

Workshop Manual Audi A2 2001 ➤

**3-cylinder TDI unit injector engine (1.4 ltr. 2-valve),
mechanics**

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Engine ID	AMF	BHC	ATL					
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Edition 02.2013

List of Workshop Manual Repair Groups

Repair Group

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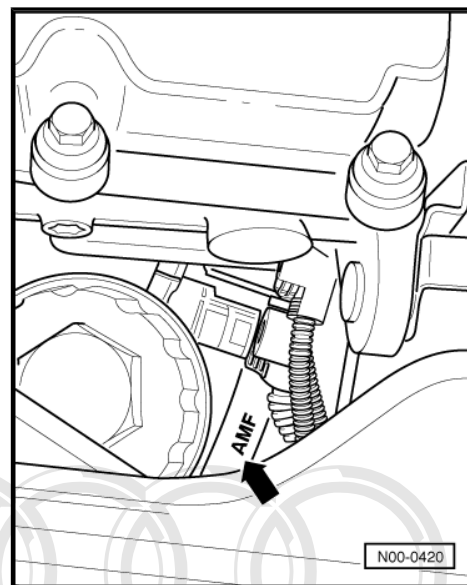
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00 – Technical data

1 Engine number

(ARL003217; Edition 02.2013)

- ◆ The engine number ("Engine code" and "Serial number") can be found at the joint between engine and gearbox -arrow-.
- ◆ Additionally there is a sticker on the toothed belt cover showing the "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		AMF	ATL	BHC
Capacity	ltr.	1.422	1.422	1.422
Power output	kW at rpm	55/4000	66/4000	55/4000
Torque	Nm at rpm	195/2200	230/1900 ... 2200	195/2200
Bore	Ø mm	79.5	79.5	79.5
Stroke	mm	95.5	95.5	95.5
Compression ratio		19.5:1	18.5:1	19.5:1
CN	at least	49	51	51
Firing order		1-2-3	1-2-3	1-2-3
Emissions standard		EU3	EU4	EU4
Exhaust gas recirculation		yes	yes	yes
Turbocharging/supercharging		Turbocharger	Turbocharger	Turbocharger
Charge air cooling		yes	yes	yes
Catalytic converter		yes	yes	yes
Valves per cylinder		2	2	2

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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 ⇒ 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.

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4 Safety precautions

When working on the fuel system note the following warnings:



WARNING

Risk of scalding - the temperature of the fuel and the fuel lines can be as high as 100 °C.

- ◆ *Allow the fuel to cool down before disconnecting the lines.*
- ◆ *Wear protective gloves.*
- ◆ *Wear safety goggles.*

Observe the following to prevent 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.
- ◆ Faults are stored in engine control unit if electrical connectors have been unplugged:
 - Connect vehicle diagnostic, testing and information system - VAS 5051B- .
 - Start "Self-diagnosis" mode.
 - Interrogate fault memory.



Caution

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

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

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

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

- ◆ *Test equipment must always be secured on the rear seat and operated from that position by a second person.*

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5 Rules for cleanliness

Even small amounts of dirt can cause malfunctions. When working on the fuel supply system, injection system, turbocharging/supercharging and charge air cooling system, pay careful attention to the following basic rules:

- ◆ 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.
- ◆ Only install clean components; replacement parts should only be unpacked immediately prior to installation. Do not use parts that have not been stored in their packing (e.g. in tool boxes etc.).
- ◆ When the system is open, do not work with compressed air and do not move the vehicle.
- ◆ Protect unplugged electrical connectors against dirt and moisture and make sure connections are dry when attaching.



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6 Checking for leaks in the fuel system

- Start the engine and let it run at medium speed for a few minutes.
- Switch off ignition.
- Check the entire fuel system for leaks.
- If leaks are found although the connections have been tightened to the correct torque, the relevant component must be renewed.
- Then carry out a test drive with at least one full-power acceleration.
- Then check the pressurised areas in the system for leaks again.



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10 – Removing and installing engine

1 Detaching bonnet

Special tools and workshop equipment required

- ♦ Engine cover protector -VAS 6011-

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Procedure

- Wash outer side of bonnet and dry with chamois leather.
- Release service flap from inside the vehicle.
- Release bonnet -arrows- and pull it forwards slightly.

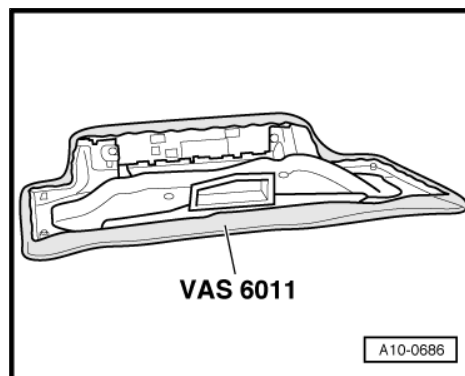
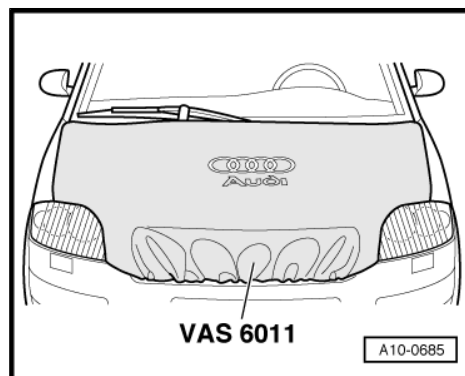
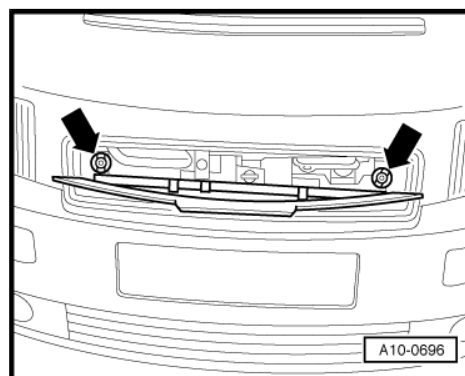
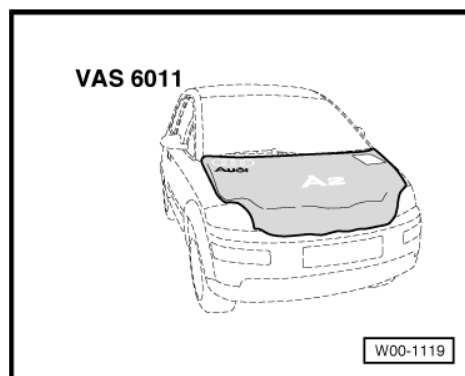
- Fasten protective cover -VAS 6011- over bonnet.

- Remove bonnet and put aside with the Audi A2 engine cover protector -VAS 6011- facing downwards.



Note

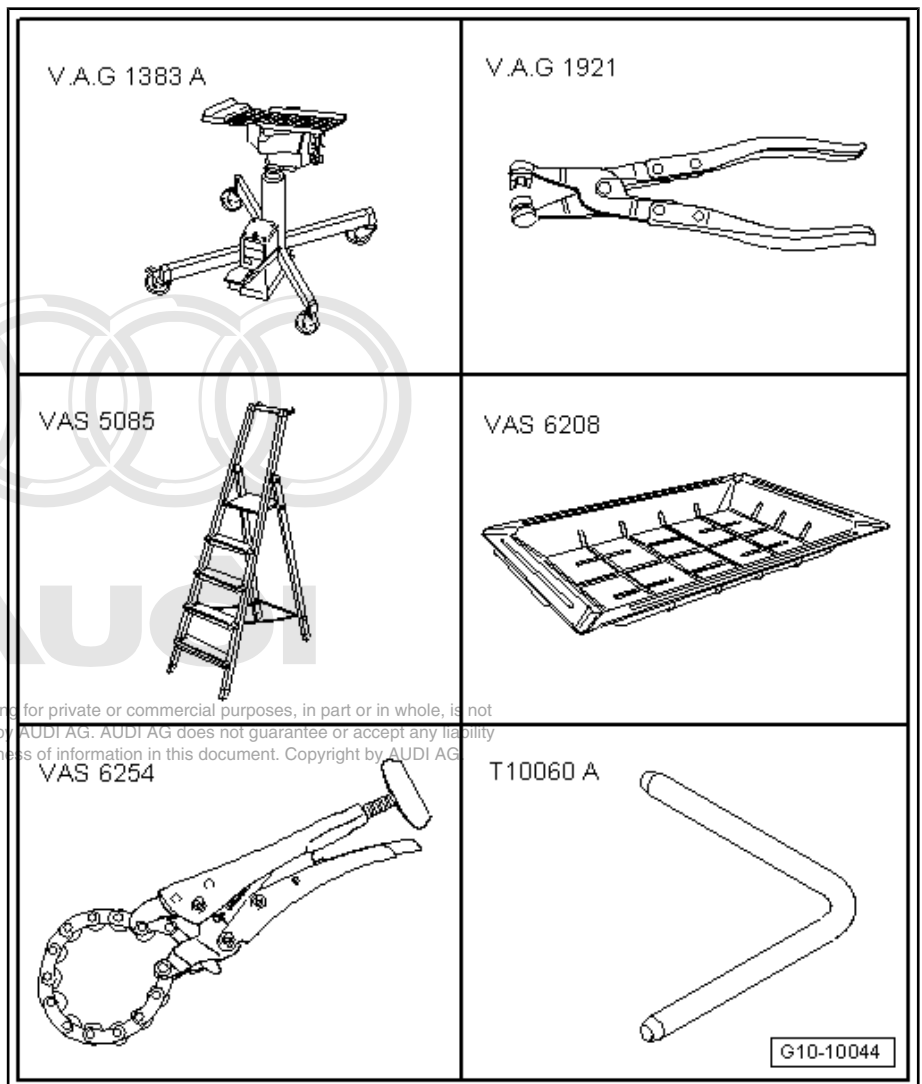
Do not store bonnet in upright position.



2 Removing engine

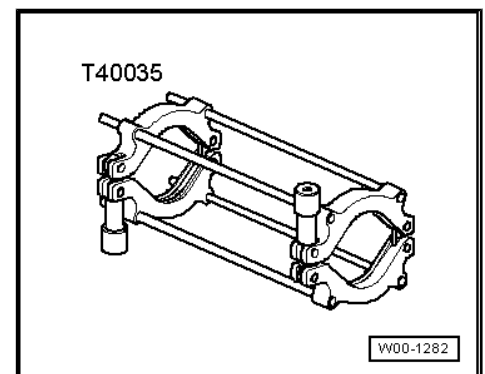
Special tools and workshop equipment required

- ◆ Engine and gearbox jack - V.A.G 1383 A-
- ◆ Hose clip pliers -V.A.G 1921-
- ◆ Stepladder -VAS 5085-
- ◆ Drip tray for workshop hoist -VAS 6208-
- ◆ Chain pipe cutter -VAS 6254-
- ◆ Locking pin -T10060 A-

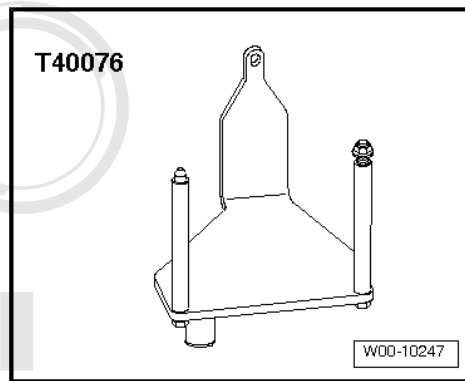


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- ◆ Setting tool -T40035-



◆ Engine support -T40076-



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Note

- ◆ *The engine is removed from underneath together with the gearbox.*
- ◆ *All cable ties which are released or cut open when removing must be fitted in the same position when installing.*



Caution

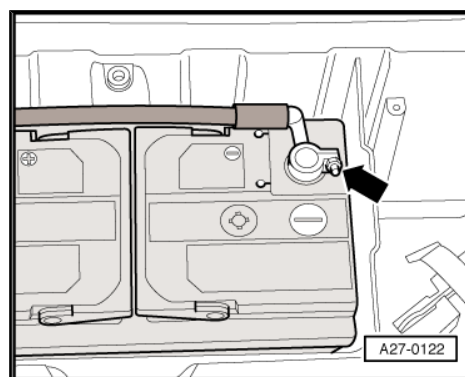
Observe notes on procedure for disconnecting the battery ⇒ Rep. gr. 27 .



Note

The battery is located in the luggage compartment panel.

- Switch off ignition and remove ignition key.
- Disconnect earth cable -arrow- at battery.



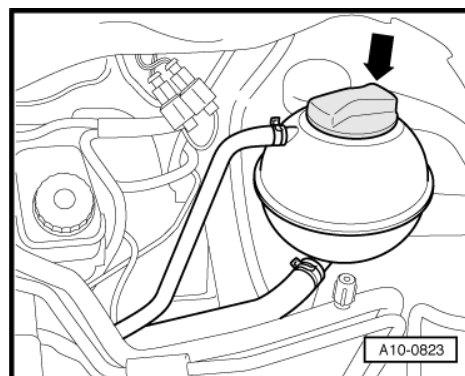
- Remove bonnet ⇒ [page 8](#) .



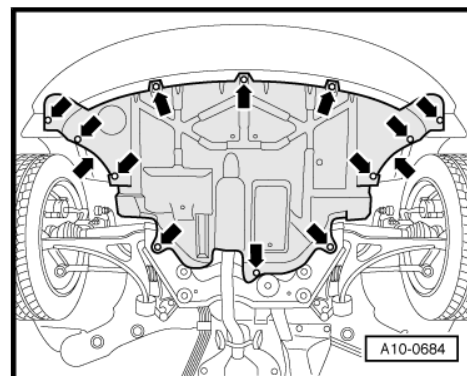
WARNING

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

- Open filler cap -arrow- on coolant expansion tank.

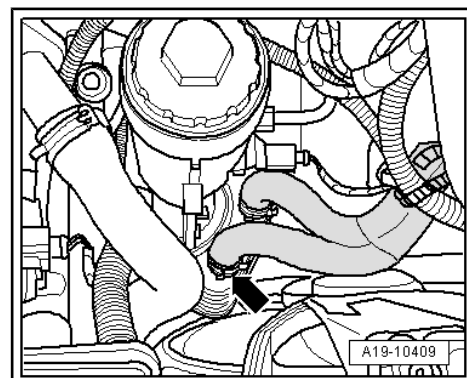
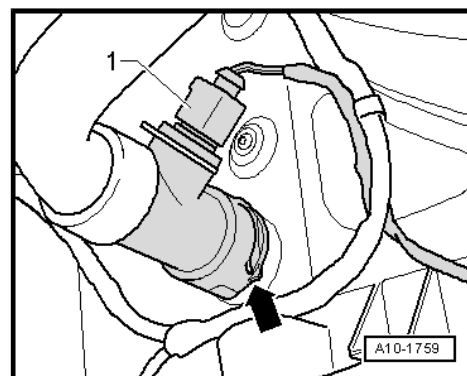


- Remove front wheels.
- Remove noise insulation -arrows-.

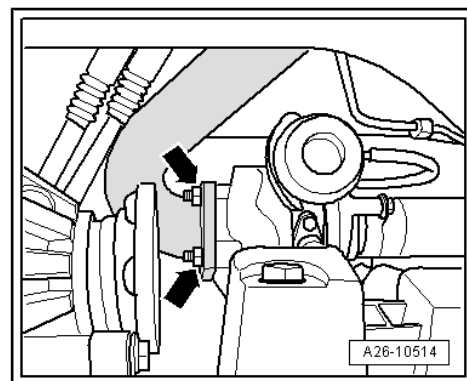
**Note**

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

- Place drip tray for workshop hoist -VAS 6208- under engine.
- Unplug electrical connector -1- at radiator outlet coolant temperature sender -G83- .
- Disconnect coolant hose (bottom) at radiator -arrow- and drain off coolant.
- Disconnect coolant hose from oil cooler -arrow-, guide downwards and drain off remaining coolant.



- Unscrew all nuts -arrows- at exhaust system/turbocharger.



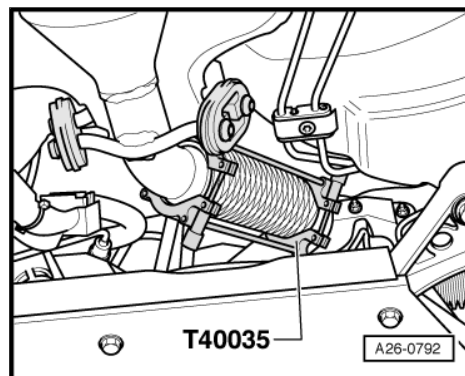
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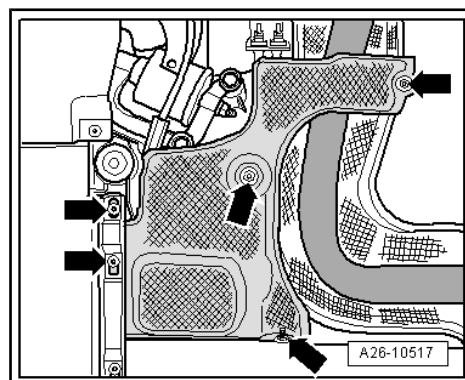
Note

To avoid any damage, the flexible joint must not be bent more than 10°.

- Support flexible joint (decoupling element) with fixing tool - T40035-.



- Unbolt heat shield for exhaust system -arrows-.

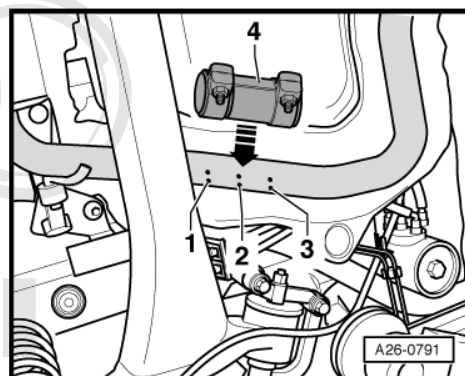


- On vehicles with two-piece exhaust pipes, loosen nuts on clamp -4- and move clamp towards rear to separate exhaust system.
- On vehicles with one-piece exhaust pipes, cut through exhaust pipe at a right angle at cutting point -2- using chain-type pipe cutter -VAS 6254-.

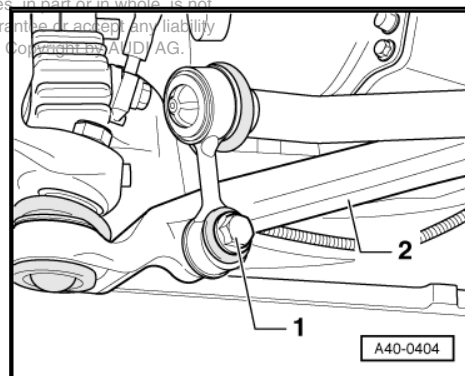


Note

Disregard -items 1 and 3-.

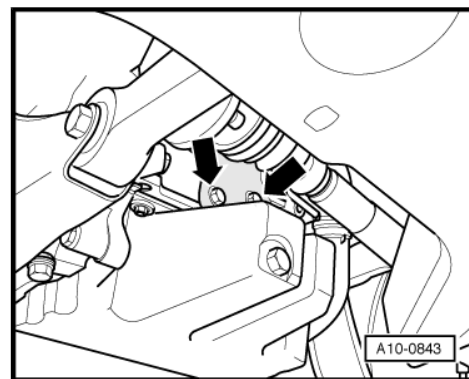


- Remove bolt -1- for coupling rod at suspension link -2-.



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- Unbolt heat shield for drive shaft (left-side) -arrows-.
- Detach drive shaft (left-side) from flange shaft of gearbox and tie up.
- Remove drive shaft (right-side) ⇒ Rep. gr. 40 .



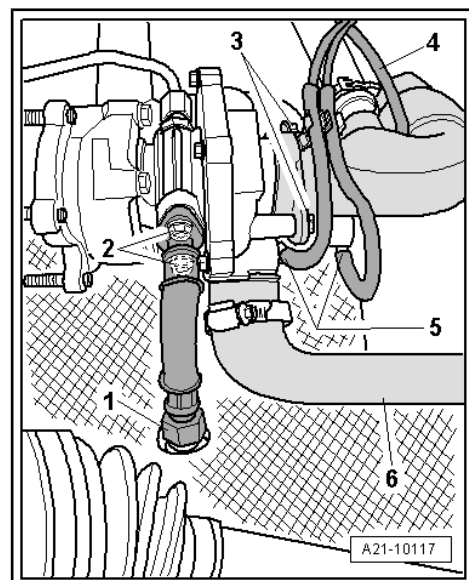
Vehicles with engine code letters AMF:

- Detach air hose -6- from turbocharger.
- Detach charge pressure control hose -5- at turbocharger and at vacuum unit for charge pressure control.
- Disconnect breather hose -4-.
- Unscrew bolts -3- and detach air pipe from turbocharger.



Note

- ◆ *The air pipe remains in installation position and is detached upwards at a later stage.*
- ◆ *Disregard -items 1 and 2-.*



Vehicles with engine code letters ATL, BHC:

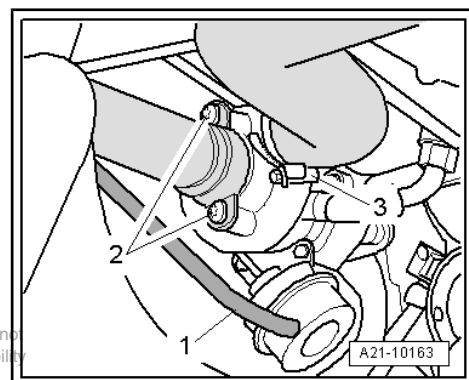
- Detach vacuum hose -1- from vacuum unit for charge pressure control and move it clear.
- Unscrew bolts -2- and detach air pipe from turbocharger.



Note

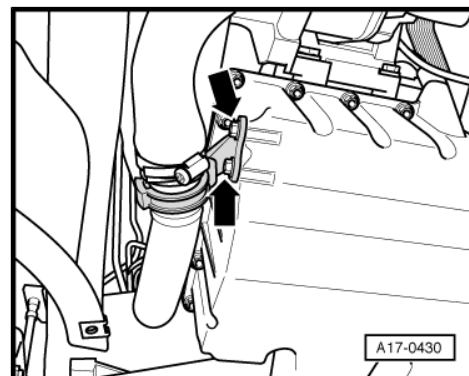
The air pipe remains in installation position and is detached upwards at a later stage.

- Detach air hose -3- from turbocharger.



All vehicles:

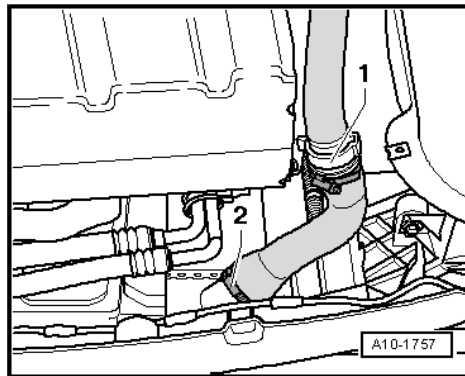
- Unbolt bracket for air pipe from sump -arrows-.



- Remove air intake hose -2- (right-side) from charge air cooler.


Note

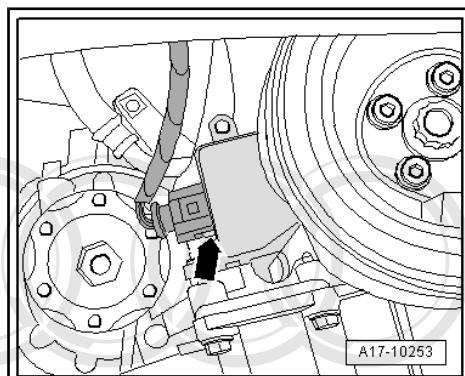
Disregard -item 1-.



- Unplug electrical connector -arrow- at oil level and oil temperature sender -G266- .
- Move wiring clear.

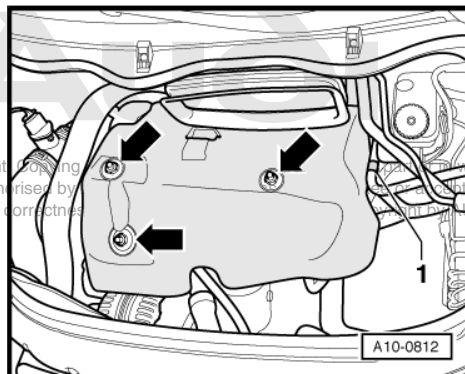

Note

Depending on version, oil level and oil temperature sender -G266- can be located at front of sump.



- If fitted, unclip bracket -1-.
- Take off engine cover panel -arrows-.
- Remove noise insulation beneath cover.

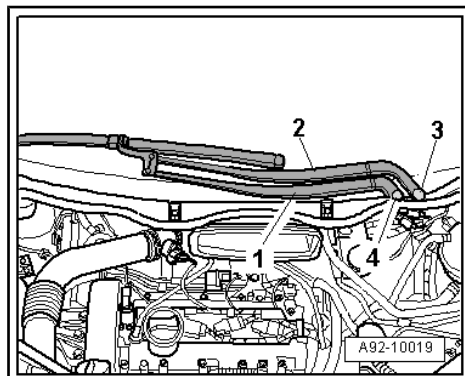
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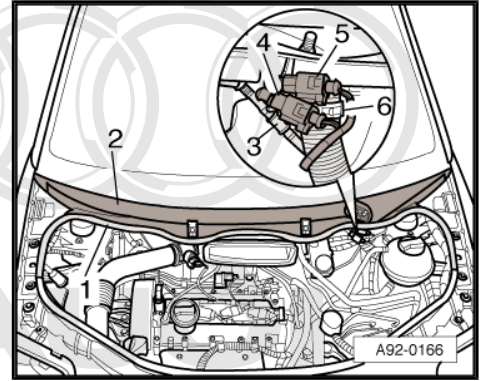
- Lever off caps -3 and 4- on two-piece windscreen wiper arm with a screwdriver.
- Slacken nuts on two-piece windscreen wiper arm a few turns.
- Release arms -1 and 2- one after the other by tilting them slightly on the wiper shafts.
- Remove nuts completely and take off two-piece windscreen wiper arm.


Note

Use puller (commercially available) to remove wiper arm if necessary.

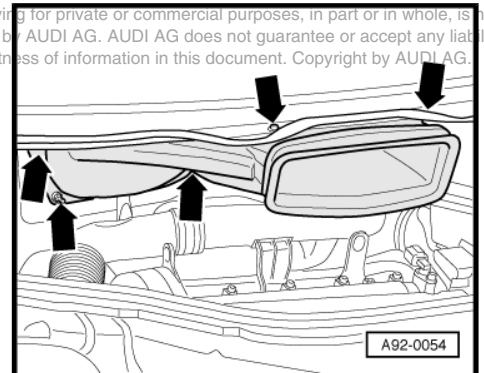


- Disconnect washer fluid hose -3-.
- If fitted, unplug electrical connectors -4 and 5- for heated washer jets.
- Open hose clip -6- using hose clip pliers -V.A.G 1921- and detach water drain hose from cowl panel grille.
- Pull off rubber seal -1- on cowl panel grille.
- Disconnect cowl panel grille -2-.



- Unscrew nuts and bolts -arrows-.
- Pull fresh air duct forwards and remove by turning it to right side of vehicle.

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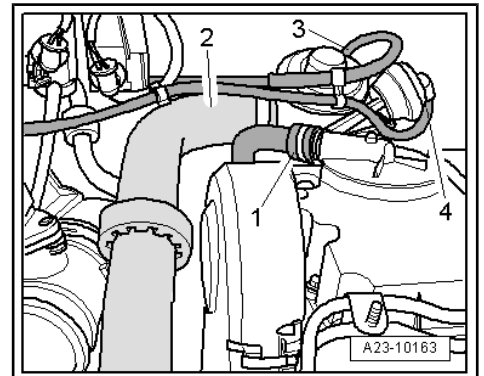
Vehicles with engine code letters AMF:

- Detach air hose -2- at mechanical exhaust recirculation valve.
- Disconnect vacuum hose -3- at mechanical exhaust gas recirculation valve.
- Disconnect vacuum hose -4- from vacuum unit for intake manifold flap.



Note

Disregard -item 1-.

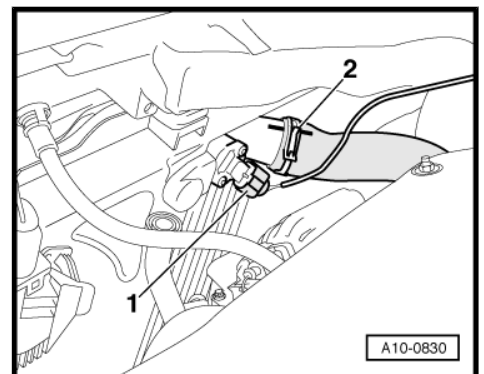


- Remove air intake hose -2- from charge air cooler.



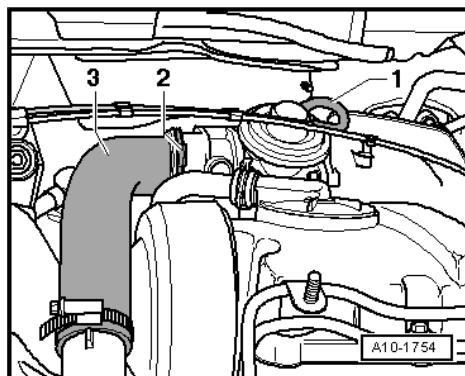
Note

Disregard -item 1-.

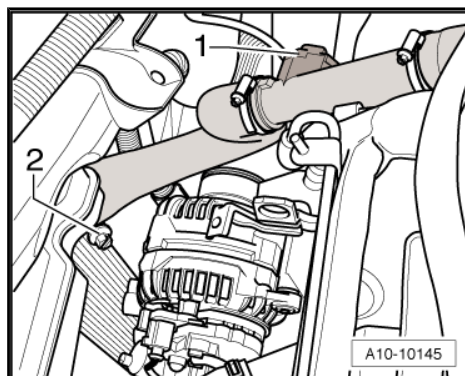


Vehicles with engine code letters ATL:

- Remove air hose -3- from intake manifold flap motor -V157- by lifting retaining clip -2- slightly.
- Disconnect vacuum hose -1- at mechanical exhaust gas recirculation valve.



- Remove air intake hose -2- from charge air cooler.
- Unplug electrical connector at charge pressure sender -G31- item 1-.



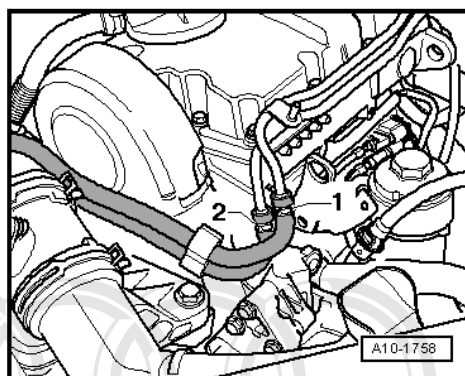
All vehicles:



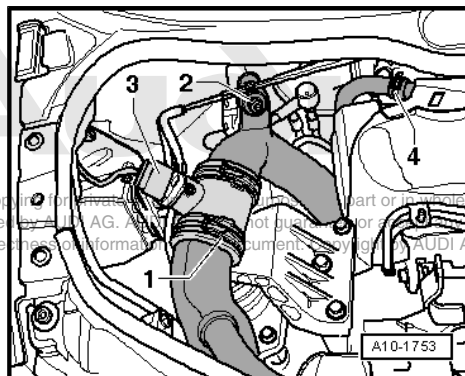
WARNING

Risk of scalding - the temperature of the fuel and the fuel lines can be as high as 100 °C.

- ◆ Allow the fuel to cool down before disconnecting the lines.
- ◆ Wear protective gloves.
- ◆ Wear safety goggles.

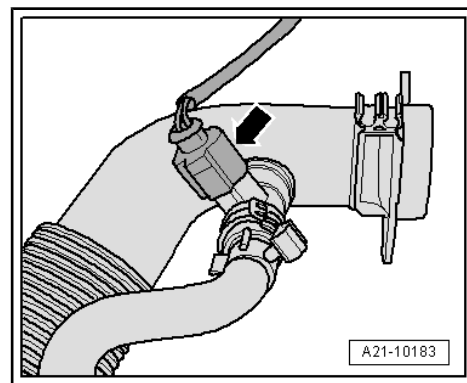


- Mark fuel supply line -2- and fuel return line -1-.
- Move fuel lines clear.
- Detach air intake hose -1- at air mass meter -G70- .
- Unplug electrical connector -3- at air mass meter -G70- .
- Remove nut -2-.
- Disconnect crankcase breather hose -4- at cylinder head cover.
- Pull air pipe out slightly together with air mass meter -G70-.



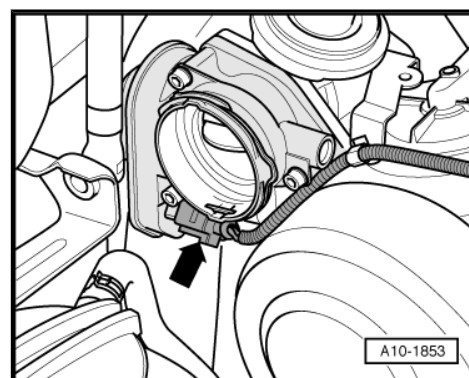
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- Detach electrical connector -arrow- at heater element for crankcase breather -N79- (if fitted).
- Remove air pipe.



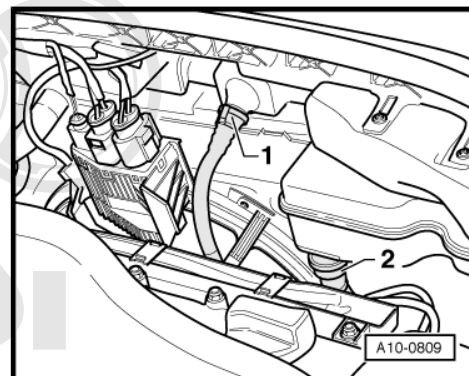
Vehicles with engine code letters ATL:

- Detach electrical connector -arrow- at intake manifold flap motor -V157-.
- Move wiring clear.

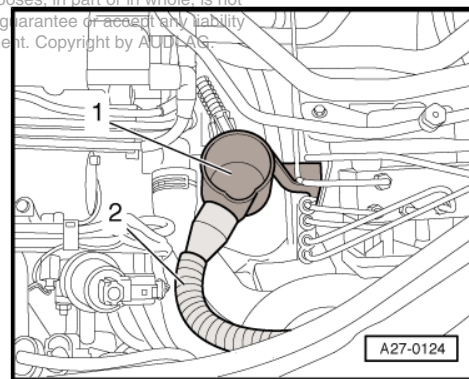


All vehicles:

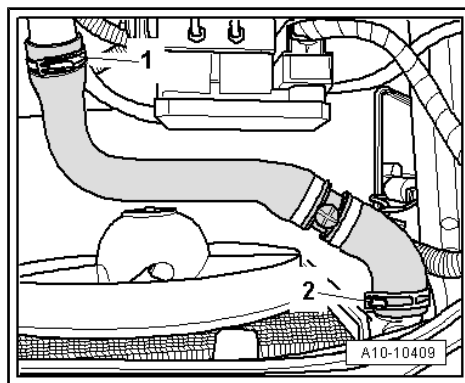
- Pull oil dipstick out of guide tube.
- Remove guide tube for oil dipstick -1-.
- Pull oil filler pipe -2- off oil filler reservoir.



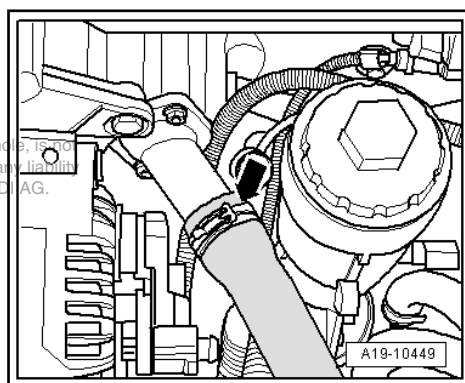
- Disconnect drain hose -2-.
- Remove water collector -1-.



- Remove top left coolant hose -items 1 and 2-.



- Detach coolant hose from hose connection at front of engine -arrow-.

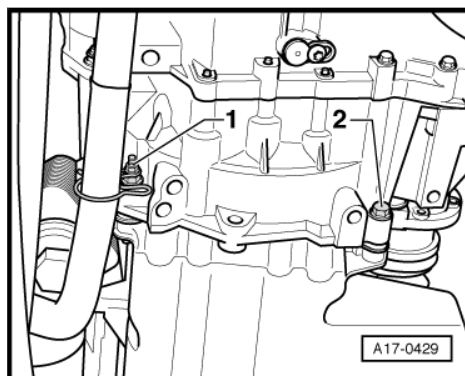


- Disengage coolant hose from retainer -1- and detach.

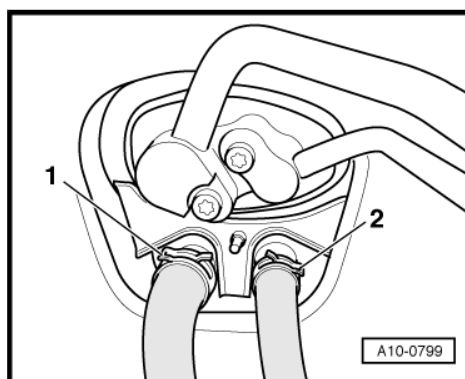


Note

Disregard -item 2-.



- Mark coolant supply hose -1- and coolant return hose -2- going to heat exchanger and disconnect coolant hoses at bulkhead.

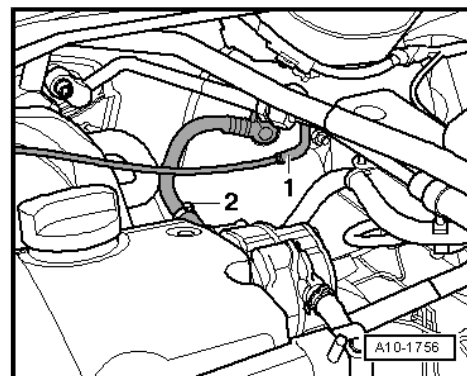


Vehicles with engine code letters ATL, BHC:

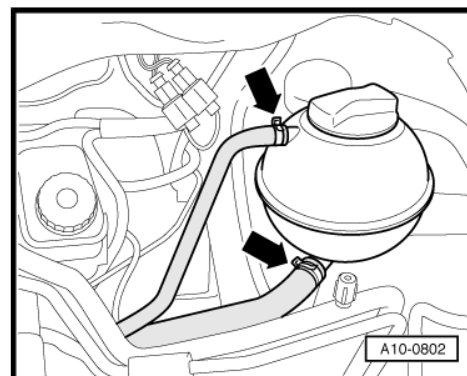
- Unplug vacuum hose -1-.

All vehicles:

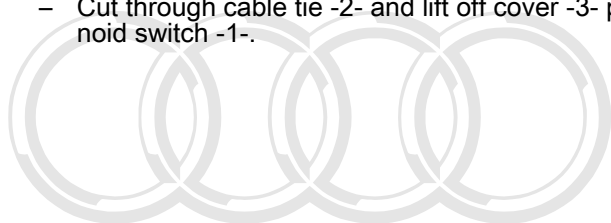
- Detach vacuum hose -2- (going to brake servo) from tandem pump.
- Move vacuum hoses clear.



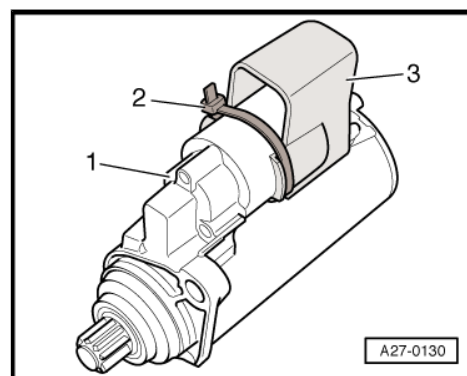
- Detach coolant hoses from coolant expansion tank -arrows- and move top coolant hose clear.



- Cut through cable tie -2- and lift off cover -3- protecting solenoid switch -1-.



Audi



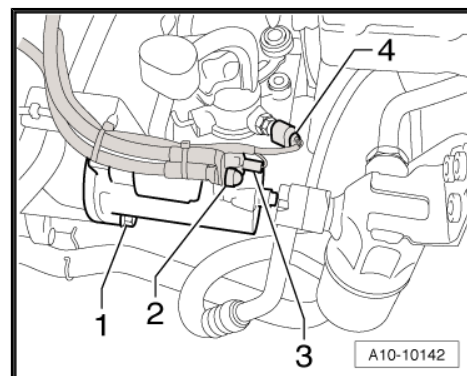
- Unplug electrical connector -4- at reversing light switch -F4-.

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- Move wiring clear.

- Unplug electrical connector (terminal 50) -item 3- at starter solenoid switch.

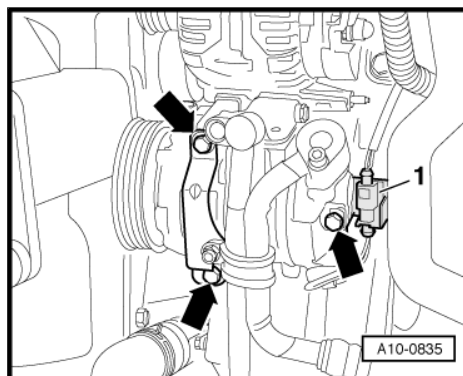
- Unscrew nut -2- and detach B+ wiring.
- Unscrew nut -1- and detach earth wire.



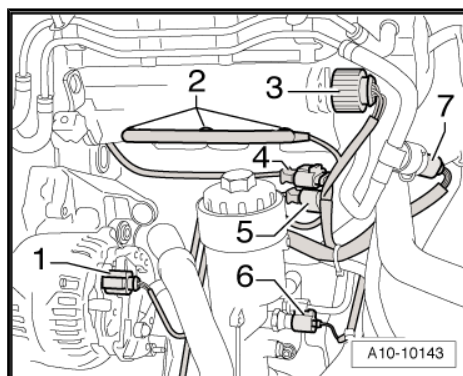
- Unplug electrical connector -1- for magnetic clutch of air conditioner compressor.


Note

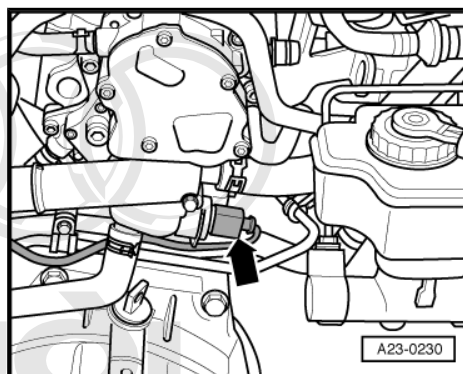
Disregard -arrows-.



- Unplug electrical connector terminal D+ -item 1- at alternator.
- Unplug electrical connectors -2- on glow plugs.
- Pull retaining tab and loosen knurled nut -3- at main connector for unit injectors.
- Unplug electrical connector for Hall sender -G40- -item 4- and for engine speed sender -G28- -item 5-.
- Unplug electrical connector -6- at oil pressure switch -F1- .
- Unplug electrical connector -7- at fuel temperature sender -G81- .



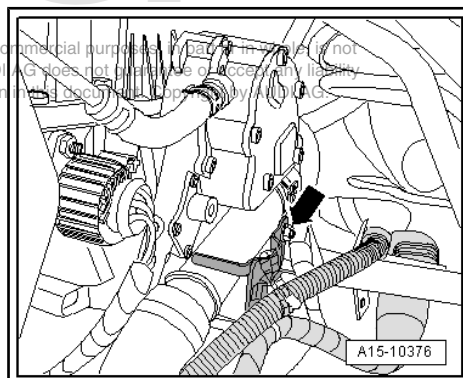
- Unplug electrical connector -arrow- at coolant temperature sender -G62- .



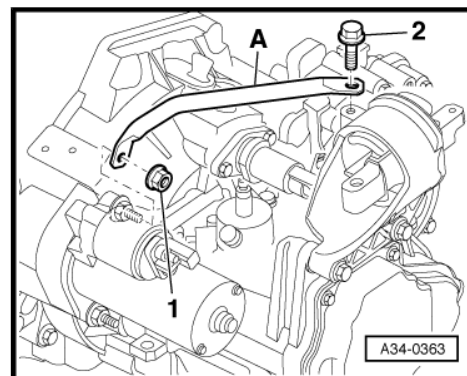
- Unbolt bracket for wiring harness from coolant connection -arrow-.

- Move clear wiring harness leading to engine.

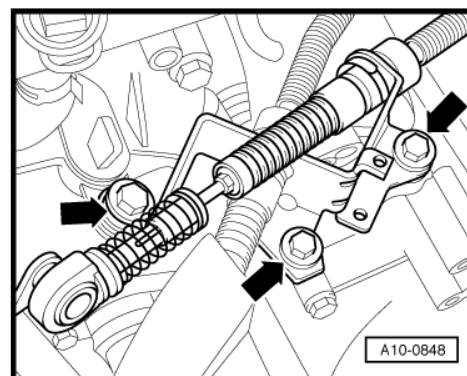
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- Remove nut -1- and bolt -2- and remove transverse support -A-.



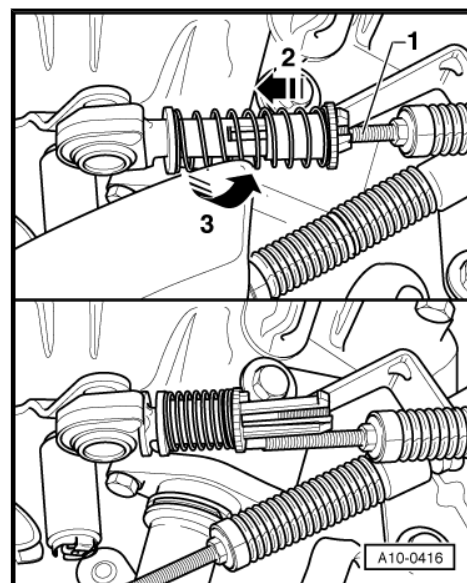
- Unbolt cable support bracket from gearbox -arrows-.



Caution

Do not remove cable end-pieces from selector shaft lever or relay lever. The cable end-pieces must be renewed if they are removed.

- Press locking sleeve in direction of -arrow 2- as far as stop and lock by turning anti-clockwise in direction of -arrow 3- to release cable end-piece for gate selector cable and gear selector cable.
- Disengage cables -1- from cable end-piece.



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- Remove bolts -arrows-.
- Disengage retainer and place slave cylinder to one side (do not open system).



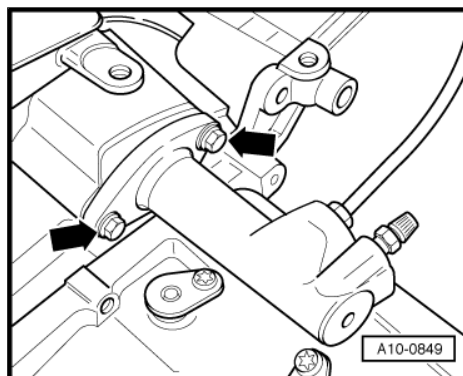
Caution

Do not operate clutch pedal with slave cylinder removed.



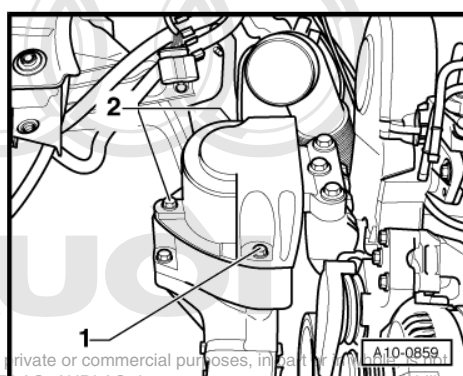
Note

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



Vehicles with cover for engine mounting

- Remove cover for engine mounting by unscrewing bolts -1 and 2-.



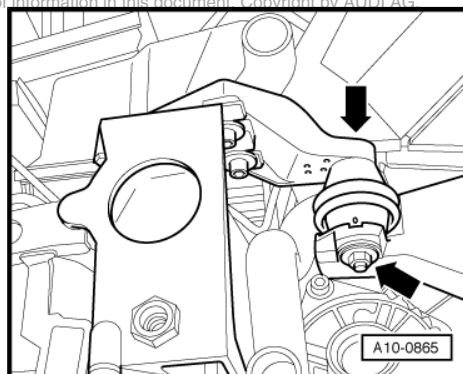
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- Loosen bolts -1 and 3- approx. 2 turns.



Note

Disregard -item 2-.



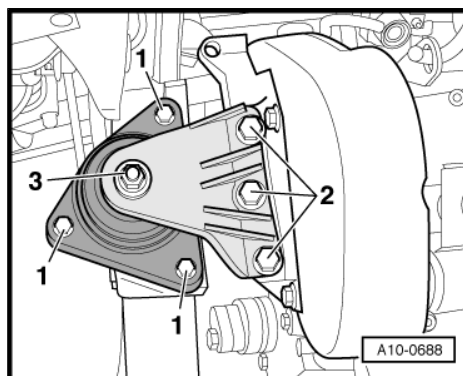
Vehicles without cover for engine mounting



Note

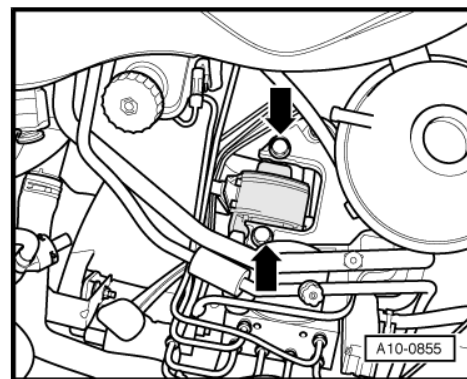
Do not loosen nut -3- unless renewing engine mounting.

- Loosen bolts -1 and 2- approx. 2 turns.



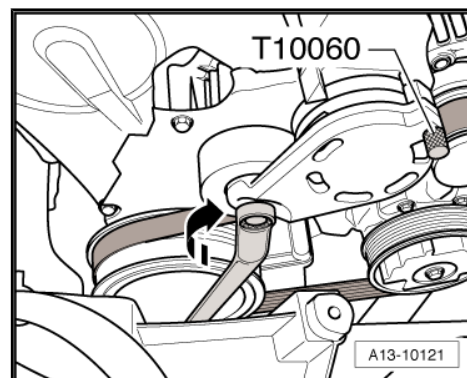
All vehicles:

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

**Note**

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

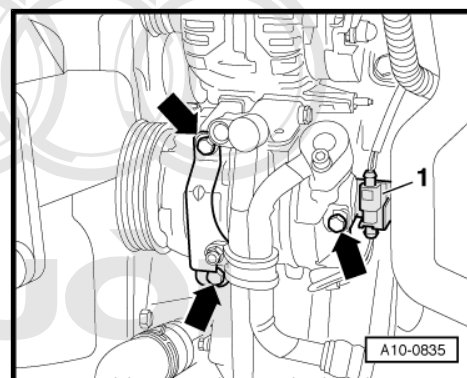
- Turn the tensioner in the direction of the -arrow- using a spanner to slacken the poly V-belt.
- Lock tensioner in position by inserting locking pin -T10060 A- in locating holes.
- Remove poly V-belt.

**Caution**

The air conditioner refrigerant circuit must not be opened.

**Note**

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



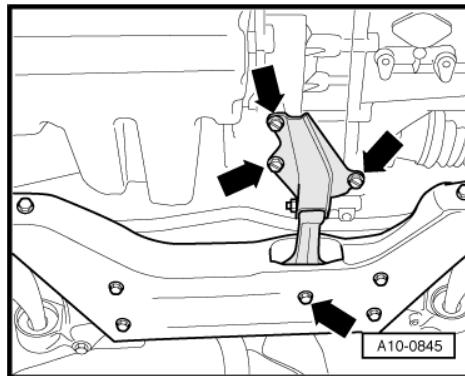
- Remove bolts -arrows- for air conditioner compressor.
- Tie air conditioner compressor up to lock carrier.

**Note**

Disregard -item 1-.

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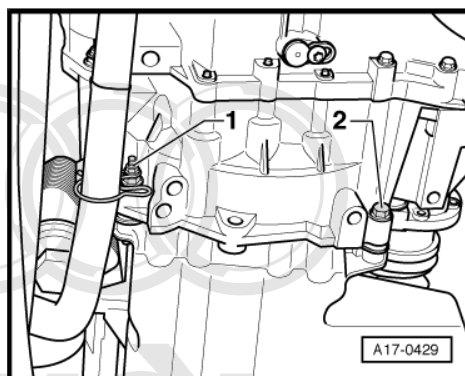
- Unscrew bolts -arrows- and remove pendulum support.



- Remove bolt -2-.


Note

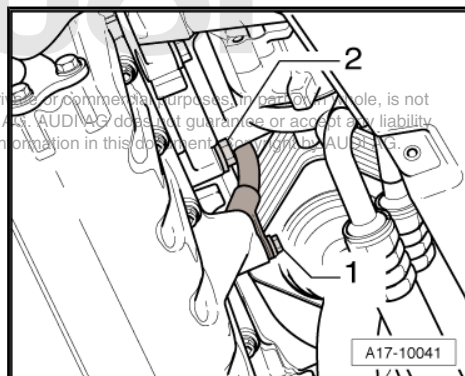
Disregard -item 1-.



- Remove bolt -2-.


Note

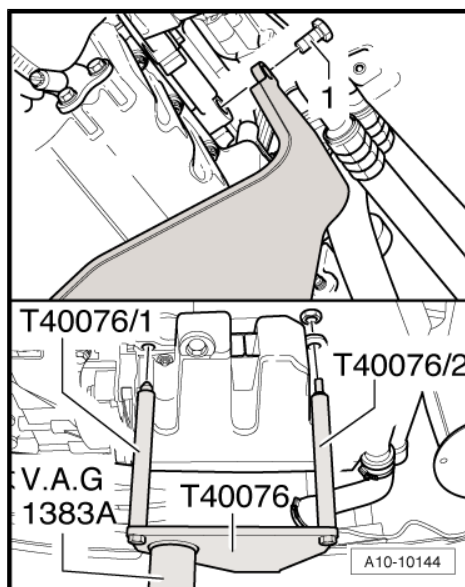
Disregard -item 1-.



- Attach engine support -T40076- to cylinder block with bolt -1- (tightening torque: approx. 20 Nm).
- Insert pin of engine support -T40076- in cylinder block and tighten nut to approx. 20 Nm to secure pin -T40076/2- .
- Insert engine and gearbox jack -V.A.G 1383 A- in engine support -T40076- .
- Raise engine/gearbox assembly slightly.

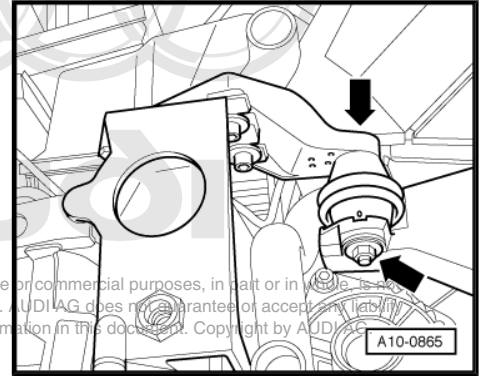

Note

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



Vehicles with cover for engine mounting

- Remove bolts -1 and 3- and detach support arm with engine mounting -2-.



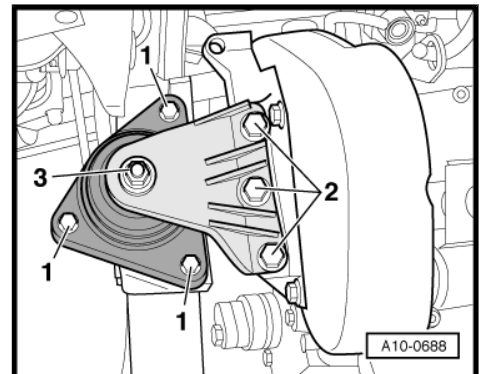
Vehicles without cover for engine mounting



Note

Do not loosen nut -3- unless renewing engine mounting.

- Remove bolts -1 and 2- and detach support arm with engine mounting.



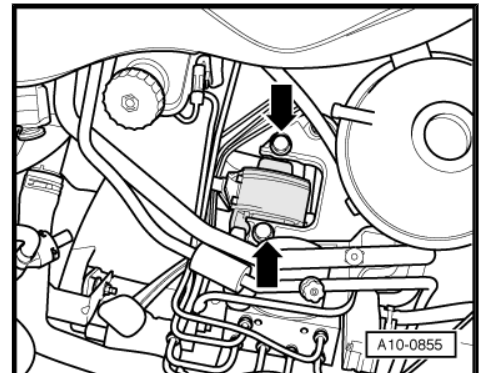
All vehicles:

- Remove bolts -arrows- on gearbox mounting.



Note

- ◆ Check that all hoses, pipes and wiring connections between engine, gearbox and body have been detached.
- ◆ Carefully guide engine/gearbox assembly when lowering to avoid damage.
- ◆ Make sure there is sufficient clearance from air conditioner compressor and between drive shaft and turbocharger.

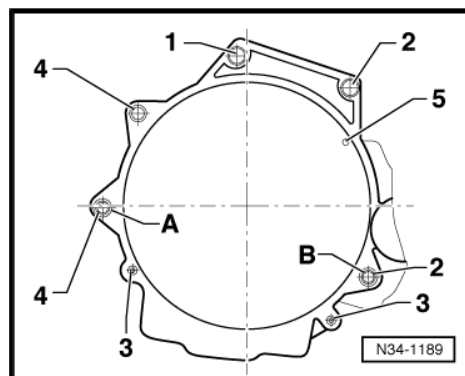


- Lower engine and gearbox slowly using engine and gearbox jack -V.A.G 1383 A- .

3 Separating engine and gearbox

Procedure

- Engine/gearbox assembly removed and attached to engine support -T40076- .
- Unscrew bolts -1 ... 5- securing engine to gearbox.
- Detach starter.
- Separate gearbox from engine.

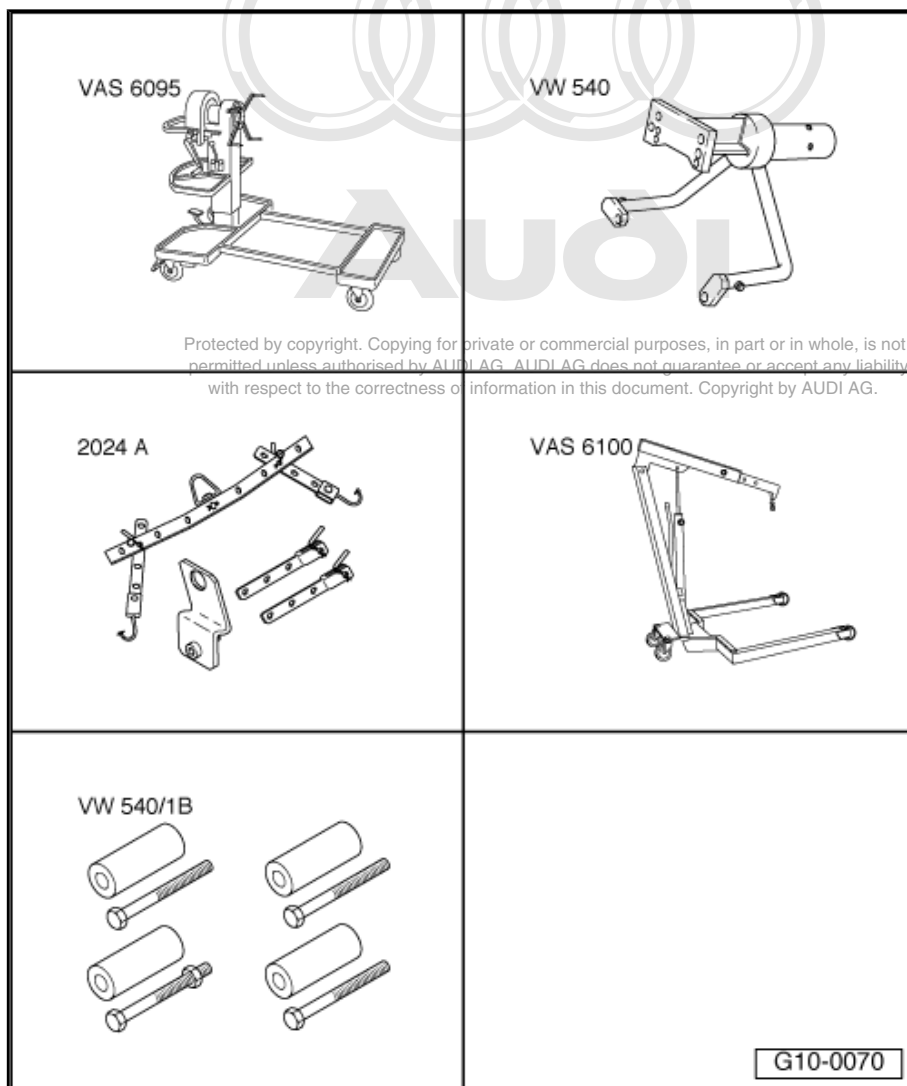


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4 Securing engine to assembly stand

Special tools and workshop equipment required

- ◆ Engine and gearbox support -VAS 6095-
- ◆ Engine and gearbox support -VW 540-
- ◆ Lifting tackle -2024 A-
- ◆ Workshop hoist -VAS 6100-
- ◆ Engine and gearbox support supplement -VW 540/1 B-



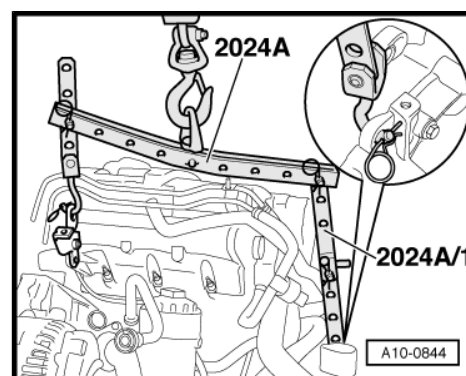
Procedure

- Engine separated from gearbox
- Attach lifting tackle -2024 A- with extension -2024 A/1- as illustrated and lift slightly using workshop hoist -VAS 6100- .



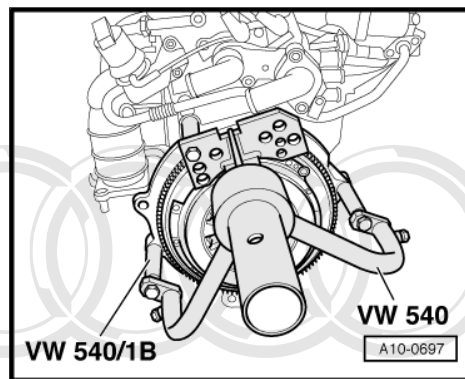
WARNING

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





- For performing assembly work, attach engine to engine and gearbox support -VW 540- with engine and gearbox support - VW 540/1 B- and engine and gearbox support supplement - VAS 6095- .



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5 Installing engine

- Engine attached to engine support -T40076-

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



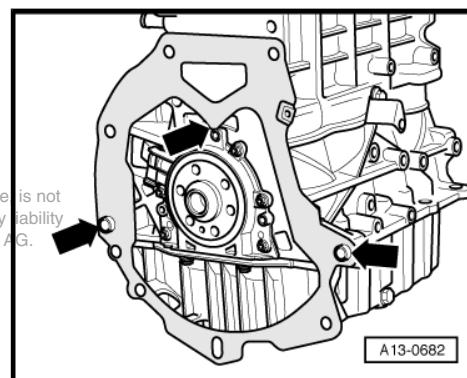
Note

- ◆ *Renew self-locking nuts and bolts when performing assembly work.*
- ◆ *Renew bolts which are tightened to a specified angle as well as oil seals and gaskets.*
- ◆ *Hose connections and hoses for charge air system must be free of oil and grease before assembly. Do NOT use lubricant.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- ◆ *Fit all cable ties in the original positions when installing.*
- Clean input shaft splines and (in the case of used clutch plates) the hub splines. Remove corrosion and apply only a very thin coating of grease for clutch plate splines to the splines. Do not lubricate guide sleeve ⇒ Rep. gr. 30 .
- Check that clutch plate is correctly centred ⇒ Rep. gr. 30 .
- Check clutch release bearing for wear, renew if necessary ⇒ Rep. gr. 30 .
- Check whether dowel sleeves for centring the engine and the gearbox are fitted in the cylinder block; install missing dowel sleeves.
- Ensure that the intermediate plate is engaged on the sealing flange and pushed onto the dowel sleeves -arrows-.
- Bolt gearbox to engine.



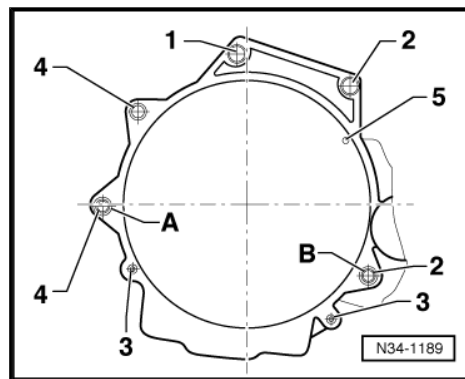
Note

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



Securing engine to gearbox

Item	Bolt	Nm
1 ¹⁾ , 2	M12x55	80
3	M10x50	40
4 ¹⁾²⁾	M12x150	80
5 ³⁾	M6x12	10
A, B	Dowel sleeves for centralising	
• 1) Bolt with M8 threaded pin • 2) Also for starter to gearbox. • 3) Cover for dual-mass flywheel.		

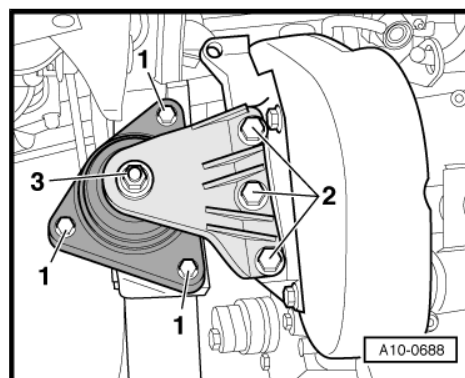


- Guide engine/gearbox assembly into the body.
- Tighten bolts -1 and 2- of assembly mounting for engine initially hand-tight.



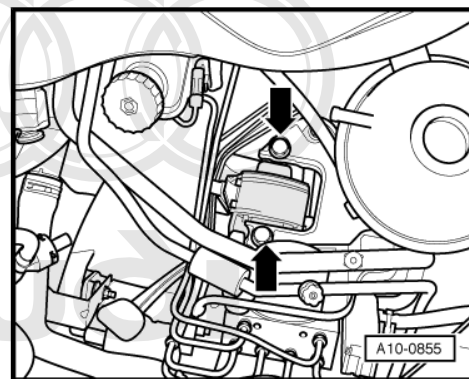
Note

Disregard -item 3-.



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- Tighten bolts of assembly mounting for gearbox -arrows- initially hand-tight.
- Use new securing bolts.
- Remove engine support -T40076- from engine.
- Install drive shafts ⇒ Rep. gr. 40 .
- Install swivel joint ⇒ Rep. gr. 40 .
- Install catalytic converter ⇒ [page 206](#) .
- Install pendulum support ⇒ [page 40](#) .
- Install air conditioner compressor ⇒ Rep. gr. 87 .
- Install starter ⇒ Rep. gr. 27 .
- Install poly V-belt ⇒ [page 42](#) .



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Caution

The clutch pedal must not be operated before installing slave cylinder.

- Install clutch slave cylinder ⇒ Rep. gr. 30 .
- Attach and adjust selector mechanism at gearbox ⇒ Rep. gr. 34 .
- Install transverse support ⇒ Rep. gr. 34 .
- Install air pipes/hoses with plug-in connectors ⇒ [page 202](#) .
- Install assembly mountings so they are free of stress ⇒ [page 33](#) and ⇒ Rep. gr. 34 .
- Electrical connections and routing ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- Observe notes on procedures required after connecting battery ⇒ Rep. gr. 27 .
- Install windscreen wiper arm ⇒ Rep. gr. 92 .
- Check oil level ⇒ [page 159](#) .



Caution

Do not use a battery charger to boost starting. There is danger of damaging the vehicle's control units.

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



Note

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

**Tightening torques**

Component		Nm
Bolts/nuts	M6	9
	M7	15
	M8	20
	M10	40
	M12	65
Except for the following:		
Battery plus (+) cable to starter		16
Earth wire to gearbox		22
Bracket for wiring harness to coolant hose/pipe connection		10
Drive shaft heat shield to cylinder block		33
Air pipe to:	Turbocharger	8
	Sump	8
	Body	8
Engine cover panel to bracket		5.5



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6 Assembly mountings

6.1 Engine mounting with cover for engine mounting - exploded view

1 - Bolt

- ☐ Renew
- ☐ 23 Nm + 90° (1/4 turn further)

2 - Bolt

- ☐ Renew
- ☐ 60 Nm + 90° (1/4 turn further)

3 - Engine mounting

- ☐ Removing and installing
⇒ [page 33](#)

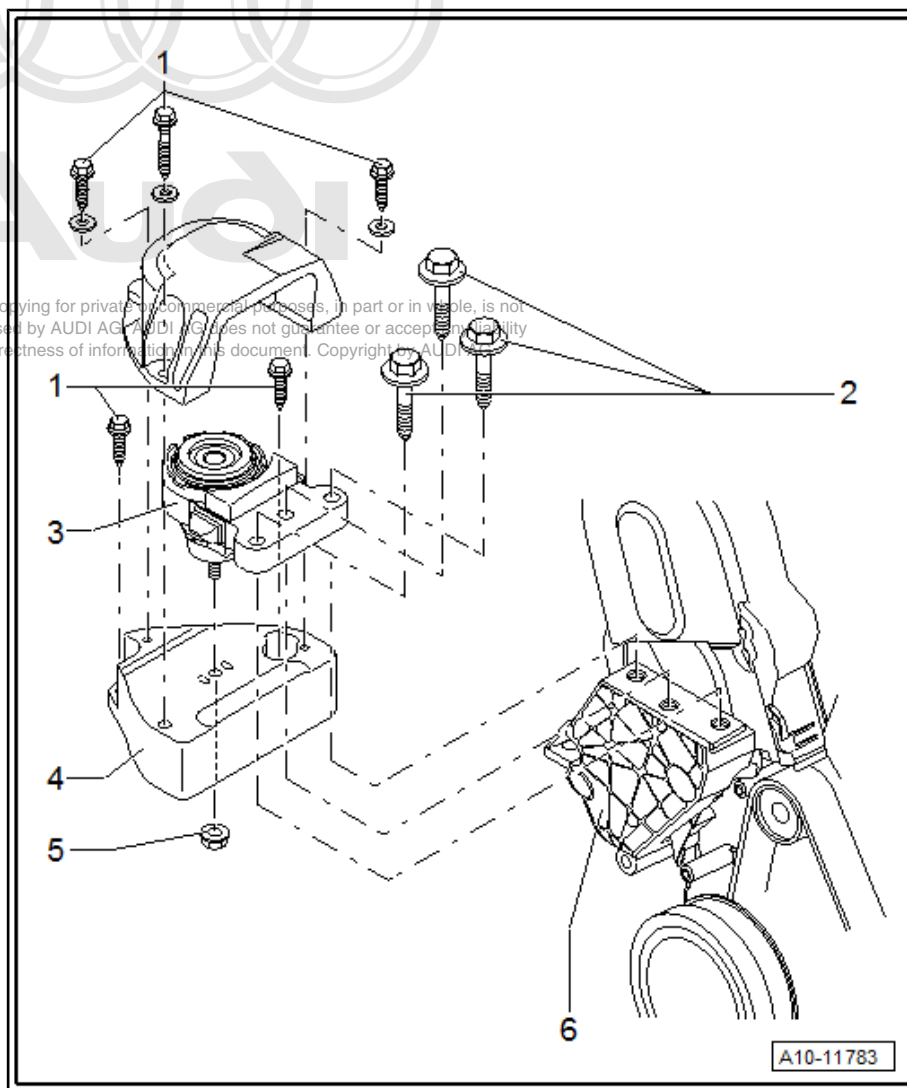
4 - Engine cross member

5 - Nut

- ☐ Do not loosen unless renewing engine mounting.
- ☐ Renew
- ☐ 32 Nm

6 - Support arm

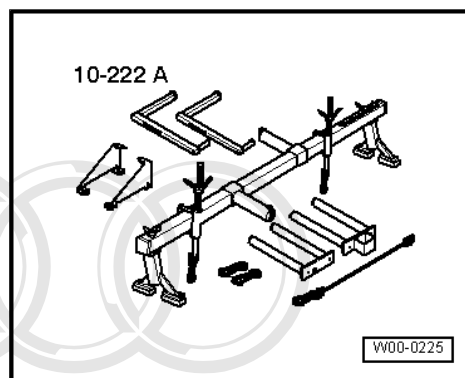
- ☐ Secure to body (45 Nm)



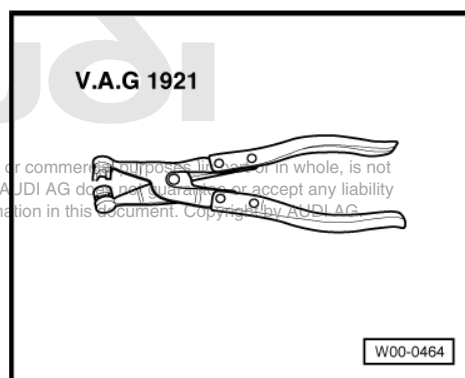
6.2 Removing and installing engine mounting with cover for engine mounting

Special tools and workshop equipment required

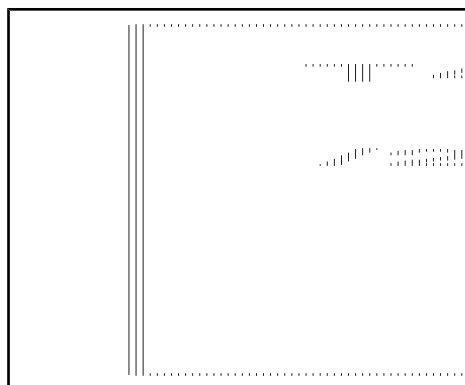
◆ Support bracket -10 - 222 A-



◆ Hose clip pliers -V.A.G 1921-



◆ Adapter -T40093/6- from engine support bracket (supplementary set) -T40093-



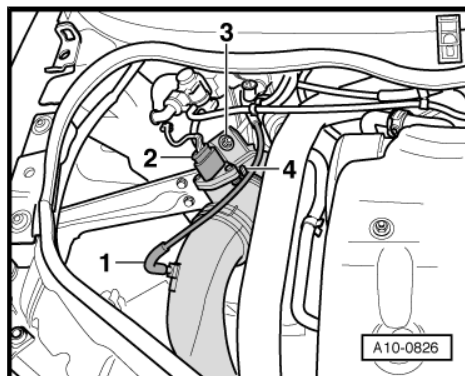
Removing

- Remove bonnet ⇒ [page 8](#) .
- Disconnect resonator, if fitted.
- Unplug electrical connector -2- at air mass meter -G70- .
- Detach vacuum hose -1-.
- Release hose clip -4- and move air pipe with air mass meter -G70- to front.



Note

Disregard -item 3-.

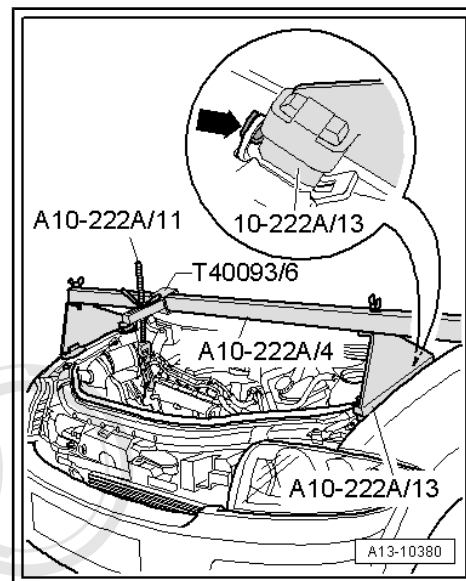


- Set up support bracket -10 - 222 A- with adapters -10 - 222 A / 13- and adapter -T40093/6- on wing panel flanges.

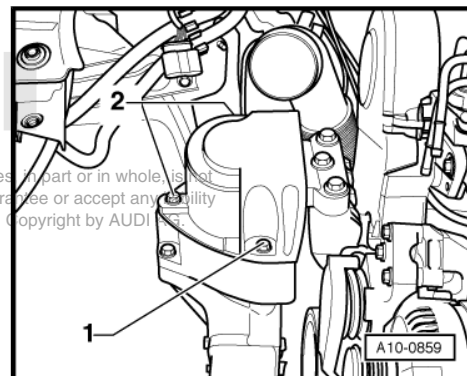
**Caution**

At the same time, engage adapter -10 - 222 A /13- in mountings for bonnet -arrow-.

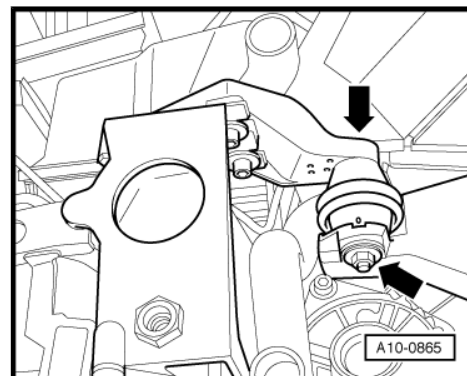
- Remove clamping bolt in adapter -T40093/6- .
- Adapter -T40093/6- is fitted with its arm pointing upwards.
- Attach hook on spindle -10 - 222 A /11- to engine lifting eye.
- Take up weight of engine using spindle (but do not raise engine).



- Remove cover for engine mounting by unscrewing bolts -1 and 2-.



- Remove bolts -1 and 3- and detach engine cross member with engine mounting -2-.



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- Unbolt engine mounting -1- from engine cross member -2-.

Installing

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

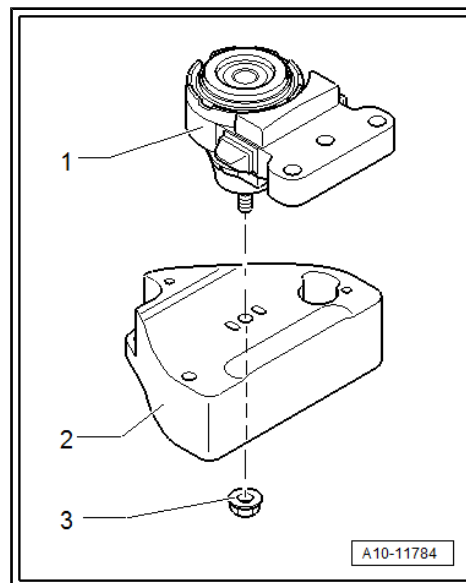


Note

- ◆ *Renew nut -3- on engine mounting.*
- ◆ *Renew the bolts tightened with specified tightening angle.*
- ◆ *Hose connections and hoses for charge air system must be free of oil and grease before assembly. Do NOT use lubricant.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- ◆ *Fit all cable ties in the original positions when installing.*

Tightening torques:

- ◆ Engine mounting with cover for engine mounting - exploded view ⇒ [page 33](#)
- Install air pipes/hoses with plug-in connectors ⇒ [page 202](#) .



6.3 Engine mounting without cover for engine mounting - exploded view



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1 - Nut

- ☐ Do not loosen unless renewing engine mounting.
- ☐ Renew
- ☐ 40 Nm + 90° (1/4 turn further)

2 - Engine cross member**3 - Bolt**

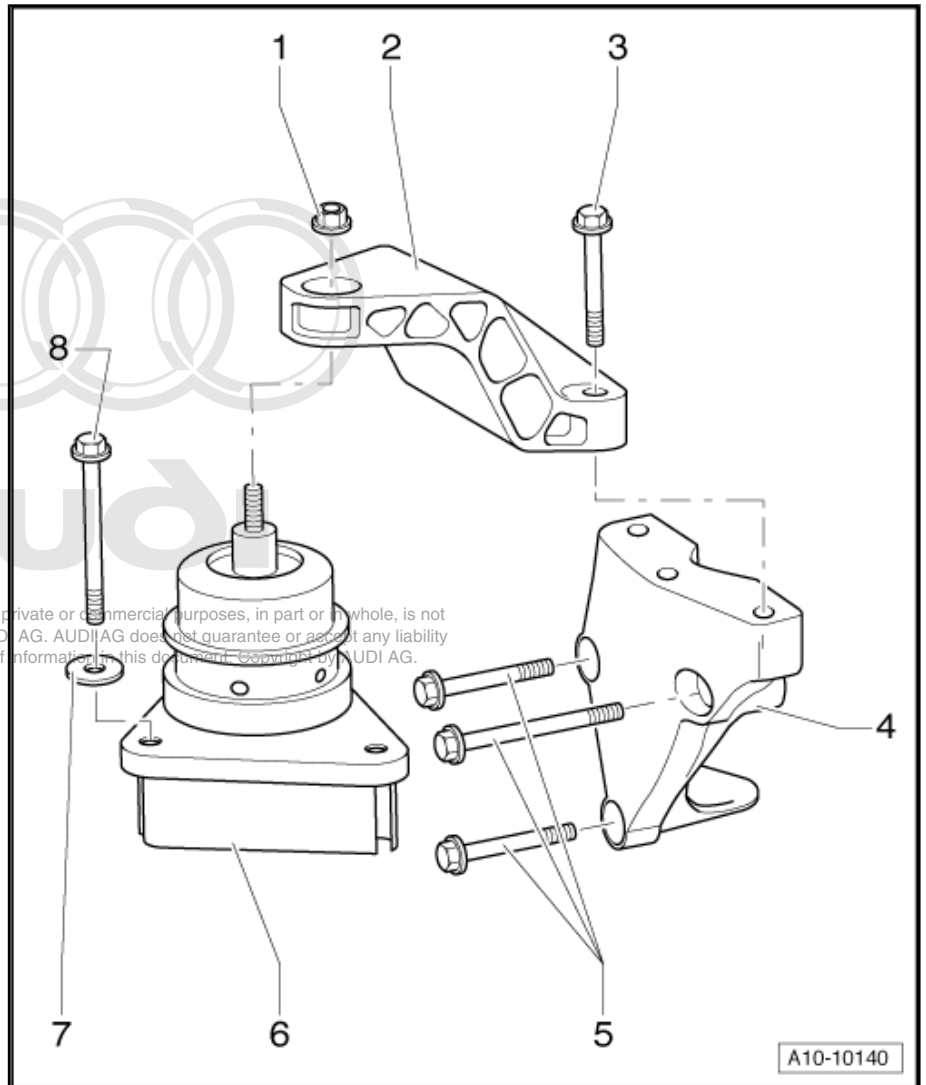
- ☐ Renew
- ☐ 60 Nm + 90° (1/4 turn further)

4 - Support arm**5 - Bolt**

- ☐ 45 Nm

6 - Engine mounting**7 - Washer****8 - Bolt**

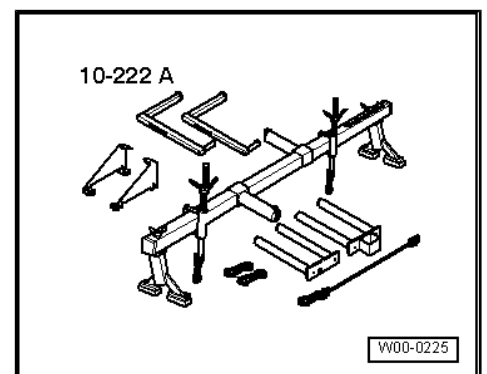
- ☐ Renew
- ☐ 23 Nm + 90° (1/4 turn further)



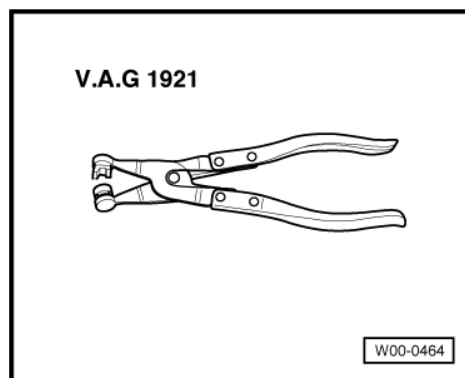
6.4 Removing and installing engine mounting without cover for engine mounting

Special tools and workshop equipment required

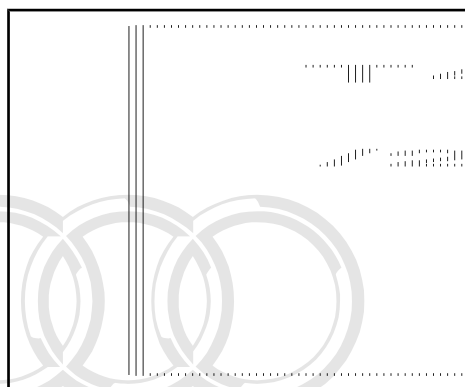
- ◆ Support bracket -10 - 222 A-



- ◆ Hose clip pliers -V.A.G 1921-

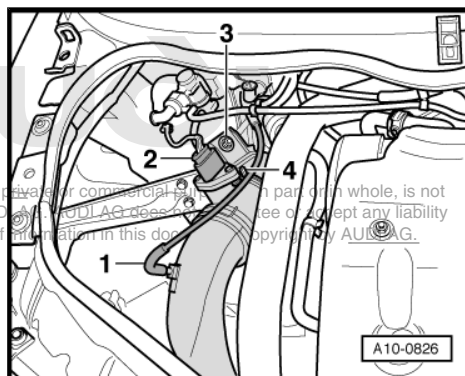


- ◆ Adapter -T40093/6- from engine support bracket (supplementary set) -T40093-



Removing

- Remove bonnet ⇒ [page 8](#) .
- Disconnect resonator, if fitted.
- Unplug electrical connector -2- at air mass meter -G70- .
- Detach vacuum hose -1-.
- Release hose clip -4- and move air pipe with air mass meter -G70- to front.



Note

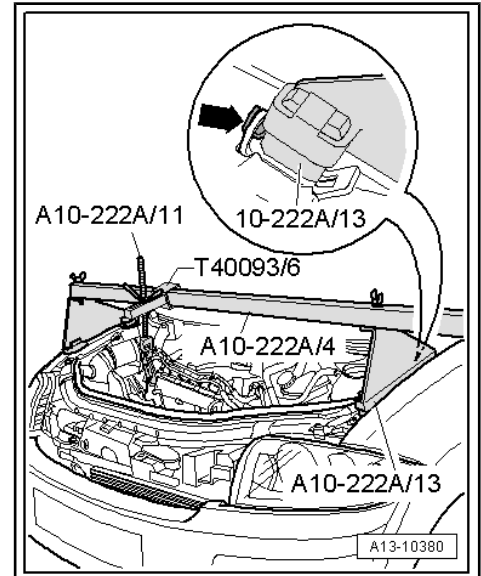
Disregard -item 3-.

- Set up support bracket -10 - 222 A- with adapters -10 - 222 A / 13- and adapter -T40093/6- on wing panel flanges.

**Caution**

At the same time, engage adapter -10 - 222 A /13- in mountings for bonnet -arrow-.

- Remove clamping bolt in adapter -T40093/6- .
- Adapter -T40093/6- is fitted with its arm pointing upwards.
- Attach hook on spindle -10 - 222 A /11- to engine lifting eye.
- Take up weight of engine using spindle (but do not raise engine).



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**Note**

Do not loosen nut -3- unless renewing engine mounting.

- Remove bolts -1 and 2- and detach support arm with engine mounting.

Installing

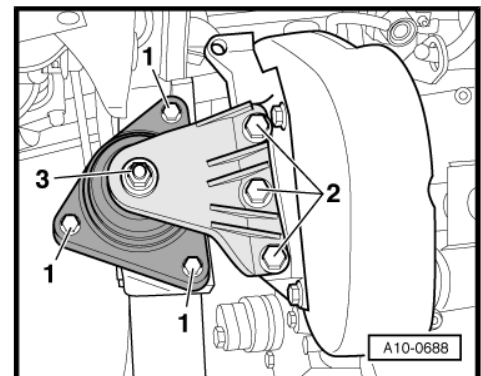
Installation is carried out in the reverse order; note the following:

**Note**

- ◆ *Renew the bolts tightened with specified tightening angle.*
- ◆ *Hose connections and hoses for charge air system must be free of oil and grease before assembly. Do NOT use lubricant.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- ◆ *Fit all cable ties in the original positions when installing.*
- Install air pipes/hoses with plug-in connectors ⇒ [page 202](#) .

Tightening torques:

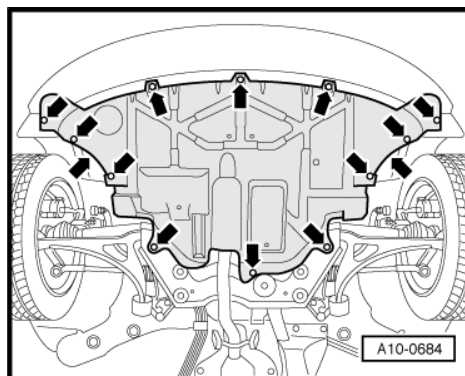
- ◆ Engine mounting without cover for engine mounting - exploded view ⇒ [page 36](#)



6.5 Removing and installing pendulum support

Removing

- Remove noise insulation -arrows-.



- Unscrew bolts -arrows- and remove pendulum support.

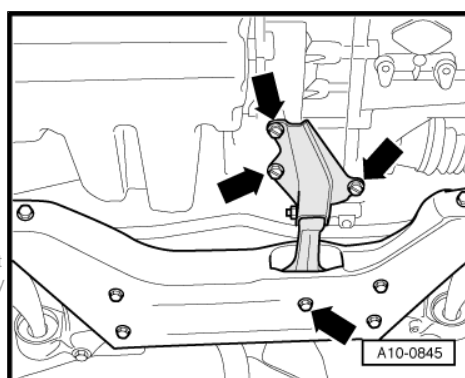
Installing

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



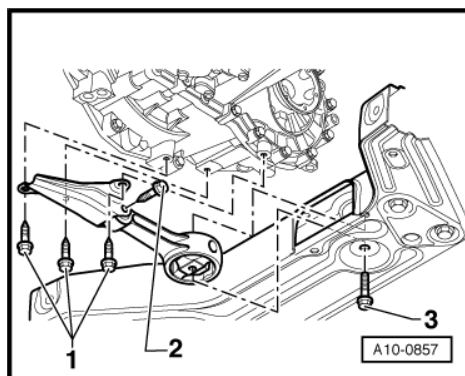
Note

Renew the bolts tightened with specified tightening angle. 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.



Tightening torques

Component	Nm
Pendulum support to: Subframe -item 3-	40 + 90° 1)2)
Gearbox -item 1-	50
Rear section of pendulum support to front section -item 2-	40 + 90° 1)2)
• 1) Renew bolt(s). • 2) 90° = one quarter turn.	



13 – Crankshaft group

1 Cylinder block (pulley end)

1.1 Poly V-belt drive - exploded view

1 - Poly V-belt

- ☐ Check for wear
- ☐ Do not kink
- ☐ Before removing, mark direction of rotation with chalk or felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.
- ☐ Removing and installing ⇒ [page 42](#)
- ☐ When installing, make sure it is properly seated on pulleys.

2 - Vibration damper

- ☐ With pulley for poly V-belt
- ☐ Removing and installing ⇒ [page 43](#)

3 - Bolt

- ☐ Renew; use only genuine bolts ⇒ Parts catalogue
- ☐ 10 Nm + 90° (1/4 turn further)

4 - Tensioner for poly V-belt

- ☐ Pivot with open-end spanner to slacken poly V-belt
- ☐ Lock tensioner with locking pin -T10060 A-

5 - Bolt

- ☐ 23 Nm

6 - Bracket for ancillaries

- ☐ Removing and installing ⇒ [page 44](#)

7 - Bush

8 - Bolt

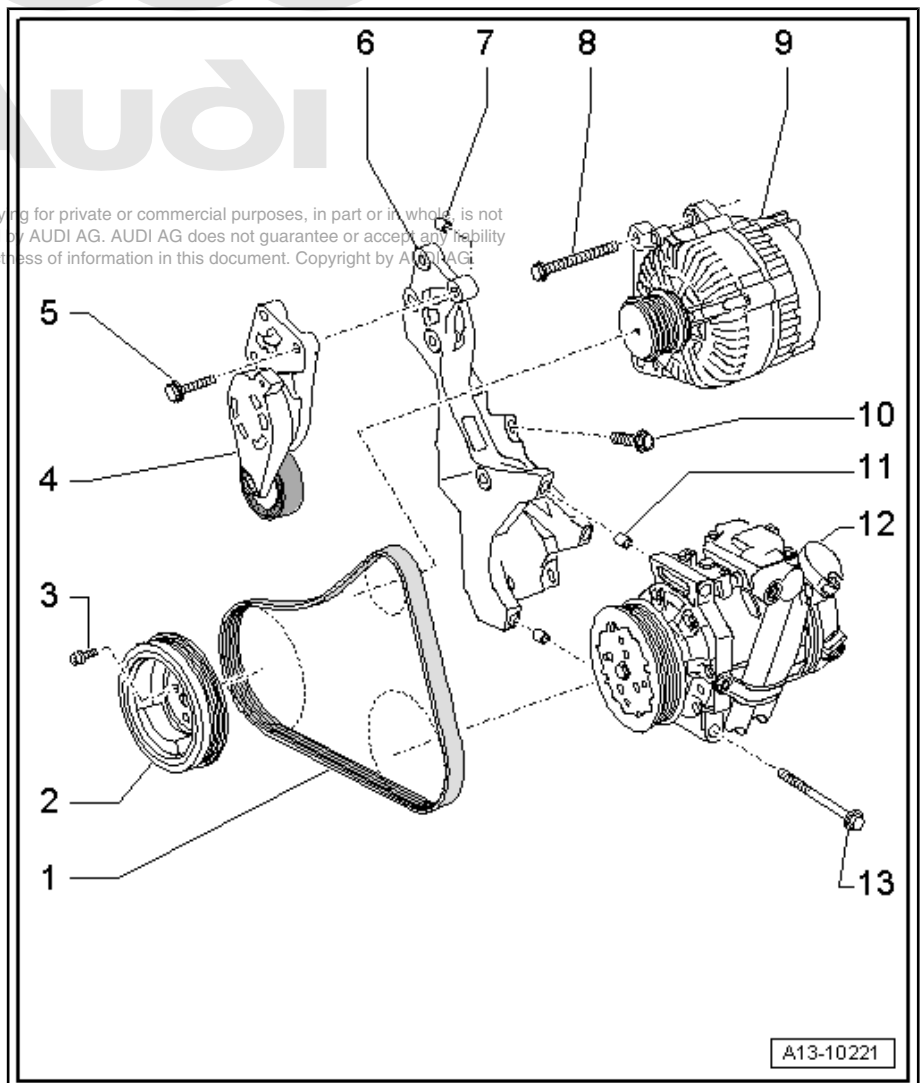
- ☐ 23 Nm

9 - Alternator

- ☐ Removing and installing ⇒ Rep. gr. 27

10 - Bolt

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



A13-10221

- ☐ Observe correct tightening sequence ⇒ [page 44](#)

11 - Bush

- ☐ 2x

12 - Air conditioner compressor

- ☐ Removing and installing ⇒ Rep. gr. 87

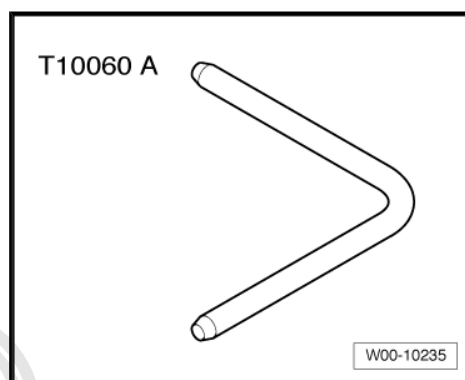
13 - Bolt

- ☐ 25 Nm

1.2 Removing and installing poly V-belt

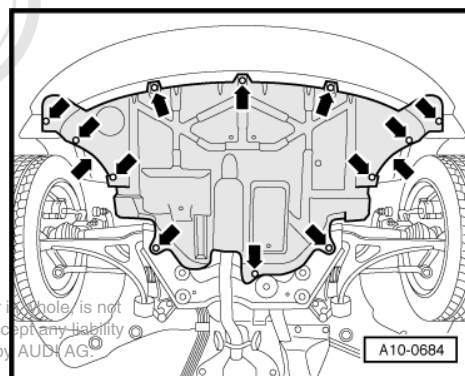
Special tools and workshop equipment required

- ◆ Locking pin -T10060 A-



Removing

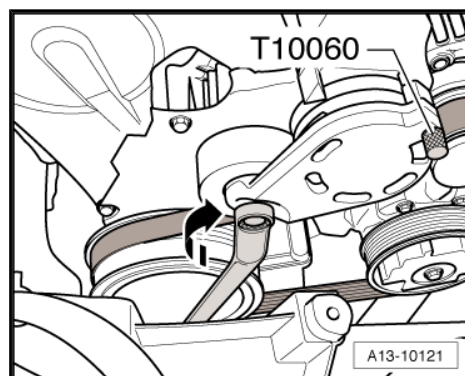
- Remove noise insulation -arrows-.



Note

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

- Turn the tensioner in the direction of the -arrow- using a spanner to slacken the poly V-belt.
- Lock tensioner in position by inserting locking pin -T10060 A- in locating holes.
- Remove poly V-belt.

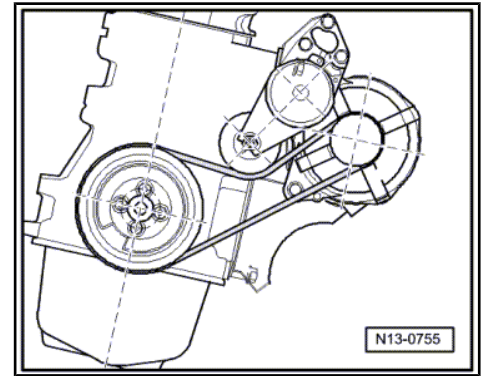


Installing

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

Vehicles not equipped with air conditioning:

- Fit poly V-belt onto crankshaft pulley and alternator pulley.

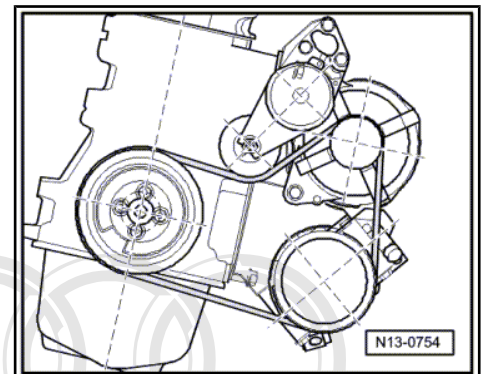


Vehicles with air conditioning:

- Fit poly V-belt onto crankshaft pulley, alternator pulley and then onto A/C compressor pulley.

All vehicles:

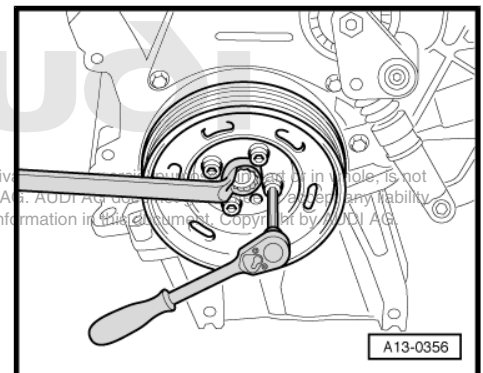
- Release tensioner and remove locking pin from locating holes.
- Make sure poly V-belt is properly positioned and correctly routed.
- Start engine and check that belt runs properly.



1.3 Removing and installing vibration damper

Removing

- Remove poly V-belt ⇒ [page 42](#).
- Unbolt vibration damper; counterhold on centre bolt with ring spanner.



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Installing

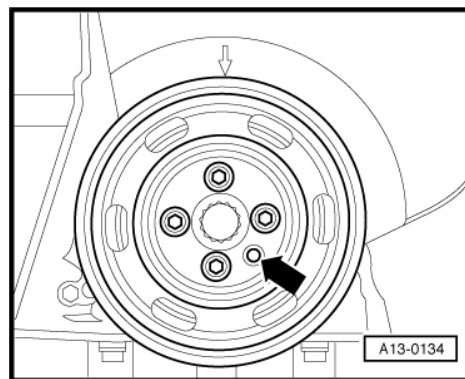
Installation is carried out in the reverse order; note the following:



Note

Renew bolts for vibration damper. Use only genuine bolts ⇒ *Parts catalogue*.

- The vibration damper can only be installed in one position. The hole in the vibration damper must be located over the projection on the toothed belt sprocket -arrow-.
- Install poly V-belt ⇒ [page 42](#).



Tightening torque

Component	Nm
Vibration damper to crankshaft sprocket	10 + 90° 1)2)
• 1) Renew bolts. • 2) 90° = one quarter turn.	

1.4 Removing and installing bracket for ancillaries

Removing

- Remove poly V-belt ⇒ [page 42](#).



Caution

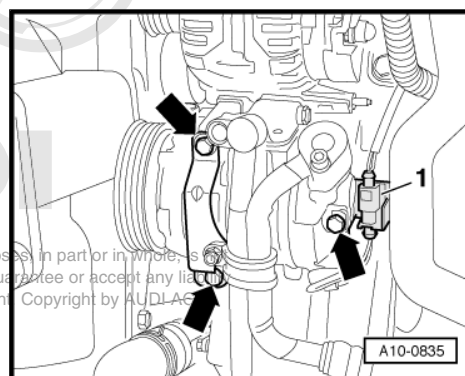
The air conditioner refrigerant circuit must not be opened.



Note

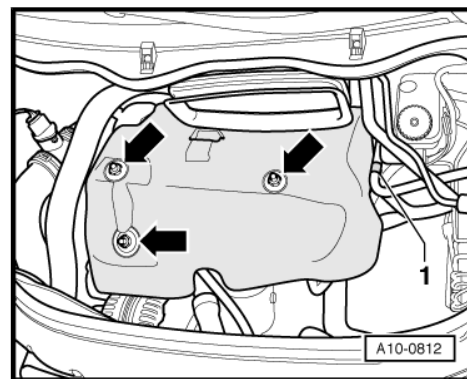
To prevent damage to the air conditioner compressor and refrigerant pipes/hoses, ensure that the pipes and hoses are not stretched, kinked or bent.

- Unplug electrical connector -1- for magnetic clutch of air conditioner compressor.
- Remove bolts -arrows- for air conditioner compressor.
- Tie air conditioner compressor up to lock carrier.

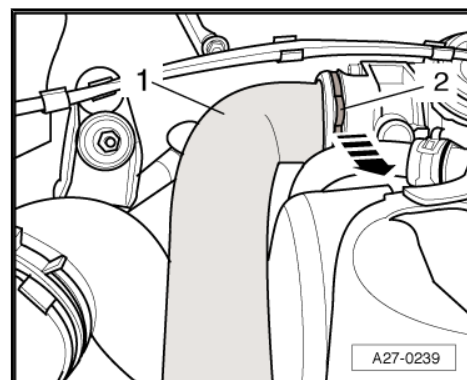


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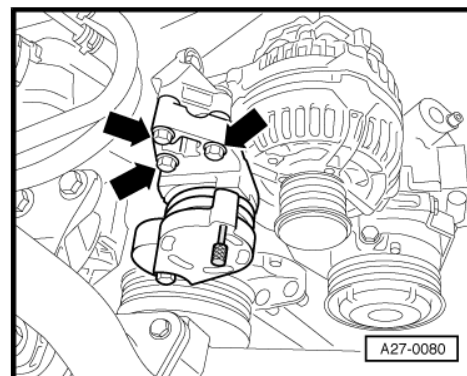
- Remove bonnet ⇒ [page 8](#) .
- If fitted, unclip bracket -1-.
- Take off engine cover panel -arrows-.



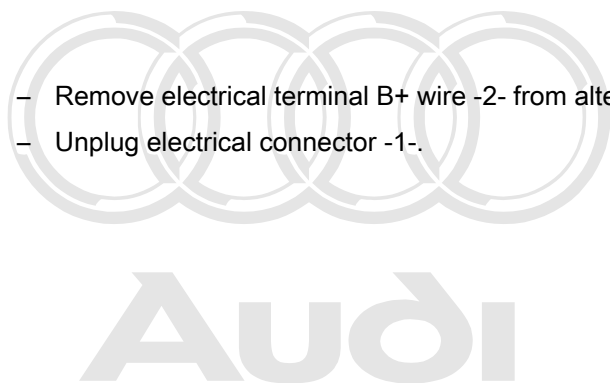
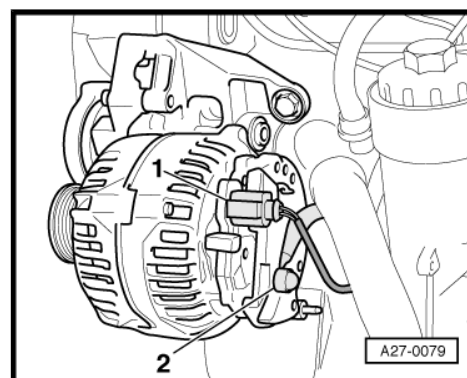
- Detach air hose -1- from intake manifold; to do this, release retaining clip -2- -arrow-, if fitted.



- Remove poly V-belt tensioner -arrows-.



- Remove electrical terminal B+ wire -2- from alternator.
- Unplug electrical connector -1-.



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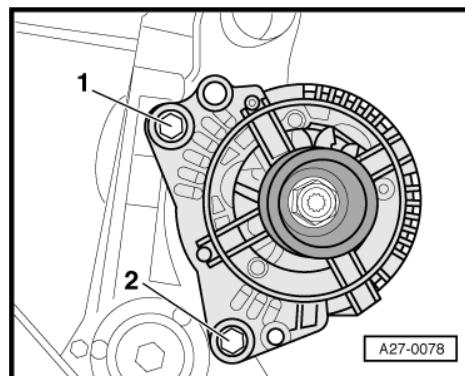
- Remove bolts -1 and 2- for alternator.



Note

- ◆ If alternator sticks in its bracket, screw securing bolt back in again down to the last 2 turns.
- ◆ Tap carefully on bolt heads with flat side of hammer to release bushes of alternator mountings.

- Lift out alternator.



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



Note

Disregard -arrow-.

Installing

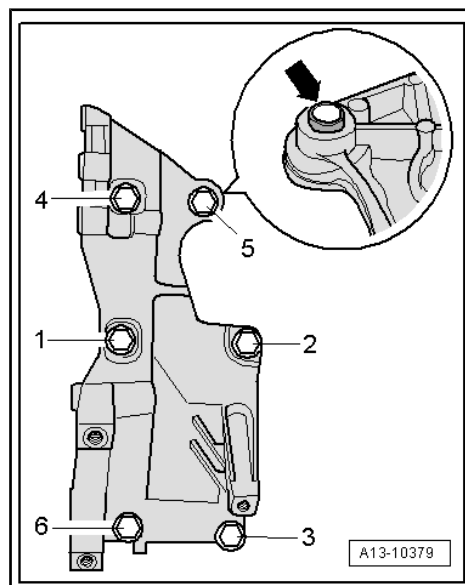
Installation is carried out in the reverse order; note the following:



Note

Hose connections and hoses for charge air system must be free of oil and grease before assembly. Do NOT use lubricant.

- Check that dowel sleeves -arrow- for bracket for alternator are inserted.
- Screw in bolts -1 ... 6- hand-tight.
- Tighten bolts in the sequence -1 ... 6-.
- Install air pipes/hoses with plug-in connectors ⇒ [page 202](#).



Tightening torques

Component	Nm
Bracket for ancillaries to cylinder block	45
Engine cover panel to bracket	5.5

2 Sealing flanges and dual-mass flywheel

2.1 Sealing flanges and dual-mass flywheel - exploded view



Note

Servicing clutch ⇒ Rep. gr. 30

1 - Oil seal

- ☐ Renewing ⇒ [page 48](#)
- ☐ Do not lubricate with oil

2 - Sealing flange (pulley end)

- ☐ Removing and installing ⇒ [page 50](#)
- ☐ Must be positioned on dowel sleeves

3 - Cylinder block

4 - Dual-mass flywheel

- ☐ Removing and installing ⇒ [page 53](#)
- ☐ To remove and install: counterhold with special tool -3386-

5 - Bolt

- ☐ Renew
- ☐ 60 Nm + 90° (1/4 turn further)

6 - Intermediate plate

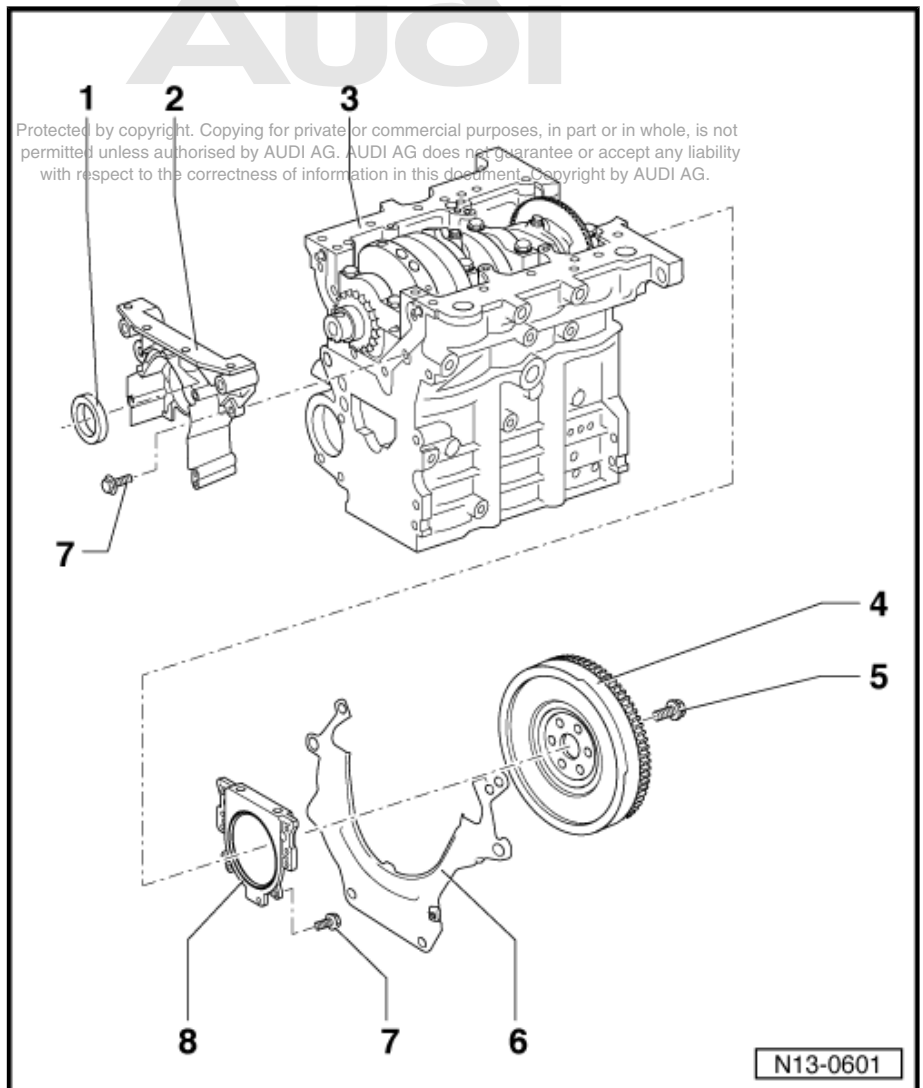
- ☐ Do not damage/bend when assembling
- ☐ Must be positioned on dowel sleeves

7 - Bolt

- ☐ 15 Nm

8 - Sealing flange (gearbox end) with oil seal

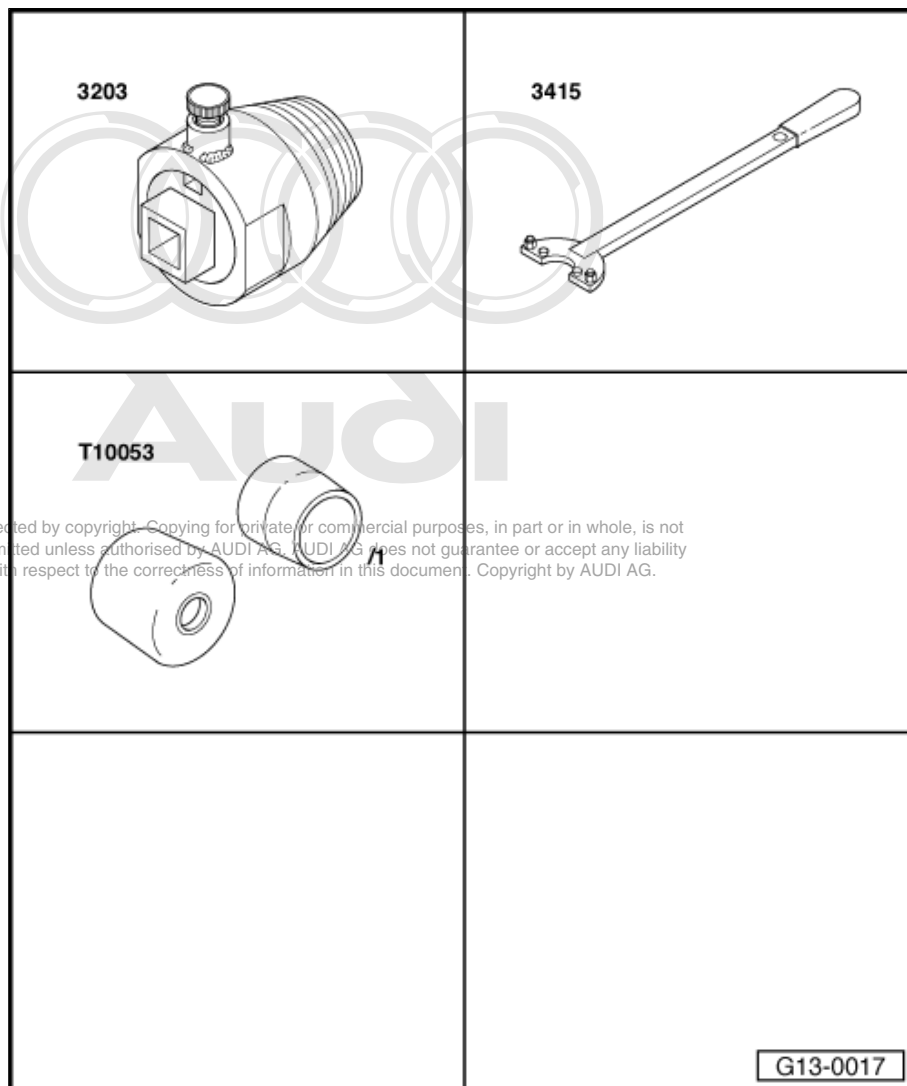
- ☐ With gasket for cylinder block
- ☐ Removing and installing ⇒ [page 54](#)
- ☐ Install using sealant; sealant ⇒ Parts catalogue



2.2 Renewing crankshaft oil seal (pulley end)

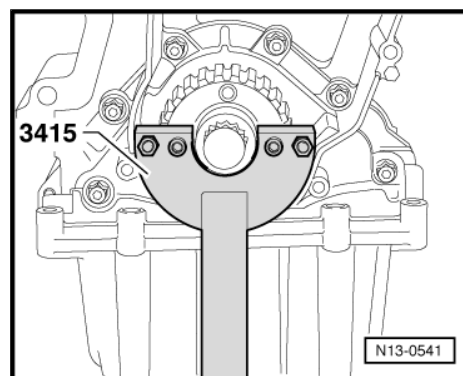
Special tools and workshop equipment required

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

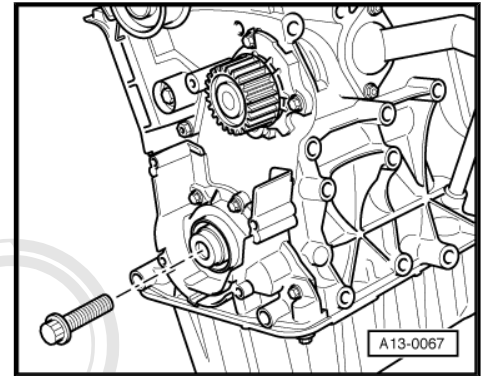


Procedure

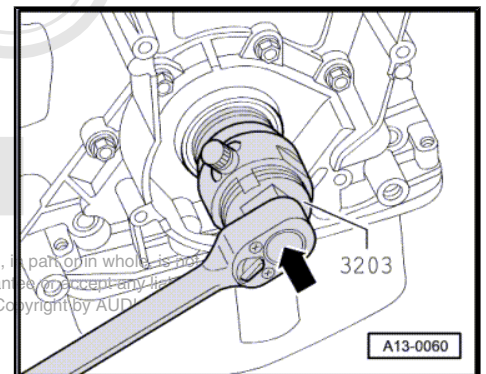
- Engine in vehicle.
- Remove toothed belt: toothed belt drive with hydraulically damped tensioning roller ⇒ [page 102](#) , toothed belt drive with friction-damped tensioning roller ⇒ [page 116](#) .
- Remove crankshaft sprocket using counterhold tool -3415- .



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



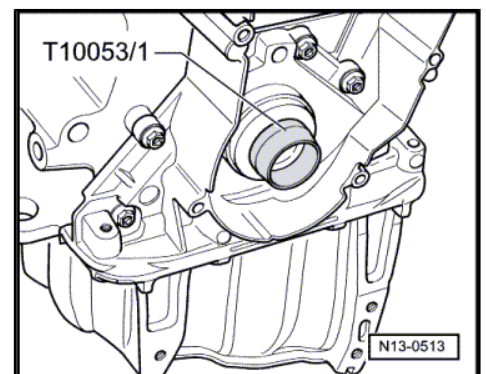
- Unscrew inner section of oil seal extractor -3203- 8 turns out of outer section and lock with knurled screw.
- Lubricate threaded head of oil seal extractor, place it in position and, exerting firm pressure -arrow-, screw it into oil seal as far as possible.
- Loosen knurled screw and turn inner part against crankshaft until the oil seal is pulled out.
- Clamp flats of oil seal extractor in vice.
- Remove oil seal with pliers.
- Clean running surface and sealing surface.



Note

Do not apply oil to sealing lip or outer circumference of seal.

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

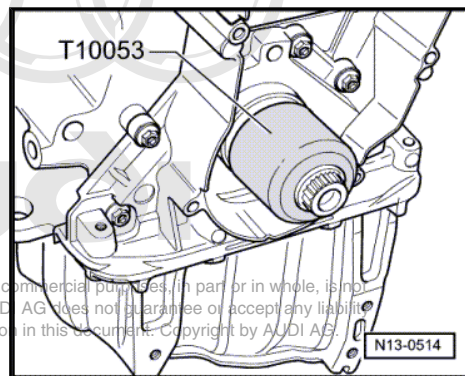


- Press in oil seal flush using the centre bolt of toothed belt sprocket and press sleeve from -T10053- .


Note

- ◆ *Renew bolt for toothed belt sprocket.*
- ◆ *Contact surface between toothed belt sprocket and crankshaft must be free of oil.*
- ◆ *Do not lubricate bolt for crankshaft sprocket!*
- Use counterhold tool -3415- when securing crankshaft sprocket.
- Install toothed belt (adjust valve timing): toothed belt drive with hydraulically damped tensioning roller ⇒ [page 109](#) , toothed belt drive with friction-damped tensioning roller ⇒ [page 123](#) .
- Install poly V-belt ⇒ [page 42](#) .

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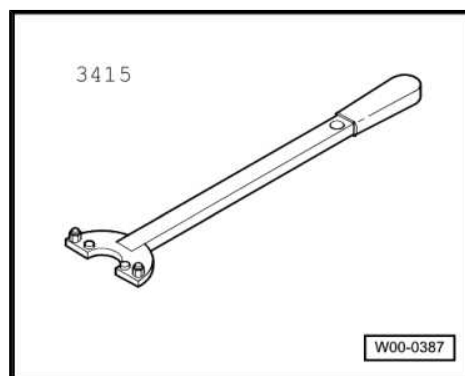

Tightening torque

Component	Nm
Toothed belt sprocket to crankshaft	120 + 90° 1)2)
• 1) Renew bolt. • 2) 90° = one quarter turn.	

2.3 Removing and installing sealing flange (pulley end)

Special tools and workshop equipment required

- ◆ Counterhold tool -3415-

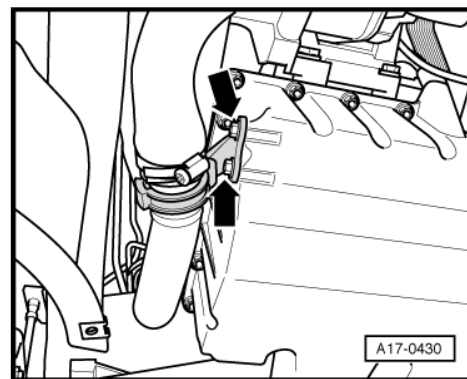


- ◆ Electric drill with plastic brush attachment
- ◆ Safety goggles
- ◆ Sealant ⇒ Parts catalogue

Removing

- Engine in vehicle.

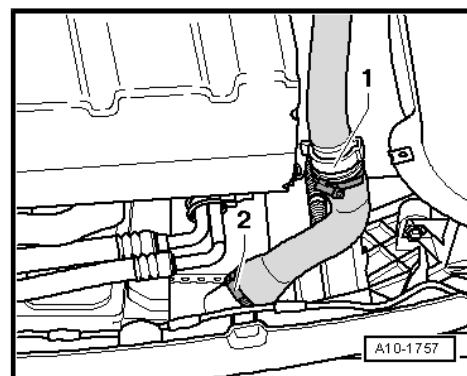
- Unbolt bracket for air pipe from sump -arrows-.



- Remove air hose -2- (right-side) from charge air cooler.

**Note**

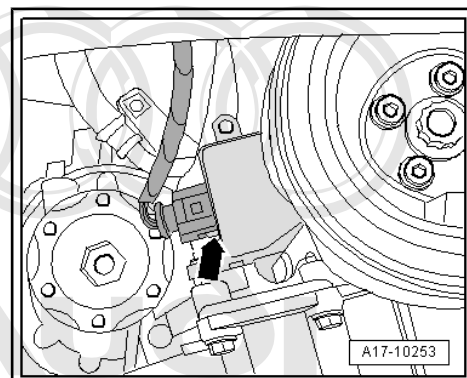
Disregard -item 1-.

**Vehicles from 05.2002:**

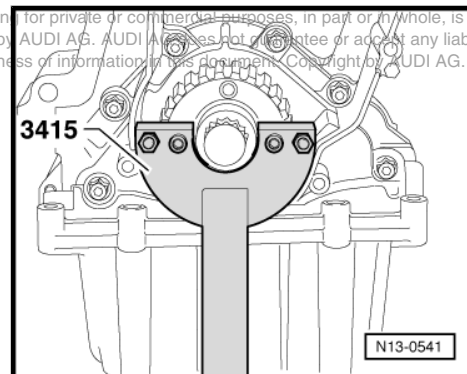
- Remove oil level and oil temperature sender -G266- -arrow-.

All vehicles:

- Remove toothed belt: toothed belt drive with hydraulically damped tensioning roller ⇒ [page 102](#) , toothed belt drive with friction-damped tensioning roller ⇒ [page 116](#) .



- Remove crankshaft sprocket using counterhold tool -3415-.



- Remove bolts -1 ... 10-.
- Lever off sealing flange (pulley end) and remove.
- Drive out oil seal with sealing flange removed.

Installing

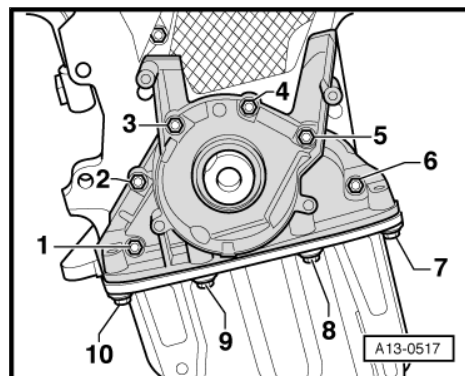
Installation is carried out in the reverse order; note the following:



Note

Place a cloth over the exposed section of the sump.

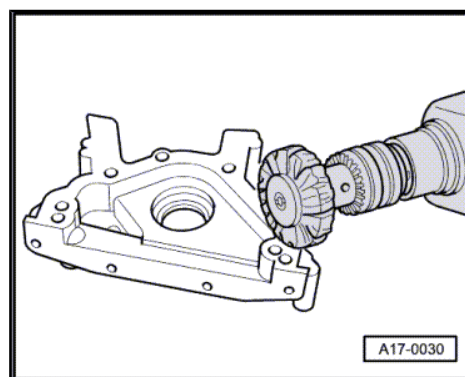
- Carefully remove any sealant residue on the cylinder block and sump.



WARNING

Wear safety goggles.

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

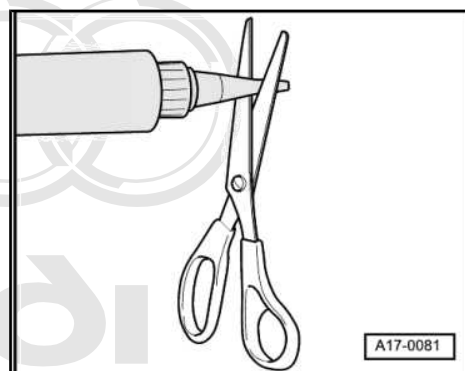


- Cut off tube nozzle at front marking (diameter of nozzle approx. 2 mm).

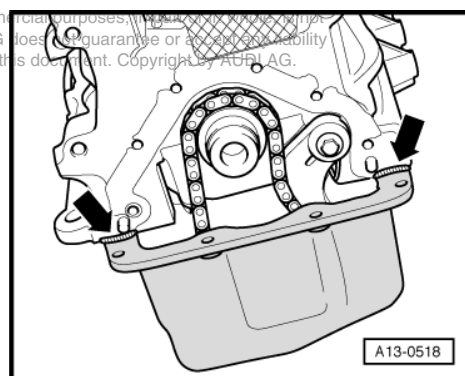


Note

The sealant must be applied at several points on the engine as described below.



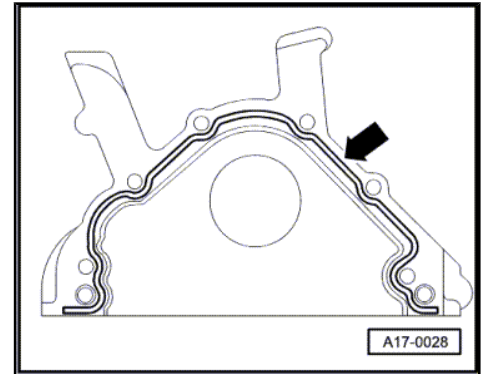
- Apply a thin bead of sealant at the edge of the joint between the cylinder block and the sump -arrows-



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

i Note

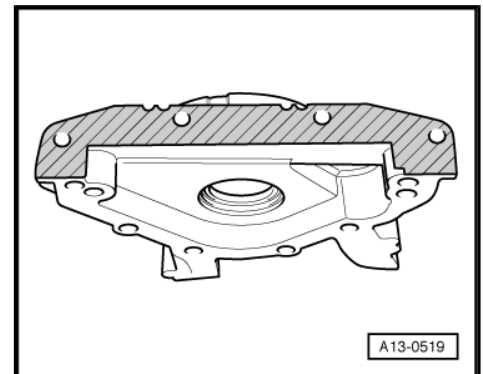
Sealant bead must not be wider than 3 mm, otherwise excess sealant could ingress into sump and clog strainer in oil intake pipe.



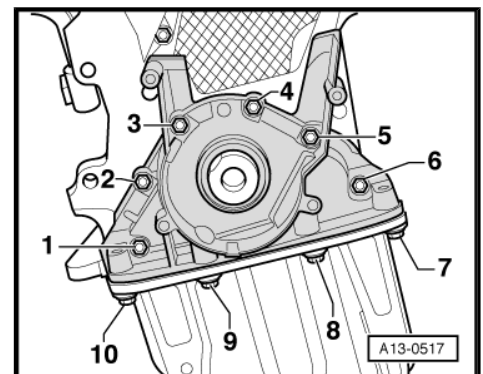
- Coat bottom sealing surface on sealing flange lightly with sealant -hatched area-.

i Note

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



- Push the sealing flange carefully onto the dowel sleeves on the cylinder block.
- Tighten bolts in the specified sequence:
 1. Tighten bolts -1 ... 6-.
 2. Tighten bolts -7 ... 10-.
- Install crankshaft oil seal (pulley end) ⇒ [page 48](#) .
- Install toothed belt (adjust valve timing): toothed belt drive with hydraulically damped tensioning roller ⇒ [page 109](#) , toothed belt drive with friction-damped tensioning roller ⇒ [page 123](#) .
- Install poly V-belt ⇒ [page 42](#) .



i Note

Hose connections and hoses for charge air system must be free of oil and grease before assembly. Do NOT use lubricant.

- Install air pipes/hoses with plug-in connectors ⇒ [page 202](#) .

Tightening torques

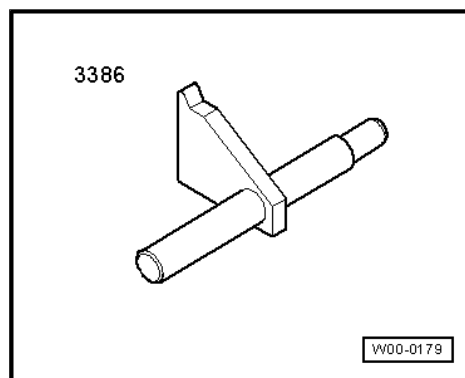
Component	Nm
Sealing flange to cylinder block	15
Air pipe to sump	8

2.4 Removing and installing dual-mass fly-wheel

Special tools and workshop equipment required

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◆ Counterhold tool -3386-



Removing

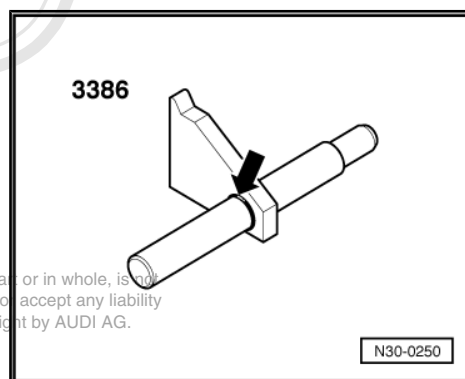
- Engine or gearbox removed.
- Remove clutch pressure plate ⇒ Rep. gr. 30 .
- Mark installation position of dual-mass flywheel on crankshaft.



Note

It must be possible to move counterhold tool -3386- axially.

- Counterhold tool can be moved axially after removing circlip -arrow-.
- Attach counterhold tool -3386- in order to loosen bolts.
- Unbolt dual-mass flywheel.



Installing

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



Note

Renew bolts for dual-mass flywheel.

- Reverse position of counterhold tool -3386- in order to tighten bolts.
- Install clutch pressure plate ⇒ Rep. gr. 30 .

Tightening torque

Component	Nm
Dual-mass flywheel to crankshaft Bolt length 19.5 mm	60 + 90° 1)2)
• 1) Renew bolts.	
• 2) 90° = one quarter turn.	

2.5 Removing and installing sealing flange (gearbox end)

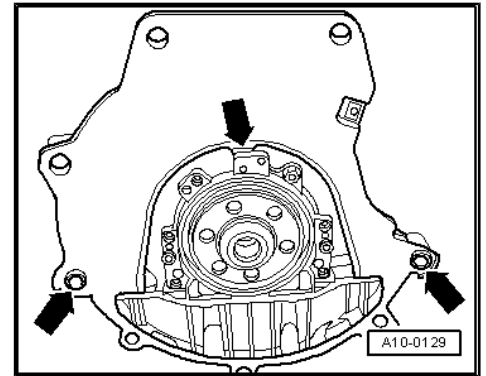
Special tools and workshop equipment required

- ◆ Electric drill with plastic brush attachment
- ◆ Safety goggles

◆ Sealant ⇒ Parts catalogue

Removing

- Gearbox removed.
- Remove dual-mass flywheel ⇒ [page 53](#).
- Detach intermediate plate at sealing flange and dowel sleeves -arrows-.



- Remove bolts -1 ... 8-.
- Pull off sealing flange (gearbox end).

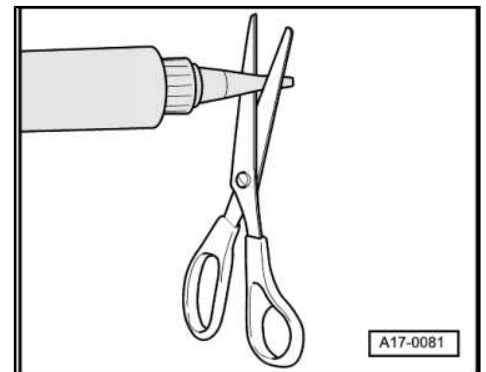
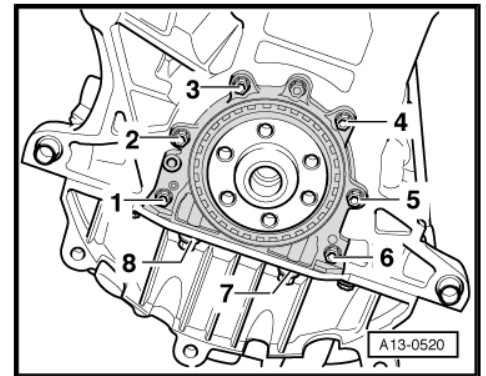
Installing



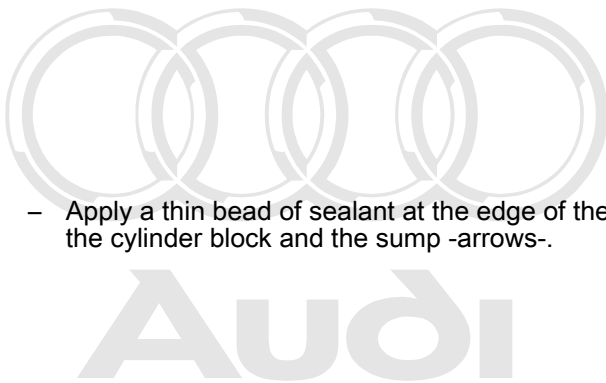
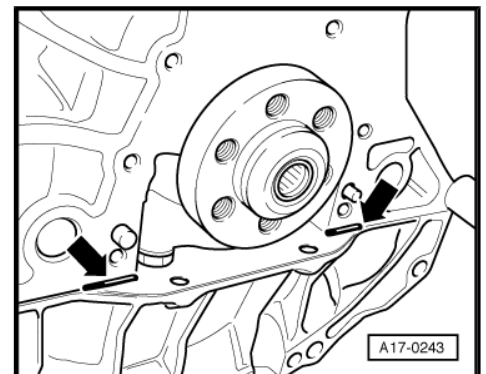
Note

Place a cloth over the exposed section of the sump.

- Carefully remove any sealant residue on the cylinder block and sump.
- Clean sealing surfaces; they must be free of oil and grease.
- Cut off tube nozzle at front marking (diameter of nozzle approx. 2 mm).



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

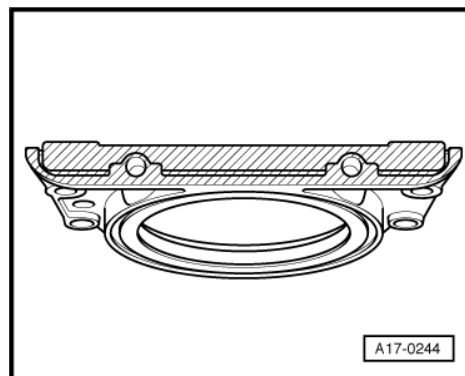


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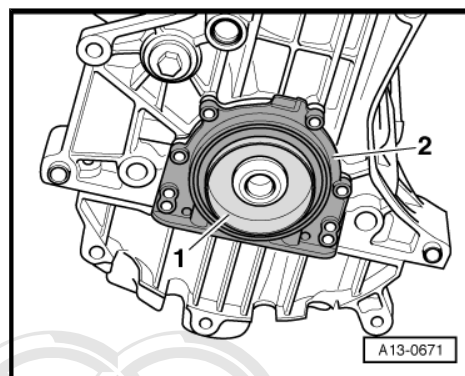
- Coat bottom sealing surface on sealing flange lightly with sealant -hatched area-.


Note

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

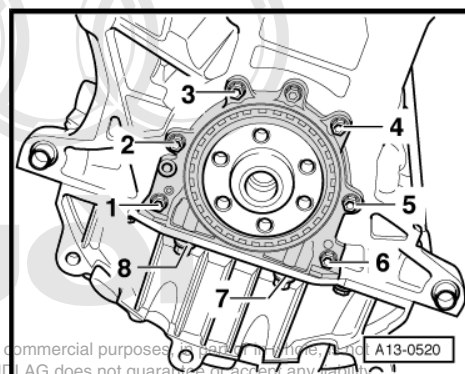


- Carefully push sealing flange -2- together with guide sleeve -1- (fitted on replacement part) onto crankshaft.
- Then push the sealing flange carefully onto the dowel sleeves on the cylinder block.



- Tighten bolts in the specified sequence:

1. Tighten bolts -1 ... 6-.
2. Tighten bolts -7- and -8-.



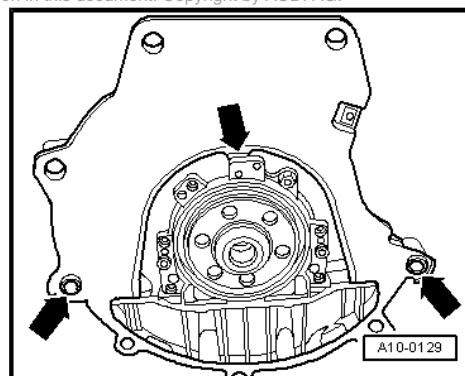
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Remaining installation steps are carried out in reverse sequence; note the following:

- Fit intermediate plate on sealing flange and push onto dowel sleeves -arrows-.
- Install dual-mass flywheel ⇒ [page 53](#) .

Tightening torque

Component	Nm
Sealing flange to cylinder block	15



3 Balance shaft and retaining frame

3.1 Balance shaft and retaining frame - exploded view



Note

All bearing and running surfaces must be oiled before assembling.

1 - Chain

- ☐ Note installation position
⇒ ["3.2 Removing and installing balance shaft and retaining frame", page 58](#)

2 - Bolt

- ☐ Renew
- ☐ Use socket -T10061- to loosen and tighten
- ☐ 100 Nm + 90° (1/4 turn further)

3 - Balance weight

- ☐ Can only be installed in one position

4 - Chain sprocket for balance shaft

- ☐ Can only be installed in one position

5 - Dowel sleeve

6 - Bolt

- ☐ Renew
- ☐ 20 Nm + 90° (1/4 turn further)

7 - Chain sprocket for oil pump

- ☐ Can only be installed in one position

8 - Baffle plate

- ☐ With sealing strip

9 - Bolt

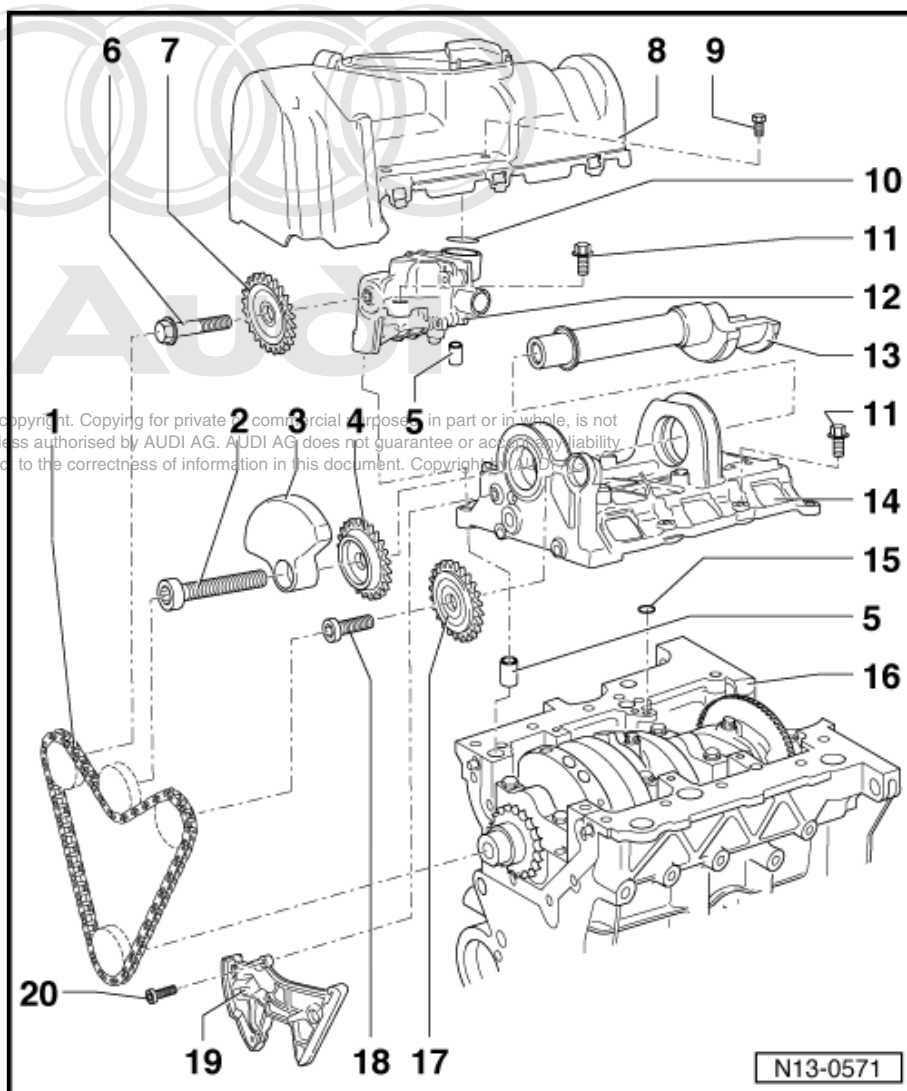
- ☐ 5 Nm

10 - O-ring

- ☐ Renew
- ☐ Check for firm attachment
- ☐ Oil lightly when fitting

11 - Bolt

- ☐ Oil pump to retaining frame, 20 Nm + 90° (1/4 turn) further; renew bolt
- ☐ Retaining frame to cylinder block: 14 Nm + 180° (1/2 turn) further; renew bolt



N13-0571

12 - Oil pump

- ☐ With pressure relief valve (11.5 bar)
- ☐ Before installing, check that the two dowel sleeves -item 5- for centring are fitted.

13 - Balance shaft

- ☐ Removing and installing ⇒ [page 58](#)

14 - Retaining frame

- ☐ Before installing, check that the fitting sleeve for centring on cylinder block is in place and that the O ring is inserted in the retaining frame.
- ☐ Removing and installing ⇒ [page 58](#)

15 - O-ring

- ☐ Renew
- ☐ Ensure secure seating in retaining frame

16 - Cylinder block**17 - Idler sprocket****18 - Bolt**

- ☐ 20 Nm

19 - Chain tensioner with tensioning rail

- ☐ To remove lock with locking pin -T10060 A-
- ☐ Removing and installing ⇒ [“3.2 Removing and installing balance shaft and retaining frame”, page 58](#)

20 - Bolt

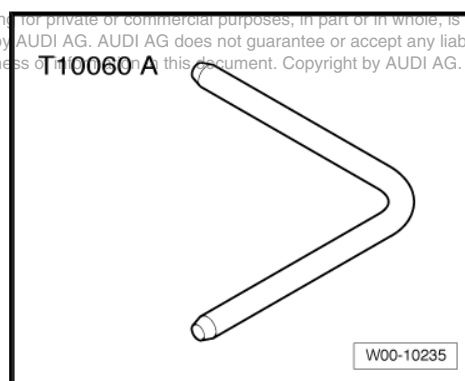
- ☐ Renew
- ☐ 8 Nm + 90° (1/4 turn further)

3.2 Removing and installing balance shaft and retaining frame

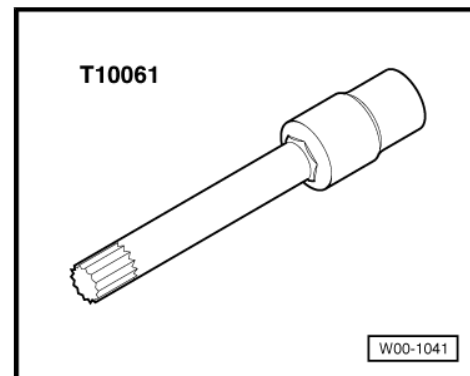
Special tools and workshop equipment required

- ◆ Locking pin -T10060 A-

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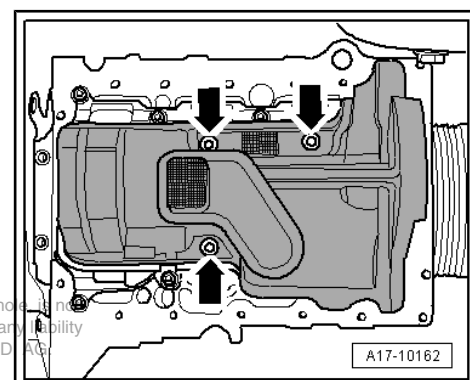


◆ Socket -T10061-

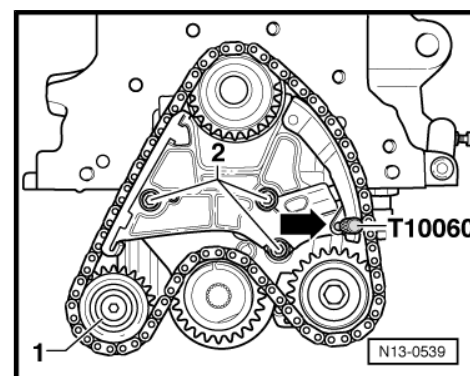


Removing

- Remove poly V-belt ⇒ [page 42](#) .
- Remove toothed belt: toothed belt drive with hydraulically damped tensioning roller ⇒ [page 102](#) , toothed belt drive with friction-damped tensioning roller ⇒ [page 116](#) .
- Remove sump ⇒ [page 146](#) .
- Remove sealing flange (pulley end) ⇒ [page 50](#) .
- Remove bolts -arrows-.
- Release the 5 retaining tabs and remove baffle plate.



- Press down chain tensioner and lock with locking pin -T10060 A- -arrow-.
- Unbolt idler sprocket -1- from retaining frame.
- Unscrew bolts -2- and remove chain tensioner.
- Remove chain from sprockets and lay it aside on a clean surface.



- Block balance shaft as shown using a spanner (24/27 mm) -item 1-.
- When blocking the balance shaft, make sure that the spanner is centred on the balance weight and at right angles to the balance shaft.
- Loosen bolt -2- at balance weight using socket -T10061- .


Note

Do not unscrew bolt all the way when loosening.

- Unbolt retaining frame -3- from cylinder block and remove retaining frame with balance shaft.
- Lay retaining frame aside on a clean surface.
- Unscrew bolt on balance weight and detach balance weight and chain sprocket.
- Turn balance shaft so that it can be removed from the bearings.

Installing

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

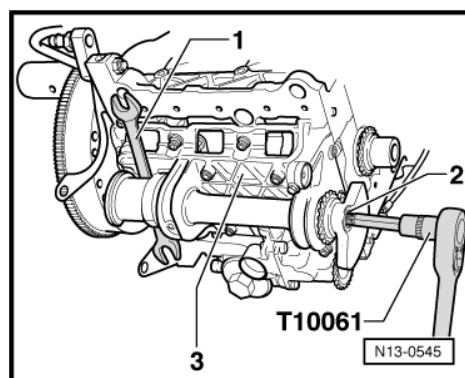
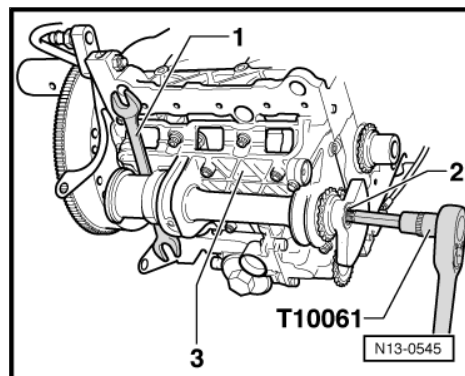

Note

- ◆ *Renew O-ring.*
- ◆ *Renew the bolts tightened with specified tightening angle.*
- Lubricate contact surfaces of bearing and insert balance shaft.
- Fit chain sprocket and balance weight on balance shaft.


Note

Chain sprocket and balance weight can only be fitted in one position.

- Tighten bolt for balance weight/chain sprocket hand-tight.
- Check that dowel sleeve in cylinder block and O-ring in retaining frame are in position before installing retaining frame.
- Tighten retaining frame -3- to cylinder block hand-tight and align.
- Check that retaining frame aligns flush with outer edge of cylinder block on pulley end.
- Tighten retaining frame in stages and in diagonal sequence.
- Block balance shaft as shown using a spanner (24/27 mm) -item 1-.
- When blocking the balance shaft, make sure that the spanner is centred on the balance weight and at right angles to the balance shaft.
- Secure balance weight using new bolt -2-.
- Install chain tensioner.



- Clean chain with a lint-free cloth.
- Ensure that mark -arrow- on crankshaft sprocket is at top.

– Lay chain over crankshaft sprocket, oil pump sprocket and balance shaft sprocket.

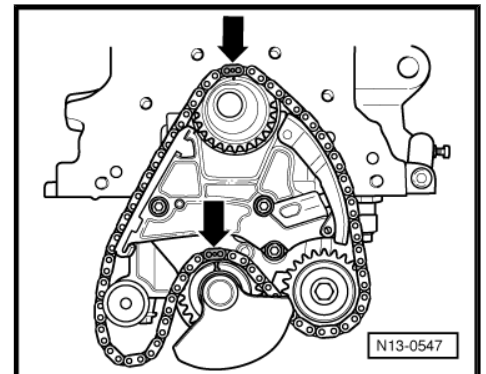
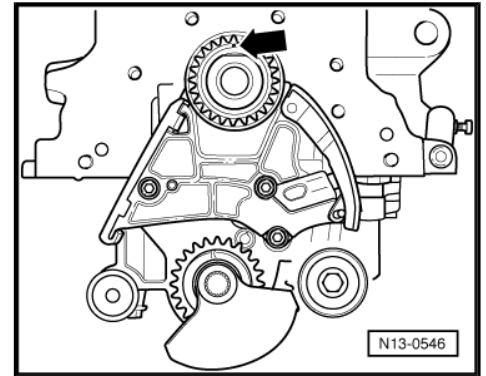
- Ensure that marks on crankshaft sprocket and balance shaft sprocket align with the colour-coded chain links -arrows-.



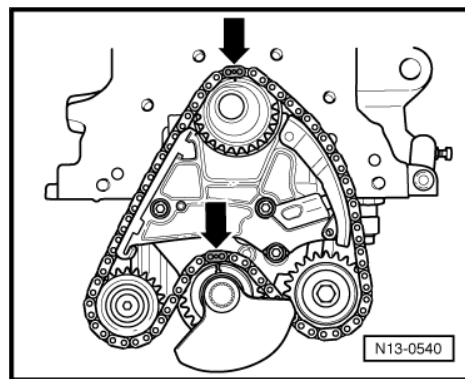
Note

The colour-coded chain links are additionally marked with a notch.

- Engage idler sprocket in chain and tighten idler sprocket to retaining frame.
- Remove locking pin from chain tensioner.



- Check that marks on crankshaft sprocket and balance shaft sprocket align with the colour-coded chain links -arrows-.
- Install sealing flange (pulley end) ⇒ [page 50](#) .
- Fit baffle plate with new O-ring. To do this:
 - Lubricate O-ring with oil.
 - Lubricate sleeve on inside of baffle plate with oil.
 - Make sure sealing tape is properly applied.
 - Make sure baffle plate engages properly in retaining frame.
- Install sump ⇒ [page 146](#) .
- Install toothed belt (adjust valve timing): toothed belt drive with hydraulically damped tensioning roller ⇒ [page 109](#), toothed belt drive with friction-damped tensioning roller ⇒ [page 123](#) .
- Install poly V-belt ⇒ [page 42](#) .



Tightening torques

Component	Nm
Retaining frame with balance shaft to cylinder block	14 + 180° ¹⁾²⁾
Balance weight with chain sprocket to retaining frame	100 + 90° ¹⁾³⁾
Chain tensioner to retaining frame	8 + 90° ¹⁾³⁾
Idler sprocket to retaining frame	20
Baffle plate to retaining frame	5
• ¹⁾ Renew bolt(s). • ²⁾ 180° = one half turn. • ³⁾ 90° = one quarter turn.	

4 Crankshaft



Note

All bearing and running surfaces must be oiled before assembling.

4.1 Crankshaft - exploded view

1 - Bearing shells 1, 2, and 4

- ☐ For bearing cap (without oil groove)
- ☐ For cylinder block (with oil groove)
- ☐ Do not interchange used bearing shells (mark positions)

2 - Bolt

- ☐ Renew
- ☐ 65 Nm + 90° (1/4 turn further)
- ☐ To measure radial clearance, tighten to 65 Nm but do not turn further

3 - Bearing cap

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

4 - Bearing shell 3

- ☐ For bearing cap (without oil groove)
- ☐ For cylinder block (with oil groove)

5 - Sender wheel

- ☐ For engine speed sender -G28-
- ☐ Sender wheel must be renewed if bolts are loosened
- ☐ Removing and installing ⇒ [page 64](#)

6 - Bolt

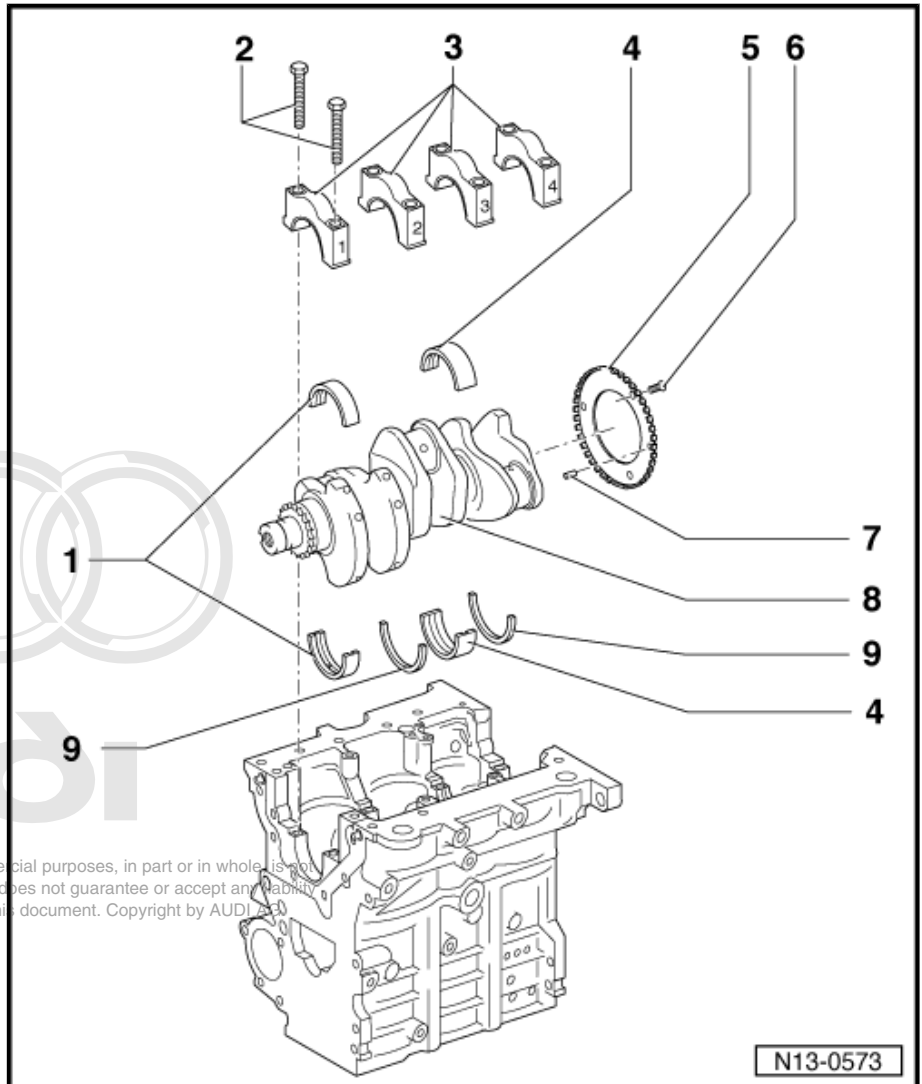
- ☐ Renew
- ☐ 10 Nm + 90° (1/4 turn further)

7 - Dowel pin

- ☐ Checking projection from crankshaft ⇒ [page 64](#)

8 - Crankshaft

- ☐ Before removing, ensure that a suitable surface is prepared so that the sender wheel -item 5- is not damaged and does not lie against any other item.
- ☐ Axial clearance when new: 0.07 ... 0.17 mm; wear limit: 0.37 mm



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- ☐ Check radial clearance with Plastigage
- ☐ Radial clearance when new: 0.03 ... 0.08 mm; wear limit 0.17 mm
- ☐ Do not rotate the crankshaft when checking the radial clearance
- ☐ Crankshaft dimensions ⇒ [page 64](#)

9 - Thrust washer

- ☐ For cylinder block, bearing 3

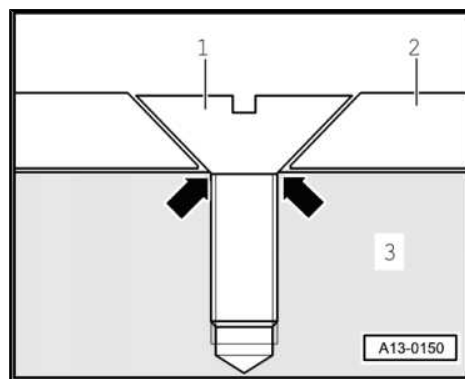
Removing and installing sender wheel

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



Note

- ◆ If the countersunk bolts are tightened a second time, the seats for the bolt heads in the sender wheel will be deformed to such an extent that the bolt heads make contact with the crankshaft -3- -arrows- and the sender wheel beneath the bolts will be loose.
- ◆ Sender wheel can only be installed in one position. Holes are off-set.



Tightening torque

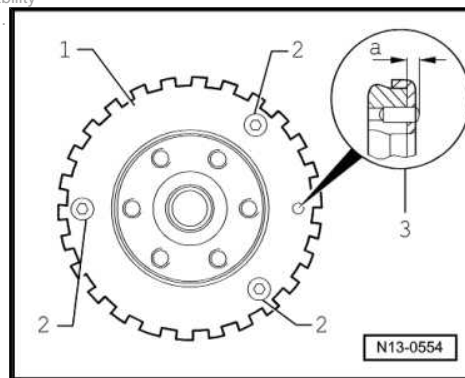
Component	Nm
Sender wheel to crankshaft	10 + 90° 1)2)
• 1) Renew bolts. • 2) 90° = one quarter turn.	

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Checking dowel pin projection out of crankshaft

- Use depth gauge to check projection -a- of dowel pin with sender wheel -1- removed.

- 1 - Sender wheel
- 2 - Bolt
- 3 - Projection of dowel pin -3- out of crankshaft
- Dimension -a- = 2.5 ... 3.0 mm.



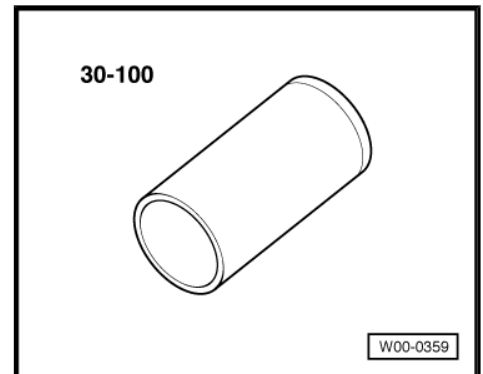
4.2 Crankshaft dimensions

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

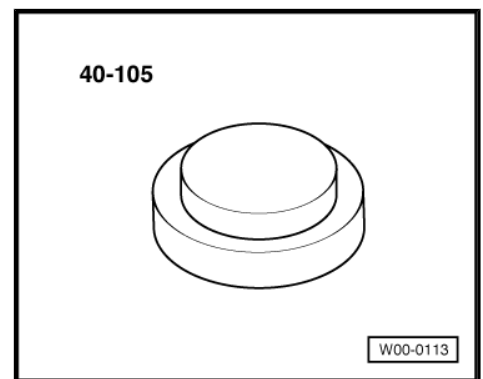
4.3 Removing and installing drive chain sprocket

Special tools and workshop equipment required

- ◆ Drift sleeve -30 - 100-



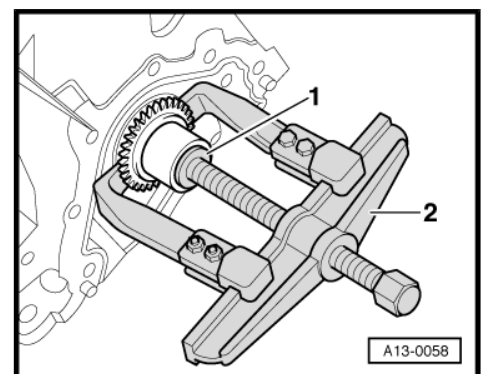
- ◆ Thrust plate -40 - 105-



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

Removing

- Remove sump ⇒ [page 146](#) .
- Remove sealing flange (pulley end) ⇒ [page 50](#) .
- Remove oil pump chain sprocket, chain tensioner and chain ⇒ [page 58](#) .
- Pull off crankshaft drive chain sprocket using e.g. claw-type puller Kukko 44-1-item 2- (protect end of crankshaft with thrust plate -40 - 105- item 1-).



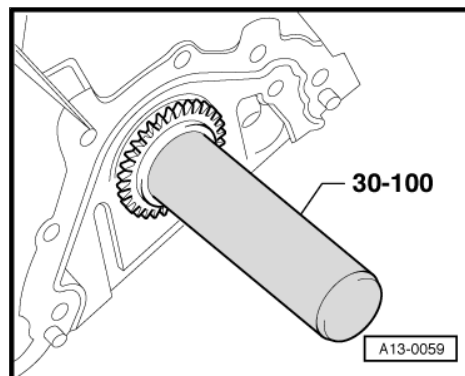
Installing



WARNING

Wear protective gloves.

- Heat drive chain sprocket in oven for approx. 15 minutes to 220°C.
- Using pliers, locate drive chain sprocket on end of crankshaft.
- Installation position: wide collar on drive chain sprocket faces engine.
- Push drive chain sprocket onto crankshaft as far as the stop using drift sleeve -30 - 100- .
- Install sealing flange (pulley end) ⇒ [page 50](#) .
- Install sump ⇒ [page 146](#) .



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5 Pistons and conrods

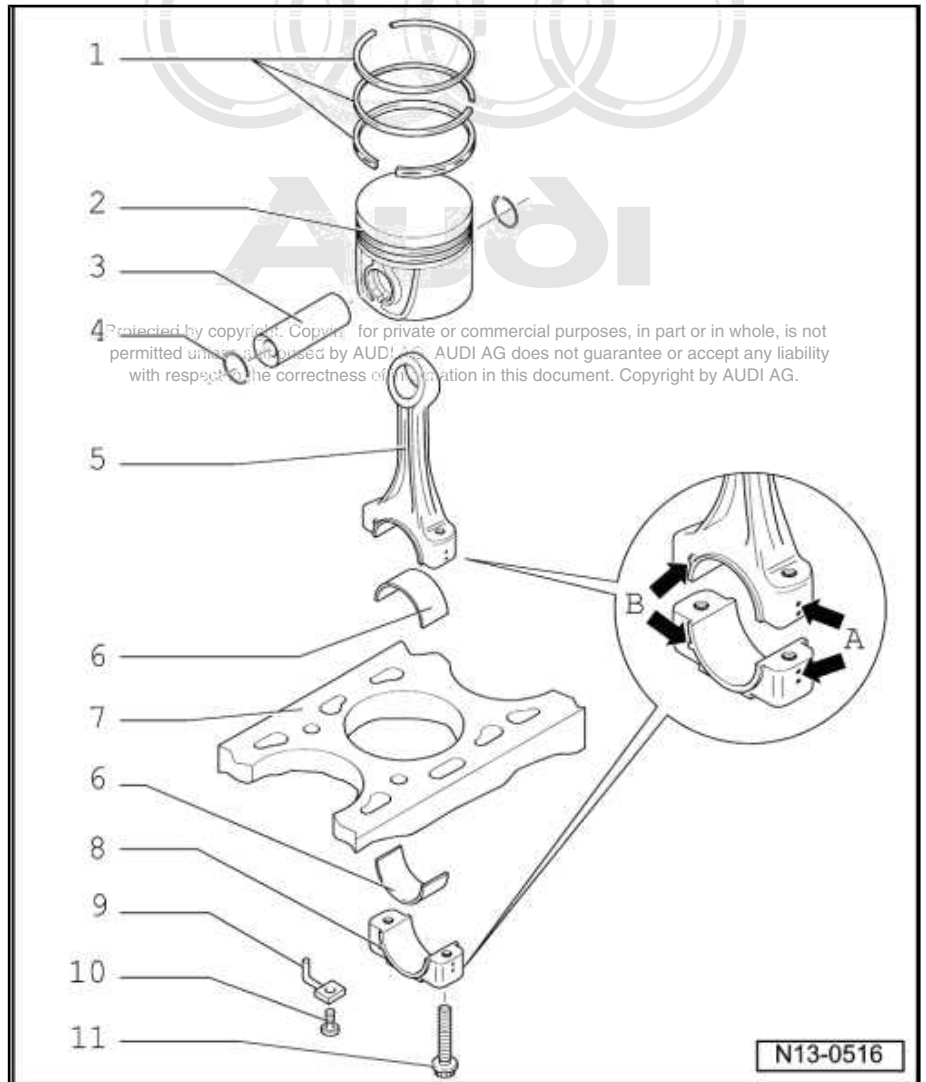
5.1 Pistons and conrods - exploded view

1 - Piston rings

- ☐ Offset gaps by 120°
- ☐ Use piston ring pliers to remove and install
- ☐ Marking "TOP" or inscription must face piston crown.
- ☐ Checking ring gap
⇒ [page 68](#)
- ☐ Checking ring-to-groove clearance ⇒ [page 68](#)

2 - Piston

- ☐ With combustion chamber
- ☐ Mark installation position and cylinder number
- ☐ Installation position and allocation of piston/cylinder ⇒ [page 69](#)
- ☐ Arrow on piston crown points to pulley end
- ☐ If cracking is visible on piston skirt, renew piston
- ☐ Checking cylinder bore ⇒ [page 69](#)
- ☐ Piston and cylinder dimensions ⇒ [page 71](#)
- ☐ Install using piston ring clamp
- ☐ Checking piston projection at "TDC"
⇒ [page 69](#)



3 - Piston pin

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

4 - Circlip

5 - Conrod

- ☐ Only renew as a complete set
- ☐ Mark cylinder allocation -A-
- ☐ Installation position: Marking -B- faces towards pulley end

6 - Bearing shell

- ☐ Installation position ⇒ [page 69](#)
- ☐ Do not interchange used bearing shells (mark positions)
- ☐ Note type: upper bearing shell (closest to piston) is made of more wear-resistant material. Distinguishing feature on new bearing shells: black marking on bearing surface near joint
- ☐ Check that it is securely seated

- ☐ Axial clearance: wear limit: 0.37 mm
- ☐ Check radial clearance with Plastigage
- ☐ Do not rotate crankshaft when checking radial clearance
- ☐ Radial clearance: wear limit: 0.08 mm

7 - Cylinder block

- ☐ Checking cylinder bore ⇒ [page 69](#)
- ☐ Piston and cylinder dimensions ⇒ [page 71](#)

8 - Conrod bearing cap

- ☐ Note installation position

9 - Oil spray jet

- ☐ For piston cooling
- ☐ Note installation position: Turn oil spray jet anti-clockwise until it makes contact with cylinder block and secure in this position

10 - Bolt

- ☐ Insert without sealant
- ☐ 27 Nm

11 - Bolt

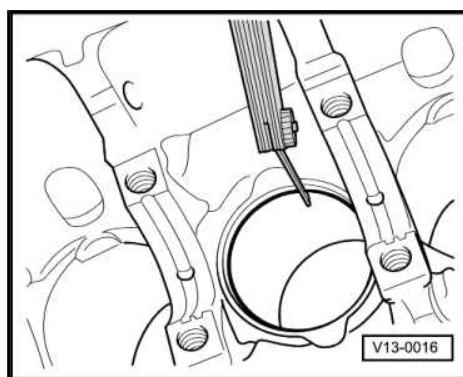
- ☐ Renew
- ☐ Lubricate threads and contact surface
- ☐ 30 Nm + 90° (1/4 turn further)
- ☐ Use old bolts when measuring radial clearance

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Checking piston ring gap

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

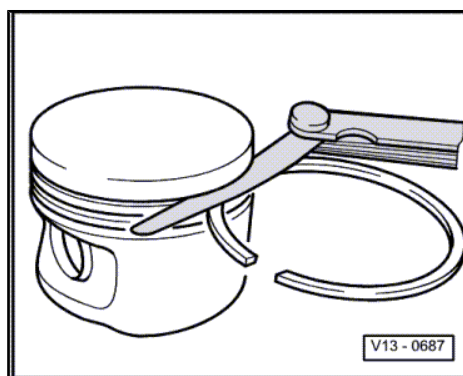
Piston ring Dimensions in mm	New	Wear limit
1st compression ring	0.25 ... 0.40	1.00
2nd compression ring	0.20 ... 0.40	1.00
Oil scraper ring	0.25 ... 0.50	1.00



Checking ring-to-groove clearance

- Clean groove in piston before checking clearance.

Piston ring Dimensions in mm	New	Wear limit
1st compression ring	0.06 ... 0.09	0.25
2nd compression ring	0.05 ... 0.08	0.25
Oil scraper ring	0.03 ... 0.06	0.15



Piston installation position and piston/cylinder allocation

Pistons in cylinders 1 and 2:

- Larger inlet valve chamber towards flywheel -arrows-.

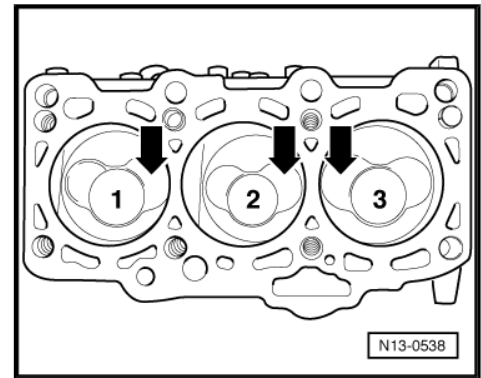
Piston in cylinder 3:

- Larger inlet valve chamber towards belt pulley side -arrow-.



Note

- ♦ With new pistons, cylinder allocation is indicated by a coloured marking on piston crown.
- ♦ Piston for cylinder 1 and 2: marked 1/2.
- ♦ Piston for cylinder 3: marked 3.



Checking cylinder bore

- Use 50 ... 100 mm internal dial gauge to take measurements at 3 points in transverse direction -A- and longitudinal direction -B-.
- Difference between measured value and nominal value: max. 0.10 mm.

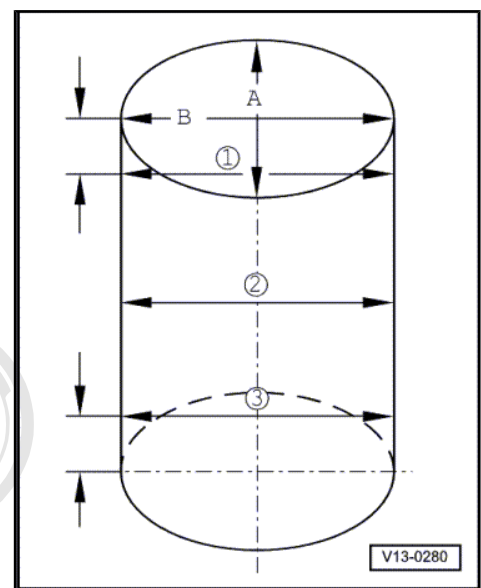
Nominal dimension

⇒ ["5.3 Piston and cylinder dimensions", page 71](#) .



Note

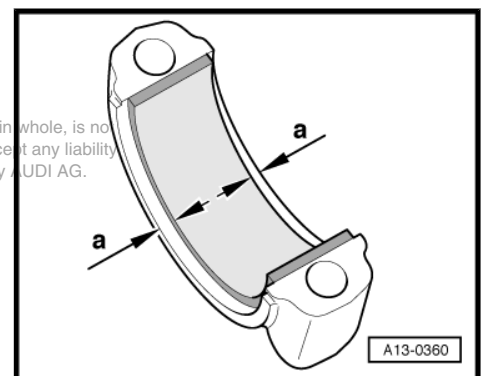
Measuring the cylinder bores must not be done when the cylinder block is mounted on a repair stand with engine and gearbox support -VW 540- , as incorrect measurements may result.



Installation position of bearing shell

- Insert bearing shells centrally in conrod/conrod bearing cap.
- Distance -a- = 2.5 mm

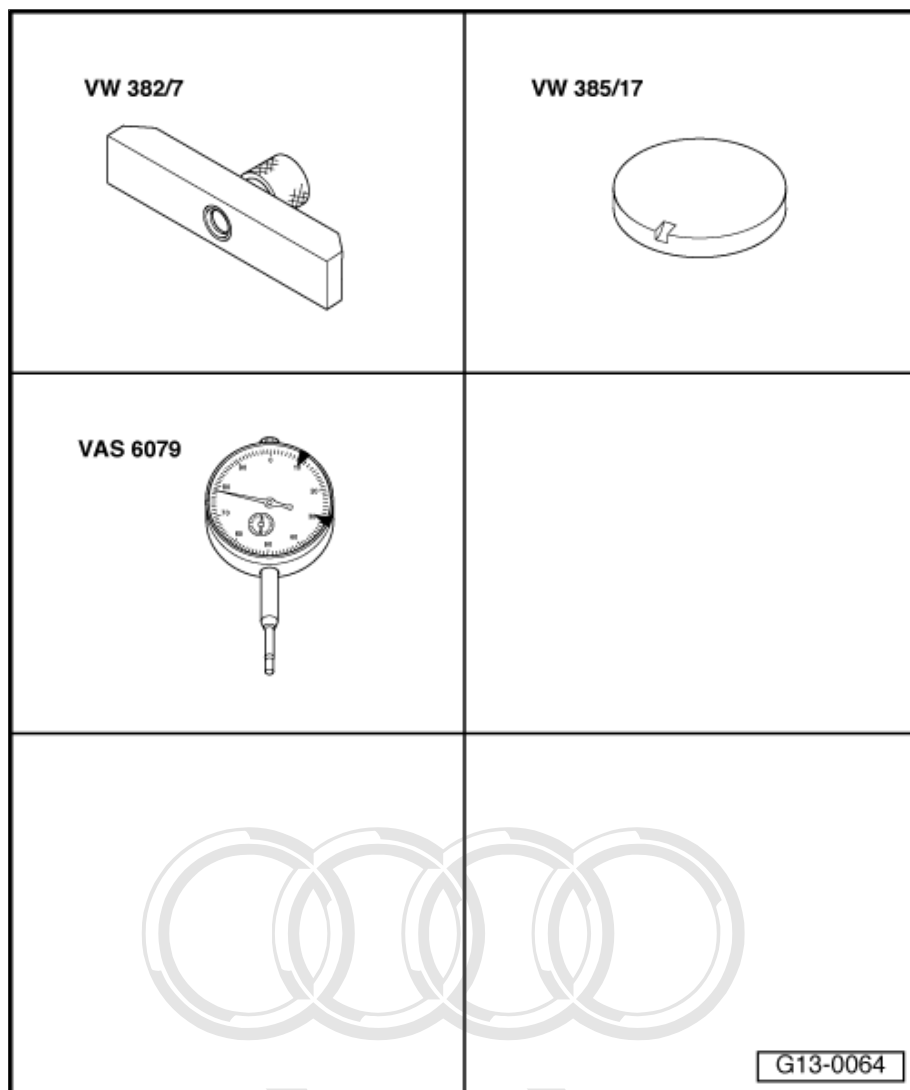
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5.2 Checking piston projection at "TDC"

Special tools and workshop equipment required

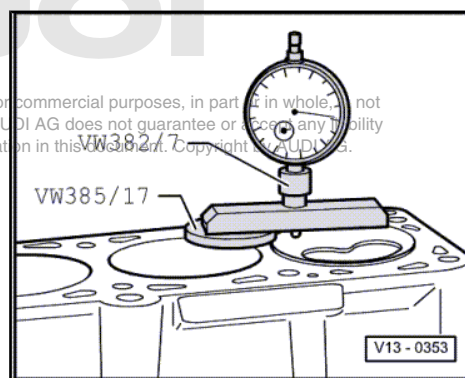
- ◆ -VW 382/7- from measuring tool -VW 382-
- ◆ -VW 385/17- from universal measuring tool -VW 385-
- ◆ Dial gauge -VAS 6079-



Procedure

- Check piston projection at “TDC” when installing new pistons or short engine.
- Install cylinder head gasket corresponding to piston projection according to table below:

Piston projection above top surface of cylinder block in mm	Identification (No. of holes)
0.91 ... 1.00	1
1.01 ... 1.10	2
1.11 ... 1.20	3



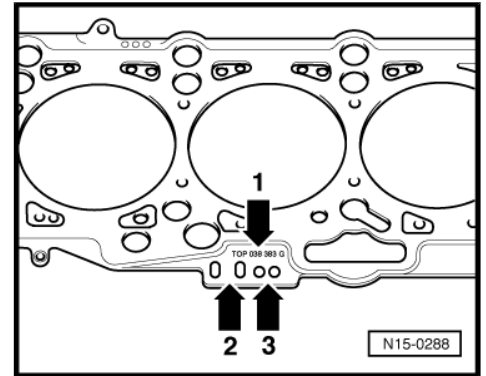
Identification of cylinder head gasket

- 1 - Part No.
- 2 - Production code (can be disregarded)
- 3 - Holes



Note

If the measured values for piston projection are not the same for all pistons, use the highest value to determine the correct gasket size.



5.3 Piston and cylinder dimensions

Honing dimension (in mm)	Piston Ø	Cylinder bore Ø
Basic dimension	79.47	79.51
1st oversize	79.97	80.01

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15 – Cylinder head, valve gear

1 Cylinder head

1.1 Cylinder head - exploded view

1 - Toothed belt cover (top)

2 - Toothed belt

- ☐ Toothed belt drive with hydraulically damped tensioning roller - exploded view ⇒ [page 100](#)
- ☐ Toothed belt drive with friction-damped tensioning roller - exploded view ⇒ [page 114](#)

3 - Bolt

- ☐ 10 Nm

4 - Bolt

- ☐ 25 Nm

5 - Bolt

- ☐ 100 Nm

6 - Camshaft sprocket

7 - Hub

8 - Toothed belt cover (rear)

9 - Sealing grommet

- ☐ Renew if damaged

10 - Hall sender -G40-

- ☐ For camshaft position
- ☐ To remove, remove sealing grommet (- item 9-) from toothed belt cover (rear)

- ☐ Checking ⇒ Rep. gr. 23

11 - Bolt

- ☐ Renew
- ☐ Note correct sequence for loosening and tightening ⇒ ["1.3 Removing and installing cylinder head", page 77](#)
- ☐ Prior to installation, insert washers in cylinder head ⇒ [Item 4 \(page 127\)](#) .

12 - Not fitted

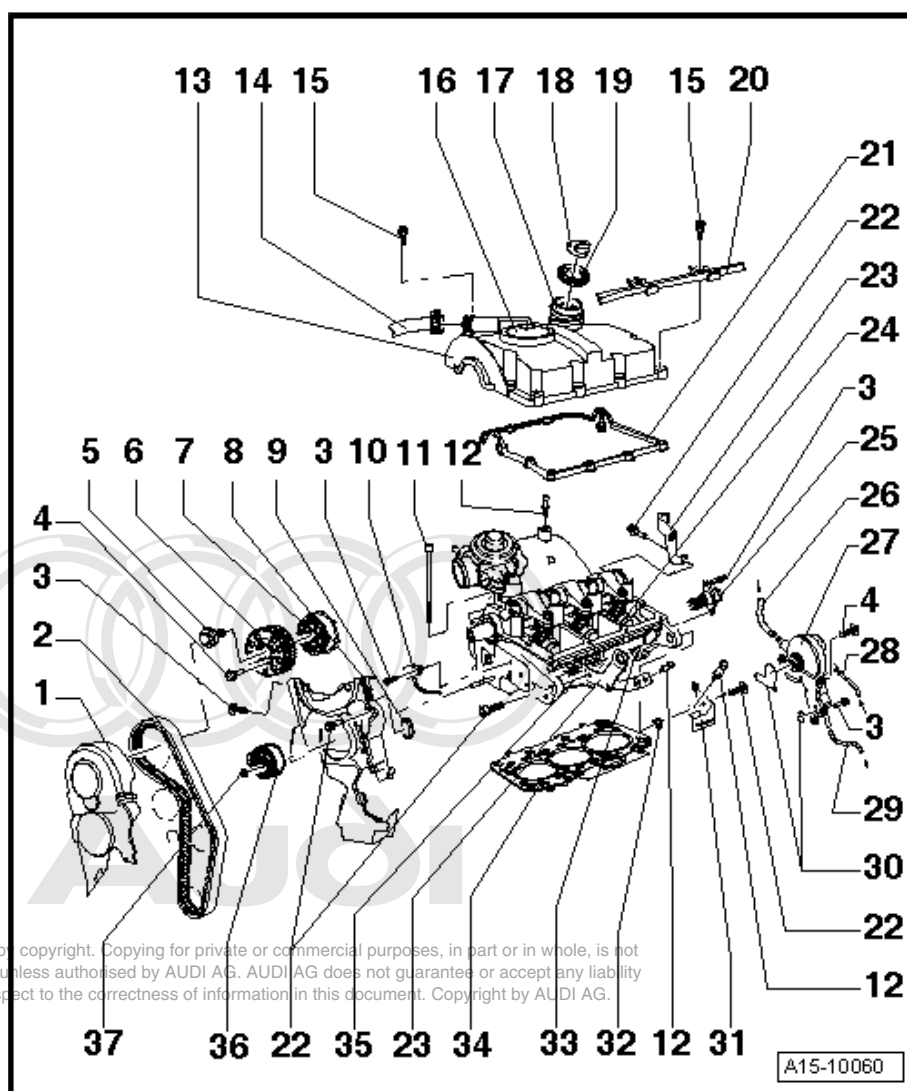
13 - Cylinder head cover

- ☐ Removing and installing ⇒ [page 74](#)

14 - Crankcase breather hose

15 - Bolt

- ☐ With seal
- ☐ Renew bolt if seal is damaged
- ☐ Note correct sequence for loosening and tightening ⇒ ["1.2 Removing and installing cylinder head cover", page 74](#)



- ☐ 10 Nm
- 16 - Pressure control valve**
 - ☐ For crankcase breather
- 17 - Oil filler neck**
- 18 - Filler cap**
 - ☐ Renew seal if damaged
- 19 - Sealing collar**
 - ☐ Renew if damaged
- 20 - Bracket**
 - ☐ For fuel lines
- 21 - Gasket for cylinder head cover**
 - ☐ Renew if damaged
- 22 - Bolt**
 - ☐ 20 Nm
- 23 - Lifting eye**
- 24 - Unit injector**
 - ☐ Removing and installing ⇒ Rep. gr. 23
- 25 - Main connector**
 - ☐ For unit injector
- 26 - From brake servo**
- 27 - Tandem pump**
 - ☐ For fuel and vacuum supply
 - ☐ Removing and installing ⇒ Rep. gr. 20
- 28 - Supply hose**
 - ☐ From fuel filter: white or with white marking
 - ☐ Check that it is securely seated
- 29 - Return hose**
 - ☐ To fuel filter: blue or with blue marking
 - ☐ Check that it is securely seated
- 30 - Gasket**
 - ☐ Renew
- 31 - Bracket**
- 32 - Tapered nut**
- 33 - Cylinder head**
 - ☐ Removing and installing ⇒ [page 77](#)
 - ☐ Checking for distortion ⇒ [page 74](#)
 - ☐ If renewed, change coolant and engine oil
- 34 - Cylinder head gasket**
 - ☐ Renew
 - ☐ Note marking ⇒ [page 74](#)
 - ☐ If renewed, change coolant and engine oil
- 35 - Glow plug**
 - ☐ Removing and installing ⇒ Rep. gr. 28



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36 - Tensioning roller

37 - Nut

- 20 Nm + 45° (1/8 turn further)

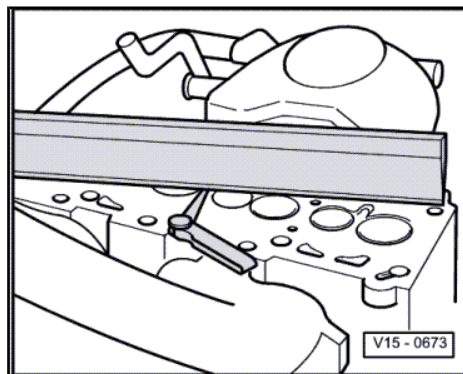
Checking cylinder head for distortion

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



Note

The cylinder heads of diesel engines must not be machined.



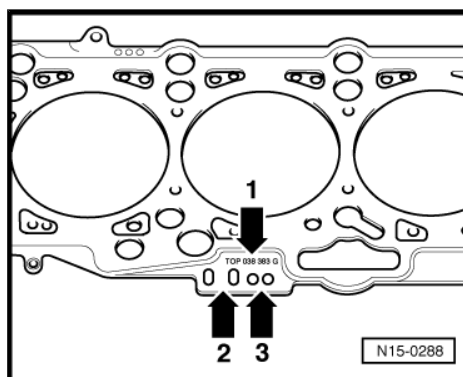
Identification of cylinder head gasket

- 1 - Part No.
 - 2 - Production code (can be disregarded)
 - 3 - Holes
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Note

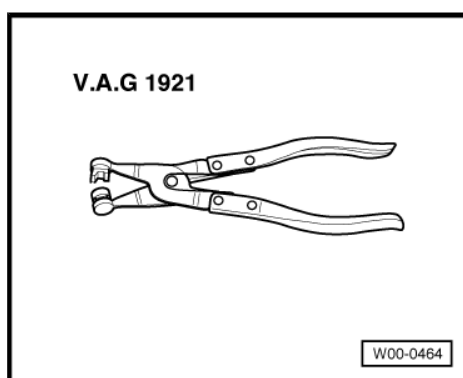
Cylinder head gaskets of different thicknesses are fitted depending on the amount of piston projection ⇒ [page 69](#). When renewing just the cylinder head gasket, the new gasket should have the same identification as the old one.



1.2 Removing and installing cylinder head cover

Special tools and workshop equipment required

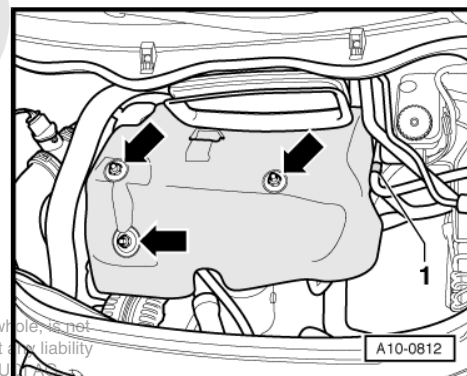
- ◆ Hose clip pliers -V.A.G 1921-



- ◆ Sealant ⇒ Parts catalogue

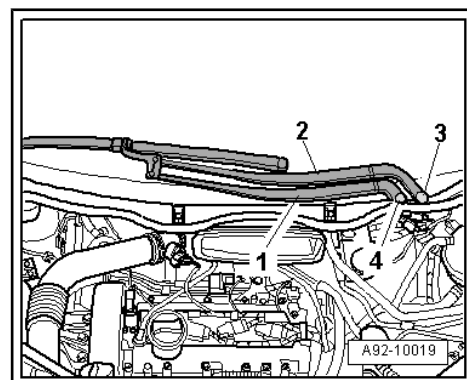
Removing

- Remove bonnet ⇒ [page 8](#).
- If fitted, unclip bracket -1-.
- Take off engine cover panel -arrows-.
- Remove noise insulation beneath cover.



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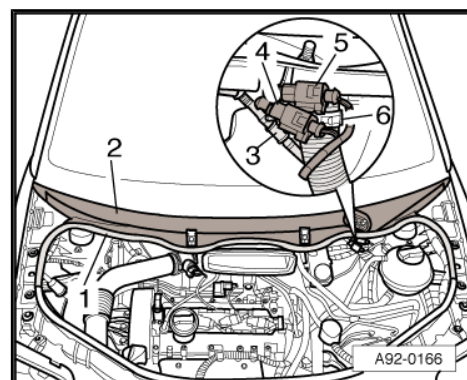
- Lever off caps -3 and 4- on two-piece windscreen wiper arm with a screwdriver.
- Slacken nuts on two-piece windscreen wiper arm a few turns.
- Release arms -1 and 2- one after the other by tilting them slightly on the wiper shafts.
- Remove nuts completely and take off two-piece windscreen wiper arm.



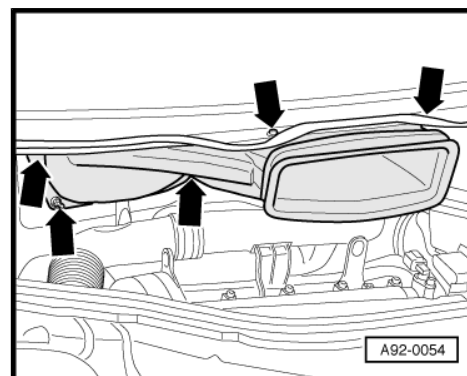
Note

Use puller (commercially available) to remove wiper arm if necessary.

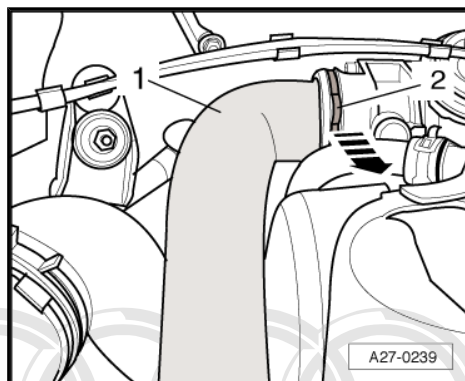
- Disconnect washer fluid hose -3-.
- If fitted, unplug electrical connectors -4 and 5- for heated washer jets.
- Open hose clip -6- using hose clip pliers -V.A.G 1921- and detach water drain hose from cowl panel grille.
- Pull off rubber seal -1- on cowl panel grille.
- Disconnect cowl panel grille -2-.



- Unscrew nuts and bolts -arrows-.
- Pull fresh air duct forwards and remove by turning it to right side of vehicle.



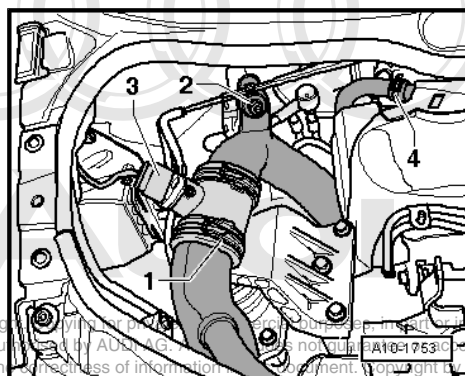
- Detach air hose -1- from intake manifold; to do this, release retaining clip -2- -arrow-, if fitted.
- Move air hose to front.



- Disconnect crankcase breather hose -4- at cylinder head cover.

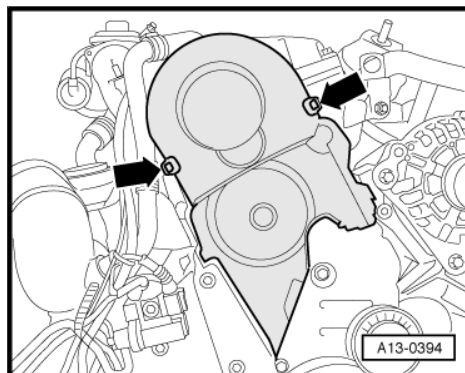

Note

Disregard items marked -1 ... 3-.



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- Remove toothed belt cover (top section) -arrows-.



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

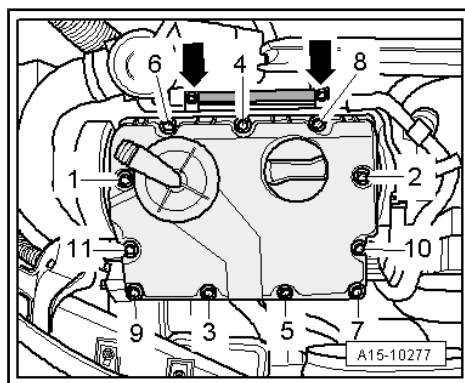

Note

Disregard -arrows-.

- Detach bracket with fuel lines.
- Remove cylinder head cover.

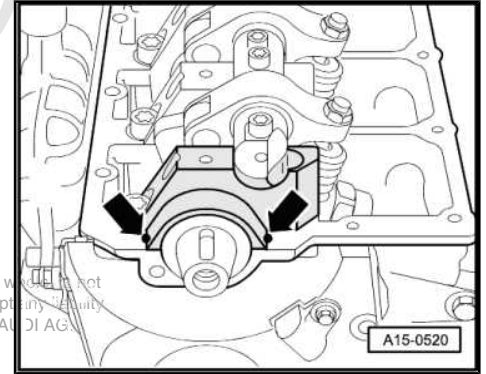
Installing

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

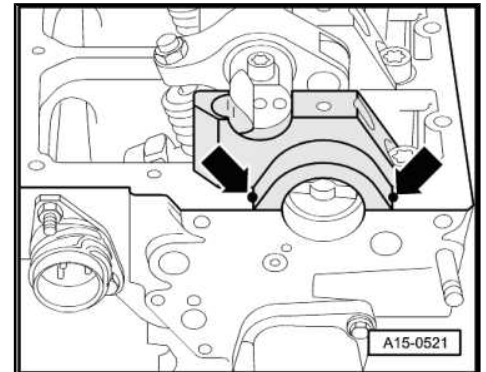

Note

- ◆ Renew gasket for cylinder head cover if damaged.
- ◆ Renew cylinder head cover bolts if gasket is damaged.
- ◆ Hose connections and hoses for charge air system must be free of oil and grease before assembly. Do NOT use lubricant.

- Apply one drop of sealant (Ø approx. 5 mm) to each sealing point at front bearing cap/cylinder head -arrows-; for sealant refer to ⇒ Parts catalogue .



- Apply one drop of sealant (Ø approx. 5 mm) to each sealing point at rear bearing cap/cylinder head -arrows-; for sealant refer to ⇒ Parts catalogue .



- Tighten bolts for cylinder head cover to final setting in the sequence -1 ... 11-.

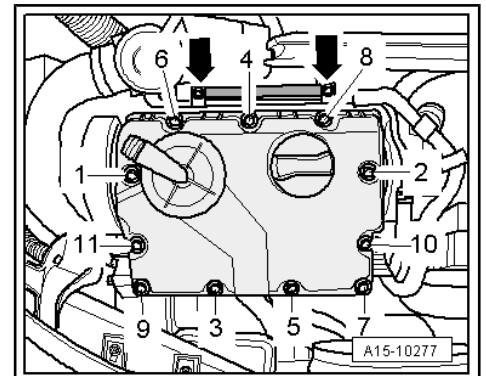


Disregard -arrows-.

- Install air pipes/hoses with plug-in connectors ⇒ [page 202](#) .

Tightening torques

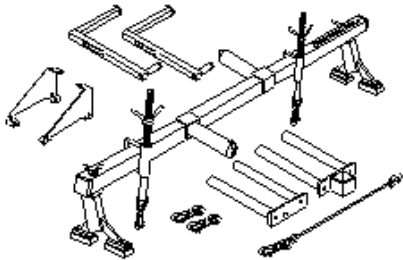
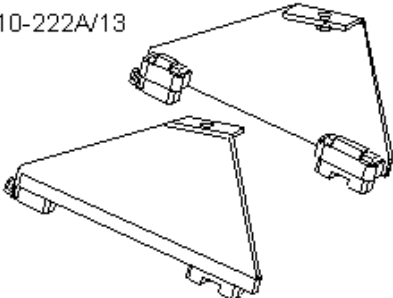
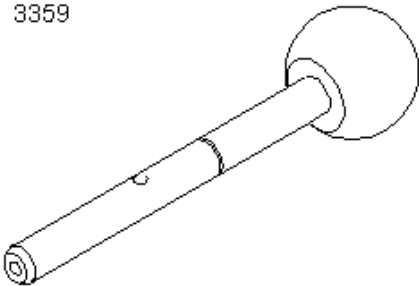
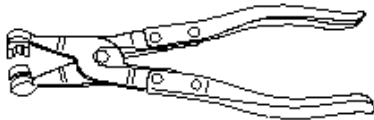
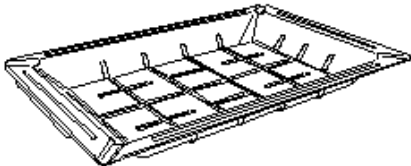
Component	Nm
Cylinder head cover to cylinder head	10
Engine cover panel to bracket	5.5



1.3 Removing and installing cylinder head

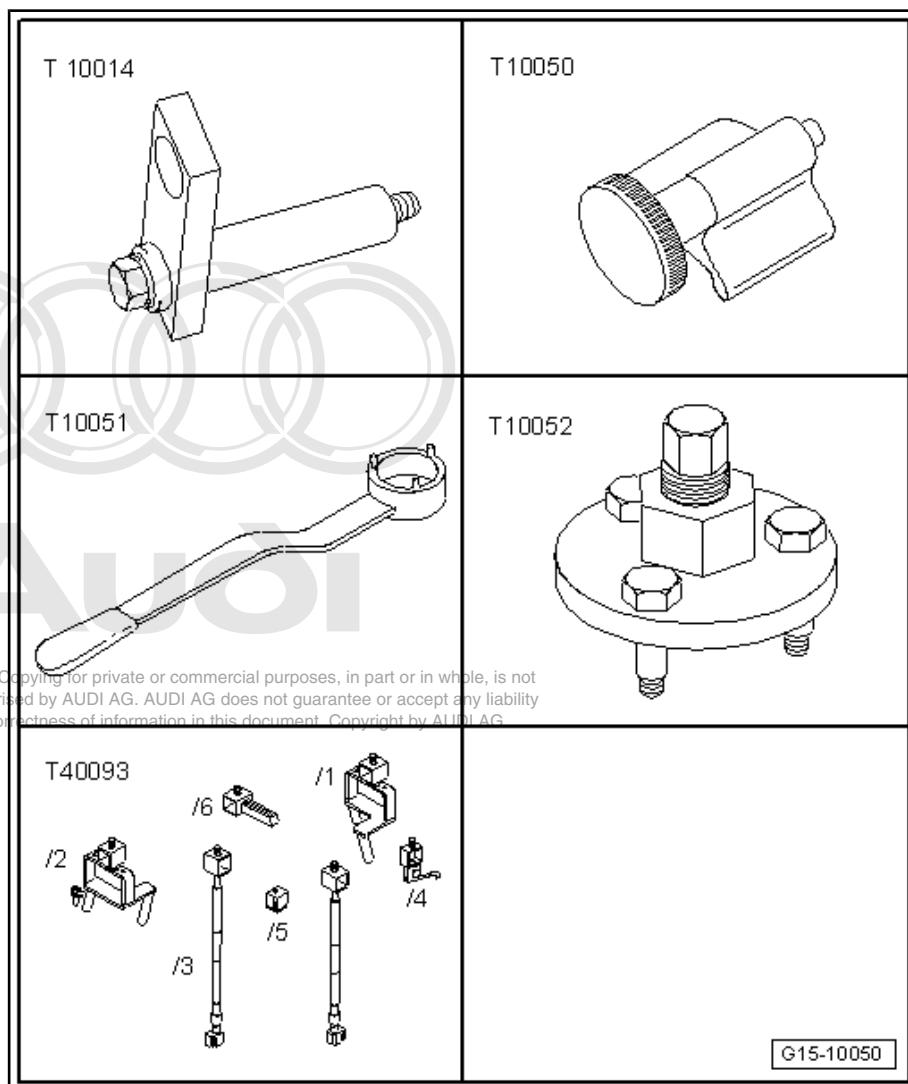
Special tools and workshop equipment required

- ◆ Support bracket -10 - 222 A-
- ◆ Adapters -10 - 222 A /13-
- ◆ Diesel injection pump locking pin -3359-
- ◆ Hose clip pliers -V.A.G 1921-
- ◆ Drip tray for workshop hoist -VAS 6208-

10-222 A 	10-222A/13 
3359 	V.A.G 1921 
VAS 6208 	G15-10049

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- ◆ Retainer -T10014-
- ◆ Crankshaft stop -T10050-
- ◆ Counterhold tool -T10051-
- ◆ Puller -T10052-
- ◆ Adapter -T40093/6- from engine support bracket (supplementary set) -T40093-



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Removing



Caution

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

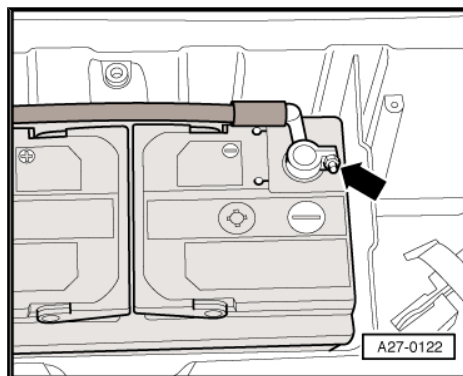


Note

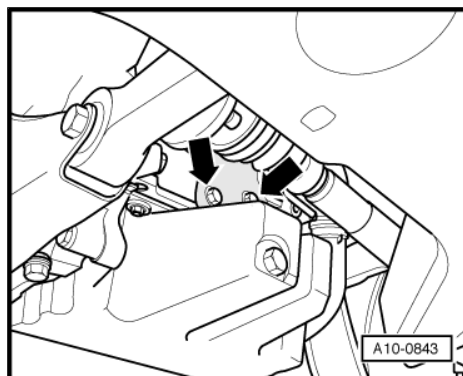
The battery is located in the luggage compartment panel.

- Switch off ignition and remove ignition key.

- Disconnect earth cable -arrow- at battery.
- Remove bonnet ⇒ [page 8](#) .
- Drain off coolant ⇒ [page 163](#) .
- Remove catalytic converter ⇒ [page 206](#) .
- Remove poly V-belt ⇒ [page 42](#) .



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



Vehicles with engine code letters AMF:

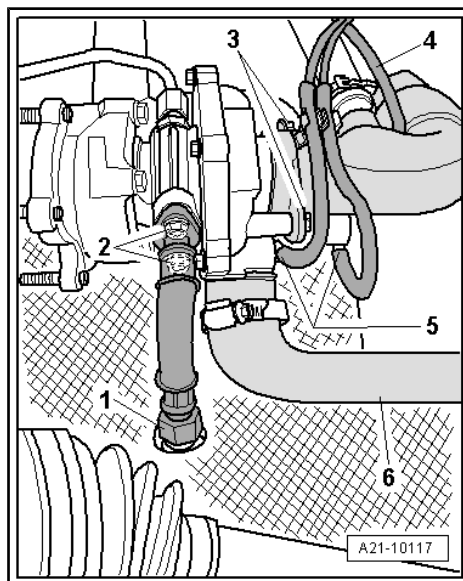
- Detach air hose -6- from turbocharger.
- Detach charge pressure control hose -5- at turbocharger and at vacuum unit for charge pressure control.
- Disconnect breather hose -4-.
- Unscrew bolts -3- and detach air pipe from turbocharger.

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Note

- ◆ The air pipe remains in installation position and is detached upwards at a later stage.
- ◆ Disregard -items 1 and 2-.



Vehicles with engine code letters ATL, BHC:

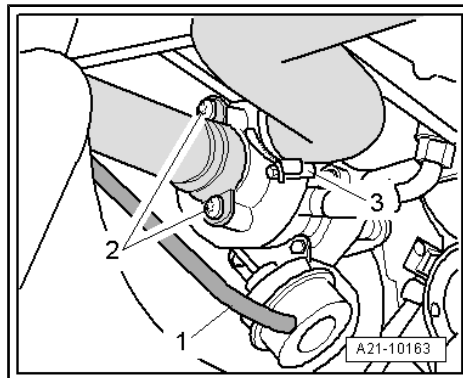
- Detach vacuum hose -1- from vacuum unit for charge pressure control and move it clear.
- Unscrew bolts -2- and detach air pipe from turbocharger.



Note

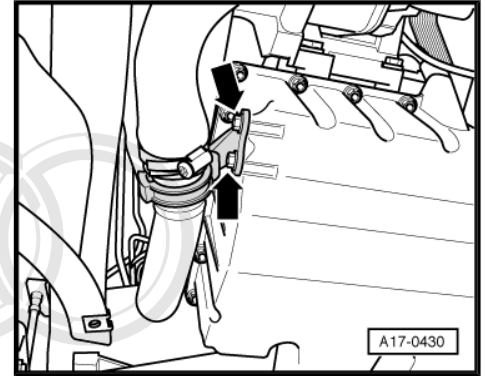
The air pipe remains in installation position and is detached upwards at a later stage.

- Detach air hose -3- from turbocharger.



All vehicles:

- Unbolt bracket for air pipe from sump -arrows-.



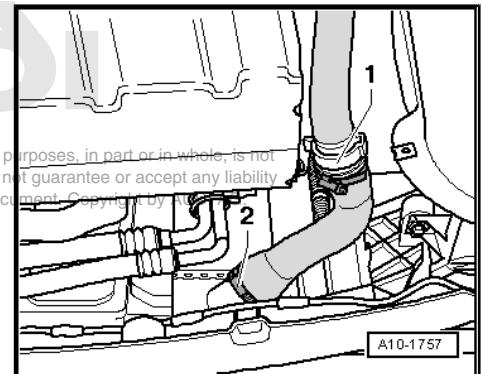
- Remove air hose -2- (right-side) from charge air cooler.



Note

Disregard -item 1-.

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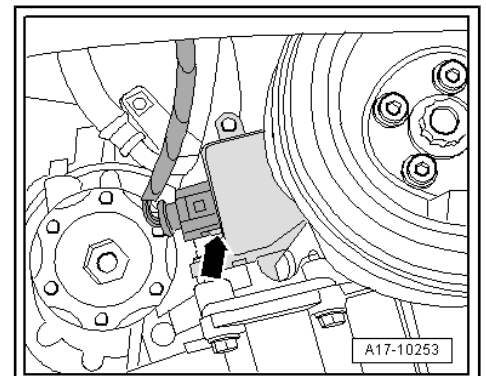


- Unplug electrical connector at oil level and oil temperature sender -G266- .
- Move wiring clear.

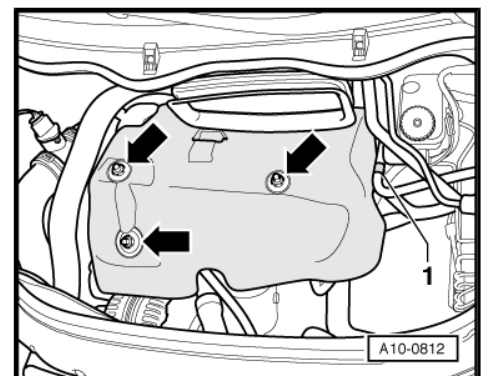


Note

Depending on version, oil level and oil temperature sender -G266- can be located at front of sump.



- If fitted, unclip bracket -1-.
- Take off engine cover panel -arrows-.
- Remove noise insulation beneath cover.

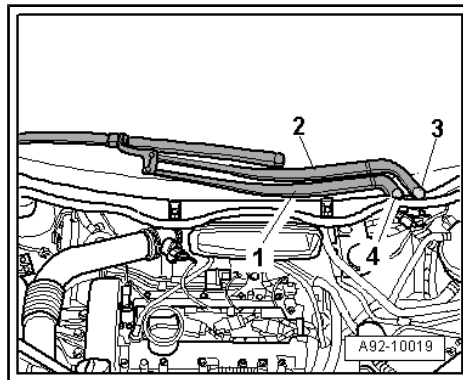


- Lever off caps -3 and 4- on two-piece windscreen wiper arm with a screwdriver.
- Slacken nuts on two-piece windscreen wiper arm a few turns.
- Release arms -1 and 2- one after the other by tilting them slightly on the wiper shafts.
- Remove nuts completely and take off two-piece windscreen wiper arm.

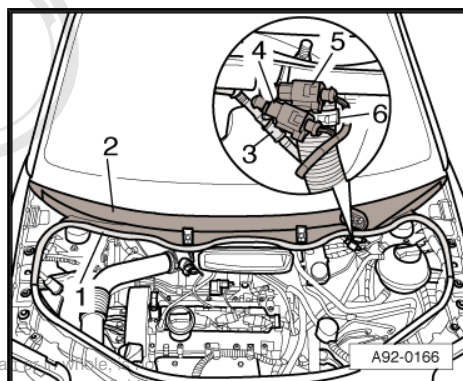


Note

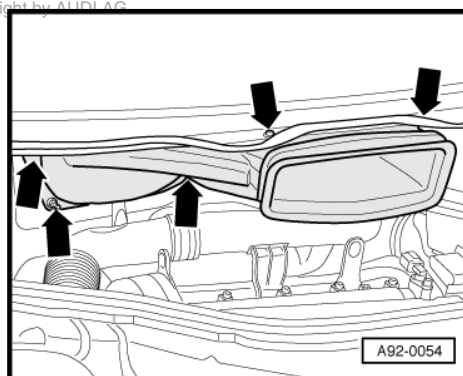
Use puller (commercially available) to remove wiper arm if necessary.



- Disconnect washer fluid hose -3-.
- If fitted, unplug electrical connectors -4 and 5- for heated washer jets.
- Open hose clip -6- using hose clip pliers -V.A.G 1921- and detach water drain hose from cowl panel grille.
- Pull off rubber seal -1- on cowl panel grille.
- Disconnect cowl panel grille -2-.



- Unscrew nuts and bolts -arrows-.
- Pull fresh air duct forwards and remove by turning it to right side of vehicle.



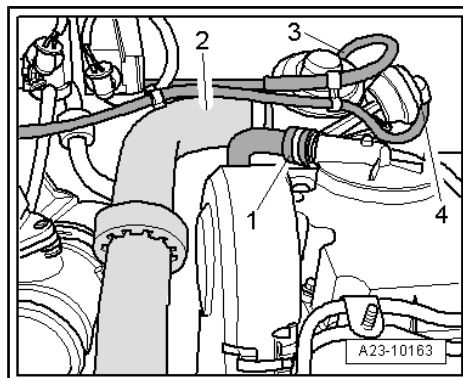
Vehicles with engine code letters AMF:

- Detach air hose -2- at mechanical exhaust recirculation valve.
- Disconnect vacuum hose -3- at mechanical exhaust gas recirculation valve.
- Disconnect vacuum hose -4- from vacuum unit for intake manifold flap.



Note

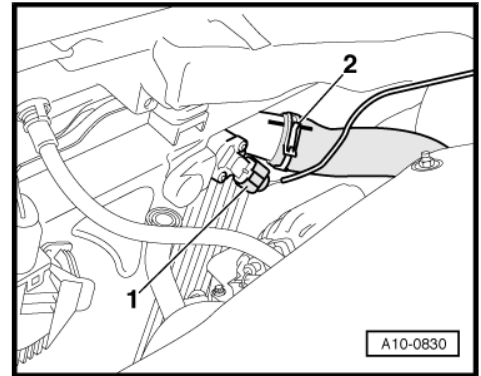
Disregard -item 1-.



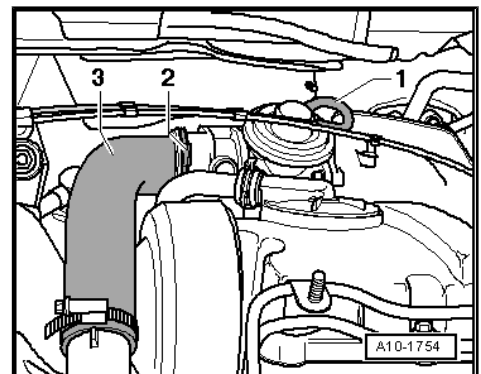
- Remove air intake hose -2- from charge air cooler.

**Note**

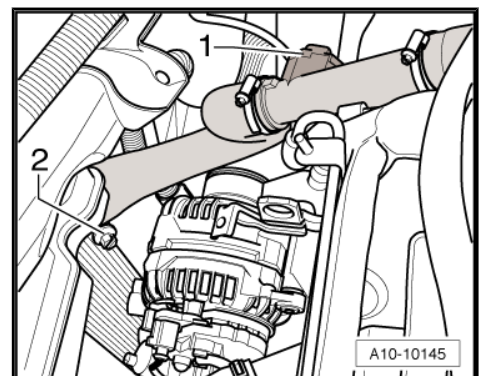
Disregard -item 1-.

**Vehicles with engine code letters ATL:**

- Remove air hose -3- from intake manifold flap motor -V157- by lifting retaining clip -2- slightly.
- Disconnect vacuum hose -1- at mechanical exhaust gas recirculation valve.

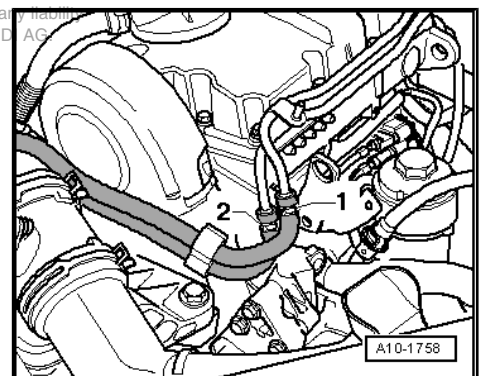


- Remove air intake hose -2- from charge air cooler.
- Unplug electrical connector at charge pressure sender -G31- -item 1-.

**All vehicles:****WARNING**

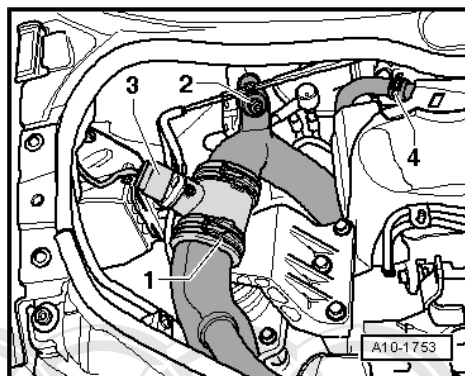
Risk of scalding - the temperature of the fuel and the fuel lines can be as high as 100 °C.

- ◆ ***Allow the fuel to cool down before disconnecting the lines.***
- ◆ ***Wear protective gloves.***
- ◆ ***Wear safety goggles.***

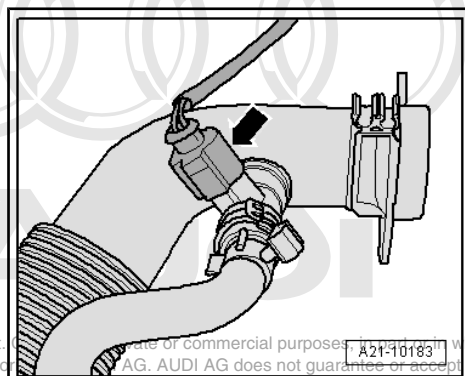


- Mark fuel supply line -2- and fuel return line -1-.
- Move fuel lines clear.

- Detach air intake hose -1- at air mass meter -G70- .
- Unplug electrical connector -3- at air mass meter -G70- .
- Remove nut -2-.
- Disconnect crankcase breather hose -4- at cylinder head cover.
- Pull air pipe out slightly together with air mass meter -G70- .



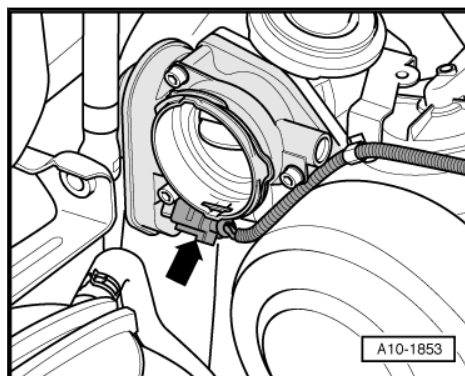
- Detach electrical connector -arrow- at heater element for crankcase breather -N79- (if fitted).
- Remove air pipe.



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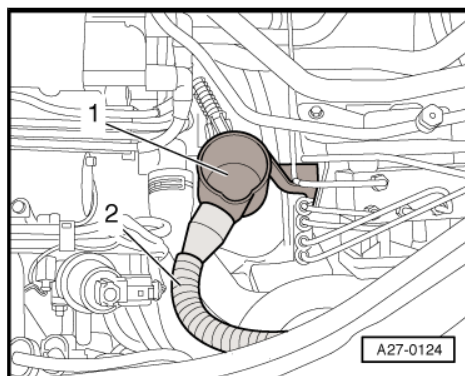
Vehicles with engine code letters ATL:

- Detach electrical connector -arrow- at intake manifold flap motor -V157- .
- Move wiring clear.

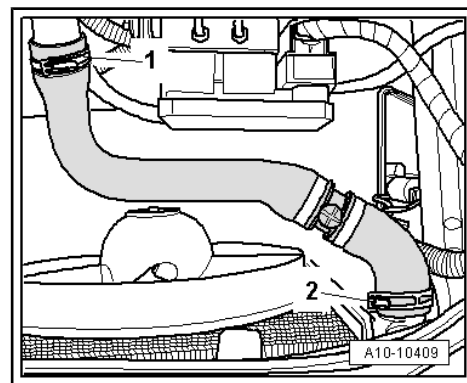


All vehicles:

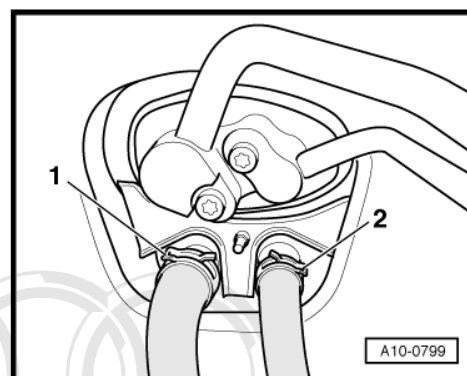
- Disconnect drain hose -2-.
- Remove water collector -1-.



- Remove top left coolant hose -items 1 and 2-.



- Mark coolant supply hose -1- and coolant return hose -2- going to heat exchanger and disconnect coolant hoses at bulkhead.

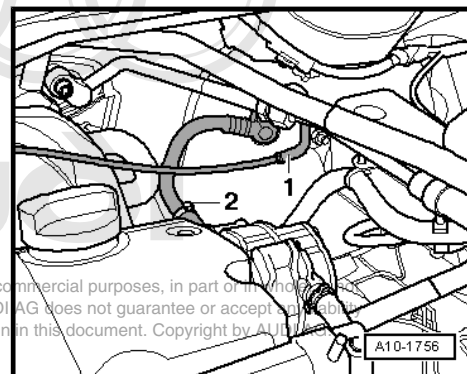


Vehicles with engine code letters ATL, BHC:

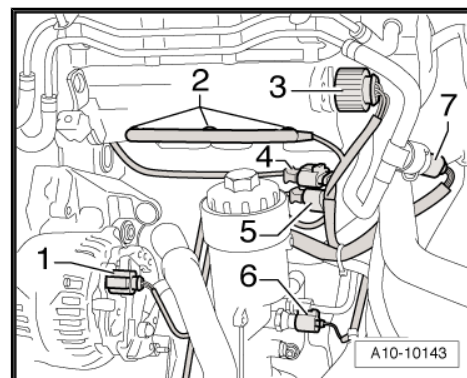
- Unplug vacuum hose -1-.

All vehicles:

- Detach vacuum hose -2- (going to brake servo) from tandem pump.
- Move vacuum hoses clear.



- Unplug electrical connectors -2- on glow plugs.
- Pull retaining tab and loosen knurled nut -3- at main connector for unit injectors.
- Unplug connector for Hall sender -G40- -item 4-.
- Unplug electrical connector -7- at fuel temperature sender -G81-.



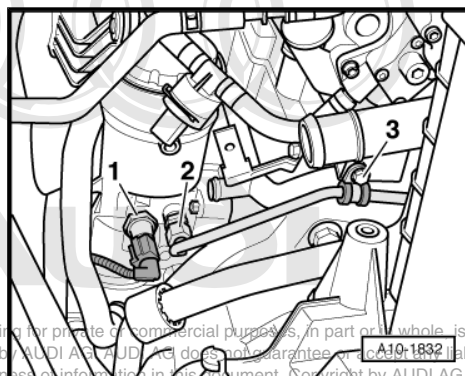
Note

Disregard -items 1, 5, 6-.

- Detach oil supply line -2- going to turbocharger at oil filter bracket.
- Remove bracket for oil supply line -3-.

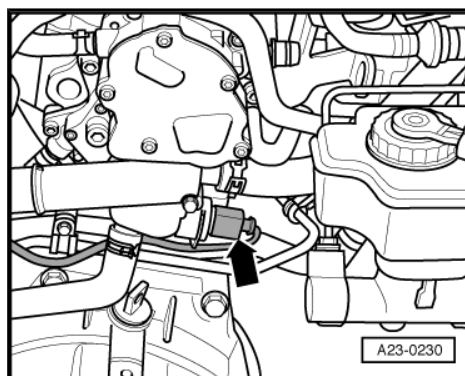

Note

Disregard -item 1-.

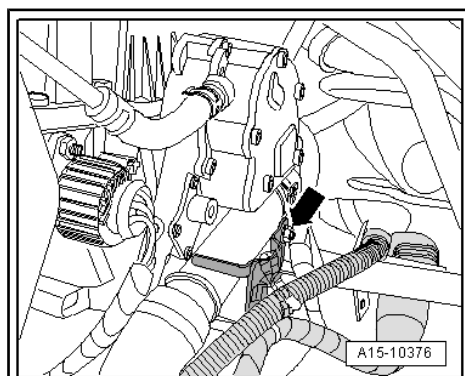


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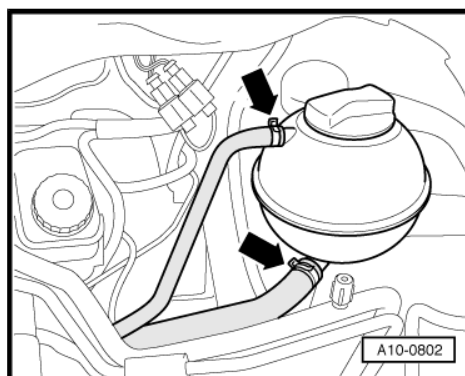
- Unplug electrical connector -arrow- at coolant temperature sender -G62- .



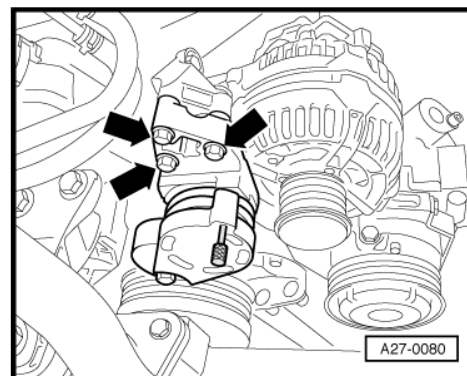
- Unbolt bracket for wiring harness from coolant connection -arrow-.
- Move electrical wiring harness clear.



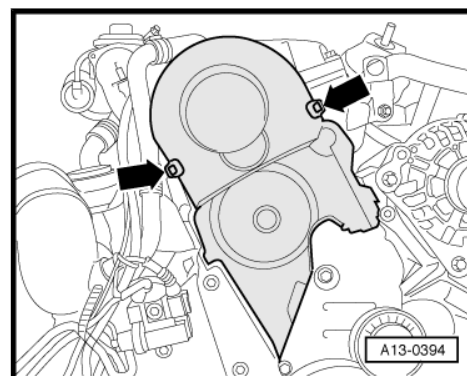
- Detach top coolant hose from coolant expansion tank -top arrow- and move clear.



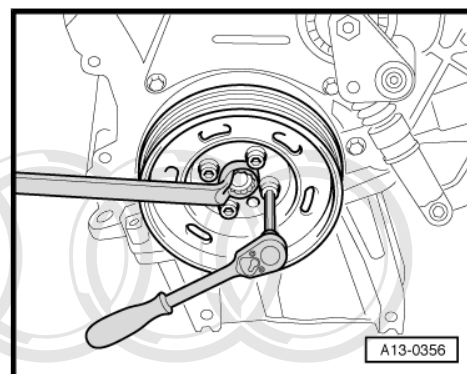
- Unscrew poly V-belt tensioner -arrows-.



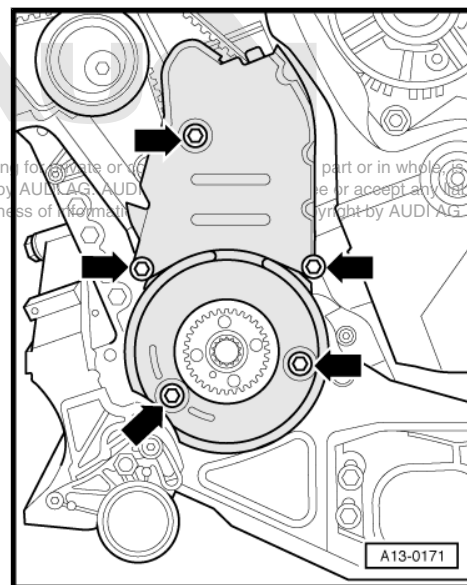
- Remove toothed belt cover (top section) -arrows-.



- Unbolt vibration damper; counterhold on centre bolt with ring spanner.



- Unbolt toothed belt cover (centre and bottom) -arrows-.

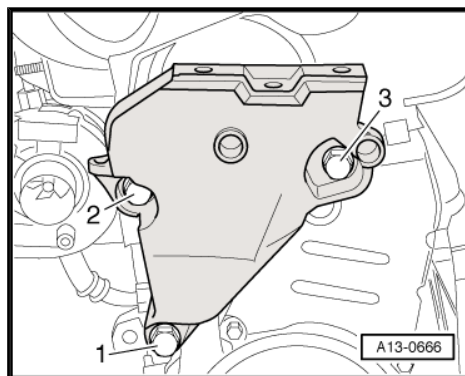


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- Remove bottom bolt -1- for engine support.

**Note**

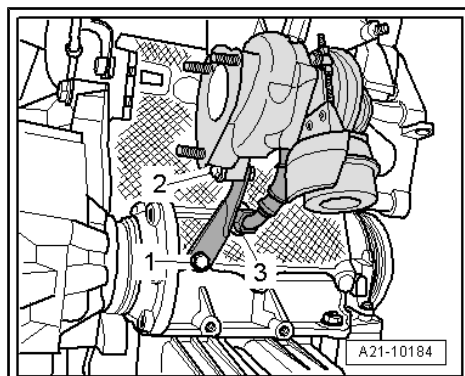
Bolts -2 and 3- do not have to be removed at this stage.

**Vehicles with engine code letters ATL, BHC:**

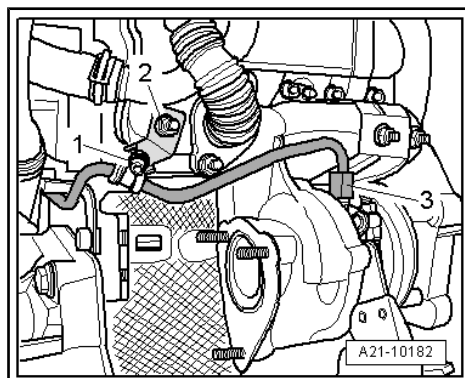
- Remove bolts -1 and 2- and detach support for turbocharger.

All vehicles:

- Remove oil return line -3- at cylinder block.



- Slacken bolt -1- approx. 3 turns.
- Remove nut -2-.
- Unbolt oil supply line -3- from turbocharger and move clear to one side.



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- Set up support bracket -10 - 222 A- with adapters -10 - 222 A / 13- and adapter -T40093/6- on wing panel flanges.



Caution

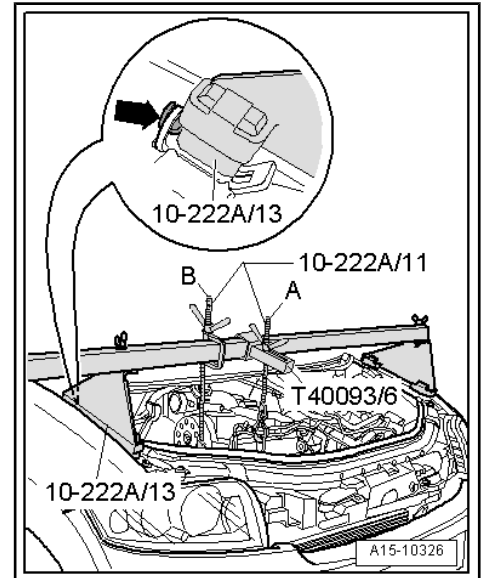
At the same time, engage adapter -10 - 222 A /13- in mountings for bonnet -arrow-.

- Remove clamping bolt in adapter -T40093/6- .
- Adapter -T40093/6- is fitted with its arm pointing upwards.
- Attach hook on spindle -10 - 222 A /11- -item A- to engine lifting eye.
- Take up weight of engine using spindle -item A- (but do not raise engine).



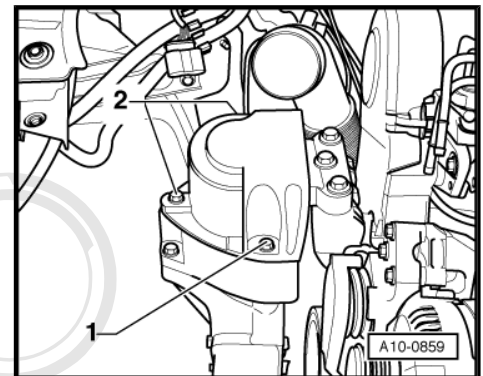
Note

The second spindle -item B- (right-side) is not used at this stage.

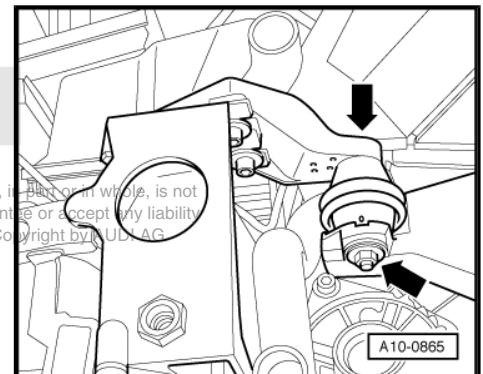


Vehicles with cover for engine mounting

- Remove cover for engine mounting by unscrewing bolts -1 and 2-.



- Remove bolts -1 and 3- and detach support arm with engine mounting -2-.



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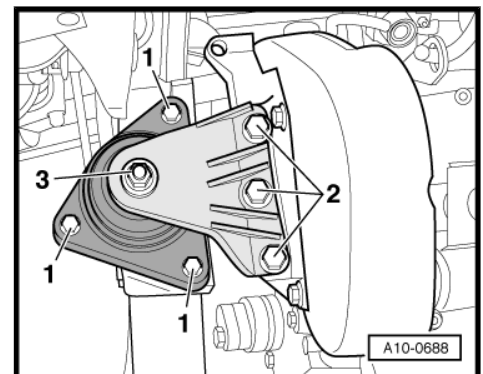
Vehicles without cover for engine mounting



Note

Do not loosen nut -3- unless renewing engine mounting.

- Remove bolts -1 and 2- and detach support arm with engine mounting.



All vehicles:

- Remove top bolts -2 and 3- and detach engine support.



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.

- Turn the crankshaft to "TDC".
- The space between the two lugs on sender wheel of camshaft must align with marking "3Z" on toothed belt cover (rear) -arrows-.
- Lock hub on camshaft with locking pin -3359- .
- Lock crankshaft sprocket with crankshaft stop -T10050-

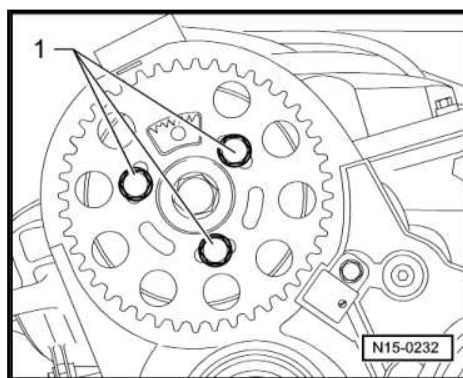
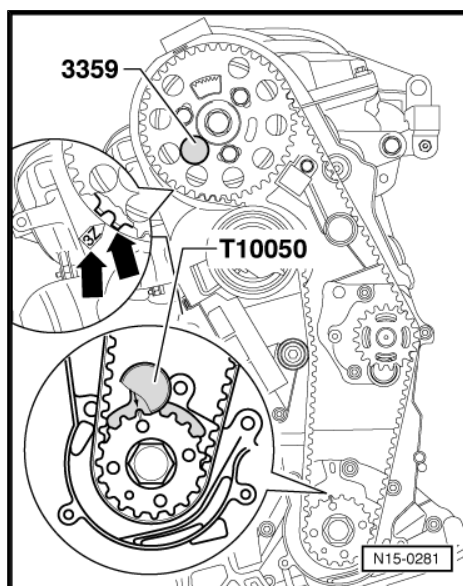
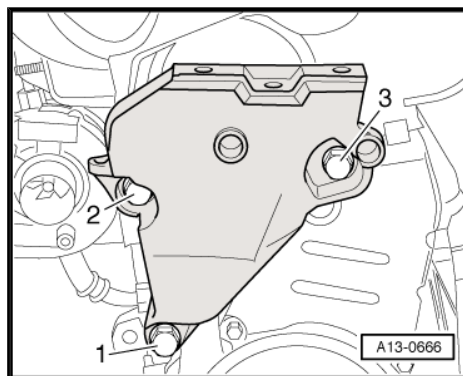
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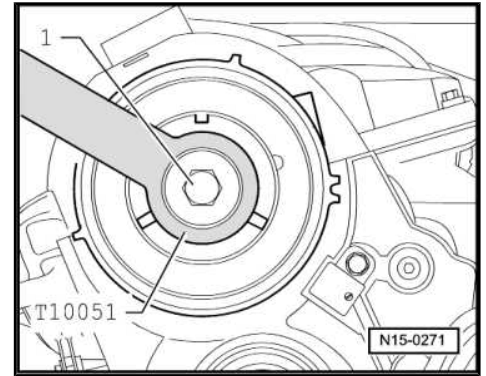
Note

The crankshaft stop can only be pushed onto the sprocket from the front face of the teeth.

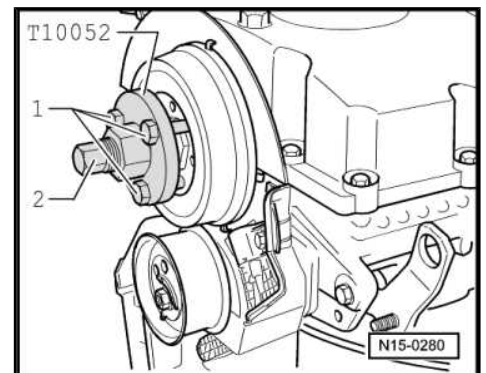
- The markings on the toothed belt sprocket and the crankshaft stop -T10050- must align. The pin of the crankshaft stop -T10050- must engage in the aperture in the sealing flange.
- Remove toothed belt: toothed belt drive with hydraulically damped tensioning roller ⇒ [page 102](#) , toothed belt drive with friction-damped tensioning roller ⇒ [page 116](#) .
- Unscrew bolts -1- and detach camshaft sprocket from hub.



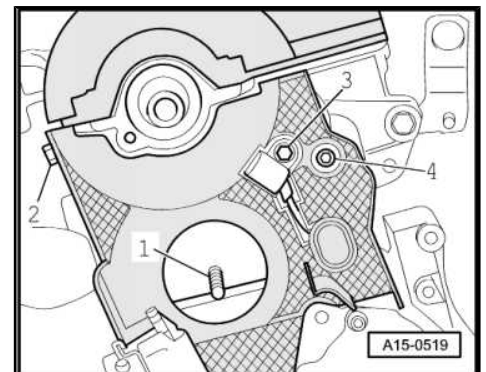
- Loosen bolt -1- for hub; use counterhold tool -T10051- .
- Then unscrew bolt approx. 2 turns.



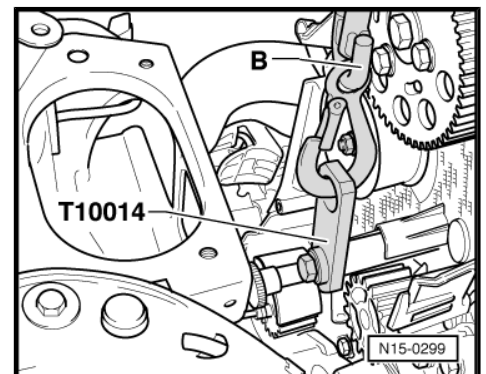
- Fit puller -T10052- on hub and fit bolts -1-.
- Remove hub from camshaft by screwing in bolt -2- while counterholding at hexagon flats (30 mm) of puller.
- Detach hub from taper of camshaft.



- Remove toothed belt tensioning roller.
- Remove bolts -2 ... 4-.
- Unscrew stud -1- using two M8 lock nuts.

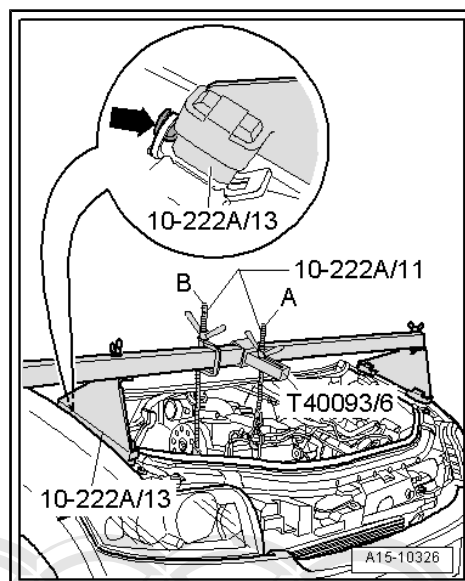


- Screw in bracket -T10014- into threaded hole above coolant pump.
- Attach free hook of spindle -10 - 222 A /11- -item B- to bracket -T10014- .



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- Lift engine via spindle -B- until spindle -A- has no more load.
- Unhook spindle -A- and move clear to one side.

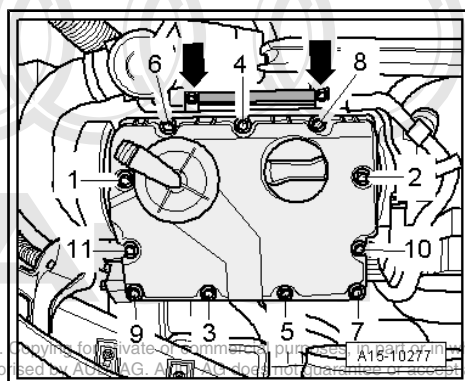


- Remove cylinder head cover bolts in the sequence -11 ... 1-.


Note

Disregard -arrows-.

- Detach bracket with fuel lines.
- Remove cylinder head cover.



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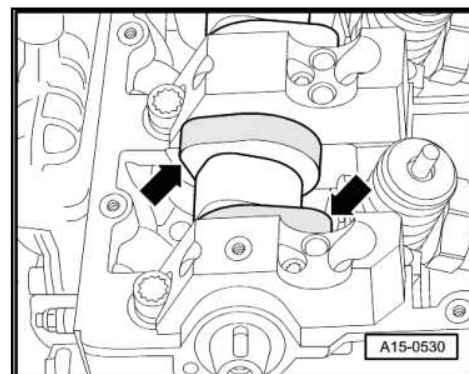
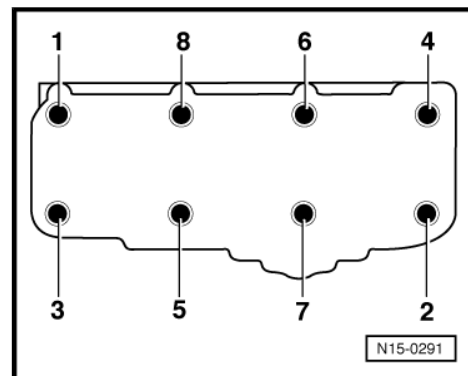
- Loosen cylinder head bolts in the sequence: -1 ... 8-.
- Carefully lift off the cylinder head with the assistance of a 2nd mechanic.
- Lay cylinder head aside on a clean surface with the combustion chamber side facing upwards.

Installing

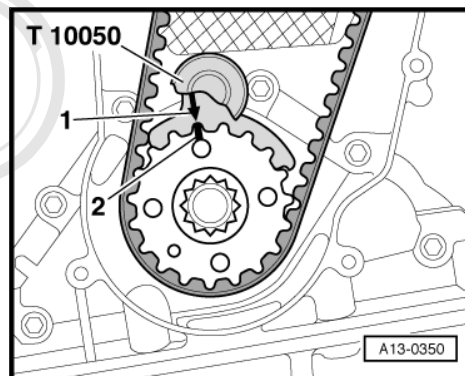


Note

- ◆ *Renew the cylinder head bolts.*
 - ◆ *Renew self-locking nuts and bolts.*
 - ◆ *Renew bolts which are tightened to a specified angle as well as oil seals and gaskets.*
 - ◆ *If repairing, carefully remove any remaining gasket material from the cylinder head and cylinder block. Ensure that no long scores or scratches are made on the surfaces.*
 - ◆ *Carefully remove any remaining emery and abrasive material.*
 - ◆ *No oil or coolant must be allowed to remain in the blind holes for the cylinder head bolts in the cylinder block.*
 - ◆ *Do not remove new cylinder head gasket from packaging until it is ready to be fitted.*
 - ◆ *Handle gasket very carefully. Damage to the silicone coating or the indented area will lead to leaks.*
 - ◆ *Cylinder heads with cracks between the valve seats may be used without reducing engine life, provided the cracks are small and not more than 0.5 mm wide.*
 - ◆ *The cylinder heads of diesel engines must not be machined.*
 - ◆ *When installing a replacement cylinder head with fitted camshaft, the contact surfaces between hydraulic tappets and cam running surfaces must be oiled after installing the cylinder head.*
 - ◆ *The plastic protectors fitted to protect the open valves should not be removed until the cylinder head is ready to be fitted.*
 - ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
 - ◆ *After fitting a new cylinder head or cylinder head gasket, change the coolant and engine oil.*
 - ◆ *After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.*
-
- Check whether the camshaft and the crankshaft are positioned at “TDC”:
 - The cams for cylinder 1 must point upwards evenly on camshaft -arrows-.



- The crankshaft sprocket must be locked with the crankshaft stop -T10050- .
- The markings on the toothed belt sprocket and the crankshaft stop -arrow- must align. The pin of the crankshaft stop must engage in the aperture in the sealing flange.



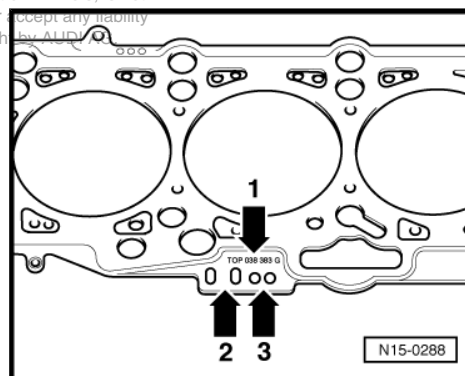
– Note identification markings on cylinder head gasket.

- 1 - Part No.
- 2 - Production code (can be disregarded)
- 3 - Holes



Note

- ◆ If the cylinder head gasket or cylinder head is renewed, be sure to install a gasket with the same identification.
- ◆ 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 69](#) .

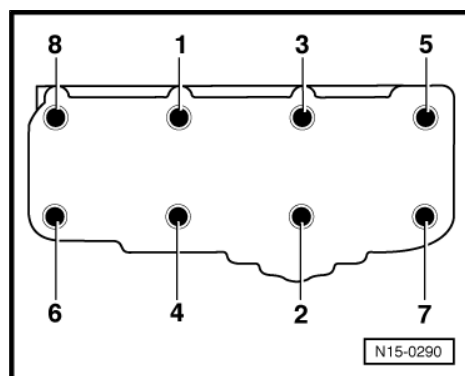


- Fit cylinder head gasket.
- Note position of centring sleeves in cylinder block.
- Check installation position of cylinder head gasket: the word "oben" (top) or the Part No. should face towards the cylinder head.
- Fit cylinder head.
- Check that all washers for cylinder head bolts are fitted in cylinder head.
- Insert new cylinder head bolts and tighten hand-tight.
- Tighten cylinder head bolts in 4 stages in the sequence indicated:
 1. Tighten with torque wrench to 40 Nm.
 2. Tighten with torque wrench to 60 Nm.
 3. Turn 90° (1/4 turn) further using a rigid wrench.
 4. Turn 90° (1/4 turn) further using a rigid wrench.

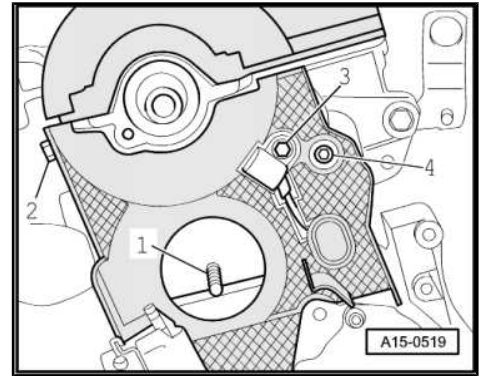


Note

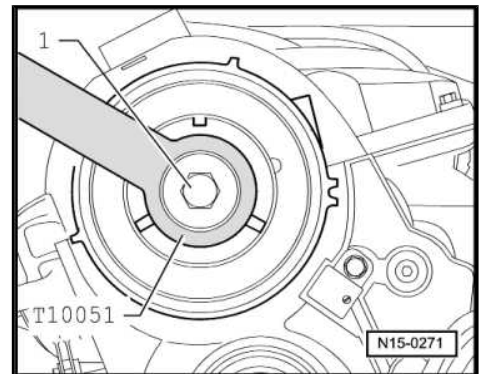
Cylinder head bolts do not have to be torqued down again later after repair work.



- Apply locking fluid to bolts -2 ... 4- and tighten; for locking fluid refer to ⇒ Parts catalogue .
- Tighten stud -1- using two M8 lock nuts.



- Attach hub to camshaft.
- Tighten securing bolt -1- (use counterhold -T10051-).

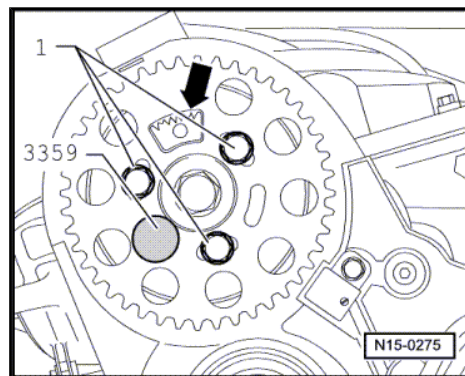


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- Push camshaft sprocket onto hub.
- Toothed segment -arrow- of camshaft sprocket must be at top.
- Screw in bolts -1- finger-tight.
- Lock hub on camshaft with locking pin -3359- .

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

- Install cylinder head cover ⇒ [page 74](#) .
- Install toothed belt (adjust valve timing): toothed belt drive with hydraulically damped tensioning roller ⇒ [page 109](#) , toothed belt drive with friction-damped tensioning roller ⇒ [page 123](#) .



Note

- ◆ *Follow all instructions for removing and installing toothed belt.*
- ◆ *Hose connections and hoses for charge air system must be free of oil and grease before assembly. Do NOT use lubricant.*
- Install vibration damper ⇒ [page 43](#) .
- Install poly V-belt ⇒ [page 42](#) .
- Install engine mounting with support arm ⇒ [page 33](#) or [page 37](#) .
- Install catalytic converter ⇒ [page 206](#) .
- Install air pipes/hoses with plug-in connectors ⇒ [page 202](#) .
- Electrical connections and routing ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- Observe notes on procedures required after connecting battery ⇒ Rep. gr. 27 .
- Install windscreen wiper arm ⇒ Rep. gr. 92 .
- Change engine oil ⇒ Maintenance ; Booklet 809 .
- Fill cooling system with fresh coolant ⇒ [page 163](#) .

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Tightening torques

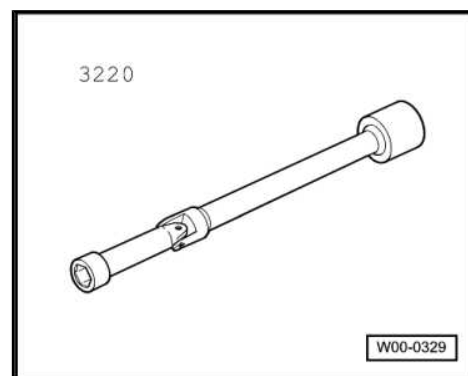
Component		Nm
Hall sender -G40- to cylinder head		10 ¹⁾
Rear toothed belt cover to cylinder head	M6	10 ¹⁾
	M8	20 ¹⁾
Stud to cylinder head		15
Hub to camshaft		100
Engine support to cylinder block		45
Oil supply line to:	Oil filter bracket	22
	Turbocharger	22
Oil return pipe to:	Turbocharger	15
	Cylinder block	30
Support for turbocharger to:	Turbocharger	20
	Cylinder block	25
Bracket for wiring harness to coolant hose/pipe connection		10
Bracket for oil supply line to coolant hose/pipe connection		10
Air pipe to:	Turbocharger	8
	Sump	8
Drive shaft heat shield to cylinder block		33
Engine cover panel to bracket		5.5
¹⁾ Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue .		

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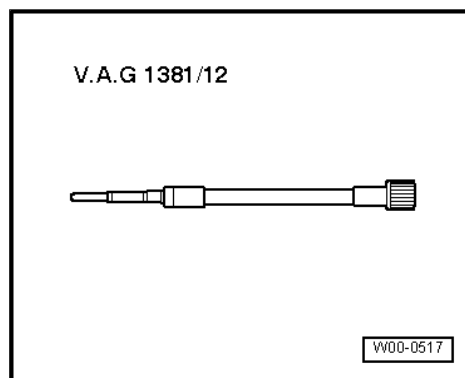
1.4 Checking compression

Special tools and workshop equipment required

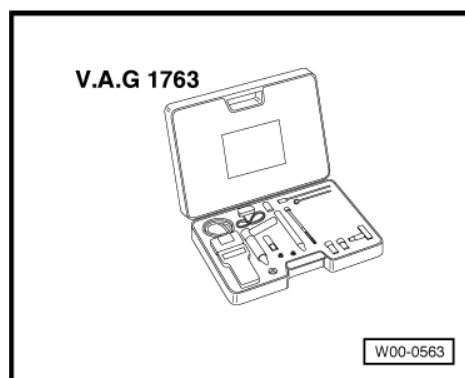
- ◆ U/J extension and socket, 10 mm -3220-



◆ Adapter -V.A.G 1381/12-

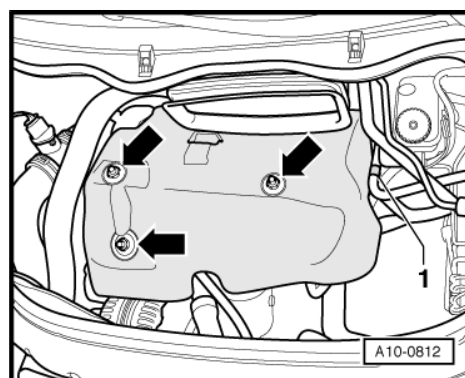


◆ Compression tester -V.A.G 1763-



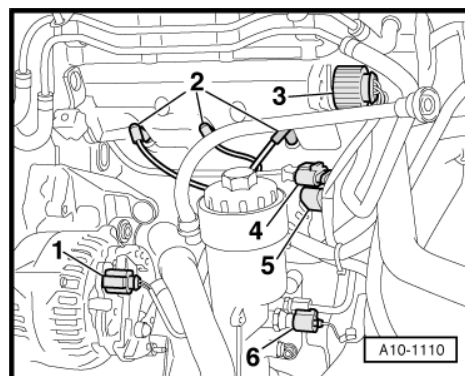
Procedure

- Engine oil temperature at least 30 °C
- Battery voltage at least 12.5 V.
- Remove bonnet [→ page 8](#). Protected by copyright. Copying for private or commercial purposes, in part or in whole, is not permitted without the written permission of 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.
- If fitted, unclip bracket -1-.
- Take off engine cover panel -arrows-.
- Remove noise insulation underneath (detach crankcase breather hose).
- Unplug electrical connectors -2- on glow plugs.
- Pull retaining tab and loosen knurled nut -3- at main connector for unit injectors.



***i** Note*

Ignore other -items-.



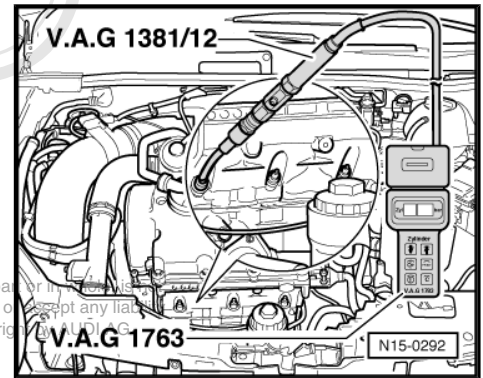
- Unscrew all glow plugs using jointed spanner -3220- .
- Screw in adapter -V.A.G 1381/12- in place of the glow plug in each cylinder.
- Test the compression pressure with the compression tester - V.A.G 1763- .

i Note

Using the compression tester -> Operating instructions

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- Have a 2nd mechanic operate starter until tester shows no further pressure increase.



Compression pressure	bar
When new	25.0 ... 31.0
Wear limit	19.0
Difference between cylinders	5.0 (maximum)

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

- Install glow plugs ⇒ Rep. gr. 28 .
- Interrogate and erase the fault memory for engine control unit, as faults are stored when the electrical connectors are unplugged ⇒ Vehicle diagnostic tester.

Tightening torque

Component	Nm
Engine cover panel to bracket	5.5

2 Toothed belt drive with hydraulically damped tensioning roller

2.1 Toothed belt drive - exploded view

1 - Toothed belt cover (top)

2 - Toothed belt

- ☐ Check for wear
- ☐ Before removing, mark direction of rotation with chalk or felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage
- ☐ Removing ⇒ [page 102](#)
- ☐ Installing (adjusting valve timing) ⇒ [page 109](#)

3 - Nut

- ☐ 20 Nm + 45° (1/8 turn further)

4 - Tensioning roller

5 - Bolt

- ☐ 100 Nm

6 - Bolt

- ☐ 25 Nm

7 - Camshaft sprocket

8 - Hub

- ☐ With sender wheel
- ☐ Use counterhold tool - T10051- when loosening and tightening
- ☐ To remove, use puller - T10052-
- ☐ Removing and installing ⇒ ["4.4 Removing and installing camshaft", page 132](#)

9 - Bolt

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

10 - Toothed belt cover (rear)

11 - Sealing grommet

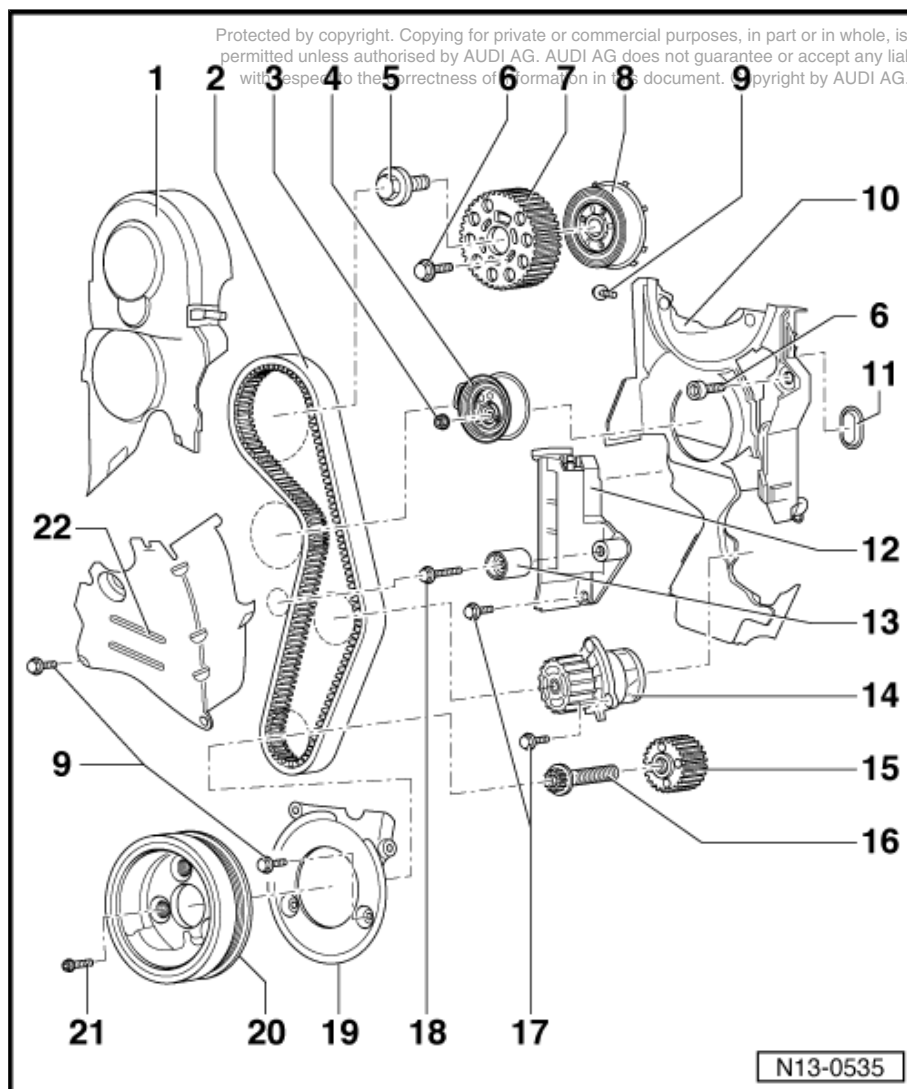
- ☐ Renew if damaged

12 - Tensioner for toothed belt

13 - Idler roller

14 - Coolant pump

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



15 - Crankshaft sprocket

16 - Bolt

- ☐ Renew
- ☐ 120 Nm + 90° (1/4 turn further)
- ☐ Use counterhold tool -3415- when loosening and tightening
- ☐ Do not additionally oil or grease the threads and shoulder

17 - Bolt

- ☐ 15 Nm

18 - Bolt

- ☐ 20 Nm

19 - Toothed belt cover (bottom)

20 - Vibration damper

- ☐ Installation position: hole in vibration damper must be positioned over raised section of toothed belt sprocket

21 - Bolt

- ☐ 10 Nm + 90° (1/4 turn further)

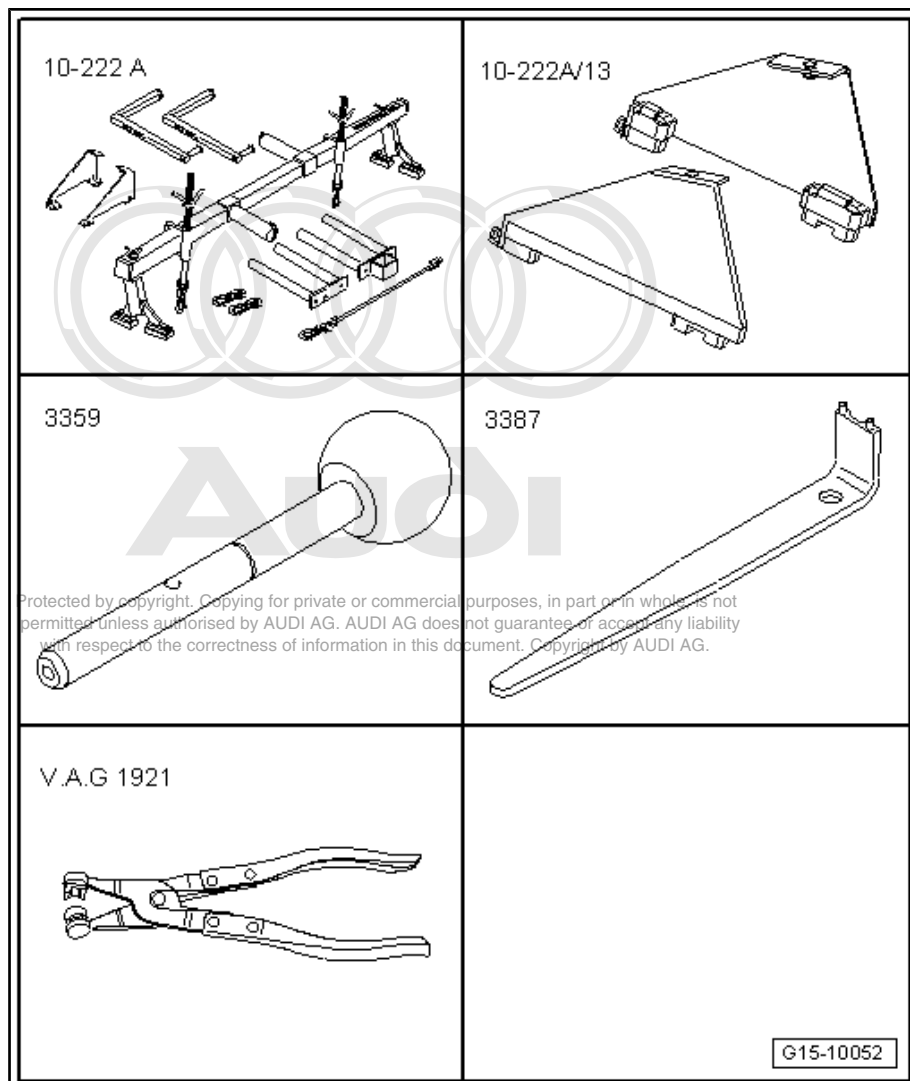
22 - Toothed belt cover (centre)

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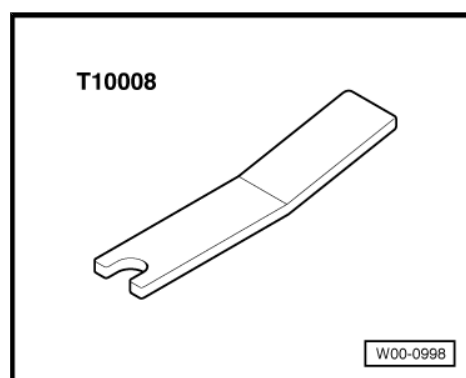
2.2 Removing and installing toothed belt

Special tools and workshop equipment required

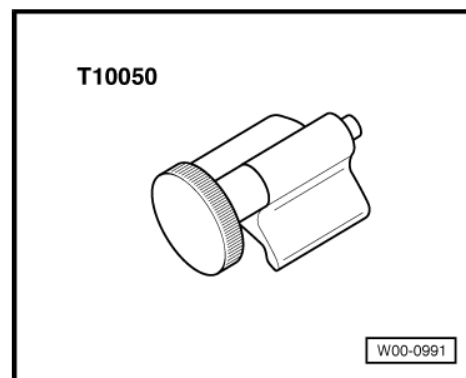
- ◆ Support bracket -10 - 222 A-
- ◆ Adapters -10 - 222 A /13-
- ◆ Diesel injection pump locking pin -3359-
- ◆ Pin wrench -3387-
- ◆ Hose clip pliers - V.A.G 1921-



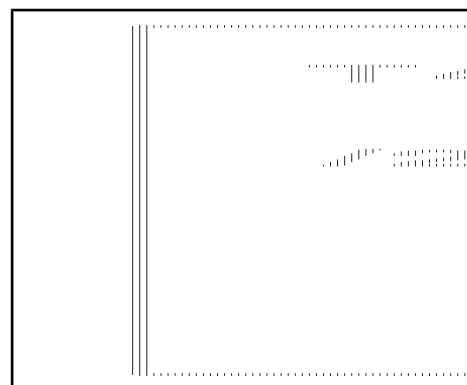
- ◆ Locking plate -T10008-



◆ Crankshaft stop -T10050-



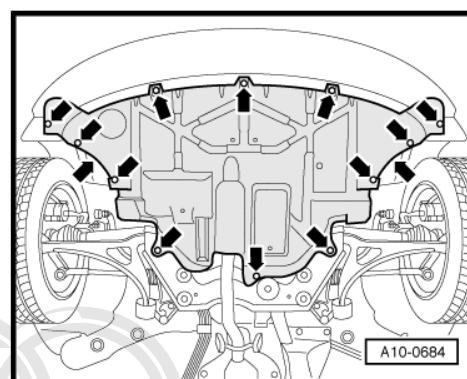
◆ Adapter -T40093/6- from engine support bracket (supplementary set) -T40093-



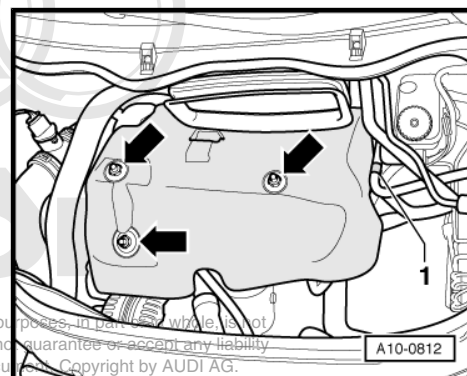
◆ Drill bit, Ø 4.0 mm

Removing

- Remove front right wheel.
- Remove noise insulation -arrows-.
- Remove poly V-belt ⇒ [page 42](#) .



- Remove bonnet ⇒ [page 8](#) .
- If fitted, unclip bracket -1-.
- Take off engine cover panel -arrows-.
- Remove noise insulation beneath cover.

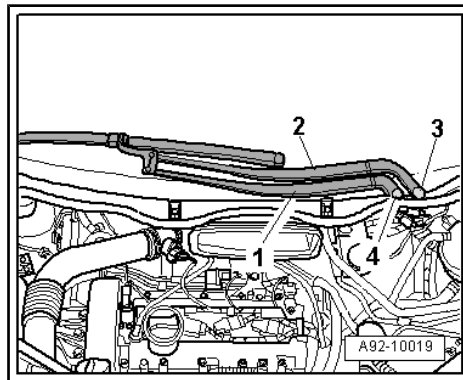


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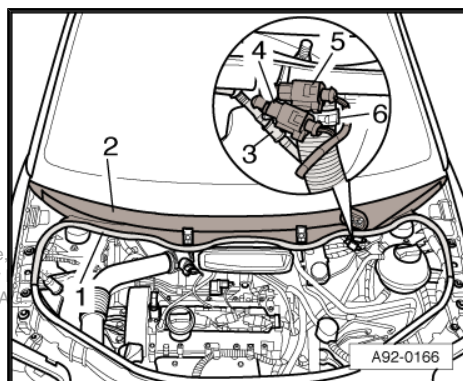
- Lever off caps -3 and 4- on two-piece windscreen wiper arm with a screwdriver.
- Slacken nuts on two-piece windscreen wiper arm a few turns.
- Release arms -1 and 2- one after the other by tilting them slightly on the wiper shafts.
- Remove nuts completely and take off two-piece windscreen wiper arm.


Note

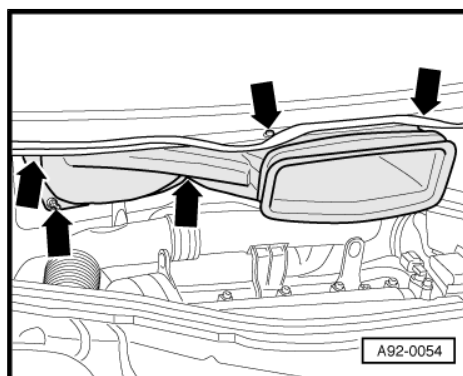
Use puller (commercially available) to remove wiper arm if necessary.



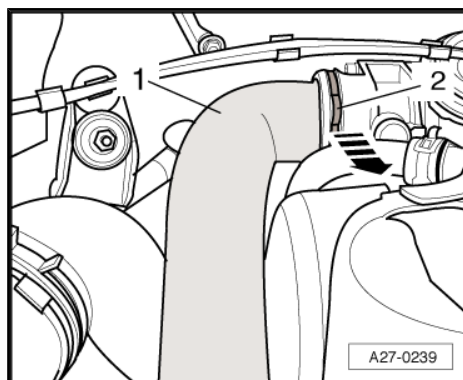
- Disconnect washer fluid hose -3-.
- If fitted, unplug electrical connectors -4 and 5- for heated washer jets.
- Open hose clip -6- using hose clip pliers -V.A.G 1921- and detach water drain hose from cowl panel grille.
- Pull off rubber seal -1- on cowl panel grille.
- Disconnect cowl panel grille -2-.
- Move washer fluid hose clear.



- Unscrew nuts and bolts -arrows-.
- Pull fresh air duct forwards and remove by turning it to right side of vehicle.

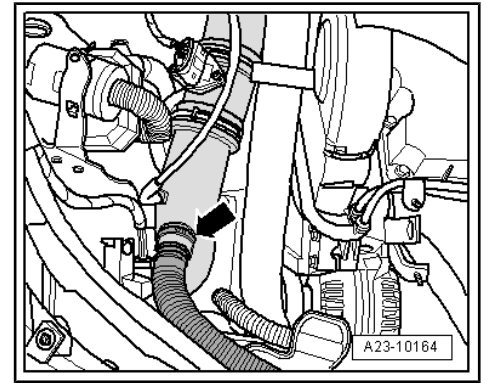


- Detach air hose -1- from intake manifold; to do this, release retaining clip -2- -arrow-, if fitted.



Vehicles with engine code letters AMF, BHC:

- Detach resonator from air pipe -arrow-.



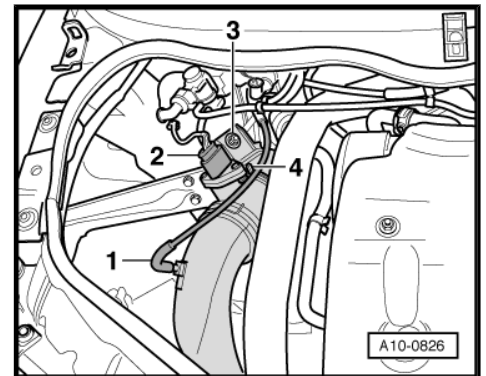
All vehicles:

- Unplug electrical connector -2- at air mass meter -G70- .
- Detach vacuum hose -1-.
- Release hose clip -4- and remove air pipe with air mass meter -G70- .

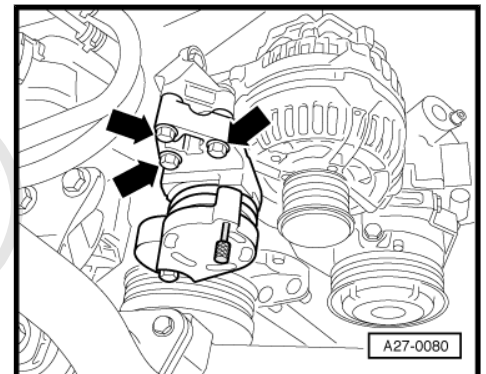


Note

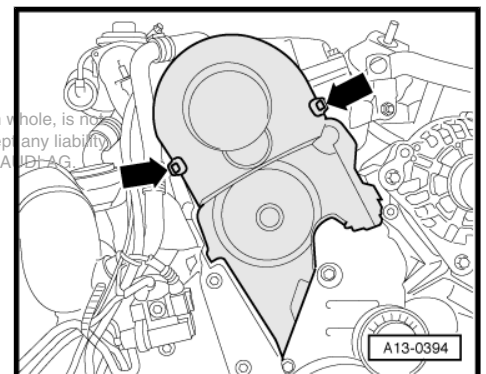
Disregard -item 3-.



- Unscrew poly V-belt tensioner -arrows-.

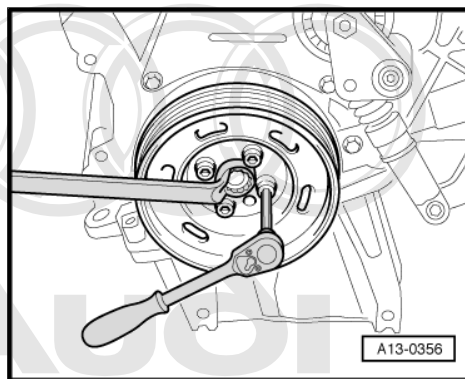


- Remove toothed belt cover (top section) -arrows-.



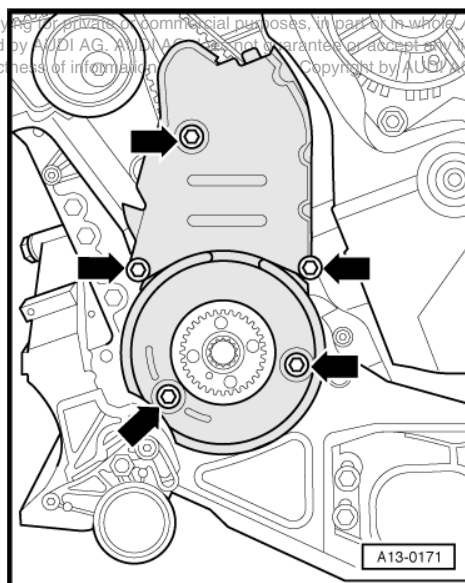
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- Unbolt vibration damper; counterhold on centre bolt with ring spanner.



- Unbolt toothed belt cover (centre and bottom) -arrows-

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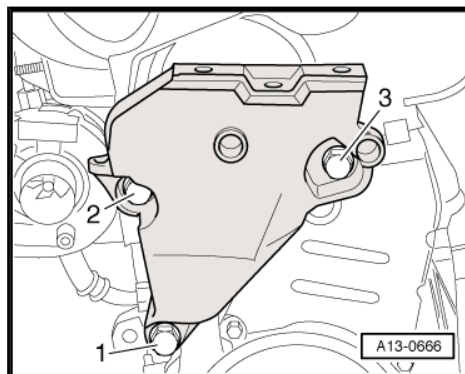


- Remove bottom bolt -1- for engine support.



Note

Bolts -2 and 3- do not have to be removed at this stage.

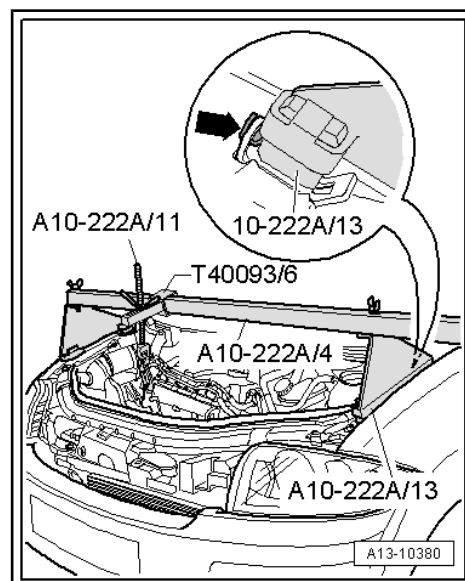


- Set up support bracket -10 - 222 A- with adapters -10 - 222 A / 13- and adapter -T40093/6- on wing panel flanges.

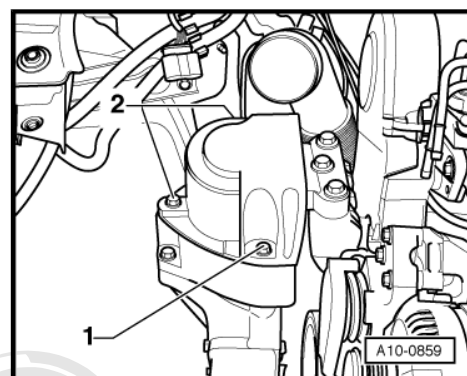
**Caution**

At the same time, engage adapter -10 - 222 A /13- in mountings for bonnet -arrow-.

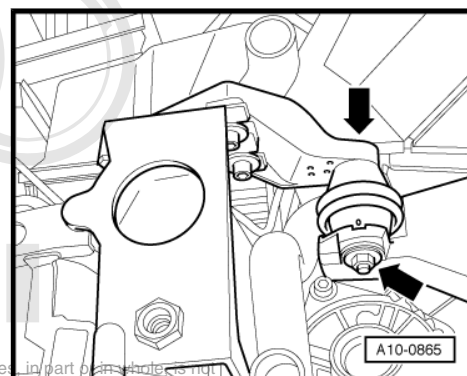
- Remove clamping bolt in adapter -T40093/6- .
- Adapter -T40093/6- is fitted with its arm pointing upwards.
- Attach hook on spindle -10 - 222 A /11- to engine lifting eye.
- Take up weight of engine using spindle (but do not raise engine).

**Vehicles with cover for engine mounting**

- Remove cover for engine mounting by unscrewing bolts -1 and 2-.

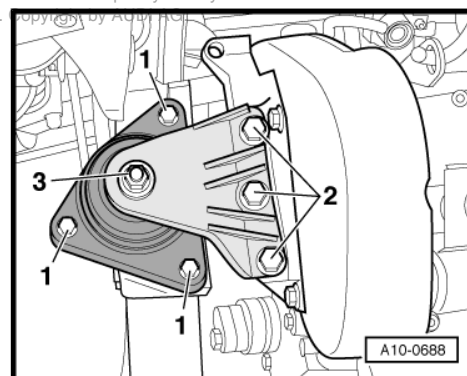


- Remove bolts -1 and 3- and detach support arm with engine mounting -2-.

**Vehicles without cover for engine mounting****Note**

Do not loosen nut -3- unless renewing engine mounting.

- Remove bolts -1 and 2- and detach support arm with engine mounting.



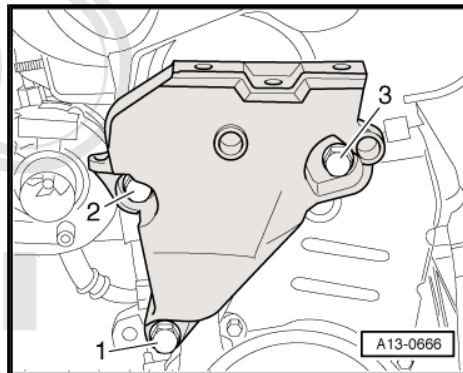
All vehicles:

- Remove top bolts -2 and 3- and detach engine support.



Note

Disregard -item 1-.



Caution

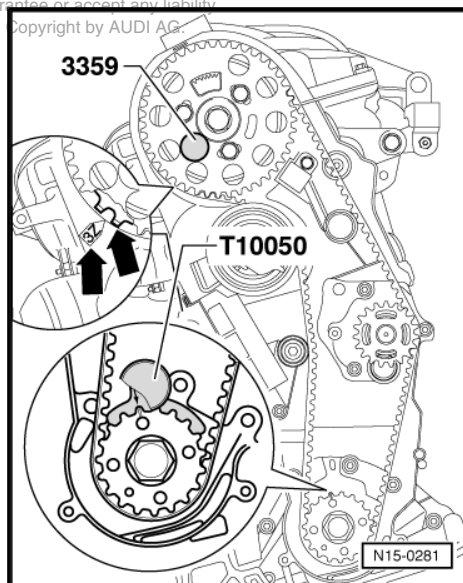
The engine must only be turned at the crankshaft, in the direction of normal engine rotation (clockwise).



Note

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

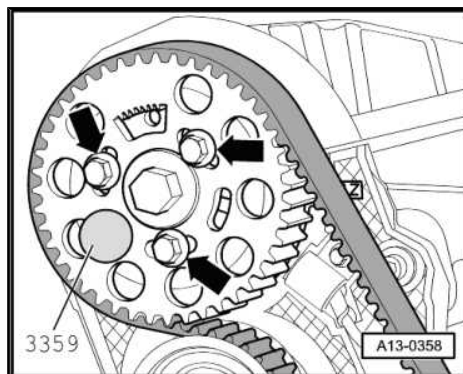
- Turn the crankshaft to “TDC”.
- The space between the two lugs on sender wheel of camshaft must align with marking “3Z” on toothed belt cover (rear) -arrows-.
- Lock hub on camshaft with locking pin -3359- .
- Lock crankshaft sprocket with crankshaft stop -T10050- .



Note

The crankshaft stop can only be pushed onto the sprocket from the front face of the teeth.

- The markings on the toothed belt sprocket and the crankshaft stop -T10050- must align. The pin of the crankshaft stop -T10050- must engage in the aperture in the sealing flange.
- Mark direction of rotation of toothed belt with chalk or felt-tip pen.
- Loosen securing bolts for camshaft sprocket -arrows-.



- Insert a hexagon key into the hexagon socket as far as the stop and use it to push the tensioning roller anti-clockwise -arrow- until you can lock the toothed belt tensioner with locking plate -T10008- .

**Note**

- ◆ *Insert the hexagon key as far as stop, to prevent damage.*
- ◆ *The toothed belt tensioner is oil-damped and can therefore only be compressed slowly by applying constant pressure.*

- Loosen securing nut for tensioning roller.
- Unscrew bolts -arrows- and detach toothed belt tensioner.
- Remove toothed belt.

Installing (adjusting valve timing)

- Camshaft locked with locking pin -3359- .
- Crankshaft locked in position with crankshaft stop -T10050- .
- Tensioning roller locked with locking plate -T10008- .

**Note**

- ◆ *Toothed belt adjustment must always be performed when the engine is cold.*

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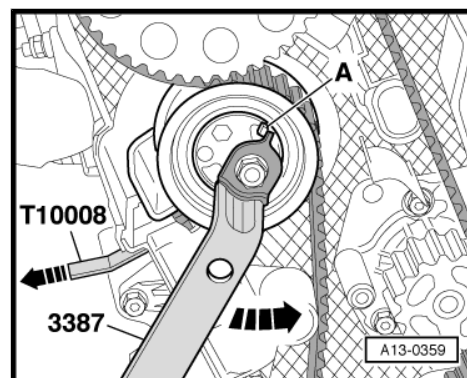
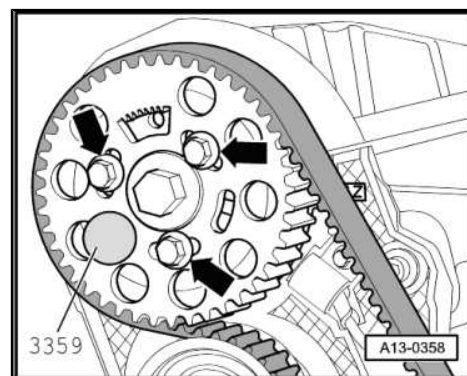
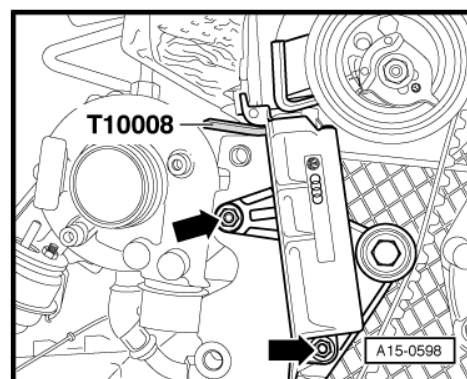
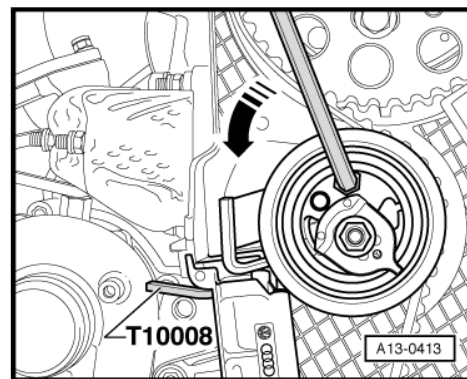
- ◆ *The crankshaft must not be at "TDC" at any cylinder when the camshaft is turned. Otherwise, there is a risk of damage to valves and piston crowns.*

- Screw in bolts -arrows-, but do not tighten.
- The camshaft sprocket must just about still turn, and must not tilt.
- Turn the camshaft sprocket in its elongated hole clockwise until the stop.
- Fit toothed belt first onto camshaft sprocket, tensioning roller, crankshaft sprocket and then onto coolant pump sprocket.

- Install toothed belt tensioner.

Adjust toothed belt tension as follows:

- Turn eccentric adjuster anti-clockwise -arrow- onto stop -A- using 2-hole pin wrench -3387- .
- Remove locking plate -T10008- .



- Wrap insulating tape around tip and shaft of 4.0 mm Ø drill bit to avoid cuts.
- Gradually relieve pressure on the tensioner and allow it to turn clockwise -arrow- until you can pull the shaft of a Ø 4.0 mm drill bit -item 2- through between the tensioning lever and the housing of the tensioner.
- Dimension -a- = 4.0 ± 1.0 mm.



Note

- ♦ Leave sufficient tolerance when adjusting, dimension -a- is reduced when tightening tensioning roller nut.
- ♦ Dimension -a- is reduced when the engine is at operating temperature.
- Hold tensioning roller in this position and tighten securing nut to 20 Nm + 45° (1/8 turn).
- First tighten bolts -arrows- for camshaft sprocket to 25 Nm.
- Remove locking pin -3359- and crankshaft stop -T10050- .



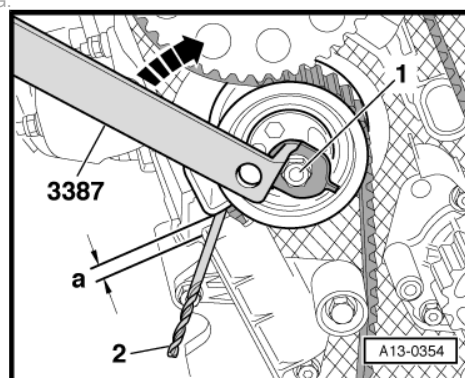
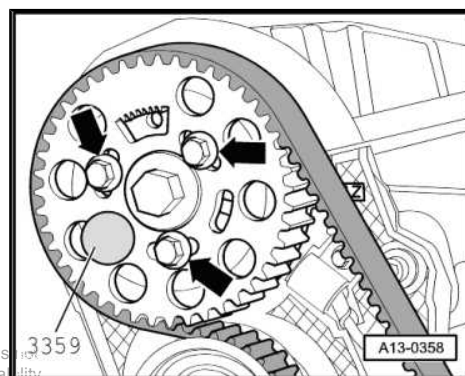
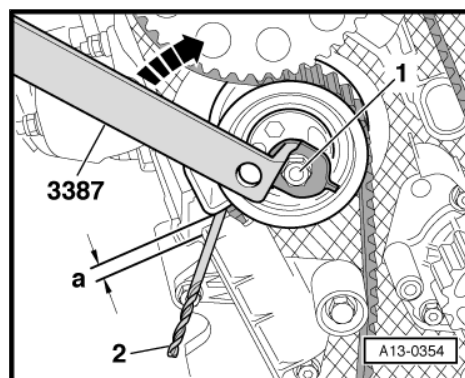
Caution

The engine must only be turned at the crankshaft, in the direction of normal engine rotation (clockwise).

- Turn crankshaft two rotations in normal direction of rotation until it is again positioned just before “TDC”
- Check again that dimension -a- is obtained between tensioning lever and housing of tensioner.
- Dimension -a- = 4.0 ± 1.0 mm.

If dimension -a- is not obtained, re-tension the tensioning roller as follows:

- Hold tensioning roller with 2-hole pin wrench -3387-, slacken nut -1- and relieve pressure on tensioner -arrow- until dimension -a- is obtained.
- Dimension -a- = 4.0 ± 1.0 mm.
- Hold tensioning roller in this position and tighten securing nut to 20 Nm + 45° (1/8 turn).

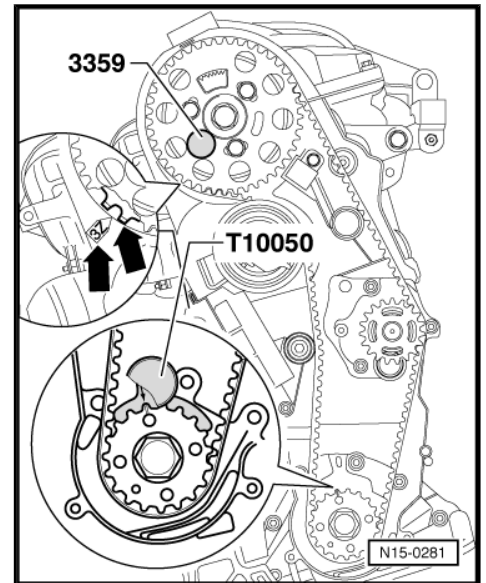


Checking valve timing:

- Lock crankshaft sprocket with crankshaft stop -T10050- once again to check the setting.
- The markings on the toothed belt sprocket and the crankshaft stop -T10050- must align. The pin of the crankshaft stop -T10050- must engage in the aperture in the sealing flange.
- The pin on the crankshaft stop -T10050- must engage in the bore in the sealing flange as the crankshaft is turned.

**Note**

- ◆ *If the crankshaft has been rotated beyond "TDC", turn it back $\frac{1}{4}$ turn so you can then reset it to "TDC" by turning in the direction of engine rotation.*
- ◆ *Do not insert the crankshaft stop -T10050- while turning the crankshaft against the normal direction of rotation.*
- Check whether it is possible to lock the camshaft hub using locking pin -3359- .



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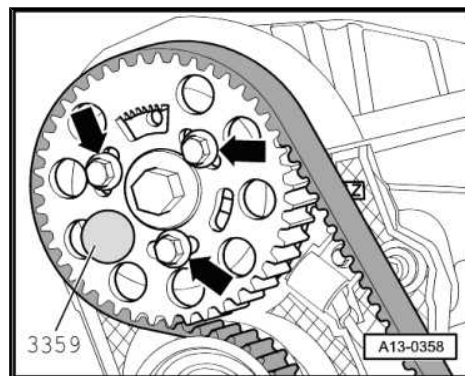
If the hub cannot be locked:

- Loosen securing bolts for camshaft sprocket -arrows-.
- Position a ring spanner at the camshaft centre bolt.
- Turn hub until locking pin -3359- can be inserted.
- Finally tighten bolts -arrows- for camshaft sprocket to 20 Nm + 45 (1/8 turn).
- Remove locking pin and crankshaft stop.



Caution

The engine must only be turned at the crankshaft, in the direction of normal engine rotation (clockwise).



- Turn crankshaft two rotations in normal direction of rotation until it is again positioned just before "TDC".
- Check valve timing once again ⇒ [page 111](#) .

Assembling:

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. Do NOT use lubricant.

- Install engine support.
- Install toothed belt cover (bottom and centre).
- Install vibration damper ⇒ [page 43](#) .
- Install support arm with engine mounting ⇒ [page 33](#) .
- Fit toothed belt cover (top section).
- Install air pipes/hoses with plug-in connectors ⇒ [page 202](#) .
- Install poly V-belt ⇒ [page 42](#) .
- Install windscreen wiper arm ⇒ Rep. gr. 92 .



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Tightening torques

Component	Nm
Toothed belt tensioner to cylinder block	15
Camshaft sprocket to hub	25
Tensioning roller for toothed belt to cylinder head	20 + 45° ¹⁾
Toothed belt cover (bottom) to cylinder block	10 ²⁾
Toothed belt cover (centre) to cylinder block	10 ²⁾
Engine support to cylinder block	45
Tensioner for poly V-belt to bracket for ancillaries	22
Engine cover panel to bracket	22
¹⁾ 45° = one eighth turn. ²⁾ Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue .	

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3 Toothed belt drive with friction-damped tensioning roller

3.1 Toothed belt drive - exploded view

1 - Bolt

- ☐ Renew
- ☐ 10 Nm + 90° (1/4 turn further)

2 - Vibration damper

- ☐ With pulley for poly V-belt
- ☐ Can only be installed in one position

3 - Toothed belt cover (bottom)

4 - Bolt

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

5 - Toothed belt cover (centre)

6 - Toothed belt cover (top)

- ☐ Engage carefully in centre toothed belt cover when installing

7 - Toothed belt

- ☐ Check for wear
- ☐ Before removing, mark direction of rotation with chalk or felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage
- ☐ Removing ⇒ [page 116](#)
- ☐ Installing (adjusting valve timing) ⇒ [page 123](#)

8 - Nut

- ☐ 20 Nm + 45° (1/8 turn further)

9 - Tensioning roller

10 - Bolt

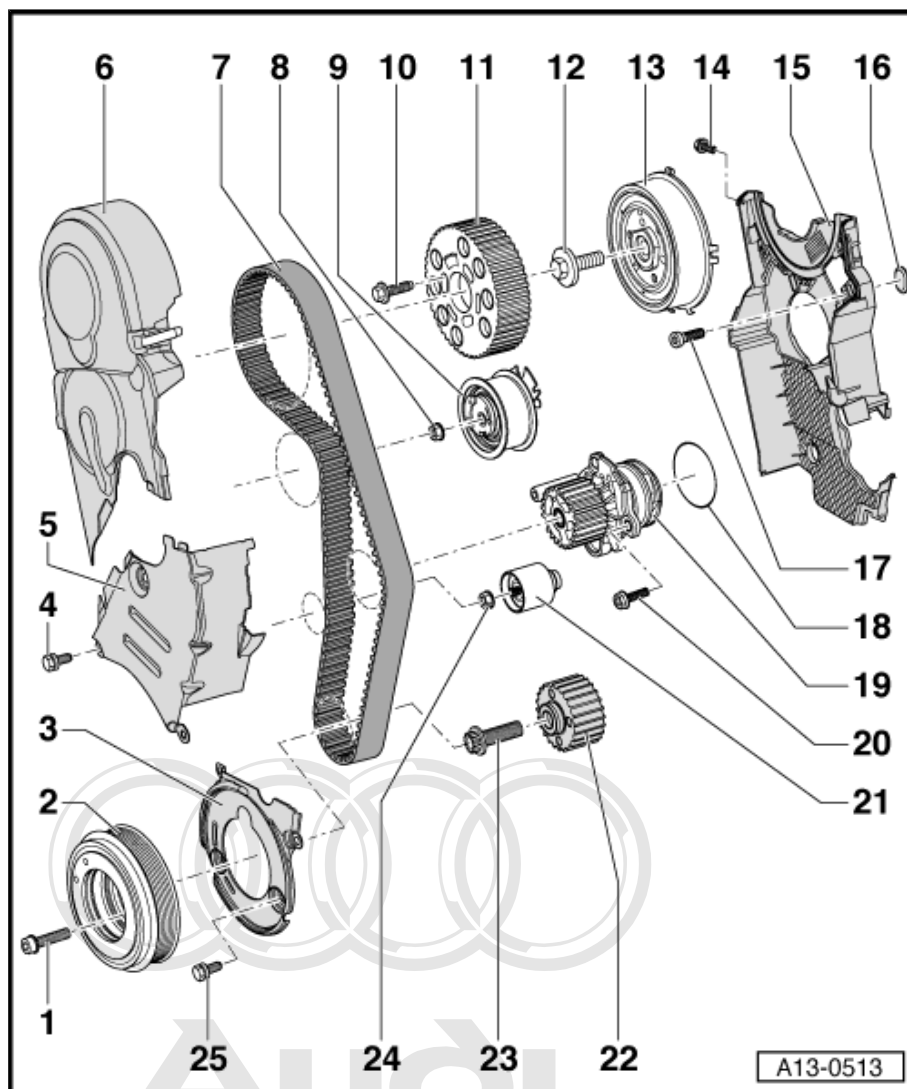
- ☐ 25 Nm

11 - Camshaft sprocket

- ☐ Mark installation position

12 - Bolt

- ☐ Use counterhold tool -T10051- when loosening and tightening ⇒ ["3.2 Removing and installing toothed belt", page 116](#)
- ☐ 100 Nm



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13 - Hub

- ☐ With sender wheel for Hall sender -G40-
- ☐ To remove, use puller -T10052- ⇒ [“3.2 Removing and installing toothed belt”, page 116](#)

14 - Bolt

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

15 - Toothed belt cover (rear)

- ☐ To remove, take out coolant pump
- ☐ When installing, engage carefully in sealing flange at pulley end.

16 - Rubber grommet

- ☐ Renew if damaged

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17 - Bolt

- ☐ 25 Nm

18 - O-ring

- ☐ Renew

19 - Coolant pump

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

20 - Bolt

- ☐ 15 Nm

21 - Idler roller**22 - Crankshaft sprocket**

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

23 - Bolt

- ☐ Renew
- ☐ Do not lubricate with oil
- ☐ Use counterhold tool -3415- when loosening and tightening
⇒ [“3.2 Removing and installing toothed belt”, page 116](#)
- ☐ 120 Nm + 90° (1/4 turn further)

24 - Nut

- ☐ 20 Nm

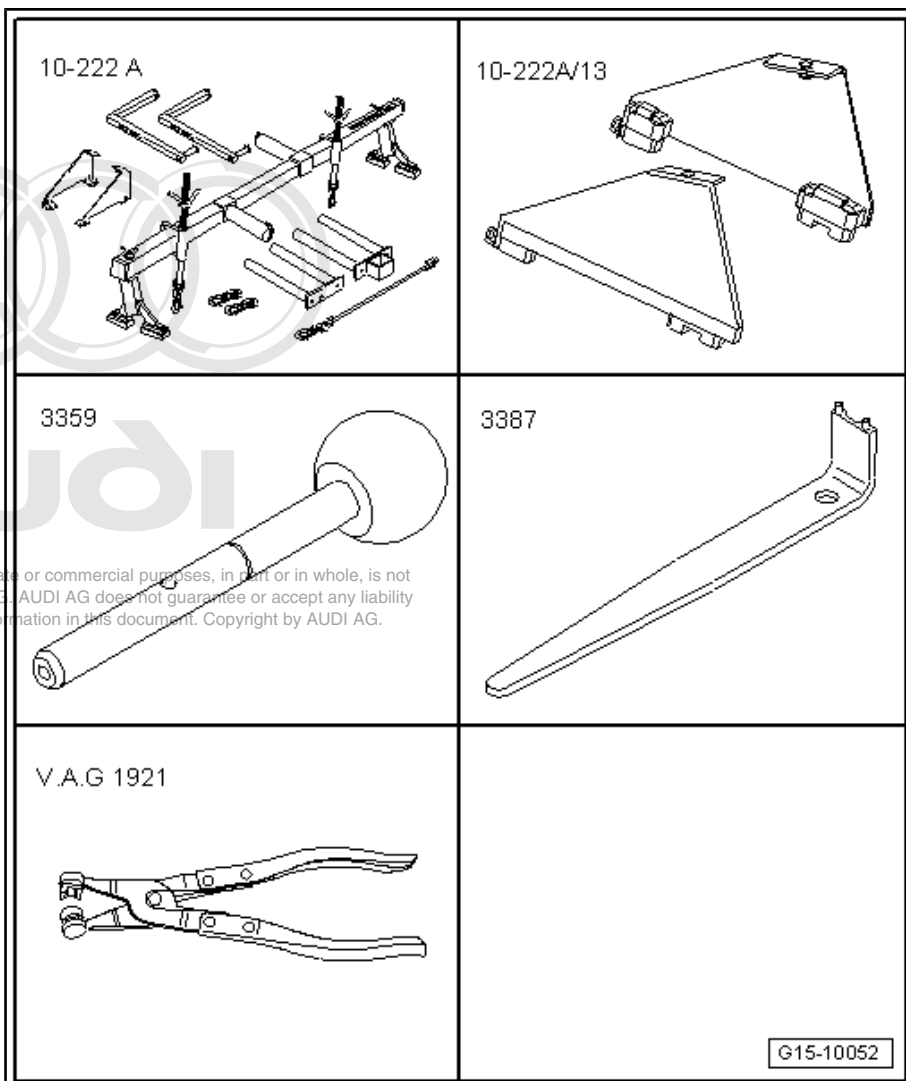
25 - Bolt

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

3.2 Removing and installing toothed belt

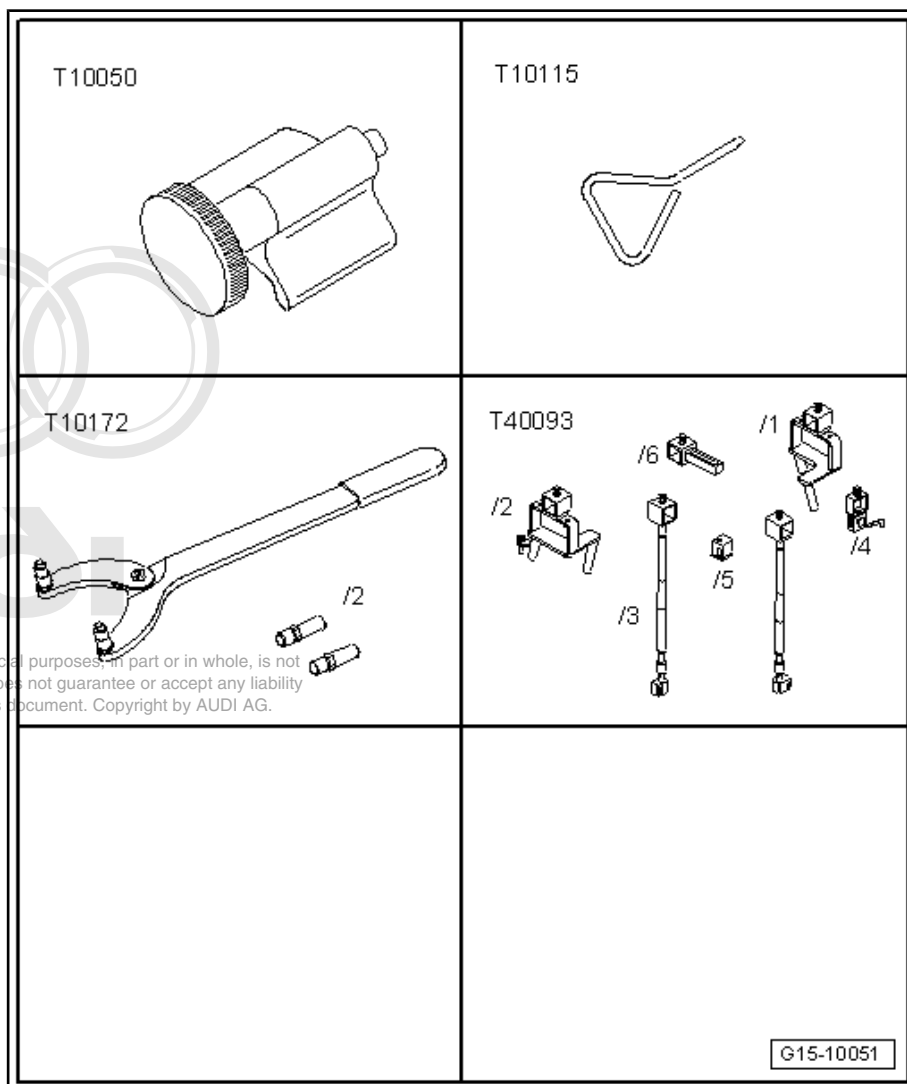
Special tools and workshop equipment required

- ◆ Support bracket -10 - 222 A-
- ◆ Adapters -10 - 222 A /13-
- ◆ Diesel injection pump locking pin -3359-
- ◆ Pin wrench -3387-
- ◆ Hose clip pliers - V.A.G 1921-



G15-10052

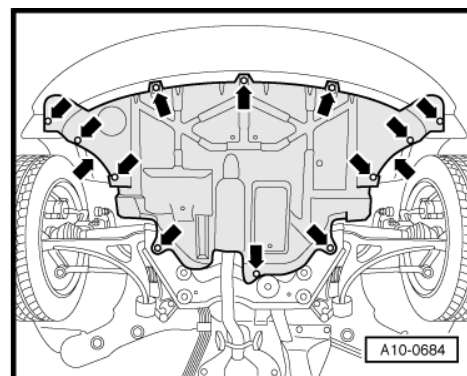
- ◆ Crankshaft stop -T10050-
- ◆ Locking pin -T10115-
- ◆ Counterhold tool -T10172-
with pins -T10172/4-
- ◆ Adapter -T40093/6- from
engine support bracket
(supplementary set) -
T40093-
- ◆ Locking fluid ⇒ Parts cata-
logue



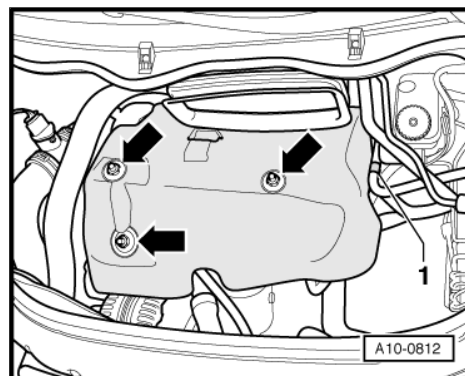
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Removing

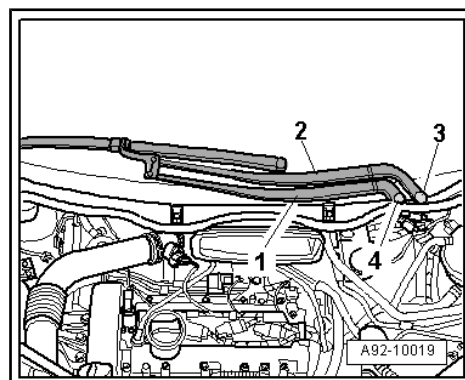
- Remove front right wheel.
- Remove noise insulation -arrows-.
- Remove poly V-belt ⇒ [page 42](#) .



- Remove bonnet ⇒ [page 8](#) .
- If fitted, unclip bracket -1-.
- Take off engine cover panel -arrows-.
- Remove noise insulation beneath cover.



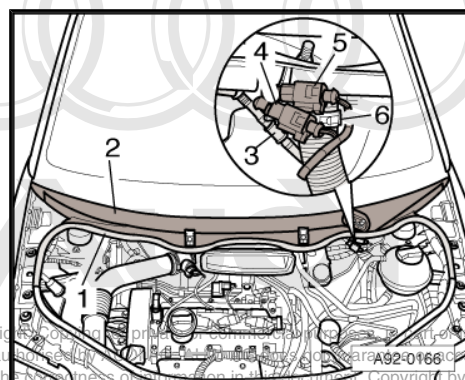
- Lever off caps -3 and 4- on two-piece windscreen wiper arm with a screwdriver.
- Slacken nuts on two-piece windscreen wiper arm a few turns.
- Release arms -1 and 2- one after the other by tilting them slightly on the wiper shafts.
- Remove nuts completely and take off two-piece windscreen wiper arm.



Note

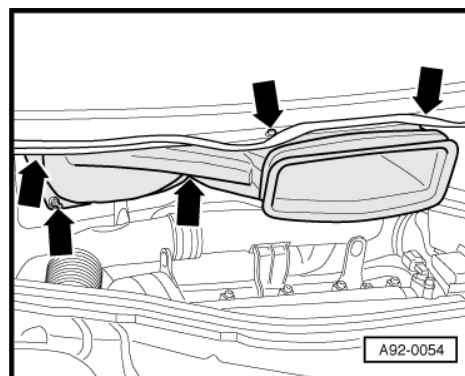
Use puller (commercially available) to remove wiper arm if necessary.

- Disconnect washer fluid hose -3-.
- If fitted, unplug electrical connectors -4 and 5- for heated washer jets.
- Open hose clip -6- using hose clip pliers -V.A.G 1921- and detach water drain hose from cowl panel grille.
- Pull off rubber seal -1- on cowl panel grille.
- Disconnect cowl panel grille -2-.
- Move washer fluid hose clear.

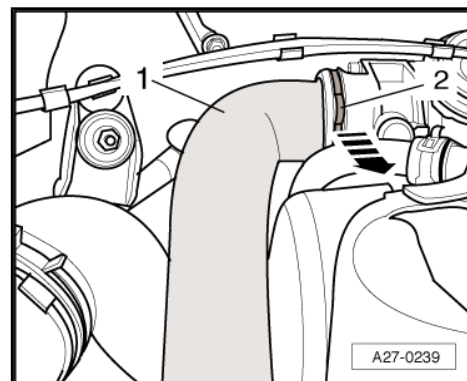


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- Unscrew nuts and bolts -arrows-.
- Pull fresh air duct forwards and remove by turning it to right side of vehicle.

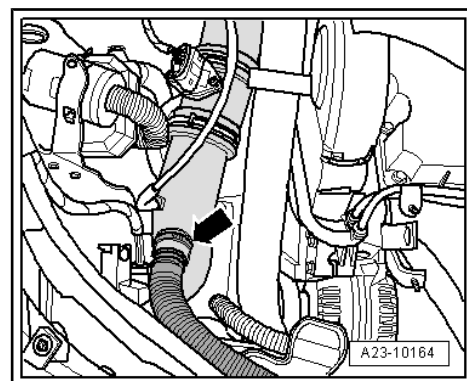


- Detach air hose -1- from intake manifold; to do this, release retaining clip -2- -arrow-, if fitted.



Vehicles with engine code letters AMF, BHC:

- Detach resonator from air pipe -arrow-.



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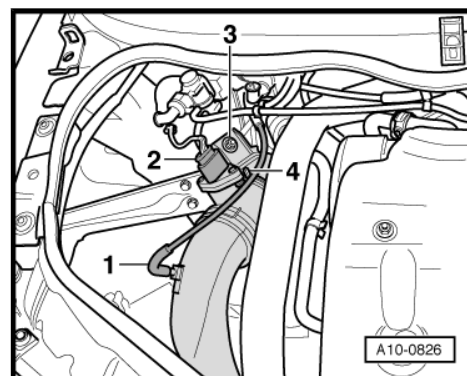
All vehicles:

- Unplug electrical connector -2- at air mass meter -G70- .
- Detach vacuum hose -1-.
- Release hose clip -4- and remove air pipe with air mass meter -G70- .

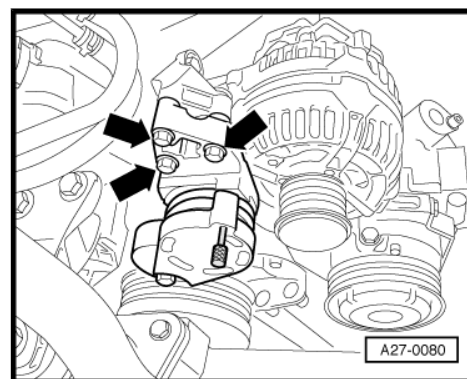


Note

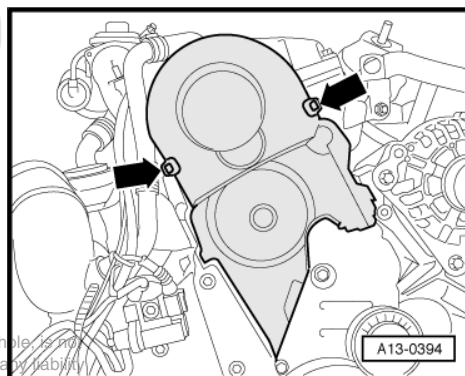
Disregard -item 3-.



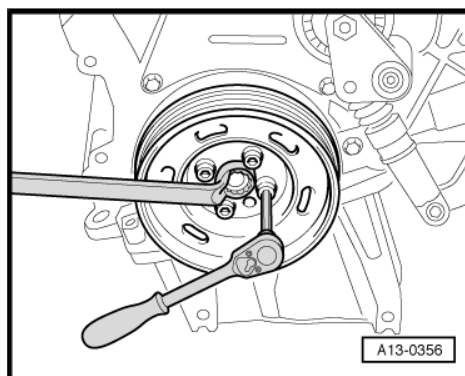
- Unscrew poly V-belt tensioner -arrows-.



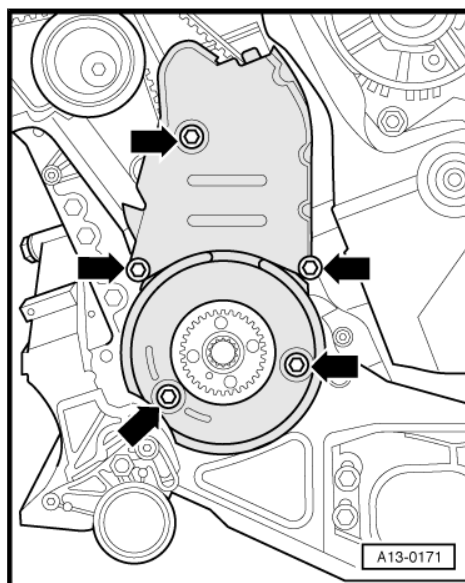
- Remove toothed belt cover (top section) -arrows-.



- Unbolt vibration damper; counterhold on centre bolt with ring spanner.



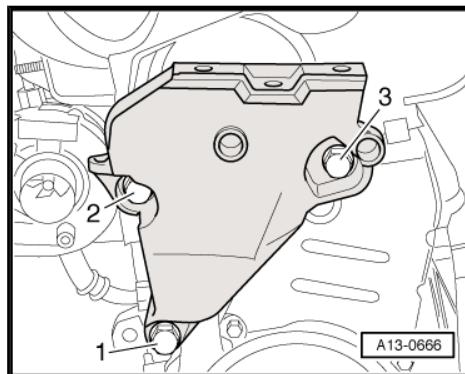
- Unbolt toothed belt cover (centre and bottom) -arrows-.



- Remove bottom bolt -1- for engine support.


Note

Bolts -2- and -3- do not have to be loosened at this stage.

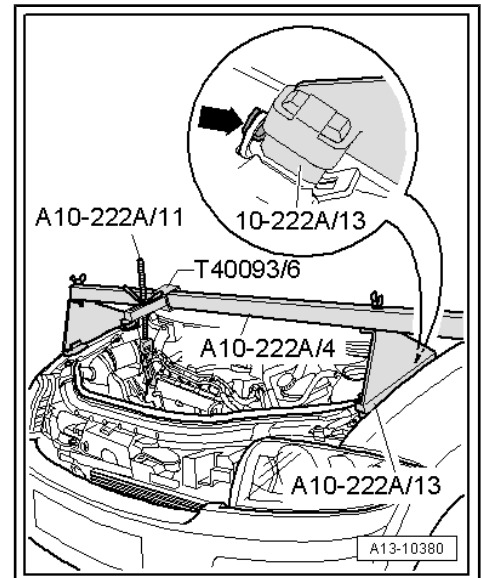


- Set up support bracket -10 - 222 A- with adapters -10 - 222 A / 13- and adapter -T40093/6- on wing panel flanges.

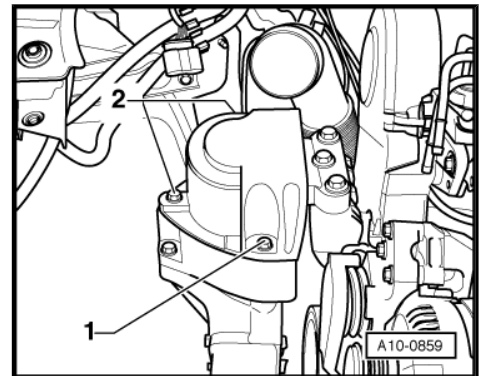
**Caution**

At the same time, engage adapter -10 - 222 A /13- in mountings for bonnet -arrow-.

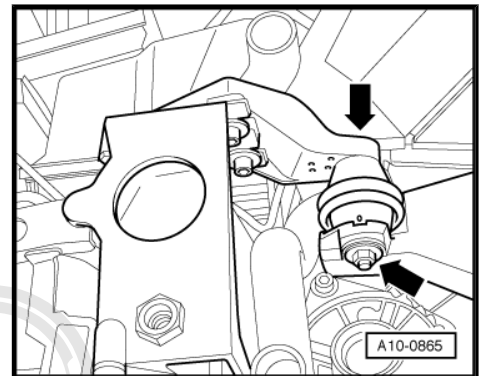
- Remove clamping bolt in adapter -T40093/6- .
- Adapter -T40093/6- is fitted with its arm pointing upwards.
- Attach hook on spindle -10 - 222 A /11- to engine lifting eye.
- Take up weight of engine using spindle (but do not raise engine).

**Vehicles with cover for engine mounting**

- Remove cover for engine mounting by unscrewing bolts -1 and 2-.

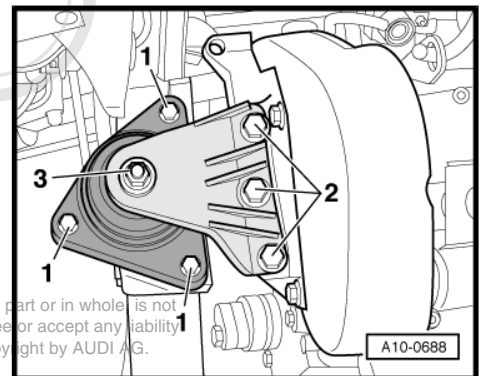


- Remove bolts -1 and 3- and detach support arm with engine mounting -2-.

**Vehicles without cover for engine mounting****Note**

Do not loosen nut -3- unless renewing engine mounting.

- Remove bolts -1 and 2- and detach support arm with engine mounting.



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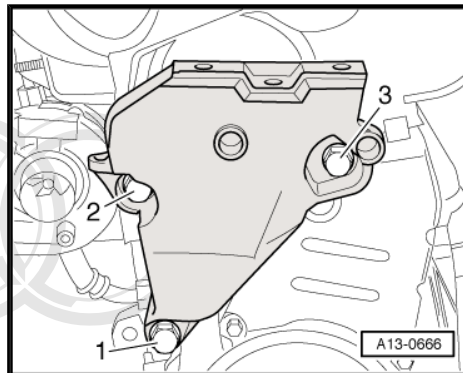
All vehicles:

- Remove top bolts -2- and -3- and detach engine support.



Note

Disregard -item 1-.



Caution

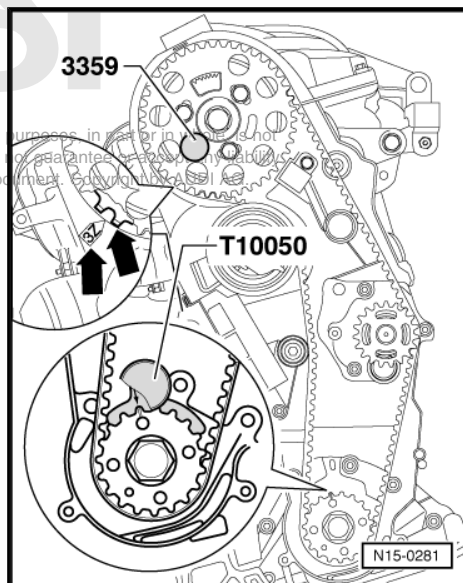
The engine must only be turned at the crankshaft, in the direction of normal engine rotation (clockwise).



Note

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

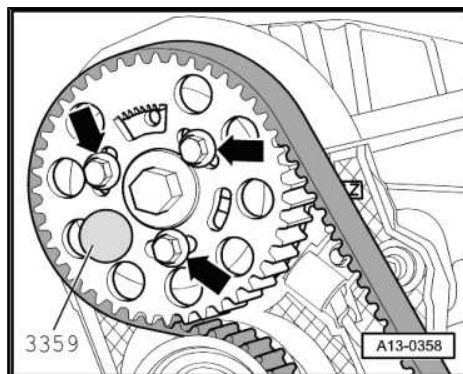
- Turn the crankshaft to "TDC".
- The space between the two lugs on sender wheel of camshaft must align with marking "3Z" on toothed belt cover (rear) -arrows-.
- Lock hub on camshaft with locking pin -3359- .
- Lock crankshaft sprocket with crankshaft stop -T10050- .



Note

The crankshaft stop can only be pushed onto the sprocket from the front face of the teeth.

- The markings on the toothed belt sprocket and the crankshaft stop -T10050- must align. The pin of the crankshaft stop -T10050- must engage in the aperture in the sealing flange.
- Mark direction of rotation of toothed belt with chalk or felt-tip pen.
- Loosen securing bolts for camshaft sprocket -arrows-.



- Loosen securing nut -1- for tensioning roller.
- Using pin wrench -3387- , turn eccentric adjuster on belt tensioner anti-clockwise -arrow- until tensioning roller can be locked in position with locking pin -T10115- .

**Note**

Instead of using the 2-hole pin wrench -3387- , you can also use the special tool Matra V/159.

- Turn pin wrench -3387- clockwise -arrow- as far as stop and tighten securing nut -1- hand-tight.
- Take off toothed belt first from coolant pump and then from the remaining sprockets.

Installing (adjusting valve timing)

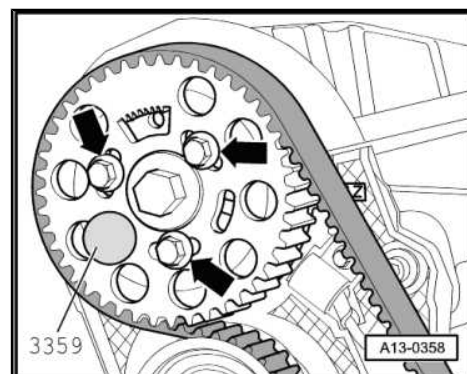
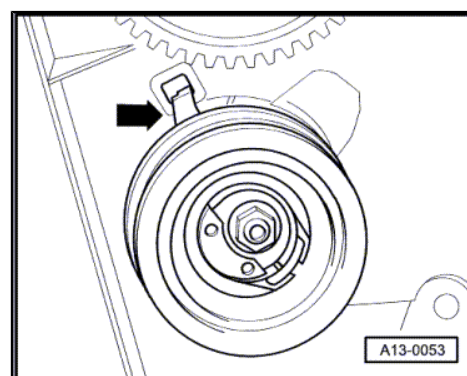
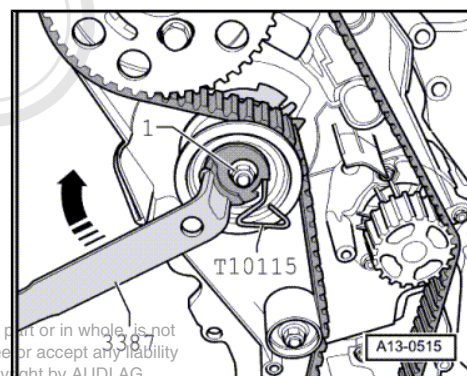
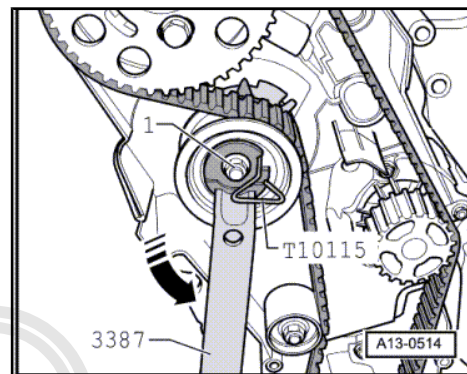
- Camshaft locked with locking pin -3359- .
- Crankshaft locked in position with crankshaft stop -T10050- .
- Tensioning roller locked with locking pin -T10115- and secured at right stop with securing nut.

**Note**

- ◆ *Toothed belt adjustment must always be performed when the engine is cold.*
- ◆ *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.*

- Ensure that tensioning roller is seated properly in rear toothed belt cover -arrow-.

- Screw in bolts -arrows-, but do not tighten.
- It should just be possible to turn the camshaft sprocket on the hub without axial movement.
- Turn the camshaft sprocket in its elongated hole clockwise until the stop.
- Fit toothed belt first onto camshaft sprocket, tensioning roller, crankshaft sprocket and then onto coolant pump sprocket.



Adjust toothed belt tension as follows:

- Remove locking pin -T10115- .
- Loosen securing nut -1- for tensioning roller.
- Turn eccentric adjuster of tensioning roller clockwise -arrow- using pin wrench -3387- until pointer -2- aligns with centre of slot on base plate.



Note

Make sure that the securing nut does not also turn.

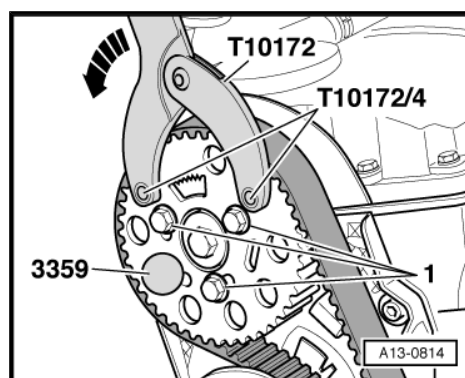
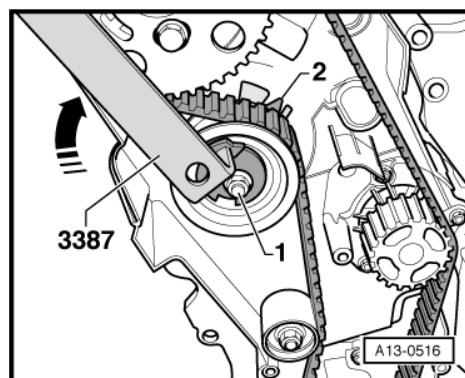
- Hold tensioning roller in this position and tighten securing nut to 20 Nm + 45° (1/8 turn).



Note

When tightening the securing nut, the pointer may move up to 5 mm (maximum) to the right of the slot in the base plate. This position must not be corrected, because the toothed belt stretches slightly when running in.

- Attach counterhold tool -T10172- with pins -T10172/4- as illustrated and apply tension to driving section of toothed belt by pressing in direction of -arrow-.
- Tighten bolts -1- on camshaft sprocket to 25 Nm.
- Remove locking pin -3359- and crankshaft stop -T10050- .



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Checking valve timing:

**Caution**

The engine must only be turned at the crankshaft, in the direction of normal engine rotation (clockwise).

- Turn crankshaft two rotations in normal direction of rotation until it is again positioned just before “TDC”.
- Lock the hub into place with the locking pin -3359- when turning.
- The space between the two lugs on ~~sender wheel of camshaft~~ must align with marking “3Z” on toothed belt cover (rear) -arrows-.

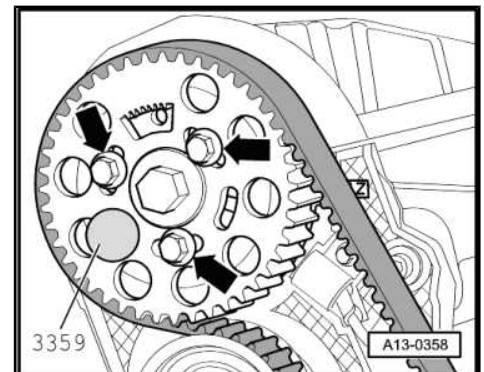
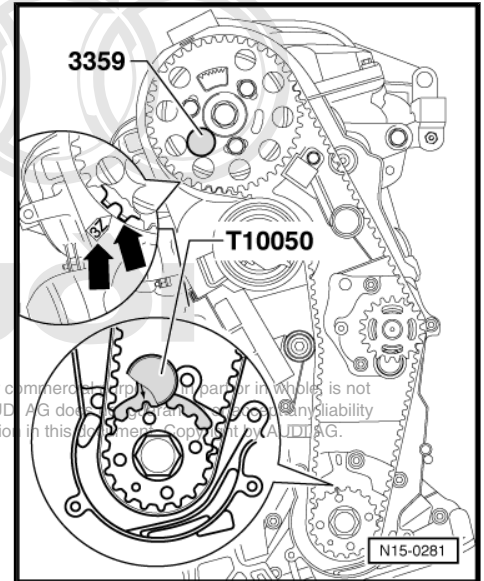
**Note**

For illustration purposes, the camshaft sprocket is shown with the toothed belt removed.

- Check whether:
 - The crankshaft can be locked with the crankshaft stop - T10050- .
 - The tensioner pointer is centred or a maximum of 5 mm to the right of the slot in the base plate.

If the crankshaft cannot be locked:

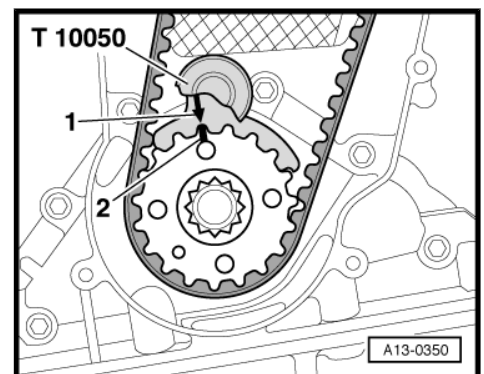
- Loosen securing bolts -arrows- of camshaft sprocket.



- Turn the crankshaft slightly further in the normal direction of rotation until it can be locked with crankshaft stop -T10050- .

**Note**

If the crankshaft has been rotated beyond “TDC”, turn it back slightly so you can then reset it to “TDC” by turning in the normal direction of rotation.



- Tighten securing bolts for camshaft sprocket -arrows- to 25 Nm.
- Remove locking pin -3359- and crankshaft stop -T10050- .



Caution

The engine must only be turned at the crankshaft, in the direction of normal engine rotation (clockwise).

- Turn crankshaft two rotations in normal direction of rotation until the crankshaft is at "TDC" again.
- Check valve timing once again ⇒ [page 125](#) .

Assembling:

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



Note

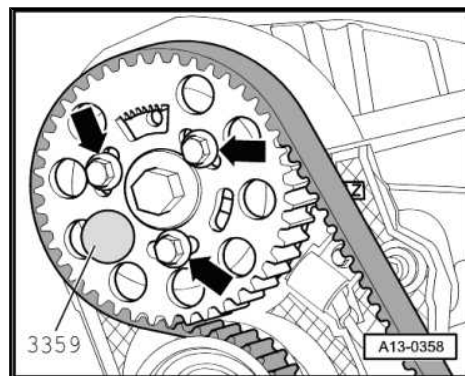
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Hose connections and hoses for charge air system must be free of oil and grease before assembly. Do NOT use lubricant.

- Install toothed belt cover (bottom and centre).
- Install vibration damper ⇒ [page 43](#) .
- Install support arm with engine mounting ⇒ [page 33](#) .
- Fit toothed belt cover (top section).
- Install air pipes/hoses with plug-in connectors ⇒ [page 202](#) .
- Install poly V-belt ⇒ [page 42](#) .
- Install windscreen wiper arm ⇒ Rep. gr. 92 .

Tightening torques

Component	Nm
Camshaft sprocket to hub	25
Tensioning roller for toothed belt to cylinder head	20 + 45° ¹⁾
Toothed belt cover (bottom) to cylinder block	10 ²⁾
Toothed belt cover (centre) to cylinder block	10 ²⁾
Engine support to cylinder block	45
Tensioner for poly V-belt to bracket for ancillaries	22
Engine cover panel to bracket	5.5
• ¹⁾ 45° = one eighth turn. • ²⁾ Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue .	



4 Servicing valve gear



Note

- ◆ After installing the camshaft, the engine must NOT be started for about 30 minutes. The hydraulic tappets have to settle (otherwise valves will strike pistons).
- ◆ After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.
- ◆ All bearing and running surfaces must be oiled before assembling.
- ◆ Removing and installing tandem pump ⇒ Rep. gr. 20.

4.1 Valve gear - exploded view

1 - Bolt

- ☐ Renew
- ☐ Note correct sequence for loosening and tightening
⇒ ["4.4 Removing and installing camshaft", page 132](#)
- ☐ 20 Nm + 1/4 turn (90°) further

2 - Rocker arm shaft

- ☐ Note correct sequence for loosening and tightening
⇒ ["4.4 Removing and installing camshaft", page 132](#)

3 - Bolt

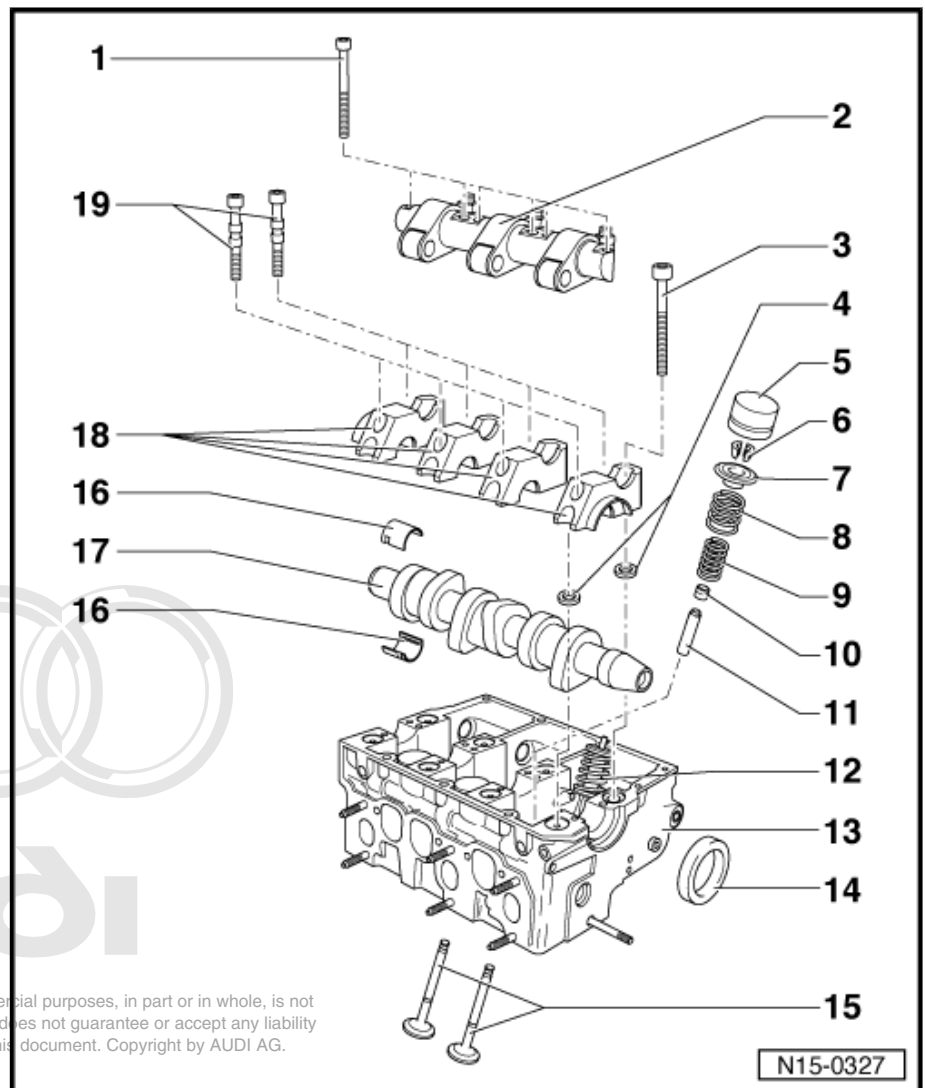
- ☐ Renew
- ☐ Note correct sequence for loosening and tightening
⇒ ["1.3 Removing and installing cylinder head", page 77](#)
- ☐ Before installing, insert washers -item 4- in cylinder head

4 - Washers

- ☐ For cylinder head bolts
- ☐ Insert into cylinder head before fitting bearing caps

5 - Hydraulic bucket tappet

- ☐ Checking ⇒ [page 135](#)
- ☐ Removing and installing ⇒ ["4.4 Removing and installing camshaft", page 132](#)
- ☐ Do not interchange (mark allocation)
- ☐ Place down with contact surface facing downwards



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- ☐ Check axial clearance of camshaft before installing ⇒ [page 129](#)
- ☐ Lubricate contact surface

6 - Valve cotters**7 - Valve spring plate****8 - Valve spring (outer)**

- ☐ Removing and installing with cylinder head installed ⇒ [“4.6 Renewing valve stem oil seals”, page 136](#)
- ☐ Remove and install with cylinder head removed using valve spring compressor -2037-

9 - Valve spring (inner)

- ☐ Removing and installing with cylinder head installed ⇒ [“4.6 Renewing valve stem oil seals”, page 136](#)
- ☐ Remove and install with cylinder head removed using valve spring compressor -2037-

10 - Valve stem oil seal

- ☐ Renewing ⇒ [page 136](#)

11 - Valve guide

- ☐ Checking ⇒ [page 140](#)

12 - Unit injector

- ☐ Removing and installing ⇒ Rep. gr. 23

13 - Cylinder head

- ☐ Machining valve seats ⇒ [page 141](#)

14 - Oil seal

- ☐ Renewing ⇒ [page 129](#)

15 - Valves

- ☐ Checking ⇒ [page 143](#)
- ☐ Valve dimensions ⇒ [page 140](#)
- ☐ Do not machine; only grinding in is permitted

16 - Bearing shell

- ☐ Note installation position
- ☐ Do not interchange used bearing shells (mark positions)
- ☐ Make sure that the retaining lugs are correctly seated in the bearing caps and the cylinder head

17 - Camshaft

- ☐ Check radial clearance with Plastigage
- ☐ Radial clearance: wear limit: 0.11 mm
- ☐ Runout: max. 0.01 mm
- ☐ Checking axial clearance ⇒ [page 129](#)
- ☐ Removing and installing ⇒ [page 132](#)

18 - Bearing cap

- ☐ Installation sequence ⇒ [4.4 Removing and installing camshaft, page 132](#)
- ☐ Bearing cap 4 is marked as bearing cap “5”.
- ☐ Apply sealant to bearing caps 1 and 4 ⇒ [page 129](#)

19 - Bolt

- ☐ Renew
- ☐ 8 Nm + 1/4 turn (90°) further

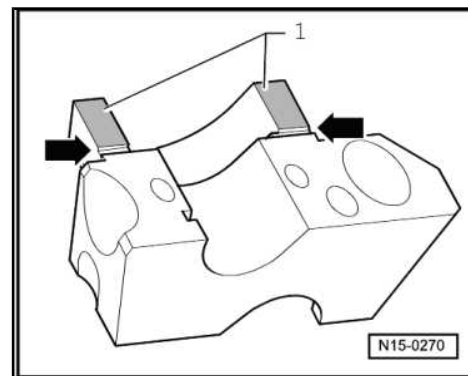
Applying sealant to bearing caps 1 and 4

- Apply a thin and even coat of sealant to surfaces -1-; sealant
⇒ Parts catalogue .



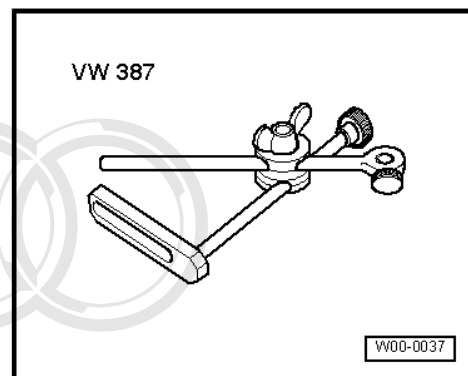
Note

- ◆ Make sure no sealant gets into the grooves -arrows-.
- ◆ Bearing cap 4 is marked as bearing cap "5".

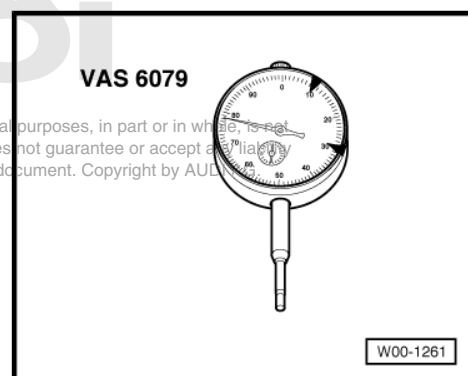


4.2 Checking axial clearance of camshaft

- ◆ Universal dial gauge bracket -VW 387-



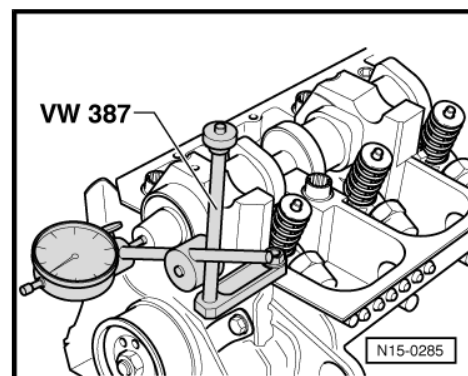
- ◆ Dial gauge -VAS 6079-



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Procedure

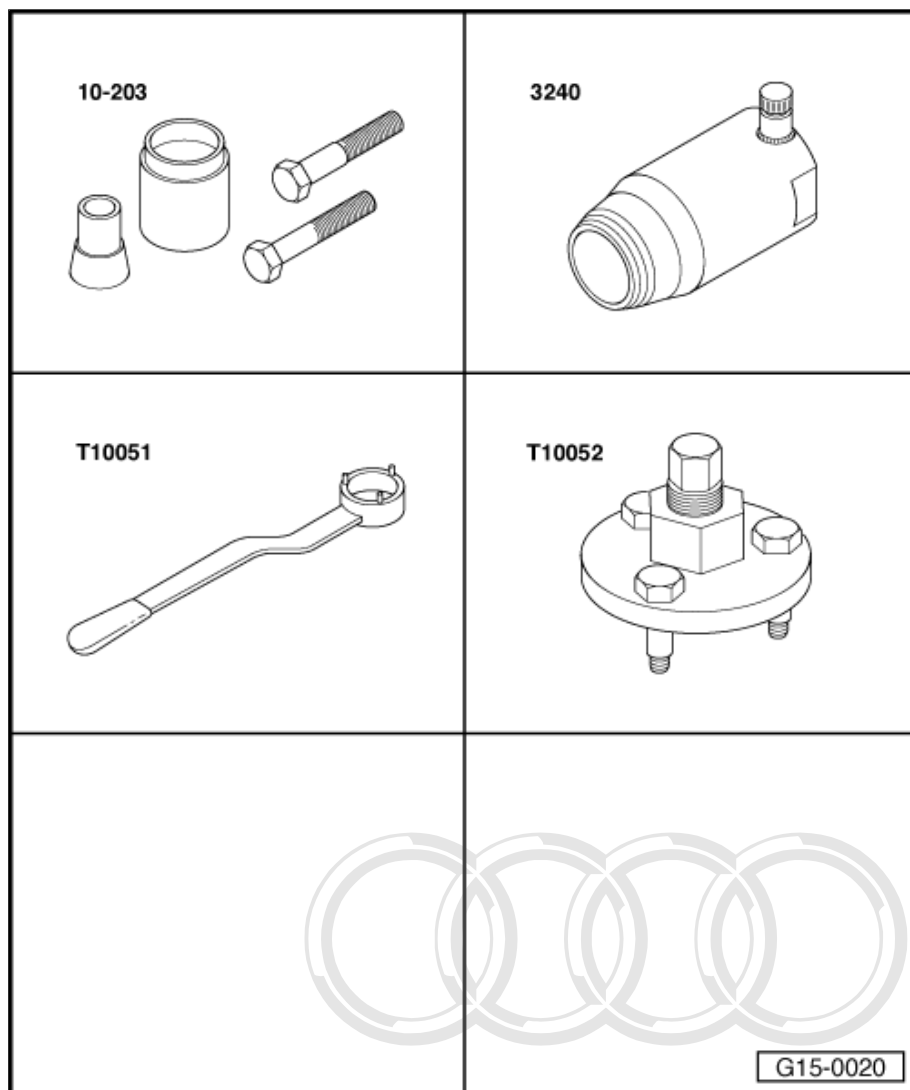
- Measure with bucket tappets removed and bearing caps fitted.
- Secure universal dial gauge bracket -VW 387- with dial gauge -VAS 6079- to cylinder head.
- Determine axial clearance.
- Wear limit: 0.15 mm.



4.3 Renewing camshaft oil seal

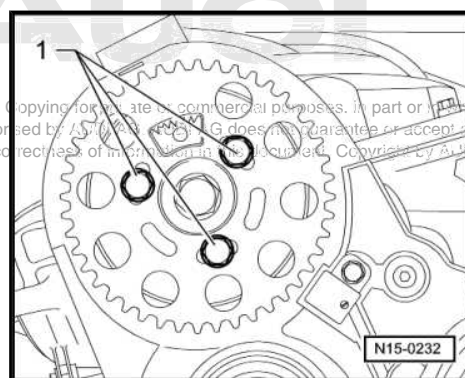
Special tools and workshop equipment required

- ◆ Fitting tool -10 - 203-
- ◆ Oil seal extractor -3240-
- ◆ Counterhold tool -T10051-
- ◆ Puller -T10052-
- ◆ Bolt M12x65

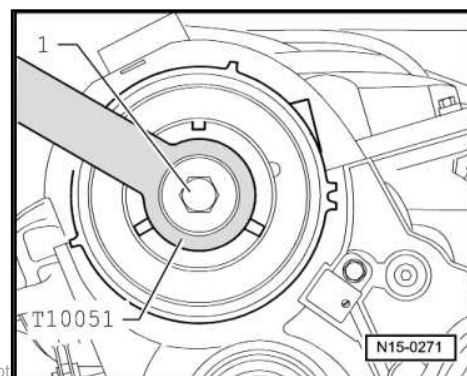


Procedure

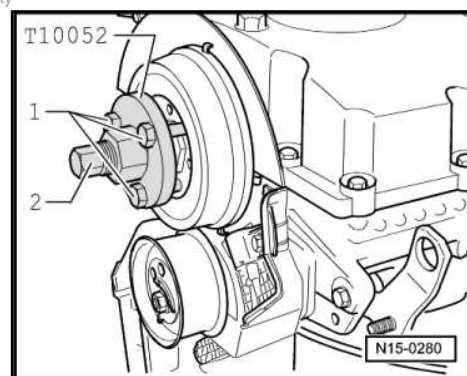
- Cylinder head installed.
- Remove toothed belt: toothed belt drive with hydraulically damped tensioning roller ⇒ [page 102](#) , toothed belt drive with friction-damped tensioning roller ⇒ [page 116](#) .
- Remove locking pin -3359- .
- Unscrew bolts -1- and detach camshaft sprocket from hub.



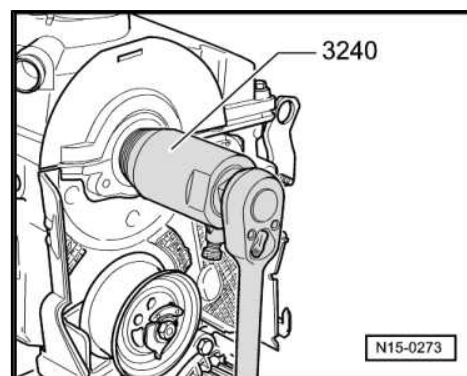
- Loosen bolt -1- for hub; use counterhold tool -T10051- .
- Then unscrew bolt approx. 2 turns.



- Fit puller -T10052- on hub and fit bolts -1-.
- Remove hub from camshaft by screwing in bolt -2- while counterholding at hexagon flats (30 mm) of puller.
- Detach hub from taper of camshaft.

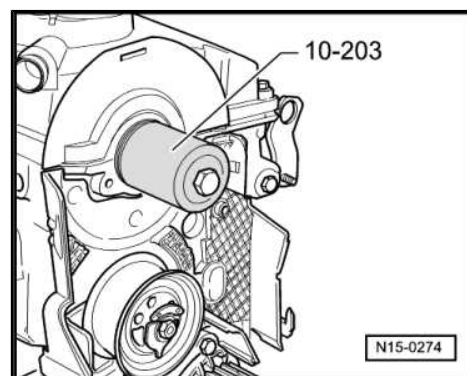


- Adjust inner part of oil seal extractor -3240- so that it is level with the outer part and lock in position with knurled screw.
- Lubricate threaded head of oil seal extractor, place it in position and, exerting firm pressure, screw it into camshaft oil seal as far as possible.
- Loosen knurled screw and turn inner section against camshaft until oil seal is pulled out.
- Clamp flats of oil seal extractor in vice.
- Remove oil seal with pliers.
- Clean running surface and sealing surface.

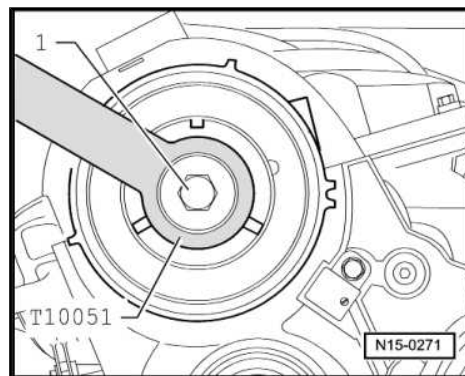
**Note**

The sealing lip of the oil seal must not be additionally oiled or greased.

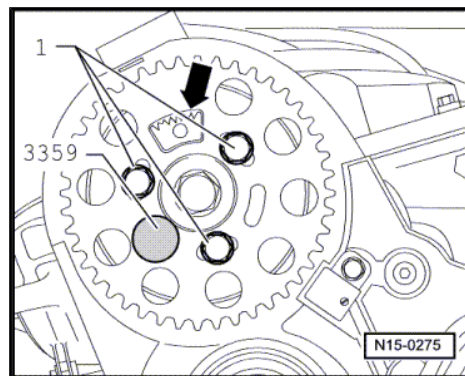
- Remove oil residue on camshaft journal with a clean cloth.
- Tape off groove on taper of camshaft with adhesive tape.
- Carefully position oil seal on camshaft.
- Press in oil seal with press piece of fitting tool -10 - 203- and bolt M12×65 as far as the stop.



- Attach hub to camshaft.
- Tighten securing bolt -1- (use counterhold -T10051-).



- Push camshaft sprocket onto hub.
- Toothed segment -arrow- in camshaft sprocket must face upwards.
- Screw in bolts -1- finger-tight.
- Lock hub on camshaft with locking pin -3359- .
- Install toothed belt (adjust valve timing): toothed belt drive with hydraulically damped tensioning roller ⇒ [page 109](#) , toothed belt drive with friction-damped tensioning roller ⇒ [page 123](#) .



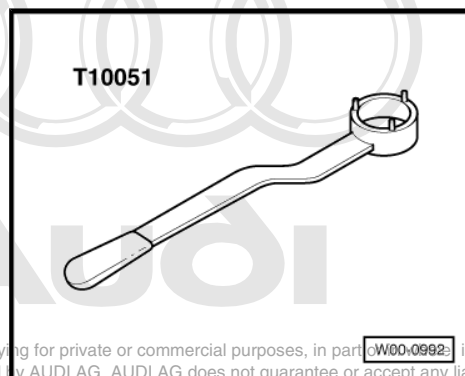
Tightening torque

Component	Nm
Hub to camshaft	100

4.4 Removing and installing camshaft

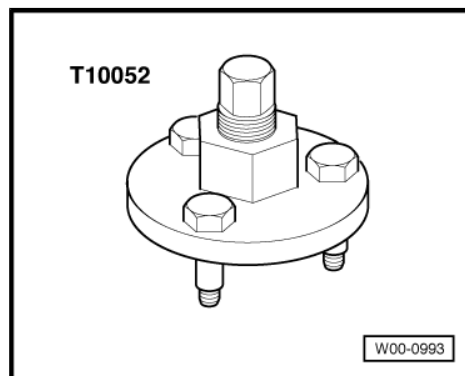
Special tools and workshop equipment required

- ◆ Counterhold tool -T10051-



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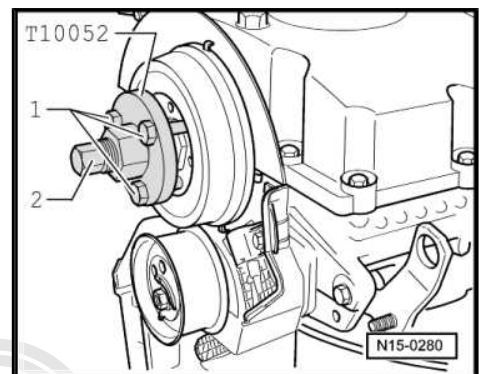
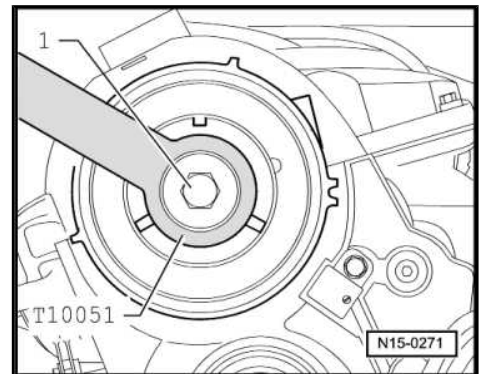
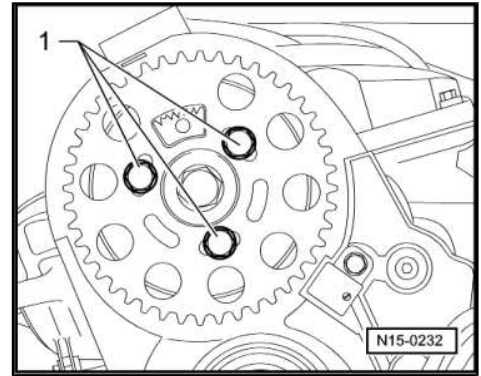
- ◆ Puller -T10052-



- ◆ Sealant ⇒ Parts catalogue

Removing

- Cylinder head installed.
- Remove toothed belt: toothed belt drive with hydraulically damped tensioning roller ⇒ [page 102](#) , toothed belt drive with friction-damped tensioning roller ⇒ [page 116](#) .
- Remove locking pin -3359- .
- Unscrew bolts -1- and detach camshaft sprocket from hub.
- Loosen bolt -1- for hub; use counterhold tool -T10051- .
- Then unscrew bolt approx. 2 turns.
- Fit puller -T10052- on hub and fit bolts -1-.
- Remove hub from camshaft by screwing in bolt -2- while counterholding at hexagon flats (30 mm) of puller.
- Detach hub from taper of camshaft.
- Remove cylinder head cover ⇒ [page 74](#) .
- First loosen outer bolts on rocker arm shaft, then inner bolts and remove rocker arm shaft.
- Remove tandem pump ⇒ Rep. gr. 20 .
- First remove bearing caps "2" and "3".
- Then loosen bearing caps "1" and "4" alternately in diagonal sequence.



Note

- ◆ *Bearing cap "4" is marked as bearing cap "5".*
- ◆ *Make sure that the camshaft bearing shells are not interchanged.*
- ◆ *Mark allocation of camshaft bearing shells on rear with a waterproof felt-tip pen.*

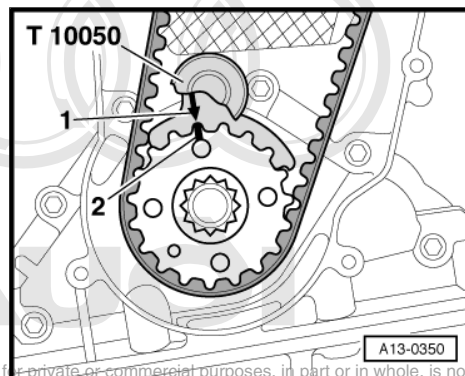
- Remove camshaft.

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Installing

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

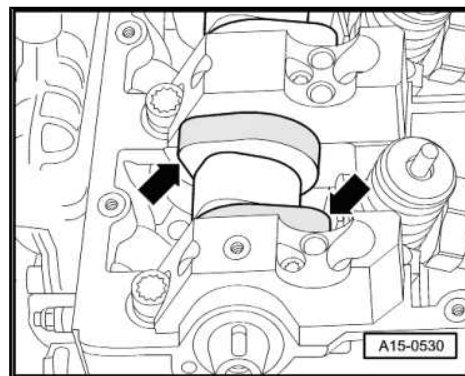
- The crankshaft sprocket must be locked with the crankshaft stop -T10050- .
- The markings on the toothed belt sprocket and the crankshaft stop -arrow- must align. The pin of the crankshaft stop must engage in the aperture in the sealing flange.



Note

- ◆ **Make sure that the used camshaft bearing shells are not interchanged (note marking).**
- ◆ **When installing the camshaft, make sure that the retaining lugs on the bearing shells are correctly seated in the bearing caps and the cylinder head.**

- Lubricate contact surfaces of camshaft.
- Install camshaft in "TDC" position for cylinder 1:
- The cams for cylinder 1 must point upwards on camshaft -arrows-.
- Tighten bearing caps "2" and "3" alternately in diagonal sequence.

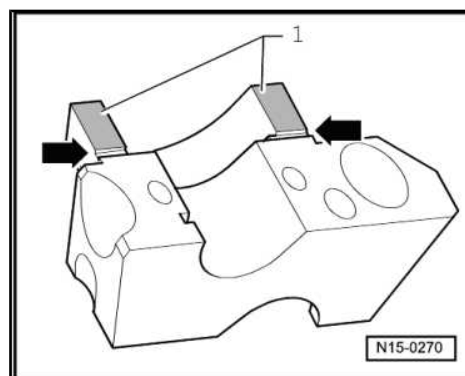


- Apply a thin and even coat of sealant to surfaces -1- on bearing caps "1" and "4"; for sealant refer to ⇒ Parts catalogue .

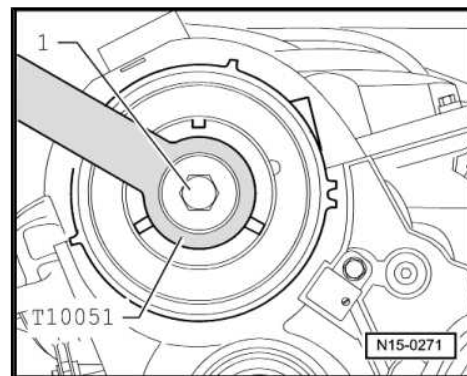


Note

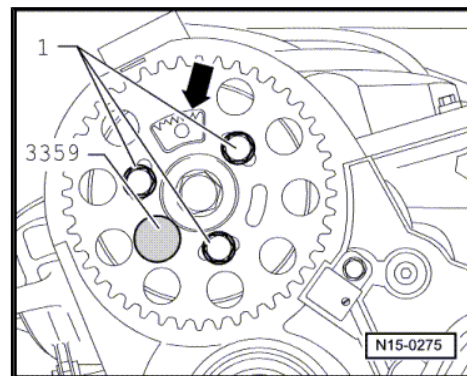
- ◆ **Bearing cap "4" is marked as bearing cap "5".**
- ◆ **Make sure no sealant gets into the grooves -arrows- or onto the other surfaces.**
- Install bearing caps "1" and "4" and tighten.
- Bearing cap "4" must be flush with the outer edge of the cylinder head, otherwise the tandem pump may leak.
- Install camshaft oil seal ⇒ [page 131](#) .
- Fit rocker arm shaft, then first tighten inner bolts then outer bolts in several stages.



- Attach hub to camshaft.
- Tighten securing bolt -1- (use counterhold -T10051-).



- Push camshaft sprocket onto hub.
- Toothed segment -arrow- in camshaft sprocket must face upwards.
- Screw in bolts -1- finger-tight.
- Lock hub on camshaft with locking pin -3359- .
- Install toothed belt (adjust valve timing): toothed belt drive with hydraulically damped tensioning roller ⇒ [page 109](#) , toothed belt drive with friction-damped tensioning roller ⇒ [page 123](#) .
- Install tandem pump ⇒ Rep. gr. 20 .
- If the rocker arm shaft or ball studs and adjuster screws were renewed, the unit injectors must be adjusted ⇒ Rep. gr. 23 .
- Install cylinder head cover ⇒ [page 74](#) .



Note

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

Tightening torques

Component	Nm
Bearing cap to cylinder head	8 + 90° 1)2)
Rocker arm shaft to cylinder head	20 + 90° 1)2)
Hub to camshaft	100
• 1) Renew bolts. • 2) 90° = one quarter turn.	

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4.5 Checking hydraulic bucket tappets

Special tools and workshop equipment required

- ◆ Feeler gauge
- ◆ Wooden/plastic wedge

Procedure



Note

- ◆ *Hydraulic bucket tappets cannot be serviced.*
- ◆ *Irregular valve noises when starting engine are normal.*
- Start engine and allow to run until radiator fan switches on.
- Increase engine speed to about 2500 rpm for approx. 2 minutes; perform test drive if necessary.



Note

If the irregular valve noise stops but repeatedly re-occurs when driving short distances, then the oil retention valve is defective. Fitting location: in oil filter bracket ⇒ [Item 3 \(page 144\)](#) . The oil retention valve cannot be renewed separately.

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

- Remove cylinder head cover ⇒ [page 74](#) .
- Turn crankshaft until cam of the bucket tappet to be checked faces upwards; to do so, push vehicle forwards with 4th gear engaged and ignition switched off.
- Determine clearance between cam and bucket tappet by pressing down bucket tappet with a suitable wood or plastic wedge.

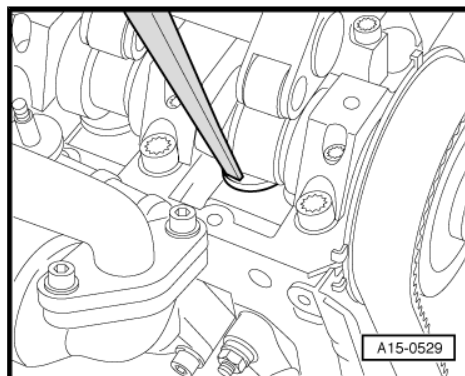
If it is possible to insert a feeler gauge of 0.20 mm between camshaft and bucket tappet:

- Renew hydraulic bucket tappet
⇒ ["4.4 Removing and installing camshaft", page 132](#) .



Note

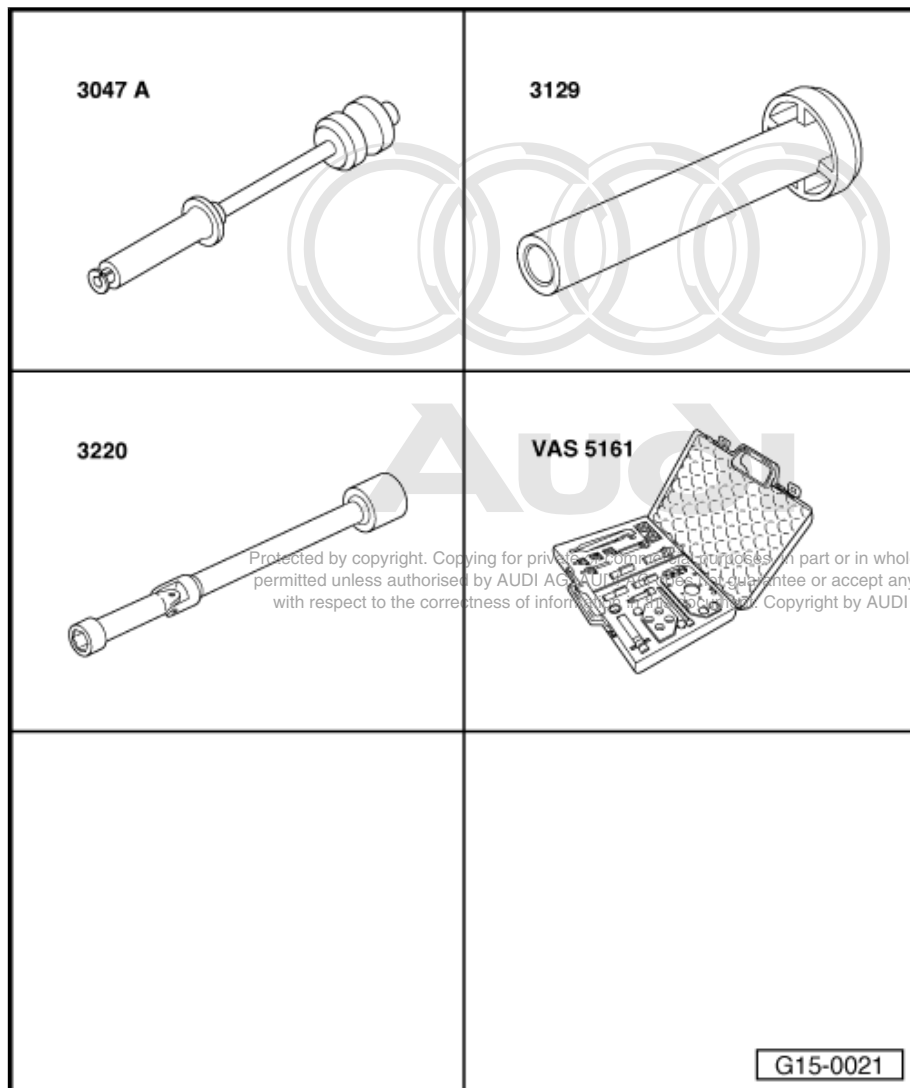
- ◆ *After installing the camshaft, the engine must NOT be started for about 30 minutes. The hydraulic tappets have to settle (otherwise valves will strike pistons).*
- ◆ *After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when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



4.6 Renewing valve stem oil seals

Special tools and workshop equipment required

- ◆ Puller -3047 A-
- ◆ Fitting tool -3129-
- ◆ U/J extension and socket, 10 mm -3220-
- ◆ Removal and installation device for valve cotters - VAS 5161-



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Procedure

- Cylinder head installed.


Note

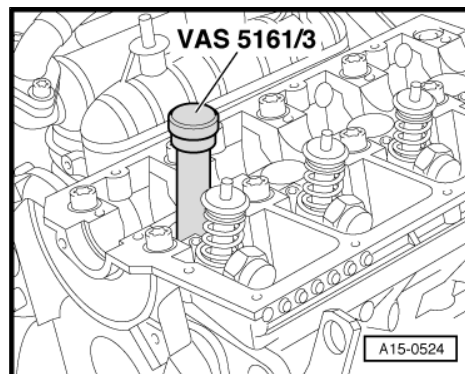
If cylinder head is removed, the valve stem oil seals can be renewed using valve spring compressor -2037-.

- Remove the camshaft ⇒ [page 132](#).
- Remove camshaft bearing shells from cylinder head.


Note

- ◆ *Make sure that the used camshaft bearing shells are not interchanged (note marking).*
- ◆ *Make sure that the hydraulic bucket tappets are not interchanged; mark allocation on rear with a waterproof felt-tip pen.*
- Remove bucket tappets out of guides.

- Place bucket tappets down on a clean surface with contact surface facing downwards in the order in which they were removed.
- Insert punch -VAS 5161/3- in bucket tappet guide.
- Knock valve cotters loose on all valves using a plastic hammer.

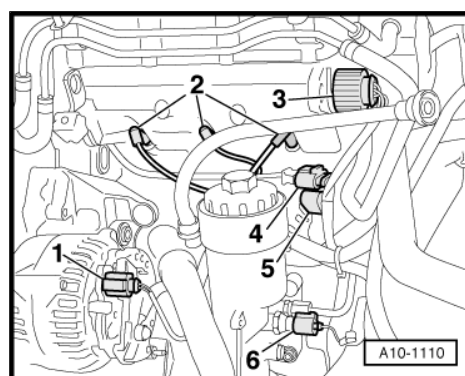


- Unplug electrical connectors -2- on glow plugs.

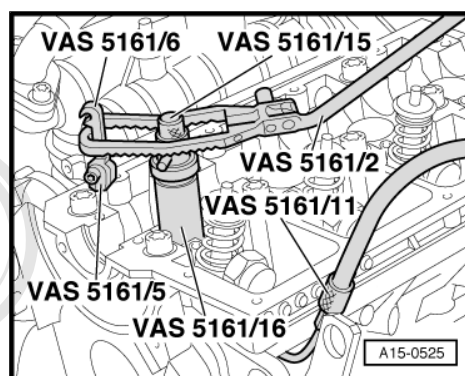

Note

Ignore other -items-.

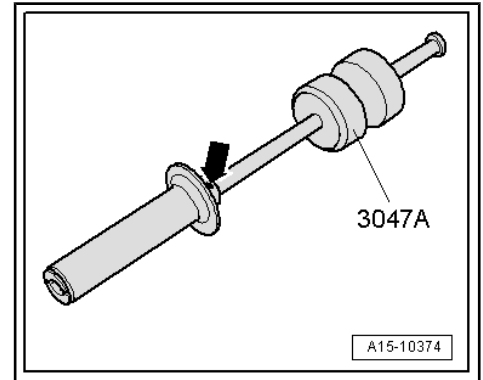
- Unscrew all glow plugs using U/J extension and socket, 10 mm -3220- .
- Set piston of the respective cylinder to “bottom dead centre”.



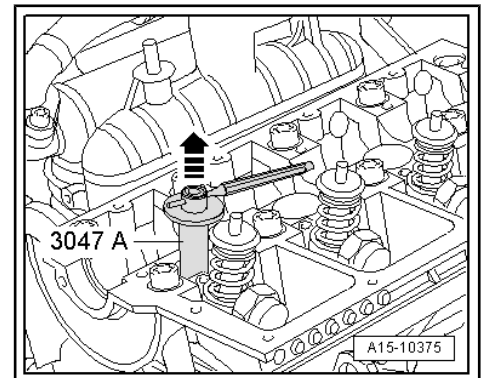
- Screw adapter -VAS 5161/11- hand-tight into the glow plug thread of the relevant cylinder.
- Screw snap-in device -VAS 5161/6- with interlocking fork (M6) -VAS 5161/5- into threaded hole on cylinder head.
- Push guide bush -VAS 5161/16- as far as it will go into bucket tappet guide on valve to be removed.
 - Installation position of guide bush: hatched areas are perpendicular to driving direction.
- Insert assembly cartridge -VAS 5161/15- into guide bush.
- Connect adapter -VAS 5161/11- to compressed air supply using a commercially available connection piece.
 - Minimum pressure: 6 bar
- Attach pressure fork -VAS 5161/2- to snap-in device -VAS 5161/6- and push assembly cartridge downwards.
- 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 cartridge.
- Release pressure fork.
- Remove assembly cartridge.
- Remove guide bush, valve spring plate and valve springs.



- Knock pin -arrow- of puller -3047 A- out using a drift and remove the extractor attachment.

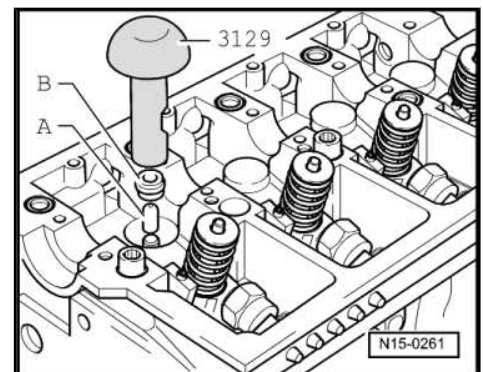


- Attach lower part of puller -3047 A- to valve stem oil seal.
- Secure puller -3047 A- with a punch or other suitable tool as shown in the illustration.
- Apply assembly lever to puller -3047 A- and pull out valve stem oil seal -arrow-.

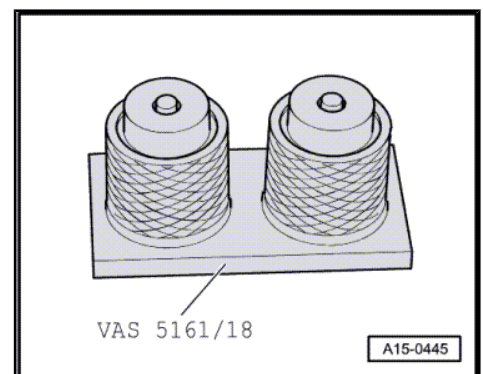
**Note**

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

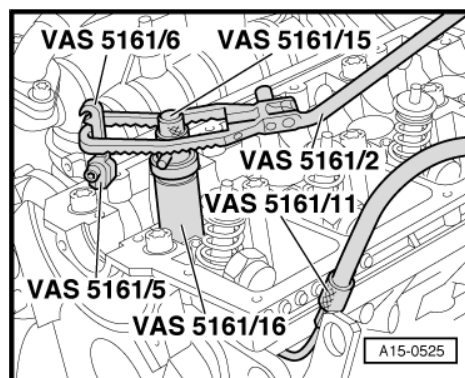
- Insert plastic sleeve -A- onto the valve stem to prevent damage to the new valve stem oil seal -B-.
- Lightly lubricate sealing lip of valve stem oil seal.
- Slip valve stem oil seal over plastic sleeve.
- Carefully press valve stem oil seal down onto valve guide using fitting tool -3129-.
- Remove plastic sleeve.
- If valve cotters had been removed from assembly cartridge they must first be inserted in insertion device -VAS 5161/18-.

**Note**

Larger diameter of valve cotters faces upwards.



- Insert valve springs, valve spring plate and guide bush -VAS 5161/16- .
- Press assembly cartridge -VAS 5161/15- onto insertion device from above and take up valve cotters.
- Re-insert assembly cartridge -VAS 5161/15- into guide bush -VAS 5161/16- .
- Push pressure fork down and pull knurled screw upwards, while turning screw in both directions – this will insert the valve cotters.
- Release pressure fork with knurled screw still in pulled position.
- Insert bucket tappets.
- Install camshaft ⇒ [page 132](#) .
- Install glow plugs ⇒ Rep. gr. 28 .

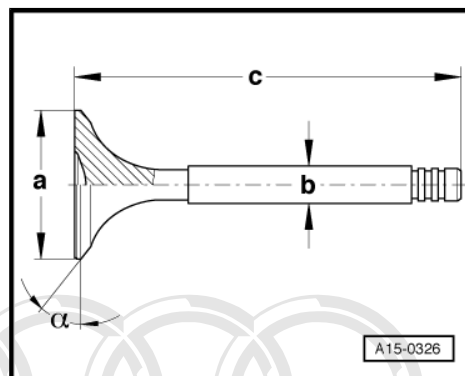


Note

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

4.7 Valve dimensions

Dimension		Inlet valve	Exhaust valve
Ø a	mm	35.95	31.45
Ø b	mm	6.980	6.956
c	mm	89.95	89.95
α	°	45	45



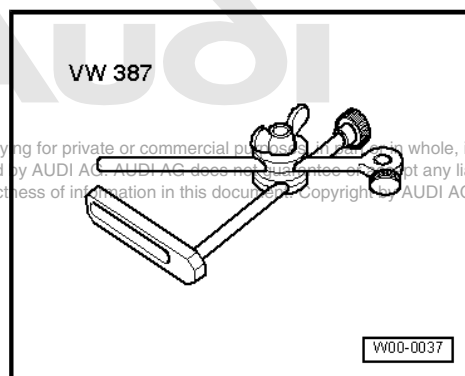
Note

Valves must not be machined. Only grinding is permitted.

4.8 Checking valve guides

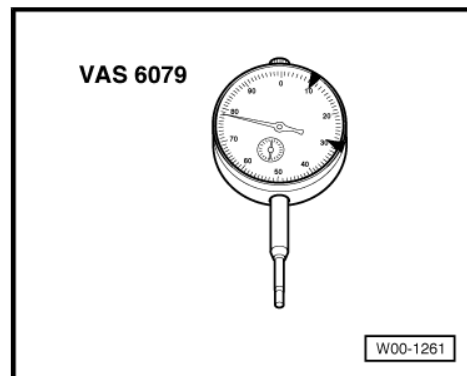
Special tools and workshop equipment required

- ◆ Universal dial gauge bracket -VW 387-



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◆ Dial gauge -VAS 6079-



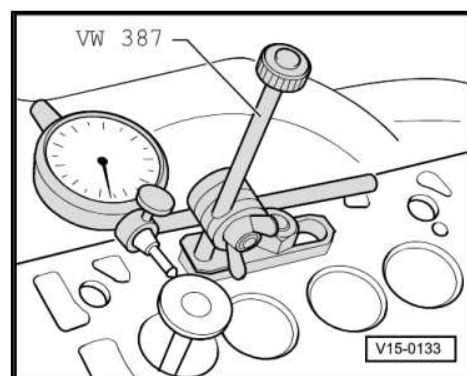
Procedure

- Insert valve into valve guide.
- End of valve stem must be flush with valve guide.
- Determine amount of sideways play.
- Wear limit: 1.3 mm.



Note

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



4.9 Machining valve seats

Special tools and workshop equipment required

- ◆ Depth gauge
- ◆ Valve seat machining tool

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



Note

- ◆ *When servicing engines with leaking valves, it is not sufficient to machine (reface) the valve seats and renew the valves. The valve guides must also be checked for wear. This is particularly important on high-mileage engines ⇒ [page 140](#).*
- ◆ *Valve seats should only be machined to the extent required to give a proper seating pattern.*
- ◆ *The maximum permissible machining dimension must be calculated before starting work.*
- ◆ *If the machining dimension is exceeded, the function of the hydraulic valve clearance compensation can no longer be ensured and the cylinder head must be renewed.*

Calculating maximum permissible machining dimension

- Insert valve and press firmly against valve seat.



Note

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

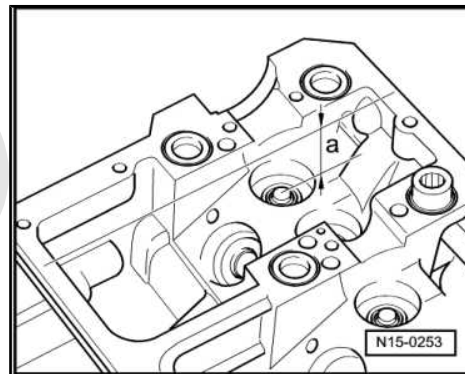
- Measure distance -a- between end of valve stem and upper cylinder head surface with a depth gauge.
- Calculate the maximum permissible machining dimension using the measured distance and the minimum dimension.
- Minimum dimension for inlet valve: 43.4 mm.
- Minimum dimension for exhaust valve: 43.2 mm

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

Example for inlet valve:

Measured distance	44.1 mm
Minimum dimension	– 43.4 mm
Maximum permissible machining dimension	= 0.7 mm

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Note

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

Machining inlet valve seat

a - Ø 35.7 mm

b - 1.6 mm

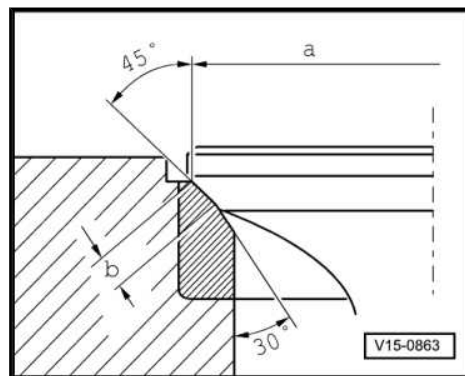
45° - Valve seat angle

30° - Correction angle (top)



Note

- ◆ Calculating maximum permissible machining dimension
⇒ [page 141](#).
- ◆ The 30° lower valve seat chamfer is necessary to ensure that the inlet channel flow characteristics are maintained.



Machining exhaust valve seat

a - Ø 31.4 mm

b - 2.7 mm

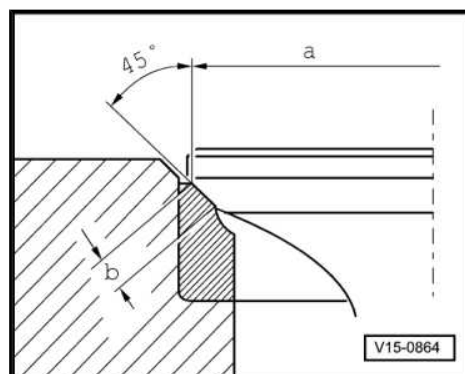
45° - Valve seat angle

30° - Correction angle (top)



Note

Calculating maximum permissible machining dimension
⇒ [page 141](#).



4.10 Checking valves

- Visually inspect for scoring on valve stem and on seating surface.

If scoring is clearly visible:

- Renew the relevant valve.



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17 – Lubrication

1 Lubrication system



Note

- ◆ If large quantities of metal shavings or particles are found in the engine oil when repairing the engine, the oil passages must be cleaned carefully in order to prevent further damage occurring later.
- ◆ The oil level must not be above max. mark on dipstick – danger of damage to catalytic converter.

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

1.1 Lubrication system - exploded view

1 - Cylinder block

2 - Gasket

- ☐ Renew

3 - Oil filter bracket

- ☐ Exploded view
⇒ [page 152](#)

4 - Bolt

- ☐ Renew
- ☐ First fit bolts on top left and bottom right, then tighten all four bolts in diagonal sequence
- ☐ 14 Nm + 90° (1/4 turn further)

5 - Seal

- ☐ Renew

6 - Quick release coupling

7 - Clip

8 - Oil filler reservoir

9 - Oil filler cap

10 - Seal

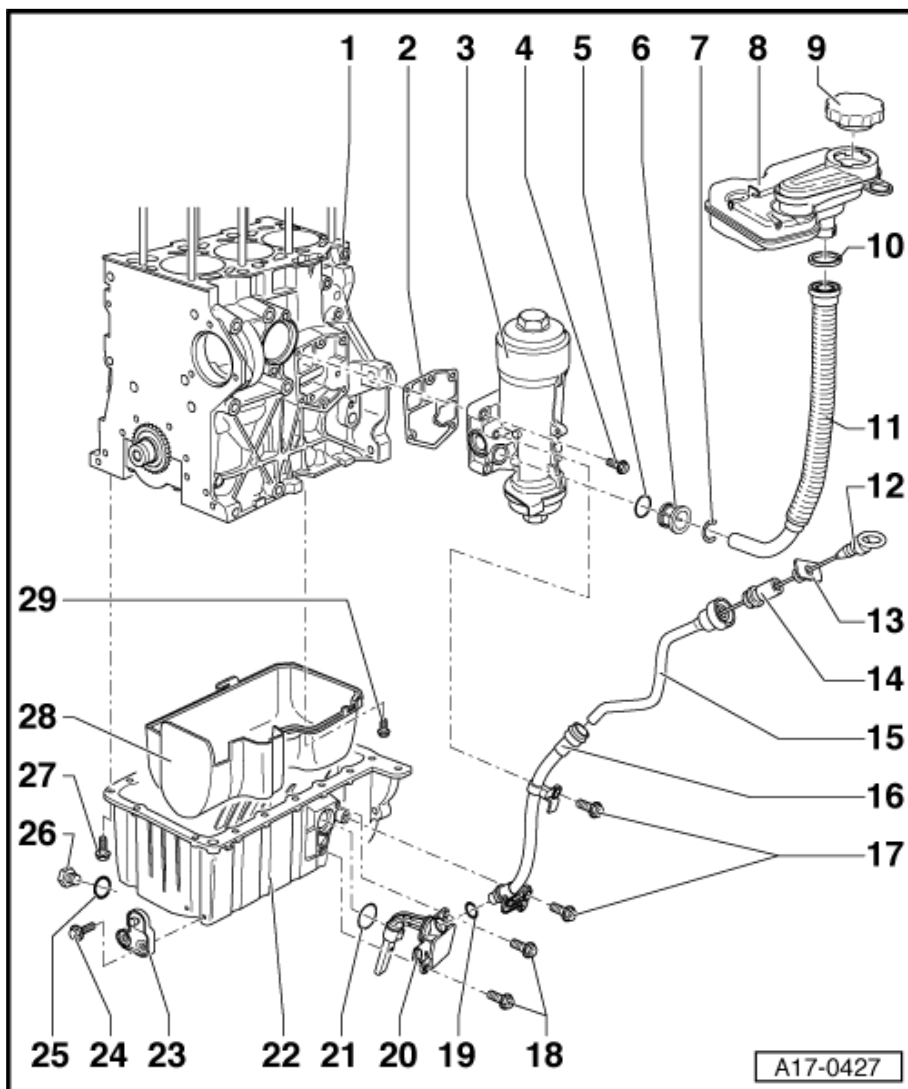
- ☐ Renew

11 - Oil filler pipe

- ☐ To remove, press oil filler pipe toward oil filter bracket and remove clip -item 7-.

12 - Oil dipstick

- ☐ The oil level must not be above max. mark on dipstick
- ☐ Markings ⇒ [page 160](#)



13 - Connecting piece**14 - Guide**

- ☐ Pull off to extract oil

15 - Guide tube for oil dipstick**16 - Oil pipe****17 - Bolt**

- ☐ 9 Nm

18 - Bolt

- ☐ 9 Nm

19 - O-ring

- ☐ Renew
- ☐ Oil lightly when fitting

20 - Oil level and oil temperature sender -G266-

- ☐ Illustration shows version fitted up to 04.2002
- ☐ Version from 05.2002 ⇒ [page 145](#)

21 - O-ring

- ☐ Renew
- ☐ Oil lightly when fitting

22 - Sump

- ☐ Removing and installing ⇒ [page 146](#)
- ☐ Clean sealing surface before installing

23 - Bracket

- ☐ For air pipe

24 - Bolt

- ☐ 8 Nm
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25 - Seal

- ☐ Renew

26 - Oil drain plug

- ☐ 30 Nm

27 - Bolt

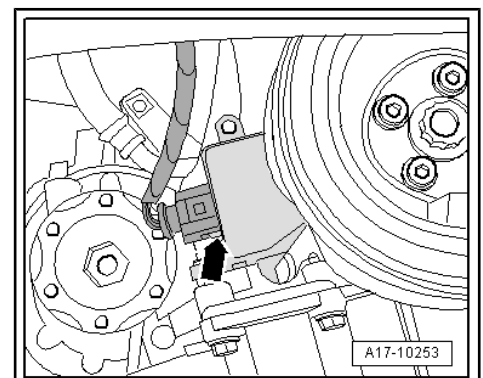
- ☐ 15 Nm

28 - Baffle plate**29 - Bolt**

- ☐ 5 Nm

Fitting location of oil level and oil temperature sender -G266- from 05.2002

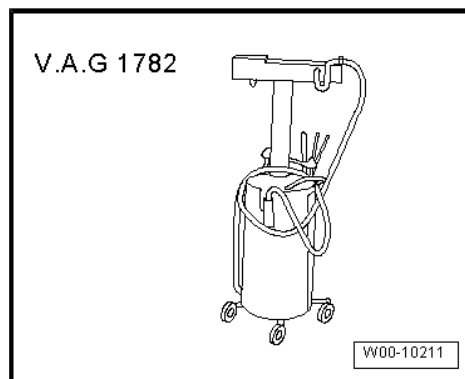
- ◆ Located at front of sump -arrow-.



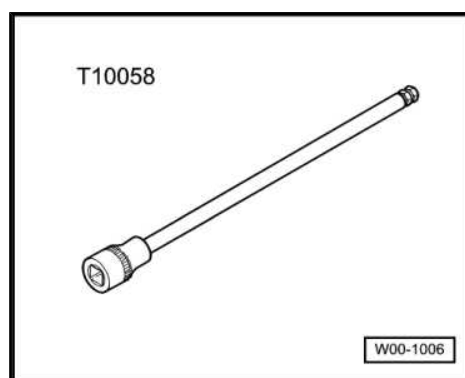
1.2 Removing and installing sump

Special tools and workshop equipment required

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



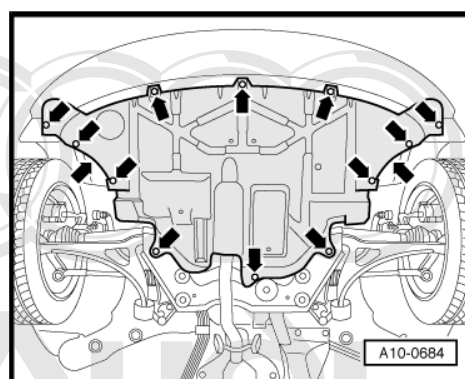
- ◆ Allen key, long reach -T10058-



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

Removing

- Pull out oil dipstick.
- Remove noise insulation -arrows-.
- Place used oil collection and extraction unit -V.A.G 1782- under engine.
- Drain off engine oil.



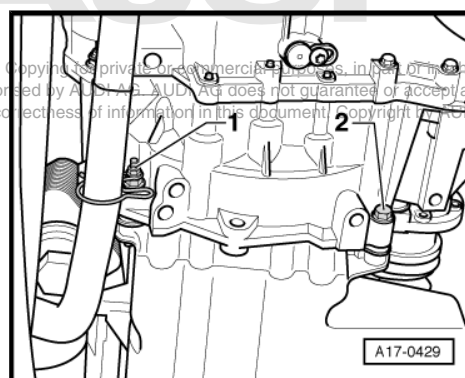
- Unscrew bracket -1-.



Note

Disregard -item 2-.

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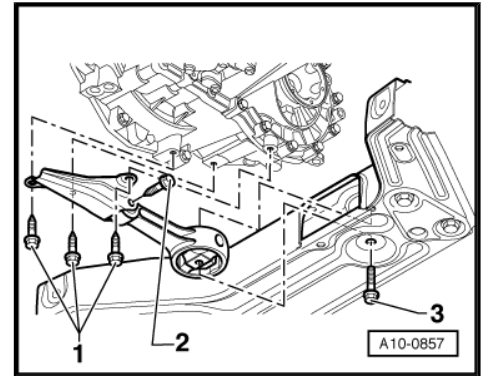


- Unscrew bolts -1- for pendulum support.

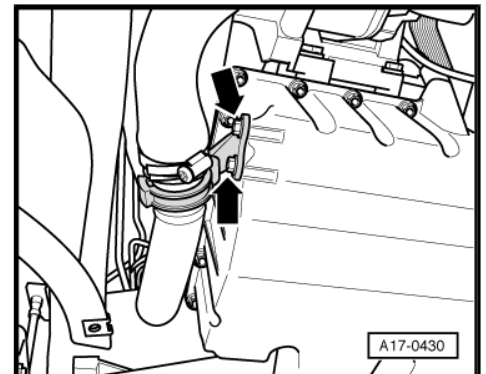


Note

Disregard -items 2 and 3-.



- Unbolt bracket for air pipe from sump -arrows-.

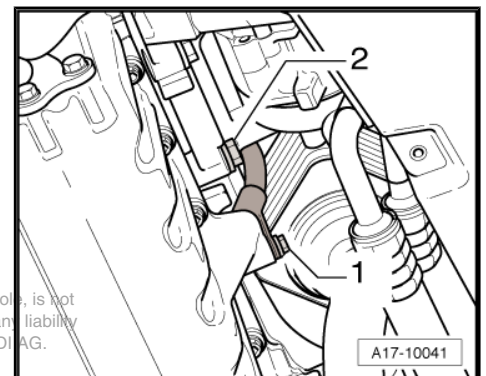


- Remove bolt -1- securing connection for dipstick guide tube on sump.

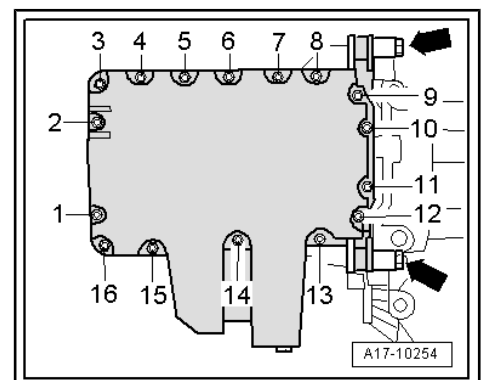


Note

Disregard -item 2-.



- Remove bolts -arrows- securing gearbox to sump.
- Slacken bolts -1 ... 16- in diagonal sequence and remove.



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Note

- ◆ *The bolts on gearbox end -1 and 2- are accessible via the recess -arrow- on the dual-mass flywheel -3- (turn the flywheel as required).*
- ◆ *The bolts can be unscrewed using Allen key (long reach) - T10058- .*
- Take off sump; if necessary loosen it by striking lightly with a rubber hammer.

Installing

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



Note

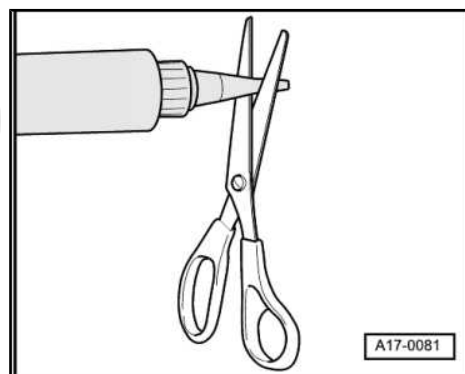
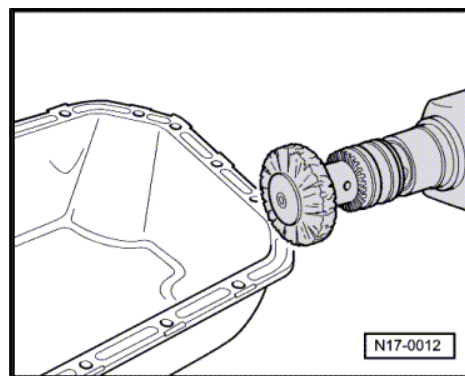
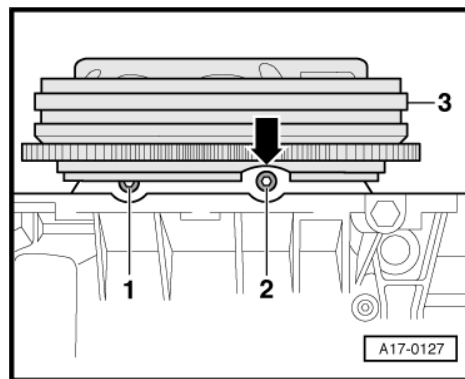
Fit new O-ring to dipstick guide tube.



WARNING

Wear safety goggles.

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

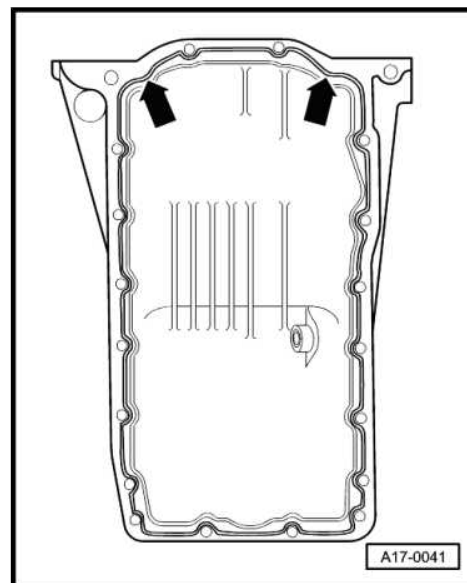


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- Apply bead of sealant onto clean sealing surface of sump as shown in illustration.
- Thickness of sealant bead: 2 ... 3 mm

**Note**

- ◆ Sealant bead must not be wider than 3 mm, otherwise excess sealant could ingress into sump and clog strainer in oil intake pipe.
- ◆ Take particular care when applying sealant bead in area of rear sealing flange -arrows-.
- ◆ The sump must be installed within 5 minutes after applying sealant.

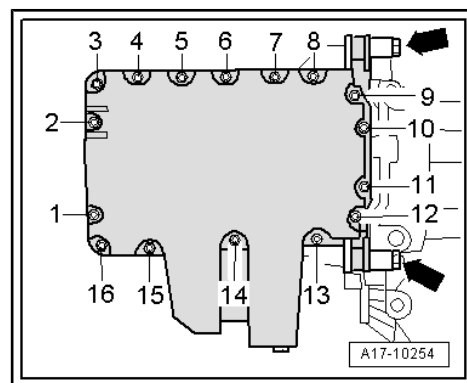


- Immediately install sump and tighten bolts in the sequence indicated:

 1. Tighten bolts -1 ... 16- securing sump to cylinder block in diagonal sequence initially to 5 Nm.
 2. Tighten bolts securing sump to gearbox -arrows-.
 3. Tighten bolts -1 ... 16- in diagonal sequence.

**Note**

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



- Install pendulum support ⇒ [page 40](#) .
- Fill up with engine oil and check oil level ⇒ [page 159](#) .

Tightening torques

Component	Nm
Sump to:	Cylinder block 15
	Gearbox 45
Oil drain plug	30
Connection for dipstick guide tube to sump	9
Air pipe to sump	8

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1.3 Oil pump and retaining frame - exploded view

1 - Cylinder block

2 - Oil spray jet

- ☐ For piston cooling
- ☐ Note installation position: Turn oil spray jet anti-clockwise until it makes contact with cylinder block and secure in this position

3 - Bolt

- ☐ Insert without sealant
- ☐ 27 Nm

4 - O-ring

- ☐ Renew

5 - Retaining frame

- ☐ Before installing, check that the fitting sleeve for centring on cylinder block is in place and that the O ring is inserted in the retaining frame.
- ☐ Removing and installing ⇒ [page 58](#)

6 - Dowel sleeve

7 - Bolt

- ☐ Oil pump to retaining frame, 20 Nm + 90° (1/4 turn) further; renew bolt
- ☐ Retaining frame to cylinder block: 14 Nm + 180° (1/2 turn) further; renew bolt

8 - O-ring

- ☐ Renew
- ☐ Check for firm attachment
- ☐ Oil lightly when fitting

9 - Oil pump

- ☐ With pressure relief valve (11.5 bar)
- ☐ Removing and installing ⇒ [page 151](#)
- ☐ Before installing, check that the two dowel sleeves for centralising are fitted.

10 - Dowel sleeve

11 - Chain

- ☐ Note installation position ⇒ ["3.2 Removing and installing balance shaft and retaining frame", page 58](#)

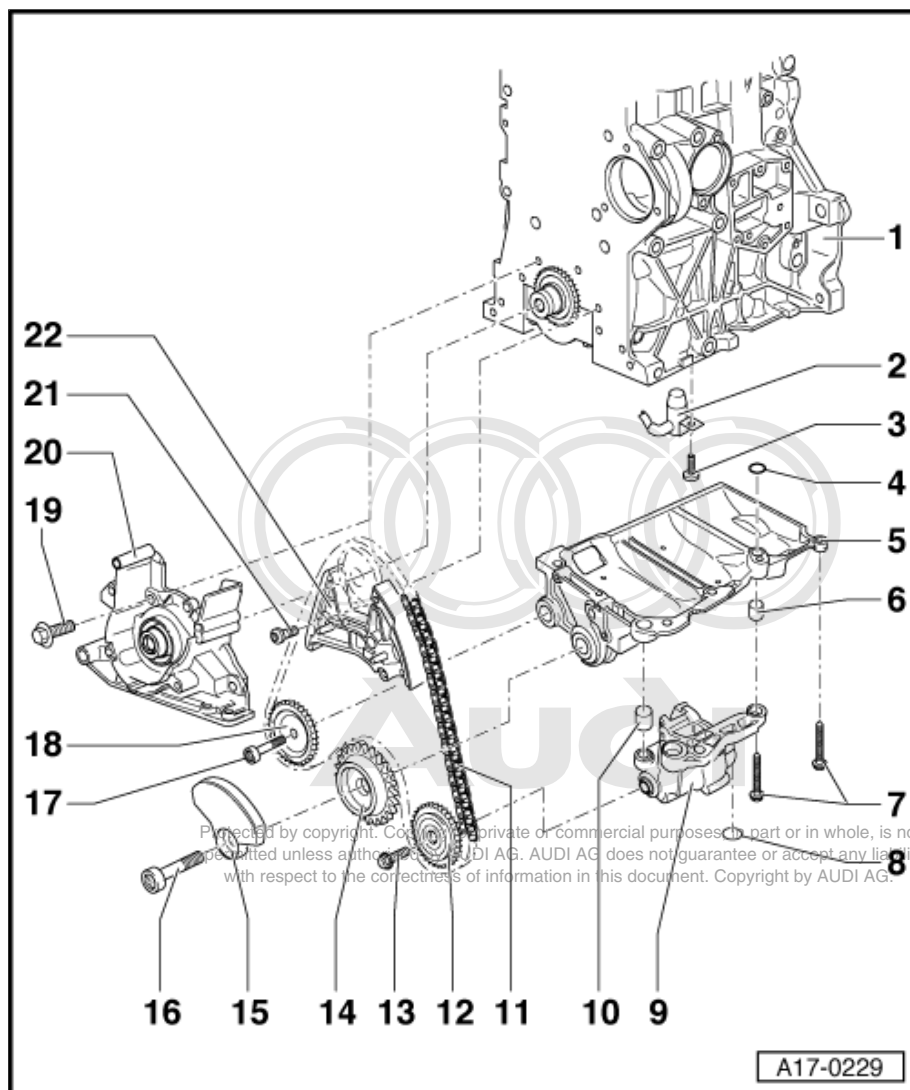
12 - Chain sprocket for oil pump

13 - Bolt

- ☐ Renew
- ☐ 20 Nm + 90° (1/4 turn further)

14 - Chain sprocket for balance shaft

- ☐ Can only be installed in one position



15 - Balance weight

- ☐ Can only be installed in one position

16 - Bolt

- ☐ Renew
- ☐ Use socket -T10061- to loosen and tighten
- ☐ 100 Nm + 90° (1/4 turn further)

17 - Bolt

- ☐ 20 Nm

18 - Idler sprocket**19 - Bolt**

- ☐ 15 Nm

20 - Sealing flange (pulley end)

- ☐ Must be positioned on dowel sleeves
- ☐ Removing and installing ⇒ [page 50](#)
- ☐ Renewing crankshaft oil seal on pulley end ⇒ [page 48](#)

21 - Bolt

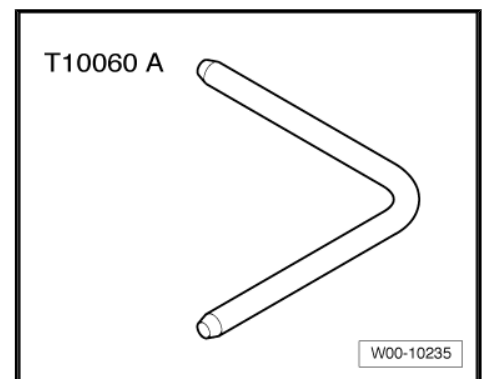
- ☐ Renew
- ☐ 8 Nm + 90° (1/4 turn further)

22 - Chain tensioner with tensioning rail

- ☐ To remove lock with locking pin -T10060 A-
- ☐ Removing and installing ⇒ [“3.2 Removing and installing balance shaft and retaining frame”, page 58](#)

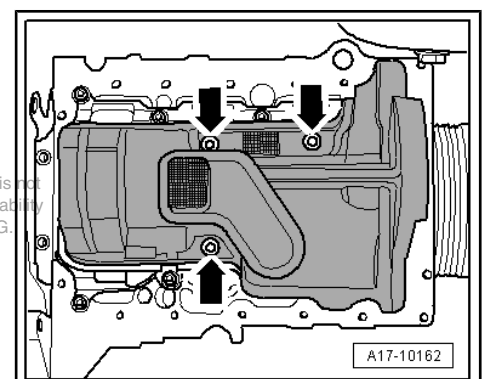
1.4 Removing and installing oil pump**Special tools and workshop equipment required**

- ◆ Locking pin -T10060 A-

**Removing**

- Remove sump ⇒ [page 146](#) .
- Remove bolts -arrows-.
- Release the 5 retaining tabs and remove baffle plate.

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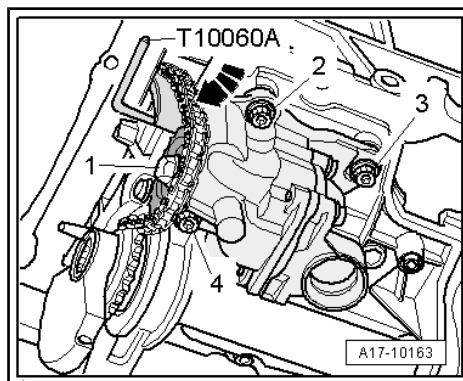


- Press down chain tensioner -arrow- and lock with locking pin -T10060 A- .



Caution

- ◆ **Do not remove oil pump sprocket from chain when detaching oil pump.**
- ◆ **Make sure that the chain remains in position on the chain sprocket. Otherwise the position of the balance shaft in relation to the crankshaft must be re-adjusted**
⇒ **page 60** .



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- Remove bolt -1-.
- Detach chain sprocket from oil pump and position it to rest in chain.
- Unscrew bolts -2 ... 4- and remove oil pump.

Installing

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



Note

Renew O-ring.

- Insert dowel sleeves ⇒ **Item 6 (page 150)** and ⇒ **Item 10 (page 150)** at top of oil pump.
- Chain sprocket can only be fitted in one position on oil pump shaft.
- Fit baffle plate with new O-ring.
- Install sump ⇒ **page 146** .

Tightening torques

Component	Nm
Chain sprocket to oil pump shaft	20 + 90° 1)2)
Oil pump to retaining frame	20 + 90° 1)2)
Baffle plate to retaining frame	5
• 1) Renew bolt. • 2) 90° = one quarter turn.	

1.5 Oil filter bracket with oil cooler - exploded view

- 25 Nm

 Renew

- ❑ Different versions
- ❑ See note ⇒ page 144
- ❑ Diagram of coolant hose connections
⇒ page 161

 Renew

- ❑ Installation position in vehicles with engine code letters AMF, BHC
⇒ [page 154](#)
- ❑ Installation position in vehicles with engine code letters ATL
⇒ [page 154](#)

- ❑ Tighten in diagonal sequence
 - ❑ 14 Nm + 90° (1/4 turn) further
- Protected by copyright

 Renew

☐ With oil retention valve

- ❑ The oil retention valve cannot be renewed separately

☐ Renew

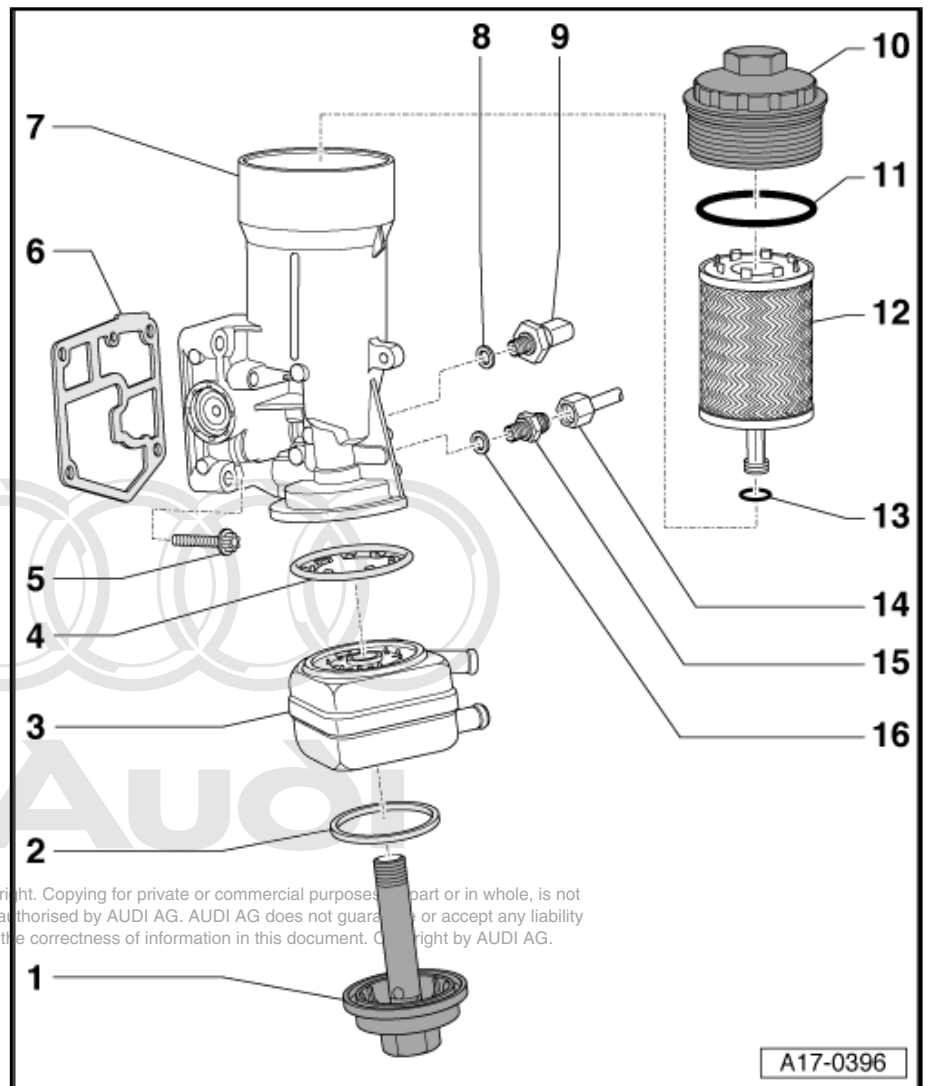
- Opening/closing pressure 0.7 bar

- ☐ Brown insulation
- ☐ Checking ⇒ page 158
- ☐ Removing and installing ⇒ page 157
- ☐ 20 Nm

25 Nm

- ❑ Detach from sealing cap -item 10-

- ☐ Renew O-rings -item 11- and -item 13- when renewing filter
- ☐ Note installation position
- ☐ Observe change intervals ⇒ Maintenance ; Booklet 809



13 - O-ring

- ☐ Renew

14 - Oil supply line

- ☐ To turbocharger
- ☐ Note installation sequence:
 - First attach both ends of pipe loosely.
 - Then tighten connections on ends of pipe to 22 Nm.
 - Finally, secure bracket.

15 - Connection

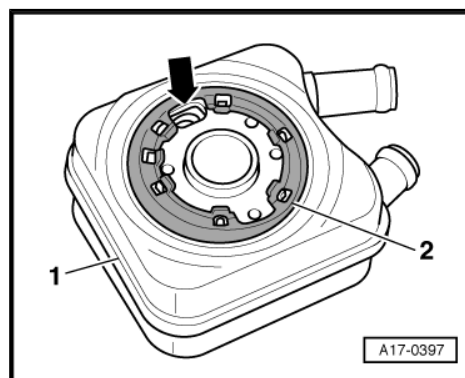
16 - Seal

- ☐ Renew

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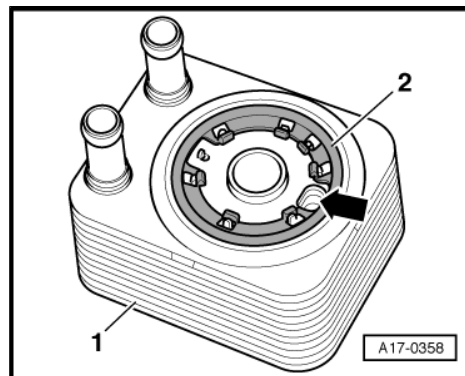
Installation position of seal for oil cooler on vehicles with engine code letters AMF, BHC

- Insert the seal -2- so that it can be attached to all tabs on the oil cooler -1-.
- The oil drilling -arrow- must not be covered by the seal.



Installation position of seal for oil cooler on vehicles with engine code letters ATL

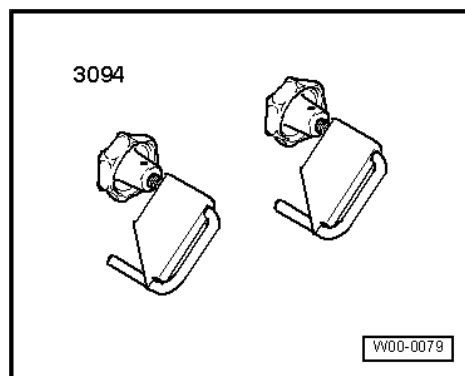
- Insert the seal -2- so that it can be attached to all tabs on the oil cooler -1-.
- The oil drilling -arrow- must not be covered by the seal.



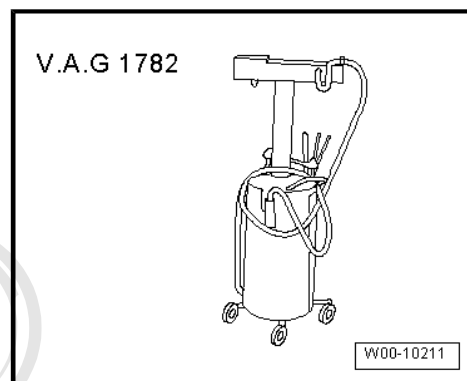
1.6 Removing and installing oil filter bracket

Special tools and workshop equipment required

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



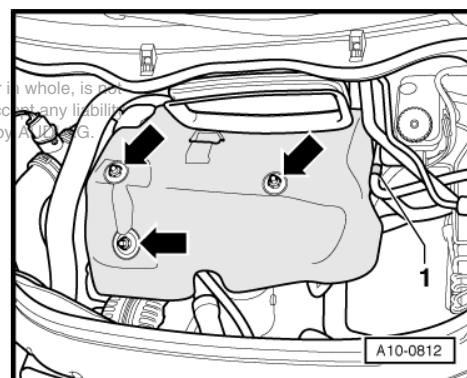
- ◆ Used oil collection and extraction unit -V.A.G 1782-



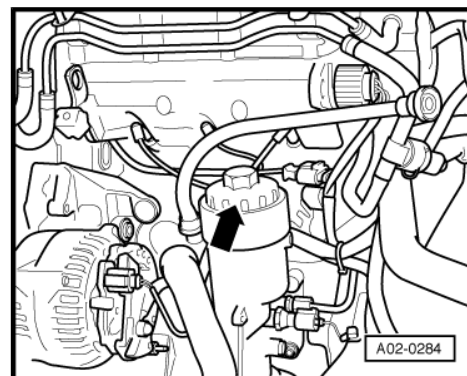
- ◆ Electric drill with plastic brush attachment
- ◆ Sealant ⇒ Parts catalogue
- ◆ Safety goggles

Removing

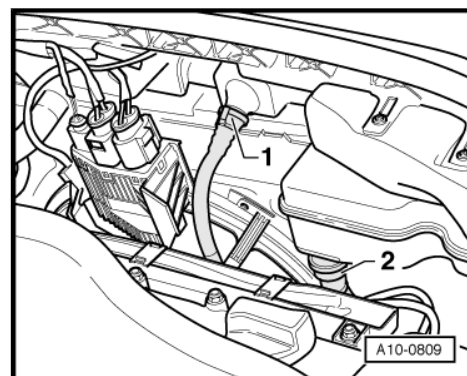
- Remove bonnet ⇒ [page 8](#).
- If fitted, unclip bracket -1-.
- Take off engine cover panel -arrows-.
- Remove noise insulation beneath cover.



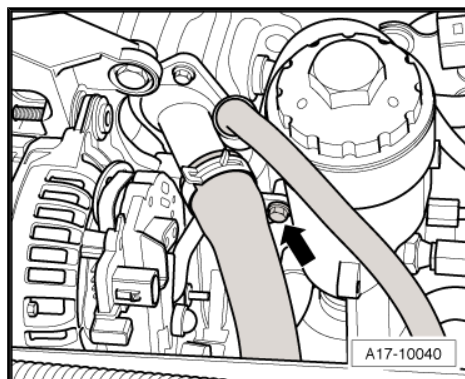
- Loosen sealing cap -arrow- several turns to drain the content of the oil filter housing into the sump.



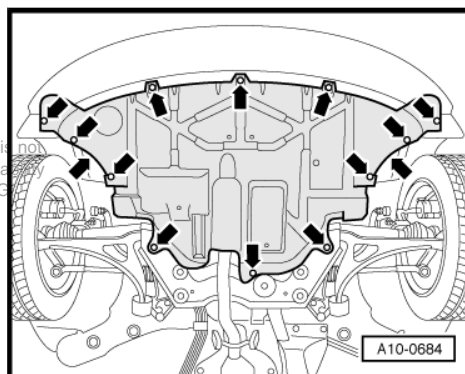
- Pull oil dipstick out of guide tube.
- Remove guide tube -1- for oil dipstick.
- Pull oil filler pipe -2- off oil filler reservoir.
- Move electrical wiring on oil filter bracket clear.



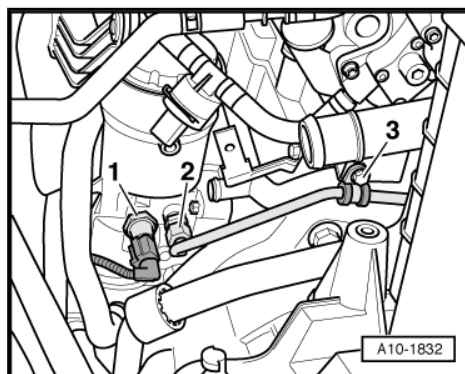
- Remove bolt -arrow- at connection for dipstick guide tube.



- Remove noise insulation -arrows-.



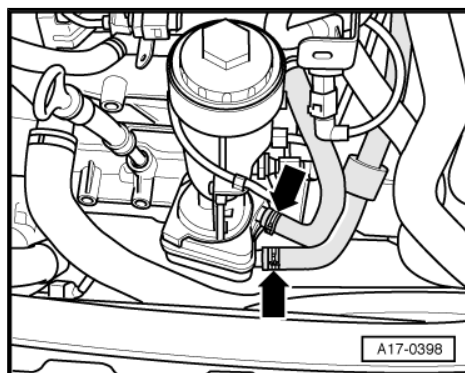
- Unplug electrical connector at oil pressure switch -F1- -item 1-.
- Place used oil collection and extraction unit -V.A.G 1782- under engine.
- Unscrew oil pressure switch.
- Detach oil supply line going to turbocharger at oil filter bracket -2-.



Note

Disregard -item 3-.

- Clamp off coolant hoses at oil cooler with hose clamps -3094- and detach -arrows-.



- Unscrew bolts -arrows- and remove oil filter bracket.

Installing

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

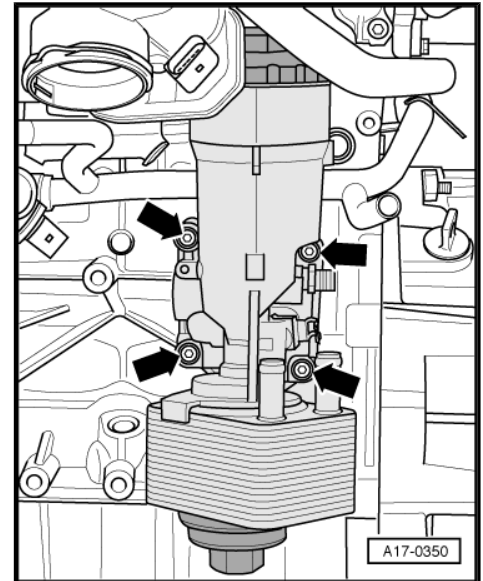
Note

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

- Fill up with engine oil and check oil level ⇒ [page 159](#) .

Tightening torques

Component	Nm
Oil filter bracket to cylinder block	14 + 90° 1)2)
Connection for dipstick guide tube to oil filter bracket	9
Oil supply line to oil filter bracket	22
Oil pressure switch to oil filter bracket	20
Connection for dipstick guide tube to sump	9
Engine cover panel to bracket	5.5
• 1) Renew bolts. • 2) 90° = one quarter turn.	



1.7 Removing and installing oil pressure switch -F1-

Removing

- Remove bonnet ⇒ [page 8](#) .
- Unplug electrical connector -arrow- at oil pressure switch -F1- .

Note

Place a cloth below the oil filter housing to catch escaping oil.

- Unscrew oil pressure switch.

Installing

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

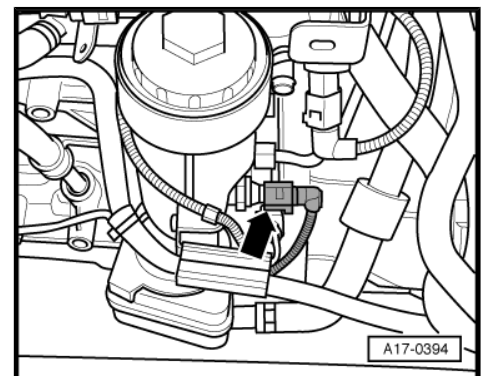
Note

Renew seal.

- Check oil level ⇒ [page 159](#) .

Tightening torque

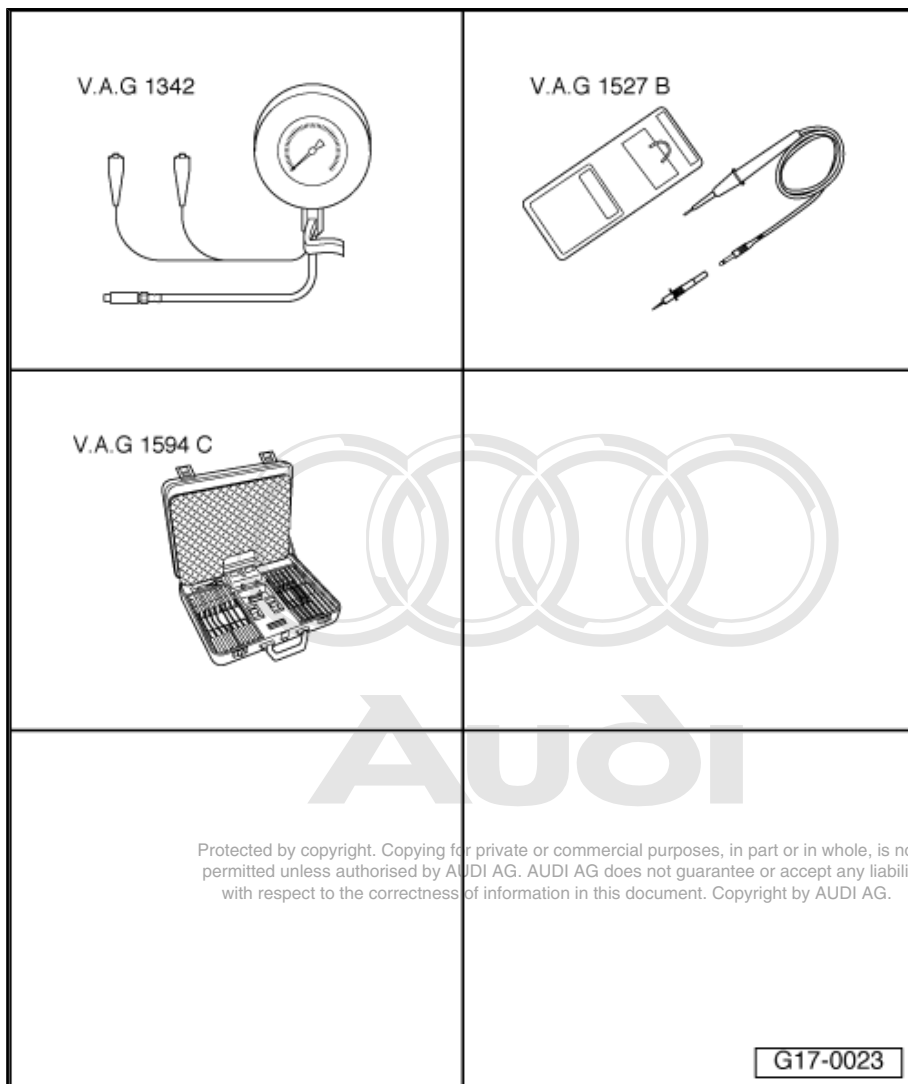
Component	Nm
Oil pressure switch -F1- to oil filter bracket	20



1.8 Checking oil pressure and oil pressure switch -F1-

Special tools and workshop equipment required

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



Procedure

- Oil level OK
- Engine oil temperature approx. 80 °C
- Remove oil pressure switch -F1- ⇒ [page 157](#) .

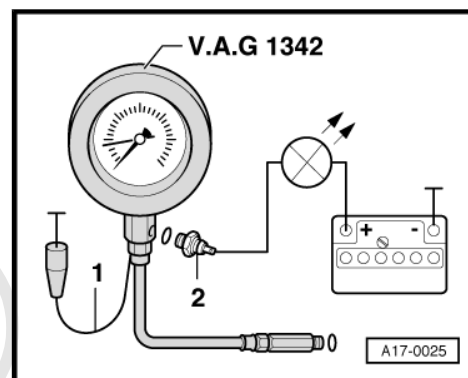
- Connect oil pressure tester -V.A.G 1342- to threaded hole for oil pressure switch.
- Screw oil pressure switch -2- into oil pressure tester - V.A.G 1342- .

Checking oil pressure switch

- Connect brown wire -1- of oil pressure tester to earth (-).
- Connect voltage tester -V.A.G 1527B- with test leads from auxiliary measuring set -V.A.G 1594C- 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 0.55 ... 0.85 bar.

If LED does not light up:

- Renew oil pressure switch.

Checking oil pressure

- Start engine.
- Minimum oil pressure at 2000 rpm: 2.0 bar

Assembling

- Install oil pressure switch ⇒ [page 157](#) .

1.9 Engine oil

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

1.10 Checking oil level

Procedure

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



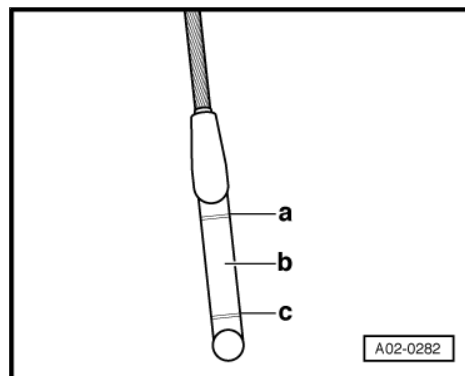
Markings on oil dipstick:

- a - Do not top up oil.
- b - Oil may be topped up.
- c - Oil must be topped up.



Note

The oil level must not be above the MAX marking -a- and not below the MIN marking -c-.



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19 – Cooling

1 Cooling system



WARNING

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



Note

- ◆ *The cooling system is under pressure when the engine is hot. If necessary, relieve pressure before commencing repair work.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) → Parts catalogue.*
- ◆ *The arrow markings on coolant pipes and on ends of coolant hoses must align.*

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1.1 Diagram of coolant hose connections

1 - Exhaust gas recirculation cooler or auxiliary heater

- ☐ Exhaust gas recirculation cooler is only fitted on engines with code letters ATL
- ☐ Fitting of auxiliary heater depends on equipment level

2 - Bleeder screw

3 - Coolant pipe

4 - Heat exchanger

- ☐ If renewed, refill system with fresh coolant

5 - Coolant pipe

6 - Coolant expansion tank

- ☐ With filler cap
- ☐ Checking pressure relief valve in filler cap
⇒ [page 177](#)

7 - Coolant hose

8 - Bleeder screw

9 - Radiator

- ☐ Removing and installing
⇒ [page 170](#)

- ☐ If renewed, refill system with fresh coolant

10 - Coolant hose

11 - Oil cooler

- ☐ If renewed, refill system with fresh coolant

- ☐ Removing and installing ⇒ ["1.6 Removing and installing oil filter bracket", page 154](#)

12 - Coolant pump/thermostat

- ☐ Removing and installing coolant pump ⇒ [page 168](#)
- ☐ Checking thermostat ⇒ [page 170](#)
- ☐ Removing and installing thermostat ⇒ [page 169](#)

13 - Cylinder head/cylinder block

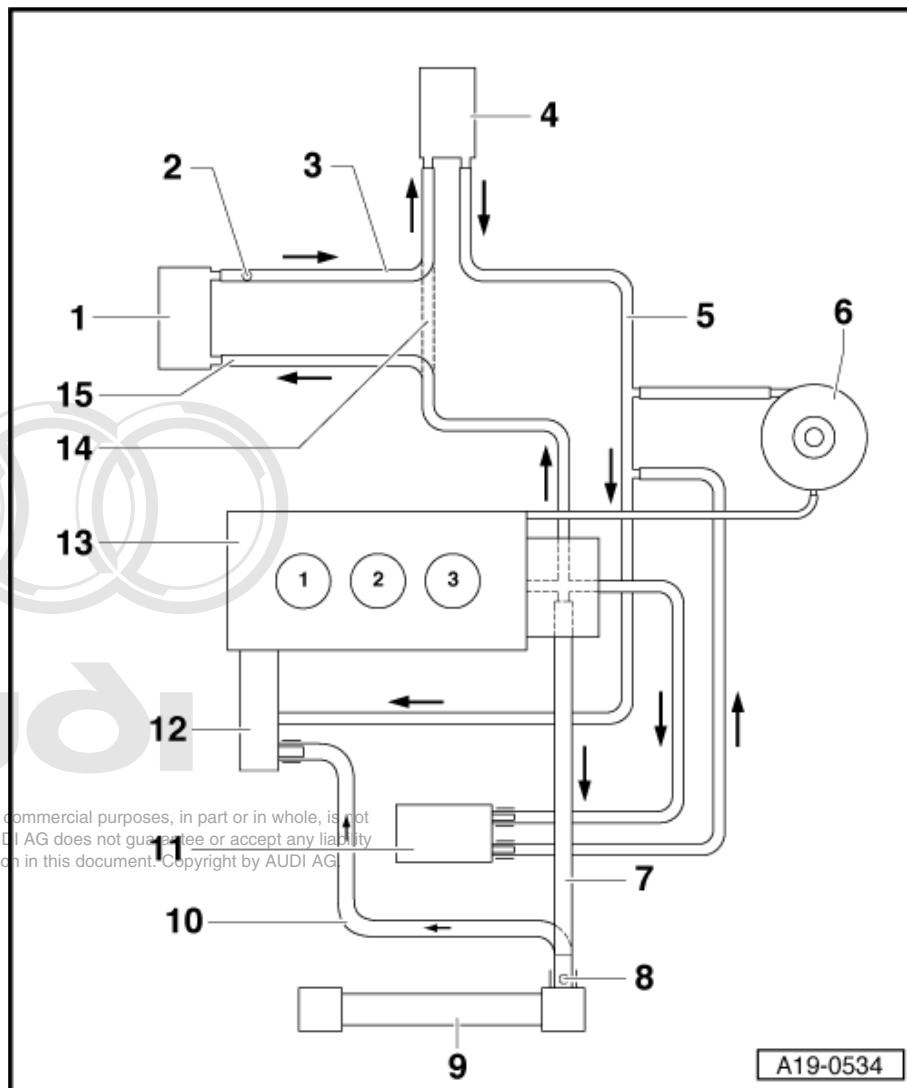
- ☐ If renewed, refill system with fresh coolant

14 - Coolant pipe

- ☐ Going to heat exchanger on vehicles without exhaust gas recirculation cooler or auxiliary heater

15 - Coolant pipe

- ☐ To exhaust gas recirculation cooler or auxiliary heater

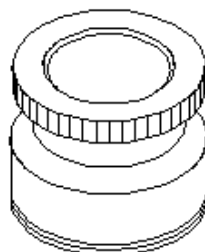


1.2 Draining and filling cooling system

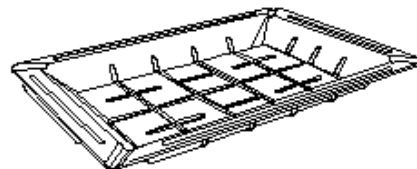
Special tools and workshop equipment required

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

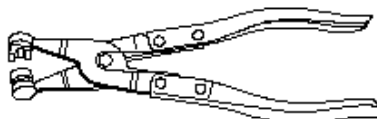
V.A.G 1274/8



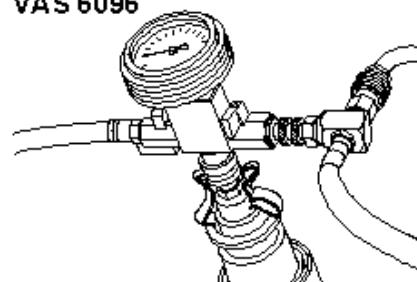
VAS 6208



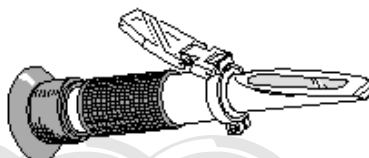
V.A.G 1921



VAS 6096



T10007



G19-10005

Draining

- Remove bonnet ⇒ [page 8](#) .



Note

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

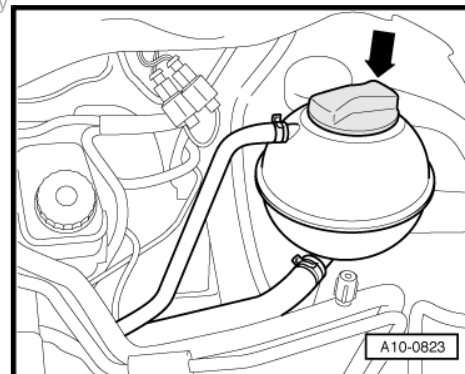
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WARNING

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

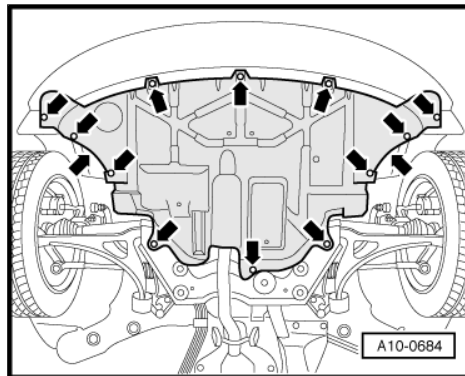
- Open filler cap -arrow- on coolant expansion tank.



A10-0823



- Remove noise insulation -arrows-.

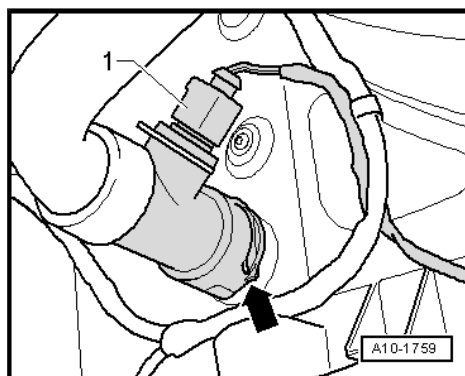


- Place drip tray for workshop hoist -VAS 6208- under engine.
- Disconnect coolant hose (bottom) at radiator -arrow- and drain off coolant.



Note

Disregard -item 1-.



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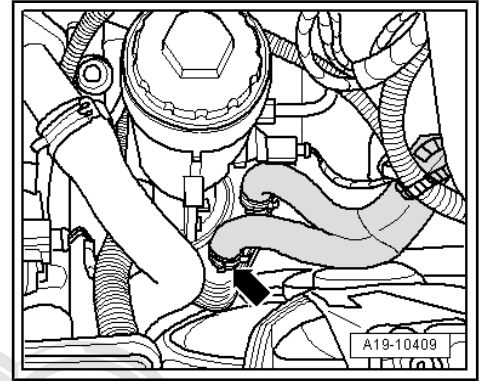
- Disconnect coolant hose from oil cooler -arrow-, guide downwards and drain off remaining coolant.

Filling



Note

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



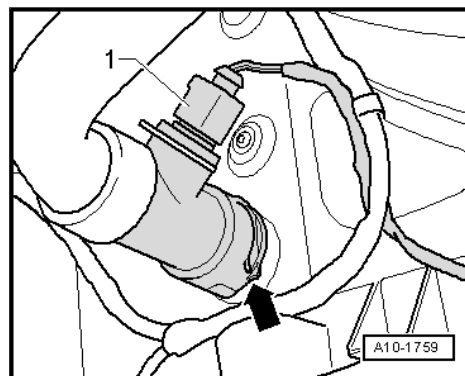
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- Connect coolant hose to lower part of radiator -arrow-.

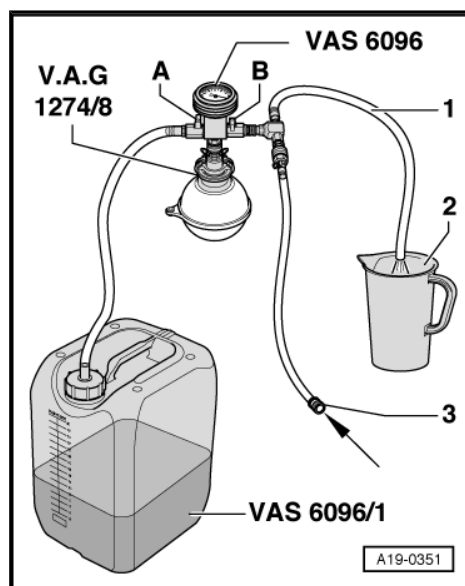


Note

Disregard -item 1-.



- Fill reservoir of cooling system charge unit -VAS 6096- with at least 6 litres of premixed coolant (based on recommended ratio):
 - »G12+« (40 %) and water (60 %) for frost protection to –25 °C
 - »G12+« (50 %) and water (50 %) for frost protection to –35 °C
 - »G12+« (60 %) and water (40 %) for frost protection to –40 °C
- Screw adapter -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-. (The vented air draws along a small amount of coolant, which should be collected.)
- Close the two valves -A- and -B- by setting lever at right angle to direction of flow.
- Connect hose -3- to compressed air.
- Pressure: 6 ... 10 bar.



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

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

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

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

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

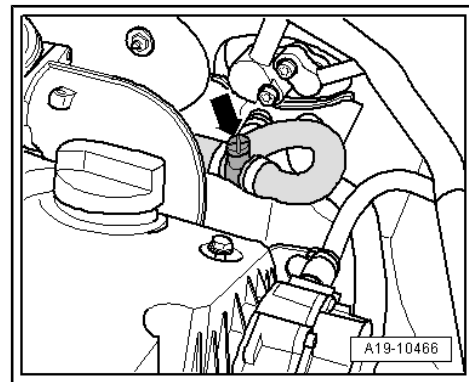
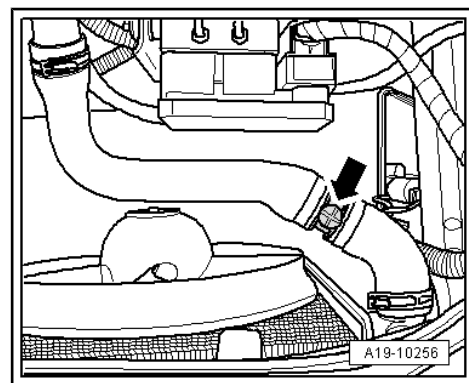
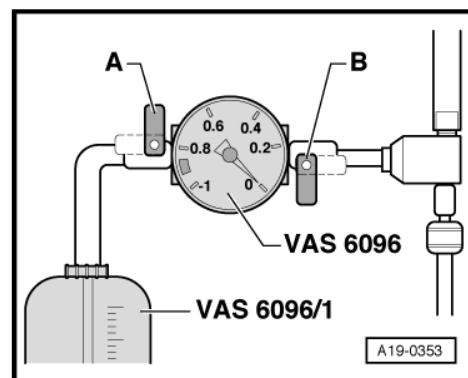
- Detach compressed air hose.
- Open valve -A-.

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

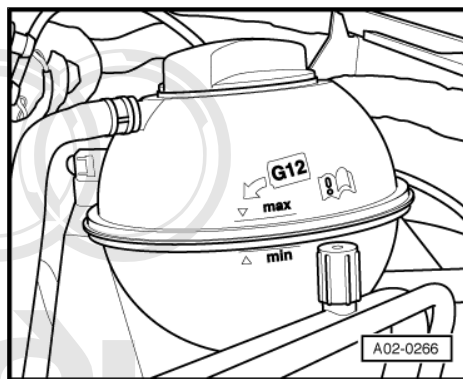
- Detach cooling system charge unit -VAS 6096- from adapter -V.A.G 1274/8- on coolant expansion tank.
- Open bleeder screw -arrow- in coolant hose at top left of radiator.
- Fill up with coolant until it flows out at bleeder hole.
- Close bleeder screw.

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- If fitted, open bleeder screw -arrow- in coolant hose going to heat exchanger for heater.
- Fill up with coolant until it flows out at bleeder hole.
- Close bleeder screw.



- Check the coolant level and top up coolant as far as the max mark.
- On vehicles with auxiliary heater, switch auxiliary heater on (for about 30 seconds) ⇒ Owner's Manual .
- Start engine, run for 2 minutes (maximum) at approx. 2000 rpm and top up coolant to max. mark on expansion tank with engine running.
- Tighten filler cap on expansion tank.
- Run engine until radiator fan cuts in.



WARNING

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

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

1.3 Removing and installing coolant pump

Removing

- Drain off coolant ⇒ [page 163](#) .
- Remove toothed belt: toothed belt drive with hydraulically damped tensioning roller ⇒ [page 102](#) , toothed belt drive with friction-damped tensioning roller ⇒ [page 116](#) .
- Remove bolts -1- and detach coolant pump -2-.
- Remove O-ring -3-.

Installing

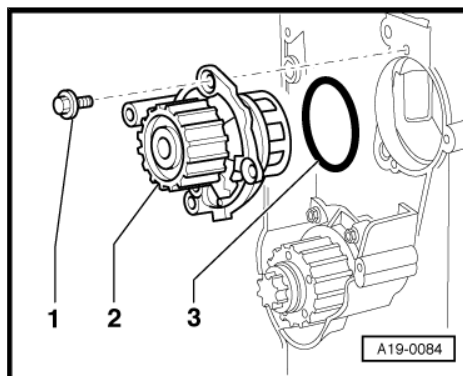
Installation is carried out in the reverse order; note the following:



Note

Renew O-ring.

- Clean and smoothen sealing surface for O-ring as required.
- Lubricate new O-ring -3- with coolant additive »G12+«.
- Fit coolant pump -2-.
- Installation position: Sealing plug in housing faces downwards.
- Install toothed belt (adjust valve timing): toothed belt drive with hydraulically damped tensioning roller ⇒ [page 109](#) , toothed belt drive with friction-damped tensioning roller ⇒ [page 123](#) .
- Fill cooling system ⇒ [page 165](#) .



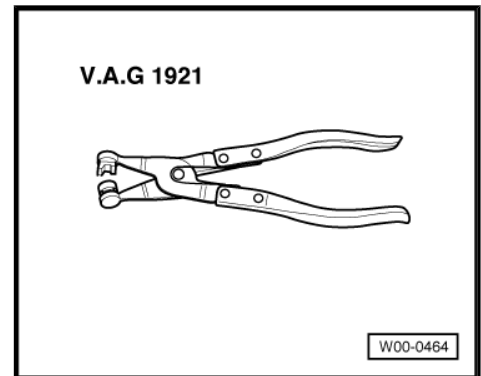
Tightening torque

Component	Nm
Coolant pump to cylinder block	15

1.4 Removing and installing thermostat

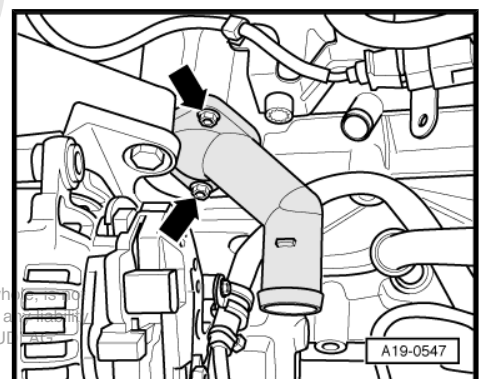
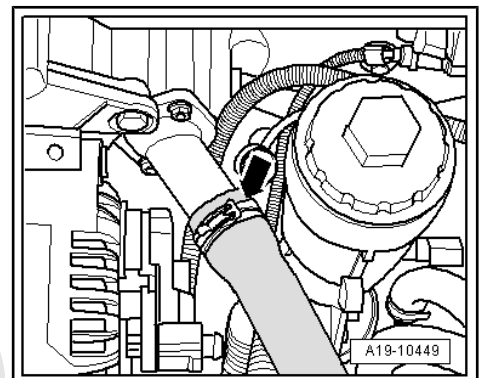
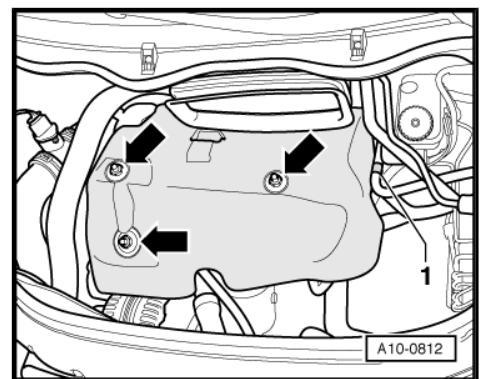
Special tools and workshop equipment required

- ◆ Hose clip pliers -V.A.G 1921-



Removing

- Remove bonnet ⇒ [page 8](#) .
- If fitted, unclip bracket -1-.
- Take off engine cover panel -arrows-.
- Remove noise insulation beneath cover.
- Drain off coolant ⇒ [page 163](#) .
- Detach coolant hose from hose connection at front of engine -arrow-.
- Unscrew bolts -arrows- and remove hose connection.
- Turn thermostat clockwise through approx. 90° (1/4 turn) and remove thermostat from hose connection.
- Remove O-ring.



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Installing

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



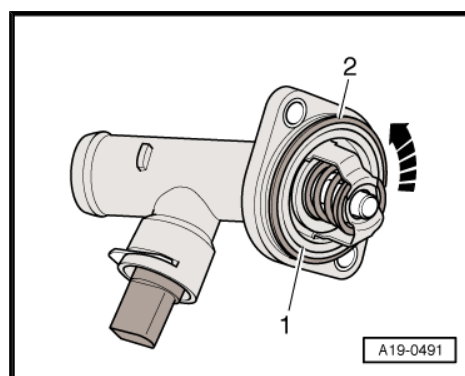
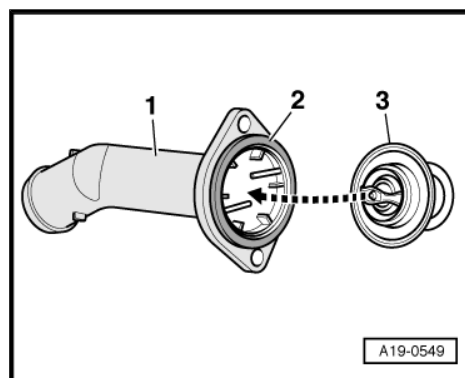
Note

Renew O-ring.

- Clean and smoothen sealing surface for O-ring as required.
- Insert thermostat -3- with new O-ring -2- into hose connection -1-.
- When inserting, the cross-piece on the thermostat should be horizontal as shown in the illustration.
- Lubricate O-ring -2- with coolant additive »G12+«.
- Turn thermostat anti-clockwise -arrow- through approx. 90° (1/4 turn).
- Fill cooling system ⇒ [page 165](#) .

Tightening torques

Component	Nm
Connection to cylinder block	15
Engine cover panel to bracket	5.5



1.5 Checking thermostat

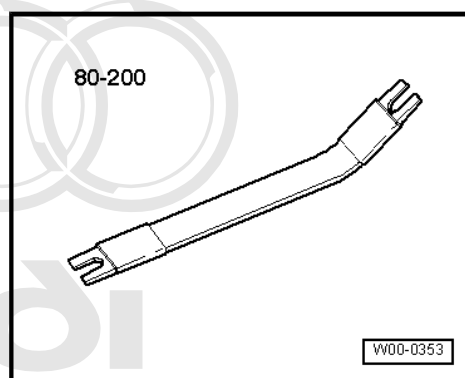
- Heat removed thermostat in water bath.

Starts to open	Fully open	Opening travel
approx. 87 °C	approx. 102 °C ¹⁾	at least 8 mm
• ¹⁾ Cannot be tested.		

1.6 Removing and installing radiator

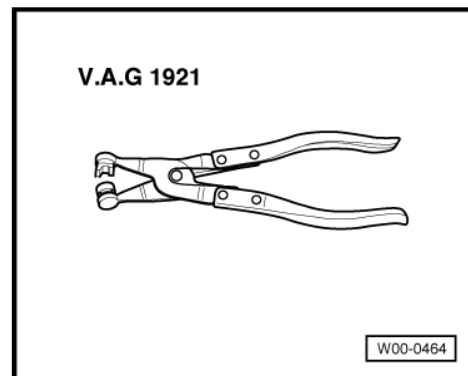
Special tools and workshop equipment required

- ◆ Removal lever -80 - 200-

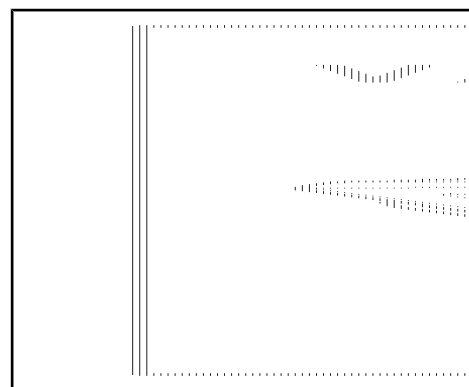


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- ◆ Hose clip pliers -V.A.G 1921-



- ◆ Drip tray for workshop hoist -VAS 6208-



Removing

- Remove bonnet → [page 8](#) .



Note

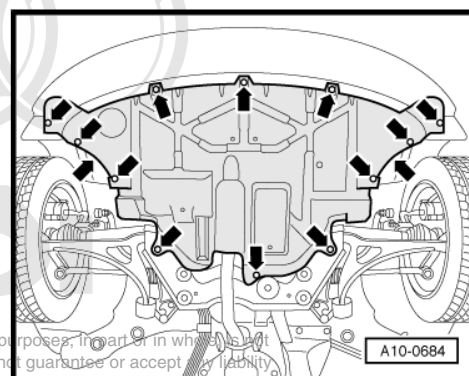
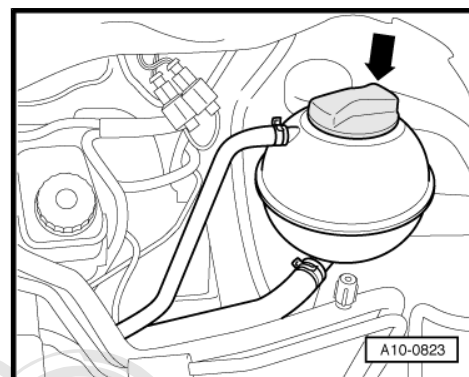
Collect drained coolant in a clean container for re-use or disposal.



WARNING

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

- Open filler cap -arrow- on coolant expansion tank.
- Remove noise insulation -arrows-.
- Remove bumper cover (front) → Rep. gr. 63 .

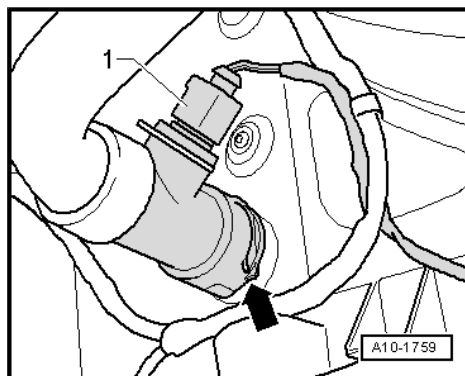


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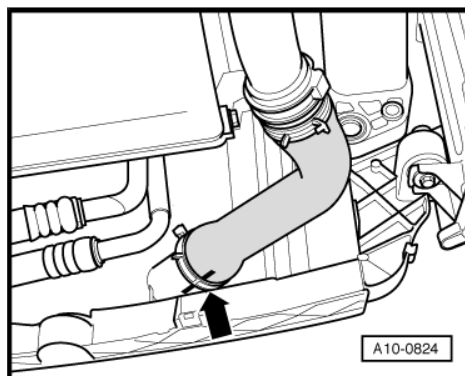
- Place drip tray for workshop hoist -VAS 6208- under engine.
- Disconnect coolant hose (bottom) at radiator -arrow- and drain off coolant.


Note

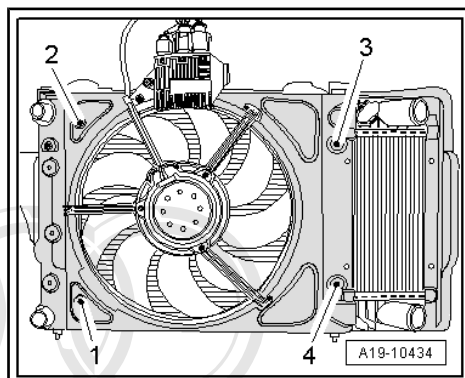
Disregard -item 1-.



- Remove bottom air intake hose from charge air cooler -arrow-.



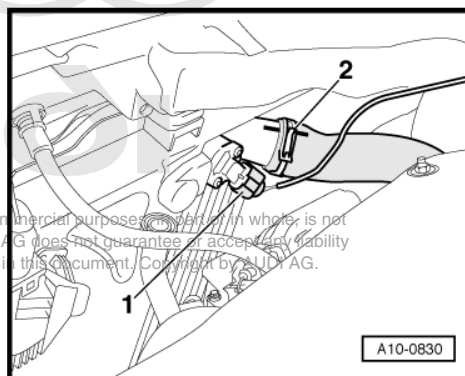
- Remove bolts -1 and 4- securing radiator at bottom of radiator cowl.


Vehicles with engine code letters AMF, BHC:

- Unplug electrical connector -1- at intake manifold pressure sender -G71- and move wiring clear.

All vehicles:

- Remove air intake hose -2- from charge air cooler.



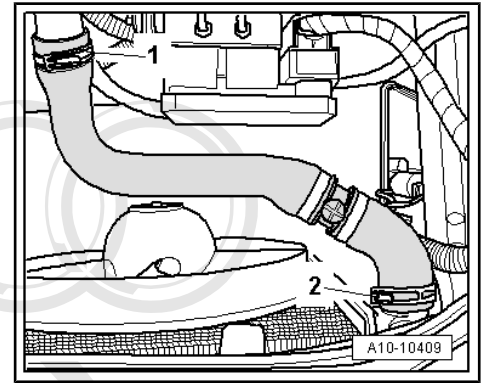
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- Detach top left coolant hose from radiator -item 2-.



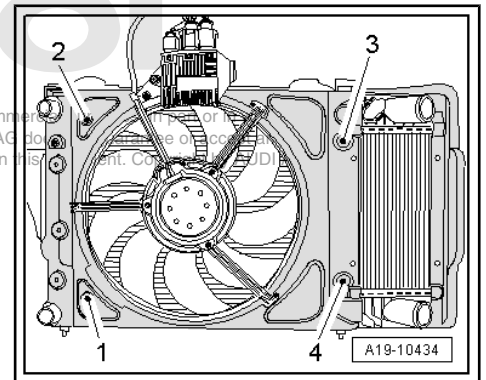
Note

Disregard -item 1-.

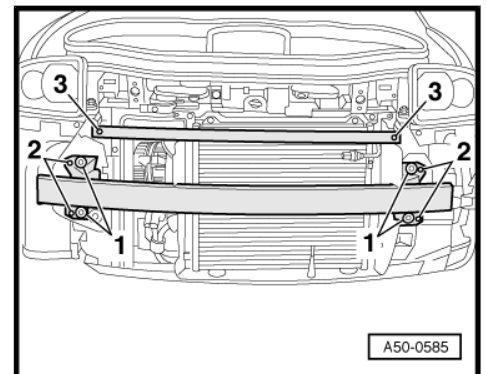


- Remove bolts -2 and 3- securing radiator at top of radiator cowl.

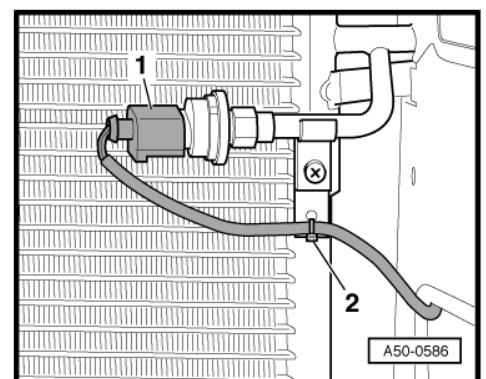
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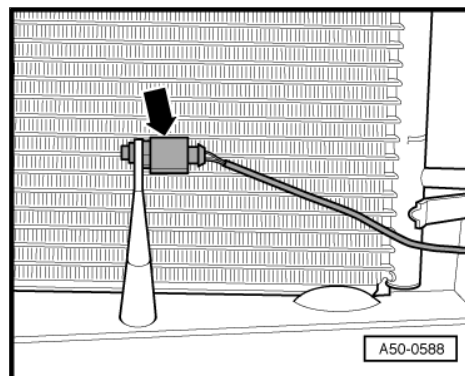
- Unplug electrical connector at horn.
- Remove two bolts each on left and right -3- and detach reinforcement rail.
- Lever off circlips -2-.
- Remove bolts on left and right -1- and detach bumper impact absorber.



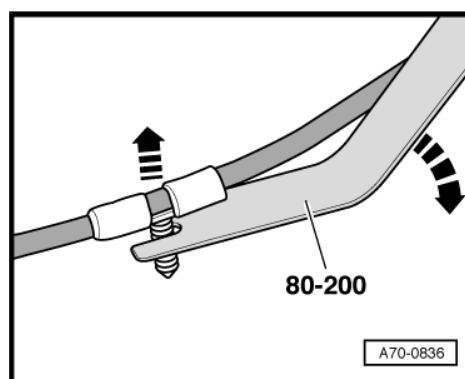
- Detach electrical connector -1- at high-pressure sender - G65- .
- Cut through cable tie -2-.



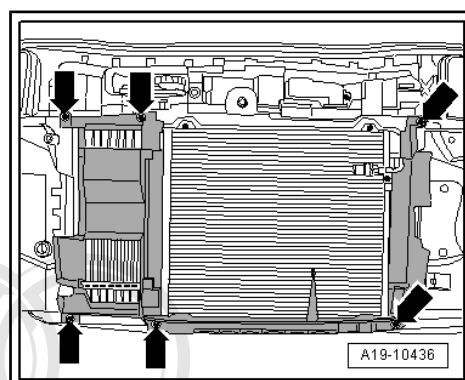
- Detach ambient temperature sensor -G17- -arrow- from bracket.



- Use removal lever -80 - 200- to press off electrical wiring harness leading to high-pressure sender -G65- and ambient temperature sensor -G17- from air duct (left-side).



- Unbolt air ducts from lock carrier -arrows-.



Caution

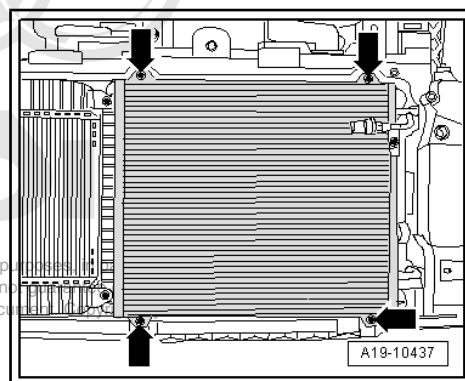
The air conditioner refrigerant circuit must not be opened.

- Remove bolts -arrows- for condenser.



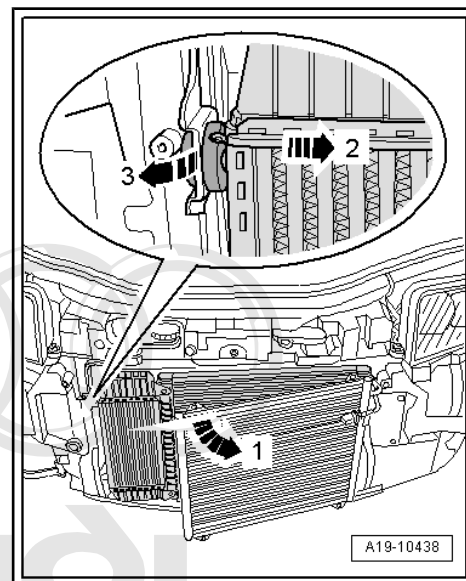
Note

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



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- Pivot condenser slightly forward on right side of vehicle -arrow 1-.
- Press radiator with charge air cooler to left side of vehicle as far as possible -arrow 2-.
- Spray rubber grommets on mounting for charge air cooler with silicone-free lubricant.
- Disengage retaining pegs of charge air cooler from rubber grommets on radiator cowl (press eyelets of radiator cowl slightly to right -arrow 3-).
- Carefully pull condenser forward as far as possible on left side (connection side).
- Guide radiator connections out of radiator cowl one by one, moving radiator up or down as required.
- Take out radiator with charge air cooler to left.



- Remove a total of 4 bolts securing charge air cooler to radiator -arrows-.

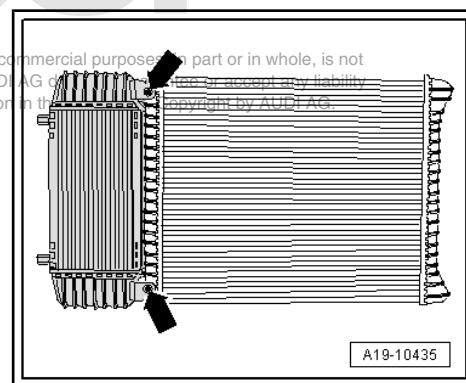
Installing

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

- Install impact absorber and reinforcement rail ⇒ Rep. gr. 63 .
- Install bumper cover (front) ⇒ Rep. gr. 63 .
- Install air pipes/hoses with plug-in connectors ⇒ [page 202](#) .
- Fill cooling system ⇒ [page 165](#) .

Tightening torques

Component	Nm
Charge air cooler to radiator	6
Radiator to radiator cowl	6
Condenser to radiator cowl	6
Air ducts to radiator cowl	1.5



1.7 Checking cooling system for leaks

Special tools and workshop equipment required

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

V.A.G 1274



V.A.G 1274/8



V.A.G 1274/9



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G19-0002

Procedure

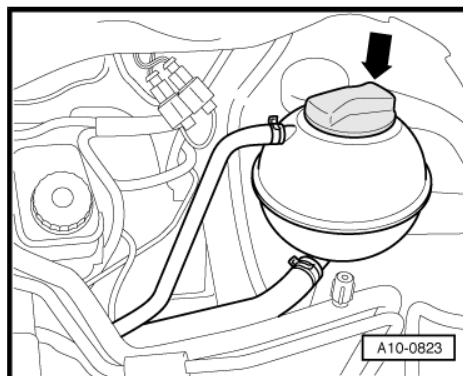
- Engine must be warm.



WARNING

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

- Open filler cap -arrow- on coolant expansion tank.

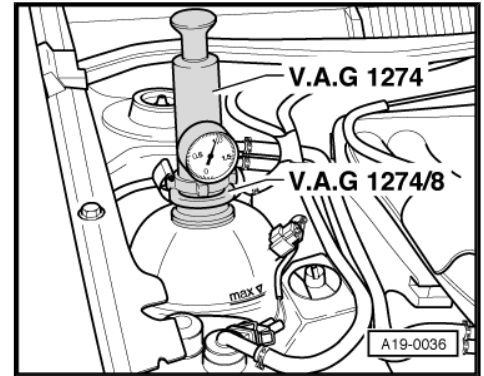


A10-0823

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

If the pressure drops:

- Trace leak and repair.

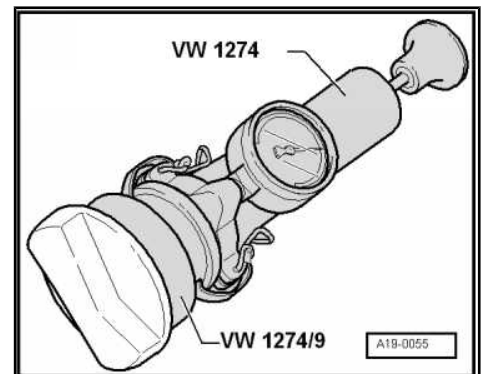


Checking pressure relief valve in filler cap

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

If the pressure relief valve does not open as described:

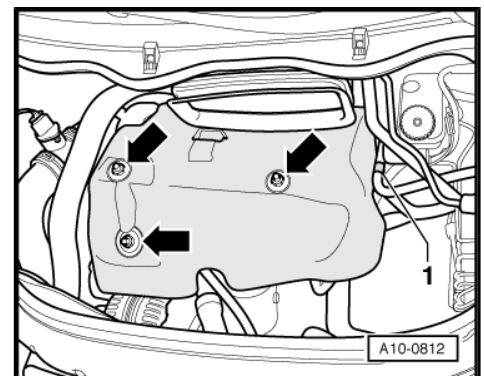
- Renew filler cap.



1.8 Removing and installing radiator fan - V7-

Removing

- Remove bonnet → [page 8](#).
- If fitted, unclip bracket -1-.
- Take off engine cover panel -arrows-.

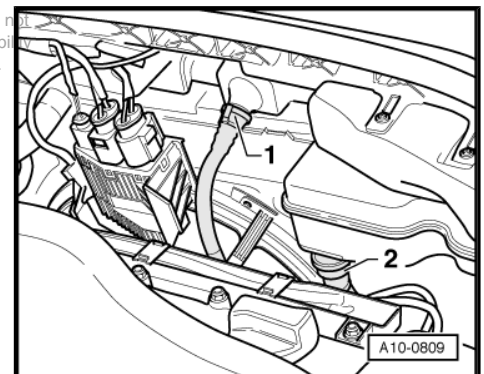


- Pull oil dipstick out of guide tube.
- Remove guide tube -1- for oil dipstick.



Note

Disregard -item 2-.



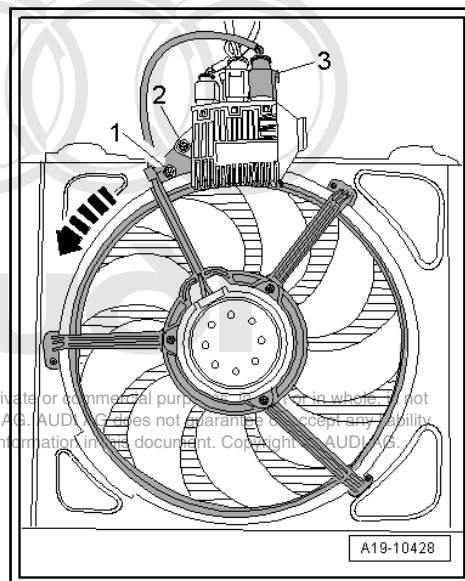
- Unplug electrical connector -3- at radiator fan control unit -J293- .
- Unscrew bolt -2- and remove radiator fan control unit -J293- .
- Remove securing bolt -1-.
- Turn retaining ring in direction of -arrow- and remove radiator fan -V7- with retaining ring.

Installing

Install in reverse order.

Tightening torques

Component	Nm
Retaining bolt for radiator fan -V7- to radiator cowl	5
Radiator fan control unit -J293- to radiator cowl	5
Engine cover panel to bracket	5.5



21 – Turbocharging/supercharging

1 Checking charge air system with turbocharger

Note

- ◆ *Observe rules for cleanliness ⇒ [page 6](#) .*
- ◆ *Renew gaskets, seals and self-locking nuts.*
- ◆ *Charge air system must be free of leaks.*
- ◆ *Hose connections and hoses for charge air system must be free of oil and grease before assembly. Do NOT use lubricant.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ [Parts catalogue](#).*

1.1 Test requirements for checking turbocharging system

- Coolant temperature at least 80 °C.
- Fault memory of engine control unit interrogated.
- Exhaust gas recirculation system OK, checking ⇒ [page 218](#) .

Note

Reliable values cannot be obtained when checking turbocharger system if the exhaust gas recirculation system is defective.

- No leaks in the intake and exhaust systems. Effects of leaks ⇒ [page 179](#) .
- Vacuum pipe to charge pressure regulating valve not obstructed, loose or leaking.
- No faults on engine or injection system (e.g. compression pressure or unit injectors).

1.2 Effects of leaks in charge air system

A - Leaks after air mass meter -G70-

Possible causes of trouble:

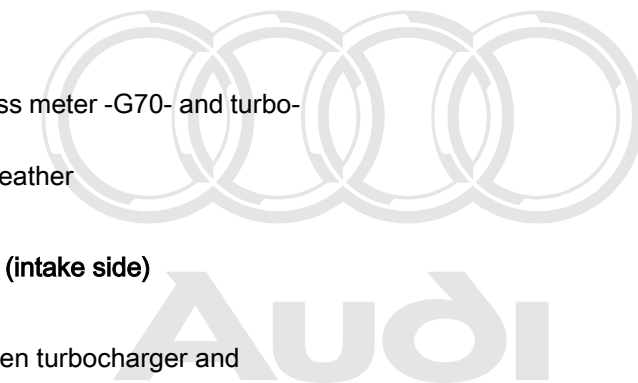
- 1 - Connecting hose between air mass meter -G70- and turbocharger
- 2 - Connecting hose to crankcase breather

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 intake hoses and pipes between charge air cooler and intake manifold
- 3 - Charge air cooler



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- 4 - Seal below intake manifold pressure sender -G71-
- 5 - Seal between intake manifold connection, mechanical exhaust gas recirculation valve and intake manifold
- 6 - Gasket between intake manifold and cylinder head

Effect: inadequate charge pressure

C - Leaks downstream of turbocharger (exhaust side)

Possible causes of trouble:

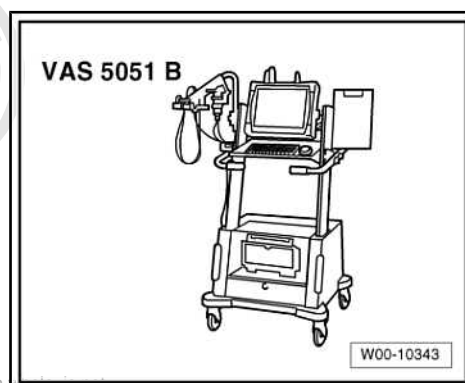
- 1 - Components of exhaust gas recirculation system
- 2 - Connection between exhaust manifold and cylinder head

Effect: inadequate charge pressure; possible smell of exhaust gas, traces of soot in engine compartment

1.3 Checking charge pressure

Special tools and workshop equipment required

- ◆ Vehicle diagnosis, testing and information system -VAS 5051-



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Procedure

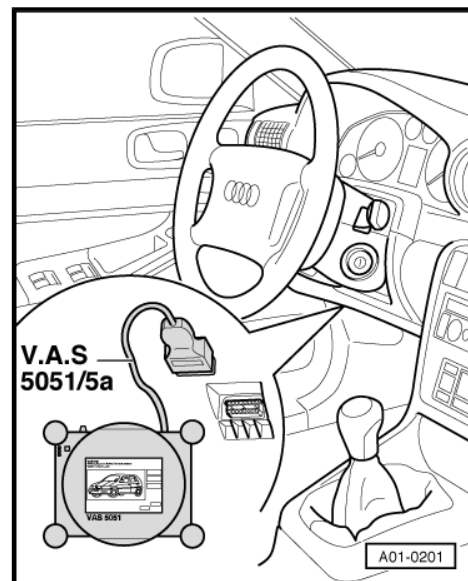
- All hoses, pipes and wiring are checked for tight fit and leak-ages.
- No leaks in the intake and exhaust systems.
- No faults on engine or injection system (e.g. compression pressure or injector units).
- Coolant temperature at least 80 °C.
- Fault memory interrogated.



WARNING

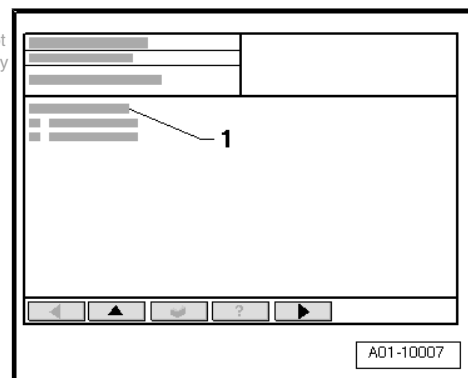
*To avoid accident risks when road testing the vehicle with test equipment, always observe the relevant safety precautions
⇒ **page 4**.*

- Start the engine and run at idling speed.
- Connect up the vehicle diagnostic, testing and information system -VAS 5051B- .



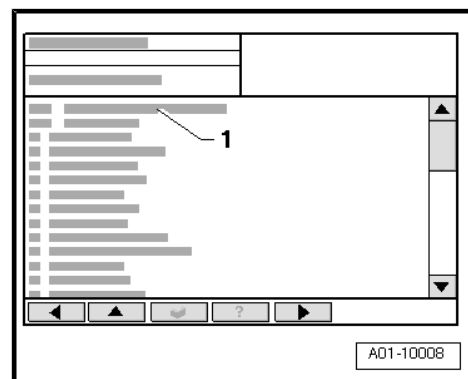
Display on -VAS 5051B- :

- From menu -1-, select system "Self-diagnosis" and press  key to activate function.



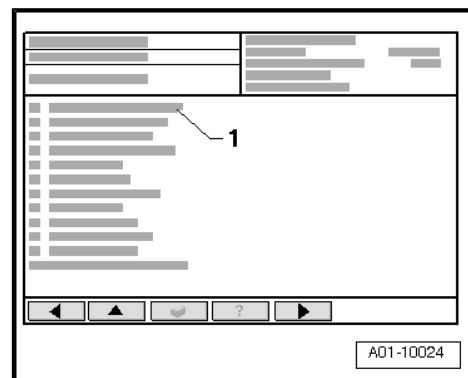
Display on -VAS 5051B- :

- From menu -1-, select vehicle system "01 - Engine electronics" and press  key to activate function.



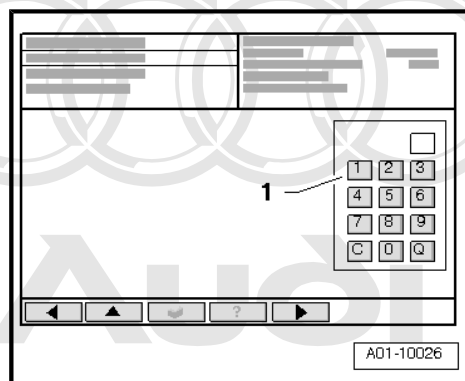
Display on -VAS 5051B- :

- From menu -1-, select function "010 - Read measured value" and press  key to activate function.



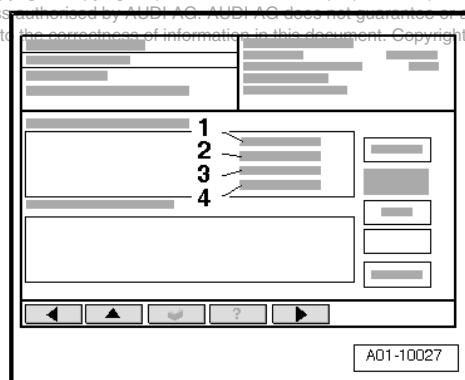
Display on -VAS 5051B- :

- Press keys **[1] [1]** on keypad -1- to select “Display group 11” and confirm entry by pressing key **[Q]**.



Display on -VAS 5051B- :

- Accelerate vehicle in 3rd gear from 2000 rpm at full throttle and observe rev counter.
- Press “Print - Save result” on -VAS 5051B- at approx. 3000 rpm.



Display zone	Display shows	Specification for engine code AMF, BHC	Specification for engine code ATL
-1-	Engine speed	2800 ... 3200 rpm	2800 ... 3200 rpm
-2-	Specification (charge pressure)	1800 ... 2100 mbar	2100 ... 2400 mbar
-3-	Actual (charge pressure)	1700 ... 2200 mbar	2000 ... 2500 mbar
-4-	Signal ratio of charge pressure control solenoid valve - N75-	... %	... %

- Exit function “010 - Read measured value” by pressing the **[Q]** key.
- Press “022 - End output”.
- Switch off ignition.

If charge pressure in display zone -3- is not within the specified range:

- Check charge air system for leaks.
- Check charge pressure control solenoid valve -N75- ⇒ Vehicle diagnostic tester.

If all the above items are OK, but the charge pressure is too low:

- Renew turbocharger
⇒ [“2.2 Removing and installing turbocharger - vehicles with engine code letters AMF”, page 186](#) or
⇒ [“2.4 Removing and installing turbocharger - vehicles with engine code letters ATL, BHC”, page 194](#) .

1.4 Diagram of vacuum hose connections

Vehicles with engine code letters AMF

1 - Variable intake manifold flap change-over valve -N239-

2 - Exhaust gas recirculation valve -N18-

3 - Charge pressure control solenoid valve -N75-

4 - Connecting piece

5 - To brake servo

6 - Non-return valve

7 - Vacuum unit for charge pressure control

8 - Turbocharger

9 - Charge air cooler

10 - Intake manifold

11 - Tandem pump

- ☐ For fuel and vacuum supply

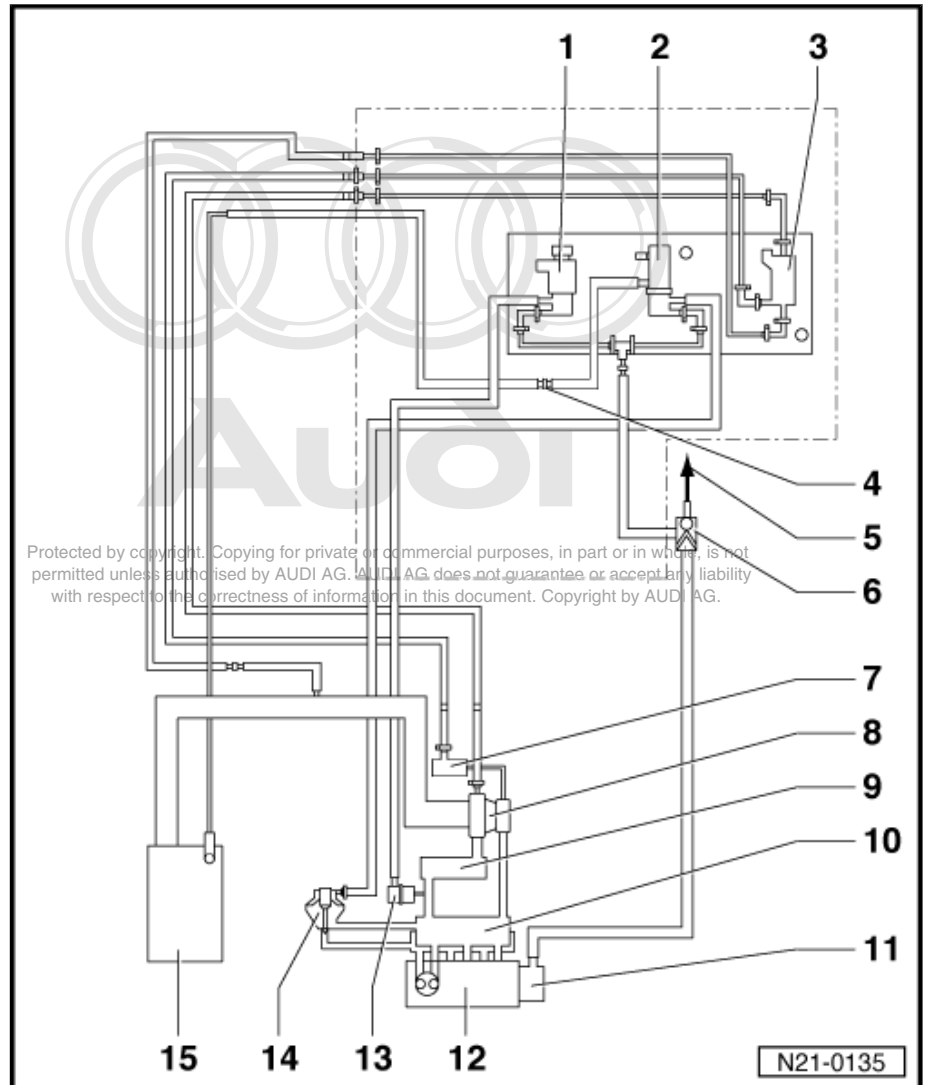
12 - Cylinder head

13 - Vacuum unit for intake manifold flap

14 - Mechanical exhaust gas recirculation valve

- ☐ Is combined with intake manifold connection
- ☐ Can only be renewed together with intake manifold connection

15 - Air mass meter -G70-



Vehicles with engine code letters ATL, BHC

- 1 - Vacuum reservoir
 2 - Throttle butterfly valve - N211-
 3 - Exhaust gas recirculation valve -N18-

- ☐ Only for vehicles with engine code BHC

- 4 - Non-return valve
☐ White connection to charge pressure control solenoid valve -N75-

- 5 - Charge pressure control solenoid valve -N75-

- 6 - To brake servo

- 7 - Non-return valve

- 8 - Vacuum unit for charge pressure control

- 9 - Turbocharger

- 10 - Charge air cooler

- 11 - Intake manifold

- 12 - Tandem pump

- ☐ For fuel and vacuum supply

- 13 - Cylinder head

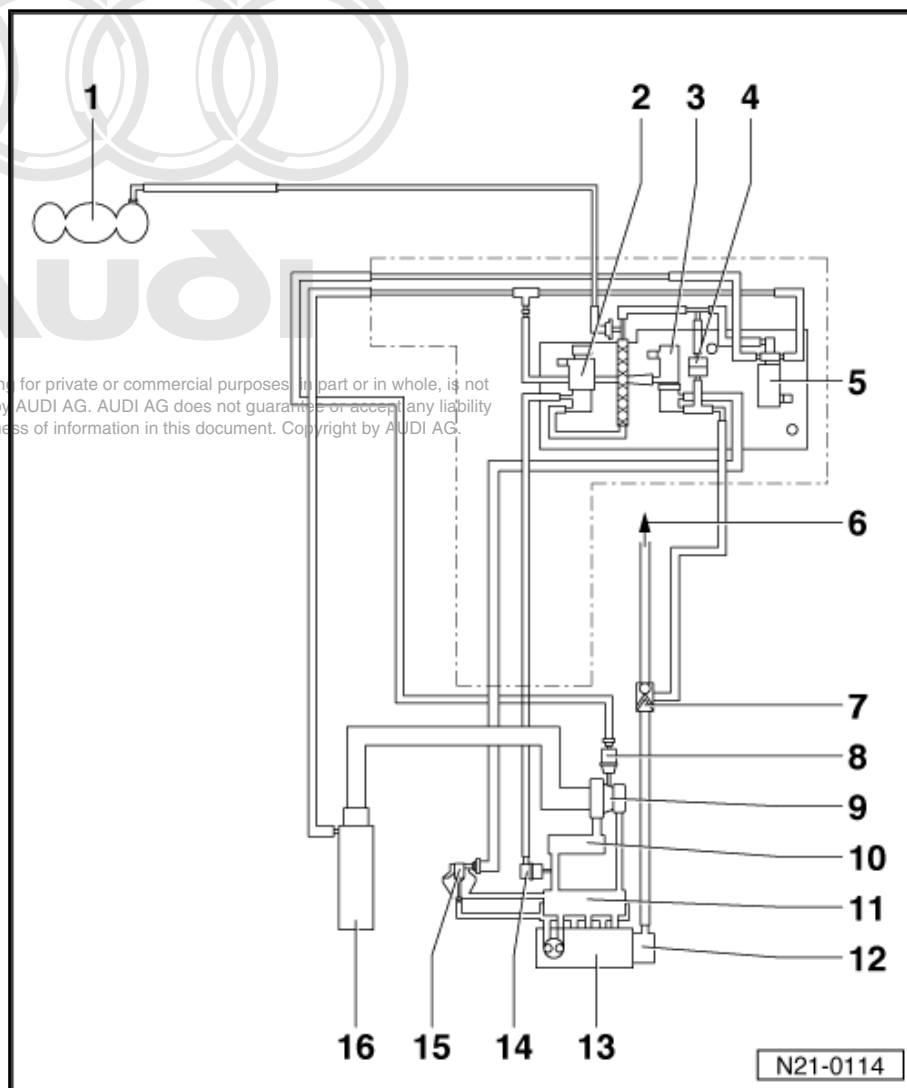
- 14 - Vacuum unit for intake manifold flap

- ☐ Only for vehicles with engine code BHC

- 15 - Mechanical exhaust gas recirculation valve

- ☐ Is combined with intake manifold connection
☐ Can only be renewed together with intake manifold connection

- 16 - Air cleaner



2 Servicing charge air system with turbocharger



Note

Observe rules for cleanliness ⇒ [page 6](#).

2.1 Turbocharger for vehicles with code letters AMF - exploded view

1 - Exhaust manifold

- ☐ Removing and installing
⇒ [page 209](#)

2 - Bolt/nut

- ☐ Renew
- ☐ Coat thread and contact surface of bolt head with high-temperature paste; ⇒ Parts catalogue
- ☐ 25 Nm

3 - Intake manifold

- ☐ Removing and installing
⇒ Rep. gr. 23

4 - From charge air cooler

5 - Gasket

- ☐ Renew
- ☐ Coating (bead) faces intake manifold
- ☐ Installation position: straight edge of gasket faces upwards

6 - Bolt

- ☐ 22 Nm

7 - Gasket

- ☐ Renew
- ☐ Installation position: straight edge of gasket faces downwards

8 - Bracket

- ☐ For heat shield

9 - Washer

10 - Heat shield

- ☐ Engage in bracket -item 8-

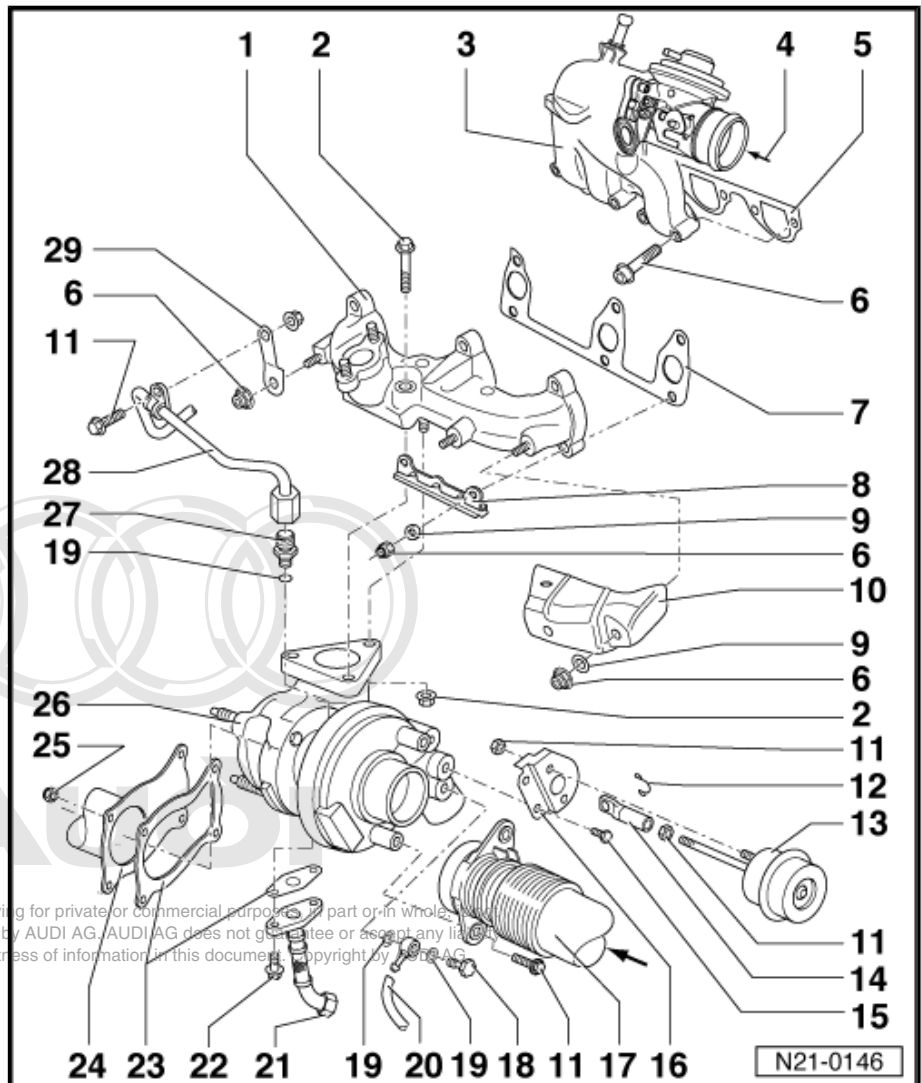
11 - Nut

- ☐ 8 Nm

12 - Circlip

13 - Vacuum unit

- ☐ For charge pressure regulating valve
- ☐ Cannot be renewed separately





14 - Operating rod

15 - Bolt

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

16 - Bracket

17 - From air cleaner

18 - Banjo bolt

- ☐ 15 Nm
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19 - Seal

- ☐ Renew

20 - Hose

- ☐ To charge pressure control solenoid valve -N75-

21 - Oil return line

- ☐ To cylinder block
- ☐ 30 Nm

22 - Bolt

- ☐ 15 Nm

23 - Gasket

- ☐ Renew

24 - Front exhaust pipe

25 - Nut

- ☐ Renew
- ☐ 25 Nm

26 - Turbocharger

- ☐ Checking charge pressure ⇒ [page 180](#)
- ☐ Removing and installing ⇒ [page 186](#)

27 - Connection

- ☐ 30 Nm

28 - Oil supply line

- ☐ From oil filter bracket
- ☐ Check for obstructions
- ☐ Before installing, fill turbocharger with engine oil at connection for oil supply line
- ☐ 22 Nm

29 - Bracket

- ☐ For oil supply line

2.2 Removing and installing turbocharger - vehicles with engine code letters AMF

Special tools and workshop equipment required

◆ Hose clip pliers -V.A.G 1921-

V.A.G 1921



W00-0464

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Removing

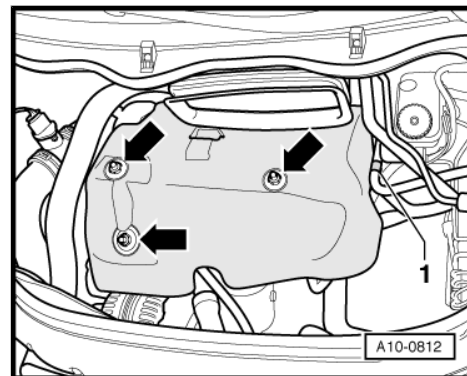


Caution

If the turbocharger has suffered mechanical damage (e.g. damaged compressor wheel), it is not sufficient merely to fit a new turbocharger. The following work must be performed in order to avoid further damage:

- ◆ *Check air cleaner housing, air filter element and air hoses for dirt and foreign particles.*
- ◆ *Check the entire charge air system (including the charge air cooler) for foreign matter.*
- ◆ *If foreign matter is found in the charge air system, clean all relevant ducts and hoses and renew charge air cooler if necessary.*

- Remove bonnet ⇒ [page 8](#) .
- If fitted, unclip bracket -1-.
- Take off engine cover panel -arrows-.
- Remove noise insulation beneath cover.

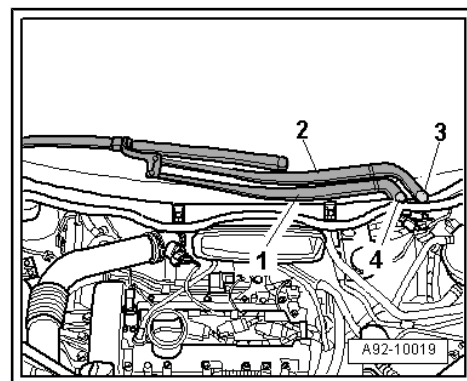


- Lever off caps -3 and 4- on two-piece windscreen wiper arm with a screwdriver.
- Slacken nuts on two-piece windscreen wiper arm a few turns.
- Release arms -1 and 2- one after the other by tilting them slightly on the wiper shafts.
- Remove nuts completely and take off two-piece windscreen wiper arm.

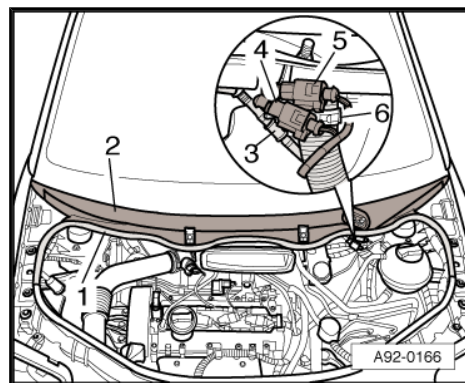


Note

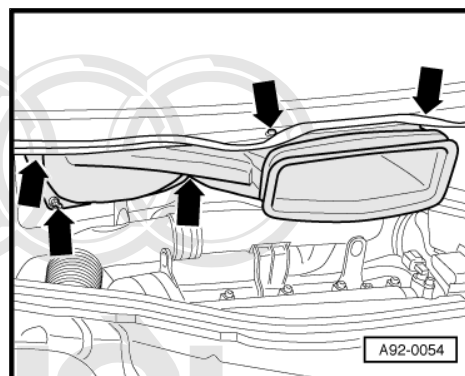
Use puller (commercially available) to remove wiper arm if necessary.



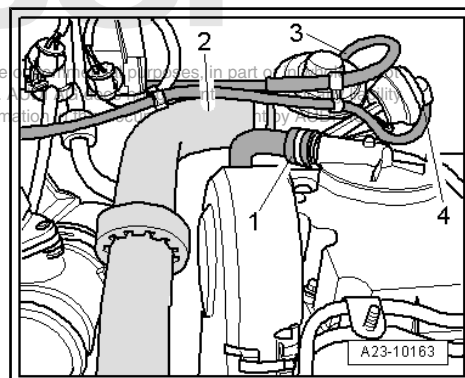
- Disconnect washer fluid hose -3-.
- If fitted, unplug electrical connectors -4 and 5- for heated washer jets.
- Open hose clip -6- using hose clip pliers -V.A.G 1921- and detach water drain hose from cowl panel grille.
- Pull off rubber seal -1- on cowl panel grille.
- Disconnect cowl panel grille -2-.



- Unscrew nuts and bolts -arrows-.
- Pull fresh air duct forwards and remove by turning it to right side of vehicle.



- Detach air hose -2- at mechanical exhaust recirculation valve.
- Disconnect vacuum hose -3- at mechanical exhaust gas recirculation valve.
- Disconnect vacuum hose -4- from vacuum unit for intake manifold flap.

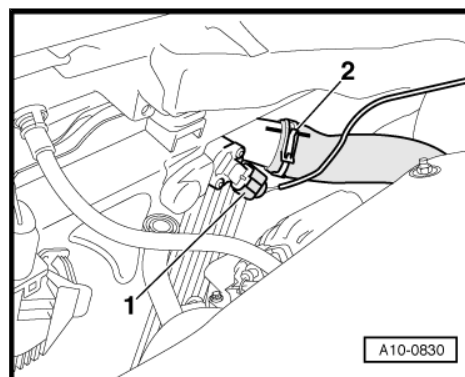

Note

Disregard -item 1-.

- Remove air intake hose -2- from charge air cooler.


Note

Disregard -item 1-.

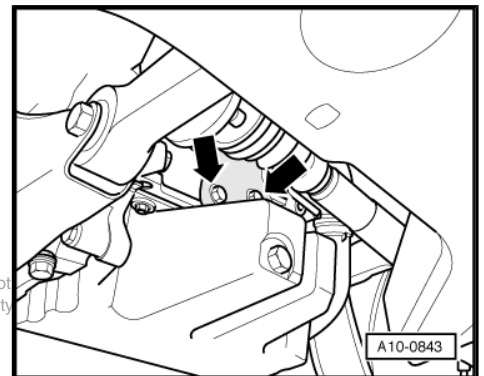
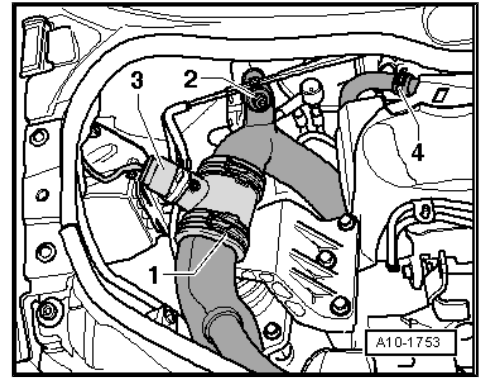


- Detach air intake hose -1- at air mass meter -G70- .
- Unplug electrical connector -3- at air mass meter -G70- .
- Remove nut -2-.
- Disconnect crankcase breather hose -4- at cylinder head cover.
- Move aside fuel lines at air pipe.

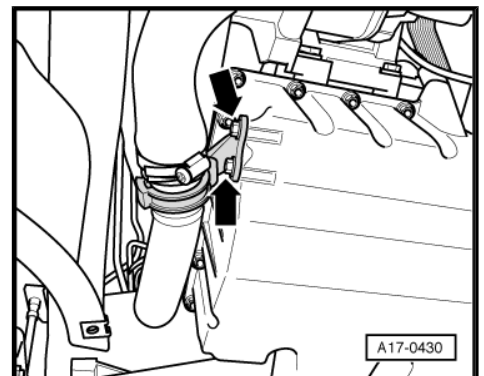
 Note

The air pipe remains in the vehicle.

- Remove front right wheel.
- Remove catalytic converter ⇒ [page 206](#) .
- Unbolt heat shield for drive shaft (left-side) -arrows-.



- Unbolt bracket for air pipe from sump -arrows-.



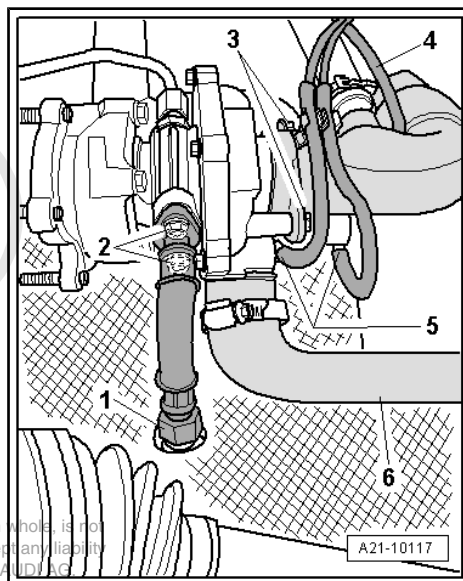
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- Detach air hose -6- from turbocharger.
- Remove oil return line by unscrewing nuts -2- and union nut -1-.
- Detach charge pressure control hose -5- at turbocharger and at vacuum unit for charge pressure control.
- Disconnect breather hose -4-.
- Unscrew bolts -3- and detach air pipe from turbocharger.


Note

The air pipe remains in the vehicle.

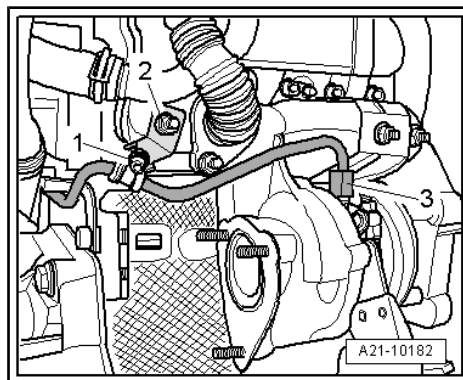
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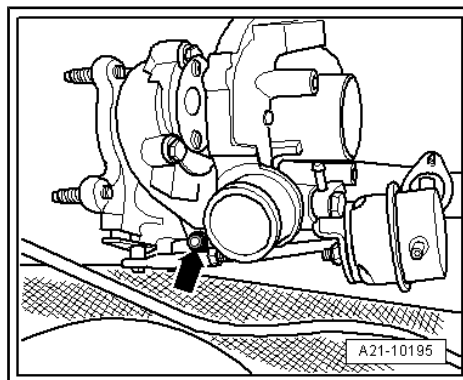
- Slacken bolt -1- approx. 3 turns.
- Unbolt oil supply line -3- from turbocharger and move clear to one side.


Note

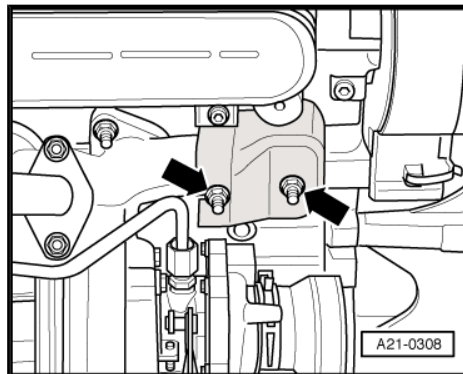
Disregard -item 2-.



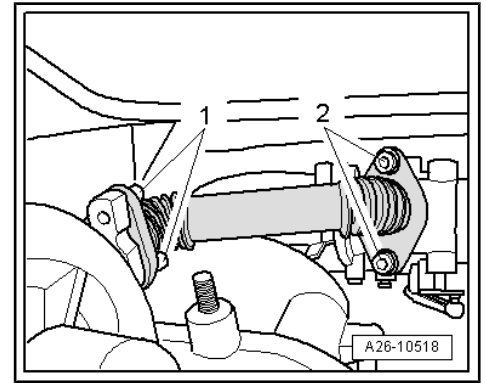
- Remove nut (bottom) -arrow- for turbocharger.
- Lift out air hose (previously disconnected from below) from turbocharger and pull out upwards.



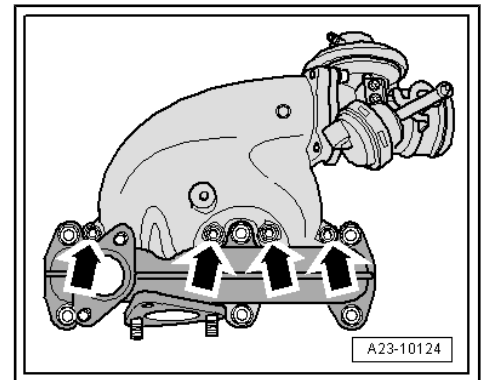
- Remove heat shield for exhaust manifold -arrows-.



- Remove connecting pipe for exhaust gas recirculation
-item 1 and 2-.



- Unscrew bolts -arrows- and remove intake manifold.



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- Remove both bolts -arrows- for turbocharger (hold turbocharger in position).
- Place turbocharger on subframe.
- Take out turbocharger downwards.

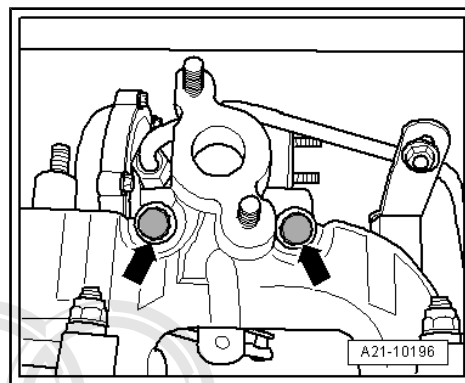
Installing

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



Note

- ◆ *Renew gaskets, seals and self-locking nuts.*
- ◆ *Fill turbocharger with engine oil at connection for oil supply line.*
- ◆ *Charge air system must be free of leaks.*
- ◆ *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) ⇒ Parts catalogue.*



- Install intake manifold ⇒ Rep. gr. 23.
- Install connecting pipe for exhaust gas recirculation (first tighten loosely and then tighten connections to specified torque).
- Install catalytic converter ⇒ [page 206](#).
- Install air pipes/hoses with plug-in connectors ⇒ [page 202](#).
- Install windscreen wiper arm ⇒ Rep. gr. 92.
- Check oil level ⇒ [page 159](#).



Note

After installing turbocharger, allow engine to idle for approx. 1 minute and do not rev up immediately to ensure turbocharger is supplied with oil.

Tightening torques

Component	Nm
Turbocharger to exhaust manifold	25 ¹⁾
Heat shield to exhaust manifold	22
Oil return pipe to: Cylinder block	30
Turbocharger	15
Oil supply line to turbocharger	22
Air pipe to: Turbocharger	8
Sump	8
Body	8
Drive shaft heat shield to cylinder block	33
Engine cover panel to bracket	5.5
• ¹⁾ Renew nuts.	

2.3 Turbocharger for vehicles with engine code letters ATL, BHC - exploded view

1 - Bolt

- ☐ 25 Nm

2 - Support

- ☐ For turbocharger

3 - Bolt

- ☐ 20 Nm

4 - Bolt

- ☐ 15 Nm

5 - Gasket

- ☐ Renew

6 - Turbocharger

- ☐ Checking charge pressure ⇒ [page 180](#)
- ☐ Removing and installing ⇒ [page 194](#)
- ☐ Can only be renewed together with exhaust manifold and vacuum unit as one unit

7 - Bracket

- ☐ For oil supply line

8 - Nut

- ☐ 10 Nm

9 - Seal

- ☐ Renew

10 - Connection

- ☐ 30 Nm

11 - Union nut

- ☐ 22 Nm

- ☐ Note installation sequence:

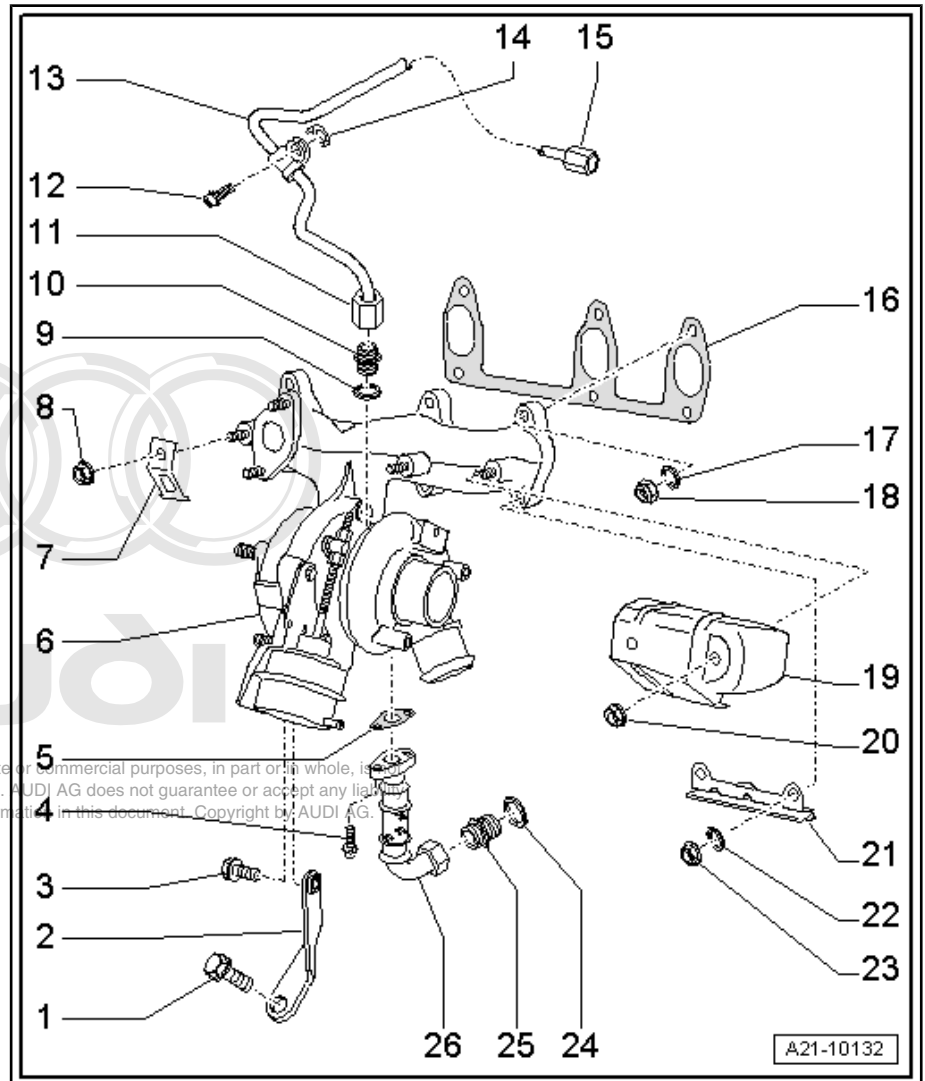
- First attach both ends of pipe loosely.
- Then tighten connections to final torque.
- Finally, secure bracket.

12 - Bolt

- ☐ 10 Nm

13 - Oil supply line

- ☐ From oil filter bracket
- ☐ Check for obstructions
- ☐ Before installing, fill turbocharger with engine oil at connection for oil supply line.
- ☐ 22 Nm
- ☐ Note installation sequence:
 - First attach both ends of pipe loosely.
 - Then tighten connections to final torque.
 - Finally, secure bracket.





14 - Square nut

15 - Union nut

- ☐ 22 Nm
- ☐ Note installation sequence:
 - First attach both ends of pipe loosely.
 - Then tighten connections to final torque.
 - Finally, secure bracket.

16 - Gasket

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- ☐ **Renew**
- ☐ Coating (bead) faces intake manifold
- ☐ Installation position: straight edge of gasket faces downwards

17 - Washer

18 - Nut

- ☐ Renew
- ☐ 25 Nm

19 - Heat shield

20 - Nut

- ☐ Renew
- ☐ 22 Nm

21 - Bracket

- ☐ For heat shield

22 - Washer

23 - Nut

- ☐ Renew
- ☐ 22 Nm

24 - Seal

- ☐ Renew

25 - Connection

- ☐ 40 Nm

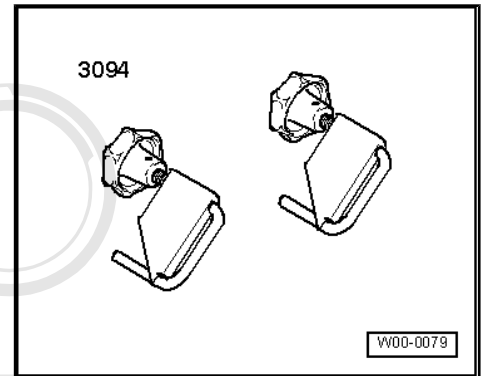
26 - Oil return line

- ☐ To cylinder block
- ☐ 30 Nm

2.4 Removing and installing turbocharger - vehicles with engine code letters ATL, BHC

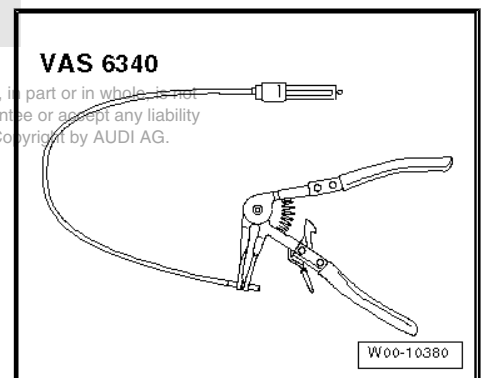
Special tools and workshop equipment required

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



- ◆ Hose clip pliers -VAS 6340-

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Removing

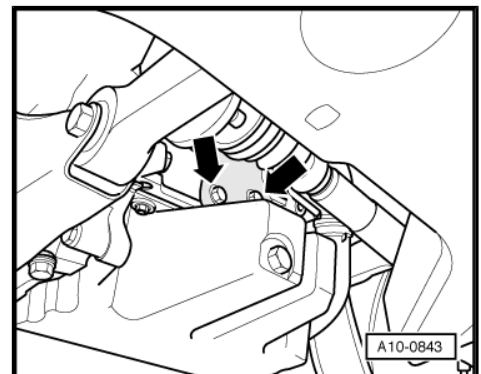


Caution

If the turbocharger has suffered mechanical damage (e.g. damaged compressor wheel), it is not sufficient merely to fit a new turbocharger. The following work must be performed in order to avoid further damage:

- ◆ Check air cleaner housing, air filter element and air hoses for dirt and foreign particles.
- ◆ Check the entire charge air system (including the charge air cooler) for foreign matter.
- ◆ If foreign matter is found in the charge air system, clean all relevant ducts and hoses and renew charge air cooler if necessary.

- Remove front right wheel.
- Remove catalytic converter ⇒ [page 206](#) .
- Unbolt heat shield for drive shaft (left-side) -arrows-.

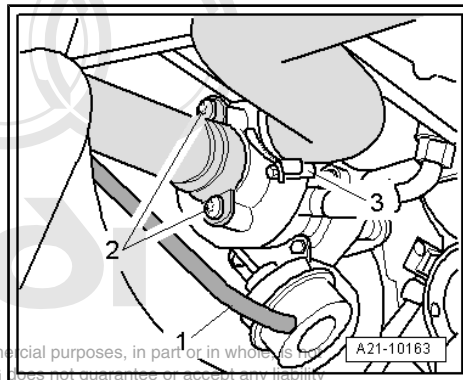


- Detach vacuum hose -1- from vacuum unit for charge pressure control and move it clear.
- Unscrew bolts -2- and detach air pipe from turbocharger.


Note

Air pipe remains in installation position.

- Detach air hose -3- from turbocharger.

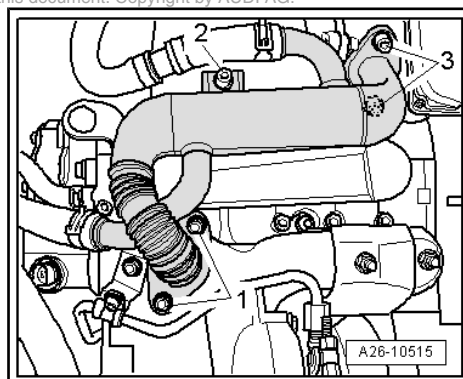


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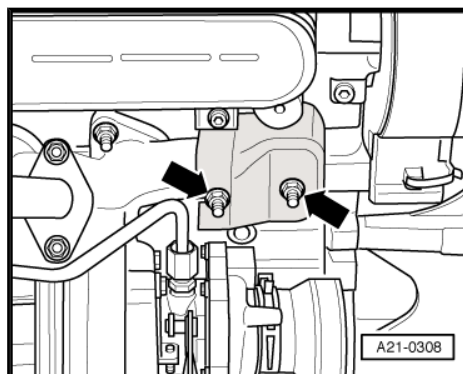
- Remove nuts -1-.


Note

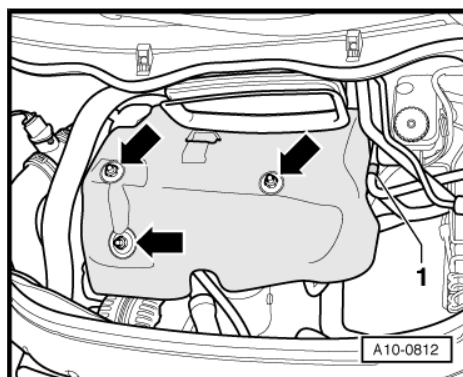
- ◆ *Shown in illustration with engine removed.*
- ◆ *The bolts -2 and 3- are removed at a later stage.*



- Remove heat shield for turbocharger -arrows-.



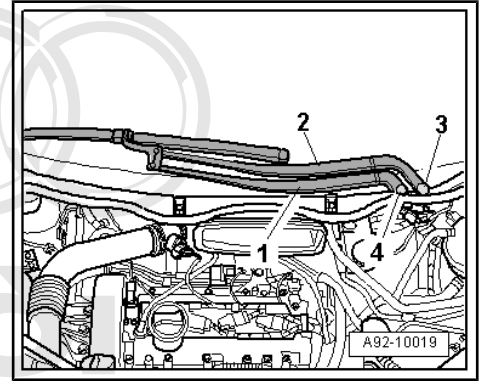
- Remove bonnet ⇒ [page 8](#) .
- If fitted, unclip bracket -1-.
- Take off engine cover panel -arrows-.
- Remove noise insulation beneath cover.



- Lever off caps -3 and 4- on two-piece windscreen wiper arm with a screwdriver.
- Slacken nuts on two-piece windscreen wiper arm a few turns.
- Release arms -1 and 2- one after the other by tilting them slightly on the wiper shafts.
- Remove nuts completely and take off two-piece windscreen wiper arm.

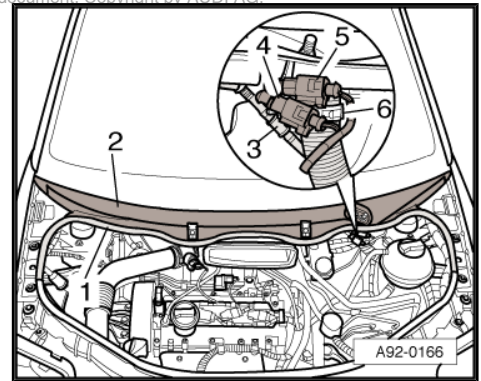
**Note**

Use puller (commercially available) to remove wiper arm if necessary.

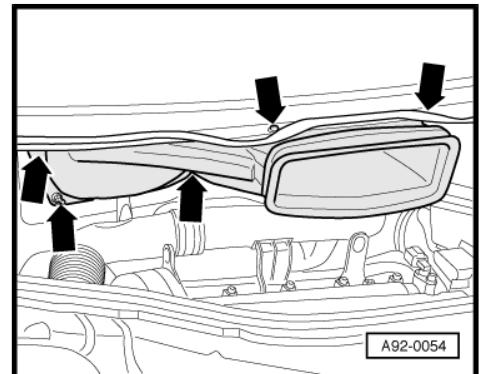


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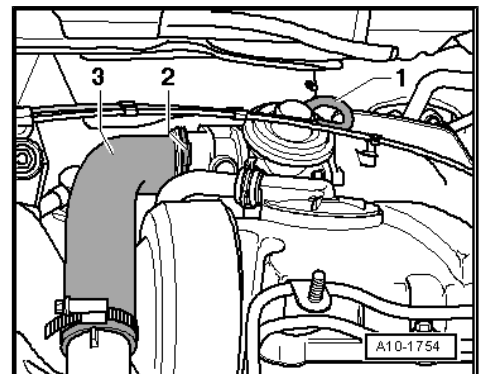
- Disconnect washer fluid hose -3-.
- If fitted, unplug electrical connectors -4 and 5- for heated washer jets.
- Open hose clip -6- using hose clip pliers -V.A.G 1921- and detach water drain hose from cowl panel grille.
- Pull off rubber seal -1- on cowl panel grille.
- Disconnect cowl panel grille -2-.



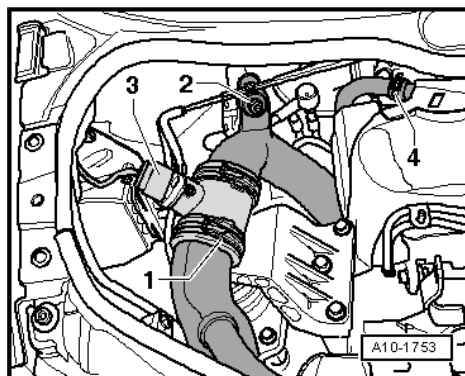
- Unscrew nuts and bolts -arrows-.
- Pull fresh air duct forwards and remove by turning it to right side of vehicle.



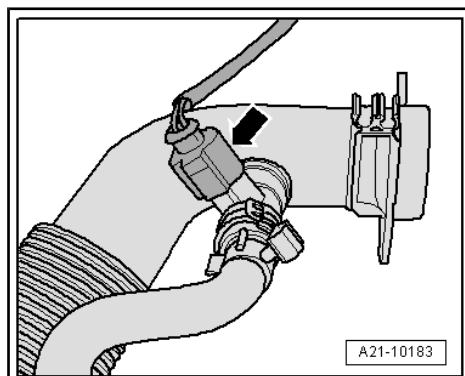
- Remove air hose -3- from intake manifold flap motor -V157- by lifting retaining clip -2- slightly.
- Disconnect vacuum hose -1- at mechanical exhaust gas recirculation valve.



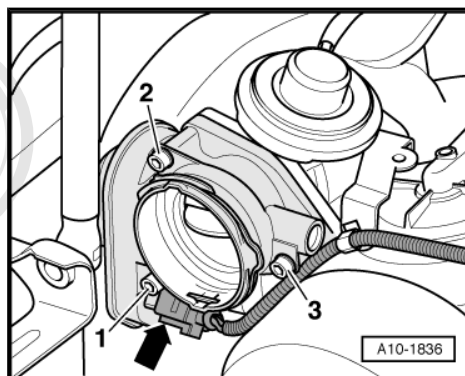
- Detach air intake hose -1- at air mass meter -G70- .
- Unplug electrical connector -3- at air mass meter -G70- .
- Remove nut -2-.
- Disconnect crankcase breather hose -4- at cylinder head cover.
- Pull air pipe out slightly together with air mass meter -G70- .



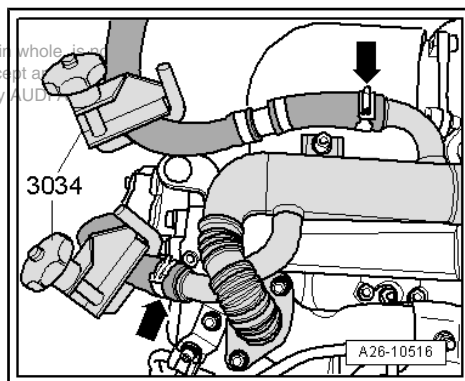
- Detach electrical connector -arrow- at heater element for crankcase breather -N79- .
- Remove air pipe.



- Detach electrical connector -arrow- at intake manifold flap motor -V157- .
- Remove bolts -1 ... 3- and take out intake manifold flap motor -V157- .



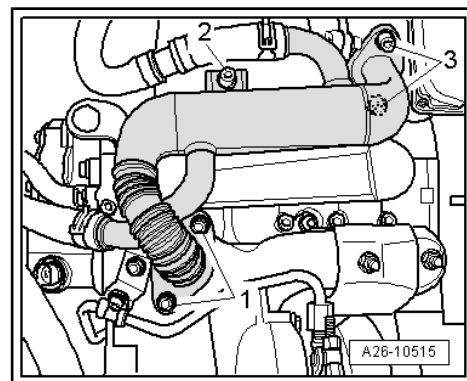
- Clamp off coolant hoses going to exhaust gas recirculation cooler using hose clamps -3094- .
- Detach coolant hoses at exhaust gas recirculation cooler.



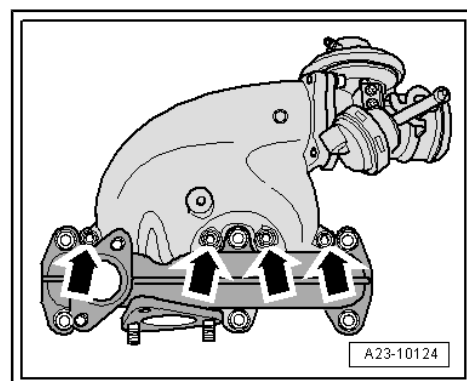
- Remove bolts -2 and 3- and detach exhaust gas recirculation cooler.

**Note**

Disregard -item 1-.



- Unscrew bolts -arrows- and remove intake manifold.

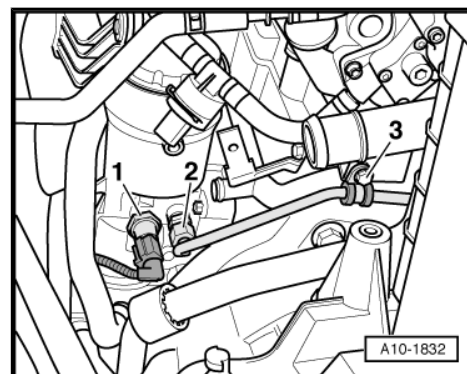


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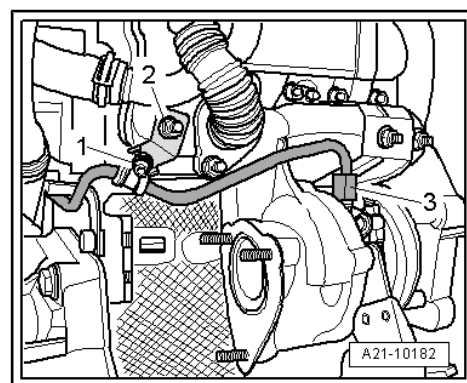
- Detach oil supply line -2- going to turbocharger at oil filter bracket.
- Remove bracket for oil supply line -3-.

**Note**

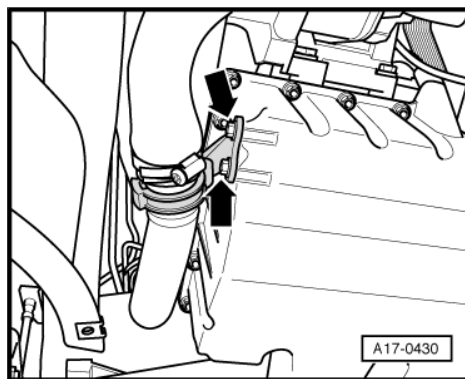
Disregard -item 1-.



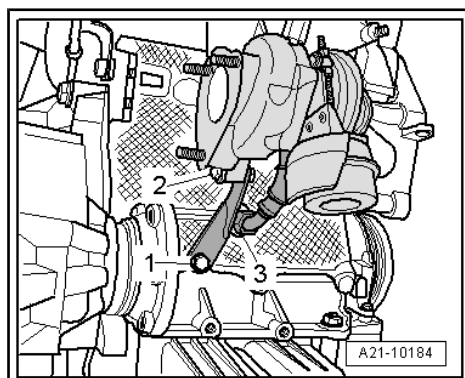
- Slacken bolt -1- approx. 3 turns.
- Remove nut -2-.
- Unbolt oil supply line -3- from turbocharger and move clear to one side.



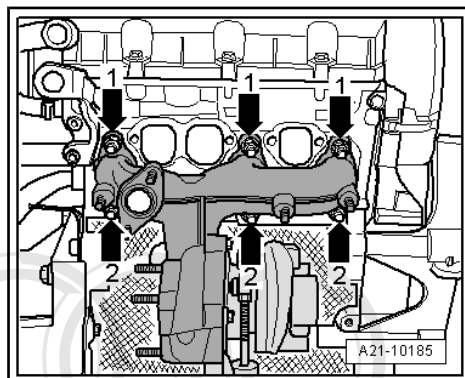
- Unbolt bracket for air pipe from sump -arrows-.



- Remove bolts -1 and 2- and detach support for turbocharger.
- Unbolt oil supply line -3- at cylinder block.



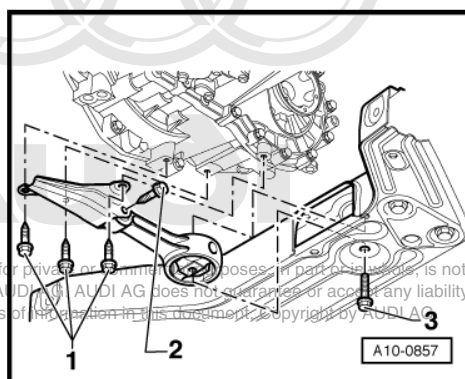
- Remove bottom nuts -arrows 2-.



- Unscrew bolts -1- for pendulum support.


Note

Disregard -items 2 and 3-.



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- Remove top nuts -arrows 1-.
- Lift out turbocharger towards left.

Installing

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



Note

- ◆ *Renew gaskets, seals and self-locking nuts.*
- ◆ *Fill turbocharger with engine oil at connection for oil supply line.*
- ◆ *Charge air system must be free of leaks.*
- ◆ *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) ⇒ Parts catalogue.*

- Install intake manifold ⇒ Rep. gr. 23 .
- Install air pipes/hoses with plug-in connectors ⇒ [page 202](#) .
- Install windscreen wiper arm ⇒ Rep. gr. 92 .
- Check oil level ⇒ [page 159](#) .

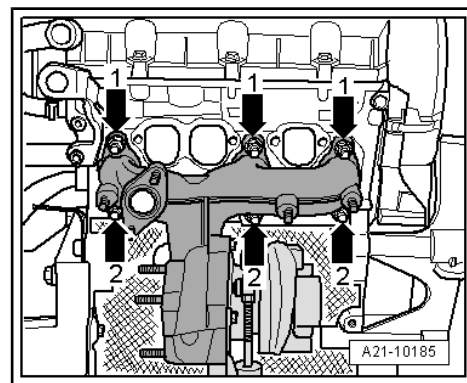


Note

After installing turbocharger, allow engine to idle for approx. 1 minute and do not rev up immediately to ensure turbocharger is supplied with oil.

Tightening torques

Component	Nm
Turbocharger to cylinder head	25 ¹⁾
Heat shield to turbocharger	22
Support for turbocharger to cylinder block	25
Oil return line to cylinder block	30
Oil supply line to:	
Turbocharger	22
Oil filter bracket	22
Exhaust gas recirculation cooler to:	
Mechanical exhaust gas recirculation valve	22
Intake manifold	20
Turbocharger	22 ¹⁾
Intake manifold flap motor -V157- to mechanical exhaust gas recirculation valve	10
Air pipe to:	
Turbocharger	8
Sump	8
Body	8
Drive shaft heat shield to cylinder block	33
Engine cover panel to bracket	5.5
• ¹⁾ Renew nuts.	



2.5 Fitting air pipes/hoses with plug-in connectors



Caution

Make sure the retaining clip is not in the locked position when fitting air pipes/hoses with plug-in connectors; otherwise the seal can be damaged and will not seal off properly.

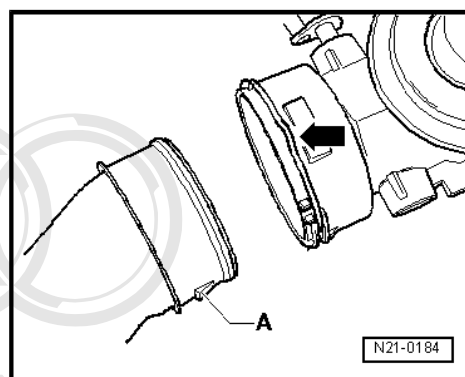
◆ *Note assembly instructions.*

Removing

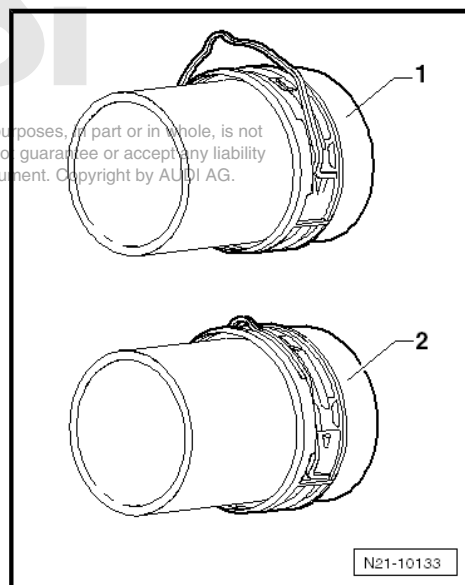
- Release plug-in connector by pulling out retaining clip -arrow-. Disconnect air pipes/hoses (do not use tools of any kind).

Installing

- Position seal in groove on air hose if seal is being renewed.
- Make sure the seal is correctly seated in the groove all round and that it is not twisted.
- Lubricate sealing surface and seal.

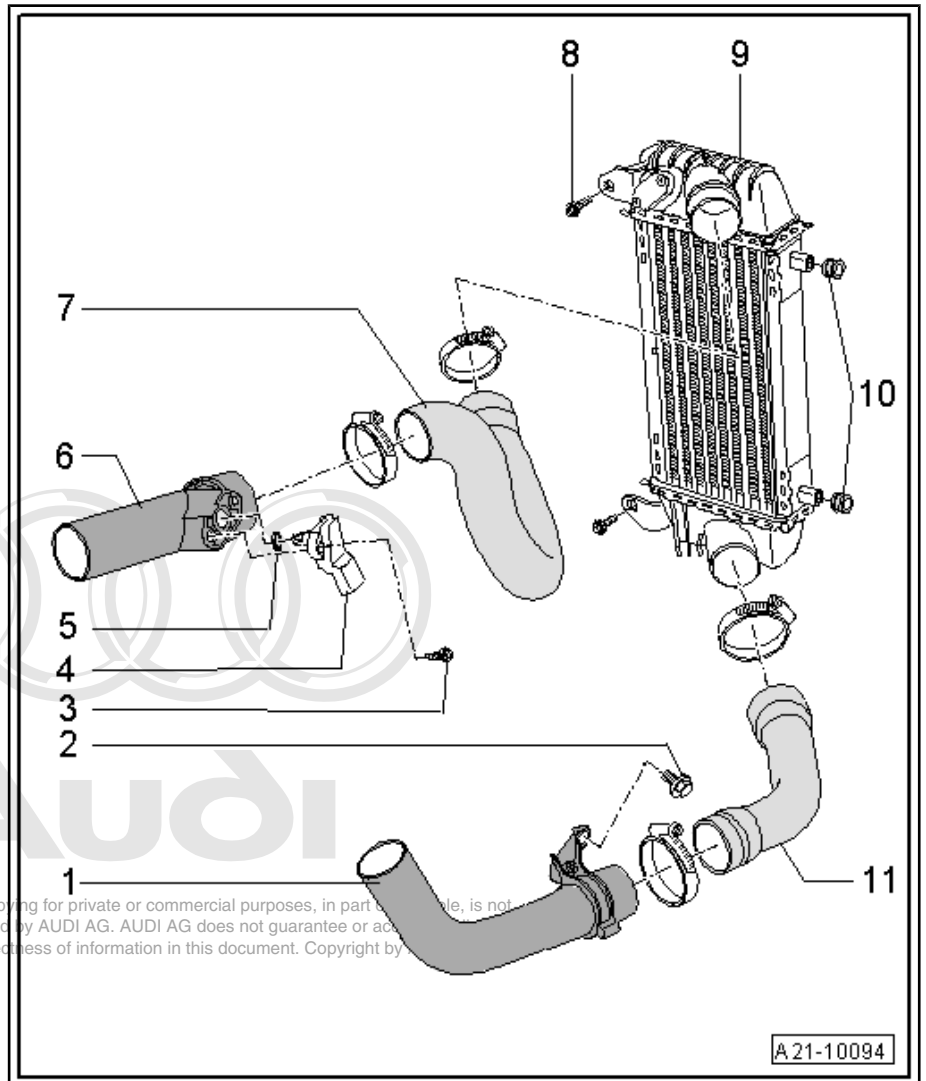


- Release retaining clip (position -1-).
- Push air pipe/hose into plug-in connector as far as stop.
- Move retaining clip to locked position -2- and press air pipe/hose down again.
- Then pull air pipe/hose to check that it is fitted correctly and that plug-in connector is locked.



2.6 Charge air cooler - exploded view

- 1 - Air pipe
- 2 - Bolt
 - ☐ 8 Nm
- 3 - Bolt
 - ☐ 3 Nm
- 4 - Charge pressure sender - G31-
 - ☐ Fitting location shown on vehicles with engine code letters ATL
 - ☐ Fitting location on vehicles with engine code letters AMF, BHC: in charge air cooler
- 5 - O-ring
 - ☐ Renew if damaged
- 6 - Air pipe
- 7 - Air hose
- 8 - Bolt
 - ☐ 6 Nm
- 9 - Charge air cooler
- 10 - Grommet
- 11 - Air pipe



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2.7 Removing and installing charge air cooler



Note

Check all hoses and pipes for correct fitting and leakage before carrying out tests or repairs.

Removing and installing charge air cooler
 ⇒ ["1.6 Removing and installing radiator", page 170](#) .

26 – Exhaust system

1 Removing and installing parts of exhaust system

1.1 Silencer - exploded view

1 - Nut

- ☐ Renew
- ☐ 25 Nm

2 - Gasket

- ☐ Renew

3 - Turbocharger

4 - Rubber mounting

- ☐ Renew if damaged

5 - Nut

- ☐ Renew
- ☐ 23 Nm

6 - Bolt

- ☐ 23 Nm

7 - Mounting

- ☐ Renew if damaged

8 - Rubber mounting

- ☐ Renew if damaged

9 - Rear silencer

- ☐ Combined in one unit with catalytic converter as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting point [⇒ page 206](#)
- ☐ Installation position of rear clamp [⇒ page 205](#)

10 - Rubber mounting

- ☐ Renew if damaged

11 - Bracket

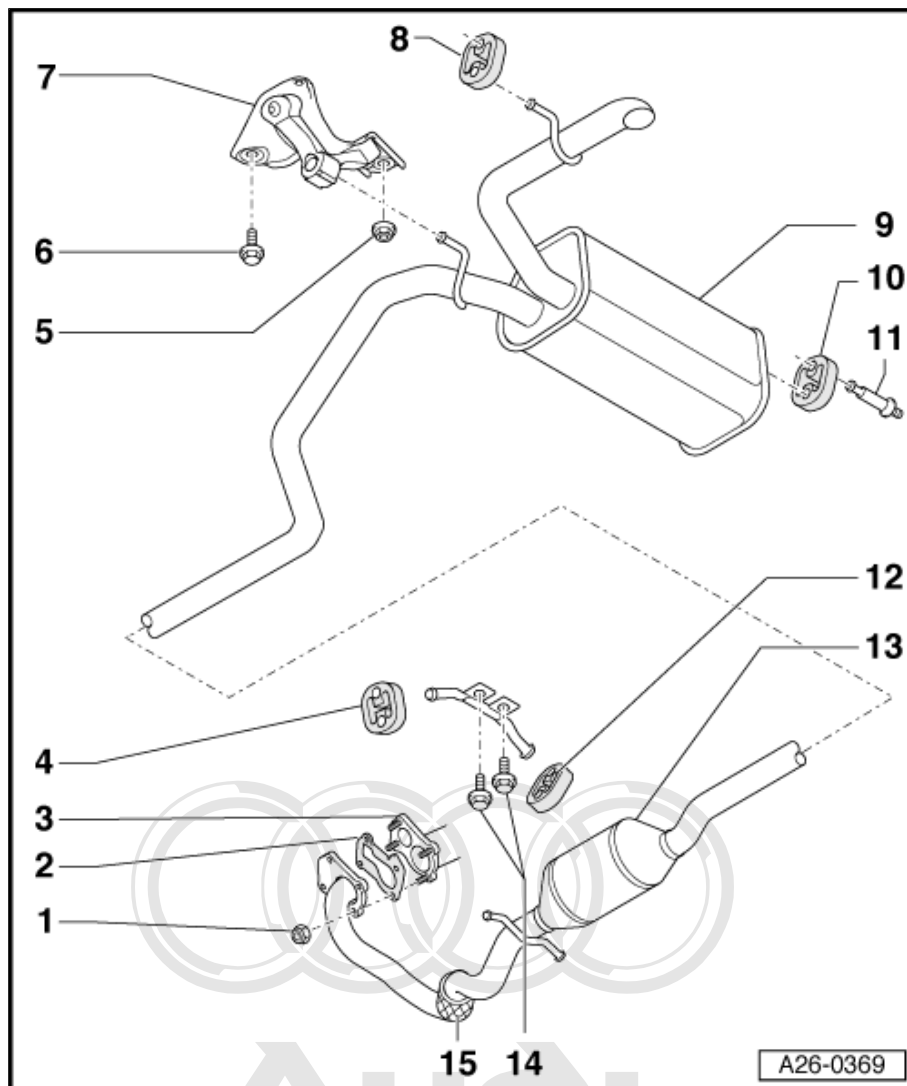
- ☐ 23 Nm

12 - Rubber mounting

- ☐ Renew if damaged

13 - Catalytic converter

- ☐ Protect against knocks and impact
- ☐ Combined in one unit with rear silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting point [⇒ page 206](#)
- ☐ Installation position of rear clamp [⇒ page 205](#)
- ☐ Removing and installing [⇒ page 206](#)



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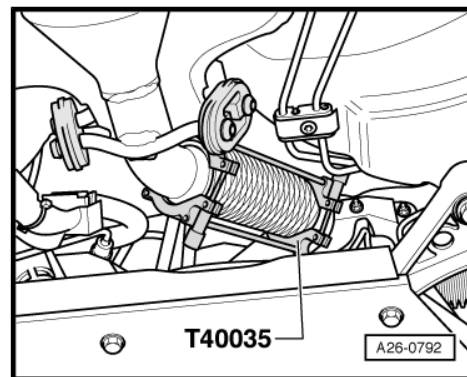
14 - Bolts

- 40 Nm

15 - Flexible joint (decoupling element)

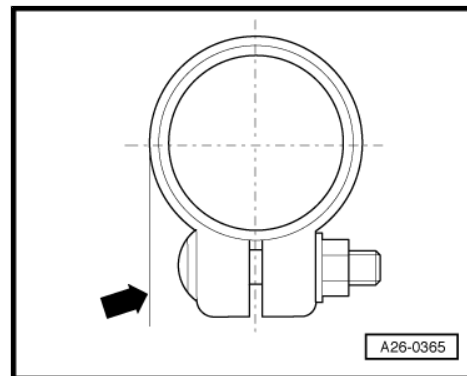
- Do not bend more than 10° – otherwise risk of damage
- Support with fixing tool -T40035- ⇒ [page 205](#) .

Supporting flexible joint (decoupling element) with fixing tool - T40035-



Installation position of rear clamp

- Install clamp so that bolts are positioned horizontally -arrow-.
- Bolt connection faces downwards.
- The thread of the bolt points to left side of vehicle.

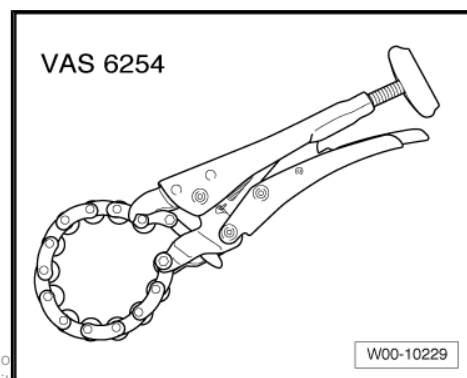


1.2 Separating catalytic converter and rear silencer

- ◆ Cutting point is provided in connecting pipe for separate replacement of catalytic converter or rear silencer.
- ◆ The cutting point is marked by an indentation on the circumference of the exhaust pipe.

Special tools and workshop equipment required

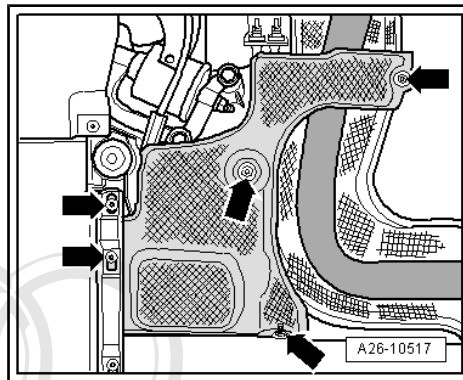
- ◆ Chain pipe cutter -VAS 6254-



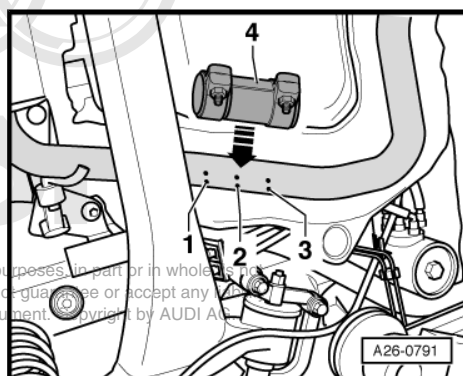
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Procedure

- Unbolt heat shield for exhaust system -arrows-.



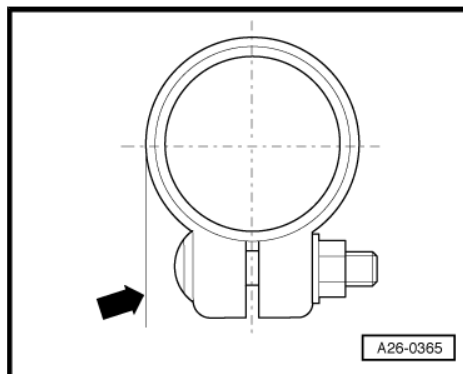
- Cut through exhaust pipe at a right angle at cutting point -2- using chain-type pipe cutter -VAS 6254- .
- When reassembling, position the clamp -4- centrally over the markings -1 and 3-.



- Install clamp so that bolts are positioned horizontally -arrow-.
- Bolt connection faces downwards.
- The thread of the bolt points to left side of vehicle.

Tightening torque

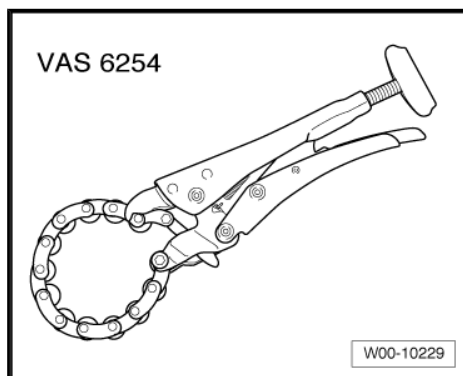
Component	Nm
Clamp	23



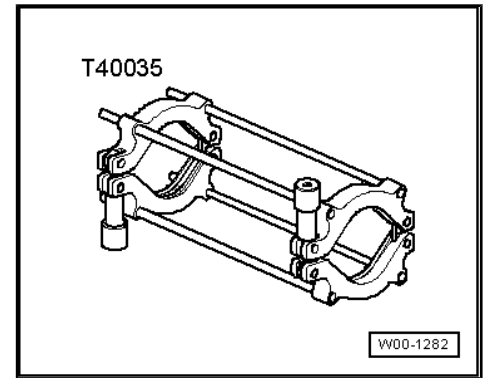
1.3 Removing and installing catalytic converter

Special tools and workshop equipment required

- ◆ Chain pipe cutter -VAS 6254-

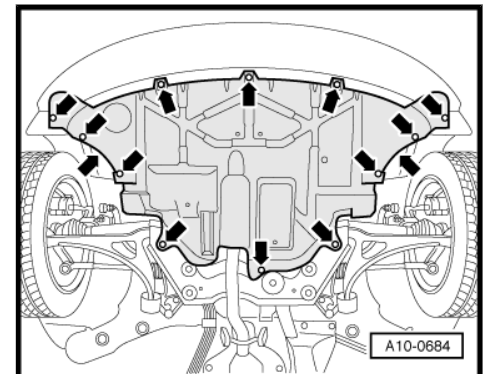


◆ Setting tool -T40035-

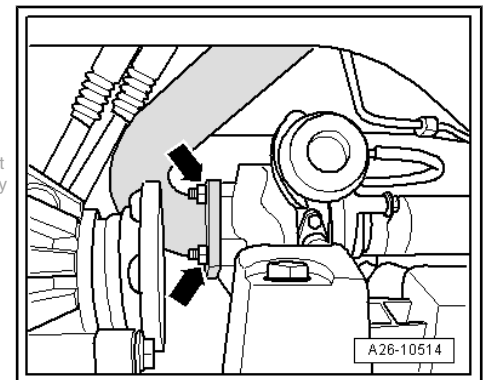


Removing

- Remove noise insulation -arrows-.



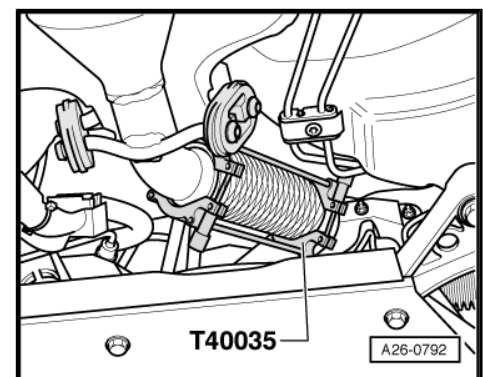
- Unscrew all nuts -arrows- at exhaust system/turbocharger.



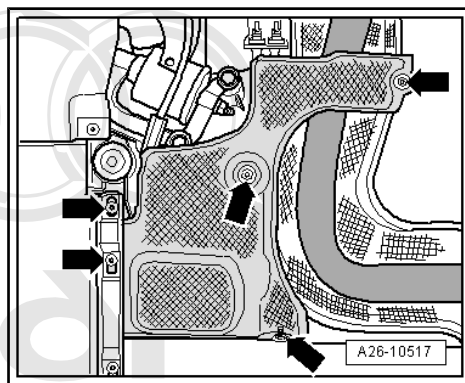
Note

To avoid any damage, the flexible joint must not be bent more than 10°.

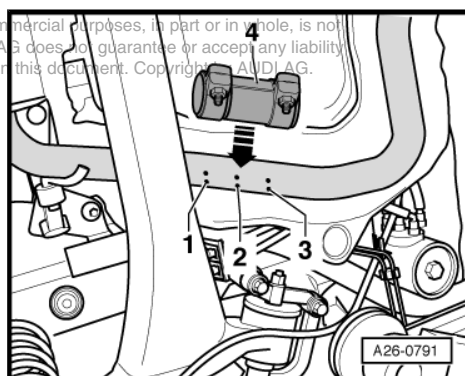
- Support flexible joint (decoupling element) with fixing tool - T40035- .



- Unbolt heat shield for exhaust system -arrows-.



- On vehicles with two-piece exhaust pipes, loosen nuts on clamp -4- and move clamp towards rear to separate exhaust system.
- On vehicles with one-piece exhaust pipes, cut through exhaust pipe at a right angle at cutting point -2- using chain-type pipe cutter -VAS 6254-.


Note

Disregard -items 1 and 3-.

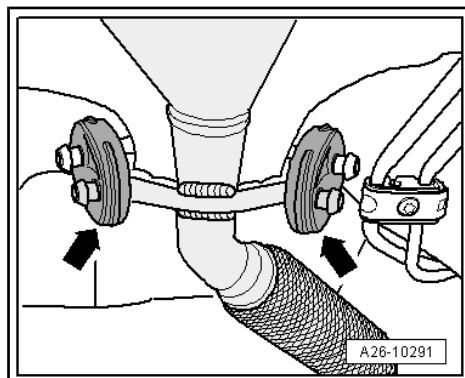
- Disengage rubber mountings -arrows- and remove catalytic converter.

Installing

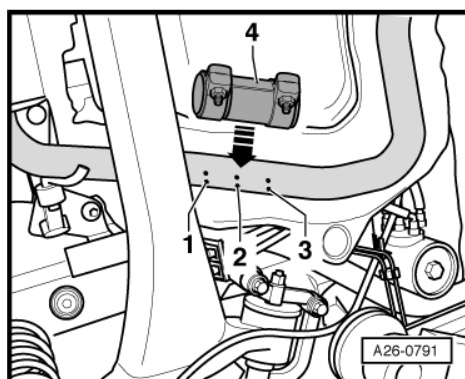
Installation is carried out in the reverse order; note the following:


Note

Renew gaskets and self-locking nuts.



- When reassembling, position the clamp -4- centrally over the markings -1 and 3-.



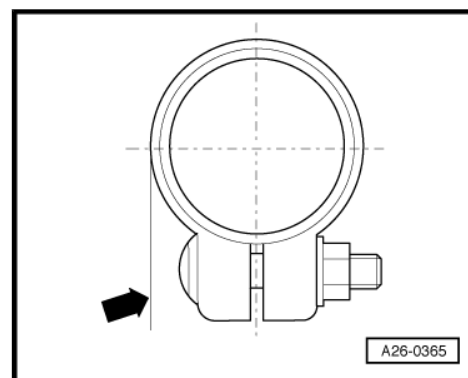
- Install clamp so that bolts are positioned horizontally -arrow-.

Bolt connection faces downwards.

The thread of the bolt points to left side of vehicle.

Tightening torques

Component	Nm
Catalytic converter to turbocharger	25 ¹⁾²⁾
Clamp	23
• ¹⁾ Renew nuts. • ²⁾ Coat threads and contact surface of bolt heads with high-temperature paste; for high-temperature paste refer to ⇒ Parts catalogue .	



1.4 Removing and installing exhaust manifold - vehicles with engine code letters AMF

Removing

- Remove turbocharger ⇒ [page 186](#) .

- Unscrew exhaust manifold.

Installing

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



Note

- ♦ *Renew gasket and self-locking nuts.*
- ♦ *Note installation position of gasket.*

- Install turbocharger ⇒ [page 186](#) .

Tightening torque

Component	Nm
Exhaust manifold to cylinder head	25

1.5 Removing and installing exhaust manifold - vehicles with engine code letters ATL, BHC



Note

The exhaust manifold is combined as one unit with the turbo-charger and cannot be renewed separately.

1.6 Checking exhaust system for leaks

- Start engine and run at idling speed.
- Plug tailpipe with cloth or plug, etc. while checking for leaks.
- Listen at joints between cylinder head/exhaust manifold, turbo-charger/catalytic converter etc. to check for leaks.
- Repair any leaks that are found.

2 Exhaust gas recirculation system

2.1 Diagram of vacuum hose connections

Vehicles with engine code letters AMF

1 - Variable intake manifold flap change-over valve -N239-

2 - Exhaust gas recirculation valve -N18-

3 - Charge pressure control solenoid valve -N75-

4 - Connecting piece

5 - To brake servo

6 - Non-return valve

7 - Vacuum unit for charge pressure control

8 - Turbocharger

9 - Charge air cooler

10 - Intake manifold

11 - Tandem pump

- ☐ For fuel and vacuum supply

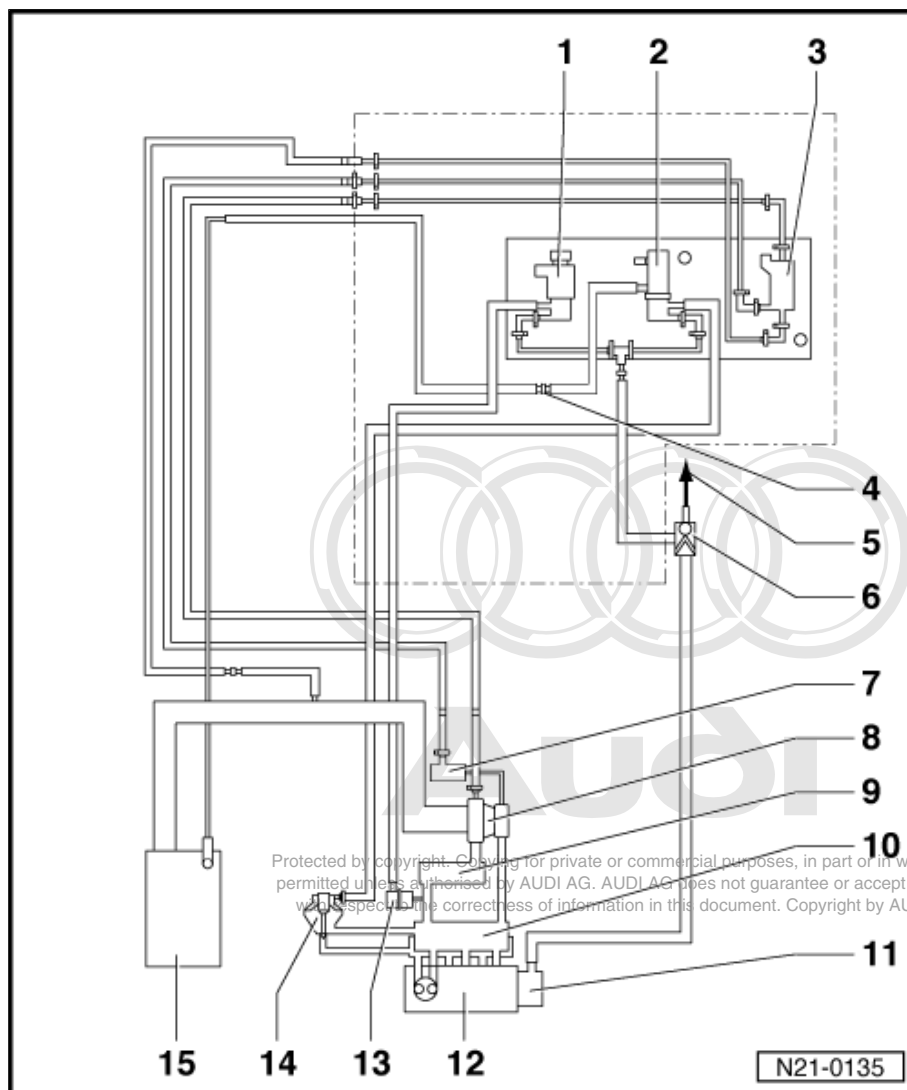
12 - Cylinder head

13 - Vacuum unit for intake manifold flap

14 - Mechanical exhaust gas recirculation valve

- ☐ Is combined with intake manifold connection
- ☐ Can only be renewed together with intake manifold connection

15 - Air mass meter -G70-



Vehicles with engine code letters ATL, BHC

1 - Vacuum reservoir**2 - Throttle butterfly valve - N211-****3 - Exhaust gas recirculation valve -N18-**

- ☐ Only for vehicles with engine code BHC

4 - Non-return valve

- ☐ White connection to charge pressure control solenoid valve -N75-

5 - Charge pressure control solenoid valve -N75-**6 - To brake servo****7 - Non-return valve****8 - Vacuum unit for charge pressure control****9 - Turbocharger****10 - Charge air cooler****11 - Intake manifold****12 - Tandem pump**

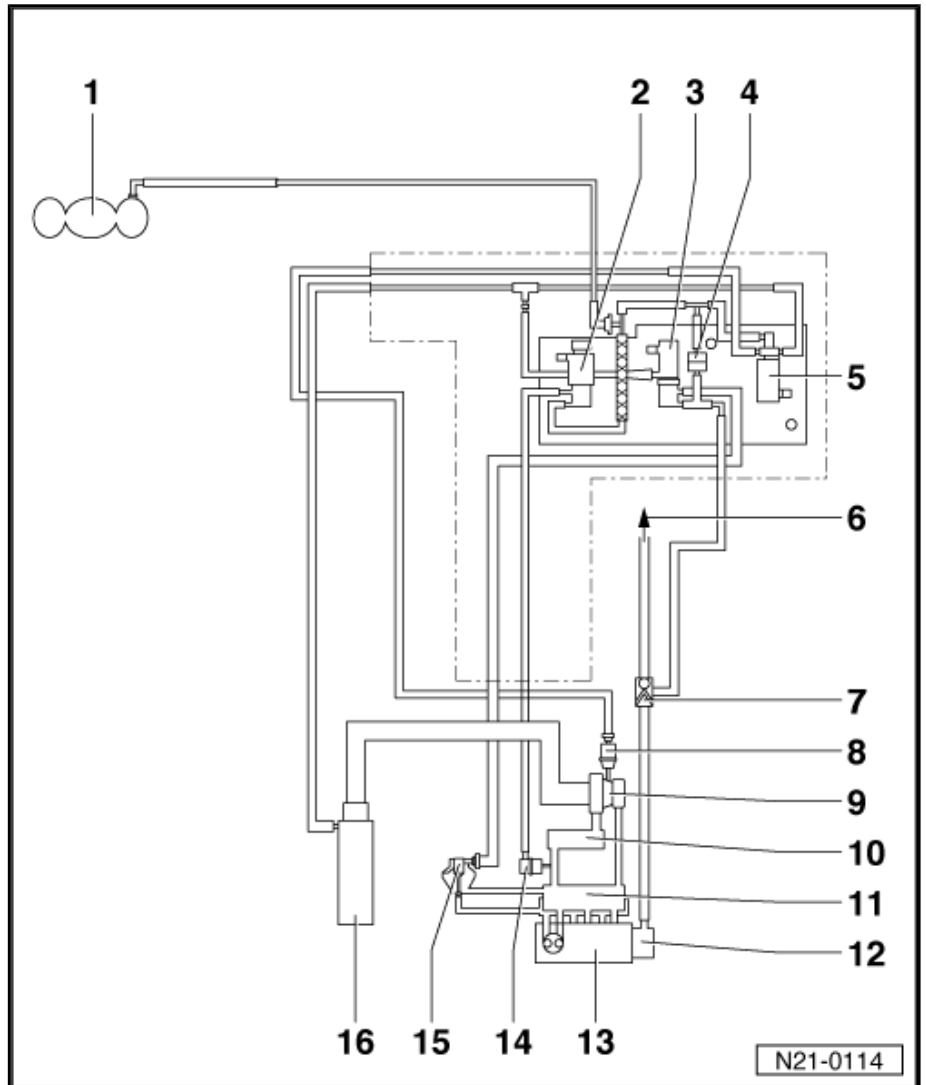
- ☐ For fuel and vacuum supply

13 - Cylinder head**14 - Vacuum unit for intake manifold flap**

- ☐ Only for vehicles with engine code BHC

15 - Mechanical exhaust gas recirculation valve

- ☐ Is combined with intake manifold connection
- ☐ Can only be renewed together with intake manifold connection

16 - Air cleaner

2.2 Exhaust gas recirculation system for vehicles with engine code letters AMF, BHC - exploded view



Note

- ◆ The exhaust gas recirculation system is activated by the engine control unit via the exhaust gas recirculation valve -N18- and the mechanical exhaust gas recirculation valve.
- ◆ The exhaust gas recirculation is switched off after approx. 2 minutes at idling speed.

1 - Gasket

- ☐ Renew

2 - Nut

- ☐ 22 Nm

3 - Bolt

- ☐ 22 Nm

4 - Intake manifold

- ☐ Removing and installing
⇒ Rep. gr. 23

5 - Vacuum unit

- ☐ For intake manifold flap

6 - Bolt

- ☐ 8 Nm

7 - O-ring

- ☐ Renew

8 - Mechanical exhaust gas recirculation valve

- ☐ With intake manifold flap
- ☐ Checking ⇒ [page 220](#)

9 - Bolt

- ☐ 10 Nm

10 - Gasket

- ☐ For intake manifold
- ☐ Renew
- ☐ Installation position:
straight edge of gasket
faces upwards

11 - Gasket

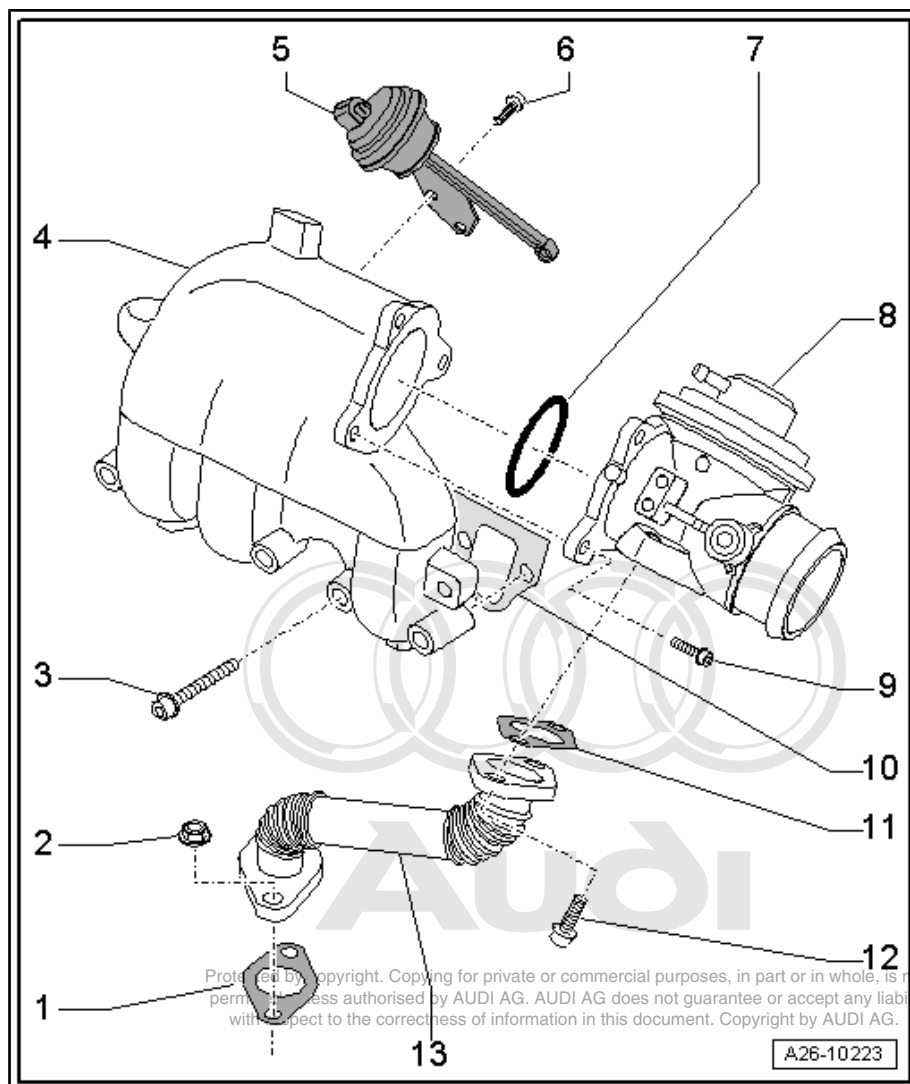
- ☐ Renew

12 - Bolt

- ☐ 22 Nm

13 - Connecting pipe for exhaust gas recirculation

- ☐ When installing, first tighten finger-tight and then tighten connections to specified torque



2.3 Exhaust gas recirculation system for vehicles with engine code letters ATL - exploded view



Note

- ◆ The exhaust gas recirculation system is activated by the engine control unit via the exhaust gas recirculation valve -N18- and the mechanical exhaust gas recirculation valve.
- ◆ The exhaust gas recirculation is switched off after approx. 2 minutes at idling speed.
- ◆ To further improve the exhaust emission values, the exhaust gas recirculation system is equipped with a cooler that is connected into the engine cooling system.
- ◆ The flow of exhaust gas that is recirculated to the combustion chamber is routed via this cooler. This reduces the temperature of the exhaust gas, which lowers the temperature in the combustion chamber and improves the exhaust emission values.

1 - Nut

- ☐ 22 Nm

2 - Bolt

- ☐ 20 Nm

3 - Exhaust gas recirculation cooler

- ☐ Removing and installing
⇒ [page 214](#)

4 - Clip

- ☐ For heat shield

5 - Heat shield

6 - Intake manifold

- ☐ Removing and installing
⇒ Rep. gr. 23

7 - O-ring

- ☐ Renew

8 - Mechanical exhaust gas recirculation valve

- ☐ Checking ⇒ [page 220](#)

9 - O-ring

- ☐ Renew

10 - Bolt

- ☐ 10 Nm

11 - Intake manifold connection with intake manifold flap motor -V157-

12 - Bolt

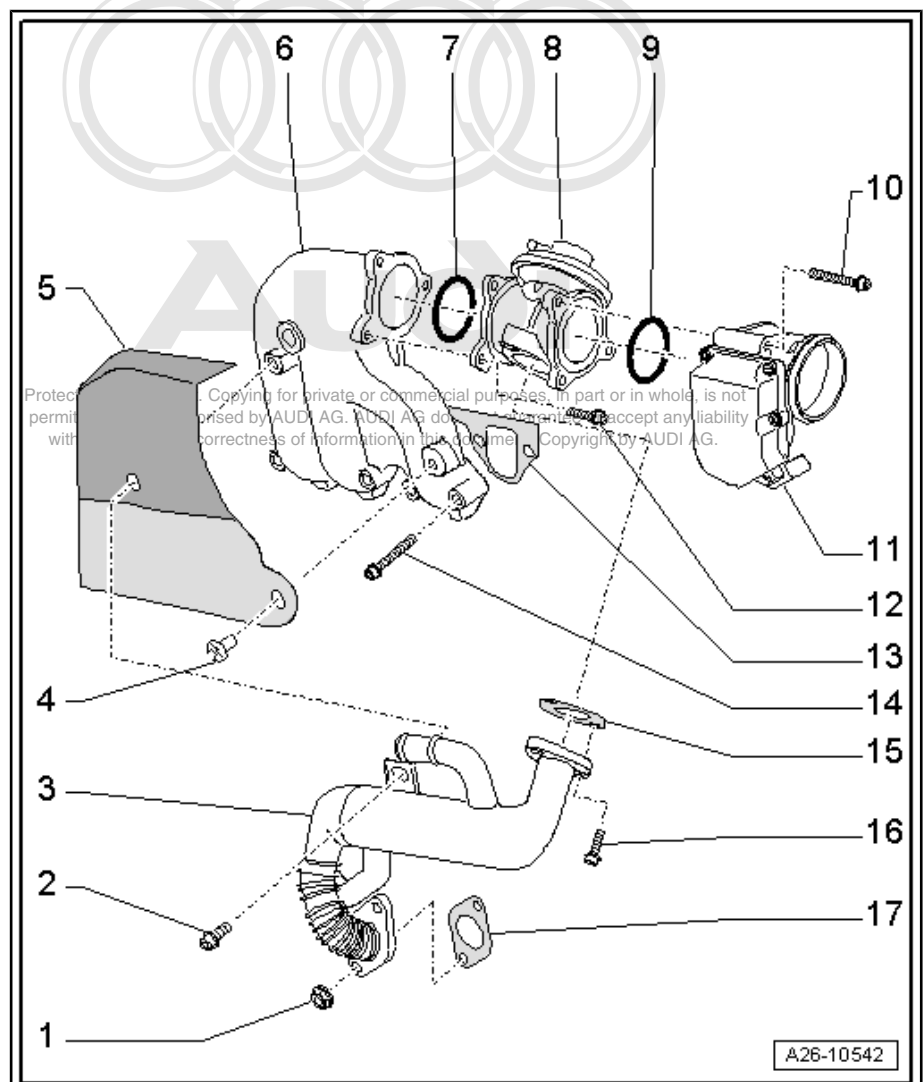
- ☐ 10 Nm

13 - Gasket

- ☐ For intake manifold
- ☐ Renew
- ☐ Installation position: straight edge of gasket faces upwards

14 - Bolt

- ☐ 22 Nm



15 - Gasket

- ☐ Renew

16 - Bolt

- ☐ 22 Nm

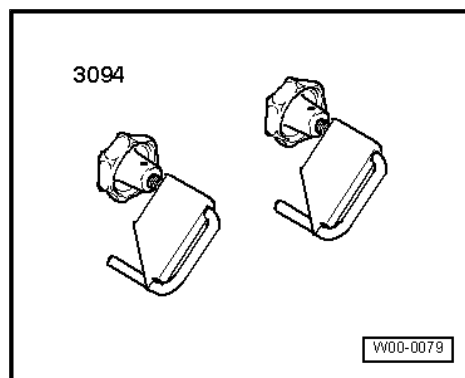
17 - Gasket

- ☐ Renew

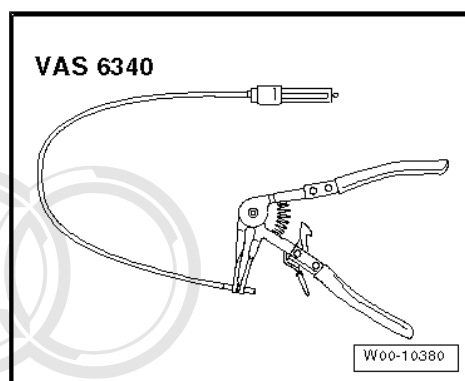
2.4 Removing and installing exhaust gas re-circulation cooler - vehicles with engine code letters ATL

Special tools and workshop equipment required

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

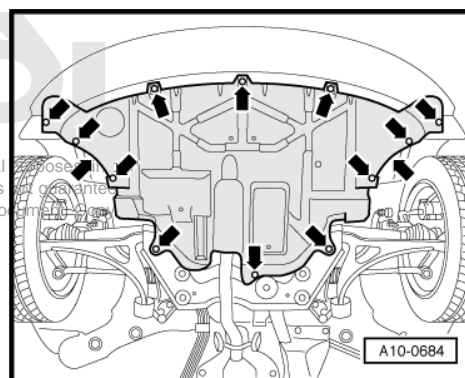


- ◆ Hose clip pliers -VAS 6340-



Removing

- Remove noise insulation -arrows-.

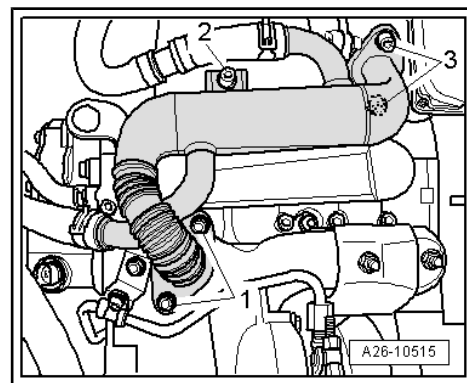


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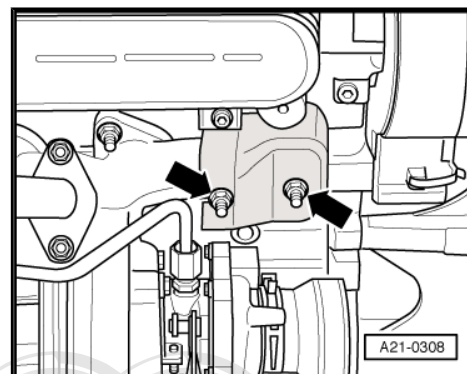
- Remove nuts -1-.

**Note**

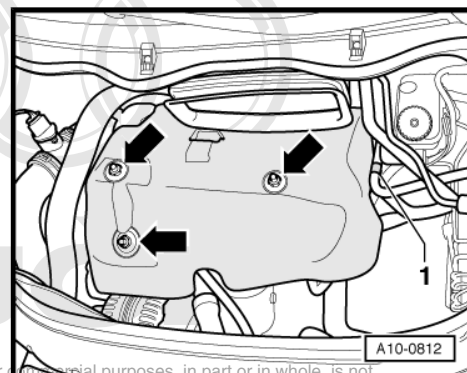
- ◆ Shown in illustration with engine removed.
- ◆ The bolts -2 and 3- are removed at a later stage.



- Remove heat shield for turbocharger -arrows-.



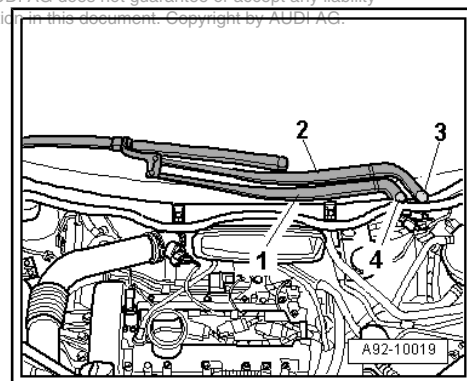
- Remove bonnet ⇒ [page 8](#) .
- If fitted, unclip bracket -1-.
- Take off engine cover panel -arrows-.
- Remove noise insulation beneath cover.



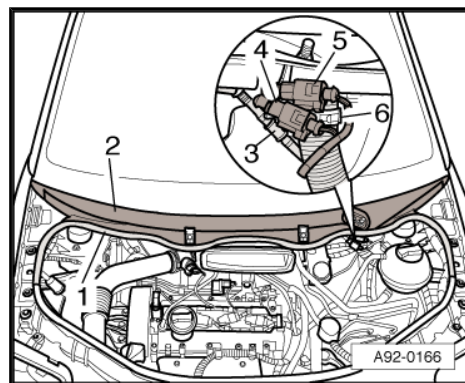
- Lever off caps -3- and -4- on two-piece windscreen wiper arm with a screwdriver.
- Slacken nuts on two-piece windscreen wiper arm a few turns.
- Release arms -1- and -2- one by one by tilting them slightly on the wiper shafts.
- Remove nuts completely and take off two-piece windscreen wiper arm.

**Note**

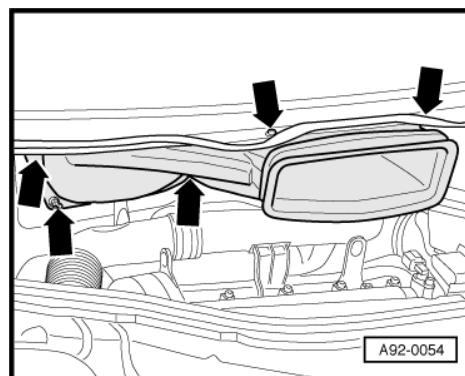
Use puller (commercially available) to remove wiper arm if necessary.



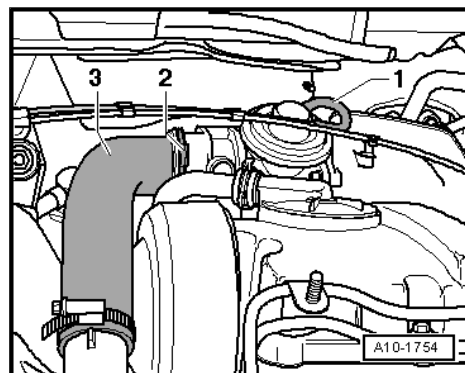
- Disconnect washer fluid hose -3-.
- If fitted, unplug electrical connectors -4- and -5- for heated washer jets.
- Open hose clip -6- using hose clip pliers -V.A.G 1921- and detach water drain hose from cowl panel grille.
- Pull off rubber seal -1- on cowl panel grille.
- Disconnect cowl panel grille -2-.



- Unscrew nuts and bolts -arrows-.
- Pull fresh air duct forwards and remove by turning it to right side of vehicle.



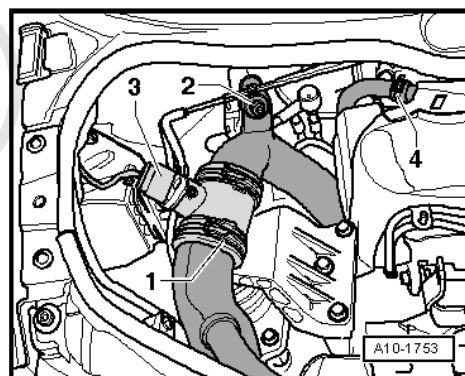
- Remove air hose -3- from intake manifold flap motor -V157- by lifting retaining clip -2- slightly.
- Disconnect vacuum hose -1- at mechanical exhaust gas recirculation valve and move vacuum hose aside.



- Detach crankcase breather hose -4- at cylinder head cover and move clear to one side.

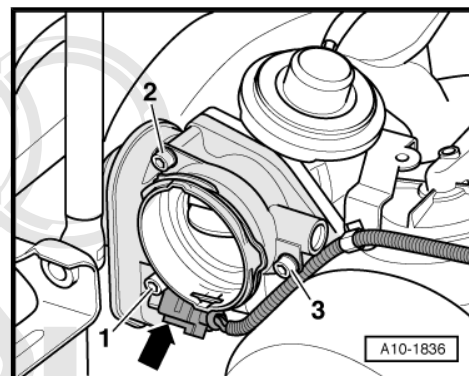

Note

Disregard items marked -1 ... 3-.

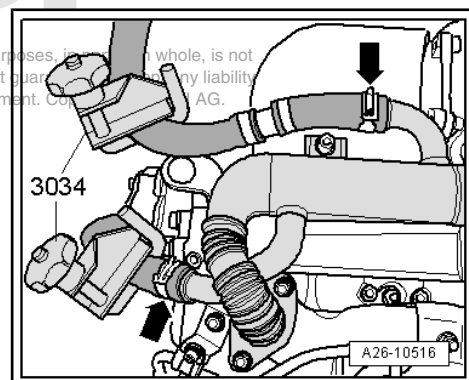


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- Detach electrical connector -arrow- at intake manifold flap motor -V157- .
- Remove bolts -1 ... 3- and take out intake manifold flap motor -V157- .



- Clamp off coolant hoses going to exhaust gas recirculation cooler using hose clamps -3094- .
- Detach coolant hoses -arrow- at exhaust gas recirculation cooler.



- Remove bolts -2 and 3- and detach exhaust gas recirculation cooler.



Note

Disregard -item 1-.

Installing

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

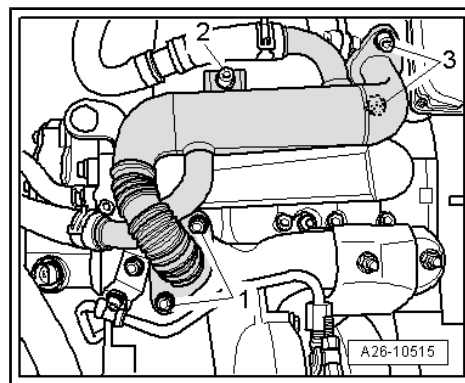


Note

- ◆ Renew gaskets, seals and self-locking nuts.
 - ◆ Charge air system must be free of leaks.
 - ◆ 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) ⇒ Parts catalogue.
- Install windscreen wiper arm ⇒ Rep. gr. 92 .

Tightening torques

Component	Nm
Heat shield to turbocharger	22
Exhaust gas recirculation cooler to:	22
Mechanical exhaust gas recirculation valve	
Intake manifold	20
Exhaust manifold	22
Intake manifold flap motor -V157- to mechanical exhaust gas recirculation valve	10
Engine cover panel to bracket	5.5

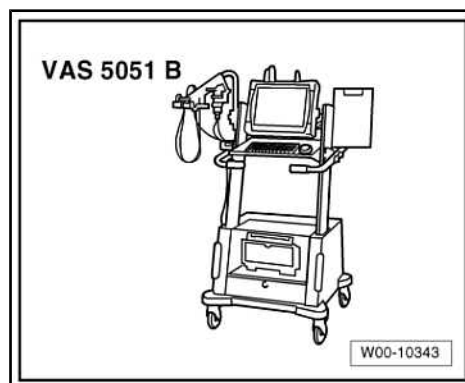


2.5 Checking exhaust gas recirculation

The exhaust gas recirculation function is checked with the vehicle diagnosis, testing and information system -VAS 5051B- in the "Basic setting" mode. In this test, the EGR valve is pulsed every 10 seconds, so that the extreme values for the EGR (air mass meter -G70-) can be read off.

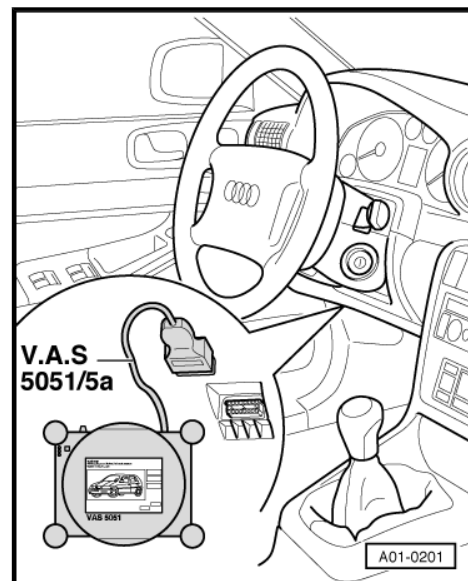
Special tools and workshop equipment required

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



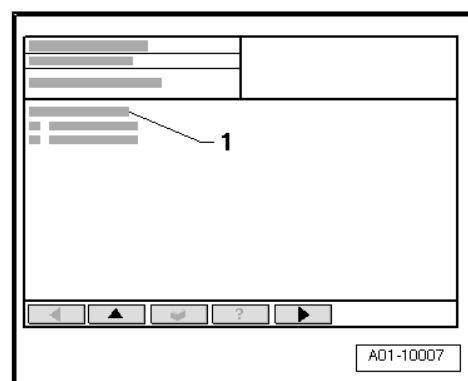
Procedure

- Coolant temperature at least 80 °C.
- Start the engine and run at idling speed.
- Connect up the vehicle diagnostic, testing and information system -VAS 5051B- .



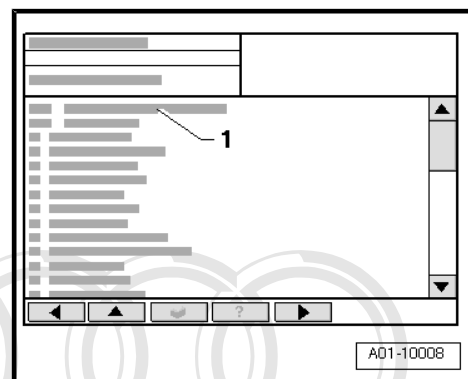
Display on -VAS 5051B- :

- From menu -1-, select system “Self-diagnosis” and press  key to activate function.



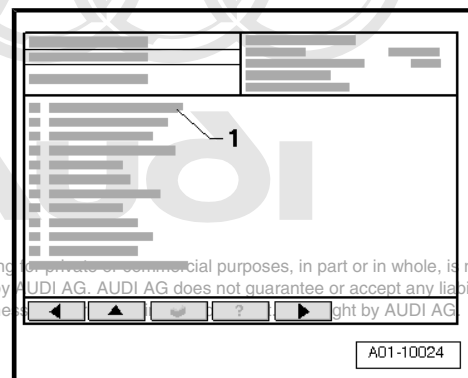
Display on -VAS 5051B- :

- From menu -1-, select vehicle system “01 - Engine electronics” and press  key to activate function.



Display on -VAS 5051B- :

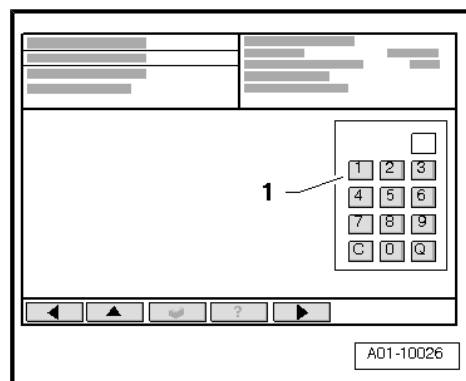
- From menu -1-, select diagnosis function “006 - Basic setting” and press  key to activate function.



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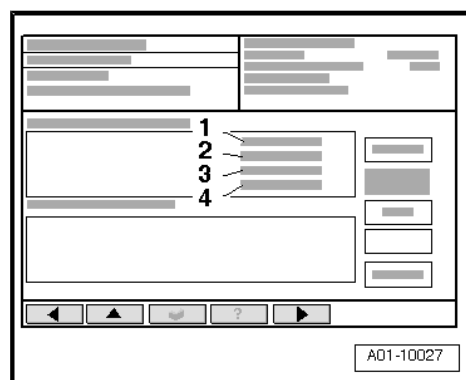
Display on -VAS 5051B- :

- Press key **[3]** on keypad -1- to select “Display group 003” and confirm entry by pressing key **[Q]**.



Display on -VAS 5051B- :

- Activate basic setting by touching key **[Activate]**.
- The idling speed is increased to 1350 rpm ... 1450 rpm.
- Check information shown in display zones -2, 3, 4-.
- Press “Print - Save result” on -VAS 5051B- .



Display zone	Display shows	Specification
-2-	Activation of exhaust gas recirculation valve -N18-	Display alternates at 10 second intervals: “EGR active” and “EGR inactive”
-3-	Intake air mass	Display alternates at 10 second intervals: Difference min. 100 mg/H
-4-	Duty cycle of exhaust gas recirculation valve -N18-	Display alternates at 10 second intervals: “20 %” and “65 %”

- End function “006 - Basic setting” by pressing **[↵]** key.
- Press “022 - End output”.
- Switch off ignition.

If the specifications are not obtained:

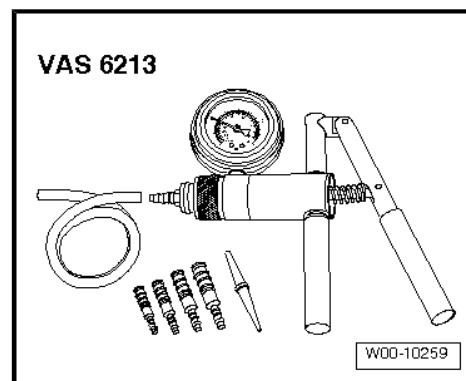
- Check mechanical exhaust gas recirculation valve ⇒ [page 220](#) .
- Check vacuum hose connections ⇒ [page 210](#) .
- Check exhaust gas recirculation valve -N18- ⇒ Vehicle diagnostic tester.

2.6 Checking mechanical exhaust gas recirculation valve

Special tools and workshop equipment required

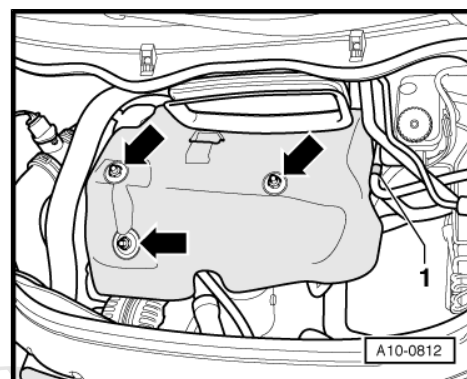
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◆ Hand vacuum pump -VAS 6213-

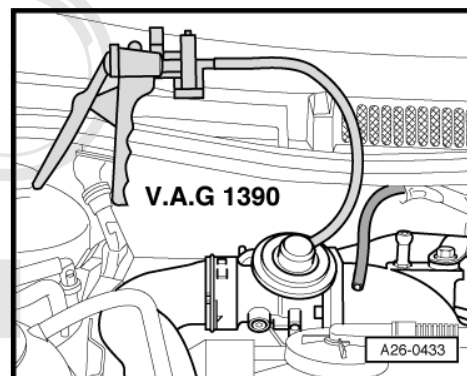


Procedure

- Remove bonnet ⇒ [page 8](#) .
- If fitted, unclip bracket -1-.
- Take off engine cover panel -arrows-.
- Remove noise insulation beneath cover.
- Remove air intake hose at intake manifold connection.



- Disconnect vacuum hose from exhaust gas recirculation valve.
- Connect hand vacuum pump to exhaust gas recirculation valve.



- Use hand vacuum pump to generate vacuum.
 - The diaphragm rod must move in -direction of arrow-.
- Pull hose of hand vacuum pump off exhaust gas recirculation valve.
 - The diaphragm rod must return to normal position.

Assemble in reverse order.

Tightening torque

Component	Nm
Engine cover panel to bracket	5.5

