

Workshop Manual Audi A4 1995 ➤

4-cylinder engine (5-valve turbo), mechanics

Engine ID

AWT

AWM

Edition 06.2013



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List of Workshop Manual Repair Groups

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

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00 – Technical data

1 Engine number

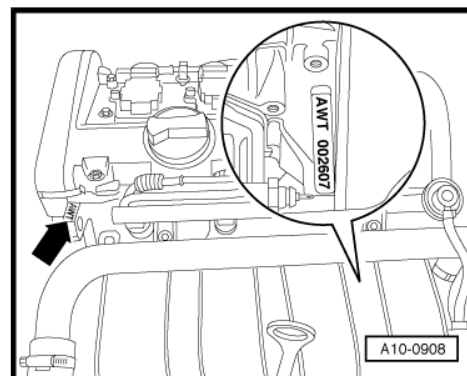
(ARL003414; Edition 06.2013)

- ◆ The engine number ("Engine code" and "Serial number") can be found on the rear left of the cylinder block.
- ◆ Additionally there is a sticker on the toothed belt cover with "Engine code" and "Serial number".
- ◆ The engine code is also included on the vehicle data sticker.



Note

The engine code is also stamped on the front engine lifting eye (visible after detaching engine cover panel).



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2 Engine data

Code letters		AWM	AWT
Capacity	ltr.	1.781	1.781
Power output	kW at rpm	125/5900	110/5700
Torque	Nm at rpm	225/1950 ... 5000	210/1750 ... 4600
Bore	Ø in mm	81.0	81.0
Stroke	mm	86.4	86.4
Compression ratio		9.3	9.5
RON	at least	95 ¹⁾	95 ¹⁾
Injection/ignition system		Bosch Motronic	Bosch Motronic
Firing order		1-3-4-2	1-3-4-2
Turbocharging/supercharging		Turbocharger	Turbocharger
Knock control		2 sensors	2 sensors
Variable valve timing		yes	yes
Intake manifold change-over		no	no
Secondary air system		yes	yes
Valves per cylinder		5	5
• ¹⁾ Unleaded premium RON 91 can also be used, but results in reduced power			



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3 Safety precautions

When working on the fuel system note the following warnings:



WARNING

Risk of injury - fuel system operates under high pressure.

- ◆ *Wrap a clean cloth around the connection and carefully loosen the connection to release the fuel pressure.*

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

- ◆ Always switch off the ignition before connecting or disconnecting electrical wiring for the injection or ignition system or tester cables.
- ◆ Always switch off ignition before washing engine.
- ◆ Faults are stored in engine control unit if electrical connectors have been unplugged:
 - Connect vehicle diagnostic, testing and information system - VAS 5051B- .
 - Start “Self-diagnosis” mode.
 - Generate readiness code in engine control unit.



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.*
- ◆ *If test and measuring instruments are operated from front passenger's seat and the vehicle is involved in an accident, the person sitting in this seat could be seriously injured when the airbag is triggered.*



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4 General repair instructions

4.1 Rules for cleanliness

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

- ◆ Carefully clean connection points and the surrounding area with engine cleaner or brake cleaner and dry thoroughly before opening.
- ◆ Plug open lines and connections with suitable protective caps immediately.
- ◆ Place parts that have been removed on a clean surface and cover them over. Do not use fluffy cloths.
- ◆ Only install clean components; replacement parts should only be unpacked immediately prior to installation. Do not use parts that have been previously unpacked and stored away loose (e.g. in toolboxes, etc.).
- ◆ When the system is open: Do not work with compressed air. Do not move the vehicle unless absolutely necessary.

4.2 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.
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4.3 Contact corrosion!

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

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

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

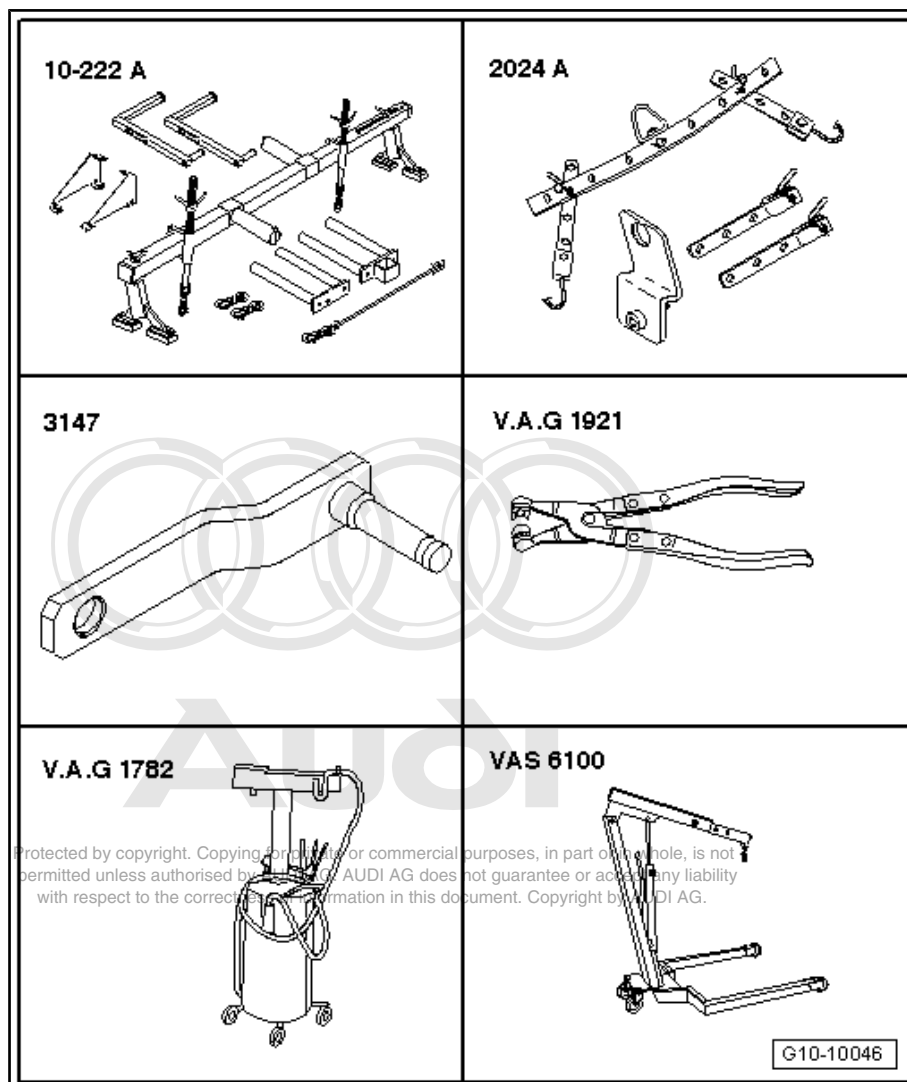
Always install new parts if you are not sure whether used parts can be re-fitted ⇒ Parts catalogue .

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.

10 – Removing and installing engine

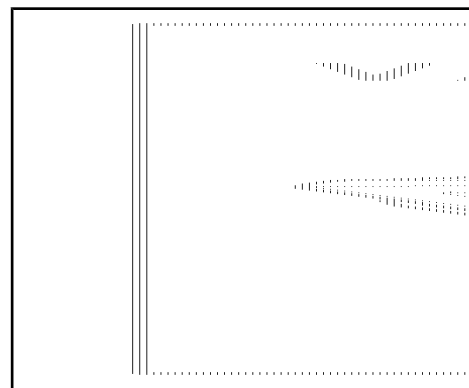
1 Removing engine



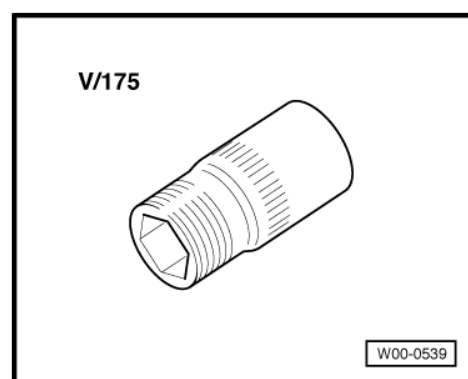
Special tools and workshop equipment required

- ◆ Support bracket - 10 - 222 A-
- ◆ Lifting tackle - 2024 A-
- ◆ Gearbox support - 3147-
- ◆ Hose clip pliers - V.A.G 1921-
- ◆ Used oil collection and extraction unit - V.A.G 1782- (for vehicles with automatic gearbox)
- ◆ Workshop hoist - VAS 6100-

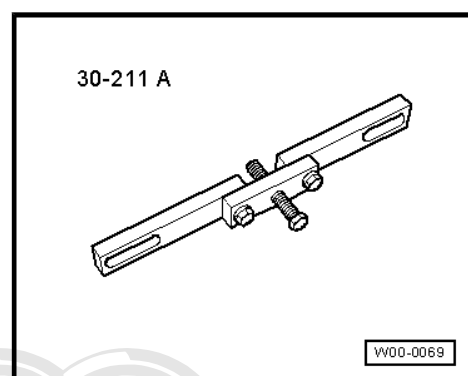
- ◆ Drip tray for workshop hoist - VAS 6208-



- ◆ 15 mm socket insert - Matra V/175- for vehicles with automatic gearbox



- ◆ Support bridge - 30 - 211 A- for vehicles with automatic gearbox



Procedure

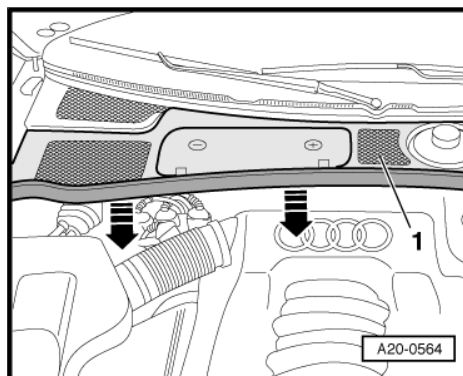


Note

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

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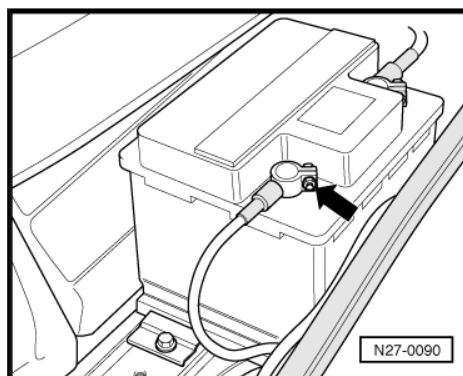
- Remove seal -arrows-.
- Pull off plenum chamber cover -1- towards front of vehicle.



Caution

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

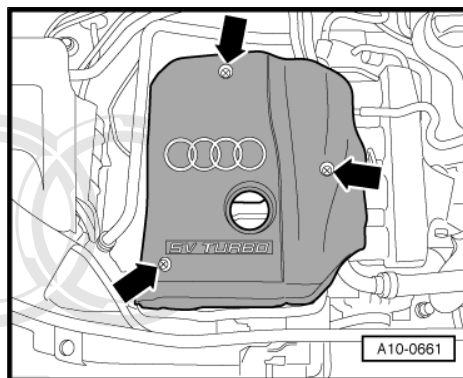
- With ignition switched off, disconnect battery earth cable -arrow-.



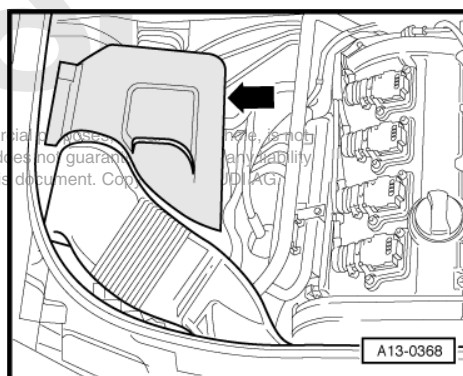
WARNING

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

- Open filler cap on coolant expansion tank.
- Release quick-release fasteners and remove engine cover panel -arrows-.

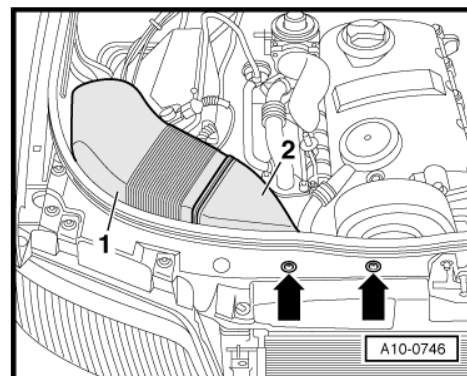


- Detach air cleaner cover -arrow-.

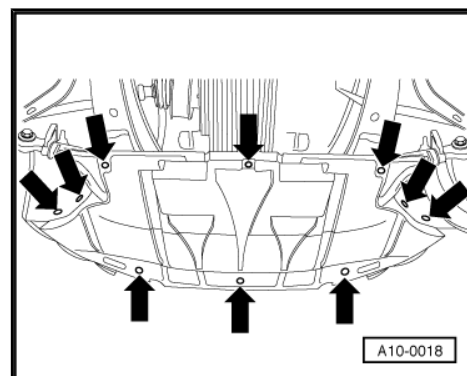


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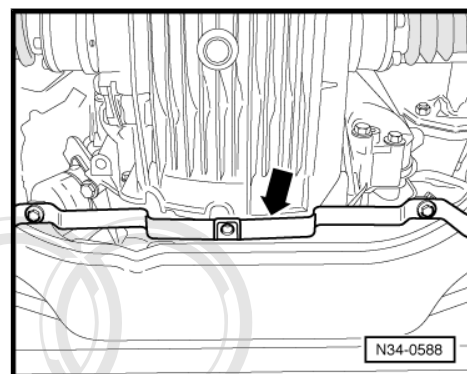
- Remove bolts -arrows-.
- Remove air duct -1 and 2-.
- Remove front bumper ⇒ Rep. gr. 63 .



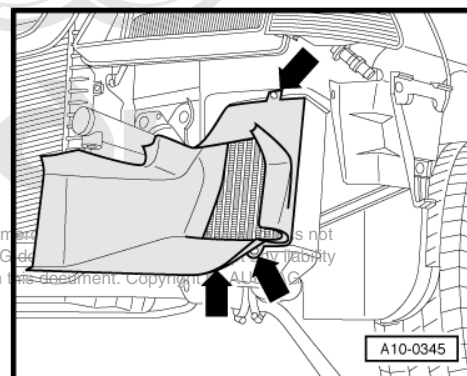
- Release fasteners -arrows- and remove noise insulation.



- Unbolt bracket for noise insulation -arrow-.

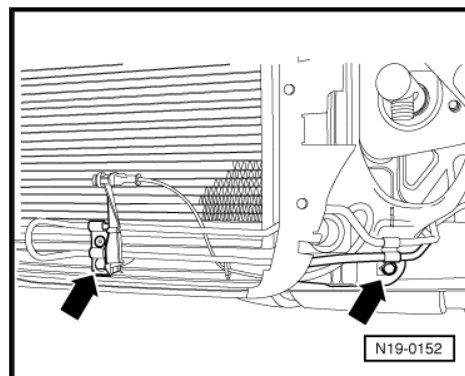


- Remove air duct in front of charge air cooler -arrows-.

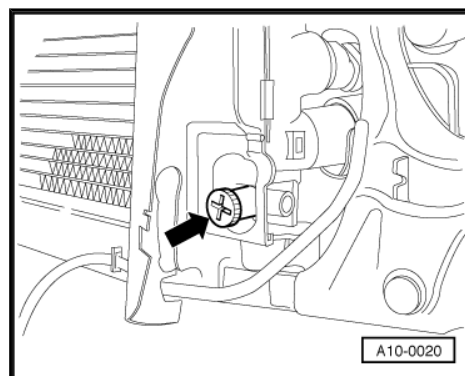


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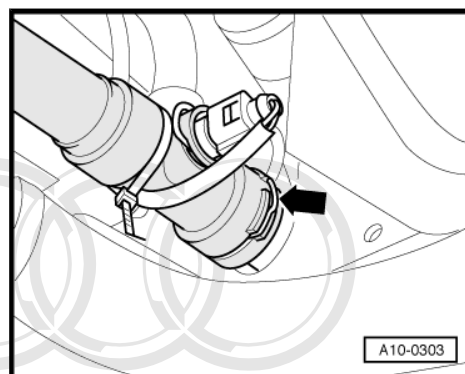
- Unclip ambient temperature sensor - G17- from bracket.
- Detach cooling pipe for power steering hydraulic fluid -arrows- and move clear; do not open hydraulic fluid circuit.



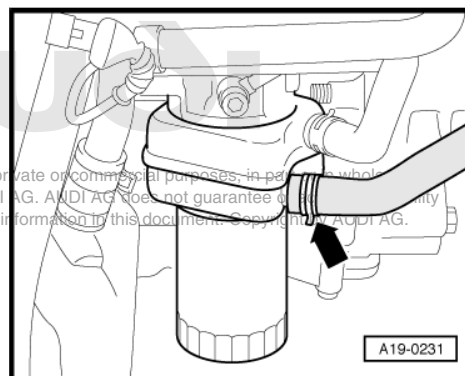
- Place drip tray for workshop hoist - VAS 6208- beneath engine.
- Turn drain plug -arrow- on radiator anti-clockwise, if necessary fit drain hose to connection.



- Detach coolant hose at bottom of radiator -arrow-.

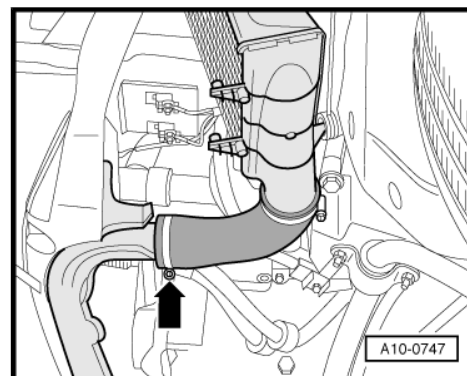


- Also disconnect coolant hose at bottom of oil cooler -arrow-, and drain off remaining coolant.
- Remove coolant hose from hose connection at thermostat.



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- Detach air hose going to charge air cooler at lock carrier (bottom left) -arrow-.
- Detach air hose going to turbocharger from lock carrier (bottom right).



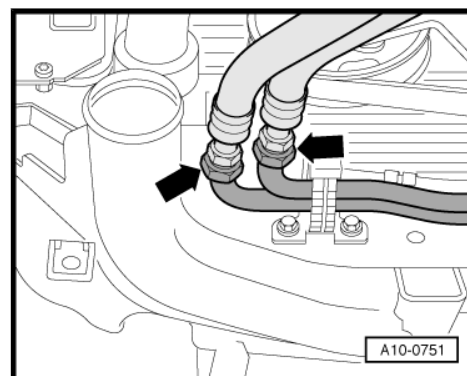
Vehicles with automatic gearbox:



Note

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

- Position used oil collection and extraction unit - V.A.G 1782- below connection point.

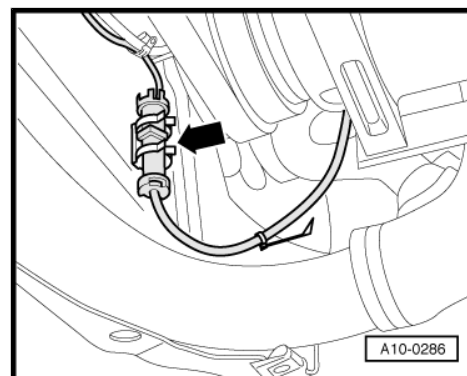


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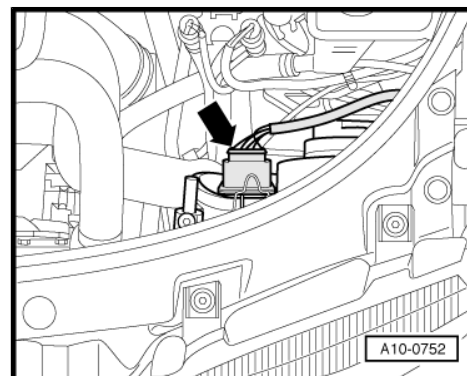
- ~~Disconnect ATF lines -arrows-~~
- Detach bracket for ATF lines (left-side) from engine.

All vehicles:

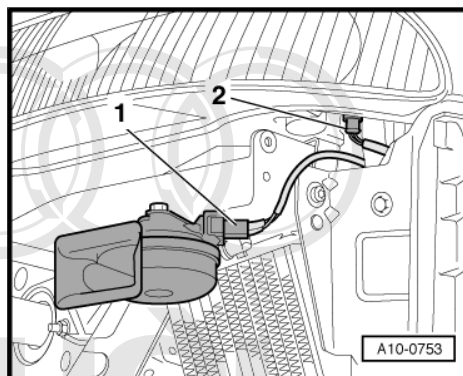
- Unclip and disconnect green electrical connector -arrow- for magnetic clutch of air conditioner compressor at lock carrier (bottom right) and move wiring clear.



- Unplug electrical connector (left and right) -arrow- for headlights.

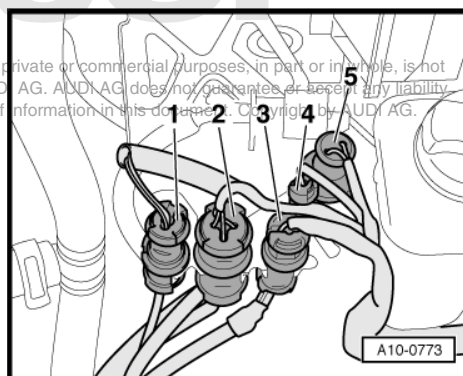


- Unplug electrical connector (left and right) -2- for turn signal indicator.
- Unplug electrical connector -1- at both horns and move wiring clear.
- Detach cable for bonnet at lock carrier ⇒ Rep. gr. 55 .



- Detach cover from power steering reservoir.
- Unplug electrical connectors -1 ... 5-.
- Move electrical wiring clear.

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- Detach coolant hose at top of radiator -arrow-.



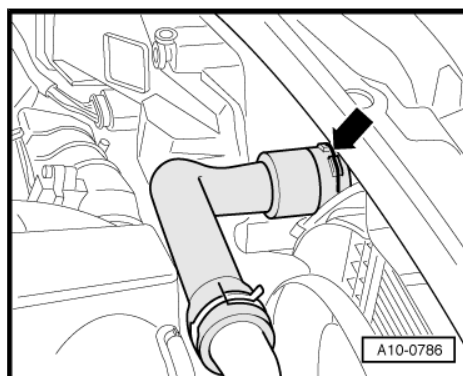
WARNING

The air conditioner refrigerant circuit must not be opened.



Note

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

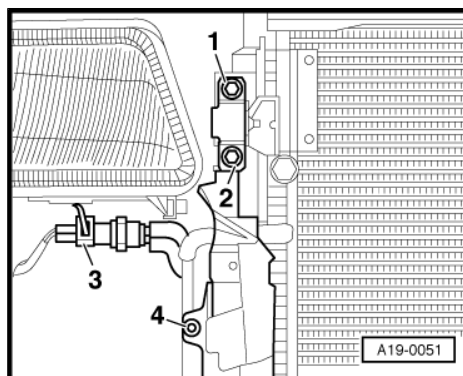


- Remove bolts -4- (left and right) for air cowls from radiator.
- Remove bolts -1 and 2- for condenser.
- Unplug electrical connector -3- at air conditioner pressure switch - F129- .
- Pull condenser up out of its bracket, pivot to side and secure to right-side front wheel with wire.



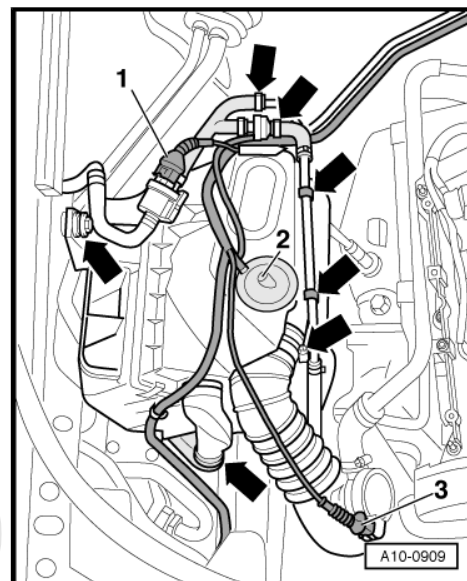
Note

Protect side panel (front) from damage.

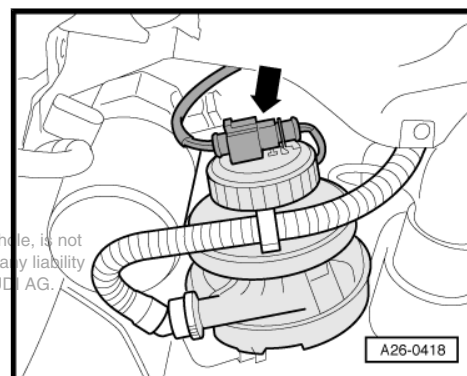


- Unbolt and remove lock carrier. Place clear of vehicle and ensure that it cannot tip over.

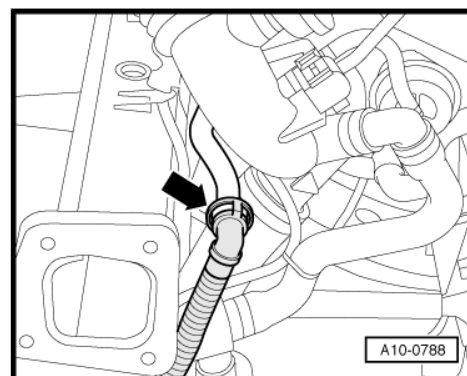
- Unplug electrical connectors:
 - 1 - On activated charcoal filter solenoid valve - N80-
 - 2 - On air mass meter - G70-
 - 3 - On charge pressure control solenoid valve - N75-
- Detach solenoid valve 1 for activated charcoal filter - N80- from air cleaner housing.
- Detach hose connections, move electrical wiring clear and remove air filter housing -arrows-.



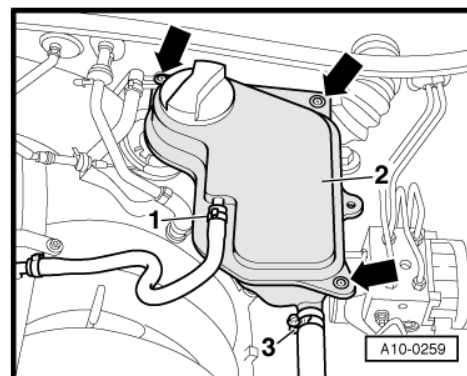
- Unplug electrical connector -arrow- at secondary air pump motor - V101- at front right of engine compartment below air cleaner housing.



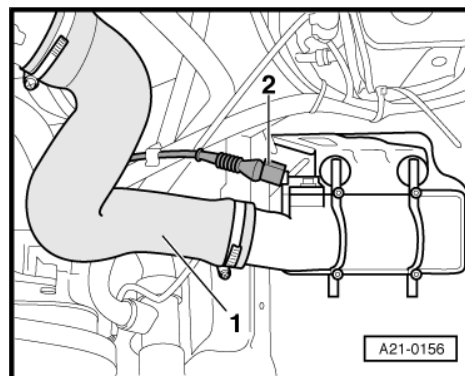
- Detach secondary air hose from secondary air pipe -arrow-.



- Detach coolant hoses -1- and -3-.
- Unbolt coolant expansion tank -2- -arrows-.
- Detach electrical wiring at coolant shortage indicator switch - F66- on coolant expansion tank (bottom).
- Detach coolant hose (left-side) going to heat exchanger from coolant pipe (bottom) on engine.
- Disconnect coolant hose (right-side) going to heat exchanger at cylinder head connection.

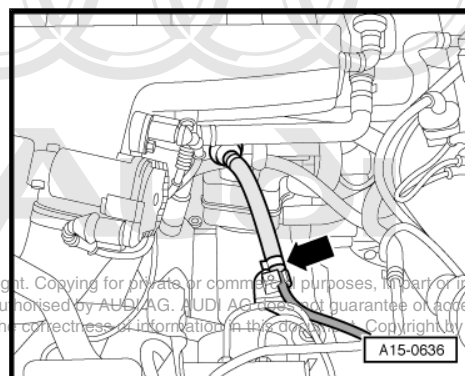
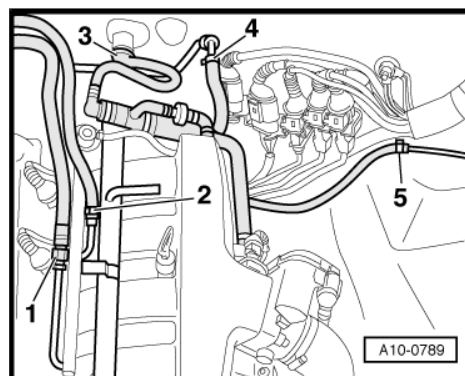


- Remove air hose -1-.
- Unplug electrical connector -2- at charge pressure sender - G31- .

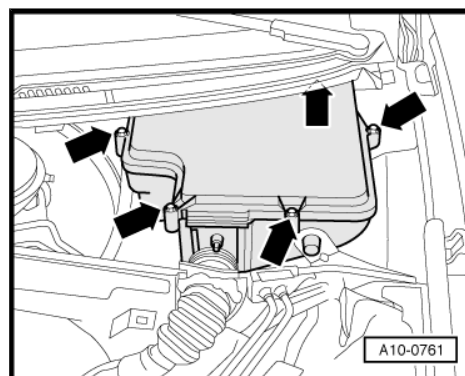

WARNING

The fuel system is pressurised. Before opening the system place a clean cloth around the connection. Then release pressure by carefully loosening the connection.

- Disconnect fuel supply line -1- and fuel return line -2- and move clear.
 - Disconnect vacuum hoses:
- 3 - To brake servo
4 - To activated charcoal filter solenoid valve 1 - N80-
5 - To vacuum reservoir
- If fitted, detach hose -arrow-.

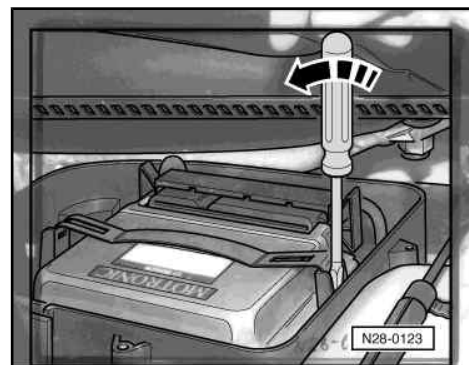


- Remove cover for electronics box in plenum chamber -arrows-.

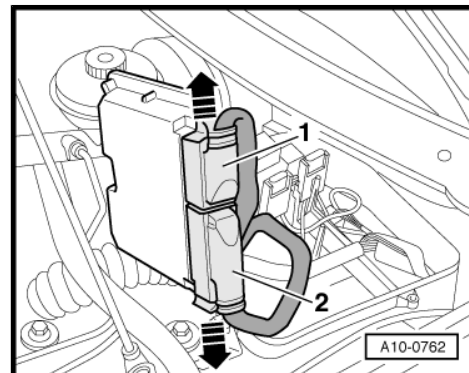


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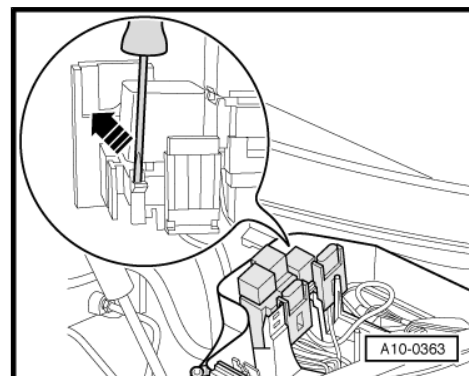
- Carefully lever out retaining strap using a screwdriver -arrow-.



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



- Release retainer -arrow- and pull auxiliary relay carrier in electronics box upwards to remove.
- Unplug electrical connectors at rear of connector console.



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- Unscrew earth wire -6-.
- Detach electrical connectors -1 ... 5- from bracket.
- Unplug electrical connectors:
 - 1 - For Lambda probe after catalytic converter - G130- (brown)
 - 2 - For Lambda probe - G39- (before catalytic converter; black)
- Unhook wiring harness -arrow- and move it clear.
- Unplug electrical connector from speedometer sender - G22- on left of gearbox, and move wire clear.

Vehicles with manual gearbox:

- Unplug electrical connector for reversing light switch - F4- from gearbox and move electrical wire clear.

All vehicles:



Note

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

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



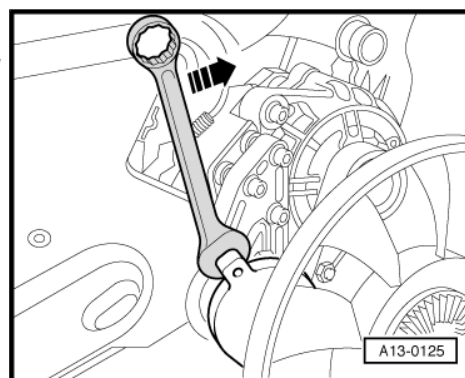
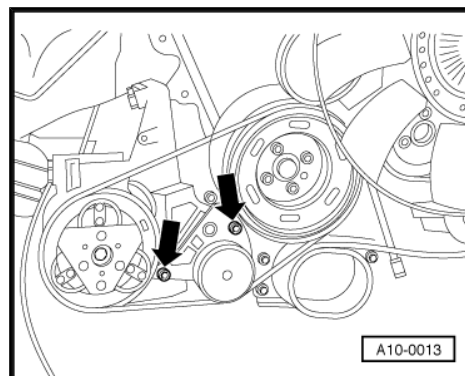
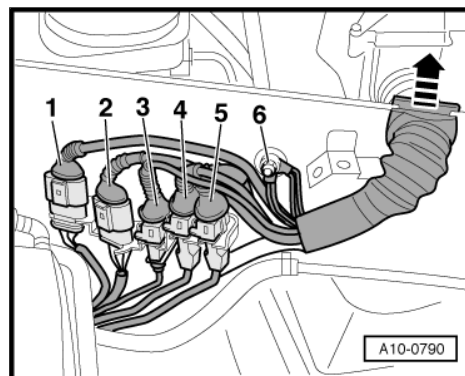
WARNING

The air conditioner refrigerant circuit must not be opened.

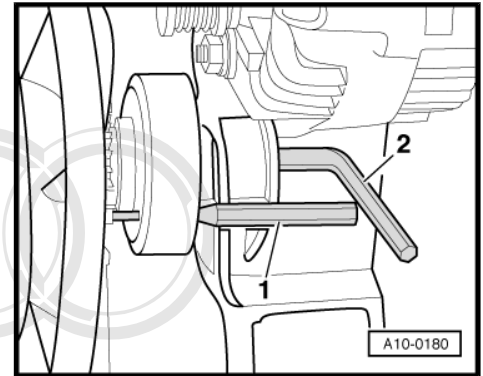
- Detach air conditioner compressor from bracket and secure to body with wire.

- To slacken poly V-belt turn tensioner in direction of -arrow-.

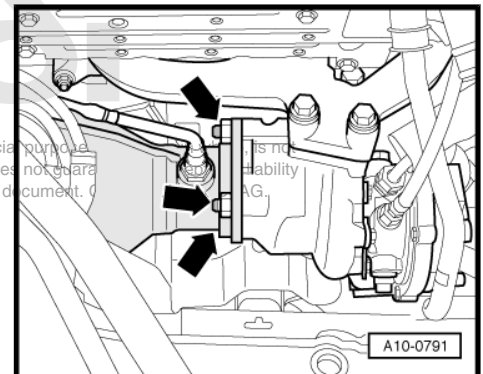
- Remove poly V-belt from pulley on alternator.



- Lock pulley for viscous fan with roll-pin drift -1- and unscrew using hexagon key -2-.
- Detach viscous fan from bearing.
- Remove poly V-belt pulley for power steering pump.
- Unbolt power steering pump and tie up to one side; the hydraulic fluid hoses/pipes remain connected.



- Remove nuts -arrows- securing catalytic converter to turbo-charger.



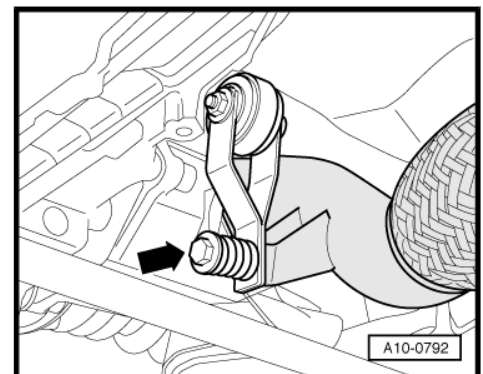
- Unbolt bracket for exhaust system -arrow-.



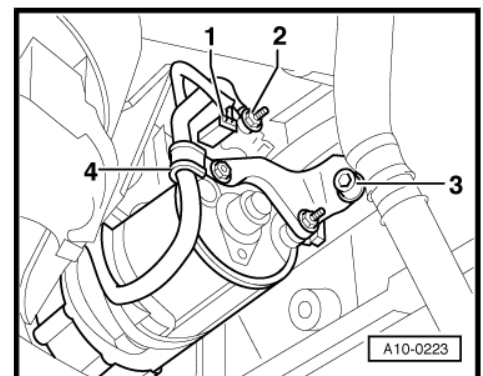
Note

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

- Disconnect exhaust pipe from turbocharger.



- Detach electrical wires -1 and 2- at starter; remove insulator from positive connection on starter.
- Remove retaining clip -4-.
- Remove bracket for starter from cylinder block -3- and from starter.
- Remove starter from gearbox.
- Remove earth cable from engine support (right-side).



Vehicles with automatic gearbox:

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

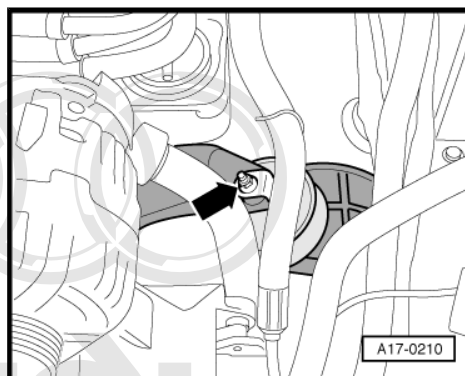
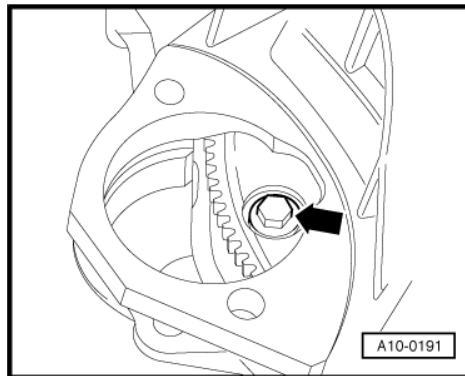


Note

When loosening torque converter bolts, counterhold at the toothed belt sprocket.

All vehicles:

- Loosen top nuts -arrow- on engine mountings (right and left) several turns.



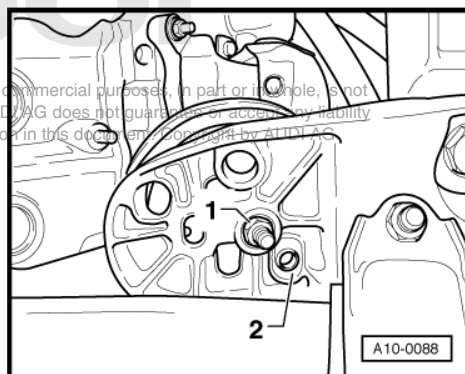
- Mark position of nuts -1- and locating sleeves -2- on bottom of engine mountings (right and left).



Note

Different mounting holes are provided for the different engine versions.

- Remove nut for engine mounting -1- on both sides.



- Raise engine and gearbox using workshop hoist.



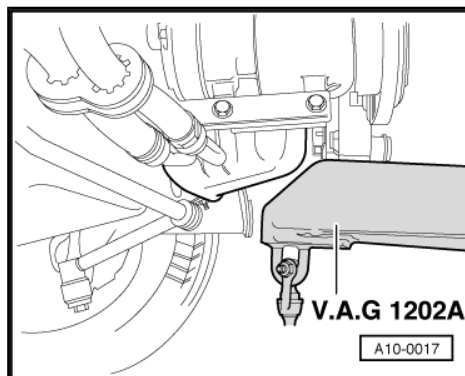
WARNING

To avoid injury, ensure adequate support.



Note

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



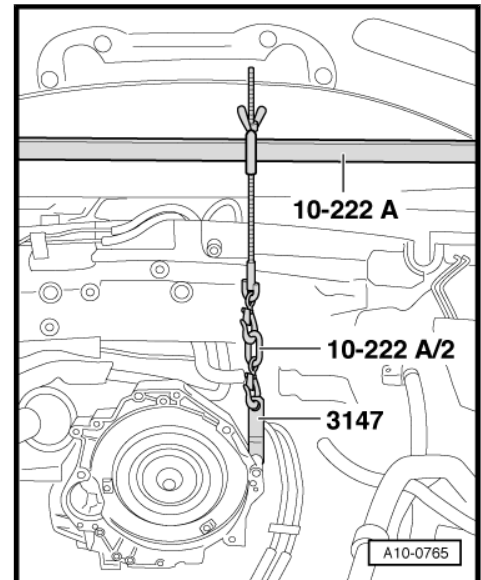
- Remove bolts (accessible from below) securing engine to gearbox.
- Lower engine again.

- Position support bracket - 10 - 222 A- behind gas-filled strut on bolted flanges of wing panels. The spindle must be at the front.
- Insert gearbox support - 3147- into bolt hole in gearbox bell housing.
- Connect gearbox support - 3147- to support bracket - 10 - 222 A- using hooks - 10 - 222 A /2- .

 Note

Shown in illustration with engine removed.

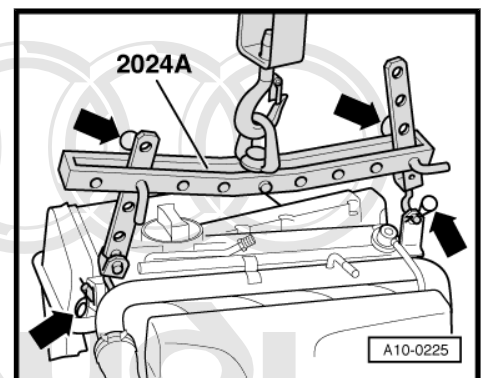
- Unscrew top engine/gearbox securing bolts; leave one bolt in place (hand-tight).



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

 Note

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



WARNING

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

- Remove remaining bolt securing engine to gearbox.

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 Note

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

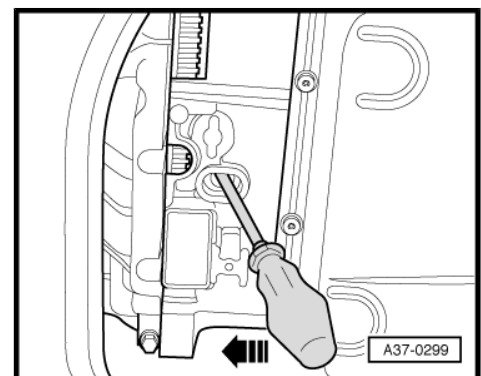
- Raise engine with workshop hoist until the studs of the engine mountings are clear.
- Tighten spindle of support bracket - 10 - 222 A- further.

Vehicles with automatic gearbox:

- Separate gearbox from engine and at the same time detach torque converter from drive plate.

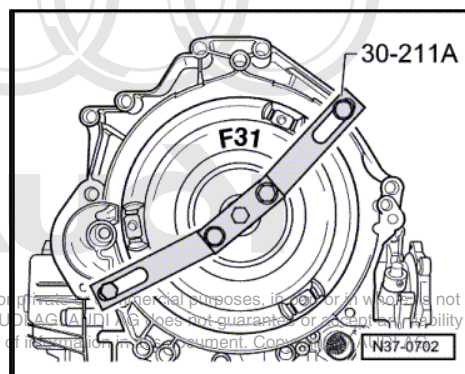
All vehicles:

- Separate engine from gearbox and guide engine forwards out of engine compartment.



Vehicles with automatic gearbox:

- Secure the torque converter in the gearbox using support bridge - 30 - 211 A- to prevent it falling out.

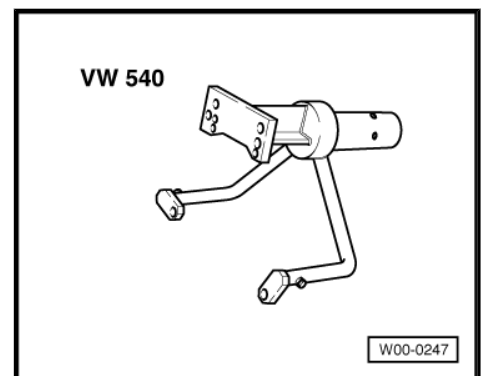


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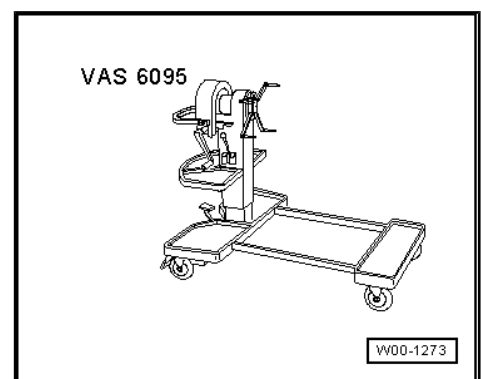
2 Securing engine to assembly stand

Special tools and workshop equipment required

- ◆ Engine and gearbox support - VW 540-

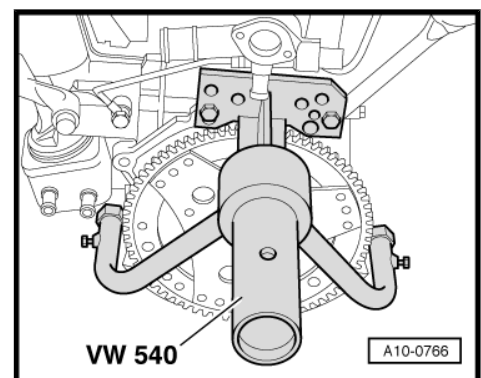


- ◆ Engine and gearbox support - VAS 6095-



Procedure

- Secure engine to engine and gearbox support - VW 540- using engine and gearbox support - VAS 6095- .



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3 Installing engine



Note

- ◆ *Renew self-locking nuts and bolts.*
- ◆ *Renew bolts which are tightened to a specified angle as well as oil seals, gaskets and O-rings.*
- ◆ *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.*
- ◆ *Fit all cable ties in the original positions when installing.*

Vehicles with manual gearbox:

- Make sure that clutch plate is properly centred ⇒ Rep. gr. 30 .
- Check clutch release bearing for wear; renew if necessary.
- Clean input shaft splines and (in the case of used clutch plates) the hub splines. Remove corrosion and apply only a very thin coating of grease for clutch plate splines - G 000 100- to the splines. Then move clutch plate back and forth on input shaft until the hub moves smoothly on the shaft. Remove any excess grease. Do not lubricate guide sleeve ⇒ Rep. gr. 30 .
- A needle bearing must be fitted in the crankshaft on vehicles with manual gearbox; install needle bearing if not already fitted ⇒ [page 66](#) .

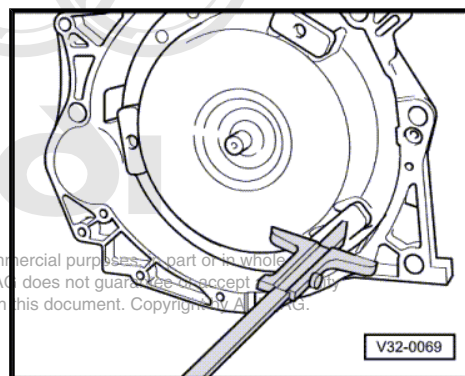
Vehicles with automatic gearbox:

- In vehicles with automatic gearbox, the needle bearing must NOT be fitted in the crankshaft; remove needle bearing if fitted ⇒ [page 66](#) .
- Checking installation depth of torque converter:
 - If the torque converter has been correctly installed, the distance between the bottom contact surfaces at the studs on the torque converter and the contact surface on the torque converter bell housing (with automatic gearbox) is approx. 23 mm.



Caution

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



- To secure torque converter on drive plate, only use new bolts (same as original equipment) as specified in ⇒ Parts catalogue .

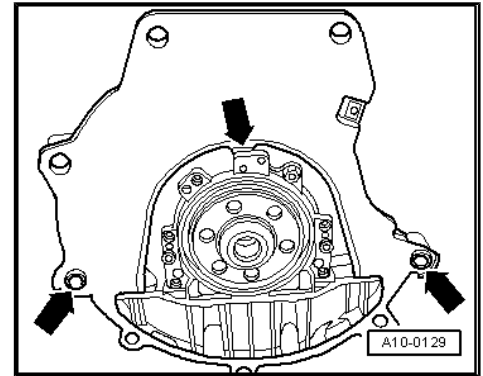


Caution

Before and during tightening of bolts on engine/gearbox flange, continually check that the torque converter behind the drive plate can be turned. If the converter cannot be turned, it must be assumed that it has not been installed correctly and the drive lugs of the ATF pump and consequently the gearbox will be damaged when the bolts are finally tightened.

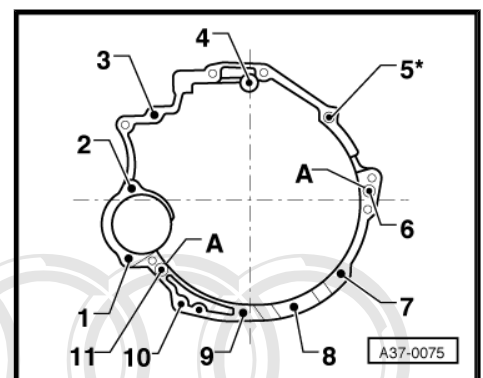
All vehicles:

- Check whether dowel sleeves for centring the engine/gearbox assembly are fitted in the cylinder block; install dowel sleeves if necessary.
- Ensure that the intermediate plate is engaged on the sealing flange and pushed onto the dowel sleeves -arrows-.
- Press intermediate plate between engine and gearbox onto dowel sleeves.
- Join engine onto gearbox and screw in one securing bolt (tighten hand-tight).
- Slacken spindle of support bracket - 10 - 222 A- .
- Lower engine, inserting studs of engine mountings into consoles for engine mountings.



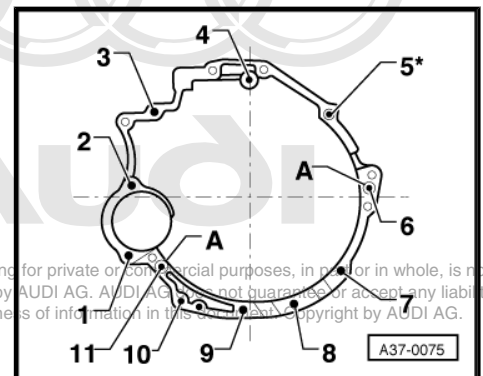
Securing engine to manual gearbox

Item	Bolt	Nm
1, 3, 4	M12x67	65
2, 6	M12x90	65
5 *), 11	M12x110	65
7 ... 10	M10x45	45
A	Dowel sleeves for centralising	
• *) The wiring harness bracket is also secured with this bolt.		



Securing engine to automatic gearbox

Item	Bolt	Nm
1, 8, 9, 10	M10x45	45
2, 3, 4, 11	M12x67	65
5 *)	M12x110	65
6	M12x90	65
7	M10x60	45
A	Dowel sleeves for centralising	
• *) The wiring harness bracket is also secured with this bolt.		



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

- Install engine mountings free of stress. To do so, shake engine before tightening engine mountings.
- Install air conditioner compressor ⇒ Rep. gr. 87 .
- Install power steering pump ⇒ Rep. gr. 48 .
- Install poly V-belt ⇒ [page 29](#) .
- Align exhaust system so it is free of stress: vehicles with front-wheel drive ⇒ [page 201](#) , vehicles with four-wheel drive ⇒ [page 207](#) .

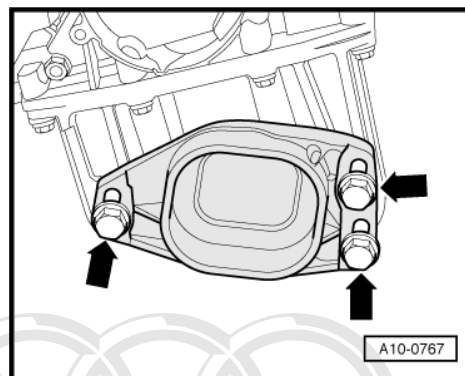
- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight, and tighten bolts.

Vehicles with automatic gearbox:

- Secure ATF lines ⇒ Rep. gr. 37 .

All vehicles:

- Install front bumper ⇒ Rep. gr. 63 .
- Electrical connections and routing ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- Observe notes on procedure for connecting the battery ⇒ Rep. gr. 27 .



Caution

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

- Check oil level ⇒ [page 139](#) .
- Fill up with coolant ⇒ [page 145](#) .

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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.*
- Check power-assisted steering fluid level ⇒ Rep. gr. 48 .

Vehicles with automatic gearbox:

- Check ATF level ⇒ Rep. gr. 37 .

Tightening torques



Note

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

Component		Nm
Bolts/nuts	M6	10
	M7	15
	M8	20
	M10	45
	M12	65
Except for the following:		
Engine mounting to subframe		25
Engine support to engine mounting		25
Torque converter to drive plate		85
Catalytic converter to turbocharger		30
Bracket for ATF lines		10
Power steering pump to bracket		23
Pulley to power steering pump		23
Viscous fan to bearing		45
A/C compressor to bracket		25
Stop for torque reaction support to sump		28
Hose clips for coolant hoses		2
Hose clips for air hoses		3.5



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13 – Crankshaft group

1 Cylinder block (pulley end)

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

1 - 10 Nm

2 - Fan wheel for viscous fan

3 - Circlip

- ☐ For viscous fan bearing
- ☐ Removing and installing
⇒ [page 159](#)

4 - 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 29](#)
- ☐ When installing, make sure it is properly seated on pulleys.

5 - Special bolt, 10 Nm + 90°
(1/4 turn) further

6 - Vibration damper with poly V-belt pulley

- ☐ Can only be installed in one position
- ☐ Removing and installing
⇒ [page 31](#)

7 - Poly V-belt pulley for viscous fan

- ☐ Removing and installing
⇒ ["2.2 Removing and installing viscous fan", page 158](#)

8 - 23 Nm

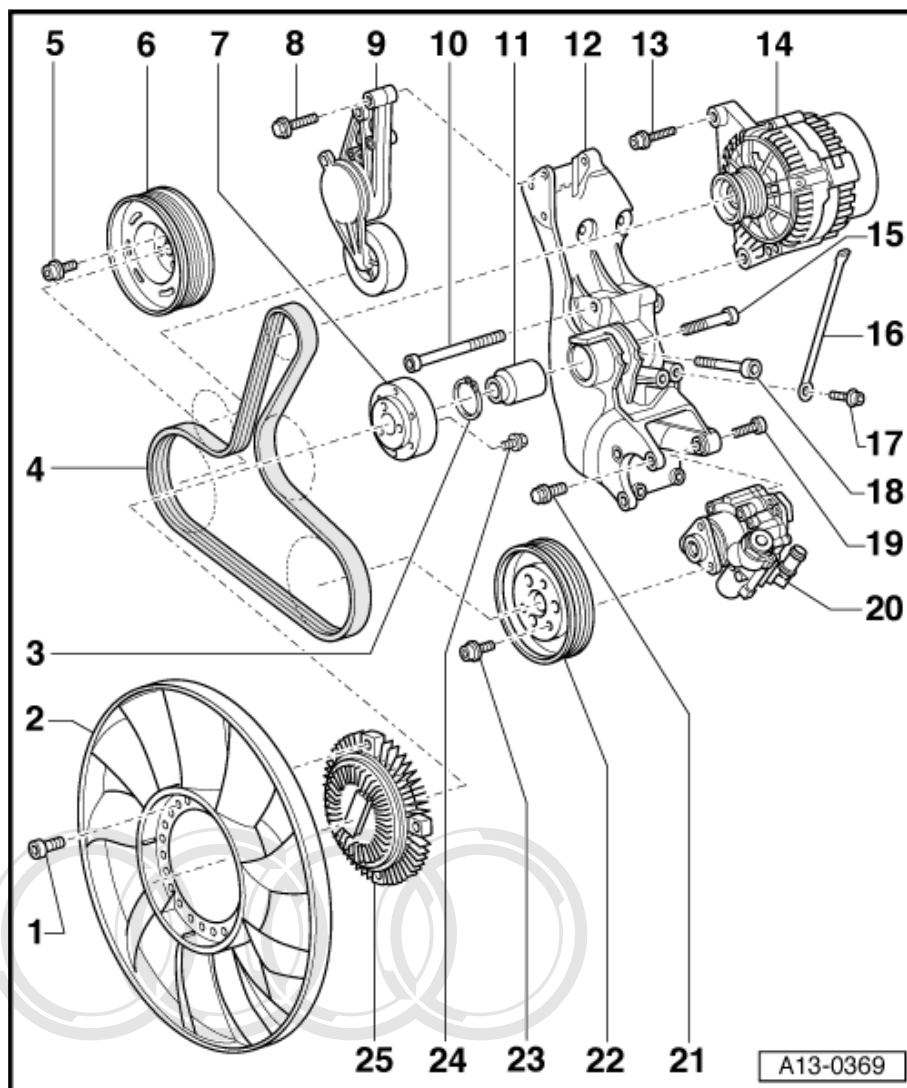
9 - Tensioner for poly V-belt

- ☐ Turn with open-end ~~spanner~~ [to slacken poly V-belt ⇒ page 29](#)
- ☐ Secure in fixing holes with suitable Allen key or locking pin
- ☐ Removing and installing ⇒ ["1.5 Removing and installing bracket for ancillaries", page 31](#)

10 - 46 Nm

11 - Bearing for viscous fan

- ☐ Removing and installing ⇒ [page 159](#)



12 - Bracket for ancillaries

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

13 - 23 Nm

14 - Alternator

- ☐ Removing and installing ⇒ Rep. gr. 27

15 - 45 Nm

16 - Support for intake manifold

17 - 20 Nm

18 - 52 Nm

- ☐ Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue
- ☐ Different bolt lengths. Allocation and tightening sequence ⇒ [page 34](#)

19 - 23 Nm

20 - Power steering pump

- ☐ Removing and installing ⇒ Rep. gr. 48

21 - 23 Nm

22 - Poly V-belt pulley for power steering pump

- ☐ Installation position: shoulder faces to front of vehicle

23 - 23 Nm

24 - Ribbed bolt, 28 Nm

25 - Viscous coupling

- ☐ Removing and installing ⇒ [“2.2 Removing and installing viscous fan”, page 158](#)

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1.2 Poly V-belt drive for air conditioner compressor - exploded view

1 - Bracket

2 - Air conditioner compressor



WARNING

The air conditioner refrigerant circuit must not be opened.

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

3 - Dowel sleeve

- ☐ Check for correct seating in bracket

4 - 33 Nm

5 - Bracket for air conditioner compressor

6 - Tensioning roller for poly V-belt

- ☐ Removing and installing ⇒ ["1.3 Removing and installing poly V-belt", page 29](#)

7 - Washer

8 - 23 Nm

9 - Poly V-belt

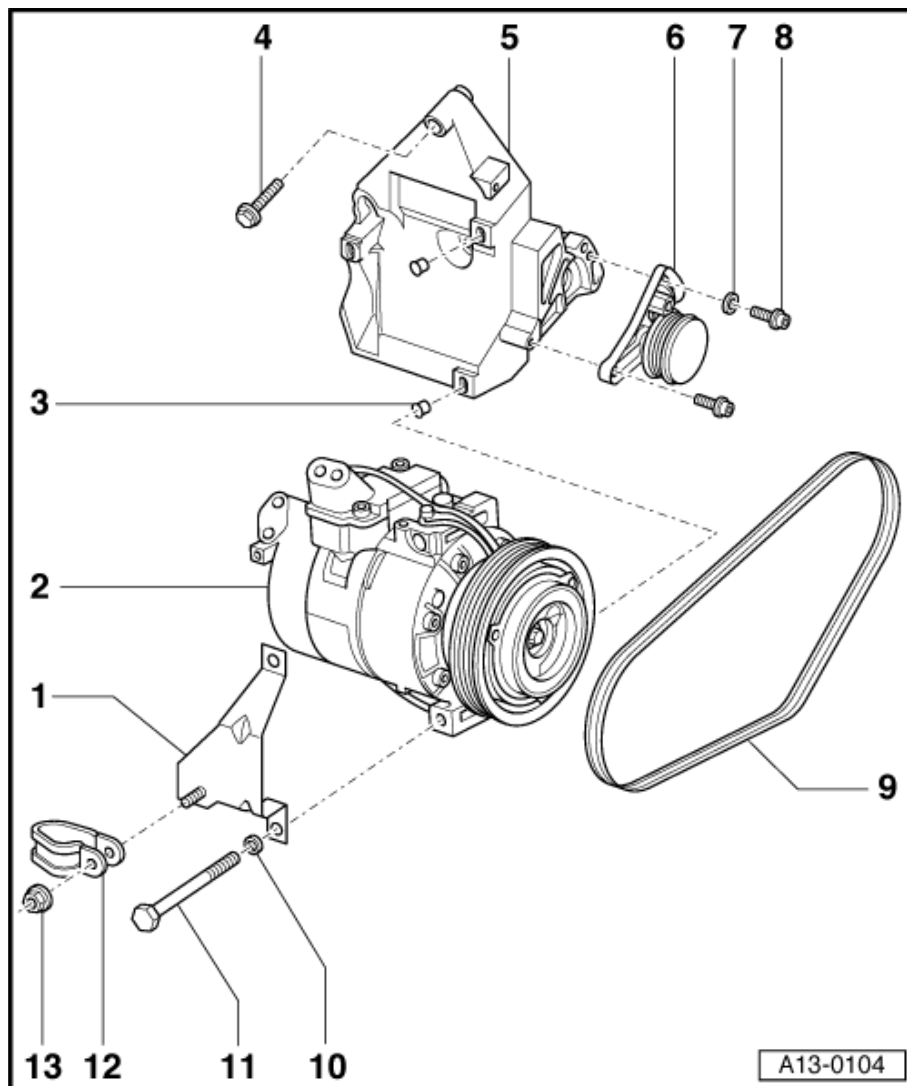
- ☐ Check for wear
- ☐ Do not kink
- ☐ Before removing, mark direction of rotation with chalk or felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.
- ☐ Removing and installing ⇒ [page 29](#)
- ☐ When installing, make sure it is properly seated on pulleys.

10 - Washer

11 - 25 Nm

12 - Retaining clamp

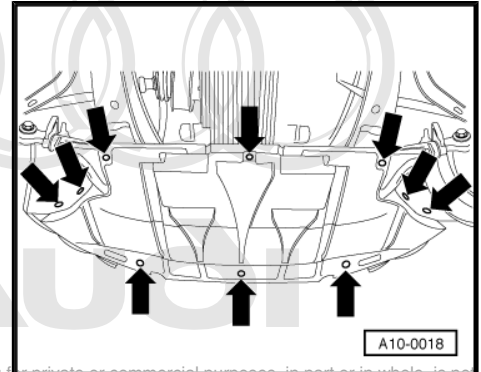
13 - 20 Nm



1.3 Removing and installing poly V-belt

Removing

- Release fasteners -arrows- and remove noise insulation.



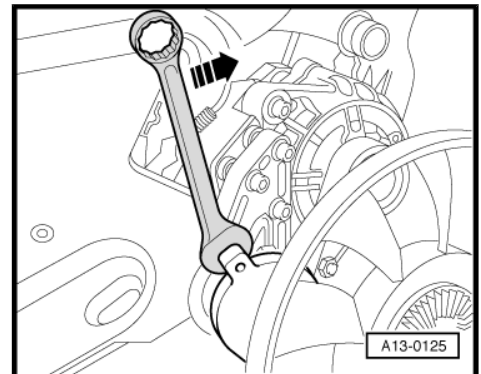
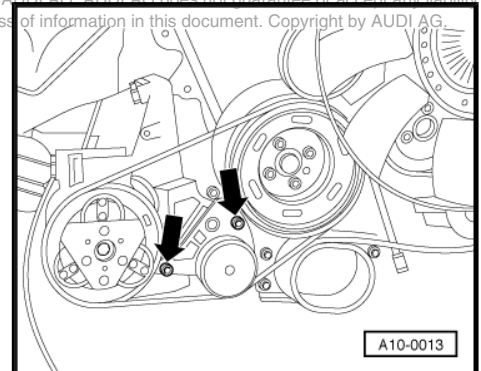
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Note

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

- Loosen securing bolts on tensioning roller for poly V-belt for A/C compressor -arrows-, slacken belt and remove.
- To slacken poly V-belt turn tensioner in direction of -arrow-.
- Remove poly V-belt from alternator pulley and release tensioner.





Note

With lock carrier in service position, poly V-belt tensioner can be locked by inserting an Allen key -arrow- or locking pin in the locating holes.

Installing

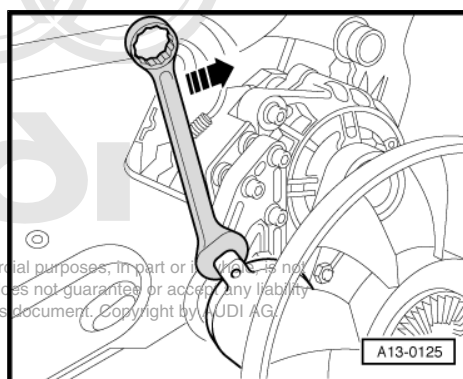
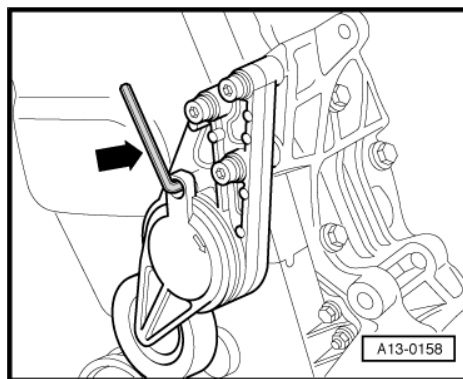
- Installation is carried out in the reverse order; note the following:



Note

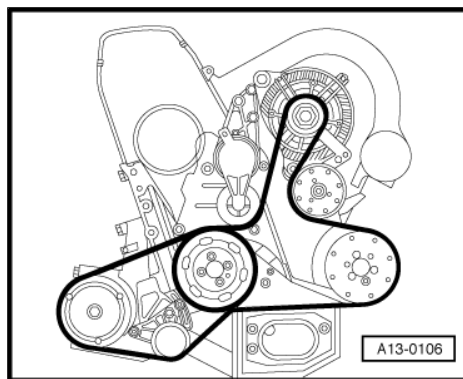
- Before fitting poly V-belts, make sure all mechanical units (alternator, air conditioner compressor, power steering pump) are firmly in position.
- Make sure poly V-belts are properly positioned and correctly routed.

- Position poly V-belt on pulleys of crankshaft and power steering pump; pull upwards with suitable tool if necessary.
- Turn tensioner in direction of -arrow-.
- Then position poly V-belt on alternator pulley and release tensioner.
- Check that poly V-belt is properly seated.



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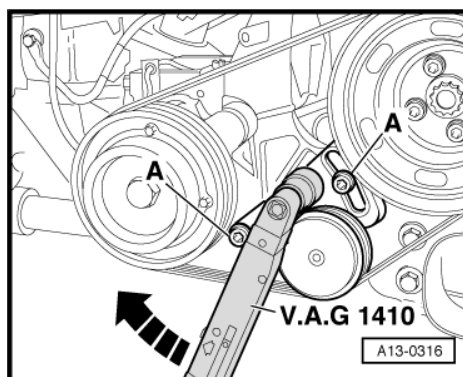
- Install poly V-belt for AC compressor as shown in illustration.



- Apply torque wrench to hexagon on tensioning roller in "seven o'clock" position as shown.
- Pre-tension tensioning roller to 30 Nm and at the same time tighten bolts -A-.
- Start engine and check that belt runs properly.

Tightening torque

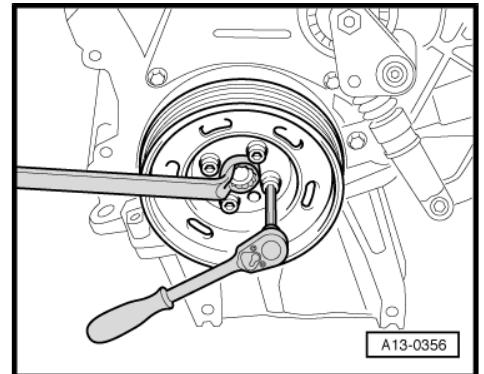
Component	Nm
Tensioning roller for poly V-belt to bracket for A/C compressor	23



1.4 Removing and installing vibration damper

Removing

- Move lock carrier to service position ⇒ Rep. gr. 50 .
- Remove poly V-belt ⇒ [page 29](#) .
- Counterhold by applying ring spanner to bolt for toothed belt sprocket and unbolt vibration damper.



Installing

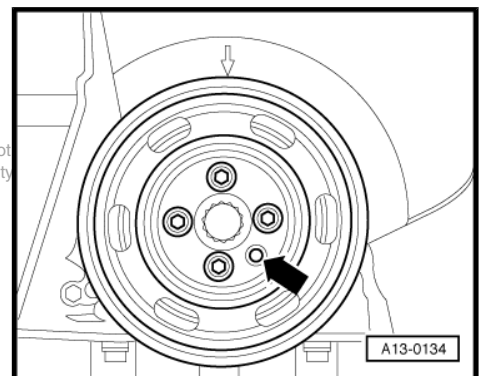
- Installation is carried out in the reverse order; note the following:



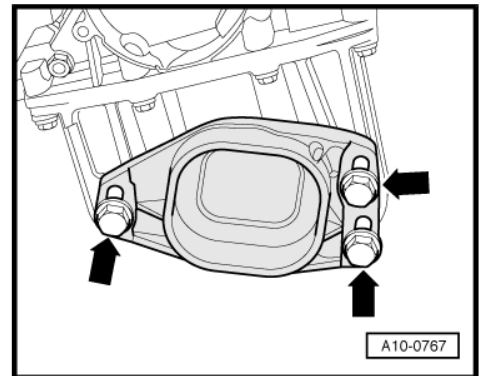
Note

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



- Install poly V-belt ⇒ [page 29](#) .
- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight and tighten nuts -arrows-.



Tightening torques

Component	Nm
Vibration damper with pulley to crankshaft	10 + 90° ¹⁾
Stop for torque reaction support to sump	28
• ¹⁾ Renew bolts. • ²⁾ 90° = one quarter turn.	

1.5 Removing and installing bracket for ancillaries

Removing

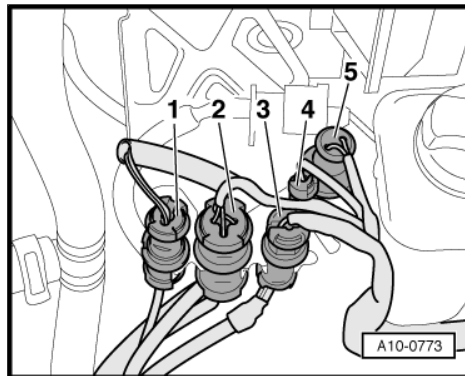


Caution

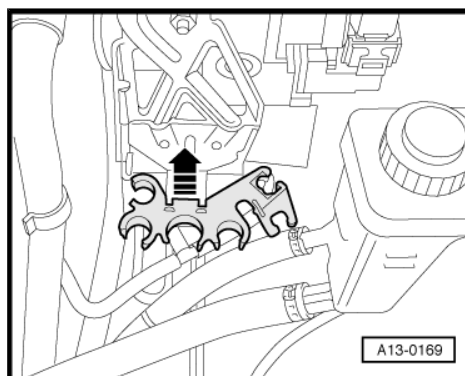
Observe notes on procedure for disconnecting the battery ⇒ Rep. gr. 27 .

- Disconnect earth wire at battery with ignition switched off.
- Detach cover from power steering reservoir.

- Detach electrical connectors -1 ... 5- from bracket.



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

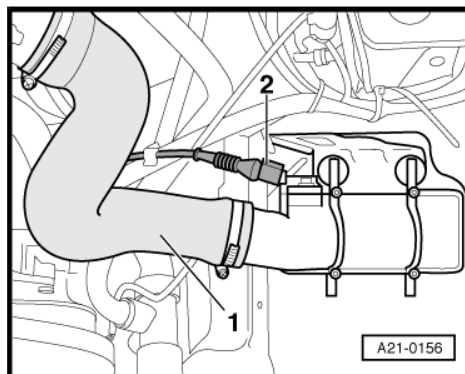


- Remove air hose -1-.

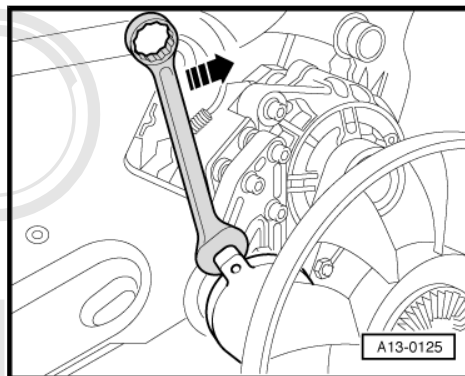


Note

Disregard -item 2-.

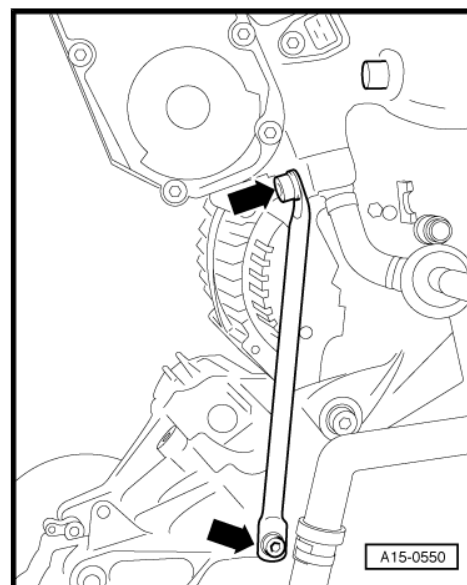
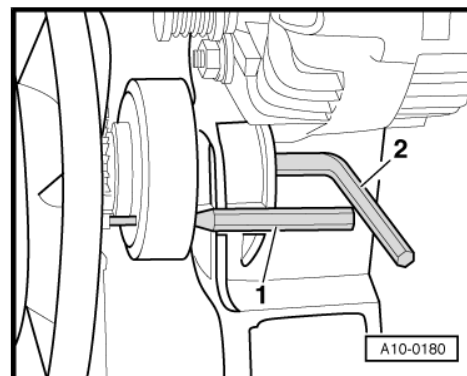


- To slacken poly V-belt turn tensioner in direction of -arrow-.
- Remove poly V-belt from alternator pulley and release tensioner.



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- Lock pulley for viscous fan with roll-pin drift -1- and unscrew using hexagon key -2-.
- Detach viscous fan forwards off bearing and place it in radiator cowl.
- Remove alternator ⇒ Rep. gr. 27 .
- Detach tensioner for poly V-belt from bracket for ancillaries.
- Unbolt poly V-belt pulley at power steering pump.
- Unbolt power steering pump and tie up to one side; the hydraulic fluid hoses/pipes remain connected.
- Remove support for intake manifold -arrows-.



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- Remove bolts -1 ... 6- and detach bracket for ancillaries.

Installing

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



Note

- ◆ *Always remove remaining locking fluid from the tapped holes in the cylinder block prior to assembly. Otherwise the new bolts can seize when screwed in, and then shear off if they have to be subsequently removed.*

- ◆ *This can be done using a thread tap.*

- Note length of bolts for bracket for ancillaries.

- ◆ -Item 1, 2- = M10x85.

- ◆ -Item 3 ... 6- = M10x45.

- Apply locking fluid to bolts; locking fluid ⇒ Parts catalogue .

- Tighten bolts -1 ... 6- in diagonal sequence.

- To facilitate attachment of alternator, knock back bushes for securing bolts slightly.

- Install power steering pump ⇒ Rep. gr. 48.

- Install alternator ⇒ Rep. gr. 27 .

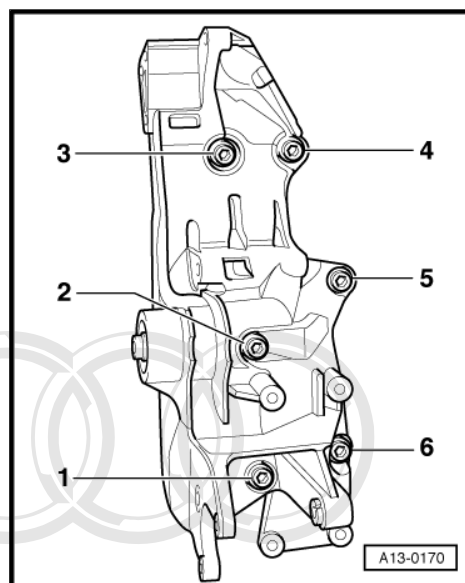
- Install viscous fan ⇒ [page 158](#) .

- Install poly V-belt ⇒ [page 29](#) .

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

Tightening torques

Component	Nm
Bracket for ancillaries to cylinder block	52 ¹⁾
Support for in- take manifold to:	
Bracket for ancillaries	20
Intake manifold	20
Poly V-belt pulley to coolant pump	23
Tensioner for poly V-belt to bracket for ancillaries	23
• ¹⁾ Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue .	



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1.6 Toothed belt drive for vehicles up to 07.2000 - exploded view

1 - Toothed belt cover (bottom)

- ☐ Unbolt vibration damper prior to removing

2 - 10 Nm

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

3 - Toothed belt cover (centre)

- ☐ Unbolt poly V-belt tensioner prior to removing
⇒ ["1.5 Removing and installing bracket for ancillaries", page 31](#)

4 - Toothed belt cover (top)

- ☐ Engage carefully in centre toothed belt cover when installing

5 - Toothed 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 ⇒ [page 36](#)
- ☐ Installing (adjusting valve timing)
⇒ [page 38](#)

6 - Idler roller

7 - 27 Nm

8 - 65 Nm

- ☐ Use counterhold tool - 3036- when loosening and tightening

9 - Camshaft sprocket

10 - Tensioning roller

11 - Washer

12 - Tensioner for toothed belt

13 - O-ring

- ☐ Renew
- ☐ Lubricate with »G12+« prior to installing

14 - Coolant pump

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

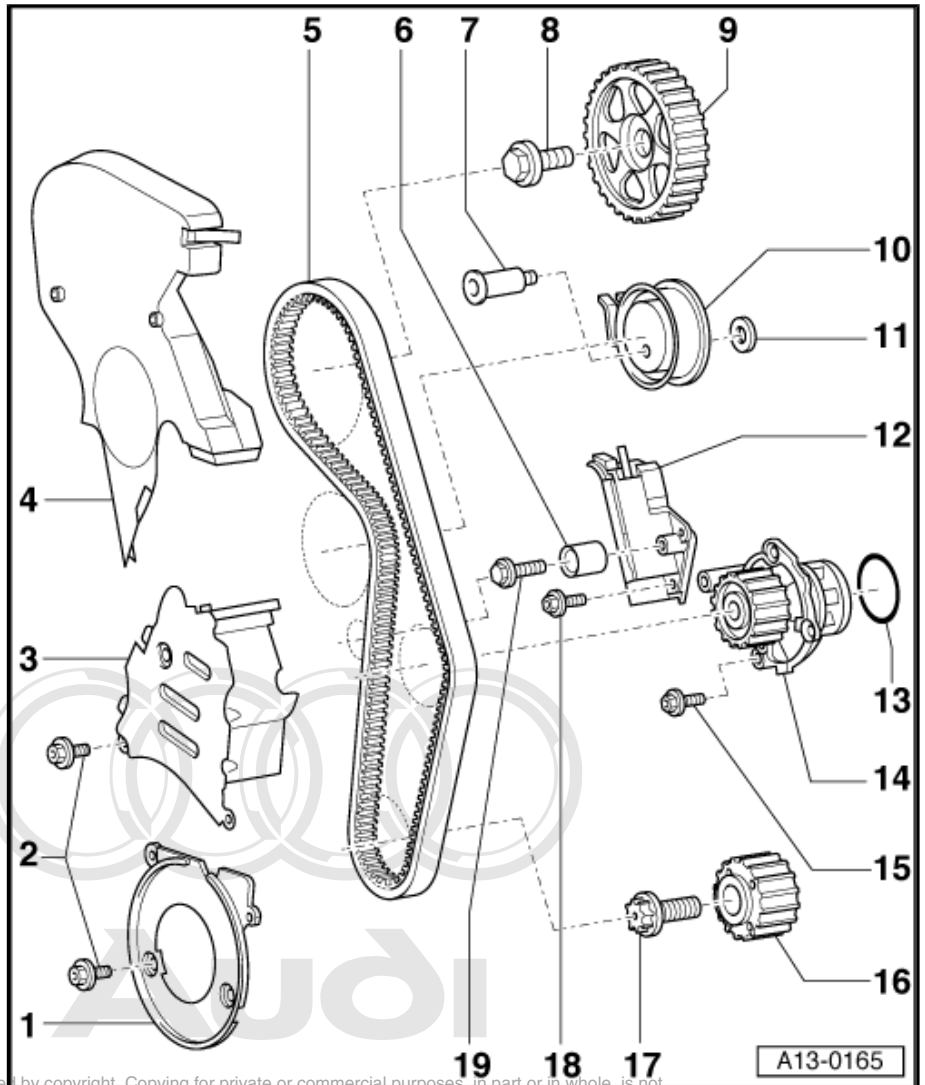
15 - 15 Nm

16 - Crankshaft sprocket

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

17 - 90 Nm + 90° (1/4 turn) further

- ☐ Renew
- ☐ Do not lubricate with oil



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- Use counterhold tool - 3415- to loosen and tighten

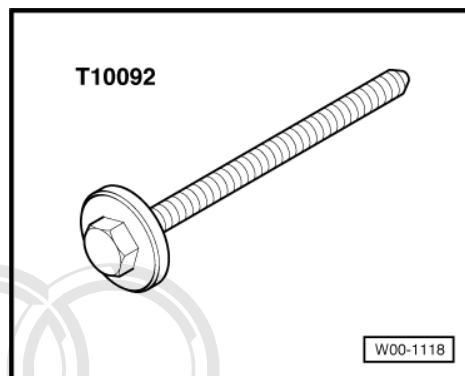
18 - 15 Nm

19 - 25 Nm

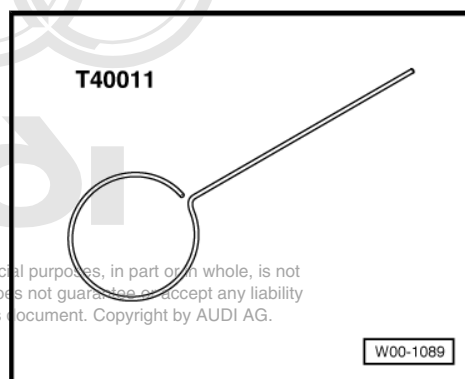
1.7 Removing and installing toothed belt - vehicles up to 07.2000

Special tools and workshop equipment required

- ◆ Tensioning bolt - T10092-



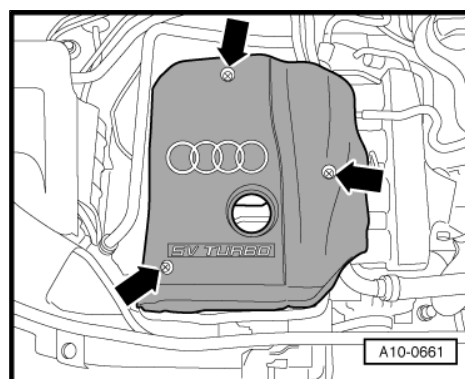
- ◆ Locking pin - T40011-



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Removing

- Release quick-release fasteners and remove engine cover panel -arrows-.
- Move lock carrier to service position ⇒ Rep. gr. 50 .
- Remove poly V-belt ⇒ [page 29](#) .
- Remove tensioner for poly V-belt
⇒ ["1.5 Removing and installing bracket for ancillaries", page 31](#) .
- Remove viscous fan ⇒ [page 158](#) .



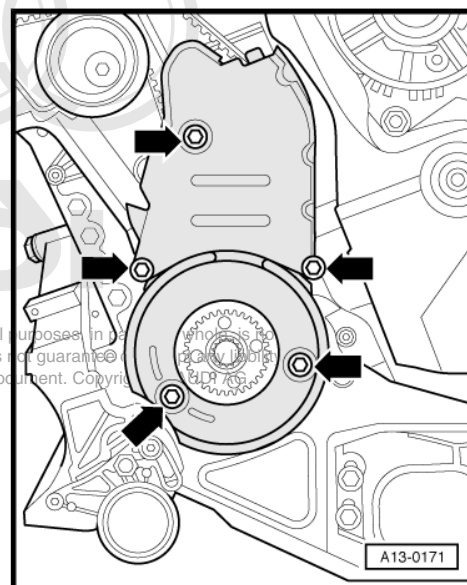
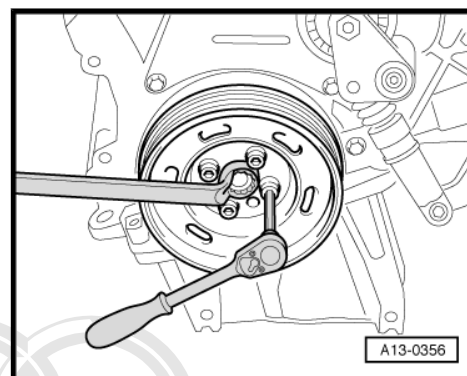
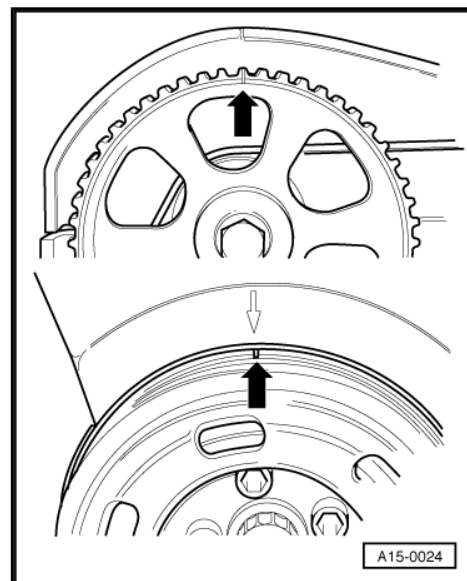
- Remove toothed belt cover (top section)



Caution

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

- Rotate crankshaft to "TDC" by turning bolt for toothed belt sprocket.
- Marking on camshaft sprocket and marking on crankshaft must be aligned to "TDC" -arrows-.
- Counterhold by applying ring spanner to bolt for toothed belt sprocket and unbolt vibration damper.
- Remove centre and bottom sections of toothed belt cover -arrows-.



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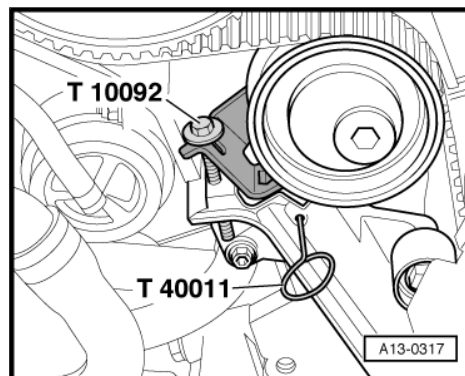
- Screw tensioning bolt - T10092- into toothed belt tensioner.
- Compress piston of tensioner just far enough so that the piston can be locked with locking pin - T40011- .
- Mark rotation direction of toothed belt with chalk or felt-tip pen and remove toothed belt.

Installing (adjusting valve timing)

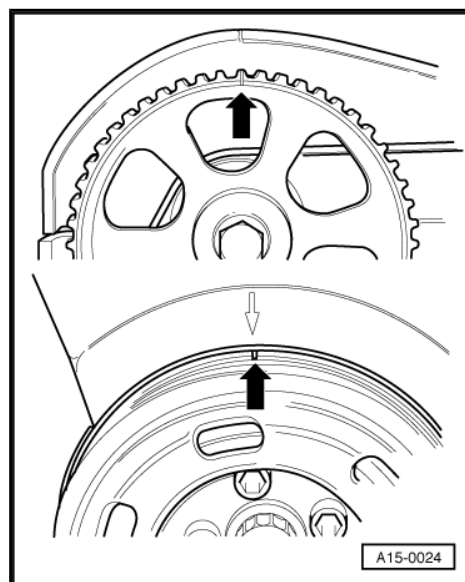


Note

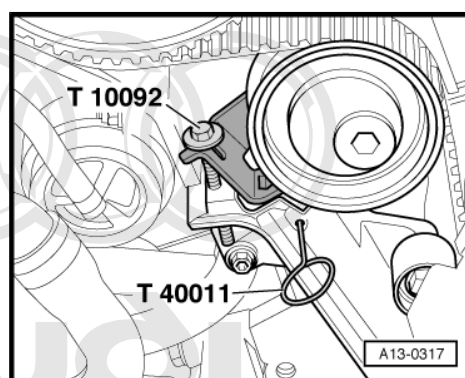
- ◆ *The toothed belt adjustment must also be performed as described below, even if the toothed belt has only been removed from the camshaft sprocket.*
- ◆ *The crankshaft must not be at "TDC" at any cylinder when the camshaft is turned. Otherwise, there is a risk of damage to valves and piston crowns.*



- Align markings on camshaft sprocket/cylinder head cover -top arrow-.
- Fit toothed belt on crankshaft sprocket (note rotation direction).
- Install toothed belt cover (bottom section).
- Secure vibration damper with one bolt (note fixing arrangement).
- Rotate crankshaft to "TDC" -bottom arrow- by turning bolt for toothed belt sprocket.
- Fit toothed belt onto coolant pump, then onto tensioning roller, and finally onto camshaft sprocket.

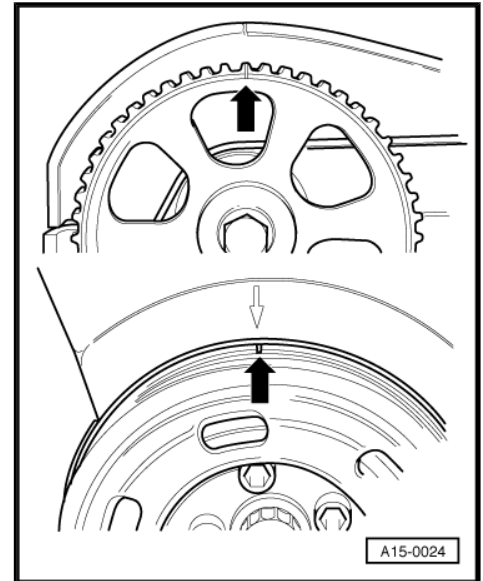


- Remove tensioning bolt - T10092- .
- Remove locking pin - T40011- from tensioner, so that piston of tensioner is released.



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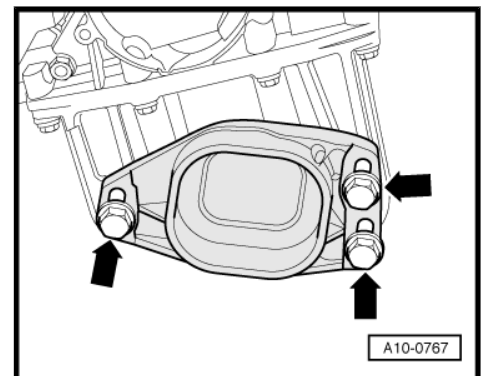
- Turn crankshaft two rotations by turning bolt for toothed belt sprocket until the crankshaft is at "TDC" again.
- Marking on camshaft sprocket and marking on crankshaft must be aligned to "TDC" -arrows-.
- Install vibration damper ⇒ [page 31](#) .
- Install viscous fan ⇒ [page 158](#) .
- Install poly V-belt tensioner
⇒ ["1.5 Removing and installing bracket for ancillaries", page 31](#) .
- Install poly V-belt ⇒ [page 29](#) .



- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight and tighten nuts -arrows-.

Tightening torques

Component	Nm
Toothed belt cover (bottom and centre section) to cylinder block	10 ¹⁾
Stop for torque reaction support to sump	28
• ¹⁾ Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue .	



1.8 Toothed belt drive for vehicles from 08.2000 - exploded view



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1 - Toothed belt cover (bottom)

- ❑ Unbolt vibration damper prior to removing

2 - 10 Nm

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

3 - Toothed belt cover (centre)

- ❑ To remove, unbolt poly V-belt tensioner

4 - Toothed belt cover (top)

- ❑ Engage carefully in centre toothed belt cover when installing

5 - Toothed belt

- ❑ 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.
- ❑ Check for wear
- ❑ Do not kink
- ❑ Removing ⇒ [page 41](#)
- ❑ Installing (adjusting valve timing) ⇒ [page 43](#)

6 - Idler roller

7 - 27 Nm

8 - 65 Nm

- ❑ Use counterhold tool - 3036- to loosen and tighten

9 - Camshaft sprocket

- ❑ Removing and installing
⇒ ["1.10 Detaching toothed belt from camshaft sprocket - vehicles from 08.2000 onwards", page 48](#)

10 - Tensioning roller

- ❑ Depending on version, a toothed belt tensioner with idler roller or a bracket for idler roller may be installed

11 - Washer

12 - Tensioner for toothed belt

13 - O-ring

- ❑ Renew
- ❑ Lubricate with coolant prior to installing

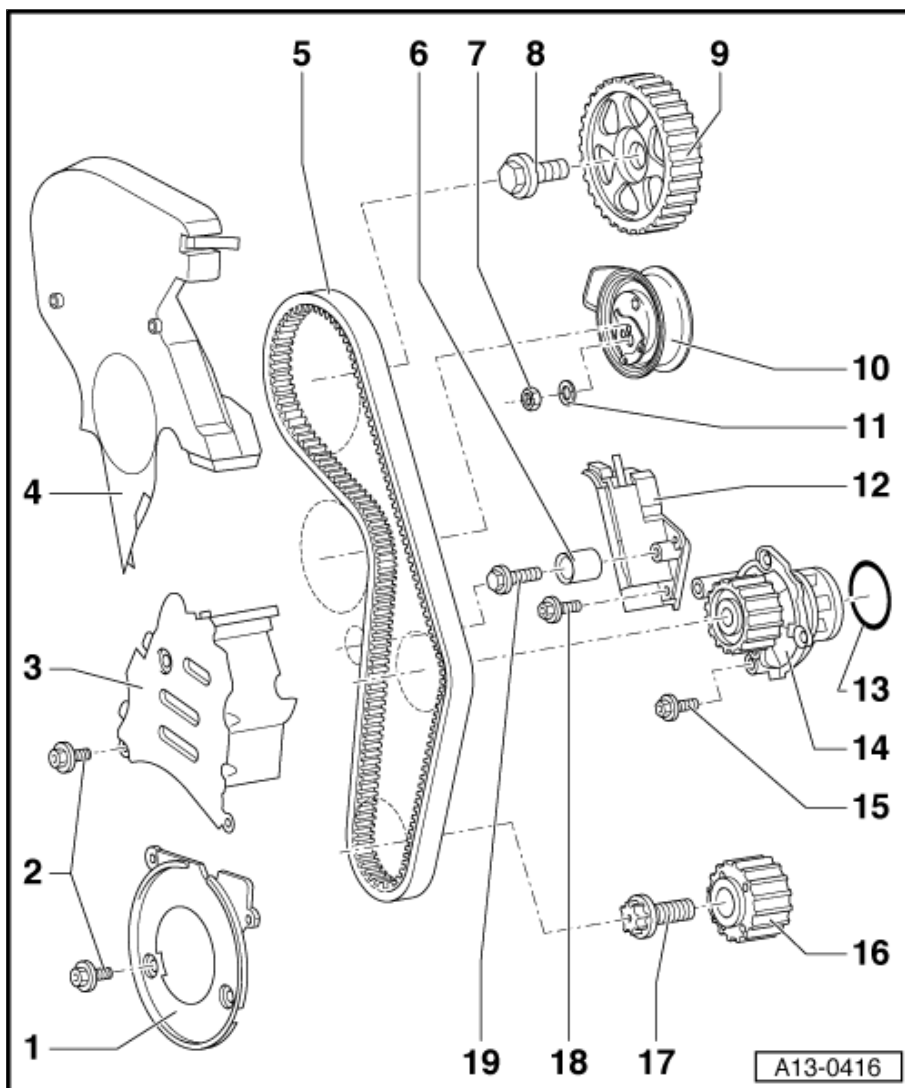
14 - Coolant pump

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

15 - 15 Nm

16 - Crankshaft sprocket

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



17 - 90 Nm + 90° (1/4 turn) further

- ☐ Renew
- ☐ Do not lubricate with oil
- ☐ Use counterhold tool - 3415- to loosen and tighten

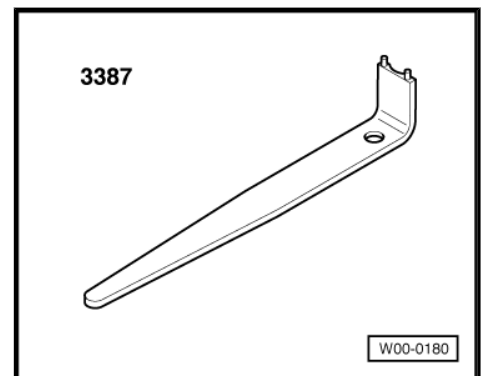
18 - 15 Nm

19 - 25 Nm

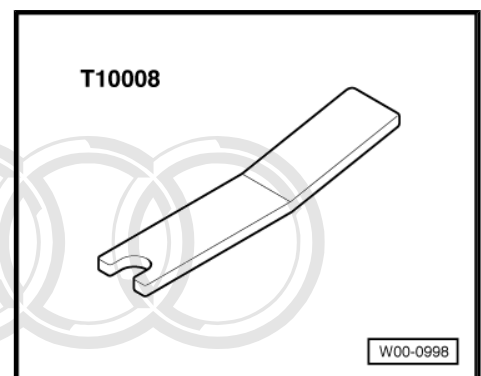
1.9 Removing and installing toothed belt - vehicles from 08.2000 onwards

Special tools and workshop equipment required

- ◆ Pin wrench - 3387-

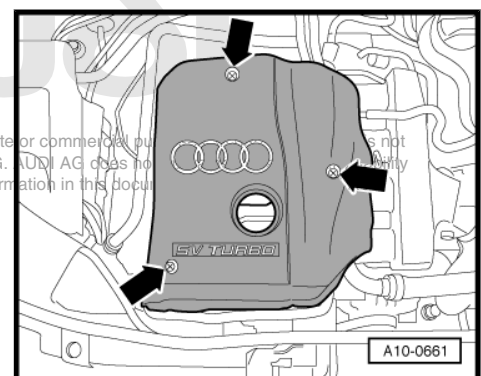


- ◆ Locking plate - T10008-



Removing

- Release quick-release fasteners and remove engine cover panel -arrows-.
- Move lock carrier to service position ⇒ Rep. gr 50.
- Remove poly V-belt ⇒ [page 29](#) .
- Remove tensioner for poly V-belt ⇒ ["1.5 Removing and installing bracket for ancillaries", page 31](#) .
- Remove viscous fan ⇒ [page 158](#) .
- Remove toothed belt cover (top section)



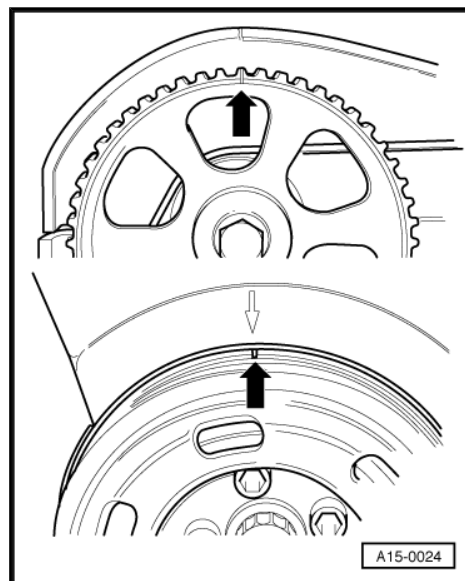
- Rotate crankshaft to “TDC” by turning bolt for toothed belt sprocket.



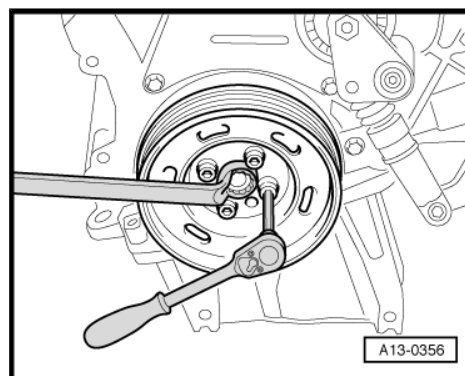
Caution

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

- Marking on camshaft sprocket and marking on crankshaft must be aligned to “TDC” -arrows-.



- Counterhold by applying ring spanner to bolt for toothed belt sprocket and unbolt vibration damper.



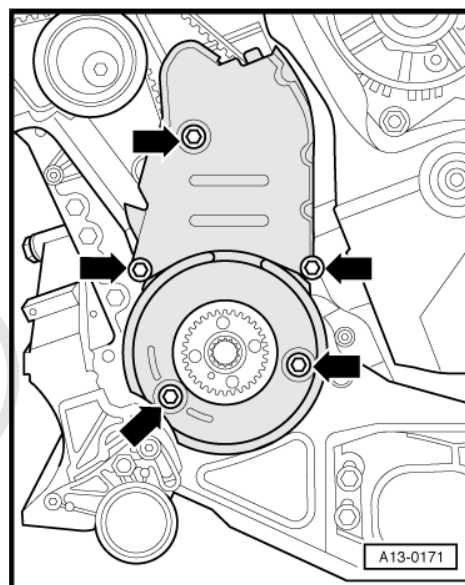
- Remove centre and bottom sections of toothed belt cover -arrows-.

With hydraulic tensioning roller

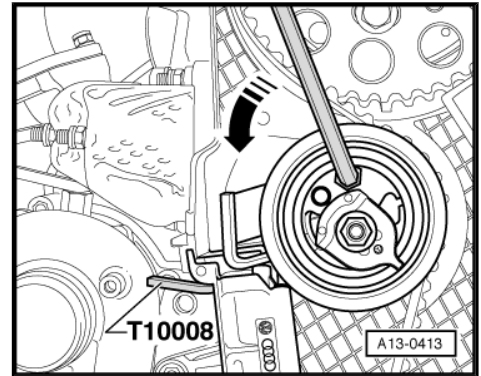


Caution

- ◆ *The toothed belt tensioner is oil-damped and can therefore only be compressed slowly by applying constant pressure.*
- ◆ *To avoid damage, do not apply more force than necessary when compressing the toothed belt tensioner.*



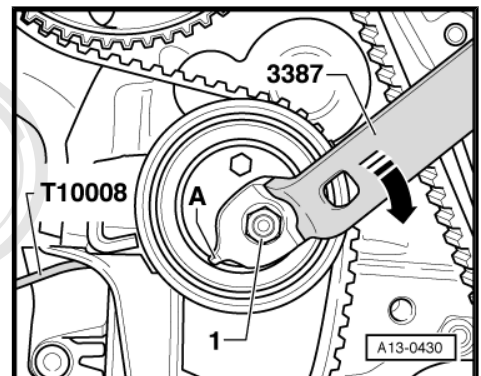
- Applying constant and moderate force, use hexagon key to press toothed belt tensioner anti-clockwise in direction of -arrow- until piston of tensioner can be locked with locking plate - T10008- .
- Insert locking plate - T10008- and make sure that it remains in place.



 Note

Do not to bend limit stop -A- of eccentric adjuster.

- To slacken toothed belt, loosen nut -1- on tensioning roller and turn eccentric adjuster clockwise -arrow- using pin wrench - 3387- .



Without hydraulic tensioning roller

- Loosen nut -1- to slacken toothed belt.

All models:

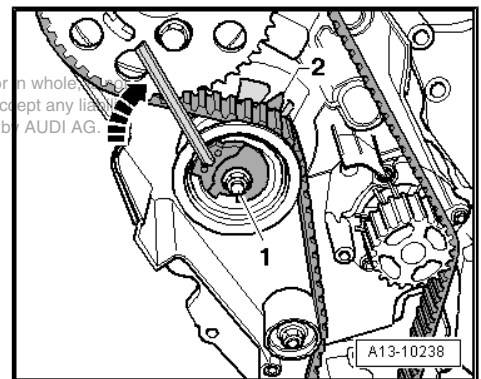
- Mark direction of rotation of toothed belt with chalk or felt-tip pen.
- Remove toothed belt.

Installing (adjusting valve timing)

 Note

- ◆ *The toothed belt adjustment must also be performed as described below, even if the toothed belt has only been removed from the camshaft sprocket.*
- ◆ *The crankshaft must not be at "TDC" at any cylinder when the camshaft is turned. Otherwise, there is a risk of damage to valves and piston crowns.*

- Fit toothed belt on crankshaft sprocket (note rotation direction).
- Install toothed belt cover (bottom section).
- Install vibration damper ⇒ [page 31](#) .
- Check that marking on camshaft sprocket is aligned with marking on cylinder head cover -arrows-.



- Align markings on camshaft sprocket / cylinder head cover and markings on vibration damper / toothed belt cover -arrows-.

With hydraulic tensioning roller

- Make sure that toothed belt tensioner is still locked with locking plate - T10008- .

All models:

- Fit toothed belt onto coolant pump, then onto tensioning roller, and finally onto camshaft sprocket.

Tensioning toothed belt

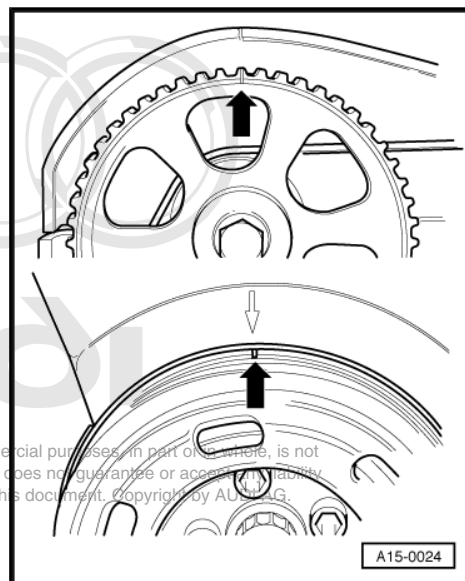


Note

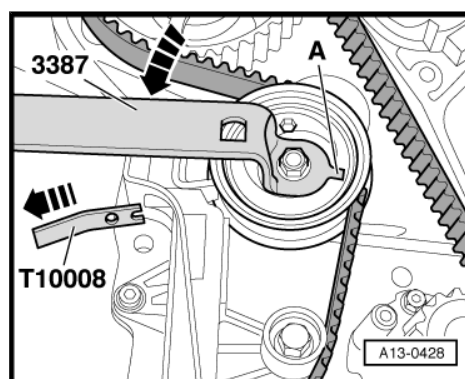
Do not to bend limit stop -A- of eccentric adjuster.

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- Turn eccentric adjuster anti-clockwise in direction of -arrow- using pin wrench - 3387- .
- Hold eccentric adjuster in this position and pull out locking plate - T10008- .

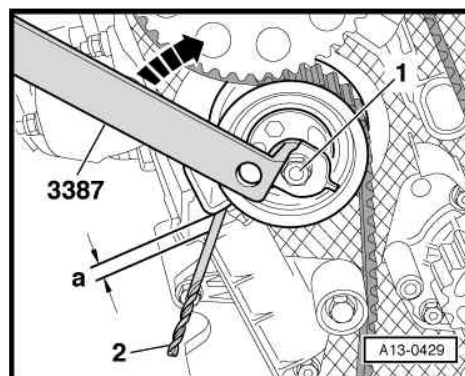


- Turn eccentric adjuster clockwise in direction of -arrow- until gauge -2- (dimension -a- = 8 mm, e.g. drill bit) can be pulled through between tensioning lever and housing of tensioner.
- Hold eccentric adjuster in this position and tighten nut -1- securing tensioning roller to 27 Nm.

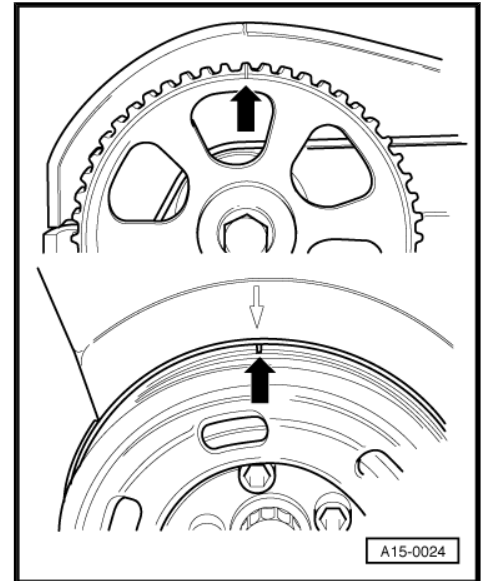


Caution

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



- Turn crankshaft two rotations by turning bolt for toothed belt sprocket until the crankshaft is at “TDC” again.
- Marking on camshaft sprocket and marking on crankshaft must be aligned to “TDC” -arrows-.



- Use gauge -2- (e.g. drill bit) to check dimension -a- between tensioning lever and housing of tensioner.
- Dimension -a- = 6 ... 10 mm.

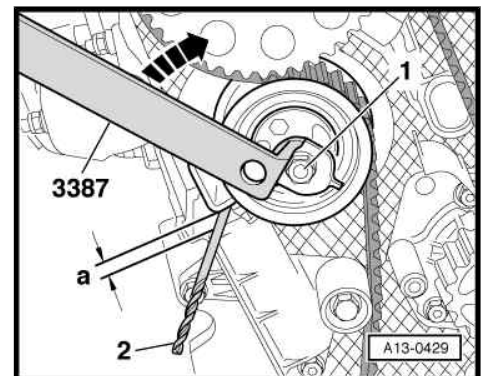
If dimension -a- is achieved, see "Assembling" ⇒ [page 47](#) .

If dimension -a- is not attained:

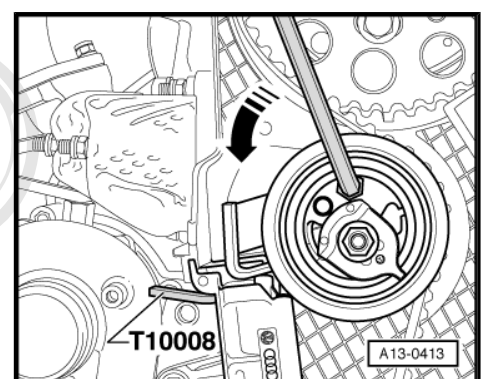


Caution

- ◆ *The toothed belt tensioner is oil-damped and can therefore only be compressed slowly by applying constant pressure.*
- ◆ *To avoid damage, do not apply more force than necessary when compressing the toothed belt tensioner.*

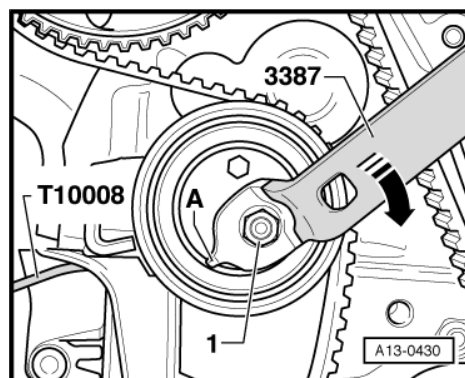


- Applying constant and moderate force, use hexagon key to press toothed belt tensioner anti-clockwise in direction of -arrow- until piston of tensioner can be locked with locking plate - T10008- .



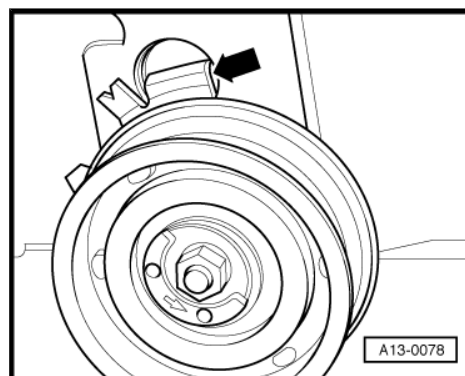
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- Loosen nut -1- on tensioning roller.
- Tension toothed belt ⇒ [page 44](#) .

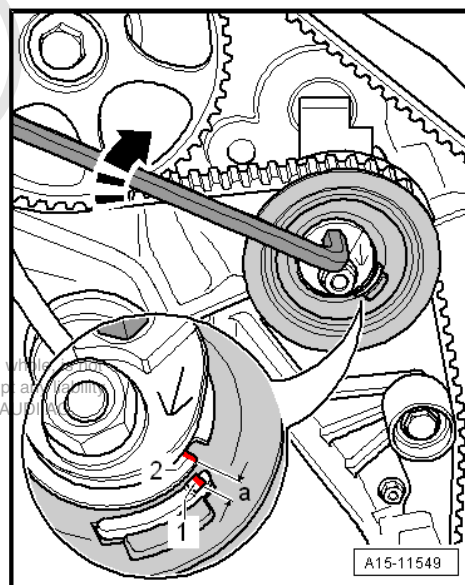


Without hydraulic tensioning roller

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



- Use a hexagon key to turn toothed belt tensioning roller in direction of -arrow- until dimension -a- is attained.
- Dimension -a- = 5 - 8 mm.



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- Turn back toothed belt tensioning roller, but do not slacken completely.
- Turn toothed belt tensioning roller in direction of -arrow- using a hexagon key until markings -1- and 2- are aligned.
- Tighten nut -3- for tensioning roller.

 Note

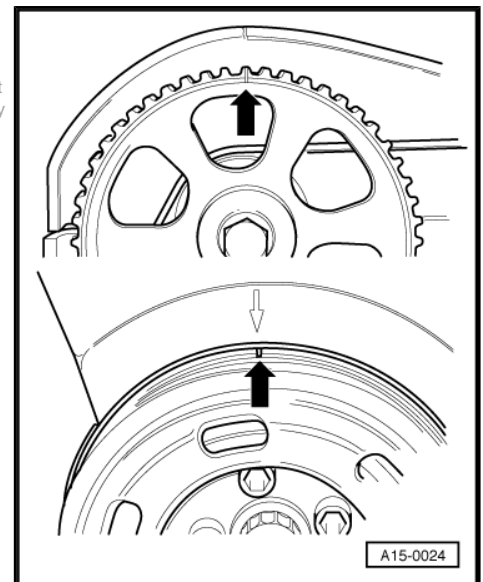
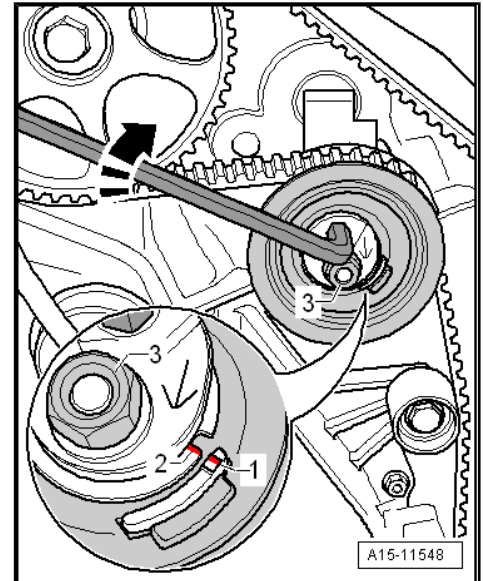
Marking -1- (right edge of projection) must coincide with marking -2-.



Caution

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

- Turn crankshaft two rotations via toothed belt sprocket bolt until it is positioned at TDC again.
- Marking on camshaft sprocket and marking on crankshaft must be aligned to TDC -arrows-.

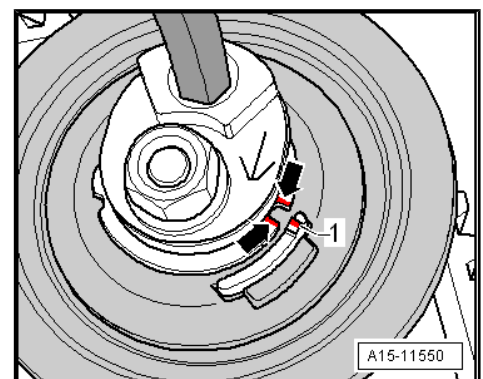


- Check toothed belt tension: marking -1- must be between markings -arrows-; correct tension if necessary.

Assembling

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

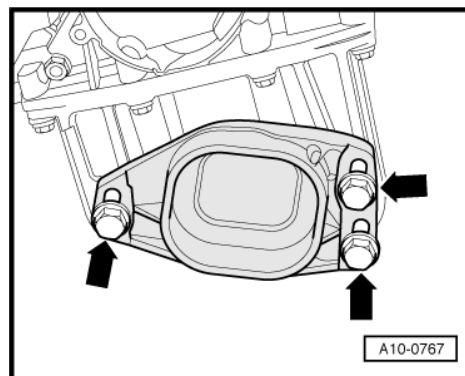
- Install top section of toothed belt cover (make sure it engages securely on centre section of toothed belt cover).
- Install viscous fan ⇒ [page 158](#) .
- Install poly V-belt tensioner
⇒ [“1.5 Removing and installing bracket for ancillaries”, page 31](#) .
- Install poly V-belt ⇒ [page 29](#) .



- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight and tighten nuts -arrows-.

Tightening torques

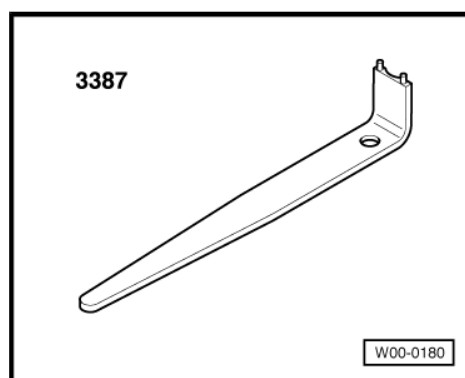
Component	Nm
Tensioning roller for toothed belt to cylinder head	27
Toothed belt cover (bottom and centre section) to cylinder block	10 ¹⁾
Stop for torque reaction support to sump	28
• ¹⁾ Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue .	



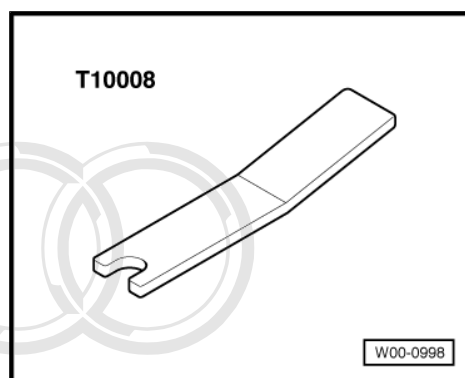
1.10 Detaching toothed belt from camshaft sprocket - vehicles from 08.2000 onwards

Special tools and workshop equipment required

- ◆ Pin wrench - 3387-



- ◆ Locking plate - T10008-



Detaching toothed belt

- Release quick-release fasteners and remove engine cover panel -arrows-.
- Move lock carrier to service position ⇒ Rep. gr. 50 .
- Remove poly V-belt ⇒ [page 29](#) .
- Remove tensioner for poly V-belt
⇒ [“1.5 Removing and installing bracket for ancillaries”, page 31](#) .
- Remove viscous fan ⇒ [page 158](#) .
- Remove toothed belt cover (top section)
- Rotate crankshaft to “TDC” by turning bolt for toothed belt sprocket.



Caution

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

- Marking on camshaft sprocket and marking on crankshaft must be aligned to “TDC” -arrows-.

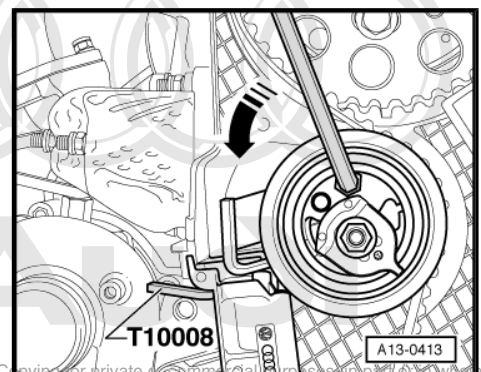
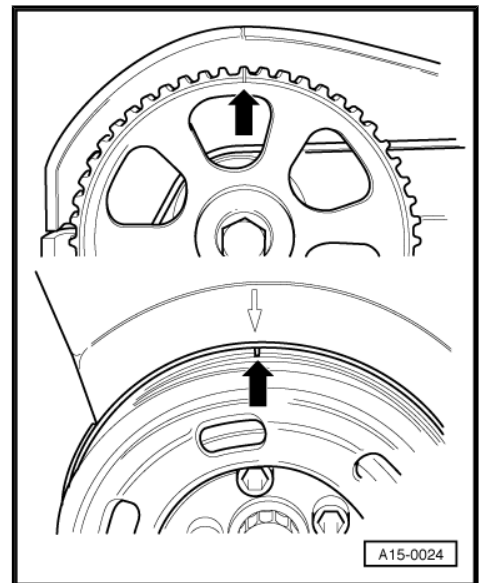
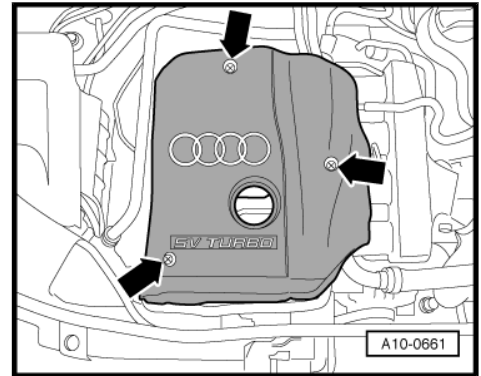
With hydraulic tensioning roller



Caution

- ◆ *The toothed belt tensioner is oil-damped and can therefore only be compressed slowly by applying constant pressure.*
- ◆ *To avoid damage, do not apply more force than necessary when compressing the toothed belt tensioner.*

- Applying constant and moderate force, use hexagon key to press toothed belt tensioner anti-clockwise in direction of -arrow- until piston of tensioner can be locked with locking plate - T10008- .
- Insert locking plate - T10008- and make sure that it remains in place.



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Note

Do not to bend limit stop -A- of eccentric adjuster.

- To slacken toothed belt, loosen nut -1- on tensioning roller and turn eccentric adjuster clockwise -arrow- using pin wrench - 3387- .

Without hydraulic tensioning roller

- Loosen nut on tensioning roller to slacken toothed belt.

All models:

- Remove toothed belt from camshaft sprocket.

Fitting toothed belt



Caution

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

- Align markings on camshaft sprocket / cylinder head cover and markings on vibration damper / toothed belt cover -arrows-.

With hydraulic tensioning roller

- Make sure that toothed belt tensioner is still locked with locking plate - T10008- .

All models:

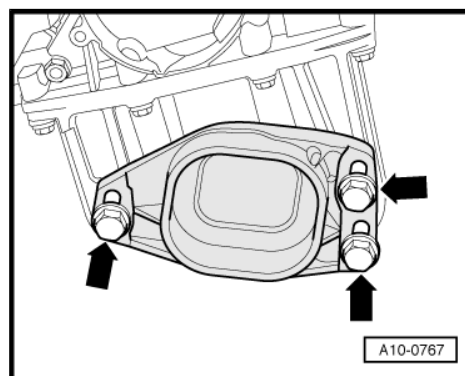
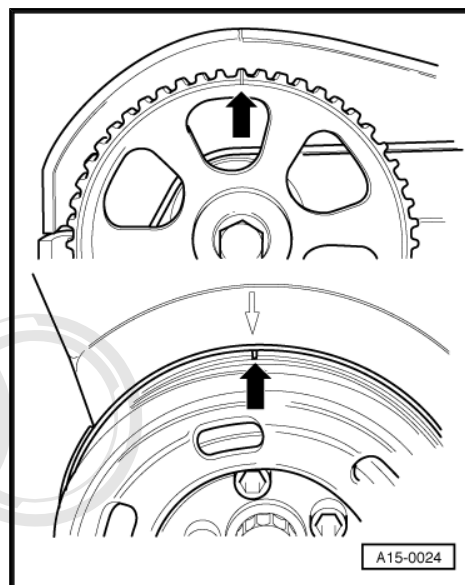
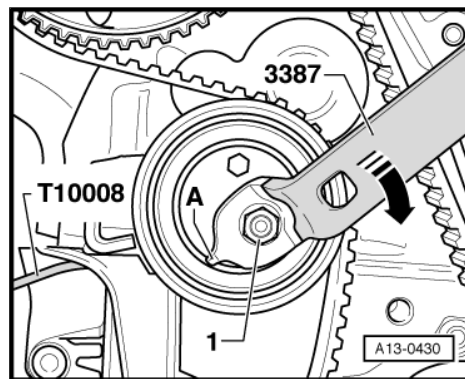
- Fit toothed belt onto coolant pump, then onto tensioning roller, and finally onto camshaft sprocket.
- Tension toothed belt ⇒ [page 44](#) .
- Install top section of toothed belt cover (make sure it engages securely on centre section of toothed belt cover).

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

- Install viscous fan ⇒ [page 158](#) .
- Install poly V-belt tensioner ⇒ ["1.5 Removing and installing bracket for ancillaries", page 31](#) .
- Install poly V-belt ⇒ [page 29](#) .
- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight and tighten nuts -arrows-.

Tightening torques

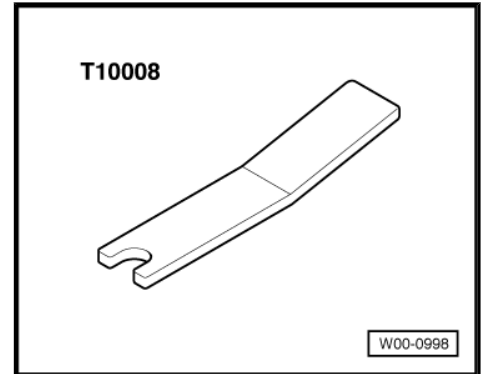
Component	Nm
Tensioning roller for toothed belt to cylinder head	27
Stop for torque reaction support to sump	28



1.11 Removing and installing toothed belt tensioner - vehicles from 08.2000 onwards

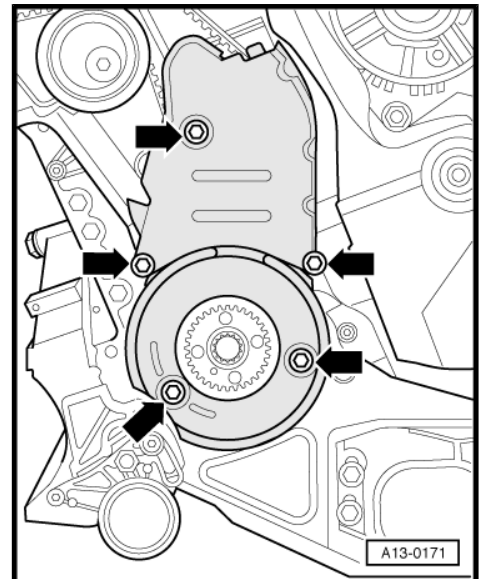
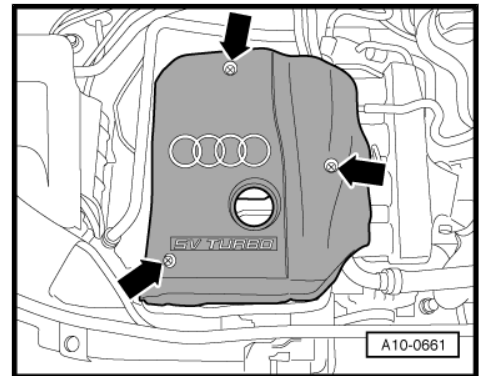
Special tools and workshop equipment required

- ◆ Locking plate - T10008-



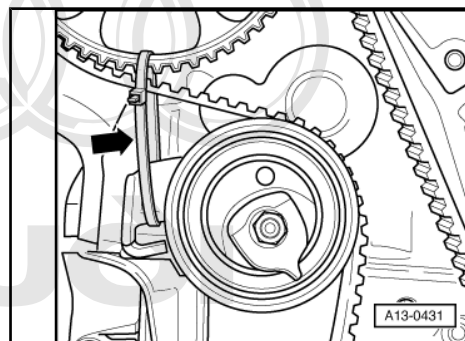
Removing

- Release quick-release fasteners and remove engine cover panel -arrows-.
- Move lock carrier to service position ⇒ Rep. gr. 50 .
- Remove poly V-belt ⇒ [page 29](#) .
- Remove tensioner for poly V-belt ⇒ ["1.5 Removing and installing bracket for ancillaries", page 31](#) .
- Remove viscous fan ⇒ [page 158](#) .
- Remove toothed belt cover (top section)
- Remove toothed belt cover (centre section) -top arrows-.



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- Secure tensioning roller using e.g. cable tie -arrow- to prevent it dropping.

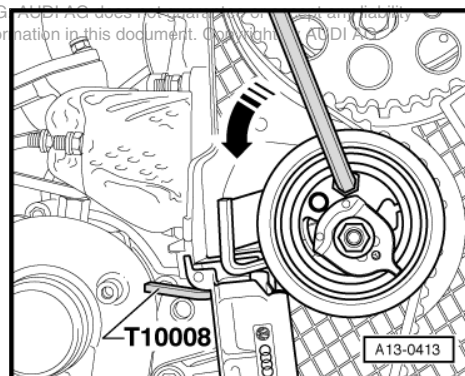


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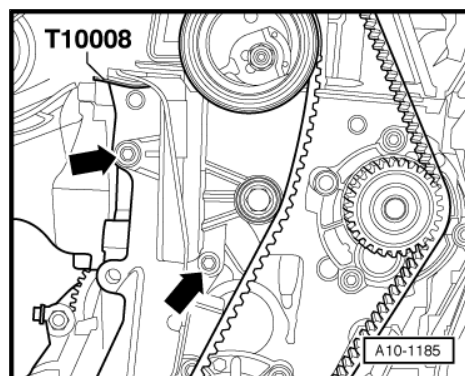


Caution

- ◆ *The toothed belt tensioner is oil-damped and can therefore only be compressed slowly by applying constant pressure.*
- ◆ *To avoid damage, do not apply more force than necessary when compressing the toothed belt tensioner.*



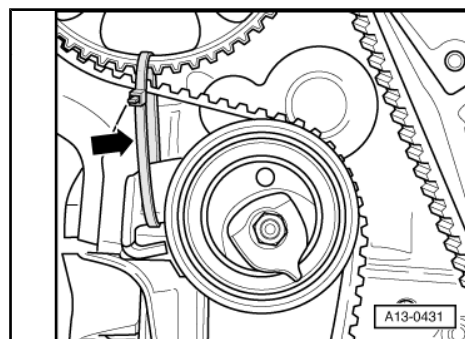
- Applying constant and moderate force, use hexagon key to press toothed belt tensioner anti-clockwise in direction of -arrow- until piston of tensioner can be locked with locking plate - T10008- .
- Insert locking plate - T10008- and make sure that it remains in place.
- Remove toothed belt tensioner -arrows-.



Installing

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

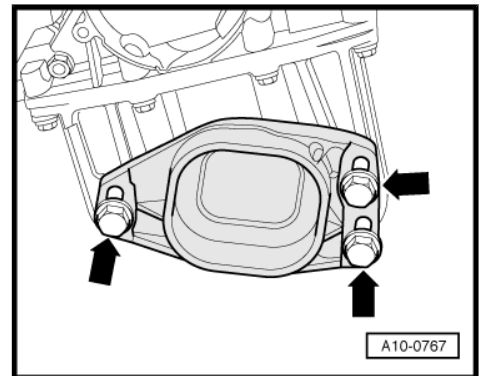
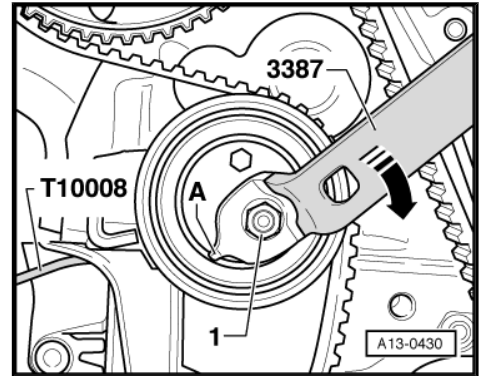
- Install toothed belt tensioner.
- Cut open cable tie -arrow-.



- Loosen nut -1- on tensioning roller.
- Tension toothed belt ⇒ [page 44](#) .
- Install top section of toothed belt cover (make sure it engages securely on centre section of toothed belt cover).
- Install viscous fan ⇒ [page 158](#) .
- Install poly V-belt tensioner
⇒ “1.5 Removing and installing bracket for ancillaries”,
[page 31](#) .
- Install poly V-belt ⇒ [page 29](#) .
- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight and tighten nuts -arrows-.

Tightening torques

Component	Nm
Tensioner for toothed belt to cylinder head	15
Tensioning roller to cylinder head	27
Toothed belt cover (bottom and centre section) to cylinder block	10 ¹⁾
Stop for torque reaction support to sump	28
• ¹⁾ Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue .	



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



Note

Servicing clutch ⇒ Rep. gr. 30

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

1 - Sealing flange (pulley end)

- ☐ Must be positioned on dowel sleeves
- ☐ Removing and installing ⇒ [page 57](#)
- ☐ Install using sealant; sealant ⇒ [Parts catalogue](#)

2 - 15 Nm

3 - Crankshaft oil seal

- ☐ Renewing ⇒ [page 55](#)
- ☐ Do not lubricate with oil

4 - Sump

- ☐ Removing and installing ⇒ [page 125](#)

5 - 15 Nm

6 - Cylinder block

- ☐ Crankshaft - exploded view ⇒ [page 64](#)
- ☐ Pistons and conrods - exploded view ⇒ [page 70](#)

7 - Bolt for dual-mass flywheel/drive plate

- ☐ Renew
- ☐ Tightening torque for dual-mass flywheel ⇒ [page 62](#)
- ☐ Tightening torque for drive plate ⇒ [page 63](#)

8 - Dual-mass flywheel/drive plate

- ☐ Removing and installing dual-mass flywheel on vehicles with manual gearbox ⇒ [page 60](#)
- ☐ Removing and installing drive plate on vehicles with automatic gearbox ⇒ [page 62](#)

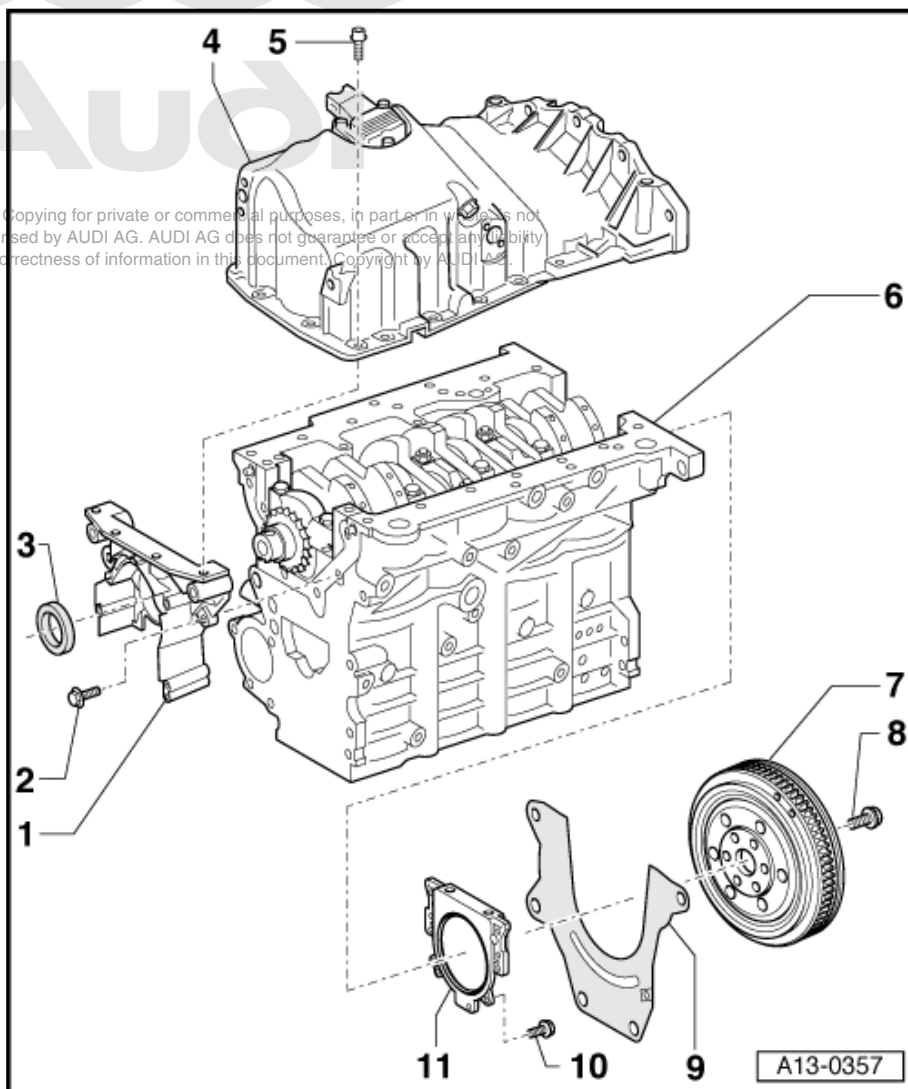
9 - Intermediate plate

- ☐ Must be positioned on dowel sleeves
- ☐ Do not damage/bend when assembling
- ☐ Is fitted onto sealing flange ⇒ [page 55](#)

10 - 15 Nm

11 - Sealing flange (gearbox end) with oil seal

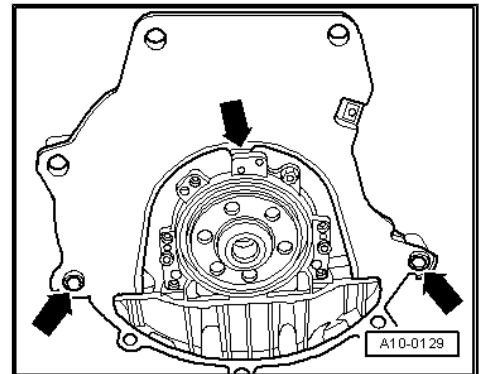
- ☐ With gasket for cylinder block



- ☐ Remove sump in order to remove and install ⇒ [page 125](#)
- ☐ Before installing, remove oil residue from crankshaft journal with a clean cloth
- ☐ Do not lubricate/grease sealing lip of oil seal
- ☐ Use guide sleeve supplied when fitting
- ☐ Take care not to fold over or damage sealing lip of oil seal when fitting

Installing intermediate plate

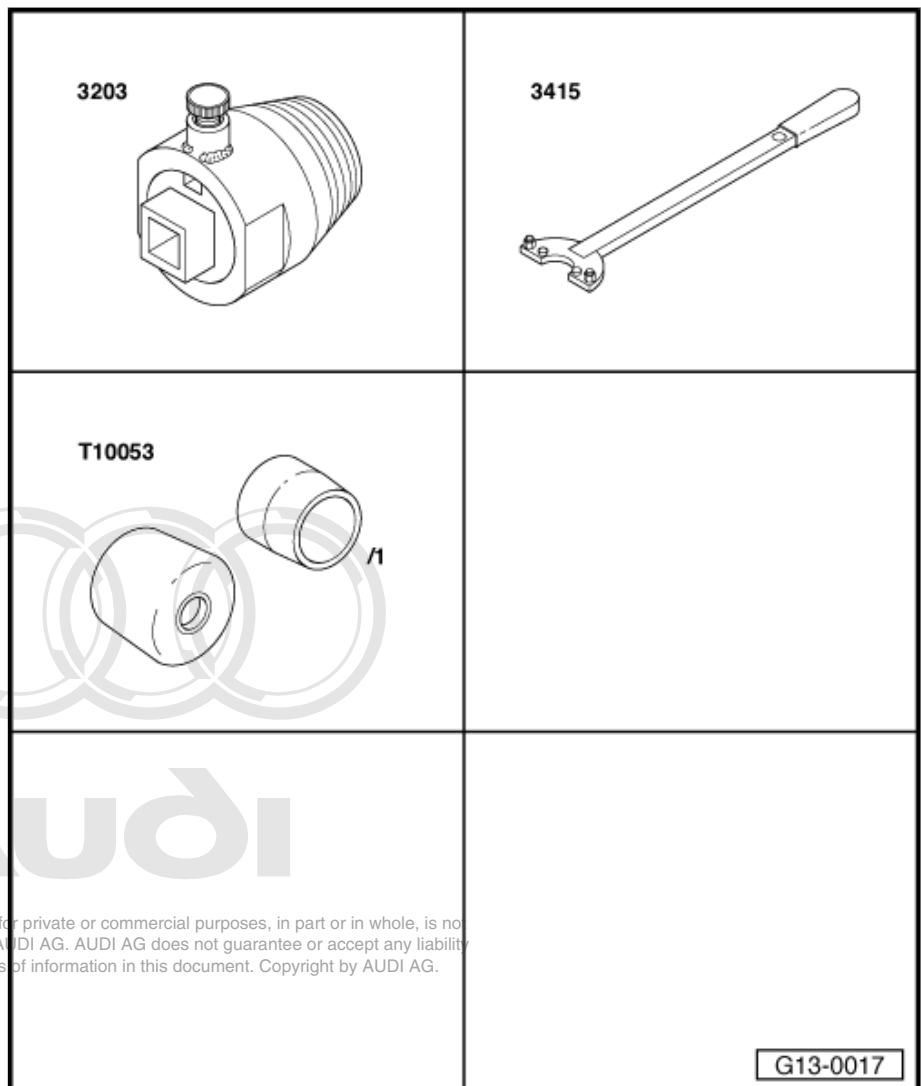
- Engage intermediate plate on sealing flange, and press onto dowel sleeves -arrows-.



2.2 Renewing crankshaft oil seal (pulley end)

Special tools and workshop equipment required

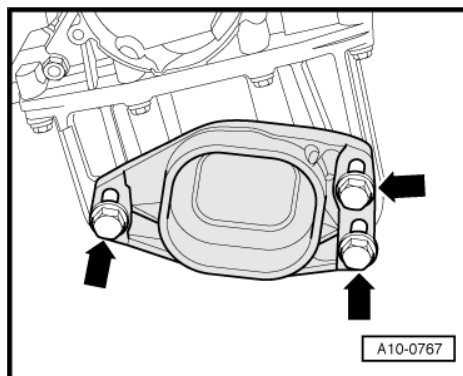
- ◆ Oil seal extractor - 3203-
- ◆ Counterhold tool - 3415-
- ◆ Assembly tool - T10053-



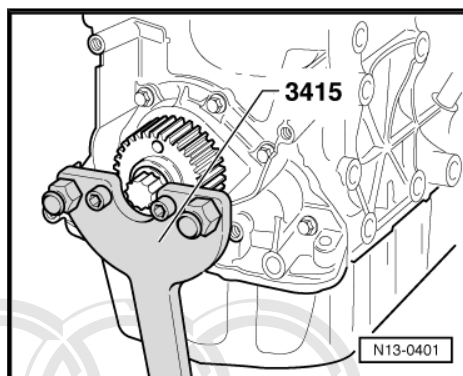
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Procedure

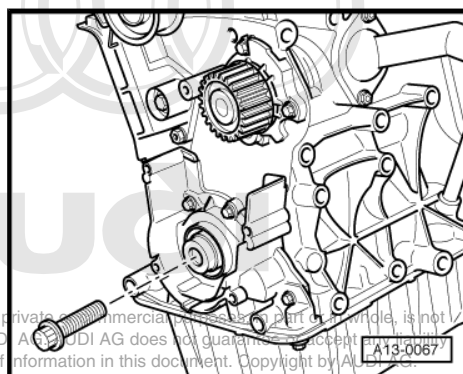
- Move lock carrier to service position ⇒ Rep. gr. 50 .
- Remove poly V-belt ⇒ [page 29](#) .
- Remove toothed belt: vehicles up to 07.2000 ⇒ [page 36](#) ; vehicles from 08.2000 onwards ⇒ [page 41](#) .
- Remove stop for torque reaction support -arrows-.



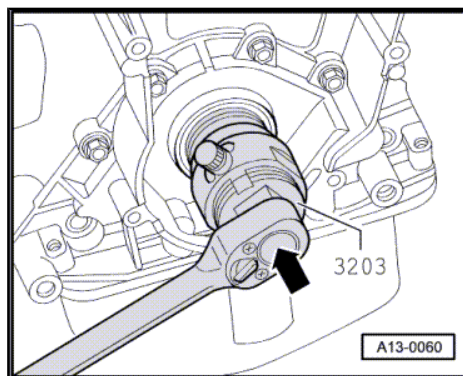
- Remove crankshaft sprocket using counterhold tool - 3415- .



- To guide oil seal extractor, screw bolt for toothed belt sprocket into crankshaft onto stop by hand.
- Unscrew inner section of oil seal extractor -3203- one turn out of outer section and lock with knurled screw.



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



- Remove oil residue from crankshaft journal with a clean cloth.
- Fit guide sleeve - T10053/1- onto crankshaft journal.

 Note

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

- Push oil seal over guide sleeve onto crankshaft journal.
- Press in oil seal using bolt for toothed belt sprocket and thrust sleeve of assembly tool - T10053- until flush.

 Note

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

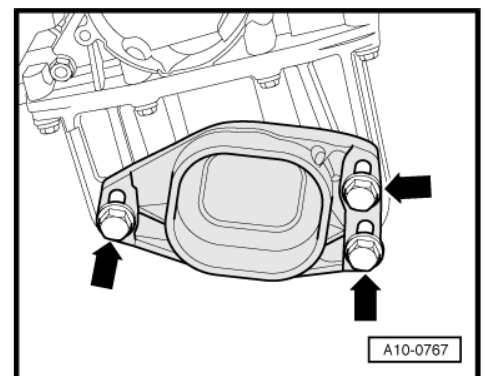
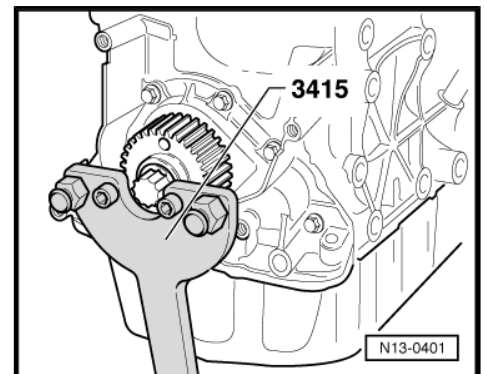
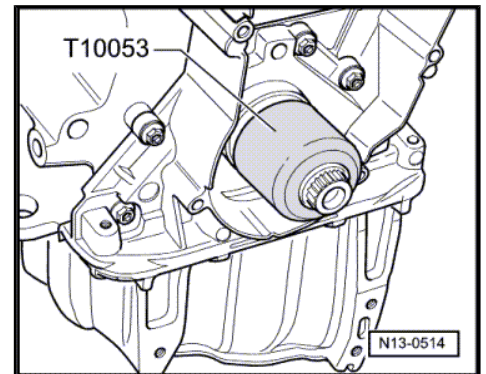
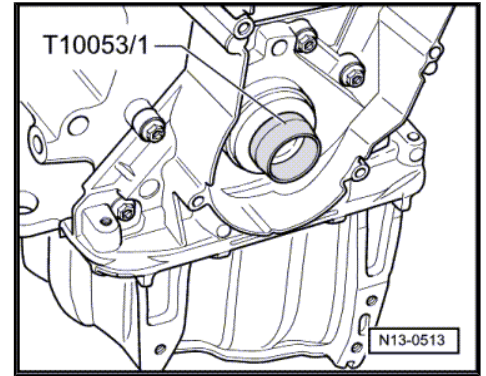
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- Install crankshaft sprocket using counterhold tool - 3415- .
- Install toothed belt (adjusting valve timing): vehicles up to 07.2000 ⇒ [page 38](#) ; vehicles from 08.2000 onwards ⇒ [page 50](#) .
- Install poly V-belt ⇒ [page 29](#) .

- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight and tighten nuts -arrows-.

Tightening torques

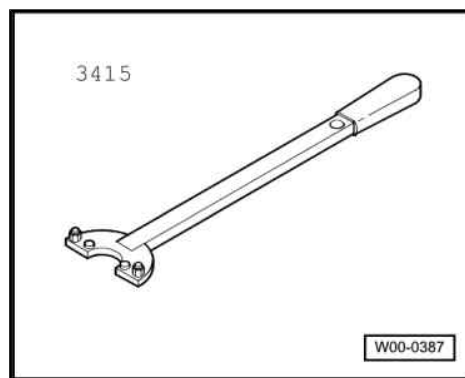
Component	Nm
Toothed belt sprocket to crankshaft	90 + 90° 1)2)
Stop for torque reaction support to sump	28
• 1) Renew bolt.	
• 2) 90° = one quarter turn.	



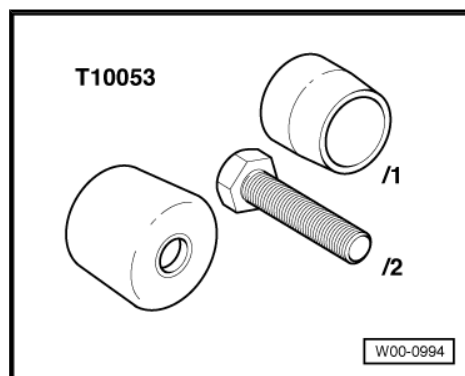
2.3 Removing and installing sealing flange (pulley end)

Special tools and workshop equipment required

◆ Counterhold tool - 3415-



◆ Assembly tool - T10053-



◆ Electric drill with plastic brush attachment

◆ Safety goggles

◆ Sealant ⇒ Parts catalogue

Removing

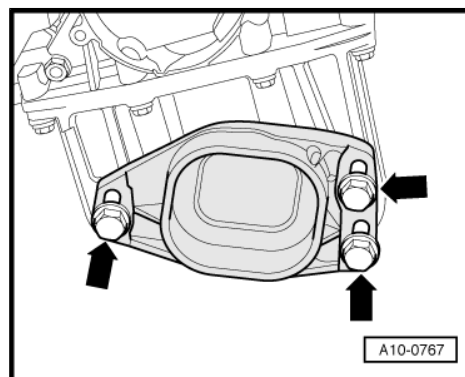
- Move lock carrier to service position ⇒ Rep. gr. 50 .
- Remove poly V-belt ⇒ [page 29](#) .
- Remove toothed belt: vehicles up to 07.2000 ⇒ [page 36](#) ; vehicles from 08.2000 onwards ⇒ [page 41](#) .



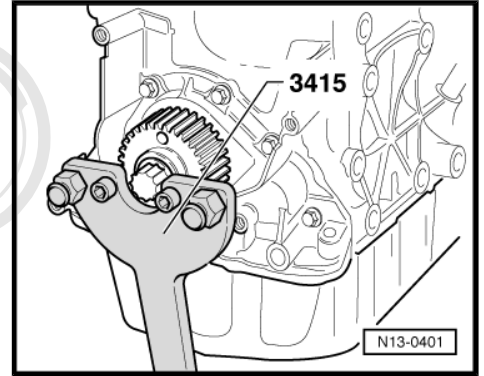
WARNING

The air conditioner refrigerant circuit must not be opened.

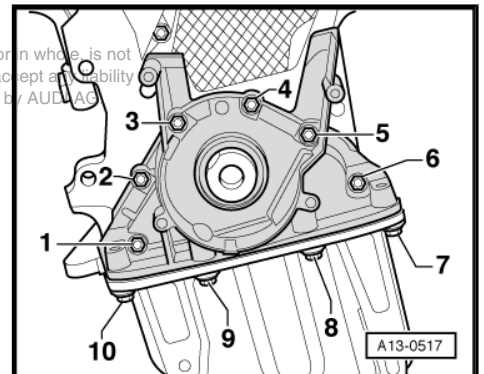
- Detach air conditioner compressor from bracket and secure to body with wire.
- Unbolt bracket for air conditioner compressor ⇒ [Item 5 \(page 28\)](#) .
- Remove stop for torque reaction support -arrows-.



- Remove crankshaft sprocket using counterhold tool - 3415- .
- Remove sump => [page 125](#) .



- Remove bolts -1 ... 6-.
- Pry off sealing flange (pulley end) and remove.



Installing



Note

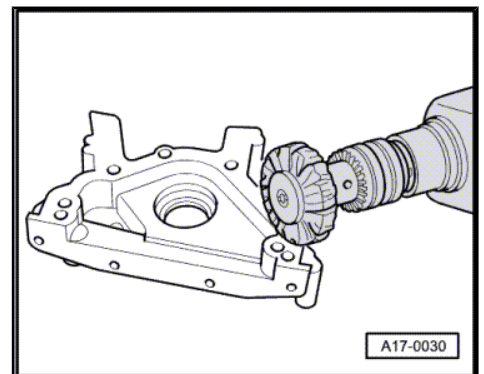
Place a cloth over the exposed section of the sump.

- Carefully remove sealant residue on cylinder block and sump.

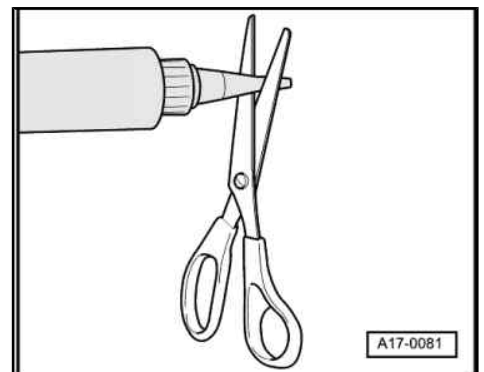


WARNING

Wear safety goggles.



- Remove sealant residue on sealing flange using rotating plastic brush or similar.
- Clean sealing surfaces; they must be free of oil and grease.
- Cut off nozzle of tube at front marking ($\varnothing$ of nozzle approx. 2 mm).



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



Note

- ◆ The sealant bead must not be thicker than specified, otherwise excess sealant could enter the sump and clog the strainer in the oil pump.
- ◆ The sealing flange must be installed within 5 minutes after applying sealant.

- Fit sealing flange and lightly tighten all bolts.



Note

Use guide sleeve -T10053/1- to fit sealing flange with the oil seal already installed.

- Tighten bolts for sealing flange in diagonal sequence.
- Install sump ⇒ [page 125](#) .



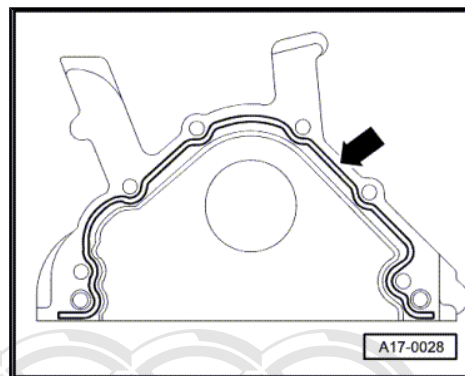
Note

After installing, allow sealant to dry for approx. 30 minutes Then (and only then) fill the engine with engine oil.

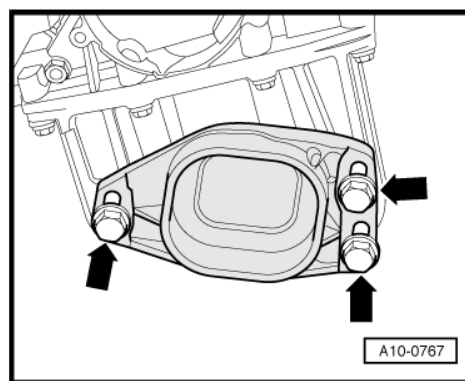
- Install crankshaft oil seal (pulley end) ⇒ [page 55](#) .
- Install toothed belt (adjusting valve timing): vehicles up to 07.2000 ⇒ [page 38](#) ; vehicles from 08.2000 onwards ⇒ [page 50](#) .
- Install bracket for air conditioner compressor ⇒ [Item 5 \(page 28\)](#) .
- Install air conditioner compressor ⇒ Rep. gr. 87 .
- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight and tighten nuts -arrows-.

Tightening torques

Component	Nm
Sealing flange to cylinder block	15
Bracket for air conditioner compressor to cylinder block	33
Stop for torque reaction support to sump	28



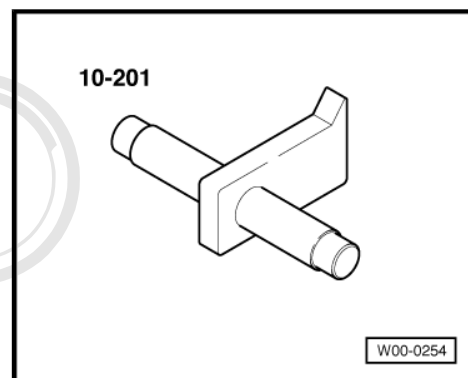
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2.4 Removing and installing dual-mass fly-wheel - vehicles with manual gearbox

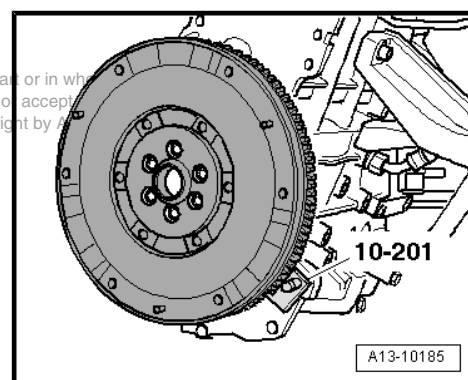
Special tools and workshop equipment required

◆ Counterhold tool - 10 - 201-



Removing

- Engine or gearbox removed.
- Remove clutch pressure plate ⇒ Rep. gr. 30.
- Mark position of dual-mass flywheel in relation to crankshaft.
- Insert counterhold tool - 10 - 201- to slacken bolts.

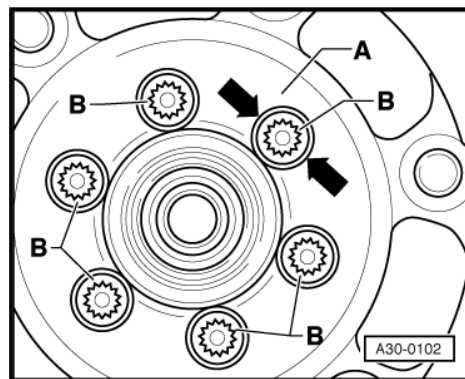




Note

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

- Rotate the dual-mass flywheel -A- so that the bolts align centrally with the holes -arrows-.
- When unscrewing the bolts, make sure that the bolt heads do not come into contact with the dual-mass flywheel; the flywheel will otherwise be damaged as the bolts are screwed out.



Installing

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



Note

Renew bolts for dual-mass flywheel.

- Fit counterhold tool - 10 - 201- the other way round to tighten bolts.
- Install clutch pressure plate ⇒ Rep. gr. 30 .

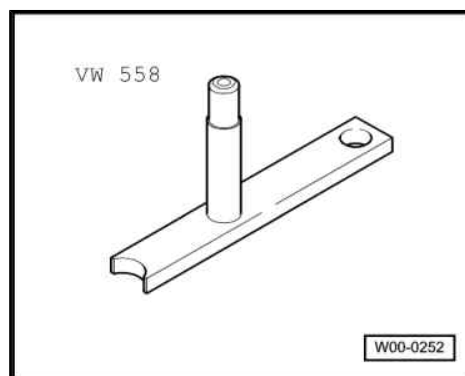
Tightening torque

Component		Nm
Dual-mass fly-wheel to crank-shaft	Bolt length 22.5 mm	60 + 90° ¹⁾²⁾
	43.0 mm	60 + 180° ¹⁾³⁾
• 1) Renew bolts. • 2) 90° = one quarter turn. • 3) 180° = one half turn.		

2.5 Removing and installing drive plate - vehicles with automatic gearbox

Special tools and workshop equipment required

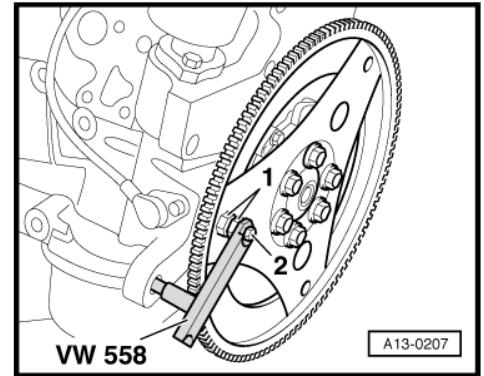
- ◆ Clutch counterhold tool - VW 558-



- ◆ Depth gauge
- ◆ Bolt M8x45
- ◆ Nuts M10 (2x)

Removing

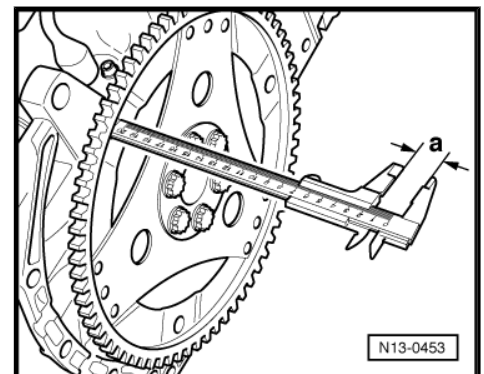
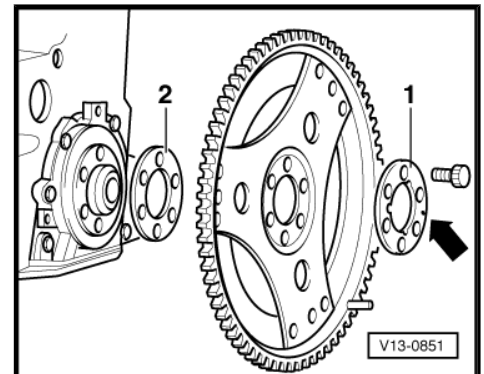
- Engine/gearbox removed.
- Mark position of drive plate in relation to crankshaft.
- Secure clutch counterhold tool - VW 558- to drive plate using M8x45 bolt -item 2-. Fit two M10 nuts -1- between counterhold tool and drive plate.
- Remove drive plate.
- Remove shim located behind.



Installing

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

- Fit shim -2- on crankshaft.
- Install drive plate with washer -1-.
- Lug -arrow- must face torque converter.
- Insert at least 3 old bolts and tighten to 30 Nm.
- Measure distance through torque converter securing hole using depth gauge.
- Specification: Distance -a- = 18.9 ... 20.5 mm.



- If specification is not attained, remove drive plate and remove or add shim -2-.
- Repeat measurement (tighten bolts on drive plate to 30 Nm).

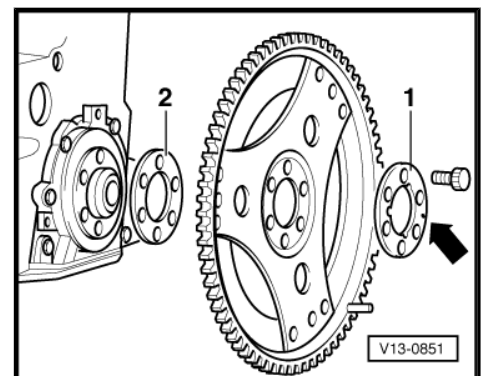


Note

Renew securing bolts for drive plate before tightening bolts to final torque.

Tightening torque

Component	Nm
Drive plate to crankshaft	60 + 90° ¹⁾²⁾
• ¹⁾ Renew bolt. • ²⁾ 90° = one quarter turn.	



3 Crankshaft



Note

- ◆ When carrying out repairs, secure engine with engine and gearbox support - VW 540- to engine and gearbox support - VAS 6095- ⇒ [page 21](#) .
- ◆ If large quantities of metal shavings or particles are found in the engine oil when repairing the engine, the oil passages must be cleaned carefully, and the oil cooler must be renewed in order to prevent further damage occurring later.

3.1 Crankshaft - exploded view

1 - Bearing shell

- ☐ For cylinder block (with oil groove)
- ☐ Do not interchange used bearing shells (mark positions)
- ☐ Fit bearing shells for cylinder block with correct colour-coding ⇒ [page 66](#)

2 - Chain sprocket

- ☐ For oil pump chain
- ☐ Renewing ⇒ [page 68](#)

3 - Bearing shell

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

4 - Thrust washers

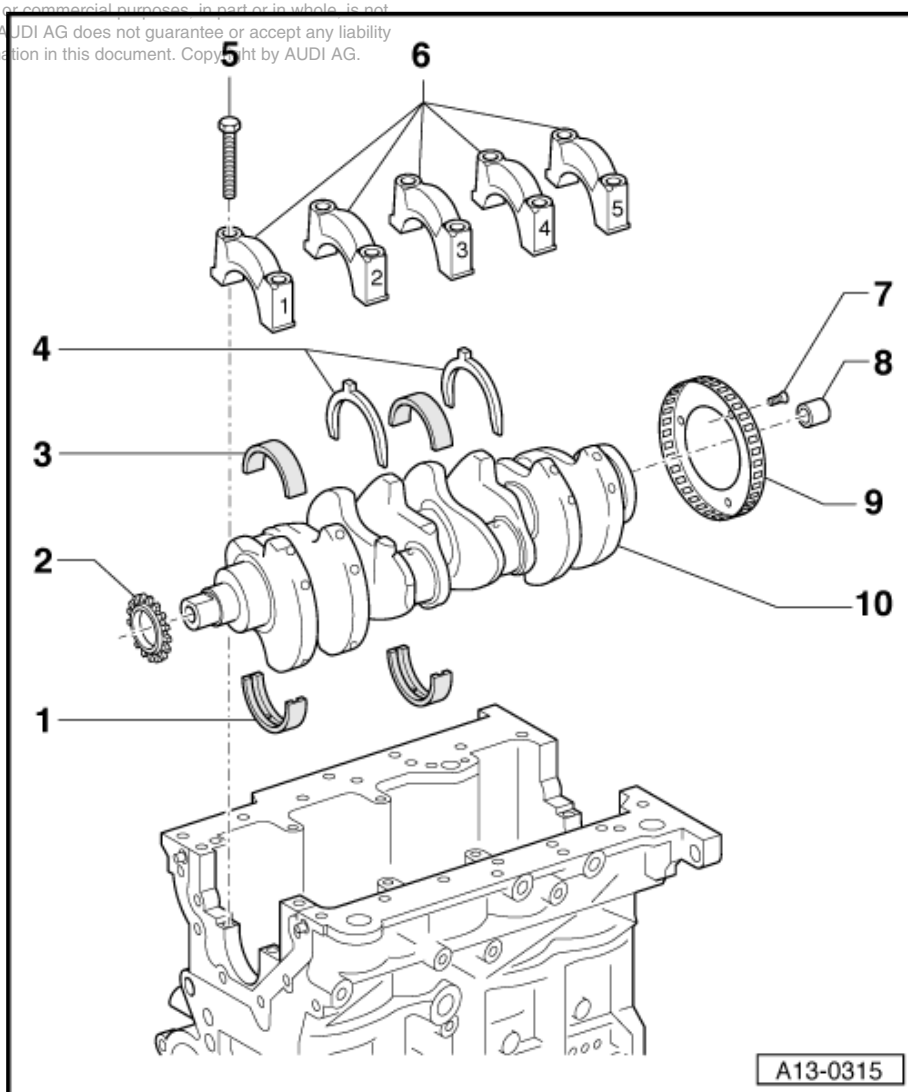
- ☐ For bearing No. 3
- ☐ Different types for cylinder block and bearing cap
- ☐ Note location

5 - 65 Nm + 90° (1/4 turn) further

- ☐ Renew
- ☐ For measuring radial clearance of crankshaft tighten to 65 Nm, but not further

6 - Bearing cap

- ☐ Bearing cap 1: Pulley end
- ☐ Bearing cap 3 with recesses for thrust washers
- ☐ Retaining lugs on bearing shells in cylinder block and bearing cap must be on the same side



7 - 10 Nm + 90° (1/4 turn) further

- ☐ Renew
- ☐ Sender wheel must be renewed if bolts are loosened ⇒ [page 65](#)

8 - Needle bearing

- ☐ For vehicles with manual gearbox
- ☐ Extracting and driving in ⇒ [page 66](#)

9 - Sender wheel

- ☐ For engine speed sender - G28-
- ☐ Can only be installed in one position (holes are off-set)
- ☐ Sender wheel must be renewed if bolts are loosened
- ☐ Removing and installing ⇒ [page 65](#)

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10 - Crankshaft

- ☐ Axial clearance (new): 0.07 ... 0.23 mm
- ☐ Axial clearance: wear limit: 0.30 mm
- ☐ Check radial clearance with Plastigage
- ☐ Radial clearance (new): 0.02 ... 0.04 mm
- ☐ Radial clearance: wear limit: 0.15 mm
- ☐ Do not rotate the crankshaft when checking the radial clearance
- ☐ Crankshaft dimensions ⇒ [page 66](#)

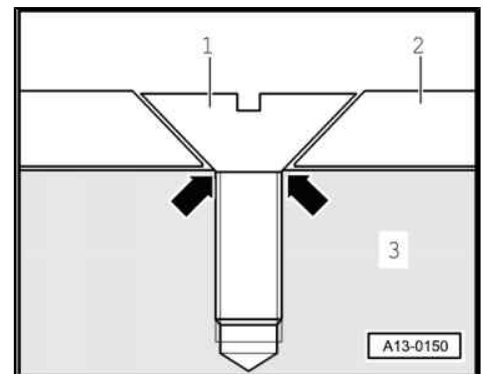
Removing and installing sender wheel

- 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 bolt. • 2) 90° = one quarter turn.	

Matching crankshaft bearing shells to bearings in cylinder block

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



Note

The -arrow- points in direction of travel.

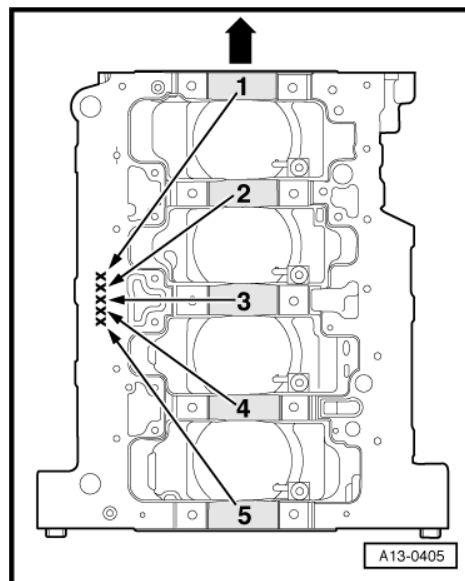
Letter codes on lower sealing surface of cylinder block indicate which bearing shell is to be fitted at each location.

Letter on cylinder block	Colour coding of bearing
G =	Yellow
R =	Red
S =	Black



Note

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



3.2 Crankshaft dimensions

Honing dimension (in mm)	Crankshaft main bearing journal Ø	Conrod bearing journal Ø
Basic dimension	54.00 -0.017 -0.037	47.80 -0.022 -0.042
1st undersize	53.75 -0.017 -0.037	47.55 -0.022 -0.042
2nd undersize	53.50 -0.017 -0.037	47.30 -0.022 -0.042
3rd undersize	53.25 -0.017 -0.037	47.05 -0.022 -0.042

3.3 Extracting and driving in needle bearing for crankshaft



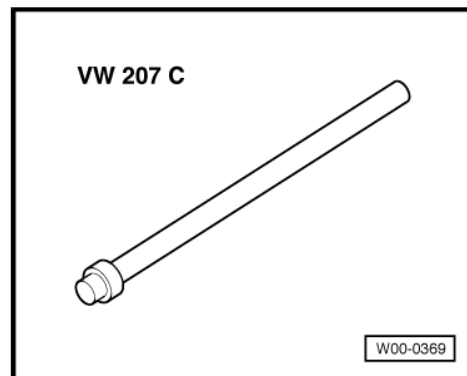
Note

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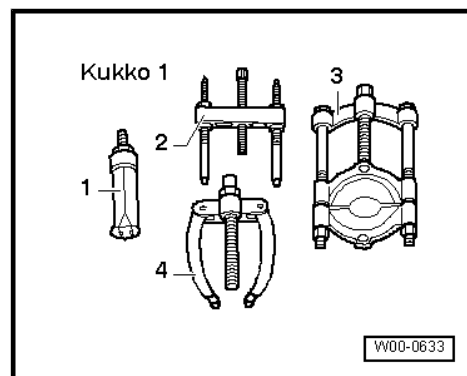
- ◆ A needle bearing must be fitted in the crankshaft on vehicles with manual gearbox; insert needle bearing if not yet fitted.
- ◆ In vehicles with automatic gearbox, the needle bearing must NOT be fitted in the crankshaft; remove needle bearing if fitted.

Special tools and workshop equipment required

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



- ◆ -1- Internal puller Kukko 21/1

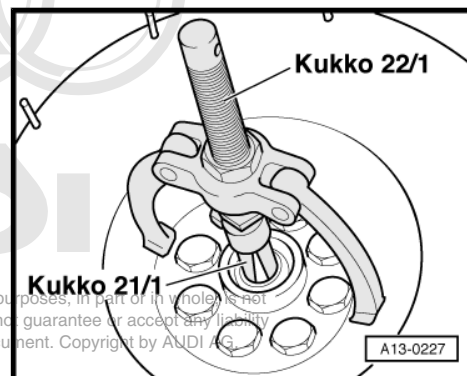


- ◆ -4- Counter-support Kukko 22/1

- ◆ Depth gauge

Pulling out

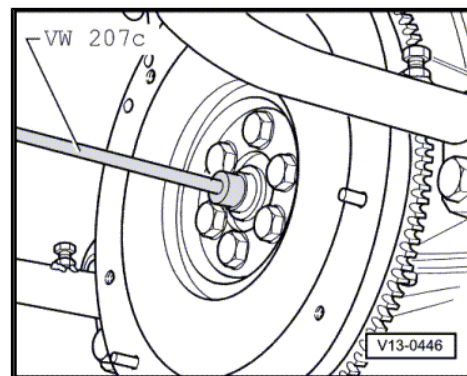
- Remove needle bearing using internal puller Kukko 21/1 and counter-support Kukko 22/1.



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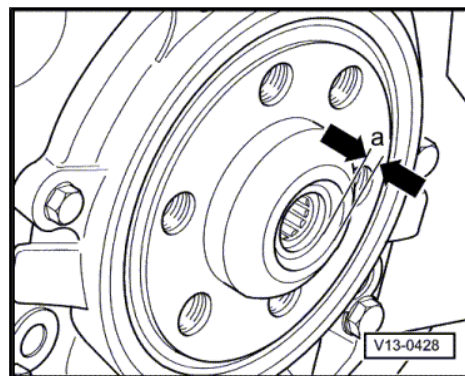
Driving in

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



Installation depth of needle bearing

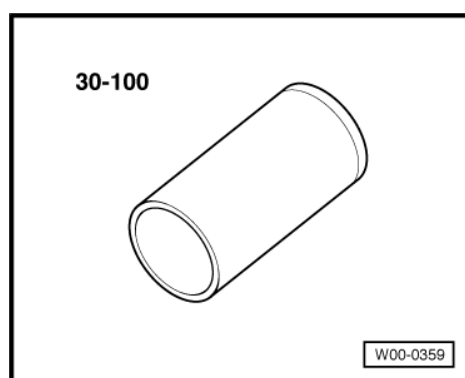
- Distance -a- = 1.5 mm



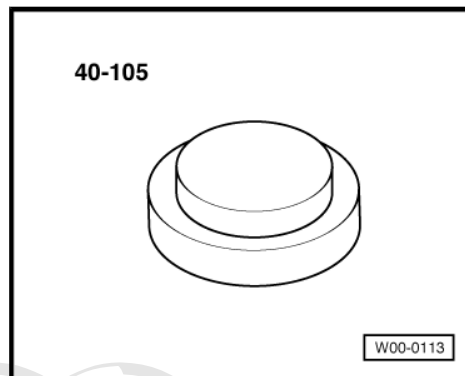
3.4 Removing and installing chain sprocket

Special tools and workshop equipment required

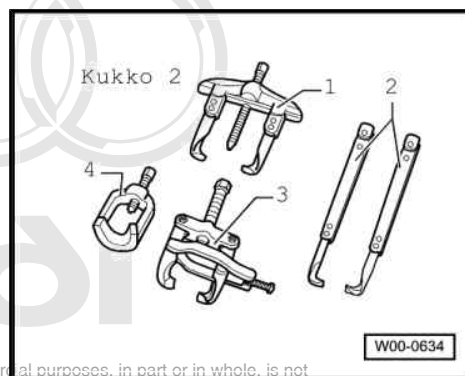
- ◆ Drift sleeve - 30 - 100-



- ◆ Thrust plate - 40 - 105-



- ◆ -1- Claw-type puller Kukko 44-1

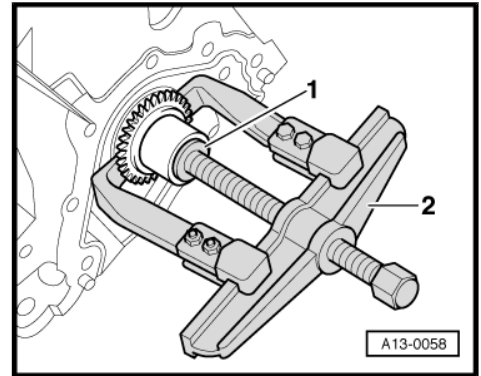


- ◆ Protective gloves

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Removing

- Engine removed ⇒ [page 6](#) .
- Remove sump ⇒ [page 125](#) .
- Remove sealing flange (pulley end) ⇒ [page 57](#) .
- Remove drive chain for oil pump ⇒ [Item 7 \(page 123\)](#) .
- Pull off crankshaft drive chain sprocket using claw-type puller Kukko 44-1 -item 2- (protect end of crankshaft with thrust plate - 40 - 105- -item 1-).



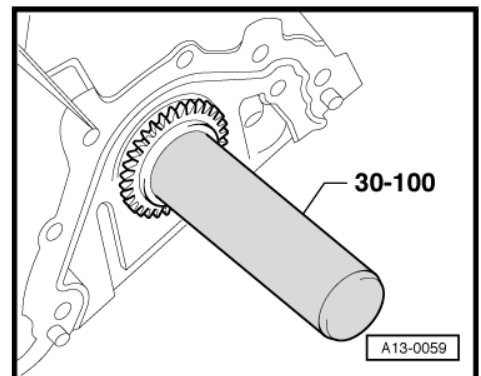
Installing



WARNING

Wear protective gloves.

- Heat chain sprocket in oven for approx. 15 minutes to 220°C.
- Using pliers, fit chain sprocket on end of shaft journal.
- Installation position: wide collar on sprocket faces engine.
- Push sprocket onto crankshaft as far as the stop using drift sleeve - 30 - 100- .



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4 Pistons and conrods



Note

- ◆ Oil spray jet and pressure relief valve ⇒ [page 72](#)
- ◆ If large quantities of metal shavings or particles are found in the engine oil when repairing the engine, the oil passages must be cleaned carefully, and the oil cooler must be renewed in order to prevent further damage occurring later.

4.1 Pistons and conrods - exploded view

1 - Bolt, 30 Nm + 90° (1/4 turn) further

- ☐ Renew
- ☐ Lubricate threads and contact surface
- ☐ Use old bolts when measuring radial clearance
- ☐ To measure radial clearance, tighten to 30 Nm but do not turn further

2 - Conrod bearing cap

- ☐ Mark cylinder number -B-
- ☐ Installation position: Markings -A- face towards pulley end

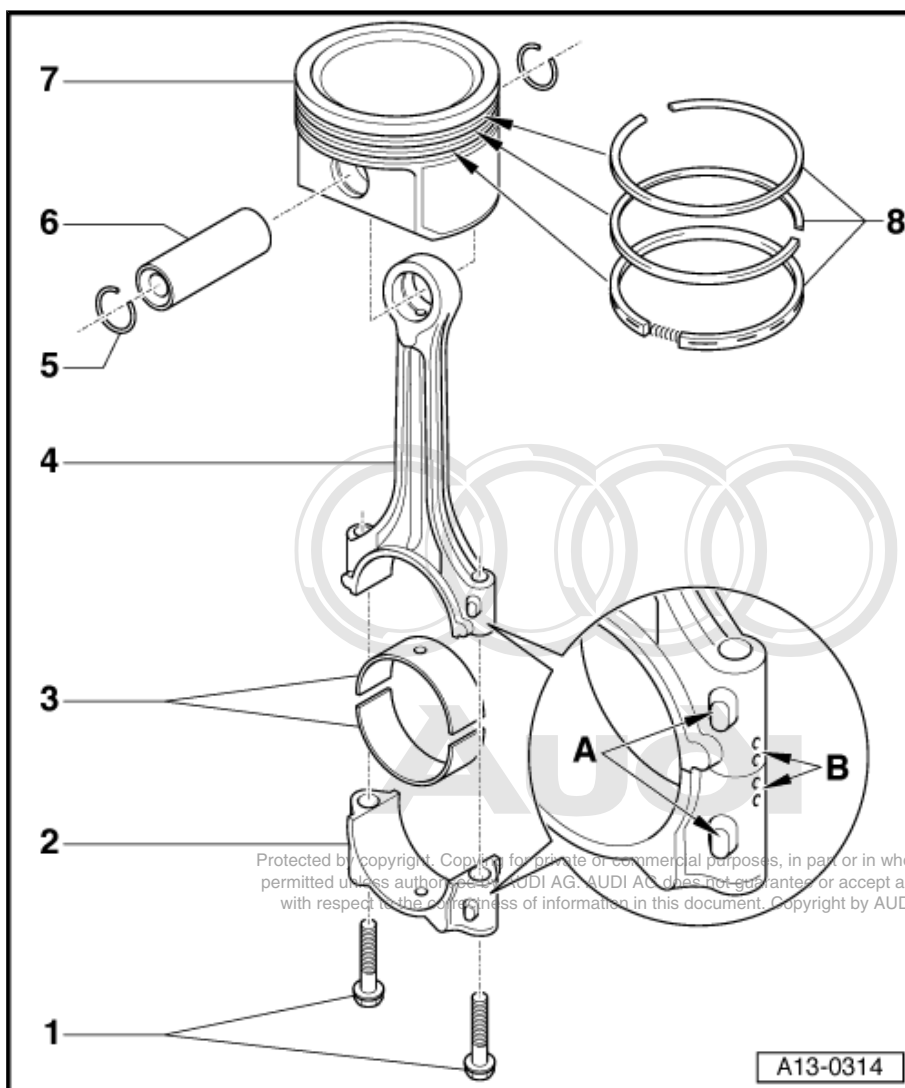
3 - Bearing shells

- ☐ Upper bearing shell with oil hole for piston pin lubrication
- ☐ Installation position ⇒ [page 72](#)
- ☐ Do not interchange used bearing shells (mark positions)
- ☐ Axial clearance (new): 0.10 ... 0.35 mm
- ☐ Axial clearance: wear limit: 0.40 mm
- ☐ Check radial clearance with Plastigage; do not rotate crankshaft when checking radial clearance

- ☐ Radial clearance (new): 0.01 ... 0.05 mm
- ☐ Radial clearance: wear limit: 0.12 mm

4 - Conrod

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



5 - Circlip

6 - Piston pin

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

7 - Piston

- ☐ Checking ⇒ [page 72](#)
- ☐ Mark installation position and cylinder number
- ☐ Arrow on piston crown points to pulley end
- ☐ Install using piston ring clamp
- ☐ Piston and cylinder dimensions ⇒ [page 73](#)
- ☐ Checking cylinder bore ⇒ [page 72](#)

8 - Piston rings

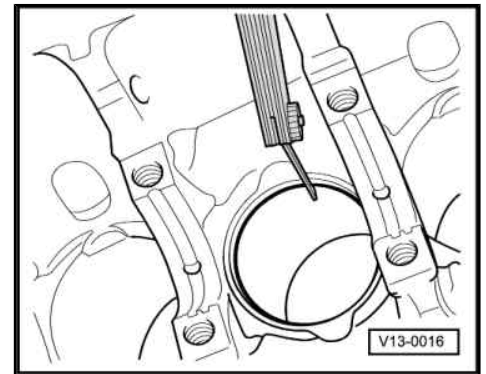
- ☐ Offset gaps by 120°
- ☐ Use piston ring pliers to remove and install
- ☐ "TOP" must face towards piston crown
- ☐ Checking ring gap ⇒ [page 71](#)
- ☐ Checking ring-to-groove clearance ⇒ [page 71](#)

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Checking piston ring gap

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

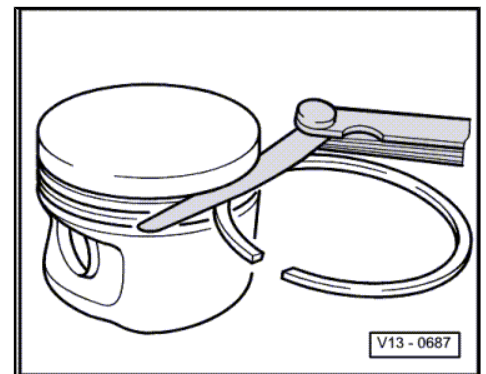
Piston ring (in mm)	New	Wear limit
1st compression ring	0.20 ... 0.40	0.8
2nd compression ring	0.20 ... 0.40	0.8
Oil scraper ring	0.25 ... 0.50	0.8



Checking ring-to-groove clearance

- Clean groove in piston before checking clearance.

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

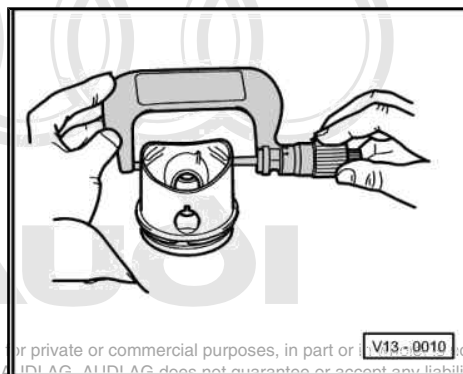


Checking piston

- Measure pistons approx 10 mm from the lower edge of skirt, at 90° to the piston pin axis.
- Maximum deviation from nominal dimension: 0.04 mm.

Nominal dimension

⇒ "4.2 Piston and cylinder dimensions", page 73 .

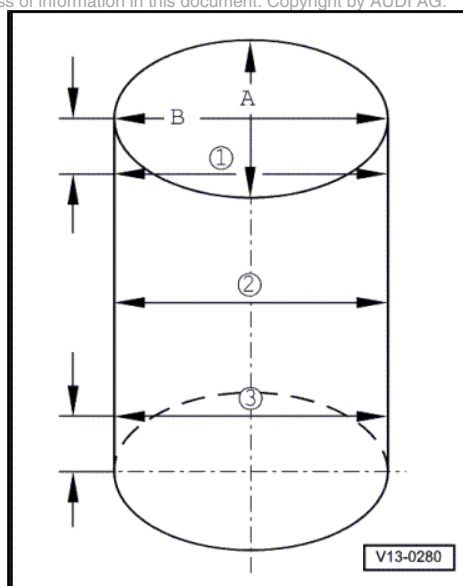


Checking cylinder bore

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

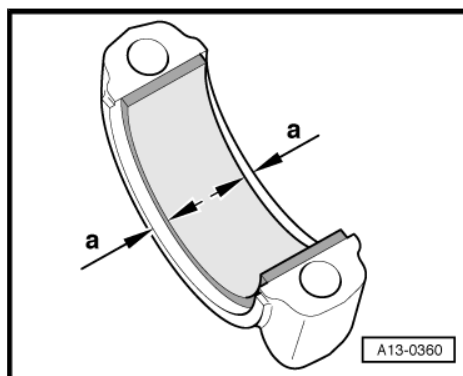
Nominal dimension

⇒ "4.2 Piston and cylinder dimensions", page 73 .



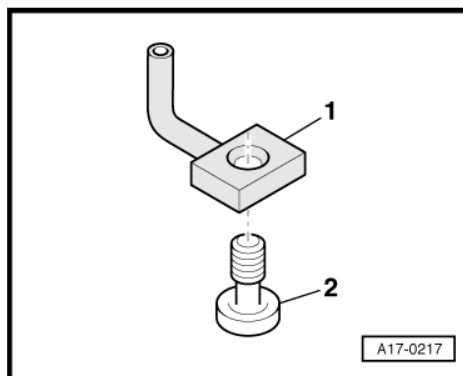
Installation position of bearing shell

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



Oil spray jet and pressure relief valve

- 1 - Oil spray jet for piston cooling
 - 2 - Bolt with pressure relief valve, 27 Nm
- Opening pressure: 1.3 ... 1.6 bar.



4.2 Piston and cylinder dimensions

Honing dimension (in mm)	Piston Ø	Cylinder bore Ø
Basic dimension	80.95 ¹⁾	81.01
Repair oversize	81.45 ¹⁾	81.51
¹⁾ Dimensions including coating (thickness 0.02 mm). The coating will wear down in service.		



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15 – Cylinder head, valve gear

1 Cylinder head

1.1 Cylinder head - exploded view

1 - Cylinder head gasket

- ☐ Renewing
⇒ ["1.3 Removing and installing cylinder head", page 78](#)
- ☐ Installation position:
Part No. towards cylinder head
- ☐ If renewed, change engine oil and coolant

2 - Cylinder head

- ☐ Removing and installing
⇒ [page 78](#)
- ☐ Checking for distortion
⇒ [page 75](#)
- ☐ Machining limit
⇒ [page 75](#)
- ☐ If renewed, change engine oil and coolant

3 - Oil deflector

- ☐ Note installation position

4 - Cylinder head bolt

- ☐ Renew
- ☐ Note correct sequence when loosening
⇒ [page 83](#)
- ☐ Note correct sequence when tightening
⇒ [page 85](#)

5 - Cylinder head cover

- ☐ Removing and installing
⇒ [page 76](#)

6 - Ignition coil

7 - Filler cap

8 - Seal

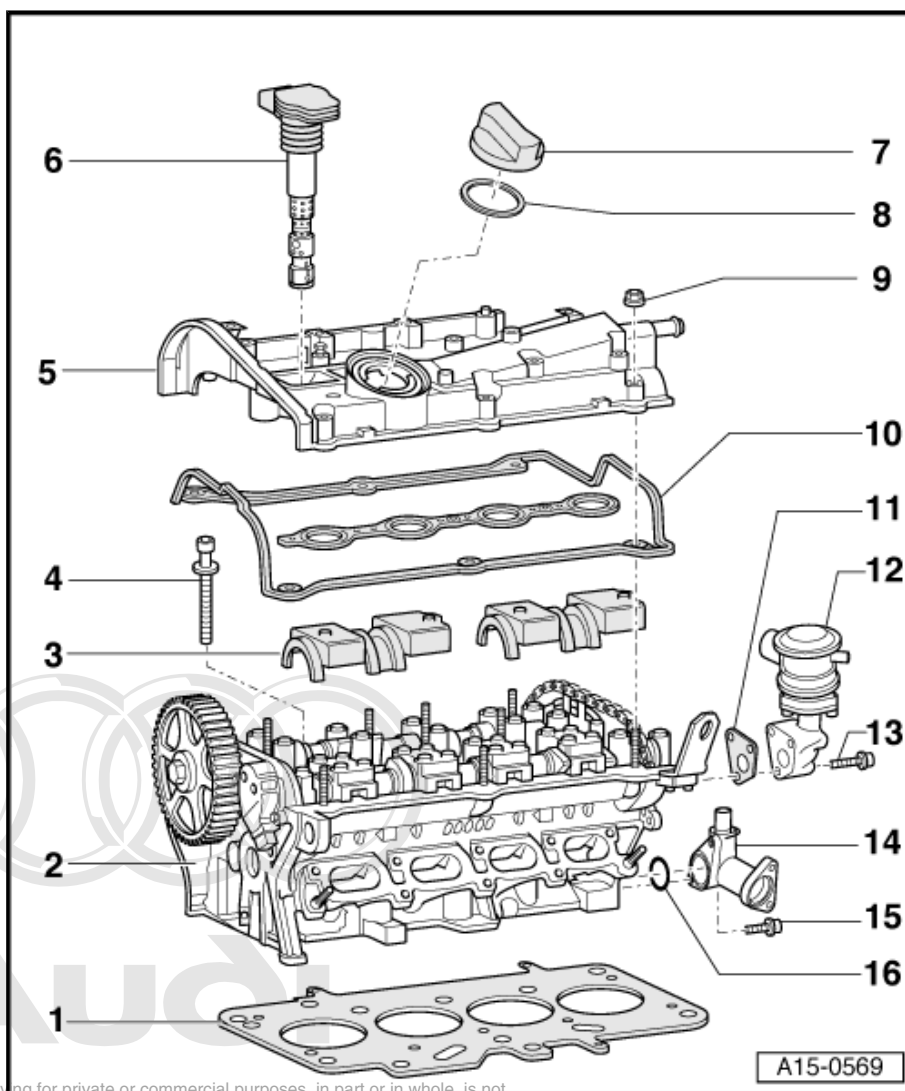
- ☐ Renew if damaged or leaking

9 - 10 Nm

- ☐ Tighten inner nuts first
- ☐ Tighten outer nuts in diagonal sequence

10 - Gaskets for cylinder head cover

- ☐ Renew if damaged or leaking
- ☐ Before fitting, apply sealant at sealing points ⇒ [page 75](#) and ⇒ [page 76](#)



11 - Gasket

- ☐ Renew

12 - Combination valve for secondary air system

- ☐ With connecting pipe
- ☐ Removing and installing ⇒ [page 232](#)

13 - 10 Nm

14 - Coolant flange

- ☐ With coolant temperature sender

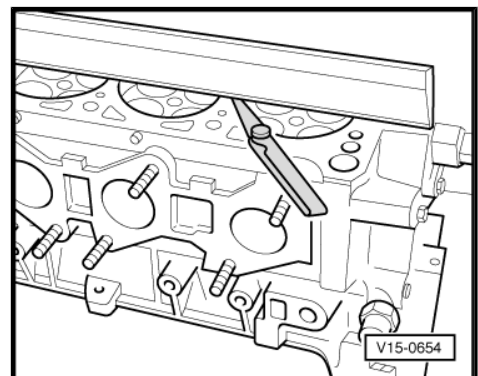
15 - 10 Nm

16 - O-ring

- ☐ Renew

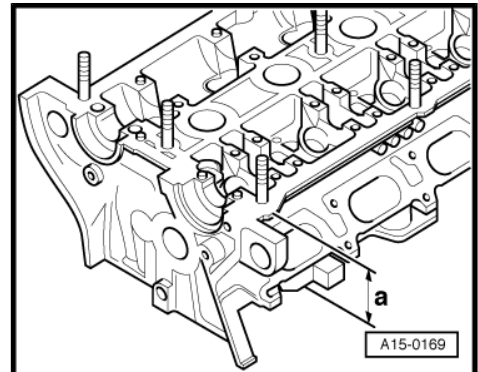
Checking cylinder head for distortion

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



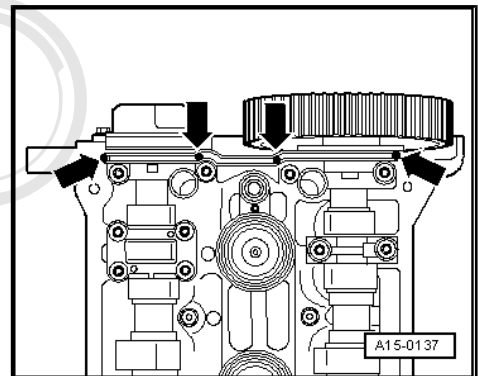
Cylinder head machining limit

- Machining of the cylinder head (surface grinding) is only permissible down to the minimum dimension -a-.
- Minimum dimension: -a- = 139.20 mm



Applying sealant to sealing points between double bearing cap and cylinder head

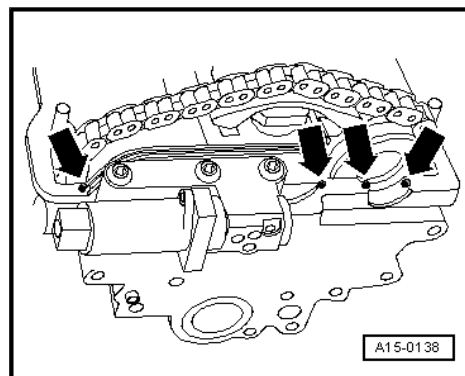
- Apply small quantity of sealant to sealing points -arrows- at top sealing surface of cylinder head; sealant ⇒ Parts catalogue .



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Applying sealant to sealing points between camshaft adjuster and cylinder head.

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

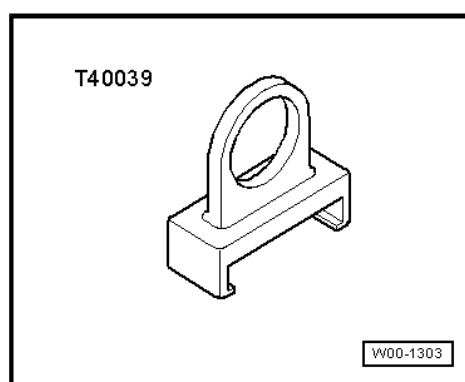


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1.2 Removing and installing cylinder head cover

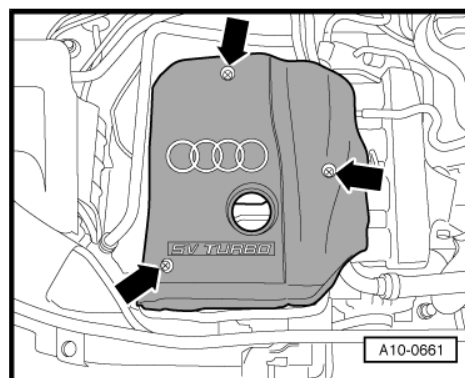
Special tools and workshop equipment required

- ◆ Puller - T40039-

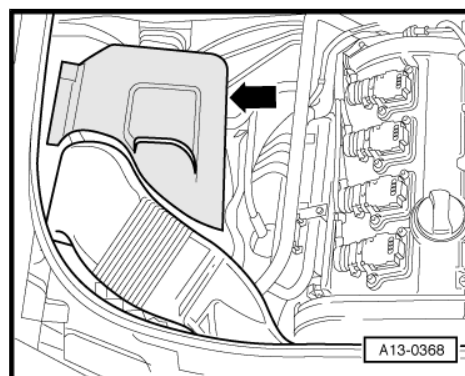


Removing

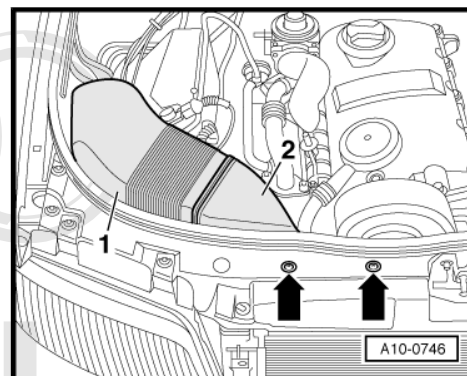
- Release quick-release fasteners and remove engine cover panel -arrows-.



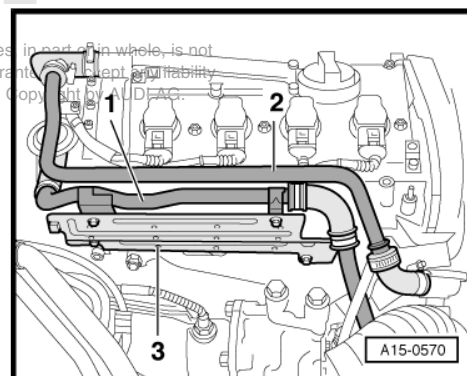
- Detach air cleaner cover -arrow-.



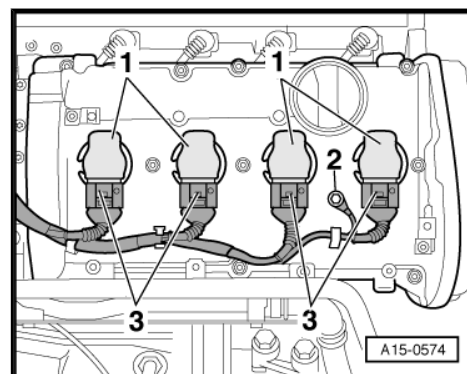
- Remove bolts -arrows-.
- Remove air duct -1 and 2-.



- Remove crankcase breather pipe -2-.
- Detach crankcase breather hose from cylinder head cover.
- Detach pipe -1- on combination valve for secondary air from cylinder head cover and heat shield -3-.
- Pivot secondary air pipe slightly to the side.

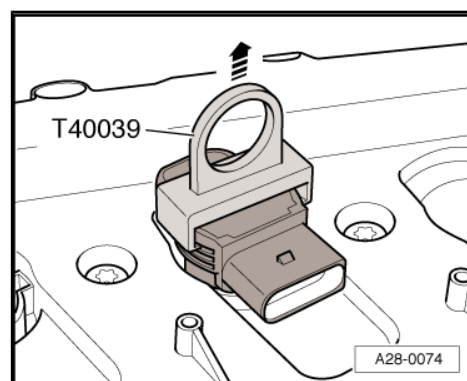


- Unscrew earth wire -2-.
- Unplug electrical connectors -3- and move electrical wiring clear.
- Pull out ignition coils -1-.



Note

Use puller - T40039- to remove ignition coils.



- Loosen two retaining clips for toothed belt cover (top section).
- Remove nuts -arrows- and detach cylinder head cover.

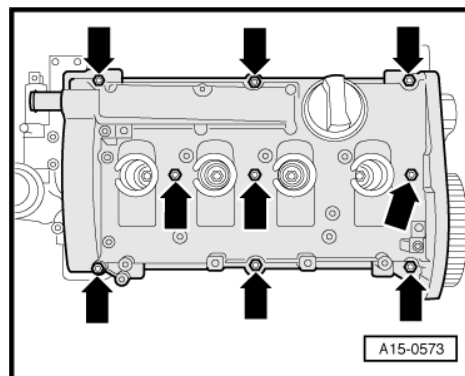
Installing

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

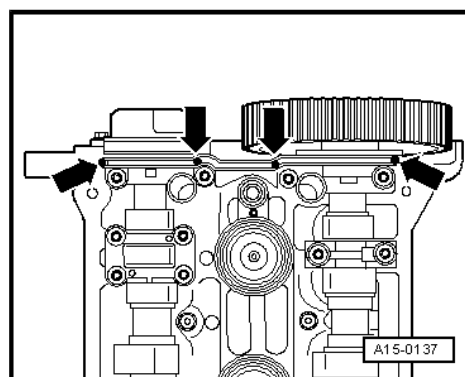


Note

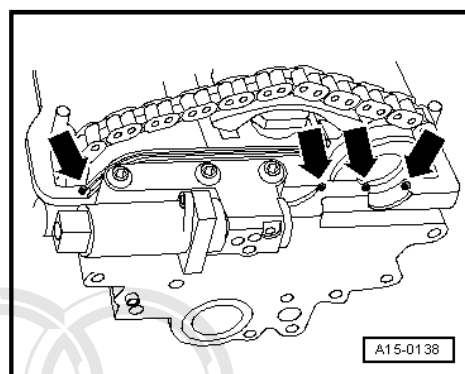
- ◆ Renew all seals and gaskets.
- ◆ Renew gaskets for cylinder head cover if damaged.
- ◆ Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.



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



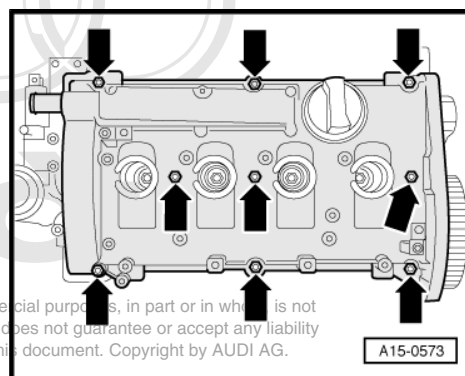
- Apply small quantity of sealant to sealing points -arrows- at top sealing surface of cylinder head; sealant ⇒ Parts catalogue .



- First tighten inner nuts for cylinder head cover and then outer nuts in diagonal sequence.
- Install top section of toothed belt cover (make sure it engages securely on centre section of toothed belt cover).

Tightening torques

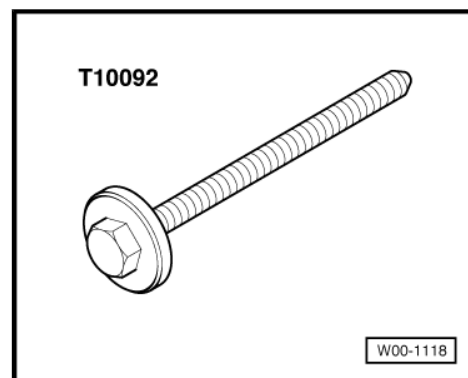
Component	Nm
Cylinder head cover to cylinder head	10
Crankcase breather pipe to cylinder head cover	10
Secondary air pipe to cylinder head cover	10
Hose clips	2



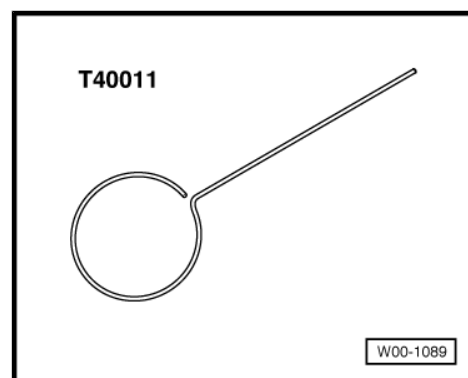
1.3 Removing and installing cylinder head

Special tools and workshop equipment required

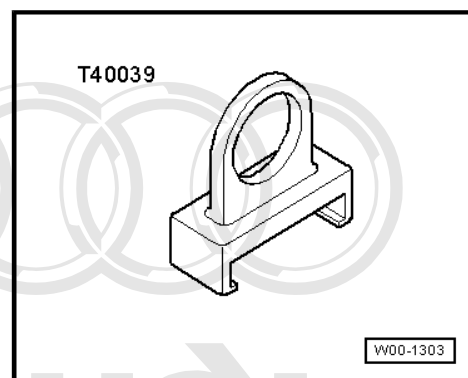
- ◆ Tensioning bolt - T10092- for vehicles up to 07.2000



- ◆ Locking pin - T40011- for vehicles up to 07.2000



- ◆ Puller - T40039-



Removing



Note

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Fit all cable ties in the original positions when installing.

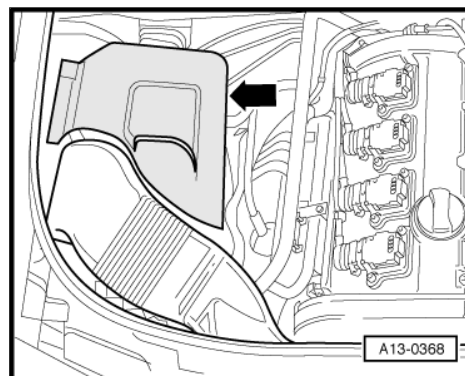


Caution

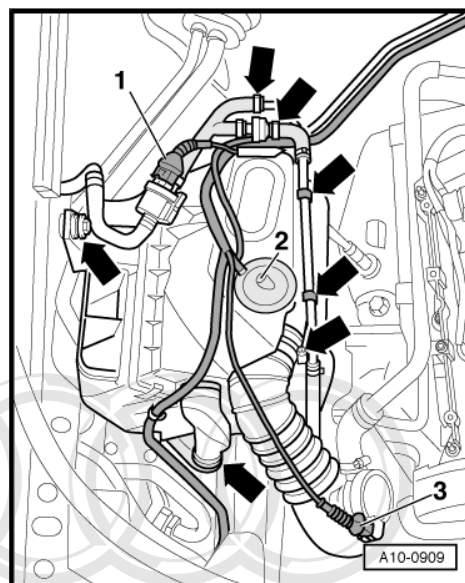
Observe notes on procedure for disconnecting the battery ⇒ Rep. gr. 27.

- Disconnect earth wire at battery with ignition switched off.
- Drain coolant ⇒ [page 143](#) .
- Move lock carrier to service position ⇒ Rep. gr. 50 .
- Remove intake manifold ⇒ [page 88](#) .

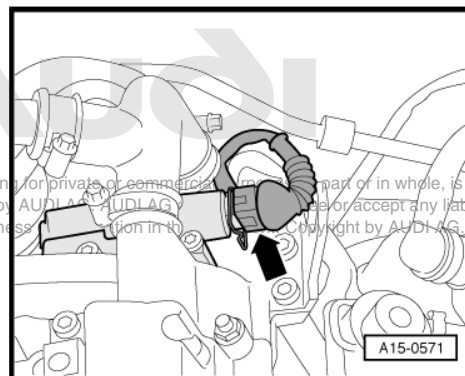
- Detach air cleaner cover -arrow-.



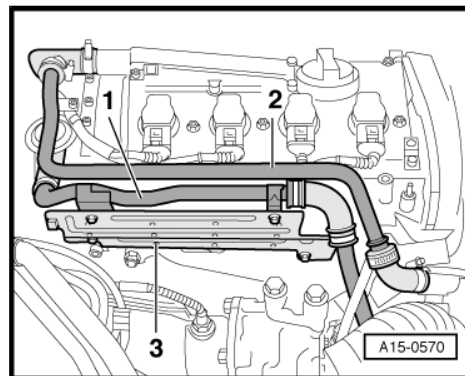
- Unplug electrical connectors:
 - 1 - On activated charcoal filter solenoid valve 1 - N80-
 - 2 - On air mass meter - G70-
 - 3 - On charge pressure control solenoid valve - N75-
- Detach solenoid valve 1 for activated charcoal filter - N80- from air cleaner housing.
- Detach hose connections, move electrical wiring clear and remove air filter housing -arrows-.



- Unplug electrical connector -arrow- at camshaft control valve 1 - N205- .

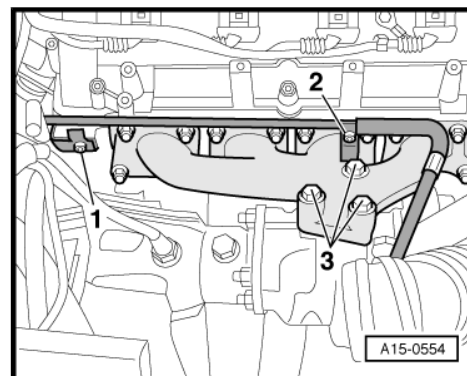


- Remove crankcase breather pipe -2-.
- Detach crankcase breather hose from cylinder head cover.
- Detach pipe -1- on combination valve for secondary air from cylinder head cover and heat shield -3-.
- Pivot secondary air pipe slightly to the side.
- Remove heat shield.

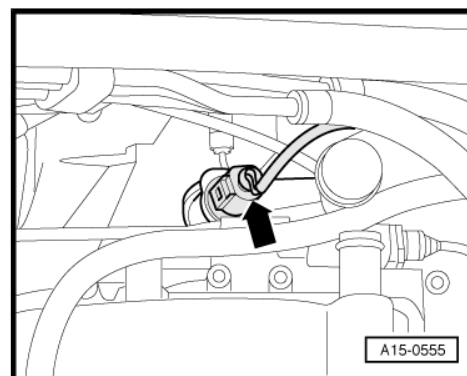


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- Remove bolts -1 and 2- for oil supply line.
- Remove bolts -3- for turbocharger.

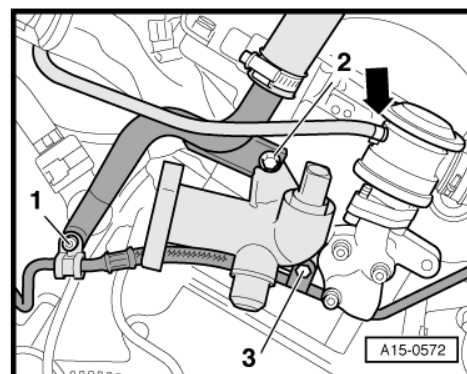


- Unplug electrical connector -arrow- at coolant temperature sender.



- Remove vacuum hose at combination valve for secondary air -arrow-.

- Remove bolts -2 and 3- and detach coolant flange.
- Remove bracket -1- for oil supply line.



Note

For illustration purposes, the installation position is shown from the rear and with the engine removed.

Vehicles up to 07.2000:

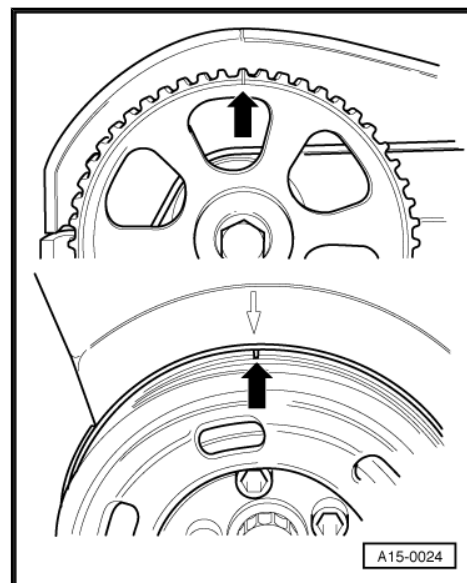
- Remove toothed belt cover (top section)



Caution

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

- Rotate crankshaft to "TDC" by turning bolt for toothed belt sprocket.
- Marking on camshaft sprocket and marking on crankshaft must be aligned to "TDC" -arrows-.



- Screw tensioning bolt - T10092- into toothed belt tensioner.
- Compress piston of tensioner just far enough so that the piston can be locked with locking pin - T40011- .



Note

Take care not to compress tensioner too far.

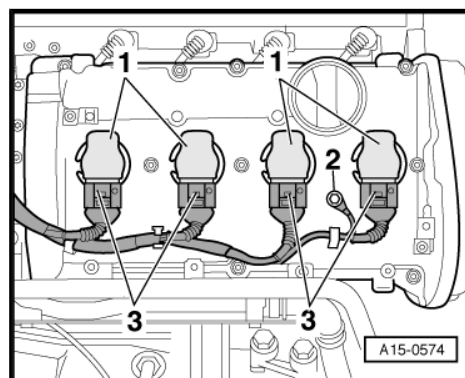
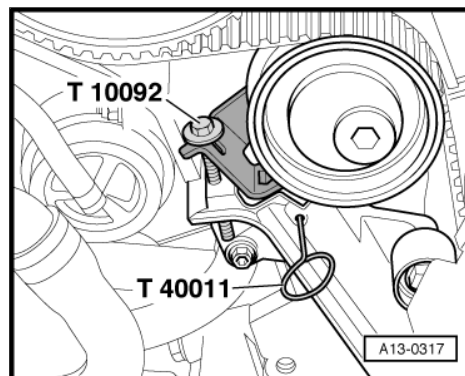
- Remove toothed belt from camshaft sprocket.

Vehicles from 08.2000:

- Take toothed belt off camshaft sprocket ⇒ [page 48](#) .

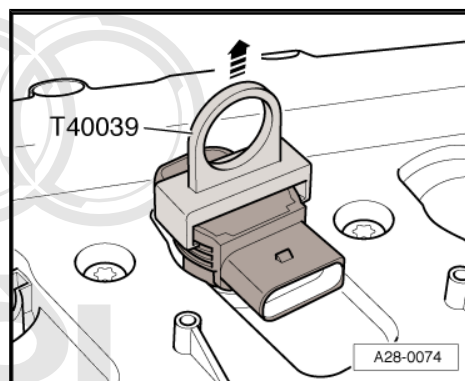
All vehicles:

- Unclip/release all electrical wires on the cylinder head and move clear.
- Detach coolant hose for heat exchanger at rear of cylinder head (release retaining clip on connecting flange).
- Unscrew earth wire -2-.
- Unplug electrical connectors -3- and move electrical wiring clear.
- Pull out ignition coils -1-.

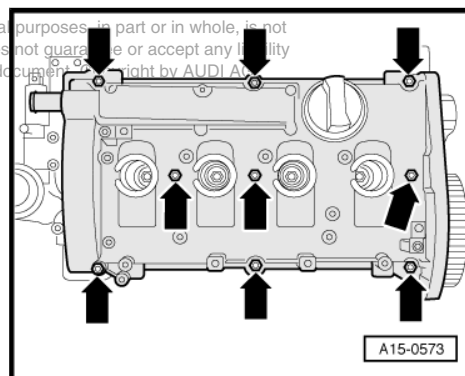


Note

Use puller - T40039- to remove ignition coils.



- Remove nuts -arrows- and detach cylinder head cover.
- Detach both oil deflectors.



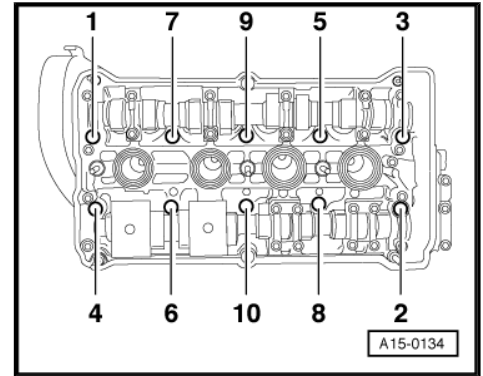
- Remove cylinder head bolts in the sequence: -1 ... 10-.
- Lift out cylinder head with the help of a 2nd mechanic.

Installing

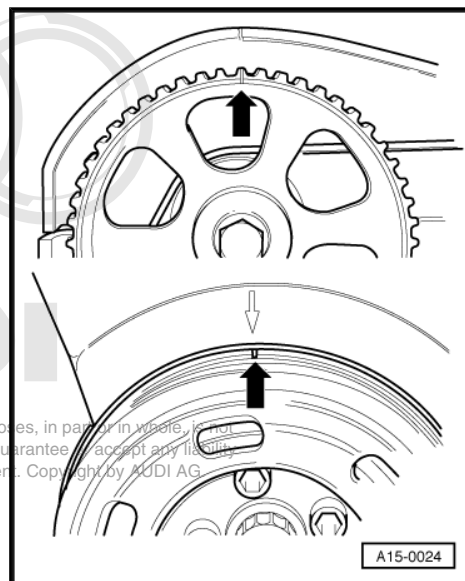


Note

- ◆ *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.*
- ◆ *Carefully remove any sealant residue from the cylinder head and cylinder block. Ensure that no long scores or scratches are made on the surfaces.*
- ◆ *Carefully remove any remaining emery and abrasive material.*
- ◆ *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 which have cracks between the valve seats or between a valve seat insert and the spark plug thread can be re-installed without reducing service life, provided the cracks are only slight and do not exceed a maximum of 0.3 mm in width, and no more than the first 4 turns of the spark plug threads are cracked.*
- ◆ *When installing an exchange cylinder head with fitted camshafts, the contact surfaces between the bucket tappets and cams 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.*
- ◆ *Fit all cable ties in the original positions when installing.*
- ◆ *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.*
- ◆ *After fitting a new cylinder head or cylinder head gasket, change the engine oil and coolant.*

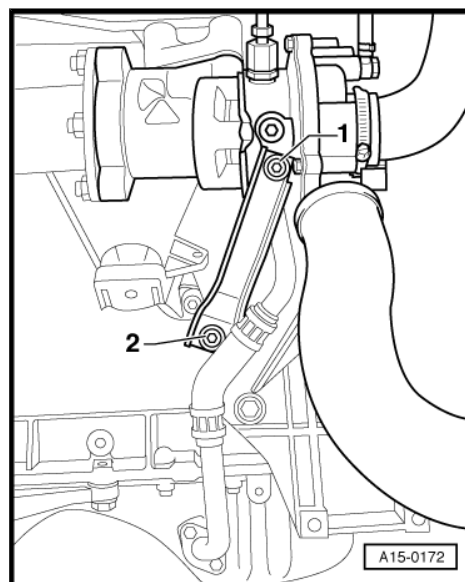


- Before installing cylinder head, set camshaft to “TDC” -top arrow-.
- Make sure that crankshaft is in “TDC” position -bottom arrow-; turn crankshaft via toothed belt sprocket bolt if necessary.

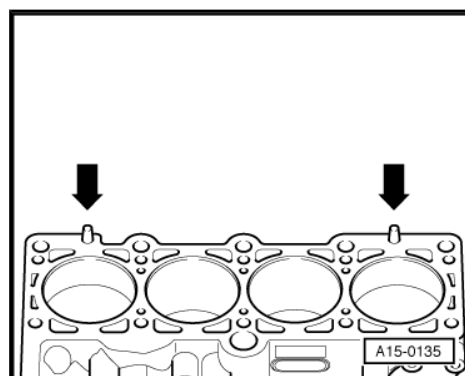


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- Slacken bolts -1 and 2- on turbocharger bracket (about 2 full turns each) so that components remain free of stress when installing cylinder head.



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



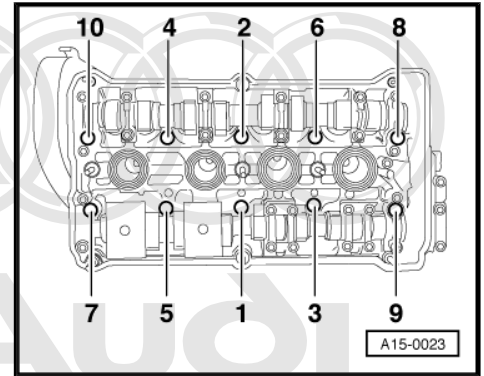
- Tighten cylinder head bolts in 3 stages in the following sequence:

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



Note

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

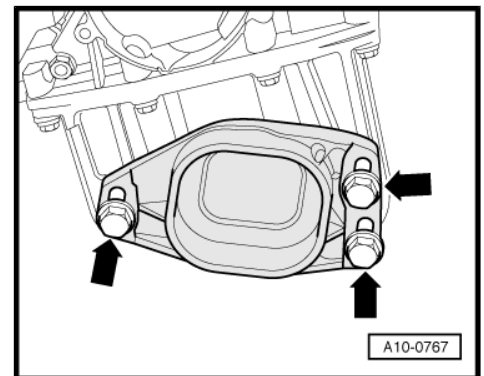


Remaining installation steps are carried out in reverse sequence, note the following:

- Secure turbocharger with new gasket to exhaust manifold and secure bracket to cylinder block ⇒ [page 187](#) .
- Install cylinder head cover ⇒ [page 76](#) .
- Install toothed belt (adjusting valve timing): vehicles up to 07.2000 ⇒ [page 38](#) ; vehicles from 08.2000 onwards ⇒ [page 50](#) .
- Install poly V-belt ⇒ [page 29](#) .
- Install intake manifold ⇒ [page 88](#) .
- Install front exhaust pipe ⇒ [page 209](#) .
- Install catalytic converter ⇒ [page 210](#) .
- Align exhaust system so it is free of stress: vehicles with front-wheel drive ⇒ [page 201](#) , vehicles with four-wheel drive ⇒ [page 207](#) .
- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight and tighten nuts -arrows-.
- Observe notes on procedure for connecting the battery ⇒ Rep. gr. 27 .
- Change engine oil ⇒ Maintenance ; Booklet 802 .
- Fill cooling system with fresh coolant ⇒ [page 145](#) .

Tightening torque

Component	Nm
Stop for torque reaction support to sump	28
Hose clips for coolant hoses	2
Hose clips for air hoses	3.5



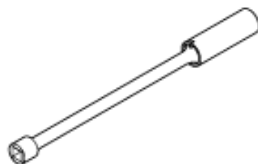
1.4 Checking compression pressure



Special tools and workshop equipment required

- ◆ Spark plug socket and extension - 3122 B-
- ◆ Compression tester - V.A.G 1763-
- ◆ Puller - T40039-

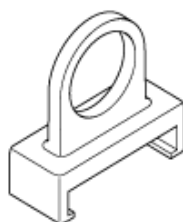
3122 B



V.A.G 1763



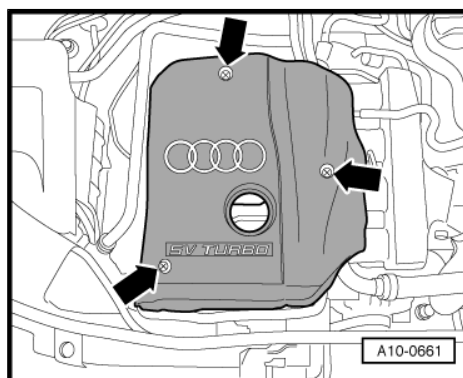
T40039



G15-0070

Procedure

- Engine oil temperature at least 30 °C
- Battery voltage at least 12.5 V
- Release quick-release fasteners and remove engine cover panel -arrows-.



A10-0661

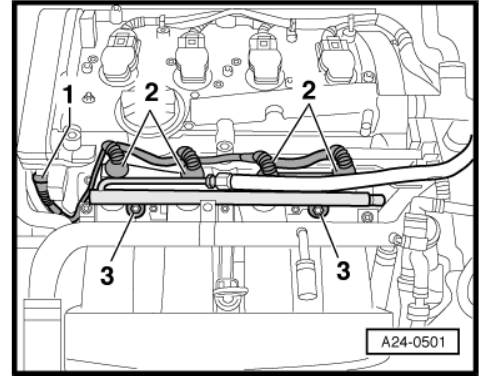
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- Unplug electrical connectors -2- at injectors.

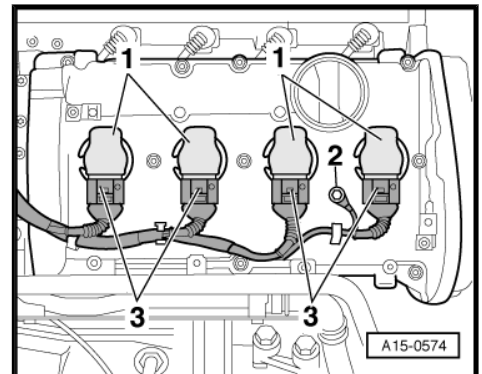


Note

Disregard -items 1 and 3-.



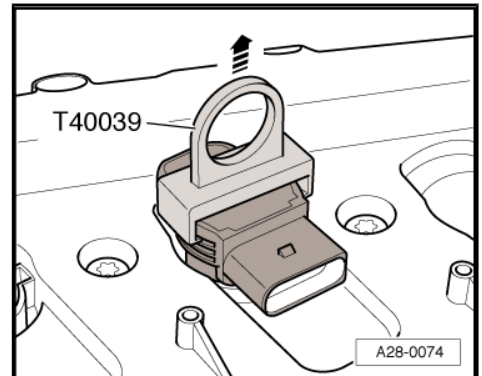
- Unscrew earth wire -2-.
- Unplug electrical connectors -3- and move electrical wiring clear.
- Pull out ignition coils -1-.



Note

Use puller - T40039- to remove ignition coils.

- Remove spark plugs with spark plug socket and extension - 3122 B- .
- Check compression pressure with compression tester - V.A.G 1763- .



Note

Using the compression tester => operating instructions .

- Have a 2nd mechanic press down the accelerator pedal completely and at the same time operate the starter until the pressure on the tester display no longer increases.
- Repeat procedure on each cylinder.

Compression pressure	bar
When new	9.0 ... 14.0
Wear limit	7.5
Difference between cylinders	3.0 (maximum)

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

- Install spark plugs => Maintenance ; Booklet 802 .
- Interrogate and erase fault memory for engine control unit, as faults are stored when electrical connectors are unplugged
=> Vehicle diagnostic tester.

2 Intake manifold

2.1 Intake manifold - exploded view

1 - Gasket

- ☐ Note installation position
- ☐ Renew

2 - 10 Nm

3 - 10 Nm

4 - O-ring

- ☐ For injector
- ☐ Renew

5 - Fuel rail

- ☐ With injectors

6 - Coolant pipe (top)

7 - 10 Nm

8 - 10 Nm

9 - O-ring

- ☐ For coolant pipe (top)
- ☐ Renew

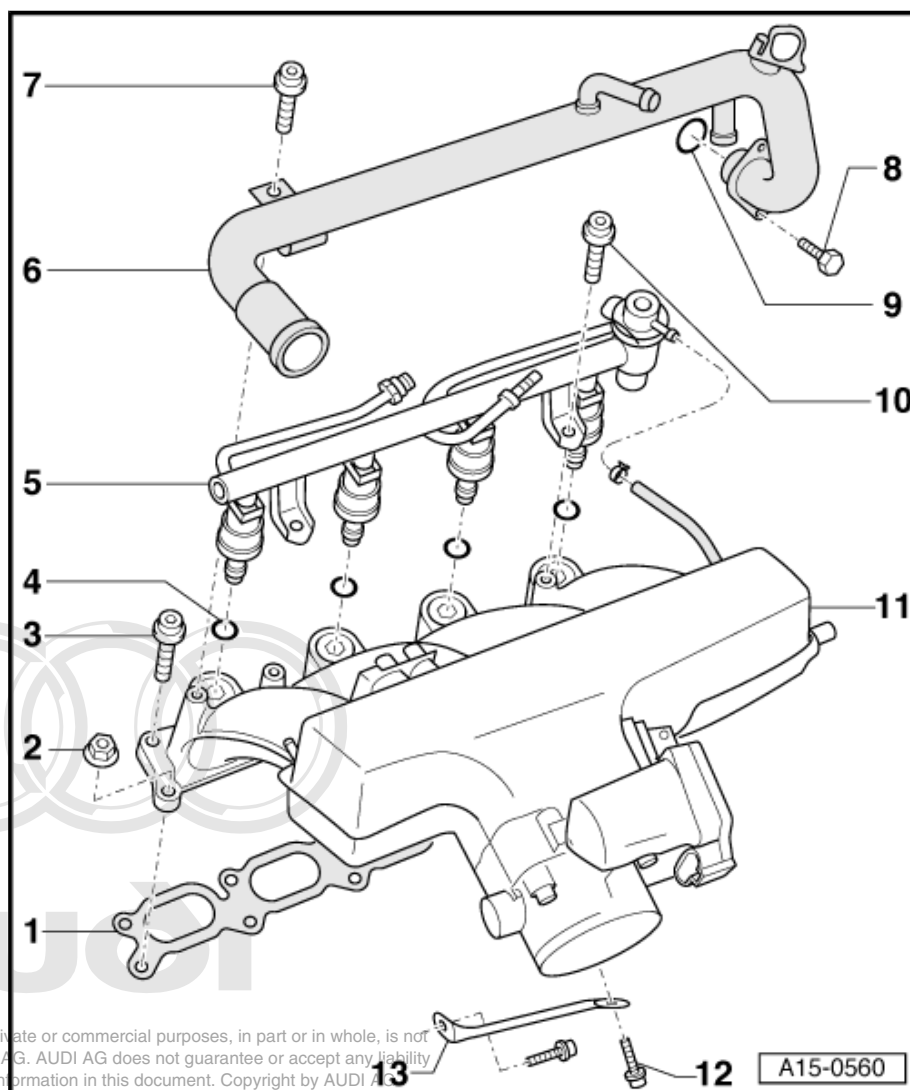
10 - 10 Nm

11 - Intake manifold

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

12 - 20 Nm

13 - Support for intake manifold

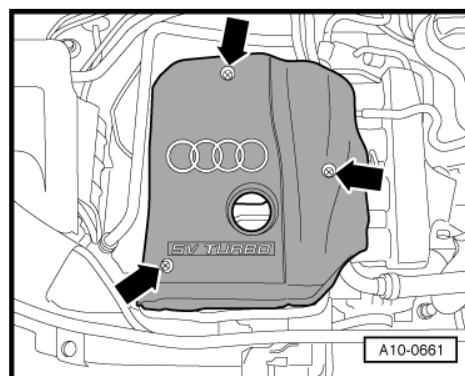


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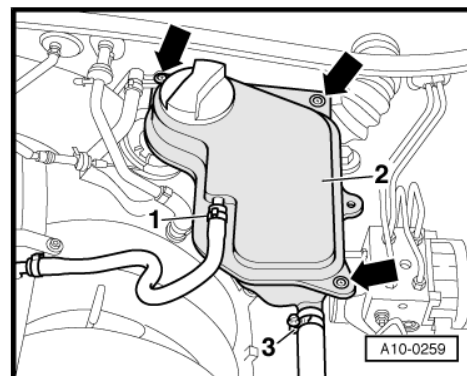
2.2 Removing and installing intake manifold

Removing

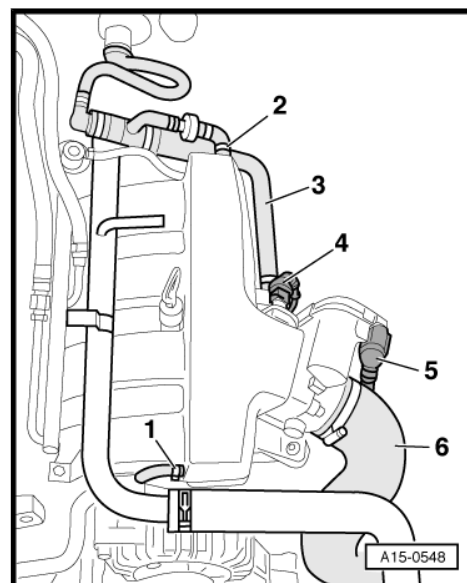
- Release quick-release fasteners and remove engine cover panel -arrows-.
- Drain coolant ⇒ [page 143](#).



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



- Detach vacuum hoses -1 ... 3-.
- Unplug electrical connectors:
 - 4 - On intake air temperature sender - G42-
 - 5 - On throttle valve module - J338-
- Disconnect air hose -6- from throttle valve module.

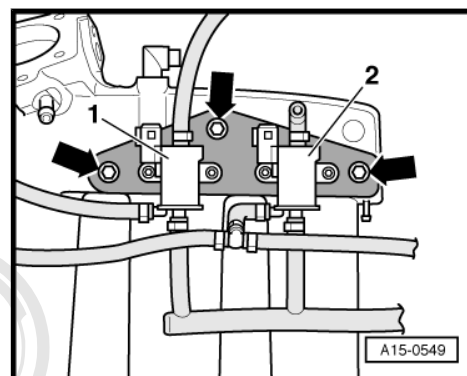


- Unbolt retaining plate for solenoid valves -arrows- located below intake manifold.

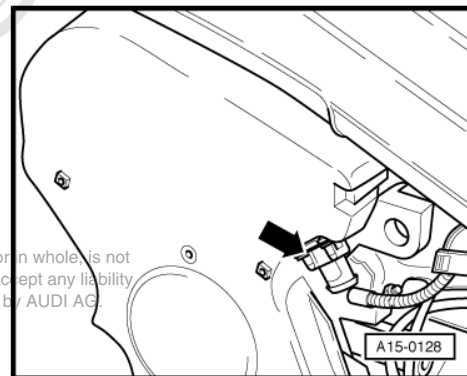


Note

The electrical connectors -1 and 2- and vacuum hoses remain attached.



- Unplug electrical connector -arrow- at Hall sender - G40-.

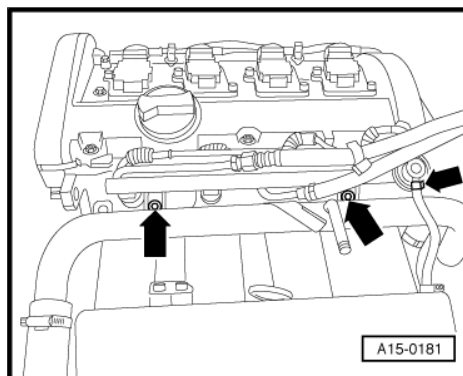


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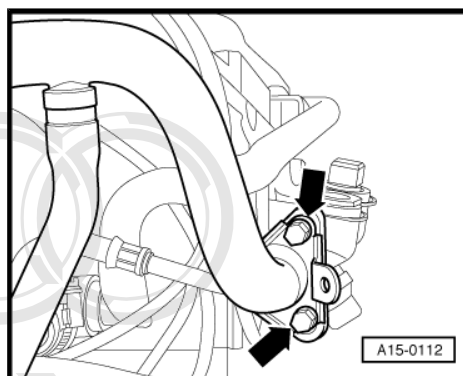
- Remove bolts for fuel rail and disconnect vacuum line from fuel pressure regulator -arrows-.
- Pull fuel rail together with injectors off intake manifold and set it aside on a clean cloth in rear of engine compartment.

**Note**

Make sure the removed injectors do not become soiled.



- Detach coolant hoses from top coolant pipe.
- Move electrical wiring on top coolant pipe clear.
- Unbolt top coolant pipe from intake manifold and from coolant flange on rear of cylinder head -arrows-.



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- Remove support for intake manifold -arrows-.
- Detach hose -1- leading to solenoid valve 1 for activated charcoal filter - N80- from intake manifold.
- Pull out oil dipstick.
- Remove bracket for dipstick guide tube.
- Unbolt intake manifold from cylinder head and remove.

i Note

Block off intake ports in cylinder head with clean rags.

Installing

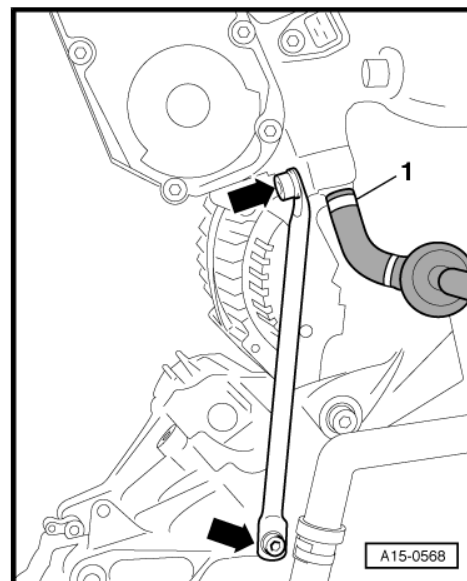
Installation is carried out in the reverse order; note the following:

i Note

- ◆ *Renew gaskets, seals and O-rings.*
- ◆ *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.*
- Observe notes on procedure for connecting the battery ⇒ Rep. gr. 27 .
- Fill up with coolant ⇒ [page 145](#) .

Tightening torques

Component	Nm
Intake manifold to cylinder head	10
Support for in- Bracket for ancillaries	20
take manifold to: Intake manifold	20
Coolant pipe Intake manifold	10
(top) to: Coolant flange	10
Fuel rail to intake manifold	10
Hose clips for coolant hoses	2
Hose clips for air hoses	3.5



3 Valve gear



Note

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

3.1 Valve gear - exploded view

1 - 65 Nm

- ☐ Use counterhold tool - 3036- to loosen and tighten

2 - Camshaft sprocket for exhaust camshaft

- ☐ Note installation position: The camshaft sprocket is installed with the smaller web facing out and the "TDC" marking is visible from the front ⇒ [page 98](#)

3 - Oil seal for exhaust camshaft

- ☐ Renewing ⇒ [page 95](#)

4 - Cylinder head

- ☐ See note ⇒ [page 92](#)
- ☐ Checking valve guides ⇒ [page 114](#)
- ☐ Machining valve seats ⇒ [page 115](#)
- ☐ Dowel sleeves for bearing caps must be positioned in cylinder head
- ☐ Apply sealant at sealing points ⇒ [page 75](#) and ⇒ [page 76](#)

5 - Valve guide

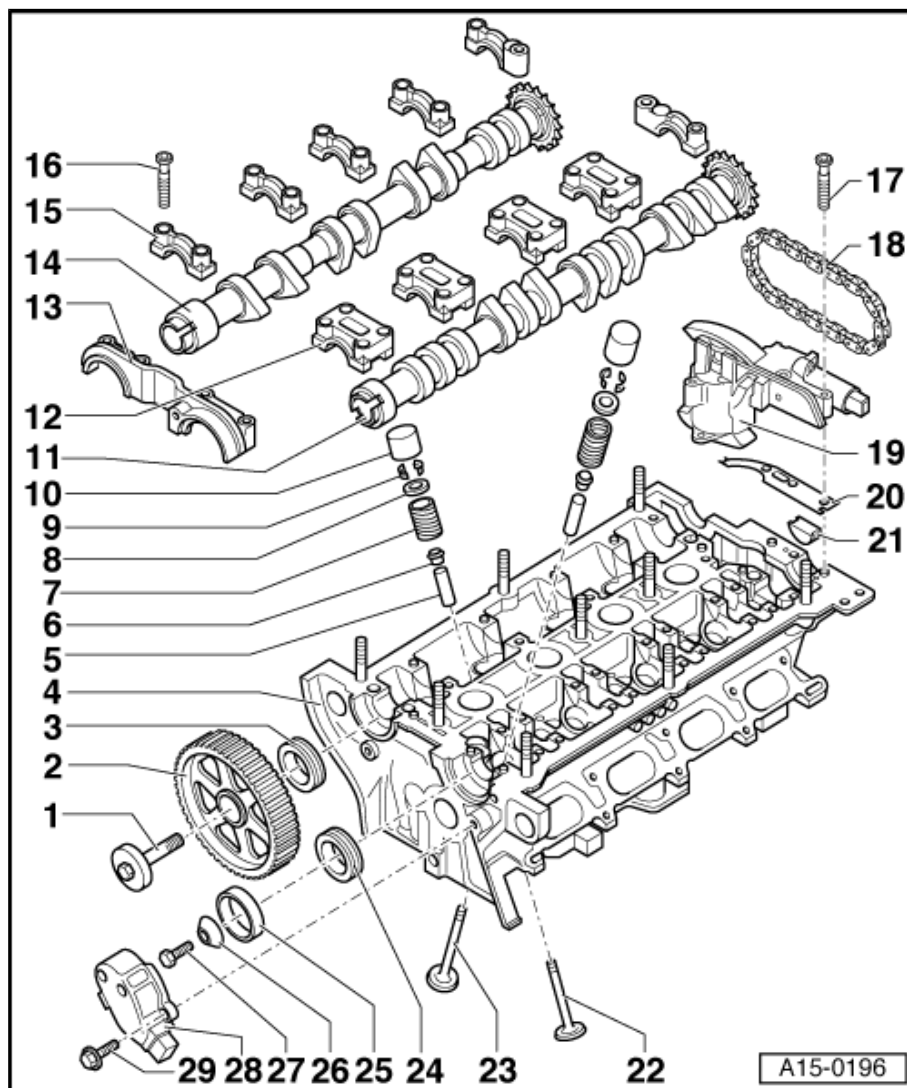
- ☐ Checking ⇒ [page 114](#)

6 - Valve stem oil seal

- ☐ Renewing ⇒ [page 109](#)

7 - Valve spring

- ☐ Removing and installing ⇒ ["3.7 Renewing valve stem oil seals", page 109](#)



8 - Valve spring plate

9 - Valve cotters

10 - Hydraulic bucket tappet

- ☐ Checking ⇒ [page 108](#)
- ☐ Removing and installing ⇒ [page 109](#)
- ☐ Do not interchange
- ☐ Place down with contact surface facing downwards
- ☐ Before installing, check camshaft axial clearance ⇒ [page 94](#)
- ☐ Lubricate contact surface

11 - Inlet camshaft

- ☐ Check radial clearance with Plastigage (bucket tappets removed)
- ☐ Radial clearance: wear limit: 0.1 mm
- ☐ Runout: max. 0.035 mm
- ☐ Checking axial clearance ⇒ [page 94](#)
- ☐ Removing and installing camshafts ⇒ [page 101](#)

12 - Bearing cap for inlet camshaft

- ☐ Must be positioned on dowel sleeves
- ☐ Dowel sleeves must be positioned in cylinder head
- ☐ Note installation position

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13 - Double bearing cap

- ☐ Must be positioned on dowel sleeves
- ☐ Dowel sleeves must be positioned in cylinder head
- ☐ Before installing, apply small quantity of sealant to sealing surface
- ☐ Applying sealant to sealing points between double bearing cap and cylinder head ⇒ [page 75](#)

14 - Exhaust camshaft

- ☐ Check radial clearance with Plastigage (bucket tappets removed)
- ☐ Radial clearance: wear limit: 0.1 mm
- ☐ Runout: max. 0.035 mm
- ☐ Checking axial clearance ⇒ [page 94](#)
- ☐ Removing and installing camshafts ⇒ [page 101](#)

15 - Bearing cap for exhaust camshaft

- ☐ Must be positioned on dowel sleeves
- ☐ Dowel sleeves must be positioned in cylinder head
- ☐ Note installation position
- ☐ Installation sequence ⇒ [page 106](#)

16 - 10 Nm

17 - 10 Nm

18 - Drive chain

- ☐ Check for wear
- ☐ Removing and installing ⇒ ["3.5 Removing and installing camshafts and camshaft adjuster", page 101](#)
- ☐ Mark installation position prior to removal if old drive chain is to be reused ⇒ [page 104](#)

19 - Camshaft adjuster

- ☐ With inlet camshaft control valve 1 - N205-
- ☐ Before removing, lock in position with chain tensioner retainer - 3366-
- ☐ Removing and installing ⇒ [page 101](#)
- ☐ Applying sealant to sealing points between camshaft adjuster and cylinder head ⇒ [page 76](#)

- ☐ Checking variable valve timing ⇒ [page 118](#)

20 - Rubber/metal gasket

- ☐ Apply sealant before installing ⇒ [page 105](#)

21 - Seal

- ☐ Renew

22 - Exhaust valve

- ☐ With sodium filling
- ☐ Note safety requirements when disposing of valves with sodium filling ⇒ [page 114](#)
- ☐ Must not be machined; only grinding-in is permissible
- ☐ Valve dimensions ⇒ [page 114](#)
- ☐ Checking valve guides ⇒ [page 114](#)
- ☐ Machining valve seats ⇒ [page 115](#)

23 - Inlet valve

- ☐ Must not be machined; only grinding-in is permissible
- ☐ Valve dimensions ⇒ [page 114](#)
- ☐ Checking valve guides ⇒ [page 114](#)
- ☐ Machining valve seats ⇒ [page 115](#)

24 - Oil seal for inlet camshaft

- ☐ Renewing ⇒ [page 99](#)

25 - Rotor for Hall sender

- ☐ Note installation position: insert lug into notch on camshaft

26 - Washer

- ☐ With taper
- ☐ Note installation position

27 - 25 Nm

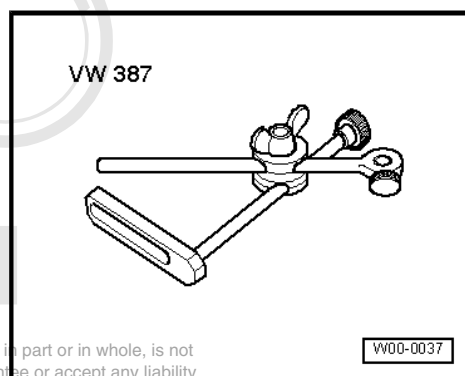
28 - Hall sender - G40- housing

29 - 10 Nm

3.2 Checking axial clearance of camshafts

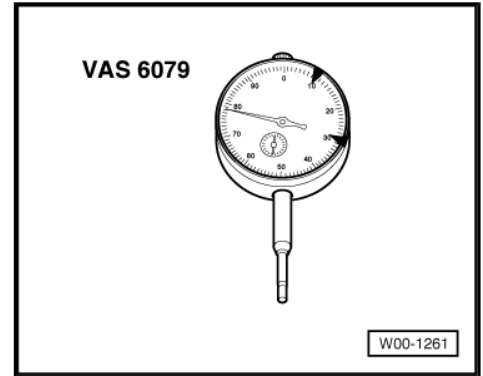
Special tools and workshop equipment required

- ◆ Universal dial gauge bracket - VW 387-



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◆ Dial gauge - VAS 6079-



Procedure

- Remove camshafts ⇒ [page 101](#) .

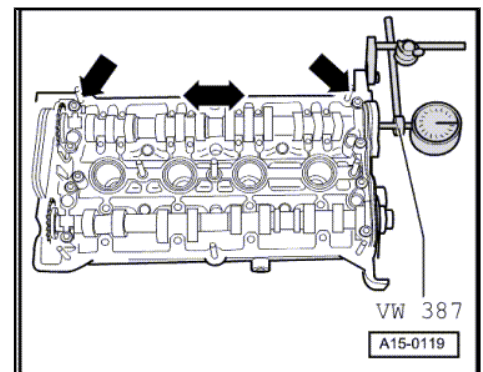


Note

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

- Remove the bucket tappets from the guides and put them down with the contact surface downwards.
- Insert camshafts in cylinder head and fit bearing cap at chain sprocket end and fit double bearing cap.

- Attach dial gauge bracket - VW 387- with dial gauge - VAS 6079- to cylinder head:
Inlet camshaft

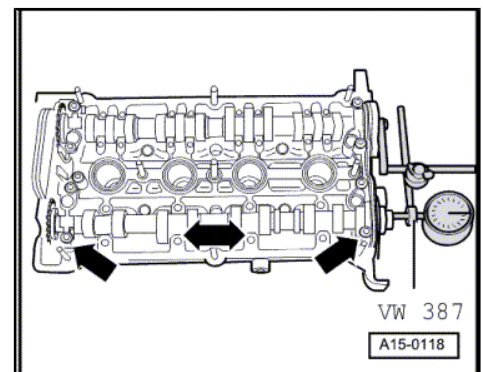


Exhaust camshaft

- Press the camshaft that is to be checked against the dial gauge by hand.
- Set dial gauge to "0".
- Press camshaft away from dial gauge and read off value:

Axial clearance

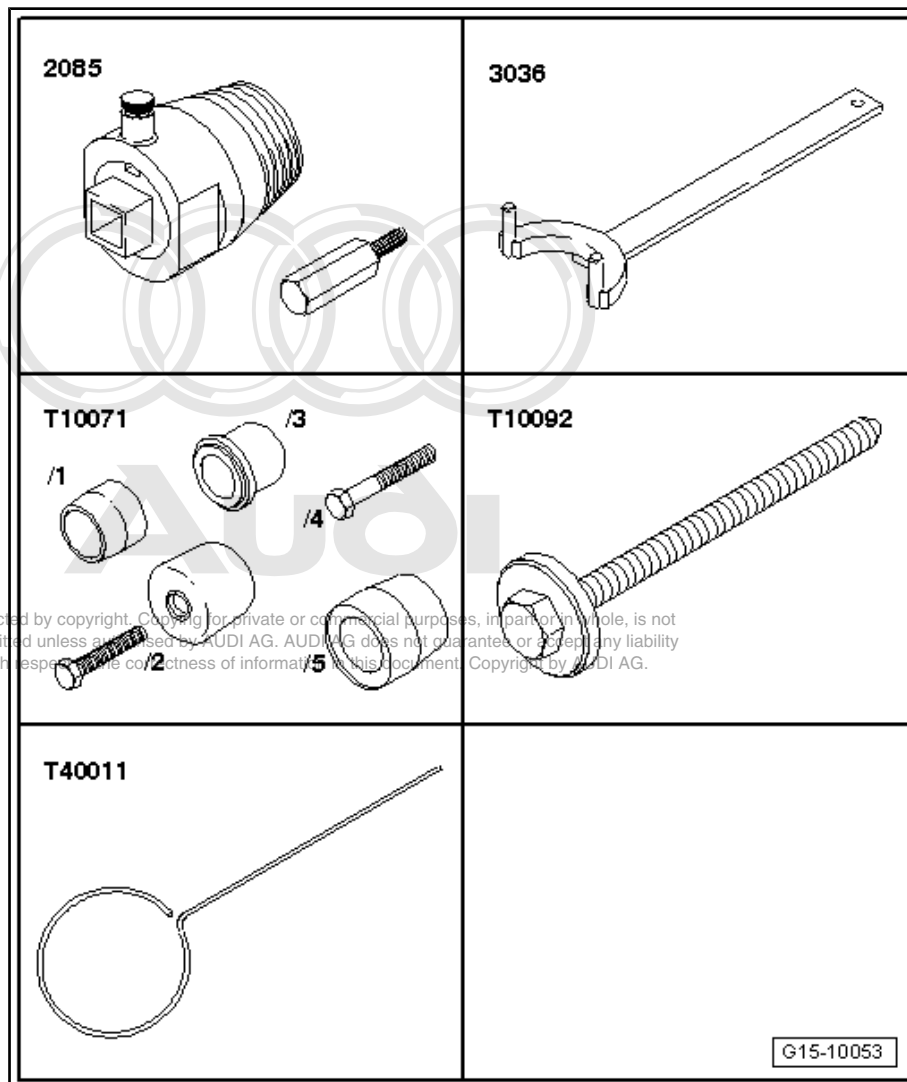
- Wear limit for inlet and exhaust camshaft: 0.20 mm.



3.3 Renewing exhaust camshaft oil seal

Special tools and workshop equipment required

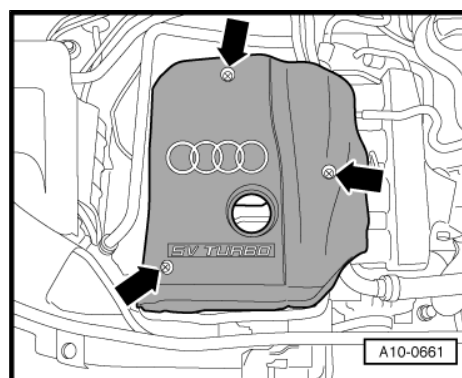
- ◆ Oil seal extractor - 2085-
- ◆ Counterhold tool - 3036-
- ◆ Assembly tool - T10071-
- ◆ Tensioning bolt - T10092- for vehicles up to 07.2000
- ◆ Locking pin - T40011- for vehicles up to 07.2000



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Procedure

- Release quick-release fasteners and remove engine cover panel -arrows-.
- Move lock carrier to service position ⇒ Rep. gr. 50 .



Vehicles up to 07.2000:

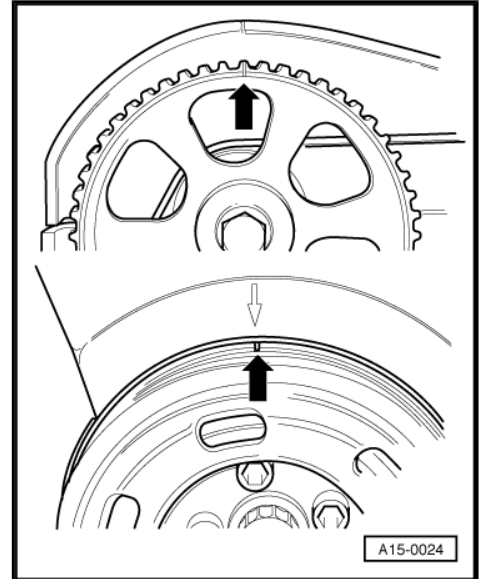
- Remove toothed belt cover (top section)



Caution

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

- Rotate crankshaft to "TDC" by turning bolt for toothed belt sprocket.
- Marking on camshaft sprocket and marking on crankshaft must be aligned to "TDC" -arrows-.



- Screw tensioning bolt - T10092- into toothed belt tensioner.
- Compress piston of tensioner just far enough so that the piston can be locked with locking pin - T40011- .



Note

Take care not to compress tensioner too far.

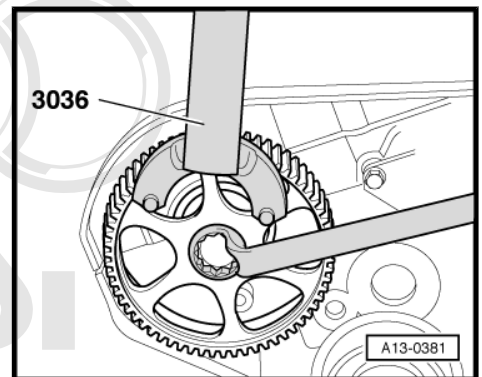
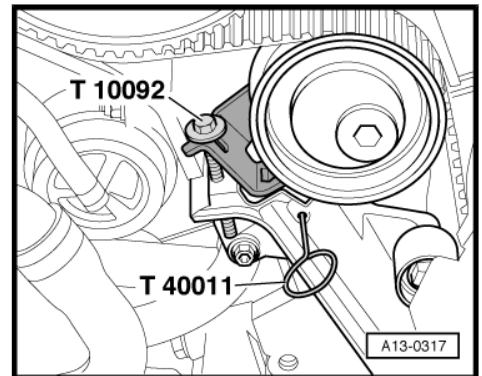
- Remove toothed belt from camshaft sprocket.

Vehicles from 08.2000:

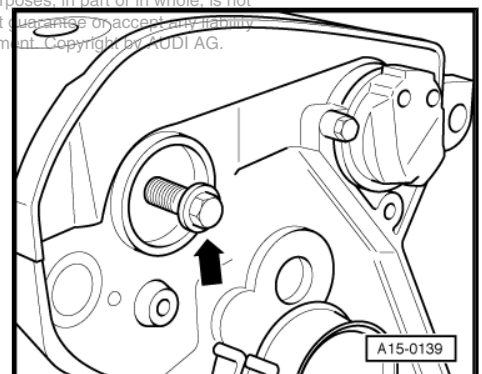
- Take toothed belt off camshaft sprocket ⇒ [page 48](#) .

All vehicles:

- Loosen camshaft sprocket bolt using counterhold tool - 3036- .
- Pull off camshaft sprocket.

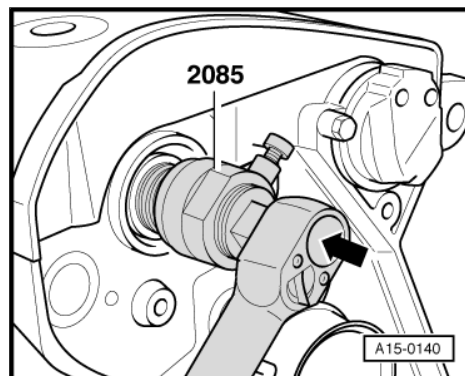


- To guide oil seal extractor, screw camshaft sprocket bolt -arrow- into camshaft as far as it will go by hand.
- Unscrew inner part of oil seal extractor -2085- 2 turns (approx. 3 mm) from outer part and lock in position with knurled screw.



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- Lubricate threaded head of oil seal extractor -2085- , place it in position and screw it into oil seal as far as possible (applying firm pressure).
- Loosen knurled screw and turn inner section against camshaft until oil seal is pulled out.
- Clamp flats of oil seal extractor in vice and use pliers to remove seal.



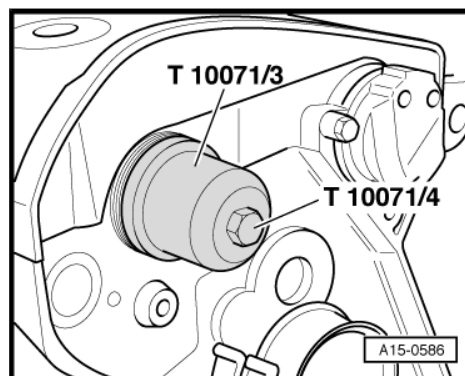
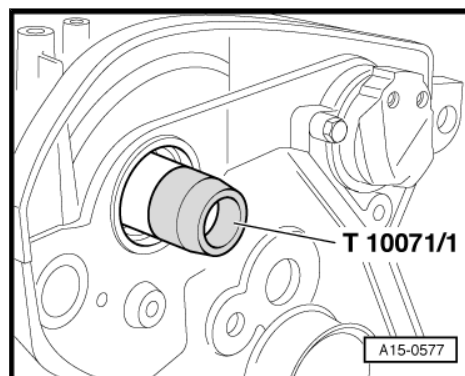
- Fit guide sleeve -T10071/1- onto camshaft journal.



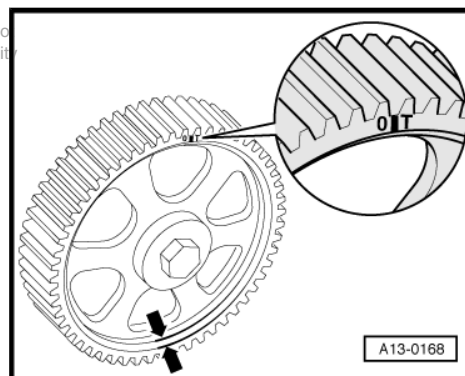
Note

Do not lubricate sealing lip of oil seal.

- Push oil seal over guide sleeve onto shaft journal.
- Take off guide sleeve.
- Press oil seal in onto stop using press sleeve -T10071/3- and bolt -T10071/4- .



- Install camshaft sprocket.
- Installation position: The thinner web of the camshaft sprocket faces outwards -arrows- and the marking for "TDC" is visible.





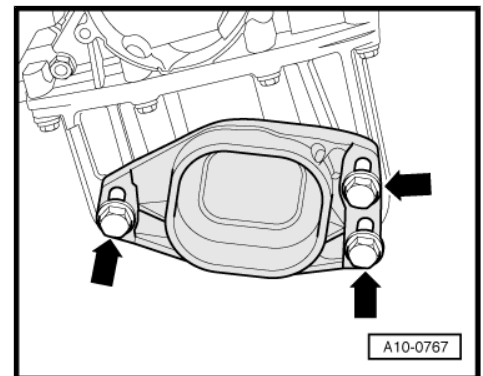
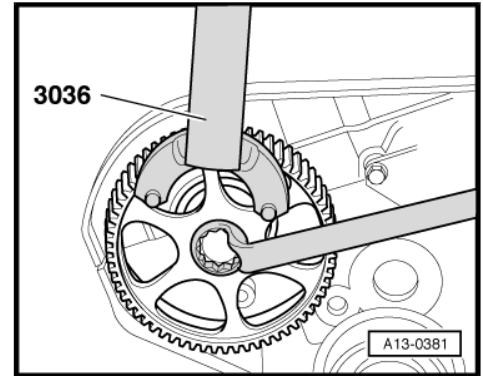
Caution

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

- Tighten camshaft sprocket bolt using counterhold tool - 3036-.
- Install toothed belt (adjusting valve timing): vehicles up to 07.2000 ⇒ [page 38](#); vehicles from 08.2000 onwards ⇒ [page 50](#).
- Install lock carrier with attachments ⇒ Rep. gr. 50.
- Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight and tighten nuts -arrows-.

Tightening torques

Component	Nm
Camshaft sprocket to camshaft	65
Stop for torque reaction support to sump	28

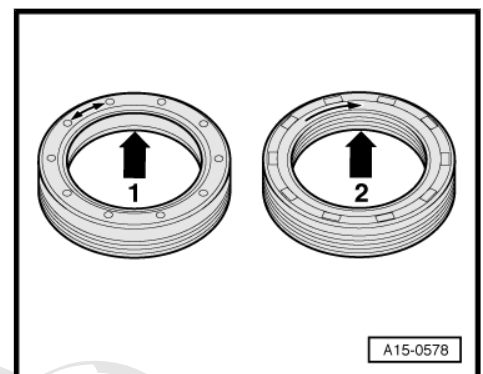


3.4 Renewing inlet camshaft oil seal



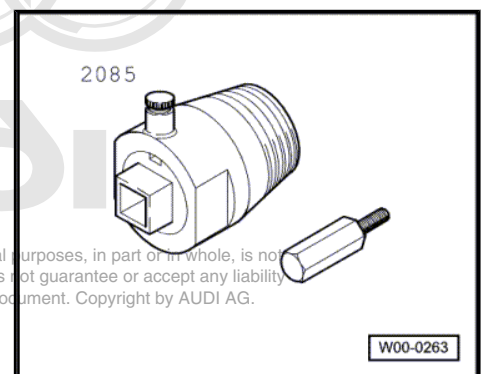
Note

- ◆ Depending on version, radial type oil seals with a spring-ring or PTFE oil seals are used.
- ◆ Distinguishing feature: the old-type radial oil seal has only one sealing lip -arrow 1- (the spring ring exerts pressure on the sealing lip). The PTFE oil seal has a thread-like sealing surface -arrow 2- and no spring ring.
- ◆ Do not stretch sealing surface of PTFE oil seal when installing.
- ◆ PTFE oil seals are matched to the direction of shaft rotation (see arrow on oil seal). Incorrect allocation to direction of rotation will result in oil leaks.



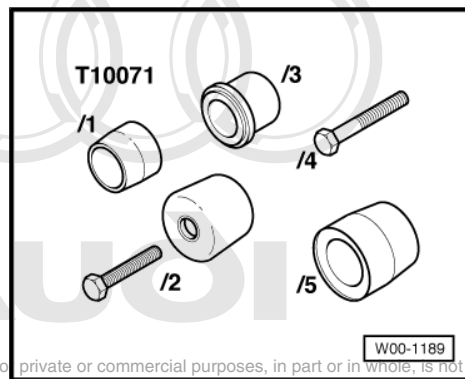
Special tools and workshop equipment required

- ◆ Oil seal extractor - 2085-



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◆ Assembly tool - T10071-

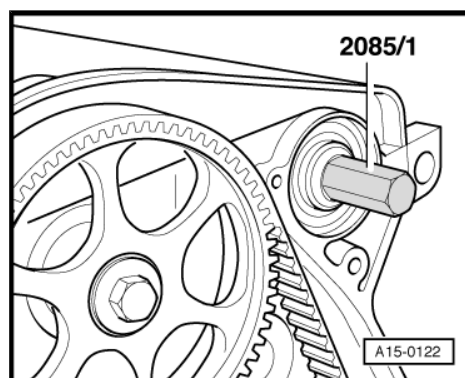
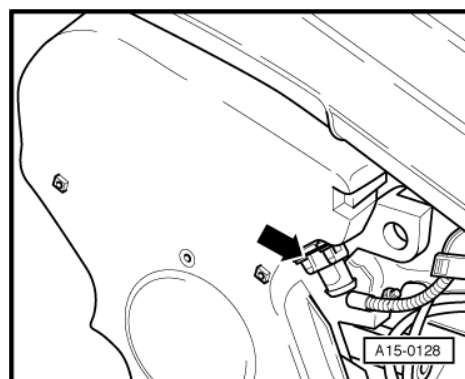
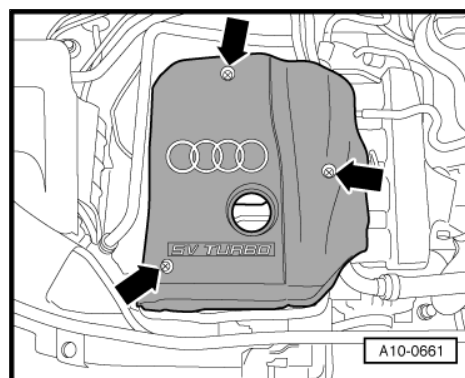


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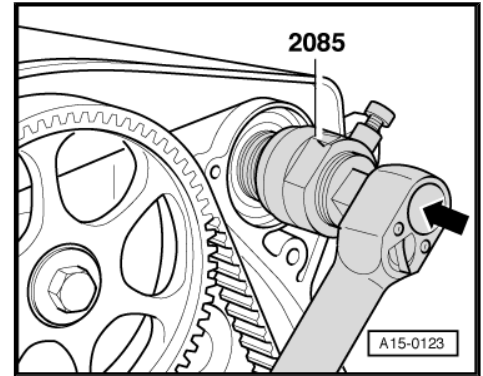
◆ Bolt M8x60

Procedure

- Cylinder head installed.
- Release quick-release fasteners and remove engine cover panel -arrows-.
- Move lock carrier to service position ⇒ Rep. gr. 50 .
- Unplug electrical connector -arrow- at Hall sender - G40- .
- Remove toothed belt cover (top section)
- Remove Hall sender ⇒ [Item 25 \(page 94\)](#) ,
⇒ [Item 26 \(page 94\)](#) and ⇒ [Item 28 \(page 94\)](#) .
- To guide oil seal extractor, screw bolt -2085/1- by hand into camshaft as far as it will go.
- Unscrew inner part of the oil seal extractor -2085- two turns (approx. 3 mm) out of the outer part and lock with knurled screw.



- Lubricate threaded head of oil seal extractor -2085- , place it in position and screw it into oil seal as far as possible (applying firm pressure).
- Loosen knurled screw and turn inner section of oil seal extractor against camshaft until oil seal is pulled out.
- Clamp flats of oil seal extractor in vice and use pliers to remove seal.
- Clean contact surface and sealing surface.



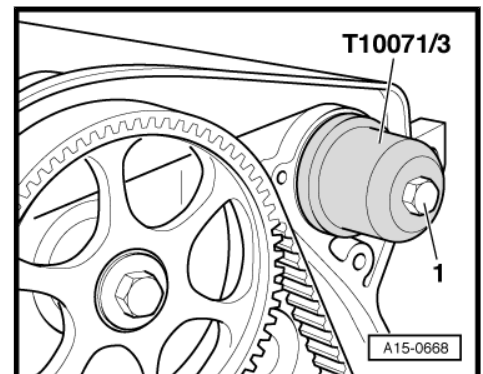
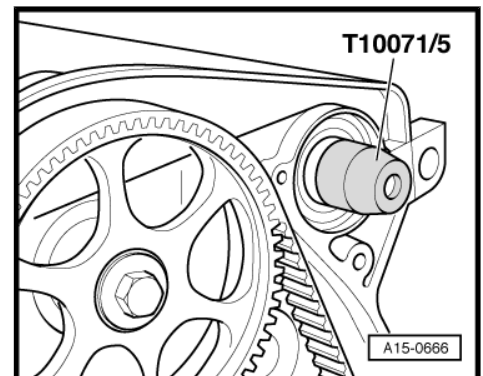
- Fit guide sleeve -T10071/5- onto camshaft journal.



Note

Do not lubricate sealing lip of oil seal.

- Push oil seal over guide sleeve onto shaft journal.
- Take off guide sleeve.
- Press oil seal in onto stop using press sleeve -T10071/3- and bolt M8x60.
- Install Hall sender ⇒ [Item 25 \(page 94\)](#) , ⇒ [Item 26 \(page 94\)](#) and ⇒ [Item 28 \(page 94\)](#) .
- Install toothed belt cover (top section).



Tightening torques

Component	Nm
Hall sender rotor to camshaft	25
Hall sender housing to cylinder head	10

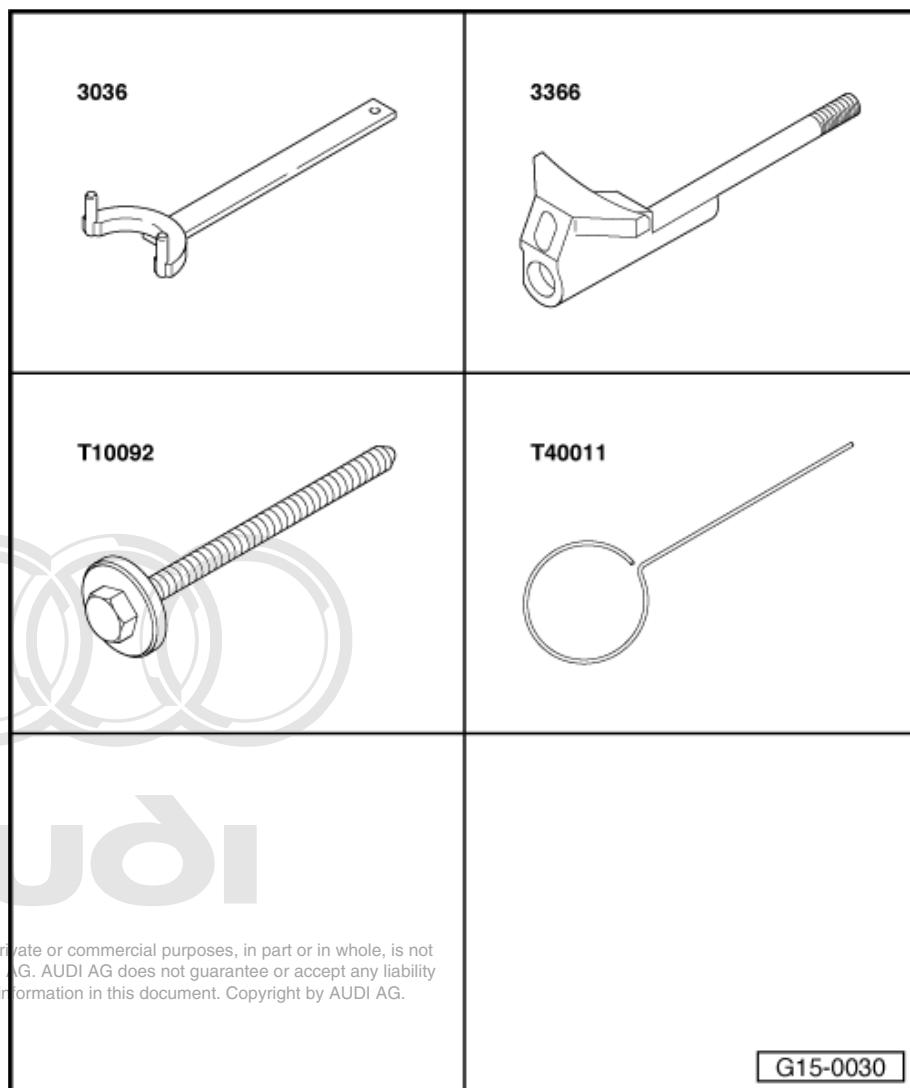
3.5 Removing and installing camshafts and camshaft adjuster



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Special tools and workshop equipment required

- ◆ Counterhold tool - 3036-
- ◆ Chain tensioner retainer - 3366-
- ◆ Tensioning bolt - T10092- for vehicles up to 07.2000
- ◆ Locking pin - T40011- for vehicles up to 07.2000
- ◆ Sealant ⇒ Parts catalogue



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Removing

- Move lock carrier to service position ⇒ Rep. gr. 50 .

Vehicles up to 07.2000:

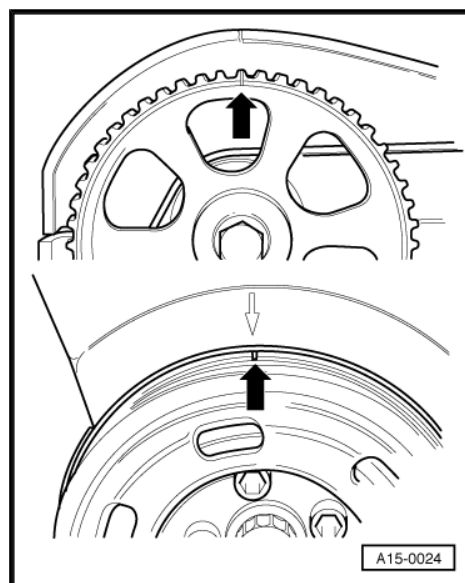
- Remove toothed belt cover (top section)



Caution

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

- Rotate crankshaft to “TDC” by turning bolt for toothed belt sprocket.
- Marking on camshaft sprocket and marking on crankshaft must be aligned to “TDC” -arrows-.



- Screw tensioning bolt - T10092- into toothed belt tensioner.
- Compress piston of tensioner just far enough so that the piston can be locked with locking pin - T40011- .



Note

Take care not to compress tensioner too far.

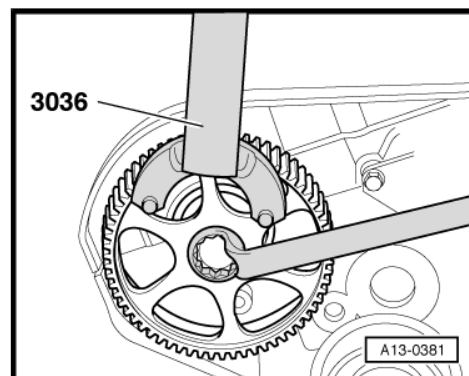
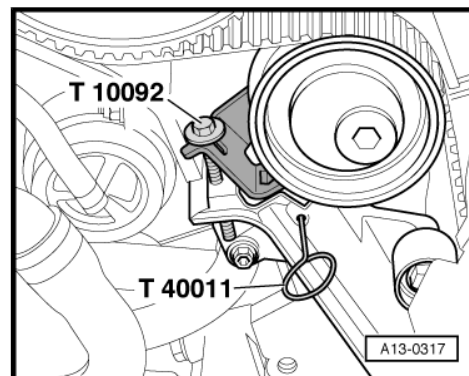
- Remove toothed belt from camshaft sprocket.

Vehicles from 08.2000:

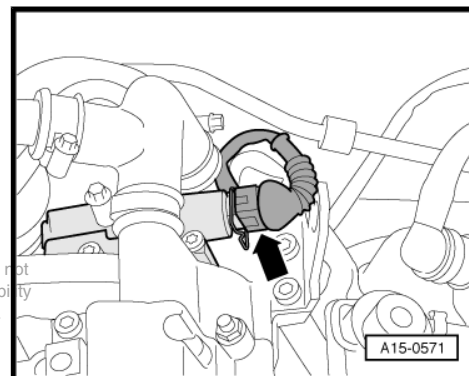
- Take toothed belt off camshaft sprocket ⇒ [page 48](#) .

All vehicles:

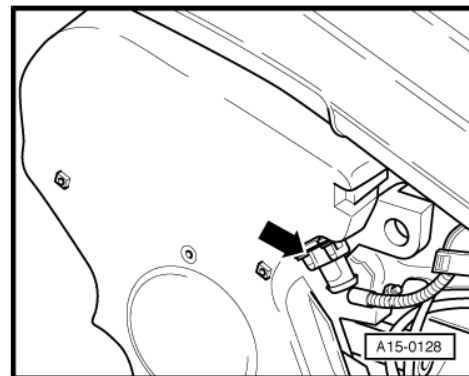
- Turn crankshaft approx. 45° anti-clockwise at bolt for toothed belt sprocket so that all pistons are clear of “TDC” position.
- Loosen camshaft sprocket bolt using counterhold tool - 3036- .
- Pull off camshaft sprocket.



- Unplug electrical connector -arrow- at camshaft control valve 1 - N205- .
- Remove cylinder head cover ⇒ [page 76](#) .
- Detach both oil deflectors.

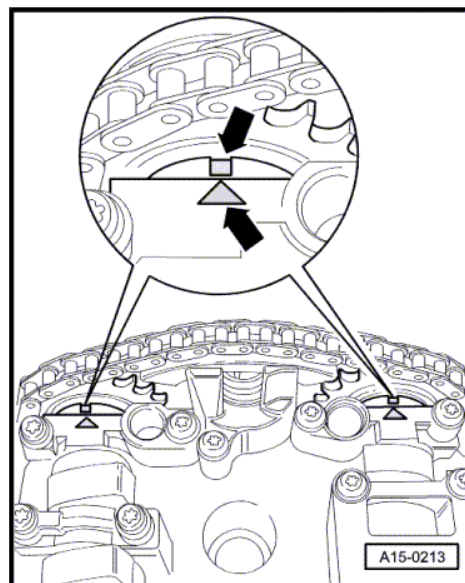


- Unplug electrical connector -arrow- at Hall sender - G40- .
- Remove Hall sender ⇒ [Item 25 \(page 94\)](#) ,
⇒ [Item 26 \(page 94\)](#) and ⇒ [Item 28 \(page 94\)](#) .



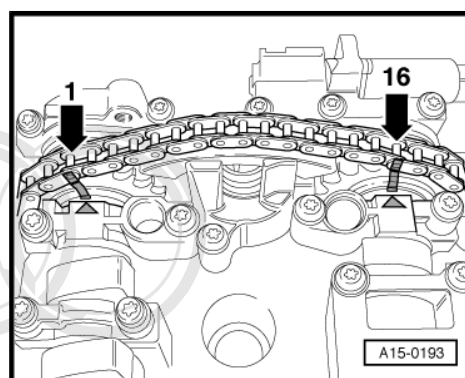
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- Check “TDC” position of camshafts again:
- The two markings on the camshafts must be in line with the two arrows on the bearing caps -arrows-.



If old drive chain is to be reused:

- Clean drive chain and sprockets of camshafts opposite the two arrows on the bearing caps and mark installation position with a coloured dot.
- The distance between the two arrows (and thus between the coloured markings) is 16 rollers on the chain.
- Notch on exhaust camshaft has a slight inward offset with respect to chain roller -1-.



Note

Do not mark chain with a centre punch or by making a notch or similar.

Continued for all drive chains:

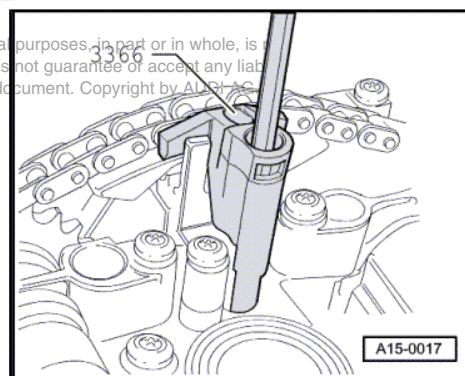
- Lock camshaft adjuster in position with chain tensioner retainer - 3366- .

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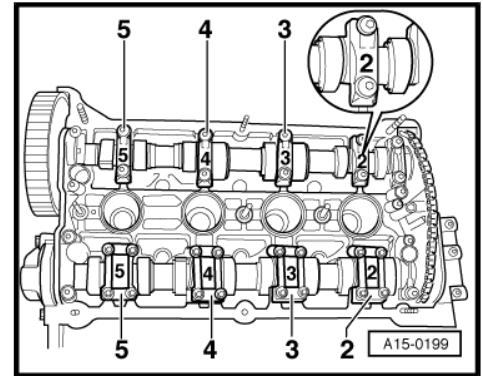


Note

Over-tightening retainer for chain tensioner can damage the camshaft adjuster.

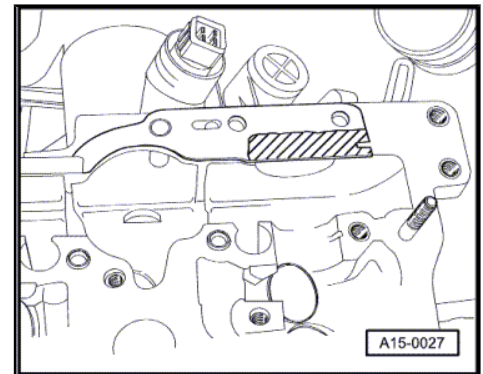


- First remove bearing caps -3 and 5- on inlet and exhaust camshafts.
- Remove double bearing cap.
- Remove both bearing caps next to chain sprockets on inlet and exhaust camshafts.
- Remove bolts securing camshaft adjuster.
- Slacken off bearing caps -2 and 4- on inlet and exhaust camshafts alternately in diagonal sequence, and remove.
- Remove inlet and exhaust camshafts with camshaft adjuster.



Installing

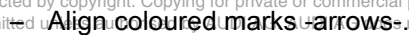
- Pistons must not be at TDC.
- Renew rubber/metal gasket for camshaft adjuster and apply a thin coat of sealant to the hatched area; sealant → Parts catalogue .

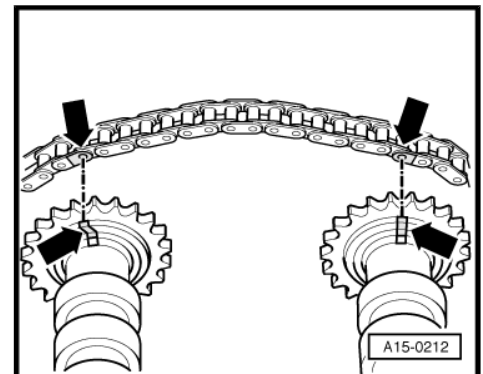


- Position drive chain as follows on camshaft chain sprockets:

If old drive chain is to be reused:

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- Align coloured marks  arrows



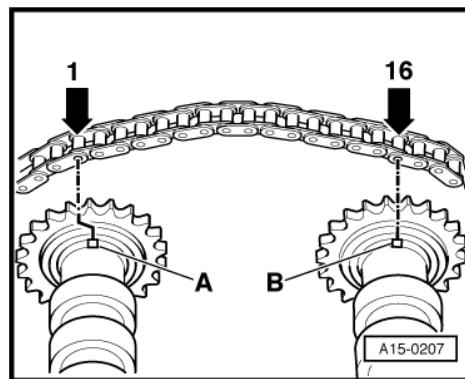
If new drive chain is being used:



Caution

- ◆ *The stated number of rollers merely provides assistance for fitting the drive chain onto the camshafts.*
- ◆ *Make sure that the arrows on the bearing caps and the notches on the camshafts align when installing camshafts (with drive chain) in cylinder head ⇒ [page 107](#).*

- The distance between notches -A and B- on the camshafts must be 16 drive chain rollers. The illustration shows the exact positions of the 1st and 16th rollers on the sprockets.
- Notch -A- is offset slightly inwards in relation to chain roller -1-.



Continued for all drive chains:

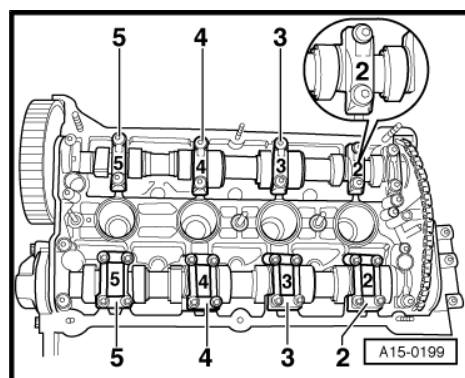
- Insert camshaft adjuster into the chain (2nd mechanic required).
- Place camshafts with drive chain and camshaft adjuster in cylinder head.
- Oil running surfaces of both camshafts.
- Dowel sleeves for bearing caps and camshaft adjuster must be positioned in cylinder head



Note

When installing bearing caps ensure that the identification mark is readable from the inlet side of cylinder head.

- Secure camshaft adjuster (pay attention to dowel sleeves).
- Tighten bearing caps -2 and 4- on inlet and exhaust camshafts alternately and in diagonal sequence (pay attention to dowel sleeves).
- Install both bearing caps next to chain sprockets on inlet and exhaust camshaft.
- Remove chain tensioner retainer - 3366- .

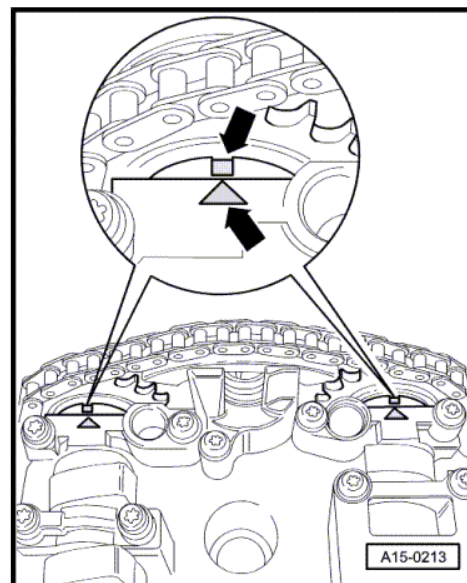


- Check that camshafts are positioned correctly:
- The two marks on the camshafts must be opposite the two arrows on the bearing caps -arrows-.

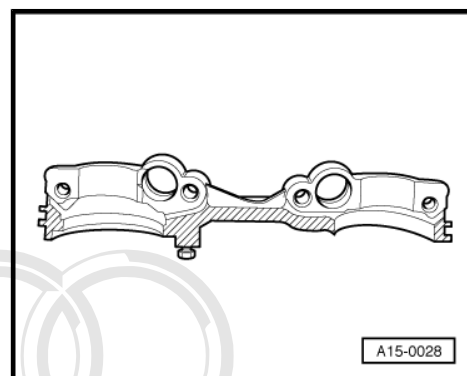


Note

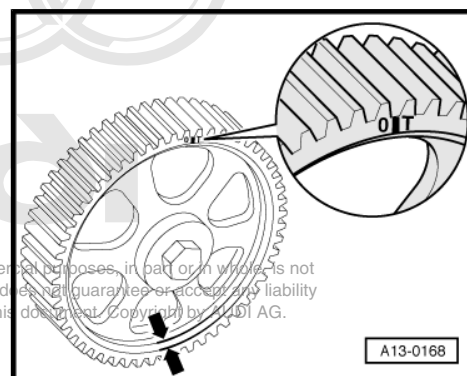
If necessary, turn camshaft slightly backwards or forwards so that the two marks coincide.



- Apply a small quantity of sealant to the hatched area on the double bearing cap and on the outer bearing cap adjacent to the camshaft adjuster; Sealant ⇒ Parts catalogue .
- Install remaining bearing caps (pay attention to dowel sleeves).
- Renewing camshaft oil seals:
⇒ [“3.3 Renewing exhaust camshaft oil seal”, page 95](#) or
⇒ [“3.4 Renewing inlet camshaft oil seal”, page 99](#) .
- Secure remaining bearing caps.

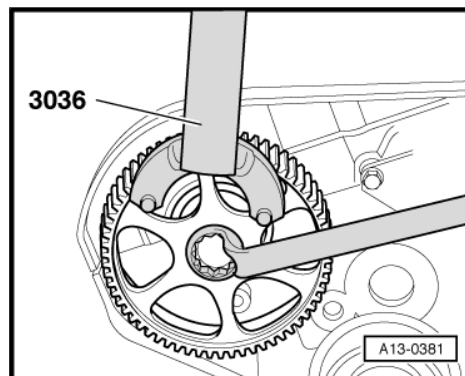


- Install camshaft sprocket.
- Installation position: The thinner web of the camshaft sprocket faces outwards -arrows- and the marking for “TDC” is visible.



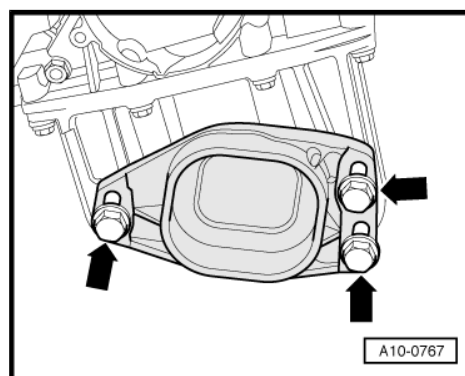
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- Tighten camshaft sprocket bolt using counterhold tool - 3036- .
- Install Hall sender ⇒ [Item 25 \(page 94\)](#) , ⇒ [Item 26 \(page 94\)](#) and ⇒ [Item 28 \(page 94\)](#) .
- Install cylinder head cover ⇒ [page 76](#) .
- Turn crankshaft approx. 45° clockwise to “TDC” position via toothed belt sprocket bolt.
- Install toothed belt (adjusting valve timing): vehicles up to 07.2000 ⇒ [page 38](#) ; vehicles from 08.2000 onwards ⇒ [page 50](#) .
- Install poly V-belt ⇒ [page 29](#) .



Note

- ◆ *After installing camshafts, wait for approx. 30 minutes before starting engine. Hydraulic valve compensation elements have to settle (otherwise valves will strike pistons).*
- ◆ *After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.*
- **Install lock carrier with attachments ⇒ Rep. gr. 50 .**
- **Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight and tighten nuts -arrows-.**



Tightening torques

Component	Nm
Bearing cap to cylinder head	10
Camshaft adjuster to cylinder head	10
Hall sender rotor to camshaft	25
Hall sender housing to cylinder head	10
Camshaft sprocket to camshaft	65
Stop for torque reaction support to sump	28

3.6 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 run until radiator fan has started up once.
- Increase engine speed to approx. 2500 rpm for 2 minutes (perform road test if necessary).

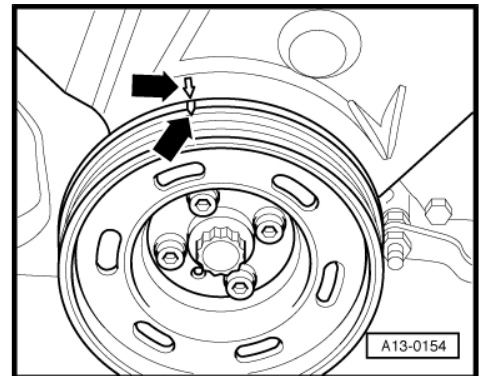


Note

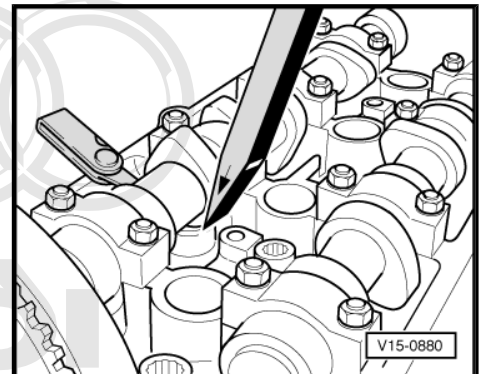
If the irregular valve noises stop but recur repeatedly during short trips, renew the oil retention valve. The oil retention valve is located in the oil filter bracket ⇒ [Item 24 \(page 136\)](#).

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

- Remove cylinder head cover ⇒ [page 76](#).
- Turn crankshaft until cams of bucket tappets to be tested are at top:
- ◆ On vehicles with manual gearbox: push vehicle in direction of travel with fourth gear engaged and ignition switched off until “TDC” marking on vibration damper aligns with marking on bottom section of toothed belt cover -arrows-.
- ◆ On vehicles with automatic gearbox: rotate crankshaft to “TDC” by turning toothed belt sprocket bolt in direction of engine rotation.



- Push bucket tappet down with a wooden or plastic wedge to determine play between cam and bucket tappet.
- If an 0.20 mm feeler gauge can be inserted between camshaft and tappet, renew tappet
⇒ [“3.5 Removing and installing camshafts and camshaft adjuster”, page 101](#).

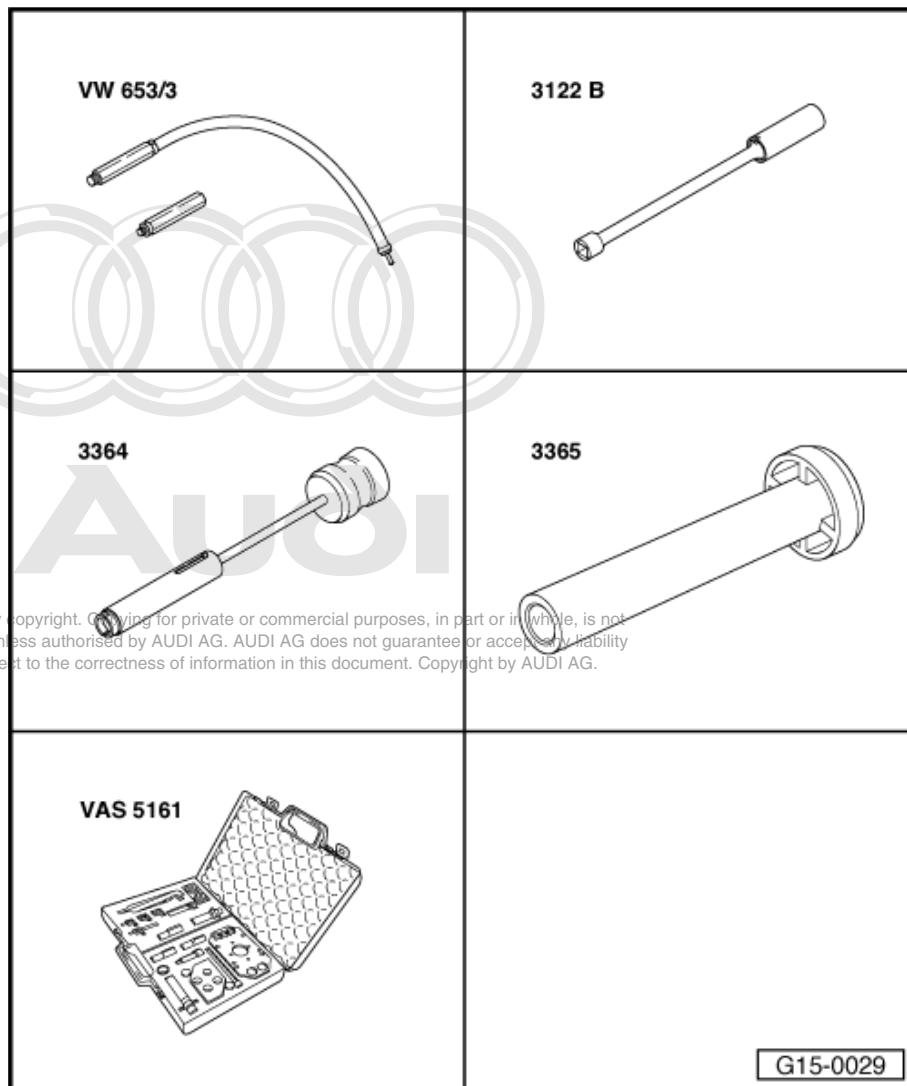


3.7 Renewing valve stem oil seals

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Special tools and workshop equipment required

- ◆ Pressure hose - VW 653/3-
- ◆ Spark plug socket and extension - 3122 B-
- ◆ Valve stem seal puller - 3364-
- ◆ Valve stem seal fitting tool - 3365-
- ◆ Removal and installation device for valve cotters - VAS 5161-



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Procedure

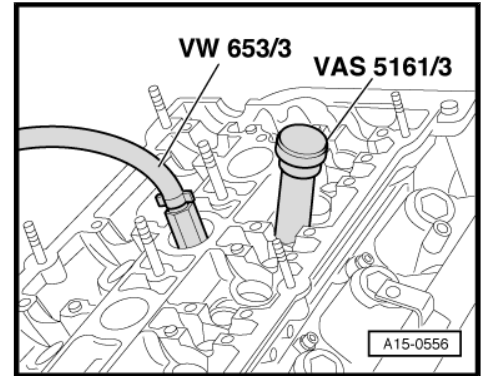
- Remove camshafts and camshaft adjuster ⇒ [page 101](#) .



Note

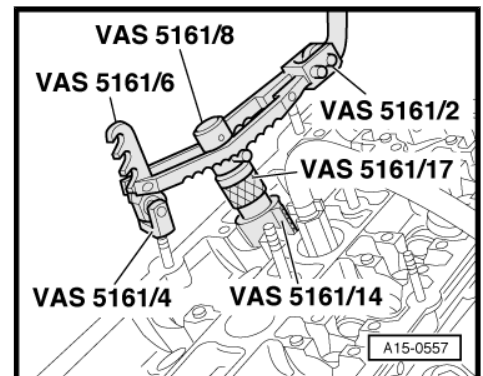
- ◆ *Take care not to interchange bucket tappets.*
- ◆ *Use waterproof felt-tip pen to mark assignment of bucket tappets on back of tappets.*
- Remove the bucket tappets from the guides and put them down with the contact surface downwards.
- Remove spark plugs with spark plug socket and extension - 3122 B- .
- Set piston of appropriate cylinder to “bottom dead centre”.

- Screw pressure hose - VW 653/3- into spark plug thread.
- Connect hose to compressed air and apply a steady pressure.
- Minimum pressure: 6 bar.
- Insert punch -VAS 5161/3- into bucket tappet guide.
- Use plastic-headed hammer to release sticking valve cotters on all five valves.



Exhaust side:

- Screw snap-in device -VAS 5161/6- with engaging fork - VAS 5161/4- onto stud on cylinder head.
- Push guide bush -VAS 5161/14- as far as it will go into bucket tappet guide on valve to be removed.
- Installation position: knurled surfaces face perpendicular to direction of travel.
- Slide knurled spacer ring -VAS 5161/17- onto assembly cartridge -VAS 5161/8- .
- Insert assembly cartridge in guide bush.
- Attach pressure fork -VAS 5161/2- to snap-in device - VAS 5161/6- and push assembly cartridge down.
- At the same time, turn knurled screw of assembly cartridge clockwise until 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.
- Take off assembly cartridge with knurled spacer ring.
- Remove guide bush, valve spring plate and valve spring.

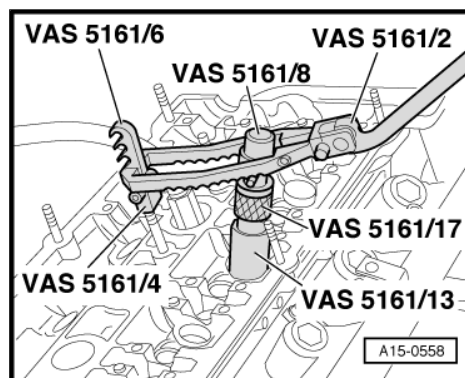


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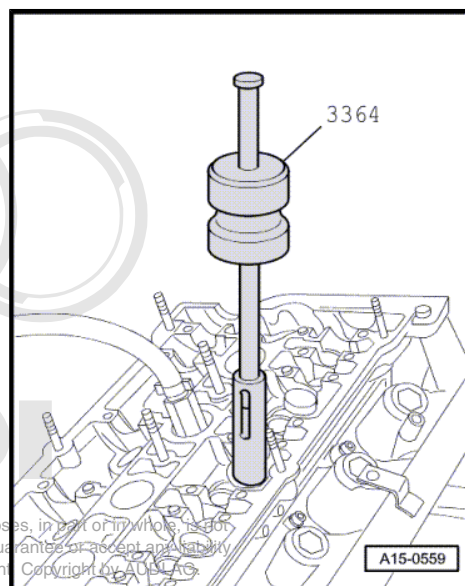
Inlet side

- Screw snap-in device -VAS 5161/6- with engaging fork - VAS 5161/4- onto stud on cylinder head.
- Push guide bush -VAS 5161/13- as far as it will go into bucket tappet guide on valve to be removed.
- ◆ Installation position: knurled surfaces face perpendicular to direction of travel.
- Slide knurled spacer ring -VAS 5161/17- onto assembly cartridge -VAS 5161/8- .
- Insert assembly cartridge in guide bush.
- Attach pressure fork -VAS 5161/2- to snap-in device - VAS 5161/6- and push assembly cartridge down.
- At the same time, turn knurled screw of assembly cartridge clockwise until 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.
- Take off assembly cartridge with knurled spacer ring.
- Remove guide bush, valve spring plate and valve spring.



Continuation for both sides:

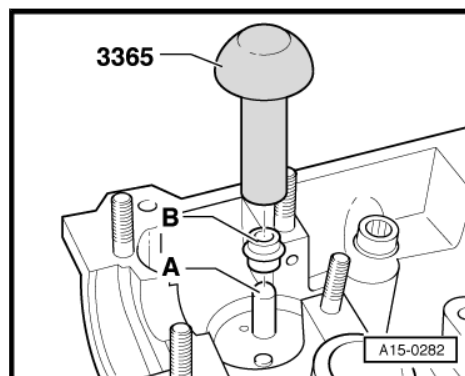
- Pull off valve stem oil seal with valve stem seal puller - 3364- .



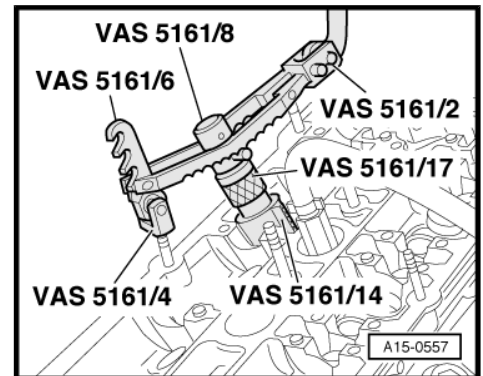
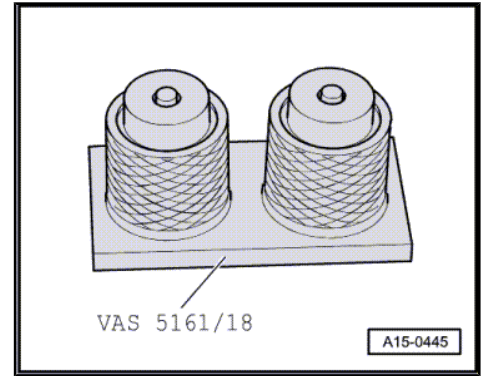
Note

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

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



- If valve cotters have been removed from assembly cartridge, they need to be put into insertion device for valve cotters - VAS 5161/18- first.
- Larger diameter of valve cotters faces upwards.
- Press assembly cartridge -VAS 5161/8- onto insertion device from above and take up valve cotters.
- Insert assembly cartridge in guide bush -VAS 5161/13- or - VAS 5161/14- .
- Press down pressure fork 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.
- Install bucket tappets.
- Install camshafts and camshaft adjuster ⇒ [page 101](#) .



Note

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

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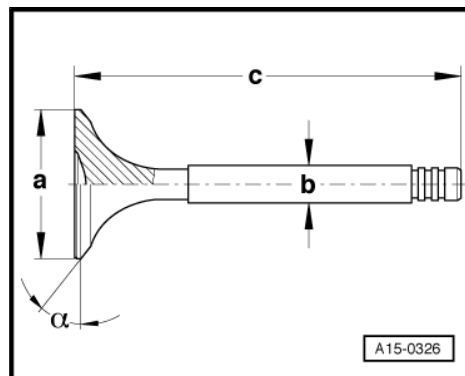
3.8 Valve dimensions



Note

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

Dimension		Inlet valve	Exhaust valve
Ø a	mm	26.80 ... 27.00	29.80 ... 30.00
Ø b	mm	5.95 ... 5.97	5.94 ... 5.95
c	mm	104.84 ... 105.34	103.64 ... 104.14
α	°	45	45



WARNING

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

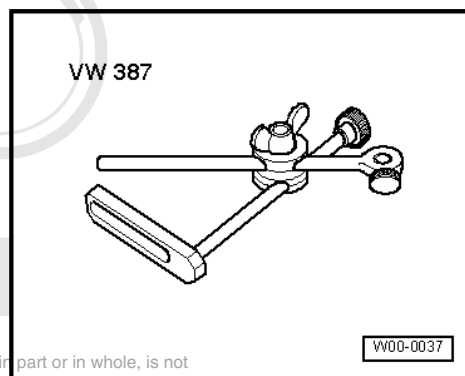
3.9 Checking valves

- Visually inspect for scoring on valve stems and valve seat surfaces.
- Renew valves with visible traces of scoring.

3.10 Checking valve guides

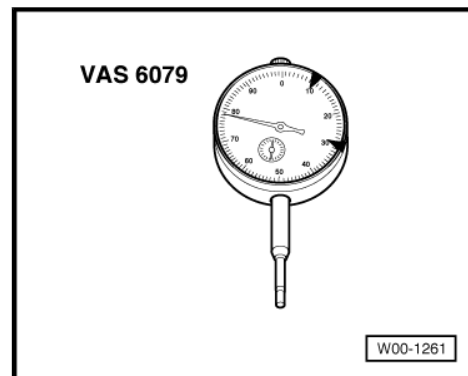
Special tools and workshop equipment required

- ◆ Universal dial gauge bracket - VW 387-



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◆ Dial gauge - VAS 6079-



Procedure

- Insert valve into guide.
- End of valve stem must be flush with valve guide.



Note

Only insert inlet valve into inlet guide and exhaust valve into exhaust guide, as the stem diameters are different.

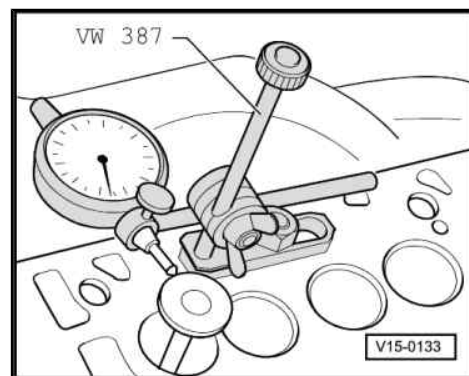
Amount of sideways play:

- Wear limit for inlet and exhaust valve guide: max. 0.8 mm.



Note

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



3.11 Machining valve seats



Note

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

Special tools and workshop equipment required

- ◆ Depth gauge
- ◆ Valve seat machining tool



Note

- ◆ When servicing engines with leaking valves, it is not sufficient to machine (reface) the valve seats and renew the valves. The valve guides must also be checked for wear. This is particularly important on high-mileage engines ⇒ [page 114](#).
- ◆ 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.

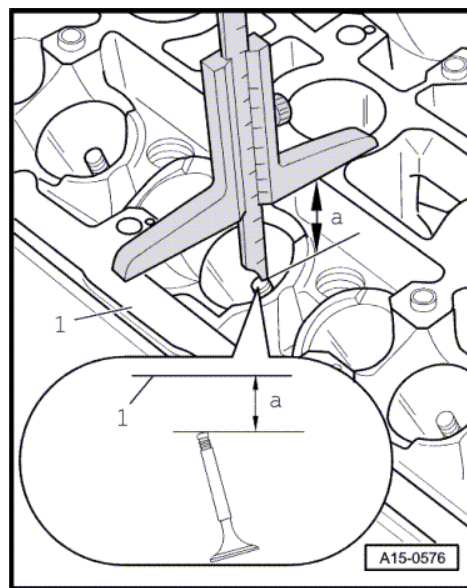
- Measure distance -a- between end of valve stem and upper cylinder head surface with a depth gauge.
- Calculate maximum permissible machining dimension from measured distance and minimum dimension.

Minimum dimensions		
Inlet valves (outer)	Inlet valve (centre)	Exhaust valves
31.0 mm	32.2 mm	31.9 mm

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

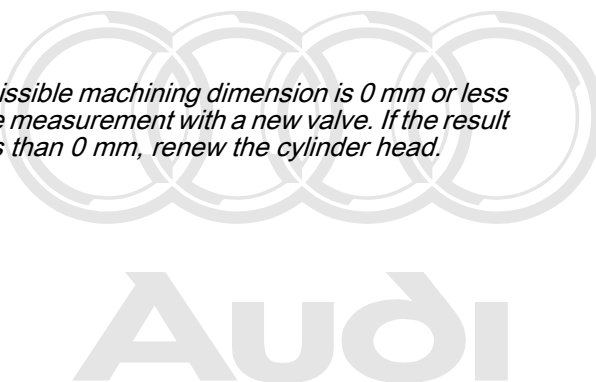
Example for inlet valve (outer):

Measured distance	31.4 mm
Minimum dimension	– 31.0 mm
Maximum permissible machining dimension	= 0.4 mm



Note

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



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Machining inlet valve seat

a - $\varnothing$ 26.2 mm

b - 1.5 ... 1.8 mm

Z - Bottom surface of cylinder head

α - 45° valve seat angle

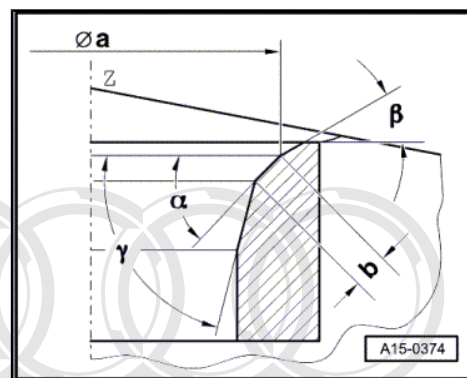
β - 30° upper correction angle

γ - 60° lower correction angle



Note

Calculating maximum permissible machining dimension
⇒ [page 116](#).



Machining exhaust valve seat

a - $\varnothing$ 29.0 mm

b - 1.8 mm

Z - Bottom surface of cylinder head

α - 45° valve seat angle

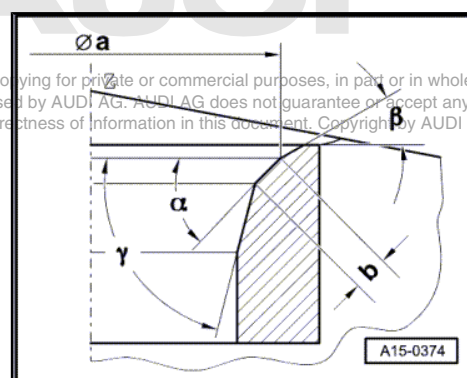
β - 30° upper correction angle

γ - 60° lower correction angle



Note

Calculating maximum permissible machining dimension
⇒ [page 116](#).



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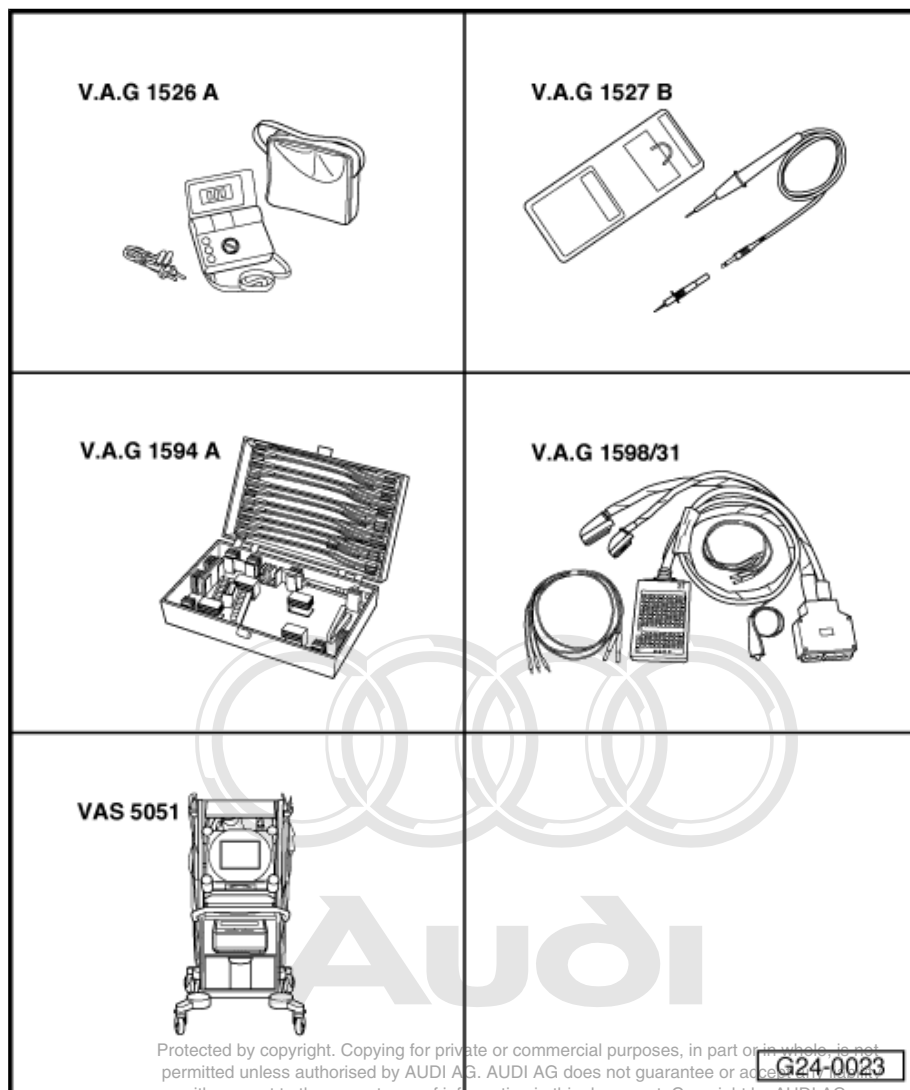
4 Checking variable valve timing

The timing of the inlet camshaft is controlled according to engine load and engine speed. Oil pressure is fed to the mechanical camshaft adjuster via the inlet camshaft control valve 1 - N205- .

4.1 Checking inlet camshaft control valve 1 - N205-

Special tools and workshop equipment required

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



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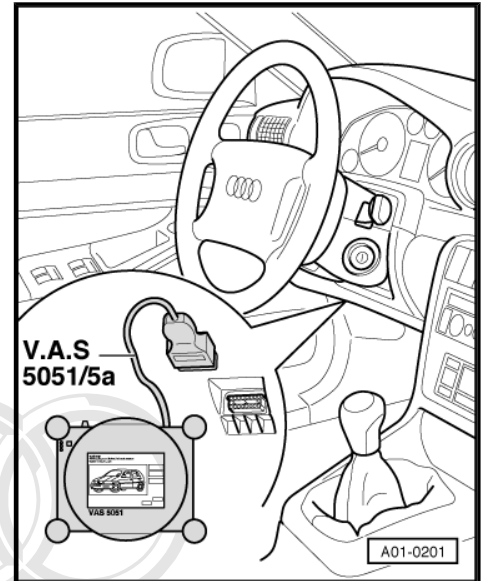
Procedure



Note

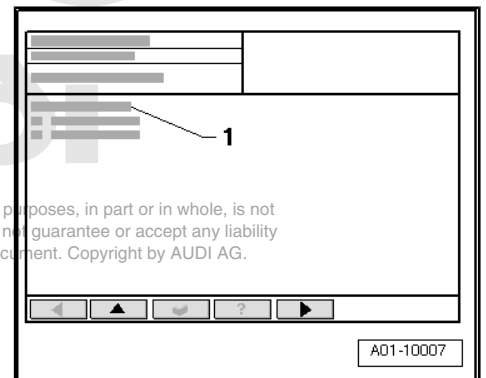
Camshaft control valve 1 - N205- and its wiring are monitored by the engine control unit.

- Vehicle diagnostic, testing and information system - VAS 5051B- connected.
- Switch on ignition and start engine.



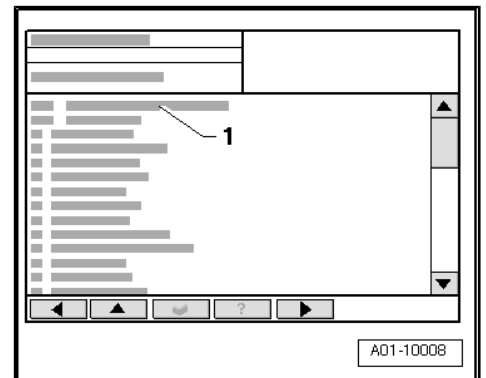
Display on -VAS 5051B- :

- From menu -1-, select “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 diagnostic function “004 - Fault memory content” and press  key to activate function.

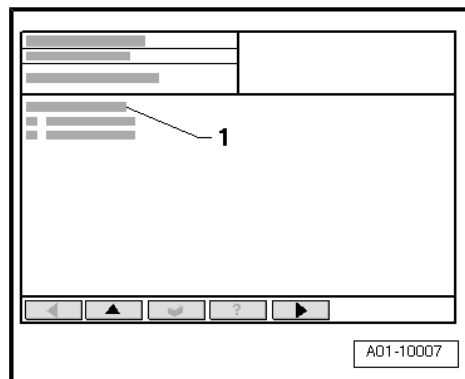


Display on -VAS 5051B- :

- From menu -1-, select diagnostic function “004.01 - Interrogate fault memory” and press key to activate function.

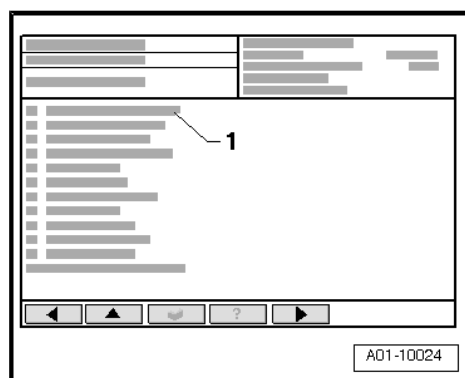
If the display shows a fault relating to inlet camshaft control valve 1 - N205- :

- Terminate diagnostic function “004.01 - Interrogate fault memory” by pressing key.



Display on -VAS 5051B- :

- From menu -1-, select diagnostic function “005 - Final control diagnosis” and press key to activate function.



- Press the key repeatedly until the following display appears:

Display on -VAS 5051B- (example):

A - 5th control element being tested

5 - Variable valve timing (camshaft adjustment)

- The valve will be activated intermittently for approx. 1 minute (and should click audibly).
- Terminate diagnostic function “005 - Final control diagnosis” by pressing key.
- Select diagnostic function “022 - End output” and switch off ignition.

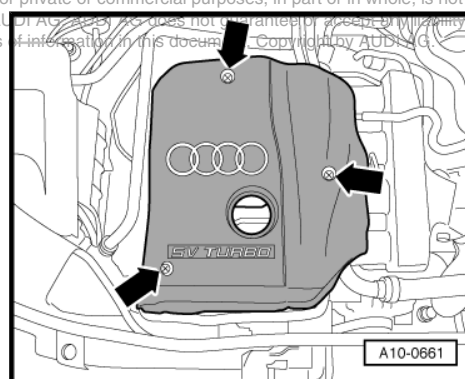


If the valve is not activated (does not click):

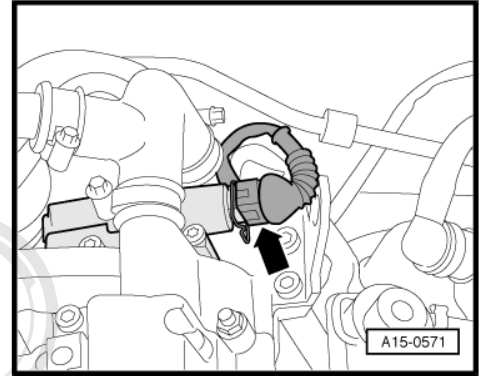
Checking internal resistance

- Release quick-release fasteners and remove engine cover panel -arrows-.

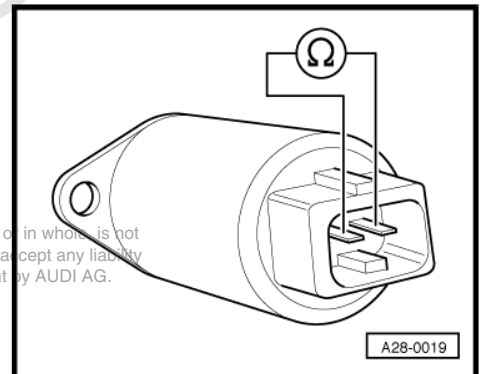
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- Unplug electrical connector -arrow- at camshaft control valve 1 - N205- .



- Connect hand-held multimeter - V.A.G 1526C- to measure resistance between contacts on inlet camshaft control valve 1 - N205- .
- Specification: 10 ... 18 Ω .
- If reading does not match specification, renew inlet camshaft control valve 1 - N205- .



If the specification is attained:

Checking voltage supply

- Fuse for inlet camshaft control valve 1 - N205- OK $\Rightarrow$ Current flow diagrams, Electrical fault finding and Fitting locations.
- Fuel pump relay - J17- OK $\Rightarrow$ Current flow diagrams, Electrical fault finding and Fitting locations.



Note

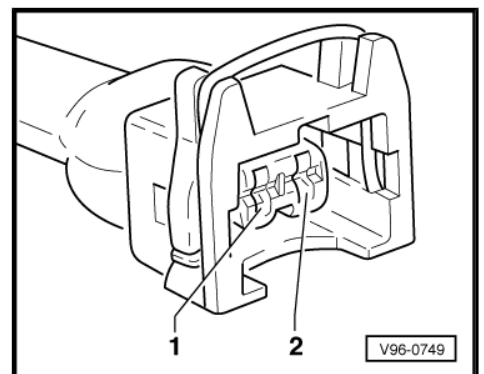
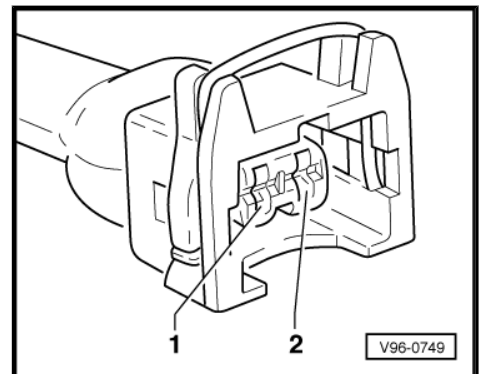
The inlet camshaft control valve 1 - N205- is supplied with power via the fuel pump relay - J17- .

- Connect voltage tester - V.A.G 1527B- between contact -1- of connector for inlet camshaft control valve 1 - N205- and earth “-”.
- Briefly operate starter.
- The LED should light up.
- If LED does not light up, check for open circuit in wiring from contact -1- of connector for inlet camshaft control valve 1 - N205- via fuse to fuel pump relay - J17- $\Rightarrow$ Current flow diagrams, Electrical fault finding and Fitting locations.
- If necessary repair wiring connection.

If the LED lights up:

Checking activation

- Connect voltage tester - V.A.G 1527B- between contact -1 and 2- of connector for inlet camshaft control valve 1 - N205- .



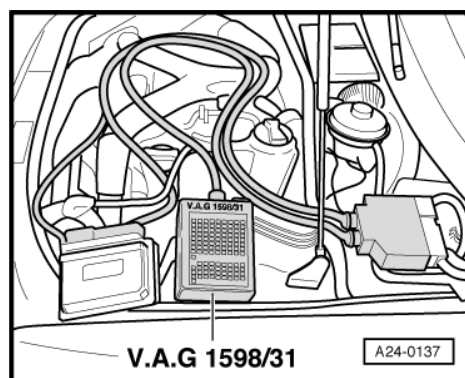
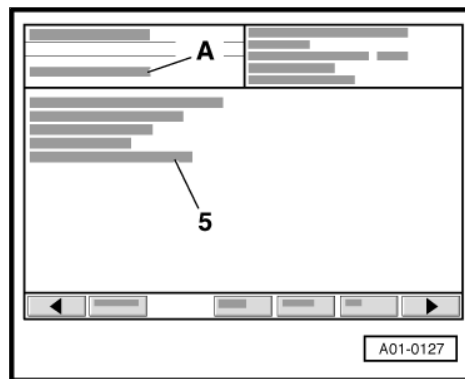
- Switch on ignition and select vehicle system “01 - Engine electronics” again.
- Repeat diagnostic function “005 - Final control diagnosis”.
- Press the  key repeatedly until the following display appears:

Display on -VAS 5051B- (example):

A - 5th control element being tested

5 - Variable valve timing (camshaft adjustment)

- The LED should flash.
- Terminate diagnostic function “005 - Final control diagnosis” by pressing  key.
- Select diagnostic function “022 - End output”, switch off ignition and unplug diagnostic connector.
- If LED does not flash or lights up continuously, connect adapter cable, 121-pin - V.A.G 1598/31- (test box) to connectors of wiring harness; do not connect engine control unit. Connect earth clip of test box to earth ⇒ Rep. gr. 24 .



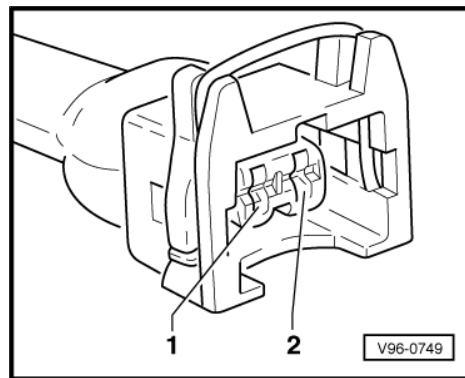
- Check for open circuit and short to positive or earth in the following wiring for inlet camshaft control valve 1 - N205- .

Connector Contact	-V.A.G 1598/31- Socket
-2-	115

- If necessary repair wiring connection.

If no fault is found:

- Renew mechanical camshaft adjuster
⇒ [“3.5 Removing and installing camshafts and camshaft adjuster”, page 101](#) .



17 – Lubrication

1 Sump and oil pump



Note

- ◆ If large quantities of metal shavings or particles are found in the engine oil when repairing the engine, the oil passages must be cleaned carefully, and the oil cooler must be renewed in order to prevent further damage occurring later.
- ◆ The oil level must not be above the "max." mark on dipstick – danger of damage to catalytic converter.
- ◆ Oil spray jet and pressure relief valve ⇒ [page 125](#)
- ◆ Removing and installing oil level and oil temperature sender - G266- ⇒ [page 125](#).
- ◆ Refer to ⇒ Maintenance tables for engine oil capacity, oil specifications and viscosity grades.

1.1 Sump, oil pump - exploded view

1 - 28 Nm

2 - Stop for torque reaction support

3 - Sump

- ☐ Removing and installing ⇒ [page 125](#)
- ☐ Install using sealant; sealant ⇒ Parts catalogue

4 - Oil pump

- ☐ With pressure relief valve (12 bar)
- ☐ Removing and installing ⇒ [page 134](#)
- ☐ Before installing, check that the two dowel sleeves -item 12- for centring oil pump/cylinder block are fitted.
- ☐ Renew if running surfaces and gears are scored
- ☐ Tightening torque for oil pump cover to oil pump housing: 10 Nm

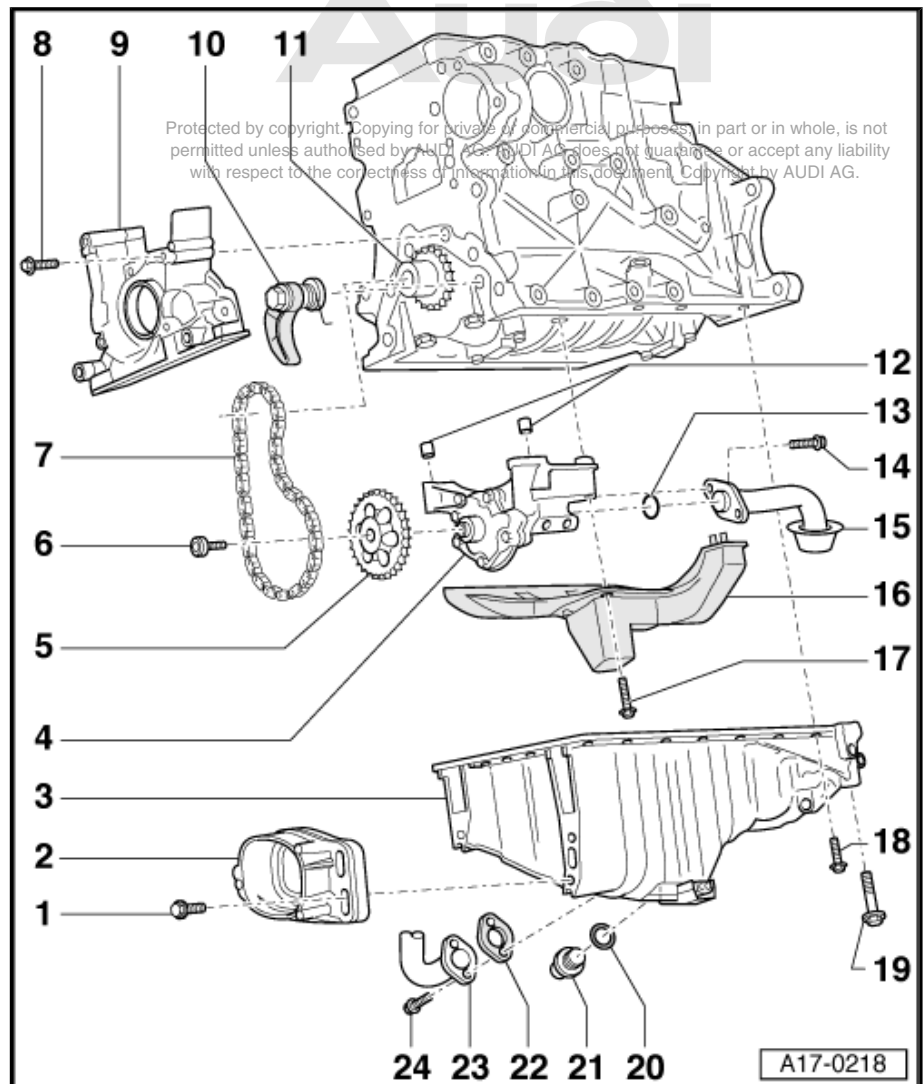
5 - Chain sprocket for oil pump

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

6 - 22 Nm

7 - Drive chain for oil pump

- ☐ Mark direction of rotation before removing





- ☐ Check for wear

8 - 15 Nm

9 - Sealing flange (pulley end)

- ☐ Must be positioned on dowel sleeves
- ☐ Removing and installing ⇒ [page 57](#)
- ☐ Install using sealant; sealant ⇒ Parts catalogue
- ☐ Renewing crankshaft oil seal - pulley end ⇒ [page 55](#)

10 - Chain tensioner

- ☐ Tighten to 16 Nm
- ☐ Do not dismantle
- ☐ Note installation position
- ☐ When installing, pre-tension spring and engage
- ☐ If the spring is broken, renew chain tensioner as complete unit

11 - Chain sprocket for oil pump

- ☐ Removing and installing ⇒ [page 68](#)

12 - Dowel sleeves

- ☐ 2x

13 - O-ring

- ☐ Renew

14 - 16 Nm

15 - Suction pipe

- ☐ Clean strainer if dirty

16 - Baffle plate

17 - 16 Nm

18 - 15 Nm

- ☐ Tighten in stages and in diagonal sequence
- ☐ Observe correct tightening sequence ⇒ [page 133](#)

19 - 40 Nm

20 - Seal

- ☐ Renew

21 - Oil drain plug, 30 Nm

22 - Gasket

- ☐ Renew

23 - Oil return line

- ☐ From turbocharger

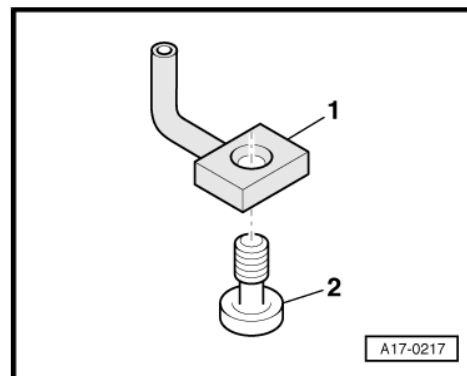
24 - 10 Nm



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Oil spray jet and pressure relief valve

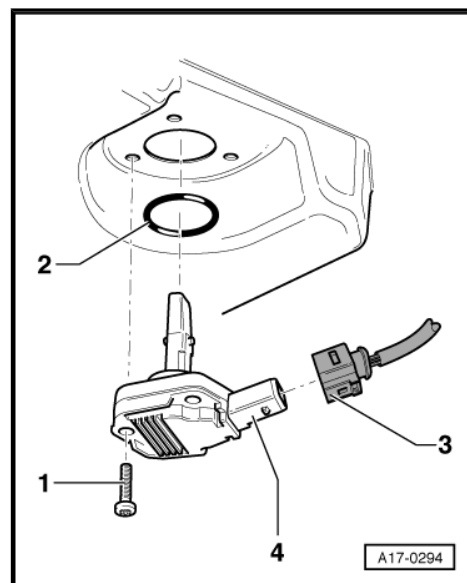
- 1 - Oil spray jet (for cooling of pistons)
- 2 - Bolt with pressure relief valve, 27 Nm
- Opening pressure: 1.3 ... 1.6 bar.



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

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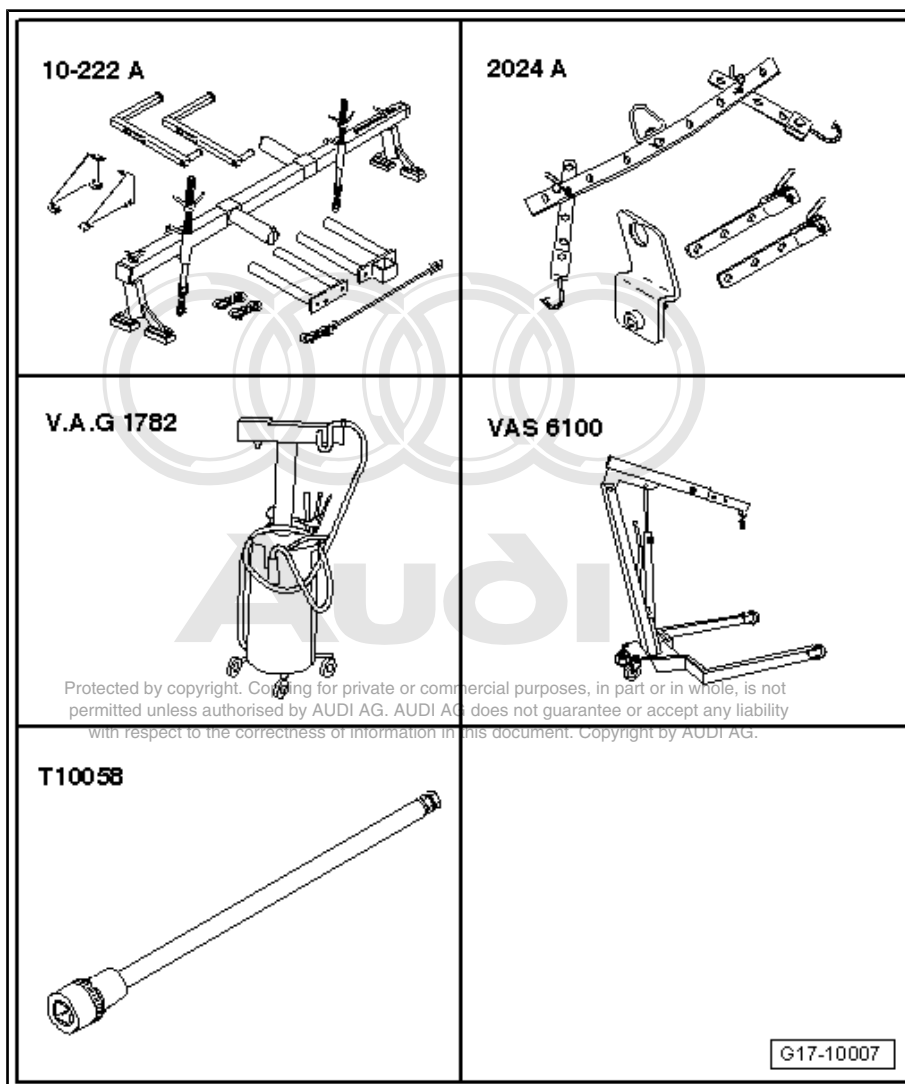
- 1 - Bolt, 10 Nm (self-locking); renew
- 2 - Seal; renew
- 3 - Electrical connector
- 4 - Oil level and oil temperature sender - G266-



1.2 Removing and installing sump

Special tools and workshop equipment required

- ◆ Support bracket - 10 - 222 A-
- ◆ Lifting tackle - 2024 A-
- ◆ Used oil collection and extraction unit - V.A.G 1782-
- ◆ Workshop hoist - VAS 6100-
- ◆ Allen key, long reach - T10058-
- ◆ Electric drill with plastic brush attachment
- ◆ Safety goggles



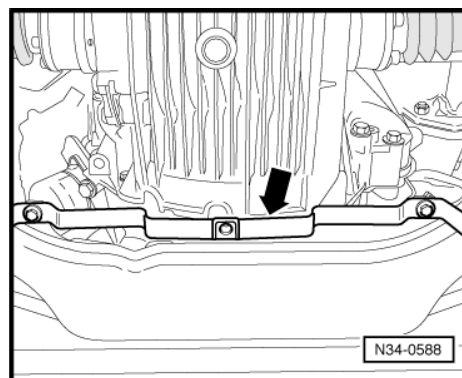
Removing



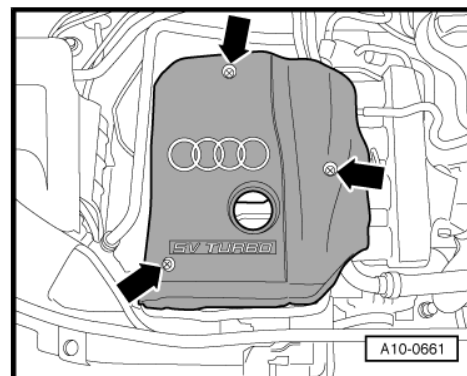
Note

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

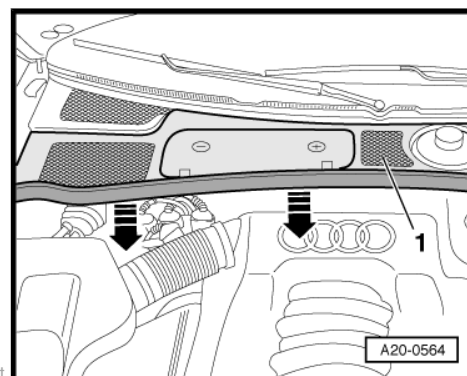
- Move lock carrier to service position ⇒ Rep. gr. 50 .
- Unbolt bracket for noise insulation -arrow-.
- Detach bottom left air hose from charge air cooler.



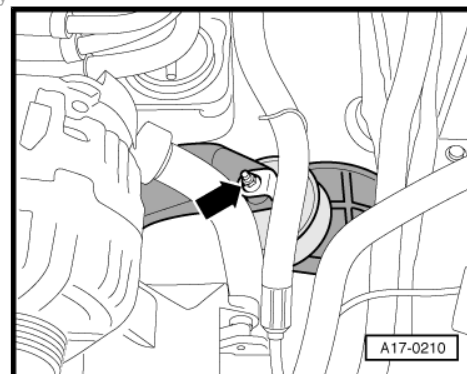
- Release quick-release fasteners and remove engine cover panel -arrows-.



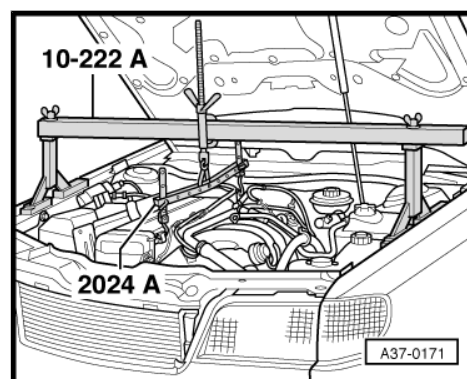
- Remove seal -arrows-.
- Pull off plenum chamber cover -1- towards front of vehicle.



- Remove top nut -arrow- on left engine mounting.



- Position support bracket - 10 - 222 A- on bolted flanges of wing panels.



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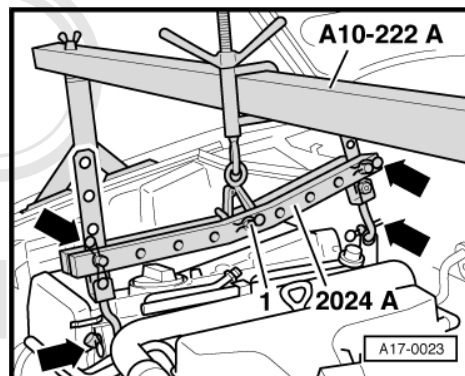
- Remove lifting eye from lifting tackle - 2024 A- .
- Reinsert pin -1- in centre hole in lifting tackle and secure with split pin.
- Hook pin of lifting tackle - 2024 A- on spindle of support bracket - 10 - 222 A- .
- Engage lifting tackle - 2024 A- in front and rear lifting eyes on engine.



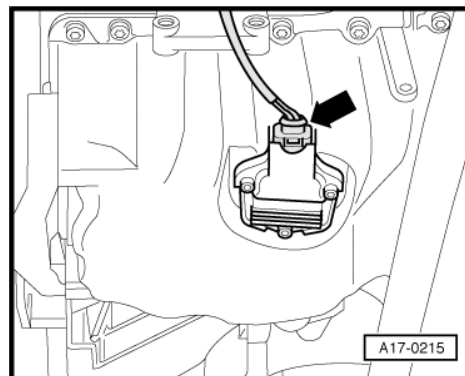
WARNING

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

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- Take up weight of engine with the spindle of support bracket, but do not lift.
- Place used oil collection and extraction unit - V.A.G 1782- underneath engine and drain off engine oil.
- Disconnect oil return line for turbocharger from sump.
- Unplug electrical connector at oil level and oil temperature sender - G266- -arrow-.



Vehicles with automatic gearbox:



Note

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

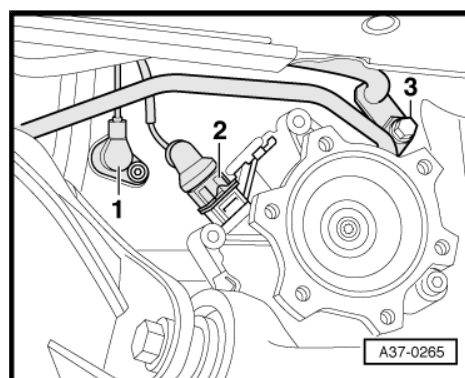
- Unscrew bolt -3- and detach ATF lines from gearbox.



Note

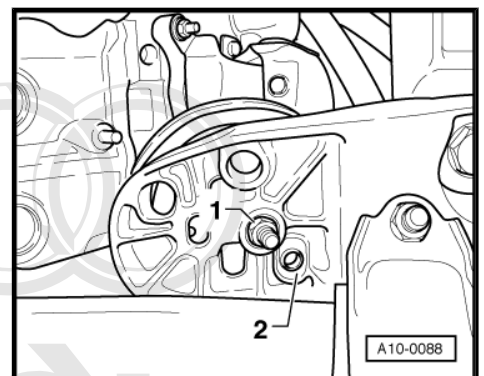
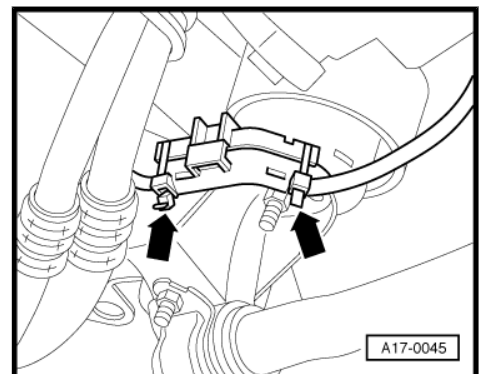
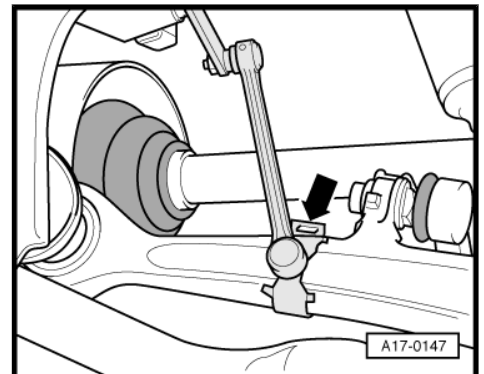
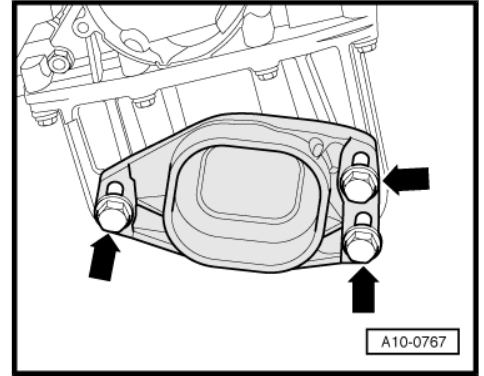
Items -1 and 2- can be disregarded.

- Detach bracket for ATF line from engine.
- Move ATF lines clear to side.



All vehicles:

- Remove stop for torque reaction support -arrows-.
- If fitted, unclip actuator rod for vehicle level sender at bottom transverse link -arrow-.
- Cut through cable ties -arrows-. Open retainer for starter wiring and take out wiring.
- Mark position of nuts -1- and locating sleeves -2- on bottom of engine mountings (right and left).



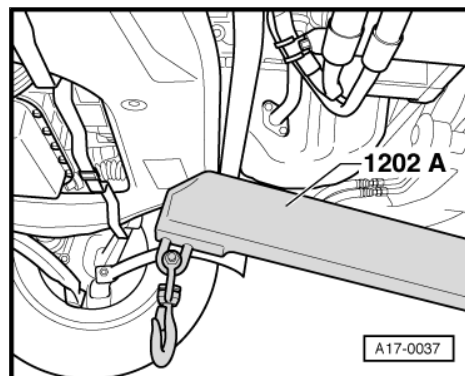
 Note

Different mounting holes are provided for the different engine versions.

- Remove nut -1- on bottom of engine mounting (right-side).
- Remove left engine mounting completely.

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- Support subframe with workshop hoist.

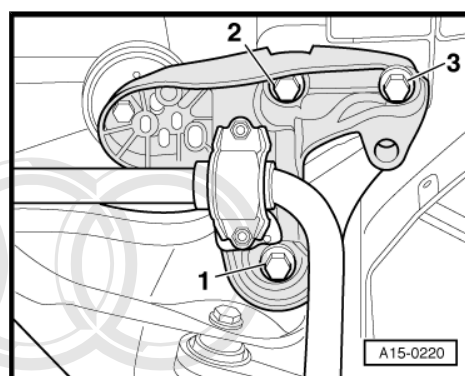


- First remove front subframe bolts -2 and 3- (left and right). Then remove bolts -1-.



Note

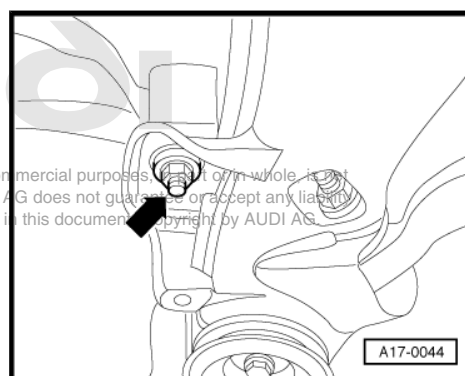
The subframe should only be unfastened and lowered at the front, as otherwise wheel alignment has to be performed.



Vehicles with manual gearbox:

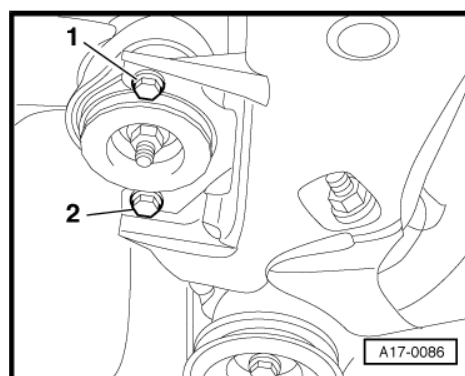
- Loosen nut -arrow- for gearbox mounting (left-side) until it is flush with lower end of bolt (turn approx. 4 threads).

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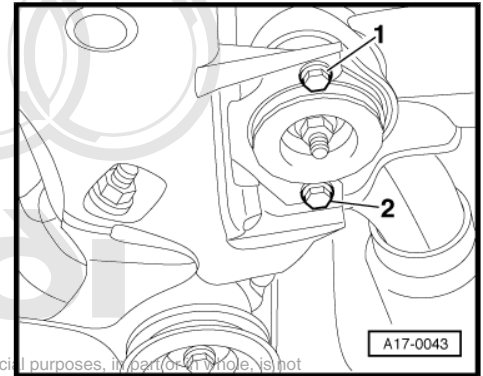
Vehicles with automatic gearbox:

- Slacken rear bolt -2- for left gearbox mounting several turns; remove front bolt -1- for left gearbox mounting.

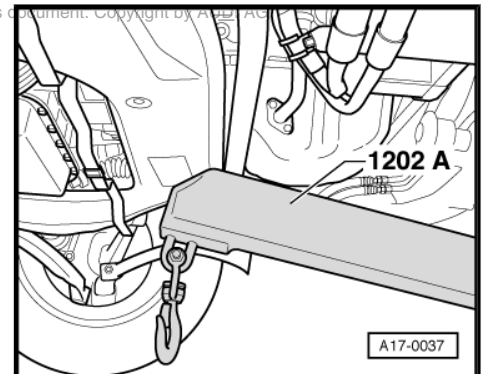


All vehicles:

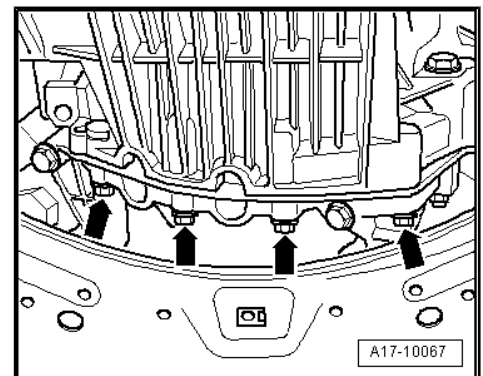
- Slacken rear bolt -2- for right gearbox mounting several turns;
remove front bolt -1- for right gearbox mounting.



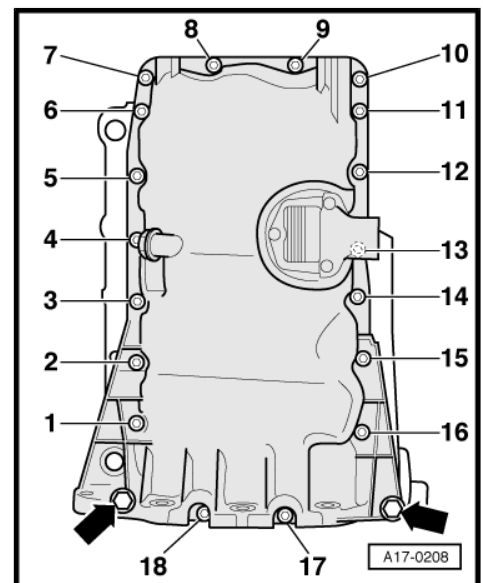
- Lower subframe slowly using workshop hoist.
- Remove workshop hoist.



- Remove bolts securing sump to gearbox -arrows-.



- Remove M10 bolts -arrows-.
- Slacken bolts -1 ... 18- in diagonal sequence and remove.





Note

Use Allen key (long reach) - T10058- to unscrew the two rear sump bolts -1 and 2-. To do so on vehicles with manual gearbox, turn the flywheel -3- until the recess -arrow- is aligned with the bolt.

- Take off sump: if necessary loosen it by striking lightly with a rubber hammer.

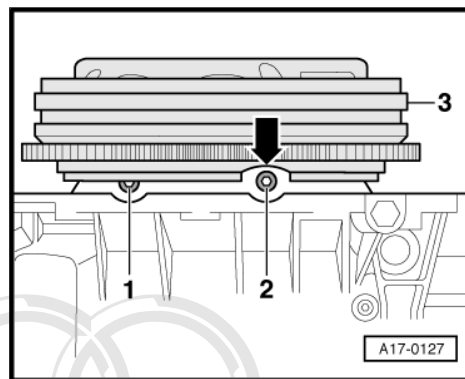
Installing

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



Note

- ◆ Renew all seals and gaskets.
- ◆ Fit all cable ties in the original positions when installing.
- Carefully remove sealant residues from cylinder block. For this purpose, remove baffle plate.

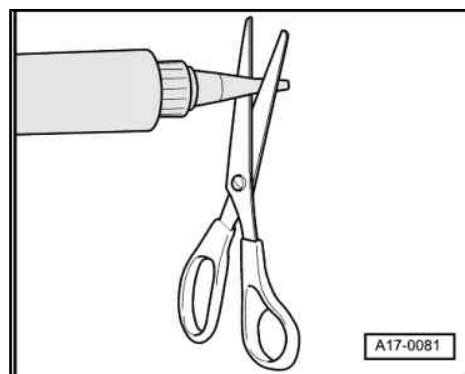
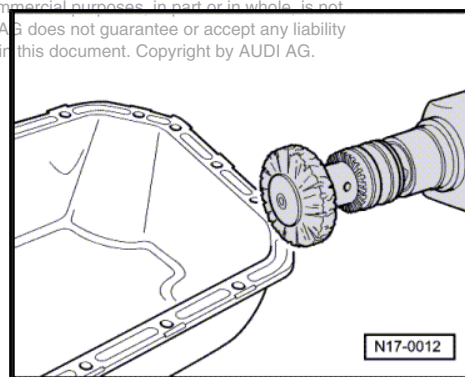


WARNING

Wear safety goggles.

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

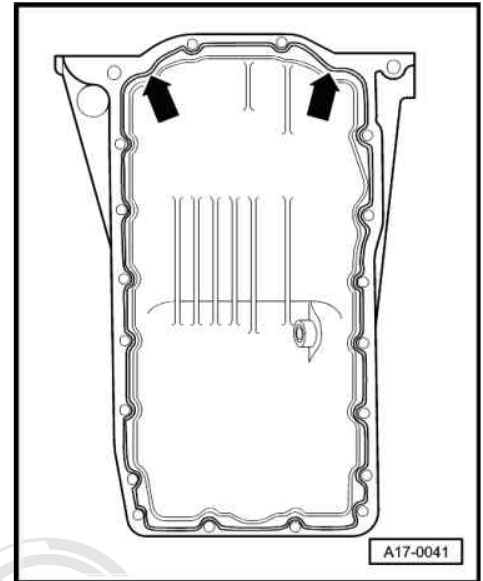
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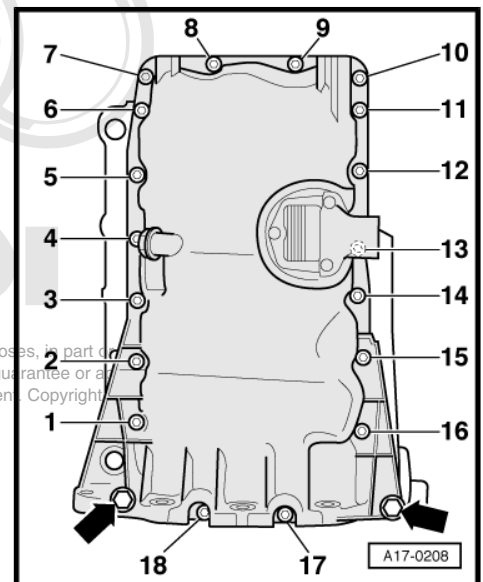
- Apply bead of sealant onto clean sealing surface of sump as illustrated.
- Thickness of sealant bead: 2 ... 3 mm

 Note

- ◆ *The sealant bead must not be thicker than specified, otherwise excess sealant could enter the sump and clog the strainer in the oil pump.*
- ◆ *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.*

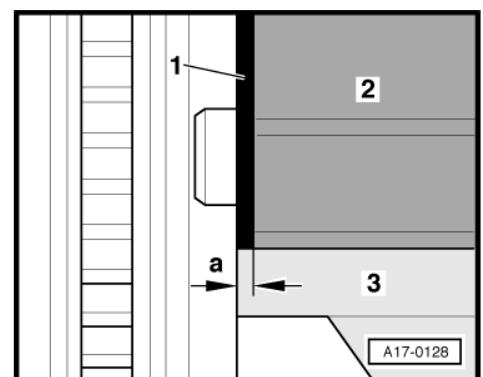


- Fit sump and tighten bolts in the sequence shown.
- 1. Pre-tighten bolts -1 ... 18- to 5 Nm in diagonal sequence.
- 2. Tighten bolts securing sump to gearbox.
- 3. Tighten M10 bolts -arrows-.
- 4. Tighten bolts -1 ... 18- in diagonal sequence.



 Note

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



- Install subframe => Rep. gr. 40 .

- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight and tighten nuts -arrows-.

Vehicles with automatic gearbox:

- Secure ATF lines ⇒ Rep. gr. 37 .

All vehicles:

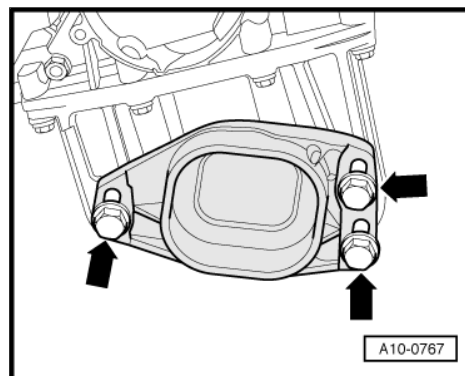
- Fill with engine oil and check oil level ⇒ [page 139](#) .

Vehicles with automatic gearbox:

- Check ATF level ⇒ Rep. gr. 37 .

Tightening torques

Component			Nm
Sump to:	Cylinder block	M7	15
		M10	40
	Gearbox		45
Stop for torque reaction support to sump			28
Engine mounting to:	Subframe		25
	Engine support		25
Gearbox support to gearbox mounting			40
Gearbox mounting to subframe			25
Oil return line to sump			10
Oil drain plug			30
Hose clips for air hoses			3.5



1.3 Removing and installing oil pump

Removing

- Remove sump and baffle plate ⇒ Page ⇒ [page 125](#) .
- Remove bolt -2- and detach chain sprocket from oil pump shaft.
- Remove bolts -1 and 3- and detach oil pump.

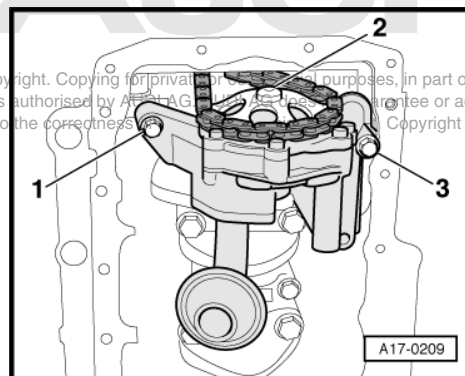
Installing

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

- Insert dowel sleeves ⇒ [Item 12 \(page 124\)](#) at top of oil pump.
- Chain sprocket can only be fitted on oil pump shaft in one position.
- Install sump ⇒ [page 132](#) .

Tightening torques

Component	Nm
Chain sprocket to oil pump shaft	22
Oil pump to cylinder block	16



2 Oil filter and oil cooler

2.1 Oil filter and oil cooler - exploded view

1 - Screw plug, 40 Nm

2 - Seal

- ☐ Renew

3 - Spring

- ☐ For pressure relief valve, approx. 4 bar

4 - Piston

- ☐ For pressure relief valve, approx. 4 bar

5 - Gasket

- ☐ Renew

6 - Oil retention valve

- ☐ Tighten to 8 Nm
- ☐ Integrated into oil filter bracket

7 - O-ring

- ☐ Renew
- ☐ Slip on as far as collar of crankcase breather pipe - item 9-

8 - Retaining clip

9 - Crankcase breather pipe

10 - 20 Nm

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

11 - Coolant pipe (bottom)

12 - Screw plug, 15 Nm

13 - Seal

- ☐ If seal is leaking, cut open and renew

14 - Oil supply line

- ☐ To turbocharger

15 - Banjo bolt, 30 Nm

16 - Seals

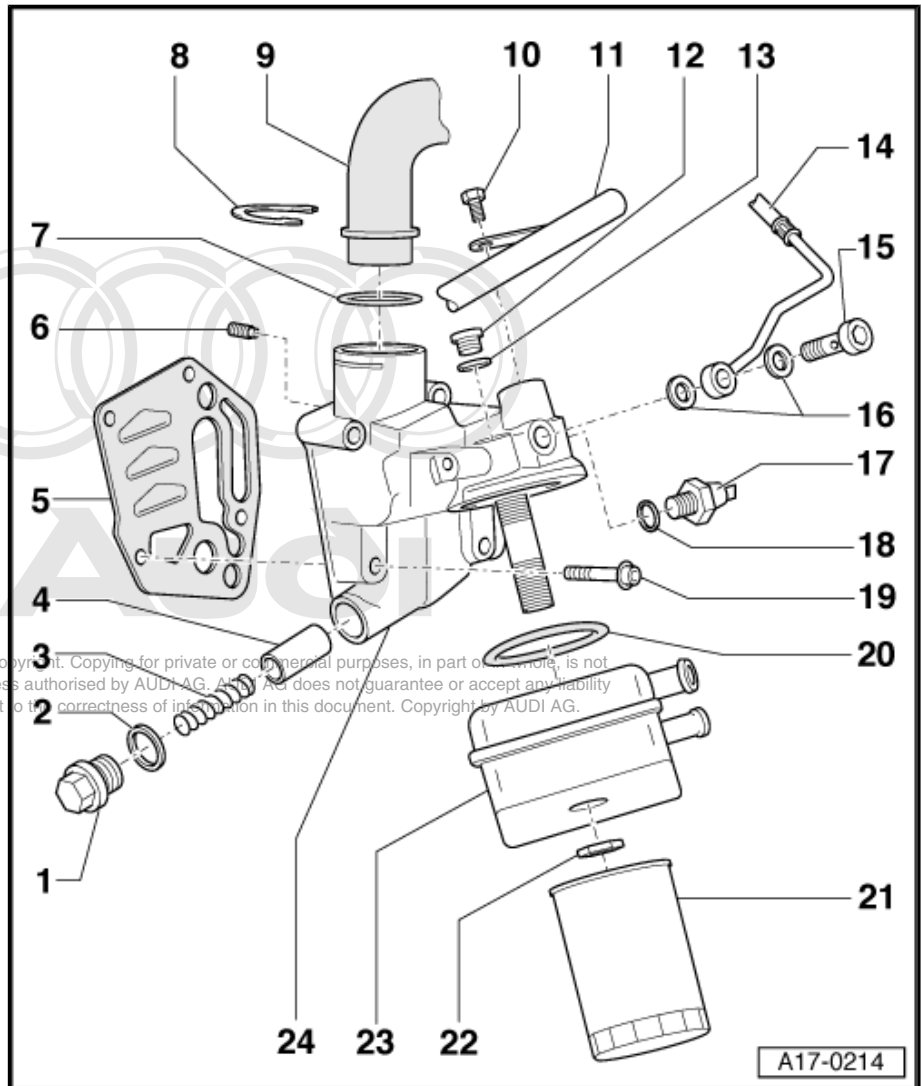
- ☐ Renew

17 - Oil pressure switch - F1-

- ☐ Opening/closing pressure 1.4 bar
- ☐ Black insulation
- ☐ Checking ⇒ [page 137](#)
- ☐ Tighten to 20 Nm

18 - Seal

- ☐ If seal is leaking, cut open and renew





19 - 15 Nm + 90° (1/4 turn) further

- ☐ Renew

20 - Seal

- ☐ Renew
- ☐ Engage in lugs on oil cooler

21 - Oil filter

- ☐ Observe change intervals ⇒ Maintenance ; Booklet 802
- ☐ Observe installation instructions on oil filter
- ☐ Tighten to 20 Nm

22 - 25 Nm

23 - Oil cooler

- ☐ See note ⇒ [page 123](#)
- ☐ Ensure clearance from surrounding components
- ☐ Diagram of coolant hose connections ⇒ [page 141](#)

24 - Oil filter bracket

- ☐ With pressure relief valve, approx. 4 bar

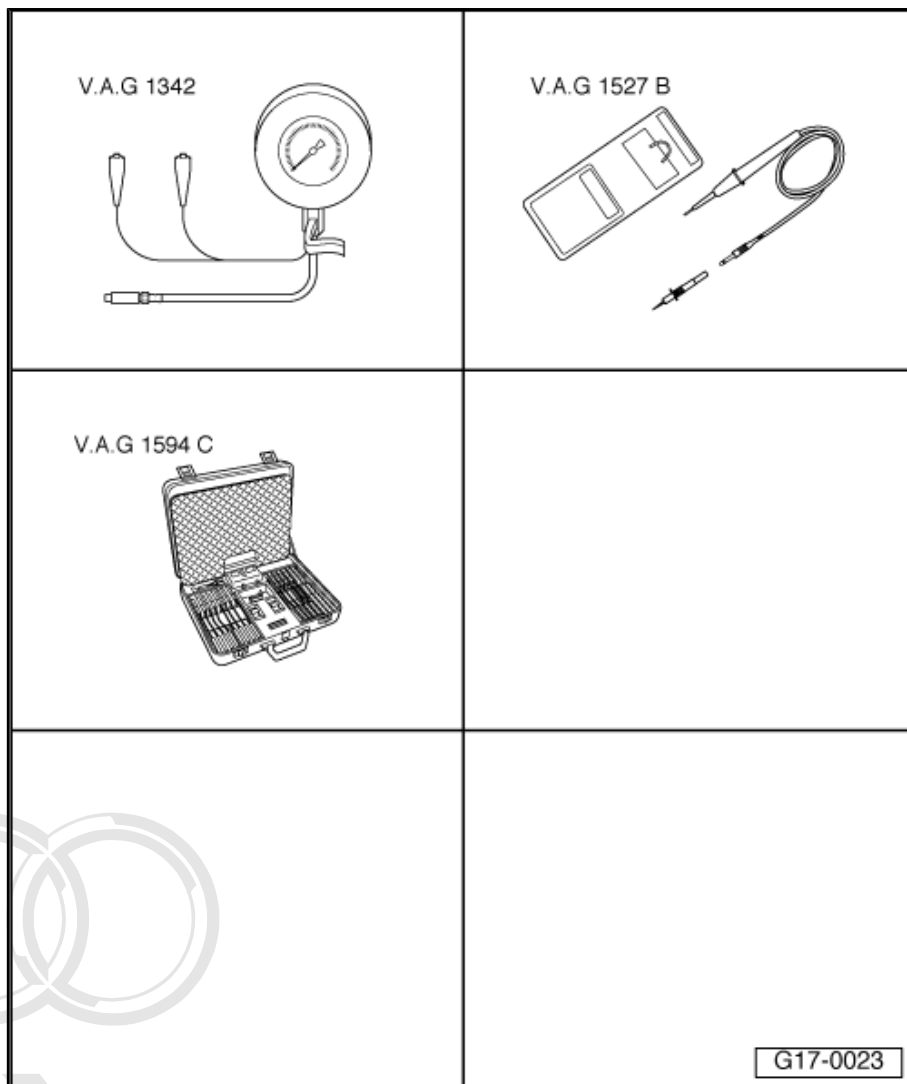


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2.2 Checking oil pressure and oil pressure switch - F1-

Special tools and workshop equipment required

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

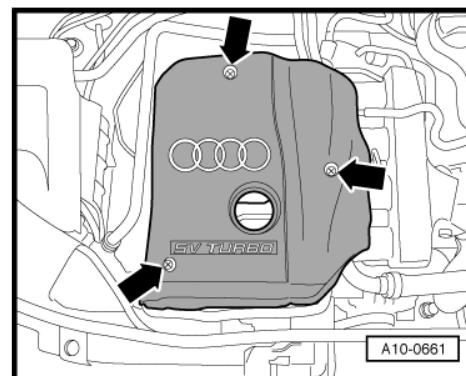


Procedure

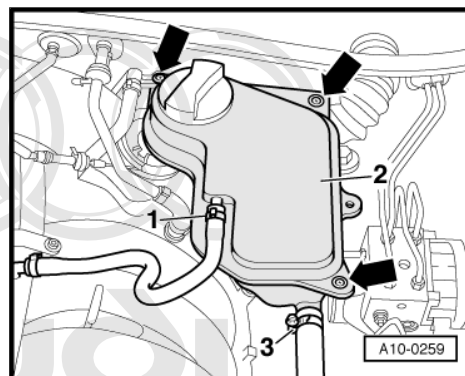
- Oil level OK

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- Engine oil temperature approx. 80 °C.
- Release quick-release fasteners and remove engine cover panel -arrows-.

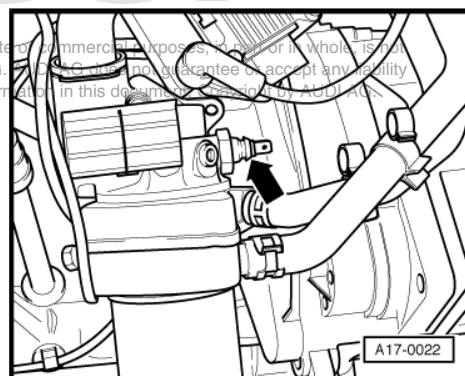


- Unbolt coolant expansion tank -2- -arrows-.
- Unplug electrical connector for coolant shortage indicator switch - F66- at expansion tank (bottom) and move expansion tank to one side (coolant hoses -1 and 3- remain attached).



- Unplug electrical connector on oil pressure switch - F1- .
- Remove oil pressure switch - F1- -arrow-

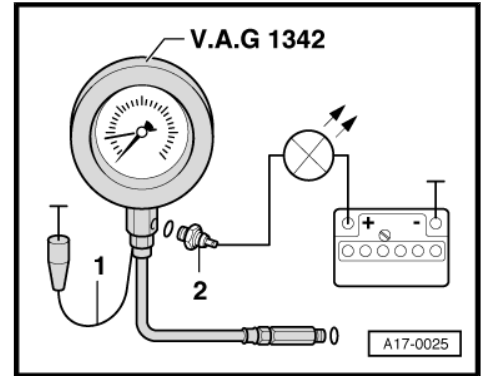
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- Connect oil pressure tester - V.A.G 1342- with adapter - V.A.G 1342/14- to bore for oil pressure switch.
- Screw oil pressure switch -2- into oil pressure tester - V.A.G 1342- .
- Connect brown wire of oil pressure tester to earth (“-”).

Checking oil pressure switch

- Connect voltage tester - V.A.G 1527 B- -item 1- with adapter leads from auxiliary measuring set - V.A.G 1594 C- to oil pressure switch and battery positive (“+”).
- LED should not light up.
- Renew oil pressure switch if LED lights up.
- Start engine.



Note

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

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

Checking oil pressure

- Start engine.
- Minimum oil pressure at 2000 rpm: 1.3 bar
- Minimum oil pressure at 3500 rpm: 3.5 ... 4.5 bar.

Assembling

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

Note

Renew seal when installing oil pressure switch.

Tightening torque

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Component	Nm
Oil pressure switch to oil filter housing	20

2.3 Engine oil

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

2.4 Checking oil level

Note

The oil level must not be above the “max.” mark on dipstick – danger of damage to catalytic converter.

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.

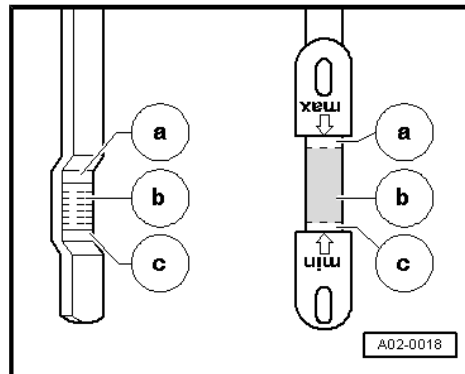
c - Oil must be topped up.

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Note

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



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.*
- ◆ *When installing coolant hoses, position them so they are free of tension and do not come into contact with other components.*
- ◆ *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 hoses must align.*

1.1 Diagram of coolant hose connections

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1 - Radiator

- ☐ Removing and installing
⇒ [page 155](#)
- ☐ If renewed, refill system
with fresh coolant

2 - Coolant pipe (top)

- ☐ Removing and installing
⇒ ["2.2 Removing and installing intake manifold"](#),
[page 88](#)

3 - Thermostat housing

- ☐ Removing and installing
thermostat ⇒ [page 151](#)
- ☐ Checking thermostat
⇒ [page 152](#)

4 - Coolant pump

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

5 - Turbocharger

6 - Cylinder head/cylinder block

- ☐ If renewed, refill system
with fresh coolant

7 - Heat exchanger

- ☐ If renewed, refill system
with fresh coolant

8 - Coolant pipe (bottom)

- ☐ Removing and installing
⇒ [page 153](#)

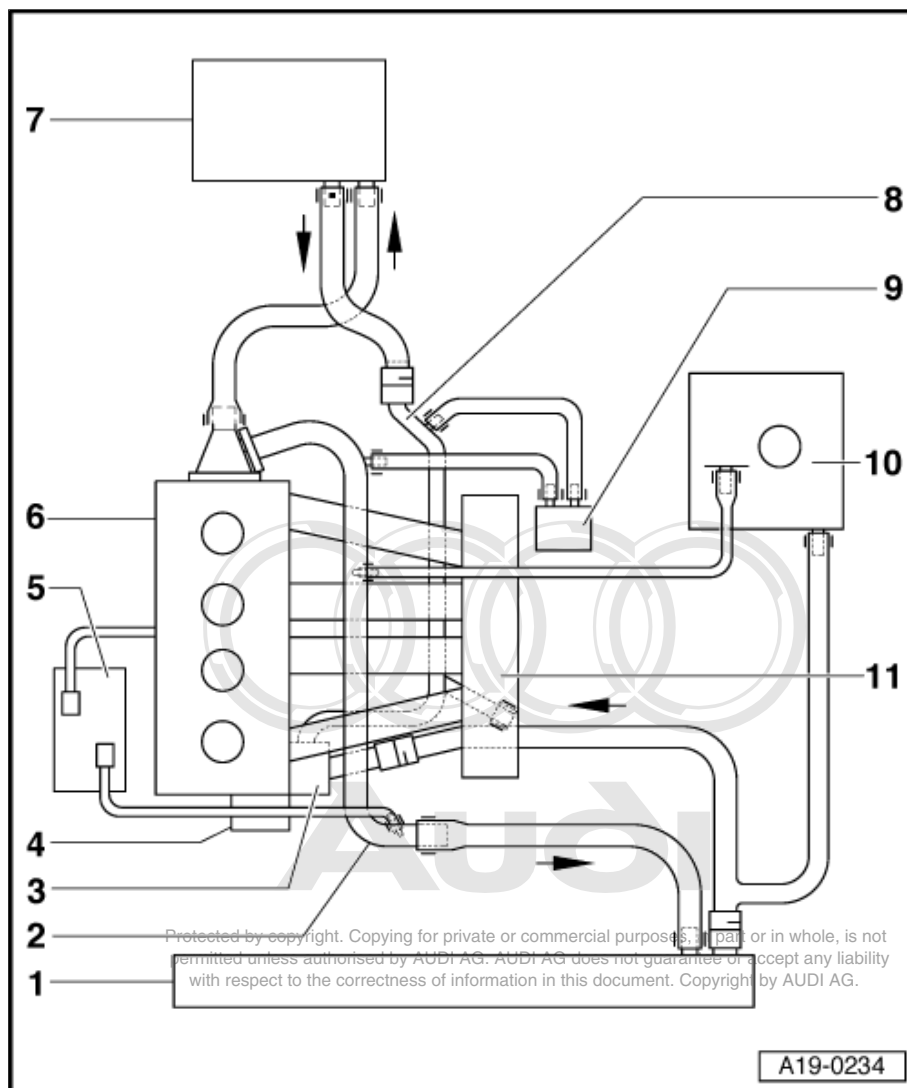
9 - Oil cooler

- ☐ Removing and installing
⇒ [Item 23 \(page 136\)](#)
- ☐ If renewed, refill system
with fresh coolant

10 - Expansion tank

- ☐ With filler cap
- ☐ Checking pressure relief valve in filler cap ⇒ [page 163](#)

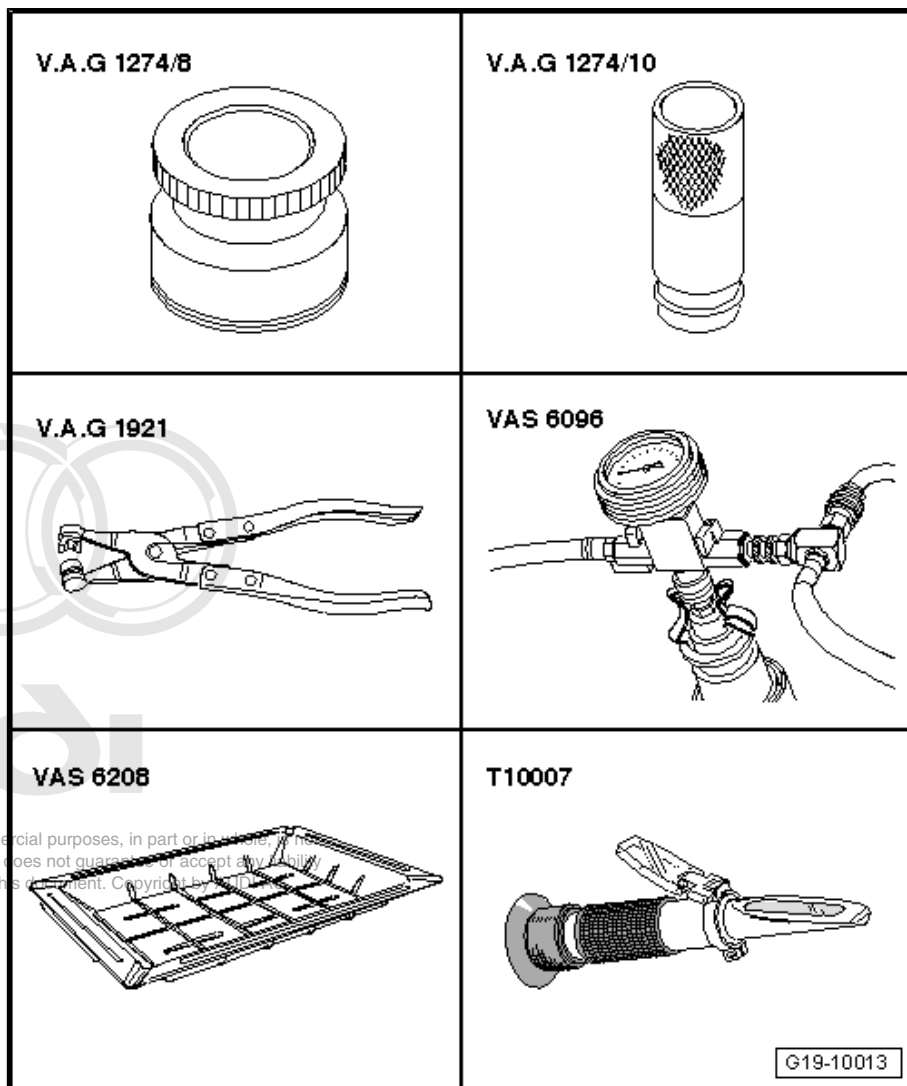
11 - Intake manifold



1.2 Draining and filling cooling system

Special tools and workshop equipment required

- ◆ Adapter for cooling system tester - V.A.G 1274/8-
- ◆ Pipe for cooling system tester - V.A.G 1274/10-
- ◆ Hose clip pliers - V.A.G 1921-
- ◆ Cooling system charge unit - VAS 6096-
- ◆ Drip tray for workshop hoist - VAS 6208-
- ◆ Refractometer - T10007-



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Draining



Note

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

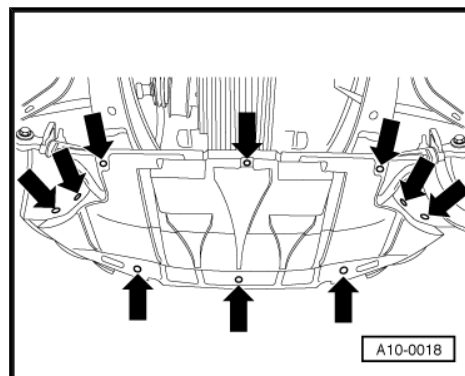


WARNING

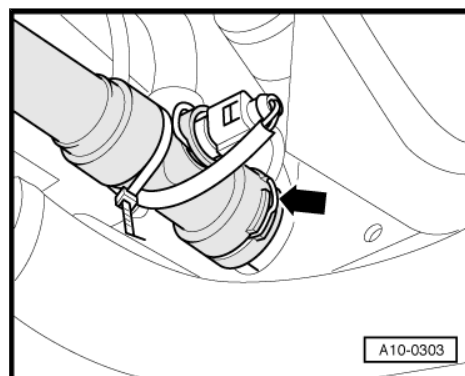
Hot steam or hot coolant can escape when expansion tank is opened; cover filler cap with cloth and open carefully.

- Open filler cap on coolant expansion tank.

- Release fasteners -arrows- and remove noise insulation.



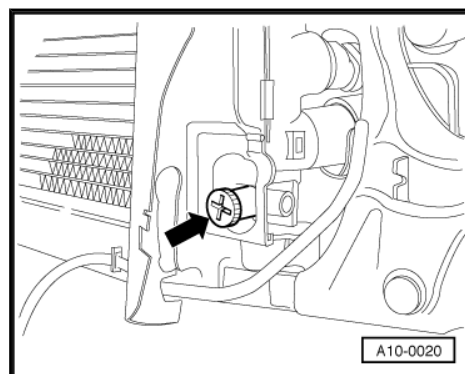
- Place drip tray for workshop hoist - VAS 6208- beneath engine.
- Detach coolant hose at bottom of radiator -arrow-.



Note

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When the bumper and the air duct in front of the charge air cooler have been detached, the coolant can also be drained out of the radiator via the drain screw -arrow- (attach auxiliary hose if necessary).



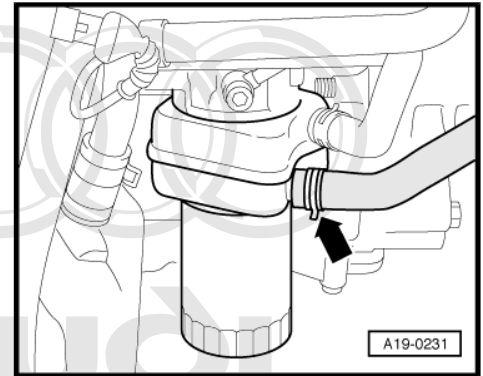
- Disconnect coolant hose at bottom of oil cooler -arrow- and drain off remaining coolant.

Filling



Note

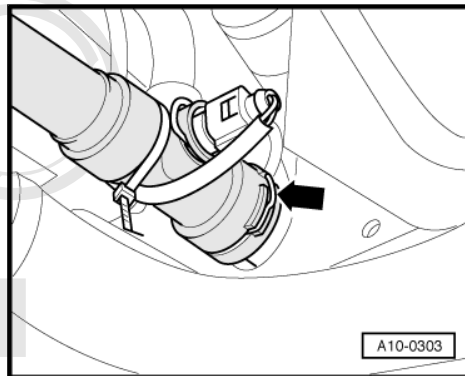
- ◆ The cooling system is filled all year round with a mixture of water and radiator antifreeze/anti-corrosion agent.
- ◆ It is important to use only coolant additive Plus - G 012 A8F A1- (also designated as »G12+«) "meeting specification TL VW 774 F". Other coolant additives could seriously impair in particular the 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.
- ◆ To check frost protection level of coolant additive »G12+« you must use a refractometer - T10007-.
- ◆ Secure all hose connections with the correct type of hose clips (same as original equipment) $\Rightarrow$ Parts catalogue.



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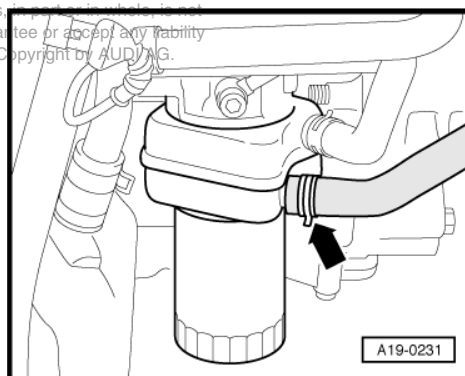
Procedure

- Connect bottom coolant hose to radiator -arrow- or close coolant drain plug at bottom of radiator.

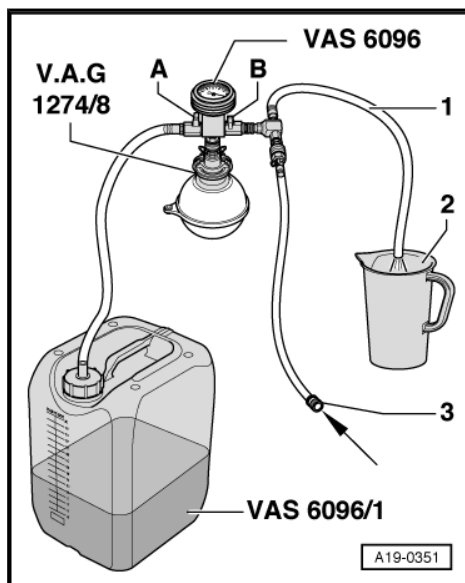


- Connect coolant hose to oil cooler -arrow-.

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- Fill reservoir of cooling system charge unit -VAS 6096- with at least 8 litres of premixed coolant (according to 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
- Fit adapter for cooling system tester - V.A.G 1274/8- onto coolant expansion tank.
- Attach cooling system charge unit - VAS 6096- to adapter - V.A.G 1274/8- .
- Run vent hose -1- into a small container -2-.



Note

The vented air draws along a small amount of coolant, which should be collected.

- Close both valves -A- and -B- (turn lever at right angles to direction of flow).
- Connect hose -3- to compressed air.
- Pressure: 6 ... 10 bar.

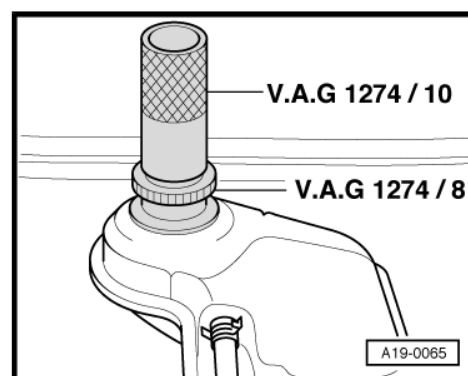
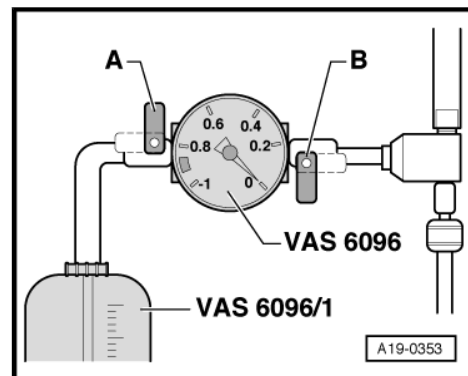
- Open valve -B- by setting lever in direction of flow.
- Run vent hose -1- into a small container -2-.



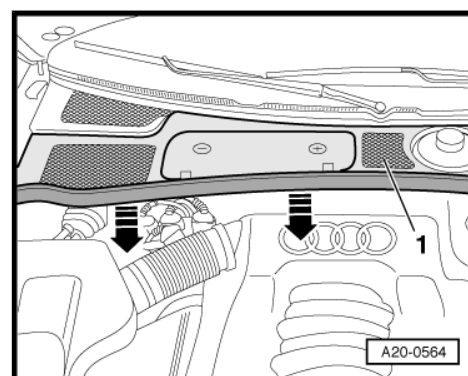
Note

The vented air draws along a small amount of coolant, which should be collected.

- Detach cooling system charge unit - VAS 6096- from coolant expansion tank.
- Fit pipe for cooling system tester - V.A.G 1274/10- onto adapter -V.A.G 1274/8- .



- Remove seal -arrows-.
- Pull off plenum chamber cover -1- towards front of vehicle.
- Push back protective cover for coolant hose on connection for heat exchanger.



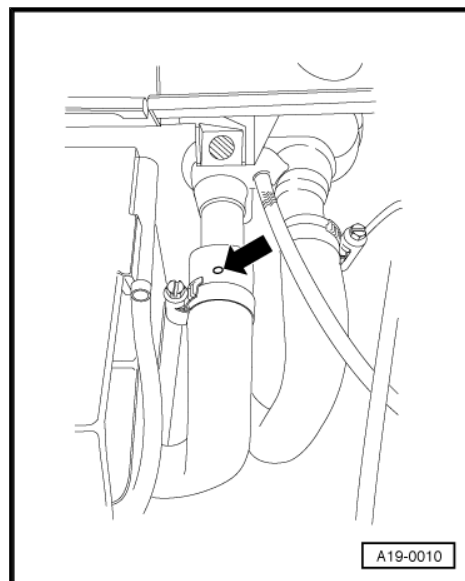
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- Release coolant hose going to heat exchanger and pull back hose until bleeder hole in hose -arrow- is no longer blocked by the connection.
- Fill up with coolant until it flows out at bleeder hole in coolant hose.
- Push coolant hose back onto connection and secure.
- Close filler cap on coolant expansion tank.
- Start engine.
- Set heater/air conditioner to “HI”.
- Run engine for 3 minutes at 2000 rpm.
- Allow engine to run at idling speed until both large coolant hoses at main radiator become warm.
- Run engine for 1 minute at 2000 rpm.
- Switch off ignition and allow engine to cool down.

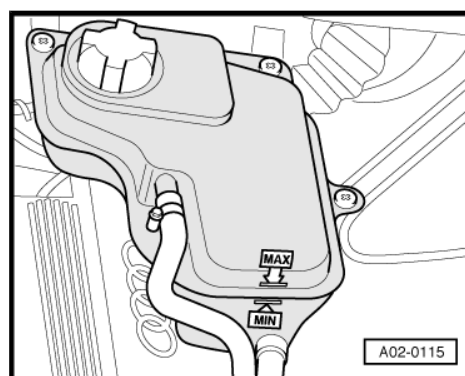


WARNING

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



- Check coolant level.
- The coolant level must be at the MAX marking when the engine is cold.
- The coolant level can be above the MAX marking when the engine is warm.



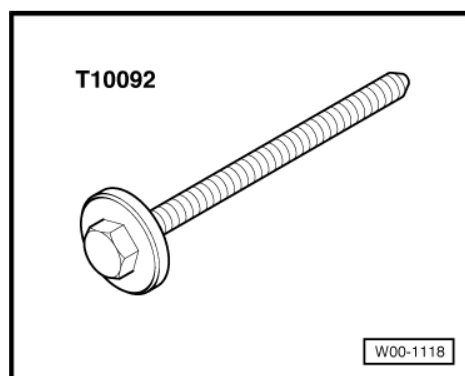
1.3 Removing and installing coolant pump

Special tools and workshop equipment required

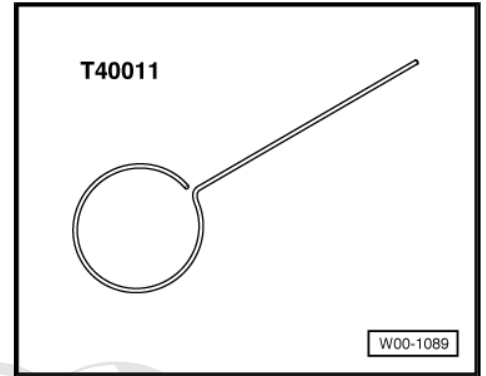
- ◆ Tensioning bolt - T10092- for vehicles up to 07.2000



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- ◆ Locking pin - T40011- for vehicles up to 07.2000



Removing

- Move lock carrier to service position ⇒ Rep. gr. 50 .
- Drain coolant ⇒ [page 143](#) .
- Remove poly V-belt ⇒ [page 29](#) .
- Remove tensioner for poly V-belt
⇒ [“1.5 Removing and installing bracket for ancillaries”,
page 31](#) .
- Remove viscous fan ⇒ [page 158](#) .

Vehicles up to 07.2000:

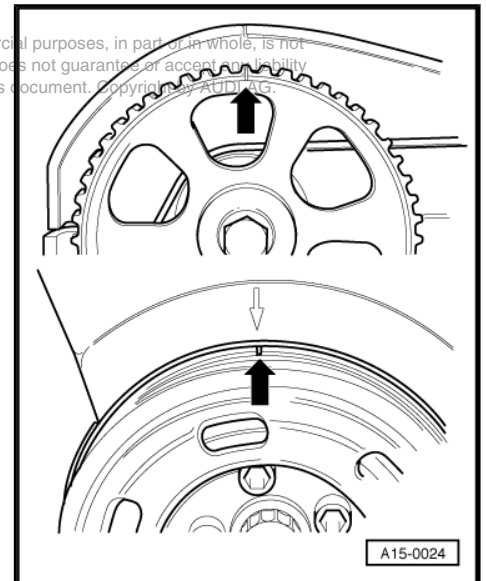
- Remove toothed belt cover (top section)



Caution

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

- Rotate crankshaft to “TDC” by turning bolt for toothed belt sprocket.
- Marking on camshaft sprocket and marking on crankshaft must be aligned to “TDC” -arrows-.



- Screw tensioning bolt - T 10092- into toothed belt tensioner.
- Compress piston of tensioner just far enough so that the piston can be locked with locking pin - T 40011- .



Note

Take care not to compress tensioner too far.

- Detach toothed belt from camshaft sprocket and from coolant pump.

Vehicles from 08.2000:

- Detach toothed belt from camshaft sprocket ⇒ [page 48](#) and from coolant pump.

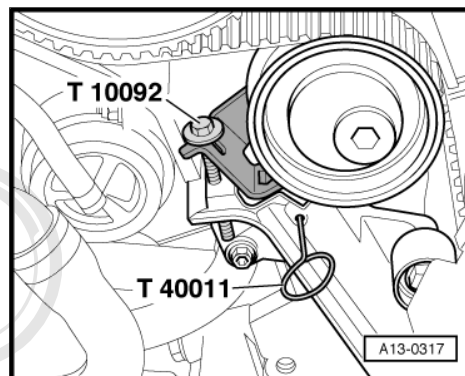
All vehicles:



Note

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Cover the toothed belt with a cloth to protect it from escaping coolant.



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

Installing

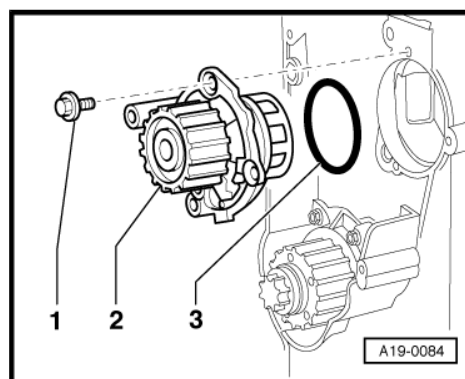
Installation is carried out in the reverse order; note the following:



Note

Fit new O-ring.

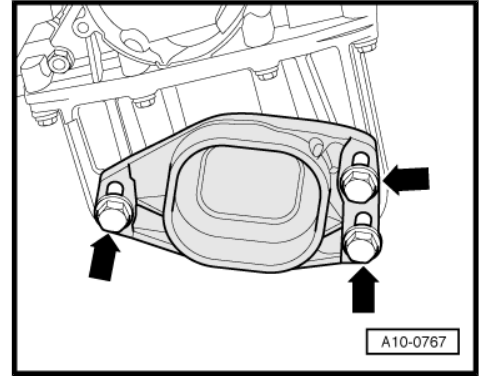
- Clean and smoothen sealing surface for O-ring.
- Lubricate O-ring -3- with coolant additive »G12+«.
- Fit coolant pump -2-.
- Installation position: Sealing plug in housing faces downwards.
- Install toothed belt (adjusting valve timing): vehicles up to 07.2000 ⇒ [page 38](#) ; vehicles from 08.2000 onwards ⇒ [page 50](#) .
- Install viscous fan ⇒ [page 158](#) .
- Install poly V-belt tensioner ⇒ [“1.5 Removing and installing bracket for ancillaries”, page 31](#) .
- Install poly V-belt ⇒ [page 29](#) .



- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight and tighten nuts -arrows-.
- Fill up with coolant ⇒ [page 145](#) .

Tightening torques

Component	Nm
Coolant pump to cylinder block	15
Stop for torque reaction support to lock carrier	28
Hose clips for coolant hoses	2



1.4 Removing and installing thermostat

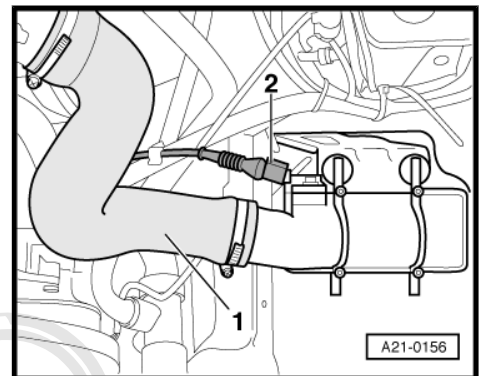
Removing



Caution

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

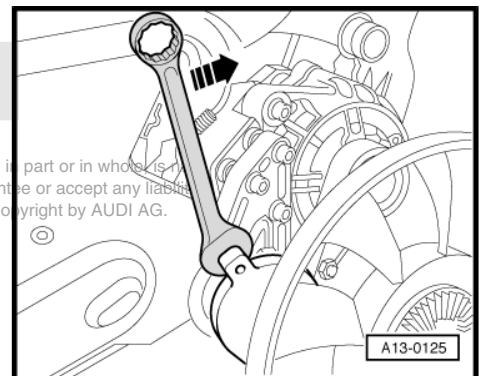
- Disconnect earth wire at battery with ignition switched off.
- Drain coolant ⇒ [page 143](#) .
- Remove air hose -1-.



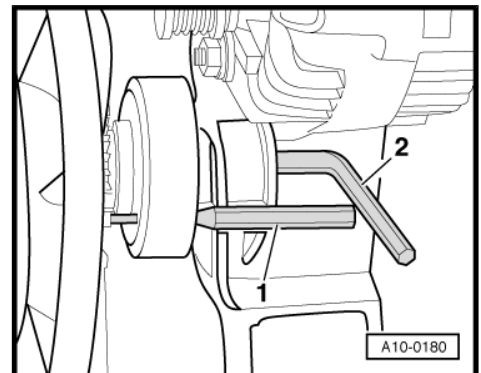
Note

Disregard -item 2-.

- To slacken poly V-belt turn tensioner in direction of -arrow-.
- Remove poly V-belt from the alternator pulley and release tensioner.

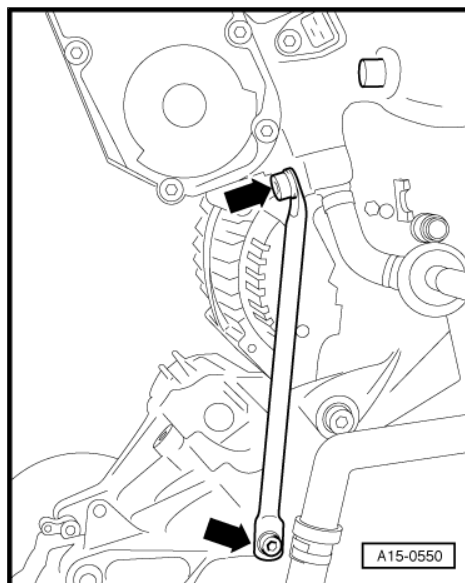


- Lock pulley for viscous fan with roll-pin drift -1- and unscrew using hexagon key -2-.
- Detach viscous fan forwards off bearing and place it in radiator cowl.
- Remove alternator ⇒ Rep. gr. 27 .



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- Remove support for intake manifold -arrows-.



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

Installing

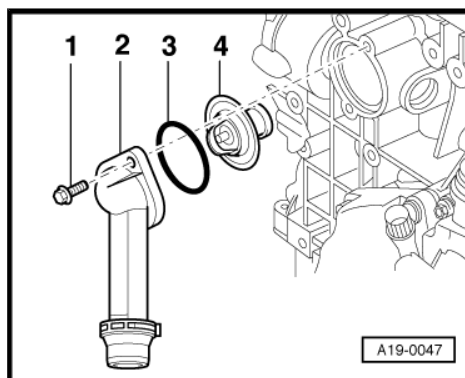
Installation is carried out in the reverse order; note the following:



Note

Renew O-ring.

- Clean and smoothen sealing surface for O-ring.
- Insert thermostat.
- ♦ Installation position: Cross-piece on thermostat should be vertical.
- Lubricate O-ring with coolant additive »G12+«.
- Install alternator ⇒ Rep. gr. 27 .
- Install viscous fan ⇒ [page 158](#) .
- Install poly V-belt ⇒ [page 29](#) .
- Observe notes on procedure for connecting the battery ⇒ Rep. gr. 27 .
- Fill up with coolant ⇒ [page 145](#) .



Tightening torques

Component	Nm
Connection to cylinder block	15
Support for intake mani- fold to:	20
Bracket for ancillaries	20
Intake manifold	20
Hose clips for air hoses	3.5

1.5 Checking thermostat

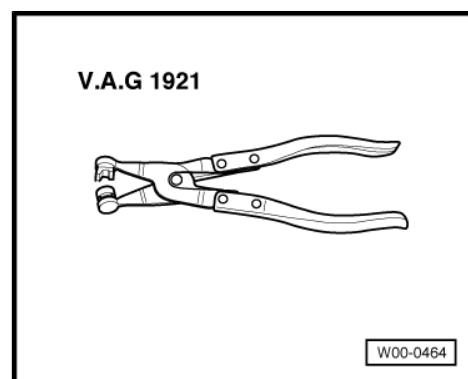
- Heat removed thermostat in water bath.

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 coolant pipe (bottom)

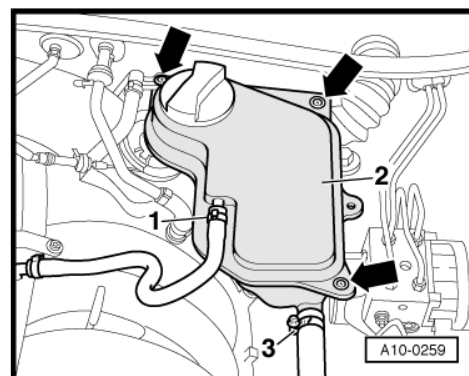
Special tools and workshop equipment required

- ◆ Hose clip pliers - V.A.G 1921-



Removing

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

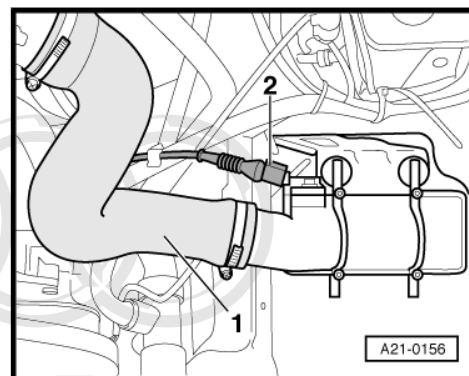


- Remove air hose -1-.



Note

Disregard -item 2-.



- Release retaining clip and detach coolant hose for heat exchanger at rear of coolant pipe -2-.
- Detach coolant hose -4- going to oil cooler from coolant pipe.
- Remove bolt -3-.
- Move electrical wiring on bottom coolant pipe clear.
- Press coolant pipe to rear and detach.
- If fitted, remove plug -5-.

Installing

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



Note

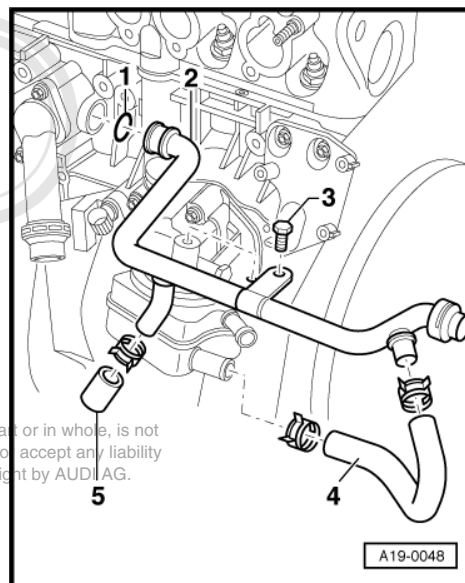
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- ◆ *Fit new O-rings.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*

- Lubricate O-ring -1- with coolant additive »G 12+« and push onto coolant pipe -2-.
- Slide coolant pipe into bore in cylinder block.
- Fill up with coolant ⇒ [page 145](#).

Tightening torques

Component	Nm
Coolant pipe to oil filter bracket	20
Hose clips for coolant hoses	2
Hose clips for air hoses	3.5

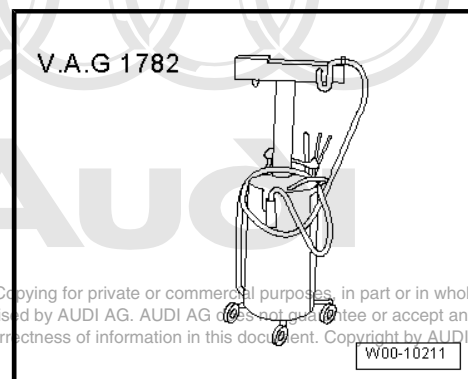


2 Radiator and viscous fan

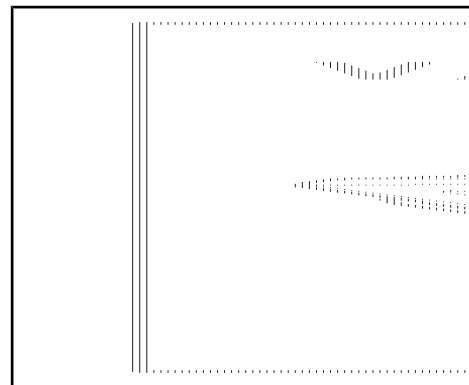
2.1 Removing and installing radiator

Special tools and workshop equipment required

- ◆ Used oil collection and extraction unit - V.A.G 1782- (for vehicles with automatic gearbox)

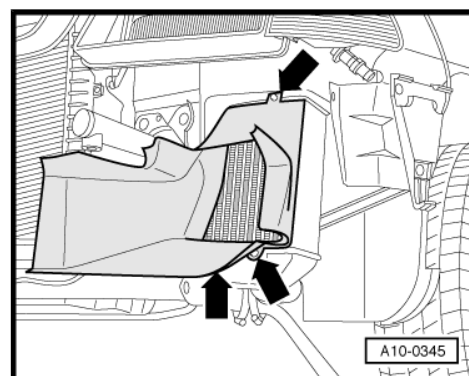


- ◆ Drip tray for workshop hoist - VAS 6208-



Removing

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



- Detach cooling pipe for power steering hydraulic fluid -arrows-.



Note

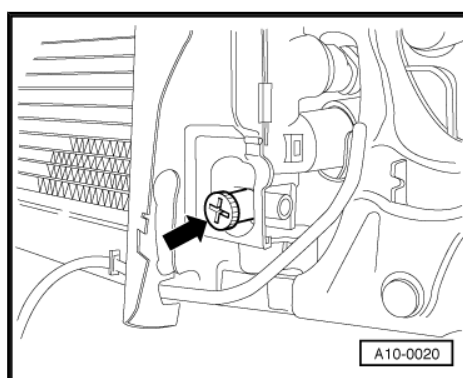
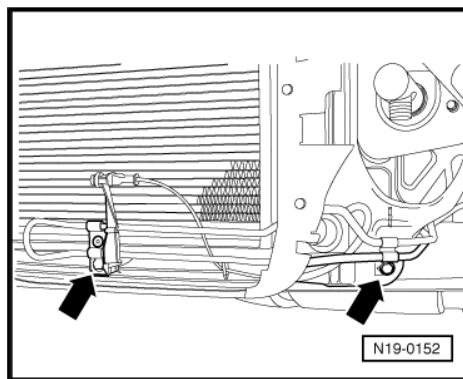
Collect drained coolant in a clean container for re-use or disposal.



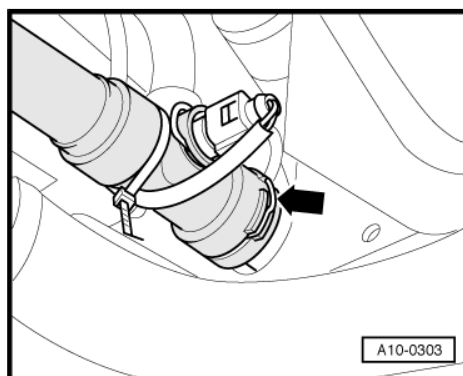
WARNING

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

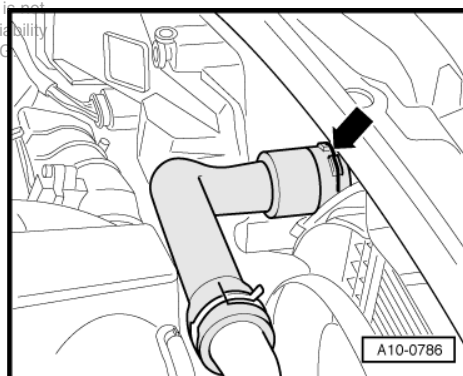
- Open filler cap on coolant expansion tank.
- Place drip tray for workshop hoist - VAS 6208- beneath engine.
- Open drain plug -arrow- on radiator, if necessary fit drain hose to connection.



- Detach coolant hose at bottom of radiator -arrow-.



- Detach coolant hose at top of radiator -arrow-.



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Vehicles with automatic gearbox:

- Remove bolts -arrows-.
- Remove air duct -1 and 2-.

Note

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

- Place used oil collection and extraction unit - V.A.G 1782- underneath.
- Detach ATF lines from radiator ⇒ Rep. gr. 37.
- Tie ATF lines up onto longitudinal member to prevent fluid escaping.

All vehicles:



WARNING

The air conditioner refrigerant circuit must not be opened.

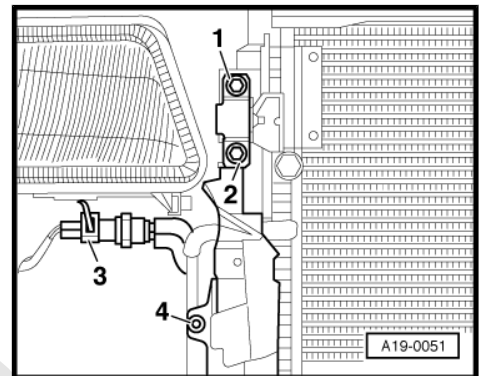
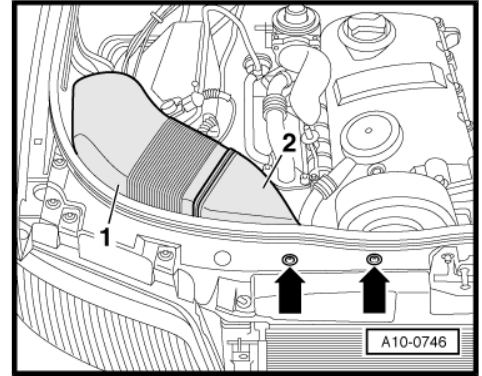
Note

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

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

Note

Protect wing panels from damage.



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

Installing

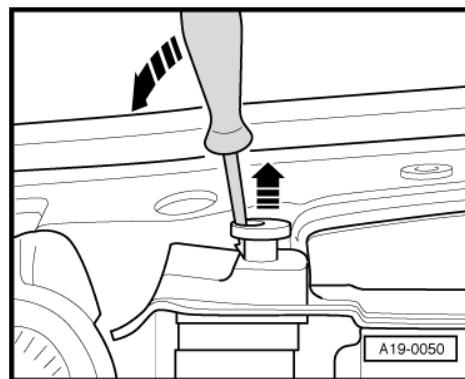
Installation is carried out in the reverse order; note the following:

Vehicles with automatic gearbox:

- Secure ATF lines ⇒ Rep. gr. 37 .

All vehicles:

- Install front bumper ⇒ Rep. gr. 63 .
- Fill up with coolant ⇒ [page 145](#) .



Note

The coolant in the entire system must be changed if the radiator is renewed.

Vehicles with automatic gearbox:

- Check ATF level ⇒ Rep. gr. 37 .

Tightening torques

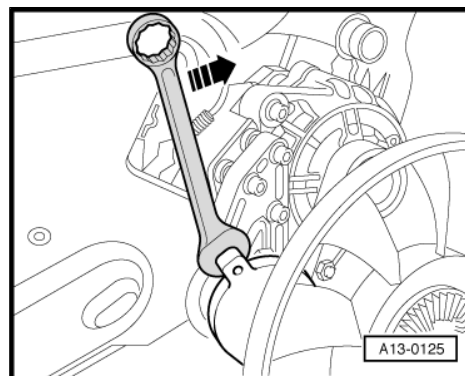
Component	Nm
Condenser to radiator	10
Cooling pipe for power steering hydraulic fluid to radiator	10
Hose clips for coolant hoses	2

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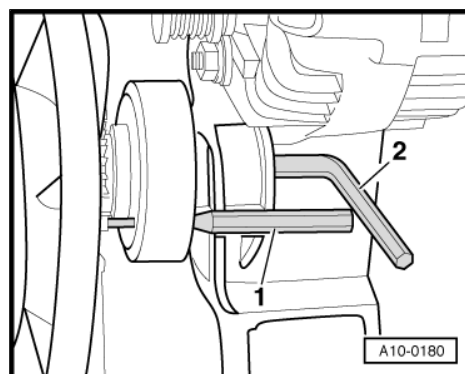
2.2 Removing and installing viscous fan

Removing

- Move lock carrier to service position ⇒ Rep. gr. 50 .
- To slacken poly V-belt turn tensioner in direction of -arrow-.
- Remove poly V-belt from the alternator pulley and release tensioner.



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



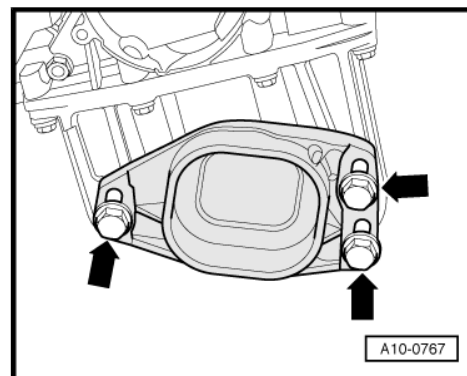
Installing

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

- Install poly V-belt ➔ [page 29](#) .
- Install lock carrier with attachments ➔ Rep. gr. 50 .
- Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight and tighten nuts -arrows-.

Tightening torque

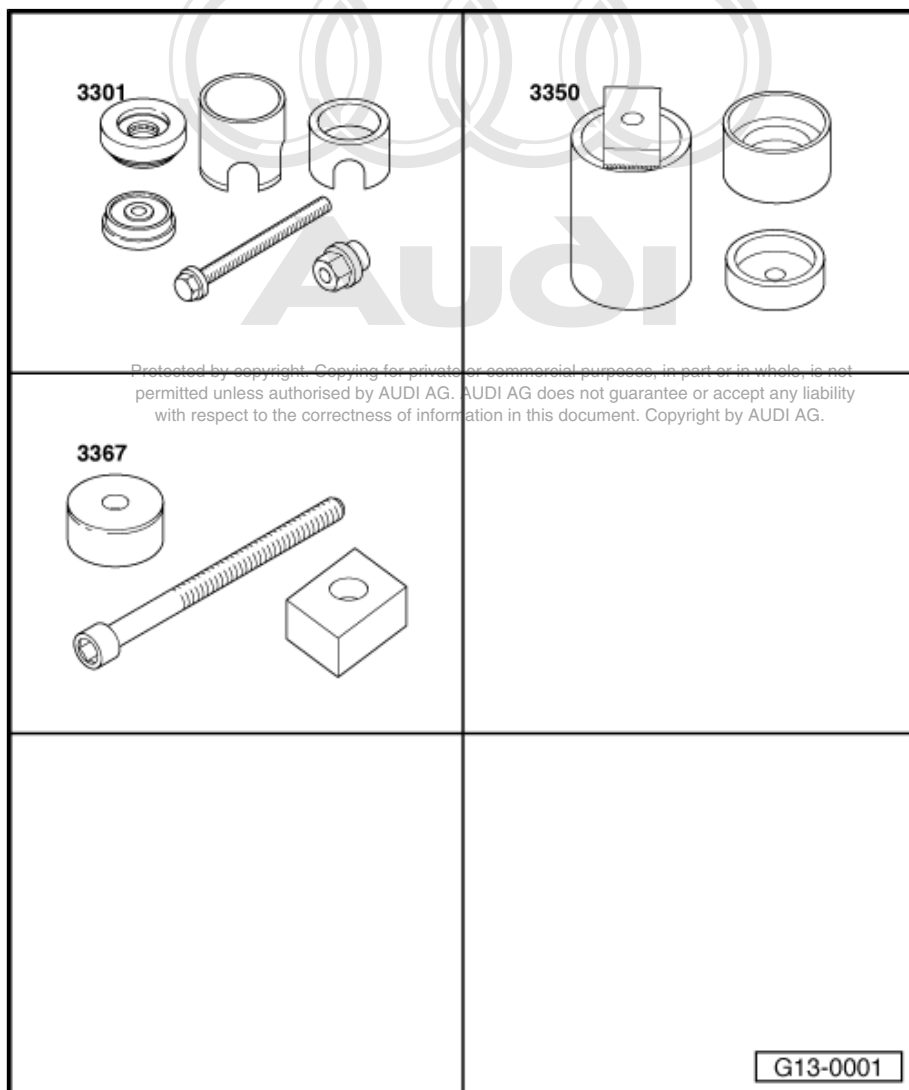
Component	Nm
Viscous fan to viscous fan bearing	45
Stop for torque reaction support to sump	28



2.3 Removing and installing viscous fan bearing

Special tools and workshop equipment required

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



Removing

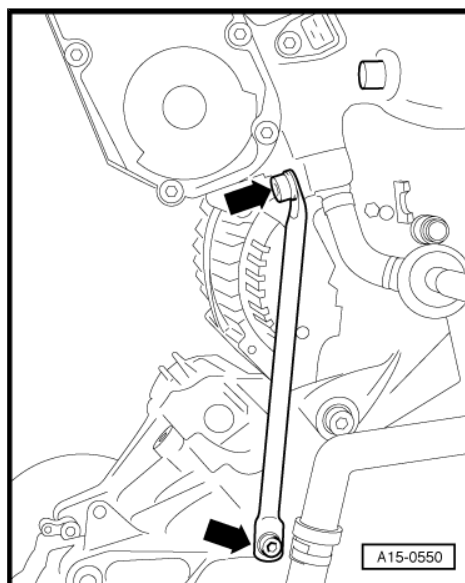
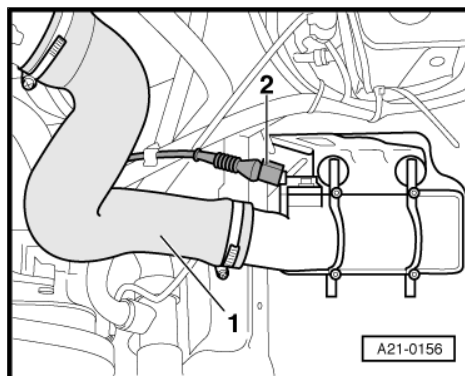
- Move lock carrier to service position ⇒ Rep. gr. 50 .
- Remove air hose -1-.



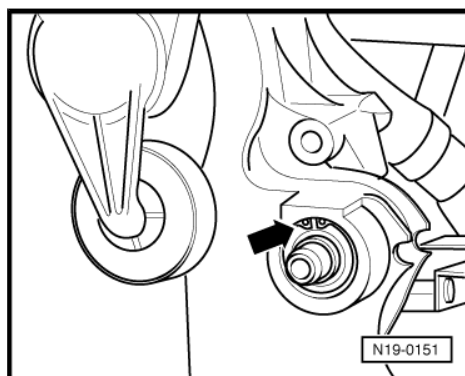
Note

Disregard -item 2-.

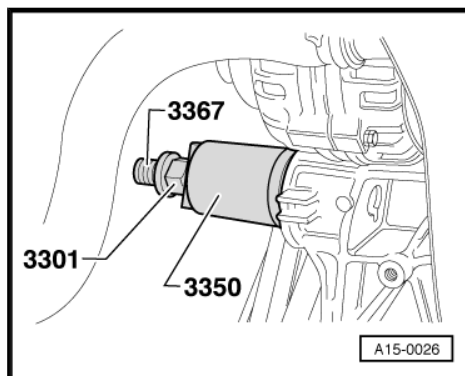
- Remove viscous fan ⇒ [page 158](#) .
- Remove support for intake manifold -arrows-.



- Remove circlip -arrow- from bearing bush.



- Pull viscous fan bearing out of bracket for ancillaries using nut from -3301- , bolt -3367/3- and tube from -3350- .

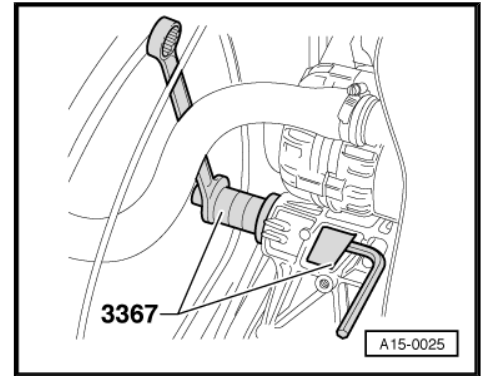


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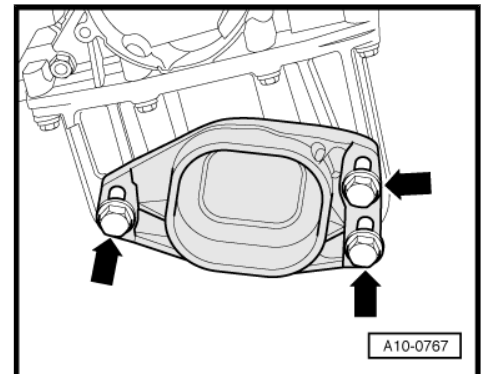
Installing

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

- Press in viscous fan bearing, using viscous fan fitting tool - 3367- and nut from -3301- .
- Fit circlip into bracket for ancillaries.
- Install viscous fan ⇒ [page 158](#) .



- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight and tighten nuts -arrows-



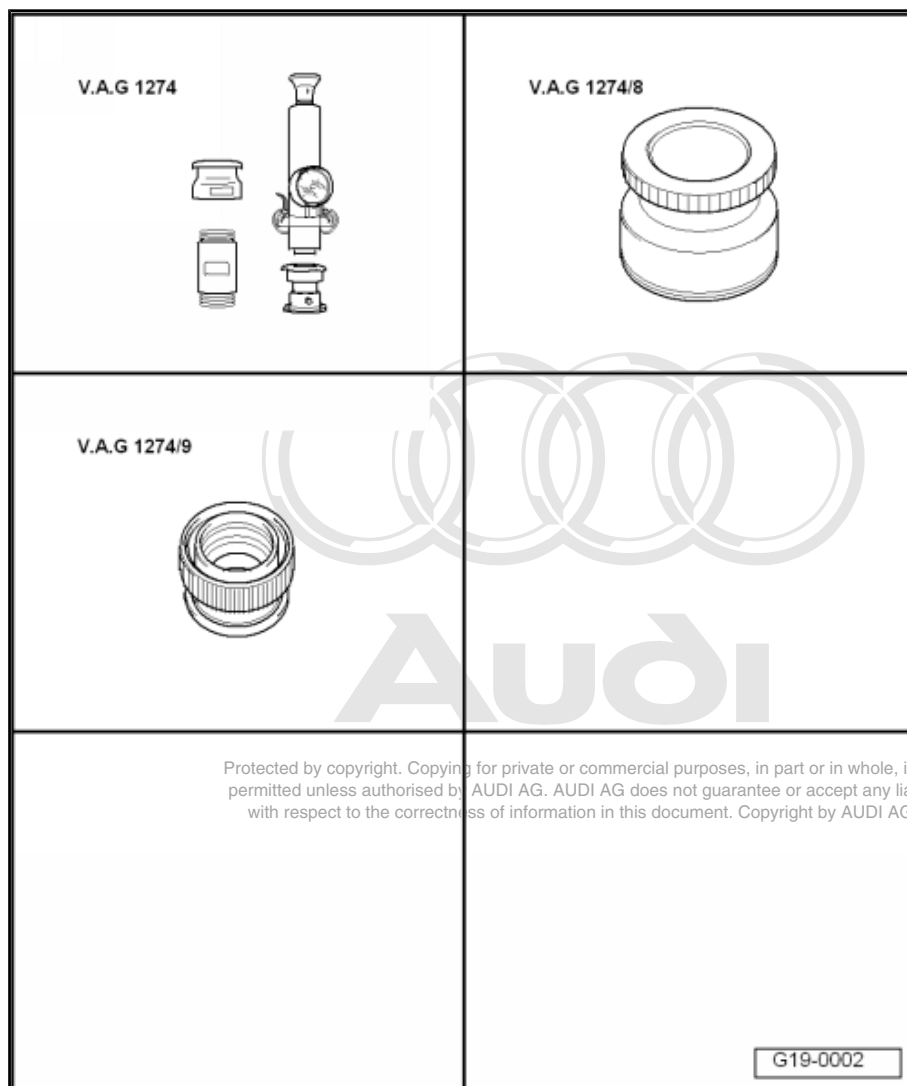
Tightening torques

Component	Nm
Support for in- take manifold	20
Bracket for ancillaries Intake manifold	20
Stop for torque reaction support to sump	28
Hose clips for air hoses	3.5

2.4 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-



Procedure

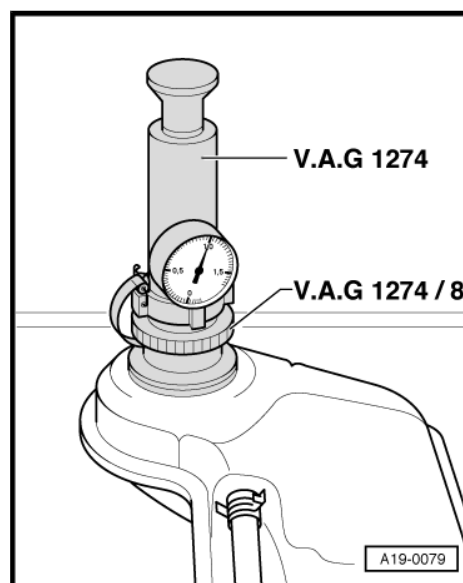
- Engine must be warm.



WARNING

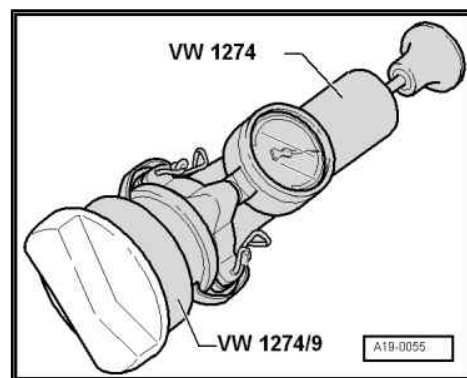
Hot steam or hot coolant can escape when expansion tank is opened; cover filler cap with cloth and open carefully.

- Open filler cap on coolant expansion tank.
- Fit cooling system tester - V.A.G 1274- with adapter - V.A.G 1274/8- onto coolant expansion tank.
- Using hand pump on cooling system tester, build up a pressure of approx. 1.0 bar.
- If this pressure is not maintained, locate and rectify leaks.



Checking pressure relief valve in filler cap

- Fit cooling system tester - V.A.G 1274- with adapter - V.A.G 1274/9- onto filler cap.
- Build up pressure with hand pump on cooling system tester.
- The pressure relief valve should open at a pressure of 1.4 ... 1.6 bar.
- Renew filler cap if pressure relief valve does not open as described.



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21 – Turbocharging/supercharging

1 Checking charge air system with turbocharger

1.1 Diagram of connections for charge pressure control system and vacuum system

Vehicles with engine code AWM

1 - Activated charcoal filter

2 - Activated charcoal filter solenoid valve 1 - N80-

3 - Non-return valve

- ☐ Between activated charcoal filter and air hose upstream of turbocharger
- ☐ Installation position: as shown in illustration, the arrow points in direction of flow

4 - Air cleaner

- ☐ With air mass meter - G70-

5 - Turbocharger

- ☐ Checking ⇒ [page 167](#)

6 - Combination valve for secondary air system

7 - Fuel pressure regulator

8 - To brake servo

9 - Non-return valve

- ☐ Between brake servo and intake manifold
- ☐ Installation position: as shown in illustration, the arrow points in direction of flow

10 - Suction-jet pump

11 - Non-return valve

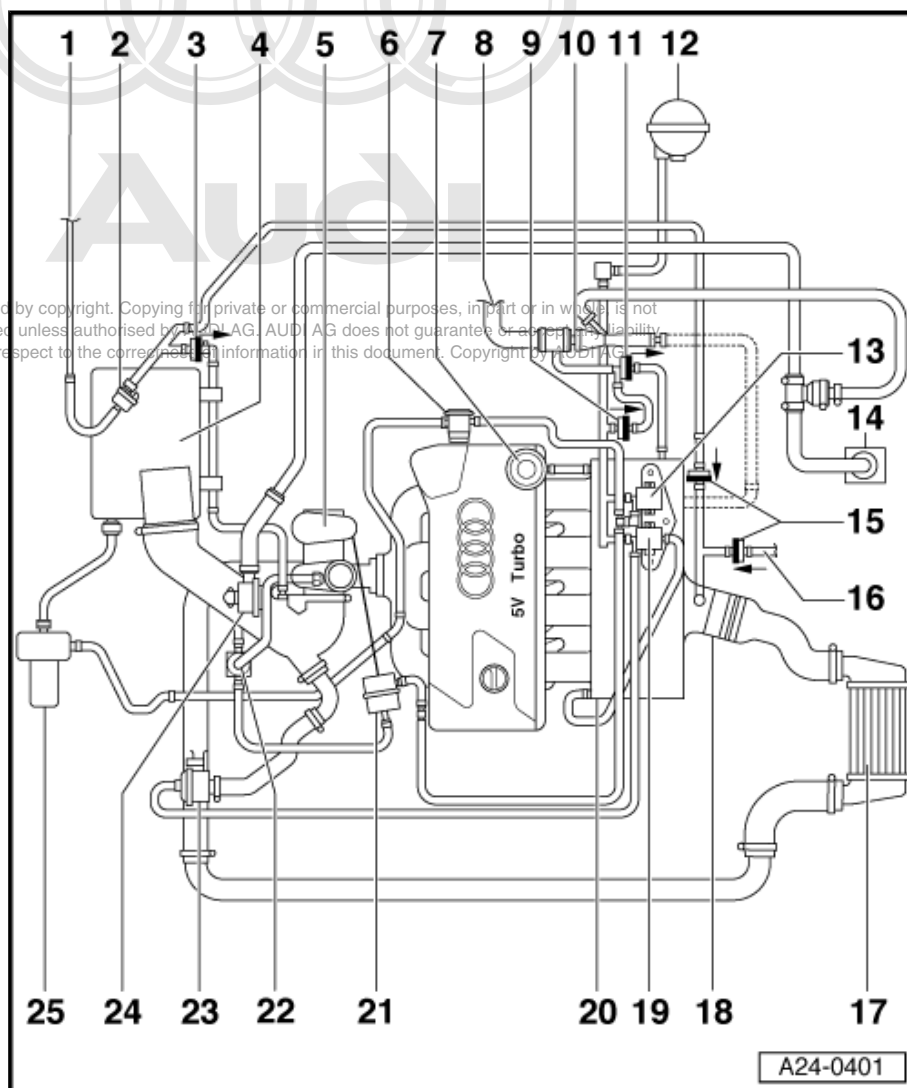
- ☐ Between brake servo and intake manifold
- ☐ Installation position: as shown in illustration, the arrow points in direction of flow

12 - Vacuum reservoir

- ☐ Fitting location: in front left wheel housing beneath liner

13 - Secondary air inlet valve - N112-

- ☐ Fitting location: below intake manifold



14 - Crankcase breather

15 - Non-return valve

- ☐ Between activated charcoal filter and intake manifold
- ☐ Installation position: as shown in illustration, the arrow points in direction of flow

16 - To fuel system diagnostic pump - V144-

17 - Charge air cooler

- ☐ With charge pressure sender - G31-
- ☐ Checking charge pressure sender - G31- ➔ [page 182](#)

18 - Throttle valve module - J338-

19 - Turbocharger air recirculation valve - N249-

- ☐ Fitting location: below intake manifold
- ☐ Checking ➔ [page 172](#)

20 - Intake manifold

- ☐ With intake air temperature sender - G42-

21 - Vacuum unit for charge pressure control

22 - Charge pressure control solenoid valve - N75-

- ☐ Checking ➔ [page 177](#)

23 - Mechanical air recirculation valve

- ☐ Checking ➔ [page 171](#)

24 - Pressure control valve for crankcase breather system

25 - Secondary air pump motor - V101-

Vehicles with engine code AWT

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1 - Activated charcoal filter

2 - Activated charcoal filter solenoid valve 1 - N80-

3 - Non-return valve

- ☐ Between activated charcoal filter and air hose upstream of turbocharger
- ☐ Installation position: as shown in illustration, the arrow points in direction of flow

4 - Air cleaner

- ☐ With air mass meter - G70-

5 - Turbocharger

- ☐ Checking ⇒ [page 167](#)

6 - Combination valve for secondary air system

7 - Fuel pressure regulator

8 - To brake servo

9 - Non-return valve

- ☐ Between brake servo and intake manifold
- ☐ Installation position: as shown in illustration, the arrow points in direction of flow

10 - Suction-jet pump

11 - Non-return valve

- ☐ Between brake servo and intake manifold
- ☐ Installation position: as shown in illustration, the arrow points in direction of flow

12 - Vacuum reservoir

- ☐ Fitting location: in front left wheel housing beneath liner

13 - Secondary air inlet valve - N112-

- ☐ Fitting location: below intake manifold

14 - Crankcase breather

15 - Non-return valve

- ☐ Between activated charcoal filter and intake manifold
- ☐ Installation position: as shown in illustration, the arrow points in direction of flow

16 - Charge air cooler

- ☐ With charge pressure sender - G31-
- ☐ Checking charge pressure sender - G31- ⇒ [page 182](#)

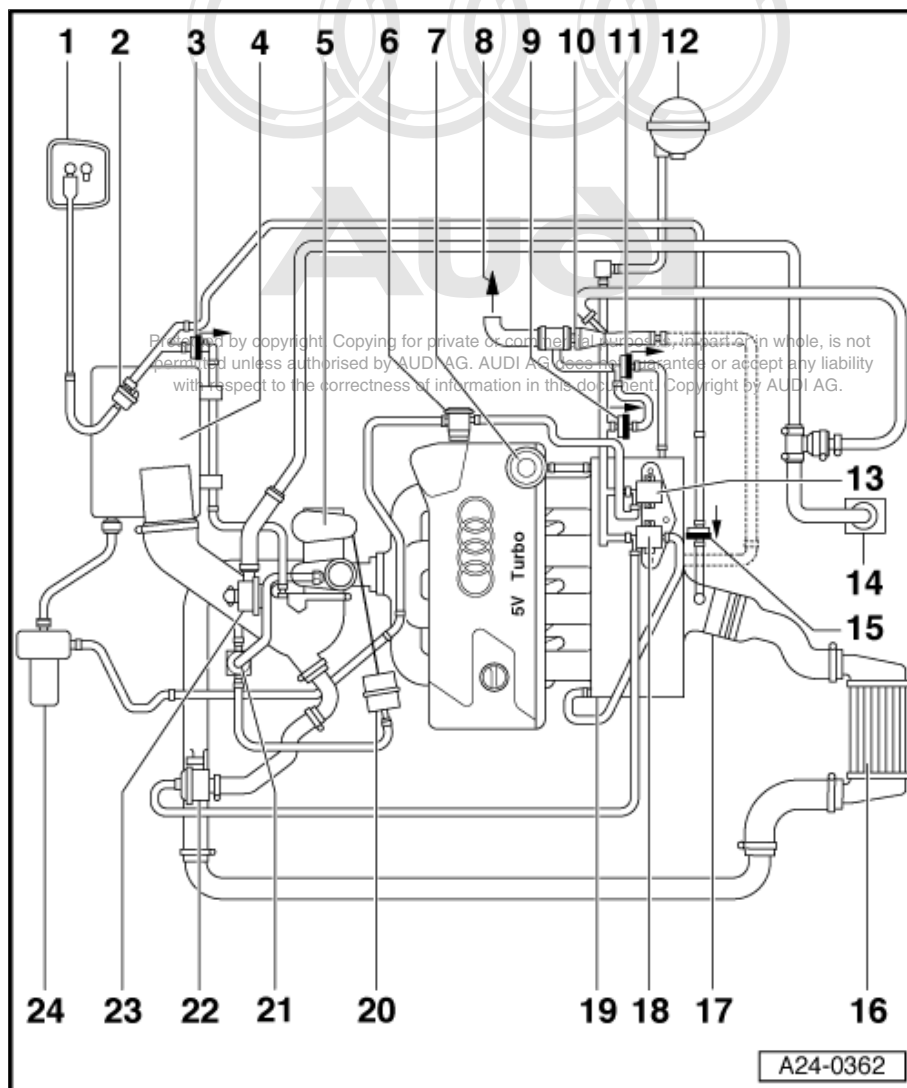
17 - Throttle valve module - J338-

18 - Turbocharger air recirculation valve - N249-

- ☐ Fitting location: below intake manifold
- ☐ Checking ⇒ [page 172](#)

19 - Intake manifold

- ☐ With intake air temperature sender - G42-



20 - Vacuum unit for charge pressure control

21 - Charge pressure control solenoid valve - N75-

□ Checking ⇒ [page 177](#)

22 - Mechanical air recirculation valve

□ Checking ⇒ [page 171](#)

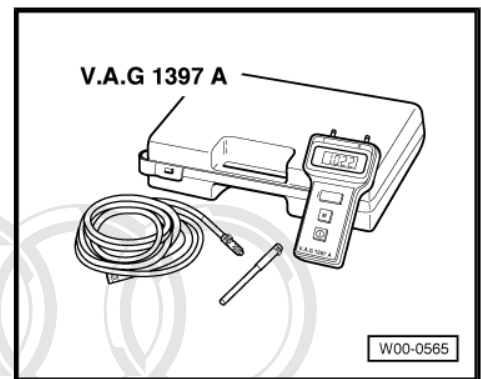
23 - Pressure control valve for crankcase breather system

24 - Secondary air pump motor - V101-

1.2 Checking turbocharger and charge pressure regulating valve

Special tools and workshop equipment required

◆ Turbocharger tester - V.A.G 1397/A-



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

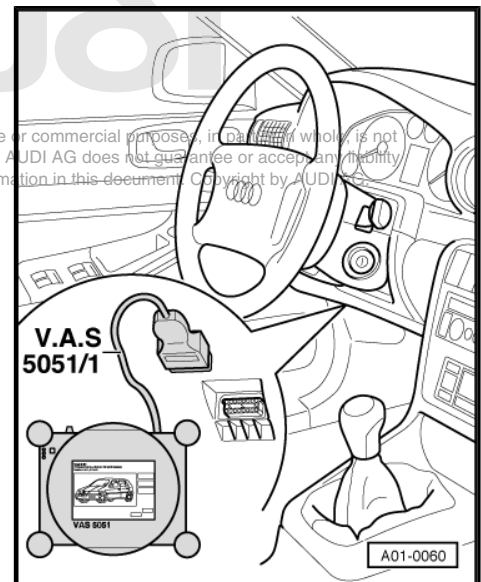
Procedure

- All hoses and pipes securely fitted and free of leaks.
- Vehicle diagnostic, testing and information system - VAS 5051B- connected.
- Fault memory interrogated, final control diagnosis performed ⇒ Vehicle diagnostic tester.

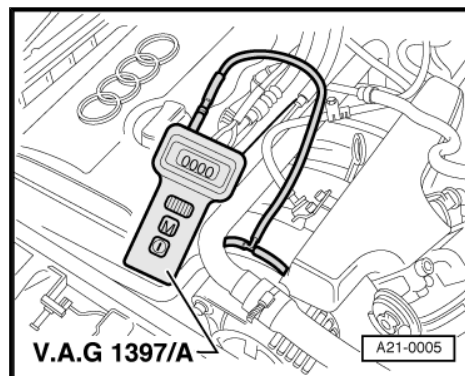


WARNING

To avoid accident risks when road testing the vehicle with test equipment, always observe the relevant safety precautions ⇒ [page 3](#).



- Connect T-piece with test hose of turbocharger tester - V.A.G 1397/A- to intake manifold (front).
- Route test hose under rear edge of bonnet and through passenger's window into passenger compartment.

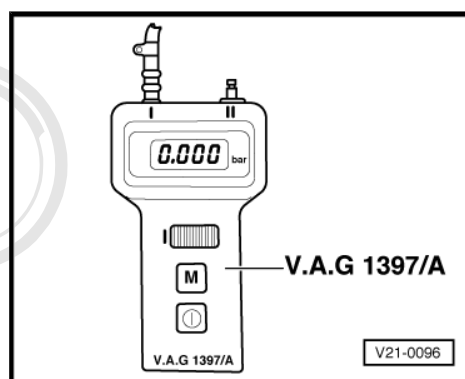


- Switch on turbocharger tester and set measuring range selector switch to position -I- (absolute pressure).
- Fit test hose to connection -I-.



Note

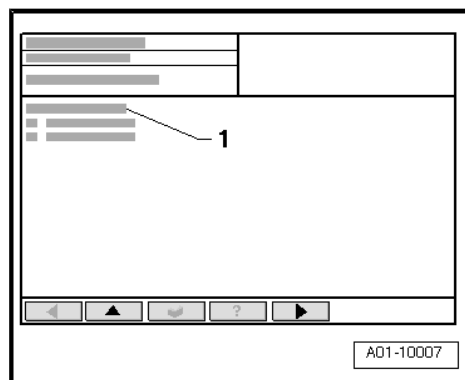
- ◆ *Hose connections must be completely airtight, otherwise measurement errors may occur.*
- ◆ *Take care not to trap test hose at bonnet and side window.*
- ◆ *Pressing memory button -M- on turbocharger tester causes last measured value to be stored until memory button -M- is pressed again or tester is switched off.*
- ◆ *The decimal point in the display flashes to indicate that the value is being stored.*
- ◆ *If the battery voltage of the turbocharger tester drops below the minimum level, an arrow will appear at the top left of the display.*
- ◆ *Before performing the test, drive vehicle moderately fast for at least 3 km (choose a route where traffic lights etc. will not hold you up).*



- Switch on ignition and start engine.

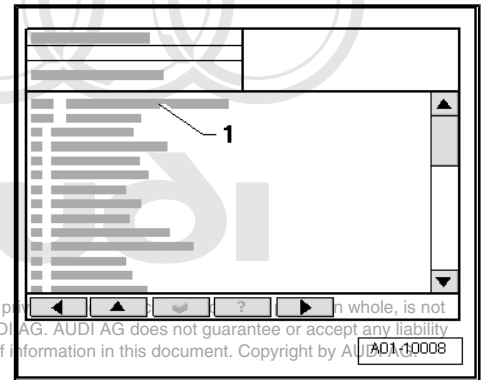
Display on -VAS 5051B- :

- From menu -1-, select “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.



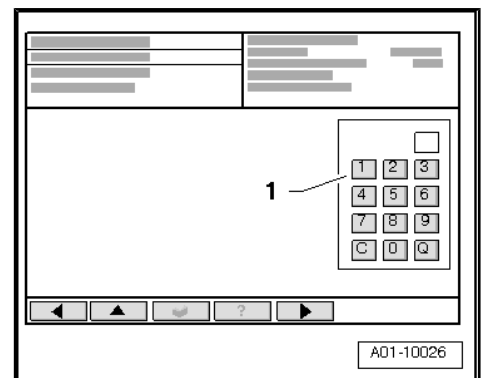
Display on -VAS 5051B- :

- From menu -1-, select function "010 - Measured values" and press  key to activate function.



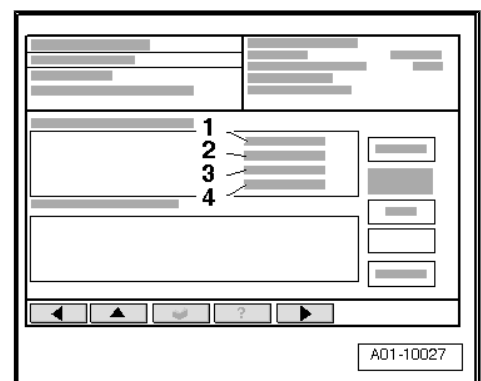
Display on -VAS 5051B- :

- Press keys    on keypad -1- to select "Display group 115" and confirm entry by pressing the  key.



Display on -VAS 5051B- :

- Check display in display zone -4-.
- Perform road test.
- Accelerate vehicle in 3rd gear from about 2000 rpm using full throttle. Observe the rev counter.
- Press  key on -VAS 5051B- and memory key -M- on -V.A.G 1397/A- simultaneously at approx. 2500 rpm.

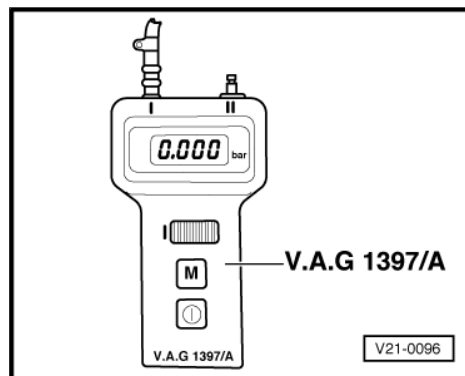


Note

The charge pressure should be measured using turbocharger tester - V.A.G 1397/A-. Vehicle diagnostic, testing and information system - VAS 5051B- is used to check whether the charge pressure is being registered by the control unit.

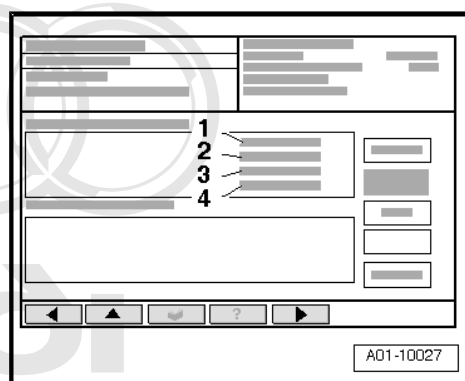
Display on -V.A.G 1397/A- :

- Specification on engine code AWM: 1.700 ... 1.800 bar.
- Specification on engine code AWT: 1.500 ... 1.600 bar.



Display on -VAS 5051B- :

- Check display in display zone -4-.
- Specification on engine code AWM: 1700 ... 1800 mbar.
- Specification on engine code AWT: 1500 ... 1600 mbar.



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Fault	Possible causes
Charge pressure below specification	◆ Charge pressure control solenoid valve - N75- defective. Checking ⇒ page 177 ◆ Hose connections to charge pressure control solenoid valve - N75- defective. Checking ⇒ "1.1 Diagram of connections for charge pressure control system and vacuum system", page 164 ◆ Charge pressure regulating valve in turbocharger stuck in open position. Renew turbocharger ⇒ page 189 ◆ Leak between turbocharger and intake manifold. Effects ⇒ page 171 ◆ Mechanical air recirculation valve defective. Checking ⇒ page 171 ◆ Turbocharger air recirculation valve - N249- defective. Checking ⇒ page 172 ◆ Turbocharger defective. Renewing ⇒ page 189
Charge pressure above specification ¹⁾	◆ Vacuum unit for charge pressure regulating valve defective. Renew turbocharger ⇒ page 189 ◆ Air leaks in hoses or connections to vacuum unit for charge pressure control (via charge pressure control solenoid valve - N75-). Checking ⇒ "1.1 Diagram of connections for charge pressure control system and vacuum system", page 164 ◆ Charge pressure regulating valve in turbocharger sticking in closed position. Renew turbocharger ⇒ page 189
• ¹⁾ If the charge pressure is too high the fuel supply will be shut off in order to protect the engine. Misfiring will then occur at high engine speeds.	

1.3 Effects of leaks

Leaks after air mass meter

◆ Effect:

Loss of power

◆ Possible causes of trouble:

- 1 - Hose connecting air mass meter to turbocharger
- 2 - Connecting hose to crankcase breather
- 3 - Connecting hose to mechanical turbocharger air recirculation valve

Leaks after turbocharger

◆ Effect:

Inadequate charge pressure

◆ Possible causes of trouble:

- 1 - Connection hoses and pipe between turbocharger and charge air cooler
- 2 - Hose between charge air coolers and intake manifold
- 3 - Charge air cooler
- 4 - Seal on charge pressure sender -G31- (in charge air cooler)
- 5 - Seal between throttle valve module and intake manifold
- 6 - Gasket between intake manifold and cylinder head

Leak on exhaust side

◆ Effect:

Inadequate charge pressure; possible smell of exhaust gas, traces of soot in engine compartment

◆ Possible causes of trouble:

- 1 - Connection between turbocharger and exhaust manifold
- 2 - Connection between exhaust manifold and cylinder head

1.4 Checking mechanical air recirculation valve



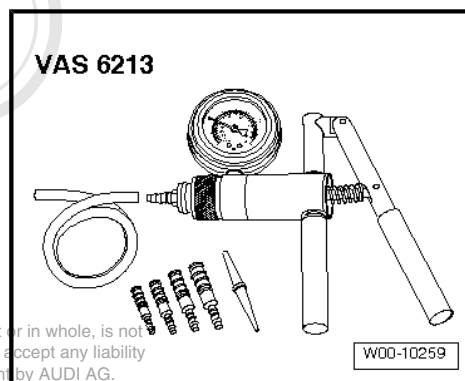
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- ◆ *The mechanical air recirculation valve is located upstream of the turbocharger. It is opened by vacuum from the air recirculation valve for turbocharger - N249- when the engine is on overrun or under part load or when idling. This dissipates the charge pressure upstream of the throttle valve and maintains a higher turbocharger speed.*
- ◆ *Check air recirculation valve in the event of loss of power or load change jolts.*

Special tools and workshop equipment required

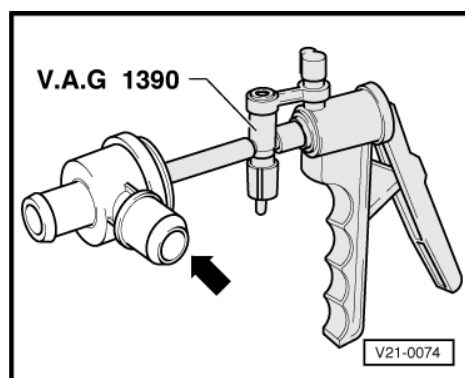
◆ Hand vacuum pump - VAS 6213-



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Procedure

- Connect hand vacuum pump to air recirculation valve.
- Operate hand vacuum pump to produce a vacuum.
- Air recirculation valve should open -arrow-
- Operate vent valve on hand vacuum pump after approx. 30 seconds.
- Air recirculation valve should close -arrow-.
- Renew the air recirculation valve if it does not open and close as specified, or if the valve plate does not seal properly when the valve is closed.



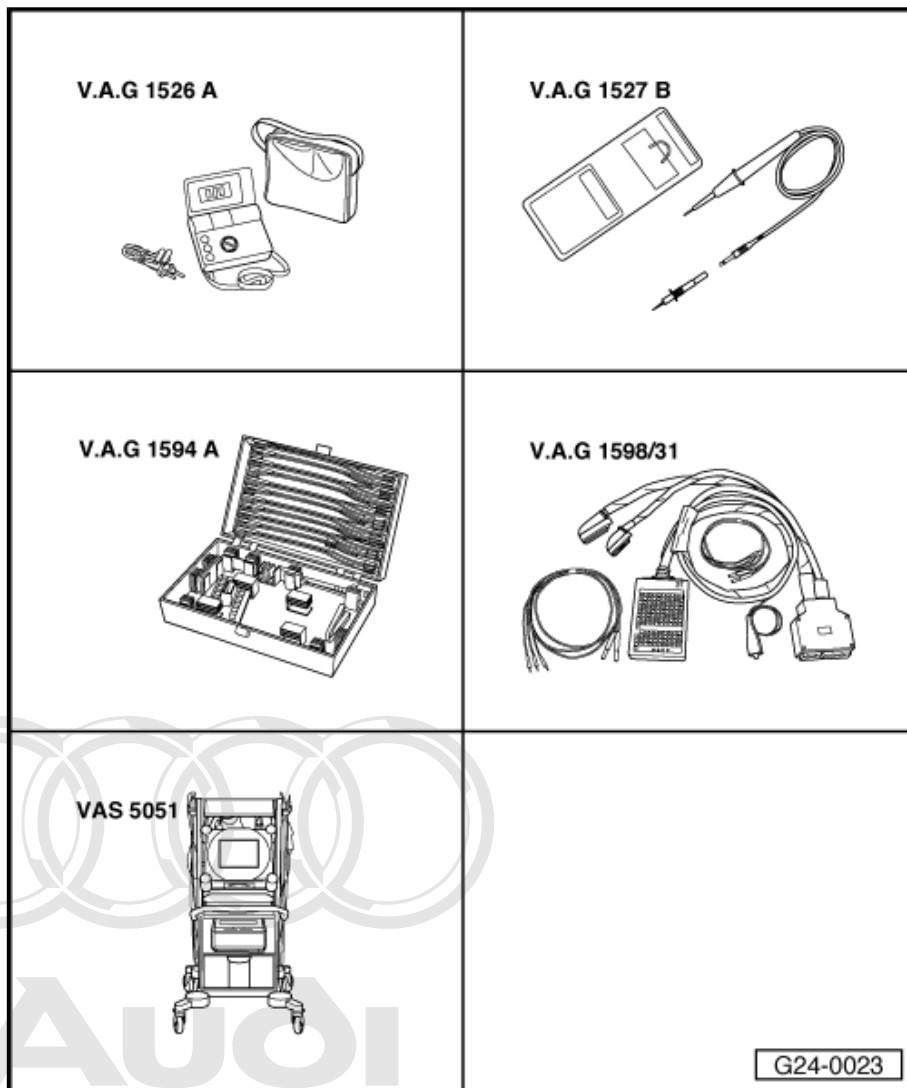
Note

Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.

1.5 Checking air recirculation valve for turbocharger - N249-

Special tools and workshop equipment required

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



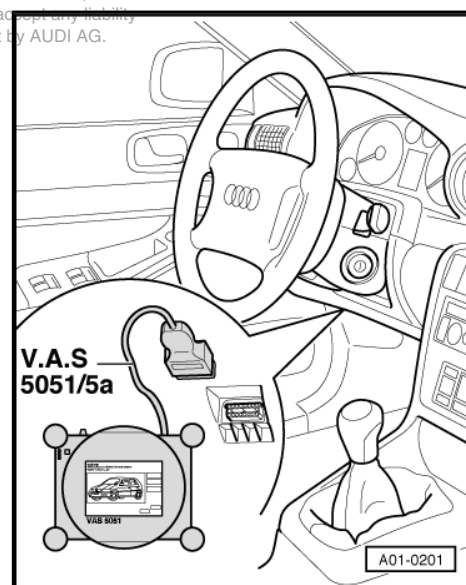
Procedure



Note

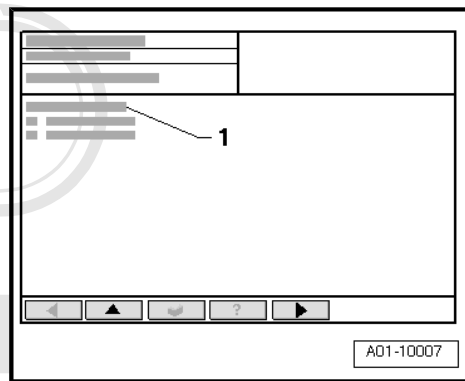
Air recirculation valve for turbocharger - N249- and its wiring are monitored by the engine control unit.

- Vehicle diagnostic, testing and information system - VAS 5051B- connected.
- Switch on ignition and start engine.



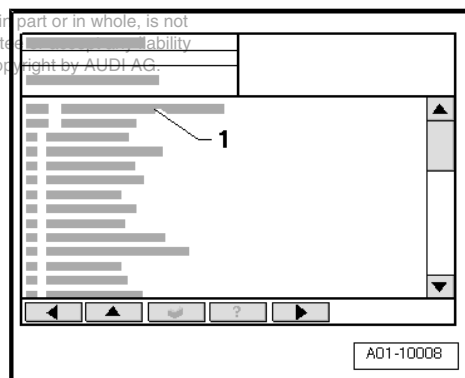
Display on -VAS 5051B- :

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



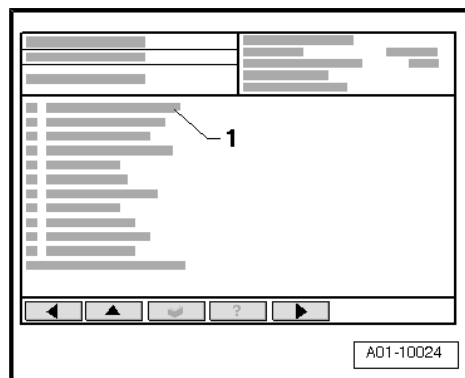
Display on -VAS 5051B-

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



Display on -VAS 5051B- :

- From menu -1-, select diagnostic function “004 - Fault memory content” and press ☐ key to activate function.

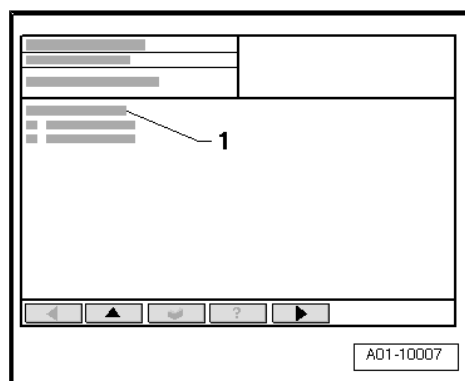


Display on -VAS 5051B- :

- From menu -1-, select diagnostic function “004.01 - Interrogate fault memory” and press ☐ key to activate function.

If the display shows a fault relating to air recirculation valve for turbocharger - N249- :

- Terminate diagnostic function “004.01 - Interrogate fault memory” by pressing ☐ key.
- Select diagnostic function “022 - End output” and switch off ignition.

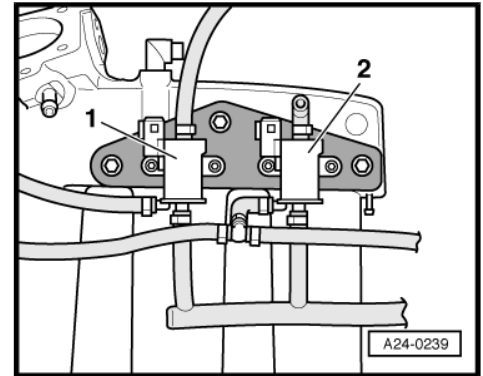


- Disconnect hoses from turbocharger air recirculation valve - N249- -item 1-; leave electrical connector attached.
- ◆ Fitting location: below intake manifold

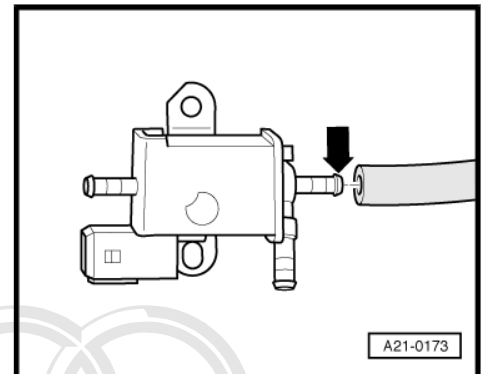


Note

The illustration shows the intake manifold from below and removed from the engine.



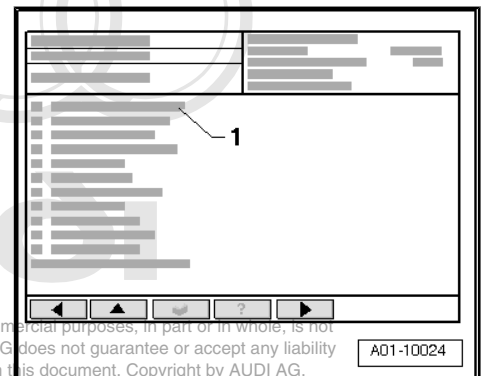
- Connect a test hose to the hose connection on the turbocharger air recirculation valve - N249- marked with an -arrow-.



- Switch on ignition and select vehicle system "01 - Engine electronics" again.

Display on -VAS 5051B- :

- From menu -1-, select diagnostic function "005 - Final control diagnosis" and press  key to activate function.



- Press the  key repeatedly until the following display appears:

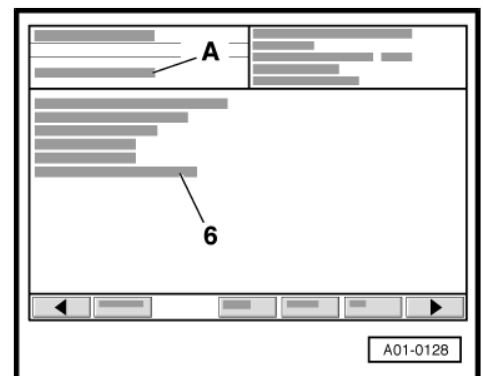
Display on -VAS 5051B- (example):

A - 6th control element being tested

6 - Turbocharger air recirculation valve - N249-

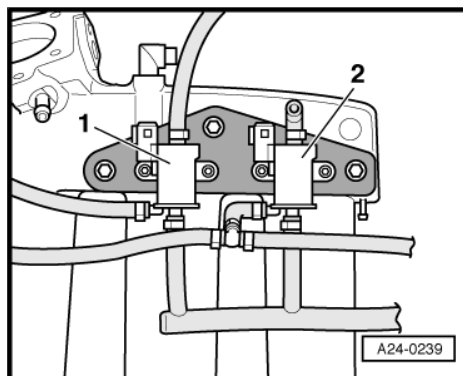
- The valve will be activated intermittently for approx. 1 minute (and should click audibly).
- The valve should open and close (check by blowing into the test hose).
- Terminate diagnostic function "005 - Final control diagnosis" by pressing  key.
- Select diagnostic function "022 - End output" and switch off ignition.

If the valve is not activated (does not click):



Checking internal resistance

- Unplug electrical connector at turbocharger air recirculation valve - N249- -item 1-.

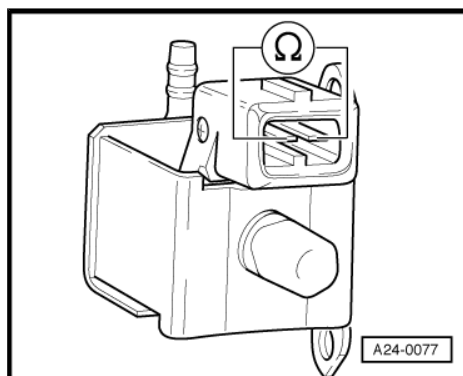


- Connect multimeter to turbocharger air recirculation valve - N249- (resistance measurement range).
- Specification: 27 ... 30 Ω .
- If reading does not match specification, renew turbocharger air recirculation valve - N249- .

If the specification is attained:

Checking voltage supply

- Fuse for turbocharger air recirculation valve - N249- OK $\Rightarrow$ Current flow diagrams, Electrical fault finding and Fitting locations.
- Fuel pump relay - J17- OK; checking $\Rightarrow$ Rep. gr. 24



Note

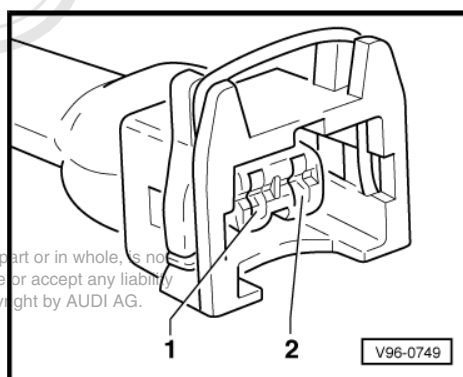
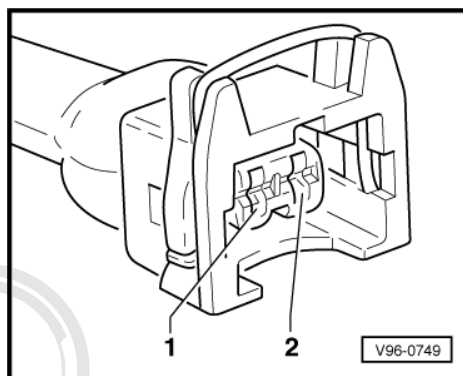
Turbocharger air recirculation valve - N249- is supplied with power via fuel pump relay - J17- .

- Connect voltage tester - V.A.G 1527B- between contact -1- of connector for turbocharger air recirculation valve - N249- and earth “-”.
- Briefly operate starter.
- The LED should light up.
- If LED does not light up, check for open circuit in wiring from contact -1- of connector for turbocharger air recirculation valve - N249- via fuse to fuel pump relay - J17- $\Rightarrow$ Current flow diagrams, Electrical fault finding and Fitting locations.
- If necessary repair wiring connection.

If the LED lights up:

Checking activation

- Connect voltage tester - V.A.G 1527B- between contacts -1- and -2- of connector for turbocharger air recirculation valve - N249- .



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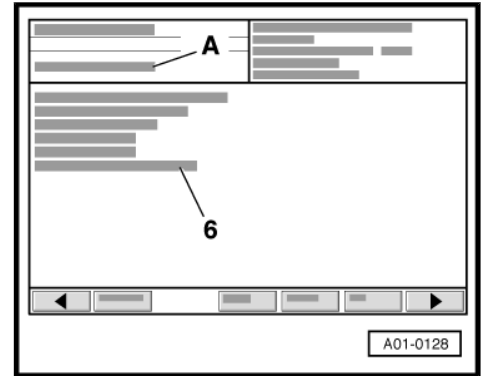
- Switch on ignition and select vehicle system “01 - Engine electronics” again.
- Repeat diagnostic function “005 - Final control diagnosis”.
- Press the  key repeatedly until the following display appears:

Display on -VAS 5051B- (example):

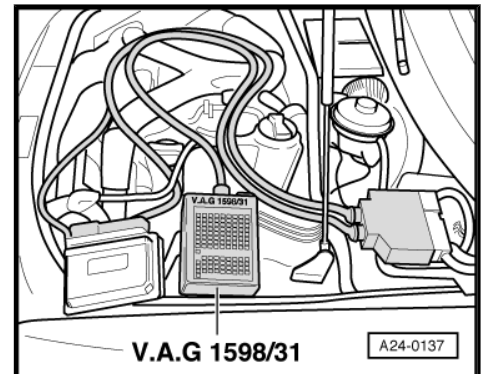
A - 6th control element being tested

6 - Turbocharger air recirculation valve - N249-

- The LED should flash.



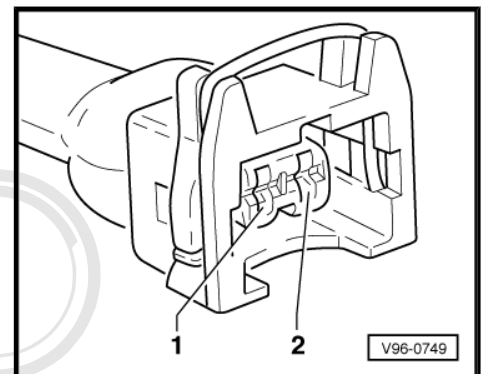
- If LED does not flash or lights up continuously, connect adapter cable, 121-pin - V.A.G 1598/31- (test box) to connectors of wiring harness; do not connect engine control unit. Connect earth clip of test box to earth ⇒ Rep. gr. 24 .



- Check for open circuit and short to positive or earth in the following wiring for turbocharger air recirculation valve - N249- .

Connector Contact	-V.A.G 1598/31- Socket
-2-	105

- If necessary repair wiring connection.

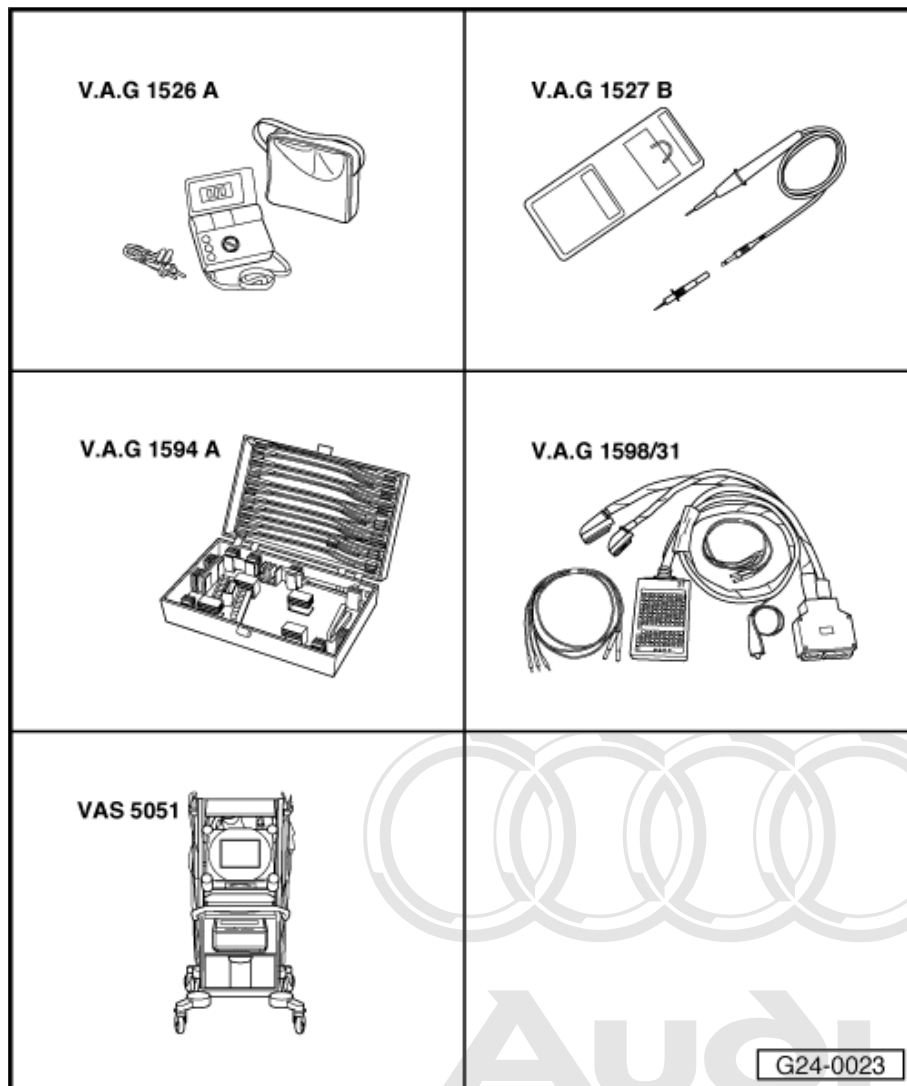


1.6 Checking charge pressure control solenoid valve - N75-

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Special tools and workshop equipment required

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



Procedure

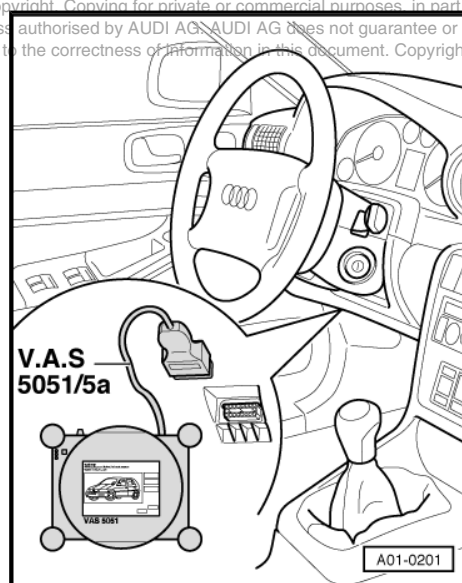


Note

The charge pressure control solenoid valve - N75- and its wiring are monitored by the engine control unit.

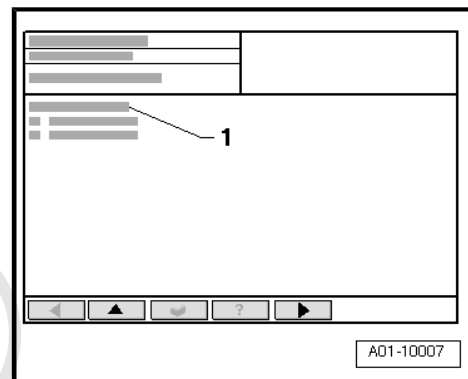
- Vehicle diagnostic, testing and information system - VAS 5051B- connected.
- Switch on ignition and start engine.

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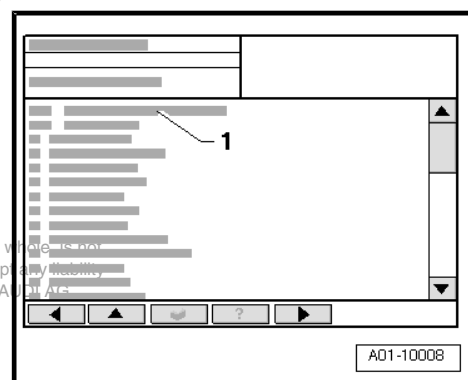
Display on -VAS 5051B- :

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



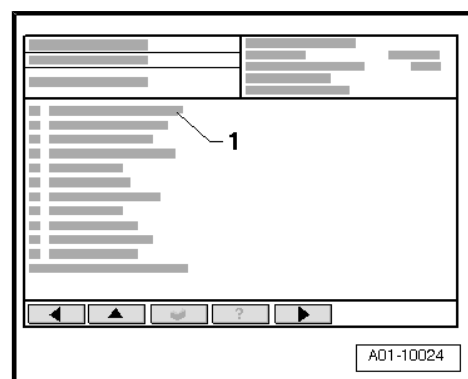
Display on -VAS 5051B- :

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



Display on -VAS 5051B- :

- From menu -1-, select diagnostic function “004 - Fault memory content” and press  key to activate function.



Display on -VAS 5051B- :

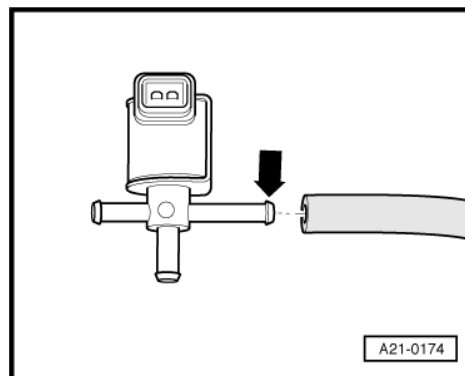
- From menu -1-, select diagnostic function “004.01 - Interrogate fault memory” and press  key to activate function.

If the display shows a fault relating to charge pressure control solenoid valve - N75- :

- Terminate diagnostic function “004.01 - Interrogate fault memory” by pressing  key.
- Select diagnostic function “022 - End output” and switch off ignition.



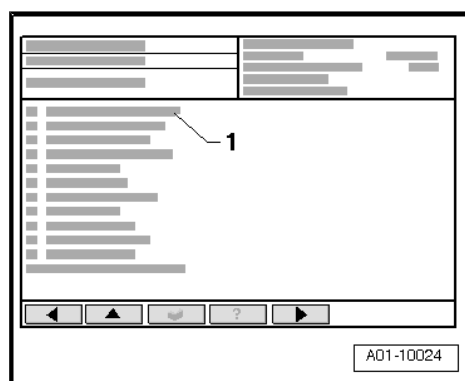
- Detach hoses from charge pressure control solenoid valve - N75- ; leave electrical connector attached.
- Connect test hose to hose connection on charge pressure control solenoid valve - N75- marked with an -arrow-.



- Switch on ignition and select vehicle system “01 - Engine electronics” again.

Display on -VAS 5051B- :

- From menu -1-, select diagnostic function “005 - Final control diagnosis” and press  key to activate function.



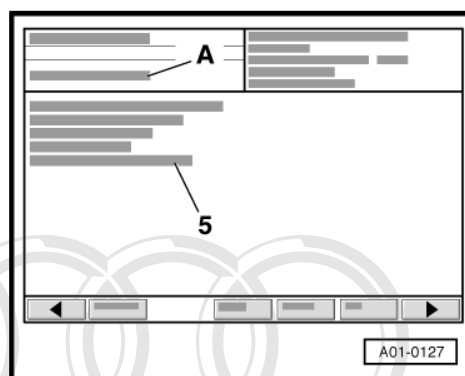
- Press the  key repeatedly until the following display appears:

Display on -VAS 5051B- (example):

A - 5th control element being tested

5 - Charge pressure control solenoid valve - N75-

- The valve will be activated intermittently for approx. 1 minute (and should click audibly).
- The valve should open and close (check by blowing into the test hose).
- Terminate diagnostic function “005 - Final control diagnosis” by pressing  key.
- Select diagnostic function “022 - End output” and switch off ignition.



If the valve is not activated (does not click):

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Checking internal resistance

- Unplug electrical connector at charge pressure control solenoid valve - N75- .
- Connect hand-held multimeter - V.A.G 1526C- to measure resistance between contacts on charge pressure control solenoid valve - N75- .
- Specification: 25 ... 35 Ω .
- If reading does not match specification, renew charge pressure control solenoid valve - N75- .

If the specification is attained:

Checking voltage supply

- Fuse for charge pressure control solenoid valve - N75- OK
⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- Fuel pump relay - J17- OK; checking ⇒ Rep. gr. 24



Note

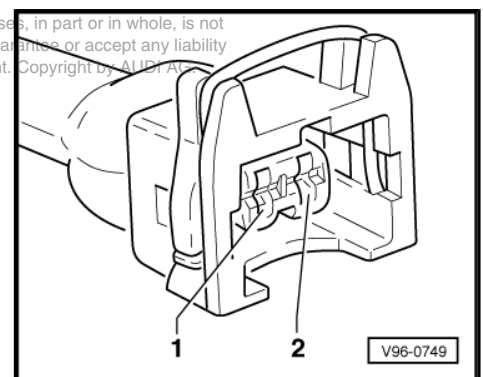
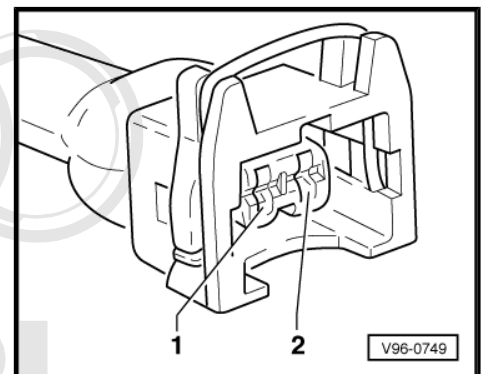
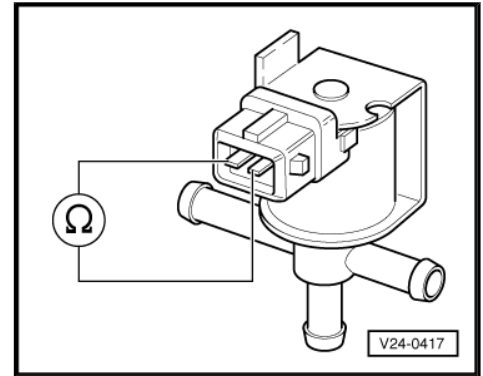
Charge pressure control solenoid valve - N75- is supplied with power via fuel pump relay - J17- .

- Connect voltage tester - V.A.G 1527B- between contact -1- of connector for charge pressure control solenoid valve - N75- and earth “-”.
- Briefly operate starter.
- The LED should light up.
- If LED does not light up, check for open circuit in wiring from contact -1- of connector for charge pressure control solenoid valve - N75- via fuse to fuel pump relay - J17- ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- If necessary repair wiring connection.

If the LED lights up:

Checking activation

- Connect voltage tester - V.A.G 1527B- between contacts -1- and -2- of connector for charge pressure control solenoid valve - N75- .



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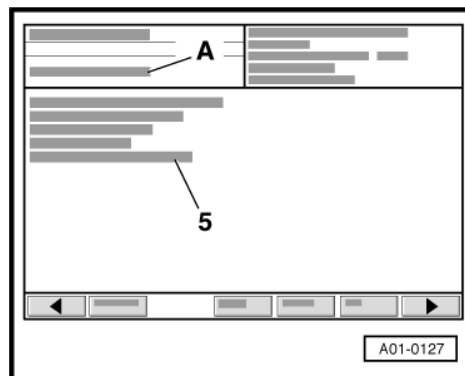
- Switch on ignition and select vehicle system “01 - Engine electronics” again.
- Repeat diagnostic function “005 - Final control diagnosis”.
- Press the key repeatedly until the following display appears:

Display on -VAS 5051B- (example):

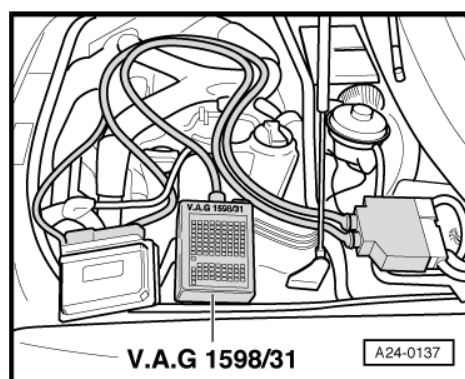
A - 5th control element being tested

5 - Charge pressure control solenoid valve - N75-

- The LED should flash.



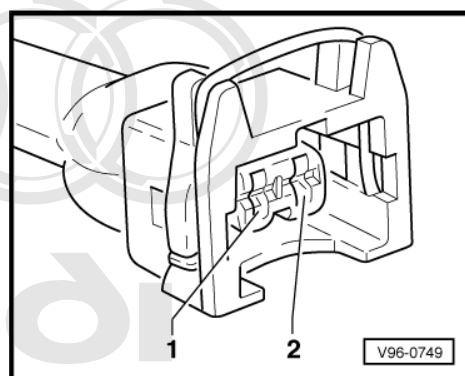
- If LED does not flash or lights up continuously, connect adapter cable, 121-pin - V.A.G 1598/31- (test box) to connectors of wiring harness; do not connect engine control unit. Connect earth clip of test box to earth ⇒ Rep. gr. 24 .



- Check for open circuit and short to positive or earth in the following wiring for charge pressure control solenoid valve - N75- .

Connector Contact	-V.A.G 1598/31- Socket
-2-	104

- If necessary repair wiring connection.

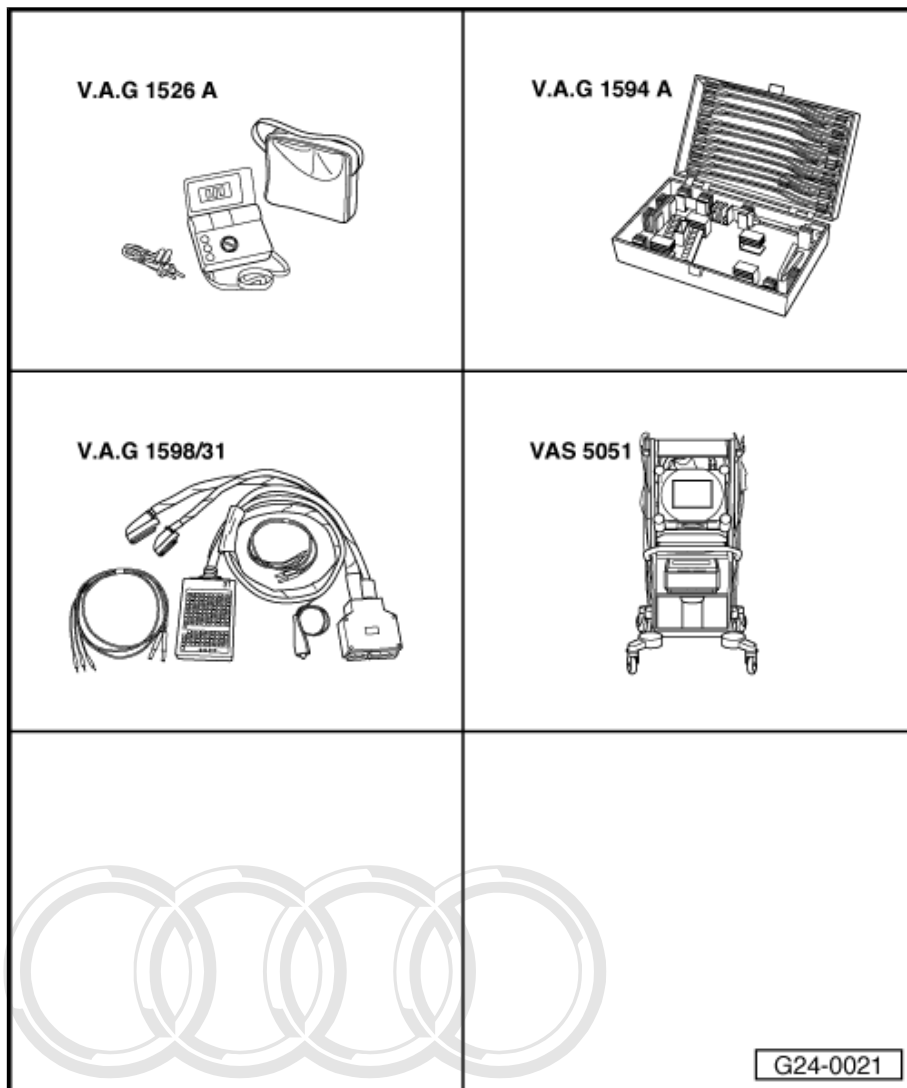


1.7 Checking charge pressure sender - G31-

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Special tools and workshop equipment required

- ◆ Hand-held multimeter - V.A.G 1526C-
- ◆ Auxiliary measuring set - V.A.G 1594C-
- ◆ Adapter cable, 121-pin - V.A.G 1598/31- (test box)
- ◆ Vehicle diagnostic, testing and information system - VAS 5051B-



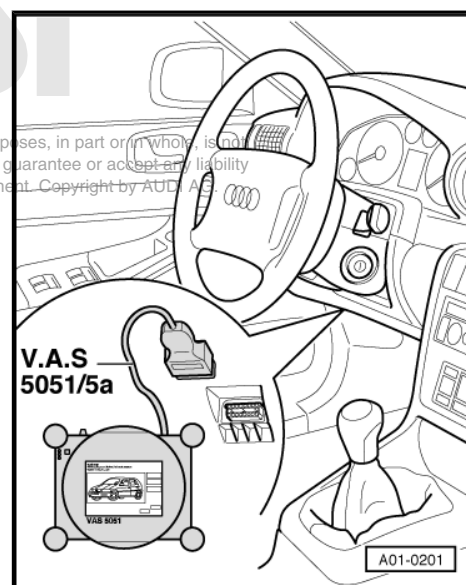
Procedure



Note

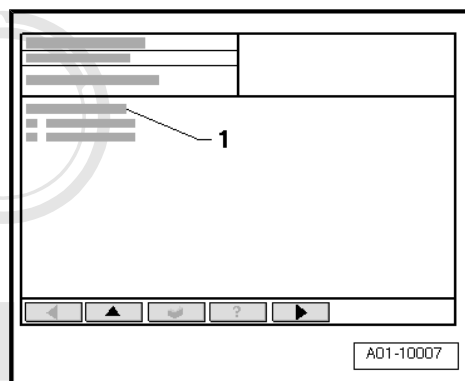
The charge pressure sender - G31- and the wiring connections are monitored by the engine control unit.

- Vehicle diagnostic, testing and information system - VAS 5051B- connected.
- Switch on ignition and start engine.



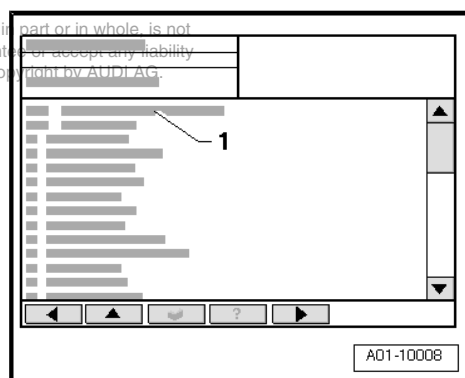
Display on -VAS 5051B- :

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



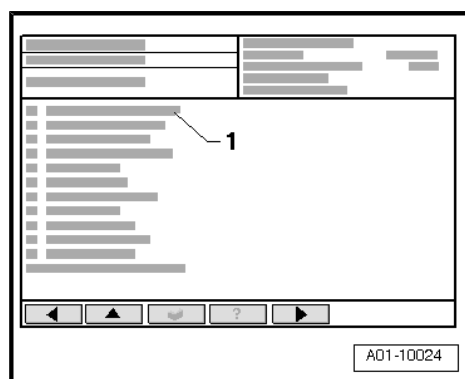
Display on -VAS 5051B-

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



Display on -VAS 5051B- :

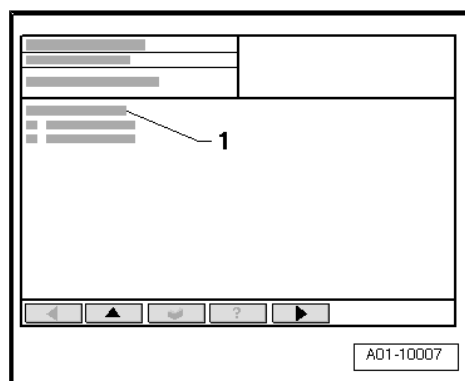
- From menu -1-, select diagnostic function “004 - Fault memory content” and press  key to activate function.



Display on -VAS 5051B- :

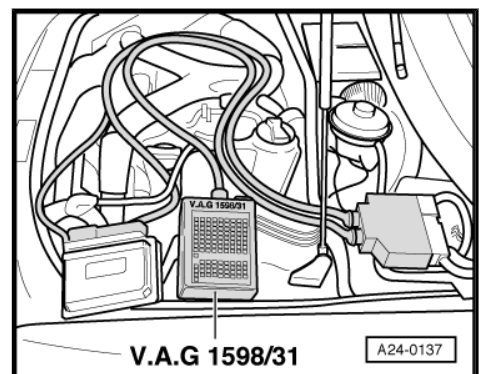
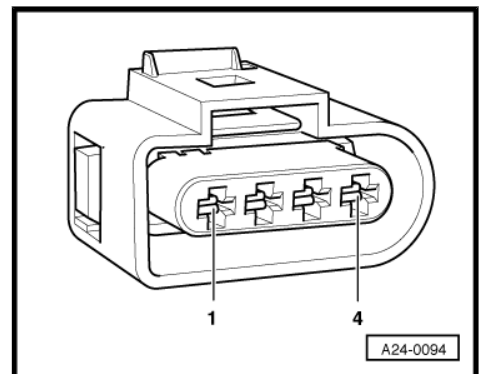
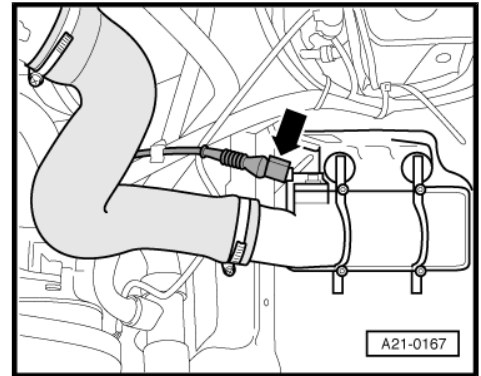
- From menu -1-, select diagnostic function “004.01 - Interrogate fault memory” and press  key to activate function.
- Terminate diagnostic function “004.01 - Interrogate fault memory” by pressing  key.

If a fault relating to charge pressure sender - G31- is displayed:



Checking voltage supply

- Fuse for charge pressure sender - G31- OK ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- Unplug electrical connector -arrow- at charge pressure sender - G31- .
- Connect hand-held multimeter - V.A.G 1526C- between contact -1 and 3- of connector for charge pressure sender - G31- .
- Switch on ignition.
- Specification: approx. 5 V.
- If specification is not attained, connect adapter cable, 121-pin - V.A.G 1598/31- (test box) to connectors of wiring harness; do not connect engine control unit. Connect earth clip of test box to earth ⇒ Rep. gr. 24 .

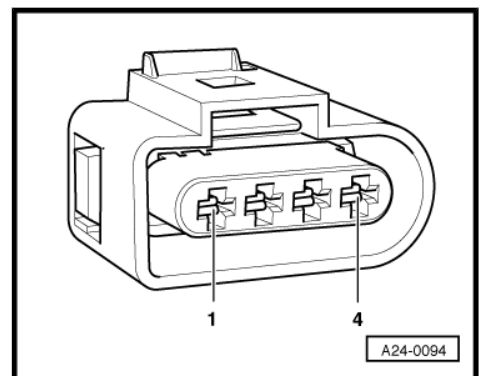


- Check for open circuit and short to positive or earth in the following wiring for charge pressure sender - G31- :

Connector Contact	-V.A.G 1598/31- Socket
-1-	108
-3-	98

- If necessary repair wiring connection.

If the specification is attained:



Audi

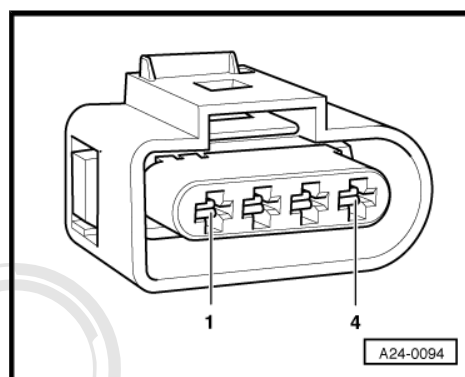
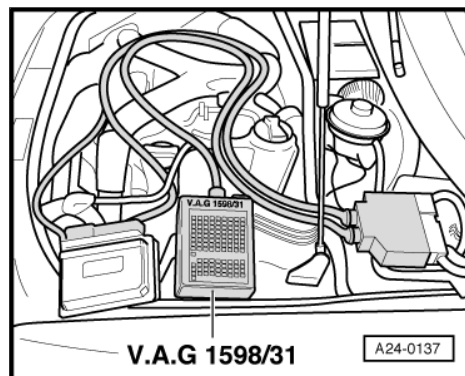
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Checking signal wire

- Connect electrical connector to charge pressure sender - G31- .
- Connect multimeter (voltage measurement range) between socket "101" and socket "108" of adapter cable, 121-pin - V.A.G 1598/31- .
- Start the engine and run at idling speed.
 - Specification: approx. 1.90 V.
- Increase engine speed by operating throttle quickly.
 - Specification: 2.00 ... 3.00 V.
- If specifications are not attained, check for open circuit and short to positive or earth in the following wiring for charge pressure sender - G31- :

Connector Contact	-V.A.G 1598/31- Socket
-4-	101

- If necessary repair wiring connection.



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2 Turbocharger and charge air cooler

2.1 Turbocharger - exploded view

Part 1

1 - 30 Nm

- ☐ Use only genuine bolts
⇒ Parts catalogue

2 - Gasket

- ☐ Renew

3 - Catalytic converter

- ☐ Removing and installing
⇒ [page 210](#)

4 - 30 Nm

- ☐ Renew

5 - Threaded connection, 30 Nm

6 - Threaded connection, 35 Nm

7 - Oil supply line

- ☐ Tighten union nut to 23 Nm
- ☐ From oil filter bracket
⇒ [Item 24 \(page 136\)](#)

8 - 3.5 Nm

9 - Heat shield

10 - 23 Nm

11 - Exhaust manifold

- ☐ Removing and installing
⇒ [page 213](#)

12 - 35 Nm

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

13 - 10 Nm

14 - Banjo bolt, 30 Nm

15 - Gasket

- ☐ Renew
- ☐ Note installation position

16 - Coolant return hose/pipe

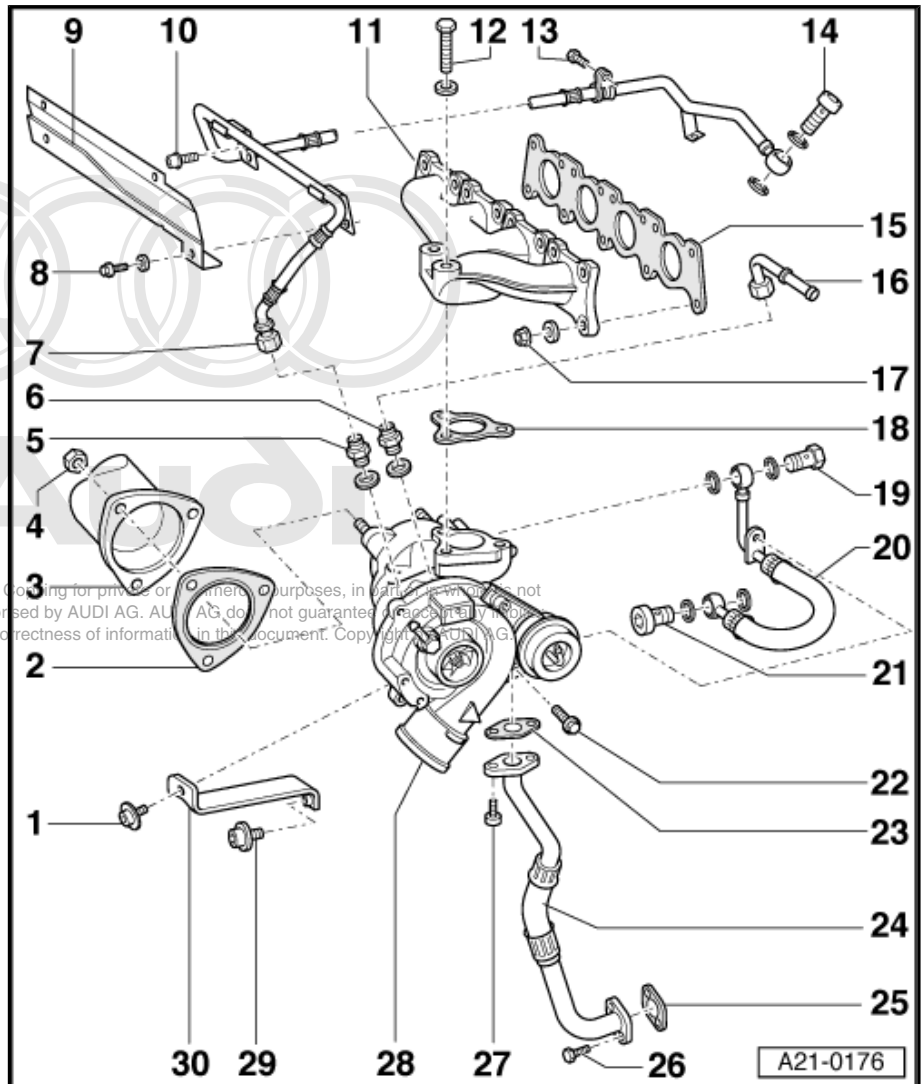
- ☐ Tighten union nut to 30 Nm

17 - 30 Nm

- ☐ Renew

18 - Gasket

- ☐ Renew





- ☐ Note installation position

19 - Banjo bolt, 35 Nm

20 - Coolant supply line

21 - Banjo bolt, 35 Nm

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

22 - 10 Nm

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

23 - Gasket

- ☐ Renew

24 - Oil return line

- ☐ To sump

25 - Gasket

- ☐ Renew

26 - 10 Nm

27 - 10 Nm

28 - Turbocharger

- ☐ Checking ⇒ [page 167](#)

29 - 25 Nm

30 - Bracket

Part 2



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1 - Vacuum hose

- ☐ To turbocharger air recirculation valve - N249-

2 - Mechanical air recirculation valve

- ☐ Checking ⇒ [page 171](#)

3 - Hose

4 - Air hose

- ☐ To turbocharger

5 - Hose

- ☐ To activated charcoal filter solenoid valve 1 - N80-

6 - Crankcase breather pipe

7 - 10 Nm

8 - Hose

9 - Pressure control valve for crankcase breather system

10 - Hose

- ☐ To turbocharger

11 - Hose

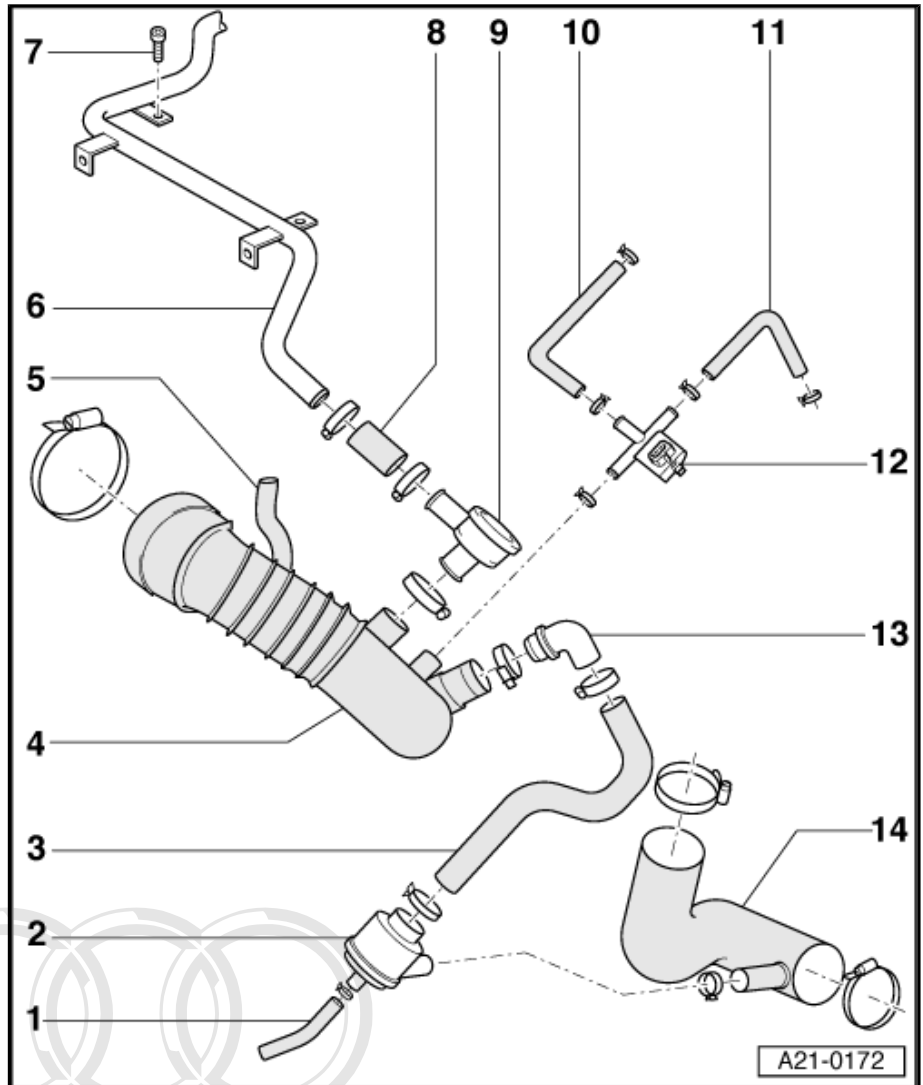
- ☐ To vacuum unit for charge pressure regulating valve

12 - Charge pressure control solenoid valve - N75-

13 - Elbow

14 - Air hose

- ☐ From turbocharger

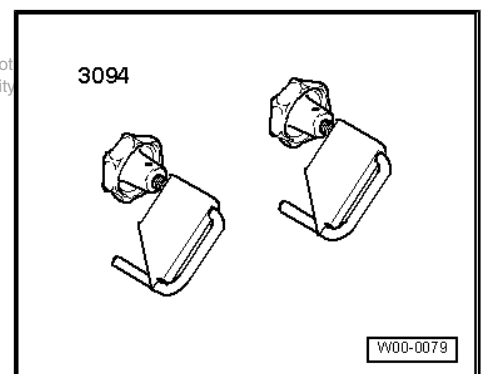


2.2 Removing and installing turbocharger

Special tools and workshop equipment required

- ◆ Hose clamps up to Ø 25 mm - 3094-

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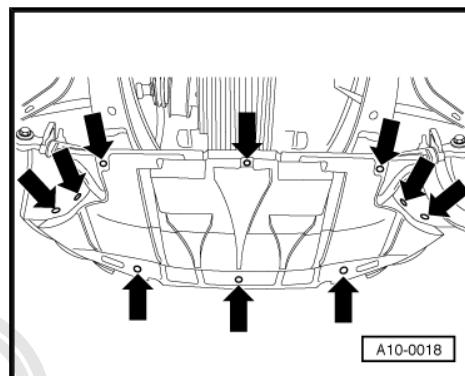
Removing



Note

Fit all heat insulation sleeves in the original position when installing.

- Release fasteners -arrows- and remove noise insulation.



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

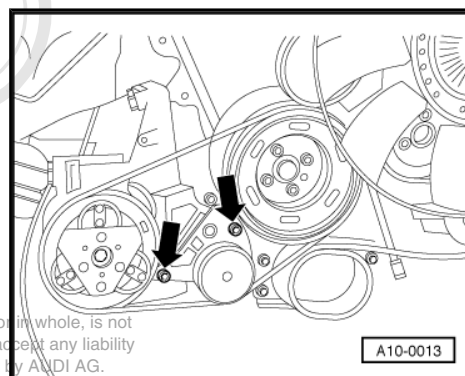


WARNING

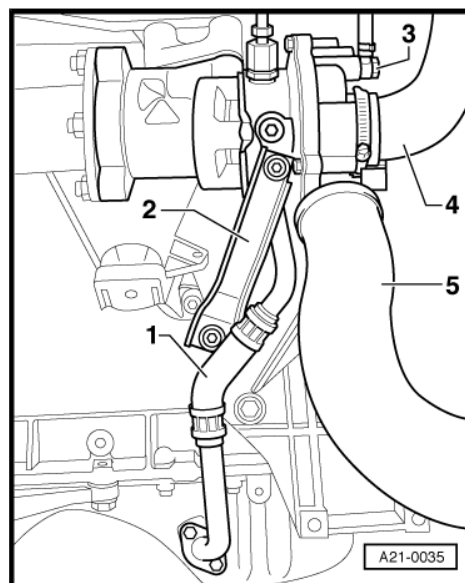
The air conditioner refrigerant circuit must not be opened.

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

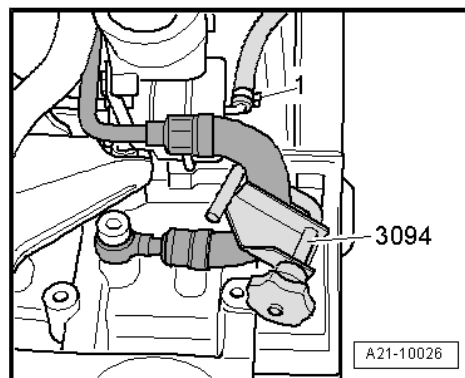
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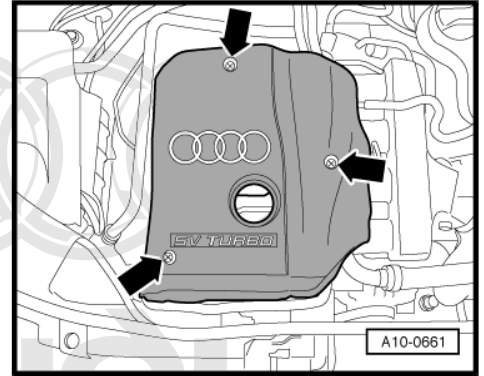
- Remove bracket -2- for turbocharger.
- Unbolt oil return line -1- from turbocharger and move clear to one side.
- Detach air hoses -4 and 5- from turbocharger.
- Remove banjo bolt -3- for pressure pipe.



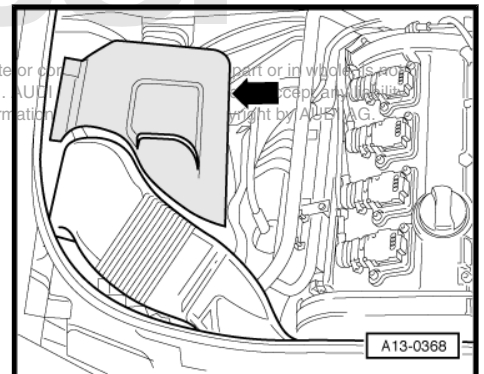
- Disconnect hose -1- at vacuum unit for charge pressure regulating valve on turbocharger.
- Clamp off coolant supply hose at bottom of turbocharger using a hose clamp -3094-.



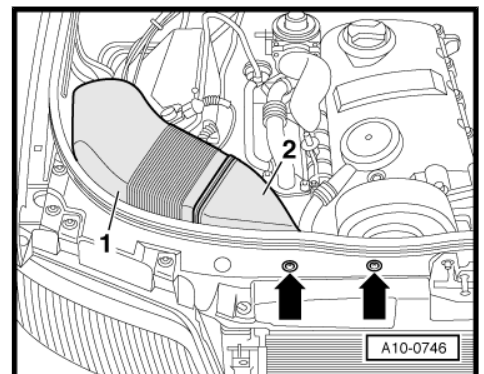
- Release quick-release fasteners and remove engine cover panel -arrows-.



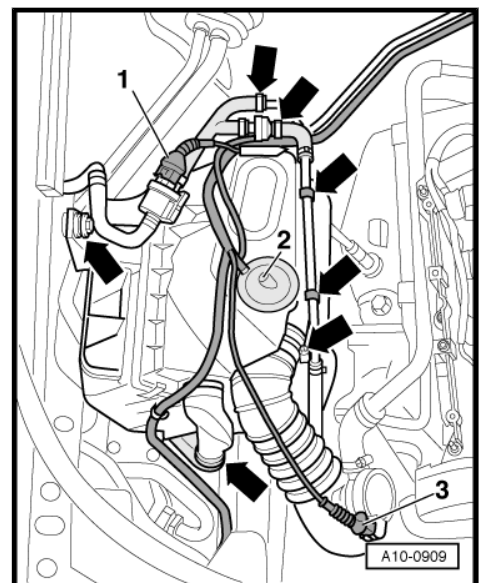
- Detach air cleaner cover -arrow-.



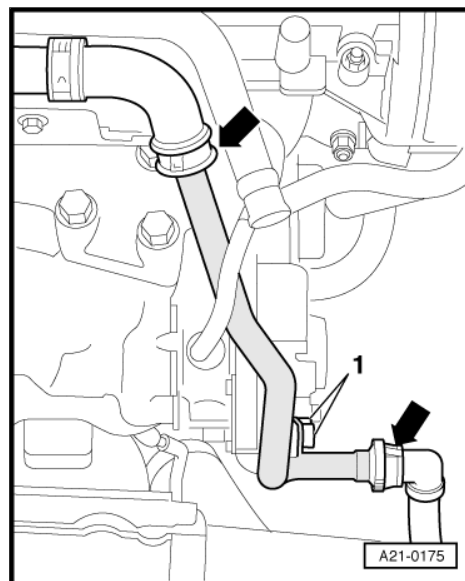
- Remove bolts -arrows-.
- Remove air duct -1 and 2-.



- Unplug electrical connectors:
 - 1 - On activated charcoal filter solenoid valve 1 - N80-
 - 2 - On air mass meter - G70-
 - 3 - On charge pressure control solenoid valve - N75-
- Detach solenoid valve 1 for activated charcoal filter - N80- from air cleaner housing.
- Detach hose connections, move electrical wiring clear and remove air filter housing -arrows-.



- Remove secondary air pipe (detach hoses -arrows- and unscrew bolts -1-).

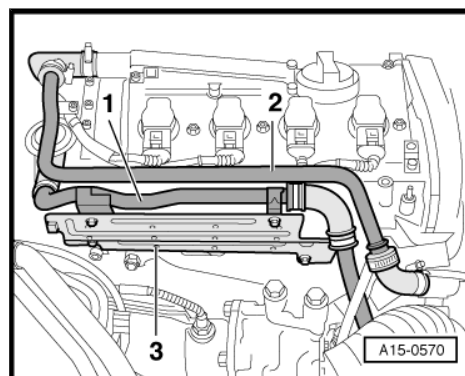


- Remove heat shield -3- from secondary air pipe -1- and from cylinder head.



Note

Disregard -item 2-.

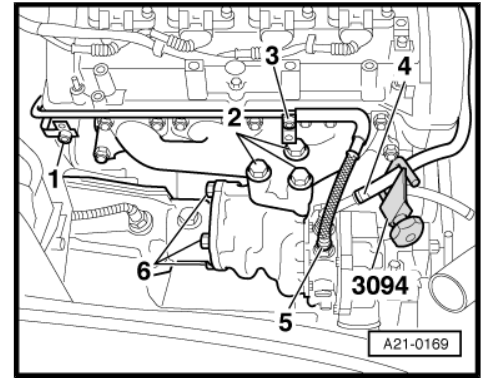


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- Unfasten sleeve on coolant return hose.
- Clamp off coolant return hose to turbocharger using a hose clamp -3094- .
- Detach coolant return hose -4- from pipe going to turbocharger; the pipe remains fitted on the turbocharger.
- Remove bolts -1 and 3- for oil supply line.
- Remove oil supply line -5- from turbocharger.

 Note

Do not bend the flexible joint (de-coupling element) in the exhaust system more than 10°, otherwise it could be damaged.



- Remove bolts -6- securing catalytic converter to turbocharger.
- Remove bolts -2- securing turbocharger to exhaust manifold.
- Move turbocharger to side, loosen retaining bracket and banjo bolt for coolant supply line on turbocharger.
- Remove turbocharger.

Installing

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

 Note

- ◆ *Renew seals, gaskets and self-locking nuts.*
- ◆ *Hose connections and hoses for charge air system must be free of oil and grease before assembly.*
- ◆ *Fit all heat insulation sleeves in the original position when installing.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*

Perform the following operations before securing the turbocharger:

- Fit coolant supply line together with bracket loosely at vacuum unit for charge pressure regulating valve.
- First tighten banjo bolt and then bolt securing bracket for coolant supply line.

 Note

Fill turbocharger with engine oil at connection for oil supply line.

- Check oil level ⇒ [page 139](#) .
- Fill up with coolant ⇒ [page 145](#) .

 Note

After installing the turbocharger, allow the engine to idle for approx. 1 minute without pressing the accelerator to ensure that the turbocharger is supplied with oil.

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Tightening torques

Component	Nm
Coolant supply line to turbocharger	35
Bracket for coolant supply line to turbocharger	10
Turbocharger to exhaust manifold	35 ¹⁾²⁾
Catalytic converter to turbocharger	30
Oil return line to turbocharger	10
Oil supply line to turbocharger	23
Oil supply line to cylinder head	23
Heat shield to: Secondary air pipe	3.5
Cylinder head	3.5
Bracket for turbo- Cylinder block	25
charger to: Turbocharger	30
Hose clips for coolant hoses	2
Hose clips for air hoses	3.5
• ¹⁾ Renew bolts. • ²⁾ Coat threads and contact surface of bolt heads with high-temperature paste; for high-temperature paste refer to ⇒ Parts catalogue .	

2.3 Charge air cooling - exploded view**Note**

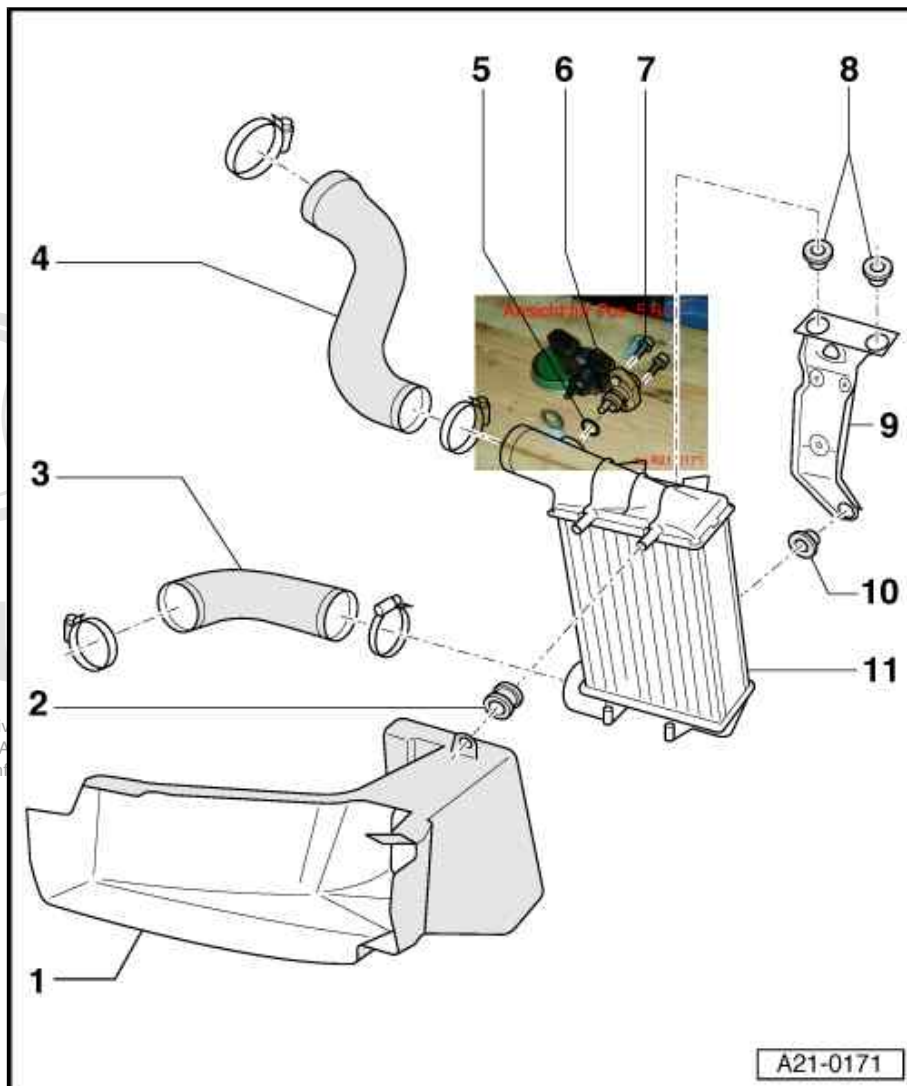
Check all hoses and pipes for correct fitting and leakage before carrying out tests or repairs.



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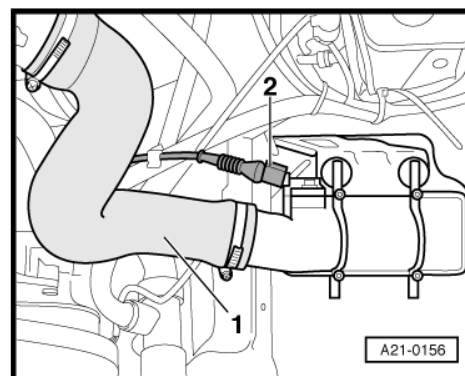
- 1 - Air duct
 - ☐ For charge air cooler
- 2 - Rubber grommet
- 3 - Air hose
 - ☐ From lock carrier
 - ☐ Must be free of oil and grease when installing
- 4 - Air hose
 - ☐ To intake manifold
 - ☐ Must be free of oil and grease when installing
- 5 - O-ring
 - ☐ Renew
- 6 - Charge pressure sender - G31-
- 7 - 3 Nm
- 8 - Rubber grommet
- 9 - Bracket for charge air cooler
 - ☐ Riveted to body
- 10 - Rubber grommet
- 11 - Charge air cooler
 - ☐ Removing and installing
⇒ [page 195](#)



2.4 Removing and installing charge air cooler

Removing

- Move lock carrier to service position ⇒ Rep. gr. 50 .
- Remove air hose -1-.
- Unplug electrical connector -2- at charge pressure sender - G31- .



- Remove air duct for charge air cooler -arrows-.
- Remove bottom air hose going to charge air cooler.
- Take out charge air cooler from underneath.

Installing

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



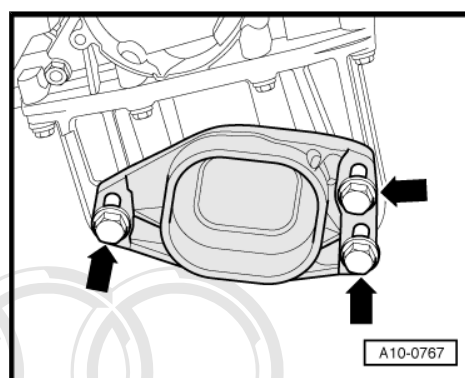
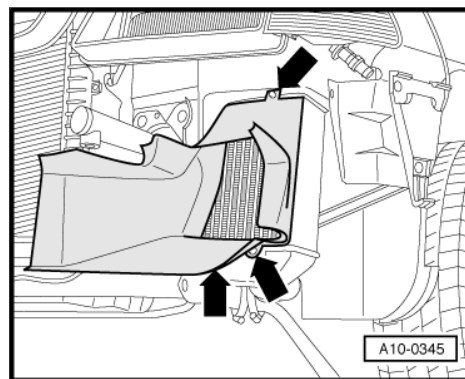
Note

- ◆ *Hose connections and hoses for charge air system must be free of oil and grease before assembly.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*

- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight and tighten nuts -arrows-.

Tightening torques

Component	Nm
Stop for torque reaction support to sump	28
Hose clips for air hoses	3.5



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26 – Exhaust system

1 Exhaust system on vehicles with front-wheel drive

1.1 Silencers - exploded view

1 - 25 Nm

2 - Mounting

- ☐ Renew if damaged
- ☐ Check preload
⇒ ["1.3 Stress-free alignment of exhaust system", page 201](#)

3 - 25 Nm

4 - Mounting

- ☐ Renew if damaged
- ☐ Check preload
⇒ ["1.3 Stress-free alignment of exhaust system", page 201](#)

5 - 25 Nm

6 - 25 Nm

7 - 30 Nm

- ☐ Renew

8 - Gasket

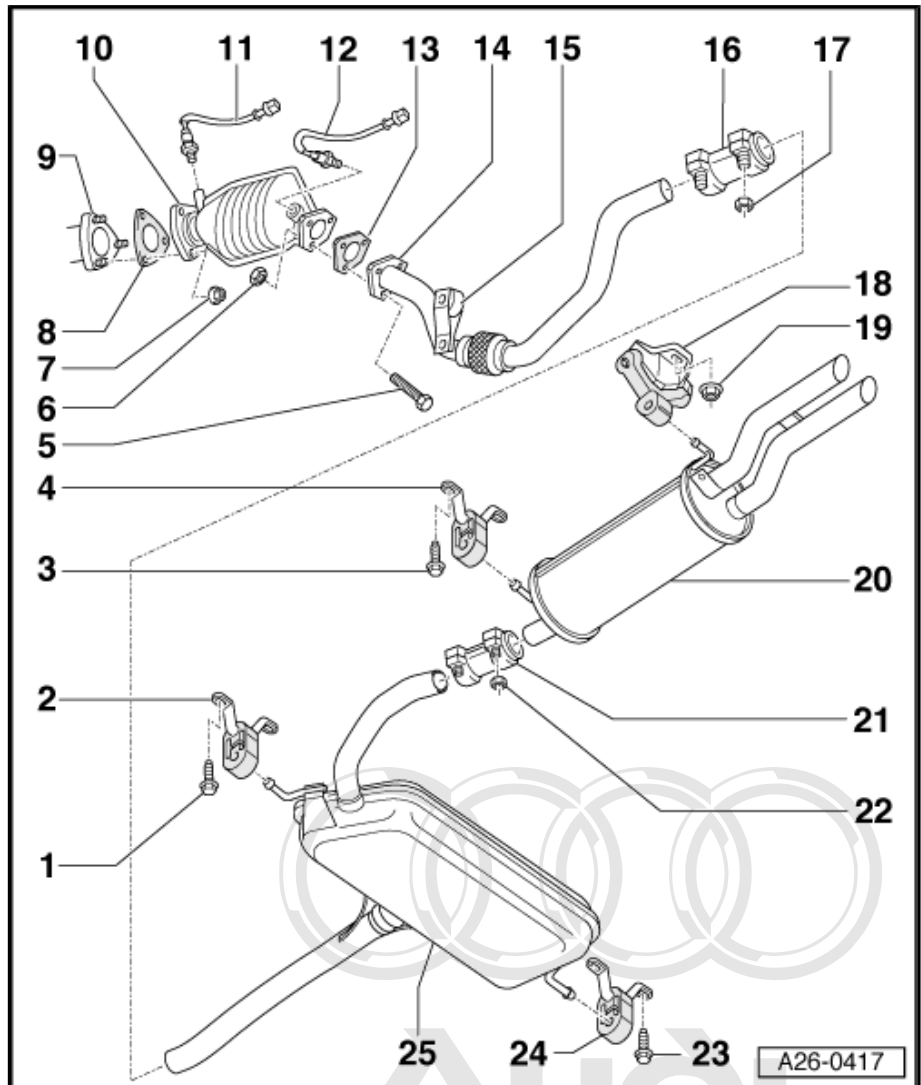
- ☐ Renew

9 - Turbocharger

- ☐ Removing and installing
⇒ [page 189](#)

10 - Catalytic converter

- ☐ Protect against knocks and impact
- ☐ Removing and installing
⇒ [page 210](#)
- ☐ Align exhaust system so it is free of stress
⇒ [page 201](#)



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

- ☐ The threads on the new Lambda probes are coated with a special assembly paste.
- ☐ If re-installing old Lambda probe, coat thread with high-temperature paste: Refer to ⇒ [Parts catalogue](#) for high-temperature paste.
- ☐ The assembly paste/high-temperature paste must not get into the slots on the probe body.
- ☐ Removing and installing ⇒ Rep. gr. 24

12 - Lambda probe after catalytic converter - G130-

- ☐ The threads on the new Lambda probes are coated with a special assembly paste.
- ☐ If re-installing old Lambda probe, coat thread with high-temperature paste: Refer to ⇒ [Parts catalogue](#) for high-temperature paste.
- ☐ The assembly paste/high-temperature paste must not get into the slots on the probe body.



- ☐ Removing and installing ⇒ Rep. gr. 24

13 - Gasket

- ☐ Renew

14 - Front exhaust pipe

- ☐ With flexible joint
- ☐ Do not bend flexible joint more than 10° – otherwise it can be damaged
- ☐ Removing and installing ⇒ [page 209](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 201](#)

15 - Mounting

- ☐ Components of exhaust pipe mountings (vehicles with manual gearbox) ⇒ [page 199](#)
- ☐ Components of exhaust pipe mountings (vehicles with automatic gearbox) ⇒ [page 200](#)

16 - Clamp (front)

- ☐ Before tightening, align exhaust system so it is free of stress ⇒ [page 201](#)
- ☐ Installation position ⇒ [page 199](#)
- ☐ Tighten bolt connections evenly

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17 - 40 Nm

18 - Mounting

- ☐ Renew if damaged
- ☐ Check preload ⇒ [“1.3 Stress-free alignment of exhaust system”, page 201](#)

19 - 25 Nm

20 - Rear silencer

- ☐ Combined in one unit with centre silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting point ⇒ [page 200](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 201](#)

21 - Clamp (rear)

- ☐ For separate replacement of centre or rear silencer
- ☐ Before tightening, align exhaust system so it is free of stress ⇒ [page 201](#)
- ☐ Installation position ⇒ [page 199](#)
- ☐ Tighten bolt connections evenly

22 - 40 Nm

23 - 25 Nm

24 - Mounting

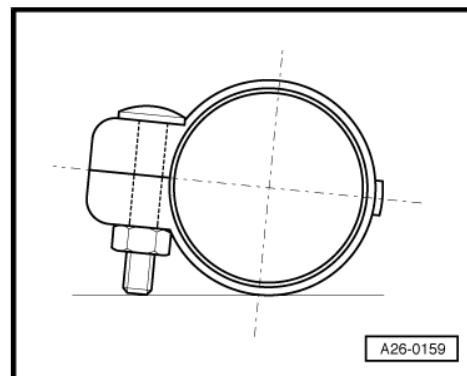
- ☐ Renew if damaged
- ☐ Check preload ⇒ [“1.3 Stress-free alignment of exhaust system”, page 201](#)

25 - Centre silencer

- ☐ Combined in one unit with rear silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting point ⇒ [page 200](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 201](#)

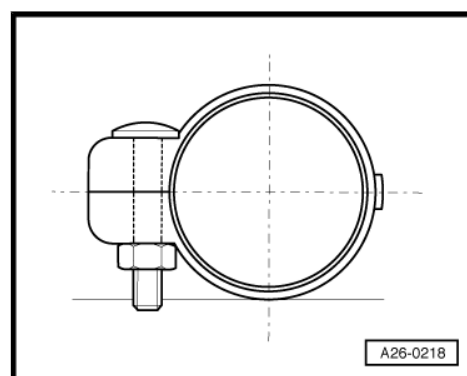
Installation position of front clamp

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



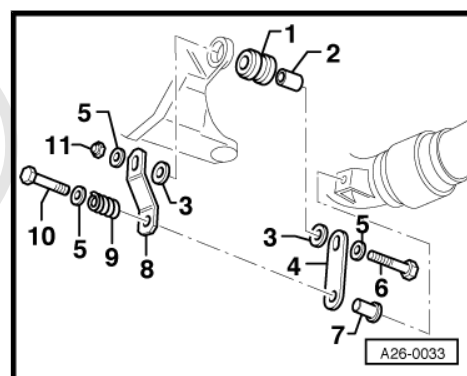
Installation position of rear clamp

- Fit clamp in horizontal position.
- Bolt connection faces to left.



Components of exhaust pipe mountings (vehicles with manual gearbox)

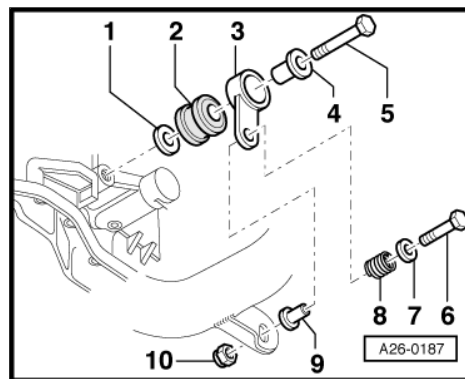
- 1 - Buffer
- 2 - Spacer
- 3 - Washer
- 4 - Bracket (right-side)
- 5 - Washer
- 6 - Bolt, 25 Nm
- 7 - Spacer sleeve
- 8 - Bracket (left-side)
- 9 - Compression spring
- 10 - Bolt, 25 Nm
- 11 - Nut, self-locking, 25 Nm



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Components of exhaust pipe mountings (vehicles with automatic gearbox)

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



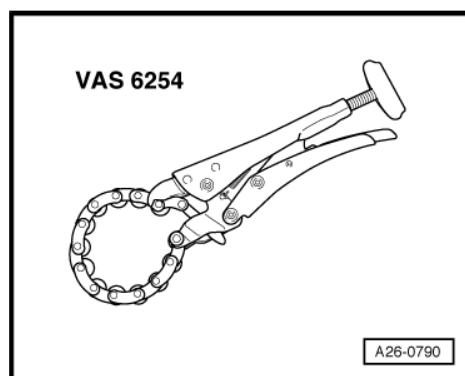
1.2 Separating centre and rear silencers

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

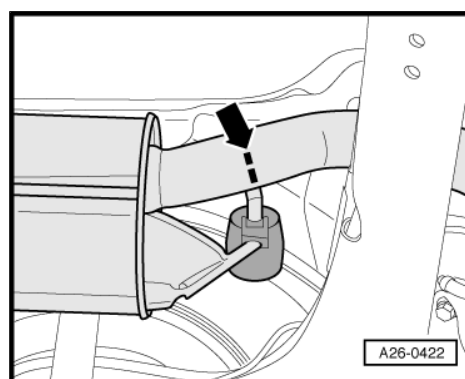
Special tools and workshop equipment required

- ◆ Chain pipe cutter - VAS 6254-

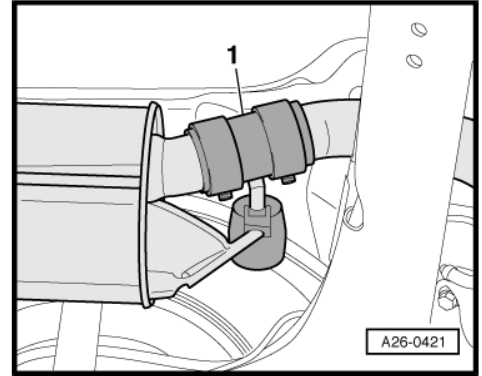


Procedure

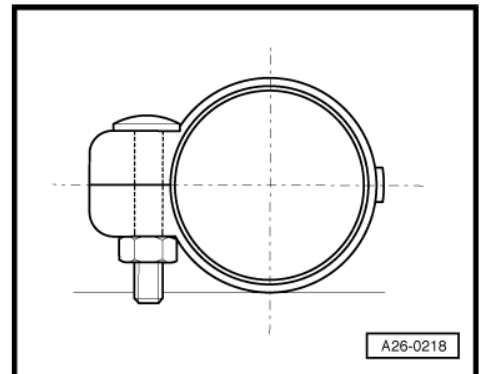
- Cut through exhaust pipe at right angles at the position marked -arrow- using chain-type pipe cutter - VAS 6254-



- When installing, position centre of clamp -1- over cutting point.



- Fit clamp in horizontal position.
- Bolt connection faces to left.
- Align the exhaust system so it is free of stress ⇒ [page 201](#).

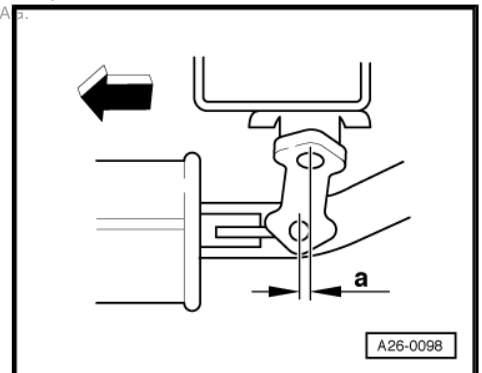


1.3 Stress-free alignment of exhaust system

- The exhaust system must be aligned when it is cool.

Vehicles without clamp between centre silencer and rear silencer

- Loosen bolts on front clamp ⇒ [Item 16 \(page 198\)](#).
- Push exhaust system towards front of vehicle -arrow-, so that rear mounting for rear silencer is preloaded by -a- = 9 ... 11 mm.
- Tighten bolt connections on clamp evenly.
- Align tailpipes ⇒ [page 202](#).



Vehicles with clamp between centre silencer and rear silencer

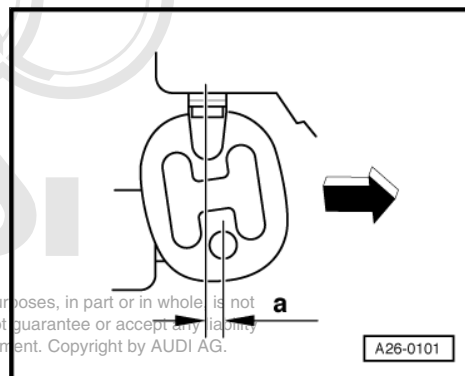


Note

On vehicles with clamp fitted between centre silencer and rear silencer, it is also necessary to align the centre silencer.

- Loosen bolts on front clamp ⇒ [Item 16 \(page 198\)](#) and rear clamp ⇒ [Item 21 \(page 198\)](#).

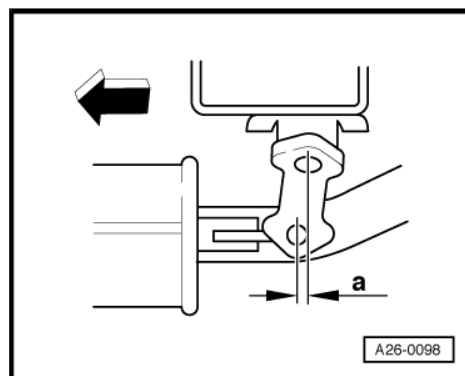
- Push front section of exhaust system towards front of vehicle -arrow-, so that rubber mounting (right-side) for centre silencer is preloaded by -a- = 7 ... 9 mm.
- Tighten bolt connections on front clamp evenly
⇒ [Item 16 \(page 198\)](#) .



- Push rear section of exhaust system towards front of vehicle -arrow- until rear mounting for rear silencer is preloaded by -a- = 9 ... 11 mm.
- Tighten bolt connections on rear clamp evenly
⇒ [Item 21 \(page 198\)](#) .
- Align tailpipes ⇒ [page 202](#) .

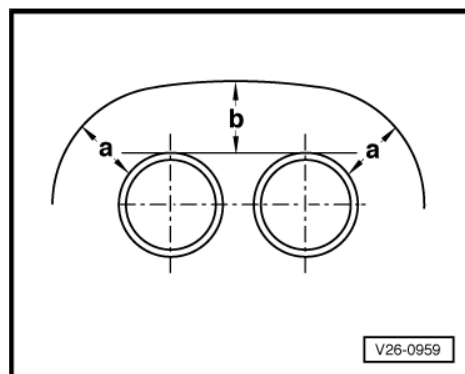
Tightening torque

Component	Nm
Bolted connections on clamps	40



Aligning tailpipes

- Align tailpipes as follows:
 - Distance -a- is the same on both sides.
 - Distance -b- from bumper cut-out to top of tailpipes should be at least 24 mm.



2 Exhaust system on vehicles with four-wheel drive

2.1 Silencers - exploded view

1 - Centre silencer

- ☐ Combined in one unit with rear silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting point
⇒ [page 206](#)
- ☐ Align exhaust system so it is free of stress
⇒ [page 207](#)

2 - 25 Nm

3 - Mounting

- ☐ Renew if damaged
- ☐ Check preload
⇒ ["2.3 Stress-free alignment of exhaust system", page 207](#)

4 - 25 Nm

5 - 25 Nm

- ☐ Renew

6 - 30 Nm

- ☐ Renew

7 - Gasket

- ☐ Renew

8 - Turbocharger

- ☐ Removing and installing
⇒ [page 189](#)

9 - Catalytic converter

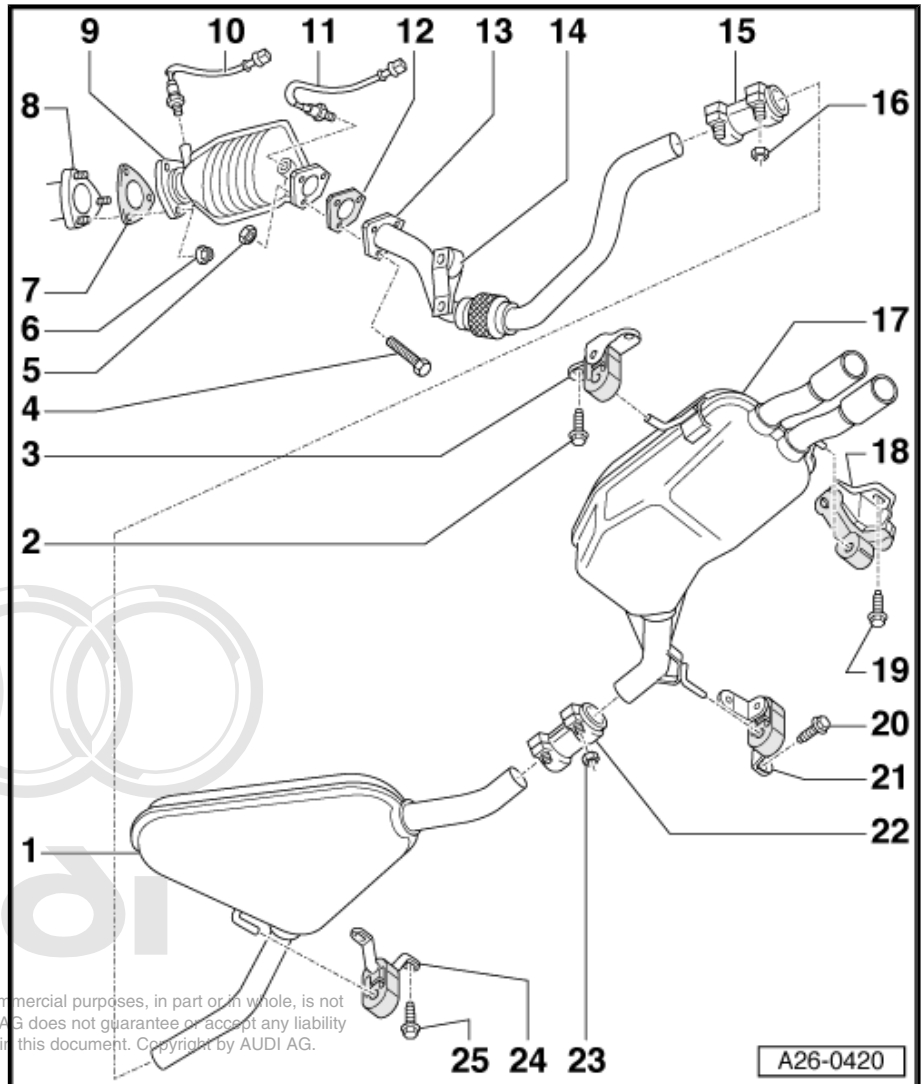
- ☐ Protect against knocks and impact
- ☐ Removing and installing ⇒ [page 210](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 207](#)

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

- ☐ The threads on the new Lambda probes are coated with a special assembly paste.
- ☐ If re-installing old Lambda probe, coat thread with high-temperature paste: Refer to ⇒ Parts catalogue for high-temperature paste.
- ☐ The assembly paste/high-temperature paste must not get into the slots on the probe body.
- ☐ Removing and installing ⇒ Rep. gr. 24

11 - Lambda probe after catalytic converter - G130-

- ☐ The threads on the new Lambda probes are coated with a special assembly paste.
- ☐ If re-installing old Lambda probe, coat thread with high-temperature paste: Refer to ⇒ Parts catalogue for high-temperature paste.
- ☐ The assembly paste/high-temperature paste must not get into the slots on the probe body.
- ☐ Removing and installing ⇒ Rep. gr. 24



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12 - Gasket

- ☐ Renew

13 - Front exhaust pipe

- ☐ With flexible joint
- ☐ Do not bend flexible joint more than 10° – otherwise it can be damaged
- ☐ Removing and installing ⇒ [page 209](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 207](#)

14 - Mounting

- ☐ Components of exhaust pipe mountings (vehicles with manual gearbox) ⇒ [page 205](#)
- ☐ Components of exhaust pipe mountings (vehicles with automatic gearbox) ⇒ [page 206](#)

15 - Clamp (front)

- ☐ Before tightening, align exhaust system so it is free of stress ⇒ [page 207](#)
- ☐ Installation position ⇒ [page 205](#)
- ☐ Tighten bolt connections evenly

16 - 40 Nm**17 - Rear silencer**

- ☐ Combined in one unit with centre silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting point ⇒ [page 206](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 207](#)

18 - Mounting

- ☐ Renew if damaged
- ☐ Check preload ⇒ [“2.3 Stress-free alignment of exhaust system”, page 207](#)

19 - 25 Nm**20 - 25 Nm****21 - Mounting**

- ☐ Renew if damaged
- ☐ Check preload ⇒ [“2.3 Stress-free alignment of exhaust system”, page 207](#)

22 - Clamp (rear)

- ☐ For individual replacement of centre silencer and the two rear silencers
- ☐ Before tightening, align exhaust system so it is free of stress ⇒ [page 207](#)
- ☐ Installation position ⇒ [page 205](#)
- ☐ Tighten bolt connections evenly

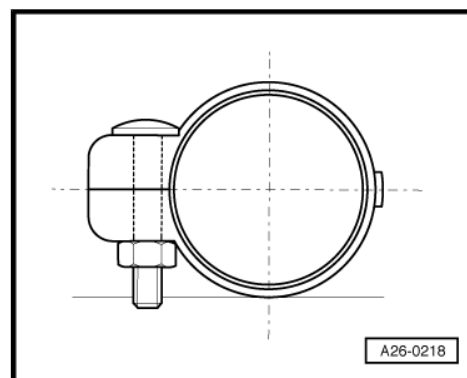
23 - 40 Nm**24 - Mounting**

- ☐ Renew if damaged
- ☐ Check preload ⇒ [“2.3 Stress-free alignment of exhaust system”, page 207](#)

25 - 25 Nm

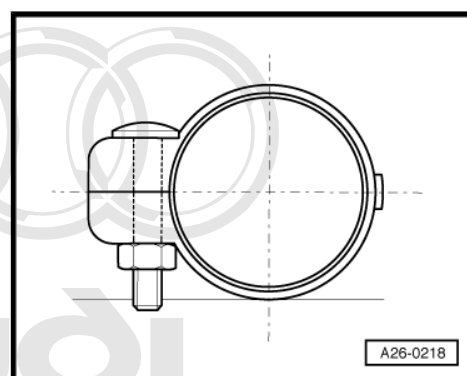
Installation position of front clamp

- Fit clamp in horizontal position.
- Bolt connection faces to left.



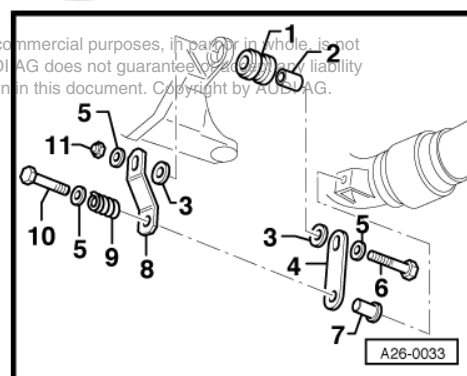
Installation position of rear clamp

- Fit clamp in horizontal position.
- Bolt connection faces to left.



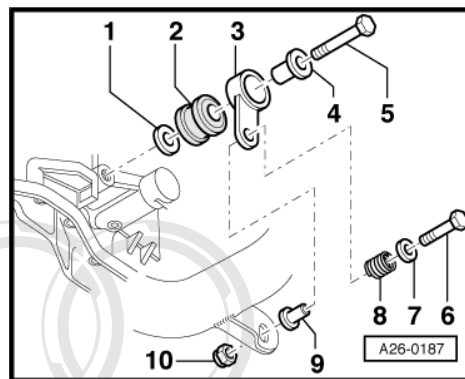
Components of exhaust pipe mountings (vehicles with manual gearbox)

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



Components of exhaust pipe mountings (vehicles with automatic gearbox)

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

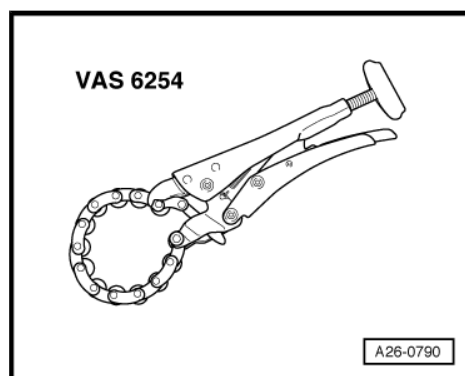


2.2 Separating centre and rear silencers

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

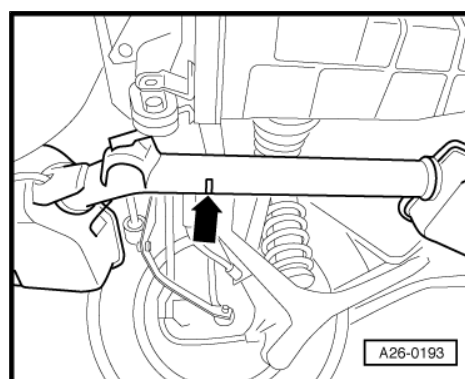
Special tools and workshop equipment required

- ◆ Chain pipe cutter - VAS 6254-

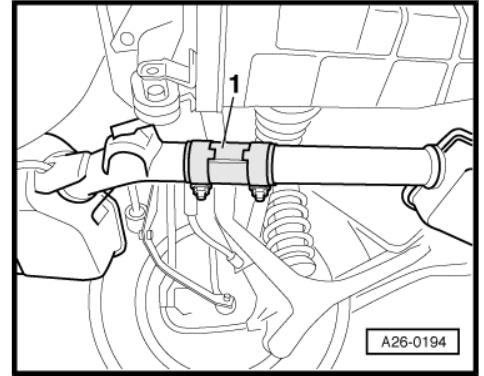


Procedure

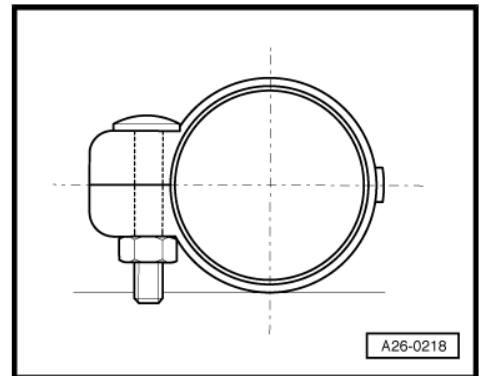
- Cut through exhaust pipe at right angles at the position marked -arrow- using chain-type pipe cutter - VAS 6254-



- When installing, position centre of clamp -1- over cutting point.



- Fit clamp in horizontal position.
- Bolt connection faces to left.
- Align the exhaust system so it is free of stress ⇒ [page 207](#) .

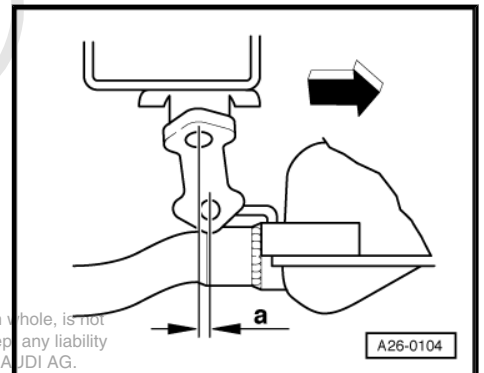


2.3 Stress-free alignment of exhaust system

- The exhaust system must be aligned when it is cool.

Vehicles without clamp between centre silencer and rear silencer

- Loosen bolts on front clamp ⇒ [Item 15 \(page 204\)](#) .
- Push exhaust system towards front of vehicle -arrow- so that mounting (rear right) for rear silencer is preloaded by -a- = 9 ... 11 mm.
- Tighten bolt connections on clamp evenly.
- Align tailpipes ⇒ [page 208](#) .



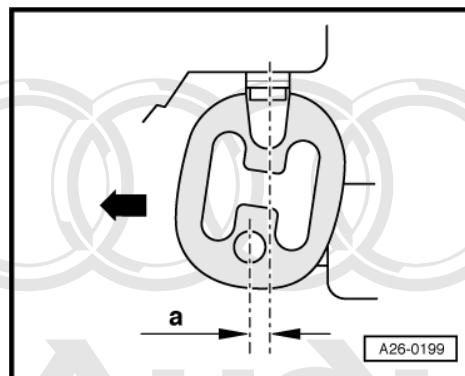
Vehicles with clamp between centre silencer and rear silencer



On vehicles with clamp fitted between centre silencer and rear silencer, it is also necessary to align the centre silencer.

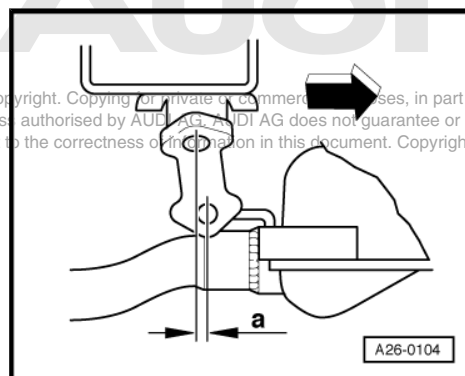
- Loosen bolts on front clamp ⇒ [Item 15 \(page 204\)](#) and rear clamp ⇒ [Item 22 \(page 204\)](#) .

- Push front section of exhaust system towards front of vehicle -arrow-, so that mounting for centre silencer is preloaded by -a- = 7 ... 9 mm.
- Tighten bolt connections on front clamp evenly
⇒ [Item 15 \(page 204\)](#) .



- Push rear silencer towards front of vehicle -arrow- until mounting (rear right) on rear silencer is preloaded by -a- = 9 ... 11 mm.
- Tighten bolt connections on rear clamp evenly
⇒ [Item 22 \(page 204\)](#) .
- Align tailpipes ⇒ [page 208](#) .

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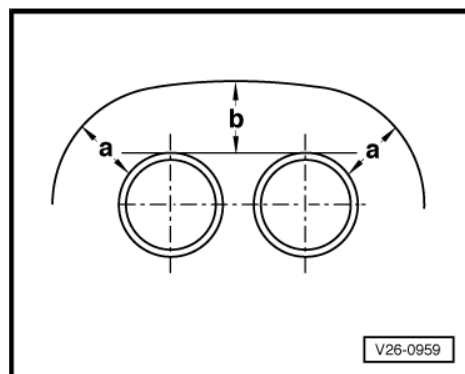


Tightening torque

Component	Nm
Bolted connections on clamps	40

Aligning tailpipes

- Align tailpipes as follows:
 - Distance -a- is the same on both sides.
 - Distance -b- from bumper cut-out to top of tailpipes should be at least 24 mm.

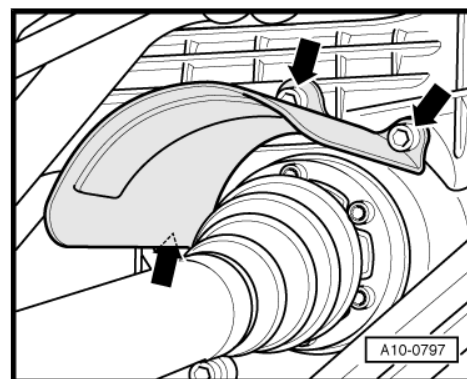


3 Front exhaust pipe, catalytic converter, exhaust manifold

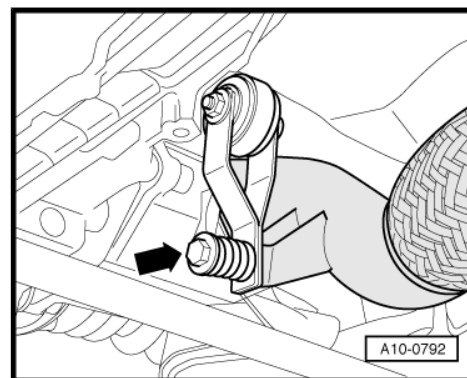
3.1 Removing and installing front exhaust pipe

Removing

- Remove bolts securing front exhaust pipe to catalytic converter that are accessible from above.
- Remove heat shield for drive shaft (right-side) -arrows-.
- Remove underbody cross member.



- Unbolt bracket for exhaust system -arrow-.



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Note

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

- Disconnect exhaust system at clamp -arrows-.
- Remove bolts securing front exhaust pipe to catalytic converter that are accessible from below.
- Detach front exhaust pipe.

Installing

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



Note

Renew gaskets and self-locking nuts.

- Align exhaust system so it is free of stress: vehicles with front-wheel drive ⇒ [page 201](#) , vehicles with four-wheel drive ⇒ [page 207](#) .

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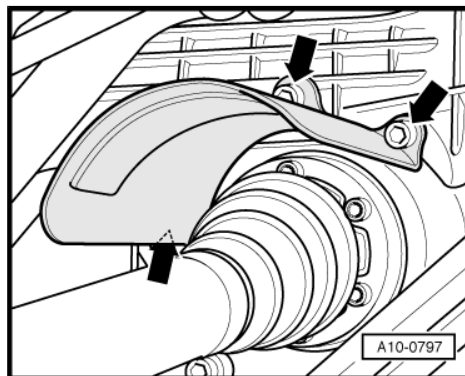
Tightening torques

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

3.2 Removing and installing catalytic converter

Removing

- Remove heat shield for drive shaft (right-side) -arrows-.
- Remove bolts securing front exhaust pipe to catalytic converter that are accessible from below.

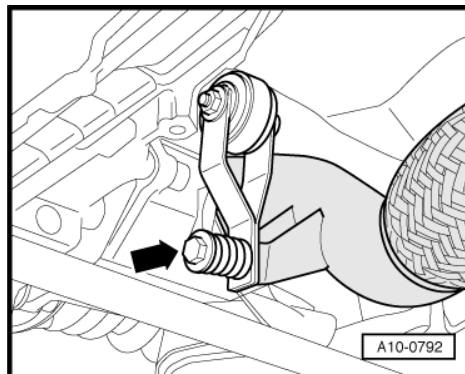


- Unbolt bracket for exhaust system -arrow-.

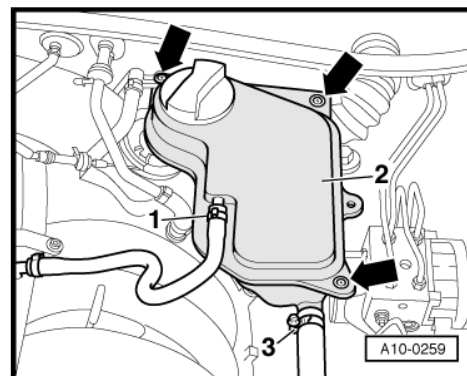


Note

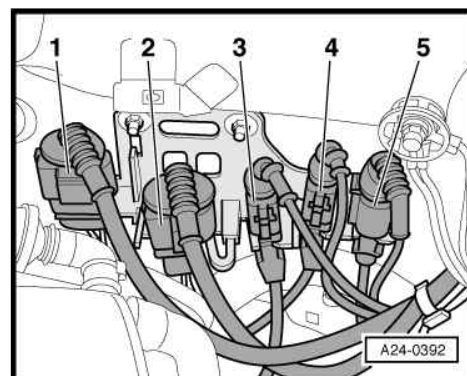
To avoid any damage, the flexible joint in the front exhaust pipe must not be bent more than 10°.



- Unbolt coolant expansion tank -2- -arrows-.
- Unplug electrical connector for coolant shortage indicator switch - F66- at expansion tank (bottom) and move expansion tank to one side (coolant hoses -1 and 3- remain attached).

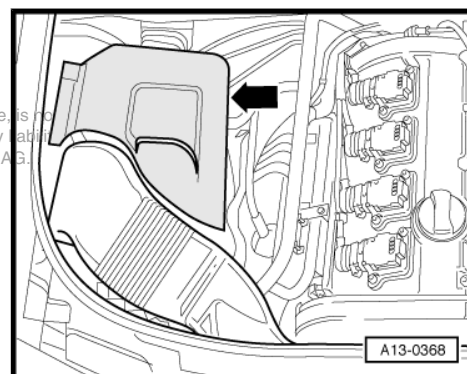


- Unplug electrical connectors and move electrical wiring clear.
- 1 - For Lambda probe after catalytic converter - G130- (brown)
 - 2 - For Lambda probe - G39- (before catalytic converter; black)

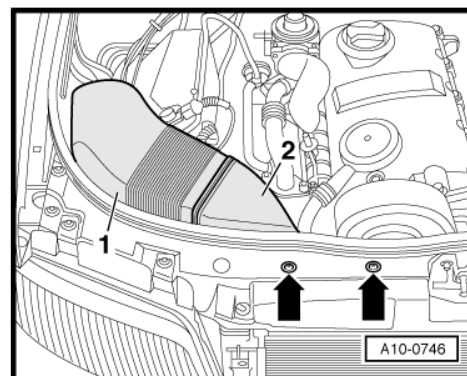


- Detach air cleaner cover -arrow-.

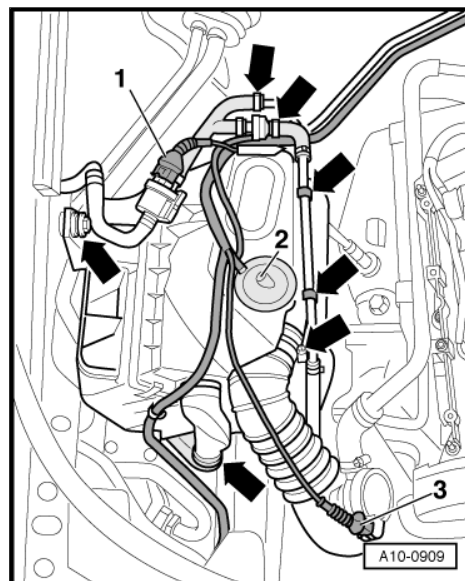
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- Remove bolts -arrows-.
- Remove air duct -1 and 2-.



- Unplug electrical connectors:
- 1 - On activated charcoal filter solenoid valve 1 - N80-
- 2 - On air mass meter - G70-
- 3 - On charge pressure control solenoid valve - N75-
- Detach solenoid valve 1 for activated charcoal filter - N80- from air cleaner housing.
- Detach hose connections, move electrical wiring clear and remove air filter housing -arrows-.



- Remove bolts securing front exhaust pipe to catalytic converter that are accessible from above.
- Remove nuts -arrows- securing turbocharger to catalytic converter.
- Lift out catalytic converter.

Installing

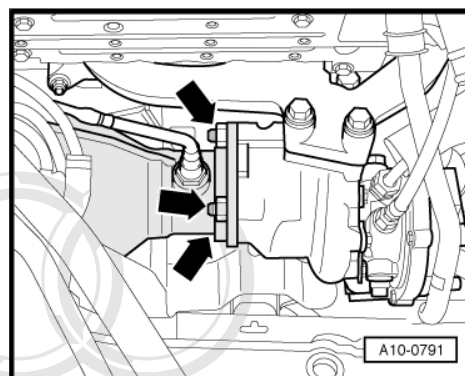
Installation is carried out in the reverse order; note the following:



Note

Renew gaskets and self-locking nuts.

- Install Lambda probe ⇒ Rep. gr. 24 .
- Align exhaust system so it is free of stress: vehicles with front-wheel drive ⇒ [page 201](#) , vehicles with four-wheel drive ⇒ [page 207](#) .



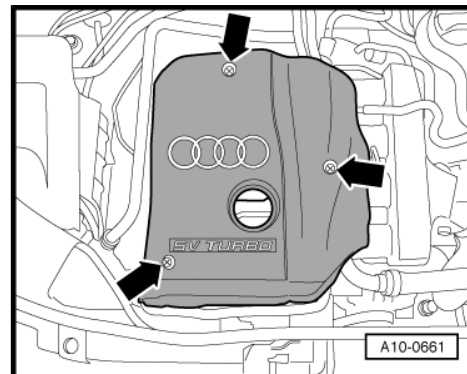
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Component	Nm
Catalytic converter to turbocharger	30
Front exhaust pipe to catalytic converter	25
Front exhaust pipe to bracket	25
Heat shield to gearbox	23
Hose clips for air hoses	3.5

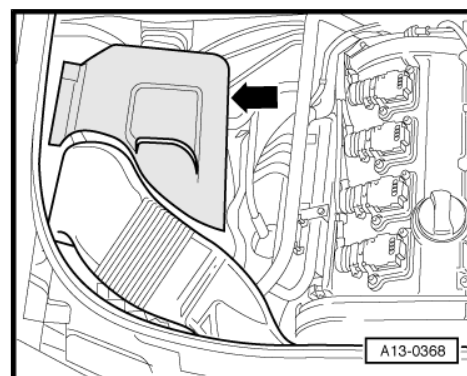
3.3 Removing and installing exhaust manifold

Removing

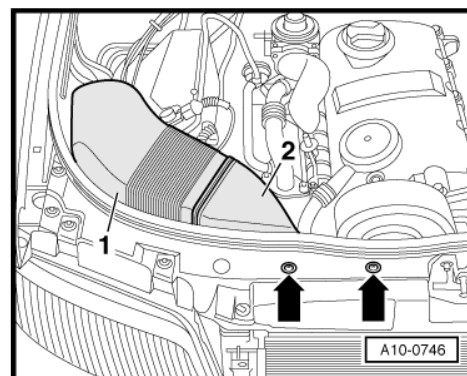
- Release quick-release fasteners and remove engine cover panel -arrows-.



- Detach air cleaner cover -arrow-.

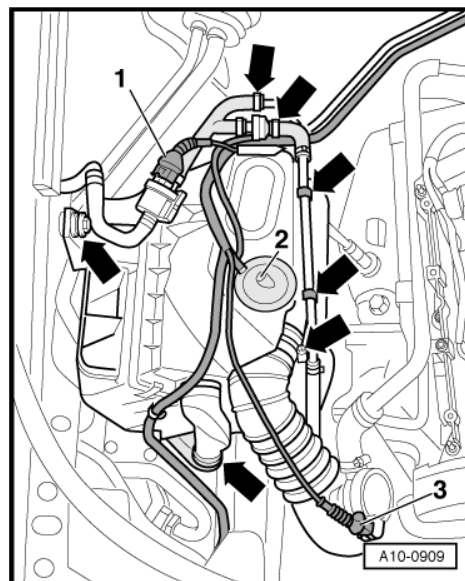


- Remove bolts -arrows-.
- Remove air duct -1 and 2-.

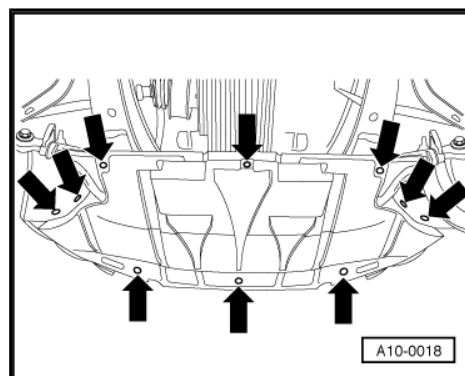


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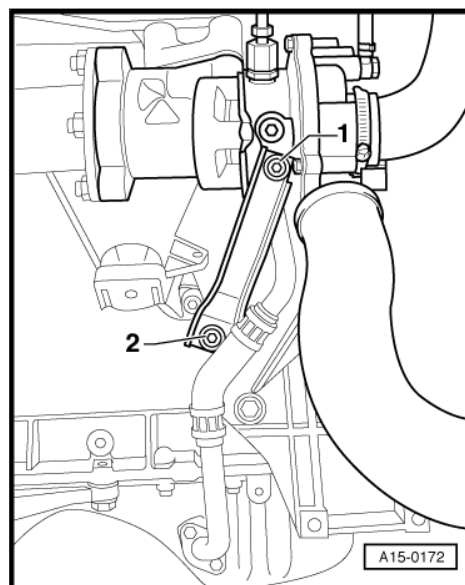
- Unplug electrical connectors:
- 1 - On activated charcoal filter solenoid valve 1 - N80-
- 2 - On air mass meter - G70-
- 3 - On charge pressure control solenoid valve - N75-
- Detach solenoid valve 1 for activated charcoal filter - N80- from air cleaner housing.
- Detach hose connections, move electrical wiring clear and remove air filter housing -arrows-.



- Release fasteners -arrows- and remove noise insulation.

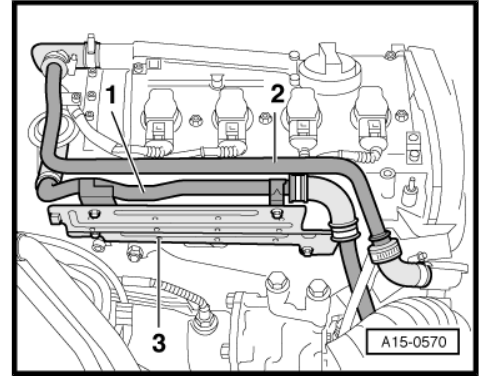


- Loosen bolts -1 and 2- on bracket for turbocharger several turns.



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- Remove heat shield -3- from secondary air pipe -1- and from cylinder head.
- Remove front hose from crankcase breather pipe -2-.
- Remove front hose from secondary air pipe -1-.

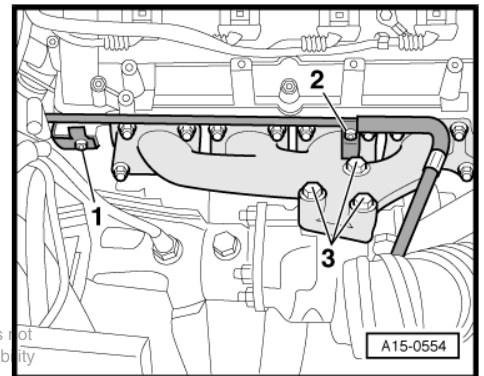


- Remove bolts -1 and 2- for oil supply line.
- Remove bolts -3- for turbocharger.
- Detach gasket between turbocharger and exhaust manifold.



Note

Seal off opening in turbocharger with a clean cloth to prevent dirt from entering.



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- Remove nuts -arrows-.
- Detach washers and exhaust manifold.

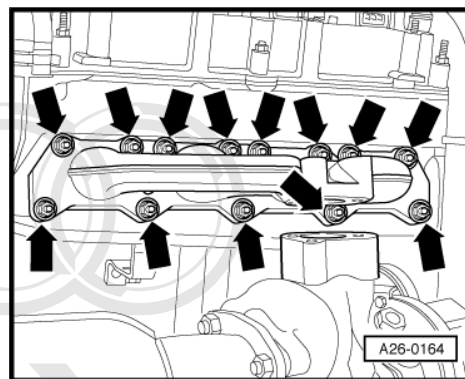
Installing



Note

Renew gaskets and self-locking nuts.

- Fit exhaust manifold to cylinder head.
- Fit turbocharger to exhaust manifold.
- Fit bracket for turbocharger to cylinder block
- Fit bracket for turbocharger to turbocharger.



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

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Tightening torques

Component	Nm	
Exhaust manifold to cylinder head	30	
Turbocharger to exhaust manifold	35 ¹⁾²⁾	
Oil supply line to cylinder head	23	
Bracket for turbo-charger to:	Cylinder block	25
	Turbocharger	30
Crankcase breather pipe to cylinder head	10	
Hose clips for air hoses	3.5	
• 1) Renew bolts. • 2) Coat threads and contact surface of bolt heads with high-temperature paste; for high-temperature paste refer to ⇒ Parts catalogue .		

3.4 Checking exhaust system for leaks

- Start engine and run at idling speed.
- Plug tailpipes during leak test (e.g. with cloth or plug).
- Listen for leaks at connection points between cylinder head/exhaust manifold, exhaust manifold/turbocharger and turbocharger/catalytic converter etc.
- Rectify any leaks that are found.

4 Secondary air system

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

Principle

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

How the system works

- ◆ In the warm-up phase, the engine control unit activates the secondary air pump via the secondary air pump relay. Air is routed to the secondary air combination valve.
- ◆ In parallel to this, the secondary air inlet valve is activated and allows vacuum to pass to the secondary air combination valve. In this way, the combination valve opens a passage for the secondary air system to supply air to the exhaust ports in the cylinder head.

4.1 Secondary air system - overview



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1 - Secondary air pump motor - V101-

- ☐ Fitting location
⇒ [page 219](#)
- ☐ Checking voltage supply
⇒ [page 230](#)

2 - Air cleaner

3 - Combination valve for secondary air system

- ☐ Fitting location
⇒ [page 219](#)
- ☐ Checking for correct operation and leakage
⇒ [page 219](#)

4 - Non-return valve

- ☐ Installation position: as shown in illustration, the arrow points in direction of flow

5 - Secondary air pump relay - J299-

- ☐ Fitting location
⇒ [page 219](#)
- ☐ Checking ⇒ [page 225](#)

6 - Motronic control unit - J220-

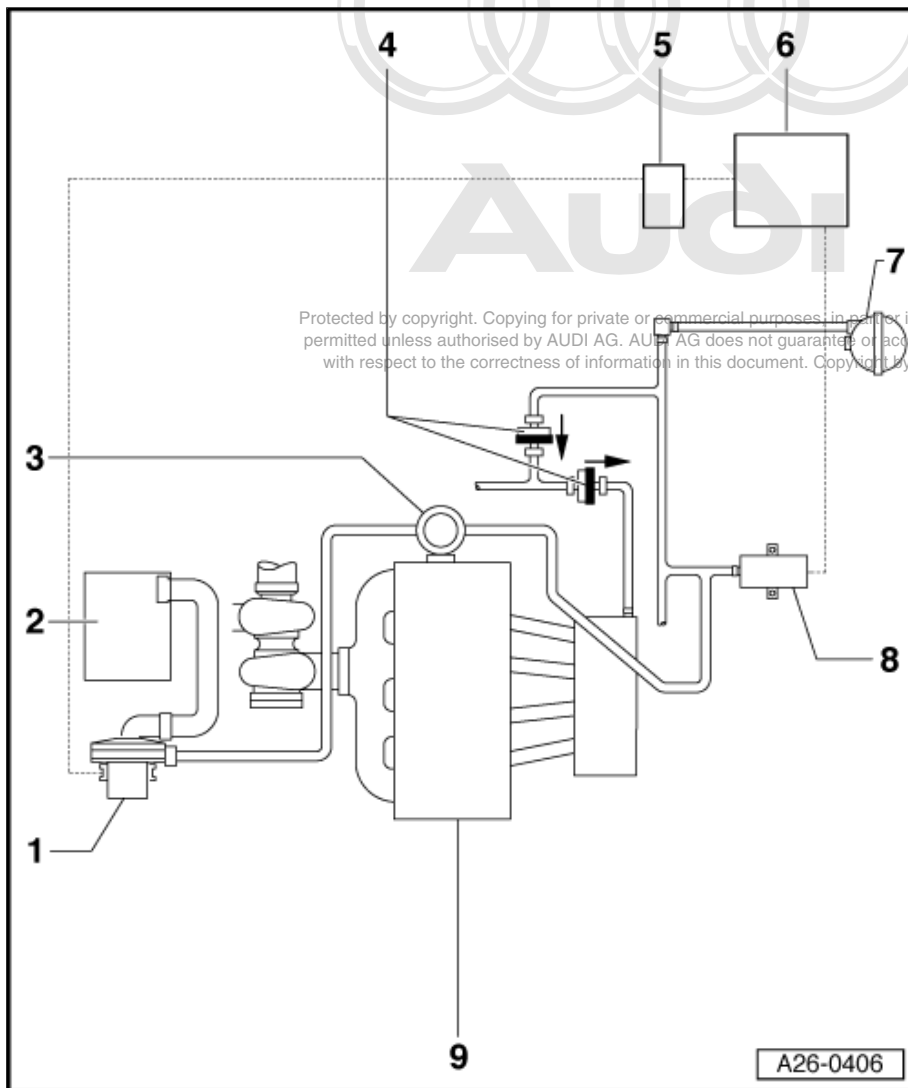
7 - Vacuum reservoir

- ☐ Fitting location: in front left wheel housing beneath liner

8 - Secondary air inlet valve - N112-

- ☐ Fitting location
⇒ [page 218](#)
- ☐ Checking ⇒ [page 220](#)

9 - Cylinder head



Fitting location of secondary air inlet valve - N112-

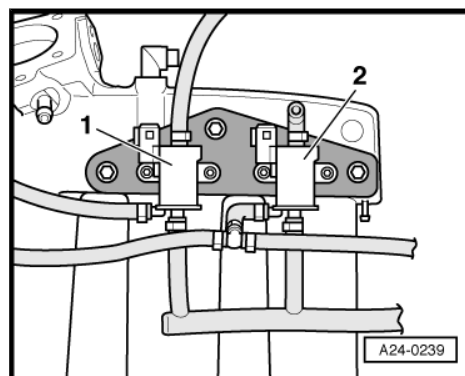
- ◆ Below intake manifold

- 1 - Turbocharger air recirculation valve - N249- (green connector)
- 2 - Secondary air inlet valve - N112- (brown connector)



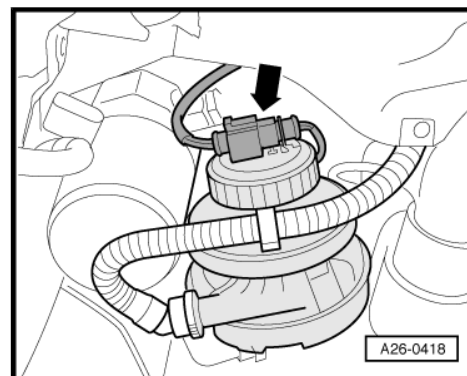
Note

For illustration purposes, the installation position is shown from the bottom and with the intake manifold removed.



Fitting location of secondary air pump motor - V101-

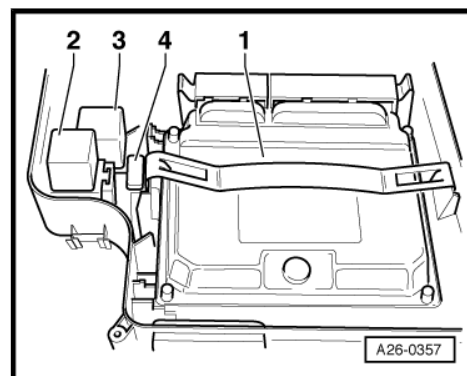
- ◆ At front right of engine compartment, below longitudinal member.



Fitting location of secondary air pump relay - J299-

- ◆ Located in 3-position relay carrier in electronics box in plenum chamber.

- 1 - Motronic control unit - J220-
- 2 - Secondary air pump relay - J299-
- 3 - Motronic current supply relay - J271-
- 4 - Secondary air pump fuse - S130-



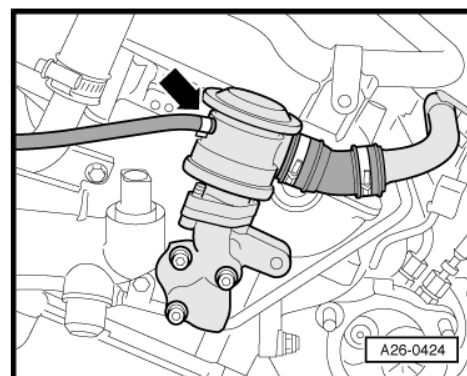
Fitting location of combination valve for secondary air system

- ◆ On rear right of cylinder head.
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Note

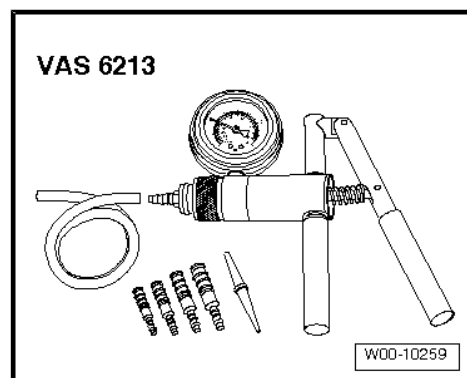
For illustration purposes, the installation position is shown from the rear and with the engine removed.



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

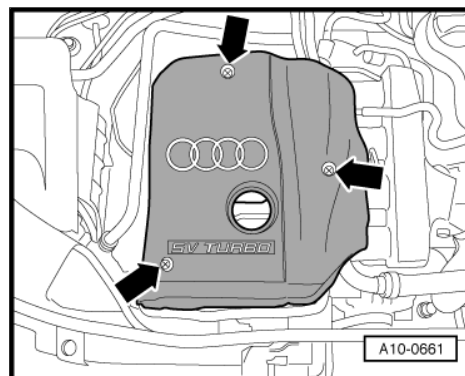
Special tools and workshop equipment required

- ◆ Hand vacuum pump - VAS 6213-



Procedure

- Vacuum hoses and hose connections do not leak.
- Vacuum hoses are not clogged.
- Release quick-release fasteners and remove engine cover panel -arrows-.



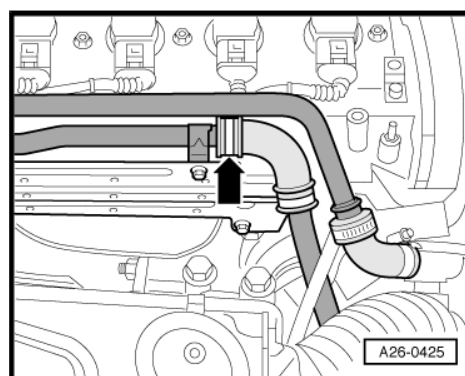
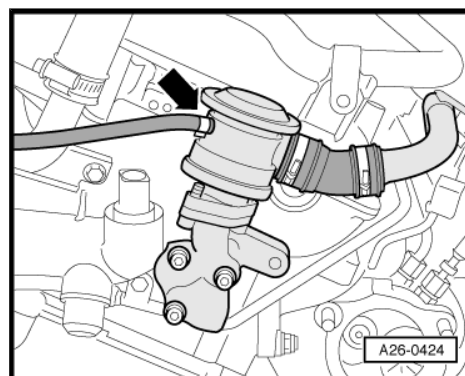
- Remove vacuum hose at combination valve for secondary air -arrow-.



Note

For illustration purposes, the installation position is shown from the rear and with the engine removed.

- Connect hand-operated vacuum pump to vacuum connection on combination valve for secondary air system.
- Disconnect hose -arrow- at pipe leading to combination valve for secondary air and attach test hose.
- Blow gently into pipe (do not use compressed air).
- The combination valve for secondary air system should be closed; it should not be possible to blow through the hose.
- Operate hand vacuum pump to produce a vacuum.
- The combination valve should open; it should now be possible to blow through the hose.
- Renew combination valve for secondary air system if valve does not react as described ⇒ [page 232](#).



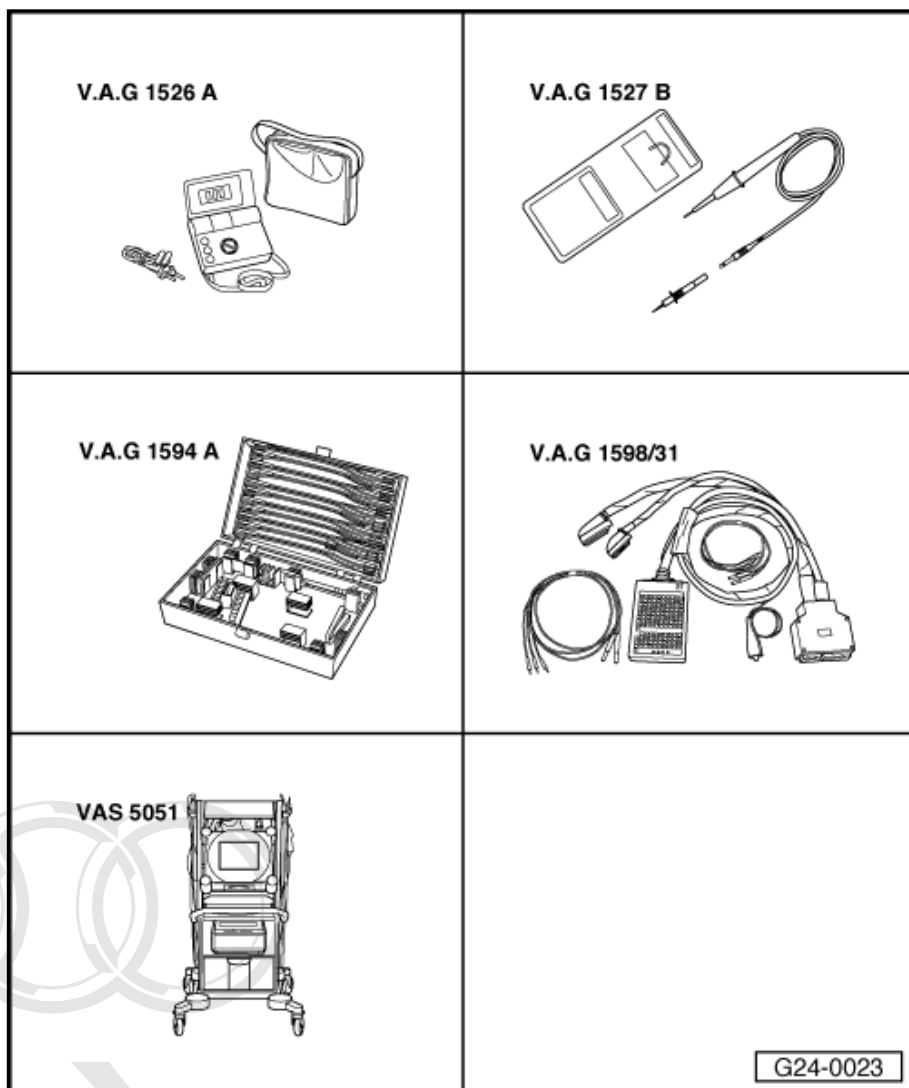
4.3 Checking secondary air inlet valve - N112-



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Special tools and workshop equipment required

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

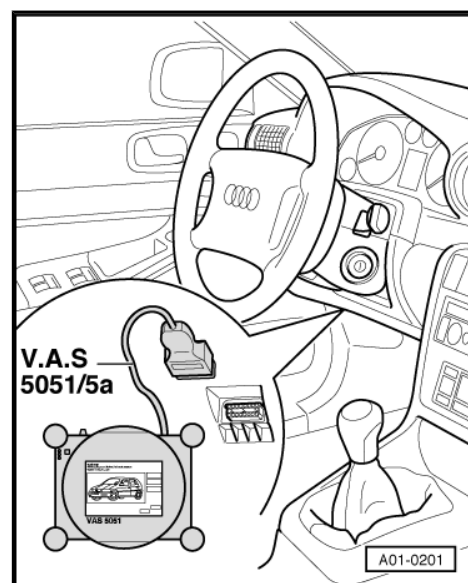


Procedure

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The secondary air inlet valve - N112- and the wiring connections are monitored by the engine control unit.

- Vehicle diagnostic, testing and information system - VAS 5051B- connected.
- Switch on ignition and start engine.



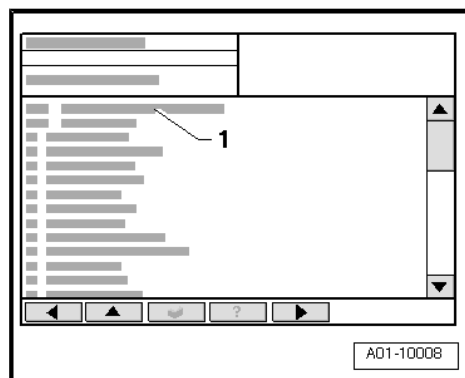
Display on -VAS 5051B- :

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



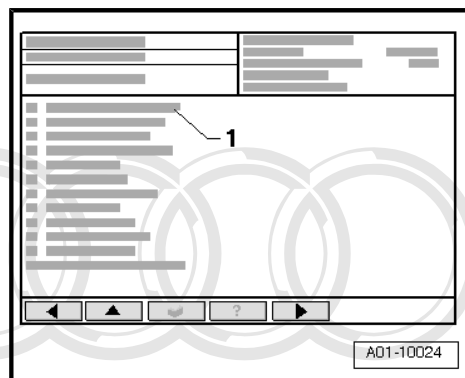
Display on -VAS 5051B- :

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



Display on -VAS 5051B- :

- From menu -1-, select diagnostic function “004 - Fault memory content” and press  key to activate function.

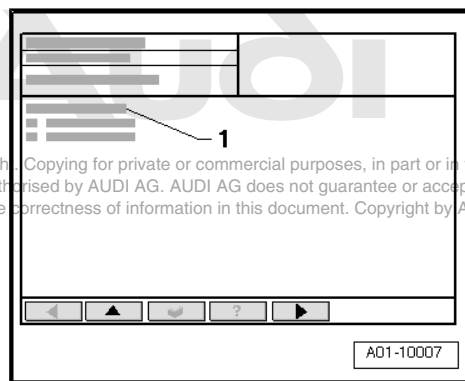


Display on -VAS 5051B- :

- From menu -1-, select diagnostic function “004.01 - Interrogate fault memory” and press  key to activate function.

If a fault relating to secondary air inlet valve - N112- is displayed:

- Terminate diagnostic function “004.01 - Interrogate fault memory” by pressing  key.
- Select diagnostic function “022 - End output” and switch off ignition.

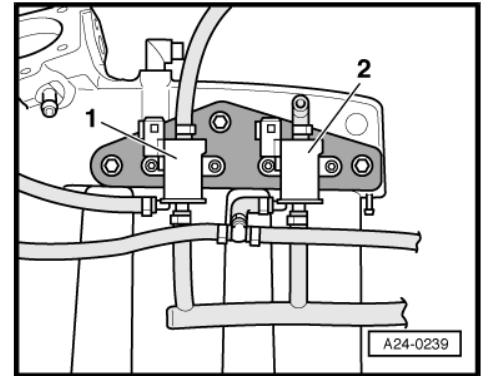


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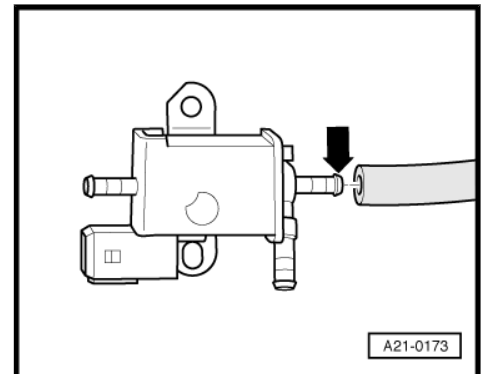
- Disconnect hoses from secondary air inlet valve - N112-
-item 2-; leave electrical connector attached.
- ◆ Fitting location: below intake manifold.

 Note

For illustration purposes, the installation position is shown from the bottom and with the intake manifold removed.



- Connect test hose to hose connection marked with -arrow- on secondary air inlet valve - N112- .



- Switch on ignition and select vehicle system "01 - Engine electronics" again.

Display on -VAS 5051B- :

- From menu -1-, select diagnostic function "005 - Final control diagnosis" and press  key to activate function.



- Press the  key repeatedly until the following display appears:

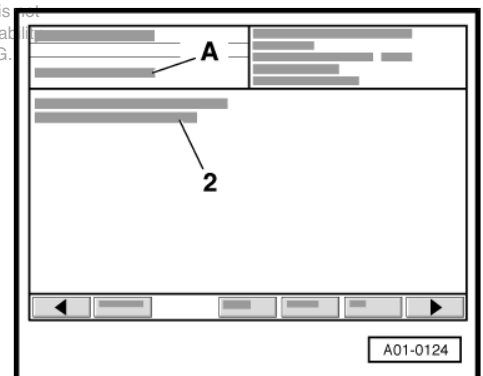
Display on -VAS 5051B- (example):

A - 2nd control element being tested

2 - Secondary air inlet valve - N112-

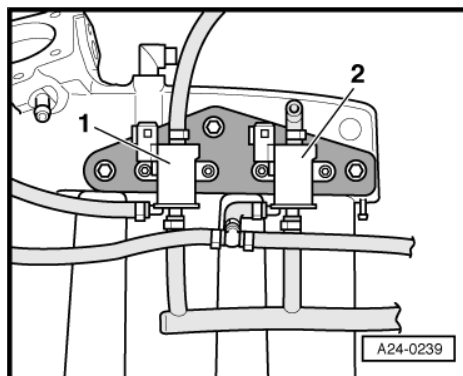
- The valve will be activated intermittently for approx. 1 minute (and should click audibly).
- The valve should open and close (check by blowing into the test hose).
- Terminate diagnostic function "005 - Final control diagnosis" by pressing  key.
- Select diagnostic function "022 - End output" and switch off ignition.

If the valve is not activated (does not click):



Checking internal resistance

- Unplug electrical connector at secondary air inlet valve - N112- -item 2-.

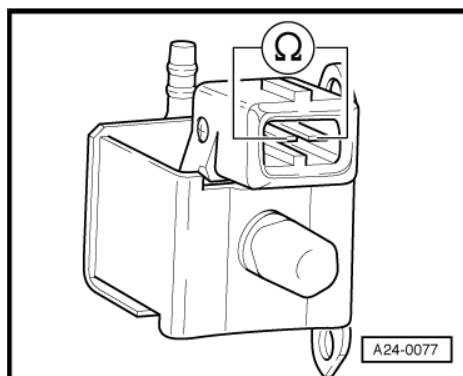


- Connect hand-held multimeter - V.A.G 1526C- to measure resistance between contacts on secondary air inlet valve - N112- .
- Specification: 27 ... 30 Ω .
- If the specification is not attained, renew secondary air inlet valve - N112- .

If the specification is attained:

Checking voltage supply

- Fuse for secondary air inlet valve - N112- OK $\Rightarrow$ Current flow diagrams, Electrical fault finding and Fitting locations.
- Fuel pump relay - J17- OK; checking $\Rightarrow$ Rep. gr. 24

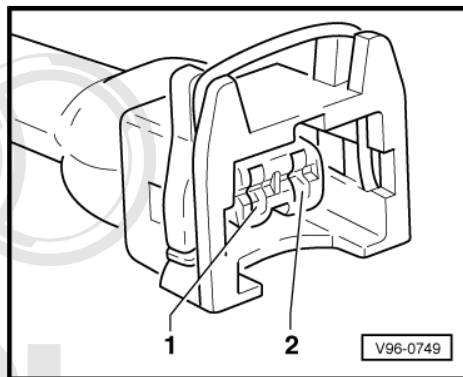


Note

The secondary air inlet valve - N112- is supplied with power via the fuel pump relay - J17- .

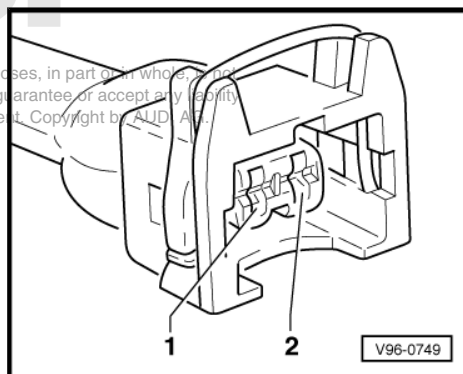
- Connect voltage tester - V.A.G 1527B- between contact -1- of connector for secondary air inlet valve - N112- and earth “-”.
- Briefly operate starter.
- The LED should light up.
- If LED does not light up, check for open circuit in wiring from contact -1- of connector for secondary air inlet valve - N112- via fuse to fuel pump relay - J17- $\Rightarrow$ Current flow diagrams, Electrical fault finding and Fitting locations.
- If necessary repair wiring connection.

If the LED lights up:



Checking activation

- Connect voltage tester - V.A.G 1527B- between contacts -1- and -2- of connector for secondary air inlet valve - N112- .



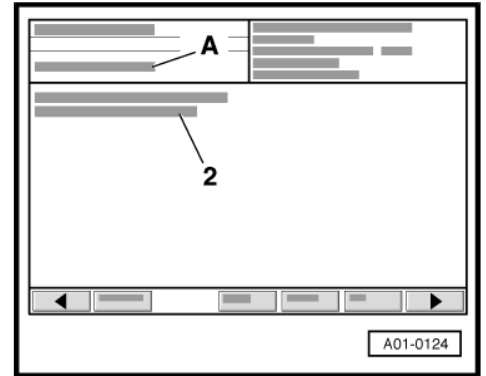
- Switch on ignition and select vehicle system “01 - Engine electronics” again.
- Repeat diagnostic function “005 - Final control diagnosis”.
- Press the  key repeatedly until the following display appears:

Display on -VAS 5051B- (example):

A - 2nd control element being tested

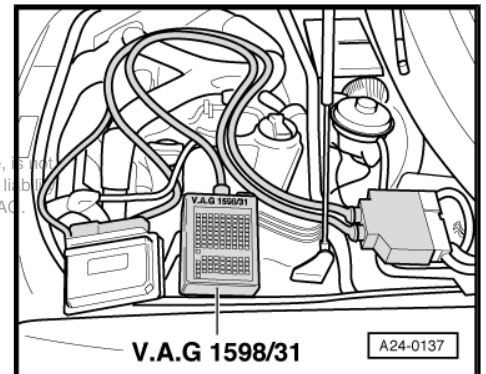
2 - Secondary air inlet valve - N112-

- The LED should flash.



- If LED does not flash or lights up continuously, connect adapter cable, 121-pin - V.A.G 1598/31- (test box) to connectors of wiring harness; do not connect engine control unit. Connect earth clip of test box to earth ⇒ Rep. gr. 24 .

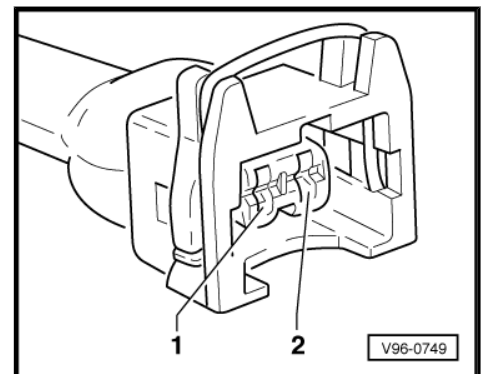
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- Check for open circuit and short to positive or earth in the following wiring for secondary air inlet valve - N112- .

Connector Contact	-V.A.G 1598/31- Socket
-2-	9

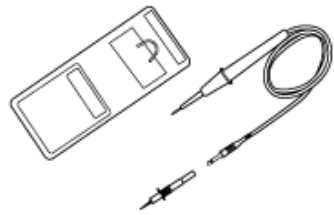
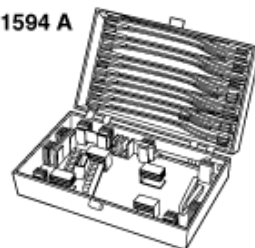
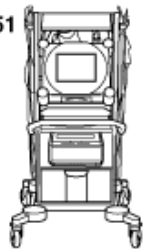
- If necessary repair wiring connection.



4.4 Checking secondary air pump relay - J299- and secondary air pump motor - V101-

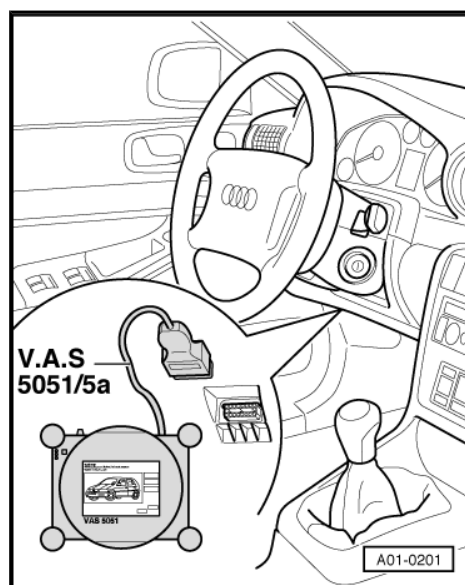
Special tools and workshop equipment required

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

V.A.G 1526 A 	V.A.G 1527 B 
V.A.G 1594 A 	V.A.G 1598/31 
VAS 5051 	G24-0023

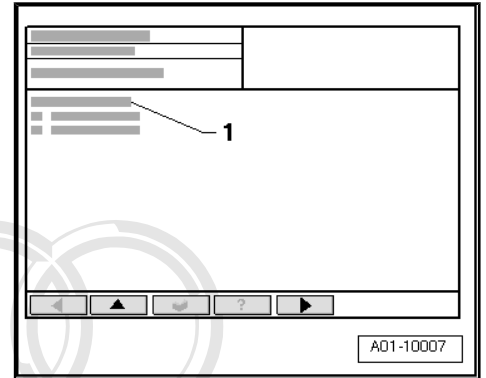
Procedure

- Vehicle diagnostic, testing and information system - VAS 5051B- connected.
- Switch on ignition.



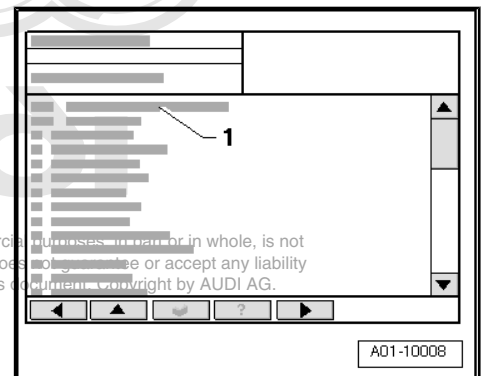
Display on -VAS 5051B- :

- From menu -1-, select “Self-diagnosis” system 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.



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Display on -VAS 5051B- :

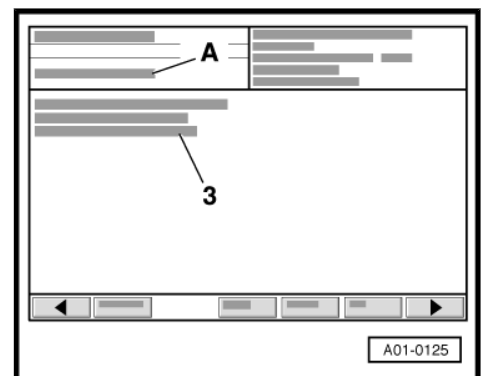
- From menu -1-, select diagnostic function “005 - Final control diagnosis” and press  key to activate function.



- Press the  key repeatedly until the following display appears:

Display on -VAS 5051B- (example):

- A - 3rd control element being tested
- 3 - Secondary air pump relay - J299-



- The secondary air pump relay - J299- -item 2- (located in electronics box in plenum chamber, left-side) should pick up and the secondary air pump motor - V101- should start up intermittently.

A - If the relay does not pick up:

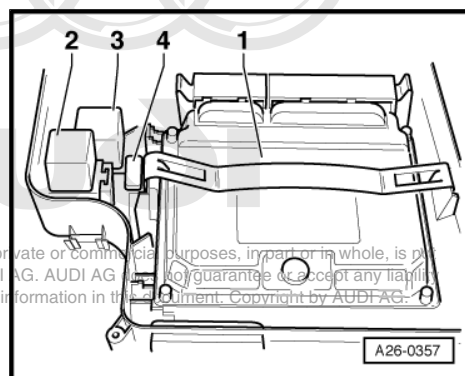
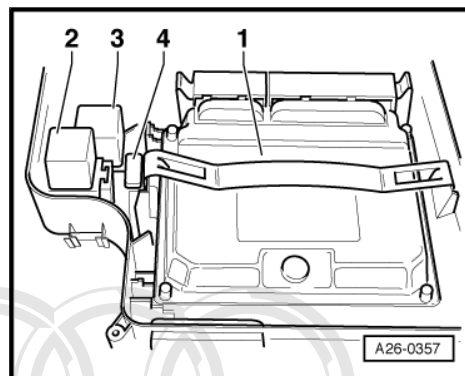
- Check voltage supply of secondary air pump relay
⇒ [page 228](#) .
- Check activation of secondary air pump relay ⇒ [page 229](#) .

B - If the relay picks up but the secondary air pump motor - V101- does not run:

- Check voltage supply of secondary air pump motor - V101-
⇒ [page 230](#) .

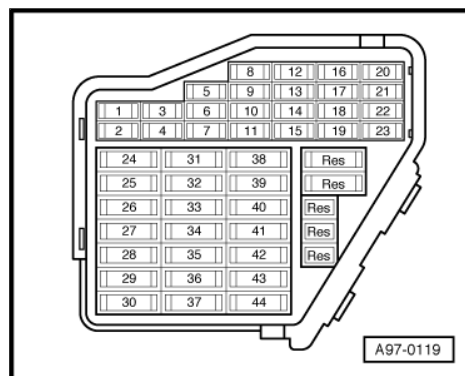
Checking voltage supply for secondary air pump relay - J299-

- Secondary air pump fuse - S130- -item 4- in electronics box in plenum chamber OK

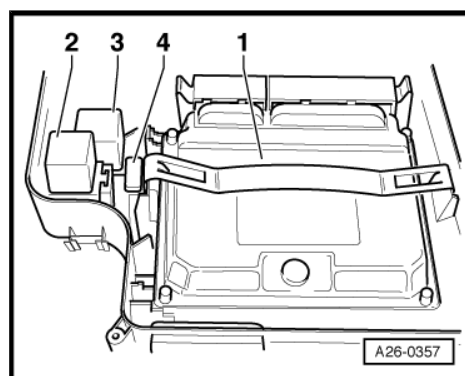


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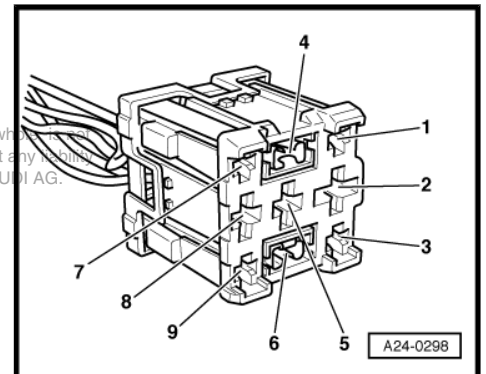
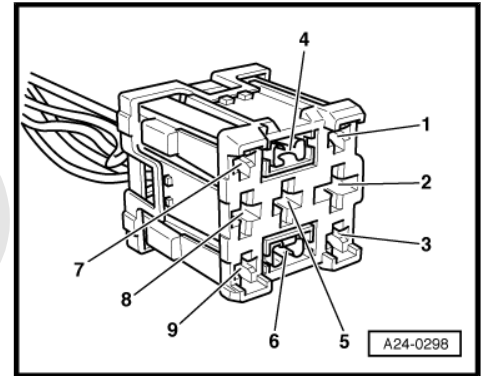
- Fuse in fuse holder - S234- (position -34-) OK.



- Switch off ignition.
- Detach relay for secondary air pump - J299- -item 2-.

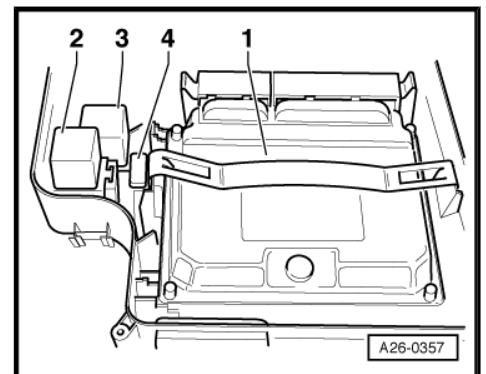


- Connect hand-held multimeter - V.A.G 1526C- between contact -8- of relay socket at position “2” in 3-position relay carrier in electronics box in plenum chamber and earth “-”.
- Specification: approx. battery voltage
- If specification is not attained, check for open circuit in wiring between secondary air pump relay - J299- via secondary air pump fuse - S130- to battery + (terminal 30) ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- If specification is attained, connect hand-held multimeter - V.A.G 1526C- between contact -4- of relay socket at position “2” in 3-position relay carrier in electronics box in plenum chamber and earth “-”.
- Briefly operate starter.
- Specification: approx. battery voltage
- If specification is not attained, check for open circuit in wiring between secondary air pump relay - J299- via fuse in fuse holder - S234- to fuel pump relay - J17- ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.

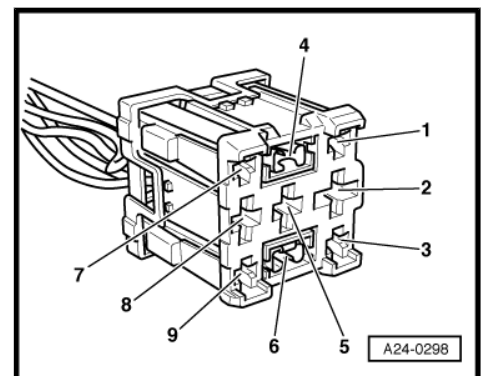


Checking activation of secondary air pump relay - J299-

- Switch off ignition.
- Detach relay for secondary air pump - J299- -item 2-.



- Connect voltage tester - V.A.G 1527B- between contact -6- of relay socket at position “2” in 3-position relay carrier in electronics box in plenum chamber and earth “-”.



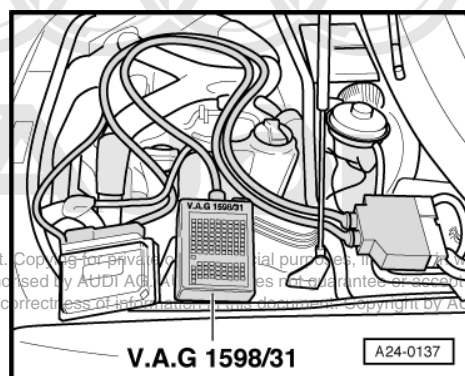
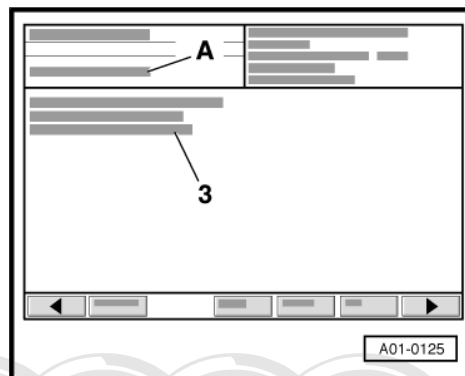
- Switch on ignition and select vehicle system “01 - Engine electronics” again.
- Repeat diagnostic function “005 - Final control diagnosis”.
- Press the key repeatedly until the following display appears:

Display on -VAS 5051B- (example):

A - 3rd control element being tested

3 - Secondary air pump relay - J299-

- The LED should flash.
- Terminate diagnostic function “005 - Final control diagnosis” by pressing key.
- Select diagnostic function “022 - End output”, switch off ignition and unplug diagnostic connector.
- If LED does not flash or lights up continuously, connect adapter cable, 121-pin - V.A.G 1598/31- (test box) to connectors of wiring harness; do not connect engine control unit. Connect earth clip of test box to earth ⇒ Rep. gr. 24 .

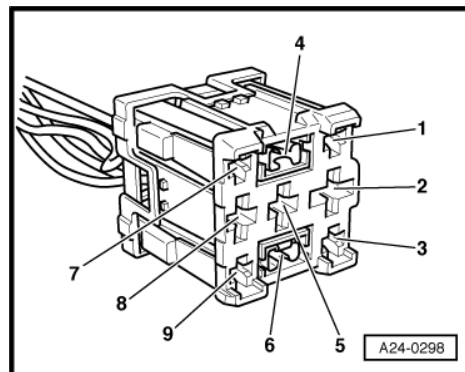


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- Check for open circuit and short to positive or earth in the following wiring for secondary air pump relay - J299- .

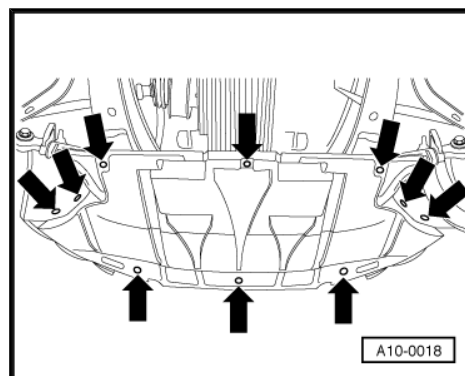
Connector Contact	-V.A.G 1598/31- Socket
-6-	66

- If necessary repair wiring connection.
- If no fault is found, renew secondary air pump relay - J299- :

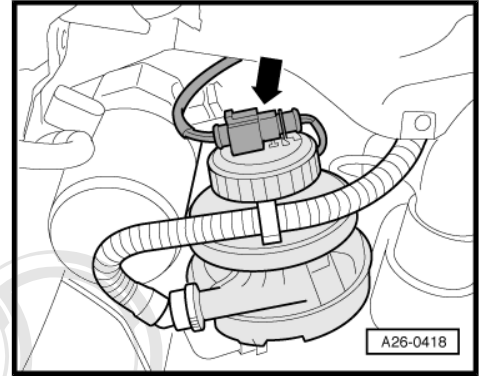


Checking voltage supply for secondary air pump motor

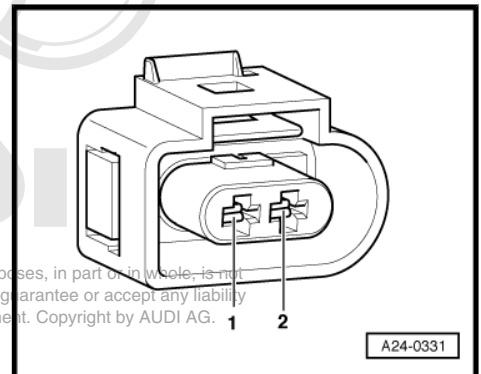
- Release fasteners -arrows- and remove noise insulation.



- Unplug electrical connector -arrow- at secondary air pump motor - V101- .
- ◆ Fitting location: at front right of engine compartment, below air cleaner housing.



- Connect voltage tester - V.A.G 1527B- between contacts -1- and -2- of connector for secondary air pump motor - V101- .



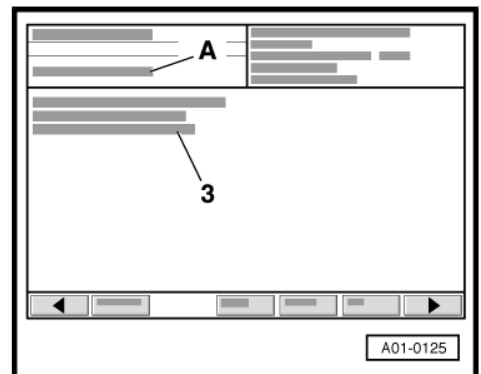
- Switch on ignition and select vehicle system "01 - Engine electronics" again.
- Repeat diagnostic function "005 - Final control diagnosis".
- Press the  key repeatedly until the following display appears:

Display on -VAS 5051B- (example):

A - 3rd control element being tested

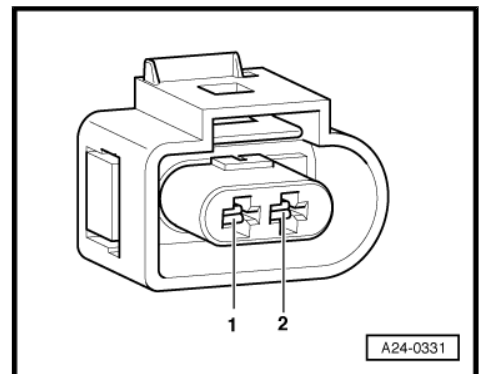
3 - Secondary air pump relay - J299-

- The LED should flash.
- Terminate diagnostic function "005 - Final control diagnosis" by pressing  key.
- Select diagnostic function "022 - End output", switch off ignition and unplug diagnostic connector.



If the LED does not flash or lights up continuously:

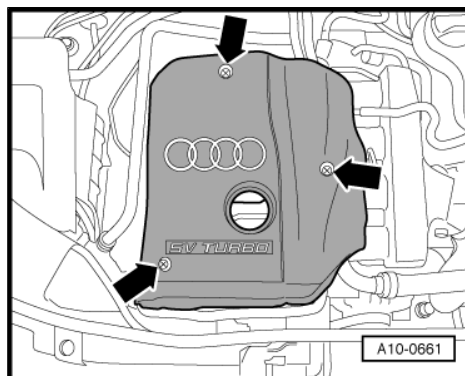
- Check for open circuit in wiring from contact -1- of connector to secondary air pump relay - J299- (on 3-position relay carrier in electronics box in plenum chamber, position "2") ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- Check for open circuit in wiring from contact -2- of connector to earth ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- If no fault is found, renew secondary air pump motor - V101- .



4.5 Removing and installing combination valve for secondary air system

Removing

- Release quick-release fasteners and remove engine cover panel -arrows-.



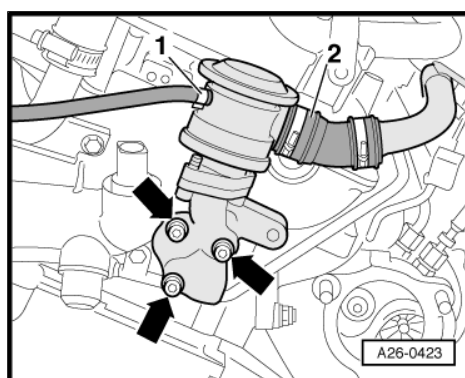
- Detach hoses -1 and 2- from combination valve for secondary air system.



Note

For illustration purposes, the installation position is shown from the rear and with the engine removed.

- Remove bolts -arrows- and detach combination valve for secondary air system.



Installing

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



Note

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

Tightening torque

Component	Nm
Combination valve for secondary air system to cylinder head	10

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