipe
- 7 - O-ring - renew
- 8 - Oil retention valve for cylinder head (right-side), 20 Nm
- 9 - O-ring - renew



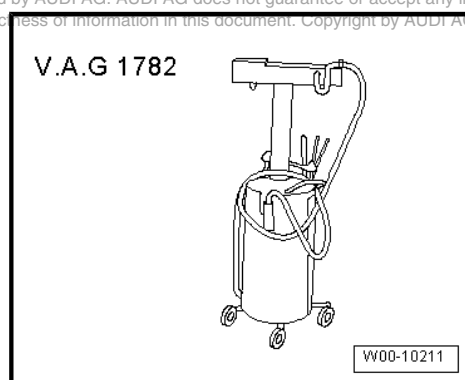
2.5 Removing and installing oil cooler

Special tools and workshop equipment required

- ◆ Pin wrench -3212-

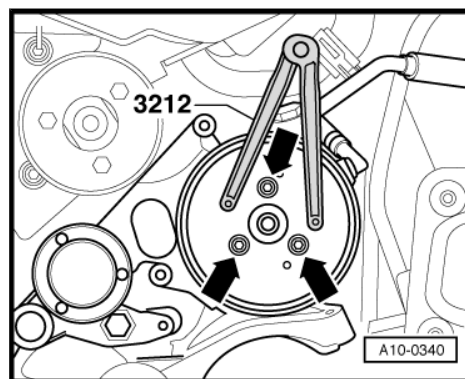


- ◆ Used oil collection and extraction unit -V.A.G 1782-



Removing

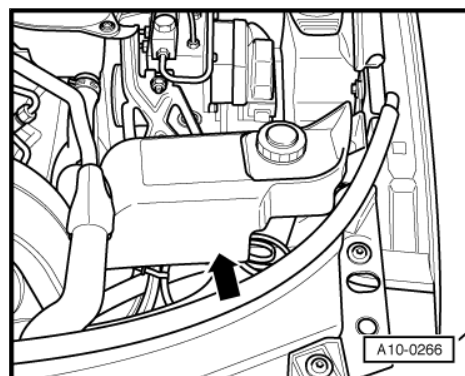
- Lock carrier must be in service position ⇒ [page 31](#) .
- Drain coolant ⇒ [page 181](#) .
- Remove poly V-belt for power steering pump, alternator and viscous fan ⇒ [page 36](#) .
- Unbolt poly V-belt pulley for power steering pump -arrows- using pin wrench -3212- as a counterhold.
- Unbolt power steering pump from bracket and place it on longitudinal member.



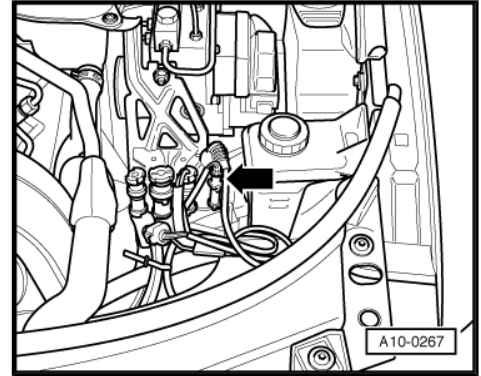
Note

Pipes of power steering pump remain connected.

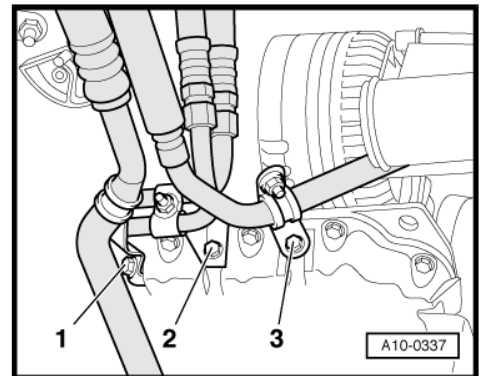
- Remove cover -arrow- at power steering fluid reservoir.



- Unplug connector -arrow- for magnetic clutch for air conditioner compressor and move wiring clear.



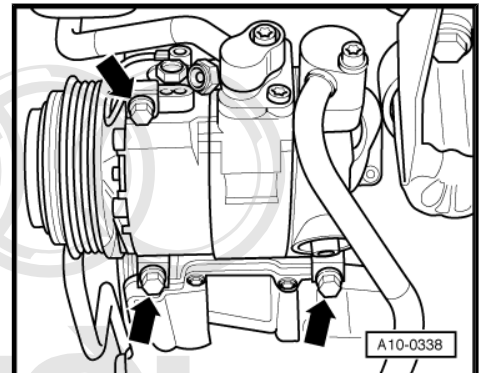
- Detach both brackets for refrigerant pipes -1- and -3- from sump.

**WARNING**

Risk of injury caused by refrigerant.

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

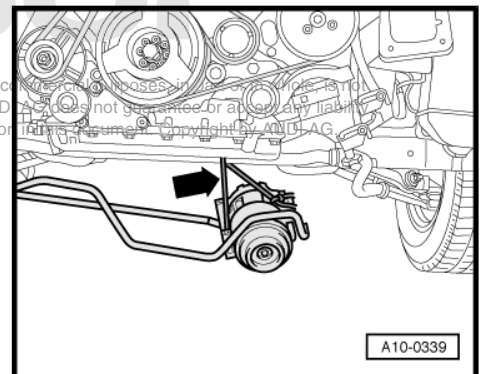
- Unbolt air-conditioner compressor from bracket -arrows-.

**Caution**

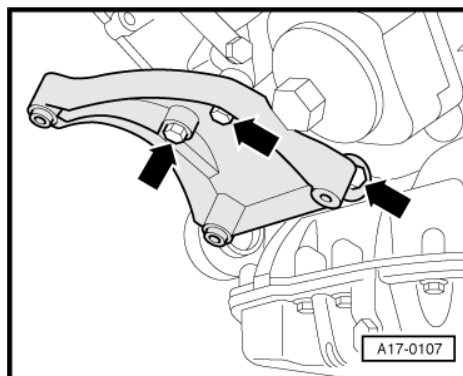
Danger of damage to refrigerant lines and hoses.

- ◆ *Do NOT stretch, kink or bend refrigerant lines and hoses.*

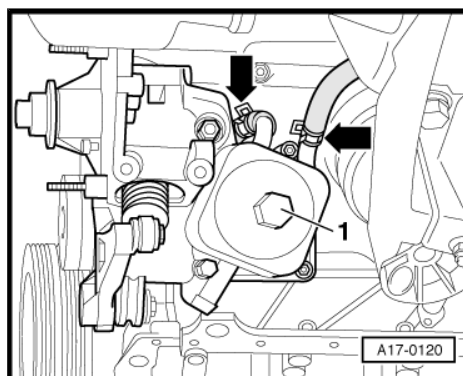
- Tie up air conditioner compressor onto subframe, leaving refrigerant lines connected -arrow-.



- Unbolt bracket for A/C compressor -arrows-.



- Slacken hose clips -arrows- and push clips back along hoses.
- Place used oil collection and extraction unit -V.A.G 1782- under engine.
- Detach rear hose from oil cooler.
- Unfasten bolted joint -1- and detach oil cooler.



Note

Caution - oil and coolant will come out.

Installing

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



Note

- ◆ Renew seals and gaskets.
- ◆ Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ *Electronic parts catalogue*.
- ◆ Make sure there is enough clearance between the hoses coming from the oil cooler and the surrounding components.
- Install poly V-belt for power steering pump, alternator and viscous fan ⇒ [page 36](#).
- Fill up with coolant ⇒ [page 184](#).
- Check engine oil level ⇒ Maintenance ; Booklet 802.

Tightening torques

Component	Nm
Power steering pump to bracket for power steering pump and oil cooler	22
Bracket for air con- Sump (top section) conditioner compressor to: Bracket for power steering pump and oil cooler	22
Air conditioner compressor to bracket	22
Poly V-belt pulley to power steering pump	22
Oil cooler to bracket for power steering pump and oil cooler	25

3 Engine oil

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

3.1 Checking engine oil level

Check engine oil level ⇒ Maintenance ; Booklet 802 .

3.2 Checking oil pressure and oil pressure switch

Special tools and workshop equipment required

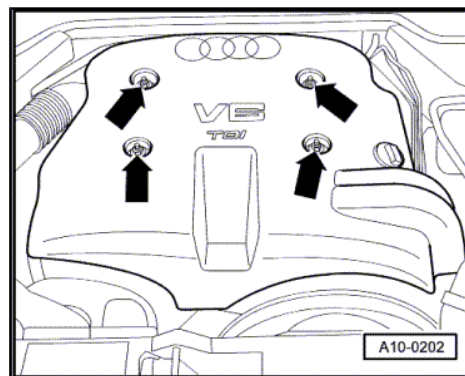
- ◆ Oil pressure tester - V.A.G 1342-
- ◆ Voltage tester -V.A.G 1527 B-
- ◆ Auxiliary measuring set - V.A.G 1594 C-

V.A.G 1342  Protected by copyright. Copying for private or commercial purposes, in part or in whole, is not permitted unless authorised by AUDI AG. AUDI AG does not guarantee or accept any liability with respect to the correctness of information in this document. Copyright by AUDI AG.	V.A.G 1527 B 
V.A.G 1594 C 	
	G17-0023

Procedure

- Oil level OK
- On vehicles with auto-check system, the "OK" display must light up (select symbol).
- Engine oil temperature approx. 80 °C.

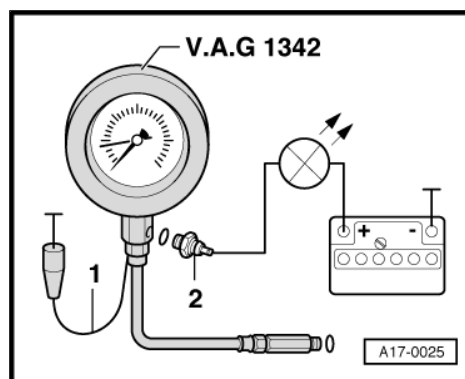
- Detach caps on engine cover panel.
- Unbolt and remove engine cover panel -arrows-.



- Unplug electrical connector on oil pressure switch -F1- .
- Unscrew oil pressure switch.
- Connect oil pressure tester -V.A.G 1342- to threaded hole for oil pressure switch.
- Screw oil pressure switch -F1- -Item 2- into oil pressure tester -V.A.G 1342- .

Checking oil pressure switch

- Connect brown wire -1- of oil pressure tester to earth (-).
- Connect voltage tester -V.A.G 1527 B- with test leads from auxiliary measuring set -V.A.G 1594 C- to oil pressure switch and battery positive (+).



- LED should not light up.

If LED lights up now:

- Renew oil pressure switch.
- Start engine.



Note

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

- LED should light up at 0.75 ... 1.05 bar.

If LED does not light up:

- Renew oil pressure switch.

Checking oil pressure

- Start engine.
- Oil pressure at idling speed: at least 0.8 bar
- Minimum oil pressure at 2000 rpm: 2.0 bar

19 – Cooling

1 Cooling system



WARNING

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

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



Note

- ◆ *The 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.*

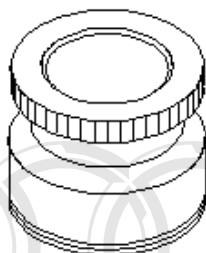
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1.1 Draining and filling cooling system

Special tools and workshop equipment required

- ◆ Adapter for cooling system tester -V.A.G 1274/8-
- ◆ Pipe for cooling system tester -V.A.G 1274/10-
- ◆ Hose clip pliers - V.A.G 1921-
- ◆ Cooling system charge unit -VAS 6096-
- ◆ Drip tray for workshop hoist -VAS 6208-
- ◆ Refractometer -T10007-

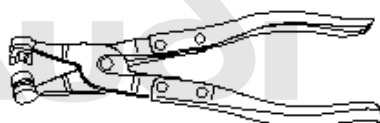
V.A.G 1274/8



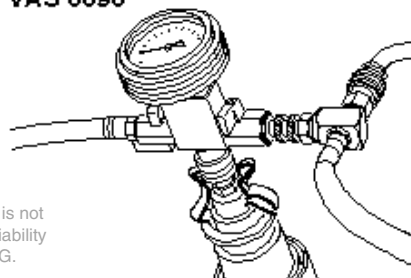
V.A.G 1274/10



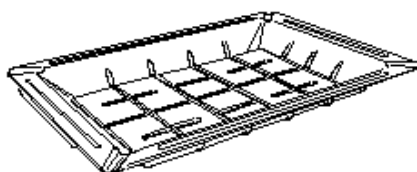
V.A.G 1921



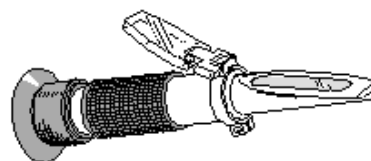
VAS 6096



VAS 6208



T10007



G19-10013

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Draining



Note

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



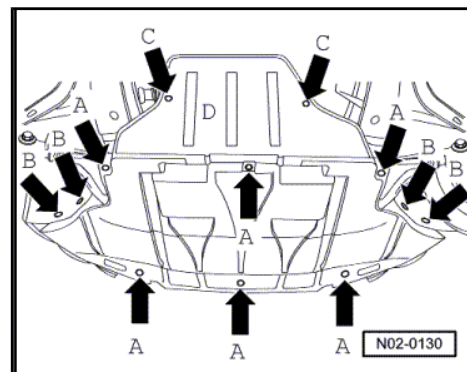
WARNING

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

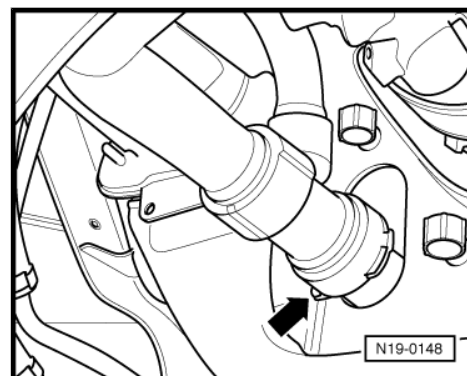
- ◆ The cooling system is under pressure when the engine is hot.
- ◆ To allow pressure to dissipate, cover filler cap on expansion tank with cloth and open carefully.

- Open filler cap on expansion tank.

- Open quick-release fasteners -A- and -B- and detach noise insulation (front).
- Place drip tray for workshop hoist -VAS 6208- beneath engine.

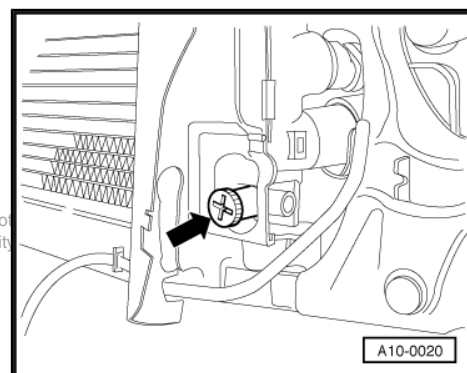


- Lift retaining clip -arrow- and disconnect coolant hose (bottom) from radiator.

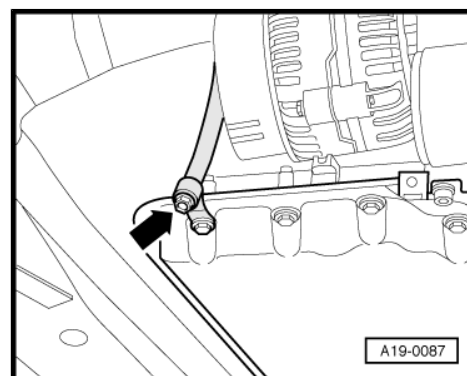
**Note**

When the bumper and the air duct for the charge air cooler are removed from the vehicle, the coolant can also be drained from the radiator via the drain plug -arrow-.

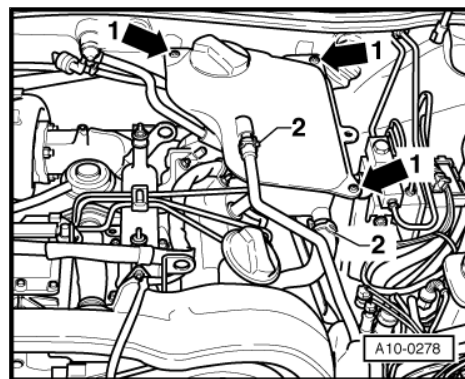
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- Open drain plug -arrow- and drain off coolant.



- Unbolt coolant expansion tank -arrows 1-.
- Detach wire for coolant shortage indicator switch -F66- and move coolant expansion tank to one side with coolant hoses -2- attached.



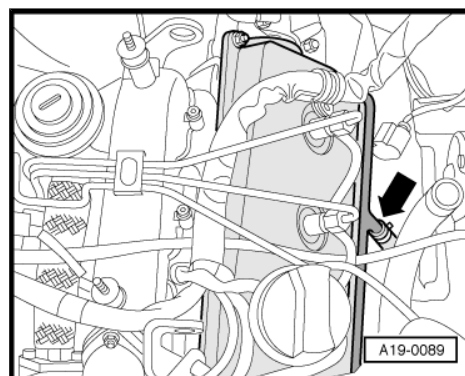
- Detach coolant hose -arrow- and press downwards to drain off coolant.

Filling

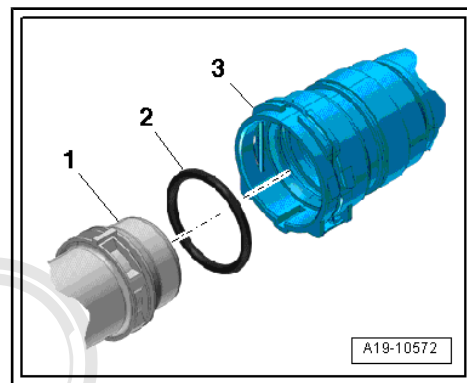


Note

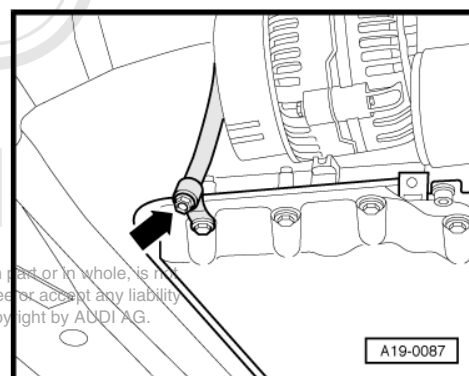
- ◆ The cooling system is filled all year round with a mixture of water and radiator antifreeze/anti-corrosion agent.
- ◆ Use only the radiator antifreeze/anti-corrosion agent approved for this engine ⇒ Electronic parts catalogue . Other coolant additives could seriously impair in particular the anticorrosion properties. The resulting damage could lead to loss of coolant and consequently to serious engine damage.
- ◆ The specified radiator antifreeze/anti-corrosion agent prevents frost and corrosion damage and stops scaling. Such additives also raise the boiling point of the coolant. For these reasons the cooling system must be filled all year round with the correct antifreeze and anticorrosion additive.
- ◆ Because of its high boiling point, the coolant improves engine reliability under heavy loads, particularly in countries with tropical climates.
- ◆ Frost protection is required down to about -25°C (in countries with arctic climate: down to about -35°C).
- ◆ The coolant concentration must not be reduced by adding water even in warmer seasons and in warmer countries. The antifreeze concentration must be at least 40 %.
- ◆ If greater frost protection is required in very cold climates, the concentration of radiator antifreeze/anti-corrosion agent can be increased, but only up to 60% (this gives frost protection to about -40°C). If the concentration exceeds 60%, frost protection decreases again and cooling efficiency is also impaired.
- ◆ Use only clean tap water for mixing coolant.
- ◆ Do not use drained coolant again if:
- ◆ radiator, heat exchanger for heater, cylinder head and cylinder head gasket or cylinder block have been renewed.
- ◆ the coolant is contaminated or dirty.
- ◆ Contaminated or dirty coolant must not be used again.
- ◆ For checking anti-freeze protection in cooling system, use refractometer -T10007- .
- ◆ Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .



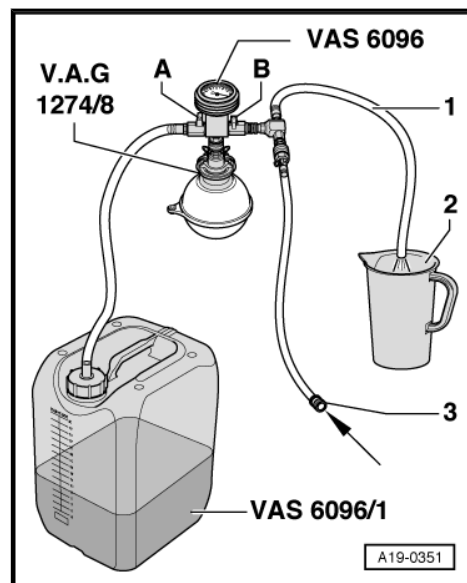
- Connect coolant hose to radiator with plug-in connector.
- Remove old O-ring -2- from coolant hose -3-.
- Lightly lubricate new O-ring with coolant and fit O-ring in coolant hose.
- Press coolant hose onto radiator -1- until it engages with a click.
- Press coolant hose in again and then pull to check that plug-in connector is correctly engaged.



- Renew seal and tighten drain plug -arrow-.
- Tightening torque: 10 Nm.
- Install and secure coolant hose to oil cooler/coolant pipe (top).



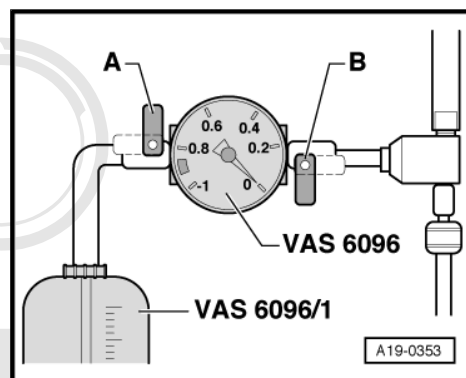
- Fill reservoir of cooling system charge unit -VAS 6096- with at least 10 litres of premixed coolant (according to recommended ratio):
 - Radiator antifreeze/anti-corrosion agent (40 %) and water (60 %) for frost protection to -25 °C
 - Radiator antifreeze/anti-corrosion agent (50 %) and water (50 %) for frost protection to -35 °C
 - Radiator antifreeze/anti-corrosion agent (60 %) and water (40 %) for frost protection to -40 °C
 - Radiator antifreeze/anti-corrosion agent ⇒ Electronic parts catalogue
- Fit adapter for cooling system tester -V.A.G 1274/8- onto coolant expansion tank.
- Attach cooling system charge unit -VAS 6096- to adapter -V.A.G 1274/8-.
- Run vent hose -1- into a small container -2-.

**Note**

The vented air draws along a small amount of coolant, which should be collected.

- Close both valves -A- and -B- (turn lever at right angles 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 of -VAS 6096- can fill with coolant.
- Close valve -A- again.
- Leave valve -B- open for another 2 minutes.
- The suction jet pump continues to generate a partial 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.

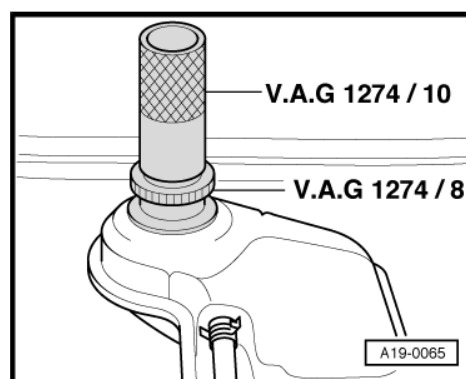


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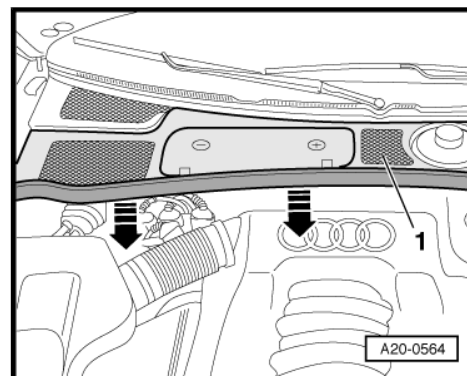


Note

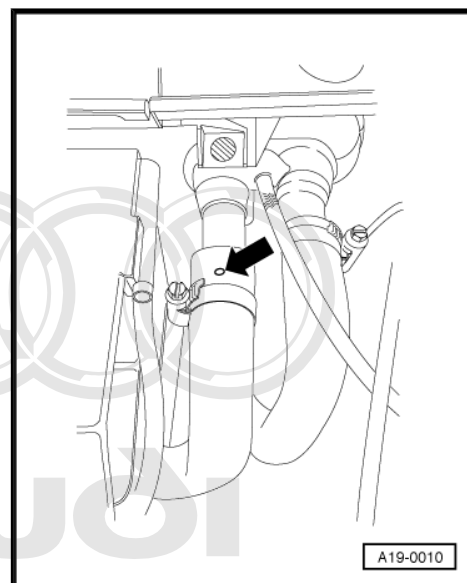
- ♦ If the needle does not reach the green zone, repeat the process.
- ♦ Check cooling system for leaks if the vacuum is not maintained.
- Detach compressed air hose.
- Open valve -A-.
- The vacuum in the cooling system causes the coolant to be drawn out of the reservoir of -VAS 6096- ; the cooling system is then filled.
- Detach cooling system charge unit -VAS 6096- from adapter -V.A.G 1274/8- on coolant expansion tank.
- Attach pipe -V.A.G 1274/10- onto adapter -V.A.G 1274/8- .



- If fitted, remove seal from plenum chamber cover -arrows-.
- Detach plenum chamber cover -1- towards the front.



- Unclip retaining clip securing boot at connection for heat exchanger and pull back boot.
- Release coolant hose going to heat exchanger and pull back hose until bleeder hole in hose -arrow- is no longer blocked by the connection.
- Fill up with coolant until it flows out at bleeder hole in coolant hose.
- Push coolant hose back onto connection and secure with hose clip.
- Close filler cap on expansion tank.
- Start engine.
- Run engine for 3 minutes at 2000 rpm.
- Then allow engine to idle until bottom coolant hose at radiator becomes hot.
- Switch off ignition and allow engine to cool down.
- Check coolant level.



- The coolant level must be at the MAX marking when the engine is cold.
- The coolant level can be above the MAX marking when the engine is warm.

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1.2 Coolant pump and thermostat - exploded view

1 - Bolt

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

2 - Bolt

- ☐ 10 Nm

3 - Screw plug

- ☐ 25 Nm

4 - Seal

- ☐ Renew

5 - Thermostat housing

6 - O-ring

- ☐ Renew

7 - Thermostat

- ☐ Removing and installing ⇒ [page 189](#)
- ☐ Checking ⇒ [page 195](#)

8 - Gasket

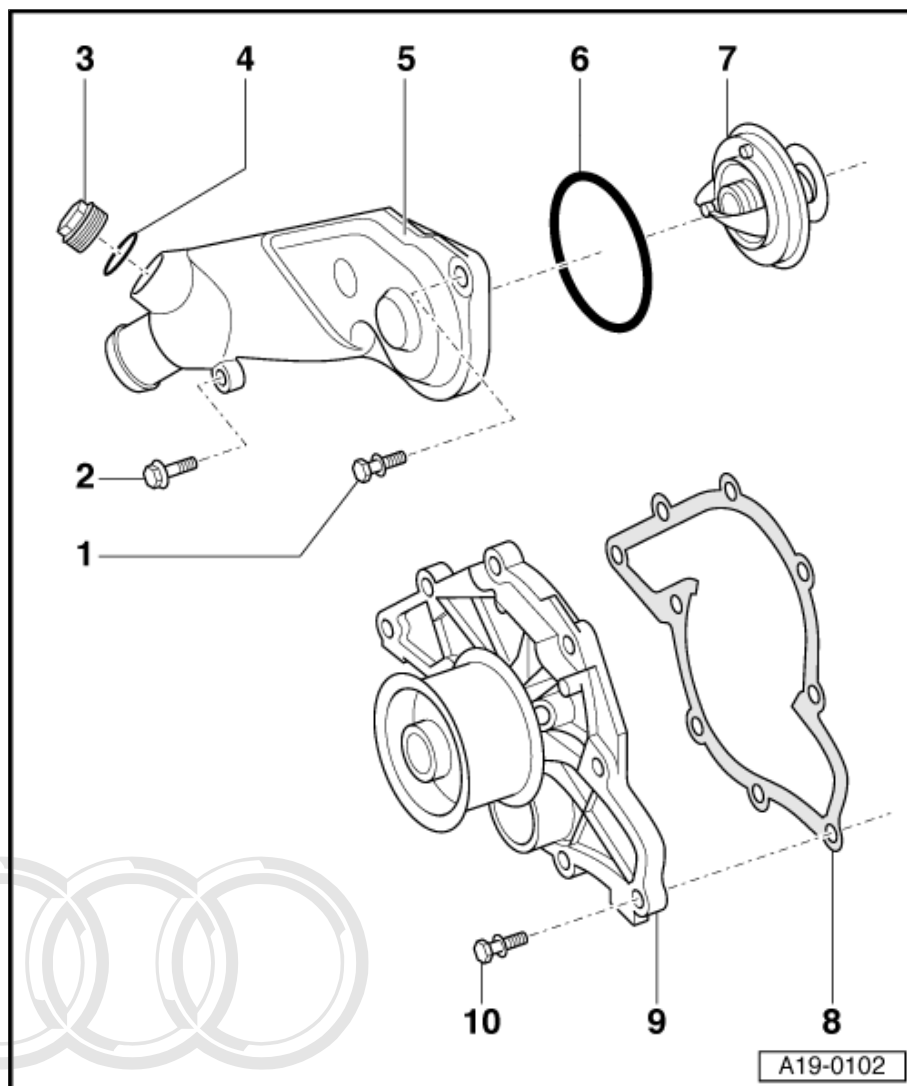
- ☐ Renew

9 - Coolant pump

- ☐ Removing and installing ⇒ [page 188](#)
- ☐ Check that pump runs freely

10 - Bolt

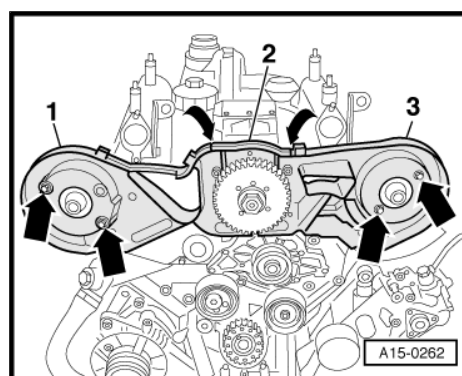
- ☐ 10 Nm



1.3 Removing and installing coolant pump

Removing

- Lock carrier must be in service position ⇒ [page 31](#)
- Drain coolant ⇒ [page 181](#)
- Remove toothed belt ⇒ [page 66](#) .
- Remove intake manifold (front section) ⇒ [page 101](#) .
- Lift off centre section of rear toothed belt cover -2-.
- Unscrew bolts -right arrows- and detach rear left toothed belt cover -3-.



- Unscrew bolts -arrows- and remove coolant pump.

Installing

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



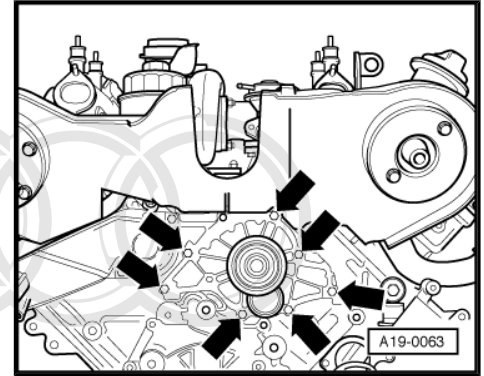
Note

Renew gaskets and seals.

- Install toothed belt (adjust valve timing) ⇒ [page 72](#) .
- Fill up with coolant ⇒ [page 184](#) .

Tightening torques

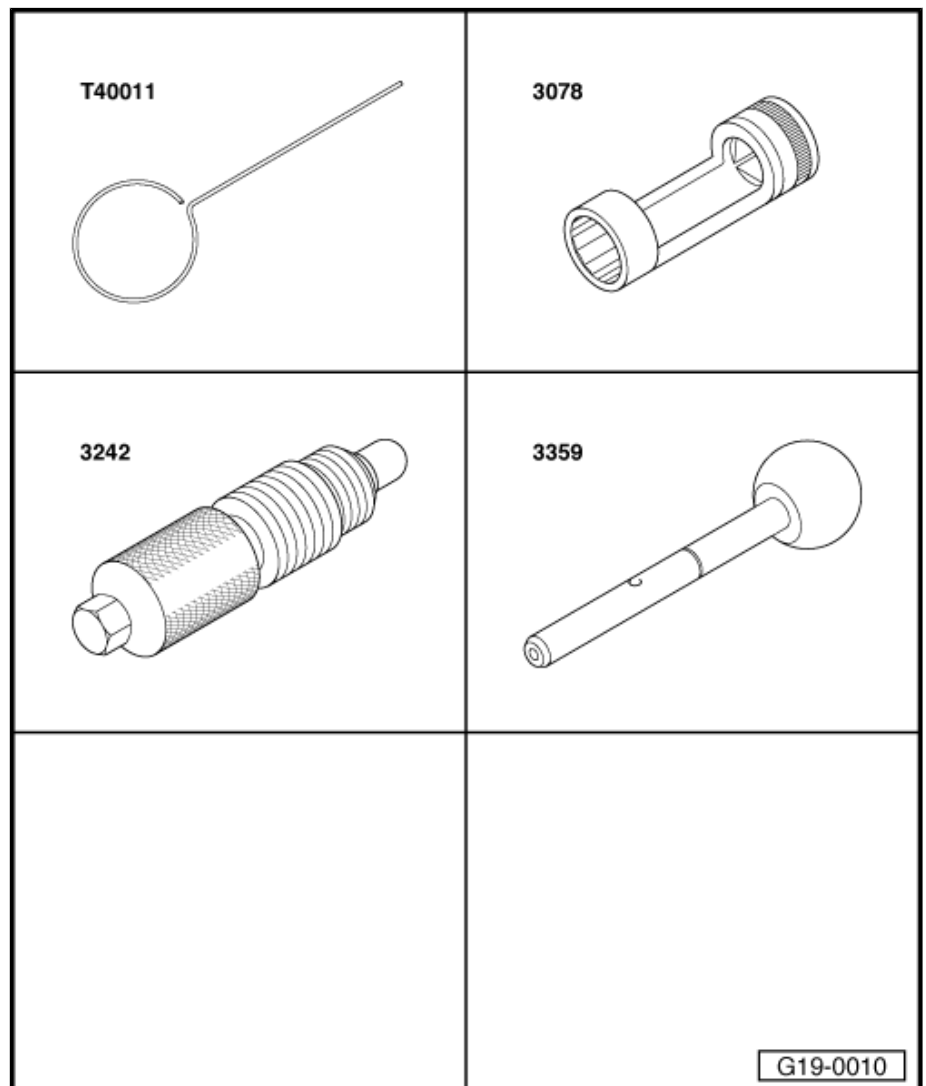
Component	Nm
Coolant pump to cylinder block	10
Cylinder head	10
Injection pump	10



1.4 Removing and installing thermostat

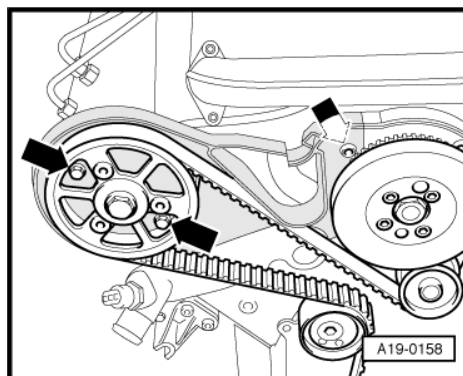
Special tools and workshop equipment required

- ◆ Locking pin -T40011-
- ◆ Socket (22 mm) -3078-
- ◆ Locking pin -3242-
- ◆ Diesel injection pump locking pin -3359-
- ◆ Locking fluid ⇒ Electronic parts catalogue



Removing

- Lock carrier must be in service position ➤ [page 31](#) .
- Remove poly V-belt for power steering pump, alternator and viscous fan ➤ [page 36](#) .
- Remove securing bolts -arrows- for toothed belt cover (rear right).
- Drain coolant ➤ [page 181](#) .

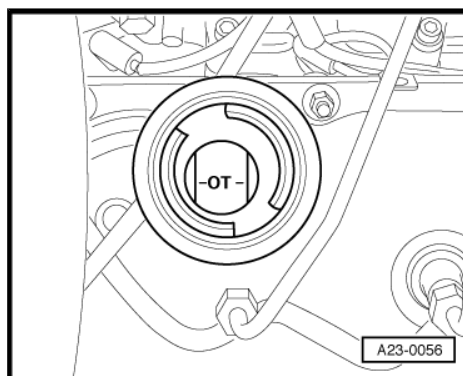


- Open oil filler cap.
- Turn engine until the marking “- OT -” (TDC) is visible on camshaft.



Caution

The engine must only be turned at the crankshaft, in the direction of normal engine rotation (clockwise).



Note

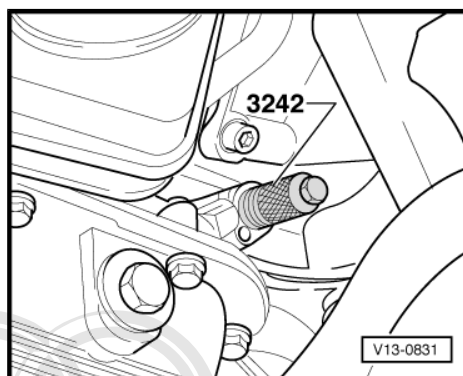
Turn over the engine at the central bolt on the crankshaft.

- Unscrew plug for TDC marking from cylinder block.



Note

There is a TDC drilling in the crankshaft directly behind the plug (it is possible to feel the hole).



WARNING

Injury risk.

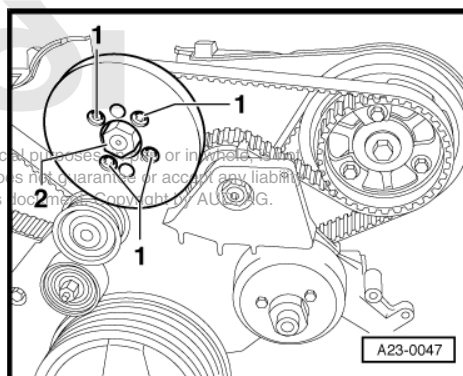
- ◆ **Do not rotate the crankshaft while feeling for the TDC drilling with your finger.**

- Screw locking pin -3242- into threaded hole where plug has been removed, and tighten.
- Remove vibration damper on injection pump sprocket (bolts -1-).



Caution

Do NOT loosen nut -2- for injection pump sprocket. Otherwise this would alter the basic setting of the injection pump. The setting cannot be re-adjusted with workshop equipment.



**Caution**

If a used belt runs in the opposite direction when it is refitted, this can cause breakage.

- ◆ *Before removing, mark direction of rotation of toothed belt with chalk or felt-tipped pen for re-installation.*

- Slacken toothed belt tensioner and take off toothed belt for injection pump.

- Remove 8 bolts -1- and detach vibration damper

**Note**

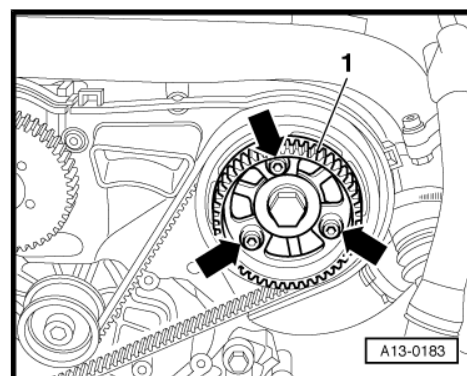
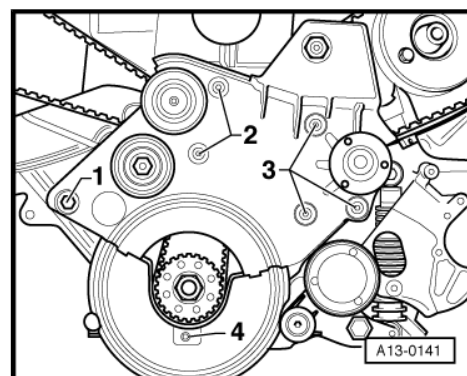
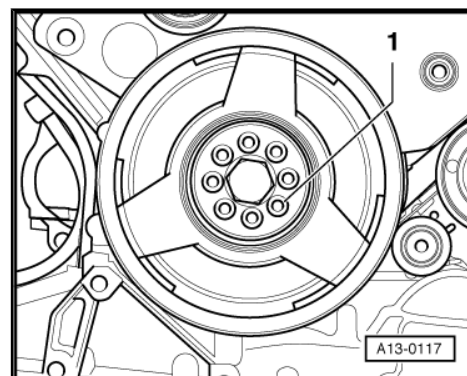
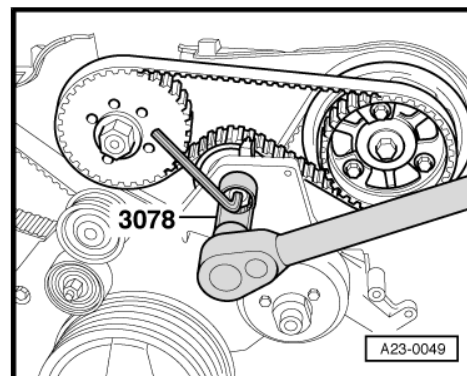
Central bolt does not have to be loosened when removing vibration damper.

- Unbolt bottom section of toothed belt cover -4-.
- Unbolt viscous fan pulley.
- Remove bolts -1 ... 3- and detach bracket for viscous fan with idler rollers.

- Unbolt drive sprocket -1- for injection pump from camshaft sprocket -arrows-.

**Note**

Do not use camshaft holders -3458- as counterhold tools.

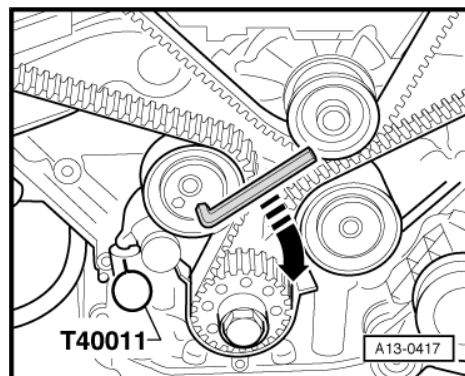


- Turn toothed belt tensioning roller in clockwise direction -arrow- using an 8 mm hexagon key until tensioning lever of tensioner is compressed far enough to allow locking pin - T40011- to be inserted into hole and plunger.



Note

The toothed belt tensioner is oil-damped and can therefore only be compressed slowly by applying constant pressure.

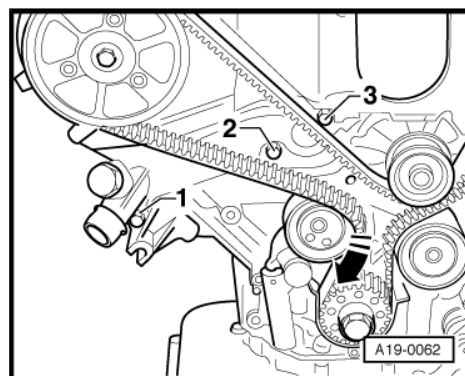


- Pull toothed belt forwards slightly on tensioning roller -arrow-.



Caution

Timing must be re-adjusted if toothed belt has slipped off tensioning roller ⇒ [page 72](#) .



- Detach coolant hose from thermostat housing.
- Remove bolts -1 ... 3- and detach thermostat housing.
- Remove O-ring and thermostat.

Installing

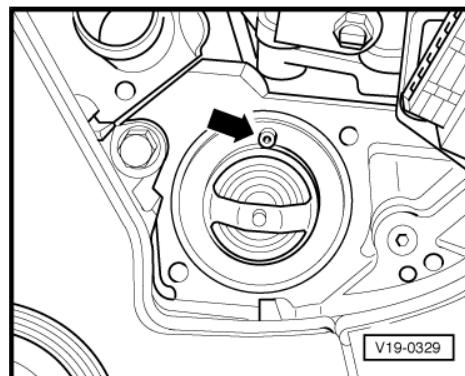
Installation is carried out in the reverse order; note the following:



Note

Renew seals and O-rings.

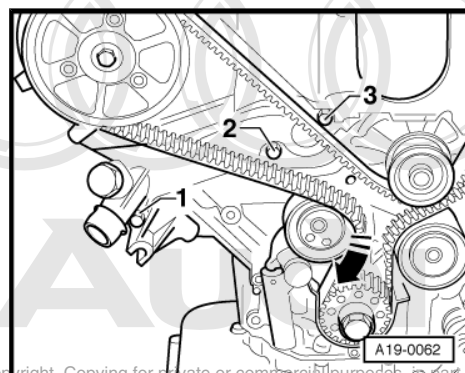
- Install thermostat (note installation position):
 - Vent valve -arrow- faces upwards.
 - O-ring faces towards housing.
- Install thermostat housing.
- Apply locking fluid to bolts -2- and -3- before installing.



Caution

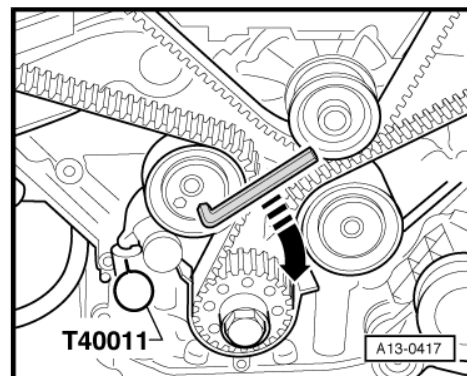
Timing must be re-adjusted if toothed belt has slipped off tensioning roller ⇒ [page 72](#) .

- Push toothed belt to rear.

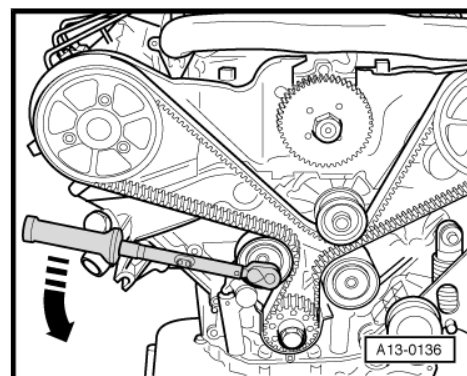


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- Use an 8 mm hexagon key to slacken toothed belt tensioning roller in clockwise direction -arrow- and pull out locking pin - T40011- .



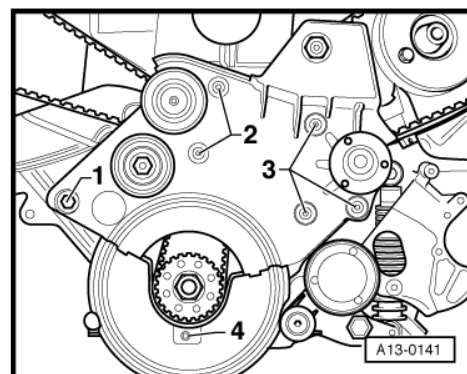
- Use torque wrench to pretension toothed belt to 15 Nm in anti-clockwise direction -arrow-.



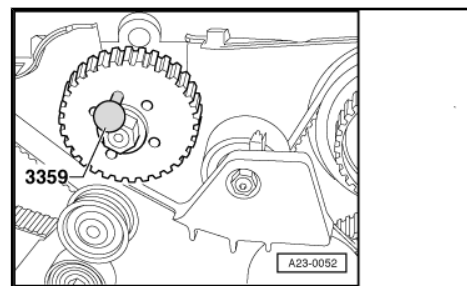
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- Tighten bolts for bracket for viscous fan:

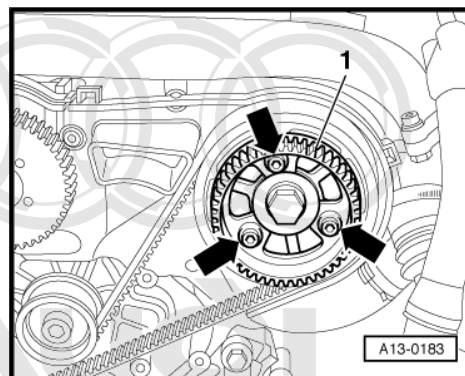
- 1 - 45 Nm
- 2 - 10 Nm
- 3 - 22 Nm
- 4 - 10 Nm



- Lock injection pump sprocket with diesel injection pump locking pin -3359- .



- Fit drive sprocket for injection pump -1- so that it is aligned centrally in elongated holes.
- Tighten drive sprocket -arrows- until it is still just possible to turn it on the camshaft sprocket.
- Position toothed belt for injection pump. Pay attention to the direction of rotation as marked upon removal.



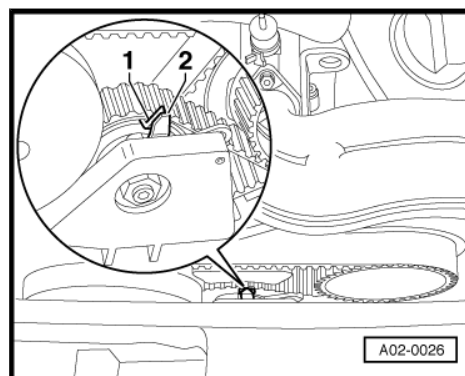
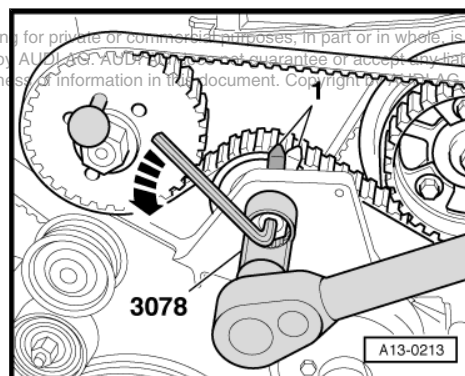
- Tension toothed belt by turning Allen key in anti-clockwise direction -arrow- until marks -1- coincide.
- Then tighten nut using socket (22 mm) -3078- .



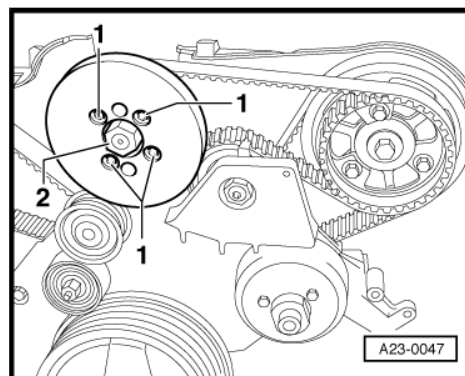
Note

Depending on version, pointer -1- may have no tip.

- Tighten bolts at camshaft sprocket.
- Remove diesel injection pump locking pin -3359- .
- Remove locking pin -3242- .
- Screw plug for the TDC mark into cylinder block with a new seal.
- Check tension of toothed belt for injection pump.
- Marks -1- and -2- must be opposite one another.



- Fit vibration damper on injection pump sprocket (bolts -1-).



- Install vibration damper. In doing so, pay attention to locking lug -arrow- on toothed belt sprocket.

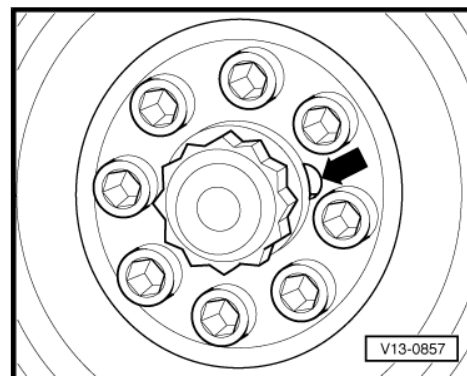
Remaining installation steps are carried out in reverse sequence; note the following:

- Install poly V-belt for power steering pump, alternator and viscous fan ⇒ [page 36](#) .
- Fill up with coolant ⇒ [page 184](#) .
- Dynamically check and adjust commencement of injection ⇒ Rep. Gr. 23 .

Tightening torques

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Component	Nm
Vibration damper to injection pump sprocket	22
Drive sprocket for injection pump to camshaft	22
Vibration damper to crankshaft sprocket	22
Screw plug in cylinder block	10
Tensioning roller for injection-pump toothed belt to bracket for viscous fan	36
Viscous fan pulley to hub	10
Viscous fan to bearing	70



1.5 Checking thermostat

- Heat removed thermostat in water bath.

Starts to open	Fully open	Opening travel
approx. 87 °C	approx. 102 °C ¹⁾	at least 8 mm
• ¹⁾ Cannot be tested.		

1.6 Coolant pipes - exploded view

1 - Bolt

- 10 Nm

2 - Bolt

- 22 Nm

3 - O-ring

- Renew

4 - Coolant temperature sender

- Coolant temperature display sender -G2- / coolant temperature sender -G62-

5 - Retaining clip

6 - Coolant pipe (right-side)

- Removing and installing ⇒ [page 200](#)

7 - Bracket

8 - Bolt

- 10 Nm

9 - Bolt

- 10 Nm

10 - Bolt

- 22 Nm

11 - Coolant pipe (top left)

- Removing and installing ⇒ [page 197](#)

12 - Bolt

- 10 Nm

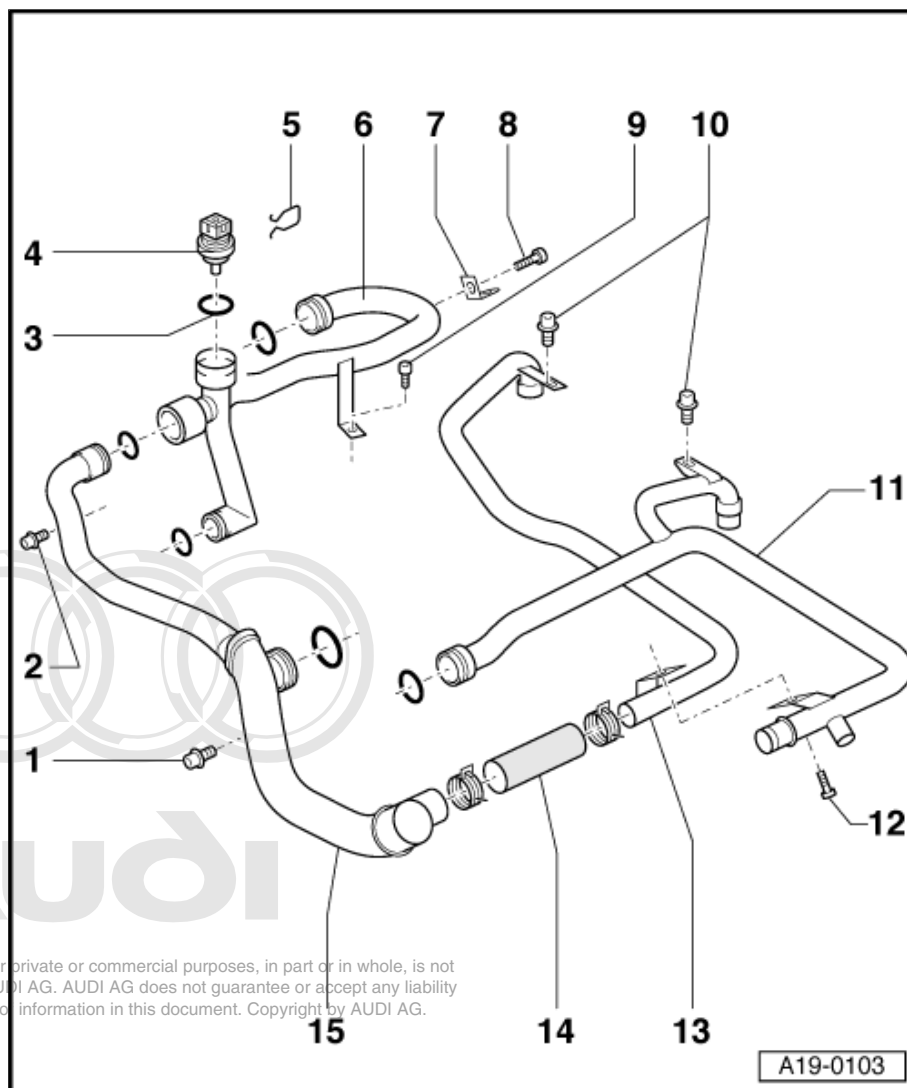
13 - Coolant pipe (bottom left)

- Removing and installing ⇒ [page 197](#)

14 - Coolant hose

15 - Coolant pipe (front)

- Removing and installing ⇒ [page 196](#)

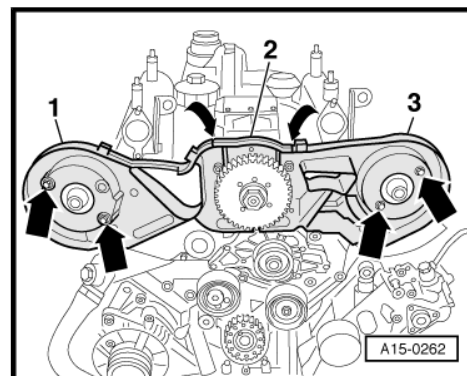


1.7 Removing and installing coolant pipe (front)

Removing

- Lock carrier must be in service position ⇒ [page 31](#) .
- Drain coolant ⇒ [page 181](#) .
- Remove toothed belt ⇒ [page 66](#) .
- Remove camshaft sprocket (right-side).
- Remove intake manifold (front section) ⇒ [page 101](#) .

- Lift off centre section of rear toothed belt cover -2-.
- Unscrew bolts -arrows- and detach rear left toothed belt cover -3- and rear right toothed belt cover -1-.



- Disconnect both coolant hoses -arrows-.
- Remove bolts -1- and -2-.
- Pull off coolant pipe towards the front.

Installing

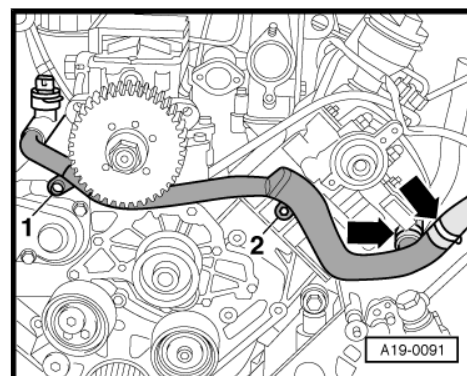
Installation is carried out in the reverse order; note the following:



Note

Renew seals and O-rings.

- Clean and smoothen sealing surface for O-ring.
- Lubricate O-ring with coolant and slide onto coolant pipe.
- Slide coolant pipe (front) into coolant pipe (right-side) and into bore in cylinder head.
- Install toothed belt (adjust valve timing) ⇒ [page 72](#) .
- Fill up with coolant ⇒ [page 184](#) .
- Dynamically check and adjust commencement of injection ⇒ Rep. Gr. 23 .



Tightening torques

Component		Nm
Front coolant pipe to:	Cylinder block	22
	Cylinder head	10
Toothed belt cover (rear) to	Cylinder head	10
	Injection pump	10

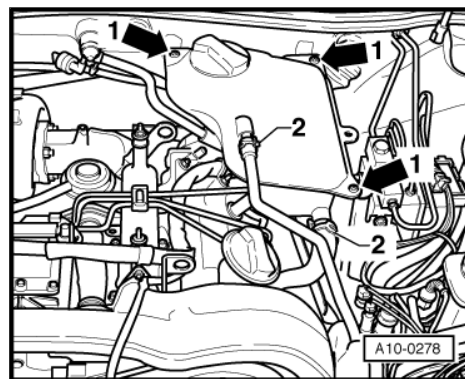
1.8 Removing and installing coolant pipes (top left and bottom left)

Removing

- Lock carrier must be in service position ⇒ [page 31](#) .
- Drain coolant ⇒ [page 181](#) .
- Remove oil filter bracket ⇒ [page 174](#) .

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- Remove coolant hoses -2-.
- Unbolt coolant expansion tank -arrows 1-.
- Disconnect electrical wiring at coolant shortage indicator switch -F66- and detach coolant expansion tank.

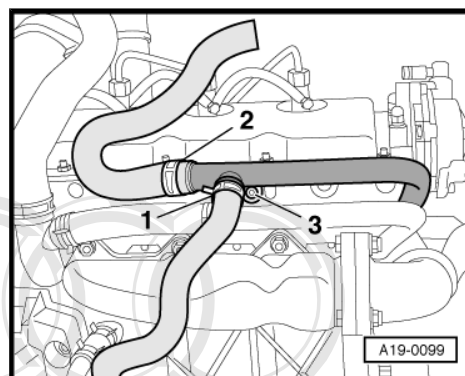


- Disconnect coolant hoses -1- and -2- at coolant pipe.
- Remove bolt -3-.

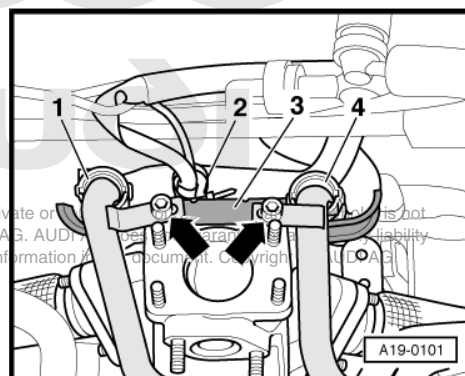


Note

Illustration shows coolant pipe with engine removed.



- Release cable tie -2- at rear of heat shield and move wiring clear.
- Unbolt heat shield -3- from intermediate flange -arrows- and remove.
- Disconnect coolant hoses -1- and -4- from coolant pipes.
- Pull coolant pipe to rear out of cylinder block.
- Swivel rear part of coolant pipe to top right and remove.



- Disconnect coolant hose -arrow-.
- Remove coolant pipe (bottom left).

Installing

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

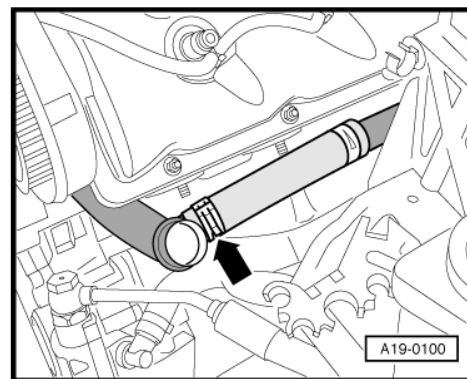


Note

- ◆ *Renew self-locking nuts.*
- ◆ *Renew seals and O-rings.*
- Install coolant pipe (bottom).
- Clean and smoothen sealing surface for O-ring.
- Lubricate O-ring with coolant and slide onto coolant pipe.
- Slide coolant pipe (top) into bore in cylinder block.
- Install oil filter bracket ⇒ [page 174](#) .
- Fill up with coolant ⇒ [page 184](#) .

Tightening torques

Component		Nm
Coolant pipe to:	Intermediate flange	22
	Cylinder head	10



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1.9 Removing and installing coolant pipe (right-side)

Removing

- Drain coolant ⇒ [page 181](#) .
- Remove oil filter bracket ⇒ [page 174](#) .
- Remove bolts -2- and -3-.
- Press coolant pipe -1- to rear and detach.

Installing

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

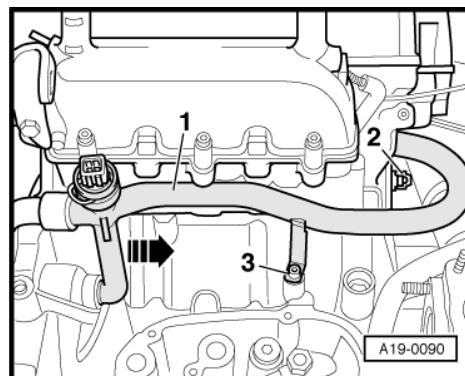


Note

- ◆ *Renew self-locking nuts.*
- ◆ *Renew seals and O-rings.*
- Clean and smoothen sealing surface for O-ring.
- Lubricate O-ring with coolant and slide onto coolant pipe.
- Slide coolant pipe into bores in cylinder block and cylinder head.
- Install oil filter bracket ⇒ [page 174](#) .
- Fill up with coolant ⇒ [page 184](#) .

Tightening torques

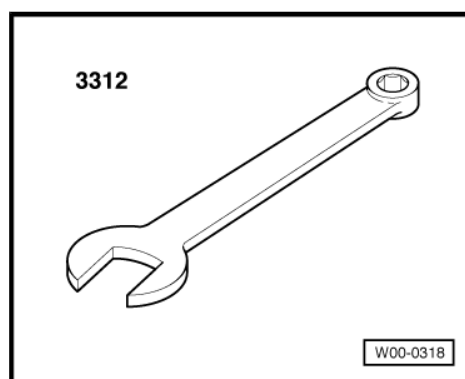
Component	Nm
Coolant pipe (right-side) Cylinder block to:	10
Cylinder head	10



1.10 Removing and installing viscous fan

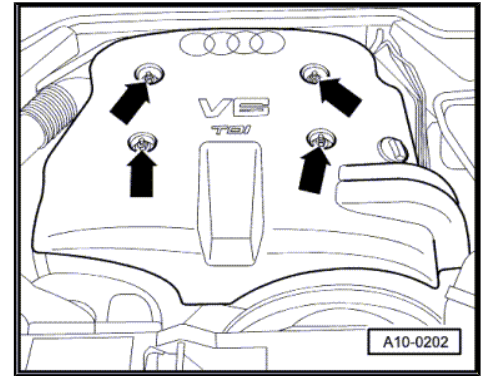
Special tools and workshop equipment required

- ◆ Open-end spanner -3312-

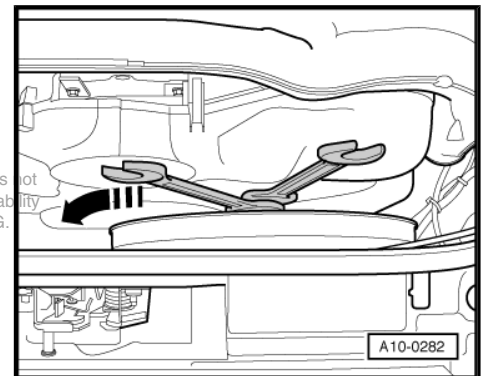


Removing

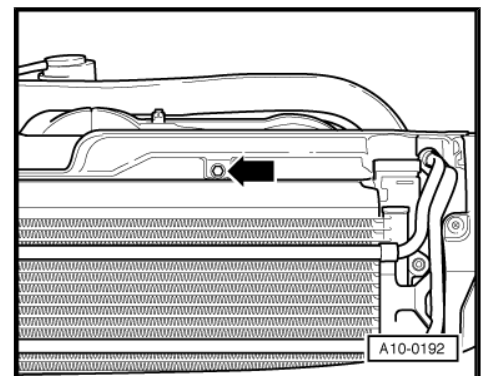
- Lock carrier must be in service position ⇒ [page 31](#) .
- Detach caps on engine cover panel.
- Unbolt and remove engine cover panel -arrows-.



- Unscrew viscous fan (32 mm).



- Unscrew bolt -arrow- from front and remove air duct for viscous fan.
- Detach viscous fan with air duct.

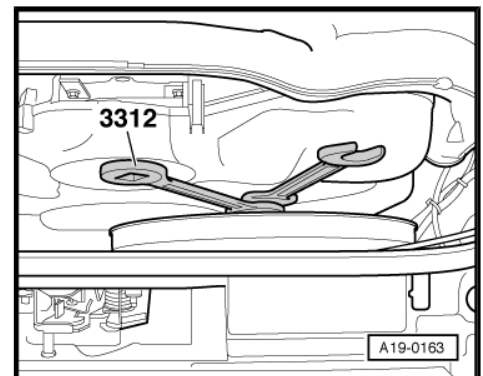


Installing

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

- Secure viscous fan.

Tightening torque for viscous fan	Nm
Torque wrench -V.A.G 1331- together with open-end spanner -3312-	37
Torque wrench -V.A.G 1331- without open-end spanner -3312-	70



1.11 Removing and installing radiator

Special tools and workshop equipment required

◆ Drip tray for workshop hoist -VAS 6208-

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Removing



Note

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

- Remove front bumper ⇒ Rep. Gr. 63 .
- Remove air duct in front of charge air cooler -arrows-.
- Detach cooling pipe for power steering hydraulic fluid -arrows-.
- Place drip tray for workshop hoist -VAS 6208- beneath engine.

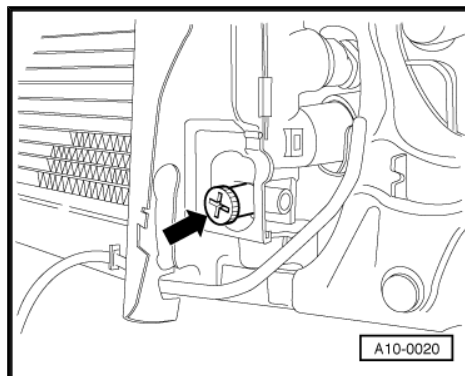
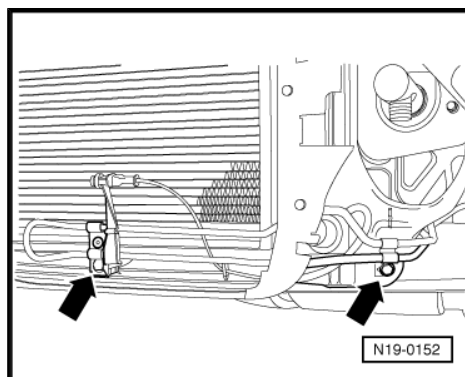
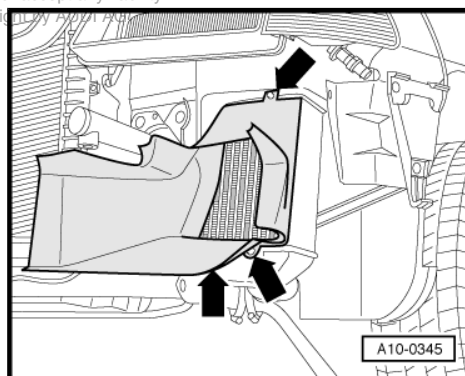
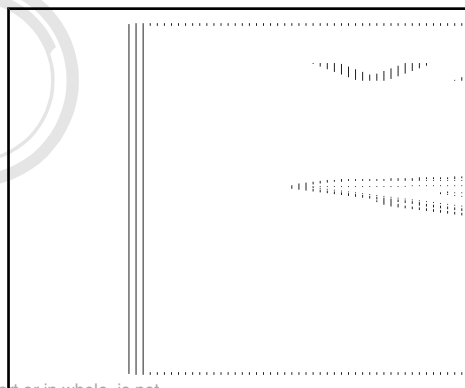


WARNING

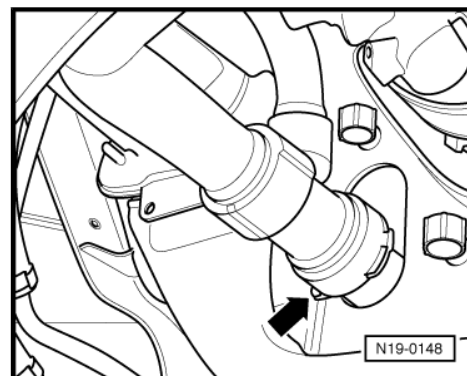
Hot steam/hot coolant can escape - risk of scalding.

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

- Open filler cap on expansion tank.
- Turn drain plug -arrow- on radiator anti-clockwise, if necessary fit drain hose to connection.



- Lift retaining clip -arrow- and disconnect coolant hoses from radiator.
- On vehicles with automatic gearbox, detach ATF pipes from radiator ⇒ Rep. Gr. 37 .



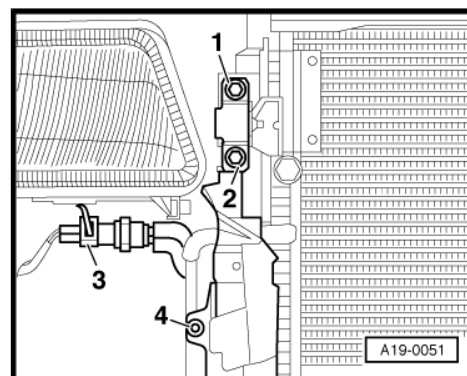
- Detach air ducts (left and right) from radiator -4-.

**WARNING**

Risk of injury caused by refrigerant.

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

- Remove bolts -1- and -2- for condenser.
- Unplug connector -3- at air conditioning system pressure switch -F129- .

**Caution**

Make sure that condenser and refrigerant pipes and hoses are not damaged.

- ◆ *Do NOT stretch, kink or bend refrigerant lines and hoses.*

- Pull condenser up out of its bracket, pivot to side and secure to right-side front wheel with wire.

**Note**

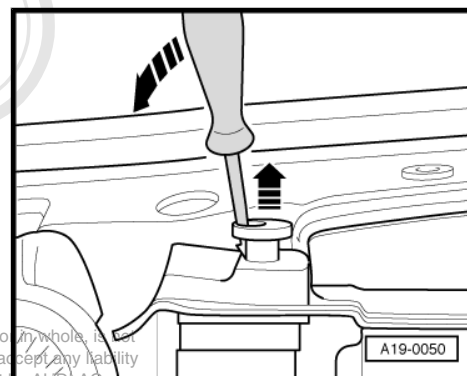
Protect wing panels from damage.

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

Installing

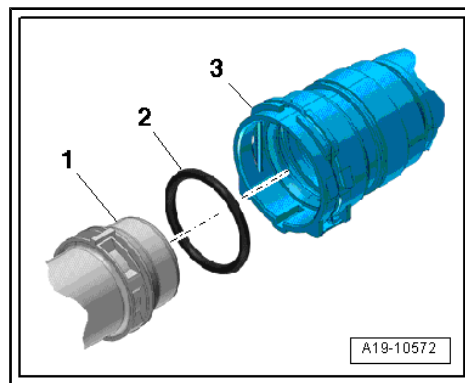
Installation is carried out in the reverse order; note the following:

- On vehicles with automatic gearbox, secure ATF pipes and check ATF level ⇒ Rep. Gr. 37 .



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- Connect coolant hose to radiator with plug-in connector.
- Remove old O-ring -2- from coolant hose -3-.
- Lightly lubricate new O-ring with coolant and fit O-ring in coolant hose.
- Press coolant hose onto radiator -1- until it engages with a click.
- Press coolant hose in again and then pull to check that plug-in connector is correctly engaged.
- Install front bumper ⇒ Rep. Gr. 63 .
- Fill up with coolant ⇒ [page 184](#) .



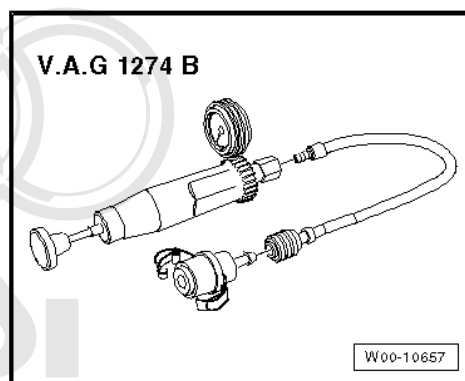
Tightening torques

Component	Nm
Condenser to radiator	10
Cooling pipe to radiator	10

1.12 Checking cooling system for leaks

Special tools and workshop equipment required

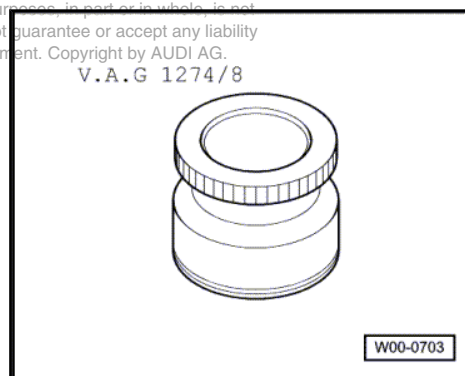
- ◆ Cooling system tester -V.A.G 1274 B-



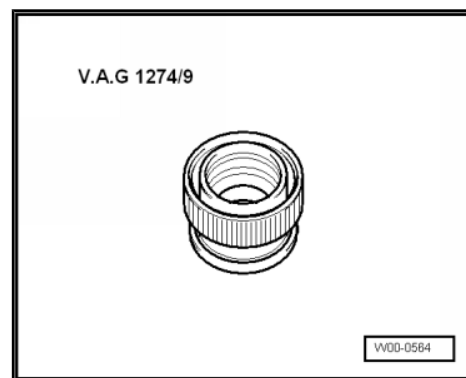
- ◆ Adapter for cooling system tester -V.A.G 1274/8-

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V.A.G 1274/8



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



Procedure

- Engine must be warm.

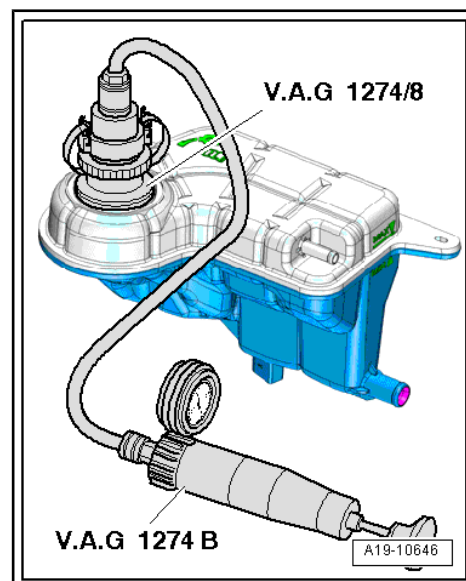


WARNING

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

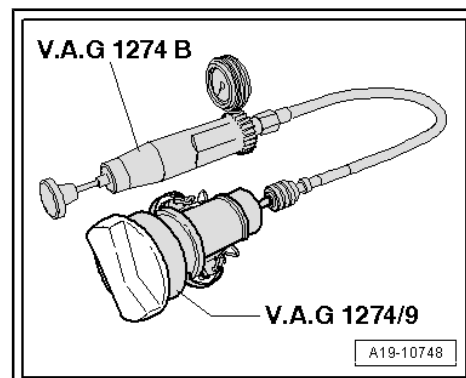
- ◆ *The cooling system is under pressure when the engine is hot.*
- ◆ *Cover filler cap on expansion tank with a cloth and open carefully to dissipate pressure.*

- Open filler cap on expansion tank.
- Fit cooling system tester -V.A.G 1274 B- with adapter - V.A.G 1274/8- onto coolant expansion tank.
- Using hand pump on cooling system tester, build up a pressure of approx. 1.0 bar.
- If this pressure is not maintained, locate and rectify leaks.



Checking pressure relief valve in filler cap

- Fit cooling system tester -V.A.G 1274 B- with adapter - V.A.G 1274/9- onto filler cap.
- Build up pressure with hand pump on cooling system tester.
- The pressure relief valve should open at a pressure of 1.4 ... 1.6 bar.
- Renew filler cap if pressure relief valve does not open as described.



- No leaks in vacuum hoses.
- Vacuum pipe to charge pressure regulating valve not obstructed, loose or leaking.
- No faults on engine or injection system (e.g. compression pressure/commencement of injection or injectors).

1.3 Effects of leaks in charge air system

A - Leaks downstream of air mass meter

Possible causes of trouble:

- 1 - Hose connecting air mass meter to turbocharger
- 2 - Connecting hose to crankcase breather

Effect:

- Loss of power

B - Leaks downstream of turbocharger (intake side)

Possible causes of trouble:

- 1 - Air intake hoses and pipes between turbocharger and charge air cooler
- 2 - Air hoses and pipes between charge air cooler and intake manifolds
- 3 - Charge air cooler
- 4 - Seal underneath charge air pressure sender -G31-
- 5 - Seals between intake manifolds
- 6 - Gaskets between intake manifold and cylinder head

Effect:

- Inadequate charge pressure

C - Leaks downstream of turbocharger (exhaust side)

Possible causes of trouble:

- 1 - Components of exhaust gas recirculation system
- 2 - Connection between exhaust manifold and cylinder head
- 3 - Connection between exhaust manifold and exhaust pipes
- 4 - Connection between exhaust pipes and intermediate flange
- 5 - Connection between exhaust manifold and turbocharger

Effect:

- Inadequate charge pressure; possible smell of exhaust gas traces of soot in engine compartment

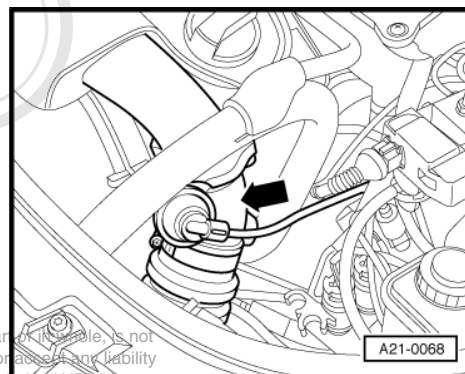

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1.4 Checking turbocharger and charge pressure control - vehicles without plug in intake manifold



Note

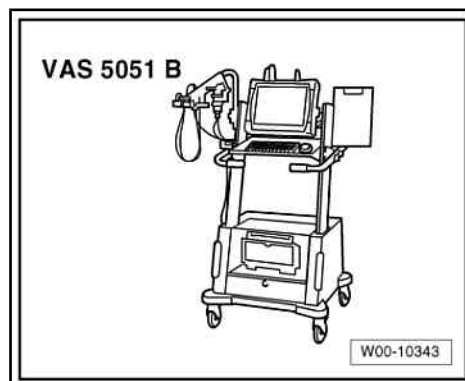
On the first production version of the engine, there is no plug in the intake manifold -arrow-.



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Special tools and workshop equipment required

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



Procedure

- Charge pressure is measured under full load while driving or on a roller dynamometer.
- Test duration per measurement: max. 10 seconds



Note

- ◆ Ensure absolute leakproof connection of hoses to avoid measurement errors.
- ◆ Before performing the test, drive vehicle moderately fast for at least 3 km (without stopping at traffic lights etc.).



WARNING

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

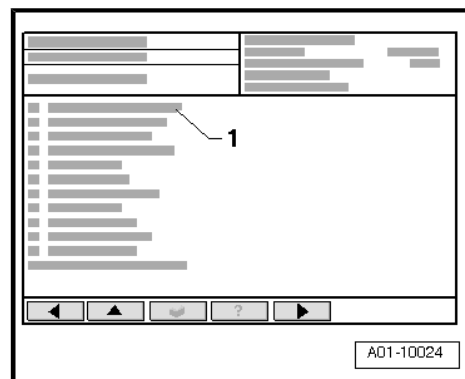
- ◆ Observe safety precautions ⇒ [page 3](#).

- Vehicle diagnostic, testing and information system -VAS 5051B- connected.
- Engine running.

- **Vehicle self-diagnosis** and vehicle system "01 - Engine electronics" selected.

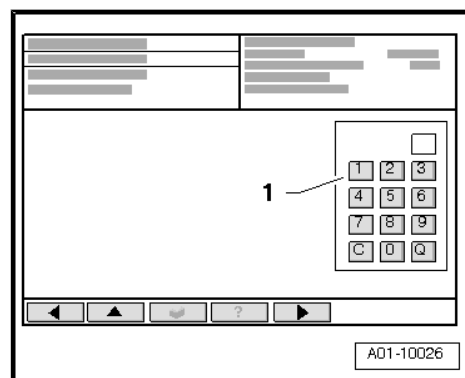
Display on -VAS 5051B- :

- From menu -1-, select diagnosis function "Measured values" and press **[Q]** key to continue.



Display on -VAS 5051B- :

- Press keys **[1] [1]** on keypad -1- to select "Display group 011" and confirm entry by pressing **[Q]** key.
- Accelerate vehicle in 3rd gear (or position 2) from 2000 rpm at full throttle while a second mechanic observes the rev counter.
- Second mechanic should press **[PRINT]** key on -VAS 5051B- at approx. 3000 rpm.



Display on -VAS 5051B- :

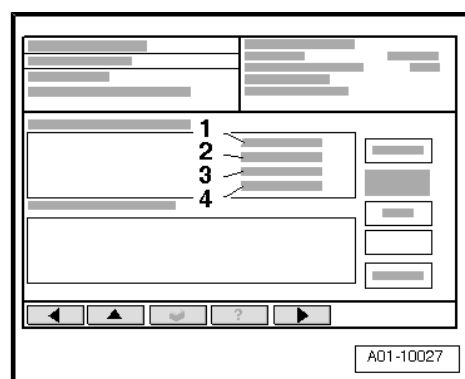
- Check display in display zone -3-.
- Specification: 1960 ... 2160 mbar.

If charge pressure is not within the specified range:

- Check linkage and vacuum unit for charge pressure control ⇒ [page 219](#)
- Check charge pressure control solenoid valve -N75- ⇒ [page 212](#) .

If both are OK, but the charge pressure is too low:

- Renew turbocharger ⇒ [page 226](#) .

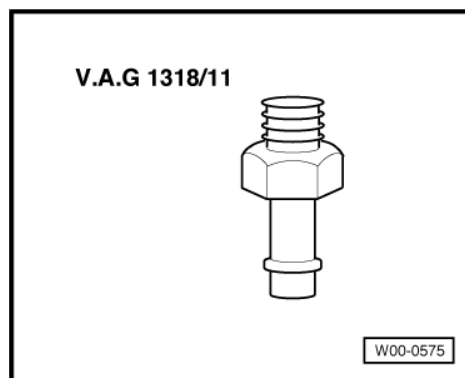


1.5 Checking turbocharger and charge pressure control - vehicles with plug in intake manifold

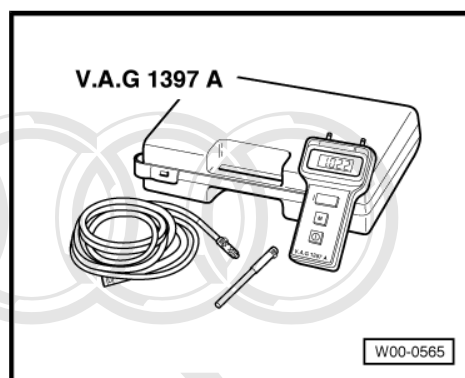
Special tools and workshop equipment required

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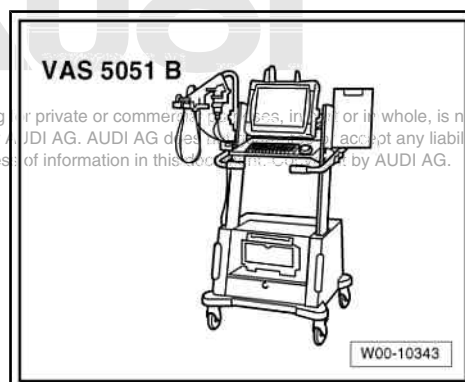
◆ Adapter -V.A.G 1318/11-



◆ Turbocharger tester -V.A.G 1397A-



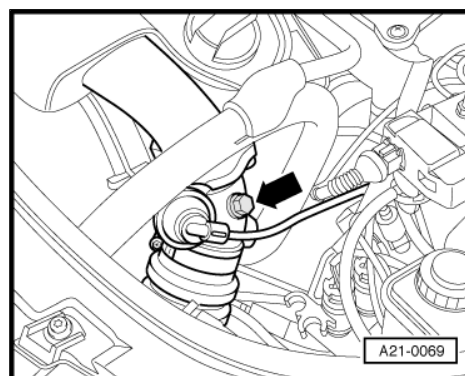
◆ Vehicle diagnostic, testing and information system -VAS 5051B-



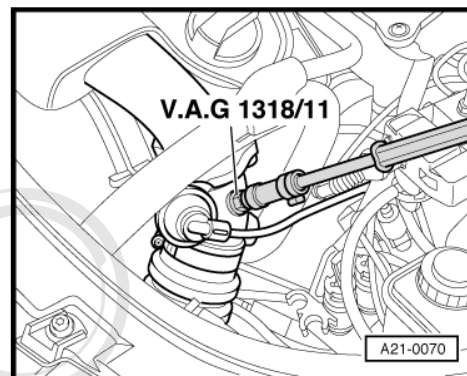
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Procedure

- Charge pressure is measured under full load while driving or on a roller dynamometer.
- Test duration per measurement: max. 10 seconds
- Unscrew plug -arrow- at intake manifold (front).



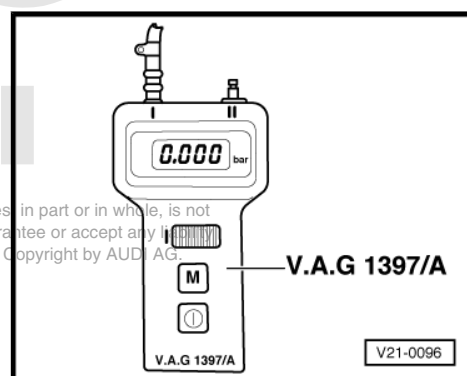
- Screw adapter -V.A.G 1318/11- into hole in intake manifold.
- Connect adapter -V.A.G 1318/11- to hose of turbocharger tester -V.A.G 1397A- using test hoses.
- Route test hose under rear edge of bonnet and through right window into passenger compartment.



- Switch on turbocharger tester and set measuring range selector switch to position -I- (absolute pressure).
- Attach test hose to connection -I-.

**Note**

- ◆ *Ensure absolute leakproof connection of hoses to avoid measurement errors.*
- ◆ *Take care not to trap test hose at bonnet and side window.*
- ◆ *Pressing memory button -M- on turbocharger tester causes last measured value to be stored until memory button -M- is pressed again or tester is switched off.*
- ◆ *The decimal point in the display flashes to indicate that the value is being stored.*
- ◆ *If the battery voltage of the turbocharger tester drops below the minimum level, an arrow will appear at the top left of the display.*
- ◆ *Before performing the test, drive vehicle moderately fast for at least 3 km (without stopping at traffic lights etc.).*

**WARNING**

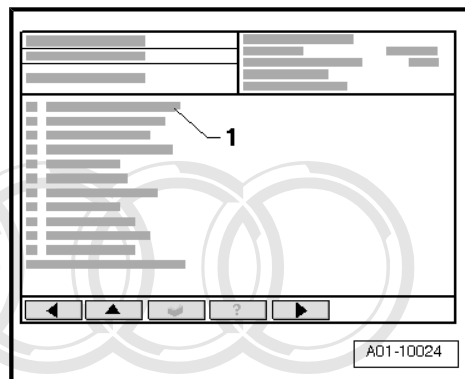
Accidents can be caused if the driver is distracted by test equipment while road-testing, or if test equipment is not properly secured.

- ◆ *Observe safety precautions ⇒ page 3.*

- Vehicle diagnostic, testing and information system -VAS 5051B- connected.
- Engine running.
- Vehicle self-diagnosis and vehicle system "01 - Engine electronics" selected.

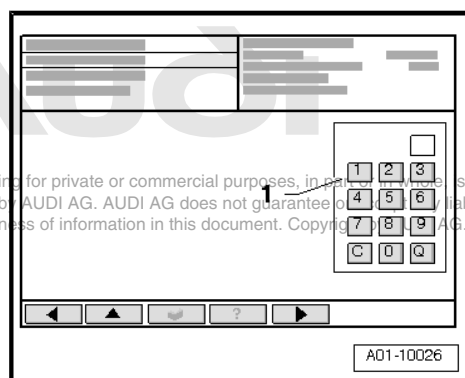
Display on -VAS 5051B- :

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



Display on -VAS 5051B- :

- Press keys on keypad -1- to select "Display group 011" and confirm entry by pressing key.
- Accelerate vehicle in 3rd gear (or position 2) from 2000 rpm at full throttle while a second mechanic observes the rev counter.
- Have the second mechanic press key on -VAS 5051B- and memory key -M- on -V.A.G 1397A- simultaneously at approx. 3000 rpm.

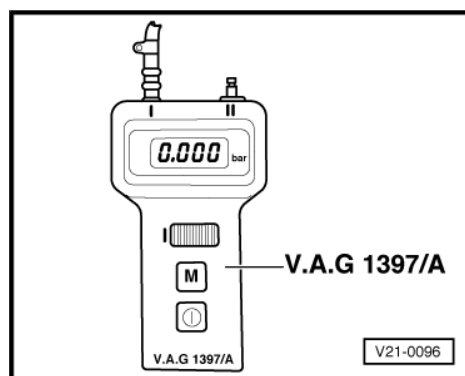


Note

The charge pressure should be measured using turbocharger tester -V.A.G 1397A-. Vehicle diagnostic, testing and information system -VAS 5051B- is used to check whether the charge pressure is being registered by the control unit.

Display on -V.A.G 1397 A- :

- Specification: 1.960 ... 2.160 bar.



Display on -VAS 5051B- :

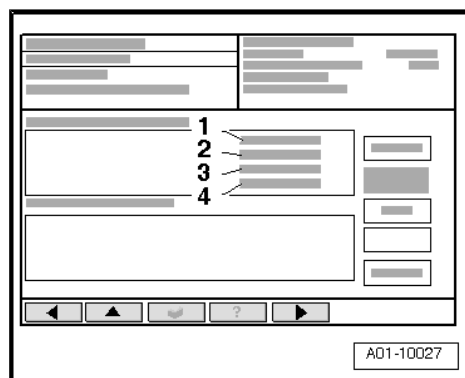
- Check display in display zone -3-.
- Specification: 1960 ... 2160 mbar.

If charge pressure is not within the specified range:

- Check linkage and vacuum unit for charge pressure control ⇒ [page 219](#).
- Check charge pressure control solenoid valve -N75- ⇒ [page 212](#).

If both are OK, but the charge pressure is too low:

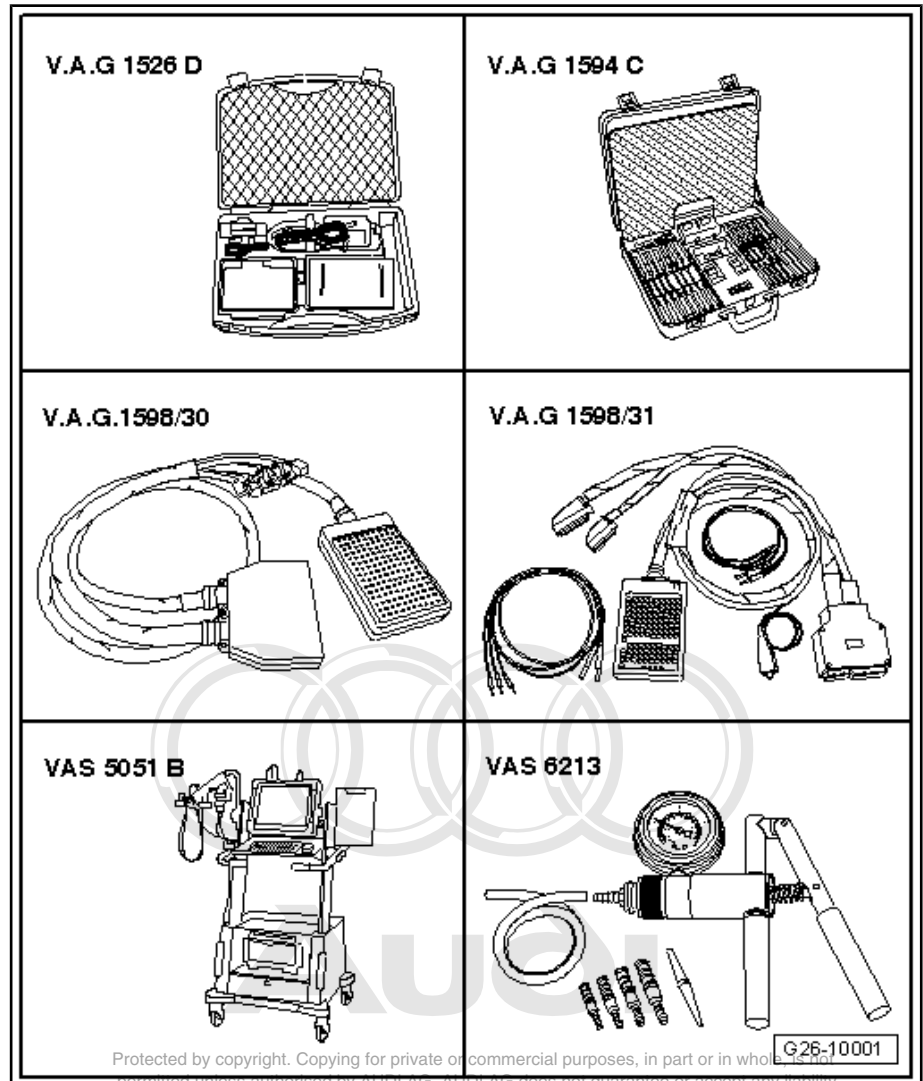
- Renew turbocharger ⇒ [page 226](#).



1.6 Checking charge pressure control solenoid valve -N75-

Special tools and workshop equipment required

- ◆ Hand-held multimeter - V.A.G 1526D-
- ◆ Auxiliary measuring set - V.A.G 1594C-
- ◆ Adapter -V.A.G 1598/30- (engine code AFB for vehicles with manual gearbox or automatic gearbox; engine code AKN for vehicles with manual gearbox)
- ◆ Adapter cable, 121-pin - V.A.G 1598/31- (engine code AKN for vehicles with automatic gearbox)
- ◆ Vehicle diagnostic, testing and information system - VAS 5051B-
- ◆ Hand vacuum pump -VAS 6213-



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Procedure



Note

Charge pressure control solenoid valve -N75- and its wiring are monitored by the engine control unit.

- Vehicle diagnostic, testing and information system -VAS 5051B- connected.
- Engine running.
- Vehicle self-diagnosis and vehicle system "01 - Engine electronics" selected.

Display on -VAS 5051B- :

- From menu -1-, select diagnostic function “Interrogate fault memory” and press  key to continue.

If the display shows a fault relating to charge pressure control valve -N75- :

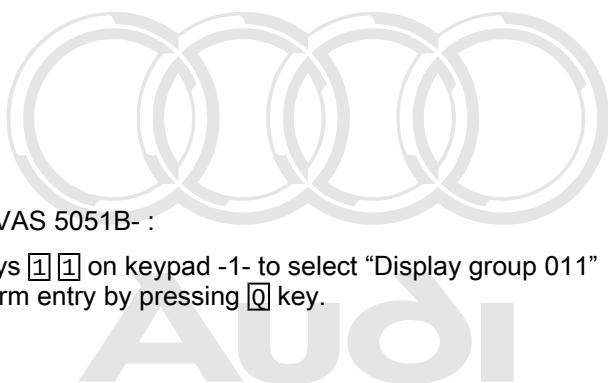
- Press  key to terminate function “Interrogate fault memory”.

Checking operation:

- Leave engine running at idling speed.

Display on -VAS 5051B- :

- From menu -1-, select diagnosis function “Basic setting” and press  key to continue.



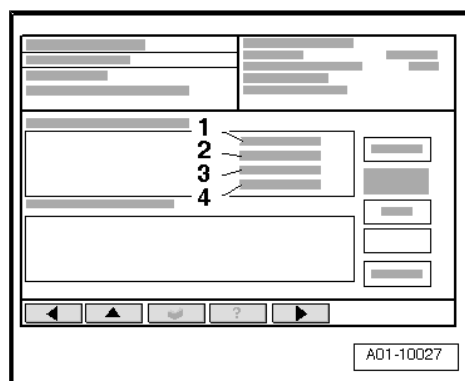
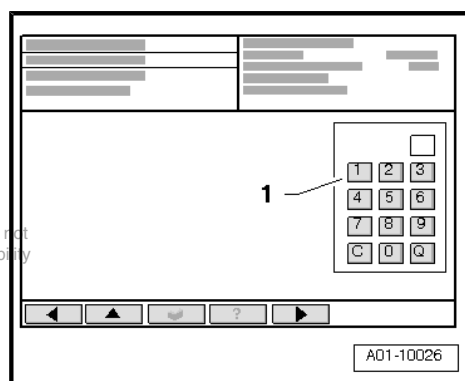
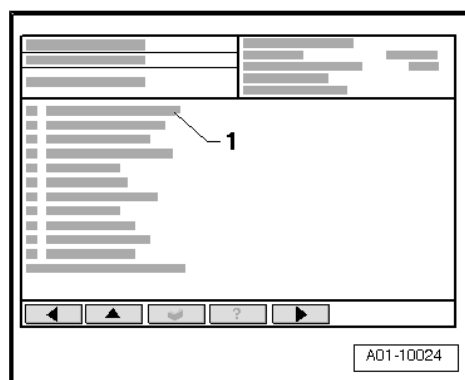
Display on -VAS 5051B- :

- Press keys   on keypad -1- to select “Display group 011” and confirm entry by pressing  key.

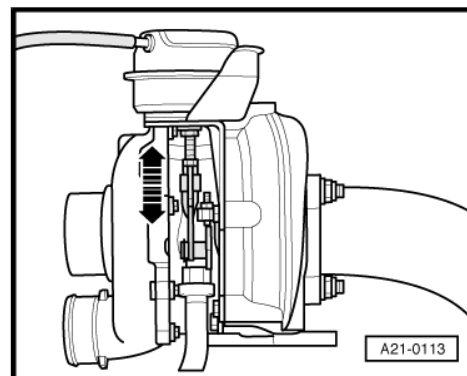
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Display on -VAS 5051B- :

- Check display in display zone -2-.
- Specification: display should alternate between “ON” and “OFF” every 10 seconds.
- Check display in display zone -4-.
- Specification: display should alternate between “0%” and “100%” every 10 seconds.



- Check operating rod of turbocharger:
- Specification: Operating rod should move up with display “ON” and down with display “OFF”.



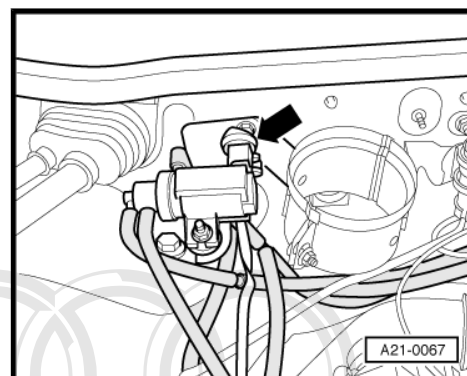
Checking mechanical operation

- Switch off ignition.
- Unplug electrical connector -arrow- at charge pressure control solenoid valve -N75- .

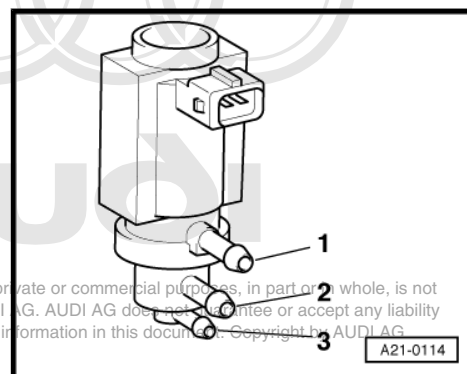


Note

Illustration shows charge pressure control solenoid valve with fuel filter removed.

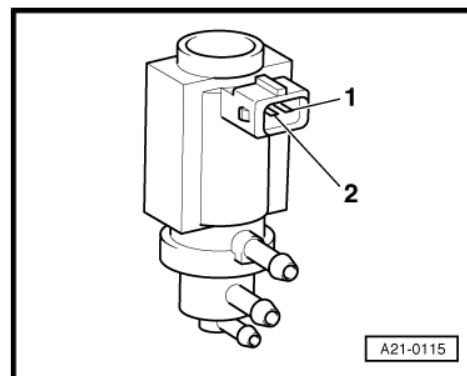


- Detach hose at vacuum connection -3- (leave hose at connection -2- attached to turbocharger).
- Connect hand vacuum pump -VAS 6213- to vacuum connection -3-.

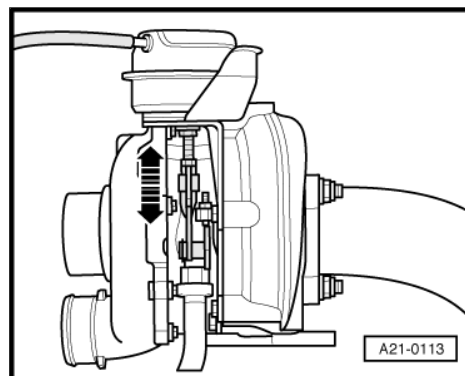


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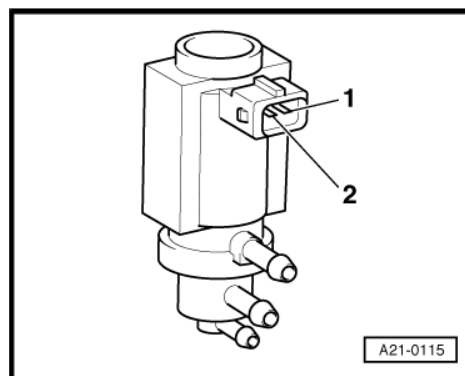
- Use a test lead from auxiliary measuring set -V.A.G 1594C- to connect contact -2- of solenoid valve to battery positive “+”.
- Connect contact -1- to earth.
- The valve should click.



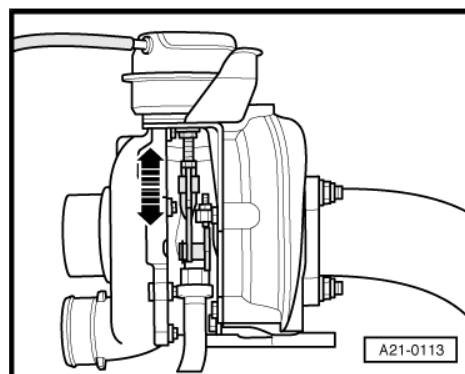
- Operate vacuum pump.
- Vacuum is applied to vacuum unit for charge pressure control at turbocharger - operating rod should move up.



- Detach earth connection from contact -1- of solenoid valve.



- Vacuum is no longer applied to vacuum unit for charge pressure control of turbocharger - operating rod should move down into rest position.



Checking voltage supply

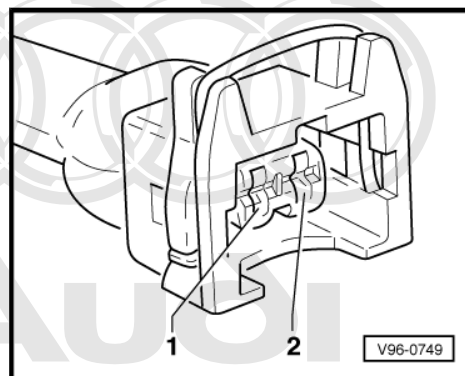
- Connect up multimeter -V.A.G 1526D- for voltage measurement as follows:

Connector Contact	Measure against
2	Earth

- Switch on ignition.
- Specification: approx. battery voltage.

If specification is not obtained:

- Check wiring connection for open circuit and short to positive or earth ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.



Checking internal resistance

- Unplug electrical connector -arrow- at charge pressure control solenoid valve -N75- .



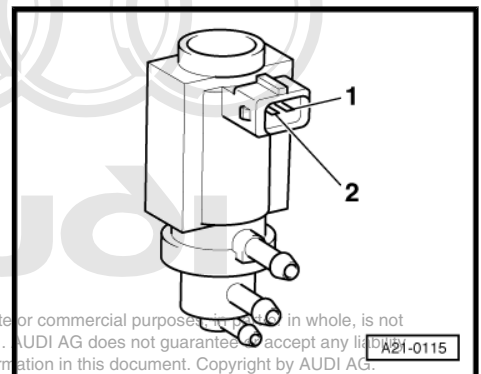
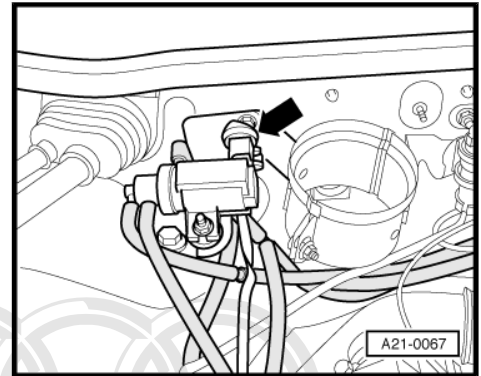
Note

Illustration shows charge pressure control solenoid valve with fuel filter removed.

- Connect hand-held multimeter -V.A.G 1526D- to valve to measure resistance.
- Specification: 14 ... 20 Ω .

If specification is not obtained:

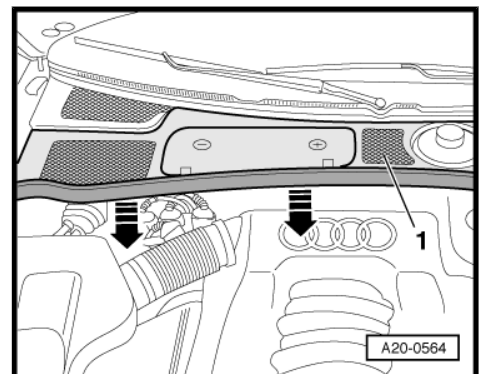
- Renew charge pressure control solenoid valve -N75- .



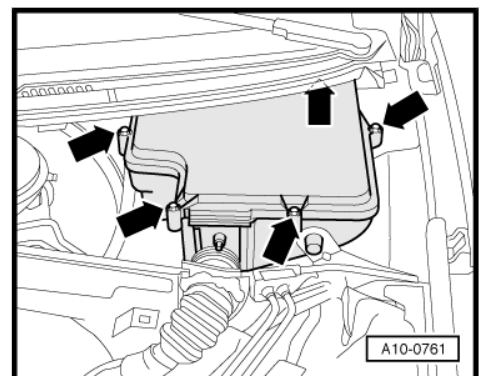
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Checking signal wire

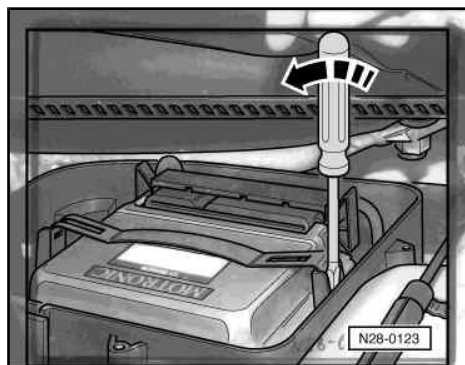
- If fitted, remove seal from plenum chamber cover -arrows-.
- Detach plenum chamber cover -1- towards the front.



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

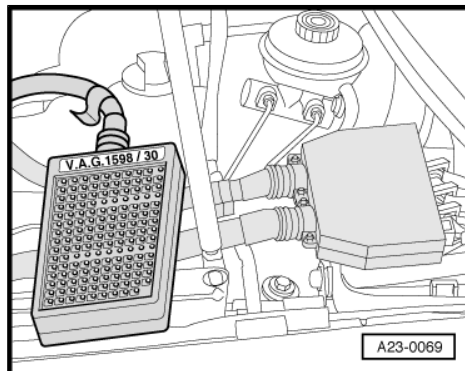


- Carefully prise off retaining strap -arrow- using a screwdriver.
- Release retaining clip and unplug connectors from control unit.



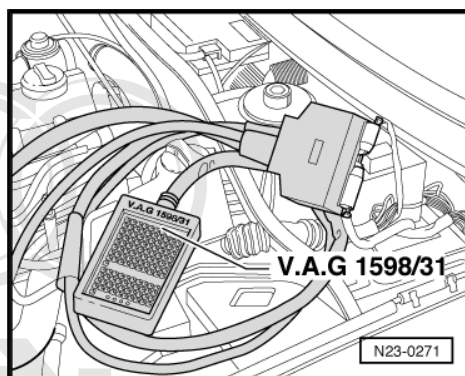
Engine code AFB for vehicles with manual gearbox or automatic gearbox, engine code AKN for vehicles with manual gearbox:

- Connect adapter -V.A.G 1598/30- to unplugged connectors for engine control unit (not to control unit).



Engine code AKN for vehicles with automatic gearbox:

- Connect adapter cable, 121-pin -V.A.G 1598/31- to connector of wiring harness (do not connect engine control unit).
- Connect earth clip of adapter cable to earth (not shown in illustration).



All vehicles (continued):



Caution

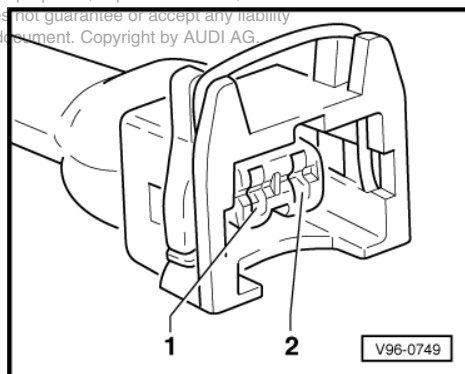
Electronic components are susceptible to damage.

- ◆ *Select the appropriate measuring range before connecting the test leads and observe test requirements.*

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

Connector Contact	-V.A.G 1598/30- Socket	-V.A.G 1598/31- Socket
1	2/21	62

- Repair wiring connection if necessary.



1.7 Checking linkage and vacuum unit for charge pressure control at turbocharger



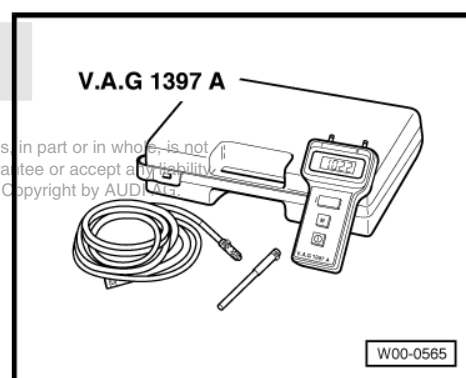
Note

- ◆ *Problems with linkage/vacuum unit for charge pressure control result in the following faults:*
- ◆ *Not achieving the specified charge pressure values.*
- ◆ *Loss of power.*
- ◆ *Uneven power delivery at part throttle*
- ◆ *Jolts when throttle is opened or closed.*

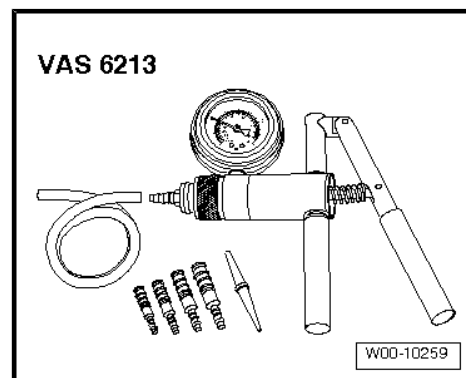
Special tools and workshop equipment required

- ◆ Turbocharger tester -V.A.G 1397A-

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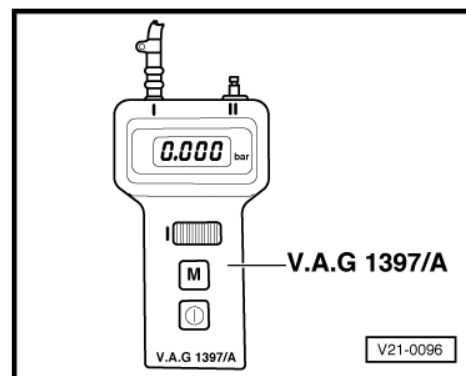
- ◆ Hand vacuum pump -VAS 6213-



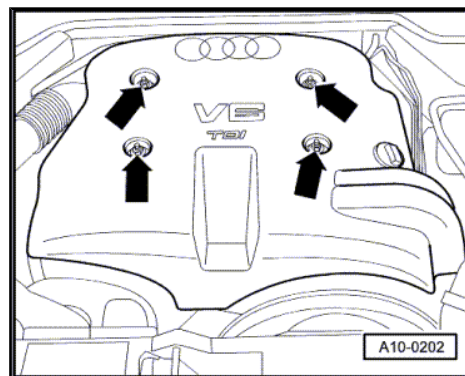
- Check that all vacuum hoses have been fitted and are not leaking ⇒ [page 206](#) .

Procedure

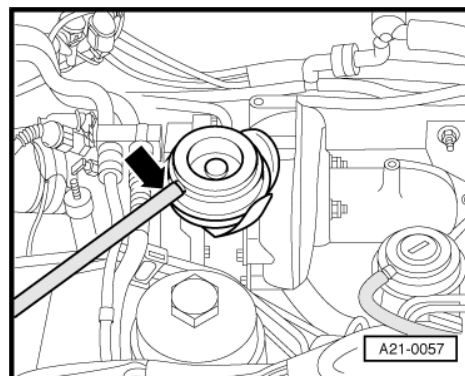
- Switch on turbocharger tester and set measuring range selector switch to position -I- (absolute pressure).
- Attach test hose to connection -I-.



- Detach caps on engine cover panel.
- Unbolt and remove engine cover panel -arrows-.



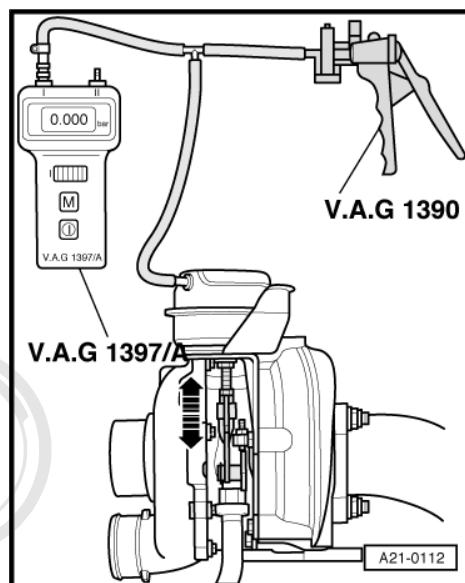
- Disconnect hose -arrow- from vacuum unit for charge pressure control.



- Connect hand vacuum pump -VAS 6213- or -V.A.G 1390- and turbocharger tester -V.A.G 1397A- using test hoses (as shown in illustration).
- Operate vacuum pump.
- Read the vacuum value on turbocharger tester -V.A.G 1397A- .
- Also observe linkage at turbocharger.
- Specification at 150 ± 20 mbar: linkage should start to move up.
- Specification at 620 ± 20 mbar: linkage should make contact with upper stop.

If the specified values are not achieved or if the linkage does not move smoothly:

- Renew turbocharger ⇒ [page 226](#) .

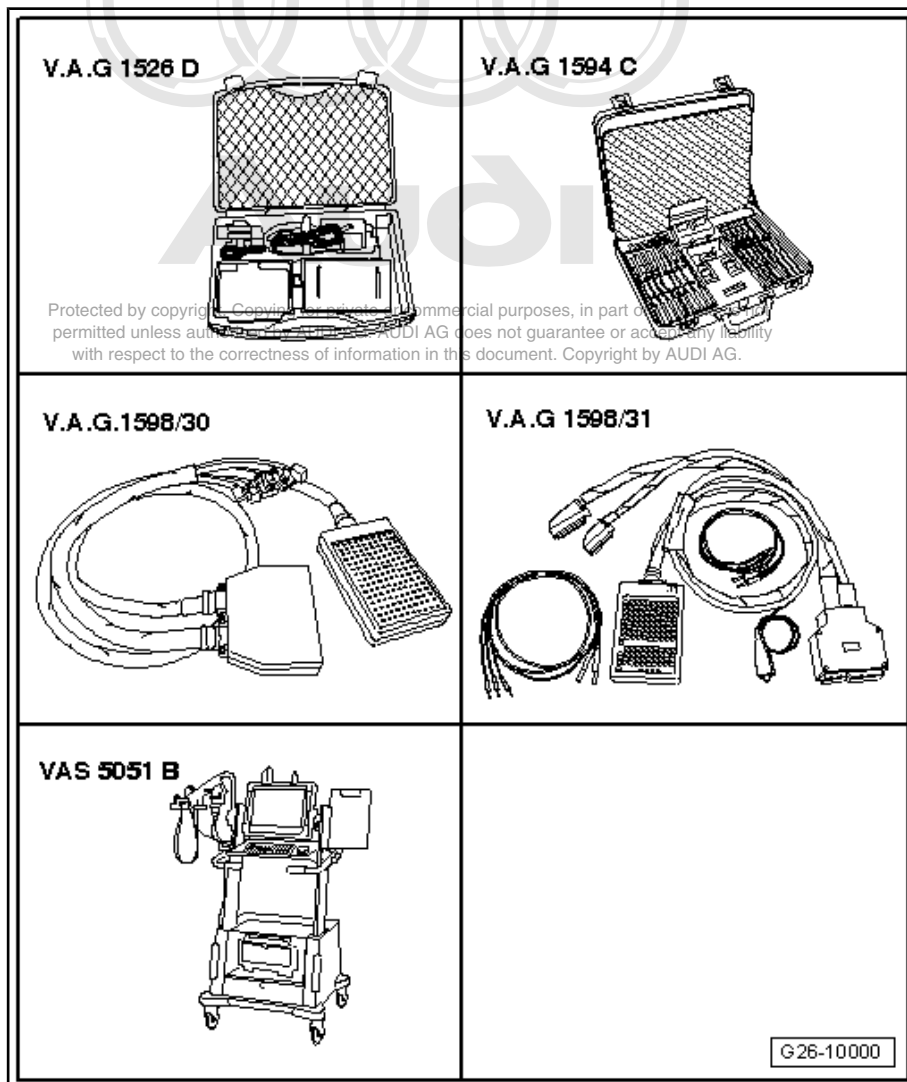


1.8 Checking intake manifold pressure sender -G71-

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Special tools and workshop equipment required

- ◆ Hand-held multimeter - V.A.G 1526D-
- ◆ Auxiliary measuring set - V.A.G 1594C-
- ◆ Adapter -V.A.G 1598/30- (engine code AFB for vehicles with manual gearbox or automatic gearbox; engine code AKN for vehicles with manual gearbox)
- ◆ Adapter cable, 121-pin - V.A.G 1598/31- (engine code AKN for vehicles with automatic gearbox)
- ◆ Vehicle diagnostic, testing and information system - VAS 5051B-

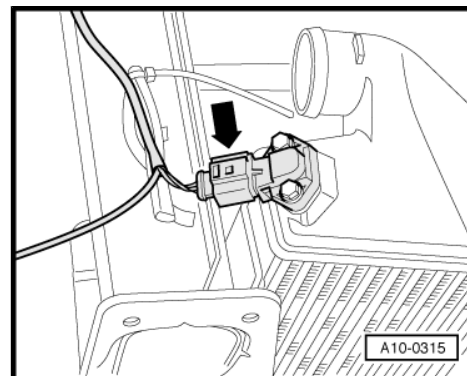


Procedure



Note

- ◆ *The intake manifold pressure sender -G71- and the wiring connections are monitored by the engine control unit.*
- ◆ *Fitting location of intake manifold pressure sender -G71- -arrow-: in charge air cooler at front left of engine compartment.*
- Vehicle diagnostic, testing and information system -VAS 5051B- connected.
- Engine running.
- Vehicle self-diagnosis and vehicle system "01 - Engine electronics" selected.



Display on -VAS 5051B- :

- From menu -1-, select diagnostic function “Interrogate fault memory” and press  key to continue.

If a fault relating to intake manifold pressure sender -G71- is displayed:

- Press  key to terminate function “Interrogate fault memory”.

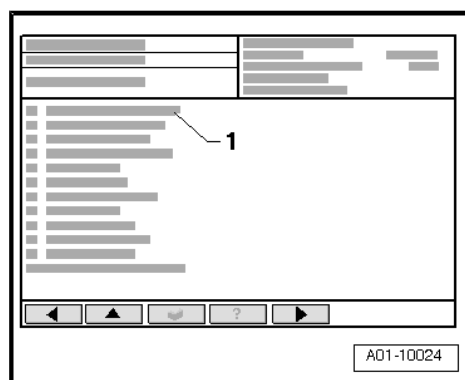


Checking operation:

- Leave engine running at idling speed.

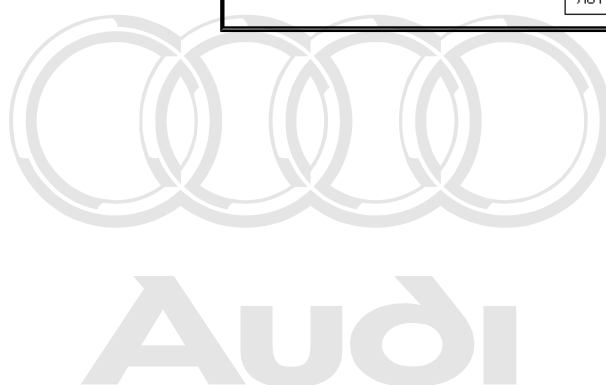
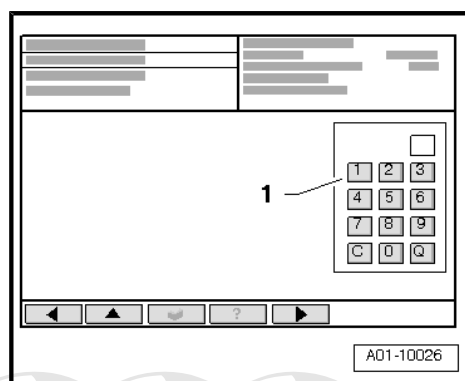
Display on -VAS 5051B- :

- From menu -1-, select diagnosis function “Measured values” and press  key to continue.



Display on -VAS 5051B- :

- Press keys   on keypad -1- to select “Display group 011” and confirm entry by pressing  key.



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Display on -VAS 5051B- :

- Check display in display zones -2- and -3-.
- Specification: The pressures should be the same (tolerance: ± 100 mbar).
- Check other possible causes for reading not matching specification:

Charge pressure too low:

- Check charge pressure control: vehicles with plug in intake manifold $\Rightarrow$ [page 209](#) , vehicles without plug in intake manifold $\Rightarrow$ [page 208](#) .

Charge pressure too high:

- Check charge pressure control solenoid valve -N75- $\Rightarrow$ [page 212](#) .
- Check whether hose for charge pressure control has become detached or clogged.
- Check linkage and vacuum unit for charge pressure control $\Rightarrow$ [page 219](#) .

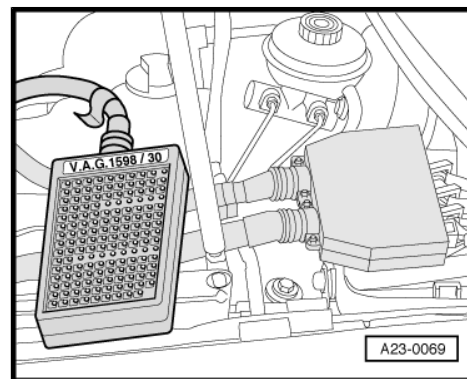
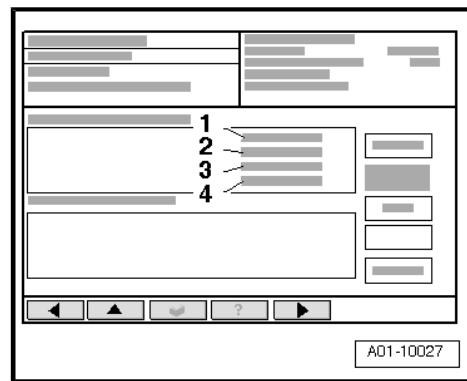
If no fault is found:

- Check wiring.

Checking wiring

Engine code AFB for vehicles with manual gearbox or automatic gearbox, engine code AKN for vehicles with manual gearbox:

- Connect adapter -V.A.G 1598/30- to unplugged connectors for engine control unit (not to control unit).



Engine code AKN for vehicles with automatic gearbox:

- Connect adapter cable, 121-pin -V.A.G 1598/31- to connector of wiring harness (do not connect engine control unit).
- Connect earth clip of adapter cable to earth (not shown in illustration).

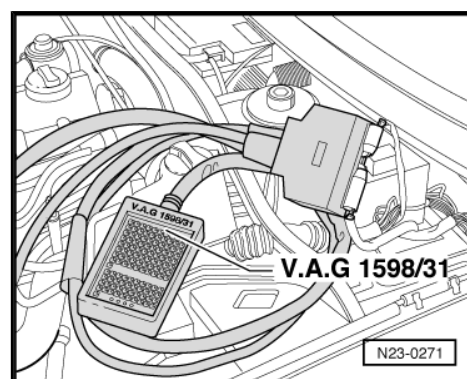
All vehicles (continued):



Caution

Electronic components are susceptible to damage.

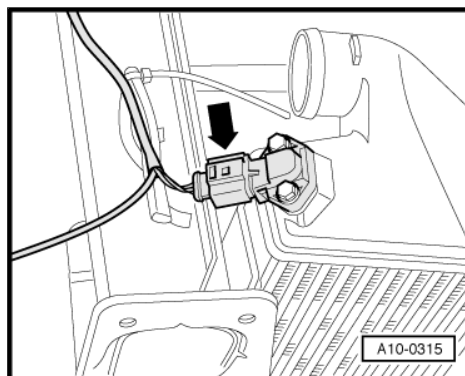
- ◆ ***Select the appropriate measuring range before connecting the test leads and observe test requirements.***



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- Unplug electrical connector -arrow- at intake manifold pressure sender -G71- .



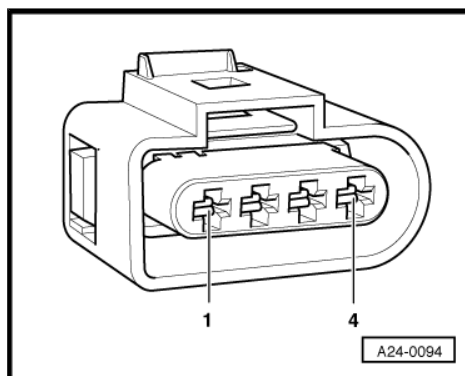
- Check for open circuit and short to positive or earth in the following wiring:

Connector Contact	-V.A.G 1598/30-Socket	-V.A.G 1598/31-Socket
1	3/16	52
3	3/14	31
4	3/15	71

- Repair wiring connection if necessary.

If no fault is found:

- Renew intake manifold pressure sender -G71- .



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2 Turbocharger

– Observe rules for cleanliness ⇒ [page 4](#) .

2.1 Turbocharger - exploded view

1 - O-ring

- ☐ Renew

2 - Oil return pipe

- ☐ To cylinder block

3 - Gasket

- ☐ Renew

4 - O-ring

- ☐ Renew

5 - Bolt

- ☐ 10 Nm

6 - Hose

- ☐ To vacuum unit for charge pressure control

7 - Bolt

- ☐ 22 Nm

8 - Oil supply pipe

- ☐ From oil filter bracket

9 - Banjo bolt

- ☐ 15 Nm

10 - Seals

- ☐ Renew

11 - Bolt

- ☐ 10 Nm

12 - Heat shield

13 - Turbocharger

- ☐ Checking: vehicles with plug in intake manifold ⇒ [page 209](#) , vehicles without plug in intake manifold ⇒ [page 208](#)
- ☐ Removing and installing ⇒ [page 226](#)

14 - Nut

- ☐ Renew
- ☐ 22 Nm

15 - Nut

- ☐ Renew

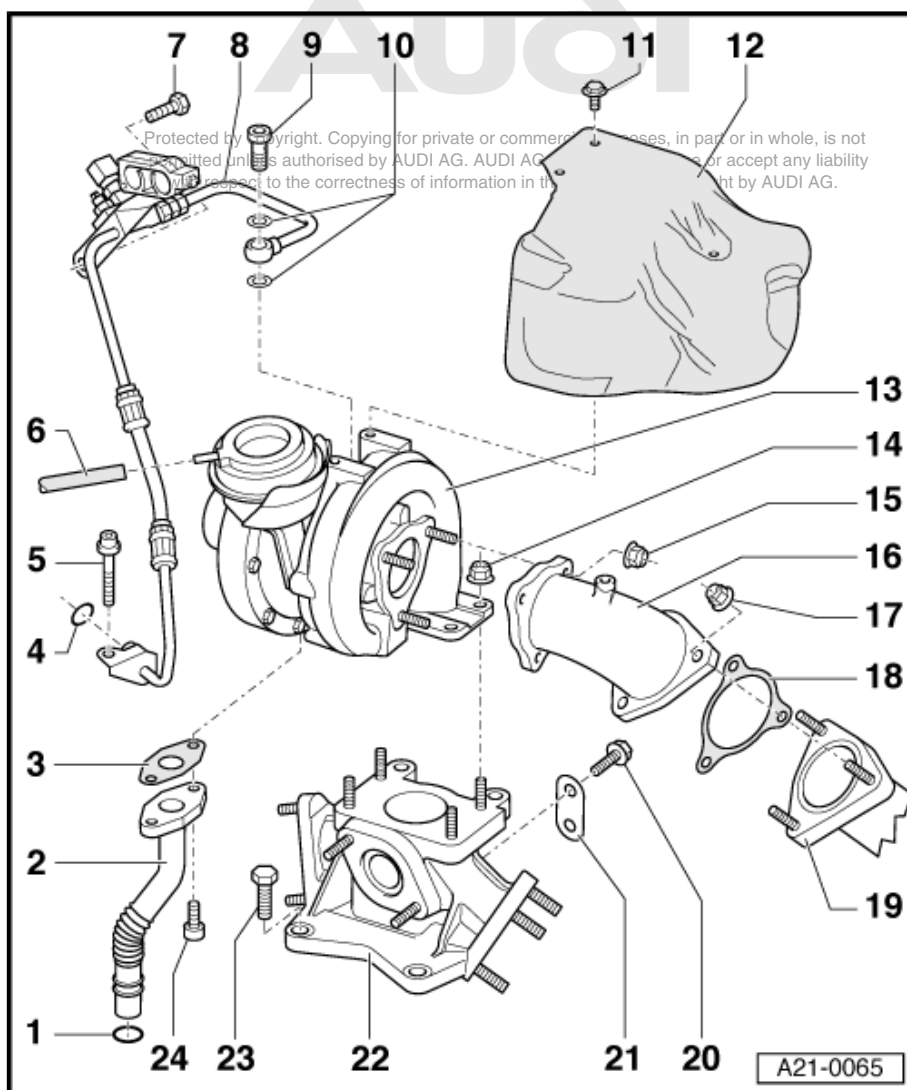
22 Nm

16 - Connection

- ☐ For turbocharger

17 - Nut

- ☐ Renew
- ☐ 25 Nm



18 - Gasket

- ☐ Renew

19 - Front exhaust pipe with catalytic converter

- ☐ Removing and installing: vehicles with front-wheel drive ⇒ [page 237](#) , vehicles with four-wheel drive ⇒ [page 245](#) .

20 - Bolt

- ☐ 22 Nm

21 - Support

- ☐ For intermediate flange

22 - Intermediate flange

- ☐ Removing and installing ⇒ [page 229](#)

23 - Bolt

- ☐ 22 Nm

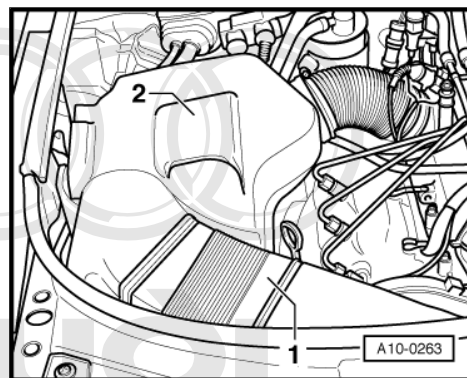
24 - Bolt

- ☐ 10 Nm

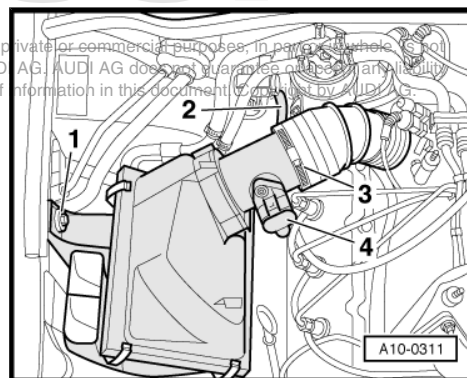
2.2 Removing and installing turbocharger

Removing

- Remove front exhaust pipe with catalytic converter: vehicles with front-wheel drive ⇒ [page 237](#) , vehicles with four-wheel drive ⇒ [page 245](#) .
- Remove air cleaner cover -2-.
- Remove air duct -1- leading to air cleaner.

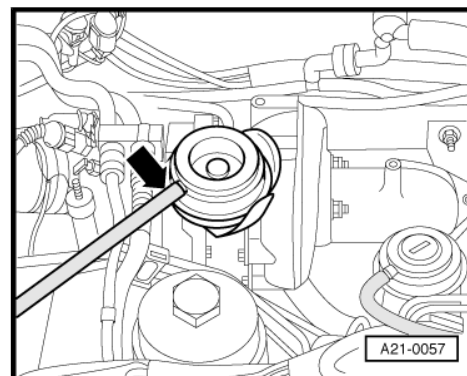


- Slacken hose clip -3-.
- Unplug electrical connector -4-.
- Pull hose -2- off air cleaner housing.
- Unscrew bolt -1- and remove air cleaner housing.

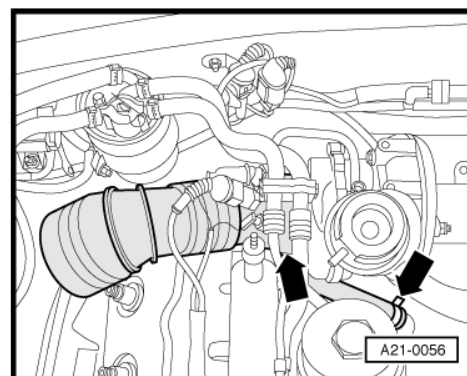


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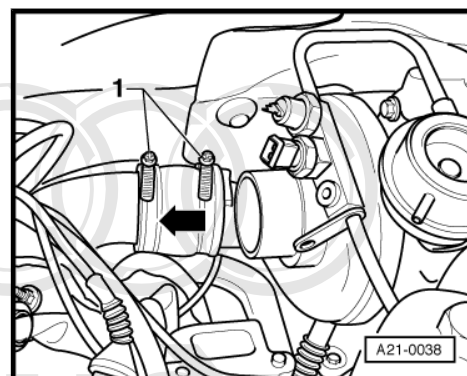
- Disconnect hose -arrow- from vacuum unit for charge pressure control.



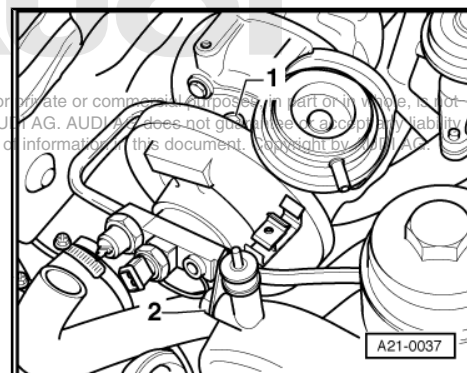
- Remove air intake hose -arrows-.



- Release hose clips -1- and push hose in direction of -arrow-.
- Unclip fuel lines from bracket at oil pipe.



- Detach oil pipe -1- at turbocharger.
- Unscrew oil pipe at intake manifold -2-.



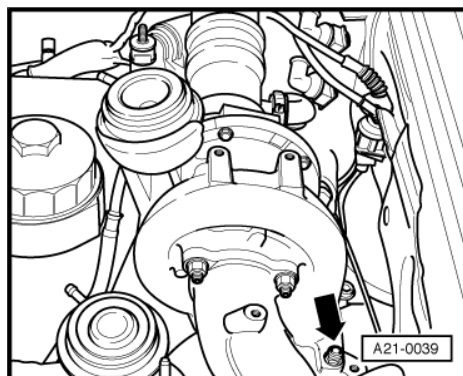
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- Remove turbocharger from intermediate flange -arrow- (4 nuts).
- Detach turbocharger.



Note

Close off oil bore in cylinder block with clean cloths.



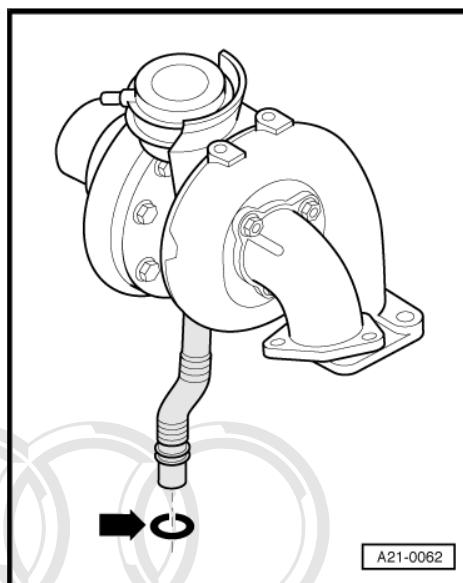
Installing

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



Note

- ◆ Renew gaskets, seals, O-rings and self-locking nuts.
 - ◆ Hose connections and hoses for charge air system must be free of oil and grease before assembly.
 - ◆ Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ *Electronic parts catalogue*.
 - ◆ When installing turbocharger, ensure that O-ring -arrow- for oil return is not damaged.
 - ◆ Fill turbocharger with engine oil at connection for oil supply pipe.
 - ◆ After installing turbocharger, allow engine to idle for approx. 1 minute and do not rev up immediately to ensure turbocharger is supplied with oil.
- Install front exhaust pipe with catalytic converter: vehicles with front-wheel drive ⇒ [page 237](#), vehicles with four-wheel drive ⇒ [page 245](#).
 - Check engine oil level ⇒ Maintenance ; Booklet 802.



Tightening torques

Component	Nm
Turbocharger to intermediate flange	22
Oil pipe to intake manifold	22
Oil return pipe to turbocharger	10
Oil supply pipe to turbocharger	15
Heat shield to turbocharger	10

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2.3 Removing and installing intermediate flange for turbocharger

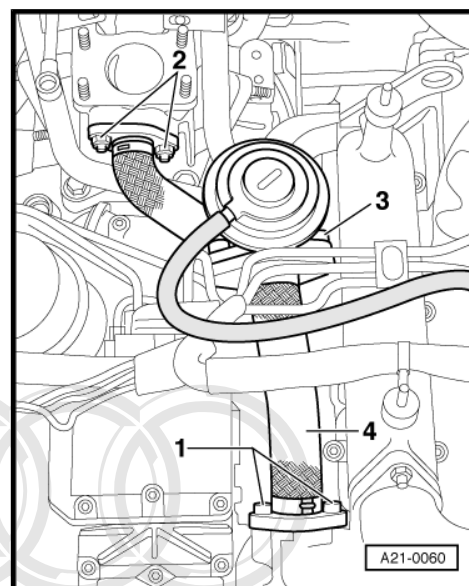
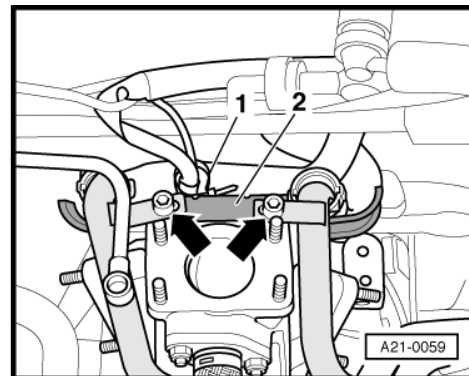
Removing

- Remove turbocharger ⇒ [page 226](#) .
- Remove exhaust manifold together with intermediate pipe: left-side ⇒ [page 251](#) , right-side ⇒ [page 254](#) .
- Release cable tie -1- at rear of heat shield and move wiring clear.
- Unscrew bolts -arrows- and detach heat shield -2- from intermediate flange.
- Unscrew bolt -3- on left of mechanical exhaust gas recirculation valve.
- Remove nuts -2- and bolts -1-.



Note

Leave the exhaust gas recirculation pipe -4- in position.



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- Remove top left securing bolt -arrow 1- on engine/gearbox flange.
- Unscrew bolts -arrows 2-.
- Guide out intermediate flange to rear right.

Installing

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

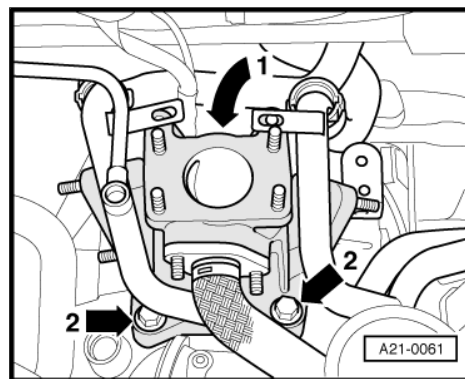


Note

- ◆ *Renew gaskets, seals and self-locking nuts.*
- ◆ *Fit all cable ties in the original positions when installing.*
- Install exhaust manifold with intermediate pipe: left-side ⇒ [page 251](#) , right-side ⇒ [page 254](#) .
- Install turbocharger ⇒ [page 226](#) .

Tightening torques

Component		Nm
Intermediate flange to cylinder block		22
Support for intermediate flange to	Gearbox	65
	Intermediate flange	22
Mechanical exhaust gas recirculation valve to intake manifold		22
Pipe for exhaust gas recirculation to	Intermediate flange	22
	Intake manifold (front)	10
Heat shield to intermediate flange		22



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3 Charge air cooling

- Observe rules for cleanliness ⇒ [page 4](#) .

3.1 Charge air cooler - exploded view



Note

The illustration shows the left-side charge air cooler.

1 - Air duct

2 - Hose

- ☐ Between charge air cooler and air duct in lock carrier
- ☐ Must be free of oil and grease when installing

3 - O-ring

- ☐ Renew

4 - Intake manifold pressure sender -G71-

5 - Bolt

- ☐ 10 Nm

6 - Hose

- ☐ Between cut-off flap connection and charge air cooler
- ☐ Must be free of oil and grease when installing

7 - Bracket

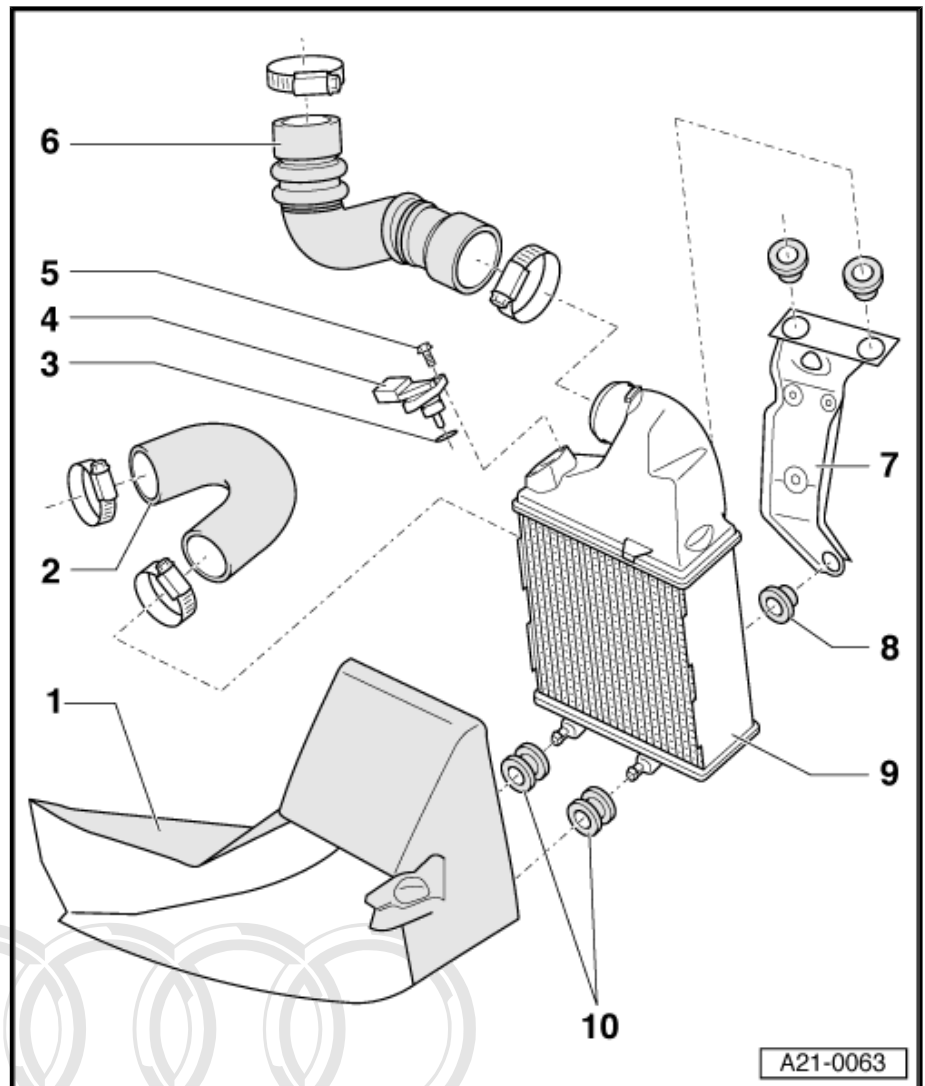
- ☐ Riveted to body

8 - Rubber grommet

9 - Charge air cooler

- ☐ Removing and installing
⇒ [page 232](#)

10 - Rubber grommet



3.2 Removing and installing charge air cooler

Removing



Note

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

- Lock carrier must be in service position ⇒ [page 31](#) .
- Detach air hose (top) from charge air cooler.



Note

The illustration shows the left-side charge air cooler.

- Unplug electrical connector -arrow- at intake manifold pressure sender -G71- .
- Disengage charge air cooler and take out from underneath.

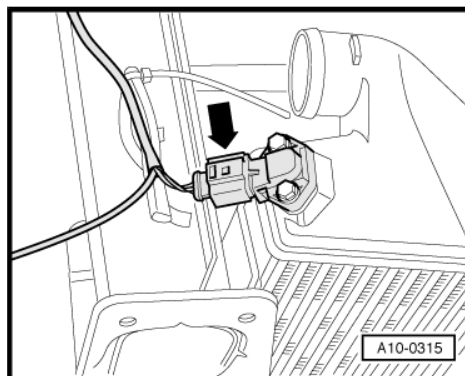
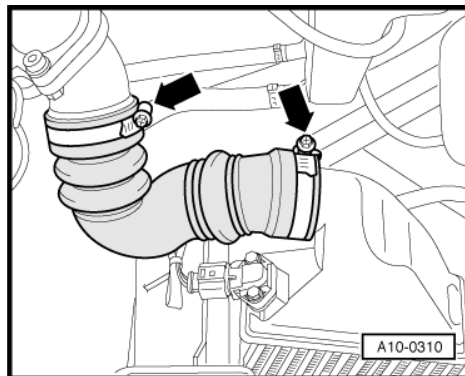
Installing

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



Note

- ◆ Hose connections and hoses for charge air system must be free of oil and grease before assembly.
- ◆ Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ *Electronic parts catalogue* .



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26 – Exhaust system

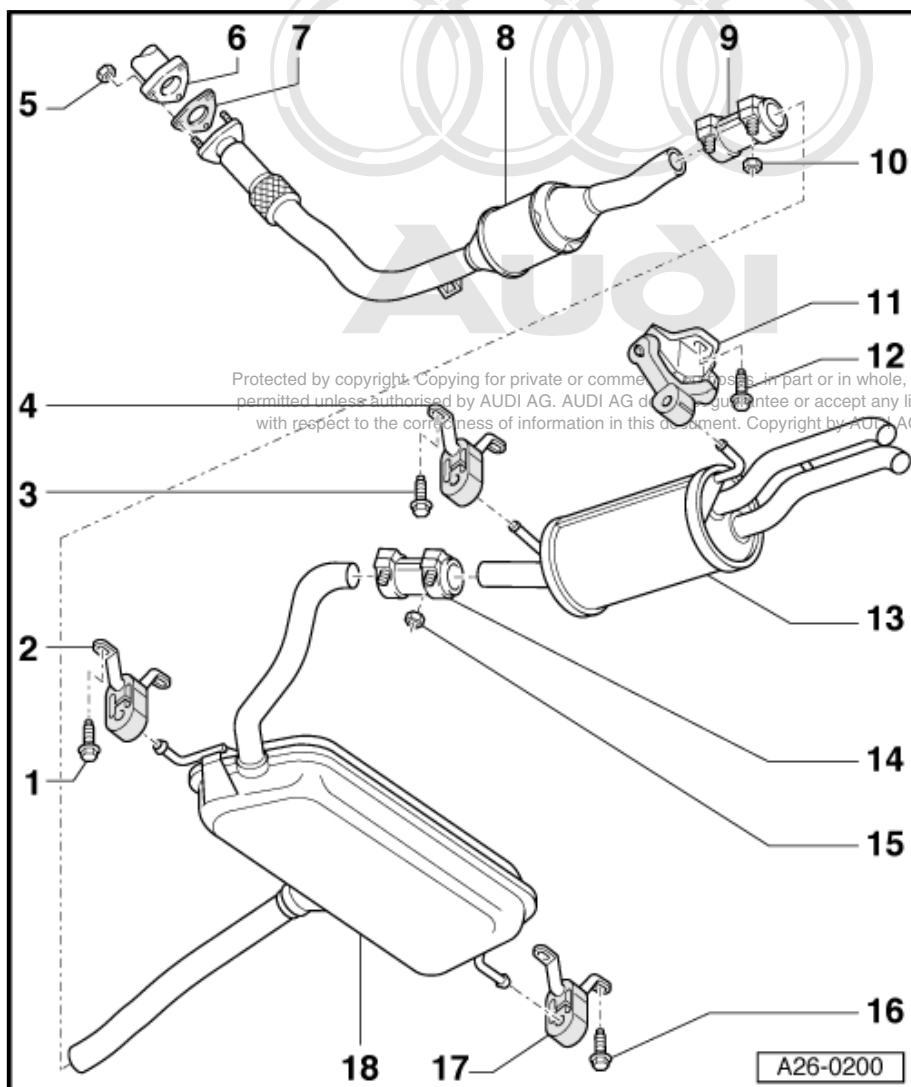
1 Exhaust system on vehicles with front-wheel drive

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.

1.1 Silencers - exploded view

- 1 - Bolt
 - ☐ 25 Nm
- 2 - Mounting
 - ☐ Renew if damaged
- 3 - Bolt
 - ☐ 25 Nm
- 4 - Mounting
 - ☐ Renew if damaged
- 5 - Nut
 - ☐ Renew
 - ☐ 25 Nm
- 6 - Connection
 - ☐ For turbocharger
- 7 - Gasket
 - ☐ Renew
- 8 - Front exhaust pipe
 - ☐ With oxidising catalytic converter
 - ☐ With flexible joint; do not bend flexible joint more than 10° – otherwise it can be damaged
 - ☐ Protect against knocks and impact
 - ☐ Removing and installing ⇒ [page 237](#)
 - ☐ Mounting components on vehicles with manual gearbox ⇒ [page 235](#)
 - ☐ Mounting components on vehicles with automatic gearbox ⇒ [page 235](#)
 - ☐ Align exhaust system so it is free of stress ⇒ [page 238](#)



9 - Clamp (front)

- ☐ Before tightening, align exhaust system so it is free of stress ⇒ [page 238](#)

- ☐ Installation position ⇒ [page 234](#)
- ☐ Tighten bolt connections evenly.

10 - Nut

- ☐ 40 Nm

11 - Mounting

- ☐ Renew if damaged

12 - Bolt

- ☐ 25 Nm

13 - Rear silencer

- ☐ Combined in one unit with centre silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting point ⇒ [page 235](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 238](#)

14 - Clamp (rear)

- ☐ For separate replacement of centre and rear silencers
- ☐ Before tightening, align exhaust system so it is free of stress ⇒ [page 238](#)
- ☐ Installation position ⇒ [page 235](#)
- ☐ Tighten bolt connections evenly.

15 - Nut

- ☐ 40 Nm

16 - Bolt

- ☐ 25 Nm

17 - Mounting

- ☐ Renew if damaged

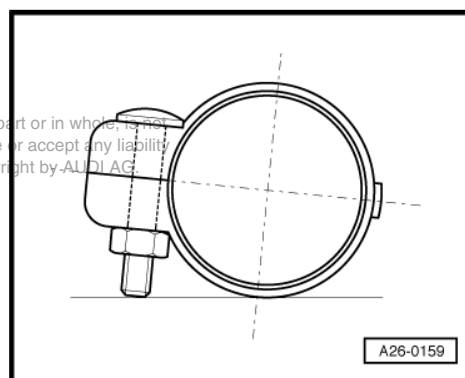
18 - Centre silencer

- ☐ Combined in one unit with rear silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting point ⇒ [page 235](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 238](#)

Installation position of front clamp

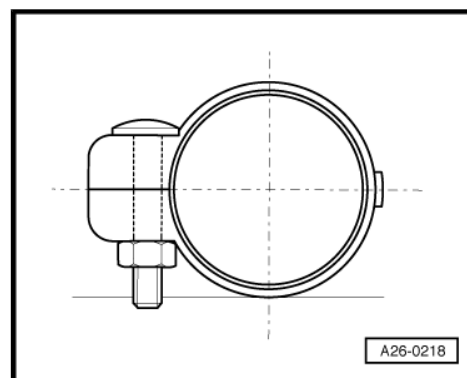
- Install clamp so that ends of bolts do not protrude beyond bottom of clamp.
- Bolt connection faces to left

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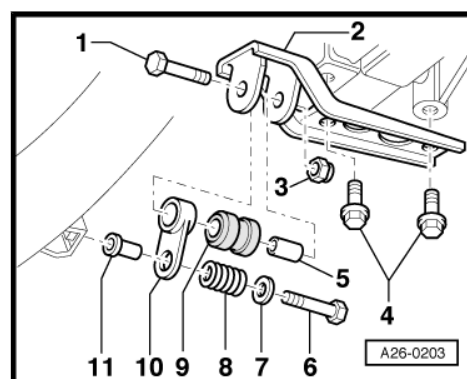
Installation position of rear clamp

- Fit clamp in horizontal position.
- Bolt connection faces to left.



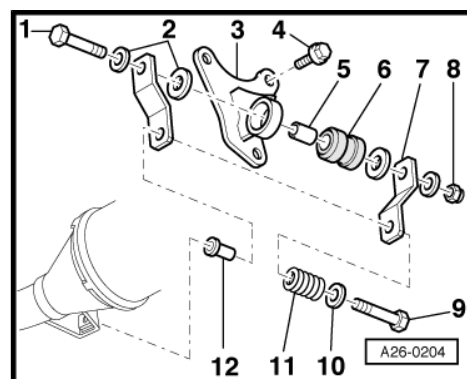
Components of exhaust pipe mountings (vehicles with manual gearbox)

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



Components of exhaust pipe mountings (vehicles with automatic gearbox)

- 1 - Bolt, 25 Nm
- 2 - Washers
- 3 - Bracket
- 4 - Bolt, 25 Nm
- 5 - Spacer
- 6 - Buffer
- 7 - Plate
- 8 - Nut, self-locking, 25 Nm
- 9 - Bolt, 25 Nm
- 10 - Washer
- 11 - Compression spring
- 12 - Spacer sleeve

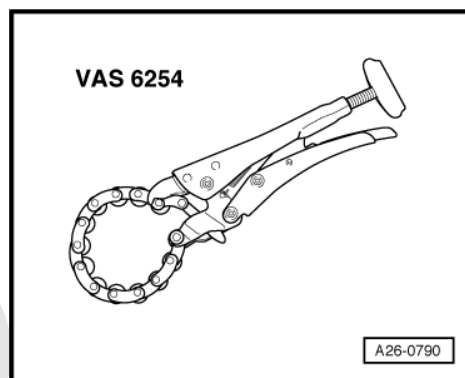


1.2 Separating centre and rear silencers

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

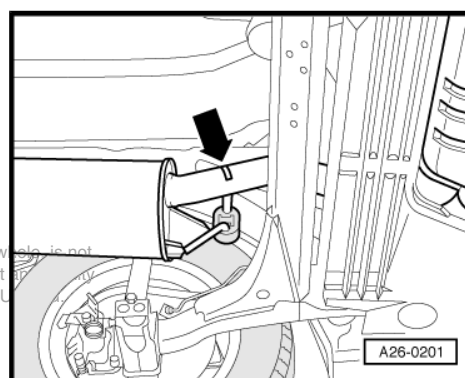
Special tools and workshop equipment required

◆ Chain-type pipe cutter -VAS 6254-

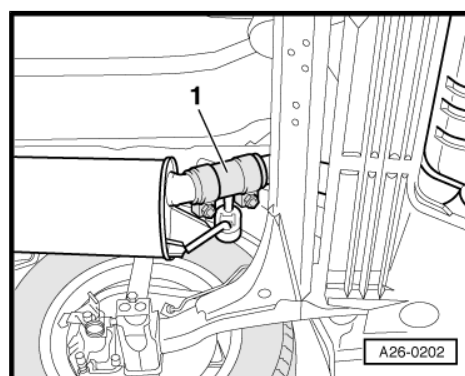


Procedure

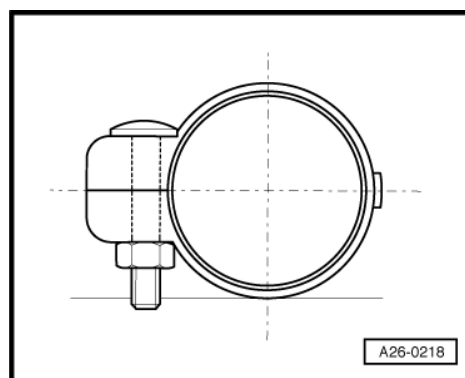
- Cut through exhaust pipe at right angle at the position marked by -arrows- using chain-type pipe cutter -VAS 6254- .



- When installing, position clamp -1- centrally over cutting point.



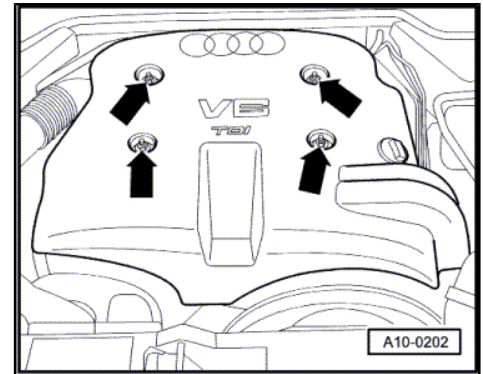
- Install clamps so that ends of bolts are horizontal.
- Bolt connection faces to left.
- Align the exhaust system so it is free of stress ⇒ [page 238](#) .



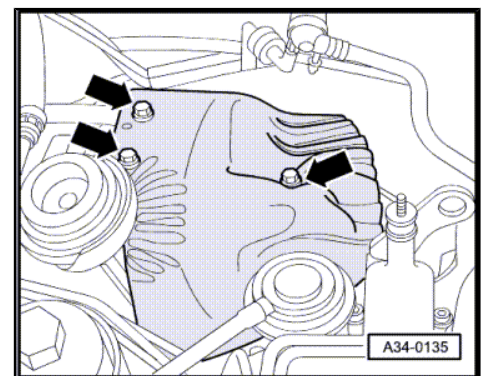
1.3 Removing and installing front exhaust pipe with catalytic converter

Removing

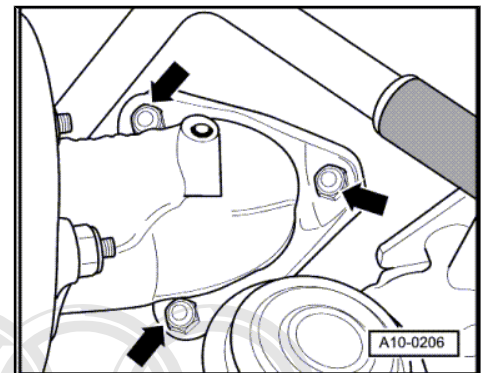
- Detach caps on engine cover panel.
- Unbolt and remove engine cover panel -arrows-.



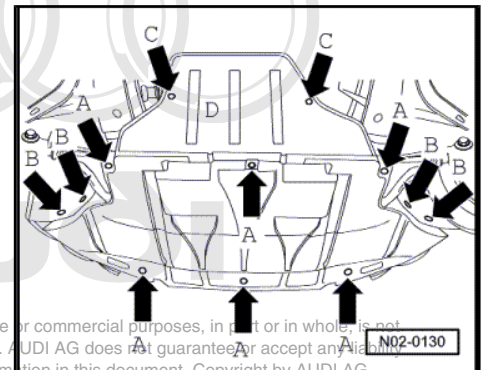
- Remove heat shield above turbocharger -arrows-.



- Unbolt front exhaust pipe from connection for turbocharger -arrows-.



- Remove noise insulation (front and rear) -arrows A ... C-.



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- Detach cross member -1-.



Caution

Risk of damage to flexible joints in front exhaust pipe

- ◆ Do not bend flexible joints in front exhaust pipe more than 10°.

- Remove front exhaust pipe together with catalytic converter -arrows-.

Installing

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



Note

Renew gaskets and self-locking nuts.

- Align the exhaust system so it is free of stress ⇒ [page 238](#).



Note

Components of exhaust pipe mountings on gearbox: vehicles with manual gearbox ⇒ [page 235](#), vehicles with automatic gearbox ⇒ [page 235](#).

Tightening torques

Component	Nm
Catalytic converter to mounting plate	25
Front exhaust pipe to connection for turbocharger	25
Heat shield to turbocharger	10
Underbody cross member to body	20

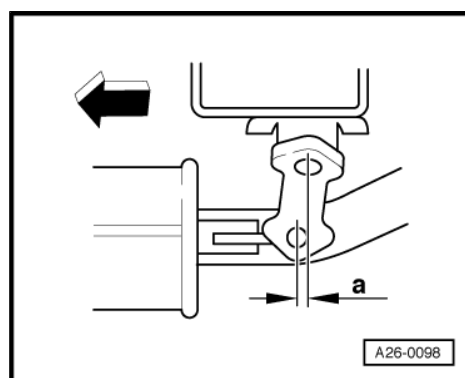
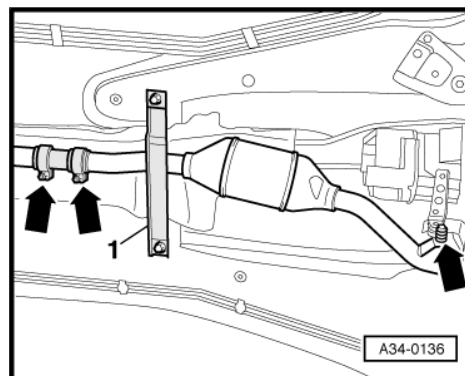
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1.4 Stress-free alignment of exhaust system

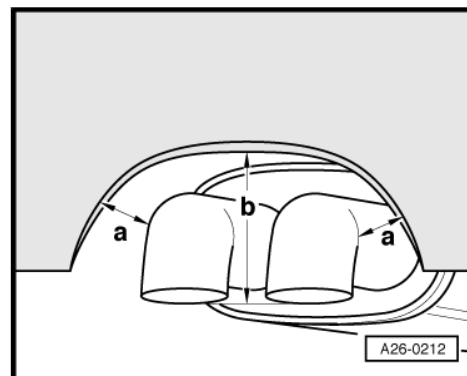
- The exhaust system must be aligned when it is cool.

Vehicles without clamp between centre silencer and rear silencer

- Loosen bolts on front clamp ⇒ [Item 9 \(page 233\)](#).
- Push exhaust system towards front of vehicle -arrow-, so that rear mounting for rear silencer is preloaded by -a- = 7 ... 9 mm.



- Align rear silencer so it is horizontal.
- Check clearance between tailpipes and bumper:
 - Distance -a- is the same on both sides.
- At the same time, distance -b- must be obtained between bumper cut-out and bottom edge of tailpipes.
 - Dimension -b- = 97 ... 103 mm.
- Tighten bolted connections of front clamp evenly to 40 Nm
⇒ [Item 9 \(page 233\)](#).



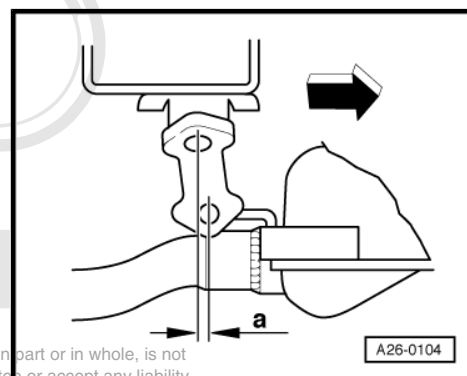
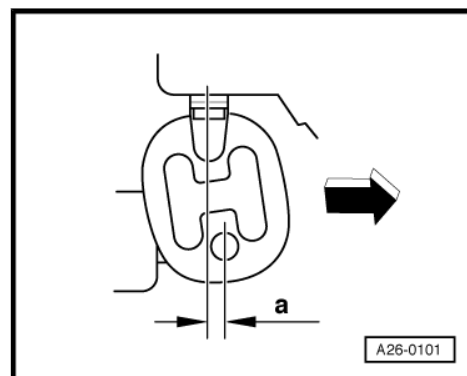
Vehicles with clamp between centre silencer and rear silencer



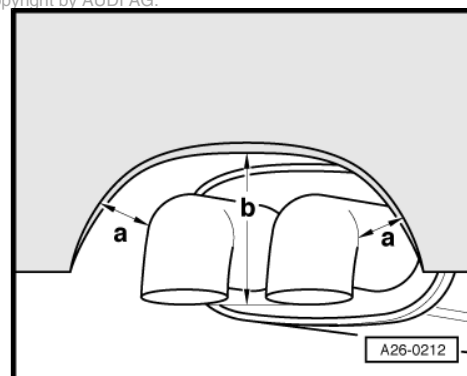
Note

On vehicles with clamp fitted between centre silencer and rear silencer, it is also necessary to align the centre silencer.

- Loosen bolts on front clamp ⇒ [Item 9 \(page 233\)](#) and rear clamp ⇒ [Item 14 \(page 234\)](#).
- Press exhaust system towards front of vehicle -arrow- so that mounting (rear left) for centre silencer is preloaded by -a- = 7 ... 9 mm.
- Tighten bolted connections of front clamp evenly to 40 Nm
⇒ [Item 9 \(page 233\)](#).
- Press rear silencer towards front of vehicle -arrow- until mounting (rear right) on rear silencer is preloaded by -a- = 7 ... 9 mm.



- Align rear silencer so it is horizontal.
- Check clearance between tailpipes and bumper:
 - Distance -a- is the same on both sides.
- At the same time, distance -b- must be obtained between bumper cut-out and bottom edge of tailpipes.
 - Dimension -b- = 97 ... 103 mm.
- Tighten bolt connections for rear clamp
⇒ [Item 14 \(page 234\)](#) evenly to 40 Nm.



1.5 Checking exhaust system for leaks

- Start engine and run at idling speed.
- Plug tailpipes during leak test (e.g. with cloth or plug).



- Listen for leaks at connection points between cylinder head/exhaust manifold, exhaust manifold/turbocharger and turbocharger/catalytic converter etc.
- Rectify any leaks that are found.



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2 Exhaust system on vehicles with four-wheel drive



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.

2.1 Silencers - exploded view

1 - Centre silencer

- ☐ Combined in one unit with rear silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting point
⇒ [page 244](#)
- ☐ Align exhaust system so it is free of stress
⇒ [page 247](#)

2 - Gasket

- ☐ Renew

3 - Nut

- ☐ Renew
- ☐ 25 Nm

4 - Connection

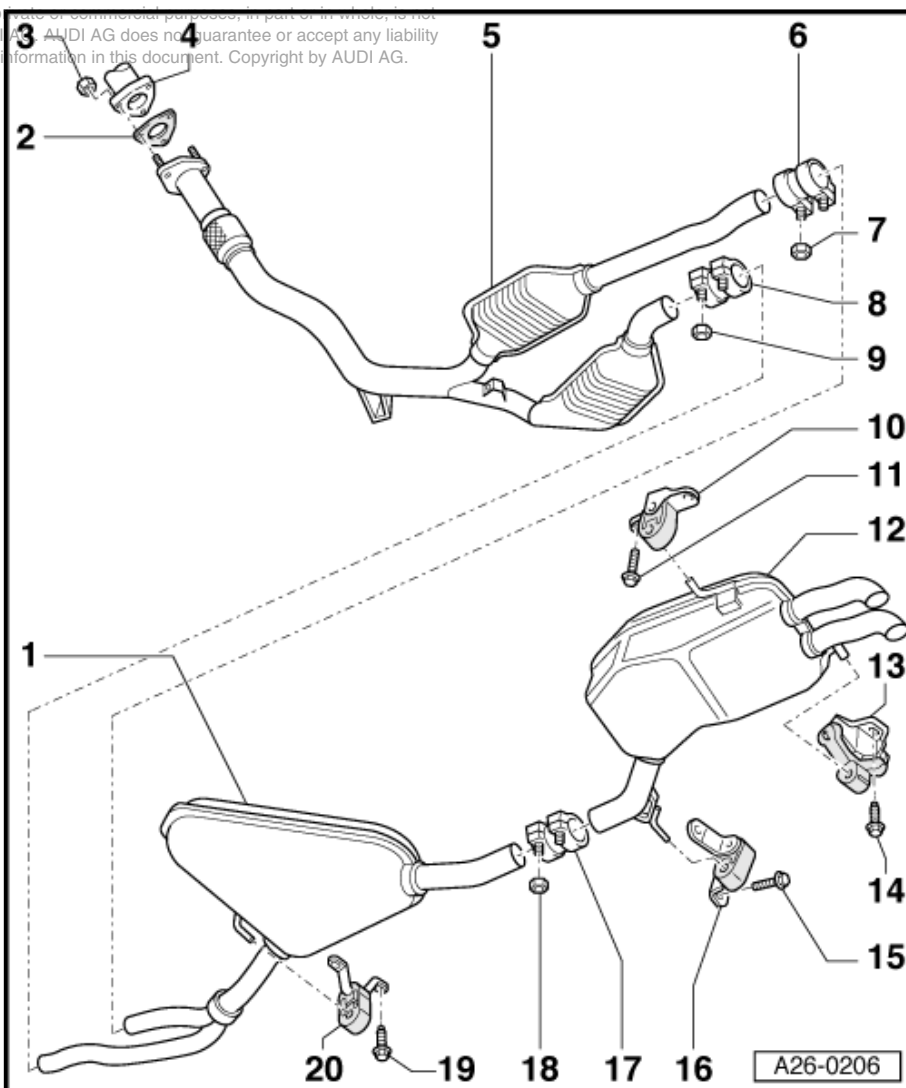
- ☐ For turbocharger

5 - Front exhaust pipe

- ☐ With oxidising catalytic converters
- ☐ With flexible joint; do not bend flexible joint more than 10° – otherwise it can be damaged
- ☐ Protect against knocks and impact
- ☐ Removing and installing
⇒ [page 245](#)
- ☐ Mounting components on vehicles with manual gearbox ⇒ [page 243](#)
- ☐ Mounting components on vehicles with automatic gearbox ⇒ [page 244](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 247](#)

6 - Clamp (front left)

- ☐ Before tightening, align exhaust system so it is free of stress ⇒ [page 247](#)
- ☐ Installation position ⇒ [page 243](#)
- ☐ Tighten bolt connections evenly.





7 - Nut

- ☐ 40 Nm

8 - Clamp (front right)

- ☐ Before tightening, align exhaust system so it is free of stress ⇒ [page 247](#)
- ☐ Installation position ⇒ [page 243](#)
- ☐ Tighten bolt connections evenly.

9 - Nut

- ☐ 40 Nm

10 - Mounting

- ☐ Renew if damaged

11 - Bolt

- ☐ 25 Nm

12 - Rear silencer

- ☐ Combined in one unit with centre silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting point ⇒ [page 244](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 247](#)

13 - Mounting

- ☐ Renew if damaged

14 - Bolt

- ☐ 25 Nm

15 - Bolt

- ☐ 25 Nm

16 - Mounting

- ☐ Renew if damaged

17 - Clamp (rear)

- ☐ For separate replacement of centre and rear silencers
- ☐ Before tightening, align exhaust system so it is free of stress ⇒ [page 247](#)
- ☐ Installation position ⇒ [page 243](#)
- ☐ Tighten bolt connections evenly.

18 - Nut

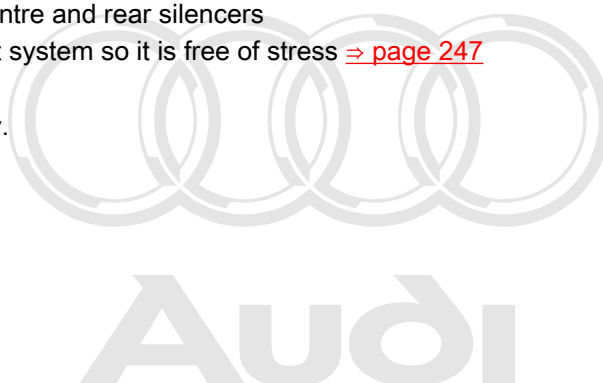
- ☐ 40 Nm

19 - Bolt

- ☐ 25 Nm

20 - Mounting

- ☐ Renew if damaged

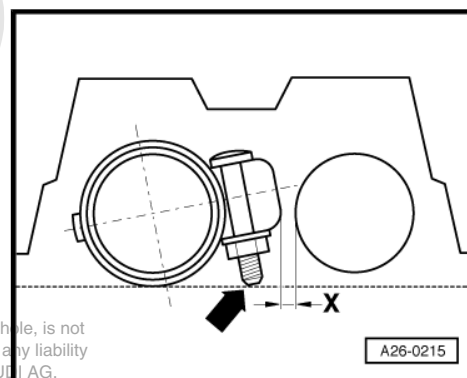


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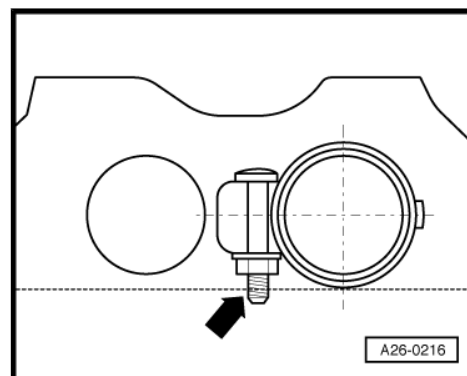
Installation position of clamp (front left)

- Install clamps so that end of bolt -arrow- does not protrude below bottom of clamp.
- Bolt connection faces to right.
- Dimension -x- = 9 mm.

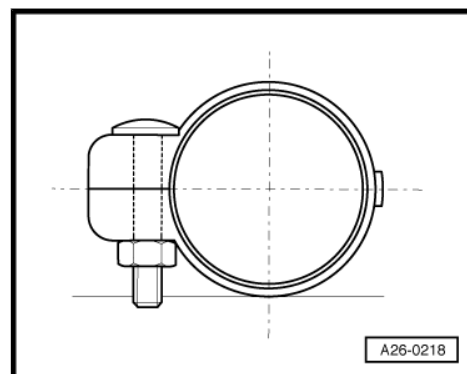
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**Installation position of clamp (front right)**

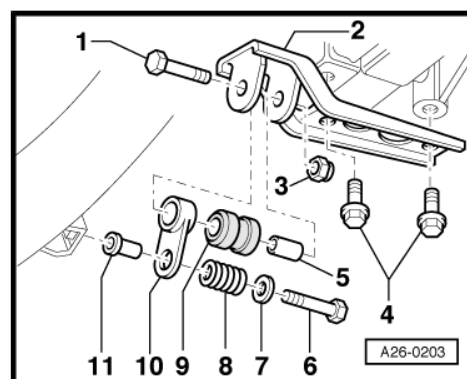
- Fit clamp in horizontal position.
- Bolt connection faces to left.

**Installation position of rear clamp**

- Fit clamp in horizontal position.
- Bolt connection faces to left.

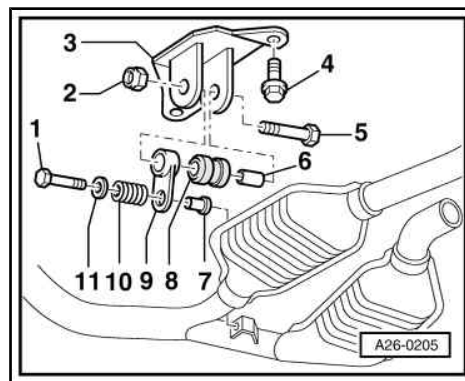
**Components of exhaust pipe mountings (vehicles with manual gearbox)**

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



Components of exhaust pipe mountings (vehicles with automatic gearbox)

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



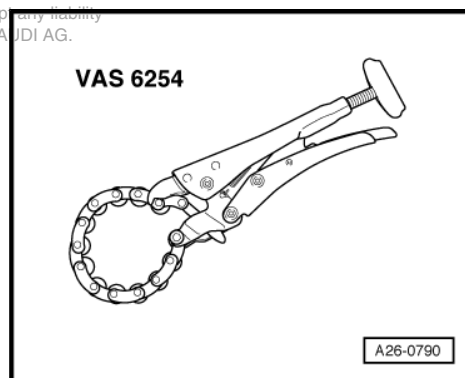
2.2 Separating centre and rear silencers

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

Special tools and workshop equipment required

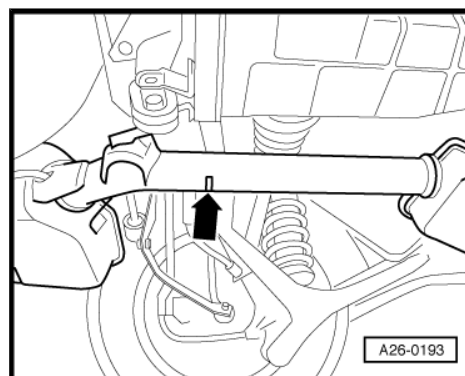
- ◆ Chain-type pipe cutter -VAS 6254-

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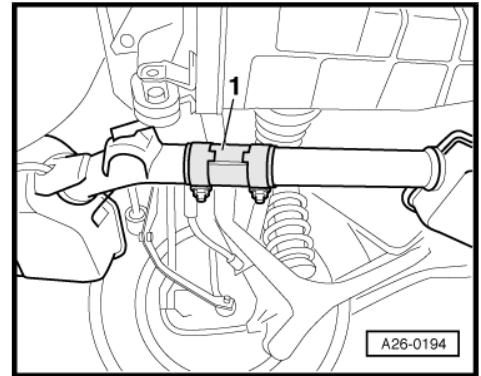


Procedure

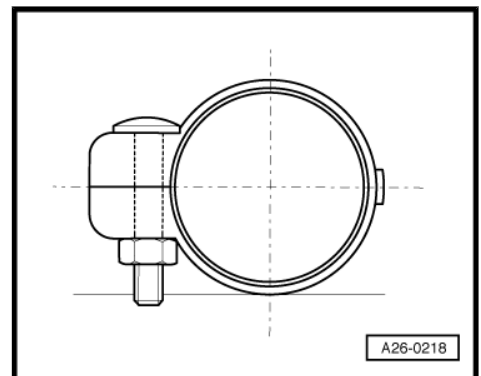
- Cut through exhaust pipe at right angle at the position marked by -arrows- using chain-type pipe cutter -VAS 6254- .



- When installing, position clamp -1- centrally over cutting point.



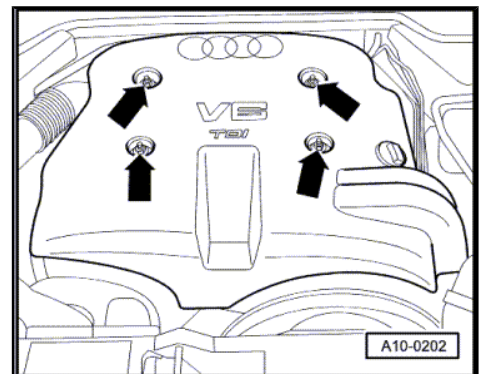
- Install clamps so that ends of bolts are horizontal.
- Bolt connection faces to left.
- Align the exhaust system so it is free of stress ⇒ [page 247](#).



2.3 Removing and installing front exhaust pipe with catalytic converter

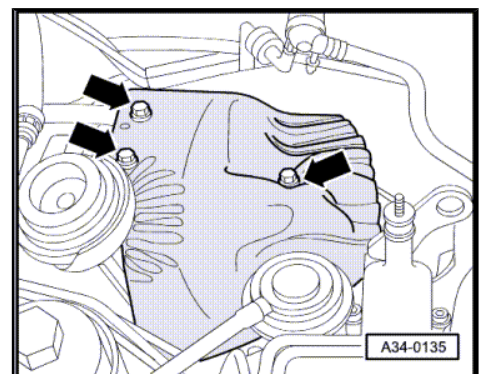
Removing

- Detach caps on engine cover panel.
- Unbolt and remove engine cover panel -arrows-.

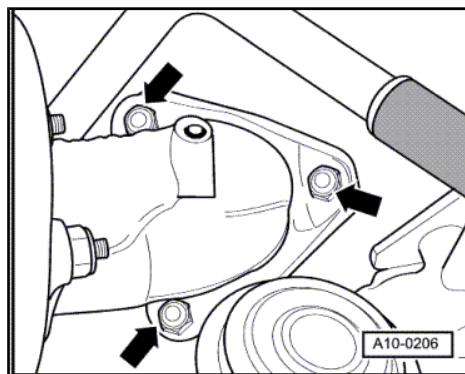


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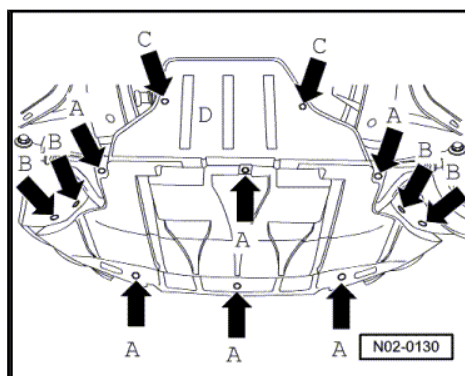
- Remove heat shield above turbocharger -arrows-.



- Unbolt front exhaust pipe from connection for turbocharger -arrows-.



- Remove noise insulation (front and rear) -arrows A ... C-.



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Caution

Risk of damage to flexible joints in front exhaust pipe

- ◆ **Do not bend flexible joints in front exhaust pipe more than 10°.**

- Remove front exhaust pipe together with catalytic converter -arrows-.



Note

- ◆ Shown for vehicle with front-wheel drive in illustration.
- ◆ 2 clamps must be released on vehicles with four-wheel drive.
- ◆ Disregard -item 1-.

Installing

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



Note

Renew gaskets and self-locking nuts.

- Align the exhaust system so it is free of stress ⇒ [page 247](#) .



Note

Components of exhaust pipe mountings on gearbox: vehicles with manual gearbox ⇒ [page 243](#) , vehicles with automatic gearbox ⇒ [page 244](#) .

Tightening torques

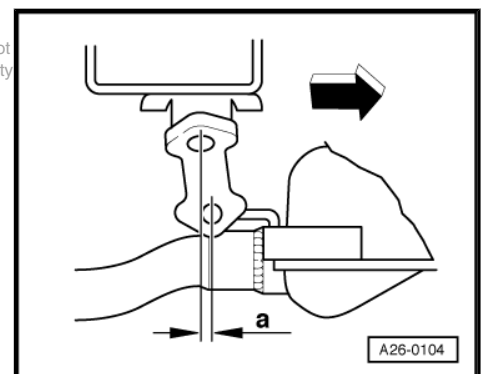
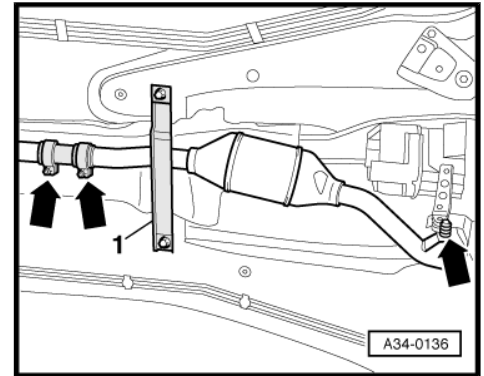
Component	Nm
Catalytic converter to mounting plate	25
Front exhaust pipe to connection for turbocharger	25
Heat shield to turbocharger	10

2.4 Stress-free alignment of exhaust system

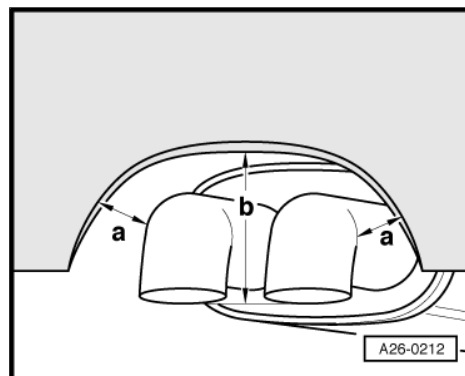
- The exhaust system must be aligned when it is cool.

Vehicles without clamp between centre silencer and rear silencer

- Loosen bolts on clamp (front left) ⇒ [Item 6 \(page 241\)](#) and clamp (front right) ⇒ [Item 8 \(page 242\)](#) .
- Push exhaust system towards front of vehicle -arrow- so that mounting (rear right) for rear silencer is preloaded by -a- = 9 ... 11 mm.



- Align rear silencer so it is horizontal.
- Check clearance between tailpipes and bumper:
 - Distance -a- is the same on both sides.
- At the same time, distance -b- must be obtained between bumper cut-out and bottom edge of tailpipes.
- Dimension -b- = 97 ... 103 mm.
- Tighten bolted connections of clamp (front left)
 - ⇒ [Item 6 \(page 241\)](#) and clamp (front right)
 - ⇒ [Item 8 \(page 242\)](#) evenly to 40 Nm.



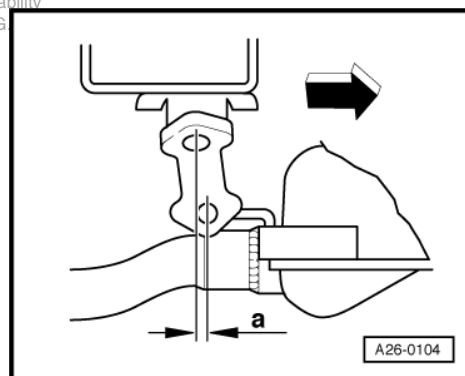
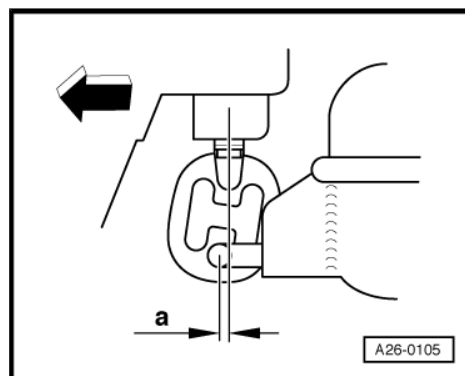
Vehicles with clamp between centre silencer and rear silencer



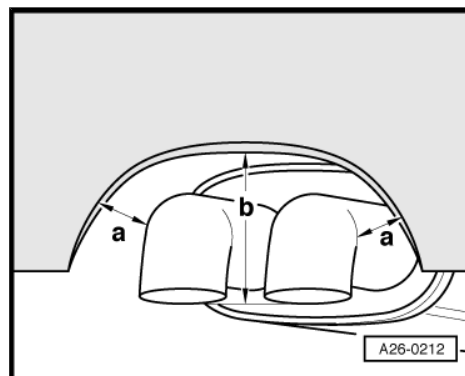
Note

On vehicles with clamp fitted between centre silencer and rear silencer, it is also necessary to align the centre silencer.

- Loosen bolts on clamp (front left) ⇒ [Item 6 \(page 241\)](#), clamp (front right) ⇒ [Item 8 \(page 242\)](#) and clamp (rear) ⇒ [Item 17 \(page 242\)](#).
- Press exhaust system towards front of vehicle -arrow- so that mounting (rear left) for front silencer is preloaded by -a- = 7 ... 9 mm.
- Tighten bolted connections of clamp (front left) ⇒ [Item 6 \(page 241\)](#) and clamp (front right) ⇒ [Item 8 \(page 242\)](#) evenly to 40 Nm.
- Press rear silencer towards front of vehicle -arrow- until mounting (rear right) on rear silencer is preloaded by -a- = 9 ... 11 mm.



- Align rear silencer so it is horizontal.
- Check clearance between tailpipes and bumper:
 - Distance -a- is the same on both sides.
- At the same time, distance -b- must be obtained between bumper cut-out and bottom edge of tailpipes.
- Dimension -b- = 97 ... 103 mm.
- Tighten bolt connections for rear clamp
 - ⇒ [Item 17 \(page 242\)](#) evenly to 40 Nm.



2.5 Checking exhaust system for leaks

- Start engine and run at idling speed.

- Plug tailpipes during leak test (e.g. with cloth or plug).
- Listen for leaks at connection points between cylinder head/exhaust manifold, exhaust manifold/turbocharger and turbocharger/catalytic converter etc.
- Rectify any leaks that are found.



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3 Exhaust manifold

3.1 Exhaust manifold with intermediate pipe - exploded view of components



Note

Illustration shows exhaust manifold of cylinder bank (left-side) with intermediate pipe.

1 - 25 Nm

- ☐ Renew
- ☐ Coat with high-temperature paste; for high-temperature paste refer to ⇒ Electronic parts catalogue

2 - Exhaust manifold

- ☐ Removing and installing: left-side
⇒ [page 251](#), right-side
⇒ [page 254](#)

3 - Gasket

- ☐ Renew

4 - Not fitted

5 - Nut

- ☐ On more recent versions: bolt
- ☐ Renew
- ☐ Coat with high-temperature paste; for high-temperature paste refer to ⇒ Electronic parts catalogue
- ☐ 25 Nm

6 - Intermediate pipe

- ☐ Removing and installing: left-side
⇒ [page 251](#), right-side
⇒ [page 254](#)

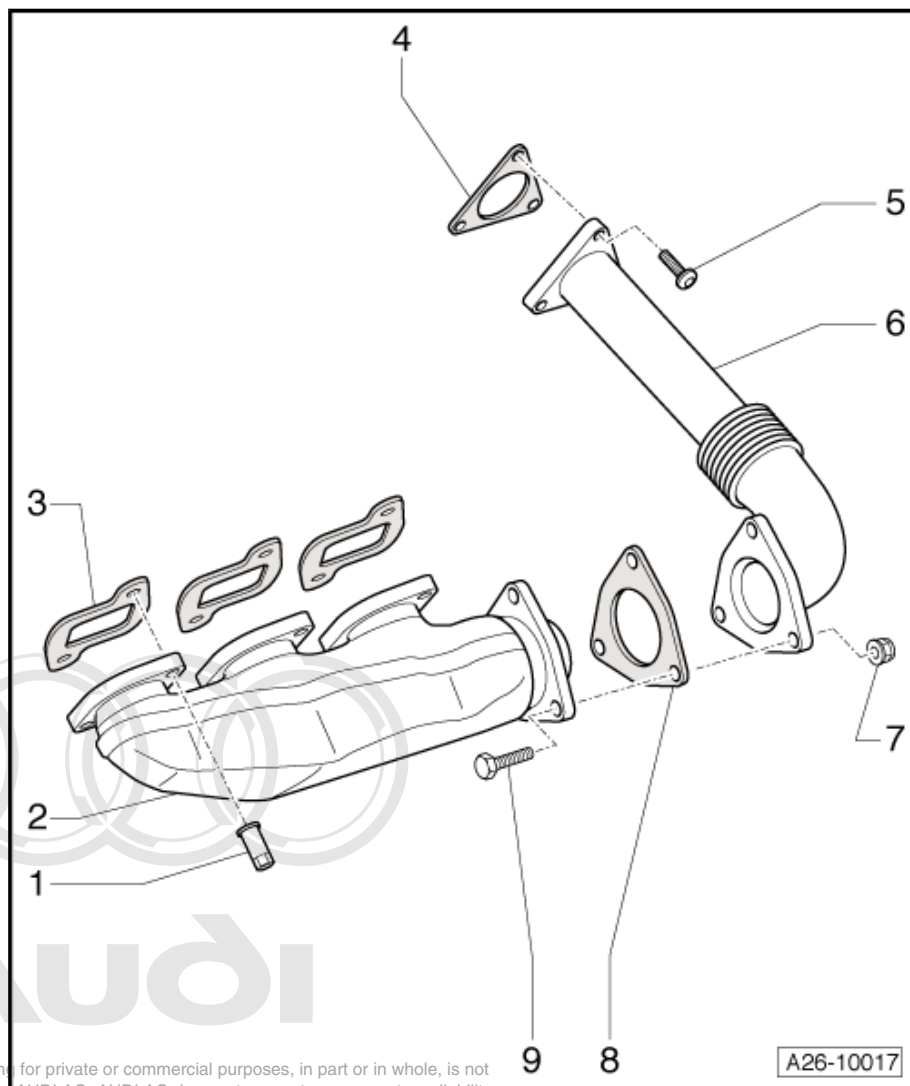
7 - Nut

- ☐ Renew
- ☐ Coat with high-temperature paste; for high-temperature paste refer to ⇒ Electronic parts catalogue
- ☐ 22 Nm

8 - Gasket

- ☐ Renew

9 - Bolt



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3.2 Removing and installing exhaust manifold (left-side) with intermediate pipe

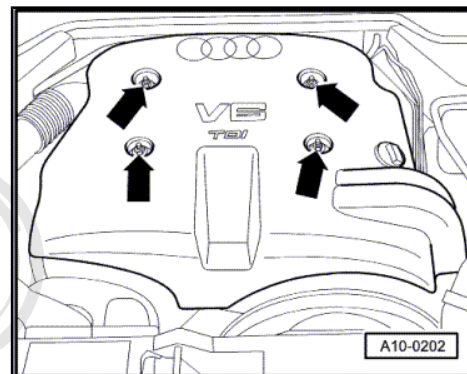
Removing



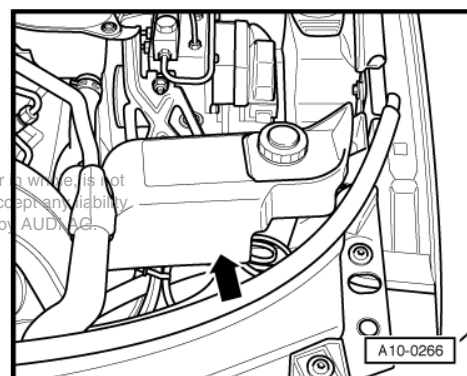
Note

The exhaust manifold (left-side) can only be removed together with the intermediate pipe (left-side).

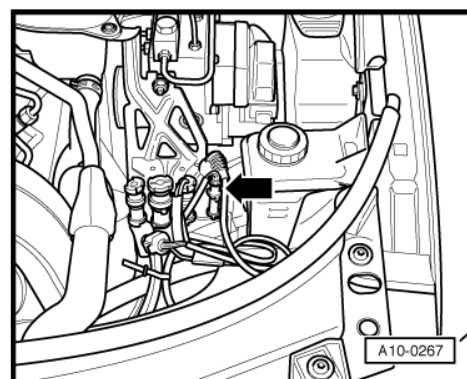
- Lock carrier must be in service position ⇒ [page 31](#) .
- Detach caps on engine cover panel.
- Unbolt and remove engine cover panel -arrows-.
- Remove poly V-belt for air conditioner compressor ⇒ [page 40](#) .



- Remove cover -arrow- at power steering fluid reservoir.

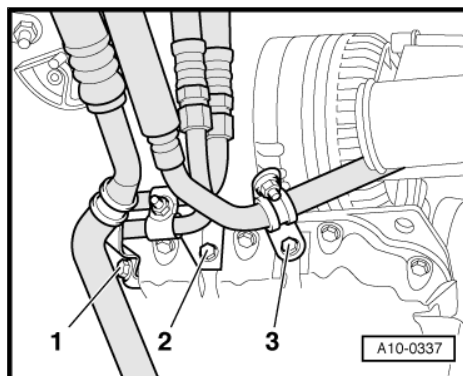


- Unplug connector -arrow- for magnetic clutch for air conditioner compressor and move wiring clear.



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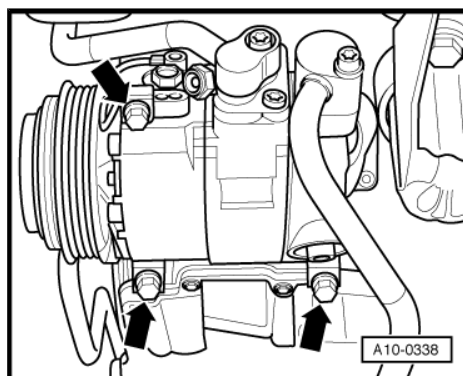
- Detach the two refrigerant line brackets -1- and -3- from sump.


WARNING

Risk of injury caused by refrigerant.

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

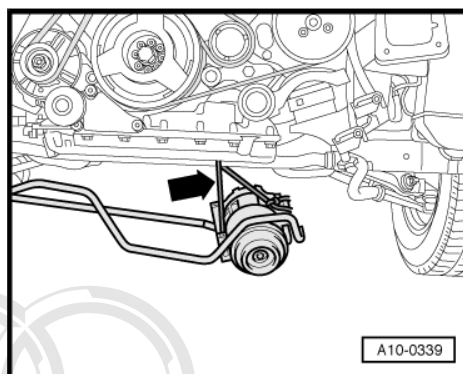
- Unbolt air-conditioner compressor from bracket -arrows-.


Caution

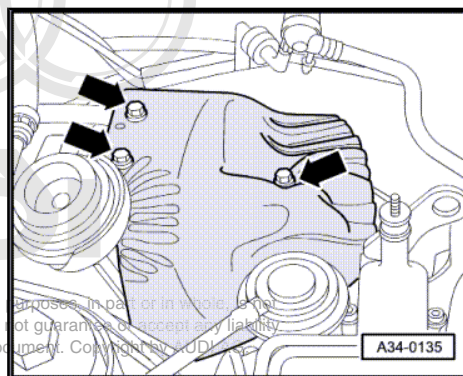
Danger of damage to refrigerant lines and hoses.

- ◆ *Do NOT stretch, kink or bend refrigerant lines and hoses.*

- Tie up air conditioner compressor onto subframe, leaving refrigerant lines connected -arrow-.

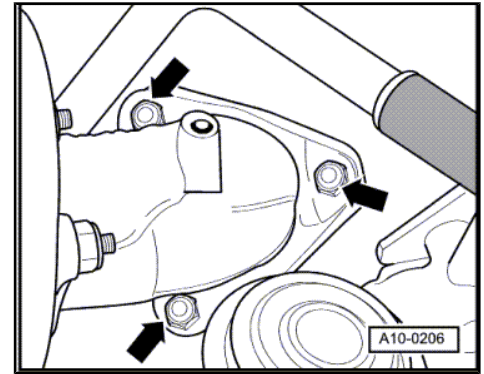


- Remove heat shield above turbocharger -arrows-.



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- Unbolt front exhaust pipe from connection for turbocharger -arrows-.

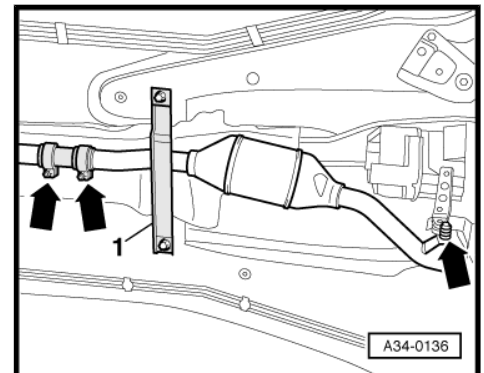


- If installed, remove cross member -1-.

**Caution**

Risk of damage to flexible joints in front exhaust pipe

- ◆ *Do not bend flexible joints in front exhaust pipe more than 10°.*

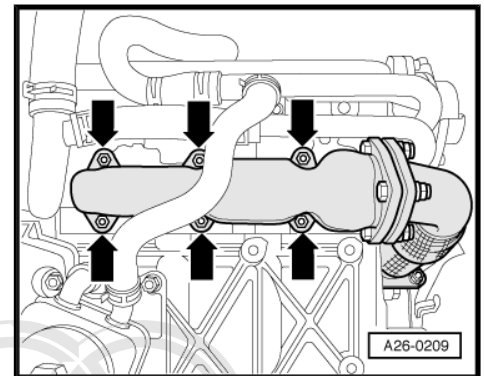


- Remove front exhaust pipe together with catalytic converter -arrows-.

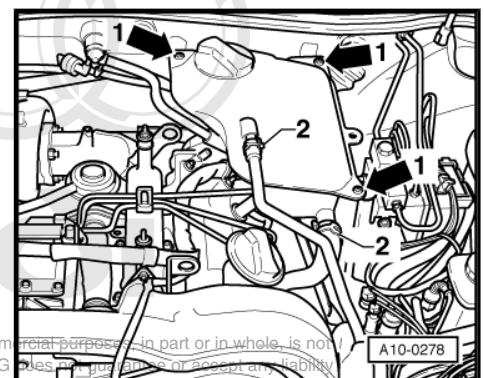
**Note**

Shown for vehicle with front-wheel drive in illustration.

- Unscrew nuts -arrows- for exhaust manifold (accessible from below).



- Unbolt coolant expansion tank -arrows 1-.
- Detach wire for coolant shortage indicator switch -F66- and move coolant expansion tank to one side with coolant hoses -2- attached.



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- Unbolt exhaust pipe from turbocharger -arrows- (accessible from above).
- Take out exhaust manifold with intermediate pipe upwards.
- Separate exhaust manifold and intermediate pipe if necessary.

Installing

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



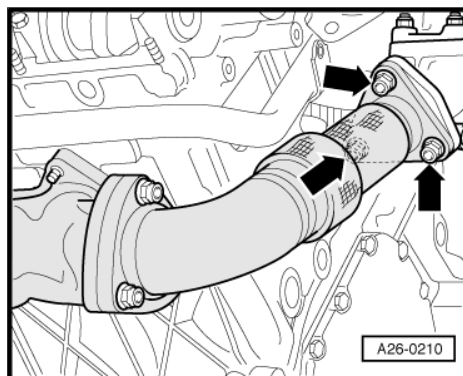
Note

Renew gaskets and self-locking nuts.

- Note installation position of gaskets for exhaust manifold:
 - Aluminium side should face towards cylinder head
- Install front exhaust pipe with main catalytic converter: vehicles with front-wheel drive ⇒ [page 237](#) , vehicles with four-wheel drive ⇒ [page 245](#) .
- Align exhaust system so it is free of stress: vehicles with front-wheel drive ⇒ [page 238](#) , vehicles with four-wheel drive ⇒ [page 247](#) .
- Install poly V-belt for air conditioner compressor ⇒ [page 40](#) .

Tightening torques

Component	Nm
Exhaust manifold to cylinder head	22
Intermediate pipe to: Exhaust manifold	22
Intermediate flange	22
Front exhaust pipe with catalytic converter to: Turbocharger	25
Gearbox support	25
Heat shield to turbocharger	10
Air conditioner compressor to bracket	22
Underbody cross member to body	20



3.3 Removing and installing exhaust manifold (right-side) with intermediate pipe

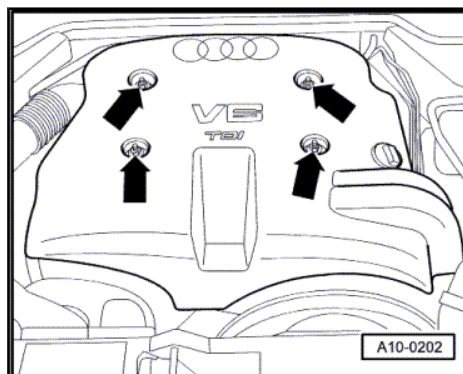
Removing



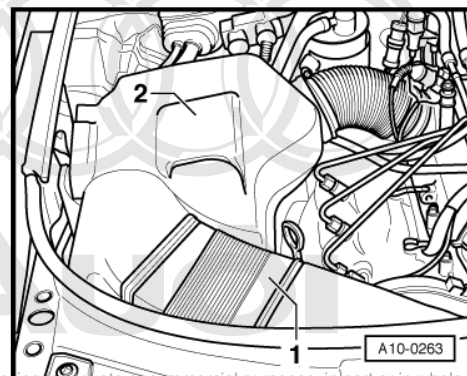
Note

The exhaust manifold (right-side) can only be removed together with the intermediate pipe (right-side).

- Detach caps on engine cover panel.
- Unbolt and remove engine cover panel -arrows-.

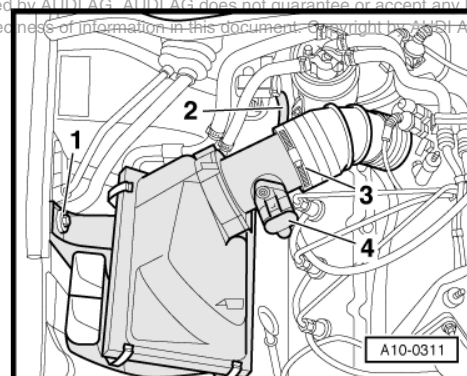


- Remove air cleaner cover -2-.
- Remove air duct -1- leading to air cleaner.

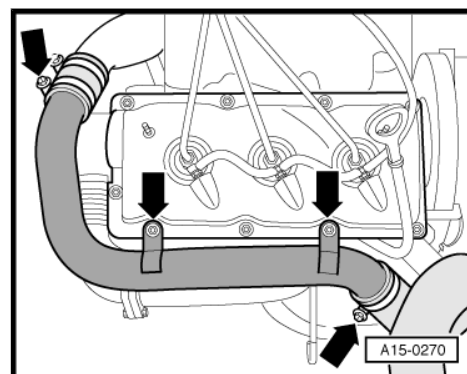


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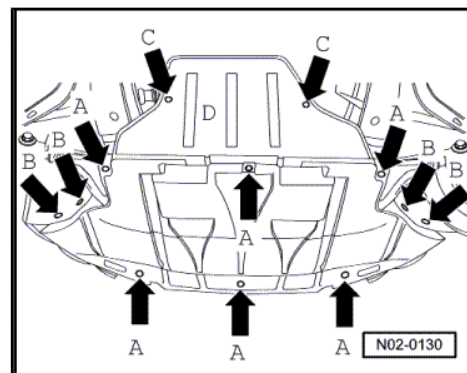
- Slacken hose clip -3-.
- Unplug connector -4-.
- Pull hose -2- off air cleaner housing.
- Unscrew bolt -1- and remove air cleaner housing.



- Remove air intake pipe between turbocharger and charge air cooler (right-side) -arrows-.



- Remove noise insulation (front and rear) -arrows A ... C-.



- First unscrew nuts for exhaust manifold and intermediate pipe accessible from below, then unscrew nuts accessible from above -arrows-.
- Take out exhaust manifold with intermediate pipe upwards.
- Separate exhaust manifold and intermediate pipe if necessary.

Installing

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

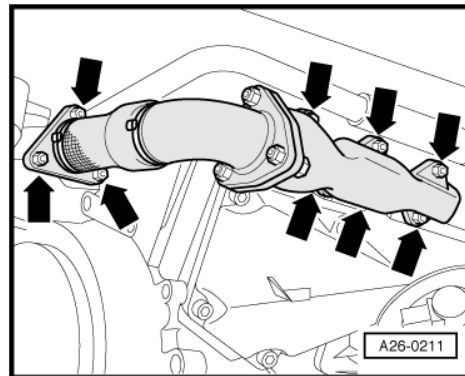


Note

- ◆ *Renew gaskets and self-locking nuts.*
- ◆ *Hose connections and hoses for charge air system must be free of oil and grease before assembly.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- Note installation position of gaskets for exhaust manifold:
 - Aluminium side should face towards cylinder head
- Align exhaust system so it is free of stress: vehicles with front-wheel drive ⇒ [page 238](#) , vehicles with four-wheel drive ⇒ [page 247](#) .

Tightening torques

Component	Nm
Exhaust manifold to cylinder head	22
Intermediate pipe to: Exhaust manifold	22
Intermediate flange	22



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4 Exhaust gas recirculation system

- ◆ The exhaust gas recirculation system is actuated by the diesel direct injection system control unit -J248- via the exhaust gas recirculation valve -N18- and the mechanical exhaust gas recirculation valve.
- ◆ The tapered plunger in the mechanical exhaust gas recirculation valve varies the opening cross section according to valve travel.
- ◆ Pulsed actuation makes it possible to obtain any required valve position.

4.1 Hose connection diagram for exhaust gas recirculation

1 - Vacuum hose

- ☐ From mechanical exhaust gas recirculation valve to exhaust gas recirculation valve -N18-

2 - Mechanical exhaust gas recirculation valve

- ☐ Checking ⇒ [page 263](#)

3 - To charge pressure control solenoid valve -N75-

4 - To breather connection at air cleaner housing

5 - Non-return valve

- ☐ Installation position (light side/dark side): as shown in illustration

6 - Brake servo

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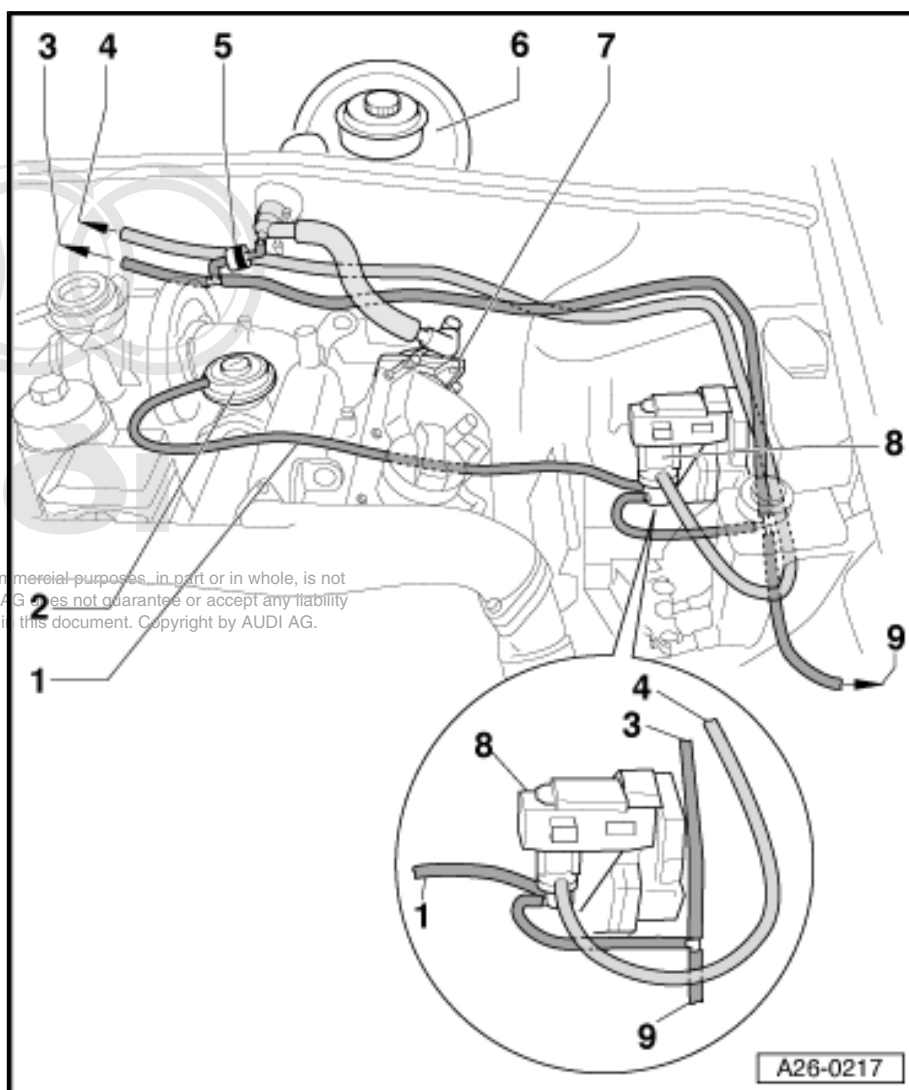
7 - Exhauster pump

- ☐ For brake servo

8 - Exhaust gas recirculation valve -N18-

- ☐ Checking ⇒ [page 259](#)

9 - To vacuum reservoir

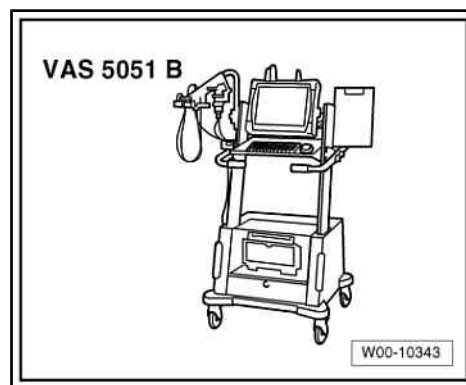


4.2 Checking exhaust gas recirculation

Checking the exhaust gas recirculation function is performed in the "Basic setting" function. In this test, the exhaust gas recirculation valve is pulsed every 10 seconds, so that the extreme values for the exhaust gas recirculation (air mass meter) can be read off in display group 003.

Special tools and workshop equipment required

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

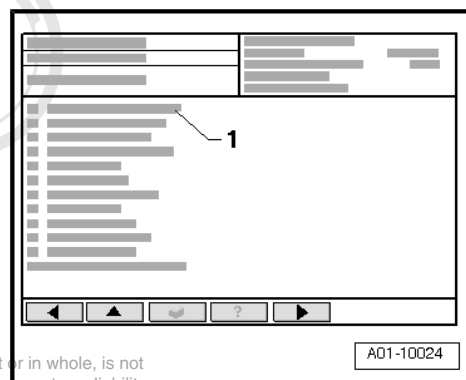


Procedure

- Coolant temperature at least 80 °C.
- Vehicle diagnostic, testing and information system -VAS 5051B- connected.
- Ignition switched on.
- Vehicle self-diagnosis and vehicle system "01 - Engine electronics" selected.

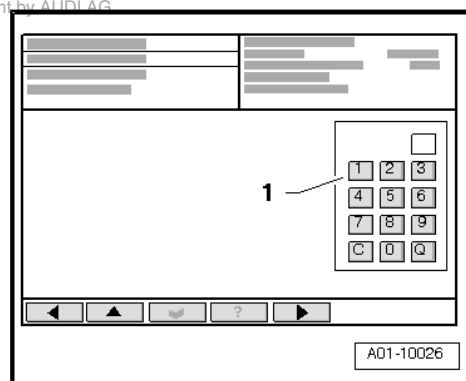
Display on -VAS 5051B- :

- From menu -1-, select diagnosis function "Basic setting" and press  key to continue.



Display on -VAS 5051B- :

- Press key  on keypad -1- to select "Display group 003" and confirm entry by pressing key .



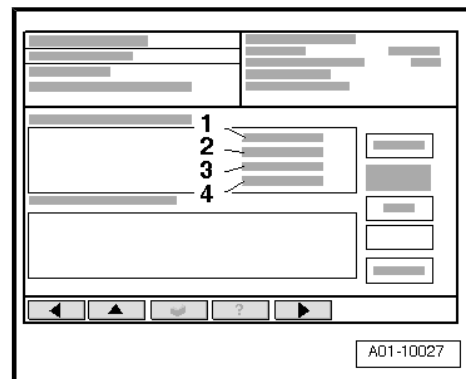
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Display on -VAS 5051B- :

- Check display in display zone -3-.
- Specification: display should alternate between "EGR n-active" and "EGR active" every 10 seconds.
- Check display in zone -3-.
- Specification: display value for intake air mass "... mg/H" (= mg per stroke) should change significantly every 10 seconds.

If the specifications are not obtained:

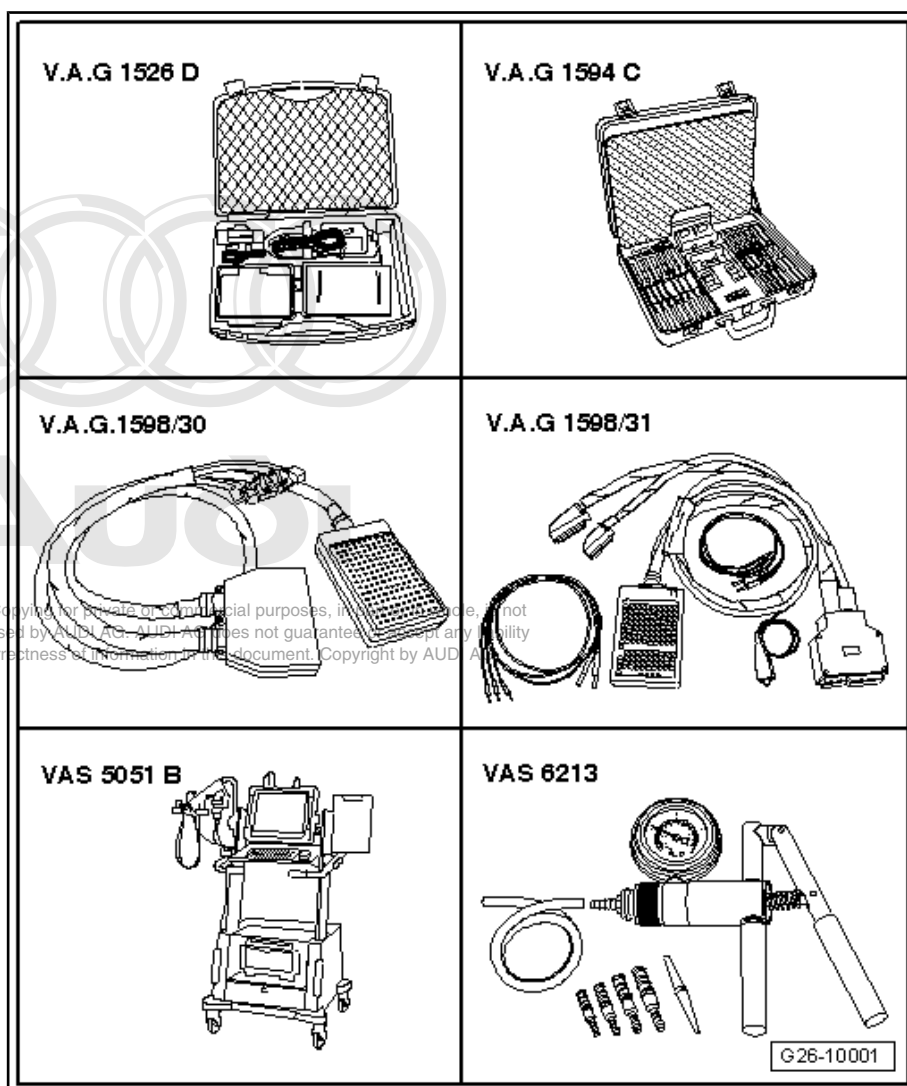
- Check exhaust gas recirculation valve -N18- → [page 259](#) .



4.3 Checking exhaust gas recirculation valve -N18-

Special tools and workshop equipment required

- ◆ Hand-held multimeter - V.A.G 1526D-
- ◆ Auxiliary measuring set - V.A.G 1594C-
- ◆ Adapter -V.A.G 1598/30- (engine code AFB for vehicles with manual gearbox or automatic gearbox; engine code AKN for vehicles with manual gearbox)
- ◆ Adapter cable, 121-pin - V.A.G 1598/31- (engine code AKN for vehicles with automatic gearbox)
- ◆ Vehicle diagnostic, testing and information system - VAS 5051B-
- ◆ Hand vacuum pump -VAS 6213-



Procedure



Note

The exhaust gas recirculation valve -N18- and the wiring connections are monitored by the engine control unit.

- Vehicle diagnostic, testing and information system -VAS 5051B- connected.
- Engine running.
- Vehicle self-diagnosis and vehicle system "01 - Engine electronics" selected.

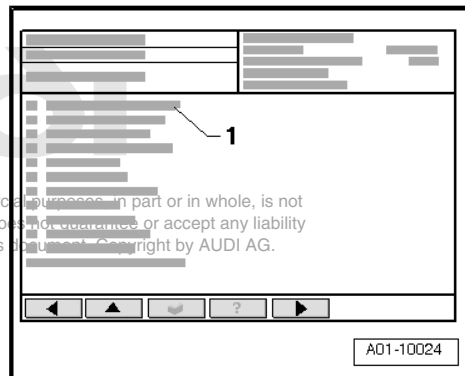
Display on -VAS 5051B- :

- From menu -1-, select diagnostic function "Interrogate fault memory" and press key to continue.

If a fault relating to exhaust gas recirculation valve -N18- is displayed:

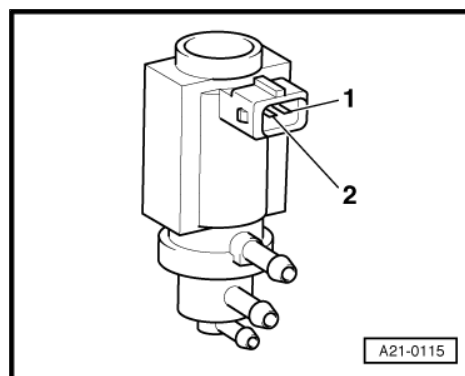
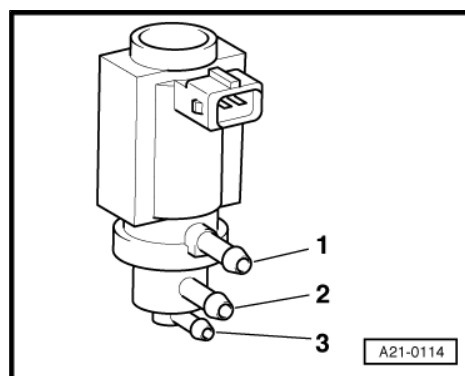
- Press key to terminate function "Interrogate fault memory".

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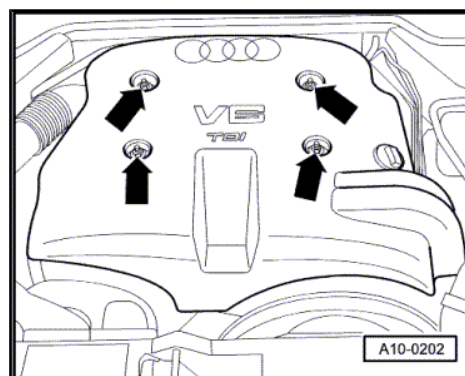


Checking mechanical operation

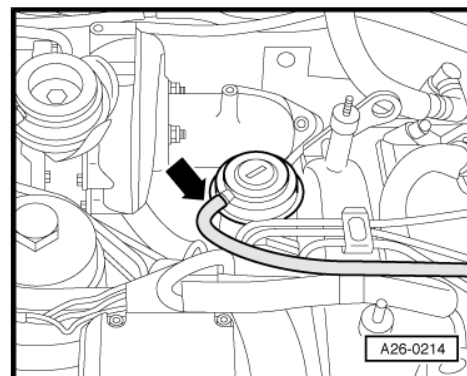
- Switch off ignition.
- Unplug electrical connector at exhaust gas recirculation valve -N18-.
- Detach hose at vacuum connection -3- (leave hose at connection -2- attached to mechanical exhaust gas recirculation valve).
- Connect hand vacuum pump -VAS 6213- to vacuum connection -3-.
- Use a test lead from auxiliary measuring set -V.A.G 1594C- to connect contact -2- of solenoid valve to battery positive "+".
- Connect contact -1- to earth.
- The valve should click.



- Detach caps on engine cover panel.
- Unbolt and remove engine cover panel -arrows-.



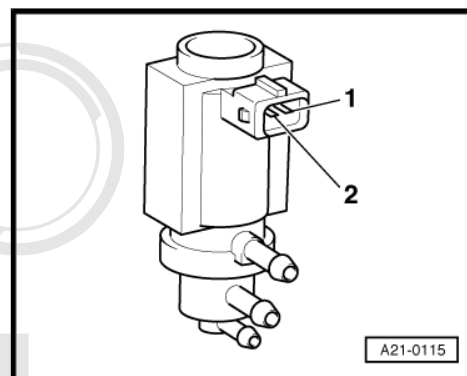
- Disconnect vacuum hose from mechanical exhaust gas recirculation valve -arrow-.
- Operate hand vacuum pump -VAS 6213- .
- Vacuum is applied to disconnected vacuum hose (feel with finger).



- Detach earth connection from contact -1- of solenoid valve.
- Operate hand vacuum pump -VAS 6213- .
- Vacuum is not applied to disconnected vacuum hose (feel with finger).

If the specifications are not obtained:

- Renew exhaust gas recirculation valve -N18- .



Checking voltage supply

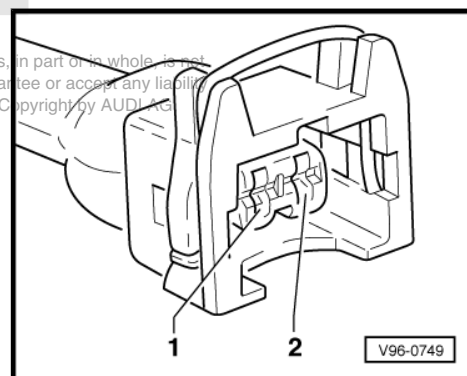
- Connect up multimeter -V A G 1526D- for voltage measurement as follows:

Connector Contact	Measure against
2	Earth

- Switch on ignition.
- Specification: approx. battery voltage.

If specification is not obtained:

- Check wiring connection for open circuit and short to positive or earth ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.

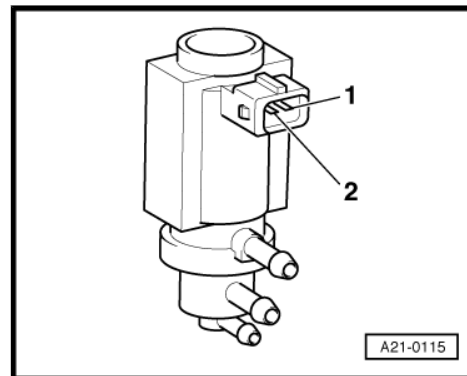


Checking internal resistance

- Unplug electrical connector at exhaust gas recirculation valve -N18- .
- Connect multimeter (resistance measuring range) to valve.
- Specification: 14 ... 20 Ω.

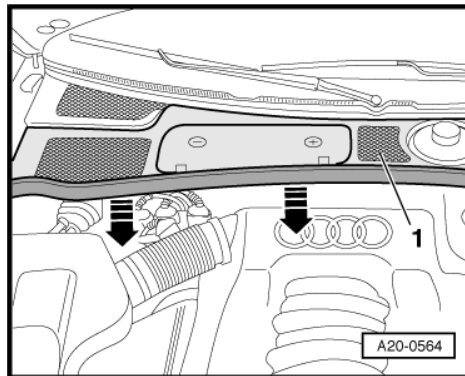
If specification is not obtained:

- Renew exhaust gas recirculation valve -N18- .

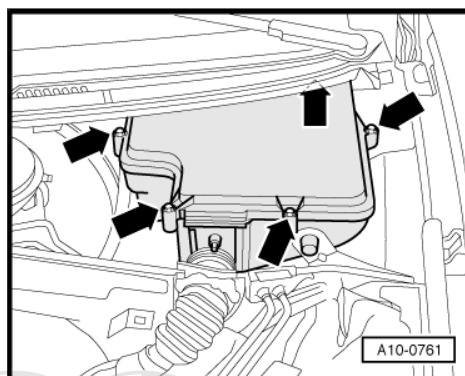


Checking signal wire

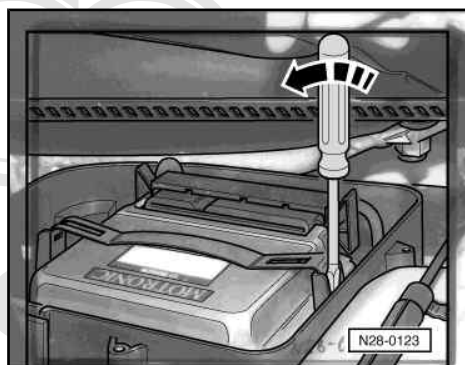
- If fitted, remove seal from plenum chamber cover -arrows-.
- Detach plenum chamber cover -1- towards the front.



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

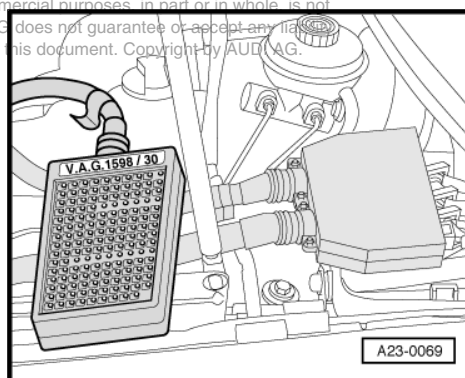


- Carefully prise off retaining strap -arrow- using a screwdriver.
- Release retaining clip and unplug connectors from control unit.



Engine code AFB for vehicles with manual gearbox or automatic gearbox, engine code AKN for vehicles with manual gearbox.

- Connect adapter -V.A.G 1598/30- to unplugged connectors for engine control unit (not to control unit).



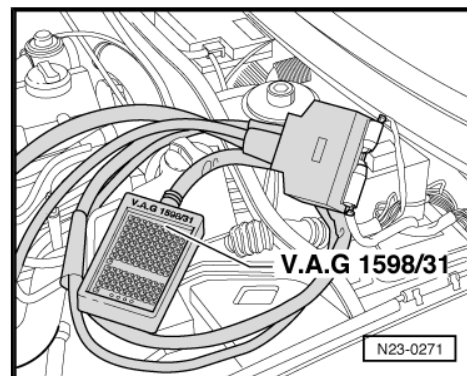
Engine code AKN for vehicles with automatic gearbox:

- Connect adapter cable, 121-pin -V.A.G 1598/31- to connector of wiring harness (do not connect engine control unit).
- Connect earth clip of adapter cable to earth (not shown in illustration).

All vehicles (continued):**Caution**

Electronic components are susceptible to damage.

- ◆ *Select the appropriate measuring range before connecting the test leads and observe test requirements.*

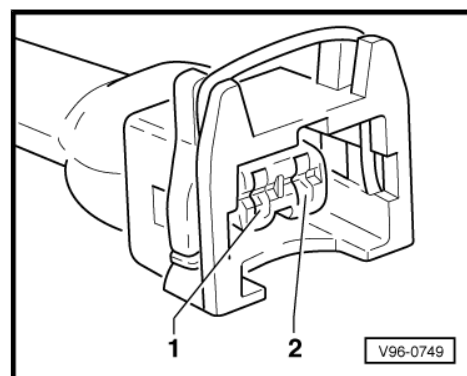


- Check for open circuit and short to positive or earth in the following wiring:

Connector Contact	-V.A.G 1598/30- Socket	-V.A.G 1598/31- Socket
1	2/13	61

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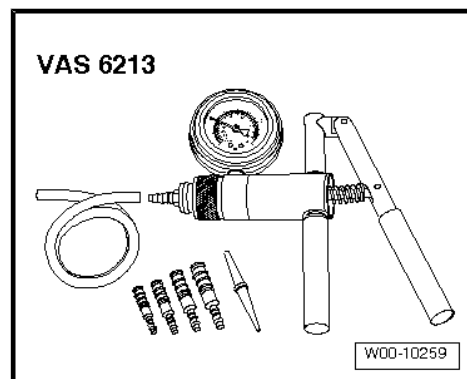
- Rectify any open/short circuit as necessary.



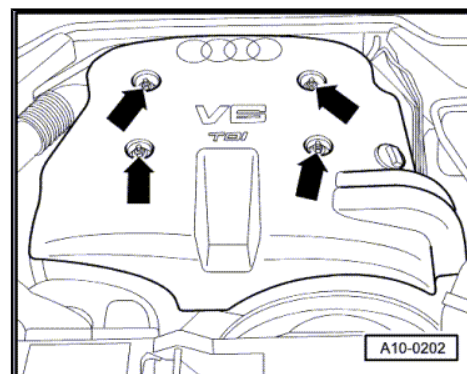
4.4 Checking mechanical exhaust gas recirculation valve

Special tools and workshop equipment required

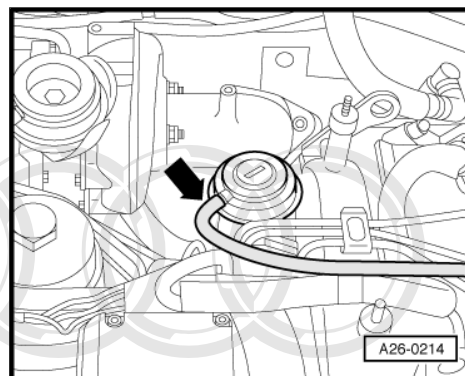
- ◆ Hand vacuum pump -VAS 6213-

**Procedure**

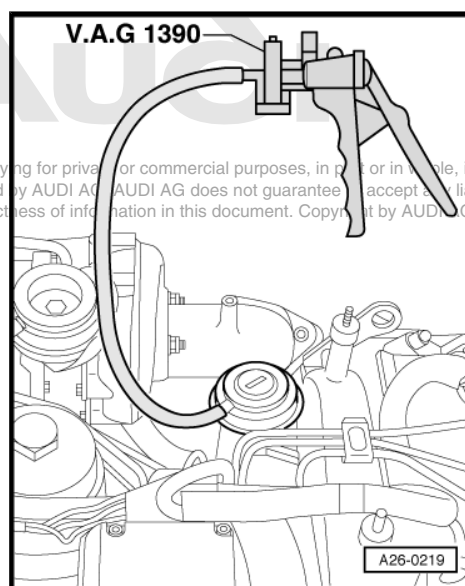
- Detach caps on engine cover panel.
- Unbolt and remove engine cover panel -arrows-.



- Disconnect vacuum hose from mechanical exhaust gas recirculation valve -arrow-.



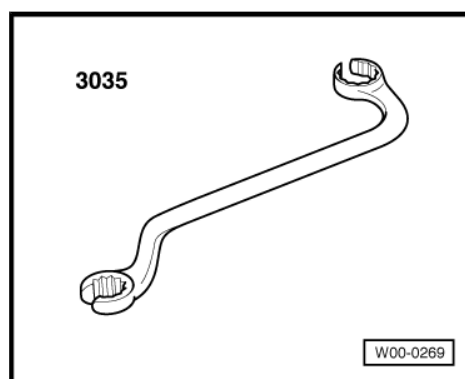
- Connect hand vacuum pump -VAS 6213- to valve.
- Operate hand vacuum pump -VAS 6213- .
- Pull hose of hand vacuum pump off exhaust gas recirculation valve.
- The closing of the valve should be clearly audible. The diaphragm rod should move towards the intake manifold.



4.5 Removing and installing mechanical exhaust gas recirculation valve

Special tools and workshop equipment required

- ◆ Ring spanner -3035-



- ◆ Torque wrench -V.A.G 1331- with ratchet -V.A.G 1331/1-

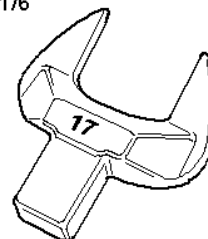
V.A.G 1331



W00-0427

- ◆ Tool insert AF 17 -V.A.G 1331/6-

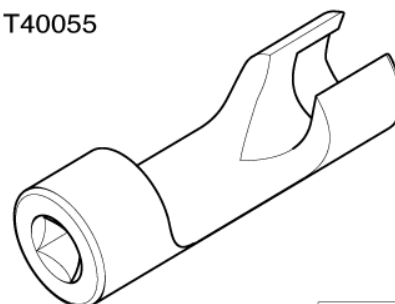
V.A.G 1331/6



W00-1126

- ◆ Socket -T40055-

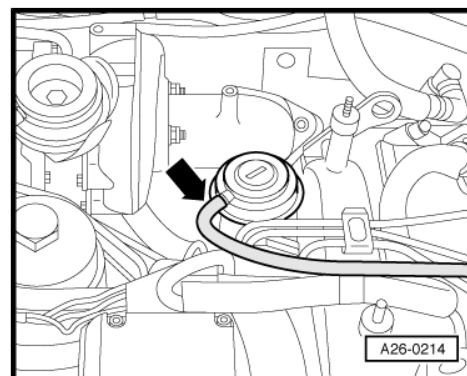
T40055



W00-10099

Removing

- Remove connection for turbocharger ⇒ [Item 16 \(page 225\)](#) .
- Remove intake manifold (front section) ⇒ [page 101](#) .
- Mark injector pipes according to cylinder (e.g. with felt-tip pen).
- Disconnect injector pipes one by one with ring spanner -3035- .
- Disconnect vacuum hose from mechanical exhaust gas recirculation valve -arrow-.



A26-0214

- Remove nuts -1- and bolt -2-.
- Detach mechanical exhaust gas recirculation valve.

Installing

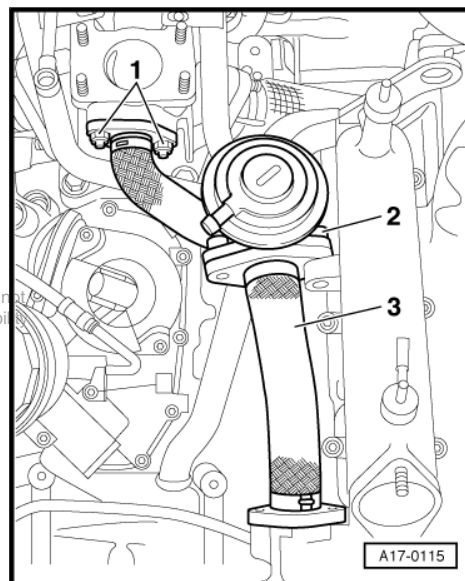
Installation is carried out in the reverse order; note the following:



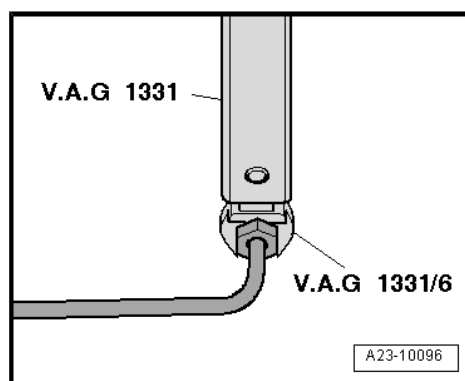
Note

Renew gaskets and self-locking nuts.

- Install injector pipes one after the other (from bottom to top).
- Ensure stress-free installation of injector pipes.



- Tighten with torque wrench -V.A.G 1331-, and tool insert AF 17 -V.A.G 1331/6-.



- Tighten with torque wrench -V.A.G 1331-, ratchet -V.A.G 1331/1- and socket -T40055-.
- Install intake manifold (front section) ⇒ [page 101](#).
- Check fuel system for leaks ⇒ [page 4](#).

Tightening torques

Component		Nm
Mechanical EGR valve to	Intake manifold	22
	Pipe for exhaust gas recirculation	22
EGR pipe to intermediate flange		22
Injector pipes to	Injectors	30
	Injection pump	30

